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WATER RESOURCES
ABSTRACTS

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

A MATHEMATICAL MODEL FOR CONSOLIDATION IN A THERMOELASTIC AQUIFER DUE TO HOT WATER INJECTION OR PUMPING,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-00602

GRAVITATIONAL STABILITY OF WATER OVER STEAM IN VAPOR-DOMINATED GEOTHERMAL SYSTEMS,
Aerospace Corp., Los Angeles, CA. Space Science Lab.
G. Schubert, and J. M. Straus.
Journal of Geophysical Research, Vol 85, No B11, p 6505-6512, November, 1980. 7 Fig, 13 Ref.

Descriptors: *Geothermal studies, *Water vapor, *Stability analysis, Geothermal resources, Mathematical studies, Condensates, Permeability.

The gravitational stability of a condensate or water layer overlying steam in a vapor-dominated geothermal system was investigated. Linear stability analysis was carried out on superposed layers of immiscible fluids in a porous medium and demonstrated that the heavy over light configuration is always unstable. A similar stability analysis was carried out for the case in which the interface separating the fluid layers is a phase change. The phase change was found to stabilize the heavy over light configuration. The conditions under which this stabilization occurs are quantified and applied to the water over steam situation characteristic of vapor-dominated geothermal systems. The condensate layer can be stabilized if the permeability near its base is no larger than about 40 sq nm (0.04 millidarcy). The special behavior of the phase change interface between water and steam permits the stabilization of the system with a nonzero permeability. (Small-FRC)
W82-00963

BUOYANCY FORCE REVERSALS IN VERTICAL NATURAL CONVECTION FLOWS IN COLD WATER,
State Univ. of New York at Buffalo. Dept. of Mechanical Engineering.
V. P. Carey, B. Gebhart, and J. C. Mollendorf.
Journal of Fluid Mechanics, Vol 97, No 2, p 279-297, March, 1980. 9 Fig, 11 Ref.

Descriptors: *Temperature effects, *Natural flow, *Buoyancy, Mathematical studies, Hydrodynamics, Saline water, Ice, Freezing, Melting.

Calculated transport is compared to experimental transport for laminar buoyancy-induced flows driven by thermal transport to or from a vertical isothermal surface in cold pure and saline water. Specifically, the consequences of temperature conditions wherein the buoyance force reverses across the thermal region owing to the presence of a density extremum are explored. This is a common condition in terrestrial waters and in technological processes utilizing cold water. A nonlinear density equation of state for both pure and saline water is presented which permits an accurate treatment of flows for bounding temperatures up to 20 deg C at salinity levels from 0 to 40 ppt and pressure levels from 1 to 1000 bars. Applications include the melting or slow freezing of a vertical ice surface in pure water as well as a heated or cooled vertical isothermal surface in pure or saline water. Calculated transport agreed well with experimental results. The results indicate that such flows are relatively weak but can lead to early laminar instability. (Small-FRC)
W82-00981

FLOW ANALYSIS OF MODELS OF THE HUBBARD BROOK ECOSYSTEM,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
J. T. Finn.
Ecology, Vol 61, No 3, p 562-571, 1980. 7 Fig, 7 Tab, 19 Ref.

Descriptors: *Flow characteristics, *Ecosystems, Model studies, Flow measurement, Flow profiles, Flow rates, Flow system, Cycling nutrients, Nutrients, Energy.

Flow analysis, a method of tracing flows of materials through a system, was applied to some of the Hubbard Brook data to determine the amount cycled per year of several elements and energy at Hubbard Brook compared to the total amount of each flowing per year in the system and also determine the pattern of nutrient and energy flow in the ecosystem. Three different models of calcium flow were compared to judge the effect of small differences in model structure on cycling and flow pattern. When all three models were analyzed using the same nutrient flux data, flow measures became very close, in spite of structural differences in the models. For these models, flow values were more important than the architecture of the models in determining cycling and flow characteristics. Flow analysis offers a new set of tools to investigators of biogeochemical cycling, which enabls comparisons between elements and across systems, and which also may serve as an aid in evaluating models of cycling. (Baker-FRC)
W82-01038

1B. Aqueous Solutions and Suspensions

AQUASOLS: THE BEHAVIOR OF SMALL PARTICLES IN AQUATIC SYSTEMS,
Johns Hopkins Univ., Baltimore, MD.
C. R. O'Melia.
Environmental Science and Technology, Vol 14, No 9, p 1052-1060, September, 1980. 11 Fig, 3 Tab, 13 Ref.

Descriptors: *Physical properties, *Water pollution, Reviews, Water resources management, Water demand, Water quality, *Particulate matter, Water treatment facilities, Wastewater treatment, Water transport, Conveyance structures, Aqueducts, Aquifers, Natural waters, Lakes, Temperature effects.

This article describes the physical processes that affect transport and fate of solid particles in aquatic systems and illustrates, using case studies, the present understanding of these processes and the extent of their effects. Three physical processes are considered: Brownian or molecular diffusion, in which random motion of small particles is brought about by thermal effects; fluid shear (either turbulent or laminar): and gravity, which produces vertical transport of particles and depends on the buoyant weight of the particles. Four case studies are summarized. Two are examinations of particle deposition at water-solid interfaces; filtration by packed beds in laminar flow, and deposition on pipe walls in turbulent flow. The other two examples consider particle transport within aquatic systems: a water treatment plant and a lake. Current available evidence suggests that most pollutants in water are particles or are associated with particles. These particles are governed by physical processes. Knowledge permits these processes to be described and controlled in treatment and transport systems for water supply and wastewater disposal. By extending these concepts to natural aquatic systems, new insights will be found into the functioning of the natural systems and the flow of materials through them. This knowledge will improve man's management of these systems and enable him to more successfully control his impact on them. (Baker-FRC)
W82-00540

ADSORPTION ON CARBON: SOLVENT EFFECTS ON ADSORPTION,
For primary bibliographic entry see Field 5F.
W82-00619

ELECTRICAL ASPECTS OF ADSORBING COLLOID FLOTATION. XI. SURFACTANT ADSORPTION ISOTHERMS, PARTICLE DISPLACEMENT, AND DIFFERENTIAL CAPACITANCE,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
J. E. Kiefer, and D. Wilson.
Separation Science and Technology, Vol 15, No 1, p 57-74, 1980. 14 Fig, 25 Ref.

Descriptors: *Bubbles, Statistical methods, *Adsorption, Isotherms, Temperature gradient, *Surfactants, Sediment-water interfaces, Electrical properties, *Air-water interfaces.

The theory of surfactant adsorption of floc particles at the air-water interface was explored. First the adsorption of surfactant onto floc particles to form a hemimicelle was examined; this renders the particles hydrophobic and permits bubble attachment to occur. Statistical mechanics were used to calculate adsorption isotherms of ionic surfactants on charged solid-water interfaces. The effects of coulombic repulsions between the ionic heads of the surfactant species are taken into account, as are the van der Waals attractions of their hydrocarbon tails. A 'squeeze-out' mechanism by means of which viscous drag forces acting tangentially to the surface of a rising bubble may detach floc particles from it is examined. A nonideal Poisson-Boltzmann equation is used to calculate the differential capcitance of the electric double layer at an interface. (Baker-FRC)
W82-00788

2. WATER CYCLE

2A. General

IDENTIFICATION OF STREAMFLOW STOCHASTIC MODELS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, J. T. B. Obeysekera, and R. A. Smith.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 853-866, July, 1981. 2 Fig, 5 Tab, 35 Ref.

Descriptors: *Stochastic processes, *Streamflow forecasting, *Model studies, Niger River, Rivers, Hydrologic models, Watersheds, Rainfall-runoff relationships, Groundwater, Autoregressive Moving Average Model.

This paper presents a method for choosing an appropriate stochastic model for annual streamflows. The type of model is chosen on the basis of a conceptual physical representation of a natural watershed, and the form, on the basis of recently developed R-functions and S-functions. Under certain assumptions, for an ARMA (p,q) (Autoregressive Moving Average Model) precipitation input the groundwater storage is an ARMA (p + 1, q) process and the streamflow is an ARMA (p + 1, q + 1) process. In general, such groundwater and streamflow processes belong to the class of restricted ARMA processes in the sense that their parameter space is a subspace of that corresponding to the general ARMA models. An example shows how the annual flows of the Niger River at Koulicoro, Africa, can be modeled by ARMA. (Cassar-FRC)
W82-00555

A GEOMORPHOLOGIC SYNTHESIS OF NONLINEARITY IN SURFACE RUNOFF,
Mississippi Univ., University. Dept. of Civil Engineering.
C. T. Wang, V. K. Gupta, and E. Waymire.
Water Resources Research, Vol 17, No 3, p 545-554, June, 1981. 7 Fig, 1 Tab, 24 Ref.

Descriptors: *Surface runoff, *Geomorphology, Rainfall-runoff relationships, Hydrographs, Runoff, Rainfall intensity, Predictions, Basins, River basins, Illinois, *Nonlinear programming.

Field 2—WATER CYCLE

Group 2A—General

A nonlinear (quasi-linear) geomorphic approach for modeling the rainfall-runoff process for a basin was developed by generalizing a recently developed linear geomorphic approach (Gupta et al., 1980). The nonlinearity in the transformation enters in partly through the dependence of the mean holding time on the rainfall intensity. Under an assumed first approximation that this dependence is the sole source of nonlinearity, an explicit quasi-linear representation results for the rainfall-runoff transformation. The kernel function of this transformation can be termed the instantaneous response function, whereas the linear rainfall-runoff transformation is termed the instantaneous unit hydrograph. Analysis of a small basin showed agreement between the quasi-linear theory results and the prediction from the kinematic wave approach. For two large (1100 sq miles) basins in Illinois, predictions from the quasi-linear approach compared well with observed flows. Computations of the measure of nonlinearity for four basins showed that it approaches 2/3 with decreasing basin size and zero with increasing basin size. A straight line was formed with a semilog plot of nonlinearity vs. square root of basins area. (Cassar-FRC)
W82-00604

MULTIVARIATE HYDROLOGIC TIME SERIES ANALYSIS,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
C. T. Hsu, and K. Adamowski.
Advances in Water Resources, Vol 4, No 2, p 83-95, June, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Runoff, *Mathematical models, *Watershed management, Model studies, Statistical analysis, Rainfall, Hydrology, Meteorological data collection, *Streamflow forecasting.

A multivariate watershed hydrologic system model was developed which involves meteorological data as the input and river flow as the output. Monthly hydrological time series of runoff, temperature, and precipitation were analyzed. This autoregressive-moving average transfer function model was adequate to model the monthly watershed system. The accuracy of estimation of runoff characteristics was enhanced with the use of the meteorological and hydrometric data. For watersheds with large storage, the improvement was not pronounced. The large storage effect plays a dominant role in the generating process of system response, and the contribution from external disturbances will be damped out before it becomes significant. To model a multivariate watershed hydrologic system, a combined deterministic-statistical approach could be used. For example, net precipitation rather than gross precipitation could be used as input. (Small-FRC)
W82-00647

STUDY OF THE FACTORS AND REGULARITIES OF RIVER RUNOFF ON THE BASIS OF DATA OF OBSERVATIONS ON REPRESENTATIVE BASINS,

Hydrometeorological Service of the USSR, Moscow.
V. D. Komarov.
Water Resources (English Translation), Vol 7, No 4, p 293-303, July-August, 1980. 8 Fig, 8 Ref. Translated from Vodnye Resursy, No 4, p 5-18, July-August, 1980.

Descriptors: *Runoff forecasting, *Representative basins, *Snowmelt, Basins, Hydrologic models, Russia, Spatial distribution, Forest watersheds, Watersheds, Small watersheds, Rivers, Snow cover, Soil moisture, Freezing, Vegetation.

River runoff observations were started in representative basins in Russia in 1924. There are 10 water balance stations in European Russia, and others in Central Asia, the Far East, and Maritime Territory. The major concern in the European sector is the spring runoff. The observation program includes runoff measurements, snow surveys, depth of freezing, soil moisture content, groundwater level, and meteorological data. By considering two types of spatial inhomogeneity, methods of calculation for runoff can be improved. The first is the variation in physiographic conditions, for example, treeless and forested zones. The second is the variation within each part of the water basin equivalent of snow cover, soil moisture content, depth of freezing, storage capacity of closed depressions, etc. The Moscow water balance station is used as an illustration in choosing representative basins. It is not necessary to choose a totally treeless basin and a totally forested basin. Instead, the Medvenka River basin (area 21.5 sq km, forest 0.26) and the Zakza River basin (area 17.0 sq km, forest 0.73) were chosen. These basins are similar in physiographic conditions, with the exception of forest cover, and are representative of larger basins. Relationships derived from these two representative basins are applied to the 18,000 sq km Cheptsa River basin, forest coverage 0.26, similar to the two representative basins in soils, relief, and vegetation. The calculated runoff agreed well with that observed in the Cheptsa basin--1974, 172 and 162 mm; 1975, 79 and 77 mm; and 1976, 59 and 56 mm. (Cassar-FRC)
W82-00652

EFFECTS OF RECENT INCREASES IN RAINFALL ON FLOODS AND RUNOFF IN THE UPPER HUNTER VALLEY,

New South Wales Univ., Kensington (Australia). School of Geography.
For primary bibliographic entry see Field 2E.
W82-00668

EFFECTS OF TROPICAL CYCLONE WALLY IN SOUTHEAST VITI LEVU, FIJI, EASTER 1980,

Victoria Univ., Wellington (New Zealand).
R. Howorth, M. J. Crozier, and I. J. Grant.
Search, Vol 12, No 1/2, p 41-43, January/February, 1981. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Landslides, *Tropical cyclones, *Excess rainfall, Rainfall, Cyclones, Storms, Rainstorms, Flooding, Floods, Viti Levu, *Fiji Islands.

As part of a slope-stability study being carried out in the Fiji Islands, landslides which occurred on Viti Levu during the time the tropical cyclone Wally passed through the area were investigated. Massive and extensive landslides occurred in the area after a rainfall exceeding 500 mm over a two-day period. The average monthly rainfall for this area is 263 mm. Severe flooding caused flood water depths of 1.0-1.5 m on the Navua River delta. Fifteen people were killed and 113 villages were affected. Times of peak discharge of the coastal rivers were coincident with the landslides. Most of the landslides occurred on the evening of April 4th. Total rainfall for April 4 was 261.8 mm, for April 3, 307.8 mm, and for April 2, 111.4 mm. Most of the slides affected only regolith, and in only one case was in situ bedrock involved. Most of the slides occurred just after nightfall, between 1800 and 2200 hr. The rain stopped at about the same time, which may have permitted the ground to regain stability. (Small-FRC)
W82-00670

POSSIBILITY OF USING TRITIUM FOR STUDYING GLOBAL CIRCULATION OF ATMOSPHERIC MOISTURE,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. I. Ferronskii, L. Yu. Ivanova, Kh. A. Kikichev, L. P. Kuznetsova, and V. V. Romanov.
Water Resources (English Translation), Vol. 7, No. 5, p 478-482, September/October, 1980. 3 Fig, 12 Ref. Translated from Vodnye Resursy, No. 5, p 171-177, Setember/October, 1980.

Descriptors: *Atmospheric moisture, *Tritium, Measurement techniques, Air circulation, Isotopic tracers, Tracers, Water vapor, Atmospheric, Global circulation.

The suitability of the isotopic tracer method for use in studying global circulation of atmospheric moisture was investigated, using as a lable the tritium (T) produced during the low-power atmospheric nuclear in China on March 14, 1978. Tritium which enters the atmosphere as a result of nuclear explosions quickly reacts with atmospheric oxygen to form the water molecular HTO. This tritium water vapor participates in the circulation of air masses and moisture in the atmosphere, permitting tracking of the movement of the incorporating air mass until the tritium label is removed by dispersion of air particles and moisture. The sampling method used is based on adsorption of water vapor during pumping of air through a drying agent, followed by electrolysis and measurement of the tritium concentration by a liquid scintillation spectrometer. The higher level of radioactivity in the atmosphere and precipitation permitted tracking of the radioactive cloud for two weeks after the explosion. Analysis of the movement of the labelled air mass demonstrated that the time of circulation of water vapor around the earth is a natural phenomenon as well as a theoretical concept. Under certain conditions of atmospheric circulation, packets of moisture may exist and be moved over long periods of time without substantial dispersion, at least in the substratosphere. The isotopic tracer method permits tracking of the movement of air masses and atmospheric moisture both in cloudy and rainy and in clear and dry weather. These results indicate that tritium, which can be injected at the required height by ordinary technical means, can be used as a tracer in experimental studies of global circulation of air masses and atmospheric water vapor. (Carroll-FRC)
W82-00863

A COMPARISON OF RAINFALL-RUNOFF MODELS,

Western Australia Univ., Nedlands.
W. D. Weeks, and R. H. B. Hebbert.
Nordic Hydrology, Vol 11, No 1, p 7-24, 1980. 10 Fig, 4 Tab, 16 Ref.

Descriptors: *Rivers, *Model studies, *Rainfall-runoff relationships, Australia, Time series analysis, Mathematical studies, Sacramento model, Monash model, Stanford model, Boughton model, *Comparison studies.

Five rainfall-runoff models were tested on 3 catchments in southwest Western Australia by calibration with 6 years of data followed by testing on a further 6-7 years of extra data. The Boughton Model, a simple conceptual model, was unacceptable because it was developed for catchments vastly different from the rivers studied. The Sacramento, Stanford, and Monash models, sophisticated conceptual models, and a black box or purely mathematical method involving a recursive time series algorithm all performed in a satisfactory manner. The straightforward Sacramento and the simple time series analysis are recommended for the larger rivers; the Monash and Stanford models, for the smaller catchments, Monash being marginally better. The Sacramento, with finite storages, and the time series analysis, with no provision for baseflow, performed poorly on the very small river. (Cassar-FRC)
W82-00911

SIMULATION OF LAKE-WATERSHED SYSTEMS, I. DESCRIPTION AND SENSITIVITY ANALYSIS OF THE MODEL,

Alberta Univ., Edmonton. Dept. of Geology.
A. S. Crowe, and F. W. Schwartz.
Journal of Hydrology, Vol 52, No 1/2, p 71-105, June, 1981. 15 Fig, 1 Tab, 19 Ref.

Descriptors: *Watersheds, *Model studies, Lakes, Groundwater, Hydrology, Water quality, Salinity, Lake morphology, Precipitation, Evaporation, Surface runoff, Flow discharge, *Lake-watershed systems.

A hydrologic transport model has been developed which is oriented primarily toward lakes and is used to examine the role that various climatic and watershed variables play in controlling the physical and chemical hydrology. The hypothetical lake-watershed system defined for the sensitivity analysis has characteristics similar to lakes in the prairie parkland of Canada. The lumped response model presented is able to simulate the hydrologic responses of a lake-watershed system to variations

in precipitation, potential evaporation and air temperatures. It operates by routing water through an idealized system. From the use of this model several conclusions were drawn. The water level and salinities of the lake depended on the general lake morphometry. Variations in groundwater chemistry over a part of the watershed do not significantly alter the salinity of the hypothetical prairie lake. Large decreases or increases in the quality of groundwater over the entire watershed will alter the salinity of the lake. The unsaturated zone primarily controls the amount of water percolating to the groundwater zone and thus indirectly influences the amount of groundwater discharged to the lake. As the amount of a watershed covered by an unsaturated zone decreases, the amount of groundwater recharge increases. Increasing the proportion of this hypothetical watershed that is impervious causes precipitation to flow directly to the lake, decreasing salinity, increasing fluctuations of lake levels and generally increasing the lake stage. Variations in precipitation and potential evaporation do not cause large fluctuations in lake levels and salinity in the large watershed used in this analysis, but would in a small lake-watershed system. (Baker-FRC)
W82-00926

SIMULATION OF LAKE-WATERSHED SYSTEMS, II. APPLICATION TO BAPTISTE LAKE, ALBERTA, CANADA,

Alberta Univ., Edmonton. Dept. of Geology.
A. S. Crowe, and F. W. Schwartz.
Journal of Hydrology, Vol 52, No 1/2, p 107-125, June, 1981. 8 Fig, 6 Tab, 21 Ref.

Descriptors: *Watersheds, *Model studies, Lakes, Groundwater, Groundwater movement, Surface-groundwater relations, Lake morphology, *Lake-watershed systems.

The applicability of a hydrologic simulation model for evaluating an actual lake-watershed system was investigated at the Baptiste Lake system in east-central Alberta, Canada. This is an important potential recreational development area, and a large data base for the area already exists. The watershed covers an area of 318 square kilometers, of which 58% is forest, 25% is standing water consisting of the subject lake, swamps and rivers, 16% is agricultural land, and less than 1% is cottage development along the lake shore. Land to the north and east of the lake is farm land, while that to the south and west is mostly swamp and forest. With the model it was possible to recapitulate a 6-year history of lake level fluctuations. The predicted and measured lake levels have a mean absolute difference of less than 0.1 meter. The cyclical character of water level fluctuations on an annual basis was also preserved in the simulation results. Although only a relatively short record of lake chemistry was available, the model was able to simulate with a reasonable degree of accuracy the total dissolved solids content of the lake. The study suggests that groundwater inflow to the lake comprises about 13% of the annual inflow from all sources and is not unreasonable for lakes in this kind of hydrological setting. (Baker-FRC)
W82-00927

ADAPTIVE HYDROLOGICAL FORECASTING - A REVIEW,

Institute of Hydrology, Wallingford (England).
P. E. O'Connell, and R. T. Clarke.
Hydrological Sciences Bulletin, Vol 26, No 2, p 179-205, June, 1981. 3 Fig, 2 Tab, 40 Ref.

Descriptors: *Runoff forecasting, *Rainfall, *Mathematical models, Forecasting, Hydrology, River basins, Reviews.

A variety of models and parameter estimation algorithms for hydrological forecasting are reviewed, including a discussion of the assumptions underlying them and some problems encountered in their application. Four models were applied to 2 months of half-hourly rainfall and runoff data for the Hirnant sub-basin of the River Dee. The four models were: Model A, a version of the River Dee sub-basin model; Model B, the simple nonlinear conceptual model used by Moore and Weiss (1980); Model C, a linear transfer function model with time variant parameters; and Model D, a selftuning predicator with PERLOG input. Models A and B had the smallest error variances, but D performed best in terms of standardized Q and S statistics. The standard assumptions of independence and identical distribution for system noise are not justified for hydrological systems. There are considerable unsolved estimation problems in real time forecasting, but it may be most beneficial to find a better representation of the spatial variation in rainfall and its effects of streamflow. (Small-FRC)
W82-00984

OVERLAND FLOW ON A DIVERGING SURFACE,

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
N. Agiralioglu, and V. P. Singh.
Hydrological Sciences Bulletin, Vol 26, No 2, p 137-147, June, 1981. 7 Fig, 2 Tab, 15 Ref.

Descriptors: *Overland flow, *Mathematical models, *Groundwater basins, Kinetics, Hydrographs, Mathematical studies, Topography.

A basin diverging flow model is presented which utilizes kinetic wave theory. A first order explicit finite difference scheme is used to solve the kinematic equations. The model is compared with the plane model. The two models yield different concentration times and hydrographs that differ in shape, depending upon the degree of divergence. The rising hydrograph rises faster for the diverging model than for the plane model. The reverse is true for the recession hydrograph. Also, the diverging model gave longer times of concentration than the plane model. In natural basins that have divergence in their geometric configurations, the divergence model may predict hydrographs reasonably well. Suitable basins are both rural and urban with upland portions which diverge and lower portions which converge. A diverging basin's response is similar to that of a cascade of planes of decreasing size, and its descrete analog is a system composed of unequal nonlinear reservoirs used in parametric hydrology. (Small-FRC)
W82-00986

2B. Precipitation

TRACE CONSTITUENTS IN CLOUD WATER, RAINWATER AND AEROSOL SAMPLES COLLECTED NEAR THE WEST COAST OF INDIA DURING THE SOUTHWEST MONSOON,

Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.
S. Sadasivan.
Atmospheric Environment, Vol 14, No 1, p 33-38, January, 1980. 3 Fig, 3 Tab, 27 Ref.

Descriptors: *Clouds, *Aerosols, *Rain, Precipitation, Seawater *India, *Trace levels, Halogens, Sulfates, Iodine, Bromine, Chlorides, Salts, Monsoons, Fallout, Chemical reactions.

Trace constituents were determined in cloud water, rain water, and impactor aerosol samples collected at a mountain top near the west coast of India during the summer monsoon in order to study the evolution of clouds and raindrops. Concentrations of trace constituents in cloud water were within the ranges previously reported for oceanic cloud water. Ratios of Cl, Br, and I to Na were close to those of seawater, indicating no incorporation of halogens in the cloud water. In cloud water there were excesses of Ca (probably from soil particles), K (from enrichment during transfer from seawater to air), and sulfates. Rainwater samples were difficult to analyze because the concentrations of trace constituents were near the detection limit. Average ammonium/sulfate ratio was 0.2; Cl and Na correlated well; and Br/Na and I/Na values were higher than samples from the coast taken previously. Aerosol particles collected under rainy conditions and clear weather conditions showed enrichment of Br and I at higher altitudes. These findings indicate that cloud droplets form on large and giant aerosol particles. There is no significant gaseous I absorption in raindrops. The aerosol composition explains the observed I enrichment in rainwater. (Cassar-FRC)
W82-00676

ON AUGUST MEAN TEMPERATURE AND THE SUCCEEDING SEASON'S RAINFALL OVER SOUTH AFRICA,

University of the Witwatersrand, Johannesburg (South Africa).
T. G. J. Dyer.
South African Journal of Science, Vol 76, No 2, p 85-87, February, 1980. 7 Fig, 1 Ref.

Descriptors: *Rainfall distribution, *Temperature control, *South Africa, Temperature, *Seasonal distribution, Precipitation, Model studies.

The relationship between August mean temperature and the total rainfall received during the following season was investigated in light of the commonly assumed interrelationship between the two factors. The study reveals that there may be some truth in the claim of an association between August mean temperature and rainfall over part of the rainy season. The correlation fields for November and December, and also for the whole season, have areas of significant coefficients. The whole-season correlation arises, however, by virtue of the form of the fields in the former two months and to a lesser extent of that which exists during January. This is based on the fact that the fields tend to weaken in an organized fashion as the season progresses. If there is a true relationship, it is highly spatially dependent, as no correlation exists to the north of a line through Bloemfontein and Durban. Even in the strongest fields the relationship accounts for only a relatively small proportion of the total relative variance in rainfall. However, these fields lend themselves to being considered as possible inputs to any model designed to forecast seasonal rainfall. (Baker-FRC)
W82-00692

A NUMERICAL COMPARISON BETWEEN LAGRANGIAN AND EULERIAN RAINFALL STATISTICS,

Stockholm Univ. (Sweden). Arrhenius Lab.
M. Hamrud, H. Rodhe, and J. Grandell.
Tellus, Vol 33, No 3, p 235-241, June, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Numerical analysis, *Precipitation, *Comparison studies, Mathematical studies, Rainfall, Precipitation scavenging, Statistical methods.

The problem of estimating statistical parameters characterizing the precipitation experienced by a parcel of air as it is carried along by the winds is of considerable interest in connection with studies of the transport and dispersion of air pollutants subject to precipitation scavenging. Lagrangian data are data relating to the 'weather' experienced by the air parcel as it is carried along by the wind. Eulerian data are meteorological observations obtained at fixed locations. This study investigated the relationship between Lagrangian and Eulerian rainfall statistics. Parameters characterizing Lagrangian precipitation statistics were derived using 850-mbar air trajectories over nothern Europe in conjunction with precipitation data. Comparisons with similar Eulerian statistics which had been spatially averaged over the area indicated that the magnitudes of these parameters differed only moderately between the two frames of reference. It therefore seems reasonable to assume as a first approximation an equality between the Lagrangian and the Eulerian estimates of the parameters studied. (Carroll-FRC)
W82-00803

RELATION OF SATELLITE-BASED THUNDERSTORM INTENSITY TO RADAR-ESTIMATED RAINFALL,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. J. Negri, and R. F. Adler.
Journal of Applied Meteorology, Vol 20, No 3, p 388-300, March, 1981. 9 Fig, 16 Ref.

Descriptors: *Thunderstorms, *Satellite technology, *Radar, *Weather forecasting, Correlation analysis, Storms, Remote sensing.

Measurements of thunderstorm intensity determined from short-interval geosynchronous digital satellite data were compared to precipitation measurements from radar data. In the satellite infrared data, the thunderstorms were defined by the location of the relative minima in the equivalent blackbody temperature field. When the evolution of a number of storms was examined, the first low level radar echo (18dBZ) appeared when the satellite observed cloud-top minimum blackbody temperature had a mean of 245 K (7.4 km). Larger reflectivities appeared as the cloud tops penetrated upward to colder temperatures. As the storms approached and penetrated the tropopause, reflectivity values greater than 50 dBZ began. A correlation was found between satellite-based estimates of thunderstorms and maximum radar reflectivity. Thunderstorm top ascent rates in the 235-240 K region indicated the intensity of the initial storm updraft and were correlated with the maximum storm reflectivity, with weak cells having minimum reflectivity and strong cells having echos equal to or greater than 50 dBZ. (Small-FRC)
W82-00806

APPARATUS FOR THE SIMULATION OF RAIN IN THE LABORATORY,

State Univ. of New York at Albany.
D. R. Derenzo, and B. Vonnegut.
Journal of Applied Meteorology, Vol 20, No 1, p 36-41, January, 1981. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Rainfall simulators, *Simulated rainfall, *Calibrations, Rainfall, Laboratory equipment.

A method is described to produce simulated rain which does not require several meters of fall. The short fall distance means that the simulated rain can be produced without the aid of a rainshaft and within the convenience of normal ceiling height. A jet of water is directed toward the periphery of an automobile tire that rotates opposite to the flow of water. The rotating tire creates air and mechanical turbulence that break the jet up into a spray of water. Three rains having rainfall rates of 14, 48, and 2100 mm/hr were investigated using the simulator. The rains had drop-size distributions that exhibited characteristics of those found in natural rains. Also, drops fell at approximately terminal velocity. The apparatus can be used to calibrate meteorological instruments that measure some aspect of rainfall either in the field or laboratory. Examples of instruments would be those dealing with water drop-soil interactions. (Small-FRC)
W82-00807

SATELLITE RAIN ESTIMATION IN THE U.S. HIGH PLAINS,

National Oceanic and Atmospheric Administration, Boulder, CO.
C. G. Griffith, J. A. Augustine, and W. L. Woodley.
Journal of Applied Meteorology, Vol 20, No 1, p 53-66, January, 1981, 10 Fig, 10 Ref.

Descriptors: *Computer models, *Satellite technology, *Rainfall, Arid climates, Clouds, Error analysis, Weather forecasting, High plains, Remote sensing.

A computer-automated technique to estimate rainfall using visible or infrared geosynchronous satellite imagery was used to estimate rainfall on 15 selected days in the High Plains. Each site was instrumented with a small, dense raingage network to provide a ground measure of rainfall for verification. Model results exceeded the corresponding gage estimates by a factor of 3-5 because the model treated convective clouds in arid regions as tropical clouds. The technique was adjusted to apply to the High Plains. Gage and satellite comparisons were made for a small area, and this comparison was extrapolated to satellite rain estimates for large areas. A second adjustment technique involved calculation of an adjustment factor using the output of a one-dimensional cumulus cloud model. Preliminary results indicated that these adjusted techniques have considerable utility. The accuracy of the model is discussed in terms of bias, mean error factor, root mean square error, and linear regression analysis. (Small-FRC)
W82-00808

EVALUATION OF AREAL VERSUS POINT RAINFALL WITH SPARSE DATA,

Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
V-T-V. Nguyen, J. Rousselle, and M. B. McPherson.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 173-178, June, 1981. 10 Fig, 1 Tab, 11 Ref.

Descriptors: *Areal precipitation, *Rainfall distribution, *Mathematical studies, Mathematical models, Precipitation, Hydrology, Geography, Probabilistic process, Mathematical equations, *Urban hydrology, *Rainfall-runoff relationships, *Runoff forecasting.

Urban hydrologic studies designed to determine runoff peaks and volumes depend on both temporal and spatial information on rainfall distribution. Since rainfall data used as input to rainfall-runoff models are measured at a point, it is necessary to establish some relationships for the transformation of point rainfall data to areal rainfall. Mean rainfalls for a fixed area and the associated rainfall for a fixed point in that area were analyzed from a probabilistic perspective, and a theoretical methodology for establishing a relationship between these values is proposed. An exponential distribution function for hourly point rainfall was used to derive the distribution relation for mean rainfall over a fixed geographic area. Values of the areal correction factor were estimated at equal levels of exceedance probability for point and areal mean rainfalls. These estimations showed that the areal correction factor is not constant for all return periods and that its value may not always be less than or equal to 1. The point-areal rainfall relationship developed by this study may be more realistic and more useful for many engineering applications because in nature the occurrence of storm centers in a given region is thought to be purely random and in engineering practice attention is often focussed on a fixed area. (Carroll-FRC)
W82-00835

ASSOCIATIONS AND MESOSCALE SPATIAL RELATIONSHIPS AMONG RAINWATER CONSTITUENTS,

Illinois State Water Survey, Urbana.
D. F. Gatz.
Journal of Geophysical Research, Vol. 85, No C10, p 5588-5598, October, 1980. 3 Fig, 13 Tab, 12 Ref.

Descriptors: *Chemistry of precipitation, *Deposition, *Factor analysis, Rainwater, Mathematical studies, Precipitation, Scavenging, Metals, Heavy metals, Sulfates, Air pollution effects.

Information about how rainwater constituents are scavenged from the atmosphere and precipitated was collected in a study of 10 rain events near St. Louis during the summers of 1972-1975. Factor analysis was used to identify groups of constituents having similar deposition patterns. Rainwater samples were collected in networks of 80 or 85 open polyethylene containers and were analyzed for Li, Na, Mg, K, Ca, Fe, Zn, Cd, In, Pb, and sulfate. Four main groupings of depositional patterns occurred: soluble soil-derived elements, insoluble soil-derived elements, soluble pollutants, and insoluble pollutants. Differences between the depositional patterns of pollutants and soil elements are probably due to the distribution of sources. The differences between soluble and insoluble portions of the same element may indicate important differences in scavenging and/or precipitation formation processes. These processes need further investigation. (Small-FRC)
W82-00964

SULFUR AND ASSOCIATED ELEMENTS AND ACIDITY IN CONTINENTAL AND MARINE RAIN FROM NORTH FLORIDA,

Florida State Univ., Tallahassee. Dept. of Oceanography.
S. Tanaka, M. Darzi, and J. W. Winchester.
Journal of Geophysical Research, Vol 85, No C8, p 4519-4526, August, 1980. 5 Fig, 4 tab, 15 Ref.

Descriptors: *Acid rain, *Sulfur, *Rainfall, *Chemical composition, Water analysis, Metals, Air pollution effects, North Florida, Baseline studies, Environmental surveys, *Florida.

The composition characteristics of north Florida rain were investivated to establish some nonurban baselines of elemental concentrations and to estimate the extent of transport of air pollutants. A new measuring technique was used, the proton-induced X-ray emission (Pixe), which could analyze a wide range of elements from S to Pb simultaneously. Elemental composition was determined for: S, K, Ca, V, Mn, Fe, Ni, Cu, Zn, Br, Sr, and Pb, from 4 ml aliquots of 38 different rain samples. Northerly air flow rain exhibited polluted and continental characteristics. Concentrations of Pb, S, and Fe were higher, and strong correlations of Br, Ca, and Fe with Pb were found. In general, southerly air flow rain had lower elemental concentrations, and element concentrations were not correlated with Pb. The average pH of northern rain was 4.4, while southern rain had an average pH of 5.3. The region of influence for atmospheric pollution industrial regions seemed larger than is usually thought. (Small-FRC)
W82-00965

THE MAGNITUDE OF THE HYDROLOGICAL FREQUENCY FACTOR IN MAXIMUM RAINFALL ESTIMATION,

Science and Education, Beltsville, MD. Hydrology.
D. M. Hershfield.
Hydrological Sciences Bulletin, Vol 26, No 2, p 171-177, June, 1981. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Rainfall, *Probable maximum precipitation, *Frequency analysis, Precipitation, Probability distribution, Mathematical studies, *Eastern United States.

Results from several sets of maximum rainfall data are compared and related in terms of a frequency factor. Chow's hydrological frequency factor is used, which is primarily a function of the recurrence interval for a particular probability distribution. This frequency factor is displayed as a function of the mean of the annual maxima for both official and unofficial rainfall observations and the probable maximum precipitation. The frequency factor is shown to be a function of the magnitude of the unofficial rainfall observations and probable maximum precipitation for areas in the eastern U.S. This suggests that the magnitude of probable maximum precipitation is largely influenced by the magnitude of the frequency factor. The geographical distribution of the probable maximum distribution factor was displayed on maps for the eastern United States, and ranged from about 20 in the south to more than 35 in the north. (Small-FRC)
W82-00983

NUMERICAL SIMULATION OF THE EFFECTS OF COOLING TOWER COMPLEXES ON CLOUDS AND SEVERE STORMS,

South Dakota School of Mines and Technology, Rapid City.
H. D. Orville, P. A. Eckhoff, J. E. Peak, J. H. Hirsch, and F. J. Kopp.
Atmospheric Environment, Vol 15, No 5, p 823-836, 1981. 12 Fig, 1 Tab, 24 Ref.

Descriptors: *Cooling towers, *Storms, Rainstorms, Hail, Rain, *Temperature effects, Simulation analysis, Mathematical studies, Model studies, *Powerplants, Heat, Clouds, Latent heat, Sensible heat.

Attempts were made to determine the effects of excess heat and vapor from large power parks on heavy rain and hailstorms through the use of numerical simulation studies. A two-dimensional, time-dependent model was used which gave realistic simulations of many severe storm processes

including heavy rains, hail and strong winds. The model is a set of partial differential equations which describe time changes of momentum, energy, and mass. Appropriate boundary and initial conditions are imposed on a domain about 20 km high by 20 km wide and 200 meter grid intervals to complete the model. Modifications were made to allow additional water vapor and heat to be added at several lower grid points to simulate effluents from a power peak. Realistic storm situations were recreated. One atmospheric sounding has a strong middle-level inversion which tends to inhibit the first convective clouds but later gives rise to a severe storm with hail and heavy rains. One other sounding is taken from a day in which a severe storm occurred in the Miami area. A third sounding depicts atmospheric conditions in which severe storms formed in the vicinity of Huron, South Dakota. Results of the study indicate that a power park emitting 80% latent heat and 20% sensible heat has little effect on the simulated storm. A case with 100% sensible heat emission leads to a much different solution, with the simulated storm reduced in severity and the rain and hail redistributed. A case in which water vapor is accumulated in a region and released over a broad depth results in slightly more rain from a severe storm. (Baker-FRC)
W82-00995

ATMOSPHERIC WATER CONTENT OVER THE TROPICAL PACIFIC DERIVED FROM THE NIMBUS-6 SCANNING MICROWAVE SPECTROMETER,

National Environmental Satellite Service, Washington, DC.
For primary bibliographic entry see Field 7B.
W82-01004

VARIATIONS IN PRECIPITATION PARAMETERS BETWEEN DROUGHT AND NON-DROUGHT PERIODS IN TEXAS AND SOME IMPLICATIONS FOR CLOUD SEEDING,

National Weather Service Stoneville, MS.
M. S. Flynn, and J. F. Griffiths.
Journal of Applied Meteorology, Vol 19, No 12, p 1363-1370, December, 1980. 1 Fig, 6 Tab, 3 Ref.

Descriptors: *Drought, *Cloud seeding, Weather modification, Moisture deficiency, Water shortage, Water deficit, Artificial precipitation, Rainfall, Irrigation practices, *Texas.

Information concerning rainfall patterns over Texas was extracted from the Texas Section of Hourly Precipitation Data of the US Weather Bureau, 1950-1973. The data involved a study of hourly rainfall for the period of time used for the current study, 1950-1969. Twelve key sites were selected for the evaluation. No easily identifiable patterns for regions emerged from the analysis of the data, which may indicate that many more than 12 sites should be included in future studies. Based on these stations, however, severe droughts in Texas appeared to be characterized by a reduction in both the number of individual rainfalls experienced and a reduction in the intensity of the falls. This indicates that days of cloud seeding opportunity as well as natural precipitation efficiency are diminished, and attempts to start rainfall by artificial methods may have limited success. Length of rainfall during severe droughts is also diminished significantly, and therefore there would be little opportunity for seeding clouds already producing rain. It is also suggested that there is a little benefit to be gained by shutting down irrigation equipment once a rain has started during a severe drought. (Baker-FRC)
W82-01006

2C. Snow, Ice, and Frost

PHYSICAL MECHANICS OF AUFEIS GROWTH,

Alaska Univ., Fairbanks. Inst. of Water Resources.
D. L. Kane.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 186-195, June, 1981. 9 Fig, 21 Ref.

Descriptors: *Aufeis, *Freezing, *Arctic, Polar regions, *Ice formation, Physical properties, River mechanics, Pore pressure, Water pressure, Groundwater, Permafrost, Frozen ground, Piezometers, Time series analysis, Mathematical studies, Alaska.

Although subsurface physical systems in arctic and subarctic regions are frequently considered to be dormant during the winter months, several heat and mass transfer processes near the surface are quite active. These include aufeis growth, which occurs when water under pressure in a stream channel flows onto the existing ice cover and freezes. Data relating to the process of aufeis growth were collected on two small watersheds near Fairbanks, Alaska, over several winters. The pressure variations of the fluid in the porous streambank were measured using piezometers installed at several sites. Time series analyses were used to correlate the variations in the observed pore pressures with climatic variables. The piezometer measurements of pore water pressure indicated that subpermafrost groundwater or groundwater from nonpermafrost regions was the source of water for these ice deposits. Groundwater pore pressures were found to be sufficient to vertically lift the soil overburden and ice in the vicinity of the stream if an impermeable barrier existed. Ice lenses, formed when the seasonal frost penetrated to a zone high in soil moisture, provided this barrier. Ice wedges were found to develop in the seasonal frost zone near the water table, and the thickness of this ice wedge decreased with increasing distance from the stream. Time series analysis of air temperature and groundwater pore pressure indicated that periods of aufeis growth would be associated with or follow periods of moderately warm weather. Although the raw data for the later winter months supported this conclusion, it was less evident in the early winter months. A time lag was also found to exist between the start of a warming trend and the corresponding increase in pore water pressure, and this time lag increased with increasing ice thickness. (Carroll-FRC)
W82-00836

OCCURRENCE OF ICE LAYERS AT THE BASE OF HIGH ARCTIC SNOWPACKS,

McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M-K. Woo, and R. Heron.
Arctic and Alpine Research, Vol. 13, No. 2, p 225-230, May 1981. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Snowpack, *Ice formation, Cold regions, *Arctic zone, Snowmelt, Melting, Interfaces, *Canada, Cornvallis Island.

Field observations were carried out near Resolute, Cornwallis Island, North West Territory, during the snowmelt periods of 1979 and 1980 at sites underlain by gravel, bog, and lake ice wich was frozen to the lake bottom. At each site, snow temperatures and temperatures at various depths in the ground or in the lake ice were measured using thermistors. The measurements suggest two stages in the formation of a basal ice layer in most High Arctic snowpacks, including seepage of the meltwater into the frozen substrate before the ice is formed and initiation and sustained growth of a basal ice layer. Each stage of development seems to be affected by a set of conditions which can terminate further ice growth. At the seepage stage, the amount of meltwater lost to the substrate depends on the nature of the frozen material and the amount of ice already frozen in its pores. Seepage loss to lake ice is negligible because of its low permeability, but the ample pore space in coarse gravel will permit substantial seepage, and basal ice layer formation may be retarded. When most pores in the frozen substrate are sealed, further supplies from the pack will freeze as a basal ice layer if the substrate is sufficiently cold to dissipate the latent heat. With warming, however, additional meltwater will slush the snow above the ice layer, or will move downslope along the ice surface. A collection of lateral drainage sometimes produces thick ice layers in topographic depressions, as long as the ground temperature remains below zero degrees centigrade for an extended time. (Baker-FRC)
W82-00844

THE EFFECTS OF SURFACE DUST ON SNOWMELT RATES,

McMaster Univ., Hamilton (Ontario). Dept. of Geography.
J. J. Drake.
Arctic and Alpine Research, Vol. 13, No 2, p 219-223, May, 1981. 1 Fig, 14 Ref.

Descriptors: *Snowmelt, *Dusts, Wind velocity, solar radiation, Mathematical studies, Mathematical models, Temperature effects, Snowpack.

A basic assessment is presented of both the albedo and other effects of surface dust on snowmelt rates. These effects are illustrated with a particular numerical example from Schefferville. A model is presented which demonstrates the changes in albedo and surface temperature in relation to dust cover. This model leads to realistic order-of-magnitude estimates of the conditions under which snowmelt will be advanced or retarded. Thick dust covers, low solar radiation and high windspeeds retard snowmelt, while thin dust covers, intense solar radiation and low windspeeds increase snowmelt rates. The results agree with an earlier observation that dust covered snow near active mine sites is completely melted some four days before the general snowpack in the area. Other experiments have demonstrated that Mount St. Helens ash retards melt at thickness greater than 10 to 20 mm. (Baker-FRC)
W82-00845

THE DISTRIBUTION OF SEA ICE MELTWATER IN THE EASTERN CANADIAN ARCTIC,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
F. C. Tan, and P. M. Strain.
Journal of Geophysical Research, Vol 85, No C4, p 1925-1932, April, 1980. 11 Fig, 3 Tab, 24 Ref.

Descriptors: *Isotopic tracers, *Sea ice, Snowmelt, *Arctic zone, Isotope studies, Salinity, *Baffin Bay, *Canada, Melt water.

The feasibility of using oxygen isotope techniques to study the formation of Baffin Bay (eastern Canadian Arctic) bottom water was investigated. Water samples and sea ice cores were collected and analyzed to determine the oxygen isotopic composition. The nature of freezing seawater is such that sea ice contains much less salt than the water from which it was formed but does not have a very different isotopic composition. The distribution of sea ice melt water in the area was determined. Results indicated that the proposal by Sverdrup et al. which suggests that this water mass is a mixture of Labrador Sea deep water and Baffin Bay surface waters may be true. The analysis also gave support to the formation mechanism proposed by Collin and Bailey. Greater than 250-m water in Nares Strait (Smith Sound) had the same isotopic composition as both Baffin Bay deep water and bottom water. The difference in salinity between the Nares Strait water and the bottom water could be due to the addition of brines during ice formation. (Small-FRC)
W82-00966

2D. Evaporation and Transpiration

TRANSPIRATION, STOMATAL CONDUCTANCE, AND PHOTOSYNTHESIS OF TOMATO PLANTS WITH VARIOUS PROPORTIONS OF ROOT SYSTEM SUPPLIED WITH WATER,

Department of Agriculture, Harrow (Ontario).
For primary bibliographic entry see Field 2I.
W82-00504

SEASONAL CHANGES IN LEAF AREA, STOMATAL AND CANOPY CONDUCTANCES AND TRANSPIRATION FROM BRACKEN BELOW A FOREST CANOPY,

Institute of Hydrology, Wallingford (England).
J. Roberts, C. F. Pymar, J. S. Wallace, and R. M. Pitman.
Journal of Applied Ecology, Vol 17, No 2, p 409-422, August, 1980. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Stomatal transpiration, *Forests, *Canopy, Leaves, Conductance, Pine trees, Trees, Evapotranspiration, Seasonal variation, Water consumption.

The use of water by forests depends both on the major tree species present and on the amount and type of undercover. Therefore, in studying the factors controlling evaporation from a Scots pine forest at Thetford Chase, East Anglia, it was necessary to estimate the contribution from the bracken undergrowth. The development of the bracken canopy beneath the forest was investigated and the values of stomatal and canopy conductances were obtained for use in calculating bracken transpiration. Transpiration from the bracken was calculated using leaf area index and stomatal conductance values and appropriate environmental variables in the Penman-Monteith Equation. Calculated transpiration agreed well with independent values derived by weighing transplanted bracken. The contribution of bracken to the total forest transpiration was over 50% when the soil was driest and the atmospheric humidity deficits were also high. Under normal summer conditions, the bracken underbrush contributed between 20 and 25% of the total forest transpiration. Bracken stomatal conductance appears to be largely insensitive to atmospheric humidity deficits or to soil moisture conditions in forest environments. (Carroll-FRC)
W82-00655

CONSUMPTIVE USE AND DAILY EVAPOTRANSPIRATION OF CORN UNDER DIFFERENT LEVELS OF NITROGEN AND MOISTURE REGIMES,

Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Agronomy.
M. Devender Reddy, I. Krishna Murthy, K. Anand Reddy, and A. Venkatachari.
Plant and Soil, Vol 56, No 1, p 143-147, 1980. 3 Fig, 6 Ref.

Descriptors: *Corn, *Evapotranspiration, *Consumptive use, Water use, Nitrogen, Crop yield, Semiarid lands, Fertilization, Soil water, *India, Soil-water-plant relationships.

Cropping of corn in the semi-arid regions of Andhra Pradesh, India, was investigated by determining corn's seasonal consumptive use, daily evapotranspiration, and water use under different levels of nitrogen and moitsure regimes. Consumptive use difference was less among different nitrogen levels, but was marked between different moisture regimes. Evapotranspiration was less in the initial stages of the growing season, attained a peak at 80% of the growing season, and declined at the end of the season when maturity was reached. As nitrogen levels increased up to 180 kg N/ha, water use efficiency increased. There was a close relationship between the continuous availability of soil moisture and the response of corn to fertilizer application. If soil moisture becomes a limiting factor, the addition of fertilizer at this time might adversely affect the yield. Among moisture regimes, higher water use efficiency was found under 20% available soil moisture depletion. (Small-FRC)
W82-00660

THE INFLUENCE OF PLANT COMMUNITIES UPON THE HYDROLOGY OF CATCHMENTS,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
J. W. Holmes, and E. B. Wronski.
Agricultural Water Management, Vol 4, No 1-3, p 19-34, 1981. 2 Fig, 8 Tab, 27 Ref.

Descriptors: *Catchment areas, *Vegetation effects, *Evapotranspiration, *Forest watersheds, Evaporation rate, Leaves, Runoff, Groundwater recharge, Hydrology, *Australia.

The effect of land use on the water yield from catchments is reviewed, with emphasis on forested land. In general, less runoff occurs on forested catchments because the evapotranspiration from them is larger than from catchments not in forest. Rainwater held upon wet foliage evaporates faster than the transpiration rate would be if the leaves were dry. Interception loss may account for the observed yields from forested catchments, up to 200 mm/yr less than, for example, grassland. The interception store can be 2 mm. Also, deep-rooted perennial plants created a soil-water deficit that is probably larger than that caused by annual pastures or cereal crops. The data available indicate that it is probable that a soil-water deficit of 250 mm each year could be created by an evergreen forest and 180 mm each year by annuals. This is valid for the climatic regions of southern Australia, where rainfall is 700 mm/year or more. This implies a yield of 70 mm/year less from forested land in runoff or recharge of groundwater. Thus, a forested area will experience enhanced evaporation of rainwater on leaves, and this may eventually cause hydrologic changes. (Small-FRC)
W82-00931

LEAF AND ENVIRONMENTAL PARAMETERS INFLUENCING TRANSPIRATION: THEORY AND FIELD MEASUREMENTS,

Wyoming Univ., Laramie. Dept. of Botany.
W. K. Smith, and G. N. Geller.
Oecologia, Vol 46, No 3, p 308-313, September, 1980. 3 Fig, 1 Tab, 21 Ref.

Descriptors: *Desert plants, *Leaves, *Transpiration, Xerophytes, Stomatal transpiration, Soil-water-plant relationships.

This paper investigated the influence of changes in leaf size or wind on transpiration at a given stomatal resistance for various combinations of air temperature and absorbed solar energy. Predicted transpiration either increased or decreased for increases in leaf size depending on the specific combinations of the above factors. Major reductions in simulated transpiration with increasing leaf size occurred for shaded, highly reflective, or specially oriented leaves (fraction of full sunlight, 0.1) at relatively high air temperatures when stomatal resistance was below 500 s per m. Increases in fraction of sunlight (to 0.7) and decreases in air temperature (to 20 C) lowered this critical resistance to below 50 s per m. When stomatal resistance was above this critical value of 500 s per m, transpiration increased with larger leaves and less wind. The theoretical results were compared to field measurements on some desert plants. (Cassar-FRC)
W82-00979

SOIL MOISTURE RELATIONS IN THE SOUTHERN CALIFORNIA CHAPARRAL,

San Diego State Univ., CA. Dept. of Biology.
E. Ng, and P. C. Miller.
Ecology, Vol 61, No 1, p 98-107, 1980. 6 Fig, 3 Tab, 53 Ref.

Descriptors: *Soil moisture, *Chaparral, *California, Drought, Moisture availability, Transpiration, Vegetation regrowth, *Soil-water-plant relationships.

Soil moisture balance and vegetation studies were conducted on two chaparral-covered slopes in southern California. Vegetation on the north-facing slope was dominated by Ceanothus greggii, and on the south-facing slope by Adenostoma fasciculatum. Vegetation cover on the north-facing slope was greater than on the south-facing slope. Throughout the year, soil moisture at 0.3-1.0 m depths was greater on the south-facing slope than on the north-facing slope. Soil texture on the two slopes did not differ significantly. Precipitation on the two slopes was the same, averaging 30 cm/year, below the usual level for this area. Subsurface drainage was greater on the south-facing slope and peaked in January, close to the time of maximum precipitation. Evaporation was greater on the south-facing slope, but transpiration was greater on the north-facing slope. The greater vegetation cover and drier soils on the north-facing slope are probably related to the drought-resistant nature of vegetation in this mediterranean climate. The greater transpiration on the north-facing slope is probably due to the ability of the plants on this slope to draw water from deeper soil layers and to maintain open stomata at lower water potentials. (Baker-FRC)
W82-01035

RATIO BETWEEN EVAPOTRANSPIRATION OF IRRIGATED CROPS FROM FLOATING LYSIMETERS AND CLASS A PAN EVAPORATION,

Department of Agriculture, Harrow (Ontario). Research Station.
C. S. Tan, and J. M. Fulton.
Canadian Journal of Plant Science, Vol 60, No 1, p 197-201, January, 1980. 3 Fig, 8 Ref.

Descriptors: *Evapotranspiration, *Vegetation effects, Evapotranspiration potential, Lysimeters, Evaporation rate, Evaporation pans, Evaporimeters, Water loss, Potatoes, Corn, Tomatoes, *Irrigation, *Vegetable crops, *Ontario, Canada.

This paper provides the crop coefficient of early potatoes, corn and processing tomatoes using evapotranspiration data on irrigated crops collected from floating lysimeters and potential crop evapotranspiration obtained from Class A pan at Harrow for the growing season of 1963 through 1972. The crop coefficient is the ratio of crop evapotranspiration to potential or maximum evapotranspiration. The value of the crop coefficient depends on the percentage of foliage cover on the soil, increasing from emergence to about 50-80% of foliage cover, remaining at a maximum value for about 2-5 weeks, and thereafter decreasing during the late season stage until the crops approach maturity. The low value of the crop coefficient at the initial stage of crop development may be attributable to the evaporation rate from bare soil. The soil evaporation can be affected by irrigation and rainfall frequency. As the soil surface water dries out, though the root zone water is ample, the value of the crop coefficient will remain at a low value. This is because the capillary flow from the root zone of the soil body to the soil surface limits the rate of evaporation. As the percentage of foliage cover continues to increase, the evaporation from soil becomes less important and remains relatively constant. (Baker-FRC)
W82-01050

2E. Streamflow and Runoff

A LEAKY RESERVOIR MODEL FOR EPHEMERAL FLOW RECESSION,

Office of Surface Mining Reclamation and Enforcement (DI), Washington, DC.
R. W. Peebles, R. E. Smith, and S. J. Yakowitz.
Water Resources Research, Vol 17, No 3, p 628-636, June, 1981. 9 Fig, 1 Tab, 12 Ref.

Descriptors: *Ephemeral streams, *Recession, *Streamflow forecasting, Reservoirs, Storage, Flood flow, Flood peak, *Model studies, Hydrographs, Infiltration, Reservoir leakage, *Streamflow depletion.

A leaky reservoir model is proposed to represent streamflow recession in an ephemeral stream. The model is described by a continuity equation, a discharge-stage relation (stream rating), and a stage-storage relation (reservoir configuration). The infiltration loss in the stream channel is analogous to leaking in the bottom of a reservoir. No input is routed through the reservoir: at the onset of the recession the reservoir has water in storage. By calibrating reservoir leakage rate and initial storage (reservoir shape) a good fit to observed curves is obtained. The most critical parameter is reservoir shape; recession curves do not change much with changing reservoir loss rate. (Cassar-FRC)
W82-00600

MULTIVARIATE HYDROLOGIC TIME SERIES ANALYSIS,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-00647

EFFECTS OF RECENT INCREASES IN RAINFALL ON FLOODS AND RUNOFF IN THE UPPER HUNTER VALLEY,

New South Wales Univ., Kensington (Australia). School of Geography.
F. C. Bell, and W. D. Erskine.
Search, Vol 12, No 3/4, p 82-83, March/April, 1981. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Runoff, *Flood frequency, Channel improvement, *Rainfall-runoff relationships, *Hunter Valley, *Australia, Streamflow, Water resources development.

Recent large and significant changes in flood frequencies and annual runoff were observed since 1946 in the Hunter Valley, Australia. Results of analysis of rainfall and runoff records since 1898 suggest that the cause is the increased rainfall and lower frequency of dry years after 1946, not catchment modifications or disturbance. Before 1946, channel and catchment modifications probably caused decreases in runoff and runoff variability during dry years and increases during wet years. After 1946 there was no effect from modification activities. (Cassar-FRC)
W82-00668

EFFECTS OF TROPICAL CYCLONE WALLY IN SOUTHEAST VITI LEVU, FIJI, EASTER 1980,

Victoria Univ., Wellington (New Zealand).
For primary bibliographic entry see Field 2A.
W82-00670

FLOODS IN KANSAS CITY, MISSOURI AND KANSAS, SEPTEMBER 12-13,

Geological Survey, Rolla, Mo. Water Resources Div.
L. D. Hauth, W. J. Carswell, Jr., and E. H. Chin.
Branch of Dist., USGS 604 South Pickett St. Alexandria, Va. 22304. Price $3.50. Geological Survey Professional Paper 1169, 1981. 47 p, 39 Fig, 4 Tab, 21 Ref.

Descriptors: *Floods, *Flood data, *Flood damage, *Flood peak, *Flood profiles, Gaging stations, Flood flow, Streamflow, Rainfall-runoff relationships, Flood frequency, Hydrologic data, Flood hydrographs, *Missouri, *Kansas, *Kansas City.

The storms of Sept. 12-13, 1977, delivered as much as 16 in. of rain, with average rainfall exceeding 10 in. in the Kansas City metropolitan area. Twenty-five lives were lost, many were left homeless, and damages exceeded $80 million. Data obtained by the National Weather Service and the U.S. Geological Survey indicate that two record-setting rainstorms occurred within 24 hours. The first storm, in the early morning, thoroughly soaked the local drainage basins. The second storm, centered along the Brush and Round Grove Creek basins, resulted in a devastating flash flood. Peak discharges were determined during and after this major flood at gaging stations and selected miscellaneous locations. Streamflows and flood volumes in many locations far exceeded estimated values for the 100-year flood. (USGS)
W82-00724

TEMPERATURE AND SOLUTE-TRANSPORT SIMULATION IN STREAMFLOW USING A LAGRANGIAN REFERENCE FRAME,

Geological Survey, NSTL Station, MS. Water Resources Div.
H. E. Jobson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-225757, Price codes: A09 in paper copy, A01 in microfiche. Geoglogical Survey Water-Resources Investigations 81-2, 1980. 165 p, 21 Fig, 2 Tab, 24 Ref.

Descriptors: *Computer models, *Temperature, *Solute transport, *Streamflow, Path of pollutants, Tracking techniques, Traveltime, Rivers, Flow, Unsteady flow, Open channels, Numerical analysis, Mathematical models, Prediction, Computer programs.

A computer program for simulating one-dimensional, unsteady temperature and solute transport in a river has been developed and documented for general use. The solution approach to the convective-diffusion equation uses a moving reference frame (Lagrangian) which greatly simplifies the mathematics of the solution procedure and dramatically reduces errors caused by numerical dispersion. The model documentation is presented as a series of four programs of increasing complexity. The conservative transport model can be used to route a single conservative substance. The simplified temperature model is used to predict water temperature in rivers when only temperature and windspeed data are available. The complete temperature model is highly accurate but requires rather complete meteorological data. Finally, the 10-parameter model can be used to route as many as 10 interacting constituents through a river reach. (USGS)
W82-00726

THE ROLE OF SUBSTRATUM IN BENTHIC MACROINVERTEBRATE MICRODISTRIBUTION AND LITTER DECOMPOSITION IN A WOODLAND STREAM,

North Carolina Univ. at Chapel Hill. Dept. of Zoology.
S. R. Reice.
Ecology, Vol 61, No 3, p 580-590, 1980. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Ecosystems, *Streams, Litter, Organic matter, *Leaves, *Decomposition, Decomposing organic matter, Detritus, *Macroinvertebrates, Spatial distribution, *Substrates, New Hope Creek, Orange County, *North Carolina, Forest watersheds.

The contribution of substratum per se on decomposition of leaf litter and microdistribution of benthic invertebrates in streams were investigated. The study was conducted in winter 1975-76 in New Hope Creek, Orange County, North Carolina. The site was Duke Forest, which affords a protected habitat. The substratum was relatively uniform, consisting of cobbles with a few boulders, some sand, and gravel. Overall litter decomposition did not vary among substrata. The fraction of animal populations in leaf packs was proportional to the biomass remaining. Animals showed substratum preferences even when velocity differences were eliminated. Preferences of common taxa were unaffected by the presence or absence of leaf packs on the substratum. Common taxa showed strong preferences for either leaves or substrata. Abundance data strongly contradict the density data. The latter measure offers more biological insight. These results emphasize the importance of substratum size as a prime determinant of the structure of lotic macroinvertebrate communities. (Baker-FRC)
W82-01037

FLOW ANALYSIS OF MODELS OF THE HUBBARD BROOK ECOSYSTEM,

Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 1A.
W82-01038

2F. Groundwater

HYDROGEOLOGICAL AND GEOPHYSICAL LOGGING.

Wuidart Engineering Ltd., Shefford Beds (England).
For primary bibliographic entry see Field 7B.
W82-00511

THE USE OF NA/CL RATIOS TO TRACE SOLUTE SOURCES IN A SEMIARID ZONE,

Weizmann Inst. of Science, Rehovot (Israel). Isotope Dept.
For primary bibliographic entry see Field 7B.
W82-00601

A MATHEMATICAL MODEL FOR CONSOLIDATION IN A THERMOELASTIC AQUIFER DUE TO HOT WATER INJECTION OR PUMPING,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 3, p 723-736, June. 1981. 1 Fig, 30 Ref.

Descriptors: *Subsidence, *Geothermal studies, Aquifer management, *Mathematical models, Model studies, *Thermal water, *Injection wells, Wells, Pore pressure, Energy, Storage.

This paper develops a mathematical model to estimate fluid pressure, temperature, land subsidence and horizontal displacement produced by hot water injection into thermoelastic confined and leaky aquifers (for energy storage), pumping from a geothermal field, or flooding a warm aquifer with cold water. Assuming that the aquifer is thin relative to the horizontal distances involved the dependent variables are average (over the aquifer thickness) values. The solid matrix is assumed to be thermoelastic. After development of three-dimensional conservation of mass and energy equations and equilibrium equations in terms of horizontal and vertical displacements, the model is derived by averaging the three-dimensional model over the vertical thickness of the aquifer, subject to conditions of plane total stress. The resulting averaged coupled equations are stated in terms of pore water pressure, temperature, and vertical and horizontal displacement. An example of a single pumping/injection well is given as an illustration. (Cassar-FRC)
W82-00602

DETERMINATION OF HYDROGEOLOGICAL PARAMETERS USING SINUSOIDAL PRESSURE TESTS: A THEORETICAL APPRAISAL,

Institute of Geological Sciences, Harwell (England). Environmental Protection Unit.
For primary bibliographic entry see Field 7B.
W82-00603

A NON-EQUILIBRIUM THERMODYNAMICS APPROACH TO TRANSPORT PHENOMENA IN CAPILLARY POROUS MEDIA,

Universidade Federal de Vicosa (Brazil).
M. Fortes, and M. R. Okos.
Transactions of the ASAE, Vol 24, No 3, p 756-760, May/June, 1981. 41 Ref.

Descriptors: Porosity, Thermodynamics, *Model studies, *Groundwater movement, Mathematical studies, Capillary water, *Porous media, Soil water, Capillary coductivity.

The objective of this work is to present a set of transport equations which incorporates most of the existing models by combining the mechanistic and irreversible thermodynamics approaches to heat and mass transfer in porous media. A comparison between the non-equilibrium thermodynamics equations and those obtained from a mechanistic reasoning leads to the evaluation of the phenomenological coefficients. DuFour and Soret's coefficients are obtained from Onsager's relationships. The model describes transport phenomena in capillary-porous media. It is shown based on the local equilibrium principle, that the isothermal driving force for both liquid and vapor transfer in a porous medium is the gradient of equilibrium moisture content. Thus, it is postulated that water, in a capillary-porous medium, can move in opposition to a moisture content gradient, but always in the direction of the equilibrium moisture content gradient. (Baker-FRC)
W82-00697

HYDROGEOCHEMISTRY AND SIMULATED SOLUTE TRANSPORT, PICEANCE BASIN, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-00723

POTENTIOMETRIC-SURFACE MAP FOR THE CRETACEOUS AQUIFER, VIRGINIA COASTAL PLAIN, 1978,

Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00727

POTENTIOMETRIC SURFACE OF THE WILCOX-CARRIZO AQUIFER; BIENVILLE, RED RIVER, NORTHERN NATCHITOCHES, AND SOUTHERN WEBSTER PARISHES, LOUISANA,

Geological Survey, Alexandria, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00728

GENERALIZED THICKNESS OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00729

APPROXIMATE GROUND-WATER-LEVEL CONTOURS, APRIL 1981, FOR THE SOQUEL-APTOS AREA, SANTA CRUZ COUNTY, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-00734

RESISTIVITY STUDY OF A COASTAL KARST TERRAIN, FLORIDA,

Geological Survey, Tampa, FL.
J. D. Fretwell, and M. T. Stewart.
Ground Water, Vol 19, No 2, p 156-162, March/April, 1981. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Resistivity, *Saline-freshwater interfaces, *Coastal aquifers, Aquifer properties, Geohydrology, Electrical properties, *Karst hydrology, *Florida, Saline water intrusion.

Results from the resistivity method for locating a fresh-salt water interface agreed with known hydrologic data. The study site was the west-central Gulf coast area of Florida, where 28 vertical electrical soundings were done. Four geoelectric layers were revealed: surficial sands; a karstic, highly transmissive carbonate; a less porous carbonate; and a saline carbonate layer with resistivity of less than 1 ohm-meter. The depth of the fresh-salt water interface decreased toward the coast. (Cassar-FRC)
W82-00817

NUMERICAL SIMULATION OF POTENTIOMETRIC SURFACE CHANGES CAUSED BY A PROPOSED OPEN-PIT ANTHRACITE MINE,

Stone and Webster Engineering Corp., Cherry Hill, NJ.
For primary bibliographic entry see Field 6A.
W82-00819

THE DEVELOPMENT OF METHODS FOR DETERMINING AQUIFER CHARACTERISTICS,

Ohio State Univ., Columbus.
R. Broadhead.
Ground Water, Vol 19, No 2, p 230-232, March/April, 1981. 1 Fig, 33 Ref.

Descriptors: *Aquifer characteristics, *Mathematical studies, *Storage coefficient, *Transmissivity, Aquifers, Groundwater reservoirs, Groundwater availability.

Recent effects in refining mathematical techniques to describe aquifer characteristics are summarized. Ground water hydrologists are primarily concerned with the storage coefficient (S) and the coefficient of transmissivity (T). The latest advance is the work by Rushton, presented in 1978. A mathematical model was developed to estimate transmissivity and the storage coefficient from pumped well data only. In 1971 Nawrocki experimentally compared four methods of determining T and S. No method was found to yield consistently higher or lower results than the others. The sensitivity of the various equations to the accuracy of the data input had not been determined. The major factor limiting the accuracy of aquifer coefficients is the inhomogeneity of real aquifers. In the future, a good appreciation for the inherent variations in the coefficients should be combined with an awareness of the final use intended for the coefficients. (Small-FRC)
W82-00827

PREDICTIVE DEPOSITIONAL MODEL FOR GLACIAL AQUIFERS,

University of South Florida, Tampa. Dept. of Geology.
M. T. Stewart.
Ground Water, Vol 19, No 2, p 133-137, March/April, 1981. 10 Fig, 1 Tab, 7 Ref.

Descriptors: *Groundwater mining, *Mathematical models, *Glacial aquifers, Aquifers, Glaciers, Bedrock, *Wisconsin, Groundwater potential.

This study defined zones within valley fill in northeastern Wisconsin that have a high probability of containing high-yield drift aquifers. A depositional model was developed to aid in the location of high-yield drift aquifers. The yield and spatial distribution of glacial aquifers were controlled by bedrock topography and glacial geology. Driller's logs were used to obtain lithologic control for identification and classification of aquifer units. This information was combined with seismic refraction and gravity survey data to derive the bedrock elevation map. Bedrock topography strongly influenced the distribution and character of glacial units and clearly delineated two glacial aquifer types: valley and morainal units. Valley aquifers are the most productive. Using statistical analysis, a model was developed which allows the knowledge of bedrock topography to be coupled with glacial geology to predict the spatial distribution of glacial aquifers. (Small-FRC)
W82-00828

THE RELATIONSHIP BETWEEN FRACTURE TRACES AND JOINTS IN A TERTIARY BASIN, SOUTHWEST MONTANA,

Indiana Univ. at Bloomington. Dept. of Geology.
For primary bibliographic entry see Field 7B.
W82-00829

WASTE HEAT BALANCE IN AQUIFERS CALCULATED BY A COMPUTER PROGRAMME,

Geologisches Landesamt Nordrheim-Westfalen, Krefeld (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W82-00830

HYDROGEOLOGY OF THE SIERRA NEVADA FOOTHILL LINEAMENT NEAR OAKHURST, CALIFORNIA,

California State Univ., Fresno. Dept. of Geology.
S. Mack, and K. D. Schmidt.
Ground Water, Vol 19, No 2, p 149-155, March/April, 1981. 5 Fig, 2 Tab, 11 Ref.

Descriptors: *Geologic history, *Groundwater, *Chlorides, Connate water, Granites, *Sierra Nevada, California, *Geohydrology.

The influence of hydrogeologic factors on the distribution of high chloride ground water is discussed for the Sierra Nevada Foothill lineament near Oakhurst, California. This northwest trending lineament extends for 60 miles along the western Sierra Nevada foothills of Fresno and Madera Counties and includes 33 wells and two springs. The high-chloride water was probably influenced by connate waters derived from the compaction of Paleozoic and early Mesozoic marine clastic rocks in the Sierra Nevada. If granitic plutons in the area are presumed to be fairly thin mushroom-like complexes emplaced in the upper crust, hydrologeologic relations are explained. Marine connate water migration upward more or less vertically from a fault zone beneath a capping of granitic rock defined the lineament. Excellent correlation was found in the Oakhurst Basin between air-photo linear features and wells yielding high-chloride water. The persistence of the high-chloride water may be due to the high density of the connate water and the lack of deep circulation of meteoric water beneath topographically low areas. (Small-FRC)
W82-00831

THE DECLINING GROUND-WATER RESOURCES OF ALLUVIAL VALLEYS: A CASE STUDY,

Geological Survey, Lawrence, KS.
For primary bibliographic entry see Field 4B.
W82-00832

A COMBINATION OF ELECTRICAL RESISTIVITY, SEISMIC REFRACTION, AND GRAVITY MEASUREMENTS FOR GROUNDWATER EXPLORATION IN SUDAN,

Groundwater Survey TNO, Delft (Netherlands).
R. A. van Overmeeren.
Geophysics, Vol 46, No 9, p 1304-1313, September, 1981. 10 Fig, 10 Ref.

Descriptors: Water resources development, *Geophysics, *Groundwater potential, Seismology, Gravity studies, Resistivity, Bedrock, Salinity, Exploration, *Geohydrology, *Sudan.

An integrated application of several geophysical exploration methods provided hydrogeologic information during groundwater exploration in the Sudan. Electrical resistivity, seismic refraction, and gravity methods were used to study prospects for additional supply of groundwater. Multilayer electrical sounding curves were already available and an additional 16 vertical electrical soundings were made. Seismic refraction work was carried out at selected locations to yield additional information on depths to bedrock. Using seismic data, a unique solution was found for the electrical souding curves, from which it was concluded that groundwater in the area was saline. Drilling tests confirmed these findings. A regional relative Bouguer anomaly map gave a picture of the general geologic structures and estimated depths to bedrock. In areas such as this where the basement rocks are close to the surface, gravity anomalies cannot be corrected with bedrock relief because of the strong influence of lateral density variations within the bedrock. Reliable data on depth to bedrock and formation resistivities could not have been obtained using only one of the techniques. (Small-FRC)
W82-00852

A METHOD FOR ESTIMATING RECHARGE AND BOUNDARY FLUX FROM GROUNDWATER LEVEL OBSERVATIONS,

Institute of Hydrology, Wallingford (England).
P. J. Smith, and R. S. Wikramaratna.
Hydrological Sciences Bulletin, Vol 26, No 2, p 113-136, June, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Groundwater recharge, *Transmissivity, *Water level, Fluctuations, Mathematical studies, Estimating equations, Groundwater management, Semiarid lands.

A new method is proposed for the estimation of recharge and boundary flux based on water level and transmissivity observations. It is particularly useful in semiarid regions where a steady state formulation can be used and recharge is confined to certain known areas. When this inferred recharge method is applied to a typical problem, it is an improvement over the implied recharge method. The variances for inferred recharge are satisfactory estimates of those obtained in simulations. Even when these variance estimates are large, alternative hypotheses can be tested about the mechanism of recharge using statistical significance tests. An error in the transmissivity distribution has less effect than an error of the same proportion in the water level observations, which means that this method can be useful in the early stages of modelling studies when only crude assessments have been made. These early results can aid

in the design of a field data collection program. (Small-FRC)
W82-00985

WELL-FIELD DRAWDOWNS USING COUPLED AQUIFER MODEL,

Law Engineering Testing Co., Tampa, FL.
L. H. Motz.
Ground Water, Vol 19, No 2, p 172-179, March/April, 1981. 10 Fig, 6 Ref.

Descriptors: *Drawdown, *Aquifers, *Wells, Model studies, Groundwater movement, Water table aquifers, Pumping tests, Evapotranspiration, Jay B Starkey Wilderness Park, *Florida.

A coupled aquifer model (Motz, 1978) was used to investigate well field drawdowns in the Jay B. Starkey Wilderness Park, Pasco County, Florida. In this model, water pumped from an underlying artesian aquifer originates from leakage through an overlying semipermeable confining bed. The source of this leakage is assumed to be a reduction in evapotranspiration from the overlying water table aquifer. The hydrologic coefficients in the coupled aquifer model were calibrated from observed pumping and water table data; water table and artesian aquifer drawdowns were estimated for different pumping rates. A coefficient of 0.00112 gpd per cu ft was obtained by matching calculated water table drawdowns to observed water table drawdowns caused by five production wells in the park. Five alternative plans for further well development were explored. The best plan recommended that the central and eastern parts of the park be developed. (Cassar-FRC)
W82-00990

DISSOLUTION OF SALT DEPOSITS BY BRINE DENSITY FLOW,

New Mexico Univ., Albuquerque. Dept. of Geology.
R. Y. Anderson, and D. W. Kirkland.
Geology, Vol 8, No 2, p 66-69, February, 1980. 4 Fig, 12 Ref.

Descriptors: *Salts, *Radioactive waste disposal, *Model studies, Waste disposal, Radioactive wastes, Flow, Flow system, Brines, Water pollution sources.

A brine density flow model is applied to the dissolution of evaporites, which has implications for the use of evaporite deposits for the storage of radioactive waste. A model simulating brine flow was constructed in which a source (aquifer) was connected to an overlying chamber containing salt by a capillary tube 0.54 m long and 0.0015 m in diameter. Water was driven through the tube by brine density difference alone and removed salt from the overlying chamber at a rate of about 1 gm/min. Continuous two way flow developed. Dissolution by means of brine flow within the Delaware Basin in western Texas is discussed, and it is suggested that similar processes may operate in other evaporite basins. Fracture systems that provide communication between pressurized and flowing fresh water aquifers and salt bodies have the potential for developing brine flow and a dissolution system. This can lead, as it has in the Delaware Basin, to collapse breccias. The potential for deep-seated dissolution by means of brine flow should be added to factors considered in risk assessment programs when considering waste depositories in evaporites. (Small-FRC)
W82-01016

2G. Water In Soils

MICROBIAL MOBILIZATION OF CALCIUM AND MAGNESIUM IN WATERLOGGED SOILS,

National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
M. P. Silverman, and E. F. Munoz.
Journal of Environmental Quality, Vol 9, No 1, p 9-12, January-March, 1980. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Soil water, *Calcium, *Magnesium, *Bacteria, Metabolism, Microbiological studies, Anaerobic conditions, Aerobic conditions, Biodegradation, Soil chemistry.

Direct measurements were made of changes in the concentrations of Ca and Mg in soil solutions as a consequence of microbial glucose metabolism and of the rates of Ca and Mg mobilization as affected by the presence or absence of atmospheric 02. Twelve California soils were amended with 0.5% glucose solution and incubated in air and anaerobically for two weeks under waterlogged conditions. In soil solutions incubated in air, there was a decrease of 1 to 2 units in the pH relative to control soils incubated without glucose. There was also a 2.4- to 29.4-fold increase in the Ca content and a 0.7- to 41-fold increase in the Mg content. Under anaerobic incubation a similar decrease in pH was determined, as well as 2.7- to 15.3-fold increases in Ca and 1.5- to 47-fold increases in Mg. Under incubation in air, the amounts of Ca and Mg increased for 3 to 10 days and then decreased. Under anaerobic conditions, concentrations reached maximum values in 7 to 10 days and did decrease later. Microbial production of various organic metabolites from glucose may be responsible for the release of Ca and Mg from exchange sites. In air, these metabolic products become susceptible to biodegradation, but they are relatively stable under anaerobic incubation. (Small-FRC)
W82-00560

EFFECT OF LEACHATE FLOW RATE ON METAL MIGRATION THROUGH SOIL,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 5E.
W82-00565

A MATHEMATICAL MODEL FOR PREDICTING MOISTURE FLOW IN AN UNSATURATED SOIL UNDER HYDRAULIC AND TEMPERATURE GRADIENTS,

Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
V. Dakshanamurthy, and D. G. Fredlund.
Water Resources Research, Vol 17, No 3, p 714-722, June, 1981. 9 Fig, 2 Tab, 24 Ref.

Descriptors: *Unsaturated flow, *Soil properties, *Pore pressure, Pore water, Soil gases, Soil water, Model studies, Mathematical models, Soil water movement.

A model is developed to predict the moisture flow in an unsaturated soil as a result of hydraulic and temperature gradients. Three partial differential equations (heat flow at above-freezing conditions, water phase and air phase) are solved simultaneously for changes in the combined thermal and hydraulic boundary conditions. Darcy's law is used to describe the flow in the water phase; Fick's law for the air phase; and Fredlund and Morgenstern's constitutive equations for the volume change of an unsaturated soil. Solving the equations produces the temperature, pore water pressure, and pore air pressure distribution with space and time in an unsaturated soil. From these values the quantity of moisture flow may be calculated. Four example problems involve prediction of the moisture flow in an unsaturated subgrade soil such as that below a highway or airfield. The information may also be used to study the dissipation of pore pressures in the compacted core material of an earthfill dam. (Cassar-FRC)
W82-00605

THE EFFECTS OF SODIUM AND ORGANIC MATTER IN SEWAGE EFFLUENT ON WATER RETENTION PROPERTIES OF SOILS,

The Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Science.
For primary bibliographic entry see Field 3C.
W82-00663

ESTIMATION OF SOIL-MOISTURE CHARACTERISTICS FROM MECHANICAL PROPERTIES OF SOILS,

Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani (India). Dept. of Agricultural Engineering.
R. K. Ghosh.
Soil Science, Vol 130, No 2, p 60-63, August, 1980. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Soil water, *Estimating equations, *Soil properties, Mathematical studies, Soil water potential, Soil science.

An empirical technique was developed to estimate soil-moisture characteristics. Soil-moisture characteristics can be determined directly from soil physical properties and a single measurement of water potential in bars at some moisture content on a volume basis. The procedure is particularly useful when a reliable soil moisture characteristic curve is not available. Usually, the physical properties of soils can be obtained from published records of routine work for any geographical location. The method is applicable for those soils for which the water potential minus the moisture content can be expressed as the water potential equals the air-entry water potential in bars times the moisture content over the saturated water content after this fraction is raised to the power of a constant. Considerable agreement was found between estimated values using this procedure and experimentally determined values. (Small-FRC)
W82-00785

EFFECTS OF JOULE HEATING ON THERMOCOUPLE PSYCHROMETER WATER POTENTIAL DETERMINATIONS,

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W82-00892

SUBSURFACE DRAINAGE AND SEDIMENT TRANSPORT MODEL,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. B. Bottcher, E. J. Monke, and L. F. Huggins.
Transactions of the ASAE, Vol 23, No 4, p 870-876, July/August, 1980. 5 Fig, 15 Ref.

Descriptors: *Sediment transport, *Mathematical models, *Subsurface drainage, Drainage, Sediments, Mathematical equations, Computer models, Simulation, Groundwater movement, Flow characteristics.

Since root zone drainage is the main incentive for subsurface drainage, most research in this area has concentrated on water movement; however, the waters involved can carry substantial amounts of sediments and nutrients. A computer model was developed which uses the GASP IV simulation language to simulate water flow and sediment movement from a subsurface drainage system and to predict these activities as a function of time for both single and multistorm events. The flow portion of the model uses a one-dimensional form of the Richard's equation and a steady state tile flow formula by Toksoz and Kirtham (1961). The output of the flow portion of the model directly controls the particle detachment portion of the model, which is based on a force balance relationship. The sediment flush observed at the beginning of some flow events is adequately described by an exponential decay function. Data collected from a 17 hectare drainage system on a Hoytville silty clay soil were used for calibration and directly proportional to drain flow, while drain flow and rainfall were continuously recorded. Moisture deficit replenishment coefficients, deep seepage, and saturated hydraulic conductivity were calibrated. The model was verified through simulation of the most active flow period of the two years during which data were collected. Comparison of the model results with observed data indicated that the model can reliably predict water yield, sediment yield, and the sediment concentration curve. There was, however, some difficulty in simulating the actual shape of the flow hydrograph. This model should facilitate planning for compliance with section 208 of the Federal Clean Water Act and provide a base for more complex nutrient and pesticide transport models. (Carroll-FRC)
W82-00894

RESIDENCE TIMES OF WATER AND SOLUTES WITHIN AND BELOW THE ROOT ZONE,
Institute of Soil Fertility, Groningen (Netherlands).
P. A. C. Raats.
Agricultural Water Management, Vol 4, No, 1-3, p 63-82, 1981. 9 Fig, 43 Ref.

Descriptors: *Estimating equations, *Soil water, *Solute transport, Mathematical studies, Solutes, Salinity, *Root zone, Water quality, Agriculture, *Netherlands.

An approach is presented to the analysis of simultaneous transport of water and solutes within the root zone and in the region between the water table and drains, ditches, or streams. Equations are presented which indicate that within the root zone the travel speed of the water or solute depends primarily on the components of the overall water balance, the average water content, and the distribution of the water uptake. Recent attempts to infer water uptake from salinity data are discussed, as are transport to drains, ditches, or streams induced by an input distributed uniformly over the soil surface. If the ratio of the half-spacing between ditches, drains, or streams and the depth to the impermeable layer is larger than about five, the following are true: The isotherms are horizontal except close to the outlets, and the transit time density distribution is approximately exponential. Estimates are presented for the retardation due to adsorption, for the influence of reactions, and for the influence of dispersion. (Small-FRC)
W82-00932

MODELING WATER FLUX ON STRIP-MINED LAND,
Science and Education Administration, Northeast Watershed Research Center, University Park, PA.
A. S. Rogowski, and B. E. Weinrich.
Transactions of the ASAE, Vol 24, No 4, p 935-940, July/August, 1981. 6 Fig, 4 Tab, 17 Ref.

Descriptors: *Model studies, *Flow measurement, *Soil water, Fluid flow, Flow pattern, Flow profiles, Spoil banks, Mine wastes, Strip mine wastes, Strip mines, Appalachia, *Land reclamation.

An attempt was made to model numerically the infiltration and redistribution of water in reclaimed topsoiled and nontopsoiled Appalachian minesoils. In these minesoils, large size fractions predominate. It was determined that infiltration and redistribution of applied water on topsoiled spoil profiles could be adequately modeled with numerical techniques using either experimentally determined values or moisture characteristics corrected for coarse fragment content and hydraulic conductivities derived from seepage flux. On nontopsoiled profiles, numerical techniques appear inadequate, and a better fit to experimental data can be obtained by subtracting from the flux the amount of water retained by the fine particles and the amount retained on the surface of coarse fragments and then considering the flux to be a function of gravity alone. However, even this approach is not completely satisfactory. At times, when the profile is reasonably dry, water seems to move rapidly through larger channels in the coarse spoil materials without appreciably wetting the rest of the profile. (Baker-FRC)
W82-00944

DRYLAND MANAGEMENT FOR SALINITY CONTROL,
J. Van Schilfgaarde.
Agricultural Water Management, Vol 4, No 1/3, p 383-391, 1981. 18 Ref.

Descriptors: *Salinity, *Water quality management, Water quality, Water resources development, Evapotranspiration, Salt balance, Salts, Farming, *Cropland, Vegetation, Reforestation, Recharge basins, *Great Plains.

Management of salinity in dryland areas may be approached through the maintenance or enhancement in situ of agricultural production, or it may be approached through increasing the yield of good quality water. In the Northern Great Plains of North America, the primary concern is the loss of agricultural production, and solutions to this are sought through the prevention of new and the reclamation of existing salt seeps. This can be accomplished at the recharge site by changing the water balance, or dealt with downstream. In the Red River Valley of North Dakota a different problem exists in that some 160,000 ha of agricultural lands have saline water tables near the surface. In the Lower Rio Grande Valley of Texas, some 40,000 ha of cultivated, nonirrigated soils have salinity problems. The problem facing Western Australia is similar to that of the Northern Great Plains. Excess water percolation due to changes in vegetation resulted in increased lateral movement through semiconfined aquifers. The salts involved are dominantly chlorides deposited in rainfall, and more emphasis is placed here on downstream water quality than on agricultural production. In order to correct dryland salinity problems, various soil properties must be investigated. The most important soil property for the evaluation of water and salt fluxes is the hydraulic conductivity. There are still many difficulties with measuring this property. When changes in water quality are the primary item of interest, the historically well-developed application of potential theory is more useful when interpreted in terms of the stream function rather than the potential function. (Baker-FRC)
W82-01018

SOIL PERCOLATION TESTS,
Indian Health Service, Seattle, WA. Office of Environmental Health.
M. E. Peterson.
Journal of Environmental Health, Vol 42, No 4, p 182-186, January/February, 1980. 2 Fig, 7 Ref.

Descriptors: *Soil properties, *Percolation, *Soil water, Leaching, Seepage, Water loss, Infiltration, Capillarity, Measuring instruments, Testing procedures, Standards.

Even though there is severe criticism of the percolation test, it is still used consistently by private, county, state, and federal agencies throughout the United States. Unless the operator is keenly aware of the sources of error in this test, accurate results will be the exception, not the rule. A recommended procedure is offered. Three or more holes should be dug, spaced uniformly over the proposed site, avoiding the use of tools that will compact or smear the soil interface of the holes. Holes should have a diameter of exactly 8 inches. The bottom and sides of the holes should be carefully scraped with a hard rake or other instrument to provide as natural a soil interface as possible, and loose material removed from the bottom of the holes. Perforated liners should be inserted vertically in the holes and gravel or some other porous supporting material carefully placed between the outside of the liner and the hole wall. About 2 in of gravel shold be added to the bottom of the hole. Holes should be presoaked to assure saturation and swelling of the soil. The percolation time is then measured. A percolation tube is described which facilitates the performance of the test. In addition to performing a percolation test at the site, it is highly recommended that a deep boring be made to look for high groundwater elevation and the presence of bedrock or other unique soil boundaries. (Baker-FRC)
W82-01044

RESPONSE OF FABABEAN YIELD, PROTEIN PRODUCTION AND WATER USE TO IRRIGATION,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2I.
W82-01089

2H. Lakes

ANTHROPOGENIC TRACE ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBON LEVELS IN SEDIMENT CORES FROM TWO LAKES IN THE ADIRONDACK ACID LAKE REGION,
Department of Energy, NY. Environmental Measurements Lab.
For primary bibliographic entry see Field 5B.
W82-00501

SAMPLING EMERGING CHIRONOMIDAE (DIPTERA) WITH SUBMERGED FUNNEL TRAPS IN A NEW NORTHERN CANADIAN RESERVOIR, SOUTHERN INDIAN LAKE, MANITOBA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. M. Rosenberg, A. P. Wiens, and B. Bilyj.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 927-936, June, 1980. 7 Fig, 4 Tab, 14 Ref.

Descriptors: *Midges, *Sampling, *Population density, Lakes, Trap efficiency, Trapping, Canada.

As part of a study on the effects of reservoir formation on Chironomidae in Southern Indian Lake, the experimental design is discussed and the sampling characteristics of the submerged funnel traps are described. Clay, bedrock, and marsh shorelines were sampled at 1.0, 2.0, 3.5, and 4.5 m depths with four replicate traps at each location. The most common offshore species differed from the most common inshore species. All offshore species were similar but inshore marsh species differed from clay and bedrock species. Precision was estimated at + or - 30% for the twelve traps at each depth and 16 traps for each shoreline type. A minimum of four traps was required to interpret emergence patterns of the most common species with one emergence peak while 16 were required if there were two emergence peaks. Continuous and discontinuous trapping gave similar results. Results indicate that the optimum sampling strategy for mesotrophic lakes would be to trap discontinuously and use many traps. (Small-FRC)
W82-00520

DIEL VARIATIONS OF SELECTED PHYSICOCHEMICAL PARAMETERS IN LAKE KISSIMMEE, FLORIDA,
Florida Dept. of Environmental Regulation, Tallahassee.
C. W. Dye, D. A. Jones, L. T. Ross, and J. L. Gernert.
Hydrobiologia, Vol 71, No 1/2, p 51-60, May 27, 1980. 7 Fig, 3 Tab, 30 Ref.

Descriptors: *Water quality, *Productivity, *Shallow water, Photosynthesis, *Lake Kissimmee, Florida, Lakes, *Physicochemical properties, Mixing, Conductivity, Wind, Destratification, Hydrogen ion concentration, Dissolved oxygen, Temperature.

Lake Kissimmee, Florida (137 sq km, mean depth 2.5 meters) may be typical of the state's lakes in the central portion of the peninsula. The diel depth profiles of dissolved oxygen, pH, temperature and conductivity made at 2 stations from July 1974 to June 1975 suggest that stratification does not occur. However, a large temperature gradient (about 5 degrees C) appeared on 2 occasions, in July and December 1974, on clear, dead calm days. Generally, any temperature differences disappeared with convective cooling at night and with wind mixing. Dissolved oxygen levels were high, maximum 11.6 mg per liter, and on rare occasions, as low as 4 mg per liter at the bottom during extreme calm in summer. Photosynthesis was the primary factor regulating pH, which was maximum in summer and in afternoon, coinciding with periods of maximum productivity. Conductivity was highest in the wet summer months and lowest during the winter dry season. The anomalous summer increase was probably a result of sewage effluent released into lakes in the Upper Basin chain which in turn flowed into Lake Kissimmee. In winter, water is not discharged from the Upper Basin. (Caesar-FRC)
W82-00535

RELATIONSHIP BETWEEN THERMAL STABILITY AND SUMMER OXYGEN DEPLETION IN A PRAIRIE POTHOLE LAKE,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. H. Papst, J. A. Mathias, and J. Barica.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1433-1438, September, 1980. 6 Fig, 14 Ref.

Descriptors: *Lakes, *Temperature effects, *Oxygen depletion, Eutrophication, Seasonal variation, Algal growth, Prairies, Thermal stratification, Lake breezes, Mixing, *Fishkill.

Periods of oxygen depletion in prairie pothole lakes which cause summer fishkill have been associated with the collapse of algal blooms, but are not necessarily caused by this collapse. The thermal instability which sometimes follows this collapse plays an important role in summerkill. Thermal stability of the pothole lakes is dependent on wind stress and night-time air temperatures. The present results aid in determining the speed with which oxygen depletion may occur, and correlate the occurence of periods of lake oxygen depletion with variations in weather conditions. The algal biomass may collapse without severe oxygen depletion in these lakes. (Geiger-FRC)
W82-00545

A PROCEDURE USING MODELING AND ERROR ANALYSIS FOR THE PREDICTION OF LAKE PHOSPHORUS CONCENTRATION FROM LAND USE INFORMATION,

Michigan State Univ., East Lansing. Dept. of Resource Development.
For primary bibliographic entry see Field 5G.
W82-00546

MODEL OF THE SEASONAL DYNAMICS OF AN ECOSYSTEM OF A SHALLOW LAKE,

Akademiya Nauk SSSR, Moscow. Inst. of Limnology.
O. V. Belyakova.
Water Resources (English Translation), Vol 7, No 5, p 450-457, September/October, 1980. 4 Fig, 24 Ref. Translated from Vodnye Resursy, No 5, p 130-139, September/October, 1980.

Descriptors: *Mathematical models, *Seasonal variation, *Ecosystems, *Lakes, Mathematical equations, Water temperature, Temperature effects, Solar radiation, Biomass, Aquatic productivity, Energy, Shallow lakes.

In order to understand and predict the reaction of a lake ecosystem to varying external effects, it is first necessary to create a mathematical model of the seasonal dynamics of the components of the ecosystem. The development of a mathematical model of the seasonal dynamics of the biomass and production of the main trophic groups of aquatic organisms and of the concentrations of biogenic elements is discussed. The inputs of the system are the mean monthly values of absorbed solar radiation, the temperature of the water mass, inflow and outflow of the lake, and the amount of production of macrophytes. The outputs of the system include dissipation of heat energy during the vital activity of aquatic organisms, the biomass of chironomids that have emerged and flown away, and the consumption of zooplankton and benthos by fishes. The results obtained on the model were compared with data obtained by direct observation on a mesotrophic lake in northwestern U.S.S.R. This comparison showed that the model provided a satisfactory reproduction of both the overall level of development and seasonal dynamics of the main components of the lake ecosystems. This model can be used to evaluate the role of the main trophic links in the seasonal dynamics of the flow of material and energy in the lake and to evaluate the possible responses of the system to quantitatively different regimes of the input variables. However, it is not suitable for evaluation of potential responses to large disturbances which would create the basis for a different energy regime. (Carroll-FRC)
W82-00552

PROBABILITY-THEORETICAL ANALYSIS OF FLUCTUATIONS IN THE LEVEL OF A CLOSED WATER BODY,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
S. V. Muzylev.
Water Resources (English Translation), Vol 7, No 5, p 403-417, September/October, 1980. 6 Fig, 31 Ref. Translated from Vodnye Resursy, No 5, p 21-41, September/October, 1980.

Descriptors: *Closed lakes, *Hydrologic budget, *Mathematical studies, Mathematical equations, Climatology, Water level fluctuations, Lakes, Stochastic process.

Closed lakes are water bodies from which rivers do not flow. The natural regimes of most of these closed water bodies have been substantially disturbed by economic measures related primarily to irrigation and streamflow regulation. In order to predict the regime of closed lakes, it is first necessary to develop a physical model which correctly reflects the regularities of the fluctuations of their levels. Previous models based on the stochastic character of river inflow and apparent evaporation used a discrete form of notation of the annual increments of components of the water balance. However, all physically real stochastic processes represent continuous functions of time. The use of the concept of continuous processes reduces the problem of water level fluctuations in a closed lake to classical problems of nonequilibrium statistical mechanics and statistical radio engineering. A continuous model describing the fluctuations of the level in a closed water body was used to obtain a quantitative estimate of the effect of the product of level fluctuations and river inflow on the statistical characteristics of the level. This effect can be neglected when the inflow variability is small, but not when the coefficients of variation of the inflow are close to unity. In the simplest case, the correlation function of level fluctuations corresponds to the component of the two-dimensional Markov process. When lags far exceed the correlation time of inflow and apparent evaporation, a first-order Markov process describes the level fluctuations sufficiently well. This continuous model permits identification of the characteristics to the case of cross correlation of the river inflow and apparent evaporation. (Carroll-FRC)
W82-00571

MICROBIAL METABOLISM OF N-NITROSODIETHANOLAMINE IN LAKE WATER AND SEWAGE,

Cornell Univ., Ithaca, NY. Soil Microbiology Lab.
J. R. Yordy, and M. Alexander.
Applied and Environmental Microbiology, Vol 39, No 3, p 559-565, March, 1980. 7 Fig, 16 Ref.

Descriptors: *Nitrogen compounds, *Metabolism, *Lakes, *Wastewater, Microbial degradation, Microorganisms, Seasonal variations, Nitrosamines, Mineralization.

The transformation of N-nitrosodiethanolamine (NDEIA) was studied in samples of lake water and sewage. Water samples were taken from North Lake in the Adirondack Preserve and from Cayuga Lake, both in New York State. Samples were taken about 1 m from the shore, at surface level. Sewage samples at pH 7.8 were collected from the primary settling tank at the Ithaca, NY sewage treatment plant. The mineralization of NDEIA in samples of these three waters was studied. At NDEIA concentrations of 1.1 microgram/ml, mineralization was never noted in the Cayuga Lake and North Lake water samples, even though the process was examined with water collected at different times of the year. In sewage, NDEIA was mineralized, with over 40% of the carbon added as NDEIA being recovered as CO2 when the experiments was completed. Even though NDEIA was not mineralized in the lake water samples, the nitrosamine was metabolized. Breakdown of about 1.0 micrograms of NDEIA per ml in North Lake water and Cayuga Lake water was caused by microorganisms. In North Lake only partial degradation was noted in the September sample, which suggests that depletion of an essential nutrient occurred in the water sample. In sewage, no seasonal variation on the microbial conversion was noted, and the products of metabolism were slowly mineralized. NDEIA was apparently converted to the same organic products in all three samples. Data suggest that these products were modified dimers of NDEIA. (Baker-FRC)
W82-00585

ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA,

Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
For primary bibliographic entry see Field 5C.
W82-00592

THEORY OF ECOLOGICAL PREDICTION OF LIMNETIC ECOSYSTEMS,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6G.
W82-00597

INFLUENCE OF SEASONAL TEMPERATURE ON THE TEMPERATURE OPTIMA OF BACTERIA IN SEDIMENTS OF LAKE GEORGE, NEW YORK,

Oregon State Univ., Corvallis. Dept. of Microbiology.
D. L. Tison, D. H. Pope, and C. W. Boylen.
Applied and Environmental Microbiology, Vol 39, No 3, p 675-677, March, 1980. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Bacteria, *Temperature effects, Lakes, *Lake George, Seasonal variations, Sediments, Nutrients, Nutrient cycling, Littoral zone, Lake sediments, New York.

The possibility of temperature limiting microbial activity in Lake George during periods of nutrient input and throughout the winter was investigated. Sediment samples were collected from a depth of 1 meter with an Ekman dredge and diluted 1:1 (vol/vol) with lake water. Temperature optima for the heterotrophic utilization of glucose and an amino acid mixture were determined throughout the year. The temperature optimum decreased with decreasing in situ temperature in the fall and winter, suggesting that selection for or adaptation by a psychrotrophic bacterial population occurred. Replicate plating of bacterial isolates from 3 and 20 degrees C indicated that a psychrotrophic bacterial population was present in the sediments throughout the year. These results indicate that decomposition and nutrient cycling processes in the sediments within the littoral zone of Lake George were probably not completely inhibited by winter temperatures, although the process rates were decreased. Utilization rates for glucose in January were about 30% of those in August, but this was thought to be due to a decrease in the numbers of active microorganisms or limitations due to factors other than temperature during the winter. (Baker-FRC)
W82-00606

CONTROL OF WATER WEEDS BY GRASS CARP IN TWO SMALL LAKES,

Marine Dept., Rotorua (New Zealand). Fisheries Research Div.
For primary bibliographic entry see Field 3B.
W82-00609

ACUTE AND CHRONIC EFFECTS OF ALUM TO MIDGE LARVA (DIPTERA: CHIRONOMIDAE),

Kennedy (Michael), Spokane, WA.
For primary bibliographic entry see Field 5F.
W82-00650

SEDIMENTS AS A SOURCE OF PHOSPHATE: A STUDY OF 38 IMPOUNDMENTS,

Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
D. C. Grobler, and E. Davies.
Water S A, Vol 7, No 1, p 54-60, January, 1981. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Lake sediments, *Phosphates, *Algal growth, Eutrophication, Suspended sediments, Bottom sediments, Phosphorus, *Nutrients, Nuisance algae, Algae, Catchment areas, Reservoirs, Mathematical studies, *South Africa.

The amount of sediment phosphate available as nutrients for algal growth was examined in sediments from 38 South African impoundments. Selenastrum capricornutum was used in a bioassay technique to determine the availability of sediment phosphate in a 21 day incubation period. When impoundments were grouped according to the geological formation of their catchments, the algal available phosphate fraction and the inorganic phosphate content of the sediments were correlated. Two regression equations were proposed to calculate the algal available phosphate level of the sediments when the inorganic phosphate levels of the sediments are known. In turbid or shallow impoundments the phosphate content of suspended sediments should also be considered as a source of algal nutrients. It was suggested that these data be considered when imposing phosphate standards in South Africa for eutrophication management. (Geiger-FRC)
W82-00653

DISTRIBUTION AND BIOLOGICAL AVAILABILITY OF REACTIVE HIGH MOLECULAR WEIGHT PHOSPHORUS IN NATURAL WATERS IN NEW ZEALAND,

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
E. White, and G. Pane.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 664-669, April, 1980. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Phosphorus, *Eutrophic lakes, *Algal growth, Streams, Phosphates, Eutrophication, Dissolved solids, Water pollution effects, Turnover time, Absorption, Nutrients, Chlorophyta, Algae, *New Zealand.

Dissolved phosphorus which is not orthophosphate is present in many eutrophic lakes and streams of the central volcanic plateau of North Island, New Zealand. One of the reactive phosphorus components was shwon by Sephadex gel chromatograms to have a molecular weight of over 5000, while a second component elutes as phosphate-phosphorus. The reactive high molecular weight phosphorus (RHMW-P) usually forms only a small fraction of the dissolved reactive phosphorus (DRP) in streams. In some eutrophic lakes, a characteristic distribution of the two forms exists and the RHMW-P/DRP ratio may be as high as 70-80%. In summer months phosphate-phosphorus dominates over RHMW-P, a situation consistent with the long phosphate turnover rates peculiar to many lakes of this region. Algal growth responses to phosphorus uptake were similar for phosphate-phosphorus and RHMW-P, but the amount of RHMW-P taken up by Chlorella varied from lake to lake. This caused problems in relating lake DRP levels to algal growth responses. (Geiger-FRC)
W82-00659

COMPARISON OF A FEW SYSTEMS FOR THE DETERMINATION OF SAPROBIC AND TROPHIC DEGREE ON THE BASIS OF PLANKTON DATA,

Katholieke Univ., Nijmegen (Netherlands) Lab. of Aquatic Ecology.
G. J. Van Nuland, and J. F. G. M. Meis.
Hydrobiologia, Vol 70, No 3, p 251-256, May 2, 1980. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Plankton, *Saprobic index, *Trophic level, Ecosystems, Mesotrophy, Water quality, Lakes, Biological properties, Phytoplankton, Zooplankton, Nutrients, Species composition, Comparison studies, Aquatic envrionment.

The biological quality of an aquatic environment, the Haarsteegse Wiel, Vlijmen, the Netherlands, was determined by five different methods. Two methods involved the saprobity; two, the trophic level; and one, chemical data. This water body, which formed following dike bursts on the River Meuse in 1610 and 1740, was studied from April to October 1977. The two methods for determining saprobic index showed, in good agreement, that the water was within the transition range between beta-mesosaprobic and oligosaprobic. The Zelinka and Marvan (1961) method, developed in Czechoslovakia, is to be used with a well-defined community, such as plankton, benthos, or epiphyton (in this study, plankton) and requires an extremely accurate identification of organisms. The Dresscher and van der Mark (1976) technique uses several indicator species in a formula for saprobic index. Since detailed identification is not necessary, it saves time. Objections to this method are the generalization and the disregard of quantities of species found. The methods for determining trophic degree, those of Hutchinson (1967), Rawson (1956), and chemical data, all indicated the Haarsteegse Wiel to be mesotrophic. (Cassar-FRC)
W82-00664

VERTICAL DISTRIBUTION OF MONOSACCHARIDES IN LAKE WATER,

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
M. Ochiai, and T. Hanya.
Hydrobiologia, Vol 70, No 1/2, p 165-169, April, 1980. 3 Fig, 3 Tab, 12 Ref.

Descriptors: *Carbohydrates, *Organic matter, *Monosaccharides, *Lakes, Glucose, Galactose, Eutrophic lakes, Dystrophic lakes, Water analysis, Phytoplankton, Heterotrophic bacteria.

Eight common monosaccharides of the dissolved organic matter were measured in 3 Japanese lakes: Nakanuma, small and eutrophic; Suwako, shallow and eutrophic; and Shirakoma-ike, dystrophic. The ratio of concentrations of carbohydrates analyzed by gas chromatography to those analyzed by the anthrone method ranged from 30.5 to 121% in Suwako, 12.9 to 51.4% in Nakanuma, and 21.2 to 38.6% in Shirakoma-ike. In surface water of Lake Suwako (eutrophic) glucose and galactose represented 40% and 24.4%, respectively, of the carbohydrates, and 16.4 to 19.2% and 18.5 to 19.8%, respectively, in the deeper water. Rhamnose made up 12.2% of surface water carbohydrates and 23.9 to 25.8% in deeper waters. Ribose and arabinose were low from surface to 5 meters; fucose, xylose, and mannose were present in intermediate concentrations. Lake Nakanuma monosaccharide levels were on the same order. In dystrophic Lake Shirakoma-ike, the vertical profiles of most monosaccharides were relatively uniform; galactose, glucose, and mannose were in greatest concentrations, but at smaller concentrations than in the eutrophic lakes. (Cassar-FRC)
W82-00665

CLASSIFICATION OF CENTRAL AMAZON LAKES ON THE BASIS OF THEIR MICROBIOLOGICAL AND PHYSICO-CHEMICAL CHARACTERISTICS,

Max Planck Inst. fuer Limnologie zu Ploen (Germany, F.R.). Dept. of Tropical Ecology.
H. Rai, and G. Hill.
Hydrobiologia, Vol 72, No 1/2, p 85-99, July 10, 1980. 10 Fig, 4 Tab, 51 Ref.

Descriptors: *Classification, *Physicochemical properties, *Microbiological studies, Algae, Nutrients, Amazon River, Flood plains, Lakes, Oxbow lakes, Varzea lakes, Ria lakes, Phytoplankton, Primary productivity, Productivity, Saprophytic bacteria, Bacteria, Chlorophyll a, Deltas, Heterotrophic bacteria, Water quality, *Lake classification, *Amazon lakes, South America.

The physical, chemical, and microbiological characteristics of 24 Central Amazonia Varzea and Ria Lakes, lateral to the Rio Negro and Rio Solimoes, were studied during the low water phase of 1975. Three water types (white, mixed, and black) were differentiated on the basis of physical and nonmetallic inorganic constituents. The eight white water lakes were highest in dissolved oxygen, 5.2-8.9 mg per liter; nitrates, 3.6-52.2 micrograms per liter; ammonium, 78-653 micrograms per liter; Fe(3+), 0.575-16.8 mg per liter; total organic carbon, 8-22.75 mg per liter; pH, 6.6-8.4; and conductivity, 31-80 micro S per cm at 20 degrees C. The 12 black water lakes had the highest Secchi disk transparencies, 95-299 cm. The four mixed lakes were highest in phosphates, 0-49.4 micrograms per liter. Physicochemical parameters with less defined differences among the lakes were: KMnO4, chloride, dissolved organic carbon, and temperature. White water lakes had the highest concentrations of saprobic bacteria, total bacteria, chlorophyll a, and microcrustaceans. Primary production (in mg C per sq meters per day) had a large range: white, 350-1500; mixed, 820-3500; and black 347-10451. Algae in the lakes further characterized the lake waters. White waters were dominated by Melosira, black waters (lower species diversity) by Peridinium, and mixed waters (greatest species diversity) by clean water indicators. (Cassar-FRC)
W82-00666

LIGHT PENETRATION AND THE INTERRELATIONSHIPS BETWEEN OPTICAL PARAMETERS IN A TURBID SUBTROPICAL IMPOUNDMENT,

Orange Free State Univ., Bloemfontein (South Africa). Inst. for Environmental Sciences.
R. D. Walmsley, M. Butty, H. van der Piepen, and D. Grobler.
Hydrobiologia, Vol 70, No 1/2, p 145-157, April, 1980. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Light penetration, *Turbidity, *Suspended sediments, Transparency, Seasonal variation, Secchi disks, Rust der Winter Dam, *South Africa, Water quality, Subtropical zone, Lakes, *Reservoirs, Stratification, Thermal stratification, Euphotic zone, Silt, Chlorophyll a.

The main factors regulating the temporal and spatial variations in water transparency in a turbid subtropical impoundment (Rust der Winter Dam, South Africa) were allochthonous inputs of silt during summer floods, impoundment morphometry, and the warm monomicitic thermal cycle. Statistically significant relationships were established between Secchi disk transparency (0.6-3.00 meters), surface water turbidity (4.2-25 JTU), mean diffuse attenuation coefficient (0.64-2.00 per meter), and beam attenuation coefficient (1.14-10.60 per meter without a filter). These relationships allowed an approximation of the 1% of surface light intensity depth (corresponding with the euphotic zone) to be made if any one of the parameters were known. Blue light attenuation was greater than red light attenuation because of the effects of suspended clay particles. (Cassar-FRC)
W82-00667

ANNUAL SUCCESSION OF PHYTOPLANKTON IN ONE HEATED POND IN CENTRAL FINLAND,

Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-00673

CHEMICAL COMPOSITION OF INTERSTITIAL WATERS IN BOTTOM SEDIMENTS OF SOME POLISH LAKES OF THE WIGRY GROUP (NORTHERN POLAND),

Akademia Rolnicza, Warsaw (Poland). Zaklad Limnologii i Rybactwa.
A. Woroniecka-Stasiak.
Acta Hydrobiologica, Vol 22, No 4, p 347-360, 1980. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Interstitial water, *Lakes, *Chemical properties, Bottom sediments, Acidity, Alkalinity, Hydrogen ion concentration, Carbon dioxide, Organic acids, Ammonium salts, *Poland, Chemical composition.

The chemical composition of interstitial waters in the sediments of Wigry lakes was investigated in nine lakes. Fifty-one to 65% of sediment weight was interstitial water, and the most important feature of the water was the acid pH, which ranged from 5.6 in Lake Suchar to 6.9 in Lakes Krzywe and Omulowek. High alkalinity was found in the interstitial waters of Lakes Wigry, Omulowek, Krzywe, Muliczne, and Przetaczek. The remaining

lakes had water of the acido-dystropic type. A linear relationship was found between alkalinity and the pH values of interstitial waters saturating some sediments. In harmonic lakes, the acid relation was conditioned by the occurrence of free CO2, and in disharmonic lakes by the occurrence of free CO2 and organic acids. Interstitial waters were a source of organic compounds and mineral salts to the hypolimnion and contained large amounts of iron and phosphorus. Large amounts of ammonium salts were found. In harmonic lakes, denitrification was responsible for the absence of nitrates and nitrites. (Small-FRC)
W82-00675

ORGANOCHLORINE RESIDUES IN KENYA'S RIFT VALLEY LAKES,

National Wildlife Federation, Washington, DC.
For primary bibliographic entry see Field 5A.
W82-00690

THE CHANGING STATUS OF REEDSWAMP IN THE NORFOLK BROADS,

Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 5C.
W82-00691

REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE,

International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5G.
W82-00705

AN IN SITU METHOD FOR MEASURING THE PRIMARY PRODUCTIVITY AND STANDING CROP OF THE EPILITHIC PERIPHYTON COMMUNITY IN LENTIC SYSTEMS,

California Univ., Davis. Div. of Environmental Studies.
For primary bibliographic entry see Field 7B.
W82-00756

INTERACTION OF ORTHOPHOSPHATE WITH IRON (III) AND ALUMINUM HYDROXIDES,

Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Engineering.
L. Lijklema.
Environmental Science and Technology, Vol 14, No 5, p 537-541, May, 1980. 5 Fig, 34 Ref.

Descriptors: *Coagulation, *Phosphates *Lakes, *Iron, *Aluminum, Water treatment, Tertiary wastewater treatment, Wastewater treatment, Chemical reactions, Hydrogen ion concentration, Eutrophication, Lake sediments, Metals, Adsorption.

The influence of pH and aging on phosphate binding by Fe(3+) or aluminum hydroxides is pertinent to water and wastewater treatment and to phosphate exchange between sediments and overlying water in lakes. In laboratory studies, similarly-shaped adsorption isotherms of phosphates on Fe(3+) hydroxide or aluminum hydroxide were obtained at pH values of 5, 6, 7, and 8. Phosphate-P concentrations varied from 0 to 0.2 nmol per liter; ratios of P adsorbed per Fe concentration varied from 0.05 to 0.2. Phosphate adsorption was greater at lower pH and at higher phosphate concentrations. More phosphate was adsorbed when the hydroxides were formed in situ. Freshly precipitated Fe(3+) hydroxide adsorbed more phosphate than 1-day-old precipitates. Ratios of adsorbed phosphate to Fe increased linearly with time over the 1000 hours of the study. Adding acid or base to shift the pH 2 units showed that adsorption and desorption changes are not completely reversible. Practical conclusions drawn from this work are: (1) rapid initial mixing of coagulants in treatment plants is most effective; (2) at low temperatures and slightly acid waters the effective phosphate adsorption can result in negatively charged phosphated complexes, resisting coagulation; (3) at pH 5 phosphate can remove Fe from iron-containing water by membrane filtration with a 0.2 micrometer filter; (4) in lakes, a variation of pH produced by photosynthetic activity can influence the adsorption capacity of the sediment; (5) high release of phosphate and Fe can occur in shallow lakes under reducing conditions throughout the sediment and with high pH in the overlying water. (Cassar-FRC)
W82-00783

THE EFFECT OF SEASON AND LOCATION ON PHOSPHOADENYLATE CONCENTRATIONS AND ADENYLATE ENERGY CHARGE IN TWO SPECIES OF FRESHWATER CLAMS,

Savannah River Ecology Lab., Aiken, SC.
J. P. Giesy, and G. W. Dickson.
Oecologia, Vol 49, No 1, p 1-7, 1981. 3 Fig, 8 Tab, 36 Ref.

Descriptors: *Clams, Ponds, Reservoirs, Lakes, *Savannah River impoundments, Mollusks, Rivers, Phosphates, *Adenosine triphosphate, Baseline studies, Seasonal variation, Monitoring, *Bioindicators, Cooling ponds, *Nuclear powerplants.

Seasonal and size related variations of adenosine triphosphate (ATP), adenosine diphosphate (ADP), 5'-adenylic acid (AMP) and total adenylate concentrations were determined in the papershell clam and Asian clam. The adenylate energy charge was also investigated. Papershell clams were collected from the thermally enriched portion of Par Pond, an impoundment on the U.S. Department of Energy's Savannah River Plant, near Aiken, SC. Asian clams were collected from the Savannah River adjacent to the Savannah River Plant. Seasonal variations were readily observable in all three adenylates as well as in the total adenylate concentration and the adenylate energy charge for each species. The periods of active reproduction cycles for each species were closely tied with the fluctuations in adenylates and energy charges. Possible relationships of the various concentrations measured to the shell length of individual animals were investigated. The different points of collection did not appear to influence the value of the adenylate energy charge on individuals of either species. The adenylate energy charge of the Asian clam was seen to increase after acclimation had occurred to laboratory surroundings and feedings had begun. A deeper understanding of adenylate energy charges and adenylate concentrations is necessary before these parameters can be used as part of a natural background in monitoring programs. (Baker-FRC)
W82-00810

FACTORS INFLUENCING FISH DISTRIBUTION IN TWO DESERT RESERVOIRS, CENTRAL ARIZONA,

Arizona State Univ., Tempe. Forestry Sciences Lab.
J. N. Rinne, W. L. Minckley, and P. O. Bersell.
Hydrobiologia, Vol 80, No 1, p 31-42, April, 1981. 4 Fig, 10 Tab, 47 Ref.

Descriptors: *Reservoirs, *Fish, *Limnology, Temperature effects, Thermoclines, Dissolved oxygen, Seasonal variation, Littoral environment, Littoral zone, Euphotic zone, *Fish populations, *Arizona.

Sampling of fishes, net plankton, phytoplankton pigments, and benthos began in the summer of 1970 and ended in autumn of 1971 in two desert reservoirs in central Arizona. The two reservoirs were Roosevelt Lake and Apache Lake. At full pool Roosevelt Lake approaches Apache Lake in maximum and mean depths, but is far larger, having almost six times the volume of Apache, twice the shoreline, and six times the mean breadth and surface area. The slope is far less severe in Roosevelt Lake. Temperature profiles vary substantially over time in these two low desert lakes, and annual cycles were similar in the two reservoirs. A basic difference between the two was in the depth of the metalimnion, which was located from 10 to 15 m in Roosevelt Lake, and at about half that depth, 5 to 7 meters, in Apache. This was attributable to wind action on the broad, unprotected surface of the former in contrast to the fjord-like nature of Apache Lake. Dissolved oxygen curves generally paralleled seasonal temperature profiles, with high concentrations from surface to bottom during winter and spring and hypolimnic oxygen deficiencies during the summer. Apache Lake was far more transparent. No single factor appeared paramount in delimiting fish population dispersion in the two desert reservoirs. The greatest abundance of fish based on vertical gillnet catches was in the upper 10 meters of water, reflecting the influence of thermocline depth, levels of dissolved oxygen concentration, and euphotic zone. Fish introduced into western reservoirs are intrinsically shallow-water, littoral inhabitants, and remain so due to inherent limnological factors characteristic of mid-latitude lentic systems. (Baker-FRC)
W82-00814

THE NATURE OF SELECTED PRAIRIE LAKE AND STREAM SEDIMENTS,

Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
For primary bibliographic entry see Field 2J.
W82-00815

GRAZING RATE DETERMINATION OF CORYNONEURA SCUTELLATA WINNERTZ (CHIRONOMIDAE:DIPTERA),

Rhode Island Univ., Kingston. Dept. of Zoology.
D. H. Kesler.
Hydrobiologia, Vol 80, No 1, p 63-66, April, 1981. 1 Fig, 10 Ref.

Descriptors: *Midges, *Littoral zone, Littoral drift, Lakes, *Phytoplankton, Aquatic drift, *Rhode Island, Grazing, Standing crops, Aquatic flora, Aquatic animals, Diptera.

The grazing rate of the larval chironomid Corynoneura scutellata Winnertz (Diptera) was investigated. Sampling was carried out in Nonquit Pond, Rhode Island. C. scutellata larvae were collected from the littoral zone. Grazing rates were determined radiometrically at different temperatures. The resulting temperature-grazing function is given. This function was then applied to field data from Nonquit Pond. A maximum grazing rate of 107 mg dry weight/square meter/day was calculated to have occurred in late June of 1978. Calculated C. scutellata grazing rates were compared to periphyton net accumulation rates. The means of these ratios ranged from 3 to 15% with a maximum of 70%, indicating that these larvae are potentially able to affect periphyton standing crop. (Baker-FRC)
W82-00822

NITROGEN AND PHOSPHORUS RECYCLING IN LAKE SAMMAMISH, A TEMPERATE MESOTROPHIC LAKE,

Washington Univ., Seattle. Dept. of Civil Engineering.
R. B. Birch, and D. E. Spyridakis.
Hydrobiologia, Vol 80, No 2, p 129-138, May, 1981. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Lakes, *Nutrients, *Nitrogen, *Phosphorus, Mesotrophic lakes, Mesotrophy, Trophic load, Dynamics, *Cycling nutrients.

Nitrogen and phosphorus budgets are presented for spring and summer for the trophogenic and tropholytic zones of Lake Sammamish. The budgets are constructed to evaluate the efficiency of nutrient recycling and increase knowledge of the overall nutrient dynamics. The budgets reveal that uptake and solubilization are the dominant fluxes and that nutrient recycling is generally efficient with the possible exception of early spring during the diatom bloom. Solubilization of particulates is much less in the tropholytic zone than the trophogenic zone. This is due to slower decomposition rates there and to the efficiency of solubilization in the overlying trophogenic zone which results in a relatively small particulate influx. Turnover times for the N and P pools are thus much faster in the trophogenic zone than in the tropholytic zone. In the trophogenic zone, however, the dissolved N pool turns over much more slowly than the dissolved P pool due to its larger size relative to algal

growth requirements. Overall there is a net loss of N and P from the water column in spring, primarily due to sedimentation and denitrification, while in summer there is a small net gain due to sediment release and a slight excess of inflow over outflow. (Baker-FRC)
W82-00824

POTENTIAL IMPACT OF SIZE-SELECTIVE PLANKTIVORY ON PHOSPHORUS RELEASE BY ZOOPLANKTON,

Wisconsin Univ.-Madison.
S. M. Bartell.
Hydrobiologia, Vol 80, No 2, p 139-145, May, 1981. 5 Tab, 28 Ref.

Descriptors: *Zooplankton, *Phosphorus, Lakes, Nutrients, Cycling nutrients, *Predation, Fish.

The speculation that size-selective predation by planktivorous fishes affects rates of phosphorus release by zooplankton at the system level through changes in both mean individual size and biomass of zooplankton was investigated. Comparisons were made of estimated rates of P release from zooplankton in lakes before and after introduction of size-selective predators, and comparisons were made among several lakes with varying abundance of predators. A laboratory model of phosphorus release by Daphnia rosea was implemented for published zooplankton data from the lakes. Size-selective feeding reduced average prey size and increased P release per unit biomass. At the system level, decreased prey standing crop associated with higher planktivore abundance could balance the size dependent increase in P release rate. However, estimates of both net reduction and net increase in rate of P release from zooplankton resulted from model application. Size-selective feeding may be important not only in energetic or evolutionary relationships between predator and prey but also in determination of the relative importance of different pathways of phosphorus flow through pelagic systems. (Baker-FRC)
W82-00825

ON LAKE BOTTOM DYNAMICS–THE ENERGY-TOPOGRAPHY FACTOR,

National Swedish Environment Protection Board, Uppsala. Water Quality Lab.
L. Hakanson.
Canadian Journal of Earth Sciences, Vol 18, No 5, p 899-909, May, 1981. 4 Fig, 10 Tab, 13 Ref.

Descriptors: *Lakes, *Bottom sediments, Erosion, Mathematical models, Models, Mathematical studies, Lake morphometry, *Limnology, Lake sediments, Sediments, Lake shores, Lake basins, Dynamics, Basins.

Some of the causal relationships that determine bottom dynamics in lakes are discussed, and a formula is suggested that expresses these causal relationships in terms of simple morphometric parameters. The benefit of such a model is that much valuable information can be gained from a minimum of work. Detailed empirical data from areas dominated by erosion, transportation, and accumulation have been determined for nine Swedish lakes or basins. The model has been calibrated against this set of data. The areal distribution of lake bottom areas dominated by erosion and transportation is governed by an energy factor, a slope factor, and a form factor. The equation which interrelates these factors is presented. Despite the fact that the formula is based on only three morphometrical standard parameters, it yields a surprisingly high correlation, which indicates that it describes the functional relationships in a proper manner. Tests have indicated that this formula is not significantly improved by accounting for the shore irregularity and lake shape factors. It is probable that the model yields the most accurate results for lakes in the size range of 1 to 5000 square kilometers. It is only applicable to single basins. In multi-basin lakes each basin must be treated separately. (Baker-FRC)
W82-00837

SEDIMENT-BASED NUTRITION OF SUBMERSED MACROPHYTES,

Army Waterways Experiment Station, Vicksburg, MS.
J. W. Barko, and R. M. Smart.
Aquatic Botany, Vol. 10, No 4, p 339-352, May 1981. 7 Tab, 48 Ref.

Descriptors: *Macrophytes, *Nutrients, *Sediments, Nitrogen, Phosphorus, Potassium, Uptake, Lakes, Plant growth, Vegetation, *Rooted aquatic plants.

An evaluation was made of the abilities of four submersed freshwater macrophytes to mobilize nitrogen, phosphorus, and potassium from different sediments in relation to their respective requirements for these nutrients. The four species involved were Bacopa caroliniana (Walt.) Robbins, Myriophyllum brasiliense Camb., Potamogeton illinoensis Morong, and Proserpinaca palustris L. With all species, N and P were readily mobilized from each of the sediments and concentrated in plant shoots at levels well above those required for growth. However, the mobilization of K from all sediments was far less effective and may have limited the growth of the species considered. Sediments represent a large and important source of N and P for rooted aquatic macrophytes, but K is probably supplied to these plants primarily from the water. N and P were excreted in only small amounts, if at all, from the species during active growth. However, considerable quantities of these nutrients can be released to the water due to plant senescence and associated decay. This represents an important mode of sediment-nutrient recycling in aquatic systems. (Baker-FRC)
W82-00843

ABSORPTION OF FENITROTHION BY PLANKTON AND BENTHIC ALGAE,

Moncton Univ., (New Brunswick).
For primary bibliographic entry see Field 5B.
W82-00874

MERCURY AND SELENIUM CONCENTRATIONS IN FISH, SEDIMENTS, AND WATER OF TWO NORTHWESTERN QUEBEC LAKES,

Noranda Research Centre, Pointe Claire (Quebec). Process Technology Dept.
For primary bibliographic entry see Field 5B.
W82-00876

AMMONIA AND NITRATE UPTAKE IN THE LOWER GREAT LAKES,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
T. P. Murphy.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1365-1372, September, 1980. 7 Fig, 1 Tab, 26 Ref.

Descriptors: *Lakes, *Primary productivity, *Nitrogen, *Limiting nutrients, Spectrophotometry, *Ammonia, *Great Lakes, Water analysis, Nutrients, Nitrate, Cycling nutrients, Data collections. Incubation, Lake Erie, Lake Ontario.

A simple radiolabeled N technique of emission spectrophotometry has been used to obtain a large data base for nitrate and ammonia uptake kinetics in Great Lakes Erie and Ontario. Short-term incubatin of water samples was necessary to prevent induction of nitrate uptake or changes in the rate of ammonium ion uptake which took place in long-term incubations. During most of the summer, uptake rates of nitrate and nitrate regeneration rates were generally slow. The slow turnover rate of particulate N, low levels of nutrients, and high affinities for ammonia suggest that the summertime primary productivity of the Lower Great Lakes is limited by nitrogen concentrations. (Geiger-FRC)
W82-00882

LIMNOLOGICAL CHARACTERISTICS OF SEVERAL LAKES ON THE LAKE WALES RIDGE, SOUTH-CENTRAL FLORIDA,

Bucknell Univ., Lewisburg, PA. Dept. of Biology.
W. F. McDiffett.
Hydrobiologia, Vol 71, No 1/2, p 137-145, May, 1980. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Nutrients, *Primary productivity, *Water quality, *Productivity, *Lakes, Eutrophication, *Florida, Phytoplankton, Nitrogen compounds, Phosphorus compounds, Limnology, Watershed development, Chlorophyll a.

Three lakes in southcentral Florida were studied from September 1976 to July 1977 to obtain basic limnological information, focusing on the productivity and nutrient relationships as affected by human activity. The lakes–Annie, Placid, and Francis–are connected seasonally by either natural drainage or man-made canals. Lake Annie is underdeveloped; the other two are partly to completely developed. All three lakes have clear, soft, nutrient-poor water. Primary production and chlorophyll a production is highest in Lake Francis. Productivity estimates (in g carbon per sq meter per year) were 205 for Francis, 75.8 for Annie, and 42.8 for Placid. Water from all three lakes responded to enrichment with N and P, but none to N alone. Lake Francis responded to P addition alone. Francis was judged nearly eutrophic, and the other two lakes oligotrophic in terms of primary productivity, light transmission, and dominant phytoplankton, and mesotrophic in terms of chlorophyll a. The water quality of these lakes appeared to be correlated with development along the shoreline and use of the surrounding watershed. (Cassar-FRC)
W82-00914

FACTORS CONTROLLING PHYTOPLANKTON PRIMARY PRODUCTIVITY IN BYRAM LAKE, MT. KISCO, N.Y., SUMMER, 1977,

Fordham Univ., Bronx, New York. Louis Calder Conservation and Ecology Study Center.
G. S. Kleppel, R. Ingram, and W. B. Samuels.
Hydrobiologia, Vol 70, No 1/2, p 95-101, April, 1980. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Primary productivity, *Eutrophic lakes, *Water depth, Stratification, Algae, Phytoplankton, Productivity, Eutrophication, Lakes, *Byram Lake, New York.

Accelerated eutrophication and algal blooms in Byram Lake, New York, prompted an investigation of phytoplankton productivity. Results suggest that horizontal and vertical microenvironments exist throughout the lake. At deeper stations, thermal stratification placed inorganic nitrogen in juxtaposition with phytoplankton in the upper metalimnion. At one station, surface productivity was ammonia-limited and bottom productivity was related to P levels. Phytoplankton productivity at a shallow station was inversely related to incident light and temperature. The vascular macrophyte bloom shaded the phytoplankton and decreased its productivity. In late summer the macrophytes decayed and released nutrients. As a result phytoplankton productivity reached a maximum in September. The failure to detect relationships between depth integrated productivity and environmental parameters suggests that the controlling factors were not measured in this study, that multiple parameter interactions regulated productivity, or that different factors were significant at different depths. (Cassar-FRC)
W82-00915

CHEMICAL COMPOSITION OF LABILE FRACTIONS IN DOM,

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
M. Ochiai, T. Nakajima, and T. Hanya.
Hydrobiologia, Vol 71, No 1/2, p 95-97, May, 1980. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Organic matter, *Amino acids, *Carbohydrates, Degradation, Microbial degradation, Labile fraction, Dissolved solids, Organic carbon, *Chemical composition, Natural waters, Lakes, Decomposition, Lake Nakanuma, *Japan, *Dissolved organic matter.

The labile fraction (biologically derived compounds such as carbohydrates, proteins, amino acids, and lipids) of dissolved organic matter (DOM) in a eutrophic lake was decomposed under anaerobic and aerobic conditions for 20 days. In

anaerobic decomposition total dissolved organic carbon decreased by 20% (initial concentration 4.19 mg C per liter), dissolved amino acids by 15% (initial concentration 0.49 mg C per liter), and dissolved carbohydrates by 48% (initial concentration 0.43 mg C per liter). In aerobic experiments with the same starting concentration, total dissolved organic C decreased by 26%, dissolved amino acids by 23%, and dissolved carbohydrates by 53%. These results show that the dissolved amino acids and dissolved carbohydrate fractions were preferentially decomposed compared with other fractions and are confirmed to be the labile fractions of dissolved organic matter. (Cassar-FRC)
W82-00917

THE USE OF ALGAL ASSAYS AND CHLOROPHYLL CONCENTRATIONS TO DETERMINE FERTILITY OF WATER IN SMALL IMPOUNDMENTS IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Biology.
J. Davis, and J. Decosta.
Hydrobiologia, Vol 71, No 1/2, p 19-34, May, 1980. 14 Fig, 7 Tab, 26 Ref.

Descriptors: *Phosphates, *Algae, *Fertility, Eutrophic lakes, Lakes, Artificial lakes, Reservoirs, *West Virginia, Chlorophyll, *Nutrients, Nitrates, Phytoplankton, Eutrophication, Selenastrum capricornutum, Trophic level, Productivity, Phosphorus.

Phosphorus was the limiting nutrient in seven small artificial lakes in West Virginia, according to 21-day algal assay tests with Selenastrum capricornutum. In every case the water was fertile enough for algae to grow well without additional nutrients. All lakes were classified mesotrophic to slightly eutrophic. Sampling was done from December 20, 1975, to October 17, 1976, once each during the spring and fall isothermal periods and biweekly during summer stratification. Total phosphate-P (in micrograms per liter) ranged from 8.1 to 16.2 in spring, 2.18 to 69.9 in summer, and 8.4 to 29.4 in fall. Nitrate-N (in mg per liter) ranged from 0.038 to 0.720 in spring, 0 to 0.370 in summer, and 0.008 to 0.170 in fall. Uncorrected chlorophyll a values (in micrograms per liter) were 1.7 to 61.4 in spring, 4.3 to 232.0 in summer, and 4.5 to 24.5 in fall. (Cassar-FRC)
W82-00919

INORGANIC TRANSFORMATION OF APPLIED PHOSPHORUS IN BRACKISH WATER FISH POND SOIL UNDER DIFFERENT WATER SALINITY LEVELS,

Central Inland Fisheries Research Inst., Barrackpore (India).
G. N. Chattopadhyay, and L. N. Mandal.
Hydrobiologia, Vol 71, No 1/2, p 125-130, May, 1980. 6 Tab, 12 Ref.

Descriptors: *Phosphorus, *Fish ponds, *Salinity, Chemical reactions, Organic matter, Phosphates, *Brackish water, Ponds, Nutrients, Fertilizers, Aquatic soils.

Transformation of phosphorus, applied as 0 or 100 ppm KH2PO4, to brackish water fish pond soil was studied at different salinity levels (trace, 10, 20, and 30 ppt) and in the presence and absence of organic matter, a P-free starch. Added P disappeared rapidly from the water phase. For example, without added organic matter and at trace salinity, 44.40 ppm P present in the water phase on the tenth day of incubation decreased to 16.2 ppm on day 100; at 30 ppt salinity, 58.90 ppm P decreased to 13.80 ppm by day 100. Increases in water salinity produced increases in amount of saloid-bound P and decreases in Bray's No. 2 extractable form P. The transformation product in highest concentration was calcium phosphate, especially in more saline water. Lesser amounts of iron phosphate and aluminum phosphate were formed. Addition of organic matter did not affect the transformation of P into calcium phosphate but reduced fixation into the iron phosphate form, increasing the availability of P in water and soil phases. These results suggest that a more effective method of adding P to brackish water ponds would be split doses in combination with organic matter. (Cassar-FRC)
W82-00920

INFLUENCE OF PHOSPHORUS LOADS AND OF SOME LIMNOLOGICAL PROCESSES ON THE PURITY OF LAKE WATER,

Polish Academy of Science, Warsaw. Inst. of Ecology.
Z. Kajak.
Hydrobiologia, Vol 72, No 1/2, p 43-50, July, 1980. 8 Tab, 68 Ref.

Descriptors: *Phosphorus compounds, *Nutrients, *Water quality, *Lakes, Cycling nutrients, Nitrogen compounds, Fish, Agriculture, Eutrophication, Aquatic life, Zooplankton, Limnology, Phytoplankton, Algae, Surface water, Lake sediments, Sediments, Sedimentation, Biomass, Seston, Reviews.

The problem of the relationship between nutrient loads and phytoplankton biomass is reviewed with special emphasis on phosphorus. Total P concentrations in pollution sources vary from 1000 mg per liter in animal waste slurries to 0.01-0.1 mg per liter from atmospheric precipitation and natural forest and meadow runoff. Surfact nonpoint outflow from towns and runoff from bare soil contribute the most P to surface waters. The contribution of agriculture to eutrophication becomes proportionally more important as more facilities remove P from sewage in tertiary treatment. P in lake water is removed by retention in the sediment, but returns again to the epilimnion through water circulation and recycling by algae and other organisms. Fish affect nutrient concentrations by stirring up bottom sediments, eliminating sedimenting feces, releasing nutrients by metabolism, changing the species composition, intensifying the decomposition process, and changing light conditions. In fish ponds with common carp, the addition of silver carp increases the phytoplankton biomass and the rate of P sedimentation and decreases the amount of P released by the zooplankton. (Cassar-FRC)
W82-00923

SIMULATION OF LAKE-WATERSHED SYSTEMS, I. DESCRIPTION AND SENSITIVITY ANALYSIS OF THE MODEL,

Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W82-00926

SIMULATION OF LAKE-WATERSHED SYSTEMS, II. APPLICATION TO BAPTISTE LAKE, ALBERTA, CANADA,

Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W82-00927

PREDICTION OF PHOSPHORUS AND NITROGEN CONCENTRATIONS IN LAKES FROM BOTH INTERNAL AND EXTERNAL LOADING RATES,

University of East Anglia, Norwich (England). School of Environmental Sciences.
P. L. Osborne.
Hydrobiologia, Vol 69, No 3, p 229-233, March, 1980. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Lake restoration, *Phosphorus compounds, *Nitrogen compounds, Lakes, Nutrients, *Eutrophic lakes, Model studies, Seasonal variation, Prediction, Loading rates.

A variation of the Vollenweider model predicting phosphorus and nitrogen concentrations from loading rates was tested with data from a shallow, eutrophic lake, Barton Broad, 70 ha in area and 1 meter deep. Both external and internal loading occurred. Predicted and observed concentrations of P and N in the outflow were similar. Splitting the year into seasons overcame the problem of fluctuations in P and N loading rates (nutrient inputs from land drainage were higher in winter, and internal loading occurred in summer). The model can be used to predict the reduction in loading rate required either to limit phytoplankton population and improve water quality or to determine the nutrient concentrations suitable for reestablishing submerged macrophytes. (Cassar-FRC)
W82-00928

PHOSPHATE MODELS, A GAP TO BRIDGE,

Station Biologique de la Tour du Valat, Arles (France).
H. L. Golterman.
Hydrobiologia, Vol 72, No 1/2, p 61-71, July, 1980. 1 Fig, 3 Tab, 31 Ref.

Descriptors: *Model studies, *Phosphates, *Phytoplankton, Statistical models, Conceptual models, Nutrients, Lakes, Sedimentation, Adsorption, Productivity, Prediction, Loading rates.

Models for predicting phytoplankton productivity as a function of phosphate loading are necessary for water management. This paper discusses the differences between statistical models and dynamic or conceptual models and makes suggestions for bridging the gap between the two. In statistical models, formulas described the relationships between the P-loading and P-concentrations based on the statistical analysis of data derived from a population of lakes. In conceptual models, processes concerning P-dynamics are measured and formulas developed to describe these processes. The constants are then adjusted iteratively to achieve best fit. Conceptual models are difficult to extend to lakes other than those for which they were developed. The easier way to bring the two types of models closer together is to have correct statistical data on total sediment load, water hardness, productivity, rainfall, and other parameters. Then conceptual models can be used for sensitivity analysis and to provide information for further analysis of statistical models. Models based on fluxes have the greatest predictive value and make it easier to apply data from one lake to another. (Cassar-FRC)
W82-00929

REVIVING ACIDIFIED LAKES,

Uppsala Univ. (Sweden). Dept. of Limnology.
W. Rohde.
Ambio, Vol 10, No 4, p 195-196, 1981. 1 Fig, 8 Ref.

Descriptors: *Lake restoration, *Acidic water, *Neutralization, Rehabilitation, Lakes, Acidity, Acid rain, Algae, Bacteria, Water pollution effects, Water pollution treatment, *Sweden, Hydrogen ion concentration, Calcium carbonate.

The progressive acidification of lakes can be somewhat counteracted by the addition of neutralizing materials, but even very acid bodies of water are objects of natural colonization within a short time. Sweden has treated about 1000 lakes by adding calcium carbonate or other neutralizing materials, but the treatment is expensive and must be repeated. When the pH reaches 4 or 5, almost none of the original organisms are able to survive. Japan's volcanic lakes with pH's of 2-5 have existed long enough for acid-tolerant and acidophilic organisms to become established. These lakes include bacteria, fungi, algae, animals, macrophytes, and one species of fish. Thus, water devoid of life is the object of colonization, and research should be undertaken to determine the best autotrophic algae to introduce as pioneers. From naturally acid waters, plankton and benthic algae could be collected and studied, and eventually used to inoculate large bodies of water. At present, the only alternative is to apply neutralizing agents. (Small-FRC)
W82-00933

METHANE FORMATION IN THE ACID PEATS OF OKEFENOKEE SWAMP, GEORGIA,

Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
G. A. King, T. Berman, and W. J. Wiebe.
American Midland Naturalist, Vol 105, No 2, p 386-389, April, 1981. 2 Tab, 14 Ref.

Descriptors: *Methane, *Swamps, Methane bacteria, Peat, Peat bogs, Peat soils, Muck soils, Organic soils, Acidity, Acidic soils, *Okefenokee Swamp, Georgia.

Gas bubbles were collected at several sites in the Okefenokee Swamp in Georgia. Rates of methane production in peat samples were determined by first obtaining cores from the various Cooter Lake and Grant Prairie sites with 4-inch OD Plexiglas coring tubes. Analysis of the gas bubbles suggests that methanogenesis does occur in the Swamp despite the low pH. No apparent trend for lesser amounts of methane was evident among samples from sites with low pH at Cooter Lakes vs. the sites with higher pH at Lake Louise and Grassy Pond. The high content of methane in bubbles relative to carbon dioxide and the lesser solubility of methane indicates that bubbles in Okefenokee peat originate from a methane nucleus. In vitro studies revealed substantial rates of methane production. This production in the swamp could result in the formation of a major habitat, the floating peat batteries, and may be a significant source of methane to the atmosphere. A cycle of sinking-floating batteries controlled by bacterial activity may exist in the peat batteries of the swamp. (Baker-FRC)
W82-00936

MEAN SUMMER CIRCULATION IN LAKE ONTARIO WITHIN THE COASTAL ZONE,

Woods Hole Oceanographic Institution, MA.
G. T. Csanady, and J. T. Scott.
Journal of Geophysical Research, Vol 85, No C5, p 2797-2812, May, 1980. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Water circulation, Lakes, *Coastal waters, Lake shores, Flow characteristics, Flow profiles, Mathematical models, *Lake Ontario.

The mean flow pattern was observed in the well-resolved coastal zone of Lake Ontario during the summer (July 15 through August 15) of 1972. Detailed velocity and temperature profiles were used to define the summer circulation pattern. Simple equilibrium models of wind-driven flow were used to explain some of the features of the flow pattern. South shore mean currents behaved remarkably like the simple theoretical model of steady wind-driven flow in a two layer basin. North shore mean flow was completely different and lacked coastal jets. This was probably due to momentum (and heat) advection during full upwelling episodes. Thus, the south shore current pattern consisted of divergent coastal jets, the eastern shore had a deep current generated by interface friction below the strong coastal jets, and the northern shore return flow of warm water was probably accomplished at some distance offshore. (Small-FRC)
W82-00967

THE EFFECT OF CHANGES IN THE NUTRIENT INCOME ON THE CONDITION OF LAKE WASHINGTON,

Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson, and J. T. Lehman.
Limnology and Oceanography, Vol 26, No 1, p 1-29, January, 1981. 13 Fig, 11 Tab, 55 Ref.

Descriptors: *Phosphorus, *Nitrogen, *Eutrophic lakes, *Nutrients, Lakes, Lake sediments, Seasonal variation, Water pollution, Wastewater disposal, Eutrophication, *Lake Washington, Washington.

Variations in nutrient income resulting from alterations in sewerage arrangements have had a significant effect on the condition of Lake Washington. Between 1941 and 1963, the lake received increasing amounts of secondary sewage effluent from the Seattle, Washington, metropolitan area, with resultant changes in the amount of nutrients in the water and in the kind and quantity of phytoplankton. The lake responded quickly to declining inputs of effluent between 1963 and 1968, when almost all discharges to the lake were discontinued. The amount of nutrients, the quantity of phytoplankton, and the proportion of blue-green algae all decreased during this period. By 1975, the lake could be regarded as having recovered from eutrophication. Calculations of phosphorus and nitrogen income sewage to the lake had much more effect on the phosphorus regime than on the nitrogen regime. Total phosphorus input varied from a high of 204,200 kilograms per year in 1964 to a low of 42,900 in 1973 and 1976, with sewage contributing about 72 percent of the total in 1962. Variation in total nitrogen ranged from a high of 1,419,000 kilograms per year in 1964 to 734,000 in 1976. Seasonal differences were found in the deposition of phosphorus to and release from the sediments. On the average, the sediments retained about 57 percent of the income over the long term. After diversion of the sewage effluent from the lake, there was a slight increase in the proportion of incoming phosphorus lost to the sediments. The amount of phosphorus lost permanently to the sediments during a year was found to be more closely related to the annual income than to the mean concentration in water. (Carroll-FRC)
W82-00987

EXPERIMENTAL MANIPULATION OF ALGAL BLOOM COMPOSITION BY NITROGEN ADDITION,

Department of Fisheries and Oceans, Winnipeg (Manitoba).
For primary bibliographic entry see Field 5C.
W82-00998

HEAVY METAL CONTENTS IN SOME MACROPHYTES FROM SAGINAW BAY (LAKE HURON, U.S.A.),

Cranbrook Inst. of Science, Bloomfield Hills, MI.
For primary bibliographic entry see Field 5B.
W82-01000

A METHOD FOR THE EVALUATION OF CONDITIONS IN A FISH POND SEDIMENT,

Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
Y. Avnimelech, M. Lacher, A. Raveh, and O. Zur.
Aquaculture, Vol 23, No 1-4, p 361-365, April, 1981. 2 Tab, 6 Ref.

Descriptors: *Bottom sediments, *Fish ponds, *Ecosystems, Phosphorus, Sediments, Organic matter, Fish, Decomposing organic matter, Anaerobic conditions, Measurement techniques.

Intensive fish farms are known to suffer significant decreases in fish growth and increases in the yield coefficient over time. This decline in fish pond fertility with time appears to result from excessive and rapid accumulation of organic carbon and nitrogen compounds in the fish pond sediment, which can cause a reduction in the oxidation potential. Although the rate of fish growth is commonly used to evaluate conditions in the fish pond, it is hard to relate fish growth to the conditions in the sediment at a given time using this method. A method for measuring fish grazing in the sediment has been developed to assist evaluation of the overall conditions in the sediments at a given time. The method involves measuring the extent of grazing of fish at the sediment by counting the phosphorus-32 tagged mud in the digestive tract of fish. The method was tested using two types of sediments (fresh soil and soil which had previously been used in intensive aquaculture systems for about 100 days) and three treatments with nutrient pellets (none, 60 grams, and 100 grams). In the control experiments, nets prevented the fish from grazing. Analysis of the uptake of the tagged mud by the fish showed that the uptake of phosphorus-32 by fish in containers with fresh soil without added nutrients was only slightly higher than the uptake of the tagged mud in the control treatment, which was not negligible. Fish in containers with fresh soil enriched with nutrients had the highest phosphorus-32 uptake. Fish in containers with enriched aged fish pond sediments, which were overloaded and anaerobic, showed phosphorus-32 uptakes which were about one third less than those in the enriched fresh soil. This method is shown to yield consistent results which are in agreement with previous experiences and observations of the fish growth in intensive ponds. (Carroll-FRC)
W82-01019

THE EFFECT OF CONTINUOUS ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE ON THE TROPHIC STATUS OF LONG LAKE, WA DURING 1979,

Eastern Washington Univ., Cheney. Dept. of Biology.
State of Washington Department of Ecology, Olympia, Document DOE 80-11, October, 1980, 86 p. 18 Fig, 25 Tab, 34 Ref.

Descriptors: *Mesotrophic lakes, Mesotrophy, *Trophic level, *Lakes, Water quality management, *Wastewater treatment, Phosphorus removal, Chlorophyll A, On-site data collections, Hydrologic data collections, Phytoplankton, Phosphates, Water quality, *Long Lake, Reservoirs, Spokane River, *Washington.

The water quality of Long Lake, an impoundment of the Spokane River, was documented in a study conducted during the second year of operation of an advance wastewater treatment facility (AWT) built by the City of Spokane in 1977. Long Lake was found to exhibit mesotrophy, as it had in a study conducted in 1978. Phosphorus removal from the sewage effluent resulted in significantly lower phosphate loads to the reservoir than before the AWT was implemented. Phytoplankton biovolumes were also reduced. Correlations showed that chlorophyll A concentrations gave a reasonable estimate of phytoplankton standing crop. In addition, areal phosphorus loading gave an excellent estimate of mean chlorophyll A concentration. The successional patterns of the major zooplankters were similar to those observed in 1978 and prior to the AWT. Zooplankton standing crops were less dense than those determined before the AWT, possibly the result of decreased food availability. Analysis of variance and least significant difference statistical evaluation showed that mean daily total and orthophosphate loads in 1979 at the AWT sewage effluent (S.E.) sampling station were significantly lower than those prior to AWT, but not from those determined in 1978. The sewage outfall effected an increase of total inorganic nitrogen and orthophosphate concentrations in the river of 1.6 and 2.5 times, respectively. (Garrison-Omniplan)
W82-01070

AN ASSESSMENT OF THE TROPHIC STATUS OF DEER, LOON, AND DIAMOND LAKES,

Washington State Dept. of Ecology, Olympia.
L. Singleton, J. Thielen, and D. Kruger.
Document DOE 80-9, July 1980. 33 p. 13 Fig, 12 Tab, 26 Ref, 3 Append.

Descriptors: *Trophic level, Mesotrophy, *Lakes, *Mesotrophic lakes, *Water pollution effects, Pollution effects, Eutrophication, Oxygen depletion, Water quality, Water quality standards, Data collection, On-site data collections, Hydrologic data collections, Deer Lake, Loon Lake, Diamond Lake, *Washington.

The trophic status of Deer, Loon, and Diamond Lakes, located north of Spokane, Washington, was evaluated during the 1978 growing season. Sampling occurred bi-weekly from May to November. Historical data were also utilized to determine if water quality had changed in any of the lakes. The results indicated that all three lakes are mesotrophic, each having nutrient and chlorophyll A concentrations below the levels established for eutrophic waters. All three lakes experience some degree of hypolimnetic anoxia, with Loon Lake the most anoxic. Deer Lake has the fewest water quality problems of the three, and the least amount of hypolimnetic oxygen depletion. Deer Lake appears able to sustain its present trophic condition longest and therefore should probably be the last of the three lakes sewered. Diamond and Loon Lakes both have some water quality problems which indicate they are not as stable. Loon Lake showed a significant decrease in water clarity and a significant decrease in the mean secchi disk depth. The anoxia observed in Diamond Lake was not as severe as in Loon Lake; however, it is still noteworthy. The water quality of Diamond Lake appears to be spatially affected by sludge beds present from previous log rafting practices. The sewering of Loon and Diamond Lakes needs further evaluation utilizing current demographic and land usage trends present at each lake. Conditions seem to have changed little since the DOE study in 1973; another study is recommended for 1983. (Garrison-Omniplan)
W82-01072

GONAD DEVELOPMENT, FECUNDITY, AND SPAWNING SEASON OF LARGEMOUTH BASS IN NEWLY IMPOUNDED WEST POINT RESERVOIR, ALABAMA-GEORGIA,

Alabama Cooperative Fishery Research Unit, Auburn.
T. J. Timmons, W. L. Shelton, and W. D. Davies.
Technical Papers of the U.S. Fish and Wildlife Service. No 100, 1980. 8 p. 2 Fig, 2 Tab, 28 Ref.

Descriptors: *Reservoir fisheries, *Bass, *Spawning, *Seasonal distribution, *Fish eggs, Fish populations, Fish establishment, Mature growth stage, Environmental effects, *West Point Reservoir, Alabama, Georgia.

After the filling of a new reservoir provides a large area and volume of water for fish population expansion, largemouth bass usually thrive for the first 3 to 10 years, after which growth rate slows. Little is known about the fecundity and sexual maturity of the early year classes of fast-growing largemouth bass in reservoirs in the southeast. West Point Reservoir, an impoundment of the Chattahoochee River, was impounded in October 1974 and filled to full power pool by May 1975. Because high turbidity precluded observation of nest-building and spawning, the spawning period was determined by observing the frequency distribution of ovarian egg diameters and calculating gonosomatic indices. The percentage of body weight contributed by the ovaries and frequency distributions of ovarian egg diameters were reliable indicators of the spawning season of the largemouth bass in the reservoir in 1977. Spawning began in mid-April and continued until mid-June. Some fish apparently spawned more than once, but no summer or fall spawning was indicated. Individual fecundity, determined by a dry weight method, ranged from 6,232 to 117,241 mature eggs for fish over 300 mm in total length. Eggs matured at a size larger than those described in other studies of largemouth bass. The fast-growing initial year classes (1975 and 1976) of largemouth bass dominated the reproducing population. (Moore-SRC)
W82-01080

THE IMPACT OF A NATURAL DRAWDOWN ON THE GROWTH OF FOUR EMERGENT SPECIES IN A PRAIRIE GLACIAL MARSH,

Iowa State Univ., Ames. Dept. of Botany and Plant Pathology.
A. G. Van der Valk, and C. B. Davis.
Aquatic Botany, Vol 9, No 4, p 301-322, December, 1980. 6 Fig, 5 Tab, 20 Ref.

Descriptors: *Marshes, *Drawdown, Water level, Drought, *Aquatic plants, Vegetation, *Ecological effects, *Eagle Lake, Iowa.

The impact of a natural drawdown in 1977 on the growth of four dominant emergent species at Eagle Lake, Iowa was investigated. Three of the species (Scirpus validus Vahl, Sparganium eurycarpum Engelm. and Typha glauca Godr.) dominate the polydominant communities of the cyclic zone of the Lake. S. eurycarpum and T. glauca also grow in monodominant communities in the non-cyclic zone. Scirpus fluviatilis Gray is found only in small monodominant stands in the non-cyclic zone. Growth of the three species was severely hampered by the drought. The drought, however, reversed a decline in vigor which had started before the drought in Scirpus validus Vahl. The drought enabled this species to exist in the marsh for two more years. The data suggest that periodic drawdowns enable several emergent species to coexist in a community due to their diverse responses to the disturbance. (Baker-FRC)
W82-01096

2I. Water In Plants

TRANSPIRATION, STOMATAL CONDUCTANCE, AND PHOTOSYNTHESIS OF TOMATO PLANTS WITH VARIOUS PROPORTIONS OF ROOT SYSTEM SUPPLIED WITH WATER,

Department of Agriculture, Harrow (Ontario).
C. S. Tan, A. Cornelisse, and B. R. Buttery.
Journal of the American Society for Horticultural Science, Vol 106, No 2, p 147-151, March, 1981. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Tomatoes, *Root development, *Irrigation requirements, Plant growth, Water requirements, *Transpiration, Photosynthesis, Stomatal transpiration, Soil moisture, Water conservation, Agriculture, Water stress, Soil water.

Tomato (Lycopersicon esculentum Mill.) plants were grown in sectional boxes so that each quadrant of the root system could be watered separately. Withholding water from 1 or 2 quadrants did not reduce transpiration, photosynthesis, stomatal conductance, or leaf surface area, suggesting that the absorption capacity of the tomato roots increased in response to the transpirational demand. The shoot:root ratio of the plants increased as the proportions of roots supplied with water increased, 18.4 at 25% watered to 27.9 at 100% watered. Withholding water from 25, 50, and 75% of the root system for two weeks, followed by full watering caused no apparent damage to the root systems in the dry quadrants. Transpiration (1.98-2.45 kg per day), photosynthesis (8.7-10.6 mg per sq dm per hour), and stomatal conductance (0.19-0.24 cm per sec) recovered fully. These results suggest that there is no need to irrigate the entire root system. (Cassar-FRC)
W82-00504

WATER RELATIONS OF THREE COWPEA CULTIVARS (VIGNA UNGUICULATA L.),

Ibadan Univ. (Nigeria). Dept. of Agronomy.
O. Babalola.
Plant and Soil, Vol 56, No 1, p 59-69, 1980. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Water stress, *Growth rates, *Crop yields, Soil water, Roots, Water use efficiency, Evapotranspiration, Cowpea, *Nigeria, Soil-water-plant relationships.

Three cowpea cultivars were investigated to determine the effect of water stress at different growth stages with respect to floral abscission and other growth parameters. Root system development and soil moisture extraction patterns were determined, and water use efficiency under dryland farming was investigated. Soil moisture stress significantly reduced growth and yield (34-46%) of all three. For Ife Brown variety, a semi-erect type, grain yield reduction was highest when stress was imposed at flowering/podding stages. There was no reduction in yield for New Era, a spreading type. Ife Brown was most sensitive to decreased matric potential, and New Era exhibited the highest formal abortion. Evapotranspiration was higher for New Era and Ife Brown than for Adzuki, an erect type. Water use efficiency was highest for New Era and least for Adzuki. New Era may not be suitable for intercropping, but Ife Brown may be popular because its drought susceptibility is intermediate. (Small-FRC)
W82-00607

THE EFFECT OF TEMPERATURE ON SALT UPTAKE BY TOMATO PLANTS WITH DIURNAL AND NOCTURNAL WATERLOGGING OF SALINIZED ROOTZONES,

Victorian Dept. of Agriculture, Ferntree Gully (Australia). Scoresby Horticultural Research Station.
D. W. West, and J. A. Taylor.
Plant and Soil, Vol 56, No 1, p 113-121, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Temperature effects, *Salinity, *Accumulation, *Tomatoes, Waterlogging, Root zone, Roots, Sodium chloride, Sodium ions, Chloride ions, Compairson studies.

Tomato plants were grown at three temperatures with the rootzones of half the plants waterlogged for the day or night period of each 24 hours. Other plants were grown with drained rootzones, and all plants were irrigated with saline (0.09 M NaCl) nutrient solution. Increase in temperature resulted in increases in leaf Na-ion and Cl-ion concentrations in plants with drained rootzones. In waterlogged plants, the maximum leaf concentration of the ions occurred at 20C. There were no differences in ion concentrations at 10C between drained and waterlogged rootzones. Waterlogging of the rootzones resulted in higher concentrations of ions in leaf and stem tissues at 20 and 28C. No differences were found in the Na and Cl ions in plant tops when plants were waterlogged during the day or night. As temperature increased, transpiration increased, but no other treatment dependent responses were noted. Thus, the direct importance of temperature of growth on the interaction between salinity and waterlogging was demonstrated. (Small-FRC)
W82-00608

MOISTURE TRANSPORT IN A SOIL-PLANT SYSTEM: A MATHEMATICAL MODEL AND FINITE ELEMENT ANALYSIS,

Weyerhauser Co., Centralia, WA.
P. Farnum, and G. F. Carey.
Advances in Water Resources, Vol 4, No 2, p 67-76, June, 1981. 10 Fig, 1 Tab, 26 Ref.

Descriptors: *Soil-water-plant relationships, *Mathematical models, *Water transport, Plant water potential, Soil water, Evapotranspiration, Finite element method, Mathematical studies.

A comprehensive integrated model was developed for the mathematical analysis of moisture transport from the soil through an individual plant to the atmosphere. The important features associated with non-linear time-dependent diffusion in a non-homogeneous soil are incorporated, including local flow to the individual roots. The flow system is modeled by modeling separate flow subsystems. The model and analysis were used to assess given environmental conditions and to assist in establishing planting guidelines in reforestation. The model's intrinsic value lies in hypothesis testing, including the proposed improvement or elaborations on particular local features. Also, models of the soil-plant system can be incorporated and their effect on the entire system determined. Model predictions compared well with actual experimental results. (Small-FRC)
W82-00648

THE EFFECT OF HEIGHT OF WATER TABLE ON THE GROWTH OF HOLCUS LANATUS WITH REFERENCE TO LOLIUM PERENNE,

Oxford Univ. (England). Dept. of Agricultural Science.
T. A. Watt, and R. J. Haggar.
Journal of Applied Ecology, Vol 17, No 2, p 423-430, August, 1980. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Soil-water-plant relationships, *Plant growth, *Water table, Water level, Soil water table, Experimental data.

Plants of Holcus lanatus L. and Lolium perenne L. occur frequently in wet sites. They invade sown areas earlier and spread more rapidly on heavy, poorly drained sites. Plants of the two weeds were grown in monocultures and in 50:50 mixtures in free-draining conditions and with water table levels of 5, 11, or 21 centimeters below the soil surface in an effort to determine the effects of depth of the water table on their growth. At the first harvest all three stand types produced the highest yields with the lowest water table, with yields decreasing with increasing height of water table. At subsequent harvest, the free-draining treatment resulted in the highest yields. The absence of significant species times stand type and stand type times water table interactions indicate that there was no difference between the effects of interspecies or intraspecies competition. There was no significant difference between the percentage nitrogen contents of the two grasses in monocultures, with increasing water table height resulting in lower concentrations of nitrogen in both species. While L. perenne did not produce surface roots, coverage of the soil surface by surface roots of H. lanatus ranged from 15% in free-draining soil to 83% in the high water table treatment. There was also an increase in the number of nodes producing roots in H. lanatus with increasing height of water table. These results indicate that adaptations made

by the H. lanatus plant when growing in soil with a high water table may contribute to their long-term survival at the expense of short-term shoot production. (Carroll-FRC)
W82-00654

CONSUMPTIVE USE AND DAILY EVAPOTRANSPIRATION OF CORN UNDER DIFFERENT LEVELS OF NITROGEN AND MOISTURE REGIMES,

Andhra Pradesh Agricultural Univ., Hyderabad (India). Dept. of Agronomy.
For primary bibliographic entry see Field 2D.
W82-00660

ANNUAL PLANT PRODUCTION-PRECIPITATION RELATIONS IN ARID AND SEMI-ARID REGIONS,

Botanical Research Inst., Pretoria (South Africa).
M. C. Rutherford.
South African Journal of Science, Vol 76, No 2, p 53-56, February, 1980. 1 Fig, 35 Ref.

Descriptors: *Crop production, *Rainfall rate, Productivity, Precipitation intensity, *Semiarid lands, *Arid lands, Semiarid climates, Climates, Water stress, Mathematical studies.

An attempt is made to appraise published relations between annual precipitation and annual plant community production for arid and semi-arid areas. In many cases formulas used are not suitable for these areas. Usually their unsuitability is due to a lack of supporting data or such other reasons as the arbitrary extrapolation of results from short intervals of a growing season over longer periods, the integration of the moisture regime with other important environmental factors, the assumption of linear or identity relations between moisture regime and production, and the limitation of the prediction to only part of the potential plant production. Discussion is given of Walter's relation, in which mean annual precipitation is related to above-ground herbaceous production for semi-arid areas of South West Africa. Discussion is also given to Rosenzweig's and Lieth's relations. The Rosenzweig curve relates annual actual evapotranspiration and above-ground plant production over a much greater range of annual precipitation than Walter's equation. Lieth's Miami Model and the C. W. Thornthwait Memorial Model both predict total production above and below ground. It is concluded that future work in this field would benefit from a clear definition of the term 'production,' objective sampling, full presentation of the data, inclusion of other climatic variables to help refine production relations and improve levels of predictability, and adequate testing of available relations before application, with the derivation of new relations where necessary. (Baker-FRC)
W82-00693

GROWTH AND NITROGEN FIXATION OF AESCHYNOMENE UNDER WATER STRESSED CONDITIONS,

Florida Univ., Gainesville. Dept. of Agronomy.
S. L. Albrecht, J. M. Bennett, and K. H. Queesenberry.
Plant and Soil, Vol 60, No 2, p 309-315, 1981. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Water stress, *Nitrogen fixation, *Tropical regions, Waterlogging, Drainage, *Legumes, Soil properties, Soil porosity, Soil moisture retention, Flooding, Nitrogen, Soil moisture deficiency, Moisture deficiency, Plant growth, *Aeschynomene, Soil-water-plant relationships.

The tolerance of nitrogen fixation was studied in several accessions of Aeschynomene americana in response to various levels of soil moisture. The accessions of A. americana were subjected to periods of flooding or soil water deficits to determine stress effects on nitrogen fixation. Cuttings of 22 field grown accessions were rooted in sand and transplanted to a mixture of Wauchula sand, peat and perlite in pots. Nitrogenase activity was determined by the acetylene reduction assay. Both flooding and drought treatments showed increased root weights. The flooding treatment did not significantly reduce nodule weight, percent nodulation, or nitrogenase activity, whereas soil moisture deficits caused reductions in these variables. Many of the accessions have effective mechanisms for maintaining active nodules under flooded conditions. Flooded plants maintained leaf water, osmotic and turgor potentials which were similar to those of the well-watered controls. Droughted plants appeared to have much lower nodule water potentials. Flooded plants maintained leaf water relationships which were slightly more favorable than those of the well-watered controls, although the differences were small. It is not known which factors specifically allow waterlogged A. americana to fix nitrogen. Accessions which showed good growth and nitrogen fixation under flooding in the greenhouse will be tested on seasonally waterlogged areas to measure performance in the field. (Baker-FRC)
W82-00758

WATER DYNAMICS IN THE SOIL-PLANT-ATMOSPHERE SYSTEM,

Science and Education Administration, Temple, TX. Grassland, Soil and Water Research Lab.
J. T. Ritchie.
Plant and Soil, Vol. 58, No. 1-3, p 81-96, 1981. 4 Fig, 34 Ref.

Descriptors: *Soil-water-plant relationships, *Agriculture, *Soil water, *Crop production, Atmospheric pressure, Transpiration, Mathematical models.

Water dynamics in the soil-plant-atmosphere system are determined by the capacity of the soil water reservoir, its depletion and replenishment, and its efficient management for crop production. Water balance calculations using computers provide a means for accurate estimations of crop yields, early warning about food shortages, and reliable irrigation scheduling and water resource planning. Reliable water balance evaluations depend upon accurate estimation of evaporation from soil and plants. Incomplete crop canopy or a deficiency of water in the root zone may cause a discrepancy between actual evaporation and maximum evaporation. Since it is almost impossible to generalize about plant response to water deficit using soil measurements, attention has been focused on the use of plant measurements for this parameter. Physical measurements sensitive to crop water deficit include plant stomatal resistance and plant water potential. However, both of these measurements are difficult to utilize for operational purposes. Accurate water balance modelling also requires estimation of the amount of water infiltration into the soil from precipitation or irrigation, which can be accomplished using either physical models of hydrologic processes or statistical models fitted to experimental data. (Carroll-FRC)
W82-00759

TEMPERATURE AND WATER RELATION PATTERNS IN SUBALPINE UNDERSTORY PLANTS,

Wyoming Univ., Laramie. Dept. of Botany.
W. K. Smith.
Oecologia, Vol 48, No 3, p 353-359, 1981. 6 Fig, 1 Tab, 30 Ref.

Descriptors: *Plant growth, *Water requirements, Transpiration, Mountains, Cold regions, Water stress, *Temperature effects, Forests, Rocky Mountains.

A comparison was made of the temperature and water relations of seven understory species that are abundant and grow sympatrically in the understory of the coniferous forests of the Rocky Mountains. Several general characteristics in the water relations of the seven species emerged. Soil moisture remained relatively high throughout the summer even though minimum plant xylem water potentials commonly decreased below minus 1.0 MPa, especially for the more shallow rooted herbaceous species. Leaf temperatures and conductances rose sharply during exposure to sunflecks, along with corresponding increases in transpiration and decreases in xylem water potentials. Midday wilting occurred for four of the seven species, all of which were herbaceous. Turgor was regained fairly rapidly during subsequent shade periods. Stomata on either leaf surface appeared to remain fully open when oriented away from direct sunlight. The stomatal opening in the morning occurred rapidly for sunlit leaves compared to a more gradual opening for plants in the shade. The amount of incident light on abaxial surfaces was not sufficient to cause full stomatal opening. The study indicated that midday wilting may be a common understory phenomenon within coniferous forests in the Rocky Mountains. Apparently, either water uptake from the soil or water transport from the roots to the leaves was not sufficient to support the transpiration demand for these herbaceous species, in contrast to the two species which were more deeply-rooted, and shrubby in nature. (Baker-FRC)
W82-00760

WATER STATUS OF SOIL AND VEGETATION IN A SHORTGRASS STEPPE,

Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.
O. E. Sala, W. K. Lauenroth, W. J. Parton, and M. J. Trlica.
Oecologia, Vol 48, No 3, p 327-331, 1981. 6 Fig, 17 Ref.

Descriptors: *Vegetation, *Soil water, Moisture stress, Water stress, Water loss, Water supply, Water shortage, Water scarcity, Water deficit, Moisture availability, *Steppes, North America, Soil-water-plant relationships, Semiarid climates, Plant growth, Available water.

Patterns of water availability were investigated in the semiarid shortgrass steppe region of North America. Specifically, attempts were made to describe the status and transfers of water among the soil-plant-atmosphere compartments during a drying cycle, the pattern of water losses from a completely wet soil profile, and how some physiological plant variables were affected throughout a drying cycle. The study site was on the piedmont or northcentral Colorado at Pawnee Site, about 61 km northeast of Fort Collins. Principal perennial species on the study site were blue grama, fringed sagewort, plains pricklypear, and needleleaf sedge. Plant and soil water measurements were taken on 15 dates during a 56 day dry cycle. At the beginning of the cycle, water loss occurred exclusively from the top layer. After that the next deeper layer also began contributing water to the total loss. Sixteen days passed before water potential values significantly different from zero were recorded in the 15 cm depth layer. In the deepest layer, 60 cm, water loss began to occur 39 days after the start of the study. Through the first 50 days of plant growth, leaf conductance and water potential at noon slowly declined. After 50 days these levels decreased rapidly. The predawn water leaf potential remained unchanged during the first 45 days, decreasing rapidly thereafter. Predawn leaf water potentials were highly correlated with water potentials of the wettest layer. It appeared that the root surface area limited the water flow through an important part of the day in this semiarid ecosystem. Axial root resistance did not appear significant in determing equilibrium status between leaves and the wettest soil layer. (Baker-FRC)
W82-00761

COMPARATIVE FIELD WATER RELATIONS OF FOUR CO-OCCURING CHAPARRAL SHRUB SPECIES,

San Diego State Univ., CA.
S. W. Roberts, P. C. Miller, and A. Valamanesh.
Oecologia, Vol 48, No 3, p 360-363, 1981. 4 Fig, 18 Ref.

Descriptors: *Water requirements, *Plant growth, Seasonal variations, *Chaparral, Shrubs, Water potentials, Drought, Water shortage, Moisture stress, Water stress.

Seasonal water use patterns were investigated in chaparral shrubs using the null-balance approach and evaluating the method with regard to previous measurements of water use patterns in these same shrubs. Field measurements of xylem pressure po-

tential and leaf conductance were made through a summer drought cycle of Adenostoma fasciculatum, Ceanothus greggi var perplexens, Quercus dumosa, and Arctostaphylos glauca, from June through November 1978 at Echo Valley, California. Progressive drought development was noted over the seasonal courses of minimum water potential measurements, with a further clear seasonal segregation by species becoming evident. Maximum conductances showed differences between species, and in A. fasciculatum there were further differences by leaf age class. No differences in maximum conductances between old and new leaves of A. glauca were noted; in general this plant showed the lowest maximum conductances. A peak in October of maximum conductance was noted in association with a short period of precipitation. Diurnal variation of water potential-leaf conductance relations showed large hysteresis early in the season for A. fasciculatum leaves on the equator-facing slope. The hysteresis decreased as the drought progressed. These findings suggest that early in the season the water is available to the shrubs and therefore stomatal behavior is largely governed by a complex array of environmental factors. Late in the season, however, stomatal behavior becomes increasingly dominated by tissue water status. (Baker-FRC)
W82-00762

THE EFFECT OF ENVIRONMENTAL UNCERTAINTY ON MORPHOLOGICAL DESIGN AND FLUID BALANCE IN SARRACENIA PURPUREA L.,

Stanford Univ., CA. Dept. of Biological Sciences.
J. Kingsolver.
Oecologia, Vol 48, No 3, p 364-370, 1981. 10 Fig, 17 Ref.

Descriptors: *Water potentials, *Plant morphology, *Pitcher plant, Leaves, Evaporation, Precipition, Drying, Rainfall, Simulation, Model studies.

The morphological design of pitcher plant leaves was considered with respect to their fluid balance in variable environments. Leaves of different sizes and geometries were compared with respect to fluid loss and fluid gain rates. Responses of these different geometries to variations in the hydric environment were analyzed. General design principles were sought in variable and unpredictable environments, with the aim of finding the leaf shape which minimizes the probability that the leaf will lose all of its fluid at any time. The major components of the leaf fluid balance were taken to be precipitation and evaporation, with all other components neglected for the predictions of leaf fluid levels. The temporal distribution of rainfall at the study area is highly non-uniform, with no measurable precipitation occurring on 62% of all days, and with less than 1.0 cm/day falling on 75.5% of the days on which precipitation fell. While no single design criterion can determine the morphology of an organism, it became increasingly clear that continual maintenance of positive fluid balance may be a relevant design criterion for leaf geometry. In terms of both shape and leaf size, the pitcher leaf of Sarracenia purpurea is indeed an effective design for reducing desiccation frequency. Desiccation is related not to the mean but to the variation in fluid volume during the season. The pitcher leaf integrates meteorological information over the time period which corresponds closely to the temporal distribution of variation in rainfall. The leaf thus acts as a low-pass filter which selectively removes the high frequency components of rainfall variation. (Baker-FRC)
W82-00811

PLANT-WATER RELATIONS AND ADAPTATION TO STRESS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
N. C. Turner, and J. E. Begg.
Plant and Soil, Vol 58, No 1-3, p 97-131, 1981. 6 Fig, 2 Tab, 180 Ref.

Descriptors: *Water stress, *Soil-water-plant relationships, Water deficit, Crop yield, Crop production, Plant morphology, *Plant growth, Plant physiology, Soil water, Evaporation, Rainfall, Literature reviews.

Water deficits affect the growth and yield of plants in many ways. While dramatic increases in yields of cereals have been experienced in areas having a regular supply of water assured through rainfall or irrigation, arid and semi-arid regions have experienced much smaller increases over the past 40 years. Improved varieties and higher fertilizer use are not as effective in increasing yields in water-limited environments as they are in more temperate regions or in areas in which irrigation can be provided. Large year-to-year variations in rainfall in Mediterranean-type environments also result in large year-to-year variations in yield per unit area. In order to achieve crop increases in cereal production in semi-arid areas, crops must be designed for adversity, particularly a limited and variable water supply. The development of crop water deficits, and the responses of plants to these deficits, are described. Plants possess a variety of developmental, morphological, and physiological mechanisms which enable them to adapt to water deficits. Rapid phenological development after germination has been widely adopted for crops in semi-arid environments. Developmental plasticity is also highly desirable for crops in these areas. Physiological mechanisms which enable plants to adapt to water stress include seed priming, stomatal control of water loss, osmotic adjustment, and cellular tolerance of dehydration. In order to improve the grain yield of crops in a Mediterranean-type environment, it is necessary to increase the water passing through the crop in transpiration, increase the water use efficiency, and/or increase the proportion of total dry matter going to the grain. While the agronomist works to ensure that the most efficient use is made of available water, the breeder must try to produce a cultivar that will give a greater yield under water-limited conditions. (Carroll-FRC)
W82-00812

CLONAL VARIATIONS IN THE WATER RELATIONS OF RED OSIER DOGWOOD DURING COLD ACCLIMATION,

Minnesota Univ., St. Paul. Lab. of Plant Hardiness.
E. A. Bray, and L. R. Parsons.
Canadian Journal of Plant Science, Vol. 61, No. 2, p 351-363, April, 1981. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Cold regions, *Acclimatization, *Trees, *Dogwood, Moisture availability, Water use efficiency, Variability.

Studies were made to determine if red osier dogwood acclimating to cold under natural photoperiod and temperature undergoes changes in water relations similar to those demonstrated in plants acclimated in growth chambers and to determine if water relations account for differences in hardiness of several climatic races of red osier dogweed. Cuttings were taken from plants in the University of Minnesota arboretrum and field plots. The races of dogwood could be divided into two groups: Oregon, Idaho and Montana varieties became hardy to between -25 and -30 degrees C, and Alaska, North Dakota and Washington varieties became hardy to between -37 and -42 degrees C. After the initial frost, daytime stomatal resistance increased first in the Alaska clone and then in the Washington, Montana and North Dakota clones, but not in Idaho and Oregon clones. The remaining water relations parameters measured did not show differences among the races of dogwood. Stem water content of all clones decreased into mid-October, when they reached a similar water content of about 1 g water/g dry weight. Midday leaf xylem pressure potential of all clones increased during acclimation. Relative water content of the stems decreased during acclimation, but later increased. The water relations parameters of the outdoor acclimation process were very similar to those reported for growth chamber studies. Thus it was concluded that dogwood races from various natural locations acclimated at different rates in a common field location. (Baker-FRC)
W82-00839

SEDIMENT-BASED NUTRITION OF SUBMERSED MACROPHYTES,

Army Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2H.
W82-00843

SOME ASPECTS OF PLANT WATER RELATIONS IN ALASKAN ARCTIC TUNDRA SPECIES,

San Diego State Univ., CA.
S. Oberauer, and P. C. Miller.
Arctic and Alpine Research, Vol. 13, No. 2, p 205-218, May, 1981. 1 Fig, 5 Tab, 21 Ref.

Descriptors: *Plant water potential, *Tundra, *Alaska, *Arctic, Water potentials, Polar regions, Arctic zone, Cold regions.

Four sites including a snow patch, a south facing slope, a north facing slope, and a tussock tundra ridge were selected for water availability measurements in arctic and alpine tundra. Xylem pressure potentials and interrelations between relative water content, xylem pressure potential, and leaf conductance of several species which are common in tussock and montane tundra were compared at these four Alaskan sites in 1977 and 1978. Evergreen shrubs were found to have the lowest leaf conductances, graminoids and forbs the highest. The relations between relative water content, xylem pressure potential and leaf conductance were not unique to a growth form nor to a vegetation zone. Although different species attained different minimum pressure potentials, individuals of a species showed similar potentials in a variety of sites. The narrow range of minimum potentials of a species and the similar behavior of species within a site indicate strong selection segregating species. (Baker-FRC)
W82-00846

WATER STRESS AND COLD HARDINESS IN FIELD-GROWN CITRUS,

Florida Univ., Gainesville. Dept. of Fruit Crops.
F. S. Davies, D. W. Buchanan, and J. A. Anderson.
Journal of the American Society for Horticultural Science, Vol. 106, No. 2, p 197-200, March 1981. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Citrus fruits, *Frost protection, *Irrigation effects, Water stress, Oranges, Fruit crops, Crop yield, Orchards, Trees, *Florida.

The treatment which permitted the least frost damage in Orlando tagelo (Citrus reticulata Blanco x Citrus paradisi Macf.) trees was no fall irrigation and under-tree sprinkling during a frost; leaf drop was 11.5% and undamaged fruit, 60%, following a frost in December 1979, in wich leaf temperature remained below -3.9C for 8 hours. Trees suffered the worst damage with fall irrigation and no sprinkling during frost. Intermediate damage was allowed by fall irrigation plus frost irrigation and no fall irrigation plus no under-tree sprinkling. Although the soil moisture content of irrigated blocks was significantly greater than for non-irrigated blocks during fall, afternoon leaf xylem water potentials and stem water contents were comparable. (Cassar-FRC)
W82-00864

WATER REQUIREMENT FOR SUGARCANE PRODUCTION,

Agricultural Research and Education Center, Belle Glade, FL.
For primary bibliographic entry see Field 3F.
W82-00899

INVESTIGATIONS OF CONTROL MECHANISMS OF GERMINATION UNDER WATER STRESS,

Department of Agriculture and Fisheries for Scotland, Edinburgh.
T. W. Hegarty, and H. A. Ross.
Israel Journal of Botany, Vol 29, No 1-4, p 83-92, 1980/1981. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Water stress, *Germination, *Water potentials, *Plant growth substances, Seeds, Plant growth, Plant physiology, *Plant water potential, Planting management.

Seedling growth immediately after germination was able to proceed at water potentials lower than those that permitted germination in most varieties of seeds studied. This differential could be reduced by growth regulators, which made the water potential of seed germination more negative. The difference was eliminated by a combination of ethrel and kinetin in red clover and lucerne. Evidence suggests that the process in germination most sensitive to water stress is the initiation of cell elongation. The differential sensitivity to moisture stress is suggested as a form of dormancy. This control mechanism shows variations in operation and response to external stimuli and depends on genetic and environmental factors. (Cassar-FRC)
W82-00912

PHOTOSYNTHESIS AND GROWTH IN POPULATIONS OF POPULUS DELTOIDES FROM CONSTRATING HABITATS,

Illinois Univ. at Urbana-Champaign. Dept. of Botany.
A. B. McGee, M. R. Schmierbach, and F. A. Bazzaz.
American Midland Naturalist, Vol 105, No 2, p 305-311, April, 1981. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Plant growth, *Habitats, Floodplain, Drought, *Soil types, Transpiration, Trees, Respiration, Photosynthesis, *Soil-water-plant relationships, *Populus deltoides.

The degree and expression of ecological differentiation among populations of Populus deltoides from three contrasting habitats were examined. The influence of some edaphic conditions upon growth, photosynthesis and transpiration in these populations was investigated. Ramets of floodplain, stripmine and sand-dune origin were grown in soils of each locality and growth parameters were measured for representative members of each population. The photosynthetic response of flooded and droughted individuals in their native soils was investigated. While the populations were different in some responses, they all accumulated more biomass in the nutrient-rich floodplain soil. Soil type inclucenced all growth parameters measured, but plant origin influenced only sme of these paramenters. Photosynthesis declined in all populations when root systems were flooded. This decline was delayed in sand-dune plants until after day 12, due perhaps to their stomatal conductance increasing initially and then declining. Response to drought was different also among the three populations. These findings indicate that Populus deltoides grows well across a wide range of soil conditions but exhibited ecological differentiation in the three contrasting habitats it usually occupies. (Bker-FRC)
W82-00935

THE MANIFESTATION OF DEHYDRATION AVOIDANCE IN WHEAT BREEDING GERMPLASM,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Field Crops.
A. Blum, G. Gozlan, and J. Mayer.
Crop Science, Vol 21, No 4, p 495-499, July/August, 1981. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Wheat, *Water stress, *Drought, Crop yield, Crop production, Irrigation effects, Stomata, Plant physiology.

The existence of and variability in dehydration avoidance was investigated within a random sample of advanced and well-adapted wheat. Selected genotypes were planted in each test and two replicate plots. Half of the plots were irrigated every 13 to 17 days, while stress blocks were not irrigated after September 24. Significant variation was found among the 19 genotypes tested in their midleaf water potentials during a stress period. Leaf water potential was correlated with the final number of grains per spike across genotypes of similar phenology in one test where drought stress developed during the spike development stage. Large variations in stomatal response were found, which indicated that dehydration avoidance in only a few of the genotypes may have resulted from stomatal sensitivity and closure at low stress levels. Most avoidant genotypes had relatively open stomata. Thus, a selection method for dehydration avoidance was investigated which, when combined with other available tests for drought resistance, may lead to the establishment of a logistic breeding program for improved yield and drought resistance in wheat. (Small-FRC)
W82-00958

VEGETATIONAL ANALYSIS OF BIG RUN BOG, A NONGLACIATED SPHAGNUM BOG IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Biology.
R. K. Wieder, A. M. McCormick, and G. E. Lang.
Castanea, Vol 46, No 1, p 16-29, March, 1981. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Bogs, *Vegetation, *Plant populations, Population density, Spatial distribution, Shrubs, Mosses, Herbs, *West Virginia, *Big Run Bog.

Although there have been numerous studies of the vegetation of Sphagnum-dominated bogs and peatlands in glaciated areas and of the vegetation in extensive Sphagnum-dominated areas in nonglaciated regions, the numerous small sized bogs in nonglaciated regions have been largely ignored. The composition and distribution of the vegetation in a small, relatively undisturbed nonglaciated Sphagnum bog in West Virginia was investigated. Vegetation was sampled from late June through early September, 1977, in a series of nested quadrants in Big Run Bog in West Virginia. The following four community types were identified using a minimum variance cluster analysis of the data: Sphagnum-Eriophorum virginicum, Sphagnum-shrub, Polytrichum-shrub, and Polytrichum-Carex canescens. These four community types cover about 85 percent of the surface of the bog, with Sphagnum communities occurring in 122 of the 126 quadrants and Polytrichum occurring in 91 of the quadrants. Vascular herbaceous species cover about 50 percent of the surface of the bog. Upright shrubs are of relatively minor importance, and most of the shrub species are generally found near the edge of the bog. The six tree species were represented by only a few individuals, and dead trees and saplings were more numerous than live ones. Several species found in the Big Run Bog have generally boreal distributions but are found at or near the southern limit of their natural ranges in Sphagnum bogs in West Virginia. Marked changes in the composition of bog vegetation have been attributed to alterations of water table level. Frequent alterations of water table level resulting from intermittent beaver habitation may be responsible for the failure of the vegetation to segregate into distinct communities in this bog. The pattern of community distribution may be related to cation concentration of surface water, pH of surface water, and soil moisture, as well as to water table fluctuations. (Carroll-FRC)
W82-00992

PHOTOSYNTHETIC RECOVERY OF RESURRECTION SPIKEMOSSES FROM DIFFERENT HYDRATION REGIMES,

Vanderbilt Univ., Nashville, TN. Dept. of General Biology.
W. G. Eickmeier.
Oecologia, Vol 46, No 3, p 380-385, September, 1980. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Desert plants, *Photosynthesis, *Drought resistance, Xerophytes, Spikemosses, Mosses, Arid climates, Plant physiology, Humidity, Texas.

The patterns and mechanisms of photosynthetic activity recovery of two resurrection spikemosses were compared in the laboratory. The two plants, found in the southwest Texas desert, were Selaginella lepidophylla Hook. and Grev. (hot, arid, low elevation, xeric environment) and S. pilifera A. Br. (high elevation, mesic environment). Photosynthetic competence was achieved much more rapidly in S. lepidophylla than in S. pilifera. Although chloramphenicol, a chloroplast protein synthesis inhibitor, significantly inhibited resumption of C02 uptake in both species, inhibition was greater in S. pilifera. The level of conserved ribulose 1,5-bisphosphate carboxylase specific activity was significantly greater in S. lepidophylla. These results support the hypothesis that desiccation produces less damage to the photosynthetic system in plants from more xeric environments than in plants from mesic environments. (Cassar-FRC)
W82-01010

SEASONAL PATTERNS OF LEAF WATER RELATIONS IN FOUR CO-OCCURRING FOREST TREE SPECIES: PARAMETERS FROM PRESSURE-VOLUME CURVES,

Duke Univ., Durham, NC. Dept. of Botany.
S. W. Roberts, B. R. Strain, and K. R. Knoerr.
Oecologia, Vol 46, No 3, p 330-337, September, 1980. 8 Fig, 37 Ref.

Descriptors: Water potentials, *Drought, *Leaves, Soil-water-plant relationships, Trees, Osmotic pressure, Plant water potential, Forests, Seasonal variation, *Forests.

Leaf water relationships were studied in 4 forest tree species (Ilex opaca Ait., American holly; Cornus florida L., flowering dogwood; Acer rubrum, red maple; and Liriodendron tulipfera L., tulip popler) during April-August 1977, a dry summer. Initial osmotic potentials (the value of the osmotic component at full turgidity) were highest at the start of the growing season and decreased as the summer progressed. Precipitation after a dry period caused an increase in initial osmotic potentials. All species but Acer maintained leaf turgor throughout the season; during the July drought Acer leaves lost some turgor at midday. Younger Ilex leaves had higher early season initial osmotic potentials than overwintering leaves from the same tree. In Liriodendron the osmotic potentials of the leaves appeared to be related to the resistance of these leaves to drought conditions. The osmotic water fraction (fraction of total leaf water available to affect osmotic potentials) was greatest in young tissue early in the season and declined throughout the season. The measured water relationships agreed with the relative positions of the species along a water-availability gradient in the order Cornus (wettest), Acer and Liriodendron (intermediate), and Ilex (driest). This suggests that these trees coexist in a drought situation because each species uses water maximally at different stages of the water availability cycle. (Cassar-FRC)
W82-01011

DRYLAND CROPPING STRATEGIES FOR EFFICIENT WATER-USE TO CONTROL SALINE SEEPS IN THE NORTHERN GREAT PLAINS, U.S.A.,

Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 3F.
W82-01023

WATER RELATIONS, SOIL FERTILITY, AND PLANT NUTRIENT COMPOSITION OF A PYGMY OAK ECOSYSTEM,

Fisheries and Wildlife, Columbia, MO.
P. B. Reich, and T. M. Hinckley.
Ecology, Vol 61, No 2, p 400-416, 1980. 11 Fig, 3 Tab, 54 Ref.

Descriptors: *Water stress, *Nutrients, *Forests, *Ecosystems, Moisture availability, Growth, *Pygmy oaks, Trees, Soil properties, Seasonal variations, Temperature effects.

A study was conducted to describe the seasonal and spatial patterns of soil-plant moisture and nutrient relations for both a pygmy and a non-pygmy forest; to examine diurnal trends in plant water deficit, leaf conductance, and certain environmental variables; and to describe differences between seedling growth of acorns from pygmy and non-pygmy oaks. The study site was Buzzard's Roost, an unusual pygmy oak ecosystem in southwest Missouri. Pygmy forest soil was very acidic, with

low levels of calcium and magnesium and high levels of aluminum. Adjacent non-pygmy forests had higher pH, Ca and Mg, and lower Al levels. Diurnal and seasonal patterns of xylem pressure potential, leaf conductance, and soil moisture content illustrated the development of very severe tree water deficits at Buzzard's Roost. Predawn and midday xylem pressure potentials decline to as low as -3610 and -4200 kPa, respectively, accompanied by complete daytime stomatal closure. However, other factors indicated that water stress was not the major factor or causative agent in the stunting process. Very low nutrient levels in the soil may be partly responsible for the existence of the pygmy oak forest. The xeric site characteristics add another severe stress to this ecosystem. The adverse soil factors set up a 'feedback' system in which nutrient loss, acidification, and changing ion solubilities increase the soil impoverishment. (Baker-FRC)
W82-01034

SOIL MOISTURE RELATIONS IN THE SOUTHERN CALIFORNIA CHAPARRAL,

San Diego State Univ., CA. Dept. of Biology.
For primary bibliographic entry see Field 2D.
W82-01035

WATER VAPOR CONDUCTANCE AND CO2 UPTAKE FOR LEAVES OF A C4 DESERT GRASS, HILARIA RIGIDA,

California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.
P. S. Nobel.
Ecology, Vol 61, No 2, p 252-268, 1980. 5 Fig, 32 Ref.

Descriptors: *Grasses, *Moisture availability, Soil moisture, *Soil-water-plant relationships, Photosynthesis, Transpiration, *Desert plants, Arid-zone hydrology, Hydrology, Arid zone, Arid lands, Arid climates, Carbon dioxide, Soil water, Hilaria rigida.

Transpiration and photosynthesis were examined over a 2 year period in the field and in laboratory conditions to help reconcile the prevalence of Hilaria rigida with potentially adverse ambient environmental factors. Availability of soil water appeared to be the major influence on seasonal stomatal activity of Hilaria rigida over the study period in the Colorado desert section of the Sonoran desert. Major stomatal opening occurred for 4.6 mo in the relatively cool winter-spring and for 1.7 mo in the late summer-early fall. The temperature optimum for carbon dioxide uptake was generally above daytime temperatures, particularly in the winter. When the daytime growth temperature was raised from 16 to 49 degrees C in laboratory experiments, the temperature optimum for CO2 uptake shifted from 29 to 43 degrees C. Besides the rather high temperature optimum for CO2 uptake, H. rigida displayed other typical C4 characteristics including Kranz anatomy, a low CO2 compensation point, and a lack of light saturation of CO2 uptake at full sunshine. Under optimal field conditions, the CO2 uptake rate can be higher than that reported for other species. The accompanying high after use efficiency may help explain the success of this hardy grass in both the Mojave and Sonoran deserts. (Baker-FRC)
W82-01039

RESPONSE OF FABABEAN YIELD, PROTEIN PRODUCTION AND WATER USE TO IRRIGATION,

Department of Agriculture, Lethbridge (Alberta). Research Station.
K. K. Krogman, R. C. McKenzie, and E. H. Hobbs.
Canadian Journal of Plant Science, Vol 60, No 1, p 91-96, January, 1980. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Moisture availability, *Crop yield, Moisture stress, Drought, Irrigation, Farming, *Fababeans, Seeds, Straw, Soil moisture, *Soil water-plant relationships, *Alberta, Canada.

The yield and quality responses of fababeans to variable soil moisture levels were investigated and the water requirements of this crop in southern Alberta were determined. Soil moisture was varied by time of stopping irrigation or by level of maintained moisture. Increased supplies of soil moisture increased the yields of seed, straw and crude protein. Evapotranspiration for the growing season averaged 544 mm, which is 16% greater than that of irrigated cereals. Efficiency of water use was about constant over the range of treatments, and yields were linearly correlated with evapotranspiration. Soil moisture must be maintained at least above 50% of the available range to achieve the full yield potential of fababeans. The potential yield of crude protein equals or exceeds that of other irrigated crops in southern Alberta. While limitations such as annual variations in length of growing season may prevent the attainment in all years of maximum yields as demonstrated in the tests conducted in this experiment, fababeans will produce high yields of seed and straw, representative of high production of vegetable protein, if soil moisture stress is not allowed to develop. (Baker-FRC)
W82-01089

2J. Erosion and Sedimentation

SEDIMENT SURVEYS IN THE DEPARTMENT OF WATER AFFAIRS,

Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 7B.
W82-00680

DEBRIS FLOW DEPOSITS OF EARLY MIOCENE AGE, DEADMAN STREAM, MARLBOROUGH, NEW ZEALAND,

Canterbury Univ., Christchurch (New Zealand). Dept. of Geology.
D. W. Lewis, M. G. Laird, and R. D. Powell.
Sedimentary Geology, Vol 27, No 2, p 83-118, August, 1980. 16 Fig, 53 Ref.

Descriptors: *River basin development, *Geologic history, *Sediments, Flow, *Debris basins, Sandstones, Conglomerate rocks, Deadman stream, *New Zealand.

An analysis is presented on conformable succession of Early Miocene conglomerates and sandstones lying between massive marine mudstones in Deadman Stream, Marlborough, New Zealand. The coarse sediments were deposited by various subaqueous debris-flow mechanisms during an early pulse of tectonism that ultimately resulted in Plio-Pleistocene eversion of the Kaikoura Mountains. High-viscosity flows and slurry-creep flow meahanisms are reflected in sparse pebbly mudstones and rare sandy conglomerates. Low-viscosity flows are reflected by other deposits that have little mud matrix. The largest clasts in the deposits have a preferred planar orientation and a preferred long-axis orientation parallel to flow direction. Microfossil data from the mudstones indicate sedimentation in an environment of outer neritic to upper bathyl aspect. Most detritus is abraded, and deposits generally fill broad shallow channels. Channeling appeared to remain relatively fixed throughout the accumulation of hundreds of meters of superimposed, commonly amalgamated debris-flow deposits. The focus of deposition probably lay shoreward of any submarine canyon or fan. (Small-FRC)
W82-00694

HOLOCENE SEQUENCES ON AN EMBAYED HIGH-ENERGY COAST: AN EVOLUTIONARY MODEL,

Geological Survey of New South Wales, Sydney (Australia). Dept. of Mineral Resources and Development.
P. S. Roy, B. G. Thom, and L. D. Wright.
Sedimentary Geology, Vol 26, No 1/3, p 1-19, April, 1980. 7 Fig, 1 Tab, 35 Ref.

Descriptors: *Estuaries, *Sedimentation, *Erosion, Sands, Sediment transport, Tidal effects, Coasts, Model studies, Marine geology, *Australia.

An evolutionary model is proposed to account for the three types of Holocene embayment fill which can be applied to coastal erosion studies. Southeastern Australia has an embayed high-energy coast which shows varying degrees of infilling. The three types of embayment fill are open ocean, barrier estuary, and drowned river valley. In mid-Holocene times, the rapid accumulation of marine sand resulted in the formation of coastal sand barriers and of estuaries that progressively infilled with fluvial deposits. There is evidence that erosion dominated over accretion during the Late Holoene; sandy bays were deepened and many barriers retreated. Using the model, with extreme or prolonged wave erosion, barriers may be destroyed and estuarine deposits relocated to produce mixed fluvial/marine sediments. Also, when an estuary completely infills and river sand is supplied to the coast, similar polygenetic sediments are produced. Coastal erosion may be countered or reversed in cases such as these. Thus, the same mechanisms seem to add or remove sand, although the exact mechanism and its perhaps cyclic nature are not well understood. (Small-FRC)
W82-00695

MOVEMENT OF LOOSE, SANDY DETRITUS BY SHALLOW WATER FLOWS: AN EXPERIMENTAL STUDY,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils.
A. J. Moss, P. H. Walker, and J. Hutka.
Sedimentary Geology, Vol 25, No 1/2, p 43-66, January, 1980. 10 Fig, 30 Ref.

Descriptors: *Sediment transport, *Overland flow, *Sand, Sediments, Flow channels, River flow, Saltation, Suspended sediments, Suspended load, Bed load, Erosion rate, Erosion, *Detritus.

The interactions between flowing water and natural, loose, sandy detritus which contained small amounts of clay, silt, and pebbles were studied in flumes using small discharges over a large range of slopes. All flows strong enough to move the full size range of bed material were supercritical and channel systems always replaced the initial sheet flows after general sediment movement began. Behaviorally distinct suspended, saltation, and contact loads were found in flows as little as 1 millimeter deep. While suspended load was entrained wherever suitable particles were exposed, saltation load was always entrained to full transportational capacity in the upstream few centimeters of the bed, with later entrainment downstream balanced by deposition. Channel formation and geometry and the transportation of suspended and contact loads were largely controlled by the interaction between saltatory particles and the flow. Saltation changed from the movement of particles in individual trajectories to migration as ballistic dispersions with increased flow vigor. While saltatory grains moved in individual trajectories, transport rate increased rapidly with slope. However, the rheologic layer formed when the bed-load concentration reached about 25 percent by volume, after which transport rate increased less strongly with slope, closely following a stream-power law. Small rills were found to transport little sand when the slope was less than 0.01. However, transporting power increased significantly through the slope range 0.01 to 0.04 and became enormous by a slope of 0.3. Small overland discharges acquired considerable power to transport pebbles when flow was concentrated into channels. Processes in small channels were found to closely parallel those in rivers for the most part, but repetitive sedimentary structures contrasted sharply with those of deeper, subcritical flows. (Carroll-FRC)
W82-00776

THE NATURE OF SELECTED PRAIRIE LAKE AND STREAM SEDIMENTS,

Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
D. W. Oscarson, J. S. Rogers, P. M. Huang, and W. K. Liaw.
International Revue der Gesamten Hydrobiologie, Vol 66, No 1, p 95-107, 1981. 3 Fig, 5 Tab, 45 Ref.

Descriptors: *Sediments, *Chemical analysis, Clays, Lakes, Streams, Hydrobiology, Nutrients, Pollutants, Organic matter, Minerals, *Saskatchewan, Canada.

The nature of sediments of selected lakes and streams of the upper Qu'Appelle River basin was examined. Sediment samples were taken from five lakes: Buffalo, Pound, Pasqua, Echo, Mission, and Katepwa, and the Qu'Appelle River, plus two of its tributaries. Principal crystalline clay minerals present in the colloidal fractions of the sediments were smectite, vermiculite, kaolinite, mica, quartz, and feldspar. The cation-exchange capacity of the sediments varied from 16.3 to 28.8 meq/100 g, and the pH ranged from slightly acid to slightly alkaline. The hydrous oxides of Al, Fe, Mn, and Si were present in significant quantities in both the colloidal and noncolloidal fractions of the sediments. These oxides may exert the dominant chemical control on nutrient movement and pollutant movement in aquatic environments. Calcium and magnesium carbonates comprise a significant fraction of the sediments. Most of the carbon in the sediments is in the organic form. The organic carbon content varied from 1.2 to 6.0%. Since crystalline clay minerals, poorly ordered sesquioxides, and organic matter play a vital role in the retention and cycling of nutrients and pollutants, knowledge of the nature and properties of sediments is essential in efforts to preserve and improve the quality of natural water systems. (Baker-FRC)
W82-00815

ON LAKE BOTTOM DYNAMICS--THE ENERGY-TOPOGRAPHY FACTOR,

National Swedish Environment Protection Board, Uppsala. Water Quality Lab.
For primary bibliographic entry see Field 2H.
W82-00837

GRAPHED EQUILIBRIUM PARAMETERS OF CHANNELS FORMED IN SEDIMENT,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
A. W. Peterson, and T. Blench.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 93-104, 1980. 7 Fig, 1 Tab, 55 Ref.

Descriptors: *Rivers, *Channels, Bed load, Flumes, Irrigation canals, Canals, Computers, Gravel, Sand, Sedimentation, *Erosion, Reviews, Graphical methods, *Channeling, Channel forming, Sediment transport, Alluvial rivers.

The origin and potential of the four-dimensional charts produced from numerical data obtained from the equilibrium dimensions of sand rivers, gravel rivers, and laboratory flumes is presented. Problems in this field have included gross disagreements among sediment load predictions from various formulas, improper transfer of flow information to rivers and canals, and differences between sand and gravel rivers. These are caused by flumes working in a transition between phases, lack of communication between workers in the field, and inapplicability of pure deductive methods to fluid-solid mixtures. Examples of the subjects discussed are Indian sand-bed canal observations, information on gravel rivers, Cooper's (1970) world flume data analysis, and the Peterson Q-factor (volumetric water discharge) and S (slope). References chosen from the multitude written on this subject feature usable photos, graphs, and tables; freedom from specialized mathematics and speculation; and references to further useful information sources. (Cassar-FRC)
W82-00881

SUBSURFACE DRAINAGE AND SEDIMENT TRANSPORT MODEL,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W82-00894

EFFECT OF SLOPE LENGTH ON EROSION FROM LOW SLOPES,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and J. D. Greer.
Transactions of the ASAE, Vol 23, No 4, p 866-869, 876, July/August, 1980. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Erosion rates, *Soil erosion, *Slope degradation, Mathematical studies, Slopes, Erosion, Runoff, Mathematical equations.

There is general acceptance of the premise that erosion increases with increasing slope length and that soil loss is proportional to slope length to some power, m. Investigations conducted over several years have resulted in the use of 0.5 as the slope length exponent for sloping farmland, with lower values being recommended for slopes of less than 4 percent. Since most of the intensively farmed flood plain soils in the United States are located on land comprised of nearly flat slopes; field studies were undertaken to determine the slope length exponents for these slopes. Simulated rainfall was applied to eight erosion plots ranging from 23 to 813 meters long on a slope of 0.2 percent. The study results support the slope length exponents recommended in Agriculture Handbook 537, although those exponents may be conservative for slopes of 1 percent. It is recommended that consideration be given to lowering the exponent to 0.15 for slopes less than 0.5 percent and to 0.2 for slopes between 0.5 and 1.0 percent. Ponding of water on part of the slope will cause the soil loss from the nearly flat slopes to be less than that predicted by the Universal Soil Loss Equation. (Carroll-FRC)
W82-00896

AERIAL PHOTOGRAPHY AS AN AID TO CROPLAND EROSION ANALYSIS,

Texas Christian Univ., Fort Worth. Dept. of Geology.
K. M. Morgan, D. R. Morris, G. B. Lee, R. W. Kiefer, and G. D. Bubenzer.
Transactions of the ASAE, Vol 23, No 4, p 907-909, 913, July/August, 1980. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Cropland, *Soil erosion, *Aerial photography, Photography, Remote sensing, Erosion rates, *Erosion control, Land management, Land use, Soil conservation, Data collections.

The development and implementation of effective soil conservation programs requires areawide erosion analysis. The Universal Soil Loss Equation is generally used to compute long-term soil losses from agricultural fields due to rill and interrill erosion for use in conservation planning. However, use of this equation is dependent on the collections of various data through field surveys. Remote sensing can provide total coverage of land use activities in watersheds and can supply accurate erosion information to agencies developing management plans for soil conservation. Color and color infrared photography at the scale of 1:60,000 were used to extract information about cropland management and conservation practices in Dane County, Wisconsin. Cropland management information determined by aerial photography included crop type, plowing, surface residue, and rotation. Information on erosion control practices covered contouring, strip cropping, and waterways. A detailed field survey of this agricultural watershed was also conducted by the Dane County Regional Plan Commission. The soil loss predictions developed on the basis of the results of the interpretations of the remote sensing air photographs were found to be in close agreement with the predictions made on the basis of the field survey results and computations made using the Universal Soil Loss Equation. (Carroll-FRC)
W82-00902

SEDIMENT SIZES ERODED FROM CROP ROW SIDESLOPES,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. D. Meyer, W. C. Harmon, and L. L. McDowell.
Transactions of the ASAE, Vol 23, No 4, p 891-898, July/August, 1980. 5 Fig, 4 Tab, 16 Ref.

Descriptors: *Soil erosion, *Particle size, *Sediments, Soil properties, Physical properties, Erosion, *Cropland, Storm runoff, *Furrows.

The soil eroded from row sideslopes of land in rowcrop production and other interrill areas constitutes a significant proportion of the sediment from cultivated cropland during erosive rainstorms. The size distribution of these sediments is a major determinant of their transportability by runoff and their potential for subsequent deposition. Crop row sideslopes of ten soils, mostly silt loams, were tested under simulated rainstorms to determine the size distribution of the undispersed eroded sediment. These size distributions were compared with those of dispersed eroded sediment and of the original soil surface. The sizes of sediment eroded from crop row sideslopes varied considerably from soil to soil, both in magnitude and in distribution pattern. Aggregates comprised much of the sediment from cohesive soils. Sediments from fine soils were often coarser than those from soils with larger primary particle sizes due to the greater aggregation of the fine soils. Sediment sizes were not significantly affected by major changes in rainfall intensity, continued erosion, or the presence or absence of crop canopy. The undispersed eroded sediment was coarser than either the surface soil or the dispersed sediment for all soils, and much coarser for many soils. The size distribution of interrill sediment appears to be a fairly distinct characteristic of a given soil in a given condition. (Carroll-FRC)
W82-00903

INTERPRETATION OF SURFACE-WATER CIRCULATION, ARANSAS PASS, TEXAS, USING LANDSAT IMAGERY,

Texas Univ. at Austin.
For primary bibliographic entry see Field 7B.
W82-00904

SEDIMENT YIELD FROM A FLATLAND WATERSHED,

Science and Education Adinistration, Oxford, MS. Sedimentation Lab.
C. E. Murphree, and C. K. Mutchler.
Transactions of the ASAE, Vol 24, No 4, p 966-969, July/August, 1981. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Sedimentation, *Deltas, *Mississippi River, Rivers, Sediments, Sediment load, Sediment erosion, Erosion, Watersheds, Watershed management, Watershed protection, *Mississippi Delta.

Erosion and sediment yields from two adjacent watersheds in the Mississippi Delta over a 5 year period are reported. The watersheds are located on the G. L. McWilliams Farm near Clarksdale, Mississippi. One watershed had a silt loam soil and the other a silty clay soil. Practically all precipitation was in the form of rainfall. Both watersheds had been used for continuous cotton production for many years, including the 5 yr study period. The five annual amounts of rainfall were well distributed around their 5 yr average, which was within 2% of the long-term average amount. The 5-yr average monthly values differed greatly. Simple linear relationships were developed by grouping the sediment yield, runoff, and rainfall data by seasons. An equation for runoff was derived as a function of precipitation for data collected from November to June and another equation for data collected from July to October. Storm runoff was related to precipitation, and sediment yield was related to storm runoff during two seasons of the year. These equations were then combined to relate sediment yield to monthly rainfall for four separate crop and climatic periods. The equations derived should be suitable for predicting sediment yields and runoff from much of the 140,000 ha of graded flatland in the delta region. Care should be taken in using them outside of this climatic area. Erodibility of soils must be considered when predicting sediment yield. As these results represent sediment yield from watersheds with an essentially unrestricted outlet, they thus represent maximum values to be expected. (Baker-FRC)
W82-00941

MECHANICS OF MUDFLOW MOBILIZATION IN LOW-ANGLED CLAY SLOPES,

Michigan State Univ., East Lansing. Dept. of Civil and Sanitary Engineering.
L. E. Vallejo.

Engineering Geology, Vol 16, No 1/2, p 63-70, July, 1980. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Mudflows, *Clays, *Soil mechanics, Estimating equations, Erosion, Rocks, Slopes.

An analytical explanation of mudflow mobilization on flat surfaces is presented. Mudflows consisting of a mixture of hard clay fragments or rocks with mud can be considered a mass of concentrated grains that are dispersed in a flowing medium. The movement of the grain flow and the unit weight of the fluid medium can be quantified. The least slope angles of mudflow were calculated using the Bagnold theoretical method for field cases, and the calculated results compared well with field measurements. The Bagnold method is an alternative to the undrained loading and the excess pore water or artesian pressure effects which have been used to explain mudflow mobilization on some low angled slopes. The Bagnold method is successful because it is based on the assumption that a mixture of solids and fluid will flow instead of slide. It is an excellent tool to interpret mobilization of mudflows made up of hard clay fragments or pieces of rock in a soft clayey matrix such as mud. (Small-FRC)
W82-00989

CHEMICAL MASS-WASTING OF THE NORTHERN YUCATAN PENINSULA BY GROUNDWATER DISSOLUTION,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2K.
W82-01015

2K. Chemical Processes

MODELING OF PROCESSES OF DECOMPOSITION OF ORGANIC MATTER IN BOTTOM SEDIMENTS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W82-00553

CORRELATION OF MICROBIAL DEGRADATION RATES WITH CHEMICAL STRUCTURE,

Environmental Research Lab., Athens, GA.
N. L. Wolfe, D. F. Paris, W. C. Steen, and G. L. Baughman.
Environmental Science and Technology, Vol 14, No 9, p 1143-1144, 1980. 2 Fig, 22 Ref.

Descriptors: *Natural waters, *Microbial degradation, Biodegradation, *Organic compounds, Phenols, Kinetics, Hydrolysis, Sediments, Chemical reactions.

Relationships are established between structure and reactivity for the microbial degradation of selected organic compounds. Second-order microbial degradation rate constants were determined in natural water samples for six compounds and were found to correlate with the second-order alkaline hydrolysis rate constants. Also, second-order microbial degradation rate constants for four phthalate esters were obtained with organisms from sediment-water samples. These were shown to correlate with the second-order alkaline hydrolysis rate constants. Similar correlations are demonstrated for the rates of oxidation of substituted phenols by mixed microbial cultures isolated from soils and Hammett constants. It is important to note that the correlations demonstrated here offer some insight into a method of predicting microbial degradation rate constants in natural waters and perhaps soils as well. (Baker-FRC)
W82-00621

INFLUENCE OF GASEOUS NITRIC ACID ON SULFATE PRODUCTION AND ACIDITY IN RAIN,

Environmental Sciences Research Lab., Research Triangle Park, NC.
For primary bibliographic entry see Field 5B.
W82-00642

ACID PRECIPITATION: THE IMPORTANCE OF NITRIC ACID,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, and G. E. Likens.
Atmospheric Environment, Vol 15, No 6, p 1081-1085, 1981. 7 Fig, 26 Ref.

Descriptors: *Acid rain, *Nitric acid, *Sulfuric acid, Fossil fuels, Air pollution effects, Environmental effects, Precipitation.

Using the information on temporal trends of sulfate and nitrate ions accumulated from the long-term precipitation data collected at Hubbard Brook Experimental Forest, New Hampshire, temporal trends were determined in the maximum contributions of sulfuric acid and nitric acid to the acidity of the precipitation. Nitric acid in acid rain was introduced primarily by increased emissions of NOX from fossil fuel combustion. Its contribution to the acidity of precipitation is becoming increasingly significant. The maximum contribution of H2SO4 to the acidity of precipitation is 73% in summer and 59% in winter. For HNO3, it is 31% in summer and 61% in winter. This analysis indicated that the importance of H2SO4 has decreased by about 30% relative to HNO3 and HNO3 has increased by about 50% relative to H2SO4 for the years studied. These conclusions should be applicable to most of the eastern United States. (Small-FRC)
W82-00643

ACIDITY FLUCTUATIONS AT A BROADLAND SITE IN NORFOLK,

Ministry of Agriculture, Fisheries, and Food, Norwich (England). Coypu Research Lab.
L. M. Gosling, and S. J. Baker.
Journal of Applied Ecology, Vol 17, No 2, p 479-490, August, 1980. 5 Fig, 3 Tab, 20 Ref.

Descriptors: *Acidity, *Environmental effects, *Acidic soils, Water pollution, Chemical properties, Aquatic plants, Aquatic animals, Agriculture, Pyrite, Wetlands, Acidic water, Water, Sulfates, Oxidation, Sulfides, *Sulfuric acid, Tropical regions, *Soil chemistry.

Acid sulfate soils, which are soils containing a relatively high level of sulfides which on oxidation form sulfuric acid, pose serious problems for agriculture in tropical regions. The main difficulty experienced from such soils in Great Britain has been the clogging of field drains with ochre deposits. However, Calthrope Broad, a wetland site in Norfolk, experienced an abrupt change in acidity from near-neutrality to just above pH 3.0 in 1970. As a result, the entire fish population of the area died, as did freshwater mussels and most aquatic macrophytes. The first rise in acidity brought a dramatic invasion by the acidophilous alga Tribonema minus. The pH of free water returned to neutrality after a period of acute acidity, but similar fluctuations occurred in most years between 1971 and 1979. Dams maintain the perched water table in the area around the broad during the winter, but evaporation and seepage cause extreme drops in water levels during the summer. As a result, the agricultural soil, which was rich in pyrites, was subjected to alternate drying and saturation, causing oxidation of the pyrite and formation of sulfuric acid. Treatment by the addition of lime in 1978 maintained neutral water in the broad, even though the acidity of the water in adjacent ditches continued to fluctuate. While all plant groups present before 1970 reappeared, only one fish species has returned to the area. (Carroll-FRC)
W82-00656

TRACE CONSTITUENTS IN CLOUD WATER, RAINWATER AND AEROSOL SAMPLES COLLECTED NEAR THE WEST COAST OF INDIA DURING THE SOUTHWEST MONSOON,

Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section.
For primary bibliographic entry see Field 2B.
W82-00676

CHEMISTRY OF LAKE WATER AND GROUNDWATER IN AREAS OF CONTRASTING GLACIAL DRIFTS IN EASTERN MINNESOTA,

Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
R. B. Brugam.
Hydrobiologia, Vol 80, No 1, p 47-62, April, 1981. 4 Fig, 7 Tab, 18 Ref.

Descriptors: *Lakes, *Chemical composition, Water analysis, Salts, Deicers, Calcium, Magnesium, Sulfates, Carbonates, Silicon dioxide, Groundwater, Ions, Roads, Water pollution sources, *Groundwater, Glacial drift, Glacial aquifers, Glacial lakes, *Minnesota.

During the winter of 1977-78 water samples were collected from 28 lakes in east-central Minnesota, 15 from Superior-lobe drift and 13 from Grantsburg-lobe drift. Groundwater samples were collected from wells near each lake. The major sources of ionic input into the study lakes are assumed to be groundwater and direct runoff from the watershed. Mann-Whitney U tests were used to determine if any statistical significance could be attached to differences between major-ion concentrations of lakes on tills of the Superior versus Grantsburg lobe. Concentrations of Ca(2+), Mg(2+), HCO3(-), SO4(-) were significantly higher in samples of groundwater from the Grantsburg lobe. No correlation was noted between groundwater concentrations of particular ions and lake-water concentrations of the same ions, implying that the sources of dissolved ions in lake water are shallow groundwater and soil leachates rather than the deeper groundwater sampled here. Na(+) and Cl(-) concentrations in some lakes appear to be strongly influenced by the use of de-icing salt on highways in winter rather than by differences in drift lithology. (Baker-FRC)
W82-00821

EFFECTS OF ION-PAIRING ON CALCULATIONS OF IONIC ACTIVITIES OF MAJOR IONS IN FRESHWATER,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
C. E. Boyd.
Hydrobiologia, Vol 80, No 1, p 91-93, April, 1981. 2 Tab, 7 Ref.

Descriptors: *Natural waters, *Ionic interference, *Ions, Mineralization, Chemical reactions, Chemical composition, Chemical potential, Metals, Inorganic chemicals, Ion-pairing.

The objective of this study was to determine whether ion pairing had an appreciable effect on the calculation of ionic concentration, ionic strength, and ionic activities of major ions in natural waters. Measured ionic concentrations for 10 waters which represented a wide range in water chemistry were obtained from Livingstone. Ionic activities were first calculated by using the Debye-Huckel equation to calculate activity coefficients for all ions and multiplying the activity coefficients by the measured molar concentrations of the ions to give activities. Next, the iterative procedure of Adams was used to calculate ionic activities that were corrected for ion-pairing. Ion-pairing had no significant effect on ionic activities of Cl(-), Na(+), or K(+). The effect of ion-pairing on ionic activities of bicarbonate was slight. The influence of ion-pairing on ionic strength and ionic activities of Ca(2+), Mg(2+), and SO4(2-) increased with increasing ionic strength. The effect of ion pairing on the calculation of ionic strength was also substantial in the highly mineralized samples. These findings suggest that it is important in rigorous work to correct for ion-pairing in calculating ionic activities for all water samples except those that are not appreciably mineralized. A large percentage of the total iron, manganese, zinc, and copper in water exists as ion-pairs rather than as free ions. (Baker-FRC)
W82-00823

RELATIONSHIPS BETWEEN WATER CHEMISTRY AND RESPIRATION RATE IN SEVERAL POPULATIONS OF LYMNAEA PEREGRA MULLER (GASTROPODA:MOLLUSCA),

G. Dussart, and R. Kay.

Hydrobiologia, Vol 69, No 1/2, p 57-65, March, 1980. 4 Tab, 34 Ref.

Descriptors: *Chemical properties, *Mollusks, *Respiration, Oxygen, Hardness, Calcium, Potassium, Cations, Anions, Correlation analysis, Water quality.

In this investigation of the effects of water chemistry on L. peregra, the most important components producing such effects were determined. Specimens were obtained in North West England; respiration rates were studied in the laboratory, and the effects of water chemistry on weight-specific oxygen consumption were noted. Some relationship was found between water chemistry and wet-dry weight ratios, between oxygen consumption and live-wet weight, and between oxygen cosumption and shell-free dry weight. There were interpopulation differences in respiration rates between snails from different sites within the same water hardness classification. Calcium and potassium concentrations appeared to significantly affect respiration rates when tested in waters of varying cations but constant anion concentrations. Cations included calcium, sodium, magnesium, and potassium. The anion used was bicarbonate. No significant differences were found in respiration rates of populations of snails taken from the same site but in different years. (Small-FRC)
W82-00854

BIOGEOCHEMISTRY OF THOREAU'S BOG, CONCORD, MASSACHUSETTS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemond.
Ecological Monographs, Vol 50, No 4, p 507-526, December, 1980. 14 Fig, 6 Tab, 42 Ref.

Descriptors: *Bogs, *Hydrogen ion concentration, *Acidity, Swamps, Chemical properties, Acid rain, Peat soils, Ions, Geologic history, *Biochemistry, *Thoreu's Bog, Massachusetts.

The pH control mechanism of the bog system of Thoreau's Bog or Gowings Swamp is presented in terms of the interaction of mineral acidity and weak acids. This bog is a floating-mat Sphagnum bog developed in a glacial kettle hole. The bog is ombrotrophic, with an annual water input of 1.45 m and an annual runoff of 0.24 m. Metal inputs are: 88 mg/sq m/yr for K, 132 mg/sq m/yr for Mg, and 54 mg/sq m/yr for Pb. The distribution of K and Mg is vertical in accordance with the inhomogeneous ion exchange chemistry of peat, while lead is distributed in accordance with historical trends in atmospheric lead fallout. Net peat accumulation rate was 180 g/sq m/yr, and annual storage rates were 36 mg/sq m/yr for K, 54 mg/sq m/yr for Mg, and 46 mg/sq m/yr for Pb. Organic acids at concentrations of 10 to the minus 3rd power eg/liter maintain bog acidity at pH 3.8. The contribution of acid rain is offset by alkalinity increases of the same magnitude resulting from sulfate reduction and nitrate uptake. (Small-FRC)
W82-00887

ANALYSIS OF PRECIPITATION CHEMISTRY AT A CENTRAL PENNSYLVANIA SITE,

Pennsylvania State Univ., University Park. Dept. of Meteorology.
V. C. Bowersox, and R. G. De Pena.
Journal of Geophysical Research, Vol 85, No C10, p 5614-5620, October, 1980. 10 Fig, 2 Tab, 11 Ref.

Descriptors: *Chemistry of precipitation, *Sulfates, *Acid rain, Acidity, Nitrates, Ammonia, Hydronium ion, Snow, Storms, Seasonal variation, Pennsylvania, Rain, Precipitation.

Data collected at the multistate atmospheric power production pollution study (MAPPPS) precipitation chemistry network were analyzed in detail. Precipitation was sampled on a storm-by-storm basis at a rural central Pennsylvania site during the period January 1, 1977, to December 31, 1978. Samples were analyzed for sulfate, nitrate, ammonium, and hydronium ion concentrations. Sulfate concentration varied seasonally, with high values in summer and low values in winter. Sulfate is of interest as the major determinant of precipitation acidity, particularly in rain. The principal contributor to H3O was sulfuric acid, but the acidity of snow was determined principally by NO3. The NH4 in precipitation can be explained by assuming equilibrium between cloud water and gaseous ammonia in air. There was a good stoichiometric balance of the four major inorganic ions. Knowledge of the nature of acid-determining components in rain can be used to help establish strategies to control the quality of precipitation. (Small-FRC)
W82-00980

MASS-TRANSPORT LIMITATION TO THE RATE OF REACTION OF GASES IN LIQUID DROPLETS: APPLICATION TO OXIDATION OF SO2 IN AQUEOUS SOLUTIONS,

Brookhaven National Lab., Upton, NY.
S. E. Schwartz, and J. E. Freiberg.
Atmospheric Environment, Vol 15, No 7, p 1129-1144, 1981. 14 Fig, 2 Tab, 29 Ref.

Descriptors: *Oxidation, *Sulfur compounds, Sulfur dioxide, Water pollution sources, Clouds, Fog, Chemical reactions, Mass transfer.

The role of mass transport in the oxidation of sulfur dioxide to sulfate in aqueous droplets is considered. As in any gas-liquid reaction, competition between mass transport and reaction is involved. Characteristic times associated with the several steps in the overall process have been identified, and expressions presented whereby these characteristic times may be evaluated for reactions in spherical drops. By comparing these characteristic times it may be determined whether a measured rate of reaction is equal to the intrinsic reaction rate or is limited by mass transport in the gas phase, at the air-water interface, or in the aqueous phase. Criteria are suggested that must be fulfilled for spatial and temporal uniformity to be achieved under experimental conditions or in the ambient atmosphere. Three steady-state criteria must be satisfied in order for a steady state to be achieved. After a steady state is reached, the concentration profiles may or may not be established at the surface, depending on the relative magnitudes of the several characteristic times. A theoretical model is presented wherein the extent of decrease in reaction rate may be calculated for each of the three mass-transport limiting processes, for a reaction that is first order in the concentration of the dissolved reagent species, and for mass transport in each of the two phases occurring by molecular diffusion. This theoretical framework has been applied to an examination of laboratory studies of sulfur dioxide oxidation in suspended droplets and to consideration of mass transport limitation to the rate of oxidation of sulfur dioxide in clouds and fogs. (Baker-FRC)
W82-00994

CHEMICAL MASS-WASTING OF THE NORTHERN YUCATAN PENINSULA BY GROUNDWATER DISSOLUTION,

Geological Survey, Reston, VA.
B. B. Hanshaw, and W. Back.
Geology, Vol 8, No 5, p 222-224, May, 1980. 2 Fig, 9 Ref.

Descriptors: *Erosion rates, Saline-freshwater interfaces, *Dissolution, Calcite, *Yucatan Peninsula, *Chemical degradation, Grounwater recharge, *Carbonate rocks, Limestone, Recharge, Solubility.

The northern part of the Yucatan Peninsula is the site of chemical erosion in its Tertiary carbonate rocks, predominantly limestone. For the 65,500 sq km study area, the mean annual discharge (equivalent to recharge) is 9800 million cu meters or 8.6 million cu meters for each 1 km of the 1100 km coastline. The area is flat and lowlying, with no stream channels. Rainfall averages 1000 mm per year. Soil cover is thin, infiltration is rapid, and transmissivity of the limestone is very high. Inland, the recharging fresh water becomes saturated with calcite, dissolving about 37.5 metric tons of calcite per sq km per year as it flows toward the coast. At the coast, the saline water also becomes saturated with calcite. When these two saturated waters of different salinities mix in the dispersion (or active mixing) zone the resulting solution is capable of dissolving as much as 1.2 mmol per liter additional calcite (or an additional 8.6 million mol per km coastline per year). The discharge near Xel Ha is about nine times greater than the average for the coastline. Calculations indicate that the lagoon in this area could be chemically incised within 3000 years. The zone of dispersion, about 3 m thick and extending 1 km inland, could completely dissolve in about 8700 years. (C[illegible]ar-FRC)
W82-01015

PHOSPHORUS, NIROGEN, AND ORGANIC CARBON FLUX IN A HEADWATER STREAM,

Georgia Univ., Athens. Dept. of Zoology.
J. L. Meyer, G. E. Likens, and J. Sloane.
Archiv fur Hydrobiologie, Vol 91, No 1, p 28-44, March, 1981. 5 Tab, 46 Ref.

Descriptors: *Streams, *Nutrients, *Chemical properties, Phosphorus, Nitrogen, Carbon, *Ecosystems, Seasonal variation, Organic carbon, Nitrogen compounds, Particulate matter, Dissolved solids, Gases, *Solute transport, Chemical reactions, Environmental effects.

Physical, chemical, and biological processes which transform nutrients entering a stream ecosystem affect the rate of transport of the element as well as its availability to the biological community. The processes responsible for these conversions in a particular stream will vary in form, rate, and relative importance for different elements. The processing of phosphorus, nitrogen, and organic carbon in Bear Brook, a forest stream in New Hampshire, were examined by constructing mass balances for each element over a one-year period. Annual inputs of nitrogen exceeded exports by 3 percent, while exports of phosphorus exceeded inputs by 12 percent. An earlier study assumed that the organic carbon budget was balanced. The stream exported 69 percent of the coarse particulate organic carbon inputs, 78 percent of coarse particulate organic nitrogen inputs, and 73 percent of coarse particulate organic phosphorus inputs in the form of fine particulates (between 0.45 micrometers and 1 millimeter), dissolved solids (less than 0.45 micrometers), or gases. Organic carbon was exported primarily in the gaseous or dissolved fraction, phosphorus was exported mostly as fine particulates, and nitrogen was transformed primarily to dissolved matter. Fluvial inputs had lower carbon to nitrogen and carbon to phosphorus ratios and a higher nitrogen to phosphorus ratio than did fluvial exports. There was a lower nitrogen to phosphorus atomic ratio in fluvial exports during the growing season than during the rest of the year. The discharge relationships observed for these elements suggest that annual changes in streamflow have different effects on the export/input ratio for each element, with organic carbon budgets showing the least variation, followed by nitrogen. The phosphorus budget appears to be the most sensitive to changes in the annual discharge. (Carroll-FRC)
W82-01021

NUTRIENT BUDGET STUDIES FOR FORESTS ALONG AN ELEVATIONAL GRADIENT IN NEW MEXICO,

New Mexico Univ., Albuquerque. Dept. of Biology.
J. R. Gosz.
Ecology, Vol 61, No 3, p 515-521, 1980. 1 Fig, 2 Tab, 24 Ref.

Descriptors: *Nutrients, *Ecosystems, Forests, Cycling nutrients, *Watersheds, Soils, Hydrology, Calcium, Magnesium, Potassium, Sodium, *New Mexico, Nutrient budget.

This paper reports studies of element inputs in bulk precipitation and outputs in stream water for a number of watersheds in New Mexico. These watersheds are located in the Tesuque Watershed Study area in the Sangre de Cristo Mountains. A number of vegetational zones occur in this area due to the influence of elevation on temperature and moisture gradients. The net organic matter increment of one of the watersheds has been estimated to be negative. The patterns in the output

and net change of calcium, magnesium, potassium and sodium among watersheds are related to soil chemistry and stream discharge rates. These factors may not be related to soil chemistry and stream discharge rates. These factors may not be related to the net organic matter increment of the ecosystem. Actual atmospheric inputs of these elements to some of the ecosystems may be an order of magnitude greater than those measured in bulk precipitation. Nitrogen outputs in stream water are strongly regulated by all of the watershed ecosystems, including the one which appears to have a negative net oganic increment. Low losses of nitrogen in stream water, however, do not mean that a system will minimize other types of N losses such as denitrification. Nutrient budgets generated from bulk precipitation and stream water discharge in the Southwest cannot prove or disprove hypotheses about nutrient regulation by net organic matter increment. Additional inputs and outputs must be quantified before a valid test can be made of the hypothesis. (Baker-FRC)
W82-01036

2L. Estuaries

MEASUREMENT OF PH IN THE ESTUARINE ENVIRONMENT ON THE NBS SCALE. (LA MESURE DU PH EN MILIEU ESTUARIEN SUR L'ECHELLE NBS),

McGill Univ., Montreal (Quebec). Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W82-00521

PARTITIONING OF NO. 2 FUEL OIL IN CONTROLLED ESTUARINE ECOSYSTEMS. SEDIMENTS AND SUSPENDED PARTICULATE MATTER,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
P. J. Gearing, J. N. Gearing, R. J. Pruell, T. L. Wade, and J. G. Quinn.
Environmental Science and Technology, Vol 14, No 9, p 1129-1136, September, 1980. 6 Fig, 2 Tab, 52 Ref.

Descriptors: *Estuarine environment, *Oil pollution, *Sediments, Suspended sediments, Suspended solids, Ecosystems, Ecology, Hydrocarbons, Fate of pollutants.

The interaction of oil hydrocarbons with estuarine suspended particulate matter and sediments is considered. No. 2 fuel oil was added as a dispersion in semiweekly doses to three controlled estuarine ecosystems. Samples of suspended particulate matter and sediments were analyzed by gas chromatography for saturated and aromatic hydrocarbons. Fractionation of the oil in the water column by adsorption to particulate matter resulted in the sedimentation of about 50% of the insoluble, saturated hydrocarbons, but less than 20% of the more soluble, aromatic hydrocarbons. The oil-derived hydrocarbons were slowly mixed down through the bioturbation zone. Biodegradation and other processes effected the removal of most of the hydrocarbons soon after the additions ended, but a residue of 10-20% in the form of branched alkanes, cycloalkanes, and aromatics in an unresolved complex mixture persisted more than 1 year later. (Baker-FRC)
W82-00541

CIRCULATION AND ENERGETICS OF A DEEP, STRONGLY STRATIFIED INLET,

Institute of Ocean Sciences, Sidney (British Columbia).
H. J. Freeland, and D. M. Farmer.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1398-1410, September, 1980. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Model studies, *Fjords, *Flow characteristics, *Flow friction, *Tidal effects, Mathematical models, Inlets, Flow characteristics, Stratification, Mixing, Tidal hydraulics, Froude number, *Saline-freshwater interfaces, *Knight Inlet, British Columbia.

A theoretic model describing steady flow in a strongly stratified fjord inlet was compared to the observed flow behavior of Knight Inlet, British Columbia. Some aspects of the model gave closer agreement with reality than others. The model was useful in assessing the limit of small interfacial friction coefficients. Interfacial friction was previously thought to dominate the flow. Inlets of this type possess circulations which usually adjust to maintain the interfacial Froude number at unity near the mouth. However, evidence is presented to show that Knight Inlet does not conform to this pattern. The mean circulation in this inlet was found to be driven by tidal interactions with little contribution from the wind. (Geiger-FRC)
W82-00547

RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS, BACTERIAL INDICATORS, AND THE OCCURRENCE OF ENTERIC VIRUSES IN ESTUARINE SEDIMENTS,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5A.
W82-00574

FACTOR ANALYSIS KF THE IMPACT OF THE ENVIRONMENT ON MICROBIAL COMMUNITIES IN THE TVARMINNE AREA, SOUTHERN COAST OF FINLAND,

Zoological Station, Tvarminne (Finland).
For primary bibliographic entry see Field 5C.
W82-00672

EFFECTS OF ENVIRONMENTAL FACTORS ON MICROBIAL POPULATIONS IN BRACKISH WATERS OFF THE SOUTHERN COAST OF FINLAND,

Zoological Station, Tvarminne (Finland).
P. Vaatanen.
Applied and Environmental Microbiology, Vol 40, No 1, p 48-54, July, 1980. 4 Tab, 29 Ref.

Descriptors: *Microbial studies, *Environmental effects, Populations, Temperature effects, Wind, Seasonal variations, *Finland, Coasts, *Estuarine environments, Brackish water, Seawater, Microorganisms, Humic acids, Chlorophyll, Organic matter, Rainfall, Wastewater outfalls, Effluents, Wastewater.

The effects of environmental factors on seasonal changes in microbial populations were studied in the Tvarminne area, off the southern coast of Finland. Samples were collected at surface levels over 1 to 2 week intervals in 1976-78. Fourteen microbiological and 10 environmental parameters were determined. Stepwise multiple regression analysis was used to explain seasonal variation in the microbiological parameters. Separate analyses were made of the data from the open-water and ice-covered periods. In analyses of data from both periods, the environmental factors included accounted for a significant proportion of the variation in the parameters for community respiration (90%) and bacterial spores (80%), and a smaller proportion (60-65%) of the variation in total counts of bacteria and plate counts of psychrophiles and yeasts. Lower values (40-55%) were obtained for the variation in the other microbiological parameters. The environmental factors with maximal contributions were organic matter, water temperature, chlorophyll, and salinity, but rainfall and winds also explained part of the variation in some microbiological parameters. In winter studies the results differed from all other seasons, the variation being controlled by parameters indicative of freshwater outflows, including humic matter, salinity, water temperature, and rainfall. (Baker-FRC)
W82-00683

SPATIAL DISTRIBUTIONS OF POLLEN IN SURFACE SEDIMENTS OF THE POTOMAC ESTUARY,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. S. Brush, and R. S. DeFries.
Limnology and Oceanography, Vol 26, No 2, p 295-309, March, 1981. 5 Fig, 6 Tab, 23 Ref.

Descriptors: *Pollen, Sediment transport, Land use, *Estuaries, *Sediments, Tracers, *Potomac River, Trees, Deposition, Tidal effects, *Spatial distribution.

Tree pollen in surface sediments of the Potomac Estuary was proportionally representative of trees growing in the area for many of the species (oak, pine, birch, hickory, elm, ash, and hazelnut-ironwood). No pollen from the tulip poplar, a major tree, was found in sediments, probably because its flowers do not release pollen to the air. Sweet gum, red maple, beech, holly, and black gum were underrepresented by the pollen, and a few minor species were overrepresented. Pollens from trees restricted to the upper watershed 60 km upstream of the tidal limit were not present in downstream estuarine deposits. Comparisons of the variability in the pollen data and in the corresponding tree data from the adjacent watershed led to conclusions that pollen grains are differentially dispersed before being deposited and are not transported great distances. These studies imply a possible use of pollen as tracer particles to determine the effects of land use on one part of a watershed on various parts of the estuary. (Cassar-FRC)
W82-00757

QUANTITATIVE ASSESSMENT OF TIDAL WETLANDS USING REMOTE SENSING,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 7B.
W82-00781

GENERAL MORPHOLOGY AND SEDIMENT PATTERNS IN TIDAL INLETS,

South Carolina Univ., Columbia. Dept. of Geology.
M. O. Hayes.
Sedimentary Geology, Vol 26, No 1/3, p 139-156, April, 1980. 16 Fig, 1 Tab, 29 Ref.

Descriptors: *Inlets, *Sedimentology, *Tidal effects, Estuaries, Sediment transport, Morphology, Deltas, Channel morphology, Tides, Sandbars.

Inlet-affiliated sedimentary barrier island units usually include an ebb-tide delta, a flood-tide delta, and inlet-fill sequences created by inlet migration and recurved spit growth. Ebb-tide deltas include a main ebb channel flanked by linear bars on either side and a terminal lobe at the seaward end. The channel is bordered by a platform of sand with swash bars. Here the sand is coarse and contains polymodal cross-bedding with a slight ebb dominance. Flood-tidal deltas include a flood ramp and bifurcating flood channels on the seaward side and ebb shields, ebb splits, and spillover lobes on the landward side. A stratigraphic sequence of a typical flood tidal delta would be bidirectional, large-scale crossbedded sand at the base, predominantly large-scale crossbedded sand in the middle, and finer-grained tidal flat and marsh sediment at the top. Inlets migrate depending upon such variables as rate of longshore sediment transport and depth of inlet. Inlet-fill contains coarse, bidirectional crossbedded sediments at the base, polydirectional crossbedded sands in the middle, and finer-grained aeolian sands at the top. (Small-FRC)
W82-00792

EFFECT OF PH AND REDOX POTENTIAL ON CONCENTRATION OF DISSOLVED NUTRIENTS IN AN ESTUARINE SEDIMENT,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. D. De Laune, C. N. Reddy, and W. H. Patrick, Jr.
Journal of Environmental Quality, Vol 10, No 3, p 276-279, July/September, 1981. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Nutrients, *Marine sediments, *Estuaries *Hydrogen ion concentration, *Oxidation-reduction potential, Phosphorus, Carbon, Ammonia, Iron, Manganese, Sediments, Dissolved solids, Gulf of Mexico.

Although both sediment redox potential and sediment pH have been shown to affect the exchange

of nutrients at the sediment-water interface, most studies dealing with these effects have been theoretical in nature. This study investigated the combined effect of pH and redox potential on the concentrations of dissolved organic carbon, phosphorus, ammonia, iron, and manganese in an estuarine sediment in the Gulf of Mexico. Sediment suspensions were maintained under conditions of controlled pH (5.0, 6.5, and 8.0) and controlled redox potentials (-200, 0, 250, and 500 mV). Nutrient concentrations were found to be strongly influenced by changes in sediment pH and in redox potentials. Dissolved organic carbon increased from 42 micrograms per milliliter at pH 5.0 and 500 mV to 93 micrograms per milliliter at pH 8.0 and -200 mV. Decreasing sediment redox potential and pH resulted in increases in the concentrations of soluble phosphorus, ammonia, iron, and manganese. Phosphorus concentrations ranged from 0.002 micrograms per milliliter at pH 8.0 and 500 mV to 0.215 micrograms per milliliter at pH 5.0 and -200 mV. The concentrations of iron and manganese ranged from less than 0.1 micrograms per milliliter at pH 8.0 and 500 mV to 101 and 13 micrograms per milliliter, respectively, at pH 5.0 and -200 mV. The influence of sediment redox potential and pH on concentration gradients between interstitial and overlying water can result in fluxes of dissolved constituents to and from the sediment. The results of this study demonstrate the need to consider the influence of variables such as sediment redox potential and pH in models of the diffusion of chemical and biochemical reactive elements across the sediment-water interface. (Carroll-FRC)
W82-00795

ESTIMATION OF MATERIAL FLUXES IN AN ESTUARINE CROSS SECTION: A CRITICAL ANALYSIS OF SPATIAL MEASUREMENT DENSITY AND ERRORS,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 7A.
W82-00816

THE ASSAY OF ADENOSINE 5'TRIPHOSPHATE EXTRACTED FROM SALT-MARSH MICROBIOTA,

South Carolina Univ., Columbia. Dept. of Biology.
L. H. Stevenson, C. A. Wilson, and T. H. Chrzanowski.
Canadian Journal of Microbiology, Vol. 27, No. 6, p 633-635, 1981. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Adenosine triphosphate, *Salt marshes, Chemical analysis, Enzymes, Bacteria, *Estuaries, Microorganisms, Marshes, Coastal waters, Tidal marshes, Aquatic life.

Data were collected to test the theory that the method employed to assay the adenosine 5'-triphosphate extracted from aquatic microbiota influences the temporal pattern of ATP density in the water of a salt-marsh creek. Water was collected from within the North Inlet Marsh, near Georgetown, SC. The sampling location monitored the major exchange point between the marsh and the Atlantic Ocean. Water was collected from 0.2 meters below the surface at 1.5 hr intervals comprising several tide cycles during February of 1979. The effect of the secondary emission pattern on the quantification of ATP was studied through 52 samples taken during the two expeditions. Assays using the integration approach produced values that were from 1.13 to 8.22 times higher than values determined by peak height analysis of the unfiltered samples and from 1.18 to 16.39 time higher in water that had been prefiltered by passage through a 1.0 micron filter. The latter samples contained bacteria as the only viable microbiota. ATP concentration values determined by integration averaged 3.6 times greater than values determined by peak height in the unfiltered samples and 4.8 times greater in the 1.0 micron filtered samples. Extracts prepared from biota in high-tide or oceanic waters did not have as great an enhanced secondary emission pattern as did extracts of samples collected at low tide. It would appear that bacteria were responsible for most of the enhanced secondary emissions observed in samples collected at or near low tide. Thus the method used to assay ATP extracted from environmental samples markedly influences the data recovered. (Baker-FRC)
W82-00838

ENRICHMENT OF THE AGRICULTURAL HERBICIDE ATRAZINE IN THE MICROSURFACE WATER OF AN ESTUARY,

Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-00877

DIEBACK OF SALT-WATER CORDGRASS (SPARTINA ALTERNIFLORA LOISEL.) IN THE LOWER CAPE FEAR ESTUARY OF NORTH CAROLINA: AN EXPERIMENTAL APPROACH TO RE-ESTABLISHMENT,

North Carolina State Univ. at Raleigh. Dept. of Botany.
R. A. Linthurst, and E. D. Seneca.
Environmental Conservation, Vol 7, No 1, p 59-66, Spring, 1980. 6 Fig, 5 Tab, 39 Ref.

Descriptors: *Spartina, *Marsh plants, *Plant growth, Vegetation, *Estuaries, Ecosystems, Marshes, Wetlands, Plant communities, Salt marshes, *Cape Fear Estuary, North Carolina.

Panne dieback of Spartina alterniflora in the Lower Cape Fear Estuary of North Carolina prompted a study, starting in 1975, of this phenomenon and the recolonization potential in the affected marshes. By September 1978 all three sites investigated (2 above and 1 below mean high water) had naturally recolonized by seeding, mainly S. alterniflora. Volunteers at the lower site were largely S. alterniflora; at the 2 higher sites, Salicornia europaea, Distichlis spicata, Scirpus robustus, and Spartina patens were also found. Experimental plots within each dieback site were regenerated most rapidly by volunteer plants transplanted from areas similar to the dieback sites and/or plants with large rhizome systems. It was concluded that this dieback was a short term phenomenon and that natural recolonization, not man's revegetation attempts, was the major factor in reestablishment of the plants. (Cassar-FRC)
W82-00889

EFFECTS OF TEMPERATURE, PH, SALINITY, AND INORGANIC NITROGEN ON THE RATE OF AMMONIUM OXIDATION BY NITRIFIERS ISOLATED FROM WETLAND ENVIRONMENTS,

University of West Florida, Pensacola. Dept. of Biology.
R. D. Jones, and M. A. Hood.
Microbial Ecology, Vol 6, No 4, p 339-347, 1980. 3 Fig, 24 Ref.

Descriptors: *Nitrification, *Oxidation, *Ammonium, *Estuarine environment, Nitrogen, *Wetlands, Temperature, Salinity, Hydrogen ion concentration, Bacteria, Marshes, Sodium, Potassium, Nitrate, Nitrite, Nitrogen cycle, Cycling nutrients.

The transformation of nitrogen and its recycling are extremely important to the productivity of aquatic ecosystems. Although factors affecting ammonium oxidation in agricultural soils and sewage have been investigated, information on factors affecting nitrification in wetland environments is lacking. Ammonium-oxidizing bacteria were examined in a freshwater marsh and in an estuarine bay over a 2-year period. Two predominant species of Nitrosomonas were consistently isolated, one from each environment. A closed culture, high cell density assay was used to determine the effects of temperature, pH, salinity, sodium, potassium, nitrite, nitrate, and ammonium concentrations on nitrification. Maximum oxidation of ammonium by the freshwater isolate occurred at 35 degrees C, pH 8.5, salinities of 0.3 to 0.5 percent sodium and potassium, and ammonium concentrations exceeding 0.5 grams per liter. The estuarine isolate exhibited maximum activity at 40 degrees C, pH 8.0, salinities of 0.5 to 1.0 percent sodium and potassium, and 0.2 grams of ammouium per liter. The sodium requirement of the estuarine isolate could be partially substituted by potassium, suggesting that the organism is a true estuarine bacterium. Salinities below 0.5 percent may severely reduce oxidation of ammonium by the bacterium in the estuarine environment. While nitrate had no significant effect on either isolate, certain combinations of ammonium nitrite were inhibitory, especially to the estuarine species. The data indicate that oxidation of ammonium by isolates from wetlands is influenced by pH and temperature and that estuarine nitrifiers may be more sensitive to and more extensively affected by salinity, ammonium concentrations, and nitrite than are isolates from fresh waters. (Carroll-FRC)
W82-00910

SEASONAL INFLUX AND DECOMPOSITION OF AUTOCHTHONOUS MACROPHYTE LITTER IN A NORTH TEMPERATE ESTUARY,

New Hampshire Univ., Durham. Jackson Estuarine Lab.
M. N. Josselyn, and A. C. Mathieson.
Hydrobiologia, Vol 71, No 3, p 197-208, June, 1980. 8 Fig, 4 Tab, 38 Ref.

Descriptors: *Detritus, *Aquatic plants, *Decomposition, Estuaries, Spartina, Zostera, Ascophyllum, Fucus, Nutrients, Great Bay, New Hampshire, Maine, Coastal waters, Salt marshes, Marshes, Algae, Nitrogen, Phosphorus, Seasonal variation.

The seasonal contribution and detrital processing of autochthonous plant litter in the Great Bay Estuary system of New Hampshire and Maine was studied for 18 months. Monthly strand line collections at two inner estuarine sites and one open coast site provided information on the seasonal influx of litter derived from each species, the halophytes, Spartina alterniflora Loisel and Zostera marina L., and the seaweeds, Ascophyllum nodosum L. Le Jolis and Fucus vesiculosus L. v. spiralis Farlow. S. alterniflora ditrital inputs were maximal in spring; Z. marina inputs, in summer. Seaweed litter was 35-85% of the total strand lien throughout the year. In the estuary the seaweeds contributed 1 to 3 times as much detrital matter as did the vascular plants, on the open coast 50 times as much. Seaweeds decomposed 3-10 times faster than vascular plant litter (which contains more cellulose) under similar environmental conditions. Decomposition was faster under submerged conditions. Nutrient depletion occurred in litter within the strand line. N and P enrichment from microbial activity and rapid leaching of carbonaceous substrates were observed under submerged conditions. (Cassar-FRC)
W82-00918

MICROBIOLOGICAL STUDIES OF A 'VIRGIN' SALT-FRESH WATER TRANSECT AT NORTH POINT, JAMES BAY, CANADA. I: BACTERIOLOGICAL ASPECTS,

Canada Centre for Inland Waters, Burlington (Ontario).
B. J. Dutka, and K. K. Kwan.
Hydrobiologia, Vol 72, No 3, p 273-280, July 2, 1980. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Baseline studies, *Bacteria, Wetlands, Salt marshes, Marshes, *James Bay, *Canada, Water analysis, *Microbiological studies, Sulfur bacteria, Eutrophication, Biomass, Saline-freshwater interfaces, Biodegradation, Sediments.

Bacterial populations were studied in water and sediment samples along a salt-fresh water shoreline transect at North Point, James Bay in northern Canada. Microbiological analysis showed that there was a very large microbial population, the greatest density occuring at the seawater stations. The few fecal indicator bacteria were a result of the animal population, not man's presence. Organic sulfur-reducing bacterial increased from 10,000 per 100 ml at the seawater stations to 100,000 per 100 ml at the brackish-fresh water interface. Sulfur-oxidizing bacteria varied from 10 to 100 per 100 ml, with highest densities in the marshland stations. Population patterns of ammonifying and denitrifying bacteria were quite similar to each other, with

ammonifiers 10 times more plentiful than denitrifiers. At the sea stations ammonifiers were high and denitrifiers low, with peaks of both in the salt marsh area. The high bacterial and heterotroph populations in the seawater stations indicate very eutrophic water. The potential biodedradation capacity of these waters is much greater than was formerly expected. (Cassar-FRC)
W82-00921

MICROBIOLOGICAL STUDIES OF A 'VIRGIN' SALT-FRESH WATER TRANSECT AT NORTH POINT, JAMES BAY II. MYCOLOGICAL ASPECTS,
Canada Centre for Inland Waters, Burlington (Ontario).
J. P. Sherry, and S. R. Kuchma.
Hydrobiologia, Vol 74, No 2, p 113-117, September 1, 1980. 3 Fig, 13 Ref.

Descriptors: *Fungi, *Baseline studies, Wetlands, Marshes, *James Bay, *Canada, Water analysis, Sediments, *Microbiological studies, Saline-freshwater interfaces.

Baseline values for fungi were determined along a salt-fresh water transect in the unimpacted North Point, James Bay, Canada, area. Fungi levels in water samples increased linearly from 28-70 CFU per 100 ml at the salt water end of the transect to 13,000-16,000 CFU per 100 ml at the fresh water end. In sediments the highest fungal densities were found inland at sites with rich, black organic sediments. Lowest fungi levels were found in sediments composed of clay and shingle fragments. (Cassar-FRC)
W82-00922

TRACE METAL FLUXES TO NEARSHORE LONG ISLAND SOUND SEDIMENTS,
New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W82-01040

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SUPERSEPARATION: SORET EFFECT REVERSED,
Scripps Institution of Oceanography, La Jolla, CA. Physiological Research Lab.
H. T. Hammel, and J. E. Maggert.
Separation Science and Technology, Vol 15, No 2, p 81-87, 1980. 1 Fig, 1 Tab, 2 Ref.

Descriptors: *Desalination apparatus, *Separation techniques, Soret effect, Osmotic pressure, Salt balance, Drinking water.

The Soret effect is attributed primarily to the fact that osmotic pressure is uniform across a solution when one side is heated and the other is cooled. When Whatman no. 40 filter paper was interspersed throughout an aqueous solution to minimize disturbance of the Soret effect caused by convection, the Soret effect was reversed. The concentration increased exponentially from nearly pure water at the cooled surface to many times the initial concentration at the heated surface. If the solution and filter paper were degassed, then the Soret effect was normal. It was concluded that microbubbles of air were entrained in the solution by the filter paper so that water vaporized on the warmer side of each bubble and condensed on the cooler side, thereby concentrating the solution near its heated surface and diluting it near its cooled surface. Continuous separation of seawater into potable water from the cooled surface was not possible in the described cell as the entrapped air in the filter paper was slowly absorbed by the condensate and removed from the cell. Continuous production of potable water was achieved, however, from a film of seawater flowing down a heated surface and supported a fraction of a millimeter from a cooled surface on which the vapor condensed and drained into a collecting trough below. (Baker-FRC)
W82-00791

3B. Water Yield Improvement

CONTROL OF WATER WEEDS BY GRASS CARP IN TWO SMALL LAKES,
Marine Dept., Rotorua (New Zealand). Fisheries Research Div.
C. P. Mitchell.
New Zealand Journal of Marine and Freshwater Research, Vol 14, No 4, p 381-390, 1980. 4 Fig, 19 Ref.

Descriptors: *Weed control, *Aquatic plants, *Carp, *Fish, Lakes, Plant growth, Waihi Beach Reservoir, Parkinsons Lake, *New Zealand, Lake restoration.

Chinese grass carp (Ctenopharyngodon idella Val.), averaging 2 kg in weight, were incrementally stocked over a 3 year period in 2 small New Zealand lakes, Waihi Beach Reservoir, a water supply impoundment, and Parkinsons Lake, a eutrophic sand dune lake with no defined outlet. In Waihi Beach Reservoir a stocking density of 26 fish per ha resulted in a change in plant species dominance (due to preferential feeding) but no long term reduction of standing crop. A stocking density of 37-52 per ha was required to heavily reduce the aquatic vegetation over 2 summers. In Parkinsons Lake 37-44 carp per ha eliminated all vegetation by midsummer. The most palatable species were Potamogeton ochreatus and Eleocharis sphacelata. At higher stocking densities, these and Egeria densa and Nitella hookeri were virtually eliminated. A more accurate estimate of weed removal rates would result if calculated on the basis of littoral zone area or number of aquatic plants. Since the degree of weed control depends on so many factors (plant growth, fish growth, mortality rates, water temperature, and standing crop), it is difficult to determine the optimum stocking density. Removal of stocked carp was difficult. However, this is necessary if aquatic weed control growths are to be managed rather than eliminated. (Cassar-FRC)
W82-00609

SEEDING-OPPORTUNITY RECOGNITION IN WINTER OROGRAPHIC CLOUDS,
Utah Water Research Lab., Logan.
G. E. Hill.
Journal of Applied Meteorology, Vol 19, No 12, p 1371-1381, December, 1980. 14 Fig, 2 Tab, 18 Ref.

Descriptors: *Cloud seeding, *Weather modification, Moisture deficiency, *Artificial precipitation, Rainfall, Cloud physics, Clouds, Temperatures, Orography, Orographic precipitation.

Basic meteorological parameters used to develop the present cloud seeding hypothesis for winter orographic storms are: cloud-top temperature, updraft speed, supercooled liquid water concentration, and precipitation rate. Analysis of supercooled water concentrations and precipitation as functions of cloud-top temperature and orographic updraft speeds indicates that seedability is marked by cloud-top temperatures from minus 22 degrees to zero degrees C and updraft speeds of 1 mile/second or greater. This hypothesis is substantiated by taking aircraft icing reports as representing supercooled water concentrations, and taking cross-barrier flow as representing vertical motion. The potential precipitation yield increases as the square of the cross-barrier wind speed increases within the suitable cloud-top temperature range. About 20% of the winter orographic clouds offer such high potential. High seedability is expected to be associated with post-frontal conditions where the cross-barrier flow is strong, high-level subsidence is occurring, and the moisture is still high at mountaintop levels, or where weak low-level moisture systems are moving with strong airflow. (Baker-FRC)
W82-01005

VARIATIONS IN PRECIPITATION PARAMETERS BETWEEN DROUGHT AND NON-DROUGHT PERIODS IN TEXAS AND SOME IMPLICATIONS FOR CLOUD SEEDING,
National Weather Service Stoneville, MS.
For primary bibliographic entry see Field 2B.
W82-01006

3C. Use Of Water Of Impaired Quality

RECYCLING URBAN STORMWATER FOR PROFIT,
Environmental Protection Agency, Edison, NJ.
R. Field, and C-Y. Fan.
Water/Engineering and Management, Vol 128, No 4, p 30-33, April, 1981. 2 Fig, 6 Tab, 25 Ref.

Descriptors: *Storm runoff, *Reclaimed water, *Water reuse, *Urban runoff, Storm water, Combined sewer overflows, Wastewater treatment, Industrial water.

Current urban storm water control and treatment technology leading to its reuse in industrial cooling and processes, irrigation, and recreational water supply are presented. Although storm water pollutant concentration varies with time and location during a storm and from one storm to another, the BOD5 is usually close to that of municipal sewage secondary effluent, and the suspended solids concentration is similar to that of raw sanitary wastewater. Combined sewer overflow quality lies between that of untreated sanitary sewage and urban storm runoff. Physical treatment units are more effective than biological systems because they can handle the highly variable flow rates and pollutant concentrations. The treatment chosen depends on the desired use: low level treatment for irrigation water and high level treatment for boiler feed water. A table lists four categories of waters, AA, A, B, and C, with the maximum concentrations of metals, anions, color, etc., allowed for each classification. A hypothetical case study of a 100 acre industrial complex illustrates the planning process. After the demand and quality requirements in each category of water quality are decided, storage and treatment facilities are designed for each class of water. Next, costs are determined. Three reuse alternatives are compared: all city water, all storm water except for potable water, and all storm water except for potable water and process water. The cheapest alternative in this case reuses stormwater for irrigation process and cooling water and gives a total water supply cost of $1.54 million, saving $800,000 over the use of city water for these purposes plus for potable water. (Cassar-FRC)
W82-00524

EFFECTS OF MUNICIPAL WASTE WATER EFFLUENT ON PERFORMANCE AND FEED QUALITY OF MAIZE VS. REED CANARYGRASS,
Science and Education Administration, St. Paul, MN.
G. C. Marten, W. E. Larson, and C. E. Clapp.
Journal of Environmental Quality, Vol 9, No 1, p 137-141, January-March, 1980. 5 Tab, 9 Ref.

Descriptors: *Wastewater farming, *Crop yield, *Corn, Grasses, Wastewater irrigation, Wastewater disposal, Crop production, Forages, Feeds, Fodder, Proteins.

The field quality and yields of dry matter, digestible dry matter, and crude protein of maize and reed canarygrass were determined when fields were managed for maximum yield and when irrigated with two levels of municipal wastewater effluent. The three treatments of plots were a control consisting of well water and mineral fertilizer, application of 5 cm of wastewater per week, and application of 10 cm of water per week. In the second through fourth year, the maize fodder was more digestible than any of the reed. The reed canarygrass always contained more crude protein than the maize. Seventeen to 36% more dry matter and 23 to 41% more digestible dry matter was yielded by the maize fodder. These differences

were reduced as effluent applications increased. Reed canarygrass yielded from 30 to 52% more crude protein per hectare. Thus, perennial grasses seem to have a superior capacity when compared to maize for removing nitrogen from soil treated with wastewater effluent. The grasses yielded the most protein per hectare but the least digestible dry matter when treated with effluent. (Small-FRC)
W82-00564

ISOLATION AND IDENTIFICATION OF PATHOGENIC MICROORGANISMS AT WASTEWATER-IRRIGATED FIELDS: RATIOS IN AIR AND WASTEWATER,

Hebrew Univ., Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5A.
W82-00579

IRRIGATION AND DRAINAGE WATERS OF A NEW IRRIGATION ZONE IN THE HUNGRY STEPPE AND POSSIBILITIES OF THEIR USE,

V. A. Molodtsov.
Water Resources (English Translation), Vol 7, No 5, p 422-430, September/October, 1980. 1 Fig, 5 Tab, 5 Ref. Translated from Vodnye Resursy, No 5, p 89-99, September/October, 1980.

Descriptors: *Irrigation, *Drainage waters, *USSR, Hungry Steppe, Water demand, Chemical analysis, Mineralization, Flushing, Chemical composition, Asia, Salts, Saline soils.

An acute shortage of fresh water resources is developing in Central Asia as a result of increasing irrigation. The mineralization and chemical composition of rivers of Central Asia, especially the Syr Darya, have changed significantly since the 1950s. The increased mineralization of the Syr Darya is primarily the result of the inflow of drainage waters from the Fergana Valley. The possibility of using waters having increased mineralization for flushing saline soils has commanded considerable interest as the need for fresh water sources has become more acute. The mineralization and chemical composition of irrigation and drainage waters of the newly irrigated zone in the Hungry steppe were observed monthly for three years in an effort to determine their suitability for use in flushing operations. These studies indicated that the use of drainage waters for flushing salinized soils was feasible in three regions of the Hungry Steppe. The waters of the Central Hungry Steppe Collector Drain (CHD) could be used for flushing the area confined to the Dzhetysai and Sardobin depressions, which contain meadow solonchaks with more than 2 percent toxic salts in the upper 1 meter layer. Drainage waters from group collector drains can be used for flushing areas in the southeastern part of the Hungry Steppe, including parts of the Khavast alluvial fan and the eastern part of the Dzhizak Steppe. Waters of Central Collector Drain No. 7 can also be used to flush the peripheral territory of the Khavast alluvial fan. The waters of the collection drains of the Khavast alluvial fan and the CHD can be used to flush the territory of the Khavast alluvial fan adjacent to the Sardobin depression. Drainage waters in the territory of the Dzhiil'min part of the Dzhizak Steppe could conceivably be used for flushing if vertical drains were constructed and well discharges were large. Drainage waters in the rest of the Hungry Steppe are not suitable for flushing soils in their vicinity. (Carroll-FRC)
W82-00658

EFFECT OF IRRIGATING LOAMY SAND SOIL BY LIQUID SEWAGE SLUDGE ON ITS CONTENT OF SOME MICRONUTRIENTS,

Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
For primary bibliographic entry see Field 5E.
W82-00661

THE EFFECTS OF SODIUM AND ORGANIC MATTER IN SEWAGE EFFLUENT ON WATER RETENTION PROPERTIES OF SOILS,

The Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Science.
S. Burns, and E. Rawitz.
Soil Science Society of America Journal, Vol 45, No 3, p 487-493, May-June, 1981. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Soil moisture retention, *Wastewater irrigation, Soil properties, Effluents, *Organic matter, *Sodium, Moisture availability, Irrigation, Infiltration.

A set of laboratory experiments conducted to test effects of sewage effluent on the water relations of soil under simulated drop irrigation is presented. Soil used was taken from two separate depths at Kfar Kayarok in the Israeli Coastal Plain. Under the conditions of this study, no amount of sewage water approximately equivalent to one season's irrigation in the field was sufficient to increase the soil's capacity to retain water. No ponding occurred, and aerobic conditions were maintained. Allowing the soil to dry a few days between irrigations was the determining factor in preventing ponding. When using effluent for crop irrigation, as opposed to utilizing cropland for effluent disposal, the intermittent wetting and drying regime is the more representative of field conditions. Effluent sodium adscrption ratio (SAR) was instrumental in increasing the amount of water held, by deflocculating the soil. Soil drying enhanced organic matter-clay complex formation between soil clay colloids and the organic solids introduced by the sewage effluent. In finer soil, these complexes were fairly stable and produced cracking in the surface which can be useful in field water management. In coarser soil less stable, organic matter-clay complexes were formed, which were easily destroyed by simulated rain application, resulting in redispersion and soil-pore blockage by organic colloisds. (Baker-FRC)
W82-00663

THAMES REARS CARP IN SEWAGE.

Water, No 38, p 38, May, 1981.

Descriptors: *Fish farming, *Wastewater, Water reuse, Fish stocking, Fisheries, Fish, Carp, Wastewater lagoons, Lagoons, England.

Sewage treatment lagoons have been stocked annually with excess stocks of small fry, and these are cropped 12 months later when they have reached about 17 cm in length. This creates a secondary function for the lagoons, the rearing of fish for which all the feed is provided by the effluent, and yet which achieve a marketable value in one year. Five hundred Kg. of quality rough fish have been removed from the Stanford lagoons by sewage operators and divisional scientific staff using the electro-fishing method. Before being distributed, the fish are given a thorough health check. The screening is very thorough, as these fish then go on to healthy fisheries. A random sample from each batch is checked for any irregularities. (Baker-FRC)
W82-00681

SALINE WATER USE AND DISPOSAL OPPORTUNITIES; COLORADO RIVER WATER QUALITY IMPROVEMENT PROGRAM,

Bureau of Reclamation, Boulder City, NV.
Special Report, Sepember, 1981. 153 p, 20 Fig, 31 Tab, 50 Ref, 4 Append.

Descriptors: *Saline water, *Impaired water use, *Cooling water, *Waste water disposal, Coal slurry pipelines, Saline water systems, Industrial water, Fuel, Solar energy, *Colorado River basins.

Saline concentrations in the Colorado River are increasing and will continue to increase as the Basin States develop their lands and available water resources. Without a program of salinity control, continued development will result in increased damages to agricultural, municipal, and industrial users. An assessment was made of the potential technical and economic feasibility of collecting saline water in the Colorado River Basin, transporting it for practical use in energy production, and exporting and disposing of wastewater in a cost-effective manner. Sixteen saline water sources were evaluated in various collection configurations for local use or export. The total water volume considered as potential sources for use or disposal is 610,000 acre-feet. Efforts were directed to highlighting opportunities of using saline water in powerplant cooling and industrial processing as well as coal slurry pipelines. The most promising beneficial use cases appear to be: local use of saline water for powerplant cooling; and a coal slurry pipeline carrying 50 or 100 million tons of coal per year to southern California using saline water as the transport medium. Other potential uses include salt gradient solar ponds for desalting and power generation. Wastewater and blowdown collection and disposal service were also examined for energy development sites located near saline water pipeline collection systems. If a long-distance pipeline is developed for other purposes, economies of scale may make wastewater collection and disposal a viable alternative. (Moore-SRC)
W82-00717

QUALITY OF IRRIGATION WATER AND EFFECTS OF SULFURIC ACID AND GYPSUM ON SOIL PROPERTIES AND SUNDANGRASS YIELDS,

Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
B. J. Alawi, J. L. Stroehlein, E. A. Hanlon Jr, and F. Turner Jr.
Soil Science, Vol 129, No 5, p 315-322, May, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: Saline soils, *Sulfuric acid, *Gypsum, *Irrigation effects, Irrigation water, *Soil properties, *Crop yield, Infiltration rate, Sudangrass.

A study is presented which was designed to show the effects of continuous irrigation with waters of different qualities on soil properties and crop yields. Also, the extent to which relatively low rates of sulfuric acid and gypsum can be used beneficially to reduce soil salinity and sodium and improve infiltration rates and crop yields was determined. Plots were irrigated over a three year period with water which had a salinity content varying from ECw of 3.2 times 10 to the 3rd power to 0.55 times 10 to the 3rd power millimhos/cm. Different soil slainities resulted, and the exchangeable sodium percentage ranged from 18.4 to 24.0 in the surface 30 cm of soil. Over a two year period, Sudangrass yields increased with decreasing water salinity after the addition of relatively low rates of 93% H2S04 and gypsum. Yields were increased by H2S04 and gypsum with all three waters the first year, but only by H2S04 the second year. Thus, sulfuric acid was generally superior to gypsum for reducing soil salinity and exchangeable sodium percentage. (Small-FRC)
W82-00767

2,500 ACRES OF WASTEWATER IRRIGATION,

J. F. Blair.
BioCycle, Vol. 22, No 3, p 30-31, May/June, 1981.

Descriptors: *Irrigation water, *Wastewater irrigation, Water reuse, Agriculture, Pipelines, Water conveyance, Water storage, Lubbock, Texas.

Near Lubbock, Texas, 7.2 mgd of treated wastewater pumped through a 16 mile pipeline will irrigate 2500 acres of cropland. At the end of the 27 inch watertight pipeline are three 15 inch lines leading to earthen storage lagoons, each 50-100 acres in area and 13 ft in depth. From the lakes, water is pumped through center pivot sprinkler systems. It is expected that cotton production will increase to 1.5 bales per acre from the nonirrigated yield of 0.5 bales per acre. Forty years' experience with wastewater irrigation on the nearby 4,000 acre Gray farm have shown that seepage never reached below 15 ft and did not enter the Ogallala aquifer. (Cassar-FRC)
W82-00769

GROWTH OF THE BAY SCALLOP, ARGOPECTEN IRRADIANS, IN A WASTE RECYCLING AQUACULTURE SYSTEM,

Woods Hole Oceanographic Institution, MA.
R. Mann, and R. E. Taylor, Jr.
Aquaculture, Vol. 24, No. 1/2, p 45-52, May, 1981. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Water recovery, *Aquaculture, *Recycling, Mollusks, *Aquatic animals, *Scallops, Wastewater treatment, Water quality, Growth, Impaired water use.

This report presents results of studies of the growth of Argopecten irradians both in a pilot scale waste recycling aquaculture system, and in laboratory systems at four temperatures when fed on phytoplankton cultured in sewage-seawater mixtures. Juvenile A. irradians were grown successfully on a diet of phytoplankton cultured in sewage-seawater mixtures. A. irradians increased from initial live and dry meat weights of 1.15 g and 0.043 g respectively, to terminal values of 9.08 g and 0.399 g, respectively. This corresponds to instantaneous growth rates for live weight and dry meat weight of 0.009 and 0.013, respectively. High mortalities were evident towards the end of the experiment, with a terminal value of 33%, giving an instantaneous mortality rate value of 0.0016. In laboratory experiments of 12 weeks in length at 12, 15, 18 and 21 degrees C, juvenile A. irradians gave values of 0.01, 0.013, 0.018, and 0.016 for live weight, 0.015, 0.015, 0.016, and 0.013 for dry weight and 0.038,0.038, 0.037 and 0.040 for instantaneous mortality rate at the respective temperatures. A. irradians exhibited specific growth rates comparable to or higher than those previously recorded for other bivalve species cultured in waste recycling systems. However, a considerable reduction in the presently high mortality rate will be needed to make A. irradians a prime candidate for practical application. (Baker-FRC)
W82-00842

MASSIVE CULTIVATION OF MICROALGAE: RESULTS AND PROSPECTS,

Kernforschungsanlage Juelich (Germany, F.R.). Inst. fuer Biotechnologie III.
For primary bibliographic entry see Field 5D.
W82-00913

ENVIRONMENTAL EFFECTS OF WATER REUSE SCHEME,

Sewage Reclamation Dept., Tel Aviv (Israel).
E. Idelovitch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 561-570, June, 1980. 4 Fig, 4 Tab, 7 Ref.

Descriptors: *Wastewater renovation, *Environmental effects, *Water reuse, *Israel, Water supply, Water demand, Water resources development, Water treatment facilities, Wastewater treatment.

Due to the scarcity of water supplies in Israel, it is not feasible to discharge wastewater into the sea. First, such discharge would be environmentally unsound. Second, the wastewater should be treated for reuse as a source of supply for agricultural, industrial, and even municipal consumers. The Dan Region Project in the Tel Aviv Metropolitan Area is the largest and most advanced water reuse scheme in Israel. The first stage of the project, now in operation, comprises facilities for advanced treatment and groundwater recharge of wastewaters discharged from the Southern Tel Aviv Metropolitan Area. These facilities serve a total population of about 400,000 and have a capacity of 20,000,000 cubic meters per year or about 15 mgd. The second part of the project deals with wastewater from the northern and eastern parts of the Tel Aviv Metro Area. Prior to the completion of the first stage, most of the wastewater which is now treated had been discharged into the Mediterranean Sea. The water now undergoes biological and physicochemical treatment, and is then recharged to the groundwater aquifer by intermittent spreading over sand basins. The reclaimed water will be used to supplement nonpotable needs. The oxidation ponds in the first stage remove settleable solids, sand, suspended solids, soluble biodegradable matter, nitrogen, and heavy metals, within a process of algae growth. A high lime-magnesium process removes suspended solids, bacteria, viruses, and some inorganic dissolved solids. The polishing ponds provide for stripping of free ammonia at high pH and for recarbonation of the lime treated effluent by absorption of carbon dioxide. (Baker-FRC)
W82-00973

EFFECTS OF WATER QUALITY ON FORAGE PRODUCTION,

Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
R. E. Zartman, T. D. Miller, J. R. Goodin, and M. Gichuru.
Journal of Environmental Quality, Vol 9, No 2, p 187-190, April/June, 1980. 4 Tab, 15 Ref.

Descriptors: *Cooling water, *Irrigation effects, *Forages, Irrigation water, Water quality, Crop yield, Alfalfa, Municipal water, Water reuse, Electric powerplants, Crop production, Lubbock, *Texas.

The effects of water quality on forage production were investigated in a 4-yr field study conducted at the Jones Station Facility in Lubbock, Texas. Three application rates (high, medium, and low) of electric powerplant cooling water and city water were used to irrigate fourwinged saltbush (Atriplex canescens) and alfalfa (Medicago sativa) stands started on a Friona fine sandy loam in 1975. Alfalfa crops reacted favorably to irrigation, with the highest yields occurring in the high-irrigation city water treatment, followed by the high irrigation blowdown water treatment. Alfalfa stands receiving medium irrigation levels produced moderate yields, while the dryland production decreased during the course of the experiment. Irrigation had little effect on yields of Atriplex stands. No differences in forage yield were found between fields irrigated with city and cooling water. It was concluded that alfalfa production benefits by irrigation with either blowdown or city water. (Geiger-FRC)
W82-01002

HEALTH ASPECTS OF URBAN WATER CONSERVATION,

East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
C. S. Bishop, and V. A. Sikora.
Journal of Environmental Health, Vol 42, No 5, p 250-252, March/April, 1980. 1 Ref.

Descriptors: *Water demand, *Conservation, Water supply, Water supply development, *Water reuse, Potential water supply, Water shortage, *Public health, Urban areas.

The nature, potential scope and limitations of the federal urban water conservation program in relationship to environmental health are considered. As demand for additional water supplies grows, conservation becomes increasingly important. Environmental health professionals must help insure that a comprehensive approach will be taken and that forthcoming innovations will not jeopardize the public health. Approaches to decrease the consumption of water include reducing pressure in the distribution system, use of water saving devices, reducing leakage, in-home wastewater recycling systems, and increased water prices. Each of these possibilities has potential problems which must be understood before they are undertaken. A great deal of controversy exists concerning reusing wastewater in the home. The concept of a split system in which water used for washing is then used for toilet flushing is interesting. However, it may lead to cross connection and the potential for contaminated water to enter the potable water supply, creating a health hazard for a large number of people. Any such water saving devices will probably be installed as a novelty and will not be used uniformly throughout a system. They may then be misused by subsequent owners of a home or by tenants. Building inspectors view this as a potential problem. (Baker-FRC)
W82-01047

3E. Conservation In Industry

GROUND-WATER USE FOR COOLING: ASSOCIATED AQUIFER TEMPERATURE CHANGES,

California Univ., Berkeley. Lawrence Berkeley Lab.
M. J. Lippman, and C. F. Tsang.
Ground Water, Vol 18, No 5, p 452-458, September/October, 1980. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Cooling water, *Injection wells, *Electric powerplants, Aquifer management, Powerplants, *Water conservation, Thermal pollution, Heated water, Groundwater.

Water and energy conservation could result if cooling waters from a steam-electric plant are injected into an aquifer for later use in heating, industry, or agriculture. This paper analyzed a simple system comprising one withdrawal and one injection well and concluded that, at rates of 3.65 million cu meters per year, the wells are usable for 2 to 8 years before the temperature of the extracted water becomes too hot to produce a cooling effect. In actual field use a much larger number of wells would be used, extending the life of the well field. The heating effects in confined aquifers are localized around the injection wells. When well operation ceases, the hot water plume drifts in the direction of the groundwater flow, gradually cooling. (Cassar-FRC)
W82-01014

3F. Conservation In Agriculture

SALINE IRRIGATION WATER.

World Farming, Vol 23, No 1, p 24, January/February, 1981.

Descriptors: *Saline water, *Irrigation practices, *Sprinkler irrigation, Water injury, Water pollution effects, Salt tolerance, Irrigation efficiency.

Sprinkling irrigation water during the evening or night can reduce leaf salt absorption by half compared with daytime sprinkling. Irrigation should be infrequent and heavy, with sprinkler rotations of 1 min or less to prevent drying between cycles. As little as 200 ppm of salts in irrigation water can injure crops if leaves accumulate salt. Furrow or flooding irrigation causes less salt injury than sprinkler irrigation for the more sensitive crops: citrus, stone fruit trees, almonds, peppers, potatoes, tomatoes, alfalfa, barley, safflower, sesame, and sorghum. (Cassar-FRC)
W82-00512

YIELD AND WATER USE OF VEGETABLE CROPS WITH SEEPAGE AND DRIP IRRIGATION SYSTEMS,

Agricultural Research and Education Center, Bradenton.
A. A. Csizinszky.
Florida Scientist, Vol 43, No 4, p 285-292, Fall, 1980. 1 Fig, 6 Tab, 6 Ref.

Descriptors: *Irrigation efficiency, *Vegetable crops, *Water use efficiency, Corn, Broccoli, Squash, Drip irrigation, Seepage, Crop yield, Water conservation, Conservation.

The effects of seepage and drip irrigation on crop yield were studied in spring 1978 on broccoli (Brassica oleracea L., Italica Group cv. 'Green Comet Hybrid'), sweet corn (Zea mays cv. 'Silver Queen'), and zucchini squash (Cucurbita pepo cv. 'Fordhook'). Yields per plant in kg (seepage and drip, respectively) were: broccoli, 0.307 and 0.198; corn, 0.191 and 0.189; and zucchini, 6.13 and 6.32. Plant densities for seep irrigation were 70-85% of the densities for drip irrigation. Yields per hectare in tons (seepage and drip, respectively) were: broccoli, 3.76 and 3.15; corn, 10.68 and 12.14; and zucchini, 45.21 and 60.67. Seepage irrigation plots received water at a constant rate of 13.31 liters per sq meter per day, and the amount of water with the drip system was adjusted every 10 days. Total amounts of water received during the growing season in liters per sq meter (seepage and drip, respectively) were: broccoli, 752 and 216; corn, 978 and 355; and zucchini, 1124 and 359. Water use (in liters) to produce 1 kg of marketable yield were: broccoli, 1999 and 684; sweet corn, 916 and

193; and zucchini, 249 and 59, for seepage and drip irrigation, respectively. (Cassar-FRC)
W82-00544

TRAVELING SPRINKLER SYSTEM AND METHOD,

Toro Co., San Marcos, CA. (Assignee).
E. J. Hunter.
U.S. Patent No 4,204,642, 33 p, 43 Fig, 8 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1260-1261, May 27, 1980.

Descriptors: *Patents, *Irrigation systems, *Sprinkler irrigation, *Application equipment, Irrigation efficiency, Irrigation practices, Irrigation operation and maintenance.

A low capital investment system for irrigating a relatively large area field, comprises a mobile base, and a sprinkler mounted on the base and adapted to accumulate water from a water supply and to intermittently discharge the accumulated water in a stream over the field. Apparatus is provided for propelling the base in a back and forth movement traversing a field, and for generally reversing the water discharge direction each time the direction of travel is reversed. The sprinkler includes a resiliently expandable reservoir construction for accumulating relatively large volume, intermittent bursts, and a drive system which also provides relatively short range, continual irrigation. Separate sprinkler units can be used on a field concurrently, or a single unit can be moved over successive areas of a field until the whole field has been covered. The system may also be combined with a center pivot device to irrigate land that would otherwise be unused. (Sinha-OEIS)
W82-00561

RESEARCH AND DEVELOPMENT TO SERVICE A SUSTAINABLE AGRICULTURE,

University of New England, Armidale (Australia).
J. R. McWilliam.
Search, Vol 12, No 1/2, p 15-21, January/February, 1981. 5 Fig, 16 Ref.

Descriptors: *Research priorities, *Irrigation efficiency, *Dry farming, Irrigation, Water use efficiency, Water management, Water resources development, *Australia.

Important problems which threaten the stability of Australia's irrigated and dry-land cropping systems are considered and the most urgent research needs are identified. The originality and effectiveness of research depends upon the quality of students and the agricultural education available to them. A successful utilization of Australia's water and soil resources depends on efficient conservation and management practices. Research is needed in the area of irrigation. Most of the water resources are located in the north, where only about 5% of available water is utilized. In the south, where irrigation is used, there are problems with the buildup of salinity and the deterioration of structure in fine-textured soil under intensive cropping. Efficient water management is especially important in areas which employ dryland cropping. Research is needed on the effects of tillage, including no-till, minimum tillage, and various forms of stubble retention and mulching. Research is also needed in crop development, past and pathogen control, and the establishment of pastures. (Small-FRC)
W82-00669

OPERATIONAL EVALUATION OF VILLAGE LEVEL IRRIGATION CONVEYANCE SYSTEMS,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
T. J. Trout, and S. A. Bowers.
Transactions of the ASAE, Vol 24, No 3, p 636-642, May/June, 1981. 9 Fig, 5 Tab, 7 Ref.

Descriptors: *Conveyance structures, *Water loss, *Irrigation ditches, Water conveyance, Leakage, Irrigation operation, Mathematical studies, Design criteria, *Pakistan.

In a study of five village level watercourse systems in Pakistan, total operational conveyance losses were measured using an adaptation of the inflow-outflow method. The extents of transient losses were quantified, as were the types of watercourse losses, to aid in the evaluation of conveyance efficiencies. Flow rates were monitored continuously, and flow hydrographs were created. Operational losses were calculated as the difference between the volume of water entering the watercourse at the head and the volume entering the irrigated fields. Total losses varied from 37 to 56%, and averaged 45% on inflow. Fifty-five percent of the losses occurred on the primary channels. Less than 1% of the losses were attributed to evaporation, and loss rates decreased with distance. Seven percent of the inflow or 15% of the losses were due to transient phenomena such as wetting dry channels, dead storage, and short-term breaches. Steady-state seepage into channel wetted perimeters was much greater than would be expected from normal infiltration. (Small-FRC)
W82-00696

LAND FORMING EFFECTS ON DRYLAND SORGHUM PRODUCTION IN THE SOUTHERN GREAT PLAINS,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
O. R. Jones.
Soil Science Society of America Journal, Vol 45, No 3, p 606-611, May-June, 1981. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Crop yield, *Cultivation, Soil moisture retention, Soil water, Moisture availability, Agriculture, Erosion, Water conservation, *Sorghum, Runoff control, *Land forming.

Research was conducted to develop low-cost land forming systems for controlling or reducing storm runoff on drylands and to determine the effectiveness of selected land forming systems in preventing runoff, controlling erosion, storing water, and increasing grain sorghum yields. Various land forming treatments investigated included conventional graded furror, conventional contour furrow, wide furrow, Orthman, mini-bench, and conservation mini-bench. All plots were tandem-disked about 0.07 meters deep in early April each year to bury residue and allow volunteer sorghum to sprout. Furrow treatments were imposed in early May. Conventionally constructed contour furrows on large fields frequently overtop during heavy, high-intensity rainstorms. Overtopping and subsequent soil erosion from runoff results when the surface-water storage capacity of furrows or border dikes is exceeded. Orthman, wide furrow, mini-bench, and conservation mini-bench treatments did not overtop but retained all precipitation from this record rainstorm because their surface-water capacity was not exceeded. Thus level land forming systems can effectively conserve precipitation and prevent runoff on large, gently sloping field areas in the Southern Great Plains. Water is the limiting resource for crop production in the area. Approximately one half of the total water requirements for a dryland sorghum crop can be provided from soil water stored at seeding time. Land leveling is the most effective conservation practice for preventing runoff and increasing dryland crop yields. (Baker-FRC)
W82-00764

EFFECT OF SOIL WATER CONTENT AND A GROWING SEASON STRAW MULCH ON GRAIN SORGHUM,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
P. W. Unger, and O. R. Jones.
Soil Science Society of America Journal, Vol 45, No 1, p 129-134, 1981. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Mulching, *Sorghum, *Soil water, Straw, Mulches, Crop production, *Crop yield, Water use efficiency, Soil moisture retention.

A study was performed to evaluate the contribution of a growing season straw mulch to grain sorghum growth, yield, grain quality, water use, and water use efficiency. Plots of Pullman clay loam were given two irrigations, one irrigation, and no irrigation prior to planting in order to simulate high, medium, and low levels of water storage in soil during fallow. Zero, 2, 4, or 8 metric tons of wheat straw per hectare were placed on the surface after the sorghum emerged. Sorghum responses to the high and medium water storage levels were similar, since the second irrigation resulted in relatively little additional storage due to the slow permeability of the soil. However, sorghum on plots receiving one or two irrigations grew taller, yielded more, and used water more efficiently than water on unirrigated plots. In general, sorghum responded more to soil water content at planting than to mulch rate during the growing season. Over a three year period, application of 8 metric tons of straw per hectare during the growing season resulted in a 19 percent increase in water use efficiency over plots receiving no mulch. Shading from the plant canopy appeared to provide the beneficial effect of a mulch during the growing season. A major beneficial effect of using a mulch during both the fallow and the growing seasons, in terms of water conservation and crop production, is the enhancement of water storage in the soil during fallow periods. (Carroll-FRC)
W82-00765

LASER DRIP IRRIGATION.

World Farming, Vol 23, No 1, p 34, January/February, 1981.

Descriptors: *Irrigation engineering, *Trickle irrigation, *Lasers, Water conservation, Computers.

An experimental laser-guided traveling trickle irrigation system features a main tower which keeps field towers in alignment with the use of a laser plane. Laser receptors in each field tower activate changes in motor speed to adjust the alignment. Water is applied near the plant, wasting none between rows. Future plans include computer programming and solar power. This system can eliminate over-irrigation, uneven distribution of water in soil, and excessive labor costs. (Cassar-FRC)
W82-00771

EVALUATING IRRIGATION SYSTEMS,

For primary bibliographic entry see Field 6B.
W82-00772

WATER STRESS AND COLD HARDINESS IN FIELD-GROWN CITRUS,

Florida Univ., Gainesville. Dept. of Fruit Crops.
For primary bibliographic entry see Field 2I.
W82-00864

SIZING RICE IRRIGATION CANALS,

D. P. Spare, J-K. Wang, and R. E. Hagan.
Transactions of the ASAE, Vol 23, No 4, p 914-918, 923, July/August, 1980. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Rice, *Irrigation canals, *Design criteria, Flood irrigation, Cropland, Canals, Irrigation design, Mathematical studies, Mathematical equations.

The peak demand for irrigation water in a paddy rice production system, which occurs at the beginning of a production season when land soaking water is introduced, determines the sizes of irrigation canals needed. Three conflicting requirements must be suitably reconciled if this peak water demand is to be minimized. First, the system-wide water demand during the land soaking period should follow as closely as possible the theoretical minimum values proposed by Hagan and Wang (1977). Second, the minimum land area to be served by a given sublateral or farm-ditch during a rotational period should not be less than that determined by local circumstances. Third, the patterns of subdivision of the project area into command and service areas to be served by laterals and farm ditches which are dictated by topographical and sociological constraints should be respected. A procedure for the design of sublateral in-field irrigation water distribution systems for paddy rice production systems which reconciles these three requirements is presented. The procedure minimizes the peak water requirement of the produc-

tion system and gives a detailed irrigation schedule for the land soaking period. The procedure has been applied to the design of the Naga-Calabanga Integrated Agricultural Development Area project, a 7,000 hectare paddy rice production system in the Philippines. (Carroll-FRC)
W82-00895

WATER REQUIREMENT FOR SUGARCANE PRODUCTION,

Agricultural Research and Education Center, Belle Glade, FL.
S. F. Shih, and G. J. Gascho.
Transactions of the ASAE, Vol 23, No 4, p 934-937, July/August, 1980. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Crop production, *Water requirements, *Sugarcane, Sugar crops, Water use, Rainfall, Lysimeters, Soil water, Soil-water-plant relationships.

The only economically feasible strategy for increasing the longevity of the organic soils of the Everglades, which are subsiding at a rate of between 1.5 and 3.1 centimeters per year, is to maintain high water tables. However, available data on the effect of water table level on water requirement and production performance of sugarcane are not adequate for making precise recommendations as to optimum water table depth for sugarcane production and soil conservation. Six lysimeters were used to control water tables at 30, 60, and 90 centimeters below the muck soil surface for sugarcane production. The effective rainfall was found to be proportional to water table depth, with about 3.4 centimeters of rainfall stored in the soil for each 10-centimeter increment of water table depth. Water table depth had a significant effect on water requirement in both the dry and the grand growth periods. Each 10-centimeter increase in water table depth resulted in a reduction in the water requirement of about 3.7 centimeters for plant crop and 2.2 centimeters for ratoon crop during the dry season and about 3.4 and 1.3 centimeters, respectively, during the grand growth period. Maintaining a high water table will increase the requirements for water for irrigation and the need for pumping for drainage following heavy rainstorms. The water required to produce 1 kilogram of fresh cane varied from 89 kilograms in plant crops to 118 kilograms in the ratoon crop. Water requirements for production of 1 kilogram of sugar ranged from 884 kilograms in plant crop to 1115 kilograms in ratoon crop, indicating lower water use efficiency by ratoon crop. (Carroll-FRC)
W82-00899

DEPTHS OF FLOW IN LEVEL BASINS,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens.
Transactions of the ASAE, Vol 23, No 4, p 910-913, July/August, 1980. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Water depth, *Basins, *Flow rates, Border irrigation, Irrigation, Infiltration, Mathematical studies, *Basin irrigation, Level basins.

The design of level basins is based on balancing the infiltration characteristics of the soil, the basin size, and the available irrigation stream (flow rate). Since the use of the largest possible stream available can cause excessive surface water depths in some cases, the design of level basins can also be dependent upon a practical limit on basin ridge or border height. A solution for the maximum surface water depth in level basins was developed from the zero-inertia border irrigation model developed by Strelkoff and Katopodes (1977). This model is based on continuity and momentum principles. The solution is applicable to rectangular basins irrigated from one end where the application time is less than the advance time to the end of the basin. A direct comparison of the solution results with the design charts in the Soil Conservation Service Border Irrigation Handbook demonstrates that the solutions presented in these charts can be in error by as much as 20 percent within a realistic range of field variables. (Carroll-FRC)
W82-00900

THE UNCERTAINTY OF CROP MODELS IN IRRIGATION OPTIMIZATION,

Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English.
Transactions of the ASAE, Vol 24, No 4, p 917-921, July/August, 1981. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Model studies, *Irrigation practices, Crop yield, Simulation, Weather, *Optimization, Irrigation efficiency.

This paper is concerned with economic optimization of irrigation practices. Optimization is taken to mean maximizing the net benefit realized from the unit of water used. Crop production models are considered which relate applied water to crop yield. It is noted that the relationship between the water applied and crop yield is characterized by substantial and largely unavoidable uncertainty, which may be so great as to influence a farmer's irrigation practices. A case study is presented in which the uncertainty of yield predictions is simulated for a situation involving irrigation of beans and sugar beets in southern Idaho. The consequences of that uncertainty are evaluated through the use of decision theory. A need for a probabilistic approach to crop modelling is demonstrated. Weather conditions are unpredictable. Irrigation efficiency is another source of considerable uncertainty. Crop models are needed which not only predict most probable yields, but also quantify the uncertainty in yield predictions. New models will need to emphasize statistical simulation techniques, and since statistical simulation usually involves large blocks of computer time, these models should be designed with computational efficiency in mind. The related research in agronomy, meteorology, soil science and engineering should be as concerned with variability of results as with central tendencies. Researchers concerned with water use and crop yield models need to develop an understanding of the practical applications of the variability and uncertainty of such models. (Baker-FRC)
W82-00940

LATERAL SIZES FOR EFFICIENT LEVEL-BASIN IRRIGATION,

Agricultural Research Service, Fort Collins, CO.
E. G. Kruse.
Transactions of the ASAE, Vol 24, No 4, p 961-967, 969, July/August, 1981. 3 Fig, 4 Tab, 2 Ref.

Descriptors: *Irrigation practices, *Computer programs, Irrigation efficiency, Level basins, Irrigation programs, Irrigation canals, *Grand Valley, Colorado.

A procedure is described whereby a computerized data base of irrigated fields in a section of the Grand Valley was sorted to determine those fields with deep enough soils and mild enough slopes for practical basin leveling. Level-basin irrigation is an old technique for applying water to the land for the benefit of crops. There is no runoff in such a situation, and crops such as rice are easily kept inundated. Pilot studies demonstrated that with proper management, irrigation water can be applied efficiently and good crop production obtained. The computer screens data on physical characteristics of irrigated fields and then uses Soil Conservation Service design procedures to predict the necessary irrigation flows for efficient level-basin applications. The United States Water and Power Resources Service is formulating designs for improved canals, laterals, and turnouts in a pilot area of the Grand Valley. The computer program compared required delivery rates for level-basin irrigation with turnout capacities, based on existing WPRS criteria. Those turnouts which need enlargement were thus identified. Arrangements were negotiated with WPRS to increase the sizing on critical turnouts. If level-basin procedures continue to show promise of increased irrigation efficiencies and if they are adopted widely on the pilot area, this procedure will receive widespread use in planning for the remainder of the Grand Valley and other irrigated areas in the upper Colorado River Basin. (Baker-FRC)
W82-00942

WATERTABLE MANAGEMENT SAVES WATER AND ENERGY,

Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
L. C. Benz, E. J. Doring, and G. A. Reichman.
Transactions of the ASAE, Vol 24, No 4, p 995-1001, July/August, 1981. 4 Fig, 7 Tab, 15 Ref.

Descriptors: *Irrigation efficiency, *Water table, Crop yield, Water table fluctuations, Water level fluctuations, Lysimeters, Groundwater movement, Farming, Corn, Sugarbeets, Water conservation, *North Dakota.

Water and energy savings possible by maintaining shallow watertables were investigated. The field expriment was conducted near Oakes, North Dakota, on soils of the Hecla-Arveson-Fossum Association. Soil textures range from sandy loams to loamy sands in the surface but have uniformly sandy subsoils. Corn and sugarbeets were grown for 3 years with four applied water treatments, three imposed water tables, and four replications. As it was impossible to maintain the watertable at prescribed depths in the field experiment, twelve nonweighing lysimeters were constructed near the field plot experiment. In the field plot studies where the growing season 3-year average watertables were 1.5, 2.1, and 2.4 meters deep, yields of corn grain, corn total dry matter, sugarbeet roots, and sugarbeet sucrose were higher with the 1.5 meter watertable than with the deeper watertables irrespective of irrigation water applied. Thus irrigation water and energy were wasted where the shallow watertable existed. For the 2.1 and 2.4 meter watertable depths, irrigation increased yields, but maximum yields never exceeded yields obtained with the shallow watertables. The lysimeter studies included a wider range of watertable depths than field plot experiments. At the shallowest watertable, crop yields were depressed. Regression analyses of normalized field and lysimeter data indicated that maximum yields were obtained with much less irrigation water when the watertable depth was about 1.3 meters than with deeper watertables. It was concluded that a managed shallow watertable is a valuable agricultural resource that can save significant amounts of irrigation water and energy. (Baker-FRC)
W82-00943

DRYLAND CROPPING STRATEGIES FOR EFFICIENT WATER-USE TO CONTROL SALINE SEEPS IN THE NORTHERN GREAT PLAINS, U.S.A.,

Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
A. L. Black, P. L. Brown, A. D. Halvorson, and F. H. Siddoway.
Agricultural Water Management, Vol 4, No 1/3, p 295-311, 1981. 5 Tab, 41 Ref.

Descriptors: *Water supply development, *Cropland, *Salinity, Farming, Wheat, Sunflower, Alfalfa, Water quality, Groundwater, Water resources development, Soil water, *Seepage control, *Soil-water-plant relationships.

Soil, water, and crop management strategies needed for the control of saline seeps are identified. These strategies are based on the specific water requirements and rooting depths of crops, soil water conservation and storage, crop residue management, disease and weed control and proper fertilization. Specific strategies considered include water conservation, cropping systems, weed control and residue management. Several conclusions were reached. The practice of summer fallowing a given field every other year restricts a farmer to a fixed cropping system with limited flexibility for adjusting cropping patterns to fit available water supplies. Summer fallow should be used judiciously instead of as a regular practice. Of great importance is an understanding of the quantity and depth of available water stored within the effective rooting zone in the recharge area to be cropped. Once the quantity and depth of available soil water are known, the crop best suited to a given supply of water can be selected. On deep soils, alfalfa can remove more soil water than any other adaptable crop in a 3 to 5 year period to depths of 6 meters if no root restricting factors are present. Second in

soil water use is biennial sweet clover. Of annual crops, safflower uses the most, followed in order by sunflower, winter wheat, rapeseed, spring wheat, spring barley, and corn. After available soil water is depleted to the maximum depth possible, a flexible cropping system can be employed. Methods of weed control plus provisions for snow management, leaving crop stubble standing or establishing tall wheatgrass barrier systems to trap and hold snow, all augment available water supplies. (Baker-FRC)
W82-01023

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

SUBMERSIBLE PUMPS HELP QUELL DAMAGE FROM MOUNT ST. HELENS MUDFLOW.
For primary bibliographic entry see Field 4D.
W82-00509

AQUATIC WEED CUTTING APPARATUS,
J. R. McClure.
U.S. Patent No 4,205,507, 13 p, 8 Fig, 13 Ref; Official Gazette of the United States Patent Office, Vol 995, No 1, p 44, June 3, 1980.

Descriptors: *Patents, *Aquatic weed control, *Equipment, *Channel improvement, Floating, Water quality control, Weed cutter.

A floating aquatic weed cutting apparatus is disclosed which is highly maneuverable and particularly useful for cutting along banks and around obstacles. The cutter bar is entirely outward of one of the lateral sides of a flotation device. The cutter bar may be moved about an axis parallel to the central axis of the flotation device to change the angular disposition of it for cutting along submerged banks and around obstacles in the water. The entire cutter may be elevated with respect to the flotation device to raise or lower it from or into the water. (Sinha-OEIS)
W82-00624

THE CASPIAN SEA PROBLEM,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
D. Ya. Ratkovich.
Water Resources (English Translation), Vol 7, No 5, p 393-402, September/October, 1980. 4 Tab, 20 Ref. Translated from Vodnye Resursy, No 5, p 5-20, September/October, 1980.

Descriptors: *Caspian Sea, *Water resources development, *Resources management, Water management, Planning, Management planning, River basin development, Irrigation, Hydroelectric power, Salinity, Fisheries, Hydrologic budget, Mathematical studies, Interbasin transfers.

The Caspian Sea is the world's largest closed water body, collecting water from an area of about 3 million square kilometers. The Volga River accounts for about 75% of the total natural inflow to the sea. Although the average salinity of the sea is stable, that of the North Caspian, which is freshened by the runoff from the Volga, varies considerably. The various branches of the economy place conflicting demands on the regime of the Caspian and of the rivers flowing into it. Planned irrigation projects will decrease the runoff of the Volga, Kura, and Ural rivers, reducing the energy produced by hydroelectric stations and the depth of navigation channels. Efforts to maintain the water flow for these purposes necessitates reduction of the height and duration of floods, which will adversely affect spawning conditions of sturgeon. Reduction of the inflow into the sea results in increased salinity and may induce a drop in the water level. The water management balance of rivers of the Caspian basin is already under stress. The planned diversion of waters to the Volga from rivers and lakes of the northern European U.S.S.R. should be correlated with the rate of development of irrigation in order to preserve the unique biological productivity of the sea, to prevent the unfavorable effect of drying of the North Caspian on the climate, and to reduce losses which would result from a drop in the water level of the sea. Diversion of small amounts of water from the Volga to the Ural river would have favorable effects on the North Caspian, freshening its waters and enriching its biogenic substances. Changes which will occur in the natural conditions in zones from which water is withdrawn, and problems which may result from these changes, should be carefully considered when planning interbasin water transfer projects. (Carroll-FRC)
W82-00657

BACKFILL ALTERATION EFFECTS ON PIPE DRAINAGE OF A CLAY SOIL,
Ohio Agricultural Research and Development Center, Wooster.
G. S. Taylor, S. S. Hundal, N. R. Fausey, and G. O. Schwab.
Soil Science Society of America Journal, Vol 45, No 3, p 611-616, May-June, 1981. 5 Fig, 12 Ref.

Descriptors: *Subsurface drainage, *Backfill, Permeability, Clays, Infiltration, *Drainage, Effects, *Pipes, Drawdown.

A highly permeable region was created directly over drains installed a number of years earlier in a soil of high clay content in order to determine the effect of a highly permeable backfill on drain flow rates and to assess how long the backfill would remain highly conductive under continuous row cropping. Backfill treatments included unaltered backfill; gravel backfill, in which a trench excavated above the drain was filled with a band of crushed stone placed between plow layer and drain; or trenched and refilled, in which the trench excavated above the drain was refilled with excavated soil. The effects of backfill treatments on drain flow indicated that a permeable backfill may improve drainage for soils that have a slowly permeable subsoil. The addition of gravel increased drain flow rates by a factor of two to three during periods of ponding, but had no effect on flow rates under nonponded conditions nor on water table drawdown rates. The ponded flow rates for drains with gravel have not changed after 3 years. During the first year trenching and refilling had the same effect on drain flow rates as gravel. During the second year, the ponded flow rates declined to only 50 or 60% of those with gravel. The permeable backfill functioned as a hydraulic connector and permitted ponded water to bypass the relatively impermeable subsoil in flowing to the drain. Backfill alterations did not affect sediment concentrations in the drain water. (Baker-FRC)
W82-00763

MODELING HYDROLOGY AND EUTROPHICATION IN A LOUISIANA SWAMP FOREST ECOSYSTEM,
Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
C. S. Hopkinson Jr, and J. W. Day Jr.
Environmental Management, Vol 4, No 4, p 325-335, July, 1980. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Swamps, *Storm water, *Environmental effects, Model studies, Coastal marshes, *des Allemands, *Louisiana, *Eutrophication, Hydrology, Wetlands, Urbanization, Lakes, Drainage canals, Nutrients, Levees, Productivity, Estuaries, Swamp forest, Water management.

The EPA Storm Water Management Model was applied to the des Allemands swamp forest, Louisiana, to determine (1) the hydrologic changes that would result from removal of spoil banks and diversion of major agricultural canals and (2) the effects of overland flow on nutrient uptake in the ecosystem. At present, the swamp becomes impounded and discharge from the forest to he lake is slow. Simulations showed that hydraulic management could increase discharge rates to the lower estuary by 22%, increase productivity of the swamp forest by 100%, and decrease lake eutrophication by 43%. Contrary to commonly held beliefs, the results suggest that these changes can be accomplished by removing levees and upland drainage canals. This would allow upland runoff to pass through the backswamp, often as sheet flow, increasing water level fluctuations in the backswamp and decreasing fluctations in the bayous. (Cassar-FRC)
W82-00890

4B. Groundwater Management

PLAN OF STUDY FOR THE REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-00730

INTERSTATE CONFLICT OVER GROUND WATER: WISCONSIN-ILLINOIS,
Wisconsin Univ.-Oshkosh. Dept. of Geology.
For primary bibliographic entry see Field 6E.
W82-00818

THE DECLINING GROUND-WATER RESOURCES OF ALLUVIAL VALLEYS: A CASE STUDY,
Geological Survey, Lawrence, KS.
M. Sophocleous.
Ground Water, Vol 19, No 2, p 214-226, March/April, 1981. 15 Fig, 14 Ref.

Descriptors: *Groundwater depletion, *Groundwater budget, *Water conservation, Mathematical models, Depletion, Artificial recharge, Groundwater recharge, Case studies, *Kansas.

Present and future ground water withdrawals in the area of the Pawnee Valley, Kansas, were evaluated for their impact on water resources. The depletion of the water resource in the area is documented, and a preliminary hydrologic budget for the area is calculated. Also, a mathematical model is adapted and calibrated to simulate the operation of the hydrogeologic system in order to evaluate schemes for managing the ground water resource. The average natural recharge in the area was 0.5 inch/year, and the amount of appropriated ground water in the area exceeded the natural recharge figure by about 11 times. The simulations indicated that without any additional development or without very wet periods, water level declines will continue indefinitely. To reduce water depletion it will be necessary to reduce water waste, to impose a not more than 40% saturated-thickness depletion allowance for the next several years, to impose a freeze on the number of irrigation wells, and to engage in artificial recharge. (Small-FRC)
W82-00832

TAMPA BAY WATER GUARDED BY COMPUTER,
Camp, Dresser and McKee, Inc., Clearwater, FL.
R. N. Armstrong, and H. V. Aiken.
American City and County, Vol 96, No 6, p 33-35, June, 1981. 1 Fig.

Descriptors: *Water demand, *Water resources development, Wells, *Florida, Computers, Computer models, Computer programs, Drawdown, Water supply, Water supply development, Water distribution, Monitoring, *Groundwater management, Groundwater availability, *Tampa Bay region.

Use of a specialized, innovative computer management system has succeeded in maximizing the precious water resources on the west coast of Florida in the Tampa Bay region. The computer monitors, manages, and protects groundwater sources so that critical short-term and long-term water supply demands can be met. By quickly analyzing real-time information, the monitoring and control system developed for the Cross Bar Ranch well field greatly enhances the ability of the operator to

respond to real-time conditions in the well field. In the past it may have taken several days of trial adjustment to fine tune pumping rates to bring a well field into compliance with regulatory permits. With this system wells can be connected or disconnected rapidly as demand shifts. A model was also derived for surge analysis. While surge analysis is not new, the surge model for the Cross Bar ranch field is the most complex yet devised. This system makes possible an effective analysis of the complex system of 17, three mgd wells. It also enhanced the sizing of surge tanks throughout the well field to minimize pressure waves generated by the starting and stopping of pumps. Use of the surge model saves an estimated $70,000-$80,000. (Baker-FRC)
W82-00934

MANAGEMENT OF RECHARGE BASINS ON THE SOUTHERN HIGH PLAINS,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
O. R. Jones, D. W. Goss, and A. D. Schneider.
Transactions of the ASAF, Vol 24, No 4, p 977-980, 987, July/August, 1981. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Recharge basins, *Resources management, Recharge, Groundwater recharge, *Water management, Infiltration rate, Infiltration, Groundwater movement.

Management practices were developed for recharge basins which would prevent sealing, reduce suspended solids accumulated on the basin bottom, or permit rapid removal of the sealing layer without a drying period. These practices would increase total quantity of water infiltrated and thereby reduce the cost of artificial groundwater recharge. Six 9.1 meter square basins were excavated 1.1 meters deep with a backhoe to remove slowly permeable surface soil and expose permeable Pleistocene age pluvial sediments. These exposed sediments had a clay loam texture with moderately blocky structure and a high calcium carbonate content. Basin surface treatments and management practices for each basin included: check treatment, organic mat, flocculent, high head, variable head, and corrugated. Results showed that infiltration rates were controlled at or near the basin bottom. Suspended solids in the water supply accumulated on the basin bottom and reduced infiltration rates with time. Management practices that prevented or delayed clay-layer formation at the basin bottom were effective in maintaining high infiltration rates longer, which resulted in greater total infiltration per unit area of basin surface. Infiltration rates and total quantity of water infiltrated were highest with the high-head treatment. Application of cotton gin trash to the basin surface was another effective management practice. Total infiltration per unit area of basin surface was able to be more than doubled by using improved management pratices. The combination of high-head with either the organic mat or flocculent treatment could result in even greater recharge effectiveness than any of the treatments alone. (Baker-FRC)
W82-00938

WELL-FIELD DRAWDOWNS USING COUPLED AQUIFER MODEL,

Law Engineering Testing Co., Tampa, FL.
For primary bibliographic entry see Field 2F.
W82-00990

ROLE OF SOLUTE-TRANSPORT MODELS IN THE ANALYSIS OF GROUNDWATER SALINITY PROBLEMS IN AGRICULTURAL AREAS,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W82-00993

ILLINOIS GROUNDWATER PROBLEMS AND NEEDS,

Illinois Environmental Protection Agency, Springfield. Div. of Land/Noise Pollution Control.
J. S. Moore.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 13-14.

Descriptors: *Groundwater management, *Groundwater pollution, *Waste disposal, *Coal mining, Groundwater availability, Hazardous materials, Grants, Technology, Administrative agencies, Administrative regulations, Policy making, Public opinion, Public participation, *Illinois.

Use of underground water for public and private supplies, industrial use, and irrigation is increasing in Illinois. Approximately 38 percent of the total state population and 82 percent of the rural populaton relied on an underground water source for drinking water as of 1970. A wide variety of activities can lead to groundwater pollution, includng waste disposal sites; improper well construction; land application of potential pollutants such as fertilizers, pesticides, and road salt; mining and quarrying; individual sewer systems; and transportation of hazardous wastes. Various control strategies are possible. Illinois should (1) examine state agency jurisdiction to identify over laps or gaps in existing regulations; (2) examine the role of non-regulatory and scientific entities in the state to ensure coordination between such programs; (3) increase public awareness of the importance of groundwater as a valuable natural resource and identify existing public values and perceptions of underground water; (4) encourage public participation in program direction and development; (5) utilize the interagency groundwater task force to increase cooperation among involved state agencies on groundwater related strategies, determine the availability of data to decision-makers and identify technological practices; and (6) continue development of a comprehensive groundwater quality management program. Funds and technology-sharing must be sought from the federal government. (Garrison-Omniplan)
W82-01052

GROUNDWATER POLLUTION IN KENTUCKY: A STATUS REPORT,

Kentucky Dept. for Natural Resources, Frankfort.
J. C. Thornton.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 17-21, 2 Fig, 5 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, Water pollution, Karst, *Waste disposal, Hazardous materials, Poisons, Groundwater availability, Sinks, Septic tanks, Seepage pits, Underground streams, Drinking water, *Water pollution control, *Kentucky.

The Commonwealth of Kentucky has had a number or problems with contaminated groundwater, particularly related to improper waste disposal practices and to problems in oil and coal fields. Many of the existing major problem areas are located within the state's widespread areas of jointed, fractured limestone, which is very susceptible to the formation of solution channels and sinkholes. This kind of topography, known as karst, covers almost 50 percent of the state and is replete with underground streams and caves. Underground streams are particularly sensitive to contamination because they flow in channels that have a much higher velocity than normal groundwaters, and receive little or no filtration from the rock. If the contamination is stopped, these systems will flush out quickly, but in most cases the sources of contamination are relatively permanent. The major drinking water source throughout the largely rural karst area is groundwater. The Department for Natural Resources and Environmental Protection's Division of Water began assessing groundwater quality problems under the auspices of Section 208 of the Clean Water Act, and learned that one of the major causes of groundwater pollution in the state is improperly designed septic tanks and seepage pits. Other causes are sediment, agrichemicals, septic tank loadings, surface mining, oil and gas production, brine disposal, construction activity, and spills. Principal needs of the Division include quality research data for each aquifer, more trained personnel for groundwater management, and regulation for groundwater monitoring, well construction, and subsurface disposal. (Garrison-Omniplan)
W82-01033

GROUND WATER IN THE OHIO RIVER BASIN PORTION OF MARYLAND: PROBLEMS AND NEEDS,

Maryland Dept. of Natural Resources, Annapolis.
E. C. Rebuck.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. P 22-26.

Descriptors: *Surface-groundwater relations, *Groundwater management, Federal jurisdiction, *Administrative regulations, State jurisdiction, *Aquifer management, Administrative agencies, Groundwater depletion, Groundwater level, Acid mine drainage, Mine acids, Hydrologic models, *Ohio River basin, *Maryland, Garrett County.

The Ohio River Basin portion of Maryland lies wholly within Garrett County, an area rich in minerals where the primary surface water resources are the Youghiogheny River and the Casselman River. While the two rivers have been shown to have good water quality, smaller tributaries do not meet stream water quality standards due to acid mine drainage pollution. Springs are important sources of domestic and municipal ground water supplies in the county. Hydraulic connection between the streams and ground waters is poorly understood. The U. S. Geological survey is pursuing a modeling study in the Casselman River Basin which will attempt to correlate base stream flow with ground water levels. On the state level, programs for ground water protection are administered by the Department of Water Resources and the Department of Health and Mental Hygiene. On the federal level, the Environmental Protection Agency is involved with activities covered by the Resources Conservation and Recovery Act of 1976, the Underground Injection Control program in the Safe Drinking Water Act (SDWA), and the sole source aquifer protection program of SDWA. Perhaps the most important technical need is the updating of the 1954 water resources reported by the USGS. Another need is better coordination among federal and state environmental regulatory efforts, especially now in times of tight economic conditions where environmental control budgets may be cut at both federal and state levels. (Garrison-Omniplan)
W82-01054

GROUNDWATER PROBLEMS AND NEEDS IN NEW YORK,

New York State Dept. of Environmental Conservation, Albany.
A. C. Tedrow.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 27-29.

Descriptors: *Groundwater management, *Drinking water, *Groundwater availability, *Groundwater pollution, Research priorities, Administrative agencies, *Administrative regulations, Waste disposal, Water management, Reclaimed water, State jurisdiction, Local governments, Brine disposal, *New York.

A Groundwater Task Force convened in 1979 by the New York State Department of Environmental Conservation examined in-house groundwater management programs. Among its conclusions were that: (1) not enough is known about the resource itself, specifically with regard to current quality levels; (2) monitoring of changes in groundwater quality is adequate, so that violations of groundwater quality standards are often not discovered until they have created a problem; (3) oil and gas and mined land reclamation progrems in the Department are understaffed, so that groundwater impacts of the activities they regulate receive insufficient attention; (4) the Department should support local efforts in managing groundwater; (5) research is needed on groundwater reclamation and renovation; (6) Department personnel must be trained to be more sensitive to groundwater concerns, and technical staff must be developed to deal with groundwater questions; (7) a

classification system should be considered that includes fresh groundwater uses other than drinking water; (8) the possibility of utilizing wasteload allocations for discharges to groundwater should be explained; and additional groundwater management activities are required in the upstate area. Under the 208 program, projects are underway to investigate the technical, institutional, and financial aspects of changes in groundwater management, to develop better controls over underground storage of hazardous materials, and to investigate pesticide and fertilizer application practices in relation to groundwater quality. In the Ohio River Basin area, there are problems with high nitrate levels and brine disposal. (Garrison-Omniplan)
W82-01055

GROUNDWATER PROBLEMS IN NORTH CAROLINA,

North Carolina Dept. of Natural Resources and Community Development, Raleigh.
P. F. Nelson.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 30-31.

Descriptors: *Groundwater management, Public opinion, *Deep wells, *Groundwater availability, *Legislation, State jurisdiction, Attitudes, Administrative agencies, Long-term planning, Multiobjective planning, Surface-groundwater relations, Boreholes, *North Carolina.

Planning for developing groundwater resources is not currently a very sophisticated process in North Carolina. Although much work has been done in the past to describe the hydrologic characteristics of the Coastal Plain aquifers, very little is known about the development potential in the Piedmont and mountain regions. Lack of knowledge of the availability of the resource, and widespread misunderstanding of groundwater on the part of the public, has resulted in its under-utilization in many areas. A hesitancy to drill deep wells prevails, although there is mounting evidence that contrary to public opinion, 600- and 700-foot wells are often extremely more productive than the borehole drilled to 175 feet. North Carolina's needs with respect to groundwater protection and wise management are: (1) recognition of the need for a comprehensive groundwater program; (2) prompt statewide implementation of the Groundwater Classification and Quality Standards; (3) an effective Water Well Contractors Licensing Board to examine and approve operators as well as contractors; (4) improved groundwater management legislation, as the existing Act is cumbersome to employ and has the potential of creating a 'patchwork quilt' of water management areas. The need to become more involved in groundwater research in the fractured rock terrain is becoming more and more critical as Piedmont cities exhaust their available surface water resource. (Garrison-Omniplan)
W82-01056

OHIO'S GROUND WATER RESOURCES AND PROBLEM AREAS,

Ohio Environmental Protection Agency, Columbus. Groundwater Div.
R. B. Stein.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 32-33.

Descriptors: *Groundwater availability, *Groundwater management, *Groundwater pollution, Water pollution, Wells, Waste disposal, Poisons, Multiobjective planning, Water use, Competing use, Long-term planning, Legislation, State jurisdiction, Administrative regulations, Public policy, *Ohio.

Ohio's ground water reserves, while abundant, are unequally distributed. Ground water quantity problems can be attributed to cyclic drought conditions. Conflicts between groundwater users have been noted in a number of areas and are usually the result of well interference between two or more large users or one large user affecting water levels in nearby shallow wells. For the most part, the problems have been resolved voluntarily by adjusting pumping rates and schedules, or by developing additional production wells beyond the area of pumping interference. Ohio, being a densely populated and highly industrial state, generates large volumes of both liquid and solid wastes. Based upon groundwater complaint investigations conducted by the Ohio EPA over the past eight years, the most prevalent ground water contamination problems are from domestic on-lot sources affecting private individual wells. Contamination has most often been the direct result of poor well construction and maintenance, or improper well abandonment. Other leading causes of contamination have been salt water effects related to oil and gas production or improperly plugged oil wells, and coal leaching effects. Ohio's major concerns in ground water program planning are to define agency roles and coordinaton, determine staff capability and training, develop public education and awareness, and increase data collection and regulatory practices. (Garrison-Omniplan)
W82-01057

PENNSYLVANIA GROUND WATER PROBLEMS AND NEEDS,

Pennsylvania Dept. of Environmental Resources, Harrisburg.
R. T. Weston.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 34-40.

Descriptors: *Groundwater management, *Long-term planning, *Groundwater availability, *Groundwater pollution, Water pollution, Coal mining, Data collection, Administrative regulation, *Legislation, Public policy, State jurisdiction, Drinking water, Multiobjective planning, *Pennsylvania.

Over half of Pennsylvania' public water supply systems obtain all their water from ground water aquifers, and another 13 percent meet part of their demands with ground water. Potentials for conflict among competing water users are growing. As water needs grow, ground water will fill an increasing part of the demand. Ground water planning is hampered by limited use data and incomplete hydrogeologic information, but several problem areas have been identified. Some Triassic basins are extremely susceptible to drought, and recharge slowly after heavy withdrawal. Interference between public and private withdrawals, such as overlapping cones of depression between neighboring wells or pumping operations, is another problem area. Mining operations frequently dewater large areas. In water quality preservation, problem areas include malfunctioning on-lot sewage systems, inadequately designed or operated waste disposal facilities, leaking storage tanks and pipelines, transportation accidents, poorly operated agricultural activities, roadways and parking lots where runoff infiltrates the ground, past or current mining, and oil and gas recovery operations. Acid drainage from bituminous coal mining is a problem in some areas. Pennsylvania has no comprehensive legal or institutional approach to water allocation. Common law often operates contrary to hydrologic fact, treating interrelated ground and surface water resources under separate and inconsistent rules. State authority to regulate water allocation is extremely narrow. A reform of State water management policy is proposed, and fourteen major goals are outlined. (Mantius-Omniplan)
W82-01058

GROUND WATER PROBLEMS VIRGINIA PORTION OHIO RIVER BASIN,

Virginia State Water Control Board, Richmond.
A. H. Giles.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 42-62. 16 Fig.

Descriptors: *Groundwater management, River basins, Geohydrology, *Groundwater pollution, Water pollution, *State jurisdiction, Rivers, Groundwater availability, Underground stream, Coal mining, Aquifers, Aquifer management, Aquifer characteristics, *Ohio River basin, *Virginia.

The area drained by the headwaters of several Ohio River tributaries in southwestern Virginia covers three geologic/physiological provinces with somewhat rugged terrain, some broad valleys and moderate climate and rainfall. Generally ground water is abundant and of good quality but hard in the limestone aquifers of the Valley and Ridge Province. In the flood plain alluvium of the Valley and Ridge and Piedmont it is moderately abundant, and in the Piedmont, Valley and Ridge and cumberland Plateau's soils and rocks other than limestone it is of relatively small yield. Faulting and fraction enhances production. Some surface pollution has been reported in limestone aquifers in the Valley and Ridge, which are especially susceptible to pollution. In the Cumberland Plateau, ground water pollution and loss of supply potentially are associated with natural gas and coal extraction activities, and most deeper aquifers are naturally salty. Metal mining elsewhere threatens ground water quality. The most serious pollution problems throughout the area are from petroleum product storage tank leaks and spills, waste facilities, and local urbanization. Effects of salt water and gas invasion have been observed in the Cumberland Plateau. The State Water Control Board has been effective in local pollution response, waste facility evaluation and well site evaluation. For most of the area, ground water information is minimal, but in some areas, county-wide ground water reports are being published. (Garrison-Omniplan)
W82-01059

GROUND WATER PROBLEMS IN WEST VIRGINIA,

West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
J. Northeimer.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 63-75. 1 Fig, 2 Tab, 2 Append.

Descriptors: *Groundwater management, *Groundwater pollution, Water pollution, State jurisdiction, *Administrative regulations, Public policy, Drinking water, *Legislation, Federal jurisdiction, Groundwater availability, Long-term planning, Multiobjective planning, *West Virginia.

Approximately 53 percent of the population of West Virginia obtains drinking water from ground water sources; however, historically there has been very little effort devoted to its protection and maintenance. Although the state ground water protection program is still in the developmental stage, participation in the various federal programs addressing ground water is providing the necessary resources for an effective regulatory framework. As the state assumes authorization for implementing these programs, the proper management of ground water will become a reality. Major limiting factors in the development of an adequate ground water management program at the state level are poorly developed control programs authorized under state statute, no central or coordinating regulatory approach or strategy, lack of initiative under the 106 program, no comprehensive monitoring network, no regulatory control over ground water development, and lack of adequate state-level funding. Statutory changes are currently being pursued at the state level to allow state implementation of federal programs which address ground water protection and maintenance, such as the Hazardous Waste Management Program under the Resource Conservation and Recovery Act, and the Underground Injection Control Program under the Safe Drinking Water Act. (Garrison-Omniplan)
W82-01060

MATHEMATICAL MODELING TECHNIQUES FOR GROUNDWATER MANAGEMENT,

Prickett (Thomas A.) and Associates, Urbana, IL.
T. A. Prickett.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 97-104. 170 Ref.

Descriptors: *Mathematical models, *Groundwater management, *Data collections, *Model studies, Hydrologic models, Hydrologic data collections, Digital computers, Computers, Multiobjective planning, Long-term planning, Decision making, Data acquisition, Numerical analysis.

Mathematical modeling has served an important role in groundwater management. Mathematical groundwater models provide a broad range of techniques for analysis of groundwater problems, including not only sophisticated numerical techniques solved with digital computers but analytical formulas worked out with desk calculators, type curves, and a table of well functions. Despite the dominance of numerical model development in the 1970s, new analytical formulas continue to be found in the recent literature. Numerical and analytical models developed to date are impressive. Also, computational devices are readily available in all ranges of price and capability. However, progress is needed that involves (1) making present and future models more useful by adequately documenting codes and procedures for their application (2) developing a large group of models aimed at solving problems in the range of simple to moderate complexity; and (3) developing models and techniques that produce results that managers can understand. Based on a survey on modeling inadequacies conducted by Bachmat (1978), the major problem with existing groundwater models was that few are documented sufficiently to be useful. The development of more simple and moderately complex models should also be keyed to quick evaluation of many alternatives. A group of educational materials is needed to help managers understand the purposes, capabilities, and results of mathematical models. (Garrison-Omniplan)
W82-01062

4C. Effects On Water Of Man's Non-Water Activities

SESTON DYNAMICS IN SOUTHERN APPALACHIAN STREAMS: EFFECTS OF CLEAR-CUTTING,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
M. E. Gurtz, J. R. Webster, and J. B. Wallace.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 624-631, April, 1980. 7 Fig, 4 Tab, 28 Ref.

Descriptors: *Clear-cutting, *Logging, *Seston, *Forest watersheds, Forest management, Road construction, *Streams, Suspended sediments, Suspended solids, Sediment transport, Seasonal variation, Storm runoff, Litter, Organic matter, Particle size, Particulate matter, Southern Appalachian streams.

Two second order streams of the southern Appalachian Mountains where heavy logging activities are practiced were studied for suspended particulate matter (seston) from July 1977 to July 1978. In the stream, which drains an undisturbed hardwood forest watershed, seston levels varied with storm flows and were lowest during winter high flows. In this stream, the majority of the organic and inorganic particles were less than 105 microns in diameter. In the stream draining a forest watershed that was clearcut in 1977, increased levels of both organic and inorganic seston were found. Most of the inorganic seston of this stream was made up of particles greater than 235 microns in diameter. These increases were attributed to sediments deposited during the building of logging roads and debris entering the stream during logging activities. The rate of stream recovery will probably depend on the rate of recovery of the surrounding terrain. (Geiger-FRC)
W82-00543

THE INFLUENCE OF PLANT COMMUNITIES UPON THE HYDROLOGY OF CATCHMENTS,

Flinders Univ. of South Australia, Bedford Park. School of Earth Sciences.
For primary bibliographic entry see Field 2D.
W82-00931

4D. Watershed Protection

SUBMERSIBLE PUMPS HELP QUELL DAMAGE FROM MOUNT ST. HELENS MUDFLOW,

Public Works, Vol 112, No 7, p 62-64, July, 1981. 3 Fig.

Descriptors: *Damage, *Flooding, *Volcanoes, *Submersible pumps, Dredging, *Mt. St. Helens, *Mudflows, Disasters, Pumps, Wastewater treatment, Water treatment facilities, *Castle Rock, Washington, Storm water.

The eruption of Mount St. Helens caused damage to the water supply and wastewater treatment works in the town of Castle Rock, 40 miles from the volcano at the confluence of the Cowlitz and Toutle Rivers. The water supply intake was plugged with ash and debris, as were all sewage and stormwater discharge outfalls. Piping was rearranged to pump the effluent over the levee into the river. Submersible pumps were used to drain the equipment and the land behind the dikes and to pump storm water from a collection point and from a street manhole. Submersible pumps were also used to return water from dredged silt piles to the river. This pump arrangement will help protect the town from serious flooding. (Cassar-FRC)
W82-00509

LAND FORMING EFFECTS ON DRYLAND SORGHUM PRODUCTION IN THE SOUTHERN GREAT PLAINS,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 3F.
W82-00764

COORDINATED EFFORT STEMS SEDIMENT AND EROSION,

Anne Arundel County Dept. of Public Works, Annapolis, MD.
D. L. Kaiser.
Public Works, Vol 112, No 7, p 54-55. July, 1981. 3 Fig.

Descriptors: *Soil conservation, *Erosion control, *Sedimentation, Conservation, *Anne Arundel County, *Maryland, Regulations, Legal aspects, Inspection, Chesapeake Bay, Soil stabilization, Permits, Grading.

Soil conservation policies are carried out in Anne Arundel County, Maryland, by the Department of Inspection and Permits, the Soil Conservation District, and the Department of Public Works. Prior to construction, a grading permit must be obtained and all plans approved. A bond or similar security is required for projects disturbing more than 15,000 sq ft of surface area. Inspections are made on site, and over 95% of violations are corrected before any notice needs to be issued. However, the mandated program review of the conservation program in 1974 and 1978 showed some inadequacies. This resulted in guidelines suggesting greater interagency communications, a new procedures manual, stricter enforcement of sediment control, and preconstruction conferences. More recently, stabilization for projects lasting over 45 days has been required. (Cassar-FRC)
W82-00766

COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,

Idaho Univ., Moscow. Dept. of Agricultural Economics.
D. J. Walker, and J. F. Timmons.
Journal of Soil and Water Conservation, Vol 35, No 3, p 177-183, July/August, 1980. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Farm management, *Soil conservation, *Sedimentation, *Erosion control, Soil erosion, Nishnabotna River, Iowa, Regulations, Cost-benefit analysis, Agricultural watersheds, Taxes, Land use, Economic aspects, Subsidies.

Soil erosion and sediment discharge reduction programs in agricultural land (study area Nishnabotna River basin, Iowa) were evaluated by linear programming. The most cost-effective policy among the 141 individuals solutions was the dual ban on fall plowing and straight row cultivation on slopes. Several strategies were effective in reducing soil losses by 50%--a ban on fall plowing, a soil loss tax of 10-20 cents per ton, and a subsidy for minimum tillage. These three alternatives entailed income penalties of 2-3%. More restrictive policies were capable of reducing soil loss up to 90%--a dual ban on fall plowing and straight row cultivation on slopes, an annual soil loss limit of 5 tons per acre, and a soil loss tax of $0.50-1.50 per ton. Income penalties on these schemes were less than 14%. (Cassar-FRC)
W82-00869

ANSWERS: A MODEL FOR WATERSHED PLANNING,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6A.
W82-00898

TRACTIVE FORCE DESIGN OF VEGETATED CHANNELS,

Science and Education Administration, Stillwater, OK. Water Conservation Structures Lab.
D. M. Temple.
Transactions of the ASAE, Vol 23, No 4, p 884-890, July/August, 1980. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Tractive forces, *Vegetation effects, *Channel flow, Mathematical studies, Design criteria, Turbulent flow, Flow resistance, Open channels, *Erosion control, Mathematical models.

Previous research designed to evaluate the value of a vegetal channel lining as an erosion control measure has established a relatively large data base for use in the development of semi-empirical design procedures. This report updates these design procedures by presenting a method for the application of tractive force principles to the design of vegetated channels. The allowable velocity approach currently used is related not only to soil properties, but also to the vegetal and geometric properties of the channel, requiring tabulation of each possible combination of channel slope, soil, and vegetal cover through separate consideration of the properties of soil and of vegetation. The proposed tractive force design procedure substantially simplified the investigation and tabulation of critical or allowable conditions by permitting separate consideration of the properties of soil and those of the vegetation. The protective value of vegetal channel lining is considered to be derived from two related interactions of the vegetation with the flow field: the generation of turbulent eddies at a significant distance from the soil boundary, creating an increase in flow resistance, and a change in the structure of the turbulent eddies in immediate proximity to the boundary. Two indices believed to relate directly to these interactions are used to classify the vegetation. Guidelines for the selection of these indices according to type and quality of cover are presented. Existing flow resistance curves are put into equational form as a single curve family. The design procedure is directly adaptable to programmed calculation, allowing the incorporation of optimization routines at little additional expense. (Carroll-FRC)
W82-00901

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

GAS CHROMATOGRAPHIC DETERMINATION OF TRIALKYL/ARYL PHOSPHATES IN DRINKING WATER, FOLLOWING ISOLATION USING MACRORETICULAR RESIN,

Health and Welfare Canada, Ottawa (Ontario). Monitoring and Criteria Div.
G. L. LeBel, D. T. Williams, and F. M. Benoit.
Journal of the Association of Official Analytical Chemists, Vol 64, No 4, p 991-998, July, 1981. 4 Fig, 5 Tab, 12 Ref.

Descriptors: *Ion exchange, *Organophosphorus compounds, *Water analysis, Phosphates, Pesticides, Drinking water, Gas chromatography, Phosphorus compounds, *Pollutant identification.

An XAD-2 screening method developed for organophosphorus pesticides was applied to the determination of trialkyl and triaryl phosphates in drinking water at the ng per liter level. Recovery studies at levels of 1, 10, and 100 ng per liter were carried out by fortification onto XAD-2 resin and by direct on-stream fortification of drinking water. Recoveries for several phosphates using direct fortification were as follows: trialkyl, 19.9-28.9%; tributyl, 88.2-101.2%; tris(2-chloroethyl), 82.9-95.5%; tri(2-ethylhexyl), 61.7-78.8%; tributoxyethyl, 104.5-125.6%; triphenyl, 95.0-107.4%; and tricresyl, 95.0-98.1%. Recoveries by continuous fortification were on the same order, with some exceptions. Drinking water samples from 6 Ontario water treatment plants contained several trialkyl and triaryl phosphates at 0.2 to 75 mg per liter levels, uncorrected for incomplete recoveries. (Cassar-FRC)
W82-00502

THIN LAYER CHROMATOGRAPHIC AND ATOMIC ABSORPTION SPECTROPHOTOMETRIC DETERMINATION OF METHYL MERCURY,

California Univ., Los Angeles. School of Public Health.
L. W. Margler, and R. A. Mah.
Journal of the Association of Official Analytical Chemists, Vol 64, No 4, p 1017-1020, July, 1981. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Methylmercury, Mercury compounds, *Pollutant identification, Thin layer chromatography, Atomic absorption spectrophotometry, Sludge, Fish.

Methyl mercury was determined by a combination of thin layer chromatography and atomic absorption spectrophotometry at 253.7 nm. The samples were first distilled with hydrochloric acid and copper sulfate and extracted twice with dithizone-chloroform, followed by chloroform. Dehydration and concentration preceded the chromatography procedure. Samples of tuna, trout, and anaerobically digested sewage sludge were analyzed; methyl mercury contents were 0.056 micrograms per g, 5.26 micrograms per g, and 0.012 micrograms per ml, respectively. Spiking showed that 90% of the methyl mercury was recovered from tuna and 73% from sewage sludge. The method was sensitive to 0.7 ng in the total Hg determination and 0.009 micrograms Hg per g in 100 g samples. (Cassar-FRC)
W82-00503

ENVIRONMENTAL VIROLOGY AND ITS PROBLEMS,

Severn-Trent Water Authority (England).
R. Morris, and W. M. Waite.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 232-244, May, 1981. 9 Ref.

Descriptors: *Viruses, *Water supply, *Public health, Culturing techniques, Potable water, Drinking water, Pollutant identification, Enteroviruses, Diseases, Microbiological studies, Water treatment, Severn-Trent Water Authority, *Great Britain.

Virus assays of waters in the Severn-Trent Water Authority jurisdiction showed that 135 (49%) of 276 surface water samples were positive, the highest level being detected being 337 pfu per liter from the River Tame. Heavily polluted rivers were 88% positive, and stored river water samples were 21% positive. Virus was present in 55% of 132 wastewater effluent samples: the highest recovery value was 5800 pfu per liter. A monkey kidney cell line, designated BGM, was the most suitable cell line tested for virus detection. The suspended cell technique gave higher recoveries than tube culture or the monolayer technique. No direct correlation was found between numbers of viruses in water and any of the bacterial indicator organisms or coliphages. Although there have been no reports of viral infections transmitted through public water supplies in the United Kingdom for many years, the Virology Unit has been established at the water authority to monitor drinking water, abstracted surface waters, and waste water effluents, and to develop more efficient and sensitive techniques for isolating and enumerating viruses. This paper includes background information on the history, character, growth, recovery and identification techniques, classification, diseases, vaccines, and survival in the water system. (Cassar-FRC)
W82-00505

R FACTORS IN COLIFORM-FECAL COLIFORM SEWAGE FLORA OF THE PRAIRIES AND NORTHWEST TERRITORIES OF CANADA,

Environmental Protection Service, Edmonton (Alberta). Microbiology Lab.
J. B. Bell, W. R. Macrae, and G. E. Elliot.
Applied and Environmental Microbiology, Vol 42, No 2, p 204-210, August, 1981. 6 Tab, 23 Ref.

Descriptors: *Coliforms, *Drugs, *Sewage bacteria, Bacteria, Escherichia coli, Public health, Canada, Raw water, Treated water.

The comparative antibiotic resistance and R factors were assessed in the coliform and fecal coliform populations found in raw and treated sewage. Results showed that 8.91% of the total coliform and 10.80% of the fecal coliform populations carried R factors. The following numbers of combinations of R determinants were found: 39 in Escherichia coli, 6 in Citrobacter, 20 in Enterobacter, 10 in Klebsiella, and 11 in Aeromonas. Seven was the maximum number of R determinants transferable simultaneously, and organisms with R factors containing determinants for chloramphenicol usually contained determinants for ampicillin. From 2 to 4% of the coliforms and fecal coliforms were resistant to chloramphenicol, and from 17 to 30% of the populations were resistant to three or more antibiotics. Final effluent discharges to the environment contained R factor carrying coliform populations of 3.1 times 10 to the 4th power/100 ml and fecal populations of 5.8 times 10 to the 2nd power/100 ml. The maximum removal of R positive bacteria from sewage before its discharge into the environment is desirable, as this may be a factor in the reduced effectiveness of antibiotics. (Small-FRC)
W82-00508

MONITORING TRACE AMOUNTS OF CADMIUM IN NATURAL WATERS,

Brandon Univ. (Manitoba). Dept. of Chemistry.
K. Srikameswaran, H. D. Gesser, and M. Venkateswaran.
Journal of Environmental Science and Health, Part A, Vol 15, No 4, p 323-337, 1980. 2 Fig, 4 Tab, 5 Ref.

Descriptors: *Cadmium, *Trace metals, Natural waters, Water analysis, *Pollutant identification, Chelating agents, Heavy metals, Monitoring.

Cadmium may be determined semiquantitatively in trace amounts in water by using 1-(2-pyridylazo-2) naphthol loaded polyester foams. This chemical is a good complexing agent in the pH 7-8 range, forming a visible orange complex with Cd. The apparatus is operated by squeezing a piece of prepared foam with a piston in a tank of water. Cd concentrations of 3.7, 7.9, 18.6 and 55.9 micrograms per liter were used to determine the amount of Cd extracted by the chemically treated foams in a given number of squeezes (250-1500). Results varied from 5 micrograms Cd from water at 3.7 micrograms per liter concentration and 250 squeezes to 200 micrograms Cd from water at 55.9 micrograms per liter concentration and 1500 squeezes. A plot of Cd extracted per squeeze vs. number of squeezes produced a straight line for each concentration tested. The concentration of Cd in unknown waters may be estimated from a graph plotting Cd concentration against micrograms Cd extracted per squeeze. Other heavy metal ions (Zn, Pb, Cu, and Fe at 100 microgram per liter levels) had no significant effect on the results. (Cassar-FRC)
W82-00516

INDUSTRIAL EFFLUENT MONITORING INCORPORATING A RECENT AUTOMATED FISH BIOMONITORING SYSTEM,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
D. Gruber, and J. Cairns, Jr.
Water, Air, and Soil Pollution, Vol 15, No 4, p 471-481, May, 1981. 4 Fig, 38 Ref.

Descriptors: *Bioindicators, *Effluents, *Industrial wastes, *Pollutant identification, Fish, Fishkill, Water quality control, Monitoring, *Munitions wastes, Respiration, Water pollution effects, Toxicity, Ammunition plant, Radford, Virginia.

A series of experiments is described which implies that the present concept of automated and continuous biological monitoring is capable of detecting an industrial spill from an ammunition manufacturing plant. The sampling facility is located on site at a US Army Ammunition Plant in Radford, Virginia. Bluegill sunfish, Lepomis macrochirus Raf., served as sensors. Each fish is monitored within individual 6 liter monitor tanks. Twenty-four similar monitor tanks are housed within a compartmentalized module. A minicomputer system converts analog signals into digital information and uses a modified peak-picking program to quantify the frequency of ventilation for each fish over time. Chemical and physical parameters of the effluent are also continuously monitored and interfaced with the computer system. The alarm system consists of a display panel with lights and a bell system within the computer's keyboard. In a 48 hr static bioassay test, the concentration of roll powder effluent which killed half the fish was 25%. However, during a subsequent exposure, all fish survived in 100% effluent. All exposed animals significantly altered their ventilatory behavior within 30 minutes after the initial introduction of the effluent. All which survived had ventilatory rates return to normal within several hours after the effluent exposure ceased. Nitroglycerin was detected at 1.2 ppm in monitor tanks in a water sample taken during a specific time period. Concentrations of DEP and lead were also determined. (Baker-FRC)
W82-00530

A STUDY OF SAMPLES OF WELL WATER COLLECTED FROM SELECTED AREAS IN CALIFORNIA TO DETERMINE THE PRESENCE OF DBCP AND CERTAIN OTHER PESTICIDE RESIDUES,

California Dept. of Food and Agriculture, Sacramento.
S. A. Peoples, K. T. Maddy, W. Cusick, T. Jackson, and C. Cooper.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 611-618, 1980. 3 Tab.

Descriptors: *Agriculture, *Agricultural chemicals, *Organic compounds, *Pesticide residues, *Water sampling, *Irrigation, Carcinogens, Wells, *Well water, Water pollution, Toxicity, Chemical analysis, Crop production, Well data, Soil contamination, Soil analysis.

A survey of possible soil and well-water contamination with DBCP and other pesticide residues

was conducted in selected California counties in 1979. Liquid 1,2-dibromo-3-chloropropane was used as a soil nematicide in California until 1977, when it was banned as a potential carcinogen. In Yolo County all well-water samples were negative. In Ventura and Riverside County wells, samples were also negative. Samples from the east of San Joaquin Valley exhibited contamination in 50% of the wells, primarily those less than 100 feet deep. The route by which DBCP contaminates water supplies is not known. (Titus-FRC)
W82-00532

DETERMINATION OF TERBUTRYN AND ITS DEGRADATION PRODUCTS IN WATER, SEDIMENTS, AQUATIC PLANTS, AND FISH,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir.
Journal of Agricultural and Food Chemistry, Vol 28, No 4, p 714-719, July/August, 1980. 4 Fig, 4 Tab, 18 Ref.

Descriptors: *Chemical analysis, *Water, *Terbutryn, Chromatography, Agricultural chemicals, *Herbicides, Ponds, Aquatic plants, Degradation, Farm ponds.

A method for the determination of terbutryn and several of its degradation products, N-deethylated terbutryn (DET), hydroxyterbutryn (HT), N-deethylated hydroxyterbutryn (DEHT), 2-(tert-butylamino)-4-(ethylamino)-s-triazine (EBT), and 2-(tert-butylamino)-4-amino-s-triazine (ABT), is reported. Water samples were extracted with dichloromethane. Sediment, aquatic plant, and fish tissue samples were extracted with aqueous acetonitrile. The hydroxytriazines were isolated by chromatography on a cation-exchange resin and cleanup on alumina and by high-pressure liquid chromatography. Recoveries of terbutryn, DET, HT, DEHT, ABT, and EBT from water (0.5 - 50 micrograms/liter) ranged from 76 to 120%. Terbutryn and DET recoveries from sediment, plants, and fish tissues (0.05 - 0.9 micrograms/gram) ranged from 74 to 106%. HT and DEHT recoveries from sediment, plant material, and fish tissue (0.1 to 1.23 micrograms/gram) ranged from 62 to 124%. (Baker-FRC)
W82-00567

SEARCH FOR LINURON RESIDUES IN TRIBUTARIES OF THE CHESAPEAKE BAY,

Du Pont de Nemours (E. I.) and Co., Wilmington, DE. Dept. of Biochemicals.
E. W. Zahnow, and J. D. Riggleman.
Journal of Agricultural and Food Chemistry, Vol 28, No 5, p 974-978, September/October, 1980. 6 Fig, 4 Tab, 14 Ref.

Descriptors: *Agricultural chemicals, *Aquatic plants, Bays, *Herbicides, *Chesapeake Bay, Tributaries, *Linuron, Leaching.

The possible transfer of linuron from farm fields into the Chesapeake Bay was examined using extraction with acetonitrile followed by liquid chromatography. In the sampling area the principal usage of linuron is on soybeans at 0.55 kg/ha. Treatment is made between mid-May and early July. The first sampling followed the first major rain at the end of the treatment season. The second sample was taken 2 months later. Mud, soil and water samples were taken. The analysis of mud and water samples taken during the two successive summers showed no evidence of linuron accumulation. Samples from drainage basins receiving up to 43,000 kg of linuron annually showed no linuron residue, i.e., less than 10 ppbw in the mud and less than 0.2 ppb, w/v in the water. On this basis it was concluded that linuron usage on fields bordering Chesapeake Bay waters and its tributaries is not a contributing factor to the recent declines in the abundance of aquatic plants in the area. (Baker-FRC)
W82-00569

EVALUATION OF VARIOUS SOIL WATER SAMPLERS FOR VIROLOGICAL SAMPLING,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
D-S. Wang, J. C. Lance, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 39, No 3, p 662-564, March, 1980. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Sampling, *Viruses, Water quality, Drinking water, Wastewater, Effluent, *Soil water, Water analysis.

Various types of ceramic soil water samplers were evaluated for virus sampling. Both tap water and sewage effluent were used in the study. Secondary sewage was collected from the effluent of an activated sludge treatment plant before chlorination. The tap water was dechlorinated with sodium thiosulfate before use. Poliovirus 1 (strain LSc), echovirus 1 (strain V239), bacteriophage T2, and bacteriophage MS-2 were added to water samples for the experiments. Before sampling, 500 ml of water was seeded with virus to obtain a concentration of 100,000-1,000,000 plaque-forming units per ml. The percentage recoveries of viruses in water samples after passage through the three samplers was determined. To test the possibility that particulate matter present in the water sample could influence the passage of virus through the samplers, the recovery of virus from both unfiltered and filtered water samples was compared. In general, no significant difference in virus recovery was observed between unfiltered and filtered samples. Soil water samples obtained from both the ceramic cup soil water sampler and the porous ceramic tube exhibited low recoveries of poliovirus and bacteriophage T2. Recoveries of MS-2 and echovirus 1 were substantially higher. The ceramic sampler constructed in the laboratory performing the investigation was consistently superior to the two commercially available soil water samplers tested. (Baker-FRC)
W82-00572

SIMULTANEOUS CONCENTRATION OF SALMONELLA AND ENTEROVIRUS FROM SURFACE WATER BY USING MICRO-FIBER GLASS FILTERS,

Nancy-1 Univ. (France). Lab. d'Hygiene et de Recherche de la Sante Publique.
D. Rolland, and J. C. Block.
Applied and Environmental Microbiology, Vol 39, No 3, p 659-661, March, 1980. 2 Tab, 6 Ref.

Descriptors: *Bacteria, *Surface water, *Salmonella, *Enteroviruses, Filters, Viruses, Monitoring, Recreation facilities, Water quality, Bacterial analysis.

Surface waters were sampled at weekly intervals in January 1979 from the Meurthe River, 8 km south from the city of Nancy, France. Salmonella testing was conducted using a micro-fiber glass filter of 8 micrometers porosity, at pH 3.5. Simultaneous concentrations of Salmonella and enterovirus were determined. Quantitative analysis indicated that Salmonella and viruses are effectively retained or adsorbed or both at pH 3.5 on micro-fiber glass filters. The viral concentrations ranged from 0 to 2.3 MPNCU/liter and the Salmonella concentrations ranged from 1 to 80 bacteria/liter. For Salmonella, as for viruses, a concentration step was required. The water tested was of poor quality due to the presence of a wastewater treatment plant output of the city located 8 km upstream. It was concluded that adsorption at pH 3.5 to microfiber glass filters offers a rapid, effective, quantitative, and relatively inexpensive method for simultaneous concentration of Salmonella and enterovirus. Recreational water quality can then be monitored for two parameters from a single concentration. (Baker-FRC)
W82-00573

RELATIONSHIPS BETWEEN ENVIRONMENTAL FACTORS, BACTERIAL INDICATORS, AND THE OCCURRENCE OF ENTERIC VIRUSES IN ESTUARINE SEDIMENTS,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
R. L. LaBelle, C. P. Gerba, S. M. Goyal, J. L. Melnick, and I. Cech.
Applied and Environmental Microbiology, Vol 39, No 3, p 588-596, March, 1980. 3 Fig, 3 Tab, 41 Ref.

Descriptors: *Estuarine environment, *Viruses, Bacteria, *Sediments, Enteric bacteria, Enteroviruses, Indicators, Bioindicators, Recreation, Recreation facilities, Public health, Epidemiology, Shellfish farming.

The occurrence of enteric viruses in estuarine sediments was examined in efforts to find a possible relationship between the presence of viruses in seawater or sediment or both and various biological and physiochemical characteristics of the environment. Sediment was found to contain greater numbers of viruses than overlying seawater on a volume basis. Several types of enteroviruses were isolated, including coxsackievirus types A16, B1, and B5, echovirus type 1, and poliovirus type 2. On several occasions, viruses were isolated from sediments when overlying waters met bacteriological water quality standards for recreational use. Only one significant association was noted in the statistical analysis of a possible relationship between viruses in seawater or in sediment and other variables. This association indicated that the number of viruses in sediment was positively correlated with the number of fecal coliforms in the sediment. No other statistically significant associations were found. Bacterial indicators and viruses in the overlying waters did not appear to be correlated. The evaluation of the presence of bacteria and viruses in sediment may give additional insight into long-term water quality conditions. It is noted that indicator bacteria in water are not reflective of the concentration of enteric viruses in marine waters. (Baker-FRC)
W82-00574

EFFECTS OF WASTEWATER SLUDGE AND ITS DETERGENTS ON THE STABILITY OF ROTAVIRUS,

Sandia Labs., Albuquerque, NM.
R. L. Ward, and C. S. Ashley.
Applied and Environmental Microbiology, Vol 39, No 6, p 1154-1158, June, 1980. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Sludge, *Viruses, *Detergents, Growth, Rotavirus, Wastewater, Reovirus.

A series of inactivation experiments in wastewater sludge were performed with SA-11, a rotavirus strain isolated from a vervet monkey. Wastewater sludge reduced the heat needed to inactivate rotavirus SA-11, and ionic detergents were identified as the sludge components which were responsible for this effect. This is similar to an effect that had been found earlier with reovirus. The quantitative effects of individual ionic detergents on rotavirus and reovirus were very different, and rotavirus was extremely sensitive to several of the detergents. However, neither virus was destabilized by nonionic detergents. On the contrary, rotavirus was stabilized by a nonionic detergent against the potent destabilizing effects of the ionic detergent sodium dodecyl sulfate. The destabilizing effects of both cationic and anionic detergents on rotavirus were greatly altered by changes in the pH of the medium. Although there may be a number of compounds in sludge that can stabilize rotavirus, nonionic detergents, which are known ingredients of sewage, were shown here to have this stabilizing effect. It is possible that removal of nonionic detergents from sludge caused the destabilizing effects of ionic detergents to be better expressed after their separation from other sludge components. (Baker-FRC)
W82-00576

GROWTH OF AEROMONAS HYDROPHILA AT LOW CONCENTRATIONS OF SUBSTRATES ADDED TO TAP WATER,

Netherlands Waterworks, Rijswijk. Testing and Research Inst.
D. Van der Kooij, A. Visser, and W. A. M. Hijnen.
Applied and Environmental Microbiology, Vol 39, No 6, p 1198-1204, June, 1980. 3 Fig, 4 Tab, 29 Ref.

Descriptors: *Drinking water, *Bacteria, Growth, Water pollution, *Aeromonas, Microorganisms, Bioassay, Water treatment, Water quality, Substrates, Biodegradation.

The growth of Aeromonas hydrophila at low substrate concentrations was investigated as part of an investigation on the behavior of different types of bacteria in tap water. Batch experiments were conducted using tap water supplied with low concentrations of substrates. Growth was assessed by colony count determinations. The isolate only multiplied in the used tap water after the addition of a small amount of an assimilable carbon compound. d-Glucose especially caused growth of the organism even at initial concentrations below 10 micrograms C per liter. At initial glucose concentrations below the substrate concentration value (12 micrograms C per liter), generation times and yield were nonlinear with l/initial glucose concentrations and initial glucose concentrations respectively. The maintenance coefficient m was calculated from these observations. At initial concentrations below the substrate concentration value of starch, no growth was noted, but complete use of starch occurred in these situations after the addition of 10 micrograms of glucose-C per liter. The results of this study demonstrated that information of ecological significance may be obtained by very simple batch experiments. Moreover, the isolate studied may be used in growth experiments to assess the maximum concentration of glucose present in water, particularly tap water, initially or after various treatment stages. (Baker-FRC)
W82-00578

ISOLATION AND IDENTIFICATION OF PATHOGENIC MICROORGANISMS AT WASTEWATER-IRRIGATED FIELDS: RATIOS IN AIR AND WASTEWATER,

Hebrew Univ., Jerusalem (Israel). Environmental Health Lab.
B. Teltsch, S. Kedmi, L. Bonnet, Y. Borenzstajn-Rotem, and E. Katzenelson.
Applied and Environmental Microbiology, Vol 39, No 6, p 1183-1190, June, 1980. 1 Fig, 8 Tab, 31 Ref.

Descriptors: *Wastewater irrigation, *Pathogens, Microorganisms, Salmonella, Enteroviruses, Bacteria, Viruses, Coliforms, Poliovirus, Spray irrigation, Sprinkler irrigation.

The occurrence of Salmonella bacteria and animal enteroviruses in aerosol emissions from wastewater irrigation sites was determined by direct assay. An evaluation was made of the suitability of coliforms as indicators of airborne contaminations. Throughout this study different types of sprinklers were used, and consequently different discharge rates, particle numbers, and aerosol volumes were generated in the experimental fields. The frequency of positive Salmonella samples was 78% in the wastewater and 18% in the airborne emissions. For enteroviruses, the frequency of positive samples was 71% in the wastewater and 44% in aerosol emissions, indicating higher frequency of enteroviruses in aerosol emissions in comparison to Salmonella. The results indicate that enteroviruses and Salmonella bacteria survive in the air better than coliform bacteria. In addition it appears that the enteroviruses are more hardy than Salmonella in wastewater aerosols. Although coliforms were present in all air samples, their use as indicators of the microbial contamination of air may result in an inaccurate assessment of the true presence or survival of pathogens. (Baker-FRC)
W82-00579

DESTRUCTION BY ANAEROBIC MESOPHILIC AND THERMOPHILIC DIGESTION OF VIRUSES AND INDICATOR BACTERIA INDIGENOUS TO DOMESTIC SLUDGES,

Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
G. Berg, and D. Berman.
Applied and Environmental Microbiology, Vol 39, No 2, p 361-368, February, 1980. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Bacteria, *Sludges, *Bioindicators, Indicators, Temperature effects, Digestion, *Viruses, Water treatment facilities, Wastewater treatment.

The usefulness of fecal coliforms, total coliforms, and fecal streptococci as indicators of viruses in raw and digested sludges is demonstrated. The extent to which indicator bacteria and some viruses are destroyed by anaerobic mesophilic and thermophilic digestion of domestic wastewater sludges as these sludge stabilization processes are currently practiced is also examined. Large variations were found in the numbers of viruses occurring over narrow ranges of numbers of fecal coliforms, total coliforms, and fecal streptococci in raw sludges and in mesophilically and thermophilically digested anaerobic sludges. This finding suggests that the bacteria were poor quantitative reflectors of the numbers of the viruses detected. All three indicator bacteria were destroyed more rapidly than were the viruses by mesophilic and thermophilic digestion of the anaerobic sludges. The relative rates for the destruction of viruses, fecal coliforms, and fecal streptococci in the digested sludges were consistent over the 17 month study. Fecal coliforms were 7 to 8 times more sensitive than the viruses to mesophilic digestion and 9 to 10 times more sensitive to thermophilic digestion. Even more sensitivity was noted among the total coliforms. The rates at which fecal streptococci were destroyed by mesophilic and thermophilic digestion of anaerobic sludges approached those at which the viruses were destroyed by those processes. This suggests that rates of fecal streptococci destruction may be used as indicators for the rates at which viruses in sludges are destroyed by these processes. (Baker-FRC)
W82-00580

MONITORING RIVER PERIPHYTON WITH ARTIFICIAL BENTHIC SUBSTRATES,

Bowling Green State Univ., OH. Dept. of Biological Sciences.
R. L. Lowe, and W. F. Gale.
Hydrobiologia, Vol 69, No 3, p 235-244, March, 1980. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Periphyton, *Substrates, *Algal growth, Algae, Rivers, *Benthic environment, *River beds, Monitoring, Susquehanna River, Species composition, Water quality analysis, Pennsylvania.

Frosted acrylic was the most satisfactory artificial substrate for studying periphyton colonization on a river bottom. Other substrates tested at the bottom of the Susquehanna River, near Falls, Pennsylvania, were smooth glass, frosted glass, Vermont slate, and sandy slate (flagstone). Natural river stones were collected for comparison. The most abundant algae on the substrates were diatoms, with Nitzschia and navicula most often dominating. The genera Cocconeis, Synedra, Asterionella, Gomphonema, Meridion, Cymbella, Fragilaria, Stephanodiscus, Cyclotella, and Melosira were also well represented. A 1-month exposure time showed very little colonization in December through April, but from May through November, communities from 1,000 to 10,000 units per sq mm were found. The densest communities were accumulated in October. The long-term, or cumulative, substrates had the densest periphyton communities in winter, with decreasing densities in June-October. The greatest periphyton density was found on a river stone in February (21,850 units per sq mm). Any of the substrates would be satisfactory to determine the dominant genera in the periphyton. The number of genera on artificial substrates tended to be higher than the numbers on river stones. It is suggested that 1-month colonization periods are not enough; substrates should be collected after several month's submergence. (Casser-FRC)
W82-00581

CATION CHROMATOGRAPHY WITH A CONDUCTIVITY DETECTOR,

Ames Lab., IA.
J. S. Fritz, D. T. Gjerde, and R. M. Becker.
Analytical Chemistry, Vol 52, No 9, p 1519-1522, August, 1980. 6 Fig, 5 Ref.

Descriptors: *Chromatography, *Cations, *Cation exchange, *Conductivity, Drinking water, Water analysis, Hardness, Ammonium, Calcium, Manganese.

A system for cation analysis which successfully separates inorganic and amine cations was developed. Using this cation chromatography system metal and ammonium cations are separated on a cation-exchange column of low capacity and are detected with a conductivity detector. There is no need for a suppressor column. Mixtures of alkali metal and ammonium ions are separated using a nitric acid eluent, while an eluent containing an ethylene-ammonium salt is used to separate magnesium, calcium, strontium, and barium ions. The procedure requires 5 to 10 min. In experiments with drinking water, the method was used to determine alkali metal ions, ammonium, magnesium(II), and calcium(II). This procedure is similar in speed and convenience to atomic spectrometry methods, and has the advantage that ammonium ions can be determined simultaneously. Cation chromatography is a promising method for water hardness analysis, as it gives both magnesium and calcium hardness. (Small-FRC)
W82-00582

ENUMERATION OF BACTERIOPHAGES AND HOST BACTERIA IN SEWAGE AND THE ACTIVATED-SLUDGE TREATMENT PROCESS,

Clemson Univ., SC. Dept. of Microbiology.
D. L. Ewert, and M. J. B. Paynter.
Applied and Environmental Microbiology, Vol 39, No 3, p 576-583, March, 1980. 6 Tab, 26 Ref.

Descriptors: *Bacteria, *Wastewater, Bacteriophage, Viruses, *Wastewater treatment, Water treatment facilities, Effluents, Influent water, Activated sludge, Sludge.

Enumeration was made of bacteriophage populations in an activated-sludge sewage treatment plant. A newly developed assay for quantitation of total phases, employing direct electron microscopic counts, was used in conjunction with the plaque assay. The total concentration of phages was significantly higher in reactor mixed liquor and effluent than in influent sewage, indicating a net production of phages within the reactor. Maximum total phage concentrations in the fluid phase of sewage, activated-sludge mixed liquor, and reactor effluent, were 2.2 times 10 to the seventh power, 9.5 times 10 to the seventh power, and 8.4 times 10 to the seventh power, respectively. In general, specific phage titers were lower in mixed liquor than in sewage, indicating that these hosts were not responsible for the net production of phages in the reactor. This study emphasizes the limitations of the plaque assay for ecological studies of phages, and suggests that bacteria responsible for phage production in activated-sludge mixed liquor either mirror components of the heterotrophic population, floc-producing strains, or members of other physiological groups. (Baker-FRC)
W82-00584

METAL SPECIATION. EFFECTS ON AQUATIC TOXICITY,

Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
H. E. Allen, R. H. Hall, and T. D. Brisbin.
Environmental Science and Technology, Vol 14, No 4, p 441-443, April, 1980. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Aquatic life, *Metals, Metal complexes, *Chelating agents, Toxicity, Metal-finishing wastes, Industrial wastes, Heavy metals, Algae, *Algal growth, Natural waters.

The effect of chelation in aquatic environments has been investigated. Experiments were conducted to demonstrate that algal toxicity is related to the free metal ion and not to the total soluble metal concentration. A series of algal bioassays was conducted in which zinc and various chelators were added. To relate algal growth to the chemical forms of zinc present, stability constants for the reaction of each of the chelators with hydrogen, calcium, and magnesium ions, as well as with zinc ions, were required. For all cultures in which there was an increased number of algae after 5 days, the logarithm of the number of cells was plotted vs. the calculated concentration of free zinc. In addition, data were included for a series of controls in which no additional chelator was added to the media, but

in which the concentration of added zinc was varied. The results demonstrated that the toxicity of trace metals to algae is directly dependent on the concentration of free metal ion rather than the total metal concentration. This method of predicting biological toxicity could be extended to natural waters provided adequate information on organism response to and equilibrium relations for the metal are available. An understanding of the relationship of an organism's response to the specific chemical form of a toxicant in the environment rather than to its total concentration is an important consideration in the development of water quality criteria. (Baker-FRC)
W82-00610

ADSORPTION AS A CONTROL OF METAL CONCENTRATIONS IN SEDIMENT EXTRACTS,

Australian Atomic Energy Commission Research Establishment, Lucas Heights.
P. S. Rendell, G. E. Batley, and A. J. Cameron.
Environmental Science and Technology, Vol 14, No 3, p 314-318, March, 1980. 3 Fig, 5 Tab, 16 Ref.

Descriptors: *Metals, *Water analysis, Chemical analysis, *Sediments, Copper, Lead, Cadmium, Heavy metals, *Adsorption, Extraction, Sediment concentration.

Extractants spiked with copper, lead, or cadmium were shaken overnight with river sediment, and the solution metal concentrations were compared before and after the overnight extraction. To give an indication of the range of extraction reagents that might be affected, adsorption was investigated as a function of pH and in the presence of reducing agents, strong and weak complexiang agents, a weak acid, an oxidizing agent, and a cation exchanger. The adsorption of added metal in these experiments was assumed to constitute evidence for the readsorption of metal released during sediment extractions. Significant adsorption of added metal occurred during overnight extraction with dilute hydrochloric acid with a pH of more than 1.5, 0.1 M hydroxylamine hydrochloride with a pH of 2, 0.1 M sodium citrate with a pH of 4.6, 1 M ammonium acetate, 10% sodium citrate-1% sodium dithionite, and 25% acetic acid. Adsorption also occurred during a hydrogen peroxide digestion procedure. The inability of reagents to prevent losses of soluble metal in these experiments strongly suggests that a proportion of the metal actually released from a sediment sample during an extraction will be readsorbed. This may lead to serious misinterpretation of extraction data, because the metal concentrations determined in the extract do not represent metal levels in the sediment fractions attacked. (Baker-FRC)
W82-00614

AN ENVIRONMENTAL SAFETY ASSESSMENT OF BUTYL BENZYL PHTHALATE,

Monsanto Co., St. Louis, MO.
W. E. Gledhill, R. G. Kaley, W. J. Adams, O. Hicks, and P. R. Michael.
Environmental Science and Technology, Vol 14, No 3, p 301-305, March, 1980. 4 Tab, 26 Ref.

Descriptors: *Chemical industry, *Environmental protection, Phthalates, Safety, Environmental effects, Assessments, Water quality, Algal growth, Toxicity, Fish, *Butyl benzyl phthalate, Biodegradation.

The environmental safety of butyl benzyl phthalate (BBP) was evaluated through both laboratory and field studies. BBP itself is relatively insoluble in water and tends to partition to soil, sediment, and biota in the aqueous environment. Biodegradation, the rate controlling process for environmental degradation of BBP, is rapid and extensive in natural water and sewage systems. Environmental levels of BBP averaged less than 1 microgram/liter in water and less than 100 ng/g in sediment. BBP is acutely toxic to a variety of algae, invertebrates, and fish in the 0.5 to 5 mg/liter range and chronically toxic to Daphnia and fathead minnows in the 0.1-0.8 mg/liter range. A bioconcentration study indicated that BBP was not an accumulative or persistent chemical in fish. Comparison of mean environmental water concentrations of BBP to laboratory chronic toxicity values for Daphnia and fathead minnows showed an average safety margin of about three orders of magnitude. This current safety assessment concludes that BBP under present use and disposal patterns does not constitute a hazard to the safety and well being of the aquatic environment. (Baker-FRC)
W82-00615

VOLTAMMETRIC CHARACTERIZATION AND CHEMICAL BEHAVIOR OF INORGANIC TIN IN NATURAL WATERS,

Istituto di Ricerca sulle Acque, Rome (Italy).
G. Macchi, and M. Pettine.
Environmental Science and Technology, Vol 14, No 7, p 815-818, July, 1980. 8 Fig, 28 Ref.

Descriptors: *Natural waters, *Tin, Seawater, Chemical analysis, Water analysis, Measuring instruments, *Volumetric analysis, Comparison studies.

Differential pulse anodic stripping voltammetry was used to test a solution containing 16 ppb of Sn(IV) in 0.04 M sodium nitrate and in artificial seawater as a function of pH. At a pH value below 7, a peak of anodic redissolution due to the oxidation of Sn(0) to Sn(II) became apparent. The peak potential shifted as a function of pH and indicated the formation of Sn(OH)(+) in the stripping process. The height of the peak decreases markedly with time in acid solution near pH 4 to 6. The results suggest that the stable forms of Sn(IV) are a function of pH. The differential pulse anodic stripping voltammetry analysis of surface seawater and samples collected at depth of 100 meters at the mouth of the Tiber River indicate the existence of Sn. The measured Sn peak was stable for at least six months. The findings indicate that soluble tin is present in natural waters in the form of Sn0(OH)3(-) when the pH is about 8. At lower values of pH, Sn may polymerize from Sn0(OH)2. (Baker-FRC)
W82-00627

DETERMINING VOLATILE ORGANICS IN WATER,

Monsanto Industrial Chemicals Co., St. Louis, MO.
J. P. Mieure.
Environmental Science and Technology, Vol 14, No 8, p 930-935, August, 1980. 4 Fig, 5 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Organic compounds, Water analysis, Chemical analysis, Isolation.

Six techniques for low-level, multicomponent analysis of volatile organics in water are described. The key to analytical techniques for volatile organic determinations lies in the isolation step. This step determines the types of compounds to be measured, the expected accuracy and precision, and the potential interferences. Once the isolation and concentration steps have been achieved, the spectroscopic or chromatographic measurement of the analyte is usually straightforward. Static headspace sampling has detection limits ranging from sub- to mid-microgram/liter concentrations, depending on the compound and the detector. Purge and trap sampling has greater sensitivity than static headspace sampling, but foaming may be a problem. Solid sorbents have been shown effective for selected compounds, but the general usage for concentrations less than 50 micrograms/liter needs verification. Liquid/liquid extraction is useful for compounds for which specific detectors are available. Precision is better than with the purge and trap technique. Sample cleanup is minimal, so removal of interferences is unlikely. Distillation is effective in concentrating water-soluble volatile organics. Semipermeable membranes are not widely used for isolation of volatiles; however, rapid analyses are possible when they are used as a selective introduction device for a mass spectrometer. (Baker-FRC)
W82-00630

ACCURATE AND EFFICIENT ESTIMATION OF BENTHIC POPULATIONS: A COMPARISON BETWEEN REMOVAL ESTIMATION AND CONVENTIONAL SAMPLING TECHNIQUES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Entomology.
F. L. Carle, and O. E. Maughan.
Hydrobiologia, Vol 71, No 1/2, p 181-187, May 27, 1980. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Sampling, *Benthos, *Species diversity, Invertebrates, Biological samples, Water quality, *Bioindicators, Circular Depletion Sampler, Benthic populations.

The continuing use of benthic communities as indicators of water quality requires use of accurate and efficient quantitative sampling techniques. The removal method using the Circular Depletion Sampler (CDS) was developed to collect consecutive subsamples from the same location, increasing the probability of capture. Average probability of capture, using three subsamples, from 270 CDS samples ranged from 0.19 for Antocha to 0.96 for Chironomidae. These population estimates were higher and less variable than single removal catches, Surber catches, or kick-net catches. Although sampling time was nearly equal for all three methods, the CDS method required less than half the time to separate the benthos from the substrate. Catchability varied with species, person collecting the samples, and sampling conditions. (Cassar-FRC)
W82-00633

IDENTIFICATION OF ORGANIC COMPOUNDS,

NUS Corp., Pittsburgh, PA., Analytical Services Lab.
G. D. Burns.
Industrial Wastes, Vol 26, No 4, p 23-25, July/August, 1980. 6 Fig.

Descriptors: *Organic compounds, *Measuring instruments, *Chemical analysis, Wastewater analysis, Wastewater composition, *Pollutant identification.

A large increase in the usefulness of gas chromatographic/mass spectrometric analytical methods is forecast as a result of increasing demands for certain standards to be met in wastewater discharging. The basis of the identification of an unknown compound is the retention time, that is, the length of time required for the compound to elute from a specific GC column under controlled conditions of column temperature and carrier gas flow rate. Mass spectrometry offers information concerning a compound's molecular weight and structure which is not available from conventional GC detectors. Computer technology has vastly increased the capabilities of a moden GC/MS system. The cost of a GC/MS with a data system varies from bench top models for about $60,000 to a complete data system for about $250,000. (Baker-FRC)
W82-00635

EVALUATION OF STANDARD AND MODIFIED M-FC, MACCONKEY, AND TEEPOL MEDIA FOR MEMBRANE FILTRATION COUNTING OF FECAL COLIFORMS IN WATER,

National Inst. for Water Research Pretoria (South Africa).
W. O. K. Grabow, C. A. Hilner, and P. Coubrough.
Applied and Enviromental Microbiology, Vol 42, No 2, p 192-199, August, 1981. 13 Tab, 31 Ref.

Descriptors: *Coliforms, *Culture media, *Water analysis, Bacteria, Agars, *Fecal coliform, Microbiological studies, Rivers, Activated sludge, Performance evaluation, Pollutant identification.

Counts obtained by means of different growth media recommended for membrane filtration counting of fecal coliforms were compared and isolates were identified to establish the composition of fecal coliforms in various water environments. Media included M-FC agar, modified M-FC agar which contains no rosolic acid, Teepol media, and MacConkey agar. Comparative tests were per-

formed on 312 samples including chlorinated effluents. M-FC agar without rosolic acid generally yielded the highest counts, was readily obtainable, was easy to prepare and handle, and yielded clearly recognizable fecal coliform colonies. Fecal coliform tests cannot be used to determine E. coli levels because in these tests the incidence of E. coli among fecal colonies varies from 51% for river water to 93% for activated sludge effluent. Klebsiella pneumoniae averaged 4% for sludge effluent and 32% for river water. The standard membrane filtration procedure using M-FC agar without rosolic acid gave clear advantages. (Small-FRC)
W82-00644

MODIFICATION OF THE STANDARD MOST-PROBABLE-NUMBER PROCEDURE FOR FECAL COLIFORM BACTERIA IN SEAWATER AND SHELLFISH,

Food and Drug Administration, Davisville, RI. Construction Batallion Center.
F. Dexter.
Applied and Environmental Microbiology, Vol 42, No 1, p 184-185, July, 1981. 1 Tab, 2 Ref.

Descriptors: *Coliforms, *Water analysis, *Seawater, Bacterial analysis, Bacteria, Brackish water, Saline water, Shellfish.

A total of 572 seawater and shellfish samples were collected and used in a study to determine whether or not presumptive tubes which take 48 hr to become positive need to be transferred to EC medium during the fecal coliform multitube most-probable-number procedure. It appeared that incorrect dilution data would be rare when the 24 hour positive tubes alone were transferred to EC. It is suggested that when the fecal coliform multitube most-probable-number procedure is performed, the presumptive test could be discontinued after 24 hr. An exception could be made for those situations in which either extreme accuracy or a high recovery rate is necessary, for example, in a comparative study of media or techniques or both. (Baker-FRC)
W82-00646

EFFECT OF OZONATION AND CHLORINATION ON THE MUTAGENIC POTENTIAL OF DRINKING WATER,

Florence Univ. (Italy). Inst. of Pharmacology.
P. Dolara, V. Ricci, D. Burrini, and O. Griffini.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 1, p 1-6, 1981. 2 Fig, 12 Ref.

Descriptors: *Chlorination, *Ozonation, *Toxicity, Water treatment, Drinking water, Water quality, Public health, Mutagenic chemicals, *Florence, Italy.

Water from a treatment plant in Florence, Italy, was tested for mutagenic activity using the Salmonella/microsomes test. The plant treats water from the Arno River with the following treatment scheme: prechlorination, addition of powdered activated carbon, coagulation and flocculation, decanting, rapid sand filtration, ozonation, and final chlorination. Dose response curves, with and without metabolic activation, were obtained by plating different amounts of DMSO concentrates. Untreated water had a negligible mutagenic activity, whereas significant, although low, mutagenic activity was introduced by chlorination. After ozone treatment, the water showed more mutagenic activity but less than after chlorination. Ozone treatment may be an alternative to chlorination for disinfection and odor removal in water treatment. Mutagenic chemicals were produced by chlorination, while ozonation could minimize the exposure to mutagenic chemicals in drinking water. The effect of ozonation on heavily contaminated waters is not known. (Small-FRC)
W82-00649

NEW WATERBORNE BACTERIOPHAGES ACTIVE ON YERSINIA ENTEROCOLITICA,

Granada Univ. (Spain). Dept. of Microbiology.
C. Calvo, J. Brault, J. M. Alonso, and H. H. Mollaret.
Applied and Environmental Microbiology, Vol 42, No 1, p 35-38, July, 1981. 5 Tab, 8 Ref.

Descriptors: *Bacteriophage, *Isolation, *Bacterial analysis, Water analysis, Viruses, Surface water, Enterobacter, Bacteria, Enteric bacteria, *Granada, Spain.

A phage typing scheme for Yersinia enterocolitica (YE) was investigated using bacteriophages isolated from surface waters. Seven bacteriophages active on YE were isolated from surface water samples collected in Granada, Spain. A comparison of the respective host ranges of these new phages and of reference phages used for YE phage typing showed that YE strains belonging to various phage types, grown at either 37 or 25 degrees C, expressed susceptibility to reference sewage water phages, whereas susceptibility to new waterborne phages, as well as to reference phages from lysogenic YE, was only demonstrated in YE strains grown at 25 degrees C. A YE strain isolated by stool culture from a pig was lysogenic for a bacteriophage which behaved like waterborne phages and reference phages from lysogenic YE strains. The possibility that the isolation of waterborne bacteriophages might, in certain circumstances, reflect the presence of lysogenic YE was raised. (Baker-FRC)
W82-00662

OCCURRENCE OF CYTOPHAGAS IN SEWAGE PLANTS,

Gesellschaft fuer Biotechnologische Forschung, m.b.H., Stockheim (Germany, F.R.).
H. Gude.
Applied and Environmental Microbiology, Vol 39, No 4, p 756-763, April, 1980. 3 Fig, 5 Tab, 27 Ref.

Descriptors: *Bacteria, *Activated sludge processes, *Cytophagas, Activated sludge, Microbiological studies, Biological treatment, Wastewater treatment.

In order to better understand biological sewage purification processes, the occurrence of bacteria belonging to the Cytophaga group in activated sludge from a treatment works was investigated. Plate count methods and the KOH-flexirubin test were used to determine Cytophagas. In the inflow sewage water, the percentage of Cytophaga colonies was generally low when compared with values for activated sludge, trickling filters, and effluent samples. Over a period of 16 months, the highest percentages of cytophagas were found in activated sludge and trickling filter samples collected during the winter. Also, cytophagas were found to have high percentages of the bacteria lytic to polymeric substrates such as cellulose, chitin, dextran, pectin, xylan, and gelatin. Polymer breakdown may be the way cytophagas contribute to sewage purification, especially at low temperatures. Isolated strains of Cytophaga had gliding motility, flexirubin pigmentation, and a low guanine plus cytosine base ratio. (Small-FRC)
W82-00682

ORGANOCHLORINE RESIDUES IN KENYA'S RIFT VALLEY LAKES,

National Wildlife Federation, Washington, DC.
J. L. Lincer, D. Zalkind, L. H. Brown, and J. Hopcraft.
Journal of Applied Ecology, Vol 18, No 1, p 157-171, April, 1981. 1 Fig, 6 Tab, 29 Ref.

Descriptors: *Pesticide residues, *Aquatic life, *Lakes, Wildlife, Pollutant identification, Chlorinated hydrocarbons, Fish, Birds, Water birds, Insects, Invertebrates, Vegetation, Algae, Eggs, Africa, Rift Valley, Lake Nakuru, *Kenya, Fate of pollutants, DDT, DDE.

Organochlorine pesticide residues were determined in aquatic life in four Rift Valley lakes in Kenya-Naivasha, Nakuru, Baringo, and Elmenteita. These lakes are closed basin systems with no external outlet. Pesticides used in the L. Nakuru catchment basin include DDT, dieldrin, toxaphene, dioxathion, and abate (temephos). The only organochlorine detected in samples was DDE, a DDT metabolite. DDE residues in vegetation, insects, fish, amphibians, mammals, bird eggs, and bird muscle are reported for each lake. Lake Elmenteita is probably the most pesticide-contaminated of the four lakes, but the small sample sizes did not permit a definite conclusion. L. Nakuru had the highest DDE levels, with L. Naivasha and Baringo, lesser levels. Some of the higher mean levels of DDE (in mg per liter oven dry weight) were: ferns in L. Naivasha, 0.107; fish in L. Baringo, 0.43-2.13; insects in L. Baringo, 0.90; and an otter from L. Nakuru, 0.35. Residues in eggs from fish eating birds were as high as 5.75 mg per liter DDE oven dry weight in the African darter from L. Nakuru. The highest residue of DDE in avian muscle tissue was 1.09 mg per liter oven dry weight in maribou stork from L. Nakuru. (Cassar-FRC)
W82-00690

TOXICS IN MUNICIPAL AND INDUSTRIAL WASTEWATERS,

Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
D. F. Bishop.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix D, November, 1980. 98 p. 1 Fig, 32 Tab, 29 Ref, 3 Append. International Joint Commission, Windsor, Ontario.

Descriptors: *Hazardous materials, *Pollutant identification, Organic compounds, Waste disposal, Waste management, Waste load, Organic loading, *Industrial wastewater, Technology, Waste characteristics, Pretreatment of water, *Toxins, *Municipal wastewater, Great Lakes.

Legislative and court actions are forcing the evolution of systematic toxic management approaches to limit environmental exposure to toxics in both Canada and the United States. This report, as background to a discussion on toxic loading estimates in the Great Lakes, reviews legislative actions in the U.S. and various treatment processes studied in a 25-city survey. Approaches evaluated for the treatment of 129 'primary pollutant' compounds included removal systems, pretreatment, toxics loads, treatability, and removability. Not unexpectedly, there was a wide variation found among industrial plants for compounds identified and concentrations recorded. Similarly, removal of specific compounds varied from zero to almost 100 percent. Of the 87 compounds detected, 24 organics and 13 metals were found in all of the plants. Chlorination for disinfection generally increased the concentrations of certain compounds. The report recommends that the following issues related to municipal and industrial wastes in the Great Lakes area be studied: updating and reliability of the estimated toxics loads, municipal and industrial sources of toxics, monitoring issues, wastewater chlorination, land treatment vs. conventional wastewater treatment, and pre-treatment vs. centralized municipal treatment. (Garrison-Omniplan)
W82-00712

NEW LIQUID CHROMATOGRAPHIC DETECTION SYSTEM FOR ENVIRONMENTAL POLLUTANTS,

Georgia Univ., Athens.
L. A. Carreira, and L. B. Rogers.
Environmental Protection Agency Report EPA-600/4-80-015, February 1980. 71 p, 30 Fig, 3 Tab, 29 Ref.

Descriptors: *Water analysis, *Liquid chromatography, *Polychlorinated biphenyls, *Hydrocarbons, Spectrometers, Solvents, Computers, Automation, *Pollutant identification.

Resonance enhanced coherent anti-Stokes Raman spectrometry (CARS) has been demonstrated as a specific identification system for liquid chromatography. To achieve this, liquid chromatographic preconcentration and separation and computer control of the liquid chromatograph/ultraviolet-visible/CARS were undertaken. Under the optimum resonance condition, spectra were obtained on 5 microliter volumes with detection limits of 1 micromolar or less under favorable conditions. Excellent fluorescence rejection and ultraviolet

CARS were also shown. A number of different species (polynuclear aromatic hydrocarbons and polychlorinated biphenyls) were surveyed by liquid chromatography with the selectivity of different stationary phases and special solvent effects examined. Observations useful in relating experimental variables in the preconcentration step to the recovery of given species were made. A system consisting of a liquid chromatograph, a scanning ultraviolet-visible spectrometer and the CARS was automated using a mini-computer. Column selection, flow rate, and solvent composition were monitored and controlled. The ultraviolet-visible spectrometer was used at a fixed wavelenth until a species was detected. The flow was stopped, the absorption spectrum was scanned, and flow was resumed. The optimum laser frequencies for resonance CARS were set from the absorption spectrum. The Raman spectra were then scanned under control of the computer with on-line signal averaging and data smoothing. (Author's abstract)
W82-00740

INTERIM METHOD FOR DETERMINING ASBESTOS IN WATER,

Environmental Research Lab., Athens, GA.
C. H. Anderson, and J. M. Long.
Environmental Protection Agency Report EPA-600/4-80-005, January 1980. 43 p, 2 Fig, 2 Tab, 13 Ref.

Descriptors: *Water analysis, *Microscopic analysis, *Asbestos, *Electron microscopy, Drinking water, Filtration, Hazardous materials, Water pollution, Pollutants.

This revised interim method for asbestos in drinking water and water supplies reflects the improvements that have been made in asbestos analytical methodology since the initial procedure was drafted. A variable, known volume of water sample is filtered through a 0.1 micrometer polycarbonate membrane filter and the filter is then carbon coated. A small portion of the filter is placed on an electron microscope grid and the filter material is removed by solution in chloroform. The material remaining on the grid is examined in a transmission electron microscope at 20,000 magnification. Chrysotile asbestos can be differentiated from amphibole by their morphologies and electron diffraction patterns. The number of fibers in a known area examined in the microscope is converted to number of fibers per liter, and the mass per liter can be calculated from the assumed density and volume of the fibers. The method can detect 0.01 million fibers per liter or 0.1 ng/1, under favorable circumstances. (Brambley-SRC)
W82-00741

SAMPLE INTAKE POSITION AND LOADING RATES FROM NONPOINT SOURCE POLLUTION,

National Forest Service, Challis, ID.
P. E. McGuire, T. C. Daniel, D. Stoffel, and B. Andraski.
Environmental Management, Vol 4, No 1, p 73-77, January, 1980. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Nonpoint pollution sources, *Runoff, *Sampling, Water quality, Monitoring, Bed load, Suspended solids, Phosphorus compounds, Nitrogen compounds, Pollutant identification, Water sampling.

Paired water samples were taken simultaneously at two different vertical positions in a flow control structure designed for monitoring nonpoint source pollution. It was determined that easily transported pollutants and those with more potential for immediate impact on water quality should be sampled at the midstage level. If total transport of contaminants from a particular land use is required, then bed load sampling must be used. Suspended solids, total phosphorus, and organic plus exchangeable N were consistently higher when sampled at the floor of the apparatus than those sampled at midstage. Dissolved molybdate reactive phosphorus and ammonium concentrations were not significantly affected by intake position. Concentrations of nitrate-nitrite were much higher when sampled at the midstage level. Levels produced by midstage sampling, expressed as a percent of bed load (floor) sampling, were as follows: suspended solids, 44; total phpsphorus, 39; organic plus exchangeable N, 35; dissolved molybdate reactive phosphorus, 80; ammonium, 71; and nitrate-nitrite, 181. (Cassar-FRC)
W82-00778

SIMULTANEOUS DETERMINATION OF IRON, CADMIUM, ZINC, COPPER, NICKEL, LEAD, AND URANIUM IN SEAWATER BY STABLE ISOTOPE DILUTION SPARK SOURCE MASS SPECTROMETRY,

National Research Council of Canada (Ontario). Div. of Chemistry.
A. P. Mykytiuk, D. S. Russell, and R. E. Sturgeon.
Analytical Chemistry, Vol 52, No 8, p 1281-1283, July, 1980. 2 Tab, 19 Ref.

Descriptors: *Seawater, *Trace elements, *Water analysis, Mass spectrometry, Chemical analysis, Copper, Iron, Zinc, Cadmium, Nickel, Lead, Uranium, Cobalt.

Seawater samples have been analyzed at trace concentration levels by stable isotope dilution spark source mass spectrometry for iron, cadmium, zinc, copper, nickel, lead, uranium, and cobalt. The samples were preconcentrated on the ion exchanger Chelex-100 and the concentrate was evaporated on a graphite or silver electrode. The results are compared with those obtained by graphite furnace atomic absorption spectrometry and inductively coupled plasma emission spectrometry. The technique avoids the use of calibration standards and is capable of producing results in cases where the analyte is only partly recovered. (Baker-FRC)
W82-00786

AQUATIC MOSSES AS MONITORS OF HEAVY METAL CONTAMINATION IN THE RIVER ETHEROW, GREAT BRITAIN,

Durham Univ. (England). Dept. of Botany.
P. J. Say, J. P. C. Harding, and B. A. Whitton.
Environmental Pollution, Series B, Vol 2, No 4, p 295-307, 1981. 3 Fig, 9 Tab, 13 Ref.

Descriptors: *Mosses, *Bioindicators, *Zinc, Heavy metals, Metals, Chromium, Aquatic plants, Rivers, Pollutant identification, Sediments, Water analysis, Monitoring, Etherow River, *Great Britain.

Zinc concentrations in two aquatic mosses, Fontinalis squamosa and Rhynchostegium riparioides, showed significant positive correlation, suggesting that these species may be useful bioindicators for Zn contamination of river water. Samples of water, sediments, and moss were collected on 5 occasions at 9 sites during 1979 and 1980 in the River Etherow, Great Britain, and analyzed for heavy metals. Levels of metals in sediments and water showed a similar pattern with the exception of proportionately higher lvels of Cr in sediments at 3 sites. Zn levels were 0.22 to 14.6 mg per liter in water, 73.7-4960 micrograms per g in sediments, and 64.1-6705 micrograms per g in mosses. Although Cr was not detected in water, it was present in mosses from some sites, indicating previous contamination. Data obtained for Amblystegium riparium and Fontinalis antipyretica were not sufficient to assess their value as monitors. (Cassar-FRC)
W82-00787

FORMATION OF N-NITROSODIETHANOLAMINE FROM DIETHANOLAMINE IN LAKE WATER AND SEWAGE,

Cornell Univ., Ithaca, NY. Dept. of Agronomy.
J. R. Yordy, and M. Alexander.
Journal of Environmental Quality, Vol 10, No 3, p 266-270, July/September, 1981. 5 Fig, 20 Ref.

Descriptors: *Wastewater, *Lakes, *Nitrosamines *Diethanolamine, Carcinogens, Nitrogen compounds, Toxins, Pollutants, Nitrite, Pollutant identification, Chromatography.

Diethanolamine (DEIA) is a compound of potential environmental concern due to its presence in a number of industrial and consumer products which result in the dicharge of large amounts of the unchanged chemical into wastewater and sewage. The N-niroso derivative of DEIA, N-nitrosodiethanolamine (NDEIA), is a proven carcinogen. This study used a thin-layer chromatographic technique with a carbon-14 labeled secondary amine to measure the possible formation of nitrosamines in samples of natural waters and sewage. The loer limit of sensitivity was 1 nanogram of nitrosamine per milliliter. The formation of NDEIA from DEIA in both lake waters and sewage was demonstrated. A combination of gas chromatography and mass spectrometry was used to verify the ientity of the product. Sewage produced the greatest amount of the carcinogenic NDEIA, while water from Cayuga Lake produced considerably less. The least amount of NDEIA was produced by water from an acid lake. The amount of DEIA added and the nitrite level in samples of the environment were found to be related to the amount of the nitrosamine formed. When samples of sewage and water from Cayuga Lake were autoclaved, NDEIA was either not formed or formed at rates much lower than in nonsterile environments. These results indicate that microorganisms or some other heat-labile factor may play a role in the formation of the nitroso compound. Although the nitrosamine could be netabolized in all three environments investigated, it persisted in lake water samples taken in the winter. (Carroll-FRC)
W82-00796

MEASUREMENT OF IN SITU RATES OF NITRIFICATION IN SEDIMENT,

Aarhus Univ. (Denmark). Inst. of Ecology and Genetics.
K. Henriksen.
Microbial Ecology, Vol 6, No 4, p 329-337, 1980. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Nitrification, *Sediments, *Chemical reactions, Ammonium, Sediment sampler, Inhibitors, In situ tests, Oxygen, Bacteria, Chemical analyses, *Marine sediments.

High numbers of nitrifying bacteria occur below the zone of oxygen penetration in marine sediments and can almost immediately oxidize ammonium when supplied with oxygen. As a result, sampling methods which introduce oxygen into anoxic parts of the sediment can be expected to give potential rather than actual nitrification rates. This paper reports the development of a method for the measurement of nitrification rates in intact sediment cores without disturbing the concentration gradients of oxygen and ammonium. N-serve (2-chloro-6-trichloromethyl-pyridine) is a specific inhibitor of the nitrifying bacteria Nitrosomonas in oxidizing ammonium to hydroxylamine, the first step in the nitrification process. Injection of 20 parts per million (ppm) of N-serve into a 0-2 centimeter surface layer of the sediment and addition of 5 ppm N-serve to the water column of sediment cores was sufficient to inhibit nitrification, but did not change the rate of ammonium production or incorporation in sediment suspensions. The sediments were incubated aerobically and anaerobically. The ammonium accumulation in sediment cores injected with N-serve was equal to the amount of ammonium which was oxidized to nitrate in the control cores. Nitrification rates measured by this method were in the range of 0 to 3 millimolecules of nitrogen per square meter per day. The agreement of this finding with the findings of previous studies substantiates the conclusion that this method gives near in situ nitrification rates. (Carroll-FRC)
W82-00798

URANIUM CONCENTRATION IN THE GROUND WATERS OF THE PULLMAN-MOSCOW BASIN, WHITMAN COUNTY, WASHINGTON, AND LATAH COUNTY, IDAHO,

Washington State Univ., Pullman. R. L. Albrook Hydraulic Lab.
For primary bibliographic entry see Field 5B.
W82-00809

SAMPLING GROUND WATER FOR ORGANIC CONTAMINANTS,

Oklahoma State Univ., Stillwater. Dept. of Geology.
W. A. Pettyjohn, W. J. Dunlap, R. Cosby, and J. W. Keeley.
Ground Water, Vol 19, No 2, p 180-189, March/April, 1981. 8 Fig, 7 Ref.

Descriptors: *Water sampling, *Groundwater pollution, *Laboratory equipment, Water quality, Wells, Sampling, Sample preparation, Pollutant identification.

Current preferred methods for the sampling of organic pollutants in groundwater are described which are used at the Ground Water Research Branch of the Robert S. Kerr Environmental Research Laboratory. For an effective sampling program, sampling equipment must be constructed of materials that have the least potential for affecting the sample, including glass and Teflon. Wells used to sample groundwater should be drilled and completed using techniques that minimize potential contamination of the aquifer. Teflon tubing can be used to case that portion of the well that extends from a few feet above the water table to the bottom of the borehole. Grab samples can be withdrawn through a sterile 6 mm Teflon tube and discharged into a sterile, calibrated one-liter heavy-wall Erlenmeyer flask with a peristaltic pump. For sampling at greater depths, a noncontaminating submersible high-lift pump can be used. Continuous sampling can utilize a system in which the water is pumped directly from the well through 6 mm Teflon tubing to two columns of adsorbent in series. Sampling systems are installed in specially constructed housings and form self-contained, easily transported units. (Small-FRC)
W82-00820

A REDUCTION-SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF SULPHATE IN WATERS,

Sydney Univ. (Australia). Dept. of Inorganic Chemistry.
Rama S. Bhat, J. M. Echert, and N. A. Gibson.
Analytica Chimica Acta, Vol. 128, p 263-267, 1981. 2 Tab, 7 Ref.

Descriptors: *Water analysis, *Sulfates, Estuarine environment, Seawater, Natural waters, Chemical analysis, *Spectrophotometry.

The reduction spectrophotometric method presented for the determination of sulfate in waters is based on the reduction of the sulfate by tin(II) chloride in hydriodic acid to hydrogen sulfide, which is then swept by nitrogen into a buffered solution of bis(2,9-dimethyl-l,10-phenanthroline)copper(II) ion. The resulting copper(I) complex is measured spectrophotometrically. With sample volumes between 10 and 1000 microliters, the limit of detection is 0.5 micrograms of sulfate. Formation of the stable complex is immediate and the reduction system can be used repeatedly. The method is applicable to fresh, estuarine, and marine waters. The common inorganic sulfur containing anions such as sulfide, sulfite, thiosulfate, tetrathionate and dithionate interfere quantitatively with the proposed method, as they are all reduced by hydrogen sulfide with the same efficiency as sulfate. No interference was present from linear alkylbenzene sulfonates. The major ions of sea water do not intefere seriously, and the method may be used without modification for the determination of sulfate in marine and estuarine waters. (Baker-FRC)
W82-00850

EVALUATION OF AN AUTOMATIC SYSTEM FOR DETECTION OF TOXIC SUBSTANCES IN SURFACE WATER USING TROUT,

Antwerpse Waterwerken (Belgium).
F. Van Hoof.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 221-225, 1980. 2 Tab, 10 Ref.

Descriptors: *Toxicity, *Bioindicators, *Monitoring, *Trout, Fish physiology, Water pollution, Experimental design, Chemical analysis, *Surface water, Streams, Sewage treatment, Environmental effects, Metabolism, Sewage effluent.

An automatic system for detection of toxic substances in surface water is evaluated. The system uses rainbow trout as test organisms, since toxicity data on fish can be more easily extrapolated to mammals than results obtained with organisms having a lower level of bioorganization. Fish in aquaria were exposed to eight chemicals representing widely used pesticides and other polluting discharges. Avoidance reactions, loss of condition or death were monitored by a set of photoelectric cells placed at the downstream end of the flow-through aquarium. No conclusive evidence of toxicity was observed for cadmium, zinc, and ethylparathion. Potassium cyanide was the only product to elicit a clear avoidance response. Carbaryl, malathion, dinitroorthocresol, and captan caused death. These results are used in calculations of lethal dose concentrations; however, they do not take into account any safety margin. The biomonitoring parameters, i.e., positive rheotaxis and opercular rhythm in fish, oxygen production and oxygen consumption in bacteria, and mobility inhibition in daphnia may be useful when results from flow-through monitoring are inadequate. (Titus-FRC)
W82-00855

DETECTION OF VOLATILE NITROSAMINES IN WASTE WATER FROM CHEMICAL PLANTS BY COMBINED CAPILLARY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,

Mainz Univ. (Germany, F.R.). Hygiene Inst.
G. Hartmetz, and J. Slemrova.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 1, p 106-112, 1980. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Volatility, *Waste water, *Chemical wastes, *Mass spectrometry, *Gas Chromatography, Industrial wastes, Carcinogens, Drinking water, Potable water, Water treatment, Water sampling, Chemical analysis, Sea water, Brackish water, Chemical wastewater, Pharmaceutical wastewater.

Seven samples of crude water from different wastewater treatment facilities and the purified waste water from a chemical-pharmaceutical plant were examined for carcinogenic materials. Concentrations of nitrosamines in the purification works effluent varied considerably with time. Findings show that volatile nitrosamines are introduced into the surface water through the waste water of chemical plants. The nitrosamine concentrations in the waste water are of the same order of magnitude as in various foodstuffs. Concentrations are so dilute in rivers as to be undetectable. (Titus-FRC)
W82-00856

SERUM ENZYMES IN RAINBOW TROUT AS TOOLS IN THE DIAGNOSIS OF WATER QUALITY,

Innsbruck Univ. (Austria). Inst. fuer Zoophysiologie.
W. Wieser, and S. Hinterleitner.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 188-193, 1980. 1 Tab, 15 Ref.

Descriptors: *Fish physiology, *Blood, *Toxicity, *Bioindicators, Water pollution, Experimental design, Chemical analysis, Trout, Streams, Sewage treatment, Environmental effects, Enzymes, Metabolism, Ammonia, Nitrate, Nitrite, *Sewage effluent, Water pollution effects.

Stress responses of trout (Salmo gairdneri) brought about by deterioration of water quality are investigated. The activities of two transaminases in the trout serum were measured and the quality of the river water was analyzed at areas where the fish were caught. Samples were obtained at various distances from a sewage outfall. The transaminase activity was found to be a function of distance from the sewageplant and to be correlated with the nitrogen content of the river water. The behavior and appearance of liver and gills of fish showed no variation from normal. Specimens caught within the plume had high values of serum glutamic oxalacetate transaminase (SGOT) and glutamic pyruvate transaminase (GPT) activity. The levels of SGOT and SGPT activity in S. gairdneri appear to be good indicators of certain types of water pollution, at least within a range characterized by total ammonia concentrations of approximately 0.5 to 12 mg/liter. Trout in natural waters, in contrast to laboratory conditions, appear to tolerate surprisingly high local pollutant concentrations. (Titus-FRC)
W82-00857

METHODS OF INVESTIGATING THE STATE OF METAL IONS IN NATURAL WATERS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik, and B. I. Nabivanets.
Water Resources (English Translation), Vol 7, No 5, p 463-477, September/October, 1980. 3 Fig, 1 Tab, 162 Ref. Translated from Vodnye Resursy, No 5, p 148-170, September/October, 1980.

Descriptors: *Metals, *Water analysis, *Measurement techniques, *Ions, Colloids, Suspended solids, Dissolved solids, Chemical analysis, Physical analysis, Separation techniques, Ionization, Hydrolysis, Oxidation.

Information concerning the forms of metal ions in natural waters is needed for developing an understanding of mechanisms for the assimilation of metals by aquatic organisms, for developing hydrochemical methods of prospecting for mineral resources, and for developing effective water treatment processes. This state-of-the-art review describes methods being used for the investigation and quantification of the forms of migration of metals in natural waters, including the distribution of metal between suspended, colloidal, and truly dissolved forms; the concentration of free noncomplexed ions of the investigated metals; the sign of the charge of the metal ions; the molecular (ionic) weight of complex or polynuclear compounds; complexation of metal ions in natural waters (kinetics of complexation, degree of complexation, strength of binding the metal into complex compounds, and complexing capacity of natural waters); and degree of oxidation (Valency) of the metal. The possibilities and limitations of each of the measurement techniques described are discussed. It is now possible to create general schemes for a systematic study of forms of migration of metal in complex natural waters. Three such general schemes are discussed. One of these schemes, developed by the authors of the article, permits the development of information on the state of metal ions in natural waters which is sufficiently complete to satisfy the needs of various specialists engaged in the problems of the study and use of natural waters. This scheme includes the successive use of various methods of investigation, permitting a quantitative determination of the portion of individual forms of the investigated element. (Carroll-FRC)
W82-00859

EFFECT OF TURBIDITY ON CHLORINATION EFFICIENCY AND BACTERIAL PERSISTENCE IN DRINKING WATER,

Oregon State Univ., Corvallis. Dept. of Microbiology.
M. W. LeChevallier, T. M. Evans, and R. J. Seidler.
Applied and Environmental Microbiology, Vol. 42, No. 1, p 159-167, July, 1981. 7 Fig, 1 Tab, 29 Ref.

Descriptors: *Drinking water, *Turbidity, *Chlorination, Disinfection, *Bacteria, Water quality, Potable water.

The influence of turbidity on drinking water quality was examined in six watersheds where turbidities at entry points to distribution lines ranged from 0.2 to 15.0 nephelometric turbidity units (NTU). Coliforms densities in raw water ranged from 11 to 500 coliforms per 100 ml, and were reduced 10- to

1,000-fold by chlorination. Coliforms in high-turbidity water (13 NTU) were reduced to only 20% of the initial count, whereas coliforms in low turbidity water (1.5 NTU) were undetectable even when large volumes were sampled, indicating a 1,000-fold or greater decrease. Disinfection efficiency was found to be negatively correlated with turbidity. Turbid water samples were examined in an attempt to determine factors which aid bacteria in surviving exposure to chlorine. Some bacteria particles were either embedded in trubidity particles or appeared to be coated with amorphous material or both. Blending of chlorinated turbid water increased the number of standard plate count bacteria as much as five times, indicating the physical separation of cells attached to common particles. The chlorine demand of the surfce water supplies was positively correlated with both the turbidity and total organic carbon content of the water, but not with other chemical parameters. It was concluded that turbidity is a useful indicator of potential problems in drinking water. (Baker-FRC)
W82-00865

GOOD LOOKS, LOW MAINTENANCE GUIDE WATER TANK CHOICE,

K. Grover.
American City and County, Vol. 95, No. 12, p 19-22, December, 1980.

Descriptors: *Water tanks, *Water storage, *Maintenance costs, *Design criteria, *Concrete construction, Storage tanks, Pipes, Materials engineering, Cost analysis, Economic aspects, Design standards, Pumps, Pumpage, Construction, Construction costs.

The design and cost of various water tanks is discussed, and examples of tanks currently in operation are cited. The three basic types of tanks used today are ground storage reservoirs, standpipes, and elevated tanks. Steel and concrete are the standard construction materials. For utilities and districts with storage needs in excess of 1.5 million gallons, tanks are constructed of welded steel or prestressed concrete, while bolted steel is appropriate for smaller tanks. Topography of the service area, availability and cost of land, and the type of water system are the prime factors influencing the choice of design. Elevated tanks assure constant pressure, accommodate variable demand, and can reduce pumpage costs. Standpipes are useful where there is some need for pressure equalization. Ground storage often offers lowest first cost and maintenance costs. It is safer and more convenient, and avoids aesthetic problems. However, land acquisition and excavation costs may be high. The newest innovation in design is the multi-use elevated tank which provides space inside for offices, pumps, controls, and storage. These are in operation in over 100 towns in the United States. (Titus-FRC)
W82-00868

DETERMINATION OF LOW NG/L LEVELS OF POLYCHLORINATED BIPHENYLS IN DRINKING WATER BY EXTRACTION WITH MACRORETICULAR RESIN AND ANALYSIS USING A CAPILLARY COLUMN,

Environmental Health Directorate, Ottawa (Ontario).
G. L. LeBel, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 397-403, 1980. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Drinking water, *Phenols, *Organic compounds, Water pollution, Contamination, Potable water, Streams, Groundwater, Chlorination, Chlorine, Gas chromatography, Water sampling, Monitoring, Experimental design, *Pollutant identification, *Polychlorinated biphenyls.

The application of the XAD-2 macroreticular method to analyze large volumes of potable water for low volumes of polychlorinated biphenyls was investigated. Contributions to the procedural blank value and the interference from other organic materials in a water sample were examined. Quantitation of recovery runs was achieved by comparing peak heights of selected peaks from the sample extracts with the corresponding peaks from standard polychlorinated biphenyl solutions. Results of tests run on well samples indicate that the detection limits are affected by the interference from other organics in the water sample but are typically in the 1 to 10 microgram per liter range for potable water from a river source. (Titus-FRC)
W82-00875

OCCURRENCE OF TETRAALKYLEAD COMPOUNDS IN THE AQUATIC ENVIRONMENT,

Canada Centre for Inland Waters, Burlington (Ontario).
Y. K. Chau, P. T. S. Wong, O. Kramar, G. A.
Bengert, and R. B. Cruz.
Bulletin of Environmental Contamination and Toxicology, Vol. 24, No 2, p 265-269, 1980. 1 Tab, 10 Ref.

Descriptors: *Aquatic environment, *Fish physiology, Fish populations, *Water pollution, *Toxicity, Microorganisms, *Lead, Organic compounds, Primary productivity, Environmental effects, Ecosystems, Gas chromatography, Spectrophotometry, Sediment, Lakes, *Tetraalkylead compounds.

Results of an extensive survey of fish, vegetation, sediment, and water for the presence of tetraalkylead compounds are presented. The samples were taken from various lakes and rivers in Ontario. Only fish samples were found to contain these compounds. The source of these compounds is thought to be antiknock gasoline additives or related commercial products. The fish containing tetraalkylead also contained high total and extractable lead. No relationship between species and size of fish and concentration of pollutant was detected. The type of tetraalkylead varied in different locations. Concentrations of the tetraalkylead were generally low, comprising less than 10 per cent of the total lead. (titus-FRC)
W82-00878

DETERMINATION OF POLYHALOGENATED PHENOLIC COMPOUNDS IN DRINKING WATER, HUMAN BLOOD SERUM AND ADIPOSE TISSUE,

Miami Univ., FL. School of Medicine.
C. Morgade, A. Barquet, and C. D. Pfaffenberger.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 257-264, 1980. 5 Tab, 8 Ref.

Descriptors: *Phenols, *Drinking water, *Halogens, *Tissue analysis, *Water sampling, Potable water, Organic compounds, Blood, Experimental design, Water pollution, Gas chromatography, Sensitivity analysis, Public health.

The blood serum of 58 women in Florida was analyzed for the presence of eight halogenated phenols, and the drinking water source for each woman was recorded. Chlorinated municipal water and nonchlorinated well water were the two sources of drinking water. Additionally, 10 samples of human adipose tissue, taken at autopsy, were analyzed. Results showed that blood serum levels of PCP were not dramatically different for the two groups of women. The concentrations in both groups were significantly below those reported for citizens in Hawaii. Tissue analyses indicate that PCP (pentachlorophenol) does not bioconcentrate in human adipose tissue to the same extent as DDT and DDE. The level of PCP in adipose tissue ranged from 0.01 to 0.08 parts per million. (Titus-FRC)
W82-00879

ALUMINUM SHADOWING-DIRECT PROJECTION PHOTOMICROSCOPY OF DIATOM FRUSTULES,

Weyerhaeuser Co., Longview, WA.
D. W. Quackenbush, and M. L. Bothwell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1160-1166, July, 1980. 3 Fig, 24 Ref.

Descriptors: *Diatoms, *Microscopy, Bacteria, Phytoplankton, *Photography, Water analysis, *Environmental gradient, *Ecology.

Accurate identification of diatom genera and species represents an important means of studying present and past environmental conditions in freshwater and marine ecosystems. The aluminum shadowing-direct projection method produced high resolution photomicrographic reproductions of diatom preparations in the 200 x 800 magnification range. This technique, which allows size determination in three dimensions, provides a simple and inexpensive alternative to low magnification scanning electron micrographs. Among the details revealed are valve surface contours, ridges and depressions, raised and depressed central areas of Cyclotella valves, external and internal valve views of pennate forms, and puncta of Stauroneis. A shadowing angle of 20 degrees gave the best results. By multiplying the measured length of shadows by tan 20 degrees, the depth of specimens or length of spines can be determined. Diatom identification and enumeration can be done directly from photographic prints, which are a permanent record. Another potential use of the method is in preparing permanent mounts for total free-living bacteria counts of water samples. (Cassar-FRC)
W82-00884

THE IMPACT OF AN INDUSTRIALLY CONTAMINATED LAKE ON HEAVY METAL LEVELS IN IT'S EFFLUENT STREAM,

Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
For primary bibliographic entry see Field 5B.
W82-00886

GRAB VERSUS COMPOSITE SAMPLING: A PRIMER FOR THE MANAGER AND ENGINEER,

Illinois Environmental Protection Agency, Springfield.
D. J. Schaeffer, H. W. Kerster, and K. G.
Janardan.
Environmental Management, Vol 4, No 2, p 157-163, March, 1980. 1 Tab, 7 Ref.

Descriptors: Sampling, *Water sampling, Water quality management, Effluents, Wastewater treatment, Monitoring, Regulations, Pollutant identification, Water analysis, Water pollution prevention, Simulation analysis, *Wastewater analysis, *Comparison analysis, Sampling techniques.

Effluent samples are usually aggregated into 24-hr composite samples for measuring compliance. This paper shows by simulation analysis that random grab samples are as effective as composite samples for monitoring purposes and provide more information on plant variability. In addition, by using a constant volume compositing regime, a single composite of n subsamples provides as much information as do n grab samples. Monthly average performance measured by M composites is the same as that measured by M random grabs taken over the same period. M grab samples are equally or more informative than the monthly average derived from flow proportional composites. For judging average plant performance, composites are better than grabs; for long term performance, grabs and composites provide the same real information. Process extremes, particularly high values, are more readily revealed by grab samples than by composite samples. This allows earlier corrective measures for out-of-control plant operations and warnings on releases of momentarily high concentrations of toxic or high BOD effluents. (Cassar-FRC)
W82-00891

PREFERENCE-AVOIDANCE REACTIONS OF CRAYFISH TO SUBLETHAL CONCENTRATIONS OF CADMIUM,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
A. F. Maciorowski, E. F. Benfield, and J. Cairns, Jr.
Hydrobiologia, Vol 74, No 2, p 105-112, September, 1980. 1 Fig, 4 Tab, 36 Ref.

Descriptors: *Cadmium, *Bioindicators, *Behavior, *Crayfish, Invertebrates, Monitoring, Water quality, Metals, Animal behavior, Water pollution effects, Aquatic environment, Pollutant identification.

Crayfish (Cambarus acuminatus) were able to detect sublethal concentrations of cadmium and respond by changing their locomotion patterns. This suggests a possible use of crayfish in continuous biomonitoring systems. The alterations in locomotor patterns included: activity without directed movement, momentary cessation of directed movement at the contaminated-uncontaminated interfece, attempts to leave the test chamber, and leaving and reentering the Cd zone. Tests were conducted in tanks using Cd concentrations of 125.0, 12.5, and 1.25 micrograms per liter. The crayfish tended to avoid the Cd area in the tank with the highest concentration and appeared to prefer the Cd side in the lower two concentrations. A possible explanation for this is that the pollutant disrupts chemosensory behavior, blocking taste receptors and natural stimuli. (Cassar-FRC)
W82-00916

HEAVY METAL CONCENTRATIONS IN THE HOLSTON RIVER BASIN (TENNESSEE),

East Tennessee State Univ., Kingsport. Dept. of Chemistry.
G. J. Young, and R. D. Blevins.
Archives of Environmental Contamination and Toxicology, Vol 10, No 5, p 541-560, September, 1981. 1 Fig, 7 Tab, 71 Ref.

Descriptors: *Heavy metals, *Water analysis, *Fish, Monitoring, Pollutant identification, Metals, Cadmium, Lead, Manganese, Zinc, Copper, Mercury, *Holston River, *Tennessee, Water pollution sources, Toxicity, Water pollution effects.

Heavy metals (Zn, Cd, Hg, Cu, Pb, and Mn) were measured in water samples and fish muscle from the Holston River Basin in Eastern Tennessee. This basin, encompassing 12 counties, contains both natural, unpolluted streams and waters heavily polluted by industrial and domestic uses. Maximum levels (in ppb) in water samples were: Zn, 1143; Mn, 637; Pb, 18; Hg, 0.6; Cd, 4; Cu, 68. In fish muscle maximum levels (in ppm) were: Cd, 0.41; Pb, 1.3; Mn, 4.3; Cu, 0.8; and Zn, 24. Median levels of Cd, Cu, Pb, and Zn in the Holston River Basin were at or below median values found in fish throughout the world; Mn levels were much higher. Serious Hg pollution problems downstream of a chlor-alkali plant operated from 1950 to 1972 were not reflected in grab water samples because large amounts of Hg are adsorbed on sediment. Fish muscle is a better indicator of Hg pollution than water samples. (Cassar-FRC)
W82-00959

SEA URCHIN SPERM BIOASSAY FOR SEWAGE AND CHLORINATED SEAWATER AND ITS RELATION TO FISH BIOASSAYS,

Washington Univ., Seattle. Fisheries Research Inst.
P. A. Dinnel, Q. J. Stober, and D. H. DiJulio.
Marine Environmental Research, Vol 5, No 2, p 29-39, 1981. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Bioassay, *Wastewater, *Echinoderms, Chlorination, Toxicity, *Seawater, Eggs, Fertilization.

Sea urchin sperm bioassay was used to assess the toxicity of a complex municipal wastewater and chlorinated seawater, and these results were compared with previous results obtained with fish. Green sea urchin or sand dollar sperm and eggs were exposed to chlorinated or unchlorinated primary sewage effluent or chlorinated seawater before fertilization of eggs. With 5-minute exposures to chlorinated sewage, eggs remained viable in up to 25% sewage while sperm viability decreased to 29% in 5% sewage and 0% in more than 10% sewage. Fertilization was successful after 5-minute exposures of the sperm to as much as 30% freshwater in seawater with a salinity of about 20 ppt, while sperm lost viability in 20% sewage/seawater dilutions. Fertilization success was reduced by 50% by 2.2% chlorinated or 4.8% unchlorinated sewage in seawater. Sea urchin and sand dollar sperm were more sensitive than marine fish sperm to sewage and chlorinated seawater. Tests with sperm cells require only short exposure times under static conditions, thus this bioassay technique may be useful to researchers. (Small-FRC)
W82-00988

DETERMINATION OF PICOGRAM AMOUNTS OF TECHNETIUM-99 BY RESIN BEAD MASS SPECTROMETRIC ISOTOPE DILUTION,

DuPont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
T. J. Anderson, and R. L. Walker.
Analytical Chemistry, Vol 52, No 4, p 709-713, April, 1980. 3 Fig, 3 Tab, 25 Ref.

Descriptors: *Nuclear powerplants, *Isotope studies, *Mass spectrometry, Resins, Radioisotopes, *Pollutant identification, Chemical analysis.

Accumulation of large amounts of technetium-99, which is produced in high yields from the fission of uranium-235 and plutonium-239, can be expected to occur concurrent with energy production by atomic fission. The volatility of technetium-99 and its aqueous mobility in soil systems create the potential for escape to the environment. This paper reports the development of an improved isotope dilution mass spectrometric technique for the analysis of technetium-99 in environmental samples. Sequential ion-exchange chromatography and ion-association solvent extraction are used to isolate technetium from a sample spiked with technetium-97. The isolated technetium is concentrated onto a pair of anion exchange beads having a diameter of about 0.3 millimeters, which are then individually analyzed on the rhenium 'V' filaments of a surface-ionization mass spectrometer. The resin bead source provides an enhanced ionization efficiency capable of permitting determination of as little as 1 picogram of technetium. This technique was used for the analysis of several environmental samples from the vicinity of the Savannah River Plant, a nuclear materials production complex. These analyses showed that technetium-99 has high mobility in water-saturated soil and that technetium-99 concentrations in the seepage basins can be expected to vary substantially with reprocessing parameters. The contribution of technetium-99 to the Savannah river was assessed by comparing upstream and downstream samples and gave an annualized instantaneous release rate to the aqueous environment of 0.05 Ci/yr. (Carroll-FRC)
W82-00999

A RAPID SIMPLE LONG-TERM TOXICITY ASSAY FOR AQUATIC CONTAMINANTS USING THE NEMATODE PANAGRELLUS REDIVIVUS,

Manitoba Univ., Winnipeg. Dept. of Zoology.
M. R. Samoiloff, S. Schulz, Y. Jordan, K. Denich, and E. Arnott.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1167-1174, July, 1980. 6 Tab, 10 Ref.

Descriptors: *Bioassays, *Water pollution effects, *Nematodes, Carcinogens, Aquatic animals, *Heavy metals, Toxicity, Pesticide toxicity, Pesticides, Physiological ecology, Water pollution, Assay, Bioindicators.

Two bioassay methods (one developmental, the other mutagenic) for determining the effects of aquatic environmental contaminants to the nematode Panagrellus redivivus are presented. The nematodes were tested with 15 known carcinogens or mutagens, 6 suspect carcinogens, and 7 heavy metals at levels of 0.01 to 1,000 micromoles/liter. An assay based on frequency of completion of postembryonic molts showed that 24 of the 28 test agents caused an increased mortality to P. redivivus. Twelve of the known carcinogens and one heavy metal caused lethal mutations in nematode chromosome assays. These assays are recommended for the detection of toxic effects to aquatic organisms due to chronic exposure to environmental water pollutants. (Geiger-FRC)
W82-01017

RELATION BETWEEN TROPHIC POSITION AND MERCURY ACCUMULATION AMONG FISHES FROM THE TONGUE RIVER RESERVOIR, MONTANA,

Montana Cooperative Fishery Research Unit, Bozeman.
G. R. Phillips, T. E. Lenhart, and R. W. Gregory.
Environmental Research, Vol 22, No 1, p 73-80, June, 1980. 3 Fig, 30 Ref.

Descriptors: *Reservoirs, *Fish, *Mercury, Toxicity, Accumulation, *Bioaccumulation, Methylmercury, Organic compounds, Mining industry, *Tongue River Reservoir, *Montana.

Fish were collected from the Tongue River Reservoir during spring and summer 1978 using trap nets or gill nets. Total mercury in fish was determined using an atomic absorption spectrophotometer. Mercury concentrations in muscle tissue from all five species of fish increased with fish length. This increase in contamination with increasing length is primarily a result of the long biological half-time of methylmercury in fishes. Male northern pike contained higher mercury concentrations than did females of similar length. This trend was a result of the slower growth of males relative to females. Mercury concentrations in some individuals of all species analyzed exceeded the FDA guideline. Maximum mercury concentrations in microgram mercury/gram observed were as follows: Northern pike 1.53, sauger 1.40, walleye 1.30, black crappie 0.64, and white crappie 0.60. Mercury concentrations in northern pike were particularly high, with 29% of the fish analyzed exceeding the FDA guidelines. Northern pike and saugers accumulated mercury nearly twice as fast as did the two species of crappie. The rate for walleyes was intermediate. It was concluded that planktivores derive most of their methylmercury body burden from water, but that piscivores receive a significant amount from both diet and water. (Baker-FRC)
W82-01041

DISPERSAL OF SALMONELLA FROM A POLLUTED STREAM TO NEIGHBORING TERRESTRIAL HABITATS,

Elmhurst Coll., IL. Dept. of Biology.
F. C. Mittermeyer, D. Cramer, and R. Ransford.
Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 269-281, 1980. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Human diseases, *Salmonella, *Bacterial analysis, Rivers, Surface waters, Sediments, Shores, Shoreline cover, Soil analysis, Bacteria, River water, Water pollution sources, Path of pollutants, *Illinois.

Environmental samples were collected from the Fox River and adjacent areas in Kane County, Illinois. Seven sampling sites were chosen from within the suburban municipalities of St. Charles, Geneva, Batavia, and North Aurora. During the first four months of the study the greatest efficiency of Salmonella recovery was achieved using BPW pre-enrichment followed by enrichment in BGTET and subsequent plating onto Brilliant Green Agar. This procedure was used exclusively thereafter. Twenty-three percent of grass samples taken from the river's edge were positive for Salmonella. Grass samples taken more than 2 meters from the river were all negative. Soil samples taken from the top 10 cm of the ground about 3 meters from shoreline were usually negative. Salmonella heidelberg was the only serotype found in the sediment samples. Attempts to isolate Salmonella from surface swabs of picnic tables, trees, poles, bridges, and other surfaces within 15 meters of the river were unsuccessful. Some animals associated with the polluted river were found to be infected with Salmonella. However, general findings lead to the conclusion that the river is not an intensive Salmonella threat to humans, except perhaps those who directly contact the water. (Baker-FRC)
W82-01043

GIARDIA PREVALENCE IN COMMERCIALLY TRAPPED MAMMALS,

Washington State Dept. of Social and Health Services, Olympia. Office of Environmental Programs.
F. Frost, B. Plan, and B. Liechty.
Journal of Environmental Health, Vol 42, No 5, p 245-249, March/April, 1980. 5 Tab, 13 Ref.

Descriptors: *Water quality, *Drinking water, Giardia, Watersheds, Parasites, Potable water, *Contamination, Public health, Water pollution sources, Mammals, Protozoa, Chlorination, Beaver, Epidemiology, *Municipal water, Animal parasites.

Several recent outbreaks of giardiasis have been linked to the presence of Giardia in municipal water supplies. In most cases human or animal contamination of drinking water has been implicated. Since chlorine may not be effective in inactivating cysts, the risk of human infection through contaminated drinking water may be significant. Commercial trappers were recruited to provide stool samples from kill-trapped animals. During the three years of the study 704 fecal samples were examined. Parasites were found in all species of animals; however, only the beaver and muskrat harbored Giardia. The percentage of Giardia-positive animals increased each year, due to the detection of infected animals in previously negative counties and to a higher prevalence of Giardia infections in animals from previously positive counties. In the second and third years, Giardia prevalence in muskrats was higher than in beavers. The finding of infected animals in the Jones Creek/Boulder Creek, Cedar River and Green River watersheds suggests that beavers can maintain the infection independent of human involvement. This indicates that human sewage is not necessary to maintain infections among wild beaver. It also suggests that protected watersheds will not insure pathogen-free water. (Baker-FRC)
W82-01046

BIOLOGICAL TESTING METHODS - COMPLIANCE WITH HAZARDOUS WASTE REGULATION CHAPTER 173-302 WAC.

Washington State Dept. of Ecology, Olympia.
Document DOE 80-12, October, 1980. 24 p, 1 Fig, 3 Tab.

Descriptors: *Fishkill, *Waste characteristics, *Hazardous materials, *Waste identification, *Fish toxins, Fish populations, Testing procedures, Toxicity, Test facilities, Poisons, Mortality, Lethal limit, Laboratory animals, *Washington.

The purpose of Washington's acute fish toxicity test is to provide a simple, reliable, low-cost method for testing the toxicity of a material against the requirements of the Hazardous Waste Regulation, Chapter 173-302 WAC. The test method developed, described in Part A of the report, is strictly a range-finding test and does not determine the actual median lethal concentration, which is defined as the concentration of material that kills 50 percent of the population (fish) within 96 hours. The method, incorporating test organisms in holding tanks in a constant-temperature room or recirculating water batch, follows the requirements of Chapter 173-302 WAC, which states that if the toxicity is not known, the waste must be tested at two concentrations: 100 mg/l and 1000 mg/l. Wastes that are highly toxic and kill fish at 100 mg/l are considered extremely hazardous, while wastes that kill fish at 1000 mg/l are considered dangerous wastes. Part B of the report describes oral rat testing whose purpose is to determine the relative biological risk of potentially hazardous waste to man and wildlife. Male albino rats weighing 200-300 grams are used for test and control animals. Wastes are introduced into the stomachs by a tube. Ten rats are used at each dosage level, and ten rats for each positive control test. Oral rat tests are used whenever a generator does not characterize the toxicity of a waste because of a lack of knowledge of the chemical composition and presence of toxic constituents, a lack of knowledge of the biological hazards of toxic constituents or the waste as a whole, and/or the inability to book-designate a waste's biological toxicity. (Garrison-Omniplan)
W82-01071

DETERMINATION OF ALKALINE EARTH AND DIVALENT TRANSITION METAL CATIONS BY ION CHROMATOGRAPHY WITH SULFATE-SUPPRESSED BARIUM AND LEAD ELUENTS,

Brigham Young Univ., Provo, UT. Dept. of Chemistry.
F. R. Nordmeye, L. D. Hansen, D. J. Eatough, D. K. Rollins, and J. D. Lamb.
Analytical Chemistry, Vol 52, No 6, p 852-856, May, 1980. 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Water analysis, *Metals, Magnesium, Calcium, Strontium, Iron, Manganese, Cobalt, Nickel, Copper, Zinc, Cadmium, Lakes, Ponds, Measuring instruments, *Chromatography.

The development of simple eluent-suppressor systems is reported. These systems allow the simultaneous ion chromatographic determination of Mg(2+), Ca(2+), and Sr(2+), and individual determinations of Mn(2+), Fe(2+), Co(2+), Ni(2+), Cu(2+), Zn(2+), and Cd(2+). Aqueous Ba(2+) and Pb(2+) which serve as eluting ions are suppressed as insoluble sulfates in a suppressor column initially loaded with SO4(2-). An H(+)-exchange postcolumn is placed between the suppressor and detector, serving to minimize the effect of pH on the conductometric base line and amplify divalent cation peak heights by a factor of about 5, thus greatly increasing the sensitivity of the technique. The major advantage of the method is the wide range of eluent pH which becomes available. Thus transition metal cations can be eluted in acidic solution without being exposed to a neutral or alkaline environment at any point in the system. Use of the ion chromatographic technique described for the analysis of Mg(2+) and Ca(2+) in pond water samples is described. The samples were analyzed both by ion chromatography using the 1 mM Ba (NO3)2 eluent at pH 4 with the post-column in line and by atomic absorption spectrometry. The results from the two techniques never differed by more than 3%. (Baker-FRC)
W82-01082

WATER HARDNESS DETERMINATION BY THE CATALYTIC POLAROGRAPHIC WAVE OF MAGNESIUM ION,

Foxboro Co., MA.
M. C. Cheney, D. J. Curran, and K.S. Fletcher, III.
Analytical Chemistry, Vol 52, No 6, p 942-945, May, 1980. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Water analysis, *Magnesium, Chemical analysis, *Hardness, Measuring instruments, Polarographic analysis, Chemical properties.

A water hardness measurement technique is presented which is based on the stoichiometric displacement of magnesium from its relatively weak EDTA complex by most divalent metal ions. Subsequent determination of free Mg(2+) using the catalytic wave that results when it is reduced at the dropping mercury electrode provides a substantial amplification effect. Though the relationship between observed catalytic current and concentration of Mg(2+) is linear over a relatively narrow range of concentration, the technique offers a rapid and sensitive method for determination of water hardness. Samples of tap water, well water, and an artificially prepared hard water containing 25.0 ppm Ca(2+) and 20.0 ppm Mg (2+) were analyzed by this method and by the standard EDTA titration method. Results were accurate to within 1% of the titration values and precision was on the order of 1%. (Baker-FRC)
W82-01083

DETERMINATION OF CHROMIUM SPECIATION IN NATURAL WATERS BY ELECTRODEPOSITION ON GRAPHITE TUBES FOR ELECTROTHERMAL ATOMIZATION,

Australian Atomic Energy Commission Research Establishment, Lucas Heights.
G. E. Batley, and J. P. Matousek.
Analytical Chemistry, Vol 52, No 11., p 1570-1574, September, 1980. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Natural waters, *Chromium, *Water analysis, Chemical analysis, Electrothermal atomization, Electrochemistry.

Studies of the electrodeposition-atomization technique and its potential for the analysis of chromium species in seawater are described. Matrix interferences can be overcome and preconcentration achieved by the electrodeposition of chromium with mercury onto pyrolytic graphite-coated tubular furnaces, using a flow-through assembly. At pH 4.7, using a desposition potential of -1.8 V vs. SCE, both Cr(VI) and Cr(III) are reduced and accumulated as metallic chromium. At the same pH, but at -0.3 V vs. SCE, only Cr(VI) is selectively reduced to Cr(III), which accumulates by adsorption. Using the labile-bound discrimination of the electrodeposition technique combined with an ultraviolet irradiation step, Cr(VI) was found to be dominant in the samples studied, with most Cr(VI) present as labile forms. (Baker-FRC)
W82-01084

ORGANIC MATRIX MODIFIERS FOR DIRECT GRAPHITE FURNACE ATOMIC ABSORPTION DETERMINATION OF CADMIUM IN SEAWATER,

National Research Council of Canada, Halifax (Nova Scotia). Atlantic Regional Lab.
R. Guevremont.
Analytical Chemistry, Vol 52, No 11, p 1574-1578, September, 1980. 3 Fig, 4 Tab, 17 Ref.

Descriptors: *Seawater, *Cadmium, Water analysis, Chemical analysis, Spectral analysis, Atomic absorption spectrometry, Reagent.

The application of citric acid, lactic acid, aspartic acid, histidine, and EDTA to direct graphite furnace analysis of cadmium in seawater is described. The agreement between analyses performed using the different reagents was very good. The application of EDTA gave results in good agreement with APDC/MIBK solvent extraction followed by graphite furnace atomic absorption and with ion exchange on Chelex-100 resin followed by isotope dilution spark source mass spectrometry. Citric acid appeared to be the most promising reagent used thus far. The sensitivity possible with this reagent is higher and the background interferences were small and easily controlled. The major difficulty with this reagent is the shortness of the atomic absorption signal. The lowest standard deviation in the measurement of cadmium in seawater was obtained using aspartic acid. In seawater this reagent had excellent sensitivity and low background absorbance. In deionized water, however, it did not promote low temperature atom production to the extent possible using citric acid or lactic acid. (Baker-FRC)
W82-01085

COMPARISON OF METHODS FOR THE DETERMINATION OF TRACE ELEMENTS IN SEAWATER,

National Research Council of Canada, Ottawa (Ontario). Div. of Chemistry.
R. E. Sturgeon, S. S. Berman, J. A. H. Desaulniers, A. P. Mykytiuk, and J. W. McLaren.
Analytical Chemistry, Vol 52, No 11, p 1585-1588, September, 1980. 3 Tab, 16 Ref.

Descriptors: *Seawater, *Chemical analysis, *Trace elements, Water analysis, Metals, Cadmium, Zinc, Lead, Iron, Manganese, Copper, Nickel, Cobalt, Chromium, Atomic absorption spectrometry, Emission spectroscopy, Ion exchange.

The analysis of coastal seawater for Cd, Zn, Pb, Fe, Mn, Cu, Ni, Co, and Cr was carried out using isotope dilution spark source mass spectrometry (IDSSMS), graphite-furnace atomic absorption spectrometry (GFAAS), and inductively coupled plasma emission spectrometry (ICPES) following trace metal separation-preconcentration using ion-exchange and chelation-solvent extraction, and direct analysis by GFAAS. Cu, Ni, Pb, Cr, and Co could not be measured by direct GFAAS in the stored seawater samples because of their inherently low concentrations and/or pronounced physicochemical matrix interference effects. Manganese

could not be determined by ICPES using a 25-fold preconcentration of the trace elements, as their levels in such concentrates remain below values at which reliable analysis can be performed. Overall good agreement was obtained between the elemental values in relation to the method of analysis. The precision of replicate determination between methods for all elements is comparable. Complete analysis of each sample by all the methods indicated usually required about two months. The results of this study give confidence in the ability of the individual methods to give accurate analytical data and in the effectiveness of the standard addition approach in compensating for physicochemical interferences arising during sample preconcentration and instrumental analysis. (Baker-FRC)
W82-01086

ENTERIC VIRUSES IN RENOVATED WATER IN MANITOBA,

Cadham Provincial Lab., Winnipeg (Manitoba).
L. Sekla, W. Stackiw, C. Kay, and L. VanBuckenhout.
Canadian Journal of Microbiology, Vol 26, No 4, p 518-523, 1980. 4 Tab, 31 Ref.

Descriptors: *Viruses, *Wastewater renovation, Water reuse, Water shortage, Wastewater treatment, Drinking water, Potable water, Effluents, Rivers, Water analysis, *Manitoba, Canada.

This paper reports on procedures used in, and the findings obtained from, recovering enteric viruses from a Manitoban waterway system consisting of a sewage treatment plant, a river, and a water treatment plant. Both the liquid and the solid (sludge) components of sewage were sampled. The viruses isolated from raw sludge, sewage, final effluent, river water, and drinking water are listed. Of the 57 poliovirus isolates from sewage, 22 were tested and found to be vaccine strains. All three viruses isolated from the river were obtained from the same sample, collected at the middle of the river near the outlet of the sewage treatment plant in October of 1978. Thirteen of the isolates from drinking water were found on samples taken 2 days apart. The first 14 isolates found were confirmed as vaccine strains. This study has demonstrated the presence of enteric viruses in sewage and drinking waters, thus confirming the hypothesis that viruses can be recycled. The presence of enteric viruses in 61.8% of the sewage samples was expected. The presence of enteric viruses in 20.5% of the final sewage effluent samples was also expected. The recovery of enteric viruses from 6.75% of the drinking water samples is a matter of concern. All viruses so recovered were polioviruses, and thos tested were found to be vaccine strains, a sequel to the extensive immunization program carried out in Manitoba since 1962. (Baker-FRC)
W82-01090

MULTIELEMENT PRECONCENTRATION OF TRACE HEAVY METALS IN WATER BY COPRECIPITATION AND FLOTATION WITH INDIUM HYDROXIDE FOR INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY,

Nagoya Univ. (Japan).
M. Miraide, T. Ito, M. Baba, H. Kawaguchi, and A. Mizuike.
Analytical Chemistry, Vol 52, No 6, p 804-807, May, 1980. 2 Fig, 4 Tab, 3 Ref.

Descriptors: *Heavy metals, *Water analysis, Measuring instruments, Chemical analysis, Chromium, Manganese, Nickel, Cobalt, Cadmium, Lead, Spectrometers, Spectral analysis, Analytical techniques.

Microgram quantities of Cr(III), Mn(II), Co, Ni, Cu(II), Cd, and Pb in 1200-ml samples were quantitatively coprecipitated with indium hydroxide at a pH of 9.5. After adding ethanolic solutions of sodium oleate and dodecyl sulfate, the precipitates are floated with numerous tiny nitrogen bubbles to the solution surface, and then collected in a small sampling tube. The procedure is simple and rapid, and suitable for operation at sampling spots. The heavy metals in the dissolved precipitates are determined by inductively coupled plasma-atomic emission spectrometry. The concentrations of the heavy metals are increased 240-fold, and those of alkali and alkaline earth metals in artificial seawater are reduced to 1/50-1/20 for sodium and potassium, and about 1/2 for magnesium, calcium, and strontium. Heavy metals at the low microgram/liter level in water or artificial seawater were simultaneously preconcentrated and determined by this procedure. The time required for preconcentration was about 40 minutes. (Baker-FRC)
W82-01097

DETERMINATION OF MOLYBDENUM IN SEA AND ESTUARINE WATER WITH BETA-NAPHTHOIN OXIME AND NEUTRON ACTIVATION,

Dalhousie University, Halifax (Nova Scotia). Dept. of Chemistry.
A. I. Kulathilake, and A. Chatt.
Analytical Chemistry, Vol 52, No 6, p 828-833, May, 1980. 1 Fig, 9 Tab, 53 Ref.

Descriptors: *Water analysis, *Molybdenum, Chemical analysis, Seawater, Neutron activation analysis, Estuaries, Trace elements, Heavy metals.

An analytical method for the determination of trace quantities of molybdenum in sea and estuarine water employing neutron activation analysis preceded by preconcentration of the element using beta-naphthoin oxime is presented. Radioactive tracers were used to investigate the various factors which can influence the sensitivity of the method. Concentrations of sodium, chlorine, and bromine in untreated seawater and cocrystallized product have been compared for evaluating the ability of beta-naphthoin oxime to reduce interferences from these three elements. Selectivity of beta-naphthoin oxime in preconcentrating molybdenum was studied using two diverse matrices, seawater and steel, which are known to contain several elements at drastically different concentrations. Molybdenum concentrations in samples of sea and estuarine water were determined with good precision and accuracy by this method. Beta-naphthoin oxime was found to be superior to alpha-benzoin oxime in selectively cocrystallizing molybdenum quantiatively from water. Detection limits were such that small amounts of molybdenum could be measured in the presence of large quantities of interfering elements. (Baker-FRC)
W82-01098

AMMONIA ELECTRODE WITH IMMOBILIZED NITRIFYING BACTERIA,

Akinomoto Co., Inc., Kawasaki (Japan). Central Research Lab.
M. Hikuma, T. Kubo, T. Yasuda, I. Karube, and S. Suzuki.
Analytical Chemistry, Vol 52, No 7, p 1020-1024, June, 1980. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Wastewater analysis, *Ammonia, Water analysis, Measuring instruments, Industrial wastes, Electrodes, Chemical analysis.

Nitrifying bacteria were immobilized by being entrapped between two membranes, a porous acetylcellulose membrane and the Teflon membrane of an oxygen electrode. This microbial sensor was then applied to the determination of ammonia in wastewaters. When a sample solution was pumped into the flow system of the sensor, the electrode current decreased to a steady state after 8 minutes. Measurement could be also made with a 3-minute pumping period with little loss of sensitivity. The calibration plot of the current difference vs. concentration of ammonia was linear up to 1.3 mg/liter. The sensor was applied to the determination of ammonia in wastewaters of a fermentation factory. The concentration of ammonia and the biological oxygen demand (BOD) of the sample solutions were determined by the distillation acidimetry and Japanese Industrial Standard methods, respectively. Good agreement was obtained between the ammonia concentration determined by the conventional method and that obtained by the microbial sensor. The relative difference betweeb the two methods was less than 6%. The results were not affected by organic compounds. The microbial sensor could be used for more than two weeks and 1400 assays. The electrode current difference decreased gradually, necessitating occasional recalibration of the electrode. (Baker-FRC)
W82-01099

DETERMINATION OF NICKEL BY DIFFERENTIAL PULSE POLAROGRAPHY AT A DROPPING MERCURY ELECTRODE,

Laurentian Univ., Sudbury (Ontario). Dept. of Chemistry.
C. J. Flora, and E. Nieboer.
Analytical Chemistry, Vol 52, No 7, p 1013-1020, June, 1980. 4 Fig, 5 Tab, 49 Ref.

Descriptors: *Water analysis, *Nickel, Metals, Chemical analysis, Polarographic analysis, Lakes, Drinking water, Potable water, Pollutant identification.

The use of differential pulse polarography (DPP) in the analysis of nickel was examined. The detection limit of the method of 2 ppb with a confidence interval of 95% and observed standard deviations of the same magnitude for the DMG-sensitized procedure are all comparable to those possible with modern electrothermal AA of nickel. Detection limits and precision are virtually limited by the ability to avoid contamination. The proposed DPP methods are well suited to the routine analysis of water and other aqueous samples. Especially advantageous is the flexibility to extend the analytical concentration range from ng/ml. The advent of the laboratory minicomputer should also lead to many innovations and improved performances with this method. In an analysis of Sudbury Lake and tap water, agreement between DPP and AA results are excellent for the July 7, 1978 data and somewhat less satisfactory for the data from the remaining time of experimentation. The DPP analysis requires no pretreatment of the water samples and is an extremely rapid, sensitive, reproducible, and convenient method conducting water analyses. The high contents of nickel found in Sudbury tap and lake water may be related to nickel emissions associated with local smelting and refining of the metal. (Baker-FRC)
W82-01100

5B. Sources Of Pollution

ANTHROPOGENIC TRACE ELEMENTS AND POLYCYCLIC AROMATIC HYDROCARBON LEVELS IN SEDIMENT CORES FROM TWO LAKES IN THE ADIRONDACK ACID LAKE REGION,

Department of Energy, NY. Environmental Measurements Lab.
M. Heit, Y. Tan, C. Klusek, and J. C. Burke.
Water, Air, and Soil Pollution, Vol 15, No 4, p 441-464, May, 1981. 2 Fig, 11 Tab, 37 Ref.

Descriptors: *Sediments, *Lakes, *Pollution load, Metals, Aromatic compounds, Hydrocarbons, *Acid rain, Acidic water, *Adirondacks, Sagamore Lake, Woods Lake, *New York, Sivter, Aluminum, Arsenic, Beryllium, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Tin, Vanadium, Zinc, Selenium, Thallium, Perylene.

The degree to which anthropogenic trace elements and polycyclic aromatic hydrocarbons have been deposited in remote lakes known to be affected by acid rainfall was investigated. The lakes investigated are located in the Adirondack State Park on the western slope of the Adirondack Mountains. Sagamore Lake is a brown water lake due to high levels of humic materials, while Woods Lake is generally clear. Sediment cores were taken from each of the lakes during March 1978. Several conclusions were reached. Except for perylene, the prime source of all parental PAHs measured and the majority of trace elements appears to be combustion. All combustion products had primarily an anthropogenic origin. Levels of all parental PAHs except perylene and levels of several of the metals significantly increased in the surface sediments of both lakes compared to their background concentrations. PAH concentrations in Woods Lake were quite high, approaching levels reported for more heavily

populated and industrialized areas. Metals were present at 3-4 times higher concentrations in Woods Lake than in Sagamore Lake. Metals and PAH levels decreased in concentration with depth to background levels in both lakes. This baseline depth corresponded to about 30 years ago. Lead has increased to the greatest extent of any of the metals considered relative to their baseline quality. Long distance atmospheric transport and region-wide deposition of anthropogenically derived elements and PAHs into these remote lakes appears to be more significant than input from local sources. (Baker-FRC)
W82-00501

RELATIONSHIPS BETWEEN SULFATE AND NITRATE ION CONCENTRATIONS AND RAINFALL PH FOR USE IN MODELING APPLICATIONS,

Battelle Pacific Northwest Lab., Richland, WA. Atmospheric Sciences Dept.
D. J. McNaughton.
Atmospheric Environment, Vol 15, No 6, p 1075-1079, 1981. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Acid rain, *Sulfates, *Nitrates, Mathematical modeling, Hydrogen ion concentration, Acidity, Air pollution effects, Anions, Rainfall, Water pollution sources.

Precipitation chemistry data for the northeastern United States were analyzed to test relationships between anthropogenic sulfate and nitrate ion contributions and rainfall pH. The data set incorporated all observations, with complete measurements of all three ion concentrations being collected from September 1976 through December 1979. A relationship was found between sulfates and nitrates and rainfall acidity expressed in terms of pH, and this relationship can be applied to deposition predictions to predict pH from regional air pollutant transport models. Variance in the pH versus ion relationships can be explained by the sulfate ion concentration alone. Thus, rainfall acidity patterns could be approximated by sulfate deposition patterns alone in cases where relative levels of nitrate ions and sulfate ions in the atmosphere are the same as those that influence precipitation. The analysis was based on the assumption that the predominant anions are anthropogenic, and this assumption could lead to an overprediction of rainfall acidity. (Small-FRC)
W82-00507

THE BREAKDOWN OF POULTRY MANURE AGGREGATES BY RAINFALL IMPACT,

Science and Education Administration, Ithaca, NY.
R. E. Muck, and D. C. Ludington.
Journal of Environmental Quality, Vol 9, No 1, p 61-65, January-March, 1980. 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Manure, *Rainfall impact, Rainfall rate, Land disposal, Simulated rainfall, *Poultry, Nitrogen, Phosphorus, *Leaching, Kinetic energy, Poultry manure.

The effects of rainfall characteristics on the breakdown of dry poultry manure aggregates were investigated, and the effects of aggregate breakdown on the leaching of N and P from poultry manure were demonstrated. Simulated rainfall was used to determine the effects of rainfall intensity, duration, drop velocity, and drop size. Aggregate breakdown was an exponential function of rainfall amount for a constant drop velocity and size. Rainfall energy and momentum both explained the aggregate breakdown results for a constant drop size. As drop size increased, aggregate breakdown seemed to increase, but these results were not statistically significant. Aggregate breakdown caused increases in the leaching of nitrogen and phosphorus from the manure. With a 4 hr, 5.08 cm/hr simulated rainfall, aggregate breakdown accounted for a 70% increase in leaching losses from the manure. Thus, the type of crop cover on which manure is spread may affect nutrient losses due to rainfall. For example, hay would intercept the rainfall before it hit the manure and thus would reduce aggregate breakdown by rainfall. (Small-FRC)
W82-00513

DYE-SENSITIZED PHOTOOXIDATION OF BROMACIL IN WATER,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Soil Residues Chemistry.
A. J. Acher, and S. Saltzman.
Journal of Environmental Quality, Vol 9, No 2, p 190-194, April-June, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Bromacil, *Degradation, *Dyes, Pesticide residues, *Herbicides, Photodegradation, Chemical reactions, Solar radiation, Irradiation, *Fate of pollutants.

To study its fate in aquatic systems, the herbicide bromacil (3-sec-butyl-5-bromo-6-methyl uracil) in aqueous solution (250 ppm) was exposed to direct solar radiation in the presence of dye sensitizers at appropriate pH. The herbicide rapidly and completely photodegraded via a debromination mechanism to 3-sec-butyl-2-acetyl-2-hydroxy hydantoin, the major product (97-98%), and the 5,5'-dimer of 3-sec-butyl-6-methyl uracil, a minor product (1-2%). Unidentified polar compounds were formed upon continued degradation. The most effective dye sensitizers were riboflavin (10 ppm) and methylene blue (2-5 ppm). Less effective sensitizers were rose bengal (5 ppm), humic acids (20 ppm), and chlorophyll (20 ppm). The reaction proceeded more rapidly at alkaline pH. With sensitizers and a reaction time of 30 min, no degradation occurred at less than pH 5, 10% at pH 7, 20% at pH 8, and 80% at pH 10. The effects of suspended solids, often found in natural waters, were tested. An anion exchange resin partially inhibited degradation, and bentonite strongly inhibited degradation. Under optimal conditions (effective sensitizer, high pH, no suspended solids) photooxidation to the intermediate products was complete within 1 hour. (Cassar-FRC)
W82-00514

ACID RAIN AT KENNEDY SPACE CENTER, FLORIDA: RECENT OBSERVATIONS,

University of Central Florida, Orlando. Dept. of Chemistry.
B. C. Madsen.
Atmospheric Environment, Vol 15, No 5, p 853-862, May, 1981. 7 Fig, 6 Tab, 15 Ref.

Descriptors: *Acid rain, *Kennedy Space Center, *Florida, Rainfall, Air pollution, Fallout, Water pollution sources, Hydrochloric acid, Sulfuric acid, Nitric acid.

Precipitation samples were collected in automated samplers designed to prevent both dry deposition and evaporation. Determinations of major cation and anion concentrations were made within 10 days after sample collection. All sampling sites were on or near the Kennedy Space Center complex in Florida. In general, summertime acidity was greater than during other times of the year. Maximum free acidity was observed during July in both 1978 and 1979. The July rainfall accounted for 21 and 10% of the total amounts received during the respective years. Lowest acidities were noted in November 1977 and April 1979. No pattern was noted when rain composition from a specific month during the first year of the study was compared to the identical time in the following year. The presence of sulfate ion can be attributed primarily to non-marine sources. Monthly and annual deposition of components which will be important if changes in rain composition occur due to future SRM launches are presented. Free acidity, nitrate ion and excess sulfate ion deposition account for the present acid loading, while chloride ion deposition reflects the influence of the marine environment. Monthly weighted average chloride ion concentrations ranged from 20 to 240 micromole/liter. The chloride: sodium ion ratio was slightly lower than that present in sea water. (Baker-FRC)
W82-00533

AQUASOLS: THE BEHAVIOR OF SMALL PARTICLES IN AQUATIC SYSTEMS,

Johns Hopkins Univ., Baltimore, MD.
For primary bibliographic entry see Field 1B.
W82-00540

PARTITIONING OF NO. 2 FUEL OIL IN CONTROLLED ESTUARINE ECOSYSTEMS. SEDIMENTS AND SUSPENDED PARTICULATE MATTER,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W82-00541

TRACE ELEMENT CONCENTRATIONS OVER MIDLAKE MICHIGAN AS A FUNCTION OF METEOROLOGY AND SOURCE REGION,

Governors State Univ., Park Forest South, IL. Coll. of Environmental and Applied Sciences.
H. Sievering, M. Dave, D. Dolske, and P. McCoy.
Atmospheric Environment, Vol 14, No 1, p 39-53, January, 1980. 7 Fig, 12 Tab, 21 Ref.

Descriptors: *Trace elements, *Air pollution, *Aerosols, Heavy metals, Metals, Lakes, *Lake Michigan, Water pollution sources, Path of pollutants, Wind, Air-water interfaces.

Aerosol samples were collected during May-September 1977 over southern Lake Michigan. This location, 87 degrees west and 42 degrees north, is in midlake, 40 to 100 km removed from any shoreline aerosol sources. The samples were analyzed for Pb, Zn, Mn, Mo, Fe, Ti, Al, Ca, and Mg. Micro- and meso-meteorological conditions were recorded. Several general conclusions were derived. Midlake metal concentration variabilities are linearly independent of wind speed and strongly and directly dependent on temperature stability of the surface layer, defined as the lowest few meters of air above the lake surface. Midlake mass concentration variability is more dependent on fine particulate aerosols with high Pb, Zn, and Mn content than on the coarse particulate fraction. Temperature stability of the surface air layer is more important than sedimentation and aerosol aging in terms of aerosol concentration variability within that layer. Midlake metal concentrations are more dependent on nearshore sources than on long range transport. The largest amount of Pb (95%), Zn and Mn (75%), and Fe (over 50%) present in the midlake atmospheric surface layer is probably anthropogenic in origin. (Cassar-FRC)
W82-00550

GROUNDWATER CONTAMINANT TRANSPORT WITH ADSORPTION AND ION EXCHANGE CHEMISTRY: METHOD OF CHARACTERISTICS FOR THE CASE WITHOUT DISPERSION,

Texas Univ. at Austin. Dept. of Civil Engineering.
R. J. Charbeneau.
Water Resources Research, Vol 17, No 3, p 705-713, June, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Solute transport, *Adsorption, *Ion exchange, *Leaching, Ion transport, Groundwater movement, Uranium, Mining engineering, Path of pollutants, Ammonia, Organic compounds.

Contaminant transport involves not only the movement of a pollutant away from a waste disposal site or the fate of constituents in recharge water, but also site restoration problems caused by emerging technologies such as in situ leach mining for uranium and in situ gasification of lignite. This paper concerns adsorption and ion exchange reactions in the absence of dispersion. The method of characteristics is used to formulate the solution for any adsorption isotherm and an arbitrary number of exchanging cations. It is applicable to linear flow systems and to nonlinear systems along streamlines in a nonuniform field. With 2 exchanging cations the complete solution may be obtained by graphical means; when there are more than 2, a computer is required to solve the problem. The first example illustrates migration of organics using the nonlinear Freundlich isotherm for adsorption of organics on lignite. The second concerns the volume of water required to restore a uranium mining site by sweeping out residual ammonia and other contaminants. (Cassar-FRC)
W82-00551

MODELING OF PROCESSES OF DECOMPOSITION OF ORGANIC MATTER IN BOTTOM SEDIMENTS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Ya. L. Fuksman.
Water Resources (English Translation), Vol 7, No 5, p 442-450, September/October, 1980. 6 Fig, 8 Ref. Translated from Vodnye Resursy, No 5, p 118-129, September/October, 1980.

Descriptors: *Mathematical models, *Decomposing organic matter, *Bottom sediments, Sediments, Organic matter, Decomposition, Mathematical equations, Mineralization, Fate of pollutants.

Although the decomposition of organic substances directly affects water quality, the mathematical description of this process is currently accomplished using rather simple models interpreting the general character of phenomena observed during the decomposition process. This paper discusses a more detailed mathematical model of biochemical processes of mineralization of organic matter with respect to bottom sediments. The systems of differential equations presented were developed on the basis of the energy balance in the heterotrophic population of bacteria. Nearly all of the parameters-constants used in the model have a definite thermodynamic or physiological significance. A flow of particles of detritus is produced by the dying phytoplankton. The amount of detritus is expressed by the weight of some biogenic element in the detritus, the cycle of which in the water body is being modeled. The biomasses of both aerobic and anaerobic bacteria are also phase variables in the model. Systems of differential equations for modeling anaerobic bacteria in an oxygen-free regime, anaerobic populations in the presence of oxygen, and populations of aerobic bacteria in the absence of anaerobic bacteria are presented. A model of the dynamics of an ecosystem with two populations is then developed which is composed of the model for the dynamics of the anaerobic population in the presence of oxygen and the model for the dynamics for the population of aerobes. (Carroll-FRC)
W82-00553

TRACE ELEMENT INPUTS FROM A COAL BURNING POWER PLANT TO ADJACENT TERRESTRIAL AND AQUATIC ENVIRONMENTS,

Savannah River Ecology Lab., Aiken, SC.
D. W. Evans, J. G. Wiener, and J. H. Horton.
Journal of the Air Pollution Control Association, Vol 30, No 5, p 567-573, May, 1980. 4 Fig, 4 Tab, 25 Ref.

Descriptors: *Powerplants, *Water pollution, *Trace elements, Coal, Plumes, Coal fuel, Fallout, Air pollution, Rainfall, Fly ash.

Levels of trace elements derived from coal ash were investigated in terrestrial and aquatic samples near an 83 MW coal burning power plant. Comparisons were made between the trace elements arising through aerial deposition during 23 years prior to the installation of electrostatic precipitators and aquatic inputs from ash disposal basins after installation. A guassian plume model was used to predict deposition patterns of 29 trace elements in coal ash around the power plant. Detectable increases were noted in Sr, As, Sb, and Be in surface soils within 3 km of the power plant. Concentrations measured in surface soils were largely consistent with the predictions. Measurements of aerial deposition of Cd, Pb, Cu, and Mn at a site 5.5 km distant were similar to those in other rural areas and indicated that little of the measured Cd, Cu, Mn, or Pb was derived from fly ash. Concentrations of 12 heavy metals in effluents from the basin receiving ash were comparable to those predicted in rainfall deposited nearest the plant. It was concluded that at other coal combustion facilities, basin disposal could be a more serious contamination threat to aquatic environments than aerial dispersal of ash. (Baker-FRC)
W82-00557

RESIDUES OF NONYLPHENOL IN SPRUCE FOLIAGE, FOREST SOIL, STREAM WATER AND SEDIMENT AFTER ITS AERIAL APPLICATION,

Forest Pest Management Inst., Sault Ste Marie (Ontario).
K. M. S. Sundaram, S. Szeto, R. Hindle, and D. MacTavish.
Journal of Environmental Science and Health, Part B, Vol 15, No 4, p 403-419, 1980. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Phenolic pesticides, *Pesticide residues, *Stream pollution, Insecticides, Water pollution, Spruce trees, Conifers, Trees, Forest soils, Sediments, Nonylphenol.

The residues of nonylphenol, a major component of the Matacil (aminocarb) formulation, were measured in a variety of natural features following aerial application of a mixture of this chemical and insecticide diluent 585 at a rate of 0.47 liters per hectare to a mixed coniferous forest in Ontario. Nonylphenol residues were found in water from the forest stream one hour after application of the insecticide to the forest and up to five days after application. The highest concentration, 9.1 ppb, which was detected one hour after spraying, decreased to trace levels of less than 2.0 ppb after 6 hours, indicating a half-life of about 2.5 hours. Water samples taken from a stagnant area of the stream showed concentrations of 1,100 ppb 4 hours after spraying, decreasing to 110 ppb in the next 2 hours, to 12 ppb within 24 hours, and to less than 1.0 ppb after 3 days. Dilution by water flow probably accounts for most of the rapid dissipation of nonylphenol residues in the stream water, while surface evaporation and co-distribution may also have been contributing factors. Residues in white spruce foliage decreased from 18.90 ppm 1 hour after spraying to about 11.34 ppm after 3 hours and to less than 0.20 ppm after 62 days. Analyses of forest soil samples collected after spraying resulted in no detections of residues. Trace levels of nonylphenol were found in only one sediment sample collected 4 hours after spraying. These data indicate that very little residue would be present in forest soil and that residues in foliage, stream water, and sediment would be non-persistent following application of nonylphenol at a rate equivalent to the seasonal allowable maximum. (Carroll-FRC)
W82-00559

ESTIMATION OF THE SALT BURDEN OF IRRIGATION DRAINAGE WATERS,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, and P. F. Pratt.
Journal of Environmental Quality, Vol 9, No 1, p 141-146, January-March. 1980. 5 Fig, 5 Tab, 10 Ref.

Descriptors: *Mathematical models, *Salts, *Irrigation water, Irrigation effects, Water pollution sources, Mathematical studies, Water analysis, Path of pollutants.

The effectiveness of several different models for the prediction of important interactions which govern the salt movement process through soil was evaluated. The three models used to predict salt concentration and mass emissions below irrigated fields included a proportional model, a steady-state model, and a dynamic model. The proportional model overestimated the salt burden for waters which tend to precipitate calcium salts and underestimated the salt burden of waters which tend to dissolve soil CaCO3. The steady-state model predicted a greater tendency toward mineral dissolution than occurs when ion exchange is considered, but it calculated a more accurate salt balance than did the proportional model. The proportional model characterized irrigation management in terms of an average ratio of drainage volume to irrigation volume (leaching fraction, LF). When the saline irrigation water had LF=0.1, the steady-state model mass emission prediction was 22% less and the transient model prediction was 36% less than the estimates of the proportional model. When the irrigation water was of high quality (LF=0.4), the predictions of the two models were 198 and 201% higher, respectively, than the predictions of the proportional model. (Small-FRC)
W82-00563

DISTRIBUTION OF SILVEX, 2,4-D, AND TCDD APPLIED TO TURF IN CHAMBERS AND FIELD PLOTS,

Science and Education Administration, Beltsville, MD. Pesticide Degradation Lab.
R. G. Nash, and M. L. Beall, Jr.
Journal of Agricultural and Food Chemistry, Vol 28, No 3, p 614-623, May/June, 1980. 3 Fig, 10 Tab, 18 Ref.

Descriptors: *Leachates, *Organic compounds, Leaching, Infiltration, Percolation, *Path of pollutants, *Agricultural chemicals, Pesticides, Herbicides, Silvex, 2,4-D, Dioxins, TCDD, Residues, Water pollution.

The fate of 2,4-D, silvex, and TCDD applied to bluegrass turf was examined in four components, soil, grass, water, and air, of microagroecosystem chambers. Concentrations employed were as follows: 1.3 kg of granular 2,4-D per hectare, 2.8 kg granular and 2.0 kg emulsifiable silvex per hectare. A high-activity radiolabeled preparation of the possible toxic trace contaminant of silvex, TCDD, was added. Residue half-times for silvex on soil were 35 days for both formulations and 10 days for granular 2,4-D. TCDD concentrations in leachate water were less than 10 to the minus 16th power and 10 to the minus 13th power g/g water after silvex applications containing 44 ppb and 7.5 ppm TCDD, respectively. Silvex and 2,4-D concentrations were in the microgram/liter range as leachates and decreased with time. TCDD concentrations were less than 0.1 pg/liter. The TCDD concentration in the leachate seemed to increase with time, peaked on day 126, and then decreased to less than 10 pg/liter by day 275. The half-life values for leachate water, with high correlation coefficients, were about 10 days for both formulations of silvex and 6.5 days for the granular 2,4-D. After day 126, the half-life values for TCDD were 65 and 57 days for the emulsifiable concentrate and granular formulations, respectively. (Baker-FRC)
W82-00568

RESIDUES OF ISOBORNYL THIOCYANOACETATE (THANITE) AND A METABOLITE IN FISH AND TREATED PONDS,

National Fishery Research Lab., La Crosse, WI.
J. L. Allen, J. B. Sills, V. K. Dawson, and R. T. Amel.
Journal of Agricultural and Food Chemistry, Vol 29, No 3, p 634-636, 1981. 3 Tab, 9 Ref.

Descriptors: *Ponds, *Fish, *Insecticides, Carp, Bass, Metabolites, Sublethal effects, Thanite, Pesticide residues, Fate of pollutants.

The insecticide isobornyl thiocyanoacetate (Thanite) induces a surfacing response in fish, which may permit live collection of fish. However, there are no data on residues of the insecticide in fish exposed to the chemical nor on the persistence of Thanite in the aquatic environment. Only a trace of the parent compound was found in carp and largemouth bass exposed to Thanite at 1 mg/liter in the laboratory. A metabolite, isobornyl alpha-(methylthio)-acetate, was isolated and identified by gas chromatography-mass spectroscopy, and a reference standard for the metabolite was synthesized. Residues of the metabolite were found in the muscle tissue of largemouth bass and in the muscle tissue, blood plasma, and bile of carp within one hour after exposure to Thanite. Residues of the metabolite decreased to undetectable levels within 24 hours of withdrawal from water containing Thanite for the bass and within 48 hours for the carp. Residues of Thanite were detectable in water and soil samples from experimental ponds up to 14 days after treatment at 0.4 mg/liter, but not at 21 days after treatment, while algae samples contained detectable levels of Thanite in the 21-day samples but not at 28 days. The metabolite found in the bass and carp was not found in samples of water, soil, or algae. The results demonstrate that Thanite is rapidly metabolized and eliminated by fish and does not persist in a pond environment beyond 3 weeks. (Carroll-FRC)
W82-00570

WATER-TO-AIR FRACTIONATION OF BACTERIA,

Florida State Univ., Tallahassee. Oceanography Dept.
T. W. Hejkal, P. A. LaRock, and J. W. Winchester.
Applied and Environmental Microbiology, Vol 39, No 2, p 335-338, February, 1980. 4 Fig, 17 Ref.

Descriptors: *Bacteria, *Air-water interfaces, Interfaces, Escherichia coli, Serratia marinorubra, Micrococcus euryhalis, Pseudomonas bathycetes, Bacillus subtilis, Water treatment facilities, Wastewater treatment, Spray irrigation, Human disease, *Path of pollutants.

An attempt was made to determine the quantitative differences among several bacterial species in their abilities to be ejected into the atmosphere by bubbles rising through water and bursting at the air-water interface. Three species of marine bacteria, Serratia marinorubra, Pseudomonas bathycetes, and Micrococcus euryhalis, were tested for their ability to be aerosolized. Bubbles were generated in suspensions of mixed bacterial cultures, and the concentration was measured for each species in the top jet drop ejected. This concentration, divided by the concentration in the bulk menstruum, is the concentration factor (CF). Bubbles were generated 2 cm below the liquid surface, and jet drops with diameters from 34 to 136 micrometers were studied. S. marinorubra and M. euryhalis had CFs which were generally 10 to 100 times greater than those of Escherichia coli, P. bathycetes, and spores of Bacillus subtilis. P. bathycetes never had a CF significantly greater than 1 at any drop size, and spores of B. subtilis had a maximum CF of 4. E. coli had a maximum CF of 6 to 1- or 2-day old cultures, but this increased to 80 when a 5 day old culture was used. This change in the CF with age of the cells indicates that composition of the cell may be a factor influencing its ability to concentrate in jet drops. (Baker-FRC)
W82-00575

UTILIZATION OF DICHLOROMETHANE BY SUSPENDED AND FIXED-FILM BACTERIA,

Stanford Univ., CA. Dept. of Civil Engineering.
B. E. Rittmann, and P. L. McCarty.
Applied and Environmental Microbiology, Vol 39, No 6, p 1225-1226, June, 1980. 2 Fig, 8 Ref.

Descriptors: *Bacteria, *Effluents, *Dichloromethane, Biodegradation, Industrial wastes, Wastewater, Growth, Organic compounds, Fate of pollutants.

The biodegradation of dichloromethane, a commonly used solvent ubiquitous in aqueous environments, is described and evidence that the chemical will support bacterial growth is offered. Bacterial cultures were enriched from a seed of primary sewage effluent over a 12 month period. Several enrichment cultures, having different bacterial densities, were developed. It was noted that culture turbidity changes and dichloromethane utilization were not significant if bicarbonate was omitted from the mineral medium. The enriched bacteria were predominately gram-negative, motile rods. Batch, suspended-growth and biofilm experiments were performed to demonstrate dichloromethane utilization. The biological utilization of dichloromethane at 1-25 mg/liter by suspended bacteria was readily apparent. Since neither carbon dioxide evolution nor intermediates were measured, it was not possible to state whether dichloromethane was completely mineralized or by what pathway it was metabolized. Even so the study shows that dichloromethane can be used as an energy source without serving as a cometabolite. Although not conclusive, the fact that suspended growth was reduced when bicarbonate was omitted from the mineral medium suggest that the autotrophic pathway was used. (Baker-FRC)
W82-00577

MICROBIAL METABOLISM OF N-NITROSODIETHANOLAMINE IN LAKE WATER AND SEWAGE,

Cornell Univ., Ithaca, NY. Soil Microbiology Lab.
For primary bibliographic entry see Field 2H.
W82-00585

MOVEMENT OF ENDOTOXIN THROUGH SOIL COLUMNS,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
S. M. Goyal, C. P. Gerba, and J. C. Lance.
Applied and Environmental Microbiology, Vol 39, No 3, p 544-547, March, 1980. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Endotoxin, *Groundwater pollution, Rainfall, Percolation, *Land disposal, *Bacteria, Wastewater disposal, Waste disposal, Adsorption, Toxins, Soil contamination.

The possible removal of endotoxin during land treatment and the chance that endotoxin can reach groundwater after land application of wastewater were investigated. The movement of endotoxin through soil columns was studied under laboratory conditions. A 10 cm diameter polyvinyl chloride pipe was packed with loamy sand from the dry Salt River bed located near Phoenix, Arizona. Either 100 or 250-cm long soil columns were employed. While it was determined that endotoxin is removed by the soil, it was noted that endotoxin-containing sewage must travel longer distances than virus-containing sewage before any appreciable removal occurs. Free endotoxin is refractory to adsorption by granulated activated-carbon columns, whereas 83% of bound endotoxin is removed by passage through two granulated activated-carbon columns in series. Thus, there is a potential for some endotoxin contamination of groundwater if the aquifer is shallow. When a simulated rainfall was applied to the columns in which the endotoxin had been adsorbed, the endotoxin concentration moved through the soil as a concentrated band. Thus it appears that rainwater can desorb endotoxin from soil and that travel of endotoxin to groundwater is a distinct possibility. In field studies, two land treatment sites were sampled to compare the amount of endotoxin in the sewage being applied and that present in groundwater samples. At Lubbock, Texas, 600 to 6000 ng of endotoxin per ml was found in the sewage, and 0.6 to 480 ng/ml in the groundwater. At Fort Devens, 300 ng of endotoxin per ml was in the sewage, and 0.3 to 30 ng/ml in the groundwater. (Baker-FRC)
W82-00586

DYNAMICS OF SELENIUM IN MERCURY-CONTAMINATED EXPERIMENTAL FRESHWATER ECOSYSTEMS,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. M. Rudd, M. A. Turner, B. E. Townsend, A. Swick, and A. Furutani.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 5, p 848-857, May, 1980. 8 Fig, 3 Tab, 32 Ref.

Descriptors: *Path of pollutants, *Aquatic animals, *Ecosystems, *Selenium, *Mercury, Bioaccumulation, Fate of pollutants, Herbicides, Fish toxins, Heavy metals, Water pollution effects, Water pollution sources, Lakes, Sulfate, Benthos, Crayfish, Bottom sediments.

The movement of selenium (Se) and mercury (Hg) through experimental aquatic ecosystems in a lake contaminated with mercury (Hg) was studied. Stable Se or sulfate water concentrations were increased while aquatic herbicides (Velpar or terbutryne) were added to the model system. Part of the water column was isolated from contact with the sediments. Radioactively labeled Se and Hg did not move simultaneously through the ecosystem either geochemically or biologically. Se was rapidly bioaccumulated in fish, crayfish, and haptobenthos, an effect which was enhanced by increased sulfate levels in the absence of exposure to bottom sediments and decreased by aquatic herbicides. Se levels of 0.1 mg/l did not affect Hg movement out of the water column, but stabilized Hg movement among different compartments of the water column. Hg bioaccumulation by fish, crayfish and haptobenthos was inhibited by elevated Se levels. Se toxicity to several aquatic species was investigated. The possible use of Se as an ameliorating agent for freshwater systems polluted by heavy metals is considered. (Geiger-FRC)
W82-00595

BIODEGRADABILITY OF HALOGEN-SUBSTITUTED DIPHENYLMETHANES,

Monsanto Co., St. Louis, MO.
V. W. Saeger, and Q. E. Thompson.
Environmental Science and Technology, Vol 14, No 6, p 705-709, June, 1980. 2 Tab, 18 Ref.

Descriptors: *Biodegradation, *Organic compounds, Molecular structure, Hydrocarbons, Halogens, *Diphenylmethanes, Activated sludge, River water, Microorganisms, Rivers.

Primary and ultimate biodegradation test procedures were used to determine the biodegradability of 32 halogenated diphenylmethanes exposed to activated sludge and river water microorganisms. Generally, diphenylmethanes having one unsubstituted phenyl ring exhibited high primary degradation rates. Those substituted on both rings were slow to degrade. Ultimate biodegradation measurements on materials with high primary degradation rates indicate that the cleavage rate of the second phenyl ring decreases, in general, with increasing levels of substitution on the ring. The data point out, however, the inherent difficulties in predicting whether a specific synthetic molecule will be biodegradable. In keeping with other facets of biological behavior, minor changes in structure can lead to drastic changes in biodegradability. (Baker-FRC)
W82-00599

THE NONFUEL MINERALS INDUSTRY: REGULATORY IMPACTS,

Mitre Corp., McLean, VA. METREK Div.
A. Hershaft, and W. Lacy.
Environmental Science and Technology, Vol 14, No 4, p 404-408, 410-412, April, 1980. 6 Tab.

Descriptors: *Mineral industry, *Metal-finishing wastes, Metallurgy, Industrial plants, Industrial wastes, Effluents, Mine wastes, Mine drainage, Drainage, Water quality, Regulations, Standards.

Water pollutants are generated at every step of metal mining and processing. Runoff from exposed ore bodies and overburden and tailing piles carries suspended solids, acid sulfate, heavy metals, and other dissolved salts. Some of these pollutants find their way into the groundwater. The slurry contains additional suspended solids, as well as chemicals used in the ore concentration process. Smelting and refining effluents contain heavy metals and other substances, sometimes ammonia, cyanides, nitrates, oil and grease, and phenols introduced with coke, as well as fluorides added as a fluxing agent. Runoff can be minimized and directed to tailing ponds of containment lagoons. Percolation to the groundwater can be controlled by lining the bottom of the pond with clay, paving material, or an impermeable plastic or rubber membrane. Public concern has generated laws in recent years to assist in the management of mining and processing wastes. Pollution from these operations can adversely affect eight types of water uses: municipal supply, industrial supply, agricultural supply, commercial fishing, wildlife preservation, recreation, navigation, and aesthetic enjoyment. Assessing the benefits to these water uses derived from the regulatory statements issued by the federal and state governments is difficult. However, there is impressive evidence of water quality improvement attributable to pollution control regulations. (Baker-FRC)
W82-00612

COAL TAR COATINGS OF STORAGE TANKS, A SOURCE OF CONTAMINATION OF THE POTABLE WATER SUPPLY,

New York State Dept. of Health, Albany. Div. of Lab. and Research.
K. Alben.
Environmental Science and Technology, Vol 14, No 4, p 468-470, April, 1980. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Storage tanks, *Coatings, Linings, Leaching, Leachates, Water storage, Water tanks, Storage, Hydrocarbons, Water quality, Water pollution sources, *Coal tar coatings, Health hazards.

Forty-liter field samples were collected in duplicate at the inlet and outlet of a 12,000 gallon

storage tank which had been given an interior coating of coal tar five years earlier. Similarly, 40-liter laboratory samples were prepared from tap water exposed to test panels coated with the same coal tar as used on the storage tank. Results obtained from GC-MS analysis of the storage tank samples indicated that concentrations of specific polycyclic aromatic hydrocarbons increased 5 to 30 times over the concentrations of the same chemicals found in the influent to the tanks. Concentrations in micrograms/liter in the influent and effluent respectively for the following compounds were: naphthalene, 0.024 and 0.025; fluorene, 0.001 and 0.021; phenanthrene + anthracene, 0.019 and 0.210; fluoranthene, 0.003 and 0.081; and pyrene 0.002 and 0.071. It was concluded that polycyclic aromatic hydrocarbons can leach from commercial coal tar coatings of storage tanks into the water supply. One of the compounds, fluoranthene, is among the six polycyclic aromatic hydrocarbons designated by the World Health Organization as possessing a health hazard when drinking water is contaminated with it. The levels of each of the chemicals detected are considered to be significant. (Baker-FRC)
W82-00616

AROMATIC AMINES IN AND NEAR THE BUFFALO RIVER,

Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
C. R. Nelson, and R. A. Hites.
Environmental Science and Technology, Vol 14, No 9, p 1147-1149, 1980. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Dye industry wastes, *Water pollution sources, Industrial wastes, Rivers, *Buffalo River, Fish, Fish diseases, Leaching, New York.

The identification of the 2-propanol-extractable, basic organic compounds present in soil and river sediment obtained near a dye manufacturing plant is described. The environmental implications of this identification are discussed. Sediment samples were collected in midchannel by an Eckman dredge during June of 1979. Soil samples were collected in 1978. The following aromatic amines were found in the sediment samples from the Buffalo River: 4,4'-bis(dimethylamino)biphenyl, 4-(dimethylamino)benzophenone, bis(4-dimethylaminophenyl)methane, bis-(4-dimethylaminophenyl)phenylmethane, 1-naphthylamine, and N-ethyl-N-phenylbenzylamine. Most of the compounds detected are either starting materials, intermediates, byproducts, or products associated with the commercial synthesis of two dyes: malachite green and crystal violet. The remaining compounds were either other products of the dyestuff plant or common industrial chemicals. The findings of so many chemicals in the soil samples suggests that the site was used as a chemical dump by the dyestuff manufacturer, and it is further suggested that the chemicals entered the Buffalo River by leaching from the dump site. Fish in the river have been exposed to these compounds by direct contact with contaminated sediment, and their numerous tumors may have resulted from this exposure. (Baker-FRC)
W82-00622

GROUNDWATER LEACHING OF ORGANIC POLLUTANTS FROM IN SITU RETORTED OIL SHALE. A MASS TRANSFER ANALYSIS,

California Univ., Berkeley. Dept. of Civil Engineering.
G. L. Amy, A. L. Hines, J. F. Thomas, and R. E. Selleck.
Environmental Science and Technology, Vol 14, No 7, p 831-835, July, 1980. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Groundwater, *Leaching, *Oil shale, Groundwater pollution, Organic compounds, Mass transfer, Diffusion coefficient.

A mass transfer analysis of laboratory data was conducted to evaluate the potential degradation of groundwater quality by organic pollutants leached from in situ retorted oil shale. Two unique samples of in situ retorted oil shale were investigated in a series of laboratory experiments. Results of the experiments were subjected to a mass transfer analysis to determine the rate-limiting step involved in the leaching of organic pollutants by groundwater. This mass transfer analysis suggested that, for one of the samples, internal diffusion through the porous infrastructure of retorted oil shale particles is the rate controlling mass transfer step. For the other sample, no single rate controlling step was conclusively identified, although it appeared that internal diffusion was important in the overall leaching phenomenon. Since internal diffusion is an extremely slow mass transfer process, it is anticipated that low, relatively constant levels of organic pollutants will appear in groundwater and persist for long periods of time. This implies that there may be a chronic, long-term groundwater pollution problem in areas of future in situ oil shale development. (Baker-FRC)
W82-00626

TRACE METAL CATALYSIS IN AQUATIC ENVIRONMENTS,

California Inst. of Tech., Pasadena. W. M. Keck Labs.
M. R. Hoffman.
Environmental Science and Technology, Vol 14, No 9, p 1061-1066, September, 1980. 4 Fig, 1 Tab, 52 Ref.

Descriptors: *Catalysts, *Trace metals, *Water pollution control, *Chemical reactions, Heavy metals, Aquatic environment, Oxidation, Reduction, Sulfur compounds, Suspended matter.

The possible roles that trace metals may play in the catalysis of aquatic reactions are exlored, and the kinetic and mechanistic aspects of hydrolysis, redox, and autoxidation reactions are explained. The applicability of certain catalytic reactions for pollution control is considered. It is noted that transition metals and associated complexes may prove useful from a commercial standpoint for improved pollution control systems. The catalyzed autoxidation of hydrogen sulfide and sulfur dioxide and other reduced sulfur compounds in the presence of homogeneous or heterogeneous organometallic complexes may provide convenient and economical methods for sulfur pollution control. The principal products of the metal phthalocyanine-catalyzed autoxidation of hydrogen sulfide and mercaptans in sour refinery distillates are reported to be colloidal sulfur, polythionates, and sulfate. Conceivably, similar catalytic systems could be used for the autoxidation of selected organic pollutants for industrial wastewater treatment. (Baker-FRC)
W82-00629

KEPONE IN THE JAMES RIVER,

Virginia Inst. of Marine Sciences, Gloucester Point.
R. J. Huggett, and M. E. Bender.
Environmental Science and Technology, Vol 14, No 8, p 918-923, August, 1980. 3 Fig, 3 Tab, 16 Ref.

Descriptors: *Rivers, *Pesticides, *Kepone, *James River, *Virginia, *Chesapeake Bay, Sediments, Bottom sediments, Surface water, Benthic environment, Toxicity, Sediment transport, Fish, Oysters, Mollusks.

The major source of Kepone contamination in Virginia was the manufacturing plants at Hopewell. However, the compound is also generated in the production and degradation of Mirex, and many environmental samples outside of this area of Virginia also record the presence of kepone. In the Chesapeake Bay, moving northward from the James River, most marine species exhibit a significant decline in kepone concentrations. Residues in bottom feeders decline very rapidly, reflecting a decrease in contamination of the immobile food supplies. Piscivorous species showed slower rates of decontamination, possible because their primary food sources were mobile and transported kepone residues to greater distances. Bluefish showed less of a decline in contamination than any other finfish, as these are highly mobile and move in and out of the James to other areas of the bay. The bottom sediments of the James have acted to some degree as a reservoir for kepone. From the bottom it cycles to solution and is taken up by plants and animals, to be returned eventually to the sediments on death of the organisms. Benthic animals may take up kepone directly and transfer it to their predators. Evidence from 1979 suggests that surface sediments are demonstrating lessening levels of contamination. It is noted, however, that a major hurricane, which has not hit this area since the 1950s, could stir up the bottom and redistribute the sediments overnight, possibly even moving the contamination into the Chesapeake Bay. (Baker-FRC)
W82-00631

TRACE ELEMENT ACCUMULATION, MOVEMENT, AND DISTRIBUTION IN THE SOIL PROFILE FROM MASSIVE APPLICATIONS OF SEWAGE SLUDGE,

California Univ., Berkeley. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 5E.
W82-00640

INFLUENCE OF GASEOUS NITRIC ACID ON SULFATE PRODUCTION AND ACIDITY IN RAIN,

Environmental Sciences Research Lab., Research Triangle Park, NC.
J. L. Durham, J. H. Overton, and V. P. Aneja.
Atmospheric Environment, Vol 15, No 6, p 1059-1068, 1981. 4 Fig, 5 Tab, 33 Ref.

Descriptors: *Acid rain, *Mathematical models, *Nitric acid, Acidity, Hydrogen ion concentration, Air pollution effects, Sulfates, Simulated rainfall.

A physico-chemical subcloud rain model was used to study the pollutant chemistry leading to rain acidification. In the model, drops fall through a polluted region containing trace gases CO2, O3, SO2, HNO3, NO, and NO2. The concentration of each chemical species within a drop was calculated. Subcloud scavenging of HNO3 may control acidification during the beginning of a rain event and may have more control over the final pH than SO2. In fact, gaseous HNO3 inhibits the production of sulfate in rain by lowering the pH. Acidification was not caused by the oxides of nitrogen, NO and NO2. In-cloud scavenging can have greater control over final acidity than subcloud scavenging. Furthermore, gaseous HNO3 is removed from the atmosphere more rapidly than SO2 or O3. In this simulation, cumulative NO3 decreased by 42% in one hour, while SO4 and pH slightly increased. This theoretical study did not consider the formation of rain in the polluted zone, and the effect of in-cloud processes are ignored. (Small-FRC)
W82-00642

ACID PRECIPITATION: THE IMPORTANCE OF NITRIC ACID,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W82-00643

THE ORGANIC POLLUTION OF RIVER CUBILLAS (GRANADA, SOUTH SPAIN),

Granada Univ. (Spain). Dept. of Ecology.
J. C. Canteras.
Acta Hydrobiologica, Vol 22, No 4, p 439-448, 1980. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Organic matter, *Low flow, *Rivers, Water pollution sources, Industrial waste, River flow, Bacteria, Chemical properties, Cubillas River, *Spain.

The pollution of the River Cubillas is investigated with emphasis on the relationship between the heterotrophic bacterial population and various chemical factors which are affected by the organic matter draining from stored olives at oil mills. The river was sampled at six locations, and the following parameters were determined: oxygen, nitrates and nitrites, total alkalinity, and phosphates. The slide sprinkling technique was used to determine the heterotrophic bacterial population. The

number of correlations between variables increased with the degree of pollution. The oil mill located between the first and second sampling stations did not greatly affect the river. The repeated addition of wastes along the river from several mills is the source of the problem because of the river's low flow with no possibility of self-purification between one mill and the next. (Small-FRC)
W82-00674

PERSISTENCE AND DISTRIBUTION OF ERYSIPELOTHRIX RHUSIOPATHIAE AND BACTERIAL INDICATOR ORGANISMS ON LAND USED FOR DISPOSAL OF PIGGERY EFFLUENT,

Victoria Dept. of Agriculture (Australia). Attwood Veterinary Research Lab.
D. S. Chandler, and J. A. Craven.
Journal of Applied Bacteriology, Vol 48, No 3, p 367-375, June, 1980. 3 Tab, 16 Ref.

Descriptors: *Animal wastes, *Land disposal, *Animal diseases, Waste disposal, Bacteria, Bioindicators, Environmental effects, Agriculture, Victoria, *Australia.

Effluent was sampled from 35 Victorian commercial piggeries and tested for the presence of Erysipelothrix rhusiopathiae, the cause of swine erysipelas. Also, the survival of the organism in soil and pasture used for the disposal of untreated piggery waste was determined. The organism was isolated from 15 of the 40 samples. It was found at disposal sites for up to two weeks after application of effluent. It was more common in soil than pasture. The survival of bacterial indicator organisms was determined and fecal coliforms in top soil survived 8 to 19 days and 5 to 12 days on pasture. Fecal streptococci survived 10 to 14 days in soil and 8 to 11 days on pasture. Laboratory studies indicated that the death rate of Erysipelothrix rhusiopathiae was six times greater than E. coli in soil at field capacity. Animals grazing on effluent disposal sites would be more likely to ingest Ery. rhusiopathiae from fecal material and topsoils of disposal sites than from pasture material. The fast decay rate means the risk of infection would be low by the time a hundred- or thousand fold reduction in E. coli or fecal coliform numbers occurred. (Small-FRC)
W82-00686

1980 ANNUAL REPORT - A PERSPECTIVE ON THE PROBLEM OF HAZARDOUS SUBSTANCES IN THE GREAT LAKES BASIN ECOSYSTEM,

International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 5C.
W82-00707

ASSESSMENT OF AIRBORNE ORGANIC CONTAMINANTS IN THE GREAT LAKES ECOSYSTEM,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
J. J. Eisenreich, B. B. Looney, and J. D. Thornton.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem. Appendix A, November, 1980. 150 p. 36 Tab, 199 Ref. International Joint Commission, Windsor, Ontario.

Descriptors: *Lakes, *Organic wastes, *Precipitation, *Organic compounds, *Water pollution sources, *Air pollution effects, Organic pesticides, Air pollution, Lake sediments, Acid rain, Chemical precipitation, Chlorinated hydrocarbons, Hydrocarbons, Water-sediment interfaces, *Great Lakes basin, Ecosystems.

No systematic survey of the identity, concentrations and frequency of occurrence of true organics has been performed in the Great Lakes Basin ecosystem; however, a review of literature and past research was conducted for both dry and wet deposition to assess current needs regarding the identification and control of organic airborne contaminants. Atmospheric deposition was found to be greater for Lakes Superior, Michigan, and Huron than for Lakes Erie and Ontario, as a result of general mass air circulation patterns, a large lake/basin area, and higher atmospheric concentrations. While atmospheric deposition of airbone PCBs is the most serious known toxic organic problem affecting Great Lakes water quality, other trace organics for which the atmospheric pathway is important include DDT-group pesticides, alpha-BHC, beta-endosulfan, methoxychlor, PAHs, and phthalate esters. The report recommends that a study be made of land-based sampling vs. over-lake sampling, the sources of airborne trace organics, and the transport of organics from urban areas to the lakes. In addition, the atmospheric pathway for the input of trace organics should be compared to other input pathways including tributary inflow, municipal and industrial discharges, and erosion. (Garrison-Omniplan)
W82-00709

ASSESSMENT OF AIRBORNE INORGANIC CONTAMINANTS IN THE GREAT LAKES,

Illinois Inst. of Tech., Chicago. Pritzer Dept. of Environmental Engineering.
H. E. Allen, and M. A. Halley.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix B, November, 1980. 160 p. 19 Fig, 22 Tab, 63 Ref, 5 Append. International Joint Commission, Windsor, Ontario.

Descriptors: *Lakes, *Water pollution sources, *Precipitation, *Heavy metals, *Air pollution effects, *Chemical precipitation, Trace metals, Air pollution, Acid rain, Water-sediment interfaces, Lake sediments, Data interpretation, On-site data collections, *Great Lakes.

Many studies of the atmospheric deposition of inorganic contaminants in the Great Lakes area have been conducted to determine the ecological and geochemical significance of such constituents as nitrate, phosphates, aluminum, cadmium, chromium, copper, iron, manganese, lead, and nickel. This report reviews these studies and concludes that true loading to the Great Lakes may never be fully known. Efforts to increase knowledge of atmospheric deposition should include consideration of sampling sites that (1) represent a relatively large area; (2) consider the optimum above-ground or ground-level height for collectors; (3) include an adequate snow collection method; (4) include rural and urban sites for any loading estimate of local point sources; (5) use wet and dry samplers; and (6) involve coordination between Canadian and U.S. monitoring efforts. It is important that data studies consider the impact and measurement of contaminated samples and the risk of sample evaporation. The report recommends that a joint monitoring network be established between the U.S. Environmental Protection Agency and the Canada Centre for Inland Waters. (Garrison-Omniplan)
W82-00710

SOURCES AND CONTROL OF ORGANIC AIR POLLUTANTS,

Ontario Ministry of the Environment, Toronto (Ontario).
R. B. Canton, and E. T. Barrow.
In: 1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem, Appendix C, November, 1980. 10 p. International Joint Commission, Windsor, Ontario.

Descriptors: *Chemical precipitation, *Air pollution effects, *Air pollution, *Chemical degradation, *Precipitation, Acid rain, Organic compounds, Catalysts, Electro-phoresis, Incineration, Waste disposal, Oxidation.

Total organic air emissions in 1978 for North America were estimated at 33 million tons, of which 38% derived from power sources used in the transportation industry and 27% were from organic solvents, such as paints, and dry cleaning and degreasing processes. This report reviews the complex issue of organic pollution sources and the available technologies for the degradation of organic pollutants. The conclusion is drawn that in most instances, current technology is capable of reducing discharges to tolerable levels. Each approach to reducing emissions---recycling, reducing quantities emitted, and reducing effects of emissions---presents technical problems. Specific reduction methods include electrostatic precipitation, chemical processes, control of ducted particulate or droplet material, control of ducted vapors, control of fugitive emissions, condensation, and incineration. The development of poison-resistant catalysts, and ceramic supports for the catalysts, has improved the capability of catalytic oxidation at temperatures well below those required for thermal oxidation of organics. It is in the use of the so-called phoretic effects---electrophoresis, diffusiophoretics, and thermophoresis---that the development of scrubber technologies has progressed most. (Garrison-Omniplan)
W82-00711

PROPOSED WATER QUALITY CONTROL PLAN FOR INDIO SUBAREA OF THE WHITEWATER HYDROLOGIC UNIT, WEST COLORADO RIVER BASIN,

California Regional Water Quality Control Board, Palm Desert. Colorado River Basin Region.
For primary bibliographic entry see Field 6F.
W82-00716

HYDROGEOCHEMISTRY AND SIMULATED SOLUTE TRANSPORT, PICEANCE BASIN, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
S. G. Robson, and G. J. Saulnier Jr.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.25. Geological Survey Professional Paper 1196, 1981. 65 p, 45 Fig, 4 Tab, 64 Ref.

Descriptors: *Geochemistry, *Groundwater, *Oil shale, *Mine drainage, Model studies, Aquifer characteristics, Water quality, Water pollution sources, Surface-groundwater relations, *Colorado, Piceance basin, Solute-transport modeling.

Oil-shale mining activities in Piceance basin in northwestern Colorado could adversely affect the ground- and surface-water quality in the basin. This study of the hydrology and geochemistry of the area used ground-water solute-transport-modeling techniques to investigate the possible impact of the mines on water quality. Maps of the extent and structure of the aquifer were prepared and show that a saturated thickness of 2,000 feet occurs in the northeast part of the basin. Ground-water recharge in the upland areas in the east, south, and west parts of the basin moves down into deeper zones in the aquifer and laterally to the discharge areas along Piceance and Yellow Creeks. The saline zone and the unsaturated zone provide the majority of the dissolved solids found in the ground water. Precipitation, ion-exchange, and oxidation-reduction reactions are also occuring in the aquifer. Model simulations of ground-water pumpage in tracts C-a and C-b indicate that the altered direction of ground-water movement near the pumped mines will cause an improvement in ground-water quality near the mines and a degradation of water quality downgradient from the tracts. Model simulations of mine leaching in tract C-a and C-b indicate that equal rates of mine leaching in the tracts will produce much different effects on the water quality in the basin. Tract C-a, by virtue of its remote location from perennial streams, will primarily degrade the ground-water quality over a large area to the northeast of the tract. Tract C-b, by contrast, will primarily degrade the surface-water quality in Piceance Creek, with only localized effects on the ground-water quality. (USGS)
W82-00723

TEMPERATURE AND SOLUTE-TRANSPORT SIMULATION IN STREAMFLOW USING A LAGRANGIAN REFERENCE FRAME,

Geological Survey, NSTL Station, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-00726

METAL LEACHING FROM SEWAGE SLUDGE ASH,

Connecticut Univ., Storrs. Dept. of Chemical Engineering.
H. E. Klei, D. Sundstrom, and C. Sweeney.
BioCycle, Vol. 22, No 3, p 41-43, May/June, 1981. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Metals, *Leaching, *Sludge ash, Acid rain, Heavy metals, Ash, Water pollution sources, Fate of pollutants, Incineration, Copper, Chromium, Cobalt, Calcium, Iron, Magnesium, Manganese, Lead, Nickel, Potassium, Sodium, Sludge disposal.

Column elution and batch leaching tests, conducted on unquenched incinerator ash from a wastewater plant, recovered varying amounts of metals using water of pH 5.3 and 4.0. No cobalt, iron, or lead was recovered in the leachates. Water at pH 4.0, simulating acid rain, eluted 27% of the Ca, 79% of Cr, 40% Ca, 28% Mg, 25% Mn, 11% Ni, 20% K, and 21 % Na after a single batch extraction. From 0 to 3.76% metals were leached during column elution tests using 6 bed volumes of liquid. Water of pH 5.3 recovered half to 75% of these amounts. If ash is extracted with water before sending it to the landfill, an appreciable fraction of the Ca and Cr may be recovered. (Cassar-FRC)
W82-00770

TRANSFORMATIONS OF NITROGEN IN A POLLUTED ESTUARY: NONLINEARITIES IN THE DEMAND FOR OXYGEN AT LOW FLOW,

Harvard Univ., Cambridge, MA. Center for Earth and Planetary Physics.
S. C. Wofsy, M. B. McElroy, and J. W. Elkins.
Science, Vol 213, No 4509, p 754-757, August 14, 1981. 2 Fig, 16 Ref.

Descriptors: *Ammonium, *Oxygen demand, *Nitrification, *Low Flow, Fate of pollutants, Sewage bacteria, Oxidation, *Potomac River, Delaware River, *Estuaries, Nitrogen cycle, Model studies, Bacteria, Nitrites, Chemical reactions.

A simple kinetic model was developed to describe the oxidation of sewage ammonium in the Potomac River. Growth of nitrifying bacteria is limited by the supply of ammonium ion, supplied at a constant rate of 200 g N per sec. The oxidation rate varies inversely with fresh water inflow, and the oxygen demand varies as the inverse square of the fresh water inflow rate. The model accounts for observed concentrations of ammonium and nitrous oxide except at stream flows less than 80 cu meters per sec (usual range 20-250 cu meters per sec, mean 130 cu meters per sec). At low flow, peculiar behavior of maximum ammonium concentrations is seen. Peak concentrations increase as flow declines from 200 to 100 cu meters per sec, but decrease below 100 cu meters per sec. Both model and observations agree that between 70 and 100% of the ammonia in the Potomac is removed by oxidation of ammonia to nitrous oxide. The rate of nitrification is lowered by a factor of 1.6 for a reduction in water temperature of 10 degrees C, in agreement with results for bacteria cultures, which gave factors of 1.5-2.2. The model is also applicable to the Delaware River. (Cassar-FRC)
W82-00777

BEHAVIOR AND TRANSPORT OF MICROBIAL PATHOGENS AND INDICATOR ORGANISMS IN SOILS TREATED WITH ORGANIC WASTES,

Florida Univ., Stanford. Inst. of Food and Agricultural Sciences.
K. R. Reddy, R. Khaleel, and M. R. Overcash.
Journal of Environmental Quality, Vol 10, No 3, p 255-266, July-September, 1981. 1 Fig, 7 Tab, 82 Ref.

Descriptors: *Bioindicators, *Pathogens, Soil disposal fields, Land disposal, Animal wastes, *Soil properties, Wastewater disposal, Organic wastes, Farm wastes, Viruses, Runoff, Water quality, Soil contamination, Mathematical models, Mathematical equations.

The survival rate of microbial pathogens in the soil after application of wastes is one of the most important factors in determining the number of organisms available for rainfall-runoff transport. A simple conceptual model based on the current state of the art was developed to describe pathogen and indicator organism behavior in land areas receiving animal wastes. The model was used to examine the effects of die-off rate and retention by soil particles on runoff water quality. Microbial die-off was described, assuming first-order kinetics. First order die-off rate constants were calculated from the literature for various pathogens and indicator organisms in soil-water systems. Correction factors were presented to adjust rate constants for changes in temperature, moisture, and pH of the soil. A 10 degree C rise in temperature was found to double the die-off rates of the organisms studied. Die-off rates also increased with a decrease in soil moisture. Soils with pH between 6 and 7 had slow die-off rates. A linear isotherm was assumed in describing the retention of pathogens and indicator organisms by soil particles. Increases in soil surface area and clay content of the soil resulted in increases in the retention of viruses. Leaching and surface runoff transport processes were considered both for land areas receiving direct applications of animal wastes and for pastures and rangeland watershed. Several areas requiring further research with respect to pathogen behavior in soils treated with organic wastes were identified. (Carroll-FRC)
W82-00797

METHYLATION OF TRIMETHYLTIN COMPOUNDS BY ESTUARINE SEDIMENTS,

California Univ., Berkeley. Naval Biosciences Lab.
H. E. Guard, A. B. Cobet, and W. M. Coleman, III.
Science, Vol 213, No 4509, p 770-771, August 14, 1981. 1 Fig, 12 Ref.

Descriptors: *Tin compounds, *Methylation, *Sediments, Fate of pollutants, Chemical reactions, *Estuarine environment, Biotransformation, Organotin compounds, Biocides, *Fouling.

The potential for environmental methylation of trialkyl tin compounds was studied in the laboratory using trimethyltin hydroxide as a model compound and anoxic, organic-rich estuarine tidal flat sediments. After 80 days' incubation, the biologically active sediments produced 2.7 times the amount of volatile tetramethyltin (maximum 2.4% of the added trimethyltin hydroxide) as compared with autoclaved control sediments. No methyltin compounds were produced in the absence of added trimethyltin hydroxide or in the presence of trimethyltin hydroxide in seawater or seawater-bentonite. The amount of trimethyltin produced was doubled by additions of 15 g Na2S and increased 70% by addition of 0.30 g sodium acetate. Adding these compounds to autoclaved sediments did not affect the amount of trimethyltin produced. These studies demonstrate a possible abiotic pathway for the formation of trimethyltin by a Lewis-base redistribution of trimethyltin hydroxide. Methylation of tin is probably of minor importance in the environment. It occurs in low yield, and the volatile, water-insoluble product should escape to the atmosphere, not accumulate in the marine environment. It is likely that the tributyltin compounds used widely as antifouling agents would also methylate to a minor degree. (Cassar-FRC)
W82-00801

URANIUM CONCENTRATION IN THE GROUND WATERS OF THE PULLMAN-MOSCOW BASIN, WHITMAN COUNTY, WASHINGTON, AND LATAH COUNTY, IDAHO,

Washington State Univ., Pullman. R. L. Albrook Hydraulic Lab.
V. T. Ichimura, and J. W. Crosby, III.
Northwest Science, Vol 55, No 1, p 10-22, February, 1981. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Uranium, *Groundwater pollution, *Groundwater basins, Washington, Idaho, *Pullman-Moscow Basin, Nuclear track technique, Leaching, Water pollutants, Path of pollutants.

The Pullman-Moscow basin is located in the southeastern part of Whitman County, Washington, and west-central Latah County, Idaho. A recent increase of uranium exploration and an earlier finding of anomalously high radiation background in samples of basin groundwater prompted this study of the concentration of dissolved uranium in the Pullman-Moscow basin. A high-sensitivity nuclear track technique, capable of detecting concentrations as low as 5 parts per trillion, was used in this study. The sampling procedure included on-site measurements of temperature, pH, and conductivity. Analysis of the samples using the nuclear track technique showed uranium concentrations as high as 25 parts per billion. Any uranium concentration higher than 6.2 parts per billion was considered anomalous. About 6.8% of the samples fell into this category. Clusters of high uranium concentration were located in groundwaters from the east and southeast sections of the Pullman-Moscow basin on or near the basalt-granite rock contact. These higher concentrations of uranium are probably the result of local leaching of uranium from granitic rocks by oxidizing meteoric waters recharging the basin. Deep, high-yield municipal and domestic wells in the central and western parts of the basin were found to contain very low uranium concentrations, probably as a result of the reducing conditions in the deep groundwater environment of the basin. Although attempts to correlate conductivity, pH, and well depth with uranium concentrations demonstrated the absence of any correlation, samples that had high uranium concentrations generally also had high conductivities. (Carroll-FRC)
W82-00809

CHEMISTRY OF LAKE WATER AND GROUNDWATER IN AREAS OF CONTRASTING GLACIAL DRIFTS IN EASTERN MINNESOTA,

Southern Illinois Univ. at Edwardsville. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2K.
W82-00821

RETENTION OF RADIONUCLIDES BY SOME AQUATIC FRESH WATER PLANTS,

Atomic Energy Establishment, Cairo (Egypt). Radiation Protection Dept.
R. M. K. El-Shinawy, and W. E. Abdel-Malik.
Hydrobiologia, Vol 69, No 1/2, p 125-129, March, 1980. 4 Tab, 15 Ref.

Descriptors: *Macrophytes, *Bioindicators, *Radioactivity, *Radioactive wastes, Aquatic plants, Hydrogen ion concentration, Cesium, Cobalt, Plutonium, Water pollution sources, Retention.

Relative uptake and accumulation of Co60, P32, and Cs134 by three aquatic macrophytes were determined in the Ismailia Canal, which is adjacent to the Egyptian Nuclear Research Center. The plants were Lemna gibba, a floating plant; Ceratophyllum demersum, a submerged plant near the water's surface; and Potamogeton crispus, a rooted submerged plant. Uptake of radionuclides decreased at increasing pH from 5 to 9. When pH was constant, uptake increased with increased contact time. Concentration factors obtained for Co60 were higher than those for P32, while Cs134 showed the lowest concentration factors for all three macrophytes. Maximum uptake values were found at all pH values after a contact time from 4 to 12 days. Thus, the tested macrophytes proved to be reliable biological indicators. They may be used in studies to develop safe limits for disposal of low level radioactive wastes and to evaluate the hazards of the accidental release of radioactivity to the canal water. (Small-FRC)
W82-00853

METHODS OF INVESTIGATING THE STATE OF METAL IONS IN NATURAL WATERS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5A.
W82-00859

WATERBORNE METHYLENE BIS(2-CHLOROANILINE) AND 2-CHLOROANILINE CONTAMINATION AROUND ADRIAN, MICHIGAN,

Food and Drug Administration, Washington, DC.
G. E. Parris, G. W. Diachenko, R. C. Entz, J. A.
Poppiti, and P. Lombardo.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 497-503, 1980. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Organic compounds, *Contamination, *Wastewater, *Environmental effects, *Industrial waste, Chemical wastes, Chlorine, Water pollution, Lagoons, Waste treatment, Discharge frequency, Flow discharge, Fish physiology, Toxicity, Carcinogens, Fish populations, Water sampling, Streams, Adrian, *Michigan.

Results which trace waterborne methylene bis (2-chloroaniline) (M2CA) and 2-chloroaniline (2CA) contamination from an industrial waste treatment lagoon in Michigan through the municipal wastewater treatment plant and surface runoff to a stream are reported. Sludge, sediment, fish, and water samples were collected and analyzed. Samples were extracted successively with ethyl acetate and methanol, and analyzed on gas chromatographic columns. M2CA was the dominant compound in the waste lagoon sediment, while 2CA is the dominant compound at the sewage treatment plant sludge. The 2CA may be more readily mobilized through the wastewater systems because of its water solubility or lesser tendency to sorb to sediments. Contamination was found in a deep well on the manufacturing site and in surface runoff from the site. No M2CA was detected in water from the Raisin River near the sewage treatment plant outfall. Possible traces of M2CA were found in the influent and effluent water from the municipal sewage treatment plant. Results of the fish tissue analysis suggest that the contaminant residues are chemically bound to macromolecules of the tissue. (Titus-FRC)
W82-00873

ABSORPTION OF FENITROTHION BY PLANKTON AND BENTHIC ALGAE,

Moncton Univ., (New Brunswick).
J. S. S. Lakshminarayana, and H. Bourque.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 389-396, 1980. 1 Fig, 1 Tab, 26 Ref.

Descriptors: *Absorption, *Uptake, *Benthos, *Pesticides, Forestry, Accumulaton, Benthic fauna, Benthic flora, Plankton, Aquatic life, *Lakes, Organic compounds, Water pollution, Zooplankton, Environmental effects, Water sampling, Fenitrothion, Fate of pollutants, *Peabody Lake, New Brunswick, Canada.

Results of a preliminary survey on the response of plankton and benthic algae of Peabody Lake in New Brunswick, Canada to fenitrothion spray formulations are presented. Fenitrothion is an organophosphate insecticide used selectively for forest protection against the spruce budworm. The survey indicates that concentrations of fenitrothion diminish rapidly under conditions where water temperatures and pH values ranged from 11 to 15 degrees Centigrade and 6.1 and 7.2 respectively. Fenitrothion is actively taken up by plankton to a degree that depends on various environmental conditions including growth rates, seasonal variation, and bloom formation. The algal species observed in the Peabody lake did not suggest any toxicity or polluted conditions. (Titus-FRC)
W82-00874

MERCURY AND SELENIUM CONCENTRATIONS IN FISH, SEDIMENTS, AND WATER OF TWO NORTHWESTERN QUEBEC LAKES,

Noranda Research Centre, Pointe Claire (Quebec). Process Technology Dept.
M. R. Speyer.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 427-432, 1980. 3 Tab, 15 Ref.

Descriptors: *Fish populations, *Sediments, Water pollution, *Lakes, Heavy metals, Toxicity, Fish physiology, *Mercury, *Selenium, Environmental effects, *Fish toxins, Ecosystems, Trace metals, Aquatic environment, Aquatic organisms, Chemical analysis, *Quebec.

Findings of a detailed study conducted in Quebec are presented. The study concerned mercury in the aquatic ecosystem and techniques to reduce the toxicity of mercury accumulated by aquatic organisms. The interaction between mercury and selenium in biological systems is both antagonistic and synergistic. Fish samples from two lakes were obtained and analyzed for mercury and selenium. Results showed significant differences between the mercury and selenium concentrations of fish samples from the two lakes. Elevated selenium concentrations in fish from Lake Dufault corresponded to elevated background selenium concentrations. The two lakes have similar physical dimensions and mining histories, but have different types of bottoms. Lake Dufault has a heavy-metal enriched sludge sediment covered by glacial clay, while Lake Duparquet has a fine silt overlying glacial clay. (Titus-FRC)
W82-00876

ENRICHMENT OF THE AGRICULTURAL HERBICIDE ATRAZINE IN THE MICROSURFACE WATER OF AN ESTUARY,

Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
T. L. Wu, L. Lambert, D. Hastings, and D.
Banning.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 411-414, 1980. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Agricultural chemicals, *Agricultural runoff, Crop production, *Estuaries, *Plankton, Agricultural watersheds, Agriculture, Farm wastes, Water pollution, Organic compounds, Diffusion, Convection, Pollutants, Water sampling, Pellicular water, Seasonal variation, *Herbicides, *Atrazine.

Results of a study of the distribution and concentration of atrazine in the Rhode River estuary in Maryland are presented. Atrazine is an herbicide commonly used to control broadleaf weeds and grasses in cornfields. During two seven-month sampling periods the peak concentractions were detected in August. Concentrations in microsurface and bulk water decreased in October. The effects of a high concentration of herbicides in the microsurface layer on the diversity and species composition of bacteria, phytoplankton, submerged macrophytes, and zooplankton exposed to the surface microlayer are not known. (Titus-FRC)
W82-00877

THE IMPACT OF AN INDUSTRIALLY CONTAMINATED LAKE ON HEAVY METAL LEVELS IN IT'S EFFLUENT STREAM,

Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
T. G. Adams, G. J. Atchison, and R. J. Vetter.
Hydrobiologia, Vol. 69, No 1/2, p 187-193, March, 1980. 1 Fig, 6 Tab, 27 Ref.

Descriptors: *Cadmium, *Zinc, *Stream degradation, Lakes, Stream pollution, Ecology, *Industrial wastes, Atomic absorption spectroscopy, Heavy metals, Water quality, Water pollution. Palestine Lake, Indiana, *Electroplating, Wastewater.

Levels of cadmium and zinc were determined in a stream receiving water from an industrially contaminated lake. Water samples were collected in Williamson Ditch (a contaminated stream flowing into Palestine Lake), Trimble Creek (a stream draining Palestine Lake), and the Tippecanoe River (a river receiving Trimble Creek). Atomic absorption spectrophotometry was used to analyze water, sediment, plant, fish, and clam samples. In Trimble Creek unweighted mean metal concentrations were: water, 51 microgram Zn/liter, 4.2 microgram Cd/liter; sediment, 592 microgram Zn/g, 48.4 microgram Cd/g; plants, 375 microgram Zn/g and 7.91 microgram Cd/g; fish, 145 microgram Zn/g and 6.02 microgram Cd/g. In general, concentrations were higher in Williamson Ditch and lower in the Tippecanoe River. The water is polluted by wastes from an electroplating plant. Results indicate that a large percentage of the metal wastes are not held in the lake. The stream which is the outlet for the lake contains metals in concentrations higher than background levels reported for other aquatic systems. (Small-FRC)
W82-00886

DEGRADATION OF HYDROCARBONS IN OXIDIZED AND REDUCED SEDIMENTS,

Louisiana State Univ., Baton Rouge, Lab. for Wetland Soils and Sediments.
R. D. Delaune, G. A. Hambrick, III, and W. H.
Patrick, Jr.
Marine Pollution Bulletin, Vol 11, No 4, p 103-106, April, 1980. 5 Fig, 10 Ref.

Descriptors: *Degradation, *Hydrocarbons, *Sediments, Wetlands, Gulf of Mexico, Oxidation, *Salt marshes, *Louisiana, Oxidation-reduction potential, Anaerobic conditions, Aerobic conditions.

The effect of sediment oxidation-reduction or redox potential on hydrocarbon degradation was investigated in samples collected from a Gulf Coast salt marsh. Carbon-14 labelled octadecane, an alkane hydrocarbon, and carbon-14 labelled naphthalene, an aromatic hydrocarbon, were used in this study. Both of these hydrocarbons were very stable in the anaerobic sediment. Naphthalene did not degrade at all in the anaerobic sediment. Naphthalene showed less degradation in both oxidized and reduced sediment than did octadecane. Hydrocarbon degradation was significantly increased by a shift from strict anaerobic conditions in the sediment, where the hydrocarbons are stable and only a few microbial species function, to aerobic sediment conditions where aerobic and facultative anaerobic bacteria function. The redox profile of the sediment cores showed a distinct oxidized surface layer, between 5 and 10 millimeters thick, in which hydrocarbons were oxidized. Beneath this layer, anaerobic conditions, in which hydrocarbons did not degrade, prevailed. The study results clearly demonstrate that petroleum hydrocarbons in estuarine environments are significantly affected by the oxidation-reduction status of the sediment in contact with the hydrocarbons, and that aromatic hydrocarbons which enter an anaerobic sediment environment may persist. (Carroll-FRC)
W82-00907

CHEMICAL COMPOSITION OF LABILE FRACTIONS IN DOM,

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W82-00917

MACROBENTHOS OF PINE ISLAND BAYOU IN THE BIG THICKET NATIONAL PRESERVE, TEXAS,

Lamar University, Beaumont, TX. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-00924

TRANSPORT OF SALTS IN SOILS AND SUBSOILS,

Volcani Inst. of Agricultural Research, Bet Dagan (Israel). Div. of Soil Physics.
E. Bresler.
Agricultural Water Management, Vol 4, No 1-3, p 35-62, 1981. 14 Fig, 23 Ref.

Descriptors: *Salts, *Soil water, *Estimating equations, Flow, Mathematical studies, Infiltration, Evaporation, Arid lands, Salinity, Water quality, *Israel, Agriculture, *Solute transport.

Factors affecting the movement of salts in saturated and unsaturated soils and subsoils under dryland conditions are reviewed. The transport occurring in homogeneous soils is described, and the factors affecting salt transport are quantitatively formulated. Equations are presented which describe combined diffusion-convection transient transport and

miscible displacement of salts and non-steady water flow. Equations and boundary conditions are described for infiltration, redistribution, and evaporation, in terms suitable for mathematical modeling. One-dimensional vertical profiles of non-interactive salts are described for homogeneous, bare fallow soil. Where physico-chemical interaction takes place between solution and soil matrix, these effects are considered. Also, vegetation effects are considered. Salt dispersion and distribution in heterogeneous fields are also discussed, including the concentration distributions for steady and transient leaking. A knowledge of these processes makes possible the development of optimum management practices to prevent the salinization of groundwaters, streamflows, and farmland. (Small-FRC)
W82-00930

EVALUATION OF WINTER APPLICATION OF LIQUID SLUDGE TO FARMLAND,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
T. Bates, J. W. Ketcheson, R. A. Johnston, and Y. K. Soon.
Water/Engineering and Management, Vol REF, No HB, p R155-156, 1981. 2 Tab.

Descriptors: *Sludge, *Land disposal, Runoff, Seasonal variation, Nitrogen, Phosphorus, Farms, Rainfall, Snowmelt, Thaw, Heavy metals, Water pollution sources, Path of pollutants, Ontario.

Field runoff was investigated from fall, winter, and spring applied sludge over a five year period on a silt loam soil at a location north of Guelph, Ontario. Rainfall averaged 858 mm and snowfall averaged 1,618 mm. Fluid anaerobically digested sludge from the North Toronto treatment plant was used for the study. Sewage was treated with ferric chloride for phosphorus removal and received secondary treatment with activation. Sludge was applied at 200 and 800 kg nitrogen/hectare rates on areas with 2% and 6% slopes. Treatments were replicated twice on each slope. Water was collected after each runoff event and total runoff, solids, and total and soluble nitrogen, phosphorus and metals were measured. Total runoff in winter was four times as much as in summer, with very little difference between the 2% and the 6% slopes. In summer there was more runoff from the steeper slope. Annual losses of N and P ranged from less than 1% to 10% of that applied and were greater in summer except for January, when total N losses were greater in the winter. Nearly all the nitrogen and phosphorus in winter runoff was water soluble, but in summer runoff only 1-2% was water soluble. Losses of nitrogen and phosphorus were high from November and January applied sludge when rainfall or snow melt immediately followed sludge application. The North Toronto sludge was low in metals, but some metal losses did occur, with the effects of slope and time of application similar to those for nitrogen and phosphorus. It was noted that fluid sludge should not exceed 1.5 cm depth on the soil surface nor supply more than the crop requirements for available nitrogen. Fluid sludge should not be applied near waterways. (Baker-FRC)
W82-00952

THE FATE OF HEAVY METALS IN THE RUHR SYSTEM AND THEIR INFLUENCE ON DRINKING WATER QUALITY,

Ruhrverband, Essen (Germany, F. R.).
K. R. Imhoff, and P. Koppe.
Water Science and Technology, Vol 13, No 3, p 211-225, 1981. 4 Fig, 9 Tab, 18 Ref.

Descriptors: *Heavy metals, *Nickel, *Drinking water, Path of pollutants, *Ruhr River, Sediments, Water pollution control, *Industrial wastewater, Artificial recharge, Recharge, Infiltration, Chelation, Water treatment, Wastewater treatment, Adsorption, Pretreatment of water, Sludge disposal, Water quality control, Manganese, Zinc, Lead, Chromium.

Nickel is used to illustrate the path of heavy metals from the factory to the drinking water supply of the heavily populated and industrialized Ruhr River basin. Ni concentrations (in mg per liter) in various influents and effluents are as follows; untreated wastewater from the 300 electroplating plants in the basin, up to 1,000; pretreated effluent, 10; combined industrial and municipal wastewater influent, 0.5; municipal treatment plant effluent, 0.3; river water (flow 40 cu meters per sec) downstream of the effluent discharge, 0.05; and waterworks reservoir, 0.04. Drinking water obtained from artificial groundwater recharge contains 7.9 micrograms per liter of Ni, and from bank infiltration, 4.5 micrograms per liter (original river water, about 38.5 micrograms per liter). Most heavy metals decreased similarly in the path from water supply source to tap, with the exception of Mn in bank filtration and Cu in artificial groundwater recharge. In the distribution system concentrations of Zn decreased; Pb, Cr, and Cd did not change; and Cu and Ni increased to 62 and 13 micrograms per liter, respectively. Measures are suggested to further reduce heavy metals in drinking water: supervision in industries and avoidance of complexing agents in industry and detergents. Other problems are the high levels of metals in land applied sewage sludge and possible mobilization of metals from river sediments and subsoil. (Cassar-FRC)
W82-00962

ASSOCIATIONS AND MESOSCALE SPATIAL RELATIONSHIPS AMONG RAINWATER CONSTITUENTS,

Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 2B.
W82-00964

SULFUR AND ASSOCIATED ELEMENTS AND ACIDITY IN CONTINENTAL AND MARINE RAIN FROM NORTH FLORIDA,

Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2B.
W82-00965

TRENCHING OF DIGESTED SLUDGE,

Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 5E.
W82-00974

BIOCONCENTRATION OF PESTICIDES BY EGG MASSES OF THE CADDISFLY, TRIAENODES TARDUS MILNE,

Illinois Natural History Survey, Urbana.
D. Belluck, and A. Felsot.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 299-306, March, 1981. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Eggs, *Caddisflies, *Bioaccumulation, *Pesticides, Aquatic insects, Biological magnification, Solubility, Fate of pollutants, Organic compounds.

Significant quantities of pesticides were accumulated by caddisfly egg masses (Triaenodes tardus Milne) from water with the following concentrations of pesticides: DDD, DDT, and HCB, 1 ppb; carbofuran, 8 ppb; dieldrin, 20 ppb; and methoxychlor, terbufos, malathion, diflubenzuron, and monuron, 100 ppb. The maximum bioconcentration factors, which correlated with phsyicochemical properties of the pesticides, were as follows: DDD, 2580; HCB, 550; DDT, 250; dieldrin, 100; methoxychlor, 80; diflubenzuron, 20; terbufos, 10; and carbofuran, malathion and monuron, zero. DDD, HCB, and DDT bioconcentration factors reached a peak at 72-96 hours, then declined sharply. Dieldrin and methoxychlor curves were not declining by the end of the 120 hour test. The remainder of the pesticides showed a small rise at 72-96 hours and decreased slightly. A strong correlation existed between water solubility of the pesticides and 72 hour bioconcentration factors. (Cassar-FRC)
W82-00982

ROLE OF SOLUTE-TRANSPORT MODELS IN THE ANALYSIS OF GROUNDWATER SALINITY PROBLEMS IN AGRICULTURAL AREAS,

Geological Survey, Reston, VA.
L. F. Konikow.
Agricultural Water Management, Vol 4, No 1/3, p 187-205, 1981. 11 Fig, 1 Tab, 20 Ref.

Descriptors: *Salinity, *Groundwater, Farming, Groundwater movement, Soil properties, Model studies, Solute transport, Salts, Surface-groundwater relationships, Hydrology, *Agricultural watersheds.

Accurate technical evaluations of the sources of salinity and of salt transport in a variety of hydrogeologic settings are important if control of groundwater salinity in agricultural areas is to be achieved. Two examples are given which illustrate the crucial role of groundwater in transporting and dispersing salts through a local or regional aquifer to the land surface or into a surface water body and the value of a model as an investigative tool to understand the processes and parameters controlling the movement and fate of the salt. The purpose of a model that simulates solute transport in groundwater is to compute the concentration of a dissolved chemical species in an aquifer at any specified place and time. The increase in salinity of groundwater and surface water in the Arkansas River Valley of south-eastern Colorado is primarily related to irrigation practices. An 18 km reach of the valley was selected for a detailed study. A detailed study was also performed in a nonirrigated area of a wheat field on a dryland farm in the South Platte River valley, near Denver. The model was also used to test some possible water management alternatives, including the coupling of artificial recharge with construction and operation of hydraulic sinks along the northern boundary of the Rocky Mountain Arsenal, which is adjacent to the dryland farm area. Such complex engineering solutions may be feasible in cases where the salt problem is predominantly related to an isolated and specific industrial activity, as is the case here. However, use of such measures in areas where salt seeps out due to agricultural activities is not likely to be helpful. (Baker-FRC)
W82-00993

DETERMINATION OF PICOGRAM AMOUNTS OF TECHNETIUM-99 BY RESIN BEAD MASS SPECTROMETRIC ISOTOPE DILUTION,

DuPont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5A.
W82-00999

HEAVY METAL CONTENTS IN SOME MACROPHYTES FROM SAGINAW BAY (LAKE HURON, U.S.A.),

Cranbrook Inst. of Science, Bloomfield Hills, MI.
J. R. Wells, P. B. Kaufman, and J. D. Jones.
Aquatic Botany, Vol 9, No 2, p 185-193, September, 1980. 1 Tab, 11 Ref.

Descriptors: *Heavy metals, *Macrophytes, *Lakes, Water pollution control, Algae, Bioaccumulation, Water pollution effects, Lake Huron, *Saginaw Bay.

An investigation was designed to see which aquatic species, if any, offered potential for the removal of heavy metals from freshwater lakes. During the summer of 1977 in Saginaw Bay (Lake Huron), 71 plants representing 22 species were collected and analyzed for heavy metal content. Neutron activation analysis was used to measure levels of Ag, As, Ba, Cd, Ce, Co, Cr, Cs, Ni, Rb, Sb, Se, Th, U, and Zn in the 21 spermatophytes and one green alga. Both submersed and emergent species showed considerable accumulations of a range of metals. Different organs of the same species or of the same plant were found to vary widely in concentrations of the same element. Highest element uptake amounts were found near the mouth of the Saginaw River. Some plants growing in the polluted bay contained lower amounts of certain metals than did plants of the same species growing in a wilderness area. Thus, plants can accumulate large amounts of metals, but these high concentrations may not result from water pollution. (Small-FRC)
W82-01000

SALINE SEEP DEVELOPMENT AND CONTROL IN THE NORTH AMERICAN GREAT PLAINS - HYDROGEOLOGICAL ASPECTS,

Montana Bureau of Mines and Geology, Butte.
M. R. Miller, P. L. Brown, J. J. Donovan, R. N. Bergatino, and J. L. Sonderegger.
Agricultural Water Management, Vol 4, No 1/3, p 115-141, 1981. 14 Fig, 2 Tab, 30 Ref.

Descriptors: *Seepage, *Salinity, Chemical properties, *Groundwater, Contamination, Water pollution sources, Groundwater movement, Seepage control, Hydrology, Geohydrology, Groundwater hydrology, Farming, Path of pollutants, *Great Plains.

Hydrogeological aspects of saline seeps are discussed, emphasizing the formation and development, regional extent and potential impacts, and effective control practices for such seeps. Dryland salinity is caused by a combination of cultural, climatic, and hydrogeological conditions. The process begins with excess water percolating down beneath the root zone, picking up soluble salts, accumulating on shallow, less-permeable layers, and forming a local groundwater flow system which moves saline water from the recharge to the discharge area or seep, where it evaporates, depositing the salts on the surface. Geological conditions favorable for such development exist throughout the Northern Great Plains region. There, sufficient soluble salts are available in the upper 6 meters of the soil profile to continue existing saline seeps for the next 25-100 years. Shallow groundwater resources appear to be showing signs of contamination by the saline seep process. High concentrations of dissolved solids, nitrates, and selenium are the most troublesome. Alternate crop-fallow farming techniques allow significant quantities of water to move beneath the root zone, activating the local groundwater flow system and contributing to dryland salinity. The use of deep-rooted perennial crops, flexible cropping systems, and surface drainage of cultivated upland recharge areas will help control dryland salinity. Research results are presented from ten years of study on a typical site, the Hanford-Bramlette test area, about 56 km northeast of Great Falls, Montana, with an area of about 65 ha. (Baker-FRC)
W82-01022

IMPACT OF WATER RESOURCE DEVELOPMENT ON SALINIZATION OF SEMI-ARID LANDS,

California Univ., Davis. School of Civil Engineering.
G. T. Orlob, and A. Ghorbanzadeh.
Agricultural Water Management, Vol 4, No 1/3, p 275-293, 1981. 9 Fig, 14 Ref.

Descriptors: *Salt balance, *River basin, *California, *San Joaquin River, Drainage, Catchment areas, Model studies, Rivers, Farming, *Tile drainage, Semiarid lands.

The development of water resources in the San Joaquin Valley of California is reviewed. The valley is one of the most productive agricultural areas of the world. All of its major rivers have been regulated for power production, water supply, flood control and irrigation. Through the Central Valley Project water was impounded and subsequently diverted to the Tulare Basin to the south. This water was replaced in part by importation from the Sacramento-San Joaquin Delta through the Delta Mendota Canal. This deprived the main river system downstream of Mendota of normal runoff and has led to a serious impact on agriculture in the northern portion of the valley. Changes in water quality have been noted, particularly a reduction in diluting flows of natural runoff and increases in salt accretions to the natural drainage courses due to irrigation drainage. By analyzing runoff and water quality at a sufficient number of locations along the San Joaquin River it was determined that virtually all of the sulfate that reaches Vernalis originates with drainage upstream of the mouth of the Merced River. The salt load carried by the San Joaquin River is steadily increasing. An important step in rectifying the basin's salt balance will be the installation of drainage facilities to convey out of the basin accretions from discrete sources. This will include tile drainage. Model studies have been made, based on the Galerkin-type Finite Element Method. A brief description of one case study using this model is presented. (Baker-FRC)
W82-01024

LEACH CHARACTERISTICS OF COAL-GASIFICATION CHAR,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. Luthy, P. Vassiliou, and M. J. Carter.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 81-103, February, 1980. 9 Fig, 6 Tab, 20 Ref.

Descriptors: *Leaching, *Coal gasification, Gasification, *Char, Infiltration, Percolation, Leachates, Carbon, Boron, Molybdenum, Metals, Acidity, Groundwater pollution, Irrigation water, Industrial wastes, Path of pollutants.

Attempts were made to quantify the extent and rate of release of trace elements from char when leached with eluants of varying qualities. Char is produced when carbon conversion is incomplete. The solid waste evaluated here was Hygas western coal char formed at about 63% carbon conversion. In a continuous-flow leaching experiment, 200 g of char was placed loosely in the leaching columns without compaction. Leachate and digested char samples were analyzed for 22 elements using simultaneous multielement analysis by inductively coupled argon-plasma atomic emission spectroscopy. Six different leaching solutions were used: distilled water (simulating rainwater), model intermediate hard water (simulating a typical surface water), model hard water, model acid mine water, acetate-tartrate/hydrosulfite eluant, and deaerated (boiled) tap water (simulating a mildly acidic mineral water with low buffering capacity). The amount of material extracted depended on the nature and strength of the extractant, with pH and buffer capacity of the extractant being important factors. Boron poses a leaching problem due to its deleterious effects on irrigation waters. Molybdenum was the only heavy metal specie routinely identified in the leachate, excluding the acetate-tartrate experiment. This could be a problem, as ground waters carry levels of this element that can give rise to plant concentrations toxic to cattle. (Baker-FRC)
W82-01025

UPTAKE OF POLYCHLORINATED BIPHENYLS BY NATURAL PHYTOPLANKTON ASSEMBLAGES: FIELD AND LABORATORY DETERMINATION OF C14-PCB PARTICLE-WATER INDEX OF SORPTION,

Texas A and M Univ., College Station. Dept. of Oceanography.
D. C. Biggs, C. D. Powers, R. G. Rowland, H. B. O'Connors, Jr., and C. F. Wurster.
Environmental Pollution, (Series A) Vol 22, No 2, p 101-110, June, 1980. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Polychlorinated biphenyls, *Phytoplankton, *Sorption, Algae, Accumulation, *Fate of pollutants, Chlorinated hydrocarbons, Pesticides, Estuarine environment, Long Island Sound.

Uptake of C14-polychlorinated biphenyls (PCB, 54% chlorine) by a natural phytoplankton community and particulate matter was studied in glass containers in the laboratory and in dialysis cultures in Long Island Sound. Particles at a concentration of 25 million cu micrometers per ml took up 19-22% of the PCB, leaving 1-3% on the glass walls of the container and 70-72% in the water. At particle concentrations 4-fold higher, particles adsorbed 66-69% of the PCB, leaving 22-23% in the water. The percentage sorption appeared to be independent of the PCB concentration (5.8 and 11.6 micrograms per liter) used. Heat-killed cells sorbed significantly more PCB than live particles. In desorption experiments, most of the PCB leached from the particles within 5 days when dialyzed against PCB-free water. The water lost PCB more rapidly than the particles. The ratio of PCB sorbed to particles to that in an equal volume of water averaged 20,000. (Cassar-FRC)
W82-01032

UPTAKE AND TRANSFER OF THE CHLORINATED HYDROCARBON LINDANE (GAMMA-BHC) IN A LABORATORY FRESHWATER FOOD CHAIN,

Hamburg Univ. (Germany, F.R.) Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 5C.
W82-01033

TRACE METAL FLUXES TO NEARSHORE LONG ISLAND SOUND SEDIMENTS,

New Hampshire Univ., Durham. Dept. of Earth Sciences.
W. B. Lyons, and W. F. Fitzgerald.
Marine Pollution Bulletin, Vol 11, No 6, p 157-161, June, 1980. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Trace metals, *Marine sediments, *Long Island Sound, *Bottom sediments, Sediment, Metals, Lead, Zinc, Cadmium, Silver, Iron, Manganese, Copper, Fluctuations, Estuaries.

Sediments can act as 'sinks' or 'traps' for trace metals in the coastal marine environment. The concentrations and fluxes of iron, manganese, copper, lead, cadmium, zinc, and silver in the sediments of two nearshore areas in Long Island Sound were investigated. The calculated natural metal fluxes of iron, manganese, zinc, cadmium, and silver for the Mystic River estuary, which is representative of the nearshore sedimentary environment of the eastern part of the Sound, were found to resemble those of the Santa Barbara Basin and the Baltic Sea rather than those of other New England estuaries. The natural fluxes of copper and lead at this site are the lowest ever reported. There was no correlation between increases in dacmium, copper, lead, silver, and zinc in the uppermost sediments and increases in organic carbon. The concentrations of these metals were all strongly correlated with each other, suggesting that they are due to increases in human activity. However, there was no strong relationship between these metals and iron. The calculated fluxes for the Branford Harbor sediments, located offshore from a more industrialized area on the western part of the Sound, resembled those of other New England estuaries. The higher anthropogenic fluxes of metals found at Branford Harbor, as compared to those at the Mystic River site, indicate greater inputs of metals in the western and central portion sections of the Sound due to human activity. Increased trace metal concentrations in the sediments of the Sound proceeding from east to west support this conclusion. Metal concentrations in the sediments at various locations appear to mirror the location of the introduction of the metals into the estuarine system. The highest metal fluxes in the sediments occurred at sites closest to known sources of anthropogenic metal inputs. (Carroll-FRC)
W82-01040

DISPERSAL OF SALMONELLA FROM A POLLUTED STREAM TO NEIGHBORING TERRESTRIAL HABITATS,

Elmhurst Coll., IL. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-01043

EFFECTS OF NITRAPYRIN ON NITRATE MOVEMENT IN SOIL COLUMNS,

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5G.
W82-01048

GROUNDWATER QUALITY MODELS - STATE OF THE ART,

Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5G.
W82-01061

EFFECTS OF RENTON WASTEWATER TREATMENT PLANT EFFLUENT ON WATER QUALITY OF THE LOWER GREEN/DUWAMISH RIVER,

Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5D.
W82-01063

THE IMPACT OF EFFLUENT FROM THE RENTON WASTEWATER TREATMENT PLANT ON THE DISSOLVED OXYGEN REGIMEN OF THE LOWER GREEN/DUWAMISH RIVER,
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5D.
W82-01064

AN INDUSTRIAL AND HAZARDOUS WASTE INVENTORY OF WASHINGTON'S MANUFACTURING INDUSTRIES (1980),
Washington State Dept. of Ecology, Olympia.
D. M. Kruger.
Document WDOE 81-4, February 1981. 28 p. 4 Fig, 12 Tab, 9 Ref, 3 Append.

Descriptors: *Industrial wastes, *Waste management, Inorganic compounds, Waste characteristics, *Landfills, *Hazardous materials, Organic wastes, Toxins, Waste dumps, Solid waste disposal, Waste disposal, Wastes, Wastewater lagoons, *Washington, *Hazardous waste inventory.

The State of Washington is currently developing a statewide hazardous waste management program. Over 500 manufacturing industries, representing 15 percent of Washington industries, were sent an inventory to obtain information on the amount, type, chemical nature (organic or inorganic), and ongoing management practices for treatment, storage, and disposal of industrial and hazardous waste. A total of 350 forms were returned, with 200 industries reporting hazardous waste generation. Inventory information showed that most of Washington's manufacturing waste is inorganic. Nearly 0.4 million tons and 14.3 million gallons of inorganic hazardous waste were generated in 1980. Common waste names reported in the inventory were waste oils, spent solvents, PCB's, heavy metal sludges, paint strippers, pentachlorophenol, metal plating sludges, and spent potliners. Most of the hazardous waste generated in Washington stays in-state. Although a variety of treatment, storage, and disposal methods exist for handling hazardous wastes, in general, little or no treatment technology is employed. Percolation and evaporation lagoons are the primary treatment methods used for liquid wastes. Most solids and sludges are not treated. The primary storage methods for hazardous solids and sludges are piles, while hazardous liquids are stored in pits, ponds, and lagoons. The primary disposal method for solids and sludges is landfilling. Recovery of hazardous wastes, at this time, is the least practiced; less than half the solid hazardous waste is either recycled or reclaimed. (Garrison-Omniplan)
W82-01065

ASSESSMENT OF WATER QUALITY CONDITIONS IN SKAMOKAWA CREEK, WASHINGTON,
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5C.
W82-01066

WATER QUALITY CONDITIONS IN THE BELLINGHAM BAY AREA 1979-1980,
Washington State Dept. of Ecology, Olympia.
R. F. Stanley.
Document DOE 80-14, December, 1980. 13 p, 2 Fig, 4 Append.

Descriptors: *Pulp and paper industry, Mills, *Wastewater treatment, *Water quality management, Wood waste, Industrial wastewater, Water quality standards, Effluent, Anaerobic bacteria, Bays, Wastewater disposal, Data collection, *Bellingham Bay area, *Washington.

The prime contributor to inner Bellingham Bay's water quality problems, and the focal point of this study, is the pump, paper, and chemical complex operated by the Georgia-Pacific Corporation along the eastern bank of the Whatcom Waterway. This large industrial facility produces, as its main product, approximately 600 tons of sulfite wood pulp per day. Other products from the mill include wastepaper pulp, semichemical pulp, tissue paper, alcohol, lignin byproducts, sulfuric acid, chlorine, and sodium hydroxide. Wastewaters resulting from these activities approach 50 million gallons per day, and in the past have accounted for more than 90 percent of the oxygen-demanding discharges to the inner harbor. The cumulative effect of these wastes and the resulting buildup of anaerobic sludge deposits on the bottom of the Whatcom Waterway resulted in environmental conditions which virtually excluded all but the very lowest and most resistant life forms. These poor conditions existed until May 1979 when Georgia-Pacific constructed a wastewater treatment plant. Data collected during two Bellingham area receiving water surveys document a major improvement in water quality. Completion of the mill's new treatment system in 1979 included the interception of all major mill waste streams. These streams were then re-routed through the mill's aerated lagoon before being discharged to outer Bellingham Bay. Study data from 1980 indicate that the mill's final effluent had a relatively minor negative impact on the quality of the outer bay waters. Environmental quality within this relatively enclosed portion of the bay continues to be somewhat degraded by remaining anaerobic sludge beds. (Garrison-Omniplan)
W82-01068

WILSON CREEK DRAINAGE - SURFACE AND GROUND WATER QUALITY, JULY 1978 TO JULY 1979.
Washington State Dept. of Ecology, Olympia.
Document DOE 80-13, November, 1980. 50 p. 12 Fig, 8 Tab, 13 Ref, 3 Append.

Descriptors: Surface water, Groundwater pollution, Water quality management, Well water, Wastewater treatment, *Urban runoff, *Industrial wastewater, *Agricultural runoff, Irrigation wells, *Water pollution sources, Effluent standards, Onsite data collection, Atomic absorption spectroscopy, *Wilson Creek, *Washington, Water pollution effects.

Surface water and groundwater quality were monitored in Wilson Creek drainage in central Washington State from July 1978 through July 1979 to evaluate impacts of irrigated agriculture, urban runoff, municipal and industrial waste disposal, and residential development. While water in domestic wells was found to meet drinking water standards, shallow irrigation wells contain water of poor bacterial quality and are fit for irrigation purposes only. Kittitas sewage treatment plant (STP) effluent was found to be significantly degrading water quality in Cooke Creek with respect to fecal coliforms, nutrients, and aesthetics. Temperature, pH, and dissolved oxygen were generally within Class A standards in Wilson Creek and its tributaries. Return flows from irrigated agriculture were identified as the cause of increased turbidity, solids, nutrient, and bacteria levels in the central and lower drainage. The other point and non-point sources monitored did not appear to impact water quality significantly. The study area encompassed approximately 190 square miles and involved 59 sampling stations. The four surface water parameters measured on site were temperature, pH, specific conductivity, and dissolved oxygen (Winkler-Azide modification). Eleven other parameters were measured in the laboratory, in addition to tests for total coliforms, chlorides, calcium hardness, and total iron. Field parameters measured in the groundwater study included temperature, pH, specific conductivity, and well water levels. Grab samples of water and sediment were collected once each month for determination of lead, mercury, and zinc content by atomic absorption spectrophotometry. (Garrison-Omniplan)
W82-01069

ENTERIC VIRUSES IN RENOVATED WATER IN MANITOBA,
Cadham Provincial Lab., Winnipeg (Manitoba).
For primary bibliographic entry see Field 5A.
W82-01090

ARE METALS FROM HIGHWAY DUSTFALL HAZARDOUS IN SWIMMING POOLS,
Florida International Univ., Miami. School of Technology.
J. A. Beech.
Journal of Environmental Health, Vol 42, No 6, p 328-331, May/June, 1980. 4 Tab, 18 Ref.

Descriptors: *Swimming pools, *Highway effects, Heavy metals, Recreation facilities, Highways, Roads, Dusts, Metals, Sediments, Water quality.

The possible effect of roadwar dust on the heavy metal content of swimming pool water was investigated. Water from 20 pools alongside busy highways was compared with water from 80 other freshwater pools classified into four groups by pool location and/or type. All samples came from public or commercial open-air pools, originally filled from the Miami municipal water supply. Powdery sediments were noted on the bottom of several pools alongside busy highways. These sediments were also analyzed. Three pool samples exceeded or equaled interim primary drinking water standards for lead or cadmium. Two of these contained 73 and 50 micrograms per liter of lead and one contained 12.1 micrograms of cadmium. Only 20 pool samples contained less than 100 mg/liter of sodium. Sodium ions are added during routine maintenance. Copper content of the sediments varied greatly. Some sediments contained very large amounts of lead. Pool sediments were somewhat higher in metals than are most roadside dusts. No significant differences were found between soluble heavy metal concentrations of water from pools alongside highways and water from other city pools. Until more is known about the properties of these bottom sediments in pools, it is recommended that they be removed from the entire circulating system when the pools are cleaned. (Baker-FRC)
W82-01093

5C. Effects Of Pollution

EFFECT OF CRUDE OIL AND PETROLEUM-DEGRADING MICROORGANISMS ON THE GROWTH OF FRESHWATER AND SOIL PROTOZOA,
Toronto Univ. (Ontario). Dept. of Zoology.
A. Rogerson, and J. Berger.
Journal of General Microbiology, Vol 124, No 1, p 53-59, May, 1981. 3 Fig, 21 Ref.

Descriptors: *Protozoa, *Oil, *Growth rates, *Bacteria, Microorganisms, Water pollution effects, Oil pollution, Microbial degradation, Microbiological studies, *Crude oil.

The ability of a known oil-degrading microflora to support the growth of several common freshwater and soil protozoa was investigated. Also, the protozoa were cultured with emulsified crude oil to study the effects of their directly ingesting oil globules. The following protozoa were cultured either in the presence or in the absence of partially degraded crude oil: Colpidium campylum, Tetrahymena pyriformis, Colpidium colpoda, Colpoda cucullus and Uroleptus. Also, the soil amoeba Naegleria gruberi was cultured. Comparisons were made using the regression coefficient characterizing the slope of the growth curve. The presence of hydrocarbons in the batch culture system did not consistently affect protozoan growth. Protozoan replication was not deterred by the oil droplets observed within the food vacuoles of ciliates. The protozoa most susceptible to reduced growth rates in the presence of emulsified oil were the small pelagic ciliates. In general, there was a slight tendency towards larger protozoa in the presence of oil. (Small-FRC)
W82-00517

ACID RAIN: FACTS AND FALLACIES,
Northeastern Forest Experiment Station, Durham, NH.
J. W. Hornbeck.
Journal of Forestry, Vol 79, No 7, p 438-443, July, 1981. 3 Fig, 45 Ref.

Descriptors: *Acid rain, *Air pollution, *Precipitation, Snowmelt, Rainfall, Acidity, Chemical properties, Industrial wastes, Forests, Ecosystems, Vegetation, Soil environment, Leaching, Water pollution effects.

The sources and effects of acid rain are complex environmental phenomena. Although the major sources are thought to be atmospheric emissions, primarily from urban sources, the exact locations of sources and the mechanisms of transformation of emissions to acid rain are not entirely understood. In the absence of long term records, it is difficult to analyze changes in rainfall acidity and whether this problem is intensifying or spreading. Long range transport of airborne emissions by weather systems has made acid rain a potential threat to aquatic and forest ecosystems in rural areas. Acid rain contains not only substances that donate hydrogen ions, such as nitric and sulfuric acid, but also dissolved ions of common and heavy metals and trace elements. Aquatic ecosystems are the most vulnerable to acid rain in the short run. Acidification of streams and lakes may lead to decreased fish populations and increased concentrations of toxic metals. Acid rain may accelerate the replacement and leaching of basic cations and speed the rate of acidification of soils, particularly shallow, coarse textured forest soils which are already lacking in basic cations. This gradual acidification of the soil could increase leaching of nutrient ions, slow microbiological processes, reduce the variety and populations of soil fauna, and increase the mobility of some toxic elements. Acid rain also appears to be depositing heavy metals on forest soils. Long range effects of acid rain may include reduction of forest productivity and alteration of species composition or diversity. (Carroll-FRC)
W82-00518

SESTON DYNAMICS IN SOUTHERN APPALACHIAN STREAMS: EFFECTS OF CLEAR-CUTTING,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W82-00543

SEDIMENTOLOGICAL AND BIOLOGICAL CHANGES IN THE WINDSOR MUDFLAT, AN AREA OF INDUCED SILTATION,

McMaster Univ., Hamilton (Ontario). Dept. of Geology.
T. R. Turk, M. J. Fisk, R. W. M. Hirtle, and R. K. Yeo.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1387-1397, September, 1980. 10 Fig, 2 Tab, 40 Ref.

Descriptors: *Tidal powerplants, *Sedimentation, *Mud flats, *Silting, *Secondary productivity, *Tidal marshes, Tidal flats, Water resources development, Aquatic productivity, Environmental effects, Sediments, Clams, Polychaetes, Amphipods, Ecological effects, Windsor, *Nova Scotia.

The effect of rapid sedimentation on the sedimentological and biological properties of an intertidal mudflat was examined at the causeway-formed mudflat at Windsor, Nova Scotia. The sediments on the Windsor mudflat have occurred as a result of construction of a tidal power dam. The Windsor mudflat is characterized by high water levels, small grain sizes and high levels of organic carbon. The amphipod, Corophium volutator and the clam, Macoma balthica are less abundant in the study site than in surrounding mudflats. The polychaete, Heteromastus filiformis is very abundant at Windsor, while M. balthica grows faster and has a shorter lifespan. However, the weight of the Windsor clams increases more slowly with increasing shell size, probably in response to the greater fluidity of Windsor sediments. These findings suggest that the secondary productivity of Corophium and Macoma could be reduced by about 66% for another decade in existing Minas Basin mudflats. (Geiger-FRC)
W82-00548

RESIDUES IN CUTTHROAT TROUT (SALMO CLARKI) AND CALIFORNIA NEWTS (TARICHIA TOROSA) FROM A LAKE TREATED WITH TECHNICAL CHLORDANE,

Simon Fraser University, Burnaby (British Columbia). Dept. of Biological Sciences.
L. J. Albright, P. C. Oloffs, and S. Y. Szeto.
Journal of Environmental Science and Health, Part B, Vol 15, No 4, p 333-349, 1980. 4 Tab, 13 Ref.

Descriptors: *Chlorinated hydrocarbons, *Residual chlorine, Water pollution, Lake sediments, *Chlordane, Sediments, *Trout, Fish, Salamanders, Amphibians, Cutthroat trout.

Laboratory studies with chlordane and other chlorinated hydrocarbons showed that these compounds were not metabolized in water but, except for lindane, were readily partitioned into the sediments where some metabolism occurred. A subsequent whole-lake study, conducted to extend these laboratory investigations, involved treatment of a lake with about 10 parts per billion of technical chlordane. The uptake of chlordane residues from the lake water and sediment and their metabolism by two macroorganisms was investigated using the California newt, Tarichia torosa, which lives closely associated with the sediment, and the cutthroat trout, Salmo clarki. The newts were collected at 14, 279, 451, and 1,036 days after the water was treated, while the trout were collected at 93, 279, 421, and 1,014 days. Both of the organisms had residue concentrations in their bodies and livers which far exceeded those in their habitat at the first sampling. These first residue concentrations resembled that of technical chlordane, except for heptachlor, which was quantitatively epoxidized in newts after 14 days. Some heptachlor was still present in trout at 93 days. Concentrations of total chlordane in body tissues of both species declined more than 98% by the final sampling. Trans-nonachlor was the most persistent constituent of technical chlordane, accounting for about 50% of the total chlordane in the specimens collected last. Although the chlordane rapidly disappeared from the water into the sediment, the concentrations of total chlordane in the bodies of newts and trout after the samplings taken at 279 days were very similar, suggesting that the newt metabolizes and eliminates chlordane residues more effectively than the cutthroat trout. Both species were found to produce oxychlordane, probably from gamma-chlordane. (Carroll-FRC)
W82-00558

EFFECT OF TEMPERATURE ON MINERALIZATION BY HETEROTROPHIC BACTERIA,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
D. L. Tison, and D. H. Pope.
Applied and Environmental Microbiology, Vol 39, No 3, p 584-587, March, 1980. 4 Fig, 9 Ref.

Descriptors: *Thermal pollution, *Bacteria, Heated water, *Temperature effects, Waste heat, Thermal powerplants, Thermal stress, Water pollution effects, Thermal water, Algae.

The results of shifts in temperature on the percentage of substrate mineralized (% Min) by pure cultures of psychrotrophic, mesophilic, and thermophilic bacteria and by naturally occurring microbial communities were studied. The possibility that changes in the % Min may be an indication of stress in microbial communities is discussed. Pure cultures of the bacteria Pseudomonas fluorescens (a psychrotroph), Escherichia coli (a mesophile) and SRL 261 (a thermophile) were shifted away from temperatures to which they were adapted. At this point the % Min increased. The increase was noticeably larger for larger temperature shifts. When natural heterotrophic bacterial populations from sediments of Lake George, New York were subjected to temperature shifts similar responses were noted. The same response was found when a thermophilic algal-bacterial mat community at the Savannah River Plant in Aiken, South Carolina was subjected to temperature shifts. It is suggested that an increase in the % Min may be an indication of thermal stress in bacterial populations. (Baker-FRC)
W82-00583

SURVIVAL OF HUMAN ENTEROVIRUSES IN THE HAWAIIAN OCEAN ENVIRONMENT: EVIDENCE FOR VIRUS-INACTIVATING MICROORGANISMS,

Hawaii Univ., Honolulu. Water Resources Research Center.
R. S. Fujioka, P. C. Loh, and L. S. Lau.
Applied and Environmental Microbiology, Vol 39, No 6, p 1105-1110, June, 1980. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Seawater, *Enteroviruses, Hawaiian Ocean, Viruses, Temperature effects, Poliovirus, Nutrients, Antibiotics, Microorganisms, *Hawaii, Oahu.

This report describes the stability of human enteroviruses in the seawaters surrounding Oahu, the major island in the state of Hawaii, and characterizes the virus-inactivating agents present in these waters. The time required for a 90% reduction of poliovirus type 1 at 24 degrees C ranged from 24 to 48 hr. Complete inactivation occurred within 72 to 96 hr. A virus-inactivating agent(s) of a microbiological nature was found in both the clean and sewage-polluted seawaters, but not in fresh, mountain stream waters. Antiviral activity disappeared when the seawater samples were subjected to boiling, autoclaving, or filtration through a 0.22- or 0.45-micrometers, but not a 1.0 micrometer membrane filter. The concept that the antiviral activity of the seawater was related to the growth activities of microorganisms was corroborated by the observed effects of added nutrients, a lower temperature of incubation, and the presence of certain antibiotics. Other enteric viruses, such as coxsackie virus B-4 and echo virus-7, were also shown to be similarly inactivated in seawater. (Baker-FRC)
W82-00587

TOXICITIES OF PARAQUAT AND DIQUAT HERBICIDES TO FRESHWATER COPEPODS (DIAPTOMUS SP. AND EUCYCLOPS SP.),

Southern Univ., Baton Rouge. LA. Dept. of Biological Sciences.
S. M. Naqvi, T-S. Leung, and N. Z. Naqvi.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 918-920, 1980. 2 Tab, 12 Ref.

Descriptors: *Paraquat, *Diquat, *Copepods, *Herbicides, Toxicity, Mortality, Crustaceans, Invertebrates, Water pollution effects, *Aquatic animals, Zooplankton.

Zooplankton were collected from a natural lake with a plankton net. Copepods were separated out by concentrating the sample and removing the upper portion containing the aggregated copepods. Freshwater copepods (Diaptomus sp. and Eucyclops sp.) were exposed to various concentrations (0 to 140 ppm) of the herbicides diquat and paraquat for 24 and 48 hours. LC50 results in ppm were: diquat, 74 at 24 hours, 19 at 48 hours; paraquat, 10 at 24 hours, 5.3 at 48 hours. Mortalities of 98-100% were observed at concentrations of 140 ppm diquat and 100 ppm paraquat in 24 hours and 60 ppm diquat and 30 ppm paraquat in 48 hours. The copepods were slightly more tolerant to these herbicides than cladocerans; however, copepods mortality in aquatic ecosystems due to excessive use of diquat and paraquat cannot be ruled out. (Cassar-FRC)
W82-00589

TOXICITY OF FIVE FOREST INSECTICIDES TO CUTTHROAT TROUT AND TWO SPECIES OF AQUATIC INVERTEBRATES,

Columbia National Fisheries Research Lab., MO.
D. F. Woodward, and W. L. Mauck.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 846-853. 1980. 3 Tab, 13 Ref.

Descriptors: *Fish, *Insecticides, *Invertebrates, Aquatic life, Toxicity, *Trout, Water pollution effects, Pesticides, Carbamate pesticides, Organophosphorus pesticides, Acephate, Fenitrothion, Trichlorofon, Aminocarb, Carbaryl, *Toxicity.

The toxicity of five forest insecticides was determined for cutthroat trout obtained from the Jack-

son Wyoming National Fish Hatchery and aquatic invertebrates, stonefly naiads from The Snake River end amphipods collected from small springs. The 96-hour LC50s for trout (Salmo clarki) in 12 degrees C soft water at pH 7.5 were (in micrograms per liter): acetate 100,000; aminocarb 28,000; carbaryl 3,950; fenitrothion 2,880; and trichlorofon 1,680. For amphipods (Gammarus pseudolimnaeus) the 96-hour LC50 were (in micrograms per liter): acephate 25,000; aminocarb 1,000-2,200; carbaryl 7-13; fenitrothion 4.3-5.6; and trichlorofon 52-108. In stoneflies (Pteronarcella badia) the 96-hour LC 50s (in micrograms per liter) were: acephate 6,400-21,200; aminocarb 26-28; carbaryl 11-29; fenitrothion 5.1-7.2; and trichlorofon 5.3-100. It is important to note that toxicity of some insecticides varies significantly (by as much as 300-fold) when they are formulated and applied in water of different pH, hardness, or temperatures. All five insecticides, excluding aminocarb, appear safe to cutthroat trout at pH 7.5 or less at normal formulation and application rates. The aquatic invertebrates are much more sensitive to the toxicants. Acephate is the safest forest insecticide to both trout and invertebrates. However, a 2 lb per acre application rate has shown evidence of cholinesterase inhibition in songbirds. (Cassar-FRC)
W82-00590

ASSESSMENT OF THERMAL DISCHARGES ON ZOOPLANKTON IN CONOWINGO POND, PENNSYLVANIA,

Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
D. Mathur, T. W. Robbins, and E. J. Purdy, Jr.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 6, p 937-944, June, 1980. 4 Fig, 5 Tab, 13 Ref.

Descriptors: *Zooplankton, *Thermal pollution, *Statistical analysis, Heated water, Temperature effects, Powerplants, Mathematical studies, Conowingo Pond, Pennsylvania.

Analysis of covariance was used to separate natural variations in zooplankton from those caused by power station operation. The covariants were: density of zooplankton at control station, ambient water temperature, and average daily river flows. The assessment was made at Conowingo Pond, a 35.8 km sq impoundment on the lower Susquehanna River which is part of the Peach Bottom Atomic Power Station, a once-through cooling system. Some of the problems associated with using the ratio of density at the control station to the density at an affected station to adjust for ambient variations were overcome using the convariance technique. Significant differences were found in adjusted preoperational and postoperational means, but these were not attributable to station operation. Multiple regression analysis indicated that an increase in zooplankton production could result from the addition of heated water when river flows were less than 280 cu m/sec. Temperature differences from ambient averaged 10C in winter and 8C in summer. (Small-FRC)
W82-00592

EFFECT OF METALS ON THE BIOMASS PRODUCTION KINETICS OF FRESHWATER COPEPODS,

Canada Center for Inland Waters, Burlington (Ontario).
U. Borgmann, R. Cove, and C. Loveridge.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 567-575, April, 1980. 5 Fig, 11 Tab, 12 Ref.

Descriptors: *Water pollution effects, *Heavy metals, *Copepods, *Toxicity, Cadmium, Copper, Mercury, Lead, Arsenic, Biomass, Aquatic productivity, Canals, Fluctuations, Seasonal variation, Crustaceans, Mathematical studies.

The effects of cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb), and arsenic (As) on the kinetics of in situ copepod production in the Burlington Canal were examined under static conditions. Nauplii were collected and exposed for two weeks to various concentrations of the metals. Biomass growth rate, mortality rate, cohort biomass growth rate and recoverable metal concentrations were calculated and subjected to mathematical analysis. Results showed seasonal cycles in toxicity for all of the metals except As. Pb toxicity was associated with the ash-free dry weight of the seston, but the fluctuations in Cd, Cu and Hg toxicity could not be explained. Metal toxicity to copepods and daphnids is often more similar in the chronic form than in the acute form. Mathematical relationships between metal levels and growth and mortality rates are presented along with a method for determining sublethal metal concentrations. (Geiger-FRC)
W82-00593

DYNAMICS OF SELENIUM IN MERCURY-CONTAMINATED EXPERIMENTAL FRESHWATER ECOSYSTEMS,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W82-00595

INSECT COMMUNITY STRUCTURE AS AN INDEX OF HEAVY-METAL POLLUTION IN LOTIC ECOSYSTEMS,

Miami Univ., Oxford, OH. Dept. of Zoology.
R. W. Winner, M. W. Boesel, and M. P. Farrell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 647-655, April, 1980. 2 Fig, 6 Tab, 28 Ref.

Descriptors: *Heavy metals, *Chironomids, *Stream pollution index, Copper, Chromium, Zinc, Aquatic insects, Caddisflies, Mayflies, Midges, Water pollution effects, Aquatic populations, Bioindicators, Macroinvertebrates, *Lotic environment, Insects, Ecosystems.

Measurements of macroinvertebrate populations in two streams of southwestern Ohio suggest that community structure shows a predictable, graded response to pollution by heavy metals. In heavily polluted regions of both streams, only chironomids and tubificid worms survived in rock rubble and riffle sections. Midge larvae predominated in the most polluted areas. The correlation coefficient for percentage of chironomids in relation to copper levels was +0.93. The lowest changes in coefficient of variation (CV) were found at the most polluted stations and increased along a gradient of decreasing metal levels. The number of chironomid species increased as metal pollution levels decreased. Caddisflies were numerically important at points of intermediate pollution along both streams, while mayflies were found only at areas of very low pollution. The percentage of chironomids present in lotic water samples is proposed as a useful index of stream pollution by heavy metals. (Geiger-FRC)
W82-00596

METAL SPECIATION. EFFECTS ON AQUATIC TOXICITY,

Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W82-00610

AN ENVIRONMENTAL SAFETY ASSESSMENT OF BUTYL BENZYL PHTHALATE,

Monsanto Co., St. Louis, MO.
For primary bibliographic entry see Field 5A.
W82-00615

ENVIRONMENTAL HEALTH HAZARDS,

For primary bibliographic entry see Field 5F.
W82-00625

HUMAN HEALTH HAZARDS ASSOCIATED WITH CHEMICAL CONTAMINATION OF AQUATIC ENVIRONMENT,

Environmental Protection Agency, Cincinnati, OH.
J. F. Stara, D. Kello, and P. Durkin.
Environmental Health Perspectives, Vol 34, p 145-158, February 1980. 1 Fig, 7 Tab, 88 Ref.

Descriptors: *Human diseases, *Water pollution, Natural waters, *Chemical wastes, Water quality, Carcinogens, Mutagens, Teratogens, Pharmacokinetics, Risks, Public health, Hazardous materials.

The development of ambient water criteria to protect human health is the focus of this paper. Both human and aquatic health assessments involve extrapolating results of observable responses in test species to projected or acceptable levels in the species of concern. Certain practical differences exist between human and aquatic risk assessment. Human health hazard assessment attempts to convert a risk from various mammalian species to only a single species. Aquatic hazard assessment is concerned with the effect of xenobiotic stress in aquatic communities, groups of species interacting by mechanisms which are neither readily quantified nor clearly understood. Information on sources of exposure, pharmacokinetics, and adverse effects must be carefully evaluated. Source data is essential to determine the contribution of exposure from water relative to all other sources. Pharmacokinetic data allow extrapolation and characterization of the mode of toxic action. Toxic effects information includes data on acute, subchronic and chronic toxicity, mutagenicity, teratogenicity, and carcinogenicity. A distinction must be made between threshold and nonthreshold effects. For carcinogens and mutagens criteria are calculated by postulating an acceptable increased level of risk and using extrapolation models to estimate the dose which would result in these increased levels of risk. For other chemicals, thresholds are assumed and criteria are calculated by deriving acceptable daily intakes. (Baker-FRC)
W82-00632

SEDIMENTS AS A SOURCE OF PHOSPHATE: A STUDY OF 38 IMPOUNDMENTS,

Department of Water Affairs, Pretoria (South Africa). Hydrological Research Inst.
For primary bibliographic entry see Field 2H.
W82-00653

ACIDITY FLUCTUATIONS AT A BROADLAND SITE IN NORFOLK,

Ministry of Agriculture, Fisheries, and Food, Norwich (England). Coypu Research Lab.
For primary bibliographic entry see Field 2K.
W82-00656

DISTRIBUTION AND BIOLOGICAL AVAILABILITY OF REACTIVE HIGH MOLECULAR WEIGHT PHOSPHORUS IN NATURAL WATERS IN NEW ZEALAND,

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
For primary bibliographic entry see Field 2H.
W82-00659

FACTOR ANALYSIS OF THE IMPACT OF THE ENVIRONMENT ON MICROBIAL COMMUNITIES IN THE TVARMINNE AREA, SOUTHERN COAST OF FINLAND,

Zoological Station, Tvarminne (Finland).
P. Vaatanen.
Applied and Environmental Microbiology, Vol 40, No 1, p 55-61, July, 1980. 2 Tab, 22 Ref.

Descriptors: *Microbial studies, *Environmental effects, Populations, Temperature effects, Wind, Seasonal variations, *Finland, Coasts, Estuarine environments, Brackish water, Seawater, Microorganisms, Rainfall, Coliforms, Wastewater outfalls, Effluents, Bacteria.

Data obtained regarding 10 environmental parameters and 16 microbiological parameters at a sampling station on the Tvarminne Archipelago, Finland, had been subjected to regression analysis in a previous study. In the present study, the correlations between the parameters were factorized using the principal axis solution, and eight of the factors of apparently greatest importance were rotated by the varimax method for the total data and the data for the open-water period. The eight factors selected were characterized by different loadings for water temperature, salinity, ice cover, organic and

humic matter, microbial counts, transparency, microbial respiration, wind vectors, and rainfall. All of the microbiological parameters aside from H2S producers, proteolytic bacteria, enterococci and yeasts are mainly loaded in one factor. The factors dealing with freshwater outflows cover 50-69% of the variance of fluorescent pseudomonads, bacterial spores, and fecal coliforms. The water temperature factor explains most of the variance of direct counts. A third factor, vernal phytoplankton bloom, not identified by regression analysis, explains most of the variance of the respiration parameters. These three factors, plus the periods before and after the bloom, covered about 90% of the factor variance in the populations and also the major part of the variance of most microbiological parameters. The west winds, summer rains, and early winter factors did not contribute much to the factor variances, but the parameters contributing to them are still needed for satisfactory interpretation of the factors. Although much of the information provided by factor analysis was the same as that of regression analysis, the environmental processes affecting microbes were easier to identify with the factor analysis than with regression analysis. (Baker-FRC)
W82-00672

ANNUAL SUCCESSION OF PHYTOPLANKTON IN ONE HEATED POND IN CENTRAL FINLAND,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. Eloranta.
Acta Hydrobiologica, Vol 22, No 4, p 421-438, 1980. 10 Fig, 4 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Cooling ponds, *Seasonal variation, Cooling water, *Temperature effects, Thermal pollution, Water quality, Primary productivity, Biomass, *Finland.

Seasonal fluctuations of phytoplankton biomass and the structure of communities were determined in a pond used to cool one small thermal power plant. The following were monitored: water quality, primary production in situ and in vitro in different temperatures, periphyton on artificial substrates, and zooplankton. The phytoplankton reached a maximum in March of 10.3 gm/cu m, primarily comprising cryptophytes and Asterionella gracillima Heib. The autumn maximum of 11.2 g/cu m was in September and was made up of Cyclotella meneghiniana Kutz. Green algae were dominant in spring and summer. The biomass minimum in the darkest winter season was less than 0.2 g/cu m. The chlorophyll alpha concentration of the phytoplankton fresh weight biomass averaged 0.34%. The Shannon diversity was calculated with natural logarithms, and on the basis of each species amounted to 2.5 to 2.9 in summer and 2.7 to 2.8 in winter. There was no significant correlation between Shannon diversity and the logarithm of the phytoplankton biomass. (Small-FRC)
W82-00673

EFFECT OF OTTER PRAWN TRAWLING ON THE MACROBENTHOS OF A SANDY SUBSTRATUM IN A NEW SOUTH WALES ESTUARY,
New South Wales State Fisheries, Sidney (Australia).
P. J. Gibbs, A. J. Collins, and L. C. Collett.
Australian Journal of Marine and Freshwater Research, Vol 31, No 4, p 509-516, 1980. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Estuarine environment, *Benthic environment, *Trawling, Benthos, Estuaries, Environmental effects, *Ecological effects, Substrates, Benthic fauna, Sediments, Crustaceans, Fishing industry, New South Wales, *Australia.

Recreational fishermen along the New South Wales coast in Australia have made persistent claims that estuarine otter prawn trawling by commercial fishermen kills benthic organisms, depriving fish species of their food source. This study made a quantitative assessment of the effect of commercial prawn trawling in New South Wales on the macrobenthos of the trawl grounds and made a visual assessment of the operation of commercial nets and otter boards underwater. Macrobenthos at three treatment sites and one control site were sampled on three occasions: before and after intensive trawling, prior to the opening of the commercial prawning season, and at the close of the commercial prawning season. Divers made underwater observations of the otter trawl nets in operation. Numerical clustering techniques were used as a preliminary step to statistical comparisons of the number of individuals, number of species, and species diversity at the four sites. The underwater observations revealed that the effect on the sea bottom and the macrobenthos was minimal when the prawn trawls were operating efficiently. Very little sand was disturbed and the sea bottom appeared only slightly marked by the trawl's passage after repeated trawls. The differences between sites demonstrated by the classificatory analysis and community statistics were thought to be due to the patchiness in distribution generally associated with benthic animals and differences in sediment types at the sites, rather than with the trawling. It was concluded that the otter prawn trawling, as conducted in most estuaries in New South Wales, causes no detectable alterations in the macrobenthic fauna of the trawl grounds. (Carroll-FRC)
W82-00677

BACTERIAL DNA REPAIR ASSAY OF SELECTED COMPOUNDS IN PULP AND PAPER MILL EFFLUENTS,
International Paper Co., Tuxedo Park, NY.
V. J. Boyle, and C. A. Simpson.
Tappi, Vol 63, No 10, p 127-130, October, 1980. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Pulp and paper industry, *Bacteria, *Mutagenesis, Water pollution effects, Effluents, Toxicity, Organic compounds.

Compounds commonly found in pulp and paper mill effluents were evaluated using the DNA Repair Test, recommended in proposed EPA guidelines. None of the chemicals--abietic acid, trichloroguaiacol, tetrachloroguaiacol, dichlorostearic acid, and epoxystearic acid--showed selective killing of the DNA polymerase-deficient (Pol A-) strain of E. coli at concentrations of 50 to 200 micrograms per disk (100-600 times more concentrated than in papermill final effluents). Nalidixic acid was used as a positive control. Results show that these compounds do not have the potential for the alteration of genetic material as assessed by the DNA Repair Test. (Cassar-FRC)
W82-00687

RECEIVING STREAM FISHERIES STUDIES RELATIVE TO SECONDARY TREATED PULP AND PAPER MILL EFFLUENTS,
Consolidated Papers, Inc., Wisconsin Rapids, WI.
J. D. Weinbauer, D. A. Thiel, V. W. Kaczynski, and C. S. Martin.
Tappi, Vol 63, No 10, p 121-125, October, 1980. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Pulp and paper industry, *Water pollution control, *Fisheries, Aquatic animals, *Water pollution effects, Fish, Effluents, Wisconsin River, Invertebrates, Benthic fauna, Pike, Water pollution prevention, Ecological effects, Wastewater treatment, Industrial wastes, Organoleptic properties, Taste.

A 70-mile section of the Wisconsin River receiving treated wastes from eight paper mills at five outfalls was the site of a biological study on fish and invertebrate populations. The walleye pike (Stizostedion vitreum) population appeared healthy, as determined by age structure, growth rates, and condition factors. A creel survey of 2028 fishermen indicated that 47.8% felt that fishing had improved over the last few years and 22.2% thought it had not improved. Flavor of the fish was designated excellent by five percent of the fishermen, good by 36%, acceptable by 46%, and poor by 13%. Walleye filets collected at four sites were evaluated by an 18-member flavor test board. The Wisconsin River fish, especially those upstream from the paper mill effluents, had more flavor impairment than control Canadian fish. Evidently, effluents and nonpoint source pollution upstream of the paper mills had more adverse affect on fish flavor than did effluents from the mills. The fish survey identified 1594 fish representing 24 species. Macroinvertebrate species have shown a clear shift from pollution-tolerant species to pollution-intolerant species over the course of the study, which has been conducted annually since 1962. These improvements in biological and water quality status correspond with construction of effluent treatment facilities at the paper mills during the 1970's. (Cassar-FRC)
W82-00688

THE CHANGING STATUS OF REEDSWAMP IN THE NORFOLK BROADS,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
L. A. Boorman, and R. M. Fuller.
Journal of Applied Ecology, Vol 18, No 1, p 241-269, April, 1981. 7 Fig, 8 Tab, 67 Ref.

Descriptors: *Wetlands, *Vegetation, *Distribution patterns, Swamps, Marshes, *Reedswamp, Rodents, Coypus, Geese, Eutrophication, Grazing, Norfolk Broads, Succession, Water pollution effects, Ecological effects, Lakes, *England.

Changes in the distribution and area of reedswamp (vegetation of various tall immersive graminoids growing where the normal summer water table is above the substratum) from 1880 to the present were documented by Ordnance Survey maps and aerial photographs of the Norfolk Broads. Between 1880 and 1905 reedswamp increased from 216.5 ha to 244.6 ha. Starting in 1905 the reedswamp area decreased steadily to the present 1977 level of 49.2 ha. Prior to 1946, losses were from succession to fern; after 1946, from regression to open water. A major factor in the decline of the reedswamp was grazing by the coypu (Myocaster coypus Molina), a large South American wetland rodent which escaped from fur farms by 1936 and became well established during the 1940's. The population reached a height of about 70,000 in 1962 and presently numbers about 15,000. Feral geese are now actively limiting reedswamp in some areas. Eutrophication appeared to have no direct effects on reedswamp, but increased sedimentation rates can make the reeds, especially the shoots, more available for grazing. Neither soil type or boat traffic were responsible for the reedswamp changes. (Cassar-FRC)
W82-00691

1980 ANNUAL REPORT, COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY,
International Joint Commission-United States and Canada, Windsor (Ontario).
1980. 34 p. 3 Tab, 11 Ref.

Descriptors: *Lakes, *Toxicity, *Water quality, *Hazardous materials, *Viruses, Epidemiology, Fish populations, Fish diseases, Aquatic populations, Enteroviruses, Toxins, *Great Lakes.

This report summarizes the 1979-80 activities of the Committee on the Assessment of Human Health Effects of Great Lakes Water Quality. High priority was placed on evaluating the health hazards of chemicals identified in the Great Lakes ecosystem. Also investigated were viruses in the Great Lakes, the development of compatible cancer registries within the Great Lakes Basin, and levels of contaminants in fish. The committee attempted a study of the health hazards of 381 compounds but found that toxicological and exposure data on the chemicals were insufficient for a meaningful evaluation. Additional toxicology and exposure studies of potentially hazardous chemicals are recommended. Results of an investigation of enteric viruses indicated that water quality standards for Great Lakes water are successfully preventing these viruses from being spread via the public water supply. However, the development of more sensitive indicators of the presence of viruses is recommended, as well as better data on the relationship between water treatment processes and the fate of water-borne viruses. The Committee also recommended that: (1) additional fish surveillance studies be carried out to assess 'real time'

exposures of man, and to assess the effectiveness of contaminant control strategies; and (2) a workshop be held on the compatibility of Great Lakes Basin cancer registries, as a prelude to a proposed cancer morbidity and mortality survey of the countries bordering Lake Ontario. Also suggested is a workshop on the interaction of toxic chemicals in the Great Lakes ecosystem. (Garrison-Omniplan)
W82-00706

1980 ANNUAL REPORT - A PERSPECTIVE ON THE PROBLEM OF HAZARDOUS SUBSTANCES IN THE GREAT LAKES BASIN ECOSYSTEM,

International Joint Commission-United States and Canada, Windsor (Ontario).
November, 1980. 70 p. 10 Tab, 20 Ref, 1 Append.

Descriptors: *Lake basins, *Contaminants, *Waste water disposal, *Chemical wastes, *Polychlorinated byphenyls, Eutrophication, Halogens, Residual chlorines, Sediments, Sludge, Aquatic populations, Human populations, Suspended solids, Trace metals, Potable water, Chlorine, *Great Lakes basin, Ecosystems.

The infusion of synthetic industrial chemicals has increased exponentially in the Great Lakes ecosystem, particularly in the last 40 years. Some of these chemicals may be toxic. This report discusses these substances relative to biological and human health effects, transport and fate, sources, and control alternatives, and presents a plan for attacking the problems. Effects on human health are often not readily distinguishable; those on aquatic life are more easily seen. Two main sources of human exposure are through drinking water and eating fish. No conclusions have been drawn concerning the health effects of the water quality. One study examined the correlation between PCB residues in Lake Michigan fish and concentrations of PCBs in the blood of those eating the fish. Higher levels were found in those eating large amounts of fish. Hazardous substances in large lakes, such as DDT, dieldrin, mirex, PCBs, phthalates, and mercury, are persistent in the water, sediment, and biota and will be widely dispersed through the lakes. Hazardous substances enter the Great Lakes through emissions to the atmosphere, industrial and municipal wastewater discharges, urban and rural land runoff, and other sources such as spills and leaching from solid waste disposal sites. Recommendations to reduce the problem of hazardous substances include reuse and treatment technologies, reducing the loss or use of stubstance that enter the air or water effluents, identifying high-exposure populations, establishing tolerance levels for toxic substances, and centralizing an information system for data on hazardous substances. (Atkins-Omniplan)
W82-00707

1980 REPORT ON GREAT LAKES WATER QUALITY - APPENDIX,

International Joint Commission-United States and Canada, Windsor (Ontario).
November 12, 1980. 82 p. 14 Fig, 17 Tab.

Descriptors: *Lake rehabilitation, *Eutrophic lakes, *Water quality, *Phosphorus removal, *Algal growth, Algal blooms, Fish populations, Fish conservation, Aquatic populations, Fish diseases, Aquatic environment, Water quality data, *Great Lakes ecosystem.

This appendix was developed to assist the Great Lakes Water Quality Board in preparing its report to the International Joint Commission. Water quality status in the Great Lakes ecosystem is presented with a review of municipal phosphorus control programs. Also included is a brief summary of the development and implementation of data quality assurance programs with specific reference to interlaboratory comparisons. Municipal phosphorus loads are presented on a lake-by-lake basis. Municipal treatment plants are ranked according to the difference between their actual annual phosphorus load and their estimated load at an effluent phosphorus concentration of 1 milligram per liter. A special section on Aquatic Ecosystem Quality reviews the progress in eutrophication control and the decreased residue levels of contaminants observed in several fish species in the lower lakes as well as in gull eggs collected throughout the basin. PCB levels in gull eggs in Lake Superior have exhibited little change, possibly reflecting the importance of atmospheric inputs. Three new problem areas have been identified in the Great Lakes Basin: Marquette and Munising bathing beaches on Lake Superior, which exceeded state fecal and total coliform objectives, and White Lake on Lake Michigan, which was added to the problem area list because of oganics found in water, sediments, and fish. (Garrison-Omniplan)
W82-00708

ACUTE TOXICITY OF ZINC TO SOME FISHES IN HIGH ALKALINITY WATER,

Illinois State Water Survey, Urbana.
P. Reed, D. Richey, and D. Roseboom.
Illinois Institute of Natural Resources, Circular 142, 1980. 21 p. 4 Fig, 5 Tab, 48 Ref, 2 Append.

Descriptors: *Fish populations, *Toxicity, *Zinc, *Alkaline water, *Fish toxins, Poisons, Catfish, Bluegills, Bass, Hazardous materials, Mud-water interfaces, Alkalinity, Water pollution effects, Water pollution sources.

The alkalinity of lakes and streams in Illinois are variable, with concentrations, as calcium carbonate, generally exceeding 200 mg/l in the northern and central part of the state and often less than 100 mg/l in the southern part. This study documents the acute toxic effects of varying concentrations of zinc on certain fishes native to Illinois. Fourteen-day bioassays were performed with bluegill fry, channel catfish fingerlings, and largemouth bass fingerlings in waters relatively high in the salts of calcium and magnesium, with correspondingly high alkalinity. The levels of total zinc in natural water bodies in Illinois generally do not exceed 0.5 mg/l. Soluble zinc concentrations are usually less than 0.05 mg/l, except in those surface waters that are significantly influenced by urban centers. Elevated concentrations of zinc occur at the mud-water interface, during anaerobic conditions, in Illinois lakes. The concentrations thus far observed are generally two to three times higher than those detected in the overlying waters. The 14-day median tolerance limit at 20 degrees Celsius was 11.0 mg/l soluble zinc for the bluegill, 8.2 mg/l soluble zinc for the channel catfish, and 8.0 mg/l soluble zinc for the largemouth bass. For protection of the fishes investigated, and in compliance with Illinois water pollution regulations, soluble zinc concentrations in Illinois streams having alkalinity and hardness should not exceed 0.8 mg/l. (Garrison-Omniplan)
W82-00713

DOES IMPROVED WASTE TREATMENT HAVE DEMONSTRABLE BIOLOGICAL BENEFITS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
H. H. Seagle Jr, A. C. Hendricks, and J. Cairns Jr.
Environmental Management, Vol 4, No 1, p 49-56, January, 1980. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Textile mill wastes, *Water quality control, *Effluents, Industrial wastes, *Wastewater treatment, Aquatic habitats, Water pollution effects, Water pollution control, Invertebrates, Fish, Zinc, Toxicity, Benthic fauna, Diversity indices, Shenandoah River, *Ecological effects.

Ten benthic surveys and 9 static fish bioassays were conducted since 1972 on the South Fork of the Shenandoah River near the Avtex rayon and polyester fibers plant at Fort Royal, Virginia. Prior to construction of an activated sludge treatment system in February 1974, zinc and BOD5 inputs averaged 239 and 733 kg per day, respectively. The benthic community, especially on the right side of the river, where the effluent was channelized, had low diversity values (0-2.42) and reduced numbers of taxa and organisms compered with the upstream control. A fish bioassay showed that the effluent was acutely toxic at an admixture of 34.5% with river water. While water chemistry and temperature were little affected by the improved waste treatment facilities, levels of Zn and BOD5 were significantly reduced and the aquatic habitat improved. The plant's treated effluent contained 70% less BOD5 and 60% less zinc. In 1974 the effluent was toxic to fish at 80% concentration, but it was more toxic after that. Diversity values for fauna increased to 1.19-3.39. Taxa and numbers of organisms increased. Only during drought conditions in 1976 and 1977 did the improved situation regress. Although the benefits of pollution control were clearly demonstrated, complete recovery of the river is unlikely, particularly in areas where the effluent is channelized and at low flow conditions. (Cassar-FRC)
W82-00779

THE RELATIONSHIP OF ENVIRONMENTAL EPIDEMIOLOGY TO WATER AND WASTEWATER PLANT OPERATORS,

Oklahoma State Dept. of Health, Oklahoma City.
D. Farley.
Southwest and Texas Water Works Journal, Vol 63, No 3, p 10, 12, June, 1981.

Descriptors: *Epidemiology, *Water pollution effects, *Wastewater treatment, Water treatment, Public health, Toxicity, Legislation, Regulations, Legal aspects, Oklahoma State Department of Health, *Wastewater plant operators, Personnel.

Water and wastewater treatment plant operators should be aware of the potential health effects of each step in the processes. The Oklahoma State Department of Health is attempting to apply the concept of epidemiology to this field. The short term acute effects of pollutants in drinking water or renovated wastewater are quickly handled, but chronic, long term effects may be discerned only by epidemiological analysis. (Cassar-FRC)
W82-00789

EFFECTS OF HYPOLIMNETIC DISCHARGE ON FISH HEALTH BELOW A RESERVOIR,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
J. M. Grizzle.
Transactions of the American Fisheries Society, Vol 110, No 1, p 29-43, January, 1981. 1 Fig, 3 Tab, 106 Ref.

Descriptors: *Sublethal effects, *Fish, *Hypolimnion, Thermal stratification, *Thermal pollution, Temperature effects, Trout, Perch, Buford Dam, Georgia, Infection, Pathology, Metals, Reservoirs, *Reservoir releases.

Dams often cause changes in the impounded stream or river which have important effects on their fish populations. The release of anoxic, hypolimnetic waters, which often contain dissolved manganese, iron, ammonia, hydrogen sulfide, and other chemicals, from impoundments may increase the downstream concentrations of these substances. Rainbow trout, brown trout, brook trout, and yellow perch from two locations in the tailwater from the Buford Dam, in Georgia, and trout from a hatchery which used the tailwater as a water supply were examined for infections, lesions, and liver metal concentration. The fish were found to be infected by 9 genera of parasites, 19 bacteria species, and 1 virus species. Many of the fish that did not have bacterial infections were found to have microscopic lesions in the gills, liver, spleen, and trunk kidney. The occurrence of lesions indicating exposure to a toxicant was related to increases in iron and manganese concentrations, but not to copper concentrations. While manganese did not indicate exposure to high levels of these metals. Since the tailwater contained copper, zinc, iron, manganese, and dissolved oxygen concentrations considered possibly harmful to fish, acclimation may have allowed survival of the fish in the river. The release of hypolimnetic water from the impoundment resulted in low pH, low dissolved oxygen concentrations, low oxidation-reduction potential, and high metal concentrations. Water characteristics, acclimation by the fish, and possible synergistic activity make most bioassay data unreliable for the prediction of the toxicity of tailwaters. (Carroll-FRC)
W82-00805

THE EFFECT OF SEASON AND LOCATION ON PHOSPHOADENYLATE CONCENTRATIONS AND ADENYLATE ENERGY CHARGE IN TWO SPECIES OF FRESHWATER CLAMS,

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2H.
W82-00810

POTENTIAL EUTROPHICATION OF THE RIDEAU RIVER BY AN URBAN DRAINAGE WATERWAY,

MacLaren (J. F.) Ltd., Willowdale (Ontario).
M. H. Habicht, K. Adamowski, and A. C. Middleton.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 165-172, June, 1981. 4 Fig, 8 Tab, 9 Ref.

Descriptors: *Eutrophication, *Predictions, *Water management, Management planning, Bioassay, Chemical properties, Storm water, Dam effects, Environmental effects, Nutrients, Algae, Biomass, *Urban watersheds, Industrial wastes, Lumber industry, *Saw mills.

Agricultural activities and industrialization promote natural nutrient enrichment, nuisance blooms of algae, depletion of dissolved oxygen, increased turbidity, and changes in aquatic communities, which lead to eutrophication. A study of the eutrophication potential of an urban drainage waterway (Saw Mill Creek) on the Rideau River in Ottawa was designed to determine the usefulness of a combination of bioassay and chemical characterization for estimating the eutrophication potential of storm water and to investigate possible effects of two storm water management alternatives on eutrophication potential. Samples were collected from the creek and the river during eight different peak storm flow conditions. Although nutrient concentrations were found to increase during storm flows, peak flow concentrations of total phosphorus and nitrogen averaged only 0.190 and 2.5 milligrams per liter, respectively. Saw Mill Creek had no significant effect on algal growth in the Rideau River at nutrient addition ratios of 5 percent or less, which probably includes most dry weather flows. However, bioassays produced significantly different algal standing biomass at 10 and 20 percent nutrient addition levels, indicating that the creek can have statistically significant effects on the algal growth in the river during peak flow conditions, when both nutrient concentrations and flow ratios are high. Algal bioassays were shown to be a valuable technique in analysis of the eutrophication of a receiving water by urban drainage water. Simulation of alum treatment of the creek using a jar test did not result in significant reductions in algal growth when compared to that at any of the nutrient addition levels. A reduction in the volume of storm flows of the creek could significantly affect algal growth in the river, however. (Carroll-FRC)
W82-00834

RELATIONSHIPS BETWEEN WATER CHEMISTRY AND RESPIRATION RATE IN SEVERAL POPULATIONS OF LYMNAEA PEREGRA MULLER (GASTROPODA:MOLLUSCA),

For primary bibliographic entry see Field 2K.
W82-00854

CONVERSION OF ABIENOL INTO TETRAHYDROEPIMANOOL BY ANAEROBIC PROCESSES IN WOODROOM DEBARKING EFFLUENT,

British Columbia Research Council, Vancouver.
A. B. McKague, and E. G-H. Lee.
Journal of Chemical Technology and Biotechnology, Vol 30, No 5, p 263-265, 1980. 5 Ref.

Descriptors: *Anaerobic conditions, *Abienol, *Wood wastes, Terpenes, Fish, Toxicity, Chemical reactions, Fate of pollutants, Tetrahydroepimanool, *Fish toxins, Organic compounds, Industrial wastes, Microbial degradation.

During a study of softwood woodroom debarking effluents toxic to fish, a sample was delayed in transit for three weeks. When retrieved and analyzed, this sample contained less than 1 mg per cu dm abienol and 13-epimanool, but contained 12 mg per cu dm of tetrahydroepimanool, which is more toxic to fish than the starting compounds. The conversion was duplicated in the laboratory by anaerobic conversion of abienol in samples of woodroom effluent. Microscopic examination of the effluent indicated the presence of a mixed culture of actively motile bacteria. (Cassar-FRC)
W82-00860

EFFECTS OF THERMAL EFFLUENTS ON COMMUNITIES OF BENTHIC MARINE MACROALGAE,

University of Southern California, Los Angeles.
J. S. Devinny.
Journal of Environmental Management, Vol 11, No 3, p 225-242, November, 1980. 2 Fig, 5 Tab, 39 Ref.

Descriptors: *Algae, *Thermal pollution, *Powerplants, Macrophytes, Benthic flora, Effluents, Marine algae, Humboldt Bay, *California, Punta Banda, Mexico, Plant communities, Species diversity, Species composition, Temperature effects.

Marine benthic macroalgae were studied in three sites with thermal water. Two study areas (Humboldt Bay, northern California, and near Long Beach, southern California) received thermal effluents from powerplants, and the third, Punta Banda, Mexico, had no powerplant discharge but a natural thermal gradient in a shallow bay with restricted circulation. Ordination analysis of the algal communities showed that a 10% change in species composition occurred for each degree of temperature up to 3C, but numbers were not reduced. Temperatures 7C above ambient eliminated large macrophytes. Populations of brown algae were reduced or eliminated, and green algal species were a larger proportion of the community. Temperatures 10C above ambient left ephemeral communities low in diversity. (Cassar-FRC)
W82-00870

EFFECTS OF A CATTLESKIN TANNERY OF STREAM QUALITY AND BENTHIC MACROINVERTEBRATES IN CENTRAL MAINE,

Maine Univ. at Orono. School of Forest Resources.
R. L. Duval, C. R. Ferris, R. B. Owen, K. E. Gibbs, and L. K. Fink.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 2, p 269-276, 1980. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Water pollution, *Industrial wastes, *Benthic fauna, *Streams, Heavy metals, Benthos, Wastewater treatment, Sulfuric acid, Chromium, Flow discharge, Environmental effects, Sediments, Water sampling, Turbidity, *Tannery wastes, Conductivity, Substrates, *Marine, Ecological effects.

The effects of a cattleskin tannery on stream quality and benthic macroinvertebrates in central Maine are discussed. Water quality measurements were made at monthly intervals during the summer months at five locations along a river which receives tannery waste. Sediment samples were collected, and the effects of the effluent and accumulation of heavy metals were determined. A distinct reduction in water and substrate quality was evident in June, coinciding with the period of lowest streamflow. The benthic invertebrate community was affected in two ways. The number of taxa was reduced by 60%, and the diversity and distribution of taxa at the collection sites were altered. The number of invertebrates samples for heavy metals was too small to permit drawing conclusions. However, the concentrations of metals found in those sampled approached lethal levels. Contamination was greatest for chromium. (Titus-FRC)
W82-00872

FACTORS CONTROLLING PHYTOPLANKTON PRIMARY PRODUCTIVITY IN BYRAM LAKE, MT. KISCO, N.Y., SUMMER, 1977,

Fordham Univ., Bronx, New York. Louis Calder Conservation and Ecology Study Center.
For primary bibliographic entry see Field 2H.
W82-00915

INFLUENCE OF PHOSPHORUS LOADS AND OF SOME LIMNOLOGICAL PROCESSES ON THE PURITY OF LAKE WATER,

Polish Academy of Science, Warsaw. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W82-00923

MACROBENTHOS OF PINE ISLAND BAYOU IN THE BIG THICKET NATIONAL PRESERVE, TEXAS,

Lamar University, Beaumont, TX. Dept. of Biology.
R. G. Darville, and R. C. Harrel.
Hydrobiology, Vol. 69, No 3, p 213-223, March, 1980. 1 Fig, 5 Tab, 27 Ref.

Descriptors: *Water quality, *Benthic fauna, *Streams, *Pine Island, *Texas, Big Thicket National Preserve, Species diversity, Biological communities, Water pollution effects, Seepage, Brines, Oil.

Water quality was generally good at 7 stations on Pine Island and Little Pine Island bayous of southeast Texas, according to surveys conducted June 1977 to May 1978. Seepage of brines from nearby oil fields was revealed by higher Cl and conductivity values at four stations. The higher chloride content (up to 1440 ppm) improved stream conditions by flocculation of suspended solids and reducing turbidity. BOD was relatively low, 0.1-10.4 mg per liter. Dissolved oxygen ranged from 0.8 ppm in small isolated pools to 12.2 ppm. Carbon dioxide concentrations generally decreased downstream. pH was lowest at the upper stations (4.2-7.4) and highest (5.4-7.8) near the sewage effluent outlet. Turbidity ranged from 20 to 395 JTU. Orthophosphates and nitrates were highest near the effluent outfall. The highest chlorophyll a concentration measured was 0.2948 mg per liter. Dominant benthic fauna were oligochaetes (62.3%) and chironomids (22.5%). The intolerant mayfly Hexagenia limbata was found at all stations except below the sewage outfall. The number of taxa found varied from 71 at the station with lowest turbidity to 43 below the effluent discharge. The highest annual diversity, 3.82, was found at the station with lowest turbidity. All other stations had diversity values of 2.57 to 3.09, indicating moderately stressed communities. (Cassar-FRC)
W82-00924

THE EFFECTS OF HEAVY METALS ON MICROBIAL BIOMASS IN SEDIMENTS OF PALESTINE LAKE,

Purdue Univ., Lafayette, IN. Dept. of Bionucleonics.
C. E. Nugent, G. J. Atchison, D. W. Nelson, and A. W. McIntosh.
Hydrogiologia, Vol 70, No 1/2, p 69-73, April, 1980. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Heavy metals, *Sediments, *Metal finishing wastes, Biomass, Microorganisms, Metals, Zinc, Chromium, Cadmium, *Palestine Lake, Indiane, Lake sediments, Lakes, Water pollution effects, Microbial degradation, Degradation, Organic matter, *Eutrophic lakes.

Palestine Lake, Indiana, a highly eutrophic lake which receives chromium, cadmium, and zinc from an electroplating plant, showed suppression of organic decomposition and low microbial biomass in the most contaminated sediment, averaging metal concentrations (micrograms per g dry weight) of 17,840 Zn, 4380 Cr, and 585 Cd. Adenosine triphosphate (ATP) concentrations and microbial colony numbers on pour plates were used as biomass indicators. The highly contaminated area had 3.7 million mean microbial colonies in 1 g sediment; the less contaminated sites had 27-62 million. ATP concentrations were 2.9 times 10 to the minus 7th power in the highly contaminated area and 4.5-7.6 times 10 to the minus 7th power in the less contaminated sites. (Cassar-FRC)
W82-00925

AN ALTERNATIVE WASTEWATER DISINFECTANT,

Maryland Environmental Service, Annapolis.
For primary bibliographic entry see Field 5D.
W82-00950

BIOCONCENTRATION OF PESTICIDES BY EGG MASSES OF THE CADDISFLY, TRIAENODES TARDUS MILNE,

Illinois Natural History Survey, Urbana.
For primary bibliographic entry see Field 5B.
W82-00982

SEA URCHIN SPERM BIOASSAY FOR SEWAGE AND CHLORINATED SEAWATER AND ITS RELATION TO FISH BIOASSAYS,

Washington Univ., Seattle. Fisheries Research Inst.
For primary bibliographic entry see Field 5A.
W82-00988

EXPERIMENTAL MANIPULATION OF ALGAL BLOOM COMPOSITION BY NITROGEN ADDITION,

Department of Fisheries and Oceans, Winnipeg (Manitoba).
J. Barica, H. Kling, and J. Gibson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1175-1183, July, 1980. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Eutrophication, *Fishkill, *Algal control, *Species composition, *Nitrogen, Nutrients, Nitrate, Algal growth, Biomass, Aquatic productivity, Primary productivity, Ammonium, Cyanophyta, Chlorophyta, Ponds.

The nutrient contents of a small prairie lake and a pond which has experienced seasonal anoxia as a result of collapses of Aphanizomenon flos-aquae blooms were experimentally manipulated to see if changes in phytoplankton composition rather than pesticides could be used to control summerkill. Ammonium, nitrate or both were added to the prairie lake in enclosures and to the whole pond over an 8 to 12-wk period. When nitrogen was added prior to the appearance of A. flos-aquae, the bloom magnitude and species composition of the algae were altered. The biomass of this alga was reduced when low level additions (0.75-1.5 g/cu m/wk) of nitrogen were added after the appearance of cyanophyte blooms. With high nitrogen additions (7-14 g/cu m/wk), cyanophytes disappeared and small chlorophytes and cryptomonads dominated. In the absence of A. flos-aquae, the fishkill did not occur. High additions of nitrogen caused significant nitrate residues in the water. Without nutrient supplements, both the lake and pond returned to heavy A. flos-aquae blooms and fishkills the following summer. (Geiger-FRC)
W82-00998

A RAPID SIMPLE LONG-TERM TOXICITY ASSAY FOR AQUATIC CONTAMINANTS USING THE NEMATODE PANAGRELLUS REDIVIVUS,

Manitoba Univ., Winnipeg. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W82-01017

THE ACTIVITY OF ENVIRONMENTAL SAMPLES IN A CELL CULTURE TEST FOR ASBESTOS TOXICITY,

Naylor Dana Inst. for Disease Prevention, Valhalla, NY.
B. Reiss, J. R. Millette, and G. M. Williams.
Environmental Research, Vol 22, No 2, p 315-321, August, 1980. 2 Tab, 21 Ref.

Descriptors: *Asbestos, *Drinking water, Potable water, *Toxicity, Culturing techniques, Cultures, Carcinogens, Particulate matter.

Six coded samples of particulate matter were provided by the United States Environmental Protection Agency for use in tests designed to assay the toxic potential of the samples through the inhibition of colony-forming efficiency of cultured human embryonic intestine-derived epithelial (I-407) cells. The samples were: (1) particulates filtered from Duluth, Minnesota drinking water, known to contain amphibole crystals, red clay, and biological fragments; (2) particulates from Seattle, Washington drinking water, containing chrysotile asbestos; (3) particulates filtered from San Francisco, California drinking water, containing chrysotile asbestos; (4) a sample of less than 2 micrometer size fraction of taconite tailings prepared by a sedimentation separation procedure; (5) a sample of attapulgite clay, a nonasbestos mineral consisting of fibers of the same or smaller diameter range as chrysotile asbestos; (6) amosite fibers, used to study the effects of ingested asbestos on rats and hamsters. The results of the assay indicated that the most toxic of the samples was amosite. The toxicities of the particulates from drinking water were about 100-fold less than that of amosite. The order of toxicity of the drinking water particulate samples decreased from San Francisco, to Seattle, to Duluth. Samples of attapulgite clay and taconite tailings displayed about half the toxicity of the drinking water particulates. These results indicate that this assay provides a sensitive and accurate method for screening asbestos and asbestiform contamination for potential toxicity. (Baker-FRC)
W82-01031

UPTAKE AND TRANSFER OF THE CHLORINATED HYDROCARBON LINDANE (GAMMA-BHC) IN A LABORATORY FRESHWATER FOOD CHAIN,

Hamburg Univ. (Germany, F.R.) Inst. fuer Hydrobiologie und Fischereiwissenschaft.
P. D. Hansen.
Environmental Pollution, (Series A) Vol 21, No 2, p 97-108, February, 1980. 4 Fig, 14 Ref.

Descriptors: *Lindane, *Food chain, *Accumulation, Daphnia, Algae, Chlorella. Stickleback, *Fish, Insecticides, Pesticides, Fate of poilutants, Adsorption, Chlorinated hydrocarbons.

The uptake, transfer, and accumulation of lindane (gamma-BHC) was studied in a freshwater food chain consisting of Chlorella sp., the primary producer; Daphnia magna, Consumer 1; and the stickleback, Gasterosteus aculeatus, Consumer 2. The algae used had an accumulation factor of 749 from a medium containing 10 micrograms per liter lindane. Total accumulation factors for the other 2 links in the food chain were: Daphnia, 66.8; and fish, 118.6. A model was developed showing the lindane accumulated by each consumer during 50 days feeding in water with 10 micrograms per liter lindane. Adsorption from water was essentially complete within 1 to 3 days while accumulation from food continued to increase. Laboratory Daphnia accumulated far more lindane than free-living Daphnia. The sublethal concentrations of lindane caused irritation and a 50% reduction in reproduction rate in Daphnia. Fish rapidly approached the equilibrium concentration. After 9 days, 67% of the total lindane was found in the fish, with large amounts in gills, stomach, liver, and gut. Female sticklebacks took up more lindane than males; males in breeding condition had an accumulation factor 5.8 times larger than those in normal condition. (Cassar-FRC)
W82-01033

ASSESSMENT OF WATER QUALITY CONDITIONS IN SKAMOKAWA CREEK, WASHINGTON,

Washington State Dept. of Ecology, Olympia.
D. Norton.
Document DOE 81-7, February, 1981. 16 p, 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Water quality standards, *Coliforms, *Streams, *Feces, Cattle, *Bacteria, Contamination, On-site data collections, Benthic environment, Fish populations, Spawning, Dissolved oxygen, Skamokawa basin, *Washington.

A sanitary survey was conducted to determine water quality conditions in the Skamokawa basin, located in Wahkiakum county in Washington. Skamokawa Creek is a small tributary of the lower Columbia River Basin. The creek met all criteria for Class A waters in the state with the exception of fecal coliforms. Skamokawa Creek was in violation of the Class A standard with a median value of 200 organisms per 100 ml with 50 percent of the samples exceeding 200 organisms per 100 ml. The high fecal coliform levels most likely result from the proximity to the creek of older homes, many of which discharge directly into the creek. This proximity prevents adequate buffering between the drain fields of the residences and the creek. In addition, cattle access is virtually unrestricted throughout most of the area. Contamination from dairy cattle could be expected to increase during the rainy season when runoff from adjacent pastures increases. Fourteen sampling stations were established, and water samples were collected for laboratory analysis of fourteen components. Physical and chemical factors analyzed were pH, total alkalinity, specific conductivity, turbidity, total suspended solids, and nutrients. Bacteriological and biological factors were also studied. Skamokawa Creek appears to be quite suitable for fish passage and spawning success, except when very heavy spawning is combined with unusually low dissolved oxygen concentrations. Dissolved oxygen concentrations during the survey were well within the acceptable limits for fish survival. Overall, it appears that the benthic community in Skamokawa Creek has been only slightly to moderately impacted. (Garrison-Omniplan)
W82-01066

WILSON CREEK DRAINAGE - SURFACE AND GROUND WATER QUALITY, JULY 1978 TO JULY 1979.

Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5B.
W82-01069

THE EFFECT OF CONTINUOUS ADVANCED WASTEWATER TREATMENT BY THE CITY OF SPOKANE ON THE TROPHIC STATUS OF LONG LAKE, WA DURING 1979.

Eastern Washington Univ., Chemey. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-01070

AN ASSESSMENT OF THE TROPHIC STATUS OF DEER, LOON, AND DIAMOND LAKES,

Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 2H.
W82-01072

CHLORINATED HYDROCARBONS AS A FACTOR IN THE REPRODUCTION AND SURVIVAL OF LAKE TROUT (SALVELINUS NAMAYCUSH) IN LAKE MICHIGAN.

National Marine Fisheries Dervice, Ann Arbor, MI. Great Lakes Fishery Lab.
Technical Papers of the U.S. Fish and Wildlife Service, No 105, 1981. 44 p, 6 Fig, 18 Tab, 136 Ref.

Descriptors: *Trout, *Lake Michigan, *DDE, *Polychlorinated biphenyls, *Toxicity, *Mortality, Growth, Pesticide residues, Metabolism, Chlorinated hydrocarbons, Aroclors, Water pollution effects, Fish behavior, Fish food, Growth stages.

Although lake trout were considered extinct in Lake Michigan by the mid 1950's, control of the sea lamprey and restocking resulted in an abundance of hatchery-produced lake trout in the lake by the early 1970's. However, no naturally produced yearling or older lake trout have been found in the lake. Studies were carried out on the performance and survival of fry hatched from eggs of Lake Michigan lake trout and exposed for 6 months to PCB's (Aroclor 1254) and DDE at concentrations similar to those present in offshore waters and zooplankton (10.0 ng/l PCB's and 1.0 ng/l DDE in water; 1.0 micro g/g PCB's and 0.1 micro g/g DDE in food) and at concentrations 5 and 25 times higher. Cumulative mortality of the fry exposed to simulated Lake Michigan levels of PCB's and DDE for 6 months was 40.7%, nearly twice that of unexposed (control) fry, and mortality at the highest exposure level was 46.5%. Evaluation of the growth, swimming performance, predator avoidance, temperature preference, and me-

tabolism of the fry showed no significant effects attributable to exposure to PCB's and DDE, except for a lowering of preferred temperature at the 25X exposures. Although several factors have undoubtedly contributed to the lack of recruitment of naturally produced lake trout in Lake Michigan, the levels of PCB's and DDE present during the early to mid 1970's were sufficient to significantly reduce survival of any fry produced in the lake and thereby impede restoration of self-sustaining lake trout populations. The added exposure of the fry to other toxic substances known to be present in the lake could have further reduced survival. (Moore-SRC)
W82-01079

MANAGING OIL AND GAS ACTIVITIES IN COASTAL ENVIRONMENTS: REFUGE MANUAL,

RPC, Inc., Austin, TX.
For primary bibliographic entry see Field 5G.
W82-01081

HEALTH EFFECTS OF MONOCHLORAMINES IN DRINKING WATER,

Massachusetts Univ., Amherst. Div. of Public Health.
G. S. Moore, E. J. Calabrese, and M. McGee.
Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 239-258, 1980. 3 Tab, 36 Ref.

Descriptors: *Chlorination, *Drinking water, Potable water, Disinfection, Chloramines, Water treatment, Water quality, *Monochloramines.

The possibility that monochloramines in drinking water might alter any of a variety of blood characteristics, including those reflecting oxidant stress, in laboratory mice exposed over a wide range of monochloramine concentrations was investigated. Male A/J mice were randomly allocated to one of seven treatment groups: 200, 100, 50, 25, and 2.5 ppm monochloramine in drinking water plus one group receiving deionized water and one group receiving deionized water with a carbonate-bicarbonate buffer. Exposure continued for 30 days. Significant decreases in water consumption were seen at monochloramine concentrations in excess of 2.5 ppm. No significant treatment-related changes in mortality were seen. With the exception of hematocrit, which rose slightly (possibly due to reduced water intake), none of the blood characteristics indicative of oxidant stress and prehemolytic conditions was significantly affected at any dose level. (Baker-FRC)
W82-01091

ASBESTOS CEMENT PIPE AND CANCER IN CONNECTICUT 1955-1974,

Yale Univ., New Haven, CT.
J. W. Meigs, S. D. Walter, J. F. Heston, J. R. Millette, and G. F. Craun.
Journal of Environmental Health, Vol 42, No 4, p 187-191, January/February, 1980. 1 Tab, 18 Ref.

Descriptors: *Pipes, *Asbestos cement, Conveyance structures, Water transport, Public health, *Carcinogens, Epidemiology.

To assess the possible influences of asbestos cement (A/C) pipe use on cancer occurrence in Connecticut, individual town cancer rates were entered into a regression equation as the dependent variable, while asbestos exposure indicators for each town were entered as independent variables. Over 40 years of cancer incidence data were available. For 82 towns in which public water supplies were delivered either partly or wholly through A/C pipe, chrysotile asbestos fibers per liter were measured at the source and in water that had passed through A/C pipe. None of these towns had asbestos values as high as 100,000 fibers/liter in source waters. No consistent patterns of association between A/C pipe and cancer were found. Fairly consistent associations of certain cancer rates with town population density and socioeconomic status were found. Socioeconomic scores of Connecticut towns were negatively associated with stomach cancer but positively associated with male colon cancer. A positive association between length of A/C pipe and incidence of kidney cancer was found for both sexes in the 1955-64 study. Also in the 1955-1964 period, a lack of corrosion control for A/C pipes was correlated with bladder cancer, and a high aggressiveness index of water was correlated with colon cancer. No evidence was seen which would warrant changing current water distribution policies for Connecticut public water due to the use of A/C pipes. (Baker-FRC)
W82-01094

5D. Waste Treatment Processes

FEEDING ANIMALS ACTIVATED SLUDGE,

S. Beszedits.
Water and Pollution Control, Vol 119, No 4, p 16, 17, 27, April, 1981.

Descriptors: *Domestic animals, *Feeds, *Activated sludge, Amino acids, Proteins, Vitamins, Sludge disposal, Industrial wastes, Recycling, Waste recovery.

Properly prepared activated sludge has been fed to chickens, pigs, cattle and other animals in experimental studies for years. It has a 25-40% protein content and is a rich source of B-vitamins. Municipal sewage sludge has been fed to pigs at levels up to 4% and to chickens at 2.5% with no adverse effects. Sludges from industry vary in protein and vitamin content according to their source. Studies on composition and feeding studies of treated wastes from breweries, slaughterhouses, citrus fruit processing plants, canneries, dairies, and cane molasses distilleries are briefly discussed. (Cassar-FRC)
W82-00523

FOAM CONTROL IN AERATION TANKS,

Terminal Island Treatment Plant, Los Angeles, CA.
K. L. Ludwig.
Water/Engineering and Management, Vol 128, No 6, p 34, 39, June, 1981.

Descriptors: *Water treatment facilities, *Foaming, *Foam separation, Wastewater treatment, Secondary wastewater treatment, Industrial wastes, Los Angeles.

The Terminal Island Treatment Plant (TITP) is one of the three large wastewater treatment plants operated by the city of Los Angeles and is located in the Los Angeles Harbor area. TITP is designed to provide complete secondary treatment for an average 30 mgd flow of combined domestic and industrial type wastewaters. The plant relies on the sludge process to achieve the desired level of secondary treatment. The plant operates under diurnal conditions. The present flow through this plant is about 60% of the design capacity, with about 45% of the flow being of industrial origin. Problems encountered due to excessive foam accumulation have been numerous. Foam has overflowed aeration tanks and drained into adjacent pipe galleries. This has required extensive cleanup operations. Since the air feed had to be cut due to extensive foaming, expensive chemical oxygen supplements had to be used. Heavy use of the spray system results in misting conditions arising around the aeration tanks, which leads to numerous other problems as well. TITP tested the Koach Foam Splitter under heavy foam conditions for about six weeks. The unit successfully reduced foams; they were destroyed at the rate of two inches of foam depth per hour for an aeration tank 30 feet wide and 300 feet long. Following the testing period, the foam splitter was installed permanently. While the foam was not completely eliminated, it was controlled. (Baker-FRC)
W82-00525

BETTER DEWATERING IMPROVES SLUDGE RECYCLING AND GIVES SIGNIFICANT ENERGY SAVINGS,

Racine Wastewater Utility, WI.
For primary bibliographic entry see Field 5E.
W82-00526

PRESSURE SEWER SYSTEMS,

Los Angeles County Sanitation District, CA.
D. Glasgow.
Water/Engineering and Management, Vol 128, No 6, p 68-70, June, 1981. 2 Fig, 5 Ref.

Descriptors: *Sewer systems, *Wastewater collection, Wastewater treatment, Water conveyance, Design considerations, Pressure head, Hydraulics, Equipment, Pumps, Interceptor sewers, Septic tanks, Septic sludge.

In geographical areas where adverse topographical conditions exist, pressure sewer systems have found increasing application. In 1978 a survey revealed that 60 individual pressure sewer systems were in use. Two major types of pressure sewer systems are the grinder pump system and the septic tank effluent pump system. A third type is the variable gradient system. The grinder pump system consists of a holding tank receiving the sewage directly from the service location and retaining it until enough liquid has accumulated to allow the grinder pump to operate for a 1 or 2 minute cycle. The septic tank effluent system consists of a conventional interceptor or septic tank in which the solid materials discharged from the service user are retained in the tank as either settled sludge or as a floating scum. A pressure sewer is normally designed to flow full at all times. During no-flow periods problems can develop due to grease or solids accumulation. Typically the pressure sewer mains are patterned in either dendriform or grid horizontal layouts. Dendriform layouts theoretically require the least amount of pressure sewer main construction. (Baker-FRC)
W82-00528

EMPIRE CONTROLLED BY COMPUTER,

Short-Elliott-Hendrickson, Inc., St. Paul, MN.
D. E. Lund.
Water/Engineering and Management, Vol 128, No 6, p 30-33, June, 1981.

Descriptors: *Water treatment facilities, *Computers, *Wastewater treatment, Tertiary wastewater treatment, Filtration, Sludge, Activated sludge, Effluents, Consolidated facilities, *Minnesota, Empire, Apple Valley, Lakeville, Farmington.

A two-stage activated sludge process followed by tertiary filtration was suggested for the Empire Wastewater Treatment Plant, serving the communities of Apple Valley, Lakeville and Farmington, Minnesota. A central computer system monitors and controls each process and about 98% of the mechanical equipment throughout the treatment facility. The system consists of two identical computers powered by an uninterruptible power supply. Either computer can serve as the primary unit, with the second one continually gathering data and being maintained in a ready status in case of a malfunction by the other. The computer system also provides the plant operators with numerous reports, logs and displays which alert operators of any critical conditions that may develop in the plant. It also creates many operating reports that normally would require a considerable amount of operator time to complete. Tertiary filtration at Empire is obtained with gravity-type dual-media filters for removal of fine suspended materials. The tertiary filters also provide a substantial safeguard in the treatment process. Methane gas produced during the primary sludge and waste activated sludge thickening process is used as fuel in the plant boilers. (Baker-FRC)
W82-00529

MIDWESTERN WASTEWATER CHARACTERISTICS,

Environmental Protection Agency, Chicago, IL.
D. H. Stoltenberg.
Public Works, Vol 111, No 1, p 52-53, January, 1980. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Wastewater composition, *Municipal wastewater, Wastewater treatment, Biological oxygen demand, Suspended solids, Water treatment facilities, Illinois, Indiana, Ohio, Minnesota, Surveys, Operating policies.

Analyses were conducted of data obtained from operation and maintenance inspection forms completed by personnel from the Environmental Protection Agency or state personnel. Inspections were conducted in 1974-1979; reports were analyzed from 100 municipalities in Illinois, Indiana, Ohio, and Minnesota, with treatment plants serving from 10,000 to more than 100,000 inhabitants. Daily per capita loadings for flow, BOD, and suspended solids were about 40% higher than values reported in standard engineering texts. Statistical analysis produced the following values (mean of 100 plants): flow, 166 gallons per capita per day; BOD5, 0.203 lb per capita per day; and suspended solids, 0.246 lb per capita per day. Comparable data from the literature were: flow, 58-135 gallons per capita per day; BOD5, 0.1-0.2 lb per capita per day; and suspended solids, 0.08-0.23 lb per capita per day. Increased use of garbage grinders may account for the increase in suspended solids loadings. (Cassar-FRC)
W82-00534

A NOTE ON THE FATE OF EL TOR CHOLERA AND OTHER VIBRIOS IN PERCOLATING FILTERS,

Surrey Univ., Guilford (England). Dept. of Microbiology.
R. R. Daniel, and B. J. Lloyd.
Journal of Applied Bacteriology, Vol 48, No 2, p 207-210, April, 1980. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Human disease, *Percolating filters, *Anaerobic conditions, *Vibrio, Performance evaluation, Wastewater treatment, Public health.

Field results and laboratory experiment results are presented from a study designed to test the ability of Vibrio cholerae El Tor and non-cholera vibrios to grow in anaerobic sewage effluent. Samples of sewage effluent from the anaerobic settling tanks of the Oxfam Sanitation System contained reduced populations of Enterobacteriaceae and small numbers of non-cholera vibrios (NCV's). Samples were passed through percolating filters made of broken honeycomb bricks or zig-zag stakes of corrugated iron. The NCV's multiplied in both filter types. In the laboratory, NCV's were able to multiply in sewage effluent in static culture. Also, Vibrio cholerae El Tor did not multiply in the laboratory but died rapidly. The efficiency of percolating filters may be improved by ensuring an excessively strong liquor and ponding of the liquid. (Small-FRC)
W82-00566

ENUMERATION OF BACTERIOPHAGES AND HOST BACTERIA IN SEWAGE AND THE ACTIVATED-SLUDGE TREATMENT PROCESS,

Clemson Univ., SC. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-00584

MOVEMENT OF ENDOTOXIN THROUGH SOIL COLUMNS,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5B.
W82-00586

LAND TREATMENT OF MUNICIPAL WASTEWATER IN SMALL COMMUNITIES,

Economics, Statistics, and Cooperatives Service, Washington, DC. Natural Resources Economics Div.
C. E. Young, and D. J. Epp.
American Journal of Agricultural Economics, Vol 62, No 2, p 238-243, May, 1980. 3 Tab, 11 Ref.

Descriptors: *Land disposal, *Municipal wastewater, *Wastewater treatment, Economic aspects, Effluents, Irrigation, Overland flow, Infiltration, Agriculture, Simulation analysis, Crop production, Cost analysis.

Many small communities allocate a substantial portion of their budgets to wastewater treatment. Increasing numbers of small rural communities are being required to provide advanced wastewater treatment in order to meet surface water quality standards. Land treatment of municipal wastewater can meet water quality standards at about half the cost of other advanced treatment alternatives. Irrigation, overland flow, or rapid infiltration can be used to apply wastewater to land for treatment and removal of pollutants. The cost of land application of wastewater (CLAW) simulation model was used to study the design of land application systems. This computer simulation model can be used to design land application systems capable of treating between 0.1 and 100 million gallons of wastewater per day using solid-set irrigation, center pivot irrigation, border strip irrigation, ridge and furrow irrigation, overland flow, and infiltration basins. The model considers preapplication treatment, effluent transmission, wastewater storage, application method, cropping, and recovery of renovated wastewater, if desired. Capital and operating costs are computed and net crop revenue is determined. The choice of crop is a significant factor in the cost of land application facilities, since crops capable of treating smaller amounts of wastewater or irrigation over shorter periods will necessitate facilities for the storage of wastewater. Federal grants for the construction of wastewater treatment facilities can lead to the choice of an option which minimizes local costs without maximizing the amount of wastewater applied. (Carroll-FRC)
W82-00588

SYSTEM FOR OIL AND WATER SEPARATION,

J. Di Perna.
U.S. Patent No 4 203,842, 5 p, 4 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 987, May 20, 1980.

Descriptors: *Patents, *Oil pollution, *Water pollution treatment, *Separation techniques, Water quality control, Equipment, Oil tankers.

The principal object of the invention is to provide an improved system for oil and water separation when these fluids are intended to be removed from a ship, so that only the water can be dumped back into the sea while the oil is collected in tanks so as not to pollute the sea water. It provides a system for oil and water separation that utilizes a siphon and vacuum means for moving the oil and water mixture instead of employing a pump. The system includes a relatively small, sealed tank upon the deck of the vessel, a hand controlled vent valve on top of the tank, an outlet end of a siphon line entering the tank while an inlet end of the siphon line may run into a collection or other tank, and discharge lines from lower and upper ends of the sealed tank being connected to pumps for discharging oil at the top and water at the bottom. (Sinha-OEIS)
W82-00611

CORRELATION OF MICROBIAL DEGRADATION RATES WITH CHEMICAL STRUCTURE,

Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 2K.
W82-00621

MANAGEMENT TRAINING IS THE KEY TO GOOD OPERATOR PERFORMANCE,

V. W. Langworthy.
Water and Sewage Works, Vol 127, No 4, p 58, April, 1980.

Descriptors: *Management planning, *Training, Administration, Water treatment facilities, *Wastewater facilities, Water distribution.

The Association of Boards of Certification has worked hard to develop compatibility between states for effective intrastate programming of operator performance levels that are acceptable for water and wastewater operations. Standardization of examination questions and formats among the various grades of certification is one area of concern. A program is needed which will encourage the top individuals in this field to aim for increased self-improvement so that situations which arise can be met by persons capable of handling them. Management/supervisory training is currently available, but few are interested in participating in these programs. Some states are now insisting that an applicant for a managerial position in the water and wastewater industry must have some management expertise. Adequate programs with adequate incentives must be accepted nationwide to increase interest in and appreciation of this area of employment. (Baker-FRC)
W82-00623

MIXING TECHNOLOGY REDUCES ENERGY USE,

General Motors Corp., Saginaw. Steering Gear Div.
H. G. Peters, Sr.
Industrial Wastes, Vol 26, No 3, p 26-27, 34, May/June, 1980.

Descriptors: *Industrial wastes, *Energy conservation, *Water treatment facilities, Wastewater treatment, Design criteria, *Oil industry, Oil pollution, Oily water, Oil.

Plant needs called for a wastewater treatment facility that could extract both soluble and insoluble oils and reduce phosphate and metal contaminates to proposed acceptable levels, while requiring the lowest levels of energy consumption possible. API-type separators were installed to remove floating oils and extract settleable solids. However, these did not deal with the soluble oils present, which ranged from 1,000-1,500 ppm, with surges as high as 5,000 ppm. A new facility was needed to handle an immediate treatment load of 1.5 mgd, with a longer-term daily treatment potential of 2.5 mgd and a short term emergency capacity of 5 mgd. The facility must extract soluble as well as insoluble oils, thus eliminating the major disposal problem, and reduce phosphate and metal contaminants to acceptable levels. The final design calls for two API-type oil separators, each of 1,000 Gpm capacity, to mechanically remove floating oils and settleable solids. The secondary treatment consists of a batching operation followed by a pumping system and a flow-splitter feeding dual dissolved air flotation cells (DAF). The tertiary treatment stage consists of two parallel systems, each fed by the two secondary DAF's. All stages of the system are supplied with additives. Wastewater passing through a final DAF is monitored for turbidity. An automatic interlock/reject system prevents the release of any wastewater that does not meet discharge standards. Actual oil in the discharge has ranged from 5 to 20 ppm, versus the 100 ppm code standard. (Baker-FRC)
W82-00634

COLD WEATHER WASTE TREATMENT,

Hoover-NSK Bearing Plant, Ann Arbor, MI.
M. Bitondo.
Industrial Wastes, Vol 26, No 1, p 29, 33, January/February, 1980. 1 Tab.

Descriptors: *Wastewater treatment, *Bacteria, Water treatment facilities, Temperature effects, Cultures, Seasonal variations, Bacterial physiology, Cold regions, Winter, Freezing, *Economic efficiency, *Ann Arbor, Michigan.

Bacterial supplementation was attempted in wastewater treatment facilities in Ann Arbor, Michigan, where the freezing temperatures encountered during the winter season would kill off the bacteria naturally found in sewage, thereby upsetting the bacterial balance needed for efficient wastewater degradation. During the 1978-1979 winter season, the plant's BOD levels were within state limits in spite of prolonged periods of freezing temperatures. During this time DBC Plus bacterial cultures were used in the bioaugmentation program. In this program specially selected and formulated bacteria are added to a sewage treatment plant. Initially relatively large doses of the preparation are added to fully inoculate the system. Application of the bacterial cultures is easy. The operation costs less than $100 per month and has enabled the company to meet state standards without expensive new equipment. (Baker-FRC)
W82-00636

FOAM CONTROL AND DEGRADATION OF NONIONIC DETERGENTS,

Sybron Corp., Salem, VA. Biochemical Div.
P. Spraker, and M. Telepchak.
Industrial Wastes, Vol 26, No 1, p 16-17, 34, January/February, 1980. 1 Fig, 2 Tab, 1 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, Detergents, Soaps, *Surfactants, *Phenols, Biodegradation, Foaming, Bacteria, Cultures, *Textile mill wastes.

A decision was made to treat textile manufacturing wastewater containing phenols and surfactants with biological methods through the addition of mutant bacterial cultures to a biotower and aerated lagoons. The increased efficiencies of the bacteria produced a system capable of biological oxidation with considerably less aeration, with large reductions obtained in energy consumption and cost. Large quantities of foam were not produced by this system. A full scale biotower was designed to remove 150 mg/liter of phenol from 30,000 Gpd wastewater. The biotower structure contains 1,000 cubic feet of packing and has 6,000 gal reservoir capacity. The recycle rate was 960 Gpm. The biotower began showing reduction of the wastewater after 8 days of operation. COD and phenol content were measured. Average COD reductions were between 58-68% from an initial value of 4,481 mg/liter. Phenol content was reduced 99.4% from an original value of 9.2 to 12.8 mg/liter. Data collected over a year's time showed up to 66% reduction of BOD. Thus the system of mutant bacteria and the biotower has produced a much more efficient system, capable of handling difficult to degrade compounds in a more cost effective manner. (Baker-FRC)
W82-00637

CHEMICAL TREATMENT SOLVES TANNERY WASTE PROBLEMS,

Gunnison Bros. Girard, PA.
M. Giles.
Industrial Wastes, Vol 26, No 2, p 30-31, March/April, 1980. 1 Fig.

Descriptors: *Tannery wastes, *Wastewater treatment, Industrial wastes, Water treatment facilities, Biological oxygen demand, Suspended solids, Aerated lagoons, Chemical treatment, Alum, Coagulation.

With the help of chemicals and specialized flexible waste treatment equipment, about 33,000 Gpd of non-uniform wastewater is treated at the Gunnison Brothers tannery in Pennsylvania. The wastewaters typically contain lime, hair and other protein, grease and fatty acids, and numerous acids and dyes. A batch type system is used in the wastewater treatment facility. Jar tests are performed daily to determine how the influent will be treated. Use of alum as the primary coagulant in conjunction with other coagulant aids has enabled the tannery to meet regulatory requirements. The company reduced suspended solids from an average of 10,000 mg/liter to 80 mg/liter; oil and grease is reduced from 30 to 10 mg/liter. BOD in the influent is about 2,000 and is reduced to 200 mg/liter. COD is reduced from 15,000 to 1,000 mg/liter. Ammonia is reduced from 100 to less than 50 mg/liter. The primary effluent is pumped to a 450,000 gal aerated lagoon, where detention time is 6-10 days. From the aerobic lagoon the wastewater is pumped to a 55,000 gal secondary settling tank for final liquid/solids separation. Wastewater in the lagoon has picked up biological sludge which is treated in the secondary treatment tank. After flocculating, settling and clarifying the wastewater is disinfected and discharged. The clear effluent flows into Brandy Run, a tributary of Elk Creek which feeds Lake Erie. Dried sludge is hauled off to a sanitary landfill. (Baker-FRC)
W82-00638

REMOVAL OF PRIORITY POLLUTANTS,

Du Pont de Nemours (E. I.) and Co., Deepwater, NJ.
D. G. Hutton.
Industrial Wastes, Vol 26, No 2, p 22, 24, 26, March/April, 1980. 6 Tab.

Descriptors: *Industrial wastes, *Chemical wastes, *Wastewater treatment, Water treatment facilities, Wastewater, *Organic compounds, Heavy metals, Acid water, Sludge, Activated sludge.

Du Pont's Chambers Works in Deepwater, New Jersey, has an effective method of handling pollutants from an organic chemicals manufacturing site by neutralization and settling followed by a combined powdered carbon-biological process. The wastewater ranged from 23-50 million gallons per day. Lime slurry is added for neutralization; polyelectrolyte is added to aid in coagulating the fines prior to primary clarification. Primary sludge settles and thickens in clarifiers, is pumped to storage tanks and filtered to 45% solids concentration, and is disposed of in a lined landfill. Powdered activated carbon is added to the primary clarifier effluent as it is fed to the secondary/tertiary biological aeration tanks. The wastewater is strongly acidic, highly colored and of medium strength. Its BOD/DOC ratio suggests a high fraction of non-biodegradable compounds. The water is slightly brackish and has a relatively low suspended solids content. Primary treatment consisting of lime neutralization and settling was far more important for metals removal than the PACT process. There are at least 20 organic priority pollutants in the plant's wastewater. Thirteen of these are in the volatiles category. The secondary/tertiary PACT process does an effective job of removing organic pollutants, with 90% removal achieved for 13 of them and greater than 75% for 18 of the 20. (Baker-FRC)
W82-00639

MECHANISM OF CHARGED MEMBRANE ULTRAFILTRATION OF SALT SOLUTIONS,

State Univ. of New York at Buffalo. Dept. of Microbiology.
C. J. Van Oss.
Separation Science and Technology, Vol 15, No 2, p 159-161, 1980. 7 Ref.

Descriptors: *Acid mine water, *Filtration, Mine drainage, Acid streams, Acidic water, Membranes, Mine wastes, Industrial wastes, Membrane processes, *Membrane filters, *Wastewater treatment, *Ultrafiltration.

Optimal electrolyte removal by charged membrane ultrafiltration from acid mine water is discussed. A positively charged membrane would be the most effective, given the preponderance of bi- and trivalent cations, in which case the anions used would preferably be monovalent, and since low pH would be desirable to enhance the membrane potential, acidification with hydrochloric rather than sulfuric acid would be preferable. There does not appear to be any advantage in generating greater upstream turbulence than that corresponding to a Reynolds number of about 2500. As high a pressure differential as is compatible with membrane longevity and energy cost should be aimed for, so as to maximize the streaming potential across the pores of the membrane skin and thus the eletrolyte retention. Salt retention is likely to be increased by higher temperatures of operation due to the influences of temperature on viscosity, conductivity, and dielectric constant of the solution. If, for reasons of longevity, anionic membranes are preferred, sulfate will lead to a better salt retention than chloride ions, but then a high pH will be more advantageous to attain maximum membrane and streaming potentials. (Baker-FRC)
W82-00641

OCCURRENCE OF CYTOPHAGAS IN SEWAGE PLANTS,

Gesellschaft fuer Biotechnologische Forschung, m.b.H., Stockheim (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W82-00682

RECEIVING STREAM FISHERIES STUDIES RELATIVE TO SECONDARY TREATED PULP AND PAPER MILL EFFLUENTS,

Consolidated Papers, Inc., Wisconsin Rapids, WI.
For primary bibliographic entry see Field 5C.
W82-00688

FUNGAL DECOLORIZATION OF KRAFT BLEACH PLANT EFFLUENTS,

North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
D. Eaton, H-M. Chang, and T. K. Kirk.
Tappi, Vol 63, No 10, p 103-106, October, 1980. 8 Tab, 10 Ref.

Descriptors: *Color removal, *Pulp and paper industry, *Fungi, Industrial wastewater, Wastewater treatment, Kraft mills, Effluents, Biological treatment.

Color was reduced by 60% in two to four days in kraft bleach plant effluents using the white rot fungus, Phanerochaete chrysosporium. Optimum conditions for decolorization were different from those favoring fungal growth. If the fungus was first allowed to grow at optimum pH, 4.3-4.8, decolorization then proceeded rapidly as low as pH 3. The best temperature for growth was 40 degrees C, but decolorization took place at temperatures as low as 28 degrees C. These results suggest that fungal decolorization is a secondary metabolic event attributable to lignin metabolism. The decolorization continued for 25 days, after which it was necessary to add glucose or cellulose, but not nitrogen. The decolorizing continued for at least 60 days before fresh cellulose was needed. Sodium chloride up to 6000 ppm did not significantly inhibit decolorization. (Casear-FRC)
W82-00689

ANAEROBIC BIOLOGICAL TREATMENT OF FOOD INDUSTRY WASTEWATERS,

Water Pollution Research Lab., Stevenage (England).
F. E. Mosey.
Water Pollution Control, Vol 80, No 2, p 273-291, 1981. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Food processing industry, *Wastewater treatment, Industrial plants, Anaerobic digestion, Effluents, Food-processing wastes, Industrial wastes, Bacteria.

High-rate biological filtration through plastic media is a rugged, reliable treatment process capable of operating at high organic loadings of two to four kg BOD/cubic meter, which is well in excess of those sustainable in conventional activated-sludge plants or biological filters. The use of anaerobic digestion for the treatment of wastewaters incurred in food processing industries is becoming more and more appealing. Over the past 10 years there has been a worldwide reawakening of interest in this method of digestion, and the process is making great strides on several fronts in the food industry. Hydrogen-utilizing methane bacteria can now be isolated and grown on a large scale in pure cultures. The biochemical pathways of these bacteria are now being studied, with new information being gained into the microbial ecology of the anaerobic digestion process. The translation of these fundamental studies into kinetic data for the process engineer is spawning a new type of anaerobic biological treatment plan every five years. The anaerobic-digestion process is currently the main research topic in the field of wastewater treatment, and its potential for treating warm, moderately concentrated waste waters, especially those produced by the food industry, is both large and increasing rapidly. (Baker-FRC)
W82-00698

THE CONTROL OF BACTERIAL POLLUTION CAUSED BY SEA DISCHARGES OF SEWAGE,

Wessex Water Authority (England).
R. G. Toms, C. L. Saunders, and E. Hodges.
Water Pollution Control, Vol 80, No 2, p 204-220, 1981. 9 Fig, 1 Tab, 4 Ref.

Descriptors: *Pollution control, *Wastewater disposal, Outfall, Chlorination, Disinfection, Bacteria, Outfall sewers, Sewers, Seawater, Wastewater treatment, Coastal waters, Water pollution control, *United Kingdom, Wessex, Model studies.

An EEC directive has imposed bacterial levels on bathing water that are considerably more stringent than frequently is true in inland rivers, particularly

downstream from sewage treatment works. The EEC directive has been aimed primarily at protecting the environment and public health. Two methods used in the Wessex Water Authority area to control the bacterial level of bathing waters are described. The siting of a long sea outfall, now being studied at various positions off the Dorset and Somerset coasts, is one method. Use of chlorination to disinfect one important short sea outfall from the Avon coast is the second method. Model studies are being devised to gain more information on the long sea outfall. The studies will consider the effect of winds, including wind-generated shear, and also the effect of the sea bed in reflecting the sewage plume. Chlorination studies have shown this to be an inexpensive method of reducing bacterial populations of bathing water in this area. The total capital cost of equipment was less than 0.5% of the cost of construction of a long sea outfall. Chlorination should, however, be looked on as a short term solution only. (Baker-FRC)
W82-00699

APPLICATION OF IMMOBILIZED HYDROGENASE FOR THE DETRITIATION OF WATER,

Massachusetts Inst. of Tech., Cambridge. Lab. of Applied Biochemistry.
A. M. Klibanov, and J. Huber.
Biotechnology and Bioengineering, Vol 23, No 7, p 1537-1551, July, 1981. 8 Fig, 35 Ref.

Descriptors: *Catalysts, *Tritium, *Radioactive wastes, Nuclear powerplants, Waste treatment, Bacteria, Enzymes, Hydrogenase, Alcaligenes eutrophus, *Platinum, *Wastewater treatment, Isotope fractionation.

Removal of tritium from water contaminated during nuclear power production was accomplished by a catalyzed hydrogen isotope exchange process using immobilized hydrogenase in place of the commonly-used platinum catalysts. Whole bacterial cells of Alcaligenes eutrophus immobilized in calcium alginate or K-carrageenan gels were efficient catalysts for the reaction of hydrogen-tritium (H-T) exchange in both a batch tank reactor and a column. This enzymatic exchange (an equilibrium between HT + H20 and H2 + HT0) was not controlled by diffusion, as shown by the dependence of the reaction rate on the amount of immobilized cells in the system and the concentration of cells in the matrix. These immobilized cells were active over a wide pH range with a maximum at 6.0-8.0 and were quite resistant to hydrogenase inhibitors such as oxygen and carbon monoxide. The rate of the exchange reaction increased five fold upon increasing the temperature from 4 to 37 C. Ten grams of cells (wet weight) were equivalent in catalyst efficiency to 1 gram of Pt02. The bacterial hydrogenases are inexpensive, readily available, and very active in water. (Caesar-FRC)
W82-00768

MANGANESE DIOXIDE AS AN ADSORBANT FOR HEAVY METALS,

West Kent Water Co. (England).
For primary bibliographic entry see Field 5F.
W82-00775

DOES IMPROVED WASTE TREATMENT HAVE DEMONSTRABLE BIOLOGICAL BENEFITS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-00779

VEGETATIVE FILTER TREATMENT OF LIVESTOCK FEEDLOT RUNOFF,

Nebraska Univ. Lincoln. Dept. of Agricultural Engineering.
E. C. Dickey, and D. H. Vanderholm.
Journal of Environmental Quality, Vol 10, No 3, p 279-284, July/September, 1981. 7 Fig, 5 Tab, 16 Ref.

Descriptors: *Feedlot runoff, *Land disposal, *Biofiltration, Runoff, Filtration, Nutrients, Biological oxygen demand, Water quality, Water pollution control, Animal wastes.

Four vegetative filters installed on feedlots in central and northern Illinois were evaluated over a 2 year period to determine the feasibility of using these systems for the management of feedlot runoff. Both channelized flow and overland flow systems were studied. Partial solids removal was achieved by settling, following which the runoff was applied directly to the experimental plots. Samples of influent, effluent, and surface flow at intermediate points were analyzed. There was no filter discharge from most runoff events. Runoff from larger events was partially discharged. Treatment with the vegetative filters resulted in reductions of nutrients, solids, and oxygen-demanding materials in the runoff of over 80 percent on a concentration basis and over 90 percent on a weight basis. Both the type of flow and the length of flow affected the degree of pollutant removal. Overland flow systems were more effective than channelized flow systems. Channelized flow systems required much greater flow lengths than overland systems for a similar degree of treatment. The discharge concentrations did not meet water quality standards for the receiving streams. The vegetative filters did not significantly reduce bacteria levels in the runoff. The study results indicate that discharge from adequate size vegetative filters ocurs only during large runoff events, when stream flows are also high, and that the overall impact of multiple vegetative filter systems appears to be negligible. (Carroll-FRC)
W82-00794

BEHAVIOR AND TRANSPORT OF MICROBIAL PATHOGENS AND INDICATOR ORGANISMS IN SOILS TREATED WITH ORGANIC WASTES,

Florida Univ., Stanford. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 5B.
W82-00797

LOW-COST WASTEWATER TREATMENT,

C. E. Morris.
Food Engineering, Vol. 53, No. 7, p 51-56, July, 1981. 3 Fig.

Descriptors: *Food-processing wastes, *Wastewater facilities, *Construction costs, Food processing industry, Industrial wastes, Costs, Oily water, Separation techniques, Runoff, Cooling water, Wastewater treatment, Vegetable oil refinery.

The nation's largest independent vegetable oil refinery located in Opelousas, Louisiana, designed and built wastewater treatment facilities to meet federal requirements in one year. Simplicity and redundancy were the keys to designing and building a system to handle both current and future flows. The engineering team hired by the company acted as its own design engineer and general contractor, but used some outside consultants. This approach helped keep costs at 2.2 million. The plant was designed to treat 121,000 gal/day and to handle increased effluent load in the future. Costs were also reduced by using simple oil/water separators in the form of gravity-separation decanters built of fiberglass reinforced plastic. Redundancy in the system permits components to be shut down for cleaning or repair without disrupting the system operation. All pumps were installed in pairs so system operation will not be jeopardized by pump failure. The system treats three wastewater streams: process wastewater, rainwater runoff, and cooling water. Chemical, mechanical, and biological processes are used. Oil residues collected by the stream are approved for soil enrichment. (Small-FRC)
W82-00841

PURIFICATION OF WASTEWATER BY ELECTROLYSIS,

Chile Univ., Santiago. Dept. of Fisica.
S. Contreras, M. Pieber, and J. Toha.
Biotechnology and Bioengineering, Vol 23, No 8, p 1881-1887, August, 1981. 9 Fig, 1 Tab.

Descriptors: *Electrolysis, *Bacteria, *Disinfection, Flocculation, *Wastewater treatment, Microbiological studies, Hydrogen ion concentration.

A simple and rapid wastewater treatment procedure is presented which is based on an electrolytic treatment. Wastewater samples containing an equivalent of 1 g of total solids per liter and about 10 to the 6th power microorganisms per liter were processed. Electrolysis was carried out at 30 V and 200 mA in a cell with two electrodes separated by an asbestos plate. Flocculation of the suspended material present in the wastewater was followed by optical density measurements. The number of microorganisms was evaluated before and after treatment. The percentage of microorganism survival decreased exponentially with increasing electrolysis time. The percentage of microorganisms decreased exponentially with increasing water volume. The effect of pH on microorganism viability was also investigated, and above and below neutral pH the percentage of microorganism survival decreased exponentially. Thus, the method can be used to produce clarified water free of microorganisms. (Small-FRC)
W82-00847

SEDIMENTATION OF ZEOLITE TYPE A IN WATER AND WASTE WATER,

Imperial Coll. of Science and Technology, London (England).
M. J. T. Carrondo, R. Perry, and J. N. Lester.
Canadian Journal of Civil Engineering, Vol. 8, No 2, p 206-217, June, 1981. 9 fig, 6 Tab, 35 Ref.

Descriptors: *Sedimentation, *Zeolites, *Wastewater treatment, Sedimentation rates, Activated sludge, Detergents, Suspended solids.

Zeolite type A is a synthetic aluminosilicate which has been considered as a possible substitute for phosphorus builders in detergents. A series of experiments was conducted to investigate the settling characteristics of zeolite type A in water and waste water. Settling column tests yielded results which compared well with predictions made by applying Stokes' law to the particle size distribution curves, despite the non-sphericity of the particles. Predictions of removals at different overflow rates made from the column tests were in substantial agreement with the results of the model sedimentation tank tests. Zeolite type A removal in water was low even at low flow rates. The presence of zeolite type A resulted in slight reductions of the percentage of suspended solids removed in static column tests using raw sewage. Zeolite type A was removed to a lesser extent than the other suspended solids, particularly during the initial stages of settling tests. Zeolite type A removal averaged 88 percent in activated sludge pilot plant tests. These results indicate that zeolite type A removals higher than 80 percent can be anticipated in wastewater treatment facilities using primary settling and secondary treatment by activated sludge; removals greater than 90 percent are regarded as probable. (Carroll-FRC)
W82-00848

PILOT PLANT PERFORMANCES IN MUNICIPAL WASTEWATER TREATMENT BY ACTIVATED CARBON ADSORPTION,

Lagos Univ. (Nigeria). Dept. of Civil Engineering.
K. O. Iwugo, and R. J. Martin.
Effluent and Water Treatment Journal, Vol 20, No 7, p 327-329, 332-336, July, 1980. 6 Fig, 2 Tab, 30 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Adsorption, *Pilot plants, Color removal, *Wastewater treatment, Organic carbon, Suspended solids.

A 0.5 cu meter per day sand-anthracite filtration-carbon adsorption pilot plant was operated under varying hydraulic loadings, organic loadings, and pH conditions to study removal of organics from municipal wastewater effluents. The carbon bed effluent organic carbon concentration varied almost directly with the concentration in the effluent after a steady state had been reached. This indicates that a certain fraction of organics in the

biologically treated sewage effluent cannot be adsorbed in this system no matter how the operating conditions are varied. The removal rates for various parameters (in mg per liter) in the granular carbon bed are summarized as follows: total organic carbon, 46.1%; soluble organic carbon, 49%; suspended solids, 56.8%; BOD5, 55.1%; BOD20, 24.5% + and color, 90%. (Cassar-FRC)
W82-00851

CHLORAMINE-T AS A POTENTIAL SCRUBBING AGENT: REMOVAL OF ODOROUS SULFUR-CONTAINING ENVIRONMENTAL POLLUTANTS,

Texas Univ., Galveston. Medical Branch.
N. M. Trieff, N. M. Made Gowda, and V. M. Sadagopa Ramanujam.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 383-388, 1980. 2 Tab, 11 Ref.

Descriptors: *Sulfur, *Odor control, Water pollution, Air pollution, *Industrial wastes, *Oxidation, Wastewater, Phenols, Carcinogens, Pollutants, Organic compounds, Chemical reactions, Chemical industry, Chemical treatment.

A detailed study of the reaction of thioacetamide, thiobenzamide, and other industrial pollutants with chloramine-T has been conducted. Odor studies were performed on the reactants and the reaction mixtures. In all cases, reaction with chloramine-T raised the odor threshold concentration. Results suggest that this oxidative technique has potential application in removing odorous contaminants from stock gases and industrial wastewater effluent. (Titus-FRC)
W82-00871

FACTS FIX FUND FINDING,

Havens and Emerson Ltd., Cleveland, OH.
For primary bibliographic entry see Field 9A.
W82-00885

DAIRY LIQUID WASTE DISTRIBUTION IN AN OVERLAND FLOW VEGETATIVE-SOIL FILTER SYSTEM,

Southern Illinois Univ. at Carbondale. Dept. of Agricultural Industries
J. J. Paterson, J. H. Jones, F. J. Olsen, and G. C. McCoy.
Transactions of the ASAE, Vol 23, No 4, p 973-977, 984, July/August, 1980. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Industrial wastewater, *Dairy industry, *Land disposal, Animal wastes, *Wastewater disposal, Wastewater irrigation, Overland flow, Water pollution control, Vegetation, Soil-water-plant relationships, *Feedlot wastes.

A vegetative-soil filter system provides a disposal method for livestock wastes which small operators can install themselves and which may be substituted for a zero-discharge system where the dairy herd comprises 100 cows or less. Distribution and management problems resulting from the use of 10 centimeter diameter polyvinyl chloride (PVC) pipe for a 'sheet flow' vegetative-soil filter system for liquid wastes from a 70 cow dairy operation are discussed. The liquid dairy wastes consisted of liquid waste from the feedlot resulting from runoff during rainfall and snowmelt plus liquid waste from the milking parlor and milkroom washwater. The width of effluent discharge was too narrow to make the best use of the utilization area when the pipe distribution line was shorter than 9 meters. Distribution lines longer than 30 meters were difficult to level for uniform flow. Under wet conditions, 1 gallon per square yard per day was found to be a safe loading rate for the filter area, except during rainfall and snowmelt events. During high rainfall events, pollution can be minimized by increasing the flow distance from the settling basin to the disposal area. The botanical composition of the filter area changed significantly over the 2-year period during which wastewater from livestock was applied daily to tall fescue sod. Maintaining a suitable grass cover was a major problem. The advantages of rotating between two or more utilization areas on a weekly basis with respect to maintenance of a grass cover are being investigated. Analysis of effluent samples from the disposal sites showed that the grass filter effectively removed pollutants from the liquid dairy wastes. (Carroll-FRC)
W82-00897

SEPARATION OF SELENIUM FROM SULFIDE LEACH LIQUORS,

Canmet, Ottawa (Ontario). Mineral Sciences Lab.
V. S. Sastri, and K. S. Subramanian.
Separation Science and Technology, Vol 15, No 1, p 75-79, 1980. 2 Tab, 7 Ref.

Descriptors: *Selenium, *Leaching, Metals, *Industrial wastes, Wastewaters, *Wastewater treatment, Coprecipitation, Cation exchange, Ion exchange.

The removal of selenium from leach liquors and metal-barren effluents before discharging into the natural waterways is essential due to the fact that selenium and its various compounds are extremely toxic and carcinogenic. A systematic study of the separation of selenium from leach solutions is presented. Selenium can be separated as the thiol complex by the procedure of Kovalskii. To effect removal as cuprous seleinde, buffer solution composed to citric acid and copper sulfate with a pH of 4.5 and aqueous ammonia was added to neutral Se(IV) solution. Aqueous hydroxylamine sulfate solution (1 ml of 10% solution) was added, and the mixture placed in a small funnel in the neck of a flask. After boiling and subsequently cooling, the contents were filtered through a microfilter stick. Separation as lead selenite is achieved by the procedure of Jachwerth based on coprecipitation of selenite as lead selenite with lead sulfate, which is subsequently dissolved in ammonium tartrate solution and the solution analyzed for selenium by a spectrophotometric method using 3,3'-diaminobenzidine as the organic complexing reagent. The separation of selenium by coprecipitation with arsenic is also possible. To achieve separation by cation exchange, an ion-exchange column 30 cm long and 2 cm in diameter is filled with cation exchange resin. The selenite solution is passed through the column; the effluent is collected and analyzed for selenium by a spectrophotometric method using 3,3'-diaminobenzidine as the complexing agent. Of these methods, the cation exchange chromatographic method gave the best separation. Coprecipitation with arsenic gave poor results. High recoveries were obtained in the case of separation as cuprous selenide. (Baker-FRC)
W82-00905

FLOC/FLOAT SYSTEM CLEANS DESALTER EFFLUENT,

Pielkenrood-Vinitex, Assendelft (Netherlands).
H. Kleen, and H. Marson.
Oil and Gas Journal, Vol 78, No 36, p 76-78, 80, September 8, 1980. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Industrial effluents, *Flocculation, *Wastewater treatment, Refinery wastes, Water treatment, Chemical coagulation, Dispersants, Emulsions, Industrial wastes, *Oil industry.

Difficult and expensive problems were caused by emulsions that formed in desalter effluent water from a Dutch refinery. The problematic emulsions formed, both water-in-oil and oil-in-water, had formerly passed through the system unseparated. They were removed with the oil and passed through a complete circuit. They built up in the cycle until on some occasions the separator system became blocked by viscous, jelly-like masses of emulsion. Solution was achieved by a design employing flocculation in a tilted plate flocculator and flotation. Alum was chosen as flocculant. Flotation was achieved by microbubbles generated from pressurized dissolved air. The treated water which flows into the main waste water treatment system is sufficiently purified to fall within the specification of 30 mg oil/kg which the refinery is expected to meet. The improvement of desalter effluent quality has reduced the frequency of plant shutdown due to exceeding the allowed population equivalent limit in the water discharge from four shutdowns to one shutdown per year. (Baker-FRC)
W82-00906

MASSIVE CULTIVATION OF MICROALGAE: RESULTS AND PROSPECTS,

Kernforschungsanlage Juelich (Germany, F.R.). Inst. fuer Biotechnologie III.
C. J. Soeder.
Hydrobiologia, Vol 72, No 1/2, p 197-209, July, 1980. 2 Fig, 10 Tab, 72 Ref.

Descriptors: *Algae, *Biological wastewater treatment, *Water reclamation, Wastewater treatment, Feeds, Reviews, Economic aspects, Bacteria, Waste treatment, Spirulina, Chlorella, Scenedesmus, Irrigation water, Manure, Animal wastes, Chemical wastes, Effluents, Lagoons, Algae harvesting, Agriculture, Protein, Tropical regions, Impaired water use.

Mass production of microalgae is reviewed with special emphasis on the most promising technology, treatment of wastewater with algae-bacteria systems to yield a proteinaceous biomass suitable as a food. These processes vary from growing Spirulina on fermented cow dung in a ditch in India to the sophisticated Japanese Chlorella factories. High rate algae ponds, which represent great improvement over sewage or effluent treatment in deep unlined ponds at long retention times, feature intensive mixing and night-time aeration. Results are aerobic wastewater treatment, reclamation of treated water for use in irrigation, and the proteinaceous algae-bacteria biomass suitable for animal feed. Least energy consuming harvesting methods are sedimentation, filtration, and flotation. Among the highest yield values reported are a mean efficiency of photosynthetic active radiation conversion of 4.8% in Bulgaria. Addition of organic substrates boosts the yields. Nutritional and toxicological aspects of algae culture are discussed. The most promising fields for increasing microalgae production are in cases where algae are obtained as byproducts from urban sewage treatment, animal wastes, mineral fertilizer wastewaters, soda manufacture from carbonate brine, and ammonia or urea manufacture. (Cassar-FRC)
W82-00913

KINETICS OF NITRATE AND AMMONIUM UPTAKE BY THE TROPICAL FRESHWATER MACROPHYTE PISTIA STRATIOTES L.,

Guam Univ., Agana. Marine Lab.
S. G. Nelson, B. D. Smith, and B. R. Best.
Aquaculture, Vol 24, No 1/2, p 11-19, May, 1981. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Nitrogen, *Kinetics, *Aquaculture, Nutrients, Macrophytes, Ammonium, Nitrates, Tropical regions, Wastewater treatment.

The kinetics of nitrogen uptake were examined for a common freshwater macrophyte Pistia stratiotes L. Nitrate-nitrogen and ammonium-nitrogen uptake were examined over a wide range of substrate concentrations gather information which would be useful in the design of aquaculture systems for ammonium and nitrate removal. Nitrate uptake rates were higher after 24 hr of exposure to the nitrate source than immediately after exposure. The rate of uptake of nitrate-nitrogen was greater in the light than in the dark. Nitrate uptake followed a pattern which could be adequately described by the Michaelis-Menten expression. Ammonium nitrogen uptake response to substrate concentration apeared to be linear. Rates of ammonium-nitrogen uptake was similar in the dark and in the light. For any given dissolved nitrogen concentration, the rate of ammonium-nitrogen uptake was greater than the rate of nitrate-nitrogen uptake. (Baker-FRC)
W82-00937

POTENTIAL FOR LAND DISPOSAL OF TWO NONBIODEGRADABLE WASTES,

Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter, R. P. Eastburn, and M. P. Neisser.
Transactions of the ASAE, Vol 24, p 945-950, July/August, 1981. 8 Fig, 5 Tab, 14 Ref.

Descriptors: *Land disposal, *Industrial wastes, Nylon, Waste disposal, Wastewater disposal, Groundwater, Water pollution sources, Groundwater pollution, *Nonbiodegradable wastes.

A series of laboratory and greenhouse experiments was conducted to evaluate the potential for land disposal of some nonbiodegradable nylon processing wastes. Two wastewaters from experimental nylon manufacturing processes were subjected to soil column, lysimeter, adsorption, phytotoxicity and biodegradation studies. The major objectives were to determine whether the wastewaters were degradated by soil microorganisms and whether land disposal could be used for the wastewaters. Two wastes of differing chemical composition were used in the study. The chemical oxygen demand concentrations of the leachate for wastes A and B versus the amount of wastewater applied at different loading rates was determined. At a low application rate of 1.3 cm/week, no leachate samples were collected for five weeks due to evaporation. In general, the soil column profiles did not remove any more COD after about 36 to 48 cm of wastewater was applied, indicating that adsorption of the organic material to the soil particles was small. The pH of the leachate varied from 5.0 to 8.0 for wastes A and B. Samples of leachate were collected for 15 weeks from the lysimeters after the initial wastewater application. Neither waste A nor waste B adsorption could be described by the Langmuir equation or the Freundlich equation. Wastewater was applied to the pots in the greenhouse study for 18 weeks. One week after application began, the grass being treated with waste B became chlorotic. High application rates appeared to have an adverse effect on the vegetation. It was concluded that the potential for using land treatment for nonbiodegradable wastes is limited. These types of wastes could cause serious groundwater contamination. (Baker-FRC)
W82-00939

EXTRACTING HEAVY METALS AND TOXIC ORGANICS FROM SLUDGE,

A. A. Kalinske.
Water/Engineering and Management, Vol REF, No HB, p R148-R151, 1981.

Descriptors: *Sludge, *Toxicity, *Wastewater treatment, Sludge thickening, Sludge drying, *Sludge disposal, *Heavy metals, Organic compounds, *Sludge conditioning.

In order to make a sludge or residue non-hazardous, it may be necessary to reduce its heavy metal content. Municipal wastewater treatment plant sludge from primary and secondary treatments will contain various amounts of toxic organics such as chlorinated hydrocarbons and toxic heavy metals. Most of these are only slightly soluble in water and tend to adhere to the suspended solids in the wastewater. The biological organisms in the secondary plant, especially those in the sludge process, have a considerable capacity to remove heavy metals present in fine particulate form and in soluble form. Metal concentrations in the raw sewage coming to any treatment plant are relatively low. Chemical treatment, such as for phosphorus removal, will usually cause additional heavy metals to be removed from the sewage by precipitation due to increases in acidity and by coagulation of colloids. The ratio of soluble to insoluble concentration of the various heavy metals in liquid sludge can be changed by the addition of chemicals for conditioning, if the pH is changed. An elevated pH will cause precipitation, to some degree, of most of the heavy metals present in solution. There are also systems for heat-treating a liquid sludge so as to condition it in order to obtain excellent dewatering without using any chemicals. The sludge is raised to a temperature of 180-210 degrees C, under pressure conditions, and held for about 30 min. Heat drying of sludge is done at some wastewater treatment plants to prepare a saleable product for use as a soil conditioner with some fertilizing properties. (Baker-FRC)
W82-00947

CONTROL SYSTEMS FOR RETURN AND WASTE SLUDGE,

Metropolitan Sanitary District of Greater Chicago, IL.
R. L. McCarthy, and R. L. Sokol.
Water/Engineering and Management, Vol REF, No HB, p R152-154, 1981. 3 Fig, 1 Tab.

Descriptors: *Sludge, *Control systems, Equipment, Sludge excess, *Wastewater treatment, Activated sludge.

Devices, instruments, and piping arrangements which may aid in the application of processes governing the return and wasting of sludge are discussed. Sludge level sensors, air lifts, and a variety of control arrangements in use are described. While air lift with gravity return is still the primary method of returning sludge in the district of Greater Chicago, several new devices have improved the process, one of which is the sludge level sensor. There are two types of sensors; one, a sonic sensor, is based on the fact that an ultrasonic signal will attenuate to a large degree when passing through a liquid containing suspended solids as opposed to passing the signal through clear water. The second, the light sensor, uses a highly sensitive photocell and an infrared or ultraviolet light source in a probe suspended in the tank. The system is presently arranged so that the return sludge rate may be selected and the system kept in balance automatically by variation of the waste sludge rate with changing level of the sludge blanket. All sludge withdrawn from the tank is air lifted into a return sludge channel. The return sludge flow into the aeration tanks is controlled, based on varying sewage flow and a preset return sludge ratio. The amount of lift needed to return final tank sludge back to the aeration tanks is usually less than 3 feet. The back-up system for all controls is the sludge level indicator. The operator on duty makes charts which show four circles and which are penciled in whenever the sludge reaches a certain indicator pipe. If necessary this information when given to the shift operator can be used to make adjustments. (Baker-FRC)
W82-00949

AN ALTERNATIVE WASTEWATER DISINFECTANT,

Maryland Environmental Service, Annapolis.
D. J. Greene.
Water/Engineering and Management, Vol 128, No 7, p 47-48, July, 1981. 6 Fig.

Descriptors: *Bromine chloride, *Disinfectants, *Secondary wastewater treatment, Wastewater treatment, Chlorination, Fish, Toxicity.

Bromine chloride was cost competive and offered advantages over other disinfectants in field trials at an activated sludge secondary wastewater treatment plant in Sykesville, Maryland. The 5 min control point residual required was 0.8 ppm equivalent total chlorine to produce a < 200 fecal coliforms per 100 ml effluent level and low or nondetectable residual in the final effluent. In a 96-hour fish survival test with fathead minnows, no fish were killed by 8 ppm BrCl in effluent, while 100% were killed in 8 ppm C12 in effluent. Bromine chloride has several advantages over chlorine. It is liquid at room temperature, 12 times more soluble in water, and more effective at lower temperatures. Bromamines formed in the process are less stable and therefore less harmful to aquatic life. Total treatment costs in cents per 1000 gal based on a 100 mgd plant are 1.6 for chlorobromination (5 ppm) and 1.9 for chlorination/dechlorination/postaeration. (Caesar-FRC)
W82-00950

SLUDGE BLANKET IN ACTIVATED FINAL CLARIFIERS,

Envirex, Inc., Milwaukee, WI.
W. H. Boyle.
Water/Engineering and Management, Vol REF, No HB, p R124, R129-R130, 1981. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Clarifiers, *Activated sludge, Sludge, *Wastewater treatment, Clarification, Chemical precipitation, Water treatment.

Activated sludge acts as a liquid and therefore seeks its own level on entering the final clarifier of a wastewater treatment plant. The heavier mixed liquor, on entering the final clarifier basin, drops to the floor or sludge blanket. It then travels along the floor until it hits an obstruction such as the peripheral wall for the center feed clarifier. Activated sludge does not settle as a discrete particle, but rather in a hindered zone of influence, and not therefore governed solely by Stokes' law of settling. Activated sludge has no choice but to seek its own liquid mass level in a clarifier if no mechanical or hydraulic limitations are imposed on it. The sludge will not likely be a homogeneous solid mixture in the sludge blanket, nor will the sludge blanket have a constant concentration of solids per unit area of the tank floor. Since sludge in each plant is different, the relative concentration will vary, but the random pattern of the contour lines of sludge will probably not differ significantly. A theoretical removal point will pass through as many as eight different solids contours for half the basin. It would be most difficult to design a sludge collector for rapid adjustment to each different concentration point. Even if well defined radial concentration points did exist, it would be impossible to say where the heavy versus the light sludge would be at any given time. To satisfy most mass loading theories and practical applications of final clarifiers, the designer and operator must take into account that sludge will settle at a level elevation and should be removed to sustain this level. While the solids concentration in the sludge blanket is not perfectly uniform, the removal device should be designed as though it were. (Baker-FRC)
W82-00951

AUTOMATION OF NORWICH SEWAGE-TREATMENT WORKS: EARLY COST CONSIDERATIONS,

Anglian Water Authority, Norwich (England). Norwich Sewage Div.
J. Hemsley, and A. Latten.
Water Pollution Control, Vol 80, No 3, p 341-355, 1981. 2 Fig, 10 Tab, 7 Ref.

Descriptors: *Automation, *Cost analysis, *Wastewater treatment, Water treatment facilities, Maintenance, Operating costs, Maintenance costs, *Norwich, England.

The effects of automated procedures on operating costs experienced at the Norwich sewage treatment works are described. An actual savings of 25,900 pounds Sterling/year thought to be attributable to automation was realized on operation. The desludging of primary sedimentation tanks was not cost effective on automatic control. However, if the same system were to be designed today, the eight ultrasonic sludge density indicators currently employed could be reduced to two, and this fact alone would mean that the costs would approximately balance the tangible benefits. The performance of the activated sludge plant during the automatic control period was clearly superior to that during the period of manual control. In efforts to gain cost figures regarding dissolved oxygen control, the DO control system of the 27.5 tcmd design DWF six-channel diffused-air, activated-sludge plant used up to four EIL Makereth DO sensors, positioned at various points around the aeration channels. To obtain data for a manual vs. automated operation, the DO control system was shut down for a time period and the DO controlled by manual adjustments to blower speed. Records of labor, power consumption, and plant performance were kept. In both manual and automated periods of operation the plant was operating in a non-nitrifying mode, and air supplied above that required to satisfy base respiration was substantially used in carbonaceous oxidation. Comparing the final costs indicated by the systems showed a present value saving on automatic control of 122,506 pounds, which is about equal to 1.5 operators or about 64 man-hr/week. (Baker-FRC)
W82-00955

GUIDELINE TABLES TO INDUSTRIAL WASTES PROBLEMS,

Water and Pollution Control, Vol 119, No 6, p 10-12, June, 1981. 1 Tab.

Descriptors: *Wastewater treatment, *Industrial wastes, *Industrial wastewater, Water quality standards.

An extensive table is presented which outlines treatments available for industry's major problem wastes. The table lists the industry, its waste problems, possible treatments, and guidelines and standards for maximum concentrations. Industries considered include basic iron and steel, agricultural chemicals, inorganic chemicals, organic chemicals, food processing, metal working and finishing, petroleum and petrochemicals, mining and metallurgy, pulp and paper, transportation industries, and tanning and rendering. Most of these wastes are in the form of contaminated water, although solid wastes are also mentioned in the table when appropriate. (Small-FRC)
W82-00956

THE CAPE FLATS SEWAGE TREATMENT WORKS,

J. G. Brand.
Civil Engineer in South Africa, Vol 23, No 4, p 124, April, 1981.

Descriptors: *Wastewater facilities, *Water reuse, *Activated sludge process, Wastewater renovation, Potable water, Secondary treatment, Oxidation, Sedimentation, *South Africa.

The Cape Flats Sewage Works, which treats primarily domestic sewage, handles an inflow of 150 Mliters/day. The older Athlone Works treats primarily industrial wastes, which are generally too saline to be reclaimed for potable use. At the Cape Flats plant, sewage is screened and grit is removed before passing into primary settling tanks and then into aeration reactors. After secondary settling, the effluent is discharged into oxidation ponds. The sludge is ultimately sold as fertilizer. The project was started in 1977, and the final value of contracts awarded was R22 million. The architectural design of the facility won a commendation by the Concrete Society of Southern Africa. Buildings such as the inlet works and blower house comprise concrete portal frames clad in color-coated curved asbestos sheeting. Selection and design of the basic process were carried out with a view to immediate compliance with the final effluent standards, and to the utlimate objective of water reuse. (Small-FRC)
W82-00957

THE FATE OF HEAVY METALS IN THE RUHR SYSTEM AND THEIR INFLUENCE ON DRINKING WATER QUALITY,

Ruhrverband, Essen (Germany, F. R.).
For primary bibliographic entry see Field 5B.
W82-00962

FLUIDIZED BED FOR BIOLOGICAL WASTEWATER TREATMENT,

Patras Univ. (Greece). Lab. of Applied Thermodynamics.
T. C. Stathis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 227-241, February, 1980. 1 Fig, 1 Tab, 15 Ref.

Descriptors. *Biological wastewater treatment, *Fluidized beds, Wastewater treatment, Biological treatment, Fluidized bed process, Microorganisms, *Nassau County, New York.

A fluidized bed system is described that is used in the treatment of municipal wastewater from Nassau County, New York, at its 60 mgd treatment plant at Bay Park, New York. Using a pilot plant of 72,000 gal/day, the 94 mg/liter of incoming primary soluble BOD effluent was being reduced to 11 mg/liter within a 16 minute total detention time. The recycle ratio for this case was equal to 2.2. Sand was used as the granular medium in the fluidized bed; this acts as a support surface upon which the biological population grows. Wastewater is first pumped through a pressurized oxygen mixing tank, where it is hydraulically mixed with pure oxygen gas and subsequently fed to the fluidized bed reactor. The fluidization of the media allows solids to pass through, thus overcoming the problems associated with packed bed systems, such as plugging and frequent backwashing. The fluidized bed system offers a much higher surface area per unit volume of reactor on which the microorganisms grow, and therefore it can operate with much higher concentrations of biological mass than other systems. As a result, the fluidized bed system requires considerably less space and lower construction costs than other systems, and it should be considered as a welcome addition to the variety of wastewater treatment systems available. (Baker-FRC)
W82-00968

MUTLICHAMBER SEPTIC TANKS,

Connecticut Univ., Storrs. School of Engineering.
R. Laak.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 539-546, June, 1980. 3 Fig, 29 Ref.

Descriptors: *Septic tanks, *Effluents, Design criteria, Wastewater treatment, Wastewater, Planning, Suspended solids, Biological oxygen demand, Multichamber septic tanks.

The concept of a multichambered septic tank is considered in contrast to the single chamber tank, which is conventionally used for small flows only. Multichamber tanks appear superior to single-chamber tanks in that up to 50% less suspended solids remain in the effluent. A change from a single chamber to a multi-chamber tank can mean a change in suspended solids removal from 75% to 80%. This represents a 20% suspended solids load improvement on the seepage bed. The surface area/depth ratio for each compartment, the loading intensity, and the outlet configuration show a significant effect on effluent quality. While overloaded tanks will undoubtedly fail, multichamber tanks often perform longer at a more satisfactory rate. To be effective, septic tanks should have a detention period longer than 24 hr, an outlet configuration with a gas baffle, maximized surface area/depth ratio for all chambers, and a multichamber tank with interconnections similar to the outlet design. (Baker-FRC)
W82-00969

CATION TRANSPORT IN PACKED BED REACTOR OF SOIL,

Florida University, Gainesville, Agricultural Engineering Department.
A. R. Overman, B. R. McMahon, R. L. Chu, and F. C. Wang.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 267-277, April, 1980. 16 Fig, 1 Tab, 12 Ref.

Descriptors: *Soil disposal fields, *Cation exchange, Model studies, Tertiary wastewater treatment, Wastewater treatment, Municipal wastewater, Kinetics, Waste disposal, Wastewater disposal, Land disposal, *Ion transport.

Cation exchange is an important process in the land treatment of municipal wastewater, since it influences the availability of several nutrients for crop uptake as well as the buffer capacity of the system to shock loading. A model of cation transport through a packed bed of soil is presented. Components of the model include convection, dispersion, and ion exchange. The method of finite differences as proposed by Gupta and Greenkorn is used to obtain a mathematical solution to the nonlinear system. The component for cation exchange is based on second-order kinetics in accord with the law of mass action. For the experiments conducted the packed bed reactor was packed with Lakeland fine sand to a bulk density of 1.66 g soil per cubic meter and a porosity of 0.376. After purging the soil air with carbon dioxide, the reactor was saturated with distilled/deionized water to assure total saturation so that pore velocities could be calculated. Several pore volumes of ammonium chloride were passed through to saturate exchange sites with ammonium ion. The pH was adjusted to 6.5. Samples were analyzed for ammonium ion with a spectrophotometer, for potassium by flame photometry, and by titration for chloride ion. Experiments were conducted by switching between ammonium chloride and potassium chloride of the same molar concentration and at pH 6.5. The findings indicate that the dynamics of cation exchange in packed soil depend upon water flow and ionic composition of the soil solution. Increases in ionic strength or flow velocity greatly increase the rate of cation exchange. The performance of land treatment systems depends on intricate coupling among hydraulic, chemical, and biological processes. (Baker-FRC)
W82-00970

BIOLOGICAL TREATMENT OF SYNTHETIC FUEL WASTEWATER,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. G. Luthy, D. J. Sekel, and J. T. Tallon.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 609-629, June, 1980. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Biological wastewater treatment, *Coal gasification, Wastewater treatment, Nitrification, Biological treatment, Ammonia, Nitrogen, Biological oxidation, Oxygen demand, Biological oxygen demand, Industrial effluents, Effluents, Gasification.

The possibility of using biological methods for the treatment of wastewater heavily laden with organic contaminants arising from a coal gasification pilot process plant was investigated. The wastewater used was obtained from the Grand Forks Energy Technology Center gasifier in Grand Forks, ND. The wastewater effluent was double decanted to remove most of the tar and oil prior to shipment. The wastewater contains on the order of 0.4 equivalents per liter total ammonia and 0.4 equivalents per liter of alkalinity. Most of the ammonia present is present as free ammonia. Wastewater was pretreated by dosing with lime to precipitate alkalinity as a calcium carbonate sludge and to raise pH when air stripping ammonia. Ammonia stripping was done to prepare influent to the biological cells. Stripping lowered ammonia concentration from an average level of 5,150 mg/liter to 330 to 580 mg/liter. Lime pretreatment and ammonia stripping removed 84% of raw wastewater alkalinity and 91% of wastewater ammonia, resulting in a significant decrease in wastewater conductivity. COD demand was reduced by 14%. Sulfide was reduced to 5 mg/liter. Biological reactors were seeded with activated sludge. Treatment of ammonia stripped wastewater at 25% strength showed very stable operating conditions. Effluent volatile suspended solids and phenolics were low, there was high removal efficiency for thiocyanate and chemical oxygen demand, and nearly complete nitrification of influent ammonia was achieved. Final studies showed wastewater could be processed at 40% strength and that nitrification was feasible with both stripped and unstripped wastewater. (Baker-FRC)
W82-00971

VACUUM FILTRATION OF METAL HYDROXIDE SLUDGES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, M. M. Ghosh, and J. T. Novak.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 363-376, April, 1980. 9 Fig, 1 Tab, 14 Ref.

Descriptors: *Sludge, *Vacuum filtration, Sludge dewatering, Filtration, Metals, *Wastewater treatment, Industrial wastes, Separation techniques.

The characteristic response of metal hydroxide sludges to vacuum filtration was examined. Both individual and mixed-metal sludges were examined regarding sludge dewatering rates, handling properties, and filtrate quality obtained during vacuum dewatering. Sludge parameters such as mean particle size and size distribution, as well as operational

parameters such as precipitation pH, were evaluated to better define their effect on the dewatering of metal hydroxide sludges. It was concluded that most metal hydroxide sludges will yield acceptable dewatering rates when subjected to vacuum filtration. Sludges of high specific resistance can be conditioned through the addition of high molecular weight polyelectrolytes. The penetration of solids during vacuum dewatering must be dealt with for certain metal hydroxide sludges. Small additions of polyelectrolyte were helpful in minimizing the amount of solids in the vacuum filtrate. Sludge floc size had the greatest effect of those parameters tested on the rate at which metal hydroxide sludges dewater. Increases in the mean floc size of a sludge produced significant improvements in the rate of sludge dewatering, as evidenced by decreased sludge specific resistance values. Insolubilization pH and variations in metal content altered sludged specific resistance by affecting the size of flocs formed during the precipitation phase of treatment. Synthetic polyelectrolytes condition metal hydroxide sludges through increases in particle size. The mechanism of polymer action appears to be interparticle bridging. (Baker-FRC)
W82-00976

WATER QUALITY EVALUATION OF REGIONAL WASTEWATER MANAGEMENT,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
D. J. Adams, and R. S. Gemmell.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 437-450, April, 1980. 6 Fig, 13 Ref.

Descriptors: *Wastewater management, *Water quality control, Urban areas, Water treatment facilities, Wastewater facilities, Design criteria, Planning, Decision making.

Regional wastewater management alternatives are discussed in relation to size, number and location of wastewater treatment plants. A two-reaction model is used in the discussion. The model assumes that the flow is uniform and steady and that there is no longitudinal dispersion. This model can predict the dissolved oxygen deficit at any time of flow downstream due to a single point discharge. The deterministic analysis reveals that for a given stream size or dilution ratio and a given stream length, an increase in the disaggregation state of wastewater treatment plants results in an improved water quality. Water quality improvement resulting from a decentralized regional wastewater treatment system is also a function of the dilution ratio. It appeared that decentralization was more beneficial in cases with relatively small streamflows. The water quality impact of regional wastewater centralization due to stochastic variability was examined with stochastic simulation models. Increasing the state of aggregation or equivalently increasing the number of wastewater discharge points resulted in minimum dissolved oxygen frequency responses with smaller variances. Thus the multiplant system resulted in a minimum stream dissolved oxygen level significantly larger than that of the single plant system. For systems of various lengths, increasing the system length not only increased the mean minimum dissolved oxygen response, but also decreased the variance of the response of multiplant systems. It was concluded that the decentralized wastewater system significantly outperformed the centralized system when the dilution was small. As the dilution ratio increased, this difference in performance decreased. (Baker-FRC)
W82-00977

CHEMICALS DISINFECT SLUDGE,

Universidad Autonoma de Nuevo Leon, Monterrey (Mexico).
A. Ramirez, and J. F. Malina, Jr.
Water and Sewage Works, Vol 127, No 4, p 52-54, April, 1980. 4 Fig, 1 Ref.

Descriptors: *Sludge disposal, *Disinfection, Ozonation, Chlorination, Land disposal, Calcium hydroxide, Lime, Ammonium hydroxide, Sludge utilization, *Wastewater treatment.

Ozone, chlorine, and calcium hydroxide plus ammonium hydroxide were considered in addition to calcium hydroxide (quicklime) alone as potential disinfectants of sewage sludge to be applied to land. Tests indicated that chlorine disinfection of sludge could produce organochlorinated substances which might pose a problem for the final disposal of treated sludge. Obnoxious odors may also develop when chlorine residuals disappear if sludge is stored in the liquid form. The addition of lime killed or inhibited bacteria, although the acid-fast bacteria demonstrated more resistance to the high pH treatment than to clorination. A decrease in bacterial survival of up to 5.5 orders of magnitude could be maintained for several days at a lime dosage of 1.2-1.5 times that needed to produce an initial pH of 12.0. Ammonium hydroxide combined with a pH of 12 (achieved by lime addition) and homogenization was tested. This combination was more efficient for acid-fast bacteria removal than lime alone. Fecal streptococcus assays were similar to those produced using lime alone. Bacterial resistance to disinfection chemicals increased in the order of total coliforms < fecal coliforms < fecal streptococci < acid-fast bacteria. Thus fecal streptococcus and acid-fast bacteria are desirable indicators for sludge disinfection studies. (Baker-FRC)
W82-01003

SCOTT BRINGS UNIQUE $25-MILLION WASTE TREATMENT FACILITIES ON-LINE,

K. E. Smith.
Pulp and Paper, Vol 54, No 2, p 98-100, February, 1980. 1 Fig.

Descriptors: *Pulp wastes, *Activated sludge process, *Wastewater treatment facilities, Pulp and paper industry, Wastewater treatment, Costs, Aeration, Aerated lagoons, Water quality, Water pollution control, *Mobile, Alabama.

A recently upgraded effluent treatment facility at a paper plant in Mobile, Alabama, includes an improved existing secondary treatment plant, new sludge dewatering equipment, and the construction of a unique 115-acre stabilization and aeration basin. The 25 million dollar project was necessary to meet EPA and future requirements. A static aeration system was added to the existing plant; the plant's effluent flows by gravity to a new 115 acre aeration and stabilization pond. Nine floating agitators aerate the effluent, which is eventually discharged into the Mobile River. Removal of the effluent discharge from Chickasaw Creek improved the appearance of the creek as well as water clarity, purity, and dissolved oxygen levels. (Small-FRC)
W82-01007

MUTANT BACTERIA CONTROL FILAMENTOUS GROWTH IN MILL WASTEWATER TREATMENT,

Polybac Corp., Allentown, PA.
T. G. Zitrides.
Pulp and Paper, Vol 54, No 2, p 172-174, February, 1980. 1 Tab.

Descriptors: *Activated sludge process, *Bacteria, *Pulp wastes, *Wastewater treatment, Pulp and paper industry, Biochemical oxygen demand, Performance evaluation.

Mutant bacteria can increase BOD5 removal rates, improve sludge settling, and increase tannin and lignin removal in activated sludge plants treating pulp mill wastes. Seeding with single-cell, nonfilamentous, mutant bacteria can replace costly hydrogen peroxide and polymer treatments for the control of filamentous organisms. The mutant bacteria were tested in an integrated chemimechanical pulp and paper mill producing 160 air dry tpd of hydrogen-peroxide bleached hardwood pulp. The mill sends 6 million gal/day of wastewater to the treatment system. Successful pilot studies justified a trial of full-scale continuous control of filamentous growth. The seeding began with a dosage of 25 lb/million gal, and for the next ten days 30 lb/day were added, followed by a maintenance dosage of 9 lb/day. After 47 days, improvement in sludge settling was 41.9%, improvement in total BOD removal was 12.2%, and the biomass remained healthy with minimum filamentous growth. (Small-FRC)
W82-01008

NEW SECONDARY TREATMENT SYSTEM BROUGHT ON-LINE AT GEORGIA-PACIFIC,

H. M. Cody.
Pulp and Paper, Vol 54, No 7, p 180-182, July, 1980. 2 Fig, 1 Tab.

Descriptors: *Pulp and paper industry, *Secondary wastewater treatment, *Stabilization lagoons, Effluents, Industrial wastes, *Wastewater treatment, Aerated lagoons, Wastewater lagoons, Lagoons, Outfall, *Puget Sound, Washington.

A $20 million secondary treatment system (lagoon plus outfall/diffuser) was installed at the Georgia-Pacific Corporation's Bellingham, Washington, mill on Puget Sound to meet effluent standards. The system consists of a stabilization lagoon designed to treat 240 million gallons with continuous aeration at a flow design of 25 million gal per day. After a residence time of 7 days, effluent from the lagoon is combined with clean water in a chamber and discharged through a 60 inch i.d. outfall pipe at a design flow of 30 million gal per day. The diffuser section is 2000 ft long and has 500 1.5 inch diameter ports at 8 ft intervals, discharging at an average 55 ft below the surface. The average BOD load into the lagoon is 110,000 lb per day; the discharge limit is 22,500 lb per day. The total suspended solids output limit is 35,300 lb per day. (Caesar-FRC)
W82-01009

SIMULATION MODELING OF PRIMARY CLARIFIERS,

Paramount Engineering Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 6A.
W82-01027

REMOVAL OF VOLATILE TRACE ORGANICS FROM WASTEWATER BY OVERLAND FLOW LAND TREATMENT,

Army Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, D. C. Leggett, and C. J. Martel.
Journal of Environmental Science and Health, Part A, Vol 15, No 3, p 211-224, 1980. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Land disposal, *Organic wastes, Organic compounds, Chlorination, Chloroform, Toluene, Volatility.

The effectiveness of a prototype overland flow land treatment system in reducing the levels of volatile trace organics in municipal wastewater was investigated. Chlorinated primary wastewater, water collected from the surface at various points downslope, and runoff were analyzed by GC/MS using a purge and trap sampler. The primary settled wastewater was chlorinated before application to the grass covered slopes, by adding 2.0 liters of 5.25% sodium hypochlorite solution to a 5300 liter holding tank and mixing for one hour. Wastewater was applied to the test site at five different application rates ranging from 0.40 cm/hr to 2.31 cm/hr. Average hydraulic detention times on the slope were determined by chloride tracer analysis at each flow rate used. The period of application was seven hours per day, five days per week. After a steady state flow was established, samples were collected from the applied wastewater, surface water at various downslope distances, and runoff. Results indicated that efficient removals of a number of volatile substances including chloroform and toluene were achieved by this method. Loss of these substances was found to follow first order kinetics. The observed behavior is consistent with a volatilization process. (Baker-FRC)
W82-01042

EFFECTS OF RENTON WASTEWATER TREATMENT PLANT EFFLUENT ON WATER QUALITY OF THE LOWER GREEN/DUWAMISH RIVER,

Washington State Dept. of Ecology, Olympia.
J. C. Bernhardt.

In: The Impact of Renton Wastewater Treatment Plant on Water Quality of the Lower Green/Duwamish River, Document DOE 81-2. January 1981. Part I. 35 p. 13 Fig, 4 Tab, 17 Ref, Append.

Descriptors: *Wastewater dilution, *Stream pollution, *Wastewater facilities, Wastewater treatment, Wastewater management, Wastewater disposal, Wastewater pollution, Waste discharge, Discharge hydrographs, Water quality standards, Water quality, On-site data collections, Washington, *Seattle.

The Municipality of Metropolitan Seattle (METRO) completed the Renton Wastewater Treatment Plant (RWTP) in 1965 to improve water quality in Lake Washington and nearby areas. As the RWTP has grown, the Department of Ecology has become increasingly concerned about the possible impacts of the discharge on stream quality. Past investigators have concentrated mainly on the lower waterway and zone of salt water intrusion, while the fresh waters above have received limited attention. This report describes the dilution and dispersion of RWTP wastewaters and measurements of selected water quality constituents. Two time-of-travel surveys were conducted on the lower Green-Duwamish River to evaluate impacts of secondary-treated wastewaters discharged from the RWTP during summer low flow. The 12-mile section of the lower river between RWTP and Harbor Island at the mouth was drift-floated on two occasions. Two small surface drogues were placed in the river near the outfall. Stream quality was generally poor, and was associated mainly with RWTP. At 4:1 and 4.4:1, the stream-to-effluent dilution ratios were far below the 20:1 recommended minimum. Violations of state standards for temperature and dissolved oxygen were observed. EPA red book criteria for total residual chlorine and ammonia (un-ionized) were exceeded, while nitrite-nitrogen reached borderline levels. The ability of the Green-Duwamish River to assimilate wastewaters discharged by RWTP appears to be exceeded at the current rate of discharge. Problems associated with the plant will increase as the plant approaches the 144 MGD ultimate site capacity. (Garrison-Omniplan)
W82-01063

THE IMPACT OF EFFLUENT FROM THE RENTON WASTEWATER TREATMENT PLANT ON THE DISSOLVED OXYGEN REGIMEN OF THE LOWER GREEN/DUWAMISH RIVER,

Washington State Dept. of Ecology, Olympia.
W. E. Yake.
In: The Impact of Renton Wastewater Treatment Plant on Water Quality of the Lower Green/Duwamish River, Document DOE 81-2. January 1981. Part II. 19 p. 8 Fig, 3 Tab, 12 Ref. Append.

Descriptors: *Wastewater treatment, *Dissolved oxygen, *Model studies, *Streeter-Phelps equation, Wastewater management, Wastewater disposal, Waste discharge, *Wastewater pollution, Sludge, Inorganic compounds, Nitrification, On-site data collections, *Seattle, Washington.

The Renton Wastewater Treatment Plant (RWTP) was completed in 1965 by the Municipality of Metropolitan Seattle (METRO) to improve water quality in Lake Washington and nearby areas. The Department of Ecology has become increasingly concerned about the possible impacts of the discharge on stream quality, especially since past investigators have concentrated on the lower waterway and zone of salt water intrusion rather than the fresh waters above. The RWTP is an activated sludge plant with an average daily dry weather flow of about 36 MGD. The flow from noon to 2 a.m. is about 50 percent greater than the average. A plant for upgrading the plant is being negotiated by METRO, DOE and EPA, and more data are needed. This report gives a detailed modeling analysis of the dissolved oxygen regime below the RWTP outfall. The model used a modification of the Steeter-Phelps equation which accounts for longitudinal dispersion. Rate constants and other variables were determined from data collected during two 24-hour drift surveys conducted in 1979. Dissolved oxygen concentrations below the plant discharge were depressed 2 to 3 mg/1. Based on model results and interpretation of survey data, nitrification of effluent ammonia was found to be responsible for about 95 percent of the observed dissolved oxygen depression. During the study there was no evidence of in-plant nitrification; all inorganic nitrogen was discharged to the Green/Duwamish system as ammonia. Model extrapolation to 1985 suggests further substantial degradation of the lower Green/Duwamish River as plant flow increased and instream dilution ratios decrease. (Garrison-Omniplan)
W82-01064

WATER QUALITY CONDITIONS IN THE BELLINGHAM BAY AREA 1979-1980,

Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 5B.
W82-01068

TREATABILITY MANUAL; VOLUME I. TREATABILITY DATA.

Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402 in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223050, Price code: A01 in microfiche only. Report EPA-600/8-80-042a, July 1980. 1089 p, 109 Fig, 642 Tab, 51 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water pollution control, Pollutants, Effluents, Physical properties, Adsorption, Biodegradation, Toxicity, Hazardous materials, Metals, Ethers, Phthalates, Phenols, Hydrocarbons, Halogenated hydrocarbons, Pesticides.

This volume supplies treatability data on specific industrial wastewater pollutants, with physical data on the pollutants, their occurrence patterns, and methods of treatment and/or removal. Pollutants are grouped according to the following chemical categories: metals and inorganics, ethers, phthalates, nitrogen compounds, phenols, aromatics, polynuclear aromatic hydrocarbons, polychlorinated biphenyls and related compounds, halogenated hydrocarbons, pesticides, oxygenated compounds, and miscellaneous. Each pollutant is described as a pure species, with appropriate physical data, its concentrations in the wastewater streams in which it is detected, and its treatability/removability by standard treatment processes. Carbon absorption and biodegradability data are presented for organic compounds, and precipitation/coagulation properties are given for metals. The pollutants considered are the 129 toxic pollutants and 74 additional pollutants deemed a hazard to the aqueous environment. (Brambley-SRC)
W82-01073

TREATABILITY MANUAL: VOLUME II. INDUSTRIAL DESCRIPTIONS.

Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161, as PB80-223068, Price code: A01 in microfiche only. Report EPA-600/8-80-042b, July, 1980. 986 p, 29 Fig, 685 Tab, 65 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, Industrial plants, Effluents, Water pollution control, *Waste characteristics, Wastewater facilities, Pollutants, Toxicity.

This volume characterizes the wastewater discharged by 22 industrial categories on a facility basis, prior to and after treatment. The pollution control methods used with the treated final effluent pollutant concentrations are also provided. Each industrial category is defined according to the Standard Industrial Classification Codes, and are divided into subcategories if the data are available. The total number of facilities in each category discharging an aqueous effluent to a receiving stream or a publicly owned treatment works is given in an industrial summary table. Wastewater characteristics are provided for each category or subcategory, and for separate processes when the data are available. The specific plant descriptions generally include a treatment system description, plant production, and wastewater flow. Removability of the 129 toxic pollutants, conventional pollutants, and others achievable by currently used treatment systems is presented, with information on treatment methods and removal efficiencies. (Brambley-SRC)
W82-01074

TREATABILITY MANUAL; VOLUME III. TECHNOLOGIES FOR CONTROL/REMOVAL OF POLLUTANTS.

Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223076, Price code: A01 in microfiche only. Report EPA-600/8-80-042C, July, 1980. 736 p, 73 Fig, 496 Tab, 70 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water pollution control, *Effluents, *Sludge disposal, Toxicity, Hazardous materials, Pollution load, Industrial plants, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This volume presents performance data and related technical information for 56 unit operations used in industrial water pollution control. The operations include 24 sludge treatment and disposal technologies, 4 wastewater conditioning technologies, and 28 generic wastewater treatment technologies classified as primary, secondary or tertiary treatment based on the types of pollutants they are designed to remove. Emphasis is placed on the 28 water treatment technologies, with concentration and removal efficiency data given for conventional pollutants, the 129 toxic pollutants, hazardous substances, and other nonconventional pollutants of concern in specific industrial wastewaters. The treatment processes are described in general terms to provide an overview, but published information on influent and effluent pollutant concentrations, removal efficiencies, point source category, scale of treatment operation, location in overall treatment system, and design and operating parameters are given. Statistical summary tables for each primary, secondary, and tertiary wastewater treatment technology incorporate all effluent concentration and removal efficiency data contained in the plant-specific data base for that technology. (Brambley-SRC)
W82-01075

TREATABILITY MANUAL; VOLUME IV. COST ESTIMATING.

Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223084, Price codes: A01 in microfiche only. Report EPA-600/8-80-042d, July, 1980. 402 p, 244 Fig, 166 Tab, 121 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Costs, Capital costs, Operating costs, Water conditioning, Sludge disposal, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This volume presents total capital investment and annual operating cost curves for 78 industrial wastewater treatment technologies. The technologies are categorized into six groups: wastewater conditioning; primary wastewater treatment; secondary wastewater treatment; tertiary wastewater treatment; sludge treatment; and disposal. The cost curves generally show costs in millions of dollars versus flowrate, and all costs have been indexed to September 1979. The estimates are valid only for comparison purposes, as they are generalized rather than site-specific and do not include land costs. The total capital investment is estimated to be 3.6 times the purchased equipment and installation cost, while the operating cost is the sum of labor, materials, chemicals, power and fuel costs and the indirect costs of overhead, taxes and insur-

ances, administrative expenses, depreciation, and interest. (Brambley-SRC)
W82-01076

TREATABILITY MANUAL; VOLUME V. SUMMARY.

Environmental Protection Agency, Washington, DC. Office of Research and Development.
Available from Supt. of Documents, GPO, Washington, DC 20402, in paper copy; available from National Technical Information Service, Springfield, VA 22161 as PB80-223092, Price code: A01 in microfiche only. Report EPA-600/8-80-042e, July, 1980. 177 p, 1 Fig, 10 Tab, 203 Ref, 4 Append.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Water pollution control, *Effluents, Toxicity, Pollution load, Indicators, Primary wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment.

This final volume on industrial wastewater treatment technologies includes summaries of the previous volumes and outlines their potential utility to National Pollutant Discharge Elimination System permit writers. Combinations of industrial processes and control technologies for which quantitative effluent data are available are listed. The median observed effluent concentrations for primary, secondary, and tertiary control technologies for conventional, toxic, and other pollutants and the median removal efficiencies for each technology are also given. A summary table presents the highest observed removal efficiency and the lowest observed effluent concentration for various pollutants as a function of the technology used to conrol the discharge. The EPA has recently allowed the use of indicator pollutants to control toxic pollutants and hazardous substances, where, by controlling a specified pollutant, other similar pollutants are assumed to be controlled. (Brambley-SRC)
W82-01077

5E. Ultimate Disposal Of Wastes

BETTER DEWATERING IMPROVES SLUDGE RECYCLING AND GIVES SIGNIFICANT ENERGY SAVINGS,

Racine Wastewater Utility, WI.
T. J. Bunker.
Water/Engineering and Management, Vol 128, No 6, p 40-42, June, 1981. 2 Fig.

Descriptors: *Sludge drying, *Wastewater treatment, Water treatment facilities, Sludge, Sludge thickening, Dewatering, Recycling, Sludge disposal.

Belt presses were chosen to replace the vacuum filters previously used to reduce the amount of recycled solids being fed to the head of the wastewater treatment plant in Racine, Wisconsin. There were several reasons for this choice. First, the presses had the ability to remove more solids during the dewatering process. Second, their power requirements were substantially lower. The new units also produced a drier sludge cake, with a solids concentration averaging 25%, compared to 15% for the vacuum filters. As a result of drier cakes, sludge handling costs were cut. Installation speed was also a consideration because of the recycling problem. Conditioned sludge is gently fed into a 7 foot gravity drainage section of the belt. Baffling devices disperse the sludge over the belt and form additional channels in the material for removal of ponded water. This free water is removed by gravity through openings in the polyester belt. Next the sludge is gently dropped to the lower of two pressure belts and becomes sandwiched between these belts to form a moving and adjustable wedge. Increasing pressure is applied by the belts as they pass through rollers of decreasing diameters, gradually forcing water from the moving wedge. The dewatered sludge is discharged on to a conveyor for transfer to a holding area where it is loaded on to a truck for ultimate disposal. (Baker-FRC)
W82-00526

EFFECT OF LEACHATE FLOW RATE ON METAL MIGRATION THROUGH SOIL,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
B. A. Alesii, W. H. Fuller, and M. V. Boyle.
Journal of Environmental Quality, Vol 9, No 1, p 119-126, January-March, 1980. 8 Fig, 8 Tab, 28 Ref.

Descriptors: *Leachates, *Flow rates, *Metals, *Migration, Leaching, *Trace elements, Aluminum, Iron, Chromium, Beryllium, Solid wastes, Water pollution sources.

The influence of flux or flow rate of municipal solid waste leachate on the attenuation of selected trace elements was evaluated in some representative United States soils. Natural municipal solid waste leachates enriched with Be, Cd, Cr, Fe, Ni, and Zn were used in soil columns under anaerobic saturated conditions. Flow rates of leachate were regulated to deliver precise fluxes ranging from 1 to 15 ml/hr. Each hour, effluent was collected and analyzed for the metal ions studied. Generally, the slower the rate of flow of the solid-waste leachate, the greater the attenuation of metal ions. The attenuation of Al, Be, Cr(VI), and Fe(II) was significantly influenced by flux. The absolute amount retained by the soil was influenced to the greatest extent by the concentration of the metal in the leachate. Flow rate of leachates from solid waste disposal sites can be controlled by controlling flux. Renovating the soil, lining the excavation, and compacting the waste to known densities are possible control techniques. (Small-FRC)
W82-00565

THE TOXIC WASTE DUMP PROBLEM AND A SUGGESTED INSURANCE PROGRAM,

State Univ. of New York Coll. at Fredonia. Dept. of Economics.
A. Fisher.
Boston College Environmental Affairs Law Review, Vol 8, No 3, p 421-461, 1980. 138 Ref.

Descriptors: *Hazardous materials, *Waste dumps, *Insurance, Toxins, Legal aspects, Safety, Landfills, *Waste disposal, Economic aspects, Environmental effects.

A National Hazardous Waste Insurance Program is discussed, and existing and pending legislation related to toxic waste disposal is reviewed. Available knowledge about the number and location of toxic waste sites and estimates of cleanup costs is presented. The environmental policy suggested here is similar in rationale and structure to the National Flood Insurance Program. It would give potential victims the opportunity to protect themselves from hazardous waste damages through the purchase of federally subsidized insurance. This could reduce disaster relief payments and promote development planning focused on reducing the chance of toxic waste damage. New York's Love Canal, Kentucky's Valley of the Drums, and North Carolina's 210 miles of PCB-contaminated highways are examples of hazardous waste disasters. The shortcomings of dump and landfill disposal of chemical wastes are highlighted by the Love Canal episode. (Small-FRC)
W82-00591

BENTONITE LINERS FOR POWER PLANT LAGOONS,

West Virginia Univ., Morgantown.
F. J. Calzonetti.
Power Engineering, Vol 84, No 3, p 61-62, March, 1980. 1 Fig, 2 Tab.

Descriptors: *Lagoons, *Bentonite, Linings, Wastewater lagoons, *Powerplants, *Waste disposal.

Waste disposal facilities to handle power plant wastes must be designed and sited so that ground and surface water resources are not contaminated. The Resource Conservation and Recovery Act of 1976 (RCRA) designates wastes as either hazardous or solid, and defines treatments accordingly. The use of natural clays as inexpensive and effective liners to control the seepage of leachates from energy facility waste ponds and lagoons is permissible. Alternatives such as synthetic membranes are commonly used, but do not appear as effective as natural clays. One particular clay, bentonite, has been the subject of much attention due to its swelling properties and ability to increase soil impermeability. Bentonite is a variety of montmorillonite clay, which was formed from volcanic ash and occurs in commercial quantities in Wyoming, Montana and South Dakota. The clay has exchangeable sodium ions and when wetted swells 15 to 20 times in volume. It is currently used across the nation for lagoon lining purposes. Untreated bentonite sells for $50 to $60 a ton plus trransportation charges. The soil texture of the site and the transport costs incurred in shipping bentonite from Wyoming to the energy facility are prime determinants of the cost of using bentonite filters. (Baker-FRC)
W82-00617

TRACE ELEMENT ACCUMULATION, MOVEMENT, AND DISTRIBUTION IN THE SOIL PROFILE FROM MASSIVE APPLICATIONS OF SEWAGE SLUDGE,

California Univ., Berkeley. Dept. of Soils and Plant Nutrition.
D. E. Williams, J. Vlamis, A. H. Pukite, and J. E. Corey.
Soil Science, Vol 129, No 2, p 119-132, February, 1980. 7 Fig, 5 Tab, 73 Ref.

Descriptors: *Trace elements, *Land disposal, *Sludge disposal, Accumulation, Barley, Heavy metals, Cadmium, Zinc, Lead, Copper, Soils, *Path of pollutants.

Sewage sludge was applied three times annually to soil on which barley was grown. One sludge was a wet cake type with a considerable amount of heavy metals, while the second air-dried sludge was primarily domestic in origin. Application rates varied from 0 to 225 metric tons/ha/yr, and the sludges were mixed into the surface 20 cm of soil. In general, sludge application was found to increase the amounts of HNO3-extractable heavy metals. DTPA extracts indicated that Cd, Zn, Pb, and Cu were highly available; Mn, Co, and Ni were moderately to slightly available; and Fe and Cr were relatively unavailable. When sludge high in metals was added, increased metal content and metal movement were limited to a depth of 30 cm, which was 10 cm below the area of sludge incorporation. The wet sludge cake resulted in increased acidity of the soil, but metal availability was not increased by this acidity. (Small-FRC)
W82-00640

EFFECT OF IRRIGATING LOAMY SAND SOIL BY LIQUID SEWAGE SLUDGE ON ITS CONTENT OF SOME MICRONUTRIENTS,

Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
F. M. Abdou, and M. El-Nennah.
Plant and Soil, Vol 56, No 1, p 53-57, 1980. 2 Tab, 12 Ref.

Descriptors: *Wastewater irrigation, Wastewater farming, *Metals, Liquid sludge, Organic matter, Zinc, Iron, Manganese, Nutrients, Land disposal.

The effect of irrigating loamy sand soil of the El-Gabal El-Asfar area near Cairo with liquid sewage sludge was investigated for some micronutrients in these soils. Levels of Zn, Fe, and Mn were determined in soils thus irrigated for 2, 25, 35, and 45 years. Sewage sludge irrigation increased both the CEC (cation exchange capacity) and organic matter content of the tested soils. There was a marked increase in the easily soluble forms of Zn, Fe, and Mn. Thus, the sludge could be used as a plant nutrient source or as a soil improver. However, the increase of these metals in soil may decrease the activity of some soil enzymes and disturb the N-mineralization. Agricultural areas irrigated with sludge must be monitored for increased levels of Pb, Cd, and Hg, even though there have been no symptoms of toxicity observed on plants growing at the current disposal site. (Small-FRC)
W82-00661

PERSISTENCE AND DISTRIBUTION OF ERYSIPELOTHRIX RHUSIOPATHIAE AND BACTERIAL INDICATOR ORGANISMS ON LAND USED FOR DISPOSAL OF PIGGERY EFFLUENT,
Victoria Dept. of Agriculture (Australia). Attwood Veterinary Research Lab.
For primary bibliographic entry see Field 5B.
W82-00686

DAIRY LIQUID WASTE DISTRIBUTION IN AN OVERLAND FLOW VEGETATIVE-SOIL FILTER SYSTEM,
Southern Illinois Univ. at Carbondale. Dept. of Agricultural Industries.
For primary bibliographic entry see Field 5D.
W82-00897

POTENTIAL FOR LAND DISPOSAL OF TWO NONBIODEGRADABLE WASTES,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W82-00939

EXTRACTING HEAVY METALS AND TOXIC ORGANICS FROM SLUDGE,
For primary bibliographic entry see Field 5D.
W82-00947

COMPOSTING IS WORKING IN CAMDEN,
Camden County Municipal Utilities Authority, NJ.
J. D. Ochs.
Water/Enineering and Management, Vol REF, No HB, p R138-140, 1981.

Descriptors: *Composting, Pilot plants, *Sludge disposal, Land application, Camden, *New Jersey, Sludge, Bulking sludge, Cost analysis.

A pilot plant was constructed in Camden County, New Jersey, to study whether composting is a good solution for Camden's sludge disposal problem. Early in the planning stage of the composting operation, the basic objective of the program had to be defined. The process was designed to make a product for multiple uses. These uses are enhanced if the plant nutrient/soil structure properties are maximized, and attempts have been made toward that end in this particular program. The compost facility can handle 26 dry tons per day, or 104 wet tons of 25% solids, operating on a two ton shift, five days per week schedule. Raw primary sludge is accumulated in a day holding tank. Moyno sludge pumps feed the 5% solids sludge to two of three Carter belt-filter presses. The third press is for standby use. The dewatered sludge is discharged to a conveyor which transports it over an automatic scale. The scale signals an automatic woodchip feeding system to regulate the ratio of bulking material added to the sludge. The composting process involves laying down a pile of woodchip/sludge mixture onto perforated iron pipes that have been covered with a layer of new woodchips about 1.5 to 2 ft deep and about 7 ft wide. Each pile is aerated for a minimum of 21 days. One of the primary cost factors in the process is the purchase of woodchips. One of the principal users of the compost to date has been a large commercial greenhouse operation. (Baker-FRC)
W82-00948

EVALUATION OF WINTER APPLICATION OF LIQUID SLUDGE TO FARMLAND,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5B.
W82-00952

TRENCHING OF DIGESTED SLUDGE,
Science and Education Administration, Beltsville, MD.
L. J. Sikora, N. H. Frankos, C. M. Murray, and J. M. Walker.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 351-361, April, 1980. 5 Tab, 18 Ref.

Descriptors: *Sludge disposal, *Trenches, Ditches, Nitrogen, Sludge digestion, Sludge cake, Sludge, Wastewater, *Leaching, Chlorides, Salts, Metals, Chemical analysis.

In trenching digested sludge, a sludge filter cake of about 20% solids is placed in trenches about 2 feet wide by 2.5 feet deep and 2 feet apart. Trenches are filled to about 80% of capacity with sludge and covered with soil from adjacent, recently dug trenches. The environmental effects of trenching were studied using varying size trenches, types of sludge and soil types. The plots containing the digested sludge trenches were located in a loamy sand of the Galestown-Evesboro series. One tillage practice studied involved leaving mounds over the trenches intact. A second treatment involved leveling and disking the area. A third treatment involved leveling and cross ripping perpendicular to the trenches with ripper shanks. Much of the chloride initially present in the sludge was leached into the profile during the first year. After 4 years nearly all the chloride was leached. More nitrogen was leached during the first two years than during the next two, with the predominant nitrogen form found in the soil being ammonia-nitrogen. After four years the sludge in the trench was near or at stabilization. The amount of mineralizable nitrogen in the sludge was low, with soil profiles having low levels of inorganic nitrogen and chloride. Zinc was the only metal found in detectable levels in the soil beneath the trenches. The amount of zinc leached was minor compared with the total zinc concentration in the entrenched sludge. Environmental effects would be primarily felt on the groundwater. The severity of the effect would be site specific, depending on soil type, depth of ground water, infiltration rate, and sludge type. (Baker-FRC)
W82-00974

A SIMULATION MODEL FOR SLUDGE DECOMPOSITION IN SOIL,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
J. T. Gilmour, and C. M. Gilmour.
Journal of Environmental Quality, Vol 9, No 2, p 194-199, April/June, 1980. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Model studies, *Sludge disposal, *Decomposition, Mathematical studies, Waste disposal, Simulation analysis, Soil amendments, Sludge, Soil water, Soil temperature, Sludge digestion, *Carbon, Carbon dioxide.

A computer model called SLUDGE was designed to calculate the amount of sludge carbon compounds converted to C02-C as a function of time for a single sludge addition incorporated into a medium-textured soil. As the type of C source undergoing decomposition varied and the temperature and water content changed, the rate constant of the expression was modified. During the rapid decomposition phase, the paradigm computes decomposition on a daily basis, and during the slow phase, on a monthly basis. The model was tested using synthetic sludge decomposition data and decomposition data for municipal sludge. Fifty percent of the municipal sludge was decomposed over a 32- to 57-month period. Yearly soil temperature and water content averages gave less accurate predictions than monthly data when used in the model. Laboratory optimum conditions ggave shorter sludge half-life times than did field conditions. When the model was modified to include annual June additions of sludge, the ratio of accumulated sludge to an annual addition was from 4.3 to 7.9 after 50 yr. These ratios were greater than those computed by equations designed to calculate such ratios under constant soil conditions. (Geiger-FRC)
W82-01001

CHEMICALS DISINFECT SLUDGE,
Universidad Autonoma de Nuevo Leon, Monterrey (Mexico).
For primary bibliographic entry see Field 5D.
W82-01003

DISSOLUTION OF SALT DEPOSITS BY BRINE DENSITY FLOW,
New Mexico Univ., Albuquerque. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01016

DREDGING AND DISPOSAL OF TOXIC MATERIAL USING JAPANESE TECHNOLOGY SUGGESTED FOR UNITED STATES,
F. T. Wooton.
World Dredging and Marine Construction, Vol 16, No 4, p 14-15, April, 1980.

Descriptors: *Dredging, *Hazardous materials, *Technology, Toxins, Japan, Spoil banks, Ocean dumping, Waste management.

The maintenance of navigation channels and harbors in Virginia is becoming extremely difficult due to the lack of dredging technology in the United States. Dredging activities will continue to be limited unless dredging and disposal methods which comply with existing environmental standards are developed. Currently, the extent and type of dredging which can be performed is determined by the pollutants in the rivers and harbors. Dredging and disposal methods used in Japan were investigated as part of an effort to develop alternative strategies for this project. The Japanese have made significant advances in the dredging field in order to eliminate severe pollution problems in their harbors. A dredge called the 'Oozer' has been developed which dredges about 80 percent solids and 20 percent water, compared to almost exactly opposite proportions dredged by a typical hydraulic dredge in the United States. In Japan, polluted dredged material is treated prior to disposal. A soil fixation process has also been developed which locks pollutants to the material being dredged and solidifies the dredged material in only a few days. This process, called the Takenaka Sludge Treatment, can be performed in a disposal area which can later be used for industrial development. The 'Oozer' appears to be capable of dredging most areas of the James River and its tributaries, as well as other areas polluted by toxic substances. (Carroll-FRC)
W82-01026

5F. Water Treatment and Quality Alteration

WHAT CAUSED THE BAD ODOR IN THE DRINKING WATER,
Williamsport Sanitary Authority, PA.
M. H. Gerardi, and M. B. Gerardi.
Water/Engineering and Management, Vol 128, No 6, p 63-65, June, 1981. 3 Tab.

Descriptors: *Drinking water, *Odors, Chemical analysis, Organic compounds, Water analysis, Bacteria, Temperature effects, Reservoirs, Potable water, Acidity, Heated water, *Odor removal, *Home water heaters, Williamsport, Pennsylvania.

Drinking water supplies for about 60,000 people in the Williamsport, PA area and several adjacent communities come from two 350 mg capacity reservoirs and a well field. During February of 1980 numerous complaints were made about a fishy or rancid odor present in the tap water supply. The odor was associated with the Hagerman Reservoir, was present only in hot water, was most objectionable in water drawn from hot water tanks which had a thermostat setting of at least 140 degrees F, and was most evident to consumers who drew from their hot water tanks in the morning and then not again until the evening, allowing the hot water in the tank to stand for 8-10 hr before use. Investigation indicated that a rancid odor was produced by Nocardia species of bacteria at pH 8.5 and 140 degrees F on Standard Methods Agar and Dextrose Tryptone Agar. Samples containing the rancid odor were analyzed. Organics identified included unsaturated and saturated aliphatic esters and ketone, amide, and carboxylic acid salts. To correct the problem customers were asked to reduce their thermostat settings to 120 degrees F. Within two days a reduction in odor was noted by

customers who complied with this request. To control Nocardia growth the pH of Hagerman Reservoir water was decreased by discontinuing the addition of soda ash. (Baker-FRC)
W82-00527

CHRYSOTILE ASBESTOS FIBER REMOVAL DURING POTABLE WATER TREATMENT. PILOT PLANT STUDIES,

Ontario Ministry of the Environment, Toronto.
R. B. Hunsinger, K. J. Roberts, and J. Lawrence.
Environmental Science and Technology, Vol 14, No 3, p 333-336, March, 1980. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Water treatment, *Asbestos, Turbidity, Filtration, Coagulation, Sedimentation, *Drinking water, Water analysis, Potable water.

Various pretreatment and filtration processes for chrysotile asbestos fiber removal from surface water were evaluated at a pilot scale treatment facility equipped with full process control. In the majority of cases filtration significantly reduced the amount of asbestos in the water from that which was encountered in the postsedimentation samples. Fiber concentrations in the finished waters were below 1,000,000 fibers/liter in all but two of the cases and below 500,000 fibers/liter in 76% of the cases. The dual media filters produced an effluent that was superior to the sand filter effluent in terms of turbidity. The actual asbestos fiber counts also reflected the superiority of the dual media filters. There does not appear to be any direct relationship between the initial and final asbestos fiber concentrations across the process. However, from a general examination of the data it is apparent that the asbestos concentrations in the filter effluents are lower than those in the raw or postsedimentation water, indicating that conventional treatment processes are effective in reducing chrysotile concentrations. The lack of a specific relation between initial and final concentrations could be due to either inconsistencies in the unit processes or inherent inaccuracies in the analytical methodology. It was concluded that objective predictions and/or decisions regarding treatment efficiency are presently impossible given the current state-of-the-art in counting technology. Consistent quantitative analysis of chrysotile asbestos fibers in river water following fortification with a concentrated chrysotile asbestos suspension could not be obtained. (Baker-FRC)
W82-00613

COAL TAR COATINGS OF STORAGE TANKS. A SOURCE OF CONTAMINATION OF THE POTABLE WATER SUPPLY,

New York State Dept. of Health, Albany. Div. of Lab. and Research.
For primary bibliographic entry see Field 5B.
W82-00616

WATER-TREATMENT CHEMICALS,

S. Miller.
Environmental Science and Technology, Vol 14, No 8, p 914-915, August, 1980.

Descriptors: *Water treatment, *Chemical treatment, Wastewater treatment, Chemical properties, Chemical reactions, Toxicity, Coagulation, Disinfection, Oxidation, Dispersants, Chemical coagulation, Catalysts, Water softening, *Water supply, Drinking water.

Nine experts from various areas of water supply, water treatment, toxicology, chemistry, engineering, analytical testing, and manufacturing procedures have been called upon by the National Academy of Sciences (NAS) to serve as a committee to examine the approximately 60 bulk chemicals used in the treatment of drinking water. The chemicals used in water treatment can be roughly divided into four major categories: coagulants and flocculants, disinfectants and oxidizers, precipitants and softeners, and miscellaneous reagents. The committee will attempt to establish guidelines for the use of these chemicals and to establish analytical tests for impurities in the bulk chemicals themselves. The ultimate product from this committee is envisioned to be a manual something like the Food Chemical Codex of 1974. Potential health problems are posed by the presence of chloroform in chlorine used for disinfection, presence of fluorides and arsenic in phosphates, heavy metal contamination, manganese and lead impurities in iron salts, and organic contaminants in polymeric coagulant aids. (Baker-FRC)
W82-00618

ADSORPTION ON CARBON: SOLVENT EFFECTS ON ADSORPTION,

S. Miller.
Environmental Science and Technology, Vol 14, No 9, p 1037-1040, 1042, 1045-1049, September, 1980. 8 Fig, 8 Tab.

Descriptors: *Solvents, *Adsorption, *Carbon, Solvophobic theory, *Water treatment, Wastewater treatment, Pollution control, Activated carbon, Adsorbents, Surface tension.

Attempts to include the solvent and its surface tension in equilibrium adsorption formalism are discussed. A semiempirical quasitheoretical approach based on partial solubility parameters called the net adsorption energy approach is presented. A general comprehensive solution interaction approach recently adapted to the adsorption of organic homologues from dilute aqueous solutions is presented. The ability to predict the effects of even simple structural modifications on the adsorption of organic molecules from dilute aqueous solutions onto activated carbon or other adsorbents could be of great value in the design and operation of large-scale commercial water or waste water treatment plants. At present attempts are being made to apply the solvophobic theory for correlating the removal of homologous organic compounds by widely different unit processes such as adsorption, hyperfiltration, and biological metabolism. Solvent interactions are significant in these as well as many other processes. (Baker-FRC)
W82-00619

MANAGEMENT TRAINING IS THE KEY TO GOOD OPERATOR PERFORMANCE,

For primary bibliographic entry see Field 5D.
W82-00623

ENVIRONMENTAL HEALTH HAZARDS,

S. Miller.
Environmental Science and Technology, Vol 14, No 6, p 648-651, June, 1980. 1 Fig.

Descriptors: *Drinking water, *Public health, Organic compounds, Disinfection, Chlorine, Activated carbon, Toxicity, Epidemiology, Human diseases, Cancer, Regulations, *Hazardous materials.

The National Academy of Sciences (NAS) has organized a Board on Toxicology and Environmental Health Hazards. This board serves the federal government, particularly regulatory agencies, by providing comprehensive documents on pollutants and risk assessments of hazardous agents and studies of scientific concepts underlying interpretation of toxicologic and epidemiologic data. The Safe Drinking Water Committee started its review of adverse health effects attributable to contaminants in drinking water in the fall of 1975. In late 1977 the first NAS report, 'Drinking Water and Health,' a 939 page document, was published. Volumes II and III have since appeared. Volume II deals with disinfection of drinking water, chemistry of disinfectants in water, and an evaluation of granular activated carbon for drinking water treatment. Volume III considers epidemiological studies of cancer frequency and certain organic constituents of drinking water, problems of risk assessment, toxicity of selected drinking water contaminants, and contributions of drinking water to mineral nutrition of humans. (Baker-FRC)
W82-00625

ANTIBIOTIC-RESISTANT BACTERIA IN DRINKING WATER,

Oregon State Univ., Corvallis. Dept. of Microbiology.
J. L. Armstrong, D. S. Shigeno, J. J. Calomiris, and R. J. Seidler.
Applied and Environmental Microbiology, Vol 42, No 2, p 277-283, August, 1981. 4 Fig, 1 Tab, 35 Ref.

Descriptors: *Drinking water, *Bacteria, *Drugs, Water quality, Public health, Pathogenic bacteria, Raw water, Water distribution.

The prevalence of drug-resistant bacteria in treated drinking waters and their relationships to multiple antibiotic resistant (MAR) bacteria in the raw source water were investigated. Drinking water from seven communities was sampled and analyzed for MAR bacteria. The MAR bacteria isolates obtained were screened against five antibiotics by replica plating. MAR bacteria made up 33.9% of 2653 standard plate count bacteria from the treated water. In two of the raw water supplies, MAR standard plate count bacteria were carried at frequencies of 20.4 and 18.6%, while levels in the respective treated waters were 36.7 and 67.8%. The following were more common in treated than untreated waters: gram-positive cocci and gram-negative, nonfermentive rods. Site-to-site variations indicated that the shedding of MAR bacteria living in pipelines may influence the populations found in tap water. The treatment of raw water and its subsequent distribution select for standard plate count bacteria exhibiting the MAR phenotype. (Small-FRC)
W82-00645

EFFECT OF OZONATION AND CHLORINATION ON THE MUTAGENIC POTENTIAL OF DRINKING WATER,

Florence Univ. (Italy). Inst. of Pharmacology.
For primary bibliographic entry see Field 5A.
W82-00649

ACUTE AND CHRONIC EFFECTS OF ALUM TO MIDGE LARVA (DIPTERA: CHIRONOMIDAE),

Kennedy (Michael), Spokane, WA.
D. S. Lamb, and G. C. Bailey.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 1, p 59-67, 1981. 1 Fig, 18 Ref.

Descriptors: *Alum, *Aquatic insects, *Toxicity, *Water treatment, Mortality, Fish food, Lakes, Assay, *Eutrophic lakes.

In view of the increasing use of alum to precipitate phosphorus in highly eutrophic lakes, the acute and chronic effects of alum to Tanytarsus dissimilis, important fish food organisms, were determined. Acute tests used alum concentrations of 80, 160, 240, 320, 400, 480, 560, 720, and 960 mg/liter. Chronic test solutions contained 10, 80, 240, 480, and 960 mg/liter of alum. In acute tests there was no apparent effect of alum on either second or third instar T. dissimilis at does between 80 and 960. Mortalities in the chronic assay were found at all alum doses. Fifty percent mortality was reached with 480 mg/liter at four days. The 50% mortality time for 80 and 240 mg/liter was between 8 and 10.5 days. At 960 mg/liter, 50% of the larvae were dead after 23 days. Heavy alum floc at 960 mg/liter appeared to cause a stress by impeding movements and feedings. Possible chemical and physical toxicity of alum must be considered when planning lake treatments. A well planned alum treatment will avoid adverse effects on the benthic insect population. (Small-FRC)
W82-00650

FLOCCULATION OF CLAY PARTICLES WITH A SYNTHETIC ANIONIC POLYMER,

Amsterdam Public Works (Netherlands).
R. R. Kruize.
Effluent and Water Treatment Journal, Vol 21, No 5, p 205-209, May 1981. 5 Fig, 9 Ref.

Descriptors: *Flocculation, *Polymers, *Clays, Turbidity, *Water treatment, Salts, Coagulation, Superfloc A-100, Adsorption, Particulate matter.

A synthetic anionic polymer, Superfloc A-100, was tested in the coagulation step of drinking water treatment using a model suspension of Winsumclay

in jar tests. Maximum flocculation (78%) occurred at 0.2-0.3 mg polymer per liter. Salt is necessary for the flocculation process. Speed of stirring higher than G = 60 per sec destroys already-formed flocs. At higher concentrations of clay, less polymer is needed to achieve the same results. At low clay concentrations sludge recirculation can improve flocculation. Higher cation valency (NaCl, CaC12, and La (N03)3) decreases the amount of salt necessary and increases maximum coagulation. Decreasing pH improves flocculation and adsorption. (Cassar-FRC)
W82-00773

REMOVAL OF NITRATE FROM PUBLIC WATER SUPPLY ABSTRACTIONS,

Anglian Water Authority (England).
L. A. Greene.
Effluent and Water Treatment Journal, Vol 21, No 4, p 161-165, April, 1981. 10 Ref.

Descriptors: *Nitrates, *Ion exchange, *Denitrification, Reverse osmosis, *Water treatment, Rivers, Sludge disposal, Pretreatment, Anglia, *Great Britain.

A review is presented on research being carried out in Anglia on treatment methods for the control of nitrate levels in public water supplies. Continuous ion exchange plants operating under optimal conditions can effectively reduce nitrates, but skilled maintenance is required in these plants. Fixed-bed nitrate removal plants operating under counter flow regeneration conditions can produce water with acceptable nitrate levels. If the shells are regenerated before nitrate breakthrough, sulfate, bicarbonate, and chloride can be removed sufficiently. Effluent disposal has been a problem; reverse osmosis can be employed to reduce the volume of effluent by 35-40%. Spiral wound reverse osmosis can concentrate effluent by 85%. Application of biological denitrification to full-scale river abstraction is being studied. Denitrification can be monitored by an automated monitor system preceded by a continuous sample system. The pretreatment plant can use methanol as the carbon source or ion exchange pilot columns. These techniques can also be applied to pumped storage impoundments. (Small-FRC)
W82-00774

MANGANESE DIOXIDE AS AN ADSORBANT FOR HEAVY METALS,

West Kent Water Co. (England).
M. J. Gray.
Effluent and Water Treatment Journal, Vol 21, No 5, p 201-203, May, 1981. 1 Tab, 32 Ref.

Descriptors: *Manganese dioxide, *Adsorption, *Heavy metals, Metals, Zinc, Cadmium, Cobalt, Nickel, Cations, Radioactive wastes, *Wastewater treatment, Water treatment, Monitoring, Chemical properties.

The surface properties, adsorption of cations, and possible uses of manganese dioxide in water treatment are discussed in this review. In natural waters Mn02 has a strong negative charge, capable of adsorbing cations, and a large surface area, up to 800 sq meters per g. Heavy metal ions are adsorbed in decreasing order: Mn(2+)>Zn(2+)>Cd(2+)>Co(2+)>Ni(2+). Adsorption is greater and less reversible for heavy metals than for alkaline earth metals. Adsorption of cations increases with increasing pH and increasing temperature. Possible applications of the properties are: monitoring trace elements in water distribution systems through nodule and deposit formation; removal of Cs137, Ce131, Sr90, and Ra from aqueous solutions; coprecipitation with radioactive wastes to minimize leaching; and removal of Cd in water and wastewater treatment. (Cassar-FRC)
W82-00775

INTERACTION OF ORTHOPHOSPHATE WITH IRON (III) AND ALUMINUM HYDROXIDES,

Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2H.
W82-00783

POINT-OF-USE WATER TREATMENT...AN ENLARGING REALITY,

For primary bibliographic entry see Field 10D.
W82-00784

ASSESSMENT OF SOME AQUEOUS RESIDUAL CHLORINE MEASUREMENTS,

Environmental Health Directorate, Ottawa (Ontario).
R. Otson, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology, Vol. 24, No. 2, p 251-256, 1980. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Chlorine, *Water sampling, *Monitoring, *Water treatment, *Residual chlorine, *Potable water, Organic carbon, Carbon, Experimental design, Dringking water, Water purification, Sewage effluent, Residual chlorine, Storage.

Sodium hypochlorite solutions, filter, plant effluent, and tap water were analyzed by the amperometric titration, residual chlorine electrode, and ferrous titrimetric methods, and the results were compared for the range 0.2 to 2.0 ppm residual chlorine. Overall precision for measurements by all three methods and in three laboratories was within 20 percent. Amperometric titration is the preferred method because of precision of measurements, simplicity of operation, and capability for multiple determinations. (Titus-FRC)
W82-00867

THE REMOVAL OF ORGANIC MATTER FROM DEMINERALISED WATER,

Central Electricity Generating Board (England). Northwestern Region.
G. Knowles, and K. Tittle.
Effluent and Water Treatment Journal, Vol 20, No 7, p 317-319, 321-322, July, 1980. 4 Fig, 5 Tab.

Descriptors: *Ion exchange, *Organic matter, *Condensates, Water treatment, *Water purification, Anion exchange, *Powerplants, Activated carbon, Water quality, Fouling, Pretreatment of water.

Organic fouling of ion exchange resins caused serious reduction in efficiency in a powerplant condensate purification plant. The source of organic matter was makeup water with levels of 0.2-1.0 mg per kg total organic carbon. Organic removal was studied at 4 stages of purification--pretreatment, anion resin beds, scavenger beds at the water plant inlet, and polishing beds at the outlet. An attempt to pretreat the makeup water with sand filtration and alum achieved only a 14.3% removal and placed an extra burden on the anion exchange unit. In the anion beds organic matter was anion exchanged onto the resin and subsequently was displaced by stronger anions. Retained organic matter was on the order of 0.42-0.46 kg per cu Cm of resin, as expected. No real difference was seen in the performance of the presently used anion resin, FFIP, and the 2 possible alternatives, IRA 900 and IRA 458. Use of scavengers, IRA 904 (a strong base anion resin) followed by Zerolit 225 (a cation bed), prior to the anion exchange was disappointing because removal efficiency was 78-80% at the anion outlet compared with 88% when the scavenger was bypassed. Although activated carbon as a scavenger removed 95% of organic matter up to the passage of 1800 bed volumes, its efficiency deteriorated to 50% after 6000 bed volumes. Polishing beds of activated carbon produced 50% removal or less after about 3000-15,000 bed volumes. A Type 1 resin, OH(-) form IRA 938, removed 60-67% of organic matter with regeneration every 4000 bed volumes. The advantages, disadvantages, and cost estimates of the 3 most likely options (activated carbon at the treatment plant inlet, activated carbon at the mixed bed outlet, or IRA 938 at the mixed bed outlet) were evaluated. Tests are underway to determine if IRA 938 has an operating life of at least 1.5 years, the breakeven point. (Cassar-FRC)
W82-00888

DIRECT FILTRATION STUDIES AT TRAVERSE CITY WATER TREATMENT PLANT,

Water Treatment Plant, Traverse City, MI.
R. Bowen.
Water/Engineering and Management, Vol 128, No 7, p 30-33, July, 1981. 1 Fig, 2 Tab.

Descriptors: *Turbidity, *Filter media, *Direct filtration, Water treatment, Alum, Raw water, *Traverse City, Michigan, Lake Michigan, Coagulation, *Filtration, Water treatment facilities.

A detailed study at the Traverse City, Michigan, water treatment plant led to the conclusion that treating the stable, low turbidity (average 0.6 NTU) raw water by direct filtration was superior to conventional treatment. Filters in the plant were: two dual-media (coal and sand) and one mixed-media (coal, sand, and garnet). Without alum addition, the mixed-media filter was superior. As alum dosage neared the optimum, mixed-media filtration was only slightly better than that with the dual-media filter. It was difficult to determine the optimum alum dosage, and residual alum was a problem. Temperature was critical to the filter run length. Runs were shorter at 36-38 F than at higher temperatures. (Cassar-FRC)
W82-00945

LOW TURBIDITY WATER FROM FAST PROCESSES,

Burlington Water Dept., VT.
T. Atherton,, and J. Goss.
Water/Engineering and Management, Vol 128, No 7, p 40-43, July, 1981. 3 Fig, 4 Tab.

Descriptors: *Turbidity, *Filtration, *Clarification, *Water treatment, *Burlington, Vermont, Pilot plants, Sand, Filter media, Flocculation, Water quality, Super-Pulsator clarifier.

The water treatment plant for the City of Burlington, Vermont, used microstraining followed by low-head automatic backwash filtration to treat low turbidity (5-15 NTU) Lake Champlain water. The flocculation and sedimentation steps were not considered necessary to meet the drinking water standards of 5 NTU in force in 1959. When turbidity maximum standards were reduced to 1 NTU in 1977, the plant was unable to meet the requirements on some occasions. A search for process modifications eliminated in-line filtration, direct filtration, and a new plant in favor of the Super-Pulsator process, which combines flocculation and clarification. A sludge blanket is formed and raw water with added chemicals is gently pulsed upward through the blanket using a vacuum process. Flocculation occurs within the sludge blanket, part of which is skimmed off the top with each pulsing cycle. Eighteen pilot filter tests on 5 media (sand at different depths and particle sizes and sand-coal) gave information on effluent turbidity, terminal headloss, and run length. Run No. 12, using single sand media, 30 inches deep, effective size 0.65-0.75 mm, at a loading of 4.0 gpm per sq ft produced a 0.21 NTU effluent from a 0.51 NTU influent with terminal headloss of 51 inches and run length of 7.2 hours. Color and Na were unaffected, and Fe was reduced by 50%. The upgraded facilities, scheduled for start of construction in fall 1981, will process 9 mgd more than the current capacity of 10 mgd. (Cassar-FRC)
W82-00946

REMOVING TRIHALOMETHANES FROM DRINKING WATER,

Environmental Protection Agency, Cincinnati, OH.
J. M. Symons, A. A. Stevens, R. M. Clark, E. E. Geldreich, and O. T. Love, Jr.
Water/Engineering and Management, Vol 128, No 7, p 50, 52, 53, 56, 61-64, July, 1981. 1 Tab, 11 Ref.

Descriptors: *Trihalomethanes *Chlorination, *Disinfectants, Standards, Drinking water, *Water treatment, Chlorinated hydrocarbons, Organic compounds, Humic acids, Ozonation, Chlorine dioxide, Aeration, Activated carbon, Adsorption, Clarification, Filtration, Costs, Residual chlorine.

Eleven treatment techniques for controlling trihalomethanes in drinking water are summarized in tabular form, listing treatment name, degree of

precursor removal, degree of trihalomethanes removal, other byproducts formed, degree of disinfection, and cost estimates for 20, 50, and 80% removal. According to EPA regulations, trihalomethanes, primarily formed by chlorination of humic materials in raw water, must not exceed 0.10 mg per liter in drinking water. Of the three unit processes—oxidation, aeration, and adsorption—each has advantages and disadvantages. Granular activated carbon, when fresh, is most effective in removing precursors, but this excellent performance is not long-lasting. Clarification, source control, oxidation, adsorption, biological degradation, and pH lowering also significantly lower precursor concentrations. The advantages and disadvantages of alternative disinfectants are discussed. Ozonation is very effective but has no residual action within the distribution system. Chloramines are easy to use and produce residual disinfection but are suspected of being toxic. Chlorine dioxide is very desirable as a disinfectant, but residuals in drinking water may exceed the 0.5 mg per liter limit. Four examples of treatment systems using chlorine as a disinfectant are discussed in detail to illustrate the evaluation process. (Cassar-FRC)
W82-00953

FERRIC CHLORIDE TAKES OVER,

Snell Environmental Group, Inc., Lansing, MI.
K. J. Guter, J. L. Mills, and P. G. Eberz.
Water/Engineering and Management, Vol 128, No 7, p 34-39, July, 1981. 1 Fig, 2 Tab.

Descriptors: *Ferric chloride, *Turbidity, *Coagulation, *Water treatment, Sludge excess, Clarification, East Lansing, *Michigan, Water treatment facilities.

Sludge buildup and turbidity problems in the water produced at the East Lansing-Meridian Township (Michigan) Water Treatment Plant were solved by replacing the ineffective alum coagulation system with ferric chloride at a concentration of 1.2 mg per liter Fe plus sludge recirculation. The liquid alum storage and feed system required only minor changes to accommodate the charge in chemicals. Hydrants are used to monitor the effectiveness of the process changes by noting the time required for turbidity to clear after opening the test hydrant. (Cassar-FRC)
W82-00954

ECONOMIC ANALYSIS OF GRANULAR-BED FILTRATION,

Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 279-291, April, 1980. 5 Fig, 13 Ref.

Descriptors: *Filtration, *Economic justification, Economic aspects, Filters, Design criteria, *Water treatment, Cost analysis, Costs.

Factors and limitations that determine whether or not a particular alternative will be cost effective for granular-bed filtration are presented. Equations are reviewed which are used to illustrate the effect of filter design and operating variables on the total annual cost of filtration, which is taken to be the sum of the annualized capital cost of the filter and the annual cost of operation. In order to compare the economic benefits of various alternatives, such as dual- and mixed-media beds, the analysis must include the effect of each on capital and operating costs. Whether the effluent quality is acceptable in both cases is determined by both the absolute and the relative magnitudes of the filter run lengths. High rate filtration appears to be economically justifiable for all practical filtration rates when the filter loading is within conventional limits. When direct filtration is used and higher solids loading rates occur, shorter run lengths, higher backwash frequency, and resulting higher operating costs may set an economic limit on the filtration rate that is near the range of current practice. Declining-rate filtration appears to have inherent characteristics that make it generally more economical than the constant-rate approach. Using the same design average filtration rate, the lower filtration rate at the end of the run in the declining-rate filter results in a greater water production per filter run. Combined with what is essentially the elimination of downtime per backwash, this effectively reduces both capital and operating costs. (Baker-FRC)
W82-00975

DISTRIBUTION SYSTEM LIABILITY,

Waukesha Water Utility, WI.
J. H. Kuranz.
Water and Sewage Works, Vol 127, No 7, p 40-41, 52, July, 1980. 1 Ref.

Descriptors: *Legal aspects, *Municipal water, Water quality, *Utilities, Water distribution, Water conveyance, *Metropolitan water management, Public health, Leakage, Liability, Negligence, Remedies, Regulations.

Both publicly owned and investor owned water utilities must face the question of the extent of their liabilities. There do not appear to be any definitive legal answers to this question at the present time. Although water utilities are not generally considered as insurers of the purity of the water furnished for public consumption, they are required to use reasonable care and diligence in providing pure and wholesome water and may be liable for resulting injuries if they do not. Water utilities have a duty and an obligation to provide quality water and service. They should protect their interests by carrying good insurance coverage and by conducting programs to ensure proper construction and maintenance of the distribution system. When water mains or laterals fail, the utility will be in a better position to defend itself if it can prove that adequate maintenance was performed and that the response to the failure was prompt. Various measures can be taken to strengthen the utility's position with respect to injury or property damage resulting from fire, thawing frozen laterals, overflowing storage tanks, and shutting off a water supply. Open excavations, blasting, and other activities related to the construction and repair of distribution system facilities place the utility and/or its contractor in a particularly vulnerable position. Benefits of litigation may include reduction of the number of claims as a result of placing the burden of proof upon the complainant, serving public notice that the utility will fight claims against it, and enhancing the public image and internal relations of the utility when negligence cannot be proved. (Carroll-FRC)
W82-01028

HOME WATER SOFTENERS, WATER SOFTNESS AND POSSIBLE HEALTH IMPLICATIONS,

Illinois Univ. at the Medical Center, Chicago. School of Public Health.
G. R. Brenniman, W. H. Kojola, and A. H. Wolff.
Journal of Environmental Health, Vol 43, No 1, p 19-21, July/August, 1980. 2 Tab, 17 Ref.

Descriptors: *Water softening, *Human diseases, Cardiovascular disease, Water treatment, Sodium, Magnesium, Calcium, Minerals, Chemical composition, Chemical analysis, Water analysis, Water quality, *Home water softeners.

This study investigates the degree to which home water softeners alter the concentrations of sodium, calcium and magnesium in drinking water and the relationship of these findings to cardiovascular disease. Water samples (615) were collected in West Dundee and McHenry, Illinois, from households which had ion exchange home water softeners. Identical studies were conducted on samples from 596 households without home water softeners. Home water softeners increased mean sodium concentrations 3.4 to 5 fold and reduced calcium and magnesium concentrations between 1.6 and 1.8 fold among the households sampled in West Dundee and McHenry. If the homeowner does not recharge the softener with salt or replace wornout resins, the efficiency of the softener in removing calcium, magnesium, and other divalent metallic cations is greatly reduced. Over 40% of the tap water from homes with softeners from either West Dundee or McHenry had mean sodium concentrations of 128.9 mg/liter or greater, and mean calcium and magnesium concentrations of 2.6 mg/liter or less. It is suggested that a study of the relationship between home water softener use and cardiovascular disease be made. (Baker-FRC)
W82-01045

DESIGN AND CONSTRUCTION OF THE DANVERS, MASSACHUSETTS WATER PROCESSING PLANT,

Jordan (Edward C.) Co., Inc., Portland, ME.
S. Medlar.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 2, p 175-179, March, 1980. 5 Ref.

Descriptors: *Design criteria, *Construction materials, Odor control, *Water supply, Color removal, Turbidity, Reservoir, Water treatment, Filtration, Adsorption, Cost effectiveness, Water quality, Chloroform, Mixing, Flocculation, Chemical coagulation, Chlorine, Lime, *Water treatment facilities, *Danvers, Massachusetts.

The design and construction of a water treatment plant in Danvers, Massachusetts is described. The water had high color, odor, iron, turbidity, and sediment, causing many consumer complaints, prior to treatment. The treatment process used was two-stage flash mixing, tapered flocculation, sedimentation, sand filtration, and granular activated carbon adsorption. Construction of the plant began in 1974 and was completed in 1977 at a cost of 4,400,000 dollars. The water supply was palatable for the first time in 100 years, as a result of the treatment plant. (Titus-FRC)
W82-01088

ASBESTOS CEMENT PIPE AND CANCER IN CONNECTICUT 1955-1974,

Yale Univ., New Haven, CT.
For primary bibliographic entry see Field 5C.
W82-01094

5G. Water Quality Control

POTENTIAL MANAGEMENT OF FLORIDA RED TIDE THROUGH SELECTIVE PHOTODYNAMIC ACTION,

University of South Florida, Tampa. Dept. of Chemistry.
J. Barltrop, B. B. Martin, and D. F. Martin.
Journal of Environmental Science and Health, Part A, Vol 15, No 2, p 163-171, 1980. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Red tide, *Water quality management, Dinoflagellates, Eutrophication, Chemical reactions, Photodynamic action, Hematoporphyrin, Porphyrin.

The effectiveness of the photodynamic action of hematoporphyrin was tested using the unarmored dinoflagellate, Gymnodinium breve. Four systems were compared: light control and dark control with the organisms in light or dark, respectively, for 24 hr versus dark and light test in which the organisms plus .00008M porphyrin are left in dark and light, respectively, for 24 hr. Essentially total destruction was noted for the last system (light test), while no statistically significant differences were noted among the other three systems. The effect of the concentration of porphyrin was tested in preliminary experiments. The percentage of red tide survival was not a linear function of porphyrin concentration. The porphyrin probably is not effective at 0.001 of the totally destructive concentration under the conditions of this experiment. However, 0.01 of the totally lethal concentration destroyed about 25% of the cells. These findings indicate the potential application of photodynamic action in the management of red tide blooms. (Baker-FRC)
W82-00515

THE DISTRIBUTION OF THE COSTS OF FEDERAL WATER POLLUTION CONTROL POLICY,

Resources for the Future, Washington, DC.

For primary bibliographic entry see Field 6B.
W82-00537

A PROCEDURE USING MODELING AND ERROR ANALYSIS FOR THE PREDICTION OF LAKE PHOSPHORUS CONCENTRATION FROM LAND USE INFORMATION,

Michigan State Univ., East Lansing. Dept. of Resource Development.
K. H. Reckhow, and J. T. Simpson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1439-1448, September, 1980. 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Model studies, *Water quality management, *Lakes, *Phosphorus, *Land use, Trophic level, Eutrophication, Mesotrophy, Oligotrophy, Mathematical studies, Watershed management, Error analysis, Prediction.

Recent studies on empirical lake modeling and error analysis have provided valuable methods for evaluating limnologic trophic quality. A technique is presented which utilizes previous models and land use data to predict lake phosphorus levels to aid in watershed management. The phosphorus flux from major types of land use is estimated along with the trophic state of the lake from the predicted phosphorus concentration. To supplement the prediction of phosphorus levels, a nonparametric error analysis is incorporated into the model. Uncertainty levels show the value of the model data generated. The procedure is applicable to most north temperate lakes, and an example of its use on Higgins Lake, Michigan is given. (Geiger-FRC)
W82-00546

DETOXIFICATION OF RESIDUAL QUATERNARIES,

Chemed Corp., Cincinnati, OH. (Assignee).
J. T. Jacob.
U.S. Patent No 4,204,954, 3 p, 3 Tab, 8 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1362, May 27, 1980.

Descriptors: *Patents, *Water treatment, *Industrial water, *Biocontrol, Chemical reactions, Neutralization, Toxicity, Water quality control, *Detoxification, Biocides, Quaternaries.

Several quaternaries are being used at the present time as biocides for the control of microbiological growth in aqueous systems. The residual quaternaries when discharged into waste streams will interfere in the biological treatment processes by inhibiting the growth of biomass. It has now been discovered that the toxic effect of the residual quaternary compounds can be removed by treating the aqueous solutions with anionic substances to neutralize the activity of the quaternaries by forming stable complexes and thus render them inactive towards aquatic life. (Sinha-OEIS)
W82-00562

TEMPORAL AND SPATIAL SCALES IN PHYTOPLANKTON ECOLOGY. MECHANISMS, METHODS, MODELS AND MANAGEMENT,

McMaster Univ., Hamilton (Ontario). Dept. of Biology.
G. P. Harris.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 5, p 877-900, May, 1980. 2 Fig, 339 Ref.

Descriptors: *Literature reviews, *Model studies, *Phytoplankton, Fluctuations, Ecology, Nutrients, Water quality management, Water quality control, Plankton, Lakes, Eutrophication, Phosphorus, Aquatic populations, Biomass, Aquatic productivity, Marine environment, Reviews, Freshwater environment.

The temporal and spatial scales of variability in marine and freshwater planktonic environments and the algal responses to them are reviewed. Problems exist with interpreting the results of nutrient model studies under nonsteady conditions. Evidence for the existence and importance of small scale, high frequency and large scale, low frequency variation in the planktonic environment is presented. Insufficient knowledge of planktonic processes may hinder the management of water quality. A new model of community structure and processes in variable environments is proposed which corrects for the algal scales of perturbation and response and permits certain predictions to be made. When the new paradigm is used, certain problems and controversies in the literature may be rectified and an enhanced ability to manage planktonic systems should result. (Geiger-FRC)
W82-00594

SYSTEM FOR OIL AND WATER SEPARATION,

For primary bibliographic entry see Field 5D.
W82-00611

THE NONFUEL MINERALS INDUSTRY: REGULATORY IMPACTS,

Mitre Corp., McLean, VA. METREK Div.
For primary bibliographic entry see Field 5B.
W82-00612

GROUNDWATER STRATEGIES,

J. Josephson.
Environmental Science and Technology, Vol 14, No 9, p 1030-1035, September, 1980. 4 Fig.

Descriptors: *Groundwater, *Pollution control, Groundwater management, Reviews, Decision making, Regulations, Administrative regulations, *Legal aspects.

Efforts underway by the Environmental Protection Agency and the United States Geological Survey to control and protect groundwater against pollution are reviewed. The EPA is conducting a three phase program. Phase I called for gathering information on water use, contamination, federal/state laws, programs, and the groundwater protection state of the art. Phase II involved workshops comprising representatives of government, business/industry, and professional and environmental advocacy groups. Phase III will be the strategy-determination phase. A clear statement of problems and issues being addressed, a national program with fully defined federal and state roles, a comprehensive EPA policy to apply to all programs concerned with groundwater, tighter relationships among cognizant federal, state and local government bodies, and a short-term action plant will all be a part of the final strategy. One topic of major interest has been the contamination plume which normally follows the direction of groundwater flow, but has been known in certain cases to deviate. Containment of these plumes comprises three principal concepts: complete horizontal and vertical blockage of plume migration, partial blockage wherein the migration is reduced, and removal of the plume through excavation or pumping out. Types of installations are briefly considered, and some attention is directed toward remedial measures. (Baker-FRC)
W82-00620

PRELIMINARY POLLUTANT LIMIT VALUES FOR HUMAN HEALTH EFFECTS,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
J. C. Dacre, D. H. Rosenblatt, and D. R. Cogley.
Environmental Science and Technology, Vol 14, No 7, p 778-780, 782-784, July, 1980. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Water pollution control, *Human diseases, Regulations, Administrative regulations, Standards, *Water quality standards, Specifications.

A preliminary pollutant limit value (PPLV) concept has been developed to predict probable environmental limits for pollutants. The PPLV is a temporary, nonregulatory value based on information currently available in the literature and that relates primarily to human health effects. PPLVs are determined in six steps: pollutants and pathways of exposure are identified; an acceptable daily dose of toxicant and partition coefficients are determined; relevant data are gathered; single pathway PPLVs are calculated for all pathways possible; critical pathways for each pollutant are selected; and the PPLV is derived by normalization of the single-pathway PPLV. The whole approach must be understood in a conceptual framework within which to provide environmental decisions. It is totally possible for two environmental engineers to obtain different results from the analysis of an identical situation. These differences may be the result of valid differences in judgement. The present treatment is only a start for critical examinations of other areas such as air pollution derived from sources in soil and water, and effects on aquatic organisms. (Baker-FRC)
W82-00628

THE DESIGN AND INTERPRETATION OF MARINE POLLUTION SURVEYS,

Clyde River Purification Board (Scotland).
For primary bibliographic entry see Field 6E.
W82-00700

GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN,

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
For primary bibliographic entry see Field 6E.
W82-00701

PHOSPHORUS MANAGEMENT FOR THE GREAT LAKES: FINAL REPORT OF THE PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE,

International Joint Commission-United States and Canada, Windsor (Ontario).
For primary bibliographic entry see Field 6E.
W82-00702

HEALTH IMPLICATIONS OF NON-NTA DETERGENT BUILDERS,

International Joint Commission-United States and Canada, Windsor (Ontario).
Report from the Task Force on the Health Effects of Non-NTA Detergent Builders. October, 1980. 80 p. 6 Tab, 100 Ref, 4 Append.

Descriptors: *Lakes, *Water quality, *Phosphorous removal, *Detergents, *Carbonates, Soaps, Phosphates, Phosphorus compounds, Wastewater treatment, Algal growth, Wastewater pollution, Algal blooms, Wastewater analysis, Data collection, *Great Lakes, International waters.

Under the 1972 Great Lakes Water Quality Agreement between Canada and the United States, measures were taken to reduce the input of phosphorus to the lakes from municipal sewage; phosphate contained in household detergents had been identified as a major contributors. Restrictions on the use of phosphate in detergents have led to an increase in the use of alternative detergent builders. The task force to study non-nitrilotriacetic acid detergent builders came to the following health effects conclusions related to these builders: (1) Carbonates, which occur naturally in water, have a long history of use as food additives, are classified as Generally Recognized as Safe (GRAS), and pose no human health hazard through their contribution of carbonate to drinking water. (2) Carboxymethyloxysuccinate (CMOS), which has been studied by Lever Brothers, is reported essentially non-toxic in those studies. (3) Carboxymethyltartronate (CMT) has been toxicologically studied by the Monsanto Company; however, the lack of primary data precludes a full assessment of its potential prolonged health effects. Based on its chemical structure and properties, CMT is not expected to pose undue health hazards. (4) Citrates ingested in drinking water have not revealed any health hazard, nor have mutagenic or teratogenic effects been reported. (5) Phosphates, soluble silicates, and Type A Zeolite are also considered to be safe to human health. (Garrison-Omniplan)
W82-00703

ECOLOGICAL EFFECTS OF NON-PHOSPHATE DETERGENT BUILDERS: FINAL REPORT ON ORGANIC BUILDERS OTHER THAN NTA,

International Joint Commission-United States and Canada, Windsor (Ontario).
Report from Task Force on Ecological Effects of Non-Phosphate Detergent Builders, July, 1980. 71 p. 7 Tab, 89 Ref, 1 Append.

Descriptors: *Lakes, *Water quality, *Phosphorous removal, *Detergents, *Phosphates, *Wastewater treatment, Soaps, Phosphorus compounds, Wastewater pollution, Algal growth, Wastewater analysis, Algal blooms, Data collection.

The Task Force on Ecological Effects of Non-Phosphate Detergent Builders was created because restrictions on detergent phosphates have been used increasingly with the result that alternate materials used by detergent manufacturers are released to the environment. The first report in this series, published in 1978, deals with the organic builder NTA (nitrilotriacetic acid). The three builders studied in this report are citrates, carboxymethyloxysuccinate (CMOS), and corboxymethyltartronate (CMT). Citrate is a natural product which is readily biodegradable by many organisms under aerobic and anaerobic wastewater treatment conditions. The Task Force believes that its use as a detergent builder will not be detrimental to the environment. However, its ability to stimulate algal growth by chelating heavy metals, its interference with the chemical precipitation of phosphate, and its removal during physiochemical treatment need to be studied further. CMOS, which does not occur in nature, is not likely to be detrimental to the environment, but investigations should be undertaken concerning (1) the effect of CMOS on dosages of chemicals used to precipitate phosphate; (2) the removal of CMOS during physiochemical treatment of wastewater; (3) the ability of CMOS to stimulate algal growth; and (4) the degradation of metal chelates of CMOS. CMT is not endorsed as a builder at this time. (Garrison-Omniplan)
W82-00704

REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE,

International Joint Commission-United States and Canada, Windsor (Ontario).
November, 1980. 127 p. 6 Fig, 17 Tab, 306 Ref.

Descriptors: *Lakes, *Ecosystems, *Hazardous materials, *Aquatic populations, *Water quality, Toxicity, Viruses, Enteroviruses, Lead. Coliforms, Bacteria, Nutrient removal, *Great Lakes.

The 1972 Great Lakes Water Quality Agreement was expanded in 1978 with its emphasis on ecosystem quality rather than the narrower focus of water quality. The Aquatic Ecosystem Objectives Committee of the Science Advisory Board was charged with developing objectives, defined as the criteria for describing a desired state of an ecosystem, a concentration of a substance, or a description of a condition that is considered protective of the most sensitive use. Objectives have been chosen as minimum goals by the governments of Canada and the U.S. as a part of the 1978 Agreement. The Committee's recommendations include the following: (1) pentachlorophenal in water should not exceed a concentration of 0.4 micrograms per liter; (2) 2,3,7,8-tetrachlorodibenzoparadioxin (TCDD) should be absent from the entire ecosystem; (3) waters used for body contact recreational activities should be substantially free from bacteria, fungi or viruses that cause enteric disorders and infections; (4) fecal coliform bacteria should not exceed a logarithmic mean of 200 fecal coliforms per 100 mL of sample; and (5) the concentration of total lead in an unfiltered water sample should not exceed 2 micrograms per litre in Lake Superior, 3 in Lake Huron, 4 in Lakes Erie and Michigan, and 5 in Lake Ontario. Additional recommendations are made regarding previous proposals concerning residual chlorine, silver, cyanide, temperature, and nutrients. Specific recommendations on nutrient objectives include limits of 5 micrograms per liter of total phosphorus concentrations in Lake Superior, Lake Huron, Georgian Bay, and the North Channel. (Garrison-Omniplan)
W82-00705

WATER MOVEMENT FOR WATER QUALITY IN CATFISH PRODUCTION,

Alabama Agricultural Experiment Station, Auburn.
C. D. Busch, and C. A. Flood, Jr.
Transactions of the ASAE, Vol 23, No 4, p 1040-1042, July/August, 1980. 1 Tab. 13 Ref.

Descriptors: *Water quality control, *Water circulation, *Fish populations, Aeration, *Fish farming. Oxidation, *Catfish, fish, Dissolved oxygen, Oxygen.

There are two categories of approaches to providing adequate dissolved oxygen levels through water movement for fish production ponds. The first is replacement, which involves introducing freshwater from an outside source to the fish production location in exchange for some or all of the existing water. The second is aeration, which involves using some mechanical treatment method to renew or maintain the dissolved oxygen level necessary for fish production. The use of mechanical means to maintain or improve water quality, either by furnishing partial water replacement or by using aerators, is of limited value when compared to photosynthetic oxygen supply. The aerators, is of limited value when compared to photosynthetic oxygen supply. The efficiency of aerators decreases as saturation is approached, and the aerator will remove oxyen from super-saturated water. The topographical components necessary for continual water exchange through gravity flow from an ample supply of good quality water are seldom encountered. Using paddle wheels or other means to move the water for the purpose of mixing may complement the naturally-created dissolved oxygen supply, preventing the buildup of high oxidation demands and near anaerobic conditions at the lower levels of ponds. (Carrol-FRC)
W82-00866

EVALUATION OF STRIPMINE SEDIMENT DETENTION BASINS IN KENTUCKY,

Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.
A. D. Ward, and C. T. Haan.
Transactions of the ASAE, Vol 23, No 4, p 854-858, 865, July/August, 1980. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Sedimentation basins, *Strip mine wastes, *Monitoring, *Kentucky, Sediments, Coal mining, Industrial wastes, Detention reservoirs, Basins, Sediment control, Sedimentation ponds, *Water pollution control.

The Surface Mine Reclamation Act of 1977 requires surface coal mining and reclamation operations to use sedimentation ponds to help control the discharge of high sediment concentrations to receiving waters. Although such ponds have been used for several decades, very little data on their performance is available, and design methods have generally proved to be inadequate. This monitoring project was designed to evaluate the effectiveness of sediment basins in controlling runoff and downstream sediment loading at two stripmine coal operations in eastern Kentucky and to develop design criteria for predicting sediment detention basin performance. Establishing a monitoring program at a sedimentation pond for strip mining operations requires the purchase and installation of a sampling unit, a stilling tower, tower instrumentation, dock, and relay cables. The research team for two or three ponds should be composed of an engineer and two technicians. The ponds monitored, which were small and inadequate to meet proposed Federal regulations, at times exhibited high trap efficiencies, but had low overall efficiencies. Simulation studies with the Deposits Model indicated that both ponds exhibit efficiencies of less than 20 percent for a 10-year, 24-hour storm. It is recommended that design plans include provision of a permanent pond capable of storing all the runoff from a 2-year, 2-hour event, installation of a mechanical dewatering device to dewater part of this stored sediment, and installation of a mechanical physical/chemical treatment system to be used during larger events. Such a design should provide pond trap efficiency approaching 100 percent while requiring chemical treatment of runoff only a few times each year. (Carroll-FRC)
W82-00893

REVIVING ACIDIFIED LAKES,

Uppsala Univ. (Sweden). Dept. of Limnology.
For primary bibliographic entry see Field 2H.
W82-00933

DRYLAND MANAGEMENT FOR SALINITY CONTROL,

For primary bibliographic entry see Field 2G.
W82-01018

SALINE SEEP DEVELOPMENT AND CONTROL IN THE NORTH AMERICAN GREAT PLAINS - HYDROGEOLOGICAL ASPECTS,

Montana Bureau of Mines and Geology, Butte.
For primary bibliographic entry see Field 5B.
W82-01022

IMPACT OF WATER RESOURCE DEVELOPMENT ON SALINIZATION OF SEMI-ARID LANDS,

California Univ., Davis. School of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-01024

EFFECTS OF NITRAPYRIN ON NITRATE MOVEMENT IN SOIL COLUMNS,

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens.
Journal of Environmental Quality, Vol 10, No 3, p 308-310, July-September, 1981. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Leaching, *Soil columns, *Nitrates, Nitrification, Inhibitors, Ureas, Groundwater pollution, Water pollution prevention, Path of pollutants, *Nitrapyrin, *Water pollution control.

The increasing cost of fertilizers and growing concern with nonpoint source water pollution has led to increased interest in more efficient use of fertilizer nitrogen. Nitrapyrin (2-chloro-6-(trichloromethyl) pyridine), which is the active ingredient of N-Serve, has specific toxicity to Nitrosomonas spp., which is the main microorganism responsible for the nitrification of ammonium to more leachable nitrogen forms in soil. This study investigated the possible benefits of a nitrification inhibitor in terms of retardation or reduction in the amounts of nitrate leaching through the soil profile into the groundwater. Nitrapyrin treated urea of an untreated urea was incorporated into the top 10 centimeters of prewetted sandy loam soil cores. The soil columns were leached periodically with distilled water. After 91 days, only 1 percent of the applied nitrogen had leached from the nitrapyrin-treated cores, while 9.7 percent had leached from the untreated cores. After 144 days, 53.0 percent of the applied nitrogen had leached from the untreated cores, while only 41.9 percent had leached from the nitrapyrin-treated cores. Examination of the cores after 144 days showed that the mineral nitrogen concentration was greater at all depths in the soil treated with nitrapyrin than in the untreated soil and that the total mineral nitrogen remaining in the untreated soil was only 70 percent of that remaining in the nitrapyrin treated soil column. These short-term results indicate that nitrification inhibitors such as nitrapyrin may have an important role to play in controlling nonpoint source pollution problems by reducing both the rate of entry and the total quantity of nitrate-nirogen leached into subsurface waters. (Carroll-FRC)
W82-01048

WATER CHEMISTRY CHANGES DURING ARTIFICIAL AERATION OF SPRUCE KNOB LAKE, WEST VIRGINIA,

West Virginia Univ., Morgantown. Dept. of Biology.
J. W. Labeugh.
Hydrobiologia, Vol 70, No 3, p 201-216, May, 1980. 9 Fig, 6 Tab, 41 Ref.

Descriptors: *Water quality, *Aeration, *Nutrients, Nitrogen, Phosphorus, Lakes, Reservoirs, Chemical properties, *Spruce Knob Lake, West Viginia, Chlorophyll, Primary productivity, Alaklinity, Chemical reactions.

Artificial aeration in Sprice Knob Lake using a modified full lift aerator increased water temperature below 3.5 meters from 13.6 to 15.6-16.5 C without causing destratification. No aeration was done in 1973, intermittent compressed air was used from July to September 1974, and continuous mechanical aeration using a propeller and aeration box, from May to September 1975. Below 3.5 meters' depth, total inorganic C, total alkalinity, nitrite, soluble reactive P, and total P were lower during aeration than during the summer of no aeration. There was no significant impact on the P budget of the impoundment. Nitrate levels were higher, 315 mg per cu meter, in 1975 than in previous years, which averaged 109-125 mg per cu meter. In early June 1975 a brief destratification caused by weather conditions increased H+ concentrations and lowered chlorophyll concentrations. Aeration produced no temperature or water chemistry changes in the epilimnion, chlorophyll, or primary production. (Cassar-FRC)
W82-01049

GROUNDWATER QUALITY MODELS - STATE OF THE ART,

Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. P. Anderson.
In: Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, Cincinnati, April 28-29, 1981. Purdue University, Water Resources Research Center, West Lafayette, IN. p 90-96, 3 Fig, 20 Ref.

Descriptors: *Groundwater pollution, *Model studies, Hydrologic models, Data collections, Hydrologic data collections, Advection, Mathematical models, Chemical reactions, Field investigations, Model testing, Waste disposal, Public policy, Public participation.

Concern over groundwater pollution has been voiced by scientists, government officials, and the general public, and has brought about a desire for increasing monitoring, techniques to predict the consequences of waste disposal on groundwater, and effective remedial measures to restore polluted groundwater. While monitoring and remedial measures are often expensive to implement, the use of a groundwater model is relatively inexpensive and is an efficient means of characterizing a field setting. However, of the three basic types of models---advection, advection-dispersion, and geochemical---only the advection type is applicable to regulation, planning and management in its present form. Advection models may be useful in instances where the contaminant is not affected by dispersion and chemical reactions, or to estimate the worst possible case for contaminant transport. The applications of advection-dispersion models and geochemical models to groundwater systems are currently in the research stages. Incorporating chemical reactions into both advection and advection-dispersion models is a difficult problem. The theoretical development of contaminant transport models is ahead of field knowledge of the processes themselves, and refinement of the models must await input from field studies. In particular, ways of correctly quantifying the dispersion process and the types and rates of chemical reactions that occur in the subsurface must be developed. (Garrison-Omniplan)
W82-01061

MANAGING OIL AND GAS ACTIVITIES IN COASTAL ENVIRONMENTS: REFUGE MANUAL,

RPC, Inc., Austin, TX.
W. L. Longley, R. Jackson, and B. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117508, Price codes: A20 in paper copy, A01 in microfiche. Fish and Wildlife Service Report FWS/OBS-81/22, September, 1981. 466 p, 11 Fig, 192 Ref, 2 Append. 14-16-0008-2152.

Descriptors: *Ecosystems, *Coastal marshes, *Wildlife refuges, *Fuel, *Exploration, Environmental effects, Salt marshes, Levees, Spoil banks, *Oil industry, Oil spills, Protection, Wildlife management, Texas, Louisiana.

The impacts of all aspects of oil and gas development on coastal ecological systems were investigated and the safeguards used in protecting refuge lands were assessed. Five wildlife refuges along the Texas and Louisiana coasts (Aransas, Brazoria, San Bernard, Delta, and Sabine National Wildlife Refuges) were selected for intensive study. They were characterized by a diversity of ecosystems; oil exploration, extraction and transport; and oil and gas development periods of various durations. Six ecosystems were identified: coastal uplands, salt marsh, brackish marsh, fresh marsh, delta marsh, and levees and spoil banks. For each ecosystem systematic impact and methods assessments were determined for the successive phases of development, seismic preexploration, access to site, wellsite preparation and operation, installation and maintenance of lines, placement and operation of production facilities, spills and cleanup, and site shutdown and restoration. Successful and proposed stipulations are given for each of these categories. A wide variety of protective measures are in use, developed from the observations and experimentation of refuge managers, often on the basis of site-specific conditions. (Brambley-SRC)
W82-01081

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

RISK AND THE DEMAND FOR SUPPLEMENTAL IRRIGATION: A CASE STUDY IN THE CORN BELT,

Kentucky Univ., Lexington. Dept. of Agricultural Economics.
J. Apland, B. A. McCarl, and W. L. Miller.
American Journal of Agricultural Economics, Vol 62, No 1, p 142-145, February, 1980. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Supplemental irrigation, *Corn belt, *Economic aspects, Mathematical models, Agriculture, Risks, Corn, *Crop production, Irrigation, Planning.

There has been a rapid increase in irrigated acreage in the Corn Belt in recent years as a result of the considerable sensitivity of corn plant growth and associated grain yield to moisture stress during pollination. Increased irrigation has resulted in renewed interest in questions relating to water resource management and to the economic feasibility of supplemental irrigation. Most studies of the economic feasibility of irrigation have focused on the relationship of increases in crop revenues to the costs of irrigation. However, no thorough analysis has been made of the impact of risk aversion on the demand by farm firms for supplemental irrigation. A mathematical programming model of a Corn Belt grain farm was used to evaluate the implications of risk aversion for the derived demand for supplemental irrigation of corn. The model, which was a slightly altered variant of the MOTAD model developed by Hazell, considered riskiness of alternative production activities. Expected profit less a cost of bearing risk was maximized by the model, subject to the technology specified and an endowment of fixed resources. The production model used in the study was an adaptation of a research and extension model of farm production in which the time characteristics of farming were critical. The results of the analysis indicate that the influence of a manager's risk posture has a marked impact on the firm's demand for irrigation. Rational farm managers who are averse to risk may use irrigation technologies even when irrigation costs are high and corn prices are low. When risk aversion is evident, the demand for irrigation as a factor of production becomes increasingly inelastic. The implications of risk aversion should be considered in descriptive analyses of the adoption of irrigation. In addition, the question of risk should be addressed in assessments of aggregate demand for irrigation. (Carroll-FRC)
W82-00522

INTERPRETING DYNAMICS OF AQUATIC RESOURCES: A PERSPECTIVE FOR RESOURCE MANAGERS,

Great Smoky Mountains National Park, Gatlinburg, TN.
G. L. Larson.
Environmental Management, Vol 4, No 2, p 105-110, March, 1980. 9 Fig, 4 Ref.

Descriptors: *Parks, *Water resources management, *Ecological effects, Planning, Aquatic environment, Lakes, *National parks, Trophic level, Environmental effects, Productivity, Biomass, Fish, Aquatic plants, Insects.

The Leopold Report (1963) recommended that the biological associations of national parks be managed in the condition existing at the time of the first visits by Europeans. Management of natural processes on the ecosystem level is suggested in this report. It is necessary to consider the effects of making changes in natural resources and to differentiate between natural and unnatural changes. This paper presents, for the resource manager, some graphical approaches to viewing the complex interactions in aquatic systems. Some of the relationships depicted are consumer biomass vs. prey biomass at high, medium, and low productivity; consumer biomass vs. growth and production of the consumer at high and low levels of productivity; and insect biomass vs. fish biomass at high and low yield and at high and low plant biomass. (Cassar-FRC)
W82-00539

TOWARDS A PREDICTIVE MODEL FOR THE ECONOMIC REGULATION OF COMMERCIAL FISHERIES,

British Columbia Univ., Vancouver. Dept. of Mathematics.
C. W. Clark.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1111-1129, July, 1980. 3 Fig, 34 Ref.

Descriptors: *Commercial fishing, *Fisheries, *Regulations, Fishing, *Model studies, Economic impact, Prediction, Taxes, Licensing.

A model for predicting the consequences of various methods of regulating commercial fisheries is developed. Alternatives considered were total catch quotas, vessel licenses, taxes on catch, allocated vessel quotas, and regulation of fishing effort. The model predicted that taxes and allocated transferable catch quotas are theoretically equivalent to each other in terms of economic efficiency and both can optimize exploitation of the common-property fishery. However, quotas provide a more direct control over the fish stock. Total catch quotas and closed seasons cause expansion of fleet capacity and shortening of the fishing season. Without additional controls, such as total catch regulation, vessel licensing could intensify fishing effort and shorten the fishing season. (Cassar-FRC)
W82-00549

LAND TREATMENT OF MUNICIPAL WASTEWATER IN SMALL COMMUNITIES,

Economics, Statistics, and Cooperatives Service, Washington, DC. Natural Resources Economics Div.
For primary bibliographic entry see Field 5D.
W82-00588

MODELING THE TRANSFORMATION OF NITROGEN COMPOUNDS FOR WATER-QUALITY MANAGEMENT IN STREAMS,

O. P. Vasil'ev, and E. V. Eremenko.
Water Resources (English Translation), Vol 7, No 5, p 437-442, September/October, 1980. 12 Ref. Translated from Vodnye Resursy, No 5, p 110-117, September/October, 1980.

Descriptors: *Mathematical models, *Water quality management, *Nitrogen compounds, Water conservation, Streams, Prediction, Water quality, Biological oxygen demand, Dissolved oxygen, Mathematical equations, Management planning, Planning.

Mathematical models are being used increasingly to make the evaluations of water quality used for water pollution control decisions, but certain improved models are not generally used in models designed to optimize the cost of conservation measures because they are poorly adapted for linking up with optimization models. The model of transformation of nitrogen compounds makes it possible to determine the concentration of standardized substances contained in wastewaters and being formed in receiving water bodies as a result of the transformation of nitrogen-containing substances. Solutions to this model, represented in the form of simple linear dependences for the concentrations of nitrogen compounds and characteristic sites of the stream, are presented which are suitable for predicting water quality and convenient for use when solving optimization problems. Linear dependences convenient for solving management problems can be obtained by examining the concentrations of substances at boundary sites of prismatic sections of the investigation channel stream. Equations for accomplishing this describe the effect of the concentration of some substances on the concentration of other, indicating the possibility of managing water quality through regulating the concentration of one substance by changing the discharge of another. The mathematical model of the formation of water quality can then be linked to the optimization model in terms of the magnitudes of wastewater discharges. (Carroll-FRC)
W82-00598

USING ECOLOGICAL KNOWLEDGE FOR DEVELOPMENT PLANNING,

East-West Environment and Policy Inst., Honolulu, Hawaii.
R. A. Carpenter.
Environmental Management, Vol 4, No 1, p 13-20, January, 1980. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Decision making, *Ecology, *Developing countries, Planning, Legal aspects, Natural resource development, Research priorities, Water resources development, Cost-benefit analysis, Economic aspects.

A multinational collaborative project has been developing natural systems assessments for developing countries. These nations, now more aware of the effects of resource exploitation, are passing legislation and organizing agencies for environmental protection. This produces channels for transferring ecological knowledge into political and administrative decision making. A satisfactory classification system considers the natural systems (terrestrial--crop, grazing, and forest lands; and aquatic--rivers, lakes, and coastal zones) as a whole and the various development sectors such as industry, agriculture, water impoundment, irrigation, domestic water supply and sewage disposal, and fisheries. Benefit-cost analysis is valuable in integrating ecological knowledge into economic development decision making. The list of priorities for ecological research includes the benefits of a healthy landscape, long term uses, results of intensified agriculture and forestry in tropical countries, and the assimilative capacity of water bodies. (Caesar-FRC)
W82-00671

RICHARDS BAY: AN ECOLOGICAL DILEMMA,

Department of Environmental Planning and Energy (South Africa).
N. Viljoen.
Civil Engineer in South Africa, Vol 22, No 4, p 84-90, April, 1980. 4 Fig, 45 Ref.

Descriptors: *Water resources development, *Planning, Management planning, Decision making, Administrative decisions, Water demand, *Harbors, *Construction, *Ecological effects, *Richards Bay, South Africa.

At Richards Bay, South Africa, planning was begun for the construction of a future harbor city of metropolitan size, and it was intended to tie in the planning with that of other projects in the area so as to conserve the natural environment. This preservation was incorporated into the policy making, program designing, and financing of the growing complex. The ecological dilemma and the vastness of the situation were resolved into areas where sufficient expertise and background knowledge already existed to ensure sound policy making, and other areas where the status of appreciation ranged from rational deductions to total ignorance. Specific studies were made of the climate and atmosphere, plant ecology, agriculture of the area, hydrogeophysical considerations, the estuarine and marine environment, freshwater ecosystems, and recreation and conservation. (Baker-FRC)
W82-00679

PLAN OF STUDY FOR THE REGIONAL AQUIFER-SYSTEM ANALYSIS OF THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON,

Geological Survey, Boise, ID. Water Resources Div.
G. F. Lindholm.
Available from the OFSS, USGS Box 25425., Denver, CO 80225, Price: $2.75 in paper copy, $3.50 in microfiche. Geological Survey, Open-File Report 81-689, June 1981. 21 p, 4 Fig, 17 Ref.

Descriptors: *Aquifer management, *Project planning, *Regional analysis *Geohydrology, Aquifer characteristics, Drawdown, Groundwater movement, Surface-groundwater relations, Groundwater recharge, Groundwater availability, Irrigation, Water supply, Model studies, Water quality, Geochemistry, *Idaho, *Orgeon, *Snake River Plain, Regional Aquifer System Analysis.

The 15,600-square-mile Snake River Plain is largely in southern Idaho and includes one of the Nation's major regional aquifers. A comprehensive investigation of the area's ground-water resources will be made as part of the U.S. Geological Survey's Regional Aquifer-System Analysis (RASA) program. Basaltic and sedimentary rocks in the Snake River Plain yield large quantities of water that are vital to the area's agricultural economy. Basaltic rocks predominate in the eastern Snake River Plain and have especially high water-yielding capabilities. Surface water, largely from the Snake River, is extensively used for irrigation and is a major source of recharge to the ground-water system. Springs issuing from basaltic rocks that form the Snake River Canyon wall near Twin Falls are the major points of ground-water discharge. Increased use of ground water for irrigation is causing concern as to the effect of large-scale withdrawals on spring flow. Ground-water flow models will be used to improve understanding of the hydrologic system, and, if feasible, to aid in evaluating management alternatives. Ground-water quality will be defined and geochemical techniques used to determine the effects of water-rock reactions on water quality. Several reports are planned on different phases of the project, concluding with a summary report. (USGS)
W82-00730

MANAGEMENT PROVOKED CONFLICT IN FISHERIES,

Oregon State Univ., Corvallis. Dept. of Anthropology.
C. L. Smith.
Environmental Management, Vol 4, No 1, p 7-11, January, 1980. 4 Fig, 10 Ref.

Descriptors: *Fisheries, *Management, *Social aspects, Plannning, *Fish management, Safe yield, Yield, Economic aspects, Regulations, Resources management.

The conflicts seen in the management of many U.S. fisheries result from the way in management concepts are applied. Managing with maximum sustainable yield means managing on the fringe of conflict because attempts to reduce yields cause different groups (public, fisherman, and consumers) to complain. Although management can constrain the ability to catch fish, it has little impact on expectations of greater catches and more profit. Social goals should be incorporated into fishery management and evaluated against management goals. A planning process adapted from the Water Resource Council is: (1) specify relevant objectives, (2) evaluate resource capabilities, (3) formulate alternative plans, (4) analyze differences among alternatives, (5) review and revise, and (6) select plan. Steps 3 and 4 are the points where these public goals need to be considered. (Caesar-FRC)
W82-00780

GAME THEORY ANALYSES APPLIED TO WATER RESOURCE PROBLEMS,

Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
M. Sheehan, and K. C. Kogiku.
Socio-Economic Planning Sciences, Vol 15, No 3, p 109-118, 1981. 1 Fig, 8 Tab, 31 Ref.

Descriptors: *Water resources development, *Negotiations, *Water allocation, Economic aspects, Communication, Remedies.

The theory of cooperative games involving two or more actors is applied to various water resource problems. The practical problem to be considered is how to apportion fairly the reduced costs and increased benefits which result when individuals join together to reap the gains of collective action. Most large resource development projects are collective in nature, and waste treatment projects usually involve at least two parties. Recently, standard-setting government agencies have participated. Scenarios are developed to illustrate the theory of cooperative games and to point out the problems and complexities involved. Recent applications of game theory are described, including optimum development of the Ganges and its tributaries for flood control, hydroelectric generation, and irrigation. Game theory can be used to help negotiators see the benefits of cooperative solutions in many situations of conflict. (Small-FRC)
W82-00802

NUMERICAL SIMULATION OF POTENTIOMETRIC SURFACE CHANGES CAUSED BY A PROPOSED OPEN-PIT ANTHRACITE MINE,

Stone and Webster Engineering Corp., Cherry Hill, NJ.
E. S. Bair, and R. R. Parizek.
Ground Water, Vol 19, No 2, p 190-200, March/April, 1981. 11 Fig, 20 Ref.

Descriptors: *Computer models, *Groundwater movement, *Mining engineering, Land use, Subsidence, *Potentiometric level, Permeability coefficient, Baseline studies, Mathematical models, Projections.

Hydrologic and hydrogeologic data were obtained, assessed, and incorporated into a groundwater flow model designed to forecast changes in a groundwater flow system caused by a proposed mining operation. The Trescott, Pinder, and Larson finite-difference flow model was modified and used to simulate potentiometric surface changes caused by the first eight years of development of an open-pit anthracite mine at Wabash Creek, Pennsylvania. The coefficient subroutine was modified to allow the value of hydraulic conductivity to vary with depth. The data input subroutine was changed to allow the number, location, and hydraulic head of constant-head nodes to vary with the time period. Also, the mass balance subroutine was altered to print out the flux into each constant-head node at the end of each time period, thus permitting calculation of changes in the rate of groundwater flow into the mine. Using

site specific values for hydraulic conductivity and other parameters, the simulations predicted that in eight years a cone of depression approximately 20,000 feet long, 8000 feet wide, and 1000 feet deep would form around the proposed mine. The numerical model demonstrated the ability to model the flow system in a complex geological terrain and change the magnitude, location, and type of stress imposed on the flow system. (Small-FRC)
W82-00819

ANSWERS: A MODEL FOR WATERSHED PLANNING,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley, L. F. Huggins, and E. J. Monke.
Transactions of the ASAE, Vol 23, No 4, p 938-944, July/August, 1980. 9 Fig, 3 Tab, 18 Ref.

Descriptors: *Watershed management, *Management planning, *Computer programs, Simulation analysis, Simulation, Mathematical studies, Mathematical models, Watersheds, Planning, Land use, Water quality management, Water pollution effects, *Nonpoint pollution sources, Runoff, Overland flow, Inflow.

The ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) program was developed as a planning model to assess the effects of land uses, management schemes, and cultural practices on the quality of water leaving the watershed; to assess pollution problems from nonpoint sources; and to define cost-effective solutions for primarily agricultural watersheds. The overall structure of the ANSWERS program comprises a hydrologic model, a sediment detachment/transport model, and several routing components necessary to describe the movement of water in overland, subsurface, and channel flow phases. A distributed parameter concept is used in the attempt to model the spatially varying processes of runoff, infiltration, subsurface drainage, and erosion. Application of the program to ungaged watersheds should result in at least comparative results for various treatment or management strategies. Experience has demonstrated the ability of the program to model observed hydrologic events on agricultural watersheds with good agreement. ANSWERS can become a valuable tool in planning cost-effective measures for controlling nonpoint source pollution when it is driven with hypothetical storms of known return interval. (Carroll-FRC)
W82-00898

TAMPA BAY WATER GUARDED BY COMPUTER,

Camp, Dresser and McKee, Inc., Clearwater, FL.
For primary bibliographic entry see Field 4B.
W82-00934

EFFECTIVENESS OF RIVER MODELS,

Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French, and P. A. Krenkel.
Water Science and Technology, Vol 13, No 3, p 99-113, 1981. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Model studies, *Water quality, *Rivers, Sensitivity analysis, Planning, Mathematical models, Willamette River, Calibration, Model testing, Data interpretation.

Modeling of river water quality is a practical tool in water resources planning and water quality management, but only if used correctly. Eight factors affecting the effectiveness of models are discussed. Some processes are not easy to model, e.g., erosion, eutrophication, and toxicity relationships. Dissolved oxygen, temperature, and dissolved solids are relatively easy to model. Indicator bacteria, sediment transport, algal growth, metal transport, nutrient transport, and pesticide transport are intermediate in complexity. General case models are not always applicable to specific rivers. The model should be chosen to fit the river, not vice versa. Concentration on a critical time period may suffice to answer the study question. For example, low dissolved oxygen may only occur during summer. Calibration and verification are necessary for good results. The two are independent, and different data sets should be used for each. Any drastic change in the river system may require recalibration and verification. Proper sampling and monitoring are important for a statistically reliable data base. The model results must be presented in nontechnical language, understandable by managers and planners. The model should be developed well in advance of actual need, so that calibration, verification, sampling, etc, can be designed and executed in an optimum fashion. The validity of the model's basic assumptions needs periodic reevaluation. A significant use of models is sensitivity analysis, showing the effect of variation of a given parameter on the output if all other factors are constant. This is illustrated with a study on the Willamette River. (Cassar-FRC)
W82-00961

WATER QUALITY EVALUATION OF REGIONAL WASTEWATER MANAGEMENT,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-00977

SIMULATION MODELING OF PRIMARY CLARIFIERS,

Paramount Engineering Ltd., Kitchener (Ontario).
R. L. Alarie, E. A. McBean, and G. J. Farquhar.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 293-309, April, 1980. 8 Fig, 4 Tab, 21 Ref.

Descriptors: *Clarifiers, *Simulation analysis, *Model studies, Clarification, Chemical precipitation, *Wastewater treatment, Filtration, Mathematical studies.

A simulation model is derived for circular primary clarifiers. Predictions from the model are compared with results from existing regression, based on models for a case study applied to the Waterloo Water Pollution Control Plant, Ontario, Canada. The simulation model was used to produce general results indicating the relationship between suspended solids removal and the parameters of overflow rate, detention time, and initial suspended solids (SS) concentrations. Two initial SS concentrations were used in conjunction with the settling property data obtained from the plant. Varying overflow rates and clarifier depths were also used. Effluent SS concentrations increased with increasing overflow rates. The performance of the clarifier deteriorated rather rapidly once an overflow rate of 39,100 liters/day/square meter was exceeded. Percent removal was usually greater at higher initial SS concentrations because of a higher proportion of settleable solids than at lower initial SS concentrations and because of a greater frequency of interparticle contact. Additional depth beyond 3.7 meters produced little improvement in the percentage of SS removal at the above overflow rate. While this may not be true for all types of wastes, it was felt to be accurate for domestic sewage. The simulation model allowed accurate predictions of the performance of the clarifier at various chemical dosages with only minimal laboratory experimentation to determine settling properties. The ability of the model for accurately predicting short-term variations in effluent characteristics may be valuable to a plant operation or to the sanitary engineer studying impact of effluent on a receiving stream. (Baker-FRC)
W82-01027

MATHEMATICAL MODELING TECHNIQUES FOR GROUNDWATER MANAGEMENT,

Prickett (Thomas A.) and Associates, Urbana, IL.
For primary bibliographic entry see Field 4B.
W82-01062

6B. Evaluation Process

THE WATERWAY THAT CANNOT BE STOPPED,

For primary bibliographic entry see Field 6E.
W82-00510

EVALUATION OF THE OLDMAN RIVER BASIN IRRIGATION PROPOSALS: IMPLICATIONS FOR INTERBASIN TRANSFERS,

Department of Agriculture, Lethbridge (Alberta). Irrigation Div.
W. Phillips, M. McMillan, and T. Veeman.
Canadian Water Resources Journal, Vol 6, No 2, p 54-61, 1981. 4 Ref.

Descriptors: *Water resources development, *Planning, *Irrigation, River basins, Irrigation efficiency, Economic aspects, *Oldman River, Interbasin transfer, Water transfer, Alberta, Canada.

The Oldman River Basin Study, Phase II, an economic evaluation, is reviewed. The role and importance of economic evaluations for water resources planning and the implications for interbasin transfers are discussed. Two issues which cast doubt upon the purported economic merits of development alternatives in the Oldman Basin are the improper inclusion of secondary benefits arising from increased regional employment, and the assumed zero opportunity cost of extra capital and labor required when shifting from dryland to irrigated agricultural land use. When these two factors are adjusted for, the benefit-cost ratio is rendered less than one, thus raising some question about the merits of the Oldman irrigation proposals in terms of economic efficiency. It is suggested that any assessment of future water development or diversion proposals should take these two factors into account. (Baker-FRC)
W82-00519

THE DISTRIBUTION OF THE COSTS OF FEDERAL WATER POLLUTION CONTROL POLICY,

Resources for the Future, Washington, DC.
L. P. Gianessi, and H. M. Peskin.
Land Economics, Vol 56, No 1, p 85-102, February, 1980. 9 Tab, 14 Ref.

Descriptors: *Water pollution control, *Public policy, *Federal jurisdiction, *Cost allocation, Economic aspects, Political aspects, Pollution control, Cost analysis, Social aspects, Costs.

In comparing the costs and benefits of a program, it is probably inaccurate to assume that dollar costs provide a reasonable approximation of the true opportunity costs of the program. A first step towards identification of the real opportunity costs and of the distributional consequences of full implementation of the Clean Water Act in its 1972 version involves description of the short-run costs as felt by families because of their tax burdens and initial increases in the costs of goods they consume. The results of investigation of these short-run costs are presented by particular income, racial, and geographic classifications. The costs used in this study assumed perfectly inelastic demands throughout the economy; were incremental in that they represented the costs to be incurred by industries and municipalities to meet the law's objectives over and above pollution control expenditures already made; and were annualized in order to permit presentation of all costs in per annum terms. Analysis of these costs indicates that the costs of industrial and federal government pollution control policies are largely felt outside of the geographical areas in which they are initially incurred; that average per family control cost burden percentages decline with increases in income; that water pollution control policy is less regressive than the clean air policy; and that whites have a greater absolute burden for pollution control, while non-whites generally have a slightly greater proportional burden. These results suggest that federal government subsidies may tend to alleviate the regressive burdens which result from shifting of polluters' costs to consumers and from relatively regressive state and local tax structures. (Carroll-FRC)
W82-00537

SMALL HYDRO INSTALLATIONS SPUR UNIQUE ENGINEERING SOLUTIONS,

Tudor Engineering Co., Riverton, WY.
D. C. Willer.
Power Engineering, Vol 84, No 1, p 62-64, January, 1980. 2 Fig.

Descriptors: *Hydroelectric plants, *Capital costs, Powerplants, Economic aspects, Decision making, Design criteria.

Capital costs of small hydropower installations range from $685 to $1400 per kW at the 1978 base cost level. The resulting energy costs varies from 13 to 25 mills/kWh. Location of a new power plant is a major engineering consideration. Various configurations must be considered to determine the one best suited to the needs at hand. Box Canyon Dam in California is a typical example of numerous dams, constructed primarily to impound water for irrigation or recreation during a period when it was not feasible economically to install generation capacity. Plans are now underway to build a 4000 kW power plant at that location, which will cost about $3 million. One interesting innovation here is the placement of the power plant under an extension of the spillway apron, which is economical and offers the least adverse visual and environmental impact. Many small hydro plants under consideration will utilize irrigation impoundments and canal drops. (Baker-FRC)
W82-00538

THE U.S. GEOLOGICAL SURVEY FEDERAL-STATE COOPERATIVE WATER RESOURCES PROGRAM,

Geological Survey, Reston, VA. Water Resources Div.
F. K. Gilbert, and T. J. Buchanan.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-691, 1981. 27 p, 2 Fig, 5 Tab, 4 Ref.

Descriptors: *Water management, *Cooperatives, *Hydrologic data, *Evaluation, Water supply, Water quality, Water use, Planning, Costs, *Federal-State cooperation, Geological survey.

The U.S. Geological Survey Federal-State Cooperative Water Resources Program is a partnership between the Geological Survey and State and local agencies for the collection of the hydrologic information needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources. The Cooperative Program has served the Nation for more than 80 years, and in 1981 more than 800 State and local agencies have cooperative programs with the Geological Survey with total funding over $80 million. The process of project selection in the Cooperative Water Resources Program is a mutual effort in which Geological Survey represents national interests, including the needs of other Federal agencies, and the cooperator represents State and local interests. The result is a balanced program that involves careful evaluation of needs, priorities, and resources. The cost sharing ratio of 50-50 is examined and determined to be the best ratio to effectively assess the Nation's water resources. The Cooperative Program is and has been relevant to the problems of the day. Much of the current technology in ground-water management, ground-water quality, and flood-plain management--to name a few--was developed as part of the Cooperative Program. (USGS)
W82-00735

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH.

Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation.
For primary bibliographic entry see Field 6D.
W82-00736

EVALUATING IRRIGATION SYSTEMS,

B. McLellan.
World Farming, Vol 23, No 1, p 12-15, January/February, 1981.

Descriptors: *Irrigation systems, *Cost-benefit analysis, *Evaluation, Economic evaluation, Labor, Farm equipment.

The most appropriate irrigation system for a given situation can be chosen by comparing cost-benefit ratios. All values must be calculated in terms of money, on a per person basis, on a yearly basis, and with all possible costs and benefits included. Some examples of costs often improperly ommited are: pollution and erosion of farmland, installation of electrical and other services, and value of food crops lost to growing of cash crops. Examples of benefits often left out are: earnings of workmen freed from farming and working as craftsment and value of bartered food crops. Formulas are given for calculating benefits, costs of irrigation systems, annual cost of each irrigation worker, annual costs of machinery, and yearly labor cost savings. (Caesar-FRC)
W82-00772

WATER QUALITY MANAGEMENT IN RIVER BASINS: US NATIONAL EXPERIENCE,

North Carolina Dept. of Natural Resources and Community Development, Raleigh.
For primary bibliographic entry see Field 6E.
W82-00800

ECONOMIC ANALYSIS OF GRANULAR-BED FILTRATION,

Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W82-00975

TREATABILITY MANUAL; VOLUME IV. COST ESTIMATING.

Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5D.
W82-01076

AN INTANGIBLE BENEFIT OF WATER POLLUTION CONTROL PROGRAMS,

Rockwell International, Pittsburgh, PA.
L. L. Moore.
Journal of Environmental Health, Vol 42, No 5, p 254-257, March/April, 1980. 5 Ref.

Descriptors: *Water quality control, *Cost-benefit analysis, *Public health, Cost analysis, Economic aspects, Costs, Decision making, Planning, Water pollution control.

Benefit analysis is discussed in the context of problems which confront environmental regulatory agencies in placing a dollar value on water pollution control measures, specifically on benefits related to improved health. Applying theoretical concepts to practical problems is difficult, time-consuming, and may require an extensive data base. Often the policy maker who expects exact information concludes that cost-benefit analysis does not deal adequately with problems. The ability to identify problems and quantify the benefits of water pollution control must be improved. One reasonable manner to include intangible benefits in the decision making process is to describe them in non-monetary but quantitative units. These explicit descriptions may provide information on the importance of the impact, even though their monetary value may still be beyond measurement. Economic assessment of human illness associated with drinking water is highly subjective. It is also difficult to place a value on a person's change in life expectancy. Disruption of the use of time is the most costly of all effects caused by illness. Some researchers have estimated the national benefits that would accrue from the reduction of waterborne communicable diseases such as hepatitis and typhoid fever. The major advantage of cost-benefit analysis may be in learning how to justify the value placed on particular outputs of a proposed policy or program. Such attempts will encourage debate and facilitate the evolution of improved analytical approaches. (Baker-FRC)
W82-01092

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PRICE ELASTICITIES FOR WATER: A CASE OF INCREASING BLOCK RATES,

Arizona Univ., Tucson. Dept. of Economics.
R. B. Billings, and D. E. Agthe.
Land Economics, Vol 56, No 1, p 73-84, February, 1980. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Water demand, *Water rates, *Mathematical models, Economic aspects, Prices, Pricing, Prediction, Mathematical equations, Municipal water, Elasticity of demand.

The presence of block rates in rate schedules has been ignored in several previous studies of price elasticity of demand for residential water. When block rates appear in the rate schedule, use of average price as the only price variable in the estimating equation tends to result in excessively large estimates of the price elasticity of demand, especially when the marginal price increases while the intramarginal rates remain constant. When marginal price is used alone in the presence of block rates, the income effects of a change in intramarginal rates with marginal price constant cannot be accounted for properly. Two studies have suggested an alternative method utilizing two price-related variables in the estimating model when rate schedules contain block rates. Several alternative versions of the model for price elasticity of demand for water when increasing block rates and/or availability of service charges appear in the rate schedule were tested using both nominal and deflated price and income data. The model uses two price-related variables: the marginal price of water and a second price variable defined by Nordin as the difference between the consumer's actual utility bill and what would have been paid if all units of the commodity had been purchased at the marginal price. Estimation of the price elasticity of demand for residential water in Tucson, Arizona, using both double logarithmic and linear equations demonstrated that the two-price variable model produces better predictions of consumer response to rate schedule changes than those resulting from a single price model. The use of real monetary values produced substantially stronger statistical results than the use of unadjusted prices and incomes, indicating that water consumers responded to the real price of water and real income levels rather than to their nominal counterparts. (Carroll-FRC)
W82-00536

FUNDAMENTAL ECONOMIC ISSUES IN THE DEVELOPMENT OF SMALL SCALE HYDRO.

Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-02, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-02, May 1980. 26 p.

Descriptors: *Institutional constraints, *Hydroelectric plants, *Economic feasibility, *Regulations, *Cost analysis, Construction costs, Operating costs, Dams, Resources development, Profits.

The costs of construction and revenues from operation of a small scale hydroelectric site have been identified, along with a range of estimates which included a profitable operation for sites with the given characteristics. Surveys of several sites show that these characteristics do exist, yet these sites have not been developed. By residual analysis, the cause was attributed to instutional costs. A rough look at the relative prices associated with hydroelectric generation reached the same conclusion. Since regulatory costs are unknown, it is difficult to place much confidence in an analysis attributing the impediment to hydro development to such regulatory costs. The present information on regulatory costs imposed on the small scale hydroelectric developer is insufficient to aid policy formation. It is neither feasible nor desirable to remove all regulation, but it must be determined where in the regulatory environment these costs can be reduced with a net benefit to society. The relevant

questions are: where the regulation is inefficient at obtaining its stated goals; and what policy options are available to remedy this instutional problem. (Moore-SRC)
W82-00722

POTENTIAL POLITICAL INFLUENCES AFFECTING THE WATER INDUSTRY,

R. C. Marini.
Journal of the New England Water Works Association, Vol. 94, No. 2, p 170-179, June, 1980.

Descriptors: *Political aspects, *Utilities, *Public participation, Public policy, Administrative decisions, *Water policy, Public relations, Policy making, Attitudes, Financing, *Pricing, Water rates, Massachusetts.

Increasing consumer awareness and federal involvement are putting new political pressures on local water industries. The Boston Water and Sewer Commission raised its rates 48% in 1978 to clear a long standing deficit. When rates were rolled back in 1979, there was geat public and news media involvement pressing for an even greater rate decrease. Small town public works officials feel even greater effects from public pressure to reduce costs or defer expension in spite of the truth that most projects must be carried out eventually, either turned back to the individual or deferred into the future. In some cases absence of leadership in the utility has caused service to deteriorate to the extent that customers refuse to pay their bills, further decreasing revenue. The water industry must take political leadership by having sound plans and budgets and providing detailed information to consumers. Aiding this process are the focus on inflation and cost of living, separation of water and sewer charges from property taxes, and the visibility of water issues in the federal government. (Cassar-FRC)
W82-00861

6D. Water Demand

EUROPEAN COMMUNITIES DIRECTIVE RELATING TO THE QUALITY OF WATER INTENDED FOR HUMAN CONSUMPTION,

Commission of the European Communities, Brussels (Belgium).
J. Smeets, and R. Amavis.
Water, Air, and Soil Pollution, Vol 15, No 4, p 483-502, May, 1981. 8 Tab.

Descriptors: *Water quality control, *Standards, Quality control, *Potable water, Regulations, Planning, International agreements, International commissions, Water supply.

The Council of Ministers in the Action Programme of the European Communities of the environment presented a directive to the Council of Ministers of the European Communities on July 22, 1975, concerning the maintenance of a specific quality of water for human consumption. The directive contained a choice of a series of parameters, the numerical values given to them, and the measures relating to the monitoring and supervision needed to establish this degree of water quality. The parameters involved are classified in five classes: organoleptic parameters, physicochemical parameters, parameters concerning substances undesirable in excessive amounts, parameters concerning toxic substances, and microbiological parameters. The technical aspects of the directive are described. (Baker-FRC)
W82-00506

THE AZOV SEA PROBLEM,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6G.
W82-00651

ENVIRONMENTAL ASPECTS OF RURAL DEVELOPMENT WITH PARTICULAR REFERENCE TO THE KEISKAMMA RIVER BASIN STUDY,

Secretary for Agriculture and Forestry, Ciskei (South Africa).
G. F. Godden, S. M. Nicol, and A. C. Venn.
Civil Engineer in South Africa, Vol 22, No 5, p 111-116, May, 1980. 3 Fig, 1 Tab.

Descriptors: *Water resources development, *Planning, Water demand, Rivers, River basins, Catchments, Keiskamma River Basin, *South Africa.

The Keiskamma River rises at an elevation of 1,500 meters in the Amatole Mountains, at the southern tip of the Drakensberg Range of Southern Africa, where it drains into a number of minor tributaries towards the more arid coastal plateau. Two distinct river valleys are formed at this lower elevation. The total area of the river basin is 2700 square kilometers of which about 85% experiences an annual rainfall less than 700 mm and about 60% in the lower and middle reaches has about 400 to 600 mm per year. The highest precipitation, 1400 mm, falls in the mountainous areas forming the northern preiphery of the catchment area. The need arose for a new water supply scheme to serve the developing industrial growth points at Dimbaza and Middledrift. The Keiskamma River was the logical choice. However, the potential inundation of 400 ha of valuable agricultural land by the dam, the effects of the new irrigation scheme and possible further afforestation in the upstream catchment, the effects of the dam runoff and irrigation withdrawals in the lower catchment, and the obvious potential for new irrigation development immediately downstream of the dam were factors to be considered. The Keiskamma River Basin Study should serve as an example of the type of investigation required to ensure that development of rural areas is achieved in the most efficient manner and in harmony with the environment. (Baker-FRC)
W82-00685

WATER - ITS USE AND THE IMPLICATIONS FOR ARKANSAS AGRICULTURE.

1981. 190 p. 29 Fig, 18 Ref, 3 Append.

Descriptors: *Agricultural hydrology, *Water use, *Competing use, *State jurisdiction, Interbasin transfers, Water shortage, Water management, Multiobjective planning, Long-term planning, Water use efficiency, Alternative planning, Groundwater management, *Arkansas.

In view of an intense interest in water use and the potential impact of public decisions on the agricultural use of water, the Arkansas Farm Bureau board of directors authorized an in-depth review of water resources, water rights law, and allocation procedures, for use by Farm Bureau members in formulating policy on the water issue. The report includes information on water sources, quality, supply, and management; an overview of water law; a list of agencies with responsibilities in water; and discussions of special issues involving Arkansas water. Arkansas has had an abundant supply of water in the past, and few conflicts over use. However, pressures may be mounting that will change this situation in the future. Agriculture must plan its role in possible future controversies. In determining the course of action for agriculture, it is important to decide whether or not water laws will provide protection for agriculture's needs. Arkansas needs a comprehensive water plan that will show statistically where the water exists in Arkansas; show present and future needs for this water, including agriculture trends; ensure that the quality of the water remains intact; and develop a procedure to help relieve acute water shortages. Regardless of decisions concerning the use of water within the state, there is the threat of exporting water to deficit areas outside the state. The principal objection to interbasin transfer is not its legality but its tremendous cost. State interests in this matter must be protected by the congressional delegation. (Garrison-Omniplan)
W82-00714

ARKANSAS WATER POLICY.

Water Policy Task Force, Little Rock, AR.
Report, December, 1980. 34 p. 51 Ref, Append.

Descriptors: *Water resources development, Groundwater management, *Allocation of resources, Water demand, Long-term planning, *Administrative regulations, Regional development, Water use, Competing use, Federal jurisdiction, State jurisdiction, Planning, Flood plain management, Water law, Legal aspects, *Arkansas, *Water policy.

As Arkansas' population grows and places new demands on finite resources, the need for effective resource management becomes increasingly critical. Decline of surface water and groundwater quality, depletion of groundwater supplied, pollution and hazardous waste disposals, and lack of coordination of water responsibilities among government agencies are all increasingly critical issues in Arkansas. A State Water Policy Task Force recommended that there be: (1) a Water Resources Council to monitor water policy implementation; (2) coordination with federal funding sources to serve community needs efficiently; (3) regional water supply systems; (4) use of Corps of Engineers lakes and natural impoundments; (5) water conservation; (6) monitoring of water quality of the Arkansas River to correct problems related to river disinfection; (7) a rate structure for new water systems that supports the project's operation and maintenance; (8) a permanent water operator training section in the Department of Health's training and licensing program; (9) routine and emergency well drilling permitted only after a community acquires a description of local aquifers from the Arkansas Geological Commission; (10) more groundwater studies; (11) legislation to give the state authority over surplus waters of the state and make decisions about interbasin transfers; (12) indepth studies of Arkansas water law. Additional recommendations were made regarding the quality of surface water, toxic and hazardous wastes, thermal discharge by industry, floodplain management, wetlands, stream preservation, and non-consumptive uses including transportation, recreation, and energy production. (Garrison-Omniplan)
W82-00715

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: JORDAN RIVER BASIN, UTAH.

Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation.
Report FERC-0084, August 1981. 70 p, 8 Fig, 18 Tab, 1 Append.

Descriptors: *Hydroelectric plants, *Water resources development, *River basin development, *Water demand, Diversion, Licensing, Municipal water, Irrigation water, Water supply, Jordan River basin, *Utah.

The Jordan River basin covers approximately 3,450 sq mi in north central Utah, and extends southeasterly from the Great Salt Lake for about 86 mi. Mean annual precipitation varies from 10 in. in the valley to over 35 in. in the high Wasatch Mountains. Water is a scarce commodity in the basin and stream flows are heavily regulated. Flows are diverted to the Jordan River basin for irrigation, municipal and industrial purposes. There are 26,550 kw of installed hydroelectric capacity in the basin in 14 plants, but the dependable capacity is very low as each is subject to flow reduction due to a lack of water during the dry season and irrigation diversions. Over half of the capacity is in the Olmsted project and in the Deer Creek plant. The Olmsted project is the largest hydroelectric plant in the basin and is presently the subject of an application for a major license. Two competing applications have also been filed. The applications are similar in that each proposes to continue project operation as in the past and none proposes significant modifications. Power generation may ultimately yield to water supply in the use of the Olmsted project flows. After development of the Jordanelle Reservoir, other Bonneville Unit features, and increased demands in the Salt Lake City metropolitan area, the flow regime which provides water to the Olmsted project will change. It is expected that high winter flows to the project will be stored upstream. It is estimated that the Olmsted project can continue to operate for 20 years before its flow is reduced for water supply purposes to

the point where continued project operation becomes infeasible. (Moore-SRC)
W82-00736

STATE WATER USE AND SOCIOECONOMIC DATA RELATED TO THE SECOND NATIONAL WATER ASSESSMENT,
Oak Ridge National Lab. TN.
A. D. Shepherd, M. E. Hodgson, J. Stewart, and K. A. Hake.
Water Resources Council Report, October 1980. 154 p, 8 Fig, 34 Tab, 30 Ref, 4 Append.

Descriptors: *Water use, *Water supply, *Water demand, *Social aspects, *Economic aspects, Public policy, Agriculture, Steam generation, Industrial water, Domestic water, Prediction.

Data generated in the Second National Water Assessment was organized by 106 hydrologically oriented Assessment Subregions (ASR's). The ASR data have been converted to state boundaries to make them more suitable for use in state and federal policy analysis. The converted Second Assessment projections of water-use and related socioeconomic data are presented by state. Water use is divided into six functional areas, agriculture, steam electric, manufacturing, domestic, minerals, and commercial, in decreasing order of volume in 1975. In 2000 the order will be the same but for reversion of manufacturing and domestic. Manufacturing is the only sector to show a decline in use. Total consumption is predicted to increase about 26% by 2000, to a daily total consumption of 133015 mgd. (Brambley-SRC)
W82-00739

LONG DISTANCE MASS TRANSFER OF WATER,
Biswas and Associates, Oxford (England).
A. K. Biswas.
Water Supply and Management, Vol 5, No 3, p 245-251, 1981. 5 Ref.

Descriptors: *Water transport, *Water supply development, *Water transfer, Conveyance structures, Water demand, Water resources development, Water allocation, Resource allocation.

Water use per capita has been increasing worldwide as the standard of living rises. The large scale artificial mass transfer of water from a water surplus region to a water deficient region in order to further the economic development of the latter is an important fact of modern life. A comprehensive assessment of available water resources, both surface and ground, must be made before entering into long distance transport. A second important consideration is the assessment of water demands for various purposes. Efficiency of water use is the third important consideration. Significant improvements could be made in the agriculture use of water, as it is sometimes extremely inefficient. The North American Water and Power Alliance has offered a program for mass transfer of water. The plan calls for the collection of surplus water from the high precipitation areas in northwestern North America and its distribution to water-scarce areas of Canada, the US and Mexico. A series of dams and power stations in Alaska and northern British Columbia would collect water and provide power to pump it up to the Rocky Mountain Trench Reservoir in southeastern British Columbia. Here the water would be lifted by pumps to the Sawtooth Reservoir in Central Idaho. From there it would flow by gravity to the western US. (Baker-FRC)
W82-00858

STATE OF WASHINGTON WATER QUALITY ASSESSMENT REPORT 1980.
Washington State Dept. of Ecology, Olympia.
For primary bibliographic entry see Field 6E.
W82-01067

6E. Water Law and Institutions

THE WATERWAY THAT CANNOT BE STOPPED,
R. J. Smith.
Science, Vol 213, No 4509, p 741-742, 744, August 14, 1981.

Descriptors: *Inland waterways, *Water transport, *Costs, *Construction, Tennessee River, Tombigbee River, Canals, Water policy, Water resources development, Judicial decisions, Legislation, Regulations, Political aspects, *Legal aspects, Economic aspects, Mississippi River, Governmental interrelations, Waterways, Channel improvement, Corps of Engineers, Water quality, Erosion, *Tennessee-Tombigbee waterway.

Construction of the Tennessee-Tombigbee waterway, now over half complete, has been challenged by Congress and court suits as too costly for the expected benefits. Congress is almost evenly divided on the issue of terminating the project, which has cost $1 billion thus far, and suffering embarassment or continuing it at costs of several more billion dollars and producing a waterway with questionable ability to save time and money in shipping. There are many hidden costs in the project--fish and wildlife impact, improvements to the Tombigbee River to remove bottlenecks, replacement of highways and bridges, and construction of facilities in the port of Mobile. A hurdle which may stop the project is the July 15 ruling that the Corps of Engineers had violated the National Environmental Policy Act and its own regulations by not preparing an impact statement showing that water quality, land erosion, and water stagnation problems would result. (Caesar-FRC)
W82-00510

THE TOXIC WASTE DUMP PROBLEM AND A SUGGESTED INSURANCE PROGRAM,
State Univ. of New York Coll. at Fredonia. Dept. of Economics.
For primary bibliographic entry see Field 5E.
W82-00591

GROUNDWATER STRATEGIES,
For primary bibliographic entry see Field 5G.
W82-00620

THE CONTROL OF BACTERIAL POLLUTION CAUSED BY SEA DISCHARGES OF SEWAGE,
Wessex Water Authority (England).
For primary bibliographic entry see Field 5D.
W82-00699

THE DESIGN AND INTERPRETATION OF MARINE POLLUTION SURVEYS,
Clyde River Purification Board (Scotland).
D. Hammerton, A. J. Newton, and T. M. Leatherland.
Water Pollution Control, Vol 80, No 2, p 189-203, 1981. 1 Tab, 23 Ref.

Descriptors: *Pollution control, *Estuarine environment, Surveys, *Scotland, River Clyde, Coasts, Estuaries, Wastewater pollution, Heavy metals, Industrial wastes.

This paper reports on experience gained in marine pollution control in Scotland and in particular on the extensive studies carried out by the Clyde River Purification Board during the past fifteen years, approximately 1960-1975. Surveys were made of estuaries, coastal waters, bacteriological sampling conditions, outfalls, and spcial techniques used in monitoring studies. Detailed accounts are offered of the Irvine Bay survey. This area has become the target of major urban and industrial development, with the result that significantly greater lodings of domestic and industrial effluents now enter the bay. Pollution from the land included suspended solids and heavy loadings of nitrogen, phosphate, chromium, zinc, cadmium, and synthetic detergents, along with dieldrin, aldrin and BHC. Silicates, manganese,nickel, mercury and DDT were also identified. The impact was naturally dependent on the mixing processes operating in the receiving waters. Pollution levels were analyzed on the beaches, in the sea water, in sediments, and in samples of biota. Monitoring programs were established. (Baker-FRC)
W82-00700

GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN,
International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
November 1980. 522 p, 85 Fig, 92 Tab, 44 Ref, 3 Append.

Descriptors: *Lakes, *Comprehensive planning, *International agreements, *Water quality standards, *Water quality management, *Data collection, Water quality control, Hydrologic data collections, Pollution load, Pollution control, Eutrophic lakes, Eutrophication, Tributaries, Pollution abatement, *Great Lakes.

Numerous agencies in Canada and the United States are responsible for determining the effectiveness of the Great Lakes' point source pollution abatement programs and the impacts of man's activities on the Lakes' ecosystem. The Great Lakes International Surveillance Plan, which presents the basic framework for surveillance activities in the Great Lakes basin as required by the 1978 Water Quality Agreement between the United States and Canada, was developed by the Surveillance Subcommittee over several years. The Surveillance Plan is a long-term strategy to coordinate the monitoring activities of the participating agencies in a cost-effective manner. It is characterized by quality assurance programs and the rapid exchange of comparable data among the various jurisdictions. Excessive inputs of nutrients and toxic substances have been and continue to be viewed with concern. The use of pesticides and toxic industrial compounds has, in many cases, been severely restricted or abolished. Further preventive measures aimed at screening new compounds and handling hazardous materials are being taken. This six-part document describes the overall plan in Section I, and the plan for each specific lake in Sections II through VI. Among the topics covered in each section are environmental Issues, Tributary Surveillance, Point Sources, Atmospheric Inputs, Connecting Channels, Nearshore Surveillance, Water Intakes, Public Perceptions, Beach Monitoring, Levels and Trends in Open Lake Waters, Fish and Wildlife Contaminants, Radioactivity, and Data Quality. (Garrison-Omniplan)
W82-00701

PHOSPHORUS MANAGEMENT FOR THE GREAT LAKES: FINAL REPORT OF THE PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE,
International Joint Commission-United States and Canada, Windsor (Ontario).
July, 1980. 129 p, 6 Fig, 9 Tab, 97 Ref, 2 Append.

Descriptors: *Lakes, *Water quality, *Phosphorus removal, *Chemical wastes, *Phosphates, Mathematical studies, Wastewater treatment, Data collection, Ecosystems, Aquatic populations, Phosphorus compounds, International commissions, International agreements, *Great Lakes basin.

By signing the 1978 Great Lakes Water Quality Agreement, the United States and Canada reaffirmed their intentions to restore and maintain the chemical, physical, and biological integrity of the Great Lakes basin ecosystem. As part of this agreement, the parties established tentative total phosphorus target loads. If these loads are confirmed by the State and Provincial Governments, they will be used as a basis for load allocations and compliance schedules for the two countries. To verify target loads and estimate lake responses to changes in phosphorus loads, various mathematical models were used. Using these data, the report suggests that improvements are needed in the estimates from point sources and tributaries, and in the methods of reporting the data. The strategies listed for assessing social and economic impacts of phosphorus control measures include regular collec-

tions of data on municipal and industrial water supplies, hydropower generation, property values, recreational use, and waterfowl habitat; establishing an Advisory Committee to provide program input and a coordinated mechanism between the U.S. and Canada to develop a comprehensive design system; and developing a social profile to record knowledge, beliefs, media reports, and leadership of the public involved. A staged-approach phosphorus management program is also outlined. (Garrison-Omniplan)
W82-00702

WATER - ITS USE AND THE IMPLICATIONS FOR ARKANSAS AGRICULTURE.

For primary bibliographic entry see Field 6D.
W82-00714

EXECUTIVE SUMMARY; LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN THE SEVEN MID-WESTERN STATES.

Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-08, Price codes: A05 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-08, May, 1980. 92 p.

Descriptors: *Water rights, *Hydroelectric plants, *Riparian rights, *Dams, *Legal aspects, Regulations, State jurisdiction, Federal jurisdiction, Navigable waters, Liability, Taxes, *Midwestern States, Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia, Wisconsin.

The relationship of federal law and regulation to state law and regulation of small scale hydroelectric facilities was determined for Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia and Wisconsin. Of these, Illinois, Kentucky, Michigan, West Virginia, and Wisconsin follow the riparian theory of law. In Indiana, the title of abutting land owners on non-navigable watercourses extends to the center of the watercourse. On navigable waters, title to the bed is vested in the state. In Ohio, the title of abutting land owners on both navigable and non-navigable watercourses extends to the middle of the watercourse and includes the subaqueous soil. Direct and indirect regulation, taxation, liability, and the availability of loans are also covered for each state. For each of the seven mid-western states, a flow diagram of regulations for small dams is provided. Federalism permits both the federal government and the state government to regulate and license certain aspects of a developer's project. Principles of federalism often support a finding that the federal regulation in question will be superior to comparable state regulation, divesting the state of regulatory authority in a given area. (Moore-SRC)
W82-00718

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN ILLINOIS.

Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-09, Price codes: A05 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-09, May, 1980. 80 p, 95 Ref.

Descriptors: *Hydroelectric plants, *Dams, *Legal aspects, *Water law, Riparian rights, Dam failure, Flood damage, Jurisdiction, Regulations, Liability, Utilities, Taxes, Natural flow doctrine, *Illinois.

Illinois follows the riparian theory of water law, so that the right to utilize the flowing water at a proposed site is dependent upon the acquisition of property interests in the abutting land on both sides of the waterway, and the title to the stream bed. The title to all navigable lakes and bodies of water is vested in the state. In Illinois, to be navigable, a stream must furnish a common passage capable of carrying commerce of practical utility to the public. Use of the water is governed by the natural flow doctrine, tempered by allowing for a reasonable use of the water. A dam owner may be held liable for all damage which results from dam breach or backflooding, unless it was caused by a reasonably unforeseeable act of God. Hydroelectric dams are not directly regulated by the state of Illinois as individual entities, but the state regulates the construction and operation of dams in general, and all public utilities are regulated. In addition, municipalities, water districts, and counties also have certain powers over the use of water and watercourses within their jurisdiction. There are many other agencies and regulations which may, in certain circumstances, affect or be of interest to small scale hydroelectric development. Financial considerations in development in Illinois include: property taxes, real estate transfer tax, public utilities tax, corporate franchise tax, corporate income tax, and financial assistance programs. (Moore-SRC)
W82-00719

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN RHODE ISLAND.

Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-11, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-11, May, 1980. 49 p, 83 Ref.

Descriptors: *Hydroelectric plants, *Dams, *Legal aspects, *Water law, Taxes, Construction, Riparian law, Licensing, Wetlands, Utilities, *Rhode Island.

Rhode Island appears to follow the reasonable use theory of reparian law. Title to the bed of a stream turns upon a determination of whether or not the stream is navigable. Navigable streams in Rhode Island are limited to those which are subject to the ebb and flow of the tide. If a stream is navigable, title to the bed is held by the state. Under the Mill Dam Act, a riparian proprietor is entitled to construct a dam for the purpose of generating power. There are no Rhode Island cases that address liability for dam breach. The Department of Environmental Management (DEM) is the most significant administrative agency with regard to dam construction, alteration and operation in the state. DEM approves all plans and specifications for the construction or substantial alteration of dams and reservoirs. Since DEM is the central administrative agency with respect to these statutes, the consequence has been an essentially one-stop licensing procedure. Wetlands, historic sites and archaeological resources are protected in Rhode Island. The Public Utilities Commission is vested with the judicial attributes of ratemaking and regulation, while the Division of Public Utilities and Carriers handles the remaining administrative functions. The extensive regulation of public utilities presents a significant cost to the developer. Owners and developers of dams will be required to pay property taxes based on the full and fair cash value of the dam, dam site, and machinery used to operate the dam. (Moore-SRC)
W82-00720

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW HAMPSHIRE.

Franklin Pierce Law Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA-04934-12, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-12, May 1980. 48 p, 100 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Water law, *Dams, Riparian rights, Regulations, Construction, Fish ladders, Eminent domain, Permits, Assessments, *New Hampshire.

The regulatory system for construction and operation of low-head hydroelectric dams in New Hampshire is comparatively simple. Provided the developer avails himself of the 5 megawatts exemption, his main regulatory agency will be the Water Resources Board. The developer must acquire both river banks, the river bed and the land needed for the impoundment. Methods of acquisition include eminent domain and the Mill Dam Act. In New Hampshire, it is the set of common law principles of riparianism that will determine the developer's rights in the water. The developer contemplating the construction of a dam with a developed output capacity of not more than 5 megawatt is exempt from all rules, regulations and statutes applying to public utilities. Exemption results in avoidance of a complex and costly regulatory process. Alterations to the watercourse require a permit from the special board. In addition the placement of the dam may constitute an obstruction in the watercourse, requiring a determination of the need for a fishladder. Once construction is complete and the dam is operational, the entity will be subject to investigations, inspections, rate setting, and liability that will span the life of the dam. There does not appear to be any rigid formula which can be used to arrive at the full and true value of a hydroelectric facility for tax assessment purposes. (Moore-SRC)
W82-00721

STATE WATER USE AND SOCIOECONOMIC DATA RELATED TO THE SECOND NATIONAL WATER ASSESSMENT,

Oak Ridge National Lab. TN.
For primary bibliographic entry see Field 6D.
W82-00739

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW JERSEY.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-16, May 1980. 73 p, 1 Fig, 84 Ref, 4 Append.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Economic aspects, Legislation, Taxes, Utilities, Dams, State jurisdiction, *New Jersey, Water rights, Permits.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdication, and also from state law. New Jersey follows the riparian theory of water law, but the rights to use of the water seem to follow both the natural flow theory and the reasonable use theory. There is no Mill Dam act but common law generally affords the same protection. Only in the case of negligence will a dam owner be held liable for damage resulting from a breach. Once a developer has obtained the requisite property rights, a dam construction permit must be obtained from the Division of Water Resources within the Department of Environmental Protection, although this requirement may be waived in certain circumstances. Small-scale hydro projects are subject to the Department of Energy and the Board of Public Utilities, which regulates the finances and sets rates for public utilities. Projects may be affected indirectly by other regulations of the Department of Environmental Protection. The Delaware River Basin Commission has jurisdiction over hydroelectric development within the basin, and issues permits for development. Small-scale hydro projects are subject to franchise, excise, gross receipts and local real estate taxes, but are eligible for loans from the New Jersey Economic Development Authority. (Brambley-SRC)
W82-00742

SUMMARY OF THE MID-ATLANTIC CONFERENCE ON SMALL-SCALE HYDROPOWER IN THE MID-ATLANTIC STATES: RESOLUTION OF THE BARRIERS IMPEDING ITS DEVELOPMENT.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-04, May 1980. 95 p, 6 Append.

Descriptors: *Hydroelectric power, *Legal aspects, *Institutional constraints, *Economic aspects, Financing, Licensing, Investment, Jurisdiction, Taxes, *Mid-Atlantic States.

Legal and institutional obstacles and the lack of rational incentives for development are considered to be the major impediments to small scale hydroelectric development at this time. One of the major problems in financing a project is the negative cash flow shown for the pre-operating and early operating stages of the project. Ways to make hydroelectric projects more attractive to a developer and potential investors include: allowing a shorter amortization period; increasing the investment tax credit to 20%; and allowing investment tax credit for environmental enhancement devices. There is a need for a simplified and expeditious licensing process by state regulatory agencies. The lead agency concept is preferable to other methods if one permit form could be developed, and all other state agencies make full and significant contributions. One-stop licensing created permit delay, and states using the one-stop procedure had problems in implementing the process. The importance of identifying the interests of all parties affected by small scale hydro development was underscored in view of the time delays occasioned by litigation and administrative mediation of disputes. Federal incentives to small scale hydro development are financial, including feasibility grants, construction grants, low-interest loans and investment tax credits. It is proposed that the federal juriadiction over small scale hydro be delegated to the states. (Moore-SRC)
W82-00743

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN VIRGINIA,

Franklin Pierce Center, Concord, NH.
Department of Energy Report DOE/RA/04934-15, May 1980. 50 p, 1 Fig, 43 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Legislation, Economic aspects, Taxes, State jurisdiction, Riparian rights, Utilities, Dams, Licenses, *Virginia.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. The theory of riparian rights follwed in Virginia is one of reasonable use, to the mean low-water mark on navigable waters. The Milldam Act allows a riparian owner to build a dam across non-navigable waters. Only public utilities may use the power of eminent domain. Before constructing a dam for hydroelectric power generation, a developer must obtain a license from the State Corporation Commission, and if the developer is a public utility, a certificate of convenience and necessity. Public utilities are subject to the Commission for rate setting. Numerous state regulations have an indirect impact on hydroelectric power projects because of the impact of the project on the environment, as do the Potomac River Basin Compact, the Ohio River Valley Water Sanitation Commission, and the Ohio River Basin Commission. A negligence theory has been followed, but there is a trend toward use of the strict liability theory for dam breaches. Taxing of a small-scale hydroelectric project depends on its classification as a public service corporation or as a private business enterprise. Financial incentives include the availability of loans from the division of Industrial Development and the Virginia Industrial Building Authority. (Brambley-SRC)
W82-00744

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN MARYLAND,

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-18, May 1980. 68 p, 1 Fig, 79 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, State jurisdiction, Utilities, Water rights, Economic aspects, Taxes, Planning, Dams, Legislation, *Maryland.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction and also from state law. In Maryland title to all navigable waters and to the soil below the high-water mark is vested in the state, but owners of adjoining land have riparian rights. Riparian rights extend to the center of a non-navigable stream. There is no public trust doctrine but the power of eminent domain may be used to obtain land for public use. Hydroelectric plants are regulated and supervised by the Public Service Commission and the Department of Natural Resources. These agencies are required to conduct long range studies of power plant sites and estimate future electric power demand. Hydroelectric power development may be affected by subagencies of the Department of Natural Resources through its regulations concerning wetlands, flood control, sediment and erosion control, pollution control and abatement, scenic and wild rivers, and archeological protection. The Public Service Commission sets rates for public utilities. There is no Mill Dam Act, and the theory of strict liability is used in cases involving breaches of dams. Hydroelectric projects are eligible for loans from the Department of Economic and Community Development, and subject to gross receipts, sales, use, real and personal property taxes. The Potomac River Basin Commission and the Susquehanna River Basin Commission are the two interstate compacts affecting Maryland's waters. (Brambley-SRC)
W82-00745

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POTENTIAL IN WISCONSIN.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-19, May 1980. 78 p, 1 Fig, 53 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Economic aspects, Legislation, Water rights, Utilities, Taxes, Dams, *Wisconsin.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction and also from state law. In Wisconsin a riparian owner owns to the middle of the bed of both navigable and non-navigable streams although on navigable streams the title is subject to the public right of navigation. Riparian owners have a right to reasonable use of the water, and dam owners are subject to the neglience theory in cases of damage resulting from dam breaches. The Department of Natural Resources regulates hydroelectric projects through 6 District offices which are responsible for all environmental concerns, and the Public Service Commission sets rates and supervises the financial affairs of those projects designated public utilities. Small scale hydroelectric projects are subject to municipal and county zoning powers, and may be affected by environmental regulations, the Public Intervenor's office, historic preservation orders, and Regional Planning Commissions. Hydroelectric projects are subject to property, income, franchise, corporate organization, gross revenue, sales, and use taxes depending upon their designation as public utilities. Financial assistance may be obtained from Industrial Development Agencies or municipalities through the Promotion of Industry Act. (Brambley-SRC)
W82-00746

A CASE STUDY ANALYSIS OF THE LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF THE HYDROLELECTRIC POWER OF THE BOARDMAN RIVER AT TRAVERSE CITY, MICHIGAN.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-33, May 1980. 149 p, 83 Ref. 3 Append.

Descriptors: *Hydroelectric plants, *Legal aspects, *Institutional constraints, *Economic aspects, *Dams, Regulations, Public opinion, Fish ladders, Cost analyses, Financial feasibility, *Michigan.

In order to meet the need for expanded power sources, the Boardman River is being considered by Traverse City and surrounding Grand Traverse County as a hydroelectric generating resource. Development of the Boardman River would occur at five dam sites: two existing dams previously generated hydroelectricity, as did a third before being washed out; one has never been used for generation, and the fifth is presently supplying power. A lack of public awareness of hydroelectric potential may be a barrier to hydroelectric development. Developers, particularly new developers such as the joint venture participants in this study, have a vital need for complete and reliable information about any intended hydroelectric development. When, as here, the developers experience substantial difficulty in becoming informed about what data is needed and how to obtain it, the project may incur substantial delay, opposition, and cost. If fish ladders are required for the dams in this system, the cost of the project will increase appreciably. In view of the perceived intensity of local public opposition to installation of the ladders, it is unlikely that development will be pursued if ladders are required. Inadequate legislative guidelines for review of hydroelectric projects in Michigan may produce permitting delays, licensing conditions and other impediments. Incentives to hydroelectric development in this case include: the feasibility grant program, the Michigan Energy Employment Act, municipal developer advantages, and the advantages of using existing dams. (Moore-SRC)
W82-00747

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN INDIANA.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-27, May 1980. 65 p, 102 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Water rights, *Dams, Reasonable use, Riparian rights, Liability, Economic aspects, Taxes, Utilities, *Indiana.

Indiana law follows the doctrine of riparianism. On navigable waters, a riparian only has title to the high water mark of the stream; title to the bed is vested in the state. Navigability is determined by the navigable in fact test. Indiana now follows the reasonable use doctrine. The right to use water may be gained by prescription. Both a Mill Dam Act and the power of eminent domain can be used to appropriate private property. There is confusion as to the liability of a dam owner for dam breach. The Division of Water issues construction permits for dams, except dams draining less than one square mile, less than 20 ft high, with less than 100 acre feet of water impounded. The Division of Fish and Wildlife may require a downstream minimum flow, fish ladders, and small boat passages under certain circumstances. The Division of Lakes and Streams has jurisdiction over lake levels of all public water lakes. Indirect regulation includes: environmental regulation; nature preserves; natural and scenic rivers; historic preservation; soil and water conservation; river valley compacts and river basin commissions; and municipal regulations. The Public Service Commission is an administrative board which regulates public utilities operating within the state. With the exception of municipal utilities, no power utility may operate in any municipality where a public utility is providing a similar service without obtaining a certificate of public convenience and necessity from the Commission. In Indiana, public utilities are not taxed much differently than private business enterprises. There is little incentive for hydroelectric development through state loans and funding. (Moore-SRC)
W82-00748

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN OHIO.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-26, May 1980. 82 p, 111 Ref.

Descriptors: *Hydroelectric plants, *Dams, *Legal aspects, *Water rights, Eminent domain, Riparian rights, Economic aspects, Liability, Regulations, Natural flow doctrine, Reasonable use, *Ohio.

The title of abutting land owners on both navigable and non-navigable streams extends to the middle of a stream and includes the subaqueous soil. If the stream is classified as navigable, title and ownership is subject to the public right of navigation. A river is classified as navigable based upon its capacity for use in transportation and commerce. The Ohio courts have combined the theories of natural flow and reasonable use. Ohio gives the power to appropriate private property to any company organized for the purpose of erecting or building dams across rivers or streams to raise and maintain a head of water for the generation of electricity. Giving an electric company the power of eminent domain greatly reduces the legal barriers to developing small scale hydroelectric power. A defendant is liable for negligence for the breach of his dam, but is strictly liable for water percolation and seepage, regardless of negligence. No dam may be constructed unless a permit has been issued by the Chief of the Division of Water, or the dam is exempt from a construction permit. A major utility facility cannot be constructed unless a developer has first obtained a certificate from the Power Siting Commission. Dam developers may also be subject to regulations regarding water pollution control, conservancy districts, watershed districts, and zoning. Indirect considerations include: endangered species; wild, scenic and recreational rivers; natural resources; historic preservation, Great Lakes Compact; Ohio River Sanitation Compact; Sanitary Districts; and the removal of mill dams. Small scale hydroelectric will be taxed as a public utility if it is classified as a public utility; otherwise it will be taxed as a private business enterprise. Loans may be available from the Department of Energy, the Ohio Development Financing Commission, or the Ohio Water Development Authority. (Moore-SRC)
W82-00749

ANALYSIS OF LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF LOW-HEAD HYDROELECTRIC POWER IN MAINE.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-20, May 1980. 69 p, 1 Fig, 81 Ref.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Legal aspects, *Regulations, Dam construction, Water rights, State jurisdiction, Inspection, Taxes, Economic aspects, *Maine.

The purpose of this paper is to guide the developer of low-head hydroelectric dam construction and operation through the de facto regulatory system as it exists in Maine. Maine follows the riparian theory of water rights, so a developer must obtain rights to both river banks, by sale, lease, or use of the abandoned dam law or Mill Dam Act. These rights are subject to the public trust doctrine. It is suggested that the developer start the regulatory process with the Public Utilities Commission, which supervises power plants of more than 1,000 kw, and which will issue a certificate of public convenience and necessity. The Board of Environmental Protection must next give approval, and if the development is to be in an unorganized or deorganized township, a certificate is required from the Land Use Regulation Commission. Notice must be filed with the Department of Inland Fish and Wildlife or the Department of Marine Resources, as appropriate. Stream alteration, coastal wetlands, or great ponds permits are then required, before construction starts. Once the project is built it is subject to inspections and regulations by these agencies. Taxes are assessed by local assessors for property tax purposes. Financial assistance is available from the Office of Energy Resources, and technical assistance from the State Development Office. It is suggested that a one-step procedure be developed within the Board of Environmental Protection to simplify the regulatory process. (Brambley-SRC)
W82-00750

A CASE STUDY ANALYSIS OF LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF THE HYDROELECTRIC POTENTIAL AT GOOSE RIVER, MAINE.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-32, May 1980. 85 p, 62 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Institutional constraints, *Dams, *Economic aspects, Water level fluctuations, Reservoirs, Regulations, Site selection, Environmental effects, Public participation, *Goose River, Maine.

The Goose River hydroelectric project is located on the Goose River in Maine, which flows from Swan Lake in the Town of Swanville through the city of Belfast to the sea. The project comprises a five dam system. A private developer proposes to use the 7,500 acre-feet of storage capacity of Swan Lake to run the four downstream power stations, generating 430 KW of total capacity which could then be sold to Central Maine Power. The impact of federal regulation on the project has been relatively minor. The Town of Swanville has intervened in the federal licensing process to express its concern regarding fluctuations in the level of Swan Lake. The Public Utilities Regulatory Policies Act (PURPA) mandate has not been significant because the purchasing utility has a history of small power purchases. Maine has two specific regulatory systems which produce a de facto regulatory system for small dams: a water management system and an energy regulatory system. The development of the Goose River Project has capitalized on the nonspecific nature of the regulatory system, bypassing most of the system by use of statutory exemptions and an artful selection of the project site. The process selected for resolving the lake level issue and its subsequent environmental effects is that of environmental mediation. Its primary advantage is the avoidance of a costly resolution through the courts. The Goose River Project is expected to show a profit for tax purposes in each year of operation. (Moore-SRC(
W82-00751

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN PENNSYLVANIA.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-17, May 1980. 67 p, 179 Ref.

Descriptors: *Hydroelectric plants, *Legal aspects, *Dams, *Water rights, Riparian rights, Dam construction, Utilities, Regulations, Taxes, Financial aspects, *Pennsylvania.

There are three methods by which rights in water may be acquired in Pennsylvania: riparian ownership, prescription, and condemnation. A conbination of the riparian doctrines of natural flow and reasonable use is used to determine the rights of riparian owners. The right to use water of any watercourse other than a navigable stream may be acquired by prescriptive rights, which are absolute and exclusive. Streams and rivers are held to be navigable in law if they are used as public trade-routes. Title to the beds of navigable rivers and lakes is held by the Commonwealth in trust for the public. The Commonwealth may grant title to the beds of navigable streams to private persons, subject to the public trust and public rights. The Public Utility Commission and the Department of Environmental Resources directly regulate dam construction and hydroelectric power production and distribution. The power of eminent domain is limited to those public utilities which have been granted a certificate of public convenience by the Public Utility Commission. Virtually all existing environmental control authority is exercised exclusively by the Department of Environmental Resources. Indirect regulation by the state is in the form of zoning, historic preservation, the Scenic Rivers Act, water pollution control, and river basin commissions. Hydroelectric developers are subject to a multitude of taxes and fees both prior to and after the hydro facility is operating. (Moore-SRC)
W82-00752

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN WEST VIRGINIA.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-22, May 1980. 126 p, 1 Fig, 66 Ref, 3 Append.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Water rights, Taxes, Utilities, Permits, State jurisdiction, Dams, *West Virginia.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. West Virginia follows the riparian theory of water law and reasonable use of the water by the riparian owner. There is no Mill Dam Act and it is not clear whether a hydroelectric development has power of eminent domain. A small-scale hydroelectric project developer must obtain approval from the Department of Natural Resources, specifically from the Coal Refuse and Dam Control Section. The Division of Fish and Game may require the construction of fish ladders. The Public Service Commission may require a certificate of public convenience and necessity, and will set rates upon completion. On some specified rivers, permits may be required under the Natural Streams Preservation Act. A state water quality certificate may be necessary. Indirect regulation may result from requirements for water pollution control, special districts, local and wetlands regulations, energy resources programs and historic preservation. After construction the project will be inspected on a continuing basis and the owner will be held liable under the negligence theory for breaches of the dam. Hydroelectric projects are subject to property, business and license taxes, and may be eligible for loans through industrial development agencies. The Potomac River Basin Compact, the Ohio River Valley Water Sanitation Commission and the Wheeling Creek Watershed Protection and Flood Prevention District Compact impact hydroelectric projects indirectly. (Brambley-SRC)
W82-00753

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN NEW YORK.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-14, May 1980. 122 p, 1 Fig, 101 Ref.

Descriptors: *Hydroelectric power, *Institutional constraints, *Legal aspects, *Regulations, Permits, Economic aspects, Legislation, State jurisdiction, Water rights, Dams, Taxes, Utilities, *New York.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. In New York land may be obtained by purchase, lease or grant by the state, or by the use of the eminent domain power of the state. A reparian owner has rights to reasonable use and diversion of flow of the water. The Public Trust Doctrine allows the state to require permits to be obtained by small-scale hydro developers; such permits are issued by the Department of Environmental Conservation. The owner of a dam is responsible only for negligence if the dam is breached. All hydroelectric projects are subject to the State Environmental Quality Review Act and require either an

environmental impact statement or a negative declaration. The Public Service Commission regulates electric power facilities with respect to construction, finances and rates. Small-scale hydro projects are subject to consideration indirectly from a number of state agencies concerned with environmental protection and energy development, and five interstate compacts. Projects are subject to initial fees, income taxes, administrative expenses and real property taxes, and may obtain development funds from the state's Industrial Development Agencies. (Brambley-SRC)
W82-00754

LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF SMALL SCALE HYDROELECTRIC POWER IN DELAWARE.

Franklin Pierce Law Center, Concord, NH.
Department of Energy Report DOE/RA/04934-13, May 1980. 108 p, 1 Fig, 75 Ref.

Descriptors: *Hydroelectric power, *Legal aspects, *Institutional constraints, *Regulations, Legislation, State jurisdiction, Water rights, Taxes, Economic aspects, Utilities, *Delaware.

The state laws and regulations affecting hydroelectric power development are reviewed in the context of Federal regulations and the power of the Federal government to pre-empt state regulations. The Public Utility Regulatory Policies Act of 1978 is expected to remove some hydroelectric projects from Federal jurisdiction, and also from state law. Delaware law recognizes riparian owners rights to reasonable use of water between high and low water marks of navigable rivers, with the state having rights to the river bed between low water marks. The Mill Dam Act implies that there is a reasonable use approach to non-navigable waters. The Public Service Commission regulates public utilities with respect to construction, operation, rate setting, and financial reporting. There is no general provision granting utilities the power of eminent domain. The Department of Natural Resources and Environmental Control is responsible for granting permits for small-scale hydro projects, and enforcing their provisions. These projects will be subject to review by the Delaware River Basin Commission, to local zoning regulations, to Soil and Water Conservation District regulations, and to the Coastal Zone Act. Small-scale hydro projects may be affected indirectly by plans of the Office of Management, Budget and Planning, the Delaware Energy Office, the State Conservation Plan, and historical site locations. Financial considerations include the payment of a license fee, gross receipts tax, real property tax, income taxes, franchise tax, and additional taxes, but projects may be eligible for loans when substantial employment opportunities may result. (Brambley-SRC)
W82-00755

FEDERAL PARTICIPATION IN LAND USE DECISION-MAKING AT THE WATER'S EDGE--FLOODPLAINS AND WETLANDS,

Economic Research Service, Washington, DC. Natural Resource Economics Div.
B. H. Holmes.
Natural Resources Lawyer, Vol 13, No 2, p 351-410, 1980. 338 Ref.

Descriptors: *Land use, *Wetlands, *Flood plains, Legal aspects, Decision making, Governmental interrelations, Water resources management, Local governments, Regulations, Legislation, Judicial decisions, Flood control, Water quality standards, Water pollution control, Nonstructural alternatives, Aquatic habitats, Flood insurance, Channel improvement, Dredging, Water law, Water policy, Coastal zone management.

Land use regulation, traditionally the prerogative of states and local governments, is increasingly a federal concern, particularly in the sphere of water resources. The National Environmental Policy Act and the Coastal Zone Management Act of 1972 are examples of the Congress' more recent attitudes toward protection of water resources. In the past the federal government has exerted control over shoreland land use through the statutes on navigable waters, over which it has jurisdiction. The Federal Water Pollution Control Act Amendments of 1972 provide one example of this. Judicial decisions have promoted the extension of federal control over land use as it affects water quality. Uses of flood plains are also controlled by the National Flood Insurance Act of 1968, the Flood Disaster Protection Act of 1973, other legislation, and executive orders. Flood control projects, assistance in flood plain management, disaster relief, and flood plain acquisition are means of implementing these laws and regulations. A unified national wetlands protection management program is emerging from the piecemeal and fragmented jurisdictions, involving many federal agencies. Wetlands preservation is currently carried out through wetlands acquisition, providing migratory bird habitats through the Water Bank Program, the Corps of Engineers permit policy for construction activities (including dredging), small watershed management (discouraging channel improvement), the National Environmental Policy Act, and the Endangered Species acts. (Cassar-FRC)
W82-00799

WATER QUALITY MANAGEMENT IN RIVER BASINS: US NATIONAL EXPERIENCE,

North Carolina Dept. of Natural Resources and Community Development, Raleigh.
N. S. Grigg, and G. H. Fleming.
Water Science and Technology, Vol 13, No 3, p 31-42, 1981. 18 Ref.

Descriptors: *Water quality control, *Regulations, *River basins, *Nonpoint pollution sources, Water management, Water policy, Water law, Water pollution control, Rivers, Effluent standards, Economic aspects, Cost effectiveness, Industrial wastes, Sewage charge, Urban runoff, Construction, Agriculture, Administrative agencies.

Since the 1970's the U.S. water quality management program has been a matter of debate between supporters of the regulatory approach and supporters of the economics-based approach. However, the great attention paid to wastewater dicharges has resulted in ignoring some of the major water quality problems non-point sources such as agriculture, storm water and construction. Water quality standards and effluent standards are used to determine the conditions of a dicharge permit (NPDES) for all dischargers. The U.S. regulatory system features uniform minimum requirements, no fee for discharge in permitted amounts, and non-transferability. A major criticism of the regulatory approach is the large amount of administrative effort required, some of which is misdirected or ineffective. However, it is unlikely that the economics-based approach could achieve the control now desired in the U.S. In its purest form the economic approach equates marginal costs and benefits. While eliminating much office work in determining effluent limitations, it would require much more field work to determine the possible damages from various discharges. The economic incentive approach charges an amount which induces dischargers to treat effluent to the limits that would achieve the water quality objective. In the United States, water quality management has passed the point where major improvements would result from modest regulatory actions. Future concerns are nonpoint sources and disposal of toxics, sludges and treatment residuals. (Cassar-FRC)
W82-00800

INTERSTATE CONFLICT OVER GROUND WATER: WISCONSIN-ILLINOIS,

Wisconsin Univ.-Oshkosh. Dept. of Geology.
C. W. Fetter, Jr.
Ground Water, Vol 19, No 2, p 201-213, March/April, 1981. 10 Fig, 6 Tab, 13 Ref.

Descriptors: *Computer models, *Aquifer management, *Groundwater depletion, Groundwater reservoirs, Groundwater management, *Wisconsin, *Illinois, Legal aspects, Interstate groundwater use.

A computer model of an aquifer system was used to model the drawdown effects resulting from pumpage in Illinois and Wisconsin as well as to predict the impact of different management plans on groundwater levels. The practical sustained yield from the Cambrian-Ordovician aquifer is 46 million gal/day in Illinois and 34 million gal/day in Wisconsin. Pumpage in Illinois has exceeded practical sustained yield every year since 1958, while practical sustained yield was reached in Wisconsin in 1975. Greater drawdown in the Chicago pumping cone has changed the regional hydraulic gradient, and 9.3 million gal/day of groundwater is currently being drained from beneath Wisconsin. Model results indicated that at the Illinois-Wisconsin border in 1973, there was 265 feet of drawdown, of which 94 feet were due to Wisconsin pumpage and 171 feet due to Illinois pumpage. To reduce Illinois pumpage, Lake Michigan water could be allocated to groundwater users in Illinois. This could result in a reduction of Illinois pumpage to less than 46 million gal/day by 1985, and the rate of groundwater decline in the aquifer would decrease subtantially. (Small-FRC)
W82-00818

WESTERN COAL MINING IN THE 1980S: A STUDY IN FEDERAL/STATE CONFLICTS,

Dechert, Price and Rhoads, Denver, CO.
D. H. Israel.
Natural Resources Lawyer, Vol 13, No 3, p 581-612, 1981. 123 Ref.

Descriptors: *Coal mining, *Legal aspects, Watershed protection, Watersheds, Regulations, Federal jurisdiction, Governmental interrelations, Groundwater, Surface water, State jurisdiction.

The preservation of surface and ground water resources of mining areas is considered as it relates to the new federal requirements concerning coal mining and reclamation. Coal mining is the first mining industry required by federal law to show affirmatively that its activities would not materially injure the hydrologic balance of both off-site and on-site areas. The circumstances and legislative history behind the call for hydrologic balance rules are reviewed. Under the new regulations, the application or permit must contain the name of the watershed and location of the surface stream or tributary into which surface and pit drainages will be discharged. Cross-section maps or plans showing the location of any subsurface water and its quality, the location of the aquifers, the estimated elevation of the water table, the location of impoundments, location of any water treatment facility, and the locations of discharges to any surface water on or adjacent to the affected land must also be included in the permit application. A reclamation plan is also needed. The regulations also deem some areas as unsuitable for mining operations, e.g., the alluvial floor limitation. There have been some federal/state conflicts concerning the new regulations. In one court it was ruled that the Secretary of the Interior cannot regulate the states' regulatory programs to demand information in mining permit applications beyond those specifically enumerated in the Surface Mining Control and Reclamation Act of 1977. This particular decision reveals the widespread feeling among federal courts that SMCRA and its federal regulators have gone too far in invading the traditional right of the states to exercise primary, if not exclusive, authority over essentially local land and water use issues. (Baker-FRC)
W82-00972

EXPERIENCE GAINED WITH THE U.S. POLLUTION CONTROL POLICIES,

Alvord, Burdick and Howson, Chicago, IL.
W. H. Richardson.
Aqua, No 2, p 245-255, 1981. 4 Fig, 25 Ref.

Descriptors: *Legal aspects, *Water pollution control, *Policy making, History, Administrative decisions, Federal jurisdiction, Political aspects, Government interrelations, *United States, Legislation.

Water pollution control efforts in the United States are viewed chronologically from 1800 to the present. Until the end of World War II, all of the pollution control activities were under the control of individual state Boards of Health or Sanitary Water Boards. The Federal Government's only concern was foreign matter in harbor waters. The

first Water Pollution Control Statute was established in 1956; this was the first time that funds were provided as Grants toward the construction of treatment facilities. The 1972 Clean Water Act established goals, deadlines and a management program. The next major change occurred in 1977. Special efforts were exerted toward toxic and hazardous substances. Other major laws bearing on pollution control included the 1974 Safe Drinking Water Act, and the 1976 Toxic Subatances Control Act. The 1974 Safe Drinking Water Act recognized the effect of organic contamination in the nation's drinking water supplies. The Conservation and Recovery Act dealt with improvements of solid waste management and encouraged the recovery of materials and energy and their reuse. In the short time that pollution control policies have been in effect, benefits have fallen short of the expected targets. However, there have been benefits in the field of technology transfer. Federal incentives have speeded activity in the area of establishing water quality standards. With the government requirements, most local municipalities and systems no longer are masters of their own fate. Currently, concern about the possible contamination of groundwater sources is of utmost interest. (Baker-FRC)
W82-00996

ENFORCEMENT UNDER THE RESOURCE CONSERVATION AND RECOVERY ACT OF 1976,

R. A. Weiland.
Boston College Environmental Affairs Law Review, Vol 8, No 3, p 641-678, 1980. 344 Ref.

Descriptors: *Regulations, *Legal aspects, *Groundwater pollution, Federal jurisdiction, Conservation, Hazardous materials, *Industrial wastes, Hazards, Water pollution sources.

The enforcement mechanisms made available to the federal government by the Resource Conservation and Recovery Act (RCRA) of 1976 to control the disposal of hazardous wastes are reviewed. Since no cases have yet been brought in which the government has used Section 7003 or Section 3008 of this act, the analysis is based on the overall language of the RCRA, its sparse legislative history, and on analogies to administrative interpretation and judicial construction of other, principally environmental, statutes. The Imminent Hazard provision is explored with discussion on the meaning of the term imminent or substantial endangerment, the special requisites for obtaining an injunction in light of the fact that the power to bring suit for equitable relief is granted in the statute, and finally, with regard to Section 7003, the relief that may be granted. Federal enforcement section of Subtitle C is discussed. Administrative and judicial enforcement options available to the government are considered, including compliance orders, civil penalties, and other civil actions. Finally, the criminal penalties provision is examined, including a discussion of entities against whom criminal sanctions may be sought and of the requirements for finding criminal liability. Interpretation is expected to parallel similar passages in the Clean Water Act.
W82-01013

DISTRIBUTION SYSTEM LIABILITY,

Waukesha Water Utility, WI.
For primary bibliographic entry see Field 5F.
W82-01028

FREEDOM FROM THE NAVIGATION SERVITUDE THROUGH PRIVATE INVESTMENT,

C. E. Larsen.
Nebraska Law Review, Vol 59, No 4, p 1073-1092, 1980. 107 Ref.

Descriptors: *Judicial decisions, *Navigation, *Legal aspects, Navigation canals, Navigable waters, Public access, Remedies.

Federal regulatory control over the navigable waters of the United States derives from the commerce clause of the Constitution. As a corollary of the federal regulatory power over interstate commerce, previous decisions of the U.S. Supreme Court have held that private property interests obstructing the free flow of navigation over navigable waters are subject to destruction or confiscation by the government without compensation. This burden on property interests, known as the federal navigation servitude, has been applied often, but not consistently, by the Supreme Court, with inequitable results. In Kaiser Aetna v. United States, 100 S. Ct. 383 (1979), the Supreme Court ruled that special circumstances may limit the power of the U.S. Congress over navigable waters of the United States in a manner negating the no compensation rule of the navigation servitude. Factors contributing to the Court's refusal to apply the navigation servitude no compensation rule included the effect of private investment in the improvement of the navigability of the waterway, the waterway's status under state law, and the conduct of the Army Corps of Engineers in approving the development of the waterway. A second case, Vaughn v. Vermillion Corp., 100 S. Ct. 399 (1979), decided the same day as the Kaiser Aetna case, involved public access to canals dug on private land by private investors. This decision clearly stated that artificially constructed waterways are not subject to a public right of access. The Kaiser Aetna decision determined, in effect, that the navigation servitude is not coextensive with the navigable waters of the United States for commerce clause purposes, but did not resolve the question of the effective reach of the federal navigation servitude. (Carroll-FRC)
W82-01030

FEDERAL WATER RESOURCES RESEARCH: A REVIEW OF THE PROPOSED FIVE-YEAR PROGRAM PLAN.

National Research Council, Washington, DC. Water Resources Research Review Committee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-135559, Price codes: A05 in paper copy, A01 in microfiche. National Academy Press, Washington, DC. 1981. 75 p, 19 Tab, 11 Ref, 2 Append. OWRT-C-0086-G(04260(1), 14-34-0001-0426.

Descriptors: *Federal water resources research, Reviews, *Management planning, *Research priorities, *Alternative planning, *Future planning, Education, Training, *Multiobjective planning, Water Resources Institutes, Administrative agencies, Water resources development, *Long-term planning, Institutions, Legal aspects, Social aspects, Political aspects, Economic aspects, Governmental interrelations, Federal jurisdiction, *Five-year plans.

The Water Resources Research Review Committee was created by the Commission on Natural Resources of the National Research Council to perform this study, which provides the Office of Wateer Research and Technology, U. S. Department of the Interior, with assistance in the preparation of the five-year water resources research plan called for in the Water Research and Development Act of 1978. The Committee studied the 1975 assessment of the nation's water resources by the U. S. Water Resources Council and other recent reports that highlight pressing water problems. The Committee then developed criteria by which to determine the research areas of highest priority. Using these criteria, the Committee identified thirty-one research areas where, in its judgement, emphasis should be placed in programming water resources research over the next five years in the continuing effort to see that the nation's water resources are used effectively to provide essential services. The thirty-one research aeas are described in relation to the professional disciplines. An alternative listing related to problem areas is contained in an appendix. The Committee concluded that: (1) the research grant programs of the Office of Water Research and Technology can serve an important role in training researchers for the future; (2) the institutional areas (social, behavioral, economic, legal, and political) should be the subject of significantly greater research effort in the future; (3) funding for actual research is only about two percent of the funding ($380 million) for all activities related to water resources by the federal government, a modest level considering the importance of water resources to the national well-being; (4) an improved management system is required for water resources research if the objectives of the Water Research and Development Act are to be achieved; and (5) three types of federal water arrangements might be considered: a managed multiagency research program; a policy committee based in the Office of Science and Te+chnology Policy in the Executive Office of the President; or a committee based in a reconstituted Water Resources Council.
W82-01051

ILLINOIS GROUNDWATER PROBLEMS AND NEEDS,

Illinois Environmental Protection Agency, Springfield. Div. of Land/Noise Pollution Control.
For primary bibliographic entry see Field 4B.
W82-01052

GROUNDWATER POLLUTION IN KENTUCKY: A STATUS REPORT,

Kentucky Dept. for Natural Resources, Frankfort.
For primary bibliographic entry see Field 4B.
W82-01053

GROUND WATER IN THE OHIO RIVER BASIN PORTION OF MARYLAND: PROBLEMS AND NEEDS,

Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 4B.
W82-01054

GROUNDWATER PROBLEMS AND NEEDS IN NEW YORK,

New York State Dept. of Environmental Conservation, Albany.
For primary bibliographic entry see Field 4B.
W82-01055

GROUNDWATER PROBLEMS IN NORTH CAROLINA,

North Carolina Dept. of Natural Resources and Community Development, Raleigh.
For primary bibliographic entry see Field 4B.
W82-01056

OHIO'S GROUND WATER RESOURCES AND PROBLEM AREAS,

Ohio Environmental Protection Agency, Columbus. Groundwater Div.
For primary bibliographic entry see Field 4B.
W82-01057

PENNSYLVANIA GROUND WATER PROBLEMS AND NEEDS,

Pennsylvania Dept. of Environmental Resources, Harrisburg.
For primary bibliographic entry see Field 4B.
W82-01058

GROUND WATER PROBLEMS VIRGINIA PORTION OHIO RIVER BASIN,

Virginia State Water Control Board, Richmond.
For primary bibliographic entry see Field 4B.
W82-01059

GROUND WATER PROBLEMS IN WEST VIRGINIA,

West Virginia Dept. of Natural Resources, Charleston. Div. of Water Resources.
For primary bibliographic entry see Field 4B.
W82-01060

STATE OF WASHINGTON WATER QUALITY ASSESSMENT REPORT 1980.

Washington State Dept. of Ecology, Olympia.
Document 81-6, December, 1980. 57 p, 8 Fig, 8 Tab.

Descriptors: *Water quality standards, *Water quality control, *Pollution effects, *Water quality management, *Long-term planning, Groundwater management, Ground water pollution, Surface water, Pollution effects, Management planning, Industrial wastewater, Municipal wastewater, Comprehensive planning, *Washington.

This biennial Water Quality Assessment Report provides an overview of the status of the chemical, biological, and physical properties of the waters of the State of Washington. The current status is that the water quality goal of 'fishable/swimmable' waters is met in 45 percent of the segments in the state. Of the 31 percent not meeting the goal, the problems in 13 percent are due principally to nonpoint sources and those in 4 percent to point sources (municipal or industrial), and it is unknown whether the goal will be met in the near future. Until the mid-1970s, water quality management efforts were focused heavily on municipal and industrial discharges. Program emphasis is now shifting from categorical problems to priority geographic problem areas, which include Commencement Bay, Duwamish Waterway, Inner Grays Harbor, lower Yakima River and Spokane River. Water quality priority areas are Willipa Bay, Lake Chelan, Puget Sound, and Duwamish Waterway and River. The Puget Sound Study will be a multiyear program of plan development and implementation. Ground water quality monitoring and control is an increased state and federal priority, and a comprehensive management strategy is being developed by the state that will examine the need for ground water quality standards, a non-degradation policy, and control of sources through the state waste discharge permit program. This strategy will allow for coordinated development and operation of programs for underground injection control, onsite waste management, and storm water management. (Garrison-Omniplan)
W82-01067

A CASE STUDY ANALYSIS OF LEGAL AND INSTITUTIONAL OBSTACLES AND INCENTIVES TO THE POTENTIAL HYDROELECTRIC DEVELOPMENT AT HIGH FALLS STATE PARK, GEORGIA.
Franklin Pierce Law Center, Concord, NH. Energy Law Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA/04934-34, Price codes: A04 in paper copy, A01 in microfiche. Department of Energy Report DOE/RA/04934-34, May, 1980. 61 p, 1 Fig, 15 Ref.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Institutional constraints, *Legal aspects, *Economic aspects, Economic efficiency, Environmental effects, Dams, Reservoirs, Licensing, Electrical transmission, *High Falls State Park, Georgia, Case studies.

There are four potential hydroelectric power sites at High Falls State Park, of which the old powerhouse site is the most favorable, economically and environmentally. The canal and penstock cradles already present would reduce construction costs. The legal requirement of keeping the water level in the reservoir constant mandates a run-of-the-river project, but this will reduce the environmental impact. A license will be required by the Federal Energy Regulatory Commission before the site can be used for hydroelectric power generation, and an environmental impact statement is part of the licensing process. The Georgia Department of Natural Resources has authority over hydroelectric projects, and, because of the age of the dam, is unlikely to license it without investigation and repairs. If the repairs are done, there seem to be few problems to use of the site, and electricity could be generated economically. There will be legal and functional problems if the Department of Natural Resources develops the site. These problems can be overcome if the Municipal Electric Authority of Georgia (MEAG) is the developer, and the MEAG has the advantage of existing power wheeling agreements, making it the most effective developer of the site. (Brambley-SRC)
W82-01078

6F. Nonstructural Alternatives

ARKANSAS WATER POLICY.
Water Policy Task Force, Little Rock, AR.
For primary bibliographic entry see Field 6D.
W82-00715

PROPOSED WATER QUALITY CONTROL PLAN FOR INDIO SUBAREA OF THE WHITEWATER HYDROLOGIC UNIT, WEST COLORADO RIVER BASIN.
California Regional Water Quality Control Board, Palm Desert. Colorado River Basin Region.
May, 1981. 62 p, 3 Fig, 12 Tab, Append.

Descriptors: *Water management, *Administrative decisions, *Long-term planning, *Water use, *Multi-objective planning, *Competing use, Water use efficiency, Aquifers, Aquifer management, Alternative planning, Water consumption, Groundwater management.

The proposed Water Quality Control Plan for the Indio subarea of the Whitewater Hydrologic Unit, West Colorado River Basin, was prepared as the first phase in updating the Plan for the Basin. For planning and reporting purposes, the Basin was divided into six major areas on the basis of economic and hydrologic characteristics: Lucerne Valley, Hayfield, Coachella Valley, Anza-Borrego, Imperial Valley, and Salton Sea. The Indio subarea is one of five within the Coachella Valley Planning Area, and its water quality issues are addressed in depth amid an overview of all six major planning areas. The groundwater in the Indio subarea lies principally in the alluvial deposits of the Coachella Valley. A deep aquifer is located along the entire length of the Valley from the San Gorgonio Pass to the Salton Sea. The area from Indio south also has a semi-perched zone resulting in a two-aquifer system; the deep aquifer is separated from the upper aquifer by an aquitard. A comparison of 1970-75 and 1938-39 groundwater quality data for shallow wells shows an increase in total dissolved solids concentrations near Indio and an increase in total hardness southeast of Indio. High nitrate concentrations (approximately 200 mg/l NO-3) were found in the Indian Wells area prior to 1937, and were attributed to the decomposition of mesquite forests. Significant variations in water quality exist within the subbasin. (Garrison-Omniplan)
W82-00716

FEDERAL PARTICIPATION IN LAND USE DECISION-MAKING AT THE WATER'S EDGE--FLOODPLAINS AND WETLANDS,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 6E.
W82-00799

COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,
Idaho Univ., Moscow. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W82-00869

6G. Ecologic Impact Of Water Development

LEAF LITTER PROCESSING IN A REGULATED ROCKY MOUNTAIN STREAM,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
R. A. Short, and J. V. Ward.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 1, p 123-127, January, 1980. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Leaves, *Litter, *Environmental effects, *Dam effects, *Macroinvertebrates, *Colorado River, Ecological effects, Streams, River systems, Mayflies, Microbial degradation, Temperature effects, Aquatic populations, Granby Dam.

The ability of regulated (dammed) streams to process leaf litter of alder was examined by the leaf litter pack method at sites before the Granby Dam along the Colorado River. Similar studies conducted on sections of the undammed Fraser River were used for comparison. Leaf processing was studied during the autumn and winter with leaf packs attached to bricks and placed in riffles. Leaching controls were kept in the water two days, and five samples from each site were retrieved after 16, 38, 52, and 66 days. Macroinvertebrates collected from study sites were classified and counted and leaf processing was evaluated by comparing dry weights of remaining leaf packs after the end of the study period. Loss rate coefficients were much higher for leaves kept in regulated waters than in unregulated waters. These findings did not support the hypothesis that reductions in macroinvertebrate shredders would decrease leaf litter processing rates in regulated streams. It was suggested that the warmer winter temperatures below the dam compensated for the virtual absence of shredder species by increasing the microbial leaf degrading activities. (Geiger-FRC)
W82-00542

THEORY OF ECOLOGICAL PREDICTION OF LIMNETIC ECOSYSTEMS,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
I. I. Nikolaev.
Water Resources (English Translation), Vol 7, No 5, p 430-436, September/October, 1980. 48 Ref. Translated from Vodnye Resursy, No 5, p 100-109, September/October, 1980.

Descriptors: *Limnology, *Prediction, *Ecosystems, Ecological effects, *USSR, Reservoirs, Stream discharge, Europe, Species composition, Benthos, *Reservoir construction.

The first period of active prediction of limnetic ecosystems in the Soviet Union is associated with intensive hydraulic engineering construction conducted between 1930 and 1950. Regular hydrobiological and ichthyologuical investigations conducted on all of the large reservoirs have made it possible to evaluate the correctness of the predictions. The species composition of pelagic and benthic communities of reservoirs on the Volga generally corresponds to predictions, although the observed intense invasions of elements of southern fauna northward and of northern fauna southward were unexpected. The predictions with respect to the formation of main communities were considerably less accurate. While the predictions indicated that pelophilous benthos should have been predominant in the reservoirs, with oligochaetes and other homotropic fauna predominating in the benthos from the first years of existence, experience showed that heterotropic fauna dominated colonization of the bottom of the reservoirs, with larvae of midges being the predominant species in the first years. There were no substantial deviations from the predictions of the development of the communities of micro- and macrovegetation of the flatland reservoirs. Quite substantial errors were made in predicting the productivity of individual communities. Predictions of the phytoplankton productivity were underestimated and that of the zoobenthos and commercial fishes overestimated for many reservoirs. Although many of the predictions were not accurate, long-term comprehensive investigations facilitated analysis of the principal causes of deviations from the predictions and promoted the formation of more realistic concepts about the processes of formation of lakelike ecosystems and the feasibility of their prediction. (Carroll-FRC)
W82-00597

THE AZOV SEA PROBLEM,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
D. Ya. Ratkovich, V. E. Prival'skii, M. V. Matushanskii, S. S. Remizova, and Yu. Yu. Marti.
Water Resources (English Translation), Vol 7, No 4, p 304-320, July-August, 1980. 3 Fig, 6 Tab, 10 Ref. Translated from Vodnye Resursy, No 4, p 19-39, July-August, 1980.

Descriptors: *Salinity, *Water management, *Water allocation, *Azov Sea, Water consumption, Diversion, Volga River, Don River, Kuban

River, Saline water intrusion, Saline lakes, Lakes, Reservoirs, Irrigation effects, Water conservation, Fisheries, Fish management, Hydroelectric plants, Reservoir releases, Water use, Navigable waters, Model studies, Agriculture, Canals, Water pollution control, Water transfer, Russia.

As water consumption increases in the heavily populated and industrialized Azov Sea Basin, river inflow and biogenic runoff decreases. This causes an increase in salinity via an inflow of Black Sea waters and a deterioration of water quality and biological productivity. Projects to reduce nonreturnable losses include a sequence of low-head hydrostations to maintain a uniform transport depth in the Volga-Don waterway, fishery projects, and limiting new irrigation according to available water. Nonreturnable water consumption in the Lower Don Basin will be 20% of the total for the entire Don Basin until 1990, then 15%. Plans for water management in the Kuban River Basin involve transfer of water from other basins, reducing the navigation season from 285 days to 140-145 days, and spawning releases for fish. A model is used to predict the salinity of the Sea at intervals up to 2010 under different variations of water consumption. These calculations show that the salinity of the Sea can be reduced to a favorable regime (9.5-10.5 %) only by complete compensation of nonreturnable withdrawals. It is unlikely that fisheries and irrigated agriculture can continue to coexist until the end of the century. The effects of the proposed Kerch Strait hydroelectric project, between the Black and Azov Seas, have not been determined, but speculations are that salinity will increase, shoreline erosion will occur, anchovy migration will be disturbed, and salinity in the freshwater spawning areas will be unfavorably changed. (Cassar-FRC)
W82-00651

THE PONGOLO FLOODPLAIN: A UNIQUE ECOSYSTEM THREATENED,

Natal Univ., Pietermaritzburg (South Africa).
J. Heeg, C. M. Breen, and K. H. Rogers.
Civil Engineer in South Africa, Vol 22, No 5, p 125-128, May, 1980. 2 Fig, 1 Ref.

Descriptors: *Flood plains, *Dams, Levees, Weirs, Flood plain management, Flood plain zoning, Flood irrigation, Benefits, Ecosystems, Pongolapoort Dam, *South Africa.

The effects on the Pongolo Floodplain resulting from the construction of the Pongolapoort Dam are examined. The Dam was constructed for the purpose of impounding the waters of the river for irrigation. This will result in an absorption of the floods which now regularly inundate the floodplain during the summer months. In examining the energy pathways and nutrient cycles of the Floodplain, two main spheres of marked flood dependence were isolated: allochthonous and autochthonous energy inputs, which are directly affected; and the fishes, an exploitable resource, which are indirectly affected through reduced energy input as well as being directly dependent on the floods in their breeding biology. The principal requirement for preserving the Pongolo Floodplain is sufficient water to flood the system, applied at the correct time to stimulate fish spawning. The amount of water required to maintain the floodplain pans at the maximum retention level is estimated at 26,000,000 cubic meters per year, based on an annual evaporation of 2,000 mm and a rainfall of 600 mm/year. However, the productivity depends on inundation of the whole area between the levees and the adjoining high ground for a reasonable period of time, and this would require an additional 100,000,000 cubic meters per year, which is 14.6% of the mean assured yield of the dam. It is estimated that, given inflatable weirs with reasonably sensitive control, the requirements can be met at an annual water cost of 42,000,000 cubic meters per year, a 67% saving on the natural flow-through system. (Baker-FRC)
W82-00684

FINAL ENVIRONMENTAL IMPACT STATEMENT: NORTH FORK STANISLAUS RIVER PROJECT NO. 2409 - CALIFORNIA.

Federal Energy Regulatory Commission, Washington, D.C. Office of Electric Power Regulation.
Report FERC/EIS-0011, June 1980. 297 p, 10 Fig, 28 Tab, 40 Ref, 8 Append.

Descriptors: *Environmental Impact Statement, *North Fork Stanislaus River, *California, *Hydroelectric power, *Environmental effects, *Electric power production, Dams, Tunnels, Transmission lines, Recreation, Flooding, Reservoirs, Wildlife habitats, Flow rates, Water quality, Social aspects, Cost-benefit analysis.

The Calaveras County Water District is proposing to construct a 205.2 MW hydroelectric project on the North Fork Stanislaus River, Stanislaus River, Highland Creek, Beaver Creek, Silver Creek, and Duck Creek in the vicinity of Arnold, California. It would require the construction of a dam, two powerhouses, three diversion dams, diversion tunnels, an afterbay dam, access roads, transmission lines, recreational facilities, and appurtenant facilities. About 2,848 acres of land would be occupied by the project, of which 2,723 acres are now Federal lands. Environmental impacts caused by construction and operation of the project would include: loss of 1865 acres of existing vegetation and wildlife habitat to the reservoirs; inundation of streams; altered flow and thermal regimes in the creeks and river; deterioration of water quality; loss of vegetation; temporary adverse impacts on air quality and ambient noise levels during construction; increased recreational use; effects on archeological sites; impacts of the increased labor force during construction; and changes in the visual resources. Alternative power sources using a combination of hydroelectric and fossil-fuel combustion were considered. The proposed project and the combination sources have the best benefit-cost ratios and would save various amounts of coal and oil. (Brambley-SRC)
W82-00737

FINAL ENVIRONMENTAL IMPACT STATEMENT: SWAN LAKE PROJECT NO. 2911 - ALASKA.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC/EIS-0012, April 1980. 189 p, 22 Fig, 16 Tab, 23 Ref, 3 Append.

Descriptors: *Hydroelectric plants, *Environmental impact statement, *Dam construction, Water quality, Turbidity, Environmental effects, Wildlife habitats, Construction, Fish, Swan Lake, *Alaska.

A 22 MW hydroelectric project on Falls Creek and Swan Lake near Ketchikan, Alaska, has been proposed. This would involve the construction of: a dam located 0.75 miles downstream from the outlet of the existing Swan Lake: a power tunnel leading to an indoor-type powerhouse at tidewater on Carroll Inlet; a switchyard; an access road; a transmission line; and appurtenant facilities. Environmental impacts caused by construction and operation of the project would include: inundation of about 460 acres of existing vegetation and wildlife habitat; inundation of about 3.5 miles of spawning habitat used by kokanee and Dolly Varden; diversion of all waters, except flood and spillage waters, at the dam, from the natural Falls Creek channel to the powerhouse; clearing of about 250 acres of land; loss of wildlife habitat, and temporary disruption of resident wildlife species in or near construction sites; disturbance of about 20 acres of land in the lower Carroll Creek watershed for extraction and processing of aggregate; turbidity and siltation in surface waters receiving drainage from construction sites and the aggregate site; temporary adverse impacts on air quality and ambient noise levels; and changes in the charactersitics of visual and recreational resources. Alternatives to the proposed action that were considered are: conservation and rate revision; alternative design arrangements; other sites; alternative forms of generating equivalent power; and denial of the application for license. (Moore-SRC)
W82-00738

MEASUREMENT OF PARTICULATES EXTRAINED IN SOME GREAT LAKES POWER PLANT COOLING WATER: AN EXERCISE IN FUTILITY,

Canada Centre for Inland Waters, Burlington (Ontario).
J. K. Leslie, and J. E. Moore.
Environmental Pollution (Series A), Vol 22, No 3, p 179-185, July, 1980. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Entrainment, *Phytoplankton, *Cooling water, Aquatic life, Measuring instruments, Great Lakes, *Powerplants, Lakes, Particulate matter, Intakes, Outlets.

Suspended particles were measured in intake and discharge cooling water at three Great Lakes electric power generating stations. Using the Coulter Counter, the total number and volume of particles in the discharge water was found to have increased by 11% and 5%, respectively, and mean size decreased 3%. Image analysis showed an 18% increase in number, 22% decrease in surface area, and 10% in linear dimension. The inverted microscope technique showed a 22% increase in number of discharge particles and a 10% reduction in total biomass. The Coulter Counter detected three times as many particles as did the other two methods. To detect a statistically significant + over - 5% change in particle number the Coulter Counter method would require 2839 samples; the image analyzer, 1541; and the inverted microscope technique, 7021. Sample numbers in this study were much smaller, on the order of 25-50. It was concluded that significant results may be obtained only with a massive sampling program. (Cassar-FRC)
W82-00782

GLEN CANYON DAM IS KILLING THE GRAND CANYON AND YOUR TAX DOLLARS ARE PAYING FOR IT.

J. Roberts.
National Parks, Vol 55, No 7/8, p 18-25, July/August, 1981. 1 Fig.

Descriptors: *Dams, *Environmental effects, Dam effects, Electric powerplants, Environmental protection, Grand Canyon, Fish, Birds, Plants, Hydroelectric power, Erosion, Beaches, Beach erosion, Water level fluctuations, *Reservoir releases, Surges.

Changes in the water level in the Colorado River as a result of manipulations at Glen Canyon Dam are discussed. These uneven releases of water through the Dam cause man-made tides to surge along the banks of the river, disrupting the naturally alternating erosion and redeposition of silt, enabling exotic species of plants to flourish on the banks while killing others that have been established there for years, eliminating some populations of birds, and allowing fish and eggs to be stranded far from the water when the surge has gone by. Beaches are washed away. The shallowness of the water at times prohibits groups of white water enthusiasts from completing their trips. Plans are in the works for making changes which will increase the destruction already being seen. These plans are being laid in supposed answer to increasing electricity needs, but opponents of the plans suggest that existing power plants could be used for far less money than will be required to make the changes, and without doing further environmental damage. (Baker-FRC)
W82-00813

TOXIC DINOFLAGELLATES AND TIDAL POWER GENERATION IN THE BAY OF FUNDY, CANADA,

Institute for Marine Environmental Research, Plymouth (England).
R. C. Reid.
Marine Pollution Bulletin, Vol 11, No 2, p 47-51, February, 1980. 2 Fig, 34 Ref.

Descriptors: *Shellfish, *Toxicity, *Dinoflagellates, *Tidal powerplants, Pyrrophyta, Red tide, *Bay of Fundy, Canada, Poisons, Public health, Plankton, Baseline studies, Planning, Prediction, Environmental effects, *Ecological effects.

Although the need for an environmental impact assessment of the proposed tidal power generation

plant to be constructed in the upper of reaches of the Bay of Fundy in Canada has been discussed by other researchers, issues relating to public health and the economic effect on mariculture were not raised. The Bay of Fundy is one of three core areas for paralytic shellfish poisoning along the eastern seaboard of North America. Core areas are defined as areas in which high levels of toxicity exceeding 80 micrograms of toxin per 100 grams of shellfish tissue occur almost every year and in which severe illness, and in some cases death, due to paralytic shellfish poisoning have been recorded. This poisoning is derived from neurotoxins contained in certain dinoflagellates which are concentrated and transferred via filter feeding mollusks to humans. Previous studies have shown that the occurrence of dinoflagellates is intimately linked to the physical structure of shelf waters, with these organisms occurring most abundantly in frontal regions and in shallow thermoclines and occurring only in small numbers in well-mixed environments. The water circulation and tidal regime of the Gulf of Maine and the Bay of Fundy will be considerably altered by construction of the proposed tidal power station. These alterations could result in changes in the occurrence of toxic dinoflagellates and associated patterns and intensity of paralytic shellfish poisoning. Changes in turbidity and sedimentation characteristics which would result from the proposed power plant would also be favorable to increases in the numbers of toxic resting cysts and toxicity in the bottom sediments. (Carroll-FRC)
W82-00908

GREAT LAKES ENVIRONMENTAL PROTECTION POLICIES FROM A FISHERIES PERSPECTIVE,

Canada Centre for Inland Waters, Burlington (Ontario).
M. G. Johnson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1196-1204, July, 1980. 33 Ref.

Descriptors: *Water resources development, *Great Lakes, *Environmental policy, Water quality management, Air pollution, Social aspects, Management planning, Long-term planning, Water supply development, Lake fisheries, *Fish management, *International waters.

International resource management plans and environmental protection policies of the Great Lakes may be categorized under the areas of water quantity and quality management, fisheries management, and air pollution abatement. Policy development often ignores the interaction of these departments and fails to deal with root causes of problems in a broad context. Ineffective use of socioeconomic data hinders the implementation of remedial programs. Management policies are needed which reach across Great Lakes resource sectors to optimize a diversity of long-term benefits to society. Collaboration between the Great Lakes Fishery Commission and the International Joint Commission is recommended to identify issues, encourage strategic planning with resource sector and public participation, and adopt a broader outlook of societal goals and public policy in relation to the finite capacity of the Great Lakes ecosystem. (Geiger-FRC)
W82-00978

FORMULATING ALTERNATIVES FOR ENVIRONMENTAL STUDIES,

Wheeler and Gray, Los Angeles, CA.
D. R. Boone.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 527-538, June, 1980. 17 Ref.

Descriptors: *Alternative planning, *Environmental protection, Planning, Management decisions, Environmental engineering, Design criteria, Legal aspects.

An overview of the legal requirements for the identification of alternatives to proposed civil engineering projects is presented. A procedure is offered which enables alternatives to be formulated to provide the project engineer with a workable approach toward meeting the alternatives requirements of the National Environmental Policy Act (NEPA). In every recommendation or report on proposals for legislation and other major actions which affect the quality of the human environment the NEPA calls for the agencies of the Federal Government to include a detailed statement concerning environmental impact, possible adverse effects, alternatives to the proposed action, the relationship between local short-term uses and the maintenance and enhancement of long term productivity, and any irreversible and irretrievable commitments of resources which would be involved in the proposed action. Even so, the degree to which alternatives are seriously considered at the project management level varies, and inadequacies have been noted. Legal and institutional constraints tend to narrow the range of alternatives considered by project planners. A revised Council on Environmental Quality guideline is attempting further change in the way future projects will be planned. (Baker-FRC)
W82-00997

MORPHOLOGICAL CHANGES OF RIVER CHANNELS CONSEQUENT UPON HEADWATER IMPOUNDMENT,

Loughborough Univ. of Technology (England).
G. E. Petts.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 374-382, July, 1980. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Geomorphology, *Streams, *Channels, *Dams, *Reservoirs, Rivers, Impoundments, Environmental effects, Sediment, Deposition, Field tests, Headwaters, Erosion, *Channel morphology, Channel accretion, Channel erosion, Great Britain.

Geomorphological data from 14 impounded rivers located throughout Britain have been used to assess the long-term impact of reservoirs upon river channels downstream, and to identify the potential problems for river management. Changes of channel size and shape have halved the water conveyance capability of 11 of the 14 rivers studied. In the absence of adequate discharge data, two surrogate variables, reservoir surface area and time-to-peak of the reservoir inflow hydrograph, are used to explain the gross variation of channel morphology downstream from reservoirs. Four mechanisms, channel erosion, redistribution of the boundary sediment, channel side deposition, and channel bed aggrandizement, contributed to the morphological changes. Long-term changes downstream from reservoirs can affect land drainage, coastal stability, water quality, navigation, structural stability, fisheries, and aesthetics, as well as the aquatic flora and fauna. (Titus-FRC)
W82-01087

7. RESOURCES DATA

7A. Network Design

ESTIMATION OF MATERIAL FLUXES IN AN ESTUARINE CROSS SECTION: A CRITICAL ANALYSIS OF SPATIAL MEASUREMENT DENSITY AND ERRORS,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
B. Kjerfve, L. H. Stevenson, J. A. Proehl, T. H. Chrzanowski, and W. M. Kichens.
Limnology and Oceanography, Vol 26, No 2, p 325-335, March, 1981. 5 Fig, 4 Tab, 12 Ref.

Descriptors: *Sampling, *Error analysis, *Estuaries, *North Inlet, *South Carolina, Water quality, Tidal effects.

The minimum number of stations in an estuarine cross section needed to calculate material fluxes within acceptable error limits was determined at North Inlet, South Carolina. Three stations, each representing a separate bathymetric regime, were selected as optimum, giving an error of 15%. To reach this conclusion 10 stations were sampled every hour for two tidal cycles in a 320 meter wide cross section. Discharge, ATP fluxes, and ammonium fluxes were computed. If the along-channel material flux is the value to be determined, distinct cross-sectional bathymetric regimes should be sampled. Calibration can be used in a well-mixed estuary to give good estimates of cross-sectional discharge or material flux from one or few samples. (Cassar-FRC)
W82-00816

A COMPARISON OF SENSITIVITY ANALYSIS AND ERROR ANALYSIS BASED ON A STREAM ECOSYSTEM MODEL,

Oak Ridge National Lab., TN.
R. H. Gardner, R. V. O'Neill, J. B. Mankin, and J. H. Carney.
Ecological Modelling, Vol 12, No 3, p 173-190, April, 1981. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Streams, *Sensitivity analysis, *Error analysis, Mathematical models, Mathematical studies, *Ecosystems, Prediction, Experimental design, Design criteria.

As ecological modeling techniques are increasingly applied to environmental problems, there is a need for increased understanding of prediction uncertainty and model limitations. Errors due to parameter estimation are particularly important to the modeler and the researcher in the field. One approach to parameter estimation, used when a complex ecosystem model is derived from population interaction theory and physiological ecology, involves determination of individual parameters through independent laboratory or field experiments. Either sensitivity analysis or Monte Carlo error analysis can be used to determine the required accuracy of these parameter values. Both of these analyses attempt to rank order the parameters according to their contributions to overall model error. While sensitivity analysis involves taking the partial derivatives of model equations with respect to individual parameters, error analysis treats each parameter as a random variable and determines the contribution of each parameter to model accuracy by statistical analysis of simulation results. Since both of these techniques can provide the information needed by field researchers, guidelines are needed for choosing the technique most suited to a specific problem. The simple correlation coefficient derived from analysis of Monte Carlo simulations appears to be a reasonable way to rank model parameters according to their contributions to prediction uncertainty.
W82-00991

7B. Data Acquisition

HYDROGEOLOGICAL AND GEOPHYSICAL LOGGING.

Wuidart Engineering Ltd., Shefford Beds (England).
Water Services, Vol 85, No 1022, p 187-188, 1981. 1 Fig.

Descriptors: *Hydrological data collection, *Measuring instruments, *Geophysics, Borehole geophysics, Boreholes, *Logging(Recording), Electrical well logging, Groundwater, Aquifer evaluation, *Geohydrology.

The logging of temperature and conductivity profiles in boreholes under changing conditions of groundwater flow was seen as a very successful method for investigating many problems of groundwater resources. The method of simultaneous logging of temperature and conductivity forms a basis for the interpretation of groundwater movement; appropriate supporting techniques can then be used in response to particular problems. Such considerations led to the production of the WEL-Micrologger. For investigations of natural gamma radiation both in boreholes and on the surface, a motorized three arm caliper is used with the Micrologger system. The signal is returned to the surface as pulses giving a continuous trace on the chart recorder. The range of the caliper can accommodate boreholes from 50 mm to 1 meter in diameter. The instrument can be used for depth

sampling and as a flowmeter. The equipment is ideally suited for producing a number of the accepted standard geophysical logs used in the determination and confirmation of formations. (Baker-FRC)
W82-00511

MEASUREMENT OF PH IN THE ESTUARINE ENVIRONMENT ON THE NBS SCALE. (LA MESURE DU PH EN MILIEU ESTUARIEN SUR L'ECHELLE NBS),

McGill Univ., Montreal (Quebec). Dept. of Chemistry.
E. Pelletier, and J. Lebel.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 4, p 703-706, April, 1980. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Hydrogen ion concentration, *Measuring instruments, *Estuaries, Ionic interference, Estuarine environment, Fluctuations, Monitoring, Reproducibility.

A modification to the classical method of measuring pH in estuaries and inshore environments is proposed. The technique employs a secondary standard of high ionic strength to monitor and adjust for the slow drift of electrodes which usually occurs over a long series of analyses on board a ship. The method is accurate to plus or minus 0.010 pH units, with a reproducibility of plus or minus 0.005 pH units for 95% of the analyzed samples. The procedure appears to be insensitive to abrupt changes in ionic strength of successive samples and provides a simple and practical way to study the pH fluctuations of estuarine environments. (Geiger-FRC)
W82-00521

SPRING FLOOD: MELTWATER OR GROUNDWATER,

Uppsala Univ. (Sweden). Div. of Hydrology.
A. Rodhe.
Nordic Hydrology, Vol 12, No 1, p 21-30, 1981. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Annual floods, *Snowmelt, *Streamflow, *Groundwater movement, *Surface-groundwater relations, Infiltration, Watersheds, Tracers, Water level, Oxygen-18, Isotopic tracers, Forest watersheds, *Sweden.

Stream discharge was separated into two flows: that originating from groundwater and the fresh melt. The environmental isotope oxygen-18 was used as a tracer in this study of two forested watersheds in southern Sweden. The separation is possible due to the seasonal variation of the isotope oxygen-18 in precipitation. The spring flood of 1979 mainly originated from groundwater. Discharged meltwater equaled the total melting over 10-15% of the basins. The results were in agreement with other studies, and the figures were assumed to represent the fraction of effluent area because no infiltration can take place in areas with the groundwater table at (or above) the ground surface. Groundwater was found to play a decisive role in the process streamflow generation; this supports the theory of influent and effluent areas for groundwater. Preliminary results from a similar study in an area situated above the postglacial shoreline indicated a smaller groundwater fraction (about 50%) of the 1980 total spring flood. Two watersheds in the original study were undertaken in basins with outwash morainic soils during a spring when the soil was almost unfrozen. (Small-FRC)
W82-00531

THE USE OF NA/CL RATIOS TO TRACE SOLUTE SOURCES IN A SEMIARID ZONE,

Weizmann Inst. of Science, Rehovot (Israel). Isotope Dept.
M. Margaritz, A. Nadler, H. Koyumdjisky, and J. Dan.
Water Resources Research, Vol 17, No 3, p 602-608, June, 1981. 4 Fig, 1 Tab, 32 Ref.

Descriptors: *Solute transport, *Tracers, *Groundwater recharge, *Groundwater movement, Sodium, Chlorides, Saline soils, Chemical reactions, Aquifers, Israel, Semiarid lands, Humid areas, Recharge, Rainfall, Dissolved solids, Path of pollutants.

The Na/Cl ratio may be a means of tracing the recharge mechanisms in semiarid regions. In the humid and arid zones, the Na/Cl ratio in groundwater is less than 1, in the transition zone, greater than 1. In this zone the combination of CaCO3 dissolution and base exchange reactions exists, whereas in humid areas minerals are already well leached and in dry areas the Ca(2+) minerals are not dissolved. An area on the south coastal plain of Israel was studied. Here the Na/Cl ratios change from 0.86-1.0 to 1.5-2.0 from north to south through addition of Na(+) to the groundwater as it interacts with soils of loessial origin. Evidently salt-accumulating profiles do not transfer water downward to the aquifer but add Na(+) salts to the groundwater from the efflorescent crust or from the upper horizon. These waters, now with a high Na/Cl ratio, may flow laterally and percolate through the soil in depressions where they can be found and traced. (Cassar-FRC)
W82-00601

DETERMINATION OF HYDROGEOLOGICAL PARAMETERS USING SINUSOIDAL PRESSURE TESTS: A THEORETICAL APPRAISAL,

Institute of Geological Sciences, Harwell (England). Environmental Protection Unit.
J. H. Black, and K. L. Kipp, Jr.
Water Resources Research, Vol 17, No 3, p 686-692, June, 1981. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Diffusivity, *Aquifer testing, *Pressure-measuring instruments, Groundwater movement, Hydraulic conductivity, Crystalline rocks, Porous media, *Borehole geophysics, Geohydrology, Measuring instruments, Permeability, Confined aquifers.

A method of measuring hydraulic diffusivity using sinusoidal pressure fluctuations in an excitation borehole is useful in fissured crystalline rocks but not in high storage/low hydraulic conductivity media such as peat and clay. Equations are derived which describe the dependence of pressures and phase lags outside the excitation borehole on distance, signal frequency, specific storage, hydraulic conductivity, and flow rates. These cover two distinct configurations: that of a point source deep within a water-saturated elastic formation and that of a line source totally penetrating a confined aquifer. For the three-dimensional examination of crystalline rock the signal frequency should be no greater than one cpd with measurement concentrating on the phase shift. Signals are measurable up to 100 meters from the source. For the two-dimensional examination of aquifer rocks in pollution studies, the line source has a more penetrating signal. Measurement would concentrate on the amplitude of the signal, and the excitation frequencies could be on the order of 100 cpd. This method is not seen as a substitute for classical aquifer testing but as a tool to be used in certain applications. (Cassar-FRC)
W82-00603

SEDIMENT SURVEYS IN THE DEPARTMENT OF WATER AFFAIRS,

Department of Water Affairs, Pretoria (South Africa).
T. P. C. Van Robbroeck.
Civil Engineer in South Africa, Vol 22, No 2, p 34-36, February, 1980. 4 Fig, 1 Tab.

Descriptors: *Dams, *Silting, *Sedimentation, Reservoir silting, Silt load, Silt, Sediments, Measuring instruments.

Use of a sophisticated, automated measuring and calculating method to measure the volume of sediment deposited in a dam over a number of years is described. The dam basin is divided into a number of compartments bounded by accurately measured cross sections taken between permanent silt beacons, the positions of which were determined beforehand. A capacity table is drawn separately for each compartment. End areas of every compartment for each contour interval are determined. Constant factors peculiar to a compartment are derived. To determine the volume of silt deposited, only the end areas of the compartments need to be resurveyed. This is done by electronic means. Echoes from an echo sounder, fitted in a survey boat, are continuously recorded on a chart. Simultaneously, the distance from a shore station is measured and recorded by the raiog, an electromagnetic range measuring device. The boat is kept on course between the silt beacons by radio signals from a surveyor observing the mast through a theodolite. The first dam to be surveyed in this manner was Welbedacht Dam on the Caledon River. It is hoped that with this new method surveys of 20 dams can be completed per year, compared to an average of two in the past. Some results of silting in dams already surveyed by this method are presented. (Baker-FRC)
W82-00680

AN IN SITU METHOD FOR MEASURING THE PRIMARY PRODUCTIVITY AND STANDING CROP OF THE EPILITHIC PERIPHYTON COMMUNITY IN LENTIC SYSTEMS,

California Univ., Davis. Div. of Environmental Studies.
S. L. Loeb.
Limnology and Oceanography, Vol 26, No 2, p 394-399, March, 1981. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Primary productivity, *Lentic environment, *Algae, Periphyton, Substrates, In situ tests, Productivity, Aquatic life, *Standing crops, Incubation, Sampling, *Lake Tahoe.

An incubation chamber and quantitative sampler were developed to measure the primary productivity and standing crop of an epilithic periphyton community. The incubation chamber is a hemispherical Plexiglas dome that encloses 200 ml of water over an area of 50 sq cm. The sampler, made of two 60-cc disposable syringes, contains a brushing device and collection device. The apparatus is serviced by SCUBA divers with minimal disturbance to the natural environment. The artificial substrate methods underestimated productivity by as much as 95%, and species composition was quite different from that in the in situ method. In this study, measurements were made up to 16 meters deep in Lake Tahoe. (Cassar-FRC)
W82-00756

QUANTITATIVE ASSESSMENT OF TIDAL WETLANDS USING REMOTE SENSING,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
D. S. Bartlett, and V. Klemas.
Environmental Management, Vol 4, No 4, p 337-345, July, 1980. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Wetlands, *Satellite technology, *Vegetation, *Remote sensing, Delaware, Spartina, Biomass, *Tidal marshes, Marshes, Landsat, Reflectance.

Effective wetlands management requires the collection of information on wetlands condition, which may be directly related to the production and distribution of emergent plant species. Remote sensing techniques were able to quantitatively determine the biomass of Spartina alterniflora (salt marsh cord grass) growing in wetlands in Delaware from April through September. Comparisons with the harvest method showed that canopy reflectance measurements in Landsat MSS Bands 4 and 5 (visible spectral region) were inversely related to the % by weight of green vegetation within the canopy. Infrared canopy reflectance was best correlated with green biomass rather than total biomass and canopy height. Spectral methods were not as highly correlated with canopy parameters for the other two species tested: Spartina patens and Distichlis spicata (salt bay). Seasonal changes in canopy characteristics and reflectance showed that in December, at visible wave lengths, the best potential existed for distinguishing between S. alterniflora and the salt hay species. Landsat/MSS digital data for July 31, 1977, was compared with harvest methods at three sites in determining mean green and mean total biomass of S. alterniflora.

Results were encouraging. For example, at Canary Creek Marsh the harvest method determined (all units in g dry weight per sq meter) mean green biomass, 451, and mean total biomass, 1081; Landsat, 407 and 1076, respectively. Woodland Beach results were: harvest, mean green, 820, and mean total, 1376; Landsat, 675, mean green, and 1206, mean total. (Cassar-FRC)
W82-00781

MEASUREMENT OF PARTICULATES EXTRAINED IN SOME GREAT LAKES POWER PLANT COOLING WATER: AN EXERCISE IN FUTILITY,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 6G.
W82-00782

THE KYHOLM CORER–A DIVER-OPERATED SEDIMENT CORER,

Aarhus Univ. (Denmark), Lab. of Physical Geography.
P. Nornberg, and C. Christiansen.
Sedimentary Geology, Vol 25, No 1/2, p 1-4, January, 1980. 1 Fig, 8 Ref.

Descriptors: *Sediment sampler, *Bottom sampling, Sampling, Bottom sediments, Sand, Sediments, *Corer.

The Kyholm corer was developed to meet the needs of a study in which it was essential to know the exact location of the sample, necessary to collect compact sandy sediments, and essential to take orientated samples so the cores could be used for paleomagnetic dating. It was also necessary that the corer not be too heavy or too bulky to be handled by SCUBA-divers. The resultant Kyholm corer is easily operated by two SCUBA-divers who place the sampler and drive the corer into the bottom by hammer. The sampler is then hauled up by means of ropes over the divers' shoulders. A cover is placed on the tube as soon as the core has been extracted from the bottom. The sampling procedure involves no twisting, so orientation of the sample is preserved. The corer samples an area of about 28 square centimeters. The prototype has been used to collect 20 samples with a sample depth of 0.9 meters without regard to type of sediment, while a slightly modified version has collected three samples with a sampling depth of 1.95 meters. There have been no problems with retention of the samples nor with disturbance of the vertical stratification. (Carroll-FRC)
W82-00793

RELATION OF SATELLITE-BASED THUNDERSTORM INTENSITY TO RADAR-ESTIMATED RAINFALL,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W82-00806

APPARATUS FOR THE SIMULATION OF RAIN IN THE LABORATORY,

State Univ. of New York at Albany.
For primary bibliographic entry see Field 2B.
W82-00807

SATELLITE RAIN ESTIMATION IN THE U.S. HIGH PLAINS,

National Oceanic and Atmospheric Administration, Boulder, CO.
For primary bibliographic entry see Field 2B.
W82-00808

A PORTABLE PUMP SAMPLER FOR LOTIC PERIPHYTON,

Northern Arizona Univ., Flagstaff. Dept. of Biological Sciences.
J. A. Hamala, S. W. Duncan, and D. W. Blinn.
Hydrobiologia, Vol 80, No 2, p 189-191, May, 1981. 1 Fig, 28 Ref.

Descriptors: *Water quality, *Monitoring, Measuring instruments, Sampling, Lotic environment, Bottom sampling, Sediments, Sediment sampler, *Substrates, *Lotic periphyton.

This note describes a simple, inexpensive sampling device and method for use in shallow flowing waters for collecting lotic periphyton on sedimentary substrates. The method offers several advantages: collection and comparison of quantitative samples of periphyton standing crop and colonization rate from intact, submerged substrata of sedimentary origin: establishment of permanent sampling sites on submerged substrata that may be monitored for seasonal or annual water quality programs; and an alternative to floating artificial samplers in areas with high recreational impact that eliminates human disturbance factors. A periphyton sampling program was initiated in May of 1979 at Slide Rock, Arizona, which is a recreational area. Members of the Bacillariophyta (diatoms) comprised the majority of the periphyton occurring on the colonization pads. Removal rates of periphyton from the substrate approached 90% based on sample counts taken from resampled colonization pads. In May of 1980 the periphyton sampling program at Slide Rock continued using the same colonization pads to withstand spring scouring events and associated high discharges indicates the applicability of these pads in ongoing water quality monitoring programs. (Baker-FRC)
W82-00826

THE RELATIONSHIP BETWEEN FRACTURE TRACES AND JOINTS IN A TERTIARY BASIN, SOUTHWEST MONTANA,

Indiana Univ. at Bloomington. Dept. of Geology.
N. C. Krothe, and M. P. Bergeron.
Ground Water, Vol 19, No 2, p 138-143, March/April, 1981. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Geologic fractures, *Aerial photography, *Groundwater mining, Aquifers, Limestone, Groundwater basins, *Montana, Groundwater potential.

A synclinal basin near Three Forks, Montana, was investigated, and the relationship between fracture traces mapped on aerial photographs and joints mapped in the field, was examined. Fracture traces were mapped in the southern half of Milligan Canyon by stereoscopic examination of 1:20,000 black and white aerial photographs. Fracture traces were transposed from the photographs to a base map using a Saltzmann projector. Also, joint and fracture orientations were measured in the field in outcrops of several pre-Tertiary formations. The Madison Group limestone which was measured in the field was a leaky artesian system. Regional flow direction was from west to east. A parallelism was found along a north-south and east-west direction which suggested that mapped fracture traces in the study area reflected areas of joint and fracture concentration in the subsurface. Field location of fracture intersections and subsequent drilling should produce high-yield water wells. (Small-FRC)
W82-00829

WASTE HEAT BALANCE IN AQUIFERS CALCULATED BY A COMPUTER PROGRAMME,

Geologisches Landesamt Nordrheim-Westfalen, Krefeld (Germany, F.R.).
W. Kley, and W. Heekmann.
Ground Water, Vol 19, No 2, p 144-148, March/April 1981. 6 Fig, 1 Ref.

Descriptors: *Groundwater reservoirs, *Heated water, *Waste heat, Computer programs, Heat, Heat transfer, *Energy, *Cologne, Federal Republic of Germany.

For many years, waste heat has been fed into the aquifers of the city of Cologne, Federal Republic of Germany, which has created a subsurface energy resource. A computer program was developed to analyze the temperature measurements in ground water and determine the isolines of the energy resource and of the recoverable amount of heat. This FORTRAN program determines the recoverable amount of heat per square unit and time in terms of heat flux density in W/sq m at a given exhaustion of the energy resource (within 10 and 20 years). A thickness of the ground water range amounting to 10 m is assumed. The results can be applied to plan and design the heat pump units. If heat pumps are not used, in the future a marked temperature rise in the ground water bearing layers will be observed. (Small-FRC)
W82-00830

A COMPARATIVE STUDY OF FOUR DREDGES USED FOR SAMPLING BENTHIC MACROINVERTEBRATES IN RIVERS,

Freshwater Biological Association, Windermere (England).
J. M. Elliott, and C. M. Drake.
Freshwater Biology, Vol 11, No 3, p 245-261, June, 1981. 6 Fig, 3 Tab, 27 Ref.

Descriptors: *Benthic environment, *Sampling, Bottom sampling, Rivers, Aquatic animals, Aquatic plants, Benthos, Aquatic life, *Dredging, Measuring instruments, Mathematical equations, *Macroinvertebrates.

Four light-weight dredges were chosen for manual operation from a small boat or the bank to secure samples of benthic macroinvertebrates in rivers. These four were: Irish triangular dredge, small Fast dredge, medium-sized and large Naturalist's dredges. The dredges usually took a similar range of stone sizes at each site, but the design of the Fast dredge was such that it excluded larger stones above 16 mm. The Irish dredge sometimes failed to operate correctly. Variations in the volume of substrate taken with each dredge were large, both between sampling units in the sample and between samples. Penetration depth was greatest for two Naturalist's dredges, smaller for the Fast dredge and smallest for the Irish dredge. The relative abundance of major taxa was similar for most dredges at each site. However, the high variability between sampling units in the same sample and thus a lack of precision in estimates of the mean number of invertebrates per sample makes the dredges unsuitable as quantitative samplers to estimate population density. There was a clear relationship between the number of taxa and the number of invertebrates taken at each site. The relationship was well described by a power law with an exponent within the range 0.18-0.53. The number of sampling units in the sample had no significant effect on the power-law equations for each site. These power-law relationships between number of taxa and number of individuals are probably applicable to samples taken with other equipment used for qualitative sampling such as pond nets and colonization samplers. (Baker-FRC)
W82-00833

EVIDENCE OF THE UNSUITABILITY OF GRAVITY CORING FOR COLLECTING SEDIMENT IN POLLUTION AND SEDIMENTATION RATE STUDIES,

Glasgow University (Scotland), Department of Chemistry.
M. S. Baxter, J. G. Farmer, I. G. McKinley, D. S. Swan, and W. Jack.
Environmental Science and Technology, Vol. 15, No 7, p 843-846, July, 1981.

Descriptors: *Sediments, *Sampling, Measuring instruments, Cores, Sedimentation, *Bottom sediments, Water pollution, Water quality.

Inherent dangers, specifically with respect to the not uncommon application of small-diameter gravity coring, in the collection of highly porous unconsolidated sediment as found in many coastal and lacustrine environments are cited. Specific evidence is presented based on the depth distributions of stable lead and manganese, 210-lead, 134-cesium, and 137-cesium in sediment cores collected at the same sites by two different devices: a small-diameter gravity corer and a soft-landing hydraulically damped Craib corer. The sediments studied were fine-grained silty clays from the deep basins of two fjordic sea lochs, Loch Goil and Gareloch, of the Clyde Sea area. The material was relatively unconsolidated and highly porous. The gravity core profiles obtained seeemed plausible when considered individually. However, discrepancies were observed which point to a substantial (more than 15

cm) loss of surface sediment using the small-diameter gravity corer. The single most damaging piece of evidence to the credibility of small-diameter gravity coring is the complete absence of 134-cesium. It is concluded, therefore, that the vertical overlapping of craib and gravity core profiles is not valid, despite the apparently reasonable matching patterns which can emerge on occasion. (Baker-FRC)
W82-00840

A COMBINATION OF ELECTRICAL RESISTIVITY, SEISMIC REFRACTION, AND GRAVITY MEASUREMENTS FOR GROUNDWATER EXPLORATION IN SUDAN,

Groundwater Survey TNO, Delft (Netherlands).
For primary bibliographic entry see Field 2F.
W82-00852

POSSIBILITY OF USING TRITIUM FOR STUDYING GLOBAL CIRCULATION OF ATMOSPHERIC MOISTURE,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2A.
W82-00863

EFFECTS OF JOULE HEATING ON THERMOCOUPLE PSYCHROMETER WATER POTENTIAL DETERMINATIONS,

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
D. C. Slack, and F. R. Riggle.
Transactions of the ASAE, Vol 23, No 4, p 877-883, July/August, 1980. 10 Fig, 22 Ref.

Descriptors: *Soil water potential, *Thermocouples, *Measuring instruments, *Soil water, Soil-water-plant relationships, Soil saturation, Psychrometry.

Thermocouple psychrometry has proved useful for the measurement of soil water potential in both laboratory and in situ environments. The magnitude and significance of Joule and resistance heating in two types of commercial soil thermocouple psychrometers on water potential determinations near saturation were investigated. The units tested were the Wescor PT51 single junction probe enclosed in a ceramic cup and the Emco PSY-350 double junction probe, which consists of two side-by-side junctions enclosed in a stainless steel cylinder covered on one end by a fine mesh screen. When water potentials were above -4 bars, a significant Joule and resistance heating was produced by a cooling current of 8 milliamperes (mA), resulting in unreliable measurements for both types of probes. The double junction probe was slightly less sensitive to heating than was the single junction probe. Significant reductions in the effects of heating at high water potentials were achieved by reducing the cooling current in the single junction probes to 3 mA. When the double junction probe was used, reduction of the cooling current to 4 mA eliminated heating problems. In each case, the reduced cooling current was applied for 15 seconds and the psychrometer was read 6 seconds after cessation of cooling. Using this procedure, reliable determinations were obtained for soil water potentials between -22 bars and -0.5 bars. Psychrometer response at water potentials below -22 bars was affected by the reduction in cooling current. The magnitude of the cooling current was found to have much more effect on heating than did the duration of the cooling current. (Carroll-FRC)
W82-00892

AERIAL PHOTOGRAPHY AS AN AID TO CROPLAND EROSION ANALYSIS,

Texas Christian Univ., Fort Worth. Dept. of Geology.
For primary bibliographic entry see Field 2J.
W82-00902

INTERPRETATION OF SURFACE-WATER CIRCULATION, ARANSAS PASS, TEXAS, USING LANDSAT IMAGERY,

Texas Univ. at Austin.
R. J. Finley, and R. W. Baumgardner.
Remote Sensing of Environment, Vol 10, No 1, p 3-22, August, 1980. 12 Fig, 3 Tab, 29 Ref.

Descriptors: Photography, *Aerial photography, *Remote sensing, *Satellite technology, Photogrammetry, Infrared imagery, Sensors, Telemetry, Sedimentation, Sediment concentration, *Sediment transport, Turbidity, Surface waters, *Coastal waters, Turbidity flow, Physical properties, Tidal effects, Wind-driven currents, *Aransas Pass, *Texas, Gulf of Mexico.

The development of plumes of turbid surface water in the vivinity of Aransas Pass, Texas has been analyzed using Landsat imagery. The shape and extent of plumes present in the Gulf of Mexico are dependent on the wind regime and astronomical tide prior to and at the time of satellite overpass. The best developed plumes are evident when brisk northerly winds resuspend bay-bottom muds and flow through the Pass is increased by wind stress. Wind-influenced surface currents assume greater significance when astronomical tides are low within the coastal bays. Where intense hydrocarbon production and transportation activity may increase the risk of spillage, knowledge of surface current direction under given wind conditions is critical. (Titus-FRC)
W82-00904

ATMOSPHERIC WATER CONTENT OVER THE TROPICAL PACIFIC DERIVED FROM THE NIMBUS-6 SCANNING MICROWAVE SPECTROMETER,

National Environmental Satellite Service, Washington, DC.
N. C. Grody, A. Gruber, and W. C. Shen.
Journal of Applied Meteorology, Vol 19, No 8, p 986-996, August, 1980. 10 Fig, 17 Ref.

Descriptors: *Atmospheric water, *Tropical regions, *Meteorological data collection, Climatic data, Satellite technology, *Remote sensing, Clouds, Precipitation, Moisture content, Microwaves, Radiosondes, Spectrometers.

The scanning microwave spectrometer (SCAMS) aboard Nimbus-6 determined integrated water vapor (precipitable water) and cloud liquid water over the tropical Pacific Ocean between 130 degrees E to 100 degrees W and 35 degrees N to 35 degrees S for the period August 18 to September 4, 1975. The 2 channel measurements, at 22.23 GHz and 31.65 GHz, were used in a nonlinear relationship, which is more accurate than linear model for the large values of precipitable water found in the tropics. The SCAMS values of precipitable water and 163 radiosonde measurements from 19 island stations showed the same variability, with a 0.5 cm rms difference. The Intertropical Convergence Zone was delineated near 10 degrees N and contained > 5 cm precipitable water and > 0.4 mm liquid water. The Southern Convergence Zone was also well demonstrated. The equatorial Pacific dry zone in both hemispheres contained < 3.5 cm of moisture and < 0.2 mm liquid. (Cassar-FRC)
W82-01004

DESCRIPTION OF A NEW SUBMERSIBLE FILTER-PUMP APPARATUS FOR SAMPLING PLANKTON,

Illinois Natural History Survey, Urbana.
S. W. Waite, and S. M. O'Grady.
Hydrobiologia, Vol 74, No 2, p 187-191, September, 1980. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Submersible pumps, *Sampling, *Plankton, Zooplankton, Phytoplankton, Pumps, Filters, Aquatic life, Copepods, Rotifers, Cladocerans, Invertebrates, Rivers, Cooling ponds, Powerplants.

A low volume submersible filter-pump apparatus is useful in collecting zooplankters and other aquatic organisms, especially in rivers and powerplant cooling lakes. Both pump and filter are enclosed in a submersible plexiglass box, forming a unit that weighs only 7.7 kg. The intake diameter, filter mesh size, and rate capacity of the pump may be manipulated to produce the desired total sample volume. A 2 min pumping time with 80 micron mesh and 1200 gallons per hour pump gives 176 liters of water, equivalent to towing a 13 cm Wisconsin-style plankton net for 17 meters. Compared with conventional tow net samplers, the filter-pump collects greater numbers of rotifers and immature copepods per unit volume and fewer mature copepods. Cladocerans capture rate is similar for both types of apparatus. (Cassar-FRC)
W82-01012

A REVIEW ON SEDIMENT TRAPS IN AQUATIC ENVIRONMENTS,

Stockholm Univ. (Sweden). Dept. of Geology.
S. Blomqvist, and L. Hakanson.
Archiv fur Hydrobiologie, Vol 91, No 1, p 101-132, March, 1981. 15 Fig, 2 Tab, 240 Ref.

Descriptors: *Aquatic environment, *Sediments, *Trap efficiency, *Bottom sediments, *Suspended solids, Reviews, Measuring instruments, Experimental design, Design standards, Sediment traps, Sediment samples.

The use of trap devices for the collection of sedimentating material is becoming increasingly important in the study of aquatic systems. A broad literature review was conducted in an effort to identify various types of sediment traps suitable for use in aquatic environments and to evaluate the benefits and limitations of these devices. Bottom sediment traps may be located either at the sediment surface or above the sediment surface in the water phase. Buoy-carried sediment traps may be either moored or free-drifting. Selection of the type of sediment trap should be based on the purpose of the investigation. The results obtained will depend on the environment in which the trap is placed. Bottom sediment traps should be used only within zones of accumulation, while buoy-carried traps will yield best results if placed in a hydrodynamically calm environment. The sediment vessel must be kept in a horizontal position throughout the registration period. The geometry and size of the sediment collection vessel are important factors controlling the results. Negative edge effects often result from the use of unsymmetric and/or angular sediment vessels. Cylindrical vessels with narrow orifices may collect a disproportionate amount of organic material in non-stagnant waters. Marking and rigging devices for buoy-carried traps need to be improved. Free drifting sediment traps require further investigation. The relationships among deposition, Reynolds number, and height-diameter ratios for cylindrical vessels need to be studied, as does the relationship between orifice area and trapping efficiency in these vessels. The complex of selective trapping and qualitative representativity of deposited matter in sediment vessels needs to be evaluated. (Carroll-FRC)
W82-01020

SOIL PERCOLATION TESTS,

Indian Health Service, Seattle, WA. Office of Environmental Health.
For primary bibliographic entry see Field 2G.
W82-01044

7C. Evaluation, Processing and Publication

SUMMARY APPRAISAL OF WATER RESOURCES IN THE REDMOND QUADRANGLE, SANPETE AND SEVIER COUNTIES, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
D. Price.
Br. of Distr. USGS Box 25286, Fed. Ctr. Denver, CO 80225. Price: $1.50. Geological Survey Miscellaneous Investigations Series Map I-1304-B, 1981. 1 Sheet, 11 Ref.

Descriptors: *Maps, *Surface water, *Groundwater, *Water quality, Water supply, Aquifer, Wells, Water yield, Dissolved solids, *Utah, Redmond quadrangle, Sevier River basin.

The Redmond Quadrangle is in the central Sevier River valley about 105 miles south of Salt Lake

City, Utah. The Sevier River, which flows northward through the quadrangle, is the principal source of surface water for the area. Average annual (1912-78) flow of the river were gaged, about 12 miles south of the quadrangle, is about 68,000 acre-feet (excluding upstream irrigation diversions). The principal source of ground water in the Redmond Quadrangle is the unconsolidated valley fill that underlies the Sevier River valley plain. The fill contains an estimated 120,000 acre-feet of recoverable water. It is tapped by many small-diameter domestic and stock wells, most of which produce less than 100 gallons per minute of water. However, available data indicate that the fill could yield several hundred gallons per minute to properly located and constructed large-diameter wells. Dissolved-solids concentrations of the surface water generally exceed 500 mg/L and periodically exceed 1,000 mg/L during low-flow periods. Dissolved-solids concentrations of the ground water also generally exceed 500 mg/L and can be expected to exceed 1,000 mg/L in many parts of the quadrangle. The principle source of the dissolved solids is the Arapien Formation of Jurassic (and Tertiary) age, which underlies much of the Redmond Quadrangle (including the valley fill) and adjacent areas. This formation contains large amounts of salt and other easily dissolved evaporite deposits. (USGS)
W82-00725

POTENTIOMETRIC-SURFACE MAP FOR THE CRETACEOUS AQUIFER, VIRGINIA COASTAL PLAIN, 1978,

Geological Survey, Richmond, VA. Water Resources Div.
H. T. Hopkins, R. F. Bower, J. M. Abe, and J. F. Harsh.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 80-965 (WRI), 1981. 1 Sheet, 11 Ref.

Descriptors: *Maps, *Groundwater, *Potentiometric level, *Aquifers, Geohydrology, Groundwater mining, Water use, Water supply, Wells, Water level, Subsidence, *Virgina, Coastal Plain.

The Atlantic Coastal Plain of Virginia includes 9,600 square miles--all or part of 40 counties east of the Fall Line. The undifferentiated Cretaceous sediments underlying this area are the most productive and extensive source of ground water, from which large withdrawals have been made over the past 40 years. In 1978, withdrawals exceeded 100 million gallons per day. To determine the effect of continued withdrawals, annual synoptic water levels for 1978 were used to prepare a map showing the approximate configuration of the potentiometric surface. (USGS)
W82-00727

POTENTIOMETRIC SURFACE OF THE WILCOX-CARRIZO AQUIFER; BIENVILLE, RED RIVER, NORTHERN NATCHITOCHES, AND SOUTHERN WEBSTER PARISHES, LOUISANA,

Geological Survey, Alexandria, LA. Water Resources Div.
G. N. Ryals.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $1.00 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 80-1179, 1980, 1 Sheet.

Descriptors: *Maps, *Potentiometric level, Aquifers, *Groundwater, Geohydrology, Contours, Water level fluctuations, Wells, Data collections, *Louisiana, *Wilcox-Carrizo aquifer.

The potentiometric surface of the Wilcox-Carrizo aquifer in central northwestern Louisiana is shown by contours using data collected from 1960 to 1980. The aquifer is not affected by regional water-level declines as no large pumping centers have been developed. Seasonal water-level fluctuations in wells are generally less than 10 feet annually. (USGS)
W82-00728

GENERALIZED THICKNESS OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,

Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Wolansky, and J. M. Garbade.
Geological Survey Open-File Report 80-1288 (WRI), 1981. 1 Sheet, 30 Ref.

Descriptors: *Maps, *Confined aquifers, *Aquifer characteristics, *Groundwater, Geohydrologic units, Geohydrology, Wells, *Florida, *Floridan aquifer, Southwest Florida Water Management District.

This map report presents the thickness of the Floridan aquifer in the Southwest Florida Water Management District. The Floridan aquifer ranges in thickness from 600 feet in the northern part of the District to 2,400 feet in the southern part. It is composed chiefly of limestone and dolomite beds that range in age from early Miocene to middle Eocene. For this investigation, the formations considered to be part of the Floridan aquifer are: Lake City and Avon Park Limestones of middle Eocene age; Ocala Limestone of late Eocene age; Suwannee Limestone of Oligocene age; and permeable parts of the Tampa Limestone and Hawthorn Formation of Miocene age that are in hydrologic contact with the rest of the aquifer. (USGS)
W82-00729

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1980--VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN.

Geological Survey, Urbana, IL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as 82-106311, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IL-80-1, 1981. 708 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Illinois.

Water resources data for the 1980 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 98 gaging stations, stage only at 5 gaging stations, stage and contents at 3 lakes and reservoirs, stage only at 1 lake station, and water quality at 125 gaging stations and 43 wells. Also included are data for 38 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W82-00731

WATER RESOURCES DATA FOR ILLINOIS, WATER YEAR 1980--VOLUME 2. ILLINOIS RIVER BASIN.

Geological Survey, Urbana, IL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-106220, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report IL-80-2, 1981. 468 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Illinois, *Illinois River basin.

Water resources data for the 1980 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 85 gaging stations, stage only at 2 gaging stations, stage only at 3 lake stations, water quality at 97 gaging stations and 33 wells, and water levels at 3 observation wells. Also included are data for 44 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W82-00732

WATER RESOURCES DATA FOR UTAH, WATER YEAR 1980.

Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108606, Price codes: A99 in paper copy, A01 in microfiche. Geological Survey Water-Data Report UT-80-1, 1981. 684 p, 12 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Utah.

Water resources data for the 1980 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 294 gaging stations; stage and contents for 22 lakes and reservoirs; water quality for 64 hydrologic stations, 194 partial-record stations, and 323 wells; and water levels for 36 observation wells. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Utah. (USGS)
W82-00733

APPROXIMATE GROUND-WATER-LEVEL CONTOURS, APRIL 1981, FOR THE SOQUEL-APTOS AREA, SANTA CRUZ COUNTY, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
R. M. Bloyd.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.25 in paper copy, $4.00 in microfiche. Geological Survey, Open-File Report 81-680, June 1981. 3 p, 1 Fig, 2 Ref.

Descriptors: *Groundwater, *Water level, *Maps, *Contours, Aquifers, Groundwater movement, Wells, Pumping, *California, Santa Cruz County, Soquel-Aptos area, Water-level declines.

Ground-water levels in selected wells were measured in the Soquel-Aptos, Calif., area in April 1981. On the basis of these measurements approximate ground-water-level contours were constructed. The general direction of ground-water movement in the Soquell-Aptos area is from the ridges in the northern part of the area, toward the adjacent canyons, and then southward toward the ocean. Ground-water pumping has caused ground-water levels to decline below sea level in the Capitola area, in the area just to the west and northwest of aptos, and in isolated local areas southwest of Rio Del Mar. Ground-water levels in the northern part of the area away from the seacoast have not declined much over time. (USGS)
W82-00734

8. ENGINEERING WORKS

8A. Structures

SMALL HYDRO INSTALLATIONS SPUR UNIQUE ENGINEERING SOLUTIONS,
Tudor Engineering Co., Riverton, WY.
For primary bibliographic entry see Field 6B.
W82-00538

MODELING GRADUAL DAM BREACHES,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W82-00554

RELIABILITY OF UNDERGROUND FLOOD CONTROL SYSTEM,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
L. Duckstein, I. Bogardi, and F. Szidarovszky.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 817-827, July, 1981. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Mining engineering, *Flood protection, *Karst hydrology, Flood control, Drainage, Underground structures, Grouting, Protection, Pumping plants, Tunnel failure, Sediment control, Manyi, Hungary.

A reliability model of an underground hydraulic engineering system for protecting mines against inflows or inrushes of water is presented. This paper considers the probability that a flood control system will fulfill its function within a given time interval. The scope covers only equipment protection, not personnel escape routes. The recommended approach for studying these complex failure events is a failure tree analysis followed by Monte Carlo simulation. Possible failure events are flooding in faces, flooding in blocks, simultaneous disturbances in several blocks, and flooding of mines. A protection system may include face protection, water cut of faces, block water cut, mine water cut, sediment settler and removal equipment, and central pumping station. An example uses the Manyi mine, Hungary, which is 300 meters below the karstic water level. Two alternative protection methods are evaluated: INSTANTAN (which provokes inrushes before full-scale mining starts) combined with artificial sealing (moderate and high), and passive control (a drainage system). Results, depicted on bar graphs, can be used in design of the protection scheme. (Cassar-FRC)
W82-00556

WHY EPA'S I/I CONTROL PROGRAM FAILS,
Westech Engineering, Inc., Salem, OR.
C. H. Steketee.
Public Works, Vol 112, No 7, p 51-53, July, 1981. 3 Fig, 1 Tab.

Descriptors: *Sewer systems, *Infiltration, *Rehabilitation, Leakage, Water mains, Pipes, Maintenance, Economic aspects.

An evaluation of the EPA program to reduce infiltration/infow (I/I) in sewer systems showed that generally the program has not been effective, especially in older systems. In 18 communities the percent reduction achieved was 0 to 60% in 8 cases, an increase in 3 cases, and no information available for 5 cases. Some of the problems encountered are water-transmitting backfill materials, piping and erosion around the sewer pipes, storm-induced infiltration, difficulties in identifying the location of leaks in surcharging sewers, transference of leaks to other locations as holes are repaired, and the necessity to fix nearly all the leaks in a section to make a significant improvement. Some suggestions learned from experience are: (1) sometimes 3 years are required to significantly reduce I/I, (2) annual reevaluation should follow evaluation and repairs, (3) the cheapest techniques should be used first, (4) upstream problems should be dealt with before downstream problems, (5) a complete renovation is more effective than making scattered repairs, (6) all leaky joints must be grouted, and (7) all system components must be repaired, not just leaky mains and manholes. (Cassar-FRC)
W82-00790

FACTORS INFLUENCING THE OCCURRENCE OF BURSTS IN IRON WATER MAINS,
Severn-Trent Water Authority (England).
R. Newport.
Aqua, No 3, p 274-278, 1981. 10 Fig, 2 Ref.

Descriptors: *Water mains, *Pipes, *Iron, Water distribution, Metal pipes, Corrosion, Water loss, Leakage, Pipelines, Soil types, Frost, Frozen ground, Materials engineering, *Pipe failure, Seven-Trent Water Authority, *Great Britain.

A statistical study on burst water mains in the Severn-Trent Water Authority revealed two major causes of failure: ground loading (frost, drought, and soil type) and corrosion (soil type, water, and pipe material). A winter peak in bursts is caused by frosts, especially those earlier in the season. The relationship may be described as: Total bursts per year = 2.5 x Total degrees of frost + 500. The magnitude of this peak can identify areas where corrosion is severe. Summer peaks, less common, appear during severe drought and are caused by ground movement as the earth cracks. Age cannot be correlated well with pipe failure. However, the spun iron pipes laid since 1952 have the highest burst rate, 0.39 burst per km per year. These show fissure corrosion resulting in a circumferential break upon stress. Average burst rates for four areas with cast iron pipes dating back to 1890 are 0.08 to 0.12 burst per km per year. Other factors affecting failure rate are: soil type (pipes laid in clay soils have twice the burst rate of those in sand and gravel), water type (soft water is worst), traffic loading, and accidental damage (during construction or before installation). (Cassar-FRC)
W82-00960

A NEW LOOK AT DESIGN OF RAW WATER PIPING,
C. F. Bowman, and W. S. Bain.
Power Engineering, Vol 84, No 8, p 73-77, August, 1980. 8 Fig, 1 Tab.

Descriptors: *Pipelines, *Design criteria, *Corrosion, Steel, Materials, Raw water, Conveyance structures, Pressure distribution, Temperature effects, Aeration, Oxidation, Water pressure, Hydraulic roughness.

A study was undertaken to determine the extent of the problem of materials building up on the inside of pipelines in the Tennessee Valley Authority system. Some recommendations are made for procedures to help mitigate this problem in the design of future power plants. About 50 sections of carbon steel raw water piping were removed from nine different TVA steam plants. Normally stagnant and normally flowing piping systems were sampled as well as both vertical and horizontal runs of pipe. The primary mechanism of material build-up was corrosion of the steel piping by aerated river water and redeposition of the corrosion products. The result is random pitting in the pipe wall and the formation of a tubercle over each pit. Pressure drop tests were performed at several plants to evaluate the effects of corrosion product buildup on pressure drop. The results of this study should have a profound impact on the design of future raw water piping systems, as the pressure drops calculated by methods recommended herein are significantly greater than those which would be calculated by presently recognized standard methods. These findings apply only to friction losses and should not be applied to form losses. (Baker-FRC)
W82-01029

8B. Hydraulics

FRONTAL JUMP CONDITIONS FOR MODELS OF SHALLOW, BUOYANT SURFACE LAYER HYDRODYNAMICS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. W. Garvine.
Tellus, Vol 33, No 3, p 301-312, June, 1981. 7 Fig, 22 Ref.

Descriptors: *Mathematical models, *Hydrodynamics, *Flow characteristics, Coastal waters, Interfaces, Thermocline, Thermal stratification, Hydraulic jump, Fluid mechanics, Lakes, Temperature effects, Saline-freshwater interfaces.

A shallow, buoyant upper layer is often found overlying heavier water of substantially greater depth in both coastal and inland waters. Examples of these moving frontal regions include surface plumes of buoyant water originating from a nearby source and the surface layer above the thermocline in lakes. This paper discusses an approach to modeling the hydrodynamics of these surface layers in which the flow field is partitioned into a frontal region where dissipative effects are important and an internal wave region in which they are not. The frontal region is treated as a horizontal discontinuity described by appropriate jump conditions. The wave region is described by nonlinear, long internal wave equations. Frontal jump conditions, which account for the transport of mass and momentum across the interface with the underlying fluid, are derived for use in applications of the model to small-scale flows where earth rotation has a negligible effect. These jump conditions are also applicable to flows where the depth of the buoyant layer vanishes on the upstream side of the front. The solution of a problem representing the sudden release of a shallow, buoyant upper layer into an unbounded domain is used to demonstrate the use of frontal jump conditions in conjunction with nonlinear internal wave equations. Although the results for zero interfacial transport are identical to the classical description of the analogous single layer problem posed by the sudden breaking of a dam, new features of the flow arise for nonzero transport. (Carroll-FRC)
W82-00804

HYDRAULIC DESIGN FOR THE TWO-STAGE STILLING BASIN,
Saskatchewan Univ. Saskatoon. Dept. of Civil Engineering.
C. D. Smith, and M. J. Klassen.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 137-145, June, 1981. 12 Fig, 3 Tab, 5 Ref.

Descriptors: *Stilling basins, *Design criteria, *Hydraulic design, Hydraulic jump, Tailwater, Basins, Mathematical studies, Hydraulic models.

The two-stage stilling basin is a design sometimes used for high head energy dissipating structures. Such stilling basins are often located in deep excavations because otherwise the natural tailwater is insufficient to force a hydraulic jump. The existence of two hydraulic jumps occurring in series in the same structure is the distinguishing feature of the two-stage stilling basin design. The tailwater depth for the first jump is created by a fixed weir at the end of the first basin. The jump in the second basin is forced by the natural tailwater depth in the downstream channel. Dissipation of most of the energy of flow in the first jump results in a considerable decrease in the required tailwater depth necessary to produce a jump in the second basin. Although the two-stage basin is substantially longer than the single-stage basin, the cost advantages of a higher floor elevation more than offset the costs of the extra length in some cases. Several hydraulic model tests for a two-stage stilling basin were conducted. The performance of the hydraulic jump in close proximity to a weir was first studied for two-dimensional flow using a parallel side flume. A design criterion was developed which was then verified on a three-dimensional model. Recommended values for the length of the first basin, length of the second basin, weir coefficient, weir shape, and weir height are included. (Carroll-FRC)
W82-00849

HYDRAULIC MODEL STUDY FOR THE DESIGN OF THE WRECK COVE CONTROL GATES,

McMaster Univ., Hamilton (Ontario). Dept. of Mechanical Engineering.
D. S. Weaver, and W. W. Martin.
Candian Journal of Civil Engineering, Vol 7, No 2, p 304-314, 1980. 14 Fig, 8 Ref.

Descriptors: *Hydraulic gates, *Reservoirs, *Flow characteristics, Model studies, Gates, Wreck Cove, *Nova Scotia, Powerplants, Outlets, Control systems, Oscillatory waves, Hydraulic models, Hydraulic design.

Scale model studies in a water tunnel were used to test the proposed configuration for the Wreck Cove, Nova Scotia, power plant vertical lift control gates. The gates are expected to operate under reasonable downpull loads and not suffer from sustained flow-induced oxicllations. Gates of similar geometry are planned upstream of the control gate and at two locations further upstream in the reservoir network. These locations differ in probable head, flow rate, and downpull. The data obtained from the model studies agree with previous results from sealed two-dimensional wind tunnel models. Maximum overall downpull coefficient is 0.4 and occurs at a gate opening of 45%. Gate slots do not significantly affect the maximum downpull coefficient or the relative opening at which it occurs. However, the downstream free surface increases the maximum downpull coefficient by about 5%. Removal of the curve fairing the bevelled gate bottom into the vertical face produces flow separation and significant buffeting of the gate. Changing the arrangement so that the bevel is downstream greatly increases downpull and could result in significant buffering if the bevelled face is submerged. (Cassar-FRC)
W82-00880

DEVELOPMENT OF MAKEUP-LINE SAFE-OPERATING CRITERIA,
Bechtel Inc., Norwalk, CA.
P. K. Su, and I. Joseph.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY2, p 269-283, February, 1980. 10 Fig, 2 Tab, 1 Ref.

Descriptors: *Mathematical models, *Powerplants, *Pipelines, Head loss, Pumping plants, Water treatment facilities, Maintenance, Operating policies, *Navajo Generating Station, Arizona.

A field experiment and mathematical analysis of the hydraulic transients were performed on the makeup lines of the Navajo Generating Station, located in northcentral Arizona near the border of Utah. The station is a three-unit, coal-fired power plant. Its makeup system, including the lake pumping station and two parallel pipe lines, conveying water from Lake Powell to the water-treatment facility at the plant site. The water is used as a makeup supply for evaporation losses and blowdown from the cooling towers of the main condenser circulating water system. After adjusting the head-loss coefficients of the pipeline and the air-chamber nozzle in the mathematical model, the results show a satisfactory agreement between the measured and calculated transient response at the air chambers and several points along the pipeline. The mathematical model was next used to develop system operating criteria that include automatic control of the water levels in the air chamber for various flow rates. The system is protected from adverse transient effects due to power interruptions. (Baker-FRC)
W82-01095

8D. Soil Mechanics

MODELING GRADUAL DAM BREACHES,
San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce, and A. J. Tsivoglou.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 829-838, July, 1981. 1 Tab, 25 Ref.

Descriptors: *Dam failure, *Erosion, Embankments, Earth dams, Model studies, Mathematical models, Channel morphology, Bank erosion, Flood peak, *Huaccoto Dam, Mantaro River, *Peru, Hydrographs, Reservoirs, Earthquakes, Landslides.

A simulation model of the gradual failure of an earth embankment dam was formulated, developed, and tested. Concepts of water and sediment routing and channel geometry were used to develop a self-contained mathematical model of the breach enlargement and the ensuing flood wave. Unsteady flow elements of the simulation are an implicit numerical solution of the complete Saint Venant equations coupled with a sequential sediment routing technique. The model was tested on the failure of a natural embankment formed by an earthquake landslide at Huaccot on the Mantaro River, Peru, in April, 1974. The failure of this 170 meter high, 3800 meter long embankment holding back 665 million cu meters of water occurred by overtopping. This developed a breach which grew under the erosive action of the waters for 48 hours, a period much longer than the usual few hours failure time documented for engineered dams. Comparisons between estimated actual and simulated flood characteristics were remarkable. Actual and simulated values were as follows, respectively: peak discharge, 13,700 and 13,200 cu meters per sec; maximum crest erosion, 35 and 37 meters; maximum flow depth, 15-20 and 12-22 meters; time from 0 to 100 cu meters per sec, both 16 hours; time from 100 cu meters per sec to peak discharge, both 10 hours; and hydrograph duration from 100 cu meters per sec to peak and recession, 32 and 34 hours. (Cassar-FRC)
W82-00554

SETTLEMENT OF A COMPACTED UNSATURATED EARTH EMBANKMENT,
University of the Witwatersrand, Johannesburg (South Africa).
G. E. Blight, G. H. H. Legge, and G. W. Annandale.
Civil Engineer in South Africa, Vol 22, No 2, p 25-29, February, 1980. 6 Fig, 16 Ref.

Descriptors: *Dams, *Soil compaction, Soil engineering, Soil mechanics, Sedimentation, *Mita Hills Dam, Mathematical studies, South Africa, Dam design, Settlement analysis.

A settlement analysis of the Mita Hills Dam, made during its design in 1956-57, has been reexamined in the light of current soil mechanics knowledge and computational procedures. The Mita Hills Dam embankment has a maximum height of 48.8 meters, a crest length of 366 meters, and consists of some one million cubic meters of rolled earth-fill. The entire downstream zone of the fill is protected from seepage by the inclined filter drain, while 12 pore pressure relief drains were provided in the heart of the downstream zone to relieve construction pore pressures. The time-settlement and void ratio-pressure characteristics of the Mita Hills soil had been measured by means of standard oedometer test techniques on specimens of soil taken from the proposed borrow pits. The difference between the original analysis and the analysis conducted in recent years indicated the results of post-construction consolidation. Use of more modern computational skills has enabled the prediction of post-construction settlement of a compacted earth embankment with increasing accuracy. The improved accuracy results more from computational improvements than from improvements in the area of soil mechanics understanding. (Baker-FRC)
W82-00678

LARGE RUBBLE-MOUND BREAKWATER FAILURES,
Harris (Frederic R.) Inc., Houston, TX.
E. H. Harlo.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol. 106, No. WW2, p 275-278, 1980. 1 Fig, 9 Ref.

Descriptors: *Coastal waters, *Breakwaters, *Jetties, *Sea walls, *Construction, Engineering, Dam construction, Construction materials, Construction methods, Stress, Stability analysis, Storms, Damage, Foundation failure.

The mechanism by which waves cause large internal water pressures and cause breakwater failures is outlined. Hydrodynamic pore pressures in the core material contribute significantly to the failure of rubble-mound structures. Steep slopes cause larger seepage pressures in the direction of incipient failure planes. The smaller the permeability of core materials next to the filter rock, the larger will be the seepage pressures along these planes. Model study of the phenomenon is recommended. This should include determination of the angle of internal friction of the core material, maximum instantaneous seepage pressures in the core, and dynamic analysis of slope stability for various breaking wave patterns at a series of stages during the maximum wave cycle. (Titus-FRC)
W82-00862

8G. Materials

SUCCEEDING WITH LINER INSTALLATION,
Water and Sewage Works, Vol 127, No 4, p 60-61, April, 1980. 1 Fig.

Descriptors: *Linings, *Reservoir linings, Ponds, Lagoons, Coating, Reservoirs.

The importance of installation technique in the application of a lining is discussed. Regardless of the type of lining membrane used, the success will depend to a very large extent on the experience and expertise of the installer. Information needed about the liner in order to make a selection includes a study of the compatibility of the liner material and scrims with the process fluids involved. A temperature test must be made of the fluid when it is injected into the pond as well as at its standing temperature. Injection and withdrawal methods must be examined, including the number and types of monitoring or inspection facilities that may be needed. The volume of liquid to be stored must be known, as well as length, width, depth, and side slope ratio of the pond. The type and condition of the soil, groundwater table and surrounding terrain as well as the location of the pond and the high and low temperatures experienced in the area must be known. Installation cost must be carefully computed before making final decisions. (Baker-FRC)
W82-00909

8I. Fisheries Engineering

FACTORS AFFECTING PUGET SOUND COHO SALMON (ONCORHYNCHUS KISUTCH) RUNS,
Washington Univ., Seattle. Coll. of Fisheries.
S. B. Matthews, and F. W. Olson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 9, p 1373-1378, September, 1980. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Salmon, *Streamflow, *Fish populations, Fish management, Fisheries, Fish hatcheries, Temperature effects, Dissolved oxygen, Mathematical studies, Seasonal variation, Runoff, *Puget sound, Washington, Water quality.

During their freshwater stream residence, juvenile coho salmon (Oncorhynchus kisutch) may be subject to such stresses as high temperature, predation, low dissolved oxygen, disease, stranding and overcrowding. These factors have been associated with streamflow conditions and may affect salmon populations. Hatchery production of salmon has also had a significant effect on coho population growth. A relationship has been recognized between rearing flow conditions and coho run strength for more than 40 years. It was theorized that the survival of hatchery coho may be positively related to the same environmental conditions that affect the stream-reared salmon. A depensatory mortality relationship between abundances of stream-reared and hatchery coho similar to that observed in pink salmon was suggested. (Geiger-FRC)
W82-00883

GREAT LAKES ENVIRONMENTAL PROTECTION POLICIES FROM A FISHERIES PERSPECTIVE,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 6G.
W82-00978

GONAD DEVELOPMENT, FECUNDITY, AND SPAWNING SEASON OF LARGEMOUTH BASS IN NEWLY IMPOUNDED WEST POINT RESERVOIR, ALABAMA-GEORGIA,
Alabama Cooperative Fishery Research Unit, Auburn.
For primary bibliographic entry see Field 2H.
W82-01080

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

FACTS FIX FUND FINDING,
Havens and Emerson Ltd., Cleveland, OH.
G. D. Simpson.
Water and Sewage Works, Vol 127, No 4, p 56, 84, April, 1980. 1 Tab, 5 Ref.

Descriptors: *Government finance, *Water treatment, *Wastewater treatment, Economic aspects, Training, Government supports, Grants, Legislation, Education.

Grants, loans, training and advisory services, and information services are among the programs available from the Federal and state governments to assist municipalities and sewer districts in discharging their responsibilities. Federal legislation in this area is contained primarily in the Water Pollution Control Act and the Clean Water Act, as well as the Safe Drinking Water Act and the Resource Conservation and Recovery Act amendments to the Solid Waste Disposal Act. Support includes grants for research and investigative studies, financing of pilot programs, grants to assist in costs for technical evaluation of operation and maintenance for demonstration projects, costs for technical evaluation of operation and costs of certain training, and scholarships to individuals for college training in the field of operation and maintenance of treatment works. Means of contacting various agencies are listed. (Baker-FRC)
W82-00885

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

POINT-OF-USE WATER TREATMENT...AN ENLARGING REALITY,
L. Vinyard.
Water and Sewage Works, Vol 127, No 4, p 8, April, 1980.

Descriptors: *Organizations, *Water quality control, Water Quality management, Water quality standards, Professional societies, Professional personnel, *Water treatment, Information retrieval, *Water quality association.

The Water Quality Association (WQA) is the spokesman for the point-of-use water-treatment industry, which provides water treatment technology for systems ranging from a single home faucet to municipal treatment for small communities. The industry consists of more than 200 manufacturers and nearly 5000 retailers. The WQA is frequently contacted to provide information needed by legislators as they attempt to formulate needed legislation and governmental approches to solving current problems. Future research conducted by the WQA will include an analysis of economics and a possible demonstration project. (Baker-FRC)
W82-00784

[illegible]

8D. Soil Mechanics

[illegible]

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

[illegible]

SUBJECT INDEX

ABIENOL
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

ABSORPTION
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

ACCLIMATIZATION
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

ACCUMULATION
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

ACID MINE WATER
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

ACID RAIN
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

Acid Rain: Facts and Fallacies,
W82-00518 5C

Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

ACIDIC SOILS
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

ACIDIC WATER
Reviving Acidified Lakes,
W82-00933 2H

ACIDITY
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

ACTIVATED CARBON
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

ACTIVATED SLUDGE
Feeding Animals Activated Sludge,
W82-00523 5D

Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

ACTIVATED SLUDGE PROCESS
The Cape Flats Sewage Treatment Works,
W82-00957 5D

Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

ACTIVATED SLUDGE PROCESSES
Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

ADENOSINE TRIPHOSPHATE
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

ADIRONDACKS
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

ADMINISTRATIVE DECISIONS
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

ADMINISTRATIVE REGULATIONS
Arkansas Water Policy.
W82-00715 6D

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

Groundwater Problems and Needs in New York,
W82-01055 4B

Ground Water Problems in West Virginia,
W82-01060 4B

ADSORPTION
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

AERATION
Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

AERIAL PHOTOGRAPHY
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

AEROMONAS
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

AEROSOLS
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

AESCHYNOMENE
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

AGRICULTURAL CHEMICALS
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

AGRICULTURAL HYDROLOGY
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

AGRICULTURAL RUNOFF
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01059 5B

AGRICULTURAL WATERSHEDS
Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

AGRICULTURE

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

AIR POLLUTION

Acid Rain: Facts and Fallacies,
W82-00518 5C

Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

AIR POLLUTION EFFECTS

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

AIR-WATER INTERFACES

Water-To-Air Fractionation of Bacteria,
W82-00575 5B

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

ALASKA

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

ALBERTA

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

ALGAE

An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

ALGAL CONTROL

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

ALGAL GROWTH

Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

ALKALINE WATER

Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

ALLOCATION OF RESOURCES

Arkansas Water Policy.
W82-00715 6D

ALTERNATIVE PLANNING

Formulating Alternatives for Environmental Studies,
W82-00997 6G

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

ALUM

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

ALUMINUM

Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

AMAZON LAKES

Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

AMINO ACIDS

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

AMMONIA

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

AMMONIUM

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

ANAEROBIC CONDITIONS

A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

ANIMAL DISEASES

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

ANIMAL WASTES

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

ANN ARBOR

Cold Weather Waste Treatment,
W82-00636 5D

ANNE ARUNDEL COUNTY

Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

ANNUAL FLOODS

Spring Flood: Meltwater or Groundwater,
W82-00531 7B

APPLICATION EQUIPMENT

Traveling Sprinkler System and Method,
W82-00561 3F

AQUACULTURE

Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

AQUATIC ANIMALS

Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

AQUATIC ENVIRONMENT

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

AQUATIC INSECTS

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

AQUATIC LIFE

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

AQUATIC PLANTS

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

AQUATIC POPULATIONS
Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

AQUATIC WEED CONTROL
Aquatic Weed Cutting Apparatus,
W82-00624 4A

AQUIFER CHARACTERISTICS
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

AQUIFER MANAGEMENT
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

AQUIFER TESTING
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

AQUIFERS
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

ARANASAS PASS
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

ARCTIC
Physical Mechanics of Aufeis Growth,
W82-00836 2C

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

ARCTIC ZONE
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

AREAL PRECIPITATION
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

ARID LANDS
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

ARIZONA
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

ARKANSAS
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

Arkansas Water Policy.
W82-00715 6D

ARTIFICIAL PRECIPITATION
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

ASBESTOS
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

Interim Method for Determining Asbestos in Water,
W82-00741 5A

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

ASBESTOS CEMENT
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

ATMOSPHERIC MOISTURE
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

ATMOSPHERIC WATER
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

ATRAZINE
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

AUFEIS
Physical Mechanics of Aufeis Growth,
W82-00836 2C

AUSTRALIA
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

AUTOMATION
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

AZOV SEA
The Azov Sea Problem,
W82-00651 6G

BACKFILL
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

BACTERIA
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Water-To-Air Fractionation of Bacteria,
W82-00575 5B

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

Cold Weather Waste Treatment,
W82-00636 5D

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

Purification of Wastewater by Electrolysis,
W82-00847 5D

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

BACTERIAL ANALYSIS
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

BACTERIOPHAGE
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

BAFFIN BAY
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

BASELINE STUDIES
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

BASIN IRRIGATION
Depths of Flow in Level Basins,
W82-00900 3F

BASINS
Depths of Flow in Level Basins,
W82-00900 3F

BASS
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

BAY OF FUNDY
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

BEHAVIOR
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

BELLINGHAM BAY AREA
Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

BENTHIC ENVIRONMENT
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

BENTHIC FAUNA
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

BENTHOS
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

BENTONITE
Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

BIG RUN BOG
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

BIOACCUMULATION
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

BIOASSAY
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

BIOASSAYS
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

BIOCHEMISTRY
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

BIOCONTROL
Detoxification of Residual Quaternaries,
W82-00562 5G

BIODEGRADATION
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

BIOFILTRATION
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

BIOINDICATORS
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

BIOLOGICAL WASTEWATER TREATMENT
Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

BLOOD
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

BOGS
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphegnum Bog in West Virginia,
W82-00992 2I

BOREHOLE GEOPHYSICS
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

BOTTOM SAMPLING
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

BOTTOM SEDIMENTS
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

BRACKISH WATER
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

BREAKWATERS
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

BROMACIL
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

BROMINE CHLORIDE
An Alternative Wastewater Disinfectant,
W82-00950 5D

BUBBLES
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

BUFFALO RIVER
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

BUOYANCY
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

BURLINGTON
Low Turbidity Water from Fast Processes,
W82-00946 5F

BUTYL BENZYL PHTHALATE
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

BYRAM LAKE
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

CADDISFLIES
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

CADMIUM
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 5A

CALCIUM
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

CALIBRATIONS
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

CALIFORNIA
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

CANADA
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

CANOPY
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

CAPE FEAR ESTUARY
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

CAPITAL COSTS
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

CARBOHYDRATES
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

CARBON
Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

CARBONATE ROCKS
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

CARBONATES
Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

CARCINOGENS
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

CARP
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

CASPIAN SEA
The Caspian Sea Problem,
W82-00657 4A

CASTLE ROCK
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

CATALYSTS
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

CATCHMENT AREAS
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

CATFISH
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

CATION EXCHANGE
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

CATIONS
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

CHANNEL FLOW
Tractive Force Design of Vegetated Channels,
W82-00901 4D

CHANNEL IMPROVEMENT
Aquatic Weed Cutting Apparatus,
W82-00624 4A

CHANNEL MORPHOLOGY
Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

CHANNELING
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

CHANNELS
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

CHAPARRAL
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

CHAR
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

CHELATING AGENTS
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

CHEMICAL ANALYSIS
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

Identification of Organic Compounds,
W82-00635 5A

The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

CHEMICAL COMPOSITION
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

CHEMICAL DEGRADATION
Sources and Control of Organic Air Pollutants,
W82-00711 5B

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

CHEMICAL INDUSTRY
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

CHEMICAL PRECIPITATION
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

CHEMICAL PROPERTIES
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

CHEMICAL REACTIONS
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

CHEMICAL TREATMENT
Water-Treatment Chemicals,
W82-00618 5F

CHEMICAL WASTES
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Removal of Priority Pollutants,
W82-00639 5D

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

CHEMISTRY OF PRECIPITATION
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00990 2K

CHESAPEAKE BAY
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Kepone in the James River,
W82-00631 5B

CHIRONOMIDS
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

CHLORDANE
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

CHLORIDES
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

CHLORINATED HYDROCARBONS
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

CHLORINATION
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

CHLORINE
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

CHROMATOGRAPHY
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

CHROMIUM
Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

CITRUS FRUITS
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

CLAMS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

CLARIFICATION
Low Turbidity Water from Fast Processes,
W82-00946 5F

CLARIFIERS
Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

Simulation Modeling of Primary Clarifiers,
W82-01027 6A

CLASSIFICATION
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

CLAYS
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

CLEAR-CUTTING
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

CLOSED LAKES
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

CLOUD SEEDING
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

CLOUDS
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

COAGULATION
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

Ferric Chloride Takes Over,
W82-00954 5F

COAL GASIFICATION
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

COAL MINING
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

Illinois Groundwater Problems and Needs,
W82-01052 4B

COAL TAR COATINGS
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

COASTAL AQUIFERS
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

COASTAL MARSHES
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

COASTAL WATERS
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

COATINGS
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

COLD REGIONS
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

COLIFORMS
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

COLOGNE
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

COLOR REMOVAL
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

COLORADO
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

COLORADO RIVER
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

COLORADO RIVER BASINS
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

COMMERCIAL FISHING
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

COMPARISON ANALYSIS
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

COMPARISON STUDIES
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

COMPETING USE
Water - Its Use and the Implications for Arkansas Agriculture,
W82-00714 6D

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin,
W82-00716 6F

COMPOSTING
Composting Is Working in Camden,
W82-00948 5E

COMPREHENSIVE PLANNING
Great Lakes International Surveillance Plan,
W82-00701 6E

COMPUTER MODELS
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

COMPUTER PROGRAMS
Answers: A Model for Watershed Planning,
W82-00898 6A

Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

COMPUTERS
Empire Controlled by Computer,
W82-00529 5D

CONCRETE CONSTRUCTION
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

CONDENSATES
The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

CONDUCTIVITY
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

CONFINED AQUIFERS
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

CONSERVATION
Health Aspects of Urban Water Conservation,
W82-01047 3C

CONSTRUCTION
The Waterway That Cannot be Stopped,
W82-00510 6E

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Large Rubble-Mound Breakwater Failures,
W82-00862 8D

CONSTRUCTION COSTS
Low-Cost Wastewater Treatment,
W82-00841 5D

CONSTRUCTION MATERIALS
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

CONSUMPTIVE USE
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

CONTAMINANTS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

CONTAMINATION
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

CONTOURS
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

CONTROL SYSTEMS
Control Systems for Return and Waste Sludge,
W82-00949 5D

CONVEYANCE STRUCTURES
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

COOLING PONDS
Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

COOLING TOWERS
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

COOLING WATER
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

Measurement of Particulates Entrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Effects of Water Quality on Forage Production,
W82-01002 3C

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

COOPERATIVES
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

COPEPODS
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

CORER
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

CORN
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

CORN BELT
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

CORROSION
A New Look at Design of Raw Water Piping,
W82-01029 8A

COST ALLOCATION
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

COST ANALYSIS
Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

COST-BENEFIT ANALYSIS
Evaluating Irrigation Systems,
W82-00772 6B

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

COSTS
The Waterway That Cannot be Stopped,
W82-00510 6E

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 5D

CRAYFISH
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

CROP PRODUCTION
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

Water Requirement for Sugarcane Production,
W82-00899 3F

CROP YIELD
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

CROP YIELDS
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

CROPLAND
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

Sediment Sizes Eroded from Crop Row Sidelopes,
W82-00903 2J

Dryland Management for Salinity Control,
W82-01018 2G

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

CRUDE OIL
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

CULTIVATION
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

CULTURE MEDIA
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

CYCLING NUTRIENTS
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

CYTOPHAGAS
Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

DAIRY INDUSTRY
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

DAM CONSTRUCTION
Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

DAM EFFECTS
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

DAM FAILURE
Modeling Gradual Dam Breaches,
W82-00554 8D

DAMAGE
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

DAMS
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 6G

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

DANVERS
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

DATA COLLECTION
Great Lakes International Surveillance Plan,
W82-00701 6E

DATA COLLECTIONS
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

DDE
Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

DEBRIS BASINS
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

DECISION MAKING
Using Ecological Knowledge for Development Planning,
W82-00671 6A

DECOMPOSING ORGANIC MATTER
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

DECOMPOSITION
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

DEEP WELLS
Groundwater Problems in North Carolina,
W82-01056 4B

DEGRADATION
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

DELAWARE
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware,
W82-00755 6E

DELTAS
Sediment Yield from a Flatland Watershed,
W82-00941 2J

DENITRIFICATION
Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

DEPOSITION
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

DES ALLEMANDS
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

DESALINATION APPARATUS
Superseparation: Soret Effect Reversed,
W82-00791 3A

DESERT PLANTS
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

DESIGN CRITERIA
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

Sizing Rice Irrigation Canals,
W82-00895 3F

A New Look at Design of Raw Water Piping,
W82-01029 8A

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

DETERGENTS
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

DETOXIFICATION
Detoxification of Residual Quaternaries,
W82-00562 5G

DETRITUS
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

DEVELOPING COUNTRIES
Using Ecological Knowledge for Development Planning,
W82-00671 6A

DIATOMS
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

DICHLOROMETHANE
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

DIFFUSIVITY
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

DINOFLAGELLATES
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

DIPHENYLMETHANES
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

DIQUAT
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

DIRECT FILTRATION
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

DISINFECTANTS
An Alternative Wastewater Disinfectant,
W82-00950 5D

Removing Trihalomethanes from Drinking Water,
W82-00953 5F

DISINFECTION
Purification of Wastewater by Electrolysis,
W82-00847 5D

Chemicals Disinfect Sludge,
W82-01003 5D

DISSOLUTION
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

DISSOLVED ORGANIC MATTER
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

DISSOLVED OXYGEN
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

DISTRIBUTION PATTERNS
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

DOGWOOD
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

DOMESTIC ANIMALS
Feeding Animals Activated Sludge,
W82-00523 5D

DRAINAGE
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

DRAINAGE WATERS
Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

DRAWDOWN
Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

DREDGING
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

DRINKING WATER
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

Environmental Health Hazards,
W82-00625 5F

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Ex-

traction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

Groundwater Problems and Needs in New York,
W82-01055 4B

Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

DROUGHT
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

DROUGHT RESISTANCE
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

DRUGS
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

DRY FARMING
Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

DUSTS
The Effects of Surface Dust on Snowmelt Rates,
W82-00845 2C

DYE INDUSTRY WASTES
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

DYES
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

EAGLE LAKE
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

EASTERN UNITED STATES
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

ECHINODERMS
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

ECOLOGICAL EFFECTS
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

ECOLOGY
Using Ecological Knowledge for Development Planning,
W82-00671 6A

Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

ECONOMIC ASPECTS
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

ECONOMIC EFFICIENCY
Cold Weather Waste Treatment,
W82-00636 5D

ECONOMIC FEASIBILITY
Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

ECONOMIC JUSTIFICATION
Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

ECOSYSTEMS
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1A

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

EFFLUENTS
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

Mutlichamber Septic Tanks,
W82-00969 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

EGGS
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

ELECTRIC POWER PRODUCTION
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

ELECTRIC POWERPLANTS
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

ELECTROLYSIS
Purification of Wastewater by Electrolysis,
W82-00847 5D

ELECTRON MICROSCOPY
Interim Method for Determining Asbestos in Water,
W82-00741 5A

ELECTROPLATING
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ENDOTOXIN
Movement of Endotoxin Through Soil Columns,
W82-00586 5B

ENERGY
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

ENERGY CONSERVATION
Mixing Technology Reduces Energy Use,
W82-00634 5D

ENGLAND
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

ENTEROVIRUSES
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

ENTRAINMENT
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

ENVIRONMENTAL EFFECTS
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

Final Environmental Impact Statement. North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 6G

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Environmental Effects of Water Reuse Scheme,
W82-00973 3C

ENVIRONMENTAL GRADIENT
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

ENVIRONMENTAL IMPACT STATEMENT
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

ENVIRONMENTAL POLICY
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00975 6G

ENVIRONMENTAL PROTECTION
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

Formulating Alternatives for Environmental Studies,
W82-00997 6G

EPHEMERAL STREAMS
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

EPIDEMIOLOGY
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

EQUIPMENT
Aquatic Weed Cutting Apparatus,
W82-00624 4A

EROSION
Modeling Gradual Dam Breaches,
W82-00554 8D

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

EROSION CONTROL
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

Tractive Force Design of Vegetated Channels,
W82-00901 4D

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

EROSION RATES
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

ERROR ANALYSIS
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

ESTIMATING EQUATIONS
Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

ESTUARIES
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

ESTUARIES *HYDROGEN ION CONCENTRATION
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

ESTUARINE ENVIRONMENT
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxi-

dation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

ESTUARINE ENVIRONMENTS
Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

EUTROPHIC LAKES
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

EUTROPHICATION
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

EVALUATION
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

Evaluating Irrigation Systems,
W82-00772 6B

EVAPOTRANSPIRATION
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

EXCESS RAINFALL
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

EXPLORATION
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

FABABEANS
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

FACTOR ANALYSIS
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

FARM MANAGEMENT
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

FATE OF POLLUTANTS
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

FECAL COLIFORM
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

FECES
Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

FEDERAL JURISDICTION
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

FEDERAL-STATE COOPERATION
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

FEDERAL WATER RESOURCES RESEARCH
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

FEEDLOT RUNOFF
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

FEEDLOT WASTES
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

FEEDS
Feeding Animals Activated Sludge,
W82-00523 5D

FERRIC CHLORIDE
Ferric Chloride Takes Over,
W82-00954 5F

FERTILITY
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

FIJI ISLANDS
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

FILTER MEDIA
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

FILTRATION
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

Low Turbidity Water from Fast Processes,
W82-00946 5F

Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

FINLAND
Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

FISH
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

FISH EGGS
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

FISH FARMING
Thames Rears Carp in Sewage.
W82-00681 3C

Water Movement for Water Quality in Catfish Production,
W82-00866 5G

FISH MANAGEMENT
Management Provoked Conflict in Fisheries,
W82-00780 6A

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

FISH PHYSIOLOGY
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

FISH PONDS
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

FISH POPULATIONS
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H
Water Movement for Water Quality in Catfish Production,
W82-00866 5G
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

FISH TOXINS
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B
Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

FISHERIES
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C
Management Provoked Conflict in Fisheries,
W82-00780 6A

FISHKILL
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C
Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

FIVE-YEAR PLANS
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

FJORDS
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FLOCCULATION
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

FLOOD DAMAGE
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD DATA
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD FREQUENCY
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

FLOOD PEAK
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD PLAINS
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G
Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

FLOOD PROFILES
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLOOD PROTECTION
Reliability of Underground Flood Control System,
W82-00556 8A

FLOODING
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

FLOODS
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

FLORENCE
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

FLORIDA
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I
Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H
Tampa Bay Water Guarded by Computer,
W82-00934 4B
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B
Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

FLORIDAN AQUIFER
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

FLOW CHARACTERISTICS
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L
Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B
Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1A

FLOW FRICTION
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FLOW MEASUREMENT
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

FLOW RATES
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E
Depths of Flow in Level Basins,
W82-00900 3F

FLUIDIZED BEDS
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

FOAM SEPARATION
Foam Control in Aeration Tanks,
W82-00525 5D

FOAMING
Foam Control in Aeration Tanks,
W82-00525 5D

FOOD CHAIN
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

FOOD PROCESSING INDUSTRY
Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 5D

FOOD-PROCESSING WASTES
Low-Cost Wastewater Treatment,
W82-00841 5D

FORAGES
Effects of Water Quality on Forage Production,
W82-01002 3C

FOREST WATERSHEDS
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

FORESTS
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

FOULING
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

FREEZING
Physical Mechanics of Aufeis Growth,
W82-00836 2C

FREQUENCY ANALYSIS
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

FROST PROTECTION
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

FUEL
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

FUNGI
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

FURROWS
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

FUTURE PLANNING
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan,
W82-01051 6E

GAS CHROMATOGRAPHY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

GEOCHEMISTRY
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

GEOHYDROLOGY
Hydrogeological and Geophysical Logging,
W82-00511 7B

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

GEOLOGIC FRACTURES
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

GEOLOGIC HISTORY
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

GEOMORPHOLOGY
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

GEOPHYSICS
Hydrogeological and Geophysical Logging,
W82-00511 7B

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

GEOTHERMAL STUDIES
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

GERMINATION
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

GLACIAL AQUIFERS
Predictive Depositional Model for Glacial Aquifers,
W82-00628 2F

GOOSE RIVER
A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

GOVERNMENT FINANCE
Facts Fix Fund Finding,
W82-00885 9A

GRANADA
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

GRAND VALLEY
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

GRASSES
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

GREAT BRITAIN
Environmental Virology and its Problems,
W82-00505 5A

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

GREAT LAKES
Great Lakes International Surveillance Plan,
W82-00701 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

GREAT LAKES BASIN
Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

GREAT LAKES ECOSYSTEM
1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

GREAT PLAINS
Dryland Management for Salinity Control,
W82-01018 2G

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

GROUNDWATER
Groundwater Strategies,
W82-00620 5G

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 7C

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

Water Resources Data for Illinois, Water Year 1980–Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980–Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

GROUNDWATER AVAILABILITY

Groundwater Problems and Needs in New York,
W82-01055 4B

Groundwater Problems in North Carolina,
W82-01056 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

GROUNDWATER BASINS

Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

Overland Flow on a Diverging Surface,
W82-00986 2A

GROUNDWATER BUDGET

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

GROUNDWATER DEPLETION

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

GROUNDWATER MANAGEMENT

Tampa Bay Water Guarded by Computer,
W82-00934 4B

Illinois Groundwater Problems and Needs,
W82-01052 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

Groundwater Problems and Needs in New York,
W82-01055 4B

Groundwater Problems in North Carolina,
W82-01056 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

Ground Water Problems in West Virginia,
W82-01060 4B

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

GROUNDWATER MINING

Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

GROUNDWATER MOVEMENT

Spring Flood: Meltwater or Groundwater,
W82-00531 7B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

GROUNDWATER POLLUTION

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

Sampling Ground Water for Organic Contaminants,
W82-00820 5A

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

Illinois Groundwater Problems and Needs,
W82-01052 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

Groundwater Problems and Needs in New York,
W82-01055 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

Ground Water Problems in West Virginia,
W82-01060 4B

Groundwater Quality Models - State of the Art,
W82-01061 5G

GROUNDWATER POTENTIAL

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

GROUNDWATER RECHARGE

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

GROUNDWATER RESERVOIRS

Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

GROWTH RATES

Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

GYPSUM

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

HABITATS

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

HALOGENS

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

HARBORS

Richards Bay: An Ecological Dilemma,
W82-00679 6A

HARDNESS

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

HAWAII

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

HAZARDOUS MATERIALS
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

Environmental Health Hazards,
W82-00625 5F

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC,
W82-01071 5A

HAZARDOUS WASTE INVENTORY
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

HEATED WATER
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

HEAVY METALS
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

Assessment of Airborne Inorgaric Contaminants in the Great Lakes,
W82-00710 5B

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Rodivivus,
W82-01017 5A

Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

HERBICIDES
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

HIGH FALLS STATE PARK
A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

HIGHWAY EFFECTS
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 5B

HOLSTON RIVER
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

HOME WATER HEATERS
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

HOME WATER SOFTENERS
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

HUACCOTO DAM
Modeling Gradual Dam Breaches,
W82-00554 8D

HUMAN DISEASE
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

HUMAN DISEASES
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

HUNTER VALLEY
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

HYDRAULIC DESIGN
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

HYDRAULIC GATES
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

HYDROCARBONS
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

HYDRODYNAMICS
Frontal Jump Conditions for Models of Shallow. Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

HYDROELECTRIC PLANTS
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

HYDROELECTRIC POWER
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

HYDROGEN ION CONCENTRATION
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS).
W82-00521 7B

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

HYDROLOGIC BUDGET
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

HYDROLOGIC DATA
Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

HYDROLOGICAL DATA COLLECTION
Hydrogeological and Geophysical Logging.
W82-00511 7B

HYPOLIMNION
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

ICE FORMATION
Physical Mechanics of Aufeis Growth,
W82-00836 2C

Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

IDAHO
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

ILLINOIS
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

Illinois Groundwater Problems and Needs,
W82-01052 4B

ILLINOIS RIVER BASIN
Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

IMPAIRED WATER USE
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

INDIA
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

INDIANA
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

INDUSRIAL WASTE
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

INDUSTRIAL EFFLUENTS
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

INDUSTRIAL WASTES
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Mixing Technology Reduces Energy Use,
W82-00634 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Removal of Priority Pollutants,
W82-00639 5D

Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 5D

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

INDUSTRIAL WASTEWATER
Toxics in Municipal and Industrial Wastewaters.
W82-00712 5A

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 5D

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01060 5B

Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

INDUSTRIAL WATER
Detoxification of Residual Quaternaries,
W82-00562 5G

INFILTRATION
Why EPA's I/I Control Program Fails,
W82-00790 8A

INJECTION WELLS
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

INLAND WATERWAYS
The Waterway That Cannot be Stopped,
W82-00510 6E

INLETS
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

INSECTICIDES
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

INSTITUTIONAL CONSTRAINTS
Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

INSURANCE
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

INTERNATIONAL AGREEMENTS
Great Lakes International Surveillance Plan,
W82-00701 6E

INTERNATIONAL WATERS
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

INTERSTITIAL WATER
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

INVERTEBRATES
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

ION EXCHANGE
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

ION TRANSPORT
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

IONIC INTERFERENCE
Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

IONS
Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

IRON
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

IRRIGATION
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

IRRIGATION CANALS
Sizing Rice Irrigation Canals,
W82-00895 3F

IRRIGATION DITCHES
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

IRRIGATION EFFECTS
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

Effects of Water Quality on Forage Production,
W82-01002 3C

IRRIGATION EFFICIENCY
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

Watertable Management Saves Water and Energy,
W82-00943 3F

IRRIGATION ENGINEERING
Laser Drip Irrigation.
W82-00771 3F

IRRIGATION PRACTICES
Saline Irrigation Water.
W82-00512 3F

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

IRRIGATION REQUIREMENTS
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

IRRIGATION SYSTEMS
Traveling Sprinkler System and Method,
W82-00561 3F

Evaluating Irrigation Systems,
W82-00772 6B

IRRIGATION WATER
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

2,500 Acres of Wastewater Irrigation,
W82-00769 3C

ISOLATION
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

ISOTOPE STUDIES
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

ISOTOPIC TRACERS
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

ISRAEL
Transport of Salts in Soils and Subsoils,
W82-00930 5B

Environmental Effects of Water Reuse Scheme,
W82-00973 3C

JAMES BAY
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

JAMES RIVER
Kepone in the James River,
W82-00631 5B

JAPAN
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

JETTIES
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

JUDICIAL DECISIONS
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

KANSAS
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

KANSAS CITY
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

KARST HYDROLOGY
Reliability of Underground Flood Control System,
W82-00556 8A

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

KENNEDY SPACE CENTER
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

KENTUCKY
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

KENYA
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

KEPONE
Kepone in the James River,
W82-00631 5B

KINETICS
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

KNIGHT INLET
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

LABORATORY EQUIPMENT
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

LAGOONS
Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

LAKE BASINS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

LAKE CLASSIFICATION
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

LAKE GEORGE
Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

LAKE KISSIMMEE
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

LAKE MICHIGAN
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan,
W82-01079 5C

LAKE ONTARIO
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

LAKE REHABILITATION
1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

LAKE RESTORATION
Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

Reviving Acidified Lakes,
W82-00933 2H

LAKE SEDIMENTS
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

LAKE TAHOE
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

LAKE WASHINGTON
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

LAKE-WATERSHED SYSTEMS
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

LAKES
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

Great Lakes International Surveillance Plan,
W82-00701 6E

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979,
W82-01070 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

LAND DISPOSAL
Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

LAND FORMING
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

LAND RECLAMATION
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

LAND USE
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

LANDFILLS
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

LANDSLIDES
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

LASERS
Laser Drip Irrigation.
W82-00771 3F

LEACHATES
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

LEACHING
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

Trenching of Digested Sludge,
W82-00974 5E

Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

LEAD
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

LEAVES
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

LEGAL ASPECTS
The Waterway That Cannot be Stopped,
W82-00510 6E

Groundwater Strategies,
W82-00620 5G

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

Distribution System Liability,
W82-01028 5F

Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

LEGISLATION
Groundwater Problems in North Carolina,
W82-01056 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

Ground Water Problems in West Virginia,
W82-01060 4B

LEGUMES
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

LENTIC ENVIRONMENT
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

LIGHT PENETRATION
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

LIMITING NUTRIENTS
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

LIMNOLOGY
Theory of Ecological Prediction of Limnetic Ecosytems,
W82-00597 6G

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

LINDANE
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

LININGS
Succeeding with Liner Installation,
W82-00909 8G

LINURON
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

LIQUID CHROMATOGRAPHY
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

LITERATURE REVIEWS
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

LITTER
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

LITTORAL ZONE
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

LOGGING
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

LOGGING (RECORDING)
Hydrogeological and Geophysical Logging.
W82-00511 7B

LONG ISLAND SOUND
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

LONG LAKE
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

LONG-TERM PLANNING
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

LOTIC ENVIRONMENT
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

LOTIC PERIPHYTON
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

LOUISIANA
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 7C

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

LOW FLOW
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

MACROINVERTEBRATES
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

MACROPHYTES
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

MAGNESIUM
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

MAINE
Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

MAINTENANCE COSTS
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

MANAGEMENT
Management Provoked Conflict in Fisheries,
W82-00780 6A

MANAGEMENT PLANNING
Management Training is the Key to Good Operator Performance,
W82-00623 5D

Answers: A Model for Watershed Planning,
W82-00898 6A

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

MANGANESE DIOXIDE
Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

MANITOBA
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

MANURE
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

MAPS
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

MARINE
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

MARINE SEDIMENTS
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

MARSH PLANTS
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

MARSHES
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

MARYLAND
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

MASS SPECTROMETRY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00836 5A

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

MATHEMATICAL MODELS
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

Overland Flow on a Diverging Surface,
W82-00986 2A

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

MATHEMATICAL STUDIES
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

MEASUREMENT TECHNIQUES
Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

MEASURING INSTRUMENTS
Hydrogeological and Geophysical Logging.
W82-00511 7B

Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

Identification of Organic Compounds,
W82-00635 5A

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

MEMBRANE FILTERS
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

MERCURY
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

MESOTROPHIC LAKES
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

METABOLISM
Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

METAL-FINISHING WASTES
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

METALS
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

METEOROLOGICAL DATA COLLECTION
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

METHANE
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

METHYLATION
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

METHYLMERCURY
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

METROPOLITAN WATER MANAGEMENT
Distribution System Liability,
W82-01028 5F

MICHIGAN
A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Ferric Chloride Takes Over,
W82-00954 5F

MICROBIAL DEGRADATION
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

MICROBIAL STUDIES
Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

MICROBIOLOGICAL STUDIES
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

MICROSCOPIC ANALYSIS
Interim Method for Determining Asbestos in Water,
W82-00741 5A

MICROSCOPY
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

MID-ATLANTIC STATES
Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

MIDGES
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

MIDWESTERN STATES
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

MIGRATION
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

MINE DRAINAGE
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

MINERAL INDUSTRY
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

MINING ENGINEERING
Reliability of Underground Flood Control System,
W82-00556 8A

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

MINNESOTA
Empire Controlled by Computer,
W82-00529 5D

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

MISSISSIPPI DELTA
Sediment Yield from a Flatland Watershed,
W82-00941 2J

MISSISSIPPI RIVER
Sediment Yield from a Flatland Watershed,
W82-00941 2J

MISSOURI
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

MITA HILLS DAM
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

MOBILE
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

MODEL STUDIES
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

Identification of Streamflow Stochastic Models,
W82-00555 2A

Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

Phosphate Models, a Gap to Bridge,
W82-00929 2H

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

Effectiveness of River Models,
W82-00961 6A

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

Simulation Modeling of Primary Clarifiers,
W82-01027 6A

Groundwater Quality Models - State of the Art,
W82-01061 5G

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

MOISTURE AVAILABILITY
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

MOLLUSKS
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

MOLYBDENUM
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

MONITORING
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

MONOCHLORAMINES
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

MONOSACCHARIDES
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

MONTANA
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

MORTALITY
Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan,
W82-01079 5C

MOSSES
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

MT. ST. HELENS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

MUD FLATS
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

MUDFLOWS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

MULCHING
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

MULTI-OBJECTIVE PLANNING
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

MULTIOBJECTIVE PLANNING
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

MUNICIPAL WASTEWATER
Midwestern Wastewater Characteristics,
W82-00534 5D

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

MUNICIPAL WATER
Distribution System Liability,
W82-01028 5F

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

MUNITIONS WASTES
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

MUTAGENESIS
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

NASSAU COUNTY
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

NATIONAL PARKS
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

NATURAL FLOW
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

NATURAL WATERS
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

NAVAJO GENERATING STATION
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

NAVIGATION
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

NEGOTIATIONS
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

NEMATODES
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

NETHERLANDS
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

NEUTRALIZATION
Reviving Acidified Lakes,
W82-00933 2H

NEW HAMPSHIRE
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

NEW JERSEY
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Composting Is Working in Camden,
W82-00948 5E

NEW MEXICO
Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

NEW YORK
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Groundwater Problems and Needs in New York,
W82-01055 4B

NEW ZEALAND
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

NICKEL
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

NIGERIA
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

NITRAPYRIN
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

NITRATES
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

NITRIC ACID
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

NITRIFICATION
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

NITROGEN
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

NITROGEN COMPOUNDS
Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

NITROGEN FIXATION
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

NITROSAMINES *DIETHANOLAMINE
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

NONBIODEGRADABLE WASTES
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

NONLINEAR PROGRAMMING
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

NONPOINT POLLUTION SOURCES
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

Water Quality Management in River Basins: US National Experience,
W82-00800 6E

Answers: A Model for Watershed Planning,
W82-00898 6A

NORTH CAROLINA
The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

Groundwater Problems in North Carolina,
W82-01056 4B

NORTH DAKOTA
Watertable Management Saves Water and Energy,
W82-00943 3F

NORTH FORK STANISLAUS RIVER
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

NORTH INLET
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

NORWICH
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

NOVA SCOTIA
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

NUCLEAR POWERPLANTS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

NUMERICAL ANALYSIS
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

NUTRIENTS
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

Phosphorus, Nitrogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

ODOR CONTROL
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

ODOR REMOVAL
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

ODORS
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

OHIO
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

OHIO RIVER BASIN
Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

OIL
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

OIL INDUSTRY
Mixing Technology Reduces Energy Use,
W82-00634 5D

Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

OIL POLLUTION
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

System for Oil and Water Separation,
W82-00611 5D

OIL SHALE
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

OKEFENOKEE SWAMP
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

OLDMAN RIVER
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

ONTARIO
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

OPTIMIZATION
The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

ORGANIC COMPOUNDS
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 3A

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

Determining Volatile Organics in Water,
W82-00630 5A

Identification of Organic Compounds,
W82-00635 5A

Removal of Priority Pollutants,
W82-00639 5D

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

ORGANIC MATTER
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

ORGANIC WASTES
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

ORGANIZATIONS
Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

ORGANOPHOSPHORUS COMPOUNDS
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

ORGEON
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

OVERLAND FLOW
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

Overland Flow on a Diverging Surface,
W82-00986 2A

OXIDATION
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

OXIDATION-REDUCTION POTENTIAL
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

OXYGEN DEMAND
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

OXYGEN DEPLETION
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00[illegible]45 2H

OZONATION
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

PAKISTAN
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

PALESTINE LAKE
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

PARAQUAT
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

PARKS
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

PARTICLE SIZE
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

PARTICULATE MATTER
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

PATENTS
Traveling Sprinkler System and Method,
W82-00561 3F

Detoxification of Residual Quaternaries,
W82-00562 5G

System for Oil and Water Separation,
W82-00611 5D

Aquatic Weed Cutting Apparatus,
W82-00624 4A

PATH OF POLLUTANTS
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

Water-To-Air Fractionation of Bacteria,
W82-00575 5B

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

PATHOGENS
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

PEABODY LAKE
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

PENNSYLVANIA
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

PERCOLATING FILTERS
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

PERCOLATION
Soil Percolation Tests,
W82-01044 2G

PERIPHYTON
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

PERU
Modeling Gradual Dam Breaches,
W82-00554 8D

PESTICIDE RESIDUES
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

PESTICIDES
Kepone in the James River,
W82-00631 5B

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

PHENOLIC PESTICIDES
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

PHENOLS
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

PHOSPHATES
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

Phosphate Models, a Gap to Bridge,
W82-00929 2H

PHOSPHATES *LAKES
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

PHOSPHOROUS REMOVAL
Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

PHOSPHORUS
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

PHOSPHORUS COMPOUNDS
Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

PHOSPHORUS REMOVAL
Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

PHOTOGRAPHY
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

PHOTOSYNTHESIS
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

PHYSICAL PROPERTIES
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

PHYSICOCHEMICAL PROPERTIES
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

PHYTOPLANKTON
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

Measurement of Particulates Entrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

Phosphate Models, a Gap to Bridge,
W82-00929 2H

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

PILOT PLANTS
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

PINE ISLAND
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

PIPE FAILURE
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

PIPELINES
A New Look at Design of Raw Water Piping,
W82-01029 8A

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

PIPES
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

PITCHER PLANT
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

PLANKTON
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

PLANNING
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

PLANT GROWTH
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

PLANT GROWTH SUBSTANCES
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

PLANT MORPHOLOGY
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

PLANT POPULATIONS
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

PLANT WATER POTENTIAL
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

PLATINUM
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

POLAND
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

POLICY MAKING
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

POLITICAL ASPECTS
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

POLLEN
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

POLLUTANT IDENTIFICATION
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Determining Volatile Organics in Water,
W82-00630 5A

Identification of Organic Compounds,
W82-00635 5A

Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

POLLUTION CONTROL
Groundwater Strategies,
W82-00620 5G

The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

POLLUTION EFFECTS
State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

POLLUTION LOAD
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

POLYCHLORINATED BIPHENYLS
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

POLYCHLORINATED BYPHENYLS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

POLYMERS
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

PONDS
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

POPULATION DENSITY
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

POPULUS DELTOIDES
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

PORE PRESSURE
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

POROUS MEDIA
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

POTABLE WATER
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

POTENTIOMETRIC LEVEL
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

POTOMAC RIVER
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

POULTRY
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

POWERPLANTS
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

PRECIPITATION
Acid Rain: Facts and Fallacies,
W82-00518 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Sources and Control of Organic Air Pollutants,
W82-00711 5B

A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

PREDATION
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

PREDICTION
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

PREDICTIONS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

PRESSURE-MEASURING INSTRUMENTS
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

PRICING
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

PRIMARY PRODUCTIVITY
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

PROBABLE MAXIMUM PRECIPITATION
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

PRODUCTIVITY
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

PROJECT PLANNING
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

PROTOZOA
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

PUBLIC HEALTH
Environmental Virology and its Problems,
W82-00505 5A

Environmental Health Hazards,
W82-00625 5F

Health Aspects of Urban Water Conservation,
W82-01047 3C

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

PUBLIC PARTICIPATION
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

PUBLIC POLICY
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

PUGET SOUND
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

PULLMAN-MOSCOW BASIN
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

PULP AND PAPER INDUSTRY
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

PULP WASTES
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

PYGMY OAKS
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

QUEBEC
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

RADAR
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

RADIOACTIVE WASTE DISPOSAL
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

RADIOACTIVE WASTES
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

RADIOACTIVITY
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

RAIN
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

RAINFALL
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

RAINFALL DISTRIBUTION
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

RAINFALL IMPACT
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

RAINFALL RATE
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

RAINFALL-RUNOFF RELATIONSHIPS
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

RAINFALL SIMULATORS
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

RECESSION
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

RECHARGE BASINS
Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

RECLAIMED WATER
Recycling Urban Stormwater for Profit,
W82-00524 3C

RECYCLING
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

RED TIDE
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

REEDSWAMP
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

REGIONAL ANALYSIS *GEOHYDROLOGY
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

REGULATIONS
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

Water Quality Management in River Basins: US Nations' Experience,
W82-00863 6E

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

REHABILITATION
Why EPA's I/I Control Program Fails,
W82-00790 8A

REMOTE SENSING
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

REPRESENTATIVE BASINS
Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

RESEARCH PRIORITIES
Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

RESERVOIR CONSTRUCTION
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

RESERVOIR FISHERIES
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

RESERVOIR LININGS
Succeeding with Liner Installation,
W82-00909 8G

RESERVOIR RELEASES
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 6G

RESERVOIRS
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

RESIDUAL CHLORINE
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

RESISTIVITY
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

RESOURCES MANAGEMENT
The Caspian Sea Problem,
W82-00657 4A

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

RESPIRATION
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

RHODE ISLAND
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

RICE
Sizing Rice Irrigation Canals,
W82-00895 3F

RICHARDS BAY
Richards Bay: An Ecological Dilemma,
W82-00679 6A

RIPARIAN RIGHTS
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

RIVER BASIN
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

RIVER BASIN DEVELOPMENT
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

RIVER BASINS
Water Quality Management in River Basins: US National Experience,
W82-00800 6E

RIVER BEDS
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

RIVERS
Kepone in the James River,
W82-00631 5B

The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

A Comparison of Rainfall-Runoff Models,
W82-00911 2A

Effectiveness of River Models,
W82-00961 6A

ROOT DEVELOPMENT
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

ROOT ZONE
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

ROOTED AQUATIC PLANTS
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

RUHR RIVER
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

RUNOFF
Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

RUNOFF FORECASTING
Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

SAGINAW BAY
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

SALINE-FRESHWATER INTERFACES
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

SALINE WATER
Saline Irrigation Water,
W82-00512 3F

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

SALINITY
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

The Azov Sea Problem,
W82-00651 6G

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

Dryland Management for Salinity Control,
W82-01018 2G

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SALMON
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

SALMONELLA
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

SALT BALANCE
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

SALT MARSHES
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

SALTS
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

SAMPLING
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

SAN JOAQUIN RIVER
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

SAND
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

SAPROBIC INDEX
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

SASKATCHEWAN
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

SATELLITE TECHNOLOGY
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

SAVANNAH RIVER IMPOUNDMENTS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

SAW MILLS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

SCALLOPS
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

SCOTLAND
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

SEA ICE
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

SEA WALLS
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

SEASONAL DISTRIBUTION
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

SEASONAL VARIATION
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

SEATTLE
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

SEAWATER
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 5A

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

SECONDARY PRODUCTIVITY
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

SECONDARY WASTEWATER TREATMENT
An Alternative Wastewater Disinfectant,
W82-00950 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

SEDIMENT SAMPLER
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

SEDIMENT TRANSPORT
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

SEDIMENTATION
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

Sediment Yield from a Flatland Watershed,
W82-00941 2J

SEDIMENTATION BASINS
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

SEDIMENTOLOGY
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

SEDIMENTS
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 2J

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

SEEPAGE
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

SEEPAGE CONTROL
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SELENIUM
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

SEMIARID LANDS
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

SENSITIVITY ANALYSIS
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

SEPARATION TECHNIQUES
System for Oil and Water Separation,
W82-00611 5D

Superseparation: Soret Effect Reversed,
W82-00791 3A

SEPTIC TANKS
Mutlichamber Septic Tanks,
W82-00969 5D

SESTON
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

SEWAGE BACTERIA
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

SEWAGE EFFLUENT
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

SEWER SYSTEMS
Pressure Sewer Systems,
W82-00528 5D

Why EPA's I/I Control Program Fails,
W82-00790 8A

SHALLOW WATER
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

SHELLFISH
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

SIERRA NEVADA
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

SILTING
Sedimentological and Biological Changes in the Windsor Mudflat, *an Area of Induced Siltation,*
W82-00548 5C

Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

SIMULATED RAINFALL
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

SIMULATION ANALYSIS
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

SLOPE DEGRADATION
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

SLUDGE
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Control Systems for Return and Waste Sludge,
W82-00949 5D

Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

SLUDGE ASH
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

SLUDGE CONDITIONING
Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

SLUDGE DISPOSAL
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Composting Is Working in Camden,
W82-00948 5E

Trenching of Digested Sludge,
W82-00974 5E

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

Chemicals Disinfect Sludge,
W82-01003 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

SLUDGE DRYING
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 5E

SLUDGES
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

SNAKE RIVER PLAIN
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

SNOWMELT
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

The Effects of Surface Dust on Snowmelt Rates,
W82-00845 2C

SNOWPACK
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

SOCIAL ASPECTS
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Management Provoked Conflict in Fisheries,
W82-00780 6A

SODIUM
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

SOIL CHEMISTRY
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

SOIL COLUMNS
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

SOIL COMPACTION
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

SOIL CONSERVATION
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00669 4D

SOIL DISPOSAL FIELDS
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

SOIL EROSION
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

Sediment Sizes Eroded from Crop Row Sidelopes,
W82-00903 2J

SOIL MECHANICS
Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

SOIL MOISTURE
Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

SOIL MOISTURE RETENTION
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

SOIL PROPERTIES

A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

Soil Percolation Tests,
W82-01044 2G

SOIL TYPES

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

SOIL WATER

Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

Soil Percolation Tests,
W82-01044 2G

SOIL-WATER-PLANT RELATIONSHIPS

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

SOIL WATER POTENTIAL

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

SOLUTE TRANSPORT

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

Transport of Salts in Soils and Subsoils,
W82-00930 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

SOLVENTS

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

SORGHUM

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

SORPTION

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

SOUTH AFRICA

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

The Cape Flats Sewage Treatment Works,
W82-00957 5D

SOUTH CAROLINA

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

SPAIN

The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

SPARTINA

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

SPATIAL DISTRIBUTION

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

SPAWNING

Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

SPECIES COMPOSITION

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

SPECIES DIVERSITY

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

SPECTROPHOTOMETRY

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

SPRINKLER IRRIGATION

Saline Irrigation Water.
W82-00512 3F

Traveling Sprinkler System and Method,
W82-00561 3F

SPRUCE KNOB LAKE

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

STABILITY ANALYSIS

Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

STABILIZATION LAGOONS

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

STANDARDS

European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

STANDING CROPS
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

STATE JURISDICTION
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

STATISTICAL ANALYSIS
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

STEPPES
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

STILLING BASINS
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

STOCHASTIC PROCESSES
Identification of Streamflow Stochastic Models,
W82-00555 2A

STOMATAL TRANSPIRATION
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

STORAGE COEFFICIENT
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

STORAGE TANKS
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

STORM RUNOFF
Recycling Urban Stormwater for Profit,
W82-00524 3C

STORM WATER
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

STORMS
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

STREAM DEGRADATION
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

STREAM POLLUTION
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

STREAM POLLUTION INDEX
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

STREAMFLOW
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

STREAMFLOW DEPLETION
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

STREAMFLOW FORECASTING
Identification of Streamflow Stochastic Models,
W82-00555 2A

A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

STREAMS
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

STREETER-PHELPS EQUATION
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

STRIP MINE WASTES
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

SUBLETHAL EFFECTS
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

SUBMERSIBLE PUMPS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

SUBSIDENCE
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

SUBSTRATES
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

SUBSURFACE DRAINAGE
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

SUDAN
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

SUGARCANE
Water Requirement for Sugarcane Production,
W82-00899 3F

SULFATES
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

SULFUR
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

SULFUR COMPOUNDS
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

SULFURIC ACID
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

SUPPLEMENTAL IRRIGATION
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

SURFACE-GROUNDWATER RELATIONS
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

SURFACE RUNOFF
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

SURFACE WATER
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00835 5A

SURFACTANTS
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

SUSPENDED SEDIMENTS
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

SUSPENDED SOLIDS
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

SWAMPS
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

SWEDEN
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

Reviving Acidified Lakes,
W82-00933 2H

SWIMMING POOLS
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 5B

TAMPA BAY REGION
Tampa Bay Water Guarded by Computer,
W82-00934 4B

TANNERY WASTES
Chemical Treatment Solves Tannery Waste Problems,
W82-00638 5D

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

TECHNOLOGY
Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

TEMPERATURE
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

TEMPERATURE CONTROL
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

TEMPERATURE EFFECTS
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 5C

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

TENNESSEE
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

TENNESSEE-TOMBIGBEE WATERWAY
The Waterway That Cannot be Stopped,
W82-00510 6E

TERBUTRYN
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

TETRAALKYLEAD COMPOUNDS
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

TEXAS
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00804 7B

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

Effects of Water Quality on Forage Production,
W82-01002 3C

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

TEXTILE MILL WASTES
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

THERMAL POLLUTION
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

THERMAL WATER
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

THERMOCOUPLES
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

THOREU'S BOG
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

THUNDERSTORMS
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

TIDAL EFFECTS
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

TIDAL MARSHES
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

TIDAL POWERPLANTS
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

TILE DRAINAGE
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

TIN
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

TIN COMPOUNDS
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

TISSUE ANALYSIS
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

TOMATOES
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

TONGUE RIVER RESERVOIR
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

TOXICITY
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

TOXINS
Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

TRACE ELEMENTS
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

TRACE LEVELS
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

TRACE METALS
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

TRACERS
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

TRACTIVE FORCES
Tractive Force Design of Vegetated Channels,
W82-00901 4D

TRAINING
Management Training is the Key to Good Operator Performance,
W82-00623 5D

TRANSMISSIVITY
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

TRANSPIRATION
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

TRAP EFFICIENCY
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

TRAVERSE CITY
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

TRAWLING
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

TREES
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

TRENCHES
Trenching of Digested Sludge,
W82-00974 5E

TRICKLE IRRIGATION
Laser Drip Irrigation.
W82-00771 3F

TRIHALOMETHANES *CHLORINATION
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

TRITIUM
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

TROPHIC LEVEL
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

TROPICAL CYCLONES
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

TROPICAL REGIONS
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

TROUT
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 5C

TUNDRA
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

TURBIDITY
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

Low Turbidity Water from Fast Processes,
W82-00946 5F

Ferric Chloride Takes Over,
W82-00954 5F

ULTRAFILTRATION
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

UNITED KINGDOM
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

UNITED STATES
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

UNSATURATED FLOW
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

UPTAKE
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

URANIUM
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

URBAN HYDROLOGY
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

URBAN RUNOFF
Recycling Urban Stormwater for Profit,
W82-00524 3C

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

URBAN WATERSHEDS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

USSR
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

UTAH
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

UTILITIES
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

Distribution System Liability,
W82-01028 5F

VACUUM FILTRATION
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

VEGETABLE CROPS
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

VEGETATION
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

VEGETATION EFFECTS
Tractive Force Design of Vegetated Channels,
W82-00901 4D

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

VIBRIO
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

VIRGINA
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

VIRGINIA
Kepone in the James River,
W82-00631 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

VIRUSES
Environmental Virology and its Problems,
W82-00505 5A

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

VOLATILITY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

VOLCANOES
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 4D

VOLUMETRIC ANALYSIS
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

WASHINGTON
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes.
W82-01072 2H

WASTE CHARACTERISTICS
Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5L

WASTE DISPOSAL
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

Illinois Groundwater Problems and Needs,
W82-01052 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

WASTE DUMPS
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

WASTE HEAT
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

WASTE IDENTIFICATION
Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

WASTE MANAGEMENT
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

WASTE WATER
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

WASTE WATER DISPOSAL
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 5C

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

WASTEWATER
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

Thames Rears Carp in Sewage.
W82-00681 3C

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

WASTEWATER ANALYSIS
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

WASTEWATER COLLECTION
Pressure Sewer Systems,
W82-00528 5D

WASTEWATER COMPOSITION
Midwestern Wastewater Characteristics,
W82-00534 5D

WASTEWATER DILUTION
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

WASTEWATER DISPOSAL
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

WASTEWATER FACILITIES
Management Training is the Key to Good Operator Performance,
W82-00623 5D

Low-Cost Wastewater Treatment,
W82-00841 5D

The Cape Flats Sewage Treatment Works,
W82-00957 5D

Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

WASTEWATER FARMING
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

WASTEWATER IRRIGATION
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

2,500 Acres of Wastewater Irrigation,
W82-00769 3C

WASTEWATER MANAGEMENT
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

WASTEWATER PLANT OPERATORS
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

WASTEWATER POLLUTION
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

WASTEWATER RENOVATION
Environmental Effects of Water Reuse Scheme,
W82-00973 3C

Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

WASTEWATER TREATMENT
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 5E

Empire Controlled by Computer,
W82-00529 5D

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

Cold Weather Waste Treatment,
W82-00636 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

Chemical Treatment Solves Tannery Waste Problems,
W82-00638 5D

Removal of Priority Pollutants,
W82-00639 5D

Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 5D

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

Purification of Wastewater by Electrolysis,
W82-00847 5D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

Facts Fix Fund Finding.
W82-00885 9A

Separation of Selenium from Sulfide Leach Liquors,
W82-00903 5D

Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

Control Systems for Return and Waste Sludge,
W82-00949 5D

Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 5D

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

Chemicals Disinfect Sludge,
W82-01003 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

Simulation Modeling of Primary Clarifiers,
W82-01027 6A

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

WASTEWATER TREATMENT FACILITIES
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

WATER
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

WATER ALLOCATION
The Azov Sea Problem,
W82-00651 6G

Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

WATER ANALYSIS
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

Interim Method for Determining Asbestos in Water,
W82-00741 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

WATER CIRCULATION
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

WATER CONSERVATION
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

WATER DEMAND
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Tampa Bay Water Guarded by Computer,
W82-00934 4B

Health Aspects of Urban Water Conservation,
W82-01047 3C

WATER DEPTH
Depths of Flow in Level Basins,
W82-00900 3F

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

WATER LAW
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

WATER LEVEL
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

WATER LOSS
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

WATER MAINS
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

WATER MANAGEMENT
The Azov Sea Problem,
W82-00651 6G

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

WATER POLICY

Arkansas Water Policy.
W82-00715 6D

Potential Political Influences Affecting the Water Industry,
W82-00861 6C

WATER POLLUTION

Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

WATER POLLUTION CONTROL

The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

WATER POLLUTION EFFECTS

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

WATER POLLUTION SOURCES

Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

WATER POLLUTION TREATMENT

System for Oil and Water Separation,
W82-00611 5D

WATER POTENTIALS

The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

WATER PURIFICATION

The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

WATER QUALITY

Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 5C

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

Effectiveness of River Models,
W82-00961 6A

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

WATER QUALITY ASSOCIATION

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

WATER QUALITY CONTROL

European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

Water Quality Management in River Basins: US National Experience,
W82-00800 6E

Water Movement for Water Quality in Catfish Production,
W82-00866 5G

Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

WATER QUALITY MANAGEMENT

Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

Great Lakes International Surveillance Plan,
W82-00701 6E

Dryland Management for Salinity Control,
W82-01018 2G

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

WATER QUALITY STANDARDS

Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

Great Lakes International Surveillance Plan,
W82-00701 6E

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

WATER RATES

Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

WATER RECLAMATION

Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

WATER RECOVERY

Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

WATER REQUIREMENTS

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Water Requirement for Sugarcane Production,
W82-00899 3F

WATER RESOURCES DEVELOPMENT

Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

The Caspian Sea Problem,
W82-00657 4A

Richards Bay: An Ecological Dilemma,
W82-00679 6A

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

Arkansas Water Policy.
W82-00715 6D

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

Tampa Bay Water Guarded by Computer,
W82-00934 4B

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

WATER RESOURCES MANAGEMENT

Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

WATER REUSE

Recycling Urban Stormwater for Profit,
W82-00524 3C

The Cape Flats Sewage Treatment Works,
W82-00957 5D

Environmental Effects of Water Reuse Scheme,
W82-00973 3C

Health Aspects of Urban Water Conservation,
W82-01047 3C

WATER RIGHTS

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

WATER SAMPLING

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

Sampling Ground Water for Organic Contaminants,
W82-00820 5A

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

WATER SOFTENING

Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

WATER STORAGE

Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

WATER STRESS

Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

WATER SUPPLY

Environmental Virology and its Problems,
W82-00505 5A

Water-Treatment Chemicals,
W82-00618 5F

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

WATER SUPPLY DEVELOPMENT

Long Distance Mass Transfer of Water,
W82-00858 6D

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

WATER TABLE

The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

Watertable Management Saves Water and Energy,
W82-00943 3F

WATER TANKS

Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

WATER TRANSFER

Long Distance Mass Transfer of Water,
W82-00858 6D

WATER TRANSPORT

The Waterway That Cannot be Stopped,
W82-00510 6E

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

Long Distance Mass Transfer of Water,
W82-00858 6D

WATER TREATMENT

Detoxification of Residual Quaternaries,
W82-00562 5G

Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

Water-Treatment Chemicals,
W82-00618 5F

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Facts Fix Fund Finding,
W82-00885 9A

Low Turbidity Water from Fast Processes,
W82-00946 5F

Removing Trihalomethanes from Drinking Water,
W82-00953 5F

Ferric Chloride Takes Over,
W82-00954 5F

Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

WATER TREATMENT FACILITIES
Foam Control in Aeration Tanks,
W82-00525 5D

Empire Controlled by Computer,
W82-00529 5D

Mixing Technology Reduces Energy Use,
W82-00634 5D

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

WATER USE
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 6D

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

WATER USE EFFICIENCY
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

WATER VAPOR
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

WATERSHED MANAGEMENT
Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Answers: A Model for Watershed Planning,
W82-00898 6A

WATERSHEDS
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

WEATHER FORECASTING
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

WEATHER MODIFICATION
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

WEED CONTROL
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

WELL WATER
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

WELLS
Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

WEST POINT RESERVOIR
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

WEST VIRGINIA
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

Ground Water Problems in West Virginia,
W82-01060 4B

WETLANDS
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

WHEAT
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

WILCOX-CARRIZO AQUIFER
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 7C

WILDLIFE REFUGES
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

WILSON CREEK
Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979,
W82-01069 5B

WISCONSIN
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

WOOD WASTES
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

YUCATAN PENINSULA
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

ZEOLITES
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

ZINC
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ZOOPLANKTON
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

[illegible]
W82-00[illegible]

WILDLIFE REFUGES
Addressing Oil and Gas Activities in [illegible] Refuge, [illegible]
W82-00[illegible]

WILSON CREEK
[illegible]
W82-00[illegible]

WISCONSIN
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

ZOOPLANKTON
Assessment of Thermal Discharge on Zooplankton in [illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

Approach. A Model for Watershed Planning.
W82-00[illegible]

[illegible]
Simulation of Lake [illegible]
W82-00[illegible]

Simulation of Lake [illegible] Application to [illegible] Lake, Alberta, Canada.
W82-00[illegible]

[illegible] Budget Models for Prediction of [illegible] in [illegible]
W82-00[illegible]

WEATHER FORECASTING
[illegible]
W82-00[illegible]

WEATHER MODIFICATION
[illegible] Experiments in Wind [illegible]
W82-00[illegible]

WEED CONTROL
Control of [illegible] Weeds [illegible]
W82-00[illegible]

WELL WATER
A Study of [illegible] of Well Water [illegible]
W82-00[illegible]

[illegible]
Well Field [illegible]
W82-00[illegible]

WEST BRANCH [illegible]
[illegible]
W82-00[illegible]

WEST VIRGINIA
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00[illegible]

The Use of Algal Assays and [illegible] in Determining [illegible] of Water in Small Impoundments in West Virginia.
W82-00[illegible]

Hydrological Analysis of the [illegible] in West Virginia.
W82-00[illegible]

Ground Water Problems in West Virginia.
W82-00[illegible]

WETLANDS
The Changing Status of Coastlands in the New [illegible]
W82-00[illegible]

Quantitative Assessment of Tidal Wetlands Using Remote Sensing.
W82-00[illegible]

Federal Participation in Land Use Decision-Making at the Water's Edge—Floodplains and Wetlands.
W82-00[illegible]

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments.
W82-00[illegible]

[illegible]
W82-00[illegible]

Water Treatment Chemicals.
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

Removal of Nitrate from Public Water Supply.
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

[illegible]
W82-00[illegible]

WATER TREATMENT FACILITIES
[illegible]
W82-00[illegible]

[illegible] Controlled by Computer.
W82-00[illegible]

[illegible]
W82-00[illegible]

Design and Construction of [illegible] Water Processing Plant.
W82-00[illegible]

WATER USE
Water - Its Use and the [illegible] in Agriculture.
W82-00[illegible]

Proposed Water Quality Controls [illegible] of the [illegible] Colorado River Basin.
W82-00[illegible]

[illegible] Water Use and [illegible] to the Second National Water Assessment.
W82-00[illegible]

WATER USE EFFICIENCY
Yield and Water Use of Vegetable Crops with [illegible]
W82-00[illegible]

WATER VAPOR
[illegible] Stability of Water Over [illegible]
W82-00[illegible]

WATERSHED MANAGEMENT
[illegible]
W82-00[illegible]

AUTHOR INDEX

ABDEL-MALIK, W. E.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

ABDOU, F. M.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

ABE, J. M.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

ACHER, A. J.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

ADAMOWSKI, K.
Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

ADAMS, B. J.
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

ADAMS, T. G.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ADAMS, W. J.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

ADLER, R. F.
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

AGIRALIOGLU, N.
Overland Flow on a Diverging Surface,
W82-00986 2A

AGTHE, D. E.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

AIKEN, H. V.
Tampa Bay Water Guarded by Computer,
W82-00934 4B

ALARIE, R. L.
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

ALAWI, B. J.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

ALBEN, K.
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 5B

ALBRECHT, S. L.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

ALBRIGHT, L. J.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

ALESII, B. A.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

ALEXANDER, M.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

ALLEN, H. E.
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

ALLEN, J. L.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

ALONSO, J. M.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

AMAVIS, R.
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

AMEL, R. T.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

AMY, G. L.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

ANAND REDDY, K.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

ANDERSON, C. H.
Interim Method for Determining Asbestos in Water,
W82-00741 5A

ANDERSON, J. A.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

ANDERSON, M. P.
Groundwater Quality Models - State of the Art,
W82-01061 5G

ANDERSON, R. Y.
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

ANDERSON, T. J.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

ANDRASKI, B.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

ANEJA, V. P.
Influence of Gaseous Nitric Acid on Sulfate Production and Acility in Rain,
W82-00642 5B

ANNANDALE, G. W.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00679 8D

APLAND, J.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

ARMSTRONG, J. L.
Antibiotic-Resistent Bacteria in Drinking Water,
W82-00645 5F

ARMSTRONG, R. N.
Tampa Bay Water Guarded by Computer,
W82-00934 4B

ARNOTT, E.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

ASHLEY, C. S.
Effecs of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

ATCHISON, G. J.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

ATHERTON, T. AND
Low Turbidity Water from Fast Processes,
W82-00946 5F

AUGUSTINE, J. A.
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

AVNIMELECH, Y.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

BABA, M.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

BABALOLA, O.
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 2I

BACK, W.
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

BAILEY, G. C.
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

BAIN, W. S.
A New Look at Design of Raw Water Piping,
W82-01029 8A

BAIR, E. S.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

BAKER, S. J.
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

BANNING, D.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

BARICA, J.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

BARKO, J. W.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

BARLTROP, J.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

BARQUET, A.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

BARROW, E. T.
Sources and Control of Organic Air Pollutants,
W82-00711 5B

BARTELL, S. M.
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

BARTLETT, D. S.
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

BATES, T.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

BATLEY, G. E.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

BAUGHMAN, G. L.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

BAUMGARDNER, R. W.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

BAXTER, M. S.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

BAZZAZ, F. A.
Photosynthesis and Growth in Populations of Populus Deltoides from Contrasting Habitats,
W82-00935 2I

BEALL, M. L. JR.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00548 5B

BEAR, J.
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

BEASLEY, D. B.
Answers: A Model for Watershed Planning,
W82-00898 6A

BECKER, R. M.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

BEECH, J. A.
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 5B

BEGG, J. E.
Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

BELL, F. C.
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

BELL, J. B.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

BELLUCK, D.
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

BELYAKOVA, O. V.
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

BENDER, M. E.
Kepone in the James River,
W82-00631 5B

BENFIELD, E. F.
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

BENGERT, G. A.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

BENNETT, J. M.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

BENOIT, F. M.
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

BENZ, L. C.
Watertable Management Saves Water and Energy,
W82-00943 3F

BERG, G.
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

BERGATINO, R. N.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

BERGER, J.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

BERGERON, M. P.
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

BERMAN, D.
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

BERMAN, S. S.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

BERMAN, T.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

BERNHARDT, J. C.
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

BERSELL, P. O.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

BEST, B. R.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

BESZEDITS, S.
Feeding Animals Activated Sludge,
W82-00523 5D

BHAT, RAMA S.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

BIGGS, D. C.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

BILLINGS, R. B.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

BILYJ, B.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

BIRCH, R. B.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

BISHOP, C. S.
Health Aspects of Urban Water Conservation,
W82-01047 3C

BISHOP, D. F.
Toxics in Municipal and Industrial Wastewaters,
W82-00712 5A

BISWAS, A. K.
Long Distance Mass Transfer of Water,
W82-00858 6D

BITONDO, M.
Cold Weather Waste Treatment,
W82-00636 5D

BLACK, A. L.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

BLACK, J. H.
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

BLAIR, J. F.
2,500 Acres of Wastewater Irrigation,
W82-00769 3C

BLENCH, T.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00681 2J

BLEVINS, R. D.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

BLIGHT, G. E.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

BLINN, D. W.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

BLOCK, J. C.
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

BLOMQVIST, S.
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

BLOYD, R. M.
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

BLUM, A.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

BOESEL, M. W.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

BOGARDI, I.
Reliability of Underground Flood Control System,
W82-00556 8A

BONNET, L.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

BOONE, D. R.
Formulating Alternatives for Environmental Studies,
W82-00997 6G

BOORMAN, L. A.
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

BORENZSTAJN-ROTEM, Y.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

BORGMANN, U.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

BOTHWELL, M. L.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

BOTTCHER, A. B.
Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

BOURQUE, H.
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

BOWEN, R.
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

BOWER, R. F.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

BOWERS, S. A.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

BOWERSOX, V. C.
Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

BOWMAN, C. F.
A New Look at Design of Raw Water Piping,
W82-01029 8A

BOYD, C. E.
Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

BOYLE, M. V.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

BOYLE, V. J.
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

BOYLE, W. H.
Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

BOYLEN, C. W.
Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

BRAND, J. G.
The Cape Flats Sewage Treatment Works,
W82-00957 5D

BRAULT, J.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

BRAY, E. A.
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

BREEN, C. M.
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

BRENNIMAN, G. R.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

BRESLER, E.
Transport of Salts in Soils and Subsoils,
W82-00930 5B

BRISBIN, T. D.
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

BROADHEAD, R.
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 2F

BROWN, L. H.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

BROWN, P. L.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

BRUGAM, R. B.
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

BRUSH, G. S.
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

BUBENZER, G. D.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

BUCHANAN, D. W.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

BUCHANAN, T. J.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

BUNKER, T. J.
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 5E

BURKE, J. C.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

BURNS, G. D.
Identification of Organic Compounds,
W82-00635 5A

BURNS, S.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

BURRINI, D.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

BUSCH, C. D.
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

BUTTERY, B. R.
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

BUTTY, M.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

CAIRNS, J. JR.
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

CAIRNS JR, J.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

CALABRESE, E. J.
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

CALOMIRIS, J. J.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

CALVO, C.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

CALZONETTI, F. J.
Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

CAMERON, A. J.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

CANTERAS, J. C.
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

CANTON, R. B.
Sources and Control of Organic Air Pollutants,
W82-00711 5B

CAREY, G. F.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

CAREY, V. P.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

CARLE, F. L.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

CARNEY, J. H.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

CARPENTER, R. A.
Using Ecological Knowledge for Development Planning,
W82-00671 6A

CARREIRA, L. A.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

CARRONDO, M. J. T.
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

CARSWELL, W. J. JR.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

CARTER, M. J.
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

CECH, I.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

CHANDLER, D. S.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00586 5B

CHANG, H-M.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

CHARBENEAU, R. J.
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

CHATT, A.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

CHATTOPADHYAY, G. N.
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

CHAU, Y. K.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

CHENEY, M. C.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

CHIN, E. H.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

CHRISTIANSEN, C.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

CHRZANOWSKI, T. H.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

CHU, R. L.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

CLAPP, C. E.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

CLARK, C. W.
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

CLARK, R. M.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

CLARKE, R. T.
Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

CLEMMENS, A. J.
Depths of Flow in Level Basins,
W82-00900 3F

COBET, A. B.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

CODY, H. M.
New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 5D

COGLEY, D. R.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

COLEMAN, W. M. III.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

COLLETT, L. C.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

COLLINS, A. J.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

CONTRERAS, S.
Purification of Wastewater by Electrolysis,
W82-00847 5D

COOPER, C.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

CORAPCIOGLU, M. Y.
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 2F

COREY, J. E.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

CORNELISSE, A.
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

COSBY, R.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

COUBROUGH, P.
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

COVE, R.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

CRAMER, D.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

CRAUN, G. F.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

CRAVEN, J. A.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organ-

isms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

CROSBY, J. W. III.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00909 5B

CROWE, A. S.
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

CROZIER, M. J.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

CRUZ, R. B.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

CSANADY, G. T.
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

CSIZINSZKY, A. A.
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

CURRAN, D. J.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

CUSICK, W.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

DACRE, J. C.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

DAKSHANAMURTHY, V.
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

DAN, J.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

DANIEL, R. R.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

DANIEL, T. C.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

DARVILLE, R. G.
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

DARZI, M.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

DAVE, M.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

DAVIES, E.
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

DAVIES, F. S.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

DAVIES, W. D.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

DAVIS, C. B.
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

DAVIS, J.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

DAWSON, V. K.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

DAY JR, J. W.
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

DE LAUNE, R. D.
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

DE PENA, R. G.
Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

DECOSTA, J.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

DEFRIES, R. S.
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 2L

DELAUNE, R. D.
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

DENICH, K.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

DERENZO, D. R.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

DESAULNIERS, J. A. H.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

DEVENDER REDDY, M.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

DEVINNY, J. S.
Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

DEXTER, F.
Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

DI PERNA, J.
System for Oil and Water Separation,
W82-00511 5D

DIACHENKO, G. W.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

DICKEY, E. C.
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

DICKSON, G. W.
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

DIJULIO, D. H.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

DINNEL, P. A.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

DOLARA, P.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

DOLSKE, D.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

DONOVAN, J. J.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

DORING, E. J.
Watertable Management Saves Water and Energy,
W82-00943 3F

DRAKE, C. M.
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

DRAKE, J. J.
The Effects of Surface Dust on Snowmelt Rates,
W82-00845 2C

DUCKSTEIN, L.
Reliability of Underground Flood Control System,
W82-00556 8A

DUNCAN, S. W.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

DUNLAP, W. J.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

DURHAM, J. L.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

DURKIN, P.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

DUSSART, G.
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00834 2K

DUTKA, B. J.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

DUVAL, R. L.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

DYE, C. W.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

DYER, T. G. J.
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

EASTBURN, R. P.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

EATON, D.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

EATOUGH, D. J.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

EBERZ, P. G.
Ferric Chloride Takes Over,
W82-00954 5F

ECHERT, J. M.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

ECKHOFF, P. A.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

EDMONDSON, W. T.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

EICKMEIER, W. G.
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

EISENREICH, J. J.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

EL-NENNAH, M.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

EL-SHINAWY, R. M. K.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

ELKINS, J. W.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

ELLIOT, G. E.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

ELLIOTT, J. M.
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

ELORANTA, P.
Annual Succession of Phytoplankton in One Hestaä Pond in Central Finland,
W82-00673 5C

ENGLISH, M. J.
The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 3F

ENTZ, R. C.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

EPP, D. J.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

EREMENKO, E. V.
Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

ERSKINE, W. D.
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 2E

EVANS, D. W.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

EVANS, T. M.
Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

EWERT, D. L.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

FAN, C-Y.
Recycling Urban Stormwater for Profit,
W82-00524 3C

FARLEY, D.
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 5C

FARMER, D. M.
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FARMER, J. G.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

FARNUM, P.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

FARQUHAR, G. J.
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

FARRELL, M. P.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

FAUSEY, N. R.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

FELSOT, A.
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

FERRIS, C. R.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

FERRONSKII, V. I.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

FETTER, C. W. JR.
Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

FIELD, R.
Recycling Urban Stormwater for Profit,
W82-00524 3C

FINK, L. K.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

FINLEY, R. J.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

FINN, J. T.
Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1A

FISHER, A.
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

FISK, M. J.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

FITZGERALD, W. F.
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

FLEMING, G. H.
Water Quality Management in River Basins: US National Experience,
W82-00800 6E

FLETCHER, K.S. III.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

FLOOD, C. A. JR.
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

FLORA, C. J.
Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

FLYNN, M. S.
Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

FORTES, M.
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

FRANKOS, N. H.
Trenching of Digested Sludge,
W82-00974 5E

FREDLUND, D. G.
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 2G

FREELAND, H. J.
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

FREIBERG, J. E.
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

FRENCH, R. H.
Effectiveness of River Models,
W82-00961 6A

FRETWELL, J. D.
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

FRITZ, J. S.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

FROST, F.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

FUJIOKA, R. S.
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

FUKSMAN, YA. L.
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

FULLER, R. M.
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 5C

FULLER, W. H.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

FULTON, J. M.
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

FURUTANI, A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

GALE, W. F.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

GALLOWAY, J. N.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

GARBADE, J. M.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

GARDNER, R. H.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

GARVINE, R. W.
Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

GASCHO, G. J.
Water Requirement for Sugarcane Production,
W82-00899 3F

GATZ, D. F.
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

GEARING, J. N.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

GEARING, P. J.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

GEBHART, B.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

GELDREICH, E. E.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

GELLER, G. N.
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

GEMMELL, R. S.
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

GERARDI, M. B.
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

GERARDI, M. H.
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

GERBA, C. P.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

GERNERT, J. L.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

GESSER, H. D.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

GHORBANZADEH, A.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

GHOSH, M. M.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

GHOSH, R. K.
Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

GIANESSI, L. P.
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

GIBBS, K. E.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

GIBBS, P. J.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 5C

GIBSON, J.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

GIBSON, N. A.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

GICHURU, M.
Effects of Water Quality on Forage Production,
W82-01002 3C

GIESY, J. P.
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

GILBERT, B. K.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

GILES, A. H.
Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

GILES, M.
Chemical Treatment Solves Tannery Waste Problems,
W82-00638 5D

GILMOUR, C. M.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

GILMOUR, J. T.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

GJERDE, D. T.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

GLASGOW, D.
Pressure Sewer Systems,
W82-00528 5D

GLEDHILL, W. E.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

GODDEN, G. F.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

GOLTERMAN, H. L.
Phosphate Models, a Gap to Bridge,
W82-00929 2H

GOODIN, J. R.
Effects of Water Quality on Forage Production,
W82-01002 3C

GOSLING, L. M.
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 2K

GOSS, D. W.
Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

GOSS, J.
Low Turbidity Water from Fast Processes,
W82-00946 5F

GOSZ, J. R.
Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 2K

GOWDA, N. M. MADE
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

GOYAL, S. M.
Movement of Endotoxin Through Soil Columns,
W82-00586 5B

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

GOZLAN, G.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

GRABOW, W. O. K.
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

GRANDELL, J.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

GRANT, I. J.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

GRAY, M. J.
Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 5F

GREENE, D. J.
An Alternative Wastewater Disinfectant,
W82-00950 5D

GREENE, L. A.
Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

GREER, J. D.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

GREGORY, R. W.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

GRIFFINI, O.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

GRIFFITH, C. G.
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

GRIFFITHS, J. F.
Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 2B

GRIGG, N. S.
Water Quality Management in River Basins: US National Experience,
W82-00800 6E

GRIZZLE, J. M.
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

GROBLER, D.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

GROBLER, D. C.
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

GRODY, N. C.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

GROVER, K.
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 5A

GRUBER, A.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

GRUBER, D.
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

GUARD, H. E.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

GUDE, H.
Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

GUEVREMONT, R.
Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 5A

GUPTA, V. K.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

GURTZ, M. E.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

GUTER, K. J.
Ferric Chloride Takes Over,
W82-00954 5F

HAAN, C. T.
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

HABICHT, M. H.
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

HAGAN, R. E.
Sizing Rice Irrigation Canals,
W82-00895 3F

HAGGAR, R. J.
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

HAKANSON, L.
On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

HAKE, K. A.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

HALL, R. H.
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

HALLEY, M. A.
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 5B

HALVORSON, A. D.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

HAMALA, J. A.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 7B

HAMBRICK, G. A. III
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

HAMMEL, H. T.
Superseparation: Soret Effect Reversed,
W82-00791 3A

HAMMERTON, D.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

HAMRUD, M.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

HANLON JR, E. A.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

HANSEN, L. D.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

HANSEN, P. D.
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

HANSHAW, B. B.
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

HANYA, T.
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

HARDING, J. P. C.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

HARLO, E. H.
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

HARMON, W. C.
Sediment Sizes Eroded from Crop Row Sidelopes,
W82-00903 2J

HARREL, R. C.
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 5C

HARRIS, G. P.
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

HARSH, J. F.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

HARTMETZ, G.
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

HASTINGS, D.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

HAUTH, L. D.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

HAYES, M. O.
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

HEBBERT, R. H. B.
A Comparison of Rainfall-Runoff Models,
W82-00911 2A

HEEG, J.
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

HEEKMANN, W.
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

HEGARTY, T. W.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

HEIT, M.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

HEJKAL, T. W.
Water-To-Air Fractionation of Bacteria,
W82-00575 5B

HEMOND, H. F.
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 2K

HEMSLEY, J.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

HENDRICKS, A. C.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

HENRIKSEN, K.
Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

HERON, R.
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

HERSHAFT, A.
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

HERSHFIELD, D. M.
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

HESTON, J. F.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

HICKS, O.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

HIJNEN, W. A. M.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

HIKUMA, M.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

HILL, G.
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

HILL, G. E.
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

HILNER, C. A.
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 5A

HINCKLEY, T. M.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

HINDLE, R.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

HINES, A. L.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

HINTERLEITNER, S.
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

HIRSCH, J. H.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

HIRTLE, R. W. M.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

HITES, R. A.
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

HOBBS, E. H.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

HODGES, E.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

HODGSON, M. E.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

HOFFMAN, M. R.
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

HOLMES, B. H.
Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

HOLMES, J. W.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

HOOD, M. A.
Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

HOPCRAFT, J.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

HOPKINS, H. T.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

HOPKINSON JR, C. S.
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 4A

HORNBECK, J. W.
Acid Rain: Facts and Fallacies,
W82-00518 5C

HORTON, J. H.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

HOWORTH, R.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

HSU, C. T.
Multivariate Hydrologic Time Series Analysis,
W82-00647 2A

HUANG, P. M.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

HUBER, J.
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

HUGGETT, R. J.
Kepone in the James River,
W82-00631 5B

HUGGINS, L. F.
Answers: A Model for Watershed Planning,
W82-00898 6A

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

HUNDAL, S. S.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

HUNSINGER, R. B.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

HUNTER, E. J.
Traveling Sprinkler System and Method,
W82-00561 3F

HUTKA, J.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

HUTTON, D. G.
Removal of Priority Pollutants,
W82-00639 5D

ICHIMURA, V. T.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

IDELOVITCH, E.
Environmental Effects of Water Reuse Scheme,
W82-00973 3C

IMHOFF, K. R.
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

INGRAM, R.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

ISRAEL, D. H.
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

ITO, T.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

IVANOVA, L. YU.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

IWUGO, K. O.
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

JACK, W.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

JACKSON, R.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

JACKSON, T.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

JACOB, J. T.
Detoxification of Residual Quaternaries,
W82-00562 5G

JANARDAN, K. G.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

JENKINS, T. F.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

JOBSON, H. E.
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

JOHNSON, M. G.
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

JOHNSTON, R. A.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

JONES, D. A.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

JONES, J. D.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

JONES, J. H.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

JONES, O. R.
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

JONES, R. D.
Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

JORDAN, Y.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

JOSEPH, I.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

JOSEPHSON, J.
Groundwater Strategies,
W82-00620 5G

JOSSELYN, M. N.
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

JURY, W. A.
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

KACZYNSKI, V. W.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

KAISER, D. L.
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

KAJAK, Z.
Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

KALEY, R. G.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

KALINSKE, A. A.
Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 5D

KANE, D. L.
Physical Mechanics of Aufeis Growth,
W82-00836 2C

KARUBE, I.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

KATZENELSON, E.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

KAUFMAN, P. B.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

KAWAGUCHI, H.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

KAY, C.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

KAY, R.
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 2K

KEDMI, S.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

KEELEY, J. W.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

KELLO, D.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

KERSTER, H. W.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

KESLER, D. H.
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 2H

KETCHESON, J. W.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

KHALEEL, R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

KICHENS, W. M.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

KIEFER, J. E.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

KIEFER, R. W.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

KIKICHEV, KH. A.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

KING, G. A.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

KINGSOLVER, J.
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

KIPP, K. L. JR.
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 7B

KIRK, T. K.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 5D

KIRKLAND, D. W.
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 2F

KJERFVE, B.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

KLASSEN, M. J.
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

KLEEN, H.
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

KLEI, H. E.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

KLEMAS, V.
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

KLEPPEL, G. S.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

KLEY, W.
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

KLIBANOV, A. M.
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 5D

KLING, H.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

KLUSEK, C.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

KNOCKE, W. R.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

KNOERR, K. R.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

KNOWLES, G.
The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

KOGIKU, K. C.
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

KOJOLA, W. H.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

KOMAROV, V. D.
Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 2A

KONIKOW, L. F.
Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

KOPP, F. J.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

KOPPE, P.
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 5B

KOYUMDJISKY, H.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

KRAMAR, O.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

KRENKEL, P. A.
Effectiveness of River Models,
W82-00961 6A

KRISHNA MURTHY, I.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

KROGMAN, K. K.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

KROTHE, N. C.
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 7B

KRUGER, D.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

KRUGER, D. M.
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

KRUIZE, R. R.
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

KRUSE, E. G.
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

KUBO, T.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

KUCHMA, S. R.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

KULATHILAKE, A. I.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

KURANZ, J. H.
Distribution System Liability,
W82-01028 5F

KUZNETSOVA, L. P.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

KWAN, K. K.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 2L

LAAK, R.
Mutlichamber Septic Tanks,
W82-00969 5D

LABAUGH, J. W.
Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

LABELLE, R. L.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

LACHER, M.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

LACY, W.
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 5B

LAIRD, M. G.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

LAKSHMINARAYANA, J. S. S.
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 5B

LAMB, D. S.
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 5F

LAMB, J. D.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

LAMBERT, L.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

LANCE, J. C.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

LANG, G. E.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

LANGWORTHY, V. W.
Management Training is the Key to Good Operator Performance,
W82-00623 5D

LAROCK, P. A.
Water-To-Air Fractionation of Bacteria,
W82-00575 5B

LARSEN, C. E.
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 6E

LARSON, G. L.
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 6A

LARSON, W. E.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

LATTEN, A.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

LAU, L. S.
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

LAUENROTH, W. K.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

LAWRENCE, J.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

LEATHERLAND, T. M.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

LEBEL, G. L.
Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

LEBEL, J.
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

LECHEVALLIER, M. W.
Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

LEE, E. G-H.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

LEE, G. B.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

LEGGE, G. H. H.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

LEGGETT, D. C.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

LEHMAN, J. T.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

LENHART, T. E.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

LESLIE, J. K.
Measurement of Particulates Entrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

LESTER, J. N.
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

LETTERMAN, R. D.
Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

LEUNG, T-S.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

LEWIS, D. W.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

LIAW, W. K.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

LIECHTY, B.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

LIJKLEMA, L.
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

LIKENS, G. E.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

LINCER, J. L.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

LINDHOLM, G. F.
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

LINNIK, P. N.
Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

LINTHURST, R. A.
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

LIPPMAN, M. J.
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

LLOYD, B. J.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

LOEB, S. L.
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

LOH, P. C.
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 5C

LOMBARDO, P.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

LONG, J. M.
Interim Method for Determining Asbestos in Water,
W82-00741 5A

LONGLEY, W. L.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

LOONEY, B. B.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

LOVE, O. T. JR.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

LOVERIDGE, C.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

LOWE, R. L.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

LUDINGTON, D. C.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

LUDWIG, K. L.
Foam Control in Aeration Tanks,
W82-00525 5D

LUND, D. E.
Empire Controlled by Computer,
W82-00529 5D

LUTHY, R.
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

LUTHY, R. G.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

LYONS, W. B.
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 5B

MACCHI, G.
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

MACIOROWSKI, A. F.
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

MACK, S.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

MACRAE, W. R.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

MACTAVISH, D.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

MADDY, K. T.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

MADSEN, B. C.
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

MAGGERT, J. E.
Superseparation: Soret Effect Reversed,
W82-00791 3A

MAH, R. A.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

MALINA, J. F. JR.
Chemicals Disinfect Sludge,
W82-01003 5D

MANDAL, L. N.
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

MANKIN, J. B.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

MANN, R.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

MARGARITZ, M.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

MARGLER, L. W.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

MARINI, R. C.
Potential Political Influences Affecting the Water Industry,
W82-00861 6C

MARSON, H.
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

MARTEL, C. J.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

MARTEN, G. C.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

MARTI, YU. YU.
The Azov Sea Problem,
W82-00651 6G

MARTIN, B. B.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

MARTIN, C. S.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

MARTIN, D. F.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

MARTIN, R. J.
Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 5D

MARTIN, W. W.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

MATHIAS, J. A.
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

MATHIESON, A. C.
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 2L

MATHUR, D.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

MATOUSEK, J. P.
Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 5A

MATTHEWS, S. B.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

MATUSHANSKII, M. V.
The Azov Sea Problem,
W82-00651 6G

MAUCK, W. L.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

MAUGHAN, O. E.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

MAYER, J.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

MCBEAN, E. A.
Simulation Modeling of Primary Clarifiers,
W82-01027 6A

MCCARL, B. A.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

MCCARTHY, R. L.
Control Systems for Return and Waste Sludge,
W82-00949 5D

MCCARTY, P. L.
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

MCCLURE, J. R.
Aquatic Weed Cutting Apparatus,
W82-00624 4A

MCCORMICK, A. M.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

MCCOY, G. C.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

MCCOY, P.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

MCDIFFETT, W. F.
Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

MCDOWELL, L. L.
Sediment Sizes Eroded from Crop Row Sidelopes,
W82-00903 2J

MCELROY, M. B.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

MCGEE, A. B.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

MCGEE, M.
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

MCGUIRE, P. E.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

MCINTOSH, A. W.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

MCKAGUE, A. B.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

MCKENZIE, R. C.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

MCKINLEY, I. G.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

MCLAREN, J. W.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

MCLELLAN, B.
Evaluating Irrigation Systems,
W82-00772 6B

MCMAHON, B. R.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

MCMILLAN, M.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

MCNAUGHTON, D. J.
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

MCPHERSON, M. B.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

MCWILLIAM, J. R.
Research and Development to Service a Sustainable Agriculture,
W82-00669 3F

MEDLAR, S.
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 5F

MEIGS, J. W.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

MEIS, J. F. G. M.
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

MELNICK, J. L.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

MEYER, J. L.
Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

MEYER, L. D.
Sediment Sizes Eroded from Crop Row Sidelopes,
W82-00903 2J

MICHAEL, P. R.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

MIDDLETON, A. C.
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 5C

MIEURE, J. P.
Determining Volatile Organics in Water,
W82-00630 5A

MILLER, M. R.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

MILLER, P. C.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

MILLER, S.
Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 5F

Environmental Health Hazards,
W82-00625 5F

Water-Treatment Chemicals,
W82-00618 5F

MILLER, T. D.
Effects of Water Quality on Forage Production,
W82-01002 3C

MILLER, W. L.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 6A

MILLETTE, J. R.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

MILLS, J. L.
Ferric Chloride Takes Over,
W82-00954 5F

MINCKLEY, W. L.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

MIRAIDE, M.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

MITCHELL, C. P.
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 3B

MITTERMEYER, F. C.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

MIZUIKE, A.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 5A

MOLLARET, H. H.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

MOLLENDORF, J. C.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1A

MOLODTSOV, V. A.
Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 3C

MONKE, E. J.
Answers: A Model for Watershed Planning,
W82-00898 6A

Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

MOORE, G. S.
Health Effects of Monochloramines in Drinking Water,
W82-01091 5C

MOORE, J. E.
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

MOORE, J. S.
Illinois Groundwater Problems and Needs,
W82-01052 4B

MOORE, L. L.
An Intangible Benefit of Water Pollution Control Programs,
W82-01092 6B

MORGADE, C.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

MORGAN, K. M.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

MORRIS, C. E.
Low-Cost Wastewater Treatment,
W82-00841 5D

MORRIS, D. R.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

MORRIS, R.
Environmental Virology and its Problems,
W82-00505 5A

MOSEY, F. E.
Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 5D

MOSS, A. J.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

MOTZ, L. H.
Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 2F

MUCK, R. E.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 5B

MUIR, D. C. G.
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

MUNOZ, E. F.
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

MURPHREE, C. E.
Sediment Yield from a Flatland Watershed,
W82-00941 2J

MURPHY, T. P.
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 2H

MURRAY, C. M.
Trenching of Digested Sludge,
W82-00974 5E

MUTCHLER, C. K.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Sediment Yield from a Flatland Watershed,
W82-00941 2J

MUZYLEV, S. V.
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

MYKYTIUK, A. P.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

NABIVANETS, B. I.
Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 5A

NADLER, A.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

NAKAJIMA, T.
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

NAQVI, N. Z.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

NAQVI, S. M.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 5C

NASH, R. G.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

NEGRI, A. J.
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 2B

NEISSER, M. P.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

NELSON, C. R.
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

NELSON, D. W.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

NELSON, P. F.
Groundwater Problems in North Carolina,
W82-01056 4B

NELSON, S. G.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

NEWPORT, R.
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

NEWTON, A. J.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

NG, E.
Soil Moisture Relations in the Southern California Chaparral,
W82-01035 2D

NGUYEN, V-T-V.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

NICOL, S. M.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

NIEBOER, E.
Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 5A

NIKOLAEV, I. I.
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

NOBEL, P. S.
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

NORDMEYE, F. R.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

NORNBERG, P.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

NORTHEIMER, J.
Ground Water Problems in West Virginia,
W82-01060 4B

NORTON, D.
Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

NOVAK, J. T.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

NUGENT, C. E.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

O'CONNELL, P. E.
Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

O'CONNORS, H. B. JR.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

O'GRADY, S. M.
Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

O'MELIA, C. R.
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1B

O'NEILL, R. V.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

OBERAUER, S.
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

OBEYSEKERA, J. T. B.
Identification of Streamflow Stochastic Models,
W82-00555 2A

OCHIAI, M.
Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

OCHS, J. D.
Composting Is Working in Camden,
W82-00948 5E

OKOS, M. R.
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

OLOFFS, P. C.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Taricha Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

OLSEN, F. J.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

OLSON, F. W.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

ORLOB, G. T.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

ORVILLE, H. D.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

OSBORNE, P. L.
Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

OSCARSON, D. W.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

OTSON, R.
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

OVERCASH, M. R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

OVERMAN, A. R.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

OVERTON, J. H.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

OWEN, R. B.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 5C

OWENS, L. B.
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

PANE, G.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

PAPST, M. H.
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

PARIS, D. F.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

PARIZEK, R. R.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

PARRIS, G. E.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

PARSONS, L. R.
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

PARTON, W. J.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

PATERSON, J. J.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

PATRICK, W. H. JR.
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

PAYNTER, M. J. B.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

PEAK, J. E.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

PEEBLES, R. W.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

PELLETIER, E.
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 7B

PEOPLES, S. A.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

PERRY, R.
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

PESKIN, H. M.
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 6B

PETERS, H. G. SR.
[illegible] Technology Reduces Energy Use,
[illegible]-00634 5D

PETERSON, A. W.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

PETERSON, M. E.
Soil Percolation Tests,
W82-01044 2G

PETTINE, M.
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 5A

PETTS, G. E.
Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 6G

PETTYJOHN, W. A.
Sampling Ground Water for Organic Contaminants,
W82-00820 5A

PFAFFENBERGER, C. D.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 5A

PHILLIPS, G. R.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 5A

PHILLIPS, W.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

PIEBER, M.
Purification of Wastewater by Electrolysis,
W82-00847 5D

PITMAN, R. M.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

PLAN, B.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

PONCE, V. M.
Modeling Gradual Dam Breaches,
W82-00554 8D

POPE, D. H.
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

POPPITI, J. A.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

POWELL, R. D.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

POWERS, C. D.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

PRATT, P. F.
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

PRICE, D.
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

PRICKETT, T. A.
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

PRIVAL'SKII, V. E.
The Azov Sea Problem,
W82-00651 6G

PROEHL, J. A.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

PRUELL, R. J.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

PUKITE, A. H.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

PURDY, E. J. JR.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

PYMAR, C. F.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

QUACKENBUSH, D. W.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

QUESENBERRY, K. H.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

QUINN, J. G.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

RAATS, P. A. C.
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 2G

RAI, H.
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 2H

RAMANUJAM, V. M. SADAGOPA
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

RAMIREZ, A.
Chemicals Disinfect Sludge,
W82-01003 5D

RANSFORD, R.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

RATKOVICH, D. YA.
The Azov Sea Problem,
W82-00651 6G

The Caspian Sea Problem,
W82-00657 4A

RAVEH, A.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

RAWITZ, E.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

REBUCK, E. C.
Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 4B

RECKHOW, K. H.
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

REDDY, C. N.
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 2L

REDDY, K. R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

REED, P.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

REICE, S. R.
The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 2E

REICH, P. B.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

REICHMAN, G. A.
Watertable Management Saves Water and Energy,
W82-00943 3F

REID, R. C.
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 6G

REISS, B.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

REMIZOVA, S. S.
The Azov Sea Problem,
W82-00651 6G

RENDELL, P. S.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

RICCI, V.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

RICHARDSON, W. H.
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

RICHEY, D.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

RIGGLE, F. R.
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

RIGGLEMAN, J. D.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

RINNE, J. N.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

RITCHIE, J. T.
Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

RITTER, W. F.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

RITTMANN, B. E.
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

ROBBINS, T. W.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 5C

ROBERTS, J.
Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It,
W82-00813 6G

Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

ROBERTS, K. J.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 5F

ROBERTS, S. W.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

ROBSON, S. G.
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

RODHE, A.
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

RODHE, H.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

ROGERS, J. S.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

ROGERS, K. H.
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 6G

ROGERS, L. B.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

ROGERSON, A.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

ROGOWSKI, A. S.
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

ROHDE, W.
Reviving Acidified Lakes,
W82-00933 2H

ROLLAND, D.
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 5A

ROLLINS, D. K.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

ROMANOV, V. V.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

ROSEBOOM, D.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

ROSENBERG, D. M.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

ROSENBLATT, D. H.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

ROSS, H. A.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

ROSS, L. T.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

ROUSSELLE, J.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

ROWLAND, R. G.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

ROY, P. S.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

RUDD, J. W. M.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

RUSSELL, D. S.
Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

RUTHERFORD, M. C.
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

RYALS, G. N.
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 7C

SADASIVAN, S.
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

SAEGER, V. W.
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

SALA, O. E.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

SALAS, J. D.
Identification of Streamflow Stochastic Models,
W82-00555 2A

SALTZMAN, S.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

SAMOILOFF, M. R.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

SAMUELS, W. B.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

SASTRI, V. S.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

SAULNIER JR, G. J.
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

SAUNDERS, C. L.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

SAY, P. J.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

SCHAEFFER, D. J.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 5A

SCHMIDT, K. D.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

SCHMIERBACH, M. R.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 2I

SCHNEIDER, A. D.
Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

SCHUBERT, G.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

SCHULZ, S.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 5A

SCHWAB, G. O.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

SCHWARTZ, F. W.
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

SCHWARTZ, S. E.
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

SCOTT, J. T.
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

SEAGLE JR, H. H.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

SEIDLER, R. J.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 5A

SEKEL, D. J.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

SEKLA, L.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

SELLECK, R. E.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

SENECA, E. D.
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 2L

SHEEHAN, M.
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 6A

SHELTON, W. L.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

SHEN, W. C.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

SHEPHERD, A. D.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

SHERRY, J. P.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

SHIGENO, D. S.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

SHIH, S. F.
Water Requirement for Sugarcane Production,
W82-00899 3F

SHORT, R. A.
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

SIDDOWAY, F. H.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SIEVERING, H.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

SIKORA, L. J.
Trenching of Digested Sludge,
W82-00974 5E

SIKORA, V. A.
Health Aspects of Urban Water Conservation,
W82-01047 3C

SILLS, J. B.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

SILVERMAN, M. P.
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

SIMPSON, C. A.
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 5C

SIMPSON, G. D.
Facts Fix Fund Finding,
W82-00885 9A

SIMPSON, J. T.
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 5G

SINGH, V. P.
Overland Flow on a Diverging Surface,
W82-00986 2A

SINGLETON, L.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

SLACK, D. C.
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

SLEMBROVA, J.
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 5A

SLOANE, J.
Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

SMART, R. M.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

SMEETS, J.
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

SMITH, B. D.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

SMITH, C. D.
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 8B

SMITH, C. L.
Management Provoked Conflict in Fisheries,
W82-00780 6A

SMITH, K. E.
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 5D

SMITH, P. J.
A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

SMITH, R. A.
Identification of Streamflow Stochastic Models,
W82-00555 2A

SMITH, R. E.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

SMITH, R. J.
The Waterway That Cannot be Stopped,
W82-00510 6E

SMITH, W. K.
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

SNYDER, B.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 5G

SOEDER, C. J.
Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 5D

SOKOL, R. L.
Control Systems for Return and Waste Sludge,
W82-00949 5D

SONDEREGGER, J. L.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

SOON, Y. K.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

SOPHOCLEOUS, M.
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

SPARE, D. P.
Sizing Rice Irrigation Canals,
W82-00895 3F

SPEYER, M. R.
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 5B

SPRAKER, P.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

SPYRIDAKIS, D. E.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

SRIKAMESWARAN, K.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

STACKIW, W.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

STANLEY, R. F.
Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

STARA, J. F.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

STATHIS, T. C.
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

STEEN, W. C.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

STEIN, R. B.
Ohio's Ground Water Resources and Problem Areas,
W82-01057 4B

STEKETEE, C. H.
Why EPA's I/I Control Program Fails,
W82-00790 8A

STEVENS, A. A.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

STEVENSON, L. H.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

STEWART, J.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

STEWART, M. T.
Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

STOBER, Q. J.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

STOFFEL, D.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

STOLTENBERG, D. H.
Midwestern Wastewater Characteristics,
W82-00534 5D

STRAIN, B. R.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

STRAIN, P. M.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

STRAUS, J. M.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

STROEHLEIN, J. L.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sudangrass Yields,
W82-00767 3C

STURGEON, R. E.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

SU, P. K.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

SUBRAMANIAN, K. S.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

SUNDARAM, K. M. S.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

SUNDSTROM, D.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

SUZUKI, S.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

SWAN, D. S.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

SWEENEY, C.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

SWICK, A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

SYMONS, J. M.
Removing Trihalomethanes from Drinking Water,
W82-00953 5F

SZETO, S.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

SZETO, S. Y.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 5C

SZIDAROVSZKY, F.
Reliability of Underground Flood Control System,
W82-00556 8A

TALLON, J. T.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

TAN, C. S.
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

TAN, F. C.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

TAN, Y.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

TANAKA, S.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

TAYLOR, G. S.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 4A

TAYLOR, J. A.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

TAYLOR, R. E. JR.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

TEDROW, A. C.
Groundwater Problems and Needs in New York,
W82-01055 4B

TELEPCHAK, M.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

TELTSCH, B.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

TEMPLE, D. M.
Tractive Force Design of Vegetated Channels,
W82-00901 4D

THIEL, D. A.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

THIELEN, J.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

THOM, B. G.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

THOMAS, J. F.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

THOMPSON, Q. E.
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 5B

THORNTON, J. C.
Groundwater Pollution in Kentucky: A Status Report,
W82-01053 4B

THORNTON, J. D.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

TIMMONS, J. F.
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

TIMMONS, T. J.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

TISON, D. L.
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 2H

TITTLE, K.
The Removal of Organic Matter from Demineralized Water,
W82-00868 5F

TOHA, J.
Purification of Wastewater by Electrolysis,
W82-00847 5D

TOMS, R. G.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

TOWNSEND, B. E.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

TRIEFF, N. M.
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

TRLICA, M. J.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

TROUT, T. J.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

TSANG, C. F.
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

TSIVOGLOU, A. J.
Modeling Gradual Dam Breaches,
W82-00554 8D

TURK, T. R.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

TURNER JR, F.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sudangrass Yields,
W82-00767 3C

TURNER, M. A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

TURNER, N. C.
Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

UNGER, P. W.
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

VAATANEN, P.
Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

VALAMANESH, A.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 2I

VALLEJO, L. E.
Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 2J

VAN DER KOOIJ, D.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

VAN DER PIEPEN, H.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

VAN DER VALK, A. G.
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 2H

VAN HOOF, F.
Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00835 5A

VAN NULAND, G. J.
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 2H

VAN OSS, C. J.
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

VAN OVERMEEREN, R. A.
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 2F

VAN ROBBROECK, T. P. C.
Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

VAN SCHILFGAARDE, J.
Dryland Management for Salinity Control,
W82-01018 2G

VANBUCKENHOUT, L.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

VANDERHOLM, D. H.
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

VASIL'EV, O. F.
Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 6A

VASSILIOU, P.
Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

VEEMAN, T.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

VENKATACHARI, A.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00640 2D

VENKATESWARAN, M.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

VENN, A. C.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00615 6D

VETTER, R. J.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 5B

VILJOEN, N.
Richards Bay: An Ecological Dilemma,
W82-00679 6A

VINYARD, L.
Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 10D

VISSER, A.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 5A

VLAMIS, J.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

VONNEGUT, B.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

WADE, T. L.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 2L

WAITE, S. W.
Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

WAITE, W. M.
Environmental Virology and its Problems,
W82-00505 5A

WALKER, D. J.
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 4D

WALKER, J. M.
Trenching of Digested Sludge,
W82-00974 5E

WALKER, P. H.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

WALKER, R. L.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

WALLACE, J. B.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

WALLACE, J. S.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 2D

WALMSLEY, R. D.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 2H

WALTER, S. D.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

WANG, C. T.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

WANG, D-S.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

WANG, F. C.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

WANG, J-K.
Sizing Rice Irrigation Canals,
W82-00895 3F

WARD, A. D.
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 5G

WARD, J. V.
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

WARD, R. L.
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

WATT, T. A.
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 2I

WAYMIRE, E.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

WEAVER, D. S.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

WEBSTER, J. R.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

WEEKS, W. D.
A Comparison of Rainfall-Runoff Models,
W82-00911 2A

WEILAND, R. A.
Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 6E

WEINBAUER, J. D.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

WEINRICH, B. E.
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

WELLS, J. R.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

WEST, D. W.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 2I

WESTON, R. T.
Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

WHITE, E.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

WHITTON, B. A.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

WIEBE, W. J.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 2H

WIEDER, R. K.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

WIENER, J. G.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

WIENS, A. P.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

WIESER, W.
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 5A

WIKRAMARATNA, R. S.
A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

WILLER, D. C.
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

WILLIAMS, D. E.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

WILLIAMS, D. T.
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

WILLIAMS, G. M.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

WILSON, C. A.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

WILSON, D.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

WINCHESTER, J. W.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

Water-To-Air Fractionation of Bacteria,
W82-00575 5B

WINNER, R. W.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 5C

WOFSY, S. C.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

WOLANSKY, R. M.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

WOLFE, N. L.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

WOLFF, A. H.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 5F

WONG, P. T. S.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

WOO, M-K.
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

WOODLEY, W. L.
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 2B

WOODWARD, D. F.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

WOOTON, F. T.
Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 5E

WORONIECKA-STASIAK, A.
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

WRIGHT, L. D.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

WRONSKI, E. B.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

WU, T. L.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

WURSTER, C. F.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

YAKE, W. E.
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

YAKOWITZ, S. J.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

YASUDA, T.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

YEO, R. K.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

YORDY, J. R.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

YOUNG, C. E.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

YOUNG, G. J.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

ZAHNOW, E. W.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

ZALKIND, D.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 5A

ZARTMAN, R. E.
Effects of Water Quality on Forage Production,
W82-01002 3C

ZITRIDES, T. G.
Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

ZUR, O.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

ORGANIZATIONAL INDEX

AARHUS UNIV. (DENMARK). INST. OF ECOLOGY AND GENETICS.
Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 5A

AARHUS UNIV. (DENMARK), LAB. OF PHYSICAL GEOGRAPHY.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 7B

AEROSPACE CORP., LOS ANGELES, CA. SPACE SCIENCE LAB.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1A

AGRICULTURAL RESEARCH AND EDUCATION CENTER, BELLE GLADE, FL.
Water Requirement for Sugarcane Production,
W82-00899 3F

AGRICULTURAL RESEARCH AND EDUCATION CENTER, BRADENTON.
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 3F

AGRICULTURAL RESEARCH SERVICE, FORT COLLINS, CO.
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 3F

AIN SHAMS UNIV., CAIRO (EGYPT). DEPT. OF SOILS.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 5E

AKADEMIA ROLNICZA, WARSAW (POLAND). ZAKLAD LIMNOLOGII I RYBACTWA.
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. OF LIMNOLOGY.
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST VODNYKH PROBLEM.
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 2H

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 6G

The Azov Sea Problem,
W82-00651 6G

The Caspian Sea Problem,
W82-00657 4A

Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 2A

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 5B

Methods of Investigating the State of Metal Ions in Natural Waters.
W82-00859 5A

AKINOMOTO CO., INC., KAWASAKI (JAPAN). CENTRAL RESEARCH LAB.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 5A

ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN.
Water Movement for Water Quality in Catfish Production,
W82-00866 5G

ALABAMA COOPERATIVE FISHERY RESEARCH UNIT, AUBURN.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 2H

ALASKA UNIV., FAIRBANKS. INST. OF WATER RESOURCES.
Physical Mechanics of Aufeis Growth,
W82-00836 2C

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 2J

ALBERTA UNIV., EDMONTON. DEPT. OF GEOLOGY.
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 2A

ALVORD, BURDICK AND HOWSON, CHICAGO, IL.
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 6E

AMES LAB., IA.
Cation Chromatography With a Conductivity Detector,
W82-00582 5A

AMSTERDAM PUBLIC WORKS (NETHERLANDS).
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 5F

ANDHRA PRADESH AGRICULTURAL UNIV., HYDERABAD (INDIA). DEPT. OF AGRONOMY.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 2D

ANGLIAN WATER AUTHORITY (ENGLAND).
Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 5F

ANGLIAN WATER AUTHORITY, NORWICH (ENGLAND). NORWICH SEWAGE DIV.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 5D

ANNE ARUNDEL COUNTY DEPT. OF PUBLIC WORKS, ANNAPOLIS, MD.
Coordinated Effort Stems Sediment and Erosion,
W82-00766 4D

ANTWERPSE WATERWERKEN (BELGIUM).
Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 5A

ARIZONA STATE UNIV., TEMPE. FORESTRY SCIENCES LAB.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 2H

ARIZONA UNIV., TUCSON. DEPT. OF ECONOMICS.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 6C

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER AND ENGINEERING.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 5E

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 3C

ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS AND INDUSTRIAL ENGINEERING.
Reliability of Underground Flood Control System,
W82-00556 8A

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRONOMY.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001 5E

ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 5D

ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LAB., FORT DETRICK, MD.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 5G

ARMY WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 2H

ATOMIC ENERGY ESTABLISHMENT, CAIRO (EGYPT). RADIATION PROTECTION DEPT.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 5B

AUBURN UNIV., AL. DEPT. OF FISHERIES AND ALLIED AQUACULTURES.
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 5C

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 2K

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization.
W82-01084 5A

BATTELLE PACIFIC NORTHWEST LAB., RICHLAND, WA. ATMOSPHERIC SCIENCES DEPT.
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 5B

BAYLOR COLL. OF MEDICINE, HOUSTON, TX. DEPT. OF VIROLOGY AND EPIDEMIOLOGY.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 5B

BECHTEL INC., NORWALK, CA.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 8B

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA). ATLANTIC OCEANOGRAPHIC LAB.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 2C

BHABHA ATOMIC RESEARCH CENTRE, BOMBAY (INDIA). AIR MONITORING SECTION.
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 2B

BIDHAN CHANDRA KRISHI VISWA VIDYALAYA, KALYANI (INDIA). DEPT. OF AGRICULTURAL ENGINEERING.
Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 2G

BISWAS AND ASSOCIATES, OXFORD (ENGLAND).
Long Distance Mass Transfer of Water,
W82-00858 6D

BOTANICAL RESEARCH INST., PRETORIA (SOUTH AFRICA).
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 2I

BOWLING GREEN STATE UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 5A

BRANDON UNIV. (MANITOBA). DEPT. OF CHEMISTRY.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 5A

BRIGHAM YOUNG UNIV., PROVO, UT. DEPT. OF CHEMISTRY.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 5A

BRITISH COLUMBIA RESEARCH COUNCIL, VANCOUVER.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 5C

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF MATHEMATICS.
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 6A

BROOKHAVEN NATIONAL LAB., UPTON, NY.
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 2K

BUCKNELL UNIV., LEWISBURG, PA. DEPT. OF BIOLOGY.
Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 2H

BUREAU OF RECLAMATION, BOULDER CITY, NV.
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 3C

BURLINGTON WATER DEPT., VT.
Low Turbidity Water from Fast Processes,
W82-00946 5F

CADHAM PROVINCIAL LAB., WINNIPEG (MANITOBA).
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 5A

CALIFORNIA DEPT. OF FOOD AND AGRICULTURE, SACRAMENTO.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 5A

CALIFORNIA INST. OF TECH., PASADENA. W. M. KECK LABS.
Trace Metal Catalysis in Aquatic Environments,
W82-00629 5B

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, PALM DESERT. COLORADO RIVER BASIN REGION.
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 6F

CALIFORNIA STATE UNIV., FRESNO. DEPT. OF GEOLOGY.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 2F

CALIFORNIA UNIV., BERKELEY. DEPT. OF CIVIL ENGINEERING.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 5B

CALIFORNIA UNIV., BERKELEY. DEPT. OF SOILS AND PLANT NUTRITION.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 5E

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 3E

CALIFORNIA UNIV., BERKELEY. NAVAL BIOSCIENCES LAB.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 5B

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 7B

CALIFORNIA UNIV., DAVIS. SCHOOL OF CIVIL ENGINEERING.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 5B

CALIFORNIA UNIV., LOS ANGELES. LAB. OF NUCLEAR MEDICINE AND RADIATION BIOLOGY.
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 2I

CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF PUBLIC HEALTH.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 5A

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 5B

CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY, NJ.
Composting Is Working in Camden,
W82-00948 5E

CAMP, DRESSER AND MCKEE, INC., CLEARWATER, FL.
Tampa Bay Water Guarded by Computer,
W82-00934 4B

CANADA CENTER FOR INLAND WATERS, BURLINGTON (ONTARIO).
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 5C

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 6G

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 5A

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I. Bacteriological Aspects,
W82-00921 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 2L

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 6G

CANMET, OTTAWA (ONTARIO). MINERAL SCIENCES LAB.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 5D

CANTERBURY UNIV., CHRISTCHURCH (NEW ZEALAND). DEPT. OF GEOLOGY.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 2J

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. DEPT. OF CIVIL ENGINEERING.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 5D

Leach Characteristics of Coal-Gasification Char,
W82-01025 5B

CENTRAL ELECTRICITY GENERATING BOARD (ENGLAND). NORTHWESTERN REGION.
The Removal of Organic Matter from Demineralised Water,
W82-00888 5F

CENTRAL INLAND FISHERIES RESEARCH INST., BARRACKPORE (INDIA).
Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 2H

CHEMED CORP., CINCINNATI, OH. (ASSIGNEE).
Detoxification of Residual Quaternaries,
W82-00562 5G

CHILE UNIV., SANTIAGO. DEPT. OF FISICA.
Purification of Wastewater by Electrolysis,
W82-00847 5D

CLEMSON UNIV., SC. DEPT. OF MICROBIOLOGY.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 5A

CLYDE RIVER PURIFICATION BOARD (SCOTLAND).
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 6E

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Identification of Streamflow Stochastic Models,
W82-00555 2A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ZOOLOGY AND ENTOMOLOGY.
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 6G

COLORADO STATE UNIV., FORT COLLINS. NATURAL RESOURCE ECOLOGY LAB.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 2I

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 5C

COMMISSION OF THE EUROPEAN COMMUNITIES, BRUSSELS (BELGIUM).
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 6D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF PLANT INDUSTRY.
Plant-Water Relations and Adaptation to Stress,
W82-00812 2I

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF SOILS.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 2J

CONNECTICUT UNIV., STORRS. DEPT. OF CHEMICAL ENGINEERING.
Metal Leaching from Sewage Sludge Ash,
W82-00770 5B

CONNECTICUT UNIV., STORRS. SCHOOL OF ENGINEERING.
Mutlichamber Septic Tanks,
W82-00969 5D

CONSOLIDATED PAPERS, INC., WISCONSIN RAPIDS, WI.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 5C

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRONOMY.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 5A

CORNELL UNIV., ITHACA, NY. SOIL MICROBIOLOGY LAB.
Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 2H

CRANBROOK INST. OF SCIENCE, BLOOMFIELD HILLS, M
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 5B

DALHOUSIE UNIVERSITY, HALIFAX (NOVA SCOTIA). DEPT. OF CHEMISTRY.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 5A

DECHERT, PRICE AND RHOADS, DENVER, CO.
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 6E

DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.
Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 8B

DELAWARE UNIV., NEWARK. DEPT. OF AGRICULTURAL ENGINEERING.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 5D

DEPARTMENT OF AGRICULTURE AND FISHERIES FOR SCOTLAND, EDINBURGH.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO).
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO). RESEARCH STATION.
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 2D

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). IRRIGATION DIV.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 6B

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). RESEARCH STATION.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 2I

DEPARTMENT OF ENERGY, NY. ENVIRONMENTAL MEASUREMENTS LAB.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 5B

DEPARTMENT OF ENVIRONMENTAL PLANNING AND ENERGY (SOUTH AFRICA).
Richards Bay: An Ecological Dilemma,
W82-00679 6A

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA).
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 5C

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 2H

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 2H

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 5A

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 5B

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). FRESHWATER SECTION.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 2H

DEPARTMENT OF WATER AFFAIRS, PRETORIA (SOUTH AFRICA).
Sediment Surveys in the Department of Water Affairs,
W82-00680 7B

DEPARTMENT OF WATER AFFAIRS, PRETORIA (SOUTH AFRICA). HYDROLOGICAL RESEARCH INST.
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 2H

DU PONT DE NEMOURS (E. I.) AND CO., DEEPWATER, NJ.
Removal of Priority Pollutants,
W82-00639 5D

DU PONT DE NEMOURS (E. I.) AND CO., WILMINGTON, DE. DEPT. OF BIOCHEMICALS.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 5A

DUKE UNIV., DURHAM, NC. DEPT. OF BOTANY.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 2I

DUPONT DE NEMOURS (E. I.) AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 5A

DURHAM UNIV. (ENGLAND). DEPT. OF BOTANY.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 5A

EAST TENNESSEE STATE UNIV., JOHNSON CITY. DEPT. OF ENVIRONMENTAL HEALTH.
Health Aspects of Urban Water Conservation,
W82-01047 3C

EAST TENNESSEE STATE UNIV., KINGSPORT. DEPT. OF CHEMISTRY.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 5A

EAST-WEST ENVIRONMENT AND POLICY INST., HONOLULU, HAWAII.
Using Ecological Knowledge for Development Planning,
W82-00671 6A

EASTERN WASHINGTON UNIV., CHEMEY. DEPT. OF BIOLOGY.
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 2H

ECOLE POLYTECHNIQUE, MONTREAL (QUEBEC). DEPT. OF CIVIL ENGINEERING.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 2B

ECONOMIC RESEARCH SERVICE, WASHINGTON, DC. NATURAL RESOURCE ECONOMICS DIV.
Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 6E

ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE, WASHINGTON, DC. NATURAL RESOURCES ECONOMICS DIV.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 5D

ELMHURST COLL., IL. DEPT. OF BIOLOGY.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 5A

ENVIREX, INC., MILWAUKEE, WI.
Sludge Blanket in Activated Final Clarifiers,
W82-00951 5D

ENVIRONMENTAL HEALTH DIRECTORATE, OTTAWA (ONTARIO).
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 5F

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 5A

ENVIRONMENTAL PROTECTION AGENCY, CHICAGO, IL.
Midwestern Wastewater Characteristics,
W82-00534 5D

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 5C

Removing Trihalomethanes from Drinking Water,
W82-00953 5F

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. OFFICE OF RESEARCH AND DEVELOPMENT.
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 5A

ENVIRONMENTAL PROTECTION AGENCY, EDISON, NJ.
Recycling Urban Stormwater for Profit,
W82-00524 3C

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF RESEARCH AND DEVELOPMENT.
Treatability Manual; Volume I. Treatability Data.
W82-01073 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 5D

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 5D

Treatability Manual; Volume V. Summary.
W82-01077 5D

ENVIRONMENTAL PROTECTION SERVICE, EDMONTON (ALBERTA). MICROBIOLOGY LAB.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 5A

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 2K

Interim Method for Determining Asbestos in Water,
W82-00741 5A

ENVIRONMENTAL SCIENCES RESEARCH LAB., RESEARCH TRIANGLE PARK, NC.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 5B

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, D.C. OFFICE OF ELECTRIC POWER REGULATION.
Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 6D

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 6G

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC. OFFICE OF ELECTRIC POWER REGULATION.
Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 6G

FISHERIES AND WILDLIFE, COLUMBIA, MO.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 2I

FLINDERS UNIV. OF SOUTH AUSTRALIA, BEDFORD PARK. SCHOOL OF EARTH SCIENCES.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 2D

FLORENCE UNIV. (ITALY). INST. OF PHARMACOLOGY.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 5A

FLORIDA DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 2H

FLORIDA INTERNATIONAL UNIV., MIAMI. SCHOOL OF TECHNOLOGY.
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 5B

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF OCEANOGRAPHY.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 2B

FLORIDA STATE UNIV., TALLAHASSEE. OCEANOGRAPHY DEPT.
Water-To-Air Fractionation of Bacteria,
W82-00575 5B

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Subsurface Drainage and Sediment Transport Model,
W82-00894 2G

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRONOMY.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 2I

FLORIDA UNIV., GAINESVILLE. DEPT. OF FRUIT CROPS.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 2I

FLORIDA UNIV., STANFORD. INST. OF FOOD AND AGRICULTURAL SCIENCES.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 5B

FLORIDA UNIVERSITY, GAINESVILLE. AGRICULTURAL ENGINEERING DEPARTMENT.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 5D

FOOD AND DRUG ADMINISTRATION, DAVISVILLE, RI. CONSTRUCTION BATALLION CENTER.
Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 5A

FOOD AND DRUG ADMINISTRATION, WASHINGTON, DC.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 5B

FORDHAM UNIV., BRONX, NEW YORK. LOUIS CALDER CONSERVATION AND ECOLOGY STUDY CENTER.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 2H

FOREST PEST MANAGEMENT INST., SAULT STE MARIE (ONTARIO).
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 5B

FOXBORO CO., MA.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 5A

FRANKLIN PIERCE CENTER, CONCORD, NH.
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 6E

FRANKLIN PIERCE LAW CENTER, CONCORD, NH.
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 6E

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 6E

FRANKLIN PIERCE LAW CENTER, CONCORD, NH. ENERGY LAW INST.
A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 6E

FRESHWATER BIOLOGICAL ASSOCIATION, WINDERMERE (ENGLAND).
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 7B

GENERAL MOTORS CORP., SAGINAW. STEERING GEAR DIV.
Mixing Technology Reduces Energy Use,
W82-00634 5D

GEOLOGICAL SURVEY, ALEXANDRIA, LA. WATER RESOURCES DIV.
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 7C

GEOLOGICAL SURVEY, BOISE, ID. WATER RESOURCES DIV.
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 6A

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 5B

GEOLOGICAL SURVEY, LAWRENCE, KS.
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 4B

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 7C

GEOLOGICAL SURVEY, NSTL STATION, MS. WATER RESOURCES DIV.
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 2E

GEOLOGICAL SURVEY OF NEW SOUTH WALES, SYDNEY (AUSTRALIA). DEPT. OF MINERAL RESOURCES AND DEVELOPMENT.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 2J

GEOLOGICAL SURVEY, RESTON, VA.
Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 5B

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 2K

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 6B

GEOLOGICAL SURVEY, RICHMOND, VA. WATER RESOURCES DIV.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 7C

GEOLOGICAL SURVEY, ROLLA, MO. WATER RESOURCES DIV.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 2E

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 7C

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 7C

GEOLOGICAL SURVEY, TAMPA, FL.
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 2F

GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.
Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 7C

GEOLOGISCHES LANDESAMT NORDRHEIM-WESTFALEN, KREFELD (GERMANY, F.R.).
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 7B

GEORGIA UNIV., ATHENS.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 5A

GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY.
Phosphorus, Nitrogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 2K

GESELLSCHAFT FUER BIOTECHNOLOGISCHE FORSCHUNG, M.B.H., STOCKHEIM (GERMANY, F.R.).
Occurrence of Cytophagas in Sewage Plants,
W82-00682 5A

GLASGOW UNIVERSITY (SCOTLAND), DEPARTMENT OF CHEMISTRY.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 7B

GOVERNORS STATE UNIV., PARK FOREST SOUTH, IL. COLL. OF ENVIRONMENTAL AND APPLIED SCIENCES.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 5B

GRANADA UNIV. (SPAIN). DEPT. OF ECOLOGY.
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 5B

GRANADA UNIV. (SPAIN). DEPT. OF MICROBIOLOGY.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 5A

GREAT SMOKY MOUNTAINS NATIONAL PARK, GATLINBURG, TN.
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00639 6A

GROUNDWATER SURVEY TNO, DELFT (NETHERLANDS).
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00812 2F

GUAM UNIV., AGANA. MARINE LAB.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 5D

GUELPH UNIV. (ONTARIO). DEPT. OF LAND RESOURCE SCIENCE.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 5B

GUNNISON BROS, GIRARD, PA.
Chemical Treatment Solves Tannery Waste Problems,
W82-00636 5D

HAMBURG UNIV. (GERMANY, F.R.) INST. FUER HYDROBIOLOGIE UND FISCHEREIWISSENSCHAFT.
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 5C

HARRIS (FREDERIC R.) INC., HOUSTON, TX.
Large Rubble-Mound Breakwater Failures,
W82-00862 8D

HARVARD UNIV., CAMBRIDGE, MA. CENTER FOR EARTH AND PLANETARY PHYSICS.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 5B

HAVENS AND EMERSON LTD., CLEVELAND, OH.
Facts Fix Fund Finding,
W82-00885 9A

HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER.
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W82-00587 5C

HEALTH AND WELFARE CANADA, OTTAWA (ONTARIO). MONITORING AND CRITERIA DIV.
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 5A

HEBREW UNIV., JERUSALEM (ISRAEL). ENVIRONMENTAL HEALTH LAB.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 5A

HOOVER-NSK BEARING PLANT, ANN ARBOR, MI.
Cold Weather Waste Treatment,
W82-00636 5D

HYDROMETEOROLOGICAL SERVICE OF THE USSR, MOSCOW.
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W82-00652 2A

IBADAN UNIV. (NIGERIA). DEPT. OF AGRONOMY.
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W82-00607 2I

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W82-00869 4D

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, SPRINGFIELD.
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W82-00891 5A

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, SPRINGFIELD. DIV. OF LAND/NOISE POLLUTION CONTROL.
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W82-01052 4B

ILLINOIS INST. OF TECH., CHICAGO. PRITZER DEPT. OF ENVIRONMENTAL ENGINEERING.
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W82-00710 5B

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Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 5A

ILLINOIS NATURAL HISTORY SURVEY, URBANA.
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 5B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 7B

ILLINOIS STATE WATER SURVEY, URBANA.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 5C

Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 2B

ILLINOIS UNIV. AT THE MEDICAL CENTER, CHICAGO. SCHOOL OF PUBLIC HEALTH.
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W82-01045 5F

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF BOTANY.
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W82-00935 2I

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Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 5D

INDIAN HEALTH SERVICE, SEATTLE, WA. OFFICE OF ENVIRONMENTAL HEALTH.
Soil Percolation Tests,
W82-01044 2G

INDIANA UNIV. AT BLOOMINGTON. DEPT. OF GEOLOGY.
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W82-00829 7B

INDIANA UNIV. AT BLOOMINGTON. SCHOOL OF PUBLIC AND ENVIRONMENTAL AFFAIRS.
Aromatic Amines in and Near the Buffalo River,
W82-00622 5B

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W82-00857 5A

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W82-00908 6G

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W82-00603 7B

INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).
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W82-00655 2D

Adaptive Hydrological Forecasting - A Review,
W82-00984 2A

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 2F

INSTITUTE OF OCEAN SCIENCES, SIDNEY (BRITISH COLUMBIA).
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 2L

INSTITUTE OF SOIL FERTILITY, GRONINGEN (NETHERLANDS).
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W82-00932 2G

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W82-00691 5C

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W82-00702 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 5C

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W82-00707 5C

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W82-00708 5C

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W82-00701 6E

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W82-00687 5C

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W82-01096 2H

IOWA UNIV., IOWA CITY. INST. OF URBAN AND REGIONAL RESEARCH.
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W82-00802 6A

ISTITUTO DI RICERCA SULLE ACQUE, ROME (ITALY).
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W82-00627 5A

JOHNS HOPKINS UNIV., BALTIMORE, MD.
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W82-00540 1B

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W82-00757 2L

JORDAN (EDWARD C.) CO., INC., PORTLAND, ME.
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W82-01088 5F

JYVAESKYLAE UNIV. (FINLAND). DEPT. OF BIOLOGY.
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W82-00673 5C

KATHOLIEKE UNIV., NIJMEGEN (NETHERLANDS) LAB. OF AQUATIC ECOLOGY.
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W82-00664 2H

KENNEDY (MICHAEL), SPOKANE, WA.
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W82-00650 5F

KENTUCKY DEPT. FOR NATURAL RESOURCES, FRANKFORT.
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W82-01053 4B

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W82-00522 6A

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W82-00893 5G

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W82-00913 5D

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W82-00851 5D

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W82-00924 5C

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W82-01100 5A

LAW ENGINEERING TESTING CO., TAMPA, FL.
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W82-00990 2F

LOS ANGELES COUNTY SANITATION DISTRICT, CA.
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W82-00528 5D

LOUGHBOROUGH UNIV. OF TECHNOLOGY (ENGLAND).
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W82-01087 6G

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W82-00890 4A

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W82-00795 2L

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 5B

MACLAREN (J. F.) LTD., WILLOWDALE (ONTARIO).
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W82-00834 5C

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W82-00872 5C

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W82-00856 5A

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W82-01017 5A

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W82-00609 3B

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W82-01054 4B

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W82-00930 5D

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W82-00768 5D

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W82-01334 1A

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W82-01091 5C

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W82-00521 7B

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Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 5G

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Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 2C

The Effects of Surface Dust on Snow-melt Rates,
W82-00845 2C

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Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 5C

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF MECHANICAL ENGINEERING.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 8B

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, IL.
Control Systems for Return and Waste Sludge,
W82-00949 5D

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Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
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Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
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Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
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A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
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Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
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A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
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Acidity Fluctuations at a Broadland Site in Norfolk,
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Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 5B

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Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 7B

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Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 2I

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Overland Flow on a Diverging Surface,
W82-00866 2A

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A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 2A

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W82-00612 5B

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W82-00599 5B

An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 5A

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Determining Volatile Organics in Water,
W82-00630 5A

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Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 5B

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Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
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Toxics in Municipal and Industrial Wastewaters,
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W82-01097 5A

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Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 7B

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Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 2G

NATIONAL ENVIRONMENTAL SATELLITE SERVICE, WASHINGTON, DC.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 7B

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Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 5B

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Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 5A

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Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
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Satellite Rain Estimation in the U.S. High Plains,
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Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 5A

NATIONAL RESEARCH COUNCIL OF CANADA (ONTARIO). DIV. OF CHEMISTRY.
Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 5A

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Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 5A

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Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 6E

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On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 2H

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Ammonia and Nitrate Uptake in the Lower Great Lakes,
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W82-01006 2B

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W82-00690 5A

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The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 5C

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Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 5D

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Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
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Effectiveness of River Models,
W82-00961 6A

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Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
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Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
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Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
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Dissolution of Salt Deposits by Brine Density Flow,
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Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
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Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
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Groundwater Problems in North Carolina,
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Fungal Decolorization of Kraft Bleach Plant Effluents,
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The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
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W82-00635 5A

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State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 6D

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 7A

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A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 2E

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Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
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Ohio's Ground Water Resources and Problem Areas,
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The Development of Methods for Determining Aquifer Characteristics,
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The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
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OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL ENGINEERING.
The Uncertainty of Crop Models in Irrigation Optimization,
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Management Provoked Conflict in Fisheries,
W82-00780 6A

OREGON STATE UNIV., CORVALLIS. DEPT. OF MICROBIOLOGY.
Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
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Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
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Multivariate Hydrologic Time Series Analysis,
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The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
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Simulation Modeling of Primary Clarifiers,
W82-01027 6A

PATRAS UNIV. (GREECE). LAB. OF APPLIED THERMODYNAMICS.
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 5D

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Pennsylvania Ground Water Problems and Needs,
W82-01058 4B

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF METEOROLOGY.
Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 2K

PIELKENROOD-VINITEX, ASSENDELFT (NETHERLANDS).
Floc/Float System Cleans Desalter Effluent,
W82-00906 5D

POLISH ACADEMY OF SCIENCE, WARSAW. INST. OF ECOLOGY.
Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 2H

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Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 5D

PRICKETT (THOMAS A.) AND ASSOCIATES, URBANA, IL.
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 4B

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Answers: A Model for Watershed Planning,
W82-00896 6A

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF BIONUCLEONICS.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
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The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 5C

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Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
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RADIATION MANAGEMENT CORP., DRUMORE, PA. MUDDY RUN ECOLOGICAL LAB.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
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Effect of Temperature on Mineralization by Heterotrophic Bacteria,
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Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
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RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
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ROCKWELL INTERNATIONAL, PITTSBURGH, PA.
An Intangible Benefit of Water Pollution Control Programs,
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Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 2I

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Soil Moisture Relations in the Southern California Chaparral,
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Modeling Gradual Dam Breaches,
W82-00554 8D

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Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 5A

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A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
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Hydraulic Design for the Two-Stage Stilling Basin,
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SASKATCHEWAN UNIV., SASKATOON. DEPT. OF SOIL SCIENCE.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 2J

SAVANNAH RIVER ECOLOGY LAB., AIKEN, SC.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 5B

The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 2H

SCIENCE AND EDUCATION ADINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Sediment Yield from a Flatland Watershed,
W82-00941 2J

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Trenching of Digested Sludge,
W82-00974 5E

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD. PESTICIDE DEGRADATION LAB.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 5B

SCIENCE AND EDUCATION ADMINISTRATION, BUSHLAND, TX. CONSERVATION AND PRODUCTION RESEARCH LAB.
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 3F

Management of Recharge Basins on the Southern High Plains,
W82-00938 4B

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Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 5G

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A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 2H

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The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
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Watertable Management Saves Water and Energy,
W82-00943 3F

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 3F

SCIENCE AND EDUCATION ADMINISTRATION, NORTHEAST WATERSHED RESEARCH CENTER, UNIVERSITY PARK, PA.
Modeling Water Flux on Strip-Mined Land,
W82-00944 2G

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 2J

Sediment Sizes Eroded from Crop Row Sidelopes,
W82-00903 2J

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.
Depths of Flow in Level Basins,
W82-00900 3F

SCIENCE AND EDUCATION ADMINISTRATION, ST. PAUL, MN.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 3C

SCIENCE AND EDUCATION ADMINISTRATION, STILLWATER, OK. WATER CONSERVATION STRUCTURES LAB.
Tractive Force Design of Vegetated Channels,
W82-00901 4D

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. GRASSLAND, SOIL AND WATER RESEARCH LAB.
Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 2I

SCIENCE AND EDUCATION, BELTSVILLE, MD. HYDROLOGY.
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 2B

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Superseparation: Soret Effect Reversed,
W82-00791 3A

SECRETARY FOR AGRICULTURE AND FORESTRY, CISKEI (SOUTH AFRICA).
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 6D

SEVERN-TRENT WATER AUTHORITY (ENGLAND).
Environmental Virology and its Problems,
W82-00505 5A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 8A

SEWAGE RECLAMATION DEPT., TEL AVIV (ISRAEL).
Environmental Effects of Water Reuse Scheme,
W82-00973 3C

SHORT-ELLIOTT-HENDRICKSON, INC., ST. PAUL, MN.
Empire Controlled by Computer,
W82-00529 5D

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W82-00558 5C

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Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 5B

SNELL ENVIRONMENTAL GROUP, INC., LANSING, MI.
Ferric Chloride Takes Over,
W82-00954 5F

SOUTH CAROLINA UNIV., COLUMBIA. BELLE W. BARUCH INST. FOR MARINE BIOLOGY AND COASTAL RESEARCH.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 7A

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF BIOLOGY.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 2L

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY.
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 2L

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 2B

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF AGRICULTURAL INDUSTRIES.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 5D

SOUTHERN ILLINOIS UNIV. AT EDWARDSVILLE. DEPT. OF BIOLOGICAL SCIENCES.
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 2K

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W82-00589 5C

STANFORD UNIV., CA. DEPT. OF BIOLOGICAL SCIENCES.
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 2I

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 5B

STATE UNIV. OF NEW YORK AT ALBANY.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 2B

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF MECHANICAL ENGINEERING.
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W82-00981 1A

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF MICROBIOLOGY.
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 5D

STATE UNIV. OF NEW YORK COLL. AT FREDONIA. DEPT. OF ECONOMICS.
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 5E

STATION BIOLOGIQUE DE LA TOUR DU VALAT, ARLES (FRANCE).
Phosphate Models, a Gap to Bridge,
W82-00929 2H

STOCKHOLM UNIV. (SWEDEN). ARRHENIUS LAB.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 2B

STOCKHOLM UNIV. (SWEDEN). DEPT. OF GEOLOGY.
A Review on Sediment Traps in Aquatic Environments,
W82-01020 7B

STONE AND WEBSTER ENGINEERING CORP., CHERRY HILL, NJ.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 6A

SURREY UNIV., GUILFORD (ENGLAND). DEPT. OF MICROBIOLOGY.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 5D

SYBRON CORP., SALEM, VA. BIOCHEMICAL DIV.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 5D

SYDNEY UNIV. (AUSTRALIA). DEPT. OF INORGANIC CHEMISTRY.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 5A

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Economic Analysis of Granular-Bed Filtration,
W82-00975 5F

TECHNISCHE HOGESCHOOL TWENTE, ENSCHEDE (NETHERLANDS). DEPT. OF CHEMICAL ENGINEERING.
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 2H

TERMINAL ISLAND TREATMENT PLANT, LOS ANGELES, CA.
Foam Control in Aeration Tanks,
W82-00525 5D

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF OCEANOGRAPHY.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 5B

TEXAS CHRISTIAN UNIV., FORT WORTH. DEPT. OF GEOLOGY.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 2J

TEXAS TECH UNIV., LUBBOCK. DEPT. OF PLANT AND SOIL SCIENCE.
Effects of Water Quality on Forage Production,
W82-01002 3C

TEXAS UNIV. AT AUSTIN.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 7B

TEXAS UNIV. AT AUSTIN. DEPT. OF CIVIL ENGINEERING.
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 5B

TEXAS UNIV., GALVESTON. MEDICAL BRANCH.
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 5D

THE HEBREW UNIV., REHOVOT (ISRAEL). DEPT. OF SOIL AND WATER SCIENCE.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 3C

TOKYO METROPOLITAN UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 2H

Chemical Composition of Labile Fractions in DOM,
W82-00917 2H

TORO CO., SAN MARCOS, CA. (ASSIGNEE).
Traveling Sprinkler System and Method,
W82-00561 3F

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 5D

TORONTO UNIV. (ONTARIO). DEPT. OF ZOOLOGY.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 5C

TUDOR ENGINEERING CO., RIVERTON, WY.
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 6B

UNIVERSIDAD AUTONOMA DE NUEVO LEON, MONTERREY (MEXICO).
Chemicals Disinfect Sludge,
W82-01003 5D

UNIVERSIDADE FEDERAL DE VICOSA (BRAZIL).
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 2F

UNIVERSITY OF CENTRAL FLORIDA, ORLANDO. DEPT. OF CHEMISTRY.
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 5B

UNIVERSITY OF EAST ANGLIA, NORWICH (ENGLAND). SCHOOL OF ENVIRONMENTAL SCIENCES.
Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 2H

UNIVERSITY OF NEW ENGLAND, ARMIDALE (AUSTRALIA).
Research and Development to Service a Sustainable Agriculture,
W82-00649 3F

UNIVERSITY OF SOUTH FLORIDA, TAMPA. DEPT. OF CHEMISTRY.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 5G

UNIVERSITY OF SOUTH FLORIDA, TAMPA. DEPT. OF GEOLOGY.
Predictive Depositional Model for Glacial Aquifers,
W82-00828 2F

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 5C

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA).
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 8D

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 2B

UNIVERSITY OF WEST FLORIDA, PENSACOLA. DEPT. OF BIOLOGY.
Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 2L

UPPSALA UNIV. (SWEDEN). DEPT. OF LIMNOLOGY.
Reviving Acidified Lakes,
W82-00933 2H

UPPSALA UNIV. (SWEDEN). DIV. OF HYDROLOGY.
Spring Flood: Meltwater or Groundwater,
W82-00531 7B

UTAH WATER RESEARCH LAB., LOGAN.
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 3B

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CHEMISTRY.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1B

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF GENERAL BIOLOGY.
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 2I

VICTORIA DEPT. OF AGRICULTURE (AUSTRALIA). ATTWOOD VETERINARY RESEARCH LAB.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 5B

VICTORIA UNIV., WELLINGTON (NEW ZEALAND).
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 2A

VICTORIAN DEPT. OF AGRICULTURE, FERNTREE GULLY (AUSTRALIA). SCORESBY HORTICULTURAL RESEARCH STATION.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00606 2I

VIRGINIA INST. OF MARINE SCIENCES, GLOUCESTER POINT.
Kepone in the James River,
W82-00631 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. CENTER FOR ENVIRONMENTAL STUDIES.
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 5A

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 4C

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 5A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF ENTOMOLOGY.
Accurate and Efficient Estimation of Benthic Populations. A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 5A

VIRGINIA STATE WATER CONTROL BOARD, RICHMOND.
Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 4B

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 2K

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF FIELD CROPS.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 2I

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET DAGAN (ISRAEL). DIV. OF SOIL PHYSICS.
Transport of Salts in Soils and Subsoils,
W82-00930 5B

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF SOIL RESIDUES CHEMISTRY.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 5B

WASHINGTON STATE DEPT. OF ECOLOGY, OLYMPIA.
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 5D

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 5B

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 2H

WASHINGTON STATE DEPT. OF SOCIAL AND HEALTH SERVICES, OLYMPIA. OFFICE OF ENVIRONMENTAL PROGRAMS.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 5A

WASHINGTON STATE UNIV., PULLMAN. R. L. ALBROOK HYDRAULIC LAB.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 5B

WASHINGTON UNIV., SEATTLE. COLL. OF FISHERIES.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 8I

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 2H

WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 2H

WASHINGTON UNIV., SEATTLE. FISHERIES RESEARCH INST.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 5A

WATER POLICY TASK FORCE, LITTLE ROCK, AR.
Arkansas Water Policy.
W82-00715 6D

WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND).
Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 5D

WATER TREATMENT PLANT, TRAVERSE CITY, MI.
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 5F

WAUKESHA WATER UTILITY, WI.
Distribution System Liability,
W82-01028 5F

WEIZMANN INST. OF SCIENCE, REHOVOT (ISRAEL). ISOTOPE DEPT.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 7B

WESSEX WATER AUTHORITY (ENGLAND).
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 5D

WEST KENT WATER CO. (ENGLAND).
Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00773 5F

WEST VIRGINIA DEPT. OF NATURAL RESOURCES, CHARLESTON. DIV. OF WATER RESOURCES.
Ground Water Problems in West Virginia,
W82-01060 4B

WEST VIRGINIA UNIV., MORGANTOWN.
Bentonite Liners for Power Plant Lagoons,
W82-00617 5E

WEST VIRGINIA UNIV., MORGANTOWN. DEPT. OF BIOLOGY.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 2H

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 2I

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 5G

WESTECH ENGINEERING, INC., SALEM, OR.
Why EPA's I/I Control Program Fails,
W82-00790 8A

WESTERN AUSTRALIA UNIV., NEDLANDS.
A Comparison of Rainfall-Runoff Models,
W82-00911 2A

WEYERHAEUSER CO., LONGVIEW, WA.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 5A

WEYERHAUSER CO., CENTRALIA, WA.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 2I

WHEELER AND GRAY, LOS ANGELES, CA.
Formulating Alternatives for Environmental Studies,
W82-00997 6G

WILLIAMSPORT SANITARY AUTHORITY, PA.
What Caused the Bad Odor in the Drinking Water,
W82-00527 5F

WISCONSIN UNIV.-MADISON.
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 2H

WISCONSIN UNIV.-MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
Groundwater Quality Models - State of the Art,
W82-01061 5G

WISCONSIN UNIV.-OSHKOSH. DEPT. OF GEOLOGY.
Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 6E

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 3C

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 2H

WUIDART ENGINEERING LTD., SHEFFORD BEDS (ENGLAND).
Hydrogeological and Geophysical Logging.
W82-00511 7B

WYOMING UNIV., LARAMIE. DEPT. OF BOTANY.
Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 2I

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 2D

YALE UNIV., NEW HAVEN, CT.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 5C

ZOOLOGICAL STATION, TVARMINNE (FINLAND).
Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 2L

[illegible] COAST, LOS ANGELES, CAL.

[illegible]

WASHINGTON UNIV., SEATTLE. [illegible]

[illegible]

WASHINGTON STATE DEPT. OF [illegible]

[illegible]

ACCESSION NUMBER INDEX

W82-00501	5B
W82-00502	5A
W82-00503	5A
W82-00504	2I
W82-00505	5A
W82-00506	6D
W82-00507	5B
W82-00508	5A
W82-00509	4D
W82-00510	6E
W82-00511	7B
W82-00512	3F
W82-00513	5B
W82-00514	5B
W82-00515	5G
W82-00516	5A
W82-00517	5C
W82-00518	5C
W82-00519	6B
W82-00520	2H
W82-00521	7B
W82-00522	6A
W82-00523	5D
W82-00524	3C
W82-00525	5D
W82-00526	5E
W82-00527	5F
W82-00528	5D
W82-00529	5D
W82-00530	5A
W82-00531	7B
W82-00532	5A
W82-00533	5B
W82-00534	5D
W82-00535	2H
W82-00536	6C
W82-00537	6B
W82-00538	6B
W82-00539	6A
W82-00540	1B
W82-00541	2L
W82-00542	6G
W82-00543	4C
W82-00544	3F
W82-00545	2H
W82-00546	5G
W82-00547	2L
W82-00548	5C
W82-00549	6A
W82-00550	5B
W82-00551	5B
W82-00552	2H
W82-00553	5B
W82-00554	8D
W82-00555	2A
W82-00556	8A
W82-00557	5B
W82-00558	5C
W82-00559	5B
W82-00560	2G
W82-00561	3F
W82-00562	5G
W82-00563	5B
W82-00564	3C
W82-00565	5E
W82-00566	5D
W82-00567	5A
W82-00568	5B
W82-00569	5A
W82-00570	5B
W82-00571	2H
W82-00572	5A
W82-00573	5A
W82-00574	5A
W82-00575	5B
W82-00576	5A
W82-00577	5B
W82-00578	5A
W82-00579	5A
W82-00580	5A
W82-00581	5A
W82-00582	5A
W82-00583	5C
W82-00584	5A
W82-00585	2H
W82-00586	5B
W82-00587	5C
W82-00588	5D
W82-00589	5C
W82-00590	5C
W82-00591	5E
W82-00592	5C
W82-00593	5C
W82-00594	5G
W82-00595	5B
W82-00596	5C
W82-00597	6G
W82-00598	6A
W82-00599	5B
W82-00600	2E
W82-00601	7B
W82-00602	2F
W82-00603	7B
W82-00604	2A
W82-00605	2G
W82-00606	2H
W82-00607	2I
W82-00608	2I
W82-00609	3B
W82-00610	5A
W82-00611	5D
W82-00612	5B
W82-00613	5F
W82-00614	5A
W82-00615	5A
W82-00616	5B
W82-00617	5E
W82-00618	5F
W82-00619	5F
W82-00620	5G
W82-00621	2K
W82-00622	5B
W82-00623	5D
W82-00624	4A
W82-00625	5F
W82-00626	5B
W82-00627	5A
W82-00628	5G
W82-00629	5B
W82-00630	5A
W82-00631	5B
W82-00632	5C
W82-00633	5A
W82-00634	5D
W82-00635	5A
W82-00636	5D
W82-00637	5D
W82-00638	5D
W82-00639	5D
W82-00640	5E
W82-00641	5D
W82-00642	5B
W82-00643	2K
W82-00644	5A
W82-00645	5F
W82-00646	5A
W82-00647	2A
W82-00648	2I
W82-00649	5A
W82-00650	5F
W82-00651	6G
W82-00652	2A
W82-00653	2H
W82-00654	2I
W82-00655	2D
W82-00656	2K
W82-00657	4A
W82-00658	3C
W82-00659	2H
W82-00660	2D
W82-00661	5E
W82-00662	5A
W82-00663	3C
W82-00664	2H
W82-00665	2H
W82-00666	2H
W82-00667	2H
W82-00668	2E
W82-00669	3F
W82-00670	2A
W82-00671	6A
W82-00672	5C
W82-00673	5C
W82-00674	5B
W82-00675	2H
W82-00676	2B
W82-00677	5C
W82-00678	8D
W82-00679	6A
W82-00680	7B
W82-00681	3C
W82-00682	5A
W82-00683	2L
W82-00684	6G
W82-00685	6D
W82-00686	5B
W82-00687	5C
W82-00688	5C
W82-00689	5D
W82-00690	5A
W82-00691	5C
W82-00692	2B
W82-00693	2I
W82-00694	2J
W82-00695	2J
W82-00696	3F
W82-00697	2F
W82-00698	5D
W82-00699	5D
W82-00700	6E
W82-00701	6E
W82-00702	6E
W82-00703	5G
W82-00704	5G
W82-00705	5G
W82-00706	5C
W82-00707	5C
W82-00708	5C
W82-00709	5B
W82-00710	5B
W82-00711	5B
W82-00712	5A
W82-00713	5C
W82-00714	6D
W82-00715	6D
W82-00716	6F
W82-00717	3C
W82-00718	6E
W82-00719	6E
W82-00720	6E
W82-00721	6E
W82-00722	6C
W82-00723	5B
W82-00724	2E
W82-00725	7C
W82-00726	2E
W82-00727	7C
W82-00728	7C
W82-00729	7C
W82-00730	6A
W82-00731	7C
W82-00732	7C
W82-00733	7C
W82-00734	7C
W82-00735	6B
W82-00736	6D
W82-00737	6G
W82-00738	6G
W82-00739	6D
W82-00740	5A
W82-00741	5A
W82-00742	6E
W82-00743	6E
W82-00744	6E
W82-00745	6E
W82-00746	6E
W82-00747	6E
W82-00748	6E
W82-00749	6E
W82-00750	6E
W82-00751	6E
W82-00752	6E
W82-00753	6E
W82-00754	6E
W82-00755	6E
W82-00756	7B
W82-00757	2L
W82-00758	2I
W82-00759	2I
W82-00760	2I
W82-00761	2I
W82-00762	2I
W82-00763	4A
W82-00764	3F
W82-00765	3F
W82-00766	4D
W82-00767	3C
W82-00768	5D
W82-00769	3C
W82-00770	5B
W82-00771	3F
W82-00772	6B
W82-00773	5F
W82-00774	5F
W82-00775	5F
W82-00776	2J
W82-00777	5B
W82-00778	5A
W82-00779	5C
W82-00780	6A
W82-00781	7B
W82-00782	6G
W82-00783	2H
W82-00784	10D
W82-00785	2G
W82-00786	5A
W82-00787	5A
W82-00788	1B
W82-00789	5C
W82-00790	8A
W82-00791	3A
W82-00792	2L
W82-00793	7B
W82-00794	5D
W82-00795	2L
W82-00796	5A
W82-00797	5B
W82-00798	5A
W82-00799	6E
W82-00800	6E
W82-00801	5B
W82-00802	6A
W82-00803	2B
W82-00804	8B
W82-00805	5C
W82-00806	2B
W82-00807	2B
W82-00808	2B
W82-00809	5B
W82-00810	2H
W82-00811	2I
W82-00812	2I
W82-00813	6G
W82-00814	2H
W82-00815	2J
W82-00816	7A
W82-00817	2F
W82-00818	6E
W82-00819	6A
W82-00820	5A
W82-00821	2K
W82-00822	2H
W82-00823	2K
W82-00824	2H
W82-00825	2H
W82-00826	7B
W82-00827	2F
W82-00828	2F
W82-00829	7B
W82-00830	7B
W82-00831	2F
W82-00832	4B
W82-00833	7B
W82-00834	5C
W82-00835	2B
W82-00836	2C

ACCESSION NUMBER INDEX

W82-00837	2H
W82-00838	2L
W82-00839	2I
W82-00840	7B
W82-00841	5D
W82-00842	3C
W82-00843	2H
W82-00844	2C
W82-00845	2C
W82-00846	2I
W82-00847	5D
W82-00848	5D
W82-00849	8B
W82-00850	5A
W82-00851	5D
W82-00852	2F
W82-00853	5B
W82-00854	2K
W82-00855	5A
W82-00856	5A
W82-00857	5A
W82-00858	6D
W82-00859	5A
W82-00860	5C
W82-00861	6C
W82-00862	8D
W82-00863	2A
W82-00864	2I
W82-00865	5A
W82-00866	5G
W82-00867	5F
W82-00868	5A
W82-00869	4D
W82-00870	5C
W82-00871	5D
W82-00872	5C
W82-00873	5B
W82-00874	5B
W82-00875	5A
W82-00876	5B
W82-00877	5B
W82-00878	5A
W82-00879	5A
W82-00880	8B
W82-00881	2J
W82-00882	2H
W82-00883	8I
W82-00884	5A
W82-00885	9A
W82-00886	5B
W82-00887	2K
W82-00888	5F
W82-00889	2L
W82-00890	4A
W82-00891	5A
W82-00892	7B
W82-00893	5G
W82-00894	2G
W82-00895	3F
W82-00896	2J
W82-00897	5D
W82-00898	6A
W82-00899	3F
W82-00900	3F
W82-00901	4D
W82-00902	2J
W82-00903	2J
W82-00904	7B
W82-00905	5D
W82-00906	5D
W82-00907	5B
W82-00908	6G
W82-00909	8G
W82-00910	2L
W82-00911	2A
W82-00912	2I
W82-00913	5D
W82-00914	2H
W82-00915	2H
W82-00916	5A
W82-00917	2H
W82-00918	2L
W82-00919	2H
W82-00920	2H
W82-00921	2L
W82-00922	2L
W82-00923	2H
W82-00924	5C
W82-00925	5C
W82-00926	2A
W82-00927	2A
W82-00928	2H
W82-00929	2H
W82-00930	5B
W82-00931	2D
W82-00932	2G
W82-00933	2H
W82-00934	4B
W82-00935	2I
W82-00936	2H
W82-00937	5D
W82-00938	4B
W82-00939	5D
W82-00940	3F
W82-00941	2J
W82-00942	3F
W82-00943	3F
W82-00944	2G
W82-00945	5F
W82-00946	5F
W82-00947	5D
W82-00948	5E
W82-00949	5D
W82-00950	5D
W82-00951	5D
W82-00952	5B
W82-00953	5F
W82-00954	5F
W82-00955	5D
W82-00956	5D
W82-00957	5D
W82-00958	2I
W82-00959	5A
W82-00960	8A
W82-00961	6A
W82-00962	5B
W82-00963	1A
W82-00964	2B
W82-00965	2B
W82-00966	2C
W82-00967	2H
W82-00968	5D
W82-00969	5D
W82-00970	5D
W82-00971	5D
W82-00972	6E
W82-00973	3C
W82-00974	5E
W82-00975	3F
W82-00976	5D
W82-00977	5D
W82-00978	6G
W82-00979	2D
W82-00980	2K
W82-00981	1A
W82-00982	5B
W82-00983	2B
W82-00984	2A
W82-00985	2F
W82-00986	2A
W82-00987	2H
W82-00988	5A
W82-00989	2J
W82-00990	2F
W82-00991	7A
W82-00992	2I
W82-00993	5B
W82-00994	2K
W82-00995	2B
W82-00996	6E
W82-00997	6G
W82-00998	5C
W82-00999	5A
W82-01000	5B
W82-01001	5E
W82-01002	3C
W82-01003	5D
W82-01004	7B
W82-01005	3B
W82-01006	2B
W82-01007	5D
W82-01008	5D
W82-01009	5D
W82-01010	2I
W82-01011	2I
W82-01012	7B
W82-01013	6E
W82-01014	3E
W82-01015	2K
W82-01016	2F
W82-01017	5A
W82-01018	2G
W82-01019	2H
W82-01020	7B
W82-01021	2K
W82-01022	5B
W82-01023	3F
W82-01024	5B
W82-01025	5B
W82-01026	5E
W82-01027	6A
W82-01028	5F
W82-01029	8A
W82-01030	6E
W82-01031	5C
W82-01032	5B
W82-01033	5C
W82-01034	2I
W82-01035	2D
W82-01036	2K
W82-01037	2E
W82-01038	1A
W82-01039	2I
W82-01040	5B
W82-01041	5A
W82-01042	5D
W82-01043	5A
W82-01044	2G
W82-01045	5F
W82-01046	5A
W82-01047	3C
W82-01048	5G
W82-01049	5G
W82-01050	2D
W82-01051	6E
W82-01052	4B
W82-01053	4B
W82-01054	4B
W82-01055	4B
W82-01056	4B
W82-01057	4B
W82-01058	4B
W82-01059	4B
W82-01060	4B
W82-01061	5G
W82-01062	4B
W82-01063	5D
W82-01064	5D
W82-01065	5B
W82-01066	5C
W82-01067	6E
W82-01068	5B
W82-01069	5B
W82-01070	2H
W82-01071	5A
W82-01072	2H
W82-01073	5D
W82-01074	5D
W82-01075	5D
W82-01076	5D
W82-01077	5D
W82-01078	6E
W82-01079	5C
W82-01080	2H
W82-01081	5G
W82-01082	5A
W82-01083	5A
W82-01084	5A
W82-01085	5A
W82-01086	5A
W82-01087	6G
W82-01088	5F
W82-01089	2I
W82-01090	5A
W82-01091	5C
W82-01092	6B
W82-01093	5B
W82-01094	5C
W82-01095	8B
W82-01096	2H
W82-01097	5A
W82-01098	5A
W82-01099	5A
W82-01100	5A

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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SELECTED
WATER RESOURCES
ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 3
MARCH 1, 1982

W82-01101 -- W82-01600

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus**. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

IDENTIFICATION OF THE WAIRAKEI GEOTHERMAL SYSTEM,
Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
For primary bibliographic entry see Field 2F.
W82-01312

ON IDENTIFICATION AND VALIDATION OF SOME GEOTHERMAL MODELS,
Department of Scienfitic and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
For primary bibliographic entry see Field 6A.
W82-01467

1B. Aqueous Solutions and Suspensions

MODELING OF ACTIVATED CARBON AND COAL GASIFICATION CHAR ADSORBENTS IN SINGLE-SOLUTE AND BISOLUTE SYSTEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
W. E. Thacker, V. L. Snoeyink, and J. C. Crittenden.
Water Resources Center, University of Illinois, Research Report No 161, July, 1981. 166 p, 31 Fig, 18 Tab, 119 Ref. S-077-ILL.

Descriptors: *Adsorbents, *Mathematical models, Solutes, *Activated carbon, *Coal gasification, *Organic compounds, Hydrologic models, Films, Bed sediment, Mathematical studies, Influent streams, Mathematical equations, Bottom sediments.

This research project had three objectives: (1) to assess the ability of a fixed-bed model to predict the effect of a sustained step change in influent concentration and to describe the process of desorption; (2) to compare with a fixed-bed model the behavior of different adsorbents in the uptake of aqueous organics; and (3) to investigate with a fixed-bed model factors that affect desorption. Both single-solute and bisolute systems were studied. A mathematical model of fixed-bed adsorption was used to predict the bed response to a sustained step change and it was observed that, under conditions approximating a drinking-water plant, the time during which the effluent concentration of a desorbed species was higher than the influent concentration was significant, whether a reduced influent concentration or competition was responsible for the desorption. Model equations, which considered that film transfer and surface diffusion controlled the adsorption rate, were solved with the technique of orthogonal collocation. Three species--3,5-dimethylphenol; 3,4-dichlorophenol; and rhodamine 6G--were the single solutes studied and the two phenols were also examined as a mixture. Four activated carbons and a coal gasification char were the adsorbents studied. The model was used to compare the adsorbents in the removal of DMP, R6G and the bisolute mixtures. Equilibrium capacity was found to have a greater influence than kinetics on fixed-bed performance. Surface area was a better indicator of capacity than pore size distribution for the solutes and adsorbents examined. (Garrison-Omniplan)
W82-01447

2. WATER CYCLE

2A. General

MODELING HYDROLOGIC TIME SERIES FROM THE ARCTIC,
Underwood McLelland and Associates Ltd., Winnipeg (Manitoba).
P. C. Baracos, K. W. Hipel, and A. I. McLeod.
Water Resources Bulletin, Vol 17, No 3, p 414-422, June, 1981. 5 Fig, 8 Tab, 18 Ref.

Descriptors: *Arctic, *Hydrologic data, *Intervention analysis, Cold regions, Meteorological data collection, Stochastic hydrology, *Time series analysis, River flow.

The general intervention model was used with hydrologic and meteorologic data from the Arctic to account for environmental interventions, missing observations in the data, changes in data collection procedures, the effects of external impacts, and extreme seasonality and other autocorrelations. Flow data (10-15 years) from 16 rivers in the Canadian Northwest Territories and meteorological data (30-40 years) from five stations were used to demonstrate the flexibility of the model. Intervention analysis also permitted the extension of 8 years of hydrometric data for the Tree River to an artificially-extended 44-year series, using 44 years of meteorologic data from a nearby weather station at Coppermine. There was good agreement between predicted and observed flows, with largest errors being found in the magnitude of peak flows. (Cassar-FRC)
W82-01198

DRAINAGE NETWORK STRUCTURE AND THE DIAMETER-MAGNITUDE RELATION,
State Univ. of New York at Buffalo. Dept. of Geography.
R. S. Jarvis, and C. H. Sham.
Water Resources Research, Vol 17, No 4, p 1019-1027, August, 1981. 7 Fig, 4 Tab, 18 Ref.

Descriptors: *Drainage patterns, *River basins, *Tributaries, Morphology, Networks, Erosion, Geohydrology, River systems, Basins, Great Britain.

The variation of drainage network structure with basin size was studied in two areas in Britain, the 1400 sq dm Southern Uplands (high plateau, deeply hewn by glacial troughs) and the 1900 sq km Culm Measures region (nonglaciated, open rolling landscape of moderately low relief). The network parameters considered were diameter (maximum number of links in any flow path from a source to the outlet, an index of mainstream length) and magnitude (number of sources in the network, proportional to basin size). Diameter increased with magnitude, but at a decreasing rate as networks were sampled over a greater size range. In the glacial basin the streams tend to follow existing glacial troughs; tributaries are larger and form a more branched Y-shaped network. In a region of normal fluvial erosion, the river network is more elongated and consists of a dominant main stream receiving small tributaries, resembling the ribs of a leaf. The sequence of tributary magnitudes down a main stream is not random. Small tributaries follow other small tributaries along the river course, each requiring little basin space and each having little effect on the size of the next tributary. However, large tributaries spread over wide areas and preclude development of other large tributaries in the near vicinity on their side of the main stream. (Cassar-FRC)
W82-01308

OPTIMAL RISK-BASED DESIGN OF FLOOD LEVEE SYSTEMS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-01313

DRAINAGE DENSITY AS AN INDEX OF CLIMATIC GEOMORPHOLOGY,
Guyana Univ., Georgetown.
J. R. K. Daniel.
Journal of Hydrology, Vol 50, No 1-3, p 147-154, March, 1981. 2 Fig, 13 Ref.

Descriptors: *Drainage density, *Geomorphology, *Denudation, Rainfall-runoff relationships, Runoff, Sediment yield, Guyana, Precipitation, Rainfall, Climatology, Rain forests, Tropical regions, Grasslands, Streamflow.

Most studies on the relationships between climate and denudation in the humid tropics use sediment yield as an important parameter to measure the rate of denudation. Since this data is not available for all catchments, this paper uses drainage density as an alternative morphometric index, combined with mean annual precipitation, to examine a tropical rain forest and a savanna in Guyana. The drainage density was computed from topographic maps, also taking the contour crenulations into consideration. A typical area in the savannas had a drainage density of 2.83 (1.76 km per sq km), and in the tropical forest receiving twice the rainfall, 3.02 (1.88 km per sq km). Drainage density was inversely related to the amount of vegetative cover. Drainage density did not increase proportionately with the rainfall in the tropical forest. The savanna has a high drainage density caused by low rainfall during a short wet season, inhibited plant growth, and greater runoff. In the rain forest the drainage density reaches a maximum level at a mean annual precipitation of about 3000 mm per year, and remains constant or decreases. (Cassar-FRC)
W82-01324

THE WATER BALANCE OF THE BETWA BASIN, INDIA,
Institute of Hydrology, Wallingford (England).
J. V. Sutcliffe, P. P. Agrawal, and J. M. Tucker.
Hydrological Sciences Bulletin, Vol 26, No 2, p 149-158, June, 1981. 4 Fig, 3 Tab, 2 Ref.

Descriptors: *Hydrologic budget, *Soil water, *Groundwater recharge, Rainfall, Runoff, Water storage, Mathematical studies, River basins, *Betwa basin, *India.

An account is provided of the water balance of the Betwa basin, India, as a framework for detailed studies of the hydrological processes and of the hydrogeology. Determination of the water balance was part of an attempt to estimate the seasonal soil moisture storage and groundwater recharge. Data from 1926 through 1975 were used to study rainfall distribution, evaporation was estimated using the Penman method, and long-term annual total inflows to Dhukwan and Matatila dams were estimated. Gross and net rainfall were compared with annual runoff to summarize the water balance. Seasonal soil moisture recharge was estimated at 175 mm. This figure is the average amount of storage available to crops after the monsoon each year. Physical studies are needed to determine more precisely the groundwater recharge for surface and deeper water bodies. (Small-FRC)
W82-01354

OBSERVATIONS ON THE HYDROGRAPHY AND INSHORE PLANKTON OF THE BAY OF BENGAL OFF BALASORE,
Ravenshaw Coll., Cuttack (India). Dept. of Zoology.
S. Pati.
Hydrobiologia, Vol 70, No 1/2, p 123-132, April, 1980. 4 Fig, 34 Ref.

Descriptors: *River runoff *Salinity, *Monsoons, *Bay of Bengal, Zooplankton, Copepods, Path of pollutants, Phytoplankton, Water quality, Runoff, Nutrients, Biomass, Productivity, Invertebrates, *Plankton, Bioindicators, India.

The hydrology of the northern part of the Bay of Bengal near the Balasore coast is governed by the monsoons and the river runoff into the bay. In a study conducted from March 1972 to February 1974, salinity, which varied from 22.35 to 33.62 parts per thousand, was lowest in October, when the two large river systems, the Ganga and the Brahmaputra, discharge huge quantities of freshwater into this part of the bay. The peak values for nutrients (phosphates, 2.26 microgram atom per liter, and nitrates, 13.4 microgram atom per liter) were observed during July to November, coinciding with the southwest monsoons. Surface temperature of the water reached maxima of 19.5

degrees C in May and September, with a minimum of 25 degrees C in winter. Dissolved oxygen concentrations were generally high 3.02-5.30 ml per liter. pH varied from 7.2 to 8.2. Standing crop was highest June to November, with a minor peak in March-April. Plankton biomass, both phytoplankton and copepods, showed peaks in April, July-August, and October. (Cassar-FRC)
W82-01362

A CATCHMENT APPROACH TO FLOOD ESTIMATION,

Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-01397

YEAR-TO-YEAR CHANGES IN THE SALINITY OF THE EASTERN ENGLISH CHANNEL, 1948-1973: A BUDGET,

Institute for Marine Environmental Research, Plymouth (England).
A. H. Taylor, P. C. Reid, T. J. Marsh, T. D. Jonas, and J. A. Stephens.
Journal of the Marine Biological Association of the United Kingdom, Vol 61, No 2, p 489-507, May, 1981. 12 Fig, 2 Tab, 21 Ref.

Descriptors: *Salinity, *Seasonal variation, *River runoff, Runoff, Model studies, *English Channel, Variability, Evaporation, Precipitation, Rainfall, Water circulation, Seawater, Mixing, Water currents, Tides.

River runoff and mixing by wind and tides are the main factors responsible for the seasonal changes of salinity in the eastern English Channel, according to predictions with a model using the calculated monthly mean total runoff data for 1948-73. Total runoff into the eastern English Channel from England and France was assessed at 214 mm or 889 cu m/sec. A long term mean salinity of 35.04 o/oo with a year-to-year variance of 0.0122 o/oo was predicted. This compares well with observed values for the main section of the channel, 35.019 o/oo with a variance of 0.0123 o/oo. Including the monthly evaporation and precipitation changes for 1961-73 improved salinity predictions. The model was able to predict about 80% of the variance of salinity in the eastern English Channel from knowledge of the salinity in the mouth of the Channel by using river runoff, evaporation, and precipitation data. About half the variance in annual mean salinity in the eastern English Channel is the result of abnormally high or low salinity water being transported through the region. Although water movements and salinity variations in the North Atlantic affect salinity of the channel mouth, there is no correlation between salinity fluctuations in the channel entrance and in the eastern English channel. (Cassar-FRC)
W82-01399

TIME DISTRIBUTION OF CLOCK HOUR RAINFALL,

Science and Education Administration, Columbia, MO.
A. T. Hjelmfelt.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980, p 379-385, 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Temporal distribution, *Rainfall, *Simulation, *Runoff, Rainfall-runoff relationships, Small watersheds, Model studies.

Simulation of runoff from rainfall events requires rainfall in time increments not greater than the time to equilibrium for the watershed. For small watersheds the time to equilibrium will be measured in minutes, whereas the easily available rainfall data will be available at clock-four intervals. A rainfall event indicated as occurring in a single clock hour will have an actual duration of not more than 60 minutes. The 60 minute equivalent is considered to be 1.13 times the clock hour rainfall. When determining time distribution of rainfall from clock hour quantities, the great variability in events must be recognized. At this time there seems little advantage in applying an average distribution to any storm with values recorded in 3 clock-hours or more. The average intensity for each hour is probably the best estimate. Most storms occurring in 1 clock-hour will last less than 60 minutes. Using the total hour as the duration will underestimate the peak discharge. Multiplying the clock hour value by 1.13 should result in the equivalent, on a return period basis, 60 minute catch on the average. The equivalent 60 minute catch can be used to obtain the time distribution for peak discharge estimates. (See also W82-10401) (Moore-SRC)
W82-01402

THE SIGNIFICANCE OF SNOWMELT ON WATER SUPPLIES IN THE NORTHEAST,

Jordan (Edward C.) Co., Inc., Portland, ME. Water Service Dept.
S. Medlar.
Journal of the New England Water Works Association, Vol 95, No 2, p 134-144, June, 1981. 4 Tab, 13 Ref.

Descriptors: *Snowmelt, *Snow depth, *Runoff, Groundwater recharge, Thaw, Rainfall, Snow density, Snow accumulation, Snow, Water supply, Northeastern United States, *New England.

Snowfall in New England for the winter of 1979-80 was analyzed to investigate the role of snowmelt in the availability of water supplies. Field information about depth and water content can be used to estimate potential runoff from snow. The average water content of snow in New England is about 18-19%, and the volume of snowmelt that reaches a reservoir depends on surface topography, frozen or thawed soil, air dynamics, watershed conditions, sunlight, temperature, wind, and vegetation. Snowmelt influences water quality by suspending turbidity, dissolving color, diluting chlorides, and changing pH. Evaporation from snow can be 80%, and snow on the ground will absorb rain until saturated. Snowmelt contributes to major flooding, and groundwater recharge is affected by snowmelt water infiltration. Rainfall has a greater recovery value than snow. The extent of this difference in recovery depends upon the time delay between precipitation and melting. (Small-FRC)
W82-01488

USING COMPUTED STREAM FLOW IN WATERSHED ANALYSIS,

Delaware Univ., Newark. Dept. of Geography.
J. R. Mather.
Water Resources Bulletin, Vol 17, No 3, p 474-482, June, 1981. 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Hydrologic budget, *Streamflow, *Watersheds, Climatology, Rainfall-runoff relationships, River basins, Precipitation, *Delmarva Peninsula, Regression analysis, Runoff, Stream gages.

Observed and computed streamflows were compared on a monthly and annual basis for 28 basins on the Delmarva peninsula, a region with little snow cover. The results of correlation-regression analysis produced three groupings of basins. For the 8 basins in the first category, the calculations obtained from the climatic water budget were in good agreement with observed streams runoff figures (regression line slope ≈ 1). In the second group of 10 basins a regression line slope = 1 was obtained, but it was displaced from the y = x line. A slight correction of the water budget (moisture storage in the root zone of the soil) produced good agreement between calculated and observed streamflow values. The third category, including 10 watersheds, had serious differences between values, which pointed to hydrologic peculiarities in the basins (deep aquifer leakage, interbasin transfers, gage error, and difference in root zone water storage). The Manokin Branch, which had the greatest differences (r = 0.61, y = 0.38 x plus 3.76) revealed a sharp change in correlation in 1968. A search of records uncovered that in that year ditching operations were started and sheet metal panels were installed around the gage. (Cassar-FRC)
W82-01538

018 MODELLING OF FRESHWATER INPUTS IN BAFFIN BAY AND CANADIAN ARCTIC COASTAL WATERS,

Quebec Univ., Montreal. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2C.
W82-01590

2B. Precipitation

FATTY ACID AND HYDROCARBON CONTENT OF SETTLING SEDIMENTS IN LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 2H.
W82-01154

A DENDROCLIMATIC RECONSTRUCTION OF ANNUAL PRECIPITATION AMOUNTS IN IOWA SINCE 1680,

Oak Ridge National Lab., TN.
D. N. Duvick, and T. J. Blasing.
Water Resources Research, Vol 17, No 4, p 1183-1189, August, 1981. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Drought, *Climatic data, *Dendrochronology, *Precipitation, *Iowa, Trees, Tree rings, Regression analysis.

Core samples from 30 white oak trees at each of three sites in central Iowa were used to determine the tree ring widths and, in turn, the total precipitation for the period about one year preceding the end of radial growth. Regression analysis of this data produced annual (August-July) precipitation information for the years 1680-1979. Predicted precipitation agreed well with precipitation in years for which data were available. Reconstructed data indicate five 10-year periods comparable in dryness to the 1930's: 1816-1825, 1735-1744, 1696-1705, 1931-1940, and 1791-1800, listed in order of decreasing dryness. The 12-year 1816-1827 period was an uninterrupted drought with yearly precipitation ranging from 62.8 cm to 79.1 cm. These values suggest that long-term planners should consider the possibility of about two such droughts each century. Such a dry spell could seriously affect water supplies in Iowa. (Cassar-FRC)
W82-01314

DEUTERIUM/HYDROGEN RATIOS IN AUSTRALIAN RAINFALL,

Australian Atomic Energy Commission Research Establishment, Lucas Heights.
P. E. Hartley.
Journal of Hydrology, Vol 50, No 1-3, p 217-229, March, 1981. 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Deuterium, *Rainfall intensity, *Isotope studies, Dew point, Climatology, *Australia, Groundwater, Precipitation, Model studies.

A simple model was developed to clarify the way in which the isotopic composition of precipitation (deuterium/hydrogen ratios) is influenced by meteorological variables. The model is consistent with monthly data measured over 3 years at 14 Australian sites. The major influences on D/H ratios are dew point and rainfall intensity. Intense storms reduce the fractionation, producing isotopically lighter rain. The lower the average rainfall of a station, the lower its D/H ratio; but the higher the rainfall in any month at a given station, the lower the D/H ratio for that month. A low dew point is associated with isotopically light vapor and less intense rain, which is isotopically heavier for a given vapor composition, resulting in a negative correlation between D content and dew point at lower latitudes (12 to 30 degrees S) and a positive correlation at higher latitudes (32 to 38 degrees S). These findings show that false conclusions may be reached in attempts to relate climate to D/H ratios of ancient groundwaters by assuming that the isotopic composition of the precipitation causing re-

charge is always directly related to average annual temperature at the time of recharge. (Cassar-FRC)
W82-01325

NOTE ON PROBABILITY APPROACH TO STUDY THE OCCURRENCE OF RAINFALL AT HYDERABAD,

All-India Co-ordinated Rice Improvement Project, Hyderabad (India).
R. K. Mahajan, and A. V. Rao.
Indian Journal of Agricultural Sciences, Vol 51, No 1, p 62-65, January, 1981. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Rainfall, *Probability distribution, Probabilistic process, Mathematical studies, Stochastic process, Frequency distribution, Rainfall distribution, Farm management, Crop yield, Hyderabad, *India.

An attempt was made to study the behavior of occurrence of dry and wet days during the crop season of rice and to determine the optimum sowing time by computing the weekly rainfall probabilities. Data relating to rainfall from 1 June to 30 September was collected for studying the distribution of rainfall. The difference between the probabilities of wet day preceded by a dry day, P (W/D), and wet day preceded by a wet day, p (W/W) tested year-wise by the usual normal deviate statistic revealed that the occurrence of a wet (or dry) day was highly influenced by the previous day's weather in all the years studied. Thus the occurrence of wet and dry days in the given tract could be strictly described by a 2-state Markov chain with the transition probability as demonstrated. The occurrence of a dry day was more probable than the occurrence of a wet day. The expected cycle of wet and dry days was 7 days. The expected number of wet and dry days was 35 and 87 days, respectively. Such data are helpful in planning proper management of crops for highest potential yield. (Baker-FRC)
W82-01380

ANOMALOUS SNOWFALL CAUSED BY NATURAL-DRAFT COOLING TOWERS,

Rand Corp., Santa Monica, CA.
L. R. Koenig.
Atmospheric Environment, Vol 15, No 7, p 1117-1128, 1981. 11 Fig, 3 Tab, 19 Ref.

Descriptors: *Cooling towers, *Snow, Precipitation, Temperature effects, Plumes, Clouds, Water vapor.

The potential for snowfall from cooling-tower plumes was investigated. Occurrences of this type have been documented in the literature. Direct observations indicate that the areal extent of snowfall from cooling towers greatly exceeds the resolution of several satellite systems, and therefore should be detected in their imagery. The model used in the present study predicts the characteristics of a plume element, or puff, as it emerges from the cooling tower, rises, and travels downwind. In all cases reported, the moisture source flux is 1000 kg/sec. It is emitted to the atmosphere as saturated air having a temperature of 25 degrees C. These conditions are appropriate for wet towers at a plant delivering about 2500 MW of electricity. In the runs discussed in this problem, the plume depth was limited to 500 meters. It was concluded that the amount of snow falling from cooling towers plumes depends on the outcome of the competition between the evaporation of the plume and the total growth of ice particles. The depth of snow depends on these factors plus the dispersion of the snow. The growth of ice depends on the concentration of ice particles and their growth rates. The evaporation of the plume depends on the ability of the ambient air to receive water vapor and the rate of mixing between the plume and its surroundings. Criteria were figured to include temperatures below minus 13 degrees C and ambient water vapor deficits less than 0.5 g/cubic meter in order for measurable snow to fall within about 50 km of a 100 kg/sec water vapor source, assuming that wind speeds are about 10 m/sec at the plume. (Baker-FRC)
W82-01512

AN ANALYSIS OF ACIDIC PRECIPITATION IN SOUTH-CENTRAL ONTARIO USING AIR PARCEL TRAJECTORIES,

Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 5B.
W82-01513

RECENT ACIDIFICATION OF PRECIPITATION IN NORTH AMERICA,

Cornell University, Ithaca, NY. Section of Ecology and Systematics.
For primary bibliographic entry see Field 5B.
W82-01514

THE INFERENCE OF GATE CONVECTIVE RAINFALL FROM SMS-1 IMAGERY,

National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
For primary bibliographic entry see Field 7B.
W82-01519

ICE NUCLEUS CONCENTRATIONS MEASURED DURING THE 1975 FLORIDA AREA CUMULUS EXPERIMENT (FACE),

MITRE Corp., McLean, VA.
For primary bibliographic entry see Field 7B.
W82-01522

AN IMPROVED METHOD FOR OBTAINING THE WATER CONTENT VALUES OF ICE HYDROMETEORS FROM AIRCRAFT AND RADAR DATA,

Air Force Geophysics Lab., Hanscom AFB, MA.
For primary bibliographic entry see Field 7B.
W82-01523

SIMULATION OF DAILY WEATHER DATA USING THEORETICAL PROBABILITY DISTRIBUTIONS,

Cornell Univ., Ithaca, NY. Dept. of Plant Pathology.
J. A. Bruhn, W. E. Fry, and G. W. Fick.
Journal of Applied Meteorology, Vol 19, No 9, p 1029-1036, September, 1980. 7 Tab, 25 Ref.

Descriptors: *Stochastic hydrology, *Weather data simulation, Distribution, Model studies, Computer models, Simulation, Agriculture, Meteorological data simulation, Precipitation, *Probability distribution, Temperature, Relative humidity, Solar radiation.

A computer model was developed to simulate daily weather data (precipitation, maximum and minimum temperature, minimum relative humidity, and total solar radiation) for agricultural purposes using a Monte Carlo technique. Two processes common to the generation of values for each weather variable were: (1) selection of a set of parameters to describe the appropriate probability distribution, using rainfall as a foundation and (2) generation of a random value from the selected probability distribution (the current day's value of the weather variable). Precipitation occurrence was described by a first order Markov chain; the amount of rain, by a probability distribution; minimum and maximum temperatures, by a trivariate normal probability distribution considering temperature on the previous and current days; and minimum relative humidity and total solar radiation, by normal distribution. The model was tested on actual weather data from Geneva, New York, and Fort Collins, Colorado, and good agreement was obtained between simulated and historical data regarding mean response, variability, and pattern of correlation associated with daily weather data from each location. Particularly accurate were precipitation, minimum temperature, and maximum temperature. (Cassar-FRC)
W82-01526

WEATHER MODIFICATION FROM COOLING TOWERS. A TEST BASED ON THE DISTRIBUTIONAL PROPERTIES OF RAINFALL,

Oak Ridge National Lab., TN. Engineering Technology Div.
A. A. N. Patrinos, and K. O. Bowman.
Journal of Applied Meteorology, Vol 19, No 3, p 290-297, March, 1980. 4 Fig, 4 Tab, 20 Ref.

Descriptors: *Weather modification, *Cooling towers, Model studies, Rainfall distribution, Artificial precipitation, Rainfall, Artificial storms, *Statistical analysis, Mathematical models.

A statistical technique is presented for the treatment of data from weather modification experiments. Data has been collected by 49 recording raingages and four recording windsets situated on a square grid installed in early 1978 to determine the potential precipitation modification effects of the Bowen Electric Generating Plant near Cartersville, Georgia. The statistical technique presented makes use of a design which resembles the crossover statistical design used in cloud seeding studies and employs the distributional properties of the sample skewness and kurtosis. The technique demonstrated an anomaly in the target area rainfall with a 90% confidence level. This anomaly is interpreted as a plant induced modification of the spatial variability of rainfall volume. No attempt was made to stratify the precipitation events by storm type or by power plant output. (Baker-FRC)
W82-01527

AN INDEX OF ARIZONA SUMMER RAINFALL DEVELOPED THROUGH EIGENVECTOR ANALYSIS,

Portland State Univ., OR.
D. M. Johnson.
Journal of Applied Meteorology, Vol 19, No 7, p 849-856, July, 1980. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Rainfall, *Mathematical studies, Variability, Spatial distribution, *Arizona, Mapping, Seasonal variation, *Summer rainfall.

Eigenvector analysis has been used to establish a single index to characterize the statewide pattern of Arizona summer rainfall. Summer storms are in most cases a response to subtropical atmospheric controls in this area. Summer rainfall contributes more to annual precipitation than does the total precipitation occurring during winter. All available climatological stations in Arizona and adjacent areas supplied data concerning the length and quality of summer precipitation records. The eigenvectors or a variance-covariance matrix are analogous to the principal components of a data set. The data matrix for this study consisted of the summer rainfall totals at 101 stations over a 50 year period. The eigenvectors become a new set of axes which represent the original data. The first time-series eigenvector was extracted and accounted for 70% of the variance. Geographic mapping of the multipliers revealed that the first eigenvector did adhere to physical reality, in that it reflected the dominant pattern of rainfall over the state. Thus its validity as an effective index was established. (Baker-FRC)
W82-01528

LIDAR DETERMINATIONS OF ATMOSPHERIC ICE CRYSTAL LAYERS AT SOUTH POLE DURING CLEAR-SKY PRECIPITATION,

Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 2C.
W82-01529

A COMPARISON OF TWO SATELLITE RAINFALL ESTIMATES FOR GATE,

Hawaii Univ., Honolulu. Joint Inst. for Marine and Atmospheric Research.
For primary bibliographic entry see Field 7B.
W82-01533

DETERMINATION OF MOISTURE FROM NOAA POLAR ORBITING SATELLITE SOUNDING RADIANCES,

National Earth Satellite Service, Washington, DC.
C. M. Hayden, W. L. Smith, and H. M. Woolf.
Journal of Applied Meteorology, Vol 20, No 4, p 450-466, April, 1981. 8 Fig, 8 Tab, 11 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Moisture content, Meteorological data collection, *Satellite technology, Radiosondes, Clouds, Weather forecasting.

A newly-developed method improves the determination of atmospheric moisture from satellite measurements. The three major changes to current operational methods are: (1) the surface contribution to the out-going radiance is substracted before making temperature and moisture retrievals, allowing better definition of low-level moisture gradients. (2) The temperature/moisture solution is subjected to a one-channel iteration to ensure that the radiative transfer equation is satisfied for low-level moisture, valuable in cases of extreme dryness. (3) A cloud moisture model defines the atmospheric moisture below the cloud in areas of extensive cloud cover, permitting a more geographically uniform picture of the moisture. TIROS-N observations made on April 10, 1979, nearly coinciding with a tornado outbreak at Wichita Falls, Texas, were used in the simulation and found credible in estimating moisture in broad layers, surface to 700 mb and 850 to 500 mb. High moisture gradients are clearly defined, and horizontal consistency is achieved. Although point comparisons with radiosondes show large discrepancies, these are explained by the difference in sampling methods. (Cassar-FRC)
W82-01535

2C. Snow, Ice, and Frost

WAVE FORMATION AND HEAT TRANSFER AT AN ICE-WATER INTERFACE IN THE PRESENCE OF A TURBULENT FLOW,
Alberta Univ., Edmonton. Dept. of Mechanical Engineering.
R. R. Gilpin, T. Hirata, and K. C. Cheng.
Journal of Fluid Mechanics, Vol 99, No 3, p 619-640, August, 1980. 13 Fig, 42 Ref.

Descriptors: *Ice-water interfaces, *Wave propagation, *Heat transfer, *Turbulent flow, Waves, Flow, Accumulation, Melting, Temperature effects.

The stability and subsequent wave growth of disturbances to an ice-water interface in the presence of a turbulent boundary-layer flow were studied experimentally. Observation of instability in the presence of a well-defined flow regime made possible the comparison of the character and stability criterion for the waves. Stability was controlled by the heat flux from the interface into the ice. Generally, when the heat flux is small as during melting, the interface is most likely to be unstable. During ice accumulation, the heat flux is large and the interface is stable. Conditions necessary for unstable ice during ice accumulation were determined. These included a sufficiently large temperature ratio and a growing ice layer with a ratio of ice-side to water-side heat fluxes of up to 2.3. These results apply only where a turbulent boundary layer is present. The same controlling factors may also be important in other flows, however. (Small-FRC)
W82-01128

EFFECT OF GRAIN SIZE AND SNOWPACK WATER EQUIVALENCE ON VISIBLE AND NEAR-INFRARED SATELLITE OBSERVATIONS OF SNOW,
California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W82-01311

WATER FROST AND ICE: THE NEAR-INFRARED SPECTRAL REFLECTANCE 0.65-2.5 MICRONS,
Hawaii Univ., Honolulu. Inst. for Astronomy.
R. N. Clark.
Journal of Geophysical Research, Vol 86, No B4, p 3087-3096. April, 1981. 11 Fig, 3 Tab, 19 Ref.

Descriptors: *Reflectance, *Ice, *Frost, Spectral analysis, *Remote sensing, Optical properties, Algorithms, Mathematical studies.

Reflectance spectra of water frost and water frost on ice are presented to demonstrate the large range of spectral contrasts and features which may be encountered in remote sensing of planetary surfaces. The data are presented with 1.5% spectral resolution in the 0.65 to 2.5 micron wavelength region. The following water absorption bands (in microns) are precisely defined: 2.0, 1.65, 1.5, the little-studied 1.25, and three previously unidentified bands (1.04, 0.90, and 0.81). A quantitative analysis was performed of the 1.5 band complex using a nonlinear least squares algorithm to resolve the band into four Gaussian components as a function of grain size and temperature. The 1.65 component was highly grain-size dependent and not a good temperature sensor as was previously thought. Also, width was found to depend on grain size but was independent of temperature. The apparent band depths seen in many planetary reflectance spectra may be explained by the fact that the relative apparent band depths are different for frost layers on ice than for thick layers of frost. (Small-FRC)
W82-01346

COMPATIBILITY OF CANADIAN SNOWFALL AND SNOW COVER DATA,
Atmospheric Environment Service, Downsview (Ontario).
B. E. Goodison.
Water Resources Research, Vol 17, No 4, p 893-900, August, 1981. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Snow cover, *Snow surveys, *Gaging, Snow depth, Snow accumulation, Snow density, Snow sampling, Snow courses, Model studies, Data collections, Precipitation, Network design, Sampling, Cold Creek basin, *Ontario, Water equivalent, *Moisture equivalent.

The accuracy and compatibility of different methods of measuring snowfall were studied in the Cold Creek Basin, Ontario. Snow was measured for snowstorms in the winter of 1972-73 using a ruler estimate based on the 10:1 ratio and the following gages: Nipher, unshielded Universal, unshielded and Alter-shielded Fischer and Porter, and Universal with Alter shield. Good agreement in storm or seasonal totals was obtained for the gaged installations after correction for environmental factors such as wind speed. The ruler estimation was inconsistent and unreliable for use in short-term analyses. The significant differences in snow cover between land use categories were maximum at the time of peak accumulation, reflecting the ability of different types of vegetation to accumulate and retain snow in an individual way. Open areas had the highest density, lowest snow water equivalent, lowest depth, and most variable snow cover. An increase in sampling density in these areas would improve reliability of results. A simple mass balance model, using corrected precipitation data, can also determine snowpack accumulation. Net snow cover determined in this manner less the melt losses and snow evaporation were within confidence limits of the mean snow cover measured in the basin. Hydrologic models can use data from various methods and locations provided: (1) precipitation measurements are corrected for gage catch variations, and (2) snow survey data represents the basin land use. (Cassar-FRC)
W82-01466

THE BEHAVIOR OF A POLAR ICE-DAMMED LAKE, ELLESMERE ISLAND, N.W.T., CANADA,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
S. P. Blachut, and S. B. McCann.
Arctic and Alpine Research, Vol 13, No 1, p 63-74, February, 1981. 5 Fig, 1 Tab, 32 Ref.

Descriptors: *Iced lakes, *Polar regions, *Hydrologic budget, Ice dams, Flow discharge, Polar ice, *Canada, *Ellesmere Island, Watersheds, River flow, Flooding.

Most of the literature on ice-dammed lakes deals with lakes associated with temperate glaciers. However, recent observations indicate that there may be many lakes associated with cold or polar ice. Preliminary reconnaissance suggested that a small, deep, isothermal lake ponded against the western margin of the Ellesmere Ice Cap on Ellesmere Island in Canada might be an important source of sudden inputs of water into the main river system of the area. Sudden, partial drainage of this lake was observed in three successive years, 1973 through 1975. Glacier outburst floods (jokulhlaups) occurred in each of these years, with the 1973 event being the most severe. The water balance of the lake and the characteristics of the ice dam, monitored in 1974, indicated that barrier flotation was the key factor in the initiation of the jokulhlaups. There did not appear to be any leakage through the ice dam prior to the jokulhlaups, which began with a violent and forceful extrusion of water at high pressure at the outlet. The annual drainage events were separate events, with drainage initiated at progressively lower levels each year. Both the total volume of water discharged and the maximum rates of discharge were smaller with each successive year. The discharge rate decreased rapidly after the first few days of the drainage event. Barrier lifting and disturbance due to flotation of the shelf ice, resulting from rising lake levels during the first part of the summer season, appeared to be the trigger mechanism initiating lake drainage. The decreasing magnitude of the jokulhlaups and the fall in maximum lake levels over the 3 year period suggest that a series of annual drainage events might be succeeded by a period of nondrainage or lake recharge. (Carroll-FRC)
W82-01511

LIDAR DETERMINATIONS OF ATMOSPHERIC ICE CRYSTAL LAYERS AT SOUTH POLE DURING CLEAR-SKY PRECIPITATION,
Nevada Univ. System, Reno. Desert Research Inst.
V. N. Smiley, B. M. Whitcomb, B. M. Morley, and J. A. Warburton.
Journal of Applied Meteorology, Vol 19, No 9, p 1074-1090, September, 1980. 18 Fig, 3 Tab, 24 Ref.

Descriptors: *Ice, *Crystal growth, Crystals, Measuring instruments, Precipitation, Antarctic, *South Pole, Clouds, Cloud seeding, Temperature, Wind, *Water content, *Atmospheric ice.

An attempt was made to determine at what altitudes ice crystals form and grow during clear-sky precipitation events at the South Pole. The study was conducted between March and November of 1975. The usefulness of the lidar technique for studying atmospheric ice crystal layers was amply demonstrated by this study. Four distinct lidar signatures were observed for 36 clear-sky precipitation events. The air masses in which the clear-sky precipitation events were occurring were rising from lower terrain. The average height of the precipitation layer tops for the 36 events was 500 (plus or minus 160) meters, which was somewhat below the average inversion height of 560 (plus or minus 190) meters. In most all cases the formation layer tops were above the inversion level. The relationships between heights of precipitation layer tops and inversions and their respective temperatures demonstrate that the influence of layers above the precipitation layer is apparently quite important, as they were present in 75% of the 36 events. The larger crystals observed were plates and clusters. The maximum temperatures at the inversion for the six events for which replicator data were reduced were between -34.6 and 41.1 degrees C, and the larger crystals usually started growing at somewhat colder temperatures at heights varying from 300 to about 2000 meters. For the six days for which replicator data were reduced, the air was supersaturated with respect to ice over a range of several hundred meters above and below the inversion in at least four instances. (Baker-FRC)
W82-01529

ICE BLOCKS MELTING INTO A SALINITY GRADIENT,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
H. E. Huppert, and J. S. Turner.
Journal of Fluid Mechanics, Vol 100, No 2, p 367-384, September, 1980. 11 Fig, 5 Tab, 15 Ref.

Descriptors: *Ice-water interfaces, *Melting, *Saline-freshwater interfaces, Icebergs, Melt water. Ice-brine systems, Fluid mechanics, Arctic, Antarctic.

Water originating from ice melting in fluid stratified with salt undergoes little vertical displacement. The melt water flows out of a thin vertical boundary layer near the ice into a series of horizontal layers. This principle could be used in collecting fresh melt water from icebergs as a water supply source. The melting process takes place mainly on the vertical walls. Being lighter, the melt water rises up the sides of the iceberg in a thin layer. This inner layer of water mixes with that in a thicker, outer boundary layer which is moving downwards. When the downward moving water reaches the level where its density equals that of the far-field water, it starts to move horizontaly and produces layers, separated from each other by a thin interface. For Antarctic conditions the typical layer thickness may be 10-30 meters and for Arctic conditions, only a few meters. The melting process was studied in the laboratory in tanks using water of uniform salinity and linearly stratified with salt and either aluminum containers or ice blocks. Motions of the water were made visible with a shadowgraph technique or flourescein and were photographed for study. (Cassar-FRC)
W82-01530

MONITORING GLACIER OUTBURST FLOODS,

National Hydrology Research Inst., Ottawa (Ontario). Div. of Snow and Ice.
G. J. Young.
Nordic Hydrology, Vol 11, No 5, p 285-300, 1980. 6 Fig, 42 Ref.

Descriptors: *Glacial lakes, *Floods, *Monitoring, Lakes, *Glaciohydrology, Ice, Dams, Reviews, Disasters, Jokulhlaups, Forecasting, *Flood forecasting, Streamflow, Snowmelt, Glacial streams, Alpine regions.

The literature on jokulhlaups (an Icelandic term describing glacial outburst floods) is reviewed. This phenomenon occurs when water impounded by ice dams, or within or on top of glacial ice, is released. Jokulhlaups, found today in most glacier-covered areas, were probably more extensive and catastrophic during the height of the last glacial period. The most common type of lake is found in an ice-free tributary valley at the side of a major valley glacier. Other less common formations produce lakes between two converging glaciers, in major ice-free valleys, and within, under, and on the surface of glaciers. Very few outbursts have been observed and documented thoroughly because they may last only a few days once every several years and produce huge, hard-to-measure discharges. The dammed water may drain under, over, or through the ice. If an outburst coincides with a snowmlet flood or major rainfall, the event may be catastrophic. Since monitoring is very difficult, forecasters must rely on case histories. Present day lakes may be identified from air photographs or satellite imagery. Past lakes are located from geomorphological and vegetational records. Summit Lake, British Columbia, dammed by the Salmon Glacier and typical of the most common situation, is described in detail. It is 5.25 km long, 0.45 to 1.25 km wide and 200 meters deep at the ice front. Apparently no emptying occurred between 1900 and 1961. The five floods between 1961 and 1970 occurred between August and December. The lake did not always fill completely before discharging. When the lake surface reaches 800 meters above sea level, careful monitoring detects the beginning of the outflow, which reaches a peak in 3-5 days, allowing a mining company downstream to prepare for road washouts. (Cassar-FRC)
W82-01558

SNOWMELT PREDICTION IN A SUBARCTIC DRAINAGE AREA,

Saskatchewan Univ., Saskatoon. Dept. of Geography.
J. E. Fitzgibbon, and T. Dunne.
Nordic Hydrology, Vol 11, No 5, p 243-254, 1980. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Snowmelt, *Runoff, *Model studies, Subarctic zone, Vegetation effects.

Three methods for predicting snowmelt were tested in a variety of subarctic environments classified according to vegetation cover (closed lichen woodland, open lichen woodland, regenerating burn, and burn) near Scheffervillw, Quebec. The crown covers for each of these categories were 25-25%, 15-25%, 5-15%, and 0-5%, respectively. The temperature index method (using mean daily air temperature) and the U.S. Army Corps of Engineers empirical energy balance method gave adequate predictions in all four melt environments. Errors expressed in % of observed snowmelt were 14-26% and 14-24%, respectively, for each method. The physical energy balance method was good for the burn areas (9% error) and not as good for the other three environments (18-40% error). (Cassar-FRC)
W82-01571

EVALUATION OF ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF NITRATE-NITROGEN IN GLACIAL SNOW, FIRN AND ICE,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-01572

018 MODELLING OF FRESHWATER INPUTS IN BAFFIN BAY AND CANADIAN ARCTIC COASTAL WATERS,

Quebec Univ., Montreal. Dept. of Earth Sciences.
P. Bedard, C. Hillare-Marcel, and P. Page.
Nature, Vol 293, No 5830, p 287-289, September 24, 1981. 4 Fig, 16 Ref.

Descriptors: *Oxygen isotopes, *Isotopic studies, Arctic, Coastal waters, Canada, *Baffin Bay, *Sea ice, Melting, Model studies, Salinity, *Saline-freshwater interfaces, Glaciers, Icebergs, Fjords, Seawater, Greenland.

Measurements of 018 versus salinity in surficial samples of Arctic coastal waters from the north shore of Alaska to western Greenland disclosed three types of water: marine standard water, continental fresh water, and sea ice melt water. A three-component model (Tan and Strain, 1980), design for Baffin Bay waters, is applied here to a larger geographical scale. The Qaumarujuk Fjord, Greenland, is an example of a two-component model--glacial meltwater mixing with marine water, no sea ice component. The Cornelius Grinnell Fjord, Baffin Island, shows glacier water and standard marine water mixing and, towards the open sea, the influence of sea ice is noted. In the Beaufort Sea along the Yukon and Alaska coast, isotopic compositions reflect the composition of the water from the Mackenzie River drainage basin. A few samples show the presence of sea ice melt water. The Arctic archipelago and northern Baffin Bay waters reflect a heterogeneous and discrete continental input and a strong influence of sea ice melt water. Marine waters have salinities of about 34.9 o/oo and delta 018 values of 0 to -0.7 o/oo; continental waters, zero salinity and delta 018 of -17 o/oo to -21 o/oo; and sea ice melt water, salinity of 2 to 9.3 o/oo and variable delta 018. (Cassar-FRC)
W82-01590

2D. Evaporation and Transpiration

ESTIMATING EVAPOTRANSPIRATION FROM IRRIGATED CROPS IN SOUTHWESTERN ONTARIO,

Department of Agriculture, Harrow (Ontario). Research Station.
C. S. Tan, and J. M. Fulton.
Canadian Journal of Plant Science, Vol 61, No 2, p 425-435, April, 1981. 10 Fig, 27 Ref.

Descriptors: *Evapotranspiration, *Crop yield, Irrigation, Farming, Plant-soil-water relationships, Water conservation, Model studies, Climatology, *Ontario.

Meteorological data and measured evaporanspiration (ET) data from irrigated crops on Fox sandy loam were used to develop an equilibrium evapotranspiration (ETeq) model. The model inputs were daily maximum and minimum air temperatures and sunshine duration measurements, which are available from local weather stations. A simple equation was developed from the equilibrium model to estimate ET, and was tested on irrigated crops over a fairly wide range of moisture and foliage cover conditions. Reasonably good agreement was achieved between ET measured with floating lysimeters and ETeq estimated with the model. The total yields of irrigated early potatoes, corn and processing tomatoes were directly related to accumulated ET rates during the growing season in southwestern Ontario. When root zone water storage and available soil moisture were high (the latter above 60% for potatoes, 50% for tomatoes and 25% for corn) the ratio of evaportranspiration to equilibrium evapotranspiration remained fairly constant. However, below these limits the ratio declines rapidly with decreasing available soil moisture. (Baker-FRC)
W82-01116

ESTIMATING EVAPOTRANSPIRATION FROM THE SONOITA CREEK WATERSHED NEAR PATAGONIA, ARIZONA,

Ben Gurion Univ. of the Negev, Beersheba (Israel). Inst. for Desert Research.
J. Ben-Asher.
Water Resources Research, Vol 17, No 4, p 901-906, August, 1981. 4 Fig, 2 Tab, 12 Ref. OWRT-A-069-ARIZ(5).

Descriptors: *Evapotranspiration, *Small watersheds, Watersheds, *Sonoita Creek, *Arizona, Model studies, Soil-plant-water relationships.

As part of a general study on surface and groundwater regimes in the 620 sq km Sonoita Creek watershed, Arizona, a model of monthly evapotranspiration (Morton's conceptual approach for large areas) was tested. A unique aspect of this watershed is the strip of dense riparian vegetation where the actual evapotranspiration equals the potential evapotranspiration. For the rest of the watershed, actual evapotranspiration is less than the potential because it is dependent on rainfall. Climatological data included were solar radiation, dew point temperature, mean monthly temperature, and humidity. The model was validated by comparing predicted and actual evapotranspiration in Africa at a similar latitude and under conditions ranging from arid to humid. Model performance on data from the Sonoita Creek watershed was good on an annual basis (but not on a monthly basis) and in the hot seasons. To compensate for the errors in the cold seasons, advection was considered. Large errors were produced by the fact that the model neglects changes in net radiation due to surface moisture content. On an annual basis the error was 52%, and on a monthly basis it ranged from 29% in August to 111% in December. Potential evapotranspiration ranged from 60 mm per month in December to 235 mm per month in May; areal evapotranspiration, from 20 mm per month in October to 55 mm per month in May. (Cassar-FRC)
W82-01306

AUTOMATIC CLASS-A PAN-FILLING SYSTEM,

Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7B.
W82-01326

2E. Streamflow and Runoff

EVALUATION OF EFFECTIVE BOUNDARY ROUGHNESS FOR GRAVEL-BED RIVERS,

New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-01161

A MODEL FOR SIMULATION OF FLOW IN SINGULAR AND INTERCONNECTED CHANNELS,

Geological Survey, Reston, VA. Water Resources Div.
R. W. Schaffranek, R. A. Baltzer, and D. E. Goldberg.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $5.00. Geological Survey Techniques of Water-Resources Investigations, Book 7, Chapter C3, 1981. 110 p, 36 Fig, 3 Tab, 17 Ref, 4 Append.

Descriptors: *Model studies, *Unsteady flow, *Networks, *Flow characteristics, Open-channel flow, Streams, Surface water, Boundary conditions, Wind tides, Seiches, Simulation, Numerical analysis, Computer programs.

A one-dimensional model is presented for simulating the unsteady flow in singular riverine or estuarine reaches and in networks and interconnected channels. The model is both general and flexible in that it can be used to simulate a wide range of flow conditions for various channel configurations. The model accommodates tributary inflow into the network channels and includes the effects of wind shear on the water-surface as a forcing function in the flow equations. Water-surface elevations and flow discharges are computed at channel junctions, as well as at specified intermediate locations within the network channels. Five example applications of the flow model are illustrated which cover such diverse conditions as a singular upland river reach in which unsteady flow results from hydropower regulations, coastal river reaches of unsteady tidal-driven flow, and a multiply connected network of channels whose flow is principally governed by wind tides and seiches in the adjoining lakes. The report includes a listing of the Fortran IV computer program and a description of the input data requirements. Model supporting programs for the processing and input of initial and boundary-value data are identified, various model output formats are illustrated, and instructions are given to permit the production of graphical output on the line printer, electromechanical pen plotters, cathode-ray-tube display units, or microfilm recorders. (USGS)
W82-01210

REGIONAL FLOOD FREQUENCY ESTIMATION AND NETWORK DESIGN,

Princeton Univ., NJ. Dept. of Civil Engineering.
N. P. Greis, and E. F. Wood.
Water Resources Research, Vol 17, No 4, p 1167-1177, August, 1981. 9 Fig, 6 Tab, 22 Ref.

Descriptors: *Flood frequency, *Regional analysis, *Network design, Probability weighted moments, Regional floods, Flood recurrence interval, *Flood forecasting.

Regional estimates of flood recurrence quantile events in gaged and ungaged basins were improved by using the probability weighted moment technique (PWM). At gaged sites PWM gave better regional estimates than the conventional methods, method of moments and maximum likelihood estimates. For ungaged basins the PWM was combined with a second method for estimating mean peak flow. Estimates were especially improved when record lengths were shorter than 20 years. The regional PWM method had an average error of 10.3% for 7 sites and 17.5% for 10 sites in Pennsylvania. Seven other ungaged methods used on the same sites had errors ranging from 25.7% to 71.1%. In an Arizona network, improvement was 9% to 31% for selected flood frequency recurrence intervals using the regression-based NARI approach. (Cassar-FRC)
W82-01294

DETERMINATION OF THE CONFIDENCE INTERVALS OF THE WAKEBY DISTRIBUTION USING ORDER STATISTICS,

Institut Nationale de la Recherche Scientifique, Sainte Foy (Quebec).
B. Bobee, and P. Boucher.
Water Resources Research, Vol 17, No 4, p 1225-1230, August, 1981. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Wakeby distribution, *Statistical analysis, *Flood frequency, Order statistics, Flood flow, Flood forecasting.

The Wakeby distribution, which accounts for the effect of separation, represents flood flows adequately. The method presented in this paper, based on the distribution of order statistics, allows determination of confidence intervals for an event of a given return period at any level for given values of the parameters. If a sample is used to estimate parameters, the procedure is approximative and may produce a small overestimation. The method is of interest in the Wakeby distribution because (1) no explicit derivation of the variation of estimation of an event with a given return period has been made, and (2) the distribution function of the order statistics can be derived in an explicit form as a result of the inverse form of the Wakeby distribution. (Cassar-FRC)
W82-01317

PHYTOPLANKTON OF FOUR RIVERS, THE TYNE, WEAR, TEES AND SWALE,

Durham Univ. (England). Dept. of Botany.
N. T. H. Holmes, and B. A. Whitton.
Hydrobiologia, Vol 80, No 2, p 111-127, May, 1981. 5 Fig, 5 Tab, 39 Ref.

Descriptors: *Ecological effects, *Rivers, *Phytoplankton, Seasonal variations, Taxonomy, Temperature effects, *England, Water transfer, Low flow, Water management, Water quality, River flow, Comparison studies.

A comparison study was made of the phytoplankton populations in four relatively fast-flowing rivers in north-east England which are associated with a water transfer scheme. The total number of live cells ranged from 200 to 20,000 cells/ml. Input of plankton from a reservoir did not influence densities at a site 25 km downstream. Diatoms formed the majority of cells in most samples, with green algae second and cryptomonads third in importance. Among the diatoms, centrics were relatively more abundant at downstream sites. The ratios of live versus dead diatoms showed marked differences with season and between centric and pennate forms. Statistics demonstrate that active growth of centric diatoms in the plankton may be important in the summer. (Baker-FRC)
W82-01376

A CATCHMENT APPROACH TO FLOOD ESTIMATION,

Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 275-289, May, 1981. 5 Fig, 11 Ref.

Descriptors: *Flood forecasting, *Gaging stations, *Catchment basins, *Northumbrian Water Authority, *Great Britain, Flood data, Flood frequency, Flood recurrence interval, Flood Studies Report, Rivers, Snowmelt, Runoff, Rainfall-runoff relationships.

Methods are presented for the determination of flood discharges of given return period at ungaged sites using catchment and geiondal flood parameters with the Flood Studies Report (1980) statistical method. Flood data from gaging stations in the Northumbrian Water Authority area and a partial duration series were used to derive standard flood parameters. Mapping these parameters revealed patterns which can be used to improve the accuracy of estimations at ungaged sites in the Northumbrian region. Some conclusions obtained from this study are: 81) flood runoffs where snowmelt is the sole contributor are potentially far more serious than is suggested by meteorological snowmelt studies; (2) the partial duration series provides data on flood behavior at low return periods, not available through the annual maximum series; (3) persistence effects produce errors in currently used partial duration series models based on a Poisson distribution of the number of exceedences within a year and an exponential distribution of the magnitude of these exceedences; (4) channel morphology and overbank storage strongly affects the distribution shape and flood growth curve; (5) drier lowland catchments have steeper growth curves than wet upland catchments in this area; and (6) adjustments based on local data can greatly improve the reliability of estimates from the Flood Studies equation. (Cassar-FRC)
W82-01397

CONCENTRATED FLOW RELATIONSHIPS,

Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
For primary bibliographic entry see Field 2J.
W82-01409

MONITORING GLACIER OUTBURST FLOODS,

National Hydrology Research Inst., Ottawa (Ontario). Div. of Snow and Ice.
For primary bibliographic entry see Field 2C.
W82-01558

DEBRIS FLOWS IN SMALL MOUNTAIN STREAM CHANNELS OF COLORADO AND THEIR HYDROLOGIC IMPLICATIONS,

Denver Univ., CO. Dept., of Geography.
J. E. Costa, and R. D. Jarrett.
Bulletin of the Association of Engineering Geologists, Vol. 18, No 3, p 309-322, August, 1981. 14 Fig, 2 Tab, 44 Ref.

Descriptors: *Stream erosion, *Debris cone, *Flood flow, Soil erosion, Erosion, Sediment transport, Sediment erosion, Stream gages, Channel improvement, Bank stabilization, Streamflow, Alluvial fans, Detritius, Levees, Dams, Flood profiles, Alpine regions.

Debris flows in small mountain streams have often been confused with waterfloods on gaging-station records and on-site studies. In areas of flooding due to intense rainfall, geomorphic, sedimentologic and hydraulic evidence was attributed to debris flows in five of the seven sites examined. Debris flows are identified by poorly sorted, unstratified and unconsolidated deposits having well-defined levees and terminal lobes. Although large boulders may be moved in debris flows, often small trees are not damaged. High-water marks and gaging-station records downstream show that only a small percentage of the debris-flow dishcharge is water. Mitigating actions for waterfloods such as channelization and damming may have little effect on debris flows. Debris flows in the Rocky Mountains may lead to overestimates of flood levels. This may lead to faulty values for data used in the design of flood-control structures. (Geiger-FRC)
W82-01597

2F. Groundwater

SEASONAL REVERSALS OF GROUNDWATER FLOW AROUND LAKES AND THE RELEVANCE TO STAGNATION POINTS AND LAKE BUDGETS,

Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
M. P. Anderson, and J. A. Munter.
Water Resources Research, Vol 17, No 4, p 1139-1150, August, 1981. 11 Fig, 2 Tab, 25 Ref.

Descriptors: *Groundwater movement, *Lakes, *Groundwater divide, Flow patterns, Stagnation point, Seasonal variation, Lake basins, Lake beds, Lake bottom springs, *Snake Lake, *Wisconsin, Flow-through lakes, Recharge, Model studies, Simulation analysis, Groundwater level, Groundwater budget.

The groundwater flow around Snake Lake, Wisconsin, was investigated with two-dimensional transient groundwater flow computer models. This flow-through lake (receives groundwater through part of the basin and recharges groundwater through the rest) showed an unusual flow system in spring 1973. A groundwater mound, i.e., an area with a water table higher than the lake surface, and a stagnation zone, which caused a reversal in the direction of groundwater flow, formed. The model simulated the changes in size and shape of the groundwater mound and the stagnation zone, as

well as the effects on the lake's water budget. The groundwater component of the lake's water budget varied from -0.014 cu ft per sec at the beginning of the simulation to +0.21 cu ft per sec 36 days later. It is likely that this flow reversal occurs every year. Factors favoring the formation of the groundwater mound and stagnation point are: location on a groundwater divide, deposits of low permeability on the downgradient side, seasonally high recharge rate, reduced thickness of aquifer under the lake, and low regional hydraulic gradient. (Cassar-FRC)
W82-01103

MASS TRANSPORT OF SOLUTES IN DUAL-POROSITY MEDIA,

Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5B.
W82-01104

SOME RECENT STUDIES ON GROUNDWATER RADON CONTENT AS AN EARTHQUAKE PRECURSOR,

Southern California Univ., Los Angeles. Dept. of Geological Sciences.
T-L. Teng.
Journal of Geophysical Research, Vol 85, No B6, p 3089-3099, June, 1980. 19 Fig, 2 Tab, 17 Ref.

Descriptors: *Radon, *Earthquakes, *Water analysis, Correlation coefficient, *Groundwater, On-site data collections, California, China, Radioactivity techniques, *Earthquake predictions.

The suggested association between radon anomalies and earthquake occurrence is discussed by reviewing experimental and field evidence. Also, the current status of groundwater radon research in relation to earthquake prediction is reviewed by the presentation of some representative studies. Experimental techniques for the detection of groundwater radon were developed in China, Japan, and the US. Radon measurement results include results from a California sampling network of 14 springs and wells. A weekly sampling program since 1974 has given an average of 3426 c/m kg. No clear correlation has been found between several small earthquake occurrences and radon variations. The extensive Chinese radon monitoring program, on the other hand, has resulted in earthquake predictions. In general, available evidence suggests an association between regional stress buildup and radon emission from crustal rocks. The discrete-sample groundwater radon measurement with the liquid N2 cold trap method has given better accuracy than continuous radon counting systems. However, it seems necessary to trade off some accuracy for the higher sampling frequency of continuous systems. (Small-FRC)
W82-01127

AN ANALYTICAL SOLUTION FOR SOLUTE TRANSPORT THROUGH FRACTURED MEDIA WITH MATRIX DIFFUSION,

National Hydrology Research Inst., Ottawa (Ontario).
G. E. Grisak, and J. F. Pickens.
Journal of Hydrology, Vol 52, No 1/2, p 47-57, June, 1981. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Solute transport, *Fracture permeability, Permeability, *Groundwater movement, Hydrology, Base flow, Infiltration, Percolation, Subsurface drainage, *Path of pollutants.

An analytical solution is presented for describing solute transport in fractured media where the solute diffuses from the fracture into the adjacent matrix. The solution is for nonreactive transport in both the fracture and the matrix. The governing conditions include one-dimensional advective transport in the fracture and one-dimensional diffusive transport, normal to the fracture, into the matrix. The utility of the solution is illustrated by applying it to laboratory data and by illustrating hypothetical cases of transport along a single fracture for large temporal and spatial scales. The Laboratory data used was derived from a column tracer test on fractured till. The retardation effect of the diffusion of the contaminant from the fracture into the matrix has important implications with regard to contaminant releases from the deep disposal or storage of toxic wastes in rock formations. For fracture water velocity, aperture and matrix diffusion coefficient of 100 meters/year, 100 micrometers and 0.000001 square centimeters/second, respectively, matrix diffusion reduces the average contaminant velocity to an exit point at 4000 meters to about 0.2% of the water velocity for media with even the least porous matrix, such as granite. (Baker-FRC)
W82-01179

GEOLOGIC AND HYDROLOGIC FACTORS CONTROLLING RADON-222 IN GROUND WATER IN MAINE,

Maine Univ. at Orono. Dept. of Civil Engineering.
W. F. Brutsaert, S. A. Norton, C. T. Hess, and J. S. Williams.
Ground Water, Vol 19, No 4, p 407-417, July/August, 1981. 11 Fig, 6 Tab, 30 Ref. OWRT-A-045-ME(4).

Descriptors: *Radon, *Granites, *Wells, *Maine, *Radioisotopes, Water analysis, Water quality, Metamorphic rocks, Pollutant identification, Water pollution sources, Groundwater, Geohydrology, Uranium, Well yield, Domestic water.

Radon-222, associated with groundwaters in uranium-containing granitic rocks in Maine, was found at concentrations up to 100,000 pCi per liter, much higher than the 500 pCi per liter recommended by the EPA. Water samples were collected from 136 granitic wells and 300 nongranitic wells in southern Maine, where the nation's top 10% incidence for some cancers occurs. The Mean Rn-222 value for groundwater from granites was 22,100 pCi per liter, range 5,000-100,000 pCi per liter; for high grade metamorphic rocks (sillimanite and sillimanite plus orthoclase), 13,630 pCi per liter, range 3,000-30,000 pCi per liter; and for low grade metasedimentary rocks (chlorite to staurolite), 1,100 pCi per liter. In granites Rn-222 increased slightly with well depth up to 50-75 meters and remained nearly constant at greater depths. Rn-222 values varied inversely with well yield and overburden thickness, and weakly inversely with Na+ values, indicative of surface water infiltration. With a given rock unit the other chemical parameters (K, Ca, Mg, Fe, Mn, Zn, and Cu) did not correlate with Rn-222 levels. (Cassar-FRC)
W82-01222

GROUND WATER,

Geraghty and Miller, Inc., Syosset, NY.
R. A. Saar, and O. C. Braids.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 921-925, June, 1981. 73 Ref.

Descriptors: *Groundwater, *Literature review, Solutes, Groundwater management, Water management, Groundwater movement, Groundwater recharge, Model studies, Nitrates, Chlorides, Organic compounds, Organic pesticides, Pesticides, Farm wastes, Leaching.

Recent developments in the area of groundwater research are cited in this literature review. Concerning water movement, studies were made of the problem of saturated-unsaturated flows in three dimensions from an injection well, examination was given to estimating the recharge of aquifers, and the numerical analysis of seepage and groundwater flow was reviewed in four sections dealing respectively with fundamental equations of seepage and groundwater flow, steady and time variant seepage, analysis of regional groundwater flow, and analysis of pumping tests. General studies on solute movement investigated waste disposal practices, leachate from landfills, and problems arising near drain fields of septic tanks. Specific solute research dealt with inorganic solutes such as calcium chloride, nitrates, and carbonates. In the area of organic sludge reports are cited which deal with the velocities of groundwater as affected by a series of homologous organic compounds, monitoring for atrazine, alachlor, and dieldrin in groundwater under farmland, ways in which viruses enter groundwater, and how soil and aquifer characteristics affect virus survival and migration rate. The importance of water reclamation through groundwater recharge was the topic of a water symposium. Groundwater resource planning was also studied heavily, with emphases on numerical models for groundwater management, mapping techniques, and specific studies of circulation of groundwater at particular sites. (Baker-FRC)
W82-01273

IDENTIFICATION OF THE WAIRAKEI GEOTHERMAL SYSTEM,

Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
L. J. Fradkin.
Water Resources Research, Vol 17, No 4, p 921-927, August, 1981. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Geothermal power, *Model studies, *Wells, Thermal water, Groundwater movement, Powerplants, Wairakei, *New Zealand, Geothermal studies.

Several models describing the Wairakei geothermal system, New Zealand, were compared and the best candidates verified. The models were obtained by choosing different equations and using different parameter estimation algorithms. The least squares algorithm was found to be compatible with the chosen model structure. The identified model showed forecasting power in comparisons of predicted and observed data on pressure drops from 1969-79. The model, therefore, can be used to control the power plant, one of the oldest geothermal plants in the world. (Cassar-FRC)
W82-01312

A COMPARISON OF THE INCOMPLETE CHOLESKY-CONJUGATE GRADIENT METHOD WITH THE STRONGLY IMPLICIT METHOD AS APPLIED TO THE SOLUTION OF TWO-DIMENSIONAL GROUNDWATER FLOW EQUATIONS,

Geological Survey, Huron, SD. Water Resources Div.
L. K. Kuiper.
Water Resources Research, Vol 17, No 4, p 1082-1086, August, 1981. 3 Fig, 14 Ref.

Descriptors: Cholesky-conjugate gradient method, *Aquifers, *Transmissivity, Confined aquifers, Unconfined aquifers, *Groundwater movement, *Model studies, Comparison studies, Strongly implicit procedure.

The incomplete Cholesky-conjugate gradient method (ICCG) originally used on laser fusion problems was compared with the strongly implicit procedure (SIP) in five test problems involving steady state simulations of groundwater flow. Three were linear confined aquifer problems, and two were nonlinear water table aquifer problems. The ICCG method performed better than SIP on the confined aquifer problems and equally well on the water table problems. An ICCG iteration required 83% as much computational time as an SIP iteration. (Cassar-FRC)
W82-01315

A MATHEMATICAL MODEL OF WATER TABLE FLUCTUATION IN A SEMI-INFINITE AQUIFER INDUCED BY LOCALIZED TRANSIENT RECHARGE,

National Geophysical Research Inst., Hyderabad (India).
S. N. Rai, and R. N. Singh.
Water Resources Research, Vol 17, No 4, p 1028-1032, August, 1981. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Water table fluctuations, *Recharge, *Aquifers, *Model studies, Groundwater recharge, Groundwater movement, Reservoirs, Unconfined aquifers, Hydraulic conductivity, Specific yield.

This paper extends the work of Marino (1974), who derived an analytical model of water table fluctuation in an unconfined aquifer which is receiving localized recharge at a constant rate and is discharging into a surface reservoir. The model

presented here considers that the law of the rate of recharge decreases linearly with time and remains constant thereafter. Using three parameters (rate of recharge, hydraulic conductivity, and specific yield) it can be applied in a more general way than the pioneering study. The aquifer is defined as homogeneous, isotropic, underlain by a horizontal impermeable base, and connected with a surface reservoir on one side. The water table fluctuations caused by variations in the three parameters are described. Conclusions were: (1) the amplitude of the water table variation due to change in the rate of recharge or hydraulic conductivity is relatively larger within the zone of recharge, while the amplitude of the water table variation due to change in the specific yield continuously increases with distance beyond the zone of recharge, and (2) as hydraulic conductivity or specific yield increases, water table variations are smaller. (Cassar-FRC)
W82-01319

ORIGIN, AGE AND MOVEMENT OF PORE WATER IN AGRILLACEOUS QUATERNARY DEPOSITS AT FOUR SITES IN SOUTHWESTERN ONTARIO,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
D. E. Desaulniers, J. A. Cherry, and P. Fritz.
Journal of Hydrology, Vol 50, No 1/3, p 231-257, March, 1981. 7 Fig, 3 Tab, 43 Ref.

Descriptors: *Groundwater dating, *Permeability, *Clays, *Ontario, *Pore water, Geohydrology, Hydraulic conductivity, Isotope studies, Waste disposal, Groundwater movement, Porous media, Dating, Diffusion coefficient.

The hydrogeologic properties of four sites in southwest Ontario were investigated to determine their suitability for waste disposal and as protective covers for regional bedrock aquifers. These locations are typical of the widespread and thick deposits of clayey till and glaciolacustrine clay. Properties measured were textural qualities, hydraulic conductivity (on the order of 10 to the minus 8th power to 10 to the minus 7th power), vertical hydraulic gradients (0.13-0.25 cm per year), and ionic and isotopic contents (O18, H2, H3, C13, and C14). Tritiated pore waters were found only within 3-6 meters of the surface, indicating that waters below this depth were recharged prior to 1952. O18 values in the pore waters were characteristic of present-day precipitation (-9 to -10%) near the surface and characteristic of much cooler waters at 20-40 meters depths (-14 to -17%). The age of the deep groundwater was determined to be 11,000 to 14,000 years. The O18, H2 and chloride concentration profiles were simulated with a model for transport by advection and diffusion in a saturated porous medium, producing effective diffusion coefficients of 3.0 times 10 to the minus 6th power sq cm per s and groundwater velocities of 0.03-0.05 cm per year. Pore water in these clay deposits is a mixture of late Pleistocene and modern waters, with the distribution of O18, H2, and chloride influenced predominantly by molecular diffusion rather than hydraulic flow. (Cassar-FRC)
W82-01321

A NUMERICAL SOLUTION FOR THE MOVEMENT OF AN INTERFACE IN A LAYERED COASTAL AQUIFER,

Technion-Israel Inst. of Tech., Haifa.
J. Bear, and I. Kapuler.
Journal of Hydrology, Vol 50, No 1-3, p 273-298, March, 1981. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Saline water intrusion, *Coastal aquifers, Groundwater movement, Aquifers, Model studies, Mathematical models, Saline-freshwater interfaces, Israel.

Seawater intrusion in a coastal aquifer is studied. In this case the aquifer is divided into several subaquifers by thin impervious layers of clay extending 1 to 3 km landward and consists of a single aquifer for the remainder of the 15 km distance from the sea. Seawater intrusion occurs as a separate advancing wedge in each of the subaquifers because of differences in freshwater discharge. Assuming that flow is normal to the coast line and horizontal in both freshwater and salt water zones, a mathematical model is stated in terms of depth to the interface in each subaquifer. Then a numerical finite difference scheme is given for solving the model in the case of a 2-layered aquifer similar to that of coastal Israel. (Cassar-FRC)
W82-01327

URANIUM ISOTOPES AS A NATURAL TRACER IN THE WATERS OF THE BET SHEAN-HAROD VALLEYS, ISRAEL,

Tel Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
J. Kronfeld, and E. Rosenthal.
Journal of Hydrology, Vol 50, No 1-3, p 179-190, March, 1981. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Uranium, *Isotope tracers, *Aquifers, *Groundwater movement, Tracers, Basalts, Carbonate rocks, Bet Shean Valley, Harod Valley, *Israel, Springs, Recharge, Groundwater recharge.

Uranium isotopes were determined in 34 samples of groundwater and springs in the Bet Shean-Harod Valleys, Israel. There was little variation in uranium content (0.40-4.20 micrograms per liter), but the U234/U238 activity ratios were distributed over a wide range (1.43-3.13). A plot of uranium content vs. U234/U238 activity ratio revealed 3 distinct clusters of samples. Waters from the Revaya well field, Cenomanian carbonate aquifer (karstic), contained 1.5 micrograms per liter U and had the highest degree of isotopic fractionation. These waters were the least mineralized and the freshest of those studied. A group with low activity ratios, caused by chemical weathering, and a broader range of U distribution were found in basaltic rocks. Intermediate in isotope ratios and U content was another carbonate group. These waters were more mature and more saline than the Revaya samples because of longer residence time in low permeability carbonate aquifers. (Cassar-FRC)
W82-01328

YIELD VERIFICATION OF A DOLOMITE AQUIFER IN NORTHEAST ILLINOIS,

Illinois Inst. of Natural Resources, Champaign.
R. T. Sasman, R. J. Schicht, C. R. Benson, and R. S. Ludwigs.
Ground Water, Vol 19, No 4, p 370-375, July/August, 1981. 5 Fig, 5 Ref.

Descriptors: *Groundwater budget, *Water level, *Pumpage, *Chicago, Illinois, Groundwater management, Recharge, Groundwater recharge, Carbonate aquifers, Aquifers, *Well yield.

Groundwater withdrawals in a 700 sq mile study area including DuPage County in the western Chicago metropolitan region increased 92% during 1966-1978, amounting to 61.7 mgd in 1978 (57.3 mgd from the shallow dolomite aquifer and 4.4 mgd from sand and gravel). During this period water levels declined as much as 30 ft in some areas, causing concern that groundwater recharge estimates were too low. A groundwater budget study indicated that recharge estimates were of the correct order of magnitude. Specific yield was 0.017. Pumping in excess of recharge was balanced by water removed from storage in the shallow aquifers. About 7.3 billion cu ft of dolomite and 3.3 million cu ft of sand and gravel were dewatered between 1966 and 1979. About 5.9 billion gal of water in excess of recharge has been withdrawn. Continued pumpage approaching the projected rate of 97.2 mgd for the year 2000 would withdraw 18 mgd more than the potential yield of these aquifers and severely dewater extensive areas. (Cassar-FRC)
W82-01334

GEOHYDROLOGIC MODELS OF THE HOUSTON DISTRICT, TEXAS,

Geological Survey, Lawrence, KS.
D. G. Jorgensen.
Ground Water, Vol 19, No 4, p 418-428, July/August, 1981. 8 Fig, 1 Tab, 26 Ref.

Descriptors: *Water level, *Land subsidence, *Saline water intrusion, Model studies, *Houston, Texas, *Geohydrology, *Aquifers, Clays, Compaction, Simulation analysis, Analog models, Potentiometric level, Groundwater movement.

The decline of water levels, land subsidence, and salt water intrusion in the Houston district were studied with three different models. Since this complex aquifer system is composed of discontinuous sand layers and easily compressible clay layers, land surface subsidence up to 210 cm at Pasadena and salt water intrusion at a rate of several hundred meters per year have resulted. The first electric analog model in the early 1960's simulated water level declines well in the city of Houston, but not at distances from the city. It pointed out that the available data and the two-aquifer conceptual model were not adequate for simulation of groundwater systems. There was no attempt to simulate land subsidence. The second analog model in the early 1970's, using new data, simulated water table declines in both aquifers (Chicot and Evangeline) very accurately. The distribution of land subsidence was only approximated. A digital model, developed in 1979, using five layers simulated water level declines, water from clay compaction, and land subsidence very accurately, but could not predict salt water intrusion. (Cassar-FRC)
W82-01335

COMPUTER MODELING AND GROUNDWATER PROTECTION,

GeoTrans, Inc., Reston, VA.
C. R. Faust, L. R. Silka, and J. W. Mercer.
Ground Water, Vol 19, No 4, p 362-365, July/August, 1981. 2 Tab.

Descriptors: *Model studies, *Groundwater movement, *Hydrologic models, Path of pollutants, Computer models, Regulations.

Although groundwater modeling has evolved to a high level, there is a danger that hydrologists and regulators will rely too strongly on this tool. A matrix is presented to help evaluate the reliability and credibility of models for different uses, such as quantity of groundwater available, pollutant movement in spills and at disposal sites, and seawater intrusion. The matrix uses a rating system from 0 to 4 to describe the suitability of a model for specific applications. A rating of 4 implies that a model is reliable for a particular application and that the data can be acquired at reasonable cost. A rating of 3 means that a model can be used for short-term (a few years) predictions or for general problems. Models rated 2 have not been sufficiently verified for specific issues but may be useful as conceptual tools for investigating general problems. The models rated 1 are in the evolutionary and research stage. Generally, model predictions may be extended with confidence into the future for about twice the period for which historical data are available. (Cassar-FRC)
W82-01336

AN APPROACH TO DETERMINING PATHWAYS AND RESIDENCE TIME OF GROUNDWATERS: DUAL RADIOTRACER DATING,

Physical Research Lab., Ahmedabad (India).
S. K. Gupta, D. Lal, and P. Sharma.
Journal of Geophysical Research, Vol 86, No C6, p 5292-5300, June, 1981. 9 Fig, 17 Ref.

Descriptors: *Flow velocity, *Radioactive tracers, *Tracers, *Groundwater movement, Model studies, Aquifers, Carbon radioisotopes, Silicon radioisotopes, Porous media.

Use of two radioactive tracers with widely differing half lives, Si32 and C14, was considered in a diffusion-advection equation for calculating steady state groundwater movement through porous media. This procedure is an improvement over the piston flow model, which overestimates flow velocity in highly dispersive groundwater systems, especially in the case of young water leaking into unconfined aquifers from overlying shallow aquifers. Simultaneous measurements of the two radioactive tracers can produce information flow velocity, dispersion coefficient, and leakage.

Errors in estimation of the mean dispersion time can arise from finite errors in the measurement of tracer concentrations and from finite nonradioactive loss of the tracers in the aquifer. (Cassar-FRC)
W82-01348

GROUNDWATER INVESTIGATIONS IN THE VALE OF STATHMORE,

Water Research Centre, Stevenage (England).
L. Clark.
Water Services, Vol 85, No 1023, p 219-220, May, 1981. 2 Fig.

Descriptors: *Groundwater availability, *Aquifer characteristics, *Geologic fractures, Fissure water, Geologic joints, Aquifer testing, Sandstones, Vale of Strathmore, *United Kingdom.

Various strategies are being investigated to provide supplementary water supplies for the Vale of Strathmore area. Early reconnaissance, geological, photo-geological, and existing-well surveys were performed to establish some understanding of the aquifer. A clear picture has emerged of the hydrogeology of the Old Red Sandstone. The Old Red Sandstone is acting as a regional fissured aquifer in which groundwater moves through a system of joints or bedding planes and not through intergranular voids as in a normal aquifer. Major water entry is through a fissure at 125 m from the surface. Most of the fissures seen on surface exposures must be closed at depth. The majority of wells in Strathmore are poor, and the water tends to be hard. The siting of a public-supply well should be aimed at intersecting a major fissure system. As yet, the extent of groundwater available from the aquifer has not been established. A production well is now being pumped to prove the resource. When used for a public supply, the water will have to be softened or blended. (Small-FRC)
W82-01400

A ONE-DIMENSIONAL, FINITE ELEMENT SALT WATER INTRUSION MODEL,

Guam Univ., Agana. Water Resources Research Center.
For primary bibliographic entry see Field 7A.
W82-01452

CARBON 14 DATING OF GROUNDWATER IN CONFINED AQUIFERS: IMPLICATIONS OF AQUITARD DIFFUSION,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. A. Sudicky, and E. O. Frind.
Water Resources Research, Vol 17, No 4, p 1060-1064, August, 1981. 4 Fig, 12 Ref.

Descriptors: *Aquitards, *Diffusion coefficient, *Dating, Groundwater movement, *Carbon radioisotopes, Confined aquifers, Aquifer systems, Tracers, Radioactive dating, Porous media, Velocity, Carbon-14.

Errors in carbon-14 dating of groundwaters in confined aquifers can be introduced by diffusive losses into fine-grained aquitards. In this theoretical analysis, a quati-two-dimensional approach is used which accounts for C14 losses by diffusion into aquitards as well as advection-dispersion transport in the aquifer. The overall effect of diffusion is to produce a slower advance of C14 along the aquifer, giving an underestimation of groundwater velocity. Errors are enhanced by small aquifer thicknesses, large diffusion coefficients, large aquitard porosity compared with aquifer porosity, and use a radioisotope with a very long half-life. Large errors are likely in stratified argillaceous aquifers unless the results are corrected for diffusion effects. The steady state distribution of C14 is relatively insensitive to the magnitude of the longitudinal dispersivity value of the aquifer, except for constituents with large half lives or for aquifers with very small groundwater velocities. An equation is presented to correct the C14 data to account for diffusion, providing the system is relatively homogeneous and stratigraphically simple. This procedure is also applicable to age dating in fractured porous media. (Cassar-FRC)
W82-01464

HYDROCHEMICAL FACIES IN A TERTIARY BASIN IN THE MILLIGAN CANYON AREA, SOUTHWEST MONTANA,

Indiana Univ. at Bloomington. Dept. of Geology.
N. C. Krothe, and M. P. Bergeron.
Ground Water, Vol 19, No 4, p 392-399, July/August, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Chemical composition, *Water quality, *Aquifers, Carbonate aquifers, Groundwater movement, *Milligan Canyon, *Montana, Anhydrite, Gypsum, Calcium bicarbonate, Sodium bicarbonate, Bicarbonates, Calcium sulfate.

Groundwater chemistry and artesian flow were studied in a synclinal basin near Three Forks, Montana, because future agricultural development in this area will increase the demand for groundwater. Water samples were collected from 29 wells and springs in the Milligan Canyon area, July 26-28, 1977, and tested for chemical parameters. Most waters in the Tertiary sediments and Madison Group carbonates are calcium bicarbonate or calcium sulfate waters, supersaturated with respect to calcite. Sodium bicarbonate waters exist in some areas. The ranges of ionic concentrations (in mg per liter) are as follows: Ca(2+), 13-246; bicarbonate, 112-328; sulfate, 29-114; and Na(+), 10-312. Flow direction is toward the east. Calcium bicarbonate waters are present in the recharge area (formed by dissolution of limestone), calcium sulfate in the center region (formed by water flowing through gypsum and/or anhydrite), and sodium bicarbonate in the discharge region (formed by cation exchange with clay minerals of volcanic origin). Decreases in concentrations of total dissolved solids and sulfate downgradient indicate sulfate reduction, followed by dilution of calcium sulfate waters by calcium bicarbonate waters originating from recharge areas to the north, northeast, and south portions of the basin. (Cassar-FRC)
W82-01481

GASEOUS NITROGEN AS EVIDENCE FOR DENITRIFICATION IN GROUNDWATER,

National Physical Research Lab., Pretoria (South Africa).
For primary bibliographic entry see Field 2K.
W82-01485

2G. Water In Soils

SCALING OF INFILTRATION BEHAVIOR IN DISSIMILAR POROUS MATERIALS,

Rothamsted Experimental Station, Harpenden (England). Dept. of Physics.
E. G. Youngs, and R. I. Price.
Water Resources Research, Vol 17, No 4, p 1065-1070, August, 1981. 9 Fig, 2 Tab, 13 Ref.

Descriptors: *Infiltration, *Soil physics, *Porous media, Soil water, Hydraulic conductivity, Capillary conductivity, Particle size.

The microscopic characteristic lengths of porous materials were obtained by three indirect methods and used in the definition of scaled variables to describe flows in their accompanying boundary conditions. The three methods used involved measurements of hydraulic conductivity at saturation, soil water pressure at half saturation, and the integral of hydraulic conductivity with soil water pressure. The porous materials tested were glass beads, washed sands, slate dust, sandy loam, and silt loam. Particle sizes varied from 2-60 micrometers in the silt loam to 350-500 micrometers in a sand. The ratios of the microscopic characteristic lengths obtained from the three methods were fairly constant between materials. Experiments with packed columns of the porous materials were used to study vertical downward infiltration, horizontal infiltration, and vertical upward capillary rise. The scaled results for these materials agreed with the theoretical predictions. This relationship may be useful in estimating soil water behavior in both dissimilar and similar porous materials, especially in field situations where soil water properties vary spatially. (Cassar-FRC)
W82-01105

STATISTICAL ANALYSIS OF THE BROOKS-COREY AND THE GREEN-AMPT PARAMETERS ACROSS SOIL TEXTURES,

Maryland Univ., College Park. School of Engineering.
R. H. McCuen, W. J. Rawls, and D. L. Brakensiek.
Water Resources Research, Vol 17, No 4, p 1005-1013, August, 1981. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Infiltration, *Soil texture, *Statistical analysis, Brooks-Corey model, Green-Ampt model, Model studies, Mathematical models, Soil water, Soil types, Silt, Clays, Loam, Hydrologic models, Error analysis.

The Brooks-Corey and Green-Ampt parameters used in infiltration equations varied significantly across the soil texture classes. Infiltration data from the literature were subjected to analysis of variance, which resulted in numerous anomalies; therefore, multivariate analysis of variance was applied. The standard errors for each soil class (clay, silt, and sand, plus all combinations) are shown in the texture triangle for the following parameters: Brooks-Corey--square root of lambda, bubbling pressure, total porosity, and soil water content; and Green-Ampt--saturated hydraulic conductivity, effective porosity, and wetting front capillary pressure term. The Duncan test was used to identify the soil texture classes for which significant differences could be identified for each infiltration model. For the Brooks-Corey model all pairs of means were significantly different at the 1% level except for (1) loam and sandy clay, (2) silt loam and clay loam, and (3) silty clay loam and silty clay. Pairs (2) and (3) are adjacent on the texture triangle; pair (1) is not. In the Green-Ampt model seven pairs were not significantly different: (1) sand and loamy sand, (2) loam and clay loam, (3) loam and sandy clay, (4) clay loam and sandy clay, (5) silty clay loam and silty clay, (6) silty clay loam and clay, and (7) silty clay and clay. All but pairs (3) and (6) are adjacent on the triangle. The parameters used in these two models are unique for each soil class and should be applied separately. The soil texture class at an ungaged site can be used in calibrating infiltration parameters. (Cassar-FRC)
W82-01107

VARIATIONS OF PH WITH ANNUAL CUMULATIVE PRECIPITATION IN ACID FOREST SOILS,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
C. B. Crampton.
Canadian Journal of Soil Science, Vol 60, No 2, p 385-387, May, 1980. 1 Fig, 7 Ref.

Descriptors: *Soil properties, *Seasonal variation, Precipitation, Acidity, Soil moisture, Moisture availability, Rain forests, *Forests, *British Columbia, *Acidic soils.

Systematic colorimetric soil pH measurements were made over an area in Belcarra Mountain in the rain forest of British Columbia. These studies were conducted over a 4 year period from 1975 to 1978. Summer values increased somewhat with total cumulative precipitation. After dry winters, lower pH values in both A and B horizons were recorded. The increase in acidification was so marked on the sandy Podzols as compared to the less light-textured Brunisols that the normal increase in pH down the profile was reversed. A substantial amount of precipitation during winter raises the water table and increases soil moisture reserves, appearing to prevent a decrease in summer pH values. It is also possible that a drying effect may have occurred during specific seasons, resulting in increased soil acidity. A summer increase in acidity would also be influenced by soil texture, as evidenced by comparing the summer pH values following the relatively wet 1975/76 winter and the relatively dry 1976/77 winter. Knowledge of the variation in soil pH values is essential for characterizing the properties of the Orthic Humo-Ferric Podzols of the area. (Baker-FRC)
W82-01118

WATER AND SALT MOVEMENT IN A SALINE-SODIC SOIL IN SOUTHERN ALBERTA,

Department of Agriculture, Lethbridge (Alberta). Research Station.
T. G. Sommerfeldt, and C. Chang.
Canadian Journal of Soil Science, Vol 60, No 1, p 53-60, February, 1980. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Soil properties, *Drainage, Seepage, Irrigation, Salts, Acidity, *Saline soils, Soil types, Water table, *Alberta, Canada.

A study was conducted on a shallow Chin loam near Vauxhall, Alberta, Canada, that had become saline-sodic, in order to better understand the internal drainage of such a system. The soil was underlain by till at 51 cm from the surface. Average water intake or infiltration for the profile was 3.76 cm/day. The Btj horizon could be a limiting layer for vertical flow. The observed horizontal hydraulic conductivity indicated that lateral flow of water in the C horizon, 36 cm/day, and in the surface of the till, 22 cm/day, could be as much as five times greater than that of Ah, 5 cm/day, and Btj, 8 cm/day, horizons. Salts were leached from the profile by application of 22 cm of water. The internal drainage of the soil was apparently sufficient to accommodate infiltrated water under normal conditions, and thus the buildup of a water table and salinization of the soil were probably due to lateral flow of water from canal seepage and irrigation mismanagement. The lateral transmission of water probably took place in the C horizon and the upper layer of till, where the horizontal hydraulic conductivity was five to seven times greater than that of the Btj and Ah horizons. The downward leaching of salts apparently was sufficient to cause the high salt buildup to occur in the Btj and C horizons rather than in the surface soil as one might expect in a semiarid, temperate climate. (Baker-FRC)
W82-01119

NITRATE REDUCTION IN AN ORGANIC SOIL-WATER SYSTEM,

Agricultural Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 5B.
W82-01129

A STUDY OF A METHOD FOR DISPLACING SOIL SOLUTION BY CENTRIFUGING WITH AN IMMISCIBLE LIQUID.

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 5B.
W82-01131

CHANGES IN SOIL WATER QUALITY RESULTING FROM THREE TIMBER CUTTING METHODS AND THREE LEVELS OF FIBER UTILIZATION,

Montana Univ., Missoula. School of Forestry.
N. Stark.
Journal of Soil and Water Conservation, Vol 35, No 3, p 183-187, July/August, 1980. 6 Tab, 14 Ref.

Descriptors: *Forest management, *Nutrients, *Soil chemistry, *Soil water, Calcium, Copper, Iron, Potassium, Manganese, Magnesium, Sodium, Zinc, Forest soils, Clays, Trees, *Logging, *Water quality, Montana.

The effects of timber harvesting methods on soil water quality were evaluated in heavy soils (30-40% clay) in the Lubrecht Experimental Forest, Montana. Methods used were: (1) clearcutting, (2) overstory removal, and (3) understory removal. Within each harvesting method there were three levels of further utilization--slash left untouched, heavy slash removal, and burning of all slash. Nutrient losses were greater in clearcutting and overstory removal treatments. Although none of the losses were excessive, Ca, Cu, Mn, and Zn are potentially limiting in terms of total ions yet to be released. Burning caused the heaviest losses of the three slash treatments, except in the clearcut-burn combination, and reduced the amount of iron in soil water. Leaving the slash in place was least damaging. These heavy textured soils have low nutrient loss and have a biological life of 9,500 (limit of Cu supply) to 9 million years (limit of Fe supply), if only woody components are removed in a 70-year rotation. Depleted Na or Cu, and Zn or Fe toxicity will ultimately limit tree growth. There is an excess of Ca and moderate quantities of K and Mn in the forest soil water. (Cassar-FRC)
W82-01135

HYDRODYNAMIC DISPERSION DURING CONSTANT RATE ABSORPTION OF WATER BY SOIL,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
D. E. Smiles, K. M. Perroux, S. J. Zegelin, and P. A. C. Raats.
Soil Science Society of America Journal, Vol 45, No 3, p 453-458, May/June, 1981. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Flow characteristics, *Soil water, *Unsaturated flow, Hydrodynamics, Absorption, Soil science, Soil columns, Mathematical studies, Soil physics.

A group of experiments is described which explored the process of hydrodynamic dispersion during transient flow in substantially unsaturated columns at whose surface water is supplied at a constant rate. A dispersion coefficient is combined with space- and time-like variables to analyze the problem. The use of constant flux adsorption and also permits simplification of the salt flow problem. The analysis is a potentially useful technique for studying dispersion during transient water flow when the soil surface is unsaturated. The method is demonstrated using a chemically inert sandy soil. In these experiments, during transient, unsaturated flow, a simple piston flow model described the process over a range of water types. The method may also be useful in the study of the process in structured soils and when chemical reactions play an important role. (Small-FRC)
W82-01174

PREDICTION OF DIFFUSION COEFFICIENTS FROM THE ELECTRICAL CONDUCTANCE OF SOIL,

Department of Agriculture, Lethbridge (Alberta). Research Station.
C. J. Plamer, and R. W. Blanchar.
Soil Science Society of America Journal, Vol 44, No 5, p 925-929, September/October, 1980. 4 Fig, 2 Tab, 24 Ref. OWRT-A-101-MO(3).

Descriptors: *Mathematical models, *Elctrical conductivity, *Salts, Soil science, Diffusion coefficient, Cation exchange.

A two-component model was developed which used electrical conductance to predict salt movement through soil by diffusion. The model considers electrical conductance in soil to be a combination of a solution and a surface process. The diffusion coefficient for K(+) in four soils with 0.0133M KCl varied from 1.64 times 10 to the -6 power to 5.0 times 10 to the -6 power eq cm/sec when computed from electrical conductivity. It varied from 1.84 times 10 to the -6 to 0.33 times 10 to the -6 sq cm/sec when computed from self-diffusion. In the soil solution, the fraction of the electrical current carried by the 0.0133M KCl varied from 0.85 to 0.13 and was inversely related to the cation exchange capacity. Good agreement was found when diffusion coefficients estimated from the self-diffusion of 42K and 24Na in concentrated and dilute systems were compared. Diffusion measurements made by electrical conductance seem to be more reproducible than those made by self-diffusion. (Small-FRC)
W82-01224

APPORTIONMENT OF NET RECHARGE IN LANDFILL COVERING LAYER INTO SEPARATE COMPONENTS OF VERTICAL LEAKAGE AND HORIZONTAL SEEPAGE,

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
J. J. Lentz.
Water Resources Research, Vol 17, No 4, p 1231-1234, August, 1981. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Soil water, *Leachates, *Infiltration, *Landfills, Path of pollutants, Groundwater, Recharge, Seepage, Drainage, Input-output analysis, Runoff.

Equations are developed to determine the water surplus in a sloping cover placed over an aboveground landfill. The water surplus in the cover is separated into vertical leakage and lateral seepage fractions using input-output analysis. The hypothetical landfill contains multiple cells 40 feet high, covered with 0.5 to 3 ft of soil, with cell surfaces sloped toward a centerline drain which removes surface water and seepage without backwater effects. This procedure allows calculation of the quality of soil water penetrating the landfill cover and thus the quantity of leachate, an important factor in the study of groundwater pollution. An example of a typical landfill is given in which 0.36 cm of soil moisture becomes available the first day and 0.05 cm more on the second day. The amounts of water accumulating in the cover layer, leaking into the waste, and seeping into the drain are calculated for each day. After 4 days the cover layer is dry, 0.313 cm has leaked to the waste, and 0.096 cm has seeped into the drain. (Cassar-FRC)
W82-01298

MEASURING THE HYDRAULIC CONDUCTIVITY OF SOIL ADJACENT TO TILE DRAINS IN A HEAVY CLAY SOIL IN THE NETHERLANDS,

Soil Survey Inst., Wageningen (Netherlands).
J. Bouma, J. W. Van Hoorn, and G. H. Stoffelsen.
Journal of Hydrology, Vol 50, No 1/3, p 371-381, March, 1981. 5 Fig, 3 Tab, 6 Ref.

Descriptors: *Hydraulic conductivity, *Tile drains, *Soil compaction, Drains, Clays, *Netherlands, Infiltration, Soil water, Percolation rate.

A new technique for measuring hydraulic conductivity was applied to heavy clay soils adjacent to tile drains. The method involves excavation of a cube of soil 25 cm on a side around a drain tile. The tile is cut so that the two ends each protrude 5 cm from the cube. Then the cube is removed from the site and covered on five sides with gypsum, which is allowed to harden. The cube is turned upside down and infiltration measured from the exposed surface. Then this surface is covered with gypsum, the opposite surface uncovered, and the measurements repeated. These measurements are characteristic of the undisturbed soil below the drain and the fill soil above the drain, respectively. Methylene blue added to the percolating water traces patterns of water movement. Tests of 12 cubes of soil and three types of pipes (fired clay, slotted plastic, corrugated plastic) showed average hydraulic conductivity values of 10 meters per day for soil below the drain and 5 meters per day above the drain. Dye studies indicated that water movement was almost exclusively along cracks, not rootholes. (Cassar-FRC)
W82-01323

REMOTE SENSING OF SOIL MOISTURE CONTENT OVER BARE FIELD AT 1.4 GHZ FREQUENCY,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W82-01345

DETERMINATION OF SOLUTION ELECTRICAL CONDUCTIVITY FROM BULK SOIL ELECTRICAL CONDUCTIVITY MEASUREMENTS BY THE FOUR-ELECTRODE METHOD,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Div. of Soil Physics.
A. Nadler, and H. Frenkel.
Soil Science Society of American Journal, Vol 44, No 6, p 1216-1221, November-December, 1980. 3 Fig, 5 Tab, 24 Ref.

Descriptors: *Conductivity, *Salinity, *Soil water, *Electrical properties, Soil physical properties, Soil chemistry, Mathematical studies, Resistivity.

A proposed linear relationship between soil electrical conductivity and soil water electrical conductivity was valid only at high salinities, greater than 4 mmho per cm, when measured by the four-electrode method. At low salinity levels, the surface conductance was not constant and made a higher contribution than soil water electrical conductivity to measured soil electrical conductivity. A method for correcting this inadequacy used the Waxman-Smits equation. Comparisons between theoretical and experimental soil electrical conductivity values for low salinities showed agreement. (Cassar-FRC)
W82-01458

NITROGEN LEACHING AS INFLUENCED BY NITROGEN MANAGEMENT AND SUPPLEMENT IRRIGATION LEVEL,

Scientific and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
For primary bibliographic entry see Field 5B.
W82-01472

SPATIAL VARIABILITY OF STEADY-STATE INFILTRATION RATES AS A STOCHASTIC PROCESS,

New Mexico Agricultural Experimental Station, Las Cruces.
J. B. Sisson, and P. J. Wierenga.
Soil Science Society of America Journal, Vol 45, No 4, p 699-704, July/August, 1981. 9 Fig, 1 Tab, 22 Ref.

Descriptors: *Stochastic processes, *Infiltration rate, Sampling, *Soil properties, Spatial distribution, Statistical analysis, *Soil water.

Autocorrelation was estimated between field-measured infiltration rates to show how this correlation affects the variance of composited samples. Space series analysis was used. Steady-state infiltration rates were measured with infiltrometers of 5, 25, and 127 cm inside diameter in a field plot. Infiltration rates were lognormally distributed for all ring sizes and autocorrelated for the 5-cm ring size. A power spectrum was computed for each of the realizations to a lag of 40. Most of the variance among observations occurred at lower frequencies or at large distances between samples. The results supported the hypothesis that sampling variance is a function of distance between observations. Recommendations include sampling in space and repeated sampling in time to detect treatment effects. For sampling a field for some attribute, the samples should be from widely dispersed locations. For sampling repeatedly in time, several dispersed samples should be composited and the exact location of each marked permanently. At the next hold effects of spatial variability to a minimum. (Small-FRC)
W82-01560

HYDRAULIC PROPERTIES OF FULLERTON CHERTY SILT LOAM,

Oak Ridge National Lab., Environmental Sciences Div.
R. J. Luxmoore, T. Grizzard, and M. R. Patterson.
Soil Science Society of America Journal, Vol 45, No 4, p 692-698, July/August, 1981. 7 Fig, 3 Tab, 13 Ref.

Descriptors: *Permeability coefficient, *Soil properties, *Loam, *Soil water, Tensiometers, Watersheds, Measuring instruments, Hydrology, Walker Branch Watershed, Tennessee.

A field drainage study was established on Fullerton cherty silt loam as a component of the hydrologic characterization of Walker Branch Watershed in eastern Tennessee. Soil water content was monitored after the soil was saturated and during free drainage using a neutron probe at depths of 10, 28, 37, 47, 89, 117, and 177 cm. The changes in water content and matric potential with time and the laboratory data on retention properties of soil cores were used to calculate the hydraulic conductivity. The data are tabulated. Field plot tensiometer results could not be clearly interpreted because of poor correspondence between tensiometer and neutron probe measurements at any given depth. The small-diameter tensiometer cups grouted into aggregated clay subsoil were not suitable for the determination of hydraulic gradient or field retention characteristics. They may be useful in determining soil macroporosity when used in combination with neutron probe measurements. The maximum hydraulic conductivity derived by the instantaneous profile method was 58 to 177 cm per day for two locations. (Small-FRC)
W82-01561

SUPER SLURPER EFFECTS ON CRUST STRENGTH, WATER RETENTION, AND WATER INFILTRATION OF SOILS,

Oklahoma State Univ., Stillwater. Dept. of Agronomy.
P. Hemyari, and D. L. Nofziger.
Soil Science Society of America Journal, Vol 45, No 4, p 799-801, July/August, 1981. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Soil water, *Infiltration, Soil properties, Sand, Clays, Soil strength, Super slurper, Soil amendments, Soil absorption capacity, Soil water retention, Soil crust strength.

The effect of hydrolyzed starch polyacrylonitrile graft copolymer, commonly called super slurper, on soil crust strength, soil water retention, and infiltration rate was investigated for three soils. Soils were a Teller sandy loam, a Tillman-Hollister clay loam, and a Cobb loamy sand. The modulus of rupture decreased significantly for each soil as the rate of super slurper use increased. A multiple range test was used to compare the water contents of six different soil treatments at each of six suctions for each soil. Tillman-Hollister clay loam had increased water retention after super slurper treatment. Super slurper at rates of 0.025, 0.5, and 0.1% did not increase water retention in Teller sandy loam or Cobb loamy sand. Super slurper decreased the rate of water entry into all three soils. Thus, super slurper has the potential for modifying soil properties, although additional research is needed to determine the longevity of the treatment effects under field conditions. (Small-FRC)
W82-01562

2H. Lakes

AN EXAMPLE OF THE APPLICATION OF STATISTICAL TECHNIQUES TO PREDICT LAKE LEVEL ELEVATIONS,

Department of the Environment, Edmonton. Div. of Design and Construction.
For primary bibliographic entry see Field 6A.
W82-01111

A QUANTITATIVE STUDY OF SHORELINE MARSH COMMUNITIES ALONG LAKE HURON IN ONTARIO,

University of Western Ontario (London). Dept. of Plant Sciences.
D. Fahselt, and M. A. Maun.
Canadian Journal of Plant Science, Vol 60, No 2, p 669-678, April, 1980. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Lake Ontario, Lakes, *Marshes, *Nuclear powerplants, Powerplants, Shoreline cover, Vegetation, Coastal marshes, Wetlands, Swamps, Nuclear reactors, Heated water, Plumes, *Thermal pollution, Temperature effects, *Ontario.

Ten marshes along the east coast of Lake Huron were surveyed. All ten were open to the influence of the lake. The lake bottom sloped away gradually from all marshy sites, and offshore the water depth was less than 2 meters for a distance of about 0.4 km. All had a basically westerly exposure, included a homogeneous area of 800 square meters or more and showed little or no evidence of human disturbance. Two Baie du Dore marshes selected for study were each treated as two separate homogeneous areas. The mean dry weight of each plant species found was determined per unit area in every marsh, and the diversity and dominance indices were calculated. Application of the sums of squares agglomeration technique showed that the two northernmost sites were the most distinctive floristically. Three of the more southern marshes located near the Bruce Nuclear Power Development clustered together into a separate group. Clustering of marshes cannot be expected to reveal whether the species composition of marshes near the power development has been affected by thermal discharges, since baseline studies had not been conducted before the plant was built. It is expected that heated effluents may cause some changes in vegetation. It is suggested that a resurvey of the area in the vicinity of the power plant be conducted in a few years when both reactors are working at full capacity. Submerged hydrophytes offshore should also be studied. (Baker-FRC)
W82-01122

CHANGES IN LAKE ONTARIO TOTAL PHOSPHORUS CONCENTRATIONS, 1976-1978,

Canada Centre for Inland Waters, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario). Aquatic Physics and Systems Div.
A. S. Fraser.
Journal of Great Lakes Research, Vol 6, No 1, p 83-87, 1980. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Phosphorus, *Seasonal variation, Lakes, Fate of pollutants, *Lake Ontario, Water quality, Sedimentation, Phytoplankton.

Lake Ontario's total phosphorus levels, which normally show a high peak in spring and an abrupt drop in late summer, were about 4 micrograms P per liter lower than expected in 1977 and 1978. Spring phosphorus levels for the whole lake were approximately 19.5 micrograms per liter in 1977 and 20.0 micrograms per liter in 1978, compared with the 1976 value, about 23.5 micrograms per liter. Loading reduction for this period accounted for only 10% of the change. The probable explanation for the lower P levels is a change in sedimentation rate of total P, such as caused by the death and sedimentation of a large phytoplankton crop just prior to overturn. It is unknown whether the lower P levels in 1977 and 1978 reflect a downward trend or whether new seasonal patterns have been established. (Cassar-FRC)
W82-01126

PETROLEUM HYDROCARBONS IN SEDIMENTS OF SAGINAW BAY, LAKE HURON,

Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 5A.
W82-01141

FERROMANGANESE NODULES FROM LAKE ONTARIO (BAY OF QUINTE): MINOR ELEMENT GEOCHEMISTRY,

University of Western Ontario (London). Dept. of Geology.
W. S. Fyfe, B. I. Kronberg, M. Peirce, and G. G. Leppard.
Journal of Great Lakes Research, Vol 6, No 3, p 203-209, 1980. 1 Fig, 3 Tab, 38 Ref.

Descriptors: *Trace elements, *Nodules, *Geochemistry, Lakes, Lake sediments, Sediments, *Lake Ontario, Ferromanganese nodules, Chemical analysis.

Ten ferromanganese nodules found in eastern Lake Ontario in the Bay of Quinte near Glenora were analyzed by spark source mass spectroscopy. Concentrations of 51 minor elements were compared with those in ferromanganese concretions from other lakes, the marine environment, and the earth's crust. Levels of minor elements were: Ba, 1%; Sr, 0.1%; F, S, Co, Zn, and La, 100 micrograms per g range; and others, 1-100 micrograms per g. Compared with marine nodules, lake nodules contained lower levels of all minor elements except Ge and were amorphous rather than crystalline. Lake nodules in this area are found in water depths of 4-8 meters and therefore have not been

exposed to water volumes as great as those in the marine environment. (Cassar-FRC)
W82-01143

A SURVEY OF ATP CONCENTRATIONS IN LAKE ONTARIO, 1975-1976,

Canada Centre for Inland Waters, Burlington (Ontario).
M. MacKinnon, and R. E. Kwiatkowski.
Journal of Great Lakes Research, Vol 6, No 3, p 177-183, 1980. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Biomass, *Adenosine triphosphate, Microorganisms, Lakes, *Lake Ontario, Chlorophyll a, Seasonal variation, Phosphorus, Organic carbon, Particulate matter, Microbiological studies.

Total microbial biomass concentrations of Lake Ontario were estimated by the adenosine-5'-triphosphate (ATP) technique for three seasons in 1975-1976. The inshore waters had a mean integrated ATP concentration of 0.142 mg per cu meter in December and 0.189 mg per cu meter in April; offshore waters, > 0.050 mg per cu meter. There was no significant difference between surface samples (0-20 meters) and bottom samples. In August, the surface layer had a mean ATP concentration of 0.452 mg per cu meter, bottom inshore waters, 0.238 mg per cu meter, and mid-water samples, 0.040 mg per cu meter. The ATP/particulate organic carbon ratio was relatively constant throughout the lake in winter and spring, but increased in summer, while the chlorophyll/particulate organic carbon ratio was constant with the season. The stepwise regression technique showed that ATP variability was explained in winter-spring by chlorophyll a and in summer by phosphorus. (Cassar-FRC)
W82-01144

A CLASSIFICATION AND DESCRIPTION OF SOME NORTHEASTERN ONTARIO LAKES INFLUENCED BY ACID PRECIPITATION,

Laurentian Univ., Sudbury (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W82-01145

SOLUBLE ELEMENT CONCENTRATIONS AND COMPLEXATION IN SOUTHEASTERN LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. Rossmann.
Journal of Great Lakes Research, Vol 6, No 1, p 47-53, 1980. 6 Tab, 16 Ref.

Descriptors: *Trace elements, *Solubility, *Chelation; Hypolimnion, Epilimnion, Lakes, Water quality, *Lake Michigan, Minerals.

Water samples were collected from both epilimnion and hypolimnion of nearshore southeastern Lake Michigan near the Donald C. Cook Nuclear Plant during 1974 and 1975. The mean elemental soluble (< 0.45 micrometers) concentrations in log(moles per liter) for the 88 epilimnion samples were: Ba, -6.5; Ca, -3.1; Co, -7.7; Cr, -7.5; Cu, -7.4; Fe, -6.9; K, -4.5; Mg, -3.3; Mn, -8.1; Mo, -6.9; Na, -3.6; Ni, -6.9; Sr, -3.9; Zn, -7.1; Cl, -3.5; soluble reactive phosphate-P, -7.5; sulfate, -3.7; and soluble reactive silica, -5.3. Values for the hypolimnion were similar except for soluble reactive silica, which was more concentrated in the hypolimnion in July of 1974 and 1975. Ions with more than 10% of their activity accounted for by complexes were: Co(2+), Cu(2+), Fe(3+), Mn(2+), Ni(2+), carbonate, sulfate, and phosphite. These estimates were obtained from thermodynamic data and solving simultaneous equations. During July 1974 the epilimnion was supersaturated with respect to dolomite, malachite, hydroxyapatite, fluoroapatite, hydroxoapatite, X-ray amorphour (Fe(OH)3, and goethite. It was undersaturated with respect to calcite, aragonite, rhodochrosite, barite, and strengite. (Cassar-FRC)
W82-01147

PHOSPHORUS UPTAKE DYNAMICS AS RELATED TO MATHEMATICAL MODELING OF CLADOPHORA AT A SITE ON LAKE HURON,

Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 5C.
W82-01149

HYPOLIMNION FLOW BETWEEN THE CENTRAL AND EASTERN BASINS OF LAKE ERIE DURING 1977 (INTERBASIN HYPOLIMNION FLOWS)

Canada Centre for Inland Waters, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario).
F. M. Boyce, F. Chiocchio, B. Eid, F. Penicka, and F. Rosa.
Journal of Great Lakes Research, Vol 6, No 4, p 290-306, 1980. 12 Fig, 4 Tab, 12 Ref.

Descriptors: *Oxygen transfer, *Lake basins, *Hypolimnion, *Water circulation, Dissolved oxygen deficit, *Lake Erie, Water currents, Lakes, Lake morphology, Interbasin transfers, Wind-driven currents, Water currents.

The two basins of Lake Erie (eastern basin, mean depth 28.5 m, and central basin, mean depth 19 m) are separated by the Pennsylvania Ridge, extending southward between the base of Long Point, Ontario to Erie, Pennsylvania. This ridge lies at 15 m depth except for a narrow 24 m deep notch. During 1977 data from ship cruises and from a network of current meters installed on and near the ridge were collected to estimate the hypolimnion flux across the sill area. A strong correlation between winds and mean flux was observed. The dynamic balance appear to be one in which the surface pressure gradient created by wind stress is opposed by internal pressure gradients and by bottom friction. Two major bursts of transport from the deeper eastern basin to the shallower central basin hypolimnion occurred, mid-June to mid-July (13 cu km of water or 20-25% of the hypolimnion volume) and July 31-August 13 (7 cu km of 17% of the hypolimnion volume). Both of these transfers were associated with persistent east winds. The August event was important in transferring dissolved oxygen to the central basin's hypolimnion during the summer oxygen depletion period, raising the mean concentration oxygen in the central basin between 0.5-1.0 mg per liter, or a quarter to a half of the oxygen demand of the central basin hypolimnion. However, this oxygen enrichment does not reach the western 2/3 of the central basin. (Cassar-FRC)
W82-01153

FATTY ACID AND HYDROCARBON CONTENT OF SETTLING SEDIMENTS IN LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. A. Meyers, S. J. Edwards, and B. Eadie.
Journal of Great Lakes Research, Vol 6, No 4, p 331-337, 1980. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Lake sediments, *Hydrocarbons, *Fatty acids, Organic compounds, *Lake Michigan, Algae, Bacteria, Lakes, Sedimentation, Organic matter, Particulate matter, Aquatic plants, Zooplankton, Phytoplankton.

Sediments were collected in traps suspended at three depths (35 m, 73 m, and 82 m) in southeast Lake Michigan near the Grand River mouth. The lake depth at this point was 83 m and the metalimnion/hypolimnion boundary at 35 m. Fatty acid concentrations were (in mg per g sediment from shallowest to deepest sample, respectively) 9.8, 5.3, and 1.7, indicating active microbial reworking and dilution by resuspended sedimentary materials. Distributions of the straight chain acids were similar in all three samples, dominated by C14, C16, and C18 acids characteristic of algae and bacteria and aquatic plants. The hydrocarbon concentrations at the three depths (micrograms per g sediment, shallowest to deepest sample, respectively) were 147.6, 35.8 and 53.4. Distributions of hydrocarbons differed markedly at the various depths. The 35 m sample had large amounts of C17-C31, typical of terrigenous plants. The two deeper samples were dominated by C27-C31 and had little C17-C19 hydrocarbons. Petroleum may be a source of some of the hydrocarbons in the 35 m sample, whereas resuspended sediments dilute the organic content of the trapped sediment at lower depths. Estimated fluxes to the bottom of the lake in this area are organic carbon, 6.59 g per sq m; fatty acids, 1.8 g per sq m and aliphatic hydrocarbons, 27 mg per sq m. (Cassar-FRC)
W82-01154

WAVE CLIMATE AND POTENTIAL LONGSHORE SEDIMENT TRANSPORT PATTERNS, NOTTAWASAGA BAY, ONTARIO,

Guelph Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-01156

A BIOASSAY STUDY OF EFFECTS OF ZOOPLANKTON, IRON AND NTA ON THE PHYTOPLANKTON PRODUCTIVITY OF A MARL LAKE,

Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
S. F. Mitchell, and R. G. Wetzel.
Hydrobiologia, Vol 68, No 3, p 235-241, February, 1980. 2 Fig, 4 Tab, 26 Ref.

Descriptors: *Phytoplankton, *Zooplankton, *Iron, *Nitrilotriacetic acid, Productivity, *Lakes, Lawrence Lake, Gull Lake, *Michigan, Chelation, Grazing, Daphnia.

Additions of nitrilotriacetic acid (NTA) and iron (in the form of FeC13) to water samples from two calcareous Michigan lakes (Lawrence and Gull) slightly stimulated phytoplankton producivity in autumn and winter. The two chemicals were added in all possible combinations of 0, 10 or 50, 100, and 200 mg per cu meter and incubated up to 168 hours. These results contrasted with a 4-fold increase in productivity found during in situ studies on marl lakes in the summer. Greatest increases in productivity were 20 and 37% at 96 hour and 168 hours, respectively, using NTA alone. In other experiments with Fe and NTA the greatest response was 5%. Daphnia pulex added to cultures reduced phytoplankton productivity by half for every 20-30 animals per liter present. Reductions were seen at all levels of addition--from 4 to 32 animals per litter. In summer up to 150 Daphnia per liter were required to halve the phytoplankton production. Possible reasons for the seasonal differences are the differences in species composition, microflagellates dominating in winter and diatoms, green algae and blue-green algae in summer. In addition, phytoplankton productivity responds much more strongly to temperature than do D. pulex filtering rates; winter zooplantkton grazing rates (8-10% per day) were on the same order as winter phytoplanton renewal rates (2-10%). (Cassar-FRC)
W82-01157

BIOGEOCHEMICAL INVESTIGATION OF BIG CREEK MARSH, LAKE ERIE, ONTARIO,

National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
A. Mudroch.
Journal of Great Lakes Research, Vol 6, No 4, No 4, p 338-347, 1980. 1 Fig, 6 Tab, 23 Ref.

Descriptors: *Marshes, *Water quality, *Sediments, Wetlands, *Big Creek Marsh, *Lake Erie, Ontario, Nutrients, Metals, Aquatic plants, Insecticides, DDT, Polychlorinated biphenyls, Pollutant identification, Fate of pollutants.

Sediment composition, nutrient and metal uptake by macrophytes, and nutrient and metal concentrations in water were studied at 6 stations in the 850 ha Big Creek Marsh, Ontario. Concentrations of Mg, Ca, Na, K, Mn, and P in surface sediments were similar at all stations with the exception of 20.95% Ca dry weight at a site covered with Elodea, which accumulates Ca. Marsh sediments were lower in Pb, Cu, Ni, and Cr than Lake Erie sediments (highest values in micrograms per g sediment dry weight: 86, 38, 48, and 119, respectively). Several samples exceeded Lake Erie

values: Zn, 1 sample, 383 micrograms per g; As, 2 samples, 64 and 112 micrograms per g; and Hg, 2 samples, 0.930 and 0.530 micrograms per g. Up to 0.018 micrograms per g p,p'-DDE and 0.013 micrograms per g p,p'-TDE, both DDT metabolites, and maximum of 0.51 micrograms per g polychlorinated biphenyls were found in sediment samples. Maximum concentrations of metals (mg per liter) in marsh water samples were: Cu, 0.078; Pb, 0.001; Ni, 0.001; and Zn, 0.018. Increases of total Kjeldahl N and ammonium-N were seen in some marsh water samples in November. This was ascribed to decomposition of some macrophytes. Submerged plants, Myriophyllum, Chara, and Elodea sp, accumulated larger quantities of Pb, Cu, Ni, Cr, and Cd than emergent plants. Ca accumulating plants had higher levels of Pb, Cu, Ni, Cr, and Cd, but Zn levels showed no correlation. (Cassar-FRC)
W82-01163

PHYTOPLANKTON PRODUCTIVITY AND STANDING CROP IN THE VICINITY OF THE LAKE HURON-SAGINAW BAY FRONT,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. A. Moll, C. O. Davis, and C. L. Schelske.
Journal of Great Lakes Research, Vol 6, No 3, p 232-246, 1980. 7 Fig, 3 Tab, 41 Ref.

Descriptors: *Phytoplankton, *Interfaces, *Eutrophication, Bays, *Lakes, Lake Huron, *Saginaw Bay, Chlorophyll a, Productivity, Nutrients, Phosphorus, Seasonal variation, Path of pollutants.

The front or interface between eutrophic Saginaw Bay water and oligotrophic Lake Huron water was located by continuous underway sampling at 1 m depth during four research cruises. Samples were analyzed for temperature, nutrients, and chlorophyll distributions. Chloride was a reliable indicator of the front, which was highly mobile. Subsequently, stations in the bay and lake were established for further sampling. Phytoplankton production began earlier in the spring in the warmer, more eutrophic bay water than in the cold, open lake water. There was less difference in phytoplankton densities by late summer. Comparing water quality by t-tests showed that the conservative variables (temperature, chloride, and extinction coefficient) and chlorophyll a and total phosphorus showed highly significant differences between bay and lake water, less significant differences between interfaces and lake, and no difference between bay and interface. Silicate, pH, and C14 uptake had significant differences between bay and interface, but not between lake and interface. The phytoplankton community at the nutrient interface had high chlorophyll a biomass (4.47 micrograms per liter), low C14 uptake (7.12 micrograms per liter per hour) and high bacterial activity (V max, 1.33), indicating the presence of a senescent assemblage. Much of the phytoplankton in the bay was removed from the water column by decomposition and settling before mixing into the open lake. However, during mid-summer several large outputs of nutrients and/or phytoplankton from bay to lake were observed. Although total phosphorus moved readily across the front, chlorophyll biomass did not. (Cassar-FRC)
W82-01164

POSTSPAWNING MORTALITY OF RAINBOW SMELT IN WESTERN LAKE SUPERIOR,

Brigham Young Univ., Provo, UT. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-01189

ORGANOCHLORINE INSECTICIDES AND PCB IN SURFICIAL SEDIMENTS OF LAKE MICHIGAN (1975),

Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
For primary bibliographic entry see Field 5A.
W82-01190

TRACE METAL MINERAL EQUILIBRIA IN LAKE ERIE SEDIMENTS,

Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
G. Matisoff, A. H. Lindsay, S. Matis, and F. M. Soster.
Journal of Great Lakes Research, Vol 6, No 4, p 353-366, 1980. 3 Fig, 3 Tab, 76 Ref.

Descriptors: *Chemical precipitation, *Lake sediments, *Trace metals, *Lake Erie, Sediments, Lakes, Saturation index, Pore water, Sulfides, Phosphates, Minerals, Carbonates, Fate of pollutants, Zinc, Cadmium, Calcium, Iron, Manganese, Lead.

An ion pair model of interstitial water chemistry of Lake Erie sediments was used to calculate the thermodynamic precipitation tendency of metal phosphate and carbonate mineral phases. It is suggested that detrital calcite, aragonite, and dolomite are dissolving and Fe and Mn carbonates are precipitating. Regenerated phosphate should be removed from solution by reacting with Ca, Fe, Mn, and Pb, with whitlockite, Ca3(PO4)2, being the predicted primary controlling phase. Apatites are supersaturated and may be precipitating. The most probable controlling mechanisms for Zn and Cd are sulfide phases, mixed mineral phases, adsorption, and/or ion exchange equilibria. Inclusion of organic complexes in the model would not improve the results significantly, except for slight reductions in predicted supersaturation.(Cassar-FRC)
W82-01191

SEASONAL FEATURES OF ZOOPLANKTON ASSEMBLAGES IN THE NEARSHORE AREA OF SOUTHEASTERN LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans, B. E. Hawkins, and D. W. Sell.
Journal of Great Lakes Research, Vol 6, No 4, p 275-289, 1980. 4 Fig, 8 Tab, 45 Ref.

Descriptors: *Zooplankton, *Seasonal variation, *Water depth, Lakes, *Lake Michigan, Plankton, Phytoplankton, Fish, Predation, Invertebrates.

Abundance of zooplankton within 11 km north, south, and offshore from the Donald C. Cook Nuclear Power Plant, southeastern Lake Michigan, varied with year, season, and depth during the period 1971-77. Results demonstrate that long-term changes in zooplankton populations can be documented convincingly only if comparisons are made in similar areas of the lake at the same time of year. Zooplankton assemblages were strongly related to water depth from mid-spring to mid-autumn. The shallowest zone studied, 5-10 m, had the least abundance and most variability in zooplankton populations. From mid-spring to mid-autumn zooplankton abundance in the 5-10 m zone was lower; after destratification, higher. Densities were low in spring (<10,000 per cu meter) and highest in summer (>50,000 per cu meter) and declined through autumn. During autumn the inshore region was dominated by cladocerans and the outer region by copepods. Factors implicated in the seasonal variations are temperature regimes, phytoplankton standing stocks, and predation. (Cassar-FRC)
W82-01192

EFFECTS OF ATMOSPHERIC PRECIPITATION ADDITIONS ON PHYTOPLANKTON PHOTOSYNTHESIS IN LAKE MICHIGAN WATER SAMPLES,

Argonne National Lab., IL.
J. I. Parker, G. T. Tisue, C. W. Kennedy, and C. A. Seils.
Journal of Great Lakes Research, Vol 7, No 1, p 21-28, 1981. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Lakes, *Phytoplankton, Aquatic plants, Plankton, Phytotoxicity, Zinc, Cadmium, Copper, *Precipitation, *Lake Michigan, Phosphates, Nitrates, Nutrients, Ammonia, Photosynthesis.

Chemical analyses were made of local precipitation in the Lake Michigan area. The effects of incremental additions of rain or snow-melt water on the photosynthetic rate of phytoplankton from the offshore water of Lake Michigan were also investigated. In three of the four experiments conducted, wet deposition was used, and in one experiment a melted snow core was used as the incremental addition. Photosynthesis was significantly increased in three experiments. In the other experiment, photosynthesis was greater than in control samples, and this precipitation sample appeared to stimulate primary productivity. Lake water averages for phosphate, nitrate, and ammonia concentration were exceeded in the precipitation samples by factors of 10, 2, and 50, respectively. Precipitation levels of silicon were lower than the concentration in lake water, but this apparently did not limit photosynthesis. Acidity of lake water was reduced only slightly by added precipitation, and no consistent relationship between these slight reductions in acidity and reduced photosynthesis could be established. Treated samples showed very significant reductions in alkalinity. Levels of zinc, cadmium, and copper in the precipitation samples greatly exceeded the lake water averages, thus producing a high potential for toxic effects on photosynthesis at treatment levels greater than 10%. The results suggest that algal nutrients and toxic trace elements in atmospheric precipitation may interact in a competitive manner to either stimulate or depress phytoplankton photosynthesis in water samples from Lake Michigan. (Baker-FRC)
W82-01156

SEDIMENT DISTRIBUTION OF METHANOGENIC BACTERIA IN LAKE ERIE AND CLEVELAND HARBOR,

Ohio State Univ., Columbus. Dept. of Microbiology.
T. E. Ward, and J. I. Frea.
Applied and Environmental Microbiology, Vol 39, No 3, p 597-603, March, 1980. 2 Fig, 3 Tab, 30 Ref.
OWRT-A-040-OHIO(2).

Descriptors: *Sediments, *Bacteria, Cleveland Harbor, *Lake Erie, *Harbors, Fluorescence, Methane bacteria, Seasonal variation, *Sediment distribution.

Results are presented from a survey made with fluorescent-antibody techniques of the seasonal and sediment distribution of a select number of known methanogens which occur naturally in the sediments of Lake Erie and Cleveland Harbor. The most numerous methanogen found in regions of high-organic-silt sediments was Methanobacterium ruminatium. The population of this species ranged from 10 to the 6th power to 10 to the 9th power cells/gram of dry sediment. Identifications were made in sand-silt, clay, or sand sediments of Methanobacterium strain MoH and Methanosarcina barkeri. These methanogens ranged in density from 10 to the 6th power to 10 to the 7th power cells/g of dry sediment. Methanospirillum hungatii was noted only after an organic enrichment was done on Cleveland Harbor sediments. The seasonal and selective sediment distribution of these methanogens appears related to the type and concentration of carbon substrate as well as to the activities of heterotrophic and sulfate-reducing bacteria. The application of the fluorescent antibody technique to these naturally occurring methanogens should increase the acquired knowledge of aquatic methanogenesis. (Baker-FRC)
W82-01233

EUTROPHICATION,

Colorado Univ. at Boulder.
A. J. Medine, and D. B. Porcella.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 908-916, June, 1981. 119 Ref.

Descriptors: *Eutrophication, *Literature review, Phytoplankton, Macrophytes, Lakes, Nutrients, Model studies, Watershed protection.

Recent progress made in the field of eutrophication studies is summarized in this review article. Specific research was conducted concerning nutrient loading, effects of controlling nutrient loads, correlations and indicators. Effects of nutrient in-

crease were seen to be dependent upon the Vollenweider phosphorus loading relationship. The proper management and economic policies to arrest water quality deterioration or reverse undesirable trends were investigated. Regional surveys were conducted of various lake systems. Efforts in the area of eutrophication and ecosystem modeling have produced new data on the physical transport coupled with biological and chemical transformations. Phosphorus uptake rates of Cladophora growing near Harbor Beach, Michigan were modeled as a function of internal phosphorus levels. Long-term responses of Lake Ontario water quality parameters were simulated. Results of a holistic approach to ecosystem modeling were presented. Nutrient sources and sinks represent another area that saw increased research in recent years. The impacts of sediment, nitrogen, and phosphorus on aquatic biota were reviewed. The roles of phosphorus loading and dynamics in lake water were noted and related to agricultural impacts, loading functions, internal loading, epilimnetic recirculation, the role of organisms in the phosphorus cycle, and phytoplankton impacts. A linear programming model, designed for use in management decisions in a Pennsylvania 208 planning area, was used to analyze the impacts and economic aspects of conservation alternatives for controlling downstream dissolved and sediment associated phosphorus loads to lakes. Pollutant transport, the atmospheric loading of phosphorus, and a study of phosphorus release in 4-liter reaction vessels using lake sediments and distilled water were each investigated. Progress was also made in the areas of biological and chemical interactions and lake restoration. (Baker-FRC)
W82-01271

THE USE OF THE EQUILIBRIUM TEMPERATURE TO ESTABLISH THE HEAT BALANCE OF A WATER SURFACE (SUR L'UTILIZATION DE LA TEMPERATURE D'EQUILIBRE POUR L'ETABLISSEMENT DU BILAN THERMIQUE D'UN PLAN D'EAU),

Complexe Scientifique des Cezeaux, Aubiere (France). Lab. Associe de Meteorologie Physique.
C. Boutin, J. P. Albignat, and H. Isaka.
Hydrological Sciences Bulletin, Vol 26, No 2, p 159-170, June, 1981. 3 Fig, 3 Tab, 11 Ref. (English summary).

Descriptors: *Lakes, *Heat balance, *Equilibrium, Mathematical studies, Heat, Water temperature, Lake Godivelle, *France.

A series of daily heat balances was determined for La Godivelle lake in France, and daily estimates of the rate of heating of the lake were made using the methods developed by Edinger et al. (1968) and Keijman (1974) for equilibrium temperature. Using these methods, the exchange coefficient and the equilibrium temperature can be calculated to yield the best possible estimate of the rate of temperature increase. Also, data are used to describe the daily and seasonal behavior of the exchange coefficient and the equilibrium temperature for the summer and autumn stratification phases of the lake. (Small-FRC)
W82-01353

DATA ON THE STAGNANT PONDS OF THE SAVANNAH OF LAMTO (IVORY COAST) (DONNEES SUR LES MILIEUX LIMNIQUES STAGNANTS DES SAVANES DE LAMTO (COTE D'IVOIRE)),

Ecole Normale Superieure, Abidjan (Ivory Coast).
P. Forge.
Hydrobiologia, Vol 72, No 3, p 293-300, July, 1980. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Ephemeral lakes, *Aquatic life, *Stagnant water, Physicochemical properties, Lakes, Ponds, Species diversity, *Ivory Coast, Water quality, Vegetation, Savannah ponds, Savannah of Lamto.

The size variation through the season of the numerous temporary ponds in the savannah at Lamto, Ivory Coast, is explained by the theoretical water surplus, calculated as a function of temperature and rainfall. Five pond types were identified: ponds on burnt savannah, ponds on non-burnt savannah, forest ponds, and pools on rocks with high and low conductivity. Except for the high conductivity rock pools, the waters were slightly acid (pH 5.5-6.0), high in iron (1-5 ppm), and low in conductivity (30-80 micromho per cm). Four depth correlated vegetation zones were apparent. The savannah ponds had the most diverse fauna, whereas the forest and rock pools had limited numbers of life forms. (Cassar-FRC)
W82-01357

MINERAL IMPACT OF LAKES AS BACKGROUND FOR THEIR BIOGENIC DYNAMICS,

Max Planck Inst. fuer Limnologie zur Holstein (Germany, F.R.).
W. Ohle.
Hydrobiologia, Vol 72, No 1/2, p 51-59, July, 1980. 15 Fig, 4 Tab, 11 Ref.

Descriptors: *Primary production, *Turbidity, *Sedimentation, Lakes, Water quality, Algae, Phytoplankton, Minerals, *Light penetration, Secchi disks, Holstein area, Germany.

Two types of lakes were identified near Holstein, Germany. The Schohsee and Schluensee were enriched with clay, silt, sand and the hydroxides of Fe and Mn as a result of construction of an embankment and influx of wash water from a gravel pit, respectively. Grossner Ploner See and Pluss-See were not subject to mineral turbidity. During windy weather the mineral-impacted lakes were very turbid, but in clear weather, very clear. The Secchi disk readings were 4.6-6.0 meters for the mineral lakes and 2.5-3.8 meters for the other two. Epilimnic phosphates were low, 5-10 mg P per cu meter in the mineral lakes and 50-150 mg P per cu meter in the other lakes. The mean value of primary productivity in Schohsee was 0.33 g C per sq meters per day and in Pluss-See, 1.05 g C per sq meters per day. In Schohsee the carbon was reused 1.7 times before settling to the sediments; in Pluss-See, 15 times. The lakes receiving mineral matter, analogous to alpine lakes receiving turbid snowmelt waters, lost small phytoplankton cells and nutrients through adsorption on detritus and greater sedimentation rates. (Cassar-FRC)
W82-01359

PHYSICO-CHEMISTRY, DESTRATIFICATION AND NUTRIENT BUDGET OF A LOWLAND EUTROPHICATED MALAYSIAN RESERVOIR AND ITS LIMNOLOGICAL IMPLICATIONS,

Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Zoology.
P. T. Arumugam, and J. I. Furtado.
Hydrobiologia, Vol 70, No 1/2, p 11-24, April, 1980. 6 Fig, 4 Tab, 28 Ref.

Descriptors: *Eutrophication, Destratification, *Nutrients, Phosphates, *Lakes, Water quality, Subang Lake, Buloh River, *Malaysia, Lake circulation, Stratification, Fishkills, Phytoplankton, Water pollution sources, Limnology, Reservoirs, Eutrophic lakes.

Extensive algal blooms and poor water quality prompted a limnological investigation of the eutrophied Subang Lake, Malaysia. Determination of the nutrient budgets showed that the reservoir is naturally oligotrophic, having very soft water with a low total dissolved iron concentration and extremely low levels of phosphate. The reservoir, similar to most Malaysian lakes, has a weak thermal stratification, an oxygenated euphotic zone, and a stable deoxygenated hypolimnion. This stratification provides for great species diversity and, at one station, vertical layering of plankton communities. The destratification that occurs on occasion results in sudden mass fish mortality and phytoplankton kills, algal blooms because of sudden liberation of nutrients from the hypolimnion, and poor taste and odor. (Cassar-FRC)
W82-01360

COMPARATIVE LIMNOLOGY OF NINE LAKES OF JAMMU AND KASHMIR HIMALAYAS,

Sri Pratap Coll., Srinagar (India). Hydrobiology Lab.
D. P. Zutshi, B. A. Subla, M. A. Khan, and A. Wanganeo.
Hydrobiologia, Vol 72, No 1/2, p 101-112, July, 1980. 4 Fig, 5 Tab, 33 Ref.

Descriptors: *Eutrophication, *Water quality, Water pollution effects, *Lakes, Himalayas, Physicochemical properties, *Limnology, Vegetation, Aquatic plants, Lake morphology, Kashmir, *India, Phytoplankton, Productivity, Algae, Comparison studies.

The physicochemical and biological features of nine lakes in the Kashmir Himalayas were studied. Two of the lakes are located in the lower Siwalik (altitude 604 meters), five in the Kashmir Valley (altitude 1584 meters), and two in the alpine region (above 2000 meters). The Siwalik lakes are subtropical, monomictic; the valley lakes are monomictic or develop unstable thermal stratification; and the alpine lakes are dimictic. The high altitude lakes have very low electrical conductivity, which increases with decreases in altitude. Most are of the medium hard water type. Ca and bicarbonate are most abundant. Cyanophycear dominate in eutrophic lakes, and diatoms and Chlorophyceae in less eutrophic lakes. Rotifers are the most common zooplankton. Macrophytes, present in 8 lakes, are not related to either altitude or physicochemical properties. One lake, Trigam, is classified as eutrophic, two lakes as meso-eutrophic and in rapid evolution, five as mesotrophic, and one as oligotrophic. Eutrophication is the result of increased human settlement in the drainage basins. (Cassar-FRC)
W82-01361

HYDROBIOLOGICAL STUDIES ON THE AJWA RESERVOIR, THE SOURCE OF RAW WATER SUPPLY TO THE BARODA WATER WORKS,

National Environmental Engineering Research Inst., Ahmedabad (India). Ahmedabad Field Centre.
I. Jayangoudar.
Hydrobiologia, Vol 72, No 1/2, p 113-123, July, 1980. 4 Tab, 22 Ref.

Descriptors: *Water quality, *Water supply, *Aquatic life, Lakes, *Reservoirs, *Ajwa Reservoir, *India, Physicochemical properties, Zooplankton, Phytoplankton, Photosynthesis, Productivity, Nutrients, Aquatic plants, *Hydrobiology.

Hydrobiological studies (April 1963 to December 1964) of the Ajwa Reservoir, India, raw water source for the Nimeta Water Works, Baroda, indicated that the surface layers are comparatively clearer and cleaner than the bottom layers from which raw water is presently being drawn for purification. No persistent thermal stratification was present. The pH was 8.1-8.7, i.e., 0.1-0.6 units lower in the bottom water than in the surface water. Total solids were maximum in June or July and minimum in August or September; water level and total solids were inversely correlated. Photosynthetic oxygen production varied considerably, 1.24-4.02 g per sq meter per day in 1963 and 0.46-1.23 g per sq meter per day in 1964. Free ammonia, nitrates, nitrites, and phosphates were absent from surface and bottom waters. Silica levels were greater in bottom waters than in surface waters. Oxidizable organic matter (permanganate value) was higher in bottom water, 1.22-5.30 ppm, than in surface water, 0.78-1.92 ppm. Zooplankton were found in far larger numbers than the nutrient-limited phytoplankton. (Cassar-FRC)
W82-01364

BALANCE OF BIOGENIC ELEMENTS IN THE ARAL SEA UPON A DROP OF ITS LEVEL,

State Oceanographic Inst., Moscow (USSR).
V. N. Bortnik.
Water Resources (English Translation), Vol 7, No 5, p 457-462, September/October, 1980. 4 Tab, 17 Ref. Translated from Vodnye Resursy, No 5, p 140-147, September/October, 1980.

Descriptors: *Water, *Hydrologic budget, *Water level, *Aral Sea, Mathematical equations, Mathematical studies, Nitrogen, Phosphorus, Silicon, Aquatic productivity, Chemical analysis, Russia.

The Aral Sea is experiencing considerable changes in the balance of bigenic elements, significant salinization, and restructuring of its hydrobiological regime as a result of a drop in the level of the sea, a reduction of its area and volume, and substantial changes in the quality of river water entering the Sea. The main component of the income part of the balance of both dissolved and solid forms of biogenic elements is the biogenic content of the Amu Darya and Syr Darya rivers. During the period 1961 through 1977, the transport of the suspended load of the Syr Darya decreased in proportion to the decrease in its water discharge, while the suspended load discharge of the Amu Darya increased by about 1.5 times in spite of a considerable decrease in volume of water discharge. The average annual specific inflow of gross nitrogen with respect to the area and volume of the sea increased by about 33 percent between 1961 and 1977. The specific inflow of gross phosphorus increased by 33 to 36 percent, while that of dissolved silica decreased by about one-third. The average annual depositions of dissolved biogenic elements now exceed their total income with river runoff and precipitation. The balances of dissolved and solid biogenic elements in the Aral Sea are almost completely determined by its water balance. (Carroll-FRC)
W82-01370

DIURNAL, DEPTH-WISE, AND SEASONAL CHANGES OF PHYSICO-CHEMICAL FACTORS IN SATHIAR RESERVOIR,

Madurai Kamaraj Univ. (India). Dept. of Biological Sciences.
V. Kannan, and S. V. Job.
Hydrobiologia, Vol 70, No 1/2, p 103-117, April, 1980. 14 Fig, 48 Ref.

Descriptors: *Water quality, *Seasonal variation, *Diurnal distribution, Lakes, *Sathiar Reservoir, *India, Reservoirs, Eutrophic lakes, Eutrophication, *Physicochemical properties.

Physicochemical factors were studied diurnally, seasonally, and depth-wise in the highly eutrophic Sathiar Reservoir in the Sirumalai range, India, from April 1977 to March 1978. Water level fluctuated 2 to 6 meters, maximum being reached during the heavy monsoon season of August to November. Phytoplankton concentrations decreased with dilution and increased with lowered water levels. Transparency varied from 11.25 in April to July to 36.0 cm in winter. Transparency was governed not only by plankton density but also by solar radiation. Surface temperatures ranged from 26.4 degrees C in December to 32.4 degrees C in May. Maximum difference in temperature between surface and bottom was 5.5 degrees C. Dissolved oxygen at the surface varied between 15 mg per liter in the late afternoon to 4.82 mg per liter prior to sunrise and did not change with the season. There was a clinograde oxygen curve and an anoxic hypolimnion. Surface pH changed 0.22 to 0.9 units with photosynthetic activity. Redox potential at the surface coincided with oxygen and pH changes and decreased at night. Total phosphorus, nitrate and Kjeldahl nitrogen values indicate that the lake is eutrophic. (Cassar-FRC)
W82-01372

INVESTIGATIONS INTO THE OCCURRENCE OF MIDGE PLAGUES IN THE VICINITY OF HARDERWIJK (NETHERLANDS),

Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
D. M. Beattie.
Hydrobiologica, Vol 80, No 2, p 147-159, May, 1981. 9 Fig, 6 Tab, 18 Ref.

Descriptors: *Midges, *Lakes, Eutrophication, Nuisance, Lighting, Insects, Aquatic insects, *Netherlands, Wolderwijd.

In response to complaints about midge swarms, a study was made of the total chironomid larval population in Wolderwijd, a large shallow Dutch lake, between February and October of 1977. The main species distribution pattern was of the same order of magnitude in both sand and stony substrates, based on substrate and total larval population size. Eutrophication did not cause extraordinarily large chironomid populations to produce excessive numbers of adult midges. The midge plagues experienced in the area are ascribed to the attraction of the midges for artificial light displayed by housing estates in the neighborhood of the lake. Unfavorable weather conditions occurring during 1977 prevented the normal development of larval populations in the lake during the summer, but the life cycle data indicate that in most years, one or more summer generations will occur with population sizes similar to that recorded for the overwintering generations. This would increase the number of occasions on which midges would be present during the summer, but not increase the number of midges on any one occasion. It was concluded that the number and frequency of midges emerging from Wolderwijd are not extraordinarily high for a shallow, temperate-zone lake of it's size. Midge larval eradication programs could upset the lake ecosystem balance. Selective light attraction and killing of adults might reduce the nuisance. (Baker-FRC)
W82-01378

THE CRUSTACEAN ZOOPLANKTON OF MALI (WEST AFRICA),

Ghent Rijksuniversiteit (Belgium). Zoology Inst.
H. J. Dumont, J. Pensaert, and I. Van de Velde.
Hydrobiologia, Vol 80, No 2, p 161-187, May, 1981. 14 Fig, 2 Tab, 55 Ref.

Descriptors: *Lakes, *Zooplankton, *Chemical composition, Chemical properties, Minerals, *West Africa, *Mali, Crustaceans, Aquatic life.

A study of the zooplankton of aquatic biotopes in Mali revealed 48 species of Phyllopoda, 24 species of Copepoda, and a freshwater shrimp. A total biogeographical discussion is not possible at this point, since, for many species, both taxonomical position and chronological records are fragmentary and uncertain. At least 29 species, however, seem to be restricted to Africa, and some even to West Africa. The water chemistry of the lakes is characterized by a low mineral content, but seems not to be distributive to any of the numerous zooplankton species encountered. The zooplankton communities are typically composed of numerous species. The Niger delta appears to be part of the biological boundary of the Sahara as far as aquatic invertebrates are concerned. West African equatorial climate endemics and arid to semi-arid endemics meet and interpenetrate each other's ranges over short distances. (Baker-FRC)
W82-01379

PHYSICAL AND CHEMICAL STUDIES OF LAGO TUPE; A CENTRAL AMAZONIAN BLACK WATER 'RIA LAKE',

Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
H. Rai, and G. Hill.
Internationale Revue der Gesamten Hydrobiologie, Vol 66, No 1, p 37-82, 1981. 34 Fig, 5 Tab, 85 Ref.

Descriptors: *Dystrophic lakes, *Physicochemical properties, Lakes, Oligotrophic lakes, *Limnology, Lake morphology, Alkalinity, Acidity, Thermal stratification, Seasonal variation, Suspended solids, Dissolved oxygen, Oxygen, Minerals, Iron, Phosphates, Nutrients, *Brazil, Lago Tupe.

All depths of the Lago Tupe, a Central Amazonian dystrophic black water, were studied for a period of one year to determine the physical and chemical properties of the lake. Thermal properties, suspended matter and dissolved solids were studied, in addition to ionic composition, alkalinity, hardness, pH and dissolved oxygen. The lake was formed in the pleistocene era; it has a surface area of 48 ha and a length of 3 km. Temperatures in this oligomictic lake varied only 0.7 degrees C at all depths for the year, but thermal stratification was exhibited. Suspended solids and salinity were low. Lago Tupe is a sodium sulfatochloride water type and showed a striking anion excess, presumably created as a result of organometal formation. All cations increased at low lake levels. According to iron levels, the lake was put into Yoshimura's category. Low alkalinity and hardness complete the profile of a system poor in minerals. The pH varied from 4.4 in wet weather to 5.8 in drier times and demonstrated a uniform vertical distribution. Dissolved oxygen was in general about 6 mg/liter but occasionally reached 11.4 mg/liter, showing a clinograde profile. Phosphates averaged 11.6 micrograms/liter and were of major importance to primary and bacterial production. Nitrate nitrogen averaged 21.68 micrograms/liter, and no evidence of nitrification was noted. Ammonia was seen as the major contributor to the nitrogen pool. Silica averaged 2.4 mg/liter and did not appear to be a distinguishing characteristic of this tropical system. Physical and chemical attributes of Lago Tupe can be viewed as an extension of and a complement to the river system of which it is an integral part. (Baker-FRC)
W82-01381

THE EFFECT OF FERTILIZATION WITH PHOSPHORUS AND NITROGEN VERSUS PHOSPHORUS ALONE ON EUTROPHICATION OF EXPERIMENTAL LAKES,

Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W82-01457

COMPARISON OF FIRST-ORDER ERROR ANALYSIS AND MONTE CARLO SIMULATION IN TIME-DEPENDENT LAKE EUTROPHICATION MODELS,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, W. F. Powers, R. P. Canale, and J. L. Moody.
Water Resources Research, Vol 17, No 4, p 1051-1059, August, 1981. 7 Fig, 1 Tab, 36 Ref.

Descriptors: *Error analysis, *Monte Carlo method, *Model studies, *Lakes, *Eutrophication, Saginaw Bay, Lake Huron, Algae, Nutrients, Phosphorus, Nitrogen, Zooplankton, Phytoplankton, Variation coefficient, Simulation analysis, Comparison studies.

Two methods for estimating variance associated with eutrophication model output were examined: Monte Carlo simulation and first-order variance propagation. The lake eutrophication model used for study simulated dynamics of phytoplankton, herbivorous and carnivorous zooplankton, three nitrogen forms, and two phosphorus forms. It was applied in this case to Saginaw Bay, Lake Huron. Results of analysis showed that the two methods had some differences. Monte Carlo means were most like the measurements, but Monte Carlo medians were most like the deterministic model output. The two methods agreed most closely on both state variable values and their variances when Monte Carlo output distributions were symmetric. Under these conditions, both estimates were measures of variance associated with total populations (such as total algae). Distributions changed dramatically with time for most state variables. For asymmetric distributions first-order variance estimates measured variability about the typical component of the total population (such as a particular species) and Monte Carlo variance estimates measured variability of the population mean, which is usually of more interest. The Monte Carlo analysis requires along computations in both long-term predictions and examination of relative error sources in complex models. (Cassar-FRC)
W82-01460

APPLICATION OF NUTRIENT-SATURATED GROWTH MODEL TO PHYTOPLANKTON MANAGEMENT IN FRESHWATER PRAWN (MACROBRACHIUM ROSENBERGII) PONDS IN HAWAII,

Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and S. R. Malecha.
Aquaculture, Vol 24, No 1/2, p 91-101, May, 1981. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Aquaculture, *Nutrients, *Model studies, Phytoplankton, Ponds, Oxygen, Aquatic plants, *Hawaii.

A model of nutrient-saturated growth of Chlorella with significant modification in only two of nine parameters was found to provide an excellent description of experimental data collected from six large experimental tanks and one earthen production pond. The results suggest that in order to maintain system stability with respect to oxygen fluctuations, primary production rates in other commercial ponds are usually kept well below levels that could be obtained under optimal conditions. Application of the model to field data shows that phytoplankton populations in prawn ponds should be kept between 150 and 400 mg/cubic meter chlorophyll a (Chl a) in order to prevent anoxia in worst case situations such as calm nights. Due to a negative correlation between light-limited growth rates and Chl a concentrations, little increase in photosynthesis occurs if Chl a concentrations are raised above 2 g/cubic meter, and there is a negative correlation between photosynthesis and Chl a concentrations for Chl a values greater than 5 g/cubic meter. Therefore even under ideal conditions 1 meter deep ponds should probably be operated with Chl a concentrations less than 2 g/cubic meters. The success of the light limited model in describing data from both monospecific continuous culture systems and diverse populations in prawn ponds suggests that the model may have wide applicability in algal mass culture systems. (Baker-FRC)
W82-01483

NEPHELOID AND SUSPENDED PARTICULATE MATTER IN SOUTH-EASTERN LAKE MICHIGAN,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
R. L. Chambers, and B. J. Eadie.
Sedimentology, Vol 28, No 3, p 439-447, June, 1981. 7 Fig, 24 Ref.

Descriptors: *Sediment distribution, *Suspended sediments, *Nepheloid layer, Lakes, *Lake Michigan, Great Lakes, Lake sediments, Sediments, Particulate matter, Thermocline, Thermal stratification, Stratification.

A benthic nepheloid layer observed in southeastern Lake Michigan was studied during April 1977 to October 1979. This layer, with high total suspended matter and high total particulate surface area, started to develop in late April and formed a distinct benthic zone by mid May. At 1 meter from the bottom, the concentrations of total suspended matter increased by 2-20 times compared with the hypolimnion. Greatest increases were observed at the shelf-slope boundary, which is also the approximate mean depth of the thermocline. Thickness of the layer varied from a few meters at the shelf-slope boundary to greater than 10 meters at the base of the slope. The particulate flux increased exponentially from 10 meters above the bottom to 1 meter above the bottom, suggesting that a large fraction of the collected material came from resuspension. It is hypothesized that currents generated during the thermal bar period resuspend the winter accumulation of surficial shelf sediments, transport it lakeward, and create the nepheloid layer. (Cassar-FRC)
W82-01499

RELEASE OF PHOSPHORUS BY CERTAIN BENTHIC INVERTEBRATES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, T. F. Nalepa, M. A. Quigley, and J. M. Malcyzk.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 978-981, August, 1981. 1 Tab, 25 Ref.

Descriptors: *Invertebrates, *Phosphorus, *Nutrient release, *Lake Michigan, Lakes, Metabolism, Macroinvertebrates, Benthic fauna, Aquatic animals, Midges, Oligochaetes, Tubificids, Stylodrilus, Phosphates, Excretion, Sediments.

Three benthic invertebrates from Lake Michigan (Stylodrilus heringianus, tubificids, and Chironomus spp.) were incubated in wet sand at 5 and 20 C for 24 hours with full and empty digestive systems to determine phosphate release rates. Results suggest that phosphate excretion could account for virtually all of the P released from aerobic sediments and must be considered an important mechanism for nutrient release into the lake. Mean weight-specific inorganic phosphate release rates ranged from 0.1 to 0.8 nmol P per mg ash free dry weight per hour. Chironomids release rates (0.27-0.81 nmol P per mg per hour) were significantly greater than rates for oligochaetes (0.12-0.27 nmol P per mg per hour). There were no significant differences in inorganic P release rates from animals with full or empty guts, with the exception of S. heringianus in the 24 hour study. Short-term experiments (30 min) showed much higher values (3.34 + or - 1.78 nmol inorganic P per mg per hour and 3.59 + or - 4.06 nmol organic P per mg per hour). Temperature effects on release rates were not as great as expected, and definitive conclusions were not possible. (Cassar-FRC)
W82-01502

THE EFFECT OF CHANGING SEDIMENT SUPPLY ON SEDIMENTATION IN A GLACIER-FED LAKE,

Illinois Univ. at Chicago Circle, Chicago. Dept. of Geological Sciences.
N. D. Smith.
Arctic and Alpine Research, Vol 13, No 1, p 75-82, February, 1981. 5 Fig, 18 Ref.

Descriptors: *Lake sediments, *Glacial sediments, *Sediment distribution, Glacial lakes, Sedimentation rates, *Canada, *Bow Lake, Alpine regions, Glacial streams.

Bow Lake, located in Alberta, Canada, has been studied as part of an investigation of sedimentation in glacier-fed intermontane lakes. This deep, thermally stratified alpine lake is fed by an overland meltwater stream from Bow Glacier, which has been generally receding from its Neoglacial maximum. The sedimentation regime of the lake was abruptly changed when a pond, acting as a sediment trap, developed at the margin of the receding glacier in 1955. Prior to this development, underflows which formed thick varves in the lower areas of the lake floor dominated sedimentation in Bow Lake. The reduction in sediment input caused the dominant mechanism of sediment dispersal to change from underflows to interflows. The inflows are now dispersed through rightward-deflected interflows moving above the hypolimnion and unaffected by bottom topography. The sediment-trapping capabilities of temporary marginal ponds and the effects which they trigger should be considered as potentially important means of creating variations in the lateral and vertical dispositions of glaciolacustrine sediments. (Carroll-FRC)
W82-01510

HISTORICAL CHANGES AND RELATIONSHIP TO INTERNAL LOADING OF SEDIMENT PHOSPHORUS FORMS IN HYPERTROPHIC PRAIRIE LAKES,

National Water Research Institute, Winnipeg (Manitoba). Freshwater Inst.
R. J. Allan, J. D. H. Williams, S. R. Joshi, and W. F. Warwick.
Journal of Environmental Quality, Vol 9, No 2, p 199-206, April/June, 1980. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Water pollution effects, *Lake sediments, Bottom sediments, Nutrients, Lake beds, Lake classification, Eutrophic lakes, Trophic level, Core logging, Geologic time, Canada.

A study was conducted on five Canadian mainstream lakes and two sloughs to see of historical changes in phosphorus form concentrations in sediment cores would provide clues to presettlement trophic state and to elucidate the role of sediment in internal nutrient loading of hypertrophic lakes. Nonapatite phosphorus levels in sediment cores showed that most Prairie water bodies were eutrophic prior to European settlement and extensive farming in the area. Urban and agricultural effluents have caused increased levels of nonapatite phosphorus in surface sediments. Organic phosphorus increases in surface sediments are attributed to post-settlement increases in lake productivity. Increases in nonapatite inorganic phosphorus in surface sediments reflect urban and/or agricultural effluents modified by upward migration and pooling. Internal loading is evidenced by declines in surface sediment nonapatite inorganic phosphorus. (Geiger-FRC)
W82-01516

ZOOPLANKTON ABUNDANCE AND DIVERSITY IN CENTRAL FLORIDA GRASS CARP PONDS,

Central Florida Univ., Orlando. Dept. of Biological Sciences.
D. L. Fry, and J. A. Osborne.
Hydrobiologia, Vol 68, No 2, p 145-155, January, 1980. 7 Fig, 6 Tab, 48 Ref.

Descriptors: *Zooplankton, *Carp, Fish, *Temporal distribution, Plankton, Distribution, Rotifers, Aquatic animals, *Ponds, *Comparison studies, Florida.

Three adjacent ponds were constructed and filled during June of 1975 at the University of Central Florida. The depth ranged from surface to 1.5 meters. Water level was maintained throughout the study by weekly filling. Nine species of rooted aquatic plants were planted in pure stands in the ponds prior to filling. In November, 9 grass carp were stocked in pond 1 and 85 grass carp were stocked into pond 2. In December the ponds were drained, and the weights, lengths, and body condition of the grass carp were determined. Grass carp did not affect the quality of the water, and they also had little direct or indirect effect on the zooplankton in the ponds. The abundance and species diversity of zooplankton were not significantly different between ponds prior to grass carp stocking. What variation in species between the ponds did exist was more likely due to temporal variation rather than to the grass carp. The number of zooplankton species was highest during the fall in pond 1, and during the summer in ponds 2 and 3. Rotifer species were in the main responsible for the seasonal variation in zooplankton species numbers. The monthly mean number of species prior to grass carp was near 10 in pond 1, elevating to 12 for pond 3. After the grass carp were placed into the ponds, the monthly mean number of species was 9 for pond 1, and more than 12 for ponds 2 and 3. Measurements of orthophosphate, nitrite nitrogen, and nitrate nitrogen changed little throughout the study. (Baker-FRC)
W82-01520

THE EFFECTS OF A NEW RESERVOIR ON THE ATTACHED DIATOM COMMUNITIES IN HUNTINGTON CREEK, UTAH, U.S.A.,

Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
L. E. Ross, and S. R. Rushforth.
Hydrobiologia, Vol 68, No 2, p 157-165, January, 1980. 3 Fig, 4 Tab, 14 Ref.

Descriptors: *Diatoms, *Population dynamics, *Reservoirs, Dams, Population density, Populations, *Powerplants, *Ecological effects, Dam construction, Huntington Creek, *Utah.

The effects of a new power plant and reservoir were examined on the structure of the attached diatom communities of Huntington Creek, Utah. Construction of the coal-fired generating plant and Electric Lake Dam was begun in 1970. One sampling site was located about 14 km below the main diversion dam on Huntington Creek. Three additional sites were established below the generating plant. A fifth site is 5 km above the North Huntington Reservoir diversion dam, near the Utah Power and Light Company. Two additional sites are at two campgrounds, while the 8th site is at the junction of the Left and Right Forks of Huntington Creek and the ninth site is 2.2 km below Stuart Fire Station at an elevation of 2250 meters. One hundred diatom taxa were identified during the study. No seasonal patterns could be identified

from the resulting phenogram. and no significant differences were seen between the 1971-72 and 1976-77 collections, before and after the completion of the power plant. Diatom communities near the dam were apparently not significantly affected by construction of the reservoir. The two most prevalent species were Achnanthes minutissima and Navicula radiosa var. tenella. These two species were collected at all nine sites, and generally were abundant throughout all collection periods. It was concluded from various statistical analyses that the reservoir had not greatly affected net-plankton and nannoplankton assemblages in the stream. (Baker-FRC)
W82-01521

COLLAPSING APHANIZOMENON FLOS-AQUAE BLOOMS: POSSIBLE CONTRIBUTIONS OF PHOTO-OXIDATION, O2 TOXICITY, AND CYANOPHAGES,

Manitoba Univ., Winnipeg. Dept. of Botany.
A. M. Coulombe, and G. G. C. Robinson.
Canadian Journal of Botany, Vol 59, No 7, p 1277-1284, July, 1981. 3 Fig, 1 Tab, 29 Ref.

Descriptors: *Algae, *Toxicity, Cyanophyta, *Eutrophication, Lakes, Eutrophic lakes, Pathogens, Viruses, *Oxidation.

Four bloom collapses of Aphanizomenon flosaquae in three shallow eutrophic pothole lakes in southwest Manitoba were examined; for the triggering mechanism. The environmental conditions before and during the blooms were not the same for each event. Therefore, a single triggering mechanism could not be cited as a cause. Three of the bloom collapses (two in mid-July 1979, one in mid-August 1979) began when the lakes were thermally stable and conditions were favorable for death from photo-oxidation and/or oxygen toxicity. The fourth, in mid-August 1973, began during a period of lake thermal instability, ruling out photo-oxidation and oxygen toxicity as the triggering mechanism in this case. Virus like particles were detected by electron mircoscopy in cells from three of the blooms (cells from the fourth could not be examined). They were polyhedral and 50-60 micrometers in diameter. Since transmission and isolation of these viruslike particles has not been proved, it cannot be stated that they triggered collapse by viral infection. Cyanophage-induced algal lysis, perhaps caused by thermal instability, may have been a factor in the algal population decline. Other contributing factors not tested in this study are bacterial and fungal pathogens of algae, autolysis, and senescence. (Cassar-FRC)
W82-01595

2I. Water In Plants

CANOPY TEMPERATURE AS A CROP WATER STRESS INDICATOR,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
R. D. Jackson, S. B. Idso, R. J. Reginato, and P. J. Pinter, Jr.
Water Resources Research, Vol 17, No 4, p 1133-1138, August, 1981. 6 Fig, 1 Tab, 22 Ref.

Descriptors: *Water stress, *Canopy, *Temperature, Evapotranspiration, Crop water stress index, Wheat, Irrigation requirements, Soil moisture, Agriculture.

A crop water stress index (CWSI) may be useful for quantitative determination of crop water stress. The CWSI is readily calculated by hand calculator or computer from canopy temperature (measured with an infrared thermometer), wet- and dry-bulb air temperature, and estimated net radiation. The index can be used in place of the stress-degree-day in situations where vapor pressure deficit data are available. The relationship can be expressed as: CWSI = 1 - E/E sub p, where E and E sub p are the actual and potential evapotranspiration. In four experimental wheat plots subjected to different degrees of water stress, pertinent variables were measured. The calculated CWSI, plotted as a function of time, closely paralleled a plot of the extractable soil water in the 0 to 1.1 meter zone. Errors may result from excess wind (increases CWSI), rapidly changing cloud conditions, inaccurate wet- and dry-bulb readings, inadequate calibration of the infrared thermometer, or including some of the soil background in the infrared reading. The CWSI may be useful as an irrigation guide for grains and alfalfa, but probably not for potatoes. (Cassar-FRC)
W82-01106

EFFECT OF WATER, NITROGEN AND ROW SPACING ON THE YIELD AND OIL CONTENT OF SAFFLOWER,

Central Arid Zone Research Inst., Jodhpur (India).
S. D. Singh, and M. Yusuf.
Indian Journal of Agricultural Sciences, Vol 51, No 1, p 38-43, January, 1981. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Crop yield, *Moisture availability, Nitrogen, Farm management, Moisture stress, Soil moisture, Safflower oil, *Safflower, Water use efficiency.

The quantitative relationship of water, nitrogen, and row spacing to yield and oil content of safflower was investigated. Field experiments were conducted using 'A 300' safflower during 1972-75. The site was in an arid climate, with an average period of bright sun for 9-10 hr, and an average daily maximum temperature of 26 degrees C during winter and 36 degrees C during March-April. Low humidity, light wind, and high open water evaporation were characteristic of the area. The soil was a coarse loam with a pH of 7.5. No contribution was made of water to the crop by rain or upward movement from lower soil depths. The yield response of safflower to N was quadratic under adequate (51 cm), negligible, and restricted (8 cm) supplies of moisture. Narrow row spacing (20 cm) required less water and N to produce optimum crop yields than did wider row spacings of 60 cm. The oil content had a quadratic relation with moisture supply but was independent of spacing. Its relationship was inverse with N levels when water supply was restricted, and direct when it was adequate. Narrow row spacing, optimum water supply of 29 cm, and adequate N of 80 kg/ha were needed to obtain optimum oil yields. (Baker-FRC)
W82-01112

COMPARISON OF TESTS CHARACTERIZING VARIETIES OF BARLEY AND WHEAT FOR MOISTURE STRESS RESISTANCE,

Department of Agriculture, Charlottetown (Prince Edward Island). Research Station.
H. G. Nass, and J. D. E. Sterling.
Canadian Journal of Plant Science, Vol 61, No 2, p 283-292, April, 1981. 5 Tab, 24 Ref.

Descriptors: *Crops, *Moisture stress, Soil moisture, Soil moisture retention, Available water, Moisture availability, Testing procedures, Barley, Wheat.

A number of simple tests were evaluated for moisture stress tolerance and avoidance in characterizing cereal cultivars. Eight cultivars of wheat and seven cultivars of barley were evaluated. Of the avoidance tests, visual wilting correlated well with tiller survival, but the water loss from leaves and stomatal diffusion resistance tests did not. Of the tolerance tests, root weight under moisture stress showed a good relationship with survival. Root weight without moisture stress correlated well with survival for wheat and somewhat less for barley. A comparison of root and leaf weight in two soils differing in moisture-holding ability was useful but less correlated with survival. An unsatisfactory tolerance test was that of germination in mannitol, as there was no correlation in rankings with drought survival. Two semi-dwarf wheat cultivars, Pitic and Fielder, and the two-rowed barley cultivars Nordal and Volla demonstrated the greatest moisture stress resistance. This study of avoidance and tolerance tests leads to the conclusion that no one test used alone has sufficient reliability to determine overall cultivar drought response in wheat and barley. At least one test measuring avoidance and one measuring tolerance should be used. (Baker-FRC)
W82-01114

CLIMATIC FACTORS CONTRIBUTING TO YEAR-TO-YEAR VARIATION IN GRAIN YIELD OF CORN ON BROOKSTON CLAY,

Department of Agriculture, Harrow (Ontario). Research Station.
V. A. Dirks, and E. F. Bolton.
Canadian Journal of Plant Science, Vol 61, No 2, p 293-305, April, 1981. 4 Fig, 11 Tab, 19 Ref.

Descriptors: *Crop yield, *Seasonal variations, Prediction, Moisture availability, Clays, Soil types, Farming, Farm management, *Corn, Climatology, Brookston clay, *Ontario.

Some climatic components contributing to the year-to-year variation in a 13 year rotation experiment involving corn grown on Brookston clay are reported. Brookston clay is an orthic humic gleysol. The results are interpreted in regard to their significance for corn production in southwestern Ontario and for the possible development of predictive models for yield. Four climatic vectors accounted for as much as 80% of the total year variance of grain yield. These four factors were moisture deficit days, available moisture, corn heat units, and an effect allowing for the special weighting of these factors during the critical tasselling-silking period. The nature of the response of corn yield to these climatic vectors depended on the level of N supplied via fertilizer, soil condition, and fertility as maintained by rotation. Prediction of yield using weather data and water budget to estimate moisture deficit days for the soil type appears feasible where corn is fertilized, and can be done by the 15th of August, which is about 6 weeks before the corn is mature. The need for basing area predictions on soil type and farm management practices is discussed. (Baker-FRC)
W82-01115

THE EFFECT OF SNOW TRAPPING AND CROPPING SEQUENCE ON MOISTURE CONSERVATION AND UTILIZATION IN WEST-CENTRAL SASKATCHEWAN,

Department of Agriculture, Swift Current (Saskatchewan). Experimental Farm.
For primary bibliographic entry see Field 3F.
W82-01117

YIELD AND PHENOTYPIC TRAITS OF SEMIDWARF AND NORMAL-STATURED BARLEY (HORDEUM VULGARE L.) GENOTYPES GROWN UNDER DIFFERING LEVELS OF MOISTURE STRESS,

Department of Agriculture, Swift Current (Saskatchewan). Research Station.
R. B. Irvine, B. L. Harvey, and B. G. Rossnagel.
Canadian Journal of Plant Science, Vol 60, No 2, p 733-736, April, 1980. 3 Tab, 10 Ref.

Descriptors: *Crop yield, *Moisture stress, Soil moisture, Barley, Moisture availability, Comparison studies.

Several environments were used to grow semidwarf and normal-statured barley genotypes. These environments differed mainly in the levels of plant available soil moisture. Grain yields differed significantly due to environment and genotype, and there was a nonsignificant tendency for semidwarf genotypes to yield less, relative to their tall counterparts, when grown in environments with restricted moisture supply. The stature of the genotype did not appear to influence the expression of yield components, harvest index or flag leaf area. This study indicates that plant stature is not consistently associated with the magnitude of any yield component, so selection procedures followed in normal-statured barleys should be effective in semidwarf populations. (Baker-FRC)
W82-01121

A PARAMETRIC CROP WATER USE MODEL,

California Univ., Los Angeles. Dept. of Geography.
J. E. Burt, J. T. Hayes, P. A. O'Rourke, W. H. Terjung, and P. E. Todhunter.
Water Resources Research, Vol 17, No 4, p 1095-1108, August, 1981. 10 Fig, 4 Tab, 80 Ref.

Descriptors: *Parametric hydrology, *Agricultural hydrology, *Water requirements, Model studies, Mathematical models, Computer models, Water consumption, Evapotranspiration, Crop production, Droughts, Soil-water-plant relationships.

Agricultural water consumption, both temporal and spatial, can be predicted with a model, WATER, which is a compromise between area-specific, data-based regression models and expensive, complex energy-mass exchange models. Among the crops for which fluctuating water demand can be simulated are wheat, corn, rye, barley, rice, potatoes, and alfalfa. Model validation was accomplished by comparison of calculated results with lysimeter data at four grain corn-growing locations in the Western states during the 1974 growing season. The model is useful in predicting the effects of droughts and other weather variables on crop water requirements. Usable in any region, it can also identify areas of optimum or marginal water conditions, adjust choice of crops to the available water, and simulate interactions of climate and plant growth to reduce the necessity for field studies. (Cassar-FRC)
W82-01310

DROUGHT SUSCEPTIBILITY OF TWO TOMATO (LYCOPERSICUM ESCULENTUM) VARIETIES,

Ibadan Univ. (Nigeria). Dept. of Agronomy.
O. Babalola, and M. O. A. Fawusi.
Plant and Soil, Vol 55, No 2, p 205-214, 1980. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Moisture stress, *Crop yield, *Tomatoes, Soil moisture, Drought, Moisture availability, *Soil-water-plant relationships.

Some effects of identical moisture stress levels were measured under field conditions on two tomato varieties. Drought susceptibility of these cultivars was measured under soil moisture conditions in greenhouse experiments. Plant height, root length, number of flowers and total dry matter production were significantly affected by soil water potential treatments. Only root length and total dry matter production were significantly different between cultivars. Fruit yield was significantly affected by soil water potential treatments and the interaction between variety and moisture. Generally the drought susceptibility factor increased with decreasing soil water potential. Findings suggest that the stomata of Fireball remained partially closed under conditions of stress in order to reduce vapor losses, thereby accounting for the higher yields under stress conditions. The slightly deeper rooting system for the Fireball variety is also a definite advantage under stress conditions, as the exploitation of the subsoil is facilitated when the soil surface dries out. (Baker-FRC)
W82-01369

HYDRAULIC CONDUCTIVITY OF FOUR COMMERCIAL CITRUS ROOTSTOCKS,

Agricultural Research and Education Center, Lake Alfred, FL.
J. P. Syvertsen.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 378-381, May, 1981. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Citrus fruits, *Permeability coefficient, Conductivity, Roots, Drought resistance, *Hydraulic conducting.

The growth characteristics and hydraulic conductivity of intact root systems of four citrus rootstocks commonly used in Florida were investigated. The plants used were 6- and 12-month old greenhouse grown seedlings of RL, sour orange (SO), Carrizo citange (Car), and Cleopatra mandarin (Cleo). Six-month old RL seedlings had the largest leaf area, while Car had the smallest. There was no difference among the root dry weights. The hydraulic conductivity of roots of 6-month old RL seedlings was significantly greater than that of SO and Cleo seedlings. Conductivities of Car were intermediate and not significantly different from either RL or SO and Cleo. Carrizo had the highest conductivity of the 12-month old seedlings, however. Rough lemon seedlings had conductivities that were significantly less than those of Car, but greater than conductivities of SO and Cleo. SO and Cleo had similar root conductivities. The hydraulic conductivity of roots of all four rootstocks increased linearly with temperatures between 15 and 30 degrees C. The slope of root conductivity vs. temperature associated with the Cleo data is significantly less than that of the other rootstocks. It is possible that differences in hydraulic conductivity of roots could result from differences in root extension or suberization as a result of differences in soil, water stress, or other environmental conditions. The relatively high root growth rate and hydraulic conductivity of RL can be used to explain its greater efficiency of soil water extraction and its ability to produce larger trees than many other citrus rootstocks. Drought resistance may also be partly explained by the hydraulic conductivity of the roots. (Baker-FRC)
W82-01546

2J. Erosion and Sedimentation

TRANSPORTS IN THE DULUTH-SUPERIOR HARBOR,

Minnesota Univ.-Duluth. Dept. of Physics.
For primary bibliographic entry see Field 5B.
W82-01136

WAVE CLIMATE AND POTENTIAL LONGSHORE SEDIMENT TRANSPORT PATTERNS, NOTTAWASAGA BAY, ONTARIO,

Guelph Univ. (Ontario). Dept. of Geography.
R. G. D. Davidson-Arnott, and W. H. Pollard.
Journal of Great Lakes Research, Vol 6, No 1, p 54-67, 1980. 9 Fig, 4 Tab, 30 Ref.

Descriptors: *Sediment transport, *Waves, *Shores, Model studies, Littoral drift, Lake shores, Lakes, Lake Ontario, *Nottawasaga Bay, Beach erosion, Wasaga Spit, Computer models, Sediment deposition, Erosion, Ontario.

A storm wave climate was hindcast for Nottawasaga Bay, Ontario, using wind records at Cove Island for 1966-70 and the Sverdrup-Munk-Bretschneider technique. This information is necessary for predicting the effects of human activities such as dredging, shore development, and oil spills on the lake coastal zone. A computer model of wave refraction within the bay incorporates 13 wave classes, defined on the basis of significant wave height, period, and direction. The total and the longshore component of wave energy flux are determined for each wave class. The total annual energy flux and net longshore component are determined for 55 points spaced at 1 km intervals by multiplying the value of energy flux at each point by the mean annual frequency for that wave class and summing the values for all relevant waves. A simple model of potential erosion, transport, and desposition patterns within the bay is developed from the variation in net longshore component values. Model predictions are compared with sediment transport patterns visible in aerial photographs and with measurements of erosion and accretion at selected points. It is concluded that deposition of sediment from the Nottawasaga River, not littoral transport, causes the eastward growth of Wasaga Spit. (Cassar-FRC)
W82-01156

A VERIFICATION STUDY ON A RESERVOIR SEDIMENT DEPOSITION MODEL,

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
A. D. Ward, D. L. Rausch, C. T. Haan, and H. G. Heinemann.
Transactions of the ASAE, Vol 24, No 2, p 340-352, March/April, 1981. 8 Fig, 3 Tab, 16 Ref.

Descriptors: *Sediment deposition. *Reservoir silting, Hydrographs, DEPOSITS model, Model studies, Mathematical models, *Agricultural reservoirs, Missouri.

Seven years' data from monitoring two agricultural reservoirs in Missouri were used to verify the DEPOSITS model, a conceptual design model for predicting the sediment trapping prformance of small impoundments. Both the model and its sedimentgraph default option gave good estimates of the reservoirs' performance during the 13 storm events in this study. The EPA overflow rate method gave poorer results. (Cassar-FRC)
W82-01176

AQUATIC SEDIMENTS,

Clarkson Coll. of Technology, Potsdam, NY.
For primary bibliographic entry see Field 5B.
W82-01279

CHANNEL INSTABILITY IN A BRAIDED, SAND BED RIVER,

Arizona State Univ., Tempe. Dept. of Geography.
W. L. Graf.
Water Resources Research, Vol 17, No 4, p 1087-1094, August, 1981. 5 Fig, 3 Tab, 26 Ref.

Descriptors: *Braided rivers, *Probabilistic process, *Channel morphology, Rivers, Aggrading rivers, Alluvial rivers, *Gila River, *Arizona, Unstable channels, Alluvial channels, Prediction, *Sedimentation, Sediment transport, Erosion.

Probabilistic approaches are a reliable guide to future behavior of braided, sand bed rivers in alluvial valleys, if no large scale interruptions interfere (large dam or bridge construction, wholesale phreatophyte changes, extensive sand and gravel mining, or radical climate change). The Gila River, Arizona, representative of this type of river, does not meet assumptions of equilibrium. Analysis of maps and photographs dating back to 1868 produced at intervals over this 112-year period reveals a pattern of instability and destructive channel migration. Zones of stability and hazardous instability alternate at about 3.2 km intervals. The sinuosity of the main channel has been close to 1.18 through the past century, although actual location of the flow has varied. Instability zones correspond with the surface of the sediment wedge behind the dam and areas of dense phreatophyte growth; stable zones, with areas controlled by bedrock, man made structures, and the requirement to maintain consistent sinuosity. (Cassar-FRC)
W82-01316

SITES OF RIVER-DERIVED SEDIMENTATION IN THE OCEAN,

Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 7B.
W82-01332

GEOMORPHOLOGY OF THE COLORADO RIVER IN THE GRAND CANYON,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
A. Howard, and R. Dolan.
Journal of Geology, Vol 89, No 3, p 269-299, May, 1981. 12 Fig, 6 Tab, 40 Ref.

Descriptors: *Geomorphology, *Sedimentation, Rivers, Alluvial deposits, Fluvial sediments, Floods, Dams, Canyons, *Colorado River, *Grand Canyon, Glen Canyon Dam, Channeling.

Three types of sedimentary deposits in the Grand Canyon, caused by the differential transport of sediment according to size, are discussed. These types are locally derived alluvial fan debris, cobble bars, and sandy alluvium. The process of sediment addition and removal is reviewed, and the effect of the Glen Canyon Dam upon the sediment budget is considered. The completion of the Dam caused a four-fold reduction in peak discharge of the river sediments, such that new fan debris may increase the gradient through some of the rapids by a factor of 1.8. The major constraint on fluvial transport is structural control. Structural control by canyon walls is indirectly important in providing the sources of alluvial fan debris. The overall river gradient is primarily determined by the balance between addition and removal of coarse debris, as most of the drop in the river occurs in rapids, where debris is contributed by tributaries and rockfalls. The equilibrium between addition and remov-

al of sedimentation is constantly changing, since both processes occur sporadically during times of flood. The morphological context of the debris-fan rapids along with the structurally controlled channel width constitute the major constraints on transport and deposition of cobbles. Some changes have been noted since the completion of Glen Canyon Dam. Post-dam tributary flooding debris deposits are stable at steeper gradients and with a narrower channel. Alluvial fans along the canyon have been noticeably enlarged between 1964 and 1973. The steeper, narrower rapids as well as formation of new rapids will probably continue throughout the lifetime of the Dam. The sand bed will probably readjust, aggrading above the rapids and scouring below. (Baker-FRC)
W82-01338

EROSIVITY 'R' FOR INDIVIDUAL DESIGN STORMS,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
K. R. Cooley.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 386-397, 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Nonpoint pollution sources, *Soil erosion, *Design storms, *Rainfall intensity, Pollution load, Agricultural runoff, Model studies, Sediments, Computer models.

In assessing nonpoint source pollution, it is necessary to estimate erosion for individual storms since sediments themselves are pollutants and carry other chemical pollutants. The pollution hazard of many chemicals applied to agricultural lands is restricted to a short period immediately after application because most chemicals deteriorate rapidly. The first few runoff-producing storms after chemical applications are therefore much more important for assessing possible pollution damage than are later storms. Annual runoff calculations are almost meaningless for chemical pollutants. A method was developed which provides R values for individual storm events of any selected standard design frequency and duration for any of the four types of storms defined by the Soil Conservation Services, types I, IA, II, and IIA. A general equation was developed which relates maximum 30 minute intensity for storms of any duration and volume of total precipitation for each type of storm. A computer program incorporating the relationships allows one to quickly and easily determine the erosivity factor R for any type and design storm selected. The effects of types of storms on the erosion potential of any given site can also be easily determined. The method allows designers of conservation measures to determine the range of R values that might be encountered and the most critical combination of storm type and soil conditions. Managers in some areas may use the distribution of erosivity with time to minimize soil loss by proper adjustment of harvesting schedules. (See also W82-01401) (Moore-SRC)
W82-01403

SELECTING A FORMULA TO ESTIMATE SEDIMENT TRANSPORT CAPACITY IN NONVEGETATED CHANNELS,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. V. Alonso.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 25, May, 1980, p 426-439, 3 Tab, 39 Ref, 1 Append.

Descriptors: *Sediment transport, *Sediment-carrying capacity, *Mathematical studies, Forecasting, Hydraulic properties, Computer models, Channel flow.

Sediment transport formulas were investigated in order to select one or more to predict transport capacity of flows in nonvegetated graded channels. The selected formula should: be framed so that it is easy to apply in computer simulation; give the total load of bed material, knowing the hydraulic and geometric properties of the flow; and provide reliable estimates when applied to channels of any size in which sediment particles are transported by the fluid. Eight sediment transport theories were examined with reference to flume and field data. This comparison was based on 40 field measurements and 225 flume experiments. Characteristics of the data were analyzed in terms of four basic dimensionless parameters. The Yang formula was the most reliable over the entire data range. The formulas developed by Ackers and White, Engelund and Hansen, and Laursen, also were found reliable but gave relatively higher errors. Of all the tested formulas, therefore, only the Yang Formula can be used with confidence to predict sand-transport capacity over the range of flow conditions usually encountered in nonvegetated channels. (See also W82-01401) (Moore-SRC)
W82-01405

MODELING EROSION AND SEDIMENT YIELD FROM FLATLAND WATERSHEDS,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and C. E. Murphree.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 446-454, 13 Ref.

Descriptors: *Sediment yield, *Erosion rates, *Model studies, *Slopes, Soil erosion, Soil water, Outlets, Drainage, *Agricultural runoff, Storage, Surface water.

The differences in erosion between flatlands and the more sloping lands are dominated by the amount of protective water cover during storm events. This is caused by greater surface storage due to low slope, the bedding type of tillage required for seedbed drainage, higher water tables, generally restricted outlets, and low runoff gradients. The generally higher soil water content and high local slopes of bedding make soil detachment higher and more available for transport, however. A larger part of the sediment probably will originate from the field surface, and fines may be enriched because of lower runoff velocities. Factors of the USLE (Universal Soil Loss Equation) generally were derived using data from slopes exceeding 3% steepness. Few K-factor determinations have been made for flatland soils whose erodibility is affected by their higher soil moistures. Research has lowered the exponent of the slope-length factor for slopes of 0.2% to 0.15% and determined the probable validity of the slope steepness relationship. A few C-factor values have been determined that reflect the wetter flatland conditions and the unique tillage required for drainage. The depositional features of flatlands could be evaluated as sediment delivery ratios to reduce USLE soil loss estimates to sediment yield. Determining soil particle sizes in the USLE-predicted soil loss for determining sediment yield from flatlands is important because of high enrichment of the finer soil fractions in the sediment. (See also W82-01401) (Moore-SRC)
W82-01406

GULLY EROSION,

Science and Education Administration, Columbia, MO.
R. F. Piest, and E. H. Grissinger.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 455-462, 1 Fig, 17 Ref.

Descriptors: *Gully erosion, *Sediment erosion, *Water polluton sources, *Soil properties, Nonpoint pollution sources, surface runoff, Drainage area, Agricultural runoff.

Types and causes of gullying vary from region to region and are ill-defined in the quantitative sense. Therefore, gully erosion rates will not be estimated in the short-term erosion/sedimentation model. If gullying is significant in the sediment accounting of a drainage basin, the gully erosion rate is estimated. Typically, gully erosion rates are highly variable, and have been related to factors both intrinsic to the watershed, and super imposed thereon. Intrinsic factors can include profile adjustments in a drainageway and depth and erodibility of soils and subsoils along the flow boundary. Extrinsic factors include climatic and manmade disturbances. Quantitative information on gully erosion rates has resulted in some empirical prediction procedures, but the state of the art is presently inadequate to define causative processes. Beginning gully length and distance from gully heads to divide are dominant indicators of gully growth. Gully erosion is also related strongly to the size of the drainage basin. Various inadequately defined factors which influence the headward advance of gullies may be accounted for by using past gullying rates calculated from maps or aerial photos. A knowledge of the overall gully erosion problem of a region can help evaluate a given erosion hazard. (See also W82-01401) (Moore-SRC)
W82-01407

SEDIMENT TRANSPORT CAPACITY OF OVERLAND FLOW,

Science and Education Administration, Lafayette, IN.
W. H. Neibling, and G. R. Foster.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 463-473, 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Overland flow, *Sediment transport, *Agricultural runoff, Model studies, Sediment yield, Slopes, Mathematical studies.

Sediment yield from many farm fields is limited by deposition on concave slopes. Deposition occurs when the sediment available for transport exceeds the transport capacity of the flow. Therefore, a relationship for sediment transport capacity of overland flow is a key component of a model designed to estimate sediment yield from agricultural fields. No widely accepted transport equations have been developed for overland flow, but streamflow sediment transport equations often are used. Several streamflow sediment transport equations were examined to determine how well each fit observed overland flow sediment transport data when the equations and their parameters were used directly, without modification or calibration. The equations considered in this analysis were Ackers-White, England-Hansen, Yang, Yalin, Meyer-Peter and Muller, and Bagnold. The Yalin equation can be used without modification to compute sediment transport capacities for overland flow. This equation gives reasonable results for the range of sediment sizes and densities characteristic of agricultural fields, in contrast to some equations that 'blow up' when extended to overland flow conditions. The Yalin equation is recommended for computing sediment transport capacity for both overland flow and concentration flow in channels and waterways on agricultural fields. (See also W82-01401) (Moore-SRC)
W82-01408

CONCENTRATED FLOW RELATIONSHIPS,

Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.
L. J. Lane, and G. R. Foster.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 474-485, 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Agricultural runoff, *Channel flow, *Shear stress, *Model studies, *Sediment transport, Channel erosion, flow rate, Temporal distribution, Mathematical studies, Rill erosion.

The concentrated flow relationships are limited to upland areas typical of farm-field situations. Representative situations include: erosion channel development in areas of fields where flow is concentrated; small channels as permanent features which normally are tilled over during cultivation; and temporary channels developing when rows or ter-

races overtop and flow proceeds cross-contour to the field edge. In this analysis, it is assumed that the peak rate is a characteristic discharge, and that the temporal distribution of shear stress in the channel is triangular. A series of regression equations was developed to estimate friction slope, and thus shear stress for spatially varied flow in triangular channels. These equations gave accurate approximations to friction slopes computed under a wide range of conditions. Once the friction slope is computed, the Yalin sediment transport equation and a critical shear stress equation are used to compute sediment transport, deposition, and detachment for open channel flow in field situations. These equations then are used to route sediment in erodible channels. A simplified channel morphology-sediment yield model was developed to estimate sediment yields and channel widths for channels in soil with a nonerodible boundary below the surface of the soil. In a rill erosion study, the simplified model produced excellent estimates of sediment yield with time, total sediment yield, and final width of the developed rills. (See also W82-01401) (Moore-SRC)
W82-01409

ENRICHMENT RATIOS FOR WATER QUALITY MODELING,

Science and Education Administration, Durant, OK. Water Quality Management Lab.
R. G. Menzel.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 486-492, 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Soil erosion, *Soil chemistry, *Water pollution sources, *Nutrients, Agricultural runoff, Water quality, Nitrogen, Phosphorus, Model studies.

Eroded soil is usually richer in nutrients than the surface soil of the watershed from which the soil comes. This enrichment results from selective erosion of fine soil particles and organic residues. The degree of enrichment must be known to predict effects of soil erosion and erosion control on water quality. Degree of enrichment is expressed as an enrichment ratio, which is the concentration of nutrient in the eroded material divided by its concentration in the soil. Data from different soil and climatic areas were examined to detect possible effects of such factors as soil texture, cropping pattern, or runoff amount on the relationship between enrichment ratios and the amount of soil eroded. With few exceptions, the enrichment ratios for nitrogen and phosphorus in eroded soil decreased markedly with amount of soil eroded. A logarithmic relationship, $\ln (ER)=2-0.2 \ln (sed)$ where (sed) is kilograms per hectare of eroded soil in individual runoff events, appears to hold for a wide range of soil and vegetative conditions. Under these conditions, the enrichment ratio probably could be predicted within a factor of 2 for an annual average, and within a factor of 5 for individual runoff events. Terraced fields and sandy soils may not follow this relationship. Nitrogen enrichment changes more rapidly with sediment discharge than phosphorus enrichment. (See also W82-01401) (Moore-SRC)
W82-01410

UNSTEADY ONE-DIMENSIONAL SETTLING OF SUSPENDED SEDIMENT,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
S. Dhamotharan, J. S. Gulliver, and H. G. Stefan.
Water Resources Research, Vol 17, No 4, p 1125-1132, August, 1981. 9 Fig, 17 Ref.

Descriptors: *Suspended sediments, *Sediment deposition, *Settling velocity, Settling basins, Sediment transport, Reservoir silting, Lake sediments, Sedimentation, Turbulent flow, Sediment concentration, Model studies, Mathematical models, Trap efficiency.

To determine how sensitive vertical suspended sediment distributions are to other physical parameters, a numerical model to solve the one-dimensional, unsteady convective-diffusive transport equation was developed. It uses a fully implicit, exponential finite difference scheme and is unconditionally stable regardless of vertical diffusivities and particle fall velocities. A generic study of vertical suspended sediment profiles and sediment trap efficiencies produced results which cover Peclet numbers from zero to infinity. Peclet numbers may be represented by Vh/D, where V is the particle fall velocity, h is the water depth, and D is the mean vertical exchange coefficient. Since particle fall velocity and vertical exchange coefficient are frequently difficult to measure, this model provides a means of simulating the effects of varying these parameters on suspended sediment concentrations and trap efficiences. Where the Peclet numbers are greater than or equal to 20, sediment deposition occurs through downward frontal movement; when less than or equal to 0.2, through columnar precipitation. Residence time is a more important factor than turbulence in determining sediment deposition rate. The generic curves may be useful in design of settling basins and predicting storage loss and reduced water quality in lakes and reservoirs. (Cassar-FRC)
W82-01463

SEDIMENT AND NUTRIENT TRAP EFFICIENCY OF A SMALL FLOOD-DETENTION RESERVOIR,

Scientific and Education Administration, Columbia, MO. Watershed Research Unit.
For primary bibliographic entry see Field 4A.
W82-01471

MANAGEMENT CONCERNS FOR SWIMMING, TUBING, AND WADING IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK,

Great Smoky Mountains National Park, Gatlinburg, TN. Uplands Field Research Lab.
For primary bibliographic entry see Field 6A.
W82-01475

RIVER BED AGGRADATION DUE TO OVERLOADING,

Iowa Univ., Iowa City. Div. of Energy.
S. C. Jain.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY1, p 120-124, January, 1981. 3 Fig, 4 Ref.

Descriptors: *Sediment transport, *Aggradation, *River beds, Degradation, Mathematical equations, Sediment load, *Missouri River.

Reliable quantitative estimates of the future rate and extent of long-term degradation and aggradation would be invaluable to river-management planning, especially along some reaches of the Missouri River. An analytical solution of the aggradation problem was developed, using a boundary condition which was more appropriate than the condition used in a recent analytical model. The boundary condition was based on the observation that the volume of sediment between the initial bed profile ($t = 0$) and the bed profile at time t must be equal to the volume of additional sediment supplied during this time. Use of the more appropriate boundary condition produces good agreement with experimental data. (Cassar-FRC)
W82-01486

THE EFFECT OF CHANGING SEDIMENT SUPPLY ON SEDIMENTATION IN A GLACIER-FED LAKE,

Illinois Univ. at Chicago Circle, Chicago. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W82-01510

SUSPENDED SEDIMENT PRODUCTION FROM FORESTED WATERSHEDS ON OAHU, HAWAII,

Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
R. D. Doty, H. B. Wood, and R. A. Merriam.
Water Resources Bulletin, Vol 17, No 3, p 399-405, June, 1981. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Watersheds, *Sediment discharge, *Suspended sediments, Water quality standards, Forested watersheds, Agricultural watersheds, Oahu, *Hawaii, Storm runoff, Standards.

Suspended sediments from four forested and two agricultural watersheds on Oahu were sampled for at least 5 years under a variety of storm conditions. Sediment loads were extremely variable among watersheds and within watersheds. Values of suspended sediment discharge in kg per sq km per year were: Kaliki, 20,000-123,000; Kipap, 124,000-617,000; Waikele, 15,000-443,000; Moanalua, 8,400-135,000; Kamoalil (first station), 2,900-721,000; and Kamoalii (second station), 31,900-112,400. Generally, more than 80% of the total suspended sediment was produced in 2% of the time. In a given storm the sediment levels rose rapidly and fell rapidly with time; peak levels were often reached within 2 hours. The great variability makes it difficult to establish effective water quality standards. (Cassar-FRC)
W82-01531

CHANGES IN SEDIMENT STORAGE IN THE COON CREEK BASIN, DRIFTLESS AREA, WISCONSIN, 1853 TO 1975,

California Univ., Los Angeles. Dept. of Geography.
S. W. Trimble.
Science, Vol 214, No 4517, p 181-183, October 9, 1981. 2 Fig, 12 Ref.

Descriptors: *Sediment yield, *Erosion, *Soil erosion, *Coon Creek, *Wisconsin, Sediment distribution, Sediment erosion, River basins, Flood plains, Alluvial plains.

A sediment budget for Coon Creek, Wisconsin, was determined for two periods, 1853-1938 and 1938-1975. The most significant pattern that has emerged from this study is that sediment yield has been small, changing little over the years, compared with either erosion or changes in sediment storage. Upland erosion was severely curtailed in the 1930's, and present sediments are coming from the stored alluvial deposits. Data suggests that sediment yield per unit area may begin to increase with basin size in agriculturally disturbed basins in humid regions, contrary to the widely held concept that sediment yield per unit area decreases with basin size. There are also strong suggestions that yield per unit area at a point in the system can change with time as a result of changes in sediment storage. The mobilization of stored sediment is significant because of pollutants adsorbed onto sediment particles.
W82-01563

2K. Chemical Processes

A COMBINED SALT TRANSPORT-CHEMICAL EQUILIBRIUM MODEL FOR CALCAREOUS AND CYPSIFEROUS SOILS,

Science and Education Administration, Kimberley, ID. Snake River Research Center.
For primary bibliographic entry see Field 5B.
W82-01230

FACTORS AFFECTING THE CHEMISTRY OF PRECIPITATION AND RIVER WATER IN AN UPLAND CATCHMENT,

Aberdeen Univ. (Scotland). Dept. of Soil Science.
J. M. Reid, D. A. MacLeod, and M. S. Cresser.
Journal of Hydrology, Vol 50, No 1/3, p 129-145, March, 1981. 6 Fig, 4 Tab, 21 Ref.

Descriptors: *Precipitation, *Rivers, *Water quality, *Chemical reactions, Water pollution sources, Rainfall, Chemical properties, Soil chemistry, Organic carbon, Glendye, *Scotland, Dye River, Factor analysis, Weathering, Nitrogen compounds, Air pollution, Mineralization, Calcium, Magnesium, Sodium, Potassium, Hydrogen ion concentration, Bicarbonates, Chlorides, Sulfates, Ammonium, Nitrates, Phosphates, Silicon, Iron, Manganese, Aluminum, *Chemistry of precipitation.

The chemistry of precipitation and river water was studied during October 1977 to September 1978 in a 41 sq km moorland catchment at Glendye, Scotland. Precipitation was very dilute (total mean ionic and organic matter, 10.43 mg per liter), weakly acidic (pH 4.33), and highly variable in composition. Compared to the precipitation, Dye River water contained more ionic and organic substances (mean total 39.456 mg per liter), was neutral (pH 6.45), and varied less in composition. Factor analysis suggested that three main processes controlled chemical composition of precipitation: aerosols of oceanic water (Na, Mg, Cl, and total organic carbon), emissions from industries and fossil fuel burning (pH), and windblown terrestrial dust. River water composition was affected by different processes: cation exchange and weathering in the soil (Ca, Mg, Na, bicarbonate, and Si), translocation of elements down the soil profile and into the river during high discharge (Fe, Mn, Al, and total organic carbon), and N demand and mineralization in the soil (ammonium and nitrate). K, Cl, sulfate, and phosphate all showed independent patterns of variation; ammonium and nitrate showed little correlation with discharge but marked seasonal variation. Analysis of river water during two storm events supported the results of the factor analysis, that is, the chemistry of river water is affected by soil processes, suggesting that nearly all the river water originates within the soil, with a minor amount from direct surface runoff. (Cassar-FRC)
W82-01322

RIVER BASIN HYDROSALINITY MODELING,

California Univ., Davis. Dept. of Land, Air and Water Resources.
K. K. Tanji.
Agricultural Water Management, Vol 4, No 1/3, p 207-225, 1981. 3 Fig, 1 Tab, 34 Ref.

Descriptors: *River basins, *Salinity, *Model studies, Australia, United States, Stream discharge, Salts, Solute transport, Groundwater movement, Salt balance, Pollution, Water quality, Computers, Irrigation pratices, Farming, Irrigation effects.

Representative hydrosalinity modeling efforts are reviewed as employed over the past two decades in the Western United States. The potential application of these efforts to the land-stream salinity problem facing Western Australia is investigated. One of the first model systems was the Woods and Orlob Lost River System Model, which combined water-quality data with computer-based modeling efforts. This first model dealt with pesticide residues that appeared to be killing water fowl. This model was followed by a second, which was designed to study low flow conditions in the Sacramento River system. The third major modeling effort was used to evaluate conditions of deteriorating water quality in the lower reaches of the San Joaquin River and their potential salinity impacts on irrigated agriculture. Model 4 was focused on salt balance in the groundwaters of the Upper Santa Ana River Basin, with some consideration on several surface water subsystems. Other models were developed to study the hydrology and total dissolved solids in the Upper Colorado River Basin, the simultaneous simulation of hydrology and salinity, simulation of flow and salinity in a stream/aquifer system in the Arkansas River system in Colorado, the total dissolved solids and nitrogen waste loadings from irrigated agriculture, and the environmental impact of irrigation projects. None of these models has strengths in modeling both water and salts for all three subsystems, soil, groundwater, and stream. It is suggested that, for Western Australia, a first-cut approximation be initially made with more simple models to obtain a fix on probable flow pathways and salt loading. (Baker-FRC)
W82-01469

OXIDATION OF SO2 IN AQUEOUS DROPLETS: MASS TRANSPORT LIMITATION IN LABORATORY STUDIES AND THE AMBIENT ATMOSPHERE,

Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
J. E. Freiberg, and S. E. Schwartz.
Atmospheric Environment, Vol 15, No 7, p 1145-1134, 1981. 1 Fig, 2 Tab, 45 Ref.

Descriptors: *Sulfur compounds, *Oxidation, Water, Fluid drops, Water pollution sources, Chemical reactions, Clouds, Fog, *Atmosphere.

The influence of mass-transport limitation on the rate of oxidation of sulfur dioxide to sulfate in aqueous solutions is considered. The aqueous-phase oxidation of sulfur dioxide involves competition between mass transport and chemical reaction. Using the conceptual framework of Schwartz and Freiberg, treating mass transport limitation to the rate of oxidation of sulfur dioxide in aqueous droplets, two laboratory studies were undertaken. As a consequence of aqueous phase mass-transport limitation the reaction reported by Barrie and Georgii, in which the rate of sulfur uptake by suspended aqueous droplets of radius 0.105 cm was determined, may be from 20% to an order of magnitude smaller than the intrinsic rates. Significant gas-phase limitation may have been present as well. Since the high solubility of S (IV) in the presence of ammonia is evident, the contact times employed in the experiments of van den Heuvel and Mason were found to be insufficient for the equilibrium reagent concentration to have been established. Thus the rates derived by Scott and Hobbs from the data of that study are considerably smaller than the intrinsic rates. In a study of the mass transport limitation in relation to fogs and clouds, it appeared that this limitation is not appreciable under ordinary ambient conditions, but may be appreciable at very high oxidation rates, such as high ozone or hydrogen peroxide concentrations. (Baker-FRC)
W82-01470

THE RELEASE OF SOIL PHOSPHOROUS TO RUNOFF IN RELATION TO THE KINETICS OF DESORPTION,

Scientific and Educational Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
For primary bibliographic entry see Field 5B.
W82-01477

HYDROCHEMICAL FACIES IN A TERTIARY BASIN IN THE MILLIGAN CANYON AREA, SOUTHWEST MONTANA,

Indiana Univ. at Bloomington. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01481

GASEOUS NITROGEN AS EVIDENCE FOR DENITRIFICATION IN GROUNDWATER,

National Physical Research Lab., Pretoria (South Africa).
J. C. Vogel, A. S. Talma, and T. H. E. Heaton.
Journal of Hydrology, Vol 50, No 1/3, p 191-200, March, 1981. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Denitrification, *Nitrogen, *Confined aquifers, Groundwater, Nitrates, Argon, Dissolved oxygen, Oxygen, Anaerobic conditions, Aquifers, Microorganisms, Bacteria, *Kalahari Desert.

Very slow denitrification in a confined aquifer was demonstrated by measuring the nitrate, oxygen, and argon concentrations and the N15/N14 ratios in artesian groundwater. The study was conducted in the sparsely populated western Kalahari Desert, which has high concentrations of nitrate from natural sources (rain or bacterial nitrogen-fixing). The ages of the water samples, measured by C14 dating, range from 1300 years to 27,000 years, increasing progressively in a southeasterly direction. Both dissolved oxygen and nitrate decrease with increasing age of groundwater, the nitrate starting to decrease only after all oxygen has disappeared at about 13,000 years. The amount of excess N increases with age and with the decrease in nitrate. The calculated N isotope fractionation factor is comparable to that reported for bacterial cultures. (Cassar-FRC)
W82-01485

2L. Estuaries

LINEARIZED SOLUTION TO INLET EQUATION WITH INERTIA,

Coastal Engineering Research Center, Fort Belvoir, VA.
T. L. Walton, Jr., and F. F. Escoffier.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW3, p 191-195, August, 1981. 2 Fig, 7 Ref.

Descriptors: *Estimating equations, *Tides, *Inlets, Tidal waters, Flow, Mathematical studies, Friction, Hydrologic aspects, Estuaries.

A solution method is described which employs a linearization technique of equating friction-work over the tidal cycle in a nonlinear approach to friction-work in a linear approach. It avoids the a priori assumptions of the form of bay tide. The method was first used in tidal computations of the Dutch delta works by Lorentz (1926) and was recently applied to inlet-bay problems by Van de Kreeke (1967). The equations are presented for the proposed solution to the hydraulic flow through inlets for simplified inlet-bay type systems. Graphical solutions of some equations are included. (Small-FRC)
W82-01183

EFFECT OF KEPONE ON ESTUARINE MICROBIAL ACTIVITY,

Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-01231

HOLLAND'S EASTERN SCHELDT ESTUARY BARRIER SCHEME: SOME ECOLOGICAL CONSIDERATIONS,

Shell Internationale Research Maatshcappij N.V., The Hague (Netherlands). Group Toxicology Div.
M. Smies, and A. H. L. Huiskes.
Ambio, Vol 10, No 4, p 158-165, 1981. 7 Fig, 35 Ref.

Descriptors: *Barriers, *Environmental effects, *Estuaries, *Flood protection, Planning, Flood control, Dems, Water properties, Sedimentation, Oxygen, Nutrients, *Netherlands, Zeeland.

The possible environmental consequences of construction and use of the Eastern Scheldt Barrier which is being built to protect Zeeland, The Netherlands, from flood waters, are discussed. The project includes the construction of a storm-surge barrier across the mouth of the estuary along with two secondary dams to separate the tidal basin of the Eastern Scheldt from the brackish-fresh water of the Rhine Scheldt shipping route. Turbulence and turbidity will decrease with decreasing mean tidal current velocities, and mean water residence time will increase. Chlorinity and nutrient concentrations depend on water residence time, so these values will be changing. There will probably be increases in net particulate carbon, which may result in increased sedimentation and resulting changes in depth. None of the effects of the barrier will be extreme. If the barrier should be completely closed for over a week, for example, to protect the estuaries from a tanker spill, problems may occur. The estuary may become anoxic, and severe ecological damage could result from lack of oxygen and flooding of the intertidal zone. (Small-FRC)
W82-01375

THE DISTRIBUTION OF MERCURY IN THE SEDIMENTS OF THE PLYM ESTUARY,

Plymouth Polytechnic (England). Dept. of Marine Science.
For primary bibliographic entry see Field 5B.
W82-01390

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

PERIODIC OPERATION FOR DESALINATION WITH THERMALLY REGENERABLE ION-EXCHANGE RESIN. DYNAMIC STUDIES,
Nagoya Univ. (Japan). Dept. of Chemical Engineering.
H. Matsuda, T. Yamamoto, S. Goto, and H. Teshima.
Separation Science and Technology, Vol 16, No 1, p 31-41, 1981. 8 Fig, 4 Ref.

Descriptors: *Desalination, *Ion exchange resins, Water treatment, Sirotherm process, Adsorption, Temperature effects.

A desalination process which uses a thermally regenerable ion exchange resin, Sirotherm TR-20, was studied to improve efficiency, i.e., to decrease the salt concentration in the cold reservoir as fast as possible. In this process, the resin in a basket is alternatively immersed in cold and hot reservoirs. It offers an inexpensive method of desalting low-salinity water where hot water is available in effluents from heat exchangers. A new periodic operation was suggested, on the basis of the observed dynamic behaviors, for the use of this resin. Adsorption isotherms at 10 and 70 C were of the Freundlich type. Surface diffusivity was dependent on the concentration of the liquid phase. Optimal adsorption time was 8 min when desorption time was 10 min. The cost of moving the basket must also be considered in relation to industrial application. (Cassar-FRC)
W82-01341

3B. Water Yield Improvement

MULTIFREQUENCY RADIOMETER DETECTION OF SUBMARINE FRESHWATER SOURCES ALONG THE PUERTO RICAN COASTLINE,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
H. J. C. Blume, B. M. Kendall, and J. C. Fedors.
Journal of Geophysical Research, Vol 86, No C6, p 5283-5291, June, 1981. 8 Fig, 4 Tab, 11 Ref.

Descriptors: *Radiometry, *Submarine springs, *Water supply, *Remote sensing, Microwaves, Springs, *Puerto Rico, Coastal aquifers, Coastal waters.

Submarine freshwater springs were detected along the Puertom Rican coast by remote sensing using the NASA Langley dual-frequency microwave radiometer system in conjunction with an infrared radiometer. The surface above fresh water is about 4 C cooler and 5% cooler in salinity than the surrounding sea water. The first flight on February 4, 1978, investigated 3/4 of the coastal area around the island, not including a portion of the northern coast. The February 6, 1978, flight concentrated on the northwestern coast where several submarine springs had been reported. Springs detected by the radiometer correlated well with reported spring locations. After separating runoff from rivers, lagoons, marshes, and bays, 44 submarine freshwater springs were located. More springs were found than had earlier been estimated. Most of the springs were in the northwest and southeast portions of the coastline. There was a 39% chance of success of finding the same springs on both missions. It is believed that a three-frequency system would reduce the effects of intervals between missions, tides, and winds, which could change locations and intensities of salinity and temperature and of the footprint fill factor. (Cassar-FRC)
W82-01349

3C. Use Of Water Of Impaired Quality

IRRIGATION MANAGEMENT OF COLORADO RIVER WATER WITH INCREASE IN SALINITY,
California Univ., Davis. Dept. of Land, Air and Water Resources.
F. E. Robinson, K. K. Tanji, J. N. Luthin, W. F. Lehman, and K. S. Mayberry.
Transactions of the ASAE, Vol 23, No 4, p 859-865, July/August, 1980. 1 Fig, 7 Tab, 25 Ref.
OWRT-A-052-CAL(3).

Descriptors: *Sprinkler irrigation, *Irrigation effects, *Salinity, *Colorado River, Crop production, Crop yield, Agriculture, Saline soils, Leaching.

Steady increases in the salt concentration of the Colorado River at the Imperial Dam have raised concerns about the effects of increased salinity on agricultural productivity on lands irrigated with Colorado River water. Field studies designed to evaluate the effects of salinity increases on crop yields and soil salination involved application of artificially salinated water to crops on a clay and a sandy clay loam by sprinkler irrigation. Significantly lower yields of snap beans, carrots, and onions were produced on plots treated with water having a level of total dissolved solids (TDS) raised to 1,350 milligrams TDS per liter than on plots treated with Colorado River water, which has 875 milligrams TDS per liter. Alfalfa crops receiving the driest irrigation treatment (a ratio of irrigation to pan evaporation of 0.57) suffered significant production yield reductions after 2 years, during which salt accumulated faster than it was applied in the irrigation water. Similar increases in soil salinity were found with the intermediate irrigation treatment (ratio 0.67); but no significant reduction in alfalfa yield was experienced after 32 months. The wettest irrigation treatment (ratio 0.78) resulted in the highest yields and in less salt accumulation in the soil than was applied in the irrigation water, indicating partial leaching. These results indicate that a 50 percent increase in the salinity of the Colorado River system would have only minor effects on most crop yields. Use of the driest irrigation treatment with a 2-year leaching cycle would result in a savings of 34 centimeters of water per year in an alfalfa crop during a time of drought. The wettest irrigation treatment would be preferable when water supplies are adequate. (Carroll-FRC)
W82-01226

WATER RECLAMATION AND REUSE,
Alberta Univ., Edmonton.
S. E. Hrudev.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 751-767, June, 1981. 334 Ref.

Descriptors: *Water reuse, *Water renovation, *Literature review, Bibliographies, Irrigation, Agriculture, Industrial water, Health aspects.

A literature review is presented of publications on water reclamation and reuse published during 1980. Several reviews of current and recent water reclamation and reuse practices in the US, Japan, the Netherlands, and South Africa became available. Papers on water reuse planning and allocation considerations included an evaluation of a series of computer models for water reuse planning. On the topic of agriculture and irrigation, several NTIS bibliographies were published, and studies dealt with such topics as salinity problems associated with municipal and industrial effluent reuse. Several publications reported investigations of the long-term effects of land irrigation with municipal wastewater. Aquaculture and wetland systems received attention in publications including an engineering assessment of aquaculture wastewater systems. Water reuse for groundwater recharge was the topic of a California symposium and other papers. The reuse of industrial water was explored for the pulp and paper industry, the textile industry, and organic chemicals processing; petroleum, coal, and synthetic fuels processing; inorganic chemicals processing, steel mills, metal processing and finishing, recirculating cooling systems and power generation, and other miscellaneous processes. Domestic reuse remained controversial, and health aspects of reclamation and reuse were considered in papers dealing primarily with bacteria and viral pathogens. (Small-FRC)
W82-01252

LAND APPLICATION OF MUNICIPAL WASTEWATER,
Nielson, Maxwell and Wangsgard, Salt Lake City, UT.
For primary bibliographic entry see Field 5D.
W82-01253

A LOOK AT SOME WATER RECLAMATION PLANTS IN SOUTHERN AFRICA,
National Institute for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W82-01352

EFFECT OF DIFFERENT LEVELS OF WATER SALINITY ON THE DECOMPOSITION OF ORGANIC MANURES IN A BRACKISH WATER FISH POND SOIL,
Central Inland Fisheries Research Inst., Barrackpore (India).
G. N. Chattopadhyay, and L. N. Mandal.
Hydrobiologia, Vol 72, No 3, p 287-292, July, 1980. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Salinity, *Fish ponds, *Manure, *Decomposition, Organic matter, Brackish water, Saline water, Nutrients, Nitrogen compounds, Nitrates, Dissolved oxygen, Carbon dioxide, Water quality, Animal wastes, Aquaculture, Organic carbon, Soils.

The rate of decomposition of cow dung (at 5% in soil samples) and poultry manure (at 1% in soil samples) was studied in waters of different salinities (0, 10, 20, and 30 ppt) under laboratory conditions. Application of the manures increased the free CO2 content in the water from 0 in the controls (water containing no manure) to 10.2-11.2 ppm with cow dung and 6.2-7.2 ppm with poultry manure. Dissolved oxygen levels in the control averaged 8.2 ppm; in the manured waters, 5.3-6.1 ppm. The pH values of soil and water declined slightly, about 0.05 to 0.2 units. The amount of nitrogen released from the organic manures to water and soil phases increased gradually with the period of incubation (100 days total) but decreased with increases in water salinity levels. Ammonium levels were always higher than nitrate levels because of anaerobic conditions. As decomposition proceeded, the amount of added organic carbon remaining in the soil decreased, but it increased slightly with increases in water salinity levels. These results suggest that in manuring of fish ponds consideration should be given to the salinity of the water, using well-decomposed manure for ponds with higher salinities. (Cassar-FRC)
W82-01363

NITROGEN BALANCES FOR AN EFFLUENT IRRIGATION AREA,
California Univ., Riverside. Dept. of Soil and Environmental Science.
L. J. Lund, A. L. Page, C. O. Nelson, and R. A. Elliott.
Journal of Environmental Quality, Vol 10, No 3, p 349-352, July-September, 1981. 4 Tab, 12 Ref.

Descriptors: *Nitrogen, *Land disposal, *Irrigation, Wastewater disposal, Impaired water use, Denitrification, Leaching, Ammonium Nitrates, Chlorides, Soil water, Soil solution, Soil-water-plant relationships.

The use of sewage effluent for irrigation in arid regions may result in substantial losses of nitrogen through the leaching of nitrate-nitrogen. Nitrate-nitrogen leaching and nitrogen balances for secondary sewage effluent irrigation systems in California were evaluated and compared with leaching

and nitrogen balances in surrounding plots irrigated with well water. Sampling of soils of the carralitos series (Typic Xeropsamment) at nine effluent irrigation plots showed that field water contents in the unsaturated zone below the root zone varied in space but not in time. Mean nitrate-nitrogen concentrations in the soil solution ranged from 15.4 to 32.4 milligrams per liter and varied significantly in both space and time, as did the mean concentrations of chlorides. Although leaching was found to be a significant process in the effluent irrigation system, it did not differ greatly from leaching in some of the surrounding agricultural fields. Calculation of nitrogen inputs and leaching volumes in conjunction with gaseous nitrogen losses for three of the nine plots studied showed that leaching was the dominant sink, accounting for between 51 and 76% of the applied nitrogen. Crop removal accounted for between about 20 and 40% of the applied nitrogen, while gaseous losses accounted for between 7 and 9% of the nitrogen. Denitrification losses were lower in the effluent-irrigated fields than in nearby agricultural fields. It is suggested that consideration be given to reducing the nitrogen loading rate as a means of reducing leaching losses of nitrogen. (Carroll-FRC)
W82-01478

VEGETATION SELECTION AND MANAGEMENT FOR OVERLAND FLOW SYSTEMS,

Cold Regions Research and Engineering Laboratory, Hanover, NH.
For primary bibliographic entry see Field 5E.
W82-01500

UTILIZATION EFFICIENCY OF NITROGEN FROM SEWAGE EFFLUENT AND FERTILIZER APPLIED TO CORN PLANTS GROWING IN A CLAY SOIL,

Volcani Inst. of Agricultural Research, Bet-Dagen (Israel).
A. Feigin, S. Feigenbaum, and H. Limoni.
Journal of Environmental Quality, Vol 10, No 3, p 284-287, July-September, 1981. 6 Tab, 18 Ref.

Descriptors: *Nitrogen, *Land disposal, *Wastewater treatment, Clays, Corn, Fertilizers, Comparison studies, Mineral water, Ammonium compounds, Nitrogen cycle, Nitrogen compounds, Impaired water use, Agriculture.

In order to achieve the efficient use of nitrogen in sewage effluents by crops, it is first necessary to have a basic understanding of nitrogen transformation in fields irrigated with this effluent. This study investigated the effect of irrigation with sewage effluent on the utilization by plants of the nitrogen in fertilizers and on nitrogen losses from the soil as well as the fate of ammonium nitrogen applied in the sewage effluent and its uptake by plants. Greenhouse experiments using nitrogen-15 as a tracer were used in this study. Ammonium-nitrogen was applied to corn grown in a clay soil in the form of a solid fertilizer, in sewage effluent, and in a mineral solution prepared to simulate the sewage effluent composition. There were no significant differences in the uptake of the ammonium sulfate-nitrogen applied as a solid fertilizer resulting from the type of irrigation water used (demineralized, sewage effluent or mineral solution). About 61 percent of the tagged ammonium-nitrogen applied as sewage effluent was taken up by the corn plants, while 14 percent was immobilized in the organic fraction of the soil. Losses of the tagged ammonium-nitrogen were about 24 percent for the sewage effluent and about 17 percent for the mineral solution. The availability of nitrogen from fertilizer incorporated into the soil prior to seeding or planting appears to be slightly greater than that of ammonium nitrogen applied in sewage effluents used for irrigation. Irrigation with sewage effluent did not affect the recovery of nitrogen applied as solid fertilizer. (Carroll-FRC)
W82-01515

TREATMENT OF SEWAGE PLANT EFFLUENT FOR USE AS MAKEUP WATER,

Burbank, CA.
W. Westbury, E. T. Allen, and J. E. Zoski.
Power Engineering, Vol 85, No 7, p 80-83, 1981. 7 Fig.

Descriptors: *Cooling towers, *Corrosion, Calcium, Phosphates, Wastewater, Water reuse, Fouling, Water treatment facilities, Burbank, California, Wastewater disposal, Effluents, Impaired water use.

A new water treatment system was used to solve the problem of deposits and corrosion in an electric powerplant cooling tower which had been caused by the sewage treatment plant effluent used in the cooling tower. The original plan to use sewage treatment plant effluent for cooling tower water in 1968 was economically motivated. The city paid a disposal fee to the city of Los Angeles for its sewage discharge, and Burbank also paid a fee for city water used as cooling tower makeup. Therefore, Burbank was able to save money on both aspects by using treatment plant effluent for cooling tower makeup. The savings amounted to $500 per million gallons of reused effluent. Over a period of time it was noticed that the efficiency of heat removal in the power plant condensers deteriorated, as indicated by an increasing difference between the condensate temperature and the condenser cooling water outlet temperature. Attempts to control condenser deposition were only partially successful. When the condensers were cleaned in June of 1979 a sample of the deposit was analyzed and shown to be primarily calcium phosphate, which came from the sewage effluent. During this time the plant used the terminal temperature difference (TTD) to monitor condenser efficiency. During the condensor fouling problems, the TTD twice reached 15 F. After the addition of a new agent to control calcium phosphate deposition, the TTD did not rise above 9 F, and the cooling system suffered no condenser fouling, even though the calcium concentration of the cooling water reached a maximum of 440 ppm and the phosphate reached 64 ppm. (Baker-FRC)
W82-01585

3D. Conservation In Domestic and Municipal Use

MANDATORY OR VOLUNTARY WATER CONSERVATION: A CASE STUDY OF IOWA COMMUNITIES DURING DROUGHT,

Iowa State Univ., Ames. Dept. of Sociology and Anthropology.
M. Y. Lee.
Journal of Soil and Water Conservation, Vol 36, No 4, p 231-234, July/August, 1981. 1 Tab, 1 Ref.

Descriptors: *Water conservation, *Water use efficiency, *Water shortage, Drought, Water distribution, User charges, *Iowa, Water policy, Policy making.

The effect of the drought of 1977 on 12 Iowa communities was evaluated by comparing mandatory and voluntary water conservation policies, the types of policy-making bodies involved, the rationales on which the water policies were based, and the effectiveness of the water conservation efforts. The communities all had severe water shortages, and all had the mayor-council form of government. Conservation policies were of two types: four communities adopted mandatory policies, while eight communities stayed with voluntary policies throughout the drought. Most communities adopted qualitative restrictions, mainly dealing with the outdoor use of water; the most widely adopted penalty was a high price for water use beyond the allowed quantity. Communities with mandatory policies rated their policies as more effective than did those with voluntary policies. An objective analysis also found these policies more effective. Policies with a quantitative restriction on a per capita basis achieved the highest degree of conservation. (Small-FRC)
W82-01553

3E. Conservation In Industry

OPTIMUM RECYCLE AND REUSE COOLING SYSTEM DESIGNS USING THE BCT PROCESS,

Tower Systems Inc., Tacoma, WA.
W. C. Sanderson, and R. L. Lancaster.
Industrial Water Engineering, Vol 18, No 3, p 24-30, May/June, 1981. 8 Fig, 7 Ref.

Descriptors: *Cooling towers, *Design criteria, Water treatment facilities, Wastewater treatment, Fouling, *Water reuse, *Industrial water.

Use of the Binary Cooling Tower (BCT) and the process associated with it serves to overcome the limitations on recycling of cooling water available in conventional cooling systems. BCT integrated cooling systems are able to concentrate cooling water wastes up to 150,000 mg/liter total dissolved solids. The plant cooling water is maintained at a solids level which is consistent with conventional cooling systems. The most common form of the BCT cooling process is a cooling system with a BCT and a conventional cooling tower operating in parallel. Blowdown from the conventional system is discharged offsite or to other disposal. This same blowdown in the BCT/tandem system flows into water treatment hardware similar to the raw water treatment system. Tandem cooling systems with a BCT and a conventional cooling tower will operate at a single steady state point with respect to water chemistry, providing the BCT makeup water is cooling tower blowdown. Cooling is shared between the primary cooling water loop and the BCT secondary loop. In cases where the BCT is integrated into cooling systems for the evaporative reduction of wastewater streams in addition to or in place of blowdown, the BCT design must be specified on the basis of annual water flows and evaporation characteristics. When the BCT is being considered for a total wet cooling application, it is designed to exactly the same parameters as a wet cooling tower. In total cooling applications the BCT has the additional operational flexibility of operating wet or dry. BCT integrated systems are also effective in reducing scaling, fouling, and corrosion in the circulating cooling water loop. Some costing information is provided. (Baker-FRC)
W82-01503

3F. Conservation In Agriculture

THE EFFECT OF SNOW TRAPPING AND CROPPING SEQUENCE ON MOISTURE CONSERVATION AND UTILIZATION IN WEST-CENTRAL SASKATCHEWAN,

Department of Agriculture, Swift Current (Saskatchewan). Experimental Farm.
K. J. Kirkland, and C. H. Keys.
Canadian Journal of Plant Science, Vol 61, No 2, p 241-246, April, 1981. 4 Tab, 10 Ref.

Descriptors: *Soil moisture, *Crop yield, *Saskatchewan, Soil moisture retention, Soil absorption capacity, Corn, Wheat, Moisture availability, Available water, Water conservation, Snow, *Snow traps.

The effectiveness of snow trapping methods for conserving moisture for wheat production was investigated. The efficiency of fallow-wheat, fallow-wheat-wheat and continuous wheat in converting annual precipitation into grain production was compared. The results demonstrated that the most effective means of retaining snow for soil moisture storage was to leave standing stubble as in the fallow-wheat-wheat rotation and continuous wheat. Snow ridging on fallow and sunflower trap strips did not significantly increase moisture reserves as compared to bare fallow. Widely spaced corn rows in rotation did increase moisture reserves to levels comparable to those achieved by standing stubble in the continuous wheat rotations. All rotations containing a fallow treatment, with the exception of row-crop fallow, had significantly higher moisture reserves available for the crop seeded on fallow than was available for those crops seeded on stubble in the more extended rotations. Continuous wheat produced higher grain yields and used the available soil moisture to produce more per year than either the fallow-wheat or the fallow-wheat-wheat rotations. (Baker-FRC)
W82-01117

A COMPARISON OF CHEMICAL AND CULTURAL CONTROL OF WEEDS IN IRRIGATION DITCHBANKS,

Regina Research Station (Saskatchewan).
For primary bibliographic entry see Field 4A.
W82-01120

IRRIGATION MANAGEMENT OF COLORADO RIVER WATER WITH INCREASE IN SALINITY,

California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3C.
W82-01226

IRRIGATION NEEDS AND YIELD OF RICE ON A SANDY-LOAM SOIL AS AFFECTED BY CONTINUOUS AND INTERMITTENT SUBMERGENCE,

Punjab Agricultural Univ., Ludhiana (India).
B. S. Sandhu, K. L. Khera, S.S. Prihar, and B. Singh.
Indian Journal of Agricultural Sciences, Vol 50, No 6, p 494-496, June, 1980. 4 Tab.

Descriptors: *Irrigation efficiency, *Rice, *Crop yield, Crop production, Irrigation practices, Irrigation requirements, Agriculture, Loam, *India, Seepage loss, *Soil-water-plant relationships.

A practical irrigation schedule was developed for rice that would reduce the irrigation requirement but not the yield. Continuous submergence and irrigation at 1, 3, 5, and 7 days was practiced on rice on a sandy loam. Continuous submergence and irrigations a day after infiltration of ponded water gave comparable grain yields. As the interval between infiltration and irrigation increased, the yield declined. Water requirements were highest with continuous submergence (170 to 204 cm), and percolation losses were large (301 to 483% of evapotranspiration). With 1-day drainage the percolation losses decreased by 32 to 57 cm and with 5-day drainage by 80 to 108 cm. Thus, once transplanted seedlings are established, irrigation can be delayed for some period after infiltration of ponded water. The safe limit of the drainage period depends on the weather. There is a potential savings of 20 to 50% in irrigation water, primarily because of the reduction in seepage losses due to the rapid decline in soil permeability with increasing saturation. (Small-FRC)
W82-01382

INPUT AND OUTPUT CONSTRAINTS AFFECTING IRRIGATION DEVELOPMENT,

Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 6B.
W82-01476

TRICKLE IRRIGATION LATERAL DESIGN ON SLOPING FIELDS,

Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8C.
W82-01537

CHARACTERIZING SPRINKLER DISTRIBUTION PATTERNS WITH A CLUSTERING ALGORITHM,

Rain Bird Western Sales Corp., Glendora, CA.
K. Solomon, and J. C. Bezdek.
Transactions of the ASAE, Vol 23, No 4, p 899-902, 906, July/August, 1980. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Sprinklers, *Mathematical studies, *Distribution patterns, Algorithms, *Irrigation efficiency, Performance evaluation.

The distribution pattern for a sprinkler, which is affected by the nozzle combination, operating pressure, and the sprinkler model, gives the water application rate as a function of radial distance from the sprinkler. Prior experience or test data may be used to estimate the distribution pattern shape of a given sprinkler, nozzle, and pressure combination. A method for determining the characteristic curve shapes representative of a sprinkler's performance was developed and applied to test data for the Rain Bird 103 Rain Gun sprinkler. The three stages comprising this method are: normalization of the distribution pattern test data, application of the K-Means clustering algorithm to the normalized pattern shapes, and analysis of the resulting cluster membership lists to determine the nozzle size and pressure situations for which each of the prototypical pattern shapes is found valid. The application rate and distance aspects of the distribution test data are converted to dimensionless forms by the distribution pattern normalization process. The resulting vectors, therefore, are quantitative expressions of pattern shape alone. Application of the K-Means clustering algorithm to analysis of a typical gun-type sprinkler indicates that it is an effective and easily implemented method for determining appropriate sprinkler pattern shapes to represent the performance of a sprinkler. This analysis resulted in the identification of three prototype pattern shapes which summarized 42 tests covering 38 combinations of nozzle size, pressure, and trajectory angle. Use of the algorithm reduces the amount of information needed to indicate a sprinkler's performance and permits estimation of distribution pattern data for untested conditions. (Carroll-FRC)
W82-01575

SIGNIFICANT FEATURES OF EMITTER FLUSHING MODE CHARACTERISTICS,

Rain Bird Western Sales Corp., Glendora, CA.
K. Solomon, and J. C. Bezdek.
Transactions of the ASAE, Vol 23, No 4, p 903-906, July/August, 1980. 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Simulation analysis, *Trickle irrigation, *Flushing, *Irrigation engineering, Irrigation design, Simulation, Mathematical studies, Flow channels, Water pressure, Energy, Hydraulics, Flow discharge, Flow control, Fluid mechanics.

Many trickle irrigation systems include automatic flushing emission devices. These emitters have flow channels which allow maximum flow at some pressure which is less than normal operating pressure in order to flush the emitter once during startup and once during shutdown. A simulation model is used to investigate the influence of the shape of an automatic flushing emitter's pressure-discharge curve on the hydraulic behavior of trickle laterals using such emitters. The proposed quantitative formulation of the pressure-discharge relation for typical automatic flushing emitters uses easily obtainable parameters with obvious physical significance. The significant features of flushing emitter pressure-discharge relationships are identified using trickle lateral line simulations based on hypothetical emitter curves. The height and shape of the flushing peak are important features. Lateral line hydraulic requirements were not affected by shifting the pressure at which peak emitter flushing flow occurred, but were negatively affected by increasing the pressure at which the emitters entered the normal emission mode. A trade-off must be made in the selection or design of flushing trickle emitters between the effectiveness of an emitter's flushing action and the potentially excessive flow rate requirements caused by the flushing mode for the system as a whole. While a large, wide flushing spike on an emitter's pressure discharge curve improves flushing effectiveness, it also increases the system flow rate and horsepower requirements. (Carroll-FRC)
W82-01576

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

A COMPARISON OF CHEMICAL AND CULTURAL CONTROL OF WEEDS IN IRRIGATION DITCHBANKS,

Regina Research Station (Saskatchewan).
R. Grover, A. E. Smith, and H. C. Korven.
Canadian Journal of Plant Science, Vol 60, No 1, p 185-195, January, a980. 2 Fig, 6 Tab, 13 Ref.

Descriptors: *Agricultural chemicals, *Irrigation canals, Irrigation design, Irrigation ditches, Leaching, Percolation, Paraquat, Herbicides, Amitrole, Dalapon, *Weed control, Water pollution sources.

Weed control in a series of irrigation ditches was attempted by the use of various herbicidal treatments and cultural methods. The ditches were similar in design to farmer head ditches. Atrazine (22.4 kg/ha), bromacil (15.2 kg/ha), monuron (38.5 kg/ha) and simazine (22.4 kg/ha) were applied during September of 1970 and reapplied during September of 1973. Paraquat (2.2 kg/ha), dalapon plus amitrole-T (11.2 + 2.2 kg/ha), paraquat plus diquat (1.1 + 1.1 kg/ha) as well as chlorflurenol (3.6 kg/ha) were applied annually each June from 1971 through 1976. Sowing was undertaken in 1971 on ditch bottoms and sides with streambank wheatgrass, sheep fescue, Russian wild ryegrass and dwart timothy. Good control of ditch weeds was obtained from 1973-76, with simazine and atrazine giving superior results to monuron and bromacil. The transport of these herbicides in the initial water flush and their leaching into the soil profile were demonstrated to be real hazards for contamination. Trace amounts of amitrole and dalapon were noted in the irrigation water immediately after herbicidal treatment. Maximum hazards from chemical contamination of the irrigation waters, both from the sterilants and the selected foliar herbicides, were found in the initial ponding of the treated ditches. In subsequent irrigations, the residue levels decreased rapidly, confirming that chemical treatments, especially with soil sterilants, may be dependent on the disposal of the initial flush as waste water, either to selected sites as catchment areas or its diversionary disposal into a drain or waste canal to be dissipated by further dilution. (Baker-FRC)
W82-01120

COMBINATION SURFACE-SUBSURFACE DRAINAGE SYSTEMS FOR HUMID REGIONS,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 106, No IR4, p 265-283, December, 1980. 13 Fig, 5 Tab, 22 Ref. OWRT-A-086-NC(6), 14-34-0001-7070.

Descriptors: *Crop production, *Drainage systems, Surface drainage, Subsurface drainage, Corn, *Humid areas, Mathematical models, Water management.

Alternative combinations of surface-subsurface drainage systems were evaluated for corn production at three locations: Columbus, Ohio; Wilmington, North Carolina; and Jacksonville, Florida. Evaluations were conducted for 60 combinations of drain depth and spacing on four separate soils at each location, and attempts were made to relate the results to simpler methods for drainage design. A water management model, DRAINMOD, was used to simulate corn production over a period of at least 25 years. The number of working days during the one-month period before seedbed preparation and SEW30 values during the growing season were predicted. Relationships were determined between the number of working days and the time required for water table drawdown from the surface to a 0.5 m depth, and between SEW30 and the time required for the water table drawdown to a 0.2 m depth. These may provide useful guidelines for first estimates of drainage designs. (Small-FRC)
W82-01228

SEDIMENT OXYGEN DEMAND AND ITS EFFECT ON DISSOLVED OXYGEN IN A CUTOFF MEANDER OF THE KASKASKIA RIVER,

Bradley Univ., Peoria, IL. Dept. of Biology.
B. J. Mathis, and T. A. Butts.

Water Resources Center, University of Illinois, Urbana. Research Report No 162, July, 1981. 40 p, 15 Tab, 8 Fig, 59 Ref, 4 Append. S-072-ILL.

Descriptors: *Dissolved oxygen, *Oxygen demand, *Channeling, Cutoffs, Meanders, *Lotic environment, Fluvial sediments, Oxygen depletion, *Sediments, Oxbow Lakes, Rivers, Channel improvement, Stagnant water, *Kaskaskia River, Illinois.

When a river or stream is channelized, channel modification not only destroys habitat and changes numerous environmental parameters but also alters meanders that have been left behind. In the Kaskaskia River, initial expectations were that cutoff meanders remaining after channelization could provide nurseries for fish and other aquatic organisms. The objectives of this investigation were to (1) evaluate the effects of channelization on dissolved oxygen and sediment oxygen demand in a cutoff meander of a major river; (2) assess habitat potential for fish in relationship to dissolved oxygen during summer months; and (3) evaluate and propose, if feasible, an alternative method of connecting cutoff meanders to the main stream of a river in future channelization projects. When stagnant or no-flow conditions prevailed, anoxic conditions created by sediment oxygen demand were observed in a significant part of the water in the meander. When no-flow conditions prevailed during the summer months, as much as 25 percent of the water in the meander became anoxic, while 65 percent fell below 5.0 mg/l. Sediment oxygen demand rates were more closely related to temperature than to sediment consistency or benthic macroinvertebrate numbers. Ambient sediment oxygen demand measured during the summer was almost three times greater than demand measured during the fall. While sediment oxygen demand in the channelized portion of the river was higher than in some stations in the meander, reaeration resulting from flowing water in the channel was sufficient to prevent anoxic conditions from developing. (Garrison-Omniplan)
W82-01448

SEDIMENT AND NUTRIENT TRAP EFFICIENCY OF A SMALL FLOOD-DETENTION RESERVOIR,

Scientific and Education Administration, Columbia, MO. Watershed Research Unit.
D. L. Rausch, and J. D. Schreiber.
Journal of Environmental Quality, Vol 10, No 3, p 288-293, July-September, 1981. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Detention reservoirs, *Nutrients, *Sedimentation, Suspended solids, Reservoirs, Flood-control storage, Storm runoff, *Trap efficiency, Sediment yield, Phosphorus, Nitrogen, *Callahan Reservoir, Missouri.

The Callahan Reservoir, a small flood-detention reservoir in central Missouri, was studied over a three year period to determine the sediment and nutrient trap efficiency and to identify factors affecting trap efficiencies. The Callahan Reservoir, which stores 1 centimeter of runoff from its 1,460 hectare drainage area, was found to remove significant amounts of sediment and nutrients from the runoff. The reservoir trapped an average of 85 percent of the incoming sediment. 77 percent of the total sediment phosphorus, and 37 percent of the inorganic nitrogen. Most of the sediment leaving the reservoir was clay. The trapping of sediment and sediment phosphorus during individual storms was related to the concentration of sediment in the runoff. The trapping of phosphorus was influenced by the concentrations of solution and sediment phosphorus. The average trap efficiency was slightly less for nitrate (40 percent) than for orthophosphorus (43 percent). Trap efficiencies for these two nutrients were not related to sediment deposition and could not be predicted on a storm basis by using hydrologic variables. Dissolved organic and hydrolyzable phosphorus had greater outflow than inflow concentrations, which could have been due to biological activity in the reservoir. These results indicate that detention reservoirs can be used as a 'best management practice' to improve water quality downstream from an agricultural watershed. However, the trap efficiencies of these reservoirs may decrease as the reservoirs fill with sediment. (Carroll-FRC)
W82-01471

WATER MANAGEMENT MODEL EVALUATION FOR NORTH CENTRAL OHIO,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, N. R. Fausey, and B. H. Nolte.
Transactions of the ASAE, Vol 24, No 4, p 922-928, July/August, 1981. 12 Fig, 5 Tab, 17 Ref.

Descriptors: *Water management, *Model studies, DRAINMOD, Resources management, Groundwater management, Water supply, Drainage patterns, Drainage, Drainage water, Artificial drainage, Soil water, *Ohio.

The application of the water management model, DRAINMOD, for an artificially drained soil in North Central Ohio was investigated. DRAINMOD is a computer simulation model for describing the performance of a drainage system on a continuous basis. The model predicts on a day-to-day, hour-to-hour basis the water table position, soil water content, drainage, evapotranspiration and surface runoff in terms of given climatological data, soil and crop properties and design parameters for the water management system to be used. The predominant soil type at the experimental site is Toledo silty clay. Tile and surface flow data were recorded continuously for the growing season each year of the study. Excess irrigation water was applied twice each year in May, June, or July to provide a repeatable 10-year return period storm. Drain flow data for the 8 years were used in this analysis, as the same crop, corn, was grown during these years. Predicted surface runoff and subsurface drainage volumes using DRAINMOD were in good agreement with measured values for all three drainage treatments. Comparisons of measured and predicted relationships showed that the times of occurrence of surface runoff and subsurface drainage events were predicted accurately in almost all cases. While there were some deviations in the magnitude of predicted and measured volumes for individual drainage events, they were usually small and, in most cases, were about the same magnitude as the differences between replications. (Baker-FRC)
W82-01536

IMPACT OF MANAGEMENT PRACTICES ON THE TALLGRASS PRAIRIE,

Colorado State Univ., Fort Collins. Natural Resource Ecology Lab.
W. J. Parton, and P. G. Risser.
Oecologia, Vol 46, No 2, p 223-234, 1980. 5 Fig, 3 Tab, 43 Ref.

Descriptors: *Mathematical models, *Prairies, *Range management, Grasslands, Farm management, Irrigation effects, Nitrogen, Phosphorus, Cattle, Agriculture, Ecology.

The ELM model, which simulates the flow of water, heat, nitrogen, and phosphorus through an ecosystem and the biomass dynamics of plants, consumers, and decomposers, was adapted to a tallgrass prairie site. Range management practices were evaluated, including: altering the grazing intensity, grazing system, and grazing time; addition of nitrogen and phosphorus to the grassland; effects of irrigation; and the effects of spring burning of the prairie. The simulations matched observed data fairly well. The model successfully represented the effects of range manipulations upon primary production, water flow variables, and nutrient cycling, but was less accurate in representing the impact of some range manipulations upon cattle weight gains. A moderately-stocked year-round cow-calf grazing system was more beneficial to the grassland than a highly stocked seasonal steer grazing system, as the cow-calf scheme increased above ground and below ground primary production and plant nutrient uptake. The addition of fertilizer was the best way to increase cattle weight gain. (Small-FRC)
W82-01580

HYDROPOWER–AN OLD TECHNOLOGY FOR A NEW ERA,

Worldwatch Inst., Washington, DC.
D. Deudney.
Environment, Vol 23, No 7 p 16-20, 37-45, September, 1981. 1 Fig, 1 Tab, 77 Ref.

Descriptors: *Hydroelectric power, *Water resources development, *Dams, Reservoirs, Environmental effects, Rural areas, Ecological effects, Energy sources, River basin development, Aluminum, International agreements, *Developing countries, *China, Social aspects, Economic aspects, Political aspects, Irrigation, Erosion, Agriculture, Fisheries, Public health.

Hydropower technology has been available since Roman times. Political and social conditions have affected its use, which decreased in periods of plentiful, cheap labor and increased with the industrial revolution and the 1973 oil shock. Many of the small dams abandoned in the era of cheap oil are being retrofitted, and the Middle Ages technique of fastening waterwheels to floating river barges is being resurrected. Total world hydropower, currently 3,207 trillion watt-hours per year, could realistically expand to 4 to 6 times that amount, considering environmental and economic constraints. Africa taps only 5% of its hydropower potential, while Norway receives 99% of its electricity and 50% of its energy from water. Switzerland exports electricity, and Nepal and Peru have this potential. The largest existing dam, Itiapu, in Brazil-Paraguay, has a 12,600 MW capacity, but this is dwarfed by proposed dams on the Yangtze River, China (25,000 MW) and the Amazon River, Brazil (66,000 MW). Ecological damage can occur--waterborne disease transmission, silting, erosion, inundation of prime agricultural land, soil salinization, soil waterlogging, fisheries destruction, and loss of unique plant and animal species. For undeveloped countries small projects can often provide needed power without the disruptions produced by the large dams. China's policy of building small projects to complement large dams is a model for developing nations. Since the untapped water resources are largely in uninhabited areas, an eventual shift of wealth, population, power, and employment to areas with abundant hydropower production can be expected. (Cassar-FRC)
W82-01593

4B. Groundwater Management

ARTIFICIAL GROUNDWATER RECHARGE,

Water Research Centre, Marlow (England).
J. B. Joseph.
Water Services, Vol 85, No 1024, p 303-304, 307-308, June, 1981. 5 Fig.

Descriptors: *Groundwater recharge, *Artificial recharge, *Underground waste disposal, *Land disposal, Wastewater treatment, Injection wells, Wastewater disposal, Water quality, *Great Britain.

Artificial groundwater recharge is used in Britain for the disposal and reclamation of wastewater. Surface spreading or injection through wells and boreholes can be used. A typical surface spreading scheme capable of recharging 45 M liters/day will require 1.5 to 2 ha of land. While boreholes require less land, they require large scale drilling equipment and complex technology and operation. Chemical as well as physical problems can occur during recharge. Reaction can lead to a deterioration in water quality and clogging or collapse of the aquifer. One advantage of artificial recharge is that a system for resource augmentation can be constructed in phases whose financing and size can be adjusted to meet changes in the demand growth pattern. For example, phase I of the Lea Valley scheme has a yield of 60 M liters/day and was designed and constructed in three years. Water is available for recharge at a marginal cost, typically 25 British Pounds Sterling/M liter. The standard cost for treated water is about 130 British Pounds Sterling. Artificial recharge can also be used for the prevention or reversal of saline intrusion. (Small-FRC)
W82-01110

COST EFFECTIVE GROUND WATER MONITORING,

R. L. Zook.
Ground Water Age, Vol 15, No 9, p 29-31, May, 1981. 3 Fig.

Descriptors: *Groundwater management, *Monitoring, *Costs, Economic aspects, Design criteria, Water management, Management decisions.

Ground Water monitoring systems can be adequate in size and still be cost effective. Cost effective ground water monitoring systems can be designed through low overhead rates, minimum field and laboratory programs to gain maximum data at the lowest possible cost without sacrificing quality, practical designs and solutions, sound management, and adequate communications with the client. Innovations in design and system size should be accompanied by innovation in material types and installation methods and extensive knowledge of materials, technologies, and methods for evaluating an adequate number of alternatives. The major factor that determines which type of multiple setup is installed is how the well system is installed. It is critical to the success of the multiple setup that leakage does not occur between the monitors in the system. Another important factor affecting the cost of multiple setups is whether the aquifer is in bedrock or soil. To obtain overall cost effectiveness, it is necessary that the initial site investigation be cost effective. It is also necessary that an adequate amount of time as well as money be spent in developing the system. (Baker-FRC)
W82-01113

RESULTS OF ACIDIZING WATER WELLS IN ARIZONA,

Hargis and Montgomery, Inc., Tucson, AZ.
D. R. Hargis, and C. A. McCauley.
Water Resources Bulletin, Vol 17, No 3, p 494-497, June, 1981. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Acidizing, *Well yield, *Water yield, Hydrochloric acid, Aquifers, Confined aquifers, Unconfined aquifers, Carbonate aquifers, Well capacity, Pumping tests, Costs, Groundwater mining, Drawdown, Arizona, Water harvesting, *Arizona, *Groundwater management.

Acidizing is a procedure used to increase production from water wells, and generally consists of placing a nontoxic acid solution in contact with the water bearing formation to dissolve out part of the stratum. Acidizing of sample wells in Arizona was beneficial for wells producing more than 500 gallons per min and marginal for those producing less than that amount. Sample wells for Wellfield No. 1, penetrating the unconfined Coconino Sandstone aquifer, and Wellfield No. 2, penetrating the confined composite Kaibab Limestone-Coconino Sandstone aquifer, were used to collect drawdown data before and after acidizing. Each well was acidized with different amounts of 15% hydrochloric acid according to borehole size and aquifer thickness. Acidizing improved the specific capacity of the Wellfield No. 1 well by 50% at pumping rates of 200-500 gallons per min and of the Wellfield No. 2 well by 100% at pumping rates of 1250-2200 gallons per min. Acidizing reduced the pumping costs in Wellfield No. 1 by 1% at 195 gallons per min to 11% at 500 gallons per min, and in Wellfield No. 2, by 6% at 1250 gallons per min to 11% at 2200 gallons per min. (Cassar-FRC)
W82-01199

POTENTIAL USE OF A STREAM-AQUIFER MODEL FOR MANAGEMENT OF A RIVER BASIN: CASE OF THE SOUTH PLATTE RIVER IN COLORADO,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-01301

THERMAL ENERGY STORAGE IN A CONFINED AQUIFER: SECOND CYCLE,

Auburn Univ., AL. Dept. of Civil Engineering.
F. J. Molz, A. D. Parr, and P. F. Andersen.
Water Resources Research, Vol 17, No 3, p 641-645, June, 1981. 10 Fig, 10 Ref.

Descriptors: *Geothermal studies, *Aquifer management, *Energy storage, Subsidence, Groundwater management, Auburn University, *Thermal water, *Injection wells, Wells, Confined aquifers, Water storage.

The second 6-month injection-storage-production cycle of the Auburn University Aquifer Thermal Energy Storage Project, beginning with injection on September 23, 1978, was performed in a similar manner to the first cycle which started March 18, 1978. Water, pumped from an upper supply aquifer and heated to 55 C with an oil-fired boiler, was injected into a deeper storage aquifer, ambient temperature 20 C. By November 25, 1978, 58,010 cu meters of water had been injected. After a 63 day storage period ending January 27, 1979, hot water production began with a initial temperature of 54 C. By March 23 the temperature had dropped to 33 C, and 66,400 cu meters of water and 76% of the injected thermal energy had been recovered. Production ended April 20, at which time 100,100 cu meters of water and 89% of the injected thermal energy had been recovered; the final temperature was 27.5 C. The second cycle differed from the first in the following aspects: (1) well clogging experienced during the first cycle was reduced by regular backwashing (8 times), and the average injection rate increased by 24%, (2) longer production period, 64 days vs. 41 days, and (3) 76% of energy was recovered vs. 66% at the same drop in production temperature to 33 C. During injection the surface elevation near the well rose 4 mm, fell during storage, and continued to fall during production to 0-2 mm above the initial elevation. This movement was caused by thermal expansion and contraction and not by head changes in the storage aquifer. (Cassar-FRC)
W82-01473

EXTRACTION TIMING AND ECONOMIC INCENTIVES FOR GEOTHERMAL RESERVOIR MANAGEMENT,

Woodward-Clyde Consultants, San Francisco, CA.
K. Golabi.
Journal of Environmental Economics and Management, Vol 8, No 2, p 156-174, June, 1981. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Geothermal resources, *Conservation, Water conservation, Resources development, Natural resources, *Cost analysis, Economic aspects, Costs.

A model is presented to consider various methods of extraction for a hot water geothermal reservoir, with emphasis on the optimal time to begin extraction. One major objective was to demonstrate how a profit-maximizing firm can determine an optimal extraction plan for a liquid-dominated reservoir, including an investigation of the sensitivity of the decision variables to such parameters as the perceived rate of growth of the value of energy, discount rate, royalties, and the penalties that can be imposed by regulatory agencies for delaying extraction. Of equal importance is the objective of providing public sector resource trustees and regulatory agencies with a model of entrepreneurial activity that can be used to study the effect of various incentives and penalties on the timing and extraction rate of geothermal resources. In the model presented, the economic life of the reservoir can go beyond breakthrough time, with the production of steam continuing until either it is not economical or it is not technically feasible to do so. It is assumed that the brine is extracted from the aquifer, and cycled through heat exchangers where the heat energy is extracted to generate steam, and the cooled brine is reinjected into the aquifer. The economic inducements studied include pre-exploitation rents and penalties and royalties. The substantial variation of starting time with penalty and royalty suggest that these kinds of economic incentives could motivate a profit-maximizing entrepreneur to accelerate or postpone production. However, if the entrepreneur's alternative rate of return is high enough, these inducements will have little effect. The optimal pumping rate decreases as royalty increases. Thus royalty can be considered an effective means for conservation. As royalty is increased, exploitation time is deferred and, when production begins, it is undertaken at a slower rate. (Baker-FRC)
W82-01504

DISCUSSION-ENGINEERING GEOLOGY OF ARID AREAS,

Water and Power Resources Service, Sacramento, CA.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol 17, No 2, p 95-99, Spring, 1980. 1 Fig.

Descriptors: *Arid-zone hydrology, *Water resources development, Deserts, Arid lands, Arid zone, Semiarid lands, Arid climates, *Groundwater, Irrigation, Leaching, Capillarity, Water supply development.

It is anticipated that areas presently viewed as deserts will, in the future, be valuable as agricultural areas, dependable source areas for solar energy, and mining and recreational-residence areas. Imported water will be a necessary item. Extensive pumpage of local ground water for irrigation can create an overdraft of groundwaters in any climatic zone, but is most likely to do so in arid or semiarid climates. Such overdrafts will lead in some cases to land subsidence, which could interfere with deliveries of surface water to areas of demand by canals. Groundwater development is generally less expensive than construction of a long conveyance import system, and probably will precede such construction. Another cause of subsidence is an increase in weight of dry sediments due to wetting with irrigation water, and corresponding compaction of unconsolidated underlying sediments. Irrigation can also lead to a buildup of shallow groundwater bodies, resulting in slope instability and a change in chemistry of groundwaters and soils. Leaching of salts would be an obvious result of importing relatively pure water into a desert. Leaching may cause loss of strength of originally hard-cemented rocks and may lead to slope failures and land sliding. The salts may eventually move and accumulate in depressions, resulting in local concentrations of salts. Drainage problems and disposal of drain water are critical in arid regions. There are no standard patterns for geologic investigations in deserts. Each project must be treated individually. (Baker-FRC)
W82-01568

4C. Effects On Water Of Man's Non-Water Activities

WATER QUALITY FROM TWO SMALL FORESTED WATERSHEDS IN SOUTHERN ILLINOIS,

Illinois Univ. at Urbana-Champaign. Dept. of Forestry.
R. J. Brozka, G. L. Rolfe, and L. E. Arnold.
Water Resources Bulletin, Vol 17, No 3, p 443-447, June, 1981. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Water quality, *Forest watersheds, *Nutrient removal, Forest hydrology, Intermittent streams, Watersheds, Streamflow, *Illinois, Nitrates, Phosphorus, Water yield, Logging.

Intermittent streams in two similar, forested watersheds in Illinois were monitored for flow volume and water quality during 1977-79 to establish a baseline prior to clearcutting one watershed in November 1979. Dominant species in both stands were oak and hickory. Annual flow varied widely between years and between watersheds. Although water quality was high in both watersheds there were significant differences between watersheds in Na+, Mg(2+), K+, Ca(2+), and nitrate; P showed no difference between watersheds. The most pronounced seasonal trend was in nitrate levels, which rose during the dormant season, peaked in February-March, and declined during the growing season. (Cassar-FRC)
W82-01140

EFFECTS OF LOGGING ON MACROINVERTEBRATES IN STREAMS WITH AND WITHOUT BUFFER STRIPS,

California Univ., Berkeley. Dept. of Forestry and Conservation.
For primary bibliographic entry see Field 5C.
W82-01227

STORM FLOW RESPONSE TO ROAD BUILDING AND PARTIAL CUTTING IN SMALL STREAMS OF NORTHERN CALIFORNIA,

Pacific Southwest Forest and Range Experiment Station, Arcata, CA.
R. R. Ziemer.
Water Resources Research, Vol 17, No 4, p 907-917, August, 1981. 7 Fig, 7 Tab, 19 Ref.

Descriptors: Flood peak, *Logging, *Road construction, Streamflow, Forest management, *Casper Creek, *California, Runoff, Evapotranspiration, Forest watersheds, *Storm runoff, Hydrographs, Peak discharge.

A total of 174 paired storm hydrographs from two sections of the Casper Creek watershed in northern California were analyzed. Selective cutting (67% removal) and tractor yarding (15% of land surface for roads, etc.) of a 85-year-old second growth redwood and Douglas fir forest in the South Fork of the watershed did not significantly change large peak streamflows as compared with the North Fork control area. The South Fork mean peak discharge was only 4% larger than that of the North Fork. However, early fall storms produced a 300% increase in peak discharge because evapotranspiration had ceased at the end of the growing season. These storms were all small and produced minor peaks. During the late fall and winter after recharge of soil moisture, both parts of the watershed had similar peak discharges. The most significant variable explaining the difference between the logged and unlogged watersheds was the annual storm number divided by the amount of watershed logged. (Cassar-FRC)
W82-01295

ESTIMATION OF IMPERVIOUS-AREA WASHOFF PARAMETERS,

Geological Survey, Reston, VA.
W. M. Alley.
Water Resources Research, Vol. 17, No 4, p 1161-1166, August, 1981. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Impervious surfaces, *Urban runoff, *Water quality, Florida, Rainfall-runoff relationships, Model studies, Urban watersheds, Rainfall intensity, Runoff, Water pollution sources.

The exponential washoff equation, commonly used in models for rainfall runoff water quality in urban areas, is often modified by an availability factor to account for the effects of runoff intensity on pollutant washoff. This study showed that, overall, the inclusion of the availability factor did not significantly improve results. However, techniques for determining the optimum values of coefficients used in these equations have been demonstrated. These procedures were applied to a 6 ha urban watershed in south Florida, where the optimized parameter values vary widely between different storms and between different constituents. (Cassar-FRC)
W82-01465

ANOMALOUS SNOWFALL CAUSED BY NATURAL-DRAFT COOLING TOWERS,

Rand Corp., Santa Monica, CA.
For primary bibliographic entry see Field 2B.
W82-01512

4D. Watershed Protection

ECONOMIC IMPACTS OF EROSION AND SEDIMENTATION CONTROL PLANS: CASE STUDIES OF PENNSYLVANIA DAIRY FARMS,

Cornell Univ., Ithaca, NY. Dept. of Agricultural Economics.
G. B. White, and E. J. Partenheimer.
Journal of Soil and Water Conservation, Vol 35, No 2, p 76-78, March/April, 1980. 4 Tab, 8 Ref.

Descriptors: *Soil conservation, *Farming, *Erosion control, Conservation, *Dairy industry, Pennsylvania, Economic aspects, Profit, Income, Sedimentation, Soil management, Legal aspects, Regulations, *Case studies.

Analyses of 12 Pennsylvania dairy farms using linear programming models showed that implementation of the state's Clean Streams Law, which requires erosion and sedimentation control, would reduce net income on 10 of the farms. The greatest anticipated income reduction was 29%. Six farms had income reductions of 6-29%. Average costs for implementing the plans were $6,420 (range $705-$14,128) without cost sharing and an average of $2,522 with cost sharing. Greatest damage to income was produced by unprofitable crop rotation (any reduction in corn silage decreased farm income). The most efficient conservation practice for all 12 farms was no-till corn. Other helpful measures were rotation changes and cover crops. This analysis suggests a flexible approach with respect to soil loss limits. Present maximum allowable soil losses, 2-4 tons per acre, may be too restrictive in some cases. The goal should be a significant reduction in soil loss rather than an absolute limit. (Cassar-FRC)
W82-01134

ANALYSIS OF NATIONAL WATER POLLUTION CONTROL POLICIES 2. AGRICULTURAL SEDIMENT CONTROL,

Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6A.
W82-01293

RESIDUE AND TILLAGE EFFECTS ON SCS RUNOFF CURVE NUMBERS,

Science and Education Administration, Beltsville, MD.
W. J. Rawls, C. A. Onstad, and H. H. Richardson.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May 1980, p. 405-425, 5 Fig, 7 Tab, 21 Ref, 1 Append.

Descriptors: *Conservation tillage, *Agricultural runoff, *Runoff rates, Rainfall-runoff relationships, Model studies, *Erosion control.

The effects of conservation tillage on reducing direct runoff ranges from slight to substantial. Soil Conservation Service (SCS) procedures used today for estimating runoff do not consider the effects of conservation tillage and no-till practices on runoff. To develop the SCS runoff curve numbers for these practices, tillage and crop data were assembled from small watersheds and plots under natural and simulated rainfall from many locations across the country. The residue left on the ground was chosen as the independent variable to represent the effects of conservation tillage practices. These data were studied to determine runoff curve numbers for single and double cropping systems under various conservation tillage practices. There are not enough data to derive an equation for predicting how conservation tillage affects runoff. Data compiled from plots and small watersheds under simulated and natural rainfall for 531 events were used, however, to develop graphs that can be used as practical guides to estimate the decrease in SCS runoff curve numbers due to a certain amount of residue on the ground or a certain percentage of the surface covered with residue. Separate guides were developed for corn and for such medium-residue crops as wheat, oats, sorghum, and soybeans. (See also W82-01401) (Moore-SRC)
W82-01404

SOIL CONSERVATION PROBLEMS AND PRACTICES: A FARMER VIEW.

Journal of Soil and Water Conservation, Vol 36, No 4, p 186-193, July/August, 1981.

Descriptors: *Soil erosion, *Erosion control, *Farming, Agriculture, Soil erosion, Salinity, Soil compaction, Wind erosion, Agricultural engineering, Farm management.

Seven prominent farmers and ranchers discussed the severity of soil erosion, voluntary vs. mandatory erosion control programs, and the prospects for the adoption of conservation tillage. Problems the farmers were experiencing included water and wind erosion, soil compaction, salinity, and absentee landlords. Changes noted during these farmers' careers included trends toward more machines and less help, more sophisticated irrigation practices, and the extensive use of chemical fertilizers. Conservation practices in use included terracing, minimum tillage, sprinklers and drip irrigation, residue management, and chisel plowing. Conservation tillage, including stubble-mulch tillage and chemical weed control were being practiced in most areas. Government action to require conservation tillage was viewed as a controversial topic. The benefits of conservation tillage were agreed upon by all farmers interviewed. (Small-FRC)
W82-01551

EROSION AND SEDIMENTATION CONTROL IN REGIONAL AND SITE PLANNING,

Pennsylvania State Univ., University Park. Dept. of Landscape Architecture.
B. K. Ferguson.
Journal of Soil and Water Conservation, Vol 36, No 4, p 199-204, July/August, 1981. 13 Fig, 1 Tab, 40 Ref.

Descriptors: *Erosion control, *Sediment control, *Regional development, Planning, Site selection, Environmental effects, Construction, Land use, Vegetation, Land management, Land cover.

Methods available to regional and site planners for minimizing erosion and sedimentation on construction sites are summarized. Illustrations of small hypothetical sites are included. The methods include: land use compression, or getting the same amount of development within a smaller land area; land use distribution, which involves putting the compressed development on the most suitable portion of the site, and facility orientation and adaptation, which involves fitting roads and buildings into a site by shaping and orientation. Also, land grading can be used, which involves shaping the land around the developed facilities, and vegetation and land cover can be used to control erosion. After construction, diversions and chutes can help divert water flows, and land covers can be useful. Preconstruction planning is the most effective means of controlling erosion and sedimentation. (Small-FRC)
W82-01552

SOIL EROSION CONTROL IN IDAHO'S COW CREEK WATERSHED: AN ECONOMIC ANALYSIS,

Idaho Wheat Growers Association, Boise.
S. H. Berglund, and E. L. Michalson.
Journal of Soil and Water Conservation, Vol 36, No 3, p 158-161, May/June, 1981. 4 Tab, 12 Ref.

Descriptors: *Erosion control, *Soil erosion, *Economic aspects, *Farm management, Watershed management, Cost analysis, Fallowing, Precipitation, Sedimentation, Soil management, Crop yield, Crop production.

Precipitation, topography and soil treatment factors make erosion a persistent problem on agricultural land in northern Idaho's Cow Creek watershed. A five point program involving cross-slope farming divided slope farming, minimum tillage, treating critical erosion areas, and restricting summer fallow was proposed to control the erosion problems of this watershed and was evaluated economically. Average costs of the program would range from $5 to $9/acre, depending on the crop rotation system used. High costs occur when income is foregone by planting less profitable crops, higher production costs are incurred and/or yields are reduced. Of the five points proposed to control erosion, treating critical areas would be the most costly, amounting to over 50% of the total program's projected expense. The rest of the costs are divided nearly equally among divided-slope

and contour farming and minimum tillage, with negligible costs being incurred by restricted summer fallow. Since continuous cropping rotation is more profitable to Cow Creek farmers, summer fallow is only used in cases of severe drought or weed infestation. (Geiger-FRC)
W82-01556

MANAGING LAND TO MEET WATER QUALITY GOALS,
Economics and Statistics Service, Washington, DC. Natural Resource Economics Div.
C. Osteen, W. D. Seitz, and J. B. Stall.
Journal of Soil and Water Conservation, Vol 36, No 3, p 138-141, May/June, 1981. 18 Ref.

Descriptors: *Water management, *Water resources development, *Watershed models, *Erosion control, *Management planning, Land management, Watershed management, Water use, Water quality management, Soil conservation, Soil erosion, Model studies.

Under Section 208 of Public Law 92-500, provisions are made for land management to control soil erosion by traditional methods. This approach is termed source control. A second approach, water-based land management (WBLM), relates the choice of land management practices and their locations to water use and water quality goals. The applications of the WBLM are discussed. The implementation of WBLM may be more difficult on the institutional level than 208 plans in agricultural areas. Under a WBLM plan, nonlandowners may be excluded from decisions in which they feel they have an interest. To allow nonlandowners to vote on WBLM motions, changes may have to be made in state soil conservation district laws. The availability of analytical tools and information will affect the WBLM planning process. Physical process models should estimate water quality parameters in conjunction with land management plans. The use of WBLM for controlling washloads and bedlods in agricultural watersheds is considered. Three sediment movement models, ANSWERS, ARM and CREAMS, which may be used in WBLM programs are described. Linear prgramming models used to manage land used for agricultural activities in a watershed should not be impossible to integrate into a WBLM plan. Other factors in integrating models into WBLM systems are discussed. The long range benefits of WBLM planning should justify the extra costs and efforts involved in its implementation. (Geiger-FRC)
W82-01557

DEBRIS FLOWS IN SMALL MOUNTAIN STREAM CHANNELS OF COLORADO AND THEIR HYDROLOGIC IMPLICATIONS,
Denver Univ., CO. Dept., of Geography.
For primary bibliographic entry see Field 2E.
W82-01597

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

A SIMPLE LOW COST APPARATUS FOR CONDITIONING LARGE VOLUMES OF WATER FOR VIROLOGICAL ANALYSIS,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, and M. Trudel.
Canadian Journal of Microbiology, Vol 26, No 4, p 548-550, 1980. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Viruses, *Water analysis, *Sampling, Measuring instruments, Microbiological studies, Filtration, Adsorption, Separation techniques, Laboratory equipment.

A Simple low cost proportioning injector is described which can effectively add chemicals such as aluminium chloride, hydrochloric acid, and sodium thiosulfate, to condition large volumes of water to detect viruses by adsorption to selected filters. This system can function at about one-tenth the cost of the bulky hydraulic proportioner. Its use should simplify the virological analysis of water, particularly for laboratories with limited funds and facilities. When drinking water is to be conditioned, two injectors are connected in-line, one for hydrochloric acid and aluminum chloride, and a second one to add sodium thiosulfate to neutralize residual chlorine. (Baker-FRC)
W82-01123

PERSISTENCE OF PSEUDOMONAS AERUGINOSA IN CHLORINATED SWIMMING POOLS,
Toronto Univ. (Ontario). Dept. of Microbiology and Parasitology.
P. L. Seyfried, and D. J. Fraser.
Canadian Journal of Microbiology, Vol 26, No 3, p 350-355, 1980. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Swimming pools, *Bacteria, *Chlorination, Chlorine, Recreation facilities, Disinfection, Acidity, Water treatment, Pseudomonas aeruginosa, Coliforms.

A study was conducted to determine the effect of the pool bather load, free chlorine residual, and pH on the incidence of Pseudomonas aeruginosa in swimming pools and to investigate the survival of specific P. aeruginosa serotypes and phage types in a chlorinated pool environment. A total of 179 Toronto and Peterborough swimming pools were sampled between May and September of 1974. The pool types included 18 above and below ground private pools as well as 59 public outdoor and 102 public indoor pools. Surface and subsurface samples were collected. Out of 266 water samples taken in 1974, P. aeruginosa was detected in 8 (21%) of the 38 private pool samples, 4 (3%) of the 124 public indoor pool samples, and 7 (7%) of the 104 public outdoor pool samples. A 36% increase in surface water counts was found compared with subsurface levels. The pH of samples ranged from 6.9 to 7.8 and the water temperature was between 22 and 32.5 degrees C. Bather load at time of sampling ranged from 0 to 25 swimmers, with the exception of one day when 120 bathers were present. The highest P. aeruginosa estimate of 2400 CFU/ml was recorded in a pool water with a bather load of 10, a temperature of 31 degrees C, and a free chlorine residual of 0.0 mg/liter. P. aeruginosa was not found in 146 samples from pools with a free chlorine level greater than 0.4 mg/liter. This study confirms other reports suggesting that single strains predominate when high counts of P. aeruginosa occur in pool waters. (Baker-FRC)
W82-01124

USE OF EXCISED ROOT CULTURES AS BIOINDICATORS OF WATER POLLUTION (UTILISATION DES CULTURES DE RACINES ISOLEES COMME TEST BIOLOGIQUE DE POLLUTION DES EAUX),
Paris Univ. (France)
M. Richez, A. Kovoor, and R. Heller.
Environmental Pollution (Series A), Vol 22, No 1, p 1-10, May, 1980. 1 Fig, 7 Tab, 4 Ref.

Descriptors: *Water analysis, *Plant tissues, *Bioindicators, *Pollutant identification, Water pollution effects, Rivers, Tomatoes, Root development, Cultures, Sein River, Marne River, *France.

Excised roots from the tomato, Lycopersicon esculentum, or other plants highly sensitive to pollutants and capable of rapid growth in vitro, can be used as bioindicators for early detection of freshwater pollution. The test consists of 2 parts: (1) 10 days of in vitro culture in the water sample with added nutrients, and (2) 48 hours exposure in sterilized dialysis bags in the river itself, followed by 8 days immersion in running water in the laboratory. Root growth is compared with controls at the end of the test period. In one test, length of tomato roots was 78 mm in distilled water, 96 mm in 2.5% river water (Marne), and 44 mm in 80% river water. In similar tests with water from the River Seine, the control roots were 87 mm long; in 25-100% river water roots were 26-30 mm. (Cassar-FRC)
W82-01133

PETROLEUM HYDROCARBONS IN SEDIMENTS OF SAGINAW BAY, LAKE HURON,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P. A. Meyers, N. Takeuchi, and J. A. Robbins.
Journal of Great Lakes Research, Vol 6, No 4, p 315-320, 1980. 3 Fig, 20 Ref.

Descriptors: *Oil pollution, *Lake sediments, Pollutant identification, Lakes, Sediments, Organic compounds, Hydrocarbons, *Saginaw Bay, *Lake Huron.

A 60 cm sediment core from Saginaw Bay was analyzed to produce a profile of petroleum contamination over the last 200 years. Aliphatic hydrocarbons averaged 385 micrograms per g in modern sediments and gradually decreased to 30 micrograms per g in sediments deposited before 1976. An unresolved complex mixture of hydrocarbons indicative of petroleum comprised 90% of the total concentration in all core sections deposited over the last 100 years. Although some of these nonbiogenic hydrocarbons may originate from natural sources, such as forest fires and erosion of ancient sediments, it is conservatively estimated that 20,000 to 40,000 tons of petroleum have been deposited in Saginaw Bay in the last 100 years. (Cassar-FRC)
W82-01141

ABUNDANCE OF ORGANIC COMPOUNDS IN WATER,
Illinois Environmental Protection Agency, Springfield.
D. J. Schaeffer, and K. G. Janardan.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 211-216, 1980. 1 Tab, 8 Ref.

Descriptors: *Organic compounds, *Water pollution, *Toxicity, *Industrial wastes, *Waste identification, Statistical methods, Pollution load, Pollutants, Environmental effects, Probabilistic process, Mathematical studies, Probability distribution, Frequency distribution, Marking techniques.

A data base for organic compounds in water was established by Shackelford and Keith. In this data base 1,258 compounds appearing in 5,720 observations on 33 water types were tabulated. A total of 175 lists which give the identities and frequencies of occurrence of organic compounds were compiled. Such data constitute the type of information which will be obtained by broad-based monitoring programs. A theoretical model was developed for analyzing the data to provide information applicable to specific compounds. The probability function governing the appearance of a compound on merged lists is identical to the Generalized Geometrical Distribution. According to this calculation, there is only a 14% chance of a specific compound being found in a given list. The maximum number of times a given compound could be expected to appear on several lists is 6. If a given compound appears more frequently than this, it suggests that its absolute rate of occurrence and detection is greater than anticipated. The low frequency of occurrence makes it unlikely that inferential procedures will be developed based on decreased frequencies of observation. The data bases may be analyzed in subsets such as finished drinking waters or specific industrial categories, and relevant estimates may be obtained to guide the collection and interpretation of new data. (Titus-FRC)
W82-01162

ALTERATIONS IN THE BOD PROCEDURE FOR THE 15TH EDITION OF 'STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER',
Iowa State Univ., Ames. Dept. of Civil Engineering.
J. C. Young, G. N. McDermott, and D. Jenkins.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1253-1259, July, 1981. 12 Ref.

Descriptors: *Biochemical oxygen demand, *Standards, *Water quality, Sample preparation, Water analysis, Dissolved oxygen, Nitrification, Wastewater.

Additions to and changes in the biochemical oxygen demand test procedure in the 15th edition of Standard Methods are described. The major changes are in sections dealing with immediate dissolved oxygen demand, sample storage, dilution water quality check, nitrification inhibition, seeding, and use of standards as a check on technique. The reasons for the modifications are also discussed. The changes will improve the utility and understanding of BOD analysis. In this edition, no provision for the separate measurement of immediate dissolved oxygen demand is made, and the maximum storage time for a sample was reset to six hours. On the topic of dilution water quality, the dilution water dissolved oxygen uptake after 5 days of incubation at 20 deg C must not exceed 0.2 mg/liter and should not exceed 0.1 mg/liter. A test for nitrification inhibitions was included because of the problems that nitrification in BOD test causes in interpreting plant performance and stream load impact. (Small-FRC)
W82-01186

ORGANOCHLORINE INSECTICIDES AND PCB IN SURFICIAL SEDIMENTS OF LAKE MICHIGAN (1975),

Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank, R. L. Thomas, H. E. Braun, D. L. Gross, and T. T. Davies.
Journal of Great Lakes Research, Vol 7, No 1, p 42-50, 1981. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Chemical wastes, Lakes, *Lake Michigan, *Insecticides, DDT, Chlordane, Endrin, Heptachlor epoxide, HEOD, Mirex, Polychlorinated biphenyls, Sediments, Lake sediments, Great Lakes.

Attempts were made to map the concentration of organochlorine insecticides and PCBs in the upper 3 cm of the bottom sediments in Lake Michigan in order to establish base levels and identify sources to enable future trends to be assessed. Samples of Lake Michigan sediment were collected using a Shipek bottom sampler. Analyses of 286 surficial sediments revealed the presence of DDT, its metabolites DDE and TDE, HEOD, chlordane, heptachlor epoxide (HE), and polychlorinated biphenyl (PCB), but no detectable residues of endrin, endosulfan, methoxychlor or mirex. The mean residue of total DDT for bottom sediments of the whole lake was 11.9 mg/g. The highest mean residue of total DDT occurred in the Milwaukee basin, at 40.79 ng/g, with the metabolites representing about 80% of the total DDT concentration. HEOD was identified and measured in 48.3% of sediments taken from the lake bottom, with 42.0% having residues between 0.1 and 1.0 ng/g. The highest mean residue occurred in the Waukegan basin. Chlordane was identified in 21.6% of the samples, with a calculated mean residue for the whole lake of about 0.37 ng/g. Highest residues occurred in the Grand Haven and Sarian basins. Heptachlor epoxide was identified in 53.9% of the samples, with the mean residue level being 0.67 ng/g. Ninety of the 286 samples (31.5%) contained no residues of the three cyclodienes, HEOD, chlordane, or heptachlor epoxide. PCBs were found in 79.6% of samples, with 67.4% of them containing 2 to 20 ng/g levels. Sixty-two sediments were analyzed for mirex, with no residues being found to a level of 0.2 ng/g. No residues of endosulfan, its sulfate, endrin, or methoxychlor were detected to a limit of 0.2 ng/g. (Baker-FRC)
W82-01190

MONITORING LEACHATE IN GROUND WATER BY CORRECTED RESISTIVITY METHODS,

Wisconsin-Milwaukee Univ. Dept. of Geological Sciences.
W. F. Kean, and R. B. Rogers.
Bulletin of the Association of Engineering Geologists, Vol 18, No 1, p 101-107, 1981. 7 Fig, 1 Tab, 10 Ref. OWRT-A-077-WISC(3).

Descriptors: *Resistivity, *Leachates, *Monitoring, Fly ash, *Path of pollutants, Leacing, Contamination, Groundwater pollution, Sampling, Electrical properties, Water quality, Waste disposal, Landfills, Measuring instruments, *Pollutant identification.

Seasonal variations in temperature from 2 to 18 C affected surface electrical resistivity readings at a landfill site, where fly ash leachate movement was monitored. Therefore, laboratory determinations were made of resistivity of samples from well borings in the study area as a function of temperature, saturation, and salinity. A Wenrer electrode configuration with 1 inch electrode spacing was used to measure resistivity. After correction, the surface resistivity measurements positively identified the leachate movement. (Cassar-FRC)
W82-01219

GEOLOGIC AND HYDROLOGIC FACTORS CONTROLLING RADON-222 IN GROUND WATER IN MAINE,

Maine Univ. at Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-01222

DETERMINATION OF LABILITIES OF SOLUBLE TRACE METAL SPECIES IN AQUEOUS ENVIRONMENTAL SAMPLES BY ANODIC STRIPPING VOLTAMMETRY AND CHELEX COLUMN AND BATCH METHODS,

State Univ. of New York at Binghamton. Lab. for Trace Methods and Environmental Analysis.
P. Figura, and B. McDuffie.
Analytical Chemistry, Vol 52, No 9, p 1433-1439, August, 1980. 4 Fig, 4 Tab, 29 Ref. OWRT-B-070-NY(2).

Descriptors: *Water analysis, *Trace metals, *Heavy metals, Chemical analysis, Rivers, Pollution load, Chemical properties.

The development and application of a method for differentiating trace metal species on the basis of relative lability is presented. The method developed for solutions of Cd, Cu, Pb, and Zn utilized anodic stripping voltammetry and Ca-Chelex resin in successive column and batch procedures. By using a characteristic time scale for the measuring technique, species were classified as 'very labile', 'moderately labile', 'slowly labile', or 'inert'. For species in each category, a range of dissociation rate constants can be estimated. A precise determination can be made at the ppb and sub-ppb levels using preconcentration of the various fractions. Applications include samples from the St. Lawrence River, Susquehanna River, a Hudson River Estuary, and secondary sewage effluent. In general, Zn and Cd were in the 'very' or 'moderately' fractions, Cu was in the 'moderately' fraction, and Pb was 'slowly labile' or 'inert'. This method can be used to yield detailed information on the various chemical forms of soluble trace metals in polluted or unpolluted waters. (Small-FRC)
W82-01229

TENAX-GC EXTRACTION TECHNIQUE FOR RESIDUAL POLYCHLORINATED BIPHENYL AND POLYAROMATIC HYDROCARBON ANALYSIS IN BIODEGRADATION ASSAYS,

Tennessee Univ., Knoxville. Dept. of Microbiology.
M. P. Shiaris, T. W. Sherrill, and G. S. Sayler.
Applied and Environmental Microbiology, Vol 39, No 1, p 165-171, January, 1980. 1 Fig, 6 Tab, 16 Ref. OWRT-B-040-TENN(2).

Descriptors: *Biodegradation, *Surface water, *Hydrocarbons, Assay, Bioassay, Chlorinated hydrocarbons, Biphenyls, Phenanthrene, Aroclor 1254.

The usefulness of Tenax-GC as an extraction polymer for biodegradation samples was evaluated. The factors affecting the efficient recovery of both PAH and PCB were determined. The method was quantitatively efficient and reproducible for phenanthrene, but variable and not quantitative for Aroclor 1254. Aqueous sample volumes and varying concentrations of organic matter influenced polychlorinated biphenyl and polyaromatic hydrocarbon extraction efficiency. Phenanthrene recovery was decreased by soil extract but unaffected by spent bacteriological culture medium. Both types of organic matter caused significant reduction of Aroclor 1254 recovery. Polyaromatic hydrocarbon and polychlorinated biphenyl biodegradation assays, performed with reservoir samples, supported the laboratory evaluation. This study demonstrated the utility of the Tenax-GC extraction technique for phenanthrene analysis in biodegradation assessment. However, Tenax-GC extraction was not appropriate for Aroclor-1254 biodegradation studies. (Baker-FRC)
W82-01235

INORGANICS,

Pope Scientific, Inc., Menomonee Falls, WI.
D. S. Polcyn.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 620-649, June, 1981. 1 Tab, 1004 Ref.

Descriptors: *Water analysis, *Pollutant identification, *Reviews, Chromatography, Spectroscopy, Potentiometers, Neutron activation analysis, Sample preparation, Heavy metals, Trace elements, Speciation.

This review of 1004 recent papers on analytical methods for inorganic constituents of water samples is basically an index to the references. It is divided into types of methods (gas and ion chromatography, voltammetric methods and their subdivisions, potentiometric methods, pH analysis, selective ion electrodes, atomic absorption spectroscopy and its subdivisions, inductively coupled plasma emission spectroscopy, atomic emission spectroscopy, ultraviolet and visible spectroscopy, fluorescence and chemiluminescence, X-ray flourescence and emission, neutron activation analysis), and analyses for specific constituents such as individual elements, oxygen demand, cyanide, and asbestos. The author also discusses new analytical chemistry books, sampling and sample storage, sample purification and concentration, heavy metal analysis, trace level analysis, instrumentation, speciation, and mass spectrometry. (Cassar-FRC)
W82-01238

ORGANICS,

Washington Univ., Seattle.
F. B. DeWalle, D. Norman, J. Sung, E. S. K. Chian, and M. Giabbai.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 659-674, June, 1981. 8 Tab, 165 Ref.

Descriptors: *Water analysis, *Organic compounds, Detergents, Pesticides, Industrial effluents, Monitoring, Water quality, Pollutant identification, Measuring instruments, Surfactants, Chemical analysis, Reviews, Biochemical oxygen demand, Chemical oxygen demand, *Total organic carbon, Streams.

The biochemical oxygen demand, chemical oxygen demand, and total organic carbon of various industrial wastes were compiled and analyzed using computers. The concentration of TOC (total organic carbon) in a flowing stream was estimated from the time of sampling. Several studies used direct extraction or preconcentration on a resin column to remove detergents from the water phase, followed by high pressure liquid chromatography or gas chromatographic separation and mass spectrometric identification. Analytical methods were also developed to determine hydrocarbons. The use of advanced analytical techniques for determination of pesticides, chlorinated hydrocarbons, and related compounds generally involves capillary GC columns using liquid phases such as OV-101, SE-54 or Carbowax 20 M. Single or multiple stage cleanup was generally required to separate the pesticides from the background organics. Preconcentration was required when the organics were present at low concentrations. Naturally occurring organics were also analyzed in water. Due to their polar nature, derivatization prior to GC was generally required. The most commonly used method was HPLC, with or without derivatization. UV, fluorescence or electrochemical detectors were employed. Low molecular weight compounds were concentrated through steam extrac-

tion or purging of the liquid phase. Numerous compounds such as the priority pollutants have been found in wastewaters, leachate or wastewater effluents. Aerobic and anaerobic degradation was observed for several compounds, whereas adsorption onto solids generally paralleled the octanol/water partition coefficients. Unit processes that were effective in removing the chemicals included activated carbon, wet oxidation, and UV/peroxide. (Baker-FRC)
W82-01239

CONTINUOUS MONITORING, AUTOMATED ANALYSIS, AND SAMPLING PROCEDURES,

Oak Ridge National Lab., TN.
W. W. Pitt Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 675-678, June, 1981. 63 Ref.

Descriptors: *Water analysis, Reviews, *Water quality, Water monitoring, *Monitoring, Wastewater analysis, Computers, *Sampling, Sample preservation, Sample preparation, Biological oxygen demand, *Wastewater analysis.

Recent research advances in the area of monitoring, analysis and sampling for water quality are cited in this review article. Much work has been done on of monitoring strategies and sampling protocols. The need for a well documented quality control system in wastewater monitoring has been recognized and is described; assistance is available from the EPA for establishing such a system. Sampling of effluents from the pulp and paper industry as well as analysis for priority pollutants has received attention. Continuous monitoring systems have been developed, including on-line monitoring and monitoring of receiving waters. An automated system for near-real-time water quality monitoring is undergoing field testing at an experimental wastewater reclamation facility. A computer-automated system for total organic carbon has been installed at two US EPA laboratories in Cincinnati. Biological monitoring systems have included work on a new concept of biological monitoring of industrial effluents using bluegill sunfish as sensors and a small on-line computer to follow the ventilatory rates of fish. Immobilized enzymes and living microorganisms have been used in sensors for wastewater monitoring. Automated analyses continue to be increasingly important in monitoring water quality, as is reflected in several literature reviews. An automated method for the direct determination of microgram levels of organic carbon in potable waters has been developed. Sampling procedures suitable for use with automatic analyzers have been developed and are discussed in relation to the type of samples required, sample storage, and reproducibility of results obtained. New methods of sample preservation have also been developed. (Baker-FRC)
W82-01240

BIOASSAYS - PROCEDURES AND RESULTS,

Ecological Analysts, Inc., Sparks, MD.
A. F. Maciorowski, J. L. Sims, L. W. Little, and E. D. Gerrard.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 974-993, June, 1981. 363 Ref.

Descriptors: *Bioassay, *Toxins, *Reviews, Literature reviews, Bioindicators, Fish, Toxicity, *Ecological effects, Monitoring, Environmental protection, Water quality, Planning, Algae, Invertebrates, Symposium, Conferences.

Various workshops and symposia have been held to deal with the suitability of laboratory methods for predicting ecosystem effects and the future of toxicology as a predictive science. Toxicity testing has proved valuable in the prediction of the environmental impact of chemicals. Regulatory aspects of biological criteria and monitoring have been investigated with special reference to the NPDES permit program. Aquatic research programs conducted and managed by the EPA were outlined, and research dealing with sublethal effects of pollutants in the sea and their effects on the physiology of marine organisms is cited. A compilation was recently published dealing with technical papers on water quality criteria for European freshwater fish. Detailed toxicity test procedures and techniques were provided for finely divided solids, pH, temperature, ammonia, dissolved oxygen, chlorine, zinc, copper and cadmium. Other tests have indicated that zebra fish provide an excellent screening test for potential toxicity. Current research is also cited which deals with the design, interpretation and strategy of bioassays; the use of bacterial bioassay test methods; assays conducted with algae and other plants; the effects of contaminated sediments on marine benthos; pollution effects on fish and amphibians; comparative testing with aquatic organisms from various trophic levels; the impact of pollution on organisms as studied through microcosms and in situ testing; the use of short term bioassays for mutagenicity and cellular toxicity; and additional studies dealing with health effects assays. (Baker-FRC)
W82-01277

MICROBIOLOGY OF WATER,

Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W82-01284

MICROBIOLOGY: METHODOLOGY AND QUALITY ASSURANCE,

Environmental Protection Agency, Cincinnati, OH.
R. H. Bordner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1098-1107, June, 1981. 120 Ref.

Descriptors: *Microbiological studies, *Quality control, *Literature review, Bibliography, Microorganisms, Bioassays, Water quality.

A literature review is presented of papers published in 1980 on the topic of methodology and quality assurance in microbiology. Research in this area deals with many applications of methodology including sampling, direct test, most probable number, membrane filter, plating, biomass, and identification procedures. Methods to provide more rapid results, to compensate for environment stress, and to screen for toxic materials utilizing bacterial bioassays were emphasized. Rapid method studies included the use of ATP concentrations to show the impact of potential pollutants on aquatic environments, and pyrolysis gas-liquid chromatography for identifying bacteria in sewage treatment effluents. In the area of quality assurance, the adequacy of individual results and accuracy of samples collected for bacteriological analysis of surface waters were evaluated using statistical techniques. The MF technique was evaluated in a polluted beach study, and a standard practice was published for enumerating microorganisms of health and sanitary significance. (Small-FRC)
W82-01285

MICROBIOLOGY: DETECTION, OCCURRENCE, AND REMOVAL OF VIRUSES,

Louisiana State Univ., Baton Rouge.
D. Roy, M. Tittlebaum, and J. Meyer.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1138-1142, June, 1981. 47 Ref.

Descriptors: *Viruses, *Fate of pollutants, *Water treatment, *Pollutant identification, Microbiological studies, Indicators, Shellfish, Adsorption, Wastewater disposal, Reviews.

Most of the new developments in detection and isolation of viruses in water samples use the adsorption-elution technique on filter media. For example, the tentative standard method recovered 0.7-32% of enteroviruses, but four major groups of enterviruses were inactivated by the glycine-NaOH reagent at pH 11.5. Evaluation of three filter media and three cell lines showed fiberglass filters and BGM cell line to be most desirable for virus recovery procedures. Virus survival was the subject of several studies. In general, seawater completely inactivated viruses within 72-96 hours. Other aspects of virus survival reported are the effects of detergents, thermoinactivation in sediments, and effects of rainfall on land applied wastewater sludge. Factors affecting virus persistence in land irrigated with wastewater treatment plant effluent were mixing time, pH, concentration of virus, and isoelectric points of both virus and adsorbent. Virus removal was 98% on a coal and sand filter bed and 99% with an added sedimentation step. In the soil, most adsorption occurred in the top 20 cm; clays were more efficient than sands and organic soils. An improved detection method for low levels of viruses in oysters, clams, and mussels was reported. Bovine parvovirus was suggested as an indicator for viruses. Fecal coliforms and fecal streptococci were not good indicators. (Cassar-FRC)
W82-01290

METAL ION CONCENTRATIONS ASSOCIATED WITH LATE SUMMER SEDIMENTS OF THE OHIO RIVER,

Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
H. T. Spencer, C. A. Leuthart, and R. S. Colyer.
Water Resources Research, Vol 17, No 4, p 959-962, August, 1981. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Metals, *Sediments, *Heavy metals, Fate of pollutants, *Ohio River, Rivers, McAlpine Pool, Pollutant identification, Aquatic life.

The Ohio River, which has been transformed into a series of long flowing lakes by 19 high lift dams for navigation, deposits a fine brown sediment during low flow in late summer. Fine sediment samples collected in McAlpine Pool contained an average of 3% (maximum 4.5%) volatile solids (dry weight). Most of the COD, H, Na, K, Al, Mn, and Pb and a significant amount of C, Cr, Fe, Cu, and Zn were associated with the volatile solids. Only Mg was associated with the nonvolatile solids. Highest concentrations of heavy metals (in micrograms per g) in the 24 samples were as follows: Cr, 87; Mn, 1719; Cu, 30; Zn, 275; Cd, 3.9; and Pb, 67. Analysis of a pooled sediment sample showed 11.0 + or - 0.8 micrograms thorium per g and 1.4 + or - 0.5 micrograms uranium per g. Since the fine sediment collects along the river banks in fish fry feeding areas, the metals contained in the sediment have the potential for entering the food chain. (Cassar-FRC)
W82-01300

PERIPHYTON ANALYSIS FOR THE EVALUATION OF WATER QUALITY IN RUNNING WATERS OF GREECE,

Athens Univ. (Greece) Inst. of Systematic Botany.
A. Economou-Amilli.
Hydrobiologia, Vol 74, No 1, p 39-48, September, 1980. 5 Fig, 2 Tab, 42 Ref.

Descriptors: *Water quality, *Periphyton, *Bioindicators, Streams, Fate of pollutants, Algae, Levadia, *Greece, Diatoms, Springs, Self-purification, Cyanophyta, Species diversity, Saprobity, Water pollution effects.

Periphyton species growing on stones, twigs, and plant life were analyzed according to Kothe's 1962 ecological method of evaluating water quality, combined with Knopp's 1955 and Kadlubowska's 1978 methods of estimating frequency of individuals. The test site was a rapidly running stream, forming cascades, near the sources of springs in Levadia, Greece. Of the 8 sampling stations, 2 were littered by tourists, 1 was marked with large oil spots and tripton, 2 were charged with wastewater influent, and 3 were free of noticeable impurities. Cymbella prostrata (Berkeley) Cleve was established as an obligatory species standard. The indicator species numbers ranged from 26-30 in the three clean sites to 8-13 in the remaining sites. The results are also graphically expressed as the percentage values of the species deficit. There was a remarkable absence of decomposers, showing the lack of heavy pollution even at the sites receiving effluent, probably a result of the turbulence and high oxygen content of the stream. (Cassar-FRC)
W82-01358

FAECAL POLLUTION OF BELGIAN COASTAL WATER,

Institut d'Hygiene et d'Epidemiologie, Brussels (Belgium).
M. Yde, and S. De Maeyer-Cleempoel.
Marine Pollution Bulletin, Vol 11, No 4, p 108-110, April, 1980. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Coastal waters, *Pollutant identification, *Belgium, *Feces, *Coliforms, Streptococcus, Bacteria, Indicators, Municipal wastewater, Agricultural runoff, Wastewater.

There is a high risk of pollution from domestic and agricultural sewage along the Belgian coast due to discharges from one river, three channels, and five urban sewage outfalls along the 60 kilometer stretch. Coliforms, fecal coliforms, and fecal streptococci were selected as indicators of fecal pollution in the Belgian coastal waters. The density of these organisms was highest on the coastline and decreased with increasing distance from the shore. Significant numbers of the indicator bacteria were found at 5 kilometers from the coastline. The densities of the organisms were similar in surface and deep-sea samples. Fecal bacteria densities appear to be moderated by warm climatological conditions. These results indicate that the Belgian coastal waters are not seriously fecally polluted. None of the samples taken 0.5 kilometers off shore exceeded swimming water standards set by the European Economic Community, and less than 15 percent exceeded standards for coliforms or fecal coliforms. (Carroll-FRC)
W82-01373

ATOMIC ABSORPTION SPECTROPHOTOMETRIC STUDIES OF CADMIUM AND ZINC IN COMMERCIAL FERTILISERS, SOILS AND RIVER WATERS,

Aligarh Muslim Univ. (India). Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W82-01388

RAPID METHODS OF CHEMICAL ANALYSIS USED IN EMERGENCY RESPONSE MOBILE LABORATORY ACTIVITIES,

Municipal Environmental Research Lab., Edison, NJ.
M. Gruenfeld, U. Frank, and D. P. Remeta.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 165-172, 4 Fig, 2 Tab, 33 Ref.

Descriptors: *Chemical anaysis, *Hazardous materials, *Pollutants, *Gas chromatography, *Infrared spectroscopy, *Fluorescence spectroscopy, Sediments, Water analysis, Quantitative analysis, Quality control, Sample preparation, Soil contamination, Oils, Pollutant identification.

The EPA's Oil and Hazardous Materials Spills Branch (OHMSB) maintains two analytical laboratory facilities: an in-house laboratory and a mobile laboratory. The mobile laboratory provides a prompt on-site chemical analysis facility to support cleanup activities in emergency situations. The in-house laboratory has developed the rapid, direct analytical methods used in the confined space of the mobile laboratory. Gas chromatography using flame ionization detectors and electron capture detectors can be used for quantitative determination of priority pollutants in water, sediments, soils, and abandoned storage tanks and drums. Synchronous exicitation fluorescence spectroscopy has been automated and is used in the quantitative determination of hazardous materials and petroleum oils in water and wet sediments. Infrared spectroscopy is used to identify and quantify petroleum oils following rapid extraction from water and sediments. These methods were used at emergencies at nine sites and supported decisions on response and cleanup. A specialized analysis and safety protocol was developed which eliminates time consuming solvent extraction and concentration procedures. A rapid, simple technique for artificially weathering petroleum oil and a procedure for removing elemental sulfur from sediments are in use. A comprehensive quality assurance/quality control protocol has been implemented to ensure the acquisition and dissemination of high quality data. (Brambley-SRC)
W82-01431

LABORATORY PROCEDURE FOR ESTIMATING RESIDUE DYNAMICS OF XENOBIOTIC CONTAMINANTS IN A FRESHWATER FOOD CHAIN,

Columbia National Fisheries Research Lab., MD.
For primary bibliographic entry see Field 5B.
W82-01443

PRELIMINARY REPORT OF STREAM SAMPLING FOR ACIDIFICATION STUDIES 1980,

New York State Dept. of Environmental Conservation, Albany.
J. R. Colquhoun, J. Symula, M. Pfeiffer, and J. Feurer.
Technical Report No 81-2, September, 1981. 36 p, 14 Fig, 1 Tab, 14 Ref, 2 Append.

Descriptors: *Acid streams, *Fish populations, *Acidic water, *Hydrogen ion concentration, Fisheries, Stream fisheries, Fish stocking, Annual runoff, On-site data collections, *Fish toxins, Fish management, Fish conservation, Adirondack streams, Lakes, Catskills, *New York.

Fish resources in the Adirondack lakes in New York provide a unique opportunity for readily accessible fishing for native and stock salmonids. Loss of this opportunity due to acidification would have serious recreational, economic, and ecosystemic consequences. Depending on the duration and extent of pH depression, fish reproduction may be inhibited, young fish may be killed, or lethal conditions for adult fish may result. During the spring snowmelt runoff, stream pH is inversely related to discharge, with the effect most severe in areas with thin soil on non-calcareous bedrock. Results of a spring 1980 study indicate that some Adirondack streams were affected by depressions of pH and alkalinity. Other streams remained acidified throughout most of the summer, while a large number of streams never reached pH levels potentially lethal to fish (below 5.0) during 1980. None of the sampled streams in the Catskills reached critical pH levels during the survey period; however, snowfall during the 1979-80 winter was abnormally low. Indices of fish populations in Adirondack streams were found to be statistically correlated with spring 1980 pH measurements. These measurements then serve as indications of past effect. Approximately 15 percent of the streams were in a 'critical' classification (a mean equilibrium meter pH reading below 5.0), but this percentage is biased by the selection of streams. It was felt that a larger proportion of all Adirondack streams was probably affected by low pH conditions in 1980, and there would be an even higher proportion after a normal winter. (Garrison-Omniplan)
W82-01453

MERCURY IN THE MUSCLE TISSUE OF FISH FROM THREE NORTHERN MAINE LAKES,

Maine Univ. at Orono; and Columbia National Fisheries Research Lab.
For primary bibliographic entry see Field 5B.
W82-01459

THE APPLICATION OF MUTAGENICITY TESTING TO DRINKING WATER,

Water Research Centre, Stevenage (England).
R. Forster, and I. Wilson.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 259-274, May, 1981. 3 Fig, 7 Tab, 46 Ref.

Descriptors: *Mutagens, *Drinking water, *Water analysis, Pollutant identification, Bacteria, Salmonella, Carcinogens, Raw water, Treated water, England.

Twenty-one unconcentrated samples from English raw and treated waters were examined for mutagenic properties using Salmonella tester strains. A chlorinated sewage effluent, which contained histidine, and one treated lowland water produced repeated positive results. Concentration procedures were also evaluated. Partial freeze drying concentrated the organic material most efficiently, having a mean total organic carbon recovery of 101.1% with a concentration rate of 6.3-12 fold. Freeze concentration, which concentrated the sample 6-11 fold, gave a mean total organic carbon recovery of 54.1%. However, samples concentrated by the freezing methods did not produce reliable results in mutagenic testing. A comparison of freeze drying/solvent extraction and XAD-2 resin adsorption/solvent desorption showed that the XAD-2 process was cheaper, less time-consuming, and more selective. High performance liquid chromatography showed promise as a method of fractionating the concentrate to further trace and identify the mutagenic materials. (Cassar-FRC)
W82-01487

RELATIONSHIP OF THE RAW WATER QUALITY TO MUTAGENS DETECTABLE BY THE AMES SALMONELLA/MICROSOME ASSAY IN A DRINKING-WATER SUPPLY,

National Inst. for Water Research, Pretoria (South Africa).
W. O. K. Grabow, P. G. Van Rossum, N. A. Grabow, and R. Denkhaus.
Water Research, Vol 15, No 9, p 1037-1043, September, 1981. 2 Fig, 2 Tab, 33 Ref.

Descriptors: *Mutagens, *Drinking water, *Organic compounds, Pollutant identification, Water quality, Water treatment, Water analysis, Chlorination.

Mutagens detected by the Ames test were related to water quality parameters in the water from the Vaal River, the drinking water supply for Parys, South Africa. The treatment process was conventional: flocculation, sedimentation, sand filtration, and chlorination. Correlations were obtained between mutagenic activity of non-volatile compounds in dichloromethane extracts and volatile halogenated hydrocarbons. Limited correlations were seen between mutagenic activity and total organic carbon contents of raw and treated water. The dry mass of extracts from neither raw nor treated water correlated with these parameters. Mutagenic activity increased in spring, probably because of increased amounts of mutagen precursors washed into the river with the first rains of the season, rising temperature, and increased algal action. With increased flow, mutagenic activity decreased and reached a stable summer level. No activity was detected in raw water, indicating that mutagens in wastewater effluents discharged 40 km upstream had been removed or inactivated. Mutagenic activity in the drinking water was 75-100 induced TA98 revertants per 100 micrograms dry extract in the absence of 89 liver preparation. Values in this range are reported for other potable water supplies. The mutagens consisted mainly of neutral organic compounds, including polycyclic hydrocarbons. The importance of routine mutagenic activity monitoring was emphasized. (Cassar-FRC)
W82-01493

U.V.-DOC CHARACTERIZATION OF PULP AND PAPER BLEACH EFFLUENTS,

Department of Scientific and Industrial Research, Wellington (New Zealand). Industrial Processing Div.
C. N. S. McLachlan.
Water Research, Vol 15, No 8, p 983-988, August, 1981. 10 Fig, 1 Tab, 17 Ref.

Descriptors: *Pulp wastes, *Organic matter *Ultraviolet radiation, Pulp and paper industry, Industrial wastes, Kraft mills, Wastewater treatment, Design criteria, Chemical analysis, Pollutant identification, Flocculation, Separation techniques.

A method for the characterization of pulp and paper bleach effluents was developed, and the aluminum salt flocculation characteristics of the effluent organic components were examined. Ligninsulphonic acid was used as a model substance, and aluminum salts were used as precipitants. U.V.-DOC and U.V.-pH plots were obtained by sequential precipitation of organic material from both

kraft and sulphite bleach effluents and were used to characterize the organic material in the effluent. The plots also provide useful information on the likely degree of purification to be achieved by different treatment processes. The plots of U.V. absorbance versus DOC produce a straight line and permit the accurate estimation of the non-U.V. absorbing DOC in effluent. Thus, DOC loadings can be estimated when designing effluent treatment systems for the highly colored, not readily biodegradable lignin-derived organic material found in pulp and paper bleach effluents. (Small-FRC)
W82-01495

A NOTE ON THE USE OF MEMBRANE FAECAL COLIFORM MEDIUM FOR ENHANCING RESOLUTION AND ACCURACY WHEN ENUMERATING A SMALL PLAQUING COLIPHAGE,

Western Australia Univ., Nedlands. Dept. of Microbiology.
W. F. Parker.
Journal of Applied Bacteriology, Vol 51, No 1, p 81-84, August, 1981. 2 Fig, 7 Ref.

Descriptors: *Culture media, *Viruses, *Bacteriophage, Agars, *Pollutant identification, Coliforms, Microbiological studies, Water analysis.

The resolution and accuracy of bacteriophage M52 plaque enumeration in water samples were improved by modifying a membrane fecal coliform medium (mFC) according to Geldreich, et al. (1965). The host strain was grown overnight in nutrient broth, the plates flooded with the culture, and excess liquid removed by draining and drying. The drop count technique was used to apply the inocula. After incubation, plaques on mFCA (mFC broth base plus agar) were more clearly resolved and more readily enumerated than plaques grown on Trypticase Soy agar. (Cassar-FRC)
W82-01507

THE ESCHERICHIA COLI CONTENT OF MYTILUS EDULIS FROM ANALYSIS OF WHOLE TISSUE OR DIGESTIVE TRACT,

University Coll. of Swansea (Wales). Dept. of Botany and Microbiology.
M. M. Al-Jebouri, and D. R. Trollope.
Journal of Applied Bacteriology, Vol 51, No 1, p 135-142, August, 1981. 3 Tab, 16 Ref.

Descriptors: *Mussels, *Mytilus, *Escherichia coli, *Shellfish, Estuarine fisheries, Microbiological studies, *Bacteria, Sewage bacteria, *Pollutant identification, Water pollution effects.

Sensitivity of bacterial counts in shellfish can be improved by using the digestive tracts, rather than whole tissue, for enumeration. Digestive systems of Mytilus edulis contained 3-6 times the number of E. coli as did whole tissue samples from the same waters. Average mean counts in mussels from Mumbles, Swansea, were: total tissue, 136-183; and digestive tract, 401-572. At Oxwich, Gower, counts were: total tissue, 6-7; and digestive tract, 24-40. Three enumeration methods were used: the 1 x 4 ml plate technique, the 4 x 1 ml pour plate technique, and the 2 x 0.2 ml spread plate technique. The 2 x 0.2 ml spread plate method and the 4 x 1 ml method performed equally well for samples from grossly polluted water, but in samples from cleaner water the 2 x 0.2 ml spread plates failed to detect E. coli in 13 batches where bacteria were detected by other methods. The 4 x 1 ml pour plate method gave no false negatives and gave consistently higher counts than the 1 x 4 ml plate technique. Digestive tract inoculum also produced better results than whole tissue samples in the semiquantitative Percentage Clean method when applied to the cleaner samples. Examination of digestive tracts designated 8 of 10 batches unsatisfactory for consumption; examination of the whole tissue, 2 of 10 batches unsatisfactory, and 6 suspicious. There were no differences in results obtained on grossly polluted samples. (Cassar-FRC)
W82-01508

DETERMINATION OF NANOGRAM QUANTITIES OF MERCURY IN WATER WITH A GOLD-PLATED PIEZOELECTRIC CRYSTAL DETECTOR,

New Orleans Univ., LA. Dept. of Chemistry.
M. H. Ho, G. G. Guilbault, and E. P. Scheide.
Analytics Chimica Acta, Vol 130, No 1, p 141-147, 1981. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Mercury, *Water analysis, *Pollutant identification, Electrodes, Field tests, On-site investigations.

Mercury in water or biological samples may be determined at the nanogram level (5-100 ng) with a gold-coated piezoelectric crystal, coupled with a direct reduction technique. The method is simple and inexpensive. The detector, free of interferences seen in cold-vapor atomic absorption, is readily portable for field use with batteries. Carrier gas flow rate, configuration of the detector cells, and sample size were critical to sensitivity. Since the detector responds to mass rather than concentration, larger samples increase sensitivity. However, a large sample volume requires a higher flow rate of gas and decreases efficiency of Hg collection on the gold electrode. Of the three configurations tested, the one providing the best contact between gold coating and sample stream is three times more sensitive as another configuration. The detector, with a lifetime of at least 60 cycles, is regenerated by thermal desorption at 170 C in a flow of hot air or nitrogen. (Cassar-FRC)
W82-01509

SOME FACTORS AFFECTING THE DETERMINATION OF PARTICULATE CARBON AND NITROGEN IN RIVER WATER,

Canada Centre for Inland Waters, Burlington (Ontario).
P. H. Whitfield, and J. W. McKinley.
Water Resources Bulletin, Vol 17, No 3, p 381-386, June, 1981. 5 Tab, 4 Ref.

Descriptors: *Sample preservation, *Water sampling, *Nitrogen compounds, *Carbon, Sampling, Rivers, Water analysis, Precision, Particulate matter, Freezing.

Water samples for the determination of particulates nitrogen and carbon should be filtered immediately after collection and the analysis performed as soon as possible. They should not be frozen. Samples collected at 4 rivers in the Vancouver area were subjected to different storage regimes after collection. Samples frozen for 1 week varied from the control by 92-282% in particulate N and 113-338% in particulate C. Samples stored at 5 C varied from the control by 70-139% in particulate N and 87-131% in particulate C. Filtering the samples directly after collection and storing for 1 day (control) or 1 week produced no significant differences between the two groups in most cases. However, for a level or precision greater than 10%, samples should be analyzed immediately. Storage for 1 week at freezing temperatures changed the proportions of the chemical forms of N (nitrate-nitrite, ammonia, dissolved organic N) in 58% of the cases; for storage at 5 C, 42%. (Cassar-FRC)
W82-01532

COMPARISON OF SELECTIVE MEDIA FOR THE ENUMERATION AND IDENTIFICATION OF FECAL STREPTOCOCCI FROM NATURAL SOURCES,

Ontario Ministry of the Environment, Rexdale.
J. E. Pagel, and G. M. Hardy.
Canadian Journal of Microbiology, Vol 26, No 11, p 1320-1327, 1980. 5 Tab, 20 Ref.

Descriptors: *Bacterial analysis, *Streptococcus, *Culture media, *Membrane filters, Agar, *Pollutant identification, Water analysis, Effluents, Wastewater analysis, Filter media, Selective media, Microbiological studies, Bacteria.

The mEnterococcus (mEnt) agar was compared with four other routinely used membrane filtration bacteria selective media and procedures for fecal streptococci recovery on samples of raw sewage, sewage effluent, and combined storm sewer water. Best overall results were obtained with mEnt agar, which gave 92% specificity for enterococci and very good recovery efficiency with low background counts. It was the only media showing appreciable recovery of other fecal streptococci, with 93% of the background colonies being confirmed as fecal streptococci (mostly S. bovis, S. equinus, or S. salivarius). Second in performance was Pfizer selective enterococcus (PSE) agar, with a specificity rate of 96% but lower recovery efficiency and high background counts. The KF agar recovered higher numbers of organisms, but only 81% were fecal streptococci. The Slanetz and Bartley (SB) medium had low specificity. The mE procedure was highly specific but gave low recoveries. A total of 512 colonies was identified from test media. (Cassar-FRC)
W82-01564

AN ESTUARINE AGAR MEDIUM FOR ENUMERATION OF AEROBIC HETEROTROPHIC BACTERIA ASSOCIATED WITH WATER, SEDIMENT, AND SHELLFISH,

Maryland Univ., College Park. Dept. of Microbiology.
R. M. Weiner, D. Hussong, and R. R. Colwell.
Canadian Journal of Microbiology, Vol 26, No 11, p 1366-1369, 1980. 3 Tab, 13 Ref.

Descriptors: *Bacterial analysis, *Agars, *Estuarine environment, Pollutant identification, Bacteria, Aquatic bacteria, Water analysis, Sediment, Oysters, Shellfish, Heterotrophic bacteria, Aerobic bacteria.

An estuarine agar of reduced salt content is recommended for enumerating aerobic, heterotrophic bacteria in samples of water, sediment, and oysters. The final concentration of added salts in the estuarine agar was 9.4% and final pH 7.5, compared with (1) 10.5% and pH 7.2 for estuarine salt water yeast extract agar and (2) no added salts and pH 7.0 for tryptone-glucose-yeast extract agar. Compared with the other agar media, the estuarine agar produced higher bacterial counts and increased taxonomic diversity from all water, sediment, and oyster samples tested. (Cassar-FRC)
W82-01565

EVALUATION OF ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF NITRATE-NITROGEN IN GLACIAL SNOW, FIRN AND ICE,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
B. C. Parker, W. J. Thompson, and E. J. Zeller.
Analyst, Vol 106, No 1265, p 898-901, August, 1981. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Nitrates, *Spectrophotometry, *Firn, Pollutant identification, Water analysis, Glaciers, *Antarctic, Ultraviolet radiation, *Snow, Ice.

The direct ultraviolet spectrophotometric method for determining nitrate-N was applied to samples of South Pole firn core. The correlation coefficient was 0.9818, relative standard deviation 2.2%, and relative error, 3.9% at the 12 microgram per liter nitrate-N level. About 40 determinations per hour are possible. No major interferences were found from calcium chloride, potassium chloride, ammonium chloride, ammonium sulfate, sodium chloride, sodium carbonate, or sodium silicate at levels likely to be found in South Pole snow. High levels of Na could depress the ultraviolet absorbance reading for nitrate-N at 210 nm by 1-2 micrograms. Comparisons with the ultraviolet spectrophotometric-standard addition method and the cadmium reduction-diazotization method produced similar values. However, the cadmium method requires at least twice as much time. Surface snow containing particulates or organic matter cannot be reliably analyzed by this method. (Cassar-FRC)
W82-01572

APPLICATION OF CAPILLARY GAS CHROMATOGRAPHY MASS SPECTROMETRY/COMPUTER TECHNIQUES TO SYNOPTIC SURVEY OF ORGANIC MATERIAL IN BED SEDIMENT,

Geological Survey, Denver, CO.
T. R. Steinheimer, W. E. Pereira, and S. M. Johnson.
Analytica Chimica Acta, Vol 129, p 57-67, August, 1981. 7 Fig, 1 Tab, 20 Ref.

Descriptors: *Organic compounds, *Sediments, Industrial wastes, Monitoring, Water pollution sources, River beds, Streambeds, *Chemical analysis, Gas chromatography.

A synoptic survey is presented so that an overview might be realized of the environmental chemistry active in an area impacted by heavy industrial activity. Organic compounds were sought in a bed sediment sample. Extraction was performed on a Soxhlet apparatus using a freeze-dried sample. The Soxhlet extract was fractionated by silica gel micro-column adsorption chromatography. Separation and identification of the organic compounds was accomplished by capillary gas chromatography/mass spectrometry. Over 50 compounds were identified including saturated hydrocarbons, olefins, aromatic hydrocarbons, alkylated polycyclic aromatic hydrocarbons, and oxygenated compounds such as aldehydes and ketones. These were present as a complex mixture resulting from natural products and pollutants from waste discharges. The deposition and concentration of these materials on the bed sediment was determined by river hydrology and other general river conditions. Many of the pollutants identified are susceptible to bioaccumulation. The redistribution of some of these contaminants into the water column during periods of high flow or other kinds of perturbation argues persuasively for synoptic-survey bed sediment analysis as an indicator of water quality. Additional refinements in the capillary column gas chromatographic portion of the analysis may reveal further organic pollutants of significance to the environment. (Baker-FRC)
W82-01573

PRECONCENTRATION FOR TRACE ELEMENT DETERMINATION IN AQUEOUS SAMPLES,

Denver Univ., CO. Dept. of Chemistry.
D. E. Leyden, and W. Wegscheider.
Analytical Chemistry, Vol 53, No 9, p 1059A-1065A, August, 1981. 55 Ref.

Descriptors: *Sample preparation, *Trace elements, *Separation techniques, Water analysis, Preconcentration, Seawater, Ion exchange, Solvent extraction, Electrodeposition, Evaporation, Adsorption, Chemical precipitation, Reviews, *Pollutant identification.

Methods for preconcentrating trace elements in water are discussed as supplements, rather than alternatives, to modern instrumentation. The simplest method of preconcentrating ions is evaporation from solution. This technique, frequently used with X-ray spectrometry, is not suitable where one ion has a high and variable concentration. Electrodeposition, particularly anodic stripping analysis, has been extremely useful. Few reagents are needed and instrumentation is simple, but deposition is very slow. Electrodeposition from seawater has been more promising than that from freshwater. A widely used preconcentration technique is liquid-liquid extraction using a water-immiscible solvent and an aqueous solution containing a chelating agent. Possible improvements in the extraction technique involve continuous extraction, countercurrent flow, combination with gas-liquid chromatography or ICP-AES, and using an organic phase which readily solidifies upon cooling after extraction. Surface adsorption of metal complexes on activated carbon or C18-bonded silica gel attains concentration factors up to 200. Precipitation in the range of interest is not quantitative but may be useful with coprecipitation agents or carrier ions. Larger concentration factors (about 40,000) are obtained with ion exchange methods. The ion may be eluted for analysis in solution or be analyzed directly on the solid matrix. Many resins are available for this purpose: Chelex 100 is widely used. Ion exchange resins may be used to impregnate paper disks or membranes. Other modifications of ion exchange techniques are foams and gels for one-time use and silylation reactions. Several specialized methods are available for specific ions. (Cassar-FRC)
W82-01574

POLYCHLORINATED BIPHENYLS AND OTHER ORGANIC CHEMICAL RESIDUES IN FISH FROM MAJOR UNITED STATES WATERSHEDS NEAR THE GREAT LAKES, 1978,

Environmental Research Lab.-Duluth, MN.
G. D. Veith, D. W. Kuehl, E. N. Leonard, K. Welch, and G. Pratt.
Pesticides Monitoring Journal, Vol 15, No 1, p 1-8 June, 1981. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Polychlorinated biphenyls, *Fish, *Pesticides, Water pollution sources, Great Lakes, DDT, Chlordane, Environmental effects, Gas chromatography, Halogenated pesticides, Bioindicators.

Exploratory studies of chemicals in fish were performed on specimens obtained from rivers in Minnesota, Wisconsin, Indiana, Michigan, Ohio and New York. Twenty-six composite fish samples were analyzed for polychlorinated biphenyls (PCBs) and related organic chemicals. In all samples, PCB mixtures resembling Aroclor 1254 were found, and 77% of the samples included mixtures resembling Aroclor 1242. DDT was a minor contaminant, while hexachlorobenzene was determined in 65% of the samples. Chlorine and components of technical chlordane were found in 38% of the samples. Pentachloroanisole was found in 15 samples, and heptachloronorbornadiene and hexachloronorbornadiene were found only in the Wabash River. Mirex was found only in Lake Ontario fish. While PCB's were found in all samples, the predominant forms were tetra-, penta-, and hexachlorobiphenyl homologs. PCBs containing two or three chlorine atoms were found in 19 of the 26 samples. Major improvements are needed in GLC/MS screening before an adequate number of samples can be evaluated. (Small-FRC)
W82-01583

CONCENTRATING ORGANICS IN WATER FOR BIOLOGICAL TESTING,

Oak Ridge National Lab., TN.
R. L. Jolley.
Environmental Science and Technology, Vol 15, No 8, p 874-880, August, 1981. 2 Tab, 111 Ref.

Descriptors: *Water analysis, *Organic compounds, Reverse osmosis, Vacuum filtration, Ultrafiltration, Solvents, Organic solvents, Activated carbon, Resins, Chromatography, Precipitation.

Various methods are described for concentration of organics in water, each having its own advantages and disadvantages. The choice of method or combination of methods to be used depends on such factors as the volatility of the organic constituent to be tested, the degree of concentration required, and the biological test system to be used. Concentration methods may be divided into two basic categories, concentration and isolation. Concentration processes remove water and leave the dissolved substances behind. Isolation processes remove the organic substances from the water. Concentration techniques include freeze concentration, lyophilization (or freeze-drying), vacuum distillation or evaporation processes, reverse osmosis, and ultrafiltration. Isolation techniques include solvent extraction, use of activated carbon, carbonaceous adsorbents, XAD resins, open-pore polyurethane, ion-exchange chromatography, precipitation, centrifugation, and gas stripping. Combination procedures are often used, to achieve as high a recovery of organics as is possible. Reverse osmosis has been combined with Donnan dialysis, solvent extraction and disorption on XAD-2 resin. Silica gel, cation-exchange resin and anion-exchange resin followed by vacuum distillation is another combination. Critical areas include the possible presence of humic materials binding lower molecular weight organic substances, lack of a representative sample, improper sample preservation and improper concentration procedures. (Baker-FRC)
W82-01591

5B. Sources Of Pollution

MASS TRANSPORT OF SOLUTES IN DUAL-POROSITY MEDIA,

Water Research Centre, Marlow (England).
R. Bibby.
Water Resources Research, Vol 17, No 4, p 1075-1081, August, 1981. 7 Fig, 2 Tab, 18 Ref.

Descriptors: *Solute transport, *Aquifers, *Porous media, Path of pollutants, Fate of pollutants, Chalk aquifer, Model studies, Mathematical models, Diffusion, Groundwater movement.

The mechanism for solute mass transport in aquifers with static water (high porosity but low permeability) is controlled by secondary processes such as molecular diffusion, adsorption, and reaction, rather than by primary processes such as convection and dispersion. An analytical solution for diffusion from a constant concentration boundary has been incorporated into a 2-dimensional mass transport model, which uses the Galerkin method of weighted residuals and isoparametric finite elements to solve the flow and transport equations. The method is used to simulate pollutant movement in the Chalk aquifer, East Kent, England, specifically the discharge of saline water (318,000 tons of chloride) from collieries into the aquifer from 1926 to 1974. The model indicates that 13% of the total mass of chloride had been discharged from the aquifer by 1978, and by 2008, 68.6% will have been discharged. An unusually large number of parameters are required to calibrate this model because the transport of solutes is so slow that field tests or tracer studies are impractical. Calibration is very difficult (especially the determination of dispersivities) unless a large amount of historical data is available on a large-scale pollution event. (Cassar-FRC)
W82-01104

FACTORS AFFECTING RADIONUCLIDE AVAILABILITY TO VEGETABLES GROWN AT LOS ALAMOS,

Los Alamoz National Lab., NM.
G. C. White, T. E. Hakonson, and A. J. Ahlquist.
Journal of Environmental Quality, Vol 10, No 3, p 294-299, July/September, 1981. 10 Tab, 18 Ref.

Descriptors: *Plutonium radioisotopes, *Vegetable crops, *Land disposal, Plutonium, Radioisotopes, Cesium, Beans, Squash, *Radioactive waste disposal, Soil contamination, Fertilizers, Path of pollutants.

There is a need for information on transuranic element transfer into human food chains. A field study was conducted to investigate the availability of plutonium-238, plutonium-239, and cesium-137 to zucchini squash and to green bush beans grown under home garden conditions in an area of the Los Alamos National Laboratory used for the disposal of treated radioactive liquid wastes. The effects of tissue type, height above soil, fertilization regime, and food cleansing procedures (for squash) on radionuclide concentrations were analyzed using analysis of variance procedures. Ratios of the concentration of a radionuclide in oven-dried vegetables to dry soil ranged from 0.0004 to 0.116 for the plutonium isotopes and from 0.051 to 0.255 for cesium-137. The plutonium concentration ratios were reduced by 30 percent when the fields were fertilized with steer manure, while cesium-137 concentration ratios were reduced by about 50 percent. The reduction due to fertilization was attributed to a stabilization of the soil surface and to increased potassium concentrations (the latter for Cesium-137 only). The finding that vegetative parts within 20 centimeters of the ground surface were about four times as heavily contaminated as plant parts growing further from the surface indicates that a major source of contamination in these plants was soil on the plant surfaces. Washing of the zucchini plants resulted in removal of about 65 percent of the contamination. The 50-year radiation doses to humans consuming these vegetables would be less than 0.05 mrem, and this would be due almost entirely to cesium-137. (Carroll-FRC)
W82-01109

NITRATE REDUCTION IN AN ORGANIC SOIL-WATER SYSTEM,

Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, P. D. Sacco, and D. A. Graetz.
Journal of Environmental Quality, Vol 9, No 2, p 283-288, April-June, 1980. 3 Fig, 5 Tab, 30 Ref.

Descriptors: *Nitrates, *Denitrification, *Agricultural runoff, *Organic soils, *Floodwater, Fate of pollutants, Nitrogen, Drainage, Farm wastes, Kinetics, Drainage water, Temperature, Soil columns, Nutrient removal, Water pollution control, Water quality control, Oxygen demand, Infiltration.

The ability of flooded organic soil to counteract the effects of soil denitrification by flood water removal of nitrate-N was examined in three laboratory experiments. Nitrate-N reduction rates in agricultural drainage water and in an underlying organic soil column were studied at nitrate-N levels of 10, 25 and 50 micrograms/ml. Energy source and temperature were varied and labeled nitrate-N was used to distinguish between denitrification and reduction to ammonium-N or organic N. Nitrate-N reduction rates at 28 degrees with no excess flood water and flood water nitrate-N removal rates were both described by first order kinetics. In soil columns treated with high oxygen-demand flood water, most of the nitrate-N disappeared before reaching the underlying soil column with rate constants that increased with temperature. At lower temperatures, more of the flood water nitrate-N diffused deeper into the soil column. These findings show that flooded organic soils may serve as a sink for reducing the nitrate-N levels of agricultural drainage waters and should be considered for use in pollution abatement programs. (Geiger-FRC)
W82-01129

A STUDY OF A METHOD FOR DISPLACING SOIL SOLUTION BY CENTRIFUGING WITH AN IMMISCIBLE LIQUID,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
B. R. Whelan, and N. J. Barrow.
Journal of Environmental Quality, Vol 9, No 2, p 315-319, April-June, 1980. 6 Fig, 4 Tab, 12 Ref.

Descriptors: *Path of pollutants, *Soil solution, *Organic solvents, *Separation techniques, Phosphates, Soil filters, Dispersants, Soil dispersants, Water pollution, Membrane filters, Suspended solids, Soil water, Septic tanks, Septic waste water.

The composition of soil solutions in the study of pollutant movements through soils is of interest because the soil is usually the moving phase. A technique using tetrachloroethylene as displacing liquid for soil solutions is described and compared to both 1,1,1-trichloroethylene and carbon tetrachloride systems. After centrifuging a soil solution with tetrachloroethylene at 170,000 m/sec for 30 min, the solution collects at the top of this dense organic liquid and may be separated by pouring through phase-separating paper. After suspended matter is removed by membrane filtration, the solution may be analyzed. The use of tetrachloroethylene as displacent was considered safer than carbon tetrachloride and did not interfere with subsequent tests for nitrate, as did 1,1,1-trichloroethylene. The present method was recommended for investigations on the movement of water-soluble pollutants through soil and was utilized to study phosphate movement below the discharge from a septic tank. (Geiger-FRC)
W82-01131

THE MOVEMENT OF SALTS FROM SOILS FOLLOWING HEAVY APPLICATION OF FEEDLOT WASTES,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. Amoozegar-Fard, W. H. Fuller, and A. W. Warrick.
Journal of Environmental Quality, Vol 9, No 2, p 269-273, April-June, 1980. 5 Tab, 16 Ref.

Descriptors: *Salts, *Manure, *Farm wastes, *Fate of pollutants, Trace elements, Heavy metals, Model studies, Soil water, Soil filters, *Fertilizers, Leachates, Leaching, Magnesium, Minerals, Calcium, Potassium, Chlorides, Sodium.

The movement of salts from soils following heavy application of feedlot manure as fertilizers was studied in relation to water management and the aggregate size of the manure. Air-dried manure was formed into three different sizes, mixed with a sandy loam soil and loaded into a plastic cylinder (15 cm diameter) packed with 10 cm of soil. This model system simulated an application rate of 100 metric tons/ha. Deionized water was passed continually or intermittently through the column, and leachates were collected in one-half of a pore volume increments for the determination of electrical conductivity (EC), pH and other factors. Initial EC's of effluent were up to 8-10 mmho/cm, sufficient to affect growth of most field crops. Heavy irrigation could be applied before planting salt-sensitive crops. The movement of sodium and potassium replaced calcium and magnesium on the soil exchange sites; consequently their movement was delayed, and the rate of irrigation water infiltration was reduced. Chloride movement resembled that of leaching manure alone, while movement of trace elements from the system was insignificant. (Geiger-FRC)
W82-01132

TRANSPORTS IN THE DULUTH-SUPERIOR HARBOR,

Minnesota Univ.-Duluth. Dept. of Physics.
K. R. Stortz, and M. Sydor.
Journal of Great Lakes Research, Vol 6, No 3, p 223-231, 1980. 12 Fig, 3 Tab, 14 Ref.

Descriptors: *Sediment transport, *Ships, *Water quality, *Path of pollutants, Water circulation, Lakes, Suspended sediments, Model studies, Hydrodynamics, Solute transport, *Harbors, *Lake Superior, *Duluth, Minnesota, Seiches.

A hydrodynamic model and a water quality model were developed for simulating the transport of particulates and dissolved material in the Duluth-Superior harbor. An average concentration of 10-15 mg per liter suspended solids was observed in the wake of moving ships. It was estimated that 100,000 kg of sediment is resuspended per passage of a ship. The model predicts that 0.1% of this resuspended material flows into Lake Superior, while the remainder settles to the edges of the shipping channels. At the rate of 1000 large ships visiting the harbor annually, the total amount of resuspended material entering the lake from the harbor is about 100 metric tons per year. Simulation of 200 kg of dissolved pollutant added to the water at the coal dock over an 8 hour period shows that peak concentrations (0.05-0.1% of the initial concentration at the spill site) would reach the Duluth entry in 5-8 days and the Superior entry in 9-17 days, depending on seiche amplitude. The residence time of the contaminant in the harbor is on the order of 30-40 days. (Cassar-FRC)
W82-01136

A CLASSIFICATION AND DESCRIPTION OF SOME NORTHEASTERN ONTARIO LAKES INFLUENCED BY ACID PRECIPITATION,

Laurentian Univ., Sudbury (Ontario). Dept. of Geography.
J. R. Pitblado, W. Keller, and N. I. Conroy.
Journal of Great Lakes Research, Vol 6, No 3, p 247-257, 1980. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Lake classification, *Acid rain, *Air pollution, Sudbury, *Ontario, Water pollution sources, Path of pollutants, Water quality, Nutrients, Urban runoff, Eutrophication, Metals, Smelting industry, Buffering capacity.

Statistical analysis of water chemistry data (23 variables for 187 lakes in the Sudbury, Ontario, area) showed that most of the chemical variability was attributable to 4 components: nutrient status, buffering status, atmospheric deposition status, and sodium chloride status. Seven distinct groups of lakes were obvious. Group 1 lakes, scattered throughout the study area, were high in nutrients and chlorophyll, reflecting cultural eutrophication. Groups 2 and 3, characteristic, dilute lakes of the Precambrian Shield, had an inverse relationship to the atmospheric deposition status and buffering status dimensions, and were low in smelter-produced ions. They differed in nutrient and chlorophyll a status, Group 2 having the higher values. Groups 4, 5, and 6 reflected the impact of airborne pollutants from smelting operations in Sudbury. Group 5 lakes, closest to the smelters, had high acidity, low buffering capcity, and high concentrations of smelter-related metals. Group 6 lakes showed a lesser impact, and Group 4, limited impact, being more buffered and productive. Group 7, a group of anomalous lakes sharing high pH and high ionic strength, were influenced by limestone bedrock or surficial material as well as urban runoff. (Cassar-FRC)
W82-01145

NONPOINT N RUNOFF FROM AGRICULTURAL WATERSHEDS INTO THE GREAT LAKES,

Department of Agriculture, Summerland (British Columbia).
G. H. Neilsen, J. L. Culley, and D. R. Cameron.
Journal of Great Lakes Research, Vol 6, No 3, p 195-202, 1980. 1 Fig, 6 Tab, 28 Ref.

Descriptors: *Agricultural watersheds, Runoff, *Nitrogen compounds, Path of pollutants, Fertilizers, *Agricultural runoff, Watersheds, Ontario, Nitrates, Ammonium, *Inflow, *Great Lakes, Water pollution control, Nutrients, Soil conservation, Nonpoint pollution sources.

Runoff nitrogen and discharge were continuously monitored in 11 agricultural watersheds in southern Ontario during 1975-1977 as part of the International Joint Commission's Pollution from Land Use Activities Reference Group project. The predominant chemical form of N runoff was nitrate-N (flow weighted concentration means, 0.57-5.62 mg per liter), followed by total Kjeldahl nitrogen (TKN) (0.64-2.37 mg per liter) and average soluble ammonium-N (0.03-0.60 mg per liter). Elevated stream dissolved N concentrations were seen in watersheds with increased areas of row crops, especially corn, extensive tile drainage, and high unit area fertilizer N additions. Elevated TKN occurred in watersheds with extensive impermeable soils, high suspended sediment concentrations, and increased surface runoff. Stream nitrate-N loadings ranged from 2.1 + or - 0.2 to 39.0 + or - 7.6 kg per watershed ha. Some watersheds with intense agricultural activity lost up to 30 kg nitrate-N per ha. Watersheds with extensive woodlot, hay, and pasture gained more nitrate-N from precipitation than was lost in runoff. The most important consideration for reducing soluble N runoff in the agricultural areas under study is efficient management of N fertilizers on the extensive areas of tile-drained corn in the lower Great Lakes basin. Total N runoff could be reduced by a fourth or a third using standard erosion control techniques such as grassed waterways and contour planting. (Cassar-FRC)
W82-01148

MERCURY AND ZINC IN THE SEDIMENTS OF SENECA LAKE, SENECA RIVER, AND KEUKA OUTLET, NEW YORK,

Hobart and William Smith Colleges, Geneva, NY.
T. R. Blackburn, J. C. Cornell, and T. R. Fogg.
Journal of Great Lakes Research, Vol 6, No 1, p 68-75, 1980. 9 Fig, 1 Tab, 10 Ref.

Descriptors: *Mercury, *Zinc, *Lake sediments, Sediments, Heavy metals, Metals, Water pollution sources, Path of pollutants, *Seneca Lake, *New York.

Sediments from Seneca Lake, New York, its principal tributary, and its outlfow were sampled from June 1974 to October 1975. Patterns of Hg and Zn concentrations indicated several probable sources of pollution: municipal sewage outfalls, abandoned industrial plants, and a coal-fired power plant. The total Hg content of the upper 2 cm of lake sediments was estimated at 139 kg Hg using an interpolation technique based on the relationship of heavy

metal content to overlying water depth and the increment of Hg above an assumed unperturbed distribution. Sediment Hg concentrations in the Seneca River were 30-480 micrograms per kg; in two heavily polluted lake sites, up to 3000 and 5500 micrograms per kg, respectively; and as high as 1302 micrograms per kg in Keuka Outlet. Zn levels were 59-157 mg per kg in the lake and up to 633 mg per kg in the outlet. Distribution of Zn paralleled that of Hg. The ratio of Zn to Hg was relatively constant at about 650. (Cassar-FRC)
W82-01151

NUTRIENT LOADING OF SOUTHERN LAKE MICHIGAN BY DRY DEPOSITION OF ATMOSPHERIC AEROSOL,

Governors State Univ., Park Forest South, IL. Coll of Environmental and Applied Sciences.
D. A. Dolske, and H. Sievering.
Journal of Great Lakes Research, Vol 6, No 3, p 184-194, 1980. 3 Fig, 6 Tab, 37 Ref.

Descriptors: *Nutrients, *Aerosols, *Air pollution, Water pollution sources, Path of pollutants, Phosphorus, Nitrogen, Nitrates, *Lake Michigan, Lakes.

Dry deposition accounted for 15% or more of all atmospheric nutrient inputs ot total phosphorus and nitrate-nitrite nitrogen and for 3% of total aerosol mass over southern Lake Michigan. High-volume samplers with cellulose fiber filters were used to collect 42 aerosol samples aboard the USEPA's R/V Roger R. Simons at 87 degrees 0 min west and 42 degrees 0 min north during May to September 1977. Micrometeorological data was documented simultaneously. Aerosol deposition velocity was estimated at 0.65 cm per sec using a diabatic drag coefficient method. Dry decomposition loading for this area of the lake was 150,000-180,000 kg per year for P and 3.5 million to 5.1 million kg per year for N. The aerosol P and N was strongly associated with fine particles, less than 1.0 micrometers in diameter. Nutrients deposited in this form are immediately available to the photosynthetically-active regions: overlake, west shore (Milwaukee), Chicago/Gary, Michigan City, and east shore. (Cassar-FRC)
W82-01152

PCB RESIDUES IN BOTTOM SEDIMENTS COLLECTED FROM THE BAY OF QUINTE, LAKE ONTARIO 1972-1973,

Ontario Ministry of Agriculture and Food, Guelph (Ontario). Pesticide Residue Lab.
R. Frank, R. L. Thomas, M. V. H. Holdrinet, and V. Damiani.
Journal of Great Lakes Research, Vol 6, No 4, p 371-376, 1980. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Polychlorinated biphenyls, *Lake sediments, Organic compounds, Sampling, Chlorinated hydrocarbons, Sediments, Lake basins, Path of pollutants, Pollutant identification, *Lake Ontario, Bay of Quinte, Water pollution sources.

Surface sediments from 214 locations on a 1 km grid were collected in 1972-1973 from the Bay of Quinte, Lake Ontario, and analyzed for polychlorinated biphenyls (PCB) levels. Mean concentration in sediment for the whole lake was 48 plus or minus 43 ng per g (range, < 2-260). Comparing the mean residue in depositional basins (50 ng per g, range < 2-200) and non-depositional zones (47 ng per g, range < 2-260) showed little difference. The six basins studied varied in mean PCB levels from 33 ng per g in Adolphous to 74 ng per g in Trenton. The high concentrations of PCB near the Trent River and the Moira River implicated these rivers as major sources of PCB to the bay. (Cassar-FRC)
W82-01155

TOXICITY AND BIOACCUMULATION OF ENDRIN AND METHOXYCHLOR IN AQUATIC INVERTEBRATES AND FISH,

Environmental Protection Agency, Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-01160

BIOGEOCHEMICAL INVESTIGATION OF BIG CREEK MARSH, LAKE ERIE, ONTARIO,

National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2H.
W82-01163

STUDIES ON UNSATURATED ZONE HYDROLOGY AND RADIONUCLIDE MIGRATION AT A SHALLOW-LAND BURIAL SITE,

California Univ., Berkeley, Dept. of Plant and Soil Biology.
R. K. Schulz, E. B. Fowler, E. H. Essington, and W. L. Polzer.
Soil Science, Vol 132, No 1, p 99-103, July, 1981. 3 Fig, 4 Tab.

Descriptors: *Radioactive waste disposal, *Infiltration, *Tritium, Hazards, Radioactive wastes, Water pollution sources, Runoff, Evapotranspiration, Crop production, Hydrology, Maxey Flats, *Kentucky.

Results of an ongoing field study to determine the migration of radionuclides at a shallow-land burial site at Maxey Flats, Kentucky, are reported. The site was closed due to excessive water entry into the trenches and subsequent migration of the radionuclides. The primary mode of water entry into the trench was by percolation through the trench cap. The movement of 3H through the trench cap was upward from the saturation zone. Tritium moved laterally from the trench, and some movement of 60Co was observed. There was no movement of 137Cs, as it was bound to the soil, and 238Pu moved only a few meters from the trench. The site was a low-level waste burial site, and when it was closed in 1977 it had accumulated about 40% of all the commercially generated low-level radioactive waste in the country. Countermeasures to reduce the present problems at the site could include trench recapping, efforts to increase water runoff from the burial site, and different cropping regimes to increase evapotranspiration. (Small-FRC)
W82-01172

AN ANALYTICAL SOLUTION FOR SOLUTE TRANSPORT THROUGH FRACTURED MEDIA WITH MATRIX DIFFUSION,

National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2F.
W82-01179

PLUME DEVELOPMENT USING LAGRANGIAN MARKER METHOD,

Minnesota Univ.-Duluth. Dept. of Physics.
G. J. Oman, and M. Sydor.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW3, p 131-148, August, 1981. 14 Fig, 21 Ref.

Descriptors: *Plumes, *Mathematical models, *Turbidity currents, Turbidity, *Clays, Runoff, Erosion, *Lake Superior, Wind, Mathematical studies, Water pollution sources, Sediment transport.

The Lagrangian marker method of plume development was used to study the major sources and sinks of red clay turbidity in extreme Western Lake Superior. Simulations of the development of the Nemadji red clay turbidity plume and the long-range transport of runoff water from the Nemadji and St. Louis Rivers were successful. Results were better than those realized by applying mixing and diffusion in finite difference methods. The numerical simulation revealed several things about the transport of pollutants, including the origin of many distinguishable features of the Nemadji red clay. The relative contributions of runoff, resuspension, shore erosion, and runoff from streams could be estimated, and the distribution of contaminated water under different wind conditions was explained. Easterly winds were shown to generate eddy circulations which tend to trap river effluents in the western part of the lake. (Small-FRC)
W82-01182

MONITORING GROUND-WATER CONTAMINATION AT A FLY ASH DISPOSAL SITE USING SURFACE ELECTRICAL RESISTIVITY METHODS,

Wisconsin-Milwaukee Univ. Dept. of Geological Sciences.
R. B. Rogers, and W. F. Kean.
Ground Water, Vol 18, No 5, p 472-478, September-October, 1980. 10 Fig, 11 Ref. OWRT-A-077-WISC(2).

Descriptors: *Fly ash, *Landfills, *Resistivity, Path of pollutants, Leaching, Leachates, Contamination, *Groundwater pollution, Monitoring, Sampling, Electrical properties, Water quality, Waste disposal.

Surface elctrical resistivity measurements effectively located the horizontal and vertical extent of leachate from a fly ash disposal site used by the Wisconsin Electric Power Co. Water samples were collected simultaneously from 33 wells on the landfill site. Laboratory measurements were made on samples from the well borings to determine the changes in resistivity of each lithology as a function of water saturation and the temperature and conductivity of the pore fluid. Profile data were corrected to a common groundwater temperature, compensating for sampling at different seasons of the year. As resistivity decreased, corresponding water samples showed increased contamination. Sampling from March 1978 to May 1979 indicated that the contamination had progressed in a southeasterly direction. This is depicted on a contour map. (Cassar-FRC)
W82-01218

MONITORING LEACHATE IN GROUND WATER BY CORRECTED RESISTIVITY METHODS,

Wisconsin-Milwaukee Univ. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5A.
W82-01219

THE EFFECT OF FLYASH DISPOSAL ON A SHALLOW GROUND-WATER SYSTEM,

Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
D. S. Cherkauer.
Ground Water, Vol 18, No 6, p 544-550, November/December, 1980. 1 Tab, 10 Fig, 6 Ref. OWRT-A-077-WISC(4).

Descriptors: *Groundwater, *Landfills, *Metals, *Contamination, *Fly ash, Waste dumps, Aquifers, Toxicity, Leachates, Infiltration, Percolation, Flow, Surface water, Groundwater recharge, Water level, Drawdown.

At a flyash landfill in Wisconsin, dry ash has been placed in contact with a shallow sand and gravel aquifer. The quality of the ground and surface waters has been monitored on a regular basis for several years following construction. Substantial modification of groundwater quality was noted. Sulfate, calcium, and magnesium concentrations increased. However, after eight years, the contamination has spread less than 200 meters from the site in a permeable aquifer. Toxic metals in the flyash appear immobile in the groundwater. The site is located in alkaline sediment upflow from groundwater discharge in a marsh, which impedes spread of contamination. (Titus-FRC)
W82-01220

RADON-222, IN POTABLE WATER SUPPLIES OF NEW ENGLAND,

Maine Univ. at Orono. Dept. of Physics.
C. T. Hess, S. A. Norton, W. F. Brutsaert, R. E. Casparius, and E. G. Coombs.
Journal of the New England Water Works Association, Vol 94, No 2, p 113-128, June, 1980. 5 Fig, 5 Tab, 15 Ref. OWRT-A-045-ME(3), and B-017-ME(2).

Descriptors: *Potable water, *Carcinogens, *Radon, Public health, *Maine, Pollutant identification, Radioactivity, Diseases, Well water, Granite, New England, Metamorphic rocks, Igneous rocks, Water supply, Path of pollutants, Water pollution effects.

Samples from private and public water supplies in all the counties of Maine were tested for radon-222. Values from northern Aroostock County water were 1000-2000 pCi per liter; southwestern Maine, up to 100,000 pCi per liter; and public utility water, from 22 pCi per liter in a well aerated lake supply to 11,000 pCi in 40 ft deep wells in gravel over granite. Average values (in pCi per liter) found in different types of rock were: granite, 25,000; sillimanite, 12,000; and chlorite, 1,200. Maximum values in well waters were associated with 100-200 ft deep wells, minimum values with shallow wells. Twenty-minute showers in a closed bathroom produced levels of radon in the air as follows: 20 pCi per liter using water of 620 pCi per liter, and 1600 pCi per liter using water of 70,000 pCi per liter. An average reading over 2-3 days was 9-10 pCi per lier in the air. Statistical studies showed that Maine's cancer rates were 122% of the national average. Significant correlations with radon levels were obtained for lung-tracea-bronchus cancer in women, and for lung and reproductive cancer in men. The highest incidences of total and lung cancers were found in counties with the highest calculated radon in water supplies. (Cassar-FRC)
W82-01221

GROUNDWATER CONTAMINATION BY SANITARY LANDFILL LEACHATE AND DOMESTIC WASTEWATER IN CARBONATE TERRAIN: PRINCIPAL SOURCE DIAGNOSIS, CHEMICAL TRANSPORT CHARACTERISTICS AND DESIGN IMPLICATIONS,

Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
J. P. Murray, J. V. Rouse, and A. B. Carpenter.
Water Research, Vol 15, No 6, p 745-757, 1981. 5 Fig, 9 Tab, 41 Ref. OWRT-B-077-MO(5).

Descriptors: *Landifils, *Groundwater pollution, *Tracers, Peth of pollutants, Water pollution sources, *Kohl Spring, Missouri, Hydrogen sulfide, Sulfides, Lithium bromide, Solute transport, Septic tanks, Wastewater disposal, Leachates.

Procedures for identification of groundwater pollution sources are illustrated in an investigation of severe pollution in Kohl Spring, Missouri, 1.5 km north of a sanitary landfill. Lithium bromide tracer studies, N:P ratios, chemical response to rainfall variation, bacterial counts, correspondence of dilution ratios for conservative pollutants, and the short interval between initiation of the landfill and the appearance of pollutants in the spring indicated that the landfill was the principal source of pollution, not nearby domestic septic tanks and domestic wastewater stabilization ponds. Geologic structure and the karst nature of the subsurface also were favorable to transport of contaminants from landfill to spring. Pollution was characterized by large amounts of hydrogen sulfide and suspended black metal sulfides. Fish and intruding fauna were killed upon exposure. Water quality in the spring improved rapidly after landfill operations were terminated. (Cassar-FRC)
W82-01223

PREDICTION OF DIFFUSION COEFFICIENTS FROM THE ELECTRICAL CONDUCTANCE OF SOIL,

Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2G.
W82-01224

A COMBINED SALT TRANSPORT-CHEMICAL EQUILIBRIUM MODEL FOR CALCAREOUS AND CYPSIFEROUS SOILS,

Science and Education Administration, Kimberley, ID. Snake River Research Center.
C. W. Robbins, R. J. Wagenet, and J. J. Jurinak.
Soil Science Society of America Journal, Vol 44, No 6, p 1191-1194, November/December, 1980. 3 Fig, 2 Tab, 21 Ref. OWRT-B-148-UTAH(3), 14-34-0001-7195.

Descriptors: *Salts, *Gypsum, *Model studies, Salinity, Calcium carbonate, Cations, Mathematical studies, Chemical precipitation, Lime, Calcium sulfate, Electrical conductivity, Conductivity, Solutes, Bicarbonates, *Saline soils, Sulfates, Carbonates, Soil chemical properties, Chemical reactions, Soil water movement, *Ion transport.

An existing water movement-salt transport model was interfaced with two subroutines, chemical precipitation-dissolution and cation exchange, to provide a computer program which successfully predicted electrical conductivity, soil adsorption ratio, and concentrations of Ca, Mg, Na, K, Cl, sulfate and bicarbonate. The transport model is also useful in the study of relative plant growth and water uptake as affected by soil moisture and salinity. Three model options were available for testing the predictions of salt transport and storage: individual ion transport without soil interaction, precipitation and dissolution of lime and gypsum during transport, and cation exchange and precipitation-dissolution reactions. It was necessary to use both subroutines to obtain results agreeing with observed measurements for a gypsiferous and a nongypsiferous soil irrigated with high, medium and low CaSO4 content waters at two leaching fractions. (Cassar-FRC)
W82-01230

PHENANTHRENE BIODEGRADATION IN FRESHWATER ENVIRONMENTS,

Tennessee Univ., Knoxville. Dept. of Microbiology.
T. W. Sherrill, and G. S. Sayler.
Applied and Environmental Microbiology, Vol 39, No 1, p 172-178, January, 1980. 3 Fig, 6 Tab, 20 Ref. OWRT-B-040-TENN(1).

Descriptors: *Biodegradation, *Hydrocarbons, Polycyclic aromatic hydrocarbons, Temperature effects, Phenanthrene, *Microbial degradation, Microorganisms, Reservoirs, Comparison studies.

An evaluation was made of the potential for significant polycyclic aromatic hydrocarbon (PAH) degradation by the indigenous microbial populations in freshwater environments. Phenanthrene was incubated with water samples from various reservoir systems in Tennessee. Biodegradation was assessed by comparison of total polycyclic aromatic hydrocarbon substrate recovery in degradation flasks relative to sterile control flasks. During 1977 field studies, the mean phenanthrene biodegradation was about 80% after a four week incubation. Within a given habitat, 45% of the total variability in phenanthrene biodegradation was attributable to the physical, chemical, and microbiological site characteristics examined. Polycyclic aromatic hydrocarbon degradation was directly related to the historical environmental pollution of the sampling sites examined, the length of biodegradation assessment, temperature, and the molecular size of the polycyclic aromatic hydrocarbon substrate. (Baker-FRC)
W82-01234

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,

Syearns and Wheeler, Cazenovia, NY.
P. E. Moffa, S. D. Freedman, E. M. Owens, R. Field, and C. Cibik.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 770-776, June, 1981. 82 Ref.

Descriptors: *Urban runoff, *Storm water, *Combined sewer overflows, Water pollution sources, Runoff, Model studies, Storm runoff, Storm overflow sewers, Wastewater treatment, Water pollution control, Water quality, Sewer systems, Reviews, Detention reservoirs, *Literature review.

A review of recent literature on urban runoff and combined sewer overflow describes the results of storm water sampling, hydrology, impact on receiving waters, control of pollution, treatment of storm water, watershed management, and rainfall-runoff models. The most polluted storm waters resulted from commercial land use; these were as high in BOD, COD, and solids, but lower in N and P, than secondary effluent. Some sources of pollution were leaves, deicing salts, automobile exhausts, and street debris. The first flush after dry weather was studied by several authors. A study of combined sewer overflows showed that some needed no abatement and others required treatment. Most streams receiving untreated storm waters showed decreased water quality. Pollution control methods include trapping first-flush waters for later treatment, storage in underground reservoirs or detention basins, and porous pavements. Treatment methods emphasize source control (drainage, erosion control, street sweeping, sewer flushing, and storage), sedimentation, swirl grit separators, and ultra-high rate filtration. Models for studying watershed management are reported. (Cassar-FRC)
W82-01254

PULP AND PAPER INDUSTRY EFFLUENT MANAGEMENT,

National Council for Air and Stream Improvement, Inc., Medford, MA.
For primary bibliographic entry see Field 5D.
W82-01260

SYNTHETIC FUEL EFFLUENTS,

Argonne National Lab., IL.
M. F. Torpy, and E. L. Stover.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 828-831, June, 1981. 33 Ref.

Descriptors: *Synthetic fuels, *Coal gasification, *Oil shale, Water pollution sources, Effluents, *Path of pollutants, Effluents, Gasification, Wastewater treatment, Leachates, Industrial wastewater, Coal liquefaction.

Wastewaters produced by synthetic fuel manufacture from coal gasification and liquefaction and oil shale processing were reviewed. Ammonia and phenol, acting synergistically, were the wastewater constituents toxic to fish. High concentrations of mutagens were present in sludges from treated wastewater. Several papers concerned analytical methods for these effluents. Activated sludge treatment effectively removed base-fraction organics, but not some aromatics and polynuclear hydrocarbons. Ammonia concentrations had to be reduced by dilution or stripping prior to biological treatment of coal gasification wastewaters. Treated effluent was used as a cooling medium, according to a patent. Leachates from spent oil shale piles appeared to be biostimulatory to Lake Powell algae. Methods for treating oil shale retort water included anaerobic digestion, steam stripping, biological treatment, activated carbon adsorption, percolation through spent shale, and evaporation. A study showed that chronic, long term groundwater pollution would be likely in areas of future in situ oil shale development. (Cassar-FRC)
W82-01263

POWER INDUSTRY WASTES,

Tennessee Valley Authority, Norris.
T-Y. J. Chu, and H. Olem.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 831-843, June, 1981. 1 Tab, 215 Ref.

Descriptors: *Electric power industry, *Thermal pollution, *Cooling water, Regulations, Thermal water, Powerplants, Nuclear wastes, Reviews, Radioactive wastes, Wastewater treatment, Water pollution sources, Aquatic life, Water reuse, Fly ash, Entrainment, Industrial wastewater.

Many papers concerning the impact of the power industry and its wastes on water resources were included in a review of recent literature. Environmental regulations relating to the power industry and water quality are summarized in a table. Retrofitting small dams for hydroelectric power production may affect the environment in several ways: disturbance of fish passage, fluctuations in water level and flow and water quality, and sedimentation from dredging. Trace metals released into the environment from fossil-fuel burning plants were studied in aquatic ecosystems, rivers, and the

marine environment. Fly ash piles and slurry threatened groundwater and surface water supplies. One case of ground water contamination by heavy metals was reported. Thermal discharge was the subject of many papers, including a state-of-the-art manual, effectiveness of cooling ponds and lakes, models for predicting heat transfer and aquatic life losses, and ecological effects. Evaluation of a cooling lake fishery showed no harmful effects from the thermal enrichment. Entrainment of zooplankton, phytoplankton, and fish at the cooling water intake was studied and methods were developed to assess the effects. Brackish groundwater, municipal wastewater effluent, and agricultural wastewater were all considered as sources for cooling water. Many wastewater treatment processes were described. Excess heated water from steam-electric plants was used in several ways: a municipal water supply, wastewater treatment, open field irrigation, aquatic facilities, greenhouses, and drying grain. Most of the other waste heat utilizations were reported as cogeneration applications. (Cassar-FRC)
W82-01265

RADIOACTIVE WASTES,

Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5D.
W82-01268

SOLID WASTES AND WATER QUALITY,

Envirodyne Engineers, Knoxville, TN.
G. R. Brower, and R. Ramkrishnadas.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 896-900, June, 1981. 51 Ref.

Descriptors: *Solid wastes, *Water quality, *Waste disposal, Water pollution sources, Leaching, Monitoring, Fate of pollutants, Regulations, Surface runoff, *Path of pollutants.

The quantity of solid waste, potentially affecting water quality in the United States, estimated at 83.1 million dry metric tons in 1977 and 262.3 million dry metric tons in 1987, has been increased by implementation of environmental legislation such as the Clean Water Act. Contamination or degradation of water supplies has been documented from many sources: septic tank drainfields, rapid infiltration sites, biological treatment wastes discharged into rivers, agricultural and surface runoff, reduced flow from energy development, snow removal dump sites, coal mines, and mercury tailings. Methods of monitoring groundwater and stream pollution from different sources, such as landfills, were reviewed. Treatment and disposal methods and their effects on water quality were described. (Cassar-FRC)
W82-01269

NON-POINT SOURCES,

Browne (F. X.) Associates, Inc., Lansdale, PA.
F. X. Browne.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 901-908, June, 1981. 137 Ref.

Descriptors: *Nonpoint pollution sources, *Literature reviews, Pollution load, Reviews, Nutrients, Runoff, Urban runoff, Sedimentation, Water quality, Watersheds, Model studies, Management planning.

Current research dealing with non-point sources as they affect water pollution treatment is updated in this literature review article. In the area of analysis and characteristics, research has advanced in evaluating the statistical reliability of grab versus composite sampling methods; studies have been conducted of the runoff into undeveloped bays in the Virgin Islands; non-point pollution data were collected on the flat coastal topography of the Maryland eastern slope; and an infiltration-inflow analysis was developed to determine the amount of excess rain and groundwater in a sewer system. Recent studies in the area of water quality effects have included studies of the relationship between precipitation, streamflow and fecal coliform levels in a rural watershed during runoff events; water quality degradation resulting from urban runoff; the spatial and temporal distribution and composition of bacteria in the sediments and overlying waters of the Lynnhaven Estuary in Virginia; and the increasing salinity, turbidity and total hardness of water in the Tigris River resulting from non-point source pollution in Baghdad. Watershed research has emphasized the importance of continued management and monitoring for nonpoint pollution in a developing watershed; the impact of urbanization and recreational development on the hydrologic and nutrient budgets of contrasting watershed systems; and the relationship between geology and vegetation of a watershed as predictors of the nutrient and heavy metal-transporting capacity of its suspended sediment. Research also advanced in the areas of model construction for non-point pollution sources, and in methods for managing these pollution problems. (Baker-FRC)
W82-01270

GROUND WATER,

Geraghty and Miller, Inc., Syosset, NY.
For primary bibliographic entry see Field 2F.
W82-01273

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5C.
W82-01278

AQUATIC SEDIMENTS,

Clarkson Coll. of Technology, Potsdam, NY.
J. V. DePinto, T. C. Young, and S. C. Martin.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 999-1007, June, 1981. 140 Ref.

Descriptors: *Aquatic soils, *Sediments, *Literature review, Sedimentology, Water pollution sources, Bibliographies, Lakes, Aquatic sediments, Sediment transport, *Path of pollutants.

A 1980 literature review is presented on the topic of aquatic sediments which covers the general areas of analytical and sampling methods, heavy metals, nutrients, biological activity, organics, and modeling. Papers referenced include a review of the use of sediment traps by Bloesch and Burns, and a review and comparison of laboratory and in situ techniques for measurement of sediment oxygen demand. Other papers dealt with the importance of sediment material in eutrophication control, and the importance of aquatic sediments as vehicles for the transport of algal nutrients and toxic materials. Sediments in the Great Lakes which originate from land drainage sources are associated with large quantities of phosphorus, industrial organic chemicals, pesticides, and heavy metals. The relationships between sediments and contaminants in aqueous environments were explored in a compilation of papers. (Small-FRC)
W82-01279

MICROBIOLOGY OF WATER,

Environmental Protection Agency, Cincinnati, OH.
E. E. Geldreich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1083-1098, June, 1981. 219 Ref.

Descriptors: *Microbiological studies, *Literature review, *Water quality, Bioindicators, Bacteria, Coliforms, Water pollution effects, Path of pollutants.

A review of the literature published during 1980 on the microbiology of water includes sections on microbial indicators of pollution, microbial ecology of water, and the microbiology of river systems, coastal areas and lakes. Studies on indicators defined the characteristics of a good indicator, discussed the coliform standard, and suggested that sulfate-reducing bacteria indicated a fecal origin. The relationships between intestinal microflora and water quality were investigated in cold-blooded animals. Several papers dealt with the natural self-purification processes by which pathogenic and indicator organisms disappear from polluted waters. Microbiology studies of rivers and lakes considered the effects of metabolic activities on the fate of pollutants in aquatic ecosystems. (Small-FRC)
W82-01284

MICROBIOLOGY OF GROUND WATER,

Environmental Protection Agency, Dallas, TX. Region VI.
M. J. Allen.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1107-1109, June, 1981. 23 Ref.

Descriptors: *Groundwater, *Microbiological studies, *Literature review, Bibliographies, Water quality, Public health, Drinking water, Bacteria, Water pollution sources, Groundwater contamination.

A literature review is presented of papers published during 1980 which concerned the microbiology of groundwater. One study isolated coagulase-positive Staphylococcus aureus from over 6% of rural well water specimens. Another study found more than one third of rural water supplies unsatisfactory. Other studies examined groundwater quality and investigated various tracers including hydrogen-sulfide positive E. coli. One study found that even deep aquifers have been contaminated by septic tank leachate. The virus hazard from wastewater sludge application was investigated, and a literature review was published dealing with viruses in groundwater. The effectiveness of disinfectants and surfactants in the control of iron bacteria was evaluated, and the movement of nitrates and phosphates in septic tank effluent was studied and found to be related to microbial activity in the soil. Another study evaluated the effect of sand-clay types and mixtures in the purification of leachfield effluents. (Small-FRC)
W82-01286

MICROBIOLOGY: DETECTION OF BACTERIAL PATHOGENS AND THEIR OCCURRENCE,

Environmental Protection Agency, Cincinnati, OH.
D. J. Reasoner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1112-1134, June, 1981. 7 Tab, 139 Ref.

Descriptors: *Pathogens, *Bacteria, *Literature review, Bibliographies, Human diseases, Water pollution effects, Enteric bacteria, Salmonella, Microbiological studies.

A literature review is presented of 1980 publications dealing with the occurrence and detection of bacterial pathogens. Information from the references is presented in tabular form. These tables include: occurrence of Salmonella serotypes and related enteric pathogens in warm-blooded animals and in cold-blooded animals; Leptospira in animals; miscellaneous bacterial pathogens and opportunistic pathogens in animals; the occurrence and detection of Enterobacteriaceae in water; the occurrence and detection of Vibrio and Campylobacter in water; and miscellaneous bacterial pathogens and opportunistic pathogens in water. Warm-blooded and cold-blooded animals provide a reservoir of salmonellae transmissible to humans. Enteric pathogens including salmonellae, shigellae, yersiniae, and the chlorela and El Tor vibrios are often waterborne. Legionella organisms are also associated with water habitats. (Small-FRC)
W82-01288

ALUMINUM IN PRECIPITATION, STREAMS, AND SHALLOW GROUNDWATER IN THE NEW JERSEY PINE BARRENS,

Pennsylvania Univ., Philadelphia.
W. W. Budd, A. H. Johnson, J. B. Huss, and R. S. Turner.
Water Resources Research, Vol 17, No 4, p 1179-1183, August, 1981. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Acidic water, *Acid rain, *Aluminum, Water quality, Air pollution, Humic acids, Fulvic acids, Organic matter, Chelation, Precipitation, Fate of pollutants, Water pollution effects, Streams, McDonalds Branch, Pine Barrens, *New Jersey, Groundwater, Hydrogen ion concentration.

Aluminum appears in waters of the New Jersey Pine Barrens at concentrations of 0-200 micrograms per liter (volume weighted average, 105 micrograms per liter) in precipitation; 100-800 micrograms per liter (volume weighted average, 345 micrograms per liter) in streams; and 0-3000 micrograms per liter (volume weighted average, 469 micrograms per liter, and excluding one very acid well, 329 micrograms per liter) in groundwater. These levels are 10 times greater than in most terrestrial waters, except for the acidified waters of New England and New York. The pH of precipitation in this study averaged 4.0; of groundwater, 4.6; and of streams, 4.1. The total (acid reactive) aluminum deposited in the McDonald's Branch basin was 140 mg per sq meter per year over the study period, May 1978 to May 1980. Stream and groundwater outputs were 149 and 110 mg per sq meters per year, respectively. Increased precipitation, streamflow, and decomposing organic matter caused higher Al inputs and outputs in summer. In streams Al may be transported as an organometallic complex with dissolved organic matter, humic and fulvic acids. Groundwater Al concentrations depend on gibbsite solubility in mineral soils and are pH dependent. (Cassar-FRC)
W82-01297

APPORTIONMENT OF NET RECHARGE IN LANDFILL COVERING LAYER INTO SEPARATE COMPONENTS OF VERTICAL LEAKAGE AND HORIZONTAL SEEPAGE,

Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
For primary bibliographic entry see Field 2G.
W82-01298

WATER CHARACTERISTICS,

Army Construction Engineering Research Lab. (Army), Champaign, IL.
E. D. Smith.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 649-659, June, 1981. 154 Ref.

Descriptors: *Acid precipitation, *Reviews, Water properties, Water analysis, Aquatic plants, Aquatic organisms, *Acid rain, *Environmental effects, Ecological effects.

Recent research on water characteristics is cited in this review article. Acid precipitation has been noted as one of the major environmental problems of the current decade. It poses a serious challenge to national and international bodies to protect water quality. Considerable interest was voiced in 1980 over the causes and effects, prevention and control of acid rain. One study estimated that acid rain was causing an estimated annual $5 billion loss in crop, forest, and aquatic yields, not including the losses due to irreversible damage. Several conferences were held during 1980 on acid rain problems. Groundwater contamination from acid rain was cited as one of the many current and anticipated problems in maintaining a clean and healthful water supply. Acid rain and vegetation interactions were studied in depth, as were the effects of acid precipitation on aquatic organisms. Several researchers reported on analytical techniques. A procedure was developed which may be useful in the quantification of acid rain via isolated precipitation events. The influence of sulfate and soluble metals in summer rains was considered. Natural sources of pollution were shown to affect acid rainfall, as reported for volcanic eruption events. Evaluation of the chemical and physical characteristics of rainfall was reported in the West Indies. Acid precipitation was studied in forest environments. Two efforts assessed the potential for acid rain to leach into the soil. The continuous determination of alkalinity in surface waters, procedures using automated techniques for determining compounds in sea water, techniques for measuring suspended solids, methods for particle analysis, and the development of final effluent monitoring were all investigated. (Baker-FRC)
W82-01305

THE DEPTH OF RAINFALL-RUNOFF-SOIL INTERACTION AS DETERMINED BY P32,

Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
L. R. Ahuja, A. N. Sharpley, M. Yamamoto, and R. G. Menzel.
Water Resources Research, Vol 17, No 4, p 969-974, August, 1981. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Phosphorus, *Rainfall-runoff relationships, *Runoff, Fate of pollutants, Tracers, *Soil adsorption capacity, Nutrient removal, Fertilizers, *Agricultural runoff.

The degree of interaction between rainfall, soil, and agricultural chemicals in runoff decreased very rapidly with depth below the surface. P32, a relatively immobile tracer, was applied at the soil surface and at depths of 0.5, 1.0, 1.5, and 2.0 cm in soil boxes. Each box received 6.5 cm per hr of simulated rainfall for 2 separate 30 min periods. Soils were Ruston fine sandy loam Bernow fine sandy loam, and Houston black clay. The average depth of interaction calculated from the data was 0.2-0.3 cm. It was more dependent on the period of rainfall than on the type of soil. The average depths of interaction were used to predict the P concentrations in runoff, which agreed well with observed values. This confirmed that the effective average depth of interaction was valid for P. Transient changes in the effective average depth during a rainfall were then calculated from simultaneous P and P32 concentrations in runoff. The effective average depth increased with time during a rainfall period, more so in the first period than in the second (30 min averages for 3 soil types and 2 storms, 0.207-0.291 cm). (Cassar-FRC)
W82-01318

GEOHYDROLOGIC MODELS OF THE HOUSTON DISTRICT, TEXAS,

Geological Survey, Lawrence, KS.
For primary bibliographic entry see Field 2F.
W82-01335

PHOSPHORUS CONCENTRATION-WATER FLOW INTERACTIONS IN TILE EFFLUENT FROM MANURED LAND,

Cornell Univ., Ithaca, NY. Dept. of Agronomy.
G. W. Hergert, D. R. Bouldin, S. D. Klausner, and P. J. Zwerman.
Journal of Environmental Quality, Vol 10, No 3, p 338-344, July-September, 1981. 10 Fig, 3 Tab, 20 Ref.

Descriptors: *Phosphorus, *Flow characteristics, *Tile drainage, Effluent, *Manure, Fertilizers, Wastewater composition, Flow rates, Nitrate, Chlorides, Perched water table, Water table, Soil solution, Calcium.

During a study of the effects of fertilizing with manure on tile effluent, it was noted that wide variations occurred in the dissolved molybdate reactive phosphorus concentrations both among weekly samples from a given plot and among plots. An irrigation experiment was undertaken to determine the factors causing these variations in phosphorus concentrations in the tile flow. Phosphorus concentrations in tile effluent during drainage events were found to increase with increasing flow, while nitrate and chloride concentrations were inversely related to flow rate. A perched water table was found to exist above high bulk density material with low vertical permeability just below the plow layer. Nitrate/chloride ratios in the tile effluent and in soil samples from various depths indicated that the flow of water to the tile was dominated by downslope movement in the plow layer and by downward movement to the tile in the relatively permeable backfill material above the tile. Phosphorus concentrations were found to be influenced by calcium or salt concentrations in soil solutions and in tile effluent during drainage events. The large increase in phosphorus concentration as the rate of tile flow increases appears to be a consequence of reduced calcium or salt concentration at high flow rates. The impact of manure in these experiments appears to be mainly due to the large amount of phosphorus added, much of which is in inorganic form, which leads to high amounts of labile phosphorus in the soil and which can sustain very high phosphorus concentrations in leaching water. (Carroll-FRC)
W82-01340

FORMATION OF N-NITROSODIMETHYLAMINE DURING TREATMENT OF MUNICIPAL WASTE WATER BY SIMULATED LAND APPLICATION,

Cornell Univ., Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 5D.
W82-01343

PREDICTING STREAM SALINITY CHANGES IN SOUTH-WESTERN AUSTRALIA,

Perth Public Works Dept. (Australia).
For primary bibliographic entry see Field 6A.
W82-01350

OBSERVATIONS ON THE HYDROGRAPHY AND INSHORE PLANKTON OF THE BAY OF BENGAL OFF BALASORE,

Ravenshaw Coll., Cuttack (India). Dept. of Zoology.
For primary bibliographic entry see Field 2A.
W82-01362

VOLATILE C1-C7 ORGANIC COMPOUNDS IN SURFACE SEDIMENTS FROM WALVIS BAY,

Woods Hole Oceanographic Institution, MA.
J. K. Whelan, J. M. Hunt, and J. Berman.
Geochimica et Cosmochimica Acta, Vol 44, No 11, p 1767-1785, 1980. 15 Fig, 3 Tab, 51 Ref.

Descriptors: *Organic compounds, *Marine sediments, *Hydrocarbons, Sediments, Sulfur compounds, Organic matter, Volatility, Walvis Bay, Capetown, *South Africa.

Volatile organic compounds were identified in marine sediments collected from Walvis Bay on the African west coast near Capetown, South Africa. Marine organisms, not air transport of material from the adjacent desert or river transport, is believed to be the source of this organic matter. The C1-C7 fraction studied in this work included alkanes (methane, ethane, propane, i- and n-butane, i- and n-pentane, and heptane), alkenes (2-methyl-2-butene, dimethylcyclopentenes, cyclohexene), oxygen containing compounds (2- and 3-methylfuran, 2,5-dimethylfuran, 2- and 3-methylbutanal, and 3-pentanone), sulfur compounds (dimethyl sulfide, thiophene, 2- and 3-methylthiophene) and aromatic compounds (benzene and toluene). Concentrations of most compounds were on the order of a fraction of a nanogram to several nanograms; toluene occurred at the highest levels other than methane. The probable precursors of many of these compounds are marine terpenes, which react in situ at temperatures less than 15 C. The more reactive compounds, furans, keto compounds, and alkenes, were not found in the deeper sections of the 220 cm cores. (Cassar-FRC)
W82-01367

MERCURY AND LEAD CONCENTRATIONS IN SOME SPECIES OF FISH FROM THE TUSCAN COASTS (ITALY),

Pisa Univ. (Italy).
S. S. Buggiani, and C. Vannucchi.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 1, p 90-92, 1980. 1 Tab, 8 Ref.

Descriptors: *Mercury, *Lead, *Fish populations, Contamination, *Toxicity, Heavy metals, Fish physiology, Tissue analysis, Coastal waters, Estuaries, Environmental effects, Water pollution, Ecosystems, *Tuscan coasts, Italy.

The concentrations of lead and mercury in tissues of marine fish near the Tuscan coasts in 1977 are reported. Composite samples obtained by mixing homogeneous samples from individual fish were analyzed. The data shows that both mercury and lead are consistently present in samples corresponding to the various fishing locations. The maximum absolute values of both metals are found in the same samples. Results suggest potential hazards to human health from small-size fish eaten after only partial removal of the viscera. Seagulls and other components of the food chain should be studied to determine the nature of the source of pollution. The results suggest widespread heavy metal contamination. The fishing areas studied are adjacent to densely populated coasts. (Titus-FRC)
W82-01368

LAND AND STREAM SALINITY IN WESTERN AUSTRALIA,

Perth Public Works Dept. (Australia).
R. M. Hillman.
Agricultural Water Management, Vol 4, No 1-3, p 11-18, 1981. 3 Fig, 3 Ref.

Descriptors: *Saline water, *Salinity, *Catchment areas, Arid lands, Runoff, *Farms, Water quality, Saline soils, Land clearing, Western Australia, *Australia.

Aspects of the problem of dryland salinity and its effects on farmlands and water resources are discussed, with emphasis on Western Australia. Salinity was first recognized as a problem in connection with the supply of boiler water for railway locomotives in 1924. During an agricultural expansion in the 1950's the problem came to the attention of the State and the general public. Today, dryland salinity has resulted in the loss of considerable agricultural land and associated economic losses. Also, only 50% of the divertible surface water remains largely unaffected and still fresh. To arrest and reverse water quality deterioration, clearing controls have been introduced on five important river catchments. Over the past ten years there has been a large research effort aimed at the problem. (Small-FRC)
W82-01374

THE INFLUENCE OF CHEMICAL CONDITIONING AND DEWATERING ON THE DISTRIBUTION OF POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE INSECTICIDES IN SEWAGE SLUDGES,

Imperial Coll. of Science and Technology, London (England). Dept. of Public Health Engineering.
For primary bibliographic entry see Field 5E.
W82-01387

ATOMIC ABSORPTION SPECTROPHOTOMETRIC STUDIES OF CADMIUM AND ZINC IN COMMERCIAL FERTILISERS, SOILS AND RIVER WATERS,

Aligarh Muslim Univ. (India). Environmental Research Lab.
N. A. Khan, A. Ahmad, A. A. Nomani, and M. Ajmal.
Environmental Pollution, Series B, Vol 2, No 4, p 259-264, 1981. 5 Tab, 18 Ref.

Descriptors: *Fertilizers, *Cadmium, *Zinc, Metals, Heavy metals, Soil analysis, Water analysis, Water pollution sources, Pollutant identification, Rivers, Path of pollutants.

Contamination of soils and waters by cadmium and zinc from commercial fertilizers was determined by atomic absorption spectrometry in soil and water samples collected near Aligarh, India. The concentrations of Cd and Zn, respectively, in fertilizers were 1.2-7.9 and 17-3070 mg per kg; in fertilized productive soils, 0.9-5.9 and 55-95 mg per kg; in barren soils, 0.14-0.06 and 7.5-10 mg per kg; in garden soils, 0.4-0.75 and 7.8-11 mg per kg; and in river water, 0.5-2.3 and 8.5-18.5 mg per liter. (Cassar-FRC)
W82-01388

THE DISTRIBUTION OF MERCURY IN THE SEDIMENTS OF THE PLYM ESTUARY,

Plymouth Polytechnic (England). Dept. of Marine Science.
G. E. Millward, and I. Herbert.
Environmental Pollution, Series B, Vol 2, No 4, p 265-274, 1981. 2 Fig, 5 Tab, 29 Ref.

Descriptors: *Mercury, *Estuaries, *Sediments, Path of pollutants, Plym Estuary, *England, Plymouth Sound, Chemical precipitation, Iron, Manganese, Clay, Organic matter, Rivers, Water pollution sources, Sewage disposal, Metals.

The concentrations of Fe (2800-439,000 micrograms per g), Mn (25-384 micrograms per g), clay (0.03-82.6%), and organic carbon (0.3-8.4%) in surface sediment samples collected in the Plym Estuary, England, correlated well with each other according to statistical analysis. However, Hg concentrations (18-2610 ng per g) were not strongly correlated with any other sediment variables. All data is reported on a dry weight basis. Cluster analysis revealed three geochemical facies. Facies P, upstream with poorly sorted sediments, had higher than expected Hg concentrations (208 ng per g compared with the average for English soils, 60 ng per g) probably as a result of the close proximity to a sewage disposal works outfall. Facies Q, further downstream where water is more saline, had 234 ng Hg per g, only a 16% increase over that of Facies P, suggesting a loss of Hg to Plymouth Sound. Facies R consisted of contaminated sediments (2060 ng per g) associated with sewage effluent disposal. (Cassar-FRC)
W82-01390

CREAMS: A FIELD-SCALE MODEL FOR CHEMICALS, RUNOFF, AND EROSION FROM AGRICULTURAL MANAGEMENT SYSTEMS.

Science and Education Administration, Washington, DC.
Conservation Research Report No 26, May, 1980. 650 p, 147 Fig, 174 Tab, 591 Ref.

Descriptors: *Nonpoint pollution sources, *Model studies, *Erosion, *Agricultural runoff, Agricultural chemicals, Sediment transport, Soil management, Mathematical models, Pesticides, Nutrients.

A mathematical model, CREAMS, was developed to evaluate nonpoint source pollution from field-sized areas under various management practices for selecting Best Management Practices to reduce nonpoint pollution to acceptable levels. CREAMS consists of three components: hydrology, erosion/sedimentation, and chemistry. In order to develop this model quickly, existing physically based models, or those that could readily be modified and improved, were assembled into a package to estimate runoff, sediment, plant nutrient, and pesticide movement in a field. The CREAMS model was developed using units common for the individual components, and therefore, contains mixed or customary units. The purpose of this publication is to provide a complete package for potential users of the model. It is divided into three main divisions. Volume I, model documentation, presents the concepts of model components. Volume II, user manual, provides information on selection of parameter values and model operation. Volume III, supporting documentation, provides the user additional information to obtain parameter values. Results of sensitivity analysis for each component are included in the publication to indicate effects of errors in parameter estimation. (See W82-01402 thru W82-01414) (Moore-SRC)
W82-01401

EROSIVITY 'R' FOR INDIVIDUAL DESIGN STORMS,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2J.
W82-01403

ENRICHMENT RATIOS FOR WATER QUALITY MODELING,

Science and Education Administration, Durant, OK. Water Quality Management Lab.
For primary bibliographic entry see Field 2J.
W82-01410

NITRATE PRODUCTION, UPTAKE, AND LEACHING,

Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Management Lab.
S. J. Smith, D. E. Kissel, and J. R. Williams.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 493-508, 5 Fig, 6 Tab, 37 Ref.

Descriptors: *Nitrates, *Soil chemistry, *Leaching, *Mineralization, *Fertilizers, *Nonpoint pollution sources, Agriculture, Soil water, Soil temperature, Watersheds, Return flow.

Nitrate in watershed soils is derived mainly from soil organic matter and applied N fertilizer. The behavior of nitrate in watershed soils is complex, and exact prediction of its fate is neither possible nor practical. A simple, abbreviated way for predicting actual amounts of nitrate produced under field conditions was developed, along with different options for assessing the fate of the nitrate. Prediction is on the basis of the soil nitrogen mineralization potential, N sub o, which may be considered as the quantity of soil organic N that is susceptible to mineralization according to first-order kinetics. N sub o can be determined conveniently based on oxidative release of NH4-N from soil organic matter using acid permanganate. Measurements are made for the plow layer (0-15 cm) and a subsurface layer (15-60 cm). For mineralization intervals longer than a day the integrated expression N = N sub 0 (1 - e super-kt) M may be used where N represents the mineralized N; N sub o, the mineralization potential; K, the temperature-adjusted rate constant; t, the time; and M, the soil water content expressed as a percentage of field capacity. The options for assessing the fate of soil and fertilizer-derived nitrate allow for the use of different types and amounts of available input data. One option is based on a water use/dry matter simulation, while the other option is based on the normal probability curve adjusted for water stress. The amount of nitrate available for leaching represents accumulated soil nitrate production plus fertilizer-derived nitrate, minus that taken up by the crop. Both return flow and vertical leaching losses can be calculated on the basis of the nitrate concentration in the root zone and the amount of water percolating through the zone. (See also W82-01401) (Moore-SRC)
W82-01411

ESTIMATING SOLUBLE (PO4-P) AND LABILE PHOSPHORUS IN RUNOFF FROM CROPLANDS,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. L. McDowell, J. D. Schreiber, and H. B. Pionke.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 509-533, 7 Fig, 6 Tab, 47 Ref.

Descriptors: *Phosphorus, *Agricultural runoff, *Soil chemistry, *Nutrients, *Nonpoint pollution sources, Mathematical studies, Vegetation, Storm runoff.

Soil P intensity values appear useful for estimating potentially soluble PO4-P in runoff from croplands. Intensity values measured from PO4-P sorption-desorption isotherms and water extracts of soils were used to estimate the annual discharge weighted soluble PO4-P concentrations from plots and watersheds differing greatly in soils, area, fertility, crops, and management. Equilibrium phosphorus concentration (EPC) values better estimated PO4-P in runoff, even when PO4-P from crop residues was an important source. Soil EPC values derived from sorption-desorption isotherms are recommended for estimating the annual discharge weighted PO4-P concentration in runoff. Soil labile P also can be determined from the isotherm, but with a greater uncertainty. simpler tests, such as water-extractable PO4-P and plant available P, can be used to estimate the EPC and the soil labile

P, respectively. They must be tested and verified for application to an area, however. PO4-P concentrations measured in runoff may vary considerably from storm to storm. Crop residues; fertilizers, depending on method of incorporation and time of runoff after application; and possible leaching from green plants can contribute significant and variable quantities of soluble PO4-P. (See also W82-01401) (Moore-SRC)
W82-01412

SOLUBLE N AND P CONCENTRATIONS IN SURFACE RUNOFF WATER,

Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
D. R. Timmons, and R. F. Holt.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 534-543, 5 Tab, 20 Ref.

Descriptors: *Surface runoff, *Nutrients, *Nitrogen, *Phosphorus, *Agricultural runoff, Leaching, Vegetation, Fertilizers, Precipitation, Tillage, Erosion control.

The loss of soluble nutrients in surface runoff for a given runoff event is a function of runoff water volume and soluble nutrient concentration. Since existing values for extraction coefficients are limited, flow weighted concentrations were compared to standard treatments for evaluating the effects of various factors on soluble nutrient concentrations. Soluble N and P concentrations in runoff water result from the interactions of factors which include precipitation, vegetation, fertilizer, tillage, plant residue, and soil. Soluble nutrients can be influenced by the type of vegetation, the stage of physiological development, and the climatic factors preceding the runoff event. The leaching of vegetation by precipitation or runoff is a mechanism that contributes nutrients to surface runoff. The concentrations of soluble N and P in surface runoff water will be influenced by: rate of fertilizer application; method of application; form of fertilizer; time of application; and precipitation after fertilization. The different tillage systems have a direct effect on incorporation of fertilizer and on the plant residue remaining on the surface. As plant residues left on the soil surface to decrease soil erosion are subject to leaching by precipitation or runoff water or both, they will tend to increase soluble nutrient concentrations, as compared to conventional tillage. (See also W82-01401) (Moore-SRC)
W82-01413

PESTICIDE CONCENTRATIONS IN AGRICULTURAL RUNOFF: AVAILABLE DATA AND AN APPROXIMATION FORMULA,

Science and Education Administration, Stoneville, MS. Delta States Agricultural Research Center.
R. D. Wauchope, and R. A. Leonard.
In: CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems, Conservation Research Report Number 26, May, 1980. p 544-559, 3 Fig, 2 Tab, 33 Ref.

Descriptors: *Pesticides, *Agricultural runoff, *Pesticide kinetics, *Nonpoint pollution sources, Pesticide residues, Surface runoff, Mathematical studies, Subsoil, Soil surface.

Major factors affecting runoff losses of pesticides include: physical and chemical properties of the formulated pesticide; application rate; location of application residue (foliage, soil surface; soil subsurface); and time elapsed between application and runoff storms. Studies have shown that runoff concentrations are roughly proportional to application rate, all other factors being equal. Regardless of pesticide or site, runoff experiments usually show that runoff concentrations decline drastically as the time elapsed between application and runoff increases. Typically, runoff concentrations decrease by a factor of two for every 2-7 days of delay. When pesticides applied as simple aqueous solutions reach their target and dry, the resultant residue should have properties similar to the pure chemical. Many insoluble pesticides are sprayed adsorbed onto solid granules or in nonpolar solvents or emulsions. This will drastically affect the availability of a pesticide for washoff, even after drying. Application of highly soluble pesticides to foliage results in greater runoff concentrations than applications to bare soil. Some pesticides are applied incorporated into subsurface soil, which leads to low runoff concentrations. All of these factors are combined into a rough mathematical formula containing two empirical constants, which are calibrated using selected data on 373 runoff events from the literature. (See also W82-01401) (Moore-SRC)
W82-01414

THE STRINGFELLOW INDUSTRIAL WASTE DISPOSAL SITE: A TECHNICAL ASSESSMENT OF ENVIRONMENTAL IMPACT,

California Dept. of Health Services, Berkely. Hazardous Materials Lab.
R. D. Stephens.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 15-20, 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Waste disposal, *Land disposal, *Industrial wastes, *Flooding, *Soil contamination, Storm runoff, Pollutants, Inorganic compounds, Metals, DDT, Leachates, Deposition, Chromium, Environmental effects, Riverside, *California, Stringfellow Quarry.

The Stringfellow Quarry industrial waste site near Riverside, California, was authorized to accept Class I wastes from 1955 to 1972. Other wastes could be accepted only with specific approval of the Regional Water Quality Control Board. Waste disposal records were incomplete, so that, when two incidents of flooding and runoff from heavy storms occurred, it was not known what pollutants may have been washed out. In the second incident approximately 1 million gallons of polluted liquid was discharged into Pyrite Wash. Liquid, surface, shallow subsurface, and vegetation samples were taken within the disposal site, and the surrounding canyon, and along Pyrite Wash for analysis for metals, anions, and organic compounds. The on-site liquid samples were homogeneous for the major inorganic constituents. The off-site samples showed that all the metals except manganese were attenuated from the leachate, with chromium being lost most rapidly. The primary organic constituent was DDT, and most of it remained as a surface layer in the disposal site. Some had migrated away from the site, and levels of 1 ppm were found some distance downstream from the site. (Brambley-SRC)
W82-01415

CASE STUDIES ON THE MIGRATION OF POLLUTANTS IN GROUND WATER,

State Univ. of New York Coll. at Oswego.
R. J. Scrudato, R. Schneider, R. Hinrichs, and P. Goliber.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC., Environmental Protection Agency Report, (1980). p 71-77, 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Waste disposal, *Land disposal, *Industrial wastes, Hazardous materials, Chemical analysis, Monitoring, *Oswego County, New York, Lake Ontario, Metals, Heavy metals, Bromine, Economic aspects, Case studies.

There are 22 hazardous waste disposal sites in Oswego County, New York, ten of which contain 55 gal barrels of industrial waste distributed by a defunct industrial waste disposal firm. Three of the sites contain more than 75% of the wastes and they also pose the greatest direct threat to surface and groundwater systems. After a preliminary survey of all the sites a drilling program was started. To date 49 auger holes have been completed at 5 sites. Drilling logs are being maintained, ground water migration is being monitored, and organic and inorganic analysis of the water are being conducted. Two sites containing 8,000 and 15,000 barrels of waste, respectively, have been subject to detailed geological and hydrological study. The first site is on the top of a hill, in a ground water recharge area, with ground water movement to the south-southeast, towards residences. The groundwater contains elevated levels of manganese, iron, zinc, and bromine. The second site is situated between two creeks, 1500 ft south of Lake Ontario. Ground and surface waters move toward the lake, and the groundwater contains elevated concentrations of manganese, iron, zinc, nickel, lead, and bromine. Although the threat to the local water resources is recognized, little remedial work has been done, due to lack of planning and funding. Groundwater monitoring and analysis are continuing. (Brambley-SRC)
W82-01424

GEOLOGICAL STUDIES OF INDUSTRIALLY-RELATED CONTAMINATION: SOIL AND GROUND WATER INVESTIGATIONS,

Metcalf and Eddy, Inc., Boston, MA.
D. H. Bruehl, N. K. Chung, and W. F. Diesl.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 78-84, 8 Fig, 2 Tab.

Descriptors: *Waste disposal, *Land disposal, *Groundwater pollution, *Paint industry, *Water pollution control, Chromium, Organic solvents, Soil contamination, Leachates, Aquifers, Chlorinated hydrocarbons, Phthalates.

A case history of an actual hazardous waste site investigation is presented to detail the phases leading to closure of a site that is posing a hazard to resources. The dump site is about 1 acre in size in a broad limestone valley, and contains paint wastes and organic solvents. It is poorly defined and covered with dense vegetation. After initial reconnaissance and data collection a baseline was drawn across the suspected site and 51 surface soil samples were taken on a grid pattern. Chromium concentrations in soil samples ranged from 20 - 280,000 mg/kg. Test pits were dug by backhoe to delineate the extent of the wastes. Organic waste, containing trichloroethylene, tetrachloroethane and dibutylphthalate, occurred primarily in a lens within the chromium waste. Laboratory extraction procedures showed that most of the chromium was non-extractable. Ground water analyses showed contamination by chromium, oil and grease, and total organic carbon. Two wells in the contaminated ground water plume contained high concentrations of 5 organic compounds on the EPA Priority Pollutant list. Of the four rehabilitation possibilities - chemical fixation with off-site or on-site disposal, on-site or off-site disposal in an approved hazardous waste landfill - the last was chosen. There was no way to fix the pollutants effectively, and, although more expensive, off-site disposal will afford greater protection to the limestone aquifer and will be quicker to implement. Sampling must be conducted to ensure that all contaminated material is removed, and a clay cap installed on the bedrock to prevent infiltration. (Brambley-SRC).
W82-01425

LOVE CANAL: CHEMICAL CONTAMINATION AND MIGRATION,

New York State Dept. of Health, Albany. Div. of Labs. and Research.
C. S. Kim, R. Narang, A. Richards, K. Aldous, and P. O'Keefe.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 212-219, 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Love Canal, New York, *Waste dumps, *Chlorinated hydrocarbons, *Dioxin, *Groundwater pollution, Storm sewers, Hazardous materials, Groundwater movement, Leachates, Soil contamination, Outfall, Sumps, Dusts, *Path of pollutants.

A brief history of Love Canal, New York, is presented, from its construction in 1890, its use as a

waste dump from 1942-1953, sale in 1953, construction of residences and a school from 1954 to the early 1970's, to the complaints and fencing of the canal in 1978. The air, soil, water and non-water-soluble liquids were analyzed; all indicated contamination by a large number of organic compounds, including many chlorinated hydrocarbons. Water, leachate, soil and sediment samples contained dioxin at concentratons of 1.4 - 312 ppt. The major swale crossing the canal site and the fill around utility lines were demonstratad not to be the main pollutant pathway, but that the storm sewers were. They received the contaminated water pumped by the sump pumps in the basements of the houses closest to the canal. Two major contaminant entry points were located, and the two outfalls of the storm sewer system were contaminated. Because of the complex mixture of chemicals the hazard posed by any one is difficult to assess. Evidence of through-ground transport of chemical wastes appears to be limited to the first ring of homes, but some canal soils have been moved for use as fill. Windborne dusts and vapors contributed to the wider distribution of chemicals. (Brambley-SRC)
W82-01436

LABORATORY PROCEDURE FOR ESTIMATING RESIDUE DYNAMICS OF XENOBIOTIC CONTAMINANTS IN A FRESHWATER FOOD CHAIN,

Columbia National Fisheries Research Lab., MD.
B. T. Johnson.
Technical Papers of the U.S. Fish and Wildlife Service, No 103, 1980. 18 p, 1 Fig, 16 Ref.

Descriptors: *Model studies, *Food chains, *Bioaccumulation, *Biodegradation, *Pollutants, Microorganisms, Daphnia, Organic compounds, Bluegills, Water pollution, Fish.

A model food chain provides a simple means for estimating, under laboratory conditions, the movement of a synthetic organic chemical contaminant. This laboratory method is designed to investigate the accumulation, transfer, degradation, and elimination (residue dynamics) of xenobiotic chemicals in a simple freshwater food chain representing three aquatic trophic levels: microorganisms (yeast, protozoa, bacteria, or algae); filter-feeder (daphnid); and fish (bluegill). Accumulation data may potentially be drawn from five routes within the model system: water to microorganisms, microorganisms to daphnids, water to daphnids, daphnids to fish, and water to fish. Also, the simultaneous use of different water and food combinations produces a number of possible permutations for the evaluation of residue dynamics. The three trophic levels of the model are never tested together in the same chamber because of the difficulties in controlling natural predator-prey relations between organisms of different trophic levels over extended periods. A flow-through diluter-system, carbon-14 labeled contaminants, gas and thin-layer chromatography, autoradiography, and liquid scintillation spectrometry are used in making residue determinations. Accumulation factors and various index values are developed for measuring and estimating potential accumulation of xenobiotic contaminants by aquatic organisms. The laboratory procedure is economical, simple, reproducible, and ecologically relevant. (Moore-SRC)
W82-01443

MERCURY IN THE MUSCLE TISSUE OF FISH FROM THREE NORTHERN MAINE LAKES,

Maine Univ. at Orono; and Columbia National Fisheries Research Lab.
J. J. Akielaszek, and T. A. Haines.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 2, p 201-208, August, 1981. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Mercury, *Trout, *Wilderness areas, *Lakes, Fish, Water pollution effects, Air pollution effects, Oligotrophic lakes, Trophic level, *Maine, Chemical analysis, Path of pollutants.

Levels of mercury were measured in the muscle tissue of brook trout (Salvelinus fontinalis) and lake trout (S. namaycush) from three lakes in northern Maine: Eagle Lake, Cliff Lake, and St. Froid Lake. Some researches have reported higher levels of mercury in trout from oligotrophic waters than in trout from eutrophic waters in unpolluted areas. This study also indicated that high mercury concentrations appear to be characteristic of certain fish in certain locations in the Allagash Wilderness Waterway and other areas in northern Maine. Mercury concentrations in lake trout, burbot, and lake whitefish were higher than might be expected. The high mercury content resulted from a combination of factors, including trophic status of the fish, increased uptake of fish mercury under oligotrophic conditions, and some source of mercury input into these aquatic systems. A likely source of mercury in wilderness Maine is contaminated precipitation. (Small-FRC)
W82-01459

A STOCHASTIC APPROACH FOR DESCRIBING CONVECTIVE-DISPERSIVE SOLUTE TRANSPORT IN SATURATED POROUS MEDIA,

Florida Univ., Gainesville. Dept. of Statistics.
P. V. Rao, K. M. Portier, and P. S. C. Rao.
Water Resources Research, Vol 17, No 4, p 963-968, August, 1981. 2 Fig, 14 Ref.

Descriptors: *Solute transport, *Porous media, *Saturated flow, Path of pollutants, Model studies, Mathematical models, Stochastic process.

A stochastic approach is presented for describing convective-dispersive solute transport during steady water flow in homogeneous, water-saturated porous media. The movement of a single solute particle is considered as homogeneous Brownian motion with a positive drift. An integral expression is derived for the form of the expected solute concentration by combining the Brownian motion assumption with the probability density function for the first passage time of a specific solute particle at a given position with the rate of entry of solute particles into the porous medium. This expression leads to known solutions for two cases where analytical solutions exist (instantaneous release and continuous input). The method is also applied to a case of periodic solute input. This method eliminates the need to solve a set of partial differential equations for each set of initial and boundary conditions and allows for estimating the confidence intervals on the drift (velocity) and diffusion (dispersion) coefficients. (Cassar-FRC)
W82-01461

ESTIMATION OF IMPERVIOUS-AREA WASHOFF PARAMETERS,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4C.
W82-01465

RIVER BASIN HYDROSALINITY MODELING,

California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2K.
W82-01469

NITROGEN LEACHING AS INFLUENCED BY NITROGEN MANAGEMENT AND SUPPLEMENT IRRIGATION LEVEL,

Scientific and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
D. R. Timmons, and A. S. Dylla.
Journal of Environmental Quality, Vol, 10, No 3, p 421-426, July-September, 1981. 5 Tab, 25 Ref.

Descriptors: *Nitrogen, *Irrigation effects, *Leaching, Nitrogen compounds, Soil types, *Fertilizers, Crop production, Corn, Nitrites, Percolation, Lysimeters, Soil water, Farm management, Nutrients.

The increased use of fertilization and supplemental irrigation on sandy soils in the northwest corn belt area has created a need for information on management practices which can be used to minimize nitrate-nitrogen leaching losses. Nitrogen was applied in droughty Estherville sandy loam soil either as granules broadcast and disked in before planting or in liquid form through the irrigation system four times during the growing season. Supplemental irrigation was applied either as a partial replenishment (2.5 cm) or as a full replenishment (5 cm) irrigation each time the available soil water reached 50% depletion. Annual soil water percolation from spring thaw to autumn freeze averaged about 7.1 cm for nonirrigated corn, 11.2 cm for 2.5-cm irrigated corn, and 18.0 cm for 5-cm irrigated corn during the 5-year period studied. Average annual nitrate-nitrogen losses from the intensely managed corn systems which were both fertilized and irrigated ranged from 17 to 62% higher than such losses from fertilized, nonirrigated corn. The 5-year average nitrate-nitrogen losses for the 5-cm irrigation level were about 31% greater than those for the 2.5-cm irrigation level. The nitrogen application method had no effect on corn yields, but the use of liquid rather than granular nitrogen fertilizer reduced nitrate-nitrogen leaching losses about 11% for the 5-cm irrigation level and not at all for the 2.5-cm irrigation level. A combination of partial replenishment irrigation with period application of fertilizer nitrogen in the irrigation water should sustain high corn yields and help to minimize soil water percolation and nitrate-nitrogen leaching losses. (Carroll-FRC)
W82-01472

THE RELEASE OF SOIL PHOSPHOROUS TO RUNOFF IN RELATION TO THE KINETICS OF DESORPTION,

Scientific and Educational Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
A. N. Sharpley, L. R. Ahuja, and R. G. Menzel.
Journal of Environmental Quality, Vol 10, No 3, p 386-391, July-September, 1981. 5 Fig, 4 Tab, 21 Ref.

Descriptors: *Phosphorus, *Surface runoff, *Soil properties, Soil aggregates, Fertilizers, Phosphates, Mathematical models, Pesticide kinetics, *Runoff.

Very little is known about the kinetics of phosphorus release during a rainfall or about the extent and dynamics of the interacting layer of surface soil. This study investigated the release of phosphorus from surface soil to runoff water under simulated rainfall conditions for five soils at several rates of fertilizer phorphorus application. An empirical model had previously been proposed for the description of the kinetics of phosphorus desorption in water as a function of rate of phosphorus addition to soil and of water/soil ratio for five different soils. This model was used to describe the release of phosphorus to runoff water from soil under simulated rainfall. Both the concentration of soluble phosphorus in runoff during an event and mean values for successive events were adequately described by this simplified kinetic model. The logarithm of soluble phosphorus concentration was found to decrease linearly during an event as the logarithm of time increased. Mean soluble phosphorus concentrations of individual runoff events increased linearly with amount of desorbable phosphorus in the surface soil, while a power function related to water/soil ratio could be used to explain the effect of increased rain intensity on concentrations. The average depth of runoff-surface soil interaction calculated from the data using the kinetic model ranged from 1.5 to 3.0 millimeters for the five soils and was significantly related to the degree of soil aggregation. There was close agreement between these depth values and those determined in early earlier studies using phosphorus-32 as a tracer. The depth of interaction increased with increase in soil slope, kinetic energy of the raindrops, and to a lesser extent, rainfall intensity. Modeling of soluble phosphorus loading in runoff could be improved by using this kinetic model. (Carroll-FRC)
W82-01477

EFFECTS OF DAIRY MANURE ON PHOSPHORUS CONCENTRATIONS AND LOSSES IN TILE EFFLUENT,

Cornell Univ., Ithaca, NY. Dept. of Agronomy.
G. W. Hergert, S. D. Klausner, D. R. Bouldin, and P. J. Zwerman.

Journal of Environmental Quality, Vol 10, No 3, p 345-349, July-September, 1981. 2 Fig, 7 Tab, 19 Ref.

Descriptors: *Phosphorus, *Tile drainage, *Manure, Animal wastes, *Dairy industry, Wastewater composition, Fertilizers, Leachage, Drainage, Water quality, Surface runoff.

In the Northeastern United States, large areas of farmland are tile drained due to poor internal drainage. The phosphorus content of tile effluent is an important consideration because a major portion of the phosphorus in these effluents is dissolved and dissolved phosphorus controls phytoplankton activity in lakes in this region. The dissolved phosphorus concentrations and losses in effluent from a tile-drained silt loam during three consecutive years of dairy manure applications were compared with those for the four years prior to manuring. The plots had received fertilizer phosphorus in the years prior to manuring and received applications of either 35 or 200 wet metric tons of manure per hectare per year during manuring. Over 95% of the effluent samples prior to manuring contained dissolved molybdate reactive phosphorus (DMRP) concentrations of less than 30 parts per billion (ppb). During the three years when manure was applied, 92% of the effluent samples from plots receiving 35 ton applications contained less than 30 ppb of phosphorus, while only 53% of the plots receiving 200 ton applications did so. The flow-weighted DMRP concentrations in the tile effluent were 116, 441, and 97 ppb for the 200 ton applications and 22, 10, and 9 ppb for the 35 ton applications, respectively, during the 3 years the manure was applied. Although the tile flow accounted for about 40% of the drainage water lost from the plots, the phosphorus contents of the tile flow amounted to 10% of the total dissolved phosphorus losses in surface runoff. These results demonstrate that annual applications of 200 metric tons of manure per hectare per year have an undesirable effect on dissolved phosphorus in tile drain effluent and provide far more phosphorus and nitrogen than corn crops can use. (Carroll-FRC)
W82-01479

THE ROLE OF ATMOSPHERIC DEPOSITION IN AN EASTERN U.S. DECIDUOUS FOREST,

Oak Ridge National Lab., TN. Environmental Sciences Div.
S. E. Lindberg, and R. C. Harriss.
Water, Air, and Soil Pollution, Vol 16, No 1, p 13-31, July, 1981. 6 Fig, 6 Tab, 59 Ref.

Descriptors: *Heavy metals, *Deposition, *Deciduous forests, *Air pollution effects, Sulfates, Solubility, Toxicity, Rainfall, Environmental effects.

Deposition rates and processes were investigated for Mn, Zn, Cd, Pb, and SO4(2-) in a forest canopy and its underlying soils. The following were determined: aerosol composition and solubility, empirical measurement of dry deposition, precipitation chemistry, and rates and processes of deposition to the forest. Atmospheric deposition supplied from 14% Mn to about 40% Zn, Cd, and SO4(2-), to about 99% Pb to the forest floor. Measured water solubility indicated that these metals may be readily mobilized following deposition. Dry deposition contributed about 20% of Cd and Zn, about 35% of SO(2-), about 55% of Pb and about 90% of Mn. Wet deposition rates for single events were one to four times greater than dry deposition rates. Thus, man's activities which influence the atmosphere may lead to a shift in the exposure of vegetation to certain nutrients and trace contaminants. Heavy metals can cause visible injury to plants, and toxic internal concentrations may exist in plants with no external damage. (Small-FRC)
W82-01491

METHYL BROMIDE AND BROMIDE-ION IN DRAINAGE WATER AFTER LEACHING OF GLASSHOUSE SOILS,

Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
R. C. C. Wegman, P. A. Greve, H. De Heer, and P. Hamaker.
Water, Air, and Soil Pollution, Vol 16, No 1, p 3-11, July, 1981. 6 Fig, 11 Ref.

Descriptors: *Methyl bromide, *Bromides, *Greenhouses, Drainage water, Leaching, Irrigation water, Fish toxins, Water pollution sources, Agriculture.

The extent of contamination of surface water with methyl bromide and bromide-ion was investigated during the leaching period of two greenhouses treated with methyl bromide. Water samples were analyzed from irrigation water, drainage water, and recipient surface water. Maximum concentrations in drainage water were 9.3 gm/cu m for methyl bromide and 72 g/cu m for bromide ion. During the drainage procedure, fish mortality was observed in the ditches around one of the greenhouses. The rate of decline of methyl bromide was estimated for surface water. The average decline of methyl bromide in the drainage ditch was about 18%. The decline was the result of degradation and volatilization processes. The average half-life for the decline of methyl bromide in the ditch sections was calculated to be 6.6 hr at a water temperature of approximately 11 deg C. Gas chromatography was used to determine concentration levels. (Small-FRC)
W82-01492

GROUNDWATER CONTAMINATION BY TRACE LEVEL ORGANICS FROM A RAPID INFILTRATION SITE,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
M. B. Tomson, J. Dauchy, S. Hutchins, C. Curran, and C. J. Cook.
Water Research, Vol 15, No 9, p 1109-1116, September, 1981. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Organic compounds, *Wastewater disposal, *Rapid infiltration, Trace levels, Effluents, Secondary wastewater, Water pollution, Groundwater pollution, Path of pollutants, Infiltration, Chlorinated hydrocarbons, Phenols, Wastewater treatment, Phoenix, Arizona.

An experimental rapid land infiltration site in Phoenix, Arizona, removed about 92% of trace organics from secondary wastewater effluent. A total of 67 organic compounds were monitored in effluent and groundwater. Classes of compounds which were removed at greater than 90% efficiency were chloroaromatics, alkylbenzenes, alkylnaphthalenes, alcohols, ketones, indoles and indenes, and alkoxyaromatics. Compounds with removals of 70-90% were chloroalkanes, alkylphenols, alkanes, and amides. Only 2% of phthalates were removed. Groundwater damped concentration fluctuations, so that there was little variation over a 5-day period. (Cassar-FRC)
W82-01496

THE PHYSICOCHEMICAL SPECIATION OF CD, PB, CU, FE, AND MN IN THE FINAL EFFLUENT OF A SEWAGE TREATMENT WORKS AND ITS IMPACT ON SPECIATION IN THE RECEIVING RIVER,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
D. P. H. Laxen, and R. M. Harrison.
Water Research, Vol 15, No 9, p 1053-1065, September, 1981. 11 Fig, 7 Tab, 48 Ref.

Descriptors: *Chelation, *Heavy metals, *Cadmium, *Speciation, Path of pollutants, Fate of pollutants, Chemical reactions, Metals, Copper, Lead, Iron, Manganese, Effluents, Rivers, Water quality, Wastewater treatment, Water pollution sources, Particulate matter.

A previously developed scheme for speciation of metals in fresh waters was applied to the analysis of a sewage treatment final effluent and to the river upstream and downstream of the effluent outfall. In this treatment plant Cd levels were high in influent and effluent. Additional metals studied were Pb, Cu, Fe, and Mn. The scheme separates particles into six size fractions. Further analysis determines total non-filterable metal, total filterable metal, ASV-labile metal, Chelex-labile metal and ultraviolet irradiation-ASV-labile metal. In the final effluent, the largest fraction (> 12 micrometers) contained 20% of the Cd, 52% of the Pb, 32% of the Cu, 58% of the Fe, and 13% of the Man. The smallest fraction (< 0.015 micrometers) contained 45% of the Cd, 10% of the Pb, 47% of the Cu, 4% of the Fe, and 83% of the Mn. Intermediate-sized fractions each contained up to 24% of the total amount of each metal. Cd and Cu, but not Pb and Fe, appeared to be complexed with organic matter. Comparing similar analyses of the river upstream and downstream of the outfall showed changes in speciation. A large part of the Cd was added to the smallest size fraction. The major proportions of Pb, Cu, and Fe were added to the colloidal and particulate size fractions, minimizing immediate toxicity to aquatic life. Most of the Mn was present in the smallest fraction. (Cassar-FRC)
W82-01498

RELEASE OF PHOSPHORUS BY CERTAIN BENTHIC INVERTEBRATES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-01502

AN ANALYSIS OF ACIDIC PRECIPITATION IN SOUTH-CENTRAL ONTARIO USING AIR PARCEL TRAJECTORIES,

Ontario Ministry of the Environment, Toronto.
J. Kurtz, and W. A. Scheider.
Atmospheric Environment, Vol 15, No 7, p 1111-1116, 1981. 1 Fig, 6 Tab, 26 Ref.

Descriptors: *Acid rain, *Distribution patterns, Distribution, Precipitation, Rainfall, Acidity, Water pollution sources, Spatial distribution, Seasonal distribution, *Ontario, Canada, Sulfates, Nitrates.

An attempt is made to relate the deposition and concentrations of hydrogen, sulfate, and nitrate ions in precipitation collected at Muskoka-Haliburton to the directions of the associated air parcel trajectories. In this manner the relative contributions from the various directions were calculated to assess proposed strategies aimed at controlling and reducing the acidity in Ontario's precipitation. Precipitation collectors were located in central Ontario in an area underlain primarily by Precambrian bedrock with a thin, glacially derived overburden. A mixed deciduous/coniferous forest covers the area, and no large or industrial centers exists within 200 km. The majority of the precipitation collected is in the form of composite samples. The size of the data set for event samples is small. The characterization of acidic precipitation events using a single trajectory may be misleading. Even so, the results of the composite sample analysis show the maximum possible deposition of hydrogen, sulfate, and nitrate ions which could correspond to each octant of trajectory origin. In the case of each of the constituents, and both warm and cold seasons, the South and South-West octants are associated with the greatest maximum possible deposition, and the North octant is associated with the lowest possible deposition. The majority of these acidic deposits at Muskoka-Haliburton was associated with trajectories from the south or southwest. The average concentrations of the individual ions in precipitation for the south, southwest, west and northwest octants are all substantial. Precipitation from the remaining octants was very infrequent. (Baker-FRC)
W82-01513

RECENT ACIDIFICATION OF PRECIPITATION IN NORTH AMERICA,

Cornell University, Ithaca, NY. Section of Ecology and Systematics.
G. E. Likens, and T. J. Butler.
Atmospheric Environment, Vol 15, No 7, p 1103-1109, 1981. 4 Fig, 36 Ref.

Descriptors: *Acid rain, *Temporal distribution, United States, Rainfall, Air pollution, Fallout, *North America, Acidity, Chemical properties.

Analysis of precipitation occurring prior to the industrial revolution, and preserved in glaciers or continental ice sheets, reveals a pH of greater than 5.0. Remote areas such as Greenland and Antarctica have a pH of about 5.5 for precipitation currently falling. However, rain and snow falling over certain regions of the world are currently 5 to 30-40 times more acid than the lowest value expected for unpolluted atmospheres. This phenomenon is observed to be widespread in non-urban as well as urban areas throughout most of eastern North America and western Europe. Annual pH values average about 4.0 to 4.5 in parts of the northeast US and southeast Canada and northwest Europe. Individual storms have been recorded at pH 3.0. During 1959 through 1966 a sampling network was established throughout the conterminous United States. The vast majority of monthly pH readings from stations west of the Mississippi River were consistently above 5.6, with modal values in the high 6's. In contrast, monthly values east of the Mississippi were much more acidic. In the past two decades the southeastern United States has undergone the most rapid decrease in pH. This area has at the same time experienced an increase in atmospheric haze, presumably from increased urban and industrial activity, which would provide a regional source of anthropogenic emissions leading to the increased acidity. The longest continuous comprehensive record of precipitation chemistry in the US was obtained for the White Mountains area of New Hampshire in the Hubbard Brook Ecosystem Study. The pH has varied between 4.03 and 4.21 since the start of record keeping in 1964. Atmospheric deposition of heavy metals and various organic pollutants also occurs, and apparently has increased concurrently with increased acidity of precipitation in eastern North America. (Baker-FRC)
W82-01514

ENVIRONMENTAL RECOVERY IN A MARINE ECOSYSTEM IMPACTED BY A SULFITE PROCESS PULP MILL,

Victoria Univ. (British Columbia).
S. F. Cross, and D. V. Ellis.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1339-1346, August, 1981. 8 Fig, 1 Tab, 10 Ref.

Descriptors: *Pulp and paper industry, *Monitoring, *Bioindicators, Aquatic life, *Ecological effects, Water pollution effects, Environmental effects, Fucus, Shores, Oligochaetes, Industrial wastes, Path of pollutants, Indicators, Neroutsos Inlet, *British Columbia, Sulfite mills.

A biological monitoring protocol was developed to assess the environmental recovery of the Neroutsos Inlet and Quatsino Sound, British Columbia, after installation of a sulfite process pulp mill pollution abatement program at the Rayonier Canada Limited plant. Three tests were used: qualitative estimation of enchytraeid/tubificid oligochaete species composition near high tide within the shoreline where obvious pollution impact was evident, Fucus-epifaunal amphipod abundance and diversity, and qualitative surveys of rocky shore fauna and flora. Sampling was done at 10 shoreline stations, representing both east and west sides of the inlet. Lumbricillus lineatus proved to be a good indicator of high concentrations of sulfite mill effluent. Moderate levels of sulfite mill effluent were reflected in the number and diversity of Fucus epifaunal amphipoda, particularly Allorchestes angusta. The point of maximum abundance of this species has moved closer to the outfall each year since 1977, indicating a decrease in pollution. Analysis of the shoreline flora and fauna illustrated the tendency of the effluent to have a greater effect on the east side of the inlet than on the west side. (Cassar-FRC)
W82-01548

RELATIONSHIP BETWEEN INCREASED CROP ACREAGE AND NONPOINT-SOURCE POLLUTION: A GEORGIA CASE STUDY,

Georgia Univ., Athens.
F. C. White, J. R. Hairston, W. N. Musser, H. F. Perkins, and J. F. Reed.
Journal of Soil and Water Conservation, Vol 36, No 3, p 172-177, May/June, 1981. 1 Fig, 7 Tab, 34 Ref.

Descriptors: *Economic aspects, *Agricultural runoff, *Nonpoint pollution sources, Soil erosion, Nutrients, Crop production, Cost analysis, *Cropland, Environmental effects, Pesticides, Nitrogen, Phosphorus, Farm wastes, Pollution load, Sediment load, Case studies, Georgia.

Between 1973 and 1976, 274,000 hectares of new cropland were brought into production in Georgia. On the average, each acre of this new cropland generated environmental loadings of 4.38 tons of sediment, 7.45 pounds of nitrogen, and 1.30 pounds of phosphorus. The impact of these nonpoint sources of pollution must be weighed against the economic benefit from the increased cultivation of land which was formerly woodland, pasture, wildlife areas, idle land, or wetlands. Some environmental impacts of new agricultural production which contribute to water quality deterioration of streams, lakes and rivers were considered. The production of increased loadings of phosphorus, nitrogen, storm runoff, sediments, and pesticides were studied in relation to the area of new cropland cultivated. Aggregate personal income for the state rose an average of $1.41 for each $1.00 increase in net farm income. Methods are recommended for calculating costs to the state for damage to water quality, soil stability, wildlife, and public health and recreation due to the impact of increased land cultivation. (Geiger-FRC)
W82-01550

STREAM NUTRIENT LEVELS AND PROXIMITY OF AGRICULTURAL AND FOREST LAND TO STREAMS: SOME RELATIONSHIPS,

Corvallis Environmental Research Lab., OR.
J. M. Omernik, A. R. Abernathy, and L. M. Male.
Journal of Soil and Water Conservation, Vol 36, No 4, p 227-231, July/August, 1981. 3 Fig, 3 Tab, 32 Ref.

Descriptors: *Nutrients, *Agricultural runoff, *Forests, Mathematical models, Runoff, Stream degradation, Land use.

The effectiveness of forest buffer zones in reducing nutrient levels in streams draining agricultural lands was evaluated by comparing stream nutrient concentrations from sets of 80 and 175 relatively large watersheds with varied patterns of forest and agricultural land use. Two mathematical models were used to test the importance of proximity of general land use types to main streams in affecting mean annual stream nutrient concentrations. Also, land use overlays for each of the 904 NES/NPS study watersheds were studied to detect disproportionate patterns of agriculture or forest proximity to main streams. The proximity of forest and agriculture to main streams did not bear a significant relationship to stream nutrient concentrations beyond that attributable to the proportion of the total watershed that these land uses comprise. It is suggested that over the years, an increasing percentage of nutrients associated with sediment intercepted by the buffer strips should eventually find its way into the streams. Thus, forested buffer strips may be only a temporary solution. (Small-FRC)
W82-01554

CHEMICAL AND BACTERIOLOGICAL QUALITY OF PASTURE RUNOFF,

Science and Education Administration, Lincoln, NE.
J. W. Doran, J. S. Schepers, and N. P. Swanson.
Journal of Soil and Water Conservation, Vol 36, No 3, p 166-171, May/June, 1981. 7 Tab, 27 Ref.

Descriptors: *Fate of pollutants, *Animal wastes, *Feedlot runoff, Feedlot wastes, *Enteric bacteria, Farm wastes, Coliforms, Streptococcus, Feces, Cattle, Bacteria, Agricultural runoff, Water quality standards, Urban runoff, *Pastures, *Nebraska.

Pasture runoff in south central Nebraska is influenced by grazing cattle and natural background characteristics. Chemically, the quality of runoff water from grazed pasture was better than that from unstocked grassland. Pasture runoff, which was of better quality than runoff from urban areas or cultivated cropland, was within recommended water quality standards. Fecal coliforms were increased 5- to 10-fold in runoff from areas grazed by cattle. Levels of fecal coliform were similar in rainfall runoff from both grazed and ungrazed pasture and cropland and urban areas. The fecal coliform counts of the runoff from these four areas exceeded water quality criteria more than 90% of the time. The fecal coliform/fecal streptococci ratio of grazed and ungrazed pasture was similar to wildlife feces, suggesting a large natural background input for these microorganisms. The water quality criteria for bacteriological inputs for runoff from pasturelands should be reevaluated in light of these findings. (Geiger-FRC)
W82-01555

PARAMETERIZATION OF CONTAMINANT TRANSPORT THROUGH AN ANISOTROPIC UNCONFINED AQUIFER,

Canada Centre for Inland Waters, Burlington (Ontario).
A. G. Bobba, and R. P. Bukata.
Nordic Hydrology, Vol 11, No 3/4, p 187-208, 1980. 10 Fig, 17 Ref.

Descriptors: *Groundwater movement, *Aquifers, *Anisotropy, Path of pollutants, Porous media, Unconfined aquifers, Model studies, Adsorption, Solute transport.

A duo two-dimensional deterministic model which considers dispersion, convection, and chemical adsorption processes of contaminant transport in a porous medium was developed and applied to a homogeneous and anisotropic unconfined aquifer. Finite difference techniques were used to consider the effects on contaminant transport of anisotropic groundwater flow (indicated by principal velocity ratios), adsorption coefficient, and dispersivity ratios. Of these parameters the principal velocity ratio (degree of aquifer anisotropy) had a dominant influence on the transport of subsurface contaminants. Contaminant concentration iso-concentration curves were illustrated for a hypothetical waste disposal site on a recharge area. These showed that the contaminant was transported a shorter distance in the lateral direction than in the downstream direction. Some transport was also noticeable in the upstream direction, probably as a result of molecular dispersion. Although this paper considers a simple aquifer, current work, soon to be reported, is directed toward aquifers closer to natural basin conditions. (Cassar-FRC)
W82-01570

EFFECTS OF WATER AND NITROGEN MANAGEMENT ON NITRATE LEACHING LOSS FROM SANDS,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
D. G. Watts, and D. L. Martin.
Transactions of the ASAE, Vol 24, No 4, p 911-916, July/August, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Nitrates, *Leaching, Irrigation management, Nitrogen, Soil properties, Sand, Permeability, Groundwater, Groundwater pollution, Water quality, Model studies, Great Plains, *Irrigation effects.

The contributions of nitrate to the groundwater system were compared as they might result from the wide range of existing management practices on irrigated sands in the central Great Plains. A mechanistic model of the soil-plant-water-nitrogen system was developed for irrigated corn on sands. It simulates the biological transformation of various nitrogen forms in the soil, nitrogen uptake by the crop, and the loss of water and nitrate from the root zone. Corn having a 105-107 day relative maturity range was simulated. The soil for which the simulations were performed is a Valentine very fine sand, with an available water holding capacity of about nine to ten percent by volume. Two nitrogen amounts, 168 and 253 kg/ha, were used in the studies. The nominal irrigation frequency in the simulations was four days. A maximum system

capacity of 0.94 cm/day was assumed. Four important factors that were seen to affect nitrate leaching loss and were controllable included irrigation amounts, nitrogen source, nitrogen amount, and timing of nitrogen application. For years of normal rainfall, about 30-35 kg/ha of nitrate leaching loss may be expected during the growing season when 168 kg/ha of N is applied to the irrigated corn. When growing season percolation is 12 cm or less, leaching loss of nitrate during the growing season is essentially independent of N source. Nitrate leaching loss increases due to either rain or excess irrigation. Nitrate uptake decreased as leaching loss increased. Nitrate uptake increased when N applications were increased by 50%. Leaching losses during the growing season were slightly increased. Nitrate residual is considerably increased, creating the potential for additional leaching loss during the following spring. (Baker-FRC)
W82-01581

CADMIUM, LEAD, MERCURY, ARSENIC, AND SELENIUM CONCENTRATIONS IN FRESHWATER FISH, 1976-77-NATIONAL PESTICIDE MONITORING PROGRAM,
Columbia National Fisheries Research Lab., MO.
T. W. May, and G. L. McKinney.
Pesticides Monitoring Journal, Vol 15, No 1, p 14-38, June, 1981. 1 Fig, 4 Tab, 91 Ref.

Descriptors: *Heavy metals, *Fish, *Water pollution sources, Industrial wastes, Air pollution effects, Cadmium, Lead, Mercury, Arsenic, Selenium, Monitoring, Rivers, Path of pollutants.

Heavy metal data gathered by the National Pesticides Monitoring Program (NPMP) during 1976-77 are presented and interpreted. Freshwater fish were collected at 98 monitoring stations and analyzed for residues of cadmium, lead, mercury, arsenic, and selenium. Range and geometric mean values in mg/kg wet weight were: Cd, 0.01-1.04, 0.07; Pb, 0.10-4.92, 0.32; Hg, 0.01-0.84, 0.11; As, 0.05-2.92, 0.27; and Se, 0.05-2.87 0.56. Cadmium concentrations have decreased since 1972; the highest concentration was found in carp on the Verdigris River near a zinc plant. There has been no significant change in lead concentrations over the years for which data are available, and the sources of lead are industrial effluents and aerosols. Mercury levels have been declining due to reduced emissions and reduced use. Paper pulping and chlor-alkali operations were common sources. Arsenic levels in fish have increased, possibly because of air pollution, smelter solid wastes, and the use of arsenical pesticides. Selenium contamination is not widespread and is associated with geologic sources and industrial effluents. All five trace elements may undergo biologically mediated transformation reactions that yield organometallic compounds that are routed through the food chain. (Small-FRC)
W82-01584

CHRYSOTILE ASBESTOS FIBERS IN DRINKING WATER FROM ASBESTOS-CEMENT PIPE,
Wisconsin Univ. Madison. Dept. of Preventive Medicine.
M. S. Kanarek, P. M. Conforti, and L. A. Jackson.
Environmental Science and Technology, Vol 15, No 8, p 923-925, August, 1981. 3 Tab. 14 Ref.

Descriptors: *Potable water, *Asbestos, pipes, Asbestos-cement pipe, Water pollution sources, *Pollutant identification, *Drinking water, Water distribution, Corrosion, *San Francisco Bay area.

The water sampling program for the San Francisco Bay epidemiology studies was designed to assess the levels of asbestos in drinking water of the area's different water distribution systems. The asbestos content of distilled water samples was below detectable limits of the analysis. In one major distribution system mean chrysotile counts were 115 times greater in drinking water after flow through the pipe. This demonstration of substantial increases in asbestos fiber counts in nonaggressive drinking water raises questions regarding the validity of aggressiveness indexes for prediction of fiber release from asbestos-cement pipes. A possible explanation of the increase in fiber counts after flow through asbestos-cement pipes is that the fibers already present in the water from natural sources break up, thus yielding higher counts. However, the water samples after flow through asbestos-cement pipe have a larger proportion of longer fibers than the before asbestos-cement pipe samples. Thus the theory of fiber breakup seems to be invalidated. Other factors that might affect the release of fibers from the pipe include size of pipe, flow rate of water, alternate wetting and drying of surfaces, quality of joint materials used, corrosive cleaners in use to flush sections of pipe, and tapping of pipe. Hydrants and other dead ends in a water distribution system often act as a reservoir for fibers released by trapping at other places in the system. (Baker-FRC)
W82-01592

5C. Effects Of Pollution

ACUTE TOXICITY OF LEACHATES FROM COAL GASIFICATION AND LIQUEFACTION SOLID WASTES TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS,
Illinois State Natural History Survey, Urbana. Aquatic Biology Section.
J. J. Suloway, R. M. Schuller, and R. A. Griffin.
Journal of Environmental Science and Health, Part A, Vol 16, No 4, p 419-445, 1981. 2 Fig, 9 Tab, 28 Ref.

Descriptors. *Toxicity, *Leachates, *Coal gasification, *Fathead minnows, Fish, Liquefaction, Bioassay, Effluents, Solid wastes, Industrial wastes, Water pollution effects.

Earlier studies have indicated that coal conversion wastes, which contain relatively large concentrations of accessory elements and which produce acidic leachates, pose a potential hazard to water resources. Surface runoff from exposed piles of solid wastes could enter into streams and lakes, and the percolation of precipitation through wastes deposited in landfills could contaminate groundwater. The acute toxicity of leachates generated from Lurgi gasification ashes, an H-Coal liquefaction residue, and an SRC-1 liquefaction residue was investigated through 96-hour static bioassays using 1 to 6 day old fathead minnow fry. The leachates generated from the Lurgi gasification ash contained concentrations of several chemicals that exceeded recommended water quality standards. Leachates generated from the liquefaction residues in which the pH was not adjusted were acutely toxic. All of the acidic leachates were acutely toxic to the fry, requiring dilutions ranging from 1:10 to as high as 1:2000 to eliminate mortality. Total mortality occurred when the fry were exposed to acidic reconstituted water for 96 hours. Some of the acidic leachates also contained concentrations of aluminum, cadmium, chromium, zinc, copper, and nickel which have been shown to be acutely toxic to fish. Mortality was probably caused by the combined effects of pH and total ionic strength of the leachates. Much of the enormous quantity of solid wastes which will be generated by coal liquefaction and gasification will probably be redeposited on the coal mining site or in landfills, where percolation of acid mine drainage through the wastes could produce highly toxic acidified leachates. (Carroll-FRC)
W82-01108

A QUANTITATIVE STUDY OF SHORELINE MARSH COMMUNITIES ALONG LAKE HURON IN ONTARIO,
University of Western Ontario (London). Dept. of Plant Sciences.
For primary bibliographic entry see Field 2H.
W82-01122

INTERACTIVE EFFECTS OF METALS IN MIXTURES ON BIOMASS PRODUCTION KINETICS OF FRESHWATER COPEPODS,
Canada Centre for Inland Waters, Burlington, (Ontario).
U. Borgmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 8, p 1295-1302, August, 1980. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Copepods, *Metals, *Toxicity, Water quality, Natural waters, Synergistic effects, Productivity, Population dynamics, Water pollution effects.

The concept of additivity of the inverse of growth rates and mortality rates is expanded to provide estimates of the toxicity of metal mixtures to natural assemblages of freshwater copepods. Fourteen binary mixtures of the metals cadmium, copper, mercury, lead, zinc, and arsenic were used. The average observed growth time increase in copepods was 17% larger than the average calculated growth time increases, indicating a slight but significant synergism. Synergism in multimetal mixtures appears to be cumulative. One of the 15 possible binary mixtures, zinc:arsenic, demonstrated a large difference between the calculated and the observed growth rates. For all other mixtures studied, most of the toxicity was accounted for by the summation of noninteractive, single metal effects. The use of the toxic unit concept, which assumes additivity of concentrations rather than effects, would have predicted antagonism in most metal interactions. Although the toxic unit concept may be of use for water quality management if more complete information is not available, it cannot be used to correctly predict synergism or antagonism of metal mixtures. (Baker-FRC)
W82-01125

PHOSPHORUS UPTAKE DYNAMICS AS RELATED TO MATHEMATICAL MODELING OF CLADOPHORA AT A SITE ON LAKE HURON,
Michigan Univ., Ann Arbor.
M. T. Auer, and R. P. Canale.
Journal of Great Lakes Research, Vol 6, No 1, p 1-7, 1980. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Phosphorus, *Algae, *Cladophora, *Lake Huron, Model studies, Mathematical models, Great Lakes, Lakes, Nutrients, Eutrophication, Fate of pollutants, Water pollution effects.

Cladophora collected near a wastewater treatment plant at Harbor Beach, Michigan, on Lake Huron, had high levels of internal phosphorus (0.25%) and low or negative P uptake rates. Cladophora in water with low levels of dissolved P had low internal P levels (0.01%) and rapid P uptake rates. This research is part of a continuing study directed at understanding and control of nuisance growths of this attached, filamentous green alga in the Great Lakes. A mathematical model was developed to predict the response of Cladophora to management and control alternatives. Preliminary model simulations of Cladophora biomass, internal P, and external P were qualitatively similar to observed field data. (Cassar-FRC)
W82-01149

SOME EFFECTS OF AGRICULTURAL LAND USE ON STREAM INSECT COMMUNITIES,
Waterloo Univ. (Ontario). Dept. of Biology.
K. W. Dance, and H. B. N. Hynes.
Environmental Pollution, (Series A), Vol 22, No 1, p 19-28, May, 1980. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Land use, *Insects, *Water quality, *Agriculture, Water pollution effects, Macroinvertebrates, Invertebrates, Suspended solids, Soil erosion, Erosion, Species composition, Agricultural runoff, Runoff, Midges, Caddisflies, Aquatic animals, Canagagigue Creek, *Ontario.

Invertebrate community composition was studied in two branches of the Canagagigue Creek, Ontario. Although the two subbasins were similar in 1840, the west branch now is 6.9% forest, 23.7% bank cultivated, and 70% raw soil at the bank. It has 6.6 tons per day of suspended sediment and 964 kg per year of allochthonous organic input (serving as invertebrate food). In the west branch (1976 figures) total coliforms were 2046 per 100 ml; total P, 1.24 mg per liter; nitrites-nitrates, 3.24 mg per liter; suspended solids, 51 mg per liter. Widespread agricultural practices include manure spreading on

fields in winter and on stream banks in summer, wading by cattle in the stream, intensive corn cropping, and uncontrolled barnyard runoff. In contrast, the east branch is 34.1% forest, 13.4% bank cultivated, and 36% raw soil at the bank. It has 3.9 tons per day suspended sediment, and 5103 kg per year allochthonous organic input. In 1976 total coliforms in the last branch were 989 per 100 ml; BOD 1.2, mg per liter; dissolved oxygen, 9.0 mg per liter; total P, 0.079 mg per liter; nitrite-nitrate, 4.07 mg per liter; suspended solids, 114 mg per liter. The east bank is largely forested with little agriculture. Another important difference is the discharge regime. In the west branch flow is 4200-7840 liters per sec in the spring snow melt period with 6 weeks of no flow in summer. In the east branch spring discharges are 2000 liters per sec, summer flow 50-170 liters per sec. The west branch contained 2 species of Plecoptera, 7 species of Trichoptera, 98 taxa (40 chironomids), and no shredders. The east branch contained 8 species of Plecoptera, 15 of Trichoptera, and 110 taxa (36 chronomids). (Cassar-FRC)
W82-01159

TOXICITY AND BIOACCUMULATION OF ENDRIN AND METHOXYCHLOR IN AQUATIC INVERTEBRATES AND FISH,

Environmental Protection Agency, Duluth, MN.
R. L. Anderson, and D. L. DeFoe.
Environmental Pollution, (Series A), Vol 22, No 2, p 111-121, June, 1980. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Insecticides, *Toxicity, *Bioaccumulation, *Aquatic animals, Methoxychlor, *Endrin, Pesticides, Invertebrates, Accumulation, Stoneflies, Caddisflies, Isopods, Snails, Fish, Bullhead, Water pollution effects.

Endrin was more toxic than methoxychlcr to stoneflies, caddisflies, isopods, snails, and bullheads in a 28 day test. Tests were performed in a flowing water system using unfiltered Lake Superior water. Concentrations for endrin were 0.03, 0.07, 0.15, 0.26, and 0.60 micrograms per liter and for methoxychlor, 0.15, 0.42, 1.30, 2.17, and 4.23 micrograms per liter. The isopod Asellus communis was most sensitive to methoxychlor; EC50 (behavior) was 1.78 micrograms per liter at 4 days, and 0.42 at 28 days; LC50 (survival) was 1.75 at 7 days and 0.42 at 23 days. Caddisflies (Hydropsyche sp.) were less sensitive. LC50 was 2.90 micrograms per liter for methoxychlor at 14 days and 1.30 micrograms per liter at 28 days. Stoneflies (Pteronarcys dorsata) and snails (Physa integra) showed no deaths in 28 days in 4.20 micrograms per liter methoxychlor. Endrin toxicities (all in micrograms per liter) were as follows: caddisfly (Brachycentrus americanus) EC50, 0.23 at 4 days, 0.017 at 14 days; LC50, 0.34 at 4 days and greater than 0.34 at 21-28 days; stonefly, EC50, 0.22 at 4 days and 0.05 at 21-28 days, LC50, 0.28 at 7 days, 0.07 at 28 days; bullhead (Ictalurus melas), LC50, 0.45 at 4 days, 0.10 at 28 days. Bioaccumulation factors were: for methoxychlor, stonefly, 348-1130, and snail, 5000-6710; for endrin, stonefly, 610-1033. (Cassar-FRC)
W82-01160

PHYTOPLANKTON PRODUCTIVITY AND STANDING CROP IN THE VICINITY OF THE LAKE HURON-SAGINAW BAY FRONT,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W82-01164

POSTSPAWNING MORTALITY OF RAINBOW SMELT IN WESTERN LAKE SUPERIOR,

Brigham Young Univ., Provo, UT. Dept. of Zoology.
W. F. Schaefer, R. A. Heckmann, and W. A. Swenson.
Journal of Great Lakes Research, Vol 7, No 1, p 37-41, 1981. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Fish populations, *Thermal stress, Heated water, Harbors, Thermal pollution, Smelt, Temperature effects, Fungus, Fish diseases, *Lake Superior, Fish mortality, Rainbow smelt.

Population characteristics and the possible causes of die-offs in rainbow smelt in Lake Superior were investigated. During the springs of 1976 and 1977, 1,958 mature adult rainbow smelt that survived spawning and 1,014 post-spawning dead rainbow smelt were examined. Rainbow smelt were collected during spawning runs at five stations, in the Amnicon River, Burle River and near-shore points off Wisconsin Point. Intensities of the die-offs were determined by counting dead fish along the beach, at 12 stations located east of Superior-Duluth along the north and south shorelines to the Cascade River in Minnesota and Cornucopia Beach in Wisconsin. The die-off of smelt in western Lake Superior reached maximum intensity 3-5 weeks after spawning peaked at each location and lasted about 2 weeks. No dead smelt were found on the beaches prior to or during spawning. The density of dead smelt on beaches decreased with distance from the Superior-Duluth harbor. All dead rainbow smelt were infected with fungus, with the most common locations being the base of the pectoral and pelvic fins and the area around the vent. Fungus was also noted on the dorsal surface of the head and on the caudal peduncle. The fungus was determined to be a non-sexual form of Saprolegnia, probably S. parasitica. The most probable cause of the die-off was temperature stress on spawning smelt in the spawning areas, which increased the susceptibility of smelt to the fungus and may also have produced an osmoregulatory imbalance. The preferred temperature for rainbow smelt is 7 degrees Centigrade. Variation in temperature is considerable between waters in the harbor and the lake, with surface water temperatures in the harbor area of about 15 degrees Centigrade. (Baker-FRC)
W82-01189

EFFECTS OF ATMOSPHERIC PRECIPITATION ADDITIONS ON PHYTOPLANKTON PHOTOSYNTHESIS IN LAKE MICHIGAN WATER SAMPLES,

Argonne National Lab., IL.
For primary bibliographic entry see Field 2H.
W82-01196

RADON-222, IN POTABLE WATER SUPPLIES OF NEW ENGLAND,

Maine Univ. at Orono. Dept. of Physics.
For primary bibliographic entry see Field 5B.
W82-01221

EFFECTS OF LOGGING ON MACROINVERTEBRATES IN STREAMS WITH AND WITHOUT BUFFER STRIPS,

California Univ., Berkeley. Dept. of Forestry and Conservation.
J. D. Newbold, D. C. Erman, and K. B. Roby.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 37, No 7, p 1076-1085, July, 1980. 2 Fig, 5 Tab, 49 Ref. OWRT-A-047-CAL(6).

Descriptors: *Water pollution effects, *Macroinvertebrates, *Logging, Stream pollution, Aquatic populations, Species diversity, Mathematical studies, Forest watersheds, Chironomids, Population density, California.

Populations of stream macroinvertebrates in commercial logging and controled watersheds throughout various sample sites of northern California were compared by a nonparametric test of community dissimilarities within matched blocks of two control and one or two treated stations. When Euclidean distance and mutual data were used as dissimilarity indices, significant effects of logging on unprotected streams were observed. Unprotected streams showed higher densities of total macroinvertebrate fauna and certain Chironomidae and lower Shannon diversity values than control waters. Narrow buffer strips (< 30 m) helped to maintain normal Euclidean distance levels but had little effect on population diversity. Streams with wide buffer strips (> 30 m) were similar to control streams in their macroinvertebrate communities and sometimes had a greater amount of diversity, showing effective protection from logging influences. (Geiger-FRC)
W82-01227

EFFECT OF KEPONE ON ESTUARINE MICROBIAL ACTIVITY,

Maryland Univ., College Park. Dept. of Microbiology.
S. A. Orndorff, and R. R. Colwell.
Microbial Ecology, Vol 6, No 4, p 357-368, 1980. 3 Fig, 2 Tab, 20 Ref. OWRT-B-034-MD(3).

Descriptors: *Insecticides, *Estuarine environment, *Microbiological studies, *Kepone, Water pollution effects, Water pollutants, Pesticides, In situ tests, Inhibitors, *Chesapeake Bay.

Natural waters have become contaminated with pesticides, such as Kepone, which may have deleterious effects on microorganisms in the waters which are responsible for mineralization of organic matter and for nutrient regeneration. A method adapted from that of Kogure et al. was used for determination of total numbers of actively metabolizing estuarine bacteria in the presence of the chlorinated insecticide Kepone in the Chesapeake Bay. Observed relationships between results obtained using this method, heterotrophic activity measurements, and a specific activity index are presented. In situ heterotrophic uptake of mixed carbon 14-amino acids and direct viable cell (DVC) count of water samples from the Bay were not significantly affected by concentrations of Kepone not exceeding 0.01 milligrams per liter. Maximum inhibition of heterotrophic uptake (about 85 to 90 percent) and of DVC count (between 45 and 97 percent) was evident when Kepone concentrations exceeded 0.2 milligrams per liter. A specific activity index (either Metabolic Activity/DVC or Kepone-resistant DVC), heterotrophic uptake, and DVC count were found to be statistically correlated to one another, but negatively correlated with concentrations of Kepone. The direct viable cell count proved to be a rapid, simple method for estimating the effect of Kepone on in situ estuarine microbial activity. (Carroll-FRC)
W82-01231

POTENTIAL HEALTH HAZARDS FROM MICROBIAL AEROSOLS IN DENSELY POPULATED URBAN REGIONS,

Louisville Univ., KY. Dept. of Biology.
L. S. Cronholm.
Applied and Environmental Microbiology, Vol 39, No 1, p 6-12, January, 1980. 1 Fig, 5 Tab, 11 Ref. OWRT-A-068-KY(2).

Descriptors: *Bacteria, *Wastewater treatment, Sludge, Human diseases, Water treatment facilities, Microorganisms, Feces, *Coliforms, *Aerosols, Air pollution, Fallout, Sludge, Activated sludge, Bacterial analysis.

This study examined whether the risk of exposure to microbial aerosols in the vicinity of aerobic sewage treatment plants could be determined with sufficient accuracy to assist in public policy decisions regarding the design and location of such plants. Samples of air upwind and downwind of the treatment plants were collected with disposable two-stage Andersen samplers. Three treatment plants were selected for study. Two of these were typical of the small activated sludge plants located in subdivisions; they treat domestic sewage. The third is the largest facility in the area, which is separate from the Louisville, Kentucky, centralized treatment facility and treats a combination of domestic and industrial wastes. Aerosolized bacteria were recovered up to 930 meters downwind of the three plants. Some homes are within this distance. Although the bacterial counts taken on foliage in the area decreased rapidly, at 48 hr after exposure they were significantly higher than the counts on unexposed leaves. The 50% lethal dose of aerosolized Klebsiella pneumoniae was comparable to the 50% lethal dose of a virulent clinical isolate, and enteric bacteria were recovered from the respiratory organs of mice after forced inhalation adjacent to an aerated sludge tank. Coliform density in the effluents of the plants was inversely related to the airborne bacterial load at those plants. This relationship was attributed to the correlation between effluent quality and extent of aeration of activated sludge. Airborne enteric bac-

teria were also isolated near a decorative fountain used by humans for wading. (Baker-FRC)
W82-01232

HEALTH EFFECTS ASSOCIATED WITH WASTEWATER TREATMENT AND DISPOSAL,

Environmental Protection Agency, Cincinnati, OH.
N. E. Kowal, and H. R. Pahren.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 776-786, June, 1981. 133 Ref.

Descriptors: *Wastewater disposal, *Sludge disposal, *Public health, Literature review, *Wastewater treatment, Land disposal, Soil amendments, Pathogens, Bacteria, Viruses, Composting, Aspergillus, Parasites, Water pollution sources, Heavy metals, Cadmium, Zinc, Agriculture, Water reuse.

This literature review discusses health effects associated with wastewater treatment plants, composting of sludge, land application of wastewater and sludge, and use of renovated water. Many cases of plant workers exposed to pathogens and chemicals are reported--chlorinated organics, hydrogen sulfide, bacteria, and endotoxins. Several studies done on risk of bacterial and viral exposures for plant workers and nearby populations failed to show significantly higher illness rates. Several papers discussed the hazards of wastewater discharges with respect to swimming, transmission of antibiotic resistance factors, and viruses. Although exposure to sludge composting did not produce a high incidence of illness, protective measures and regular health examination for workers are recommended. Of particular concern is Aspergillus fumigatus. Studies on land application of wastewater and sludges revealed few ill effects in animals fed sludge, crops grown on sludge amended soils, or exposed humans. However, some potential and actual cases of disease transmission were noted: grazing animals, persons living in kibbutzim practicing wastewater spray irrigation, well water pollution, a cholera outbreak, and leptospirosis incidence. Potential chemical threats from land application are pesticides, polynuclear aromatic hydrocarbons, toxic trace elements (particularly Cd), and nitrates. There is not much information on health effects of treated wastewater reused as part of the potable water supply, but it is preferable to use renovated water for nonpotable uses. Of great concern are pathogens and mutagenic or carcinogenic materials, such as halogenated organics, in reclaimed water. (Cassar-FRC)
W82-01255

MARINE AND ESTUARINE POLLUTION,

California State Univ., Long Beach.
D. J. Reish, G. G. Geesey, P. S. Oshida, F. G. Wilkes, and A. J. Mearns.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 925-949, June, 1981. 6 Tab, 351 Ref.

Descriptors: *Marine environment, *Literature review, *Water pollution sources, Sludge, Ocean dumping, Waste disposal, Bioaccumulation, Toxicity, Pesticides, Organic compounds, Pollutants, Microorganisms, Viruses, Bacteria, Effluents, *Estuarine environment.

Recent advances in the area of marine and estuarine pollution are cited in this literature review. Two international marine pollution symposia were published with topics including heavy metal pollution, radioactive materials, oil and related substances, pesticides, industrial and domestic pollution, environmental evaluation and management, biochemical, physiological, genetic, and behavioral effects, pathobiology, and monitoring. In the area of pesticides, investigations were made concerning the value of various methods of study, the acute effects of certain chemicals, sublethal effects, metabolism, fate, bioaccumulation, and residues. In the area of microbiology specific work was done on microorganisms as pollutants, bacterial disease, viruses, pollutant-microbe interactions, and the conducting of surveys. For complex effluents and environments papers focused on the toxicity of contaminants to marine and estuarine animals. Oil pollution studies considered specific analytical methods, residues of oil in water and sediment, residues in biota, dispersants, field studies, toxicity and sublethal effects, bioaccumulation, diseases and abnormalities, and the ocean dumping of sludge plus methods of dredging and recovery. (Baker-FRC)
W82-01274

THERMAL EFFECTS,

Rexnord Inc., Milwaukee, WI.
J. B. Cravens.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 949-965, June, 1981. 9 Fig, 194 Ref.

Descriptors: *Thermal pollution, *Literature review, Heated water, Plumes, Thermal power, Thermal stress, Thermal water, Lakes, Reservoirs, Plants, Aquatic animals, Model studies, Streams, Rivers, Estuarine environment.

Recent research in the area of thermal effects as they relate to water pollution is cited in this literature review article. A far-field mathematical model was presented for numerical simulation of transient one- or two-dimensional thermal distribution in regions of severe reversing-flow conditions. Power plant intake effects were assessed at population and ecosystem levels. Temperature guidelines for power stations in Canada were concerned with protection of ichthyoplankton. The MacArthur-Wilson equilibrium model was used to analyze zooperiphyton on experimental substrates. Water temperature time series data was analyzed, leading to development and parameterization of a stochastic model able to simulate variations in water temperature characteristic of littoral zones of North American lakes. Specific site studies were conducted at cooling lakes and reservoirs, in specific streams and rivers, at the Great Lakes, in marine and estuarine systems, and in experimental ecosystems. Effects of hot-water evacuation were studied on growth and reproduction of plants in the vicinity. Effects of thermal water pollution were also studied on the reproduction, development, morphology, and feeding of animal species in the general area. The effects of temperature on specific diseases and parasites were investigated along with biochemical reaction studies. Some beneficial uses of warmer than natural water were also considered. (Baker-FRC)
W82-01275

BIOASSAYS - PROCEDURES AND RESULTS,

Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 5A.
W82-01277

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
C. B. Murphy, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 993-999, June, 1981. 1 Tab, 96 Ref.

Descriptors: *Heavy metals, *Environmental effects, *Bioaccumulation, Biological magnification, Acid rain, Mercury, Lead, Zinc, Copper, Cadmium, Lakes, Estuaries, Environmental pollutants, Toxicity, Water pollution effects, Path of pollutants.

Several studies have identified the presence of heavy metals in the environment. Average mercury levels in fish taken from New York waters appeared to be about 30% lower in recent tests than they had been in 1970 data. However, mercury levels were seen to be increasing in fish from several large non-industrialized Adirondack Mountain lakes, suggesting effects from acid rain. Cadmium and lead have been found in mussels from the St. Lawrence estuary. Studies are also cited dealing with the detection of copper and zinc in environmental waters and the effects of these metals on the surrounding environment. Bioconcentration studies have indicated that age of the cell population and concentration of the pollutant are factors which influence the degree of concentration of a chemical in an organism or in the tissue of an organism. Cadmium accumulation in sea worms, mercury accumulation in rainbow trout, pollutant biomagnification in bluegill sunfish, and the mercury content of pike have all been investigated. Toxicity studies and literature reviews have been conducted for arsenic, cadmium, copper, chromium, lead, mercury, zinc, selenium, and other metals. The effect of water hardness on toxicity of cadmium to aquatic organisms was investigated, along with the chloride dependent cellular detoxification mechanism. The role of bacteria in the detoxification of heavy metals in the environment, the effect of complexation of metals with synthetic agents, and the influence of water temperature on the transfer of methylmercury in the freshwater trophic chain were studied. Theoretical and mathematical approaches to the combined effects on freshwater fish and other aquatic life of mixtures of toxicants in water were also studied. (Baker-FRC)
W82-01278

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
A. L. Buikema, Jr., E. F. Benfield, and B. R. Niederlehner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1007-1015, June, 1981. 105 Ref.

Descriptors: *Invertebrates, *Water pollution effects, *Literature review, Bibliographies, Toxicity, Bioindicators, Bioassay, Organic compounds, Metals.

A review is presented of 1981 literature dealing with the effects of pollution on freshwater invertebrates, which includes the general topics of methods, microcosms, communities, cladocera, other zooplankters, amphipods, decapods, insects, mollusks, and protozoa. The proceedings of a meeting on invertebrate bioassays emphasized toxicity testing. The proceedings covered the advantages and disadvantages of using the following in toxicity tests: Daphnia, chironomids, Hexagenia, amphipods, copecodes, molluscan larvae, polychaetes, and grass shrimp. A literature review paper considered other potential species and toxicity testing methods. An extensive review on polycyclic aromatic hydrocarbons in the aquatic environment is referenced, as is a similar review dealing with benzene, xylene, and toluene. Toxicity of metals was the subject of a new handbook and an aquatic toxicology meeting. A book on ecosystem restoration dealt with recovery processes in damaged ecosystems. A review is referenced which concerns aspects of the development of water quality standards. (Small-FRC)
W82-01280

FRESHWATER MACROINVERTEBRATES,

Michigan Univ., Ann Arbor. School of Natural Resources.
M. A. Quigley.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1015-1027, June, 1981. 191 Ref.

Descriptors: *Macroinvertebrates, *Water pollution effects, *Literature review, Bibliographies, Ecology, Industrial wastes.

A review of 1980 literature on freshwater macroinvertebrates is presented which includes the general topics of indexes and indicators, organic and other wastes, physical environmental alterations, distribution and habitat requirements, production, food and feeding, periodicity and drift, animal-sediment interactions, and methods. A book on oligochaete aquatic biology and a proceedings on Corbicula cover information on population dynamics, the effects of human activities, and other topics. A collection of papers on Ephemeroptera and a similar collection on Chironomidae are referenced which concern the biology and ecology of these

macroinvertebrates. References dealing specifically with water pollution issues include a survey of the effects of coal mining on a stream environment and macroinvertebrate communities and an examination of the effects of coal industry wastes on a small river. The effects of organic pollutants in the River Trent and the consequences of acidified lakes in Sweden were considered by other referenced papers. (Small-FRC)
W82-01281

THE EFFECTS OF POLLUTION ON FRESHWATER FISH,

Environmental Protection Agency, Duluth, MN.
R. L. Spehar, A. E. Lemke, Q. H. Pickering, T. H. Roush, and R. C. Russo.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1028-1076, June, 1981. 1 Tab, 376 Ref.

Descriptors: *Fish, *Water pollution effects, *Literature review, Fish toxins, Bibliographies, Organic compounds, Water quality, Industrial wastes, Environmental effects.

A review is presented of 1980 literature on the effects of pollution on freshwater fish. An extensive table is included which summarizes the acute and chronic toxicity of inorganic and organic pollutants to freshwater fish. Published literature included many reviews and symposia which presented information on water quality, physical and chemical pollutants, and industrial and municipal effluents. These include the aquatic toxicity of Cu, Cn, V, and chlorophenol, and the effects of natural and artificial sources of radiation. Other papers concerned the effects of Hg, the effects of mosquito control agents, and the relationship between biotransformation and toxicity of xenobiotic chemicals in fish. Most of the articles cited deal with the effects of chemical pollutants. Papers are cited which deal with the effects of chlorine and wastewater, and pulp and paper wastes. (Small-FRC)
W82-01282

SUBSTRATE ASSOCIATED MICROFAUNA,

Texas University at Dallas, Richardson.
G. R. Lanza, and W. T. Waller.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1076-1083, June, 1981. 53 Ref.

Descriptors: *Microorganisms, *Literature review, *Toxicity, Water pollution effects, Bibliographies, Chlorine, Oil pollution, Pesticides.

A review is presented of 1980 literature on substrate associated microfauna which includes a section on papers dealing with toxicity studies. Respiration at two temperatures of two species of freshwater leech exposed to chlorine were studied. The use of Chilomonas paramecium populations in acute toxicity testing was evaluated, and the oxygen uptake in freshwater planaria exposed to various pesticides was studied. The sensitivity of 12 species of marine ciliates to high thermal stress was studied. The effects of crude oil on the Red Sea coral Stylophora pistillata were studied in the laboratory, and 500 potential pollutants were tested on bacteria, green algae, and protozoa. One study monitored stream pollution using protozoan communities and artificial substrates. The effect of the Cadiz oil spill on selected meiofauna was determined, and another study considered the effects of alkanes from the Buccaneer oil field in the Gulf of Mexico on benthic organisms. Other reports discussed the sampling, preservation, and physiological characterization of substrate-associated microfauna in aquatic systems. The structure, function and colonization patterns of substrate-associated microfauna as affected by ecological factors are also reviewed. (Small-FRC)
W82-01283

DISEASE OUTBREAKS CAUSED BY DRINKING WATER,

Harvard School of Public Health, Boston, MA.
G. F. Craun.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1134-1138, June, 1981. 39 Ref.

Descriptors: *Diseases, *Drinking water, *Pathogens, Reviews, Water pollution sources, Water pollution effects, Epidemiology, Public health, Human diseases, Infection, Water treatment, Poisons, Giardiasis, Cooling water, Viruses, Bacteria, Parasites.

Disease borne by drinking water caused 2 deaths and 48,193 cases of Illness in the U.S. during 1971-78. Of the 224 outbreaks of disease, 58% were in non-community water systems. However, most cases of illness (69%) resulted from problems in community water systems. Contamination of distribution systems was responsible for 38% of the outbreaks, and treatment deficiencies, for 33%. Cases of chemical poisoning involved a cross connection between a ship's drinking water system and the photographic developing machines and several incidents of excessive fluoride addition in water treatment systems. Giardia lamblia was the most frequently encountered pathogen, and outbreaks of waterborne giardiasis have been increasing in frequency. Most have occurred in systems using surface water with chlorination as the only treatment. Studies of a gastroenteritis outbreak at Crater Lake National Park in 1975 showed 5 cases of hepatitis A in 2206 persons exposed and not given immune serum globulin, but this was not statistically significant. On a national level waterborne hepatitis A amounts to 35-120 average annual cases, or 1% of the annual reported hepatitis A cases. Other outbreaks of waterborne disease were caused by toxigenic E. coli on a cruise ship, a water humidification system in a large factory, Legionella pneumophila in cooling and air conditioning systems, and nontuberculous myobacteria in the southeastern U.S. (Cassar-FRC)
W82-01289

WATER CHARACTERISTICS,

Army Construction Engineering Research Lab. (Army), Champaign, IL.
For primary bibliographic entry see Field 5B.
W82-01305

INFLUENCE OF PCBS IN WATER ON UPTAKE AND ELIMINATION OF DDT AND DDE BY LAKE TROUT,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
R. J. Hesselberg, and L. W. Nicholson.
Journal of Environmental Quality, Vol 10, No 3, p 315-318, July-September, 1981. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Polychlorinated biphenyls, *DDT, *Trout, Water pollution effects, Pollutants, *Lake Michigan, DDE, Fish, Sublethal effects, Pesticides, Chlorinated hydrocarbons, Bioaccumulation, Metabolism.

Several species of fish in Lake Michigan, particularly lake trout, were heavily contaminated with DDT and its metabolites during the 1960s. Although DDT was banned in the states bordering the lake in 1970, researchers predicted that more than a century would be needed to reduce DDT contamination below detectable levels. However, by 1976, residues of total DDT in lake trout from Lake Michigan had declined from 10.5 micrograms per gram in 1970 to 5.7 micrograms per gram. The detection of relatively high concentrations of polychlorinated biphenyls (PCBs) in lake trout tissues during this period led to the hypothesis that uptake and elimination of DDT and DDE by the fish may have been influenced by the accumulation of PCBs in the fish. Fingerling lake trout were exposed to various combinations of DDT and DDE (100 nanograms per liter) and PCBs (100 and 500 nanograms per liter) in water for 12 weeks in order to determine what, if any, effect PCBs had on the uptake or elimination rates of DDT and DDE. PCB exposure was continued for an additional 16 weeks after completion of exposures to DDT and DDE in order to measure any effect the PCBs might have on DDT and DDE elimination by the fish. Comparison of the DDT and DDE accumulation and elimination rates showed that PCBs did not influence these processes in lake trout. These results indicate that the decline of DDT and DDE in fish from Lake Michigan is not related to the presence of PCBs, but actually reflects a decrease in the amount of these contaminants available to the fish from the food or water. (Carroll-FRC)
W82-01342

A HYDROBIOLOGICAL SURVEY OF A POLLUTED CANAL,

Baghdad Univ. (Iraq). Dept. of Biology.
M-B. M. Mohammad.
Hydrobiologia, Vol 74, No 2, p 179-186, September, 1980. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Water quality, *Wastewater disposal, *Aquatic life, *Water pollution effects, *Qanat Al-Jaish Canal, *Iraq, Canals, Benthic fauna, Invertebrates, Macroinvertebrates.

The chemical, physical, and biological aspects of the 23.5 km long, 25 meters wide, and 1.5 meters deep Qanat Al-Jaish canal, Baghdad, Iraq, is documented. The canal receives wastewater from the Jamila residential quarter and contains a variety of waste and refuse. Sampling at 4 stations over a 12-month period starting February 1978 showed that species diversity of net aquatic life varied inversely with the degree of pollution as measured by BOD (3.2-20 mg pr liter). In the benthos, diversity indices increased with increases in amounts of silt and organic detritus. Fauna in the canal consisted of 41 species in 6 phyla, arranged in order of abundance: Arthropoda, Annelida, Aschelminthes, Mollusca, Platyhelminthes and Rhynchocoela. The indices of diversity were not directly related to concentrations of phosphate (6.0-8.5 mg per liter), nitrite (0.3-0.46 mg per liter), ammonia (0.55-0.79 mg per liter), temperature (11-31 degrees C), oxygen content (0-9 mg per liter), chloride (70-130 mg per liter), hardness (400-600 mg per liter), pH (7.0-7.9), Secchi disk transparency (0.1-0.7 meters), and water velocity (0.5-1.3 meters per sec). The waste stream entering the canal contained no macroscopic animals except for the pollutant-resistant tubificid worm, Limnodrilus. The waste stream, with high levels of salts and low levels of dissolved oxygen, raised the canal BOD from 5 mg per liter to 11-20 mg per liter, with a reduction to 10-15 mg per liter within 14 km downstream. (Cassar-FRC)
W82-01356

MINING POLLUTION AND THE DIET OF THE PURPLE-STRIPED GUDGEON MOGURNDA MOGURNDA RICHARDSON (ELEOTRIDAE) IN THE FINNISS RIVER, NORTHERN TERRITORY, AUSTRALIA,

Australian Atomic Energy Commission Research Establishment, Lucas Heights.
R. A. Jeffree, and N. J. Williams.
Ecological Monographs, Vol 50, No 4, p 457-485, December, 1980. 5 Fig, 15 Tab, 102 Ref.

Descriptors: *Mine drainage, *Fish, *Diets, Heavy metals, Sulfate, Mine wastes, Industrial wastes, Aquatic animals, Toxicity, *Finniss River, *Australia, Water pollution effects, Eleotridae, Abandoned mines, Copper mines, Uranium mines.

The diet of the freshwater eleotrid Mogurnad mogurnda Richardson in the Finniss River, Australia, was investigated, and pollutants in the river were determined which reach the river from Rum Jungle, an abandoned uranium/copper mining area. The pollutant discharge contained large amounts of copper, zinc, manganese, and sulfate at low pH values. The fish ate high abundances of animals of the taxa Dytiscidae, Chironomidae, Ceratopogonidae, Trichoptera, Odonata, Copepoda, and Pisces. Five foods were more abundant in the diets of the polluted zone, and three in those of the unpolluted zone. Two categories of foods were contrasted for their usefulness in distinguishing between the zones by both hierarchical agglomerative and discriminant function analysis. Aquatic respirers were more effective than those obtaining oxygen directly from the atmosphere or via a film or bubble of air. The relevance for pollution studies of dietary analysis rather than sampling fauna directly is discussed in terms of food substitution.

switching, strategies for abundance and recovery by the fauna, and possible effects of pollutants on the fish as an intervening collector. (Small-FRC)
W82-01366

EVALUATION OF THE POLLUTED RIVER SAVINJA WITH THE HELP OF MACROPHYTES,

Ljubljana Univ. (Yugoslavia). Biological Inst.
D. Vrhovsek, A. Martincic, and M. Kralj.
Hydrobiologia, Vol 80, No 2, p 97-110, May, 1981. 6 Fig, 7 Tab, 23 Ref.

Descriptors: *Monitoring, *Pollution load, *Rivers, Environmental protection, Water pollution control, *Savinja River, *Yugoslavia, Saprophytic bacteria, Oligotrophy, Trophic level, Mesotrophy, Aquatic plants, Water quality, Water pollution effects.

The influence of inorganic and organic pollution on the river Savinja, Slovenia, a typical Alpine river in its upper part and a lowland river in its lower part, was evaluated with the help of macrophytes. Mosses were particularly helpful in quantitative estimations of the percentage of their coverage and species composition. All other emersal and submersal plants were also listed and included in the qualitative interpretations of the degree of saprobicity. Qualitative and percentile composition was investigated at nine points along the Savinja river, chosen with the intention of determining gradual changes in macrophyte growth on account of the water current and the influence of individual pollutants. With the aid of species composition and stages of saprobicity, the Savinja can be divided into segments. The upper part is oligosaprobic, from Celje to Lasko beta mesosaprobic, and to the river's mouth alpha-beta mesosaprobic. When comparing the concentrations of some ions it was determined that they do not surpass the toxic levels and therefore the differences in species content are not the result of ion concentrations, but rather of the synergistic effects with other types of pollution. (Baker-FRC)
W82-01377

THE EFFECT OF POLLUTANTS FROM THE COAL INDUSTRY ON THE FISH FAUNA OF A SMALL RIVER IN THE SOUTH WALES COALFIELD,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
J. Scullion, and R. W. Edwards.
Environmental Pollution (Series A), Vol 21, No 2, p 141-153, February, 1980. 3 Fig, 5 Tab, 38 Ref.

Descriptors: *Fish populations, *Mine wastes, *Coal mines, *Acid mine drainage, Water pollution effects, Toxicity, Rivers, Trout, Iron, Mine drainage, Acid streams, Suspended solids, Silting, Water quality, Invertebrates, Fish food organisms, Population density, Taff Bargoed, *Wales.

The Taff Bargoed, a river in south Wales, receives pollution from coal mine sources at three separate locations: acid drainage from coal stockpiles in the headwaters, pumped mine water containing high levels of silt, and ferruginous drainage of neutral pH from old mine workings. Brown trout (Salmo trutta) populations and water quality were studied at 11 stations in the river. Trout density was very low, less than 0.05 per sq meter, downstream of acid and ferruginous drainage, in the latter cases as a result of poor invertebrate food supplies rather than toxic water. In the silty water, average suspended solids 100 mg per liter, trout densities of less than 0.15 per sq meter were found, and the fish were in poorer condition. Trout eggs had 85-87% hatching rates in unpolluted water, 1.3% downstream of the silty mine water and 13.3% downstream of the ferruginous drainage. The stoneback (Noemacheilus barbarulus L.) was reduced in density at the silted stations. Bullhead (Cottus gobio L.) has been essentially eliminated since 1969, probably as a result of the acid water. Minnows (Phoxinus phoxinus L.) were only found in the upper and middle reaches of the river and in patchy distribution. Eels (Anguilla anguilla L.) were absent from the upper reaches and rare elsewhere. (Cassar-FRC)
W82-01389

ABATE: EFFECTS OF THE ORGANOPHOSPHATE INSECTICIDE ON BLUEGILLS AND INVERTEBRATES IN PONDS,

Columbia National Fisheries Research Lab., MO.
H. O. Sanders, D. F. Walsh, and R. S. Campbell.
Technical Papers of the U.S. Fish and Wildlife Service, No 104, 1981. 8 p, 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Organophosphorus pesticides, *Toxicity, *Insecticides, *Bluegills, *Invertebrates, Growth, Immature growth stage, Fish food, Biomass, Larvicides, Aquatic insects, Enzymes.

The organophosphate insecticide Abate is used for controlling larvae of mosquitoes and black flies. In view of the possible broad use of Abate in different geographical locations, an attempt was made to evaluate the effects of this insecticide on pond fish and aquatic invertebrates. Application of Abate three times (at about montly intervals) to duplicate 0.04 ha earthen ponds at 18 g/ha (the recommended application rate) and 180 g/ha caused no mortality of bluegills. In ponds treated with 18 g/ha, fewer bluegill fry were produced than in control ponds, brain acetylcholinesterase activity was not affected, and accelerated growth of both fry and adults appeared to result from heavy feeding on dead or moribund Diptera larvae that resulted from each of the first two applications. In ponds treated with 180 g/ha, ovary development in bluegills was initially faster than in bluegills from control ponds, the number of fry produced per female was lower than in control ponds, brain acetylcholinesterase activity in bluegills was strongly inhibited after the second and third treatments, and biomass of Diptera in the ponds was reduced about 40%, but other invertebrates were unaffected. The routine use of Abate at the recommended rate should have little adverse effect on fishery resources. (Moore-SRC)
W82-01445

ENVIRONMENTAL IMPACT AND HEALTH EFFECTS OF WASTEWATER CHLORINATION,

Illinois Univ. at the Medical Center, Chicago, IL. School of Public Health.
For primary bibliographic entry see Field 5D.
W82-01451

THE EFFECT OF FERTILIZATION WITH PHOSPHORUS AND NITROGEN VERSUS PHOSPHORUS ALONE ON EUTROPHICATION OF EXPERIMENTAL LAKES,

Fisheries and Marine Service, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler.
Limnology and Oceanography, Vol 25, No 6, p 1149-1152, November, 1980. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Nutrients, *Eutrophication, *Phytoplankton, Nitrogen compounds, Phosphorus compounds, *Lakes, Fertilizers, Chlorophyll, Water pollution effects, Ice, Productivity.

A paper by Fee (1979) (See W80-02462) on the relation between lake morphometry and primary productivity and its use in interpreting whole-lake eutrophication experiments was criticized on several points. An erroneous conclusion was drawn that the fertilization of a lake with both P and N caused larger increases in chlorophyll than fertilization with P alone. In addition, phosphorus inputs were uncorrected, and no allowance was made for a lag in phytoplankton response to changes in a lake's loading regime. Furthermore, it was erroneous to state that winter disposal apparently only slightly reduced the effect of nutrient additions. The author of these comments concluded that in the experimental lakes under investigation, which are near equilibrium in P loading, chlorophyll concentrations are not dependent on the amount of N added. P loading, corrected for water renewal, accounted for 80% of the variance in chlorophyll regardless of N:P ratio in the loading. Removal of nutrients under winter ice or into the hypolimnion greatly reduces chlorophyll concentration. (Cassar-FRC)
W82-01457

COMPARISON OF FIRST-ORDER ERROR ANALYSIS AND MONTE CARLO SIMULATION IN TIME-DEPENDENT LAKE EUTROPHICATION MODELS,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-01460

ORGANIC CONTAMINATION OF GROUND WATER: TELL IT ALL,

Dedham Water Co., MA.
P. Burden.
Journal of the New England Water Works Association, Vol 95, No 2, p 109-118, June, 1981. 4 Fig.

Descriptors: *Public relations, *Water conservation, *Groundwater pollution, *Water supply, Water conveyance, Public opinion, Public health, *Dedham, Massachusetts, Trichloroethane, Trichloroethylene, Water demand, Water pollution.

The community relations effort by the Dedham Water Company in Massachusetts after about 30% of the total water supply was lost due to organic contaminants is described. Increased consumer understanding of the problem facing the water company resulted in better community cooperation. The potential for customer water demand to exceed the available supply of 50 mgd over the Memorial Day weekend made necessary a general meeting with municipal and state officials, and the use of newspapers, radio, and television. The initial information released to the public told of the steps leading to the discovery of trichloroethane and trichloroethylene contamination, the attempts to determine the source of contamination, the adverse impact on total water supply by having to remove two wells from service, the type of restrictions placed on water use, and the steps the utility was taking to restore full service to customers. A data sheet on the company was also made available. A letter was also mailed to 11,500 customers. The program was successful in reducing water demand to the required levels. (Small-FRC)
W82-01474

THE INTERACTION OF TREATED BLEACHED KRAFT MILL EFFLUENT AND DISSOLVED OXYGEN CONCENTRATION ON THE SURVIVAL OF THE DEVELOPMENTAL STAGES OF THE SHEEPSHEAD MINNOW (CYPRINODON VARIEGATUS),

Academy of Natural Sciences of Philadelphia, PA. Benedict Estuarine Research Lab.
W. C. Graves, D. T. Burton, L. B. Richardson, and S. L. Margrey.
Water Research, Vol 15, No 8, p 1005-1011, August, 1981. 6 Tab, 41 Ref.

Descriptors: *Pulp wastes, *Dissolved oxygen, Fish, *Fish toxins, Kraft mills, Pulp and paper industry, Industrial wastes, Ecological effects, Growth stages, Water pollution effects.

The interaction of various dissolved oxygen concentrations on the acute toxicity of treated bleached kraft mill effluent (BKME) was investigated using sheepshead minnow: embryos, fry, juveniles, and adults. The comparative sensitivity among developmental stages was determined. The interaction between dissolved oxygen concentration and effluent toxicity was assessed by exposing the organisms to a complete composite design in a 3 x 3 factorial matrix with two replicates per cell. Nominal effluent test concentrations were 0, 50 and 100%, and nominal DO concentrations were 1.0, 3.0, and 5.0 mg/liter. Effluent concentration influenced embryo survival, but there was no reaction to DO concentration. The survival of fry was related to DO concentration, with no interaction with BKME concentrations up to 100%. Juvenile minnows demonstrated increased sensitivity to BKME at a nominal DO concentration of 1.0 mg/liter. BKME did not affect adult fish under any of the conditions tested. Thus, the toxicity of BKME to the minnow is a function of developmental stage and DO concentration. (Small-FRC)
W82-01494

EFFECT OF COPPER ON NITRIFICATION IN ACTIVATED SLUDGE,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
F. Braam, and A. Klapwijk.
Water Research, Vol 15, No 9, p 1093-1098, September, 1981. 10 Fig, 3 Tab, 10 Ref.

Descriptors: *Copper, *Nitrification, *Activated sludge, Hydrogen ion concentration, Nitrilotriacetic acid, Bacteria, Microorganisms, Heterotrophic bacteria, Toxicity, Water pollution effects.

The nitrification rate in activated sludge was affected by the free copper concentration in bath experiments. In turn, the free copper concentration was influenced by pH, sludge concentration, and the presence of nitrilotriacetic acid (NTA). Free copper concentrations increased with decreases in pH. For example, with 9.13 times 10 to the minus 5th power mol Cu per liter the free copper concentration was 4.0 times 10 to the minus 7th power mol per liter at pH 6.5 and 10 to the minus 8th power mol per liter at pH 8.4. At constant pH, free copper concentrations as a function of added copper were greater at 0.7 g per liter of mixed liquor suspended solids than at 1.4 g per liter. Extending the copper exposure period from 1 day to 3 days did not improve the nitrification rate; the organisms did not acclimatize to copper. Addition of NTA, a strong copper-complexing agent, allowed recovery of the nitrification rate; the longer the interval between copper addition and subsequent NTA addition, the longer the recovery time. Nitrifying bacteria were no more or less sensitive to copper toxicity than were heterotrophic microorganisms. (Cassar-FRC)
W82-01497

THE EFFECTS OF A NEW RESERVOIR ON THE ATTACHED DIATOM COMMUNITIES IN HUNTINGTON CREEK, UTAH, U.S.A.,

Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
For primary bibliographic entry see Field 2H.
W82-01521

ENVIRONMENTAL RECOVERY IN A MARINE ECOSYSTEM IMPACTED BY A SULFITE PROCESS PULP MILL,

Victoria Univ. (British Columbia).
For primary bibliographic entry see Field 5B.
W82-01548

THE EFFECTS OF ORGANOPHOSPHORUS PESTICIDES ON ESTUARINE AMMONIUM OXIDIZERS,

University of West Florida, Pensacola. Dept. of Biology.
R. D. Jones, and M. A. Hood.
Canadian Journal of Microbiology, Vol 26, No 11, p 1296-1299, 1980. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Organophosphorus pesticides, *Ammonium, *Pesticides, Water pollution effects, Insecticides, Methyl parathion, Parathion, Guthion, Fonofos, EPN, Abate, Dicapthon, Phenols, Sediments, *Estuarine environment, Oxidation, Nitrites, Anaerobic conditions, Aerobic conditions, Aquatic bacteria, Bacteria, Microbial degradation.

The effects of seven organophosphate pesticides and their degradation products on ammonium oxidation (nitrate formation) in the estuarine environment were studied with pure compounds in axenic cultures, with pure compounds in natural sediment populations, and with aged pesticides in axenic cultures. Ammonium oxidation inhibition at the level of 10 mg per liter pesticide was less than 1% for methyl parathion, EPN, guthion, and dicapthon; 3% for abate; 5% for parathion; and 32% for fonofos. Inhibitions by degradation products of methyl parathion at 10 mg per liter were: methyl paraoxon, zero; p-nitrophenol, 25%; and p-aminophenol, 100%. Nitrite inhibition by 10 mg per liter pesticides and degradation products in natural sediments varied with time of incubation. Guthion, fonofos, methyl parathion, and parathion cultures were almost completely inhibited by day 14, but some showed increased temporary activity about day 9. In aging studies using methyl parathion, parathion, and guthion nitrite production (in mg nitrite-N per liter) was as follows: unaged-84.1-86-0; aerobic conditions-control 83.7, pesticides, 74.4-75.4; static aeration--control 88.4, pesticides, 69.2-77.9; and anaerobic conditions--control, 35.4, pesticides 24.5-27.3. Data suggest that parent compounds have little effect on ammonium oxidation in estuarine sediments, but certain pesticide metabolites may reduce ammonium oxidation, especially under anaerobic conditions. (Cassar-FRC)
W82-01567

ACID PRECIPITATION: BASIC PRINCIPLES AND ECOLOGICAL CONSEQUENCES,

North Carolina State Univ. at Raleigh.
E. B. Cowling, and C. B. Davey.
Pulp and Paper, Vol 55, No 8, p 182-185, August, 1981. 25 Ref.

Descriptors: *Acid rain, *Pulp and paper industry, *Forests, Water pollution effects, Ecological effects, Air pollution, Aquatic life, Soil chemistry, Heavy metals, Nutrient loss, Water quality.

The pulp and paper industry is involved with both the cause and effects of acid precipitation. It is responsible for small, but locally important, emissions, and it owns a significant share of forest land impacted by this pollution. Although significant quantities of desirable plant nutrients (nitrogen and sulfur) are added to the forest system by precipitation, the acidity and its determental effects may outweight the benefits. Damage to the ecosystem is most likely to occur when major inputs of acid precipitation coincide with sensitive stages of a life form (such as fish eggs and larvae), and in poorly buffered, noncalcareous soils and rocks. In the laboratory and field, many biological effects of acid precipitation have been demonstrated--necrotic lesions on foliage, nutrient loss from foliar organs, reduced resistance to pathogens, accelerated erosion of waxes on leaf surfaces, reduced rates of decomposition of leaf litter, inhibited formation of terminal buds, increased seedling mortality, and heavy metal accumulation. Soil microbiological processes such as nitrogen fixation, mineralization of forest litter, and nitrification of ammonium compounds are inhibited, the degree depending on degree of cultivation and soil buffering capacity. Water quality is impacted by contact with vegetation, soil, and bedrock. Acid precipitation mobilizes cations, especially the toxic Al, Mn, and Zn, and nutrients, K, Ca, and Mg. (Cassar-FRC)
W82-01586

STRATEGIES OF RESPONSE TO COPPER, CADMIUM, AND LEAD BY A BLUE-GREEN AND A GREEN ALGA,

Ottawa Univ. (Ontario). Dept. of Biology.
V. M. Laube, C. N. McKenzie, and D. J. Kushner.
Canadian Journal of Microbiology, Vol 26, No 11, p 1300-1311, 1980. 7 Fig, 6 Tab, 33 Ref.

Descriptors: *Algae, *Heavy metals, *Toxicity, Water pollution effects, Fate of pollutants, Chlorophyta, Cyanophyta, Growth rates, Food chains, Metals, Copper, Cadmium, Lead, Eutrophication, Nitrilotriacetic acid, Chelation, Accumulation, Sediments, Ecological effects.

Interactions between algae and heavy metals varied with the type of algae and the metal. Heavy metal ions, Cu(2+), Cd(2+), and Pb(2+), inhibited growth of the cyanophyte, Anabaena strain 7120, and the chlorophyte Ankistrodesmus braunii. Complete inhibition was observed at 0.0001 and 0.001 M Cu and Cd, and a lag in growth at lesser concentrations. In 0.0001, 0.00001, and 10 to the minus 8th power M Pb, cells grew as well as controls. Intermediate Pb concentrations of 10 to the minus 6th power and 10 to the minus 7th power were more inhibitory than some higher concentrations because of precipitate formation at concentrations higher than 0.00001 M. Addition of the chelating agent nitrilotriacetic acid did not protect the algae from metal toxicity. In Anabaena 7120 lysis occurred in early but not late stages with Cu; the other metals did not cause lysis. A. braunii cells were not lysed by any of the metals. Anabaena 7120 growing in 0.00001 M Cu did not accumulate Cu within the cell, but about half the Cd was cell-associated in Anabaena cells growing in 0.00001 M Cd. A. braunii bound substantial amounts of Cu and Cd during growth in metal ion solutions. When algae were grown over dialysis sacs containing sediment with 100 ppm Cu(2+) or Cd(2+), metals were mobilized from the sediment and accumulated in the A. braunii cells and culture medium. In Anabaena 7120 cultures, Cd removed from the sediment was found in cells and culture medium, but Cu was associated entirely with the culture medium. Large algal blooms could be a significant factor in accumulating toxic metals from the water and sediments and thus entering the food chain. (Cassar-FRC)
W82-01598

5D. Waste Treatment Processes

RECLAMATION OF WASTEWATER WITH A SOIL-TURF FILTER: I: REMOVAL OF NITROGEN,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
E. L. Anderson, I. L. Pepper, and W. R. Kneebone.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1402-1407, September, 1981. 2 Fig, 7 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Filtration, Filtered wastewater, Clay, Sand, Nitrogen, Filter media, Water quality, *Soil-turf filter.

Maximum rates at which secondary treated wastewater could be applied to a soil-turf filter without harming the turf and still yield leachate averaging less than 10 mg/liter nitrate-nitrogen were determined. Two lysimeter units were filled with 95% sand, 1% silt, and 4% clay. Ten others were filled with 89% sand, 5% silt, 4% clay, and 2% organic matter. Both soils had a pH of 8.3. All plots were seeded to bermudagrass. Overseeded annual ryegrass was grown during cooler seasons. Plots were drip-irrigated with secondary wastewater twice a week. Secondary treated wastewater was obtained from the Randolph Park Sewage Treatment Plant. Nitrogen in the wastewater varied seasonally from 3 to 23 mg/l ammonium-nitrogen, from 0.5 to 16 mg/l nitrate nitrogen, and from 1 to 5 mg/l organic nitrogen. During the first 6 weeks of the study less than 10% of the applied N was recovered in leachates. These initial high removal values were probably the result of ammonium adsorption in the soil and high turf grass use, as plots had not been fertilized for 3 months prior to the study. Stepwise regression equations showed that predictions of nitrate-nitrogen concentration in leachate could be based mainly on the rate of wastewater application. Season and dry weight yield of turf clippings were also important factors. In summer the sand-turf filter could renovate a maximum 12.7 cm/week, yielding 9 cm/wk recharge, compared to 18.7 cm/wk, yielding 12.5 cm/wk recharge for the mix-turf filter. Selection of soils with a higher clay content would increase purification of the wastewater, but decrease the volume of recharge water. (Baker-FRC)
W82-01101

RECLAMATION OF WASTEWATER WITH A SOIL-TURF FILTER: II: REMOVAL OF PHOSPHORUS, BORON, SODIUM AND CHLORINE,

Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
E. L. Anderson, I. L. Pepper, W. R. Kneebone, and R. J. Drake.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1408-1412, September, 1981. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Filtration, Filtered wastewater, Filter media, Sodium, Calcium, Magnesium, Boron, Phosphorus, Chlorine.

This paper discusses the removal and potential hazards of phosphorus, boron, sodium, and chlorine from wastewater secondarily treated by means

of a soil-turf filter. Ten lysimeters were filled with sand, and ten were filled with mix. Plots were drip-irrigated with secondarily treated wastewater at high loading rates. Lysimeter leachate was collected and analyzed. As the rate of application of wastewater increased, leachate P concentrations significantly increased. Once the soil became saturated with P, more P remained in solution. For recharge purposes, application rates of wastewater to the soil-turf filter were limited primarily by leachate nitrate concentrations currently determined by the US EPA. Summer values were 12.7 cm/wk for the sand-turf fiter compared to 18.7 cm/week for the mix-turf filter. Corresponding winter values for sand and mix were 13.6 and 21.9 cm/wk, respectively. Boron as borate is not retained by a soil-turf filter because it is an anion and not held by exchange sites, nor is it easily precipitated in the soil. Hence leachate concentrations of B were similar to those of wastewater. Sodium was not removed by a soil-turf filter, but in itself is unlikely to be a human health hazard of the reclamation process. Chlorine concentrations were generally low due to sunlight-induced degradation of chlorine during aerated lagoon storage of wastewater. Overall, the reclamation system described would seem to have good potential for reducing water deficits in the southwestern US. (Baker-FRC)
W82-01102

BACTERIA: MAN'S ALLIES IN WATER POLLUTION CONTROL,

China Features, Beijing (China).
H. Lin.
Environmental Management, Vol 4, No 4, p 285-286, July, 1980. 1 Fig.

Descriptors: *Chemical wastes, *Bacteria, *Biodegradation, *Water pollution control, Wastewater treatment, Industrial wastewater, Organic compounds, Degradation, Ponds, Fish, Aquatic animals, Toxicity, Ya'er Lake, *China.

Bacteria were used to treat organic chemical manufacturing wastes in a series of three purification ponds before entering the 7000 hectare Ya'er Lake, Hubei Province, People's Republic of China. The first and second ponds, 100 ha each, use the native pond bacteria to decompose the organic wastes for 100-120 days, during which 80-90% of the pollution is eliminated. Fish in the third pond, 210 ha, are healthy and show no abnormalities. Water from this pond enters the lake pollution-free. Prior to 1976, when this treatment system was built, the few fish and shrimp surviving in the polluted lake were not fit for human consumption. The methods developed here have been applied to other industrial wastewaters as well. (Cassar-FRC)
W82-01158

DEMONSTRATION TESTING OF ALUM RECOVERY BY LIQUID ION EXCHANGE,

Michigan State Univ., East Lansing. Dept. of Civil Engineering.
D. A. Cornwell, G. C. Cline, J. M. Przybyla, and D. Tippin.
Journal of the American Water Works Association, Vol 73, No 6, p 326-332, June, 1981. 12 Fig, 7 Tab, 6 Ref.

Descriptors: *Ion exchange, *Alum, *Sludge conditioning, Coagulation, Water treatment, Pilot plants, *Tampa, Florida.

A pilot plant for alum recovery from water treatment sludge by liquid ion exchange was operated at the Tampa, Florida, Hillsborough River plant. The major components of the 0.63 liter per sec system were sludge collection and feed, extraction, stripping, and residual sludge treatment. Both types of mixing, rapid and slow, recovered more than 90% of the alum. It is predicted that the full-scale plant would have a similar recovery. The solvent consisted of 15% volume to volume octyl acid phosphate, 2% tributyl phosphate, and 83% petroleum solvent (Kermac 627). Of the two process flow schemes the contactor performed better than the mixer-settler. The contactor was easier to operate, did not produce phase inversion or raffinate entrainment in the extract, and had a much smaller bleed solids stream requiring solvent recovery. However, the contactor required a longer detention time and was more expensive to construct. The quality of the recovered alum was similar to that of the commercial alum. There was no significant buildup of Ba, Na, Cu, Cr, Mg, Mn, or Ag. Zn and Pb were extracted at low concentrations, and the metal concentrations in the recovered alum were in the same range as in the commercial alum. Total organic carbon was 206 mg per liter, compared with 100 mg per liter in commercial alum. Recovered alum contained 34 g per liter Al(3+), but when adjusted to 17.1% Al2O3, jar test results were identical for recovered and commercial alum. The sludge showed a 50% reduction and readily settled to a 10% solids concentration. (Cassar-FRC)
W82-01167

ADVANCED WASTEWATER PLANT IS ENERGY SAVER,

Capital Consultants, Inc., Lansing, MI. Industrial and Environmental Div.
R. T. Beaupre, W. T. Harvey, and J. R. Marry.
Water/Engineering and Management, Vol 128, No 8, p 30-33, August, 1981. 1 Fig, 2 Tab.

Descriptors: *Biological wastewater treatment, *Wastewater treatment facilities, *Treatment plants, Gravity filters, Aeration, Ammonia, Biochemical oxygen demand, Energy, Economic aspects, *Advanced wastewater treatment.

A new advanced wastewater treatment plant built for Charlotte, Michigan, uses rotating biological disc units. The secondary treatment system consists of 12 electro-mechanically driven rotating biological discs. The primary and secondary processing was designed to remove 90% BOD5 and suspended solids and 95% ammonia at an average wastewater flow of 1.2 mgd. Outdoor concrete tanks with mixed media beds, precast concrete underdrains, water surface wash, and pneumatic controls make up the gravity filters. A reaeration systems ensures a minimum of 5.0 mg/liter of dissolved oxygen in the final effluent. The sludge digestion system is a high-rate, two-stage system which generates digester gas. Primary heating for the control building is provided by three water-to-air heat pumps which operate with the chlorinated final effluent. These heat pumps provide heating, ventilation, dehumidification, and cooling. The low bid for construction of the facility was $4,895,000, and the plant was completed in August 1980. (Small-FRC)
W82-01177

A SUCCESSFUL LOW TECHNOLOGY WASTEWATER PROCESS,

Donohue and Associates, Inc., Sheboygan, WI. Environmental Div.
P. P. Stecker.
Water/Engineering and Management, Vol 128, No 8, p 46, 47, 49, August, 1981. 2 Fig.

Descriptors: *Filtration, *Sand filters, *Seasonal variation, Wastewater treatment, Performance evaluation, Recreation wastes, Economic aspects, Biochemical oxygen demand, Nitrification, Lake Michigan, Barleys Harbor, *Wisconsin.

A circulating sand filtration system was installed in the small resort town of Baileys Harbor, Wisconsin. Activated sludge and rotating biological systems were also considered for the site, but they could not as easily produce a 20 mg/liter effluent, would be more difficult to operate, and would be less able to accomodate the varying wastewater loadings. The recirculating sand filter effluent was discharged to a wetland, as this cost $500,000 less than a Lake Michigan discharge. The system is made up of a septic tank and the intermittent sand filter. The system produces effluent BOD and suspended solids levels of 10 to 20 mg/liter or less, and high levels of 10 to 20 mg/liter or less, and high levels of nitrification are also obtained. Sand with an effective size in the range of 0.25 to 1.5 mm was used in the filter. The system easily handles wide seasonal or weekly variations in wastewater flow. (Small-FRC)
W82-01178

PHARMACEUTICAL COMPANY'S AERATION SYSTEM SAVES ENERGY,

Hoffmann-la-Roche, Belvidere, NJ.
J. S. Brandl.
Industrial Wastes, Vol 26, No 2, p 16, 19, March/April, 1980.

Descriptors: *Wastewater treatment, *Industrial wastes, *Aeration, Aerobic digestion, *Pharmaceutical industry, Mechanical equipment, Activated sludge process, Mixing, Oxygenation, Energy conservation.

An expanded wastewater treatment plant at the Hofmann-la-Roche facility processes all the industrial waste water (about 98%) and the sanitary sewage (about 2%) from the plant's 1000 employees. During periods of rain the entire facility's rooftop surfaces, diked areas, and tank farm drain into the treatment plant. A total of 2 MGD, on the average, flow to the treatment plant, which discharges effluent to the Delaware River within the limits of the EPA NPDES permit. The aeration system is efficient, providing cost savings in electric power. A two-stage activated sludge system functions as the heart of the treatment plant. The wastewater treatment plant is manned 24 hr, seven days a week, by 11 licensed operators. The annual budget to run the plant is in excess of $1,000,000. Wastewater entering the treatment plant has a pH ranging from 2.0 to 12.5, an average temperature of 90 degrees F and an average 5-day BOD of 1,000 mg/liter. The average daily flow is 2 MGD and presently ranges from 1.6 to 2.2 MGD. Grit is removed in a 75,000 gal pre-clarifier, before wastewater enters the equalization ponds. From the primary clarifiers the wastewater enters the two-stage activated sludge process. The flow is nutrient adjusted by adding either ammonium hydroxide or phosphoric acid. All sludges generated are sent to the aerobic digester where detention time is 20-30 days. (Baker-FRC)
W82-01180

HIGH-SOLUBILITY GAS FLOTATION,

Union Carbide Corp., South Charleston, WV. Chemicals and Plastics.
R. A. Conway, R. F. Nelson, and B. A. Young.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1198-1205, July, 1981. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Sludge thickening, *Flotation, *Solubility, Activated sludge, Digestion, Performance evaluation, *Wastewater treatment, Industrial wastes, Separation techniques.

A comprehensive bench-scale evaluation was made of dissolved gas flotation for sludge thickening, comparing air and two potentially available higher solubility gases. The two process gases chosen for comparison with air were an off-gas from an oxygen activated sludge system and combusted digester gas. Flotation tests using each gas were conducted with an industrial recycle sludge, 9900 mg/liter total suspended solids, at R/Q values (ratio of recycle to sludge flow) of 0.11 to 1.5. Another duplicate series was run at R/Q = 0.97 with coagulant addition. Results indicated that the operation of existing dissolved-air systems could be improved by decreasing the recycle flow or increasing the sludge flow. Also, a new flotation system could be smaller and more competitive if high-solubility gases were used. Combusted digester gas was effective at a gas to solids ratio of 0.01 to 0.04, while oxygen activated sludge gas was effective at a gas to solids ratio of 0.04 or greater. (Small-FRC)
W82-01184

ENERGY REQUIREMENT FOR SMALL WASTEWATER TREATMENT SYSTEMS,

Utah State Univ., Logan. Coll. of Engineering.
E. J. Middlebrooks, C. H. Middlebrooks, and S. C. Reed.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1172-1197, July, 1981. 15 Fig, 24 Tab, 14 Ref.

Descriptors: *Energy, *Wastewater treatment, *Costs, Economic aspects, Data collections, Ponds, Infiltration, Overland flow, Secondary treatment.

Energy requirements are summarized for all viable alternatives available for the treatment of flow rates of 190 to 19,000 cu m/day of wastewater. Data are presented in tabular form, and most unit operations and processes can be estimated by combining data. As energy costs increase, they are fast becoming the predominant factor in the selection of small-flow treatment systems. Low energy systems are attractive because they are often easier to maintain and minimize highly skilled operation requirements. The most energy efficient system described is a facultative pond followed by rapid infiltration. If surface discharge is necessary and impermeable soils exist, a facultative pond followed by overland flow is the second most energy efficient system considered. Physical-chemical advanced secondary treatment systems utilize the most energy of conventional systems which meet the federal standard effluent requirements. (Small-FRC)
W82-01185

DATA BASE DEVELOPMENT FOR THE DESIGN OF A RADIUM-226 REMOVAL PROCESS,

Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. W. Averill, P. M. Huck, G. H. Kassakhian, D. Moffett, and R. T. Webber.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1233-1242, July, 1981. 6 Fig, 7 Tab, 6 Ref.

Descriptors: *Data collections, *Radium-226, *Chemical precipitation, *Wastewater treatment, Barium, Clarification, Filtration, Pilot plants, Radium radioisotopes.

Benchmark and pilot plant studies were performed on mechanical wastewater treatment systems to remove radium-226 from impoundment area effluents. Two wastewater treatment processes have been evaluated thus far; both of them incorporate barium-radium coprecipitation in series-connected stirred tank reactors. A clarification process included coprecipitation followed by rapid mixing of a chemical coagulant, flocculation in series connected mechanical flocculators, and solids-liquid separation in a clarifier. The other process is a filtration process which includes coprecipitation followed directly by solid-liquid separation using chemically aided granular media filtration. Both processes produced total radium-226 activity levels of less than 0.37 Becquerel/liter and dissolved radium-226 levels approaching or equal to 0.11 Becquerel/liter. The results of these studies make up a preliminary data base on physico-chemical treatment methods for radium-226. The processes will be tested under steady-state conditions. (Small-FRC)
W82-01188

DENITRIFICATION OF BLACKWATER WITH GREYWATER,

Connecticut Univ., Storrs. Dept. of Civil Engineering.
R. Laak, M. A. Parese, and R. Costello.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE3, p 581-590, June, 1981. 2 Fig, 3 Tab, 15 Ref. OWRT-A-999-CONN(20), 14-34-0001-0107.

Descriptors: *Denitrification, *Biological treatment, *Domestic wastes, Nitrogen removal, Performance evaluation, *Wastewater treatment, Organic carbon, Wastewater.

A nitrogen removal technique called RUCK is being developed for on-site systems, which will be useful where nitrate pollution from septic tank systems may be a potential problem. It is a biological technique which is passive, energy-free, and requires no more maintenance than a septic tank. The system was field tested for nitrogen removal efficiency at a house site using laundry and sink wastes as the organic carbon source, and at condominiums using the entire greywater flow. Blackwater and greywater flowed into separate septic tanks. Blackwater passed through a subsurface sand bed and then to a rock filter tank, while greywater went straight to the rock filter tank. Final treatment was a seepage bed. Nitrifying reactors of 1.5 ft of concrete-sand media provided a reliable method for the nitrification of blackwater septic tank effluent. Comparable denitrification efficiencies were obtained using either greywater or methanol as a carbon source. When greywater and blackwater are separated, an overall nitrogen removal of over 70% can be achieved. (Small-FRC)
W82-01225

PHYSICAL AND CHEMICAL METHODS,

Florida Univ., Gainesville.
J. Zoltek, Jr., and E. L. Melear.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 679-687, June, 1981. 158 Ref.

Descriptors: *Physicochemical treatment, *Wastewater treatment, Industrial wastewater, Organic compounds, Water reuse, Coagulation, Filtration, Membrane processes, Adsorption, Activated carbon, Ion exchange, Oxidation, Reviews.

New developments in physical and chemical methods of wasteater treatment are reviewed. Water reuse is a reality at several plants. Topics classified under coagulation and solids separation include dissolved air flotation and foam separation. Polymers removed wastewater components in woolscour effluent, kraft liquor, and raw wastewater. Phosphates were precipitated by fly ash extract, alum, iron and aluminum hydroxides, oxygen nitrification, and FeC13-lime. Efficiency and mechanisms of coagulation, sedimentation, and filtration were discussed in about 30 papers. Activated carbon was the most commonly reported adsorption material for wastewater treatment. In addition to theoretical studies, papers describe activated carbon treatment for a variety of organic chemicals and oil refinery wastewater. Other adsorbents mentioned were synthetic resins, sludges, sediments, clays, and peat. Ion exchange systems were used to remove heavy metals, detergents, ammonium, hydrochloric acid, and low molecular weight organic acids. Membrane processes successfully treated waters containing radium, thio salts and metal ions from mining effluents, paraffin oil/water emulsions, polyvinyl alcohol, and inorganic salts inmine water. Suspended solids (60%) and BOD (27%) were removed in a combined sewer system flow by ultra high rate filtration. Air, oxygen, or ozone were used to oxidize various pollutants--hydrogen sulfide, phenols, toxic refractories, nitrilotriacetic acid, cyanide, and surfactants. (Caesar-FRC)
W82-01241

BIOLOGICAL FILTERS,

Brigham Young Univ., Provo, UT.
S. L. Klemetson, and G. L. Rogers.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 687-700, June, 1981. 144 Ref.

Descriptors: *Biological filters, *Rotating biological contactors, *Reviews, *Wastewater treatment, Filters, Trickling filters, Nitrification, Anaerobic conditions, Fluidized beds, Aquaculture.

Rotating biological contactors (RBC) formed the topic of more than half of the recent papers on the subject of biological filters in wastewater treatment. Among the apsects of RBC discussed were: microbial populations, biofouling, kinetics of denitrification, kinetics of nitrification, mathematical models, operating and performance, oxygen transfer, anaerobic RBC, pressurized systems, ferrous iron removal, and treatment of specific wastewaters (explosives, phenol-formaldehyde, aquaculture, chemicals, tanneries, and combined sewer overflows). Fixed biological filters were successfully adapted for many applications. However, problems were experienced in pesticide removal. Fluidized bed reactors were studied theoretically and using models. The most promising adsorbent for removing residual organics was activated carbon. A fluidized bed process removed 95% of the BOD from corn wet milling wastewater. Use in domestic and industrial waste treatment is still in the experimental stage. Anaerobic biological filters treated vegetable tanning effluents, carbohydrate wastes, and wastewaters containing soluble gum, propylene glycol, and caustic soda. Biofilters were used in recirculating filters for aquaculture. The inert media were stone, shells, plastics, sand, and charcoal or combinations of these materials. (Caesar-FRC)
W82-01242

ACTIVATED SLUDGE,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. H. Sherrad, D. A. Smith, and J. E. Alleman.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 700-709, June, 1981. 135 Ref.

Descriptors: *Activated sludge, *Industrial wastewater, *Nitrification, *Wastewater treatment, Model studies, Design criteria, Phosphorus removal, Sludge, Microorganisms, Shock loads, Oxygen transfer, Oxygen uptake, Aeration, Activated carbon, Aerobic digestion, Reviews.

A review of recent literature on activated sludge lists mathematical models for analyzing the process. Design concepts and options studied in the laboratory and in pilot plants include determination of sludge age by total solids mass, mutant bacteria for refinery wastewaters, air vs. pure oxygen, continuous vs. intermittent feeding conditions, the deep shaft process, calculation of rotor size based on hydraulic head losses in looped reactors, and rotary biological contactors for supplemental oxidation in activated sludge aeration basins. Responses of activated sludge systems to shock loads and methods of improving performance are discussed. Various workers improved sludge characteristics by using a minimum 2.0 mg per liter dissolved oxygen in a brewery treatment plant, sludge ages of 15-20 days, a stalked bacteria (Caulobacter), growth inhibitors for Sphaerotilis, plug flow, an anoxic mixing stage in the aeration basin, and reduction in longitudinal mixing. Oxygen uptake and transfer is shown to depend on diffuser header pattern and desnsity. Some authors propose oxygen uptake and transfer as a control variable; others state the opposite. Nitrification is the subject of several reviews and many studies. Phosphorus removal for advanced wastewater treatment is accomplished by adding metallic salts to the activated sludge tanks without chemical addition (dependent on COD removal), adding an anaerobic stage, the PHOSTRIP process, and ferrous ion addition. The activated sludge process is used to treat industrial wastewaters containing phenol, coal gasification quench wastes, petrochemical wastes, chemical-pharmaceutical wastes, textile wastes, tannery wastes, food processing wastes, distillery wastes, and brewery wastes. Powdered activated carbon improved the activated sludge process with respect to organic compounds, color, and organic shock loads. (Caesar-FRC)
W82-01243

LAGOONS AND OXIDATION PONDS,

Utah State Univ., Logan.
D. B. George.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 709-711, June, 1981. 14 Ref.

Descriptors: *Oxidation lagoons, *Stabilization lagoons, *Literature review, Bibliographies, Wastewater treatment, Water reuse, Mathematical models, *Lagoons, *Oxidation ponds.

A literature review is presented of publications on lagoons and oxidation ponds published in 1980. Articles fall into the general categories of process performance and biology, upgrading of lagoons, and process models. Connecticut published standards on lagoon systems for the disposal of septage. Several studies dealt with the Dan Region Project, which is the largest and most advanced water reuse scheme in Israel which utilizes oxidation ponds. A study on stabilization ponds in Peru

examined the use of treated wastewater for agricultural purposes. More stringent wastewater treatment plant discharge standards resulted in several studies on upgrading existing lagoons. An in situ method is alum addition, another study investigated water hyacinth, and another evaluated the culturing of fathead minnows. Process models included a biogeochemical model developed to describe the dynamic responses of carbon, nitrogen, phosphorus, and pathogenic contaminants in facultative wastewater stabilization ponds. (Small-FRC)
W82-01244

ANAEROBIC PROCESSES,

Institute of Gas Technology, Chicago, IL.
K. F. Fannin, J. R. Conrad, D. E. Jerger, V. Srivastava, and S. Gosh.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 711-720, June, 1981. 1 Tab, 79 Ref.

Descriptors: *Anaerobic digestion, *Literature review, *Bibliographies, Anaerobic bacteria, Wastewater treatment, Fermentation, Anaerobic lagoons.

A review of the literature published in 1980 is presented for anaerobic processes. Several papers dealt with microbiology, including classification and characterization, cellulose hydrolysis and ethanol production, acidogenesis, and methanogenesis. Papers on process characterization concerned biodegration and biotoxicity, while process optimization and process application were the topics of other publications. A general review was published on the status of research and technology on the conversion of wastes and biomass to various forms of usable energy. Another review of solar and biomass technologies considered applications for cotton ginning residue combustion, etc. Studies on the development and investigation of fermenters were reviewed, and the potential of anaerobic digestion for the conversion of wet biomass to energy was evaluated. A table is presented which summarizes data from the operation and performance of anaerobic digestion studies. (Small-FRC)
W82-01245

DENTRIFICATION,

Greater Chicago Metropolitan Sanitary District, IL.
M. Krup, and B. S. Prakasam.
Journal of the Water Pollution Federation (Literature Review Issue), Vol 53, No 6, p 720-726, June, 1981. 65 Ref.

Descriptors: *Dentrification, *Literature review, *Bibliographies, Nitrogen removal, Nitrogen, Bacteria, Activated sludge process, *Wastewater treatment.

A literature review is presented of publications appearing during 1980 on the topic of denitrification. Papers were published in several areas including slurry processes, attached growth processes, and soil denitrification, and there were several new patents. Bench-scale studies were reported of sequencing batch biological reactors utilizing bacterial storage of raw waste organic components to supply the electron donor needed for denitrification. Studies designed activated sludge units for the removal of nitrogen and phosphorus, and one study reported on the results of an activated sludge system utilizing passes through an aeration tank to treat wastewater. Forty-seven denitrifying bacteria were isolated in one study of a model wastewater treatment system which consisted of two nitrification reactors and clarifiers and three denitrification columns. Environmental factors which affect soil column denitrification were explored, and pilot plant studies were used in one investigation of plant-soil systems to determine the fate of applied N during overland flow. Many patents were obtained for denitrifying systems employing mainly suspended growth systems. (Small-FRC)
W82-01246

ONSITE ALTERNATIVES FOR TREATMENT AND DISPOSAL,

Wisconsin Univ.-Madison.
W. C. Boyle, and R. J. Otis.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 733-737, June, 1981. 48 Ref.

Descriptors: *Literature review, *Bibliographics, *Wastewater treatment, *Underground waste disposal, Septic tanks, *Wastewater disposal, On-site investigations, Sewage disposal, Reviews, Conferences.

A literature review is presented of 1980 publications on the topic of onsite alternatives for wastewater treatment and disposal. It covers the general areas of onsite treatment, subsurface disposal systems, evapotranspiration, septage management, management, and small community facilities. A book was published outlining alternatives for homes, groups of dwellings, and some industrial and commercial establishments. EPA published a comprehensive design manual, and the forty papers presented at the 6th National Conference on Individual Onsite Wastewater Systems addressed state-of-the-art research. Several articles focused on the compost toilet and septic tank design. Subsurface disposal systems were studied, and the attenuation of pollutants in soils, site evaluation, and the performance of soil adsorption systems were addressed. A state-of-the-art review was published on cost effective and environmentally sound alternatives to septage treatment and disposal. As many small communities are interested in alternative treatement, one paper reviewed the role of public and private interests in onsite system management programs. (Small-FRC)
W82-01248

O & M WASTEWATER COLLECTION AND TREATMENT FACILITIES,

Valley Sanitary District, CA.
D. D. Drury.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 737-739, June, 1981. 30 Ref.

Descriptors: *Literature review, *Wastewater collection, *Wastewater facilities, Operating policies, Maintenance, Bibliographies, Activated sludge process, Wastewater treatment.

A literature review is presented of 1980 literature on the operation and maintenance of wastewater collection and treatment facilities. In the area of improving operations, a study of 120 plants concluded that 85 to 90% of the plants were not meeting NPDES discharge permit requirements but could have if appropriate operations and maintenance procedures had been followed. Studies in operating the activated sludge process included one on the deep-shaft activated sludge plant in Marsh Farm, Tilbury, and the startup of an oxidation ditch in winter. Plant startup and operator training studies included a study of the problems associated with fluctuating waste loads. Computer control systems were described in papers on computer aided operations. The effect of the collection system on plant operations was explored in several papers including a survey of 14 treatment plants in Northern California before and during the recent drought. Other papers on operation and maintenance included some on the maintenance problems caused by the eruption of Mount St. Helens. (Small-FRC)
W82-01249

DISINFECTION,

Georgia Inst. of Tech., Atlanta.
J. P. Gould, and C. N. Haas.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 739-748, June, 1981. 2 Tab, 154 Ref.

Descriptors: *Disinfection, *Literature review, *Chlorination, *Ozonation, Trihalomethanes, Environmental effects, Water treatment, *Wastewater treatment, Bibliographies, Carcinogens.

A literature review is presented of 1980 publications dealing with disinfection of water and wastewater. Two tables are included: the first on inactivation of various microorganisms by chlorine, and the second on inactivation of various microorganisms by ozone. A comprehensive review of potable water disinfection was published which summarized aspects of wastewater chlorination. One paper reported on the use of chlorine for the prevention of well clogging during groundwater recharge, while another dealt with the inactivation by ozone of six viruses in a continuous flow reactor. The effects of disinfectants on higher organisms were investigated in studies of bluegill, catfish, bass, crustaceans, and insects. One epidemiologic study found a significant positive correlation between pancreatic cancer and trihalomethane levels in drinking water. New analytical methods were described, and the chlorination of inorganic compounds was explored by several studies. The formation of trihalomethanes was also investigated, including one study on the influence of ozone pretreatment on their formation. (Small-FRC)
W82-01250

WASTEWATER COLLECTION,

AES Engineers, Inc., Willow Springs, IL.
S. Chatterjee, and T. Heuer.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 748-750, June, 1981. 32 Ref.

Descriptors: *Sewer systems, *Literature review, *Bibliographies, Wastewater facilities, Design criteria, Construction, Rehabilitation, *Wastewater collection.

A review of the 1980 literature published on wastewater collection is presented. It covers publications in the areas of design and construction, sewer rehabilitation, safety, and wastewater pumping. Papers referenced include a concise and systematic method for the determination of optimum sewer diameter and slope for a given flow capacity. Another paper noted water conservation measures that may reduce wastewater flows by 25%. One experimental study demonstrated the use of conduits for wastewater treatment using sludge and air/oxygen supply. Sewer rehabilitation topics included a study emphasizing the need for assessment of infiltration/inflow problems in order to better define the role of sewage treatment plant operators. An overview was presented of the potential methods of combined sewer overflow pollution abatement. Safety was addressed in several papers, one of which attributed most sewer worker deaths to hydrogen sulfide gas rather than lack of oxygen. Troubleshooting techniques for wastewater pumping systems were outlined in one paper, and the results of an EPA pipe needs survey were published. (Small-FRC)
W82-01251

LAND APPLICATION OF MUNICIPAL WASTEWATER,

Nielson, Maxwell and Wangsgard, Salt Lake City, UT.
J. H. Reynolds.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 767-770, June, 1981. 30 Ref.

Descriptors: *Land disposal, *Literature review, *Municipal wastewater, *Bibliographies, Water reuse, Overland flow, Denitrification, Infiltration, Design criteria.

A literature review is presented on the land application of municipal wastewater. Articles published during 1980 covered the general topics of design parameters, case studies, and water reuse. General publications included a history of the federal water pollution control legislation, including a discussion of EPA policy on land treatment. A published review of the recent application of overland flow treatment of municipal wastewater included a design guide based on operating experience in Davis, California. Laboratory studies on design parameters included a study of nitrogen removal and infiltration rates using primary effluent applied to soil columns. The long-term effects of irrigation with wastewater as well as the effects of rapid infiltration were examined. Reuse studies included groundwater recharge with tertiary effluent by way of spreading basins, and a water quality management facility which is designed to demonstrate

innovative techniques for recycling municipal wastewater including a lake-land treatment system. (Small-FRC)
W82-01253

HEALTH EFFECTS ASSOCIATED WITH WASTEWATER TREATMENT AND DISPOSAL,

Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W82-01255

MEAT-, FISH-, AND POULTRY-PROCESSING WASTES,

Battelle-Columbus Lab., Columbus, OH.
J. H. Litchfield.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 787-791, June, 1981. 1 Tab, 56 Ref.

Descriptors: *Meat processing industry, *Fish handling facilities, *Poultry, Industrial wastewater, *Food processing industry, Proteins, Land disposal, Wastewater disposal, *Wastewater treatment, Lagoons, Flotation, Odor control, Reviews.

Meat processing wastewaters were successfully treated in aerated lagoons, by electrocoagulation and flotation of fat and oil, in a vertical cylindrical separating chamber, in an electrolytic microbubble system using a noncoagulant mineral acid, and by digestion (fellmongering wastes). In addition to publications on environmental regulations and bibliographies, work was done on fish processing wastewater treatment by primary methods, pressure flotation, activated sludge, rotating disks, activated carbon-activated sludge, coagulation, aerated chambers, and recovery of protein for reuse. Water from poultry processing was frequently land-applied. Other treatment systems were chemical coagulation, DAF treatment, aerated lagoons, clarification, stabilizing lagoons, filtration, ultrafiltration, and breakpoint chlorination. Disinfection of poultry wastewater was accomplished with chlorine or chlorine dioxide. Odors from an anaerobic lagoon system were controlled by treating the odorous air with gaseous chlorine, dilute acid bed, and dilute caustic bed, in series. (Cassar-FRC)
W82-01256

FERMENTATION INDUSTRY,

Notre Dame Univ., IN.
R. L. Irvine.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 791-795, June, 1981. 57 Ref.

Descriptors: *Fermentation, Wastewater disposal, *Wastewater treatment, Reviews, Aerobic treatment, Anaerobic digestion, Biological treatment, *Industrial wastewater.

The 1980 literature on treatment and disposal of fermentation industry wastes includes 18 review articles on general subjects; reuse, recycle, and recovery of single-cell protein and other products; and comparisons of treatment alternatives (anaerobic systems were generally superior to aerobic treatment). Some of the individual papers describe treatment alternatives. A Canadian brewery uses a full-scale deep shaft treatment facility to meet pretreatment effluent standards of 300 g per cu meter BOD and 350 g per cu meter suspended solids. Bench scale continuous flow activated sludge reactors removed > 90% of brewery wastewater COD in another study. Problems with filamentous organisms in bench reactors were solved by aerating recycled sludge separately for 19-32 hours before return to the aeration basin. Distillery waste treatment methods included ultrafiltration, reverse osmosis, electrodialysis, and anaerobic treatment. Winery wastewaters were easily and inexpensively disposed of on soil with good drainage. Formaldehyde in pharmaceutical fermentation waste products was reduced to 0.5-1 g per cu meter using a maximum initial concentration of 1200 g per cu meter and 3 weeks incubation. Other treatment methods for pharmaceutical wastes included aerobic digestion, biological treatment, and biofiltration. (Cassar-FRC)
W82-01257

DAIRY WASTES,

Kraft, Inc., Glenview, IL.
J. C. Groenewold.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 795-797, June, 1981. 34 Ref.

Descriptors: *Dairy industry, *Wastewater treatment, Industrial wastewater, Milk, Activated carbon, Trickling filters, Flotation, Reviews.

Recent literature on managing dairy industry wastewaters included papers on minimizing the amount of waste by improving manufacturing processes and equipment, characterization of wastewaters from a multiproduct plant, and whey disposal and utilization. In individual papers the following subjects were discussed: discharge of dairy plant wastewater without pretreatment into a properly functioning municipal treatment system, advantages of deep shaft treatment facilities, use of trickling filters to remove 50% BOD as a pretreatment, land disposal on soil with good drainage properties, activated carbon treatment of a 164.5 g per cu meter carbohydrate and 23.5 g per cu meter protein wastewater, extended aeration activated sludge treatment (removed 99% BOD and 95-98% suspended solids), the difference in the metabolic rates for lactose and proteins in a milk plant wastewater, activated sludge-biological filters, and an aerated lagoon treatment system for ice cream waste. Current research concerned protein removal with activated carbon (96% BOD, 93% solids, 91% hexane extractables), acidification and continuous air flotation for protein and fat removal, electroflotation, electrocoagulation with ferric chloride addition, and the best grases for a cold weather cheese factory irrigation system. (Cassar-FRC)
W82-01258

TEXTILE WASTES,

Auburn Univ., AL.
J. F. Judkins, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 797-799, June, 1981. 25 Ref.

Descriptors: *Textile mill wastes, *Dye industry wastes, Reviews, *Wastewater treatment, Industrial wastewater, Flotation, Flocculation, Surfactants, Ozonation, Chlorination, Oxidation, Activated carbon, Adsorption, Water reuse, Aerobic treatment.

The variety of substances (dyes, retarding agents, softening agents, surfactants, fibers, sizing agents, etc.) occurring in textile wastewaters requires a variety of treatment processes. Some of the recent developments in textile wastewater treatment are reviewed: equalization and neutralization, flocculation, flotation, activated sludge treatment, evaporation, activated carbon adsorption, ozonation, chemical coagulation, biological treatment, chlorination, reverse osmosis, foam fractionation, gamma radiation, wet oxidation, ion exchange, TSF filtration process, ultrafiltration for size recovery, and aerobic digestion. The reuse of partially purified water or recycled municipal effluent for some processes such as rinse water or dyeing water was studied. (Cassar-FRC)
W82-01259

PULP AND PAPER INDUSTRY EFFLUENT MANAGEMENT,

National Council for Air and Stream Improvement, Inc., Medford, MA.
G. W. Gove.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 799-814, June, 1981. 158 Ref.

Descriptors: *Pulp and paper industry, *Water pollution effects, Secondary wastewater treatment, Industrial wastewater, Wastewater treatment, Regulations, Economic aspects, Forest management, Effluents, Model studies, *Reviews, Aquatic life, Pollutant identification, Water pollution prevention, Color removal, Coagulation, Clarification, Foam separation, Sludge disposal.

This review of recent papers on pulp and and paper industry wastewater is divided into five classifications. General subjects include national policies, economics, and sources and treatment of effluents. Studies on receiving waters, biological effects of pulp and paper mill effluents, and characterization of effluents resulted in information on predicting the path of pollutants in rivers, containment of wastewaters in ponds, bioassays of aquatic life (fish, shellfish, phytoplankton), mutagenicity of components in mill effluents, a fish tainting protocol, guidelines for priority pollutant sampling and analysis, analytical methods for effluents, and characterization of process streams. Pulping liquor disposal and recovery work concerned methods to reduce the amount of pollutants discharged into the environment. Physicochemical treatment methods include changes in various processes to minimize pollutant formation; water recycling and reuse; coagulation; clarification; ultrafiltration, radiation, and biological treatment for color reduction; condensate stripping; fractionation; membrane techniques; ion exchange; electrochemical processes; and ozonation. Secondary treatment processes in use on the plant scale are: activated sludge, oxygen activated sludge, aerated stabilization basins, 2-stage biological treatment, and flood irrigation of tree plantations. Laboratory and pilot plant secondary treatment studies concern filamentous growth in oxygen activated sludge plants, biological filters, short circuiting in oxidation ponds, and the oxygen balance in aeration tanks. (Cassar-FRC)
W82-01260

PETROLEUM PROCESSING WASTES,

Oklahoma State Univ., Stillwater.
E. L. Stover, and M. F. Torpy.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 824-828, June, 1981. 53 Ref.

Descriptors: *Oil recovery, *Water reuse, *Wastewater treatment, Industrial wastewater, Reviews, Oil wastes, Organic compounds, Flotation, Filtration, Ultrafiltration, Algae.

A review of recent literature on petroleum processing wastes includes information on regulations, literature reviews, analytical methods, and treatment systems. An analytical method for polynuclear aromatic hydrocarbons at levels of 1.0 micrograms per liter has been used successfully. One widely used treatment process for wastes of simple to complex composition included API primary treatment, granular filtration, and biological filtration. Dissolved air flotation and electrolyte techniques were more effective in oil and grease removal than was dispersed air application. Tubular ultrafiltration systems produced effluents meeting regulatory requirements; 2 to 3 year membrane lives were expected. Several aerobic treatment units operating at refineries produced effluents with total BOD of 13 mg per liter. In one case, oily wastewater and domestic wastewater were treated in 2-stage aeration tanks. Mutant microbes adapted to refinery wastes were studied in the laboratory and with mathematical models. The activated sludge process was improved by using high sludge age and adding powdered activated carbon. Other methods of treating refinery wastewaters included single cell algae (Chlorella and Scenedesmus), land application to crops, reverse osmosis and reuse in the refinery, lime soda ash, and evaporation using waste heat as an energy source. A method for recovering fuel oil from contaminated groundwater was described. Laboratory studies on transport of oil to the sediments in an estuarine system showed that 10-20% persisted after a year. (Cassar-FRC)
W82-01262

SYNTHETIC FUEL EFFLUENTS,

Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W82-01263

STEEL INDUSTRY WASTES,

Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. T. Vachon, and N. W. Schmidtke.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 844-847, June, 1981. 58 Ref.

Descriptors: *Metal finishing wastes, *Steel industry, *Wastewater treatment, Industrial wastewater, Reviews, Heavy metals, Cyanide.

The past year's literature on steel industry wastes included general articles on environmental impacts, including water quality, and pollution control regulations. Water recycling systems were the subject of 7 papers. Wastewater from coke production was treated by several processes: hydrogen peroxide; separate removal of ammonia, cyanide, and oil, with recombination for phenol and organics removal by biological oxidation; FeSO4 plus polyacrylamide; precipitation of iron cyanides with Na salts of sulfite, thiosulfate, dithionite, and pyrosulfite; ion exchange; nitrification; and settling tanks with filter beds. Dry quenching was less damaging to the environment than wet quenching. Blast furnace gas scrubbing water was treated with alkaline chlorination, ozonation, and reverse osmosis. Magnetic filtration was effective in removing suspended solids from hot strip mill effluent. Pickling wastewater lowered phosphorus levels and improved process operating conditions in municipal wastewater treatment systems. Metal finishing wastewaters, high in heavy metal and cyanide, were subjected to electrolytic precipitation, evaporation, reverse osmosis, ion exchange, electrodialysis, ozonation, and many other methods. (Cassar-FRC)
W82-01264

ELECTROPLATING AND CYANIDE WASTES,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
W. R. Knocke.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 847-851, June, 1981. 47 Ref.

Descriptors: *Metal-finishing wastes, *Cyanide, *Heavy metals, Wastewater treatment, Industrial wastes, Reviews, Metals, Chromium, Cadmium, Regulations, Water conservation, Ozonation, *Electroplating.

A review of 1980 literature on electroplating and cyanide wastes included recent regulations and methods for wastewater treatment and analysis. Four categories of metal finishing wastes were classified as hazardous under the Response Conservation and Recovery Act, Part 261.31: spent solutions from electroplating operations, wastewater treatment sludges from electroplating operations, plating sludges from plating baths, and spent stripping and cleaning solutions from plating operations. It was expected that 1680 of the 2336 operating electroplating jobshops would be closed because of the new regulations. Processes for wastewater treatment and metals removals were: sulfide precipitation techniques, electrolytic ferrite formation for removal of chromate, seawater electrolysis, chromium ferrocyanide gels, chelating resins containing an iminodipropionic acid salt, and the surfactant Amifat (N-acyl-L-glutamic acid). A centralized system was proposed to treat wastes from 10 nearby shops in Providence, Rhode Island. Metal recovery techniques which conserve energy, metals, and water were reviewed. These involved temperature modifications, evaporative recovery, filtration, ion exchange, electrolytic transfer systems with polyester membranes, and electrochemical cells. Cyanide waste treatment was examined by several authors. Some of the processes were: ozonation, activated carbon adsorption, heating to 210 C in a sealed container, percolating through a column of steel scrap, and algal systems which work best at cyanide levels < 1 mg per liter. Sludge treatment and disposal methods were reviewed. (Cassar-FRC)
W82-01266

CHEMICALS AND ALLIED PRODUCTS,

Union Carbide Corp., South Charleston, WV.
T. W. Siegrist.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 851-861, June, 1981. 139 Ref.

Descriptors: *Chemical wastewater, *Organic compounds, *Activated carbon, *Wastewater treatment, Reviews, Industrial wastewater, Regulations, Physicochemical treatment, Insecticides, Phenols, Ozonation, Biological treatment, Oxidation, Water reuse.

Waste treatment in the chemical industry was reviewed. Costs of pollution abatement were outlined in several papers. Treatment methods, classified by product type, were discussed for phenol and derivatives (adsorption with activated carbon and/or polymers, acidification with sulfuric acid plus alpha-ray irradiation, ozonation, combined physicochemical and biological treatment); polychlorinated biphenyls (ultraviolet-ozone treatment, critical-fluid extraction, bacterial degradation); kepone (aerobic treatment, photolytic decomposition promoted by amines); dioxins (bacterial oxidation); fatty acid wastes (upflow anaerobic treatment); and other organic compounds--heterocyclics, halogenated diphenylmethanes, melamine-formaldehyde resin wastewater, methanol manufacturing wastes, glycol and glycerol production wastes, butyl benzyl phthalate, dichloromethane, and 3,3'-dichlorobenzidine. Wastes treated at the source for recycling, recovery, or pretreatment purposes included those from manufacturing of fertilizers, acrylic monomers, organic solvents, benzene, munitions, polystyrene, caprolactam, and polyester fibers. A variety of organic chemicals were degraded by biological treatment. Physical-chemical treatment for chemical pollutants was the subject of 42 papers, for example, trihalomethanes, trichloroethylene, petrochemical wastewaters, phenol and derivatives, polychlorinated biphenyls, proteins, amino acids, polysaccharides, phthalates, oil and grease, and heavy metals. Activated carbon treatment was widely used for many of these wastes. Other treatment processes were wet oxidation, shipboard incineration, ozonation-radiation, reverse osmosis, steam stripping, electrolytic treatment, ion-precipitate flotation, and solidification. (Cassar-FRC)
W82-01267

RADIOACTIVE WASTES,

Oak Ridge National Lab., TN.
B. G. Blaylock, and C. S. Fore.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 861-896, June, 1981. 8 Tab, 375 Ref.

Descriptors: *Radioactive wastes, *Path of pollutants, Waste disposal, Regulations, Radioisotopes, Uranium, Water pollution control, Industrial wastes, Literature review.

Several topics pertinent to water pollution were included in a review of the 1980 literature on radioactive wastes. Eight tables summarize the activities at symposia and workshops. The remaining literature has been divided into nine categories: general programs, isolation, waste treatment, storage, environmental transport, monitoring, risk assessment, remedial action programs, and socioeconomic aspects. The path of radioactive materials buried in rocks was studied by several authors. One stated that leach rate experiments were grossly over-pessimistic. Data was collected as input for a model which will predict the fate of radionuclides in canisters dumped into the ocean. Shallow land burial for low-level wastes was studied, and the danger of water penetration and plant root penetration noted. About 85 papers concerning radioactive waste treatment were classified as follows: volume reduction, incineration, calcination, vitrification, solidification, partitioning (separating) and transmutation (changing) troublesome radionuclides, transuranic wastes, and facilities for handling wastes. Migration of radionuclides in the environment (theoretical and case studies) was described by many authors. Over 350 computer models have been developed for this purpose. Remedial action programs included regulations and methods for prevention and cleaning up of uranium mill tailings at several active and inactive sites. (Cassar-FRC)
W82-01268

MICROBIOLOGY OF WASTEWATER TREATMENT,

Drexel Univ., Philadelphia, PA.
W. O. Pipes.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1142-1145, June, 1981. 44 Ref.

Descriptors: *Microbiological studies, *Viruses, *Water pollution sources, Reviews, Activated sludge, Microorganisms, Pathogens, *Wastewater treatment, Industrial wastewater, Sphaerotilus, Trickling filters, Oxidation ponds, Land disposal, Indicators, Bacteria.

A variety of subjects is included in a review of recent literature on wastewater treatment microbiology. Bacteria causing a filamentous sludge were identified as Sphaerotilus and Leucothrix. Some of the conditions inhibiting growth of these undesirable organisms were dissolved oxygen concentrations above 2 mg per liter, chlorination of return sludge, presence of antibiotics, and soluble Fe. Other studies on activated sludge concerned a method for estimating the viable fraction of microorganisms, a prey-predator model, and a method for enumeration of bacteriophages. Oocystis cells were used in a two-phase tertiary treatment process in ponds. Ozone doses of 15-50 mg per liter removed 98% of green algae from an oxidation pond. Virus survival in land application of wastewater was studied by several authors. Since drying inactivated the viruses, a cyclic application procedure was suggested. Clays removed viruses most effectively, and sandy soils the least. The first 5 cm of soil adsorbed about 75% of the viruses. Later, mobilization by rain caused viruses to be readsorbed at lower levels in the soil profile. In the sludge treatment process viruses were quickly inactivated in an anaerobic digester. However, fecal coliforms were destroyed 7-8 times faster at mesophilic temperatures and 9-10 times faster at thermophilic temperatures. Microorganisms suitable for degrading certain industrial wastewaters were found for distillery wastes and lemonade processing water. In searches for bacterial indicators of viruses, there was no relationship between coliforms and certain viruses. Several authors measured airborne pathogens near wastewater treatment plants. (Cassar-FRC)
W82-01291

FORMATION OF N-NITROSODIMETHYLAMINE DURING TREATMENT OF MUNICIPAL WASTE WATER BY SIMULATED LAND APPLICATION,

Cornell Univ., Ithaca, NY. Dept. of Agronomy.
S. Greene, M. Alexander, and D. Leggett.
Journal of Environmental Quality, Vol 10, No 3, p 416-421, July-September, 1981. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Nitrogen compounds, *Land disposal, *Wastewater treatment, Municipal wastewater, Nitrogen, Simulation analysis, Nitrosation, Carcinogens, Mathematical equations, Nitrites, Soil filters, Soil water, Nitrosamines, *Leachates.

N-nitrosamines represent a group of potentially serious pollutants which may be formed or leached through soil when wastewater is applied to land. One of these, N-nitrosodimethylamine (NDMA) is a highly toxic compound which can be formed from amines added by pesticides or root excretions in nitrate-amended soil. The extent of NDMA formation and the behavior of its precursors were examined in soils incubated with sewage and in effluent from soil columns percolated with sewage. NDMA formation was investigated in Lake George sand and Arkport fine sandy loam amended with sewage, 250 micrograms of dimethylamine (DMA), and 50 micrograms of nitrite-nitrogen per gram. Although the rates of NDMA formation were similar in the two soils, the rates of destruction of DMA and nitrite differed significantly between the two soils. Both DMA and nitrite levels

decreased more rapidly in the Arkport soil than in the Lake George soil. The amount of NDMA that accumulated in Lake George sand amended with sewage under nonpercolating conditions was found to be a linear function of the amount of DMA and nitrite added. On a molar basis, 0.8% of the DMA and 1.3% of the nitrite added to the soil was converted to the carcinogen, NDMA. Smaller amounts of conversion occurred when sewage containing the precursors was percolated through this soil. The moisture level of the soil also influenced the extent of nitrosation. These findings demonstrate the facility with which NDMA leaches through soils. Although it is not known whether DMA and nitrite levels ever reach concentrations high enough to result in NDMA formation in the field, the demonstrated fact that nitrosamine formation is likely to occur under conditions resembling those of land application of wastes suggests that groundwater and surface water near existing land treatment areas should be monitored for NDMA and other nitrosamines. (Carroll-FRC)
W82-01343

REMOVAL OF PHOSPHORUS FROM WASTE WATER BY SOIL UNDER AEROBIC AND ANAEROBIC CONDITIONS,

Connecticut Agricultural Experiment Station, New Haven.
D. E. Hill, and B. L. Sawhney.
Journal of Environmental Quality, Vol 10, No 3, p 401-405, July-September, 1981. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Soil filters, Anaerobic conditions, Aerobic conditions, Groundwater pollution, Fertilizers, Tile drains, Soil absorption capacity.

Previous studies have demonstrated that the movement of phosphorus added to soils in wastewater or as fertilizer is extremely slow. Reducing conditions caused by flooding in cultivated soils with tile drains can increase the mobility of this phosphorus, however. A simulated wastewater containing 12 micrograms of phosphorus per milliliter of solution was added to a fine sandy loam soil underlain by bedrock at 72 centimeters two or three times a week over a 2.5 year period. The water table fluctuated between 25 and 75 centimeter depths during this period. Analyses of the effluent from weep holes at different depths indicated that the wastewater moved along preferred pathways in heterogeneous soil and produced breakthrough of phosphorus to ground water before all sorption sites were fully saturated with phosphorus. The mobility of phosphorus increased under the anaerobic conditions produced when the water table was closest to the surface. This enhanced mobility increases the transport of phosphorus to the groundwater in soils which are used for continued wastewater disposal. The phosphorus sorption capacity of a soil is reduced by long-term wastewater renovation, although sorption sites can be regenerated and the potential for additional phosphorus sorption increased by periodic resting. There was a reasonably good agreement between estimates of phosphorus retention based on its concentration in influent and effluent solutions and bulk density of the soil and laboratory determinations of phosphorus retained following wastewater renovation. Most of the phosphorus retained in the soil is transformed into unavailable forms. (Carroll-FRC)
W82-01344

SANITATION SERVICE MANAGEMENT IN FRANCE (LA GESTION DES SERVICES D'ASSAINISSEMENT EN FRANCE),

Ingenieurs a la Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
For primary bibliographic entry see Field 6F.
W82-01351

A LOOK AT SOME WATER RECLAMATION PLANTS IN SOUTHERN AFRICA,

National Institute for Water Research, Pretoria (South Africa).
J. Van Leeuwen, L. R. J. Van Vuuren, J. W. Funke, and A. J. Clayton.
Aqua, No 2, p 0256-0262, 1981. 6 Fig, 1 Tab, 25 Ref.

Descriptors: *Water reuse, *Water resources development, *Wastewater renovation, Water use, Water quality, Water pollution control, Drinking water, Potable water, *Water conservation, *South Africa.

Various water reclamation plants operation in South Africa are reviewed, including the Sappi plant near Springs, the Mondi plant near Durban, the Stander Water Reclamation Plant at Pretoria, the LFB pilot plant at Pretoria, the Athlone pilot water reclamation plant at Cape Town, and the Windhoek Water Reclamation Plant in South West Africa. A review of these plants indicated that it is possible to reclaim water from wastewater for many applications. Water can be reclaimed to conform to any quality criteria, including those for potable water. Reclaimed water may in many cases be an economically viable alternative to water from conventional, potable supplies. Cooperation between local authorities and industry is a vital part of the success of any reclamation operation. In southern Africa the cost of reclaimed water is about equal to the consumer price of drinking water obtained by conventional purification of surface water. In some cases costs of pumping water from distant sources are high, and it may prove economical to distribute reclaimed water from wastewater sources which are easily accessible. Since quality standards for industrial processes are lower than for domestic reuse purposes, the cost is lower for industrial reuse. The relatively low irrigation water quality requirements in the area lend themselves to water reuse without costly intermediate treatment. Water reclamation not only offers an extension of the usefulness of a given quantity of water, but can also play an important role in combating pollution. (Baker-FRC)
W82-01352

EXPANSION OF EFFLUENT CONSTRAINED TREATMENT PLANTS,

Newcastle Univ., New South Wales (Australia). Dept. of Civil Engineering.
B. J. Williams.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 571-589, June, 1980. 7 Fig, 9 Tab, 10 Ref.

Descriptors: *Water treatment facilities, *Cost analysis, Design criteria, Water quality, Wastewater treatment, Land application, Wastewater facilities, Loading rate.

An approach is presented for use in planning an extension of sewage treatment plants to provide both for increased loads of sewage and for more stringent controls on the concentrations of various pollutants in the effluents from the treatment plants. The objective is to determine what size primary, secondary, and tertiary treatment plants should be built in each of several planning stages in order to minimize total discounted costs over the entire planning period and provide sufficient treatment for the increasing raw sewage load. The plan was applied to the Melbourne and Metropolitan Board of Works Farm (MMB), which has represented a very successful example of land treatment of sewage for the last 85 years. The farm comprises a carefully operated system of land filtration, grass filtration and lagoons, but has become overloaded over the past few years. Extension is limited by the availability of suitable land. The MMB plans to build conventional treatment plants on the site to supplement the farm. The proposed schemes involve continued use of existing farm treatment processes plus primary and secondary treatment with either tertiary treatment or an outfall to Bass Strait. A series of sensitivity tests has been carried out on operations and maintenance costs of plant and the farm, predicted sewage loads and scale factors. The most important of these was the effect of variation in sewage load. A 10% reduction in waste load results in savings of between 17 and 24% for the 1 and 8% discount rates. Relaxation of the water quality constraint allows substantial savings to be made in treatment costs. (Baker-FRC)
W82-01355

DESIGN AND CONSTRUCTION OF SHIELDHALL SEWAGE-TREATMENT WORKS, GLASGOW,

Strathclyde Regional Council (Scotland).
W. T. Greer.
Water Pollution Control, Vol 80, No 2, p 260-272, 1981. 10 Fig.

Descriptors: *Wastewater treatment, *Design criteria, Water treatment facilities, Economic aspects, Construction, Planning, Costs, *Glasgow drainage area, Great Britain.

Shieldhall was the third and last sewage treatment works built to serve the Glasgow drainage area. It was opened in May of 1910. Site selection had been beset with difficulties over the years. Until the early 1960's siting choice was restricted by the fact that the most valuable industrial land in Glasgow was along the riverside and adjacent to the shipyards. After siting problems had been solved, a new wastewater treatment works was designed for the area, which would produce a 30:20 standard effluent. In view of the necessity of maintaining treatment throughout the reconstruction period, it was decided to build the new works in two phases. Phase I was constructed on newly acquired ground and consists of a low-level pumphouse, presedimentation works, primary-sedimentation tanks, storm-sewage tanks, a sludge pumphouse and underground storage tanks, sewer diversions and a new outfall channel to the River Clyde. Phase II was to include aeration tanks, secondary settlement tanks, a return activated-sludge pumphouse and a further overhead sludge-storage tank. Work began on Phase I in April of 1975. Permission has now been obtained to proceed with phase II, and the civil engineering work commenced in March of 1980. The entire project is to be completed by 1984. (Baker-FRC)
W82-01385

SCAYNES HILL STW EXTENSIONS INCLUDE PLASTIC MEDIA FILTRATION,

Water Services, Vol 85, No 1020, p 92-93, 95, February, 1981. 3 Fig.

Descriptors: *Wastewater treatment, Sludge lagoons, Lagoons, Wastewater irrigation, Filtration, Tertiary wastewater treatment, *Water treatment facilities, Haywards Heath sewage, Great Britain.

Prior to 1905 Haywards Heath sewage was treated at three separate sewage farms. In 1934, due to pollution of the River Ouse, a modern disposal works was begun to replace the broad irrigation system that had been in use. This new system consisted of four brick inverted pyramid primary settling tanks with a total capacity of 814 cubic meters and six brick percolating filters containing 2800 cubic meters of clinker. Phase I of a new sewage system began in 1961 to deal with flooding at Ashenground. Phase II consisted of enlarging the Scaynes Hill Works and laying a 840 mm gravity sewer. Phase III involved the closure of another works and construction of a pumping station. Each of these phases was completed by 1966. In 1971 the sludge lagoons were abandoned and a vacuum filtration sludge dewatering plant constructed with three tertiary effluent lagoons. Recently two settling tanks with mechanical scrapers were built to supplement the two existing ones, and the four tanks now handle all incoming flows up to 21,600 cubic meters/day. (Baker-FRC)
W82-01386

RURAL SANITATION IN DEVELOPING COUNTRIES,

Hawksley (Watson), High Wycombe (England).
J. M. Sidwick.
Effluent and Water Treatment Journal, Vol 21, No 5, p 210-212, 214, 215, May, 1981. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Waste disposal, *Developing countries, *Sanitation, Public health, Rural areas, *Wastewater treatment, Methane, Septic tanks, Agriculture, Composting, Fish ponds, Algae, Irrigation, Wastewater irrigation, Land disposal.

Disposal methods for human excreta in developing countries are evaluated and compared. In the ab-

sence of adequate waste disposal, the benefits from water supplies being developed through the International Drinking Water Supply and Sanitation Decade programs are reduced. Low cost methods listed in order of increasing mean total cost ($18.7-$64.9 per household per year in 1978 dollars) are pour flush toilet, pit privy, communal toilet, vacuum truck cartage, low cost septic tank, composting toilet, and bucket cartage. Although many of these disposal methods produce odors, insect problems, and health hazards in handling and removal, they can provide an answer to handling excreta in rural areas until more effective waterborne sewage systems are feasible. Reuse of excreta is a widely used disposal method throughout the world. However, public health hazards must be reduced to an absolute minimum. The main reuse options are direct use of nightsoil on the land, composting, wastewater irrigation, agriculture, algae and fish culture, animal food, and biogas production. (Cassar-FRC)
W82-01392

NEW APPROACHES TO ANAEROBIC SLUDGE DIGESTION,

Water Pollution Research Lab., Stevenage (England).
A. M. Bruce.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 215-229, May 1981. 4 Fig, 5 Tab, 35 Ref.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Wastewater treatment, Biological treatment, Biodegradation, Digestion, Composting, Aerobic digestion, Lime, Sludge thickening, Lagoons, Great Britain.

Mesophilic anaerobic sludge digestion has been a satisfactory process since its development in the 1920's. The high initial cost is a disadvantage. Of the alternative processes reviewed (aerobic digestion, lime stabilization, and composting) lime stabilization is most satisfactory, depending on the local cost of lime and the land available for disposal. The efficiency of the conventional single stage, completely mixed reactor design may be improved either by reducing retention periods or by thickening sludge before digestion. Recent experiments have shown that mesophilic digestion of raw sludge of up to 9% solids and retention periods as low as 13 days may be satisfactory. Removing dead zones by adequate mixing and grit removal also improves efficiency. A graph shows the effect of population size on capital costs of a primary anaerobic digestion plant at different loading rates (1 to 4 kg volatile solids per cu meters per day). (Cassar-FRC)
W82-01398

REMEDIAL TECHNIQUE OF CONTROLLING AND TREATING LOW VOLUME LEACHATE DISCHARGE,

Nassaux-Hemsley, Inc., Chambersburg, PA.
For primary bibliographic entry see Field 5G.
W82-01428

COMPARATIVE EVALUATION OF PROCESSES FOR THE TREATMENT OF CONCENTRATED WASTEWATERS AT UNCONTROLLED HAZARDOUS WASTE SITES,

TRW Environment Engineering Div., Redondo Beach, CA.
M. Ghassemi, K. Yu, S. Quinlivan, and F. J. Freestone.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 160-164, 4 Tab.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Hazardous materials, *Evaluation, Economic aspects, Reverse osmosis, Ultrafiltration, Ion exchange, Wet oxidation process, Coagulation, Precipitation, Activated sludge process, Ozonation, Waste disposal sites.

This paper summarizes the results of an evaluation of the suitability and economics of several commercially available water and wastewater treatment processes for use in mobile units for on-site treatment of highly contaminated waters. Seven processes were evaluated: reverse osmosis (RO); ultrafiltration (UF); ion exchange (IE); wet air oxidation (WAO); high purity oxygen activated sludge process (HP); UV-ozone oxidation (UV); and coagulation/precipitation (CP). It was assumed the equipment mounted on a single trailer would treat 227,000 l/day, based on single processes, not combinations. All the processes except UF and UV are widely used commercially and all but HP, CP, RO and IE appear to be the most promising processes, because they are compact, quick to start and stop, convenient to service, and do not require skilled field operating labor. The necessary electricity can be generated on-board and they can handle a wide variety of wastes. None of the processes was effective individually, but RO and IE could be made so with either pretreatment of post-treatment, or a combination of two processes could be used. Capital costs range from $35,000-$650,000; labor, energy, and materials costs also vary widely. (Brambley-SRC)
W82-01430

EVALUATION OF REMEDIAL TREATMENT, DETOXIFICATION AND STABILIZATION ALTERNATIVES,

Anderson-Nichols and Co., Inc., Boston, MA
M. A. Sills, J. J. Struzziery, and P. T. Silbermann.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 192-201, 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, *Water pollution control, *Waste disposal, *Hazardous material, Detoxification, Immobilization, Stabilization, Wastewater treatment, Wastewater collection, Wastewater disposal, Economic aspects, Environmental effects.

A systematic evaluation procedure has been developed for the identification of the most cost effective, environmentally sound treatment, detoxification or stabilization methods for the remedial management of uncontrolled hazardous waste sites. In situ detoxification, stabilization and immobilization techniques have been developed. Detoxification involves the injection of chemicals or biological agents into the contaminated soil. Stabilization is accomplished by converting contaminants to insoluble forms through chemical reactions, or encapsulating them in a highly insoluble matrix. Immobilization techniques may be applied alone or in conjunction with others; they rely on the injection of materials which prevent further movement of the contaminants. Withdrawal, treatment and disposal options depend on the nature of the site and the contaminants. Collection and withdrawal methods include collection wells, subsurface gravity collection drains, impervious grout curtains, and cut-off trenches, while the treatment options include reverse osmosis, ultrafiltration, ion exchange, wet air oxidation, activated carbon, ozonation/UV radiation, and chemical and biological treatment. Three final disposal options to be evaluated are discharge to municipal sewage treatment plant, discharge to a surface water body, and land application. The systematic two-phase iterative screening procedure identifies the most promising management alternatives in the first phase, then subjects them to more intense technical, economical and environmental evaluations. (Brambley-SRC)
W82-01434

BACKGROUND DOCUMENT FOR MODIFICATION OF PH EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR POINT SOURCES REQUIRED BY NPDES PERMIT TO MONITOR CONTINUOUSLY EFFLUENT PH.

Environmental Protection Agency, Washington, DC. Office of Analysis and Evaluation.
Report EPA-440/2-80-083, November, 1980. 132 p, 6 Fig, 21 Tab, 13 Ref.

Descriptors: *Industrial wastewater, *Hydrogen ion concentration, *Monitoring, *Regulations, Water pollution control, Water quality standards, Effluents, Industrial plants.

The information presented in this report evolved in response to a petition from various industries seeking relief from absolute compliance with the 6-9 pH categorical standard when continuous monitoring is required. The standard of pH 6-9 was initially intended for those situations where grab or composite samples were to be monitored, but has been adopted for use in continuous monitoring situations. Two studies were conducted to verify the original regulations. A total of 15 plants were visited, each of which was using continuous pH monitoring, and their monitoring data were surveyed to determine how frequently the effluent was out of the standard pH range. The causes of the excursions out of range were identified. Thirteen of fourteen plants for which data were available were able to achieve compliance over 99% of the time over periods of 6 months and more. On a monthly basis eight of the plants had at least one month exceeding a 99% monthly standard. The long excursions from the standard were usually due to process or treatment system upsets, and instrumentation malfunctions, none of which should be a factor in modifying pH standards. The EPA maintains the 99% monthly compliance time, and recommends that a plant is not to be outside the categorical pH range continuously for more than 30 min. (Brambley-SRC)
W82-01438

ENVIRONMENTAL IMPACT AND HEALTH EFFECTS OF WASTEWATER CHLORINATION,

Illinois Univ. at the Medical Center, Chicago, IL. School of Public Health.
G. R. Brenniman.
Illinois Institute of Natural Resources, Chicago. Document No 81/27, July 1981. 63 p, 8 Tab, 149 Ref.

Descriptors: *Chlorination, *Wastewater treatment, *Residual chlorine, *Public health, Chloroform, Water treatment, Chlorinated hydrocarbons, Carcinogens, Fish toxins, Safety, Toxicity, Epidemiology, *Environmental effects.

There are some benefits to chlorinating wastewater effluents; however, many scientists have expressed a concern about the environmental impact and health effects of this process, particularly the effect of residual chlorine on fish and other aquatic life, and about the reaction of chlorine with organic materials in the effluents. These may form chlorinated hydrocarbons that persist in the environment, magnify through the food chain, and even cause cancer. A critical review of the literature and studies on quantifying the toxicity of chlorine to aquatic organisms showed that low concentrations of total residual chlorine (TRC) in wastewater are detrimental to aquatic life. A TRC concentration of 0.003 mg/l is safe for freshwater aquatic life continuously exposed to this residual; however, chlorine residuals in wastewater effluents and many receiving streams in Illinois exceed this safe concentration. The human cancer risk from chloroform found in drinking water appears to be low, but the risk from several carcinogens mixed together in water supplies and extrapolated from animal studies is not known. Epidemiologic studies have shown some association between gastro-intestinal and urinary tract cancer mortality and exposure to chlorinated drinking water. Most of these associations are not consistent across gender and race groups and generally are inconclusive. Research is needed on the transformation, metabolism, and bio-magnification of organochlorine compounds as they move through the food chain, and more epidemiologic studies are needed to clarify the risks of drinking chlorinated water. (Garrison-Omniplan)
W82-01451

ANAEROBIC CARBON FILTER FOR DEGRADATION OF PHENOLS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
M. T. Suidan, W. H. Cross, M. Fong, and J. W. Calvert.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE3, p 563-579, June,

1981. 10 Fig, 3 Tab, 15 Ref. OWRT-A077-6A(3), 14-34-0001-8011.

Descriptors: *Anaerobic digestion, *Activated carbon, *Phenols, Industrial wastes, *Wastewater treatment, Chemical oxygen demand, Methane, Catechol, Cresol, Mathematical equations.

An anaerobic activated carbon packer bioreactor was used to treat synthetic wastewaters bearing catechol, o-cresol, and a mixture of o-cresol and glucose. The process performance in converting the primary phenolic constituent as well as reducing the COD and organic content of the substrate was evaluated. Also, methane production was monitored. Chemical oxygen demand biomass yield coefficients of 11 to 15% were obtained. This low sludge productivity represents savings in sludge disposal costs. A methane gas production rate equivalent to 2.21 kcal/g of COD can be expected from the system. A mathematical expression which represents the relationship between wastewater characteristics that favor an anaerobic filter is $0.00457C - (35 - T) > 0$, where C = the concentration of biodegradable COD in milligrams/liter and T = the temperature of the raw wastewater in degrees C. (Small-FRC)
W82-01454

PURIFICATION OF MUNICIPAL WASTEWATER BY SUBSEQUENT REVERSE OSMOSIS AND ANAEROBIC DIGESTION,

Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
J. C. Van Den Heuvel, R. J. Zoetemeyer, and C. Boelhouwer.
Biotechnology and Bioengineering, Vol 23, No 9, p 2001-2008, September, 1981. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Reverse osmosis, *Anaerobic digestion, *Combined treatment, *Wastewater treatment, Municipal wastewater, Drinking water, Methane, Performance evaluation, Water quality.

The combined process of reverse osmosis followed by anaerobic digestion was applied to municipal wastewater. Membrane deterioration was studied in terms of permeate flux and rejection, and the quality of the permeate with respect to its possible use for the production of drinking water was determined. Also, the digestability of the brine by the anaerobic process and the amount of methane evolved were determined. The results of experiments were positive, with the permeate being a good quality as a raw material for drinking water. The wastewater was concentrated 7.7 fold, and continuous anaerobic digestion of the brine removed over 90% of the BOD, evolving the expected amount of methane. When environmental quality and the production of drinking water are considered, the combined process shows promise for highly populated areas which lack groundwater or surface water of good quality. (Small-FRC)
W82-01468

MECHANISM OF ENTEROVIRAL INACTIVATION BY OZONE,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
D. Roy, P. K. Y. Wong, R. S. Engelbrecht, and E. S. K. Chian.
Applied and Environmental Microbiology, Vol 41, No 3, p 718-723, March, 1981. 5 Fig, 20 Ref.

Descriptors: *Wastewater treatment, *Viruses, *Ozone, Enterovirus, Poliovirus, Laboratory studies, Mirobiological studies, Disinfection, Kinetics.

The mechanism by which ozone inactivates viruses was elucidated using radiolabeled poliovirus 1 (Mahoney) to identify the major reactions and lethal sites involved. Residual ozone concentrations in viral suspensions were maintained at 0.3-0.8 mg/l to ensure at least 99% inactivation. Ozone had no effect on the overall structural integrity of the viral protein coat. Electrophoretic analysis of poliovirus capsid polypeptides labeled with 14C-amino acids suggested possible damage to two of the four polypeptide chains on the protein coat (VP1 and VP2), but the damage was insufficient to prevent attachment to host cells and thus to block viral replication. The sedimentation profile of centrifuged viral RNA extracted after exposure of labeled virus to 0.31 mg/l ozone for up to 2 min indicated damage to the RNA, which may have been fragmented into a number of short chains. Such damage would account for inactivation. This finding is consistent with studies showing that inactivation of viruses by ozone is rate limited by the diffusion of ozone through the protein coat and into the nucleic acid core. (Carroll-FRC)
W82-01482

STABILITY OF ACTIVATED SLUDGE PROCESSES BASED ON STATISTICAL MEASURES,

California Univ., Davis. Dept. of Civil Engineering.
S. Niku, and E. D. Schroeder.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 457-470, April, 1981. 4 Fig, 9 Tab, 16 Ref.

Descriptors: *Activated sludge process, *Statistical analysis, *Stability analysis, Wastewater treatment, Design criteria, Biological oxygen demand, Suspended solids, Contact stabilization, Standard deviation, *Wastewater facilities.

The stability of 43 activated sludge treatment plants was evaluated by statistical analysis. Standard deviation was selected as the most appropriate indication of stability in this study. Theroretically, it is a measure of dispersion, and practically, it is the most familiar and simplest term among the possible measures of stability--variance, coefficient of variation, and coefficient of stability. Plants were ranked with respect to stability, based on standard deviation vs. coefficient of stability of effluent BOD concentration and by standard deviation vs. coefficient of stability of effluent suspended solids (SS) concentration. Plants defined as stable operated at a standard deviation of less than 10 g per cu m for both effluent BOD and SS and a mean effluent BOD of less than 17 g per cu m, mean effluent SS less than 15 g pr cu m. There was little correlation between plant size and effluent quality. Examination of process type vs. stability revealed that the step feed or step aeration modifications of the conventional activated sludge process gave the best-year-round results for BOD removal; conventional activated sludge, for SS removal. The complete mix modification of the activated sludge and the contact stabilization process produces higher than average effluent BOD and SS concentrations, with the contact stabilization process having the worst performance characteristics. To achieve a stable activated sludge process plants should be designed for an effluent BOD concentration of less than 13-15 g per cu m and an effluent SS concentration of less than 1012 g per cu m. (Cassar-FRC)
W82-01489

EFFECT OF COPPER ON NITRIFICATION IN ACTIVATED SLUDGE,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
For primary bibliographic entry see Field 5C.
W82-01497

OPTIMUM RECYCLE AND REUSE COOLING SYSTEM DESIGNS USING THE BCT PROCESS,

Tower Systems Inc., Tacoma, WA.
For primary bibliographic entry see Field 3E.
W82-01503

THE WAYNE COUNTY, MICHIGAN, WASTEWATER COLLECTION AND TREATMENT SYSTEM,

Wayne County Board of Public Works, MI.
D. R. Egeland, and T. G. Biehl.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1366-1369, September, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Wastewater collection, Sludge, *Wayne County, *Michigan, Design criteria, Municipal wastewater, Wastewater management, Wastewater facilities.

A description is offered of the wastewater collection and treatment system in service for Wayne County, Michigan. Planning for the system began in the early 1930s; it currently serves a population of 1,100,000 in 39 municipalities located in 5 counties. Initial designs called for seven primary-treatment plants, together with intercepting sewers to convey the wastewater to the plants. Growth during the ensuing years resulted in the construction of two or more inland treatment plants and a large lagoon facility. Overall planning has been developed so as to use the large flow in the Detroit River to assimilate the treatment wastewater effluent and to protect the water quality of the smaller tributary rivers by eliminating wastewater treatment plant discharge. When the Huron Valley Project is completed, the Wayne County system will include the Northeast District, the Rouge Valley District and the Downriver District. The proposed Huron Valley plant features a biological treatment process involving a sequential anaerobic/aerobic environment that promotes the growth of organisms suitable for removing excess phosphorus as well as biochemical oxygen demand from the waste stream. The sludge disposal facilities consist of thickening in circular covered gravity tanks, sequential thermal conditioning and decanting of sludge, vacuum filtration with cloth media, fluid bed incinerators designed to achieve autogenous combustion of the thermally conditioned sludge with waste heat recovery, steam and electric power generation, and sidestream treatment, involving precipitation of phosphorus with lime. The Wayne County Board's largest plant treated an average of 85 mgd in 1980 at a basic charge of $552/million gallons. (Baker-FRC)
W82-01505

DETROIT - FRESH CLEAN WATER,

Detroit Water and Sewerage Dept., MI.
H. W. Bierig, A. C. Davanzo, J. W. Hubbell, and F. Pollard.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1359-1369, September, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Detroit, Municipal wastewater, Municipal wastes, History, Water pollution control, Wastewater management, Combined sewers.

In 1836 a water pollution control program was begun for the city of Detroit with the construction of sewers that ran perpendicular to the river and emptied directly into it. The city continued to grow, and in 1914 a proposal was made to screen the combined sewer outfalls at the river's edge. In 1925 a comprehensive study proposed a plant near the southwestern corner of the city, with local topography and geological conditions being of key importance in planning one large treatment plant. Despite the flat terrain, almost 85% of Detroit is served by a gravity collection system, with pumping needed only at the treatment plant's main pump station. The other 15% of the city is served by combination sanitary/stormwater pump stations, remotely controlled from a central location in downtown Detroit. Although the combined system was constructed using mostly typical interceptor-level, float-controlled regulators, larger units at key locations have been modified for remote operation. The adverse effects of incoming rainfall can be reduced through reliance on weather forecasts. In 1969 it was decided to proceed with construction of two activated sludge systems. The first-phase construction of activated sludge systems included two intermediate variable-speed lift pumps, feeding the two aeration basins. Following aeration the flow proceeded to clarifiers, each with its own return sludge pump. While all this work was being undertaken in the Detroit area, other localities in the metropolitan region took their own approach to the collection and treatment of wastewater. (Baker-FRC)
W82-01506

DYNAMIC NUTRIENT CYCLE MODEL FOR WASTE STABILIZATION PONDS,

Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and D. R. F. Harleman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil

Engineers, Vol 106, No EE1, p 37-54, February, 1980. 19 Fig, 2 Tab.

Descriptors: *Cycling nutrients, *Stabilization ponds, Ponds, Nutrients, *Wastewater treatment, Tertiary wastewater treatment, Advanced wastewater treatment, Model studies, Mathematical models, Optimum development plans, Design criteria.

A reliable and predictive method was sought for the optimum design and analysis of waste stabilization ponds that would go beyond the classical biochemical oxygen demand (BOD) approach and consider biological and nutrient dynamics. Attention is focused on facultative stabilization ponds, as they appear to be very promising and widely used for complete treatment of wastewater. In order to develop a usable model for waste stabilization ponds, it is necessary to describe both the hydraulic transport and the biological and chemical transformation of material. A model is developed which includes representation of the following: mineralization of organic compounds, organism growth, net loss of material by settling of nonbiodegradable organic matter, atmospheric reaeration of carbon dioxide, and removal of fecal coliforms by death and predation. Stabilization ponds are capable of providing at least secondary treatment of raw sewage while also removing significant amounts of nitrogen and phosphorus without process modification. While the use of stabilization ponds alone for high level tertiary treatment may not be feasible, they can, if properly designed in conjunction with solids removal mechanisms, provide a tertiary level of treatment. At present primary concern of future research on waste stabilization ponds should be in the area of data collection. (Baker-FRC)
W82-01541

SURVEY OF TREATMENT PLANT DESIGN AND OPERATION DEFICIENCIES,

Montgomery (James M.) Inc., Pasadena, CA.
D. L. Smith, and R. V. Daigh.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1272-1282, August, 1981. 15 Fig, 1 Tab.

Descriptors: *Performance evaluation, *Process control, *Design criteria, *Wastewater treatment facilities, Operating policies, Training, Activated sludge, Clarification, Sludge disposal, Monitoring.

A survey of eight wastewater facilities with chronic operating problems revealed that the reasons for poor performance were evenly split between design and operation deficiencies. The most frequent design problems were grit removal/clarifier, pump control, and sludge handling systems. Of less importance were design loadings, reactor design, chlorine contact time, metering, and laboratory minor design details to cause severe operations problems. Inadequate monitoring was slightly more prominent among the operations deficiencies than other factors: staffing, inadequate maintenance, digester supernating/sludge withdrawal, return activated sludge operation, sludge pumping, infiltration/inflow industrial discharge, and aerator operation maintenance. Where chronic noncompliance at a plant is noted, emphasis should be placed on cause-effect relationships and controlled experimentation with process variables during operator training programs. (Cassar-FRC)
W82-01543

DESIGN AND COST COMPARISON OF BIOLOGICAL NITROGEN REMOVAL PROCESSES,

International Environmental Consultants Ltd., Toronto (Ontario).
R. W. Wilson, K. L. Murphy, P. M. Sutton, and S. L. Lackey.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1294-1302, August, 1981. 2 Fig, 9 Tab, 18 Ref.

Descriptors: *Denitrification, *Nitrogen removal, *Biological treatment, *Wastewater treatment, *Penticton, British Columbia, Cost analysis, Design criteria, Nitrates, Ammonium, Land disposal, Ion exchange.

The most cost effective biological nitrogen removal process for the City of Penticton, British Columbia, was one-sludge pre-denitrification. This process uses the oxidizable organic matter in the raw wastewater as electron donor for the denitrification process. The process design was based on a 20-day aerobic solids retention time and a 10-day anoxic solids retention time at a minimum temperature of 8 C. Desired N levels in the treated effluent were 5 mgd per liter nitrate-N and 1 mg per liter ammonium-N. The one-sludge post-denitrification process was nearly as cost effective, followed by the two-sludge post-denitrification. Non-biological methods studied were ammonia stripping, ion exchange, and land disposal, all of which were 30-50% more expensive than the biological N removal processes. (Cassar-FRC)
W82-01544

PIPELINE FRICTION LOSSES FOR WASTEWATER SLUDGES,

Havens and Emerson Ltd., Cleveland, OH.
M. C. Mulbarger, S. R. Copas, J. R. Kordic, and F. M. Cash.
Journal of the Water Pollution Control Federation, Vol 53, No 8, 1303-1313, August, 1981. 16 Fig, 2 Tab, 18 Ref.

Descriptors. *Pipelines, *Friction loss, *Head loss, *Wastewater treatment, Pipe flow, Sludge, Rheology, Reviews, Shear stress, Turbulent flow, Laminar flow, Rigidity, Hydraulic loss, *Literature review.

The past 50 years' literature on frictional head losses associated with pipeline conveyance of wastewater solids was reviewed. The rheological data were summarized to discover trends as a function of the sludge slurry concentration. Trend lines were drawn to allow prediction of laminar flow head losses and the transition from laminar to turbulent flow regimes. Turbulent flow head losses obeyed conventional flow relationships. The head loss predictions divided into operating and worst case categories, were verified with operating data from several cities' treatment plants. Appended are predictive head loss curves for cast or ductile iron lines of seven diameters from 4 inches to 20 inches, representing both routine operation and worst case. (Cassar-FRC)
W82-01545

FACTORS AFFECTING THE FATE OF HEAVY METALS IN THE ACTIVATED SLUDGE PROCESS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
P. O. Nelson, A. K. Chung, and M. C. Hudson.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1323-1333, August, 1981. 12 Fig, 5 Tab, 34 Ref.

Descriptors: *Heavy metals, *Activated sludge process, *Adsorption, Water pollution effects, Wastewater treatment, Metals, Zinc, Copper, Bacteria, Cadmium, Microorganisms, Fate of pollutants, Toxicity.

Activated sludge bacteria rapidly adsorbed cadmium, copper, and zinc from solution within 1 hour after dosing in batch reactor experiments. Attempts to compare metal ion adsorption by live and inactivated bacteria produced erratic results; it is likely that physical and chemical factors, rather than biological factors, control the adsorption mechanism. Adsorption isotherms represented the distribution of metals between bacterial solids and solution phases. Conditional adsorption constants, presented in a table, indicated that Cu had a greater adsorption density than Cd at equivalent molar concentrations. As the pH increased, Cu adsorption increased up to pH 8, then decreased. The order of affinity for bacterial solids at pH 7 was Zn > Cu > Cd. pH was the single most important factor affecting metal adsorption on organic and inorganic surfaces. As pH increased, adsorption of Cd and Zn increased, reaching a maximum 90% removal at pH 10. Cu adsorption was almost 100% at pH 7, decreasing sharply to 40% or less at low and high pH. Adsorption of Cd, Cu, and Zn was greater at 5 days residence time than at 1 day, consistent with the hypothesis that exocellular polymers produced by the bacteria are largely responsible for uptake of metal ions. Solubilities, speciation, and distribution between the soluble and particulate (bacteria) phases were calculated from data obtained in this study and from the literature. (Cassar-FRC)
W82-01547

OPERATIONAL PROBLEMS WITH ROTATING BIOLOGICAL CONTACTORS,

Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
J. A. Hitdlebaugh, and R. D. Miller.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1283-1293, August, 1981. 10 Fig, 5 Tab, 26 Ref.

Descriptors: *Nitrification, *Rotating biological contactors, *Performance evaluation, *Wastewater treatment, Ammonia, Solids contact processes, *Biological treatment, Chemical oxygen demand, Dissolved oxygen, Suspended solids.

Investigation into the cause of operating difficulties with a rotating biological contactor, part of a U.S. Army installation's 23,000 cu meters per day wastewater treatment plant, showed that the reasons for exceeding effluent limitations were different in summer and winter. In summer the poor performance was caused by low dissolved oxygen (less than 1 mg per liter) in the first four of six stages in the contactor. The white mass of Beggiatoa in the early stages indicated anaerobic conditions. Although very little soluble BOD remained after treatment, the suspended solids and ammonia exerted considerable oxygen demand. Supplemental oxygen and removal of suspended solids would allow more surface area for nitrification. Nitrification was limited both by low dissolved oxygen and low pH (6.5-6.7 vs. optimum 8.0-8.5). The winter difficulties were not a result of low dissolved oxygen but of low wastewater temperatures and too low pH. (Cassar-FRC)
W82-01549

HIGH TEMPERATURE ULTRAFILTRATION WITH KYNAR POLY(VINYLIDENE FLUORIDE) MEMBRANES,

Penwalt Corp., King of Prussia, PA. Technological Center.
W. D. Benzinger, B. S. Parekh, and J. L. Eichelberger.
Separation Science and Technology, Vol 15, No 4, p 1193-1204, 1980. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Waste water treatment, *Membrane filters, *Ultrafiltration, *Performance evaluation, Separation techniques, Industrial wastes, Textile mill wastes, Oxidation, Oxidized waste water, Organic solvents, Polymers.

Many commercial ultrafiltration membranes used in concentrating textile sizing wastes and other industrial wastes and in processing food products are damaged by drying, extremes of temperature and pH, organic solvents, and strong oxidants. An ultrafiltration membrane made from KYNAR poly(vinylidene fluoride) is described, which resists many of these elements. The membranes may be dried and rewetted or even autoclaved and still retain their integrity. Pilot plant studies were performed on simulated textile sizing wastes using spiral-wound modules made from these ultrafiltration membranes. Satisfactory performance of the membranes has been noted after continuous operation at 186 F and 20-25 psi for 7 months with flux rates up to 15 gallons/sq ft/day and 97% retention of the poly(vinyl alcohol). (Geiger-FRC)
W82-01566

APPLICATION OF AERIAL PHOTOGRAPHS AND SURFICIAL GEOLOGIC MAPS TO THE DETERMINATION OF SUITABILITY OF LAND FOR SEPTIC TANK SYSTEMS,

Federal Energy Regulatory Commission, Washington, DC.
For primary bibliographic entry see Field 7B.
W82-01569

OPEN-PORE POLYURETHANE AS A MEDIUM FOR COAL CONVERSION PROCESS AQUEOUS EFFLUENT CLEANUP,

Oak Ridge National Lab., TN. Chemical Technology Div.
M. S. Denton, S. R. Dinsmore, J. I. Brand, and J. Beams.
Separation Science and Technology, Vol 15, No 3, p 587-613, 1980. 13 Fig, 3 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Absorption, *Polymers, *Synthesis, Separation techniques, Industrial wastes, Liquid wastes, Electron microscopy, Graphical methods, Cleanup, Coal conversion wastewater.

In coal conversion processes, polymerized open-pore polyurethane is often used as a medium for the cleanup of aqueous effluents. Optimum conditions for synthesizing open-pore polyurethane (OPP) were investigated in situ by varying the reaction conditions and studying OPP structures by electron microscopy and flow-rate tests. Under these conditions, large 1-inch by 12-inch columns were polymerized and compared with identical columns filled with three common commercial adsorbents (a petroleum-based activated charcoal, a carbonaceous adsorbent and XAD-2) using a four-column, bench-scale adsorption apparatus. For each column, breakthrough curves of a synthetic and an actual coal conversion waste water were plotted. OPP was intermediate in capacity for synthetic effluent adsorption between XAD resin and carbon adsorbents, and phenol breakthrough was minimal. The in-situ polymer was more readily eluted with solvent than the other sorbents. OPP efficiency for carbonizer aqueous scrubber adsorption was somewhat lower, possibly because of the low phenol content. (Geiger-FRC)
W82-01577

O2 BLEACHING SHOWS POTENTIAL FOR REDUCING COSTS AND EFFLUENT PROBLEMS,

North Carolina State Univ. at Raleigh. Dept. of Pulp and Paper Science.
H-M. Chang.
Pulp and Paper, Vol 5 No 3, p 87-91, March, 1980. 4 Fig, 20 Ref.

Descriptors: *Pulp and paper industry, *Oxygen, *Bleaching wastes, Closed systems, Pollutant load, Water pollution control, Water quality standards, Industrial wastes, Economic aspects.

Oxygen bleaching processes are the only commercially proven alternatives that significantly reduce pollutant load and effluent volume in pulp and paper mills. The basic process is reviewed, and the major advantages and disadvantages are discussed. Oxygen bleaching is a modular operation between the digesters and conventional bleach plant. It continues delignification and removes about 50% of the residue lignin from the pulp. Because the oxygen bleaching effluent can be integrated into the closed cycle of the pulp mill chemical-recovery system, up to 50% of the total organic load in the bleach plant effluent can be eliminated. Oxygen bleaching may be the most cost-effective method of meeting anticipated stringent effluent standards. The system does entail high capital costs, as it requires expensive equipment which must be fabricated from stainless steel to avoid corrosion problems. Also, special safety considerations are required to monitor and control buildup of explosive vapors and gas. (Small-FRC)
W82-01578

CLOSEUP OF WHITEWATER SYSTEM HELPS MENASHA MEET EFFLUENT STANDARDS,

Menasha Corp., Otsego, MI.
B. Buchanan.
Pulp and Paper, Vol 54, No 3, p 60-62, March, 1980. 3 Fig, 1 Tab.

Descriptors: *Pulp and paper industry, *White water, *Water reuse, Industrial wastes, Closed systems, Industrial plants, Water quality standards.

Closeup of the whitewater system was implemented at a 360 tpd non-sulfur corrugating medium mill in order to meet effluent standards. Whitewater was screened for long fiber removal, and an in-line turbine flowmeter network was installed in the freshwater system, while daily mill balances were run on the computer. The system had a relatively low cost, modular construction, short installation time, positive long-fiber protection for critical reuse areas, and the capability to handle a high feed solids loading. A Sinclair Float Wash FD6 fractionator was used. The next phase of the mill closeup program will be to replace the following current freshwater-supplied items on fractionated whitewater: pulp, refiner and agitator seals, deck and vibrating flat screen showers, breast roll showers, and trim knockoff showers. Satisfactory performance of the fractionator and satisfactory response of the paper machine to the fractionated water have made the initial closeup a success. (Small-FRC)
W82-01579

TREATMENT OF SEWAGE PLANT EFFLUENT FOR USE AS MAKEUP WATER,

Burbank, CA.
For primary bibliographic entry see Field 3C.
W82-01585

ROSARIO DOMINICANA'S CYANIDE TAILINGS DAM CONSTRUCTION AND OPERATION,

Martiki Coal Corp., Denver, CO.
R. Addison, and R. O. Cranor.
Mining Engineering, Vol 33, No 6, p 709-714, June, 1981. 12 Fig, 4 Tab.

Descriptors: *Tailings, *Mine wastes, *Waste water treatment, *Dam construction, Surface runoff, Dam design, Cyanide, Diversion dams, Mine drainage, Gold, Silver, Gravity dams, Reclaimed water, Separation techniques, Relief, Wells, Diversion structures, *Dominican Republic.

The construction and operation of a tailings dam in the Dominican Republic are described. The dam is located downstream from an 8.5 kt/d open pit gold/silver mine located in an agricultural area subject to earthquakes and heavy rainfall. Incorporated into the core of the dam is a vertical gravel filter drain which discharges into the horizontal drainage blanket that extends to the downstream toe of the embankment. This arrangement prevents saturation of the downstream half of the dam wall. Relief/observation wells were drilled at critical points along the downstream toe to allow for seepage through the limestone foundation and to relieve uplift pressures. Tailings from the mill are discharged from a 4-train countercurrent decantation (CCD) thickener system after cyanide extraction of gold and silver. A water reclamation system was set up for use as wash on the last thickener of the CCD train. The alkalinity of the reclaim water serves to bind dust on road surfaces, and the reclaim water storage tank provides reserve water for the fire pump. A polyvinyl chloride pipe was used to divert a runoff stream from the dam to the Mejita River. (Geiger-FRC)
W82-01589

TREATMENT OF PULP AND PAPERMILL WASTEWATERS AND THE USE OF THE OXYGEN ACTIVATED SLUDGE SYSTEM,

R. W. Fuggle.
Effluent and Water Treatment Journal, Vol 21, No 6, p 259-262, 266-269, June, 1981. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Pulp and paper industry, *Unox process, *Oxygenation, Ozonation, *Wastewater treatment, Industrial wastewater, Activated sludge process.

The oxygen activated sludge process, or Unox process, is used to treat wastewaters at 24 pulp and paper mills worldwide. The basis of this process is economical separation of oxygen from air on site and a covered tank divided into compartments, providing a series of completely mixed stages and retaining the characteristics of the plug flow reactor. This process has several advantages over air aeration: more efficient contact of oxygen with sludge, saving power; a more stable, better-settling biomass; reduced retention time; better performance under shock loads; decreasing oxygen costs with increasing size of generator; better odor control; and use of oxygen in additional plant processes. Pilot plant and bench scale studies of this process were carried out in several countries widely varying wastewater types. The following conclusions were reached: (1) 90% of BOD can be removed at sludge loadings up to 1 kg BOD per kg MLVSS, (2) a large proportion of suspended solids are inert to biological treatment, especially in sulfite pulping mills, (3) the system was sensitive to the high temperatures (50C) encountered, (4) the Unox process handled shock loadings and mill shutdowns with greater stability, (5) caustic was required for pH maintenance, and (6) fish toxicity tests showed a 90% survival in treated effluent vs. zero in untreated kraft mill effluent. The use of ozone as a chlorine substitute, as a tertiary treatment, and in managing sulfide odors is in the research stage. (Cassar-FRC)
W82-01594

LAND TREATMENT SITE EVALUATION IN SOUTHEASTERN MOUNTAINOUS AREAS,

Law Engineering Testing Co., Marietta, GA.
G. L. Taylor, Jr.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 261-266, August, 1981. 4 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Municipal wastewater, *Land disposal, *Site selection, Waste disposal, Wastewater disposal, Hydraulic loading, Environmental effects, Design criteria, Percolation, Evapotranspiration, Mathematical studies.

The treatment of municipal waste water by application to land offers an alternative to in-plant treatment which eliminates the environmental impact of direct discharge to surface waters. The site for land treatment must take into account soil, climatic, geologic, hydrologic and vegetation factors. The hydrologic budget evaluation consisting of investigations of design precipitation, evapotranspiration, percolation of water to groundwater, and waste water hydraulic loading must also be performed. Seventeen site selection guidelines are presented and divided into two groups according to their impact on the site selection process. In addition, computation of a hydraulic loading range allows comparison of different land treatment sites and enables evaluation of the feasibility of land treatment with respect to other alternate treatments on a preliminary basis. (Geiger-FRC)
W82-01596

5E. Ultimate Disposal Of Wastes

ARTIFICIAL GROUNDWATER RECHARGE,

Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 4B.
W82-01110

INFRARED SPECTROSCOPIC STUDY OF THE WATER-SOLUBLE FRACTION OF SEWAGE SLUDGE-SOIL MIXTURES DURING INCUBATION,

Sonoma State Univ., Rohnert Park, CA. Dept. of Chemistry.
G. D. Schaumberg, C. S. LeVesque-Madore, G. Sposito, and L. J. Lund.
Journal of Environmental Quality, Vol 9, No 2, p 297-303, April-June, 1980. 6 Fig, 2 Tab, 27 Ref.

Descriptors: *Sludge disposal, *Sludge digestion, *Soil water, *Alkaline soils, *Acidic soils, Wastewater disposal, Soil amendments, Soil organic matter, Biodegradation, Anaerobic digestion, Infrared spectroscopy, Degradation, Decomposition, Nitrates, Sulfates.

Four soil-sludge mixtures prepared from two anaerobically digested sewage sludges and two sandy soils with different pH's were maintained at two different levels of soil water content for 100 weeks at 250 degrees under laboratory conditions. Sludge decomposition was monitored by infrared spectra

of evaporated films prepared from extracts taken periodically from the mixtures. In alkaline soil maintained at 1/3-bar soil water tension, and for both sludges, polysaccharides, proteinaceous material, and sulfonate and/or sulfate compounds disappeared after about 10 weeks. During the same time, carboxylates and nitrates appeared or increased in intensity. Similar changes occurred in the alkaline soil maintained at water saturation, but at a much slower pace. IR spectral changes in the acidic soil maintained at 1/3-bar soil water tension were also slightly retarded. The extracts of acidic, water-saturated soil incubated with either sludge gave the least amount of spectral changes. (Geiger-FRC)
W82-01130

DEMONSTRATION TESTING OF ALUM RECOVERY BY LIQUID ION EXCHANGE,

Michigan State Univ., East Lansing. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-01167

STUDIES ON UNSATURATED ZONE HYDROLOGY AND RADIONUCLIDE MIGRATION AT A SHALLOW-LAND BURIAL SITE,

California Univ., Berkeley, Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W82-01172

SLUDGE TREATMENT, UTILIZATION, AND DISPOSAL,

Duke Univ., Durham, NC.
P. A. Vesilind.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 726-733, June, 1981. 173 Ref.

Descriptors: *Literature review, *Bibliographies, *Sludge disposal, Wastewater treatment, Sludge utilization, Wastewater management, Public health, Legal aspects.

A literature review is presented of 1980 publications on sludge treatment, utilization, and disposal. Environmental Protection Agency regulations on the manufacture of sludge-derived products were reviewed, and several papers dealt with energy considerations in sludge management. Optimization of sludge management techniques was explored in studies which included the development of a computer program which permitted the selection of various sludge handling unit operations. The importance of public opinion in sludge management alternatives selection was emphasized by one paper. Waste activated sludge processing was investigated, and the most cost effective system was dissolved air flotation, mesophilic digestion, centrifugal dewatering, compost drying, and sale of the final product. Safety hazards in sludge processing were examined in one article. This included the health risks associated with producing food chain substances out of the sludge. General areas covered by the publications were: sludge properties; industrial, nutrient-laden, and water treatment sludges; thermal conditioning and incineration; thickening; dewatering; stabilization; and ultimate disposal and utilization. (Small-FRC)
W82-01247

ONSITE ALTERNATIVES FOR TREATMENT AND DISPOSAL,

Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5D.
W82-01248

A STUDY OF REGIONAL TEMPERATURE AND THERMOHYDROLOGIC EFFECTS OF AN UNDERGROUND REPOSITORY FOR NUCLEAR WASTES IN HARD ROCK,

California Univ., Berkeley. Lawrence Berkeley Lab.
J. S. Y. Wang, C. F. Tsang, N. G. Cook, and P. A. Witherspoon.
Journal of Geophysical Research, Vol 86, No B5, p 3759-3770, May, 1981. 17 Fig, 4 Tab, 18 Ref.

Descriptors: *Waste disposal, *Radioactive wastes, *Groundwater movement, *Thermodynamics, Temperature effects, Density, Viscosity, Transmissivity, Geologic fractures, Environmental effects, Toxicity.

Three important aspects of the design and performance of underground respositories for the disposal of nuclear wastes were investigated. First, heat released by the radioactive decay of the nuclear wastes causes changes in the temperature distribution in the rock which produce thermally induced components of compressive stress in the heated rock and tensile components of stress outside of this zone. Second, the magnitude and temporal changes of the temperatures in the rock are affected by the type of waste and the time it is buried, and the characteristics of different wastes are discussed. Third, the temperature changes in the rock affect the density and viscosity of water. These changes in the temperature of groundwater may result in perturbations of the hydrologic flow which in turn may affect the isolation of toxic components of the waste. A model is presented of buoyancy groundwater flow through a simple fracture system. This flow is a function of vertical and horizontal fracture transmissivities as well as changes in groundwater density and viscosity. (Small-FRC)
W82-01347

THE INFLUENCE OF CHEMICAL CONDITIONING AND DEWATERING ON THE DISTRIBUTION OF POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE INSECTICIDES IN SEWAGE SLUDGES,

Imperial Coll. of Science and Technology, London (England). Dept. of Public Health Engineering.
A. E. McIntyre, J. N. Lester, and R. Perry.
Environmental Pollution, Series B, Vol 2, No 4, p 309-320, 1981. 6 Tab, 27 Ref.

Descriptors: *Polychlorinated biphenyls, *Insecticides, *Sludge conditioning, *Chlorinated hydrocarbons, Pollutant identification, Organic compounds, Pesticides, Dieldrin, Gamma-HCH, Aroclors, Land application, Sludge disposal, Dewatering, Path of pollutants, Water pollution sources.

Polychlorinated biphenyls and organochlorine insecticides were associated with the solid matter in sewage sludge, according to mass balances derived for these materials in two treatment works. One process involved coagulation of primary digested sludge with aluminum chlorohydrate followed by dewatering using vacuum filtration; the other, conditioning of consolidated mixed primary sludge with Zetag 94S, an organic polyelectrolyte, and subsequent dewatering by pressure filtration. The dewatering chemicals did not interfere with analysis of the organochlorine compounds in conditioned sludges. Using either Aquafloc 4051 or Zetag 94S the ranges (in micrograms per liter) were: Aroclor 1260, 3.14-3.74; p,p'-DDE, 1.04-1.54; gamma-HCH, 6.54-8.60; and dieldrin, 7.72-9.00. In the filtrates from the vacuum filtration plant and the pressure filtration plant no Aroclor 1260, gamma-HCH, or p,p'-DDE was detected. The vacuum process filtrate contained 0.007-0.026 micrograms per liter dieldrin and the pressure filtration filtrate, 0.008-0.012 micrograms per liter dieldrin. Concentrations of organochlorines in sludge cakes (micrograms per g) were: Aroclor 1260, 0.25-0.51; p,p'-DDE, 0.04-0.05; gamma-HCH, 0.13-0.16; and dieldrin, 0.15-0.17. (Cassar-FRC)
W82-01387

THE NATIONAL ASSESSMENT OF THE GROUND-WATER CONTAMINATION POTENTIAL OF WASTEWATER IMPOUNDMENTS,

Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5G.
W82-01419

COMPARATIVE EVALUATION OF PROCESSES FOR THE TREATMENT OF CONCENTRATED WASTEWATERS AT UNCONTROLLED HAZARDOUS WASTE SITES,

TRW Environment Engineering Div., Redondo Beach, CA.
For primary bibliographic entry see Field 5D.
W82-01430

STABILIZATION/SOLIDIFICATION OF WASTE FROM UNCONTROLLED DISPOSAL SITES,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
P. G. Malone, R. J. Larson, and T. E. Meyers.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 180-183, 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Land disposal, *Waste disposal, *Hazardous materials, *Water pollution prevention, Toxicity, Metals, Anions, Organic compounds, Landfills, Incineration, Portland cements, Asphalt, Polymers, Adsorption, Waste disposal sites.

Stabilization/solidification can be employed as a step to facilitate safe transport and disposal of the wastes at the estimated 2000 unauthorized or uncontrolled sites in the U.S. Stabilization/solidification is appropriate for both on-site and off-site ultimate disposal, and has cost and safety advantages over drum overpacks. Once the liquid wastes have been identified and characterized by their major constituents the stabilization/solidification process may be chosen. Admix techniques using Portland cement, organic polymers or other binding agents are most suited to toxic metal wastes. Thermoplastic incorporation into asphalt, sulfur or polyethylene, and encapsulation in an inert jacket are suitable disposal techniques to contain soluble toxic dry salts and toxic anions. Toxic organics can be adsorbed onto clays, but their continued volatilization must be prevented by some sort of vapor-tight barrier. All the stabilized wastes may be recontainerized and landfilled since they no longer threaten to contaminate ground or other water resources. The stabilized organics may also be incinerated. (Brambley-SRC)
W82-01432

IDENTIFICATION AND RECLAMATION OF CHROMIUM SLUDGE DISPOSAL SITES,

Maryland Office of Environmental Programs, Annapolis.
W. L. Ramsey.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 259-261, 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Sludge disposal, *Chromium, *Groundwater pollution, *Land disposal, Monitoring, Soil contamination, Sludge bed, Water pollution control, Wastewater treatment, Industrial wastes, Organic solvents, *Sludge treatment.

In 1978 an Interim Facility Permit was issued in Maryland to a company requiring it to develop a new technique for handling chromium sludge and a plan to renovate existing sludge beds. Twenty-five wells were located in the area; water from them was analyzed. Chromium levels up to 276 ppm were reported. Monitoring wells were dug around the sludge beds. The ground water was found to be contaminated to a level of 0.25 ppm, but the direction of groundwater was found to be southeast, and not the anticipated southwest. In searching for additional monitoring well sites, another dump was discovered which was the major source of contamination. The sludge beds were renovated by removing contaminated soil to bedrock and hauling it to a safe site. The area was backfilled, contoured and stabilized, and within 2 months the groundwater in the monitoring wells closest to the site showed declines in chromium from 0.25 ppm to 0.001 ppm. The dimensions of the new dump were determined by taking core samples and placing sampling wells. Traces of organic solvents were found. The heavily contaminated soil will be removed down to the bedrock, and the site will be capped with clay, regraded and

stabilized. The company has installed a new wastewater treatment system which reduces the volume of sludge. The sludge is transported to a safe disposal facility. (Brambley-SRC)
W82-01437

EFFECTS OF SANITARY LANDFILL LEACHAGE ON SOME SOIL CHEMICAL PROPERTIES,

Science and Education Administration, Morgantown, WV.
W. M. Winant, H. A. Menser. and O. L. Bennett.
Journal of Environmental Quality, Vol 10, No 3, p 318-322, July-September, 1981. 6 Tab, 21 Ref.

Descriptors: *Soil chemistry, *Leachages, *Sanitary landfills, Landfills, Chemical properties, Soil properties, Wastewater treatment, Effluents, Land disposal, Chemical composition.

Land disposal by spray irrigation has been successfully used to treat leachate from sanitary landfills through substantial reductions in chemical oxygen demand, electroconductivity, and total nutrient content of the leachate. Soil chemical analyses were performed to determine the efficacy of land disposal used in conjunction with soil amendments as a method for decontamination of leachage from a sanitary landfill. Experimental plots received leachage only or leachate plus lime, rock phosphate, or superphosphate. The plots received about 100 centimeters of leachage from a sanitary landfill over a 6-month period, after which soil samples were collected to a depth of 60 centimeters. Application of the fertilizers and leachage in combination to woodland soils significantly increased the extractable soil calcium, magnesium, potassium, strontium, and zinc levels as compared with pre-irrigation values at a soil depth of 0 to 5 centimeters. Extractable manganese was significantly higher at soil depths of 30 centimeters in all of the leachate-treated plots as compared with pre-irrigation values. Iron, phosphorus, and Kjeldahl nitrogen levels were not significantly changed by leachate irrigation. Soil pH was increased from 4.7 to 5.8 at the 0 to 5 centimeter depth and from 4.5 to 5.7 at the 15 to 30 centimeter depth by irrigation with leachate. Although most elements were attenuated to some extent by the soil, lime and fertilizer addition did little to influence soil absorptive capacity. (Carroll-FRC)
W82-01480

VEGETATION SELECTION AND MANAGEMENT FOR OVERLAND FLOW SYSTEMS,

Cold Regions Research and Engineering Laboratory, Hanover, NH.
A. J. Palazzo, T. F. Jenkins, and C. J. Martel.
Public Works, Vol 112, No 8, p 49-52, August, 1981. 2 Tab, 5 Ref.

Descriptors: *Overland flow, *Vegetation, *Crop yields, *Land disposal, Flow, Wastewater disposal, Agriculture, Nutrients, Nitrogen, Phosphorus, Grasses.

Domestic wastewater was applied over a four-year period at various rates to study plant growth and nutrient removal on each of three overland flow test slopes. Establishment of forage grasses, plant yields, and uptake of nutrients were determined. Domestic sewage from the town of Hanover, New Hampshire, was applied weekly, with each weekly application period spanning a five-day period, seven hours per day. The waste contained an average of 35 mg/liter of total nitrogen and 6 mg/liter of total phosphorus. Annual plant yields on a dry weight basis for a minimum of two harvest periods ranged from 3.4 to 5.4 tons/acre. This was almost three times the average yield of hay grown in the state. None of the concentrations of elements measured in the harvested plants was in the deficiency or toxicity ranges, indicating growth of healthy plants. Reed canary grass, orchard grass, and tall fescue all had good persistence on the overland flow slopes. (Small-FRC)
W82-01500

ELECTRO-OSMOSIS CHEMISTRY AND WATER QUALITY,

Lowell Univ., MA.
B. A. Segall, C. E. O'Bannon, and J. A. Matthias.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No GT10, p 1148-1152, October, 1980. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Waste disposal, *Dewatering, *Electro-osmosis, *Slope stabilization, Waste management, Separation techniques, Membrane processes, Electrochemistry, Electrodes, Anodes, Cathodes, Water quality, Soil water, Dredging.

Studies were made on the feasibility of using electro-osmosis to increase the capacity of dredged material disposal sites by reducing the water content of in-place material and increasing the shear strength of containment area embankment foundations. Some theories on the electrochemical process of electro-osmosis which may be used to improve the process for application in slope stabilization and foundation dewatering are reported. The chemical characteristics of electro-osmosis process water, which may become an environmental pollutant, are presented. Electro-osmosis water is highly alkaline, contains organic material, is highly colored, and may contain high levels of pesticides, heavy metals, or other substances from the soil or water mass. Moving the electrodes during electro-osmotic dewatering was effective in reducing polarization and increasing the rate of dewatering. This procedure has the added advantage of enabling dewatering of an entire soil mass when needed for a particular application. (Geiger-FRC)
W82-01518

REMEDIAL ACTION CONTROLS GROUND-WATER CONTAMINATION AT A PAPER MILL SLUDGE DISPOSAL SITE,

Soil Testing Services of Wisconsin, Inc., Green Bay.
For primary bibliographic entry see Field 5G.
W82-01582

5F. Water Treatment and Quality Alteration

THE PROBLEMS OF NON-RETURN AND THE USE OF VALVES IN DRINKING WATER PROTECTION AGAINST WASTE WATER RETURN, APPLYING THE REGULATIONS IN FORCE,

B. Rochette.
Aqua, No 2, p 27-31, 1980. 4 Fig, 2 Tab.

Descriptors: *Hydraulic valves, *Return flow, *Wastewater management, Water distribution, *Drinking water, Water pollution control, Flow regulations, Water mains, Pressure head, Regulations, Water pollution sources, *Water supply systems.

Many cases of wastewater entering the water distribution system have been reported in European cities. Common causes of this problem are lowering of main pressure caused by large demand, repairs, and breakage; and high pressure systems on the consumer end. Most European countries have regulations for preventing return flow. Check valves are often used to control the problem. The linear parallel displacement valve fulfills conditions specified by most legislatures. Minimum and maximum requirements are described for mechanical characteristics of the casing, tightness (must be tight for 3-10 min at 3 cm water column pressure and from 0-16 bars), head loss, and reliability (must work through 100,000 cycles of operation) of non-return valves. (Cassar-FRC)
W82-01142

CHEMICAL EQUILIBRIA IN SPLIT-TREATMENT SOFTENING OF WATER,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
K. A. Zipf, Jr., and R. G. Luthy.
Journal of the American Water Works Association, Vol 73, No 6, p 304-311, June, 1981. 8 Fig, 5 Tab, 11 Ref.

Descriptors: *Water softening, *Equilibrium, *Split treatment, Hardness, Calcium compounds, *Water treatment, Lime, Sodium carbonate, Chemical reactions, Langlier equations, Saturation index, Carbonates, Water quality.

Equations and methods of solution are developed for split treatment water softening problems in order to see how treated water quality parameters and operating variables are related to chemical requirements. Split treatment, generally applied to high-Mg waters, divides the raw water into two streams, one treated with excess lime, and the other bypassed or untreated. These streams are recombined and treated with soda ash for noncarbonate hardness removal. Both the lime softening process (9 equations, 12 variables) and the lime-soda ash process (10 equations, 12 variables) may be solved by assigning values to two decision variables. The soda ash dosage is zero in the one treatment. Solution sets are described for the decision variables combinations as follows: effluent hardness and pH, effluent alkalinity and pH, lime dose and bypass fraction. Several examples of computer-aided graphical solutions are presented. The bypass fraction may be raised from about 0.25 to about 0.90. Effective minimum effluent pH is 7.8-8.0. There is usually a minimum associated with chemical costs and effluent quality variables. The hydroxide concentration is usually a limiting figure in split treatment. (Cassar-FRC)
W82-01165

INTERPRETING LABORATORY RESULTS FOR THE DESIGN OF RAPID MIXING AND FLOCCULATION SYSTEMS,

Servicos de Engenharia Emilio Baumgart Ltd., Belo Horizonte (Brazil).
J. R. Bratby.
Journal of the American Water Works Association, Vol 73, No 6, p 318-325, June, 1981. 11 Fig, 2 Tab, 21 Ref.

Descriptors: *Flocculation, *Coagulation, *Mixing, *Water treatment, Alum, Turbidity, Settling velocity, Polyelectrolytes, Laboratory tests, Brazil.

A 3-liter laboratory batch reactor for measuring flocculation under rapid mixing conditions is described. The raw water was obtained from the Lago Descoberto, Brazil water supply. Optimum conditions derived from using this batch reactor were: primary coagulant--3 mg per liter alum at pH 6.4; rapid mixing velocity gradient--650 per sec for 0.5 to 8 sec; anionic polyelectrolyte--0.15 mg per liter; preflocculation--3 equal volume tanks, velocity gradients 100 per sec each, total retention time 20 min; flocculation system--3 tanks with velocity gradients, 100 per sec, 50 per sec, and 30 per sec, respectively; total retention time, 31.5 min; settling overflow rate, 9 cm per min with effluent quality of 0.5 ftu; design overflow 6 cm per min. (Cassar-FRC)
W82-01166

DISINFECTION,

Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 5D.
W82-01250

MICROBIOLOGY OF POTABLE WATER,

Environmental Protection Agency, Dallas, TX. Region VI.
M. J. Allen.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 1109-1112, June, 1981. 42 Ref.

Descriptors: *Microbiological studies, *Potable water, *Literature review, *Bibliographies, Drinking water, Domestic water, Viruses, Bacteria, Water distribution, Water quality.

A literature review is presented of 1980 articles on the microbiology of potable water. Research included an evaluation of the use of granular activated carbon whicch identified needed research including investigation of the factors responsible for the initiation of microbial growth on GAC surfaces and the microbial generation of organic compounds during carbon treatment. A study on the

inactivation of cell-associated poliovirus and coxsackievirus found that higher ozone residuals were required than for nonassociated viruses. Also, natural poliovirus isolates found in drinking water were more resistant to chlorine inactivation than were standard laboratory virus strains. One study examined 23 potable water supplies for viruses and found ten virus positive samples. An investigation of water encrustations from seven water systems by scanning electron microscopy found algae, actinomycetes, diatoms, and filamentous and flagellated bacteria. Several studies supported the concept that microorganisms promote a localized corrosion of metal and tubercle formation, and that the microbial ecosystems influence the concentrations of numerous constituents in distributed waters. (Small-FRC)
W82-01257

MALAWI: A COMMUNITY APPROACH.

UNESCO Courier, Vol 34, No 2, p 16-17, February, 1981.

Descriptors: *Water supply development, *Public participation, *Malawi, Developing countries, *Water distribution, Drinking water, Africa.

Clean water is now available to 70% of urban dwellers and 35% of the rural inhabitants in Malawi, population 5 million. Local involvement has been responsible for this progress toward the government's goal of safe, potable water within 400 meters for all people by 1990. As an example, the Mulanje West Project is described. When shallow wells and the nearby river periodically failed after extensive tree removal, the government designed a water distribution system, and the villagers provided construction labor. About 200 men, women, and children worked enthusiastically on digging trenches for 30 km of main line and 210 km of branch lines, as well as installing concrete aprons and drains for the taps. In other areas where shallow wells are appropriate, villagers supply bricks, sand, oxcarts, and labor, and the government provides pumps and concrete slabs. In cities, water projects are financed by water charges. (Cassar-FRC)
W82-01365

THE RIVER OUSE WATER SUPPLY SCHEME,

Yorkshire Water Authority (England).
R. Dobson.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 3, p 265-290, May, 1980. 7 Fig, 3 Tab.

Descriptors: *Water treatment facilities, *Construction, *Yorkshire Water Authority, Water resources development, Ouse River, Political aspects, Social aspects, Reservoirs, Pipelines, Pumping plants, Planning, Rivers, *England.

The background, planning, and construction of a large water source development on the River Ouse in Yorkshire, England, is described in detail. The facilities consisted of abstraction works, pumping station, a 28.6 km pipeline, and a reservoir bypass. Although planning began in the late 1960's the drought of 1975-76 was a factor in deciding in October 1976 to build the plant as quickly as possible. Water was pumped from the river only 18 months after detail design commenced and 11 months after construction contracts were let. Overall costs were 10,000,000 pounds. Some of the noteworthy details involved in the project were: (1) the raw water has wide variations in hardness (65 to 290 mg per liter) and a rich nutrient supply, (2) river flooding is frequent and widespread, (3) a 48-hour storage channel protects the supply from pollution, (4) landowners objected to installation of power transmission lines and pipeline construction, (5) delivery of construction materials and equipment was closely monitored to prevent delays, (6) the abstraction works land was owned by a fishing club, (7) the pipeline route had to be adjusted so archaeologists could study two medieval villages, and (8) excavation in hard sandstone near the reservoir was simplified by threading the bypass pipe through an unused 40 inch diameter cast iron pipe laid in 1847. (Cassar-FRC)
W82-01371

DEVELOPMENTS IN SEDIMENTATION AND FLOTATION,

Water Research Centre, Stevenage (England).
T. F. Zabel.
Effluent and Water Treatment Journal, Vol 21, No 4, p 166, 168-169, 172, April, 1981. 2 Fig, 1 Tab.

Descriptors: *Sedimentation, *Flotation, *Suspended load, Drinking water, Flocculation, *Water treatment, Performance evaluation, Pilot plants, Rivers, Water treatment facilities, *Great Britain.

Lamella sedimentation and flotation are developments which increase the surface loadings of water treatment plants. In co-current or down-flow lamella sedimentation systems developed in Sweden, the flocculated suspension passes in laminar flow from the surface downwards through a system of parallel plates. Flocculated particles settle on the plates and run smoothly down to the sludge collector. The clarified water is withdrawn at the bottom of the plates. In the counter-current system, the flocculated water enters from the sides at the lower edge of the lamellae through channels and moves upwards between the lamellae. Again, the particles settle on the plates and slide down into the sludge collector. This system has a simpler design and was tested in a pilot plant on the Thames River. The process can be operated up to 30 m/hr and produces acceptable settled water for further treatment by rapid gravity filtration. The most likely application for lamella sedimentation is the treatment of lowland river waters with heavy solids loads. Flotation is particularly effective for stored waters containing high algal loads or low turbidity, highly colored waters. There are approximately 20 flotation plants operating in the United Kingdom, which range in size from 2.3 to 36 M liter/day. (Small-FRC)
W82-01391

REGENERATION OF ANION EXCHANGE RESINS BY CALCIUM CARBONATE AND CARBON DIOXIDE,

Kernforschungszentrum Karlsruhe (Germany, F.R.).
W. Holl, and B. Kiehling.
Water Research, Vol 15, No 8, p 1027-1034, August, 1981. 8 Fig, 4 Tab, 18 Ref.

Descriptors: *Anion exchange, *Bicarbonates, *Regeneration, Ion exchange, Resins, Drinking water, *Water treatment, Sulfates, Nitrates, Chlorides, Costs, Environmental effects.

Anion exchange resins in the bicarbonate form can reduce the concentration of neutral salts in water at a lower cost than cation exchange resins. Regeneration can be carried out with CO2 and CaCO3, which are inexpensive, environmentally safe substances. The wastewater generated contains only calcium salts in moderate concentrations, and total dissolved salinity is actually reduced because of the low solubility of carbonates of bivalent cations. Sulfate and nitrate ions are strongly preferred by all ion exchange resins, while affinity for chloride ions is less pronounced. Theoretical and experimental evaluations of exchange equilibria in regeneration with CO2 and CaCO3 found that only in incomplete conversion to the bicarbonate form is achieved. Method efficiency depends on the type of resin, the original counterion, and CO2 pressure. Thus, the resins only reduce sulfate, nitrate, and chloride concentrations. Since SO4(2-) and NO3(1-) are the most noxious anions in drinking water, anion exchange resins in the bicarbonate form are important. (Small-FRC)
W82-01484

INVESTIGATION OF VOLATILE ORGANICS REMOVAL,

American Water Works Service Co., Inc., Haddon Heights, NJ.
D. L. Kelleher, E. L. Stover, and M. Sullivan.
Journal of the New England Water Works Association, Vol 95, No 2, p 119-133, June, 1981. 8 Fig, 4 Tab, 1 Ref.

Descriptors: *Activated carbon, *Groundwater pollution, *Filtration, Adsorption, Water treatment, Iron, Manganese, Trichloroethane, Wells, Public health, Dedham, Massachusetts, Volatility, *Organic compounds, Westwood.

A comprehensive program to evaluate treatment techniques for removing volatile organic compounds from the wells of the Dedham Water Company (White Lodge Well fields in Westwood, Massachusetts) is described. The well field consisted of four conventional gravel-packed wells ranging from 70 to 76 feet deep with an estimated safe yield of 4.5 mgd. Significant levels of 1,1,1-trichloroethane (TCEA) were found in two of the wells. Twenty-five locations throughout the watershed were sampled, but no source was found for the contamination. Parallel air stripping and carbon adsorption studies were conducted to determine the feasibility of removing the organic compounds. Aeration and glauconite or greensand were evaluated for the removal of iron and manganese. The manganese greensand filter was capable of removing iron and manganese, and both packed-bed stripping columns and activated carbon columns were capable of removing TCEA. The most economical treatment alternative was air stripping and manganese greensand filtration. (Small-FRC)
W82-01490

RELATIONSHIP OF THE RAW WATER QUALITY TO MUTAGENS DETECTABLE BY THE AMES SALMONELLA/MICROSOME ASSAY IN A DRINKING-WATER SUPPLY,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-01493

CHEMICAL CONTROL OF MUSSEL SETTLEMENT IN A COOLING WATER SYSTEM USING ACROLEIN,

Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
J. W. Rijstenbil, and G. C. Van Galen.
Environmental Pollution, Series A, Vol 25, No 3, p 187-195, 1981. 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Cooling water, *Fouling, *Mussels, Acrolein, Powerplants, Aquatic animals, Corrosion control, Estuaries, Toxicity, Industrial water, *Water treatment.

The influence of acrolein on young, newly settled mussels in a powerplant cooling water system is described. The aim of the control program is to expel most of the young mussels at a sublethal acrolein level, having a minimum discharge of the antifoulant into the receiving estuary. Young mussels were collected from bottom material and seaweeds of Lake Grevelingen in October of 1978. Toxicity tests were conducted in aquaria. Seawater was refreshed weekly and kept in circulation. Acrolein was added in concentrations of about 0.2, 0.4, 0.6 and 1.0 ppm. After exposure for periods of 2, 4, 6, 8, 12, 16, 20, or 24 hr, samples of mussels were examined. Two types of reaction were noted in mussels exposed to acrolein. Some had closed valves, and some mussels had become detached. There was no relationship between valve closure and time of exposure. It appeared that the mussels reacted immediately after exposure to acrolein by closing their valves. However, the percentage of mussels with closed valves increased with higher acrolein concentrations. In control experiments about 13% of the mussels became detached in the absence of acrolein in flowing seawater. Under the same circumstances a settlement reduction of 84% may be achieved in practice. A 24 hr application of 0.6 ppm acrolein followed by a 48 hr seawater flow was recommended. An environmental concentration below the toxicity threshold of 0.06 ppm acrolein will be achieved by a tenfold dilution on discharge. (Baker-FRC)
W82-01501

ORGANICS IN WATER - AN ENGINEERING CHALLENGE,

Stanford Univ., CA. Dept. of Environmental Engineering.
P. L. McCarty.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil

Engineers, Vol 106, No EE1, p 1-17, February, 1980. 4 Fig, 6 Tab, 16 Ref.

Descriptors: *Organic matter, *Drinking water, Reviews, *Water treatment, Water treatment facilities, Wastewater treatment, Industrial wastes, Domestic wastes, Organic wastes, Separation techniques, Organic compounds, Activated-carbon, Adsorption, Filtration, Adsorbents, Suspended solids, Coagulation, Oxidation, Volatility.

The nature of organic matter in water and its removal characteristics by possible treatment processes are reviewed. The purpose of the review is to indicate those processes which appear to have most promise in the near and far term for removing organic materials from drinking water supplies. Organic material in water may be either suspended or dissolved. That which is suspended is readily removed by normal chemical treatment and filtration. Dissolved materials may range from simple organic molecules to large and complex polymeric materials. Most of them arise from biological processing and decomposition of natural materials and are called humic materials. Processes for removal of organic materials include coagulation; oxidation, both chemical ad biological; membrane filtration; adsorption; liquid-liquid extraction; and volatilization. Activated-carbon adsorption has been shown in several studies to be the most effective single process for removing soluble organic materials in general. Mention is made of Water Factory 21, where treatment includes lime addition, air stripping, recarbonation, multi-media filtration, activated-carbon adsorption, and final chlorination. Reverse osmosis has also been employed at this plant since 1978. More than 100 different trace organics were identified in biologically treated wastewaters used as the water supply to Water Factory 21. In order to continue to protect the environment, the fate of organics stripped from water into the air must be carefully evaluated. Activated-carbon adsorption and biological growths associated with its use result in the production of organic chemicals that are different from those being removed. (Baker-FRC)
W82-01540

SMALL WATER SYSTEMS: ROLE OF TECHNOLOGY,

Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE1, p 19-35, February, 1980. 7 Fig, 8 Tab, 13 Ref.

Descriptors: *Water supply, *Reviews, Water supply development, Water quality, *Water treatment facilities, Maintenance, Cost analysis, Water supply systems, Technology.

Some of the issues related to small water system problems are reviewed, with suggested feasible solutions. A prevailing characteristic of water supply technology is the effect of economics of scale. Small systems are a victim of their own size. Installation, operation, and maintenance of sophisticated control processes together with monitoring systems may result in substantial total and unit cost increases for small systems. Small systems also seem to have a larger share of quality problems. Some of the more common deficiencies include inadequate source protection, improper disinfection or control of disinfection or both, inadequate clarification or control of clcrification and insufficient pressure in the distribution system. A commonly suggested solution for small system problems is that of regionalization in which a small community can join with other small communities or with a larger one to form a regional water supply. Technological solutions have also been investigated. The effectiveness of conventional coagulation and lime softening processes for the removal of certain metals has been studied. Package water treatment plants consisting of prefabricated and largely preassembled clarification and filtration units are commonly used in some sections of the US by small water systems. Various approaches to managing small systems are also being investigated and tried at various locations. (Baker-FRC)
W82-01542

CHRYSOTILE ASBESTOS FIBERS IN DRINKING WATER FROM ASBESTOS-CEMENT PIPE,

Wisconsin Univ. Madison. Dept. of Preventive Medicine.
For primary bibliographic entry see Field 5B.
W82-01592

5G. Water Quality Control

PUBLIC CONCERNS AND PLUARG: SELECTED FINDINGS AND DISCUSSION,

Toronto Univ. (Ontario). Dept. of Geography.
R. J. Mason.
Journal of Great Lakes Research, Vol 6, No 3, p 210-222, 1980. 1 Fig, 8 Tab, 24 Ref.

Descriptors: *Public participation, *Water pollution control, *Land use, Water policy, Planning, *International Joint Commission, *Great Lakes, Attitudes, Agriculture, Surveys, Pollution from Land Use Activities Reference Group.

The International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG) completed a program in which 17 public consultation panels (9 from 8 U.S. states and 8 from Canada) submitted reports detailing their views and recommendations on pollution control and land use. There were few significant differences on the national level in output from the 17 panels, which consisted of persons representing 19 categories, such as small business, students, women, farmers, and conservationists. There were some differences between the panels' consensus and the PLUARG report to the International Joint Commission on the importance of certain issues. The public consultation program was judged successful in terms of achieving its objectives and in terms of participant satisfaction. (Cassar-FRC)
W82-01137

MODELLING EFFECTS OF REMEDIAL PROGRAMS TO AID GREAT LAKES ENVIRONMENTAL MANAGEMENT,

Canada Centre for Inland Waters, Burlington (Ontario).
M. G. Johnson, J. C. Comeau, T. M. Heidtke, W. C. Sonzogni, and B. W. Stahlbaum.
Journal of Great Lakes Research, Vol 6, No 1, p 8-21, 1980. 4 Fig, 8 Tab, 38 Ref.

Descriptors: *Phosphorus, *Great Lakes, *Water pollution control, Lakes, Lake Erie, Lake Huron, Lake Ontario, Model studies, Nonpoint pollution sources, International Joint Commission, Water pollution sources, Agriculture, Water quality control, Urban runoff, Fertilizers, Effluent standards, Storm water.

PLUARG (the International Joint Commission's Pollution from Land Use Activities Reference Group) used computer simulation to determine which remedial programs were most economical, practical, and effective for reaching target lake loads of phosphorus for Lakes Erie, Ontario, and southern Huron. The process relied on a large and diverse information base on point and nonpoint pollution sources in the Great Lakes basin, including sub-basin unit area pollution loads (classified by land use and land form), per capita municipal pollutant inputs, river transmission factors, and remedial program effectiveness. The remedial measures included three levels of treatment for rural areas with reductions in total P load of 5-10%, 25%, and 40% (costs: minimal, $600 per sq km, and $2700 per sq km, respectively), and two treatment levels for urban areas: vacuum street cleaning and runoff storage and treatment by sedimentation. For municipal treatment plants three levels of residual P concentrations were considered, 1.0 ppm, 0.5 ppm, and 0.3 ppm, at costs of $2350, $3340, and $9370 per 1000 persons served. For example, the least cost strategy for Lake Ontario's 7000 ton P reduction was as follows: rural management, lowest level; effluent from treatment plants, 0.5 ppm; and urban nonpoint treatment, lower level. (Cassar-FRC)
W82-01146

STUDIES FOR ABATEMENT OF POLLUTION FROM COMBINED SEWER OVERFLOWS IN CANADA,

MacLaren (James F.) Ltd., Toronto (Ontario). Water Resources Div.
P. E. Wisner, W. G. Clarke, and A F. Roake.
Journal of Hydrology, Vol 51, No 1-4, p 329-338, May, 1981. 4 Fig, 4 Tab, 5 Ref.

Descriptors: *Model studies, *Combined sewers, Simulation, Runoff, *Urban runoff, Biological oxygen demand, Oxygen demand, Suspended solids, Water pollution sources, Municipal wastes, Municipal wastewater, Sewers, Water quality, *Combined sewer overflows, Pollution abatement studies, *Canada.

The use of urban runoff models to study water quality problems in Winnipeg, Edmonton, Hamilton, St. Thomas, Sarnia and other Canadian cities is described. Different simulation models were used at different stages of a project. Planning models were used for an overall assessment of the urban runoff problem and for preliminary estimates of the cost effectiveness of different abatement procedures. Design/analysis models are oriented towards the detailed simulation of storm events, and can be used for accurate predictions of flows and concentrations at any point in the urban system and the receiving waters as well. The lumped quality model offers a preliminary step toward simplified quality modelling. Work with this model may be useful in other drainage environments as well, due to its great flexibility. The interfacing of simulation models has been used to obtain a general approach to the analysis of urban water-quality problems. In the Winnipeg study, the first stages of storm runoff were predicted to contain greater pollutant concentrations in the combined sewage than those which would be found during dry-weather flow due to the scour of solids deposited in the trunk combined sewers during dry weather. The study concluded that separation was not the most effective abatement method for the existing combined system. Instead a system of total management involving storage, overflow treatment and nonstructural controls such as sewer flushing is both more effective and more economic. Studies in Edmonton illustrate the use of simulation techniques to assess overflow pollution in the context of all sources of pollutants affecting North Saskatchewan River quality. As a result of these studies, various combinations of storage, flow equalization, upgraded central treatment and source control are being investigated and evaluated in terms of simulated water quality and economics. (Baker-FRC)
W82-01200

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,

Syearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 5B.
W82-01254

COAL AND COAL MINE DRAINAGE,

Tennessee Valley Authority, Chattanooga.
H. Olem.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 814-824, June, 1981. 1 Tab, 158 Ref.

Descriptors: *Coal mining, *Mine wastes, *Water pollution effects, Water quality, Acid mine drainage, *Water pollution control, Regulations, Water pollution sources, Wastewater treatment, Path of pollutants, Aquatic life, Industrial wastewater.

The recent literature on the effects of the coal industry on water quality lists several government reports on this subject as well as regulatory developments since passage of 1977 legislation. About 15 abstract collections, bibliographies, and reviews on coal and the environment have been published in the last year. Formation of mine drainage is the

subject of work relating to bacterial and chemical actions on rocks and minerals. About 60 authors wrote papers on the impact of mine drainage on water quality in coal fields in Europe and the U.S. In one case, acidity was increased 580% by renewed mining activity. Mathematical models are featured in many papers. The differences between eastern and western U.S. coal mining are highlighted; mining activities in the west do not produce as much acidic drainage as in the east. However, western rivers are more susceptible to increased sedimentation and salt loadings. Groundwater quality was evaluated in mining areas throughout the U.S. There were severe effects in some locations in the northern Great Plains and lesser effects in eastern Ohio, Indiana, and Illinois. Several publications discuss the impact of mining on benthic invertebrates, zooplankton, and fish. Treatment methods for mine drainage water include lagoons for neutralization and iron removal, rotating disks for biological oxidation of ferrous iron, and lime neutralization with further treatment to enhance the municipal potable water supply, and sedimentation ponds. Prevention and control of mine slow-release anionic detergents on surface mines and coal refuse piles, recycling effluents, use of crushed limestone, and reclamation projects for surface-mined land. The effects of coal cleaning and coal transportation and storage on water quality are discussed. (Cassar-FRC)
W82-01261

EUTROPHICATION,
Colorado Univ. at Boulder.
For primary bibliographic entry see Field 2H.
W82-01271

DISSOLVED OXYGEN IN STREAMS AND RESERVOIRS,
Tennessee Valley Authority, Chattanooga.
C. E. Bohac.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 916-921, June, 1981. 65 Ref.

Descriptors: *Dissolved oxygen, *Literature review, Reviews, *Streams, Rivers, *Reservoirs, Standards, Surface runoff, Runoff, Water quality, Model studies, Oxygen demand, Oxygen transfer.

Current research dealing with dissolved oxygen in streams and reservoirs is cited in this review article. In reviewing standards which had been established for streams, it was concluded that the standards had been developed without enough information regarding their practical implementation. The Urban Runoff Pollution Control Program was studied with particular emphasis on receiving water quality models of three types: simplified or desktop models for preliminary planning; detailed models for planning and design; and operational models for supervisory control. Water quality was investigated in lakes and streams, with particular emphasis on winter oxygen depletion rates, severe hypolimnetic oxygen depletion in Canyon Lake, specific reference to two Yukon rivers where severe dissolved oxygen depressions during winter months were reported, and various hypolimnetic oxygen parameters. A reaction chamber was developed to study interactions of sediments or newly flooded soils with an overlying water column. In the area of improving water quality, the addition of hydrated lime to a lake, the treatment of water with alum resulting in a six-fold decrease in soluble phosphorus and a 17-fold decrease in orthophosphate, and aeration of a model lake system were studied. Water quality models were engineered which were used to determine wasteload allocations, to investigate alternative water quality policies in relation to waste discharges, to describe vertical and horizontal variability of a water body, to estimate economic benefit for water pollution control programs, and to predict the impact of storm loads on phosphorus, fecal coliforms, and dissolved oxygen. Oxygen demand was studied both from the general point of view and with emphasis on the effect of photosynthesis on oxygen demand. Oxygen transfer was also investigated. (Baker-FRC)
W82-01272

ANALYSIS OF NATIONAL WATER POLLUTION CONTROL POLICIES 1. A NATIONAL NETWORK MODEL,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6A.
W82-01292

ECONOMICS,
Clemson Univ., SC.
J. C. Hite.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 615-617, June, 1981. 20 Ref.

Descriptors: *Economic aspects, *Water pollution control, *Costs, *Reviews, Agriculture, Erosion control, Water quality.

The recent decline in number of papers concerning economics of water quality can be attributed to the perception that water scarcity is a more important consideration than environmental degradation. Several theoretical questions were addressed: the balance of resource protection vs. industrial development, effluent charges and market structure, an optimal pollution control program under conditions of imperfect information, and compensating payments in salary externality problems. Agricultural economists produced a variety of papers on tradeoffs between agricultural production costs and sediment damage, research needed on erosion and sedimentation problems, the effect of tenure arrangements vs. regional factors on erosion levels, converting noncropland to cropland in the Mississippi delta, and reaction of farmers to public programs on soil conservation. A series of articles investigated how transferable discharge rights might be used for phosphorus pollution control in Lake Michigan. A study of annualized costs of water pollution abatement by industry and by family income class showed that low-income families would bear a disproportionately high portion of pollution control costs. Real spending for all types of pollution abatement increased by 5% in 1978, and for water pollution abatement, by 9%. Reasons for economists' objections to technology-based effluent standards were stated in a definitive work. (Cassar-FRC)
W82-01304

THE WORKINGS OF THE CONTROL OF POLLUTION ACT IN TIDAL WATERS: A VIEW OF THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
For primary bibliographic entry see Field 6E.
W82-01383

THOUGHTS ON THE NEED TO CONTROL DISCHARGES TO ESTUARIAL AND COASTAL WATERS,
Department of the Environment, London (England).
For primary bibliographic entry see Field 6E.
W82-01384

RURAL SANITATION IN DEVELOPING COUNTRIES,
Hawksley (Watson), High Wycombe (England).
For primary bibliographic entry see Field 5D.
W82-01392

USE OF THE CONTINGENCY FUND AT STRINGFELLOW HAZARDOUS WASTE DISPOSAL SITE,
Coast Guard, Hamilton AFB, CA. Pacific Strike Team.
G. A. Reiter, and R. M. Mandel.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980 Washington, DC, Environmental Protection Agency Report (1980). p 21-24, 2 Tab, 5 Ref.

Descriptors: *Waste disposal, *Land disposal, Flooding, *Water pollution control, Costs, Federal jurisdiction, Wastewater treatment, Berms, Planning, Water pollution prevention, State jurisdiction, *Stringfellow Quarry, *California.

Because of the repeated flooding and overflow of pollutants from the Stringfellow Quarry waste disposal site, and the exhaustion of local abatement funds, the California State Water Resources Control Board (RWQCB) petitioned the EPA for use of Section 311(k) funds of the Clean Water Act. Use of the funds was authorized and a number of actions were taken in March 1980. Three and a half million gallons of liquid wastes were removed and treated at the Palo Verde treatment site. The berms were strengthened to prevent collapse, and a pump was installed to remove accumulating liquids in pond No. 1. Pumping and aeration were continued by the RWQCB after the Federal activities ceased. The value of a coordinated response was demonstrated in dealing with hazardous waste site discharges. Effective planning from the time of notification to termination is possible, although the estimates of the immediacy of the threat and appropriate mitigation measures may differ among the agencies involved. (Brambley-SRC)
W82-01416

PRELIMINARY RISK EVALUATION FOR SUSPECTED HAZARDOUS WASTE DISPOSAL SITES IN CONNECTICUT,
TRC Environmental Consultants, Inc., Wethersfield, CT.
D. Unites, M. Possidento, and J. Housman.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980. Washington, DC, Environmental Protection Agency Report (1980). p 25-29, 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Waste disposal, *Land disposal, *Hazardous materials, *Toxicity, Evaluation, Priorities, Water supply, *Water pollution prevention, Pollutants, Groundwater pollution, Polychlorinated biphenyls, Pesticides, Fishkill, Runoff, *Connecticut.

Connecticut Public Act No. 79-605 mandates the commissioner of environmental protection to inventory toxic or hazardous waste disposal sites and the types and amounts of wastes disposed therein. A four-phase program has been developed, which is in progress. The first phase resulted in the identifying of 3072 potentially hazardous sites, with 28 added later. The second phase resulted in giving priority for site investigation to those sites in towns with the largest populations using private wells, with low priority given to towns with public water supplies. The third phase is a preliminary evaluation using a flow chart which identifies seven critical conditions requiring immediate action. These are: improperly disposed liquid polychlorinated biphenyls; asbestos that can become airborne; improperly disposed pesticides; disposal within 200 ft of a drinking water supply; possible fire or explosion; fish kills; and discharge of hazardous materials to storm sewers or surface water. The final phase is a more detailed analysis based on a numerical scoring system. Approximately 30% by area of the state has been reviewed, with 10 sites referred for further study or enforcement action, and 20 notices of violation for minor problems have been issued. (Brambley-SRC)
W82-01417

RATING THE HAZARD POTENTIAL OF WASTE DISPOSAL FACILITIES,
JRB Associates, Inc., McLean, VA.
C. Kufs, D. Twedell, S. Paige, R. Wetzel, and P. Spooner.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC Environmental Protection Agency Report (1980). p 30-41, 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Waste disposal, *Land disposal, *Hazardous materials, Waste management, Waste characteristics, Evaluation, Path of pollutants, Water quality control, Groundwater, Surface water, Environmental protection, Pollution rating systems.

A method has been developed for use by hazardous waste coordinators in the evaluation of the hazards posed by land disposal facilities to popula-

tions, ground and surface waters, and critical environments. The method has three elements: the rating factor system which rates the general hazard potential of the site; the additional points system which modifies the rating based on site-specific factors; and the scoring system which interprets the ratings in meaningful terms. There are 31 factors in the rating factor system, in four categories: receptors, pathways, waste characteristics, and waste management practices. By assigning a point score to each factor a numeric value may be obtained for each category, and when summed, for the overall score. Sites may be ranked for hazard by relative or absolute overall score, or by single category scores. The single category scores are appropriate when significant data are lacking about a particular site. The rating forms are presented, and scores are given for actual sites for sample site rankings. (Brambley-SRC)
W82-01418

THE NATIONAL ASSESSMENT OF THE GROUND-WATER CONTAMINATION POTENTIAL OF WASTEWATER IMPOUNDMENTS,

Environmental Protection Agency, Washington, DC.
L. R. Silka.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC. Environmental Protection Agency Report (1980). p 45-48, 3 Tab, 5 Ref.

Descriptors: *Waste disposal, *Land disposal, *Groundwater pollution, *Wastewater lagoons, *Industrial wastes, Linings, Monitoring, Hazardous materials, Water supply, Groundwater movement, Municipal wastes, Farm wastes, Mine wastes, Brines, Surveys.

The EPA assisted the states in conducting the Surface Impoundment Assessment with the aim of determining the number, location and potential effects of these sites on groundwater and of improving the information on impoundments and groundwater protection. A total of 77,678 sites were identified, 10,819 of which the were industrial sites, which were given highest priority in subsequent analyses. The industrial waste sites are estimated to cover about 430,000 acres and receive 50 billion gallons per day of influent. Fewer than 30% are lined, and more than 95% have no regular monitoring. About half the sites contain waste which may have potentially hazardous constituents. Thirty percent overlie usable aquifers and are underlain by zones which allow free movement of escaping wastes. About one third of these sites are within one mile of a water supply well which would be in the path of contaminated water flowing from the site. Similar lack of proper siting, design and monitoring is indicated in the information obtained for municipal, agricultural, mining, and oil and gas brine waste liquids sites. The industrial and municipal sites pose the greatest threat to drinking water resources, while the remainder threaten agricultural groundwater resources. The minimal monitoring of the waste sites results in discovery of contamination only after gross, noticeable environmental changes occur. (Brambley-SRC)
W82-01419

EVALUATION OF HYDROGEOLOGIC CONDITIONS,

Geraghty and Miller, Inc., Annapolis, MD.
J. J. Geraghty.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC. Environmental Protection Agency Report, (1980). p 49-52, 8 Ref.

Descriptors: *Hydrologic data, *Land disposal, *Waste disposal, *Hazardous materials, *Groundwater pollution, Evaluation, Monitoring, Water quality, Wells, Geophysics, Seismology, Groundwater movement, Plumes.

Current hazardous waste regulations contain requirements for monitoring the groundwater around disposal sites, and for investigating subsurface conditions if the groundwater has become contaminated. Some of the subsurface exploratory procedures used prior to monitoring or remedial action are described. The objectives of the exploration may differ, but in each case the geology, hydrology and the water quality will be investigated. Most investigations will require the drilling of wells, but preliminary studies can minimize their number and maximize the information they yield. This information may be obtained from geological records, site observations, past drilling records, and operational wells in the area. Geophysical surveys using seismic or electrical resistivity methods can provide information on the geology and hydrology and are most useful when some prior knowledge exists. Magnetometer surveys and temperature studies may also be useful. Hydrologic information is best obtained from test wells which can be logged, pumped and sampled, and they will give additional geologic information. Several wells may be necessary to determine the movement of water in an aquifer, and the contaminant plume dimensions. The information collected can then be used to predict possible changes in directions and rates of plume movement due to natural variations or human invervention. (Brambley-SRC)
W82-01420

PRACTICAL ASPECTS OF GROUND WATER MONITORING AT EXISTING DISPOSAL SITES,

Law Engineering Testing Co., Atlanta, GA.
J. R. Absalon, and R. C. Starr.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 53-58, 4 Fig, 4 Ref.

Descriptors: *Waste disposal, *Land disposal, *Monitoring, *Groundwater pollution, *Wells, Landfills, Aquifers, Waste characteristics, Sampling, Protection, Landfills, Wastewater lagoons, Water pollution control, Resource Conservation and Recovery Act.

The Resource Conservation and Recovery Act requires monitoring of ground water at surface impoundments, landfills and land treatment facilities to determine the impact of waste disposal on the quality of the water in the uppermost aquifer beneath the site. The site geology and waste facility characteristics are determined from available information, records, and field investigations. These investigations will aid in the most effective placement of monitoring wells. Monitoring wells should be installed using methods, equipment, and materials that minimize changes in the aquifer, introduction of foreign materials, and cross contamination betwen wells and aquifers. Aquifer changes can be prevented by sealing between aquifers and using appropriate drilling techniques. Foreign materials which may contaminate ground water include water and drilling muds from the boring process, contaminants adhering to the drilling equipment, and the well material itself, especially when PVC is used as the casing. Wells should be pumped or bailed before monitoring samples are taken, so as to obtain water unaffected by the drilling process. Samples must be treated or preserved to maintain their integrity before testing. In dealing with sites containing hazardous wastes, workers and the public must be protected from exposure, by the appropriate equipment and information. (Brambley-SRC)
W82-01421

SITE ASSESSMENT: IMPROVING CONFIDENCE LEVELS WITH SURFACE REMOTE SENSING,

Technos Inc., Miami, Florida.
R. C. Benson, and R. A. Glaccum.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 59-65, 9 Fig, 3 Ref.

Descriptors: *Waste disposal, *Land disposal, *Hazardous materials, *Groundwater contamination, Surveys, Groundwater movement, Leachates, *Remote sensing, Radar, Magnetic studies, Water pollution control, Plumes, Geologic formations, Subsurface mapping.

Remote sensing of hazardous wastes sites allows a great deal of information to be gained about the geology of the site, materials in the site, and movement of leachate from the site. The four most useful methods available are found penetrating radar, electromagnetics, magnetometry, and metal detection, frequently used in combination with each other. Electromagnetic conductivity data can be used to locate geological details such as fractures, paleosinks, and pockets through which contaminants may move, and also contaminant plumes. Radar can be used to locate and estimate the size of trenches. Metal detectors are used to locate metal objects such as drums, while the ferrous or non-ferrous nature of the metal can be determined by magnetometry. Continuously measuring instruments have been designed to produce a continuous record from a pass over a site. By running closely spaced parallel survey lines information can be mapped over the entire site area, quickly and inexpensively in comparison with direct sampling methods. (Brambley-SRC)
W82-01422

MAPPING CONTAMINATED SOIL PLUMES BY KRIGING,

Resources Management Associates, Lafayette, CA.
S. F. Moore, and D. B. McLaughlin.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 66-70, 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Hazardous materials, *Plumes, *Subsurface mapping, *Soil contamination, Spatial distribution, Mathematical models, Groundwater pollution, Groundwater movement, Monitoring.

Data on the distribution of hazardous waste contaminants in soils are inherently uncertain and incomplete. An effective mapping method was developed to study the contaminant plumes in the soil at the Hanford, Washington, nuclear waste site. Statistical formulation of the problem led to the choice of kriging as an appropriate estimation procedure to facilitate computer mapping. Kriging is based on assumptions about the variation in spatial differences of a variable, rather than absolute values. A kriging model partitions observed variability between a local drift function and a random process which has a spatial correlation structure represented by the variogram. Solution of the contaminant mapping problem consists of: setting up a grid of points at which contaminant values are to be estimated; forming the 'kriging equations' at each grid point and solving for the weighting factors; computing the estimate and its variance at each grid point; and drawing in smooth contour lines delineating the contaminant distribution throughout the area of interest. The method was used to determine ruthenium-106 movement at a tank farm. Some locations of higher values are identified; these represent priority candidate sites for additional sampling wells. (Brambley-SRC)
W82-01423

GEOLOGICAL STUDIES OF INDUSTRIALLY-RELATED CONTAMINATION: SOIL AND GROUND WATER INVESTIGATIONS,

Metcalf and Eddy, Inc., Boston, MA.
For primary bibliographic entry see Field 5B.
W82-01425

REMEDIAL OPTIONS FOR GROUND WATER PROTECTION AT ABANDONED SOLID WASTE DISPOSAL FACILITIES,

Penn Environmental Consultants, Inc., Pittsburgh, PA.
D. Threlfall, and N. J. Dowiak.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC. Environmental Protection Agency Report, (1980). p 131-134, 2 Tab, 5 Ref.

Descriptors: *Waste disposal, *Land disposal, *Groundwater pollution, *Water quality control, Infiltration, Leachates, Drainage, Cost analysis, Soil compaction, Impervious soils.

Remedial measures to protect ground water will depend on the subsurface conditions and the characteristics of the waste. Limited remedial measures such as site covering or controlling the flow of surface water may be sufficient if there are geologic barriers to leachate migration, little or no ground water is affected, or the waste has a low-hazard potential. Extensive measures such as leachate collection systems, ground water collection systems, slurry walls or covers may be required if there are no geologic barriers, usable ground water is affected, or if the waste is significantly hazardous. An evaluation was performed at an abandoned strip mine pit, 10 acres in area and 60 ft deep, which had been used for the disposal of neutralized acid waste sludges. Significant infiltration was occurring from the surface into the ground water which flowed into good quality surface water. A drainage collection network was designed to intercept leachate as it emerged downstream from the site, and it was conveyed to a water treatment plant. An impermeable cover was necessary to prevent leachate formation. Bentonite soil additives, PVC membranes and compacted local soil were considered. Compacted local soil was the least expensive option, and, once the sludge had dried out, sufficient compaction was possible to obtain the necessary impermeability. This approach combined economic and technical feasibility, but leachate collection and treatment must be continued until the cover is in place. (Brambley-SRC)
W82-01426

TOP-SEALING TO MINIMIZE LEACHATE GENERATION, CASE STUDY OF THE WINDHAM, CONNECTICUT, LANDFILL,

SMC-MARTIN, King of Prussia, PA.
G. H. Emrich, and W. W. Beck, Jr.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 135-140, 6 Fig, 2 Ref.

Descriptors: *Landfills, *Groundwater pollution, *Water pollution control, *Leachates, Municipal wastes, Grading, Monitoring, Lysimeters, Water quality, Plumes, Water pollution prevention, Case studies, *Windham, Connecticut.

The Windham, Connecticut, Landfill was selected to demonstrate remedial actions to abate or minimize pollution from closed landfills. The system of remedial actions used at this site included regrading, covering at a minimum depth of 15 cm with local sand and gravel and a minimum of 10 cm of fine-grained sand washings, the application of a 20-mil PVC cover and a final 46-cm vegetated cover. A monitoring system has been installed consisting of suction lysimeters and pan lysimeters to determine the movement of moisture through the refuse, a ground water monitoring system consisting of wells to determine fluctuations in the water table as well as the rate and movement of leachate in the ground water, and surface water monitoring system consisting of staff gages in nearby ponds. Monitoring of the landfills has continued for several years established complete baseline data, and will continue for two years following the installation of the remedial action alternatives to determine their effectiveness. In the seven months since the implementation of the remedial action, the groundwater quality has improved and the leachate plume has retreated to the landfill. (Brambley-SRC)
W82-01427

REMEDIAL TECHNIQUE OF CONTROLLING AND TREATING LOW VOLUME LEACHATE DISCHARGE,

Nassaux-Hemsley, Inc., Chambersburg, PA.
W. T. Hemsley, and W. C. Koster.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 141-146, 3 Fig, 6 Tab.

Descriptors: *Landfills, *Leachates, *Water pollution control, *Waste disposal, *Wastewater treatment, Wells, Drains, Heavy metals, Coagulation, Carbon adsorption, Chlorination, Sludge disposal, Water quality standards, Suspended solids, Pollution load, *Franklin County, Pennsylvania.

The remedial measures installed to control leachate at a landfill after closure are described. The site has an area of 15 acres on a steeply bedded shale in Franklin County, Pennsylvania. The newer part of the site is graded to provide good surface drainage but was the source of the leachate to be controlled. Piezometers were used to produce a groundwater map, and determine infiltration and horizontal permeability. Based on these figures, it was recommended that collection wells, with connections to a collection drain, be installed around the perimeter, and that the leachate be treated chemically before discharge. Four collection wells were dug, with a total leachate yield of 8.15 gpm. The leachate exceeded the state discharge requirements in suspended solids, BOD, ammonia-nitrogen, iron, lead, mercury and copper. Laboratory tests indicated that alum would be the most effective coagulant, but that activated carbon filtration was necessary to remove metals. The final leachate treatment is chlorination. The sludge is taken to an approved landfill, and the discharge meets the Pennsylvania requirements. (Brambley-SRC)
W82-01428

SURFACE WATER MANAGEMENT AT HAZARDOUS WASTE SITES,

Dames and Moore, Atlanta, GA.
T. J. Doyle.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 152-159, 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Land disposal, *Waste disposal, *Water pollution prevention, *Hazardous materials, *Regulations, Environmental protection, Runoff, Floods, Flood control, Spillways, Water pollution sources, Surface water management.

The regulations applicable to hazardous waste sites and water resource protection are reviewed. A site may not be located in regulatory floodways, coastal high hazard areas, the 500-yr floodplan, or wetlands. In some cases permission may be granted for a site in an environmentally sensitive area, if it is designed, constructed, operated and maintained so that it would not be inundated by a specific flood or storm event. In order to protect surface waters from contamination it must be shown that runoff will not enter the facility, or diversion structures must be provided. These may include interceptor ditches, underflow systems, or diversion ditches, pipelines and tunnels. The use of diversion facilities can be reduced by installing floodwater detention basins, to reduce the peak discharge from any storm. Liquid or semi-liquid storage impoundments must have an adequate freeboard or an emergency spillway, sufficient to withstand the Probable Maximum Flood. Hazardous waste facilities must operate in compliance with the Clean Water Act in respect to point and non-point pollutant sources. They must have a closure plan which will be implemented for at least 30 yrs from the date of closure, to prevent soil erosion and exposure of hazardous waste to the environment. (Brambley-SRC)
W82-01429

BENCH SCALE ASSESSMENT OF TECHNOLOGIES FOR CONTAMINATED GROUND WATER TREATMENT,

Touhill, Shuckrow and Associates, Inc., Pittsburgh, PA.
A. J. Shuckrow, A. P. Pajak, J. W. Osheka, and S. C. James.
In. EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report, (1980). p 184-191, 9 Fig, 2 Tab, 3 Ref.

Descriptors: *Groundwater pollution, *Water treatment, *Waste dumps, *Pollutants, *Organic compounds, Biological treatment, Activitated carbon, Adsorption, Chemical coagulation, Resins, Membrane processes, Stripping, Continuous flow.

Contaminated groundwater is a consequence of uncontrolled industrial waste sites which may need treatment to remove the contaminants. An initial study reduced 18 potential technologies for removing 500 compounds in 12 classes to six - biological treatment, chemical coagulation, carbon adsorption, membrane processes, resin adsorption, and stripping. It was recognized that no single treatment would be effective so five processtrains were designed: biological/carbon sorption, carbon/biological, biophysical, membrane/biological, stripping/carbon sorption. Bench scale studies were conducted with an actual contaminated ground water. It contained over 70 organic pollutants, primarily priority pollutants, but heavy metals were not believed to be a problem. Carbon adsorption was most effective in removing organic pollutants, with resin sorption and air stripping somewhat less effective, although significant residual total organic carbon (TOC) remained in all samples. Continuous flow studies were then conducted using stream stripping and granular activated carbon. Small scale biological reactors were also tested, first to acclimate the organisms to the contaminated water, then to test their effectiveness in removing TOC. Up to 60-80% TOC removal was achieved. These studies will continue; biophysical treatment and pretreatment methods will be studied. (Brambley-SRC)
W82-01433

EVALUATION OF REMEDIAL TREATMENT, DETOXIFICATION AND STABILIZATION ALTERNATIVES,

Anderson-Nichols and Co., Inc., Boston, MA
For primary bibliographic entry see Field 5D.
W82-01434

PRELIMINARY DESIGN AND COST ESTIMATES FOR REMEDIAL ACTIONS AT HAZARDOUS WASTE DISPOSAL SITES,

JRB Associates, Inc., McLean, VA. Waste Management and Resource Recovery Div.
S. F. Paige, C. H. Morgan, H. C. Bryson, G. E. Hunt, and P. J. Rogoshewski.
In: EPA National Conference on Management of Uncontrolled Hazardous Wastes, October 15-17, 1980, Washington, DC, Environmental Protection Agency Report (1980). p 202-207, 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Waste disposal, *Water pollution control, *Groundwater pollution, *Hazardous materials, *Design criteria, Costs, Soil contamination, Land disposal, Waste characteristics, Capital costs, Maintenance costs, Financing, Budgeting.

Uncontrolled hazardous waste sites can cause contamination of the surface, groundwater, air, sewer and water lines, soils and sediments. Any remedial action must first consider the contaminated areas and then prepare a design plan and estimate its cost. The preliminary design will consider the remedial activities, the necessary equipment, wastes or residues that may be generated and their final disposition, land requirements, site characteristics, the dimensions of the techniques to be performed, and the time needed for each activity. The preliminary design information is used to estimate overall costs, which comprise immediate and longterm costs. The immediate costs are the capital, labor and other costs associated with the installation of the remedial action techniques. The long-term costs are those required for maintenance, monitoring and general operation of the equipment, and may be required in perpetuity. This very long-term financial requirement necessitates determinations of site costs, inflation, discount rate, the size of contingency funds, and the means of generating these funds. (Brambley-SRC)
W82-01435

IDENTIFICATION AND RECLAMATION OF CHROMIUM SLUDGE DISPOSAL SITES,

Maryland Office of Environmental Programs, Annapolis.
For primary bibliographic entry see Field 5E.
W82-01437

NEW OPPORTUNITIES FOR IN-PLANT REDUCTION OF POLLUTANTS THROUGH PROCESS CHANGES,

International Paper Co., Tuxedo Park, NY.
J. J. Renard, R. B. Phillips, H. Jameel, and A. W. Rudie.
Tappi, Vol 64, No 8, p 51-54, August, 1981. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Pulp and paper industry, *Pollution load, *Kraft mills, Water pollution prevention, *Water pollution control, Oxygenation, Process control, Chlorine dioxide, Anthraquinone, Costs.

The most significant effective option for reducing pollution from a beached kraft mill was oxygen delignification of the unbleached pulp. Application of oxygen in the caustic extraction stage was least effective. However, both oxygen-based options reduced product costs. The other two processes evaluated, cooking to lower kappa numbers with anthraquinone catalyst and use of chlorine dioxide in the first bleaching stage with hypochlorite in the extraction stage, were more costly. The four methods reduced pollution loads between 20% and 60%. For a new mill, oxygen delignification requires a sizable capital investment and is generally not recommended over the less complicated process using oxygen in the extraction stage. For an existing mill the two oxygen-based options are preferred. (Cassar-FRC)
W82-01559

REMEDIAL ACTION CONTROLS GROUNDWATER CONTAMINATION AT A PAPER MILL SLUDGE DISPOSAL SITE,

Soil Testing Services of Wisconsin, Inc., Green Bay.
J. A. Senger.
Tappi, Vol 64, No 8, p 41-43, August, 1981. 5 Fig.

Descriptors: *Pulp and paper industry, *Leachates, *Landfills, Industrial wastes, Sludge disposal, Water quality, Groundwater, *Water pollution prevention, Water pollution control.

Leachate from an abandoned primary sludge landfill at a paper mill was controlled by taking advantage of existing hydrogeological conditions. Three problems contributed to the seepage: the site received discharge from a city storm sewer pipe, sandy soils directly underneath the sludge fill contained groundwater, and pore water was released during sludge consolidation. Corrective measures included diverting the sewer pipe away from the landfill; construction of a retaining dike, a clay cutoff wall downgradient, a collection pipe and two 20,000 gal storage tanks (from which leachage is routed to the treatment plant; and deposition of 2 feet of sand and 6 inches of topsoil as a final cover, which was then seeded and planted with grass and shrubs. These measures have greatly improved groundwater quality. Currently sludge is disposed of in two cells lined with clay. A sand blanket confines the sludge and allows leachage to drain into the cell for collection and transport to the treatment plant. (Cassar-FRC)
W82-01582

SITING AND DESIGN OF TAILINGS IMPOUNDMENTS,

Klohn Leonoff Inc., Denver, CO.
For primary bibliographic entry see Field 8A.
W82-01588

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

AN EXAMPLE OF THE APPLICATION OF STATISTICAL TECHNIQUES TO PREDICT LAKE LEVEL ELEVATIONS,

Department of the Environment, Edmonton. Div. of Design and Construction.
S. D. Koppula.
Canadian Journal of Civil Engineering, Vol 8, No 2, p 114-121, June, 1981. 3 Fig, 7 Tab, 10 Ref.

Descriptors: *Predictions, *Water levels, *Lakes, *Mathematical models, Statistical methods, Land use, Flood control, Storm water, Water level fluctuations, Management planning, Statistical models.

Advance knowledge of the magnitude of the temporal variations of future lake levels can assist the development of optimum stormwater management strategies relating to flood control, land use measures, and budgeting. Knowledge of future lake levels is very important, since these lake levels will determine the type of objectives and strategies which management must develop. The use of two statistical methods to examine available data on monthly lake water levels is reported. The Box-Jenkins forecasting technique consists of fitting a mixed autoregressive integrated moving average (ARIMA) model to the data and extracting conditional expectations. Harmonic analysis involves fitting a sine-cosine curve which possessed the property of regular undulating oscillations to data when the cyclical movements of a time series composed of seasonal variations, cyclic fluctuations, and random variations cover the same time span. These two statistical models are used to predict future lake levels in Lesser Slave Lake in Alberta, Canada, using monthly water level data, and these predictions are compared with actual observations. The predictions made by the Box-Jenkins model were found to be closer to the recorded observations than those made by harmonic analysis. Combination of the results from the two independent models to develop a composite forecast gave results which were slightly better than those given by either of the independent models alone. The composite model permitted consideration of the inherent cycles of periodicity greater than 12 months, resulting in improved forecasts. (Carroll-FRC)
W82-01111

WATER MULTIPLIERS–REGIONAL IMPACT ANALYSIS,

Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
C. T. K. Ching.
Water Resources Bulletin, Vol 17, No 3, p 454-457, June, 1981. 3 Tab, 10 Ref.

Descriptors: *Regional planning, *Water demand, *Input-output analysis, Planning, Water resources development, Economic aspects, Moel studies, Water multipliers, *Nevada, Leontief models, Employment, Income.

The Leontief input/output model is typical of methods for assessing the impacts of changes in regional economy produced by growth and/or decline. Sales, income or value added, and employment are the economic variables commonly used. This paper suggests that resource multipliers be added to the analysis. Direct water coefficients (acre-feet per $1000) and water multipliers for Humboldt and Lander Counties, Nevada, are devised for each of 22 sectors of the input/output model. Direct water coefficients vary from 0.001 for Communication to 12.8240 for Alfalfa and Other Hay. Water multipliers vary from 154.5250 for the Food Processing industry to the order of 1 for half of the sectors such as Service Station, Transportation, Health Services, and Local Government. This means that for each unit (acre-feet) change in direct water use by the Food Processing industry, total water use in the economy would change by 154.525 units. However, the shock to the economy is measured, not by unit change in direct water use, but by a change in final demand for the commodities. A table lists the estimated changes in output, income, employment, and water use for a $100,000 change in final demand in each sector. In the case of the Food Processing industry, these figures are $177,489, $22,772, 3.0 FTE, and 216.34 acre ft, respectively. (Cassar-FRC)
W82-01138

COMPUTER MODELING OF LOS ANGELES WATER RESOURCES,

Los Angeles City Dept. of Water and Power, CA.
B. W. Kuebler.
Journal of the American Water Works Association, Vol 73, No 7, p 341-345, July, 1981.

Descriptors: *Computer models, *Water resources development, *Water level fluctuations, Groundwater, Surface water, Groundwater recharge, Pumping, *Los Angeles, California.

Computer models for surface water and groundwater were developed to aid in the scheduling of operations and in planning for the future. The Owens-Mono surface water model is used to model the Mono and Owens River basins, which have four major reservoirs with a combined capacity of 288,000 acre-feet. The model schedules operations for the runoff year (April through March). Also, this model has been used to simulate the operations of the aqueduct system over a 31-year base period as part of a study of the environmental impact of groundwater pumping. The Los Angeles groundwater model is used to predict water level changes due to groundwater recharge and variations in the amount of pumping. The Owens Valley groundwater model is used to give a rough estimate of how the basin responds to various recharge and extraction schemes with existing and proposed wells. Developing or updating a computer model is a good way to comprehend how a resource functions, even if the model is not the best way of arriving at decisions on how to use that water resource. (Small-FRC)
W82-01168

DESIGN AND MERIT OF A RIVER-AQUIFER MODEL FOR OPTIMAL USE OF AGRICULTURAL WATER,

Colorado State Univ., Fort Collins. Engineering Research Center.
H. J. Morel-Seytoux, C. J. Daly, T. Illangasekare, and A. Bazaraa.
Journal of Hydrology, Vol 51, No 1-4, p 17-27, May, 1981. 5 Fig, 9 Ref.

Descriptors: *Irrigation programs, *Design criteria, Planning, Drought, Rivers, Aquifers, Groundwater, Wells, Surface water, *South Platte River, *Colorado, Agriculture, Model studies, Simulation, *Surface-groundwater relations.

Important steps in the design of a river-aquifer model for optimal use of agricultural water are discussed. The area under study consisted of a 90 mile reach of the South Platte River in the eastern plains of Colorado and of its associated alluvial aquifer. Irrigated agriculture is widely practiced in this area, with the major crops being corn, sugar beets, beans and alfalfa. Irrigation water comes mainly from surface water supplied by three reservoirs and an extensive system of distribution canals. Groundwater is used as a supplementary source through pumped wells. The study was made to find an optimum strategy of managing the river-aquifer system under drought conditions. Considerations to be included in the model design included system size and geometry, length of time steps and the total time horizon, lumping of parameters and variables, water allocation, and water rights. Once designed, the model was successfully applied to the field problem. The design procedures used made it possible to apply the model at a very moderate cost of $350 (US) for a simulation and still maintain very high accuracies in simulating the physical behavior. (Baker-FRC)
W82-01193

ANALYSIS OF NATIONAL WATER POLLUTION CONTROL POLICIES 1. A NATIONAL NETWORK MODEL,

Resources for the Future, Inc., Washington, DC.
L. P. Gianessi, and H. M. Peskin.
Water Resources Research, Vol 17, No 4, p 796-801, August, 1981. 1 Fig, 1 Tab, 27 Ref.

Descriptors: *Water quality, *Path of pollutants, *Water pollution control, Model studies, Network design, Mathematical models, Water pollution sources, Rivers, Lakes, Reservoirs, Bays, Urban runoff, Nonpoint pollution sources.

A water pollution network model was developed to study the implication of federal water pollution control policies on a national level. It consists of a water network, a set of assignment functions for injecting pollutants into the network, and equa-

tions or rules for transmitting the pollutants throughout the network. Bodies of water with average flows of 1000 cu ft per sec or greater and receptors of pollutants from major urban areas or two or more counties were chosen for inclusion in the model. However, some small, polluted rivers were included, and some large, pristine, rivers and short polluted tributaries were excluded. In all, the network contains 304 rivers, 175 lakes and reservoirs, 37 bays, 10 sections of Great Lakes shoreline, and 26 ocean shoreline segments. Nodes (1051 river and 249 other) were established at: major population centers, entrances of major tributaries, beginnings of estuaries, entrances to reservoirs, river mouths, and within very long river sections without other nodes. Each county, except for 13 completely arid counties, is assigned at least one node. Point discharges and urban runoff are assumed to enter the network at nodes, and nonpoint sources, between the nodes. Hydrodynamic data and geographical data were obtained from U.S. Geologic Survey publications and other sources. The pollution transport functions are used to convert injections of pollutants at the nodes to concentrations of pollutants at and between nodes. Although no formal testing of the model has been done, a deficiency is noticeable. Leaving out many small tributaries underrates the flow at the next downstream node. (Cassar-FRC)
W82-01292

ANALYSES OF NATIONAL WATER POLLUTION CONTROL POLICIES 2. AGRICULTURAL SEDIMENT CONTROL,

Resources for the Future, Inc., Washington, DC.
L. P. Gianessi, and H. M. Peskin.
Water Resources Research, Vol 17, No 4, p 803-821, August, 1981. 5 Fig, 11 Tab, 30 Ref.

Descriptors: *Agricultural runoff, *Sediment control, *Water pollution control, *Path of pollutants, Model studies, Mathematical models, Water quality, Phosphates, Dissolved oxygen, Nitrogen, Biological oxygen demand, Nonpoint pollution sources.

A national water network model was used to predict the effects of several agricultural sediment control policies on water quality. The most widespread violations were found for total Kjeldahl nitrogen (TKN) and total phosphorus (TP), with fewer for BOD5 and dissolved oxygen. Three policies were simulated: (1) a point source control policy, (2) a cropland sediment control policy, and (3) full implementation of both policies. Model results suggest that the third alternative would result in significant improvement on water quality in about one-third of the river points in the country. Water quality violations would be reduced 31% for BOD5, 24% for TKN, 25% for TP, and 44% for dissolved oxygen. However, even with full implementation of point source and sediment control about half of the nation's rivers would violate TP and TKN standards. Maps depict which of the 105 regions of the country would have significantly fewer violations of each pollutant if a cropland sediment control policy were implemented. (Cassar-FRC)
W82-01293

A SURVEY OF MATHEMATICAL OPTIMIZATION MODELS AND ALGORITHMS FOR DESIGNING AND EXTENDING IRRIGATION AND WASTEWATER NETWORKS,

Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
C. E. Mandl.
Water Resources Research, Vol 17, No 4, p 769-775, August, 1981. 6 Fig, 28 Ref.

Descriptors: *Model studies, *Irrigation design, *Wastewater facilities, Network design, Mathematical models, Algorithms, Water conveyance, Water quality, Design criteria, Experimental design, Costs, Construction costs, Operating costs, Linear programming, Sensitivity analysis, Optimization.

Network models and algorithms useful in designing and expansion of irrigation and wastewater systems are reviewed. No one model dominates on the basis of both computational efficiency and quality of solution. Trying to minimize construction and/or operating costs typically results in a concave cost (objective) function due to economies of scale. For large networks (200 or more nodes) linear or piecewise linear (separable) programming plus sensitivity analysis should be tried first. For smaller networks an integer programming approach described by several authors may be successful. If the network is a tree structure, the Polymeris (1978) or Converse (1972) algorithms are more efficient. However, none of the models considers water quality constraints, only optimal network design in terms of construction and/or operating costs. (Cassar-FRC)
W82-01296

POTENTIAL USE OF A STREAM-AQUIFER MODEL FOR MANAGEMENT OF A RIVER BASIN: CASE OF THE SOUTH PLATTE RIVER IN COLORADO,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, T. Illangasekare, M. W. Bittinger, and N. A. Evans.
Water Science and Technology, Vol 13, No 3, p 175-187, 1981. 5 Fig, 7 Ref. OWRT-B-076-COLO(6), OWRT-B-109-COLO(9), and OWRT-B-144-COLO(8).

Descriptors: *Water management, *Irrigation water, *Drought, *River basins, Water allocation, Agriculture, Aquifer management, Canal linings, Irrigation efficiency, Model studies, *South Platte River, Colorado, *Computer models, Simulation analysis.

A computer simulation study was conducted to determine the best water management strategy, particularly under drought conditions, for conjunctive use of surface and groundwaters for a 90-mile section of the South Platte River. Five runs of the model were made. The Historical Run used data for 1952-1961. Calculated river flow at Julesburg agreed with recorded flows. The Lined Canals Run proposed lining canals with seepage losses of 25% or more. Water allocation strategy consisted of allowing the diversion of the minimum of four quantities: water need, water right, legal water availability, and historical diversion. The Farm Efficiency Run assumed that irrigation efficiency improved from a historical value of 40-50% to 75% under the same water allocation strategy as the Lined Canals Run. The Pumping-as Needed Run allocated surface water as before, but allowed pumping up to existing capacity to meet crop needs unsatisfied by surface water supplies. The fifth run was a Combination Run. The best remedy [illegible] water supplies was to draw supplemental water from the aquifer wherever and whenever needed during drought. The resulting lowering of the water table would reach an equilibrium state within two years if no more land is put into production. Canal lining and increased farm efficiency, depending on surface water, would save only small amounts of water in times of drought when surface water supplies are small. This model study confirms previous work which concluded that wells should be pumped during dry years and allowed to recharge during years with normal stream flow. (Cassar-FRC)
W82-01301

SYSTEMS ANALYSIS,

Cornell Univ., Ithaca, NY.
J. R. Stedinger, and D. Pei.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 612-615, June, 1981. 56 Ref.

Descriptors: *Systems analysis, *Water pollution control, *Planning, *Water management, Regional planning, Storm water, Monitoring, Water quality, Model studies, Reviews, Nonpoint source pollution, Urban runoff, Eutrophication, Lakes, Wastewater treatment, Clean Water Act, *Literature review.

Literature on systems analysis applied to water management included methods useful in regional planning and development. Several papers concerned EPA Section 208 (Clean Water Act) studies and the differences in program implementation in similar areas. Marketable discharge permits, a tiered permit system, and taxation schemes to achieve desired pollutant abatement levels were discussed. Water quality models were developed, refined, and used in new applications. Some of the conclusions of these studies were: nitrification was the dominant cause of dissolved oxygen depletion in the Willamette River, Oregon; and low-flow augmentation was less costly than water treatment. Three models predicted different degrees of eutrophication in Lake LaFarge, Wisconsin. Models were applied to Great Lakes eutrophication and phosphorus loading. Books on water quality modeling, especially for rivers, were published. Nonpoint source pollution research concerned combined sewer overflows, the problems of STORM and SWMM models, a decomposition dynamic programming algorithm for determining optimal control of storm water, and a critique of current nonpoint pollution source models. Systems analysis and computers in wastewater treatment operation improved performance and efficiency, minimized costs, and helped choose optimum expansion designs. Decentralized treatment facilities produced higher dissolved oxygen concentrations than centralized facilities. Water quality monitoring and network design were reviewed and evaluated. Intervention analysis was used to determine the effects of wastewater treatment in phosphorus reduction and for estimating missing data. (Cassar-FRC)
W82-01303

STUDY OF A COMPLEX WATER RESOURCES SYSTEM WITH SCREENING AND SIMULATION MODELS,

Indian Inst. of Tech., New Delhi.
M. C. Chaturvedi, and D. K. Srivastava.
Water Resources Research, Vol 17, No 4, p 783-794, August, 1981. 6 Fig, 9 Tab, 15 Ref.

Descriptors: *Systems analysis, *Water resources development, *Linear programming, Model studies, Dams, Reservoirs, *Narmada River, *India, River basin development, Simulation, Planning, Multipurpose projects.

The Narmada River basin, India, was studied using a combination of a mathematical programming screening model and a simulation model. The screening models were used to find a reasonably small set of optimal design alternatives for a large complex multipurpose water resources system which includes six major dams. Two linear programming deterministic models were used, one continuous (LPDC) and one discontinuous (LPDD). Simulation analysis then supplied the near-optimum solution in terms of objective function. The LPDC model produced realistic and improved results when compared with values obtained by conventional design methods. The LPDC also specified output targets and capacities for better regulation of mean monthly flows at all sites. The LPDD model predicted excess reservoir capacity needed for drought and wet years and helped in selecting the range of variables for simulation by random sampling for the alternative selected by the LPDC model. (Cassar-FRC)
W82-01309

DAILY OPTIMIZATION OF POWER GENERATION IN CASCADE HYDROSYSTEMS (A STOCHASTIC APPROACH),

Institutul Politehnic din Bucuresti (Romania). Power Div.
A. Diacon, I. Setnanu, and R. Popa.
Journal of Hydrology, Vol 51, No 1/4, p 57-65, May, 1981. 5 Fig, 5 Tab, 4 Ref.

Descriptors: *Powerplants, *Optimization, Systems analysis, Planning, Model studies, Hydroelectric power, Electric power, Electric power production, Resources development.

A general model is proposed with the probability density functions of stochastic variables estimated according to hydrological conditions and operational practice of a cascade hydrosystem. The system considered is comprised of a cascade containing hydroelectric facilities and associated

buffer reservoirs located downstream of a major, multiannual regulating reservoir. Daily optimization of power generation for such a hydrosystem is very advantageous. Releasing of water through turbines during on-peak hours of the load-curve is desirable, while during off peak hours it is more suitable to store the inflow discharges in such a way that a more favorable energy production is obtained. The inflow discharges and the discharges for water supply uses of water storages are considered as random variables, with their probability density functions being estimated according to both hydrological conditions and operational practice. The reliability of the proposed model is proved by an actual numerical case study; the input-output data as well as the optimization algorithm are presented in detail. (Baker-FRC)
W82-01320

HYDROELECTRICAL MODEL FOR OPTIMAL OPERATION OF A SINGLE MULTIPURPOSE RESERVOIR,

National Water Plan Commission, Mexico City.
A. Guitron.
Journal of Hydrology, Vol 51, No 1/4, p 67-73, May, 1981. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Reservoirs, *Model studies, Irrigation practices, Stochastic models, Electric power production, Hydroelectric power, Operating policies, Administration, *Mexico.

A dynamic programming model is described in its application to the construction of a projected reservoir in the northwest zone of Mexico. The purposes to which the water in the reservoir is to be put include irrigation, electric energy production, flood control and water quality control. The operation policy is obtained for a fixed design, the physical objectives of the analysis being to determine the optimal releases and water storage of the reservoir during the operation period. Irrigation water volumes are treated in parametric form, establishing in this way a production function for energy and water, while satisfying the other restrictions on withdrawals and storage levels. The model which was developed was applied to a projected reservoir located on the Fuerte River in northwest Mexico. The historical mean annual stream-flow of Fuerte River at Huites station is 3.733 times 10 to the 9th power cubic meters, the useful capacity 3.91 times 10 to the 9th power cubic meters, and the dead capacity 0.28 times 10 to the 9th power cubic meters. The model results indicate the maximum peak energy that it is possible to produce for several levels of firm irrigation water. The mean secondary energy produced is also indicated. While the model is applicable to an operating policy for a single reservoir, the Huites project is part of a complex system requiring the integral operation of multiple reservoirs and irrigation areas. However, the model will be helpful in defining initial points for the search for an optimal operation policy of the total system. (Baker-FRC)
W82-01329

RURAL WATER SUPPLY AND RELATED SERVICES IN DEVELOPING COUNTRIES-COMPARATIVE ANALYSIS OF SEVERAL APPROACHES,

Bajard (Y.) Associates Ltd., Vancouver (British Columbia).
Y. Bajard, M. Draper, and P. Viens.
Journal of Hydrology, Vol 51, No 1/4, p 75-88, May, 1981. 3 Ref.

Descriptors: *Water resources development, *Planning, Resources development, Rural areas, Water supply development, Water requirements, Sanitation, Water demand, Africa, Tropical regions, *Developing countries.

Technical and educational aspects of rural water supply and sanitation programs are reviewed for Kenya, Cameroon, Senegal, The Gambia, Mali, Ivory Coast, Ghana, Benin and Ethiopia. Water availability and distribution in tropical Africa are generally poor. Several problems come to light on examining the various development schemes either proposed or underway. There is a general lack of recognition by host countries and donor agencies that water supplies and sanitation are inseparable aspects of development which must be tackled together. There is, in general, a reluctance to give due consideration to non-technical aspects of the problem. It is not widely realized that western technology, while efficient on the short term but sociologically brutal, may not be the best solution to the water problem. Training is lacking in both operation and management areas. There is a general lack of recognition that the projects must be seen within an overall framework, usually the country as a whole, even though action may be limited to a small part of that country. The projects are often conceived at a distance without sufficient reference to the local context. A plan is presented to take each of these shortcomings and devise a system of overcoming them. (Baker-FRC)
W82-01330

PREDICTING STREAM SALINITY CHANGES IN SOUTH-WESTERN AUSTRALIA,

Perth Public Works Dept. (Australia).
I. C. Loh, and R. A. Stokes.
Agricultural Water Management, Vol 4, No 1/3, p 227-254, 1981.

Descriptors: *Salinity, *Water pollution sources, Groundwater pollution, Land management, Farming, Solute transport, Model studies, Catchments, Reforestation, Water supply, *Agricultural runoff, *Forest watersheds, Streams, Inflow, *Australia.

The range of hydrologic responses and salinity variations of rivers and streams which drain forested and agricultural land in the Darling Range of south-western Western Australia are described. Appropriate approaches to modeling stream salinity changes to solve different problems are discussed, and a model is described which can be used to predict the annual salinity and flow of a large river system subject to a long history of permanent clearing. The geology of the Darling Range is dominated by the Archean Shield, a granitic basement underlying the lateritic soil profiles of the region. Soil associations have generally formed in situ and are characterized by lateritic gravels and duricrust overlying pallid zones of sandy clays or clay and a zone of weathered bedrock. Natural forest vegetation is characterized by a variety of Eucalyptus species with deep roots extended into the subsoils and weathering profile. The regional model described predicts the flow and salinity from a 2830 km square catchment, the Wellington Reservoir Catchment, subject to a long clearing history, and is designed to assist planning for long term catchment management. The model is based on a general quantitative knowledge of the hydrologic characteristics of small catchments within different rainfall zones across the catchment and represents the compilation of results from 10 years of study. Low salinities of the Darling Range prior to clearing were seen to dramatically increase in salt load following clearing. Current findings suggest that the moeil is overpredicting salinities in dry years. Improvements could be gained by further study of groundwater discharge to streams from year to year and a more careful study of effects of different geometric patterns of clearing and aquifer dimensions on groundwater discharge. (Baker-FRC)
W82-01350

METHODS FOR GENERATING ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S-Y. Chang, E. D. Brill, Jr., and L. D. Hopkins.
Water Resources Center, University of Illinois, Research Report No 160, July, 1981. 114 p, 17 Tab, 14 Fig, 29 Ref. S-078-ILL.

Descriptors: *Model studies, *Optimization, Resources development, Alternative planning, Multiobjective planning, *Water resources development, Mathematical models, System analysis, Wastewater treatment, Planning, Comprehensive planning, Project planning.

An optimization model is generally not a perfect representation of a complex water resources planning problem because not all important issues can be captured in a model. However, optimization models can be used to generate planning alternatives that are good and different, though not optimal, so that the decision maker can examine a wide range of alternatives. This approach is called modeling to generate alternatives (MGA). Several MGA methods--a random method, a branch and bound/screening (BBS) method, a Hop-Skip-Jump (HSJ) and a Fuzzy HSJ method--are described, and the potential use of these methods for generating good and different alternative solutions is assessed. The methods are illustrated using a wastewater treatment system planning problem, which is formulated as a mixed integer programming (MIP) model. The results suggest that all four MGA methods can be used in a complex water resource planning process to generate planning alternatives that are good and different. The common disadvantage of the quantitative methods of measuring differences among alternatives is that they cannot measure how far, in the spatial sense, the changes are made. With the HSJ method, the differences among alternatives are greater for the first several alternatives and decrease for additional alternatives. The Fuzzy HSJ method generates alternatives with the same general trend as HSJ. With the random generation method, the possibility of generating the same alternative is larger for a small planning problem than for a large one. The two-step BBS method uses the APEX code, then a screening process to select solutions that are different from each other. (Garrison-Omniplan)
W82-01449

GENERATING ALTERNATIVE SOLUTIONS FOR DYNAMIC PROGRAMMING MODELS OF WATER RESOURCES PROBLEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Landscape Architecture.
L. D. Hopkins, E. D. Brill, Jr., and B. Wong.
Water Resources Center, University of Illinois, Research Report No 163, August, 1981. 31 p, 9 Fig, 2 Tab, 11 Ref. Append. S-078-ILL.

Descriptors: *Alternative planning, *Model studies, *Multiobjective planning, Flood plain management, Management planning, Mathematical models, Model testing, Land use, Long-term planning, Flood plains, Bottomland, Projections, *Water management.

Using modeling to generate alternative (MGA) techniques, three methods to identify different, feasible alternative solutions to dynamic programming problems concerning water resources are evaluated. The methods, which differ in the procedure for identifying different alternatives, are: (1) adapting the kTH best policy method based on a difference constraint; (2) generalizing this method by treating difference and the known objective as two components to be weighted; and (3) searching a modified trace-back for solutions of maximum difference. Applying the second technique to a floodplain management model resulted in a solution in which all land use decisions, except one non-floodplain land use and one floodplain land use, were different from the decisions in the original solution. The economic rent objective was 11 percent lower than in the original solution. The outflow at the base of the watershed was approximately 26,000 cubic feet per second, compared with 20,000 cubic feet per second in the original solution. This illustrates that for a realistic problem, a variety of alternatives can be obtained without greatly reducing the economic rent from the optimal solution to a model of the problem. The intent to obtain alternatives that are perceivable as different with respect to implicit knowledge is, therefore, satisfied. This analysis could be used as a mental blockbuster to confront the analyst with policy options that are suggested by consideration of alternatives rather than by the original solution or past experience. The weighted difference approach is the most promising among the approaches considered. (Garrison-Omniplan)
W82-01450

PERFORMANCE EVALUATION OF A STOCHASTIC OPTIMIZATION MODEL FOR RESERVOIR DESIGN AND MANAGEMENT WITH EXPLICIT RELIABILITY CRITERIA,

Purdue Univ., Lafatette IN. School of Civil Engineering.
For primary bibliographic entry see Field 8A.
W82-01462

ON IDENTIFICATION AND VALIDATION OF SOME GEOTHERMAL MODELS,

Department of Scienfitic and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
L. J. Fradkin, M. L. Sorey, and A. McNabb.
Water Resources Research, Vol 17, No 4, p 929-936, August, 1981. 2 Fig, 24 Ref.

Descriptors: *Geothermal studies, *Model studies, *Well hydralics, Groundwater movement, Wairakei, *New Zealand, Thermal water, Mathematical models, Deep wells, *Geothermal resources.

The best of several models for production in the Wairakei geothermal field, New Zealand, was a lumped parameter model identified as a slow drainage model in which the upper two-phase portion of the reservoir serves mainly as a source of liquid for the underlying liquid region from which most of the production is obtained. This study also considered general models, reduced models, distributed parameter models, and combinations of these. Models were validated by comparing their forecasting powers with identified parameter values and by testing these identified values against additional data. Although the chosen slow drainage model gives a significantly simple conception of the reservoir, it is quite adequate for describing the production field's response with a minimum of parameters. It also provides good estimates of field parameters such as porosity, permeability, and recharge-storage ratio. (Cassar-FRC)
W82-01467

MANAGEMENT CONCERNS FOR SWIMMING, TUBING, AND WADING IN THE GREAT SMOKY MOUNTAINS NATIONAL PARK,

Great Smoky Mountains National Park, Gatlinburg, TN. Uplands Field Research Lab.
G. L. Larson, and W. E. Hammitt.
Environmental Management, Vol 5, No 4, p 353-362, July, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Recreation demand, *Water sports, *Environmental effects, Swimming, Parks, Soil compaction, Erosion, Stream banks, Streams, *Great Smoky Mountain National Park.

The great abundance of swimmers and innertube floaters along streams in the Great Smoky Mountains National Park made necessary this study on potential resource impacts. The main types of aquatic use other than fishing are described. The following were determined: the amount of each use, patterns of use, site use at each location, and potential impacts and user conflicts. Sampling was conducted at several sites on three streams. Use was concentrated during the afternoons and at certain streams and study sites most appropriate for the activity. Major impacts were soil compaction and erosion along the streambanks and the physical disturbance of the stream bottoms due to moving stones to construct temporary dams and raceways. Management objectives for the area will have to be specified, and the amount and character of chage permitted to occur in these streams because of recreational use must be determined. Further study is needed to determine that level of aquatic use that a stream can support without excessive damage. (Small-FRC)
W82-01475

SIMULATION OF DAILY WEATHER DATA USING THEORETICAL PROBABILITY DISTRIBUTIONS,

Cornell Univ., Ithaca, NY. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2B.
W82-01526

INTERDISCIPLINARY ENVIRONMENTAL ANALYSIS FOR TIMBER SALE PLANNING,

Klamath National Forest, Yreka, CA.
F. H. Jackson.
Water Resources Bulletin, Vol 17, No 2, p 301-306, April, 1981. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Planning, *Interdisciplinary studies, Water resources development, *Forestry, Environmental control, Environmental policy, Decision making, Administrative decisions, *California, Klamath National Park.

The systematic interdisciplinary process currently used for the development, evaluation, and selection of alternatives for timber harvest projects on the Happy Camp Ranger District of Klamath National Forest in northern California is described. The process begins with an inventory of resources and a team of specialists headed by a decision-maker, as well as a set of management objectives and constraints. It uses a mechanism which will set up conditions conducive to identification of appropriate alternatives reflecting the degree to which single alternatives can fulfill all objectives. A decision package of effectively displayed information is prepared, and a decision is made and documented. An impact matrix sheet is prepared, listing all resource factors and all alternatives for a given area on one sheet. Hydrologic resource factors considered are stream stability, stream temperature and stormflow turbidity. The specialists involved, including a water resources specialist, identify problem areas, predict impacts of proposed treatments, and help to develop management strategies. The team includes a decision-maker who is ultimately responsible for the project. (Baker-FRC)
W82-01539

MANAGING LAND TO MEET WATER QUALITY GOALS,

Economics and Statistics Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 4D.
W82-01557

6B. Evaluation Process

HYDROPOWER LOSSES FROM NAVIGATION IN THE SNAKE-COLUMBIA RIVERS: 1978-79,

Washington State Univ., Pullman. Dept. of Environmental Science.
For primary bibliographic entry see Field 6D.
W82-01139

A SURVEY OF MATHEMATICAL OPTIMIZATION MODELS AND ALGORITHMS FOR DESIGNING AND EXTENDING IRRIGATION AND WASTEWATER NETWORKS,

Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
For primary bibliographic entry see Field 6A.
W82-01296

EFFECT OF INVESTMENTS IN WATER SUPPLY AND SANITATION ON HEALTH STATUS: A THRESHOLD-SATURATION THEORY,

Michigan Univ., Ann Arbor. School of Public Health.
H. I. Shuval, R. L. Tilden, B. H. Perry, and R. N. Grosse.
Bulletin of the World Health Organization, Vol 59, No 2, p 243-248, 1981. 6 Fig, 13 Ref.

Descriptors: *Public health, *Cost-benefit analysis, *Water supply development, Developing countries, Threshold-saturation theory, Planning, Waste disposal, Social aspects, Economic aspects, Water resources development.

The threshold-saturation theory is proposed to relate investments in sanitation and water supply to health. Three variables are considered: health status, socioeconomic status, and sanitation level. The two-tiered S-shaped logistic form assumes that at the lower end of the socioeconomic spectrum there is a threshold below which investments in community water supplies or sanitation alone result in little improvement in health status. At the other end of the socioeconomic scale, there is a point of saturation beyond which investments in conventional community sanitation facilities produce no further health benefits. Preliminary support for this theory was obtained by using published data on sanitation level, life expectancy, and adult literacy rates for 65 developing countries. (Cassar-FRC)
W82-01331

EXPANSION OF EFFLUENT CONSTRAINED TREATMENT PLANTS,

Newcastle Univ., New South Wales (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-01355

PRELIMINARY DESIGN AND COST ESTIMATES FOR REMEDIAL ACTIONS AT HAZARDOUS WASTE DISPOSAL SITES,

JRB Associates, Inc., McLean, VA. Waste Management and Resource Recovery Div.
For primary bibliographic entry see Field 5G.
W82-01435

INPUT AND OUTPUT CONSTRAINTS AFFECTING IRRIGATION DEVELOPMENT,

Michigan Univ., Ann Arbor. School of Natural Resources.
G. Schramm.
Journal of Hydrology, Vol 51, No 1-4, p 1-16, May, 1981. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Irrigation design, *Planning, Design criteria, Irrigation practices, Irrigation programs, Farming, Agriculture, Decision making, Administrative decisions, *Mexico.

The development of an extensive irrigation project in Mexico for the purposes of increasing agricultural output and alleviating rural poverty and unemployment is reviewed, with emphasis on the manner in which shifting projections and parameters change the overall benefits initially expected from such a long term project. Government allocations to the agricultural sector increased 7-fold from 1970 to 1975. However, other supports were also needed, such as short- and long-term credit, availability of fertilizers, seeds and insecticides, and accessibility to markets and marketing facilities. These factors are termed input constraints. Output constraints are basically market related. They occur because hoped-for, predicted markets for certain crops do not materialize or are available only at prices far below those predicted in the project planning stage. It is suggested that, in countries where conditions are such that a wide variety of crops will fluorish, new projects should generally be evaluated on the basis of low-value crop production only. When high value are included in this evaluation, there must be specific reasons to believe that this product will be superior to already existing ones. Expected price levels for all specialty crops should be based on observed price levels in the local or regional markets to be served. Studies should be undertaken on an ongoing basis to estimate yearly the likely growth in demand for higher value crops. The necessary inputs, including education and demonstration plots, must be figured into the cost-benefit analysis of the project from the beginning. (Baker-FRC)
W82-01476

EXTRACTION TIMING AND ECONOMIC INCENTIVES FOR GEOTHERMAL RESERVOIR MANAGEMENT,

Woodward-Clyde Consultants, San Francisco, CA.
For primary bibliographic entry see Field 4B.
W82-01504

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ON WATER TARIFF EQUALIZATION POLICIES,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Applied Engineering.
S. H. Hanke.
Water/Engineering and Management, Vol 128, No 8, p 33-34, August, 1981. 12 Ref.

Descriptors: *User charges, *Water policy, *Policy making, Water costs, Public policy, Pricing, Administrative decisions, Regional planning, Economic aspects, Investment.

Intra-system water tariff equalization policies based on forward-looking costs are discussed. This type of policy requires all customers in a certain customer class to pay the same price per unit volume and the same fixed charge per period regardless of which local system they are in. This type of system has been proposed in France and the United Kingdom and is believed to be necessary for the development of an equitable regional or national strategy for water development. Equalization policies mean that users in low-cost systems subsidize users in high-cost systems. One disadvantage is that since price and charges are not related to the real cost of water, inefficiency may be encouraged. Where the political power of the low-cost and high-cost users is equal, or where the power of the high-cost users dominates, overinvestment will occur in the high-cost systems and underinvestment in the low-cost systems. (Small-FRC)
W82-01175

SUPPLY-DEMAND COORDINATION IN WATER RESOURCES MANAGEMENT,

Centro Teoria dei Sistemi, Milano (Italy).
G. Guariso, D. Maidment, S. Rinaldi, and R. Soncini-Sessa.
Water Resources Research, Vol 17, No 4, p 776-782, August, 1981. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Water supply, *Water demand, *Interbasin transfers, *Water resources management, Optimization, Water management, Irrigation, Water transfer, Water delivery, Benefits, Cost-benefit analysis, Algorithms, Marginal costs, Northwest Water Plan, *Mexico, Pricing.

Optimal water supplies and demands in a network were determined by an iterative algorithm which combines the results of models for each supply and demand unit. It works with marginal benefits and costs rather than total benefits and costs. The key idea is that the cost of delivering a unit of water must be equal to the benefit generated at that point. Some simplifying assumptions made are: water quality is not considered, all flows are available at the same time, and all supplies have the same reliability. The method is applied to the proposed Northwest Water Plan in Mexico, involving transfer of water from south to north along the Mexican coast of the Gulf of California. Declining groundwater levels and seawater intrusion are the problems behind this proposed transfer. The system consists of four supplies (one groundwater system and three reservoirs) and four irrigation demand areas. If the transfer scheme is built according to plan, the annual total net benefit from crop production in the region would increase by 6% to $784.2 million; construction and maintenance costs are estimated at $16.1 million per year; and the benefit-cost ratio is 2.7. The water price in the source region would rise from 4 cents to 9 cents per cu meter and fall from 24 cents to 10.5 cents in the receiving area. Solving the problem by classical price coordination methods requires an eight-dimensional search, while the method presented in this paper is one-dimensional. (Casser-FRC)
W82-01299

LCONOMICS,

Clemson Univ., SC.
For primary bibliographic entry see Field 5G.
W82-01304

6D. Water Demand

WATER MULTIPLIERS–REGIONAL IMPACT ANALYSIS,

Hawaii Univ., Honolulu. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 6A.
W82-01138

HYDROPOWER LOSSES FROM NAVIGATION IN THE SNAKE-COLUMBIA RIVERS: 1978-79,

Washington State Univ., Pullman. Dept. of Environmental Science.
C. F. Culver, and C. B. Millham.
Water Resources Bulletin, Vol 17, No 3, p 501-503, June, 1981. 1 Tab, 7 Ref.

Descriptors: *Energy loss, *Electric power, *Locks, Dams, Hydroelectric power, Powerplants, Dams, Recreation, Transportation, *Navigation, Rivers, *Snake River, *Columbia River, Washington, Boating, Water use, Water demand.

Power losses from commercial and recreational lockages on the Snake-Columbia River complex were, respectively, 100,206,000 and 14,900,000 kWH in 1977 (a year of low flow), 125,958,000 and 28,748,000 kWH in 1978, and 127,483,000 and 34,259,000 kWH in 1979. Losses for 1978-79 would have met power requirements for 10,500 Washington State households for 2 years (at an annual rate of 15,000 kWH per household). Any boat traveling from Portland, Oregon, to Lewiston, Idaho, and back uses a minimum of 8 lockages at a total energy loss of 77,000 kWH or replacement cost of $3,000. Planned low-head hydropower development sites in the State of Washington would produce energy quantities comparable to the losses due to pleasure boat lockages at the present dams. The authors question whether commercial towboats should continue to enjoy cost-free passage and whether there are more energy-conserving methods of transporting recreational boats over dams. (Casser-FRC)
W82-01139

PREFERENCES FOR ALLOCATING RIVER RECREATION USE,

Montana Univ., Missoula. School of Forestry.
S. F. McCool, and J. Utter.
Water Resources Bulletin, Vol 17, No 3, p 431-437, June, 1981. 6 Tab, 18 Ref.

Descriptors: *Recreation demand, *White water, *Allotments, Surveys, Middle Fork, *Salmon River, Idaho, Allocation of resources, Resource allocation, Rivers, Permits, Water management, Water policy, Regulations.

Allocation of white water stream recreational use between commercial and private sectors was the subject of a questionnaire to which 1,166 individuals responded during the 1978 river floating season at Middle Fork of the Salmon River, Idaho. The 3 groups (commercial users, private users, and those whose applications for a trip permit were rejected) most preferred the Even-Pool allotment technique (a 50-50 split with leftover allotments going to the other sector). The Middle Fork System (46% for commercial use, 54% for private use) was also highly favored. As a group, the commercial users liked Advance Reservation first and Knowledge and Skill Requirements, second. Private users and rejectees ranked Lottery first, and Knowledge and Skill Requirements, second. There appeared to be no relationship of the importance of stress release/escape scale to the allocation techniques. The results of this study show that river managers may have considerable latitude in selecting allocation techniques. Users appear to prefer allocation techniques which they have experienced favorably in the past, which seem fair, and which do not intrude on the activities on-site. Other methods which received more than 50% approval from any one of the groups were: Historical Use, Even Split (50-50), Percentage of Disappointment (a certain percentage of applicants from each sector), Treat Everyone the Same, and Lottery-Reservation. (Casser-FRC)
W82-01181

SUPPLY-DEMAND COORDINATION IN WATER RESOURCES MANAGEMENT,

Centro Teoria dei Sistemi, Milano (Italy).
For primary bibliographic entry see Field 6C.
W82-01299

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; BRAZOS RIVER BASIN, TEXAS-NEW MEXICO.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0059, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0059, Revised 1980. 14 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric power, Flood control, Cooling water, *Reservoirs, Storage reservoirs, Thermal powerplants, Consumptive use, Saline water, *Multipurpose reservoirs, *Brazos River basin, Texas, New Mexico.

The Brazos River basin heads in eastern New Mexico about 25 miles northwest of the city of Clovis and extends in a southeasterly direction diagonally across Texas to the Gulf of Mexico, with an associated area that includes the coastal drainage north and east of the Brazos River to Galveston Bay. Average annual precipitation in the basin varies from 17 inches in the extreme headwater area to 46 inches near the Gulf of Mexico. There are 38 reservoirs in the basin (existing or under construction) with storage capacities in excess of 5,000 acre-feet. Nine of these are Federal projects, and two existing reservoirs support hydroelectric facilities. All of the Federal and one of the non-Federal reservoirs have space allocated for storage of floodwaters. There are 242 flood-water retarding structures with about 1,400 sq mi of drainage area. Water withdrawn for cooling purposes was estimated to be 1,547 million gallons per day with an estimated consumption rate of 1[illegible] million gallons per day. Potential hydroelectric projects in the Brazos River basin include Wynn Mountain, Inspiration Point, Hightower, DeCordova Bend, Bee Mountain, Belton, and a third unit at Possum Kingdom. There are twelve potential storage reservoirs in the basin. There may be 20 steam-electric generating plants in operation with generating capacities of 25 megawatts or greater located in the area by 1985. Fresh and saline water withdrawals for cooling purposes are estimated at 111 and 1,242 million gallons per day, respectively. The consumption rates for fresh and saline water are estimated at 74 and 8 million gallons per day, respectively. (Moore-SRC)
W82-01439

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; SAVANNAH AND EDISTO RIVER BASINS AREA; GEORGIA-SOUTH CAROLINA-NORTH CAROLINA.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0075, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0075, Revised February 1981. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Savannah River basin, *Edisto River basin, Reservoirs, Flood control, Recreation, Navigation, Cooling water, Wild rivers, Harbors, Water supply, Planning, *Multipurpose reservoirs, Georgia, South Carolina, North Carolina.

This revised report presents updated information on the water resources of the Savannah and Edisto River Basins, and information on new and planned developments. There are 17 hydroelectric developments in the Savannah basin, existing or nearing completion, and none in the Edisto basin. The total installed capacity will be 1,712,830 kw. The reservoirs also provide flood-control storage capacity, and recreation. Below Augusta, a channel 9 ft deep and 90 ft wide is maintained. There are five steam-electric generating plants which withdraw a total of 2,363 mgd of water for cooling purposes. In the two basins 14 sites have been identified for potential hydroelectric projects. The Chattooga River is

the only river in the basin presently included in the National Wild and Scenic Rivers System; several others are being considered for inclusion. Fifteen retired hydroelectric projects have the potential for redevelopment. The steam-electric cooling water requirements are projected to be 599 mgd in 2000. Major studies are in progress to determine if any modifications should be made to the existing Savannah Harbor project, and to investigate the water supply, flood control, drainage and storm runoff, recreation, navigation, beach erosion, and fish and wildlife of the Savannah area. (Brambley-SRC)
W82-01440

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; AMERICAN RIVER BASIN, CALIFORNIA,
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0076, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0076, Revised March 1981. 18 p, 3 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *American River, California, Reservoirs, Irrigation, Cooling water, Flood control, Storage capacity, Wild rivers, Diversion channels, Water demand, Planning, *Multipurpose reservoirs.

This revised report presents updated information on the water resources of the American River Basin and information on new and planned developments. There are 15 hydroelectric plants existing or under construction, and three license applications are pending. Total installed capacity is 1,046,715 kw, and the reservoirs also provide water for irrigation, power plant cooling, and municipal and industrial uses, and provide storage capacity for flood control. The only steam-electric plant is a nuclear plant which draws 8 mgd of water from the river for cooling purposes. This is expected to increase to 59 mgd by 2000. A segment of the North Fork of the American River is included in the National Wild and Scenic Rivers System, and a segment of the South Fork is being considered. Thirteen sites have been identified as having potential for hydroelectric development. Some of these sites may become part of multi-site projects, involving diversion pipelines and tunnels. Development will be subject to other water demands, including municipal and industrial supplies, flood control, water quality, and fish and wildlife, and to regulations specifying minimum flows in the river. (Brambley-SRC)
W82-01441

ORGANIC CONTAMINATION OF GROUND WATER: TELL IT ALL,
Dedham Water Co., MA.
For primary bibliographic entry see Field 5C.
W82-01474

HYDROPOWER–AN OLD TECHNOLOGY FOR A NEW ERA,
Worldwatch Inst., Washington, DC.
For primary bibliographic entry see Field 4A.
W82-01593

6E. Water Law and Institutions

NEBRASKA GROUND WATER LAW AND ADMINISTRATION,
J. D. Aiken.
Nebraska Law Review, Vol 59, No 4, p 917-1000, 1980. 448 Ref.

Descriptors: *Nebraska, *Water law, *Groundwater management, Water policy, Legal aspects, Groundwater, Water rights, Water quality, Groundwater mining, Irrigation, Legislation.

Nebraska is rich in groundwater when compared to other western states. In spite of this, groundwater is in short supply in many parts of the state. Although 87 percent of the groundwater used in Nebraska in 1975 was for irrigation, groundwater also supplied 99 percent of total municipal water use, 83 percent of rural domestic and stock watering use, 78 percent of cooling water for power plants, and 100 percent of self-supplied industrial water use. The historical development of Nebraska groundwater law is discussed decade by decade, beginning with the windmill era existing prior to 1930, and including descriptions of the technological and historical conditions affecting groundwater development and use and discussion of the effects of these conditions on the evolution of Nebraska groundwater law. Finally, Nebraska groundwater law and policy are examined with respect to the institutional framework, rights of use, groundwater transfers, well interference conflicts, groundwater mining, conflicts between surface and groundwater users, and groundwater quality. While well interference conflicts in Nebraska are resolved through a combination of common law doctrines of reasonable use and correlative rights and of statutory preferences, there is no clear basis for the resolution of surface-groundwater disputes. The status of groundwater transfers is also unclear. State groundwater management objectives are lacking, and groundwater quality protection is limited. Continued groundwater development and mining can be expected to force legislators and judges to address groundwater policy issues in the future. (Carroll-FRC)
W82-01236

LAW,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
W. E. Cox, and W. R. Walker.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 617-619, June, 1981. 41 Ref.

Descriptors: *Water law, *Legal aspects, *Water pollution control, Legislation, Reviews, Water quality standards, Planning, Effluent limitations, Nonpoint pollution sources, Enforcement, Judicial decisions, Wastewater treatment, *Literature review.

The recent reduction in significant additions to water quality legislation has produced a reduction in literature on the legal aspects of water pollution. Some recent papers concerned institutional structures for water quality protection and the lack of coordination between water quality and quantity planning. Congress was accused of turning decision making over to the public and the courts. Several authors discussed the Clean Water Act, the nonpoint source pollution problem in the Great Lakes, and effluent limitation and water quality standards. Some of the court cases reviewed concerned challenges to effluent limitations in the crushed stone and mining industries, a carbon tetrachloride spill in the Ohio River basin, interpretation of the Clean Water Act covering oil and hazardous waste spills, and spill penalties. Other subjects discussed were: the impact of Safe Drinking Water Act control measures on drinking water suppliers, whether the consumer or polluter should bear costs of treatment, proposed Safe Drinking Water Act amendments and their effect on groundwater quality, EPA enforcement activities, and marine pollution on the international scale. (Cassar-FRC)
W82-01302

FEDERAL COMMON LAW OF NUISANCE EXPANDS,
E. M. Sommer.
Natural Resources Journal, Vol 21, No 2, p 419-423, April, 1981. 22 Ref.

Descriptors: *Common law, *Judicial decisions, *State jurisdiction, Legal aspects, *Water pollution control, Industrial wastes, Polychlorinated biphenyls, *Illinois.

The case of Illinois v. Outboard Marine Corporation is reviewed, in which Illinois filed action against the company for allegedly discharging highly toxic polychlorinated biphenyls (PCBs) from its Waukegan, Illinois plant into North Ditch, Waukegan Harbor, and Lake Michigan. The federal government also filed a complaint under the Refuse Act, the Federal Water Pollution Control Act, and the federal common law of nuisance. The courts significantly expanded the federal common law of nuisance by holding that Illinois had a federal common law cause of action in nuisance against an in-state pollution source. As a result of the litigation, the federal common law of nuisance now appears to extend to navigable waters that are purely intrastate. Thus, there is now an additional tool for combatting pollution within territorial boundaries. Also, states can now sue intrastate polluters on the basis of federal common law without satisfying the federal jurisdictional requirement of diversity. (Small-FRC)
W82-01337

THE WORKINGS OF THE CONTROL OF POLLUTION ACT IN TIDAL WATERS: A VIEW OF THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD,
Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Lab.
P. C. Wood.
Water Pollution Control, Vol 80, No 2, p 180-188, 1981. 4 Ref.

Descriptors: *Pollution control, *Legal aspects, Regulations, Permits, Law enforcement, Estuaries, Planning, *United Kingdom, *Tidewater, Effluents, Discharge permits, Fisheries.

The probable future involvement of the British Ministry of Agriculture, Fisheries and Food (MAFF) with the part of the Control of Pollution Act 1974 related to tidal waters is considered. Some of the technical problems of relevance to the MAFF which are likely to be encountered by the authorities are also considered. Under Part II of the Act, water authorities will be required to issue consents for new and existing discharges. This should be based on the application of quality objectives which, among other things, will require the designation of the use of estuaries or parts of estuaries. Environmental quality standards needed to meet these quality objectives must be established. The application of discharge control based on quality objectives requires experience with the complexity of marine ecosystems, and with conditions in the specific area. The setting of consent conditions for new or existing discharges will require the MAFF to give its views to the Secretary of State within six weeks of publication of proposed conditions. (Baker-FRC)
W82-01383

THOUGHTS ON THE NEED TO CONTROL DISCHARGES TO ESTUARIAL AND COASTAL WATERS,
Department of the Environment, London (England).
P. H. Garnett.
Water Pollution Control, Vol 80, No 2, p 172-179, 1981. 6 Ref.

Descriptors: *Estuarine environment, *Pollution control, Legal aspects, Planning, Coastal waters, International waters, Organizations, Management, International agreements, Estuaries, *United Kingdom.

Public opinion has begun to manifest itself in England toward desiring cleanup of polluted estuaries and coastal waters. This attitude is reflected in the Third Report of the Royal Commission on Environmental Pollution and in the report of the Ministry of Housing and Local Government Working Party on Sewage Disposal, 1970. Part II of the Control of Pollution Act calls for control of all discharges of sewage and industrial effluent to all non-tidal and tidal rivers, estuaries and coastal waters. In order that tidal water quality objectives may be met, a first step would be to establish a classification of tidal-water quality. There also are international legislative concerns which influence the implementation of Part II of the Control of Pollution Act. In particular, the Paris Convention is of concern, which seeks to eliminate pollution from land-based sources. The cost of implementation is briefly considered. (Baker-FRC)
W82-01384

USE OF THE CONTINGENCY FUND AT STRINGFELLOW HAZARDOUS WASTE DISPOSAL SITE,
Coast Guard, Hamilton AFB, CA. Pacific Strike Team.
For primary bibliographic entry see Field 5G.
W82-01416

PRACTICAL ASPECTS OF GROUND WATER MONITORING AT EXISTING DISPOSAL SITES,
Law Engineering Testing Co., Atlanta, GA.
For primary bibliographic entry see Field 5G.
W82-01421

SURFACE WATER MANAGEMENT AT HAZARDOUS WASTE SITES,
Dames and Moore, Atlanta, GA.
For primary bibliographic entry see Field 5G.
W82-01429

MIDDLESEX COUNTY SEWERAGE AUTHORITY V. NATIONAL SEA CLAMMERS ASSOCIATION: IMPLIED PRIVATE RIGHTS OF ACTION FOR DAMAGES UNDER THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972,
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
P. J. Manning.
Environmental Law, Vol 12, No 1, p 197-229, Fall, 1981. 265 Ref.

Descriptors: *Water law, *Judicial decisions, *Private rights, Legal aspects, *Water pollution control, Water pollution effects, Federal Water Pollution Control Act, *Shellfish, Middlesex County Sewerage Authority, National Sea Clammers Association.

The Supreme Court's opinion on the Middlesex County Sewerage Authority v. National Sea Clammers Association case did not settle the question of implied private rights of action under federal statutes. The Association filed suit in federal district court, complaining that various government officials had permitted toxic waste dishcarges into waters entering the Atlantic Ocean, where a massive algal bloom and subsequent collapse killed large numbers of shellfish. The case was dismissed in the district court for lack of jurisdiction. The Third Circuit Court of Appeals ruled that individuals injured by pollution violations of the Federal Water Pollution Control Act could seek damages. On appeal, the Supreme court rejected the Appeals Court conclusion, holding that Congress intended that private remedies in addition to those expressly provided should not be implied. Although this decision was correct, the haphazard use of the Cort v. Ash test in the analysis resulted in confusion in lower court rulings. Federal acts to control water pollution are reviewed, as well as the courts' analyses of this case and pertinent precedents. (Caesar-FRC)
W82-01455

AVOYELLES SPORTSMEN'S LEAGUE V. ALEXANDER,
K. L. Rosenbaum.
Environmental Law, Vol 12, No 1, p 231-242, Fall, 1981. 66 Ref.

Descriptors: *Wetlands, *Judicial decisions, *Land clearing, Water pollution prevention, Dredging, Legal aspects, Clean Water Act, Water law, Avoyelles Sportsmen's League v. Alexander, Farming, Lake Long, *Louisiana, Bayous.

The court ruled that clearing trees and shrubs from 20,000 acres of bottomland hardwoods in the Natchitoches basin, Louisiana (Lake Long tract) for soybeans farming was a violation of the Clean Water Act. In Avoyelles Sportsmen's League v. Alexander, the June 1979 decision ruled that land clearing operations were point sources of pollution under section 301, that the activities did produce dredged or fill materials (the cleared vegetation), that section 404 exemptions for normal farming and silviculture activities did not apply, and that the clearing activities would alter drainage and circulation patterns of the waters. In March 1981 the court ruled that this tract was a part of the waters of the U. S. as defined in the Clean Water Act. Although this decision was strongly in favor of environmentalists, its effectiveness in preserving wetlands may be lessened by budget cuts, lack of enforcement, and recent rulings that denial of a section 404 permit can be interpreted as taking of property without just compensation. (Caesar-FRC)
W82-01456

THE WATER DECADE (1981-1990).
UNESCO Courier, Vol 34, No 2, p 11-15, February, 1981.

Descriptors: *Developing countries, *Water supply development, *Public health, International Drinking Water Supply and Sanitation Decade, United Nations, Planning, Costs, Rural areas, Waste disposal.

The International Drinking Water Supply and Sanitation Decade is a worldwide cooperative effort to provide clean water and sanitation for all by the year 1990. The 1975 data indicate that fewer than 500 million of the 2000 million people in developing countries (not including China) have adequate water and sanitation. About 80% of sickness and disease can be attributed to these inadequacies. Widely varying cost estimates have been proposed for implementing the Decade's goals. The costliest option, $600 billion 1978 dollars for 100% coverage, assumes that urban households will all have water taps and be connected to sewer systems, rural households, standpipes or handpumps and individual latrines. Using acceptable but less sophisticated, lower cost technology, an 80% coverage could be reached for $300 billion. Participants in the Decade will be governments of both developed and developing countries, industry, educational institutions, and United Nations agencies. (Caesar-FRC)
W82-01534

A WATER RIGHTS STRATEGY FOR MINING OPERATIONS IN THE WESTERN US,
J. C. Green.
Mining Engineering, Vol, 33, No 8, p 1220-1222, August, 1981. 1 Fig.

Descriptors: *Water rights, *Mineral industry, *Water law, Legal aspects, Consumptive use, Environmental effects, Colorado, Western United States.

Legal and engineering issues in mining water rights in the semi-arid West are discussed. Water rights can be transferred by drying up historically irrigated lands to develop a new industrial water supply in an over-appropriated basin. An augmentation plan allows a new use of water by compensating the river system with various resources, sometimes at other locations. Before a mine begins operation, the water rights in the area must be reviewed, and the possible impacts of the operation on ground and surface waters must be assessed. The amount of consumptive use is important. Water rights must often be acquired, and it may take from one to three years to complete the augmentation plan. Most of the examples in this article deal with policies of the state of Colorado, but the concepts and principles used in other western states are similar. Early planning of a water rights strategy is often crucial to the mine planning process. (Small-FRC)
W82-01587

COMPELLED SELF-INCRIMINATION AND THE FEDERAL WATER POLLUTION CONTROL ACT,
J. McVey.
Natural Resources Journal, Vol 21, No 3, p 599-606, July, 1981. 61 Ref.

Descriptors: *Water law, *Judicial decisions, *Oil spills, Legal aspects, Constitutional law, Regulations, Federal Water Pollution Control Act, United States v. Ward, Arkansas River basin.

Ward, lessor of an Oklahoma drilling facility, was assessed a $500 civil penalty by the Coast Guard upon reporting, as required under the Federal Water Pollution Control Act, an oil spill into a tributary of the Arkansas River. Ward claimed, and the Tenth Circuit Court of Appeals agreed, that the act of reporting the spill was self-incriminating under the Fifth Amendment. The majority opinion of the U.S. Supreme Court found that the proceedings for assessment of a civil penalty was not a criminal or quasi-criminal proceeding, and therefore the Fifth Amendment privilege could not be invoked. The dissenting opinion stated that the reporting requirement is a form of compelled self-incrimination. (Caesar-FRC)
W82-01600

6F. Nonstructural Alternatives

THE PROBLEMS OF NON-RETURN AND THE USE OF VALVES IN DRINKING WATER PROTECTION AGAINST WASTE WATER RETURN, APPLYING THE REGULATIONS IN FORCE,
For primary bibliographic entry see Field 5F.
W82-01142

PREFERENCES FOR ALLOCATING RIVER RECREATION USE,
Montana Univ., Missoula. School of Forestry.
For primary bibliographic entry see Field 6D.
W82-01181

SANITATION SERVICE MANAGEMENT IN FRANCE (LA GESTION DES SERVICES D'ASSAINISSEMENT EN FRANCE),
Ingenieurs a la Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
B. Auclair, and J-F. Bost.
Aqua, No 2, p 17-19, 21, 1981. 4 Fig.

Descriptors: *Wastewater treatment, *Maintenance, *France, Water treatment facilities, Management, Planning, Decision making, *Water pollution control.

An economic incentives program was instituted in an effort to curb water pollution in France. Highly effective municipal and industrial purification plants and sewerage systems have since been developed. Capital expenditures for maintaining the operation come from taxation and from fees charged directly to the user, based either on his water consumption or on the quantities of pollutants discharged. Organization and maintenance operations are conducted by the people or districts served by the facilities or can be handled through a firm of specialists on a contract basis. La Lyonnaise des Eaux handles cleansing services for some 600 townships throughout France. Different operation and maintenance problems are posed by each community, naturally influenced by the specific pollutants contained in the waste, Distinctions must be made between preventative maintenance, emergency services, and operation and upkeep, as all these activities have widely differing needs both in equipment and in human resources. The role of the operator must also take into account surveillance of connections with existing networks and ensure that discharges comply with prescribed standards. These tasks are more easily fulfilled by a company specializing in this area of operation and maintenance than by a municipal department. (Baker-FRC)
W82-01351

6G. Ecologic Impact Of Water Development

AN EMPIRICAL METHODOLOGY FOR ESTIMATING ENTRAINMENT LOSSES AT POWER PLANTS SITED ON ESTUARIES,
National Power Plant Team, Ann Arbor, MI.
J. Boreman, C. P. Goodyear, and S. W. Christensen.
Transactions of the American Fisheries Society, Vol 110, No 2, p 253-260, March, 1981. 3 Tab, 10 Ref.

Descriptors: *Entrainment, *Larvae, *Powerplants, *Estuaries, Fish, Shellfish, Eggs, Juvenile growth stage, Aquatic animals, Cooling water, Electric powerplants, Mortality, *Model studies, Mathematical equations, Potomac River, Rivers, Bass, Spawning, Forecasting, Planning, Nuclear powerplants, Potomac River estuary, *Douglas Point Nuclear Plant.

The Empirical Transport Model is a generalized mathematical equation for estimating the conditional entrainment mortality rate of aquatic organisms (especially fish and shellfish) due to water withdrawal from an estuary by one or more powerplants. The model is based on empirically derived age-, time-, and space-variant entrainment susceptibility data. There are two forms of the equation: the single-cohort approach (entrainable organisms are placed in the water body at the same time, e.g., by spawning over a short time interval) and the multiple-cohort approach (entrainable organisms introduced into the water body over an extended period). Model application requires data on water body morphometry, powerplant flow rates, probability of entrainment survival, and the duration, distribution, and abundance of entrainable age groups. The model was used to estimate the entrainment mortality of early stages of striped bass for the proposed Douglas Point Nuclear Plant on the Potomac River. Mortality rates obtained were 0.142% for eggs, 0.234% for yolk-sac larvae, 0.22% for fin-fold larvae, and total rate through the fin-fold stage, 0.398%. (Cassar-FRC)
W82-01173

ENTRAINMENT AND IMPINGEMENT IN POWER PLANT COOLING SYSTEMS,

Electric Power Research Inst., Palo Alto, CA.
W. Chow, I. P. Murarka, and R. W. Brocksen.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 53, No 6, p 965-973, June, 1981. 143 Ref.

Descriptors: *Powerplants, *Aquatic life, Plankton, Hydroelectric plants, Electric powerplants, Cooling, Design considerations, Entrainment, Fish, *Cooling water, *Ecological effects.

Current research is reviewed on developments to define and control the characteristics of cooling water from the biological as well as the engineering standpoint. The biological view deals with advances in ecological concerns and findings on entrainment and impingement at power plants. Plant design aspects deal with advances in engineering designs to meet biological criteria. Entrainment mortalities to eggs larvae and small fish directly affect fish communities. Whether irreversible damage is done through impingement and entrainment is still being debated. Counts and estimates of fish losses are carried out at most cooling water intake locations. Findings of numerous studies in this field suggest that entrainment and impingement of organisms depends to a large extent on the schooling behavior of fish, including fish migrations. Entrainment of eggs and larvae occurred only during periods when the particular species was spawning and hatching. To assess the impacts and make a biological evaluation of the significance of entrainment and impingement mortality, it is necessary to have an accurate estimate of the fish population being impacted. The population level modeling approach is frequently employed to assess the fraction of a given population suffering mortality losses from entrainment and impingement. Plant design aspects considered include the intake structure design, offshore studies on fish mortality, use of barriers and screens, and collection, removal and return systems. (Baker-FRC)
W82-01276

HOLLAND'S EASTERN SCHELDT ESTUARY BARRIER SCHEME: SOME ECOLOGICAL CONSIDERATIONS,

Shell Internationale Research Maatshcappij N.V., The Hague (Netherlands). Group Toxicology Div.
For primary bibliographic entry see Field 2L.
W82-01375

PHYTOPLANKTON OF FOUR RIVERS, THE TYNE, WEAR, TEES AND SWALE,

Durham Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2E.
W82-01376

ECOLOGY OF LARVAL FISHES IN LAKE OAHE, SOUTH DAKOTA,

Fish and Wildlife Service, Pierre, SD. North Central Reservoir Investigations.
W. R. Nelson.
Technical Papers of the U.S. Fish and Wildlife Service, No 101, 1980. 20 p, 7 Fig, 20 Tab, 29 Ref.

Descriptors: *Reservoirs, *Spawning, *Larval growth stage, *Aquatic habitats, *Water level fluctuations, *Fish, Reservoir operation, Fish food, Vegetation, Flooding, Shores, Ecology, Lake Oahe, *South Dakota.

In reservoir environments, which are less stable than those of natural lakes, characteristics such as water level fluctuation, shoreline erosion, and sedimentation often have profound effects on fish reproduction. Before existing water management programs are altered, the spawning and nursery area requirements for the predominant species must be understood. The time and location of spawning, food of larvae, and habitats used as nursery areas by young of the year fishes were studied from 1972 to 1975 in South Dakota waters of Lake Oahe, a main stem Missouri River reservoir. Sampling locations were in the tributary rivers and their embayments. The most heavily used spawning areas were in the rivers, which were the exclusive spawaing ground for five fishes (goldeneye, walleye, sauger, white sucker, and minnows), and the major spawning ground of three others (white bass, buffalo, and carp). The upper reaches of the embayments were the preferred spawning locations of crappies and the preferred nursery areas of most young fishes. The lower reaches were the primary spawning grounds of yellow perch, burbot, shiners and darters. Year-class strength of river-spawning species was primarily dependent on above average water levels, which inundated terrestrial vegetation to provide a substrate for egg deposition and cover for larvae. Preserving adequate streamflow and enhancing reservoir shoreline areas by managing water levels, seeding vegetation, and eliminating grazing alongshore would probably ensure adequate reproduction of most species. (Moore-SRC)
W82-01444

7. RESOURCES DATA

7A. Network Design

REGIONALIZATION OF THE UPPER GREAT LAKES WITH RESPECT TO SURVEILLANCE EUTROPHICATION DATA,

Canada Centre for Inland Waters, Burlington (Ontario).
R. E. Kwiatkowski.
Journal of Great Lakes Reserch, Vol 6, No 1, p 38-46, 1980. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Monitoring, *Great Lakes, *Regional analysis, Lakes, Water quality, Water temperature, Chlorides, Nutrients, Lake Superior, Lake Huron, Sampling, *Eutrophication, International Joint Commission.

Lake Superior, Lake Huron, and the Georgian Bay-North Channel were divided into regions using a regression model developed by El-Shaarawi and Kwiatkowski (1977). Water quality parameters considered were: chloride, temperature, nitrate-nitrite, silica, total P, and chlorophyll a. The zones obtained in this study were similar to those proposed by the International Joint Commission for Lake Huron and the North Channel-Georgian Bay. However, results for Lake Superior indicate fewer zones than previously designated. Water temperature and chloride (from road salt) appeared to be the most reliable parameters for delineating zones. Inputs and currents were important factors in the size and shape of the regions. These studies are a step toward establishing a cost effective surveillance program for the Great Lakes by reducing the frequency of whole-lake surveys. (Cassar-FRC)
W82-01150

NEARSHORE SPATIAL DISTRIBUTION OF FISHES IN GILL NET SAMPLES, CAYUGA LAKE, NEW YORK,

Department of Energy, Pittsburgh, PA. Pittsburgh Energy Technology Center.
M. D. Dahlberg.
Journal of Great Lakes Research, Vol 7, No 1, p 7-14, 1981. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Fish populations, *Spatial distribution, Lakes, Seasonal variation, *Cayuga Lake, *New York, Temperature effects, Distribution, Trout, Northern pike, Bass, White sucker, Alewife, Yellow perch, Carp.

Nylon gill nets were set for 24 hr at monthly intervals at a proposed sampling site at Cayuga Station during December 1975 through December 1976. Gill nets were set on the bottom, and at the surface, middle and bottom layers. Water temperature during testing ranged from about 2 to about 22 degrees C at the surface, and from 2 to 13.6 degrees C at the 100 ft depth. Dissolved oxygen was at or near saturation in all weekly observations. The findings indicated that temperature was the most important factor in controlling the depth distribution of fish in Lake Cayuga. Warmwater species such as alewife, northern pike, spottail shiner, trout-perch and yellow perch concentrated in inshore and surface waters during the summer. Coldwater species such as rainbow smelt and lake trout concentrated in hypolimnetic waters during the summer. A limited number of Atlantic salmon were captured, at a maximum temperature of 13.9 degrees C. A direct relationship was noted between catch size and water temperature for yellow perch, alewife, and three other species which were captured in small numbers. The effect of water temperature on fish activity appears to be the primary factor in the seasonal vulnerability to the passive netting, at least for those species which are present year round in this study area. (Baker-FRC)
W82-01195

LIMNETIC LARVAL FISH OF THE MAUMEE AND SANDUSKY RIVER ESTUARIES,

Ohio State Univ., Put-in-Bay. Center for Lake Erie Area Research.
C. L. Cooper, W. C. Bartholomew, C. E. Herdendorf, J. M. Reutter, and F. L. Snyder.
Journal of Great Lakes Research, Vol 7, No 1, p 51-54, 1981. 2 Tab, 13 Ref.

Descriptors: *Estuaries, *Fish populations, Rivers, *Maumee River, *Sandusky River, Fish, Lake Erie basin, *Ohio.

A series of studies conducted in the Maumee River and Sandusky River estuaries on Lake Erie between 1975 and 1977 is summarized. The Maumee River study area encompassed a 14 sq km zone extending from the river mouth to the riffles above the head the estuary at Perrysburg, Ohio. The Sandusky River study area encompassed a 2 sq km zone extending from the river mouth at the head of Sandusky Bay to the upper limit of the estuary at the Fremont, Ohio, riffle, a distance of 24.9 km. Collections were made during daylight hours with conventional plankton nets. A limited number of samples were taken at night. A total of 17 taxa of larval fish was reported from the Maumee River estuary oer the three year sampling period. Greater carp larvae densities were indicated in the littoral areas and may have resulted in an overall underestimate of their abundance in the study areas. During periods of high densities, more larval gizzard shad and white bass were found in sheltered low flow portions than in the mid-channel portion of the midestuary sampling location. The predominant number of rainbow smelt and yellow perch larvae were collected at the Maumee River mouth location. Only limited numbers were collected farther upstream, and neither species was collected in the Sandusky River estuary. The study indicated a patchy, or nonrandom, distribution of walleye eggs, while larvae were randomly distrib-

ated. Overall, larval walleye densities decreased from relatively high densities upstream to relatively low densities downstream. (Baker-FRC)
W82-01197

REGIONAL FLOOD FREQUENCY ESTIMATION AND NETWORK DESIGN,

Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01294

WATER-QUALITY MONITORING: A GLOBAL APPROACH,

United Nations Environment Program, Geneva (Switzerland). Regional Seas Programme Activity Center.
R. Helmer.
Nature and Resources, Vol 17, No 1, p 7-13, January-March, 1981. 2 Fig.

Descriptors: *Monitoring, *Water analysis, *Global Environmental Monitoring System, Water quality, World Health Organization, International commissions, Water pollution, Network design.

The Global Environmental Monitoring System includes a World Health Organization project on Global Water Quality Monitoring (GEMS/WATER) established in 1976 with the following purposes: to strengthen existing water monitoring systems and establish new ones, to define and improve the validity and comparability of water quality data within and among member states, and to assess the incidence and long term trends of water pollution by certain persistent, hazardous substances. The ultimate goal is 1200 monitoring stations. To date, 388 have been identified in 62 countries: 227 on rivers, 74 on lakes, and 87 in aquifers. Data is routinely produced from 87 of the 236 recently-activated stations. Three categories of parameters have been established: basic (pH, dissolved oxygen, etc.), optional (total organic carbon, phytoplankton, etc.), and globally significant (heavy metals, pesticides, etc.). A concern for the immediate future is analytical quality control. (Cassar-FRC)
W82-01339

IMMEDIATE DETECTION OF HETEROGENEITIES IN CONTINUOUS MULTIVARIATE, OCEANOGRAPHIC RECORDINGS. APPLICATION TO TIME SERIES ANALYSIS OF CHANGES IN THE BAY OF VILLEFRANCHE SUR MER,

Biochimie Marine, Villefranche-sur-Mer (France). Station Zoologique.
F. Ibanez.
Limnology and Oceanography, Vol 26, No 2, p 336-349, March, 1981. 11 Fig, 3 Tab, 16 Ref.

Descriptors: *Sampling, *Multivariate analysis, *Heterogeneity, Time series analysis, Oceanography, Salinity, Monitoring, Water quality, Villefranche sur Mer, France, *Marine environment.

This paper presents an index that can be used in water sampling aboard ship to immediately detect discontinuities in continuously monitored, multivariate recordings of many physical and chemical variables. At every sampling point, the generalized distance is computed between the new multivariate observation and the centroid of the n previously recorded observations. These n points form a window, whose width determines the sensitivity of the index. By its mathematical formulation the distance takes into account the variations in range of the variables and their correlations. The validity of the index was first tested on simulated series into which different types of changes were arbitrarily introduced. The index is applied to a 4-year temperature and salinity series of weekly observations at a station in the bay of Villefranche sur Mer, France. (Cassar-FRC)
W82-01393

MAPPING CONTAMINATED SOIL PLUMES BY KRIGING,

Resources Management Associates, Lafayette, CA.
For primary bibliographic entry see Field 5G.
W82-01423

METHODS FOR GENERATING ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-01449

GENERATING ALTERNATIVE SOLUTIONS FOR DYNAMIC PROGRAMMING MODELS OF WATER RESOURCES PROBLEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Landscape Architecture.
For primary bibliographic entry see Field 6A.
W82-01450

A ONE-DIMENSIONAL, FINITE ELEMENT SALT WATER INTRUSION MODEL,

Guam Univ., Agana. Water Resources Research Center.
D. N. Contractor.
Technical Report No 20, February, 1981. 20 p, 9 Fig, 10 Ref, 4 Append.

Descriptors: *Coastal aquifers, *Model studies, Mathematical models, Computer models, *Aquifer management, Seawater, Fortran, Saline water, Aquifer characteristics, Model testing, Prediction, Computers, Computer programs, Saline water intrusion.

Groundwater resources near the coastline and on islands should be managed in such a way that salt water intrusion into an aquifer does not jeopardize the quality of the water resource. Management of the salt water intrusion includes knowing the location of the wedge and predicting its response to changes in aquifer recharge and pumpage so that its future location can be controlled. A model is needed to make these predictions. The model may be analytical in nature for simple geometries, or numerical for more complicated aquifers. This report describes a one-dimensional, finite element salt water intrusion model, which can be very useful in understanding local features of an extensive aquifer system. A one-dimensional model can be an appropriate tool when first-cut results are necessary in a limited time. Two-dimensional models can be used to provide one-dimensional results, but only by using twice the number of nodes used in a one-dimensional model. Two-dimensional models should be used whenever the necessary data, computer facilities, and budget are available. A one-dimensional model's advantages are its simplicity, low cost of data aquisition, low computer time, and low total cost, as well as its versatility. Confined and unconfined aquifers can be handled, and time-dependent situations can be taken into account. In addition, non-homogeneities can be specified in the longitudinal direction. The computer program was written in Fortran. The nodes are numbered consecutively from left to right and the elements are numbered so that they are the same as the node number at the left-hand end of the element. A pump can be located at any node in the system. (Garrison-Omniplan)
W82-01452

COMPATIBILITY OF CANADIAN SNOWFALL AND SNOW COVER DATA,

Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2C.
W82-01466

7B. Data Acquisition

FIXED ENDPOINT ALKALINITY DETERMINATION,

California Univ., Berkeley, Sanitary Engineering Research Lab.
F. Pearson.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1243-1252, July, 1981. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Water analysis, *Alkalinity, *Acidity, Chemical properties, Chemical analysis, Volumetric analysis, Water quality, Laboratory tests, Analytical techniques, *Hydrogen ion concentration.

A theoretically developed procedure for alkalinity determination is proposed which offers the advantage over existing methods of requiring less analytical manipulation of the sample when both alkalinity and acidity are to be determined. It also has the ability to take into account the contribution to alkalinity and/or acidity by noncarbonate weak electrolytes which cannot be accomplished by existing methods without determining the entire titration curve. The theoretical development of the procedure is presented, and examples are given of the use of the first two equations. Also, experiments to test the validity of the procedure are summarized. Titrations to pH 4.5 and 8.3 can be used to calculate alkalinity and acidity values to equivalence endpoints. Manual titrations are performed rapidly, and automated determination of alkalinity or acidity is feasible with the new system. The validity of the procedure was confirmed for a limited range of conditions, and anomalous results were found to occur in some waters such as those of high ionic strength. More verification testing is required before the procedure can be adopted unequivocally for an unknown water type. (Small-FRC)
W82-01187

EFFECT OF GRAIN SIZE AND SNOWPACK WATER EQUIVALENCE ON VISIBLE AND NEAR-INFRARED SATELLITE OBSERVATIONS OF SNOW,

California Univ., Santa Barbara. Dept. of Geography.
J. Dozier, S. R. Schneider, and D. F. McGinnis, Jr.
Water Resources Research, Vol 17, No 4, p 1213-1221, August, 1981. 10 Fig, 1 Tab, 24 Ref.

Descriptors: *Snow cover, *Albedo, *Satellite technology, Remote sensing, Snow surveys, Water content, *Snowmelt, Snow water equivalence, Particle size, Snowpack, Wavelengths.

A model for spectral snow albedo by Wiscombe and Warren shows that visible reflectance is sensitive to snow water equivalence and contamination by aerosols, but near-infrared reflectance is sensitive to grain size and not to other variables. Therefore, satellite radiometric data can be used to infer snow water equivalence and snow grain size. When grain size is large (500-1000 micrometers), visible wavelengths may also estimate snow water equivalence. The TIROS-N series satellites' infrared channel is not in the range most sensitive to grain size. A shift of channel near infrared wavelengths from 0.7-1.0 micrometers to 1.0-1.2 micrometers would improve sensitivity to grain size and decrease sensitivity to snow water equivalence. Satellite data collected on April 12, and 27, 1980, over Lake Winnipeg, Manitoba, and over 3 lakes in central Saskatchewan were compared with ground observations at these locations. (Cassar-FRC)
W82-01311

AUTOMATIC CLASS-A PAN-FILLING SYSTEM,

Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
M. D. Burgess, and C. L. Hanson.
Journal of Hydrology, Vol 50, No 1-3, p 389-392, March, 1981. 1 Fig, 1 Tab.

Descriptors: *Evaporation pans, *Control systems, *Automation, Pan evaporation, Electrical equipment, Evaporation rate.

The National Weather Service Class-A pan is the standard evaporation measuring device in the United States and several other countries. A low-cost battery-operated system to automatically fill Class A evaporation pans from stored water was developed using integrated circuit technology. The system is suitable for use in remote areas where batteries are used for power to maintain the water level between 5.08 and 7.62 cm below the top of the pan. Trials at four locations near Boise, Idaho, in 1979 revealed no electronics or battery prob-

lems. The system can operate for 6 months on a 20-A-hour low self-discharge battery. (Cassar-FRC)
W82-01326

SITES OF RIVER-DERIVED SEDIMENTATION IN THE OCEAN,

Delaware Univ., Newark. Coll. of Marine Studies.
R. J. Gibbs.
Geology, Vol 9, No 2, p 77-80, February, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Sediment deposition, *Rivers, *Remote sensing, Mississippi River, Colorado River, Delaware Bay, Chesapeake Bay, Deltas, Sea level, Alluvial fans, Amazon River.

Landsat satellite imagery (Band 4) was used to identify the seaward boundary of turbid waters for 22 of the world's large rivers. At the Amazon River mouth, surface water samples for suspended matter analysis were collected at the time the imagery was made. It was concluded that rivers are depositing suspended sediments on the shelf areas or in estuaries, not on the vast submarine fans created during a lower sea level era. Assuming no changes in the present rates of sediment deposition, the calculated times to fill the present sediment areas range from 2630-3406 years for the Ganges-Brahmaputra system to 936,000 - 1.2 million for the Yenisei-Ob system. The higher values account for compaction and subsidence. Values for some U. S. rivers were (in years): Mississippi, 79,242-102,619; Colorado, 8,515-11,027; Delaware Bay, 80,772-104,600; Chesapeake Bay, 109-963-142,403; and the Delaware Shelf, which includes the Chesapeake and Delaware Bays, 464,538-601,577. Only the Ganges, Yellow, and Indus Rivers are likely to fill their shelves before significant sea level changes occur. (Cassar-FRC)
W82-01332

AN ALL-TEFLON BAILER AND AN AIR-DRIVEN PUMP FOR EVACUATING SMALL-DIAMETER GROUND-WATER WELLS,

Camp, Dresser and McKee, Inc., Milwaukee, WI. Environmental Sciences Div.
D. F. Buss, and K. E. Bandt.
Ground Water, Vol 19, No 4, p 429-431, July/August, 1981. 1 Fig, 3 Ref.

Descriptors: *Well data, *Water sampling, *Pumps, Sampling, Groundwater, Monitoring, Water quality, Small-diameter wells.

Sampling of small diameter wells (2 inches) was facilitated by use of an all-teflon bailer and an air-driven pump with a teflon ball. This apparatus, which can purge 18.5 liters from a 2 inch diameter well in 6-8 minutes (vs. raising and lowering a 0.5 liter conventional bailer 37 times), minimizes contamination of the sample and is very easy to disassemble and clean. The pump was effective to 100 ft, the greatest depth tested. Construction materials, readily available from hardware and plastic piping supply stores, cost less than $25, excluding the tygon tubing. (Cassar-FRC)
W82-01333

REMOTE SENSING OF SOIL MOISTURE CONTENT OVER BARE FIELD AT 1.4 GHZ FREQUENCY,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
J. R. Wang, and B. J. Choudhury.
Journal of Geophysical Research, Vol 86, No C6, p 5277-5282, June, 1981. 6 Fig, 18 Ref.

Descriptors: *Soil moisture, *Microwaves, *Radiometery, Model studies, Moisture content, *Remote sensing.

An algorithm for estimating moisture content of a bare soil from the observed brightness temperatures at 1.4 GHz is based on a radiative transfer model calculation (Wilheit, 1978). Some modifications are made to account for the effects of surface roughness. Besides the brightness temperatures, additional inputs required are effective soil thermodynamic temperature, precise relation between moisture content and the smooth field brightness temperature, and two parameters related to surface roughness. The algorithm is applied to two series of radiometer observations, truck mounted and airborne. The estimated moisture contents compare favorably to those observed in the top 2 cm layer of soil. (Cassar-FRC)
W82-01345

WATER FROST AND ICE: THE NEAR-INFRARED SPECTRAL REFLECTANCE 0.65-2.5 MICRONS,

Hawaii Univ., Honolulu. Inst. for Astronomy.
For primary bibliographic entry see Field 2C.
W82-01346

MULTIFREQUENCY RADIOMETER DETECTION OF SUBMARINE FRESHWATER SOURCES ALONG THE PUERTO RICAN COASTLINE,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 3B.
W82-01349

SITE ASSESSMENT: IMPROVING CONFIDENCE LEVELS WITH SURFACE REMOTE SENSING,

Technos Inc., Miami, Florida.
For primary bibliographic entry see Field 5G.
W82-01422

THE INFERENCE OF GATE CONVECTIVE RAINFALL FROM SMS-1 IMAGERY,

National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
W. L. Woodley, C. G. Griffith, J. S. Griffin, and S. C. Stromatt.
Journal of Applied Meteorology, Vol 19, No 4, p 388-408, April, 1980. 19 Fig, 7 Tab, 7 Ref.

Descriptors: *Rainfall distribution, *Remote sensing, *Satellite technology, Measuring instruments, Diurnal distribution, Temperature effects, Precipitation, Rainfall area, Rainstorms, *Atlantic Ocean, *Africa.

An automated technique making use of geosynchronous, infrared satellite imagery and a set of empirical relationships has been employed to estimate rainfall in the eastern Atlantic and western Africa during the Global Atmospheric Research Program's Atlantic Tropical Experiment (GATE). The satellite-derived rain estimates are low for the Atlantic and high for Africa when compared with radar and raingage estimates of precipitation. The daily satellite-derived maps of rainfall were generally similar to the radar products, but have lower point maxima. This difference is primarily caused by the method of rainfall apportionment and secondarily by the differences in resolution of the radar and satellite. Based on satellite-derived rain estimates, the rainfall in the eastern Atlantic appears to be of lesser magnitude, but about equal in coverage to the western Pacific. Most of the significant convective activity occurs in the Intertropical Convergence Zone (ITCZ), stretching west-southwest from Africa. Rain maxima showed a close association with the sea surface temperature. A disproportionate amount of rainfall occurs over the water areas during the day and over the land areas during the late evening. The diurnal rainfall studies suggest a midday maximum of rainfall over the water areas and a late evening maximum over Africa and the northern part of South America. The center of action for cloud formation, merger and dissipation, and the area of maximum rainfall occur along the southwest African coast near 11 degrees N. (Baker-FRC)
W82-01519

ICE NUCLEUS CONCENTRATIONS MEASURED DURING THE 1975 FLORIDA AREA CUMULUS EXPERIMENT (FACE),

MITRE Corp., McLean, VA.
J. Wisniewski, and G. Langer.
Journal of Applied Meteorology, Vol 19, No 6, p 676-682, June, 1980. 5 Fig, 16 Ref.

Descriptors: *Ice, *Cloud seeding, Weather modification, Artificial precipitation, Tropical regions, Florida, Measuring instruments, Remote sensing, Nucleation.

Ice nuclei concentrations over Florida were obtained by two techniques. First, about 390 membrane samples were collected using a sequential membrane filter system. The second method called for continuous ice nuclei concentrations to be obtained by the NCAR acoustical ice nucleus counter. The technique using collection membranes gave concentrations of ice nuclei about two orders of magnitude lower than those obtained by the NCAR acoustical counter, with both sets of samples obtained at identical time periods. It is recommended that the membrane technique should not be used alone in maritime studies. The ice nuclei concentrations obtained with the NCAR acoustical counter were shown to naturally increase by a factor of 2 to 3 during the course of normal afternoon convective activity; these factors are reasonable compared to observed glacation. These increases are probably due to turbulence within the storm areas stirring up soil particles from the ground and increasing ice nuclei concentrations or to ice nuclei being released by evaporation of small precipitation particles between the cloud base and the surface or in the downdraft. In certain cloud seeding experiments, these natural ice nuclei increases may make seeding less effective. It is suggested that a spectrum of ice nuclei concentrations be obtained to measure nucleation activities at several specified temperatures. This can be achieved by varying the cloud chamber temperature and glycol gravity of the NCAR counter. (Baker-FRC)
W82-01522

AN IMPROVED METHOD FOR OBTAINING THE WATER CONTENT VALUES OF ICE HYDROMETEORS FROM AIRCRAFT AND RADAR DATA,

Air Force Geophysics Lab., Hanscom AFB, MA.
V. G. Plank, R. O. Berthel, and A. A. Barnes, Jr.
Journal of Applied Meteorology, Vol 19, No 11, p 1293-1299, November, 1980. 5 Fig, 3 Ref.

Descriptors: *Snow, Rain, *Hydrometeorology, *Meteorological data collection, Data collections, *Ice, Clouds, Precipitation, Aircraft, Radar, Weather forecasting, *Water content.

The spectral parameter k (equal to M divided by the square root of Z) computed from aircraft size distribution for single samples of ice hydrometeors (snow and ice crystals) is a much more stable parameter, under L (physical size) and D (equivalent melted diameter) conversion assumption, than is either spectral M (spectral liquid water content) or spectral Z (spectral radar reflectivity factor). Using k rather than Z sub R, more accuracy is possible in correlating multiple-sample aircraft data with simultaneously acquired, independent radar measurements of A and Z sub R. Spectral k is also useful as a reference parameter to differentiate between cloud conditions on different days or between different clouds, and applies also to water hydrometeors (rain). The k value appears to be primarily dependent on total number of hydrometeors and secondarily dependent on the form factor of the distribution (most observed distributions being quasi-exponential). (Cassar-FRC)
W82-01523

A BALLOONBORNE INSTRUMENT FOR THE MEASUREMENT OF VERTICAL PROFILES OF SUPERCOOLED LIQUID WATER CONCENTRATION,

Utah Water Research Lab., Logan.
G. E. Hill, and D. S. Woffinden.
Journal of Applied Meteorology, Vol 19, No 11, p 1285-1292, November, 1980. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Clouds, *Supercooling, *Remote sensing, Measuring instruments, *Water content.

Vertical profiles of the concentration of supercooled liquid water in clouds were measured by a vibrating wire placed in the humidity duct of a standard U.S. rawinsonde. As ice collects on the

wire, the natural frequency of vibration varies. The supercooled water concentrations are obtained from this wire frequency measurement and the air velocity relative to the instrument. Vibration frequency may be monitored on the ground for remote readings. Calibration of the frequency change vs. ice mass accumulation is done both theoretically and experimentally in a wind tunnel in the presence of supercooled water. For further verification, paint sprayed on the upwind side of the wire was used to simulate ice mass. The method is illustrated by a description of sounding at 0010 GMT February 8, 1980, in a stratocumulus deck above Richmond, Utah. In this case the cloud thickness was estimated at 350 meters with a 409 meter maximum. The supercooled liquid water concentration was 0.1 g per cu meter. This method is well suited for studies of winter orographic clouds. (Cassar-FRC)
W82-01524

EXPERIMENTAL VERIFICATION OF THE LINEAR RELATIONSHIP BETWEEN IR EXTINCTION AND LIQUID WATER CONTENT OF CLOUDS,

Nevada Univ. System, Reno. Desert Research Inst.
A. W. Gertler, and R. L. Steele.
Journal of Applied Meteorology, Vol 19, No 11, p 1314-1317, November, 1980. 3 Fig, 6 Ref.

Descriptors: *Clouds, *Remote sensing, *Lasers, Fog, Meteorological data collection, *Water content.

A CO2 laser extinction transmissometer was used to measure the IR extinction of clouds and fogs. Using an established linear relationship (based on the Chylek approximation to the Mie theory) between extinction and liquid water content, the liquid water content of clouds of varying droplet size (2.3-8.7 micrometers) and concentrations (up to 3 g per cu meter) have been determined. The values agreed well (correlation coefficient 0.98) with liquid water contents derived from a simultaneous cloud collection. There was little difference between monodisperse and polydisperse droplets. This method is adaptable for airborne measurements. (Cassar-FRC)
W82-01525

A COMPARISON OF TWO SATELLITE RAINFALL ESTIMATES FOR GATE,

Hawaii Univ., Honolulu. Joint Inst. for Marine and Atmospheric Research.
O. Garcia.
Journal of Applied Meteorology, Vol 20, No 4, p 430-438, April, 1981. 11 Fig, 4 Tab, 6 Ref.

Descriptors: *Rainfall, *Remote sensing, *Satellite technology, Precipitation, Sensors, Estimating, Tropical regions, Africa, Comparison studies.

Rainfall estimate comparisons derived from two satellite rainfall estimation techniques for the GATE experiment are made. One technique, the Kilonsky-Ramage technique, uses polar orbiting satellites for 1 degree resolution rainfall estimates over the tropics. The second technique used, the Griffith-Woodley technique, uses geostationary satellite data to generate much higher resolution estimates. The two techniques showed good correspondence between the A scale isohyetal patterns and rainfall volumes estimated for periods ranging from 1 to 80 days. Over African and nearby ocean areas the largest discrepancies were noted. In these cases the Griffith-Woodley estimates were higher. When only oceanic points are compared, correlation coefficients between the two estimates are higher, ranging up to 0.92 for the entire GATE period. Including continental areas of the A scale brings about a lowering of the correlation coefficients, reaching 0.66 for phase 2. Large discrepancies over Africa and oceanic areas are associated with a nocturnal peak of rainfall not detected by the daytime passes of the polar orbiting satellite used in the Kilonsky-Ramage calculations. It is concluded that the Kilonsky-Ramage technique can provide a low cost and fairly reliable estimate of monthly rainfall over the tropical oceans. This technique can also identify on a daily basis areas of significant rainfall and can estimate daily rainfall volumes over large areas. (Baker-FRC)
W82-01533

DETERMINATION OF MOISTURE FROM NOAA POLAR ORBITING SATELLITE SOUNDING RADIANCES,

National Earth Satellite Service, Washington, DC.
For primary bibliographic entry see Field 2B.
W82-01535

APPLICATION OF AERIAL PHOTOGRAPHS AND SURFICIAL GEOLOGIC MAPS TO THE DETERMINATION OF SUITABILITY OF LAND FOR SEPTIC TANK SYSTEMS,

Federal Energy Regulatory Commission, Washington, DC.
S. D. Connors.
Bulletin of the Association of Engineering Geologists, Vol 17, No 3, p 153-162, Summer, 1980. 3 Fig, 2 Tab.

Descriptors: *Septic tanks, *Aerial photography, Wastewater treatment, Permeability, Bedrock, Water table, Geological formations, Photography, Glacial sediments, Remote sensing, Planning, Wyoming County, New York.

Aerial photographs, surficial geology, grain size analysis and permeability tests were used to determine the suitability of the area around the town of Arcade, Wyoming County, New York for septic tank systems. Based on topography and type of surficial deposits, the study area can be divided into three regions readily discernible on aerial photographs and topographic maps. These are: upland till area, wide valley areas and areas of glacial outwash deposits, and an undulating, hilly morainal area. Bedrock underlying the town of Arcade consists of Upper Devonian gray to black shales, gray siltstones and brown sandstone. Surficial deposits in the area consist of glacial till, outwash, ice contact deposits, [illegible] deposits and recent alluvium. Four soil associations, based on the parent glacial material, are recognized in the town of Arcade. These are: Erie-Landford, developed on glacial till; Bath-Valois and Howard-Madrid, developed on contrasting glacial deposits; and Chenango-Howard-Castile, developed on glacial outwash deposits. Septic tank fields in the first association need careful design due to slow permeability, seasonal high water table and shallow depth to bedrock. The Chenango-Howard-Castile soils tend to provide good septic tank fields. Use of the Bath-Valois and Howard-Madrid associations requires careful investigation due to the extreme variability of physical properties within short distances and with depth. Laboratory testing indicated that soils in the town of Arcade were generally unsuited for septic tank systems. The best suited area occurs in the village of Arcade, which has a sewer system. The upland till area is considered the least favorable area. (Baker-FRC)
W82-01569

7C. Evaluation, Processing and Publication

ABUNDANCE OF ORGANIC COMPOUNDS IN WATER,

Illinois Environmental Protection Agency, Springfield.
For primary bibliographic entry see Field 5A.
W82-01162

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1980--VOLUME 1. ARKANSAS RIVER BASIN, RED RIVER BASIN, SABINE RIVER BASIN, NECHES RIVER BASIN, TRINITY RIVER BASIN AND INTERVENING COASTAL BASINS.

Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123670, Price codes: A99 ($42.00) in paper copy, A01 in microfiche. Geological Survey Water-Data Report TX-80-1, 1981. 595 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, Arkansas River basin, Red River basin, Sabine River basin, Neches River basin, Trinity River basin.

Surface-water data for the 1980 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-01201

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1980--VOLUME 2. SAN JACINTO RIVER BASIN, BRAZOS RIVER BASIN, SAN BERNARD RIVER BASIN AND INTERVENING COASTAL BASINS.

Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123464, Price codes: A21 in paper copy, A01 in microfiche. Geological Survey Water-Data Report TX-80-2, 1981. 472 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, San Jacinto River basin, Brazos River basin, San Bernard River basin.

Surface-water data for the 1980 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-01202

WATER RESOURCES DATA FOR TEXAS, WATER YEAR 1980--VOLUME 3. COLORADO RIVER BASIN, LAVACA RIVER BASIN, GUADALUPE RIVER BASIN, NUECES RIVER BASIN, RIO GRANDE BASIN AND INTERVENING COASTAL BASINS.

Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123472, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey, Water-Data Report TX-80-3, 1981. 583 p, 1 Fig.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Texas, Colorado River basin, Lavaca River basin, Guadalupe River basin, Nueces River basin, Rio Grande basin.

Surface-water data for the 1980 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Texas. (USGS)
W82-01203

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 1. COLORADO RIVER BASIN, SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-116997, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-1, 1981. 451 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *California, Colorado River basin, Southern Great Basin, Pacific slope basins.

Volume 1 of water resources data for the 1980 water year for California consists of records of stage, discharge, and water quality of streams; stage and contents in lake and reservoirs; and water levels in wells. This report contains discharge records for 174 gaging stations, stage and contents for 18 lakes and reservoirs, water quality for 51 stations and water levels for 165 observation wells. Also included are 9 crest-stage partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01204

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-122243, Price codes: A23 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-2, 1981. 521 p, 3 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes Reservoir, Wells, Water level, Data collections, Sites, *California, Pacific slope basins.

Volume 2 of water resources data for the 1980 water year for California consists of records of stage, discharge, and water quality of streams and wells; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This report contains discharge records for 159 gaging stations, stage and contents for 19 lakes and reservoirs, water quality for 116 stations and 32 wells, and water levels for 85 observation wells. Also included are 4 crest-stage partial-record stations and 3 low-flow partial-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01205

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117003, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-3, 1981. 429 p, 12 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *California, Southern central valley basins, The Great Basin.

Volume 3 of water resources data for the 1980 water year for California consists of records of stage, discharge, gage-height, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water levels and water quality of wells. This report contains discharge records for 185 gaging stations, stage and contents for 39 lakes and reservoirs, gage-height records for 2 lakes, water quality for 62 stations, and water levels for 56 observation wells. Also included are 11 crest-stage partial-record stations and one water-quality partial-record station. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01206

WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1980--VOLUME 4. NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE.
Geological Survey, Menlo Park, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117011, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CA-80-4, 1981. 451 p, 12 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *California, Northern central valley basins, The Great Basin, Sacramento River basin.

Volume 4 of the water resources data for the 1980 water year for California consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This report contains discharge records for 199 gaging stations, stage and contents for 34 lakes and reservoirs, precipitation data for stations, water quality for stations, water levels for 54 observation wells and water quality for 26 wells. Also included are 16 crest-stage partial-record stations and 7 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as special investigations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in California. (USGS)
W82-01207

WATER RESOURCES DATA FOR HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1980 - VOLUME 1. HAWAII.
Geological Survey, Honolulu, HI. Water Resources Div.
Geological Survey Water-Data Report HI-80-1, 1981. 270 p, 15 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Hawaii.

Volume 1 of water resources data for the 1980 water year for Hawaii and other Pacific areas consist of records of stage, discharge, and water quality of streams; and water levels and water quality in wells and springs. This report contains discharge records for 109 gaging stations; water quality for 10 gaging stations, 103 partial-record flow stations, and 156 wells; and water levels for 22 observation wells. Also included are 109 crest-stage partial-record stations and 19 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W82-01208

WATER RESOURCES DATA FOR HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1980 - VOLUME 2. TRUST TERRITORY OF THE PACIFIC ISLANDS, GUAM, AMERICAN SAMOA, AND NORTHERN MARIANA ISLANDS.
Geological Survey, Honolulu, HI. Water Resources Div.
Geological Survey Water-Data Report HI-80-2, 1981. 158 p, 16 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Hawaii, Mariana Islands, Carolina Islands, Samoa Islands.

Volume 2 of water resources data for the 1980 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams; stage of a reservoir; and water levels in wells and springs. This report contains discharge records for 41 gaging stations, stage only record for 1 gaging station, water quality for 1 gaging station and 49 partial-record stations, water temperature for 23 gaging stations, water levels for 13 observation wells, tide level for 1 tide station, and 7 water level less tide level tables. Also included are 33 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating Governments and Federal agencies in other Pacific areas. (USGS)
W82-01209

WATER RESOURCES DATA FOR SOUTH CAROLINA, WATER YEAR 1980.
Geological Survey, Columbia, SC. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-127127, Price codes: A15 in paper copy, A01 in microfiche. Geological Survey Water-Data Report SC-80-1, 1981. 319 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *South Carolina.

Water resources data for the 1980 water year for South Carolina consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 74 gaging stations, stage-only records for 10 gaging stations, stage and contents

for 11 lakes and reservoirs, water quality for 33 gaging stations, and water levels for 45 observation wells. Also included are 41 crest-stage parital-record stations. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina. (USGS)
W82-01211

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1980--VOLUME 2. SUSQUEHANNA AND POTOMAC RIVER BASINS.

Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-115908, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-80-2, 1981. 353 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, Susquehanna River basin, Potomac River basin.

Water resources data for the 1980 water year for Pennsylvania consist of records of discharge and water quality of streams; contents of lakes and reservoirs; and water levels of ground-water wells. This volume contains records for water discharge at 100 stations, contents at 13 lakes and reservoirs, water quality at 35 gaging stations, and water levels at 25 observation wells. Also included are data for 21 crest-stage, 15 low-flow, and 129 water-quality partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analysis. These data together with the data in Volumes 1 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W82-01212

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1980--VOLUME 1. HUDSON BAY BASIN, MISSOURI RIVER BASIN.

Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-127713, Price codes: A99 ($45.00) in paper copy, A01 in microfiche. Geological Survey Water-Data Report MT-80-1, 1981. 651 p, 9 Fig, 4 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Montana, Hudson Bay, Missouri River basin.

Water resources data for the 1980 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. Volume 1 of this report contains discharge records for 176 gaging stations, stage only records for 1 lake station, stage and contents for 6 lakes and reservoirs, water quality for 118 stations, and water lvels for 9 observation wells. Also included are 141 crest-stage partial-record stations and 23 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection programs, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)
W82-01213

WATER RESOURCES DATA FOR MONTANA, WATER YEAR 1980--VOLUME 2. UPPER COLUMBIA RIVER BASIN.

Geological Survey, Helena, MT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-127721, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Data Report MT-80-2, 1981. 184 p, 6 Fig, 4 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Resevoirs, Wells, Water level, Data collections, Sites, *Montana, Columbia River basin.

Water resources data for the 1980 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water lvels in wells. Volume 2 of this report contains discharge records for 48 gaging stations, stage and contents for 3 lakes and reservoirs, water quality for 22 stations and 3 lakes, and water levels for 14 observation wells. Also included are 24 crest-stage partial-record stations and 20 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data-collection programs, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana. (USGS)
W82-01214

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 3A: SOUTHWEST FLORIDA SURFACE WATER.

Geological Survey, Tallahassee, FL. Water Resources Division.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131186, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report FL-80-3A, 1981. 576 p, 15 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Florida, Southwest Florida.

Water resources data for the 1980 water year in Florida consist of continuous or daily discharge for 271 streams, periodic discharge for 47 streams, continuous or daily stage for 67 streams, periodic stage for 49 streams, peak discharge for 76 streams and peak stage for 23 streams; continuous or daily elevations for 75 lakes and periodic elevations for 128 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; and quality of water data for 301 surface water sites and 842 wells. The surface-water data in this volume for southwest Florida includes continuous or daily discharge for 68 streams, periodic discharge for 24 streams, peak dicharge for 16 streams, continuous or daily stage for 18 streams and periodic stage for 9 streams; continuous elevations for 35 lakes and periodic elevations for 78 lakes; and quality of water for 100 surface water sites. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-01215

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 3B: SOUTHWEST FLORIDA GROUND WATER.

Geological Survey, Tallahassee, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131194, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report FL-80-3B, 1981. 560 p, 19 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, Water analysis, Water temperature, Chemical analysis, Wells, Water level, Data collections, Sites, *Florida, Southwest Florida.

Water resources data for the 1980 water year in Florida consist of continuous or daily discharge for 271 streams, periodic discharge for 47 streams, continuous or daily stage for 67 streams, periodic stage for 49 streams, peak discharge for 76 streams and peak stage for 23 streams; continuous or daily elevations for 75 lakes and periodic elevations for 128 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; and quality of water data for 301 surface water sites and 842 wells. The ground-water data in this volume for southwest Florida includes continuous ground water levels for 236 wells, periodic ground water levels for 250 wells, and miscellaneous water level measurements for 1119 wells; and quality of water for 242 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-01216

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1980--VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER.

Geological Survey, Lakewood, CO. Water Resources Div.
Geological Survey Water-Data Report CO-80-2, 1981. 387 p, 4 Fig, 4 Tab, 40 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Colorado River basin.

Water-resources data for Colorado for the 1980 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations, stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Colorado. (USGS)
W82-01217

8. ENGINEERING WORKS

8A. Structures

REDESIGN CONTROLS MANHOLE LEAKAGE,

For primary bibliographic entry see Field 8G.
W82-01237

RISK MODELS FOR FLOOD LEVEE DESIGN,

Nevada Univ. Systems, Reno. Dept. of Civil Engineering.
Y. K. Tung, and L. W. Mays.
Water Resources Research, Vol 17, No 4, p 833-841, August, 1981. 6 Fig, 5 Tab, 29 Ref.

Descriptors: *Levees, *Risks, *Flood protection, Safety, *Design criteria, Flood damage, Flood recurrence interval, Model studies, Hydraulic structures, Hydraulic engineering, Hydraulic models, Hydraulic design, Flood control.

Both hydrologic and hydraulic uncertainties are considered in development of risk models for overtopping in flood levee design. This is a refinement over conventional procedures, which consider only the hydrologic variables (such as flood flows)

and use a safety factor to account for all other uncertainties. Models systematically analyze hydrologic uncertainties (inherent, model, and parametric) and hydraulic uncertainties (model, construction and material, and flow operational conditions) and define the risk and reliability of overtopping. Both static and time dependent risk models are presented. Results show that the simple return period method can underestimate risk by 10-50%. It is best to use composite models for risk analysis because the risk-safety factor relationships are very sensitive to the hydrologic loading probability model used. The risk-safety factor relationships can be used to design new flood levee systems or analyze old systems; to determine risk factors; to evaluate expected damage; and to determine minimum costs, either construction or damage. (Casser-FRC)
W82-01307

HYDROELECTRICAL MODEL FOR OPTIMAL OPERATION OF A SINGLE MULTIPURPOSE RESERVOIR,

National Water Plan Commission, Mexico City.
For primary bibliographic entry see Field 6A.
W82-01329

YANGTZE GORGES SCHEME COULD YIELD 110 TWH/YEAR.

International Water Power and Dam Construction, Vol 33, No 4, p 21-23, April, 1981.

Descriptors: *People's Republic of China, *Hydroelectric power, *Hydroelectric plants, Powerplants, Electric power production, *Yangtze River, Site selection, Flood control, Navigable rivers, Navigation, Planning, *Dam construction, Asia, China.

A massive hydroelectric plant is currently being planned for the Yangtze River in the People's Republic of China. The proposed 200-meter high prestressed concrete dam will include a hydroelectric power station, which will have a 25 GW capacity and will generate 110 TWh per year. Two sites for the dam are under consideration, both of which are located at the end of the Xiling Gorge on the Yangtze River. The Yangtze River, which is 6300 kilometers long, has an estimated total power potential of 230 GW, which is 2.5 times that of all the rivers in the United States. The Gezhouba dam, currently under consturction, is a first step towards building a power project on the river. Although the lake behind the Gezhouba dam will raise the water level of the Yangtze by more than 20 meters, the proposed project will still involve one of the biggest lock systems in the world. Located at the vital intersection of north and south and east and west, the proposed project will provide electricity for industries in many river ports, coastal cities, And mining areas. The lake behind the proposed project will also facilitate navigation of the three gorges upstream from the dam, which are currently hazardous, and eliminate the necessity to switch cargo to navigation channel. The new reservoir will also be able to control flooding in downstream areas. (Carroll-FRC)
W82-01394

HYDRAULIC MODEL STUDY OF DAULE-PERIPA SPILLWAY AND OUTLET WORKS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
K. L. Houston.
Report GR-81-9, June, 1981. 83 p, 61 Fig, 13 Tab.

Descriptors: *Hydraulic models, *Spillways, *Outlets, *Model studies, Erosion, Flow discharge, Hydroelectric plants, River beds, Stilling basins, Daule-Peripa spillway, Daule River, *Ecuador.

Two hydraulic models were built and studied to verify the original design of the Daule-Peripa spillway and outlet works to be constructed on the Daule River in Ecuador. The 1:80-scale spillway model included the approach channel, spillway, outlet works, powerplant, and downstream river channel. The model showed that excavation was not necessary in the spillway approach channel. A discharge curve and gate opening combinations were derived from the model. The flow over the crest was satisfactory with the piers shortened; however, it impinged upon the gate trunnion pins at higher discharges. On the spillway chute, all offsets greater than 3 mm should be ground to a 1:10 chamber. The stilling basin walls were overtopped for discharges greater than 2300 cu m/s; however, pressures indicated that they would remain stable. The velocities downstream of the stilling basin were within the design range; however, the riverbed eroded for about 24 m downstream of the apron. The 1:50.65-scale outlet works model included two 9-m-diameter concrete-lined tunnels with intakes for either diversion flow or for flow through the penstock and permanent outlet works. The model provided discharge information for the uncontrolled diversion flow and the gated permanent outlet works. Flow through the tunnel bends and velocities downstream of the stilling basins were satisfactory. No erosion occurred downstream of the outlet works or the powerplant. The penstock intake with the trashrack installed passed all discharges without vortices being formed.
W82-01446

PERFORMANCE EVALUATION OF A STOCHASTIC OPTIMIZATION MODEL FOR RESERVOIR DESIGN AND MANAGEMENT WITH EXPLICIT RELIABILITY CRITERIA,

Purdue Univ., Lafatette IN. School of Civil Engineering.
M. H. Houck, and B. Datta.
Water Resources Research, Vol 17, No 4, p 827-832, August, 1981. 4 Tab, 23 Ref.

Descriptors: *Reservoir design, *Reservoir operation, Reservoir releases, Reservoir capacity, Stochastic process, Linear programming, *Model studies, Mathematical models, Planning.

A multiple linear decision rule (LDR) model for reservoir design and operation proved superior to a single-LDR model in an application to a hypothetical reservoir on the Gunpowder River, Maryland. Under identical operating requirements the multiple LDR models designated smaller reservoir capacities and more closely simulated expected performance criteria than did single-LDR models. As the number of LDR's in a season (each conditioned on the previous season's streamflow) increased, the optimal capacity decreased. The multiple-LDR models require more data and manipulation of numbers and are slightly larger than single-LDR models, but remain within reasonable computability limits. (Casser-FRC)
W82-01462

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT: PERFORMANCE,

Stone and Webster Engineering Corp., Boston, MA.
W. F. Swiger, P. A. Wild, and T. J. Lamb.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No GT6, p 673-689, June, 1980. 9 Fig, 16 Ref.

Descriptors: *Dam construction, Dam stability, Performance evaluation, Dams, Dam design, *Design criteria, Civil engineering, Leakage, *Powerplants, Seepage, Cooling water, Water storage, Reservoirs, Surge tanks, Northfield Mountain Project, *Massachusetts.

The performance of civil works at the Northfield Mountain Pumped Storage Project has met design standards. Minimal leakage occurs from the upper reservoir, and the amount of seepage into the powerhouse and underground works is also small. The vertical ventilation shaft collects leakage from the pressure shaft occurring along a bedding plane shear. Part of this water is used in cooling equipment, while the remainder is discharged to the tailrace tunnel. During excavation, elastic movements of the roof and walls of the powerhouse cavern occurred. Since the excavation has been completed, no additional movements have been observed in 8 years. The dam of the upper reservoir has settled at a faster rate, probably due to the rapid cycling of water of a pumped storage facility. Tiltmeter studies during start-up and initial operation showed small elastic rock motions consistent with directions and character of load applications. No detailed analytical predictions of movement were made with which to compare measured values. (Geiger-FRC)
W82-01517

SITING AND DESIGN OF TAILINGS IMPOUNDMENTS,

Klohn Leonoff Inc., Denver, CO.
S. G. Vick.
Mining Engineering, Vol 33, No 6, p 653-657, June, 1981. 4 Fig.

Descriptors: *Tailings, *Wastewater treatment, *Dam design, Mine wastes, Waste disposal, Dam construction, Gravity dams, Separation techniques, Mine drainage, Dam sites, Metals, Underground waste disposal, Ocean dumping.

Some major factors to be considered in the design of tailings disposal facilities and some available methods for this purpose are discussed. The site characteristics which should be examined are topography, drainage area, geology/seismicity, precipitation and evaporation. The tailings' graduation, physical and chemical properties and clay content should be known for possible use as dam fill material. The pH, metallic cations and anions and othe toxic materials of the effluent must be characteristized along with its oxidation or leaching potential. Essential features of the mine or mill to be studied are the tailings and effluent output, recirculation capacity, and amount of sand tailings that may be used for backfilling. The advantages and disadvantages of three dam designs, the upstream, downstream and centerline methods, are presented. Other underground tailings disposal options include slope backfilling and 'below grade' disposal, which is required for the disposal of uranium tailings. The possibilities of thickened discharge methods and offshore disposal of tailings are also considered. (Geiger-FRC)
W82-01588

ROSARIO DOMINICANA'S CYANIDE TAILINGS DAM CONSTRUCTION AND OPERATION.

Martiki Coal Corp., Denver, CO.
For primary bibliographic entry see Field 5D.
W82-01589

8B. Hydraulics

EVALUATION OF EFFECTIVE BOUNDARY ROUGHNESS FOR GRAVEL-BED RIVERS,

New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
D. I. Bray.
Canadian Journal of Civil Engineering, Vol 7, No 2, p 392-397, 1980. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Boundary process, *Gravel, *River beds, Rivers, River flow, *Flow velocity, Mathematical studies, Estimating equations, *Hydraulic roughness.

An optimum means for estimating the effective boundary roughness for the Keulegan equations was evaluated using data for 67 Alberta gravel-bed river reaches. The value of C (coefficient equal to effective boundary roughness over bed material size) decreased with an increase in the characteristic bed material size used to evaluate the effective boundary roughness. The characteristic bed material size must be multiplied by a constant when determining the effective boundary roughness. When using the Keulegan equation, errors in the estimation of the average velocity may range from 20 to 100% when the optimum measure of effective boundary layer is not used. For values of relative smoothness greater than 3.5, the Keulegan equation should be used. When relative smoothness is less than 3.5, the energy degradation results more from a jet than a wake process, and a jet process represents a different class of energy degradation than that assumed in the Keulegan method. (Small-FRC)
W82-01161

VERTICAL VELOCITY PROFILES IN STRATIFIED FLOWS,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
S. C. McCutcheon.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY8, p 973-988, August, 1981. 6 Fig, 3 Tab, 21 Ref.

Descriptors: *Flow characteristics, *Velocity distribution, *Stratified flow, Flow velocity, Monin-Obukhov equation, Prandtl-von Karman equation, Boundary layers, Open-channel flow, Turbulent flow.

A study was conducted on the shape of the vertical velocity profile in a unidirectional, two-dimensional, turbulent, fully developed, continuously stratified flow. Turbulence was produced by movement of fluid over a rough boundary. Flows in laboratory flumes stratified by salt were used to verify the predicted results. The Prandtl-von Karman velocity law was not applicable to stratified flows, but the velocity profile expressions, modified with the Monin-Obukhov scaling length, described velocity gradients and vertical profiles in stably stratified flows. The coefficient for a linear approximation of the Monin-Obukhov function was 5.8 + or - 0.3, comparable to the accepted value of 5.2 + or - 0.5 for atmospheric boundary layer flows. The importance of the width to depth ratio in stratified flow, noted in previous studies, was confirmed. If the width to depth ratio is 4.3 or less, stratified flows in flumes are characterized by peculiar vertical velocity profiles. Previous work by French (1978) was declared non-valid for two-dimensional flows because the Monin-Obukhov scaling length was incorrectly defined. (Cassar-FRC)
W82-01171

OPTIMAL RISK-BASED DESIGN OF FLOOD LEVEE SYSTEMS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
Y. K. Tung, and L. W. Mays.
Water Resources Research, Vol 17, No 4, p 843-852, August, 1981. 8 Fig, 9 Tab, 6 Ref.

Descriptors: *Levees, *Risks, *Flood protection, Flood damage, Flood control, *Design criteria, Model studies, Hydraulic structures, Hydraulic engineering, Hydraulic models, Hydraulic design, Optimization.

Optimal design procedures for flood levee systems are determined using methods of risk analysis which include both hydraulic and hydrologic uncertainties. The objective is to find the best flood levee system design for the least total cost. Two models are developed for this purpose: dynamic programming (DP) and discrete differential dynamic programming (DDDP). The 3 design philosophies examined considered 3 degrees of risk; no risk, only inherent hydrologic risk, and both hydrologic and hydraulic risks. The DDDP approach produced more accurate results with much less computer time and storage than did DP in an example using data from the Guadalupe River, Texas. (Cassar-FRC)
W82-01313

DEVELOPMENT OF UPTON INTAKE WORKS, RIVER SEVERN SUPPLY SCHEME, WITH THE AID OF A MODEL,
Severn-Trent Water Authority, Birmingham (England).
M. S. Kothari.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 245-258, May, 1981. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Intakes, *Model testing, *Hydraulics, Water treatment facilities, Upton, *Severn River, Rivers, Sumps, Screens, Tunnels, *Great Britain.

A 1:5 scale model was used to determine the maximum reliable abstraction rate for the existing Upton intake for the River Severn. The model confirmed that the present abstraction rate of 182 million liters per day produces no evident surface or submerged vortices. Therefore, no baffles in sumps or increased submergence of pumps are necessary. To reduce energy losses at the connection between the main and interconnecting tunnels and to avoid a hydraulic jump, a smooth concrete connecting piece was installed. If an abstraction rate of 200 million liters per day (projected for 2001) or greater is required, an extra tunnel would be essential between the common bandscreen chamber and the new sump. The model predicts that replacement of two bandscreens (1200 mm) would allow an abstraction rate of 170 million liters per day, lower than the calculated 182 million liters per day. Replacement of all three bandscreens would allow a reliable abstraction rate of 200 million liters per day, according to both model and calculated results. (Cassar-FRC)
W82-01395

8C. Hydraulic Machinery

TRICKLE IRRIGATION LATERAL DESIGN ON SLOPING FIELDS,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
H. J. Braud, and A. M. Soom.
Transactions of the ASAE, Vol 24, No 4, p 941-944, 950, July/August, 1981. 7 Fig, 1 Tab, 14 Ref.

Descriptors: *Trickle irrigation, *Slopes, Design criteria, Irrigation, Irrigation practices, Hydraulics, *Irrigation design.

New analytical expressions are presented to relate the physical variables in lateral line hydraulics. Design equations are offered in implicit form, relating the variables in trickle lateral hydraulics. They are: length, diameter, operating pressure, emitter flow characteristics, tube friction, discharge uniformity coefficient, emitter discharge exponent, emitter spacing requirement, and land slope. The equations are in such a form that they can be inserted into many programmable digital calculators and are very convenient for direct application to field use. The equations eliminate the need for design charts or tables. Both the Hazen-Williams and the Blasius fraction equations are used and compared through graphic solutions for limiting lateral length. (Baker-FRC)
W82-01537

SIGNIFICANT FEATURES OF EMITTER FLUSHING MODE CHARACTERISTICS,
Rain Bird Western Sales Corp., Glendora, CA.
For primary bibliographic entry see Field 3F.
W82-01576

8D. Soil Mechanics

LIQUEFACTION ANALYSIS FOR MULTIDIRECTIONAL SHAKING,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. Ghaboussi, and S. U. Dikmen.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT5, p 605-627, May, 1981. 16 Fig, 16 Ref.

Descriptors: *Liquefaction, *Seismic waves, *Earthquakes, Waves, Soil mechanics, Model studies, Computers, Soil engineering, Soil water, Interstitial water, Stability analysis, Construction.

A new method of analysis is presented for computing the response and the liquefaction potential of horizontally-layered ground subjected to three components of earthquake base acceleration. The theoretical basis of the proposed method of analysis is described, and the main aspects of the response to multidirectional shaking are demonstrated through a series of case studies. These case studies were performed by using a new computer program, LASS-III, which was developed for analysis of multidirectional shaking of horizontally-layered ground. The results of the analyses indicate that the vertical component of base acceleration has only a minor influence on the development and pattern of liquefaction, that interaction between the two horizontal components of shaking significantly influences the development and pattern of liquefaction, that increasing the amplitude of the base acceleration in a one-directional analysis such that the peak base acceleration equals the resultant of the peak base accelerations in two directions does not completely reproduce the major effects present in a two-directional analysis, and that interaction between the two horizontal components of shaking produced surface response spectra which were somehow different from those of one-directional analysis. (Baker-FRC)
W82-01169

CYCLIC STRENGTHS COMPARED FOR TWO SAMPLING TECHNIQUES,
Ertec Western Inc., Long Beach, CA.
C. Espana, R. C. Chaney, and D. Duffy.
Journal of the Geotechnical Engineering Division. Proceedings of the American Society of Civil Engineers, Vol 107, No GT5, p 563-576, May, 1981. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Sampling, *Liquefaction, Nuclear powerplants, Powerplants, Soil properties, Soil engineering, Soil water, Water pollution prevention, Construction, Soil strength, Soil tests.

Cyclic triaxial liquefaction test results have been compared for soil samples obtained by two different sampling and laboratory preparation techniques. Results indicate a reduced cyclic strength for samples that were obtained by Pitcher barrel sampling followed by tube cutting and trimming by mechanical extrusion into a mold. Significantly higher cyclic strengths were obtained for large-diameter, hand-carved, block samples which were further hand-trimmed into test-size specimens by either further hand-trimming, saturation and trimming, or freezing and trimming. The lower cyclic strengths noted for the tube samples were believed to be caused by the destruction of adhesion bonds that existed between soil particles in situ. Soil sampling by block-sampling techniques minimized the destruction of these bonds. The formation of the adhesion bonds in granular material can be caused by the consolidation of a sand material under high effective stresses for a short time, or under low effect stresses for a long time. The process of Pitcher barrel sampling and subsequent laboratory preparation combined to cause disturbance. Block sampling into clear large-diameter plastic cylinders allowed retention of a reasonably undisturbed sample. The laboratory preparation techniques where block samples were saturated, drained, and then further hand-carved, or frozen with liquid nitrogen and hand-carved, were effective in minimizing disturbance. (Baker-FRC)
W82-01170

SOIL-BENTONITE SUPPLY TRENCH CUTOFFS,
Engineered Construction International, Inc., Pittsburg, PA.
D. J. D'Appolonia.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No GT4, p 399-417, April, 1980. 15 Fig, 1 Tab.

Descriptors: *Slurries, *Cutoffs, *Bentonite, *Backfill, Trenches, Soil filters, Barriers, Viscosity, Permeability, Earthworks, Soil water, Soil compaction, *Seepage control, *Structural engineering.

Cutoff walls using the soil-bentonite backfill method of slurry trench construction are used for seepage control in excavating, water retaining structures, and preventing pollutant seepage from contaminating ground water. Many of the slurry trench cutoff walls in the United States were not designed to meet project specifications. Similar requirements are often assigned to totally different projects. Rational designing involves selecting engineering properties that meet specific properties of wall permeability, certain environmental criteria, and cutoff compressibility and strength. Specification provisions for slurry properties, trench

excavation, backfill placement, and backfill material for the project are recommended. The slurry should have a minimum viscosity of 40 sec-Marsh to assure trench stability and good filter cake formation. The unit weight of the slurry, as sampled near the bottom of the trench, should be at least 240 kilograms/cu meter lighter than the backfill for proper slurry displacement. The trench should have a minimum width of 610 mm. Trenches keyed in soil should have a minimum key depth of 0.6 m. The backfill material should have a uniform consistency corresponding to a slump of 50-150 mm at the time of placement. The backfill should be composed of granular material containing 20-40% fines to minimize permeability and compressibility. Plastic fines may be used to increase impermeability. Bentonite should be added to the mix and the water content of the soil should be controlled. When the contained fluid is a pollutant changes in permeability of the wall may be regulated by adjusting the content of the fines. (Geiger-FRC)
W82-01599

8F. Concrete

AN INVESTIGATION INTO THE EFFECTS OF THERMAL MOVEMENT IN THE WALLS OF SERVICE RESERVOIRS,

Severn-Trent Water Authority, Birmingham (England).
A. A. Redhead.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 3, p 203-214, May, 1981. 11 Fig, 6 Ref.

Descriptors: *Concrete construction, *Reservoir construction, *Cracks, *Ladbroke Service Reservoir, Thermal stress, *England.

The Ladbroke Service Reservoir, South Warwickshire, England, was constructed in two compartments of equal size using sulfate resisting Portland cement to reduce the effects of alkali attack, which had caused serious cracks in another reservoir built 14 years previously. This paper reports the results of an investigation of thermal cracks which occurred after the walls had been cast on site. Both single and fragmented cracks, usually vertical, developed 400 to 2400 mm from the base 4 or 5 days after pouring the concrete. Stress gages recorded movement as high as 1.66 mm per 10 C change on a cold morning. The single cracks that formed near the thickest part of the wall were closest to the area of greatest heat of hydration. The fragmented cracks were caused by one wall pulling on the adjacent wall. Cracks in this reservoir did not exceed those allowed in the design, and all mid-panel hairline cracks healed 10 days after the reservoir was filled. Suggestions to reduce the tendency to cracking were: use steel shuttering, cool the hottest portion of the wall with cold water sprays, use low heat cement, and cast the wall stem no more than 4 or 5 days after the wall base has been poured. (Cassar-FRC)
W82-01396

8G. Materials

REDESIGN CONTROLS MANHOLE LEAKAGE,

W. L. Sheppard.
Water and Sewage Works, Vol 127, No 2, p 50-52, February, 1980. 1 Fig, 9 Ref.

Descriptors: *Sewers, *Construction methods, Construction materials, Construction joints, Sewer systems, *Waterproofing, Sealants, Manhole construction.

Weaknesses of the most common designs for manhole construction are described, including the sewer connections made from them, and the redesign necessary to correct the weaknesses. The manhole that is to be liquid tight must be structurally strong, incorporate a liquid-tight membrane, and be protected from physical or other damage by an internal brick or tile lining. A liquid-tight precast manhole requires continuous water stops inserted at all junctures of all sections and at the connection with the bottom slab, if this is separate. All joints should be tooled and filled with a strong, water-tight adhesive such as epoxy. A manhole may also be fashioned completely from fiberglass-reinforced plastic, somewhat like a cylindrical tank. The selection of membrane and mortar materials for use in industrial waste sewers must take into consideration the range of chemical content and temperature of wastes to be passing through. (Baker-FRC)
W82-01237

8I. Fisheries Engineering

EVIDENCE OF NATURAL REPRODUCTION BY PLANTED LAKE TROUT IN LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
D. J. Jude, S. A. Klinger, and M. D. Enk.
Journal of Great Lakes Research, Vol 7, No 1, p 57-61, 1981. 1 Fig, 1 Tab, 33 Ref.

Descriptors: *Fish populations, Lakes, *Lake Michigan, Great Lakes, Fish, *Trout, Powerplants, Fish management, *Fish establishment, Fish eggs.

Sampling for lake trout fry was performed near the J. H. Campbell Power Plant, in southeastern Lake Michigan, near Port Sheldon, Michigan, where new offshore intake and discharge pipelines were built. About 1296 meters of pipeline were covered with 10- to 20- cm diameter crushed limestone, 594 meters of which was overlaid with an incomplete layer of 1.2 to 1.5 meter diameter, 900 kg limestone boulders. An additional length of 360 meters had a complete 1.5 meter layer of large riprap covering a base of crushed limestone. Rocky substrate was therefore available at all depth contours from shore to 11 meters. Since 1965 over 34 million fin-clipped lake trout yearlings have been stocked in Lake Michigan in an effort to reestablish self-sustaining populations. Lake trout fry were first collected on 21 April, 1980, by the larval fish sled in 12 and 15 meters of water in the area of new riprap at the north transect. During 19-22 May, 1980, lake trout fry were widely dispersed. Appearance of lake trout fry at the south transect, 3.1 km south of the area in which they are believed to have hatched, suggests either extensive movements by these fish or drifting with currents or both. Successful spawning near the Campbell Plant was probably related to the newly placed riprap. (Baker-FRC)
W82-01194

COOLING WATER INTAKE SCREENING DEVICES USED TO REDUCE ENTRAINMENT AND IMPINGEMENT,

National Power Plant Team, Ann Arbor, MI.
E. S. Fritz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-116055, Price codes: A03 in paper copy, A01 in microfiche. Report FWS/OBS-76/20.9, July, 1980. 24 p, 12 Fig, 20 Ref.

Descriptors: *Entrainment, Impingement, *Intakes, *Screens, *Cooling water, Environmental effects, Mortality, Aquatic animals, Radial wells.

Closed cycle cooling systems reduce the volume of cooling water withdrawn from a water body at least 90% of that required for once-through cooling systems. To be considered an alternative to closed cycle cooling a once-through cooling system with its screening device must be shown to reduce impingement and entrainment mortality for aquatic organisms by 90% of that expected of a once-through system fitted with a vertical traveling screen. Cooling water intake screening devices evaluated include modified vertical traveling screens, single-entrance double-exit screens, horizontal traveling screens, passive intake screens, radial wells, artificial filter beds, and porous dikes. The intake technologies show some promise for reducing the impacts of entrainment and impingement. However, evidence is insufficient to demonstrate that any of these intake systems alone or in combination can afford the protection that is presently attainable by closed cycle cooling. The most effective systems, the radial well and artificial filter bed, can only provide enough water for make up water in closed cycle systems. The screening devices, both active and passive, do not yet have a sufficient data base to demonstrate effectiveness or reliability. More experience is needed operating and maintaining these devices before they can be considered as alternatives to closed cycle cooling for minimizing the adverse impact of cooling water intakes. (Moore-SRC)
W82-01442

SUBJECT INDEX

ABSORPTION
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

ACID MINE DRAINAGE
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

ACID PRECIPITATION
Water Characteristics,
W82-01305 5B

ACID RAIN
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

Water Characteristics,
W82-01305 5B

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

Recent Acidification of Precipitation in North America,
W82-01514 5B

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

ACID STREAMS
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

ACIDIC SOILS
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

ACIDIC WATER
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

ACIDITY
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

ACIDIZING
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

ACTIVATED CARBON
Chemicals and Allied Products,
W82-01267 5D

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

Investigation of Volatile Organics Removal,
W82-01490 5F

ACTIVATED SLUDGE
Activated Sludge,
W82-01243 5D

Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

ACTIVATED SLUDGE PROCESS
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

ADENOSINE TRIPHOSPHATE
A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

ADSORBENTS
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

ADSORPTION
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

ADVANCED WASTEWATER TREATMENT
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

AERATION
Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

AERIAL PHOTOGRAPHY
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

AEROSOLS
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

AFRICA
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

AGARS
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

AGGRADATION
River Bed Aggradation Due to Overloading,
W82-01486 2J

AGRICULTURAL CHEMICALS
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

AGRICULTURAL HYDROLOGY
A Parametric Crop Water Use Model,
W82-01310 2I

AGRICULTURAL RESERVOIRS
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

AGRICULTURAL RUNOFF
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems,
W82-01401 5B

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 2J

Concentrated Flow Relationships,
W82-01409 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

AGRICULTURAL WATERSHEDS
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

AGRICULTURE
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

AIR POLLUTION
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

AIR POLLUTION EFFECTS
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

AJWA RESERVOIR
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

ALBEDO
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

ALBERTA
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

ALGAE
Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

ALKALINE SOILS
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

ALKALINITY
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

ALLOTMENTS
Preferences for Allocating River Recreation Use,
W82-01181 6D

ALTERNATIVE PLANNING
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

ALUM
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

ALUMINUM
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

AMERICAN RIVER
Water Resources Appraisals for Hydroelectric Licensing: American River Basin, California.
W82-01441 6D

AMMONIUM
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

ANAEROBIC DIGESTION
Anaerobic Processes,
W82-01245 5D

New Approaches to Anaerobic Sludge Digestion,
W82-01398 5D

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

ANIMAL WASTES
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

ANION EXCHANGE
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

ANISOTROPY
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

ANTARCTIC
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

AQUACULTURE
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

AQUATIC ANIMALS
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

AQUATIC HABITATS
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

AQUATIC LIFE
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

AQUATIC SOILS
Aquatic Sediments,
W82-01279 5B

AQUIFER CHARACTERISTICS
Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

AQUIFER MANAGEMENT
A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 7A

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

AQUIFERS
Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 5B

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

AQUITARDS
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

ARAL SEA
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 2H

ARCTIC
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

ARID-ZONE HYDROLOGY
Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

ARIZONA
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 2D

Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

ARTIFICIAL RECHARGE
Artificial Groundwater Recharge,
W82-01110 4B

ASBESTOS
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

ATLANTIC OCEAN
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

ATMOSPHERE
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

ATMOSPHERIC ICE
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

ATMOSPHERIC WATER
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

AUSTRALIA
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

Land and Stream Salinity in Western Australia,
W82-01374 5B

AUTOMATION
Automatic Class-A Pan-Filling System,
W82-01326 7B

BACKFILL
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

BACTERIA
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

BACTERIAL ANALYSIS
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

BACTERIOPHAGE
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

BAFFIN BAY
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

BARRIERS
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

BAY OF BENGAL
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

BELGIUM
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

BENTONITE
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

BETWA BASIN
The Water Balance of the Betwa Basin, India,
W82-01354 2A

BIBLIOGRAPHICS
Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

BIBLIOGRAPHIES
Anaerobic Processes,
W82-01245 5D

Destrification,
W82-01246 5D

Sludge Treatment, Utilization, and Disposal,
W82-01247 5E

Wastewater Collection,
W82-01251 5D

Land Application of Municipal Wastewater,
W82-01253 5D

Microbiology of Potable Water,
W82-01287 5F

BICARBONATES
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

BIG CREEK MARSH
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

BIOACCUMULATION
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

BIOASSAY
Bioassays - Procedures and Results,
W82-01277 5A

BIOCHEMICAL OXYGEN DEMAND
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

BIODEGRADATION
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

BIOINDICATORS
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

BIOLOGICAL FILTERS
Biological Filters,
W82-01242 5D

BIOLOGICAL TREATMENT
Denitrification of Blackwater with Greywater,
W82-01225 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

BIOLOGICAL WASTEWATER TREATMENT
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

BIOMASS
A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

BLEACHING WASTES
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

BLUEGILLS
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

BOUNDARY PROCESS
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

BOW LAKE
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

BRAIDED RIVERS
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

BRAZIL
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

BRAZOS RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico.
W82-01439 6D

BRITISH COLUMBIA
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

BROMIDES
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

CADMIUM
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilizers, Soils and River Waters,
W82-01388 5B

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

CALIFORNIA
Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

CALLAHAN RESERVOIR
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

CANADA
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

CANOPY
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

CARBON
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

CARBON RADIOISOTOPES
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

CARCINOGENS
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

CARP
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

CASE STUDIES
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

CASPER CREEK
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

CATCHMENT AREAS
Land and Stream Salinity in Western Australia,
W82-01374 5B

CATCHMENT BASINS
A Catchment Approach to Flood Estimation,
W82-01397 2E

CAYUGA LAKE
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

CHANNEL FLOW
Concentrated Flow Relationships,
W82-01409 2J

CHANNEL MORPHOLOGY
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

CHANNELING
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

CHELATION
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

CHEMICAL ANALYSIS
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

CHEMICAL ANAYSIS
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

CHEMICAL COMPOSITION
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

CHEMICAL PRECIPITATION
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

CHEMICAL REACTIONS
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

CHEMICAL WASTES
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

CHEMICAL WASTEWATER
Chemicals and Allied Products,
W82-01267 5D

CHEMISTRY OF PRECIPITATION
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

CHESAPEAKE BAY
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

CHICAGO
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

CHINA
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Hydropower--An Old Technology for a New Era,
W82-01593 4A

CHLORINATED HYDROCARBONS
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

Love Canal: Chemical Contamination and Migration,
W82-01436 5B

CHLORINATION
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

Disinfection,
W82-01250 5D

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

CHROMIUM
Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

CITRUS FRUITS
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

CLADOPHORA
Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

CLAYS
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

CLIMATIC DATA
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

CLOUD SEEDING
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

CLOUDS
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

COAGULATION
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

COAL GASIFICATION
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

Synthetic Fuel Effluents,
W82-01263 5B

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

COAL MINES
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

COAL MINING
Coal and Coal Mine Drainage,
W82-01261 5G

COASTAL AQUIFERS
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 7A

COASTAL WATERS
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

COLIFORMS
Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

COLORADO
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Water Resources Data for Colorado, Water Year 1980–Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

COLORADO RIVER
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

COLUMBIA RIVER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

COMBINED SEWER OVERFLOWS
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

Urban Runoff and Combined Sewer Overflow,
W82-01234 5B

COMBINED SEWERS
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

COMBINED TREATMENT
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

COMMON LAW
Federal Common Law of Nuisance Expands,
W82-01537 6E

COMPARISON STUDIES
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

COMPUTER MODELS
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

CONCRETE CONSTRUCTION
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

CONDUCTIVITY
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

CONFINED AQUIFERS
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

CONNECTICUT
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

CONSERVATION
Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

CONSERVATION TILLAGE
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

CONSTRUCTION
The River Ouse Water Supply Scheme,
W82-01371 5F

CONSTRUCTION METHODS
Redesign Controls Manhole Leakage,
W82-01237 8G

CONTAMINATION
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

CONTROL SYSTEMS
Automatic Class-A Pan-Filling System,
W82-01326 7B

COOLING TOWERS
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 2B

Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 2B

Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

COOLING WATER
Power Industry Wastes,
W82-01265 5B

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

COON CREEK
Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

COPEPODS
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

COPPER
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

CORN
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

CORROSION
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

COST ANALYSIS
Expansion of Effluent Constrained Treatment Plants,
W82-01355 5D

Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

COST-BENEFIT ANALYSIS
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

COSTS
Cost Effective Ground Water Monitoring,
W82-01113 4B

Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

Economics,
W82-01304 5G

CRACKS
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

CROP PRODUCTION
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

CROP YIELD
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

CROP YIELDS
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

CROPLAND
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

CROPS
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

CRYSTAL GROWTH
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

CULTURE MEDIA
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

CUTOFFS
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

CYANIDE
Electroplating and Cyanide Wastes,
W82-01266 5D

CYCLING NUTRIENTS
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 5D

DAIRY INDUSTRY
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

Dairy Wastes,
W82-01258 5D

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

DAM CONSTRUCTION
Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 8A

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

DAM DESIGN
Siting and Design of Tailings Impoundments,
W82-01588 8A

DAMS
Hydropower--An Old Technology for a New Era,
W82-01593 4A

DATA COLLECTIONS
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

DATING
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

DDT
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

DEBRIS CONE
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

DECIDUOUS FORESTS
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

DECOMPOSITION
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

DEDHAM
Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

DELMARVA PENINSULA
Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

DENDROCHRONOLOGY
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

DENITRIFICATION
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

Denitrification of Blackwater with Greywater,
W82-01225 5D

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

DENTRIFICATION
Dentrification,
W82-01246 5D

DENUDATION
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 2A

DEPOSITION
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

DESALINATION
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

DESIGN CRITERIA
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

DESIGN STORMS
Erosivity 'R' for Individual Design Storms,
W82-01403 2J

DETENTION RESERVOIRS
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

DETROIT
Detroit - Fresh Clean Water,
W82-01506 5D

DEUTERIUM
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

DEVELOPING COUNTRIES
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

Rural Sanitation in Developing Countries,
W82-01392 5D

The Water Decade (1981-1990),
W82-01534 6E

Hydropower--An Old Technology for a New Era,
W82-01593 4A

DEWATERING
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

DIATOMS
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

DIETS
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

DIFFUSION COEFFICIENT
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

DIOXIN
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

DISEASES
Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

DISINFECTION
Disinfection,
W82-01250 5D

DISSOLVED OXYGEN
Dissolved Oxygen in Streams and Reservoir,
W82-01272 5G

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

DISTRIBUTION PATTERNS
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

DIURNAL DISTRIBUTION
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

DOMESTIC WASTES
Denitrification of Blackwater with Greywater,
W82-01225 5D

DOMINICAN REPUBLIC
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation,
W82-01589 5D

DOUGLAS POINT NUCLEAR PLANT
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

DRAINAGE
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

DRAINAGE DENSITY
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 2A

DRAINAGE PATTERNS
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

DRAINAGE SYSTEMS
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

DRINKING WATER
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

Organics in Water - An Engineering Challenge,
W82-01540 5F

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

DROUGHT
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

DULUTH
Transports in the Duluth-Superior Harbor,
W82-01136 5B

DYE INDUSTRY WASTES
Textile Wastes,
W82-01259 5D

DYSTROPHIC LAKES
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

EARTHQUAKE PREDICTIONS
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

EARTHQUAKES
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

ECOLOGICAL EFFECTS
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

Bioassays - Procedures and Results,
W82-01277 5A

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

ECONOMIC ASPECTS
Economics,
W82-01304 5G

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

ECUADOR
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

EDISTO RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 6D

ELCTRICAL CONDUCTIVITY
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

ELECTRIC POWER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

ELECTRIC POWER INDUSTRY
Power Industry Wastes,
W82-01265 5B

ELECTRICAL PROPERTIES
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

ELECTRO-OSMOSIS
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

ELECTROPLATING
Electroplating and Cyanide Wastes,
W82-01266 5D

ELLESMERE ISLAND
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

ENDRIN
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

ENERGY
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

ENERGY LOSS
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

ENERGY STORAGE
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

ENGLAND
The River Ouse Water Supply Scheme,
W82-01371 5F

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

ENGLISH CHANNEL
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

ENTERIC BACTERIA
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01535 5B

ENTRAINMENT
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

ENVIRONMENTAL EFFECTS
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

Water Characteristics,
W82-01305 5B

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

EPHEMERAL LAKES
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

EQUILIBRIUM
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilisation de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

EROSION
CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems,
W82-01401 5B

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

EROSION CONTROL
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

Soil Conservation Problems and Practices: A Farmer View,
W82-01551 4D

Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

Managing Land to Meet Water Quality Goals,
W82-01557 4D

EROSION RATES
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

ERROR ANALYSIS
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

ESCHERICHIA COLI
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

ESTIMATING EQUATIONS
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

ESTUARIES
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

ESTUARINE ENVIRONMENT
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

Marine and Estuarine Pollution,
W82-01274 5C

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

EUTROPHICATION
Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

Eutrophication,
W82-01271 2H

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

EVALUATION
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

EVAPORATION PANS
Automatic Class-A Pan-Filling System,
W82-01326 7B

EVAPOTRANSPIRATION
Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 2D

FARM MANAGEMENT
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

FARM WASTES
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

FARMING
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 4D

FARMS
Land and Stream Salinity in Western Australia,
W82-01374 5B

FATE OF POLLUTANTS
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

FATHEAD MINNOWS
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

FATTY ACIDS
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

FECES
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

FEEDLOT RUNOFF
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

FERMENTATION
Fermentation Industry,
W82-01257 5D

FERTILIZERS
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

FILTRATION
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

A Successful Low Technology Wastewater Process,
W82-01178 5D

Investigation of Volatile Organics Removal,
W82-01490 5F

FINNISS RIVER
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

FIRN
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

FISH
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77- National Pesticide Monitoring Program,
W82-01584 5B

FISH ESTABLISHMENT
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

FISH HANDLING FACILITIES
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

FISH PONDS
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

FISH POPULATIONS
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

FISH TOXINS
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

FLOCCULATION
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

FLOOD FLOW
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

FLOOD FORECASTING
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

A Catchment Approach to Flood Estimation,
W82-01397 2E

Monitoring Glacier Outburst Floods,
W82-01558 2C

FLOOD FREQUENCY
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 2E

FLOOD PROTECTION
Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

FLOODNG
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

FLOODS
Monitoring Glacier Outburst Floods,
W82-01558 2C

FLOODWATER
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

FLORIDA
Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 7C

FLOTATION
High-Solubility Gas Flotation,
W82-01184 5D

Developments in Sedimentation and Flotation,
W82-01391 5F

FLOW CHARACTERISTICS
Vertical Velocity Profiles in Stratified Flows,
W82-01171 8B

Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

A Model for Simulation of Flow in Singular and Interconnected Channels, W82-01210 2E

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land, W82-01340 5B

FLOW VELOCITY

Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers, W82-01161 8B

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating, W82-01348 2F

FLUORESCENCE SPECTROSCOPY

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities, W82-01431 5A

FLUSHING

Significant Features of Emitter Flushing Mode Characteristics, W82-01576 3F

FLY ASH

Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods, W82-01218 5B

The Effect of Flyash Disposal on a Shallow Ground-Water System, W82-01220 5B

FOOD CHAINS

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain, W82-01443 5B

FOOD PROCESSING INDUSTRY

Meat-, Fish-, and Poultry-Processing Wastes, W82-01256 5D

FOREST MANAGEMENT

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization, W82-01135 2G

FOREST WATERSHEDS

Water Quality from Two Small Forested Watersheds in Southern Illinois, W82-01140 4C

Predicting Stream Salinity Changes in South-Western Australia, W82-01350 6A

FORESTRY

Interdisciplinary Environmental Analysis for Timber Sale Planning, W82-01539 6A

FORESTS

Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils, W82-01118 2G

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships, W82-01554 5B

Acid Precipitation: Basic Principles and Ecological Consequences, W82-01586 5C

FOULING

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein, W82-01501 5F

FRACTURE PERMEABILITY

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion, W82-01179 2F

FRANCE

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux), W82-01133 5A

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France), W82-01351 6F

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau), W82-01353 2H

FRANKLIN COUNTY

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge, W82-01428 5G

FRICTION LOSS

Pipeline Friction Losses for Wastewater Sludges, W82-01545 5D

FROST

Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns, W82-01346 2C

GAGING

Compatibility of Canadian Snowfall and Snow Cover Data, W82-01466 2C

GAGING STATIONS

A Catchment Approach to Flood Estimation, W82-01397 2E

GAS CHROMATOGRAPHY

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities, W82-01431 5A

GEOCHEMISTRY

Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry, W82-01143 2H

GEOHYDROLOGY

Geohydrologic Models of the Houston District, Texas, W82-01335 2F

GEOLOGIC FRACTURES

Groundwater Investigations in the Vale of Stathmore, W82-01400 2F

GEOMORPHOLOGY

Drainage Density as an Index of Climatic Geomorphology, W82-01324 2A

Geomorphology of the Colorado River in the Grand Canyon, W82-01338 2J

GEOTHERMAL POWER

Identification of the Wairakei Geothermal System, W82-01312 2F

GEOTHERMAL RESOURCES

On Identification and Validation of Some Geothermal Models, W82-01467 6A

Extraction Timing and Economic Incentives for Geothermal Reservoir Management, W82-01504 4B

GEOTHERMAL STUDIES

On Identification and Validation of Some Geothermal Models, W82-01467 6A

Thermal Energy Storage in a Confined Aquifer: Second Cycle, W82-01473 4B

GILA RIVER

Channel Instability in a Braided, Sand Bed River, W82-01316 2J

GLACIAL LAKES

Monitoring Glacier Outburst Floods, W82-01558 2C

GLACIAL SEDIMENTS

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake, W82-01510 2H

GLACIOHYDROLOGY

Monitoring Glacier Outburst Floods, W82-01558 2C

GLASGOW DRAINAGE AREA

Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow, W82-01385 5D

GLOBAL ENVIRONMENTAL MONITORING SYSTEM

Water-Quality Monitoring: A Global Approach, W82-01339 7A

GRAND CANYON

Geomorphology of the Colorado River in the Grand Canyon, W82-01338 2J

GRANITES

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine, W82-01222 2F

GRAVEL

Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers, W82-01161 8B

GREAT BRITAIN

Artificial Groundwater Recharge, . W82-01110 4B

Developments in Sedimentation and Flotation, W82-01391 5F

Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model, W82-01395 8B

A Catchment Approach to Flood Estimation, W82-01397 2E

GREAT LAKES

Public Concerns and PLUARG: Selected findings and Discussion,- W82-01137 5G

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management, W82-01146 5G

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes, W82-01148 5B

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data, W82-01150 7A

GREAT SMOKY MOUNTAIN NATIONAL PARK
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

GREECE
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

GREENHOUSES
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

GROUNDWATER
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

The Effect of Flyash Disposal on a Shallow Ground-Water System.
W82-01220 5B

Ground Water.
W82-01273 2F

Microbiology of Ground Water,
W82-01286 5B

Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

GROUNDWATER AVAILABILITY
Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

GROUNDWATER BUDGET
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

GROUNDWATER CONTAMINATION
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

GROUNDWATER DATING
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

GROUNDWATER DIVIDE
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

GROUNDWATER MANAGEMENT
Cost Effective Ground Water Monitoring,
W82-01113 4B

Results of Acidizing Water Wells in Arizona,
W82-01199 4B

Nebraska Ground Water Law and Administration,
W82-01236 6E

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

GROUNDWATER MOVEMENT
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

Computer Modeling and Ground-Water Protection,
W82-01336 2F

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

GROUNDWATER POLLUTION
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

Love Canal: Chemical Contamination and Migration,
W82-01436 5B

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

Investigation of Volatile Organics Removal,
W82-01490 5F

GROUNDWATER RECHARGE
Artificial Groundwater Recharge,
W82-01110 4B

The Water Balance of the Betwa Basin, India,
W82-01354 2A

GULLY EROSION
Gully Erosion,
W82-01407 2J

GYPSUM
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

HARBORS
Transports in the Duluth-Superior Harbor,
W82-01136 5B

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

HAWAII
Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas. Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

HAZARDOUS MATERIAL
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

HAZARDOUS MATERIALS
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

HEAD LOSS
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

HEAT BALANCE
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

HEAT TRANSFER
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

HEAVY METALS
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

Electroplating and Cyanide Wastes,
W82-01266 5D

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

HETEROGENEITY
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

HOUSTON
Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

HUMID AREAS
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

HYDRAULIC CONDUCTING
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

HYDRAULIC CONDUCTIVITY
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

HYDRAULIC MODELS
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

HYDRAULIC ROUGHNESS
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

HYDRAULIC VALVES
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

HYDRAULICS
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

HYDROBIOLOGY
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

HYDROCARBONS
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

HYDROELECTRIC PLANTS
Yangtze Gorges Scheme Could Yield 110 TWh/Year,
W82-01394 8A

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina,
W82-01440 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California,
W82-01441 6D

HYDROELECTRIC POWER
Yangtze Gorges Scheme Could Yield 110 TWh/Year,
W82-01394 8A

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico,
W82-01439 6D

Hydropower--An Old Technology for a New Era,
W82-01593 4A

HYDROGEN ION CONCENTRATION
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH,
W82-01438 5D

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

HYDROLOGIC BUDGET
The Water Balance of the Betwa Basin, India,
W82-01354 2A

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 2H

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

HYDROLOGIC DATA
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

HYDROLOGIC MODELS
Computer Modeling and Ground-Water Protection,
W82-01336 2F

HYDROMETEOROLOGY
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

HYPOLIMNION
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

ICE
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

ICE-WATER INTERFACES
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

ICED LAKES
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

IDAHO
Preferences for Allocating River Recreation Use,
W82-01181 6D

ILLINOIS
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

Federal Common Law of Nuisance Expands,
W82-01337 6E

IMPERVIOUS SURFACES
Estimation of Impervious-Area Washoff Parameters,
W82-01465 6C

INDIA
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

The Water Balance of the Betwa Basin, India,
W82-01354 2A

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

INDUSTRIAL WASTES
Abundance of Organic Compounds in Water,
W82-01162 5A

Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

INDUSTRIAL WASTEWATER
Activated Sludge,
W82-01243 5D

Fermentation Industry,
W82-01257 5D

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 5D

INDUSTRIAL WATER
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

INFILTRATION
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 2G

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 2G

INFILTRATION RATE
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 2G

INFLOW
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

INFRARED SPECTROSCOPY
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

INJECTION WELLS
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

INLETS
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

INPUT-OUTPUT ANALYSIS
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

INSECTICIDES
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

INSECTS
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

INTAKES
Development of Upton Intake Works, River Severn Supply Scheme. With the Aid of a Model,
W82-01395 8B

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

INTERBASIN TRANSFERS
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

INTERDISCIPLINARY STUDIES
Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

INTERFACES
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

INTERNATIONAL JOINT COMMISSION
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

INTERVENTION ANALYSIS
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

INVERTEBRATES
Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

ION EXCHANGE
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

ION EXCHANGE RESINS
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

ION TRANSPORT
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 5B

IOWA
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 3D

IRAQ
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

IRON
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

IRRIGATION
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

IRRIGATION CANALS
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

IRRIGATION DESIGN
A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 6A

Input and Output Constraints Affecting Irrigation Development,
W82-01476 6B

Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 8C

IRRIGATION EFFECTS
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

IRRIGATION EFFICIENCY
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

IRRIGATION ENGINEERING
Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

IRRIGATION PROGRAMS
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

IRRIGATION WATER
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

ISOTOPE STUDIES
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

ISOTOPE TRACERS
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

ISOTOPIC STUDIES
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

ISRAEL
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

IVORY COAST
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

JUDICIAL DECISIONS
Federal Common Law of Nuisance Expands,
W82-01337 6E

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 6E

Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

KALAHARI DESERT
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

KASKASKIA RIVER
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

KENTUCKY
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

KEPONE
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

KOHL SPRING
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

KRAFT MILLS
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

LADBROKE SERVICE RESERVOIR
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

LAGOONS
Lagoons and Oxidation Ponds,
W82-01244 5D

LAKE BASINS
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

LAKE CLASSIFICATION
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

LAKE ERIE
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

LAKE HURON
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

LAKE MICHIGAN
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

LAKE ONTARIO
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

LAKE SEDIMENTS
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

LAKE SUPERIOR
Transports in the Duluth-Superior Harbor,
W82-01136 5B

Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

LAKES
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 2H

The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

LAND CLEARING
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

LAND DISPOSAL
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

Artificial Groundwater Recharge,
W82-01110 4B

Land Application of Municipal Wastewater,
W82-01253 5D

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 5D

LAND SUBSIDENCE
Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

LAND USE
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

LANDFILLS
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

LANDIFLLS
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

LARVAE
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

LARVAL GROWTH STAGE
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

LASERS
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

LEACHAGES
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

LEACHATES
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

LEACHING
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

LEAD
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

LEGAL ASPECTS
Law,
W82-01302 6E

The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

LEVEES
Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

LIGHT PENETRATION
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

LIMNOLOGY
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

LINEAR PROGRAMMING
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

LIQUEFACTION
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

LITERATURE REVIEW
Lagoons and Oxidation Ponds,
W82-01244 5D

Anaerobic Processes,
W82-01245 5D

Dentrification,
W82-01246 5D

Sludge Treatment, Utilization, and Disposal,
W82-01247 5E

Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

Disinfection,
W82-01250 5D

Wastewater Collection,
W82-01251 5D

Water Reclamation and Reuse,
W82-01252 3C

Land Application of Municipal Wastewater,
W82-01253 5D

Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

Eutrophication,
W82-01271 2H

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 5G

Ground Water,
W82-01273 2F

Marine and Estuarine Pollution,
W82-01274 5C

Thermal Effects,
W82-01275 5C

Aquatic Sediments,
W82-01279 5B

Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Freshwater Macroinvertebrates,
W82-01281 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 5C

Substrate Associated Microfauna,
W82-01283 5C

Microbiology of Water,
W82-01284 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 5A

Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

Law,
W82-01302 6E

Systems Analysis,
W82-01303 6A

Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

LITERATURE REVIEWS
Non-Point Sources,
W82-01270 5B

LOAM
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

LOCKS
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

LOGGING
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

LOS ANGELES
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

LOTIC ENVIRONMENT
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

LOUISIANA
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

LOVE CANAL
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

MACROINVERTEBRATES
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

Freshwater Macroinvertebrates,
W82-01281 5C

MAINE
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

MAINTENANCE
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 6F

MALAWI
Malawi: A Community Approach,
W82-01365 5F

MALAYSIA
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

MALI
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

MANAGEMENT PLANNING
Managing Land to Meet Water Quality Goals,
W82-01557 4D

MANURE
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

MARINE ENVIRONMENT
Marine and Estuarine Pollution,
W82-01274 5C

Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

MARINE SEDIMENTS
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

MARSHES
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

MASSACHUSETTS
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

MATHEMATICAL MODELS
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

MATHEMATICAL STUDIES
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

MAUMEE RIVER
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

MEAT PROCESSING INDUSTRY
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

MELTING
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

MEMBRANE FILTERS
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

MERCURY
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

METAL FINISHING WASTES
Steel Industry Wastes,
W82-01264 5D

Electroplating and Cyanide Wastes,
W82-01266 5D

METALS
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

METEOROLOGICAL DATA COLLECTION
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

METHYL BROMIDE
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils.
W82-01492 5B

MEXICO
Supply-Demand Coordination in Water Resources Management.
W82-01299 6C

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

Input and Output Constraints Affecting Irrigation Development.
W82-01476 6B

MICHIGAN
A Bioassay Study of Effects of Zooplankton. Iron and NTA on the Phytoplankton Productivity of a Marl Lake.
W82-01157 2H

The Wayne County, Michigan, Wastewater Collection and Treatment System.
W82-01505 5D

MICROBIAL DEGRADATION
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

MICROBIOLOGICAL STUDIES
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

Microbiology of Water,
W82-01284 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 5A

Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

Microbiology of Wastewater Treatment,
W82-01291 5D

MICROORGANISMS
Substrate Associated Microfauna,
W82-01283 5C

MICROWAVES
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

MIDGES
Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 2H

MILLIGAN CANYON
Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

MINE DRAINAGE
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

MINE WASTES
Coal and Coal Mine Drainage,
W82-01261 5G

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

MINERAL INDUSTRY
A Water Rights Strategy for Mining Operations in the Western US.
W82-01587 6E

MINERALIZATION
Nitrate Production. Uptake. and Leaching.
W82-01411 5B

MISSOURI RIVER
River Bed Aggradation Due to Overloading.
W82-01486 2J

MIXING
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems.
W82-01166 5F

MODEL STUDIES
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries.
W82-01173 6G

Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 6A

Identification of the Wairakei Geothermal System,
W82-01312 2F

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

Computer Modeling and Ground-Water Protection,
W82-01336 2F

CREAMS: A Field-Scale Model for Chemicals. Runoff, and Erosion from Agricultural Management Systems.
W82-01401 5D

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Concentrated Flow Relationships,
W82-01409 2J

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

Methods for Generating Alternative Solutions to Water Resources Planning Problems.
W82-01449 6A

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems.
W82-01450 6A

A One-Dimensional. Finite Element Salt Water Intrusion Model.
W82-01452 7A

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models.
W82-01460 2H

Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria.
W82-01462 8A

On Identification and Validation of Some Geothermal Models.
W82-01467 6A

River Basin Hydrosalinity Modeling,
W82-01469 2K

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

MODEL TESTING
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

MOISTURE AVAILABILITY
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

MOISTURE CONTENT
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

MOISTURE EQUIVALENT
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

MOISTURE STRESS
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

MONITORING
Cost Effective Ground Water Monitoring,
W82-01113 4B

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Water-Quality Monitoring: A Global Approach,
W82-01339 7A

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH,
W82-01438 5D

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

Monitoring Glacier Outburst Floods,
W82-01558 2C

MONSOONS
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

MONTANA
Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin,
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin,
W82-01214 7C

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

MONTE CARLO METHOD
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

MULTIOBJECTIVE PLANNING
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

MULTIPURPOSE RESERVOIRS
Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico,
W82-01439 6D

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina,
W82-01440 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California,
W82-01441 6D

MULTIVARIATE ANALYSIS
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

MUNICIPAL WASTEWATER
Land Application of Municipal Wastewater,
W82-01253 5D

Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 5D

MUSSELS
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

MUTAGENS
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

MYTILUS
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

NARMADA RIVER
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

NAVIGATION
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

NEBRASKA
Nebraska Ground Water Law and Administration,
W82-01236 6E

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

NEPHELOID LAYER
Nepheloid and Suspended Particulate Matter In South-Eastern Lake Michigan,
W82-01499 2H

NETHERLANDS
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 2H

NETWORK DESIGN
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

NETWORKS
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

NEVADA
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

NEW ENGLAND
The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 2A

NEW JERSEY
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

NEW YORK
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

NEW ZEALAND
Identification of the Wairakei Geothermal System,
W82-01312 2F

NEW ZEALAND

On Identification and Validation of Some Geothermal Models,
W82-01467 6A

NITRATES
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

NITRIFICATION
Activated Sludge,
W82-01243 5D

Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

NITRILOTRIACETIC ACID
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

NITROGEN
Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

NITROGEN COMPOUNDS
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

NITROGEN REMOVAL
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

NODULES
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

NONPOINT POLLUTION SOURCES
Non-Point Sources,
W82-01270 5B

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems,
W82-01401 5B

Erosivity 'R' for Individual Design Storms,
W82-01403 2J

Nitrate Production, Uptake, and Leaching,
W82-01411 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

NORTH AMERICA
Recent Acidification of Precipitation in North America,
W82-01514 5B

NORTHUMBRIAN WATER AUTHORITY
A Catchment Approach to Flood Estimation,
W82-01397 2E

NOTTAWASAGA BAY
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

NUCLEAR POWERPLANTS
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

NUTRIENT RELEASE
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

NUTRIENT REMOVAL
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

NUTRIENTS
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

Enrichment Ratios for Water Quality Modeling,
W82-01410 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

OHIO
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

OHIO RIVER
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

OIL POLLUTION
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

OIL RECOVERY
Petroleum Processing Wastes,
W82-01262 5D

OIL SHALE
Synthetic Fuel Effluents,
W82-01263 5B

OIL SPILLS
Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

ONTARIO
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

OPTIMIZATION
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

ORGANIC COMPOUNDS
Abundance of Organic Compounds in Water,
W82-01162 5A

Organics,
W82-01239 5A

Chemicals and Allied Products,
W82-01267 5D

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

Investigation of Volatile Organics Removal,
W82-01490 5F

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

Concentrating Organics in Water for Biological Testing,
W82-01591 5A

ORGANIC MATTER
Organics in Water - An Engineering Challenge,
W82-01540 5F

ORGANIC MATTER *ULTRAVIOLET RADIATION
U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 5A

ORGANIC SOILS
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

ORGANIC SOLVENTS
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

ORGANOPHOSPHORUS PESTICIDES
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

OSWEGO COUNTY
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

OUTLETS
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

OVERLAND FLOW
Sediment Transport Capacity of Overland Flow,
W82-01408 2J

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

OXIDATION
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

OXIDATION LAGOONS
Lagoons and Oxidation Ponds,
W82-01244 5D

OXIDATION PONDS
Lagoons and Oxidation Ponds,
W82-01244 5D

OXYGEN
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

OXYGEN DEMAND
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

OXYGEN ISOTOPES
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

OXYGEN TRANSFER
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

OXYGENATION
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 5D

OZONATION
Disinfection,
W82-01250 5D

OZONE
Mechanism of Enteroviral Inactivation by Ozone,
W82-01482 5D

PAINT INDUSTRY
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

PARAMETRIC HYDROLOGY
A Parametric Crop Water Use Model,
W82-01310 2I

PASTURES
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

PATH OF POLLUTANTS
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

Transports in the Duluth-Superior Harbor,
W82-01136 5B

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Synthetic Fuel Effluents,
W82-01263 5B

Radioactive Wastes,
W82-01268 5D

Solid Wastes and Water Quality,
W82-01269 5B

Aquatic Sediments,
W82-01279 5B

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

Love Canal: Chemical Contamination and Migration,
W82-01436 5B

PATHOGENS
Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

PENNSYLVANIA
Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins,
W82-01212 7C

PENTICTON
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

PEOPLE'S REPUBLIC OF CHINA
Yangtze Gorges Scheme Could Yield 110 TWh/Year,
W82-01394 8A

PERFORMANCE EVALUATION
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

PERIPHYTON
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

PERMEABILITY
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

PERMEABILITY COEFFICIENT
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

PESTICIDE KINETICS
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

PESTICIDES
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

PHARMACEUTICAL INDUSTRY
Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

PHENOLS
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

PHOSPHORUS
Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

PHOSPHORUS REMOVAL
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 5D

PHYSICOCHEMICAL PROPERTIES
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Physical and Chemical Studies of Lago Tupe: A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

PHYSICOCHEMICAL TREATMENT
Physical and Chemical Methods,
W82-01241 5D

PHYTOPLANKTON
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

PIPELINES
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

PLANKTON
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

PLANNING
Systems Analysis,
W82-01303 6A

Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

Input and Output Constraints Affecting Irrigation Development,
W82-01476 6B

Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

PLANT TISSUES
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

PLUMES
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

PLUTONIUM RADIOISOTOPES
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

POLAR REGIONS
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

POLICY MAKING
On Water Tariff Equalization Policies,
W82-01175 6C

POLLUTANT IDENTIFICATION
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

Inorganics,
W82-01238 5A

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

POLLUTANTS
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

POLLUTION CONTROL
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

POLLUTION LOAD
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

POLYCHLORINATED BIPHENYLS
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlori-

nated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

POLYMERS
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

PONDS
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

POPULATION DYNAMICS
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

PORE WATER
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

POROUS MEDIA
Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 5B

Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

POTABLE WATER
Radon-222. In Potable Water Supplies of New England,
W82-01221 5B

Microbiology of Potable Water,
W82-01287 5F

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

POULTRY
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

POWERPLANTS
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

PRAIRIES
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

PRECIPITATION
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

PREDICTIONS
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

PRIMARY PRODUCTION
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

PRIVATE RIGHTS
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 6E

PROBABILISTIC PROCESS
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

PROBABILITY DISTRIBUTION
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

PROCESS CONTROL
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

PUBLIC HEALTH
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

The Water Decade (1981-1990),
W82-01534 6E

PUBLIC PARTICIPATION
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

Malawi: A Community Approach,
W82-01365 5F

PUBLIC RELATIONS
Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

PUERTO RICO
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

PULP AND PAPER INDUSTRY
Pulp and Paper Industry Effluent Management,
W82-01260 5D

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 5D

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 5D

PULP WASTES
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 5A

PUMPAGE
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

PUMPS
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

QANAT AL-JAISH CANAL
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

QUALITY CONTROL
Microbiology: Methodology and Quality Assurance,
W82-01285 5A

RADIOACTIVE TRACERS
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

RADIOACTIVE WASTE DISPOSAL
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

RADIOACTIVE WASTES
Radioactive Wastes,
W82-01268 5D

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

RADIOISOTOPES
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

RADIOMETERY
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

RADIOMETRY
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

RADIUM-226
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

RADON
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

RAINFALL
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

Time Distribution of Clock Hour Rainfall,
W82-01402 2A

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

RAINFALL DISTRIBUTION
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

RAINFALL INTENSITY
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

Erosivity 'R' for Individual Design Storms,
W82-01403 2J

RAINFALL-RUNOFF RELATIONSHIPS
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

RANGE MANAGEMENT
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

RAPID INFILTRATION
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

RECHARGE
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

RECREATION DEMAND
Preferences for Allocating River Recreation Use,
W82-01181 6D

Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

REFLECTANCE
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

REGENERATION
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

REGIONAL ANALYSIS
Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

REGIONAL DEVELOPMENT
Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

REGIONAL PLANNING
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

REGULATIONS
Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH,
W82-01438 5D

REMOTE SENSING
Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

RESERVOIR CONSTRUCTION
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

RESERVOIR DESIGN
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

RESERVOIR OPERATION
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

RESERVOIRS
Dissolved Oxygen in Streams and Reservoirs,
W82-01272 5G

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico,
W82-01439 6D

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

RESIDUAL CHLORINE
Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

RESISTIVITY
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

RETURN FLOW
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

REVERSE OSMOSIS
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

REVIEWS
Inorganics,
W82-01238 5A

Biological Filters,
W82-01242 5D

Pulp and Paper Industry Effluent Management,
W82-01260 5D

Bioassays - Procedures and Results,
W82-01277 5A

Economics,
W82-01304 5G

Water Characteristics,
W82-01305 5B

Small Water Systems: Role of Technology,
W82-01542 5F

RICE
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

RISKS
Risk Models for Flood Levee Design,
W82-01307 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

RIVER BASINS
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

River Basin Hydrosalinity Modeling,
W82-01469 2K

RIVER BEDS
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 8B

River Bed Aggradation Due to Overloading,
W82-01486 2J

RIVER RUNOFF
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

RIVER RUNOFF *SALINITY
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

RIVERS
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

ROAD CONSTRUCTION
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

ROTATING BIOLOGICAL CONTACTORS
Biological Filters,
W82-01242 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 5D

RUNOFF
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Time Distribution of Clock Hour Rainfall,
W82-01402 2A

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 2A

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

RUNOFF RATES
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

SAFFLOWER
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

SAGINAW BAY
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

SALINE-FRESHWATER INTERFACES
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

SALINE SOILS
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

SALINE WATER
Land and Stream Salinity in Western Australia,
W82-01374 5B

SALINE WATER INTRUSION
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

SALINITY
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

Land and Stream Salinity in Western Australia,
W82-01374 5B

Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

River Basin Hydrosalinity Modeling,
W82-01469 2K

SALMON RIVER
Preferences for Allocating River Recreation Use,
W82-01181 6D

SALTS
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 5B

SAMPLE PREPARATION
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

SAMPLE PRESERVATION
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

SAMPLING
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 5A

Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

SAN FRANCISCO BAY AREA
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

SAND FILTERS
A Successful Low Technology Wastewater Process,
W82-01178 5D

SANDUSKY RIVER
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

SANITARY LANDFILLS
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

SANITATION
Rural Sanitation in Developing Countries,
W82-01392 5D

SASKATCHEWAN
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

SATELLITE TECHNOLOGY
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

SATHIAR RESERVOIR

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

SATURATED FLOW

A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

SAVANNAH RIVER BASIN

Water Resources Appraisals for Hydroelectric Licensing: Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina,
W82-01440 6D

SAVINJA RIVER

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

SCOTLAND

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

SCREENS

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

SEA ICE

018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

SEASONAL VARIATION

Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

A Successful Low Technology Wastewater Process,
W82-01178 5D

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

SEASONAL VARIATIONS

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

SEDIMENT-CARRYING CAPACITY

Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

SEDIMENT CONTROL

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

SEDIMENT DEPOSITION

Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

SEDIMENT DEPOSITION, *RESERVOIR SILTING

A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

SEDIMENT DISCHARGE

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

SEDIMENT DISTRIBUTION

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

SEDIMENT EROSION

Gully Erosion,
W82-01407 2J

SEDIMENT TRANSPORT

Transports in the Duluth-Superior Harbor,
W82-01136 5B

Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 2J

Concentrated Flow Relationships,
W82-01409 2J

River Bed Aggradation Due to Overloading,
W82-01486 2J

SEDIMENT YIELD

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

SEDIMENTATION

Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

Developments in Sedimentation and Flotation,
W82-01391 5F

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

SEDIMENTS

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

Aquatic Sediments,
W82-01279 5B

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

SEEPAGE CONTROL

Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

SEISMIC WAVES

Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

SENECA LAKE

Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

SEPARATION TECHNIQUES

A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

SEPTIC TANKS

Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

SETTLING VELOCITY

Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

SEVERN RIVER

Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

SEWER SYSTEMS

Wastewater Collection,
W82-01251 5D

SEWERS

Redesign Controls Manhole Leakage,
W82-01237 8G

SHEAR STRESS
Concentrated Flow Relationships.
W82-01409 2J

SHELLFISH
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972.
W82-01455 6E

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract.
W82-01508 5A

SHIPS
Transports in the Duluth-Superior Harbor.
W82-01136 5B

SHORES
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario.
W82-01156 2J

SIMULATION
Time Distribution of Clock Hour Rainfall.
W82-01402 2A

SIMULATION ANALYSIS
Significant Features of Emitter Flushing Mode Characteristics.
W82-01576 3F

SITE SELECTION
Land Treatment Site Evaluation in Southeastern Mountainous Areas.
W82-01596 5D

SLOPE STABILIZATION
Electro-Osmosis Chemistry and Water Quality.
W82-01518 5E

SLOPES
Modeling Erosion and Sediment Yield from Flatland Watersheds.
W82-01406 2J

Trickle Irrigation Lateral Design on Sloping Fields.
W82-01537 8C

SLUDGE CONDITIONING
Demonstration Testing of Alum Recovery by Liquid Ion Exchange.
W82-01167 5D

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges.
W82-01387 5E

SLUDGE DIGESTION
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation.
W82-01130 5E

New Approaches to Anaerobic Sludge Digestion.
W82-01398 5D

SLUDGE DISPOSAL
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation.
W82-01130 5E

Sludge Treatment, Utilization, and Disposal.
W82-01247 5E

Health Effects Associated with Wastewater Treatment and Disposal.
W82-01255 5C

Identification and Reclamation of Chromium Sludge Disposal Sites.
W82-01437 5E

SLUDGE THICKENING
High-Solubility Gas Flotation.
W82-01184 5D

SLUDGE TREATMENT
Identification and Reclamation of Chromium Sludge Disposal Sites.
W82-01437 5E

SLURRIES
Soil-Bentonite Supply Trench Cutoffs.
W82-01599 8D

SMALL WATERSHEDS
Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona.
W82-01306 2D

SNAKE LAKE
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets.
W82-01103 2F

SNAKE RIVER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79.
W82-01139 6D

SNOW
Anomalous Snowfall Caused by Natural-Draft Cooling Towers.
W82-01512 2B

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice.
W82-01572 5A

SNOW COVER
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow.
W82-01311 7B

Compatibility of Canadian Snowfall and Snow Cover Data.
W82-01466 2C

SNOW DEPTH
The Significance of Snowmelt on Water Supplies in the Northeast.
W82-01488 2A

SNOW SURVEYS
Compatibility of Canadian Snowfall and Snow Cover Data.
W82-01466 2C

SNOW TRAPS
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan.
W82-01117 3F

SNOWMELT
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow.
W82-01311 7B

The Significance of Snowmelt on Water Supplies in the Northeast.
W82-01488 2A

Snowmelt Prediction in a Subarctic Drainage Area.
W82-01571 2C

SOIL ADSORPTION CAPACITY
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32.
W82-01318 5B

SOIL CHEMISTRY
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization.
W82-01135 2G

Enrichment Ratios for Water Quality Modeling.
W82-01410 2J

Nitrate Production, Uptake, and Leaching.
W82-01411 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands.
W82-01412 5B

Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties.
W82-01480 5E

SOIL COMPACTION
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands.
W82-01323 2G

SOIL CONSERVATION
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms.
W82-01134 4D

SOIL CONTAMINATION
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact.
W82-01415 5B

Mapping Contaminated Soil Plumes by Kriging.
W82-C1423 5G

SOIL EROSION
Erosivity 'R' for Individual Design Storms.
W82-01403 2J

Enrichment Ratios for Water Quality Modeling.
W82-01410 2J

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 4D

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis.
W82-01556 4D

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975.
W82-01563 2J

SOIL FILTERS
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions.
W82-01344 5D

SOIL MOISTURE
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan.
W82-01117 3F

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency.
W82-01345 7B

SOIL PHYSICS
Scaling of Infiltration Behavior in Dissimilar Porous Materials.
W82-01105 2G

SOIL PROPERTIES
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils.
W82-01118 2G

SOIL PROPERTIES

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta.
W82-01119 2G

Gully Erosion.
W82-01407 2J

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption.
W82-01477 5B

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process.
W82-01560 2G

Hydraulic Properties of Fullerton Cherty Silt Loam.
W82-01561 2G

SOIL SOLUTION

A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 5B

SOIL TEXTURE

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures.
W82-01107 2G

SOIL-TURF FILTER

Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen.
W82-01101 5D

SOIL WATER

Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation.
W82-01130 5E

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization.
W82-01135 2G

Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil.
W82-01174 2G

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage.
W82-01298 2G

The Water Balance of the Betwa Basin. India.
W82-01354 2A

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method.
W82-01458 2G

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process.
W82-01560 2G

Hydraulic Properties of Fullerton Cherty Silt Loam.
W82-01561 2G

Super Slurper Effects on Crust Strength. Water Retention. and Water Infiltration of Soils.
W82-01562 2G

SOIL-WATER-PLANT RELATIONSHIPS

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties.
W82-01369 2I

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence.
W82-01382 3F

SOLID WASTES

Solid Wastes and Water Quality.
W82-01269 5B

SOLUBILITY

Soluble Element Concentrations and Complexation in Southeastern Lake Michigan.
W82-01147 2H

High-Solubility Gas Flotation.
W82-01184 5D

SOLUTE TRANSPORT

Mass Transport of Solutes in Dual-Porosity Media.
W82-01104 5B

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion.
W82-01179 2F

A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media.
W82-01461 5B

SONOITA CREEK

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona.
W82-01306 2D

SOUTH AFRICA

A Look at Some Water Reclamation Plants in Southern Africa.
W82-01352 5D

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay.
W82-01367 5B

SOUTH CAROLINA

Water Resources Data for South Carolina. Water Year 1980.
W82-01211 7C

SOUTH DAKOTA

Ecology of Larval Fishes in Lake Oahe. South Dakota.
W82-01444 6G

SOUTH PLATTE RIVER

Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water.
W82-01193 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado.
W82-01301 6A

SOUTH POLE

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation.
W82-01529 2C

SPATIAL DISTRIBUTION

Nearshore Spatial Distribution of Fishes in Gill Net Samples. Cayuga Lake. New York.
W82-01195 7A

SPAWNING

Ecology of Larval Fishes in Lake Oahe. South Dakota.
W82-01444 6G

SPECIATION

The Physicochemical Speciation of Cd. Pb. Cu. Fe. and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River.
W82-01498 5B

SPECTROPHOTOMETRY

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow. Firn and Ice.
W82-01572 5A

SPILLWAYS

Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works.
W82-01446 8A

SPLIT TREATMENT

Chemical Equilibria in Split-Treatment Softening of Water.
W82-01165 5F

SPRINKLER IRRIGATION

Irrigation Management of Colorado River Water with Increase in Salinity.
W82-01226 3C

SPRINKLERS

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm.
W82-01575 3F

STABILITY ANALYSIS

Stability of Activated Sludge Processes Based on Statistical Measures.
W82-01489 5D

STABILIZATION LAGOONS

Lagoons and Oxidation Ponds.
W82-01244 5D

STABILIZATION PONDS

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds.
W82-01541 5D

STAGNANT WATER

Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)).
W82-01357 2H

STANDARDS

Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater'.
W82-01186 5A

STATE JURISDICTION

Federal Common Law of Nuisance Expands.
W82-01337 6E

STATISTICAL ANALYSIS

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures.
W82-01107 2G

Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics.
W82-01317 2E

Stability of Activated Sludge Processes Based on Statistical Measures.
W82-01489 5D

Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall.
W82-01527 2B

STEEL INDUSTRY

Steel Industry Wastes.
W82-01264 5D

STOCHASTIC HYDROLOGY

Simulation of Daily Weather Data Using Theoretical Probability Distributions.
W82-01526 2B

STOCHASTIC PROCESSES

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process.
W82-01560 2G

STORM RUNOFF

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California.
W82-01295 4C

STORM WATER
Urban Runoff and Combined Sewer Overflow.
W82-01254 5B

STRATIFIED FLOW
Vertical Velocity Profiles in Stratified Flows.
W82-01171 8B

STREAM EROSION
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications.
W82-01597 2E

STREAMFLOW
Using Computed Stream Flow in Watershed Analysis.
W82-01538 2A

STREAMS
Dissolved Oxygen in Streams and Reservoirs.
W82-01272 5G

STREPTOCOCCUS
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources.
W82-01564 5A

STRINGFELLOW QUARRY
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site.
W82-01416 5G

STRUCTURAL ENGINEERING
Soil-Bentonite Supply Trench Cutoffs.
W82-01599 8D

SUBMARINE SPRINGS
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline.
W82-01349 3B

SUBSURFACE MAPPING
Mapping Contaminated Soil Plumes by Kriging.
W82-01423 5G

SULFUR COMPOUNDS
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere.
W82-01470 2K

SUMMER RAINFALL
An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis.
W82-01528 2B

SUPERCOOLING
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration.
W82-01524 7B

SURFACE-GROUNDWATER RELATIONS
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water.
W82-01193 6A

SURFACE RUNOFF
Soluble N and P Concentrations in Surface Runoff Water.
W82-01413 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption.
W82-01477 5B

SURFACE WATER
Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays.
W82-01235 5A

SUSPENDED LOAD
Developments in Sedimentation and Flotation.
W82-01391 5F

SUSPENDED SEDIMENTS
Unsteady One-Dimensional Settling of Suspended Sediment.
W82-01463 2J

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan.
W82-01499 2H

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii.
W82-01531 2J

SWIMMING POOLS
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools.
W82-01124 5A

SYNTHESIS
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup.
W82-01577 5D

SYNTHETIC FUELS
Synthetic Fuel Effluents.
W82-01263 5B

SYSTEMS ANALYSIS
Systems Analysis.
W82-01303 6A

Study of a Complex Water Resources System with Screening and Simulation Models.
W82-01309 6A

TAILINGS
Siting and Design of Tailings Impoundments.
W82-01588 8A

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

TAMPA
Demonstration Testing of Alum Recovery by Liquid Ion Exchange.
W82-01167 5D

TEMPERATURE
Canopy Temperature as a Crop Water Stress Indicator.
W82-01106 2I

TEMPORAL DISTRIBUTION
Time Distribution of Clock Hour Rainfall.
W82-01402 2A

Recent Acidification of Precipitation in North America.
W82-01514 5B

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds.
W82-01520 2H

TEXAS
Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980 -Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

TEXTILE MILL WASTES
Textile Wastes.
W82-01259 5D

THERMAL POLLUTION
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

Power Industry Wastes.
W82-01265 5B

Thermal Effects.
W82-01275 5C

THERMAL STRESS
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

THERMAL WATER
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

THERMODYNAMICS
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

TIDES
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

TIDEWATER
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

TILE DRAINAGE
Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

TILE DRAINS
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

TIME SERIES ANALYSIS
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

TOMATOES
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

TOTAL ORGANIC CARBON
Organics.
W82-01239 5A

TOXICITY
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

Abundance of Organic Compounds in Water.
W82-01162 5A

Substrate Associated Microfauna.
W82-01283 5C

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

TOXINS
Bioassays - Procedures and Results,
W82-01277 5A

TRACE ELEMENTS
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

TRACE METALS
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

TRACERS
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

TRANSMISSIVITY
A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

TRAP EFFICIENCY
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir.
W82-01471 4A

TREATMENT PLANTS
Advanced Wastewater Plant is Energy Saver.
W82-01177 5D

TRIBUTARIES
Drainage Network Structure and the Diameter-Magnitude Relation.
W82-01308 2A

TRICKLE IRRIGATION
Trickle Irrigation Lateral Design on Sloping Fields.
W82-01537 8C

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

TRITIUM
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

TROUT
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

TURBIDITY
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

TURBIDITY CURRENTS
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

TURBULENT FLOW
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

TUSCAN COASTS
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

ULTRAFILTRATION
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

UNDERGROUND WASTE DISPOSAL
Artificial Groundwater Recharge,
W82-01110 4B

Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

UNITED KINGDOM
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

UNOX PROCESS
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System.
W82-01594 5D

UNSATURATED FLOW
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

UNSTEADY FLOW
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

URANIUM
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

URBAN RUNOFF
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada.
W82-01200 5G

Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

Estimation of Impervious-Area Washoff Parameters,
W82-01465 4C

USER CHARGES
On Water Tariff Equalization Policies,
W82-01175 6C

UTAH
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

VEGETABLE CROPS
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

VEGETATION
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

VELOCITY DISTRIBUTION
Vertical Velocity Profiles in Stratified Flows,
W82-01171 8B

VIRUSES
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 5A

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

Microbiology of Wastewater Treatment,
W82-01291 5D

Mechanism of Enteroviral Inactivation by Ozone,
W82-01482 5D

A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

WAKEBY DISTRIBUTION
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 2E

WALES
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

WASTE DISPOSAL
Solid Wastes and Water Quality,
W82-01269 5B

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

Rural Sanitation in Developing Countries,
W82-01392 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

WASTE DUMPS
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

Love Canal: Chemical Contamination and Migration,
W82-01436 5B

WASTE IDENTIFICATION
Abundance of Organic Compounds in Water,
W82-01162 5A

WASTE WATER TREATMENT
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation,
W82-01589 5D

WASTEWATER ANALYSIS
Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

WASTEWATER COLLECTION
O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

Wastewater Collection,
W82-01251 5D

The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 5D

WASTEWATER DISPOSAL
Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

WASTEWATER FACILITIES
O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 6A

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

WASTEWATER LAGOONS
The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

WASTEWATER MANAGEMENT
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

WASTEWATER RENOVATION
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

WASTEWATER TREATMENT
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

High-Solubility Gas Flotation,
W82-01184 5D

Energy Requirement for Small Wastewater Treatment Systems.
W82-01185 5D

Data Base Development for the Design of a Radium-226 Removal Process.
W82-01188 5D

Denitrification of Blackwater with Greywater.
W82-01225 5D

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions.
W82-01232 5C

Physical and Chemical Methods.
W82-01241 5D

Biological Filters.
W82-01242 5D

Activated Sludge.
W82-01243 5D

Dentrification.
W82-01246 5D

Onsite Alternatives for Treatment and Disposal.
W82-01248 5D

Disinfection.
W82-01250 5D

Health Effects Associated with Wastewater Treatment and Disposal.
W82-01255 5C

Meat-, Fish-, and Poultry-Processing Wastes.
W82-01256 5D

Fermentation Industry.
W82-01257 5D

Dairy Wastes.
W82-01258 5D

Textile Wastes.
W82-01259 5D

Petroleum Processing Wastes.
W82-01262 5D

Steel Industry Wastes.
W82-01264 5D

Chemicals and Allied Products.
W82-01267 5D

Microbiology of Wastewater Treatment.
W82-01291 5D

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application.
W82-01343 5D

Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions.
W82-01344 5D

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France).
W82-01351 6F

Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow.
W82-01385 5D

Scaynes Hill STW Extensions Include Plastic Media Filtration.
W82-01386 5D

Rural Sanitation in Developing Countries.
W82-01392 5D

New Approaches to Anaerobic Sludge Digestion.
W82-01398 5D

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge.
W82-01428 5G

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites.
W82-01430 5D

Environmental Impact and Health Effects of Wastewater Chlorination.
W82-01451 5D

Anaerobic Carbon Filter for Degradation of Phenols.
W82-01454 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion.
W82-01468 5D

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

The Wayne County, Michigan, Wastewater Collection and Treatment System.
W82-01505 5D

Detroit - Fresh Clean Water.
W82-01506 5D

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil.
W82-01515 3C

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds.
W82-01541 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes.
W82-01544 5D

Pipeline Friction Losses for Wastewater Sludges.
W82-01545 5D

Operational Problems with Rotating Biological Contactors.
W82-01549 5D

Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup.
W82-01577 5D

Siting and Design of Tailings Impoundments.
W82-01588 8A

Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System.
W82-01594 5D

Land Treatment Site Evaluation in Southeastern Mountainous Areas.
W82-01596 5D

WASTEWATER TREATMENT FACILITIES

Advanced Wastewater Plant is Energy Saver.
W82-01177 5D

Survey of Treatment Plant Design and Operation Deficiencies.
W82-01543 5D

WATER

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level.
W82-01370 2H

WATER ANALYSIS

A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis.
W82-01123 5A

Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor.
W82-01127 2F

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux).
W82-01133 5A

Fixed Endpoint Alkalinity Determination.
W82-01187 7B

Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods.
W82-01229 5A

Inorganics.
W82-01238 5A

Organics.
W82-01239 5A

Continuous Monitoring, Automated Analysis, and Sampling Procedures.
W82-01240 5A

Water-Quality Monitoring: A Global Approach.
W82-01339 7A

The Application of Mutagenicity Testing to Drinking Water.
W82-01487 5A

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector.
W82-01509 5A

Concentrating Organics in Water for Biological Testing.
W82-01591 5A

WATER CIRCULATION

Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

WATER CONSERVATION

A Look at Some Water Reclamation Plants in Southern Africa.
W82-01352 5D

Organic Contamination of Ground Water: Tell it All.
W32-01474 5C

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought.
W82-01553 3D

WATER CONTENT

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration.
W82-01524 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds.
W82-01525 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation.
W82-01529 2C

WATER DEMAND

Water Multipliers--Regional Impact Analysis.
W82-01138 6A

Supply-Demand Coordination in Water Resources Management.
W82-01299 6C

WATER DEPTH

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

WATER DISTRIBUTION

Malawi: A Community Approach.
W82-01365 5F

WATER LAW

Nebraska Ground Water Law and Administration.
W82-01236 6E

Law,
W82-01302 6E

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972.
W82-01455 6E

A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 6E

Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

WATER LEVEL

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level.
W82-01370 2H

WATER LEVEL FLUCTUATIONS

Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

WATER LEVELS

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

WATER MANAGEMENT

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

Systems Analysis,
W82-01303 6A

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

Managing Land to Meet Water Quality Goals,
W82-01557 4D

WATER POLICY

On Water Tariff Equalization Policies,
W82-01175 6C

WATER POLLUTION

Abundance of Organic Compounds in Water,
W82-01162 5A

WATER POLLUTION CONTROL

Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

Coal and Coal Mine Drainage,
W82-01261 5G

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

Law,
W82-01302 6E

Systems Analysis,
W82-01303 6A

Economics,
W82-01304 5G

Federal Common Law of Nuisance Expands,
W82-01337 6E

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 6F

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 6E

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

WATER POLLUTION EFFECTS

Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

Pulp and Paper Industry Effluent Management,
W82-01260 5D

Coal and Coal Mine Drainage,
W82-01261 5G

Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Freshwater Macroinvertebrates,
W82-01281 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 5C

A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

WATER POLLUTION PREVENTION

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

WATER POLLUTION SOURCES

Marine and Estuarine Pollution,
W82-01274 5C

Microbiology of Wastewater Treatment,
W82-01291 5D

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

Enrichment Ratios for Water Quality Modeling,
W82-01410 2J

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

WATER POLLUTON SOURCES

Gully Erosion,
W82-01407 2J

WATER QUALITY

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

Transports in the Duluth-Superior Harbor,
W82-01136 5B

Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

Water Resources Data for Texas, Water Year 1980--Volume 1, Arkansas River Basin, Red

WATER QUALITY

River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 7C

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Solid Wastes and Water Quality,
W82-01269 5B

Microbiology of Water,
W82-01284 5B

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

Estimation of Impervious-Area Washoff Parameters,
W82-01465 4C

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

WATER QUALITY CONTROL
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

WATER RENOVATION
Water Reclamation and Reuse,
W82-01252 3C

WATER REQUIREMENTS
A Parametric Crop Water Use Model,
W82-01310 2I

WATER RESOURCES DEVELOPMENT
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

Water Resources Appraisals for Hydroelectric Licensing: Brazos River Basin, Texas-New Mexico,
W82-01439 6D

Water Resources Appraisals for Hydroelectric Licensing: Savannah and Edisto River Basins Area: Georgia-South Carolina-North Carolina,
W82-01440 6D

Water Resources Appraisals for Hydroelectric Licensing: American River Basin, California,
W82-01441 6D

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

Managing Land to Meet Water Quality Goals,
W82-01557 4D

Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

Hydropower--An Old Technology for a New Era,
W82-01593 4A

WATER RESOURCES MANAGEMENT
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

WATER REUSE
Water Reclamation and Reuse,
W82-01252 3C

Petroleum Processing Wastes,
W82-01262 5D

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 5D

WATER RIGHTS
A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 6E

WATER SAMPLING
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

WATER SHORTAGE
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 3D

WATER SOFTENING
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

WATER SPORTS
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

WATER STRESS
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

WATER SUPPLY
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

Small Water Systems: Role of Technology,
W82-01542 5F

WATER SUPPLY DEVELOPMENT
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

Malawi: A Community Approach.
W82-01365 5F

The Water Decade (1981-1990).
W82-01534 6E

WATER SUPPLY SYSTEMS
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

WATER TABLE FLUCTUATIONS
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

WATER TREATMENT
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

Developments in Sedimentation and Flotation,
W82-01391 5F

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

Organics in Water - An Engineering Challenge,
W82-01540 5F

WATER TREATMENT FACILITIES
Expansion of Effluent Constrained Treatment Plants,
W82-01355 5D

The River Ouse Water Supply Scheme,
W82-01371 5F

Scaynes Hill STW Extensions Include Plastic Media Filtration,
W82-01386 5D

Small Water Systems: Role of Technology,
W82-01542 5F

WATER USE EFFICIENCY
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 3D

WATER YIELD
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

WATERPROOFING
Redesign Controls Manhole Leakage,
W82-01237 8G

WATERSHED MODELS
Managing Land to Meet Water Quality Goals,
W82-01557 4D

WATERSHEDS
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

WAVE PROPAGATION
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

WAVES
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

WAYNE COUNTY
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 5D

WEATHER DATA SIMULATION
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

WEATHER MODIFICATION
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 2B

WEED CONTROL
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

WELL DATA
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

WELL HYDRALICS
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

WELL YIELD
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

WELLS
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Identification of the Wairakei Geothermal System,
W82-01312 2F

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

WEST AFRICA
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

WETLANDS
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

WHITE WATER
Preferences for Allocating River Recreation Use,
W82-01181 6D

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 5D

WILDERNESS AREAS
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

WINDHAM
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

WISCONSIN
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

A Successful Low Technology Wastewater Process,
W82-01178 5D

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

YANGTZE RIVER
Yangtze Gorges Scheme Could Yield 110 TWh/Year,
W82-01394 8A

YORKSHIRE WATER AUTHORITY
The River Ouse Water Supply Scheme,
W82-01371 5F

YUGOSLAVIA
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

ZINC
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Water,
W82-01388 5B

ZOOPLANKTON
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

AUTHOR INDEX

ABERNATHY, A. R.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

ABSALON, J. R.
Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

ADDISON, R.
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

AGRAWAL, R. P.
The Water Balance of the Betwa Basin, India,
W82-01354 2A

AHLQUIST, A. J.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

AHMAD, A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

AHUJA, L. R.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

AIKEN, J. D.
Nebraska Ground Water Law and Administration,
W82-01236 6E

AJMAL, M.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

AKIELASZEK, J. J.
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

AL-JEBOURI, M. M.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

ALBIGNAT, J. P.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

ALDOUS, K.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

ALEXANDER, M.
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

ALLAN, R. J.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

ALLEMAN, J. E.
Activated Sludge,
W82-01243 5D

ALLEN, E. T.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

ALLEN, M. J.
Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

ALLEY, W. M.
Estimation of Impervious-Area Washoff Parameters,
W82-01465 4C

ALONSO, C. V.
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

AMOOZEGAR-FARD, A.
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

ANDERSEN, P. F.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

ANDERSON, E. L.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

ANDERSON, M. P.
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

ANDERSON, R. L.
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

ARCHER, D. R.
A Catchment Approach to Flood Estimation,
W82-01397 2E

ARNOLD, L. E.
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

ARUMUGAM, P. T.
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

AUCLAIR, B.
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 6F

AUER, M. T.
Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

AVERILL, D. W.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

BABALOLA, O.
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

BAJARD, Y.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

BALTZER, R. A.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

BANDT, K. E.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

BARACOS, P. C.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

BARNES, A. A. JR.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

BARROW, N. J.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

BARTHOLOMEW, W. C.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

BAZARAA, A.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

BEAMS, J.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

BEAR, J.
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

BEATTIE, D. M.
Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 2H

BEAUPRE, R. T.
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

BECK, W. W. JR.
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

BEDARD, P.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

BEN-ASHER, J.
Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 2D

BENFIELD, E. F.
Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

BENNETT, O. L.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

BENSON, C. R.
Yield Verification of a Dolomite Aquifer in Northeast Illinois.
W82-01334 2F

BENSON, R. C.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing.
W82-01422 5G

BENZINGER, W. D.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes.
W82-01566 5D

BERGERON, M. P.
Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana.
W82-01481 2F

BERGLUND, S. H.
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis.
W82-01556 4D

BERMAN, J.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay.
W82-01367 5B

BERTHEL, R. O.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data.
W82-01523 7B

BEZDEK, J. C.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm.
W82-01575 3F

Significant Features of Emitter Flushing Mode Characteristics.
W82-01576 3F

BIBBY, R.
Mass Transport of Solutes in Dual-Porosity Media.
W82-01104 5B

BIEHL, T. G.
The Wayne County, Michigan, Wastewater Collection and Treatment System.
W82-01505 5D

BIERIG, H. W.
Detroit - Fresh Clean Water.
W82-01506 5D

BITTINGER, M. W.
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado.
W82-01301 6A

BLACHUT, S. P.
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada.
W82-01511 2C

BLACKBURN, T. R.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York.
W82-01151 5B

BLANCHAR, R. W.
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil.
W82-01224 2G

BLASING, T. J.
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680.
W82-01314 2B

BLAYLOCK, B. G.
Radioactive Wastes.
W82-01268 5D

BLUME, H. J. C.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline.
W82-01349 3B

BOBBA, A. G.
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer.
W82-01570 5B

BOBEE, B.
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics.
W82-01317 2E

BOELHOUWER, C.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion.
W82-01468 5D

BOHAC, C. E.
Dissolved Oxygen in Streams and Reservoirs.
W82-01272 5G

BOLTON, E. F.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay.
W82-01115 2I

BORDNER, R. H.
Microbiology: Methodology and Quality Assurance.
W82-01285 5A

BOREMAN, J.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries.
W82-01173 6G

BORGMANN, U.
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods.
W82-01125 5C

BORTNIK, V. N.
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level.
W82-01370 2H

BOST, J-F.
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France).
W82-01351 6F

BOUCHER, P.
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics.
W82-01317 2E

BOULDIN, D. R.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent.
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land.
W82-01340 5B

BOUMA, J.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands.
W82-01323 2G

BOUTIN, C.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau).
W82-01353 2H

BOWMAN, K. O.
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall.
W82-01527 2B

BOYCE, F. M.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

BOYLE, W. C.
Onsite Alternatives for Treatment and Disposal.
W82-01248 5D

BRAAM, F.
Effect of Copper on Nitrification in Activated Sludge.
W82-01497 5C

BRAIDS, O. C.
Ground Water.
W82-01273 2F

BRAKENSIEK, D. L.
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures.
W82-01107 2G

BRAND, J. I.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup.
W82-01577 5D

BRANDL, J. S.
Pharmaceutical Company's Aeration System Saves Energy.
W82-01180 5D

BRATBY, J. R.
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems.
W82-01166 5F

BRAUD, H. J.
Trickle Irrigation Lateral Design on Sloping Fields.
W82-01537 8C

BRAUN, H. E.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975).
W82-01190 5A

BRAY, D. I.
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers.
W82-01161 8B

BRENNIMAN, G. R.
Environmental Impact and Health Effects of Wastewater Chlorination.
W82-01451 5D

BRILL, E. D. JR.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems.
W82-01450 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems.
W82-01449 6A

BROCKSEN, R. W.
Entrainment and Impingement in Power Plant Cooling Systems.
W82-01276 6G

BROWER, G. R.
Solid Wastes and Water Quality.
W82-01269 5B

BROWNE, F. X.
Non-Point Sources.
W82-01270 5B

BROZKA, R. J.
Water Quality from Two Small Forested Watersheds in Southern Illinois.
W82-01140 4C

BRUCE, A. M.
New Approaches to Anaerobic Sludge Digestion,
W82-01398 5D

BRUEHL, D. H.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

BRUHN, J. A.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

BRUTSAERT, W. F.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

BRYSON, H. C.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

BUCHANAN, B.
Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 5D

BUDD, W. W.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

BUGGIANI, S. S.
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

BUIKEMA, A. L. JR.
Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

BUKATA, R. P.
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

BURDAN, P.
Organic Contamination of Ground Water: Tell it All,
W82-01474 5C

BURGESS, M. D.
Automatic Class-A Pan-Filling System,
W82-01326 7B

BURT, J. E.
A Parametric Crop Water Use Model,
W82-01310 2I

BURTON, D. T.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

BUSS, D. F.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

BUTLER, T. J.
Recent Acidification of Precipitation in North America,
W82-01514 5B

BUTTS, T. A.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

CALVERT, J. W.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

CAMERON, D. R.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

CAMPBELL, R. S.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

CANALE, R. P.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 5C

CARPENTER, A. B.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

CASH, F. M.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

CASPARIUS, R. E.
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

CHAMBERS, R. L.
Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

CHANEY, R. C.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

CHANG, C.
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

CHANG, H-M.
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 5D

CHANG, S-Y.
Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

CHATTERJEE, S.
Wastewater Collection,
W82-01251 5D

CHATTOPADHYAY, G. N.
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

CHATURVEDI, M. C.
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

CHENG, K. C.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

CHERKAUER, D. S.
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

CHERRY, J. A.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

CHIAN, E. S. K.
Mechanism of Enteroviral Inactivation by Ozone,
W82-01482 5D

Organics,
W82-01239 5A

CHING, C. T. K.
Water Multipliers--Regional Impact Analysis,
W82-01138 6A

CHIOCCHIO, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

CHOUDHURY, B. J.
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

CHOW, W.
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

CHRISTENSEN, S. W.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

CHU, T-Y. J.
Power Industry Wastes,
W82-01265 5B

CHUNG, A. K.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

CHUNG, N. K.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

CIBIK, C.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

CLARK, L.
Groundwater Investigations in the Vale of Stathmore,
W82-01400 2F

CLARK, R. M.
Small Water Systems: Role of Technology,
W82-01542 5F

CLARK, R. N.
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 2C

CLARKE, W. G.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

CLAYTON, A. J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

CLINE, G. C.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

COLQUHOUN, J. R.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

COLWELL, R. R.
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

COLYER, R. S.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

COMEAU, J. C.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

CONFORTI, P. M.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

CONNORS, S. D.
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

CONRAD, J. R.
Anaerobic Processes,
W82-01245 5D

CONROY, N. I.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

CONTRACTOR, D. N.
A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 7A

CONWAY, R. A.
High-Solubility Gas Flotation,
W82-01184 5D

COOK, C. J.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

COOK, N. G.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

COOLEY, K. R.
Erosivity 'R' for Individual Design Storms,
W82-01403 2J

COOMBS, E. G.
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

COOPER, C. L.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

COPAS, S. R.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

CORNELL, J. C.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

CORNWELL, D. A.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

COSTA, J. E.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

COSTELLO, R.
Denitrification of Blackwater with Greywater,
W82-01225 5D

COULOMBE, A. M.
Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

COWLING, E. B.
Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

COX, W. E.
Law,
W82-01302 6E

CRAMPTON, C. B.
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

CRANOR, R. O.
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 5D

CRAUN, G. F.
Disease Outbreaks Caused by Drinking Water,
W82-01289 5C

CRAVENS, J. B.
Thermal Effects,
W82-01275 5C

CRESSER, M. S.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

CRITTENDEN, J. C.
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

CRONHOLM, L. S.
Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 5C

CROSS, S. F.
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

CROSS, W. H.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

CULLEY, J. L.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

CULVER, C. F.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

CURRAN, C.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

D'APPOLONIA, D. J.
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

DAHLBERG, M. D.
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 7A

DAIGH, R. V.
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

DALY, C. J.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

DAMIANI, V.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

DANCE, K. W.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

DANIEL, J. R. K.
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 2A

DATTA, B.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

DAUCHY, J.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

DAVANZO, A. C.
Detroit - Fresh Clean Water,
W82-01506 5D

DAVEY, C. B.
Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 5C

DAVIDSON-ARNOTT, R. G. D.
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

DAVIES, T. T.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

DAVIS, C. O.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

DE HEER, H.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

DEFOE, D. L.
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

DENKHAUS, R.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

DENTON, M. S.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

DEPINTO, J. V.
Aquatic Sediments,
W82-01279 5B

DESAULNIERS, D. E.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

DEUDNEY, D.
Hydropower--An Old Technology for a New Era,
W82-01593 4A

DEWALLE, F. B.
Organics,
W82-01239 5A

DHAMOTHARAN, S.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

DIACON, A.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

DIESL, W. F.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 5B

DIKMEN, S. U.
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

DINSMORE, S. R.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 5D

DIRKS, V. A.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 2I

DOBSON, R.
The River Ouse Water Supply Scheme,
W82-01371 5F

DOLAN, R.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

DOLSKE, D. A.
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

DORAN, J. W.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

DOTY, R. D.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

DOWIAK, N. J.
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

DOYLE, T. J.
Surface Water Management at Hazardous Waste Sites,
W82-01429 5G

DOZIER, J.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

DRAKE, R. J.
Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

DRAPER, M.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

DRURY, D. D.
O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

DUFFY, D.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

DUMONT, H. J.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

DUNNE, T.
Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

DUVICK, D. N.
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

DYLLA, A. S.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

EADIE, B.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

FADIE, B. J.
Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

ECONOMOU-AMILLI, A.
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

EDWARDS, R. W.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

EDWARDS, S. J.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

EGELAND, D. R.
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 5D

EICHELBERGER, J. L.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

EID, B.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

ELLIOTT, R. A.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

ELLIS, D. V.
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

EMRICH, G. H.
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

ENGELBRECHT, R. S.
Mechanism of Enteroviral Inactivation by Ozone
W82-01482 5D

ENK, M. D.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

ERMAN, D. C.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

ESCOFFIER, F. F.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

ESPANA, C.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 8D

ESSINGTON, E. H.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

EVANS, M. S.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

EVANS, N. A.
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

FAHSELT, D.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

FANNIN, K. F.
Anaerobic Processes,
W82-01245 5D

FAUSEY, N. R.
Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

FAUST, C. R.
Computer Modeling and Ground-Water Protection,
W82-01336 2F

FAWUSI, M. O. A.
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 2I

FEDORS, J. C.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

FEIGENBAUM, S.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

FEIGIN, A.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

FERGUSON, B. K.
Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 4D

FERRARA, R. A.
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 5D

FEURER, J.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

FICK, G. W.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

FIELD, R.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

FIGURA, P.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

FITZGIBBON, J. E.
Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

FOGG, T. R.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

FONG, M.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

FORE, C. S.
Radioactive Wastes,
W82-01268 5D

FORGE, P.
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 2H

FORSTER, R.
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

FOSTER, G. R.
Concentrated Flow Relationships,
W82-01409 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 2J

FOWLER, E. B.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

FRADKIN, L. J.
Identification of the Wairakei Geothermal System,
W82-01312 2F

On Identification and Validation of Some Geothermal Models,
W82-01467 6A

FRANK, R.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

FRANK, U.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

FRASER, A. S.
Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

FRASER, D. J.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

FREA, J. I.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

FREEDMAN, S. D.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

FREESTONE, F. J.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

FREIBERG, J. E.
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

FRENKEL, H.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

FRIND, E. O.
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

FRITZ, E. S.
Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 8I

FRITZ, P.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

FRY, D. L.
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

FRY, W. E.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

FUGGLE, R. W.
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 5D

FULLER, W. H.
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

FULTON, J. M.
Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

FUNKE, J. W.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

FURTADO, J. I.
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 2H

FYFE, W. S.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

GARCIA, O.
A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 7B

GARDNER, W. S.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

GARNETT, P. H.
Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 6E

GEESEY, G. G.
Marine and Estuarine Pollution,
W82-01274 5C

GELDREICH, E. E.
Microbiology of Water,
W82-01284 5B

GEORGE, D. B.
Lagoons and Oxidation Ponds,
W82-01244 5D

GERAGHTY, J. J.
Evaluation of Hydrogeologic Conditions,
W82-01420 5G

GERRARD, E. D.
Bioassays - Procedures and Results,
W82-01277 5A

GERTLER, A. W.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

GHABOUSSI, J.
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 8D

GHASSEMI, M.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

GIABBAI, M.
Organics,
W82-01239 5A

GIANESSI, L. P.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

GIBBS, R. J.
Sites of River-Derived Sedimentation in the Ocean,
W82-01332 7B

GILPIN, R. R.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

GLACCUM, R. A.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

GOLABI, K.
Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

GOLDBERG, D. E.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

GOLIBER, P.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

GOODISON, B. E.
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

GOODYEAR, C. P.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 6G

GOSH, S.
Anaerobic Processes,
W82-01245 5D

GOTO, S.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

GOULD, J. P.
Disinfection,
W82-01250 5D

GOVE, G. W.
Pulp and Paper Industry Effluent Management,
W82-01260 5D

GRABOW, N. A.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

GRABOW, W. O. K.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

GRAETZ, D. A.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

GRAF, W. L.
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

GRAVES, W. C.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

GREEN, J. C.
A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 6E

GREENE, S.
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

GREER, W. T.
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 5D

GREIS, N. P.
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

GREVE, P. A.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

GRIFFIN, J. S.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

GRIFFIN, R. A.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

GRIFFITH, C. G.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

GRISAK, G. E.
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

GRISSINGER, E. H.
Gully Erosion,
W82-01407 2J

GRIZZARD, T.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

GROENEWOLD, J. C.
Dairy Wastes,
W82-01258 5D

GROSS, D. L.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

GROSSE, R. N.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

GROVER, R.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

GRUENFELD, M.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

GUARISO, G.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

GUILBAULT, G. G.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

GUITRON, A.
Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

GULLIVER, J. S.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

GUPTA, S. K.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

HAAN, C. T.
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

HAAS, C. N.
Disinfection,
W82-01250 5D

HAINES, T. A.
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 5B

HAIRSTON, J. R.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

HAKONSON, T. E.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

HAMAKER, P.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

HAMMITT, W. E.
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

HANKE, S. H.
On Water Tariff Equalization Policies,
W82-01175 6C

HANSON, C. L.
Automatic Class-A Pan-Filling System,
W82-01326 7B

HARDY, G. M.
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

HARGIS, D. R.
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

HARLEMAN, D. R. F.
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 5D

HARRISON, R. M.
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

HARRISS, R. C.
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

HARTLEY, P. E.
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

HARVEY, B. L.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

HARVEY, W. T.
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

HAWKINS, B. E.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

HAYDEN, C. M.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

HAYES, J. T.
A Parametric Crop Water Use Model,
W82-01310 2I

HEATON, T. H. E.
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

HECKMANN, R. A.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

HEIDTKE, T. M.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

HEINEMANN, H. G.
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

HELLER, R.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

HELMER, R.
Water-Quality Monitoring: A Global Approach,
W82-01339 7A

HEMSLEY, W. T.
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

HEMYARI, P.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 2G

HERBERT, I.
The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

HERDENDORF, C. E.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

HERGERT, G. W.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

HESS, C. T.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

HESSELBERG, R. J.
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

HEUER, T.
Wastewater Collection,
W82-01251 5D

HILL, D. E.
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 5D

HILL, G.
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

HILL, G. E.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

HILLAIRE-MARCEL, C.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

HILLMAN, R. M.
Land and Stream Salinity in Western Australia,
W82-01374 5B

HINRICHS, R.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

HIPEL, K. W.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

HIRATA, T.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

HITDLEBAUGH, J. A.
Operational Problems with Rotating Biological Contactors,
W82-01549 5D

HITE, J. C.
Economics,
W82-01304 5G

HJELMFELT, A. T.
Time Distribution of Clock Hour Rainfall,
W82-01402 2A

HO, M. H.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

HOLDRINET, M. V. H.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

HOLL, W.
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

HOLMES, N. T. H.
Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

HOLT, R. F.
Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

HOOD, M. A.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

HOPKINS, L. D.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

HOUCK, M. H.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

HOUSMAN, J.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

HOUSTON, K. L.
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

HOWARD, A.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

HRUDEY, S. E.
Water Reclamation and Reuse,
W82-01252 3C

HUBBELL, J. W.
Detroit - Fresh Clean Water,
W82-01506 5D

HUCK, P. M.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

HUDSON, M. C.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

HUISKES, A. H. L.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

HUNT, G. E.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

HUNT, J. M.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

HUPPERT, H. E.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

HUSS, J. B.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

HUSSONG, D.
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

HUTCHINS, S.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

HYNES, H. B. N.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

IBANEZ, F.
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

IDSO, S. B.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

ILLANGASEKARE, T.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

IRVINE, R. B.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

IRVINE, R. L.
Fermentation Industry,
W82-01257 5D

ISAKA, H.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 2H

JACKSON, F. H.
Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 6A

JACKSON, L. A.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

JACKSON, R. D.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

JAIN, S. C.
River Bed Aggradation Due to Overloading,
W82-01486 2J

JAMEEL, H.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

JAMES, S. C.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

JANARDAN, K. G.
Abundance of Organic Compounds in Water,
W82-01162 5A

JARRETT, R. D.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 2E

JARVIS, R. S.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

JAYANGOUDAR, I.
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 2H

JEFFREE, R. A.
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

JENKINS, D.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

JENKINS, T. F.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

JERGER, D. E.
Anaerobic Processes,
W82-01245 5D

JOB, S. V.
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

JOHNSON, A. H.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

JOHNSON, B. T.
Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

JOHNSON, D. M.
An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 2B

JOHNSON, M. G.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

JOHNSON, S. M.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

JOLLEY, R. L.
Concentrating Organics in Water for Biological Testing,
W82-01591 5A

JONAS, T. D.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

JONES, R. D.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

JORGENSEN, D. G.
Geohydrologic Models of the Houston District, Texas,
W82-01335 2F

JOSEPH, J. B.
Artificial Groundwater Recharge,
W82-01110 4B

JOSHI, S. R.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

JUDE, D. J.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

JUDKINS, J. F. JR.
Textile Wastes,
W82-01259 5D

JURINAK, J. J.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 5B

KANAREK, M. S.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

KANNAN, V.
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 2H

KAPULER, I.
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

KASSAKHIAN, G. H.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

KEAN, W. F.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

KELLEHER, D. L.
Investigation of Volatile Organics Removal,
W82-01490 5F

KELLER, W.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

KENDALL, B. M.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 3B

KENNEDY, C. W.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

KEYS, C. H.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

KHAN, M. A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

KHAN, N. A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

KHERA, K. L.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

KIEHLING, B.
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 5F

KIM, C. S.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

KIRKLAND, K. J.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 3F

KISSEL, D. E.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

KLAPWIJK, A.
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

KLAUSNER, S. D.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

KLEMETSON, S. L.
Biological Filters,
W82-01242 5D

KLINGER, S. A.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 8I

KNEEBONE, W. R.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

KNOCKE, W. R.
Electroplating and Cyanide Wastes,
W82-01266 5D

KOENIG, L. R.
Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 2B

KOPPULA, S. D.
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 6A

KORDIC, J. R.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

KORVEN, H. C.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

KOSTER, W. C.
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 5G

KOTHARI, M. S.
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

KOVOOR, A.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

KOWAL, N. E.
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

KRALJ, M.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

KRONBERG, B. I.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

KRONFELD, J.
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

KROTHE, N. C.
Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 2F

KRUP, M.
Dentrification,
W82-01246 5D

KUEBLER, B. W.
Computer Modeling of Los Angeles Water Resources,
W82-01168 6A

KUEHL, D. W.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

KUFS, C.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

KUIPER, L. K.
A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 2F

KURTZ, J.
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

KUSHNER, D. J.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

KWIATKOWSKI, R. E.
Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

LAAK, R.
Denitrification of Blackwater with Greywater,
W82-01225 5D

LACKEY, S. L.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

LAL, D.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

LAMB, T. J.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

LANCASTER, R. L.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

LANE, L. J.
Concentrated Flow Relationships,
W82-01409 2J

LANGER, G.
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

LANZA, G. R.
Substrate Associated Microfauna,
W82-01283 5C

LARSON, G. L.
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 6A

LARSON, R. J.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

LAUBE, V. M.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

LAWS, E. A.
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

LAXEN, D. P. H.
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 5B

LEE, M. Y.
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 3D

LEGGETT, D.
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D

LEHMAN, W. F.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

LEMKE, A. E.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

LENTZ, J. J.
Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 2G

LEONARD, E. N.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

LEONARD, R. A.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

LEPPARD, G. G.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

LESTER, J. N.
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

LEUTHART, C. A.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

LEVESQUE-MADORE, C. S.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

LEYDEN, D. E.
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

LIKENS, G. E.
Recent Acidification of Precipitation in North America,
W82-01514 5B

LIMONI, H.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

LIN, H.
Bacteria: Man's Allies in Water Pollution Control,
W82-01158 5D

LINDBERG, S. E.
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 5B

LINDSAY, A. H.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

LITCHFIELD, J. H.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

LITTLE, L. W.
Bioassays - Procedures and Results,
W82-01277 5A

LOH, I. C.
Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

LUDWIGS, R. S.
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

LUND, L. J.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

LUTHIN, J. N.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

LUTHY, R. G.
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

LUXMOORE, R. J.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

MACIOROWSKI, A. F.
Bioassays - Procedures and Results,
W82-01277 5A

MACKINNON, M.
A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

MACLEOD, D. A.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

MAEYER-CLEEMPOEL, S. DE
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

MAHAJAN, R. K.
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

MAIDMENT, D.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

MALCYZK, J. M.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

MALE, L. M.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

MALECHA, S. R.
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

MALONE, P. G.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

MANDAL, L. N.
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 3C

MANDEL, R. M.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

MANDL, C. E.
A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 6A

MANNING, P. J.
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 6E

MARGREY, S. L.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

MARRY, J. R.
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

MARSH, T. J.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

MARTEL, C. J.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

MARTIN, D. L.
Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

MARTIN, S. C.
Aquatic Sediments,
W82-01279 5B

MARTINCIC, A.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

MASON, R. J.
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

MATHER, J. R.
Using Computed Stream Flow in Watershed Analysis,
W82-01538 2A

MATHIS, B. J.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

MATIS, S.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

MATISOFF, G.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

MATSUDA, H.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

MATTHIAS, J. A.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

MAUN, M. A.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

MAY, T. W.
Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77. National Pesticide Monitoring Program,
W82-01584 5B

MAYBERRY, K. S.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

MAYS, L. W.
Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Risk Models for Flood Levee Design,
W82-01307 8A

MCCANN, S. B.
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 2C

MCCARTY, P. L.
Organics in Water - An Engineering Challenge,
W82-01540 5F

MCCAULEY, C. A.
Results of Acidizing Water Wells in Arizona,
W82-01199 4B

MCCOOL, S. F.
Preferences for Allocating River Recreation Use,
W82-01181 6D

MCCUEN, R. H.
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 2G

MCCUTCHEON, S. C.
Vertical Velocity Profiles in Stratified Flows,
W82-01171 8B

MCDERMOTT, G. N.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

MCDOWELL, L. L.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

MCDUFFIE, B.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

MCGINNIS, D. F. JR.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

MCINTYRE, A. E.
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

MCKENZIE, C. N.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 5C

MCKINLEY, J. W.
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

MCKINNEY, G. L.
Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

MCLACHLAN, C. N. S.
U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 5A

MCLAUGHLIN, D. B.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

MCLEOD, A. I.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

MCNABB, A.
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

MCVEY, J.
Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 6E

MEARNS, A. J.
Marine and Estuarine Pollution,
W82-01274 5C

MEDINE, A. J.
Eutrophication,
W82-01271 2H

MEDLAR, S.
The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 2A

MELEAR, E. L.
Physical and Chemical Methods,
W82-01241 5D

MENSER, H. A.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

MENZEL, R. G.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

Enrichment Ratios for Water Quality Modeling,
W82-01410 2J

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

MERCER, J. W.
Computer Modeling and Ground-Water Protection,
W82-01336 2F

MERRIAM, R. A.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

MEYER, J.
Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

MEYERS, P. A.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 2H

Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

MEYERS, T. E.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

MICHALSON, E. L.
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 4D

MIDDLEBROOKS, C. H.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

MIDDLEBROOKS, E. J.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01135 5D

MILLER, R. D.
Operational Problems with Rotating Biological Contactors,
W82-01549 5D

MILLHAM, C. B.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

MILLWARD, G. E.
The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 5B

MITCHELL, S. F.
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

MOFFA, P. E.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

MOFFETT, D.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

MOHAMMAD, M-B. M.
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

MOLL, R. A.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

MOLZ, F. J.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

MOODY, J. L.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

MOORE, S. F.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

MOREL-SEYTOUX, H. J.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

MORGAN, C. H.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

MORLEY, B. M.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

MUDROCH, A.
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 2H

MULBARGER, M. C.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 5D

MUNTER, J. A.
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 2F

MURARKA, I. P.
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

MURPHREE, C. E.
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

MURPHY, C. B. JR.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 5C

MURPHY, K. L.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

MURRAY, J. P.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

MUSSER, W. N.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

MUTCHLER, C. K.
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

NADLER, A.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

NALEPA, T. F.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

NARANG, R.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

NASS, H. G.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

NEIBLING, W. H.
Sediment Transport Capacity of Overland Flow,
W82-01408 2J

NEILSEN, G. H.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 5B

NELSON, C. O.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

NELSON, P. O.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 5D

NELSON, R. F.
High-Solubility Gas Flotation,
W82-01184 5D

NELSON, W. R.
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

NEWBOLD, J. D.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

NICHOLSON, L. W.
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 5C

NIEDERLEHNER, B. R.
Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

NIKU, S.
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

NOFZIGER, D. L.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 2G

NOLTE, B. H.
Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

NOMANI, A. A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

NORMAN, D.
Organics,
W82-01239 5A

NORTON, S. A.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F
Radon-222, In Potable Water Supplies of New England,
W82-01221 5B

O'BANNON, C. E.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

O'KEEFE, P.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

O'ROURKE, P. A.
A Parametric Crop Water Use Model,
W82-01310 2I

OHLE, W.
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 2H

OLEM, H.
Coal and Coal Mine Drainage,
W82-01261 5G
Power Industry Wastes,
W82-01265 5B

OMAN, G. J.
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

OMERNIK, J. M.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 5B

ONSTAD, C. A.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

ORNDORFF, S. A.
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 5C

OSBORNE, J. A.
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

OSHEKA, J. W.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

OSHIDA, P. S.
Marine and Estuarine Pollution,
W82-01274 5C

OSTEEN, C.
Managing Land to Meet Water Quality Goals,
W82-01557 4D

OTIS, R. J.
Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

OWENS, E. M.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

PAGE, A. L.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

PAGE, P.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

PAGEL, J. E.
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 5A

PAHREN, H. R.
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

PAIGE, S.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

PAIGE, S. F.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

PAJAK, A. P.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

PALAZZO, A. J.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

PAREKH, B. S.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 5D

PARESE, M. A.
Denitrification of Blackwater with Greywater,
W82-01225 5D

PARKER, B. C.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

PARKER, J. I.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

PARKER, W. F.
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

PARR, A. D.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

PARTENHEIMER, E. J.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

PARTON, W. J.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

PATI, S.
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

PATRINOS, A. A. N.
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 2B

PATTERSON, M. R.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

PAYMENT, P.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 5A

PEARSON, F.
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

PEI, D.
Systems Analysis,
W82-01303 6A

PEIRCE, M.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

PENICKA, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

PENSAERT, J.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

PEPPER, I. L.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

PEREIRA, W. E.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

PERKINS, H. F.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

PERROUX, K. M.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

PERRY, B. H.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

PERRY, R.
The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 5E

PESKIN, H. M.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

PFEIFFER, M.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

PHILLIPS, R. B.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

PICKENS, J. F.
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 2F

PICKERING, Q. H.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

PIEST, R. F.
Gully Erosion,
W82-01407 2J

PINTER, P. J. JR.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

PIONKE, H. B.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

PIPES, W. O.
Microbiology of Wastewater Treatment,
W82-01291 5D

PITBLADO, J. R.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 5B

PITT JR, W. W.
Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

PLAMER, C. J.
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 2G

PLANK, V. G.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

POLCYN, D. S.
Inorganics,
W82-01238 5A

POLLARD, F.
Detroit - Fresh Clean Water,
W82-01506 5D

POLLARD, W. H.
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 2J

POLZER, W. L.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

POPA, R.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

PORCELLA, D. B.
Eutrophication,
W82-01271 2H

PORTIER, K. M.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

POSSIDENTO, M.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

POWERS, W. F.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

PRAKASAM, B. S.
Dentrification,
W82-01246 5D

PRATT, G.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

PRICE, R. I.
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

PRIHAR, S.S.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

PROKOPOVICH, N. P.
Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

PRZYBYLA, J. M.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

QUIGLEY, M. A.
Freshwater Macroinvertebrates,
W82-01281 5C

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

QUINLIVAN, S.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

RAATS, P. A. C.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

RAI, H.
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 2H

RAI, S. N.
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

RAMKRISHNADAS, R.
Solid Wastes and Water Quality,
W82-01269 5B

RAMSEY, W. L.
Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 5E

RAO, A. V.
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

RAO, P. S. C.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

RAO, P. V.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 5B

RAUSCH, D. L.
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

RAWLS, W. J.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 2G

REASONER, D. J.
Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

REDDY, K. R.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

REDHEAD, A. A.
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

REED, J. F.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

REED, S. C.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

REGINATO, R. J.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

REID, J. M.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

REID, P. C.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

REISH, D. J.
Marine and Estuarine Pollution,
W82-01274 5C

REITER, G. A.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

REMETA, D. P.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 5A

RENARD, J. J.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

REUTTER, J. M.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

REYNOLDS, J. H.
Land Application of Municipal Wastewater,
W82-01253 5D

RICHARDS, A.
Love Canal: Chemical Contamination and Migration,
W82-01436 5B

RICHARDSON, H. H.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

RICHARDSON, L. B.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

RICHEZ, M.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 5A

RIJSTENBIL, J. W.
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

RINALDI, S.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

RISSER, P. G.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

ROAKE, A F.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

ROBBINS, C. W.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 5B

ROBBINS, J. A.
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

ROBINSON, F. E.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

ROBINSON, G. G. C.
Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 2H

ROBY, K. B.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

ROCHETTE, B.
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 5F

ROGERS, G. L.
Biological Filters,
W82-01242 5D

ROGERS, R. B.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B
Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

ROGOSHEWSKI, P. J.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 5G

ROLFE, G. L.
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 4C

ROSA, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

ROSENBAUM, K. L.
Avoyelles Sportsmen's League V. Alexander,
W82-01456 6E

ROSENTHAL, E.
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

ROSS, L. E.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

ROSSMANN, R.
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 2H

ROSSNAGEL, B. G.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 2I

ROUSE, J. V.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 5B

ROUSH, T. H.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

ROY, D.
Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

ROY, D.
Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

RUDIE, A. W.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 5G

RUSHFORTH, S. R.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

RUSSO, R. C.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

SAAR, R. A.
Ground Water,
W82-01273 2F

SACCO, P. D.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

SANDERS, H. O.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

SANDERSON, W. C.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

SANDHU, B. S.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

SASMAN, R. T.
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

SAWHNEY, B. L.
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 5D

SAYLER, G. S.
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

SCAVIA, D.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

SCHAEFER, W. F.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

SCHAEFFER, D. J.
Abundance of Organic Compounds in Water,
W82-01162 5A

SCHAFFRANEK, R. W.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 2E

SCHAUMBERG, G. D.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

SCHEIDE, E. P.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 5A

SCHEIDER, W. A.
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 5B

SCHELSKE, C. L.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 2H

SCHEPERS, J. S.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

SCHICHT, R. J.
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 2F

SCHINDLER, D. W.
The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

SCHMIDTKE, N. W.
Steel Industry Wastes,
W82-01264 5D

SCHNEIDER, R.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

SCHNEIDER, S. R.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

SCHRAMM, G.
Input and Output Constraints Affecting Irrigation Development,
W82-01476 6B

SCHREIBER, J. D.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

SCHROEDER, E. D.
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

SCHULLER, R. M.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

SCHULZ, R. K.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

SCHWARTZ, S. E.
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

SCRUDATO, R. J.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

SCULLION, J.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

SEGALL, B. A.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 5E

SEILS, C. A.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

SEITZ, W. D.
Managing Land to Meet Water Quality Goals,
W82-01557 4D

SELL, D. W.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 2H

SENGER, J. A.
Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

SETEANU, I.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 6A

SEYFRIED, P. L.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

SHAM, C. H.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

SHARMA, P.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 2F

SHARPLEY, A. N.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

SHEPPARD, W. L.
Redesign Controls Manhole Leakage,
W82-01237 8G

SHERRAD, J. H.
Activated Sludge,
W82-01243 5D

SHERRILL, T. W.
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

SHIARIS, M. P.
Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

SHUCKROW, A. J.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

SHUVAL, H. I.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

SIDWICK, J. M.
Rural Sanitation in Developing Countries,
W82-01392 5D

SIEGRIST, T. W.
Chemicals and Allied Products,
W82-01267 5D

SIEVERING, H.
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 5B

SILBERMANN, P. T.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

SILKA, L. R.
Computer Modeling and Ground-Water Protection,
W82-01336 2F

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

SILLS, M. A.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

SIMS, J. L.
Bioassays - Procedures and Results,
W82-01277 5A

SINGH, B.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

SINGH, R. N.
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 2F

SINGH, S. D.
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

SISSON, J. B.
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 2G

SKAGGS, R. W.
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 4A

Water Management Model Evaluation for North Central Ohio,
W82-01536 4A

SMIES, M.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

SMILES, D. E.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

SMILEY, V. N.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

SMITH, A. E.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 4A

SMITH, D. A.
Activated Sludge,
W82-01243 5D

SMITH, D. L.
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 5D

SMITH, E. D.
Water Characteristics,
W82-01305 5B

SMITH, N. D.
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 2H

SMITH, S. J.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

SMITH, W. L.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

SNOEYINK, V. L.
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

SNYDER, F. L.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 7A

SOLOMON, K.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

SOMMER, E. M.
Federal Common Law of Nuisance Expands,
W82-01337 6E

SOMMERFELDT, T. G.
Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 2G

SONCINI-SESSA, R.
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

SONZOGNI, W. C.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

SOOM, A. M.
Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 8C

SOREY, M. L.
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

SOSTER, F. M.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

SPEHAR, R. L.
The Effects of Pollution on Freshwater Fish,
W82-01282 5C

SPENCER, H. T.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 5A

SPOONER, P.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

SPOSITO, G.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

SRIVASTAVA, D. K.
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 6A

SRIVASTAVA, V.
Anaerobic Processes,
W82-01245 5D

STAHLBAUM, B. W.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

STALL, J. B.
Managing Land to Meet Water Quality Goals,
W82-01557 4D

STARK, N.
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 2G

STARR, R. C.
Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 5G

STECKER, P. P.
A Successful Low Technology Wastewater Process,
W82-01178 5D

STEDINGER, J. R.
Systems Analysis,
W82-01303 6A

STEELE, R. L.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 7B

STEFAN, H. G.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 2J

STEINHEIMER, T. R.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 5A

STEPHENS, J. A.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

STEPHENS, R. D.
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

STERLING, J. D. E.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

STOFFELSEN, G. H.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

STOKES, R. A.
Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 6A

STORTZ, K. R.
Transports in the Duluth-Superior Harbor,
W82-01136 5B

STOVER, E. L.
Investigation of Volatile Organics Removal,
W82-01490 5F

Petroleum Processing Wastes,
W82-01262 5D

Synthetic Fuel Effluents,
W82-01263 5B

STROMATT, S. C.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

STRUZZIERY, J. J.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

SUBLA, B. A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

SUDICKY, E. A.
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

SUIDAN, M. T.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

SULLIVAN, M.
Investigation of Volatile Organics Removal,
W82-01490 5F

SULOWAY, J. J.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 5C

SUNG, J.
Organics,
W82-01239 5A

SUTCLIFFE, J. V.
The Water Balance of the Betwa Basin, India,
W82-01354 2A

SUTTON, P. M.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

SWANSON, N. P.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

SWENSON, W. A.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

SWIGER, W. F.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

SYDOR, M.
Plume Development Using Lagrangian Marker Method,
W82-01182 5B

Transports in the Duluth-Superior Harbor,
W82-01136 5B

SYMULA, J.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 5A

SYVERTSEN, J. P.
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

TAKEUCHI, N.
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 5A

TALMA, A. S.
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

TAN, C. S.
Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

TANJI, K. K.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

River Basin Hydrosalinity Modeling,
W82-01469 2K

TAYLOR, A. H.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 2A

TAYLOR, G. L. JR.
Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 5D

TENG, T-L.
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

TERJUNG, W. H.
A Parametric Crop Water Use Model,
W82-01310 2I

TESHIMA, H.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

THACKER, W. E.
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1B

THOMAS, R. L.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 5A

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 5B

THOMPSON, W. J.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

THRELFALL, D.
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 5G

TILDEN, R. L.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 6B

TIMMONS, D. R.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

TIPPIN, D.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 5D

TISUE, G. T.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

TITTLEBAUM, M.
Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 5A

TODHUNTER, P. E.
A Parametric Crop Water Use Model,
W82-01310 2I

TOMSON, M. B.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 5B

TORPY, M. F.
Petroleum Processing Wastes,
W82-01262 5D

Synthetic Fuel Effluents,
W82-01263 5B

TRIMBLE, S. W.
Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

TROLLOPE, D. R.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

TRUDEL, M.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 5A

TSANG, C. F.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

TUCKER, J. M.
The Water Balance of the Betwa Basin, India,
W82-01354 2A

TUNG, Y. K.
Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 8B

Risk Models for Flood Levee Design,
W82-01307 8A

TURNER, J. S.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

TURNER, R. S.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

TWEDELL, D.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

UNITES, D.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

UTTER, J.
Preferences for Allocating River Recreation Use,
W82-01181 6D

VACHON, D. T.
Steel Industry Wastes,
W82-01264 5D

VAN DE VELDE, I.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

VAN DEN HEUVEL, J. C.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

VAN GALEN, G. C.
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 5F

VAN HOORN, J. W.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

VAN LEEUWEN, J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

VAN ROSSUM, P. G.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 5A

VAN VUUREN, L. R. J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 5D

VANNUCCHI, C.
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 5B

VEITH, G. D.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

VESILIND, P. A.
Sludge Treatment, Utilization, and Disposal,
W82-01247 5E

VICK, S. G.
Siting and Design of Tailings Impoundments,
W82-01588 8A

VIENS, P.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

VOGEL, J. C.
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 2K

VRHOVSEK, D.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 5C

WAGENET, R. J.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 5B

WALKER, W. R.
Law,
W82-01302 6E

WALLER, W. T.
Substrate Associated Microfauna,
W82-01283 5C

WALSH, D. F.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

WALTON, T. L. JR.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

WANG, J. R.
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 7B

WANG, J. S. Y.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

WANGANEO, A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

WARBURTON, J. A.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

WARD, A. D.
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 2J

WARD, T. E.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 2H

WARRICK, A. W.
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

WARWICK, W. F.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

WATTS, D. G.
Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 5B

WAUCHOPE, R. D.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

WEBBER, R. T.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 5D

WEGMAN, R. C. C.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 5B

WEGSCHEIDER, W.
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 5A

WEINER, R. M.
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 5A

WELCH, K.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

WESTBURY, W.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

WETZEL, R.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 5G

WETZEL, R. G.
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 2H

WHELAN, B. R.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

WHELAN, J. K.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

WHITCOMB, B. M.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 2C

WHITE, F. C.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 5B

WHITE, G. B.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 4D

WHITE, G. C.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 5B

WHITFIELD, P. H.
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

WHITTON, B. A.
Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

WIERENGA, P. J.
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 2G

WILD, P. A.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

WILKES, F. G.
Marine and Estuarine Pollution,
W82-01274 5C

WILLIAMS, B. J.
Expansion of Effluent Constrained Treatment Plants,
W82-01355 5D

WILLIAMS, J. D. H.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 2H

WILLIAMS, J. R.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

WILLIAMS, J. S.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 2F

WILLIAMS, N. J.
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

WILSON, I.
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

WILSON, R. W.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 5D

WINANT, W. M.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

WISNER, P. E.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 5G

WISNIEWSKI, J.
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 7B

WITHERSPOON, P. A.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

WOFFINDEN, D. S.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

WONG, B.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 6A

WONG, P. K. Y.
Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 5D

WOOD, E. F.
Regional Flood Frequency Estimation and Network Design,
W82-01294 2E

WOOD, H. B.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 2J

WOOD, P. C.
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 6E

WOODLEY, W. L.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 7B

WOOLF, H. M.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 2B

YAMAMOTO, M.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

YAMAMOTO, T.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 3A

YDE, M.
Faecal Pollution of Belgian Coastal Water,
W82-01373 5A

YOUNG, B. A.
High-Solubility Gas Flotation,
W82-01184 5D

YOUNG, G. J.
Monitoring Glacier Outburst Floods,
W82-01558 2C

YOUNG, J. C.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 5A

YOUNG, T. C.
Aquatic Sediments,
W82-01279 5B

YOUNGS, E. G.
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

YU, K.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

YUSUF, M.
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 2I

ZABEL, T. F.
Developments in Sedimentation and Flotation,
W82-01391 5F

ZEGELIN, S. J.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 2G

ZELLER, E. J.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

ZIEMER, R. R.
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 4C

ZIPF, K. A. JR.
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

ZOETEMEYER, R. J.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

ZOLTEK, J. JR.
Physical and Chemical Methods,
W82-01241 5D

ZOOK, R. L.
Cost Effective Ground Water Monitoring,
W82-01113 4B

ZOSKI, J. E.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01565 3C

ZUTSHI, D. P.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

ZWERMAN, P. J.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B

ORGANIZATIONAL INDEX

ABERDEEN UNIV. (SCOTLAND). DEPT. OF SOIL SCIENCE.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 2K

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA. BENEDICT ESTUARINE RESEARCH LAB.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 5C

AES ENGINEERS, INC., WILLOW SPRINGS, IL.
Wastewater Collection,
W82-01251 5D

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 2I

AGRICULTURAL RESEARCH AND EDUCATION CENTER, SANFORD, FL.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 5B

AGRICULTURAL UNIV., WAGENINGEN (NETHERLANDS). DEPT. OF WATER POLLUTION CONTROL.
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 5C

AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MA.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 7B

ALBERTA UNIV., EDMONTON.
Water Reclamation and Reuse,
W82-01252 3C

ALBERTA UNIV., EDMONTON. DEPT. OF MECHANICAL ENGINEERING.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 2C

ALIGARH MUSLIM UNIV. (INDIA). ENVIRONMENTAL RESEARCH LAB.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 5B

ALL-INDIA CO-ORDINATED RICE IMPROVEMENT PROJECT, HYDERABAD (INDIA).
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 2B

AMERICAN WATER WORKS SERVICE CO., INC., HADDON HEIGHTS, NJ.
Investigation of Volatile Organics Removal,
W82-01490 5F

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF CHEMICAL TECHNOLOGY.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 5D

ANDERSON-NICHOLS AND CO., INC., BOSTON, MA
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 5D

ARGONNE NATIONAL LAB., IL.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 2H

Synthetic Fuel Effluents,
W82-01263 5B

ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOGRAPHY.
Channel Instability in a Braided, Sand Bed River,
W82-01316 2J

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER AND ENGINEERING.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 5D

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 5B

ARMY CONSTRUCTION ENGINEERING RESEARCH LAB. (ARMY), CHAMPAIGN, IL.
Water Characteristics,
W82-01305 5B

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 5E

ARMY ENVIRONMENTAL HYGIENE AGENCY, ABERDEEN PROVING GROUND, MD.
Operational Problems with Rotating Biological Contactors,
W82-01549 5D

ATHENS UNIV. (GREECE) INST. OF SYSTEMATIC BOTANY.
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 5A

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 2C

AUBURN UNIV., AL.
Textile Wastes,
W82-01259 5D

AUBURN UNIV., AL. DEPT. OF CIVIL ENGINEERING.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 4B

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS.
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 2B

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 5C

BAGHDAD UNIV. (IRAQ). DEPT. OF BIOLOGY.
A Hydrobiological Survey of a Polluted Canal,
W82-01356 5C

BAJARD (Y.) ASSOCIATES LTD., VANCOUVER (BRITISH COLUMBIA).
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 6A

BATTELLE-COLUMBUS LAB., COLUMBUS, OH.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 5D

BEN GURION UNIV. OF THE NEGEV, BEERSHEBA (ISRAEL). INST. FOR DESERT RESEARCH.
Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 2D

BIOCHIMIE MARINE, VILLEFRANCHE-SUR-MER (FRANCE). STATION ZOOLOGIQUE.
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 7A

BRADLEY UNIV., PEORIA, IL. DEPT. OF BIOLOGY.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 4A

BRIGHAM YOUNG UNIV., PROVO, UT.
Biological Filters,
W82-01242 5D

BRIGHAM YOUNG UNIV., PROVO, UT. DEPT. OF BOTANY AND RANGE SCIENCE.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 2H

BRIGHAM YOUNG UNIV., PROVO, UT. DEPT. OF ZOOLOGY.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 5C

BROOKHAVEN NATIONAL LAB., UPTON, NY. DEPT. OF ENERGY AND ENVIRONMENT.
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 2K

BROWNE (F. X.) ASSOCIATES, INC., LANSDALE, PA.
Non-Point Sources,
W82-01270 5B

BURBANK, CA.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 3C

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 8A

CALIFORNIA DEPT. OF HEALTH SERVICES, BERKELY. HAZARDOUS MATERIALS LAB.
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 5B

CALIFORNIA STATE UNIV., LONG BEACH.
Marine and Estuarine Pollution,
W82-01274 5C

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND CONSERVATION.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 5C

CALIFORNIA UNIV., BERKELEY, DEPT. OF PLANT AND SOIL BIOLOGY.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 5B

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 5E

CALIFORNIA UNIV., BERKELEY, SANITARY ENGINEERING RESEARCH LAB.
Fixed Endpoint Alkalinity Determination,
W82-01187 7B

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 5D

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 3C

River Basin Hydrosalinity Modeling,
W82-01469 2K

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF GEOGRAPHY.
A Parametric Crop Water Use Model,
W82-01310 2I

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 2J

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCE.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 3C

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF GEOGRAPHY.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 7B

CAMBRIDGE UNIV. (ENGLAND). DEPT. OF APPLIED MATHEMATICS AND THEORETICAL PHYSICS.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 2C

CAMP, DRESSER AND MCKEE, INC., MILWAUKEE, WI. ENVIRONMENTAL SCIENCES DIV.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 7B

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 5C

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 2H

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 5G

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 7A

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 5A

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 5B

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 2H

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Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 2H

CAPITAL CONSULTANTS, INC., LANSING, MI. INDUSTRIAL AND ENVIRONMENTAL DIV.
Advanced Wastewater Plant is Energy Saver,
W82-01177 5D

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. DEPT. OF CIVIL ENGINEERING.
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 5F

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF GEOLOGICAL SCIENCES.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 2H

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA).
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
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Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 2H

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W82-01363 3C

CENTRO TEORIA DEI SISTEMI, MILANO (ITALY).
Supply-Demand Coordination in Water Resources Management,
W82-01299 6C

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Bacteria: Man's Allies in Water Pollution Control,
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CLARKSON COLL. OF TECHNOLOGY, POTSDAM, NY.
Aquatic Sediments,
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CLEMSON UNIV., SC.
Economics,
W82-01304 5G

COAST GUARD, HAMILTON AFB, CA. PACIFIC STRIKE TEAM.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 5G

COASTAL ENGINEERING RESEARCH CENTER, FORT BELVOIR, VA.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 2L

COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, HANOVER, NH.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 5E

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Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 6A

COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 6A

COLORADO STATE UNIV., FORT COLLINS. NATURAL RESOURCE ECOLOGY LAB.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 4A

COLORADO UNIV. AT BOULDER.
Eutrophication,
W82-01271 2H

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MD.
Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 5B

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 5C

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Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 5B

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Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, WEMBLEY (AUSTRALIA). DIV. OF LAND RESOURCES MANAGEMENT.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 5B

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W82-01353 2H

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN.
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
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CONNECTICUT UNIV., STORRS. DEPT. OF CIVIL ENGINEERING.
Denitrification of Blackwater with Greywater,
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Systems Analysis,
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CORNELL UNIV., ITHACA, NY. DEPT. OF AGRICULTURAL ECONOMICS.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
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CORNELL UNIV., ITHACA, NY. DEPT. OF AGRONOMY.
Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 5B
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 5D
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 5B

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Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 2B

CORNELL UNIVERSITY, ITHACA, NY. SECTION OF ECOLOGY AND SYSTEMATICS.
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CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
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DAMES AND MOORE, ATLANTA, GA.
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DELAWARE UNIV., NEWARK. DEPT. OF GEOGRAPHY.
Using Computed Stream Flow in Watershed Analysis,
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Preconcentration for Trace Element Determination in Aqueous Samples,
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Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
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Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO). RESEARCH STATION.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
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Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 2D

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Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
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Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
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Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
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Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
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DEPARTMENT OF SCIENFITIC AND INDUSTRIAL RESEARCH, LOWER HUTT (NEW ZEALAND). PHYSICS AND ENGINEERING LAB.
On Identification and Validation of Some Geothermal Models,
W82-01467 6A

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Identification of the Wairakei Geothermal System,
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An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
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Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
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Detroit - Fresh Clean Water,
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A Successful Low Technology Wastewater Process,
W82-01178 5D

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Microbiology of Wastewater Treatment,
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Sludge Treatment, Utilization, and Disposal,
W82-01247 5E

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Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 2E

ECOLE NORMALE SUPERIEURE, ABIDJAN (IVORY COAST).
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
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Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 6G

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Soil-Bentonite Supply Trench Cutoffs,
W82-01599 8D

ENVIRODYNE ENGINEERS, KNOXVILLE, TN.
Solid Wastes and Water Quality,
W82-01209 5B

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 5C

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Microbiology of Water,
W82-01284 5D

Microbiology: Methodology and Quality Assurance,
W82-01285 5A

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 5B

ENVIRONMENTAL PROTECTION AGENCY, DALLAS, TX. REGION VI.
Microbiology of Ground Water,
W82-01286 5B

Microbiology of Potable Water,
W82-01287 5F

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Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 5C

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The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 5G

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Data Base Development for the Design of a Radium-226 Removal Process,
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Steel Industry Wastes,
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ENVIRONMENTAL RESEARCH LAB., DULUTH, MN.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 5A

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W82-01170 8D

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Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 7B

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Water Resources Appraisals for Hydroelectric Licensing: Brazos River Basin, Texas-New Mexico.
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W82-01440 6D

Water Resources Appraisals for Hydroelectric Licensing: American River Basin, California.
W82-01441 6D

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Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 6G

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The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 5C

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Physical and Chemical Methods,
W82-01241 5D

FLORIDA UNIV., GAINESVILLE, DEPT. OF STATISTICS.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
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W82-01202 7C

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W82-01573 5A

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W82-01205 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
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Vertical Velocity Profiles in Stratified Flows,
W82-01171 8B

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W82-01465 4C

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A Model for Simulation of Flow in Singular and Interconnected Channels,
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Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water,
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Disinfection,
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Computer Modeling and Ground-Water Protection,
W82-01336 2F

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Evaluation of Hydrogeologic Conditions,
W82-01420 5G

GERAGHTY AND MILLER, INC., SYOSSET, NY.
Ground Water,
W82-01273 2F

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The Crustacean Zooplankton of Mali (West Africa),
W82-01379 2H

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Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
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GREATER CHICAGO METROPOLITAN SANITARY DISTRICT, IL.
Dentrification,
W82-01246 5D

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A One-Dimensional, Finite Element Salt Water Intrusion Model,
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Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
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Drainage Density as an Index of Climatic Geomorphology,
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Pipeline Friction Losses for Wastewater Sludges,
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Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 2H

HAWAII UNIV., HONOLULU. INST. FOR ASTRONOMY.
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
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W82-01533 7B

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HOBART AND WILLIAM SMITH COLLEGES, GENEVA, NY.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 5B

HOFFMANN-LA-ROCHE, BELVIDERE, NJ.
Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 5D

IBADAN UNIV. (NIGERIA). DEPT. OF AGRONOMY.
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
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IDAHO WHEAT GROWERS ASSOCIATION, BOISE.
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Abundance of Organic Compounds in Water,
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ILLINOIS STATE NATURAL HISTORY SURVEY, URBANA. AQUATIC BIOLOGY SECTION.
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The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
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Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 5D

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W82-01169 8D

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W82-01447 1B

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 6A

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 5D

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Water Quality from Two Small Forested Watersheds in Southern Illinois,
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Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
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Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
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Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
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INSTITUT ARMAND-FRAPPIER, LAVAL (QUEBEC). CENTRE DE RECHERCHE EN VIROLOGIE.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
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Faecal Pollution of Belgian Coastal Water,
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Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
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Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
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Anaerobic Processes,
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The Water Balance of the Betwa Basin, India,
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Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
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W82-01418 5G

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A Verification Study on a Reservoir Sediment Deposition Model,
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Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
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Effect of Kepone on Estuarine Microbial Activity,
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An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
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Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
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Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
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Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
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Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
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Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
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Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
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W82-01181 6D

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Pulp and Paper Industry Effluent Management,
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Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
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Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
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Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
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Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 2H

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 2H

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 2H

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Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
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Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 6A

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Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
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W82-01313 8B

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Risk Models for Flood Levee Design,
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Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
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Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
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Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
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Water Management Model Evaluation for North Central Ohio,
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Fermentation Industry,
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Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 2G

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Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 5A

Radioactive Wastes,
W82-01268 5D

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 2B

Concentrating Organics in Water for Biological Testing,
W82-01591 5A

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Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
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Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
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W82-01197 7A

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Petroleum Processing Wastes,
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Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
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Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
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An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
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Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
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Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
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Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
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Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
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Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
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Erosion and Sedimentation Control in Regional and Site Planning,
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Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 5B

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Predicting Stream Salinity Changes in South-Western Australia,
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Land and Stream Salinity in Western Australia,
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An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
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Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
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The Distribution of Mercury in the Sediments of the Plym Estuary,
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Inorganics,
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An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
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PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
Regional Flood Frequency Estimation and Network Design,
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Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
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Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 3F

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Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 8A

QUEBEC UNIV., MONTREAL. DEPT. OF EARTH SCIENCES.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 2C

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Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 3F

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Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
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Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 2A

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A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
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Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 6A

RESOURCES MANAGEMENT ASSOCIATES, LAFAYETTE, CA.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 5G

REXNORD INC., MILWAUKEE, WI.
Thermal Effects,
W82-01275 5C

RICE UNIV., HOUSTON, TX. DEPT. OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
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Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
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Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 2G

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF GEOGRAPHY.
Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 2C

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 4D

SCIENCE AND EDUCATION ADMINISTRATION, BOISE, ID. NORTHWEST WATERSHED RESEARCH CENTER.
Automatic Class-A Pan-Filling System,
W82-01326 7B

SCIENCE AND EDUCATION ADMINISTRATION, COLUMBIA, MO.
Time Distribution of Clock Hour Rainfall,
W82-01402 2A

Gully Erosion,
W82-01407 2J

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 5B

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY MANAGEMENT LAB.
Nitrate Production, Uptake, and Leaching,
W82-01411 5B

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. WATER QUALITY MANAGEMENT LAB.
Enrichment Ratios for Water Quality Modeling,
W82-01410 2J

SCIENCE AND EDUCATION ADMINISTRATION, KIMBERLEY, ID. SNAKE RIVER RESEARCH CENTER.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 5B

SCIENCE AND EDUCATION ADMINISTRATION, LAFAYETTE, IN.
Sediment Transport Capacity of Overland Flow,
W82-01408 2J

SCIENCE AND EDUCATION ADMINISTRATION, LINCOLN, NE.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 5B

SCIENCE AND EDUCATION ADMINISTRATION, MORGANTOWN, WV.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 5E

SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.
Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 5B

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 2J

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 5B

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 2I

Erosivity 'R' for Individual Design Storms,
W82-01403 2J

SCIENCE AND EDUCATION ADMINISTRATION, STONEVILLE, MS. DELTA STATES AGRICULTURAL RESEARCH CENTER.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 5B

SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ. SOUTHWEST RANGELAND WATERSHED RESEARCH CENTER.
Concentrated Flow Relationships,
W82-01409 2J

SCIENCE AND EDUCATION ADMINISTRATION, WASHINGTON, DC.
CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems,
W82-01401 5B

SCIENTIFIC AND EDUCATION ADMINISTRATION, COLUMBIA, MO. WATERSHED RESEARCH UNIT.
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 4A

SCIENTIFIC AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 5B

SCIENTIFIC AND EDUCATIONAL ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 5B

SERVICOS DE ENGENHARIA EMILIO BAUMGART LTD., BELO HORIZONTE (BRAZIL).
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 5F

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 8B

SEVERN-TRENT WATER AUTHORITY, BURMINGHAM (ENGLAND).
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 8F

SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ N.V., THE HAGUE (NETHERLANDS). GROUP TOXICOLOGY DIV.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 2L

SIMON FRASER UNIV., BURNABY (BRITISH COLUMBIA). DEPT. OF GEOGRAPHY.
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 2G

SMC-MARTIN, KING OF PRUSSIA, PA.
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 5G

SOIL SURVEY INST., WAGENINGEN (NETHERLANDS).
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 2G

SOIL TESTING SERVICES OF WISCONSIN, INC., GREEN BAY.
Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 5G

SONOMA STATE UNIV., ROHNERT PARK, CA. DEPT. OF CHEMISTRY.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 5E

SOUTHERN CALIFORNIA UNIV., LOS ANGELES. DEPT. OF GEOLOGICAL SCIENCES.
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 2F

SRI PRATAP COLL., SRINAGAR (INDIA). HYDROBIOLOGY LAB.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 2H

STANFORD UNIV., CA. DEPT. OF ENVIRONMENTAL ENGINEERING.
Organics in Water - An Engineering Challenge,
W82-01540 5F

STATE OCEANOGRAPHIC INST., MOSCOW (USSR).
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 2H

STATE UNIV. OF NEW YORK AT BINGHAMTON. LAB. FOR TRACE METHODS AND ENVIRONMENTAL ANALYSIS.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 5A

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF GEOGRAPHY.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 2A

STATE UNIV. OF NEW YORK COLL. AT OSWEGO.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 5B

STONE AND WEBSTER ENGINEERING CORP., BOSTON, MA.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 8A

STRATHCLYDE REGIONAL COUNCIL (SCOTLAND).
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 5D

SYEARNS AND WHEELER, CAZENOVIA, NY.
Urban Runoff and Combined Sewer Overflow,
W82-01254 5B

TECHNION-ISRAEL INST. OF TECH., HAIFA.
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 2F

TECHNOS INC., MIAMI, FLORIDA.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 5G

TEL AVIV UNIV. (ISRAEL). DEPT. OF GEOPHYSICS AND PLANETARY SCIENCES.
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 2F

TENNESSEE UNIV., KNOXVILLE. DEPT. OF MICROBIOLOGY.
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 5A

TENNESSEE VALLEY AUTHORITY, CHATTANOOGA.
Coal and Coal Mine Drainage,
W82-01261 5G

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 5G

TENNESSEE VALLEY AUTHORITY, NORRIS.
Power Industry Wastes,
W82-01265 5B

TEXAS UNIVERSITY AT DALLAS, RICHARDSON.
Substrate Associated Microfauna,
W82-01283 5C

TORONTO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 5G

TORONTO UNIV. (ONTARIO). DEPT. OF MICROBIOLOGY AND PARASITOLOGY.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 5A

TOUHILL, SHUCKROW AND ASSOCIATES, INC., PITTSBURGH, PA.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 5G

TOWER SYSTEMS INC., TACOMA, WA.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 3E

TRC ENVIRONMENTAL CONSULTANTS, INC., WETHERSFIELD, CT.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 5G

TRW ENVIRONMENT ENGINEERING DIV., REDONDO BEACH, CA.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 5D

UNDERWOOD MCLELLAND AND ASSOCIATES LTD., WINNIPEG (MANITOBA).
Modeling Hydrologic Time Series from the Arctic,
W82-01198 2A

UNION CARBIDE CORP., SOUTH CHARLESTON, WV.
Chemicals and Allied Products,
W82-01267 5D

UNION CARBIDE CORP., SOUTH CHARLESTON, WV. CHEMICALS AND PLASTICS.
High-Solubility Gas Flotation,
W82-01184 5D

UNITED NATIONS ENVIRONMENT PROGRAM, GENEVA (SWITZERLAND). REGIONAL SEAS PROGRAMME ACTIVITY CENTER.
Water-Quality Monitoring: A Global Approach,
W82-01339 7A

UNIVERSITY COLL. OF SWANSEA (WALES). DEPT. OF BOTANY AND MICROBIOLOGY.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 5A

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF. DEPT. OF APPLIED BIOLOGY.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 5C

UNIVERSITY OF WEST FLORIDA, PENSACOLA. DEPT. OF BIOLOGY.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 5C

UNIVERSITY OF WESTERN ONTARIO (LONDON). DEPT. OF GEOLOGY.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 2H

UNIVERSITY OF WESTERN ONTARIO (LONDON). DEPT. OF PLANT SCIENCES.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 2H

UTAH STATE UNIV., LOGAN.
Lagoons and Oxidation Ponds,
W82-01244 5D

UTAH STATE UNIV., LOGAN. COLL. OF ENGINEERING.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 5D

UTAH WATER RESEARCH LAB., LOGAN.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 7B

VALLEY SANITARY DISTRICT, CA.
O & M Wastewater Collection and Treatment Facilities,
W82-01249 5D

VICTORIA UNIV. (BRITISH COLUMBIA).
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Activated Sludge,
W82-01243 5D

Electroplating and Cyanide Wastes,
W82-01266 5D

Effects of Pollution on Freshwater Invertebrates,
W82-01280 5C

Law,
W82-01302 6E

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 5A

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 2J

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF SOIL PHYSICS.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 2G

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGEN (ISRAEL).
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 3C

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF ENVIRONMENTAL SCIENCE.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 6D

WASHINGTON UNIV., SEATTLE.
Organics,
W82-01239 5A

WATER AND POWER RESOURCES SERVICE, SACRAMENTO, CA.
Discussion-Engineering Geology of Arid Areas,
W82-01568 4B

WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND).
New Approaches to Anaerobic Sludge Digestion,
W82-01398 5D

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 5B

Artificial Groundwater Recharge,
W82-01110 4B

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Developments in Sedimentation and Flotation,
W82-01391 5F

Groundwater Investigations in the Vale of Stathmore,
W32-01400 2F

The Application of Mutagenicity Testing to Drinking Water,
W82-01487 5A

WATERLOO UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 5C

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 2F

Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 2F

WAYNE COUNTY BOARD OF PUBLIC WORKS, MI.
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 5D

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF MICROBIOLOGY.
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 5A

WISCONSIN-MILWAUKEE UNIV. DEPT. OF GEOLOGICAL SCIENCES.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 5A

WISCONSIN UNIV.-MADISON.
Onsite Alternatives for Treatment and Disposal,
W82-01248 5D

WISCONSIN UNIV.-MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points end Lake Budgets,
W82-01103 2F

WISCONSIN UNIV. MADISON. DEPT. OF PREVENTIVE MEDICINE.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 5B

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF GEOLOGICAL SCIENCES.
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 5B

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 5B

WOODWARD-CLYDE CONSULTANTS, SAN FRANCISCO, CA.
Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 4B

WORLDWATCH INST., WASHINGTON, DC.
Hydropower--An Old Technology for a New Era,
W82-01593 4A

YORKSHIRE WATER AUTHORITY (ENGLAND).
The River Ouse Water Supply Scheme,
W82-01371 5F

ACCESSION NUMBER INDEX

W82-01101	5D
W82-01102	5D
W82-01103	2F
W82-01104	5B
W82-01105	2G
W82-01106	2I
W82-01107	2G
W82-01108	5C
W82-01109	5B
W82-01110	4B
W82-01111	6A
W82-01112	2I
W82-01113	4B
W82-01114	2I
W82-01115	2I
W82-01116	2D
W82-01117	3F
W82-01118	2G
W82-01119	2G
W82-01120	4A
W82-01121	2I
W82-01122	2H
W82-01123	5A
W82-01124	5A
W82-01125	5C
W82-01126	2H
W82-01127	2F
W82-01128	2C
W82-01129	5B
W82-01130	5E
W82-01131	5B
W82-01132	5B
W82-01133	5A
W82-01134	4D
W82-01135	2G
W82-01136	5B
W82-01137	5G
W82-01138	6A
W82-01139	6D
W82-01140	4C
W82-01141	5A
W82-01142	5F
W82-01143	2H
W82-01144	2H
W82-01145	5B
W82-01146	5G
W82-01147	2H
W82-01148	5B
W82-01149	5C
W82-01150	7A
W82-01151	5B
W82-01152	5B
W82-01153	2H
W82-01154	2H
W82-01155	5B
W82-01156	2J
W82-01157	2H
W82-01158	5D
W82-01159	5C
W82-01160	5C
W82-01161	8B
W82-01162	5A
W82-01163	2H
W82-01164	2H
W82-01165	5F
W82-01166	5F
W82-01167	5D
W82-01168	6A
W82-01169	8D
W82-01170	8D
W82-01171	8B
W82-01172	5B
W82-01173	6G
W82-01174	2G
W82-01175	6C
W82-01176	2J
W82-01177	5D
W82-01178	5D
W82-01179	2F
W82-01180	5D
W82-01181	6D
W82-01182	5B
W82-01183	2L
W82-01184	5D
W82-01185	5D
W82-01186	5A
W82-01187	7B
W82-01188	5D
W82-01189	5C
W82-01190	5A
W82-01191	2H
W82-01192	2H
W82-01193	6A
W82-01194	8I
W82-01195	7A
W82-01196	2H
W82-01197	7A
W82-01198	2A
W82-01199	4B
W82-01200	5G
W82-01201	7C
W82-01202	7C
W82-01203	7C
W82-01204	7C
W82-01205	7C
W82-01206	7C
W82-01207	7C
W82-01208	7C
W82-01209	7C
W82-01210	2E
W82-01211	7C
W82-01212	7C
W82-01213	7C
W82-01214	7C
W82-01215	7C
W82-01216	7C
W82-01217	7C
W82-01218	5B
W82-01219	5A
W82-01220	5B
W82-01221	5B
W82-01222	2F
W82-01223	5B
W82-01224	2G
W82-01225	5D
W82-01226	3C
W82-01227	5C
W82-01228	4A
W82-01229	5A
W82-01230	5B
W82-01231	5C
W82-01232	5C
W82-01233	2H
W82-01234	5B
W82-01235	5A
W82-01236	6E
W82-01237	8G
W82-01238	5A
W82-01239	5A
W82-01240	5A
W82-01241	5D
W82-01242	5D
W82-01243	5D
W82-01244	5D
W82-01245	5D
W82-01246	5D
W82-01247	5E
W82-01248	5D
W82-01249	5D
W82-01250	5D
W82-01251	5D
W82-01252	3C
W82-01253	5D
W82-01254	5B
W82-01255	5C
W82-01256	5D
W82-01257	5D
W82-01258	5D
W82-01259	5D
W82-01260	5D
W82-01261	5G
W82-01262	5D
W82-01263	5B
W82-01264	5D
W82-01265	5B
W82-01266	5D
W82-01267	5D
W82-01268	5D
W82-01269	5B
W82-01270	3B
W82-01271	2H
W82-01272	5G
W82-01273	2F
W82-01274	5C
W82-01275	5C
W82-01276	6G
W82-01277	5A
W82-01278	5C
W82-01279	5B
W82-01280	5C
W82-01281	5C
W82-01282	5C
W82-01283	5C
W82-01284	5B
W82-01285	5A
W82-01286	5B
W82-01287	5F
W82-01288	5B
W82-01289	5C
W82-01290	5A
W82-01291	5D
W82-01292	6A
W82-01293	6A
W82-01294	2E
W82-01295	4C
W82-01296	6A
W82-01297	5B
W82-01298	2G
W82-01299	6C
W82-01300	5A
W82-01301	6A
W82-01302	6E
W82-01303	6A
W82-01304	5G
W82-01305	5B
W82-01306	2D
W82-01307	8A
W82-01308	2A
W82-01309	6A
W82-01310	2I
W82-01311	7B
W82-01312	2F
W82-01313	8B
W82-01314	2B
W82-01315	2F
W82-01316	2J
W82-01317	2E
W82-01318	5B
W82-01319	2F
W82-01320	6A
W82-01321	2F
W82-01322	2K
W82-01323	2G
W82-01324	2A
W82-01325	2B
W82-01326	7B
W82-01327	2F
W82-01328	2F
W82-01329	6A
W82-01330	6A
W82-01331	6B
W82-01332	7B
W82-01333	7B
W82-01334	2F
W82-01335	2F
W82-01336	2F
W82-01337	6E
W82-01338	2J
W82-01339	7A
W82-01340	5B
W82-01341	3A
W82-01342	5C
W82-01343	5D
W82-01344	5D
W82-01345	7B
W82-01346	2C
W82-01347	5E
W82-01348	2F
W82-01349	3B
W82-01350	6A
W82-01351	6F
W82-01352	5D
W82-01353	2H
W82-01354	2A
W82-01355	5D
W82-01356	5C
W82-01357	2H
W82-01358	5A
W82-01359	2H
W82-01360	2H
W82-01361	2H
W82-01362	2A
W82-01363	3C
W82-01364	2H
W82-01365	5F
W82-01366	5C
W82-01367	5B
W82-01368	5B
W82-01369	2I
W82-01370	2H
W82-01371	5F
W82-01372	2H
W82-01373	5A
W82-01374	5B
W82-01375	2L
W82-01376	2E
W82-01377	5C
W82-01378	2H
W82-01379	2H
W82-01380	2B
W82-01381	2H
W82-01382	3F
W82-01383	6E
W82-01384	6E
W82-01385	5D
W82-01386	5D
W82-01387	5E
W82-01388	5B
W82-01389	5C
W82-01390	5B
W82-01391	5F
W82-01392	5D
W82-01393	7A
W82-01394	8A
W82-01395	8B
W82-01396	8F
W82-01397	2E
W82-01398	5D
W82-01399	2A
W82-01400	2F
W82-01401	5B
W82-01402	2A
W82-01403	2J
W82-01404	4D
W82-01405	2J
W82-01406	2J
W82-01407	2J
W82-01408	2J
W82-01409	2J
W82-01410	2J
W82-01411	5B
W82-01412	5B
W82-01413	5B
W82-01414	5B
W82-01415	5B
W82-01416	5G
W82-01417	5G
W82-01418	5G
W82-01419	5G
W82-01420	5G
W82-01421	5G
W82-01422	5G
W82-01423	5G
W82-01424	5B
W82-01425	5B
W82-01426	5G
W82-01427	5G
W82-01428	5G
W82-01429	5G
W82-01430	5D
W82-01431	5A
W82-01432	5E
W82-01433	5G
W82-01434	5D
W82-01435	5G
W82-01436	5B

W82-01437	5E
W82-01438	5D
W82-01439	6D
W82-01440	6D
W82-01441	6D
W82-01442	8I
W82-01443	5B
W82-01444	6G
W82-01445	5C
W82-01446	8A
W82-01447	1B
W82-01448	4A
W82-01449	6A
W82-01450	6A
W82-01451	5D
W82-01452	7A
W82-01453	5A
W82-01454	5D
W82-01455	6E
W82-01456	6E
W82-01457	5C
W82-01458	2G
W82-01459	5B
W82-01460	2H
W82-01461	5B
W82-01462	8A
W82-01463	2J
W82-01464	2F
W82-01465	4C
W82-01466	2C
W82-01467	6A
W82-01468	5D
W82-01469	2K
W82-01470	2K
W82-01471	4A
W82-01472	5B
W82-01473	4B
W82-01474	5C
W82-01475	6A
W82-01476	6B
W82-01477	5B
W82-01478	3C
W82-01479	5B
W82-01480	5E
W82-01481	2F
W82-01482	5D
W82-01483	2H
W82-01484	5F
W82-01485	2K
W82-01486	2J
W82-01487	5A
W82-01488	2A
W82-01489	5D
W82-01490	5F
W82-01491	5B
W82-01492	5B
W82-01493	5A
W82-01494	5C
W82-01495	5A
W82-01496	5B
W82-01497	5C
W82-01498	5B
W82-01499	2H
W82-01500	5E
W82-01501	5F
W82-01502	2H
W82-01503	3E
W82-01504	4B
W82-01505	5D
W82-01506	5D
W82-01507	5A
W82-01508	5A
W82-01509	5A
W82-01510	2H
W82-01511	2C
W82-01512	2B
W82-01513	5B
W82-01514	5B
W82-01515	3C
W82-01516	2H
W82-01517	8A
W82-01518	5E
W82-01519	7B
W82-01520	2H
W82-01521	2H
W82-01522	7B
W82-01523	7B
W82-01524	7B
W82-01525	7B
W82-01526	2B
W82-01527	2B
W82-01528	2B
W82-01529	2C
W82-01530	2C
W82-01531	2J
W82-01532	5A
W82-01533	7B
W82-01534	6E
W82-01535	2B
W82-01536	4A
W82-01537	8C
W82-01538	2A
W82-01539	6A
W82-01540	5F
W82-01541	5D
W82-01542	5F
W82-01543	5D
W82-01544	5D
W82-01545	5D
W82-01546	2I
W82-01547	5D
W82-01548	5B
W82-01549	5D
W82-01550	5B
W82-01551	4D
W82-01552	4D
W82-01553	3D
W82-01554	5B
W82-01555	5B
W82-01556	4D
W82-01557	4D
W82-01558	2C
W82-01559	5G
W82-01560	2G
W82-01561	2G
W82-01562	2G
W82-01563	2J
W82-01564	5A
W82-01565	5A
W82-01566	5D
W82-01567	5C
W82-01568	4B
W82-01569	7B
W82-01570	5B
W82-01571	2C
W82-01572	5A
W82-01573	5A
W82-01574	5A
W82-01575	3F
W82-01576	3F
W82-01577	5D
W82-01578	5D
W82-01579	5D
W82-01580	4A
W82-01581	5B
W82-01582	5G
W82-01583	5A
W82-01584	5B
W82-01585	3C
W82-01586	5C
W82-01587	6E
W82-01588	8A
W82-01589	5D
W82-01590	2C
W82-01591	5A
W82-01592	5B
W82-01593	4A
W82-01594	5D
W82-01595	2H
W82-01596	5D
W82-01597	2E
W82-01598	5C
W82-01599	8D
W82-01600	6E

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Subject Fields

NATURE OF WATER

WATER CYCLE

WATER SUPPLY AUGMENTATION AND CONSERVATION

WATER QUANTITY MANAGEMENT AND CONTROL

WATER QUALITY MANAGEMENT AND PROTECTION

WATER RESOURCES PLANNING

RESOURCES DATA

ENGINEERING WORKS

MANPOWER, GRANTS, AND FACILITIES

SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 4
APRIL 1, 1982

W82-01601 -- W82-02100

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus**. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

APPLICATIONS OF STRIPPING ANALYSIS TO METAL DETERMINATIONS IN NATURAL WATERS,

Colorado State Univ., Fort Collins. Dept. of Chemistry.
J. E. Bonelli.
PhD Dissertation, 1980. 187 p 4 Fig, 4 Tab, 182 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-28725.

Descriptors: *Metal *Analytical techniques, *Electrochemistry, Water, Freshwater, Zinc, Cadmium, Lead, Copper, Thallium, Water analysis, Stripping analysis.

Analytical methods for the simultaneous multielement determination of zinc, cadmium, lead, and copper, and for the determination of thallium in natural waters are presented. The methods were optimized for their specific intended applications, evaluated, and applied to ultratrace metals determinations in a variety of natural water samples. Interference effects due to intermetallic compound formation, variations in acidity, and unresolved oxidation processes were evaluated and minimized. A positive interference on copper determinations due to iron was identified and characterized. A simple, experimental compensation technique for this latter interference effect was devised and applied to copper determinations in a river water sample. Experimental results indicate that anodic stripping determinations can be performed in a thiocyanage supporting electrolyte medium. Although the gallium electrode was found to be of limited utility for trace analysis by anodic stripping voltammetry, its unique characteristics may lead to other electrochemical applications. (Sinha-OEIS)
W82-01670

NON-EQUILIBRIUM WATER/ROCK INTERACTIONS,

Stanford Univ., CA. Dept. of Geology.
W. E. Dibble, Jr.
PhD Dissertation, 1980. 179 p, 17 Fig, 9 Tab, 118 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-24643.

Descriptors: *Crystal growth, *Mass transfer, Interfaces, Silicates, Chemical reactions, *Mass transport, *Mineral water reactions.

The results of established crystal growth theory and silicate dissolution experiments are combined in developing a new model for mineral/water reactions controlled by surface processes. The overall reaction rate at steady-state is determined by coupling equations for the velocities of mass transport and interface detachment processes. Non-steady state processes can be successfully treated when interface reactions control the rate. For most sparingly soluble minerals, diffusion through the solution can be neglected as a rate-determining factor. Experimental rate data for quartz dissolution are used to define molecular activation mechanisms based on the kink-site detachment model. The quartz dissolution mechanism involves binding of ionic species to surface detachment sites. Surface binding reactions are controlled mainly by the sign and magnitude of the surface electrostatic potential. The dissolution of silicates is more complex than quartz dissolution because most silicates dissolve incongruently. To determine variations in interface composition as a result of incongruent dissolution, values of the chemical potentials of components in the bulk solid phase must be known. The results are used to predict chemical potential values for F- and Li-bearing components and for components in the exchange position of smectites. They show that small amounts of fluorine in a sheet silicate significantly affect the Gibbs energy of formation. (Sinha-OEIS)
W82-01684

1B. Aqueous Solutions and Suspensions

THE SPREADING OF THIN LIQUID FILMS ON A WATER-AIR INTERFACE,

McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
M. Foda, and R. G. Cox.
Journal of Fluid Mechanics, Vol 101, No 1, p 33-51, November, 1980. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Films, *Oil-water interfaces, *Physical properties, Thin films, Monomolecular films, Water-air interfaces, Surface tension, Fate of pollutants, Oil pollution, Fluid mechanics.

The spreading of liquid layers on the surface of an immiscible supporting liquid (example, an oil slick on a water body) occurs according to three basic mechanisms: first, gravity opposed by inertia; then, gravity opposed by viscous drag; and finally, after a very long time, when the layer is almost molecularly thin, surface tension, replacing gravity. The paper produces a similarity solution for unidirectional spreading in the third stage, when surface tension is the driving force. The monolayer is considered to be spreading on a quiescent water surface, such as in a long channel. Assumptions are that: (1) the monolayer spreads in a positive direction so that the length is a function of time, (2) the monolayer thickness does not vary, and (3) oil must be continually supplied to the monolayer. The solution gives both the size of the film as a function of time and the velocity and thickness distribution along the spreading film. Experiments with spreading of silicone fluid on distilled water at rest in a channel (120 x 9 x 5 cm deep) produced good agreement with the theory. (Cassar-FRC)
W82-01955

THE CONTAINMENT OF AN OIL SLICK BY A BOOM PLACED ACROSS A UNIFORM STREAM,

McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
N. D. Di Pietro, and R. G. Cox.
Journal of Fluid Mechanics, Vol 96, No 3, p 613-640, February, 1980. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Films, *Oil-water interfaces, *Surface tension, Physical properties, Fluid mechanics, Thin films, Monomolecular films, Water-air interfaces, Oil pollution.

In a spreading oil slick a surface tension region exists between the gravity-viscous and monolayer regions. Pressure differences across the oil-water and oil-air interfaces are important in this region, usually only a few mm wide. The surface tension region is important because it is necessary to connect the solution with the gravity-viscous and monolayer regions, and the slopes of the interfaces are largest here. This idea is used to find the theoretical thickness profile of an oil layer contained upstream of an oil boom placed across a channel in which water is flowing at a constant velocity. The total length of the spreading layer and its thickness at the barrier are found as functions of velocity and volume. It is assumed that: (1) the velocity difference across the oil layer is small compared with the water velocity, (2) the monolayer and bulk layer lengths are much larger than the capillary length scale, (3) the interfaces have small slopes, (4) inertia effects in oil and the pressure variations in substrate flow are neglected, (5) the boundary layer in the water is laminar, and (6) the monolayer is not depleted. General conditions for validity of results are discussed. Modifications are given for the case where the boundary layer in the substrate is turbulent. Experimental results from studies on unsteady spreading on quiescent water in a channel agreed well with theory. (Cassar-FRC)
W82-01956

2. WATER CYCLE

2A. General

CAN WE MODEL THE RAINFALL-RUNOFF PROCESS TODAY,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
F. Naef.
Hydrological Sciences Bulletin, Vol 26, No 3, p 281-289, September, 1981. 4 Fig, 4 Tab, 6 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, Runoff, Rainfall, Mathematical studies, Simulation.

This paper attempts to illustrate how some of the widely used models for simulating rainfall-runoff processes in a basin are able to operate with data which can be collected with reasonable effort and expense. Models available for such tasks include simple ones such as the unit hydrograph, Nash cascade, runoff coefficient and linear regression; mathematical models which are models with a simple structure but which employ sophisticated methods for parameter or error estimation such as CLS; conceptual models such as Stanford and Sacramento; and physically based models which are based on the solution of differential equations for evapotranspiration, infiltration and runoff. Models of different complexity were calibrated to three small basins with dense networks of recording rain gauges and reliable stream gauges. Under average conditions it was found that the simulation and forecasting of discharge were not difficult tasks. They could be successfully solved using simple concepts. Furthermore, the selection of the model was not critical to the result. However, forecasts made under extraordinary conditions or extrapolations using the models tested appeared to be practically a matter of luck. None of them truly reflected the runoff process, and the data were not available in the required quality. (Baker-FRC)
W82-01609

KINEMATIC FLOW APPROXIMATION OF RUNOFF ON A PLANE: AN EXACT ANALYTICAL SOLUTION,

Griffith Univ., Brisbane, Queensland (Australia). School of Australian Environmental Studies.
J. Y. Parlange, C. W. Rose, and G. Sander.
Journal of Hydrology, Vol 52, No 1-2, p 171-176, June, 1981. 1 Fig, 8 Ref.

Descriptors: *Overland flow, *Model studies, *Rainfall-runoff relationships, *Excess rainfall, *Watershed management, Flow patterns, Mathematical equations, Mathematical studies, Storm runoff, Surface runoff, Laminar flow, Sheet erosion, Soil erosion, *Plane flow, Irrigation effects, Erosion control.

An analytical solution is offered for the estimation of kinematic flow for an excess rainfall runoff. The solution operates on any arbitrary function of time and generalizes a previously proposed model for situations of constant excess rainfalls over a finite period of time. The problem of overland flow was solved by the method of characteristics using a system of mathematical equations. The solution was applied successfully to calculate the runoff resulting from a variable rate of excess rainfall, and also to a problem in border irrigation. The model reproduces the results of an earlier qualitative solution which dealt with the rise and drop of the water level and the progressive reduction of the region where the sheet has a constant thickness. (Geiger-FRC)
W82-01617

PARAMZTER ESTIMATION OF RAINFALL-RUNOFF MODELS WITH HETEROSCEDASTIC STREAMFLOW ERRORS–THE NONINFORMATIVE DATA CASE,

Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
S. Sorooshian.

Journal of Hydrology, Vol 52, No 1/2, p 127-138, June, 1981. 1 Fig, 1 Tab, 12 Ref. OWRT-C-90320-G(9442)(1).

Descriptors: *Rainfall-runoff relationships, *Model studies, Runoff, Precipitation, Stochastic hydrology, Hydrology, Streamflow.

Due to practical difficulties encountered in obtaining adequate weight estimates, the use of the weighted least-squares criterion for parameter estimation of rainfall-runoff models has been restricted. An estimation procedure is presented which is able to correct the effect of heteroscedastic (changing variance) streamflow errors. The noninformative data case is assumed, and for that a Bayesian formulation is used to automatically estimate the proper weights. Subsequently, the weights are used in the maximum likelihood estimator to evaluate the model parameters. A four-parameter model was used to test the new method, and comparisons were made with the simple least squares criterion and with the weighted objective function of the HEC-1 of the US Army Corps of Engineers, using synthetic data. The study indicated that the need for specifying subjective weighting functions or guessing the values of the weights was totally eliminated. Sensitivity analysis revealed that the resulting response surface of the MLE criterion where the search for model parameters takes place was smoother and more concentric. The improved concentricity of the parameter space helped the search algorithm and increased the chances for convergence to a parameter set which was closer to the true set. The study also suggested that special care is needed in selecting weighting functions. If the selected weighting rule does not explain to some degree the stochastic properties of the errors, then the resulting parameter estimates may produce wrong forecasts. The implementation of the new procedure was easy. (Baker-FRC)
W82-01657

A MODEL OF THE ANTARCTIC SINK FOR STRATOSPHERIC WATER VAPOR,

Iowa State Univ., Ames.
A. R. Douglass.
PhD Dissertation, 1980. 137 p, 24 Fig, 14 Tab, 65 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06007.

Descriptors: *Water balance, *Water vapor, *Antarctic, Model studies, Exchange processes.

The main focus of the work is the development of a model through which the sink mechanism can be quantified and understood in the context of the rest of the annual water vapor budget. The classical description of the stratospheric water vapor distribution is discussed and other proposed sources of stratospheric water vapor and their implications for the annual budget are considered. Observational evidence that led to the proposal of the Antarctic sink mechanism is also presented. The upper limit of the amount of water vapor removed from the stratosphere in 1973 is slightly larger than the lower limit of estimates of the amount of water vapor added to the stratosphere by oxidation of methane. If no other sources are operational, and the methane source strength were shown to be the low estimate, the Antarctic sink would allow balance to be achieved in the annual budget. Even so, it would be difficult to explain the observed water vapor distribution if this high altitude source were to be balanced only by a south polar sink. At least in the northern hemisphere, where there is no winter stratospheric sink, the lack of a pronounced vertical and poleward gradient of water vapor mixing ratio remains a puzzle, especially if the methane source is at the upper limit of the estimates. Although any circulation proposed for the stratosphere must not contradict the observations of stratospheric water vapor, it is with caution that the water vapor may be used as a tracer of trophosphere to stratosphere exchange processes. (Sinin-OEIS)
W82-01686

ANALYSIS OF THE ORIGIN OF WATER WHICH FORMS LARGE AUFEIS FIELDS ON THE ARCTIC SLOPE OF ALASKA USING GROUND AND LANDSAT DATA,

Maryland Univ., College Park.
For primary bibliographic entry see Field 2C.
W82-01690

GEOCHEMISTRY AND HYDRODYNAMICS IN THE HUTT AND LEEMAN EVAPORITIC LAGOONS, WESTERN AUSTRALIA: A COMPARATIVE STUDY,

Uranerz Australia Party, Ltd., Subiaco.
For primary bibliographic entry see Field 2L.
W82-01746

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1972,

Science and Education Administration, Beltsville, MD. Water Data Lab.
Science and Education Administration, Miscellaneous Publication Number 1412, September 1981. 437 p, 98 Fig, 630 Tab, 75 Ref. J. B. Burford, J. L. Delashmutt, and R. T. Roberts, compilers.

Descriptors: *Agricultural watersheds, *Hydrologic data, *Precipitaion, Rainfall-runoff relationships, Experimental basins, Steamflow, Steam discharge.

Selected hydrologic data from 131 watersheds for 1972 are reported including data on monthly precipitation and runoff for all the watersheds; annual maximum discharge and maximum volumes of runoff for intervals of 1, 2, 6, and 12 hours and 1, 2, and 8 days for 117 watersheds; daily precipitation for 130 watersheds; mean daily discharge for 131 watersheds; daily maximum and minimum air temperature for 18 watersheds; and detailed information on one or more selected typical storm events for 98 watersheds. Information on selected storm events includes: tabular data for antecedent rainfall and runoff; data on rainfall intensity and runoff for the event and on accumulated depth of rainfall and runoff; description of watershed conditions at the time of the selected events; and plottings of runoff hydrograms and rainfall histograms. For newly established watersheds, descriptions of watershed physical characteristics, instrumentation, land management and recommended area of application of the results are given. There are 19 waterhseds installed in recent years and not previously reported. (Moore-SRC)
W82-01772

A MATHEMATICAL MODEL OF THE HYDROLOGIC REGIME OF THE UPPER NILE BASIN,

Snowy Mountains Engineering Corp., Cooma (Australia).
J. A. H. Brown, F. M. J. Ribeny, E. J. Wolanski, and G. P. Codner.
Journal of Hydrology, Vol 51, No 1-4, p 97-107, May, 1981. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Mathematical models, *Hydrological regime, *Nile Basin, Catchment basins, Basins, River basins, Africa, Channel flow, Lakes, Systems engineering, Computer programs.

The Upper Nile Basin Model was developed as part of the Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga, and Mobutyu Sese Seko (Albert), sponsored by the United Nations Development Program. The hydrology of the basin is dominated by the role of the lakes, which cover about 20% of the total surface area. The model comprises three separate models combined into an overall system, which is the Upper Nile Basin Model. A catchment model enables the runoff of the catchments contributing to the three lakes to be estimated from rainfall and evapotranspiration data. A lake model computes outflows and changes in storage for various inflows and operational rules. A channel model is used to predict the movement of water in the main river channels between the lakes. The Upper Nile Basin Model includes a total of 36 programs and a master program which controls their selection. The 36 programs can be called up automatically in any predetermined sequence. Beginning with only rainfall and evaporation data, the model is capable of simulating the behavior of the whole basin and of computing the outflows from the system downstream of Lake Mobutu Sese Seko. Provisions for preselection of programs for a particular study, inclusion of new programs, and easy replacement or revision of individual existing programs contribute to the flexibility of the model. (Carroll-FRC)
W82-01857

AN AQUIFER SIMULATION PROGRAM FOR MICRO-BASED PROCESSORS,

Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
For primary bibliographic entry see Field 2F.
W82-01879

DEVELOPMENT AND APPLICATIONS OF A RUNOFF MODEL FOR SNOWCOVERED AND GLACIERIZED BASINS,

Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 2C.
W82-01885

SPATIAL SIMULATION OF SNOW PROCESSES,

Danish Inst. of Applied Hydraulics, Hoersholm.
For primary bibliographic entry see Field 2C.
W82-01887

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: THEORY,

Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina, Jr., W. C. Huber, and J. P. Heaney.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 781-797, August, 1981.

Descriptors: *Mathematical models, *Storm runoff, Storm water, Urban runoff, *Wastewater treatment, Simulation models, Water quality, Computers, Prediction, Water pollution, Storage requirements, Mathematical equations.

Preliminary planning and assessment of storm water storage and treatment needs and facilities is increasingly based on long-term characterization of the rainfall/runoff process rather than on selection of a particular design storm event. This characterization is achieved either by a deterministic approximation using continuous simulation models or through probabilistic analysis of storm event loads and storage/treatment device performance. This report discusses the development of a deterministic approach in which mathematical models are derived from the principle of conservation of mass to represent the movement, decay, storage, and treatment of storm water runoff pollutants and dry weather wastewater flows through natural and engineered transport systems. These mathematical models describe the transient response of storage/treatment systems to highly variable forcing functions of flow and concentration both for completely mixed systems of constant and variable volumes and for one-dimensional advective-dispersive systems. (Carroll-FRC)
W82-01980

2B. Precipitation

A STOCHASTIC CLUSTER MODEL OF DAILY RAINFALL SEQUENCES,

Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. L. Kavvas, and J. W. Delleur.
Water Resources Research, Vol 17, No 4, p 1151-1160, August, 1981. 3 Fig, 3 Tab, 34 Ref. OWRT-B-036-IND(20).

Descriptors: *Rainfall, *Stochastic process, Model studies, Cluster models, Neyman-Scott model, Precipitation, *Indiana, Weather patterns.

The Neyman-Scott cluster process was applied to a two-level point stochastic model for rainfall

events at a given station in the time dimension. The primary level is rainfall-generating mechanisms; the secondary level, the rainfalls generated by the mechanisms. The cluster model assumes superposition of rainfalls (that the rainfall events occur in clusters and that the occurrence of rainfall events in a certain time interval is caused both by the given mechanism in the time interval and also by generating mechanisms which occurred before the interval). The model was tested with rainfall data from six stations in Indiana. Since the cluster model is time homogeneous, it may be of practical use only for stationary rainfall occurrences. (Cassar-FRC)
W82-01651

VARIOUS KINETIC ENERGY CHARACTERISTICS OF HAILPATTERNS IN THE GROSSVERSUCH IV EXPERIMENT,

Groupement National d'Etudes des Fleaux Atmospheriques, Grenoble (France).
J. F. Mezeix, and N. Doras.
Journal of Applied Meteorology, Vol 20, No 4, p 377-386, April, 1981. 10 Fig, 4 Tab, 21 Ref.

Descriptors: *Hail, *Kinetic energy, Kinetics, Precipitation, Sleet, Storms, Weather modification, Experimental data, Switzerland.

The Grossversuch hailpad network of hailfalls was used to record distinct hailpatterns and calculate their kinetic energy. Hailpad data was collected from 184 distinct non-seeded hailpatterns, so that possible characteristics of kinetic energy of hailpatterns might be grasped. It was noted from the four years of recorded data from 1975 through 1978 that the four year multi-annual distribution of global energy may be considered as lognormal, represented by a probability density function. The annual lognormal distributions, however, have statistically different means. Relations were established between global kinetic energy and several physical parameters of hailpatterns. Viewed from the kinetic energy aspect, the hail phenomenon seems to be organized. The regularity of the evolution of the physical characteristics of hailfalls may suggest an hypothesis of a hail production mechanism similar from one hailfall to another. Where kinetic energy is concerned, the result stays within the continuum for all the hailfalls. Some of the properties common to hailfalls will probably aid in the identification of physical effects in storm modification experiments. (Baker-FRC)
W82-01732

EVALUATION OF A PRECIPITATION MAP USING A SMOOTHED ELEVATION-PRECIPITATION RELATIONSHIP AND OPTIMAL ESTIMATES (KRIGING),

Service Hydrologique National, Bern (Switzerland).
F. A. deMontmollin, R. J. Olivier, R. G. Simard, and F. Zwahlen.
Nordic Hydrology, Vol 11, No 3/4, p 113-120, 1980. 4 Fig, 9 Ref.

Descriptors: *Precipitation, *Kriging, *Altitude, *Maps, *Switzerland, Mountains, Anomaly maps, Rain gages.

An annual average precipitation map for a mountainous 1600 sq km area between Neuchatel and Lausanne, Switzerland, was evaluated by the anomaly method, improved by using an optimal smoothed altitude index and universal kriging. Data from 45 rain gaging stations for the years 1974-76 were used. Altitude data was obtained from a data bank containing all the digitized altitudes for the western part of Switzerland on a 50-mile grid. A near optimal filtering window of 7 km was chosen. The average altitude over an area of optimized size was designated the index elevation. The precipitation range was 720-1200 mm, the higher amounts being found in the southern slope of the Jura Mountains and Jorat hills and the dry region in the center. (Cassar-FRC)
W82-01892

PHOTOMETRIC INVESTIGATIONS OF PRECIPITABLE WATER AND OPTICAL DEPTH WAVELENGTH EXPONENTS IN AN URBAN AREA,

Wyoming Univ., Laramie. Dept. of Atmospheric Science.
T. Yokses.
Journal of Applied Meteorology, Vol 19, No 5, p 616-622, May, 1980. 4 Fig, 20 Ref.

Descriptors: *Aerosols, *Atmospheric water, *Water vapor, Urban areas, *Precipitation, Wavelengths, Data collections, Optical properties, *Photometry, St Louis, Missouri, METROMEX.

Aerosol loading and atmospheric precipitable water were monitored in the St. Louis urban area during Project METROMEX 1976. Data were collected with a six-channel Volz sunphotometer. A least-square fit of photometric observations to spatially and temporally proximate radiosonde measured precipitable water vapor produced the exponent (1/1.993) in the precipitable water equation. This indicates agreement with the square-root absorption law of band models. Wavelength exponents calculated from least-square fits of five water vapor transmission band optical depths to wavelengths were represented by a wavelength exponent of 1.71 + or - 0.54 using 70 observations. Modal values of the wavelength exponent were centered at 1.60 and 1.90. Trends in daily evolution of the wavelength exponent indicate the growth and decay of corresponding Junge-type power law aerosol size distributions similar to those measured in situ during previous studies in the same area. (Cassar-FRC)
W82-01966

OBSERVATIONS OF TWO COLORADO THUNDERSTORMS BY MEANS OF A ZENITH-POINTING DOPPLER RADAR,

Arizona Univ., Tucson. Inst. of Atmospheric Physics.
L. J. Battan.
Journal of Applied Meteorology, Vol 19, No 5, p 580-592, May, 1980. 7 Fig, 20 Ref.

Descriptors: *Thunderstorms, *Radar, Storms, Colorado, Arizona, Velocity, Wind velocity, Hail, Precipitation, Remote sensing.

A pulsed-Doppler radar, operated with its antenna pointed toward the zenith, was used to obtain data on the distributions of radar reflectivity, mean Doppler velocity, velocity, vertical air velocity, and Doppler-velocity variance in two thunderstorms over eastern Colorado. Data were collected at height intervals centered 152 meters apart. Previous studies have shown that many thunderstorms include a series of turbulent updraft cores spaced at distances of 1 to 3 kilometers, each of which is surrounded by sinking or slowly rising air. The cores are each composed of a current of rising air which includes a number of eddies having diameters of a few hundred meters to 1 or 2 kilometers. The two thunderstorms observed during the course of this study demonstrated some of the characteristics generally attributed to multicell thunderstorms, but the cell sizes were smaller and more frequent than previously reported. Hailstorms in southeastern Arizona also exhibited a series of turbulent updraft cores. On the basis of similarities between the thunderstorms observed in Colorado and those observed elsewhere, it is suggested that the variable nature of the radar reflectivities and updrafts may be a characteristic feature of most thunderstorms and that they may contribute significantly to the highly variable nature of hail. (Carroll-FRC)
W82-01967

WATER-ICE AND WATER-UPDRAFT RELATIONSHIPS NEAR -10 DEGREES C WITHIN POPULATIONS OF FLORIDA CUMULI,

National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
R. I. Sax, and V. W. Keller.
Journal of Applied Meteorology, Vol 19, No 5, p 505-514, May, 1980. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Cloud physics, *Crystallization, Rain, Clouds, Ice, Temperature effects, *Convective precipitation, *Florida.

During most late spring and summer afternoons, south Florida experiences a large population of cloud towers in various stages of development, with tops near the -10 C level. Penetration of several of these convective towers near their tops in the temperature range of -4 C to -12 C with aircraft specifically equipped to obtain cloud physics data resulted in the collection of an in-cloud microphysical data set which demonstrated a sequential development of cloud water, rainwater, graupel, and crytalline ice as the cloud ages. Repeat penetrations of some convection towers showed that some, but not all, experienced a very rapid onset of graupel. A separate data set showed a large scatter in the relationship between maximum value of cloud water and maximum value of vertical velocity, suggesting that measurements of cloud water, by themselves, can be misleading as an indication of cloud growth activity. The sequential pass data showing the evolution of ice and water are consistent with a rime-splintering, secondary ice production hypothesis. The variability in the decay of the cloud water mass observed from one cloud to another appears to be related to the detailed structure of the updraft and to the manner in which mixing of drier ambient air is occurring near the top of the cloud envelope. Three case studies are used to demonstrate the variabilities encountered in the evolutionary sequence of the four parameters. (Carroll-FRC)
W82-01968

ANOMALIES IN TEMPERATURE AND RAINFALL DURING WARM ARCTIC SEASONS AS A GUIDE TO THE FORMULATION OF CLIMATE SCENARIOS,

J. Williams.
Climatic Change, Vol 2, No 3, p 249-266, 1980. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Weather patterns, *Arctic, *Precipitation, Climatology, Atmospheric pressure, Air temperature, Seasonal variation, Air circulation.

Temperature, precipitation, and pressure anomalies in the northern hemisphere were investigated for the Arctic's 10 warmest winters (mean temperature -13.5 C) and 10 warmest summers (mean temperature 10.5 C) during the last 70 years. Means for the remaining years were -15.8 C in winter and 9.5 C in summer. This study was undertaken to secure information applicable to the problem of global warming from increased CO2 in the atmosphere. During warm periods in the Arctic, circulation changes produce anomalies elsewhere in the Northern Hemisphere, with some areas cooling and some warming. Warm winters produce larger amplitude anomalies than warm summers. In warm winters the sea level pressure field differs from the long-term mean in several regions, specifically Greenland-North Atlantic, while warm summers produce no such differences. Warm summers are associated with large coherent areas of increasing or decreasing mean precipitation in the Northern Hemisphere, as a result of circulation changes, while warm winters have no significant effect on precipitation. During warm Arctic summers, Alaska and the west coast of the U.S. are drier; the southern states and Florida, wetter. Positive differences in precipitation at several North American stations were as follows (in mm): Jacksonville, 103; Charleston, 103; New Orleans, 103; Yuma, 14; Sandusky, 54; Prince George, 57; Masset, 55. Negative differences (in mm) were found at: Topeka, -82; Peoria, -83; Des Moines, -74; Crete, -96; Lincoln, -106; Valentine, -47; Huron, -50; and Prince Albert, -42. (Cassar-FRC)
W82-01975

SIMPLIFIED METHOD FOR RAINFALL INTENSITIES,

Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
G. H. Hargreaves.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 281-288, September, 1981. 1 Tab, 8 Ref.

Descriptors: *Precipitation, *Rainfall intensity, *Developing countries, Rainfall distribution, Weather data collections.

Several rainfall amount-intensity relationships were investigated with particular focus on providing rainfall intensity data for developing countries, where such data is inadequate for water resources development projects. Methods evaluated were regressions predicting maximum monthly rainfall from mean monthly rainfall, 10-year return period, 24-hour duration amounts from maximum monthly rainfall, and the full range of rainfall intensity-duration-frequencies from the 10-year 24-hour values. Data from Central America, the U.S., India, Australia, and, to a more limited extent, the world were used. Maximum monthly precipitation and outlying and evelope values can be reliably estimated from mean monthly rainfall. There is a fairly good relationship between 10-year, 24-hour rainfall and maximum monthly rainfall. For durations of 30 min to 4 days and return periods of 5 to 100 years, precipitation amounts vary approximately as the fourth root of the time and the sixth root of the return period. Errors may result from not compensating for anomalous storms, short records, inadequate station coverage, and nonrepresentative locations. Further statistical analysis of the equations in this paper is recommended to determine the extent of their application on a global scale. (Cassar-FRC)
W82-01978

NOTE ON RANDOM RAINDROPS AND SAMPLING ERROR,

Otago Univ. (New Zealand).
W. E. Bardsley.
Nordic Hydrology, Vol 11, No 1, p 1-6, 1980. 1 Tab, 4 Ref.

Descriptors: *Sampling, *Errors, *Rain gages, Mathematical studies, Precipitation, *Rainfall, Radar, Statistics.

Rain gage measurements and radar reflectivity of a given volume of air containing raindrops are among the variables of interest in precipitation studies which can be interpreted as series of random numbers of random variables. Some statistical results obtained by Robbins (1948) were used to obtain a general expression for the coefficient of variation of such variables when the number of terms per sum and the transformed variables follow any specified probability distribution. Some simple expressions are obtained for the special case of an exponential distribution of raindrop diameters. Some conclusions of Gertzman and Atlas (1977) were obtained as special cases of the general expression. (Cassar-FRC)
W82-02032

TOWARDS AN UNDERSTANDING OF THE EFFECTS OF OROGRAPHY ON THE DISTRIBUTION OF PRECIPITATION OVER THE CAPE PENINSULA,

Washington Univ., Seattle. Dept. of Atmospheric Sciences.
D. A. Erasmus.
South African Journal of Science, Vol 77, No 7, p 295-298, July, 1981. 5 Fig, 6 Ref.

Descriptors: *Orographic precipitation, *Precipitation intensity, *Cape Peninsula, Precipitation, Climates, Air circulation, Vortices, Flow, *South Africa.

The precipitation distribution in the vicinity of Table Mountain in the Cape Peninsula, South Africa, was investigated for five rainfall periods during the winter of 1977. For each of these periods, precipitation was associated with the passage of eastward moving baroclinic disturbances. An important factor was a strong flow of warm moist air at low levels to maintain the liquid water content of the feeder clouds. Seeding particles were generated at intermediate altitudes, which augmented rainfall and resulted in the downward displacement of the precipitation maximum. A vorticity was observed which may result in localized increases in rainfall. The vorticity may be the result of the confluence of fast moving air streams in the lee of the col between Table Mountain and Devil's Peak. A more comprehensive data network is needed to further understand precipitation in the area. (Small-FRC)
W82-02085

2C. Snow, Ice, and Frost

ANALYSIS OF THE ORIGIN OF WATER WHICH FORMS LARGE AUFEIS FIELDS ON THE ARCTIC SLOPE OF ALASKA USING GROUND AND LANDSAT DATA,

Maryland Univ., College Park.
D. K. Hall.
PhD Dissertation, 1980. 141 p, 18 Fig, 16 Tab, 53 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03882.

Descriptors: *Water sources, *Meteorological data, *Groundwater, Arctic, Melt water, *Alaska, Surface-groundwater relations, *Aufeis fields, River ice.

The origin of the water which forms large aufeis fields (overflow river ice) on the Arctic Slope of Alaska has been controversial. For this study, various hypotheses were tested using ground and satellite data to analyze the origin of the aufeis water. In addition, meteorological data from 1972 through 1979 were analyzed and graphically displayed with aufeis extent. It is concluded that aufeis extent in a given river channel on the Arctic Slope is controlled by discharge from reservoirs of groundwater. It seems probable that precipitation passes into limestone aquifers in the Brooks Range, through an interconnecting system of subterranean fracturs in calcareous rocks and ultimately discharges into alluvial sediments on the coastal plain to form aufeis. It is speculated that only small (perhaps beaded) aufeis patches are affected by local meteorological conditions of the months just prior to aufeis formation. (Sinha-OEIS)
W82-01690

ON THE VALUES AND VARIABILITY OF DEGREE-DAY MELTING FACTOR IN FINLAND,

Finnish Hydrological Office, Helsinki.
E. Kuusisto.
Nordic Hydrology, Vol 11, No 5, p 235-242, 1980. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Snowmelt, *Degree-day factor, *Heat transfer, Solar radiation, Forests, Precipitation, Seasonal variation, Snow depth, Snow density, *Finland.

The degree-day factor, widely used in snowmelt forecasting, was studied using data collected from 12 stake stations, each with 25 stakes in forest and 9 on open field. During 1959-1978 about 96,000 snow depth and 17,000 snow density measurements were obtained. The water equivalent of snow was calculated on the basis of the average of snow depth and density. The annual maximum water equivalent ranged between 80 and 180 mm at different stations in southern and central Finland, and between 120 and 250 mm in northern Finland. The seasonal averages of degree-day factor varied widely from station to station. For forest sites the mean was 2.42 mm per degree C per day (range 1.75-3.36 mm per degree C per day) and for open sites, 3.51 mm per degree C per day (range 2.82-4.94 mm per degree C per day). A 10% increase in canopy cover in forest sites decreased the degree-day factor by about 0.16 mm per degree C per day. On rainy pentades the average degree-day factors (in mm per degree C per day) were 2.16, 2.33, and 2.79 for forest and 3.21, 3.33, and 3.38 for open field in the precipitation classes 0-1, 1-10, and > 10 mm, respectively, contrary to expectations that greater solar radiation on clear days could lead to higher degree-day factors. The degree-day factor varied seasonally. In Finland in March it was 30-70% of the seasonal mean, which was reached during early April in the south and late April in the north. There was a greater increase in open field than in forest. (Cassar-FRC)
W82-01735

SUMMER ICE AND CARBON DIOXIDE,

Lamont-Doherty Geological Observatory, Palisades, NY.
G. Kukla, and J. Gavin.
Science, Vol 214, No 4520, p 497-503, October 30, 1981. 4 Fig, 3 Tab, 62 Ref.

Descriptors: *Ice, *Carbon dioxide, Temperature effects, Seasonal variation, Antarctic, Polar regions, Model studies.

Changes occurring in the surface air temperature of the earth and in the areas of snow and sea ice are reviewed. Data have been collected from satellite monitoring systems, from ship reports, from the Oceanographic Atlas of the Polar Seas, and from various published ice charts. The information gathered yielded several conclusions. The multiyear variability in the extent of the Antarctic sea ice is considerable and has a large potential impact on the energy budget of the middle and high southern latitudes. In the late spring and summer ice around Antarctica during the last few years has been less extensive than reported in atlases published prior to 1970. Pack ice in specific areas appears to have been more extensive from November through February in the 1930's than it is at present. The observations agree qualitatively with the expected effect of a carbon dioxide increase. The mean surface air temperatures along selected northern latitudes during spring and summer were higher in 1974 to 1978 than in 1934 to 1938. The positive anomalies appear to be associated with the seasonally shifting belt of melting snow. This finding is consistent with the temporal and spatial impact of increasing carbon dioxide predicted by the energy balance model. It is concluded that studies of highly variable components of the climate system such as snow and pack ice fields and associated surface air temperatures should be given priority in the search for early signs of a carbon dioxide effect. Conclusions about a relationship of the observed changes in snow and sea ice areas and surface air temperatures to carbon dioxide increases are only tentative. (Baker-FRC)
W82-01843

GLACIER SURVEYS IN ALBERTA - 1979,

National Water Research Inst., Burlington, (Ontario). Water Resources Branch.
I. A. Reid, and J. O. G. Charbonneau.
Report Series No 69, 1981. 18 p, 6 Fig, 20 Tab, 9 Ref.

Descriptors: *Glaciers, *Athabasca glacier, *Saskatchewan glacier, Surveys, Surface water, Runoff, Linear change, Volumetric change, Stereoscopic terrestrial photographs, *Alberta, *Melt water, Streamflow, *Glaciohydrology.

Glaciers act as natural regulators, storing water in winter and releasing it in summer. To gain some understanding of this phenomenon and the contribution which glaciers make to streamflow, the predecessors of the Water Survey of Canada began glacier surveys in 1945. The earlier surveys offered some clue to the role of the glacier, but the data collected were not sufficient to provide the overall picture. Following adoption of photogrammetric survey techniques, however, the glacier surveys have evolved to the extent that it is now feasible to produce a series of maps from which the linear, areal, directional and volumetric changes can be determined. The surveys have revealed that the glaciers, in general, are becoming smaller in size; hence the regulating effect on streamflow is diminishing. (WATDOC)
W82-01855

DEVELOPMENT AND APPLICATIONS OF A RUNOFF MODEL FOR SNOWCOVERED AND GLACIERIZED BASINS,

Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
L. Gottlieb.
Nordic Hydrology, Vol 11, No 5, p 255-272, 1980. 9 Fig, 2 Tab.

Descriptors: *Glaciers, *Snowmelt, *Runoff, Glaciohydrology, *Model studies, Ice cover, Peyto Glacier, Alberta, Johan Dahl Land Glacier, Greenland, *Runoff forecasting.

A model for prediction of daily runoff from snowcovered and glacial basins was developed and applied to two basins. The model divides the basin into an ice-free area and an ice-covered area, accounting for the large differences in heat balance,

runoff, meteorological conditions, and snow cover between the two types of areas. The heat exchage between atmosphere and snow or ice cover is calculated by a modified degree-day approach or, if the data are available, by the complete energy balance equation. The NAM model, a conceptual, lumped rainfall-runoff model, is used to calculate the amount of water routed to the stream each day. In the ice-covered area, runoff originates from the melting of seasonal snow cover and from melting of the permanent ice mass. The model treats the routing of melt water over the ice as a simple linear reservoir. The model was tested on the Peyto Glacier Basin, Alberta, for which 8 years of runoff data and meteorological observations were available. Overall agreement was quite good, but the model did not predict major peak flows accurately. The model was also used for the study of the Johan Dahl Land glacierized basin, Greenland, of interest in hydropower development. Here, 15 years of synthetic runoff were generated from 4 years of discharge data (1976-79). Estimates of average runoff were greatly improved; the standard deviation obtained using the 15 years generated data plus 4 years actual observations was half that of the standard deviation using only 4 years of observed runoff. (Cassar-FRC)
W82-01885

SPATIAL SIMULATION OF SNOW PROCESSES,
Danish Inst. of Applied Hydraulics, Hoersholm.
A. G. Thomsen.
Nordic Hydrology, Vol 11, No 5, p 273-284, 1980. 10 Fig, 1 Tab, 4 Ref.

Descriptors: *Snowmelt, *Snow accumulation, *Satellite technology, Simulation analysis, Model studies, Watersheds, Hydrographs, Streamflow, Forest management, Remote sensing.

A system of simulation models designed to efficiently use both traditional and remotely sensed data sources is presented. Watershed information on topography, vegetation, and soils in digital terrain models serve as a data base for watershed analysis, classification of snow in Landsat imagery, and automatic generation of parameter decks for operating distributed simulation models of snow cover dynamics and streamflow generation. The system is tested in the Williams Fork Watershed in the Central Rocky Mountains of Colorado, area 476 sq km, elevation 2380 to 4137 meters. The models can be used individually or in combination. EXTRACT automatically defines hydrologic response units and calculate their parameters from data in overlays. WATBAL is a snow process simulation model requiring daily extreme temperatures and precipitation as driving variables. LATFLOW simulates overland flow and baseflow contributions to the snowmelt hydrograph and the dominant lateral flow component. Using EXTRACT it is also possible to simulate watershed response to thinning or clear cutting timber stands. SNOWPCT is available for classifying the fractional snow covered area within Landsat pixels (ground resolution elements). (Cassar-FRC)
W82-01887

EVAPORATION FROM A SNOW COVER-- REVIEW AND DISCUSSION OF MEASUREMENTS,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 2D.
W82-01888

LIMITATIONS IN HYDROLOGICAL INTERPRETATIONS OF THE SNOW COVERAGE,
Federal Inst. for Snow and Avalanche Research, Davos/Weissfluhjoch (Switzerland).
J. Martinec.
Nordic Hydrology, Vol 11, No 5, p 209-220, 1980. 10 Fig, 2 Tab, 7 Ref.

Descriptors: *Snow cover, *Runoff, *Snowmelt, Seasonal variation, Alpine regions, Dischma Basin, *Switzerland.

Although patterns of receding snow cover in a given area are similar from year to year, they cannot be used to reliably predict the volume of stored snow or water and seasonal runoff. The Dischma basin, Switzerland, had similar snow cover (about 40-45%) on July 5, 1974, and June 8, 1976, but the measured runoffs for 150 degree days from the starting date were 14.2 million cu meters and 6.4 million cu meters, respectively. Similar snow cover in June 21, 1972, and July 17, 1978, produced 9.6 million cu meters and 12.8 cu meters, respectively. The areal extent of the snow cover appears to be related to the ratio of the current water equivalent to its maximum value in the respective year. (Cassar-FRC)
W82-01889

2D. Evaporation and Transpiration

WATER REQUIREMENTS AND MAN-INDUCED CLIMATE CHANGE,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
G. H. Hargreaves.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 247-255, September, 1981. 9 Ref.

Descriptors: Evapotranspiration, *Water requirements, *Climatology, *Agriculture, Research priorities, *Carbon dioxide, Water management, Temperature, Air temperature, Crop production, *Global climate change.

The global temperature rise expected over the next 50 years as a result of increased concentrations of CO2 in the atmosphere from fossil fuel burning will affect water requirements. Doubling of CO2 concentrations would increase temperatures by 2 C near the equator and 8 C at 83 degrees latitude. This temperature rise would shift crop zones 250-300 miles further north and increase photosynthesis. Total increases in water requirements, considering increases due to higher temperature and increases in length of growing season, are 16% at 30 degrees latitude, 27% at 40 degrees, 42% at 50 degrees, and 63% at 60 degrees. At the same time, rainfall in the 37-47 degree latitudes, where the major portion of U.S. corn and livestock is produced, is expected to decrease. However, potential benefits (increased crop production) may result from higher global temperatures if water is available in sufficient quantities at the required locations. (Cassar-FRC)
W82-01633

ENVIRONMENTAL AND PHYSIOLOGICAL CONTROL OF WATER FLUX THROUGH PINUS CONTORTA,
Colorado State Univ., Fort Collins. Dept. of Forest and Wood Sciences.
S. W. Running.
Canadian Journal of Forest Research, Vol 10, No 1, p 82-91, March, 1980. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Trees, *Stomatal transpiration, *Soil-water-plant relationships, Leaves, Water potential, Pine trees, Air temperature, Temperature, Humidity, Conductance, Evapotranspiration, Forests, Experimental forest, *Colorado.

Humidity responses studied in a stand of Pinus contorta Dougl. ex Loud lodgepole pine in the Fraser Experimental Forest, Colorado, were similar to those reported for other conifers. The following measurements were recorded during June-August 1978: leaf conductance, leaf water potential, temperature, humidity, and radiation. The daily range of leaf conductances decreased 10-fold from June (0.12-0.16 cm per sec) to August (0.01-0.03 cm per sec). There was a high correlation between predawn leaf water potential and morning maximum leaf conductance. There was not enough difference in stomatal response in needles of different ages to permit formal analysis. Generally, older needles appeared unable to close their stomata as tightly as new needles, and maximum leaf conductance was slightly lower and more erratic in the oldest needles. Low atmospheric humidity significantly decreased midday leaf conductance. Minimum leaf water potential threshold was -1.8 to -2.0 MPa. The seasonal change in total soil-water-plant resistance to water flux was nonlinearly correlated with changes in predawn leaf water potential, which is an indirect measure of soil water potential. (Cassar-FRC)
W82-01827

EVAPORATION FROM A SNOW COVER-- REVIEW AND DISCUSSION OF MEASUREMENTS,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Nordic Hydrology, Vol 11, No 5, p 221-234, 1980. 9 Fig, 1 Tab, 19 Ref.

Descriptors: *Snow cover, *Evaporation, Condensation, Heat transfer, Snowmelt, Seasonal variation, Air temperature, Lysimeters, *Sweden.

A review of the literature and lysimeter measurements in Sweden demonstrated that total evaporation from snow cover during the season was only 10-20 mm. The calculated net total evaporation, accounting for the energy supply, for a single day in April was 0.14 mm. Variation in evaporation over the day, April 6, 1978, at Lulea, was from -5 mm per hour to 10 mm per hour. During midwinter when air was dry, little evaporation occurred. In spring solar radiation was available but the vapor pressure difference was very small. In the beginning of May 1979 evaporation rates were 0.6-0.8 mm per day, decreasing to zero by May 14 and becoming negative (condensation) May 15-23. Total evaporation was 6 mm, but net evaporation only 3 mm. The aerodynamic formula is most frequently used for determining evaporation on a routine basis, but should be used together with energy balance computations, because evaporation rate is limited by available energy. The profile method, which compensates for the effect of density stratification in the air, can be used on a short-term basis. (Cassar-FRC)
W82-01888

WAYS OF SUCCESSIVE REFINEMENT OF METHODS OF CALCULATING THE DUTY OF WATER,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. I. Budagovskii, and L. Ya. Dzhogan.
Water Resources (English Translation), Vol 7, No 6, p 483-500, November-December, 1980. 4 Fig, 27 Ref. Translated from Vodnye Resursy, No 6, p 29-51, November-December, 1980.

Descriptors: *Irrigation efficiency, *Evaporation, *Consumptive use, Evapotranspiration, Water use efficiency, Soil water, Mathematical studies.

Methods for the calculation of the nonreturnable consumption of water for irrigation were refined. Existing methods for making this calculation are at least 20-25 years old. The new refinement replaces the biological curve of evaporation and considers soil evaporation as a function of its water content. The effect of precipitation on soil water evaporation is also considered. One of the most important steps is determining the extent of nonproductive evaporation. The heat-water balance method of calculating evaporation is also refined. The assumption of equality of the critical water content for transpiration and evaporation by bare soil was eliminated. (Small-FRC)
W82-02094

2E. Streamflow and Runoff

LOG PEARSON III DISTRIBUTION - EFFECT OF DEPENDENCE, DISTRIBUTION PARAMETERS AND SAMPLE SIZE ON PEAK ANNUAL FLOOD ESTIMATES,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol 52, No 1-2, p 149-159, June, 1981. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Flood peak, *Mathematical studies, *Flood forecasting, Markov process, Statistical methods, Analysis of variance, Correlation analysis, Flood plain management, Flood control, Flood profiles.

The effect of sample size, distribution parameters and dependence on peak annual flood estimates by the log Pearson III distribution was examined in 172 Australian streams. Overall results showed that positive skewness flood estimates were underestimated, while those for negative skewness were overestimated. The percentage difference (d) decreased with increasing sample size. However, in streams with great variability and skewness, errors of over 40% may be expected. Analyses of distribution parameters showed that the mean did not affect d. The difference was at a minimum when skewness was between -0.5 and 0. The lag-1 autocorrelation had little effect on d-values. Based on 30 years of data, the 100-year peak flood estimate for Australian streams is in error by about 10% using the log Pearson III distribution. For individual streams, errors as high as 50% could occur. (Geirger-FRC)
W82-01649

LOG PEARSON III DISTRIBUTION - AN EMPIRICALLY-DERIVED PLOTTING POSITION,

Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol 52, No 1-2, p 161-163, June, 1981. 1 Tab, 5 Ref.

Descriptors: *Mathematical studies, *Monte Carlo method, *Flood frequency, Flood peak, Flood forecasting, Statistical methods, Flood control, Flood profiles, Graphical analysis, Graphical methods, Comparison studies.

The log Pearson Type III (LP-III) distribution has been adopted as the standard distribution for flood frequency analysis in several countries; however, no appropriate plotting position has been recommended for its use. A Monte Carlo analysis was undertaken to determine an appropriate value for alpha, the constant in the general plotting position formula used in the LP-III distribution. The optimum value of alpha was found to vary with the shape of the distribution or g, the coefficient of skewness of the logarithms of the peak annual discharges. The optimum value of alpha over all values of g was close to 0.4. This value was in agreement with previous studies on the optimum value of the constant used in the general plotting position formula of the LP-III distribution. (Geiger-FRC)
W82-01650

LEGAL CHALLENGE OF THE UNGAGED WATERSHED,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. F. Kibler, J. M. Hrubovack, and D. C. Froehlich.
Water Resources Bulletin, Vol 17, No 3, p 458-465, June, 1981. 1 Fig, 5 Tab, 17 Ref. OWRT-A-049-PA(4), 14-34-0001-8040.

Descriptors: *Flood peak, *Judicial decisions, *Culverts, Flood frequency, Watersheds, *Runoff forecasting, *Pennsylvania, Legal aspects, Gaging, Hydrographs, Flood plain zoning, Design floods, Hydrologic aspects.

Methods for estimating flood peak discharges in ungaged Pennsylvania watersheds were compared in connection with a court case in which the design of highway culverts carrying the Wissahickon Creek near Lansdale, Pennsylvania, was contested by a landowner in the basin. The Environmental Hearing Board ruled in favor of the defendants on August 25, 1976, and further appeals did not produce any change in the decision. Methods used by the plaintiff and the resulting Q50 were as follows: Soil Conservation Service Composite Hydrograph, 2922 and 2120 cfs; and Regional Science Research Institute (Hammer, 1974) method, 1933 cfs. Methods used by the defendants and resulting Q50 were: Potter, 744 cfs; PSU III, 1366 cfs; Department of Environmental Resources B curve, 1390 cfs; Soil Conservation Service Flood Peak, 1140, 1440, and 1940 cfs. Six methods applicable to ungaged Pennsylvania watersheds were evaluated on 38 years' data from the Little Mahoning Creek and the Aquashicola Creek. Standard errors resulting from application of these methods to a total of 10 gaged stations were as follows: Federal Highway Administration method, 63.6%; United States Army of Engineers, 41.5%; Department of Environmental Resources, 26.5%; U. S. Geological Survey methods, 47.2%; Pennsylvania Department of Transportation Flood Peak Frequency Design Manual (PSU III) 38.9%; and Pennsylvania Flood Index Map, 31.5%. Those methods developed from a large number of stations within the study region performed better. Generally, methods that depend on mapping of point values, such as the C-index, were better than either regression models or iso-line contours. (Cassar-FRC)
W82-01664

PREDICTING STORM RUNOFF FROM SMALL GRASSLAND WATERSHEDS WITH THE USDAHL HYDROLOGIC MODEL,

Oklahoma State Univ., Stillwater.
R. L. Bengtson.
PhD Thesis, 1980. 187 p, 38 Fig, 68 Tab, 45 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-27163.

Descriptors: *Model studies, *Watersheds, *Storm runoff, Hydrologic data, Grasslands, Calibration, *Oklahoma, *Runoff forecasting, Comparison studies, Hydrologic models, Predictions.

A study of the capabilities of the USDAHL model was conducted on four grassland watersheds located in central Oklahoma. The objectives of this study were: (1) to calibrate the USDAHL model to find those hydrologic parameters which best simulate the observed runoff, (2) to test the transferability of the model by applying it to three watersheds using the preceding hydrologic parameters and comparing the observed runoff against the simulated runoff, and (3) to identify any components of the USDAHL model that require improvements. Based on the analysis and interpretation of the results of this study, the following conclusions were made: (1) The hydrologic parameters to be varied during calibration are the vegetative parameter (A), depression storage (VD), evapotranspiration (ET/EP), and deep groundwater recharge (GR); (2) The Type II calibration procedure proved to be the best procedure for calibrating the USDAHL model; (3) Subsurface flow can be ignored for small watersheds of the type studied with ephemeral runoff; and (4) The model overpredicted annual peak rates of flow when calibrated for runoff yield. (Sinha-OEIS)
W82-01672

INVESTIGATIONS INTO THE DYNAMICS OF WATER MOVEMENT ON A LOW RELIEF LANDSCAPE ON THE EASTERN SHORE OF MARYLAND,

Maryland Univ., College Park.
For primary bibliographic entry see Field 2F.
W82-01673

FLOOD CONTROL ON THE PARANA AND PARAGUAY RIVERS,

Motor-Columbus Consulting Engineers, Inc., Baden (Switzerland).
W. Keller, J. van Duivedijk, and G. Mondada.
International Water Power and Dam Construction, Vol 33, No 7, p 35-43, July, 1981. 7 Fig, 2 Tab.

Descriptors: *Flood control, *Rivers, *Reservoirs, Diversion, Storage, Model studies, Mathematical models, Floods, *Argentina, *Paraguay, Economic aspects, Flood damage, Social impact, Parana River, Paraguay river.

The objectives of flood studies conducted on the Parana and Paraguay Rivers were to obtain an understanding of the extraordinary floods with a return period of 10 to 100 years which have devastating effects on the riverine areas in Argentina and Paraguay; to obtain the same for extreme floods resulting either from natural causes or from the rupture of dams upstream; to determine precisely the hydraulic and economic consequences of these types of floods; and to propose, evaluate and carry out preliminary designs for possible flood-protection works. The study area was influenced by the reach of the Parana river between the mouth of the Iguazu and Baradero in the delta of the Parana river, and the reach of the Paraguay river between Asuncion and its confluence with the Parana river, for a total river length of about 2000 km. Extensive surveys and studies were made in the area to evaluate the economic consequences of the floods. The extent of flooding differed considerable along the river and mainly depended on the topographical situation. To obtain a proper understanding of the inundation phenomena under various flow conditions, a mathematical model of the river system was designed, including the flood plains and adjacent areas which are inundated only during extraordinary floods. One of the possibilities for protection against floods is the temporary storage of flood water in reservoirs. Other plans include the diversion of high discharges through floodways and the local embankments around urban or rural centers. Cost aspects are considered briefly. (Baker-FRC)
W82-01707

LOG PEARSON III DISTRIBUTION - IS IT APPLICABLE TO FLOOD FREQUENCY ANALYSIS OF AUSTRALIAN STREAMS,

Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
T. A. McMahon, and R. Srikanthan.
Journal of Hydrology, Vol 52, No 1/2, p 139-147, June, 1981. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Flood frequency, Flood forecasting, Forecasting, Floods, Streams, *Australia, *Mathematical studies, Maximum flow, Annual runoff, *Log Pearson distribution.

An analysis was made using moment ratio diagrams of peak annual discharges of 172 Australian streams. The study made use of the log Pearson Type III distribution as it has been adopted for use in flood frequency analysis. To test the acceptability of the LP-III distribution as a general flood frequency distribution for Australian streams, moment ratio values for the peak annual discharge series were plotted. When the study had been completed it was concluded that the log Pearson III distribution could be recommended as a suitable general distribution for flood frequency analysis. The theoretical distributions - normal, 2-parameter log-normal, gamma, Gumbel, Weibull, and exponential - fitted the data poorly. The procedure of setting the coefficient of skewness (g) of the logarithms of peak annual discharges to zero, if the sample value of g is not statistically different from zero, is questioned. It is concluded that, at least for the case where g is greater than zero, this practice is not to be followed, but rather the sample value of g should be used. (Baker-FRC)
W82-01731

LOW-FLOW FREQUENCY AND FLOW DURATION OF TENNESSEE STREAMS,

Geological Survey, Nashville, TN. Water Resources Div.
R. L. Gold.
Geological Survey Open-File Report 78-807, 1981. 361 p, 7 Fig, 1 Plate, 2 Tab, 20 Ref.

Descriptors: *Low flow, *Flow duration, *Streamflow, *Flow rates, Hydrologic data, Gaging stations, Sites, Drainage area, *Frequency analysis, Streams, Flow characteristics, Regulated flow, Average flow, Discharge measurement, Streamflow forecasting, Maps, *Tennessee.

Low-flow frequency and duration data are presented to define variations of the low flow of Tennessee streams both in time and place. Analysis has been made of 204 continuous record stations, both regulated and unregulated and 651 partial-record stations operated either by the U.S. Geological Survey or Tennessee Valley Authority through the 1975 water year. Flow duration and frequency data have been tabulated for the continuous record sites using the digital computer and graphical

methods. Frequency data only is presented for partial-record sites computed in most cases by comparing several discharge measurements at the site with concurrent daily mean flow for an appropriate gaging station. Flow duration data can be used to define a flow duration curve, with the slope at points on that curve used to establish the dependability of the stream to sustain a particular flow. Low-flow frequency data are presented to predict the probability that a specified flow or lesser flow will recur through time. (USGS)
W82-01779

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE DESCHUTES RIVER BASIN, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
J. E. Cummans.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $3.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-639, 1981. 20 p, 4 Fig, 4 Tab, 5 Ref.

Descriptors: *Low flow, *Streamflow, *Streamflow forecasting, *Data collections, Flow rates, Discharge measurements, Correlation analysis, Gaging stations, Precipitation, Fish management, Hydrologic data, *Washington, Deschutes River basin.

The streams in the basin usually have their low flows in August and September. Seven-day low flows were smallest in 1952 when annual rainfall at the Olympia airport was also the least during the 1945-75 period of continuous gaging-station records in the basin. The magnitude and frequency of seven-day low flows were estimated for 23 streamflow sites, either from frequency analysis of data at long-term stations or from correlation of measured or computed discharges at a streamflow site with data at a long-term station. Seven-day low flows ranged from no-flow at one tributary of Deschutes River having a drainage area of 1.85 square miles to 98 cubic feet per second for Deschutes River near its mouth, where the drainage was 162 square miles. Mean monthly flows were determined for two long-term stations and estimated for months of July to September for the other streamflow sites. (USGS)
W82-01781

STAGE-DISCHARGE RELATIONS AT DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-01793

A MATHEMATICAL MODEL OF THE HYDROLOGIC REGIME OF THE UPPER NILE BASIN,

Snowy Mountains Engineering Corp., Cooma (Australia).
For primary bibliographic entry see Field 2A.
W82-01857

STATISTICAL DETERMINATION OF DESIGN LOW FLOWS,

Bechtel, Inc., San Francisco, CA.
A. Prakash.
Journal of Hydrology, Vol 51, No 1-4, p 109-118, May, 1981. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Statistical methods, *Design flow, *Low flow, Prediction, Flow, Mathematical studies, Probabilistic process, Minimum flow, Streamflow, River low.

In designing non-safety-related and safety-related hydraulic structures for use in the nuclear power industry, it is necessary to ensure that these facilities are able to perform their design functions during the n-year low and the probable minimum flow, respectively. Although probabilistic approaches have been developed to estimate low stream flows of a recurrence interval of n years, no attempt appears to have been made to define the probable minimum flow. Analysis of the low stream flows of 66 streams in the United States has deomonstated that the SMEMAX transformation normalizes the available data for all of the streams and provides reasonable estimates of low flows up to a recurrence interval of 100 years. For higher recurrence intervals, predictions made with SMEMAX are overly conservative. Qualitatively, the probable minimum flow is defined as a hypothetical flow that can be considered to correspond to the least runoff available from existing geomorphic conditions and a critical combination of reasonably possible hydrometeorological factors which are conducive to minimum stream flows. Two statistical approaches can be adopted to obtain a quantitative estimate of the probable minimum flow. The first involves defining the probable minimum flow as the lower boundary parameter in the three-parameter Gumbel's bounded exponential distribution. The second approach involves assigning a low frequency of occurrence to the probable minimum flow, frequently 10 to the minus 7th power. Since the first approach was found to provide an overestimation of the probable minimum flow for seven out of the ten streams analyzed, it is suggested that a variety of appropriate distributions be tried and the one giving the best fit be used for deriving a quantitative estimate of probable minimum flow. (Carroll-FRC)
W82-01858

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: APPLICATIONS,

Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina, Jr., W. C. Huber, and J. P. Heaney.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 799-816, August, 1981. 18 Fig, 2 Tab, 20 Ref.

Descriptors: *Mathematical models, *Storm runoff, Storm water, Urban runoff, Wastewater treatment, Simulation models, Water quality, Computers, Biological oxygen demand, Prediction, Water pollution, Des Moines, Des Moines River.

Mathematical models derived from a unified concept of pollutant mass transport through the various components of the physical system have been developed to describe the response of storage/treatment systems to highly variable storm water inflows. This methodology has been successfully applied to the actual urban area configuration of Des Moines, Iowa, and its receiving water, the Des Moines River. Continuous simulation was used to examine system behavior in terms of both historical sequence of events and frequency of occurrence of events of various magnitudes. Use of a well-mixed constant volume model to represent a hypothetical urban runoff control facility, combined with increases in the hydraulic detention times while providing secondary treatment to dry weather flow, resulted in predictions of appreciable increases in the frequency of occurrence of events which equaled or exceeded a given dissolved oxygen concentration in the receiving water. Comparison of measured effluent biological oxygen demand mass rates showed that the well-mixed constant volume model closely described the performance of a detention tank in Milwaukee, Wisconsin. The well-mixed storage/treatment models predict an immediate response at the system outfall to variations in storm water volume. Any well-mixed constant volume basin providing a sufficiently long detention for inflows accomplishes concentration equalization by both volumetric mixing and pollutant decay. Although the primary function of variable volume systems is to provide flow equalization, the pollutant peak and mean mass rates from these systems can be effectively decreased by reducing peak and mean outflow rates. (Carroll-FRC)
W82-01981

LEARNING FROM THE SKIPTON FLOOD,

R. B. Russell.
Water, No 30, p 20-22, January, 1980. 6 Fig, 3 Ref.

Descriptors: *Flood forecasting, *Flash floods, *Forecasting, Floods, Warning systems, Flood data, Meteorological data collection, Satellite technology, Hydrologic data, *Great Britain.

The flood which occurred in Skipton, Great Britain, in June 1979 followed a rainstorm with return periods in excess of 500 years. Such storms occur over some urban area in England and Wales on the average of once a year. A total of about 3 hours elapsed between the first appearance of the storm on the record of the radar sited about 170 kilometers away and the cessation of the storm. The flood peak occurred only an hour after the beginning of the intense rainfall in the area and at about the same time as the end of rainfal. Although only a very alert analyst would have deduced from the radar mosaic alone that a potentially dangerous situation was developing prior to the commencement of intense rainfall, a trained forecaster with access to radar and satellite data would have been alert to the development of the possibility for rapid storm growth in the area much earlier. Consultation between trained meteorologists and hydrologists could have provided warning of the flood 1 to 2 hours before the event. Even such a short lead time can result in significant financial savings and avoidance of losses of life, as well as appropriate diversions of traffic and mobilization of relief services. A radar system served by appropriately trained meteorological and hydrological staff and integrated with satellite information provides the best chance for issuing flood warnings in cases such as this. There is also a possibility that surveys could be conducted to identify urban areas potentially at risk from such localized events of extremely long return period. (Carroll-FRC)
W82-02063

THE DAY THAT THE RAIN CAME DOWN,

L. Freeman.
Water, No 31, p 2-4, March, 1980.

Descriptors: *Flood control, *Warning systems, *Flood damage, *Great Britain, Flood protection, Regional floods, Floodproofing, Management planning.

Extensive flooding which resulted from record rainfalls in areas served by the Welsh, Wessex, and South West water authorities in Great Britain provided many lessons for the water industry. A total of more than 125 communities experienced some flooding ranging in degree from 30 to over 100 year return periods. Heavy constant rainfall over a 24-hour period permitted warnings up to 16 hours in advance of the flood event on long and fairly easily predictable rivers, but very short warning periods on other short, sharp, and flashy rivers. In some cases, flood waters were significantly higher than predicted. While the warnings resulted in significant reductions of property losses in many communities, in others people felt a false sense of security resulting from fairly recent construction of flood protection works and failed to take precautionary measures. Lessons provided to the water authorities by these floods included the need for training exercises, especially in areas which experience only infrequent floodings; the need to review the strength of essential private flood protection walls and banks and to determine whether water authorities should take over responsibility for them; the need to make provisions for evacuation of water after the rivers subside, especially in areas where protection works prevent the flow of water back into the river bed; the need to evaluate the security of communications systems; and the need to record flood experiences so that future water authority personnel can benefit from what is learned during such events. The effectiveness of flood alleviation schemes in many communities during this flood event should encourage other communities to proceed with planned flood control measures. (Carroll-FRC)
W82-02064

METHODS OF STUDYING INVERTEBRATE DRIFT IN RIVERS,

Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
For primary bibliographic entry see Field 7A.
W82-02074

HYDROLOGIC AND ANTHROPOGENIC FACTORS AFFECTING WATER QUALITY IN THE RIVERS OF THE UKRAINIAN CARPATHIANS,

Akademiya Nauk URSR, Kiev. Inst. Hydrobiologii.
For primary bibliographic entry see Field 5B.
W82-02076

2F. Groundwater

A GRAPHICAL APPROACH TO PREDICTION OF GROUNDWATER POLLUTANT MOVEMENT,

North Carolina State Univ. at Raleigh. Dept. of Marine Earth, and Atmospheric Sciences.
For primary bibliographic entry see Field 5B.
W82-01634

GROUNDWATER DISCHARGE TO THE PACIFIC OCEAN,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
I. S. Zektser, and R. G. Dzhamalov.
Hydrological Sciences Bulletin, Vol 26, No 3, p 271-279, September, 1981. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Groundwater movement, *Ocean circulation, Pacific Ocean, Inflow, Hydrology, Discharge measurement, Coastal aquifers.

Concepts concerning groundwater outflow to the oceans of the world are presented. A method for evaluating submarine groundwater is discussed, with estimates for discharge to the Pacific Ocean along all its coastline and major islands. Through the analysis of groundwater discharges over a generation of time to the Pacific Ocean it is noted that this global process depends on a complex combination of various natural factors such as climate, topography, geology and hydrogeology. The dynamics of groundwater flow, permeability and storage properties of the unsaturated zone and aquifers, and other factors strongly influence submarine groundwater discharge. In the main, however, groundwater discharge value depends on the structure of inflow and outflow elements of the water balance of drainage basins, which in turn are governed by the ratio of heat and moisture as the main indicator of the natural physiographical zoning. The distribution of values of groundwater discharge to the world ocean on a global scale is therefore subject to latitudinal physiographical zoning. These values gradually increase from subtropic regions to moderate areas, sharply increase in wet subtropics and tropics, and decrease in semiarid and arid regions. Anomalous large or small values of submarine groundwater discharge, associated with the shielding effect of mountains on atmospheric circulation patterns, wide karst development, drainage effects of river valleys, and other factors are confined to local coastal areas and generally are known not to affect the general dependence of groundwater discharge to the ocean on the latitudinal physiographic zoning. (Baker-FRC)
W82-01647

INVESTIGATIONS INTO THE DYNAMICS OF WATER MOVEMENT ON A LOW RELIEF LANDSCAPE ON THE EASTERN SHORE OF MARYLAND,

Maryland Univ., College Park.
M. S. Christy.
PhD Dissertation, 1980. 172 p, 27 Fig, 3 Tab, 87 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03869.

Descriptors: Groundwater, Runoff, *Soil moisture, Water table, *Storm runoff, Watersheds, Maryland, *Dorchester County, *Groundwater runoff, Coastal aquifers, Tidal flats.

The role of groundwater in storm runoff events and the dynamics of the subsurface watershed were the focal points of this study. The investigations were carried out over a three year period at a study site on a tidewater peninsula in Dorchester County on the Eastern Shore of Maryland. The role of groundwater in runoff was evaluated with a recently developed storm hydrograph separation technique using naturally occurring isotopes as basin wide tracers. Results of the study showed both typical behavior patterns of water movement and patterns that were seemingly unique to a flat landscape. Traditional and modeled evaluations of storm runoff show groundwater to be only a minor contributing factor. Quantitative isotopic analysis showed that in fact there was a major groundwater contribution to the runoff occurring at this study site. A factor of runoff that appears to be unique to landscapes of low relief is the distinct threshold between high storm yield and no storm yield. When both the soil moisture and the watertable are relatively high, there is substantial runoff even from low volume rain events. However, regardless of rainfall volume and/or intensity, when the soil moisture and the height of the watertable are low, there is no apparent runoff. An average watertable depth of 36 cm below the ground surface was the apparent threshold for storm runoff at this site. Above and below this level there was and was not runoff, respectively. (Sinha-OEIS)
W82-01673

NUMERICAL ANALYSIS OF TRANSIENT SALT/FRESH-WATER INTERFACE IN COASTAL AQUIFERS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. I. Layla.
PhD Dissertation, 1980. 206 p, 24 Fig, 4 Tab, 101 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22411.

Descriptors: *Numerical analysis, *Aquifers, *Saline water intrusion, Interfaces, Coasts, Estuaries, *Coastal aquifers, Saline-freshwater interfaces.

The simultaneous effect of the salt-and the freshwater flow on the areal distribution of the interface in coastal aquifers was studied under transient conditions. A two-dimensional model was developed to simulate the growth or the decay of the interface in confined or unconfined aquifers. The contribution from the capillary region to the interface elevation change was also studied. A numerical model using the Galerkin-finite element method was developed to solve the flow equations describing the flow of fresh and salt waters. The adequacy of the numerical model in predicting the interface elevation was verified by comparing its results with existing physical and steady-state analytical solutions. The numerical model was used to solve various problems pertaining to different flow conditions in order to illustrate the effect of salt-water friction, capillary flow and capillary storage on the transient development of the interface. The results indicate that salt-water flow significantly influences the rate of growth of the interface. The influence of capillary flow on the interface elevation is more pronounced at small initial saturated thickness, while the contribution of the static moisture profile on the capillary storage is greatest at small depths to the water table. (Sinha-OEIS)
W82-01693

COMPONENTS OF SATURATED ZONE THICKNESS IN A NIGERIAN BASEMENT COMPLEX REGOLITH,

Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
Hydrological Sciences Bulletin, Vol 26, No 3, p 291-303, September, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Saturation zone, Groundwater hydrology, Saturated soils, Saturated flow, Mathematical studies, *Nigeria, Spatial distribution, *Groundwater, *Geohydrology.

An attempt is reported to obtain an optimum prediction of the gross spatial distribution of the thickness of the zone of saturation in the regolith of a typical deeply weathered Basement Complex area in southwestern Nigeria. The technique employed is a combination of the algebraic polynominal trend surface and conventional regression models. The study attempted to determine the components of saturated zone thickness in the regolith of the study area and identify environmental factors or processes responsible for their presence, and to obtain an optimally determined equation by which depths of the groundwater medium to be penetrated by wells at specific sites within the study area could be predicted ahead of the actual sinking operations with a reasonably high level of confidence. The tentative conclusion drawn from this study applies more to the humid and low relief areas of the Basement Complex. It states that the thickness of the saturated zone in the regolith has a regional trend, increasing from the major river channel to the interfluve. While the regional component follows the general spatial trend of weathering depth, the local component of the gross spatial distribution arises from the irregular contour of the basal surface of weathering and differential rates of regolith removal by fluvial erosional processes. The local component, about 16% of the gross spatial distribution, is adequately described by a conventional regression equation in which the independent variable is weathering depth. This method has several advantages over that of fitting progressively higher-order trend surfaces to spatial data. (Balker-FRC)
W82-01710

THE RELATIONSHIP BETWEEN MACRO-TOPOGRAPHY AND THE GROUNDWATER QUALITY IN THE GREAT FISH RIVER BASIN, EASTERN CAPE PROVINCE,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
E. A. W. Tordiffe, and B. J. V. Botha.
Water SA, Vol 7, No 3, p 113-138, July, 1981. 21 Fig, 4 Tab, 10 Ref.

Descriptors: *Topography, *Groundwater hydrology, *Impaired water quality, *Geohydrology, Calcium, Sodium, Chlorine, Connate water, *South Africa, Water pollution sources, Chemical properties, Geochemistry, Chemistry of precipitation, Water quality, Great Fish River basin.

The relationship between the geomorphologic region and ground water quality was investigated in the Great Fish River Basin in Eastern Cape Province, South Africa. The area studied is about 25,000 sq km and contains the following geomorphologic regions: the Margin Region, the Great Escarpment, the Headbasin, and the Interior Plateau. A distinct relationship was found between the regions and ground water characteristics. High percentages of Ca(+2) and HCO3(-1) were determined in the higher lying Interior Plateau, and high Na(+1) and Cl(-1) were found in the ground water of the Headbasin and Marginal Region. Groundwater movement is almost stagnant in these last two low lying regions. The differences in quality may be due to the influence of connate marine waters from the sedimentary rocks of the Dwyka Formation and Ecca Group. Atmospheric salts may also be deposited. Meteoric water in the Interior Plateau can dissolve CaCO3, but as this water percolates down toward the lower regions it becomes saturated with Ca(+2) and HCO3(-1). Then the CaCO3 is precipitated as calcrete. (Small-FRC)
W82-01718

GROUNDWATER DISCHARGE THROUGH SPRINGS WITH WELL-DEFINED OUTLETS—A CASE STUDY FROM JELOYA-MOSS, S. NORWAY,

Norges Landbrukshoegskole, Vollebekk. Dept. of Geology.
J. O. Englund, and K. F. Meyer.
Nordic Hydrology, Vol 11, No 3/4, p 145-158, 1980. 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Springs, Artesian wells, Recharge, Groundwater recharge, Wells, Aquifers, Fissure water, *Norway, *Geohydrology, *Geochemistry.

The hydrogeology and chemistry of five springs and an artesian well in the Jeloya-Moss area were investigated for a year starting June 7, 1977, as part of a project concerning groundwater in Norway. All the springs drain fissured-rock aquifers and are of the overtopped, unconfined type. The artesian well drains confined water from a sand and gravel

aquifer below marine clay. Discharges are variable, and can be described by the variability index, or ratio of the lowest yield to the greatest. The well has a discharge of 1944-2736 liters per hour and a variability index of 0.71. The springs' variability indexes range from 0.01 to 0.53. If no discharge occurs, the springs would theoretically dry up within 2 months to 3 years and the well, in 6.5 years. Average residence time of the water in the aquifers ranges from 4.5 days to 180 days in the springs and 301 days in the well. Chemical composition of the water is similar to that of the deep groundwater, 30-100 meters below land surface. However, changes in composition take place as the water moves through the rocks. The longer the residence time, the higher the concentration of dissolved solids. Brackish water in the well is a result of dissolution of fossil sea salts. Most of the protons in precipitation are consumed in the chemical weathering process; only 1-2% of the weathering is caused by precipitation. (Cassar-FRC)
W82-01748

SELECTED DRILL-STEM-TEST DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01774

SELECTED HYDROGEOLOGIC DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01777

HYDROGEOLOGY OF WELL-FIELD AREAS NEAR TAMPA, FLORIDA, PHASE 1--DEVELOPMENT AND DOCUMENTATION OF A TWO-DIMENSIONAL FINITE-DIFFERENCE MODEL FOR SIMULATION OF STEADY-STATE GROUND-WATER FLOW,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-01780

HYDROGEOLOGY OF THE GATLINBURG AREA, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
A. Zurawski.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $12.00 in paper copy, $8.00 in microfiche. Geological Survey Open-File Report 79-1167 (WRI), August, 1979. 79 p, 45 Fig, 5 Tab, 12 Ref.

Descriptors: *Geohydrology, *Groundwater availability, *Water supply, *Aquifer characteristics, Test wells, Water yield, Geologic fractures, Water quality, Chemical analysis, Well logs, Water management, Planning, Evaluation, *Tennessee, Gatlinburg.

A study of ground-water availability in the Gatlinburg area, Tenn., was undertaken to improve concepts of ground-water occurrence in the Blue Ridge and demonstrate that ground water is present in sufficient quantities to provide an alternative to surface water as a source of supply. Of 25 test wells, 8 produced between 50 and 116 gallons per minute. The Gatlinburg area, located on the northern flank of the Great Smoky Mountains, is underlain by fractured, variably metamorphosed, sedimentary rocks. The most effective criteria for choosing well sites were valley areas with 7 percent or less land slope, presence of fracture traces, and deep overburden. Mapped faults were not a good indicator of ground-water occurrence. The largest amounts of ground water occur in irregularly shaped zones of deep and intense weathering in the rocks underlying broad, fracture-controlled valleys. Permeable zones along fractures at depths of 170 feet or less supply most of the water. (USGS)
W82-01782

GROUNDWATER LEVELS IN NEBRASKA 1980,

Geological Survey, Lincoln, NE. Water Resources Div.
M. S. Johnson, and D. T. Pederson.
Nebraska Water Survey Paper Number 51, September 1981. 65 p.

Descriptors: *Groundwater, *Wells, *Water level, *Water level fluctuations, Observation wells, Hydrographs, Well data, Aquifer characteristics, Hydrologic data, *Nebraska.

This report summarizes the 1980 water-level changes in Nebraska on a statewide basis and by major areas where significant changes from estimated predevelopment levels have occurred. It describes the availability of data on water levels, provides information on changes in the water-level measurement program during the year, and summarizes data on the two major causes of water-level changes--precipitation and groundwater use. Because of the large amount of available data, much of the information presented in this report is of a generalized nature. The maps showing areas where water levels have risen or declined are an interpretation of point-value data, and some areas may not be precisely delineated. Changes in water levels are illustrated by hydrographs of 89 continuous-record wells for the period of record. (USGS)
W82-01785

RECORDS OF WATER LEVELS IN UNCONSOLIDATED DEPOSITS IN EASTERN SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01788

AN AQUIFER SIMULATION PROGRAM FOR MICRO-BASED PROCESSORS,

Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore, and R. V. Avadhanulu.
Ground Water, Vol 19, No 4, p 400-406, July/August, 1981. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Computer programs, *Simulation analysis, *Aquifers, Groundwater movement, Pumping tests, Aquifer characteristics, Aquifer systems.

A computer program for simulating an aquifer system was devised for use with a microprocessor. Written in both FORTRAN IV and BASIC languages, the program requires only 10K bytes of memory for the generate code. It can be used to study the aquifer system under steady-state and dynamic conditions with constant flux or no-flux boundaries, conversion from confined to unconfined conditions in both homogeneous and heterogeneous aquifer systems, as well as the effects of evapotranspiration and constant recharge. The effect of pumping on an aquifer is studied for multiple pumping periods, and predictions can be reviewed at various time steps within each pumping period. The program is illustrated using a problem solved by Trescott et al. (1976) on an IBM/370 with a program of 100K bytes length. Results were essentially the same on both computers, with convergence after 45 iteractions on the microprocessor and 34 on the larger computer. (Cassar-FRC)
W82-01879

DRAWDOWNS AT THE FREE WATER TABLE DURING PUMPING TESTS IN ARTESIAN AND SEMIARTESIAN AQUIFERS,

TERRAQUA Aps, Kalundborg (Denmark).
H. Kaergaard.
Nordic Hydrology, Vol 11, No 3/4, p 159-168, 1980. 5 Fig, 13 Ref.

Descriptors: *Water table, *Groundwater storage, *Drawdown, Transmissivity, *Pumping tests, Aquifer testing, Artesian aquifers, Well hydrographs.

Long term storage in artesian and semiartesian aquifers was calculated from relatively short pumping tests (3-5 weeks) by studing the drawdown at the water table. Although the fluctuations are small under these conditions, results may be improved by performing the tests during dry periods such as summer or frost, choosing wells with small daily fluctuations, and observing the largest possible number of wells in the observation area. Pumping tests were used to study two aquifers, at the Torkildstrup-Lillebraende Waterworks and at the Karup Waterworks, Denmark. The first was a white chalk aquifer overlain by a clay aquitard, and the second, an anisotropic aquifer 50-60 meters thick. Reasonable estimates of transmissivity were obtained using mathematical models created for drawdown at the water table from pumping of deep groundwater. (Cassar-FRC)
W82-01890

MORPHOLOGY, HYDROLOGY AND HYDROCHEMISTRY OF KARST IN PERMAFROST TERRAIN NEAR GREAT BEAR LAKE, NORTHWEST TERRITORIES,

National Hydrology Research Inst., Calgary (Alberta).
R. O. van Everdingen.
National Hydrology Research Institute, Paper No 11, Inland Waters Directorate Scientific Series No 114, 1981. 53 p, 32 Fig, 8 Tab, 53 Ref.

Descriptors: *Karst hydrology, Hydrologic measurements, *Precipitation, Rainfall, Geochemistry, *Snowmelt, Subsurface runoff, Bedrock stratigraphy, Permafrost, Sinkholes, Soluble rocks, Contaminants, Morphology, Stratigraphy, Great Bear Lake, *Northwest Territories, Canada.

Collapse karst is widespread in the Franklin Mountains, Colville Hills and Great Bear Plain between Great Bear River and 67 N. Collapse features in the area are interpreted as being the result of subsurface solution of evaporites from the Upper Cambrian Saline River Formation and the Lower Devonian Bear Rock Formation; they appear to be concentrated on and around a number of small 'domes' on the Keele Arch. Integrated surface drainage is limited or lacking over portions of the karst area. Hydrologic measurements (rates of inflow into sinkholes; water levels in seasonally flooded depressions; discharge from springs) indicate that subsurface runoff may be as high as 40 mm per year or about 15% of the annual precipitation and that rainfall rates as low as 6 mm per day can initiate recharge to the karst-water system. Results of deuterium and oxygen-18 analyses show that snowmelt provides a major portion of the recharge; tritium levels in discharge from springs indicate that residence times in the karst-water system are relatively short. Seasonal flooding of karst depressions may cause problems for future engineering developments in the region; the tendency of the karst to collapse presents a special geotechnical hazard in addition to the problems related to the widespread occurrence of ice-rich permafrost. The karst-water system is extremely vulnerable to contamination from the surface because of the close spacing of high-rate recharge points and the unfiltered nature of the recharge. Once a contaminant has entered the karst-water system, rapid subsurface transport will make containment, recovery and cleanup after an accidental spill difficult or impossible. (WATDOC)
W82-01904

MATHEMATICAL MODEL FOR REGIONAL LAND SUBSIDENCE DUE TO PUMPING 1. INTEGRATED AQUIFER SUBSIDENCE EQUATIONS BASED ON VERTICAL DISPLACEMENT ONLY,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 4, p 937-946, August, 1981. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Subsidence, *Aquifers, *Compressibility, *Model studies, Mathematical models, Compaction, Groundwater mining, Piezometric head, Confined aquifers, Terzaghi equation.

A regional land subsidence model is developed using Terzaghi's concept of effective stress, essentially horizontal flow in the aquifer, and only vertical soil compressibility. First, the three-dimensional equation of (saturated) water mass conservation is obtained for the compressible fluid and solid matrix. This is then integrated over the aquifer's thickness, considering conditions on the top and bottom surfaces bounding the aquifer. The result is a flow equation in terms of averaged piezometric head. By relating changes in head to land subsidence, an equation for land subsidence as a single dependent variable results. Examples are given for single- and multi-layered confined aquifers and a phreatic aquifer. The equation is applied to pumping from a hypothetical 6-layered confined aquifer. (Cassar-FRC)
W82-01926

MATHEMATICAL MODEL FOR REGIONAL LAND SUBSIDENCE DUE TO PUMPING 2 INTEGRATED AQUIFER SUBSIDENCE EQUATIONS FOR VERTICAL AND HORIZONTAL DISPLACEMENTS,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 4, p 947-958, August, 1981. 4 Fig, 12 Ref.

Descriptors: *Subsidence, *Aquifers, *Compressibility, Model studies, Mathematical models, Compaction, Groundwater mining, Piezometric head, Confined aquifers, Biot's equations.

A model for regional aquifer consolidation due to pumping considers both vertical land subsidence and horizontal displacement. It is based on Biot's work on coupled three-dimensional consolidation. These equations are averaged over the vertical thickness of an aquifer, assuming shear-free boundaries and plane stress. An analytical solution is given for the case of a single well pumping from an infinite homogeneous isotropic aquifer. Estimates of changes in averaged values of piezometric head, vertical subsidence, and horizontal displacement can be obtained. About half the volume strain is produced by vertical subsidence and half by horizontal displacement. The piezometric head obtained for the special case of radial flow is identical to that obtained by non-coupled models. However, for general cases, non-coupled models which neglect horizontal displacement give vertical subsidence values twice that of the values obtained in the model described here. (Cassar-FRC)
W82-01927

THE STATISTICAL MECHANICAL THEORY OF GROUNDWATER FLOW,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, and S. Y. Chu.
Water Resources Research, Vol 17, No 4, p 885-892, August, 1981. 1 Fig, 25 Ref.

Descriptors: *Aquifers, *Statistical mechanics, *Energy equation, Fluid mechanics, *Groundwater movement, Porous media, Theoretical analysis.

Macroscopic differential equations of transport in porous media are derived according to statistical mechanics. The general method is applied to derive the balance of mass and of linear momentum in the groundwater component of an aquifer that is not deformed by water flowing through it. Statistical mechanics is used to define the components of the internal energy and to derive a microscopic equation of total energy balance. The partial specific internal energy and the kinetic energy of groundwater in a pore is affected by a force such as gravity, but the total energy of groundwater is not. The standard groundwater flow equation is shown to be a special case of the macroscopic equation of internal energy balance. The derivation of this equation is not connected with mass balance, but instead is the equation of internal energy balance for isothermal groundwater movement in a homogeneous, isotropic aquifer whose solid phases are unaffected by changes in groundwater pressure. (Cassar-FRC)
W82-01982

STEADY PERIODIC FLOW THROUGH A RECTANGULAR DAM,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Mathematics and Statistics.
J. H. Knight.
Water Resources Research, Vol 17, No 4, p 1222-1224, August, 1981. 11 Ref.

Descriptors: *Dupuit-Forchheimer theory, *Groundwater level, *Groundwater movement, Tidal effects, Oscillatory waves, Water level, Sea level, Reservoirs, Aquifers, *Coastal aquifers.

The Dupuit-Forchheimer formula (D-F) for discharge through a homogeneous rectangular dam gives the average discharge when reservoir levels oscillate, if the mean squares of the levels are used. In the case of steady oscillation, the time average of the pressure integral can be found, which leads to a generalization of the D-P discharge formula. In the tidal oscillation case, groundwater in a coastal aquifer responds to the tides, so that the equilibrium water level far from the sea equals the root mean square of the sea level. For a deep aquifer the water level is near mean sea level, and for a shallow aquifer, about 23% higher than mean sea level. The integral properties predicted for the D-F theory via the Boussinesq equation are exact in spite of controversy on the validity of the D-F assumptions that the pressure distribution is almost hydrostatic. (Cassar-FRC)
W82-01983

AN INTEGRAL TRANSFORM METHOD FOR THE LINEARIZED BOUSSINESQ GROUNDWATER FLOW EQUATION,

Cold Regions Research and Engineering Lab., Hanover, NH.
C. J. Daly, and H. J. Morel-Seytoux.
Water Resources Research, Vol 17, No 4, p 875-884, August, 1981. 11 Fig, 2 Tab, 10 Ref.

Descriptors: *Aquifers, *Velocity, *Potentiometric head, *Groundwater movement, Porous media, Confined aquifers, Unconfined aquifers, Water table, Anisotropy, Darcys law, Mass transfer, Boussinesq Equation.

The potentiometric head in nonhomogeneous aquifers under both steady and unsteady flow conditions is determined by an analytical procedure based on the use of orthogonal functions. Selection of the appropriate sets of orthogonol functions permits the solution of problems over finite, semifinite, and unbounded domains. Continuous and differentiable solutions, which are especially important in accurate determination of velocity field, are produced. The solution can be directly calculated at any point in the domain of the problem at any time; no grid or discretization is needed. Flow problems subject to nonhomogeneous boundary conditions and constant gradient boundary conditions may be solved by the integral transform approach. Point source problems are solved by use of a Dirac forcing term in the differential equation. The technique is applied to one- and two-dimensional flow problems where conditions are described by the linearized Boussinesq equation and results in the expression of potentiometric heads in analytic form. Limitations of this technique are: (1) flow domains are restricted to a rectangular geometry, and (2) rapidly varying potentiometric fields require solution of large numbers of equations. (Cassar-FRC)
W82-01984

SCALE-DEPENDENT DISPERSION IN A STRATIFIED GRANULAR AQUIFER,

National Hydrology Research Inst., Ottawa (Ontario).
J. F. Pickens, and G. E. Grisak.
Water Resources Research, Vol 17, No 4, p 1191-1211, August, 1981. 17 Fig, 10 Tab, 77 Ref.

Descriptors: *Solute transport, *Sampling, *Dispersivity, Porous media, Tracers, Aquifers, Sand aquifers, Chalk River Nuclear Plant, Scale effects, *Groundwater movement, Hydraulic conductivity, Wells.

A constant value for dispersivity of 0.7 cm was found to be representative and independent of travel distance at the scale of an individual level within a sand aquifer at the Chalk River Nuclear Laboratories. The laboratory-scale dispersivity for sand from the study site was 0.035 cm. Differences in scale between the laboratory and individual level dispersivities result from the greater inhomogeneity in the aquifer and from averaging caused by the groundwater sampling system. Full-aquifer dispersivities (single well tests using I131 as a tracer) were 3 and 9 cm. This indicates a scale effect with the value obtained dependent on the effect of transverse migration of tracer between the layers and the total injection volume. In 2-well tests (using Cr51-EDTA tracer) the full-aquifer dispersivity of 50 cm was scale-dependent, controlled by the distance between the injection and withdrawal wells and hydraulic conductivity distribution in the aquifer. Expressions for scale-dependent full-aquifer dispersivity (as a function of the mean travel distance) related distance to the statistical properties of a stratified geologic system where the hydraulic conductivity distribution is normal, log normal or arbitrary. These results show the importance of the groundwater sampling scale in interpreting values of dispersivity. (Cassar-FRC)
W82-01986

APPLICATIONS OF AERIAL PHOTOGRAPHY,

For primary bibliographic entry see Field 7B.
W82-01988

HYDRAULIC CONNECTION BETWEEN LAKE MICHIGAN AND A SHALLOW GROUNDWATER AQUIFER,

Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
D. S. Cherkauer, and B. Zvibleman.
Ground Water, Vol 19, No 4, p 376-381, July/August, 1981. 7 Fig, 22 Ref.

Descriptors: *Hydraulic gradient, *Aquifers, *Lake beds, *Lake Michigan, Carbonate aquifers, Sediments, Lakes, Plumes, Recharge, Groundwater recharge, Hydraulic conductivity, Groundwater movement, Permeability, *Surface-groundwater relations.

Heavy pumping from a dolomite aquifer, source of water for the City of Mequon, Wisconsin, on the Lake Michigan shore, reversed the natural hydraulic gradient and allowed lake water to flow into the aquifer. In July 1978, high quality lake water (total dissolved solids, 200 ppm) was identified as a plume extending about 2 km into the aquifer (600-800 ppm total dissolved solids). The hydraulic connections between lake and aquifer are located in the lake bed, where areas of thin sand and gravel sediment contact permeable bedrock ridges. Flow seems to follow the ridges toward the center of the cone of depression formed in the aquifer by heavy pumping. In the spring of 1979 recharge and reduced pumping produced changes in configuration and reduction in size of the plume. (Cassar-FRC)
W82-02010

EXTENSION OF THE INTEGRODIFFERENTIAL APPROACH TO INHOMOGENEOUS MULTIAQUIFER SYSTEMS,

Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Investigaciones en Matematicas Applicadas y en Sistemas.
J. P. Hennart, R. Yates, and I. Herrera.
Water Resources Research, Vol 17, No 4, p 1044-1050, August, 1981. 2 Fig, 11 Ref.

Descriptors: *Leaky aquifers, *Heterogeneity, Aquitards, Groundwater movement, Aquifers, Model studies, Mathematical models, *Aquifer systems.

The integrodifferential model for multiaquifer systems, which assumes homogeneity in the vertical direction, has been extended to general heterogeneous multiaquifer systems. This paper develops an approach for a heterogeneous leaky aquifer system in which properties of the system are arbitrary functions of position in both horizontal and vertical directions. Aquitards are eliminated, leading to a system of integrodifferential equations. Details of numerical implementation of the system are given with particular emphasis on efficient approximation of the horizontal heterogeneity in the aquifers and on the use of a class of finite element in time integration schemes, including most well-known time integration schemes and leading to consistent updating formulas for the memory and influence terms. (Cassar-FRC)
W82-02017

GROUNDWATER CHEMISTRY OF SOME SELECTED AREAS IN SOUTHEASTER NORWAY,

Norges Landbrukshoegskole, Vollebekk.
For primary bibliographic entry see Field 2K.
W82-02020

TERRAIN, GROUNDWATER AND SECONDARY SALINITY IN VICTORIA, AUSTRALIA,

Soil Conservation Authority of Victoria, Kew (Australia).
J. J. Jenkins.
Agricultural Water Management, Vol 4, No 1/3, p 143-171, 1981. 11 Fig, 5 Tab, 24 Ref.

Descriptors: *Salinity, *Soil properties, *Groundwater pollution, Water pollution sources, Groundwater movement, Groundwater hydrology, Terrain analysis, Topography, Hydrology, *Victoria, Australia.

The problems of increasing secondary salinity in Victoria, Australia, are reviewed. Regional and local geological conditions including land form, the present and past climate and its ecological effects, and the specific forms of land use applied all affect the degree of salinization insofar as area and severity are concerned. Salinization occurs in all but the highest and wettest areas in Victoria. The dryland salinity phenomena can only be explained in terms of groundwater movement. Soil throughflow is clearly inadequate in all the Victorian physiographic situations in which persistent salting occurs. Reasons for this include an inadequate quantity of available soluble ions stored in the soil to maintain continuing salt seeps, the excessively low horizontal hydraulic conductivities of the soil compared with their substrates, and the presence of saline groundwater either unconfined or under pressure, or frequently both. The major controlling factor in salinization is the water recharge-discharge system. Any solution must therefore involve the control of water both at and below the surface. The additional recharge which follows clearing must be prevented, and the pressures which have built up in confined aquifers and water tables which have risen must be reduced. In order to control the problem, a detailed knowledge of the conditions prevailing in each area in relation to the causative factors involved must exist. The corollary of a permanent reduction in soil salting therefore is a corresponding improvement in water supply quality. (Baker-FRC)
W82-02046

EXCESS AIR IN GROUNDWATER,

Council for Scientific and Industrial Research, Pretoria (South Africa). Natural Isotopes Div.
T. H. E. Heaton, and J. C. Vogel.
Journal of Hydrology, Vol 50, No 1-3, p 201-216, March, 1981. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Recharge, *Soil gases, *Air entrainment, *Nitrogen, *Argon, Groundwater, Infiltration, Excess air, South Africa.

Examination of dissolved nitrogen and argon in 81 groundwater samples from 6 areas in South Africa showed that many samples contained air in excess (up to 10 ml per kg water) of the amount expected for equilibrium in the atmosphere. The excess gas is ascribed to the solution of air bubbles trapped by infiltrating water in the unsaturated zone during recharge. Data show that N and A concentrations have not been significantly modified by chemical reactions, such as nitrification, or radioactive decay within the aquifer. Factors that favor air entrapment are fine soil with its small pores and narrow capillary channels and intermittent recharge caused by heavy rainfall interspersed with long dry periods. (Cassar-FRC)
W82-02099

2G. Water In Soils

SIMULATION OF THE TOPOGRAPHIC INFLUENCE ON SLAR DATA FOR SOIL MOISTURE DETECTION IN A HILLY AREA,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
R. Meier.
Remote Sensing of Environment, Vol 11, No 2, p 245-251, July, 1981. 6 Fig, 5 Ref.

Descriptors: *Soil water, *Remote sensing, *Model studies, Topography, Terrain analysis, *Radar, Moisture profiles, Simulation analysis, Mathematical studies, Catchment areas.

Although side-looking airborne radar (SLAR) has great potential for remote sensing of soil moisture conditions, the variability of the recorded signal in a hilly area can affect all of the other parameters which influence the signal. The effects of a hilly terrain may be minimized by estimating the influence of the topography on the microwave backscatter. A SLAR image may be simulated by a digital terrain illumination model. Grid elements of 50 m of a 3.2 sq km catchment were modeled and correlated to the corresponding model, with favorable results. Remaining variations were explained, to a great extent, by changes in soil moisture in the catchment area. The sensitivity of microwave backscatter to decreasing incidence angle was demonstrated when two extremely different moisture conditions were compared. The spatial distribution of soil moisture was unavailable due to inadequate spatial resolution of the heterogeneous catchment. (Geiger-FRC)
W82-01605

SOIL MOISTURE UPDATING AND MICROWAVE REMOTE SENSING FOR HYDROLOGICAL SIMULATION,

Science and Education Administration, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, A. D. Nicks, G. A. Coleman, and E. T. Engman.
Hydrological Sciences Bulletin, Vol 26, No 3, p 305-319, September, 1981. 5 Fig, 7 Tab, 19 Ref.

Descriptors: *Model studies, *Soil moisture, Remote sensing, Microwaves, Radiation, Soil water.

The possibility of measuring soil moisture in the upper soil layer using microwave remote sensing was investigated. Four different simulations were performed on each of the four basins studied. The first two simulations compared the effects of using daily total and breakpoint precipitation input data. The second two simulations resembled the first two, except that in addition soil moisture updating was performed. This was accomplished by modifying the model to read in all of the observed soil moisture values and store them. When the simulation reached a day on which soil moisture was measured, the measurements were substituted for the current simulation values of both soil layers. The findings indicate that both soil moisture simulation and input rainfall were affecting the model stimulations. Using updates or breakpoint precipitation values individually did not improve the simulation, whereas using both did. It was concluded that soil moisture observations for updating are valuable when the model exhibits a bias in simulating soil moisture. A second problem relates to the particular model structure used. A third problem was the lack of sensitivity to soil moisture updates, which could be related to the spatial scale of the basins used in the studies. Finally, annual runoff was the only criterion used to judge the model's performance. Additional tests are needed. (Baker-FRC)
W82-01611

SIMPLE IN SITU DETERMINATION OF HYDRAULIC CONDUCTIVITY BY POWER FUNCTION DESCRIPTIONS OF DRAINAGE,

Hawaii Univ., at Manoa, Honolulu. Water Resources Research Center.
S. K. Chong, R. E. Green, and L. R. Ahuja.
Water Resources Research, Vol 17, No 4, p 1109-1114, August, 1981. 7 Fig, 1 Tab, 16 Ref. OWRT-B-054-HI(5).

Descriptors: *Hydraulic conductivity, *Drainage, *Hydraulic gradient, *Soil water, Infiltration, Pressure head, Darcys law.

A method of calculating soil hydraulic conductivity from field measurements of soil water content and soil water pressure head during infiltration and redistribution was developed. This method is applicable to a wider range of soil water contents than the Nielsen et al. (1973) method for estimating hydraulic conductivity. A unit hydraulic gradient was assumed, and a power function described the changes in water content and pressure head with time during the redistribution period. The method was used at 7 experimental sites (tilled sugar cane fields on oxisols) at Oahu, Hawaii, where the total hydraulic head gradient varied from 0.3 during early stages of drainage to 2.0 after several days. Unit hydraulic gradient was usually approached during the intermediate stages of drainage (1,000-10,000 min), and this is the point where hydraulic conductivity values would be most reliable. Comparisons with the more complicated Darcy method showed that the simplified method was reliable for field use in well-drained soils. (Cassar-FRC)
W82-01666

SIMULATION OF WATER AND NITROGEN MOVEMENT AND NITROGEN TRANSFORMATIONS IN FOREST SOILS,

Washington State Univ., Pullman. Dept. of Agronomy and Soils.
S. J. Riha.
PhD Dissertation, 1980. 174 p, 33 Fig, 25 Tab, 65 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX80-25956.

Descriptors: *Soil moisture, *Nitrogen cycle, *Model studies, Forest soils, Soil water, Soil water movement, Water transport.

A model was developed to simulate rates of nitrogen transport and transformation in forest soils under Douglas-fir. Simulations were run for soils which were undisturbed, fertilized with urea-N or in which no root uptake of nitrogen was occurring. The model required inputs of basic soil, microbe, and plant characteristics. Environmental inputs were daily precipitation and maximum and minimum air temperature. The model predicts the rates of mass flow and diffusion of nitrogen to roots, immobilization of NH4+ by soil heterotrophs, mineralization of organic nitrogen by heterotrophs, nitrification of NH4+ by autotrophs and leaching of nitrogen below the root zone. The model was tested against water and nitrogen data collected in the field. Soil water flow was modeled using a one-dimensional finite element numerical solution of the Richards equation. Solutes were assumed to be transported by convection with the water. Rates of nitrogen transformation and active root uptake were described by Michaelis-Menten equations. It was assumed that tree roots, heterotrophs, and autotrophs compete simultaneously for soil NH4+. The flux of NH4+ to these three groups was assumed to be limited by the diffusion of NH4+ within the soil which has made a function of the water content of the soil. The model predicted fairly constant levels of NH4+ throughout the year and in general a return to these levels after a forest soil is perturbed. In an undisturbed soil, it was estimated that approximately 10% of the total nitrogen mineralized is immobilized, 45% diffuses to roots, and 45% is nitrified. (Sinha-OEIS)
W82-01668

EFFECT OF PERIODS OF MOISTURE AVAILABILITY ON GROUNDNUT CROP IN THE SAURASHTRA REGION OF GUJARAT,

Bansilal Amritlal Coll. of Agriculture, Anand (India).
K. R. Patel, and P. D. Mistry.
Indian Journal of Agricultural Sciences, Vol 51, No 4, p 266-270, April, 1981. 5 Tab, 11 Ref.

Descriptors: *Soil moisture, *Crop yield, Groundnut, Rainfall, Moisture availability, Soil water, Available water, Moisture content, *Soil-water-plant relationships, *India.

The probable period(s) of availability of soil moisture were estimated by the water budget technique in groundnut, which is rainfed in the Saurashtra region of Gujarat, India. Daily temperature data for the 1960-1974 period were collected, along with information on field capacity, bulk density and permanent wilting point as well as root depth at different stages of plant growth. The rainfall was taken as the income and evapotranspiration as the loss of water. Potential evapotranspiration was computed according to Thornthwaite's formula and was adjusted by multiplying with the day-length factor for different months during the growing season. The analysis indicated that the yield of groundnut was linearly related to the percentage of moisture available days on fitting a linear equation. On the average, a 60% reduction in yield was noted as due to lack of adequate soil moisture. The crop suffered for want of soil moisture in a majority of the years. The short duration bunch variety was found to be more suitable than the spreading type. The stations studied were ranked in suitability for groundnut production. (Baker-FRC)
W82-01708

LEACHING OF FERTILIZER IONS IN A ULTISOL FROM THE HIGH RAINFALL TROPICS: LEACHING THROUGH UNDISTURBED SOIL COLUMNS,

International Inst. of Tropical Agriculture, Ibadan (Nigeria).
J. L. Pleysier, and A. S. R. Juo.
Soil Science Society of America Journal, Vol 45, No 4, p 754-760, July/August, 1981. 7 Fig, 5 Tab, 24 Ref.

Descriptors: *Nitrate, *Leaching, *Soil columns, Fertilizers, Ion transport, Infiltration, Aluminum, Calcium, Potassium, Magnesium, Tropical regions, Excess rainfall.

The leaching and downward movement of Ca(+2), K(+1), Mg(+2), and NO3(-1) applied to the barge surface of undisturbed soil columns of a Ultisol (Typic Paleudult) from the high rainfall region of southeastern Nigeria were studied. The soil columns were leached with 2420 mm of water, the average annual rainfall at the sampling site. Nitrate added in the form of Ca, Mg, or K salts leached readily through the profile. The leachability of cations was K less than Al which was about the same as Ca and Mg but less than Na. Nitrate was accompanied mainly by Al(+3) ions. When the profile contains a high degree of exchangeable Al saturation, the downward movement of Ca may be predicted by Walter's formulation of ion exchange chromatography. Because nitrate leached along with Al(+3) ions in the strongly acid Ultisols, it is questionable whether common crop and fallow plant species would be capable of utilizing the subsoil nitrate in this environment. (Small-FRC)
W82-01721

SIMULATION OF SOIL WATER WITHIN THE ROOT ZONE OF A CORN CROP,

Kentucky Univ., Lexington. Dept. of Agronomy.
D. Radcliffe, T. Hayden, K. Watson, P. Crowley, and R. E. Phillips.
Agronomy Journal, Vol 72, p 19-24, January/February, 1980.

Descriptors: *Soil-water-plant relationships, *Corn, *Root zone, Model studies, Agriculture, Soil water, Infiltration, Evaporation, Transpiration, Drainage, Leaf area index.

A model was developed to calculate the infiltration, evaporation, transpiration and deep drainage of soil water in the root zone of corn (Zea mays L.) throughout a growing season. Inputs are data such as solar radiation, maximum and minimum temperature, leaf area index, and rainfall. Components of the model are potential evaporation, leaf area index, infiltration and distribution of surface water, and uptake of water. This model incorporates the effect on the distribution of rainwater due to channelizing in the cracks and non-capillary pores of a highly structured soil. The model was tested on two soils using soil moisture records from 4 years in one case and 1 year in the other. Agreement of simulated and actual soil water contents in silt loams in Kentucky was good. Two methods of modeling plant uptake of soil water, mechanistic and empirical, were very similar in accuracy. (Cassar-FRC)
W82-01834

EFFECT OF BULK DENSITY ON CALIBRATION OF NEUTRON MOISTURE PROBE FOR ORGANIC SOILS,

Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
G. S. Rahi, and S. F. Shih.
Transactions of the ASAE, Vol 24, No 5, p 1230-1233, 1240, September-October, 1981. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Soil water, *Density, Measuring instruments, *Organic soils, Soil types, Peat soils, Soil organic matter.

The effect of bulk density on water content estimation by the neutron probe was evaluated, a technique to improve the water content estimation was developed, and the performance of the technique was compared in relation to the original calibration curve. The bulk density significantly affected the water content measurements in organic soils if the neutron thermalization technique was used to monitor the water content. The original calibration curve in the laboratory studies indicated a difference of up to 0.10 cubic centimeter/cubic centimeter in volumetric water content for a bulk density difference of only 0.04 g/cubic centimeter in soil wetted to identical water contents. Volumetric water content over a depth of 75 cm in lysimeters varied between 0.006 to 0.167 cubic centimeters/cubic centimeter when gravimetric determination was compared with the calibration curve estimation. Bulk density of organic soil at different depths in lysimeters ranged from 0.26 to 0.37 g/cubic centimeter. A modified technique was tested to adjust neutron count ratio to account for differences in bulk density. The technique was based on the relation between count ratio and macroscopic neutron cross section of components of soil, including water. The water content estimated by the modified method was more precise than that determined by the original method. The measured water content differences between the gravimetric method and the original method decreased by 50 to 90% with the modified method. (Baker-FRC)
W82-01861

TRANSPORT OF SALTS IN CATCHMENTS AND SOILS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
T. Talsma.
Agricultural Water Management, Vol 4, No 1/3, p 103-113, 1981. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Salts, *Soil properties, Catchment areas, Rainfall-runoff relationships, Catchment basins, Water pollution sources, *Watersheds, Convection, Diffusion coefficient, *Saline soils, Runoff, Stream discharge, *Australia.

A rapid assessment technique was used to measure and evaluate catchment hydraulic conductivity at various soil depth intervals. The mean hydraulic conductivities were shown to provide a satisfactory basis for explaining the contrasting runoff hydrographs. Changes in the quality of streamwater in relation to runoff were considered for the Picadilly catchment with deep and permeable soils, and for the Greens catchment with shallow and slowly permeable soils. Total salinity, as well as potassium concentration, varies very little with increasing discharge at Picadilly. Different relationships were apparent for the Greens catchment, where the dilution of salt concentrations in groundwater with substantial quick return and overland flow at high discharge rates yielded a decreasing relationship between electrical conductivity and discharge rate, with low overall electrolyte concentration at high discharge. The transport of salt through leaching occurs via water which does not join the stream as surface runoff, but instead enters the soil profile. In studies on the Picadilly catchment, a 90 kg/ha surface applied potassium chloride solution was leached through the soil. Soluble chloride did not move beyond 1.2 meters soil depth, and became increasingly adsorbed in the deeper part of the soil profile. It was concluded that solute concentrations reaching stream water in catchments, with soils of similar chemical properties as at Picadilly, would be very much retarded and strongly attenuated. Measured soil properties were also used to examine the critical water table depths for surface soil salinization under irrigated and dryland conditions. (Baker-FRC)
W82-01880

PENETRATION AND DISTRIBUTION OF TRITIATED WATER IN SOILS OF A LYSIMETER,

Eotovs Lorand Univ., Budapest (Hungary). Dept. of Physical Chemistry and Radiology.
P. Fodor-Csanyi, S. Takala, L. Alhonen-Hongisto, J. K. Miettinen, and G. L. Horvath.
Nordic Hydrology, Vol 11, No 3/4, p 169-186, 1980. 11 Fig, 5 Tab, 9 Ref.

Descriptors: *Tritium, *Soil water, *Infiltration rate, Radioactive tracers, Tracers, Lysimeters, Gravel, Sand, Soil types.

The movement of tritiated water was much faster through gravel than through fine sand in lysimeter experiments, started June 21, 1977, in Finland. Simulated precipitation (30-60 mm) was applied to three plots of soil, 10 sq meters and 1.5 meters deep, one containing gravel and two containing fine sand, all without plants. Under the same amount of rain and irrigated water, the total tritium activity (or tritium pulse) in gravel was between 30-45 cm the second day and between 45-60 cm the eighth day. There was nearly zero activity between 0 and 135 cm at 150 days. In the fine sand plots, the maximum tritium activity was located at 15-30 cm after 34 days, and at 60-135 cm after 1 year. Velocity of infiltration in gravel was 16 cm per day at the beginning of the experiment and 6 cm per day at the end; in sand, 0.5 cm per day. The tritium activity reached the lysimeter bottom considerably later than predicted by a mathematical equation. (Cassar-FRC)
W82-01886

PROPERTIES OF THE SORPTIVITY FOR EXPONENTIAL DIFFUSIVITY AND APPLICATION TO THE MEASUREMENT OF THE SOIL WATER DIFFUSIVITY,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. D. Braddock, J. Y. Parlange, and I. G. Lisle.
Soil Science Society of America Journal, Vol 45, No 7, p 705-709, July/August, 1981. 3 Tab, 29 Ref.

Descriptors: *Soil water, *Sorption, *Diffusion coefficient, Mathematical studies, Soil properties.

The integral relation used to calculate diffusivity developed by Parlange et al. (1980) is replaced by an expression which is exact when the soil-water diffusivity obeys an exponential law. This new expression will be more appropriate for normal soils. The power law or exponential function can be used where the diffusivity depends on the water concentration. The exponential case is related to the power case, but there are some complications. Some of the properties of the solutions are generated. Sorptivity can be represented by a simple relation to a universal function of the water content. Optimization method results are compared with results obtained here, and both are applied to the

measurement of soil-water diffusivity. Also, the method can be used to determine soil-water diffusivity when sorptivity is measured for variable water content at the surface. (Small-FRC)
W82-01897

EFFECT OF FIELD VARIABILITY IN SOIL HYDRAULIC PROPERTIES ON SOLUTIONS OF UNSATURATED WATER AND SALT FLOWS,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Dept. of Soil Physics.
D. Russo, and E. Bresler.
Soil Science Society of America Journal, Vol 45, No 4, p 675-681, July/August, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Soil properties, *Permeability coefficient, *Flow, Salt, Spatial distribution, Soil properties, *Unsaturated flow, Mathematical studies, *Soil water, Hydraulic conductivity.

The extent to which the inherent spatial variability of soil hydraulic properties influences water and salt flow distributions was investigated. Also, predicted salt and water flows are examined in terms of their structures and their effects on the utilization of field-measured soil data. The governing water and salt flow equations are solved numerically using actual field data of soil hydraulic conductivity and differential water capacity. The data were from measurements made in 30 different field locations and matched data obtained from a Monte-Carlo simulation that considered the correlations between the parameters of the hydraulic functions. Simulated values of variables were used to estimate distribution types and its moments for pressure head, water fluxes, wetting front position, and solute concentration. Distances in the field where the horizontal flow components were negligibly small compared to vertical flow components were about 10 cm. Values of field scale dispersivity were larger than pore scale dispersivity and increased with soil depth. (Small-FRC)
W82-01898

THE INFLUENCE OF TILLAGE ON SOIL WATER BEHAVIOR,

Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
A. P. Hamblin, and D. Tennant.
Soil Science, Vol 132, No 3, p 233-239, September, 1981. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Soil water, *Available water, *Agricultural engineering, *Wheat, Farming, Sand, *Australia, Soil types, Water conservation, Soil-water-plant relationships, Climates.

A soil water study was performed at a site located in the West Australian wheat belt which has a Mediterranean climate. Of the annual average rainfall of 348 mm, 83% falls between May and October. The soil is a deep yellow sandy loam of weak, incohesive structure, overlying sandy lateritic gravel occurring at 1.5 to 2 meters, containing 10% clay and having 1.2% organic matter in the top 10 cm. The site was cropped to lupins in the year before the study and then cropped to wheat for three consecutive years. Undisturbed 5.5 and 7.0 cm diameter cores were taken from the surface 10 cm for measuring soil physical parameters. Three intensities of tillage disturbance were then imposed for the three successive years. One intensity was a conventional district practice (CON) of one disk ploughing, one pass with a scarifier, and seeding with a tyne-drill (combine). The second method involved a minimum tillage treatment (MIN) consisting of one application of paraquat-diquat at 2 liters per ha, followed by tyne-drill seeding. The third technique involved a zero tillage treatment (ZERO) using the same herbicide, but followed by seeding with a triple-disk seeder. The CON treatment disturbed the soil to about 10 cm, the MIN to about 4 cm, and the ZERO cut only shallow slots, between which the soil was not disturbed. The findings of the study infer that, whereas most soil water could be lost through drainage from the ploughed treatment in a wet year, most soil evaporation will take place from the direct drilled soil (especially zero tillage), and during the average growing season, water will move more rapidly within the ploughed profile than in the other two treatments. Where direct drilling is adopted on sandy soils, minimum rather than zero tillage should be the aim. (Baker-FRC)
W82-02022

DIRECT EVIDENCE OF WATER-SOLUBLE ORGANIC MATTER LEACHING IN BROWN EARTHS AND SLIGHTLY PODZOLIZED SOILS,

Luxembourg Foundation Univ., Arlon.
J. Herbauts.
Plant and Soil, Vol 54, No 2, p 317-321, 1980. 2 Tab, 14 Ref.

Descriptors: *Organic matter, *Leaching, Soil porosity, Carbon, Lysimeters, Moisture meters, Soil moisture, Podzols, Soil types, Nitrogen, *Brown soils.

The leaching of organic carbon, organic nitrogen and mineral nitrogen was measured at different depths in four different forest soils using semi-active tension lysimeters. Drainwaters were collected in the soil under surface holorganic layers and under the humic layer. Precipitation beneath forest canopy was simultaneously collected with pluviometers at each lysimeter site. Determination of organic carbon was made using a Dohrmann DC-50 Total Organic Carbon Analyzer. Inorganic nitrogen was determined colorimetrically and total nitrogen measured after a sulfo-perchloric pretreatment. Organic carbon contents in waters collected beneath forest canopy were similar at the two study sites, with a seasonal fluctuation apparently related to the amount of rainfall. Under leaf litter layers, leachates were enriched in water-soluble carbon, and this enrichment was stronger under holorganic layers of the brown podzolic soil. Under humic layers the organic carbon concentrations of leachates were appreciably lower than under holorganic layers, but the decrease is less pronounced beneath the moder than beneath the mull. Mobilization of organic carbon beneath the horizons is always higher in weakly podozolized soils than in non-podzolized acid brown earth. The contents of mineral nitrogen are usually higher in the brown soil, probably as a consequence of contrasting nitrogen mineralization rates in the humic layers of these soils. (Baker-FRC)
W82-02034

WAYS OF SUCCESSIVE REFINEMENT OF METHODS OF CALCULATING THE DUTY OF WATER,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2D.
W82-02094

2H. Lakes

A METHOD OF OBJECTIVE ANALYSIS FOR CURRENTS IN A LAKE WITH APPLICATION TO LAKE ONTARIO,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. B. Rao, and D. J. Schwab.
Journal of Physical Oceanography, Vol 11, No 5, p 739-750, May, 1981. 8 Fig, 4 Tab, 14 Ref.

Descriptors: *Lakes, *Mathematical studies, *Wind-driven currents, *Water circulation, Great Lakes, *Lake Ontario, Vortices, Mathematical equations, Water currents, Lake basins, Flow pattern, Air circulation.

The flow field of large lakes was represented in terms of transport stream function based on the observation that the mean circulation in large lakes is almost non-divergent in character. An equation was formulated in which the transport stream function may be calculated when the vorticity field is known. Another equation is provided for the determination of the current vector. However, since currents are measured and not vorticity, the proposed objective analysis method expands the transport streamfunction in terms of the eigenvectors of a third equation. A Lanczos procedure is used to calculate the eigenvalues and eigenvectors which are characteristic of a particular lake. The expansion coefficients are determined by minimizing the squared error between the calculated horizontal velocity vector field and available current meter data. Currents may be reconstructed at any point, since the eigenvector functions are known for the entire domain of the basin. The present procedure has been used in gathering winter data from Lake Ontario in connection with the International Field Year for the Great Lakes. (Geiger-FRC)
W82-01616

ABUNDANCE, LIFE HISTORY, AND GROWTH OF INTRODUCED POPULATIONS OF THE OPOSSUM SHRIMP (MYSIS RELICTA) IN SUBALPINE CALIFORNIA LAKES,

California Univ., Davis. Div. of Environmental Studies.
M. D. Morgan.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 989-993, August, 1981. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Opossum shrimp, *Productivity, *Growth, *Lakes, Donner Lake, Fallen Leaf Lake, Lake Tahoe, *California, Invertebrates, *Fish food, Population growth, Ecosystems, Fish populations.

Lake productivity was an important factor in the growth of opossum shrimp (Mysis relicta), introduced into Donner Lake and Fallen Leaf Lake, California, in 1965. This species is important in the food dynamics of fish populations. The overall densities of populations in Donner Lake were 238 per sq meter in August 1978, 123 per sq meter in June 1979, and 108 per sq meter in November 1980. In Fallen Leaf Lake, the densities were 114 per sq meter in August 1978 and 103 per sq meter in June 1979. These figures indicate that the mysids are well-established throughout both lakes. Mysids reproduced in the spring at ages 1 and 2 years, living for 2 years. In nearby Lake Tahoe, a much less productive lake, the growth rate of mysids was much slower, taking twice as long to reach similar population densities. The Lake Tahoe population was not reproductive during its first 2 years. (Cassar-FRC)
W82-01638

RELATIONSHIPS BETWEEN NANNOPLANKTON AND LAKE TROPHIC STATUS,

McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-01640

DESTRATIFICATION AND REAERATION AS TOOLS FOR IN-LAKE MANAGEMENT,

Salford Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-01648

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-73. I. THE EFFECTS OF EUTROPHICATION ON STANDING CROP AND COMPOSITION OF PHYTOPLANKTON,

Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W82-01653

PHYTOPLANKTON PHOTOSYNTHESIS AND ITS RELATION TO STANDING CROP AND NUTRIENTS IN TWO WARM-MONOMICTIC SOUTH ISLAND LAKES,

Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
S. F. Mitchell, and C. W. Burns.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 51-67, 1981. 8 Fig, 6 Tab, 58 Ref.

Descriptors: *Seasonal variation, *Phytoplankton, *Photosynthesis, Nutrients, Standing crops, Phosphate, Nitrates, Algal blooms, Stagnant water, Lakes, *New Zealand, Eutrophication, Lake Hayes, Lake Johnson.

Lake Hayes and Lake Johnson, New Zealand, were assessed for seasonal and vertical changes in phytoplankton, photosynthesis, chlorophyll, nutrients, pH, and major ions over a two-year period. These results were related to previously published results for phytoplankton species composition and standing crop, zooplankton, and oxygen for the same period. Accumulations of the nutrients PO4-P and NH4-N in the anoxic hypolimnia were important cyclic phenomena. In the autumn, surface concentrations of PO4-P reached 40-50 mg/cu m and NH4-N reached 150-400 mg/cu m, while the surface maxima of NO3-N were 26 mg/cu m in Lake Johnson and 60 mg/cu m in Lake Hayes. In 1970, Lake Johnson had a large accumulation of chlorophyll degradation products in the anoxic hypolimnion, and metalimnetic maxima were record occasionally. Stagnation was related to annual minima of photosynthesis and chlorophyll, with secondary minima occurring in winter. Autumn increases in photosynthesis and total chlorophyll content of the lakes were related to nutrient entrainment as the thermocline sank. In some summers, algal blooms were related to PO4-P concentrations. (Small-FRC)
W82-01700

BENTHIC MACROINVERTEBRATES OF LAKE TAUPO,

Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
D. J. Forsyth, and I. D. McCallum.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 41-46, 1981. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Macroinvertebrates, *Seasonal variation, *Lakes, Lake sediments, Population density, Water depth, Oligochaetes, Snails, Midges, Lake Taupo, *New Zealand, Benthic fauna, Bays, Sediments, *Limnology.

The seasonal abundance of benthic macroinvertebrates was determined as part of a study of the limnology of Lake Taupo. Samples were collected from the profundal zone and from two transects from the littoral to the profundal zone of Lake Taupo from August 1974 to July 1975. Samples were also collected from Lake Taupo's six bays in the winter of 1975 and 1976. Chironomus zealandicus Hudson dominated chironomid populations at most sites, and Potamopyrgus antipodarum or oligochaete worms dominated the fauna at most sites. Seasonal changes in population densities were noticed. Oligochaetes dominated the fauna in four of the bays, and P. antipodarum was dominant in two bays. In the Lake Taupo area there were fewer than eight species of chironomid, four of gastropod mollusc, and two fo bivalve mollusc, along with the oligochaete worms. The annual mean standing crop of total microinvertebrates was 714 + or - 76 per sq m. Differences in species composition between the profundal zone and the transects were due to the depth preferences of different species. (Small-FRC)
W82-01702

LIMNOLOGY OF LAKE REREWHAKAAITU,

Waikato Univ., Hamilton (New Zealand). School of Science.
M. A. Chapman, V. H. Jolly, and E. A. Flint.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 2, p 207-224, 1981. 8 Fig, 4 Tab, 33 Ref.

Descriptors: *Limnology, *Lake morphometry, *Agricultural watersheds, Thermal stratification, Water depth, Lakes, Craters, Zooplankton, *Lake Rerewhakaaitu, *New Zealand.

The limnology of Lake Rerewhakaaitu was studied, and a comparison was made between the main lake and a connected, deeper crater lake. The lake has a catchment area of 4969 ha, of which 88% has been developed for agriculture, mostly dairy farming. Results emphasized the importance of morphometry. The main lake was usually homothermal, although temporary stratification occurred periodically and the oxygen content of the deeper water could be as low as 2 gm/cu m. The crater area had strong thermal and chemical stratification that persisted well into winter. Morphometry was related to the failure of the crater to become fully reoxygenated during its brief period of homothermy. Zooplankton populations of the two lakes also differed. In the main lake there were usually more bosmina but considerably fewer Ceriodaphnia and greater numbers of Pione. In the crater, adult Calamoecia were generally more abundant. (Small-FRC)
W82-01705

ON THE USE OF CAROTENOID STRATIGRAPHY IN LAKE SEDIMENTS FOR DETECTING PAST DEVELOPMENTS OF PHYTOPLANKTON,

H. Zullig.
Limnology and Oceanography, Vol 26, No 5, p 970-976, September, 1981. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Carotenoids, *Eutrophication, *Bottom sediments, *Lakes, Sedimentology, Lake sediments, Algal growth, Diatoms, Phytoplankton, Lake Zurich, *Switzerland.

The concentrations of certain carotenoids in cores of sediments were measured, and their accumulation rates over time were determined in an attempt to trace the development of the phytoplankton over the last 150-500 years in several eutrophic Swiss lakes. Ten lakes were investigated, and the results from Lake Zurich are presented and discussed. A method involving one-dimensional chromatography with four sequential development steps was used for the separation of plankton carotenoids and sediment carotenoids. Annual couplets of sediment are formed in the lake, consisting of black layers of iron sulfide formed from late summer until the beginning of winter and a light-colored layer of allochthonous clay deposited during spring and summer. The first sign of eutrophication occurred in 1896; sediments from this year contained the diatom Tabellaria fenestrata and the carotenoids fucoxanthin and diadinoxanthin. Later sediments indicated a wavelike development of the plankton, dominated by diatoms and 0. rubescens. Since 1970, oscillaxanthin has declined to the limit of detection, but other pigments are present. Algae are also still present, although there has been a decline. (Small-FRC)
W82-01706

RECENT CHANGES IN LEVEL OF LAKE VICTORIA,

Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Mobutu Sese Seko, Entebbe (Uganda).
For primary bibliographic entry see Field 4A.
W82-01711

ECOLOGICAL CHARACTERISTICS OF THE RHIZOSPHERE MICROFLORA OF MYRIOPHYLLUM HETEROPHYLLUM,

Massachusetts Univ., Waltham. Department of Environmental Science.
For primary bibliographic entry see Field 4A.
W82-01796

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS 1968-73, III. THE MACROINVERTEBRATE COMMUNITY: ITS DEVELOPMENT, COMPOSITION, AND CHANGE IN RESPONSE TO EUTROPHICATION,

Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W82-01797

ABIOTIC VERSUS BIOTIC UPTAKE OF RADIOPHOSPHORUS IN LAKE WATER,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, D. R. Slavens, and L. M. Maloney.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 889-895, August, 1981. 4 Fig, 2 Tab, 26 Ref.

Descriptors: *Phosphorus removal, *Accumulation, *Algae, Lakes, Radioisotopes, Phosphorus radioisotopes, Selenastrum, Lake Michigan, Glutaraldehyde, Formaldehyde, Carbonylcyanide m-chlorophenylhydrazone, Inhibitors.

Carbonylcyanide m-chlorophenylhydrazone (CP), a phosphorylation inhibitor, was a more satisfactory agent for estimating abiotic uptake of radiophosphorus in lake water than the commonly-used glutaraldehyde or formalin. It effectively blocked biological P uptake and did not cause release of detectable amounts of inorganic P31 from algae into the water. Tests using Selenastrum capricornutum and Lake Michigan water showed that uptake of inorganic P33 in the presence of 0.001 mol per liter CP was less than or equal to 0.01% and that inorganic P31 release from microorganisms was nondetectable. When particulate matter recovered from heat- or glutaraldehyde- treated samples was resuspended in water, insignificant amounts of inorganic P33 were taken up, less than or equal to 2% of controls. Although P uptake in moderately buffered Lake Michigan water is almost exclusively biotic, waters with high concentrations of silt, clay, iron, calcium, or humic materials show considerable abiotic uptake. The CP method should produce the highest possible values for the abiotic mechanism in these waters. (Cassar-FRC)
W82-01824

METHANOGENESIS IN FRESHWATER SEDIMENTS: INHERENT VARIABILITY AND EFFECTS OF ENVIRONMENTAL CONTAMINANTS,

Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-01825

THE ROLE OF PHOTOTROPHIC BACTERIA IN THE SULFUR CYCLE OF A MEROMICTIC LAKE,

Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
T. B. Parkin, and T. D. Brock.
Limnology and Oceanography, Vol 26, No 5, p 880-890, September, 1981. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Sulfur cycle, *Bacteria, *Meromictic lakes, Lakes, Sulfur, Photoropism, Agricultural watersheds, Hydrogen sulfide, Diurnal variation, *Lake Knaack, Wisconsin.

The sulfur cycle at the thermocline of meromictic Knaack Lake was investigated with emphasis on how the photosynthetic bacteria in the lake affect and are affected by these transformations. Sulfide in water samples was determined by the methylene blue method, which has a detection limit of 0.05 mg/liter. Oxygen, dissolved inorganic carbon, and bacteriochlorophyll were also determined. Knaack Lake has a surface area of 1.1 ha, a maximum depth of 22 m, and a mean depth of 7 m. It is located in central Wisconsin farmland. Sulfate concentrations were very low all year. In spring and summer, sulfate concentrations in the epilimnion ranged from 0.5 to 0.7 mg/liter and in the hypolimnion from 0.1 to 0.2 mg of SO4(-2) per liter. Elemental sulfur was found only during the partial mixing period in November, when 20-30 microgram S/liter was present throughout the water column. During the day, H2S was absent at the level of the green sulfur bacteria, but H2S built up at night. Carbon dioxide studies indicated that the green bacteria were photosynthetically active in the light and oxidized the H2S. (Small-FRC)
W82-01831

THE CONTRIBUTIONS OF TEMPERATURE AND THE INPUT OF ORGANIC MATTER IN CONTROLLING RATES OF SEDIMENT METHANOGENESIS,

Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
C. A. Kelly, and D. P. Chynoweth.

Limnology and Oceanography, Vol 26, No 5, p 891-897, September, 1981. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Lake sediments, *Methane, *Temperature effects, Organic matter, Decomposing organic matter, Sediments, Lakes, Fluctuations.

The effects of temperature and of the supply of organic matter on rates of methanogenesis were studied in two freshwater lakes with different organic inputs and sediment temperatures. As was seen in earlier experiments, the natural cold-temperature methanolgenic rate in a particular sediment could be increased readily by increasing the temperature. When temperature was fairly constant for long periods such as during summer stratification, the rate of methane flux was directly proportional to and maximally adjusted to the rate of carbon input. Methane flux averaged 47% of organic input. Thus, when temperature changes rapidly, its effect will be predictably superimposed upon the effect of organic input. (Small-FRC)
W82-01832

RESONANT OSCILLATION IN DULUTH-SUPERIOR HARBOR,

Minnesota Univ., Duluth. Dept. of Physics.
T. F. Jordan, K. R. Stortz, and M. Sydor.
Limnology and Oceanography, Vol 26, No 1, p 186-190, January, 1981. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Resonance, *Harbors, *Oscillatory waves, Mathematical studies, Mathematical equations, *Lake Superior, Duluth, Minnesota, Water level fluctuations, Lakes, Flow characteristics.

The Duluth-Superior Harbor has two inlets to Lake Superior and a constriction separating the inner and the outer harbor. The masses of water moving in and out of the inlet channels can act as oscillators, coupled by the water level in the harbor and excited by oscillations of the lake level. Such oscillations at inlets to harbors, called Helmholtz resonances, can contribute significantly to mass movement and the flushing rate of a harbor. The dimensions of the Duluth-Superior Harbor and its inlets produce a Helmholtz resonance with a period comparable to the periods of free surface oscillations of Lake Superior, and the constriction may be considered as a possible third coupled oscillator. A Helmholtz resonance with a period of between 2.1 and 2.3 hours was calculated in the harbor. Some modes of oscillation of Lake Superior were found to have periods of about 2.0 and 2.3 hours. Spectral analysis of fluctuations of harbor water levels showed a mode of oscillation with a period of 2.1 hours. Analysis of water level oscillations in the harbor and currents in an inlet channel showed Helmholtz resonance periods of 2.1 hours, which seem to be excited by lake oscillations of nearly the same period. (Carroll-FRC)
W82-01837

FAYETTEVILLE, GREEN LAKE, NEW YORK: 3H-3HE WATER MASS AGES AND SECONDARY CHEMICAL STRUCTURE,

Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, D. E. Hammond, W. B. Clarke, and T-H. Peng.
Limnology and Oceanography, Vol 26, No 1, p 110-122, January, 1981. 3 Fig, 8 Tab, 38 Ref.

Descriptors: *Meromictic lakes, *Chemocline, *Residence time, Chemical stratification, *Green Lake, *New York, Lakes, Isotope studies, Tritium, Helium, Limnology, Chemical analysis, Water analysis.

Green Lake, located near Fayetteville, New York is probably one of the most intensively studied meromictic lakes in the world. New chemical and isotopic measurements made in the lake in 1974 and 1975 are reported. The results of these measurements indicate the presence of an upper and a lower monimolimnion spearated by a secondary chemocline. The secondary chemocline, found at about 32.5 meters, is marked by distinct enrichments in S(2-), methane (CH4), total carbon dioxide N(+), and C1(-). Water mass ages were determined using tritium and tritiugenic helium. The upper monimolimion (16 to 32.5 meters) showed a mean annual age of 3.1 years, while the mean annual age of the lower monimolimnion was 5.8 years. The increased residence time of the S(2-) and CH4, which are produced in situ in the lower monimolimnion, causes enrichments of these substances at the secondary chemocline. A separate and probably diffuse groundwater input appears to be the most likely cause of Na(+), C1(-), He4, and sigma carbon dioxide enrichments and tritium depletions in the lower monimolimnion. The presence of a strong point source of groundwater to the upper monimolimnion at about 20 meters is suggested by the carbon 14, radon 222, and He3 profiles. New strontium 90 and cesium 137 measurements taken during this study are inconsistent with a previously published two-box model. (Carroll-FRC)
W82-01838

VOLTAMMETRIC STUDIES ON THE STABILITY OF THE ZN(II) CHELATES WITH NTA AND EDTA AND THE KINETICS OF THEIR FORMATION IN LAKE ONTARIO WATER,

Kernforschungsanlage Juelich, G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
B. Raspor, H. W. Nurnberg, P. Valenta, and M. Branica.
Limnology and Oceanography, Vol 26, No 1, p 54-66, January, 1981. 4 Fig, 6 Tab, 36 Ref.

Descriptors: *Zinc, *Chelating agents, *Organic matter, Lakes, Heavy metals, Chemical reactions, Kinetics, Voltammetry, Stability analysis, *Lake Ontario, Dissolved solids.

Voltammetric techniques were extended to the analysis of zinc NTA and zinc EDTA chelates in freshwater from Lake Ontario. Both of the ligands involved are more or less biologically nondegradable and reduce the toxicity of heavy trace metals by inhibiting their uptake by aquatic organisms through chelation. Differential pulse anodic stripping voltammetry was used to study the specific effects of ionic excess constituents, such as alkaline earth cations and chloride and hydroxide anions, on the stability and kinetics of formation of zinc (II) levels. Competition for the chelating ligands was found to have the most pronounced adverse specific effects on chelate stability. This was particularly true when the alkaline earth ions calcium (II) or magnesium (II) were present in substantial excess over the level of the heavy trace metals. While the results obtained in voltammetric studies of seawater are generally valid due to the rather constant macrocomponent composition and pH, inland waters have considerable diversity in composition, ionic strength, and pH. As a result, the concentrations of NTA and EDTA required to achieve a certain degree of chelation for a heavy trace metal in a certain type of water will give approximate information on the levels of the chelating components with chelator strength comparable to the dissolved organic matter required to attain a similar degree of chelation. It is also possible to develop estimates of the capacity of the dissolved organic matter for trace metal chelation and predictions of the significance of the particular kind of dissolved organic matter if the conditional stability constants of chelating components of the dissolved organic matter are known. (Carroll-FRC)
W82-01839

THE RELATIVE IMPORTANCE OF PROTOZOANS, ROTIFERS, AND CRUSTACEANS IN A FRESHWATER ZOOPLANKTON COMMUNITY,

Georgia Univ., Athens. Dept. of Zoology.
M. L. Pace, and J. D. Orcutt, Jr.
Limnology and Oceanography, Vol 26, No 5, p 822-830, September, 1981. 4 Fig, 2 Tab, 36 Ref.

Descriptors: *Zooplankton, *Protozoa, *Lakes, *Population density, Aquatic animals, Aquatic populations, Biological communities, Rotifiers, *Lake Oglethrope, Georgia.

The zooplankton community of Lake Oglethrope was sampled over a period of 13 months in this study of a macro- and microzooplankton association. Throughout the year, protozoans were numerically the most abundant organisms in the zooplankton, usually an order of magnitude greater than rotifers which were also abundant. Nauplii were abundant in winter. Macrozooplankton reached highest densities in May (Ceriodaphnia reticulata), October (Daphnia parvula and Diaptomus siciloides) and December (D. parvula and D. siciloides). Densities of protozoans were highest in the metalimnion, where scuticociliates bloomed in zones of intense bacterial activity. During these blooms, protozoa accounted for up to 62% of the zooplankton biomass. Protozoa are rarely included in studies of freshwater zooplankton communities, but since they make a significant contribution to rates of grazing, nutrient regeneration, and secondary productivity, they should not be ignored. (Small-FRC)
W82-01840

NITROUS OXIDE IN FRESHWATERS OF THE GREAT LAKES BASIN,

Cornell Univ., Ithaca, NY.
E. Lemon, and D. Lemon.
Limnology and Oceanography, Vol 26, No 5, p 867-879, September, 1981. 8 Fig, 4 Tab, 19 Ref.

Descriptors: *Nitrous oxide, *Great Lakes, *Seepage, Deep water, Surface effects, Diffusion models, Air-water interfaces.

The transport of nitrous oxide in the freshwaters of the Great Lakes Basin was investigated to determine the amount of seepage-water N20 from the land which enters streams, lakes, and the sea. Air and water samples were collected in the Great Lakes and Cayuga Lake. N20 was produced in a relatively 02-rich environment above the thermocline in deep water lakes and was reduced to N2 in the deeper, less oxic waters below the thermocline. Calcuation of N20 flux densities for the lakes indicated a wider range than has been reported for oceans. Two diffusion models were used to calculate exchange values of N20 between the atmosphere and the lakes. Groundwater under a large dairy farm was rich in N20, but once the N20 seeped into a headwaters tributary it was lost to the atmosphere. Generally, large amounts of N20 are dissolved in seepage or groundwater on the land, but once exposed to the open air, quickly disappeared into the atmosphere. (Small-FRC)
W82-01841

MORPHOLOGY, HYDROLOGY AND HYDROCHEMISTRY OF KARST IN PERMAFROST TERRAIN NEAR GREAT BEAR LAKE, NORTHWEST TERRITORIES,

National Hydrology Research Inst., Calgary (Alberta).
For primary bibliographic entry see Field 2F.
W82-01904

VARIANCE ESTIMATES FOR A DYNAMIC EUTROPHICATION MODEL OF SAGINAW BAY, LAKE HURON,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, R. P. Canale, W. F. Powers, and J. L. Moody.
Water Resources Research, Vol 17, No 4, p 1115-1124, August, 1981. 2 Fig, 7 Tab, 56 Ref.

Descriptors: *Variation coefficients, *Error analysis, *Model studies, Mathematical models, Lakes, *Eutrophication, *Saginaw Bay, *Lake Huron, Algae, Nutrients, Phosphorus, Nitrogen, Zooplankton, Phytoplankton, Correlation coefficient.

First-order variance propagation was used to estimate variance in a eutrophication model output based on variable initial conditions, parameters, and external loads. This model is an eight-state-variable, nonlinear, time-dependent food chain model designed to simulate seasonal dynamics in Saginaw Bay, Lake Huron. The eight variables are phytoplanktons, herbivorous and carnivorous zooplankton, three chemical forms of N, and two chemical forms of P. Coefficients of variance during summer were similar to those measured.

Important parameters in terms of model sensitivity and variance propagation were identified for the variables for different times during the 350-day simulation. These included maximum phytoplankton specific growth rate, herbivorous zooplankton filter rate, carbon to chlorophyll ratio, and P to chlorophyll ratio. Parameter variance can be reduced in several ways: aggregating model state variables to reduce the number of uncertain parameters, acquiring additional laboratory and field data, limiting the range of true state variables aggregated as a single model state variable and characterized by assumed constant parameters, and reducing the variances associated with the most sensitive parameters. (Cassar-FRC)
W82-01917

CALCULATION OF BRACHIONUS RUBENS PRODUCTION BY THE DIRECT METHOD AND BY EDMONDSON'S METHOD,

Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
G. L. Vasil'yeva, and N. P. Blokhina.
Hydrobiological Journal, Vol 16, No 3, p 22-26, 1980. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Rotifers, *Productivity, *Lakes, *Lake Baikal, Aquatic animals, Chlorella, Chlorophyta, Water analysis, Mathematical studies, Aquaculture, USSR.

A comparison was made between the calculation of the production of rotifers by Edmondson's method and direct calculations of the removed biomass, i.e., with direct calculations of production, with reference to the abundant rotifer species Brachionus rubens. Data was obtained in summers of 1973 and 1974 during the mass cultivation of the rotifer B. rubens as a fish feed at the Baikal Biological Station. The rotifers were reared in five concrete tanks in the open on the shore of Lake Baikal. Rotifers were fed on the alga Chlorella vulgaris. Poor development of the culture was noted in 1973, with an increase in the overall abundance of rotifers in 1974, especially an intensive increase in the number of juveniles. The effect of water temperature on the duration of the individual development of rotifers was manifested fairly clearly. The temporal variations in the production of rotifers as calculated by the Edmondson method are in full agreement with those obtained by calculating the biomass, with a few exceptions. Production calculated by Edmondson's method was compared with directly recorded production. In these findings, the recording of production by the direct removal of biomass is fairly accurate. All that is not allowed for is elimination. However, it is suggested that it might be possible that there was no elimination in the brief periods between removals of biomass. The figure for production yielded by Edmondson's method is fairly close to empirical data obtained by direct calculation. Thus the present method satisfactorily described the productivity of the rotifers. (Baker-FRC)
W82-01921

EFFECT OF THE LIMING OF INTENSIVELY EXPLOITED PONDS ON PHYTOPLANKTON DEVELOPMENT,

Akademiya Nauk URSR, Kiev. Inst. Hidobiologii.
N. N. Kharitonova, and L. V. Gorobets.
Hydrobiological Journal, Vol 16, No 4, p 35-39, 1980. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Reservoirs, *Phytoplankton, *Ponds, Aquaculture, Plankton, Nitrogen, Phosphorus, Fertilizers, Nutrients, *Lime, Ecological effects.

The effect of the liming of extensively exploited ponds on phytoplankton development was investigated during 1972-1973 in rearing ponds No. 13 and 14 of the 'Tsentral'nyy' unit of the Donets Fish Combine. The ponds had an area of 53.8 and 118 ha, respectively, a mean depth of 1.89 and 1.97 meters respectively, and were typified by weak water exchange, intensive development of phytoplankton, and the presence of a large amount of suspended organic matter, as a result of which the transparency of the water was low. Higher water plants were essentially absent. Stocking density ranged from 6100 to 8000 fish/ha. The ponds were treated with organic fertilizer in the early spring and with N-P fertilizers throughout the summer. Lime was applied manually from a boat at a rate of 71-147 kg/ha. Phytoplankton samples were taken before the addition of lime, and also on the 3rd, 6th, 9th, 12th and 15th days thereafter. The samples were taken and processed by the standard procedures. Liming caused a brief reduction in the abundance and biomass of algae. Cyanophyta and Protococcinea proved most sensitive to the application of lime, with Volvocineae, Conjugatae and Euglenophyta being less sensitive. The development of Bacillariophyta was not appreciably affected by liming, but on occasion their abundance and biomass increased after lime had been added. The application of lime led to a significant improvement in the hydrochemical regime of the ponds, for example increased oxygen content and reduced content of dissolved organic matter in the water. The N-P fertilizers must be used following liming at a rate of 100-200 kg/ha for more rapid and controlled development of the phytoplankton. (Baker-FRC)
W82-01923

THE HYDROFLORA OF URBAN PONDS AS AN INDEX OF THEIR SANITARY AND BIOLOGICAL STATE,

Kharkov Univ. (USSR).
A. M. Matviyenko, T. V. Dogadina, N. I.
Il'chenko, R. I. Meshcheryakova, and O. V.
Savvina.
Hydrobiological Journal, Vol 16, No 4, p 45-48, 1980. 1 Tab, 20 Ref.

Descriptors: *Ponds, *Water quality, *Algae, Acidity, Urban areas, Fungi, *Kharkov, USSR, Recreation facilities, Eutrophic lakes, Eutrophication, Taxonomy.

The hydroflora were investigated in six ponds over a period of 2 years in Kharkov. Pond 1 was produced by damming a ravine and is used for recreational purposes. Pond 2 is a river pond situated in a densely populated area of the city. Pond 3 developed in a sand quarry and is used as a pond park and sports center. Pond 4 was produced by damming gullies and ravines and is used for recreation. Pond 5 is an excavated pond located in a densely populated area and is used for recreation. Pond 6 is an excavated pond with a dam and embanked shores, uced for recreation. In the investigation, 294 intraspecific algal taxa were found in the phytoplankton. The largest numbers of different species were found in ponds 1 and 6, 149 and 136, respectively; the largest numbers of species are from the Protococcophyceae and Cyanophyta. Protococcophyceae and Bacillariophyta predominate in the phytoplankton of the ponds studied. Some rare species were also found, such as Ilsteria lobata, never reported before in the USSR. Ponds 1 and 4 were classified as moderately eutrophic, ponds 2 and 6 as strongly eutrophic, and pond 5 as eutrophic-polytrophic. Pond 3 was shown to be oligotrophic. The distribution of aquatic fungi showed the number of species to be poor, with ponds 1, 5 and 6 containing 18, 19, and 19 species, respectively. The oxygen content of the ponds was satisfactory. Permanganate oxidizability varied considerably. The pH was almost always low, 4.8-6.3. The phosphate content of the water ranged from 0.1 to 0.3 mg/l. (Baker-FRC)
W82-01924

CONTOURITES IN LAKE SUPERIOR,

Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
T. C. Johnson, T. W. Carlson, and J. E. Evans.
Geology, Vol 8, No 9, p 437-441, September, 1980. 6 Fig, 27 Ref.

Descriptors: *Contours, *Lakes, *Bottom currents, Lake sediments, Lake morphology, Water currents, Bottom sediments, *Lake Superior, Seismology.

Preliminary evidence is presented for the existence of contourites in Lake Superior. The lake floor underlying the Keweenaw Current was traversed with a 3.5 kHz seismic-reflection profiling system on five cruises. Sediment samples were also obtained. The seismic reflection profiles observed can be attributed to turbidity currents or to contour currents. The geometry of the acoustic bed forms gives strong support for contour currents, as there are distinct wavy reflectors in a scoured trough at a depth of 200 m at the base of the trough. Hyperbolic echoes are found adjacent to the trough, and overlapping echoes farther lakeward. Sediment cores contained what appeared to be contours. There were irregular, thin sand layers with sharp upper and lower contacts, interbedded with sandy clay. This is the first report of marine-like contours in a lacustrine environment. (Small-FRC)
W82-01935

ZOOPLANKTON SPECIES DIVERSITY IN LAKE ST. CLAIR, ONTARIO, CANADA,

Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-01937

PHYTOPLANKTON ACCUMULATION IN LANGMUIR CELLS,

British Columbia Univ., Vancouver. Dept. of Mathematics.
G. T. Evans, and F. J. R. Taylor.
Limnology and Oceanography, Vol 25, No 5, p 840-845, September, 1980. 3 Fig, 17 Ref.

Descriptors: *Phytoplankton, *Langmuir cells, *Water circulation, Lakes, *Red tide, Dinoflagellates, Eutrophication, Wind.

The distribution of phytoplankton in Langmuir circulations is examined. In this case downwind transport is ignored, and only movement in a vertical cross section perpendicular to the axis is considered. The cell is 10 meters wide, and has a surface speed of 1.5 cm per sec, typical of that occurring with a 5 meter per sec wind. The water movement appeared to be relatively unimportant compared with the phytoplankton movement. Stommel's model (1949) is not applicable when phytoplankton velocities are not constant. The accumulation of phytoplankton by Langmuir cells depends greatly on the starting position of the organisms and on their vertical movement patterns. In red tides, the bloom from organisms will be swept into rows if they are on the surface when the Langmuir circulation starts. If the algae are below the surface, they may either be swept to the surface or not enter the circulation, depending on their depth. Those organisms in the center of the cell may remain below the surface, where they are not evident. (Cassar-FRC)
W82-01946

EFFECTS OF THERMOCLINE DISPLACEMENT UPON SUBSURFACE CHLOROPHYLL MAXIMA IN LAKE MICHIGAN,

Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. A. Bowers.
Journal of Great Lakes Research, Vol 6, No 4, p 367-370, 1980. 3 Fig, 15 Ref.

Descriptors: *Chlorophyll, *Thermocline, Lakes, *Lake Michigan, Thermal stratification, Wind.

Distinct subsurface maxima in the vertical distribution of chlorophyll have been observed in Lake Michigan during thermal stratification. This study determined that the depths of these maxima were significantly correlated with thermocline displacements from equilibrium in the nearshore areas. These water movements are a response to wind. During relatively calm periods in 1975 a distinct deep chlorophyll layer was present. In 1976 the periodic wind stress from the north and northeast created downwelling. The resulting deeper, less distinct thermocline decreased light intensity and increased turbulence, thus decreasing algal productivity and biomass. (Cassar-FRC)
W82-01957

SOUTHERN LAKE MICHIGAN SEDIMENTS: CHANGES IN ACCUMULATION RATE, MINERALOGY, AND ORGANIC CONTENT,

Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.

For primary bibliographic entry see Field 2J.
W82-01958

INORGANIC CHEMISTRY OF PARTICULATE MATTER FROM THE NEARSHORE ZONE OF LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.
R. Rossmann.
Journal of Great Lakes Research, Vol 6, No 4, p 348-352, 1980. 5 Tab, 16 Ref.

Descriptors: *Particulate matter, *Trace metals, *Sinks, Lakes, Chemical precipitation, *Lake Michigan, Suspended sediments, Sediments, Lake sediments, Phytoplankton, Zooplankton, Metals, Heavy metals, Hypolimnion, Epilimnion, Calcium carbonate, Manganese oxides, Dolomite.

Suspended particulate matter collected near the Donald C. Cook Nuclear Plant, Lake Michigan, during 1974 through 1976 contained major amounts of trace metals relative to the soluble fraction. This particulate matter serves as a sink and a conveyor of trace metals to the sediments. Fe, K, Mg, and Mn were always more concentrated in the hypolimnion than in the epilimnion, and Ca, Cr, Cu, Na, Sr, Zn, and total P were almost always more concentrated in the hypolimnion than in the epilimnion. Sediment resuspension was the cause of this hypolimnion enrichment. Plankton were not significantly involved in trace metal particulate chemistry. Ratios of metals concentrations in phytoplankton:particulates and zooplankton:particulates did not exceed 0.058, whereas metals ratios in particulates:solubles were as high as 16 (Mn). Although calcium carbonate precipitated during the summer months, peaking in September, it is not important in this nearshore region as a P or trace metal sink because resuspension occurs regularly and river output is continuous. The substances most strongly correlated with trace metals were dolomite and hydrated Mn oxides, and possibly an organic substance of unknown composition. (Cassar-FRC)
W82-01959

THE POPULATION ECOLOGY OF IRON BACTERIA (GENUS OCHROBIUM) IN A STRATIFIED EUTROPHIC LAKE,

Freshwater Biological Association, Cumbria (England). Windermere Lab.
J. G. Jones.
Journal of General Microbiology, Vol 125, No 3, p 85-93, 1981. 8 Fig, 2 Tab, 34 Ref.

Descriptors: *Bacteria, *Eutrophication, Lakes, Population dynamics, Stratification, Seasonal variation, Iron, *England, English Lake District.

The present study examined the population ecology of Ochrobium sp. to determine the depth at which the organism grew in a eutrophic lake. Samples were taken over the deepest point of Esthwaite Water, a eutrophic lake with a surface area of 1 square kilometer and a mean depth of 6.4 meters. The hypolimnion of the lake becomes deoxygenated during summer stratification. At the onset of summer stratification in Esthwaite Water the release and immediate oxidation of ferrous ions from the sediment increased the turbidity in the overlying water. Ochrobium sp. capsules and Leptothrix sp. filaments were found in the turbid zone; their presence suggested either growth in situ or an upward migration from the sediment. Within a month the zone of iron oxidation and the Ochrobium sp. and Leptothrix sp. populations had moved upward into the water column, and peaks were found at depths of 12 to 13 meters. Turbidity profiles indicate the depth at which ferrous ions are oxidized and thus the depth to which oxygen must penetrate periodically. Within a week the hypolimnion had become deoxygenated further, carbon dioxide concentrations had increased, and the zone of iron oxidation had developed a sharp peak. The Leptothrix sp. and Ochrobium sp. had increased by an order of magnitude and were now separated into two distinct zones, the former above and the latter just below the peak of oxidized iron. During the period of most rapid growth it appeared that the generation time for Ochrobium sp. was 29 hr, but this did not allow for losses due to grazing and population migration. Later in the season wind-induced turbulence dispersed the zone of iron oxidation and the population of Ochrobium sp. The population overwintered in the sediment. (Baker-FRC)
W82-01977

ABUNDANCE DYNAMICS OF MICROORGANISMS IN THE DECOMPOSITION OF MACROPHYTES,

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. M. Kudryavtsev, and Yu. V. Yeshov.
Hydrobiological Journal, Vol 16, No 4, p 14-18, 1980. 4 Tab, 7 Ref.

Descriptors: *Decomposition, *Macrophytes, *Microorganisms, *Bacteria, Organic matter, Nutrients, Temperature effects, Acidity, Aquatic plant, Banks, Vegetation, Water quality, Fungi, Reservoirs, Decomposing organic matter, Rybinsk Reservoir, USSR.

The dynamics of the development of microorganisms were observed during the death and decomposition of higher water plants under laboratory conditions. Experiments were conducted in 10-liter capacity glass aquaria filled with water from the bank areas of Rybinsk reservoir, which are overgrown with water plants. Also added were 10 g of wet biomass of water-lily, pondweed and bulrush. The plants were collected at periods of intensive growth. Samples were taken at fixed intervals from these containers for determination of the total number of bacteria on Synpor membrane filters by Razumov's method. During the observation period the temperature of the water varied only slightly, and the pH varied in the range of 7.35-8.25. Oxygen saturation of the water was 75-90%. The observations revealed that the total quantity of bacteria fluctuates appreciably in the decomposition of higher water plants. The abundance of bacteria in the experimental aquaria was 1.5-2.5 times greater than in the control. Intensive reproduction of bacteria was noted at the start of the experiment. Their highest abundance was recorded on day 3. Subsequently the rate of reproduction was affected by a number of factors, including temperature, illumination, and nutrient concentration. The abundance of bacteria was not the same in the decomposition of different species of macrophytes. The largest quantity was recorded in the decomposition of pondweed and water-lily, the least in the decomposition of bulrush. The readily decomposable part of the organic matter was oxidized by the saprophytic microflora. The bacteria noted were mainly nonsporulating. Consequently, the bacteria that decompose starch and cellulose are involved in utilization of organic matter of macrophytes along with microscopic fungi, the abundance of which ranged between a few tens and hundreds of thousands of cells milliliter. (Baker-FRC)
W82-01999

QUANTIFICATION OF THE LAKE TROPHIC TYPOLOGIES OF NAUMANN (SURFACE QUALITY) AND THIENEMANN (OXYGEN) WITH SPECIAL REFERENCE TO THE GREAT LAKES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. C. Chapra, and H. F. H. Dobson.
Journal of Great Lakes Research, Vol 7, No 2, p 182-193, 1981. 4 Fig, 6 Tab, 38 Ref.

Descriptors: *Trophic level, *Lakes, *Oxygen depletion, Water quality, Mathematical studies, *Great Lakes.

Oxygen deficit of the Great Lakes is studied as a fundamental measure of the lake trophic state. Naumann's concept focuses on visual symptoms of eutrophication related to plant production in the lake's surface area. Thienemann's concept focuses on the oxygen concentration in deep waters. An attempt is made to express these two concepts on a common dimensionless scale in order to allow comparison of their relative importance in different parts of the lakes. Separate trophic scales and indices were developed; the scales are comparable, as they are expressed in a dimensionless form with a lower bound of zero and a mesotrophic range of 5 to 10. Using these scales, Lakes Superior, Huron, and Michigan were classified as oligotrophic. In terms of surface water quality, central and eastern Lake Erie and Lake Ontario were classified as mesotrophic, but on the oxygen scale they ranged from eutrophic in central Lake Erie to oligotrophic in Lake Ontario. For lakes of similar primary production, areal oxygen depletion is directly proportional to hypolimnion thickness. (Small-FRC)
W82-02004

COMPARATIVE LIMNOLOGY OF INNER LONG POINT BAY, LAKE ERIE, AND ADJACENT WATERS OF THE OUTER BAY,

Ontario Ministry of Natural Resources, Wheatley. Lake Erie Fisheries Research Station.
For primary bibliographic entry see Field 5B.
W82-02005

NITRATE ACCUMULATION IN AEROBIC HYPOLIMNIA: RELATIVE IMPORTANCE OF BENTHIC AND PLANKTONIC NITRIFIERS IN AN OLIGOTROPHIC LAKE,

Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
W. F. Vincent, and M. T. Downes.
Applied and Environmental Microbiology, Vol 42, No 4, p 565-573, October, 1981. 6 Fig, 4 Tab, 35 Ref.

Descriptors: *Oligotrophic lakes, *Nitrates, Accumulation, Lakes, Benthos, Plankton, *Nitrification, Hypolimnion, Thermal stratification, Stratification, *Lake Taupo, *New Zealand.

The rate of accumulation of nitrate-nitrogen and the nitrification intermediate, nitrous oxide, was determined in the well-oxygenated hypolimnion of the largest oligotrophic lake in New Zealand. An examination of the vertical distribution of nitrifying bacteria was made by short-term radioisotopic assay to establish the relative contribution of benthic and planktonic species to the observed deepwater accumulation of oxidized nitrogen. The lake under study was Lake Taupo, a moderately large, deep, oligotrophic lake in the central volcanic plateau of North Island, New Zealand. Both nitrate and nitrous oxide accumulated in the hypolimnion of the lake throughout stratification. The two forms of oxidized nitrogen increased in concentration with increasing depth toward the sediments, where the concentrations of dissolved reduced nitrogen were two orders of magnitude higher than concentrations in the overlying water. Nitrification rates were measured by dark C-14 labeled carbon dioxide assays with and without the inhibitor nitrapyrin. The fastest rates were recorded for planktonic nitrifiers in the epilimnion and benthic species in the surficial 2.5 mm of the sediments. Nitrifying bacteria were least active in the deep hypolimnion. Deepwater accumulation of nitrate in Lake Taupo must therefore be a product of benthic rather than planktonic nitrification. (Baker-FRC)
W82-02023

EFFECT OF DIFFERENT WATER SALINITY LEVELS AND ORGANIC MATTER APPLICATION ON THE COMPOSITION OF WATER SOLUBLE AND EXCHANGEABLE BASES IN A BRACKISHWATER FISH POND SOIL,

Central Inland Fisheries Research Inst., Barrackpore (India).
G. N. Chattopadhyay, and L. N. Mandal.
Hydrobiologia, Vol 74, No 1, p 33-37, September, 1980. 3 Fig, 13 Ref.

Descriptors: *Fish ponds, *Organic matter, *Salinity, *Brackish water, ponds, Bases, Manure, Aquaculture, *Water pollution effects, Sodium, Potassium, Calcium, Magnesium, Soils, Nutrients.

Behavior of different water soluble and exchangeable bases in brackish water fish pond soil under different water salinity levels (0 to 30 ppt) in the presence and absence of added organic matter

were studied. Results indicated that the higher water salinity levels could adversely affect biological production of the ponds by increasing the amount of water soluble and exchangeable Na(+) (1.6 milliequivalent (me) per 100 g at trace salinity to 3.9-5.5 me per 100 g at 30 ppt salinity) and decreasing Ca(2+) (15.8-16.9 me per 100 g at trace salinity to 10.6 me per 100 g at 30 ppt salinity). Mg(2+) levels did not show a distinct relationship with water salinity without added organic matter. However, with organic matter, the Mg(2+) content increased from 11.7 me per 100 g at trace salinity to 14.6 me per 100 g at 30 ppt salinity. Application of organic manures was beneficial, increasing the exchangeable Ca(2+) and decreasing the exchangeable Na(+) in the soil. K(+) content was unaffected by organic matter treatment. SAR values of waters increased with increases in water salinity and decreased slightly on organic matter treatment. (Cassar-FRC)
W82-02027

A CONTROL MECHANISM OF THE PHYTOPLANKTON RESPIRATION IN A EUTROPHIC RESERVOIR,

Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
J. Benndorf.
Hydrobiologia, Vol 72, No 1/2, p 125-129, July, 1980. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Respiration, *Photosynthesis, *Phytoplankton, *Carbon dioxide, Lakes, Reservoirs, *Eutrophic lakes, Bautzen Reservoir, Light intensity, Compensation light intensity, Bautzen Reservoir, Germany.

Water samples taken in the eutrophic Bautzen Reservoir, German Democratic Republic, between June 1976 and December 1978 had very low or non-existent free carbon dioxide on several sampling occasions when water temperatures were above 15 C, the incident light exceeded 500 J per sq cm per day, and there was no wind-induced agitation. The compensation light intensities (where photosynthesis equals respiration of the phytoplankton) were also very low, less than 0.2 J per sq cm per day, in the absence of CO2. The compensation light intensity increased with increasing concentrations of CO2. This result is interpreted as a minimizing of cell respiration at a low CO2 supply. Consequences of this control mechanism are high phytoplankton growth rates even at CO2 limitation during the light hours, storage of polyphosphates and possibly a high dark CO2 assimilation during the night. This shows possible errors inherent in the measurement of gross photosynthesis by the light-dark bottle technique and the calculation of the gross and net photosynthesis from the direct, continuous measurement of oxygen at low CO2 supply. (Cassar-FRC)
W82-02030

SEASONAL AND DIURNAL CHANGES OF CHLOROPHYLL IN A TROPICAL FRESH WATER IMPOUNDMENT,

Kamaraj Univ., Madurai (India). School of Biological Sciences.
V. Kannan, and S. V. Job.
Hydrobiologia, Vol 69, No 3, p 267-271, March, 1980. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Eutrophic lakes, *Phytoplankton, *Chlorophyll, Nutrients, Lakes, Seasonal variation, Diurnal distribution, Algae, Sathiar Reservoir, *India, Reservoirs.

The highly eutrophic Sathiar Reservoir, India, had a higher maximum production of chlorophyll a (37.16 + or - 3.93 micrograms per liter in July 1977) than any previously recorded in Indian waters. Minimum chlorophyll a was 2.2 + or - 0.61 micrograms per liter in September 1977, following the rains which caused dilution, outflow, and sedimentation with silt. Chlorophyll b fluctuated from 1.32 to 18.91 micrograms per liter. Daily chlorophyll levels were highest at 12 noon (occasionally at 3 p.m.) and minimum at 6 a.m. (Cassar-FRC)
W82-02052

EXPERIENCE WITH LAKE AND RESERVOIR RESTORATION TECHNIQUES IN THE GERMAN DEMOCRATIC REPUBLIC,

Institut fuer Wasserwirtschaft, Berlin (German D.R.).
H. Klapper.
Hydrobiologia, Vol 72, No 1/2, p 31-41, July, 1980. 4 Fig, 2 Tab, 34 Ref.

Descriptors: Lake rehabilitation, *Eutrophic lakes, *Water resources management, Lakes, *Lake restoration, Water quality control, Water pollution prevention, *German Democratic Republic, Rehabilitation, Regulations, Fertilizers, Wastewater treatment, Nutrients, Hypolimnion, Aeration, Nitrogen compounds, Phosphorus compounds, Economic aspects, Social aspects, Phosphates, Reservoirs.

The intensive use of land and water resources has accelerated eutrophication of lakes in the German Democratic Republic. As of 1978, the total of 524 lakes have been classified as follows: 3.4% oligotrophic and mesotrophic, dimictic; 59.4% eutrophic; 29.6% polytrophic; and 9.6% hypertrophic. Several rehabilitation methods have been used in this country to prevent pollution and restore affected ecosystems. Government regulations control water use, establish protective zones, and specify fertilizer type and timing of applications. Sewage sludge and manures are extensively used as soil treatments, storage basins being provided for the winter months. Wastewater treatment removes nutrients by phosphate precipitation and denitrification. The water bodies themselves may be treated in situ by nutrient precipitation with aluminum sulfate, hypolimnetic depletion (withdrawing the nutrient-rich water for irrigation or drinking water), encouragement of desirable species of fish, increasing lake depth by damming, protection from light, covering sediments with inert material, changing flow patterns, desilting, aeration of surface or hypolimnion, addition of sodium nitrate to inhibit hydrogen sulfide formation, and controlling undesirable aquatic plants and animals. Improvements in both economic and social aspects resulted from these rehabilitation measures. (Cassars-FRC)
W82-02054

DISSOLVED OXYGEN DEPENDENT PHOSPHORUS RELEASE FROM PROFUNDAL SEDIMENTS OF LAKE CONSTANCE (OBERSEE),

Bayreuth Univ. (Germany, F.R.).
T. Frevert.
Hydrobiologia, Vol 74, No 1, p 17-28, September, 1980. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Phosphorus, *Dissolved oxygen, *Lake sediments, Sediments, Nutrients, Lake Constance, Path of pollutants.

Profundal sediments of Lake Constance did not release significant phosphorus as long as dissolved oxygen remained above 1 ppm and pH ranged between 7 and 8 in the overlying water. Experiments in perspex tubes using sediment-water systems from the lake also determined that the presence of a diatom sludge and carbonate-phosphate coprecipitate (CaCO3 + CaHPO4) increased the P release up to 0.5 mg per sq meters per day, an amount not significant to the P balance in this lake. The annual late summer increase of total P in profundal Lake Constance cannot be explained by P release from the sediment. It is more probable that P is accumulated from sinking of P-bound detritus of biogenic and/or tributary origin. (Cassar-FRC)
W82-02055

ENVIRONMENTAL STUDIES: THEIR IMPLICATIONS AND THE SPECIAL CASE OF EGYPT,

For primary bibliographic entry see Field 6G.
W82-02062

PHOSPHORUS CYCLING IN A DENSE POTAMOGETON PECTINATUS L. BED,

Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.
C. Howard-Williams, and B. R. Allanson.
Oecologia, Vol 49, No 1, p 56-66, 1981. 9 Fig, 6 Tab, 50 Ref.

Descriptors: *Cycling nutrients, *Lakes, *Phosphorus, Natural waters, Seasonal variation, Sago pondweed, Sediments, Benthic environment, Benthos, Nutrients, Aquatic plants, *Swartvlei Lake, *South Africa, Brackish water, Ogliotrophic lakes.

The dynamics of phosphorus concentration was studied in the littoral zone of Swartvlei, a southern African coastal lake. The implications of the nutrient pathways were examined in the regulation of phosphorus concentrations in the water. This brackish lake is oligotrophic and unpolluted, with an ionic composition the same as that of diluted sea water. Surface and bottom water samples were collected from two depth zones in the Potamogeton beds, at two-weekly or monthly intervals from 1975 to the end of 1978. The highest levels of phosphorus concentration were found in the sediment samples, with phosphorus concentration decreasing through above ground macrophytes, detritus, benthic invertebrates, below ground macrophyte tissue, epiphytic algae, water soluble phosphorus, and waterborne particulate phosphorus. The annual growth and decomposition patterns of Potamogeton were seen to control the seasonal variations in phosphorus concentrations in various groups. When the fate of a given input of phosphorus to the water was measured, 32% of it was found to be taken up by the large epiphtyic algae, 17% by the Potamogeton, 16% by the benthic fauna, 28% by the sediments and 7% by microorganisms associated with detritus. A closed cycle of phosphorus movement was evident. When any phosphorus was released from decaying macrophytes, reabsorption rapidly occurred through the epiphytic algae. Once phosphorus has entered the cycling of the macrophyte community, it seems unlikely that it would ever enter into open circulation in the lake. (Baker-FRC)
W82-02070

ESTIMATION OF THE PRODUCTION OF PLANKTONIC INFUSORIANS IN CONNECTION WITH FLUCTUATIONS IN THEIR ABUNDANCE,

Gorkii State Univ. (USSR).
M. A. Kuznetsova, and T. P. Arsanova.
Hydrobiological Journal, Vol 16, No 3, p 15-21, 1980. 6 Fig, 4 Tab, 5 Ref.

Descriptors: *Plankton, *Productivity, *Ponds, *Population dynamics, Gorky Region, Lakes, Populations, Aquatic populations, Aquatic life, Biomass, Seasonal variation, *USSR.

The object of this study was to calculate the production of planktonic infusorians on the basis of daily observations of 5 and 10 days. In two separate water bodies daily measurements were taken of water temperature, the abundance of planktonic infusorians, their rate of reproduction, and the rate of their consumption. A small urban pond and Lake Velikoye were studied. The pond is in a forest park, and has an area of about 2 ha and a maximum depth of 1.5 meters. It is fed by springs and ground water. The planktonic infusorians of the pond are six species of Spirotricha: Halteria grandinella, Tintinndium fluviatile, Strombidium viride, Codonella cratera, Strombidium sp. and Strombilidium sp. The population quality of all species is characterized by a sudden increase and decrease within a period of several days. The duration of reproduction periods for all species of infusoria was comparable to the duration of the latent periods for which populations of a specific species either disappeared completely or were severely depressed in quantity. The temperature of the water was one of the major factors regulating infusoria quantity fluctuations. The production of infusoria obtained as a result of daily observations was about twice as low as the production found in ten-day intervals. (Baker-FRC)
W82-02072

EFFECT OF FERTILIZERS ON THE PRIMARY AND BACTERIAL PRODUCTION OF REARING PONDS IN THE VOLGA DELTA,

Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
V. I. Vorob'yev, and A. F. Sokol'skiy.
Hydrobiological Journal, Vol 16, No 3, p 27-31, 1980. 5 Tab, 11 Ref.

Descriptors: *Fertilizers, *Ponds, *Aquatic life, *Aquaculture, Nitrogen, Phosphorus, Nutrients, Minerals, Fish, *Fish farming, *Volga Delta, USSR.

Model experiments were carried out at the Volga experimental plant of the Caspian Fisheries Research Institute to determine the effect of organomineral micronutrient fertilizers on the productivity of the ponds of this group. These experiments enabled an assessment to be made of the effectiveness of the different types of fertilizers on primary and bacterial production, and also on the chemical composition of the water of these ponds. Five experimental rearing ponds were used, each having an area of 0.65-2.0 ha and a mean depth of about one meter. Ammonium nitrate and superphosphate were added to pond No. 21 at a rate of 12 kg/ha. Reeds cut and prepared 2 years earlier were added to pond No. 22. The reeds had already spent one season in the water as fertilizer, but because they had been only 40-50% mineralized in that season, they had been left for another year. N and P mineral fertilizers were also added to this pond, each at a rate of 12 kg/ha. Superphosphate and ammonium nitrate were added to pond No. 23 at 12 kg/ha, and cobalt chloride was also added at a rate of 2 kg/ha over the season. Only superphosphate at 12 kg/ha was added to ponds No. 15 and 40, along with cobalt chloride at 2 and 5 kg/ha, respectively, over the season. The findings yielded the conclusion that the use of cobalt in the rearing ponds and elsewhere in the case of cobalt deficits makes it possible to create more favorable abiotic conditions in the water, to practically double the rate of bioproductive processes, and to involve other trace elements in the biological cycle. (Baker-FRC)
W82-02077

PHYTOPLANKTON DISTRIBUTION IN THE SOUTHERN AND MIDDLE PARTS OF LAKE BAIKAL,

Akademiya Nauk SSSR, Novosibirsk. Inst. Fiziki.
N. A. Frank, L. A. Shchur, A. D. Aponasenko, and F. Ya. Sid'ko.
Hydrobiological Journal, Vol 16, No 3, p 13-15, 1980. 2 Fig, 7 Ref.

Descriptors: *Lakes, *Phytoplankton, Distribution, Vertical distribution, Spatial distribution, *Lake Baikal, Chlorophyll, Biomass, USSR, Chlorophyll a.

Hydrobiological and hydrooptical research was carried out in July of 1974 in the southern and middle parts of Lake Baikal between Slyudyanka settlement and the Ol'khonskiye Vorota strait with the objective of determining the abundance and biomass of the phytoplankton, its chlorophyll a content, the characteristics of the attenuation of the water and other hydrooptical characteristics. A total of 44 sampling sites were chosen. Chlorophyll content in the surface zone of the water at a depth of 1 meter in the southern part of Lake Baikal as far as Cape Kadil'nyy ranged between 0.1 mg/cubic meter and 0.3 mg/cubic meter, and the abundance and biomass of the phytoplankton were respectively 3000 to 40000 cells/liter and 12-40 mg/cubic meter. Chlorophyll content 1 km from the shore of the lake is on the average 1 to 1/5 times the content in the central part of the lake. The vertical distribution of chlorophyll has a clear maximum at a depth of 5 to 10 meters. Investigations around the mouth of the Solzan River did not reveal appreciable differences in the vertical and horizontal distribution of chlorophyll a from the values characteristic for the southern part of Lake Baikal. The drift of the Selenga River had an appreciable effect on phytoplankton distribution in the middle part of Lake Baikal. (Baker-FRC)
W82-02078

FINDS OF RELICT INFUSORIA IN KIEV RESERVOIR,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Koval'chuk.
Hydrobiological Journal, Vol 16, No 4, p 27-31, 1980. 7 Fig, 17 Ref.

Descriptors: *Reservoirs, *Plankton, Benthos, Infusoria, Protozoa, Aquatic life, *Halophytes, *Kiev Reservoir, Salt tolerance, Reservoir stages, USSR.

A number of halophilous forms which were discovered during an investigation of the benthic Infusoria of Kiev reservoir in 1977-1978 are described. Forms found included: Prorodon taurinus, Lacrymaria caudata, Lagynurus pumilio, Frontonia aberrans, Cyclidium helgolandicum, Cristigera minuta, Lehmanniella elegans, Metopus vestitus, and Condylostoma remanei. All the relict forms of Infusoria were found in a small area round the village of Strakholes'ye above Teterev Bay, where marshes in which conditions are favorable to the existence of these infusorians existed before the filling of the reservoir. The species composition of the relict forms was most varied in the autumn in the psammon, and also in bulrushes, apparently in connection with the resistance of individual populations of this plant to salinification. The fact that there is a predominance of the boreal element in the relicts suggests an incursion of waters from the Baltic into the Black Sea during one of the transgressions. During the period of their existence in isolation, the relict infusorians of Kiev Reservoir have changed relatively little, and it is therefore concluded that the isolation has not been lengthy. (Baker-FRC)
W82-02079

THE PREDICTED CONTENT OF ORGANIC AND BIOGENIC MATTER IN THE WATER OF VILYUY RESERVOIR AND THE EXTENT TO WHICH IT HAS BEEN CONFIRMED,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. M. Labutina, and A. I. Denisova.
Hydrobiological Journal, Vol 16, No 4, p 77-80, 1980. 2 Tab, 6 Ref.

Descriptors: *Reservoirs, *Organic matter, *Permafrost, Prediction, Decomposing organic matter, *Vilyuy Reservoir, Vegetation, Water quality, Water pollution sources, USSR.

The Vilyuy reservoir lies in the northeast of the country in a permafrost region. The reservoir was formed in southwestern Yakutia by the damming of the Vilyuy River 21 km below the mouth of the Akhtaranda River. When the reservoir was filled, 30,000,000 cubic meters of forest were inundated. For several years the submerged tree trunks were the source of various chemicals that found their way into the water. The submerged vegetation and soils have appreciably influenced water quality in the reservoir and the content of organic and biogenic matter. Long-term records on the seasonal content of organic and biogenic matter in the water of Vilyuy River and its affluents were used to analyze and predict the expected concentrations of organic and biogenic matter during the period of 1969-1975 in the waters of the reservoir. When the predicted and the actual concentrations were compared, it was found that the deviations of the former from the latter did not exceed plus or minus 8%. River discharge was the main factor in the formation of the hydrochemical regime of the reservoir. Arboreal vegetation took second place, and soils took third. (Baker-FRC)
W82-02080

BACTERIOPLANKTON AND PHYTOPLANKTON IN THE KIEV SECTOR OF KANEV RESERVOIR DURING THE PERIOD OF ITS FORMATION,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Gavrishova, and L. N. Chernitskaya.
Hydrobiological Journal, Vol 16, No 4, p 6-14, 1980. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Reservoirs, *Phytoplankton, *Bacteria, Water quality, Self-purification, Algae, Plankton, *Kanev Reservoir, Reservoir stages, Water pollution sources, USSR.

The hydrobiological regime of the Kiev sector of Kanev reservoir was investigated during the period of its creation via microbiological indices and phytoplankton. In 1975, which was the fourth year of filling, the highest bacteriological indices occurred. This year was characterized by extreme temperature and hydrologic features. From 1975-1977, the bacteriological indices increased relative to the data obtained in 1972-1974. This is in agreement with the trend toward an increase in the abundance of bacterioplankton during the first years of the creation of a reservoir. During this period of time a gradual increase was noted in algal biomass, and an increase was also seen in the number of algal species, due to the conversion of the sector to a reservoir. In spite of alterations in the ratio and abundance of the algae, the dominant composition of the main groups was maintained. Using data from an analysis of the distribution of the abundance of bacterioplankton and phytoplankton at different points in the Kiev sector of the reservoir, a rank estimate was prepared of water quality. The rank indices of the water at the beginning, in the middle and at the end of the sector ranged between 4 and 6 in the classification of Zhukinskiy. This finding suggests that the capacity of the water in the Kiev sector of the reservoir to undergo self-purification declined slightly after the filling of the Kanev reservoir. (Baker-FRC)
W82-02081

PLANKTONIC INFUSORIA OF KIEV AND KREMENCHUG RESERVOIRS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Nebrat.
Hydrobiological Journal, Vol 16, No 4, p 23-27, 1980. 16 Ref.

Descriptors: *Reservoirs, *Plankton, *Protozoa, Productivity, Lake ice, Infusoria, Ukraine, Seasonal variation, Temperature effects, Stagnant water, *Kiev Reservoir, *Kremenchug Reservoir, USSR.

The study of planktonic infusoria of Kiev and Kremenchug reservoirs began in the spring of 1972 and continued until autumn of 1975. A total of 110 species of infusoria were identified in the plankton from these two reservoirs, of which 85 were new for the Dnieper and its reservoirs, and 29 for the Ukraine. Holotricha were the most richly represented in the reservoirs investigated with 60 species or 54.5%, followed by Spirotricha with 40 species or 35.7%, and Peritricha for 11 species or 9.8%. The species were identified during seasonal excursions and showed wide variations with the seasons. In terms of abundance, T. fluviatile took first place among the dominant species of Infusoria in the pelagic zone of Kremenchug reservoir at 41.8% of total abundance. The highest population density of this species was recorded in the lower part of the reservoir at 50.3%. Small Spirotricha typical of stagnant and bog waters were dominant during the spring months in the shallow upper parts of the Kremenchug reservoir. A total of 45 species were found in the reservoirs in the autumn. The number of species of infusoria remaining below the ice in water bodies was very small and their abundance at this time of the year is low. (Baker-FRC)
W82-02082

INVESTIGATION OF TURBULENCE AND LANGMUIR CIRCULATION IN LAKE LADOGA,

Akademiya Nauk SSSR, Leningrad. Inst. of Lake Studies.
N. N. Filatov, S. V. Rjanzhin, and L. V. Zaycev.
Journal of Great Lakes Research, Vol 7, No 1, p 1-6, 1981. 5 Fig, 19 Ref.

Descriptors: *Water circulation, *Lakes, *Russia, Turbulence, Water currents, *Ladoga Lake.

Experimental measurements were taken of currents in the gulf of the northeast part of the nearshore zone of Lake Ladoga, USSR. Horizontal measurements were carried out at a 5 meter depth for 3 months. Measurements were also made of current fluctuations, both horizontal and vertical. Kinetic

energy spectra and the corresponding linear invariant spectra of currents calculated from measurements at a 10 meter depth in the offshore zone of the lake for a wide range of frequencies showed several maxima which corresponded to the following events: synoptic oscillations of currents with time scales of about 2 to 4 days, inertial oscillations of 13 to 14 hr periods, Langmuir circulation with time scales of 5 to 10 minutes, micrometeorological oscillations with a time scale of 1 minute, and oscillation with the periods of surface waves in the upper layer. From the measurements of vertical fluctuations, horizontal fluctuations, and gradients of mean speed of currents, coefficients of vertical turbulent exchange were determined. The dependencies of mean vertical current speed and depths of penetration of Langmuir circulations as a function of wind speed and stratification were calculated. The calculated relations were not linear. (Baker-FRC)
W82-02100

2I. Water In Plants

EFFECT OF PERIODS OF MOISTURE AVAILABILITY ON GROUNDNUT CROP IN THE SAURASHTRA REGION OF GUJARAT,

Bansilal Amritlal Coll. of Agriculture, Anand (India).
For primary bibliographic entry see Field 2O.
W82-01708

SOIL WATER STUDIES ON SMALL LUCERNE PLOTS,

Department of Agriculture and Fisheries, Stellenbosch (South Africa).
D. J. Beukes, and H. W. Weber.
Water SA, Vol 7, No 3, p 166-174, July, 1981. 4 Fig, 4 Tab, 18 Ref.

Descriptors: *Hay, *Soil water, *Soil-water-plant relationships, Irrigation effects, Crop yield, Crop production, Water use efficiency, Agriculture, Alfalfa, *South Africa.

Lucerne was grown in the field under four soil water depletion (SWD) levels; 15%, 35%, 55%, and 75%. The primary objective of this investigation was to determine the finer details of methods and instruments for measuring soil water, but the present paper discussed the secondary objectives: to determine the changes in soil water content and soil water pressure as well as the water use characteristics of lucerne. Irrigation requirements were established of 1100 mm for a 15% SWD and 700 mm for a 75% SWD. There was a direct relationship between the soil water regime and the amount of water consumed. With a 15% SWD level the rate of evapotranspiration equaled that of pan evaporation. Changes in soil water content and soil water pressure occurred on a much shallower level with a 15% than with a 75% SWD. When there was a decrease in the SWD level, there was an increase in the growth rate of lucerne, a decrease in the water use efficiency, and an increase in hay production. (Small-FRC)
W82-01713

ECOLOGICAL AND PHYSIOLOGICAL FEATURES OF THE ROOT SYSTEM OF INSHORE HYDROPHYTES,

Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
For primary bibliographic entry see Field 5B.
W82-01715

THE EFFECT OF DIFFERENT WATER REGIMES ON PLANT GROWTH AND NODULE STRUCTURE OF GREENHOUSE-GROWN WINGED BEAN (PSOPHOCARPUS TETRAGONOLOBUS),

University of West Indies, Kingston (Jamaica). Dept. of Botany.
E. L. Rathfelder.
Annals of Applied Biology, Vol 98, No 1, p 143-148, May, 1981. 4 Fig, 23 Ref.

Descriptors: *Soil-water-plant relationships, *Water stress, *Root development, Beans, Waterlogging, Nodules, Greenhouses.

Three water regimes were applied to the potted seedlings of winged beans (Psophocarpus tetragonolobus cv. Chimbu Illinois) in a greenhouse: control (field capacity, 20% water by weight added each morning), stress (half of field capacity, 10% water by weight added each morning), and wet (pots standing in water to produce waterlogging in the bottom 1 cm). Root nodules did not form in the stressed plants until 4 weeks, compared with 3 weeks in the other treatments. Nodules were 54% smaller than those in control plants and 39% smaller than in waterlogged plants. These differences decreased with time. (Cassar-FRC)
W82-01723

NOTE ON THE ROLE OF IRRIGATION FREQUENCIES ON THE REGROWTH OF BERSEEM,

Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India).
A. Kumar, and S. D. Rai.
Indian Journal of Agricultural Sciences, Vol 51, No 3, p 194-196, March, 1981. 1 Fig, 1 Tab.

Descriptors: *Irrigation effects, *Crop production, *Soil water, Vegetation regrowth, Plant growth, Crop yield, Forages, *India.

The effect of soil moisture on the regeneration of berseem (Trifolium alexandrinum Juslen) was evaluated in a 1976-77 field study. Irrigation of the crop at a ten day interval was ideal for favorable growth and high yield of green fodder. Frequent watering may have helped the crop hydrolyze and mobilize the root carbohydrates. When irrigation frequency was reduced, the rate of regrowth was reduced. The rate of dry matter accumulation in the first ten days after cutting increased with the advancement of cuts. This effect was more conspicuous when irrigation frequencies were reduced. Thus, with frequent irrigation and a sufficiently high water table, berseem can continuously supply forage. The crop accumulated the highest dry matter/day during the first 10 days after cutting, regardless of the irrigation scheme used. (Small-FRC)
W82-01745

SIMULATION OF SOIL WATER WITHIN THE ROOT ZONE OF A CORN CROP,

Kentucky Univ., Lexington. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W82-01834

EFFECT OF SOIL MOISTURE STRESS ON LEGUME-RHIZOBIUM SYMBIOSIS IN SOYBEANS,

Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science.
T. R. Rathore, P. K. Chhonkar, R. S. Sachan, and B. P. Ghildyal.
Plant and Soil, Vol 60, No 3, p 445-450, 1981. 3 Tab, 9 Ref.

Descriptors: *Water stress, *Soybeans, *Symbiosis, Soil-water-plant relationships, Legumes, Soil moisture deficiency.

Soybeans, cv. Hark, in pots were subjected to water stress (temporary wilting for 3 days) at each of several stages: nodule initiation (NIS), early flowering (EFS), midbloom (MBS), early flowering and midbloom (EFS + MBS), rapid pod filling, (RPS), and midbloom and rapid pod filling (MBS + RPS). Moisture stress did not affect nitrogen status of roots or number of bacteroids. However, leghemoglobin content, number and weight of pods per pot, number and weight of seeds per pot, and seed protein content were all affected to varying degrees by moisture stress at different stages. In general, moisture stress reduced leghemoglobin content of root nodules, N uptake, yield and seed protein content, and delayed flower initiation and plant maturity. Stress at the early stages only (NIS or EFS) allowed plants to recover and produce normal yields, but stress at later stages halved the yield. Stress at EFS + MBS and MBS + RPS was less harmful than either EFS or MBS deprivation alone, indicating an increased adaptability. (Cassar-FRC)
W82-01846

DOUBLE AND MONOCROPPED WHEAT AND GRAIN SORGHUM UNDER DIFFERENT TILLAGE AND ROW SPACINGS,

Oklahoma State Univ., Stillwater. Dept. of Agronomy.
R. J. Crabtree, and G. A. Makonnen.
Soil Science, Vol 132, No 3, p 213-219, September, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: Available water, *Agricultural engineering, Farming, Soil water, Resources management, Soil-water-plant relationships, Water resources development, *Wheat, *Sorghum, Crop yield, *Experimental farms, Oklahoma.

A field study was conducted on wheat double-cropped with grain sorghum under rain-fed conditions at the Oklahoma Vegetable Research Station at Bixby. The soil was a Wynona silt loam with 0 to 1% slope. The experiment ran from December 1975 to November 1979. The effects of tillage and row spacings on soil water content and yields of monocropped (MC) and double-cropped (DC) wheat and grain sorghum were studied. When planted at the same time and over a 4-year period, DC wheat yielded 2260 kg per ha, compared with 2890 for monocropped wheat. Drought produced a failure in the grain sorghum as the second crop for 1 of the 4 years. For the 3 years of successfully double-cropped grain sorghum with conventional tillage, the yield in 50 cm rows was 4080 kg/ha, compared with 3810 kg/ha in 75 cm rows. No-tillage, DC grain sorghum in 50 cm rows yielded 3830 compared with 3590 kg/ha in 75 cm rows. When planted at the same time as the DC grain sorghum with conventional tillage, MC grain sorghum in 50 cm rows yielded 4150 kg/ha, compared to 3760 kg/ha in 75 cm rows. For the DC treatments, water content in 120 cm of soil profile was not significantly affected by tillage and row spacings during the grain sorghum growing period. However, tillage and planting operations must be timely to prevent loss of water in the soil-seed environment when attempting to establish a stand for the double crop. On the average only 12% of the precipitation that fell from mid-June to early October for the 3 years of successful DC was detected as stored water in the MC wheat plots. More grain production and more effective use of annual precipitation and soil water were achieved in 3 out of the 4 years when wheat and grain sorghum were DC. (Baker-FRC)
W82-01862

CONTROL OF PEACH TREE GROWTH AND PRODUCTIVITY BY REGULATED WATER SUPPLY, TREE DENSITY, AND SUMMER PRUNING,

Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
D. J. Chalmers, P. D. Mitchell, and L. van Heek.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 307-312, May, 1981. 7 Tab, 19 Ref.

Descriptors: *Irrigation practices, *Crop yield, *Fruit crops, Irrigation, Water supply, Trickle irrigation, *Peaches, Irrigation efficiency, Growth rates.

Various methods were used to determine if they could be productive in controlling tree vigor and fruit production in ultra-dense peach orchards. Root competition, summer pruning, and regulated irrigation all inhibited tree growth, but regulated irrigation combined with root competition generated from high tree density was the most effective. Yields of fruit and growth of fruit were significantly increased up to 30% by high tree density combined with low rate of water application, when water stress limited shoot growth but stimulated subsequent fruit growth. The production of increased fruit yield while simultaneously reducing vegetative growth indicates that irrigation can be

used as a powerful management strategy to manipulate plant growth for greater fruitfulness in much the same manner as dwarfing rootstocks. These data do show that the effects intensified as root competition intensified at the closer spacing and also as the root system grew. Management treatments that concentrate the root system, such as controlled wetted zones as in trickle irrigation, natural barriers as in shallow soils, or even artificial barriers could be expected to increase the effectiveness of regulated irrigation. Increased yields with reduced irrigation will only be obtainable, however, for as long as the tree has excess vegetative vigor that can be suppressed in favor of fruit growth. As trees become older and lose their potential for vegetative growth, there will be less need to control them, and the harvest index will increase naturally. The irrigation strategy will be determined according to the natural vigor of the trees, the age of the planting, the soil type, the fruit growth, and the crop load. (Baker-FRC)
W82-01883

RESPONSES OF GRAIN SORGHUM TO VARIABLE WATER SUPPLY UNDER TWO IRRIGATION FREQUENCIES,

California Univ., Davis. Dept. of Land, Air, and Water Resources.
For primary bibliographic entry see Field 3F.
W82-01944

CORN AND ALFALFA PRODUCTION AS INFLUENCED BY LIMITED IRRIGATION,

Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
For primary bibliographic entry see Field 3F.
W82-01945

INFLUENCE OF TRICKLE AND SPRINKLE IRRIGATION ON GOLDEN DELICIOUS APPLE QUALITY,

Irrigated Agriculture Research and Extension Center, Prosser, WA.
For primary bibliographic entry see Field 3F.
W82-02001

EFFECT OF PROFILE SOIL MOISTURE AND PHOSPHORUS LEVELS ON THE GROWTH AND YIELD OF ANONUTRIENT UPTAKE BY CHICKPEA,

Haryana Agricultural Univ., Hissar (India).
S. Singh, and H. C. Sharma.
Indian Journal of Agricultural Sciences, Vol 50, No 12, p 943-947, December, 1980. 3 Tab, 7 Ref.

Descriptors: *Crop production, *Soil water, Crop yield, Chickpea, Nutrients, Nitrogen, Phosphorus, Water stress, Soil-water-plant relationships.

A field experiment was conducted in 1975-76 and 1976-77 with all combinations of three profile soil-moisture levels, 125, 160 and 200 mm/m, with and without 50 mm of additional irrigation water, allocated to main plots and four doses of phosphorus, 0, 4.5, 9.0, and 13.5 kg P/ha, in the subplots. A split plot design was used. Soils were sandy loam, low in organic carbon and available nitrogen, medium in phosphorus, and high in potassium. The pH of the soil was 7.8; maximum water retention capacity of the soil profile was 225 mm/m. In the 3rd, 4th, and 5th weeks of January the amount of rainfall received was 3.5, 2.6, and 10.0 mm, and in the 2nd and 3rd weeks of February it was 2.6 and 16.2 mm, respectively. Significant increases in dry matter accumulation owing to higher initial soil-moisture levels were recorded at all the stages of crop growth, although the yield increment became smaller with successive increases in soil profile moisture. The additional irrigation of 50 mm given 60 days after sowing further increased the dry matter, and to a greater extent at lower levels of soil profile moisture than at higher levels. Phosphorus application increased dry matter accumulation significantly at all growth stages. Higher moisture supply by building 200 mm of initial profile soil moisture supplemented with 50 mm of protective irrigation 60 days after planting the crop resulted in 71.5 and 51.3% increase in N and P uptake by chickpea crop over the lower level (125 mm) of soil moisture. (Baker-FRC)
W82-02042

EFFECT OF SOIL-MOISTURE TENSIONS AND PRECEDING WINTER CROPS ON THE YIELD AND WATER-USE EFFICIENCY OF SUCCEEDING CROP OF TOSSA JUTE,

Bidhan Chandra Krishi Vishwa Vidyalaya, Kalyani (India).
H. Sen, P. K. Jana, and S. P. Maity.
Indian Journal of Agricultural Sciences, Vol 50, No 12, p 948-951, December, 1980. 1 Fig, 6 Tab, 5 Ref.

Descriptors: *Crop production, *Soil water, Water stress, Crop yield, Wheat, Potatoes, Mustard, Soil-water-plant relationships.

The influence of soil-moisture tension was investigated in sandy-loam soil on the fiber yield of tossa jute. In 1973 and 1974 the experiment was conducted with three soil-moisture tensions for each of the three winter crops, wheat at 0.3, 0.5, and 1.0 atm, mustard at 0.5, 1.5, and 2.5 atm, and potato at 0.3, 0.6, and 0.9 atm, and three soil moisture tensions at 0.3, 0.6, and 0.9 atm for jute. The higher yield of jute was associated with decreases in soil-moisture tension. The preceding winter crops and the maintenance of different soil-moisture tensions for each of these winter crops had no significant effect on fiber yield, stick yield, and height of the plant. The water use efficiency increased with an increase in soil-moisture tension. The yield and water use efficiency demonstrated that a maintenance of 0.6 atm tension was useful. (Baker-FRC)
W82-02045

TURNOVER OF TRITIATED WATER IN CALAMONDIN PLANTS,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
For primary bibliographic entry see Field 5A.
W82-02048

2J. Erosion and Sedimentation

SEDIMENT-CONTAMINANT TRANSPORT MODEL,

Battelle Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5B.
W82-01614

TEMPORAL AND SPATIAL VARIATIONS OF MERCURY, LEAD, ZINC, AND COPPER IN SEDIMENTS OF THE SAGUENAY FJORD,

Laval Univ. (Quebec). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-01639

NOTE ON TWO LIMIT DISTRIBUTIONS OF BEDLOAD MOVEMENT,

Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Journal of Hydrology, Vol 52, No 1-2, p 165-169, June, 1981. 9 Ref.

Descriptors: *Sediment transport, *Model studies, *Mathematical studies, *Bed load, Sediment load, Statistical methods, Channel erosion, Channel flow, Analysis of variance, Mathematical equations, Sediment erosion.

Many models of bedload transport described channel-floor particle movement in terms of a one-dimensional unidirectional random walk. The transported particles are assumed to experience a rest period, prior to each step, which is large in relation to the time spent in the next phase of movement. A case of bedload transport was considered where the step length and rest periods are identically distributed, yet independent random variables. In the model described, as time approaches infinity, the distance an arbitrary particle is transported is shown to be a normally distributed random variable. The mean and variance of this limit distribution may be obtained as simple functions of the mean and variance of the step lengths and rest periods. As the distance an arbitrary particle is transported approaches infinity, similar results are observed for the time it takes for the transport. (Geiger-FRC)
W82-01643

SPATIAL AND TEMPORAL VARIATIONS IN CESIUM-137 AND CARBON IN SEDIMENTS OF SAGUENAY FJORD (VARIATIONS SPATIALES ET TEMPORELLES DU CESIUM-137 ET DU CARBONE DANS DES SEDIMENTS DU FJORD DU SAGUENAY),

Laval Univ. (Quebec). Dept. of Chemistry.
C. Barbeau, R. Bougie, and J-E. Cote.
Canadian Journal of Earth Sciences, Vol 18, No 6, p 1004-1011, June, 1981. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Sedimentation rates, *Fjords, Cesium, *Cesium radioisotopes, Radioisotopes, Cores, Canada, Erosion, Sedimentation, Sediments, *Saguenay Fjord, Quebec.

Measurements were made of the rate of accumulation of sediments in the Saguenay Fjord, Quebec, Canada. The measurements were made from cesium-137 activity in 19 cores. The data varied between sediment rates of greater than 1.0 cm/year upstream and 0.2 cm per year downstream. In cores from the northern basin, the cesium-137 profiles indicate that they follow the pattern of fallouts on the ground, reflecting the impact of a sudden inflow of clay from a major mudslide. In large basins indications are that the rate of sedimentation is less influenced by external happenings. At upstream locations the carbon content and the C/N ratio are higher. Based on cesium-137 dating, core sections show carbon contents that reflect changes caused by the forest industry over the years. (Baker-FRC)
W82-01644

FIELD OBSERVATIONS OF THE ISOTOPIC COMPOSITION OF PARTICULATE ORGANIC CARBON IN THE SOUTHERN NORTH SEA AND ADJACENT ESTUARIES,

Institute for Soil Fertility, Groningen (Netherlands). Delft Hydraulic Lab.
W. Salomons, and W. G. Mook.
Marine Geology, Vol 41, No 3-4, p M11-M20, June, 1981. 3 Fig, 7 Tab, 14 Ref.

Descriptors: *Organic carbon, *Sediment transport, *Fluvial sediments, *Isotope studies, Organic matter, Sediment distribution, Soil erosion, Peat soils, Organic soils, Peat, Suspended sediments, Sediments, Mixing, Sedimentation, *Estuaries, North Sea.

The isotopic composition of the organic carbon in a large number of sediments from the southern North Sea and in fluvial and estuarine deposits was determined field tests. Organic matter in fluvial sediments and suspended matter was found to contain carbon isotopes in a range characteristic of continental organic matter (-25 to -28 o/oo). In sediments of marine sedimentation sites and in marine suspended matter, delta C13 values fluctuated between -20 and -25 o/oo. The low mean values of -13.2 o/oo for the deposited sediments indicated a high content of continental organic matter deposited from present-day rivers or from the erosion of peat layers from the terrestrial or marine environment. The source of detrital continental organic matter could not be ascertained by stable isotope studies. In the estuarines examined, the content of organic matter decreased and the delta C13 values increased in the seaward direction, probably as a result of the mixing of fluvial and marine sediments. (Geiger-FRC).
W82-01714

DISTRIBUTION, MORPHOLOGY, AND ORIGIN OF SEDIMENTARY FURROWS IN COHESIVE SEDIMENTS, SOUTHAMPTON WATER,

Institute of Oceanographic Sciences, Taunton (United Kingdom).
For primary bibliographic entry see Field 2L.
W82-01720

SEDIMENT TRANSPORT AND A RESERVOIR SITUATION FORMULA FOR ZIMBABWE-RHODESIA,

Rhodesia Univ., Salisbury. Dept. of Civil Engineering.
P. R. B. Ward.
Civil Engineer in South Africa, Vol 22, No 1, p 9-15, January, 1980. 11 Fig, 5 Tab, 21 Ref.

Descriptors: *Sediment transport, *Reservoir silting, *Rhodesia, Silt, Silting, Sedimentation, Suspended load, Rivers.

A three year experimental program to determine the amount of sediment transported by Rhodesian rivers is described. The findings are based on river measurements of sediment transported past hydrological gauging stations and not on measurements of reservoir siltation rates. The sediment yield depends on several factors, including rainfall, geology, land tenure and catchment slope. Measurements of suspended sediment concentrations in water samples were made by a turbidity method. Four or five samples from each sampling site, taken during flood flows, were analyzed for size distributions. A representative value for losses of suspended sediments from large catchments in Rhodesia is 38 t/sq km/year. Allowing an extra 10% loss by transport of dissolved solids, and the total loss from catchments is 42 t/sq km. This figure was in agreement with previously determined findings which had been based on reservoir siltation rates. However, this figure was several times smaller than data for small catchments under heavy human occupation in Tanzania.
W82-01736

CROP RESIDUE REMOVAL AND TILLAGE; EFFECTS ON SOIL EROSION AND NUTRIENT LOSS IN THE CORN BELT,

Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
M. J. Lindstrom, S. C. Gupta, C. A. Onstad, R. F. Holt, and W. E. Larson.
Agricultural Research Service, Agriculture Information Bulletin Number 442, October 1981. 35 p, 1 Fig, 13 Tab, 13 Ref.

Descriptors: *Cropland, *Nutrient removal, *Soil erosion, *Cultivation, Soil conservation, Biomass, Fuel, Corn belt, Crop yield, Productivity, Farm management.

Soil erosion is already a serious problem in the U. S., and if large amounts of crop residues are removed for use as biomass for fuels, soil erosion would be accelerated. The Universal Soil Loss Equation (USLE) was used to predict soil erosion for five residue and tillage management systems, and the amounts of residue that could be removed without undue damage to the soil. Crop acreage and yield data for 6 years were compiled by counties in 10 states in the corn belt. The tillage systems were: conventional tillage, all residue removed; conservation tillage, with either 1,500 or 3,500 lb of residue remaining; and no till, with 1,500 or 3,500 lb of residue remaining. Calculated soil losses for each residue and tillage management system combination with assigned crop rotations were compared with the soil loss tolerances defined as the maximum soil loss that is considered safe for continued long-term, maximum productivity of the soil. As the residue and tillage systems become more conservative the soil-loss values decrease, but even with the most conservative, situations arose where the soil loss exceeded acceptable levels. Areas are identified where crop residues may be used for alternate uses, and where they should not be, under any particular tillage regime. When residues are removed the nutrients they would return to the soil must be replaced. (Brambley-SRC)
W82-01770

SEDIMENT ANALYSES FOR SELECTED SITES IN THE SOUTH PLATTE RIVER IN COLORADO AND NEBRASKA, AND THE NORTH PLATTE AND PLATTE RIVERS IN NEBRASKA--SUSPENDED SEDIMENT, BED-LOAD, AND BED MATERIAL,

Geological Survey, Denver, CO. Water Resources Div.
J. E. Kircher.
Available from the OPSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $6.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-207, 1981. 46 p, 27 Fig, 8 Tab, 4 Ref.

Descriptors: *Data collections, *Suspended sediment, *Bed load, *Watershed management, Sampling, Sites, *Sediment transport, Discharge measurement, Particle size, *Colorado, *Nebraska, South Platte River, North Platte River, Platte River.

Sediment samples were collected on the South Platte, North Platte, and Platte Rivers in Colorado and Nebraska during the 1979 and 1980 runoff seasons. Suspended-sediment concentrations ranged from 62 to 3,705 milligrams per liter and the maximum load was 45,547 metric tons per day. The percentage of suspended sediment samller than sand (less than 0.062 millimeter) was as follows: 23 to 78 percent for the South Platte River, 9 to 30 percent for the North Platte River, and 2 to 89 percent for the Platte River. Bedload-transport rates ranged from 0.0085 to 0.67 kilogram per second per meter of channel width for the entire study area. The median grain size of bedload ranged from 0.6 to 2.6 millimeters for the South Platte River, 0.5 to 0.8 millimeter for the North Platte River, and 0.6 to 1.2 millimeters for th Platte River. The median grain size of bed material for the South Platte River ranged from 0.3 to 2.4 millimeters, compared to 0.5 to 0.9 millimeter for the North Platte River, and 0.4 to 3.1 millimeters for the Platte River. (USGS)
W82-01776

SEDIMENT DATA FOR STREAMS NEAR MOUNT ST. HELENS, WASHINGTON--VOLUME 1, 1980 WATER-YEAR DATA,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01792

DIFFUSION OF SEDIMENT ON THE LEE OF DUNE-LIKE BEDFORMS: THEORETICAL AND NUMERICAL ANALYSIS,

Louisiana State Univ., Baton Rouge. Dept. of Geology.
C. Chakrabarti, and D. R. Lowe.
Sedimentology, Vol 28, No 4, p 531-545, August, 1981. 10 Fig, 1 Tab, 28 Ref.

Descriptors: *Sediment deposition, *Bed load, *Dunes, Sediment transport, Model studies, Numerical analysis, Sediment sorting, Particle size, Deposition.

The diffusion and deposition on the leeside of dune-like bedforms is describing semiquantitatively by theoretical and empirical analysis of flow structure, sediment transport, and sediment size characteristics of the dune crest. Simulation analysis shows that flow velocity, flow depth, and sediment size strongly influence deposition rate and texture of leeside sediment before avalanching. Sorting of this bed material strongly controls grain size and deposition rate gradients. This model can promote understanding of mechanisms of sediment transport and of palaeoflow properties determined from sediment texture analysis. (Cassar-FRC)
W82-01842

ESTIMATING EROSION AND SEDIMENT YIELD ON FIELD-SIZED AREAS,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
G. R. Foster, L. J. Lane, J. D. Nowlin, J. M. Laflen, and R. A. Young.
Transactions of the ASAE, Vol 24, No 5, p 1253-1262, 1981. 4 Fig, 4 Tab, 32 Ref.

Descriptors: *Erosion, *Model studies, Sedimentation, Mathematical models, Soil management, Management practices, Erosion control, *Sediment yield.

A model is described which, while simply constructed and usable over a broad range of situations at reasonable cost, embodies the latest knowledge on the fundamentals of erosion mechanics. The model may be used without calibration or collection of data to determine parameter values. It can be linked to hydrologic and chemical transport models and was developed for that specific purpose as a component of CREAMS, a field scale model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. The basis of this model is the assumption that the Universal Soil Loss Equation (USLE) storm erosivity and the peak runoff rate at the watershed outlet can be used to characterize a storm's rainfall, runoff, and sediment yield. A quasi-steady state is assumed. Hydrologically and hydraulically a typical watershed may be divided into areas or elements of overland flow, channel flow, or impounded runoff. Each type of flow is treated in the model with a specific set of equations for that type of flow from an overland flow or channel segment, the model computes a potential sediment load which is the sum of the sediment load from the immediate upslope segment plus that added by lateral inflow within the segment. The model gave reasonable results when compared with data from concave plots under simulated rainfall, single terrace watersheds, small watersheds with impoundment terraces, and a small watershed under conservation tillage. This model may be a useful tool for analyzing the influence of alternate management practices on erosion and sediment yield from field-sized areas. (Baker-FRC)
W82-01849

RESOURCE INVENTORY--SHEET, RILL AND WIND EROSION,

Soil Conservation Service, Washington, DC.
R. I. Dideriksen.
Transactions of the ASAE, Vol 24, No 5, p 1246-1252, September-October, 1981. 4 Fig, 11 Tab, 14 Ref.

Descriptors: *Erosion, *Statistics, Wind erosion, Sheet erosion, Gully erosion, Channels, Rill erosion.

The most up-to-date statistical data available on natural resources was supplied in 1977 by the National Resource Inventories findings. Sheet, rill, and wind erosion continue to be a major national problem. Cropland loss of soil by sheet and rill erosion is estimated to be 1.7 billion tons annually. In 19 states the average cropland erosion rate exceeded 11.2 tons/ha. Fifty percent of all sheet and rill erosion occurs on cropland. Cropland without adequate conservation treatment has an average annual soil loss of 1.5 billion tons, more than eight times the amount on adequately protected land. Pastureland, rangeland, and forest land account for another 1.7 billion tons of soil lost by sheet and rill erosion. The annual erosion rate on pastureland in four states exceeded 11.2 tons/ha. Very steep areas make up one fourth of the total pastureland, but account for 62% of the pastureland erosion. The rangeland sheet and rill erosion rate in four states is more than 11.2 tons/ha. Areas with limiting soil conditions make up one third of the total rangeland acreage, but account for two thirds of the rangeland erosion. About 17% of the nonfederal forest land is grazed and erodes at six times the rate of ungrazed forest land. Wind erosion in the 1976-77 winter blowing season damaged 3.2 million ha of land in the Greater Plain States. The average annual loss due to wind erosion exceeded 11.2 tons/ha on cropland in 3 states and rangeland in 4 states. (Baker-FRC)
W82-01850

THE APPLICATION OF RADIOACTIVE TRACERS FOR DETERMINATION OF BED-LOAD TRANSPORT IN ALLUVIAL RIVERS,

Copenhagen Univ. (Denmark). Dept. of Geography.
T. Thomsen.
Nordic Hydrology, Vol 11, No 3/4, p 133-144, 1980. 4 Fig, 4 Tab, 17 Ref.

Descriptors: *Bed load, *Radioactive tracers, *Alluvial rivers, *Sediment transport, Rivers, Ansager

River, Denmark, Centroid velocity, Mixing, Ripple marks, Tracers.

Bed load transport rate in an alluvial river was determined by a radioactive isotope tracer method. There was a difference of 25% between the results obtained from tracer studies and the values computed by the Engelund and Fredsoe (1976) model on sediment transport. Natural sand (704 g) from the Amager River, labeled with Cr-51 (activity level 515 mCi) was injected into the river and radioactivity surveyed on 4 occasions. The centroid velocities (in meters per day) were 3.1, 4.9, 1.3, and 1.5 at 6 days, 13 days, 41 days, and 71 days after injection. The higher rates on days 6 and 13 show a higher transport rate of sediment particles in the surface of the mobile layer prior to complete mixing between active and inactive sediment particles. The mixing depth or mobile layer was about 15 cm deep. Activity in the uppermost 4.5 cm was more than twice as high as in the underlying 10 cm. This indicated a maximum ripple form height of 4.5 cm. The material transporting width was about 5.4 cm, range 3.05-9.90. Bed load transport rates were 3.19 tons per day for the 13-41 day period and 3.65 tons per day for the 42-71 day period. (Cassar-FRC)
W82-01893

HYDRAULIC GEOMETRY AND MINIMUM RATE OF ENERGY DISSIPATION,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang, C. C. S. Song, and M. J. Woldenberg.
Water Resources Research, Vol 17, No 4, p 1014-1018, August, 1981. 2 Fig, 2 Tab, 30 Ref.

Descriptors: *Energy dissipation, *Channel morphology, *Hydraulic geometry, Rivers, *Sediment transport, Morphology, Equilibrium, Erosion.

The theory of minimum rate of energy dissipation was applied in conjunction with the Manning-Strickler equation and the dimensionless unit stream power equation for sediment transport (Yang, 1973) to a theoretical river with self-formed channels of approximately rectangular shape. The theory states that a system is in equilibrium when its rate of energy dissipation is at a minimum. When a system, such as a river, is subjected to constraints, it adjusts itself until it approaches the equilibrium conditions. The calculated exponents (width, 9/22; depth, 9/22; and slope, -1/6) of the hydraulic geometry relationships proposed by Leopold and Maddock (1953) agreed very well with those measured in the laboratory by Barr et al. (1980). The theoretically derived hydraulic geometry exponents also agreed with observed values from natural river gaging stations. Channel depth can be readily adjusted in accordance with the minimum rate of energy dissipation theory, but width adjustment may depend not only on discharge and sediment load, but also on past history of the river, erodibility of the bank, valley width, vegetation, and man-made structures and improvements. (Cassar-FRC)
W82-01918

SOUTHERN LAKE MICHIGAN SEDIMENTS: CHANGES IN ACCUMULATION RATE, MINERALOGY, AND ORGANIC CONTENT,

Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
D. K. Rea, R. A. Bourbonniere, and P. A. Meyers.
Journal of Great Lakes Research, Vol 6, No 4, p 321-330, 1980. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Lake sediments, *Sedimentation rates, Chemical reactions, *Lake Michigan, Sediment deposition, Water-sediment interfaces, Organic matter, Carbonates, Organic carbon, Fulvic acid, Cores, Particle size.

The last 3550 years of sedimentation in southeast Lake Michigan were reconstructed, using data obtained from three 1-meter gravity cores. At a depth of 50-60 cm (3300 years ago) an abrupt decrease in sedimentation rate and changes in sediment character are evident. These are associated with the lowering of water levels shortly after the end of the Nipissing high lake levels 4000 years ago. Sediment accumulation rates are about 50 g per sq m per year through the upper core section and 900 g per sq m per year in the lower section. Median grain sizes are 6.4 phi units at the core surface, 7.3 phi units at 45 cm, and 7-8 phi units for the lower section. In the lower core section (rapid accumulation rate) sediments are finer and contain a higher proportion of carbonates, inorganic C, and humin, and a lower proportion of organic carbon and fulvic acid. The differences in carbonates and organic fractions depend on the residence time in the oxidized surface layer. Rapidly accumulating material has tens of years for carbonate dissolution and organic C decomposition, whereas slowly sedimenting material may be exposed to chemical attack for hundreds of years. (Cassar-FRC)
W82-01958

R-FACTORS FOR SOIL LOSS IMPACT PREDICTION,

Construction Engineering Research Lab., Champaign, IL.
R. E. Riggins, and J. T. Bandy.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 851-857, August, 1981. 3 Fig, 8 Ref.

Descriptors: *Soil erosion, *Rainfall impact, *Prediction, Mathematical equations, *Cropland, Risks, Precipitation.

Soil loss is an important consideration in many environmental impact analysis situations. The universal soil loss equation, described in Agriculture Handbook No. 537 (HB537), can be used to predict soil loss from agricultural lands. However, while agricultural soil loss has generally been predicted on an average annual basis, there is a growing need for consideration of other time intervals. Incorporation of risk into impact analysis also permits the design of erosion control relative to the costs associated with failure. In addition, effective impact analysis requires a source of readily-available, inexpensive data. A procedure has been developed for determining design rainfall erosion indices for given storm periods for use in soil-loss impact analysis. The procedure brings together a new, simpler method of calculating rainfall erosion values, the concept of risk, and readily available precipitation data. Design rainfall erosion values can be selected on the basis of return interval or simple risk. Any time interval up to 1 year can be considered. Application of the technique to precipitation data from stations in Texas and Georgia showed that rainfall erosion values followed a log-normal probability distribution and could be adjusted to be comparable with values published in the HB 537. (Carroll-FRC)
W82-01963

ACCURACY OF SUSPENDED SEDIMENT MEASUREMENTS IN NATURAL STREAMFLOWS,

Institute of Civil and Construction Engineering, Split (Yugoslavia). Faculty of Civil Engineering.
O. Bonacci.
Journal of Hydraulic Research, Vol 19, No 3, p 195-209, 1981. 3 Fig, 6 Tab, 4 Ref.

Descriptors: *Suspended sediments, *Streamflow, *Mathematical models, Analysis of variance, Mathematical studies, Experimental design, Rivers, Drava River, Monte Carolo method, Case studies, Yugoslavia, *Sediment transport.

A simulation model was developed to investigate the influence of individual factors on the pulsation of the suspended sediment transport in the cross-section of an open streamflow. These results, combined with analysis of variance and experimental planning, made it clear that the selection and number of measurement verticals were important and that measurements should be carried out quickly. Satisfactory accuracy can be obtained when 4 to 7 measurement verticals are used. As the concentration of sediment increases, the number of verticals should increase. The position of the sample points on the vertical did not affect the accuracy of suspended sediment measurements. These conclusions were validated by measurements carried out on the profile of the Drava River near Botovo, Yugoslavia. The relative measurement error ranged from 10 to 60%. (Small-FRC)
W82-02002

2K. Chemical Processes

KINETICS FOR THE AQUATIC ENVIRONMENT,

Oregon Graduate Center, Beaverton.
J. F. Pankow, and J. J. Morgan.
Environmental Science and Technology, Vol 15, No 10, p 1155-1164, October, 1981. 7 Fig, 35 Ref.

Descriptors: *Chemical reactions, *Kinetics, *Mathematical studies, *Model studies, *Aquatic environment, Chemical properties, Phosphates, Metal complexes, Differential equations, Mathematical equations, Metals, Iron, Equilibrium, Adsorption, Oxidation, Hydrogen ion concentration.

Many natural water systems never reach complete equilibrium and are governed by the chemical kinetics of the system. In this, the first part of a two-part article, the kinetics of tripolyphosphate hydrolysis and Fe(II) oxidation are discussed. For tripolyphosphate, the most effective condensed phosphate detergent builder, hydrolysis occurs in two steps and obeys a first-order rate law. Equations were formulated to describe changes in orthophosphate concentration as a function of time. Conversion of half of the tripolyphosphate to orthophosphate took about 10 days. If rate constants are increased by a factor of 10, the conversion time is reduced to two days. When anoxic groundwaters surface, when hypolimnetic waters undergo spring and fall overturns, and when acid mine drainage is discharged to a river, the oxidation by oxygen of Fe(II) to Fe(III) takes place. The effects of pH, concentration, and various ligands on the oxidation kinetics are discussed. These findings plus future research on the catalytic oxidation of Mn(II) in the presence and absence of ligand and the adsorption of a metal ion onto the surfaces of suspended particles in the presence of ligand will be used to draw certain conclusions about the appropriateness of kinetics or equilibrium modeling as applied to natural water chemistry phenomena. (Geiger-FRC)
W82-01631

COPPER(II)- AND CADMIUM(II)-BINDING ABILITIES OF SOME NEW HAMPSHIRE FRESHWATERS DETERMINED BY DIALYSIS TITRATION,

New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W82-01632

THE USE OF SPECIFIC CONDUCTANCE IN STUDIES OF NATURAL WATERS AND SOIL SOLUTIONS,

Lanchester Polytechnic, Conventry (England). Dept. of Geography.
For primary bibliographic entry see Field 7A.
W82-01646

WATERSHED CONSTITUENT LOADING ANALYSIS UTILIZING EMPIRICAL HYDROCHEMICAL MODELING TECHNIQUES,

Utah State Univ., Logan.
For primary bibliographic entry see Field 5B.
W82-01676

NON-EQUILIBRIUM WATER/ROCK INTERACTIONS,

Stanford Univ., CA. Dept. of Geology.
For primary bibliographic entry see Field 1A.
W82-01684

THE RELATIONSHIP BETWEEN MACRO-TOPOGRAPHY AND THE GROUNDWATER QUALITY IN THE GREAT FISH RIVER BASIN, EASTERN CAPE PROVINCE,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01718

GROUNDWATER DISCHARGE THROUGH SPRINGS WITH WELL-DEFINED OUTLETS—A CASE STUDY FROM JELOYA-MOSS, S. NORWAY,
Norges Landbrukshoegskole, Vollebekk. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01748

WATER QUALITY STUDY - SOUTHWEST MINNESOTA PUBLIC WATER SUPPLIES,
Minnesota Univ., Minneapolis. School of Public Health.
C. P. Straub, V. M. Goppers, and R. D. Singer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-147497, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of Minnesota, Report, March, 1981. 24 p, 7 Fig, 2 Tab, 7 Ref. OWRT-A-038-MINN(1).

Descriptors: *Water quality, *Water resources, *Water supply, *Groundwater, *Surface water, *Public health, *Municipal water, Rock River watershed, Wells, Sampling locations, Glacial aquifers, Bedrock aquifers, Geohydrology, Precipitation, Southwest Minnesota, Minnesota.

Municipal water supplies in the Rock River watershed in Southeastern Minnesota were tested on a monthly basis for two years for the anions nitrate-nitrogen, sulfate, chloride, and bicarbonate alkalinity as $CaCO_3$; and for total dissolved solids, conductivity, and pH. Ratios of the various anions were used to identify changes in water quality not associated with dilution. Seasonal changes in water qualtiy were not necessarily reflicted in changes of ratios; concentrations of nitrate-nitrogen increased in many cases, exceeding permissible concentrations specified in the Interim Primary Drinking Water Standards. High dissolved solids concentrations generally exceeded levels specified in the Secondary Drinking Water Standards. Groundwater concentrations were compared with surface water samples from the several streams, springs, and lakes in the area, and some correlations were made between land use and groundwater quality and precipitation. Data from the study were used to call attention to deficiencies in water quality to water consumers in the communities concerned. (Mullen-IPA)
W82-01795

KINETICS FOR THE AQUATIC ENVIRONMENT,
Oregon Graduate Center, Beaverton.
J. R. Pankow, and J. J. Morgan.
Environmental Science and Technology, Vol 15, No 11, p 1306-1313, November, 1981. 8 Fig, 6 Ref.

Descriptors: *Aquatic environment, *Kinetics, *Equilibrium, *Chemical reactions, Oxidation, Model studies, Chelation, Adsorption, Metals, Manganese, Iron.

A previous paper on kinetic concerned overall reaction rates and the degree to which a pair of opposing reactions within an overall system is maintained at equilibrium. This paper extends the discussion of kinetics in natural water systems to three examples: the autocatalytic oxidation of Mn(2+) in both presence and absence of ligand, and the adsorption of a metal ion on the surface of suspended particulates in the presence of a ligand. The suitabilities of equilibrium and kinetic calculations for inclusion in models are compared for several situations. Equilibrium models are useful when reactions occur very quickly or extremely slowly with respect to the period of interest, for example the conversion of Fe(2+) to Fe(3+) during a rapid autumnal lake turnover. In the absence of equilibrium, kinetics can be used. This requires inclusion of appropriate input or sink terms in the differential equations as well as running mass balance equations. Cases of this type could include algae blooms, sediment remineralization, and antropogenic inputs, although the equilibrium approach may be applicable under certain conditions. (Cassar-FRC)
W82-01806

THE SIGNIFICANCE OF WET AND DRY SYNOPTIC REGIONS ON LONG-RANGE TRANSPORT OF POLLUTION AND ITS DEPOSITION,
British Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 5B.
W82-01877

THE GEOCHEMICAL CONTROL OF SEAWATER (SILLEN REVISITED),
Massachusetts Inst. of Tech., Cambridge.
R. E. McDuff, and F. M. M. Morel.
Environmental Science and Technology, Vol 14, No 10, p 1182-1186, October, 1980. 3 Fig, 3 Tab, 24 Ref.

Descriptors: *Geochemistry, Alkalinity, *Seawater, Ions, Chemical precipitation, Chemical properties, *Chemical reactions, Geophysics.

The dominant sources and sinks in the oceanic balance of seawater ions are discussed in this consideration of Sillen's classic work on ocean chemistry. The Sillenian concept of a heterogeneous chemical control of seawater alkalinity is reconciled with modern ideas of the processes actually controlling the major ion concentrations in the ocean. An alkalinity loss by calcium carbonate precipitation can balance the alkalinity input from rivers. Alkalinity is also controlled indirectly by carbonate metamorphism, which buffers the CO_2 content of the atmosphere. The ocean composition seems to be dominated by geophysical rather than geochemical processes. The acid-base chemistry is fundamentally controlled by heterogeneous chemical processes. (Small-FRC)
W82-01936

GROUNDWATER CHEMISTRY OF SOME SELECTED AREAS IN SOUTHEASTER NORWAY,
Norges Landbrukshoegskole, Vollebekk.
J-O. Englund, and J. A. Myhrstad.
Nordic Hydrology, Vol 11, No 1, p 33-54, 1980. 12 Fig, 2 Tab, 26 Ref.

Descriptors: *Water quality, *Rocks, *Chemical properties, *Groundwater, Aquifers, Groundwater movement, Seawater, Minerals, Brackish water, *Geochemistry, *Norway.

Groundwater in 3 areas of southeast Norway, the Lake Mjosa district, As, and Moss-Jeloy, were characterized by chemical analysis of 98 wells drilled 15 to 110 meters deep in bedrock. Since the groundwater surface in bedrock is usually present well below the overlying morainic or glacifluvial material, the water must penetrate this material. Therefore, weathering of minerals in the unsaturated zone is an important factor in determining the chemical composition of groundwater. The movement of groundwater is so slow that water quality is dependent on the solution of reservoir rocks below the groundwater surface. The highest specific electrical conductances, 550 microS per cm, were in dark calcareous shales, and the lowest, 300 microS per cm, in sandstone and gneisses. In the As and Moss-Jeloy regions, which are below the Late-postglacial marine limit, groundwater is influenced by ancient sea salts and fossil sea water. Groundwater from Late Precambrian rocks contains mainly calcium, bicarbonate, and sulfate; from Cambro-Ordovician rocks, magnesium, sodium, potassium, and bicarbonate. Above the Late-Postglacial marine limit groundwater in gneisses and gabbroes is dominated by calcium and bicarbonate; below this limit, by sodium, chloride, and bicarbonate. The composition of groundwater is largely governed by mineral-water equilibria. Most water samples in this study have not yet reached equilibrium with their surrounding minerals. (Cassar-FRC)
W82-02020

PHYTOBENTHOS OF THE RIVER TEES AND ITS TRIBUTARIES,
Durham Univ. (England). Dept. of Botany.
N. T. H. Holmes, and B. A. Whitton.
Freshwater Biology, Vol 11, No 2, p 139-168, April, 1981. 5 Fig, 4 Tab, 57 Ref.

Descriptors: Measurement techniques, *Benthos, *Phytoplankton, Rivers, Plant populations, Population density, Population dynamics, Algae, Seasonal variation, *Tees River, *Great Britain.

No previous studies of plant communities in flowing water have combined detailed floristic and objective quantitative surveys for a whole stretch of river over an extended period of time, although several meet three of these four requirements. This paper presents a standard method for describing plant communities in fast-flowing streams and rivers which is based on the selection of a representative 10-meter length of the stream which can be relocated exactly. A semi-quantitative account is then developed based on a combination of estimates of the relative areas covered by different physiognomic forms and the relative proportions of species present. Application of this method to the River Tees system in Great Britain is reported. Comparison of semi-quantitative analyses developed for six sites on the river showed that the site located directly below the Cow Green retention reservoir, which site had markedly regulated flows, differed from the other five sites in various ways. Bryophytes were found to comprise a greater cover at this site than elsewhere on the river system throughout the year, and a conspicuous growth of Phormidium occurred in autumn. During late summer and early autumn, filamentous green algae of a variety of species were also abundant at this site. Similar seasonal growth was also found at the site located furthest downstream, where the species Cladophora glomerata was dominant. The two upstream sites experienced conspicuous spring diatom 'bursts', which also occurred about a month later at the two downstream sites. Data from this study indicate that if time permits only one sample to be taken from a particular stretch of river, a sample taken in late summer probably provides the most information on flora and life forms. Appendices provide detailed lists of the taxa and diatoms identified at each of the six sites. (Carroll-FRC)
W82-02065

2L. Estuaries

SALT DISPERSION IN THE HUDSON ESTUARY,
Lamont-Doherty Geological Observatory, Palisades, NY.
K. Hunkins.
Journal of Physical Oceanography, Vol 11, No 5, p 729-738, May, 1981. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Salinity currents, *Estuaries, *Water currents, *Tidal effects, Salt balance, Shear, Seasonal variation, Mixing, Salinity, Mathematical studies, Tidal currents, *Hudson River estuary, New York.

Salt transport through river estuaries to the sea is balanced by landward dispersion influenced by physical mixing processes. The currents and salinity levels of the lower Hudson estuary were studied to evaluate the relative importance of these dispersion processes. Weakly significant correlations existed between wind and currents. Three cross-sectional surveys provided estimates of salt dispersion by other practices. Current and salinity data were decomposed into various temporal and spatial means, and departures from these means and covariances between the various quantities were interpreted in terms of physical dispersion processes. The steady shear of gravitational circulation was the main cause of salt dispersion in the lower Hudson estuary. Between spring high-flow and summer low-flow conditions, steady shear salt dispersion varied by a factor of 5. Salt dispersion by tidally varying shear was lower in magnitude. The relations between sectionally averaged current and salinity yielded a negative dispersion, which was attributed to the tendency of bottom tidal

currents to lead upper layer currents in phase and the increased longitudinal salinity gradient near the surface. (Geiger-FRC)
W82-01615

NITRATE REDUCTION TO AMMONIUM AND ORGANIC NITROGEN IN AN ESTUARINE SEDIMENT,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5B.
W82-01625

COHERENCE BETWEEN WIND AND CURRENT EVENTS IN A NEARSHORE, SHALLOW WATER, WAVE DOMINATED ENVIRONMENT,

Old Dominion Univ. Norfolk, VA.
G. M. Hecker.
PhD Dissertation, 1980. 123 p, 41 Fig, 36 Ref, 3 Append, University Microfilms International, Ann Arbor, MI; Order No GAX81-11390.

Descriptors: Winds, *Current meters, *North Carolina, Currents, Waves, Tidal waters, Shallow water, *Wave action, Nearshore, *Wind-driven currents.

Five days of observation were made of the current at four depths in a water depth of eight meters, and accompanying record of local wind one-half kilometer from shore at the U.S. Army Corps of Engineers Coastal Engineering Research Center field facility at Duck, North Carolina beginning five May 1978. The current was measured with a state-of-the-art electromagnetic current meter having a 0.2-second response time and an accuracy of + or - 2 centimeters per second. At each depth a ten-minute record was made each hour with a sampling interval of one-eighth second. The frequency components of the record were analyzed and found to be essentially free from noise and bias. The record of one hundred and twenty (less five lost due to loss of amplifier power supply) ten-minute averages was also analyzed for frequency components. Semidiurnal and diurnal tidal components and quadratic curve trends were identified. Analyses by fast fourier transform revealed that the component of the wind perpendicular to the coast had significant coherence with the alongshore component of the current. (Sinha-OEIS)
W82-01674

NUMERICAL ANALYSIS OF TRANSIENT SALT/FRESH-WATER INTERFACE IN COASTAL AQUIFERS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-01693

HYDROLOGY OF OKARITO LAGOON AND THE INFERRED EFFECTS OF SELECTIVE LOGGING IN OKARITO FOREST,

Forest Research Inst., Christchurch (New Zealand).
For primary bibliographic entry see Field 4C.
W82-01703

FIELD OBSERVATIONS OF THE ISOTOPIC COMPOSITION OF PARTICULATE ORGANIC CARBON IN THE SOUTHERN NORTH SEA AND ADJACENT ESTUARIES,

Institute for Soil Fertility, Groningen (Netherlands). Delft Hydraulic Lab.
For primary bibliographic entry see Field 2J.
W82-01714

DISTRIBUTION, MORPHOLOGY, AND ORIGIN OF SEDIMENTARY FURROWS IN COHESIVE SEDIMENTS, SOUTHAMPTON WATER,

Institute of Oceanographic Sciences, Taunton (United Kingdom).
R. D. Flood.
Sedimentology, Vol 28, No 4, p 511-529, August, 1981. 18 Fig, 44 Ref.

Descriptors: *Estuaries, *Bottom sediments, *Water currents, Furrows, Cohesion, Erosion, Deposition, Sedimentology, Southampton Water, Drowning, *Sediments, Sediment distribution.

Furrow morphology, sediments, structure and associated water flow were observed during a year-long investigation of Southampton Water furrows. Studies included side-scan sonar/fathometer surveys, diver observation and sampling, temperature/salinity measurement, and current speed measurement. Furrows in six well-defined patches apparently resulted from short periods of erosion followed by long periods of deposition. All of the furrows are parallel, 0.5 to 15 m troughs aligned with the dominant current. Some furrows have different characteristics such as width. Narrow furrows accumulate sediment at greater than 3.6 cm/year. Coarse sediments such as shells fill the bottoms of furrows and act to widen the furrows when moved by currents. Large furrows may remain in the same place for 12 years, while small furrows may last a month. (Small-FRC)
W82-01720

GEOCHEMISTRY AND HYDRODYNAMICS IN THE HUTT AND LEEMAN EVAPORITIC LAGOONS, WESTERN AUSTRALIA: A COMPARATIVE STUDY,

Uranerz Australia Party, Ltd., Subiaco.
A. V. Arakel.
Marine Geology, Vol 41, No 1-2, p 1-35, May, 1981. 14 Fig, 4 Tab, 25 Ref.

Descriptors: *Hydrologic cycle, *Playas, Lake basins, Seawater, Ponds, Ponding, *Geochemistry, *Lagoons, Precipitation, Lake beds, Groundwater, Lake sediments, Lake evaporation, Minerals, Sedimentation, Brines, *Australia, Hydrodynamics.

The geochemical characteristics and hydrologic circulation of the Hutt and Leeman Lagoons, located in the northern part of the Perth Basin, Western Australia, are compared. These lagoons are shallow evaporative basins which resulted from ponding in a Pleistocene dune terrain. The present-day lagoons have playa surfaces in which sedimentation is related to the distribution and interaction of groundwaters, seawater, and lagoonal brines. Precipitation is limited to ephemeral halite in ponded waters along with the diagenetic emplacement of calcium carbonate and calcium sulfate in sediments. The lagoonal circulation is controlled predominantly by playa surfaces, which are mostly below sea level. A net influx of sea water, impelled by a hydrostatic head of up to 4 meters, is balanced each season by evaporative reflux. (Geiger-FRC)
W82-01746

SEASONAL AND SPRING-NEAP TIDAL DEPENDENCE OF AXIAL DISPERSION COEFFICIENTS IN THE SEVERN - A WIDE, VERTICALLY MIXED ESTUARY,

Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles, and P. J. Radford.
Journal of Fluid Mechanics, Vol 98, No 4, p 703-726, June, 1980. 7 Fig, 3 Tab, 25 Ref.

Descriptors: *Estuaries, *Diffusion coefficient, *Salinity, *Tidal effects, Seasonal variation, Runoff, Saline-freshwater interfaces, *Severn estuary, *United Kingdom.

Results are presented for the seasonal and spring-neap tidal dependence of the dispersion coefficient in the Severn Estuary based on observations of the axial salinity distributions during 1971-1976. Results are also given for the seasonal dependence of residence times expressed as functions of axial distance along the estuary. The coefficients were derived from salt budget calculations based on 29 sets of observations, and regression analysis was used to determine simple linear and logarithmic relationships for the dispersion coefficients in terms of tidal range and the total rate of input of fresh water. Generally, the coefficients increased with increasing runoff and usually depended upon tidal range. There was a small decrease with increasing tidal range in the seaward part of the estuary and a large increase with increasing tidal range towards the head. Yearly averaged coefficients ranged from 1000 to 10,000 sq m/sec. When dispersion coefficients were applied to calculations of residence times, the residence time of the whole estuary varied from about 100 days during the winter to 200 days during the summer. (Small-FRC)
W82-01749

ESTUARINE DREDGE AND FILL ACTIVITIES: A REVIEW OF IMPACTS,

Florida State Dept. of Environmental Regulation, Tallahassee,
S. A. Johnston, Jr.
Environmental Management, Vol 5, No 5, p 427-440, September, 1981. 6 Fig, 33 Ref.

Descriptors: *Dredging, *Estuaries, *Silting, Suspended load, Turbidity, *Ecological effects, Suspended solids, Environmental effects, Fish, Aquatic life.

The effects and impacts of dredge and fill activities on estuaries are discussed with emphasis on biological and water quality impacts. Recommendations are made for improving and mitigating deleterious effects. The biological effects of turbidity may cause reduced visibility and reductions in the availability of food for fish. High levels of suspended solids can reduce oyster growth and may have toxic effects on various larvae. Dissolved oxygen concentrations are lower near some dredging and filling sites, and pH can be reduced. Siltation can have drastic effects, including the immediate removal of organisms through suffocation and the long-term elimination of many desirable species of flora and fauna. Resuspension of bottom materials can result in the release of nutrients as well as the possible release of toxicants. Where coastal wetlands can not be circumvented during construction projects, bridging should be used rather than filling and embankment. The turbidity caused by dredging and filling can be reduced through the use of a turbidity diaper. (Small-FRC)
W82-01805

A SENSITIVITY ANALYSIS OF AN ECOSYSTEM MODEL OF ESTUARINE CARBON FLOW,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology.
J. K. Summers, and H. N. McKellar, Jr.
Ecological Modelling, Vol 13, No 4, p 283-301, September, 1981. 3 Fig, 5 Tab, 36 Ref.

Descriptors: *Estuaries, *Ecosystems, Dynamics, Organic matter, *Model studies, Sensitivity analysis, North Inlet, Sedimentation, Coastal waters, *Carbon cycle.

An estuarine carbon exchange model is examined using some techniques from systems theory, principally sensitivity analysis. The use of such techniques is demonstrated, and suggestions are made for their application to large ecosystem research projects. The model employed in the analysis has recently been used to estimate the annual net exchange rates of carbon between the North Inlet estuary, South Carolina, and the ocean as well as to elucidate the sources and storages of this carbon flow. The model is a 19-compartment real time deterministic formulation of the four major subsystems which comprise the North Inlet estuary: marsh, water column, oyster reef and subtidal benthos. To estimate parameter performance for the model, sensitivity analysis was performed on the 122 parameters over long periods of 5 years to ensure that long-term effects would be visible. Statistical relationships between perturbations of component interactions and system behaviors were investigated using these analyses. The major conclusion from a study of this model is that much more research is needed in the North Inlet system before a more precise structural framework for the North Inlet model can be attempted. Primary areas for continued research include characterization of the interaction between marsh grasses and algae; the extent of microbial recycling of dissolved organic carbon in the water column; and the community energetics of the North Inlet nekton and avian fauna. Concerning total organic exchange with the sea, specific research is needed into the variability

and contents of particulate organic matter in coastal waters, photosynthesis, planktonic microbial respiration, dissolved organic matter utilization by microbes, tidal washout from the marsh surface, and sedimentation from the water column to the subtidal sediments. (Baker-FRC)
W82-01875

GULF OF MEXICO WETLANDS: VALUE, STATE OF KNOWLEDGE AND RESEARCH NEEDS,

National Marine Fisheries Service, Beaufort, NC. Southeast Fisheries Center.
G. W. Thayer, and J. F. Ustach.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIB, May, 1981. p 1-30, 3 Fig, 3 Tab, 73 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Wetlands, *Estuaries, *Habitats, *Ecosystems, *Fisheries, Aquatic habitats, Spatial distribution, Detritus, Spawning, Vegetation, Fauna, Growth, Coastal marshes, *Gulf of Mexico.

Approximately 50% of the commercial and recreational fishes in the Gulf of Mexico and 80-90% of the fishery landings are estuarine-dependent. Coastal wetlands provide habitats and food resources that make estuarine-nearshore zones vital spawning, nursery and feeding areas for aquatic species. Although there is a great deal of information on plant species in Gulf wetlands, little quantitative data exist on mixed species communities and submergent species and on the factors regulating growth and production of most wetland plants. There is a paucity of quantitative data on the abundance and distribution of faunal components, including forage species and meiofauna, and on growth and mortality rates of juvenile fishes, age-specific utilization, and resource partitioning within wetland habitats. One of the most important, yet poorly understood, aspects of wetland ecology is the production, decomposition, utilization, and export of detrital material from Gulf wetlands. When one considers that about 75% of the total plant production in Gulf estuarine-wetland areas is derived from macrophytes, the importance of developing a sound information base on the decomposition process is obvious. Intensive long-term studies on a few systems and extensive short-term studies on many systems on a regional basis within the Gulf are needed to understand natural variability among organisms and their habitats, as well as the range of conditions and variability of wetland ecosystems. (Moore-SRC)
W82-01902

APPARATUS TO PRODUCE TIDAL FLUCTUATIONS IN A SIMULATED SALT MARSH SYSTEM,

University of West Florida, Pensacola.
C. R. Cripe.
Progressive Fish Culturist, Vol 42, No 1, p 32-33, January, 1980. 3 Fig, 3 Ref.

Descriptors: *Salt marshes, *Tides, *Laboratory equipment, Tidal marshes, Water level fluctuations, Estuarine environment, Simulators, *Pesticide kinetics.

An apparatus was designed to aid in studying pesticide dynamics in simulated salt marsh systems by producing tidal fluctuations in tanks. Water entered the test tanks (3 m in diameter and 0.6 m deep) at 3 liters/min through a siphon and headbox arrangement and discharged through a constant-level excurrent siphon that could be raised and lowered by a motor and gear assembly. During each revolution of the motor, the apparatus raised and lowered the water level in the tank about 10 cm, which simulated a sinusoidal tidal cycle. The motor and gear apparatus control timing and can be changed to vary the tidal cycle. (Small-FRC)
W82-01930

PHYTOPLANKTON DISTRIBUTIONS OBSERVED DURING A 3 1/2 DAYS FIXED-STATION IN THE LOWER ST. LAWRENCE ESTUARY,

Quebec Univ., Rimouski. Dept. of Oceanography.
M. Sinclair, J. P. Chanut, and M. El-Sabh.
Hydrobiologia, Vol 75, No 2, p 129-147, October, 1980. 11 Fig, 4 Tab, 35 Ref.

Descriptors: *Phytoplankton, *Species diversity, *Turbulent flow, Estuaries, Chlorophyll, *St. Lawrence estuary, Thalassiosira, Species composition, Niches, Productivity, Variability, Diatoms, Flagellates, Biomass.

Phytoplankton biomass, species composition, and variability in physiological state were investigated from July 31 to August 4, 1975, during a fixed station cruise off Rimouski, Wuebec, in the St. Lawrence Estuary. The temperature-salinity data and current data suggest that a single water mass on the order of tens of kilometers was present during this study. The surface composition of phytoplankton was relatively constant. In areas of high chlorophyll, Thalassiosira were dominant. Pennate diatoms and flagellates dominated at a surface discontinuity in salinity. The biomass distributions appeared to be a function of physical (turbulence, etc.) rather than biological processes in this small-scale study. On the scale of hours and kilometers, the biomass and primary productivity varied widely. The ratios of productivity/biomass and carbon/chlorophyll were associated with species composition differences. Niche diversity (as indicated by the relative constancy in species composition) was low despite the physical heterogeneity of the surface water. This is a result of the high turbulence associated with estuarine environments. (Cassar-FRC)
W82-01938

WATER QUALITY IMPACTS EXCHANGING WATER BETWEEN SEA AND A CLOSED ESTUARY,

Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
For primary bibliographic entry see Field 5G.
W82-01991

TIDE-INDUCED RESIDUAL FLOW IN SHALLOW BAYS,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. Van De Kreeke, and A. A. Chiu.
Journal of Hydraulic Research, Vol 19, No 3, p 231-249, 1981. 5 Fig, 23 Ref.

Descriptors: *Flow patterns, *Tidal effects, *Bights, Bays, Shallow water, Eddies, Mathematical studies, Flow velocity, Residual flow.

Residual flow patterns were computed in a square bight and a semi-enclosed basin using a finite difference technique. The computations for the square bight suggested that the differences between the Lagrangian mean velocity and the residual flow divided by the mean depth are small. The tidally averaged equations demonstrated the dynamics of the tide-induced residuals. These equations' source terms were interpreted as residual stresses associated with the first order tidal motion. When restricted to the interior of the square bight, good agreement was found between numerically and semi-analytically computed residual flows. Numerically computed residual flow patterns for the semi-enclosed basin showed large eddies. Eddies are not present in the tidal flow. The present difference formulation of the advective terms may need modification. (Small-FRC)
W82-02003

ON SOME CHYTRIDS FOUND IN ESTUARINE HABITATS,

Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.). Dept. of Botany.
A. Ulken.
Botanica Marina, Vol 23, No 6, p 343-352, June, 1980. 11 Fig, 1 Tab, 13 Ref.

Descriptors: *Fungi, *Aquatic fungi, *Estuaries, Bottom sampling, Brackish water, Water pollution effects, Rivers, Weser River, Federal Republic of Germany, River Tay, Great Britain, Comparison studies.

The occurrence of chytrids and thraustochytrids at seven stations between Bremerhaven and Bremen-Lesum on the river Weser were observed from 1976 to the present. Bottom samples which included small amounts of mud were taken monthly, and fungi from the samples were grown for two to four weeks. Nine species of fungi were isolated, all of which were able to live and propagate in brackish waters. Sporulation mechanisms were observed, and physiological abilities were investigated, including the destruction of keratin and chitin materials. Results from the river Weser fungi were compared with results obtained in an investigation of fungal occurrence in the river Tay in the United Kingdom, between Dundee and Perth. The Tay is unpolluted, while the Weser contains industrial salts from the Kali mines. River Tay results were similar to those of the river Weser. (Small-FRC)
W82-02038

PCB AND HCB IN THE SEDIMENTS AND WATERS OF THE TIBER ESTUARY,

Rome Univ. (Italy). Ist. d'Igiene.
G. Puccetti, and V. Leoni.
Marine Pollution Bulletin, Vol 11, No 1, p 22-25, January, 1980. 1 Fig, 6 Tab, 30 Ref.

Descriptors: *Marine sediments, *Estuaries, *Pollutants, *Tiber River, Italy, *Sediments, Polychlorinated biphenyls, Benzenes, Chlorinated hydrocarbons, Toxicity, Water pollution, Hexachlorobenzene.

Environmental pollution by polychlorinated biphenyls (PCB) has received considerable attention since the substance was discovered in animal tissues in 1966. Various studies have established its presence in aquatic sediments, wastewaters, organisms, and food. Previous research has demonstrated the presence of PCB in the catchment area of the Tiber River in Italy. This study investigated the range of PCB and of hexachlorobenzene (HCB) in the coastal seawaters and sediments of the mouth of the Tiber. Although HCB has limited and controlled applications in agriculture in Italy, the substance is diffused throughout the environment. Water analyses showed that PCB was present in 85 of 86 samples taken over a two year period in concentrations ranging from 0.009 to 1,000 parts per billion (ppb), with a mean value of 0.297 ppb. The four sediment samples all contained PCB, in concentrations ranging from 28 to 770 ppb. Only 16 percent of the water samples contained HCB, with concentrations ranging from 0.002 to 0.01 ppb, and none of the sediment samples contained HCB. These findings with respect to HCB indicate that the substance is not stable in the marine environment or that it is diluted there. Sampling sites closer to the coast contained less PCB than ones further out, suggesting that the water from the Tiber River acts as a microbiological decontaminating agent or that pollution of the marine environment further from the coast occurs through the atmosphere. The PCB concentrations found in this study are 100 to 300 times higher than the concentration considered acceptable on the basis of toxicity experiments with aquatic organisms. It is recommended that Italy develop standards for the concentrations of PCB in urban and industrial effluents. (Carroll-FRC)
W82-02057

ECONOMIC INSTRUMENTS FOR CONTROLLING EFFLUENT DISCHARGES TO THE RIVER TEES ESTUARY,

Newcastle upon Tyne Univ. (England). Dept. of Economics.
B. Beavis, and C. K. Rowley.
Marine Pollution Bulletin, Vol 11, No 5, p 120-124, May, 1980. 1 Fig, 6 Ref.

Descriptors: *Effluents, *Water pollution control, *Economic aspects, Industrial wastewater, *Great Britain, Mathematical models, Estuaries, Feasibility studies, Water quality standards, Taxes, Costs, Cost-benefit analysis, *Tees River.

For many years England and Wales have applied statutory controls of effluent discharges less strictly in the case of tidal rivers and estuaries than in the case of non-tidal rivers. Following a recom-

mendation in 1972 that all industrial discharges to tidal waters and estuaries be brought under statutory control, alternative control mechanisms, and particularly the feasibility of using a system of charges instead of consents for controlling effluent discharges, were investigated. A one-dimensional water quality model of the River Tees, in which parameters vary only with respect to distance along the river, was combined with a cost abatement model to permit estimation of the pattern of abatement which would achieve specific water quality standards within specific time periods at the minimum aggregated private costs to all major dischargers. A multi-period approach permitted evaluation of the costs of introducing a variety of abatement procedures at different specific time periods at two year intervals over a 10-year period. Least cost solutions were found to be sensitive to both the level of water quality achieved and the date by which the water quality standard was required to be achieved. The solutions were generaly insensitive to the choice of discount rate. The study results indicate that a tax-price solution based on some knowledge of spatial water quality considerations and erring on the side of harshness in order to guarantee the satisfaction of the water quality standard on the basis of the initial tax-price vector may provide a less costly alternative than consents. The tax-price solution is shown to be an economically feasible approach in the case of the River Tees. (Carroll-FRC)
W82-02060

AMERICIUM IN INTERTIDAL SEDIMENTS FROM THE COASTAL ENVIRONS OF WINDSCALE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-02098

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

CYCLING ZONE ADSORPTION APPLIED TO PURIFICATION OF BRACKISH WATER WITH THERMALLY REGENERABLE ION-EXCHANGE RESINS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
K. S. Knaebel.
PhD Dissertation, 1980. 195 p, 46 Fig, 19 Tab, 104 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19939. NSF-ENG 77-19951.

Descriptors: *Desalination, *Ion exchange, *Separation techniques, Water treatment, Brackish water, Mathematical models, Resins, Cycling zone adsorption, Deionization.

Cyclic variation of the temperature of a dilute aqueous NaCl feed to a fixed bed of thermally regenerable ion-exchange resin leads to alternate purification and enrichment of the product. The effects of operating conditions and staging of zones in series on separation are examined experimentally. The resins considered are Amberlite XD-2 and XD-5; the latter exhibits superior exchange capacity. A mathematical model that accounts for dissipative processes is proposed, and agrees with experimental results at high flow rates and cycling frequencies. A second model, which incorporates the Langmuir isotherm but assumes local equilibrium, is developed and agrees with experimental results at low flow rates and low cycling frequencies. An economic feasibility study indicates that the process is competitive with reverse osmosis and other deionization processes. (Sinha-OEIS)
W82-01696

MULTI-SALINE SAMPLE DISTILLATION APPARATUS FOR HYDROGEN ISOTOPE ANALYSES: DESIGN AND ACCURACY,
Geological Survey, Reston, VA. Water Resources Div.
A. A. Hassan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-115460, Price codes A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-25, 1981. 4 p, 1 Fig, 2 Ref.

Descriptors: *Water sampling, *Distillation, *Salinity, Dehydration, Hydrogen, Isotope studies, Temperature, Stable isotopes.

A distillation apparatus for saline water samples was designed and tested. Six samples may be distilled simultaneously. The temperature was maintained at 400 C to ensure complete dehydration of the precipitating salts. Consequently, the error in the measured ratio of stable hydrogen isotopes resulting from incomplete dehydration of hydrated salts during distillation was eliminated. (USGS)
W82-01789

3C. Use Of Water Of Impaired Quality

COMPOSITION OF FRUIT AND VEGETABLE PROCESSING WASTES,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W82-01601

RIVER BASIN SEQUENTIAL WATER USE AND SALINITY EFFECTS ON CROP YIELD ECONOMICS,
Utah State Univ., Logan.
For primary bibliographic entry see Field 3F.
W82-01671

FOOD AND ENERGY PRODUCTION: CONJUNCTIVE WATER PLANNING,
Wright Water Engineers, Inc., Denver, CO.
W. L. Lorah, and K. R. Wright.
Journal of Hydrology, Vol 51, No 1-4, p 89-96, May, 1981. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Conjunctive use, *Water reuse, *Semiarid lands, Land reclamation, Irrigable land, Oil fields, Saline soils, Cropland, Leaching, Salts, Suspended solids, Dissolved solids, Injection, Multiobjective planning.

As competition for water between energy and agricultural interests increases, it is ever more necessary to find innovative approaches to water management which optimize limited water resources. A plan is presented which could meet the needs of both a large-scale waterflooding scheme for increased oil production and irrigation for a cropland reclamation project. Oil production and agricultural lands are frequently found in the same area in much of the Persian Gulf region. Modern irrigation techniques can be used to reclaim much of the cropland in this region, which has become saline and less productive, through the process of leaching. The proposed conjunctive water supply and treatment plan calls for river water to be diverted onto the saline lands for treatment to remove suspended solids. At the same time, this treatment process would leach salts from the soil. The treated water and the salts would then be captured by an underground drainage system for delivery to the oil field for subsequent injection around the oil reservoir. Use of the leachate from the agricultural sector as an acceptable raw supply for the oil industry would eliminate the need to construct a costly mechanical water treatment plant. Expenses eliminated by the plan could be used to assist a land development program, which might otherwise be economically impractical. The primary consideration for the oil industry in developing such a conjunctive use plan would be economic water treatment. The agricultural sector would need to evaluate both costs and benefits and would need to experiment with various crops. Factors which could make land treatment infeasible are identified, and field and laboratory work that must be undertaken to determine feasibility is described. (Caroll-FRC)
W82-01856

REARING PACIFIC SALMON IN SALTWATER PONDS FERTILIZED WITH DOMESTIC WASTEWATER, DATA REPORT, JUNE 1979 - MAY 1980,
Humboldt State Univ., Arcata, CA. Dept. of Fisheries.
G. H. Allen, J. Hedgepeth, J. Pandozzi, and M. Jennings.
August, 1980. 73 p, 10 Fig, 28 Tab, 27 Ref, Append.

Descriptors: *Wastewater renovation, *Fish physiology, *Fish populations, *Salmon, Trout, Municipal wastewater, Fish stocking, Fisheries, Wastewater treatment, Oncorhynchus, Fish, *Arcata, California.

Two experiments concerned with raising juvenile salmonids in two 0.15-hectare wastewater-seawater fish ponds were conducted at the City of Arcata, CA, sewage treatment facility on the north arm of Humboldt Bay. Rainbow trout (Salmo gairdneri) were reared in one pond during the summer of 1978, and rainbow trout and coho (silver) salmon (Oncorhynchus kisutch) were reared together in both ponds from fall 1979 to spring 1980. Survival of trout in summer was less than 10 percent for both vibriosis-vaccinated and unvaccinated trout. It is suggested that the probable causes of low survival were periods of high water temperature (24-25 degrees centigrade), especially when combined with salinities of approximately 20 ppt. Survival of coho salmon and trout in winter rearing was high in ponds--at least 60 percent, and perhaps as high as 90 percent in South Pond. Rainbow trout survival was good but lower than for coho. Coho salmon and steelhead rainbow trout reared in four-meter square pens all showed high survival in the 60- to 96-percent range. Trout grew to a larger size than coho over a shorter rearing period and provided a net production of fish from the ponds. Coho growth was mainly in late winter and spring months prior to smolting, with slightly less weight of coho biomass in the ponds at the end of the rearing period than at the beginning. Density-dependent relationships between number of fish per unit area, length attained by surviving fish, and percent of smolting were established, using both pen-reared and pond-reared fish. As currently managed, natural flood production would allow at least 10,000 25-gram smolts to be produced in one of the 0.15-hectare ponds. (Garrison-Omniplan)
W82-01906

A PROPOSAL FOR RECLAMATION BY DILUTION OF IRRIGATION WATER,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, G. Sinai, and L. H. Stolzy.
Irrigation Science, Vol 1, No 3, p 161-168, 1980. 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Soil reclamation, *Irrigation water, *Saline water, *Saline soils, Water quality control, Solute transport, Reclamation, Salts, Agricultural hydrology, Cooling water, Drainage water, Controlled drainage, Leaching, Root zone, Model studies, Reclaimed water.

Reclamation of a soil salinized from irrigation with saline water was explored using a salt transport-chemical equilibrium model. The procedure involves a saline irrigation water derived from power plant cooling water residual (EC = 4.2 mmho per cm) diluted with well water (EC = 0.5 mmho per cm) to produce a mixture (EC = 1.4 mmho per cm) which is alternated with the saline water in 2-year cycles. This method allows continued use of the land and minimizes the discharge of salt below the root zone. During the saline irrigation year some salt is precipitated, and some if redissolved during the diluted irrigation year, for a net precipitation of 18% for the complete cycles. This compares with a net precipitation of zero for traditional methods. Although traditional leaching methods reduce salinity and sodicity of the root zone faster than the dilute irrigation method, they

allow more salt to be carried below the root zone and hence to the groundwater or other receiving waters. (Cassar-FRC)
W82-01943

3E. Conservation In Industry

MANAGING WATER AT HELICOPTER PLANT,
For primary bibliographic entry see Field 5D.
W82-01974

3F. Conservation In Agriculture

FURROW ADVANCE RATES UNDER SURGE FLOW SYSTEMS,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
A. A. Bishop, W. R. Walker, N. L. Allen, and G. J. Poole.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 257-264, September, 1981. 6 Fig, 6 Ref.

Descriptors: *Irrigation efficiency, *Furrow irrigation, *Infiltration rate, *Surges, Water conservation, Compacted soils, Soil compaction.

A study of furrow irrigation proved that the advance phase was accomplished with less water using surge flows than with continuous flows. In a field planted to corn with 30 inch row spacing, 600 ft long furrows, and 1.46% average slope, two types of furrows alternated: wheel furrows (compacted by tractor wheels) and non-wheel furrows (unaffected by tractor wheels). Differences between advance rates in surge flow and continuous flow were very pronounced in the first water application to newly formed non-wheel furrows. The time required for the water to advance to the end of the 600 ft row was less than 500 min for surge flows (10 min cycles--1/3 on and 2/3 off, 1/2 on and 1/2 off, and 2/3 on and 1/3 off) and 3500 min for continuous flow. In non-wheel furrows on the second irrigation, advance times for the 600 ft row were 650 min for continuous flow and 100 to 350 min for the three surge flow regimes. Changing the cycle time to 20 min increased the advance time in surge flow to 80 min, compared with 40 min for a 10 min cycle and 240 min for continuous flow in the same trial. There was no significant difference between 5, 10, and 20 min cycles in newly formed non-wheel furrows. Apparently, surge flow altered the characteristics of the furrow, accelerating the development of thin surface seals in the bottom of the furrows and decreasing permeability. This research indicates that surge flow can reduce the volume of water needed for the advance phase, equalize water distribution, and eliminate runoff. (Cassar-FRC)
W82-01612

CASE STUDIES OF AGRICULTURAL WATER CONSERVATION,
Sonnen (M. B.) Co., Inc., Walnut Creek, CA.
M. B. Sonnen, B. B. Dendy, and K. P. Lindstrom.
Water Resources Bulletin, Vol 17, No 3, p 394-398, June, 1981. 2 Tab, 5 Ref. OWRT-C-90134-C(9428)(2), 14-34-0001-9428.

Descriptors: *Agriculture, *Surveys, *Economic aspects, *Water conservation, Farming, Irrigation practices, Loans, Land leveling, Conjunctive use, Water reuse, Public opinion, Planning.

A survey of 13 farmers in four irrigation districts located in California and Texas revealed that a majority was in favor of changing their water delivery systems to closed conduits, removing phreatophytes, reusing irrigation tail water, and avoiding salinity problems. Farmers responded negatively to proposals for collecting local runoff for irrigation, altering land to capture excess rainfall, locating an additional surface water source, developing soil salinity problems with their current irrigation methods, and installing drains. The most widespread methods of water conservation in use were land leveling, especially with laser controlled equipment; adjusting crops to water short periods; and reuse of irrigation tail waters. Conjunctive use of ground and surface waters is almost universally practiced. Water conservation is practiced because of its economic benefits, not for altruistic or ethical purposes. Farmers would respond to incentives for further water conservation practice. Although greater government incentive mechanisms would not be likely to reduce water use much more than 15%, training and education programs and increased loan programs for installation of water conservation equipment are recommended. (Cassar-FRC)
W82-01667

RIVER BASIN SEQUENTIAL WATER USE AND SALINITY EFFECTS ON CROP YIELD ECONOMICS,
Utah State Univ., Logan.
H. O. Fapohunda.
PhD Dissertation, 1980. 319 p, 32 Fig, 44 Tab, 70 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19243.

Descriptors: Water resources, *Model studies, *River basins, Resources development, *Salinity, Crops, Economics, Agriculture, *Crop yield, Economic aspects, Impaired water use, Water use, Sequential Use Model, *Nigeria, Resources management, Crop yield economics.

An economic simulation model is combined with an existing hydrologic and salinity model (BSAMS) in order to predict management effects of sequential water use in a river basin. The hydrologic, salinity and economic systems are closely interrelated in any water resource project. Comprehensive planning is difficult if the three systems are analyzed independently; hence, it is advantageous to incorporate all three systems into a single working model, now called the Sequential Use Model. This model uses functions which relate seasonal crop evapotranspiration and soil solution salt concentration to yields. In essence, the output from the hydrologic (seasonal evapotranspiration) and salinity (soil solution salt concentration) models become inputs into the economic model, which predicts the net return to the given hydrologic and salinity conditions. The model provides a means of determining the relative efficiency of water use with respect to production or net returns for several management alternatives. The marginal values of water can be evaluated for all alternative uses or cropping schemes and the most profitable can then be selected. The sequential use model is applied to an actual hydrologic unit, the Madejia River Basin in Nigeria to demonstrate its applicability to management and planning problems. (Sinha-OEIS)
W82-01671

EXPLOITING THE WATERS OF LAKE CHAD.
For primary bibliographic entry see Field 8A.
W82-01726

IMPRESSIONS OF SOIL AND WATER CONSERVATION IN CHINA,
Soil Conservation Service, Washington, DC.
For primary bibliographic entry see Field 4D.
W82-01730

THE CHAMBAL PROJECT: PROBLEMS AND SOLUTIONS,
Madhya Pradesh Irrigation Dept., Bhopal (India).
For primary bibliographic entry see Field 4A.
W82-01739

IRRIGATION FOR BRAZIL'S POLIGONO DAS SECAS,
Themag Engenharia Ltda., Sao Paolo (Brazil).
F. M. G. Budweg.
International Water Power and Dam Construction, Vol 33, No 8, p 20-22, August, 1981. 1 Fig, 3 Ref.

Descriptors: *Irrigation programs, *Civil engineering, Water resources development, *Semiarid lands, Resources development, Irrigation, Drought, Flood control, Sao Francisco River, *Brazil.

A regional plan to divert wet season runoff of the Sao Francisco river over long distances for irrigation to mitigate the problems of drought in Brazil is described. Not only is the lack of water a problem, there is also the problem of catastrophic flooding when rain does occur in this area of Brazil. In spite of these difficulties, large tracts of the region's land are used for raising livestock and farming. The Sao Francisco is the only river flowing through the semi-arid northeast which carries large volumes of water from the southeastern region of the country where rainfall is much more regular and more abundant. Two large reservoirs contribute considerably to the regulation of the river's flow, the Tres Marias and the Sobradinho. Watershed management plans will be combined with plans to store excess runoff of the flood seasons to transform many of the rivers of the northern half of the polygon of drought from seasonal to perennial rivers and thus provide the basis for large scale irrigation projects. Two basic plans are currently being considered. The first plan calls for diversion of part of the wet season runoff from the Sao Francisco to the north. According to estimates, about 780,000 ha in the semi-arid region north of the Sao Francisco would be suitable for farming by irrigation if water were available without limitation. Roughly 140,000 ha could be irrigated from locally existing sources. The overall development would take decades and be one of the largest single irrigation projects ever completed. (Baker-FRC)
W82-01744

LOW ENERGY PRECISION APPLICATION (LEPA) IRRIGATION SYSTEM,
Texas Agricultural Experimental Station, Lubbock.
W. M. Lyle, and J. P. Bordovsky.
Transactions of the ASAE Vol 24, No 5, p 1241-1245, September-October, 1981. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Irrigation practices, Design criteria, Rainfall, Runoff, *Irrigation design, Rainfall-runoff relationships, *Furrow irrigation.

A new concept in irrigation system design is introduced, along with a report of preliminary results. The system is characterized by and has been labeled as a low energy precision application (LEPA) system, which rather than spraying water into the air at moderate to high pressures, distributes it directly to the furrow at very low pressure through drop tubes and orfice controlled emitters. The system continuously moves through the field in a linear fashion. It is used in conjunction with micro-basin land preparation, which also optimizes the utilization of rainfall by minimizing runoff. The combined system was designed to minimize the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. From the results of testing thus far completed, it appears that significant savings in both water and energy resources are indicated. The system has been evaluated in terms of irrigation efficiency, water use efficiency (yield per gross unit of water delivered to the field), and energy conservation. (Baker-FRC)
W82-01859

DRIP IRRIGATION UNIFORMITY CONSIDERING EMITTER PLUGGING,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
V. F. Bralts, I. P. Wu, and H. M. Gitlin.
Transactions of the ASAE, Vol 24, No 5, p 1234-1240, September-October, 1981. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Drip irrigation, Irrigation practices, Mathematical studies, Statistical analysis.

The present research is an attempt to statistically include emitter plugging in the calculations for uniformity of single and dual chamber drip irrigation lateral lines. The theoretical development of orifice type emitter flow variation due to partial and/or complete plugging is discussed. Through the examples provided the study showed that emitter plugging can be statistically included in the

calculations of uniformity of emitter flow of single and dual chamber drip irrigation lateral lines. In addition, the number of emitters per plant has been shown to be important when calculating uniformity of emitter flow, including emitter plugging. The inclusion of emitter plugging in drip irrigation design enables the design engineer to assess the ramifications of potential plugging on uniformity of emitter flow and ultimately on crop yields. The various system design requirements such as irrigation water filters, lateral line chemical treatment and lateral line flushing can be balanced with acceptable levels of emitter plugging and uniformity. Furthermore, remedial measures such as increased irrigation time or lateral line replacement could be made when uniformity decreases below acceptable limits. Design curves and nomographs have been developed which simplify the inclusion of emitter plugging in design of drip irrigation lateral lines. These design charts are based upon the statistical uniformity coefficient. Similar charts can be easily developed for other uniformity measures. (Baker-FRC)
W82-01860

EFFECT OF IRRIGATION PRACTICES AND METHODS OF SOWING-CUM-IRRIGATION ON THE PERFORMANCE OF SAFFLOWER,

Central Soil Salinity Research Inst., Karnal (India).
R. K. Rajput, S. N. Singh, J. S. Yadav, and B. M. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 5, p 316-320, May, 1981. 4 Tab, 8 Ref.

Descriptors: *Crop yield, *Irrigation effects, *Furrow irrigation, Irrigation practices, Crop production, Agriculture, Statistical analysis, India, *Safflower.

A field experiment was conducted to determine the most sensitive growth stage of safflower for moisture stress and to determine the best method of sowing vis-a-vis irrigation for good seed yield and water economy. Treatments included combinations of eight post-sowing irrigation schedules based on crop growth stages and four methods of sowing-cum-irrigation. The relationship between post-sowing irrigation schedules and methods of sowing-cum-irrigation was not statistically significant during both seasons of the experiment as well as in the pooled analysis. Irrigation at any growth stage was beneficial, and the effect was pronounced when irrigation was applied at the flowering stage followed by irrigation at the milk stage. At the test site where the soils are deep, highly moisture retentive, and medium textured, safflower can successfully be grown with row spacing of 50 cm and alternate furrow irrigation. Irrigations applied at the flowering stage and the milk stage will ensure a yield of about 2700 kg/ha. (Small-FRC)
W82-01878

CONTROL OF PEACH TREE GROWTH AND PRODUCTIVITY BY REGULATED WATER SUPPLY, TREE DENSITY, AND SUMMER PRUNING,

Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 2I.
W82-01883

INTRASEASONAL WATER ALLOCATION IN DEFICIT IRRIGATION,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Bras, and J. R. Cordova.
Water Resources Research, Vol 17, No 4, p 866-874, August, 1981. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Water requirements, *Irrigation requirements, *Crop yield, *Water allocation, Model studies, Stochastic process, Soil moisture deficiency, Cost-benefit analysis, Economic aspects, Profit, Evapotranspiration.

An optimal irrigation policy is derived by applying a model which considers the intraseasonal stochastic variance in crop water requirements and the dynamics of the soil moisture depletion process. The goal of the simulation is maximum profits. General expressions are derived analytically for computing the first two moments of the soil moisture content and of total actual evapotranspiration. The conditional probability distribution of soil moisture content at the end of each decision stage and the associated first moment of the total actual evapotranspiration are used within a stochastic control algorithm, using dynamic programming, to obtain the solution. Among the assumptions required are: lumped soil system, deterministic potential evapotranspiration and irrigation water supply, one crop, simplistic rainfall model, soil moisture averaged through depth, and unquantified farmers' risk aversion. A case study of corn growing on Nunn clay loam soil in Colorado in 1974 is used to test the model. The 120-day growing season is divided into 15 eight-day decision stages and the optimal water allocation solved for limited and unlimited water cases. Results are depicted in graphs plotting net benefits (Dollars per acre) vs. available irrigation water at the root zone (mm) when the cost of irrigation water is $0.16 per mm. (Cassar-FRC)
W82-01916

RESPONSES OF GRAIN SORGHUM TO VARIABLE WATER SUPPLY UNDER TWO IRRIGATION FREQUENCIES,

California Univ., Davis. Dept. of Land, Air, and Water Resources.
J. M. Faci, and E. Fereres.
Irrigation Science, Vol 1, No 3, p 149-159, 1980. 6 Fig, 2 Tab, 19 Ref.

Descriptors: *Sorghum, *Irrigation efficiency, *Water stress, Sprinkler irrigation, Basin irrigation, Soil-water-plant relationships, Evapotranspiration, Crop yield, Grain crops.

Sorghum bicolor L. Moench Cv. Pioneer 846 was grown during 1977 in deep loam soil under different irrigation regimes. Treatments were: Experiment I--sprinkler irrigation; initial soil condition, dry; water application at 2 day intervals or at 10-14 day intervals; Experiment II--basin irrigation; initial soil conditions, fully wetted; water applications at 1 week intervals or nonirrigated. Seasonal amounts of water applied were between 5.1 and 77.0 cm. Linear relationships were found of both total dry matter production and grain yield to seasonal evapotranspiration in both variations of Experiment I. Grain yield and dry matter production were the same with both irrigation frequencies when the evapotranspiration values were near potential. At low evapotranspiration values the Experiment I low frequency irrigation yielded more grain and dry matter than did the Experiment I high frequency irrigation. Higher frequency irrigation allowed more water evaporation from the soil and less recovery from water stress. Grain yields were higher for a similar evapotranspiration in Experiment II weekly irrigation than for Experiment I. (Cassar-FRC)
W82-01944

CORN AND ALFALFA PRODUCTION AS INFLUENCED BY LIMITED IRRIGATION,

Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
A. Retta, and R. J. Hanks.
Irrigation Science, Vol 1, No 3, p 135-147, 1980. 9 Fig, 7 Tab, 10 Ref.

Descriptors: *Grain crops, *Irrigation practices, *Evapotranspiration, Model studies, Corn, Alfalfa, Crop yield, Water stress, Varieties, Hanks model, Irrigation efficiency, Logan, *Utah.

Six varieties of corn and three varieties of alfalfa were grown under varying degrees of irrigation in two seasons (1976 and 1977) at Logan, Utah. Dry matter yields and, in most cases, grain yields, showed a linear relationship to evapotranspiration. There was little difference in yields among the varieties. The slopes of the regression lines (relative dry matter and grain yields:relative evapotranspiration) varied considerably between the 2 years but not among varieties. The slope in alfalfa changed less than in corn, partly as a result of the lesser degree of soil evaporation in alfalfa. Yields predicted by Hanks' (1974) water balance computer model to estimate dry matter and grain yields of field crops from inputs of standard soils, weather, and plant data agreed well with measured yields for both grains. (Cassar-FRC)
W82-01945

DEVELOPMENT OF SOLUTIONS FOR LEVEL-BASIN DESIGN,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, T. Strelkoff, and A. R. Dedrick.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 265-279, September, 1981. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Irrigation efficiency, *Distribution, *Basin irrigation, Irrigation design, Spatial distribution, Infiltration, Level basin design, Water conservation.

This paper discusses methods of estimating distribution uniformities for a wide variety of flow rates, run lengths, infiltration characteristics, and flow resistances for the design and management of irrigation in level basins. An example illustrates the use of the method in applying a given depth of water (4 inches) everywhere in a field at a desired uniformity (80%). It was seen that halving the run length can almost triple the basin area without sacrificing any uniformity. If the run length is decreased for a given basin area, distribution uniformity is greatly improved and the amount of applied water decreased. For a shorter basin, the distribution uniformity does not respond as drastically to changes in flow rate. (Cassar-FRC)
W82-01976

OPTIMAL DESIGN OF BORDER IRRIGATION SYSTEMS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. M. Reddy, and W. Clyma.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 289-306, September, 1981. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Border irrigation, *Irrigation requirements, *Crop yield, Profit, Water conservation, Optimization, Surface irrigation, Economic aspects, Water requirements, Model studies, Basin irrigation, Cost-benefit analysis.

An optimal border irrigation system design was developed to obtain maximum profits within the system constraints and variables. A two-step process established the relationship between yield and design variables. First, a hydraulic model determined the relationship between water requirement efficiency and the design variables. Second, a crop production model and the hydraulic model determined the relationship between crop yield and water requirement efficiency. These two relationships were combined with a mathematical programming technique. The model considered produce values and the costs of labor, water, ditch construction, and crop production, but not the negative effects of runoff and deep percolation. Design variables included were inflow rate, time of inflow, length of run, number of lengths of run, border width, and number of border widths. Graded borders and level basins were considered separately. This technique provides both the optimum management techniques for given field conditions and optimum design for new systems. (Cassar-FRC)
W82-01977

INFLUENCE OF TRICKLE AND SPRINKLE IRRIGATION ON GOLDEN DELICIOUS APPLE QUALITY,

Irrigated Agriculture Research and Extension Center, Prosser, WA.
S. R. Drake, E. L. Proebsting, Jr., M. O. Mahan, and J. B. Thompson.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 255-258, May, 1981. 4 Tab, 12 Ref.

Descriptors: *Apples, *Sprinkle irrigation, *Trickle irrigation, Irrigation practices, Fruit crops, Trees, Soil-water-plant relationship, Water use efficiency, Crop yield, *Irrigation efficiency.

Trickle irrigation of Golden Delicious apples (Malus domestica Borkh.) resulted in a generally higher quality product than did sprinkle irrigation in studies conducted in Washington during 1978 and 1979. Comparisons in growing regimes of trickle and sprinkle plots, respectively, were as follows: total water applied, 38 and 75 cm in 1978, 46 and 91 cm in 1979; leaf water potentials, -14 and -12 bars in 1978, -12 and -11 bars in 1979. In the trickle plots the soil remained moist in a 1.5 meter diameter circle around each tree, but reached the permanent wilting point in June. Differences in crop yields were not significant. Trickle-irrigated apples matured earlier, produced applesauce of better consistency, showed less weep of thawed frozen slices, and were higher in yellow color, soluble solids, and pH. Sprinkle-irrigated apples after 5 months storage were of higher eating quality (juicier and with lower soluble solids/titratable acidity ratio). Frozen apple slices from sprinkle irrigation plots were firmer. (Casear-FRC)
W82-02001

AGRICULTURAL CONSERVATION PROGRAM: AN EVALUATION,
Agricultural Stabilization and Conservation Service, Washington, DC.
J. R. Henry.
Water Resources Bulletin, Vol 17, No 3, p 438-442, June, 1981. 1 Tab.

Descriptors: *Cost sharing, *Agricultural conservation Program, *Conservation, Economic aspects, Water policy, Water conservation, *Soil conservation, *Irrigation, Ponds, Erosion control, Forestry, Agriculture, Farms.

The Agricultural Conservation Program (ACP) authorizes cost sharing with land owners for projects to conserve water, soil, and wildlife and for agriculture-related pollution prevention and control. This paper summarizes Phase I of the appraisal of this program, concentrating on soil and water conservation, and excludes wind erosion, water quality, changes in productive capacity, wildlife habitats, and offsite impacts. Information was collected from 171 counties in 46 states, 5% of all counties, for a total of 60,836 cases. Overall results show that the ACP is doing a very good job in meeting its stated purposes, but effectiveness can be improved with planning and greater use of scientific tools such as soil maps and the Universal Soil Loss Equation. More than 52% of shared cost erosion control projects were installed on land with low erosion rates, less than 5 tons per acre per year; only 27% on land eroding at high rates, 5-14 tons per acre per year. Almost 63% of irrigation water practices were applied to lands receiving 4 ft or less per acre per year; 34% to lands receiving 4-8 ft per acre per year; and 4% to lands receiving 8 ft per acre per year or more. The 4% accounted for over 33% of total volume of water conserved. As the capacity of impoundments increased, costs per acre foot of storage capacity declined and costs per acre increased. (Casear-FRC)
W82-02019

WATER USE, YIELD AND QUALITY OF RAPESEED AS INFLUENCED BY SPACING, IRRIGATION AND TIME OF HARVEST WHEN RAISED IN A MULTIPLE-CROPPING SYSTEM,
Chandra Shekhar Azad Univ. of Agriculture and Technology, Kanpur (India).
S. Bhan, M. Balaraju, and V. Ram.
Indian Journal of Agricultural Sciences, Vol 50, No 10, p 760-763, October, 1980. 2 Tab, 7 Ref.

Descriptors: *Irrigation requirements, *Rapeseed, *Water requirements, Water conservation, Agriculture, *India, Irrigation efficiency.

Water use efficiency of a rapeseed crop was greatest (4.60 kg grain per mm water in 1976-77 and 6.85 kg per mm in 1977-78) using two irrigations, at flower initiation and at pod development. Water use for this regime was 206.3 mm in 1976-77 and 212.2 mm in 1977-78. In 1976-77 and 1977-78 unirrigated fields produced 3.6 and 4.24 kg grain per mm water, respectively, using 134.2 and 127.6 mm of water, respectively. Water use efficiency for one irrigation at flower initiation was 4.46 kg per mm in 1976-77 and 5.73 kg per mm in 1977-78; for one irrigation at pod development, 3.53 kg per mm in 1976-77 and 5.14 kg per mm in 1977-78. Harvest of rapeseed at physiological maturity did not adversely affect yield, although the 1000 grain weight and percent oil were very slightly higher for the more mature crop. The two-week earlier rapeseed harvest facilitated sowing of a late wheat crop. (Casear-FRC)
W82-02031

SHORTENING THE IRRIGATION INTERVAL AS A MEANS OF SAVING WATER IN A BANANA PLANTATION,
Volcani Inst. of Agricultural Research, Bet-Dagan Israel). Div. of Subtropical Horticulture.
E. Lahav, and D. Kalmar.
Australian Journal of Agricultural Research, Vol 32, No 3, p 465-477, 1981. 7 Fig, 8 Tab, 9 Ref.

Descriptors: *Irrigation practices, *Water conservation, Agricultural engineering, Farming, *Bananas, Arid climates, *Israel, Soil-water-plant relationships.

Information was sought on the effect of irrigation intervals and water amounts on the water and salt distribution in the soil profile and on the nutrient concentration in the leaf lamina and petiole of the banana sucker. The experimental site was located in the northern coastal plain of Israel. The soil was a brown low-lime grummusol. Organic matter was 1.0% and the nitrate level was 25 ppm. Wetting cycle treatments were irrigation at 3-day intervals and pulsed irrigation. The different treatments considerably affected the wetted soil volumes, with the effect of the water quantity being greater than that of the irrigation interval. The relationship between the wetted soil volumes and the yield showed that the lowest yield was obtained from suckers irrigated with a reduced water amount once in 3 days. Irrigation with the same water amount but by pulses increased the wetted soil volume, shortened the period of water stress, and therefore increased yields. The regular water amount applied at 3-day intervals resulted in the largest wetted soil volume, but the water stress period was considerably longer than that with the same water amount given by pulses, thus lowering the average yield. An increase in water tension at the lower layer in treatments by irrigated pulses showed that no water excess reached this layer. However, the increase in tension in the lower soil layer did not result in any negative effect on the sucker development, its roots, or its yields. During the 3-day interval between irrigation treatments, the upper soil layer was drying out and, due to the water consumption of the sucker increasing during the season, the water tension before irrigation increased. In cases of wide spacing, water loss was due to evaporation. With narrow planting distances, water loss was due to plant uptake. It was concluded that shortening the interval between periods of irrigation may be a good means of saving water. (Baker-FRC)
W82-02093

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PARISH IS NOT LIABLE FOR SUBSIDENCE.
For primary bibliographic entry see Field 6E.
W82-01603

RECENT CHANGES IN LEVEL OF LAKE VICTORIA,
Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Mobutu Sese Seko, Entebbe (Uganda).
G. W. Kite.
Hydrological Sciences Bulletin, Vol 26, No 3, p 233-243, September, 1981. 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Lakes, *Dams, *Water level, Rivers, Streamflow, *Lake Victoria, Precipication, Evaporation, Water level fluctuations.

Under natural conditions, the outflow from Lake Victoria was controlled by the Ripon Falls in the Victoria Nile at Jinja. Following construction of the Owen Falls Dam, these falls have become partially submerged. The center portion of the falls was removed, so that today there is subcritical flow in the center of the river and supercritical flow on each side over the remains of the rapids. The excesses and shortages are volumes of water and, when divided by the areas of Lake Victoria corresponding to the appropriate levels, can be converted to depths over the lake, thus apparently establishing the effects of the Owen Falls dam on the level of Lake Victoria. The components of the water balance of Lake Victoria are, in order of decreasing importance, rainfall over the lake, evaporation from the lake, outflow from the lake, and runoff from the surrounding land areas. During the period from 1961 to 1964, the level of Lake Victoria rose by about 2.5 meters; over the period 1977 to 1980 it rose by around 1.5 meters. These rises are unusual, given the normal small variation of such a large lake. Use of a lake routing model has shown that the most recent rise in lake level can be simulated very closely if the observed precipitation volumes are increased by between 25 and 30%, suggesting that the observed data may be underestimates of the true precipitation. Rapid changes in lake levels and river flows such as those described here render the use of long term average statistics unreliable for design purposes. (Baker-FRC)
W82-01711

THE CHAMBAL PROJECT: PROBLEMS AND SOLUTIONS,
Madhya Pradesh Irrigation Dept., Bhopal (India).
D. S. Sinha.
International Water Power and Dam Construction, Vol 33, No 8, p 25-28, August, 1981. 3 Fig.

Descriptors: *Irrigation programs, *Flood control, *Drainage, *Chambal Project, *India, Civil engineering, Madhya Pradesh, Engineering, Soil water, Weed control, Waterlogging, Construction, Canal construction.

The Chambal Project serving Madhya Pradesh, India, is described. Three dams and 350 km of major canals supply this irrigation project. The purpose of the project was to offer protection from heavy flooding in the area. It became obvious that a large flood reserve would have to be maintained in the reservoir, with a corresponding loss of useful capacity, if proper utilization of the monsoon waters was to be achieved. Breaches in the Chambal canal also created problems for the area. Weed growth in the canal compounded the breaching problem, reducing the canal's carrying capacity. With the advent of irrigation and constant flow of the canal water, large areas became water-logged. Where irrigation is introduced for the first time, a rise in the groundwater table is expected. If surface and subsurface drainage are lacking, when water oozes out from the canal embankment or leaks through the subsoil, the waterlogging problem becomes enormous. The Chambal project was visualized in the early 1950s and planned an irrigation intensity of 70% of the cultivable area. However, factors made the amount of water this was able to supply inadequate to the need. Farmers started growing high yielding wheat instead of the normal variety. The higher yielding crop required significantly greater amounts of water. When they farmed all the area available, instead of the predicted 70% of it, again demand exceeded supply. Night irrigation was not being carried out, and during these hours water was allowed to go to waste into the drains. Problems have been somewhat overcome by ending canal weed problems, strengthening the canal embankments, and land levelling and land shaping. (Baker-FRC)
W82-01739

USING THE BAMBOO (BAMBUSA VULGARIS) AS FIELD DRAINAGE MATERIAL,

Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
E. U. Nwa.
Transactions of the ASAE, Vol 24, No 4, p 974-976, July/August, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Drainage, *Irrigation practices, *Nigeria, *Bamboo, Water table, Rainfall, Runoff, Waterlogging, Salinity, Subsurface drainage, Surface drainage.

The bamboo was tested as an inexpensive material for making field drains. A set of uniform bamboo pipes was cut into 4 meter lengths. The septum at the nodes was removed by boring through. Holes were drilled evenly spaced around each pipe. Two parallel drains, 20 meters long (i.e., 5 pipes each), were installed across the slope of a sloping test field at a spacing of 15 meters. The depth of the drain was one meter and the slope was 0.2%. Crushed stones, about 6.5 mm in diameter, were used as envelope material. The depth of the water table below the ground surface was measured in the ground water tubes a day or two after each rainfall and at weekly intervals during long rainless periods. At the peak of the rains the stream water at the lower end of the slope backed into the evacuation ditch up to the position of the lower drain, rendering it less effective. In general, the two drains proved fairly effective. The outflow rate naturally increased with the amount of rainfall. It also responded to the rainfall intervals, increasing, decreasing or remaining constant depending on the intervals. The maximum drain outflow rate of 32 liters/minutes was obtained between the end of July and the end of September. Rainfall was very regular during this period. It was concluded that bamboo can be used effectively for field drainage. (Baker-FRC)
W82-01743

STAGE-DISCHARGE RELATIONS AT DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
D. M. Mades.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $8.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-1009, 1981. 56 p, 19 Fig, 23 Tab, 11 Ref.

Descriptors: *Stage-discharge relations, *Dams, *Streamflow, *Regulated flow, Concrete dams, Movable dams, Slide, Radial gates, Locks, Outlets, Orifice flow, Model sutides, Discharge coefficients, Discharge measurement, Gaging station, *Illinois, Illinois River, Des Plaines River.

Stage-discharge relations were developed for the Brandon Road Dam on the Des Plainse River and the Dresden Island, Marseilles, Starved Rock, Peoria, and La Grange Dams on the Illinois River. At Brandon Road Dam, streamflow is regulated by the operation of tainter gates and headgates. Tainter gates are operated to regulate streamflow at the Dresden Island, Marseilles, and Starved Rock Dams. Peoria Dam and La Grange Dam comprise timber Chanoine wickets which are lowered to a horizontal position on the streambed when used for streamflow regulation. Both dams have concrete abutments housing butterfly valves that are also used for regulation. A total of 50 discharge measurements ranging from 49.0 to 2,450 cubic meter per second were used to determine discharge coefficients in equations expressing discharge as a function of headwater depth, tailwater depth, and gate opening. A stage-discharge relation for Chanoine wicket dams developed from a U.S. Army Corps of Engineers hydraulic model study in 1937 and 1938 was verified with discharge measurements made downstream from the Peoria and La Grange Dams. (USGS)
W82-01793

ECOLOGICAL CHARACTERISTICS OF THE RHIZOSPHERE MICROFLORA OF MYRIOPHYLLUM HETEROPHYLLUM,

Massachusetts Univ., Waltham. Department of Environmental Science.
J. R. Blotnick, J. Rho, and H. B. Gunner.
Journal of Environmental Quality, Vol 9, No 2, p 207-210, April/June, 1980. 1 Fig, 3 Tab, 26 Ref. OWRT-B-066-MASS(1), 14-34-0001-9075.

Descriptors: *Aquatic weed control, *Rhizosphere, *Nitrogen fixing bacteria, Weeds, Plant growth, Aquatic weeds, Aquatic plants, Nutrients, *Mesotrophic lakes, Aquatic bacteria, Aquatic productivity, Surface water, Species composition, Population density, Cycling nutrients.

There has been an increased interest in the growth patterns and nutrient requirements of vascular plants as problems associated with nuisance weed growth in aquatic environments increased. During periods of active plant growth, bacterial populations associated with the rhizosphere and rhizoplane of the water milfoil, Myriophyllum heterophyllum, were examined in the littoral zone of a softwater, mesotrophic lake of Massachusetts. Species composition of the rhizoplane bacteria differed markedly from that of adjacent sediments; however, the population density of heterotrophic bacteria in each of these sites was similar. In the rhizoplane, large populations of bacteria capable of reducing nitrate and performing ammonification were found. Nitrogen-fixing activity was significantly greater on root surfaces than in lake sediments. Intense rhizosphere activity was linked to the bimodal productivity cycle of M. heterophyllum. It was suggested that the large populations of rhizoplane bacteria involved in nutrient transformations may more readily supply aquatic plants with available nutrients than do the nonrhizosphere populations. (Geiger-FRC)
W82-01796

BIOLOGICAL CONSEQUENCES OF STREAM ROUTING THROUGH A FINAL-CUT STRIP MINE PIT: BENTHIC MACROINVERTEBRATES,

Argonne National Lab., IL.
W. S. Vinikour.
Hydrobiologia, Vol 75, No 1, p 33-43, October 4, 1980. 1 Fig, 7 Tab, 47 Ref.

Descriptors: *Macroinvertebrates, *Diversion, *Stream biota, Land reclamation, Lakes, *Goose Creek, *Wyoming, Benthic fauna, Streams, Mayflies, Midges, Tubificids, Coal mining, Aquatic life, Benthos, Strip mine lakes, Water quality.

Rerouting Goose Creek near Sheridan, Wyoming, through a final-cut strip mine pit (650 meters x 350 meters at the widest) to reach the coal reserves beneath the stream bed disrupted the normal riffle/pool sequence, forming a lake-type habitat. A study of the macrobenthos in the pit revealed a change from dominance by net-spinning hydropsychids and mayflies to dominance by tubificid worms (Limnodrilus hoffmeisteri) and midge larvae (Chironomus sp., Procladius sp., and Tanypus stellatus). A few other insects which drifted in from the creek were found in the upstream portion of the pit. None occurred in the downstream portion because of fish predation or unfavorable habitat. The pit, which receives sewage effluent and agricultural runoff, helps to improve water quality. The water leaving the pit has lower diurnal oxygen sags, ammonia-N concentrations, and fecal coliform levels than the entering water. (Cassar-FRC)
W82-01948

STREAMLINED REGULATIONS COULD HELP MAKE NEW STORMWATER MANAGEMENT CONCEPTS PART OF THE TRADITION,

C. R. Curtis, and R. C. Hinde.
Water and Pollution Control, Vol 119, No 8/9, p 22-23, 37, August/September, 1981. 2 Fig, 13 Ref.

Descriptors: *Storm water, *Water managment, Legal aspects, Regulations, Administrative regulations, Decision making, Computer models, Model studies, *Flood control, *Toronto.

Shortly after Hurricane Hazel reached the Metropolitan Toronto area in 1954 the Metropolitan Toronto and Region Conservation Authority was formed with the aim of acting as a strong, constructive force for flood control, to protect people and property from flooding. By 1971 an ambitious program of problem identification, analysis, and implementation had begun. Stormwater quality problems were identified and the basic data was gathered from observations at test catchments. Analytical numeric tools were developed to model both quality and quantity of stormwater. The most significant computer program resulting from this research was a version of the Storm Water Management Model, modified for Canadian conditions: CANSWMM. While the analytical techniques were being developed, training seminars for the people who would be involved in stormwater management modeling proceeded. Various computer models were explained. Some municipalities prepared Storm Drainage Criteria Manuals as guides for the development within their bounds. Local conservation implementation of stormwater management is often complicated by existing legislation and common law, as well as by government policy. The rights and obligations of municipalities and landowners must be considered in the design and implementation of any stormwater management scheme. Overlapping of jurisdictions is also a problem in legislation affecting stormwater management. It is hoped that the legal, procedural, and policy problems will soon be resolved so that stormwater management can move ahead. (Baker-FRC)
W82-02000

THE DAY THAT THE RAIN CAME DOWN,

For primary bibliographic entry see Field 2E.
W82-02064

4B. Groundwater Management

OPERATING POLICIES FOR A SURFACE/GROUND WATER SYSTEM,

Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and L. M. Tomlinson.
Water Resources Bulletin, Vol 17, No 3, p 406-413, June, 1981. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Safe yield, *Conjunctive use, *Reservoir operation, *Groundwater management, Carbonate aquifers, Transmissivity, Groundwater recharge, Recharge, Springs, Simulation analysis, Lincolnshire Limestone aquifer, *England.

Conjunctive use of a hypothetical surface reservoir, storage volume 20,000 megaliters, and the Lincolnshire Limestone aquifer in eastern England was simulated. In this aquifer water enters in the outcrop region and flows toward the confined aquifer in which the wells are located. Storage coefficients and transmissivities vary widely in different sections. Fissures developed by solution permit excess water to flow from springs. Five alternative operating policies were considered for the period 1961-77. Greatest safe yield (or maximum constant yield) was 123 megaliters per day (22,600 gal per min), using combined control rules for reservoir and aquifer by a combined simulation. Other options produced safe yields of 84 to 118 megaliters per day. Extending the 17 year data to 100 years gave a maximum safe yield of 120 megaliters per day. Excluding the critical dry year, 1976, simulations showed a maximum yield of 162 megaliters per day. This illustrates that the method is very sensitive in input. (Cassar-FRC)
W82-01741

4C. Effects On Water Of Man's Non-Water Activities

LONG TERM RESPONSES OF STREAMFLOW FOLLOWING CLEARCUTTING AND REGROWTH,

Southeastern Forest Experiment Station, Asheville, NC. Coweeta Hydrologic Lab.
L. W. Swift, Jr., and W. T. Swank.

Group 4C—Effects On Water Of Man's Non-Water Activities

Hydrological Sciences Bulletin, Vol 26, No 3, p 243-256, September, 1981. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Stream discharge, *Forest management, *Clear-cutting, Cutting management, Forest watersheds, Forestry, Forests, Revegetation, Reforestation, Vegetation establishment, Runoff, Streamflow, North Carolina, Experimental basins.

Three experimental basins were maintained at Coweeta Hydrologic Lab in western North Carolina. Two basins were totally clearcut without removal of forest products - one of them twice, while the third was a forest management demonstration and received a mix of thinning, clearcutting, and noncutting. Changes in streamflow immediately after cutting and as the forest regrew are reported and related to variations in vegetation, climate and basin elevation. The results of the study clearly indicated that streamflow from mountain basins increases when the forest is cut, and that these increases decline as the vegetation regrows. The data from the study allow closer examination of the factors influencing the trend line equations fitted to streamflow increases. Vegetative regrowth is the dominant change occurring after the forest is cut on a basin and thus is the prime determinant of the trend lines for the Coweeta experiments. The most significant finding was that the slopes of the trend lines were essentially identical for all cases, despite the fact that these experiments involved different sets of years, different degrees of cutting, and basins with distinctly different physiography and elevation. Climatic variation was the most likely cause for departures of streamflow increases from the smooth trend line. The mixed hardwood forest of one basin was clearcut twice in the past 40 years. During the second regrowth period, streamflow increased after the first year at about one half the increases at the same points in time after the first treatment. Variability of flow seemed partly related to precipitation. (Baker-FRC)
W82-01610

HYDROLOGY OF OKARITO LAGOON AND THE INFERRED EFFECTS OF SELECTIVE LOGGING IN OKARITO FOREST,

Forest Research Inst., Christchurch (New Zealand).
J. M. Macpherson.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 25-39, 1981. 11 Fig, 14 Ref.

Descriptors: *Logging, *Suspended sediment, *Diversion, *Estuaries, Rivers, Lagoons, Ecological effects, Hydrology, Hydrologic budget, Okarito Lagoon, *New Zealand.

The relative impact of selective logging and the Waitangi-taona River diversion on Okarito Lagoon were assessed. The hydrology of the 20 sq km estuary was determined. The diversion of the Waitangi-taona River in 1967 may be responsible for the fact that the surface sediment was consistently muddier than the subsurface sediment. Most sediment is supplied by river or erosion of tidal channel margins. Freshwater inflows into the lagoon vary from less than 11 cu m/sec to more than 750 cu m/sec during storms. When the estimated yield and water inflow effects of the 1967 river diversion are compared with the short-term effects of selective logging, the effects of logging on sediment yield, water balance, and dissolved solids inputs should be small. If there are future studies of the ecological impact of physical changes in the lagoon and its catchment, the 1967 diversion should receive the most attention. (Small-FRC)
W82-01703

THE EFFECTS OF MAN ON BASIN RUNOFF, AND ON THE WATER BALANCE AND WATER STAGE OF THE CASPIAN SEA,

Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
I. A. Shiklomanov.
Hydrological Science Bulletin, Vol 26, No 3, p 321-328, September, 1981. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Basin irrigation, *Hydrologic budget, Water demand, Water supply, Irrigation effects, Environmental effects, *Caspian Sea, Rivers, Runoff, *Water level fluctuations, *Sea level.

An assessment of the role of man's activities on governing the changes in inflows and sea stage was made to begin to ascertain the measures needed to solve the problems of the Caspian Sea. The main rivers flowing into the Sea are the Volga, Ural, Kura, Terek, Sulak, and Samur. The principal effects of man in the basins of these rivers from the point of view of runoff include construction and operation of reservoirs, irrigation, agrotechnical measures, and industrial and municipal water consumption. Investigations of long-term runoff fluctuations based on data from hydrometeorological sites were made, together with an analysis of changes in natural meteorological factors and the development of economic activity in the basins. Water balance estimations were also made, based on the study of water balance components in basin sub-areas where changes in evaporation and flow formation conditions occur due to man's activity. According to the data analyzed, the regime of surface inflow into the sea was practically natural until 1940, when a man-induced reduction of inflow occurred, amounting to 6.3 cubic kilometers/year, or 2.2% of the natural surface inflow. At present the inflow reduction is 38 cubic kilometers per year, or 13%. It appears in the future that this reduction will increase to 65-70 cubic kilometers per year, or 23% of the natural inflow. During 1955-1973 the construction and operation of reservoirs was the main problem. Now irrigation demands play the major role. By the end of this century, two-thirds of the reduction in total runoff to the sea will result from irrigation, due to the area of the basin being irrigated. If climatic conditions are average and if the effects of man's activities continue, the sea level is expected to decrease gradually to 29.5 meters above mean sea level by the end of this century. (Baker-FRC)
W82-01709

4D. Watershed Protection

RECONSTRUCTION OF A SMALL DAM FOR A RECREATIONAL LAKE.

Public Works, Vol 112, No 9, p 113-115, September, 1981. 5 Fig.

Descriptors: *Lakes, *Recreation facilities, Swamps, Erosion, Dams, Earth dams, Construction, Dam construction, Construction methods, Economic aspects, Management, *Erosion control, *Lake Lucerne, *New Jersey.

In Old Bridge Township, New Jersey, deterioration of a small dam on Lake Lucerne was resulting in increased sediment washing into the lake, and the resultant loss of the lake to the people for recreational purposes. Money was taken from a housing and community development grant to rehabilitate the dam and the surrounding 36.7 acres of woodland and marshland. Initially the design for the dam called for an elaborate concrete structure with a spillway. However, preliminary estimates indicated that the cost of such a structure would far exceed available monies. The final plan called for the establishment of a concrete wall of the dam and the placing of the outlet pipe in such a position as to allow increased fish and other aquatic life, which would then in turn take care of the mosquito problem. Local public works and recreation departments removed debris that had accumulated in parts of the lake over the years, including shopping carts, tires, boards and bottles. Several area residents were directed to clean up their properties which bordered the lake. The bottom of the lake was dredged to remove organic material and accumulated debris. The preconstruction meeting was held in April, 1980, and construction began in the latter part of the month. To reduce erosion, large riprap stone was placed on the sides of the spillway and on the downstream side at the pipe outlet. The stone was placed on top of a wire mesh and grouted. To provide access to the land around the lake the embankment over the outlet pipe was constructed 12 feet wide. Future work includes the construction of a foot bridge. The lake will remain a low-key recreational area open to area residents for nonpowered boating, fishing, hiking, birdwatching, and photography. (Baker-FRC)
W82-01604

HYDRAULIC TESTING OF PLASTIC FILTER FABRICS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8G.
W82-01613

KINEMATIC FLOW APPROXIMATION OF RUNOFF ON A PLANE: AN EXACT ANALYTICAL SOLUTION,

Griffith Univ., Brisbane, Queensland (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2A.
W82-01617

EROSION AND SEDIMENT CONTROL IN CHINA'S YELLOW RIVER BASIN,

A. R. Robinson.
Journal of Soil and Water Conservation, Vol 36, No 3, p 125-127, May/June, 1981. 1 Tab, 6 Ref.

Descriptors: *Fluvial sediments, *China, *Erosion control, *Terracing, *Diversion structures, Sedimentation, Sluices, Erosion, Accelerated erosion, Slope degradation, Loess, Check dams, Penstocks, Gully erosion, Gullies, Irrigation water, *Yellow River basin.

The Yellow River of China carries the largest sediment load of any river in the world, causing a soil loss of 12 tons/acre/year over the river's entire watershed. The loess plateau which constitutes about 60% of the Yellow River watershed has become heavily populated and farmed. About one-third of the soil of this area had been destroyed or badly damaged by erosion. Large gullies have been cut in the loess plateau and in some areas annual soil loss averages 45 tons/acre. About 10 to 40% of the precipitation runs off the heavily gullied land. The Sanmen Gorge Dam built on the Yellow River in 1960 has been plagued by sedimentation problems. In 1962, the Chinese began sluicing through the dam to reduce sediment deposition within the reservoir. In 1965, diversion tunnels were opened, and penstocks were converted to sluiceways. In 1970, additional diversion outlets were opened, and power generation was reduced to a third of that originally planned. Terracing and vegetative coverings are used to reduce erosion in the loess areas. Check dams or gully plugs help to contain runoff and sediment in gullies. Diverted flows laden with sediment are used for irrigation, and warping, a process of improving sandy soil, is practiced to increase farmland acreage. Great sediment loads in the middle and lower Yellow River continue to create challenging problems for water storage and the maintenance of reservoirs. (Geiger-FRC)
W82-01729

IMPRESSIONS OF SOIL AND WATER CONSERVATION IN CHINA,

Soil Conservation Service, Washington, DC.
P. M. Howard.
Journal of Soil and Water Conservation, Vol 36, No 3, p 122-124, May/June, 1981.

Descriptors: *Soil erosion, *China, *Water resources development, *Water supply development, *Irrigation water, Natural resources, *Soil conservation, Soil stabilization, Water reuse, Water use, Fertilizers, Irrigation, Irrigation practices, Water management, Water conservation.

Soil and water conservation practice in the People's Republic of China is going through a transition. Part of this change stems from modernization of land and farm management practices which call for more irrigation water. China also gives high priority to the use of water for navigation and has stepped up measures to improve drainage and control flooding. Although China has vast water resources, many rivers are not located near irrigable land, and their high sediment contents often cause flooding. During the last 30 years, many physical

structures have been built to help alleviate some of the problems. More work is needed on water reuse and spills. The rich sediment deposits of the Yellow River have been used for farmland. Until watershed erosion is controlled, the use of reservoirs for reducing flood peaks and trapping sediment will be limited. Mechanical parts are rapidly worn by the high sediment content of the water. Several critical sites along the Yellow River have been targeted for major erosion control programs. Revegetation has aided eroded areas that were destroyed by the rapid harvesting of forests. More collaboration between and research from national government, local government and academic organizations on erosion problems is needed. Human waste is often applied to vegetable crops grown near the cities; animal manure is composted with other organic materials and applied to mostly rice and cotton crops. Chemical fertilizers are being used increasingly where available. More progress in the better use of natural resources in China is expected through exchange of information with other countries. (Geiger-FRC)
W82-01730

CROP RESIDUE REMOVAL AND TILLAGE; EFFECTS ON SOIL EROSION AND NUTRIENT LOSS IN THE CORN BELT,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
For primary bibliographic entry see Field 2J.
W82-01770

THE LAKE TAHOE BASIN: A SYSTEMS ANALYSIS OF ITS CHARACTERISTICS AND HUMAN CARRYING CAPACITY,
Energy Policy Studies, Inc., Omaha.
For primary bibliographic entry see Field 6A.
W82-01807

EVALUATING SCOUR AT CULVERT OUTLETS,
Colorado State Univ., Fort Collins. Engineering Research Center.
J. F. Ruff, and S. R. Abt.
Transportation Research Record, No 785, p 37-40, 1980. 6 Fig, 3 Ref.

Descriptors: *Culverts, *Scour, *Erosion, Conduits, Sand, Gravel, Soil erosion, Energy dissipation, Channel scour, Conveyance structures, Design criteria, Erosion control.

The scour characteristics of uniform, noncohesive bed materials were studied in laboratory flumes. Two flume sizes were used: 6.1 m wide x 2.4 m deep x 30.5 m long and 1.2 m wide x 0.9 m deep x 4.6 m long. Test culverts were 100, 254, 356, and 457 mm in diameter. Scour holes in sand and gravel were similar in appearance. After 31 min the gravel scour hole was 85-90% of the full depth reached at 316 min and the sand scour hole was 80% of the depth reached at 316 min. The equations presented offer a refinement of existing methods for estimating the depth, length, width, and volume of scour holes. When culvert diameter, design discharge, and median diameter of the channel bed uniform material are known, the equations may be used to determine scour hole characteristics and to evaluate alternative scour protection methods and energy of dissipators. (Cassar-FRC)
W82-01934

AGRICULTURAL CONSERVATION PROGRAM: AN EVALUATION,
Agricultural Stabilization and Conservation Service, Washington, DC.
For primary bibliographic entry see Field 3F.
W82-02019

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

PLANNING WITH GREAT UNCERTAINTY: A REVIEW AND CASE STUDY OF THE SAFE DRINKING WATER CONTROVERSY,
Livingston Coll., New Brunswick, NJ. Dept. of Urban Studies.
M. R. Greenberg, and G. W. Page.
Socio-Economic Planning Sciences, Vol 15, No 2, p 65-74, 1981. 4 Tab, 59 Ref.

Descriptors: *Water pollution effects, *Public health, *Epidemiology, *Drinking water, New Jersey, Potable water, Chemical wastes, Organic compounds, Toxicity, Human population, Environmental policy, Future planning, Political aspects, Mortality, *Water treatment.

The monitoring of drinking water for toxic substances, especially organic pollutants, and the assessment of their risk to human health have become controversial environmental planning issues in the United States since 1974, when it was announced that people from Lousiana suffered high cancer risks from drinking Mississippi River water containing organic chemicals. A review is presented of the chemical contamination of potable water suppliesin the United States. The relation of polluted waters to the incidence of cancer is explored, and special attention is given to New Jersey, which has the highest rates of cancer mortality of any state in the country. When the US EPA carcinogenic potential coefficients were extrapolated to New Jersey potable water data, only 26 of 700 toxic chemicals found in United States water supplies were identified. Since relatively few suppliers provide most of the water supply of this state, the samples would have to be weighed by source and population in order to produce any significant relation to increased cancer risks. Improved monitoring of potable water supplies and more sophisticated epidemiological studies are needed to effectively solve environmental planning issues and decide on actions to safeguard public health. (Geiger-FRC)
W82-01606

RAPID, QUANTITATIVE SEPARATION OF CHLOROPHYLLS AND THEIR DEGRADATION PRODUCTS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
P. G. Falkowski, and J. Sucher.
Journal of Chromatography, Vol 213, No 2, p 349-351, August, 1981. 2 Fig, 11 Ref.

Descriptors: *Water analysis, *Chlorophyll, Measuring instruments, Chromatography, Sediments, Chlorophyll a.

A high-pressure liquid chromatographic system is described for the determination of the major chlorophylls and their degradation products, including chlorophyll a, b, and c, chlorophyllide a, phaeophorbide a, and phaeophytins a and b. For extraction of field samples, 100 to 200 ml sea water were filtered on 25 mm glass-fiber filters. The filters were ground in a tissue grinder with 2 ml of absolute methanol and brie filtered through a glass-fiber filter into a graduated centrifuge tube. The ground glass filters were reextracted on the filter manifold with an additional 1 ml of methanol. A 25-microliter volume of pooled pigment extracts was applied to the HPLC column for analysis. A two-step solvent program was used to resolve chlorophyll c from chlorophyllide a and phaeophorbide a and at the same time allow phaeophytin a to elute in a reasonable time. Methanol-water (90:10) was applied until phaeophorbide a was eluted, followed by methanol-water (98:2). Solvent delivery was automatically programmed with a single-step solenoid valve. The major chlorophylls and the degradation products were separated in 18 minutes. Less than 0.1 pmole of chlorophyll a can be detected by this procedure. This method should serve as a supplement to the simple fluorometric method. For general water analysis, the simple fluorometric method is rapid and precise. For some applications, however, significant artifacts prevent its use alone, for example in the analysis of sediment samples rich in humic and other organic acids. (Baker-FRC)
W82-01619

A SELECTIVE MEDIUM FOR THE ENUMERATION OF STREPTOCOCCUS BOVIS BY MEMBRANE FILTRATION,
Leeds Univ. (England). Dept. of Civil Engineering.
J. I. Oragui, and D. D. Mara.
Journal of Applied Bacteriology, Vol 51, No 1, p 85-93, August, 1981. 4 Tab, 33 Ref.

Descriptors: *Culture media, *Bioindicators, *Streptococcus bovis, *Animal wastes, *Pollutant identification, Microbiological studies, Membrane filters, Agar, Ammonium sulfate, Indicators, Farm wastes, Sewage bacteria, Bacteria, Water analysis.

A new selective medium for the determination and enumeration of Streptococcus bovis was developed for bacterial examination of water and sewage samples. This organism is the predominant fecal streptococcus in farm animals and is relatively rare in humans. Thus it can serve as an indicator of pollution from animal wastes. The membrane-bovis agar medium uses the ability of S. bovis to use ammonium sulfate as its sole nitrogen source as an identifying characteristic. In this medium other common water, sewage, and fecal bacteria are completely inhibited, except for one streptococcus strain associated with pigs. Of 541 colonies isolated from feces, sewage, and stream water, 97% were S. bovis. (Cassar-FRC)
W82-01620

MATACIL RESIDUE DETERMINATION IN FOLIAGE, FISH, SOIL AND WATER,
Mobay Chemical Corp., Kansas City, MO. Div. of Agricultural Chemicals.
C. W. Stanley, and L. M. Delphia.
Journal of Agricultural and Food Chemistry, Vol 29, No 5, p 1038-1039, September-October, 1981. 2 Tab, 5 Ref.

Descriptors: *Matacil, *Pesticide residues, *Gas chromatography, Water analysis, Soil analysis, Insecticides, Separation techniques, Pesticides, Pollutants, Fish, Leaves, Forest soils, Forests, Litter, *Pollutant identification.

A technique is described for detecting the insecticide, Matacil, in foliage, fish, soil, and water without the use of a moisture-sensitive reagent for derivatization. After extraction into 1,2-dichloroethane-methanol, the Matacil was cleaned up by partitioning between organic and aqueous solutions. The sample was derivatized with 1-fluoro-2,4-dinitrobenzene and detected by gas chromatography. Recoveries of the insecticide from fish, foliage and soil fortified with 0.05 ppm Matacil and from water fortified with 0.01 and 0.005 ppm Matacil ranged from 68 to 127%. The lower limit of detection was below 0.001 ppm for water and below 0.01 ppm for fish, foliage and soil. When the present technique is used, the temperature at which the derivatization of Matacil is carried out is not critical, and the resultant derivative is stable. (Geiger-FRC)
W82-01621

SURVIVAL OF ENTEROVIRUSES ADSORBED ON GLASS MICROFIBERS DURING POSTAL TRANSPORT (SURVIE DE VIRUS ENTERIQUES ADSORBES SUR MICROFIBRE DE VERRE AU COURS D'UN TRANSPORT POSTAL),
Nancy-1 Univ. (France). Lab. d'Hygiene et de Recherche de la Sante Publique.
J. C. Joret, and J. C. Block.
Canadian Journal of Microbiology, Vol 27, No 2, p 246-248, February, 1981. 2 Tab, 8 Ref.

Descriptors: *Viruses, *Sample preservation, *Water analysis, *Wastewater analysis, Pollutant identification, *Enteroviruses, Sewage viruses, Polioviruses.

The survival of two enteroviruses was determined after adsorption on glass microfiber filters, 8 micrometers x 60 mm length. Recovery rates for poliovirus type 1, Mahoney strain, were 65 + or - 20% upon immediate elution from the filters and 40 + or - 7% after postal transport at ambient temperatures. Indigenous wastewater viruses showed 100% recovery upon immediate elution, 39% after postal transport at ambient temperatures, and 65% after postal transport at freezing temperatures. Recovery rates were considered satisfactory enough to justify postal shipment of samples for qualitative determination of enteroviruses in water. (Cassar-FRC)
W82-01637

CHARACTERIZATION OF AN ENZYMATIC DETERMINATION OF ARSENIC(V) BASED ON RESPONSE SURFACE METHODOLOGY,

South Carolina Univ., Columbia. Dept. of Chemistry.
R. J. Matthews, S. R. Goode, and S. L. Morgan.
Analytica Chimica Acta, Vol 133, No 2, p 169-182, May 1, 1981. 9 Fig, 4 Tab, 29 Ref. OWRT-B-121-SC(1).

Descriptors: *Arsenic, *Water analysis, Chemical analysis, Enzymes, Pollutant identification.

The use of response surface methodology in developing a method for the enzymatic analysis of arsenic in water is described. A Box-Behnken three-level fractional factorial experimental design was used to characterize the reaction-rate response surface as a function of five experimental factors. Interpretation of the results of regression analysis provides an operational description of the analytical method as well as information that can be correlated with the mechanism of the chemical reaction. The initial simplex optimization produced improved reaction rate response and located a region of near-stationary response. This region, in which further response surface experiments were performed, has been shown to be fairly insensitive to changes in the experimental factors. The characterization of the reaction rate response in this region has facilitated an understanding of the factor effects and interactions that can be correlated with fundamental chemical knowledge to produce an analysis resistant to the effects of uncontrolled changes in experimental factors. (Baker-FRC)
W82-01656

SEDIMENT BACTERIAL INDICATORS IN AN URBAN SHELLFISHING SUBSTUARY OF THE LOWER CHESAPEAKE BAY,

Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
C. W. Erkenbrecher, Jr.
Applied and Environmental Microbiology, Vol 42, No 3, p 484-492, September, 1981. 6 Fig, 2 Tab, 41 Ref. OWRT-A-080-VA(2).

Descriptors: *Bacteria, *Sediments, *Estuaries, Water pollution effects, Shellfish, Coliforms, Feces, Public health, *Chesapeake Bay, Bacterial analysis, Path of pollutants.

The spatial and temporal distributions and compositions of bacteria in sediments and overlying waters in an urban shellfishing area of the lower Chesapeake Bay region, the Lynnhaven Estuary, were determined. Samples were collected in triplicate at least bimonthly from 11 sites. Bacterial analyses and physiochemical analyses were performed on water and sediment samples. The data showed marked fluctuations in the physiocochemical parameters and the indicator bacteria (total and fecal coliforms and fecal streptococci). The inlet site, which had higher water salinity and coarser sediment, had lower overall bacterial desnities than did the headwater sites. Sediment bacterial counts were higher than bacterial counts of the overlying waters. The counts were above the safe limits for shellfish-growing waters and indicated that the system was fecally polluted. Urban and agricultural runoff were the primary sources of pollution, although failed septic tank systems were also thought to contribute to the problem. Thus, sediments seemed to be a reservoir for high densities of indicator bacteria and could pose a health problem. (Small-FRC)
W82-01661

APPLICATIONS OF STRIPPING ANALYSIS TO METAL DETERMINATIONS IN NATURAL WATERS,

Colorado State Univ., Fort Collins. Dept. of Chemistry.
For primary bibliographic entry see Field 1A.
W82-01670

GEOGRAPHIC VARIATIONS IN WATER QUALITY AND RECREATIONAL USE ALONG THE UPPER WALLOWA RIVER AND SELECTED TRIBUTARIES,

Oregon State Univ., Corvallis. Dept. of Geography.
T. R. McDowell.
PhD Thesis, 1980. 235 p, 37 Fig, 19 Tab, 93 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-13668.

Descriptors: *Water quality, *Baseline studies, *Spatial distribution, *Oregon, Rivers, Water pollution, Recreation, Bacteria, Freshwater, Wallowa River basin, Fecal matter.

This study was designed to examine geographic variations in water quality and recreational use along the upper Wallowa River and selected tributaries in the Wallawa Mountains, an area of concentrated and dispersed wilderness recreation. Analysis conducted during the baseline study revealed that waters in the area drained by the upper Wallowa River were physically and chemically quite pure; however, there were notable temporal and spatial variations in the physical and chemical characteristics of the area's streams. It was concluded that waters upstream from Wallowa Lake are generally nutrient-poor. Nutrient concentrations vary seasonally with hydrological conditions and biological activity, and geographically with differences in watershed lithology. Bacterial water quality based on fecal coliform counts varies significantly between sites and with geographical patterns of recreational use. Bacterial water quality also varies significantly with background environmental conditions (habitats). Bacterial water quality is closely correlated with precipitation events in the middle and lower portions of the study area, but not in the headwaters where sources of fecal contamination are relatively absent. Levels of fecal coliform bacteria in streams outside the alpine zone frequently exceed acceptable limits established for total coliforms in public drinking water; however, no standards exist for unprotected water sources. (Sinha-OEIS)
W82-01681

RANDOM DIFFERENTIAL EQUATIONS IN WATER QUALITY MODELING,

Utah State Univ., Logan.
For primary bibliographic entry see Field 6A.
W82-01688

REVERSE PHASE CONCENTRATION OF TRACE POLYCYCLIC AROMATIC HYDROCARBONS IN WATER,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
D. G. Marsh.
PhD Dissertation, 1980. 182 p, 48 Fig, 33 Tab, 117 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-10468.

Descriptors: *Chemical analysis, *Aromatic compounds, *Water pollution, Pollutant identification, Oil pollution, Chromatography, Polycyclic aromatic hydrocarbons(PAHs), Trace levels.

The determination of polycyclic aromatic hydrocarbons (PAHs) has been accomplished in a wide variety of matrixes. The analysis of water samples for trace levels of PAHs has typically been accomplished by cumbersome multiple extraction techniques. An examination of the phenomenon of trace concentration of PAHs was chosen as the experimental emphasis. The retention behavior of the PAHs, their fluorescence spectra, and a fluorescence normalization procedure are presented. The use of spectrofluorometry to separate chromatographically unresolved peaks was examined. Frontal and elution chromatography were compared, and the elution technique was used to predict frontal retention behavior of PAHs in pure water. The relation between mobile phase strength and reverse phase PAH elution retention at low organic mobile phase concentration was examined. The retention characteristics of concentrator columns were predicted based on correlations to known liquid chromatography approaches. The effects of a variety of concentrator columns on the concentrate analysis was examined. Concentrator column packing, type and concentrator column inner diameter were varied and optimum conclusions were obtained. The optimum system was selected and used to analyze highly polluted Virginia Tech Duck Pond water which was spiked with PAHs at the ppt level. (Sinha-OEIS)
W82-01689

TOXIC SUBSTANCES IN WATER: PATTERNS OF CONTAMINATION AND POLICY IMPLICATIONS,

Rutgers - the State Univ., New Brunswick, NJ.
G. W. Page, III.
PhD Thesis, 1980. 294 p, 8 Fig, 31 Tab, 138 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22576.

Descriptors: *Water pollution, *Groundwater, *Surface waters, *Toxicity, Public health, *New Jersey, Surface-groundwater relations, Comparison studies, Case studies, Public policy.

Public policy designed to protect public health from the dangers of water supplies contaminated with toxic substances is discussed with particular attention to policy which treats ground water less stringently than surface water in monitoring and treating water for toxic substances. The central research question addressed in this dissertation is how the contamination of ground water with toxic substances compares to the contamination of surface water with toxic substances in New Jersey. The data used include 692 ground water samples and 320 surface water samples collected throughout New Jersey. The method of determining the relative contamination of ground water and surface water by toxic substances is a set of three analyses. These analyses are repeated for several subsets of the data. The results are remarkably consistent for each of the three analyses for every subset of the data. A comparison of the patterns of toxic substances contamination identified by factor analysis in the ground water and the surface water data sets reveals that these patterns of contamination are very highly correlated between the two data sets. Case studies of two municipalities in Middlesex County, New Jersey are presented. The experiences of these two municipalities are compared and contrasted and used to examine the policy implications of toxic substances contamination of water supplies. (Sinha-OEIS)
W82-01695

HEALTH ASPECTS OF ORGANIC SUBSTANCES IN SOUTH AFRICAN WATERS - OPINIONS AND REALITIES,

National Inst. for Water Research, Pretoria (South Africa).
J. F. J. Van Rensburg.
Water SA, Vol 7, No 3, p 139-149, July, 1981. 3 Fig, 7 tab, 22 Ref.

Descriptors: *Drinking water, *Organic compounds, *Carcinogens, Public health, Water quality standards, Water analysis, Water quality management, *Literature review, *South Africa.

A literature review is presented of available information on the determination of permissible concentrations of organic micro-pollutants in potable water in an attempt to propose guidelines for South African water quality standards. Progress in the United States and Europe is summarized. A

relatively inexpensive and simple method of expressing and evaluating the possible health hazard of organic pollution is the OPI (organic pollution index) and related analytical methods. Water supplies exceeding OPI limits could be referred to sophisticated laboratories for detailed analysis. The water supplies that have been investigated in South Africa have not presented a health hazard due to volatile organic micropollutants except for a few locations including the Vaal River below the Barrage. More advanced analytical techniques are needed for non-volatile organic matter in water. When tests indicate the presence of mutagens in potable water, more sophisticated investigations, in this case chemical techniques, should be performed. (Small-FRC)
W82-01712

DISTRIBUTION OF VIBRIO PARAHAEMOLYTICUS IN FINFISH HARVESTED FROM PORTO NOVO (S. INDIA) ENVIRONS: A SEASONAL STUDY,

Center of Advanced Study in Marine Biology, Porto Novo (India).
G. B. Nair, M. Abraham, and R. Natarajan.
Canadian Journal of Microbiology, Vol 26, No 11, p 1264-1269, 1980. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Vibrio parahaemolyticus, *Bacteria, *Fish, Fate of pollutants, Pollutant identification, Pathogens, Porto Novo, *India, Bay of Bengal.

The pathogenic bacterium, Vibrio parahaemolyticus, was isolated from fish samples collected at five locales in the Porto Novo, India, region as follows: estuary, 35.6%; mangroves, 40.6%; Bay of Bengal, 3.9%; landing site, 46.8%; and fish market, 40.6%; average of all locales, 36.8%. Highest levels of bacteria were found in July and August in the mangroves and in April in the other locales. Mullets had the highest isolation rates, 56.3%. Fish become contaminated at the market through sprinkling with estuarine water and lack of refrigeration. (Cassar-FRC)
W82-01737

ORGANIC SUBSTANCES IN WATER,

Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-C, 1981. 19 p, 3 Fig, 2 Tab, 13 Ref. (Edited by Greeson, P. E.).

Descriptors: *Water quality, *Organic compounds, *Environmental effects. *Pollutant identification, Taste, Odors, Classification, Solutes, Natural waters.

This is the third of several compilations of briefing papers on water quality by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected organic substances in water. Briefing papers are included on 'Why study organic substances in water.', 'Taste and odor in water', and 'Classification and fractionation of organic solutes in natural waters'. (USGS)
W82-01783

INFECTIOUS WATERBORNE DISEASES,

Geological Survey, Reston, VA. Water Resources Div.
P. E. Greeson.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-D, 1981. 16 p, 8 Fig, 2 Tab, 90 Ref.

Descriptors: *Water quality, *Water pollution effects, *Pollutant identification, *Infection, *Diseases, Bacteria, Viruses, Parasites, Contamination, Drinking water, Waterborne diseases.

This is the fourth in a series of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains a paper on; Infectious waterborne diseases', which discusses 36 infectious diseases of man that can be or are strongly suspected of being transmitted by water. Of the 36 diseases, 12 are caused by bacteria, 4 are caused by viruses, 19 are caused by parasites, and 1 has numerous infectious agents. (USGS)
W82-01784

MICROBIOLOGY OF THE AQUATIC ENVIRONMENT,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-01786

COMPARISON OF LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION FOR CONCENTRATING MUTAGENS IN AMES SALMONELLA/MICROSOME ASSAYS ON WATER,

National Inst. for Water Research, Pretoria (South Africa).
W. O. K. Grabow, J. S. Burger, and C. A. Hilner.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 442-449, October, 1981. 4 Tab, 14 Ref.

Descriptors: *Salmonella, *Bioassay, *Mutagens, Microorganisms, Contaminants, Potable water, Wastewater, Rivers, Vaal River, Drinking water, *South Africa.

Mutagen recovery from different waters was compared using dichloromethane (DCM) liquid-liquid extraction and adsorption on Amberlite XAD resins, techniques often employed for recovery of mutagens from water. Grab samples were collected from the final product of a multiple-barrier wastewater reclamation plant, from laboratory tap water representing a potable water supply prepared mainly from surface water, and from the Vaal River at points about 50 meters below the barrage, 20 meters below the influent of a wastewater effluent from Sasolburg, and 1 kilometer below the inflow point of a wastewater effluent from Vanderbijlpark. The mutagenicity ratio (MR) values for concentrates of the four Vaal River samples showed that DCM extraction yielded the highest mutagenic activity for two samples, and XAD-2 adsorption for one. DCM extracts had the highest mutagenic activity for two samples, and XAD-2 concentrates for three of the ten samples of reclaimed water. DCM extracts had the highest MR value for 11 and XAD-2 concentrates for two of the 15 tap water samples. Mutagenic activity was detected in DCM extracts of all 15 tap water samples, while XAD concentrates of two samples failed to show mutagenic activity at all. Dose-response tests were conducted on nine tap water samples. At least 14 of the 18 DCM extracts had higher MR values for dimethyl sulfoxide dilutions than for the original extract. In the case of XAD-2 this was noted for only one of the nine concentrates. Although this study shows that DCM liquid-liquid extraction is superior to XAD adsorption for concentrating mutagens from a variety of waters, it indicates that both methods have their limitations. (Baker-FRC)
W82-01812

GAUZE FILTRATION AND ENRICHMENT PROCEDURES FOR RECOVERY OF VIBRIO CHOLERAE FROM CONTAMINATED WATERS,

John Hopkins Univ., Baltimore, MD. Div. of Geographic Medicine.
W. M. Spira, and Q. S. Ahmed.
Applied and Environmental Microbiology, Vol 42, No 4, p 730-733, October, 1981. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Filtration, *Vibrio, Bacteria, Public health, Epidemics, Water analysis, Enrichment, Pollutants, Human diseases, Microbiological studies, Monitoring, Surface waters, Drinking water.

Gauze filtration was tested as a simple, inexpensive technique for sampling of nonflowing surface waters. The procedure proved more effective in recovering Vibrio cholerae 0:1 than culturing 1 liter water samples and required about the same amount of effort. The most effective combination of enrichment and plating media for isolating V. cholerae from contaminated surface waters is presented. The perfect performance of 18 hr alkaline bile-peptone water (ABPW) enrichment of filtration samples in the study plus the demonstrated superiority of filtration over water grab sampling in 6 hr enrichment cultures suggests that a larger scale evaluation would better demonstrate the significance of this method. The ability of 18 hr ABPW enrichment cultures of filtration samples was then evaluated to isolate laboratory grown V. cholerae biotype eltor from pond water into which it was added in graded concentrations. The procedure was able to detect V. cholerae at concentrations as low as 10 organisms per liter of natural pond water. Thus the method appears accurate and inexpensive for conducting large scale surveillance of water sources for contamination by V. cholerae biotype eltor, the organism which is responsible for the current cholera pandemic in Bangladesh. (Baker-FRC)
W82-01815

DETERMINATION OF HEXACHLOROCYCLOPENTADIENE AT THE NANOGRAM PER LITER LEVEL IN DRINKING WATER,

Health and Welfare Canada, Ottawa (Ontario).
F. M. Benoit, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 303-308, September, 1981. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Potable water, *Pollutant identification, *Water sampling, Resins, Solvents, *Hexachlorocyclopentadiene, Water analysis, Chemical analysis, Organic compounds.

A solvent extraction method is described for the determination of hexachlorocyclopentadiene (HCCP) in drinking water. The possibility that HCCP is light sensitive was investigated by storing half of a solution of HCCP at known concentration in the dark and the other half in a clear glass container in the light for a period of nine days. A steady decrease in HCCP concentration in the exposed solution was noted. It was concluded, therefore, that HCCP is light sensitive in both organic and aqueous solutions, and that the rate of decay is dependent on the intensity of the incident radiation. Next the efficiency of XAD-2 resin to extract HCCP from water was estimated by passing tap water through two cartridges containing XAD-2 resin connected in series such that the effluent from the first was passed through the second. It was concluded that the extraction of HCCP from water with XAD-2 macroreticular resin cannot be used to quantify accurately the level of HCCP in drinking water, but may be used to screen water samples qualitatively. In cases where the anticipated levels of HCCP in drinking water are high, analysis of low water volumes by solvent extraction is possible. However, the limit of detection by the organic solvent method is about 50 ng/liter, whereas with the XAD-2 method the level of HCCP in raw water which is detectable is about 0.5 ng/liter. (Baker-FRC)
W82-01819

DETERMINATION OF FREE METAL ION CONCENTRATIONS USING BIOASSAYS,

Canada Centre for Inland Waters, Burlington (Ontario); and National Oceanic and Atmospheric Administration, Ann Arbor. Great Lakes Environmental Lab.
U. Borgmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 999-1002, August, 1981. 2 Tab, 20 Ref.

Descriptors: *Trace metals, *Cooper, *Bioassay, Pollutant identification, Heavy metals, Toxicity, Metals, Aquatic life, *Copepods, Invertebrates, Chelation, Amino acids.

Trace metal levels were determined by comparing metal toxicity to copepods before and after the addition of weak complexing agents (amino acids) with known stability constants. The growth of

freshwater copepods was affected at free copper concentrations as low as the order of 10 to the minus 10th power. These trace levels are lower than those detected by any other method, including metal ion electrodes. The method is applicable to natural waters or artificial media and the decrease in growth rates or any other quantifiable response used as a measure of free metal concentration. (Cassar-FRC)
W82-01821

SIMULTANEOUS DETERMINATION OF TRACE METALS IN SEWAGE AND SEWAGE EFFLUENTS BY INDUCTIVELY COUPLED ARGON PLASMA ATOMIC EMISSION SPECTROMETRY,

Ontario Ministry of the Environment, Rexdale (Ontario). Lab. Services Branch.
M. M. Moselhy, and P. N. Vijan.
Analytica Chimica Acta, Vol 130, No 1, p 157-166, 1981. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Metals, *Wastewater analysis, *Emission spectroscopy, *Trace metals, Heavy metals, Pollutant identification, Spectroscopy, Atomic absorption spectroscopy.

Inductively coupled plasma emission spectroscopy (I.C.P.) was adapted for simultaneous determination of several trace metals in sewage and sewage effluents. Aqua regia was chosen as the reagent for sample digestion after comparisons with sulfuric-nitric and prechloricnitric acid mixtures. Correlation coefficients between the i.c.p. and atomic absorption methods were 0.979-0.999 for Cr, Pb, Fe, Ni, Cu, Zn, and Cd. Other metals determined were: Al, Ca, Co, Mg, Mn, Mo, Sr, Tl, and V. (Cassar-FRC)
W82-01828

NITRATES, CHLORATES AND TRIHALOMETHANES IN SWIMMING POOL WATER,

Florida International University, Miami. Drinking Water Quality Research Center.
J. A. Beech, R. Diaz, C. Ordaz, and B. Palomeque.
American Journal of Public Health, Vol 70, No 1, p 79-82, January, 1980. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Swimming pools, *Nitrates, *Chlorates, *Trihalomethanes, Public health, Swimming, Water quality, Human pathology, Metabolism, *Miami, Florida.

Water of selected swimming pools in the Miami area was analyzed for contaminants that might present a hazard to users, including nitrates, chlorates, and trihalomethanes. The average concentration of nitrates was 8.6 mg/liter, and of chlorates was 16 mg/liter. The average concentration of trihalomethanes in beach-front saline pools was 657 micrograms/liter, and in freshwater pools was 125 micrograms/liter. The maximum concentration of nitrate was 54.8 mg/liter, of chlorate 124 mg/liter, and of trihalomethanes 439 micrograms/liter (freshwater) and 1287 micrograms/liter (salt water). While adults can consume considerable amounts of nitrate and chlorate without ill effects, the effects of these chemicals on young infants are not clear. Because of the popularity of infant swimming class, and because of the possibility of infants and young children ingesting large amounts of water during swimming, the effects of these levels of contaminants must be studied further. The adsorption of trihalomethanes through the skin also needs study. (Small-FRC)
W82-01835

DETERMINATION OF GERMANIUM, VANADIUM, AND TITANIUM BY CARBON FURNACE ATOMIC ABSORPTION SPECTROMETRY,

Polish Academy of Science, Zabrze. Inst. of Environmental Engineering.
M. Studnicki.
Analytical Chemistry, Vol 52, No 11, p 1762-1764, September, 1980. 3 Tab, 39 Ref.

Descriptors: *Atomic absorption spectroscopy, *Germanium, *Vanadium, *Titanium, Water analysis, Chemical interference, Metals.

The determination of germanium, vanadium, and titanium by carbon furnace atomic adsorption spectrometry was investigated, with emphasis on interferences which may lead to an increase or decrease in the absorption signal. Acids were found to strongly influence the signal for all three elements. Nitric acid increased the signal of germanium, but decreased the signals of vanadium and titanium. Sulfuric acid decreased the signal of all examined elements. Phosphoric acid increased the signal of vanadium and titanium, but decreased the signal of germanium. Hydrochloric acid increased the signal of titanium and decreased the signals of vanadium and germanium. On the whole, the ammonium salts of these acids had similar effects. For all examined elements, the working range was 0.1 to 0.5 ppm, and calibration graphs were linear up to a concentration of approximately 0.4 ppm. Sensitivities were: 0.015 ppm for germanium 0.03 ppm for vanadium, and 0.09 ppm for titanium. (Small-FRC)
W82-01836

A GEL PARTITION MODEL FOR ORGANIC DESORPTION FROM A POND SEDIMENT,

Maryland Univ., College Park. Dept. of Chemistry.
D. H. Freeman, and L. S. Cheung.
Science, Vol 214, No 3422, p 790-792, November 13, 1981. 3 Fig, 24 Ref.

Descriptors: *Sediments, *Organic carbon, *Ponds, Adsoprtion, *Model studies, Gels, Chemical analysis.

A sediment model is described which expresses the natural affinity of nonpolar compounds for the relatively nonpolar polymeric component, called humin or kerogen, that is present in most sediments. Physical considerations were used to derive criteria that minimize this affinity and maximize the ease of extraction. An experiment was performed on the liquid extraction of a lipophilic compound in a simplified situation where the compound was known to be present in high concentration in an industrial pond sediment. Several experiments were conducted to attempt to distinguish between equilibrium and nonequilibrium desorption from sediment. In general, agreement was noted between the gel partition model and the hypothesized behavior of the humin-kerogen structure in sediment samples during extraction of the lipophilic solute DEHP. The model correctly predicted near-optimal extraction by dichloromethane and predicted conditions for gel concentration that were consistent with the finding of slow secondary diffusion in a nonoptimal liquid. These results indicate that partitioning or adsorption effects alone would tend to be irreversible unless the equilibrium condition is clearly demonstrated experimentally. In aqueous systems equilibrium may be particularly difficult to obtain. In attempting to desorb lipiphilic substances from sediment samples that are finely divided, it is clear that the humin-kerogen pore structure needs to be kept open by use of proper extractive conditions, including use of a suitable swelling-dissolving liquid that provides adequate diffusion rates. (Baker-FRC)
W82-01844

LOADING ESTIMATES TO LAKE ERIE, 1967-1976,

National Water Research Inst., Burlington (Ontario).
A. S. Fraser, and K. E. Willson.
Scientific Series No 120, 1981. 23 p, 10 Fig, 1 Tab, 16 Ref, 2 Append.

Descriptors: *Wastes, Discharges, *Atmospheric loading, Phosphorous, Nitrogen, Nitrate, Ammonia, Mathematical models, Great Lakes, *Lake Erie, Nutrients, Total load, *Effluents, Water pollution sources.

This report presents the author's best estimate of the loading for several chemical variables to Lake Erie. Every effort has been made to obtain original raw data as accepted by local agencies so that a truly independent assessment of loadings could be made. The raw data, once obtained, were treated uniformly to eliminate the difficulties that arise from the comparison of loads calculated by various techniques. However, because of the limitations of sampling a highly variable natural system in the environment, the results included in this study must be called estimates and hence may be subject to unknown or unaccountable errors, which make placement of confidence limits difficult. Nevertheless, the following document is presented with the belief that the results represent the most comprehensive, independent study of loadings to Lake Erie presently available. (WATDOC)
W82-01852

VARIATIONS AND MECHANISMS OF ASBESTOS FIBRE DISTRIBUTION IN STREAM WATER,

National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
H. Schreier, and J. Taylor.
Technical Bulletin, No 118, 1981. 17 p, 21 Fig, 3 Tab, 51 Ref.

Descriptors: *Minerals, *Asbestos, Concentrations, *Streams, *Basins, Surveys, Natural sources, Sources, Distribution, *Sumas River Basin, British Columbia, Washington State, Variations, Spatial, Distribution, Temporal distribution.

Asbestos fiber concentrations were determined in a ten-month study on the Sumas River in British Columbia and Washington State. Regional background levels were found to be somewhat lower than the water affected by the slide, but nevertheless the values were high, reaching concentrations of up to 10 sup 10 fibres/litre. Six stations were sampled during the major hydrologic events of the 1979-1980 season, and all showed seasonal fluctuations in asbestos concentration, some as high as four orders of magnitude. In addition, great differences in concentrations were also found between stations (10 sup 8 -10 sup 13 fibers/litre). This suggests that occasionally collected grab samples provide an insufficient data base for asbestos analysis of stream water. A laboratory settling experiment, which used stream bed sediments, was carried out to study the mechanism of transport of fibers. Evidence was produced to suggest that suspended asbestos fibers settle to the bottom in the absence of turbulence and water movement. The rate of settling decreases with time, and smaller fibers appear to remain in suspension longer than larger fibers. Some limited evidence of this process was also found in one stream station where the highest asbestos concentrations and the largest concentrations and smallest range in fiber size, during minimum streamflow. Unfortunately, this process could not be identified consistently, and particle interferences during the settling process are thought to be the cause of the more complex settling pattern of asbestos fibers. (WATDOC)
W82-01853

INTERLABORATORY QUALITY CONTROL STUDY NO. 26, ARSENIC AND SELENIUM IN WATER,

National Water Research Inst., Burlington (Ontario). Water Quality Branch.
V. Cham, and K. I. Aspila.
Report Series No 68, 1980, 12 p, 6 Fig, 6 Tab, 19 Ref, Append.

Descriptors: *Arsenic, *Silenium, *Water analysis, *Toxicity, Carcinogens, Elements, Concentrations, Data collections, Detection limits, Atomic absorption spectrometry, Pollutant identification.

An intercomparison study on the determination of arsenic and selenium in water is described. Thirty Canadian laboratories participated, and each analyzed 10 natural, spiked and distilled water samples preserved with 0.2% H2S04 in polyethylene containers. The concentration of both elements ranged from 0 to 1000 microg/L. Pooled analytical data were assessed using several statistical analyses-which included outlying tests, paired sample treatments, and ranking technique-to determine laboratory performance and bias. The majority of participants using the atomic absorption technique via atomization of hydrides produced reliable results. Based on the data from this study, this technique was assessed to be preferable to colorimetry,

atomic emission and atomic absorption using graphite atomizer because of its good sensitivity and its capability of analyzing the whole concentration range. (WATDOC)
W82-01854

STANDARD PROCEDURE FOR TESTING THE ACUTE LETHALITY OF LIQUID EFFLUENTS.

Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report No EPS 1-WP-80-1, 1980, 11 p. 4 Ref, Append.

Descriptors: *Acute toxicity, *Effluents, *Rainbow trout(Salmo gairdneri), *Bioassay, Standard methods, Lethal limit, Toxicity, Trout.

This procedure represents a simpler alternative to the test for acute toxicity described in regulations and guidelines already published by the federal government. While it has not been designed for scientific research, this procedure has been developed in the course of a number of years of laboratory experience, as well as through extensive review of available literature and consultation with a number of scientists. It has been demonstrated to be a valid test for lethality of an effluent, and allows a large number of tests to be performed under a variety of circumstances. Other tests may be developed in the future to accommodate changes in bioassay methods and best practicable wastewater treatment technology. The intent of this test is to provide sufficient standardization so that the various effluents now subject to federal regulations and guidelines can be dealt with as equitably as possible. Further information regarding techniques and equipment may be obtained from the Environmental Protection Service (EPS) Laboratories listed in the Appendix. (WATDOC)
W82-01905

NUMERICAL TAXONOMY ANALYSIS OF BACTERIA ISOLATED FROM THE COMPLETED 'MOST PROBABLE NUMBERS' TEST FOR COLIFORM BACILLI,

Maryland Univ., College Park. Dept. of Microbiology.
B. Austin, D. Hussong, R. M. Weiner, and R. R. Colwell.
Journal of Applied Bacteriology, Vol 51, No 1, p 101-112, August, 1981. 2 Fig, 4 Tab, 42 Ref.

Descriptors: *Most Probable Number test, *Coliforms, *Bacteria, *Taxonomy, Pollutant identification, Enterobacter, Lactobacillus, Water analysis, Microbiological studies.

Lactose-fermenting bacteria isolated from water, estuarine sediment, and oyster samples from Chesapeake Bay were identified and compared with results of the widely-used Most Probable Number (MPN) test for coliforms. In all, 13 phena were found. Escherichia coli, Citrobacter freundii, Klebsiella pneumoniae, Serratia liquefaciens, Serratia marcescens, Erwina herbicola, Hafnia alvei, Acinebacter calcoaceticus, and Chromobacterium violaceum were positively identified. Two phena strongly resembled Pseudomonas aeruginosa and P. fluorescens. Two phena, which did not appear to be Enterobacteriaceae, could not be identified. The large number of non-enterobacter isolates suggests that the MPN method may not be reliable for assessing the sanitary quality of water samples. Some strains of E. coli, E. herbicola, H. alvei, and non-enterobacters appeared to lose their ability to ferment lactose upon storage on laboratory media at room temperature for 6 weeks. (Cassar-FRC)
W82-01911

VARIATIONS IN TRACE METAL CONTENT OF THE MUSSEL CHOROMYTILUS MERIDIONALIS (KR.) WITH SEASON AND SEX,

National Research Inst. for Oceanography, Stellenbosch (South Africa).
M. J. Orren, G. A. Eagle, H. F-K. O. Hennig, and A. Green.
Marine Pollution Bulletin, Vol 11, No 9, p 253-257, September, 1980. 4 Tab, 21 Ref.

Descriptors: *Mussels, *Bioindicators, *Trace metals, Monitoring, Sampling, Biological samples, Iron, Copper, Lead, Cadmium, Manganese, Zinc, South Africa.

Trace metal contents of whole bodies of mussels were determined on C. meridionalis collected in June and November from intertidal pools at Bloubergstrand, near Cape Town, South Africa. The mussels in the area had fairly low concentrations of trace metals when compared to those from other areas, but were similar to results obtained for C. meridionalis and Perna perna by other workers at unpolluted sites in the vicinity. In males, copper, iron, lead, zinc, and manganese increased significantly from June to November. In females, iron, lead, cadmium, copper, and zinc increased significantly. This seasonal variation may be due to phytoplankton productivity and the availability of food, or to the effect of temperature on the rate of excretion. Because of the differences found in sexes, for monitoring purposes, only sexually immature animals should be used. Rigid standardization of mussel sampling procedures for use as water quality indicators is needed. (Small-FRC)
W82-01969

WATER QUALITY INDICES: AN ADDITIONAL MANAGEMENT TOOL,

Middlesex Polytechnic, London (England).
For primary bibliographic entry see Field 5G.
W82-01994

ION FLOTATION-SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF CHROMIUM (VI),

Tokyo Metropolitan Univ (Japan). Dept. of Industrial Chemistry.
M. Aoyama, T. Hobo, and S. Suzuki.
Analytica Chimica Acta, Vol 129, p 237-241, August, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Metals, *Water pollution control, Natural waters, *Pollutant identification, Pollutants, *Chromium, Monitoring, Industrial wastes, Chemical analysis, Water analysis, Spectrophotometry, Flotation, Separation techniques.

The usefulness of diphenylcarbazide (DPCI) as a selective collector for chromium has been investigated. Optimum conditions are described for the flotation of chromium(VI) in batch and continous experiments. The proposed method is rapid and applicable to the determination of chromium(VI) at microgram/liter levels. For batch flotation enough sulfuric acid was added to a 1 liter sample containing 3-70 micrograms of chromium(VI) to make the acidity 0.1 M. After adding 5 ml of 1% DPCI solution and shaking for 5 min, the solution was transferred to the separation tube. Nitrogen was passed at a flow rate of 105 ml/min into the tube and 1% sodium lauryl sulfate (SLS) solution was pumped into the tube at a flow rate of 0.54 ml/min. The foam coming out of the separation tube was collected for 20 min in the foam collector which contained 0.5 ml of n-butanol. The subsided foam solution was transferred to a 50-ml volumetric flask and diluted to the mark with water. Absorbance was measured at 540 mm, using water as reference. The procedure for continuous flotation is also described. During batch flotation studies the effects of diverse ions on the flotation of Cr(VI) were investigated, and it was determined that only a few ions interfered. Even so, Cr(VI) in the sample is measured. If this system were connected with a continous photometric detector, a good pollution monitoring system would be realized. (Baker-FRC)
W82-02007

ON SITE CONTINUOUS LIQUID-LIQUID EXTRACTION OF NONPOLAR ORGANIC COMPOUNDS IN WATER,

Bremen Univ. (Germany, F.R.). Dept. of Chemistry.
B. Stachel, K. Baetjer, M. Cetinkaya, J. Dueszeln, and U. Lahl.
Analytical Chemistry, Vol 53, No 9, p 1469-1472, August, 1981. 6 Fig, 4 Tab, 7 Ref.

Descriptors: *Insecticides, *Water analysis, Pollutant identification, *Weser River, *Germany, Pesticides, Lindane, Hexachlorobenzene, Hexachlorocyclohexane, Chlorinated hydrocarbons.

The Ahnoff and Josefsson apparatus for determining pesticides in water by continuous liquid-liquid extraction was modified by installation of an electronically directed water level regulator. Analysis of 500 liter water samples using from the Weser River, Federal Republic of Germany, using this method of concentration and gas chromatography gave the following results: alpha-1,2,3,4,5,6-hexachlorocyclo-hexane (alpha-BHC), 3.3 ng per liter; lindane (gamma-BHC), 11.6 ng per liter; hexachlorobenzene (HCB), 0.4 ng per liter; and beta-BHC, not detected. Detection limits (in ng per liter) were: 0.2, 0.5, 0.2, and 0.7, respectively. Laboratory studies of added pesticides gave the following recoveries: alpha-BHC, 77.0%; lindane, 73.8%; and alpha-BHC plus HCB, 44.7%. (Cassar-FRC)
W82-02008

MEASUREMENT OF HEAVY WATER CONCENTRATION WITH A DENSITY METER,

National Inst. of Radiological Sciences, Chiba (Japan). Div. of Environmental Health.
Y. Inoue, K. Tanaka, and Y. Kasida.
Analyst, Vol 106, No 1263, p 609-619, June, 1981. 8 Fig, 5 Tab, 6 Ref.

Descriptors: *Water analysis, *Deuterium, Measuring instruments, Density, Density meter, Heavy water, Water treatment.

The applicability of a high-sensitivity density meter was investigated for the determination of the deuterium content of water, the determination of the separation factor, alpha, in the electrolytic enrichment process for deuterium, and to remove the drawbacks associated with conventional methods of density measurement. The effects of temperature and solute impurities on the method were investigated and the purification of water by sublimation and anion-exchange techniques were examined as a means of overcoming the latter. The methods, using a high-sensitivity density meter, proved applicable to the accurate determination of levels of deuterium in water samples above 0.1 mol-%. Electrical conductivity or specific resistance proved to be a good measure of the purity of the water to be used for the densitometry. Purification of the water to a specific resistance value was achieved easily using a combination of anion exchange and sublimation procedures. These techniques are relatively simple and rapid in comparison with conventional purification methods and the time required for the purification may be shortened by as much as 5 hr per sample. The simultaneous handling of many samples was easy to achieve. The density meter allowed density measurements to be completed within 10 min. In general, this method was superior to the conventional methods with respect to sample size, measuring time, sensitivity and accuracy. (Baker-FRC)
W82-02009

ON THE PRESENCE OF FECAL STEROIDS IN SEDIMENTS FROM TWO MEXICAN HARBORS,

Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias del Mar y Limnologia.
R. L. Fscalona, M. T. L. Rosales, and E. F. Mandelli.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 289-295, 1980 2 Fig, 2 Tab, 13 Ref.

Descriptors: *Aquatic environment, Wastes, *Contamination, *Harbors, Sediments, Feces, Water pollution, Coastal waters, Coasts, Estuaries, Marine sediments, Wastewater, Microorganisms, Bacteria, Bioindicators, *Wastewater, *Mexico.

Samples of sediments from two coastal cities in Mexico were analyzed for coprostanol and cholesterol to determine the degree of sewage pollution in the two areas. Coprostanol concentrations ranged from 0.006 to 0.44 parts per million in the Veracruz harbor. These are relatively low ocncen-

trations and indicate the absence of direct sewage discharges from the city. Unreported sewage outfalls from shipyards are believed to be the major source of fecal pollution. Concentrations were significantly higher in Mazatlan, ranging from 0.020 to 0.20 parts per million. Mazatlan discharges a high percentage of untreated sewage into the harbor. (Titus-FRC)
W82-02012

AN ANALYSIS OF THE AQUATIC MACROPHYTE, MYRIOPHYLLUM EXALBESCENS, AS AN INDICATOR OF METAL CONTAMINATION OF AQUATIC ECOSYSTEMS NEAR A BASE METAL SMELTER,

Department of Fisheries and Oceans, Winnepeg (Manitoba). Freshwater Inst.
W. G. Franzin, and G. A. McFarlane.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 597-605, 1980. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Aquatic organisms, *Ecosystems, *Contamination, *Trace metals, *Bioindicators, Tissue analysis, Macrophytes, Lakes, Aquatic environments, Physical properties, Chemical properties, Vegetation, Environmental effects, Industrial wastes, Water pollution.

The suitability of Myriophyllum exalbescens as an indicator of metal contamination in aquatic ecosystems was tested. Metal concentrations of samples of the species populations in six lakes with a range of metal contamination in water and sediment were analyzed. Prepared plant samples were analyzed for iron, manganese, lead, copper, cadmium, and zinc by flame atomic absorption spectrophotometry. Comparison of plant metal concentrations with the metal concentrations in lake waters and sediments showed that a fair correspondence existed only for zinc. This result, coupled with observations of year to year variance in plant metal concentrations, suggests that aquatic plants are unreliable indicators. (Titus-FRC)
W82-02016

DETECTION OF ORGANOPHOSPHATE INSECTICIDE BY AN IMMOBILIZED-ENZYME SYSTEM,

Visva-Bharati Univ., Santiniketan (India). Dept. of Zoology.
S. Bhattacharya, C. Alsen, H. Kruse, and P. Valentin.
Environmental Science and Technology, Vol 15, No 11, p 1352-1355, November, 1981. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Organophosphorus pesticides, *Enzymes, *Insecticides, Pollutant identification, Parathion, Carbaryl, Pesticide residues, Water analysis, Trace levels.

Low levels of organophosphate insecticides were detected in water samples using acetylcholinesterase covalently bound to poly(maleic anhydride) on a Celite 545 column. The second-order rate constant for paraoxon (10 to the minus 7th power M) was within the range of that found in a stirred suspension, but a significant increase in the rate constant was seen at paraoxon concentrations of 10 to the minus 8th to 10th powers M. Reactivation by obidoxime confirmed that the enzyme inhibition effect was caused by an organophosphate. All concentrations of carbaryl-paraoxon mixtures showed a decrease in rate of inhibition on the column. (Cassar-FRC)
W82-02025

EXPERIENCE WITH A SIMPLE METHOD FOR THE BIOLOGICAL EVALUATION OF SURFACE WATER QUALITY,

Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
Th. G. N. Drescher, and H. van der Mark.
Hydrobiologia, Vol 71, No 1/2, p 169-173, May, 1980. 1 Tab, 19 Ref.

Descriptors: *Bioindicators, *Saprobity, *Water quality, *Pollutant identification, Surface water, Water analysis, Algae, Ciliates, Euglenophyta, Chlorococcales, Diatoms, Peridinium, Chrysophyta, Conjugales.

The simple method for the evaluation of saprobity in surface water, published by the authors in 1974 and 1976, is discussed. It was designed for use by water and sewage treatment laboratories and requires identification of a number of groups rather than species. Organisms in four groups are identified and their presence used in a formula to calculate the saprobic quotient, which ranges from -3 for very severe pollution with many organic substances to +3 for very slight pollution with few organic or inorganic substances. Group A comprises Ciliates (indicators for polysaprobity); Group B, Euglenophyceae (indicators for alphamesosaprobity); Group C, Chlorococcales and Diatoms (indicators for beta-mesosaprobity); and Group D, Peridineae, Chrysophyceae, and Conjugales (indicators for oligosaprobity). This method cannot be used satisfactorily when surface water contains a bloom of an organism, during cold weather, and under turbid water conditions. Sampling should be done away from a bank and at a depth of 50 cm. (Cassar-FRC)
W82-02029

TURNOVER OF TRITIATED WATER IN CALAMONDIN PLANTS,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
A. Mantell, E. E. Goldschmidt, and S. P. Monselise.
Journal of the American Society for Horticultural Science, Vol 105, No 5, p 741-744, September, 1980. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Plant populations, *Water requirements, Absorption, Nutrients, Calamondin plants, Transpiration, *Fruit crops, *Radioactivity, Tritium.

The relative water turnover was investigated in the vegetative and reproductive parts of calamondin plants as affected by different environmental conditions. The plants used were about 3 yr old and 40 cm tall, with fruit at different stages of development. Uptake measurements were made using tritium-labeled nutrient solution. The turnover was much greater in vegetative tissue than in the fruit. Even after three days, the radioactivity of water in the fruit, relative to that in the solution, did not reach 20% compared with about 60% in the leaf tissue. The radioactivity of water in pedicel reached 60%, similar to that in leaf tissue. Decay of radioactivity in fruit was considerably slower than in other organs when the plant was transferred from a labelled to a non-labelled solution. The turnover of water in fruit was extremely slow even when transpiration was increased by exposing the entire plant or the fruit alone to a stream of dry air. Defoliation of fruit-bearing branches decreased the entry of water into fruit tissues. The availability of water for fruit growth in view of the competition offered by the leaves is discussed. (Baker-FRC)
W82-02048

ISOLATION OF THE MYCOBACTERIUM AVIUM-M. INTRACELLULARE-M. SCROFULACEUM COMPLEX FROM TANK WATER IN QUEENSLAND, AUSTRALIA,

Chest Clinic, Brisbane (Australia).
R. E. Tuffley, and J. D. Holbeche.
Applied and Environmental Microbiology, Vol 39, No 1, p 48-53, January, 1980. 1 Fig, 5 Tab, 35 Ref.

Descriptors: *Bacteria, *Water tanks, Human diseases, Fitzroy River, Rivers, Queensland, *Australia, Mycobacterium, Cultivated lands, Agriculture, Cropland, *Rainwater.

The isolation of mycobacteria is reported from 67 of 205 rainwater tanks in three areas of Queensland. M. intracellulare was a comon isolate, and representatives of eight disease-related serotypes were found. Organisms of the MAIS complex and M. gordonae were the most frequent isolates. Rapid growers were found in two tanks near Rockhampton, whereas the M. terrae-M. triviale-M. nonchromogenicum complex was isolated occasionally in the Fitzroy basin. No M. simiae were found. Mycobacteria were recovered from 7 of the 32 tanks sampled repetitively from the city of Toowoomba. All three isolates of M. intracellulare occurred after the heavy summer rainfall in January. M. intracellulare and M. gordonae were the principal isolates recovered from 7 and 9 of the 32 tanks sampled, respectively, in Rockhampton Hinterland. Mycobacteria were isolated from 46 of the 141 tanks sampled in the Fitzroy Basin. The presence of plowed land did not appear to influence the isolation rate of M. intracellulare on rural holdings, but small towns set in virgin bushland had a significantly lower isolation rate for M. intracellulare than did those with adjacent cultivation. The results of serotyping 30 isolates in the MAIS complex indicated that the commonest serotype was serotype 23, which was found in nine separate tanks, five of these being obtained from one area where cultivation extends for 50 km in a strip 5 km wide. Humans who consume the contaminated tank water are free of symptoms, but none have been medically examined. It is suggested that mycobacteria adhering to dust particles disturbed mechanical cultivation may be the source of contamination. (Baker-FRC)
W82-02069

USE OF KNOPP'S METHOD TO ASSESS SELF-PURIFICATION PROCESSES IN WATER BODIES AND WATER COURSES,

Byelorussia Univ., Minsk (USSR). Experimental Biological Special Topics Research Lab.
For primary bibliographic entry see Field 5B.
W82-02073

THE USE OF LEECHES TO IDENTIFY PESTICIDES IN WATEP,

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
L. N. Lapkina, and B. A. Flerov.
Hydrobiological Journal, Vol 16, No 3, p 78-83, 1980. 7 Fig, 2 Ref.

Descriptors: *Water analysis, *Pesticides, Agricultural chemicals, Chemical analysis, Bioassay, *Leeches, Toxicity, Organophosphorus compounds, Organochlorines, Organic pesticides, Bioindicators, *Pollutant identification.

Leeches of the family Hirudinidae were placed in glass jars with screw caps containing at least 200 ml of water per leech. Leeches were thus exposed to chlorophos, carbophos, rogor, sevin, polychloropinene, and lindane. Also tested were three pharmacological preparations: eserine, proserine, and armine. It is noted that the symptom of the toxic action of chlorophos and PCP on different species of leech indicates the possibility of using members of this class of worms to detect the presence of particular substances in water. The sensitivity and rapidity of this method of analysis differ in relation to the specific poison being studied and the species used. A poison concentration of 0.1 mg/l causes specific bending under of the hind segments in the medicinal leech within 40 min in sevin solutions, 3.5 hr in armine, and 27.5 hr in chlorophos. Deeper stages of intoxication, including shortening of the body, opening of the pharynx, phasic increase, and decline of mass are not reached under the effect of sevin and chlorophos at this concentration, but in armine solutions they are manifested within 7-8 hr. An increase of sevin concentration to 1 mg/l and of chlorophos to 0.3 mg/l leads to the manifestation of poisoning symptoms and to more rapid poisoning. The sensitivity of this method of analysis is of interest when compared with that of other methods of analysis for these contaminants in water. (Baker-FRC)
W82-02075

5B. Sources Of Pollution

SEDIMENT-CONTAMINANT TRANSPORT MODEL,

Battelle Pacific Northwest Lab., Richland, WA.
Y. Onishi.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107,

No HY9, p 1089-1107, September, 1981. 10 Fig, 20 Ref.

Descriptors: *Kepone, *Sediment transport, Sediment deposition, *Path of pollutants, Pesticides, Insecticides, Adsorption, *James River, Virginia, Model studies, Rivers, Suspended sediments, FETRA model.

An unsteady two-dimensional element model, FETRA, was developed to simulate sediment and pollutant transport in rivers and estuaries. It includes sediment/contaminant interactions such as adsorption and desorption of contaminants; and transport, deposition, and resuspension of contaminated sediments. The model handles three sizes of sediment separately. The sediment transport submodel includes mechanisms of: (1) advection and diffusion/dispersion of sediments; (2) fall velocity and cohesiveness, (3) deposition on the river bed, (4) erosion from the river bed, and (5) sediment contributions from point/nonpoint sources and subsequent mixing. The migration of sediment and the pesticide kepone, deposited in the James River Estuary, Virginia, in the early 1970s was simulated. During calibration the model was adjusted until total sediment concentrations at maximum ebb, slack tide, and maximum flood for a net fresh water river discharge of 58.3 cu meters per sec at River Mile 76 were reproduced. The model was verified for a net fresh water discharge of 247 cu meters per sec. The computed dissolved kepone concentrations were 0.0048-0.0084 micrograms per liter and the total kepone concentration, 0.007-0.017 micrograms per liter, with peak liter and the total kepone concentration, 0.007-0.017 micrograms per liter, with peak concentration at River Mile 48 at the maximum flood tide. The model suggests that suspended sediments carry 12-53% of the total kepone being transported, while 47-88% is dissolved. Over a tidal cycle the average kepone concentration was 0.0076 micrograms per liter, indicating that 14.0 kg of kepone is transported toward Chesapeake Bay each year at a fresh water discharge of 58.3 cu meters per sec. (Cassar-FRC)
W82-01614

MATACIL RESIDUE DETERMINATION IN FOLIAGE, FISH, SOIL AND WATER,

Mobay Chemical Corp., Kansas City, MO. Div. of Agricultural Chemicals.
For primary bibliographic entry see Field 5A.
W82-01621

INFLUENCE ON GROUNDWATER FROM THE BERMED INFILTRATION POND,

Dorchester County Health Department, Cambridge, MD.
For primary bibliographic entry see Field 5D.
W82-01622

NITROUS OXIDE EMISSION FROM SIMULATED OVERLAND FLOW WASTEWATER TREATMENT SYSTEMS,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5D.
W82-01624

NITRATE REDUCTION TO AMMONIUM AND ORGANIC NITROGEN IN AN ESTUARINE SEDIMENT,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. J. Buresh, and W. H. Patrick, Jr.
Soil Biology and Biochemistry, Vol 13, No 4, p 279-283, 1981. 4 Tab, 17 Ref.

Descriptors: *Estuarine environment, *Chemical reactions, *Nitrogen, Nitrates, Ammonia, Sediments, Fate of pollutants, *Estuarine environment.

The probable magnitude of conversion of nitrate to ammonium and organic nitrogen in a flooded estuarine sediment was investigated. Sediment covered by a layer of water was incubated in unsealed containers open to the air. Nitrate was added to the overlying water of the sediment-water systems in order to simulate the fate of nitrate entering an anaerobic sediment zone from the overlying water column and aerobic sediment layer. The reduction of nitrate in nature is presumably better represented by this type of incubation technique than by one employing an inert gas atmosphere. In order to determine what effect the intensity of reduction has on nitrate reduction the influence of redox potential on nitrate reduction to ammonium was also investigated. Estuarine sediment was obtained with a Peterson dredge from the bottom of a shallow lake in coastal Louisiana. Total N content, total C content, and pH of the sediment were 0.52, 7.8, and 7.4%, respectively. Water salinity and pH in the lake from which the sediment was obtained were 20 mg/ml and 7.8, respectively. The study showed that after the addition of labelled nitrate to the sediment-water systems the quantity of labelled organic N continually increased with time, whereas labelled ammonium-nitrogen initially increased more rapidly, but then decreased. These trends suggest that at least some labelled ammonia formation preceded production of labelled organic nitrogen. Dissimilatory reduction of nitrate to ammonia and subsequent incorporation of the ammonia into organic matter was the probable mechanism for the formation of labelled ammonia and organic nitrogen. The results of the study suggest that only about 15% of the nitrate reduced in the examined estuarine sediment was reduced to ammonia and recycled in the sediment. (Baker-FRC)
W82-01625

A GRAPHICAL APPROACH TO PREDICTION OF GROUNDWATER POLLUTANT MOVEMENT,

North Carolina State Univ. at Raleigh. Dept. of Marine Earth, and Atmospheric Sciences.
C. W. Welby.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 237-243, August, 1981. 8 Fig, 8 Ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Waste disposal, *Flow nets, Landfills, Model studies, Geohydrology, Mathematical studies, Graphical methods, Leachates, Graphical analysis, Flow pattern, Fate of pollutants, Water pollution effects, Prediction, Groundwater pollution.

In analyzing a potential or actual groundwater pollution problem, it is important to accurately estimate when and where the contaminant may come into contact with the biological realm and the amounts that may appear at an outflow boundary over a period of time. Geography-time distributions and geography-quantity distributions are useful aids in making decisions concerning waste disposal processes. A method using contour maps and simple graphs and based on flow net and vector analyses allows for prediction of pollutant arrival times at an outflow boundary and variations of pollutant concentrations across that boundary in space and with time. Macro- and megascale aspects of groundwater pollution may be studied with this procedure. The technique may be applied to problems of potential groundwater pollution by sanitary landfill leachate, leaks from waste-holding ponds, or leaks from underground gasoline storage tanks. The present method may also be used in reconnaissance studies for evaluating hazardous waste sites using available hydrogeologic data. In addition, the method can be used for site evaluation and for the prediction of long-term downstream effects of contaminant leakage from a disposal site. (Geiger-FRC)
W82-01634

PERSPECTIVE ON MANAGEMENT AND DISPOSAL OF HAZARDOUS WASTES,

North Carolina State Univ. at Raleigh. Dept. of Marine Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 5E.
W82-01635

TEMPORAL AND SPATIAL VARIATIONS OF MERCURY, LEAD, ZINC, AND COPPER IN SEDIMENTS OF THE SAGUENAY FJORD,

Laval Univ. (Quebec). Dept. of Chemistry.
C. Barbeau, R. Bougie, and J-E. Cote.
Canadian Journal of Earth Sciences, Vol 18, No 6, p 1065-1074, June, 1981. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Sedimentation rates, *Heavy metals, *Fjords, Canada, Mercury, Lead, Zinc, Cores, *Saguenay Fjord, Quebec.

This paper examines trace metal contents of core sediments taken in the Sanguenay fjord in relation to the dating provided by cesium-137 and the industrial and geological events up to 1978. Core sediment samples were taken in 1976 and 1978. The upper part of most cores contained high concentrations of mercury and decreasing concentrations of lead and zinc. The thickness of mercury-enriched sediments varied from high in the northern basin to low in the southern and intermediate basins, with an increase in the western basin. Except for the increased consumption of gasoline after the Second World War, there is no chronological mark related to lead in the Saguenay region. The pre-1940 period is characterized by an average concentration of 17 microg/g of lead, with the highest values close to 40 microg/g. Post-1940 concentrations are of an average 45 microg/g. The narrow range of concentration and the average values of 85 and 21 microg/g for zinc and copper in pre-1940 sediments indicate that not much enrichment of the sediments took place before 1940. The enrichment factor during the post-1940 period is identical for both elements, but much smaller than for lead. It was concluded that the northern basin of the fjord holds most of the anthropogenic material, but the accumulation rates and loadings vary significantly inside the basin. More than 50% of the sediments settle in the southern part of the basin. Material from the 1971 Saint-Jean-Vianney landslide is present in most parts of the basin and has modified the quality of sediments until at least 1976. Mercury input is below 0.5 microg/g in fresh sediment since 1970. (Baker-FRC)
W82-01639

COOLING POTENTIAL OF MISSOURI RIVER IN MISSOURI,

Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY11, p 1813-1825, November, 1980. 3 Tab, 4 Fig, 7 Ref. OWRT-B-061-IA(3).

Descriptors: *Rivers, *Thermal properties, *Cooling, *Electric powerplants, Effective capacity, Temperature effects, Water temperature, Water cooling, Condensers, Powerplants, Ecology, Energy, Climatic data, Flow, Thermal capacity, Reservoirs, *Missouri River, Missouri.

The steady-state Iowa Thermal Regime model was used to determine the thermal regimes of the Missouri River along a study reach corresponding to average meteorological and hydrological conditions for one month of each of the four seasons. The natural and modified thermal regimes resulting from the imposition of external heat loads from power plants and other sources are calculated. Results are shown in the form of temperature distributions along the river for the cases of both existing power plants and power plants proposed for installation within the next decade. Based on the existing thermal standards of the state regulatory agencies, the remaining heat assimilation capacity of the river is computed, and sites and capacities of future permissible once-through-cooled power plants of a reasonably large size are determined. The resultant temperature distributions corresponding to these future permissible plants are also presented. No remaining heat assimilation capacity in the vicinity of Kansas City exists. No additional power plants upstream from Kansas City could be installed because of their downstream effects. At the low flow conditions, some existing and proposed power plants can violate the excess temperature limitation if they operate at full load. The total future permissible plant capacity, based on low flow conditions, is about 1300 NW for fossil-fueled plants. (Titus-FRC)
W82-01654

PERIPHYTIC COMMUNITY RESPONSE TO CHRONIC NUTRIENT ENRICHMENT BY A RESERVOIR DISCHARGE,

Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 5C.
W82-01658

SEDIMENT BACTERIAL INDICATORS IN AN URBAN SHELLFISHING SUBSTUARY OF THE LOWER CHESAPEAKE BAY,

Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W82-01661

NUTRIENT RUNOFF FROM AGRICULTURAL AND NON-AGRICULTURAL WATERSHEDS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
M. D. Smolen.
Transactions of the ASAE, Vol. 24, No. 4, p 981-987, July/August, 1981. 4 Fig, 5 Tab, 15 Ref. OWRT-A-058-VA(4).

Descriptors: *Watersheds, *Nutrient removal, Nitrogen, Phosphorus, Leaching, Rainfall, Land use, Farming, *Agricultural runoff.

This study was designed to assess changes in the nitrogen and phosphorus content of stream water attributable to agricultural cropping activity. The background nutrient content was examined as represented by the non-agricultural control watershed. While sediment is considered important, it was not measured directly. Three adjacent watersheds at the Institute near Blackstone, Virginia were selected for hydrologic and water quality monitoring. They had been out of agricultural production for the preceding 35-40 years. In 1975 and 1976 corn and grasses were planted over large areas. Most fertilizer applications occurred during these two years. In subsequent years most of the fertilizer was associated with small plot research. The findings of the study indicate that agricultural activity caused a significant increase in nitrogen and phosphorus concentration and yield. Spring and fall nitrogen and phosphorus peak concentrations occurred earlier in the treated watershed and paralleled the timing of cultural activity. Background water quality, as represented by the control watershed, showed extremely low inorganic nitrogen content. Although there was a 2.5 to 3-fold increase in total phosphorus content in the treated watershed, there was little increase in soluble orthophosphate concentration. Essentially all of the excess phosphorus attributable to agricultural cropping activity was found in the organic and particulate bound fraction, which may be amenable to control by soil conservation practices. Mass balance of the inorganic nitrogen input to the watersheds from rainfall and the export of total nitrogen in streamflow suggests that the control watershed was very nearly in equilibrium with respect to nitrogen. (Baker-FRC)
W82-01662

WATERSHED CONSTITUENT LOADING ANALYSIS UTILIZING EMPIRICAL HYDROCHEMICAL MODELING TECHNIQUES,

Utah State Univ., Logan.
J. S. Fifield.
PhD Dissertation, 1980. 230 p, 26 Fig, 22 Tab, 65 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-05104.

Descriptors: *Watersheds, *Model studies, Salts, Chemistry, Colorado River, *Salinity, *Dissolved solids, Path of pollutants, *Salt loading, Stream loading, Hydro-chemical models, Basin constituents.

In studying the hydrochemical characteristics of a watershed, a valuable tool available to engineering lies in utilization of computer models. One stochastic, one lump parameter and 13 deterministic models were reviewed and analyzed for technique, assumptions, data requirements and ability to simulate the hydrology and chemical system of a basin. In order to obtain sufficient chemical data at a low cost, it was proposed that complex chemical agorithms might be adequately represented by the results of empirical analysis that utilize only stream quantity and quality data. Concluding that complex algorithms can be adequately represented by the results of empirical analysis resulted in the modification of a hydrologic model to a hydrochemical model. The modified deterministic model was calibrated on 80,200 acres of the Grand Valley, Colorado. Subsequent management runs indicate that only a net minimal reduction of salt loading to the Colorado River will be realized by lining canals, laterals and ditches whereas substantial reduction will result upon increased farm efficiency and/or reduction of spills. When optimal management conditions are met, sulfate will decrease the most and potassium the least. A reduction in the amount of data needed to perform basin with hydrochemical research of salt loading to a stream is realized thus resulting in lower costs for calibration and management studies utilizing deterministic models. (Sinha-OEIS)
W82-01676

BIOLOGICAL AND PHYSICAL INVESTIGATIONS OF BODIES OF WATER BENEATH DENSE WATER HYACINTH POPULATIONS BEFORE AND AFTER CHEMICAL TREATMENT,

Florida Univ., Gainesville. Dept. of Botany.
W. W. Brower, II.
PhD Dissertation, 1980. 277 p, 122 Fig, 5 Tab, 23 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX 81-05560.

Descriptors: *Water quality, *Aquatic weeds, *Herbicides, Water hyacinth, Chemical treatment, *Ponds, Weed control, Eichhornia crassipes.

Dense infestations of water hyacinths or other free-floating, mat-forming aquatic weed species, dramatically affect the water quality below them. Hyacinth mats were chemically treated with 2,4-D, which proved to be an efficient means of aquatic weed control. After chemical teatment, floating mats of dying hyacinths were persistent on the pond surfaces for several months. Water quality under the decaying mats was worse than under actively growing hyacinths. Phytoplankton and zooplankton populations were much reduced while the periphyton diatom populations were variable. Open water conditions were established approximately six months after herbicide application, and water quality slowly improved. Phytoplankton populations were large after hyacinth treatment and disappearance, being mostly composed of blue-green algae, but with occasional large seasonal green algae populations. Periphyton diatom populations increased in both the pond surfaces and depths. Zooplankton populations were reduced after open water conditions were established and were largely composed of various rotifers and crustaceans. Sedimentation was 5.8 times greater after herbicide application. (Sinha-OEIS)
W82-01678

GEOGRAPHIC VARIATIONS IN WATER QUALITY AND RECREATIONAL USE ALONG THE UPPER WALLOWA RIVER AND SELECTED TRIBUTARIES,

Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 5A.
W82-01681

TOXIC SUBSTANCES IN WATER: PATTERNS OF CONTAMINATION AND POLICY IMPLICATIONS,

Rutgers - the State Univ., New Brunswick, NJ.
For primary bibliographic entry see Field 5A.
W82-01695

ECOLOGICAL AND PHYSIOLOGICAL FEATURES OF THE ROOT SYSTEM OF INSHORE HYDROPHYTES,

Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
N. N. Smirnova.
Hydrobiological Journal, Vol 16, No 3, p 38-48, 1980. 106 Ref.

Descriptors: *Self-purification, *Aquatic plants, *Swamps, Wetlands, *Hydrophytes, Calcium, Potassium, Nitrogen, Phosphorus, Metabolism, Roots, Nutrients, Eutrophication, Water quality, Literature review, Hydrobiology, Fate of pollutants, Nutrients.

Data concerning anatomy, morphology and metabolism peculiarities of higher aquatic plants and their root systems was analyzed. The structural functional features of the plants' growth under different ecological conditions are studied. In contrast to terrestrial plants, the root system of hydrophytes is permanently located in a bottom material that is supersaturated or inundated with water. Among the higher water plants there have been appreciable phylogenetic changes of anatomical and morphological structure, especially in the root system. Inshore hydrophytes are a transitional form between land plants and true hydrophytes, and consequently their anatomical and morphological structure has typical attributes of both. The specific habitat of aquatic and swamp plants has promoted the development of anatomical and morphological features, ensuring the normal gaseous metabolism of the root system with receipt of sufficient oxygen from the atmosphere by the subterranean organs. The self-purification of water bodies results from physicochemical processes and from the activity of hydrobionts. The absorbing capacity of higher water plants is most important in this regard. The absorbing function of the root system is expressed to different degrees in highly hydrophilous plants in relation to the chemical nature of the water and the reserves of nutrients in the bottom deposits. The most important chemical elements for determining the degree of eutrophication of water bodies, such as nitrogen, phosphorus, potassium, and calcium, may be removed from circulation in a water body for a fairly long time by means of reeds, reedmance, bulrushes, and reed sweetgrass. The subaerial portion of the plant biomass may be harvested at the end of the growing season, thus removing these chemicals more completely. (Baker-FRC)
W82-01715

FORMATION OF WATER QUALITY IN THE IRTYSH-KARAGANDA CANAL,

Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
O. P. Oksiyuk, G. N. Oleynik, G. B. Tulepova, A. N. Timerkayeva, and E. G. Belobaba.
Hydrobiological Journal, Vol 16, No 3, p 31-38, 1980. 7 Fig, 9 Ref.

Descriptors: *Canals, *Water quality, *Bacteria, *Aquatic plants, Nitrogen, Organic matter, Minerals, Plankton, Water pollution sources, Aquatic life, Water conveyance, Water transfer, *Irtysh-Karaganda Canal, *USSR, Diversion channels.

The Irtysh-Karaganda canal was constructed to convey water to the industrial regions of the dry area of Central Kazakhstan. Its source of water is the Belaya River, an arm of the Irtysh. The overall length of the canal is 457 km. The canal is intended to receive local runoff, the bulk of which enters it during the flood period. The canal and its reservoirs are intensively overgrown with higher water plants, forming a large phytomass and appreciably affecting water quality. Monthly data on hydrochemical, bacteriological and hydrobiological indices covering a two-year period at fixed observation points along with the results of an expedition study in July 1977-1979 provided material for this study on water quality formation along the canal. In the spring, permanganate oxidizability (PO) is mainly attributable to the local runoff entering the canal at flood time. Values are especially high in the middle part of the canal. After the water has passed through the reservoirs PO increases, and it continues to increase to the end of the canal. The water in the canal is gradually enriched with organic matter in July, with evidence indicating an increase in bichromate oxidizability as the water passes through the reservoirs and comes to the end of the canal. The concentration of ammonia nitrogen in the canal water is low. The dynamics of mineral forms of nitrogen in the canal are not uniform. In the first third of the canal the abundance of bacterioplankton is slightly reduced, but after the reservoirs it increases to the level on entry. The quantity of heterotrophic bacteria in

flood water varies widely. Distribution of bacteria of the E. coli group and the distribution of dry residue are considered briefly. (Baker-FRC)
W82-01716

DISTRIBUTION OF VIBRIO PARAHAEMOLYTICUS IN FINFISH HARVESTED FROM PORTO NOVO (S. INDIA) ENVIRONS: A SEASONAL STUDY,

Center of Advanced Study in Marine Biology, Porto Novo (India).
For primary bibliographic entry see Field 5A.
W82-01737

EFFECTS OF A CATTLE FEEDLOT ON GROUND-WATER QUALITY IN THE SOUTH PLATTE RIVER VALLEY NEAR GREELEY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Borman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-224321, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-83, 1981. 78 p, 14 Fig, 10 Tab, 19 Ref.

Descriptors: Water quality, *Groundwater pollution, Water pollution sources, *Feedlots, *Farm wastes, *Cattle, Nitrates, Leachate, Percolation, Observation wells, Water table, Chemical analysis, *Colorado, South Platte River valley.

Changes in water quality in an alluvial aquifer resulting from the operation of a feedlot stocked with 90,000 cattle have been minimal. Monitoring water quality in 19 observation wells from April 1974, prior to the operation of the feedlot, to June 1978, after about 4 years of operation, indicates that chloride concentrations have increased slightly in one well downgradient from a runoff-retention pond. Chemical analyses of water from two lysimeters installed in the unsaturated zone indicate that leachate from the feedlot has percolated to a depth of at least 5 feet but has not percolated to a depth of 20 feet. The small changes in groundwater quality caused by the feedlot are likely the result of the limited available recharge, a relatively impermeable manure pack, soil clogging under the cattle pens resulting in slow vertical movement of leachate through the unsaturated zone, soil clogging under the unlined runoff-retention ponds, and denitrification in the unsaturated zone. (USGS)
W82-01790

QUALITY OF WATER AND TIME OF TRAVEL IN PART OF TILLATOBA CREEK BASIN, MISSISSIPPI, OCTOBER 1974 TO SEPTEMBER 1980,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01791

PERSISTENCE OF 3-(TRIFLUOROMETHYL)-4-NITROPHENOL IN AQUATIC ENVIRONMENTS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. A. Thingvold, and G. F. Lee.
Environmental Science and Technology, Vol 15, No 11, p 1335-1340, November, 1981. 6 Fig, 1 Tab, 30 Ref.

Descriptors: *3-(Trifluoromethyl)-4-nitrophenol, *Fish management, *Degradation, Lamprey, *Great Lakes, Pesticides, *Larvicides, Fate of pollutants, Microbial degradation, Phenols, Organic compounds, Lakes, Aquatic environment.

A sea lamprey larvicide, 3-(trifluoromethyl)-4-nitrophenol (TFM), did not degrade chemically or microbially in sediment-free water over an 80 day test period in the laboratory. Added since 1958 to tributaries of the Great Lakes, the chemical enters the lakes and persists for extended periods. It is expected that the level could approach 0.015 micrograms per liter, considerably less than levels harmful to nontarget aquatic life. The LC50 for rainbow trout is 0.53 to 40 mg per liter, depending on life stage. No degradation was evident with organisms derived from sediments, lake water, activated sludge, raw sewage, river water, and with microorganisms adapted to small amounts of TFM. Nutrient enrichment studies with sucrose and glucose-glutamate produced no TFM degradation. In a cometabolism test with sodium benzoate, the benzoate was metabolized, but the TFM remained. Although no degradation was seen in these aqueous system tests, decomposition in sediments or by photolysis cannot be ruled out without testing. (Cassar-FRC)
W82-01798

OXIDATION OF PHENOLIC ANTIOXIDANTS IN A RIVER SYSTEM,

Midwest Research Inst., Kansas City, MO.
V. Lopez-Avila, and R. A. Hites.
Environmental Science and Technology, Vol 15, No 11, p 1388-1390, November, 1981. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Phenols, *Chemical wastewater, *Organic compounds, Antioxidants, Fate of pollutants, *Path of pollutants, Sediments, Oxidation-reduction potential, Quinones, *Pawtuxet River, Rhode Island, Chemical industry, Rivers.

The general environmental fate of phenolic antioxidants in river systems is transformation into quinones or quinone methides. The formation of 2,6-di-tert-butylbenzo quinone from 2,6-di-tert-butylphenol (BHT), an antioxidant, was studied in sediment cores near to and 1 km downstream from a plant on the Pawtuxet River, Rhode Island, where antioxidants are manufactured. The phenol is oxidizing to the quinone up to the 18 cm depth in the near-plant sediment core and up to the 36 cm depth in the downstream core; below that depth the opposite reaction is occurring. Considering the sedimentation rates, these transformation depths are at 9 years ago (near-plant) and 12 years ago (downstream). An unknown compound, later identified as 2,6-tert-butylbenzoquinone 4-(carboxymethyl)methide, was observed at concentrations of 20 ppb in river water but not in wastewater. This is an oxidation product of the methyl and octadecyl esters of 3-(3,5-di-tertbutyl-4-hydroxy) propionic acid, also antioxidants manufactured at the plant. (Cassar-FRC)
W82-01801

ORGANIC COMPOUNDS FOUND NEAR DUMP SITES IN NIAGARA FALLS, NEW YORK,

Indiana Univ. at Bloomington. Dept. of Chemistry.
V. A. Elder, B. L. Proctor, and R. A. Hites.
Environmental Science and Technology, Vol 15, No 10, p 1237-1243, October, 1981. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Water pollution sources, *Waste disposal, *Chemical wastes, Organic compounds, *Waste dumps, Landfills, *Love Canal, Niagara River, Rivers, Industrial wastes, New York.

This paper reports the identification of antrhopogenic organic compounds at three sites in and near the Niagara River, in the city of Niagara Falls, New York. The 102nd Street dump site forms a bay 0.8 km long and 0.4 km wide which is actually part of the Niagara River. Four different dump sites make up the shoreline of the 102nd Street bay. It also receives runoff from the Love Canal area through a storm sewer. Another site was Bloody Run Creek, which is 200 meters long and is little more than a drainage ditch for the Hyde Park landfill. The third sampling site was Gill Creek, which runs through an industralized complex. All sampling sites drain directly into the Niagara River. Seventy-nine organic compounds were found in the 102nd Street bay area, Bloody Run Creek, and Gill Creek. Most were present at levels of 0.1 to 1 ppb. Compounds which had been dumped in large amounts were detected in most water and sediment samples. Large amounts of chlorinated benzenes and toluenes were found at all three sites. Other compounds included chlorotoluenes, polycyclic aromatic hydrocarbon derivatives, PCBs, trichlorophenol and other phenols, benzotrifluorides, mirex, and phenothiazine. A large number of benzyl derivatives and a few unusual fluorinated compounds were also found. These were probably waste byproducts of the industrial chemical production of benzyl chloride and (trifluoromethyl)chlorobenzene, respectively. These hazardous waste disposal sites were the major sources for most of the compounds identified. (Baker-FRC)
W82-01802

ENVIRONMENTAL ASSESSMENT OF INDUSTRIAL DISCHARGES BASED ON MULTIPLICATIVE MODELS,

Environmental Protection Agency, Research Triangle Park, NC.
M. R. Leadbetter, and W. G. Tucker.
Environmental Science and Technology, Vol 15, No 11, p 1355-1360, November, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Industrial wastewater, *Water pollution sources, Fate of pollutants, Wastewater disposal, Variability, *Model studies, Mathematical studies, Mathematical models, Effluents, Statistics, Errors.

The severity of a substance in an industrial discharge is defined as the ratio of the substance concentration to an estimated safe level. If the ratio is greater than 1, the source is classified as dirty, and if less than 1, as clean. When severities downstream from the source are of interest, a transport model must be used to relate the concentrations to factors measured at the source. Use of a multiplicative model on an effluent discharge from an industry is illustrated. The model is designed to classify a large number of the clean-dirty borderline cases as dirty, while minimizing the number of rather clean sources which are classified incorrectly. Another illustration using a textile plant effluent measured total suspended solids over 40 days to produce 57 observations. Considering only one measurement, 47 of the 57 cases were designated as dirty, but taking two observations on each of five representative days produced a clean classification. Severity at a downstream point can be calculated using concentration of pollutant in effluent, effluent discharge rate, river flow rate, and the standard concentration. (Cassar-FRC)
W82-01808

PREDICTING PRIORITY POLLUTANTS FROM PETROCHEMICAL PROCESSES,

Environmental Protection Agency, Washington, DC.
H. E. Wise, Jr., and P. D. Fahrenthold.
Environmental Science and Technology, Vol 15, No 11, p 1292-1304, November, 1981. 5 Fig, 5 Tab, 6 Ref.

Descriptors: *Chemical wastewater, *Organic compounds, *Priority pollutants, Water pollution sources, Chemical industry, Nitrophenols, Nitrogen compounds, Polynuclear aromatic hydrocarbons, Plastics, *Petroleum products, Metals, Chlorinated hydrocarbons, Aromatic compounds, Phenols, Nitrosamines, Chlorophenols.

Characterization of wastewater effluent from 172 commercial products and processes at 40 sites in the organic chemical, plastics, and synthetic fiber industries revealed that priority pollutants were associated with certain combinations of precursors and generic processes. Although the precursors and processes are widely used, it is only the particular critical combinations that produce priority pollutants. Most of these are associated with the early stages of production and are generally refined away on the route to the commercial product. Of the 116 recognized organic priority pollutants, 75 were verified in this study. Although some feed stocks such as acrylonitrile, phenol, and vinyl chloride are themselves priority pollutants, some are also introduced as impurities or reaction products of impurities in feedstocks or solvents. A table lists the 17 plastics and synthetic fibers effluents which contained greater than 0.5 ppm of priority pollutants, the monomers, and the chemical nature of pollutants generated. A similar table lists 71 organic chemical effluents which contained greater

than 0.5 ppm priority pollutants, with the generic processes, feedstocks, and chemical nature of pollutants generated. (Cassar-FRC)
W82-01809

COMPOSITION OF LEACHAGE FROM SURFACE-RETORTED AND UNRETORTED COLORADO OIL SHALE,

Colorado Univ at Boulder. Dept. of Geological Sciences.
K. G. Stollenwerk, and D. D. Runnells.
Environmental Science and Technology, Vol 15, No 11, p 1340-1346, November, 1981. 2 Fig, 5 Tab, 47 Ref.

Descriptors: *Leachates, *Oil shale, *Solute transport, Fate of pollutants, Water pollution sources, Colorado, Trace elements, Metals, Dissolved solids, Water quality, Waste characteristics, Mine wastes, Molybdenum, Arsenic, Selenium, Boron, Fluorine.

Groundwater and surface water in the Piceance Creek Basin, Colorado, may become contaminated by elements leached from retorted and fresh oil shale if development of this resource proceeds in this region. Laboratory leaching studies determined that a typical initial leachage composition from shale piles would probably contain the following pollutants (in mg per liter): fresh oil shale--total dissolved solids (TDS) 18000, Mo 9, B 32, F 16; Paraho retorted oil shale--TDS 28000, Mo 3, B 3, F 10; TOSCO II retorted oil shale--TDS 55000, Mo 9, B 18, F 19. The elements As and Se appear to present no threat to water quality. It is predicted that Mo would be present as Mo04(2-), boron as B(OH)3 and B(OH)4(-), and fluorine as free F(-). Although sulfuric acid would be generated, the abundance of carbonates and alkaline soils in this region would neutralize most of the acid, preventing acid pollution problems. The degree of leaching and contamination depends on many factors: chemical composition of the oil shale, presence of readily soluble minerals, temperature and atmosphere in retort, particle size distribution of retorted oil shale, annual precipitation, and location of shale pile in the drainage basin. Although the initial leachage would not meet recommended water quality criteria, the concentrations of TDS, Mo, and B would be reduced after passage of 1 or 2 pore volumes of water through the shale. This might require 1 or 2 centuries. F would remain at high concentrations, however, (Cassar-FRC)
W82-01810

INVESTIGATION OF SELECTIVE UPTAKE OF POLYCHLORINATED BIPHENYLS BY SPARTINA ALTERNIFLORA LOISEL,

North Carolina State Univ. at Raleigh. Pesticide Residue Research Lab.
E. Mrozed Jr., and R. B. Liedy.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 481-488, October, 1981. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Estuarine environment, *Polychlorinated biphenyls, *Aquatic plants, Adsorption, Accumulation, Chromatography, *Path of pollutants, Metabolism.

The movement of chlorinated hydrocarbons in the estuarine ecosystem and the role of Spartina alterniflora Loisel in this movement have been investigated. Specifically, the study was designed to provide evidence that S. alterniflora represents a potential pathway for the movement of PCB's in the estuarine system, to determine if uptake of PCB'S is a selective process, and to assess the effect of selective uptake on the reliability of concentration estimates based on the use of standard-sample chromatogram comparisons. A total of 0.3 mg of Aroclor 1254 was applied to 3.0 kg of washed coarse river bottom sand contained in buckets. Five S. alterniflora specimens were planted in each bucket of treated soil and immediately watered with nutrient solution. The final PCB concentration was 1.0 or 0.75 ppm based on soil dry weight or soil and water weight, respectively. Plants were harvested after a 90-day growth period with average minimum and maximum daily temperatures of 13.32 and 0.2 or 31.4 and 0.5 degrees C respectively. Samples were prepared for chromatography of soil, belowground tissues, and aerial tissues. The uptake of PCB's by S. alterniflora was shown to be selective for the lower chlorinated components of Aroclor 1254. Early peaks were enhanced relative to the standard in both types of plant tissue samples. Shifting of the chromatographic pattern of Aroclor 1254 as a result of PCB uptake indicates that this process changes the character of the PCB mixture. Enhancement of the early eluting components in belowground tissues is probably a result of the water solubility of the variously chlorinated congeners. Further shifting of the pattern towards the lesser chlorinated components in the aerial tissues suggests that some alteration of the mixture occurs within the plant. (Baker-FRC)
W82-01813

DENITRIFICATION ASSOCIATED WITH PERIPHYTON COMMUNITIES,

Geological Survey, Menlo Park, CA. Water Resources Div.
F. J. Triska, and R. S. Oremland.
Applied and Environmental Microbiology, Vol 42, No 4, p 745-748, October, 1981. 2 Fig, 13 Ref.

Descriptors: *Denitrification, *Cladophora, Chlorophyta, Streams, Rocks, Sedimentary rocks, Nitrous oxide, Algae, Nitrogen, Oxygen.

The periphyton community was examined in San Francisquito Creek, a small suburban drainage about 30 miles south of San Francisco. The community consisted of a Cladophora sp, mat which developed over the stream bed rocks. During summer low flows the filamentous mat undergoes senescence characterized by dense epiphtyic growth of diatoms, bacteria, and accumulation of fine organic particles which coat the filament surface. The fine particulates, when examined microscopically, contained a dense and diversified bacterial flora. Algal tissue were composited into a single sample. The scrapings of decomposing mats produced nitrous oxide when incubated under nitrogen plus 15% acetylene. Denitrification was enhanced by sodium nitrate and was inhibited by autoclaving, mercuric chloride, and oxygen. No nitrous oxide was formed without acetylene being present. Chloramphenicol did not inhibit nitrous oxide formation. Therefore the enzymes were constitutive. Incubation of periphyton scrapings in the light during field experiments inhibited denitrification due to algal photosynthetic oxygen production. The diurnal periphyton-associated denitrification rate was estimated to be 45.8 micromol of nitrous oxide per square meter per day as determined by averaging light, aerobic plus dark, and anaerobic rates over a 24 hr period. (Baker-FRC)
W82-01814

DISSOLVED HYDROCARBONS AND RELATED MICROFLORA IN A FJORDAL SEAPORT: SOURCES, SINKS, CONCENTRATIONS, AND KINETICS,

Alaska Univ., Fairbanks. Inst. of Marine Science.
D. K. Button, B. R. Robertson, and K. S. Craig.
Applied and Environmental Microbiology, Vol 42, No 4, p 708-719, October, 1981. 5 Fig, 4 Tab, 37 Ref.

Descriptors: *Biodegradation, *Hydrocarbons, *Seawater, Toluene, Estuaries, Fjords, Harbors, Water pollution sources, Microbiological studies, Oil tankers, Water treatments, Ballast, Port facilities, Terpenes, Conifers, Alaska, *Port Valdez.

The dynamics of dissolved hydrocarbon metabolism in seawater were investigated. Shallow-water samples were taken from Port Valdez and from a more oceanic station in Prince William Sound. The study was performed by continuous addition of radiolabeled toluene, representing a solute component, of the treated oil tanker ballast water which is discharged at Port Valdez. At 0.5 micrograms of toluene added per liter, most rates of toluene oxidation were in the range of 1 to 30 pg/liter/hr. Near the ballast water injection point, a layer of warm ballast water, rich in bacteria, that was trapped below the less-dense fresh surface water was detected. Toluene residence times were about 2 weeks in this layer, 2 years elsewhere in Port Valdez, and 2 decades in the surface water of the adjacent, more oceanic receiving estuary. Mixing was adequate for a steady-state treatment; it was demonstrated that 98% of the toluene was flushed from Port Valdez before metabolism, giving a resultant steady-state concentration of 0.18 micrograms/liter. Total bacterial biomass from direct counts and organism size data was usually near 0.1 mg/liter. However, the values ranged up to 0.8 mg/liter in the bacteria rich layer. The origin of additional hydrocarbon source was sought to explain the observations that the population of toluene oxidizers was large with respect to the amount of toluene consumed and that water from a nearby, nonpolluted estuary was equally active in facilitating toluene metabolism. Terpenes can be washed from spruce trees by simulated rainfall, and thus riparian conifers may provide an additional and significant hydrocarbon source to seawater. (Baker-FRC)
W82-01816

A SURVEY OF TRIHALOMETHANES IN THE DRINKING WATER SYSTEM OF MURJREESBORO, TENNESSEE,

Middle Tennessee State Univ., Murfreesboro.
W. B. Kasso, and M. R. Wells.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 295-302, September, 1981. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Trihalomethanes, *Potable water, *Water treatment, Water pollution sources, Organic compounds, Disinfectants, Chlorination, Drinking water, *Murfreesboro, Tennessee.

A study was performed to establish consistent and accurate trihalomethane levels to which Murfreesboro residents are being exposed and to evaluate seasonal changes and patterns of THM concentrations as related to the distribution of drinking water. Murfreesboro is a city of about 35,000 persons located 30 miles southeast of Nashville. Two separate water treatment plants, each with distinct water sources, serve the community. Six sample sites were chosen, and sampling continued for a period of 10 months. Average chloroform levels in samples collected were lowest in the winter, of the three seasons monitored. Spring levels were slightly higher, and summer values were well above the maximum contamination levels of 100 ppb established by the EPA. Bromodicloromethane concentrations followed a similar seasonal pattern, while chlorodibromomethane levels were relatively steady during the 10 months. Three sites averaged above the maximum allowable total trichloromethane contamination level of 100 ppb, with highest concentrations again in summer. These sites were fed entirely by a specific water plant. The variation from site to site was attributed mainly to the differences in source water plants and the distance of each site from the respective water plant. The plant with the highest levels of chloroform obtained its raw water from the Stones River; the other water treatment plant obtained its raw water from groundwater sources. Various methods of improving the quality of water at the substandard plant are briefly considered. (Baker-FRC)
W82-01817

FATE OF KEPONE AND MIREX IN A MODEL AQUATIC ENVIRONMENT: SEDIMENT, FISH, AND DIET,

Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
D. R. Skaar, B. T. Johnson, J. R. Jones, and J. N. Huckins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 3, p 931-938, August, 1981. 6 Fig, 35 Ref.

Descriptors: *Kepone, *Mirex, *Food chains, *Fate of pollutants, Pesticide residues, Insecticides, Bluegills, Fish, Daphnia, Aquatic environment, Degradation, Sediments, Accumulation, Metabolism, Chlorinated hydrocarbons.

Kepone and mirex did not degrade after 56 days' incubation in freshwater sediments under aerobic or anaerobic conditions and moved through a daphnia-bluegill food chain. A concentration of 0.1

micrograms per g of either insecticide labelerl with C14 showed no primary or biological degradation in two sediments, one from kepone-contaminated Bailey Creek and one with no kepone contamination. After 28 days exposure to 0.046 plus or minus 0.01 mg per kg in food and 158 plus or minus 13 ng per liter in water, bluegills contained 1.68 plus or minus 0.11 mg per kg kepone, mean total body residue. The accumulation factor was 10,606. Equilibrium had not been reached during the test. The estimated half life of kepone in these fish was 25 days. Mirex exposure for 28 days at 0.24 plus or minus 0.05 mg per kg in food and 161 plus or minus ll ng per liter in water produced a mean total body residue of 1.98 plus or minus mg per kg. The accumulation factor was 12,274, with no significant elimination in mirex-free water. Neither insecticide was metabolized by the fish. Bluegills exposed to insecticide-free water and fed contaminated daphnia for 28 days accumulated 0.036 plus or minus 0.005 mg per kg kepone and 0.143 plus or minus 0.29 mg per kg mirex for mean total residues of 0.078 plus or minus 0.020 mg per kg kepone and 0.125 plus or minus 0.037 mg per kg mirex. The fish accumulated twice as much DDT under similar conditions. (Casar-FRC)
W82-01820

DETERMINATION OF MINERAL FIBER CONCENTRATIONS IN FISH TISSUES,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-01822

POTENTIAL FOR BIODEGRADATION OF PHTHALIC ACID ESTERS IN MARINE REGIONS,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
B. F. Taylor, R. W. Curry, and E. F. Corcoran.
Applied and Environmental Microbiology, Vol 42, No 4, p 590-595, October, 1981. 3 Fig, 4 Tab, 26 Ref.

Descriptors: *Organic compounds, *Biodegradation, *Bacteria, Estuaries, Seawater, Rivers, Mississippi River, Deltas, Marine sediments, Phthalate esters, Marine environment, Sediments, Fate of pollutants.

This paper describes the presence of bacteria which aerobically degrade phthalic acid and phthalic acid esters (PAEs) in water and sediments from marine sources. This potential for PAE degredation was determined by comparing the counts of bacteria which grew aerobically on dibutyl phthalate (DBP) with the total counts of aerobic heterotrophic bacteria. The study took place in the Mississippi River estuary. Water samples and surface sediments from freshwater and marine environments were also collected from the Miami region and the New Orleans delta region. Bacteria that grew aerobically on DBP and o-phthalic acid were readily detected in both sediments and water samples. Pure cultures of bacteria were isolated on seven different phthalic acid esters from freshwater and marine sources. The marine isolates were taxonomically diverse and grew on a variety of phthalic acid esters. Dibutyl phthalate and o-phthalic acid supported growth in full-strength synthetic seawater medium, but sodium-dependent catabolism was demonstrable only for o-phthalic acid. The present study indicates that a variety of bacteria exist in some regions that can degrade o-phthalic acid and its esters in marine media. (Baker-FRC)
W82-01829

VOLTAMMETRIC STUDIES ON THE STABILITY OF THE ZN(II) CHELATES WITH NTA AND EDTA AND THE KINETICS OF THEIR FORMATION IN LAKE ONTARIO WATER,

Kernforschungsanlage Juelich, G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
For primary bibliographic entry see Field 2H.
W82-01839

NITROUS OXIDE IN FRESHWATERS OF THE GREAT LAKES BASIN,

Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 2H.
W82-01841

TOXICITY AND BOD EFFLUENTS DERIVED FROM KRAFT PULPING OF AGED WOOD CHIPS,

A. Wong.
Pulp and Paper Canada, Vol. 82 No 7, p 33-34, 36-38, 40-41, July, 1981. 14 Fig, 2 Tab, 22 Ref.

Descriptors: *Pulp and paper industry, *Toxicity, Effluents. Kraft mills, Biological oxygen demand, *Industrial wastes.

The effects of pulping and aged wood chips on mill effluent quality, yield and quality of byproducts, and on pulp quality were studied. It was proposed that it might be possible for kraft mills to reduce their discharges of toxic substances by judicious storage of chips prior to pulping. An experimental chip pile was built at a bleached kraft mill. The bark content of the chips was about 6%. The temperature within the chip pile was monitored regularly at six different locations. The ambient air temperature appeared to have some effect on the interior temperature of the chip pile. Although the temperature in the center of the chip pile ranged from 30 degrees C near the start of the experiment to about 5 degrees C at the end of the test, it is not known whether there was a high microbiological activity within the pile at such temperatures. The toxicity of the blow liquor derived from the pulping of the aged lodgepole pine chips was decreased in comparison to that of blow liquor derived from the pulping of fresh wood chips, by as much as 39% for liquor which had been produced from 26 week old chips. For spruce chips there was no appreciable change in toxicity. A loss of acetone-soluble and ether-soluble extractibles for both pine and spruce chips took place during storage. The decrease in resin acids in blow liquor was noted to be greater for pine than for spruce in storage. The biological oxygen demand of pine and spruce blow liquors was not changed substantially over the 26 week chip storage period. It was concluded that the toxicity of the blow liquor derived from the pulping of aged wood chips was decreased slightly in comparison to that of blow liquor derived from the pulping of fresh wood chips. The yield and quality of tall oil also declined. The loss of turpentine yield for both chips was considerable. Burst and tear strengths of pulps produced from aged wood chips were not altered appreciably. (Baker-FRC)
W82-01845

LOADING ESTIMATES TO LAKE ERIE, 1967-1976,

National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-01852

VARIATIONS AND MECHANISMS OF ASBESTOS FIBRE DISTRIBUTION IN STREAM WATER,

National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
For primary bibliographic entry see Field 5A.
W82-01853

INTERLABORATORY QUALITY CONTROL STUDY NO. 26, ARSENIC AND SELENIUM IN WATER,

National Water Research Inst., Burlington (Ontario). Water Quality Branch.
For primary bibliographic entry see Field 5A.
W82-01854

THE NATURAL ACIDITY OF SOME UNPOLLUTED WATERS IN SOUTHEASTERN ALASKA AND POTENTIAL IMPACTS OF ACID RAIN,

Oak Ridge National Lab., TN. Environmental Sciences Div.
D. W. Johnson.
Water, Air and Soil Pollution, Vol 16, No 2, p 243-252, August, 1981. 1 Fig, 3 Tab, 29 Ref.

Descriptors: *Organic acids, *Baseline studies, *Acid rain, *Acidic water, *Watershed models, Forest watersheds, Watersheds, Acidic soils, Bogs, Color, Hydrogen ion concentration, Alkalinity, Model studies, Minerals, Surface water, Anions, Cations, Sulfates, Alaska.

Near Petersburg, Alaska, natural, unpolluted waters draining surface soils and bog soils containing organic acids display pH values below 4.7. Nearby streams have pH values around 6 or slightly below. Studies were carried out to determine the role of carbonic and organic acids in forest soil leaching processes at this site as compared to others in Washington and Costa Rica. Water samples were collected and analyzed for color, pH, alkalinity and various minerals, anions and cations. Projections of the effects of acid rains and organic acids were formulated using a worst-case model. Results showed that the greatest potential declines in pH would occur in the already acidic waters, while very little change would occur in the near neutral waters. In neither case do the predicted changes in acidity present cause for alarm, since the occurrence of acidic precipitation is not common in this area at present. The findings of this forest watershed study may serve as background data in the event of future pollution by sulfate inputs. (Geiger-FRC)
W82-01867

DEPOSITION OF SULPHUR GASES FROM MULTIPLE SCATTERED SOURCES IN ALBERTA,

Department of Agriculture, Lacombe (Alberta). Research Station.
D. R. Walker, A. C. Dick, and M. Nyborg.
Water, Air, and Soil Pollution, Vol 16, No 2, p 223-231, August, 1981. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Water pollution sources, *Sulfur, *Fate of pollutants, *Air pollution effects, Path of pollutants, Industrial wastes, Air pollution, Sulfate, Environmental effects, Crop yield, Legumes, Rainfall, *Alberta, Canada.

The deposition of sulfur (S) on soils, plants, and free water surfaces was studied at 47 monitoring stations located in the Canadian provinces of Alberta and Saskatchewan. Results were analyzed in relation to sampling site distance from industrial S emission sources. Approximately 7 to 9 kilograms/hectare of sulfate sulfur was deposited annually in a 4600 sq km area containing or adjacent to ten S emission sources with provincially-set emission standards of 330 tons of S/day. The annual S deposition rate declined to 4 to 6 kilograms/hectare at distances of 40 or more km from the S emission sources. S levels in rainfall ranged from 0.7 to 3.9 kilograms/hectare in the high S emission area. Free-water surface sites within the high S emission area adsorbed 2 to 3 times the amount of S adsorbed at sites 40 or more km away from the S emission sources. Lower yields of legume crops were obtained for non-fertilized plots far away from S emission sites than for non-fertilized plots close to S emission sources. (Geiger-FRC)
W82-01868

THE MERCURY CYCLE,

Swedish Water and Air Pollution Research Lab., Goeteborg (Sweden).
C. Brosset.
Water, Air, and Soil Pollution, Vol 16, No 2, p 253-255, August, 1981. 1 Fig.

Descriptors: *Path of pollutants, *Mercury, *Lakes, *Water pollution, *Air pollution, Heavy metals, Precipitation, Metal complexes, Seasonal variation, Fate of pollutants, Hydrogen ion concentration, Pesticide kinetics, *Sweden.

An intensive study of Hg in air, precipitation, and lake water in Sweden has resulted in the development of a tentative model for the cycling of this heavy metal. In the ground layer air mercury is present mostly as a metallic vapor. The total concentration of Hg decreases, but the ratio of water-soluble Hg to total mercury increases, with height above the ground. Most of the water-soluble Hg is formed in the air by oxidation or methylation and

is wet and dry deposited in the water phase of terrestrial and aquatic systems. Deposited Hg is reduced to metallic vapor and temporarily or permanently bound to condensed phases. The reaction velocity of these processes determines the level of respective Hg compounds in the water phase. The reemission of mercury vapor into the atmosphere shows a seasonal variation, while the magnitude of reemissions is determined by specific properties of the local receptor. Data supporting the proposed mercury cycle is discussed. High concentrations of methylmercuric chloride generally are found in lakes with low water pH. Levels of this mercury compound in fish meat seem to be directly related to the concentration of methylmercuric chloride in lake water. (Geiger-FRC)
W82-01869

TRANSPORT OF NONPOLAR ORGANIC COMPOUNDS FROM SURFACE WATER TO GROUNDWATER. LABORATORY SORPTION STUDIES,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
R. P. Schwarzenbach, and J. Westall.
Environmental Science and Technology, Vol 15, No 11, p 1360-1367, November, 1981. 5 Fig, 5 Tab, 27 Ref.

Descriptors: *Organic compounds, *Sorption, *Infiltration, Fate of pollutants, Path of pollutants, Chlorinated hydrocarbons, Hydrocarbons, Leaching, Landfills, Groundwater recharge, Recharge, Water treatment, Aquifers, Sediments.

Sorption equilibria for low concentrations of nonpolar organic compounds of low to intermediate lipophilicity in a river water-groundwater infiltration system were described by the equation S = K sub p times C, where S = concentration in liquid phase. Sorption by aquifer materials was reversible. This relationship is important in several applications: treatment of river water by artificial or natural bank infiltration, artificial groundwater recharge, and leaching of pollutants from landfills. Laboratory experiments were conducted using toluene; di-, tri-, and tetramethylbenzenes; n-butylbenzene, tetrachloroethylene, chlorobenzene, and di-, tri-, and tetrachlorobenzenes with several sorbents (natural river and lake sediments, kaolin, silica, and activated sewage sludge). For a variety of sorbents, the partition coefficient for a particular compound can be estimated from its 1-octanol/water partition coefficient and from the organic carbon content of the sorbents if the amount of organic carbon is greater than 0.1%. The compounds under investigation were highly mobile in organic-poor sorbents. Flow velocities affected sorption kinetics and thus material transport. (Cassar-FRC)
W82-01873

THE SIGNIFICANCE OF WET AND DRY SYNOPTIC REGIONS ON LONG-RANGE TRANSPORT OF POLLUTION AND ITS DEPOSITION,

British Meteorological Office, Bracknell (England).
F. B. Smith.
Atmospheric Environment, Vol 15, No 5, p 863-873, 1981. 7 Fig, 4 Tab, 6 Ref.

Descriptors: *Pollutants, *Precipitation, *Fallout, Synoptic analysis, Rainfall, *Air pollution, Mathematical studies, Sulfur dioxide, Model studies.

This paper has developed the idea of Rodhe and Grandell for differentiating between synoptic regions with a high probability of rain and those with little or no rain in the average Lagrangian removal of sulfur pollution from air in the boundary layer. To describe this intermittent wet deposition, four simultaneous rate of change equations were presented and solved. The equations also include the effects of dry deposition, oxidation of sulfur dioxide to sulfate, and the probability that the pollution may be advected from dry regions into wet regions and vice versa. The wet deposition terms reflect the geographical variation of long-term average rainfall and the variation of the probability of rain with wind direction. The equations thus represent the average statistical fate of pollution on its way from its source to a specified receptor. As an example, the average wet deposition rates at Frankfurt for different wind directions were compared on the assumption that all the sulfur pollution originates from a ring of imaginary equal continuous sources 900 km upwind. Three main conclusions were reached. First, the wet depositions were significantly different from those obtained using the simple model which fails to differentiate between mobile wet and dry synoptic regions. Second, the results are somewhat insensitive to the selected magnitudes of the parameters, which is fortunate, as they are not accurately known. Third, the wet depositions are not highly sensitive to the upwind average rainfall probability distributions. Typically, variations of only 20% in average wet-deposition rates with wind direction are implied. (Baker-FRC)
W82-01877

TRANSPORT OF SALTS IN CATCHMENTS AND SOILS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2G.
W82-01880

TOXICANT ACCUMULATION IN HYDROBIONT TISSUES FOLLOWING EFFLUENT DISCHARGE,

Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
For primary bibliographic entry see Field 5C.
W82-01919

BIODEGRADATION OF SODIUM ALKYLBENZENESULFONATE IN PLANKTON-CONTAINING POND WATER,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Potapova, N. P. Galagan, I. A. Babenko, and L. I. Bagnyuk.
Hydrobiological Journal, Vol 16, No 4, p 49-53, 1980. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Ponds, *Biodegradation, *Surfactants, *Bacteria, *Plankton, Dissolved oxygen, Sludge, Organic compounds, Industrial wastes, Fate of pollutants, Model studies, Water pollution effects.

This paper reports a small part of the current research on the biodegradation of sodium alkylbenzenesulfonate (SABS), an anionic surfactant, in model ecosystems of various complexity. The object of the study was to examine the decomposition of SABS in natural water containing plankton and the effect of SABS on the plankton biocenosis. The following parameters were investigated: temperature, pH of the medium, content of dissolved oxygen, total abundance of bacterioplankton and the ratio of morphological groups in it, bacterial destruction, aggregation, and dehydrogenase activity of the bacterioplankton. The degradation of the SABS was estimated from the alteration of its content in time. Experiments were carried out under laboratory conditions in June-July 1979. The aquaria were filled with pond water containing plankton and with the same water to which sludge from a pond had been added. Samples were taken on days 1, 3, 5, 10, 15, 20, 25, and 40. SABS was added to the experimental aquaria at a rate of 2 mg/l. The background SABS content in the control and experimental aquaria of both systems was 0.02-0.04 mg/l. The degradation of SABS within 40 days was complete in the system to which sludge was added, and 92% in the system without sludge. The addition of SABS did not affect dissolved oxygen content or the pH of the medium, but did change the structure and functional state of the bacterioplankton. Changes in bacterial destruction and in the aggregation of the bacterioplankton were dependent on the level of degradation of SABS and on the type of system, whereas changes in dehydrogenase activity were dependent solely on SABS concentration. A strong negative correlation between the aggregation of the bacterioplankton and bacterial destruction was noted. (Baker-FRC)
W82-01925

THERMOPHILLIC AND THERMOTOLERANT FUNGI ISOLATED FROM THE THERMAL EFFLUENT OF NUCLEAR POWER GENERATING REACTORS: DISPOSAL OF HUMAN OPPORTUNISTIC AND VETERINARY PATHOGENIC FUNGI,

Chicago Univ., IL. Dept. of Medicine.
J. W. Rippon, R. Gerhold, and M. Heath.
Mycopathologia, Vol 70, No 3, p 169-179, 1980. 1 Fig, 13 Tab, 22 Ref.

Descriptors: *Fungi, *Public health, *Thermal water, Fate of pollutants, Aspergillus, Pathogens, Cooling water, Thermophilic fungi, Powerplants, Quad Cities Power Plant, Illinois, Nuclear powerplants.

Samples of water, foam, microbial mat, soil, and air obtained near the Quad Cities Power Station, Illinois, during 1977-78 contained 53 species of thermotolerant and thermophilic fungi. Eleven species of opportunistic Mucocorales and Aspergillus and 1 veterinary pathogen, Dactylaria gallopava, were found in soil, water, foam, and mat in the intake bay, discharge bay, and cooling canal, where the water is warm. Aspergillus fumigatus was most numerous. In areas of cooler water the opportunistic fungi decreased in abundance. Air samples from 6 locations contained 9 species of fungi in low abundance. This study confirms that there is little public health hazard due to dissemination of thermophilic fungi from the power plant area to the environment. (Cassar-FRC)
W82-01928

ACID RAIN AGREEMENT,

R. J. Smith.
Science, Vol 209, No 4459, p 890, August 22, 1980.

Descriptors: *Acid rain, *International agreements, *Political constraints, Canada, Water quality control, Institutional constraints, Water pollution sources.

Scientific working groups from Canada and the U.S. have been established to prepare for acid rain negotiations scheduled for June 1981. The groups will take air samples and estimate impact of acid rain on the environment, determine the precise origin of acid rain, and develop a strategy for abatement. Some constraints on the negotiations are costs (potentially $400-500 million for Canada and 5 to 8 times that for the U.S. between now and 2000), the relative independence of Canada's provinces, and the U.S. utility lobby. (Cassar-FRC)
W82-01933

CHROMIUM LEVELS IN FISH FROM A LAKE CHRONICALLY CONTAMINATED WITH CHROMATES FROM COOLING TOWERS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Elwood, J. J. Beauchamp, and C. P. Allen.
International Journal of Environmental Studies, Vol 14, No 4, p 289-297, 1980. 2 Fig, 4 Tab, 33 Ref.

Descriptors: *Chromium, *Fish, *Cooling water, Fate of pollutants, White Oak Lake, Melton Hill Reservoir, *Tennessee, *Reservoirs, Lakes, Chromates, Metals, Heavy metals, Bluegills, Mosquitofish, Bass, Absorption, Accumulation.

Chromium levels in fish were determined in White Oak Lake, contaminated with chromates from cooling water blowdown, and the nearby uncontaminated Melton Hill Reservoir. Total Cr levels (in mg per liter) in White Oak water were 0.1-0.3 in 1969, 0.1 in 1973, and 0.01-0.14 in 1974. Fish species were bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), goldfish (Carassius auratus), and mosquitofish (Gambusia affinis). Results suggest that Cr levels in muscle and whole body of most species analyzed are inversely related to fish weight. Mean Cr concentration (in micrograms per g) in bluegill were 1.22, muscle

and 1.45, whole body; and in largemouth bass 0.51, muscle and 0.82, whole body. There were no significant differences between Cr levels in: (1) bluegill vs. largemouth bass, (2) whole body vs. muscle tissues, and (3) fish from the contaminated vs. the uncontaminated reservoirs. Goldfish collected in 1969 contained 9.79 micrograms per g (whole body), and 0.92 micrograms per g in 1973. Feeding habits apparently did not affect Cr levels. It is possible that fish can regulate Cr concentrations actively by reduced absorption and/or increased secretion of Cr or passively by a limitation of binding sites, or that some of the Cr is in a nonabsorbable form. (Cassar-FRC)
W82-01941

THE CONTAINMENT OF AN OIL SLICK BY A BOOM PLACED ACROSS A UNIFORM STREAM,

McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
For primary bibliographic entry see Field 1B.
W82-01956

INORGANIC CHEMISTRY OF PARTICULATE MATTER FROM THE NEARSHORE ZONE OF LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.
For primary bibliographic entry see Field 2H.
W82-01959

SELENIUM: A WATER POLLUTANT FROM FLUE GAS DESULFURIZATION,

Slippery Rock State Coll., PA. Dept. of Chemistry.
W. G. Sayre.
Journal of the Air Pollution Control Association, Vol 30, No 10, p 1134, 1980. 1 Tab, 3 Ref.

Descriptors: *Selenium, *Industrial wastes, Water pollution sources, Groundwater pollution, Water quality, Drinking water, Public health.

Small discharges of the blowdown water from the scrubber loop of some flue gas desulfurization techniques could cause large scale problems of surface or groundwater pollution. This discharge would contain maximum SeO3(-2) concentrations of 15.2 mg/liter and maximum concentrations of SeO4(-2) of 1.1 times 10 to the 6th power mg/liter. The levels of selenate and selenite are many orders of magnitude larger than permissible levels for drinking water. (Small-FRC)
W82-01960

MIXING ZONE ANALYSIS FOR RIVER PLUMES,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. P. Pialy.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 731-746, August, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Thermal pollution, *Mathematical models, *Temperature effects, Water pollution, Mixing, Nuclear powerplants, Water cooling, Water quality standards.

Steam-electric powerplants which utilize open-cycle cooling of plant condensors discharge heated water directly into natural water bodies. This results in the formation of thermal plumes in the receiving water in regions adjacent to the discharge outfall, with a mixing zone, in which the temperature gradient is largest, occurring near the outfall. Allowable maximum sizes for these mixing zones are usually specified for a given plant for both a seasonal mean flow condition and a seasonal worst-case flow, generally equal to the 7-day, 10-year low flow for the season. This paper describes a method for using field data from thermal plume surveys to develop mixing zone models capable of evaluating the effects of thermal discharges. These models can be used to develop proper compliance criteria for powerplant operations at low river flows. If the regulatory agency which routinely reviews and verifies the powerplant compliance with the applicable standards accepts and approves the data sets generated by these models for a given powerplant, it may waive the requirement for monthly plume surveys, which are commonly required under current regulations. (Carroll-FRC)
W82-01961

UPLAND MARSH FOR WATER QUALITY CONTROL,

Agricultural Research and Education Center, Lake Alfred, FL.
S. F. Shih.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 861-864, August, 1981. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Marshes, *Time series analysis, *Water quality control, Wastewater treatment, Wetlands, Nutrients, Mathematical studies, Vegetation, Plant growth, *Plant nutrient uptake.

Although many studies have investigated the use of vascular plants to improve the water quality of fresh water marshes, previous researchers have not emphasized the application of models to determine plant nutrient uptake in marshes. This study used time series analysis to analyze plant nutrient uptake, used the F-test as the statistical criterion to determine the possibility of any component existing in series, and demonstrated the application of time series analysis to interpolate missing data. Since plant nutrient uptake is a function of time, time series analysis can be used to observe the trends, cyclical movement, and residual pattern of a water quality system in marsh areas. Total phosphate data taken at 4 hour intervals over a 5 day period in September was used to demonstrate the application of time series analysis. The Fourier coefficients, amplitude, phase angle, and percent of variance were determined for each harmonic at three sampling sites. The Fourier analysis showed that three harmonics explained over 83 percent of the variance. The amplitudes were much smaller in the marsh than in the slough, confirming the reduction of total phosphate after the water flowed through the marsh zone. Interpolation of missing data based on time series function resulted in somewhat higher values than estimations based on conventional linear function. The F-test for the cyclic function component of the marsh site was significant at the 0.01 level, demonstrating the existance of the cyclic component in the marsh zone system. (Carroll-FRC)
W82-01962

THE MODELING OF AQUATIC ECOLOGICAL SYSTEMS,

Akademiya Nauk URSR, Kiev. Inst. Kibernetiki.
A. G. Ivakhnenko.
Hydrobiological Journal, Vol 16, No 3, p 1-9, 1980. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Mathematical models, *Ecosystems, *Forecasting, *Water pollution sources, Planning, Mathematical studies, Statistical methods, Computers, Water quality, Lakes, Reservoirs, Lake Baikal, Dnieper reservoirs, USSR.

General properties of mathematical models of aquatic ecological systems are discussed, and modeling languages, typical input and output requirements, and problems with models are considered. Output variables that adequately describe the state of the object have to be selected. A support function and a structure for the mathematical model, such as order of derivatives, must be selected. Estimates of the parameters or coefficients of the model must also be obtained. A computer can be used to scan a large number of variables and determine which equations are most useful to the model. Long term forecasting and the optimization of the planning of water systems are two applications for aquatic system models. The uses of these techniques are illustrated by examples from Lake Baikal and the Dnieper chain reservoirs. (Small-FRC)
W82-01972

DREDGED MATERIAL EVALUATIONS: CORRELATIONS BETWEEN CHEMICAL AND BIOLOGICAL EVALUATION PROCEDURES,

For primary bibliographic entry see Field 5C.
W82-01985

SCALE-DEPENDENT DISPERSION IN A STRATIFIED GRANULAR AQUIFER,

National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2F.
W82-01986

ACID RAIN AND ENVIRONMENTAL POLICY,

Thompson (Boyce) Inst., Ithaca, NY.
J. S. Jacobson.
Journal of the Air Pollution Control Association, Vol 31, No 10, p 1071-1073, October, 1981. 1 Tab, 14 Ref.

Descriptors: *Acid rain, *Decision making, Acidity, Rainfall, Cost-benefit analysis, Economic aspects.

Various seemingly paradoxical scientific questions are posed which relate to the problem of acid rain and its effect on the environment and environmental policy. The first paradox discussed concerns the supposed increase in fossil fuel usage over the last several decades, with the resultant increases in emissions of pollutants from the combustion of fuels which cause acid rain. Despite these increases, experts do not agree on whether acidity of rain has increased in eastern North America. The second paradox concerns the effect of acid rain on vegetation. If the rain is supposedly harmful, why have some reports shown increases and others, decreases in the growth of crops and trees with the application of simulated acid rain. The third paradox concerns the effect of acid rains on fish life in lakes. If acid rain falls throughout eastern North America, why have some lakes become acid and lost fish populations while others have not. Since unequivocal answers to these scientific questions are not available, a systematic approach is needed for developing policy which can be useful for solving the problem. It appears that traditional cost-benefit analysis can not be the sole basis for decision-making, but that it will be helpful. Research needs must be identified, and the upper and lower limits for alternative strategies must be determined. (Baker-FRC)
W82-01987

A NATIONAL SURVEY OF TRI(HALOALKYL)-, TRIALKYL-, AND TRIARYLPHOSPHATES IN CANADIAN DRINKING WATER,

Environmental Health Directorate, Ottawa (Ontario).
D. T. Williams, and G. L. LeBel.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 450-457, October, 1981. 3 Tab, 14 Ref.

Descriptors: *Potable water, *Organophosphorus compounds, *Canada, Phosphates, Rubber, Drinking water, Water pollution sources.

Twenty-nine municipalities across Canada were chosen for a survey regarding potable water contaminants. Samples of potable water were collected twice a year at the treatment plant of each municipality. Contaminants investigated included tri(haloalkyl)-, trialkyl- and triarylphosphates (TAP). A comparison of TAP levels with raw water sources indicated that higher TAP levels were found in potable water obtained from river sources as compared to lake sources. Groundwater sources in general gave very low TAP levels in the treated water. Of the drainage basins involved, St. Lawrence, Great Lakes, and Lake Winnipeg basins have higher levels of TAP compared to Atlantic Sea Board, Columbia, and Pacific Sea Board basins. The fraction of TAP values greater than 10 ng/liter was only 10% with the exception of tributoxyethyl phosphate, for which values were higher than 10 ng/liter. This compound is used in rubber gaskets such as those installed in plumbing, and high contaminant levels can result if water is left standing in water pipes. Studies are suggested to

locate the specific sources of TAP contamination. (Baker-FRC)
W82-01989

MATHEMATICAL MODELING OF STREAM WATER QUALITY BY A NEW MOMENT METHOD: FIELD INVESTIGATION OF A TIDAL RIVER,

National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 7B.
W82-01995

COMPARATIVE LIMNOLOGY OF INNER LONG POINT BAY, LAKE ERIE, AND ADJACENT WATERS OF THE OUTER BAY,

Ontario Ministry of Natural Resources, Wheatley. Lake Erie Fisheries Research Station.
J. H. Leach.
Journal of Great Lakes Research, Vol 7, No 2, p 123-129, 1981. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Limnology, *Lakes, *Water pollution effects, Aquatic productivity, Nutrients, Shallow water, Bays, Deep water, Alkalinity, Dissolved oxygen, Water properties, *Lake Erie, Long Point Bay.

Water quality and productivity were investigated in the Inner and Outer Long Point Bay, and current limnological conditions in the Inner Bay were compared with the results of a 1962 study. The Inner Bay is unique, as it has not been subjected to the pollutant loadings from point sources typical of most of the bay. The area east of the bay is currently undergoing industrial and urban development, and this study will provide benchmark data against which future studies of the environment can be compared. The Inner Bay, because of shallow depth and higher nutrient regimes, was more productive than the Outer Bay and had extensive macrophyte growths and higher chlorophyll alpha standing crops. All fourteen parameters studied were significantly different in the two bays except for nitrate, total alkalinity, and dissolved oxygen. The Inner Bay is eutrophic while the Outer Bay is mesotrophic. Changes in the Inner Bay since the 1962 study included increases in nitrate and nitrite and total alkalinity. (Small-FRC)
W82-02005

GEOLOGIC ASPECTS OF WASTE DISPOSAL SITE EVALUATIONS,

Law Engineering Testing Co., Marietta, GA.
For primary bibliographic entry see Field 5E.
W82-02011

ENVIRONMENTAL FATE OF METHYL EUGENOL,

Science and Education Administration, College Station, TX. Cotton Insects Research Lab.
T. N. Shaver, and D. L. Bull.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 619-626, 1980. 4 Fig, 1 Tab, 6 Ref.

Descriptors: Environmental effects, *Pesticides, Organic compounds, *Tomatoes, Soil analysis, Crop production, Agricultural chemicals, Water sampling, Chemical analysis, Leaching, Radioactive half-life, Bioaccumulation, Radioactive tracers, Radioisotopes, Carbon, Chromatography, *Methyl eugenol, *Fate of pollutants.

The fate of methyl eugenol in soil, water, and tomatoes is described. Methyl eugenol is a compound used as a synthetic lure in fruit fly control programs. Samples of radioactive and nonradioactive methyl eugenol were prepared and applied to soil, water and tomatoes. The half-life of methyl eugenol was measured in the samples, and samples were analyzed for the presence of eugenol. Results indicate that methyl eugenol dissipates rapidly from soil and water. About 98% of the material was lost within 96 hr at 32 degrees C. Leaching studies indicate that the compound is immobile in the soils tested, sand and loam. Only 3.8% of the applied dose of methyl eugenol was recovered after a 24 hr period from tomatoes treated topically. A small increase in unextractable radiocarbon was noted in the tomato pulp after 3 days. (Titus-FRC)
W82-02013

PARASITE OVA IN ANAEROBICALLY DIGESTED SLUDGE,

Cutter Lab., Shawnee, KS. Bayvet Div.
R. G. Arther, P. R. Fitzgerald, and J. C. Fox.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1334-1338, August, 1981. 3 Tab, 24 Ref.

Descriptors: *Parasite, *Eggs, *Sludge lagoons, Land application, Lagoons, Diseases, Public health, Pathogens, Sludge disposal, Water pollution sources, Fate of pollutants, Anaerobic digestion, Nematodes, *Chicago.

Lagooned anaerobically digested sludge samples from the Metropolitan Sanitary District of Greater Chicago were examined for viable parasitic ova on four dates during 1976 and 1977. Mean numbes of ova per 100 g dry lagooned sludge and the % capable of embryonation were as follows: Ascaris spp., 203, 24%; Toxocara spp. 173, 10%; Toxascaris leonina, 48, 43%; and Trichuris spp., 36, 6%. In fresh anaerobically digested sludge 20-64% of ova were capable of embryonation. The fact that ova of four genera of parasites survived anaerobic sludge digestion and lagooning shows that land application methods should be carefully evaluated. Conditions which favor development of parasites into transmissible forms are overhead spraying and surface irrigation. Subsurface injection and deep trench operation decrease the number and concentration of ova dispersed on the surface and reduce the oxygen available to the ova. However, subsurface application would also protect the ova from ultraviolet light and dehydration, which are unfavorable for embryonation. Sources of these parasitic ova are infected humans, pigs, dogs, and cats; they reach the sewer system from pasture runoff, slaughterhouses, street runoff, and animal shelter wastewater. (Cassar-FRC)
W82-02018

AQUATIC MICROBIOLOGY WITH REFERENCE TO TANNIN DEGRADATION,

Madras Univ. (India). Centre of Advanced Study in Botany.
A. Mahadevan, and G. Muthukumar.
Hydrobiologia, Vol 72, No 1/2, p 73-79, July, 1980. 3 Fig, 2 Tab, 42 Ref.

Descriptors: *Tannins, *Aquatic fungi, *Microbial degradation, Reviews, Degradation, Biodegradation, Fungi, Aquatic bacteria, Aquatic environment, Organic compounds, *Tannery wastes, Chemical properties, Microorganisms, Waste treatment, Microbiological studies, Water pollution sources, Fate of pollutants.

This review discusses tannin degradation in the aquatic environment. Tannins reach the rivers of India from many sources, notably tannery wastes. Plant tannins are amorphous, water soluble, polyhydroxy polyphenolic substances of molecular weights 500-3000, which form complexes with proteins and polymerize. Tannins are toxic to many microorganisms and inhibit microbial growth by suppressing respiration, nitrification, or enzyme action. The compounds may be degraded by some bacteria, yeast, and fungi, but vary in their susceptibility according to chemical form and particular organism. Microorganisms which can degrade tannins belong to the following species: Fusarium, Cylindrocarpon, Endothia, Achromobacter, Pseudomonas, Aspergillus, Penicillium and others. Degradation of tannins is greater in sugar-free media and with nitrogen sources such as sodium nitrate and ammonium sulfate. (Cassar-FRC)
W82-02028

PLANT BIOTESTS IN THE BIOINDICATION OF THE RAINFALL POLLUTION IN AN OIL REFINERY REGION,

Akademia Rolniczej, Warsaw (Poland). Inst. of Environmental Protection.
For primary bibliographic entry see Field 5C.
W82-02033

TERRAIN, GROUNDWATER AND SECONDARY SALINITY IN VICTORIA, AUSTRALIA,

Soil Conservation Authority of Victoria, Kew (Australia).
For primary bibliographic entry see Field 2F.
W82-02046

BROMIDE IN CANTERBURY GROUND WATER,

Department of Scientific and Industrial Research, Christchurch (New Zealand). Chemistry Div.
E. T. J. Bathurst, L. J. Thomson, and L. F. Wilkinson.
New Zealand Journal of Marine and Freshwater Research, Vol 14, No 4, p 409-411, 1980. 2 Fig, 3 Ref.

Descriptors: *Bromides, *Industrial wastes, Methyl bromide, Path of pollutants, Water pollution sources, *New Zealand, *Groundwater pollution.

Citizens living south and west of Christchurch, New Zealand, draw their water from unconfined aquifers, which are feared to be contaminated with methyl bromide industrial wastes. Analysis of 250 of the 600 wells in the area showed a bromide:chloride ratio which was constant and close to that of natural waters. Although a few wells had bromide levels as high as 0.2 mg per cu meter and high levels of dissolved ions, these higher concentrations were not widespread. It was concluded that the present bromide levels were no threat to health. (Cassar-FRC)
W82-02056

DEGREE OF POLLUTION OF SEVERAL MAJOR STREAMS ENTERING TOLO HARBOUR, HONG KONG,

Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M-H. Wong, KC. Ho, and TT. Kwok.
Marine Pollution Bulletin, Vol 11, No 2, p 36-40, February, 1980. 2 Fig, 7 Tab, 16 Ref.

Descriptors: *Water pollution sources, *Industrial wastes, *Municipal wastes, River water, *Tolo Harbour, *Hong Kong, Land development, Marine environment, Marine sediments, Nitrogen, Phosphorus, Cadmium, Copper, Iron, Manganese, Lead, Zinc, Organic compounds, Path of pollutants.

Tolo Harbour is a land-locked sea in Hong Kong which has only a narrow outlet. Although untreated domestic and industrial wastes discharged into the harbor via several major streams are expected to be diluted and flushed away by tidal waves, decreasing volume of water in the harbor has led to low dilution of the wastes. Water and sediment samples from eight rivers were analyzed for total nitrogen content, total phosphate, cadmium, copper, iron, manganese, lead, and zinc. The sediment samples were also examined for total organic carbon. The pH of the water samples ranged from 6.0 to 8.1, with values falling between 6.8 and 7.8 for most rivers. Five of the rivers showed extremely low dissolved oxygen values, indicating that these rivers were bacteriologically active and contaminated by organic wastes. All of the water samples showed only trace amounts of phosphate. The high nutrient load in the sediments of two of the rivers indicates serious organic pollution. Water samples collected from seven of the eight rivers were found to contain one or more metal pollutants in concentrations exceeding the upper safety limits for drinking water. Sediments for five of the rivershad high levels of one or more heavy metals. Three rivers were found to be grossly polluted by both organic and inorganic contaminants. Strong legislation regarding the discharge of untreated wastes, careful planning of residential and industrial development, and a plan for final disposal of pig and poultry manure from agricultural areas are needed to prevent further deterioration of the harbor's environment. (Carroll-FRC)
W82-02058

THE DYNAMICS OF ANAEROBIC PHENOL BIODEGRADATION IN LOWER GREENLAND,

Harwell Lab., Oxon (England). Environmental and Medical Sciences Div.
J. F. Rees, and J. W. King.
Journal of Chemical Technology and Biotechnology, Vol 31, No 5, p 306-310, May, 1981. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Phenols, *Biodegradation, *Landfills, Leaching, Anaerobic digestion, Percolation, Simulation analysis, Waste disposal, Groundwater pollution, Mathematical equations.

The high solubility and poor adsorption of phenol by domestic refuse in a landfill environment can result in the leaching of phenol and pollution of groundwater. The most significant mechanism for reducing the concentration of phenol within the landfill and within an underlying porous rock formation may be anaerobic biodegradation. An artificial landfill leachate containing phenol was percolated through columns of disturbed Lower Greensand in an effort to establish the rates of anaerobic phenol degradation in a porous rock formation and to identify inhibitory concentrations of phenol and other factors affecting those rates. Phenol degradation was observed at concentrations up to 8.2 grams per cubic decimeter, but decomposition was increasingly inhibited above 3.0 grams per cubic decimeter. Maximum decomposition rates were observed at concentrations ranging from 1.5 to 3.0 grams per cubic decimeter. The maximum reaction velocity values at a flow of 0.5 cubic centimeters per hour was 1.05 grams per cubic decimeter per hour, and the Michaelis constant value was 450 milligrams phenol per cubic decimeter. The zero order rate constant and first-order rate constant increased with increasing flow rate. The data were used to develop equations for calculating the rates of phenol degradation in a real landfill. (Carroll-FRC)
W82-02071

USE OF KNOPP'S METHOD TO ASSESS SELF-PURIFICATION PROCESSES IN WATER BODIES AND WATER COURSES,

Byelorussia Univ., Minsk (USSR). Experimental Biological Special Topics Research Lab.
G. A. Inkina, and N. V. Dubko.
Hydrobiological Journal, Vol 16, No 3, p 69-73, 1980. 3 Tab, 12 Ref.

Descriptors: *Water analysis, *Self-purification, Water quality, Microorganisms, Oxidation, Fate of pollutants, Biotransformation, Lakes, Rivers, *USSR, Volga River.

Research was carried out in lakes of different types and in the Svisloch and Volga Rivers as moderately polluted water courses, in order to obtain comparative data by Knopp's method on the self-purification capacity of waters of different origin and to test the method under different conditions. Unfiltered and filtered water were used; oxygen content was determined in the control and experimental flasks, as were the abundance of microorganisms, the doubling time of the bacterial biomass, and the rate of cell respiration. The lakes contained water ranging from pure through eutrophic to highly eutrophic in character. It was concluded that the 6 hour duration suggested for the experiment by Knopp was too short for the lakes investigated. The relative heterotrophic activity of the bacteria was determined by the method of Godlewska-Lipowa for the water bodies and water courses investigated. According to current data the coefficient of heterotrophic activity (A/B) should increase as the pollution of water bodies and water courses increased. Use of the method revealed an inverse relation between the A/B coefficient and the extent of trophicity of the lakes in contrast to the positive correlation found by Godlewska-Lipowa in the Mazurian lakes in Poland. It was thus found in the application of the methods of Knopp and Godlewska-Lipowa to water bodies and water courses of various types and degrees of pollution that these methods do permit some assessment of potential capacity of the aquatic microflora to mineralize organic matter of the protein and carbohydrate type. However, further development is needed, and these methods cannot now be recommended as standard methods of water assessment. (Baker-FRC)
W82-02073

HYDROLOGIC AND ANTHROPOGENIC FACTORS AFFECTING WATER QUALITY IN THE RIVERS OF THE UKRAINIAN CARPATHIANS,

Akademiya Nauk URSR, Kiev. Inst. Hydrobiologii.
V. M. Shnakov.
Hydrobiological Journal, Vol 16, No 3, p 62-66, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Rivers, *Water quality. *Ukraine, *Water pollution sources, Hydrologic properties, Hydrologic aspects, Flow characteristics, Flow rates, Flow discharge, Hydrodynamics, USSR.

The Dniester, Danube and Visla basins contain the rivers of the Carpathian region of the Ukraine. The mean annual discharge of all the rivers of the region is about 15 cubic kilometers. Water consumption in the region is about 17% of the annual discharge. A large part of the wastewater discharged by the various areas of the economy is treated so as to upgrade it to established standards. A portion of the water is discharged without treatment. Basic hydrologic factors which affect the water quality of the Carpathian rivers include water content, flow rate, water temperature, the vegetation of the basin, the soils and subsoils of the basin, and the state of the water surface. An increase in the water content of rivers improves their capacity for dilution and self-purification and has a positive effect on water quality. The rivers of the southwestern slope of the Carpathians have the greatest water content. The water content of the rivers changes in the course of the year. A high water period occurs from March to August in the mountains, with the least discharge noted in winter and autumn. The Volhynian-Podolian region is typified by a spring flood, a summer low-water period, autumn floods and a winter low-water period. An increase in water temperature increases its dissolving power and content of dissolved salts. The concentration of pollutants in the river waters in the individual zones of the region differs in relation to hydrologic conditions, the siting of industrial enterprises, and population densities. The effect of the anthropogenic factor on river water quality in the region is felt up to an altitude of 400-500 meters and is increased at lower altitudes. (Baker-FRC)
W82-02076

BACTERIOPLANKTON AND PHYTOPLANKTON IN THE KIEV SECTOR OF KANEV RESERVOIR DURING THE PERIOD OF ITS FORMATION,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W82-02081

STREAM POLLUTION IN HONG KONG - AN APPRAISAL,

Hong Kong Univ. Dept. of Botany.
I. J. Hodgkiss.
Environmental Conservation, Vol 8, No 2, p 119-125, Summer, 1981. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Natural streams, *Hong Kong, *Water pollution sources, Water quality, Water law, Water pollution prevention, Environmental protection.

Stream pollution in Hong Kong is discussed, with an outline of the history of stream pollution, data on the magnitude of the present problem, and future prospects. Many of the lowland streams are severely polluted, despite government attempts to control effluent discharges to streams. Ordinances were seldom enforced in the past, but new legislation is being passed which can be effective if enforced. Until a government policy toward existing industrial dischargers is established there will be little relief. Also, agricultural discharges must be treated. If domestic, industrial, and agricultural pollution sources are controlled, stream quality can be improved. (Small-FRC)
W82-02084

HYDROCARBON CONCENTRATIONS IN WATER AND SEDIMENTS FROM UK MARINE WATERS, DETERMINED BY FLUORESCENCE SPECTROSCOPY,

Ministry of Agriculture, Fisheries and Food, Burnham-on-Crouch (England). Fisheries Lab.
R. J. Law.
Marine Pollution Bulletin, Vol 12, No 5, p 153-157, May, 1981. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Oil pollution, *Hydrocarbons, *Water analysis, *Path of pollutants, Water pollution sources, English Channel, North Sea, *United Kingdom, Irish Sea, Estuaries, Sediments, Pollutant identification, Organic compounds, Spectroscopy.

Sediment and water at the 1 meter depth were sampled in the North Sea, English Channel, Irish Sea, and several estuaries along the United Kingdom coast, January 1978 to September 1979. Fluorescence spectroscopy revealed that the mean total hydrocarbon concentrations of water samples were (in micrograms per liter, using Ekofisk light crude oil as a standard): northern North Sea, 1.3; western Channel, 1.5; eastern Channel and southern North Sea, 2.5; and Irish Sea, 2.6. Estuarine and coastal samples were higher in hydrocarbons, up to 74 micrograms per liter at the main entrance to the River Mersey, a heavily industrialized area. Sediment total hydrocarbon levels were 0.27 to 340 micrograms per g dry weight, based on Ekofisk crude oil as a standard, the higher values occurring inshore. The highest total hydrocarbon concentration in offshore sediments was 120 micrograms per g at the Norfolk gas field. Water sampling 22 days after the wreck of the tanker, Amoco Cadiz, on the Brittany coast in early 1978 showed higher concentrations than in the following year. Concentrations of hydrocarbons were higher in fine sediments than in coarse sediments. (Cassar-FRC)
W82-02097

AMERICIUM IN INTERTIDAL SEDIMENTS FROM THE COASTAL ENVIRONS OF WINDSCALE,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Marine Pollution Bulletin, Vol 12, No 5, p 149-153, May, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Americium, *Radioisotopes, *Nuclear energy, Plutonium, Water analysis, Sediments, Intertidal areas, Windscale, *Ravenglass Estuary, Path of pollutants, England.

Americium activities ranged from < 3 pCi per g to 191 pCi per g in intertidal sediments collected along the open coast and embayments of northwest England. The study centered on Ravenglass Estuary, 10 km south of the Windscale nuclear fuel reprocessing plant. Greatest activities were found in the Ravenglass Estuary (River Esk, mean 69 pCi per g; River Irt, mean 60 pCi per g). These levels are 7 times higher than levels found in sediments 10 km from Windscale in the northeast Irish Sea (15-47 pCi per g). Study of a 10 meter x 10 meter area showed no correlation of americium activity with grain size of sediment. However, americium activities ranged from 46.9 to 195.8 pCi along a transect through salt marsh (mean activity 102.8 pCi per g), silt bank (mean 65.6 pCi per g) and channel section. Explanations for this enrichment in the marshes were: (1) only spring tides at high water cover this area, and (2) the rate of sediment accumulation is slow and may allow americium formation from plutonium in the surface sediments. (Cassar-FRC)
W82-02098

5C. Effects Of Pollution

ACID PRECIPITATION,

B. Hileman.
Environmental Science and Technology, Vol 15, No 10, p 1119-1124, October, 1981. 7 Fig.

Descriptors: *Water pollution effects, *Acid rain, *Air pollution effects, *Fishkill, Air pollution, Fallout, Drinking water, Water pollution, Precipitation, Environmental effects, Aquatic life, Hydrogen ion concentration, Water pollution sources, Nitrogen compounds, Sulfuric acid, Runoff, Water pollution control.

When acid precipitation falls on areas that lack calcium carbonate, the acid is not neutralized and the runoff may acidify nearby lakes and streams killing fish and other aquatic organisms. Significant portions of Ontario, Quebec, and the eastern United States receive precipitation that is about 40 times more acidic than background values. Acid deposition into the atmosphere is caused mainly by emissions of SO2 and nitrogen oxides from the burning of fossil fuels. The sulfate ion also exchanges readily with calcium ions in soil leaving hydrogen ions behind to acidify the soil and water contained in a watershed. It has been difficult to assign a relative importance to man-made and natural sources as causative agents for acid precipitation. Acid waters tend to dissolved aluminum compounds, thus releasing aluminum ions which are very toxic to fish. Often in acidic lakes, filamentous algae and fungi proliferate. The loss of fish and many amphibians from acidified waters may affect populations of birds that feed on these organisms. Acid rain leaches many major minerals and trace metals from soils. It may also retard the decay of leaves slowing the rate of return of nutrients to the soil. Acid rain may cause drinking water supplies to become contaminated by heavy metals. Some emission control strategies and regulatory measures to control the problem are discused. (Geiger-FRC)
W82-01607

AN ALTERNATIVE FOR MEETING THE NITRATE STANDARD FOR PUBLIC WATER SUPPLIES,

Harvard School of Public Health, Boston, MA. Dept. of Epidemiology.
G. F. Craun.
Journal of Environmental Health, Vol 44, No 1, p 20-25, August, 1981. 29 Ref.

Descriptors: *Drinking water, *Nitrates, *Water pollution effects, Potable water, Nitrites, Human diseases, Diseases, Public health, Epidemiology, Water pollution sources, Water treatment, *Methemoglobinemia, Infants.

In 1945, nitrate in drinking water was first associated with methemoglobinemia in infants. The development of the disease depends on the bacterial conversion of nitrate to nitrite before or after ingestion and occurs almost exclusively in infants less than 3 months old. Most reported cases have been associated with drinking water contaminated with more than 22 mg/liter nitrate-nitrogen. Some surface water supplies, primarily reservoirs, have been found to intermittently exceed the EPA limit on nitrate levels. Many individual wells in Illinois, Kansas, Missouri, Nebraska, Oklahoma, Texas, and Wisconsin have been reported to exceed 10 mg/l nitrate nitrogen, but EPA regulations do not apply to individual water systems. A survey of 8844 wells in Illinois showed that 27% of them exceeded 10 mg/l nitrate-nitrogen and in one county in Texas some wells exceeded 110 to 690 mg/l nitrate-nitrogen levels. Water high in nitrate can be blended with water low in nitrate to produce water that does not exceed the EPA limit, but this may not be technically or economically feasible in some areas. Although technology does exist to remove nitrate from water, the treatment is considered too sophisticated for smaller water systems, and costs for equipment, operation, maintenance, and disposal of the highly concentrated waste products from treatment are expensive. A program to warn parents to substitute an alternate source of water for infant feeding has been successfully instituted in the past in some areas where the nitrate levels have exceeded the limits. For example, in two California water systems that exceeded the limit, consumers received a printed warning on every water bill, and a further warning was sent to all new parents from the county health department. (Baker-FRC)
W82-01623

INCREASED TOXICITY OF AMMONIA TO RAINBOW TROUT (SALMO GAIRDNERI) RESULTING FROM REDUCED CONCENTRATIONS OF DISSOLVED OXYGEN,

Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. V. Thurston, G. R. Phillips, R. C. Russo, and S. M. Hinkins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 983-988, August, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Ammonia, *Trout, *Dissolved oxygen, Water pollution effects, Fish, *Toxicity, Oxygen depletion, Nitrogen compounds, Rainbow trout.

Ammonia toxicity to rainbow trout (Salmo gairdneri) fingerlings increased as dissolved oxygen (D.O.) decreased over the test range 2.6-8.6 mg per liter. In 96-hour flow-through tests, some of the LC50 values (in mg NH3 per liter) ranged from 0.812 at 8.58 mg per liter D.O., to 0.316 at 2.64 mg per liter D.O. Fish were reared in water from a ground spring. Reduced D.O. concentrations were achieved by mixing this water with degassed water. The LC50 values were reached earlier at low D.O. concentrations than at high concentrations. Similar toxicity tests at 12, 24, 48, and 72 hours showed that the shorter the time period, the more pronounced the positive relationship between LC50 and D.O. concentration. This suggests that either individual fish requiring higher oxygen concentrations died early in the tests and/or the survivors became acclimatized to the ammonia. The recommended minimum D.O. concentration of 5.0 mg per liter (EPA, 1977) caused 30% less tolerance to ammonia than at 8.5 mg per liter D.O. Since any reduction below the highest tested (8.6 mg per liter) reduced tolerance of rainbow trout fingerlings to ammonia, it is recommended that water quality standards for D.O. consider the possible background levels of ammonia as well as the likelihood of temporary increases in those concentrations. (Cassar-FRC)
W82-01629

RELATIONSHIPS BETWEEN NANNOPLANKTON AND LAKE TROPHIC STATUS,

McGill Univ., Montreal (Quebec). Dept. of Biology.
S. Watson, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 960-967, August, 1981. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Trophic level, *Algae, *Nannoplankton, Plankton, Eutrophication, Water pollution effects, Lakes, *Lake Memphremagog, Biomass, Nutrients, Quebec-Vermont.

Analysis of data from Lake Memphremagog, which exhibits varying degrees of eutrophication, and published data from other lakes supported the hypotheses that as eutrophication increases (1) nannoplankton biomass increases and (2) the percentage of nannoplankton biomass decreases. This was true when trophic status was defined by total algal biomass. Seasonal means of total phosphorus, but not necessarily single measurements of total P, also correlated well with trophic status. However, the relationship of total P to hypothesis (2) was valid only in Lake Memphremagog, not in the other lakes. Net plankton had a less predictable relationship with total P than did nannoplankton. Empirical relationships to predict total nannoplankton from total algal biomass or total P were presented. (Cassar-FRC)
W82-01640

RELATING POPULATION GROWTH TO SHELLFISH BED CLOSURES: A CASE STUDY FROM NORTH CAROLINA,

East Carolina Univ., Greenville, NC. Dept. of Sociology and Anthropology.
J. R. Maiolo, and P. Tschetter.
Coastal Zone Management Journal, Vol 9, No 1, p 1-18, 1981. 1 Fig, 2 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Population dynamics, *Coastal zone management, Ecological effects, Economic impact, Environmental effects, *Shellfish, Population density, Coastal waters, Economic aspects, Shellfish farming, Cost-benefit analysis, Regression analysis, Impaired water quality, Case studies, *North Carolina.

During the 1970's legislation was passed showing local and national concern for regulating the development of coastal zones. Yet there remains a scarcity of data and methodologies for use in estimating the social and economic impacts of coastal development. In an empirical attempt to address this problem, data from two North Carolina coastal counties covering a 27-year period was analyzed. Over the time span examined, population growth in both counties was accompanied by increasing amounts of estuarine acreage closed to shellfishing due to decreased water quality along with decreased landings and exvessel values in the hard clam fishery. Specific estimates of landings and value losses per 1,000-person increase in the permanent population (as a proxy for total population) were developed by regression analysis. The economic and social consequences of coastal population growth are discussed. More research is needed on treatment of polluted waters, the cost-benefits of alternative growth patterns, and the effects on the coastal fish and shellfish markets and industry. (Geiger-FRC)
W82-01641

ACUTE TOXICITY OF INCREASED PH TO FRESHWATER SHRIMP PARATYA CURVIROSTRIS,

Auckland Regional Authority (New Zealand). Water Lab.
T. L. Shaw.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 91-93, 1981. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Hydrogen ion concentration, *Toxicity, *Shrimp, Water pollution effects, Alkaline water, Thermal powerplants, Industrial wastes, Rivers, *New Zealand, Waikato River, Freshwater shrimp.

The sensitivity of migrating freshwater shrimps to a range of pH values in the Waikato River was investigated. Migrating shrimps were trapped and exposed to pH values ranging from 7.47 through 10.66. Distributions of mortality in solutions in which death occurred were log-normal. There was no mortality in the control solution nor in those in which the initial pH was 9.50 or less. Localized increases in the pH of the river water to 9.71 would be detrimental to Paratya curvirostris populations. It is not known if the migration behavior of the shrimp would be changed or if migration would be disrupted. A thermal power station on the river has been granted a permit to discharge 8200 cu m of highly alkaline waste per day (up to 55 moles of hydroxide equivalent). The maximum concentration of hydroxide must not exceed 0.07 mM. Most of the plume should remain below pH 8.85. It is not known how these changes in the sublethal alkali concentrations will affect shrimp. (Small-FRC)
W82-01645

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-73. I. THE EFFECTS OF EUTROPHICATION ON STANDING CROP AND COMPOSITION OF PHYTOPLANKTON,

Nebraska Univ., Lincoln. School of Life Sciences.
G. L. Hergenrader.
Hydrobiologia, Vol 71, No 1/2, p 61-82, May 27, 1980. 16 Fig, 6 Tab, 33 Ref. OWRT-A-067-NEB(1), 14-34-0001-1129.

Descriptors: *Eutrophication, *Phytoplankton, *Standing crops, Turbidity, Water pollution effects, Fertilizers, Agriculture, Nutrients, Chlorophyll a, *Salt Valley, *Nebraska, *Reservoir, Species distribution, Cyanophyta, Diatoms, Eutrophic lakes, Lakes.

The effects of eutrophication on standing crop and phytoplankton composition were investigated in four Salt Valley, Nebraska, flood control reservoirs during June, July, and August 1968-1973. These impoundments, constructed in 1961-1968, receive nutrient-rich runoff from land used for

intensive row crop agriculture. The oldest reservoir, Wagon Train, differed from the other three, Branched Oak, Pawnee, and Stagecoach, in its high inorganic turbidity, which controlled the production processes and affected the phytoplankton crop. Mean summer chlorophyll a concentrations in Wagon Train were usually in the range of 25-34 mg per cu meter, with a mean high in 1973 of 56.4 mg per cu meter. In the clear water reservoirs, chlorophyll a, phytoplankton number, and phytoplankton volume were correlated with reservoir age, the oldest having chlorophyll a concentrations up to 247 mg per cu meter and mean phytoplankton volumes up to 329 cu mm per liter, values in the hypertrophic class. The clear water reservoirs had 2-6 times higher chlorophyll a contents at the end of the study, the newest reservoir showing the greatest increase. Blue-green algae (Microcystis, Aphanizomenon, and Anabaena) quickly became dominant by the second year after construction. They comprised 80-95% of the total in most years. In Wagon Train, diatoms predominated in the early years of the study, 1968-1970. All lakes were considered eutrophic or hypereutrophic and are expected to remain so unless the agricultural practices change or the clear reservoirs develop turbidity. (Cassar-FRC)
W82-01653

PERIPHYTIC COMMUNITY RESPONSE TO CHRONIC NUTRIENT ENRICHMENT BY A RESERVOIR DISCHARGE,

Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
M. D. Marcus.
Ecology, Vol 61, No 2, p 387-399, 1980. 7 Fig, 3 Tab, 65 Ref. OWRT-C-7054(6207)(3).

Descriptors: *Nutrients, *Diatoms, *Eutrophication, Nitrogen, Chlorophyll, Population dynamics, Algae, Plankton, *Reservoir releases, Downstream, Ecological effects, Streams.

This report describes periphytic development and growth in a stream below a montane reservoir with a deep-water release. The first study presented characterizes temporal and spatial periphytic growths and diatom populations on microscope slides at four stream sites below the reservoir. The second study examined increasing periphytic accumulations and diatom succession on two series of slides at a single site. Comparisons of the most upstream site with the three lower sites revealed that the discharges to Hyalite Creek stimulated periphytic productivity, increased periphytic proportions of chlorophyll a in the organic accumulations, and increased diatom species diversity and evenness. It was thought that ammonia nitrogen discharged from the reservoir was the primary factor influencing periphytic growth. Cocconeis placentula var. lineata generally dominated 70-80% of the diatom communities at the three downstream sites, whereas only three individuals of this species were noted at the upper site. Species other than Cocconeis appeared to have higher initial growth rates. Due to higher efficiencies for obtaining or incorporating limiting nitrogen resources, Cocconeis became the dominant species downstream. Species diversity at first increases and subsequently decreases as a function of resource abundance. (Baker-FRC)
W82-01658

EFFECT OF ALUMINUM SPECIATION ON FISH IN DILUTE ACIDIFIED WATERS,

Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll, Jr., J. P. Baker, J. J. Bisogni, Jr., and C. L. Schofield.
Nature (London), Vol 284, No 5752, p 161-164, March 13, 1980. 2 Fig, 1 Tab, 14 Ref. OWRT-A-073-NY(2).

Descriptors: *Acidic water, *Fish, *Aluminum, Sublethal effects, Water pollution effects, Acidity, Chemical properties, Toxicity, Hydrogen ion concentration, Speciation, Organic compounds, Fluorides, Sulfates, *Adirondack region, New York.

Water quality data were collected from several acidified lakes and streams in the Adirondack region of New York State in order to characterize aluminum chemistry in these waters and to assess the relative toxicity of various aluminum species to fish. Total aluminum levels increased dramatically with decreasing pH. Increased levels of labile aluminum, including free aluminum and aluminum fluoride, hydroxide, and sulfate complexes, accounted for most of the response to decreasing stream pH and increasing flow. Variations in organically chelated aluminum were found to be independent of hydrogen ion activity but significantly correlated with total organic carbon measurements. Aluminum complexes with dissolved organic ligands comprise the dominant fraction of aluminum in the waters studied, while fluoride complexes were the dominant inorganic aluminum species. Studies of the toxicity of various aluminum species to brook trout fry and to white sucker fry showed that complexation of aluminum with fluoride and/or with citrate significantly reduced the toxicity of aluminum solutions to these fry and that aluminum toxicity to fish is dependent on hydrogen ion activity. Aluminum toxicity to these fish decreased with decreasing pH. Fry survival rates in water treated with aluminum and complexed with fluoride and/or citrate were not significantly different from control solutions at equivalent pH values. Since organically complexed aluminum is the dominant form of aluminum species in these waters, it is suggested that measurements of total aluminum concentrations may result in substantial overestimations of potential toxicity. (Carroll-FRC)
W82-01663

THE EFFECTS OF CHLORINATED SEA WATER ON THE BLUE CRAB, CALLINECTES SAPIDUS,

College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
C. E. Laird.
PhD Dissertation, 1980. 152 p, 39 Fig, 16 Tab, 100 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-03589.

Descriptors: *Water pollution, *Toxicity, *Chlorination, *Crabs, Estuaries, Seawater, Mortality, Callinectes sapidus.

The effects of chlorinated sea water on the blue crab, Callinectes sapidus Rathbun, were evaluated through measurements of acute toxicity, serum constituents (protein, total ninhydrin positive substances, chloride, osmotic, sodium, potassium, calcium, and magnesium concentrations), oxygen consumption and ventilation rates in whole crabs, and oxygen consumption of excised gills. Histological examination of gills was also performed. The 96-hr LC50 for female blue crabs exposed to chlorinated sea water at 21 deg. C and 14 o/oo was 0.86 mgC12/1 C10 (chlorine induced osidants). The value for males under similar conditions was 0.84 mgC12/1 C10. Mortality was uncommon below 0.61 mgC12/1, but reached 100% with as little as 1.15 mgC12/1. Since magnesium regulation in the blue crab occurs at the bladder wall, the implication is that C10 acts on the crab at this internal site. This possibility compounds the already difficult problem of toxicant identification when using C10. (Sinha-OEIS)
W82-01679

PETROLEUM DEGRADATION BY NATURALLY OCCURRING POPULATIONS OF MARINE BACTERIA FROM MIDDLE ATLANTIC OUTER CONTINENTAL SHELF WATERS,

College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
For primary bibliographic entry see Field 5G.
W82-01683

PHYTOPLANKTON PHOTOSYNTHESIS AND ITS RELATION TO STANDING CROP AND NUTRIENTS IN TWO WARM-MONOMICTIC SOUTH ISLAND LAKES,

Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W82-01700

EFFECTS OF ARTIFICIAL SHADING ON PERIPHYTON AND INVERTEBRATES IN A NEW ZEALAND STREAM,

Auckland Univ., (New Zealand). Dept. of Zoology.
D. R. Towns.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 2, p 185-192, 1981. 3 Fig, 1 Tab, 32 Ref.

Descriptors: *Algal growth, *Invertebrates, *Light penetration, Stream biota, Natural streams, Snails, Caddisflies, *New Zealand, Eutrophication, Periphyton, Aquatic plants, Comparison studies, Canopy, Sunlight.

The association between longterm periphyton cover and the abundance of invertebrates was investigated by artificially shading a small section of the Waitakere River prone to extensive periphyton growth. Invertebrates were sampled in shaded and unshaded areas. Beneath the canopy, the light intensity was 6% of that recorded in the unshaded area under overcast conditions. All visible attached periphyton disappeared in the shaded area, and total detritus dry weights were significantly lower. The snail, Potamopyrgus antipodarum, dominated the shaded area and was also abundant outside of the canopy. The hydropsychid caddisfly and the blackfly were more abundant under the canopy, but all chironomid species and rhyacophilid, hydroptilid, and conoesucid caddisflies were more abundant outside. The study indicates that the fauna associated with extensive algal cover make up three groups. The first comprises species directly associated with living algal material. The second includes species which feed on the inhabitants of algal cover and/or algal detrius but are excluded from areas of extreme cover through interference with attachment sites. The third is species which are most abundant in sections prone to long-term periphyton growths, but are not affected by the removal of living algae by shading. (Small-FRC)
W82-01701

ECOLOGICAL STUDIES OF PHYTOPLANKTON IN THE WAIKATO RIVER AND ITS CATCHMENT,

Auckland Univ., (New Zealand). Dept. of Botany.
C. W. Y. Lam.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 95-103, 1981. 6 Fig, 5 Tab, 24 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Population density, Aquatic plants, Water analysis, Temperature effects, Rivers, Flow, Waikato River basin, *New Zealand, Eutrophication, Water pollution effects, *Ecological effects.

Sixty-nine genera (118 species) of phytoplankton were identified in the main streams and lakes of the Waikato River catchment. The study also included in situ readings of temperature, conductivity, and dissolved oxygen, and laboratory chemical analysis of water samples. The phytoplankton density increased downstream, reflecting the general enrichment of water from Lake Taupo to the river mouth. Changes in nutrient content that occurred between Lake Aratiatia and Lake Ohakuri were of major importance. The maximum and minimum of population density were controlled by seasonal changes of Melosira granulata var. angustissima. Temperature appeared to be an important factor controlling algal abundance. Flow rate also seemed important, but further research is needed to delineate the relative importance of flow conditions and temperature during the critical summer months. (Small-FRC)
W82-01704

ON THE USE OF CAROTENOID STRATIGRAPHY IN LAKE SEDIMENTS FOR DETECTING PAST DEVELOPMENTS OF PHYTOPLANKTON,

For primary bibliographic entry see Field 2H.
W82-01706

EFFECT OF THE COPPER CONTENT OF DISTILLERY SPENT WASH ON ITS UTILIZA-

TION FOR SINGLE-CELL PROTEIN PRODUCTION BY GEOTRICHUM CANDIDUM, HANSENULA ANOMALA AND CANDIDA KRUZEI,

New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
J. P. Quinn, T. W. Barker, and R. Marchant.
Journal of Applied Bacteriology, Vol 51, No 1, p 149-157, August, 1981. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Fermentation, *Copper, *Toxicity, Heavy metals, Yeasts, Fungi, Aquaculture, Biomass, Microorganisms, Industrial wastewater, Wastewater treatment, Water pollution effects, Chelation, Organic matter, *Whiskey distillery wastewater.

A fungus, Geotrichum candidum, and two yeasts, Hansenula anomala and Candida kruzei, obtained from Irish malt whiskey distillery spent wash, were grown in batch and continuous culture on samples of the spent wash, which contained copper at several concentrations ranging from 3.0 to 22.0 mg per liter. Maximum growth rates of G. candida were 0.294-0.337/hr at Cu concentrations of 3.0-11.5 mg per liter 0.255/hr at 17.5 mg Cu, per liter and 0.263/hr at 22.0 mg Cu per liter. This 20% reduction in growth rate at the highest Cu concentrations is less than expected because the high level of organic matter in the spent wash produces considerable complexing of the Cu, thus reducing toxicity. The biomass accumulated as much as six times the Cu present in the spent wash. In continuous culture with a mixed population of the three organisms, the biomass yields declined with increasing dilution rate and the cell Cu concentration increased, so that total Cu removed from the medium remained fairly constant. It is unlikely that the Cu levels normally found in spent wash (3-16 ppm) would inhibit the growth rate of these organisms. However, the Cu accumulated in the biomass is in excess of those recommended for animal diets. (Cassar-FRC)
W82-01750

IMPACTS OF NAVIGATIONAL DREDGING ON FISH AND WILDLIFE: A LITERATURE REVIEW,

Fish and Wildlife Service, Washington, DC. Office of Fishery Assistance.
For primary bibliographic entry see Field 6G.
W82-01768

ORGANIC SUBSTANCES IN WATER,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-01783

INFECTIOUS WATERBORNE DISEASES,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-01784

MICROBIOLOGY OF THE AQUATIC ENVIRONMENT,

Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-E, 1981. 33 p, 15 Fig, 6 Tab, 27 Ref. (Greeson, P.E., editor).

Descriptors: *Water quality, *Microbiological studies, *Aquatic environment, *Aquatic life, Ecosystems, Lakes, Reservoirs, Detritus, Decomposing organic matter, *Water pollution effects, Stormwater, Bacteria, Chemical reactions, Iron compounds, Iron bacteria.

This is the fifth of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, non-technical, easy-to-understand manner. The U.S. Geological Survey Circular contains papers on the microbiology of the aquatic environment. Briefing papers are included on 'The ecological role(s) of aquatic microorganisms in lakes and reservoirs', 'Effects of bacteria on the chemical and physical state of iron', and 'Microorganisms in stormwater: A summary of recent investigations'. (USGS)
W82-01786

BIOTA AND BIOLOGICAL PARAMETERS AS ENVIRONMENTAL INDICATORS,

Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-B, 1981. 24 p, 4 Fig, 56 Ref. (Edited by Greeson, P.E.).

Descriptors: *Water quality, *Benthos, *Aquatic life, *Environmental effects, Species diversity, Algal growth, Biomass, Adenosine triphosphate, Lake classification.

This is the second of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected biota and biological parameters as environmental indicators. Briefing papers are included on 'Species diversity and its measurement', 'Algal growth potential', 'Estimation of microbial biomass by measurement of adenosine triphosphate (ATP)', and 'Lake classification: Is there method to this madness.'. (USGS)
W82-01794

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS 1968-73. III. THE MACROINVERTEBRATE COMMUNITY: ITS DEVELOPMENT, COMPOSITION, AND CHANGE IN RESPONSE TO EUTROPHICATION,

Nebraska Univ., Lincoln. School of Life Sciences.
G. L. Hergenrader, and D. C. Lessig.
Hydrobiologia, Vol 75, No 1, p 7-25, 1980. 10 Fig, 5 Tab, 65 Ref. OWRT-A-014-NEB(8).

Descriptors: *Reservoirs, *Macroinvertebrates, *Eutrophication, Water pollution effects, *Salt Valley, Nebraska, Invertebrates, Aquatic animals, Eutrophic lakes, *Nutrients, *Agricultural runoff, Midges, Oligochaetes, Clams, Hexagenia.

The macroinvertebrate communities in four Salt Valley, Nebraska, flood control reservoirs were studied during 1968-70. All the reservoirs are shallow and eutrophic, receiving nutrients from agricultural runoff. The most recently filled reservoir was least eutorphic, although the chlorophyll a standing crop was low in the oldest (Wagon Train), which was high in inorganic turbidity. In the newest reservoir, chironomids, oligochaetes, and fingernail clams were the early colonizers. Oligochaetes and fingernail clams decreased with increasing eutrophication. Hexagenia reached a maximum in the middle of the eutrophication continuum (Pawnee) and was absent from the most eutrophic reservoir (Stagecoach). Palpomyia increased with increasing eutrophication. Chaoborus was present in all reservoirs and did not show tendencies to increase or decrease with eutrophication. Chironomids were predominant in all reservoirs in the last year of the study. Standing crop was greatest in late fall-early winter and smallest during summer. (Cassar-FRC)
W82-01797

ESTUARINE DREDGE AND FILL ACTIVITIES: A REVIEW OF IMPACTS,

Florida State Dept. of Environmental Regulation, Tallahassee,
For primary bibliographic entry see Field 2L.
W82-01805

ACUTE TOXICITY OF AN IN SITU SHALE OIL PROCESS WASTEWATER AND IT'S MAJOR COMPONENTS TO DAPHNIA MAGNA,

Colorado State Univ., Fort Collins.
L. N. Burnham, W. W. Melvin, and R. M. Buchan.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 338-343, September, 1981. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Oil shale, *Toxicity, *Industrial wastewater, Shales, Microorganisms, *Daphnia, Crustaceans, Inorganic compounds, Industrial wastes, Wastewater, Water pollution effects.

The potential environmental hazard of an in situ shale oil process wastewater to aquatic organisms was investigated by determining the acute toxicity (48 hr) of this effluent to Daphnia magna. The effluent under study was obtained from the Laramie Energy Technology Center's experimental true in situ shale oil site near Rock Springs, Wyoming. A synthetic effluent was also prepared by mixing each of the major inorganic components identified in the real effluent at the concentrations found. The acute toxicity of this synthetic mixture was then compared with that of the original samples. Differences in the acute toxicities for the two test waters, the original sample and the synthetic effluent, were significant. The original effluent was 1.5 times as toxic as the synthetic mixture. Linearity was exhibited between log concentration and mortality for both the original effluent sample and the synthetic mixture. Regression lines were parallel, indicating similar modes of toxicity. In fact, the synthetic mixture appeared to exert its toxic effect as though it were a dilution of the original effluent. While these results indicate an important role for inorganics, particularly un-ionized ammonia, in the toxicity of the original effluent, the inorganics cannot be construed to be primarily responsible for the acute toxicity demonstrated against D. magna. It appears that not all the toxic components of the original effluent have as yet been identified. (Baker-FRC)
W82-01811

COMPARISON OF LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION FOR CONCENTRATING MUTAGENS IN AMES SALMONELLA/MICROSOME ASSAYS ON WATER,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-01812

EFFECT OF AN AERIAL APPLICATION OF CARBARYL ON BROOK TROUT (SALVELINUS FONTINALIS),

Maine Univ. at Orono. Dept. of Zoology and Columbia National Fisheries Research Lab., MO.
T. A. Haines.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 534-542, October, 1981. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Fish, *Pesticides, *Water pollution effects, Maine, Carbaryl, *Trout, Organic chemicals, Toxicity, Pesticide toxicity, Streams, Water pollution sources, Small watersheds.

Carbaryl was applied to two small forested watersheds at the rate of 0.5 lb active ingredient/acre in two applications spaced 7 days apart to determine the effect of this split application on brook trout mortality, condition factor, food, and brain AChE activity. The areas chosen were drained by two small streams located in northwestern Maine. Endemic brook trout predominated in the fish fauna of both streams. Mean fish brain AChE activity was significantly lowered (15 to 34%) in fish from the Little Russel Stream; slightly smaller reductions were found in fish from Logan Brook. The results of the in situ toxicity test indicated no mortalities associated with spray application. The AChE depression in fish of the Little Russel Stream disappeared within 24 hr. The fish stomach contents, expressed as percent of body weight, did not change after the first spraying but did increase after the second. The increase in invertebrates in the stomachs after spraying resulted primarily from increased numbers of Ephmeroptera and Trichoptera, and to a lesser extent, Diptera. (Baker-FRC)
W82-01818

DETERMINATION OF MINERAL FIBER CONCENTRATIONS IN FISH TISSUES,

Environmental Research Lab.-Duluth, MN.
A. R. Batterman, and P. M. Cook.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 952-959, August, 1981. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Asbestos, *Fish, *Mineral industry, Fate of pollutants, Lake Superior, Pollutant identification, Fibers, Accumulation, Electron microscopy, Trout, Catfish, Arctic char, Anadromous fish.

Mineral fibers in fish tissue were determined by transmission electron microscopy examination after removal of water and organic matter by freeze-drying and low temperature ashing. Lake trout native to Lake Superior waters containing amphibole fibers from asbestos industry tailings had large numbers of chemically similar amphibole fibers in kidney tissue (up to 1428 fibers per mg), but only a few fibers in muscle (5 per mg) and liver (45 per mg). Only one amphibole fiber was found in all tissue samples from fish raised in the laboratory in amphibole-contaminated water. Lake trout from two locations with different fiber concentrations had corresponding differences in tissue fiber concentrations. The probable route for fiber accumulation in fish tissue is ingestion in food. The low levels of mineral fibers found in fish muscle tissue indicate that human consumption of fish from asbestos-contaminated waters is not of such great concern as asbestos-contaminated drinking water. (Cassar-FRC)
W82-01822

METHANOGENESIS IN FRESHWATER SEDIMENTS: INHERENT VARIABILITY AND EFFECTS OF ENVIRONMENTAL CONTAMINANTS,

Tennessee Univ., Knoxville. Dept. of Microbiology.
D. Pedersen, and G. S. Sayler.
Canadian Journal of Microbiology, Vol 27, No 2, p 198-205, February, 1981. 4 Fig, 5 Tab, 32 Ref.

Descriptors: *Methane bacteria, *Variability, *Sediments, Toxicity, *Water pollution effects, Lake sediments, Bacteria, Organic compounds, Polychlorinated biphenyls, Mercury, Phenanthrene, Polynuclear aromatic hydrocarbons, Paraquat, Herbicides, Coal liquefaction, Phenols, Melton Hill Reservoir, Tennessee.

The following aspects of methanogenesis in freshwater sediments were examined: temporal and spatial variability and effects of contaminants. At three sampling sites in the Melton Hill Reservoir, Tennessee, daily rates of methane production in the sediments varied substantially between replicates, among subsamples at a site, and among the three sites. Maximum rates occurred in August (24.4 plus or minus 24.6 to 764 plus or minus 75.6 nmol methane per g dry weight sediment) and minimum in January (0.3 plus or minus 0.5 to 22.2 plus or minus 4.4 nmol methane per g sediment). Statistical analysis showed that 20% of the variation in rates of methanogenesis could be attributed to the % of organic matter, 11% to pH, 6.6% to E sub h and the incubation temperature, and 3.7% to redox potential of the sediment. Neither number of methanogens nor depth of overlying water were significant in this respect. When toxicants were added to sediments, methanogenesis was inhibited at concentrations of 2570 mg per liter methyl viologen (paraquat), 100 mg per liter phenanthrene, and a 1:30 dilution of coal liquefaction waste effluent. No inhibition was seen after statistical analysis of test results from adding up to 10 mg per liter mercuric chloride or 10 mg per liter polychlorinated biphenyls. Effects of the toxicants were much slighter than expected, probably as a result of their interaction and inactivation with the sediments. (Cassar-FRC)
W82-01825

MERCURY METHYLATION BY FISH INTESTINAL CONTENTS,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. Rudd, A. Furutani, and M. A. Turner.
Applied and Environmental Microbiology, Vol 40, No 4, p 777-782, October, 1980. 2 Fig, 1 Tab, 27 Ref.

Descriptors: *Bioindicators, *Fish, *Mercury, *Methylation, Lakes, Radiometry, Bacteria, Water pollution effects, Canada, Ontario, *Wabigoon River basin.

Mercury methylation by fish intestinal contents was investigated as part of a larger project concerned with the severe mercury pollution problem of the Wabigoon River system of Northwestern Ontario. Fish were sampled from Clay Lake and Ball Lake, which are part of the Wabigoon River system, and from other nearby lakes which are not contaminated with mecury. Methylation occurred in the gut contents of fish obtained from five of the six lakes, and it occurred in all six species tested. Fish methylating activity was plotted against the total weight of intestinal contents, and something other than the quantity of food seemed to be influencing the rate of methylation. It may be the larger quantity of intestinal mucus found in the piscivorous species. Intestinal mucus is the site of the intense bacterial activity in other species and may be important here with respect to the contribution of intestinal mercury methylation to the concentration of mercury in the tissues. A radiochemical method was used which enabled the study of methylation in natural samples over short time periods. This method will be useful in the determination of mercury uptake routes. (Small-FRC)
W82-01830

NITRATES, CHLORATES AND TRIHALOMETHANES IN SWIMMING POOL WATER,

Florida International University, Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5A.
W82-01835

EFFECTS OF SEDIMENTATION ON THE GRAVELS OF AN INDUSTRIAL RIVER SYSTEM,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
A. W. H. Turnpenny, and R. Williams.
Journal of Fish Biology, Vol 17, No 6, p 681-693, December, 1980. 6 Fig, 4 Tab, 26 Ref.

Descriptors: Dissolved oxygen, *Silting, *Fish populations, Gravel, Silt, *Coal mining, Industrial wastes, Rivers, *Mine wastes, Spawning, Fish eggs, Trout, Fish stocking, *Wales, *Ecological effects.

The effects of coal industry siltation on the natural recovery of trout populations in an industrial river were assessed in the Ebbw Fawr, South Wales. Fertilized rainbow trout eggs were planted in river gravels. Dissolved oxygen content of the water was determined, as was the apparent velocity of water flow through the gravels. Survival ranged from 91% in a control group to 0% at stations below the steelworks. Oxygen deprivation was responsible for high mortalities during incubation and the production of undersized fry. A progressive decline in dissolved oxygen was found in artificial redds due to siltation with resulting stagnation of intra-gravel water. The natural limiting factor may be the behavioral responses of spawning fish, as trout will not attempt to cut a redd when gravel permeability is low and where an appreciable downwelling is not detected by the fish. Fish stocking policies and the enhancement of natural recruitment by spawning channels may partially remedy the effects of many years' pollution of the rivers of the South Wales coal area. (Small-FRC)
W82-01881

ACUTE TOXICITIES OF THE HERBICIDES KOMEEN AND HYDROTHOL-191 TO GOLDEN SHINER (NOTEMIGONUS CRYSOLEUCAS),

California State Dept. of Fish and Game, Sacramento. Water Pollution Control Lab.
B. J. Finlayson.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 4, p 676-681, October, 1980. 2 Tab, 14 Ref.

Descriptors: *Fish, *Toxicity, *Herbicides, Pesticides, Aquatic weed control, Canals, Hardness, Chemical properties, Water pollution effects, Natural waters, Laboratory studies, Komeen, Hydrothol-191.

Studies were performed in American River water (soft) and a formulated hard water to determine the toxicity of the herbicides Komeen (Copper-ethylenediamine complex; 8% copper equivalent) and Hydrothol-191 (endothall) to fish. Komeen and Hydrothol-191 were suggested for controlling Hydrilla infestation in the All American Canal System (California). No previous continuous-flow toxicity tests on representative fish species had been conducted, nor had the effects of water quality on toxicity been investigated. Golden shiners were fasted for 48 hr, and acclimated to soft water for 2 wk or to hard water for 4 days prior to testing. Flow-through bioassays were conducted in 20 liter plexiglass tanks. Komeen 96-hr LC50 values were 630 ppm in hard water and 67 ppm in soft water. Hydrothol-191 120-hr LC50 values were 0.32 ppm in hard water and 1.6 ppm in soft water. It was concluded that of the two herbicides only Komeen can be used in this environment without extensive fish loss. (Carroll-FRC)
W82-01882

THE VALUE OF ECOLOGICAL MONITORING IN THE MANAGEMENT OF PETROLEUM INDUSTRY EFFLUENT DISCHARGES: EXPERIENCE IN ESSO PETROLEUM COMPANY U.K. REFINERIES,

Esso Petroleum Co. Ltd., London (England).
For primary bibliographic entry see Field 5G.
W82-01913

GENERALIZED COMPUTER SIMULATION MODEL FOR THE IMPACT ASSESSMENT OF INDUSTRIAL WATER USE ON FISH POPULATIONS,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemistry and Environmental Engineering.
C. Kleinstreuer, and B. E. Logan.
Water Science and Technology, Vol 13, No 7, p 363-390, 1981. 13 Fig, 1 Tab, 49 Ref.

Descriptors: *Fish populations, *Powerplants, *Industrial water, Cooling water, Water pollution effects, Impingement, Industrial wastes, Intakes, *Model studies, Computer models, Fisheries, Aquatic life, Oxygen, Dissolved oxygen, Fish harvest, Environmental effects, Entrainment.

The effects of man's activities on fish populations are simulated with a computer model. In the modeling framework, fish losses are regarded as sinks to the ecosystem. A lumped parameter approach is used. Components of the model are input data (environmental boundary conditions, plant operational conditions, and data on species concentration and fish life cycles), flow sub-models (ecosystem discretization and hydrodynamic factors), water quality submodels (temperature, dissolved oxygen, and pollutants), and a fish population model (age-structured fish population and net fish losses from natural or man-induced causes). This multi-species simulation is age-structured like a Leslie matrix and predicts oscillatory behavior like the Lotka-Volterra equation. A case study using far-field fish data from Lake Dardanelle and impingement data from Arkansas Nuclear One, Russelville, reveal that impingement dynamics are a reflection of the aquatic population dynamics. Estimates for gizzard shad and white crappie populations agreed well with actual data sets. The threadfin shad population dynamics were not as comparable, probably because the temperatures used were not representative enough. This model is also useful for evaluation of powerplant site alternatives and design and the impacts of industrial wastes, sudden dissolved oxygen depletions, and excessive fishing. (Cassar-FRC)
W82-01915

VARIANCE ESTIMATES FOR A DYNAMIC EUTROPHICATION MODEL OF SAGINAW BAY, LAKE HURON,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-01917

TOXICANT ACCUMULATION IN HYDROBIONT TISSUES FOLLOWING EFFLUENT DISCHARGE,

Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
Ya. M. Grushko, O. M. Kozhova, and L. M. Mamontova.
Hydrobiological Journal, Vol 16, No 3, p 55-58, 1980. 34 Ref.

Descriptors: *Bioaccumulation, *Effluents, *Fate of pollutants, Self-purification, Heavy metals, Cadmium, Mercury, Arsenic, Zinc, Lead, Cobalt, Copper, Naphthalene, Pyrene, Toxicity, Methyl antracene, Pyrelene, Benzanthrene, Organic compounds, *Fish, Plants, Hydrobiology, Literature review, Public health.

Data has been drawn from various literature sources concerning the accumulation of toxic substances in hydrobiont tissues after the fish and aquatic organisms were exposed to effluent discharge. Cadmium, chromium, copper, lead, nickel, zinc, and silver are accumulated in fish tissues from water polluted by industrial effluents. Mercury is accumulated from water by microorganisms and by the tissues of benthic organisms and fishes. An increase in the concentration of cadmium by comparison with the environmental concentration was noted in the liver, gills and muscle tissues of fishes. Hydrophytes and rice growing in water are polluted by cadmium and accumulate it. Arsenic and chromium were also shown to accumulate in fish tissues. Some organometallic compounds were also concentrated from water in the tissues of hydrobionts. The tissues of Daphnia accumulate methylmercury. Phenylmercuric acetate is concentrated from water by fishes, mollusks, verious microorganisms and insects. Chlorinated biphenyls are concentrated by hydrobionts from water polluted by chemical industry effluents. Fish also concentrate the saturated hydrocarbons. Other organic toxicants such as insecticides and carcinogens are capable of biological accumulation in hydrobionts. The fact that many toxicants are accumulated by hydrobionts from the water of water bodies polluted by high concentrations of effluents must be taken into consideration when setting the maximum permissible concentrations of noxious substances in water bodies. The accumulation of toxicants by hydrobionts cannot be regarded as a factor in the self-purification of water bodies, as there is a risk that hydrobionts will die or that their fecundity will be reduced, and a high risk of poisoning to persons eating fish products exists. (Baker-FRC)
W82-01919

EFFECT OF SODIUM DODECYLSULFATE ON UNICELLULAR GREEN ALGAE OF THE GENUS CHLORELLA,

Akademiya Nauk URSR, Kiev. Inst. Botaniki.
L. I. Lenova, S. S. Stavskaya, and M. Ya. Ratushnaya.
Hydrobiological Journal, Vol 16, No 3, p 58-61, 1980. 5 Fig, 14 Ref.

Descriptors: *Surfactants, *Algae, Detergents, Dispersants, Soaps, Chlorella, Environmental effects, *Water pollution effects.

The effect of an individual anionic surfactant, sodium dodecylsulfate (SDS), on bacterially pure cultures of unicellular green algae of the genus Chlorella was investigated. Bacteria-free cultures of 3 intact and 23 mutant algal strains of Chlorella genus were used. In order to select strains capable of growing in the presence of surfactants, the algae under investigation were reared in agar nutrient media with SDS in various concentrations (1-200 mg/l). In the research in liquid media, the effect of the substance on the algae was assessed from the increase in biomass, counting the total number of Chlorella cells in a Goryayev chamber, and from the ratio of living to dead cells. The study showed that SDS in a concentration of 1-50 mg/l did not have an adverse effect on algal growth in rearing of C. vulgaris strains in the agarized nutrient medium. Inhibition of the growth of all the algal strains investigated, to different degrees, was noted in the presence of 100 mg/l SDS. The algae did not grow on solid media containing 200 mg/l of the surfactant. The mutant Chlorella strains behaved differently. Some inhibition of growth by comparison with controls was noted in the rearing of strains g-9, 14, 244, g-10, g-6, and 31 mut, reared on FDGA liquid medium to which surfactant was added. Microfloccules appeared in the experimental cultures of g-9, 14, g-10 and g-6, 31 mut on the fifth through sixth days, with their quantity increasing toward the end of the study. The content of dead cells increased appreciably, and cell detritus appeared. Marked inhibition of growth was noted for strains ty-0-19 and T5E12, which can be reared in the liquid nutrient medium with the surfactant. The data obtained indicate that the maximum dose of SDS that does not inhibit cell division in the algae investigated is 50 mg/l and, for only one strain, 200 mg/l. In no case was there a reduction in inhibition over time. (Baker-FRC)
W82-01920

BIOLOGICAL POLLUTION AND POLLUTION CONTROL IN CANALS DIVERTING FLOW FROM ONE RIVER BASIN TO ANOTHER,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. P. Oksiyuk, and F. B. Stol'berg.
Hydrobiological Journal, Vol 16, No 4, p 1-6, 1980. 8 Ref.

Descriptors: *Canals, *Biomass, *Eutrophication, Water quality, Aquatic life, Aquatic plants, Phytoplankton, Benthos, Agricultural runoff, Industrial wastes, Self-purification, Water transfer, Diversion channels, Diatoms, Interbasin transfer, Water treatment, *USSR.

The balance between the processes of self-purification and biological pollution in canals is dependent on the abundance of algae, and also on those characteristics of artificial watercourses that affect their self-cleansing capacity. Water in canals originating from lowland rivers and from reservoirs created on them is especially subject to biological pollution. The bloom created by diatoms is one of the major sources of biological pollution in canals diverting flow from basin to basin. Filter plants that take water from the canal experience great difficulties every year at the time of profuse growth of diatoms. The amount of phytoplankton removed at the Upper Kal'mius filter plant reaches 10 to 50 t per day. Increased amounts of coagulants (2-2.5 times) are required for water purification. Polyacrylamide is added, and intensive rinsing of the filters is carried out frequently. Activated charcoal is also used, and chlorination procedures are modified. In contrast to phytoplankton, which is directly removed from the water at pumping stations, plant foulings, large quantities of which develop on the sides of lined canals, usually emerge as an indirect source of biological pollution that has an adverse effect on water quality due to the entry of decay products into the water. The stability of the substrate in canals creates conditions conducive to the formation of a large algal biomass on the slopes, as a result of which a large amount of organic matter accumulates, and the mineralization of this matter does not proceed sufficiently. The major means of controlling biological interference is preventing entry of biogenic matter via the effluents from industrial enterprises, built-up areas, and agricultural lands. (Baker-FRC)
W82-01922

THE HYDROFLORA OF URBAN PONDS AS AN INDEX OF THEIR SANITARY AND BIOLOGICAL STATE,

Kharkov Univ. (USSR).
For primary bibliographic entry see Field 2H.
W82-01924

BIODEGRADATION OF SODIUM ALKYLBENZENESULFONATE IN PLANKTON-CONTAINING POND WATER,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W82-01925

OCCULT HEMOGLOBIN AS AN INDICATOR OF IMPINGEMENT STRESS IN FISHES,

New York State Dept. of Public Service, Albany. Office of Environmental Planning.
P. A. Isaacson, and N. J. Morrisson, III.
Progressive Fish Culturist, Vol 42, No 1, p 9, January, 1980. 1 Ref.

Descriptors: *Fish, *Fish barriers, *Powerplants, Cooling water, Fish behavior, Gills, Blood, Fish physiology, Entrainment, Stress analysis.

The use of occult hemoglobin in fish dermal mucus was assessed as an indicator of impingement stress. During the impingement process at cooling water intake sites, fish are subjected to various types of stress which can result in the death of fish. Fish collected from traveling screens at an operating power plant on the upper Hudson River were tested for stress using the hemoglobin released into the dermal mucus of the teleostean fishes as an indicator. Hemastix, a commercially available test strip, was used. The method was effective, but the test strips may be too sensitive, in that any stress including that of capture releases sufficient occult hemoglobin to give a maximum color reaction. (Small-FRC)
W82-01931

ZOOPLANKTON SPECIES DIVERSITY IN LAKE ST. CLAIR, ONTARIO, CANADA,

Windsor Univ. (Ontario). Dept. of Biology.
J. M. Winner, P. H. Patrick, and D. G. Wallen.
Hydrobiologia, Vol 75, No 1, p 57-63, October, 1980. 4 Fig, 4 Tab, 24 Ref.

Descriptors: *Lakes, *Zooplankton, *Species diversity, *Lake St. Clair, Ontario, Nutrients, Invertebrates, Water quality, Chlorophyll a, Nitrates, Phosphates, Silicates, Eutrophied lakes, Water pollution effects, Cladocerans, Copepods, Rotifers, Thames River, Primary productivity, Productivity, Urban runoff, Agricultural runoff.

Zooplankton species diversity, chlorophyll a, and water quality were studied in Lake St. Clair, Ontario, during the summer of 1971. The lake receives urban and agricultural runoff. As determined by weekly sampling at three sites the chemical parameters of the water were as follows (in g per liter): chlorophyll a, 0.02-8.65; particulate C, 25.5-270; nitrate, 2.0-55.9; total P, 0-0.033; and reactive silicate, 121-4990. Stations 1 and 2, enriched by Thames River drainage, had the highest primary productivity and zooplankton species diversity. There was no significant correlation between total zooplankton diversity and chlorophyll a. However, chlorophyll a, reactive silicate and nitrate correlated positively with cladocerans and copepods at stations 2 and 3. Rotifers were negatively correlated with chlorophyll a, nitrate, and reactive silicate. The results indicate that cladocerans, copepods, and rotifers occupy different ecological niches, and that in nutrient-rich lakes, factors other than food are limiting. (Cassar-FRC)
W82-01937

EFFECTS OF THE AQUATIC HERBICIDE 2,4-D DMA ON THE ECOLOGY OF EXPERIMENTAL PONDS,

Columbia National Fishery Research Lab., MO.
T. P. Boyle.
Environmental Pollution (Series A), Vol 21, No 1, p 35-49, January, 1980. 2 Fig, 6 Tab, 27 Ref.

Descriptors: *Aquatic life, *Herbicides, *Growth, Water pollution effects, Fish, Bluegills, Phytoplankton, Algae, Chlorophyll a, Nutrients, Macrophytes, Ecological effects, Invertebrates, Zooplankton, Aquatic weed control.

In experimental ponds the dimethylamine salt of 2,4-dichlorophenoxyacetic acid (2,4-D DMA) stimulated growth of rooted macrophytes at the 5 kg per ha application rate and stimulated photosyn-

thetic uptake of C14 in natural phytoplankton communities at concentrations of 2 mg per liter. Bluegill condition factors and growth were improved at the 10 kg per ha dose. Weights of fish were 16 g vs. 10.6 g in controls, and lengths were 9.4 cm vs. 8.4 cm in controls. Initial concentrations of 0.90 mg per liter (10 kg per ha dose) and 0.35 mg per liter (5 kg per ha dose) peaked at 7 days (1.2 and 0.60 mg per liter, respectively) and both declined to the non-detectable level of 0.1 mg per liter by 56 days. Statistical analysis of covariance by path analysis revealed that gross production in 2,4-D DMA treated ponds was related to planktonic chlorophyll a and dissolved nutrients. It was believed that nutrients leaked from plants into water and stimulated phytoplankton growth. (Cassar-FRC)
W82-01949

ECOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF DIKEROGAMMARUS HAEMOBAPHES IN THE AREAS IN WHICH HEATED WATER IS DISCHARGED FROM THE TRIPOL'YE POWER STATION,

Akademiya Nauk URSR, Kiev. Inst. Hidrologii.
L. A. Kititsyna.
Hydrobiological Journal, Vol 16, No 4, p 61-68, 1980. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Zooplankton, *Cooling water, *Heated water, Power plants, Thermal pollution, *Environmental effects, Fish food, Water pollution effects, Gammarids, Food chains, Tripol'ye power station, USSR.

The response of Dikerogammarus haemobaphes to the heated water of Knaev reservoir was determined during the three years of reservoir construction. In the area around the district power station certain changes occurred in the species composition of the benthos. As the water became warmer, Chaetogammarus ishnus and Pontogammarus were no longer dominant, but Dikerogammarus was. Samples were collected by dredge and bottom-grab, and the calorific value of the gammarids, their metabolic rate, and other indices were determined. Dikerogammarus haemobaphes had adapted well to the heated waters in the reservoir and withstood a wide range of water temperatures. They can be introduced into other cooling facilities to provide fish food. (Small-FRC)
W82-01970

A PRELIMINARY STUDY OF THE EFFECT OF PUMPED-STORAGE PLANT OPERATION ON ZOOPLANKTON,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Ya. Ya. Tseyeb, and G. A. Zhdanova.
Hydrobiological Journal, Vol 16, No 4, p 31-35, 1980. 2 Tab, 8 Ref.

Descriptors: *Zooplankton, *Hydroelectric plants, Powerplants, Plankton, Aquatic life, *Reservoirs, Entrainment, Hydroelectric power, Electric power production, *Kiev reservoirs, USSR, Ecological effects.

The effect of pumping water from the Kiev reservoirs on the qualitative and quantitative composition of the zooplankton in the pumped-storage facility was investigated. Attempts were also made to assess the general effect of the Kiev pumped-storage plant on the zooplankton of Kiev Reservoir. When the species and quantitative composition of the zooplankton of Kiev reservoir in the area of the water intake were compared it was noted that the upward pumping of water had a lethal effect on zooplankton. There were far fewer zooplankton species in the upper pumped-storage facility than in the reservoir, with the total number of species being reduced from 20 to 9 in the spring, and from 37 to 24 in the summer and autumn. The species which disappeared were those whose biomass was least, primarily Rotatoria. Among the crustaceans such large forms as Daphnia cuculiata, D. hyalina, Leptodora kindtii and Eurvtemora velox perished. The mortality of zooplankton in the downward release of the water was calculated on the basis that the figures would be equivalent to those obtained in the pumping regime of the pumped-storage station. It was established that about 1% of the initial zooplankton biomass would survive in the course of a day in the area of the water intake in the spring as a result of the successive effect of the pumping and turbine regimes of the pumped-storage plant. While the adverse effect of the Kiev pumped-storage hydroelectric plant is manifested in the almost total death of the zooplankton entering its sphere, it is ultimately very weak and cannot appreciably affect the food resources of fishes consuming zooplankton. (Baker-FRC)
W82-01971

DREDGED MATERIAL EVALUATIONS: CORRELATIONS BETWEEN CHEMICAL AND BIOLOGICAL EVALUATION PROCEDURES,

R. A. Laskowski-Hoke, and B. L. Prater.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1260-1262, July, 1981. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Dredging, *Sediments, *Benthic fauna, Pollutant identification, Water pollution effects, Bioindicators, Bioassay, *Lake Michigan, Lake sediments, Chemical analysis, Ecological effects, Invertebrates, *Spoil disposal, Evalution.

A bulk sediment-chemistry evaluation procedure (EPA Regions V and IX) and an elutriate test (U.S. Army Corps of Engineers) were compared with a bioassay technique as a means of evaluating disposal methods for dredged material. Forty sediment samples collected in 1977 from Lake Michigan were analyzed. The elutriate process required analysis of ammonia, COD, total P, total Kjeldahl N, nitrate, nitrite, chloride, sulfate, and 8 heavy metals. The sediment-chemistry technique relied on analysis of total Kjeldahl N, total P, COD, sieve size, oil, grease, cyanide, and 11 metals. Test organisms for the bioassay were Pimephales promelas Rafinesque, Hexagenia limbata Walsh, Lirceus fontinalis Rafinesque, and Daphnia magna Straus. Statistical analysis of results indicated that a combination of bulk sediment-chemistry and sediment bioassays would be the most efficient and ecologically sound approach to evaluating the effects of dredged materials on benthic communities. (Cassar-FRC)
W82-01985

A NEW METHOD FOR ASSESSING THE LETHAL IMPACT OF SHORT-TERM, HIGH-LEVEL DISCHARGES OF POLLUTANTS ON AQUATIC ANIMALS,

Sunderland Polytechnic (England). Dept. of Biology.
P. D. Abel.
Water Science and Technology, Vol 13, No 7, p 347-352, 1981. 5 Fig, 1 Tab, 3 Ref.

Descriptors: *Water pollution effects, *Aquatic animals, *Copper, *Pesticides, *Toxicity, *Lindane, Insecticides, Chlorinated hydrocarbons, Mortality, Lethal limit, Poisons, Pesticide toxicity.

The effects of the organochlorine pesticide, lindane, and of copper on Gammarus pulex were investigated by a new method designed to evaluate the lethal impact on aquatic animals of brief exposure to high concentrations of water pollutants. Results demonstrated that animal mortality due to a brief exposure to high levels of a poison may continue for up to 3 weeks after the initial exposure. Combinations of exposure time and poison concentration which result in appreciable mortality were sometimes lower than continuous exposure mortality values of conventional toxicity test systems. The present method is considered more useful than conventional toxicity test procedures in predicting the outcome of water pollution incidents involving the brief discharge of high levels of pollutants. (Geiger-FRC)
W82-01993

TEMPERATURE TOLERANCE AND THE FINAL PREFERENDUM - RAPID METHODS FOR THE ASSESSMENT OF OPTIMUM GROWTH TEMPERATURES,

Tromso Univ. (Norway). Inst. for Fiskerifag.
M. Jobling.
Journal of Fish Biology, Vol 19, No 4, p 439-455, October, 1981. 2 Fig, 2 Tab, 138 Ref.

Descriptors: *Heated water, *Fish, Water pollution effects, Thermal pollution, Thermal water, Powerplants, Cooling water, Industrial water, Thermal stress, Growth, *Ecological effects, Literature review.

Correlations were sought between the preferred temperature, temperature tolerance, and optimum growth for some species of fish. Values for growth optima, final preferenda and temperature tolerance were extracted from the published literature, and correlations were drawn between these indicators of thermal requirements. These values are listed in a table by species. Linear regression analyses were used to show relationships among temperature requirements of fishes. The analysis of the data suggested that the final preference gives a good indication of the optimum temperature for growth. Thus the determination of the preferenda could be used as a rapid method for estimating the temperature required to promote maximum growth of fishes. A good correlation was also found between lethal temperature and optimum temperature for growth. Such information is valuable in determining possible ill effects on fish from the discharge of cooling water from power generating stations, with the resultant addition of waste heat to natural waters. (Baker-FRC)
W82-01996

DYNAMICS OF CARP GROWTH AND BIOSYNTHETIC PROCESSES IN THE LIVER OF THE CARP REARED IN CONTAINERS IN HEATED WASTE WATER FROM THEMAL POWER STATIONS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. Yu. Yevtushenko, and V. D. Romanenko.
Hydrobiological Journal, Vol 16, No 4, p 58-61, 1980. 1 Fig, 7 Ref.

Descriptors: *Heated water, *Fish, Growth, *Carp, Thermal stress, Temperature effects, *Water pollution effects, Thermal powerplants, Powerplants, Thermal power, Cooling water, *Thermal pollution.

Carp were raised in containers in heated wastewater from thermal power stations to determine the effect of the heated water on the growth of the fish. The study revealed uneven accumulation of body biomass at different stages in the vegetation period in the rearing of the carp. A definite relationship was established between the growth rate of the carp and its initial mass. The relative mass increment of the body of carp of different initial mass during the first month of such rearing was slightly retarded in comparison with the following months of rearing. At the same time, the difference in the relative increments of carp of the different weight groups in the initial period of container rearing was not significant. A sharp increase in the growth rate of the carp in the containers was noted in July. The relative increase in the body mass of the first group of fish was 121.2% relative to the previous month, while in the second experimental group it had increased over this period by 160.3%. The rate of biosynthetic processes in the liver was relatively high during the initial period of rearing, one month after the stocking of the containers. Beginning in the second half of August, the rate of uptake of radiocarbon into organic compounds extractable from the liver of carp caught in August declined by comparison with the previous month by 22.1%. An even lower rate of uptake of the radioactivity was noted in autumn. The data revealed a higher growth rate of the carp in container rearing in warm water in July through August. The relative increment in the body mass of the fish declined sharply in the second half of August, in spite of the fact that the water temperature in the water used for cooling purposes remained fairly high at that time. (Baker-FRC)
W82-01998

PARASITE OVA IN ANAEROBICALLY DIGESTED SLUDGE,

Cutter Lab., Shawnee, KS. Bayvet Div.
For primary bibliographic entry see Field 5B.
W82-02018

EFFECT OF DIFFERENT WATER SALINITY LEVELS AND ORGANIC MATTER APPLICATION ON THE COMPOSITION OF WATER SOLUBLE AND EXCHANGEABLE BASES IN A BRACKISHWATER FISH POND SOIL,

Central Inland Fisheries Research Inst., Barrackpore (India).
For primary bibliographic entry see Field 2H.
W82-02027

PLANT BIOTESTS IN THE BIOINDICATION OF THE RAINFALL POLLUTION IN AN OIL REFINERY REGION,

Akademia Rolniczej, Warsaw (Poland). Inst. of Environmental Protection.
D. Zukowska-Wieszczek, and H. Zimny.
Plant and Soil, Vol 55, No 2, p 321-325, 1980. 4 Tab, 5 Ref.

Descriptors: *Rainwater, *Chemical composition, *Water pollution sources, *Acid rain, Chemical analysis, Acidity, Heavy metals, Sulfates, Nitrates, Industrial wastes, Plant growth, Cucumbers, Beans, Beetrouts, Water pollution effects, Bioindicators, Environmental effects, Oil industry, Europe.

Rainfall was collected during spring and summer at four points localized in the vicinity of the largest oil refinery in Europe. The rain water was analyzed chemically by atomic absorption spectroscopy. Sulfur was estimated by nephelometric methods, chlorine was measured argentometrically and pH, electrometrically. Beans, beetroot and cucumber were grown in the rainwater. Rainwater collected near the industrial and oil refinery regions had a pH value ranging from 2.4 to 4.4. Chemical analysis showed that the water was high in minerals and pollution by heavy metal ions as well as having increased acidity due to sulfates, nitrates and nitrites. The germination capacity of seeds treated with rain water from the refinery region was significantly decreased in comparison to those germinating on distilled water. Impairment of seed germination capacity was higher for seeds germinating on water from the summer than from the spring rainfalls. Seedling growth, while vigorous at first, soon showed signs of shortening and thickening of the hypocotyl and maceration of root-cap. Beetroot showed the most significant changes. (Baker-FRC)
W82-02033

MICROBIAL POLLUTION OF COASTS AND ESTUARIES: THE PUBLIC HEALTH IMPLICATIONS,

PHLS Centre for Applied Microbiology and Research, Porton Down, Wiltshire (England). Reference Laboratory for Environmental Hygiene.
G. I. Barrow.
Water Pollution Control, Vol 80, No 2, p 221-230, 1981. 15 Ref.

Descriptors: *Estuaries, *Pollution load, *Public health, Microorganisms, Coasts, *Effluents, Estuarine environment, Shellfish, Recreation, Water use, Swimming, *Great Britain.

Potential microbial health hazards and their relation to sewage pollution of estuaries and coastal waters in Britain are considered. The risks essentially concern the possibility of infection from bathing and from the consumption of molluscan shellfish. Rivers have traditionally been used to carry domestic sewage and industrial effluents. Even efficient sewage treatment does not remove all bacteria and other micro-organisms. The presence of any microbial pathogens in coastal waters presents potential health risks. There is no absolute relationship between the presence of a pathogen and the risks of contracting the associated disease, even in susceptible persons, and each case must be considered on its merits. Basic knowledge of the reservoir of a pathogen, its origin, mode of spread, route of infection, and the degree of susceptibility of the community or individual are all factors which need to be examined. No significant evidence has been gained linking the degree of sewage contamination of coastal or other waters with defined diseases. No public health evidence exists in the United Kingdom to suggest that either bathing or the consumption of shellfish should be prohibited solely due to non-compliance with any of the microbiological parameters specified in the EEC directives. (Baker-FRC)
W82-02051

THE EFFECTS OF MINE DRAINAGE AND ORGANIC ENRICHMENT ON BENTHOS IN THE RIVER NENT SYSTEM, NORTHERN PENNINES,

Freshwater Biological Association, Wareham (England). River Lab.
P. D. Armitage.
Hydrobiologia, Vol 74, No 2, p 119-128, September, 1980. 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Zinc, *Benthic fauna, *Mine drainage, *Water pollution effects, Heavy metals, Rivers, Streams, *Nent River, Algal growth, Nutrients, Aquatic animals, Mine wastes, Acid mine drainage, Organic wastes, *England.

Lead mining in the River Nent system, northern England, reached its peak in the 18th century. Except for brief operation of a flotation plant in 1942-43, there has been no mining activity there since 1921. This paper reports the impact on the benthic fauna of zinc and other heavy metals, acid mine drainage, and organic enrichment from agricultural and domestic sources. Sites were divided into three zinc areas (low, 0.01-0.36 mg per liter; medium, 0.77-1.68 mg per liter; and high, 2.08-7.60 mg per liter) and one acid site. Zn levels were negatively correlated with numbers of taxa. At mainstream sites with Zn levels of 0.7-1.7 mg per liter massive growths of the Zn- and pollution-resistance alga Stigeoclonium tenue were associated with low faunal abundance. Chandler biotic scores showed a downward trend from the river's source to the junction with the River Tyne. No sign of improvement in the water quality was seen 8 km downstream of the major Zn input. Relationships between the acid water section, the Ca concentrations, and the Zn levels with respect to toxicity are discussed. (Cassar-FRC)
W82-02053

EFFECTS OF POLLUTION UPON THE BENTHOS OF BELFAST LOUGH,

Northern Ireland Department of Agriculture, Coleraine, Fisheries Research Laboratory.
J. G. Parker.
Marine Pollution Bulletin, Vol 11, No 3, p 80-83, March, 1980. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Benthos, *Water pollution effects, *Belfast Lough, *Northern Ireland, Benthic fauna, Salinity, Temperature effects, Bays, Path of pollutants, Harbors.

Belfast Lough, a bay lying between the North Channel and the mouth of the River Lagan, is the receiving water for the domestic and industrial wastewater from the city iof Belfast and other towns surrounding the lough. Benthic studies are being conducted to determine the effects of pollution on the spatial pattern of benthic life in the bay. Samples obtained from 41 sites resulted in the collection of about 40,000 specimens of benthic fauna. Three of the sampling sites in the harbor area yielded no benthic macrofauna. Sites within the docks area which did support benthic fauna were dominated by Oligochaeta, followed by polychaetes. The distribution of polychaetes, which dominated the fauna of 19 of the sampling sites, showed a significant positive correlation with graphic kurtosis, but not with any other environmental factor. The distribution of Oligochaeta, which were next in order of abundance and dominated 11 sampling sites, was not significantly associated with salinity, but did decrease significantly with distance from Belfast, with depth, and with surface temperature. The distribution of Isopoda, which were third in order of abundance, was not significantly associated with any of the physical or chemical parameters investigated. Amphipods, which dominated six ampling sites although they were slightly less abundant than isopods, were the only species significantly correlated with salinity. The results of this study indicate that benthic fauna in the harbor area suffers from the gross effects of pollution, while fauna in the outer lough is subjected to diffusely distributed pollutants. (Carroll-FRC)
W82-02059

SEASONAL VARIATIONS IN THE ACTUAL FECUNDITY OF DAPHNIA MAGNA IN A LABORATORY CULTURE,

Moscow State Univ. (USSR).
Ye. F. Isakova.
Hydrobiological Journal, Vol 16, No 4, p 69-71, 1980. 1 Fig, 11 Ref.

Descriptors: *Daphnia, *Cultures, *Water pollution effects, Rivers, *Moscow River, Productivity, Crustaceans, Floods, Runoff, Growth, Population dynamics, Seasonal variation, USSR.

The object of this study was to determine changes in the survival rate and fecundity of Daphnia cultivated in water from the Moscow River in different seasons. Seventy-eight consecutive generations of the parthenogenetically reproducing crustacean D. magna were investigated. Twice during the study near 100% mortalities of the Daphnia were recorded. The first occurrence was in March 1974, when water was taken from the river during the spring flood. The second time water had a lethal effect on Daphnia occurred between the middle of July and September of 1975. The summer of 1975 was one of frequent thunder storms and torrential rain. Hydrochemical analysis of the river water at this period showed that the total biological oxygen demand (BOD) was double the normal level. Ammonium content was also doubled, which indicated organic pollution of the water. It is probable that runoff from the fields and atmospheric precipitation had a lethal effect on the hydrobionts. Several alternating periods of raised or lowered fecundity were noted during the study. Seasonal variations in the abundance of plankton crustaceans are due under natural conditions both to changes in environmental factors and to interactions within an between populations. The findings allowed the conclusion that the fluctuations in the indices of the survival of Daphnia in water from the Moscow River are not governed by seasonal factors, but are dependent on the quality of the water, in particular on its content of toxic ingredients. A periodic reduction in fecundity was noted in the winter and in the summer months. (Baker-FRC)
W82-02083

WANTED: WATER FOR DEVELOPMENT,

For primary bibliographic entry see Field 6D.
W82-02088

WATER QUALITY MANAGEMENT OF LAKE NEUSIEDLER, AUSTRIA,

Federal Inst. on Water Resources Research (Switzerland).
H. Fleckseder.
Aqua, No 5, p 3-7, 1981. 1 Fig, 9 Ref.

Descriptors: *Water quality, *Eutrophication, Phosphorus, Water management, Water quality management, Water quality control, *Lake Neusiedler, *Austria, Water treatment facilities.

Lake Neusiedler, Austria, is extremely shallow, with an average depth of some 2 meters. During its history the lake has dried up completely several times. In the north, west and south, the drainage area is formed by a mountainous ridge, whereas in the east it is flat and a surface drainage line cannot be easily drawn. The sub-surface drainage area seems to be even more complicated. The total lake area varies between 250 and 300 square kilometers, with the open water amounting to 130 to 160 square kilometers. Waulka Creek is the largest permanent discharge into Neusiedler See. A marked eutrophication was noted by limnologists investigating the lake during the last decade. The cause was traced to increased input of phosphorus. Data available suggest that such a shallow area of

water can be easily endangered by an imbalance in its water budget, an increase in the area of the reedbelt, and additional phenomena of eutrophication. One quarter of the drainage area is utilized intensively for agriculture with high nutritional dosing for growing grapes, sugar beet, vegetables and other crops. Some 15% of the drainage area consists of forest, 2% of orchards, 2% of sealed surfaces, an additional 2% occupied by Lacken (brackish ponds) and 1% by swamp. The climatic properties of the area and the large evapotranspiration of the lake are of prime importance for the microclimate in the area directly surrounding the lake. At least once a year, if possible under peak conditions, every water treatment plant is checked in a 24 hr run for load entering, load leaving, oxygen uptake, iron dosed and additional features. (Baker-FRC)
W82-02090

SOME EFFECTS OF SEWAGE DISCHARGE UPON PHYTOPLANKTON IN HONG KONG,

Fisheries Research Station, Aberdeen (Hong Kong).
G. B. Thompson, and J. Ho.
Marine Pollution Bulletin, Vol 12, No 5, p 158-173, May, 1981. 5 Fig, 22 Ref.

Descriptors: *Phytoplankton, *Wastewater disposal, *Species composition, *Chlorophyll a, *Hong Kong, Coastal waters, Estuaries, Water pollution sources, Water pollution effects.

Chlorophyll a and species composition were determined in the coastal waters of Hong Kong, December 1974 to July 1976, to survey the impact of 280 million tons of untreated sewage which is discharged into Victoria Harbor each year. Chlorophyll a in the western coastal area, characterized by estuarine conditions, was 2-6 micrograms per liter (maximum 8.3 micrograms per liter). In the central section, Victoria Harbor, site of the sewage outfalls, chlorophyll a levels were as high as 20.2 micrograms per liter. To the east, where oceanic conditions prevail, chlorophyll a reached a maximum of 2.6 micrograms per liter. Taxonomic diversity was unaffected by pollution except in summer, when Chaetoceros spp. were predominant in net phytoplankton samples. During autumn early winter, Skeletonema costatum was abundant in the polluted Victoria Harbor area. (Cassar-FRC)
W82-02095

5D. Waste Treatment Processes

COMPOSITION OF FRUIT AND VEGETABLE PROCESSING WASTES,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
B. A. Prior, and H. J. Potgieter.
Water SA, Vol 7, No 3, p 155-159, July, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Food-processing wastes, *Byproducts, *Carbohydrates, Effluents, Fruit crops, Vegetable crops, Waste disposal, Aquaculture.

The composition and variability of effluent produced by pineapple and fruit and vegetable canneries were investigated over a one year period. All samples were analyzed for: chemical oxygen demand, Kjeldahl nitrogen, phosphorus, carbohydrate, reducing sugars, pH, and microbial count. The effluents were found to be especially rich in carbohydrates. For pineapple effluent, the mean weekly carbohydrate concentration was 19.8 g/liter, the daily mean was 20.3 g/liter, and the hourly mean was [illegible]4.2 g/liter. The weekly mean carbohydrate concentration in effluent of the fruit and vegetable cannery was 2.1 g/liter for stream A and 1.9 g/liter for stream B. Treatment of the effluent by biological wastewater treatment methods would be difficult because of the low nitrogen and phosphorus contents relative to the high COD. Conversion of the pineapple effluent into yeast protein is feasible. An alternative would be to produce ethanol. The fruit and vegetable cannery effluent is not suitable for by-product recovery, and a traditional disposal technique such as land disposal should be considered. This effluent may have to be screened before piping, and gypsum may have to be added to counteract the sodium. (Small-FRC)
W82-01601

STEP FED PLUG FLOW REACTOR FOR BIOLOGICAL WASTEWATER TREATMENT VERSUS CONTINUOUS FLOW STIRRED TANK REACTOR (CFSTR),

Technion-Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
M. Green, and G. Shelef.
Journal of Environmental Sciences, Vol 24, No 4, p 25-26, July/August, 1981. 1 Fig, 8 Ref.

Descriptors: *Wastewater treatment, *Plug flow, Sludge, Effluents, Flow, Continuous flow, Suspended solids, Biological oxygen demand, Activated sludge process, Activated sludge, Comparison studies.

The two general categories of continuous flow reactors in use for handling wastewater are the ideal continuous flow stirred tank reactor (CFSTR) and the ideal plug flow reactor. These two categories are compared in this paper. CFSTRs are characterized by essentially constant levels of solids, organic matter, and oxygen demand throughout the reactor. CFSTRs for biological wastewater treatment usually operate under severe substrate limiting conditions, dictated by the final effluent quality requirements. The efficiency of these systems is relatively low, as the specific substrate removal rate is proportional to the substrate concentration. The nominal sludge age is higher than the bacterial lifetime, so most of the sludge cells are dead. The ideal plug flow is defined as a laminar flow under conditions of perfect mixing in the lateral plane and no mixing in the longitudinal direction. A step fed plug flow reactor is a special case of a plug flow reactor in which the reactor receives the inflow in several points throughout its length. A higher sludge viability is achieved. A step fed plug flow reactor for biological wastewater treatment inherently has two advantages over a CSTR. The first is the possibility of working under substrate saturation conditions and hence under conditions of high specific substrate removal rates, and the second, an increase in the biomass net growth rate along the system, which results in a higher sludge viability. To achieve a maximum removal efficiency, a step fed plug flow system should be highly loaded along most of its length, while to achieve high performance the end section of the plug flow reactor should remain without feeding and allow for enough flow time to obtain highly polished effluent. Studies have shown that the use of sewage conveyance conduits for wastewater treatment by biological sludge introduction and air can give effluent of secondary quality. (Baker-FRC)
W82-01618

INFLUENCE ON GROUNDWATER FROM THE BERMED INFILTRATION POND,

Dorchester County Health Department, Cambridge, MD.
L. W. Coble, Jr.
Journal of Environmental Health, Vol 44, No 1, p 27-31, August, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Groundwater pollution, *Ponds, *Infiltration, *Wastewater disposal, Domestic wastes, Municipal wastes, Wastes, *Wastewater treatment, Bacteria, Septic tanks, Groundwater recharge, Aerobic conditions, Aerobic treatment, Water pollution sources.

The bermed (diked) infiltration pond concept involves pretreating household wastes by means of a conventional septic tank with the effluent being pumped to an open or closed sand filter, and subsequently to the pond. The household wastes may also be pretreated by an aerobic treatment unit and pumped directly to the pond. Dilution, surface area, chemical reactions, and algae action are all involved in final treatment of the pretreated wastewater in the pond. Large volumes of water enter the pond from precipitation, surface drainage from inside the berm, and the pretreated wastewater. Water leaves the pond by evaporation and infiltration. The pond excavation must expose a permeable water-bearing substratum that will transmit water. The water-bearing substratum helps to maintain the pond water level, which would otherwise be lowered by evaporation during the summer months. The bermed infiltration pond allows unconfined groundwater recharge. The large pond size provides storage capacity and adequate infiltration area to allow effective infiltration during the wet season when water tables are highest and percolation rates retarded by saturated soil conditions. The pretreatment of the household wastewater is sufficient to allow further treatment in the bermed infiltration pond without the pond becoming anaerobic. Movement of nitrate nitrogen and growth of coliform and fecal coliform bacteria are not observed in the groundwater outside the pond excavation. Movement of chlorides and phosphorus in the groundwater can be expected about 150 feet from the pond. Therefore, increased deep well separation distances from 50 to 150 feet for this source of contamination and large parcel size requirements are justified to protect the residents' and adjacent property owners' water supplies. (Baker-FRC)
W82-01622

NITROUS OXIDE EMISSION FROM SIMULATED OVERLAND FLOW WASTEWATER TREATMENT SYSTEMS,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
C. J. Smith, R. L. Chen, and W. H. Patrick, Jr.
Soil Biology and Biochemistry, Vol 13, No 4, p 275-278, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Nitrous oxide, *Land disposal, *Wastewater treatment, Wastewater disposal, Waste disposal, Nitrogen, Ammonia, Overland flow, Flow, *Air pollution sources.

The contribution of overland flow wastewater treatment systems to the atmospheric concentration of nitrous oxide was investigated. A low permeability Mhoon slit loam soil from Baton Rouge, Louisiana was used in the study. Soil preparation involved air drying and sieving. About 27 kg air-dried limed or unlimed Mhoon soil was uniformly packed into each of 4 test models to a depth of 10 cm. The soil was compacted to a bulk density similar to that existing under natural conditions. The soil surface was seeded with perennial ryegrass at a rate of 100 g/square meter and watered occasionally with tapwater until germination. The models were maintained for 4 weeks by adding wastewater to establish the sod and establish a nearly constant rate of N transformations. Wastewater used was a secondary treated effluent from the Baton Rouge treatment plant. The overland flow system of wastewater disposal produced or caused a net nitrous oxide evolution to the atmosphere. Liming the soil increased the nitrous oxide evolution about 4-fold in comparison to that of the unlimed soil receiving wastewater containing 10 microg ammonium-nitrogen/ml. The rate of nitrous oxide evolution from the limed and unlimed soil systems was estimated to be 6.0 and 1.5 kg nitrous oxide-nitrogen/ha/yr, respectively. The increased rate of nitrous oxide evolution observed when the soil pH was increased from 5.8 to 7.1 is possibly due to an increase in the nitrification and denitrification rates. The mechanism for the production of nitrous oxide in the soil-plant microcosm is not known. (Baker-FRC)
W82-01624

CENTURY-OLD BOARD MILL OPERATES WITH ZERO EFFLUENT DISCHARGE,

J. C. W. Evans.
Pulp and Paper, Vol 55, No 7, p 98-99, July, 1981.

Descriptors: *Pulp and paper industry, *Waste recovery, *Recycling, *Water reuse, Performance evaluation, Wastewater treatment, Filtration, Flocculation, Clarification, Industrial wastes, Biocides, Corrosion control.

The Halltown Paperboard Company mill, located on a stream emptying into the Shenandoah River, has been recycling all effluent from its production of paperboard from wastepaper since 1969. Before

the changeover to recycling of its waste water, the mill occasionally had to close due to water shortages. To eliminate the need for freshwater in the system, some internal 'closed loops' such as liner white water from the paper machine was recirculated back to the liner pulper. An old stream bed running under the mill carries all effluent back to a pumping station. From here, the effluent is pumped to the water treatment clarifier and the fiber is recovered by Hydrasieves. Sludge is pumped from the bottom of the clarifier to the filler pulper. Clarified water is aerated and stored for use in the liner and filler pulpers. Suspended solids in the clarifier are settled by the polymer used as a drainage aid. Biocides are used to control bacteria and slime. The mill has experienced breakdowns in the clarifier, causing spills into the nearby stream, as well as many other failures in the closed system. Use of stainless steel has corrected severe corrosion problems, and the need for constant maintenance is slowly diminishing. (Geiger-FRC)
W82-01626

USING ZETA POTENTIAL TO OPTIMIZE COAGULATING AID DOSES USED TO TREAT FOOD PROCESSING WASTES,

Cornell Univ., Ithaca, NY. Dept. of Food Science.
F. W. Welsh, and R. R. Zall.
Process Biochemistry, Vol 16, No 4, p 31-33, 42, June/July, 1981. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Food-processing wastes, *Zeta potential, Monitoring, Industrial wastes, Suspended solids, *Coagulation, *Wastewater treatment, Water treatment, Chemical oxygen demand.

The purpose of this paper is to indicate a use for zeta potential analysis as a method of monitoring coagulation processes used in treating food processing liquid waste effluents. Three different kinds of food processing liquid waste effluents were studied: from a fruit juice processing operation, from a scallop shucking operation, and from an egg washing operation. Jar test results for the three wastes were compared to zeta potentials. The fruit juice processing waste effluent samples were an example of the low colloidal concentration type of waste. A small net zeta potential change, from the initial zeta potential to the optimum zeta potential, occurred with the minimization of sample turbidity. Food processing wastes containing large amounts of colloidal materials are more easily treated with coagulants. This improved coagulant treatability of the waste must also be observable from the zeta potential analysis results. The scallop shucking wastewater was an example of a colloidal type of waste. For this waste, the net zeta potential change was 15 mv. The waste parameter concentration removed from the scallop shucking waste effluent at its optimum coagulant does was significantly different from its pH adjusted counterpart. The largest net zeta potential change (30 mv) was noted with the egg washing effluent. This highly colloidal effluent also exhibited the largest suspended solids reduction. A first order relationship was noted between the changes in the colloidal solids concentration as measured by suspended solids, content of the waste and the net change in zeta potential. Thus coagulant treatability of a food processing waste effluent is a function of the zeta potential change, as it is affected by the suspended solids change of the wastewater. Zeta potential can be used to monitor coagulation processes for effluent treatment. (Baker-FRC)
W82-01627

REMOVAL OF ORGANICS FROM WATER BY GRANULAR ACTIVATED CARBON AND MICROORGANISMS,

National Coal Board, Stoke Orchard (England). Coal Research Establishment.
J. Wilson.
Process Biochemistry, Vol 16, No 4, p 9-12, June/July, 1981. 2 Fig, 38 Ref.

Descriptors: *Water treatment, *Activated carbon, Carbon adsorption, Microorganisms, Bacteria, Biological treatment, Reviews, *Wastewater treatment, *Organic compounds, Dissolved solids.

While the treatment of wastewater by biological methods is widespread, the treated water may remain contaminated and unsuitable for discharge to waterways. As an extra treatment stage to remove soluble organics that persist an obvious development is the use of granular activated carbon (GAC) along with biological treatment. Experiences of enhanced removal of organics from contaminated water by GAC as a result of adventitious biological activity on the GAC have been reported for a number of cases ranging from pilot to full-scale plants. A large advanced water treatment pilot plant at Pomona, California is cited where municipal wastewater was treated. At this plant of 45 cubic meter/hr capacity, effluent from an activated sludge plant was passed downwards through GAC columns. Removal of organics was better than expected; this was attributed to the action of biological flora that had become established adventitiously in the GAC beds. Early experience with the nuisance of sulfide emission, caused by anaerobic biological activity on sulfates in the water, was obtained at the Blue Plains Advanced water treatment plant, operating at 8 cubic meter/hour capacity on municipal wastewater. The addition of sodium nitrate to the GAC influent stopped sulfide emission and enhanced biological oxidation on GAC. The combination of ozone and GAC with biological activity is of increasing interest in wastewater treatment, especially in the US, and some case histories are cited. A method of regeneration has been developed that relies on biological activity as an alternative to thermal processes. Disadvantages of biological activity on GAC and areas needing further study include: the nature of the compounds produced by bacterial action, including toxicity; high bacterial counts in GAC effluents; and the production of polar, partly adsorbable compounds with the use of ozone. (Baker-FRC)
W82-01628

WATER REUSE: ULTRAFILTRATION OF INDUSTRIAL AND MUNICIPAL WASTEWATERS,

Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and K. W. Plaumann.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1206-1212, July, 1981. 4 Fig, 7 Tab, 19 Ref. OWRT-R-0048(7809)(1), 14-34-0001-7809.

Descriptors: *Ultrafiltration, *Water reuse, *Industrial wastes, Filtration, Wastewater treatment, Municipal wastes, Membrane filters, Performance evaluation, Organic carbon, Separation techniques.

The potential role for ultrafiltration in industrial and municipal water reuse was evaluated, working with plate-and-frame systems and wastewaters from the textile, food, pulp and paper, and general manufacturing industries, and from a wastewater treatment plant. An on-site study was performed using secondary effluent from a municipal wastewater treatment plant. The wastewaters most suitable for ultrafiltration appeared to be: textile bleach, oily waste, secondary effluent, polyvinyl alcohol, and pulp and paper waste in that order. More than 40% total organic carbon was removed using a fluoro-polymer membrane; for pulp and paper waste, 58% total organic carbon removal was obtained with a cellulosic membrane. The secondary effluent study found about 50% total organic carbon removal with fluoro-polymer, polysulfone, and polytetrafluoroethylene membranes. A typical minimum energy requirement was 4.60 k Wh/cu m for the filtration of secondary effluent with a polysulfone membrane. (Small-FRC)
W82-01652

THE EFFECTS OF SECONDARY SEWAGE EFFLUENT ON THE WATER QUALITY, NUTRIENT CYCLES AND MASS BALANCES, AND ACCUMULATION OF SOIL ORGANIC MATTER IN CYPRESS DOMES,

Florida Univ., Gainesville.
For primary bibliographic entry see Field 5G.
W82-01687

WATER PURIFICATION STUDIES WITH ACTIVATED CARBON AND FOAM FLOTATION,

Vanderbilt Univ., Nashville, TN.
N. A. K. Mumallah.
PhD Dissertation, 1980. 156 p, 19 Fig, 33 Tab, 121 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-01683.

Descriptors: *Wastewater treatment, *Separation techniques, Water pollution control, Water purification, *Foam separation, Heavy metals, Flotation.

The floc foam flotation of chromium (III) with ferric hydroxide and NLS; the precipitate foam flotation of copper using the chelating agents dodecyldithiocarbamate and LIX-reagents; precipitate flotation of nickel, cobalt, manganese, zinc and cadmium with LIX-reagents; and precipitate flotation of copper, manganese and zinc using mono lauryl phosphate are reported. The effects of pH, ionic strength and the presence of interfering anions such as SO4(2-), HPO4(2-) and EDTA on these foam flotations have been investigated. The objectives of the work were to develop a satisfactory flotation method for chromium and to examine the abilities of some novel chelating surfactants to carry out effective flotation in the presence of ions which interfere with NLS. (Sinha-OEIS)
W82-01692

SLOWHILL COPSE SEWAGE TREATMENT WORKS.

Water Services, Vol 85, No 1025, p 335-337, July, 1981. 7 Fig.

Descriptors: *Wastewater facilities, *Wastewater treatment, Water treatment facilities, Sewer systems, Primary wastewater treatment, Advanced wastewater treatment, Sludge, *Southampton, *England.

A description is offered of the new sewage treatment works at Slowhill Copse. The new works is being built in two phases. Phase I, already operational, provides preliminary treatment and primary settlement for all present flows, which are then discharged to Southampton Water via the original works outfall. The maximum design dry weather flow for phase 1 is 23,270 cubic meters/day from a contributing population of about 45,000 persons. Phase 2 will complete the project and will provide the secondary and sludge treatment processes, with effluent to Royal Commission standard being discharged to Southampton Water via a new works outfall of 1350 mm diameter. The main structures being built for phase 2 are aeration channels, final settlement tanks, return activated sludge system, sludge consolidation tanks, sludge treatment buildings, pipelines, services and roads. The main structures of phase 1 include primary settlement tanks, storm tanks, modifications to the existing primary sedimentation tanks, the electrical and control buildings and associated pipelines and services. The works follow a conventional pattern of treatment such as screening, grit removal, primary settlement, biological treatment by surface aeration, and final settlement. The major building structure is the sludge treatment building, which comprises a deep basement housing the sludge pumping equipment and wet wells, a sludge thickening hall which houses two Komline Sanderson flotation thickener units, and the associated chemical dosing and compressed air units. (Baker-FRC)
W82-01727

PARASITE EGG AND CYST REDUCTION IN OXIDATION DITCHES AND AERATED LAGOONS,

National Environmental Engineering Research Inst., Nagpur (India).
P. V. R. C. Panicker, and K. P. Krishnamoorthi.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1413-1419, September, 1981. 9 Fig, 3 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Oxidation, *Parasites, Oxidation ditches, Oxidation lagoons, Oxidation ponds, Ponds, Effluents, Human diseases, *Aerated lagoons, Public health, *India.

The efficiency of removal of helminth eggs and protozoan cysts in nonconventional pilot wastewater treatment systems such as the oxida-

tion ditch and aerated lagoon at the Nagpur campus of the National Environmental Engineering Research Institute was examined. Egg and cyst counts in individual raw wastewater samples varied from 122 to 860 organisms per liter. In raw wastewater, protozoan cysts (Entamoeba histolytica and Giardia lamblia) formed the majority, whereas the helminth eggs were comparatively fewer in number. The majority of protozoan cysts and helminth eggs were removed during the process of treatment in the oxidation ditch. The efficiency of the oxidation ditch as a means of removing the parasites compares favorably with that of the activated sludge process, with the removal of Ascaris in a majority of samples ranging from 95 to 100%. During this study the biochemical oxygen demand reduction ranged from 95 to 99%, and the effluent BOD was up to 10 mg/liter. With a three day detention time, the average BOD removal in the lagoon was 81.4%. BOD of the final effluent ranged between 12 and 45 mg/l, with an average of 27 mg/l. The presence of relatively large numbers of cysts and eggs in the lagoon effluents indicates improper settling. Addition of a settling tank is needed to improve the quality of the effluent. The present study did not include variability experiments. No correlation was found in this study between the removal of parasites and some operational conditions such as increased retention time, SRT, or MLVSS. Removal efficiency in the aerated lagoon was less than that of the oxidation ditch. (Baker-FRC)
W82-01733

EFFECT OF THE COPPER CONTENT OF DISTILLERY SPENT WASH ON ITS UTILIZATION FOR SINGLE-CELL PROTEIN PRODUCTION BY GEOTRICHUM CANDIDUM, HANSENULA ANOMALA AND CANDIDA KRUZEI,

New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-01750

EFFECT OF REAGENT MIXING RATE ON ADSORPTION PROCESS FOR AM-FE2O3.H2O,

Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W82-01799

REMOVAL OF ELEMENTAL MERCURY FROM WASTEWATERS USING POLYSULFIDES,

Domtar Ltd. Research Center, Senneville (Ontario).
D. M. Findlay, and R. A. N. McLean.
Environmental Science and Technology, Vol 15, No 11, p 1388-1390, November, 1981. 1 Tab, 8 Ref.

Descriptors: *Sodium polysulfide, *Mercury, *Chloralkali plants, Sulfides, Polysulfides, *Wastewater treatment, Chemical wastewater, Industrial wastewater, Metals, Heavy metals.

Sodium polysulfides removed both elemental and ionic mercury from wastewater and sludge from a Hg cell chloralkali plant. In plant operation, addition of 20 ppm sodium polysulfide to the existing treatment (37 ppm sodium hydrosulfide and 75 ppm FeCl3) reduced Hg concentration to an average of 11 ppb, compared to 87 ppb without Na polysulfide. The sludge resulting from brine treatment contained 150 ppb elemental Hg and 5200 ppb total Hg. Various treatments reduced Hg concentrations to the following levels: 50 ppm Na hydrosulfide alone, 30 ppb elemental and 430 ppb total; Na polysulfide alone, 3 ppb elemental and 65 ppb total; and 50 ppm of each, 3 ppb elemental and 53 ppb total. In a brine sludge sample with 720 ppb elemental Hg and 1390 ppb total Hg polysulfide alone reduced concentrations of Hg to 1 ppb and 20-30 ppb, respectively. Best results are obtained when pH is maintained at 9-12, polysulfide solution is less than 1 week old, chlorine or hypochlorite are removed, and 75-100 ppm FeCl3 is added as a flocculant. (Cassar-FRC)
W82-01800

PRECIPITATE FLOTATION STUDIES WITH MONOLAURYL PHOSPHATE AND MONOLAURYLDITHIOCARBAMATE,

Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
N. A. Mumallah, and D. J. Wilson.
Separation Science and Technology, Vol 16, No 3, p 213-228, 1981. 1 Fig, 6 Tab, 35 Ref.

Descriptors: *Chemical precipitation, *Flotation, *Metals, *Ions, Copper, Zinc, Magnesium, Monolauryl phosphate, Lauryldithiocarbamate, Chelating agents, *Wastewater treatment, Industrial wastes, Separation techniques.

The precipitate flotation of copper(II), manganese(II), and zinc(II) with monolauryl phosphate was investigated at various pH's and ionic strengths. Also, the potential of lauryldithiocarbamate to chelate copper(II) and remove it by foam flotation was evaluated at various pH's and in the presence of various anions which show interference in the removal of Cu(II) by flotation. At pH's of 7-10, very good removal of Cu(II) precipitated as the hydroxide followed flotation, but below pH 7 removal was difficult. When Cu(II) was coprecipitated with ferric hydroxide and floated with lauryl phosphate, good removal was also obtained in the pH range 1-10. Mn(II) was removed successfully by flotation with lauryl phosphate in less than 10 min, and Zn(II) removal was successful when Zn(II) was coprecipitated with ferric hydroxide in the ratio Fe:Zn of 2 or more and at pH's of 8.5-10. Lauryl phosphate was much better than sodium lauryl sulfate, dithiocarbamate, or other commercial reagents in removing transition metal ions from aqueous solution. (Small-FRC)
W82-01863

DETROIT'S WWTP: ONE OF THE WORLD'S BIGGEST,

Detroit Dept. of Water Supply, MI. Water and Sewer Treatment.
A. C. Davanzo.
Water/Engineering and Management, Vol 128, No 9, p 38-41, September, 1981.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Sludge disposal, Sewage systems, Phosphorus removal, Water pollution prevention, Remote control, Effluent limitations, Water quality standards, Aeration, Incineration, Waste disposal, *Wastewater facilities, Detroit.

The Detroit wastewater treatment plant, which provides treatment for over 76 communities, is described. An extensive sewage collection network with monitoring devices forms the backbone of the system. Work to build interceptors to collect the flow of perpendicular trunk sewers was delayed until 1940. At present the plant processes an average of 650 mgd, with peaks to 900 mgd. Pumping, primary treatment and solids disposal capacities were expanded in the 1950's and 1960's to meet increased loads from an increasing population. In the 1960's plans were made to improve effluent discharges by phosphorus removal. An oxygen aeration system was also adopted in the early 1970's. Some effluent quality problems arose in the latter part of this decade, which were handled by increased staff and better training of plant personnel. Solids disposal is still a problem. Fourteen multiple hearth incinerators are used to handle solids; however, measures to meet air pollution standards are still being studied. Industrial wastes contribute large amounts of grease, which is handled by landfilling. Inlet modifications have solved the problems of the peripheral inflow/outflow clarifiers. (Geiger-FRC)
W82-01865

SIMPLE RETENTION TIME ANALYSIS IN TRICKLING FILTERS USING CONDUCTIVITY,

Trinity Coll., Dublin (Ireland).
N. F. Gray.
Effluent and Water Treatment Journal, Vol 21, No 8, p 345-347, August, 1981. 3 Fig, 12 Ref.

Descriptors: *Trickling filters, *Conductivity, *Tracers, *Retention time, Sodium chloride, Performance evaluation, Costs, *Wastewater treatment.

A comprehensive assessment was performed of all the non-radioactive tracers available for the measurement of retention time in trickling filters. Sodium chloride was the most convenient. The rate of adsorption of the chloride by the biological film was relatively constant, especially over short periods of time. Also, it had only an extremely slight effect on the treatment process, and consequently a low environmental impact. Sodium chloride has a low bulk cost when compared to other possible tracers. A simple conductivity meter and cell can be used to monitor the chloride. The method is simple, rapid, reproducible, and economical, making it possible to include the regular measurement of retention time in the routine assessment of trickling filter efficiency. (Small-FRC)
W82-01876

A MULTILEVEL MODEL AND ALGORITHM FOR SOME MULTIOBJECTIVE PROBLEMS,

Chiyoda Chemical Engineering and Construction Co. Ltd., Yokohama (Japan).
For primary bibliographic entry see Field 6A.
W82-01884

ACTIVATED SLUDGE NICKEL TOXICITY STUDIES,

Chulalongkorn Univ., Bangkok (Thailand). Inst. of Environmental Research.
S. Sujarittanonta, and J. H. Sherrard.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1314-1322, August, 1981. 7 Fig, 1 Tab, 30 Ref.

Descriptors: *Activated sludge process, *Nickel, *Toxicity, Heavy metals, Metals, Nitrification, Wastewater treatment, Biological treatment, Microorganisms, Aerobic digestion, Organic loading.

The effects of nickel on the activated sludge process were studied in three laboratory experimental units and a control and found to depend on COD:Ni(2+) ratio, microorganism concentration:Ni(2+) ratio, and operating mean cell residence time. The feed solutions contained: (1) 1 mg per liter Ni(2+) and 396 mg per liter COD, (2) 5 mg per liter Ni(2+) and 391 mg per liter COD, and (3) 1 mg per liter Ni(2+) and 787 mg per liter COD. In all three feed solutions Ni reduced COD removal efficiency slightly as compared to the control, indicating that activated sludge performance was not influenced by metal ion concentration alone but was also dependent on wastewater strength and mean cell residence time. Nitrification was significantly inhibited by solutions (1) and (2) but not by solution (3). Nitrifying organisms were much more sensitive to Ni than were heterotrophic organisms. Both COD removal efficiency and toxicity to nitrifiers appeared to be dependent on the ratio of COD:Ni(2+) rather than on the concentration of Ni(2+) alone. Values of Y max (microorganism cell yield) and b (maintenance energy coefficient) were higher in solutions (1) and (2) than in the control. This was attributed to a shift in microbial species as a response to Ni or to the stimulatory effects of Ni on microbial activity. Microorganism concentration increased with increased mean cell residence time, and toxicity was related to the ratio of Ni concentration to biomass concentration. (Cassar-FRC)
W82-01895

EXTRACTION OF COPPER WITH LIQUID SURFACTANT MEMBRANES,

Kyushu Univ., Fukuoka (Japan). Dept. of Organic Synthesis.
F. Nakashio, and K. Kondo.
Separation Science and Technology, Vol 15, No 4, p 1171-1191, 1980. 13 Fig, 23 Ref.

Descriptors: *Wastewater treatment, *Copper, *Surfactants, Separation techniques, Heavy metals, Chelating agents, *Membrane filters, Solvents, Hydrogen ion concentration, Metallurgy, Metals, Metal complexes.

Interest in the application of solvent extraction for the recovery of metals has increased, especially in

industrial resource recycling, hydrometallurgical processing and waste water treatment. The extraction of copper using liquid surfactant membranes containing a mobile carrier was conducted in a stirred transfer cell. The resistance of the diffusion step in the liquid surfactant membrane was negligible when compared with that of the diffusion step along with chelating complex formation in the extraneous aqueous solution. Initial rates of copper extraction varied inversely as the 0.5 power of hydrogen-ion concentration at low pH levels, but were not affected by hydrogen-ion concentrations at high pH levels. In the low pH range, the initial rate of copper extraction was proportional to the level of benzoylacetone, the mobile carrier in the membranes. At high pH and high benzoylacetone levels, the initial rate of copper extraction was affected very little by the concentration of the mobile carrier. The batch-type stirred tank findings support a model of liquid surfactant membranes which is presented. Further work is needed on the effects of emulsion breakdown which may occur after longer treatment periods. (Geiger-FRC)
W82-01896

OXYGEN BLEACHING SHOWS POTENTIAL FOR REDUCING COSTS, EFFLUENT PROBLEMS,

MoDo-Chemetics, A. B., Ornskoldsvik (Sweden).
L. Almberg, A. Jamieson, and S. Waldestam.
Pulp and Paper, Vol 54, No 3, p 92-95, March, 1980. 4 Fig, 6 Tab, 5 Ref.

Descriptors: *Bleaching wastes, *Oxygen, *Pulp and paper industry, Biological treatment, Economic aspects, Cost, Performance evaluation, Wastewater treatment, Industrial wastes.

A comparative economic analysis was made of oxygen bleaching vs. biological treatment at a mill making fully bleached softwood kraft pulp. Two cases were examined: one where the mill already exists and the pollution abatement process is added, and the other where a more extensive investment is contemplated. Installation of an oxygen stage in an existing bleach line will permit reduction in pollution quantities by 42-79% while saving up to $1/ton of pulp after allowing for depreciation. The capital cost would be about $8.8 million. In a new plant, installation of an oxygen bleaching sequence instead of a non-oxygen sequence would reduce pollution by 35 to 60%, while saving about $5/ton of pulp after allowing for depreciation. The extra capital costs would be about $4.9 million. Energy costs are an area of current concern, and mills can generate much or all of the direct energy required from waste liquor or wood. Sequence plays a major role in making the mill less sensitive to future oil prices. (Small-FRC)
W82-01899

SELECTIVE REMOVAL OF HEAVY METAL IONS FROM AQUEOUS SOLUTIONS BY DIAFILTRATION OF MACROMOLECULAR COMPLEXES,

Forschungsinst. Berghof G.m.b.H., Tuebingen (Germany, F.R.).
H. Strathmann.
Separation Science and Technology, Vol 15, No 4, p 1135-1152, 1980. 11 Fig, 3 Tab, 5 Ref.

Descriptors: *Heavy metals, *Membrane filters, *Ultrafiltration, *Industrial wastes, Separation techniques, Ion exchange, Waste water treatment, Filtration, Chelating agents, Mathematical equations, Precipitation, Metal complexes.

A method for selectively removing heavy metal ions from aqueous solutions by a combined process of ultrafiltration and treatment with macromolecular chelating agents or emulsified liquid ion exchange materials is described. The macromolecular complex should have high selectivity, water solubility and binding capacity, and narrow molecular weight distribution. The membrane should exhibit high flux and a sharp molecular weight cut-off. Mathematical equations for determining the enrichment factor, complex capacity and polymer solubility are given, and fractional losses of metal due to incomplete rejection of the complex are discussed. Necessary conditions for polarization, polymer precipitation, and the emulsified liquid ion exchanger are outlined. Chelating agents are evaluated in terms of their selectivity, capacity, and load factor. The selective removal of heavy metal ions from industrial effluents was examined in laboratory tests. (Geiger-FRC)
W82-01900

ENVIRONMENTAL DESIGN AND OPERATION OF NANTICOKE THERMAL GENERATING STATION,

Ontario Hydro, Toronto. Central Thermal Services.
P. M. Wiancko.
Journal of Great Lakes Research, Vol 7, No 2, p 96-104, 1981. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Industrial wastes, *Thermal powerplants, *Monitoring, *Environmental effects, Water pollution sources, *Lake Erie, Canada, Wastewater treatment, *Nanticoke Thermal Generating Station.

The various systems of the Nanticoke Thermal Generating Station which interface with the environment are described, and monitoring activities designed to monitor possible environmental effects are outlined. The 4,000 MW fossil-fueled plant is located on the north shore of Long Point Bay on Lake Erie. Up to 150 cu m/sec of cooling water is used: 60% for condenser cooling and 40% for discharge tempering. Chemical-laden wastes, fly ash and bottom ash, treatment plant wastes, coal pile drainage, and sewage are retained in a 76 ha lagoon for about forty days. The lagoon drains constantly into the lake at a rate of 0.4 cu m/sec. The station monitors all water processing and waste systems, air quality (for SO2), fugitive coal dust, fish impingement, and seasonal stack impingement of migrating birds. To date, the aquatic environment in the area has remained relatively stable. (Small-FRC)
W82-01907

TECHNOLOGY AND PERFORMANCE OF THE HI-CAPACITY THICKENER,

Envirotech Corp., Salt Lake City, UT.
R. C. Emmett, and R. P. Klepper.
Mining Engineering, Vol 32, No 8, p 1264-1269, August, 1980. 4 Fig, 3 Tab, 3 Ref.

Descriptors: *Mine wastes, *Flocculation, *Clarification, *Wastewater treatment, Industrial wastewater, Coal, Uranium, Iron, Ores, Coagulation, High capacity thickener, Pilot plants, Thickeners, Separation techniques.

The high capacity thickener (HCT) for clarifying mining wastes was studied on the pilot plant scale using wastewaters from coal, uranium, and iron ore processes. Feeds from 4 coal preparation plants (3 producing refuse tailings from froth flotation, and 1 producing a -28 mesh size fraction of coal and refuse) containing 2-15% solids were treated in the HCT with 1-30 ppm anionic thickener. Underflow solids concentrations of 25-39 weight % were produced at 10 times the conventional loading rate. Iron ore concentrate and acid soluble precipitate from a uranium process were successfully treated in a pilot plant with little operator attention. Using iron ore tailings, the HCT also performed comparably to conventional thickeners at the same flocculation dosage. The HCT produced underflow concentrations as high as 63% from a feed containing neutral uranium ore without any difficulty. Maximum benefits from flocculation may be obtained by: mechanical flash mixing of flocculant and pulp, staged addition (at least three stages) of flocculant, introduction of flocculated slurry beneath the pulp level, damping feed fluctuation by inclining the plate zone in the region above the feed inlet, sufficient compression volume beneath the feed inlet, higher than normal raking torque, and reliable instrumentation and control systems. (Cassar-FRC)
W82-01929

SUBSTRATE FLUX INTO BIOFILMS OF ANY THICKNESS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, and P. L. McCarty.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 831-849, August, 1981. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Bacteria, *Substrates, *Fluctuations, Mathematical models, Biomass, Films, *Wastewater treatment, Biological wastewater treatment, Nutrients, Water treatment.

Bacteria which grow as fixed films may have a significant influence on many biological processes in nature and in water and wastewater treatment plants. Steady-state biofilms are defined as those which are not growing or decaying over time. The substrate flux and thickness of a steady-state biofilm can be predicted from the substrate concentration and fundamental biofilm parameters and are based on the kinetics and energetics of substrate utilization and biofilm growth. A model has been developed for estimating the substrate flux into a biofilm of any thickness. The inclusion of mass-transport resistance in the model causes the flux to become a direct function of the bulk substrate concentration. This model can be used to predict the flux of a single, rate-limiting substrate when the biofilm thickness is independently known, even though the biofilm thickness can be nonsteady-state. This may happen when a biofilm at varying bulk substrate concentrations is exposed to fluctuations in wastewater. In such a situation, biofilm thickness might be determined based on longer-term average utilization rates. Experiments with short-term changes in substrate loading demonstrated that removal of substrates to levels below the minimum concentration of rate-limiting substrate able to sustain steady-state biofilm can be accomplished in the short term by nonsteady-state biofilms which undergo net decay and that the model can successfully predict substrate utilization from independently derived parameters if reasonable estimates of the biofilm thickness are available. (Carroll-FRC)
W82-01964

HYDRAULIC MODELING FOR WASTE STABILIZATION PONDS,

Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and D. R. F. Harleman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 817-830, August, 1981. 9 Fig, 1 Tab, 14 Ref.

Descriptors: *Hydraulic models, *Stabilization ponds, *Wastewater treatment, Performance evaluation, Mathematical models, Simulation analysis, Water quality, Flow characteristics.

The hydraulic transport and the biological and chemical transformation processes within a waste stabilization pond determine the treatment performance. Efforts were made to identify the appropriate hydraulic design of waste stabilization ponds using dye tracer studies and model simulations to indicate the efficiency of various pond geometries and inlet and outlet configurations. Some of the test ponds were found to have treatment efficiencies well below that of completely-mixed flow, and avoidance of these configurations is recommended. None of the ponds tested achieved the efficiency of plug flow. Evaluation of hydraulic models for water quality simulation in waste stabilization ponds showed that treatment efficiencies predicted by the completely-mixed flow model compared well with those determined by analysis of dye tracer studies. This comparison was based on treatment efficiency for first-order decaying substances at steady state. The development of a return flow model which realistically represents the transport process is reported. The model uses three input parameters: the dispersion coefficient in the active zone, the size of the active zone, and the dilution ratio. (Carroll-FRC)
W82-01965

MANAGING WATER AT HELICOPTER PLANT,

B. Rose.

Industrial Finishing, Vol 56, No 1, p 34-36, January, 1980.

Descriptors: *Reclaimed water, *Water costs, *Metal-finishing wastes, Water management, Wastewater treatment, Boiler water, Water reuse, Industrial wastewater, Aircraft, Chromium, Metals.

The use of reclaimed water has saved $60,000 a year in water and waste treatment costs and $20,000 a year in fuel costs for the Bell Helicopter Textron plant. The chromate rinse waters plus other selected wastes are routed to a surge tank, where the pH is adjusted to 6-7, if necessary. Wastewater is pumped into the reduction unit at the rate of 50 gpm. Here hexavalent chromium at concentrations of 50-60 mg per liter is continually reduced to the trivalent state by an electrochemical process using consumable iron electrodes. Further treatment involves a lamella separator, addition of polyelectrolytes, and sand filtration. The treated water, of higher quality than city or well water, is used as boiler feed water. Concentrated wastes from other processes are treated prior to discharge to the municipal sewer system. The $330,000 reclamation system has paid for itself 3 times over in about 2 years by reducing city water consumption and sewer charges, allowing boiler water to be recycled less often, and lessening the demand on the waste treatment system. (Cassar-FRC)
W82-01974

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: THEORY,

Duke Univ., Durham, NC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-01980

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: APPLICATIONS,

Duke Univ., Durham, NC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01981

COMBINING SEWER WATER PURIFICATION PROCESSES TO TREAT EFFLUENTS PRODUCED BY TRANSIENT POPULATIONS,

Limoges Univ. (France). Fondation de L'Eau Limoges.
G. Casteignau.
Water Science and Technology, Vol 13, No 7, p 315-329, 1981. 5 Fig, 4 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Combined treatment, *Chemical treatment, *Population dynamics, Pilot plants, Organic carbon, Phosphorus, Nitrogen, Nitrification, Nutrient removal, Chemical coagulation, Coagulation, Flocculation, France.

The added sewage produced by transient populations, especially in leisure resorts of coastal areas, sometimes exceeds the purification capacity of biological wastewater treatment processes. Comparative studies carried out in the field and in pilot plants demonstrate the value of adding coagulation-flocculation treatment to the biological treatment of sewage in areas of transient populations. The transfer of nitrogen, phosphorus and carbon charges was analyzed to evaluate the effectiveness of combined chemical and biological treatment. The production of sludge and sludge treatment by various processing patterns are compared, along with management strategies for operating combined units for the biological/physicochemical treatment of increased loadings of wastewater due to transient populations. (Geiger-FRC)
W82-01992

CONTROL OF BARK LANDFILL LEACHATES WITH AN ANAEROBIC TREATMENT SYSTEM,

Stora Kopparberg-Bergvik, Skutskar (Sweden).
S. Rydin, and P. Haglund.
Tappi, Vol 64, No 8, p 59-62, August, 1981. 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Pulp and paper industry, *Wood wastes, *Leachates, Anaerobic conditions, *Wastewater treatment, Industrial wastes, Landfills, Bark, Methane, Water pollution control.

A pulp mill developed a bark landfill to treat bark leachates, reducing BOD by 90% and COD by 60%. The landfill itself acted as an aerobic filter, on which a stable methane-forming bacteria developed. In the present full-scale system, leachate from the landfill is collected in ditches, sent to a buffer pond (3000 cu meters), and pumped over the bark at 1 cu meter per min. Although the process is pH-dependent, it has not been necessary to adjust the pH, probably because some lime sludge is present. Stopping the recycling for any reason causes a temporary drop in COD removed. Heavy rain or snowmelt has not interfered, and the heat produced evaporates excess water. The installation cost $150,000, one-tenth the cost of other alternatives. (Cassar-FRC)
W82-02006

THE FLOWERING OF WASTEWATER TREATMENT,

Utah State Univ., Logan. Coll. of Engineering.
E. J. Middlebrooks, and S. C. Reed.
Water/Engineering and Management, Vol 128, No 6, p 51-54, June, 1981. 2 Tab.

Descriptors: *Wastewater treatment, *Aquatic plants, Water treatment facilities, Design criteria, Nutrients, Biological oxygen demand, Suspended solids, *Water hyacinth.

The use of aquatic plants in wastewater treatment systems to reduce the concentration of contaminants to levels equivalent to secondary, advanced secondary and tertiary effluents has been proposed and tried on a small scale over the past 10 years. The water hyacinth plant in particular appears to have potential for application in small community wastewater treatment facilities. Most commonly a stabilization pond is incorporated, followed by a series of water hyacinth culturing tanks which can produce an advanced secondary effluent. A properly designed facility is efficient, economical, and requires very little energy input. There should be no odor problem and it can be impractical in cold regions. Thus far all operations using the water hyacinth cover less than 4 hectares in area, and most are smaller than one hectare. Hyacinth systems processing a secondary effluent can be designed to handle about 2,000 cubic meters/ha/day if the principal objective is to control BOD 5 and suspended solids in the effluent. If nutrient removal is the most important consideration, the best hydraulic loadin ragte has not yet been established. Most systems have been designed to operate with three cells in series. If the purpose is to remove nutrients, it is necessary to maontain the hyacinth culture in an active growth phase, requiring that harvesting be conducted frequently. (Baker-FRC)
W82-02015

LIMNOLOGY AND PERFORMANCE OF WASTE TREATMENT LAGOONS,

Technische Univ., Dresden (German D.R.).
D. Uhlmann.
Hydrobiologia, Vol 72, No 1/2, p 21-30, July, 1980. 8 Fig, 12 Ref.

Descriptors: *Ponds, *Lagoons, *Wastewater lagoons, Wastewater treatment, *Limnology, Daphnia, Biological oxygen demand, Phytoplankton, Zooplankton, Bacteria, Sewage bacteria, Dissolved oxygen.

Sewage treatment lagoons arranged in series sever some of the connections between parts of the food web. Generally the first cell is the main site of bacterial activity, which decomposes solid and dissolved organic matter to form methane. In the second cell phytoplankton and associated bacteria operate under aerobic conditions. If the BOD load of the third cell does not exceed 5 g per cu meters per day and temperatures are not too low, high concentrations of Daphnia and other filter feeding zooplankton further reduce bacterial counts to 99% of the count in the first cell inflow. This water can be used for irrigation. Temporal fluctuations in bacteria, phytoplankton, zooplankton, and dissolved oxygen can range over two orders of magnitude. Even after upsets due to weather conditions and unusual growths, systems return to a clear water state. These ponds are usually resistant to mixing, except in tropical lowlands with warm nights, where short-circuiting is the normal situation. A chart depicts the BOD removal as a function of BOD load and residence time of the water. For example, the rate coefficient of BOD removal is 0.21 per day for 10 days residence time and BOD load of 25 g per cu meter per day. (Cassar-FRC)
W82-02026

POLLUTION FROM FARMS,

Thames Water Authority, London (England).
R. P. Wheeler.
Effluent and Water Treatment Journal, Vol 20, No 2, p 61, 63-65, February, 1980. 3 Tab, 12 Ref.

Descriptors: *Farm wastes, *Animal wastes, *Waste treatment, Water pollution sources, Hogs, Dairy industry, Wastes, Manure, Organic wastes, Farm lagoons, Lagoons, Land application, England, Wales.

In 1977 warnings were issued on 1293 cases of farm waste pollution in England and Wales. The largest percentage of these violations were concerned with dairy and yard washings and overflowing or breaking banks of manure stores. The same situations were responsible for most of the total of 76 violations in the Thames Water Authority area in 1978. A table lists the types of farm wastes and their BOD in mg per liter: silage, 40,000; piggeries, 10,000; cowstalls, 3,000; dairy produce, 1,800; and poultry processing, 1,000. Many methods of waste treatment have proved uneconomical for the farmer. A compromise is minimal partial treatment to consolidate solid material, aeration, and storage in tanks or lagoons. After six months storage, the waste can be land applied. One Berkshire pig farmer used a centrifuge to separate the solids, sprayed the aerated effluent on land, and sold the dry wastes as fertilizer. (Cassar-FRC)
W82-02039

THE SEWERAGE POLICY OF THAMES WATER,

Thames Water Authority (England).
For primary bibliographic entry see Field 6E.
W82-02040

POLLUTION SOLUTIONS–THE WIRE DRAWING INDUSTRY,

Effluent and Water Treatment Journal, Vol 20, No 6, p 299, 301, 303, June, 1980. 1 Fig, 2 Tab.

Descriptors: *Wire industry, *Heavy metals, *Sedipac clarifier, Wastewater treatment, Metal finishing industry, Industrial wastewater, Effluent standards, Metals, Clarifiers.

The Sedipac clarifier, a high performance tilted tube separation system, is used in the Tinsley Wire (Sheffield) Limited plant for removing metal hydroxides from neutralized mixed effluent. The automatically monitored and controlled system operates at surface loadings of 6-7 cu m per sq m per hour. A mixing tank allows for buffering in case of a highly polluted flow. Sludge is discharged to a thickening and holding tank for subsequent filtration. Since the plant's startup early in 1980, 92% of the total effluent volume has conformed to river discharge standards. It is expected that 99% compliance will be reached after the staff gains more experience. The raw untreated rinsewater contains (in ppm) 734 Fe, 112 Zn, 5 Cu, 39 Pb, 1 Cd, and 45 N. Treated effluent mean levels are well below consent levels. Only the maximum Cu and Pb concentrations slightly exceeded standards on occasion. (Cassar-FRC)
W82-02041

DEVELOPMENTS IN INSTRUMENTATION AND AUTOMATION IN SEWAGE TREATMENT,

Thames Water Authority, London (England). Metropolitan Public Health Div.
R. A. R. Drake, and H. R. S. Page.
Water Pollution Control, Vol 80, No 2, p 231-242, 1981. 21 Ref.

Descriptors: *Wastewater treatment, *Automation, Planning, Water treatment facilities, Operation, Management decisions, Computers. Design criteria.

The strategy for development and implementation of automation in sewage treatment facilities should be coordinated and operating guidelines established for those who are responsible for designing and specifying control systems. The reliability of instrumentation, sensors and control systems is a vital factor, and should be given additional attention in system design. Optimization of treatment processes, quality control, energy savings and better use of existing facilities will become increasingly important as improvements in these areas are made by the correct use of automation. Significant advances have been made in recent years on instrumentation for measurement of flow, sludge blanket level, dissolved oxygen and filtrability. Adequate preventive maintenance is necessary to prevent sensors from being damaged by prolonged exposure to sewage. Specific applications of automation in British water treatment plants are presented. Persistent impediments to complete wastewater treatment plant automation are the lack of a raw influent quality sensor, insufficient sensor reliability, and need for better understanding of sewage treatment processes. (Baker-FRC)
W82-02043

TECHNICAL AND ECONOMIC IMPLICATIONS OF INSTALLING AN INDUSTRIAL WASTE-WATER PRETREATMENT PLANT,

Environmental Control Consultancy Services Ltd., London (England).
D. Anderson.
Water Pollution Control, Vol 80, No 2, p 292-305, 1981. 6 Fig, 7 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Design criteria, Industrial wastes, Economic aspects, Dye industry wastes, Yorkshire Water Authority, *Great Britain, *Wastewater facilities.

Technical and financial problems that face industry in regard to meeting the standards and limitations imposed by regulatory bodies in installing an industrial wastewater pretreatment plant are described. The system discussed was for a medium-sized multi-product dyestuffs company, discharging 4.5 tcmd of wastewater. The effluent had an average pH value of 1.5 and could produce 100-150 tons/week of neutralized sludge. The most difficult technical problem was to remove, to acceptable levels, various metals used in the company's processes. Methods of treatment included precipitation, precipitate flotation, cementation, liquid-liquid extraction, adsorption, ion-exchange, electrolysis, evaporative distillation and electrodialysis. A comprehensive laboratory experimentation program was begun, encompassing both flotation and precipitation techniques. The results indicated that satisfactory reductions could be achieved, but that equipment availability and the pressing time schedules dictated that a precipitation process should be employed. The development work indicated that a stepped precipitation process was desirable and that to ensure efficient removal of metals a minimum total retention period of 2.5 hr was mandatory within the reactors, and a similar time within the thickener. Sludge dewatering was accomplished using one rotary vacuum filter plus one filter press of the variable chamber type. Capital and operating costs are noted. (Baker-FRC)
W82-02044

KINETICS AND DIFFUSION PROCESSES IN COLOUR REMOVAL FROM EFFLUENT USING WOOD AS AN ADSORBENT,

Queen's Univ., Belfast (Northern Ireland). Dept. of Industrial Chemistry.
G. McKay, and V. J. P. Poots.
Journal of Chemical Technology and Biotechnology, Vol 30, No 6, p 279-292, 1980. 7 Fig, 4 Tab, 19 Ref.

Descriptors: *Color removal, *Wood, *Dyes, Wastewater treatment, Adsorption, Sawdust, Activated carbon, Diffusion coefficients, Boundary layers, *Textile mill wastes, Industrial wastewater.

The adsorption of a basic dye, Astrazone Blue, and an acidic dye, Telon Blue, on sawdust made from Sitka spruce, Picea sitchensis, was studied. The process was controlled by intraparticle diffusion, except for some boundary layer resistance in the early stages of adsorption. The activation energies for adsorption of Astrazone Blue and Telon Blue on the sawdust were 16.8 kJ per mole and 9.6 kJ per mole, respectively. Diffusion coefficients were 6 to 18 times 10 to the minus 13th power sq cm per sec for Astrazone Blue at 18 degrees C and 3 to 8 times 10 to the minus 13th power sq cm per sec for Telon Blue at 18 degrees C. This variation in diffusivities is attributed to boundary layer effects. Agitation increased the rate of color removal. An increase in temperature produced an increase in the rate of adsorption for both dyes in the early stages. After that, the rate increased with the basic dye and decreased with the acid dye. Costs for removing Telon Blue with sawdust were 1.5% that of activated carbon; Astrazone Blue, 8.2%. (Cassar-FRC)
W82-02047

PRODUCTION OF AROMATIC ACIDS DURING ANAEROBIC DIGESTION OF CITRUS PEEL,

Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
A. G. Lane.
Journal of Chemical Technology and Biotechnology, Vol 30, No 6, p 345-350, 1980. 2 Tab, 11 Ref.

Descriptors: *Citrus fruits, *Anaerobic digestion, *Organic acids, Biological treatment, Food processing wastes, Aromatic compounds, Organic compounds, Acids, Benzoic acid, Phenylacetic acid, Phenylpropionic acid, Limonene, *Wastewater treatment, Toxicity, Flavonoids, Coumarins.

The aromatic acids, benzoic, phenylacetic, and phenylpropionic, were found in liquors after failure of the anaerobic digestion of commercially prepared citrus oils, distilled citrus oils, limonene, and the nonvolatile residue of lemon oils. The aromatic acids themselves were not toxic to the digestion process. When they were added to feedstocks, they degraded rapidly. Materials as yet unidentified were responsible for the toxicity. Experiments showed that phenylpropionic acid was probably derived from flavonoids and benzoic acid, and phenylacetic acid from courmarins. Hand-prepared orange albedo with 2 mg oil per 100 g was not toxic to the digestion process during 21 days of study; no aromatic acids were detected. (Cassar-FRC)
W82-02049

A MECHANISTIC MODEL OF A PACKED-BED ELECTRODE CELL TO REMOVE METAL IONS FROM DILUTE EFFLUENT SOLUTIONS,

University of the Witwatersrand, Johannesburg (South Africa). Dept. of Chemical Engineering.
A. W. Bryson, and K. A. Dardis.
Journal of Chemical Technology and Biotechnology, Vol 30, No 1, p 14-19, 1980. 2 Fig, 1 Tab, 13 Ref.

Descriptors: *Cathodes, *Metal-finishing wastes, *Packed beds, Wastewater treatment, Industrial wastewater, Electrodes, Nickel, Chromium, Zinc, Copper, Electroplating.

A pilot plant for treating electroplating waste effluents was designed with the aid or a mathematical model of a porous cathode cell. Copper, zinc, nickel, and chromium were reduced by greater than 90% (influents 13.5-37.5 mg per cu dm, effluents 0.9-1.5 mg per cu dm) using acid copper wash and zinc cyanide wash (flow rate 360 cu dm per hour) and nickel and chromium wash (flow rate 180 cu dm per hour). Dimensions of the cell's packed section were 1.9 m x 0.35 m x 5 mm. Packing was crushed graphite, size range 1.2-1.7 mm. (Cassar-FRC)
W82-02050

5E. Ultimate Disposal Of Wastes

GEOLOGIC AND HYDROLOGIC IMPLICATIONS OF HAZARDOUS WASTES MANAGEMENT RULES ON SITING IN NORTH CAROLINA,

Ebasco Services, Inc., Greensboro, NC.
G. L. Bain, and P. Hansen.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 267-275, August, 1981. 7 Fig, 18 Ref.

Descriptors: *Land disposal, *Waste management, *Waste storage, Waste disposal, Environmental effects, Model studies, Mathematical studies, Groundwater movement, Geohydrology, *North Carolina, Economic aspects, *Site selection.

Having to predict the ultimate fate of disposed wastes may make site evaluation for waste disposal expensive. To accurately predict the effects of sorption, mechanical dispersion, ionic diffusion, and osmosis on the concentration of waste species, good groundwater flow models and simulations of solute transport are needed. The ideal disposal zone should also contain flat-lying, homogeneous, non-fractured silt-stone, clay or silty sandstone situated well above the water table. Most waste disposal sites in North Carolina do not meet these criteria. Under the Resource Conservation and Recovery Act, federal and state laws may enforce the use of presently accepted safe disposal practices and monitoring techniques. The financial and environmental impact of these regulations on the generation of wastes will depend on the extent to which they address geohydrologic complexities. (Geiger-FRC)
W82-01630

PERSPECTIVE ON MANAGEMENT AND DISPOSAL OF HAZARDOUS WASTES,

North Carolina State Univ. at Raleigh. Dept. of Marine Earth and Atmospheric Sciences.
H. S. Brown, and H. E. LeGrand.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 231-235, August, 1981. 1 Fig, 2 Ref.

Descriptors: *Hazardous materials, *Waste disposal, *Graphical analysis, *Groundwater pollution, Waste management, Model studies, Site selection, Geohydrology, Hydrologic aspects, Water pollution effects, Graphical methods, Mathematical studies.

The overall problem of managing and disposing of hazardous wastes is compounded by the polarized ideas of regulatory officials, geologists and hydrologists, design engineers, and owners and operators of waste management facilities. Added complications arise from the negative views held by various sectors of the public. A standardized system for surveying waste disposal sites and their contaminant input is sought that can use either in-depth derived data or general site data. The system should include concise descriptions and evaluations of all existing and planned hazardous waste sites. The standardized evaluations should identify the hydrogeological characteristics of a site on a scale of various aquifer sensitivities to contamination spread. A scale of severity of contamination identifies a particular waste's toxicity, concentration, volume and persistence, four parameters which are integrated into a graphical matrix showing the potential for groundwater pollution. This sytem allows for the development of acceptance or rejection standards based on the natural setting and on engineering modifications to the site. (Geiger-FRC)
W82-01635

ROLE OF THE GEOTECHNICAL CONSULTANT IN SITING SUITABLE AREAS FOR HAZARDOUS WASTE DISPOSAL,

Soil and Material Engineers, Inc., Raleigh, NC.
E. W. Glover, Jr.

Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 227-230, August, 1981.

Descriptors: *Waste disposal, *Hazardous materials, *Site selection, *Geohydrology, Hydrologic aspects, Systems analysis, Leaching, Waste management, Land disposal, Waste dumps, Engineering geology, Leachates, Solid wastes.

The geotechnical consultant can be of valuable assistance in choosing a hazardous waste disposal site. The consultant may suggest areas more appropriate to disposal and carry out preliminary site evaluations based upon the available literature. Utilizing this data, the consultant may rank the sites in order of preferences to select the best site and develop plans for test borings and for field and laboratory monitoring of well installations. When the field work is completed, engineering studies are conducted to evaluate seepage from the storage area, the potential for leaching, the appropriate collection system for leachates, and flood level designs. The final report is considered as part of the permit documents to support licensing of the site as a proper disposal area for hazardous wastes. (Geiger-FRC)
W82-01636

FLOW CALCULATIONS FOR HOUSEHOLD EFFLUENT DISPOSAL IN ELEVATED SAND MOUNDS,

Environmental Protection Agency, Ann Arbor, MI.
T. D. Mott, D. D. Fritton, and G. W. Petersen.
Journal of Environmental Quality, Vol 10, No 3, p 311-314, July-September, 1981. 4 Fig, 15 Ref. OWRT-B-098-PA(4).

Descriptors: Flow, *Mathematical equations, *Soil absorption capacity, *Land disposal, *Wastewater disposal, Domestic wastes, Sand, *Sand mounds, Hydraulic conductivity, Design flow, Rural areas, Household wastewater.

On-site disposal and renovation of household wastewaters present serious problems in many urban fringe and rural areas. About half of all on-site systems fail to perform satisfactorily over their entire design life of 15 to 20 years. Elevated sand mound disposal systems have been used in Pennsylvania, since the soil is generally not suitable for conventional on-site effluent disposal systems. However, about 40 percent of these systems malfunctioned in less than 5 years. Since the malfunctions were associated with observations of surface discharges of effluent, this study investigated the ability of the soil to transmit effluent from an elevated sand mound to the groundwater system. It was assumed that both the infiltration surfaces and the groundwater system were able to accept the effluent. The flow calculation method used was predicated upon separation of the effluent flow into horizontal and vertical flow components. Darcy's law written in cylindrical coordinates was used to calculate horizontal flow. Vertical flow was calculated, assuming that flow was limited by a single, slowly permeable layer of known thickness. The calculations demonstrate that the lateral plus vertical flow capacity of the soil must exceed the anticipated effluent input if the disposal system is to perform satisfactorily. Data requirements for evaluation of the suitability of a specific site for disposal of household wastewater using a mound system are identified. Calculations made using data representative of many of the failing mound systems in Pennsylvania indicate that these failures result from the inadequacy of the combined lateral and vertical flow capability. (Carroll-FRC)
W82-01660

INDUSTRIAL WASTE DUMPING AT DEEP-WATER SITES IN THE GULF OF MEXICO,

National Ocean Survey, Rockville, MD. Ocean Dumping and Monitoring Div.
E. R. Meyer, and C. E. Warsh.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIC, May, 1981. p 211-239, 2 Fig, 6 Tab, 29 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Industrial wastes, *Ocean dumping, *Sludge disposal, *Environmental effects, Biological wastewater treatment, Chemical wastes, Organic compounds, Microorganisms, *Gulf of Mexico.

About 10 different kinds of industrial wastes were dumped at two deepwater sites in the Gulf of Mexico between 1973 and 1978. The Western Gulf site, south of Galveston, Texas, was used during the study exclusively by the Shell Chemical Company of Deer Park, Texas. The material dumped at the site was a biological sludge consisting of living and dead microorganisms (primarily bacteria and protozoans), inorganic salts, and a large variety of organic compounds in suspension and solution, produced by a biological waste water treatment system. Results of the dump site study program indicate that the overall environmental consequences of discharging the biosludge produced by the Shell Chemical Company plant were negligible. Both the liquid and solid portions of the waste samples examined during the program had deleterious effects upon all test species during laboratory tolerance experiments when the wastes were of sufficiently elevated concentration. The results of waste tracking experiments indicated that waste concentrations of that magnitude probably do not persist in the field more than a few hours during dumping episodes. The wastes, at low concentrations, actually seemed to increase rates of growth in green algae species and reproduction in the amphipod Amphithoe valida. In view of the depauperate nature of the dumping area, the actual long-term biological impacts of dumping there appear to have been minimal. (Moore-SRC)
W82-01903

CENTRIFUGAL DEWATERING,

Pennwalt Ltd. (England).
J. E. Remfry.
Water and Waste Treatment, Vol 24, No 9, p 23-24, September, 1981. 4 Fig, 1 Tab.

Descriptors: *Sludge drying, *Centrifugation, *Sludge disposal, Sludge cake, Alum sludge, Performance evaluation, Costs, *United Kingdom.

Municipal and industrial effluent treatment sludges can be dewatered using the decanting centrifuge. Mechanical dewatering has many advantages, including the avoidance of large lagoons and the production of a readily disposable cake. The centrifuge can treat all types of sludge and can be made mobile and moved from plant to plant. Also, installation is compact and operation is non-labor intensive. Performance figures are presented for the main types of sludge that are centrifuged: alum, ferric, and lime. Characteristics of the raw water, especially turbidity, influence the nature of the sludge produced. There are now centrifugal sludge dewatering installations at almost all of the British water authority areas. (Small-FRC)
W82-01912

A TEST UTILIZING SEDIMENT TRAPS, SURVEY RODS, AND RADIOGRAPHS TO MONITOR SEDIMENT ACCUMULATION FROM A DREDGING DISPOSAL OPERATION,

NALCO Environmental Sciences, Northbrook, IL.
For primary bibliographic entry see Field 7B.
W82-01950

GEOLOGIC ASPECTS OF WASTE DISPOSAL SITE EVALUATIONS,

Law Engineering Testing Co., Marietta, GA.
D. G. Miller, Jr., and W. J. Alexander.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 245-251, August, 1981. 3 Fig, 9 Ref.

Descriptors: *Waste disposal, *Geohydrologic units, *Groundwater hydrology, *Fate of pollutants, Land disposal, Site selection, Hydrologic aspects, Waste management, Hydrologic systems, Geomorphology, Path of pollutants, Groundwater movement, Geohydrology, Planning.

In response to increasingly stringent regulatory standards and variations in site-specific guidelines, the evaluation of waste disposal sites is becoming more comprehensive. Since greater attention is being given to the fate of pollutants at each site, studies of groundwater movement and the effects of various subsurface materials on the dispersal of contaminants are required. Some relevant hydrologic conditions and site-specific variations are reviewed for Coastal Plain, Piedmont, Valley and Ridge areas of the eastern United States. Multiphased evaluations of waste disposal sites are practical when such diverse physiographic sections are considered. For existing waste disposal facilities, the initial phase of evaluation combines knowledge of area geology and operational information. Subsequent studies include a detailed assessment of localized hydrogeologic units and the availability and suitability of existing soil and rock formations as construction materials. In siting new facilities, the most suitable geologic area of the province is initially defined. (Geiger-FRC)
W82-02011

WASTE DISPOSAL--CHOOSING AND LICENSING SITE,

Severn Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5G.
W82-02035

POLLUTION FROM FARMS,

Thames Water Authority, London (England).
For primary bibliographic entry see Field 5D.
W82-02039

5F. Water Treatment and Quality Alteration

PLANNING WITH GREAT UNCERTAINTY: A REVIEW AND CASE STUDY OF THE SAFE DRINKING WATER CONTROVERSY,

Livingston Coll., New Brunswick, NJ. Dept. of Urban Studies.
For primary bibliographic entry see Field 5A.
W82-01606

COPPER(II)- AND CADMIUM(II)-BINDING ABILITIES OF SOME NEW HAMPSHIRE FRESHWATERS DETERMINED BY DIALYSIS TITRATION,

New Hampshire Univ., Durham. Dept. of Chemistry.
R. E. Truitt, and J. H. Weber.
Environmental Science and Technology, Vol 15, No 10, p 1204-1208, October, 1981. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Adsorption, Inorganic compounds, *Heavy metals, Water quality control, Chemical properties, Binders, Separation techniques, *Copper, *Cadmium, Cations, Drinking water, Ions, Potable water, Pollutants, Water supply, Water quality management, Anions, New Hampshire.

Processes such as adsorption to particulates, complexation by naturally occurring ligands, and precipitation all act to regulate the aquatic levels of free heavy metal ions which may be toxic to aquatic life and to man. The ability of seven New Hampshire freshwater samples to sequester divalent copper and cadmium ions was studied by a dialysis titration technique in laboratory tests. Five samples, three from rivers and two from reservoirs, were representative of local drinking water supplies. Pond and swamp samples were included for comparison. The potential binding levels (PBL) were calculated as indicators of the copper- and cadmium-binding properties of the water samples. Copper cation PBL values ranged from 1.1 to 15.1 micromolar, while cadmium cation PBL values ranged from 0.0 to 9.7 micromolar. Alkalinity, pH, dissolved organic carbon, hardness, conductance and UV absorbance were correlated with copper ion and cadmium ion PBL values in six of the seven samples analyzed. Copper ion PBL values were significantly correlated with the inorganic

properties, but not the organic properties of the samples at the 90% confidence level. Nonunity slopes of copper experiments suggested complexing of copper ions with the inorganic anionic constituents of the water samples. No significant trends at the 99% confidence level were found for the cadmium ion PBL values. (Geiger-FRC)
W82-01632

THE REMOVAL OF ORGANIC MATTER FROM SURFACE WATER SUPPLIES BY ANION EXCHANGE RESINS,

C. A. Macko.
PhD Thesis, 1980. 227 p, 66 Fig, 30 Tab, 102 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19545.

Descriptors: *Water pollution, *Water quality control, *Organic matter, *Anion exchange, Pollutant identification, Surface waters, Resins, *Mississippi River, Heavy metals, Amberlite IRA-904.

This investigation focused on the nature of naturally occurring organics and their removal from water supplies by the strong base anion exchange resin, Amberlite IRA-904. Mississippi River water was ultrafiltered to determine the molecular size distribution of the organic carbon and for anion exchange removal studies. Results indicated that dissolved organic carbon (DOC) concentrations in the Mississippi River varied seasonally. Anion exchange of river water involves a multicomponent system in which competition plays a major role. All experiments were done with the resin originally in the chloride form and at the natural pH of the river water. Regeneration of columns was done with 1.0 M NaCl with DOC recovery at 77-95% with 3 empty bed volumes of regenerant. Besides organics, the regenerant was found to contain significant quantities of trace inorganics and metals indicating uptake of these ions by the resins. Fe, Ca, B, and Zn were found in concentrations of 100-1000 times their value in an equal volume of river water. Al, P, Mn and Ni were found to be concentrated to a lesser extent. Amberlite IRA-904 showed significant removal of high molecular weight organics from surface water supplies, producing an effluent of as low as 0.5 mg/L DOC (bed depth 31 cm). Removal and subsequent recovery of trace metals in the regenerate brine indicated an additional advantage to the use of resins in water treatment. (Sinha-OEIS)
W82-01697

DRINKING WATER AND ITS TREATMENT: AN INTERVIEW WITH PROFESSOR SONTHEIMER,

S. Miller.
Environmental Science and Technology, Vol 14, No 5, p 510-512, 514, May, 1980.

Descriptors: *Drinking water, *Water treatment, *Germany, Chlorination, Ozonation, Ozone, Chlorine, Wells, Rivers, Percolation, Groundwater.

In Germany 50% of the drinking water supplies come from surface water, but practically all river waterworks use some sort of ground filtration. Water is drawn from wells along the rivers at distances from 50 to 100 meters so that the retention time in the ground is from 30 to 100 days. This practice reduces the organics concentration in the water about 75% from what was originally present in the raw river water. Thus activated carbon can be used in the treatment train with a much greater efficiency than would otherwise be possible. Biological treatment is used extensively because of its cost effectiveness. Slow sand filters are used where river bank filtration is not possible. Breakpoint chlorination is not used in Germany today; instead, ammonia is removed biological. Ozone is used for special purposes including enhancement of biological treatment. A small dose of ozone improves flocculation in difficult conditions. While consideration is being given to establishing guidelines for permissible trihalomethane concentrations in drinking water, such guidelines are not being considered for Germany, as chlorination is not used in water treatment there. (Baker-FRC)
W82-01728

EFFECT OF REAGENT MIXING RATE ON ADSORPTION PROCESS FOR AM-FE2O3.H2O,

Stanford Univ., CA. Dept. of Civil Engineering.
A. R. Appleton, Jr., and J. O. Leckie.
Environmental Science and Technology, Vol 15, No 11, p 1383-1386, November, 1981. 5 Fig, 7 Ref.

Descriptors: *Mixing, *Coagulation, *Heavy metals, *Adsorption, Metals, Cadmium, Water treatment facilities, Flocculation, Ferric chloride, Wastewater treatment, Water treatment.

There was no significant variation in physicochemical surface characteristics in freshly precipitated or 1 hour aged amorphous Fe2O3(H2O) coagulant in a well-mixed system with mean residence times from 5 to 30 sec. Cd(2+) at a trace level was used as a diagnostic tool. The removal of trace metals by adsorption onto Fe(3+) flocs in water or wastewater treatment systems is not affected by mixing conditions as long as complete dispersion of the flocculant takes place within 30 sec. (Cassar-FRC)
W82-01799

ALUMINUM SULFATE TREATMENT: SHORT-TERM EFFECT ON COMPLEX PHOSPHORUS COMPOUNDS IN A EUTROPHIC LAKE,

Michigan State Univ., Hickory Corners, Kellogg Biological Station.
D. A. Francko, and R. T. Heath.
Hydrobiologia, Vol 78, No 2, p 125-128, March, 1981. 2 Fig, 11 Ref.

Descriptors: *Eutrophic lakes, *Phosphorus compounds, *Alum, Hypolimnion, *Water treatment, Orthophosphates, Lake restoration, Epilimnion, West Twin Lake, Ohio, Nutrients, Phosphorus removal, Process efficiency.

Previous studies have demonstrated that hypolimnetic application of liquid aluminum sulfate (alum) may accelerate lake reclamation by removing phosphorus from the water column and by sealing anoxic sediments to reduce the release of nutrients. This study was designed to investigate the effectiveness of alum applications to the hypolimnion in removing various complex phosphorus compounds occurring in eutrophic lakes. These complex phosphorus compounds include phosphomonoesters, polyphosphates, and ultraviolet-sensitive phosphorus compounds. Alum was applied to the hypolimnion of West Twin Lakes, a culturally eutrophic hardwater lake in northeastern Ohio. Orthophosphate was effectively removed from the lake by this treatment, but complex phosphorus compounds were not. Potentially available phosphomonoesters comprised a considerable proportion of the complex phosphorus fraction in the lake water both before and after the alum treatment. Most of the complex phosphorus compounds remaining in the lake water after the alum treatment were capable of releasing orthophosphate on treatment with alkaline phosphatase. These results indicate that aluminum sulfate treatment may be ineffective in removing all biologically available phosphate compounds from the lake water. Further research is required to determine the overall applicability of alum treatment as a nutrient inactivation method. (Carroll-FRC)
W82-01833

TACKLING THE NITRATE PROBLEM,

Effluent and Water Treatment Journal, Vol 21, No 7, p 313, July, 1981.

Descriptors: *Water treatment, *Nitrates, Ion exchange, Water treatment facilities, Municipal water, Industrial water, Food processing industry, Water quality, *Nitrate removal.

Nitrate removal units are available for the removal of high nitrate levels from public water supplies. These high nitrate levels are of particular concern to the flood processing industry. Nitrate concentrations in excess of 1 ppm have a depolarizing effect on the half-cell corrosion reaction, resulting in accelerated deterioration of food cans. High nitrate concentration can also lead to the staining of cans and the discoloration of certain meats. The automatic nitrate removal units employed in the industry operate at flow rates from as low as 30 liters/hour up to 10,000 liters per hour, and will reduce nitrate levels to between 5 and 10 mg/liter. The units operate by absorbing nitrates on to an ion exchange resin, which releases an equivalent quantity of chloride. A counterflow regeneration ion exchange technique which effectively halves the salt consumption during regenerations and produces significant process cost savings has been developed for large scale operations. In a major cannery complex with a throughput of 5,000 gal per hour, nitrate nitrogen levels were reduced from 10-12 to 0.2 ppm. Another successful operation involves the treatment of nitrate bearing borehole water. However, nitrate removal from municipal water, a costly process, appears to be a long way from implementation. (Baker-FRC)
W82-01874

SUBSTRATE FLUX INTO BIOFILMS OF ANY THICKNESS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-01964

A NATIONAL SURVEY OF TRI(HALOALKYL)-, TRIALKYL-, AND TRIARYLPHOSPHATES IN CANADIAN DRINKING WATER,

Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W82-01989

EXPERIENCE WITH LAKE AND RESERVOIR RESTORATION TECHNIQUES IN THE GERMAN DEMOCRATIC REPUBLIC,

Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 2H.
W82-02054

DISINFECTION OF DRINKING WATER IN DEVELOPING COUNTRIES,

Omnium de Traitment et de Valorisation, Courbevoie (France). Water Dept.
J. Sibony.
Aqua, No 5, p 21-27, 1981. 2 Fig, 6 Tab, 15 Ref.

Descriptors: *Potable water, *Disinfection, Chlorination, Ozonation, Drinking water, Water quality, Human diseases, Chlorine, Ozone, Microorganisms, *Developing countries.

Various means of achieving disinfection of drinking water in developing countries are reviewed. In many outbreaks of human disease, drinking water has carried the pathogenic agent. When water has been treated and then filtered, the effectiveness of disinfection will directly depend on the quality of clarification. In hot countries, treatment without filtration will always lead to suspicions that the water is carrying organisms that do not respond significantly to the normal disinfectants used. The effectiveness of chlorination is affected by the water acidity, presence of ammonia, temperature levels, and retention time. The presence of dissolved organic matter in the water to be disinfected is harmful in several ways. First, more chlorine will be consumed. Second, the treated water will taste of chlorine due to the flavor of the organochlorinated compounds. As a means of control to test the amount of total chlorine present, the orthotolidine test can be used. However, the preferable method is to use the diethyl-p-phenylene-diamine test, which measures only the free chlorine. A level of free chlorine equal to 0.1 ppm maintained throughout the network provides an excellent guarantee that the water is properly disinfected against bacteria, provided that the water has been cleared of suspended solids. The benefits of ozone disinfection over and above chlorination are considered. The preparation of the water for ozonation, contact time and concentration, significance of pH, temperature, ammonia, and means of control are all considered. Use of post-chlorination after ozone disinfection is briefly considered. (Baker-FRC)
W82-02091

5G. Water Quality Control

PROTECTING VIRGINIA'S WATERWAYS,

J. Josephson.
Environmental Science and Technology, Vol 15, No 10, p 1125-1127, October, 1981. 1 Fig, 2 Tab.

Descriptors: *Water quality control, *Water pollution prevention, *Pesticide residues, *Kepone, Water pollution treatment, Waste water treatment, Water pollution control, Heavy metals, Chlorine, Pesticides, Fluvial sediments, Environmental effects, Dredging, *James River, Virginia, Shellfish farming.

The Virginia Environmental Endowment engaged the National Wildlife Federation to study the Kepone incident, which caused extensive pollution of the James River, and examine strategies to prevent future episodes of environmental pollution by toxic substances. The Federation recommended careful screening of discharges from publically owned treatment works through the National Pollutant Discharge Elimination system and by application of the Cairns matrix. The federation also recommended new dredging procedures to minimize disturbances of Kepone-containing sediments. Highest priority for sediment cleanup should be given to areas for shellfish farming and public water supply sources. Screening for heavy metals, chlorine and chloramines was suggested along with research to identify effective, nonhalogenated waste water treatment processes. More sophisticated chemical residue detection methods for water and living tissue was called for and more research on depuration mechanisms was suggested. Problems in the implementation of the federations report and reaction to its findings are discussed. (Geiger-FRC)
W82-01608

PUBLIC OPINION AND INTEREST GROUP POSITIONS ON CHESAPEAKE BAY ISSUES: IMPLICATIONS FOR RESOURCE MANAGEMENT,

Maryland Technical Advisory Service, College Park.
For primary bibliographic entry see Field 6B.
W82-01642

DESTRATIFICATION AND REAERATION AS TOOLS FOR IN-LAKE MANAGEMENT,

Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Water SA, Vol 7, No 3, p 185-189, July, 1981. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Destratification, *Lake restoration, *Aeration, Aerators, Mixing, Rehabilitation, Lakes, Reservoirs, Reservoir operation, *Thermal stratification prevention, Evaporation, *South Africa.

Methods to prevent or destroy thermal stratification and/or to aerate lake water are described. Many devices used for the destratification of reservoirs or lakes can also be used for hypolimnetic reaeration, including diffusers, bubble guns, and Helixors. No theoretical basis has been developed for most of these methods and devices. The Helixor is based on small bubbles kept in contact with the water for comparatively long periods by circulation around a helix as the bubbles rise. Oxygen is dissolved in the water in the body of the Helixor. The total volume of water moved by the Helixor per day in one application was 1% of the total volume of the reservoir. Helixor models are presented which simulate destratification. Helixors are best at preventing stratification. In addition to aiding destratification, the surface temperature is reduced in summer, which results in a decrease in the rate of evaporation. In an area where the annual evaporation is 1800 mm per year, this reduced evaporation yields a total water savings of about 50 mm. Trial runs for these devices are planned in South Africa. (Small-FRC)
W82-01648

BIOLOGICAL AND PHYSICAL INVESTIGATIONS OF BODIES OF WATER BENEATH DENSE WATER HYACINTH POPULATIONS BEFORE AND AFTER CHEMICAL TREATMENT,

Florida Univ., Gainesville. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-01678

A LIMNOLOGICAL INVESTIGATION OF A TROPICAL FRESH-WATER ECOSYSTEM: THE BELIZE RIVER, BELIZE, CENTRAL AMERICA,

Western Michigan Univ., Kalamazoo.
V. J. B. Gonzalez.
PhD Dissertation, 1980. 221 p, 11 Fig, 20 Tab, 137 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-25554.

Descriptors: *Water quality control, *Ecosystems, Freshwater, Rivers, *Belize, Central America, River ecology.

At present the water supply system for the country of Belize is from both groundwater and surface water sources. With increasing demands being placed on the water resources of Belize, adequate management programs for such resources must be developed. The study described herein aims at approaching a comprehensive understanding of the ecosystem of the Belize River. To avoid a severe degradation of the water quality in the Belize River, a continuing effort should be made to assess the ecological relationships that exist within it. Bacterial counts, chemical analyses, biota assessments, and other parameters that are necessary in the determination of water quality should be the major aspects of the continuing effort. The information so gained will provide the fundamental environmental data that are necessary for the development and reassessment of management programs. Evidence gathered in this investigation supports the conclusion that the major portion of the Belize River is currently of a high quality. It is recommended that every effort be made to limit the pollution of the river in the regions of Stations 1 and 2 where the water is already of low quality. Adequate sewage treatment and specific legislation governing the dumping of industrial waters need to be implemented. It is also recommended that continuous monitoring of the river be undertaken. Finally, the need to protect waterways should be brought to the attention of the Belizean public. This task may be accomplished primarily through the educational system. (Sinha-OEIS)
W82-01682

PETROLEUM DEGRADATION BY NATURALLY OCCURRING POPULATIONS OF MARINE BACTERIA FROM MIDDLE ATLANTIC OUTER CONTINENTAL SHELF WATERS,

College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
A. E. Maccubbin.
PhD Dissertation, 1980. 169 p, 28 Fig, 13 Tab, 96 Ref, 11 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03585.

Descriptors: *Bacteria, *Microbial degradation, *Biodegradation, *Oil pollution, Water pollution, Petroleum, Oil industry, Oil spills, Pseudomonas, Middle Atlantic Ocean, Hydrocarbons.

Bacterial populations indigenous to surface (1 m) waters of the Middle Atlantic Outer Continental Shelf were sampled at seasonal intervals to determine the abundance and distribution of petroleum-degrading (HC) and 'total' heterotrophic (HET) bacteria. Simultaneously, unweathered South Louisiana crude oil (SLCO) was added to aliquots of surface water samples to evaluate rates and patterns of degradation of hydrocarbon. Degradation was studied using selected nutrient and temperature regimes in both closed flask and prototype 'open' or continuous dilutions systems. HET bacterial levels generally decreased with distance from land. HC bacteria were most abundant in the coastal boundary layer. Changes in values of HC/HET often were not directly related to the abundance of petroleum-degrading bacteria. In closed flasks the composition of bacterial populations changed slightly in response to SLCO addition; Pseudomonas predominated after 48 days. Pseudomonas isolates exhibited the greatest ability for petroleum degradation in pure culture. Degradation of SLCO in closed flasks characteristically resulted in removal of n-alkanes and selected aromatics at rates related to season, sampling location, and nutrient regime. Aromatic compounds were often removed concomitantly with n-alkanes. Although maximum rates of degradation were observed at 15 degrees C using coastal water inocula and inorganic nutrient enrichment, all shelf waters sampled contained bacteria capable of petroleum degradation. (Sinha-OEIS)
W82-01683

THE EFFECTS OF SECONDARY SEWAGE EFFLUENT ON THE WATER QUALITY, NUTRIENT CYCLES AND MASS BALANCES, AND ACCUMULATION OF SOIL ORGANIC MATTER IN CYPRESS DOMES,

Florida Univ., Gainesville.
F. E. Dierberg.
PhD Dissertation, 1980. 324 p, 67 Fig, 38 Tab, 267 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-05570.

Descriptors: *Water quality, *Nutrients, *Organic matter, Sewage effluents, Nitrogen, Wetlands, Tertiary treatment, *Florida, *Cypress domes, Secondary sewage.

The capability of cypress domes to act as efficient nutrient traps has been demonstrated for a natural and sewage-enriched cypress dome. Mass balance models indicated that 87% of the nitrogen and 92% of the phosphorus loadings were retained within a cypress dome receiving secondary sewage effluent, removal efficiencies that are among the highest reported for any wetland ecosystem receiving treated sewage. Thus, cypress domes seem to be effective natural tertiary treatment systems. Field data and laboratory investigations demonstrated that denitrification was a major nitrogen sink in both natural and sewage-enriched domes. Bulk precipitation was the most important factor in supplying new minerals and nutrients (except nitrogen) to the natural cypress dome. Analyses of standing waters of natural and sewage-enriched cypress domes near Gainesville, Florida, over a 4.5-year period showed that discharge of secondary sewage effluent altered the soft, acid water found in natural domes to a neutral, moderately hard condition. Furthermore, the absence of dissolved oxygen, high levels of phosphorus, nitrogen, biochemical oxygen demand, and the presence of hydrogen sulfide mean that treated sewage effluent has a substantial impact on water quality. Water samples from shallow wells, ceramic soil moisture tubes, and laboratory percolation columns indicated that the underlying organic matter and sands were serving as an effective barrier to the transport of sewage pollutants to the shallow aquifer immediately below. (Sinha-OEIS)
W82-01687

REGULATING THE QUALITY OF DRINKING WATER: AN ECONOMIC ANALYSIS OF THE SAFE DRINKING WATER ACT OF 1974,

Wisconsin Univ.-Madison.
R. L. Raucher.
PhD Thesis, 1980. 342, p 22 Fig, 42 Tab, 44 Ref, 6 Append, University Microfilms International, Ann Arbor, MI; Order No GAX 81-03294.

Descriptors: *Economic feasibility, *Water quality control, Regulations, Legislation, Potable water, *Economic analysis, *Drinking water, Safe Drinking Water Act.

The first half of the thesis provides a framework with which to investigate whether or not the market failure associated with imperfect information can justify government intervention in general, and the imposition of regulations such as those embodied in the Safe Drinking Water Act in specific. The second portion of the thesis pertains to the economic impacts of the regulations. It consists mainly of the presentation and analysis of empirical results generated by two microdata simulation models. Nonmodel analyses are also provided, as

are policy recommendations and conclusions. The focus of the study then shifts to the indirect effects of the transfer of funds from water consumers to producers of treatment supplies. The model used to simulate the output, employment, and distributional consequences of interregional trading and production relationships is described, and regional shares of the changes in the level and composition of economic activity are then presented and analyzed. (Sinha-OEIS)
W82-01691

POLLUTION PERMITS AND MARKETS FOR WATER QUALITY,

Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 6A.
W82-01699

CONTROLLING RUNOFF FOR LIVESTOCK FEEDLOTS; A STATE OF THE ART,

Science and Education Administration, Lincoln, NE.
C. B. Gilbertson, J. C. Nye, R. N. Clark, and N. P. Swanson.
Agricultural Research Service, Agriculture Information Bulletin Number 441, October, 1981. 21 p, 7 Fig, 1 Tab, 50 Ref.

Descriptors: *Feedlot wastes, *Feedlot runoff, *Livestock, *Water pollution control, Water pollution sources, Rainfall, Storms, Waste characteristics, Design criteria, Irrigation, Land disposal, Evaporation.

Runoff from livestock feedlots is a recognized water pollution source, which is now controlled by the Federal Water Pollution Control Act Amendments. Feedlots are included in the industrial category and are identified as a point source. Runoff resulting from storm events less severe than a 24 hour, 10-year storm must be controlled; in 1983 the limit will be a 24 hour 25-year storm. Feedlot runoff can be estimated from equations relating runoff to storm rainfall and the surface of the lot. In northern latitudes, snow melt must be considered. The chemical and solid constituents of feedlot runoff vary widely, with highest levels of total solids, volatile solids, and chemical oxygen demand being found in snow melt. Designs for runoff control have the following features: diversion of runoff from outside the feedlot area; provision of proper feedlot drainage; use of debris basins; use of detention or holding ponds; and provision of proper techniques for land application. Ultimate disposal of the runoff depends on the local soil, climate and the size of the feedlot. The runoff may be used for irrigation, allowed to evaporate, or be run onto the land. Knowledge of the groundwater is needed before a disposal system is planned, and proper cleaning and maintenance of the facility is essential. (Brambley-SRC)
W82-01769

TYING UP TCE,

Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI.
A. E. Singhal.
Water/Engineering and Management, Vol 128, No 9, p 56, 58, 60, 63, September, 1981. 2 Fig, 3 Tab.

Descriptors: *Organic compounds, *Activated carbon, *Water treatment, *Groundwater pollution, Water pollution control, Separation techniques, Adsorbents, Drinking water, Cost analysis, Pilot plants, Design criteria, Water pollution, Packed beds, Filters, Adsorption, *Trichloroethylene.

A groundwater supply contaminated with trichloroethylene (TCE) was used as a study site to investigate the removal of organic compounds from water. To remove TCE, purging the aquifer, aeration and adsorption were suggested. Carbonaceous or activated carbon adsorption by itself or in conjunction with aeration showed the best potential for meeting EPA drinking water standards. Granular activated carbon (GAC) proved very effective in the removal of TCE in both laboratory and pilot studies. A cost/effectiveness analysis was performed on GAC removal with on-site regeneration, GAC after aeration plus off-site carbon regeneration, and removal by Ambersorb XE-340 following aeration and on-site regeneration of the adsorbent. The latter two TCE removal techniques yielded total annual costs within 1% of each other. Pilot plant studies using Filtrasorb 300 high activity carbon columns were set up to determine design criteria for effective TCE removal. Two contactors in series each providing 8-10 minutes of contact time appeared suitable for meeting the criteria of 20 microg/liter in the effluent. A third backup unit was suggested to allow maintenance and service of the two main units. If a packed bed system is used, pre-filtration minimizes the amount of backwashing of the carbon beds. Design parameters for a treatment system capable of handling a flow of 450 gpm are summarized. (Geiger-FRC)
W82-01866

THE VALUE OF ECOLOGICAL MONITORING IN THE MANAGEMENT OF PETROLEUM INDUSTRY EFFLUENT DISCHARGES: EXPERIENCE IN ESSO PETROLEUM COMPANY U.K. REFINERIES,

Esso Petroleum Co. Ltd., London (England).
J. S. Lemlin.
Water Science and Technology, Vol 13, No 7, p 437-464, 1981. 17 Fig, 2 Tab, 10 Ref.

Descriptors: *Oil pollution, *Monitoring, *Ecological effects, Water pollution effects, Water pollution sources, Water pollution control, Wastewater treatment, Water quality control, *United Kingdom, Cooling water, Process water, Ballast, Industrial wastewater, Oil refineries, Salt marshes, Wastewater disposal, Fawley Refinery, Milford Haven Refinery, Aquatic life.

Uses of water, potential pollution sources, effluent treatment processes, and ecological monitoring in two United Kingdom Esso petroleum refineries are described. Ecological monitoring programs have been successfully integrated into the management of refinery effluents. Fawley Refinery, capacity 19.2 million tons per year, is a complex installation using large quantities of water. Milford Haven Refinery, capacity 15 million tons per year, is almost exclusively air cooled. After treatment, Fawley effluents are discharged through two outfalls into a salt marsh. Average effluent quality is (in mg per liter): oil, 10.0; phenols, 0.4; sulfides, 0.3, ammonia, 3.0; and BOD, 30.0. The salt marshes had suffered significant oil pollution damage by the late 1960's. Therefore, an ecological monitoring system was set up. The average Milford Haven effluent contains (in mg per liter): oil, 16; phenols, 0.45; sulfides, 0.3; ammonia, 1.0; and BOD, 35. It discharges through a single outfall into a rocky bay. Increasing the residence time of effluent in lagoons and general tightening of procedures decreased the pollution levels in the 1970's. Ecological monitoring has pointed out the most cost-effective strategies for reducing environmental damage for each site. (Cassar-FRC)
W82-01913

THE HAZARDS OF HAZARDOUS WASTE MANAGEMENT,

Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 6E.
W82-01940

A PROPOSAL FOR RECLAMATION BY DILUTION OF IRRIGATION WATER,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3C.
W82-01943

UPLAND MARSH FOR WATER QUALITY CONTROL,

Agricultural Research and Education Center, Lake Alfred, FL.
For primary bibliographic entry see Field 5B.
W82-01962

WATER QUALITY IMPACTS EXCHANGING WATER BETWEEN SEA AND A CLOSED ESTUARY,

Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
C. P. de Vos, J. S. L. Vink, B. A. Bannink, and J. Leentvear.
Water Science and Technology, Vol 13, No 7, p 271-285, 1981. 9 Fig, 5 Ref.

Descriptors: *Water quality management, *Estuaries, *Dams, *Destratification, *Salinity, Water quality control, Sluices, Mixing, Stratification, Lakes, Salt water, Polders, Oxygen balance, Grevelingen, *Netherlands.

The estuarine branch, Grevelingen, in the Netherlands was dammed off from the North Sea in 1971 to create a large salt water lake for nature conservation, recreation, and fisheries development. The salinity level decreased during excess precipitation and polder water discharges. To remedy problems of salinity regulation, a water exchange sluice was completed in the dam by 1978. The new exchange of water between the lake and the North Sea was accompanied by a permanent salt-stratification in the lake. In the summer of 1979, oxygen consumption in the hypolimnion was greater than the replenishment, while in June and July, oxygen levels near the bottom decreased to less than 1 milligram/liter. The exchange of sea and lake water during the summer did not prevent stratification of the lake. Oxygen balance problems were solved after the increased inflow of oxygen-saturated seawater into the hypolimnion due to density differences late in July. The sluice was closed during the 1980 summer period. (Geiger-FRC)
W82-01991

WATER QUALITY INDICES: AN ADDITIONAL MANAGEMENT TOOL,

Middlesex Polytechnic, London (England).
M. House, and J. B. Ellis.
Water Science and Technology, Vol 13, No 7, p 413-423, 1981. 8 Fig, 15 Ref.

Descriptors: *Water quality management, *Classification, Management planning, Planning, *United Kingdom, Rivers, Water pollution, Scottish Development Department, *Water quality indices.

A comparison of the geometric weighted formulation of the Scottish Development Department (SDD) water quality index with the National Water Council (NWC) and Thames Water Authority (TWA) classifications showed 76% and 81% agreement, respectively. This suggests that, with modifications, the SDD could be successfully used to monitor changes in water quality. In its present form it is most accurate in good quality waters and less accurate in low quality waters. There are several advantages to adopting a water quality index: (1) it reduces a large amount of data to a single index, (2) it reduces subjective judgments, (3) it provides more information on water quality, (4) it allows greater detail in describing specific river reaches and in showing small changes in quality, (5) it reports specific quality rather than qualitative approximations, and (6) it is more easily understood by laymen. (Cassar-FRC)
W82-01994

REVIVING THE RIO RECONQUISTA,

Thames Water Advisory Service (England).
P. Borrows.
Water, No 38, p 24-26, May, 1981. 1 Fig.

Descriptors: *Water pollution control, *Planning, Water pollution prevention, Rivers, Industrial wastes, Effluents, Food-processing wastes, *Argentina, *Odors, *Hydrogen sulfide.

The polluted condition of the Rio Reconquista in Argentina gave rise to the generation of hydrogen sulfide to such an extent that in the summer many stretches of the river could not be approached. The Rio Reconquista rises in the grass lands to the west of Buenos Aires. The pollution in the river has been caused by uncontrolled discharges of domestic sewage and industrial wastes, with the latter arising from a variety of sources, either from food processing plants or petrochemical industries. One of the first steps taken to correct the situation involved the establishment of a pollution control

authority with adequate powers to stop the major sources of pollution from entering the river. Work was designed to take place in two stages. First, an initial three months were needed to tender documents and undertake a further study of the pollution. Second, a longer period extending over several years was set to build and commission the sewerage system extension and possibly another treatment works built on the river Matanza. Groundwater and resource planning would also be undertaken. (Baker-FRC)
W82-02014

WASTE DISPOSAL–CHOOSING AND LICENSING SITE,
Severn Trent Water Authority, Birmingham (England).
K. Selby.
Water, No 30, p 11-13, January, 1980. 1 Tab.

Descriptors: *Waste disposal, *Groundwater pollution, *Water pollution prevention, Site selection, Licensing, Legal aspects, Underground waste disposal, Water quality, *Great Britain.

Water authorities in Great Britain are responsible for ensuring the protection and proper use of all inland water, including water in the underground strata. The Control of Pollution Act of 1974 includes a waste disposal site licensing procedure which for the first time provides for proper control of waste disposal operations and for the involvement of water authorities in the licensing of sites. Factors affecting the degree of risk to water quality from waste disposal operations include the chemical and physical nature of the wastes, the quality and volume of leachate produced, the geology and hydrogeology of the disposal site, and the existing and desired quality of the water resource which is at risk. The aquifer protection policy developed by the Severn Trent Water Authority is based on identification of the resource vulnerability in hydrogeological terms and classification of activities considered to present a risk of groundwater pollution in each resource risk area. The four risk areas or protection zones range from high risk areas within one kilometer of public water supply boreholes, within which no waste disposal sites are permitted, to areas not located over either major or minor aquifers, in which there are few restrictions on the establishment of waste disposal sites unless surface water protection is needed. This policy allows for the identification of clearly acceptable or clearly unacceptable proposals, allowing limited resources to be concentrated on the marginal and more important proposals. Conditions which the water authority has recommended be included in some licenses for the protection of water quality have covered the type and volume of waste to be deposited, the inclusion of facilities at the site to prevent the formation and movement of leachate, leachate treatment and disposal facilities and other drainage provisions, and monitoring arrangements. Of recommendations made with respect to 879 licenses, only 6 have resulted in appeals. (Carroll-FRC)
W82-02035

WATER POLLUTION: A RISK TO THE FUTURE IN THE CASE OF THE RHINE (EAUX POLLUEES' AVENIR EN DANGER DANS LE CAS DU RHIN),
Zurich Service des Eaux (Switzerland).
M. Schalekamp.
Aqua, No 6, p 126-136, 1980. 56 Fig.

Descriptors: *Water quality control, *Chemical wastes, Water pollution control, Industrial wastes, Fish, *Rhine River.

Measurements made in 1978 by the International Committee of Rhine Basin Water Supply Undertakings show that water quality in the Rhine River has improved. For example, the level of lignosulfonic acid has fallen considerably. Although fish can now live in the river, they are still inedible because chemical pollution levels and salt content are high. Concentrations of toxic substances are 14.5 times higher in the lower Rhine than in Lake Constance. Prompt implementation of the Salt Convention, a treaty on chemical pollution, and better treatment of industrial wastes will further improve water quality in the Rhine, which serves as the water supply for 20 million people. This report urges that the health of the Rhine should not be judged by the fact that fish are returning, but rather in terms of water quality and human health. (Cassar-FRC)
W82-02067

WATER QUALITY MANAGEMENT OF LAKE NEUSIEDLER, AUSTRIA,
Federal Inst. on Water Resources Research (Switzerland).
For primary bibliographic entry see Field 5C.
W82-02090

POLAND: COMING TO GRIPS WITH POLLUTION,
D. Hinrichsen.
Ambio, Vol 10, No 1, p 40-41, 1981. 1 Tab.

Descriptors: *Industrial wastes, *Water pollution sources, *Water pollution control, Air pollution, Environmental effects, Acid rain, *Poland.

Groundwater pollution by coal mining operations and subsidence of groundwater and river levels are among the problems caused by industrialization in Poland's Silesian Triangle. Steel mills, coal-fired power stations, coal mines, chemical plants, and metallurgical and engineering companies are highly concentrated in this area; many use outdated technologies. Acid rain is a serious problem, affecting soil and vegetation. The Vistula River in this area is polluted beyond all acceptable limits, and its water level has been dropping by 10 cm a year. The Polish Academy of Sciences Research Center for Nature Protection and Natural Resources in Krakow and the Institute of Environmental Engineering, Zabrze, are working to improve the environment. However, they are understaffed and underfinanced and must consider tradeoffs between the country's need for more and cheaper energy and environmental improvement. (Cassar-FRC)
W82-02092

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

LAND-USE CONFLICT IN WILDLAND WATERSHED MANAGEMENT: A MULTIPLE OBJECTIVE ECONOMIC ANALYSIS,
California Univ. Davis.
W. C. Kinney.
PhD Dissertation, 1980. 270 p, 16 Fig, 23 Tab, 107 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-05389.

Descriptors: *Land use, *Watersheds, Model studies, Mathematical models, Economics, Multiobjective planning, Forest management, *Resources management, Multiple use of resources.

Economically efficient wildland watershed management requires a means of determining the relative value of noncommensurable forest outputs. This study develops a multiple objective mathematical programming model for determination and analysis of marginal economic tradeoffs between these outputs. These inputed tradeoffs are used to analyze alternative forest management activities, each of which produce a specific combination of joint forest outputs. Using a study area watershed in the Los Padres National Forest in California, the analysis first attempts to define the watershed's efficient production possibilities for these joint outputs. Successive parameterization of objective constraint levels generates the watershed's efficient production possibilities frontier. The Los Padres Forest has no commercially productive timber lands, and exists primarily for watershed protection. The predominant vegetation is chaparral, a group of bushy species which are highly susceptible to fire at certain times. Alternative management activities analyzed include prescribed rotational burning and vegetative type conversion. The joint production process is defined by the level of water runoff, sediment erosion, wildfire output, wildlife habitat potential, and visual resource impact for a given level of investment in intensive fuel management activities. The programming model identifies a relevant subset of all possible efficient output vectors, and provides the rates of product transformation betwen them. The economic analysis of these watershed management alternatives indicates that present vegetative conditions are generating significant inefficiencies in the management of public resources. (Sinha-OEIS)
W82-01675

WATER MANAGEMENT IN THE COLORADO RIVER BASIN: AN APPLICATION OF NONLINEAR TRANSPORTATION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Economics.
K. E. Boles.
PhD Dissertation, 1980. 110 p, 7 Fig, 2 Tab, 67 Ref, 2 Append. University Microfilms International Ann Arbor, MI; Order No GAX-17769.

Descriptors: *Model studies, *Water management, *Water resources, *Colorado River basin, Land use, Treatment, Flow augmentation, Recharge, Reclamation, Recycling, Desalination, Transportation algorithms.

Recent developments in transportation algorithms and a decomposition strategy are utilized to develop a comprehensive water resources management model of the Colorado River Basin which can be solved quickly. This model permits both quality and quantity levels to be considered at all points within the system. The quality and quantity requirements are used as parameters in the determination of an optimal system of piping, treatment levels, recycling, reclamation, groundwater recharge, reservoir usage, flow agmentation, land use and other management alternatives. Several optimum systems are then compared as to costs, allocations and quality of output under differing legal, economic, technological and environmental assumptions. A full analysis of the Colorado River Basin water supply and quality situation under various constraint assumptions is presented. A thorough analysis is performed of the interaction and impacts of eight Bureau of Reclamation salinity control projects. The primary emphasis is on examining the impacts and alternatives involved with the Yuma desalination project. Finally a summary of both the Colorado River Basin analysis and the success of using the model and solution technique is given along with conclusions derived from these two facets of the study. (Sinha-OEIS)
W82-01677

A STRUCTURAL SYSTEMS ANALYSIS APPROACH TO DETERMINE OPTIMUM OPERATING POLICIES FOR IRRIGATION AND HYDROPOWER GENERATION FOR WATER RESOURCES, SYSTEMS,
California Univ., Berkeley.
F. J. Gonzales-Villarreal.
Doctor of Engineering Dissertation, 1980. 233 p, 29 Fig, 17 Tab, 58 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-12930.

Descriptors: *Water resources development, *Irrigation, *Computer programs, Mathematical models, *Mexico, Powerplants, Hydropower generation.

The main contribution of this research is the development of a methodology and the implementation of the computer programs for analyzing water resources systems with a twofold purpose; irrigation and power generation. The methodology can be classified as a multilevel hierarchical approach. Special attention is given to integrating the optimization and simulation models that describe the different parts of subsystems of the whole system as well as to analyzing the stochastic nature of the streamflow and other local conditions within the framework of the targets and objectives of a national agricultural production system and a regional power generation set-up. The methodology is

applied to the case of the Yaqui River in northwestern Mexico. (Sinha-OEIS)
W82-01680

A LIMNOLOGICAL INVESTIGATION OF A TROPICAL FRESH-WATER ECOSYSTEM: THE BELIZE RIVER, BELIZE, CENTRAL AMERICA,

Western Michigan Univ., Kalamazoo.
For primary bibliographic entry see Field 5G.
W82-01682

THE MANAGEMENT OF WATER RESOURCES: A SYNTHESIS OF GOAL PROGRAMMING AND INPUT-OUTPUT ANALYSIS WITH APPLICATION TO THE IOWA ECONOMY,

Iowa State Univ., Ames.
E. K. Mensah.
PhD Dissertation, 1980. 243 p, 3 Fig, 36 Tab, 61 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06030.

Descriptors: *Water resources development, *Economics, *Iowa, Management, Model studies, *Water management, Resources management, Multiobjective planning.

This study focuses on the development of a multi-objective model combining input-output analysis and goal programming for providing guidance in the allocation of the water resources of Iowa. The model was applied in the allocation of water between the economic sectors of the state of Iowa to satisfy the state's water needs for economic and demographic projections to 2020. The 1972 input-output technical coefficients matrix of Iowa developed by Barnard was modified to include commodity-wise marginal properties to consume. This extension of the basic input-output model was aimed at capturing the income effect of consumption on production and resource utilization. It thus includes a comprehensive multiplier analysis of the effects of a shock in one sector of the economy throughout the entire economic system. The analysis has confirmed that the state of Iowa, as well as its eight major water supply areas, have enough water resources to satisfy the long term growth projections to the year 2020. This conclusion embraces only quantity of water regardless of quality demanded or quality supplied. (Sinha-OEIS)
W82-01685

RANDOM DIFFERENTIAL EQUATIONS IN WATER QUALITY MODELING,

Utah State Univ., Logan.
B. A. Finney.
PhD Dissertation, 1980. 190 p, 43 Fig, 8 Tab, 42 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-05105.

Descriptors: *Model studies, *Mathematical models, *Water quality, Biological Oxygen Demand, Equations, Probabilistic process, Differential equations, Dissolved oxygen.

A probabilistic river water quality model is developed with the capability of determining the joint and marginal probability density function of BOD and DO at any point in a river. The one dimensional steady-state model can be applied to a river system with any reasonable number of point loads and diversions and lateral surface and subsurface inflow. The model can simultaneously consider randomness in the initial conditions, inputs, and coefficients of the water quality equations. Any empirical or known distribution can be used for the initial condition. The randomness in the water quality equation inputs and coefficients is modeled as a Gaussian white noise process. The joint pdf of BOD and DO is determined by numerically solving the Fokker-Plank equation. Moment equations are developed which allow the mean and variance of the marginal distribution of BOD and DO to be calculated independently of the joint pdf. An upper limit on the coefficient noise variance parameter is presented for which the BOD-DO covariance matrix will be asymptotically stable. The probabilistic river water quality model is applied to two problems, a sensitivity problem and a hypothetical problem. (Sinha-OEIS)
W82-01688

THE TECHNOLOGY TRANSFER PROCESS IN WATER RESOURCES R&D MANAGEMENT,

Stanford Univ., CA. Dept. of Civil Engineering.
C. E. Downs.
PhD Dissertation, 1980. 217 p, 24 Fig, 13 Tab, 162 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-11627.

Descriptors: *Water resources, *Model studies, *Water policy, Technology, Planning, Research and development, Saline water.

The scope of this study, for reasons of manageability, is restricted to water resources R&D management considerations, and particularly the adaptiveness of R&D resource allocation decisions. The study is divided into two parts in order to afford an intuitive feel for the adaptive interrelationships between the technology transfer process, the R&D management function, and the public policy making process as well as a theoretical perspective for modeling and analysis. The first part is devoted to the development of the nature and context of the problem, its basis in research and the policy state space concept and model. The policy state space model has its basis in the recognition of the common cybernetic characteristics of the adaptive processes involved and suggests a first step toward a new theory of public policy evaluation. The second part is a case study of the adaptiveness of the R&D policies for the former Office of Saline Water. The objective of the case study is to illustrate the application of the policy state space model and to assess its utility both in evaluating the adaptiveness of the policy making process in water resources R&D management and its symbiotic link with the technology transfer process as well as in broader studies of the policy making process. (Sinha-OEIS)
W82-01694

POLLUTION PERMITS AND MARKETS FOR WATER QUALITY,

Wisconsin Univ.-Madison.
W. B. O'Neill.
PhD Thesis, 1980. 199 p, 17 Tab, 119 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-07851.

Descriptors: *Water pollution control, *Water quality, *Pollution abatement, Economic justification, Market value, Permits, *Model studies, Transferable discharge permits(TDP's).

The analysis begins with the development of an economic river basin model which identifies a well-defined index of water quality as a commodity subject to competing demands by polluters. The model utilizes linear programming optimization techniques to conduct a cost-effectiveness comparison of the market strategy with two commonly proposed alternative abatement plans. Comparison of the abatement costs implied by the three strategies provides information about the effect of market transactions costs on the choice of a control plan. In particular, the cost difference between the market and the alternative plans is an estimate of the maximum level of transactions costs consistent with choice of the market strategy. Initially a single period model is constructed which assumes steady-state conditions on the Fox River in Wisconsin. Simulation of a variety of market structures and river conditions provides evidence that the market strategy may be significantly less costly than the alternative plans. A multi-period model is also developed and used to analyze the choice of control strategy in the case of varying river conditions and the associated assimilative capacities. Fox River simulation results again support the cost-effectiveness of the transferable discharge permits (TDP's) market. In both sets of analyses, the market simulations also provide information on the nature of permit trading and on the type of market supervision which would be necessary if a TDP market were to be instituted. (Sinha-OEIS)
W82-01699

FLOOD CONTROL ON THE PARANA AND PARAGUAY RIVERS,

Motor-Columbus Consulting Engineers, Inc., Baden (Switzerland).
For primary bibliographic entry see Field 2E.
W82-01707

OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN,

Southampton Univ. (England). Inst. of Irrigation Studies.
J. R. Rydzewski, and H. A-H. Rashid.
Water Resources Bulletin, Vol 17, No 3, p 367-372, June, 1981. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Irrigation, *Water allocation, *Water deficit, *Jordan, Diversion, Conjunctive use, Water resources, Agriculture, Water management, Model studies, Optimization.

Optimal allocation of water resources to three agricultural areas in the arid region east of the Jordan River was accomplished, using nonlinear programming to maximize productivity of irrigation water while allowing for crop water deficits, and linear programming to determine the cheapest alternative. The three agricultural regions are I, 14,000 ha; II, 9,000 ha; and III, 13,000 ha of Cultivable Commanded Area. The Jordan River itself becomes too saline for irrigation purposes 50 km south of its source in Lake Tiberias. The available water sources are its eastern tributaries, the Yarmouk, Zarqa, and Arab rivers and their storage reservoirs, major groundwater resources in Region III, and promising groundwater sources in Region II. The cropping pattern suggested for this frost-free region is 20% perennial (citrus, banana, and lucerne), 80% winter crops (wheat, barley, vegetables, onions, and berseem), and 50% summer crops (vegetables, sunflower, groundnut, sesame, and fodder). Yearly crop water requirements are 19,400 cu meters per ha with no rainfall and 15,800 cu meters per ha allowing for some rainfall. Annual crop demand would be at least 760 million cu meters with 70-75% efficiency. A table lists the recommended monthly water allocation for 3 years for each agricultural region from each of eight water sources, the Yarmouk River and its storage being prominent. (Casser-FRC)
W82-01742

HYDROGEOLOGY OF WELL-FIELD AREAS NEAR TAMPA, FLORIDA, PHASE 1--DEVELOPMENT AND DOCUMENTATION OF A TWO-DIMENSIONAL FINITE-DIFFERENCE MODEL FOR SIMULATION OF STEADY-STATE GROUND-WATER FLOW,

Geological Survey, Tallahassee, FL. Water Resources Div.
C. B. Hutchinson, D. M. Johnson, and J. M. Gerhart.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $17.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-630, 1981. 129 p, 11 Fig, 2 Tab, 12 Ref.

Descriptors: *Geohydrology, *Model studies, *Simulation analysis, *Groundwater movement, Finite element method, Aquifer characteristics, Wells, Water table, Leakage, Pumping, Drawdown, *Florida, Tampa, Floridan aquifer, Cross Bar Ranch well field, Morris Bridge well field.

A two-dimensional finite-difference model was developed for simulation of steady-state groundwater flow in the Floridan aquifer throughout a 932-square-mile area, which contains nine municipal well fields. The overlying surficial aquifer contains a constant-head water table and is coupled to the Floridan aquifer by a leakage term that represents flow through a confining layer separating the two aquifers. Under the steady-state condition, all storage terms are set to zero. Utilization of the head-controlled flux condition allows head and flow to vary at the model-grid boundaries. Procedures are described to calibrate the model, test its sensitivity to input-parameter errors, and verify its accuracy for predictive purposes. Also included are attachments that describe setting up and running the model. An example model-interrogation

run shows anticipated drawdowns that should result from pumping at the newly constructed Cross Bar Ranch and Morris Bridge well fields. (USGS)
W82-01780

THE LAKE TAHOE BASIN: A SYSTEMS ANALYSES OF ITS CHARACTERISTICS AND HUMAN CARRYING CAPACITY,

Energy Policy Studies, Inc., Omaha.
M. W. Gilliland, and B. D. Clark.
Environmental Management, Vol 5, No 5, p 397-407, September, 1981. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Lake Tahoe, *Carrying capacity, *Systems analysis, Public policy, Planning, Watershed management, Watershed protection, Legal aspects, Urbanization, Environmental effects, Ecological effects.

An environmental assessment of the Lake Tahoe Basin was made which was aimed at analyzing the federal role in the preservation of the area. A systems approach was utilized which is applicable to both urban and natural environments that are characterized by similar resource constraints. Urban growth in the area has been exponential and has caused significant damage to the environment. The area experiences congestion, violations of air and water quality standards, losses in wildlife, and degradation of visual resources (views). Full protection for the area requires the definition of a carrying capacity for the basin and management of the growth process. An environmental thresholds standards analysis was performed, using three threshold levels of sediment and nutrient inputs into the lake. The three hypothetical loading rates correspond to three levels of lake water quality, and thus to three possible perceptions of ecological damage. Available mitigation funds also influence the calculated carrying capacity of the basin. (Small-FRC)
W82-01807

LONG-RUN EFFECTS OF ENVIRONMENTAL REGULATION,

International Bank for Reconstruction and Development, Washington, DC. Policy Planning Div.
R. G. Ridker, and W. D. Watson.
Natural Resources Journal, Vol 21, No 3, p 565-587, July, 1981. 3 Fig, 7 Tab.

Descriptors: *Long-term planning, *Water pollution control, *Regulations, *Economic aspects, Environmental effects, Planning, Water policy, Population growth, Effluent standards, Social costs, Cost-benefit analysis.

The relationship between the generation of pollutants, environmental regulations, and economic growth over a 50-year period is examined. It appears that pollution can be substantially improved without undue interference with the national economy as long as fiscal and monetary policy brings about increases in savings and as long as disadvantaged sectors are helped. On the negative side, there is profound ignorance on the environmental consequences of past and future human activities or the results of using different forms of energy. Five quality factors should be considered in judging the conclusion: Policies analyzed were based on uniform national emissions standards, which do not account for overcontrol or undercontrol in some areas. Pollutants were considered as an aggregate. Investments for pollution abatement and for energy-efficient capital may reduce economic growth if there are not sufficient savings to finance the extra capital requirements. Constraints of local requirements and decisions could seriously reduce growth. Uncertainty about future environmental pressures may also slow economic growth; for example, at some point acid rain, loss of topsoil, or rapid population growth may produce acute pressure. A table shows the indexes of per capita economic welfare for relaxed controls, strict controls, least-cost controls, and controls at 1975 levels for the years 1975, 1985, 2000, and 2025. The least-cost policy would lead to the highest per capita welfare index (3.22) by the end of the 50-year period vs. 3.20 for relaxed controls, 3.17 for strict controls, and 3.14 for 1975 controls. (Cassar-FRC)
W82-01848

SIMULATING EFFECTS OF COMBINED SEWER OVERFLOWS,

Lozier Engineers, Inc., Rochester, NY.
H. M. Shapiro, J. B. Blenk, and M. P. Allen.
Water/Engineering and Management, Vol 128, No 9, p 79-80, 82, 84, September, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Storm-overflow sewers, *Wastewater pollution, *Model studies, *Project planning, Simulation analysis, Mathematical studies, Sewers, Storm sewers, Storm runoff, Hydraulic models, Cost analysis, *Chemung County, New York.

Chemung County, New York, has taken measures to upgrade its waste water treatment facilities. A simulation study was organized to determine the cost effectiveness of overflow storage with subsequent treatment, the effect of combined dry weather and treated or untreated overflow on stream standards, and the effects of increased plant efficiency on the reduction of combined sewer overflow (CSO). A STORM-WQRRS (Water Quality River-Reservoir) continuous simulation model was selected to predict the quantity and quality of storm water and dry weather flow. The three major steps involved in these predictions entailed computations of runoff quantity and quality and storage, treatment and overflow of runoff. The WQRRS modeling concept is based on fundamental laws of conservation and kinetics as they apply to studies of continually-stirred-tank reactors and is structured of three separate but interchangeable modules: a reservoir module, a stream hydraulic module, and a stream quality module. The CSO impact on the Chemung River was determined by application of the STORM model to data obtained from a site 5 miles above the CSO source. The WQRRS model yielded results of little value in the evaluation of CSO impact. The WQSTAT statistical program was employed to reduce the output of CSO impact. The WQSTAT statistical program was employed to reduce the output to more usable form. After the simulation analysis was complete, the consultant recommended no additional CSO abatement work at the present time. However, design of a regional treatment facility is currently underway. (Geiger-FRC)
W82-01864

A MULTILEVEL MODEL AND ALGORITHM FOR SOME MULTIOBJECTIVE PROBLEMS,

Chiyoda Chemical Engineering and Construction Co. Ltd., Yokohama (Japan).
N. Takama, and D. P. Loucks.
Water Resources Bulletin, Vol 17, No 3, p 448-453, June, 1981. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Decision making, *Chemical wastewater, *Multiobjective planning, *Wastewater treatment, Industrial wastewater, Optimization, Planning, Algorithms.

An interactive decision making model is presented to aid in solving multiobjective problems associated with large scale convex multilevel systems. At each step the decision maker carries out pairwise comparisons, which are reflected on higher level decision variables. The procedure is applied to the design of a wastewater treatment system for a chemical manufacturing plant. The performance of the system is evaluated by three criteria: efficiency of the waste treatment process, system reliability, and cost. The treatment system is decomposed into two subsystems, each with a treatment efficiency and a cost criterion. The first subsystem consists of a number of treatment units which are evaluated to obtain the minimum pollutant discharge for a given cost. The second subsystem consists of control units to produce maximum system reliability at a given cost. (Cassar-FRC)
W82-01884

THE ECONOMICS OF COOPERATION OVER COLLECTIVE BADS,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, and D. W. Bromley.
Journal of Environmental Economics and Management, Vol 8, No 2, p 134-150, June, 1981. 5 Fig, 29 Ref.

Descriptors: *International agreements, *Pollution taxes, Economic aspects, *Theoretical analysis, Water quality control, Water pollution control, Taxes, Model studies, Nonstructural alternatives.

Pollution released in one country frequently produces damages in other nations; for example, both Canada and the U.S. are affected by contaminants in the Great Lakes. This paper adapts concepts of trade in public goods to present a theory of cooperation over reciprocated collective bads. Similar techniques are used for analysis of public goods and exchanged collective bads. Both theories conclude that joint actions involving efforts greater than the sum of those undertaken independently can produce Pareto-superior results, some of which are optimal. The two theories differ in the meaning attached to the trade region and in incentives to cooperate. Since collective bads are damaging to a nation's welfare, cooperation is much more urgent than working out economics in supplying public goods. Although tax policies are useful in studying cooperative arrangements, they present many obstacles in practice. Among the obstacles involved in making agreements between reciprocating polluters are costs of negotiations and enforcement, deception, self-interest, and blackmail. Overcoming these problems may involve acquiring accurate information on the physical system and on consumer preferences, agreement on principles of cooperation, and correction of misinformation. (Cassar-FRC)
W82-01909

LOGISTICS OF FARM WATER SUPPLY.

New Zealand Journal of Agriculture, Vol 140, No 6, p 38-39, 41, 43, July, 1980. 6 Fig.

Descriptors: *Water conveyance, *Farming, Water supply development, Water resources development, Rivers, Wells, Pumps, Pipes, Costs, Financial considerations, *New Zealand.

Factors involved in establishing a good water supply system for a farm are reviewed in the form of a case study. The farm site was Massey University's Riverside farm, located five miles south of Mount Bruce in Wairarapa, New Zealand. Originally the farm depended on two small pumps drawing water from the river, which proved to be inadequate for stock watering, farm work and domestic purposes as well as being subject to breakdowns due to flooding in the river. Sound initial planning is needed to build a system. This planning should include an aerial photograph of the farm and a topographical map of the area, an estimate of water requirements for present and future needs, full details and level and flow rate of all available water sources, and the location and level of all outlets, troughs, houses, etc. In this case, with head available on the hills, a pumped gravity system was a natural choice. The system chosen involved drawing water from the river and pumping it into a ring main, the two sides of which join towards the top of the farm to feed a 22,000 liter concrete tank acting as a reservoir. Pipe choices depend on the pressures expected. Pressure is a function of the topography. (Baker-FRC)
W82-02037

6B. Evaluation Process

PUBLIC OPINION AND INTEREST GROUP POSITIONS ON CHESAPEAKE BAY ISSUES: IMPLICATIONS FOR RESOURCE MANAGEMENT,

Maryland Technical Advisory Service, College Park.
P. S. Florestano, and P. A. Rathbun.
Coastal Zone Management Journal, Vol 9, No 1, p 19-39, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Resources management, *Public policy, *Policy making, *Chesapeake Bay, Water management, Water policy, Administrative decisions, Surveys, Recreation, Commercial fishing, Environmental policy, Environmental protection, Nuclear powerplants, Water pollution.

A twofold methodological approach was employed to review public opinion on a number of environmental topics concerning the use and management of the Chesapeake Bay and determine if policies advocated by various public interest groups reflect the preferences of Maryland citizens. Data collected addressed water pollution, government regulation of private land, waterfront construction, and recreational boating, nuclear powerplants, oil spills, responsibility for discharge of toxic substances, dredging of bay channels and port expansions, and preferential treatment for the seafood industry. Telephone surveys of a random sample of state residents, mail surveys of interest groups, and personal interviews with interest-group leaders were conducted to identify policy stands on Chesapeake Bay issues. The findings revealed that interest group policies, in general, reflect the public's attitude on environmental and Bay-related issues. Citizens and interest groups alike did not seem to place more importance on the increased need for energy than for the protection of the environment. (Geiger-FRC)
W82-01642

RIVER THERMAL STANDARDS COSTS IN THE UPPER MIDWEST,

Iowa Univ., Iowa City. Dept. of Civil Engineering.
T. E. Croley, A. R. Gianquinta, and R. A. Woodhouse.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 65-77, May, 1981. 2 Fig, 4 Tab, 15 Ref. OWRT-B-061-IA(2).

Descriptors: *Electric powerplants, *Cost-benefit analysis, *Thermal pollution, *Temperature effects, Powerplants, Thermal powerplants, Environmental effects, Water resources development, Thermal stress, Standards, Water quality standards, Costs, Rivers, Mathematical studies.

An evaluation was made of the marginal (incremental) changes in cooling-related water consumption (evaporative loss) and power-plant cooling costs which result from unit changes in river temperature standards along the Upper Mississippi and Missouri Rivers in the MAPP region. Some hypothetical river thermal standards for powerplants were examined including the extreme cases of free thermal discharge and no thermal discharge. Various restrictive levels for standards are studied for their probable impact on the MAPP region. One way of representing thermal standards is by trade-off relationships which are based on cost/benefits analyses. Environmental objective functions were difficult to define due to the noncommensurable nature of the benefits of fish and wildlife preservation and the costs of meeting certain thermal standards. Decision makers may have difficulty in determining future thermal standards when the costs of providing different levels of environmental protection are considered in the cost/benefit evaluation. (Geiger-FRC)
W82-01655

THE NATIONAL COMMISSION ON WATER QUALITY: A CASE STUDY IN CONGRESSIONAL POLICY ANALYSIS,

Texas Univ. at Dallas, Richardson.
R. B. Outen.
PhD Dissertation, 1980. 335 p, 118 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13925.

Descriptors: *Water quality, *Water policy, Legislation, Behavior, United States, *Case studies, *Congressional policy, National Commission on Water Quality.

This analysis of the National Commission on Water Quality has been structured around a series of propositions concerning the behavior of the National Commission on Water Quality and the Congress. The analysis has demonstrated that the stated propositions concerning 'normative behavior' were not borne out. To a very large degree, they failed to predict the behavior of the National Commission on Water Quality or the Congress in responding to the Commission's reports and recommendations. The data suggest, therefore, that the original goal model was invalid. The Congress-dominated, mixed membership structure of the Commission institutionalized powerful political tensions which subsequently exerted a strong influence on the way the Commission behaved. Through individual personalities and political events peculiar to the issue area provided a unique texture and color, the underlying fabric of behavior was the result of the dominant presence of Congressional members on the Commission. (Sinha-OEIS)
W82-01669

WATER MANAGEMENT IN THE COLORADO RIVER BASIN: AN APPLICATION OF NON-LINEAR TRANSPORTATION ALGORITHMS,

Arizona Univ., Tucson. Dept. of Economics.
For primary bibliographic entry see Field 6A.
W82-01677

THE MANAGEMENT OF WATER RESOURCES: A SYNTHESIS OF GOAL PROGRAMMING AND INPUT-OUTPUT ANALYSIS WITH APPLICATION TO THE IOWA ECONOMY,

Iowa State Univ., Ames.
For primary bibliographic entry see Field 6A.
W82-01685

AN ECONOMIC AND INSTITUTIONAL ASSESSMENT OF THE WATER PROBLEM FACING THE TUCSON BASIN,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
A. H. Griffin.
PhD Dissertation, 1980. 407 p, 14 Fig, 52 Tab, 127 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28529.

Descriptors: *Water supply, *Groundwater, *Water users, *Economics, Arizona, Water rights, Water levels, Mining, Agriculture, Urbanization, Multiple use of resources, *Tucson.

The occurrence and use of water in the region is examined in order to determine the real nature of Tucson's water problem. The institutions governing the use of water in the Basin are described and the disputes between the local water users are discussed. An account is given of the use of water by businesses and residences in Tucson, by the copper mines to the south of Tucson, and by the farms in the Basin. The effect of changes in the cost and availability of water on each of these classes of water user is investigated and the effect that changes in water use could have on the region's economy is discussed. The occurrence of groundwater is described and the merits of the proposed Central Arizona Project are investigated. Various ways of balancing the region's water budget are described and an assessment is made of the effect that curtailing the use of water in the region would have upon the local water users and the region's economy. The principal conclusions are as follows: There is no danger of the supply of water in the Basin becoming exhausted in the near future. The economic and physical effects of the continuing fall in the level of the water table are unlikely to be serious. The region's water budget could be balanced very economically by retiring all agriculture in the region and making modest reduction in the amount of water consumed by urban water users and the copper mines. Given suitable institutional arrangements, curtailing the use of water in the Basin would be a much more economical way of balancing the region's water budget than building the Central Arizona Project. The final conclusion is that the real water problem is an institutional problem. (Sinha-OEIS)
W82-01698

INTEGRATED AGRICULTURAL DEVELOPMENT IN THE PHILIPPINES,

Asian Development Bank, Manila (Philippines). Agriculture and Rural Development Dept.
K. Takase.
International Water Power and Dam Construction, Vol 33, No 8, p 22-24, August, 1981. 2 Fig.

Descriptors: *Irrigation programs, *Resources development, *Philippines, Irrigation, Rural areas, Rural sociology, Cost analysis, Financing, Agricultural engineering.

The Asian Development Bank has approved 81 loans amounting to $1261 million in the area of irrigation and rural development projects. In 1966 the government of the Philippines placed highest priority on rice self-sufficiency centered on irrigation development, which was the prerequisite for growth of the new high yielding varieties of rice. The World Bank proposed the construction of a storage dam on the basis that water resources should first be secured. The Pantabangan dam in Nueva Ecija was completed in August 1974 with the aim of irrigating 83,000 ha. In 1968 the National Irrigation Administration selected a 140 ha pilot area within the Angat River Irrigation System to tackle the problem of ditches and drainage. The design and construction of farm ditches for irrigation and drainage was undertaken, and a number of measuring stations were established in the area. A series of demonstrations and educational campaigns was also conducted. A year after the project began, the density of farm ditches had increased from 16 to 62 m/ha, systematic water application became effective, high yielding varieties were planted, and fertilizers were applied, causing a jump in the pilot scheme paddy yields from 2.3 t/ha in 1968 to 3.1 t/ha in 1969. This project pioneered not only the improvement and rehabilitation of irrigation, drainage and service roads, but also the inegretion of land reform, compact farm associations, supervised credit, and the training of staff and leading farmers. Additional attention is needed on cost effectiveness and socio-economic benefits as well as project implementation and loan administration. (Baker-FRC)
W82-01725

ADDENDUM TO: SOURCES OF POWER-PLANT COOLING WATER IN THE DESERT AREA OF SOUTHERN CALIFORNIA--RECONNAISSANCE STUDY,

Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Koehler, and M. J. Mallory.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-527, June, 1981. 28 p, 9 Fig, 3 Tab, 14 Ref.

Descriptors: *Evaluation, *Groundwater availability, *Groundwater basins, *Water cooling, *Powerplants, Aquifers, Pumping, Deserts, Water quality, *California, Southern California.

A hydrologic reconnaissance study was made in five basins in southern California previously classified as suitable for providing sufficient ground water for cooling a 1,000-megawatt electric-power generating plant. The criteria used to evaluate the basins were (1) theoretical aquifer response to pumping, (2) alternative sources of water, and (3) chemical quality of water. The basins were ranked relative to each other for the three criteria and in overall suitability. On the basis of subjective analysis, the basins were ranked in the following order for overall suitability: (1) Calzona-Vidal Valley, (2) Middle Amargosa Valley, (3) Chuckwalla Valley, (4) Soda Lake Valley, and (5) Caves Canyon Valley. (USGS)
W82-01773

STATIONARY SOURCE POLLUTION POLICY AND CHOICES FOR REFORM,

Resources for the Future, Washington, DC.
For primary bibliographic entry see Field 6E.
W82-01847

LONG-RUN EFFECTS OF ENVIRONMENTAL REGULATION,

International Bank for Reconstruction and Development, Washington, DC. Policy Planning Div.
For primary bibliographic entry see Field 6A.
W82-01848

SIMULATING EFFECTS OF COMBINED SEWER OVERFLOWS,
Lozier Engineers, Inc., Rochester, NY.
For primary bibliographic entry see Field 6A.
W82-01864

GULF OF MEXICO: A SOCIOECONOMIC VIEW OF COMPETING RESOURCES,
C. O. French.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIA, May, 1981. p 1-40, 2 Fig, 16 Tab, 59 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Social aspects, *Economic aspects, *Water pollution, *Environmental effects, Competing use, Industrial wastes, Water use, Wetlands, Habitats, Waste disposal, Oil industry, Fisheries, Agriculture, *Coastal waters, *Gulf of Mexico States, Water demand.

The socioeconomic environment of the coastal region of the Gulf of Mexico is highly varied in terms of human quality. Although specific data are essentially unavailable, sound policy development and effective management are dependent upon correct assessment of these factors. The socioeconomic activities that effect the greatest alteration in the Gulf of Mexico region include: demographic changes; industrial development (petroleum, waterborne transportation, and ocean dumping); and commercial fishing. The five states covered by the study are Texas, Louisiana, Mississippi, Alabama, and Florida. The primary ways in which socioeconomic sectors interact with coastal processes are: generation of industrial and domestic wastes that are discharged into the environment; habitat modification such as impounding, draining, polluting, and filling wetlands; and natural resource exploitation, including water use. Various socioeconomic sectors may generate the same kinds of activities, so the environmental impact of one sector is often difficult to distinguish. In general, there has been rapid population growth in the South during the last decade, with the greatest rates of increase occurring in the coastal belt. Increasing industrial development and employment have paralleled urban growth and rural decline. Commercial and industrial resource uses in the Gulf are most closely associated with petroleum and petrochemical production, commercial fishing, recreation, and agriculture. (Moore-SRC)
W82-01901

A COMPREHENSIVE METHODOLOGY FOR PROJECT APPRAISAL AND ENVIRONMENTAL PROTECTION IN MULTINATIONAL RIVER BASIN DEVELOPMENT,
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
C. Yapijakis, and A. H. Molof.
Water Science and Technology, Vol 13, No 7, p 425-436, 1981. 5 Fig, 19 Ref.

Descriptors: *River basin development, *Decision making, *Alternative planning, Project planning, Planning, *Cost-benefit analysis, Environmental effects, Social aspects, Political aspects, Water resources development, *International waters.

A decision making method for evaluating alternatives for multinational river basin development is presented. This method intended as a tool, not as a panacea. Factors considered are benefit-cost ratio, capital outlay, environmental and social impacts, and manageability/technology level. Each government creates a coordinating group, a weighting panel, and a rating panel, each composed of specialists and experts. The coordinating group lists project alternatives, defines the factors in terms of its government's policies, and chooses the rating and weighting panels. The weighting panel establishes a weighting scheme for each of the aspects. Each member of the rating panel judges the alternatives in their field of expertise by any method—model construction, experiments, point assignment procedures, etc. Final selection of an alternative is done by one of 2 methods: ranking the alternatives from all countries in a single matrix on an equal weight basis, or producing a single list from the combined project ratings from each country. (Cassar-FRC)
W82-01914

OPTIMAL DESIGN OF BORDER IRRIGATION SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W82-01977

TECHNICAL AND ECONOMIC IMPLICATIONS OF INSTALLING AN INDUSTRIAL WASTE-WATER PRETREATMENT PLANT,
Environmental Control Consultancy Services Ltd., London (England).
For primary bibliographic entry see Field 5D.
W82-02044

SEVERN BARRAGE SCHEME GETS FAVOURABLE RESPONSE.
International Water Power and Dam Construction, Vol 33, No 9, p 48-50, September, 1981. 4 Fig.

Descriptors: *Tidal powerplants, *Severn River, *Electric power production, Tidal energy, Tides, Costs, Feasibility studies, United Kingdom, Water use, Cost-benefit analysis.

The configuration for the Severn tidal scheme with the highest cost-benefit ratio is a single basin, with electricity being generated in the ebb mode only. It would have an installed capacity of 7.2 MW and a 19 km-long barrage. It would produce about 13 TWh/year or about 6% of the United Kingdom's electricity demand, and would cost $10,640 million to build. The major benefit of the tidal scheme would be to reduce the amount of coal burnt by 5 to 8 times 10 to the 6th power tons. In the preferred scheme, the optimized number of turbines would be 160, each rated at 25 MW and 9 m in diameter. The economic justification for a barrage is dependent upon the cost of coal and the availability and cost of nuclear power. At the least, tidal power should be viewed as a valuable supplementary source of electricity, and is the leading renewable source. The environmental consequences of a barrage would be wide ranging. (Small-FRC)
W82-02089

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

STANDARDS AND CHARGES IN THE CONTROL OF TRADE EFFLUENT DISCHARGES TO PUBLIC SEWERS IN ENGLAND AND WALES,
York University, Heslington (England). Institute of Social and Economic Research.
M. G. Webb, and R. Woodfield.
Journal of Environmental Economics and Management, Vol 8, No 3, p 272-286, September, 1981. 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Effluents, *Economic aspects, *Industrial wastes, Discharge measurement, Standards, Regulations, Pricing, *Effluent charges, *England, Wales.

The revised charging scheme for discharges of trade effluent to public sewers introduced by the new water authorities in England and Wales are described. The charge scheme has been applied to effluent discharges from industries. The impact of these charges on the dischargers, the instruments used for the control of trade effluents to public sewers, and the relationship between optimal levels of trade effluent charges and levels of capacity at collective sewage works are considered. The revised charging schemes were based on a charging formula as recommended by the National Water Council. The primary aim of the charges is to allocate to the dischargers the costs incurred by the water industry for the reception, conveyance, treatment and disposal of waste products produced by industry. However, there is a total lack of empirical evidence to justify the chosen formula. Other problems involved in the use of the trade effluent charging scheme in combination with the consent standards include the determination of optimal collective treatment capacity, the optimal allocation of consent standards for given capacity, and the determination sample of discharges in the Southern Division of the Yorkshire Water Authority. One of the greatest problems was the use of regionally equalized charges based on historic accounting costs, which give dischargers inaccurate price signals. The study demonstrated that although the charging formula is related to volume, biological and sludge strengths of effluent treated, in practice the major determinant of a discharger's charge is the volume of effluent discharged. (Baker-FRC)
W82-01717

CHARGING FOR WATER SUPPLY IN ENGLAND AND WALES IN THE 1980S,
National Water Council, London (England).
D. Kinnersley.
Aqua, No 3, p 7-9, 1981.

Descriptors: *Water metering, *Water rates, Water policy, Water distribution, *England, *Wales.

Water meters are scheduled for installation in England and Wales beginning April 1981. At present only 5% of consumers, mainly industrial and agricultural, are metered. This system replaces the property tax type of charge in force since Victorian times. Not many shops and businesses have responded to the opportunity for metering, since water is one of their minor concerns. It is expected that only 20% of households will be metered by 1990, because installation and maintenance costs are the responsibility of the consumer. (Cassar-FRC)
W82-01722

CHARGING POLICIES FOR WATER SERVICES,
Leicester Univ. (England). Dept. of Economics.
P. R. Herrington, and M. G. Webb.
Water Services, Vol 85, No 1025, p 341-344, 346-347, July, 1981. 13 Ref.

Descriptors: *Water policy, *User charges, *Marginal costs, Public policy, Costs, Economic aspects, Legal aspects, *United Kingdom.

The objectives for nationalized industries set out in White Papers are applied to the water industry in this consideration of charging policies. The Water Act of 1973 set April 1981 as the date by which water authorities in England and Wales were to levy chages that are non-discriminatory and related to supply costs. Charging policies based on marginal costs are suggested to generate revenues which exceed costs and depreciation. Some of the difficulties with such a project include the problem of measurement of marginal costs, the metering of consumers not now metered, and the satisfaction of externally imposed financial objectives. The present charges are based on the rateable value of consumer's premises and are generally unrelated to the costs which consumers impose on water authorities. Thus, a transition period would be required before the policy based on marginal costs was fully implemented. Customers who would be adversely affected by the policy change would have time to adjust during this transition. (Small-FRC)
W82-01734

THE CALIFORNIA STATE WATER PROJECT—CURRENT ACTIVITIES AND FUTURE MANAGEMENT PLANS.
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 6E.
W82-01851

REGULATION FOR ENVIRONMENTAL PROTECTION: THE NANTICOKE INDUSTRIAL COMPLEX, ONTARIO, CANADA,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W82-02024

WATER: A LOW-PRICED BUT HIGH-COST RESOURCE,
Murdoch Univ. (Western Australia).
C. D. Ditwiler.
Search, Vol 12, No 3/4, p 73-77, 1981. 10 Ref.

Descriptors: *Water policy, *Social aspects, *Pricing, Water allocation, Water conservation, Water resources development, Water resources management, Water law, Planning, Economic aspects, Population dynamics, *Australia, Urban sociology.

In Australia, a dry continent, the government controls the development and allocation of water supplies. The price of water is low relative to its cost. Water conservation, recirculation, and transfer schemes receive little attention. Factors influencing water development strategies are population and economic growth and the trend toward the urban-oriented quality of life. Public concern over water will likely emerge in an indirect way. Problem areas may include the social impacts (financial and nonfinancial) of water supply and sewer system construction and pricing on urban development, the social costs of a uniform price for water of all qualities and at all periods of use (pea and off peak), and the social costs of ignoring declining groundwater tables. The water supply must be managed in an integrated manner on a regional basis in connection with other physical resources such as land and air. (Cassar-FRC)
W82-02061

6D. Water Demand

WATER REQUIREMENTS AND MAN-INDUCED CLIMATE CHANGE,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
For primary bibliographic entry see Field 2D.
W82-01633

A STRUCTURAL SYSTEMS ANALYSIS APPROACH TO DETERMINE OPTIMUM OPERATING POLICIES FOR IRRIGATION AND HYDROPOWER GENERATION FOR WATER RESOURCES, SYSTEMS,
California Univ., Berkeley.
For primary bibliographic entry see Field 6A.
W82-01680

AN ECONOMIC AND INSTITUTIONAL ASSESSMENT OF THE WATER PROBLEM FACING THE TUCSON BASIN,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 6B.
W82-01698

MOROCCO'S LARGEST MULTIPURPOSE SCHEME,
Ministere des Travaux Publics et des Communications, Rabat (Morocco). Direction de l'Hydraulique.
For primary bibliographic entry see Field 8A.
W82-01724

SUSTAINING THE GROWTH OF PROVENCE.
International Water Power and Dam Construction, Vol 33, No 8, p 28-29, August, 1981.

Descriptors: *Irrigation programs, *Water supply development, Provence, *France, Drought, Water demand, Water shortage, Water supply, *Water resources development, Civil engineering.

The Provence Canal Company's attempts to meet the various water demands of the Mediterranean region of France are described. The problem of water is especially crucial in areas bordering on the Mediterranean Sea. The Provence area has always suffered a lack of water, due to geographical and climatic conditions. Tourists were met with a water shortage in the hotels in the area, brought about by a severe drought. Fortunately water is close at hand, coming from the Alps or from the peaks in the Basses-Alps region. The conduit is the Verdon river, which joins with the Durance river in the plains at the bottom of the Rhone valley. Since the Verdon runs from east to west, its water must be artificially channelled toward the coastal region. Shortly after the Second World War, the regional development policy in France took concrete form in a series of five-year plans to provide modern facilities in poorer areas of France. The Provence Canal was built; its first major aim was to halt the economic decline of the rural areas of France, caused by water shortages. The Provence Canal Company won the concession to build a canal in 1963 as part of the overall plan to develop the basin of the Durance river. Swift growth of industry around Marseilles in the past decade has emphasized the need for adequate water supplies. The needs of agriculture are equally extensive, and farming happens to be one of the most essential functions of the region from an economic, social and ecological point of view. Between 1969 and 1976 additional canals were constructed to link Rians to coastal regions situated to the east and west of Toulon. The third section, scheduled for completion in 1985, will consist chiefly of two branches, the Marseilles-East branch and the Var branch leading to the Arcs, and the irrigation of 27,000 additional ha of farmland. (Baker-FRC)
W82-01738

OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN,
Southampton Univ. (England). Inst. of Irrigation Studies.
For primary bibliographic entry see Field 6A.
W82-01742

IRRIGATION FOR BRAZIL'S POLIGONO DAS SECAS,
Themag Engenharia Ltda., Sao Paolo (Brazil).
For primary bibliographic entry see Field 3F
W82-01744

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: ALLEGHENY RIVER BASIN; PENNSYLVANIA-NEW YORK.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-00444, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0083, Revised March, 1981. 16 p, 3 Fig, 7 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Allegheny River basin, Navigation, Reservoirs, Water use, Wild rivers, Flood control, Water pollution control, Planning, Pennsylvania, New York.

This revised report presents updated information on the water resources of the Allegheny River Basin, and information on new and planned developments. There are two existing Federal navigation projects on the river, one for open channel improvement and the other for slack-water improvement. There are 19 reservoirs with storage capacities of over 5,000 acre-feet. Two of these reservoirs are used for hydroelectric power production, and there are nine steam-electric generating plants drawing a total of 792 mgd of water from the Allegheny and its tributaries. There are six outstanding preliminary permits and 13 preliminary permit applications pending for nine hydroelectric projects. Sections of the Allegheny and Clarion Rivers have been disqualified for inclusion in the National Wild and Scenic Rivers System, but as additional section of the Allegheny is being considered. There are about 30 potential hydroelectric project sites in the Allegheny River Basin. Additional needs in the basin addressed by recent studies include flood control, pollution control, water supply and wastewater management. (Brambley-SRC)
W82-01751

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; COLORADO RIVER BASIN, TEXAS.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0079, Revised February, 1981. 17 p, 3 Fig, 6 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Colorado River basin, Texas, Reservoirs, Water storage, Cooling water, Water supply, Flood control, Irrigation, Water quality.

This revised report presents updated information on the water resources of the Colorado River Basin, Texas, and information on new and planned developments. There are 32 reservoirs in the basin with storage capacities over 5,000 acre feet constructed or under construction. Six are associated with hydroelectric power generation, while they and the remainder provide for water supplies, flood control, irrigation and steam-electric cooling. There are nine steam-electric plants which use water for cooling, drawing a total of 521 mgd. One steam-electric plant is under construction in the basin. Studies are being conducted to identify sources for additional municipal and industrial water supplies, and to evaluate the needs of the area for enhancing water quality, fish and wildlife, and recreation. Fifteen sites have been identified as potential reservoirs for storage, hydroelectric and flood control purposes, and a further five could be developed as hydroelectric projects. There is one retired hydroelectric plant in the basin. Cooling water requirements are expected to reach 9,000 mgd for electricity production of 213,160 GWh in the year 2000. (Brambley-SRC)
W82-01752

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; MENOMINEE RIVER BASIN; MICHIGAN, WISCONSIN,
Federal Energy Regulatory Commission, Chicago, IL. Chicago Regional Office.
S. Sawar, and J. Gage.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0048, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0048, Revised August, 1980. 14 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Cooling water, River basins, Licensing, Planning, Utilities, *Menominee River basin, Michigan, Wisconsin.

The Menominee, Peshtigo, Oconto, and Escanaba Rivers, along with the smaller Cedar, Ford, and White Fish Rivers, all discharge into the Green Bay portion of Lake Michigan. The average annual rainfall in the basin is about 30 inches, and the average runoff is approximately 12 inches. The river is not subject to destructive floods, and irrigation in the basin is unnecessary. The Menominee River and its tributaries are important water power streams having 20 developments with a total installed capacity of 107,177 kw. A considerable degree of natural flow regulation is provided by the large number of swamps and small lakes in the upper part of the watershed. There are 33 existing hydroelectric projects, with a total installed capacity of 145,271 kw in the basin. Included in the total are 2 plants that belong to non-Federal, publicly-owned utilities, 7 industrial plants, and 24 privately-owned utility plants. There are also two retired hydroelectric projects. There are five fossil-fueled steam-electric generating stations in the basin, all of which employ once-through cooling. There are five potential hydroelectric development sites in the basin and three potential additions to existing hydroelectric powerplants. There are no rivers in the basin area included in the Federal Wild and Scenic River Act, but some of the rivers fall within State wild river programs. There are no pumped storage projects or potential sites in the basin area. There are also no known steam-electric generating

plants proposed for future construction. (Moore-SRC)
W82-01753

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; LOWER RED RIVER BASIN; ARKANSAS, LOUISIANA, OKLAHOMA AND TEXAS,

Federal Energy Regulatory Commission, Fort Worth, TX. Fort Worth Regional Office.
P. McKee.
Planning Status Report FERC/DOE-0045-6, Revised 1980. 14 p, 3 Fig, 5 Tab.

Descriptors: *Water resources development, *Cooling water, *Hydroelectric power, *Water use, Reservoirs, Consumptive water use, Navigation, Channel improvement, *Red River basin, Arkansas, Louisiana, Oklahoma, Texas.

The Lower Red River basin excludes the Little River and the Ouachita-Black River basins, and is the remainder of the Red River drainage area from below Denison Dam to the Red River juncture with the Mississippi River. Average annual precipitation varies from about 37 inches in the west portion to over 59 inches in the lower east portion. Thirteen major reservoirs, each with a total storage capacity in excess of 70,000 acre-feet, exist or are under construction in the basin. There is no existing hydroelectric capacity in the basin. There has been considerable development in the basin, other than reservoirs, in the interest of flood control, drainage, and bank stabilization. There are 12 fossil-fueled steam-electric generating plants, with capacities of 25 mw or greater, in the basin. The estimated condenser cooling water withdrawn from the sources totaled 29 mgd and the estimated consumption was 13 mgd. Six preliminary permit applications are pending for hydroelectric projects in the basin. There are 12 potential storage reservoirs in the Lower Red River basin. The River and Harbor Act of 1968 authorized the Red River Waterway. The 5 locks downstream from Shreveport are designed to provide a slack water channel 9 ft deep and 200 ft wide from the Mississippi River to Shreveport. The existing channel will be realigned and stabilized as necessary to develop and maintain an efficient navigable channel. Projected steam-electric generation cooling water needs in the basin for 1985 are 57 mgd withdrawn and 33 mgd consumed. (Moore-SRC)
W82-01754

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; KENNEBEC RIVER BASIN, MAINE.

Federal Energy Regulatory Commission, New York. New York Regional Office.
Planning Status Report FERC-0045/3, Revised 1980. 15 p, 2 Fig, 4 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Water use, *Reservoirs, Recreation, Industrial water, Water pollution sources, Pulp and paper industry, Navigation, *Kennebec River basin, Maine.

The Kennebec River basin is located in the west central portion of Maine. The total area of the watershed is approximately 5,900 sq mi and constitutes about 18% of the total area of Maine. Annual precipitation over the basin averages about 42 in. with over 50 in. at the higher headwater elevations. Forest products production activities such as logging, wood transportation, and pulp and paper manufacturing dominate land and water use in this area. The Kennebec River basin is a multiple water use area with impoundments used for power generation, industrial water supply, and recreation. There are 17 existing water power installations in the basin with a total installed capacity of 215,620 kw. There are no existing Federal reservoir projects in the Kennebec River basin and none are authorized. Commercial navigation is carried on in the 45 mile tidal portion of the Kennebec River. Pulp and paper mills, the prime cause of water quality degradation, are presently constructing pollution abatement facilities throughout the basin. There are no steam-electric plants located in the area. There are 20 potential hydroelectric developments in the Kennebec River basin, but none is authorized for construction. There are 32 retired hydro plants in the basin with a total capacity of 7,300 kw. (Moore-SRC)
W82-01755

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; CUMBERLAND RIVER BASIN; KENTUCKY-TENNESSEE.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0077, Revised February, 1981. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Cumberland River basin, Reservoirs, Flood control, Recreation, Water quality control, Wild rivers, Cooling water, Planning, Kentucky, Tennessee.

This revised report presents updated information on the water resources of the Cumberland River Basin, and information on new and planned developments. There are 10 reservoirs used for hydroelectric power generation, although they also have flood control and recreation functions, and there are eight smaller reservoirs used for flood control, recreation and water quality control. The total hydroelectric installed capacity is 945,860 kw. There are four steam-electric generation plants in the basin, withdrawing 1,645 mgd of cooling water from the Cumberland River. Studies are being conducted on additional flood control, water supply, water quality, erosion control, harbors and waterways, conservation and recreation measures on the Cumberland and its tributaries. There are eight potential hydroelectric power sites and seven retired sites. Designation of segments of the Cumberland River and its tributaries as a National River and Recreation Area or Kentucky Wild Rivers will preclude some of the potential developments. Projected cooling water requirements are estimated to be 1,846 mgd by 2000. (Brambley-SRC)
W82-01756

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; TOMBIGBEE-WARRIOR RIVER BASIN; ALABAMA-MISSISSIPPI.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0078, Revised February, 1981. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, Tombigbee River, Warrior River, Locks, Dams, Reservoirs, Recreation, Water supply, Flood control, Storage capacity, Cooling water, Wild rivers, Planning, Navigation, *Tombigbee-Warrior River basin, Alabama, Mississippi.

This revised report presents updated information on the water resources of the Tombigbee-Warrior River Basin, and information on new and planned developments. All but four of the 18 locks on the rivers have been eliminated or replaced by a series of dams and locks. Construction on the Tennessee-Tombigbee Waterway project is continuing. There are 8 existing storage reservoirs, primarily for recreation and water supply, but three have hydroelectric powerplants which have an installed capacity of 242,625 kw. One of the storage reservoirs also provides flood storage capacity. The six steam-electric generating plants withdraw 1,801 mgd of water from the rivers for cooling purposes. There are six hydroelectric projects with preliminary permits outstanding. The West Fork of the Sipsey Fork and its tributaries have been included in the National Wild and Scenic Rivers System, and other rivers are being considered for inclusion. Seven potential water resource developments have been identified which would provide an additional 271,000 kw of installed capacity. Projected cooling water requirements are estimated to be 878 mgd by 2000. (Brambley-SRC)
W82-01757

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; BLACK RIVER BASIN, NEW YORK.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0081, Revised March, 1981. 14 p, 3 Fig, 5 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Black River basin, New York, Reservoirs, Water storage, Wild rivers, Flood control, Water pollution control, Recreation, Planning.

This revised report presents updated information on the water resources of the Black River Basin, and information on new and planned developments. There are 11 major reservoirs in the basin, with a total storage capacity of 183,000 acre-feet. The usable storage is diverted to the New York State Barge Canal via the Black River Feeder Canal System, or used for downstream hydroelectric power generation. There are 25 existing hydroelectric power installations in the basin having an installed capacity of 103,375 kw. Ten potential hydroelectric project sites have been identified and there are 21 retired hydroelectric projects which have potential for redevelopment. While none of the rivers in the basin are included in the National Wild and Scenic Rivers System, two river segments are included in the Nationwide Rivers Inventory, and these segments are included in the New York State Wild and Scenic Rivers System, and other segments are being studied for inclusion. Other needs of the Black River Basin have been identified as pollution abatement, flood control, recreation, and storage for streamflow regulation. (Brambley-SRC)
W82-01758

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; GRAND RIVER BASIN, MICHIGAN,

Federal Energy Regulatory Commission, Chicago, IL. Chicago Regional Office.
W. Pawlikowski.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0065, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0065, Revised November, 1980. 12 p, 3 Fig, 4 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Grand River basin, Michigan, Lake Michigan, Cooling water, Groundwater, Flood control, Financial feasibility, Reservoirs, Nonstructural alternatives, Planning, Navigation, Diversion.

This revised report presents updated information on the water resources of the Grand River Basin, and information on new and planned developments. There are seven hydroelectric plants in the basin with a total installed capacity of 6,134 kw, and another 28 retired plants with an installed capacity of about 12,000 kw. The four steam-electric plants in the basin withdraw 140.3 mgd of water for cooling purposes. Three mgd is drawn from wells; the remainder is drawn from the Grand River. Studies have shown that while flood control by use of reservoirs is feasible in the basin, and that significant flood control benefits would result, reservoirs built solely for this purpose are not economically feasible. Public opinion is against multiple-use reservoirs, so flood control will be achieved by nonstructural measures: flood forecasting, flood plain regulation, floodproofing, and permanent evacuation of flood plains. There are four potential hydroelectric power sites in the basin, and one which could be enlarged, to add 18,700 kw of installed capacity. Studies are being conducted to determine the effects of increased Lake Michigan diversions at Chicago, and the feasibility of extending navigation year round. (Brambley-SRC)
W82-01759

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; POTOMAC RIVER BASIN; PENNSYLVANIA, MARYLAND, WEST VIRGINIA, VIRGINIA, AND DISTRICT OF COLUMBIA,

Federal Energy Regulatory Commission, New York. New York Regional Office.
C. Goggins.
Planning Status Report FERC-0047, Revised 1980. 15 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Potomac River basin, Storage reservoirs, Flood control, Water supply, Recreation, Water quality, Cooling water, Wild rivers, Strip mine wastes, Planning, Mine drainage, Pennsylvania, Maryland, West Virginia, Virginia, District of Columbia.

This revised report presents updated information on the water resources of the Potomac River Basin, and information on new and planned developments. There are 12 water storage reservoirs in the basin with capacities of over 5,000 acre-feet, used for water supply, flood control, recreation and water quality, and there are many smaller flood protection projects. The nine existing hydroelectric installations have a total installed capacity of 11,522 kw. Surface water provides the 2.6 billion gal of cooling water withdrawn daily by the 11 steam-electric plants in the basin. Segments of the Potomac and its tributaries are being considered for inclusion in the National Wild and Scenic Rivers System. Studies are being conducted on the effects of strip mining operations on the rivers, and on possible solutions to abandoned mine drainage problems. Fourteen potential hydroelectric sites have been identified, three of which will also function as storage reservoir sites. An additional 12 sites have been identified for storage reservoirs. Cooling water withdrawals are estimated to be 2.55 billion gal/day in 2000. (Brambley-SRC)
W82-01760

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: UPPER ARKANSAS RIVER BASIN; COLORADO, KANSAS, AND NEW MEXICO.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0060, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0060, Revised August, 1980. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Arkansas River basin, Reservoirs, Flood control, Water supply, Irrigation, Diversion structures, Dams, Cooling water, Wells, Colorado, Kansas, New Mexico.

This revised report presents updated information on the water resources of the Upper Arkansas River Basin, and information on new and planned developments. Reservoir development in the basin has been primarily for flood control with some hydroelectric development. The Trinidad Lake project for flood control, and the Pueblo Dam and Reservoir for flood control, hydroelectric power, water supply, and irrigation are completed. There are five hydroelectric projects in the basin, complete or under construction, with a total installed capacity of 207,310 kw. The Pueblo Reservoir is the terminal reservoir of the Fryingpan-Arkansas project which consists of facilities designed primarily to divert water from the Western Slope of the Rocky Mountains to the water-short areas on the Eastern Slope. The major facilities are six storage dams and reservoirs, 16 diversion structures, and nine tunnels. There are 15 steam-electric plants in the basin, with an installed capacity of 2,921,000 kw, which withdrew 66 mgd of water from the rivers or wells for cooling purposes. This volume is expected to rise to 69 mgd in 2000. There are nine potential sites for hydroelectric power development, with a total installed capacity of 269,200 kw. There is potential for pumped storage development, and potential for further flood control measures. (Brambley-SRC)
W82-01761

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; WESTERN GREAT LAKES TRIBUTARIES; MICHIGAN, WISCONSIN, INDIANA AND ILLINOIS.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0045-1, Revised 1980. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Great Lakes tributaries, Water pollution, Lake Michigan, Reservoirs, Cooling water, Navigation, Planning, Water pollution sources, Wilderness areas, Natural waters, Rivers, Michigan, Wisconsin, Indiana, Illinois.

This revised report presents updated information on the water resources of the Western Great Lakes Tributaries, and information on new and planned developments. Pollution is becoming a problem in the water resources of the area, with Lake Michigan most seriously affected. Domestic and industrial wastes are the prime pollutant source, but agricultural and urban runoff are significant. There are 16 hydroelectric projects in the area and six reservoirs for storage purposes only. There are 24 steam-electric plants with an installed capacity of 11,421 MW, which withdraw a total of 6,826 mgd of water for cooling purposes. Studies are being conducted to determine the feasibility of extending navigation year-round in the Great Lakes, and on a number of channel and harbor improvements. Seven sites have been identified as potential hydroelectric sites, and there are 23 retired sites which may have potential for redevelopment. Federal and State Natural Areas, State Wilderness Areas and State Natural Rivers designations, actual and potential, will preclude hydroelectric power development. Cooling water requirements are expected to be 2,296 mgd by 2000. (Brambley-SRC)
W82-01762

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: PENOBSCOT RIVER BASIN, MAINE,

Federal Energy Regulatory Commission, New York. New York Regional Office.
M. Janiszewski.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0056, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0056, Revised August 1980. 14 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, Water demand, Water use, Water storage, Consumptive water use, Planning, *Penobscot River basin, Maine.

The Penobscot River basin is the largest in Maine and the second largest in New England. The average annual precipitation in the basin is 41 inches. There is an abundance of water storage facilities in the basin in the form of lakes, reservoirs, and ponds. There are 20 existing hydropower developments in the basin including five storage projects that regulate streamflow for the benefit of downstream hydropower generation. The developments have a total installed capacity of 152,227 kw. The capacity includes 30,870 kw as the equivalent of 41,388 horsepower in mechanical drive units. The oil-fired Graham Station is the only steam-electric plant located in the basin. The average amount of water withdrawn for 1977 was 1.4 mgd with negligible consumption. There are no potential reservoirs or power projects in the basin which have been authorized for Federal construction. There are significant potentials for hydroelectric power developments. In addition, the 21 retired hydroelectric projects have potential for redevelopment due to changing economic and environmental considerations. The Allagash Wilderness Waterway is a component of the Wild and Scenic Rivers System, but affects no known potential hydroelectric power development. The East and West Branches of the Penobscot River have been under study for inclusion in the system, which would preclude future development of hydroelectric power in the East and West Branches. In 1985, the cooling water withdrawn by Graham Station is estimated at 19 mgd with negligible consumptive use. The estimated annual cooling water withdrawal for steam electric generation in 2000 is estimated at 111 mgd and consumptive use at 1 mgd. (Moore-SRC)
W82-01763

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: ALTAMAHA RIVER BASIN, GEORGIA,

Federal Energy Regulatory Commission, Atlanta, GA. Atlanta Regional Office.
R. Crisp, and W. Duke.
Planning Status Report FERC-0055, Revised August, 1980. 13 p, 2 Fig, 9 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, *Water demand, Water supply, Industrial water, Flood control, Consumptive water use, Water use, Waste disposal, *Altamaha River basin, Georgia.

The Altamaha River, which drains an area of 14,564 sq mi entirely within Georgia, is formed by the confluence of the Ocmulgee and Oconee Rivers 137 mi above the mouth. The average annual precipitation over the basin is approximately 48.9 in. Several of the basin's major industries such as pulp and paper, mineral processing, textiles, chemicals, and food processing place heavy demands upon water resources, either for supply or waste disposal. Existing water resources developments within the Altamaha basin include 17 relatively small flood prevention reservoirs developed by the Soil Conservation Service; 5.5 mi of flood protection works at Macon; the unlicensed, non-Federal run-of-river hydroelectric developments at Milstead, Juliette, Snapping Shoals, and Barnett Shoals; and four licensed non-Federal hydroelectric developments. The 8 hydroelectric projects within the basin have a total installed capacity of 389,532 kw. The four retired hydroelectric projects have a total installed capacity of 6,230 kw. Water supply for municipal use is obtained principally from surface water sources. There are two fossil-fueled and one nuclear-fueled stream-electric plants with a total generating capacity of 3,627 mw. The estimated 1978 total cooling water withdrawn is 851 mgd, and the total consumption is 23 mgd. Plant Scherer is the only steam-electric plant being constructed in the basin. The estimated total cooling water withdrawal is 29 mgd, and consumption is 19 mgd. There is substantial undeveloped hydroelectric power potential in the Altamaha River basin. Certain segments of rivers within the basin have been proposed for consideration for inclusion in the National Wild and Scenic Rivers System. (Moore-SRC)
W82-01764

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; SANTEE RIVER BASIN; SOUTH CAROLINA-NORTH CAROLINA.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0073, Revised March 1981. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Santee River basin, Diversion channels, Harbors, Shoals, Dredging, Flow rates, Cooling water, Planning, Navigation, North Carolina, South Carolina.

This revised report presents updated information on the water resources of the Santee River Basin, and information on new and planned developments. There are 39 existing hydroelectric projects in the basin, and one under construction, with a total installed capacity of 1,858,426 kw. The plant underconstruction is the St. Stephen project, part of the Cooper River Rediversion project. This project will return much of the flow of the Santee River to its original channel instead of the diverted route into the Cooper River. The aim is to reduce the shoaling problem and increased dredging of Charleston Harbor which resulted from the greatly increased flow following the diversion. There are 23 potential hydroelectric projects in the basin and 43 retired hydroelectric sites which have potential for redevelopment. Four of these sites are being investigated. There are 11 steam-electric plants which withdraw 2,182 mgd of water for cooling purposes; this volume is expected to rise to 3,074 mgd by 2000. Modifications will be made to Charleston Harbor to construct and maintain a 40 ft depth, and a 38 ft navigation channel will be

dredged and maintained on the Shipyard River. (Brambley-SRC)
W82-01765

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: TENNESSEE RIVER BASIN; VIRGINIA-TENNESSEE-NORTH CAROLINA-MISSISSIPPI, GEORGIA-KENTUCKY-ALABAMA.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0074, Revised March 1981. 15 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Tennessee River basin, *Hydroelectric plants, Flood control, Navigation, Cooling water, Water use, Wild rivers, Resources management, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, Alabama.

This revised report presents updated information on the water resources of the Tennessee River Basin, and information on new and planned developments. The estimated population of the area in 1978 was 3,600,000. There are 48 existing hydroelectric projects within the Tennessee River Basin, providing a total installed capacity of 5,333,050 kw. Twenty-nine are projects of the Tennessee Valley Authority (TVA), with a capacity of 4,794,250 kw. The TVA projects are operated primarily for flood control and navigation and produce over 16 billion kwh of electricity. There are nine steam-electric generating plants in the basin, with cooling water withdrawal rates of 4,790 mgd. There are six outstanding Federal Energy Regulatory Commission licenses covering nine developments and eight applications pending covering ten developments. The Obed River and its tributaries have been made part of the National wild and Scenic rivers System, and the Nolichucky River is being studied for inclusion. A comprehensive inventory of all water and land resource projects, complete, in progress, or proposed, is being conducted to aid in the increased coordination among the various agencies involved with water resource management. Seventeen potential water resource developments for flood control, hydroelectric power or other purposes are identified and 32 sites, now closed, are identified as potential hydroelectric power sites. The Tennessee-Tombigbee Waterway project is scheduled for completion in 1986. (Brambley-SRC)
W82-01766

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING, SAGINAW AND AU SABLE RIVER BASINS AREA, MICHIGAN.

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0061, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0061. Revised 1980. 12 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, *Wild rivers, River basins, Thermal powerplants, Licensing, *Saginaw River basin, Au Sable River basin, Michigan, Lake Huron.

The Saginaw and Au Sable River basins area lies entirely within Michigan on the west shore of Lake Huron and comprises approximately 3% of the Great Lakes drainage area. Annual rainfall in the basin averages about 28 inches. The average discharge of the Saginaw River at its mouth is about 4,000 cu ft/s, while the average discharge of the Au Sable is about 1,700 cu ft. There are 11 existing hydroelectric powerplants in the Saginaw and Au Sable River basins with a total installed capacity of 52,160 kw. All of the powerplants are owned and operated by investor-owned utilities except for the 360 kw St. Louis plant on the Pine River. There are seven fossil-fuel steam-electric generating stations in the Saginaw and Au Sable River basins, and a nuclear steam-electric plant under construction. All but two of the fossil-fueled plants employ once-through cooling. The Au Sable River is presently under study for inclusion in the National Wild and Scenic Rivers System. Four potential hydroelectric power developments and the possible addition to an existing project would be prohibited by wild and scenic river designation. The total estimated capacity foregone would be an estimated 58,700 kw and an average annual generation output of about 163,900,000 kwh. (Moore-SRC)
W82-01767

ADDENDUM TO: SOURCES OF POWERPLANT COOLING WATER IN THE DESERT AREA OF SOUTHERN CALIFORNIA--RECONNAISSANCE STUDY,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-01773

HYDROPOWER VS. SALMON: THE STRUGGLE OF THE PACIFIC NORTHWEST'S ANADROMOUS FISH RESOURCES FOR A PEACEFUL COEXISTENCE WITH THE FEDERAL COLUMBIA RIVER POWER SYSTEM,

Lewis and Clark Coll. Portland, OR. Northwestern School of Law.
For primary bibliographic entry see Field 6E.
W82-01804

FOOD AND ENERGY PRODUCTION: CONJUNCTIVE WATER PLANNING,

Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 3C.
W82-01856

PRESERVING INSTREAM FLOWS IN OREGON'S RIVERS AND STREAMS,

For primary bibliographic entry see Field 6E.
W82-01871

GULF OF MEXICO: A SOCIOECONOMIC VIEW OF COMPETING RESOURCES,

For primary bibliographic entry see Field 6B.
W82-01901

PERSEVERANCE PRODUCES COUNTY PARK,

York Water Co., PA.
W. T. Morris.
Public Works, Vol 111, No 3, p 62-63, March, 1980.

Descriptors: *Legal aspects, *Parks, Recreation facilities, Public lands, Reservoirs, Management planning, Decision making, Planning, Conjunctive use, Case studies, Pennsylvania.

Copperation between government and private enterprise produced success in the William H. Kain County Park, located in York County, Pennsylvania. An agreement was reached between the water company and the commissioners of the area which allowed the county to use free of charge the reservoir lands and waters of both lakes which serve as impoundments for the water company. The agreement specifies that although the area is to be used for recreational purposes, the prior and overriding use is for water utility purposes. No activity is permitted which would in any way interfere with that use. In return for this usage, the county agreed not to erect a dam, lake or impoundment, or otherwise obstruct the flow of the East Branch of Codorus Creek and tributaries upstream from Lake Redman. A supplemental agreement was also issued which licensed the county to use about 400 to 500 acres of other company lands for recreational purposes under the same conditions. Many problems remained involving legal language, and various suggestions were made to surmount these difficulties. Finally, acceptable agreements were reached. (Baker-FRC)
W82-01932

WATER QUALITY AND THE DEMAND FOR RECREATION,

Illinois State Univ., Normal. Dept. of Economics.
G. Blomquist, and G. Fishelson.
International Journal of Environmental Studies, Vol 14, No 4, p 317-321, 1980. 2 Tab, 12 Ref.

Descriptors: *Water quality, *Recreation demand, *Parks, Regression analysis, *Illinois, Dissolved oxygen, Coliforms, Economic aspects, Evaluation.

Weak responses in demands for recreation were detected for changes in water quality parameters. The attendance at 74 Illinois state parks and recreation areas in 1976 was analyzed. Variables employed were water quality, facilities, nonwater attributes, and distance. Regression analysis showed that the number of annual visits depends on travel costs, price of complements and substitutes, attributes of the park (museums, boating, horseback riding, and hunting), and water quality. Dissolved oxygen was not significant at any reasonable level, but fecal coliforms above 200 per ml was significant at the 90% level. The shortcomings of this analysis were: (1) length of visitor stay was not considered, (2) water quality data was not sufficiently detailed, and (3) annual median water quality was used, not seasonal values. (Cassar-FRC)
W82-01942

LOGISTICS OF FARM WATER SUPPLY.

For primary bibliographic entry see Field 6A.
W82-02037

WANTED: WATER FOR DEVELOPMENT,

P. Harrison.
Ambio, Vol 9, No 3-4, p 202, 1980.

Descriptors: *Developing countries, *Water supply development, *Sanitation, *Public health, Human diseases, International Drinking Water and Sanitation Decade, United Nations, Water pollution effects.

An investment of 140,000 million dollars will be required over ten years to meet the goals set by the International Drinking Water and Sanitation Decade. A World Health Organization survey in 1975 found that three out of every five people in poor countries were without adequate water, and two out of three had inadequate sanitation. Illness and infant mortality in the Third World is due in large part to this situation. Better water and sanitation can cut skin and eye infections and diarrhea from 50 to 100%. Schistosomiasis can cut workers' productivity by 15 to 80%, and malaria is a major cause of absenteeism at work and at school. Both of these are water related diseases. The situation in Bangladesh is improving after the installation of 50,000 tubewells, but only one house in 20 has a sanitary latrine. To reach the 1990 goal, Third World countries will have to divert more resources to rural areas, which contain two thirds of the population but have received only 17% of the investment in water and sanitation. (Small-FRC)
W82-02088

6E. Water Law and Institutions

PARISH IS NOT LIABLE FOR SUBSIDENCE.

Public Works, Vol 112, No 9, p 64-65, September, 1981.

Descriptors: *Dredging, *Legal aspects, Subsidence, Canals, Maintenance, Land tenure, Land rights, Liability, *Drainage canals, *Louisiana.

A drainage canal was dredged in Louisiana, with the result that a property owner brought suit for damages for loss to his property. The canal crossed and bounded his land. The land owner claimed that as a result of the dredging, his land was subject to both erosion and subsidence. The solid land, it was claimed, applied pressure and the silt below oozed out. The trial court entered a judgment for the defendant, finding no causal connection between the depth of the Bayou and the subsidence. Another court did find a causal connection, claiming that a relationship did exist between the piercing of the clay layer and subsidence. However, the Court could not find the Parish either negligent nor strictly liable. Proof was provided that the canal had not in fact been

dredged, but rather had only been brushed clean, without disturbing the clay layer. (Baker-FRC)
W82-01603

THE NATIONAL WATER POLICY REVIEW AND WESTERN WATER RIGHTS LAW REFORM: AN OVERVIEW,

Nebraska Univ., Lincoln.
J. D. Aiken.
Nebraska Law Review, Vol 59, No 2, p 327-344, 1980. 73 Ref. OWRT-C-80138(8412)(1).

Descriptors: *Water policy, *Water rights, *Legal aspects, Nebraska, Colorado, Washington, California, Irrigation water, Water use efficiency, Groundwater management, Water management, Groundwater mining, River regulation, Regulations, Well regulations, Water law, Judicial decisions, Legislation, Western States.

Although economic development has traditionally been accepted as a primary objective in the formulation of state and federal water policies, the achievement of most economic development objectives has resulted in increased public concern regarding the protection and preservation of natural resources. Inconsistent federal water policies have resulted from the enactment of federal environmental legislation which conflicts with existing reclamation, flood control, and hydroelectric power production programs. Water development programs are also being subjected to closer budgetary examinations than in the past. The proposed major objectives of a review and development of a national water resources management policy initiated by President Carter in 1977 included modification of state water laws to meet the environmental protection and water use efficiency objectives. Strong protests by the western states resulted in the elimination of this reform in state water rights laws as an explicit objective. However, several existing innovative water policies adopted by some western states may serve as models for state and federal officials searching for water policy alternatives. These include farm-level irrigation water use efficiency programs in Nebraska; groundwater mining regulations in Nebraska; minimum streamflow legislation in several western states; procedures for resolving conflicts between surface and groundwater users in Colorado; and policies for conjunctive management of groundwater and surface water in Washington and California. These water law developments are described, and their relevance to other western states is evaluated. Social, economic, and political objections to reform objectives constitute the major obstacle to water law reforms. Alternatives which accommodate development as well as reform objectives are both necessary and possible. Better integration of federal water programs is perhaps the most important water policy contribution the federal government could make at this time. (Carroll-FRC)
W82-01659

LEGAL CHALLENGE OF THE UNGAGED WATERSHED,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01664

THE NATIONAL COMMISSION ON WATER QUALITY: A CASE STUDY IN CONGRESSIONAL POLICY ANALYSIS,

Texas Univ. at Dallas, Richardson.
For primary bibliographic entry see Field 6B.
W82-01669

REGULATING THE QUALITY OF DRINKING WATER: AN ECONOMIC ANALYSIS OF THE SAFE DRINKING WATER ACT OF 1974,

Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5G.
W82-01691

HYDROPOWER VS. SALMON: THE STRUGGLE OF THE PACIFIC NORTHWEST'S ANADROMOUS FISH RESOURCES FOR A PEACEFUL COEXISTENCE WITH THE FEDERAL COLUMBIA RIVER POWER SYSTEM,

Lewis and Clark Coll. Portland, OR. Northwestern School of Law.
M. C. Blumm.
Environmental Law, Vol 11, No 2, p 211-300, Winter, 1981. 461 Ref.

Descriptors: *Water use, *Legal aspects, *Hydroelectric power, *Fisheries, Salmon *Anadromous fish, Hydroelectric plants, Powerplants, *Columbia River, Water demand, Water supply, Resources development, Resources management.

This article documents the inherent conflicts between employing Columbia Basin water projects primarily to maximize power production and preserving the basin's depleted anadromous fish runs. The legislative history of dam authorizations was also surveyed, and no congressional intent was uncovered that hydropower should dominate project operations to the exclusion of the fisheries. There was strong evidence, on the contrary, that Congress intended that hydropower generation and fisheries preservation should coexist. However, the decision making structure in government project operations has overlooked this intent, and fish and wildlife protection has not been given equal consideration in the planning stages. A general overhaul of the decision making structure is needed. A restructing can be accomplished through compliance with the spirit and letter of the National Environmental Policy Act and the Fish Wildlife Coordination Act. Supplying sufficient streamflows to protect anadromous fish runs will necessitate changes in regional hydroelectric consumption. The fundamental issue in this regard is the lack of effective mechanisms designed to modify peak load demands placed on the hydropower resource. More systematic investigation is needed of alternative, less costly ways of simultaneously meeting hydroelectric energy demands and protecting fisheries. The economic value of the salmon produced in the Columbia River makes it essential that some solution to the problem be found before this source of income is extinguished. (Baker-FRC)
W82-01804

STATIONARY SOURCE POLLUTION POLICY AND CHOICES FOR REFORM,

Resources for the Future, Washington, DC.
W. Harrington, and A. J. Krupnick.
Natural Resources Journal, Vol 21, No 3, p 539-564, July, 1981.

Descriptors: *Water pollution control, *Regulations, *Economic aspects, Legal aspects, Political aspects, Effluent standards, Permits, Water law, Water quality standards, Water policy, Environmental effects, Air pollution, Administrative agencies, Cost effectiveness.

Proposed reforms of the water and air pollution policies formulated in the early 1970's are described. Procedural reforms change the procedures used to develop and implement environmental regulations and can reduce costs. Using 2 or 3 contractors to provide background information for a regulation would be initially more costly but, in the long run, might reduce total costs by producing more reliable information and regulations more acceptable to industry. Greater subcategorization (tailor-made regulations for individual industries) could promote competition by preserving some of the older plants and help hold down the inflation rate. On the other hand subcategorization can reduce productivity by preserving obsolete plants. Permit reform measures include extending permit life, improving coordination between federal and state agencies with respect to permits and regulations, establishing a regulatory clearing house, and initiating a one-step permitting process. Cost effectiveness standards would equalize marginal abatement costs and minimize costs of obtaining the resulting reductions in aggregate emissions; this has several problems, however. Innovation waivers could be granted to allow time to work out difficulties in new abatement technologies. Substantive reforms have begun to supplant the technology-based approach in some states and in EPA planning. These include the bubble policy, banking emissions allowances for future expansion or as an offset, marketable pollution permits, and effluent charges. Proponents of these reforms claim that desired environmental quality may be obtained at lower economic costs. Opponents fear that any change represents a retreat from the nation's commitment to environmental quality. (Cassar-FRC)
W82-01847

THE CALIFORNIA STATE WATER PROJECT—CURRENT ACTIVITIES AND FUTURE MANAGEMENT PLANS,

California State Dept. of Water Resources, Sacramento.
Bulletin 132-80, October 1980. 197 p. 12 Fig, 12 Tab, 5 Append.

Descriptors: *Water management, *Comprehensive planning, Structural engineering, Environmental engineering, Canal design, *Multiobjective planning, *Economic aspects, Canal construction, Future planning, Open channels, Legislation, Water policy, Projections, *California.

Legislation that provides a comprehensive plan for meeting the water needs of the State Water Project (SWP) through the year 2000 was approved by the California Legislature in 1980. SB200 authorizes (1) the Peripheral Canal, a proposed 43-mile-long canal to move water across the Sacramento Delta to aqueducts serving southern California; (2) construction of facilities to maintain Suisun Marsh as a habitat for birds and wildlife in the Delta; (3) ground water storage in lieu of comparable surface storage; and (4) additional storage projects in the Sacramento Valley system. Additionally, feasibility studies on enlarging Shasta Dam will be integrated into detailed studies of surface storage alternatives included in SB200. Assembly Constitutional Amendment 90, approved by the Legislature, contains Delta-San Francisco Bay guarantees and protection for the North Coast wild rivers. SWP components and implementation plans for additional segments are discussed in terms of future water supply plants, future costs of water service, negotiations for joint operating agreement of SWP and the federal Central Valley Project, the interagency drainage program, and other matters. Also discussed are future construction costs, operating costs, and project financing descriptions that include construction expenditures, capital requirements, financing, operating revenues, and power costs. Capital requirements through 2000 are estimated at $10.1 billion. Among the steps taken to ensure power supply for the SWP through the year 2000 are the development of 3 geothermal power plants, a geothermal biomass plant, 15 hydroelectric power plants, and contracting for joint ownership of a coal-fired power plant. (Garrison-Omniplan)
W82-01851

POLLUTION CONTROL: CHANGING APPROACHES,

Experimental Research and Technology, Inc., Concord, MA.
S. H. Schroeder.
Environmental Science and Technology, Vol 15, No 11, p 1286-1291, November, 1981.

Descriptors: *Legislation, *Regulations, *Water pollution control, Superfund, Clean Water Act, Federal Water Pollution Control Act, Resource Conservation and Recovery Act, Legal aspects, Permits, Liability, Water quality control, Water quality standards, Effluent standards.

The evolution of pollution control legislation in the past 10 years is discussed. A major difficulty has been the gap between regulations and the scientific knowledge necessary for implementation. Several approaches have been used in formulating pollution control programs. The Federal Water Pollution Control Act (FWPCA), 1972, was technology-based, requiring a minimum level of control according to available technology. This simplified the regulatory process, but did not consider local environmental effects. Ambient water quality standards were then added. The implementation was delegated to the EPA and the states, resulting in a regulatory tangle. In 1977 the FWPCA was

amended and its name changed to the Clean Water Act. The NRDC Consent Decree was adopted, formalizing the technology-based approach, with the exception of exemptions for thermal and publicly owned treatment works effluents in some cases. The Resource Conservation and Recovery Act requires definition of hazardous substances and cradle-to-grave standards of handling, to be implemented by permit. The Act poses great difficulties in decision making for permit writers and is concerned with all aspects of the environment (air, water, etc.). The Superfund, in contrast to previous legislation, is concerned with liabilities. Harmful releases are cleaned up and liabilities assigned to the polluters. Problems arise in assigning liability because of uncertain cause-effect relationships and because of the long time lapse between cause and observed effect in many situations. The fund covers only government cleanup effort costs, not individual damages for death, disease, or property damage. A crucial element in the success of any pollution control program is the ease of implementation, given the uncertainty of knowledge of toxic materials and their effects. The author urges participation by the technical community in legislative and regulatory processes to prevent adoption of unrealistic programs. (Cassar-FRC)
W82-01870

PRESERVING INSTREAM FLOWS IN OREGON'S RIVERS AND STREAMS,

C. C. Sherton.
Environmental Law, Vol 11, No 2, p 379-419, Winter, 1981. 247 Ref.

Descriptors: *Instream flow, *Legal aspects, Water supply development, Water resources development, Water management, Resources management, *Oregon, State jurisdiction.

The growing population and increasing demands of industry in Oregon project ever increasing water needs. However, the availability of water in that state varies greatly by geography and season. This paper examines means to preserve instream flows that are being or could be used within the general structure of Oregon's water laws. The history and basic principles of Oregon water law are reviewed, past and potential use of existing provisions of Oregon water laws in preserving instream flows are examined, several means of preserving instream flow that have been proposed or are in use elsewhere are analyzed for their potential use in Oregon, and an effective and politically feasible strategy is presented for preserving instream flows in Oregon. The current system of planning for the use of water resources in Oregon and the appropriation permit system do not provide adequate protection to instream flows for uses such as fishing, recreation, hydroelectric power, and pollution abatement. Certain administrative and minor statutory changes could improve the operation of the existing system. However, there is a need to recognize water rights for instream uses on a par with water rights for consumptive uses. The major recommendation from this study is that Oregon recognize appropriative water rights for instream uses. Recognition of such rights would in most cases be the most effective means of preserving instream flows in streams which have unappropriated water, and of returning instream flows to streams where all the water has been appropriated for consumptive use. This recognition can be achieved by amending Oregon's statutes governing water permits, and is not incompatible with the appropriations doctrine as developed in Oregon. Only certain agencies should have the power to apply for instream appropriations. (Baker-FRC)
W82-01871

PERSEVERANCE PRODUCES COUNTY PARK,

York Water Co., PA.
For primary bibliographic entry see Field 6D.
W82-01932

THE HAZARDS OF HAZARDOUS WASTE MANAGEMENT,

Maryland Dept. of Natural Resources, Annapolis.
J. B. Coulter.
Industrial Wastes, Vol 26, No 5, p 26, 28-29, September-October, 1980.

Descriptors: *Hazardous materials, *Waste management, *Water pollution sources, Wastes, Waste storage, Incineration, Waste disposal, Groundwater pollution, Organic compounds, Poisons, Toxins, Landfills, *Sharptown, Maryland.

In Sharptown, Maryland, a small business man established an operation to recycle waste oil. After the business failed, it was discovered that the waste oil contained a medley of hazardous substances such as PCBs in concentrations as high as 310,000 ppm. The man was heavily fined, and the townspeople became increasingly alarmed over the possibility of various emergencies arising out of these chemicals. Tests at that time showed no contamination of the groundwater supplies, but there was no test available to verify that contaminating materials were not presently moving through the soil on their way to the groundwater sources. Models were constructed and studies performed to determine the best course of action should any spillage or leakage of materials be noted. A federal-state response team endorsed a decision to move the wastes from Sharptown to some other location where they could be safely stored pending destruction by incineration at an EPA approved facility which would be constructed. After several legal suits and countersuits, the transfer of the hazardous materials was made, and the material is now under constant guard until the incinerators can be completed. It is suggested that hazardous waste managers should take constructive measures, which does not include downplaying the problem or understating the severity of it. Landfills should be avoided if at all possible. Actions which are dangerous must be outlawed. Safe facilities for hazardous waste must be established. A meaningful legal definition of the term hazardous waste is sought. (Baker-FRC)
W82-01940

WATER SANITATION LEGISLATION REGARDED AS THE BASIS OF WATER QUALITY MONITORING,

Institute of General and Municipal Hygiene, Moscow (USSR).
G. N. Krasovsky, N. N. Litvinov, Z. I. Zholdakova, and L. J. Vasiukovitch.
Water Science and Technology, Vol 13, No 7, p 391-392, 1981.

Descriptors: *Water quality standards, *Reservoirs, *Effluent standards, Legal aspects, Regulations, Legislation, Water supply, Standards, Drinking water, Multipurpose reservoirs, Monitoring.

A unified three-element regulatory system for water quality monitoring is suggested for guaranteeing the safety of drinking water from open reservoirs used for domestic and recreational purposes. The three parts are: drinking water standards, water reservoir quality standards, and sewage effluent conditions. Each part states a maximum allowable concentration. Toxicological, organoleptic, and epidemiological criteria must be added to the conventional water reservoir quality standards to ensure safety. (Cassar-FRC)
W82-01990

STREAMLINED REGULATIONS COULD HELP MAKE NEW STORMWATER MANAGEMENT CONCEPTS PART OF THE TRADITION,

For primary bibliographic entry see Field 4A.
W82-02000

REGULATION FOR ENVIRONMENTAL PROTECTION: THE NANTICOKE INDUSTRIAL COMPLEX, ONTARIO, CANADA,

Waterloo Univ. (Ontario). Dept. of Geography.
J. G. Nelson, J. C. Day, and S. Jessen.
Environmental Management, Vol 5, No 5, p 385-395, September, 1981. 1 Fig, 3 Tab, 41 Ref.

Descriptors: *Environmental protection, *Regulations, *Industrial plants, Monitoring, Economic aspects, Industrial wastes, Water pollution sources, Water pollution effects, *Lake Erie, Canada.

The effectiveness of the environmental protection regulatory system for the $2.2 billion iron and steel plant, oil refinery, and thermal generating station planned for the Nanticoke Industrial Complex was evaluated. Literature reviews and environmental impact studies performed by various industries and government agencies were assessed. In general, the project and its various impacts were regulated and managed reasonably efficiently and without significant known impacts to date. Industry has suggested that the costs of the environmental controls have been too high. In the future, continuous monitoring, more comprehensive research, and better overall environmental management will be required if the benefits of Nanticoke are not to be achieved at potentially avoidable costs to fishing, agriculture, and tourism. Attention must be paid to the accumulative impact of the complex. (Small-FRC)
W82-02024

THE SEWERAGE POLICY OF THAMES WATER,

Thames Water Authority (England).
J. L. Dakers.
Effluent and Water Treatment Journal, Vol 20, No 1, p 29-31, January, 1980. 2 Tab.

Descriptors: *Sewerage, *Thames Water Authority, *Water policy, *Priorities, Wastewater treatment, Capital costs, Water quality, Great Britain.

The Thames Water Authority provides water services for 12 million people over an area of 13,100 sq km. Sewerage tasks are mostly performed by the district councils under contract with the Authority. In view of limited resources, a table of priorities for capital expenditures was established. There are five classes. Class one concerns public health, expansion in housing and industry. Class two involves maintaining or replacing existing systems and allowing for increased demand by present consumers. Classes three, four, and five concern improvements in service and water quality and first time services. Details of the Water Authority responsibilities are given. Alternatives in selecting a sewage disposal system and the policies for first time sewerage are presented. (Cassar-FRC)
W82-02040

STRUCTURAL ASPECTS OF THE WATER SUPPLY IN THE FEDERAL REPUBLIC OF GERMANY,

Verband der Deutschen Gas- und Wasserwirtschaft e.V./Deutscher Verein des Gas und Wasserfaches e.V., Bonn (Germany, F.R.).
H-J. Arens.
Aqua, No 1, p 13-14, 1981.

Descriptors: *Water management, *Political aspects, *Federal Republic of Germany, *Water supply, Water resources development, Water use, Germany.

Political and legal aspects of the water supply system in the Federal Republic of Germany are discussed, together with some general aspects of water production and water utilization. Federal German legislative power in the field of water management is limited to basic regulations. Individual Laender, or states, are charged with granting approvals and licenses for water use, protecting waters against pollution and rehabilitating polluted waters, and establishing water management plans. Local authorities are responsible for securing water supplies for their areas and disposing of waste waters. Although there are about 7,300 public water supply undertakings in the country, about 55 percent of the water quantity delivered is produced by a very few large undertakings. About 52 percent of the water is delivered by municipally-owned waterworks, with joint stock companies and private limited companies delivering the rest. There is increasing cooperation between neighboring communities in water supply management. Cooperation in the form of long-distance water suppliers is also becoming more common. Over 60 percent of the total production of the public water supply comes from groundwater, although there is a tendency to produce more surface water in congested areas. While consumption of public water

supplies by households and small businesses increased by 36 percent from 1970 to 1979, use by industry dropped by about 25 percent, largely as the result of increased recycling of water and other water conservation measures. In addition, industry produces large quantities of water for its own supply. Competition between the public water supply and industry for water resources is increasing, requiring more regional planning of water management. (Carroll-FRC)
W82-02066

STREAM POLLUTION IN HONG KONG - AN APPRAISAL,
Hong Kong Univ. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-02084

INTERNATIONAL COOPERATION TO PROTECT THE BALTIC,
Ministry of Agriculture, Stockholm (Sweden). Environmental Div.
B. Hagerhall.
Ambio, Vol 9, No 3/4, p 183-186, 1980. 10 Ref.

Descriptors: *International commissions, *Baltic Sea, *Environmental protection, Organizations, Water pollution control, Pollution prevention, DDT, Polychlorinated biphenyls.

The Convention on the Pollution of the Marine Environment of the Baltic, one of the most comprehensive environmental agreements ever ratified, was signed by all of the Baltic states in 1974 and went into effect in 1980. The Convention covers discharges from land-based sources, including air pollution, discharges from ships, dumping of wastes, and international cooperation to combat spillages of oil and hazardous substances at sea. The Baltic Marine Environmental Protection Commission was established by the Convention. Its purpose is to recommend measures relating to the purposes of the Convention, recommend amendments to the Convention, define pollution control criteria and objectives, and promote scientific and technological research. Current goals of the Commission are to draft a prohibition of the use of DDT, to regulate or prohibit PCB discharge and use, and conduct scientific evaluations on the present state of pollution of the Baltic by PCBs, mercury, cadmium, lead, copper, zinc, and their compounds. Oil emissions and environmental quality guidelines are also areas of current concern. (Small-FRC)
W82-02087

6F. Nonstructural Alternatives

EFFLUENT FEES, AN ALTERNATIVE SYSTEM FOR ACHIEVING WATER QUALITY: A CASE STUDY,
Auburn Univ., AL. Dept. of Economics.
A. N. Link, and F. A. Scott.
Water Resources Bulletin, Vol 17, No 3, p 498-500, June, 1981. 4 Tab, 8 Ref. OWRT-A-074-ALA(2), 14-34-0001-0101.

Descriptors: *Water quality control, *Effluent charges, *Black Warrior River, *Alabama, Costs, Water pollution control, Economic aspects, Industrial wastes, Municipal wastes.

The effluent fee system and the uniform standards system of water quality control were compared for a 30-mile section of the Black Warrior River, Alabama, which receives discharges from 6 major industries and 2 municipalities. Using BOD removal as a basis and an effluent fee of $0.0587 per pound BOD discharged, the polluters would have to remove 47,593 pounds BOD per day to meet the same water quality standards as under the uniform standards system. However, 2 of 6 firms would find it cheaper to remove zero BOD, 2 firms and 1 municipality would find it cheaper to remove less BOD, and 2 firms and 1 municipality would find it cheaper to remove more BOD than under the present uniform standards system. Total daily cost for all 8 dischargers is $1224.50 under the effluent fee system and $1839.50 under the uniform standard system, a difference of $224,475 annualy to achieve the same water quality. (Cassar-FRC)
W82-01665

STANDARDS AND CHARGES IN THE CONTROL OF TRADE EFFLUENT DISCHARGES TO PUBLIC SEWERS IN ENGLAND AND WALES,
York University, Heslington (England). Institute of Social and Economic Research.
For primary bibliographic entry see Field 6C.
W82-01717

FLOODPLAIN MANAGEMENT: A FLOOD AND LAND PLANNING SYSTEM,
Vermont House of Representatives, Montpelier.
M. D. Arnold.
Environmental Conservation, Vol 8, No 2, p 97-106, Summer, 1981. 5 Fig, 21 Ref.

Descriptors: *Flood plain management, *Flood protection, *Flood damage, Legal aspects, Land use control, Political aspects.

Floodplain management, a systematic regime of land and flood management by which floodable areas are turned to uses that are compatible with flooding, is reviewed. By using floodplain management, human trauma and physical damage of floods can be reduced. Man-made developments are kept out of floodplains or are designed to resist or accommodate water damage. Floodplain management is more economic and less socially costly than structures used to control flooding. Flood management tools include: citizen intervention, regulation, property rights purchase, structures, relocation of settlements, weather forecasting and warning, government loan and guarantee activities, government flood insurance, private and government disaster aid, banking regulations, farm preservation, erosion control, and water quality management. Political reform is necessary before this approach to floods becomes more general. (Small-FRC)
W82-01872

THE ECONOMICS OF COOPERATION OVER COLLECTIVE BADS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W82-01909

ECONOMIC INSTRUMENTS FOR CONTROLLING EFFLUENT DISCHARGES TO THE RIVER TEES ESTUARY,
Newcastle upon Tyne Univ. (England). Dept. of Economics.
For primary bibliographic entry see Field 2L.
W82-02060

INTERNATIONAL COOPERATION TO PROTECT THE BALTIC,
Ministry of Agriculture, Stockholm (Sweden). Environmental Div.
For primary bibliographic entry see Field 6E.
W82-02087

6G. Ecologic Impact Of Water Development

RELATING POPULATION GROWTH TO SHELLFISH BED CLOSURES: A CASE STUDY FROM NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Sociology and Anthropology.
For primary bibliographic entry see Field 5C.
W82-01641

A WATER QUALITY ASSESSMENT OF DEVELOPMENT IN THE SENEGAL RIVER BASIN,
Agency for International Development, Washington, DC. Bureau for Africa.
M. S. Gould.
Water Resources Bulletin, Vol 17, No 3, p 466-473, June, 1981. 8 Fig, 2 Tab, 11 Ref.

Descriptors: *Water quality, *Environmental effects, *River basin development, *Senegal River, *Africa, Model studies, Mathematical models, Aquatic life, Dams, Water resources development, Agriculture, Irrigation, Fish, Dredging, Sediment yield, Dissolved oxygen, Estuaries, Saline water barriers.

The impacts of proposed water resources development in the Senegal River basin were studied with mathematical modeling and examination of case histories. This paper concerns the water quality aspect of the environmental assessment, which also draws on nine other major disciplines. Although this basin is relatively undeveloped, analytical techniques for more highly developed basins were successfully used. It was concluded that the proposed development plans should have minor negative impact on water quality in the basin. However, the Diama Dam, built to prevent salt water intrusion into the upper river, will adversely affect spawning of marine and estuarine fish. Dissolved oxygen in the river would remain high and more uniform with the aid of flow regulation. Minimum dissolved oxygen concentrations in the estuary would be lower, reaching a projected 1 mg per liter by 2028. Other projects under consideration are the Manantali Dam for flow regulation and hydropower, irrigated agriculture, dredging for improved navigation, and industrial and municipal development. The reservoir created by Manantali Dam will initially be eutrophic due to nutrient releases and organic matter from inundation of 480 sq km of savanna forest. For the first few years aquatic vegetation could be a nuisance, and fish productivity would be high. The low dissolved oxygen concentration in the first 20 km of river below the dam would be hazardous to aquatic life. Similar lakes in Africa usually take about 5 years to evolve into a mesotrophic state. Agricultural fertilizers and pesticides will have a minor impact on water quality if proper practices are used. Dissolved solids in the river should not increase beyond 150 mg per liter with proper irrigation practices. (Cassar-FRC)
W82-01740

IMPACTS OF NAVIGATIONAL DREDGING ON FISH AND WILDLIFE: A LITERATURE REVIEW,
Fish and Wildlife Service, Washington, DC. Office of Fishery Assistance.
K. O. Allen, and J. W. Hardy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-137853, Price codes: A05 in paper copy, A01 in microfiche. Report FWS/OBS-80/07, September, 1980. 88 p, 7 Fig, 228 Ref, Append.

Descriptors: *Dredging, *Literature review, *Fish, *Wildlife, *Environmental effects, Navigation, Water pollution, Channel improvement, Estuaries, Habitats, Hydrology, Ecosystems, Ecological effects.

This review covers impacts to fish, other aquatic organisms, and wildlife, as well as habitat enhancement opportunities, resulting from construction of new navigational channels and maintenance dredging of existing channels. The type of dredging equipment used determines, to a great extent, the viable disposal alternatives, the type and magnitude of potential impacts, and the potential for habitat development. About 99% of the dredging volume in the U.S. is accomplished by hydraulic dredges. The composition of dredged material from a particular site affects its pollution potential as well as the potential for habitat development or other beneficial uses. Dredged material from new channels or new works projects often has chemical and engineering properties which create fewer environmental problems than material from maintenance projects. Material removed during maintenance dredging of navigational channels is an accumulation of detached soil particles which have been transported by wind and water, and may contain a variety of contaminants. In coastal areas, some of the most severe long-term impacts from dredging are caused by the physical changes in

estuaries due to new work dredging. Maintenance dredging and dredged material disposal pose less severe threats, except where the sediments contain high levels of contaminants. Most research on river dredging was conducted in the upper Mississippi River and may only be partially applicable to other river systems. Impacts to the water column are generally slight. The alteration of river through new channel construction or deepening projects has severe direct and indirect impacts on the entire river and floodplain ecosystem. Long-term impacts include changes in hydrology and stream gradient that impact the river, swamps, backwaters, and the entire floodplain. (Moore-SRC)
W82-01768

SOME ENVIRONMENTAL AND SOCIAL IMPACTS OF THE JAMES BAY HYDROELECTRIC PROJECT, CANADA,

Brock Univ., St. Catharines (Ontario). Inst. of Urban and Environmental Studies.
F. Berkes.
Journal of Environmental Management, Vol 12, No 2, p 157-172, March, 1981. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Environmental effects, *Hydroelectric plants, *Subarctic zone, *James Bay, Canada, Social impact, Fisheries, Land tenure.

The James Bay hydroelectric project, which consists of a series of dams affecting the watersheds of several rivers in northern Quebec, is the most ambitious energy project ever attempted in Canada. Construction of the project, located in subarctic Canada, began in 1972, shortly after the project was announced. However, environmental information needed to plan mitigation measures was not available until about 1975. This pattern appears to be characteristic of large-scale development projects in remote areas, where the time lags involved in obtaining detailed environmental data are so lengthy that engineering plans proceed, for economic reasons, without the benefit of this environmental data as planning input. None of the 1975 recommendations for environmental protection measures with respect to the estuarine subsystem were adopted by the project. An environmental impact case study of the effects of the LaGrande Complex phase of the James Bay development examines the estuarine fisheries subsystem and the effects on this subsystem of changes in the flow regime of the LaGrande River, the relocation of the first dam on the LaGrande, saltwater encroachment up the river during the filling of the second dam, and the changes in the thermal regime of the river. A social impact case study discusses the effects of the road network associated with the hydroelectric project on the land tenure system of the native Cree Indians of the area. These analyses show that it is not easy for large projects in frontier areas to accommodate environmental considerations, since the lead times are too great and too little is known about the environment when the engineering decisions are being made. In addition, it is often impossible to assess the impacts of these projects after the fact due to the absence of baseline data and to the existence of a cumulative effect of relatively insignificant incremental impacts. (Carroll-FRC)
W82-01908

TRACING FOOD WEBS WITH STABLE HYDROGEN ISOTOPES,

Carnegie Institution of Washington, DC. Geophysical Lab.
M. F. Estep, and H. Dabrowski.
Science, Vol 209, No 4464, p 1537-1538, September, 1980. 1 Fig, 6 Ref.

Descriptors: *Food chains, Algae, Snails, Hydrogen, Mice, Mollusks, Chemical properties, Isotopic tracers, Boothbay harbor, Maine, Marine environment, Tidal pools, Metabolism, *Ecosystems, *Biological samples, *Biochemistry, Ecology, Food chains.

The relationship between the organically bonded hydrogen isotopic content of an animal and its food source was investigated using laboratory mice. Also investigated was the relationship between a simple, natural population consisting of snails and their possible algal food sources. The study concluded that the hydrogen isotopic content of the animal's food and not its water determine the animal's hydrogen isotopic content. Liver and muscle tissue from mice reared on a diet with a specific ratio of deuterium to hydrogen (D/H) had the same D/H ratio as in the food, not in the water. Northern Atlantic intertidal snails that feed almost exclusively on the brown alga Fucus vesiculosus have the same D/H ratio as Fucus vesiculosis and not that of the other algae made available to the snails. (Baker-FRC)
W82-02021

ENVIRONMENTAL STUDIES: THEIR IMPLICATIONS AND THE SPECIAL CASE OF EGYPT,

J. Rzoska.
Water Supply and Management, Vol 4, No 1/2, p 21-24, 1980. 2 Ref.

Descriptors: *Technical societies, *Environmental effects, Publications, Information exchange, Limnology, *Lake Nasser, *Egypt, Egyptian Society of Environmental Science, History, *Nile river, Social aspects, Economic aspects.

Integration of scientific disciplines in environmental studies is necessary, as illustrated by the efforts of the Egyptian Society of Environmental Sciences. The cultivable and inhabited land in Egypt is confined to the Nile River valley and is a product of the river. Desirable aims of water resources research in Egypt include studies of the historical succession of the land and its waters as well as the recent changes caused by the Aswan High Dam. Integrated historical and current studies are needed on Lake Qarun, the Wadi Natrun, and the delta lakes. Egypt's environmental problems are narrower in scope than in most countries, being confined to Lake Nasser, the Nile River, and its valley. Some suggestions for future consideration are a monograph on Lake Nasser (extending to old terraces, sediments, and ancient written records), and studies of the Wadi Natrun, the delta lakes, and fisheries. The Society should have a governing board of prominent scientists, a library of books on environmental subjects, information dissemination, and facilities for large and small workshops. (Cassar-FRC)
W82-02062

7. RESOURCES DATA

7A. Network Design

THE USE OF SPECIFIC CONDUCTANCE IN STUDIES OF NATURAL WATERS AND SOIL SOLUTIONS,

Lanchester Polytechnic, Conventry (England). Dept. of Geography.
I. D. L. Foster, I. C. Grieve, and A. D. Christmas.
Hydrological Sciences Bulletin, Vol 26, No 3, p 257-269, September, 1981. 4 Fig, 4 Tab, 27 Ref.

Descriptors: *Natural waters, *Specific conductivity, Water, Conductivity, Soil solution, Mineral water, *Dissolved solids, Suspended solids, Iron, Aluminum, Manganese.

In the absence of non-ionized material and above a pH of around 5.5, specific conductance has been considered a useful measure of total dissolved solids (TDS) for routine water quality analysis. Regression relationships may be used to explain high proportions of variance in TDS loads. In the study presented herein, the levels of dissolved organic matter in stream water and in throughfall were too low and displayed too little variability to be of significance in affecting the specific conductance (SC)/TDS relationship. Water samples for chemical analysis were obtained from two areas. First, river water samples were collected at a small cultivated basin in East Devon from the main stream and three sub-basins: a tile drain, drainage ditch and a woodland stream unaffected by cultivation. Second, water samples were collected from a variety of locations in a forested basin in North Warwickshire. Weekly samples were taken from the main stream and from throughfall beneath the tree canopy during 1978 and 1979. The soil water samples taken did have sufficient variation in dissolved organic matter (DOM) to influence the regression relationship, and DOM must be considered in estimating the dissolved load carried in soil solutions. It may also be of significance in streams draining moorland catchments. Attempts to calculate SC from consideration of the properties of simple solutions were relatively unsuccessful, although improvements in the McNeal model were achieved by including pH in a partial correlation data. Further improvements resulted from consideration of the effects of iron, aluminum, and manganese, whose solubility at low pH is greatly enhanced. (Baker-FRC)
W82-01646 •

METHODS OF STUDYING INVERTEBRATE DRIFT IN RIVERS,

Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
Yu. A. Shustov, and V. A. Shirokov.
Hydrobiological Journal, Vol 16, No 3, p 66-68, 1980. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Rivers, *Invertebrates, *Drift, Sampling, Sample preparation, Water sampling, Biological samples, Chrionomidae, Simuiiidae, Ephemeroptera, Trichoptera, *Aquatic drift, *USSR.

In an attempt to study invertebrate drift in rivers, a trap was set in a river for a specified period of time, and the material obtained fixed with 4% formalin and processed in the laboratory. The drift sample contains benthic invertebrates, zooplankton organisms, winged and land insects, fish larvae, filamentous algae, scraps of aquatic vegetation, fallen leaves from trees and other debris. Trap exposure time is usually between a few minutes and a few hours to obtain material for a drift sample. Exposure time must be clearly identified in the study, however. Drift samples were taken on one of the bars of the Lizhma, a salmon river in the basin of Lake Onega, in August of 1978 for exposure times of 0.5, 1, 2, 4, and 8 hr. Samples were taken only during daylight, not before 8 a.m. nor after 8 p.m. The river reach sampled was a bar, where depth of 0.5 meters and flow rate of 0.3 meters/second were uniform over the whole width of the river, 15 meters. The results show that sampling times of .5 hours and 1 hour are to be preferred from the whole range of times investigated when taking drift samples under similar conditions. In order to study invertebrate drift in rivers under conditions differing from these, the optimum exposure time should be determined by similar methods. There were appreciable fluctuations in the abundance of the invertebrate drift in this study. The distribution density of benthic invertebrates and the level of drift in the river were not solely determined by the main environmental factors, but were also conditioned by a number of local conditions, the extent of the development of fouling on the stones, or the amount of organic detritus in the bottom material. (Baker-FRC)
W82-02074

WHERE DO WE GO FROM HERE.

R. Briggs.
Water, No 40, p 19-21, September, 1981. 1 Tab, 6 Ref.

Descriptors: *Automation, *Data acquisition, *Data collections, *Monitoring, *Data transmission, Computers, Hydrologic data collection, Water quality management, Water quality control, Sensors, Water treatment, Wastewater treatment.

A report issued by the National Water Council/Department of the Environment Working Party on Control Systems contains guidelines to clarify the water industry's needs for instrumentation, control, and automation (ICA) in water and wastewater treatment technology. To help implement these recommendations, representatives of the environment, industry and engineering factions were incorporated as consultants in the design stages of ICA improvements. Accurate data is required at each level of the management hierarchy in order for water industry management to be effective. Monitoring devices may be used to check the

quality of effluents and protect downstream receiving waters. A number of factors are listed which have contributed to the United Kingdom's dissatisfaction with the overall precision obtained from ICA equipment in the water industry in recent years. In transferring information about water quality to the final user, the weakest unit in the chain is usually the sensor. New advances to improve sensors used in water quality monitoring include the use of computer control and multifunctional sensor devices. (Geiger-FRC)
W82-02086

7B. Data Acquisition

ELECTRONIC MEASUREMENT AND RECORDING OF EVAPORATION LOSS,

J. A. Drabbe.
Water SA, Vol 7, No 3, p 150-154, July, 1981. 6 Fig.

Descriptors: *Evaporation, *Water storage, *Measuring instruments, Storage tanks, Drinking water, Surface tension, Rainfall.

A new electronic system for the measurement of evaporation loss in water storage tanks is described, which includes the recording of the data on a weekly or monthly chart. As the water level falls due to evaporation, a sensitive probe in the still-well switches on the supply of water to a flowmeter. This measures and delivers calibrated quantities directly to the still-well, where the rising water touches the probe and switches off the control circuit. Surface tension is used to provide a quick break of contact when the water surface suddenly falls away. The probe is constructed primarily of platinum, and the flow meter consists of two plastic bottles filled alternately with a sliding valve operated by 12 V solenoids. To counter the effects of rain, a small probe opens a small solenoid-operated drain cock to allow incoming rain to flow to waste. To date, results with the new method have been very encouraging. This method provides continuous readings rather than the required daily readings. (Small-FRC)
W82-01602

SOIL MOISTURE UPDATING AND MICROWAVE REMOTE SENSING FOR HYDROLOGICAL SIMULATION,

Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2G.
W82-01611

REMOTE SENSING IN DEVELOPMENT,

Agency for International Development, Washington, DC.
C. K. Paul, and A. C. Mascarenhas.
Science, Vol 214, No 4517, p 139-145, October 9, 1981. 3 Fig, 9 Ref.

Descriptors: *Remote sensing, *Developing countries, *Satellite technology, *Water resources development, Exploration, Land use.

Among the uses of remote sensing in developing countries is subsurface water location. Satellite images of Bangladesh have located flooded and dry regions and indicated the vigor of vegetation (rice) between the wet and dry seasons. Understanding the changing flood patterns along rivers allows proper designation of land use. Landsat imagery in the Rukwa region, Tanzania, showed that Lake Rukwa was one body of water rather than two separate bodies as depicted on available maps, and that 5% of lakeshore land supposedly suitable for agriculture was actually under water. One problem with interpretation of satellite imagery to locate specific water resources is the technical expertise and computer equipment required, but often not available, in this part of the world. (Cassar-FRC)
W82-01719

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, TAYLOR CREEK, FLA., AND LITTLE RIVER, GA., 1979 DATA REPORT,

Science and Education Administration, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, L. H. Allen, Jr., P. O'Neill, and R. Slack.
Agricultural Research Results ARR-NE-13, September 1981. 38 p, 8 Fig, 11 Tab, 16 Ref, 1 Append.

Descriptors: *Remote sensing, *Aerial photography, *Soil water, Humid areas, Hydrologica data, Monitoring, Infrared imagery, Sensors, Georgia, Florida.

As part of a project to evaluate remote sensing in hydrologic studies, with primary emphasis on soil moisture measurements, in a wide range of physiographic and climatic areas, data were collected in late 1978 and during 1979 in two humid areas: Taylor Creek, Florida, and Little River, Georgia. Experiments were designed to collect remote sensing data concurrent with ground observations of hydrologically significant parameters and phenomena, primarily soil moisture within several surface layers. The observations were made on intensively monitored watersheds. The sampling locations in Florida were all in or west of the Taylor Creek Watershed. One flightline covered mostly citrus grove sites and the other traversed mostly pasture and swampy areas. All sampling locations in Georgia were within the Little River Experimental Watershed. The land cover has about 33% in crops, 40% in woodlands, and 8% in urban categories. The NASA 929 (C-130B) aircraft was the sensor platform used in these experiments. The sensor configuration included color infrared photography, a modular multispectral scanner, a thermal infrared radiometer, C and L band radiometers, a passive microwave scanner, and four active microwave sensors: K, C, L, and P band scatterometers. (Moore-SRC)
W82-01771

EFFECT OF THE ALGAL LENGTH/APERTURE LENGTH RATIO ON COULTER ANALYSES OF LAKE SESTON,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
H. A. Vanderploeg.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 912-916, August, 1981. 2 Fig, 1 Tab, 28 Ref.

Descriptors: *Algae, *Particle size, *Seston, Lakes, Aquatic life, Phytoplankton, *Lake Michigan, Particle shape, Coutler Counter, Organic matter.

The accuracy of sizing long, thin algae in Lake Michigan water was improved by a more suitable combination of aperture tubes in the Coutler Counter method. Both seston and nylon fibers 200 and 500 micrometers long were sized in aperture tubes of different sizes. There was poor count overlap in some size ranges. This was caused by particles whose length was greater than the aperture length. The suggested technique uses the observations that the large aperture tubes more correctly size the longer particles and that count overlap is usually best in the smallest size categories. The largest tube selected must have an aperture length greater than the length of the longest algae. The size difference between apertures is affected by the shape of the seston. Although excellent count overlap was obtained with 50 and 400 micrometer aperture tubes for mixtures of microspheres similar to the lake seston, it was necessary to add a 140 or 200 micrometer tube for seston mixtures containing long, thin algae. (Cassar-FRC)
W82-01823

POWER SPECTRAL ANALYSIS OF A FORCEMAIN FAILURE CAUSED BY WATERHAMMER,

McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
W. James, R. R. Hennessy, and J. W. Disher.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 36-44, 1980. 5 Fig, 6 Ref.

Descriptors: *Water hammer, *Pipe failure, *Water pressure, Pipelines, *Main sewers, Leakage, Remote sensing, Spectral analysis, Monitoring, Water loss.

Leakage problems in a 14 inch asbestos cement sewage forcemain, 3963 ft long, in Ancaster, Ontario, prompted installation of pressure recording equipment on September 9, 1976. Between this date, and September 14, when a pipe failure occurred, 18 pressure recordings were made. This produced a complete record of water hammer pressure waves during deterioration and failure. Power spectral analysis pinpointed the initial small break, which was not detectable on the surface until several days later. After the initial crack appeared, the waterhammer wave changed dramatically. A noticeable frequency shift in the rigid column wave occurred shortly before the ultimate failure, which was caused by an apparent merging of the primary waterhammer wave with an existing and gradually increasing lower frequency wave. Air pockets increasing in size with deterioration produced short-duration, high pressures. Superposition of the two waves produced enough energy to rupture the already damaged pipes. This method may be useful in monitoring the condition of long pipelines. (Cassar-FRC)
W82-01826

DISCHARGE MEASUREMENTS BY A NEWFORMED RELATIVE SALT-DILUTION METHOD IN SMALL TURBULENT STREAMS,

Norges Landbrukshoegskole, Vollebekk.
L. Bjerve, and O. Groterud.
Nordic Hydrology, Vol 11, No 3/4, p 121-132, 1980. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Discharge measurement, *Stream discharge, *Conductivity, Salt dilution method, Turbulent flow, Saline solution injection, Tracking techniques.

A new salt dilution method for determining water discharge in small turbulent streams relies on injection of concentrated salt solution at constant feed and measuring the dilution level downstream by in situ conductivity readings. Three injection apparatuses are described: a 7 liter chicken feeding bucket for 100 liters per sec discharge, a float-chamber apparatus for larger volumes and discharge up to 300 liters per sec, and a vacuum chamber apparatus for large water discharges. This constant injection method is compared with several other methods (sudden injection, V-notch weir, collection, and Harlacher) and found comparable. For the turbulent streams the new method was easier and more reliable. (Cassar-FRC)
W82-01891

THE APPLICATION OF RADIOACTIVE TRACERS FOR DETERMINATION OF BED-LOAD TRANSPORT IN ALLUVIAL RIVERS,

Copenhagen Univ. (Denmark). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-01893

A SIMPLE DEVICE FOR QUANTITATIVE PSEUDOPERIPHYTON SAMPLING,

Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animaux et Zoologie.
C. Amoros.
Hydrobiologia, Vol 68, No 3, p 243-246, February 16, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Water sampling, *Invertebrates, *Sampling, Cladocerans, Copepods, Bottom sediments, *Ponds, Aquatic plants, Littoral zone.

A simple device for sampling small invertebrates living among aquatic macrophytes in a pond is described. The device consists of a methyl methacrylate tube 1.2 meters high and 50 mm inside diameter, open at both ends and fitted with a sharp iron part at the bottom. It is operated by quickly pushing the bottom of the tube into the pond sediments deep enough to obtain a core to serve as a bottom stopper when the device is raised from the water. After inserting a rubber stopper in the

top, the captured animals and water are released through emptying holes in the side of the tube onto a filter form counting and identification. Sampling of cladocerans and copepods at two sites in the littoral zone of a fishpond produced good correlation within each station, but not between the two stations, using three replicate samples. (Cassar-FRC)
W82-01894

THE USE OF REMOTE SENSING FOR AN INTEGRATED INVENTORY OF A SEMI-ARID AREA,

Arizona Univ., Tucson. Office of Arid Lands Studies.
D. A. Mouat, J. B. Bale, K. E. Foster, and B. D. Treadwell.
Journal of Arid Environments, Vol 4, No 2, p 169-179, June, 1981. 4 Fig, 20 Ref.

Descriptors: *Semiarid lands, *Remote sensing, *Mapping, Arid lands, *Satellite technology, Pima County, Arizona, Vegetation, Geology, Water resources development, Water resources management, Soil types, Land use, Photography, Resources development, Resources management.

The Pima County, Arizona, Resources Inventory provides maps of land use and selected natural resources for a 23,000 sq km semiarid area. Satellite photography and other imagery supplied information on land use, natural vegetation distribution, land forms, and soil types. Field work supplied data on soil types from previously mapped areas, surficial geology, and slope angle. The maps produced by this project are usable for many purposes, including water resources management and development. Begun in 1976, the total costs for the inventory project were $72,000 or $3.00 per sq km. The method is applicable to any large arid or semiarid region. (Cassar-FRC)
W82-01910

MEASUREMENT OF IRRIGATED ACREAGE IN WESTERN KANSAS FROM LANDSAT IMAGES,

Kansas State Geological Survey, Lawrence.
K. M. Keene, and C. D. Conley.
Environmental Geology, Vol 3, No 2, p 107-116, 1980. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Irrigation, *Kansas, Agriculture, Infrared imagery, Landsat.

Video image analysis permitted rapid measurement of irrigated summer crops in western Kansas. Spectral response on LANDSAT MSS band 5 (visible red, 0.6-0.7 micrometers) images produces a low response from irrigated summer crops and high response from harvested and fallow fields and most soil types. This permits measurement of irrigated acreage at the rate of 1 hour per county, about 876 sq mi. Standard 1:1,000,000 LANDSAT positive transparency images are used for interpretation. This is a significant time savings compared with the 6 weeks required to analyze LANDSAT data describing a 3140 sq mi area using the false color composite image method. The video image analysis is prone to error when there is significant vegetation growth along streams or other water bodies and when ponds and reservoirs are present. In western Kansas neither of these conditions interferes with analysis. If necessary, the area of significantly large water bodies may be substracted from the irrigated acreage. (Cassar-FRC)
W82-01939

DEVICE FOR COLLECTING REPLICATE ARTIFICIAL SUBSTRATE SAMPLES OF BENTHIC INVERTEBRATES IN LARGE RIVERS,

Institute of Paper Chemistry, Appleton, WI.
D. R. Wefring, and J. C. Teed.
Progressive Fish Culturist, Vol 42, No 1, p 26-28, January, 1980. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Sampling, *Mechanical equipment, *Rivers, Costs, Design criteria, *Benthic fauna, *Invertebrates.

A device was designed for use in large rivers for suspending triplicate modified multi-plate samplers. Ease of construction and transportation and flexibility of use were important considerations, along with low cost and durability. The device consists of two zinc-plated mending plates bolted together and suspended from an expanded polyethylene boat fender with plastic-coated aircraft cable. Materials for the unit, excluding samplers, cost about $7.00. A field study indicated that the sampling unit provides an unbiased and inexpensive means of positioning triplicate modified multiplate samplers in large rivers. The unit also accommodates Periphytometer II samplers for monitoring periphyton communities. (Small-FRC)
W82-01947

A TEST UTILIZING SEDIMENT TRAPS, SURVEY RODS, AND RADIOGRAPHS TO MONITOR SEDIMENT ACCUMULATION FROM A DREDGING DISPOSAL OPERATION,

NALCO Environmental Sciences, Northbrook, IL.
G. R. Alther, and R. K. Wyeth.
Environmental Geology, Vol 3, No 2, p 97-105, 1980. 8 Fig, 5 Ref.

Descriptors: *Dredging, *Sediment discharge, *Measuring instruments, *Spoil disposal, Sediment distribution, Sediment traps, Survey rods, Radiographs, *Lake Erie, Fate of pollutants.

A combination of sediment traps, survey rods, and radiographs reduced errors in measuring the dispersal of dredged material (fine sand and coarse silt) in Lake Erie near Ashtabula, Ohio. The site was sampled before dumping began and four times after dredge material disposal during 1976. Dredge records indicate that about 24.1 million kg of sediment was discharged. The usual uncertainties with records of this type can be 45-65%. Errors in acoustic methods are 40-70%. The survey rod method accounted for 18,000 cu meters or 16.7 million kg (70%) of the material discharged, and the sediment traps, 14,000 cu meters or 12.5 million kg. Radiographs of sediment cores detected differences between the original and newly-deposited sediments. At the center of the disposal site 18 cm of sediment had accumulated the first day of disposal, May 24. The flat, cone-shaped pile increased to 28 cm after 3 days and to 36 cm after 1 week. (Cassar-FRC)
W82-01950

PHOTOMETRIC INVESTIGATIONS OF PRECIPITABLE WATER AND OPTICAL DEPTH WAVELENGTH EXPONENTS IN AN URBAN AREA,

Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2B.
W82-01966

OBSERVATIONS OF TWO COLORADO THUNDERSTORMS BY MEANS OF A ZENITH-POINTING DOPPLER RADAR,

Arizona Univ., Tucson. Inst. of Atmospheric Physics.
For primary bibliographic entry see Field 2B.
W82-01967

APPLICATIONS OF AERIAL PHOTOGRAPHY,

T. Gass.
Water Well Journal, Vol 35, No 8, p 38-39, August, 1981. 1 Fig.

Descriptors: *Groundwater, *Remote sensing, Aerial photography, Water supplies, Water resources development, Groundwater budget.

Applications of aerial photography and technology for the possible improvement of evaluating groundwater resources are considered. Recent advances in remote sensing technology have enhanced the ability to evaluate local and regional hydrogeological conditions. Aerial photography provides two basic types of clues for evaluating groundwater resources. Direct indicators refer to the detection of physical characteristics of the ground directly associated with groundwater. These would include the identification of springs, seeps and discharges of groundwater into surface water bodies. Indirect indicators are clues which enable assumptions or inferences to be made about groundwater resources. Some of these indirect indicators provide information for defining groundwater availability and changes in groundwater conditions. Various techniques of remote sensing are available. Black and white and color photography can give evidence of surface water-groundwater interfaces, soil moisture and some types of vegetation, along with delineation of structural geology, rock type, soil type, vegetation patterns and drainage characteristics. Thermal infrared imagery can detect soil moisture, soil types, zones of groundwater discharge and changes in rock type. One very successful application has been in detecting groundwater discharging to bodies of open water. Side looking airborne radar (SLAR) can detect soil changes and lineaments, distinguish between coarse- and fine-grained surface materials, and delineate zones of recharge. The monopulse radar system is relatively new and offers the ability to penetrate soil depth of 10 meters or to the top of the table if it is less than 35 feet beneath the surface. (Baker-FRC)
W82-01988

MATHEMATICAL MODELING OF STREAM WATER QUALITY BY A NEW MOMENT METHOD: FIELD INVESTIGATION OF A TIDAL RIVER,

National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
C-G. Wen, J-F. Kao, and L. K. Wang.
Journal of Environmental Management, Vol 12, No 2, p 127-140, March, 1981. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Mathematical models, *Water quality, *Tidal rivers, Streams, Pollution load, Biological oxygen demand, Dissolved oxygen, Oxygen demand, Water pollution control, Tam-Sui River, *Taiwan, Path of pollutants.

A new moment method has been developed which can be used to systematically identify water quality parameters for both tidal and non-tidal streams. Results of a field study conducted on the Tam-Sui River in Taiwan, Republic of China, are used to demonstrate the use of this method to identify the following water quality parameters: (1) the reaeration coefficient; (2) the coefficient of organic settling and other parameters; (3) the rate of organic addition to the overlying water from the bottom deposits as well as local run-off; (4) the oxygen production rate of photosynthesis; and (5) the longitudinal dispersion coefficient. The following information must be known in order to use this method: the stream velocity, the downstream distance, the stream water temperature, the biochemical oxygen demand of stream water at each sampling station, the dissolved oxygen of stream water at each sampling station, and the biochemical oxygen demand reaction rate. A chi-square test was conducted to evaluate the correctness of the biochemical oxygen demand model and the dissolved oxygen deficit model developed for the Tam-Sui River. This analysis showed that the proposed moment method can effectively estimate the characteristic parameters of steady state stream models. Observed biochemical oxygen demand and dissolved oxygen values from sampling stations on the Tam-Sui River were in excellent agreement with those estimated by the mathematical models. Once the biochemical oxygen demand model and the dissolved oxygen models have been developed for a stream, the biochemical oxygen demand and dissolved oxygen deficit at any downstream distance X can be readily calculated, and the degree of stream pollution can be assessed. (Carroll-FRC)
W82-01995

SCREENED AUGER AIDS INVESTIGATION,

Johnson Co., Haslett, MI.
D. M. Baron.
Johnson Driller's Journal, Vol 53, No 1, p 4-5, 1981.

Descriptors: *Drilling equipment, *Augers, Well screens, Wells, Test wells, *Groundwater pollution, *Chemical wastes, Muskegon, Michigan.

A new screened auger facilitated drilling on an investigation of groundwater contamination at an abandoned chemical plant dump near Muskegon, Michigan. The later modification of the apparatus consisted of a 2-ft long well screen with an 18 inch stainless steel flush tubing on each end, to which was welded the continuous auger flighting and the top and bottom ends of the hollow stem auger. It eliminates the problem of sand-lock inside hollow stem augers. The 3 and 1/4 inch inside diameter auger can also accept a submersible pump for efficient water extraction and downhole geophysical tools. (Cassar-FRC)
W82-02096

7C. Evaluation, Processing and Publication

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1972,
Science and Education Administration, Beltsville, MD. Water Data Lab.
For primary bibliographic entry see Field 2A.
W82-01772

SELECTED DRILL-STEM-TEST DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the OFSS,USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $4.75 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-326, (WRI), April, 1981. 20 p, 1 Fig, 1 Plate, 1 Tab, 3 Ref.

Descriptors: *Data collections, *Groundwater, *Aquifers, *Test wells, Potentiometric level, Oil wells, Transmissivity, Maps, Sites, *Montana, Northern Great Plains, Drill-stem tests.

Selected drill-stem-test data were collected for use in the hydrologic analysis of aquifers in the northern Great Plains area of Montana. To supplement existing data defining the potentiometric surface of various aquifers, shut-in pressures recorded during drill-stem tests of oil and gas test wells were used to calculate the altitude of the potentiometric surface. The transmissivity of the aquifers also was calculated if sufficient data existed. Records for 627 drill-stem tests from 523 wells are tabulated in this report. Data include well location, well name, formation tested, well epth, tested interval, date tested, test number, flow period, transmissivity, shut-in pressure, and altitude of water surface. Locations of the wells are shown on a map at a scale of 1:1,000,000. (USGS)
W82-01774

SURFICIAL GEOLOGY OF DUGWAY QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $2.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-335 (WRI), 1981. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, Geohydrology, Wells, Water yield, Maps, *New York, Oswego County, Dugway quadrangle.

The location and extent of 11 kinds of surficial deposits in Dugway quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the lithology and potential for groundwater development at any specific location. (USGS)
W82-01775

SELECTED HYDROGEOLOGIC DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $8.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-534, August, 1981. 241 p, 1 Fig, 1 Plate, 1 Tab, 3 Ref.

Descriptors: *Groundwater, *Data collections, *Aquifer characteristics, *Well data, Wells, Springs, Sites, Water use, Water level, Groundwater movement, Specific capacity, Specific conductivity, Water temperature, Aquifers, Transmissivity, Storage coefficient, *Montana, Northern Great Plains, *Hydrologic maps.

Selected hydrologic data have been used in a 4-year study of aquifers of Cenozoic and Mesozoic age in the northern Great Plains to define the hydrologic system and to generate hydrologic maps. Records of 6,754 wells and 188 springs are tabulated in the report. The well data include site location, county, date completed, depth of well, casing diameter, type of lift, use of water, principal aquifer, altitude of land surface, water level, discharge, specific capacity, specific conductance, and water temperature. The spring data include site location, county, use of water, principal aquifer, altitude of land surface, type of spring, discharge, date discharge measured, specific conductance, and water temperature. Locations of the wells and springs are shown on a map at a scale of 1:1,000,000. (USGS)
W82-01777

LOW-FLOW FREQUENCY AND FLOW DURATION OF TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-01779

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $6.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-817, July, 1981. 46 p, 3 Fig, 2 Tab.

Descriptors: *Data collections, *Sites, *Hydrologic data, Water quality, Surface water, Groundwater, Available water, *Montana.

The report describes the investigative efforts of the U.S. Geological Survey toward the water resources of Montana. Hydrologic information and knowledge of the water resources are gained and disseminated principally by programs of (1) collecting hydrologic data on a continuing basis, (2) conducting water-resources appraisals of surface and ground water, (3) conducting supportive research in hydrology and related fields, (4) disseminating water data and results of investigations to the public, (5) coordinating acquisition of water data by Federal agencies, and (6) providing technical assistance in hydrologic fields to other government agencies. (USGS)
W82-01787

RECORDS OF WATER LEVELS IN UNCONSOLIDATED DEPOSITS IN EASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
W. L. Bradford.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $31.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-924, June, 1981. 253 p, 4 Fig, 2 Tab.

Descriptors: *Water level, *Observation wells, *Awuifers, Sites, Water measurement, Monitoring, Well data, Hydrographs, *South Dakota, Minnehaha County.

Water levels in unconsolidated deposits measured by the U.S. Geological Survey and State agencies throughout eastern South Dakota during the period 1948-1980 are presented in tabular and graphic form. (USGS)
W82-01788

QUALITY OF WATER AND TIME OF TRAVEL IN PART OF TILLATOBA CREEK BASIN, MISSISSIPPI, OCTOBER 1974 TO SEPTEMBER 1980,
Geological Survey, Jackson, MS. Water Resources Div.
G. A. Bednar.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver CO. 80225, Price: $12.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-825, 1981. 87 p, 23 Fig, 10 Tab, 10 Ref.

Descriptors: *Water quality, Surface water, *Streamflow, *Dye releases, Watershed management, Data collections, Suspended sediments, Discharge measurement, Nutrients, Biochemical oxygen demand, Bacteria, Gaging stations, Sites, Water analysis, *Path of pollutants, *Time of travel, *Mississippi, Tallahatchie County, Yalobusha County, Grenada County, *Tillatoba Creek basin.

A 6-year quality-of-water and time-of-travel study was conducted during the construction phase of a flood-water protection and flood prevention project in a 118 square mile area of Tillatoba Creek basin in northwest Mississippi. Weekly suspended sediment, daily discharge, time of travel, nutrient, biochemical oxygen demand, bacteria and field data were collected. The study was conducted by the U.S. Geological Survey in cooperation with the U.S. Soil Conservation Service. The results of the study are presented in graphs and tables without interpretation. (USGS)
W82-01791

SEDIMENT DATA FOR STREAMS NEAR MOUNT ST. HELENS, WASHINGTON--VOLUME 1, 1980 WATER-YEAR DATA,
Geological Survey, Tacoma, WA. Water Resources Div.
R. L. Dinehart, J. R. Ritter, and J. M. Knott.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $11.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-822, 1981. 82 p, 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Fluvial sediments, Data collections, *Streams, *Sediment load, Monitoring, Sediment transport, Particle size, Sediment distribution, Sediment discharge, Sampling, Water temperature, Suspended sediments, *Volcanoes, *Washington, *Mount St. Helens, Toutle River basin, Cowlitz River basin.

This report presents fluvial sediment data collected primarily in response to the eruption of Mount St. Helens. To monitor the sediment transported by streams in the Mount St. Helens area and the particle-size distributions of the sediment, the Water Resources Division of the U.S. Geological Survey initially established 18 fluvial sediment stations. In this report, concentrations and discharges of suspended sediment are given for 16 fluvial-sediment stations (5 are in the Toutle River basin) and for 11 miscellaneous sampling sites. Also included are particle-size distributions of suspended sediment and bed material, water discharge, and water temperature for many of the sediment samples. Daily sediment discharges for the period May 18 to September 30 were calculated for Toutle River at Highway 99 near Castle Rock and Cowlitz River at Castel Rock. Over 150 million tons of sediment are estimated to have passed the Toutle River at Highway 99 station on May 18-19, 1980. High concentrations of suspended sediment persist-

ed at several stations throughout the spring and summer of 1980. (USGS)
W82-01792

8. ENGINEERING WORKS

8A. Structures

RECONSTRUCTION OF A SMALL DAM FOR A RECREATIONAL LAKE,
For primary bibliographic entry see Field 4D.
W82-01606

MOROCCO'S LARGEST MULTIPURPOSE SCHEME,
Ministere des Travaux Publics et des Communications, Rabat (Morocco). Direction de l'Hydraulique.
N. Dinia, and R. B. Bischof.
International Water Power and Dam Construction, Vol 33, No 7, p 19-25, July, 1981. 10 Fig, 4 Tab, 3 Ref.

Descriptors: *Dam construction, *Water supply development, Hydroelectric power, Irrigation, Rivers, *Morocco, Water resources development, Potable water.

Eighty percent of all state investments for agriculture in Morocco are concerned with irrigation projects. It is hoped that this policy will not only ensure adequate food supply for this country, which imports a considerable part of its basic food requirements, but also help to provide jobs and solve the severe problem of the rural exodus. In an average year 80% of the precipitation falls between November and April. The ratio between annual discharge in a typical dry year and the discharge in a typical wet year is as large as 1:6. Dry years often occur consecutively. One major project is the Al Massira multipurpose scheme, which is also the keystone of the Oum-er-R'bia development plan. The Al Massira dam is located halfway between the cities of Casablanca and Marrakesh on the lower reach of the Oum-er-R'bia river. The purpose of the plan is to supply drinking water for towns along the lower reach of the river, especially for the coastal region between Casablanca and Safi; to supply water to the phosphate industry; to extend the irrigated area in the Doukkala region from 40,000 to 100,000 ha; to supply peak energy at a yearly rate of 240 GWh; and to provide flood control. Specifics of dam construction discussed include selection of dam type, standard buttresses, grouting and drainage, foundation excavation, mass concrete, and monitoring arrangements. For the saddle dam construction used specific information is available concerning foundation, fill materials, spillways, hydrological data, bottom outlets, power intakes, and river diversion. (Baker-FRC)
W82-01724

EXPLOITING THE WATERS OF LAKE CHAD,
International Water Power and Dam Construction, Vol 33, No 8, p 15-16, August, 1981. 2 Fig, 1 Tab.

Descriptors: *Irrigation programs, *Canal construction, Seepage, Water supply, Water resources development, Resources development, Chad Basin, *Lake Chad, Lakes, *Africa, Nigeria.

An irrigation project drawing on the waters of one of the largest of Africa's lakes, Lake Chad, is described. The lake covers some 100,000 ha of flat clay plain in Bornu State, 120 km northeast of the state capital, Maiduguri. The lake is land-locked, with no outlet, and is fed mainly by the river Chari. The basic principle of the scheme is that water is drawn from Lake Chad through a 29 km intake channel to the main pumping station at Kirinowa. The main canal then runs for some 22 km to a diversion structure which provides a main canal to each of the three irrigated areas. The initial 9 km of the intake channel were first excavated by scrapers to half the final depth, when groundwater was found, and thereafter dredged. The remaining 20 km was dredged by floating cuttersuction dredgers. The main canal from Kirinowa station to the main diversion structure is 22 km long, and was a cut-and-fill construction with embankments; the bed was clay-lined to a minimum thickness of 1 meter. The project will have four main pumping stations. Hydrological studies show that lake levels during 1870-1970 have generally been higher than at present. Thus the droughts of the early 1970s are regarded as temporary aberrations, rather than as indicative of new low norms. Careful planning has ensured that the water balance in the lake can be maintained and the lake's variation in level can be kept to a reasonable minimum. (Baker-FRC)
W82-01726

CAPE TOWN WATERWORKS SERVICE RESERVOIRS: PLATTEKLOFF (1974) AND TYGERBERG (1964),
Civil Engineer in South Africa, Vol 22, No 1, p 19-21, January, 1980. 3 Fig.

Descriptors: *Reservoirs, *Water treatment, *Cape Town, South Africa, Water demand, Water resources development, Water supply.

The major purposes of normal gravity supply service reservoirs are to permit operation of filtration and pumping plant at substantially constant rates over given periods, usually of about a week, and to allow main pipeline capacity of less than the absolute peak demand rate; to maintain a more or less constant supply pressure as near as topography permits to the center of gravity of the area supplies by the reservoir, thus permitting optimum design of the distribution system and safeguarding this as well as private installations against excessive pressure; and to provide a supply in the event of short-term failure of or damage to conservation works, filtration works and pumping plants caused by normal and abnormal events. Two water supply projects are described which terminate in covered filtered water service reservoirs, the Wemmershoek and Voelvlei projects. It is difficult to forecast the optimum water levels for the various main reservoirs feeding a gravity supply. Storage depth is also difficult to determine objectively. Reservoirs with vertical walls of mass or reinforced concrete are usually cheapest, especially when surrounded by backfilling or embankment. The task of landscaping a service reservoir which is necessarily located above the level of most adjacent developments and is a landmark only to air travellers is easily done with planting of embankment slopes and grassing adjacent grounds. Brief mention is made of the construction costs. (Baker-FRC)
W82-01747

EVALUATING SCOUR AT CULVERT OUTLETS,
Colorado State Univ., Fort Collins. Engineering Research Center.
For primary bibliographic entry see Field 4D.
W82-01934

GROUT CURTAIN IN THE FOUNDATION OF THE ARCH DAM OF THE INGURI HYDROELECTRIC STATION,
E. V. Krylova. M. B. Remenyak, and G. G. Tuzhikhin.
Hydrotechnical Construction, No 10, p 991-996, October, 1980. 3 Fig, 2 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 10, p 4-7, October, 1980.

Descriptors: *Grouting, *Dam foundations, *Arch dams, Foundation rocks, Permeability, Karst, Absorption, Rock mechanics, *Inguri Dam, USSR, Hydroelectric plants, Carbonate rocks, Seepage control.

The installation of the 120 m deep grout curtain in the foundation of the Inguri hydroelectric plant dam, USSR, is described. Although simulations indicated that seepage losses would not exceed the permissible limits, a grout curtain was constructed for protecting the abutting bank masses from water encroachment and for reducing general seepage discharge. Zones with relatively high permeability were found in the right bank fault and the left bank ancient terraces. The curtain is double-row with 1.7 m between rows and was constructed in descending zones of 5 m. Control holes were tested in crucial regions. Absorption of grout varied between 20 and 4000 kg per m. The greatest grout absorption occurred on the left bank, where karstification was present. Before grouting, 3% of the rocks had a specific water absorption of less than 0.02 liters per min, and after grouting, 80% had less than 0.03 liters per min. Maximum values of specific water absorption decreased from 3 to 0.71 liters per min. As of January 1980 the curtain is operating effectively. Further treatment is planned for some large joints. (Cassar-FRC)
W82-01973

RECORDING UNDERGROUND,
Yorkshire Water Authority (England).
C. Humphries.
Water, No 34, p 33-34, September, 1980. 2 Fig.

Descriptors: *Sewers, *Water mains, *Maps, Sewer systems, Water conveyance, Pipelines, Metropolitan water management, Water management, Standards, Wastewater management, *Great Britain.

Adequate records of sewers and water mains are essential for the design, construction, reconstruction, maintenance, and operation of these water conveyance systems. The water industry in Great Britain has about 500,000 kilometers of sewers and water mains buried out of sight which are worth perhaps 50,000 million pounds sterling. Location records are needed to provide clear information on the position, size, level, materials, function, and age of the apparatus. Condition records are needed to provide information on the condition and operational history of the apparatus, including the results of inspections and surveys and a record of all maintenance and repair work. There is a need for more comprehensive statutory minimum requirements for records and for more standardization of record systems. Standard formats should be adopted for record maps and a standard referencing system should be implemented. Duplicate sets of records should be maintained in a secure location. The possibility of future computerization of records should be considered when revising record systems. The Standing Technical Committee on Sewers and Water Mains has also made several recommendations with respect to access to maps and records, public access to information, the inclusion of non-statutory information in public utilities records, and special arrangements for fundings and transfer of records. (Carroll-FRC)
W82-02036

SULBY RESERVOIR - PROVIDING WATER FOR THE ISLE OF MAN,
Hill (G.H.)., Manchester (England).
P. G. Eccles.
Water Services, Vol 85, No 1023, p 233-235, May, 1981. 1 Fig.

Descriptors: *Rockfill dams, *Reservoir construction, *Reservoir stages, Reservoirs, Dam design, Long-term planning, Water resources development, *Isle of Man, Great Britain.

The construction of the Sulby reservoir includes construction of a dam designed to meet the Isle of Man's water needs for 25 years, followed by construction of a larger dam to meet more distant needs. The drawdown works, pumping station, and rising main are to be completed by spring 1981. The reservoir should be totally operational by the summer of 1982. The dam site is located along the Sulby river and is underlain by Manx slate. The outer shells of the dam are of rockfill obtained from the quarry within the reservoir basin. The original first stage dam is provided with a 750 mm thick central asphaltic concrete core designed to be extended later. After full development, the catchment area will be 1620 ha, with a reservoir capacity of 4540 liters. The water supply pipe has valved intakes at three levels, and water will be supplied by gravity to the filter plant at Sulby Village. Water is also supplied to a hydroelectric generating station below Block Eary. The reservoir is needed to meet the increasing summer demand of visitors to the island. (Small-FRC)
W82-02068

8C. Hydraulic Machinery

INTAKES AND OUTLETS FOR LOW-HEAD HYDROPOWER,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Pugh.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY9, p 1029-1045, September, 1981. 16 Fig, 27 Ref.

Descriptors: *Hydroelectric plants, *Intakes, *Outlets, *Design criteria, Hydraulic structures, Hydraulic machinery, Turbines, Hydraulic turbines, Reviews, Construction costs, Poweeplants, Vortices, Piers, Trash racks, Fish passages, Flow discharge.

A state of the art survey on design practices for hydropower development in low-head (less than 20 meters) sites is based on the literature and on information from manufacturers and consultants in the field. With rising fossil fuel costs making the low-head sites more attractive economically, it is desirable to determine possible design changes to lower construction costs without producing significant head losses. Flow passages for low-head hydropower development cannot be standardized because of structural and geological differences and fish passages. However, where geological and structural considerations are similar, the same design may be used for a series of installations, reducing engineering and design costs. The possibility of shortening draft tubes (responsible for 30% of civil costs) using boundary layer control is explored. No research in this area has been done on hydraulic turbines. Intakes may probably be reduced in size or simplified in shape without losing efficiency because flow volumes are low. An example is the use of flat surfaces to approximate curved surfaces. Many hydraulic structures were designed with the demands of high flows and pressures experienced in high-head systems. Since low-head systems do not exert these severe demands, it is possible that equipment can be simplified. (Cassar-FRC)
W82-01979

8D. Soil Mechanics

PROBABILISTIC STABILITY ANALYSIS OF EARTH SLOPES,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. H. Vanmarcke.
Engineering Geology, Vol 16, No 1/2, p 29-50, July, 1980. 10 Fig, 21 Ref.

Descriptors: *Stability analysis, *Slope stability, *Probabilistic process, Soil stabilization, Mathematical studies, Slopes.

The basic three-dimensional stability problem of earth slopes is considered within a probabilistic framework for slopes under drained, undrained, or partially drained conditions. The methodology presented permits analysis for fairly general shapes of the failure surface by representing effects attributable to the end sections of the failure surface in a simplified manner. It is necessary to account for the three-dimensional nature of the problem in extending conventional stability analysis into the realm of probability. Estimates can be obtained for the probability that failure will occur anywhere along an embankment, which has important implications in the design of cuts and slopes. This method can be a cornerstone for the construction of a more complete methodology of slope reliability assessment which can incorporate time effects and uncertainties about loading and environmental conditions. (Small-FRC)
W82-01932

CURRENT METHODS OF DYNAMIC ANALYSIS FOR SEISMIC STABILITY OF EARTH DAMS,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. F. Marcuson, III, P. F. Hadala, and A. G. Franklin.
Engineering Geology, Vol 16, No 1/2, p 19-28, July, 1980. 2 Fig, 21 Ref.

Descriptors: *Dam stability, *Stability analysis, *Earth dams, Seismology, Earthquakes, Liquefaction, Engineering.

Two methods used by the U.S. Army Engineers Waterways Experiment Station to analyze the seismic stability of earth dams are outlined. Evaluation of the liquefaction potential of a dam includes a field investigation, routine laboratory tests, development of a soil profile, seepage analysis, static analysis, development of design earthquake, dynamic analysis, determination of available strength of material, comparison of shear strength and shear stress, and factor of safety. Permanent displacement analysis combines the sliding block analysis with the embankment response analysis. This analysis leads to an estimate of the amount of permanent displacement of the rigid mass. This method also includes laboratory tests, stability analysis, computation of displacement potential, and determination of tolerable displacement potential. These analyses provide insight so that the proper engineering judgment can be made. (Small-FRC)
W82-01953

THE ACCURACY OF EQUILIBRIUM METHODS OF SLOPE STABILITY ANALYSIS,

California Univ., Berkeley. Dept. of Civil Engineering.
J. M. Duncan, and S. G. Wright.
Engineering Geology, Vol 16, No 1/2, p 5-17, July, 1980. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Stability analysis, *Slope stability, *Equilibrium, Mathematical studies, Safety, Slopes, Soil stabilization.

Equilibrium methods of slope stability analysis are discussed including equations, unknowns, and assumptions, and the accuracy of the methods is evaluated. Inaccuracies can arise from the assumptions that are made and neglected conditions of equilibrium. The ordinary method of slices, force equilibrium procedures, and Bishop's modified method do not satisfy all of the conditions of equilibrium. Under some circumstances, these methods may be inaccurate. For example, the ordinary method of slices may give values of F (factor of safety) which are 50% smaller than the corrected value if used for effective stress analyses of slopes with high pore pressures. Methods which satisfy all conditions of equilibrium, including Janbu's, Spencer's, and Morgenstern and Price's methods have accuracies of + or - 5%. When these methods are used, the engineer is justified in considering the factors of safety he calculates to be correct in terms of the mechanics of the problem. (Small-FRC)
W82-01954

8E. Rock Mechanics and Geology

TECTONIC STATE: ITS SIGNIFICANCE AND CHARACTERIZATION IN THE ASSESSMENT OF SEISMIC EFFECTS ASSOCIATED WITH RESERVOIR IMPOUNDING,

Geological Survey, Menlo Park, CA.
R. O. Castle, M. M. Clark, A. Grantz, and J. C. Savage.
Engineering Geology, Vol 15, No 1/2, p 53-99, January, 1980. 9 Fig, 5 Tab, 133 Ref.

Descriptors: *Reservoir filling, *Seismicity, *Tectonics, Rock mechanics, Geologic faults, Seismology, Strain, Stress, Geologic fractures, Earthquakes, Deformation, Geologic history, *Reservoir design.

An assessment of seismicity associated with filling of large reservoirs should begin with an evaluation of the natural tectonic state. This will reveal whether the impoundment itself is the basic cause of seismicity, it is coincidental, or it is the result of a triggering effect, which is most likely. Deformational style is more critical in forecasting the occurrence of impoundment-induced seismicity than are existing fractures or accumulated elastic strain. Reservoir-associated seismicity is usually seen in areas combining steeply dipping faults, relatively high strain rates, and other extensional or horizontal-shear strains. Reservoir loading may modify the natural tectonic state, as do the following: underground explosions, fluid injection, fluid extraction, underground mining, and volcanic emissions. The possibility of seismic activity is enhanced by reservoir filling as a result of increased fluid pressures and surface loading, which increases the likelihood of crustal failure in areas of normal and transcurrent faulting and inhibits failure in areas of thrust faulting. A table summarizes data on 57 dams throughout the world, their vital statistics, geology, and tectonic activity. Of 33 reservoir sites where seismic activity has been documented, 10 are in seismic areas. (Cassar-FRC)
W82-01951

8G. Materials

HYDRAULIC TESTING OF PLASTIC FILTER FABRICS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Y. H. Chen, D. B. Simons, and P. M. Demery.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 307-324, September, 1981. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Plastics, *Fabrics, *Filters, *Hydraulic properties, *Erosion control, Filter media, Soil types, Bacteria, Permeability coefficient, Soil stabilization, Soil conservation, Soil water, Bank stabilization.

Plastic filter fabrics of the nonwoven type (mean opening size, 0.10-0.95 mm) were laboratory-tested in four types of fine soil (sand, loam, and two sandy loams) to document their hydraulic performances. These materials provide an inexpensive, durable, easy-to-install alternative to a graded filter system. They have been used in bank protection, subdrainage protection, beach protection, and erosion control at bridges. The hydraulic analysis of each fabric consisted of 6 phases: a water filtration discharge study, a water pressure analysis, an analysis of sediment discharge through the plastic filters, a soil size distribution analysis, an analysis of permeability changes, and a bacterial and fabric filter analysis. The presently used Corps of Engineers criteria were found too conservative. The following procedure is recommended for selecting a filter fabric: (1) determine the soil permeability coefficient and size distribution of soil layers to be protected, (2) apply given equation to determine whether or not the soil is a filter (natural graded soils usually are), and (3) select a fabric with a permeability coefficient equal to or larger than that of the soil, using one given equation if the soil layer is not a filter, and two given equations if the soil layer is a filter. Local clogging of the filter can be expected in the latter case under conditions of high discharge. (Cassar-FRC)
W82-01613

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

A PERSPECTIVE ON ESTUARINE AND COASTAL RESEARCH FUNDING,

Dartmouth Coll., Hanover, NH.
C. B. Officer, L. E. Cronin, R. B. Biggs, and J. H. Ryther.
Environmental Science and Technology, Vol 15, No 11, p 1282-1285, November, 1981. 3 Tab.

Descriptors: *Research facilities, *Estuaries, *Financing, *Publications, Research properties, Coastal waters, Administrative agencies, Environmental effects, Funding, Universities.

The academic community has produced 77% of the past 5 years' refereed research literature on estuaries, and federal, state, municipal, and industrial sources, the remainder. The most significant cause of this disproportionality is that scientists within the government laboratories are generally required to solve problems needing immediate attention, whereas academia performs more basic research. Academic institutions received 31-37% of total federal estuarine-related funds, depending on the source of the statistics. The National Science Foundation is given credit for more support (21%) than any single agency and has the lowest cost per publication. Most of the federal research facilities for marine environmental research have been established in the past 10 years, but academic research facilities have not been similarly expanded. The authors suggest that the academic community and federal agencies should cooperate in identifying and implementing research on a regional and national scale. (Cassar-FRC)
W82-01803

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

U.S. GEOLOGICAL SURVEY REPORTS ON THE WATER RESOURCES OF FLORIDA, 1886-1980, SECOND EDITION,
Geological Survey, Tallahassee, FL. Water Resources Div.
N. D. Hoy, J. D. Simmons, and M. Claiborne.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, $28.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-816, 1981. 212 p.

Descriptors: *Bibliographies, *Groundwater, *Surface water, Publications, Indexing, *Florida.

The U.S. Geological Survey has released a listing of its reports on water resources in Florida for the period 1886-1980. Most of the reports contained in the listing were prepared by the U.S. Geological Survey in cooperation with numerous public agencies in Florida. The compilation has a full bibliographic list of reports, arranged alphabetically by senior author. In addition, the reports are indexed by geographic areas and by subject. Only two lines are used for each entry in the indexed portions, the complete reference being given only in the bibliographic list. (USGS)
W82-01778

9C: Hydraulic Machinery

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10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

[illegible]

[illegible]

[illegible]

SUBJECT INDEX

3-(TRIFLUOROMETHYL)-4-NITROPHENOL
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

ACCUMULATION
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

ACID RAIN
Acid Precipitation,
W82-01607 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Acid Rain Agreement,
W82-01933 5B

Acid Rain and Environmental Policy,
W82-01987 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ACIDIC WATER
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

ACTIVATED CARBON
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Tying Up TCE,
W82-01866 5G

ACTIVATED SLUDGE PROCESS
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

ACUTE TOXICITY
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

ADIRONDACK REGION
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

ADSORPTION
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

AERATED LAGOONS
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

AERATION
Destratification and Reaeration as Tools for In-Lake Management.
W82-[illegible] 5G

AERIAL PHOTOGRAPHY
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

AEROSOLS
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

AFRICA
Exploiting the Waters of Lake Chad.
W82-01726 8A

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

AGRICULTURAL CONSERVATION PROGRAM
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

AGRICULTURAL ENGINEERING
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

AGRICULTURAL RUNOFF
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

AGRICULTURAL WATERSHEDS
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

AGRICULTURE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Case Studies of Agricultural Water Conservation,
W82-01667 3F

AIR ENTRAINMENT
Excess Air in Groundwater,
W82-02099 2F

AIR POLLUTION
The Mercury Cycle,
W82-01869 5B

The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

AIR POLLUTION EFFECTS
Acid Precipitation,
W82-01607 5C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

AIR POLLUTION SOURCES
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

ALABAMA
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

ALASKA
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

ALBERTA
Glacier Surveys in Alberta - 1979,
W82-01855 2C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

ALGAE
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

ALGAL GROWTH
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

ALLEGHENY RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

ALLUVIAL RIVERS
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

ALTAMAHA RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

ALTERNATIVE PLANNING
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

ALTITUDE
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

ALUM
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

ALUMINUM
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

AMERICIUM
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

AMMONIA
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

ANADROMOUS FISH
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

ANAEROBIC DIGESTION
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

ANIMAL WASTES
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Pollution from Farms,
W82-02039 5D

ANION EXCHANGE
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

ANTARCTIC
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

APPLES
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

AQUACULTURE
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

AQUATIC ANIMALS
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

AQUATIC DRIFT
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

AQUATIC ENVIRONMENT
Kinetics for the Aquatic Environment,
W82-01631 2K

Microbiology of the Aquatic Environment,
W82-01786 5C

Kinetics for the Aquatic Environment,
W82-01806 2K

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

AQUATIC FUNGI
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

AQUATIC LIFE
Microbiology of the Aquatic Environment,
W82-01786 5C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

AQUATIC ORGANISMS
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

AQUATIC PLANTS
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

The Flowering of Wastewater Treatment,
W82-02015 5D

AQUATIC WEED CONTROL
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

AQUATIC WEEDS
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

AQUIFER CHARACTERISTICS
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

AQUIFER SYSTEMS
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

AQUIFERS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

ARCATA
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

ARCH DAMS
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

ARCTIC
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

ARGENTINA
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Reviving the Rio Reconquista,
W82-02014 5G

ARGON
Excess Air in Groundwater,
W82-02099 2F

ARKANSAS RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico,
W82-01761 6D

AROMATIC COMPOUNDS
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

ARSENIC
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

ASBESTOS
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

ATHABASCA GLACIER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

ATMOSPHERIC LOADING
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

ATMOSPHERIC WATER
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

ATOMIC ABSORPTION SPECTROSCOPY
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

AUFEIS FIELDS
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

AUGERS
Screened Auger Aids Investigation,
W82-02096 7B

AUSTRALIA
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Transport of Salts in Catchments and Soils,
W82-01880 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

AUSTRIA
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

AUTOMATION
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

Where Do We Go from Here.
W82-02086 7A

AVAILABLE WATER
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

AWUIFERS
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

BACTERIA
Sediment Bacterial Indicators in an Urban Shellfishing Subetuary of the Lower Chesapeake Bay,
W82-01661 5A

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

BALTIC SEA
International Cooperation to Protect the Baltic,
W82-02087 6E

BAMBOO
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

BANANAS
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

BASELINE STUDIES
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

BASIN IRRIGATION
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

Development of Solutions for Level-Basin Design,
W82-01976 3F

BASINS
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

BED LOAD
Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

BELFAST LOUGH
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

BELIZE
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

BENTHIC FAUNA
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01983 5C

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

BENTHOS
Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

BIBLIOGRAPHIES
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

BIGHTS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

BIOACCUMULATION
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

BIOASSAY
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

BIOCHEMISTRY
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

BIODEGRADATION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

BIOINDICATORS
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

BIOLOGICAL SAMPLES
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

BIOLOGICAL WASTEWATER TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

BIOMASS
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

BLACK RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Black River Basin, New York.
W82-01758 6D

BLACK WARRIOR RIVER
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

BLEACHING WASTES
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

BORDER IRRIGATION
Optimal Design of Border Irrigation Systems,
W82-01977 3F

BOTTOM CURRENTS
Contourites in Lake Superior,
W82-01935 2H

BOTTOM SEDIMENTS
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

BRACKISH WATER
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

BRAZIL
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

BROMIDES
Bromide in Canterbury Ground Water,
W82-02056 5B

BROWN SOILS
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

BYPRODUCTS
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

CADMIUM
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

CALIFORNIA
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

CANADA
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

CANAL CONSTRUCTION
Exploiting the Waters of Lake Chad.
W82-01726 8A

CANALS
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

CAPE PENINSULA
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

CAPE TOWN
Cape Town Waterworks Service Reservoirs: Platteklоff (1974) and Tygerberg (1964).
W82-01747 8A

CARBOHYDRATES
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

CARBON CYCLE
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

CARBON DIOXIDE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Summer Ice and Carbon Dioxide,
W82-01843 2C

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

CARCINOGENS
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

CAROTENOIDS
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

CARP
Dynemics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

CARRYING CAPACITY
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

CASE STUDIES
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

CASPIAN SEA
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

CATHODES
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

CATTLE
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

CENTRIFUGATION
Centrifugal Dewatering,
W82-01912 5E

CESIUM RADIOISOTOPES
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

CHAMBAL PROJECT
The Chambal Project: Problems and Solutions,
W82-01739 4A

CHANNEL MORPHOLOGY
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

CHELATING AGENTS
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

CHEMICAL ANALYSIS
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

CHEMICAL COMPOSITION
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

CHEMICAL PRECIPITATION
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

CHEMICAL PROPERTIES
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

CHEMICAL REACTIONS
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

CHEMICAL TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

CHEMICAL WASTES
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

Screened Auger Aids Investigation,
W82-02096 7B

CHEMICAL WASTEWATER
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

CHEMOCLINE
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

CHEMUNG COUNTY
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

CHESAPEAKE BAY
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

CHICAGO
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

CHINA
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

Impressions of Soil and Water Conservation in China,
W82-01730 4D

CHLORALKALI PLANTS
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

CHLORATES
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

CHLORINATION
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

CHLOROPHYLL
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

CHLOROPHYLL A
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

CHROMIUM
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

CITRUS FRUITS
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

CIVIL ENGINEERING
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

CLADOPHORA
Denitrification Associated With Periphyton Communities,
W82-01814 5B

CLARIFICATION
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

CLASSIFICATION
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

CLEAR-CUTTING
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

CLIMATOLOGY
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

CLOUD PHYSICS
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

COAGULATION
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

COAL MINING
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

COASTAL AQUIFERS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

COASTAL WATERS
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

COASTAL ZONE MANAGEMENT
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

COLIFORMS
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

COLOR REMOVAL
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

COLORADO
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

COLORADO RIVER BASIN
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas,
W82-01752 6D

COLUMBIA RIVER
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

COMBINED TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

COMPREHENSIVE PLANNING
The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

COMPRESSIBILITY
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

COMPUTER PROGRAMS
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

CONDUCTIVITY
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

CONGRESSIONAL POLICY
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

CONJUNCTIVE USE
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

CONSERVATION
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

CONSUMPTIVE USE
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

CONTAMINATION
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

CONTOURS
Contourites in Lake Superior,
W82-01935 2H

CONVECTIVE PRECIPITATION
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

COOLING
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

COOLING WATER
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

COOPER
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

COPEPODS
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

COPPER
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

CORN
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

COST-BENEFIT ANALYSIS
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

COST SHARING
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

CRABS
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

CROP PRODUCTION
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02043 2I

CROP YIELD
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Optimal Design of Border Irrigation Systems,
W82-01977 3F

CROPLAND
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

CRYSTAL GROWTH
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

CRYSTALLIZATION
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

CULTIVATION
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

CULTURE MEDIA
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

CULTURES
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

CULVERTS
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

Evaluating Scour at Culvert Outlets,
W82-01934 4D

CUMBERLAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Cumberland River Basin, Kentucky-Tennessee.
W82-01756 6D

CURRENT METERS
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

CYCLING NUTRIENTS
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

CYPRESS DOMES
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

DAM CONSTRUCTION
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

DAM FOUNDATIONS
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

DAM STABILITY
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

DAMS
Recent Changes in Level of Lake Victoria,
W82-01711 4A

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DAPHNIA
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

DATA ACQUISITION
Where Do We Go from Here.
W82-02086 7A

DATA COLLECTIONS
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

Where Do We Go from Here.
W82-02086 7A

DATA TRANSMISSION
Where Do We Go from Here.
W82-02086 7A

DECISION MAKING
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

Acid Rain and Environmental Policy,
W82-01987 5B

DECOMPOSITION
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

DEGRADATION
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

DEGREE-DAY FACTOR
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

DENITRIFICATION
Denitrification Associated With Periphyton Communities,
W82-01814 5B

DENSITY
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

DESALINATION
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

DESIGN CRITERIA
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

DESIGN FLOW
Statistical Determination of Design Low Flows,
W82-01858 2E

DESTRATIFICATION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DEUTERIUM
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

DEVELOPING COUNTRIES
Remote Sensing in Development,
W82-01719 7B

Simplified Method for Rainfall Intensities,
W82-01978 2B

Wanted: Water for Development,
W82-02088 6D

Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

DIATOMS
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

DIFFUSION COEFFICIENT
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

DISCHARGE MEASUREMENT
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

DISEASES
Infectious Waterborne Diseases,
W82-01784 3A

DISINFECTION
Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

DISPERSIVITY
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

DISSOLVED OXYGEN
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

DISSOLVED SOLIDS
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

DISTILLATION
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

DISTRIBUTION
Development of Solutions for Level-Basin Design,
W82-01976 3F

DIVERSION
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

DIVERSION STRUCTURES
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

DORCHESTER COUNTY

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

DRAINAGE

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

The Chambal Project: Problems and Solutions,
W82-01739 4A

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

DRAINAGE CANALS

Parish Is Not Liable for Subsidence.
W82-01603 6E

DRAWDOWN

Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

DREDGING

Parish Is Not Liable for Subsidence.
W82-01603 6E

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

DRIFT

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

DRILLING EQUIPMENT

Screened Auger Aids Investigation,
W82-02096 7B

DRINKING WATER

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

DRIP IRRIGATION

Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

DUNES

Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

DUPUIT-FORCHHEIMER THEORY

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

DYE RELEASES

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

DYES

Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

EARTH DAMS

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

ECOLOGICAL EFFECTS

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

ECONOMIC ANALYSIS

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

ECONOMIC ASPECTS

Case Studies of Agricultural Water Conservation,
W82-01667 3F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

ECONOMIC FEASIBILITY

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

ECONOMICS

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

ECOSYSTEMS

A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

EFFLUENT CHARGES

Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

EFFLUENT STANDARDS

Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

EFFLUENTS

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

EGGS

Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

EGYPT
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

ELECTRIC POWER PRODUCTION
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

ELECTRIC POWERPLANTS
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

ELECTROCHEMISTRY
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

EMISSION SPECTROSCOPY
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

ENERGY DISSIPATION
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

ENERGY EQUATION
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

ENGLAND
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

Slowhill Copse Sewage Treatment Works.
W82-01727 5D

Operating Policies for a Surface/Ground Water System,
W82-01741 4B

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ENTEROVIRUSES
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

ENVIRONMENTAL EFFECTS
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

ENVIRONMENTAL EFFECTS, *POLLUTANT IDENTIFICATION
Organic Substances in Water,
W82-01783 5A

ENVIRONMENTAL PROTECTION
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

International Cooperation to Protect the Baltic,
W82-02087 6E

ENZYMES
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

EPIDEMIOLOGY
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

EQUILIBRIUM
Kinetics for the Aquatic Environment,
W82-01806 2K

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

EROSION
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

Evaluating Scour at Culvert Outlets,
W82-01934 4D

EROSION CONTROL
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ERROR ANALYSIS
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

ERRORS
Note on Random Raindrops and Sampling Error,
W82-02032 2B

ESTUARIES
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

ESTUARINE ENVIRONMENT
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

EUTROPHIC LAKES
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

EUTROPHICATION
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

EVALUATION
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

EVAPORATION
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

EVAPOTRANSPIRATION
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

EXCESS RAINFALL
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

EXPERIMENTAL FARMS
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

FABRICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

FALLOUT
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

FARM WASTES
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Pollution from Farms,
W82-02039 5D

FARMING
Logistics of Farm Water Supply,
W82-02037 6A

FATE OF POLLUTANTS
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

Environmental Fate of Methyl Eugenol,
W82-02013 5B

FEDERAL REPUBLIC OF GERMANY
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

FEEDLOT RUNOFF
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

FEEDLOT WASTES
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

FEEDLOTS
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

FERMENTATION
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Krusei,
W82-01750 5C

FERTILIZERS
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

FILMS
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

FILTERS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

FILTRATION
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

FINANCING
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

FINLAND
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

FISH
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

FISH BARRIERS
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

FISH FARMING
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

FISH FOOD
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

FISH MANAGEMENT
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

FISH PHYSIOLOGY
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

FISH PONDS
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

FISH POPULATIONS
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

FISHERIES
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

FISHKILL
Acid Precipitation,
W82-01607 5C

FJORDS
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

FLASH FLOODS
Learning from the Skipton Flood,
W82-02063 2E

FLOCCULATION
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

FLOOD CONTROL
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

The Chambal Project: Problems and Solutions,
W82-01739 4A

Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

The Day That the Rain Came Down,
W82-02064 2E

FLOOD DAMAGE
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

The Day That the Rain Came Down,
W82-02064 2E

FLOOD FORECASTING
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Learning from the Skipton Flood,
W82-02063 2E

FLOOD FREQUENCY
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

FLOOD PEAK
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Legal Challenge of the Ungaged Watershed,
W82-01664 2E

FLOOD PLAIN MANAGEMENT
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

FLOOD PROTECTION
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

FLORIDA
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

FLOTATION
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

FLOW
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

FLOW DURATION
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FLOW NETS
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

FLOW PATTERNS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

FLOW RATES
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FLUCTUATIONS
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

FLUVIAL SEDIMENTS
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

FOAM SEPARATION
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

FOOD CHAINS
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

FOOD-PROCESSING WASTES
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

FORECASTING
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Learning from the Skipton Flood,
W82-02063 2E

FOREST MANAGEMENT
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

FRANCE
Sustaining the Growth of Provence,
W82-01738 6D

FREQUENCY ANALYSIS
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FRUIT CROPS
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

FUNGI
Thermophilic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

FURROW IRRIGATION
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

GAS CHROMATOGRAPHY
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

GEOCHEMISTRY
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

GEOHYDROLOGIC UNITS
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

GEOHYDROLOGY
Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GEOLOGY
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GERMAN DEMOCRATIC REPUBLIC
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

GERMANIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

GERMANY
Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

GLACIAL AQUIFERS
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GLACIERS
Glacier Surveys in Alberta - 1979,
W82-01855 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

GLACIOHYDROLOGY
Glacier Surveys in Alberta - 1979,
W82-01855 2C

GLOBAL CLIMATE CHANGE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

GOOSE CREEK
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

GRAIN CROPS
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

GRAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

GRAPHICAL ANALYSIS
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

GREAT BRITAIN
Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

Recording Underground,
W82-02036 8A

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Learning from the Skipton Flood,
W82-02063 2E

The Day That the Rain Came Down,
W82-02064 2E

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

GREAT LAKES
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

GREAT LAKES TRIBUTARIES
Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

GREEN LAKE
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

GROUNDWATER
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Groundwater Levels in Nebraska 1980,
W82-01785 2F

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Applications of Aerial Photography,
W82-01988 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

GROUNDWATER AVAILABILITY
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GROUNDWATER BASINS
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

GROUNDWATER HYDROLOGY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

GROUNDWATER LEVEL
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

GROUNDWATER MANAGEMENT
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

GROUNDWATER MOVEMENT
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

GROUNDWATER POLLUTION
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Tying Up TCE,
W82-01866 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

Bromide in Canterbury Ground Water,
W82-02056 5B

Screened Auger Aids Investigation,
W82-02096 7B

GROUNDWATER POTENTIAL
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GROUNDWATER RUNOFF
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

GROUNDWATER STORAGE
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

GROUTING
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

GROWTH
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

GULF OF MEXICO
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

GULF OF MEXICO STATES
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

HABITATS
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

HAIL
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 2B

HALOPHYTES
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

HARBORS
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

HAY
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

HAZARDOUS MATERIALS
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

The Hazards of Hazardous Waste Management,
W82-01940 6E

HEAT TRANSFER
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

HEATED WATER
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Thermal Power Stations,
W82-01998 5C

HEAVY METALS
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

Pollution Solutions--The Wire Drawing Industry,
W82-02041 5D

HERBICIDES
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

HETEROGENEITY
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

HEXACHLOROCYCLOPENTADIENE
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

HONG KONG
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

HUDSON RIVER ESTUARY
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

HYDRAULIC CONDUCTIVITY
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

HYDRAULIC GEOMETRY
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

HYDRAULIC GRADIENT
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

HYDRAULIC MODELS
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

HYDRAULIC PROPERTIES
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

HYDROCARBONS
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

HYDROELECTRIC PLANTS
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia.
W82-01760 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

HYDROELECTRIC POWER
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

HYDROGEN ION CONCENTRATION
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

HYDROGEN SULFIDE
Reviving the Rio Reconquista,
W82-02014 5G

HYDROLOGIC BUDGET
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

HYDROLOGIC CYCLE
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

HYDROLOGIC DATA
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

HYDROLOGIC MAPS
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

HYDROLOGICAL REGIME
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

HYDROPHYTES
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

ICE
Summer Ice and Carbon Dioxide,
W82-01843 2C

ILLINOIS
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Water Quality and the Demand for Recreation,
W82-01942 6D

IMPAIRED WATER QUALITY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

INDIA
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

The Chambal Project: Probiems and Solutions,
W82-01739 4A

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

INDIANA
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

INDUSTRIAL PLANTS
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

INDUSTRIAL WASTES
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W87-01907 5D

Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

Bromide in Canterbury Ground Water,
W82-02056 5B

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Poland: Coming to Grips with Pollution,
W82-02092 5G

INDUSTRIAL WASTEWATER
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

INDUSTRIAL WATER
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

INFECTION
Infectious Waterborne Diseases,
W82-01784 5A

INFILTRATION
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

INFILTRATION RATE
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

INGURI DAM
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

INSECTICIDES
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

INSTREAM FLOW
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

INTAKES
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

INTERNATIONAL AGREEMENTS
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

Acid Rain Agreement,
W82-01933 5B

INTERNATIONAL COMMISSIONS
International Cooperation to Protect the Baltic,
W82-02087 6E

INTERNATIONAL WATERS
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

INVERTEBRATES
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

ION EXCHANGE
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

IONS
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

IOWA
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

IRRIGATION
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

Agricultural Conservation Program: An Evaluation,
W82-02019 3F

IRRIGATION DESIGN
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

IRRIGATION EFFECTS
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

IRRIGATION EFFICIENCY
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

Development of Solutions for Level-Basin Design,
W82-01976 3F

Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

IRRIGATION PRACTICES
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

IRRIGATION PROGRAMS
Integrated Agricultural Development in the Philippines,
W82-01725 6B

Exploiting the Waters of Lake Chad,
W82-01726 8A

Sustaining the Growth of Provence,
W82-01738 6D

The Chambal Project: Problems and Solutions,
W82-01739 4A

Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

IRRIGATION REQUIREMENTS
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Optimal Design of Border Irrigation Systems,
W82-01977 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

IRRIGATION WATER
Impressions of Soil and Water Conservation in China,
W82-01730 4D

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

IRTYSH-KARAGANDA CANAL
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

ISLE OF MAN
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

ISOTOPE STUDIES
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

ISRAEL
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

JAMES BAY
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

JAMES RIVER
Protecting Virginia's Waterways,
W82-01608 5G

Sediment-Contaminant Transport Model,
W82-01614 5B

JORDAN
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

JUDICIAL DECISIONS
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

KANEV RESERVOIR
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

KANSAS
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KARST HYDROLOGY
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

KENNEBEC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Kennebec River Basin, Maine.
W82-01755 6D

KEPONE
Protecting Virginia's Waterways,
W82-01608 5G

Sediment-Contaminant Transport Model,
W82-01614 5B

Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

KHARKOV
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

KIEV RESERVOIR
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

KIEV RESERVOIRS
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

KINETIC ENERGY
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 2B

KINETICS
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

KREMENCHUG RESERVOIR
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

KRIGING
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

LABORATORY EQUIPMENT
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

LADOGA LAKE
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

LAGOONS
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

LAKE BAIKAL
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

LAKE BEDS
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

LAKE CHAD
Exploiting the Waters of Lake Chad.
W82-01726 8A

LAKE ERIE
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

LAKE HURON
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

LAKE KNAACK
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

LAKE LUCERNE
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

LAKE MEMPHREMAGOG
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

LAKE MICHIGAN
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

LAKE MORPHOMETRY
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

LAKE NASSER
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

LAKE NEUSIEDLER
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

LAKE OGLETHROPE
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

LAKE ONTARIO
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

LAKE REREWHAKAAITU
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

LAKE RESTORATION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

LAKE SEDIMENTS
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

LAKE ST. CLAIR
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada, W82-01937 5C

LAKE SUPERIOR
Resonant Oscillation in Duluth-Superior Harbor, W82-01837 2H
Contourites in Lake Superior, W82-01935 2H

LAKE TAHOE
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity, W82-01807 6A

LAKE TAUPO
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake, W82-02023 2H

LAKE VICTORIA
Recent Changes in Level of Lake Victoria, W82-01711 4A

LAKES
Reconstruction of a Small Dam for a Recreational Lake, W82-01604 4D
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario, W82-01616 2H
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes, W82-01638 2H
Benthic Macroinvertebrates of Lake Taupo, W82-01702 2H
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton, W82-01706 2H
Recent Changes in Level of Lake Victoria, W82-01711 4A
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community, W82-01840 2H
The Mercury Cycle, W82-01869 5B
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method, W82-01921 2H
Contourites in Lake Superior, W82-01935 2H
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada, W82-01937 5C
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes, W82-02004 2H
Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay, W82-02005 5B
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed, W82-02070 2H
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal, W82-02078 2H
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga, W82-02100 2H

LAND DISPOSAL
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems, W82-01624 5D
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina, W82-01630 5E
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds, W82-01660 5E

LAND USE
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis, W82-01675 6A

LANDFILLS
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland, W82-02071 5B

LANGMUIR CELLS
Phytoplankton Accumulation in Langmuir Cells, W82-01946 2H

LARVICIDES
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments, W82-01798 5B

LEACHATES
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale, W82-01810 5B
Control of Bark Landfill Leachates with an Anaerobic Treatment System, W82-02006 5D

LEACHING
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns, W82-01721 2G
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils, W82-02034 2G

LEAKY AQUIFERS
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems, W82-02017 2F

LEECHES
The Use of Leeches to Identify Pesticides in Water, W82-02075 5A

LEGAL ASPECTS
Parish Is Not Liable for Subsidence, W82-01603 6E
The National Water Policy Review and Western Water Rights Law Reform: An Overview, W82-01659 6E
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System, W82-01804 6E
Preserving Instream Flows in Oregon's Rivers and Streams, W82-01871 6E
Perseverance Produces County Park, W82-01932 6D

LEGISLATION
Pollution Control: Changing Approaches, W82-01870 6E

LIGHT PENETRATION
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream, W82-01701 5C

LIME
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development, W82-01923 2H

LIMNOLOGY
Benthic Macroinvertebrates of Lake Taupo, W82-01702 2H
Limnology of Lake Rerewhakaaitu, W82-01705 2H
Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay, W82-02005 5B
Limnology and Performance of Waste Treatment Lagoons, W82-02026 5D

LINDANE
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals, W82-01993 5C

LITERATURE REVIEW
Health Aspects of Organic Substances in South African Waters - Opinions and Realities, W82-01712 5A
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review, W82-01768 6G

LIVESTOCK
Controlling Runoff for Livestock Feedlots; A State of the Art, W82-01769 5G

LOG PEARSON DISTRIBUTION
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams, W82-01731 2E

LOGGING
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest, W82-01703 4C

LONG-TERM PLANNING
Long-Run Effects of Environmental Regulation, W82-01848 6A

LOUISIANA
Parish Is Not Liable for Subsidence, W82-01603 6E

LOVE CANAL
Organic Compounds Found Near Dump Sites in Niagara Falls, New York, W82-01802 5B

LOW FLOW
Low-Flow Frequency and Flow Duration of Tennessee Streams, W82-01779 2E
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington, W82-01781 2E
Statistical Determination of Design Low Flows, W82-01858 2E

MACROINVERTEBRATES
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H
Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01946 4A

MACROPHYTES
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

MAIN SEWERS
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

MAPPING
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

MAPS
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B
Recording Underground,
W82-02036 8A

MARGINAL COSTS
Charging Policies for Water Services,
W82-01734 6C

MARINE SEDIMENTS
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

MARSHES
Upland Marsh for Water Quality Control,
W82-01962 5B

MASS TRANSFER
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MASS TRANSPORT
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MATACIL
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

MATHEMATICAL EQUATIONS
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

MATHEMATICAL MODELS
Random Differential Equations in Water Quality Modeling,
W82-01688 6A
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A
Mixing Zone Analysis for River Plumes,
W82-01961 5B
The Modeling of Aquatic Ecological Systems,
W82-01972 5B
Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

MATHEMATICAL STUDIES
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H
Kinetics for the Aquatic Environment,
W82-01631 2K
Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MEASURING INSTRUMENTS
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

MECHANICAL EQUIPMENT
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

MELT WATER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

MEMBRANE FILTERS
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D
Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

MENOMINEE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

MERCURY
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C
The Mercury Cycle,
W82-01869 5B

MEROMICTIC LAKES
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

MESOTROPHIC LAKES
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

METAL *ANALYTICAL TECHNIQUES
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

METAL-FINISHING WASTES
Managing Water at Helicopter Plant,
W82-01974 5D
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

METALS
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

METEOROLOGICAL DATA
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

METHANE
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

METHANE BACTERIA
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

METHEMOGLOBINEMIA
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

METHYL EUGENOL
Environmental Fate of Methyl Eugenol,
W82-02013 5B

METHYLATION
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

MEXICO
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

MIAMI
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

MICROBIAL DEGRADATION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MICROBIOLOGICAL STUDIES
Microbiology of the Aquatic Environment,
W82-01786 5C

MICROORGANISMS
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

MINE DRAINAGE
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

MINE WASTES
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

MINERAL INDUSTRY
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

MINERAL WATER REACTIONS
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MINERALS
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

MIREX
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

MISSISSIPPI
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

MISSISSIPPI RIVER
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

MISSOURI RIVER
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

MIXING
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

MODEL STUDIES
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Kinetics for the Aquatic Environment,
W82-01631 2K

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Pollution Permits and Markets for Water Quality,
W82-01699 6A

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

MONITORING
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Where Do We Go from Here.
W82-02086 7A

MONTANA
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

MONTE CARLO METHOD
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

MOROCCO
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

MOSCOW RIVER
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

MOST PROBABLE NUMBER TEST
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

MOUNT ST. HELENS
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

MULTIOBJECTIVE PLANNING
The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

MUNICIPAL WASTES
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

MUNICIPAL WATER
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

MURFREESBORO
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

MUSSELS
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

MUTAGENS
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

NANNOPLANKTON
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

NANTICOKE THERMAL GENERATING STATION
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

NATURAL RESOURCES
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

NATURAL STREAMS
Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

NATURAL WATERS
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

NEBRASKA
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Groundwater Levels in Nebraska 1980,
W82-01785 2F

NENT RIVER
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

NETHERLANDS
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

NEW JERSEY
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

NEW YORK
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

NEW ZEALAND
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

Logistics of Farm Water Supply.
W82-02037 6A

Bromide in Canterbury Ground Water,
W82-02056 5B

NICKEL
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

NIGERIA
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

NILE BASIN
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

NILE RIVER
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

NITRATE
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

NITRATE REMOVAL
Tackling the Nitrate Problem.
W82-01874 5F

NITRATES
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

Tackling the Nitrate Problem.
W82-01874 5F

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

NITRIFICATION
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

NITROGEN
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Excess Air in Groundwater,
W82-02099 2F

NITROGEN CYCLE
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

NITROGEN FIXING BACTERIA
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

NITROUS OXIDE
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

NORTH CAROLINA
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

NORTHERN IRELAND
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

NORTHWEST TERRITORIES
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

NORWAY
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

NUCLEAR ENERGY
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

NUMERICAL ANALYSIS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

NUTRIENT REMOVAL

Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

NUTRIENTS

Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

OBSERVATION WELLS

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

OCEAN CIRCULATION

Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

OCEAN DUMPING

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

ODORS

Reviving the Rio Reconquista,
W82-02014 5G

OIL POLLUTION

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

OIL SHALE

Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

OIL-WATER INTERFACES

The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

OKLAHOMA

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

OLIGOTROPHIC LAKES

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

OPOSSUM SHRIMP

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

OREGON

Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

ORGANIC ACIDS

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

ORGANIC CARBON

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

ORGANIC COMPOUNDS

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Organic Substances in Water,
W82-01783 5A

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

Tying Up TCE,
W82-01866 5G

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

ORGANIC MATTER

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

ORGANIC SOILS

Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

ORGANOPHOSPHORUS COMPOUNDS

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

ORGANOPHOSPHORUS PESTICIDES

Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

OROGRAPHIC PRECIPITATION

Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

OSCILLATORY WAVES

Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

OUTLETS

Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

OVERLAND FLOW

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

OXIDATION

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

OXYGEN

Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

OXYGEN DEPLETION

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

PACKED BEDS

A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

PARAGUAY

Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

PARASITE

Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5D

PARASITES
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

PARKS
Perseverance Produces County Park,
W82-01932 6D

Water Quality and the Demand for Recreation,
W82-01942 6D

PARTICLE SIZE
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

PARTICULATE MATTER
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

PATH OF POLLUTANTS
Sediment-Contaminant Transport Model,
W82-01614 5B

A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

The Mercury Cycle,
W82-01869 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

PAWTUXET RIVER
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

PEACHES
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

PENNSYLVANIA
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

PENOBSCOT RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

PERMAFROST
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

PERMEABILITY COEFFICIENT
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

PESTICIDE KINETICS
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

PESTICIDE RESIDUES
Protecting Virginia's Waterways,
W82-01608 5G

Metacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

PESTICIDES
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

Environmental Fate of Methyl Eugenol,
W82-02013 5B

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

PETROLEUM PRODUCTS
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

PHENOLS
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

PHILIPPINES
Integrated Agricultural Development in the Philippines,
W82-01725 6B

PHOSPHORUS
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

PHOSPHORUS COMPOUNDS
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

PHOSPHORUS REMOVAL
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

PHOTOMETRY
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

PHOTOSYNTHESIS
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

PHYSICAL PROPERTIES
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

PHYTOPLANKTON
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

PIPE FAILURE
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

PLANE FLOW
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

PLANKTON
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

PLANNING
Reviving the Rio Reconquista,
W82-02014 3G

PLANT NUTRIENT UPTAKE
Upland Marsh for Water Quality Control,
W82-01962 5B

PLANT POPULATIONS
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

PLASTICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

PLAYAS
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

PLUG FLOW
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

POLAND
Poland: Coming to Grips with Pollution,
W82-02092 5G

POLICY MAKING
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

POLITICAL ASPECTS
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

POLITICAL CONSTRAINTS
Acid Rain Agreement,
W82-01933 5B

POLLUTANT IDENTIFICATION
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

Infectious Waterborne Diseases,
W82-01784 5A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

POLLUTANTS
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

POLLUTION ABATEMENT
Pollution Permits and Markets for Water Quality,
W82-01699 6A

POLLUTION LOAD
Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

POLLUTION TAXES
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

POLYCHLORINATED BIPHENYLS
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

PONDS
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

POPULATION DENSITY
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

POPULATION DYNAMICS
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

PORT VALDEZ
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

POTABLE WATER
A Survey of Trihalomethanes in the Drinking Water System of Murfreesboro, Tennessee,
W82-01817 5B

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

POTENTIOMETRIC HEAD
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

POTOMAC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

POWERPLANTS
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

PRECIPITAION
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

PRECIPITATION
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

Simplified Method for Rainfall Intensities,
W82-01978 2B

PRECIPITATION INTENSITY
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

PREDICTION
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

PRICING
Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

PRIORITIES
The Sewerage Policy of Thames Water,
W82-02040 6E

PRIORITY POLLUTANTS
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

PROBABILISTIC PROCESS
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

PRODUCTIVITY
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

PROJECT PLANNING
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

PROTOZOA
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

PUBLIC HEALTH
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Wanted: Water for Development,
W82-02088 6D

PUBLIC POLICY
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

PUBLICATIONS
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

PULP AND PAPER INDUSTRY
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

PUMPING TESTS
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

RADAR
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

RADIOACTIVE TRACERS
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

RADIOACTIVITY
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

RADIOISOTOPES
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

RAIN GAGES
Note on Random Raindrops and Sampling Error,
W82-02032 2B

RAINBOW TROUT (SALMO GAIRDNERI)
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

RAINFALL
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

Note on Random Raindrops and Sampling Error,
W82-02032 2B

RAINFALL IMPACT
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

RAINFALL INTENSITY
Simplified Method for Rainfall Intensities,
W82-01978 2B

RAINFALL-RUNOFF RELATIONSHIPS
Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

RAINWATER
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

RAPESEED
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

RAVENGLASS ESTUARY
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

RECHARGE
Excess Air in Groundwater,
W82-02099 2F

RECLAIMED WATER
Managing Water at Helicopter Plant,
W82-01974 5D

RECREATION DEMAND
Water Quality and the Demand for Recreation,
W82-01942 6D

RECREATION FACILITIES
Reconstruction of a Small Dam for a Recreational Lake,
W82-01604 4D

RECYCLING
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

RED RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

RED TIDE
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

REGULATED FLOW
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

REGULATIONS
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

Pollution Control: Changing Approaches,
W82-01870 6E

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

REMOTE SENSING
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Remote Sensing in Development,
W82-01719 7B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

Applications of Aerial Photography,
W82-01988 7B

RESEARCH FACILITIES
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

RESERVOIR
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

RESERVOIR CONSTRUCTION
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

RESERVOIR DESIGN
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

RESERVOIR FILLING
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

RESERVOIR OPERATION
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

RESERVOIR RELEASES
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

RESERVOIR SILTING
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

RESERVOIR STAGES
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

RESERVOIRS
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 8A

Water Resources Appraisal for Hydroelectric Licensing: Kennebec River Basin, Maine.
W82-01755 6D

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

RESIDENCE TIME
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

RESONANCE
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

RESOURCES DEVELOPMENT
Integrated Agricultural Development in the Philippines,
W82-01725 6B

RESOURCES MANAGEMENT
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

RESPIRATION
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

RETENTION TIME
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

RHINE RIVER
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

RHIZOSPHERE
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

RHODESIA
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

RIVER BASIN DEVELOPMENT
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

RIVER BASINS
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

RIVERS
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

ROCKFILL DAMS
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

ROCKS
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

ROOT DEVELOPMENT
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

ROOT ZONE
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

ROTIFERS
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

RUNOFF
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

RUNOFF FORECASTING
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

RUSSIA
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

SAFE YIELD
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

SAFFLOWER
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SAGINAW BAY
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

SAGINAW RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

SAGUENAY FJORD
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

SALINE SOILS
Transport of Salts in Catchments and Soils,
W82-01880 2G

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SALINE WATER
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SALINE WATER INTRUSION
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

SALINITY
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

SALINITY CURRENTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

SALMON
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

SALMONELLA
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

SALT LOADING
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

SALT MARSHES
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

SALT VALLEY
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

SALTS
Transport of Salts in Catchments and Soils,
W82-01880 2G

SAMPLE PRESERVATION
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

SAMPLING
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

Note on Random Raindrops and Sampling Error,
W82-02032 2B

SAND MOUNDS
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

SANITATION
Wanted: Water for Development,
W82-02088 6D

SANTEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

SAPROBITY
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

SASKATCHEWAN GLACIER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

SATELLITE TECHNOLOGY
Remote Sensing in Development,
W82-01719 7B

Spatial Simulation of Snow Processes,
W82-01887 2C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

SATURATION ZONE
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

SCOUR
Evaluating Scour at Culvert Outlets,
W82-01934 4D

SEA LEVEL
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

SEASONAL VARIATION
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

SEAWATER
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

SECONDARY WASTEWATER TREATMENT
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

SEDIMENT DEPOSITION
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

SEDIMENT DISCHARGE
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

SEDIMENT LOAD
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

SEDIMENT TRANSPORT
Sediment-Contaminant Transport Model,
W82-01614 5B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

SEDIMENT YIELD
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

SEDIMENTATION RATES
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

SEDIMENTS
Sediment Bacterial Indicators in an Urban Shellfishing Subestuary of the Lower Chesapeake Bay,
W82-01661 5A

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

SEDIPAC CLARIFIER
Pollution Solutions--The Wire Drawing Industry,
W82-02041 5D

SEEPAGE
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

SEISMICITY
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

SELENIUM
Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

SELF-PURIFICATION
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

SEMIARID LANDS
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

SENEGAL RIVER
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

SEPARATION TECHNIQUES
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

SESTON
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

SEVERN ESTUARY
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

SEVERN RIVER
Severn Barrage Scheme Gets Favourable Response,
W82-02089 6B

SEWERAGE
The Sewerage Policy of Thames Water,
W82-02040 6E

SEWERS
Recording Underground,
W82-02036 8A

SHARPTOWN
The Hazards of Hazardous Waste Management,
W82-01940 6E

SHELLFISH
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

SHRIMP
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

SILENIUM
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

SILTING
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

SIMULATION ANALYSIS
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

SINKS
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

SITE SELECTION
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

SITES
Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

SLOPE STABILITY
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

SLUDGE DISPOSAL
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Centrifugal Dewatering,
W82-01912 5E

SLUDGE DRYING
Centrifugal Dewatering,
W82-01912 5E

SLUDGE LAGOONS
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

SNOW ACCUMULATION
Spatial Simulation of Snow Processes,
W82-01887 2C

SNOW COVER
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

SNOWMELT
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Spatial Simulation of Snow Processes,
W82-01887 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

SOCIAL ASPECTS
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

SODIUM POLYSULFIDE
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

SOIL ABSORPTION CAPACITY
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

SOIL COLUMNS
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

SOIL CONSERVATION
Impressions of Soil and Water Conservation in China,
W82-01730 4D

Agricultural Conservation Program: An Evaluation,
W82-02019 3F

SOIL EROSION
Impressions of Soil and Water Conservation in China,
W82-01730 4D

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

SOIL GASES
Excess Air in Groundwater,
W82-02099 2F

SOIL MOISTURE
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

SOIL PROPERTIES
Transport of Salts in Catchments and Soils,
W82-01880 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

SOIL RECLAMATION
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SOIL WATER
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

SOIL-WATER-PLANT RELATIONSHIPS
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

SOLUTE TRANSPORT
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

SORGHUM
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

SORPTION
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

SOUTH AFRICA
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

SOUTH DAKOTA
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

SOUTHAMPTON
Slowhill Copse Sewage Treatment Works.
W82-01727 5D

SOYBEANS
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SPATIAL DISTRIBUTION
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

SPECIES COMPOSITION
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

SPECIES DIVERSITY
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

SPECIFIC CONDUCTIVITY
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

SPOIL DISPOSAL
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

SPRINGS
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

SPRINKLE IRRIGATION
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

ST. LAWRENCE ESTUARY
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

STABILITY ANALYSIS
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

STABILIZATION PONDS
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

STAGE-DISCHARGE RELATIONS
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

STANDING CROPS
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

STATISTICAL MECHANICS
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

STATISTICAL METHODS
Statistical Determination of Design Low Flows,
W82-01858 2E

STATISTICS
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

STOCHASTIC PROCESS
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

STOMATAL TRANSPIRATION
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

STORM-OVERFLOW SEWERS
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

STORM RUNOFF
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

STORM WATER
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

STREAM BIOTA
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

STREAM DISCHARGE
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

STREAMFLOW
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

STREAMFLOW FORECASTING
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

STREAMS
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

STREPTOCOCCUS BOVIS
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

SUBARCTIC ZONE
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

SUBSIDENCE
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

SUBSTRATES
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

SULFUR
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

SULFUR CYCLE
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

SUMAS RIVER BASIN
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

SURFACE-GROUNDWATER RELATIONS
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

SURFACE TENSION
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

SURFACE WATER
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

SURFACE WATERS
Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

SURFACTANTS
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

SURGES
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

SURVEYS
Case Studies of Agricultural Water Conservation,
W82-01667 3F

SUSPENDED SEDIMENT
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 6C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

SUSPENDED SEDIMENTS
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

SWAMPS
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

SWARTVLEI LAKE
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

SWEDEN
The Mercury Cycle,
W82-01869 5B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

SWIMMING POOLS
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

SWITZERLAND
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

SYMBIOSIS
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SYSTEMS ANALYSIS
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

TAIWAN
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

TANNERY WASTES
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

TANNINS
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

TAXONOMY
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

TECHNICAL SOCIETIES
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

TECTONICS
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

TEES RIVER
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

TEMPERATURE EFFECTS
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

Mixing Zone Analysis for River Plumes,
W82-01961 5B

TENNESSEE
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

TENNESSEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

TERRACING
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

TEST WELLS
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

TEXTILE MILL WASTES
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

THAMES WATER AUTHORITY
The Sewerage Policy of Thames Water,
W82-02040 6E

THEORETICAL ANALYSIS
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

THERMAL POLLUTION
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

Mixing Zone Analysis for River Plumes,
W82-01961 5B

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Thermal Power Stations,
W82-01998 5C

THERMAL POWERPLANTS
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

THERMAL PROPERTIES
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

THERMAL STRATIFICATION PREVENTION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

THERMAL WATER
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

THERMOCLINE
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

THUNDERSTORMS
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

TIBER RIVER
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

TIDAL EFFECTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

TIDAL POWERPLANTS
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

TIDAL RIVERS
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

TIDES
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

TILLATOBA CREEK BASIN
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

TIME OF TRAVEL
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

TIME SERIES ANALYSIS
Upland Marsh for Water Quality Control,
W82-01962 5B

TITANIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

TOLO HARBOUR
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

TOMATOES
Environmental Fate of Methyl Eugenol,
W82-02013 5B

TOMBIGBEE-WARRIOR RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

TOPOGRAPHY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

TORONTO
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

TOXICITY
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5D

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

TRACE METALS
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

TRACERS
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

TREES
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

TRICHLOROETHYLENE
Tying Up TCE,
W82-01866 5G

TRICKLE IRRIGATION
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

TRICKLING FILTERS
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

TRIHALOMETHANES
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

TRITIUM
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

TROPHIC LEVEL
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

TROUT
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

TUCSON
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

TURBULENT FLOW
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

UKRAINE
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

ULTRAFILTRATION
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

UNITED KINGDOM
Charging Policies for Water Services,
W82-01734 6C

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Centrifugal Dewatering,
W82-01912 5E

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

UNSATURATED FLOW
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

USER CHARGES
Charging Policies for Water Services,
W82-01734 6C

USSR
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

UTAH
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

VANADIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

VARIABILITY
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

VARIATION COEFFICIENTS
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

VELOCITY
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

VIBRIO
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

VIBRIO PARAHAEMOLYTICUS
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

VICTORIA
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

VILYUY RESERVOIR
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

VIRUSES
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

VOLCANOES
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

VOLGA DELTA
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

WABIGOON RIVER BASIN
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

WALES
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

WARNING SYSTEMS
The Day That the Rain Came Down,
W82-02064 2E

WASHINGTON
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

WASTE DISPOSAL
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

WASTE DUMPS
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

WASTE MANAGEMENT
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

The Hazards of Hazardous Waste Management,
W82-01940 6E

WASTE RECOVERY
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

WASTE STORAGE
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

WASTE TREATMENT
Pollution from Farms,
W82-02039 5D

WASTES
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

WASTEWATER
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

WASTEWATER ANALYSIS
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

WASTEWATER DISPOSAL
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

WASTEWATER FACILITIES
Slowhill Copse Sewage Treatment Works,
W82-01727 5D

Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

WASTEWATER LAGOONS
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

WASTEWATER POLLUTION
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

WASTEWATER RENOVATION
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

WASTEWATER TREATMENT
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

Slowhill Copse Sewage Treatment Works,
W82-01727 5D

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

The Flowering of Wastewater Treatment,
W82-02015 5D

Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

WATER ALLOCATION
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

WATER ANALYSIS
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

WATER BALANCE
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

WATER CIRCULATION
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

WATER CONSERVATION
Case Studies of Agricultural Water Conservation,
W82-01667 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

WATER CONVEYANCE
Logistics of Farm Water Supply.
W82-02037 6A

WATER COOLING
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

WATER COSTS
Managing Water at Helicopter Plant,
W82-01974 5D

WATER CURRENTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

WATER DEFICIT
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

WATER DEMAND
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

WATER HAMMER
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

WATER HYACINTH
The Flowering of Wastewater Treatment,
W82-02015 5D

WATER LEVEL
Recent Changes in Level of Lake Victoria,
W82-01711 4A

Groundwater Levels in Nebraska 1980,
W82-01785 2F

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

WATER LEVEL FLUCTUATIONS
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

Groundwater Levels in Nebraska 1980,
W82-01785 2F

WATER MAINS
Recording Underground,
W82-02036 8A

WATER MANAGEMENT
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

The California State Water Project--Current Activities and Future Management Plans,
W82-01851 6E

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

WATER MANAGMENT
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

WATER METERING
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

WATER POLICY
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Charging Policies for Water Services,
W82-01734 6C

The Sewerage Policy of Thames Water,
W82-02040 6E

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

WATER POLLUTION
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

The Mercury Cycle,
W82-01869 5B

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

WATER POLLUTION CONTROL
Pollution Permits and Markets for Water Quality,
W82-01699 6A

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

Pollution Control: Changing Approaches,
W82-01870 6E

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

Reviving the Rio Reconquista,
W82-02014 5G

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Poland: Coming to Grips with Pollution,
W82-02092 5G

WATER POLLUTION EFFECTS

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Acid Precipitation,
W82-01607 5C

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02055 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

WATER POLLUTION PREVENTION

Protecting Virginia's Waterways,
W82-01608 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

WATER POLLUTION SOURCES

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

The Hazards of Hazardous Waste Management,
W82-01940 6E

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

Poland: Coming to Grips with Pollution,
W82-02092 5G

WATER PRESSURE

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

WATER QUALITY

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

Pollution Permits and Markets for Water Quality,
W82-01699 6A

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

Organic Substances in Water,
W82-01783 5A

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 2K

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

Water Quality and the Demand for Recreation,
W82-01942 6D

Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

WATER QUALITY CONTROL

Protecting Virginia's Waterways,
W82-01608 5G

Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

Upland Marsh for Water Quality Control,
W82-01962 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

WATER QUALITY INDICES

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

WATER QUALITY MANAGEMENT
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

WATER QUALITY STANDARDS
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

WATER RATES
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

WATER REQUIREMENTS
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

WATER RESOURCES
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 2K

WATER RESOURCES DEVELOPMENT
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

Remote Sensing in Development,
W82-01719 7B

Impressions of Soil and Water Conservation in China,
W82-01730 4D

Sustaining the Growth of Provence.
W82-01738 6D

Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisal for Hydroelectric Licensing: Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing: Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing: Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisals for Hydroelectric Licensing: Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing: Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing: Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing: Grand River Basin, Michigan,
W82-01759 6D

Water Resources Appraisal for Hydroelectric Licensing: Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing: Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

WATER RESOURCES MANAGEMENT
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

WATER REUSE
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WATER RIGHTS
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

WATER SAMPLING
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

WATER SOURCES
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

WATER STORAGE
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

WATER STRESS
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

WATER SUPPLY
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 2K

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

WATER SUPPLY DEVELOPMENT
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

Impressions of Soil and Water Conservation in China,
W82-01730 4D

Sustaining the Growth of Provence.
W82-01738 6D

Wanted: Water for Development,
W82-02088 6D

WATER TABLE
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

WATER TANKS
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

WATER TREATMENT
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D
Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F
Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 8A
A Survey of Trihalomethanes in the Drinking Water System of Murfreesboro, Tennessee,
W82-01817 5B
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F
Tying Up TCE,
W82-01866 5G
Tackling the Nitrate Problem.
W82-01874 5F

WATER USE
Water Resources Appraisals for Hydroelectric Licensing: Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D
Water Resources Appraisal for Hydroelectric Licensing: Kennebec River Basin, Maine.
W82-01755 6D
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

WATER USERS
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

WATER VAPOR
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

WATERSHED MANAGEMENT
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

WATERSHED MODELS
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

WATERSHEDS
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B
Transport of Salts in Catchments and Soils,
W82-01880 2G

WAVE ACTION
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

WEATHER PATTERNS
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

WELL DATA
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

WELLS
Groundwater Levels in Nebraska 1980,
W82-01785 2F

WESER RIVER
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

WETLANDS
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

WHEAT
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

WHISKEY DISTILLERY WASTEWATER
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

WILD RIVERS
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

WILDLIFE
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

WIND-DRIVEN CURRENTS
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

WIRE INDUSTRY
Pollution Solutions--The Wire Drawing Industry.
W82-02041 5D

WOOD
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

WOOD WASTES
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

WYOMING
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

YELLOW RIVER BASIN
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ZETA POTENTIAL
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

ZINC
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ZOOPLANKTON
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

AUTHOR INDEX

ABEL, P. D.
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

ABRAHAM, M.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

ABT, S. R.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

AHMED, Q. S.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

AHUJA, L. R.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

AIKEN, J. D.
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

ALEXANDER, W. J.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

ALHONEN-HONGISTO, L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

ALLANSON, B. R.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

ALLEN, C. P.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

ALLEN, G. H.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

ALLEN, K. O.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

ALLEN, L. H. JR.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

ALLEN, M. P.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

ALLEN, N. L.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

ALMBERG, L.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

ALSEN, C.
Detection of Organophosplate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

ALTHER, G. R.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

AMOROS, C.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

ANDERSON, D.
Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

AOYAMA, M.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

APONASENKO, A. D.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

APPLETON, A. R. JR.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

ARAKEL, A. V.
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

ARENS, H-J.
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

ARMITAGE, P. D.
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ARNOLD, M. D.
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

ARSLANOVA, T. P.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

ARTHER, R. G.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

ASPILA, K. I.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

ASTON, S. R.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

AUSTIN, B.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

AVADHANULU, R. V.
An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

BABENKO, I. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

BAETJER, K.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

BAGNYUK, L. I.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

BAIN, G. L.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

BAKER, J. P.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

BALARAJU, M.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

BALE, J. B.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

BANDY, J. T.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

BANNINK, B. A.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

BARBEAU, C.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

BARDSLEY, W. E.
Note on Random Raindrops and Sampling Error,
W82-02032 2B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

BARKER, T. W.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

BARON, D. M.
Screened Auger Aids Investigation,
W82-02096 7B

BARROW, G. I.
Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

BATHURST, E. T. J.
Bromide in Canterbury Ground Water,
W82-02056 5B

BATTAN, L. J.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

BATTERMAN, A. R.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 9C

BEAR, J.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

BEAUCHAMP, J. J.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

BEAVIS, B.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

BEDNAR, G. A.
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

BEECH, J. A.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

BELORABA, E. G.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

BENGTSON, R. L.
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

BENGTSSON, L.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

BENNDORF, J.
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

BENOIT, F. M.
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

BERKES, F.
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

BEUKES, D. J.
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

BHAN, S.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

BHATTACHARYA, S.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

BIGGS, R. B.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

BISCHOF, E. B.
Morocco's Largest Multipurpose Scheme,
W82-01734 8A

BISHOP, A. A.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

BISOGNI, J. J. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

BJERVE, L.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

BLENK, J. B.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

BLOCK, J. C.
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

BLOKHINA, N. P.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

BLOMQUIST, G.
Water Quality and the Demand for Recreation,
W82-01942 6D

BLOTNICK, J. R.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

BLUMM, M. C.
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

BOLES, K. E.
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

BONACCI, O.
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

BONELLI, J. E.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

BORDOVSKY, J. P.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

BORGMANN, U.
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

BORMAN, R. G.
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

BORROWS, P.
Reviving the Rio Reconquista,
W82-02014 5G

BOTHA, B. J. V.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

BOUGIE, R.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

BOURBONNIERE, R. A.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

BOWERS, J. A.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

BOYLE, T. P.
Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

BRADDOCK, R. D.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

BRADEN, J. B.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

BRADFORD, W. L.
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

BRALTS, V. F.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

BRANICA, M.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

BRAS, R. L.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

BRESLER, E.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

BRIGGS, R.
Where Do We Go from Here.
W82-02086 7A

BRIZ-KISHORE, B. H.
An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

BROCK, T. D.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

BROMLEY, D. W.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

BROSSET, C.
The Mercury Cycle,
W82-01869 5B

BROWER, W. W. II.
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

BROWN, H. S.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

BROWN, J. A. H.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

BRYSON, A. W.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

BUCHAN, R. M.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

BUDAGOVSKII, A. I.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

BUDWEG, F. M. G.
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

BULL, D. L.
Environmental Fate of Methyl Eugenol,
W82-02013 5B

BURESH, R. J.
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

BURGER, J. S.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

BURNHAM, L. N.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

BURNS, C. W.
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

BUTTON, D. K.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

CANALE, R. P.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

CARLSON, T. W.
Contourites in Lake Superior,
W82-01935 2H

CASTEIGNAU, G.
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

CASTLE, R. O.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

CETINKAYA, M.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

CHAKRABARTI, C.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

CHALMERS, D. J.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

CHAM, V.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

CHANUT, J. P.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

CHAPMAN, M. A.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

CHAPRA, S. C.
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

CHARBONNEAU, J. O. G.
Glacier Surveys in Alberta - 1979,
W82-01855 2C

CHATTOPADHYAY, G. N.
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

CHEN, R. L.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

CHEN, Y. H.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

CHERKAUER, D. S.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

CHERNITSKAYA, L. N.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

CHEUNG, L. S.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

CHHONKAR, P. K.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

CHIU, A. A.
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

CHONG, S. K.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

CHRISTENSEN, E. R.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

CHRISTMAS, A. D.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

CHRISTY, M. S.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

CHU, S. Y.
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

CHYNOWETH, D. P.
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

CLAIBORNE, M.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

CLARK, B. D.
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

CLARK, M. M.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

CLARK, R. N.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

CLARKE, W. B.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

CLEMMENS, A. J.
Development of Solutions for Level-Basin Design,
W82-01976 3F

CLYMA, W.
Optimal Design of Border Irrigation Systems,
W82-01977 3F

COBLE, L. W. JR.
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

CODNER, G. P.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

COLEMAN, G. A.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

COLWELL, R. R.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

CONLEY, C. D.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

COOK, P. M.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

CORAPCIOGLU, M. Y.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

CORCORAN, E. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

CORDOVA, J. R.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

COTE, J-E.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

COULTER, J. B.
The Hazards of Hazardous Waste Management,
W82-01940 6E

COX, R. G.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

CRABTREE, R. J.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

CRAIG, K. S.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

CRAUN, G. F.
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

CRIPE, C. R.
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

CRISP, R.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

CROLEY, T. E.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

CRONIN, L. E.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

CROWLEY, P.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

CUMMANS, J. E.
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

CURRY, R. W.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

CURTIS, C. R.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

DABROWSKI, H.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

DAKERS, J. L.
The Sewerage Policy of Thames Water,
W82-02040 6E

DALY, C. J.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

DARDIS, K. A.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

DAVANZO, A. C.
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

DAY, J. C.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

DE VOS, C. P.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estua/y,
W82-01991 5G

DEDRICK, A. R.
Development of Solutions for Level-Basin Design,
W82-01976 3F

DELLEUR, J. W.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

DELPHIA, L. M.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

DEMERY, P. M.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

DEMONTMOLLIN, F. A.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

DENDY, B. B.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

DENISOVA, A. I.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

DI PIETRO, N. D.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

DIAZ, R.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

DIBBLE, W. E. JR.
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

DICK, A. C.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

DIDERIKSEN, R. I.
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

DIERBERG, F. E.
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

DINEHART, R. L.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

DINIA, N.
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

DISHER, J. W.
Power Spectral Analysis of a Forcemain Failure Caused by Watrrhammer,
W82-01826 7B

DITWILER, C. D.
Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

DOBSON, H. F. H.
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

DOGADINA, T. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

DORAS, N.
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 2B

DOUGLASS, A. R.
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

DOWNES, M. T.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

DOWNS, C. E.
The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

DRABBE, J. A.
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

DRAKE, R. A. R.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

DRAKE, S. R.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

DRESSCHER, TH. G. N.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

DRISCOLL, C. T. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

DUBKO, N. V.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

DUESZELN, J.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

DUKE, W.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

DUNCAN, J. M.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

DZHAMALOV, R. G.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

DZHOGAN, L. YA.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

EAGLE, G. A.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

ECCLES, P. G.
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

EL-SABH, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

ELDER, V. A.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

ELLIS, J. B.
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

ELWOOD, J. W.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

EMMETT, R. C.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

ENGLUND, J-O.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

ENGMAN, E. T.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

ERASMUS, D. A.
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

ERKENBRECHER, C. W. JR.
Sediment Bacterial Indicators in an Urban Shellfishing Subestuary of the Lower Chesapeake Bay,
W82-01661 5A

ESCALONA, R. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

ESTEP, M. F.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

EVANS, G. T.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

EVANS, J. C. W.
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

EVANS, J. E.
Contourites in Lake Superior,
W82-01935 2H

FACI, J. M.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

FAHRENTHOLD, P. D.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

FALKOWSKI, P. G.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

FAPOHUNDA, H. O.
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

FERERES, E.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

FERRARA, R. A.
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

FIFIELD, J. S.
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

FILATOV, N. N.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

FINDLAY, D. M.
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

FINLAYSON, B. J.
Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

FINNEY, B. A.
Random Differential Equations in Water Quality Modeling,
W82-01688 6A

FISHELSON, G.
Water Quality and the Demand for Recreation,
W82-01942 6D

FITZGERALD, P. R.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

FLECKSEDER, H.
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

FLEROV, B. A.
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

FLINT, E. A.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

FLOOD, R. D.
Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

FLORESTANO, P. S.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

FODA, M.
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

FODOR-CSANYI, P.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

FORSYTH, D. J.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

FOSTER, G. R.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

FOSTER, I. D. L.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

FOSTER, K. E.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

FOX, J. C.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

FRANCKO, D. A.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

FRANK, N. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

FRANKLIN, A. G.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

FRANZIN, W. G.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

FRASER, A. S.
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

FREEMAN, D. H.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

FREEMAN, L.
The Day That the Rain Came Down,
W82-02064 2E

FRENCH, C. O.
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

FREVERT, T.
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

FRITTON, D. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

FROEHLICH, D. C.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

FURUTANI, A.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

GAGE, J.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

GALAGAN, N. P.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

GASS, T.
Applications of Aerial Photography,
W82-01988 7B

GAVIN, J.
Summer Ice and Carbon Dioxide,
W82-01843 2C

GAVRISHOVA, N. A.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

GERHART, J. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

GERHOLD, R.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Dispersal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

GHILDYAL, B. P.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

GIANQUINTA, A. R.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

GIAQUINTA, A. R.
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

GILBERTSON, C. B.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

GILLILAND, M. W.
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

GITLIN, H. M.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

GLOVER, E. W. JR.
Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

GOGGINS, C.
Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

GOLD, R. L.
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

GOLDSCHMIDT, E. E.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

GONZALES-VILLARREAL, F. J.
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

GONZALEZ, V. J. B.
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

GOODE, S. R.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

GOPPERS, V. M.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

GOROBETS, L. V.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

GOTTLIEB, L.
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

GOULD, M. S.
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

GRABOW, W. O. K.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

GRANTZ, A.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

GRAY, N. F.
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

GREEN, A.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

GREEN, M.
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

GREEN, R. E.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

GREENBERG, M. R.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

GREESON, P. E.
Infectious Waterborne Diseases,
W82-01784 5A

GRIEVE, I. C.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

GRIFFIN, A. H.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

GRISAK, G. E.
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

GROTERUD, O.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

GRUSHKO, YA. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

GUNNER, H. B.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

GUPTA, S. C.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

HADALA, P. F.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

HAGERHALL, B.
International Cooperation to Protect the Baltic,
W82-02087 6E

HAGLUND, P.
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

HAINES, T. A.
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

HALL, D. K.
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

HAMBLIN, A. P.
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

HAMMOND, D. E.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

HANKS, R. J.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

HANSEN, P.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

HARDY, J. W.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

HARGREAVES, G. H.
Simplified Method for Rainfall Intensities,
W82-01978 2B
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

HARLEMAN, D. R. F.
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

HARRINGTON, W.
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

HARRISON, P.
Wanted: Water for Development,
W82-02088 6D

HASSAN, A. A.
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

HAYDEN, T.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

HEANEY, J. P.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E
Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

HEATH, M.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

HEATH, R. T.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

HEATON, T. H. E.
Excess Air in Groundwater,
W82-02099 2F

HECKER, G. M.
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

HEDGEPETH, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

HENDERSON-SELLERS, B.
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

HENNART, J. P.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

HENNESSY, R. R.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

HENNIG, H. F-K. O.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

HENRY, J. R.
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

HERBAUTS, J.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

HERGENRADER, G. L.
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C
Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

HERRERA, I.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

HERRINGTON, P. R.
Charging Policies for Water Services,
W82-01734 6C

HILEMAN, B.
Acid Precipitation,
W82-01607 5C

HILNER, C. A.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

HINDE, R. C.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

HINKINS, S. M.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

HINRICHSEN, D.
Poland: Coming to Grips with Pollution,
W82-02092 5G

HITES, R. A.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

HO, J.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

HO, KC.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

HOBO, T.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

HODGKISS, I. J.
Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

HOLBECHE, J. D.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

HOLMES, N. T. H.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

HOLT, R. F.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

HORVATH, G. L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

HOUSE, M.
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

HOWARD, P. M.
Impressions of Soil and Water Conservation in China,
W82-01730 4D

HOWARD-WILLIAMS, C.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

HOY, N. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

HRUBOVACK, J. M.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

HUBER, W. C.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

HUCKINS, J. N.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

HUMPHRIES, C.
Recording Underground,
W82-02036 8A

HUNKINS, K.
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

HUSSONG, D.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

HUTCHINSON, C. B.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

IL'CHENKO, N. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

INKINA, G. A.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

INOUE, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

ISAACSON, P. A.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

ISAKOVA, YE. F.
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

IVAKHNENKO, A. G.
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

JACKSON, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

JACOBSON, J. S.
Acid Rain and Environmental Policy,
W82-01987 5B

JAMES, W.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

JAMIESON, A.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

JANA, P. K.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

JANISZEWSKI, M.
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

JENKINS, J. J.
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

JENNINGS, M.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

JESSEN, S.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

JOB, S. V.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

JOBLING, M.
Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

JOHNSON, B. T.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

JOHNSON, D. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

JOHNSON, D. W.
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

JOHNSON, M. S.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

JOHNSON, T. C.
Contourites in Lake Superior,
W82-01935 2H

JOHNSTON, S. A. JR.
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

JOLLY, V. H.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

JONES, J. G.
The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

JONES, J. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

JORDAN, T. F.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

JORET, J. C.
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

JOSEPHSON, J.
Protecting Virginia's Waterways,
W82-01608 5G

JUO, A. S. R.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

JURY, W. A.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

KAERGAARD, H.
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

KALFF, J.
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

KALMAR, D.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

KANNAN, V.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

KAO, J-F.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

KASIDA, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

KASSO, W. B.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

KAVVAS, M. L.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

KEENE, K. M.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KELLER, V. W.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

KELLER, W.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

KELLY, C. A.
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

KHARITONOVA, N. N.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

KIBLER, D. F.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

KING, J. W.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

KINNERSLEY, D.
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

KINNEY, W. C.
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

KIRCHER, J. E.
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

KITE, G. W.
Recent Changes in Level of Lake Victoria,
W82-01711 4A

KITITSYNA, L. A.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

KLAPPER, H.
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

KLEINSTREUER, C.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

KLEPPER, R. P.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

KNAEBEL, K. S.
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

KNIGHT, J. H.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

KNOTT, J. M.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

KOEHLER, J. H.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

KONDO, K.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

KOVAL'CHUK, A. A.
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

KOZHOVA, O. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

KRASOVSKY, G. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

KRISHNAMOORTHI, K. P.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

KRUPNICK, A. J.
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

KRUSE, H.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

KRYLOVA, E. V.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

KUDRYAVTSEV, V. M.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

KUKLA, G.
Summer Ice and Carbon Dioxide,
W82-01843 2C

KUMAR, A.
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

KUUSISTO, E.
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

KUZNETSOVA, M. A.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

KWOK, TT.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02056 5B

LABUTINA, T. M.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

LAFLEN, J. M.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

LAHAV, E.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

LAHL, U.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

LAIRD, C. E.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

LAM, C. W. Y.
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

LANE, A. G.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

LANE, L. J.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

LAPKINA, L. N.
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

LARSON, W. E.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

LASKOWSKI-HOKE, R. A.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

LAW, R. J.
Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

LAYLA, R. I.
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

LEACH, J. H.
Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

LEADBETTER, M. R.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

LEBEL, G. L.
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

LECKIE, J. O.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

LEE, G. F.
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

LEENTVAAR, J.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

LEGRAND, H. E.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

LEMLIN, J. S.
The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

LEMON, D.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

LEMON, E.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

LENOVA, L. I.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

LEONI, V.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

LESSIG, D. C.
Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

LEVINGS, G. W.
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

LIEDY, R. B.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

LINDSTROM, K. P.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

LINDSTROM, M. J.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

LINK, A. N.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

LISLE, I. G.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

LITVINOV, N. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

LOGAN, B. E.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

LOPEZ-AVILA, V.
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

LORAH, W. L.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

LOUCKS, D. P.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

LOWE, D. R.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

LYLE, W. M.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

MACCUBBIN, A. E.
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

MACKO, C. A.
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

MACPHERSON, J. M.
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

MADES, D. M.
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

MAHADEVAN, A.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MAHAN, M. O.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

MAIOLO, J. R.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

MAITY, S. P.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

MAKONNEN, G. A.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

MALLORY, M. J.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

MALONEY, L. M.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

MAMONTOVA, L. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

MANDAL, L. N.
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater-Fish Pond Soil,
W82-02027 2H

MANDELLI, E. F.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

MANTELL, A.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

MARA, D. D.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

MARCHANT, R.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 3C

MARCUS, M. D.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

MARCUSON, W. F. III
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

MARSH, D. G.
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

MARTINEC, J.
Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

MASCARENHAS, A. C.
Remote Sensing in Development,
W82-01719 7B

MATTHEWS, R. J.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

MATVIYENKO, A. M.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

MCCALLUM, I. D.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

MCCARTY, P. L.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

MCDOWELL, T. R.
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

MCDUFF, R. E.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MCFARLANE, G. A.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

MCKAY, G.
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

MCKEE, P.
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

MCKELLAR, H. N. JR.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

MCLEAN, R. A. N.
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

MCMAHON, T. A.
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MEDINA, M. A. JR.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

MEIER, R.
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

MELVIN, W. W.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

MENSAH, E. K.
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

MESHCHERYAKOVA, R. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

MEYER, E. R.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

MEYER, K. F.
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

MEYERS, P. A.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

MEZEIX, J. F.
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 2B

MIDDLEBROOKS, E. J.
The Flowering of Wastewater Treatment,
W82-02015 5D

MIETTINEN, J. K.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

MILLER, D. G. JR.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

MILLER, S.
Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

MILLER, T. S.
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

MISTRY, P. D.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

MITCHELL, P. D.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

MITCHELL, S. F.
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

MOLOF, A. H.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

MONDADA, G.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

MONSELISE, S. P.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

MOODY, J. L.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

MOOK, W. G.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

MOREL, F. M. M.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MOREL-SEYTOUX, H. J.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

MORGAN, J. J.
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

MORGAN, M. D.
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

MORGAN, S. L.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

MORRIS, W. T.
Perseverance Produces County Park,
W82-01932 6D

MORRISSON, N. J. III.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

MOSELHY, M. M.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

MOTT, T. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

MOUAT, D. A.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

MROZED JR, E.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

MUMALLAH, N. A.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

MUMALLAH, N. A. K.
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

MUTHUKUMAR, G.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MYHRSTAD, J. A.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

NAEF, F.
Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

NAIR, G. B.
Distribution of Vibrio Parahaemclyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

NAKASHIO, F.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

NATARAJAN, R.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

NEBRAT, A. A.
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

NELSON, J. G.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

NICKS, A. D.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

NOWLIN, J. D.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

NURNBERG, H. W.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

NWA, E. U.
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

NYBORG, M.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01866 5B

NYE, J. C.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

O'NEILL, P.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Little River, Ga., 1979 Data Report,
W82-01771 7B

O'NEILL, W. B.
Pollution Permits and Markets for Water Quality,
W82-01699 6A

OFFICER, C. B.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

OKSIYUK, O. P.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

OLEYNIK, G. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

OLIVIER, R. J.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

OMORINBOLA, E. O.
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

ONISHI, Y.
Sediment-Contaminant Transport Model,
W82-01614 5B

ONSTAD, C. A.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

ORAGUI, J. I.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

ORCUTT, J. D. JR.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

ORDAZ, C.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

OREMLAND, R. S.
Denitrification Associated With Periphyton Communities,
W82-01814 5B

ORREN, M. J.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

OUTEN, R. B.
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

PACE, M. L.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

PAGE, G. W.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

PAGE, G. W. III.
Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

PAGE, H. R. S.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

PALOMEQUE, R.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

PANDOZZI, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

PANICKER, P. V. R. C.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

PANKOW, J. F.
Kinetics for the Aquatic Environment,
W82-01631 2K

PANKOW, J. R.
Kinetics for the Aquatic Environment,
W82-01806 2K

PARKER, J. G.
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

PARKIN, T. B.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

PARLANGE, J. Y.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

PATEL, K. R.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

PATRICK, P. H.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

PATRICK, W. H. JR.
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

PAUL, C. K.
Remote Sensing in Development,
W82-01719 7B

PAWLIKOWSKI, W.
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01739 6D

PEDERSEN, D.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

PEDERSON, D. T.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

PENG, T-H.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

PETERSEN, G. W.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

PHILLIPS, G. R.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

PHILLIPS, R. E.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

PIALY, P. P.
Mixing Zone Analysis for River Plumes,
W82-01961 5B

PICKENS, J. F.
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

PLAUMANN, K. W.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

PLEYSIER, J. L.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

POOLE, G. J.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

POOTS, V. J. P.
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

POTAPOVA, N. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

POTGIETER, H. J.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

POWERS, W. F.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

PRAKASH, A.
Statistical Determination of Design Low Flows,
W82-01858 2E

PRATER, B. L.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

PRIOR, B. A.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

PROCTOR, B. L.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

PROEBSTING, E. L. JR.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

PUCCETTI, G.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

PUGH, C. A.
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

QUINN, J. P.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

RADCLIFFE, D.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

RADFORD, P. J.
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

RAHI, G. S.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

RAI, S. D.
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

RAJPUT, R. K.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

RAM, V.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

RAO, D. B.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

RASHID, H. A-H.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

RASPOR, B.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

RATHBUN, P. A.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

RATHFELDER, E. L.
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

RATHORE, T. R.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

RATUSHNAYA, M. YA.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

RAUCHER, R. L.
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

REA, D. K.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

REDDY, J. M.
Optimal Design of Border Irrigation Systems,
W82-01977 3F

REED, S. C.
The Flowering of Wastewater Treatment,
W82-02015 5D

REES, J. F.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greensand,
W82-02071 5B

REID, I. A.
Glacier Surveys in Alberta - 1979,
W82-01855 2C

REMENYAK, M. B.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

REMFRY, J. E.
Centrifugal Dewatering,
W82-01912 5E

RETTA, A.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

RHO, J.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

RIBENY, F. M. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

RIDKER, R. G.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

RIGGINS, R. E.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

RIHA, S. J.
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

RIPPON, J. W.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

RITTER, J. R.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

RITTMANN, B. E.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

RJANZHIN, S. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

ROBERTSON, B. R.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

ROBINSON, A. R.
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ROMANENKO, V. D.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Thermal Power Stations,
W82-01998 8C

ROSALES, M. T. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

ROSE, B.
Managing Water at Helicopter Plant,
W82-01974 5D

ROSE, C. W.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

ROSSMANN, R.
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

ROWLEY, C. K.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

RUDD, J. W.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

RUFF, J. F.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

RUNNELLS, D. D.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

RUNNING, S. W.
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

RUSHTON, K. R.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

RUSSELL, R. B.
Learning from the Skipton Flood,
W82-02063 2E

RUSSO, D.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

RUSSO, R. C.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

RYDIN, S.
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

RYDZEWSKI, J. R.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

RYTHER, J. H.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

RZOSKA, J.
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

SACHAN, R. S.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SALOMONS, W.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

SANDER, G.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

SAVAGE, J. C.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

SAVVINA, O. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

SAWAR, S.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

SAX, R. I.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

SAYLER, G. S.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

SAYRE, W. G.
Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

SCAVIA, D.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

SCHALEKAMP, M.
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

SCHMUGGE, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

SCHOFIELD, C. L.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

SCHREIER, H.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

SCHROEDER, S. H.
Pollution Control: Changing Approaches,
W82-01870 6E

SCHWAB, D. J.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

SCHWARZENBACH, R. P.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

SCOTT, F. A.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

SELBY, K.
Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

SEN, H.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

SHAPIRO, H. M.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

SHARMA, B. M.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SHARMA, H. C.
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

SHAVER, T. N.
Environmental Fate of Methyl Eugenol,
W82-02013 5B

SHAW, T. L.
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

SHCHUR, L. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

SHELEF, G.
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

SHERRARD, J. H.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

SHERTON, C. C.
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

SHIH, S. F.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

Upland Marsh for Water Quality Control,
W82-01962 5B

SHIKLOMANOV, I. A.
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

SHIROKOV, V. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

SHMAKOV, V. M.
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

SHUSTOV, YU. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

SIBONY, J.
Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

SID'KO, F. YA.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

SIMARD, R. G.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

SIMMONS, J. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

SIMONS, D. B.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

SINAI, G.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SINCLAIR, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

SINGER, R. D.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

SINGH, S.
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

SINGH, S. N.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SINGHAL, A. E.
Tying Up TCE,
W82-01866 5G

SINHA, D. S.
The Chambal Project: Problems and Solutions,
W82-01739 4A

SKAAR, D. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

SLACK, R.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

SLAVENS, D. R.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

SMIRNOVA, N. N.
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

SMITH, C. J.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

SMITH, F. B.
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

SMITH, R. J.
Acid Rain Agreement,
W82-01933 5B

SMOLEN, M. D.
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

SOKOL'SKIY, A. F.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

SONG, C. C. S.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

SONNEN, M. B.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

SOROOSHIAN, S.
Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

SPIRA, W. M.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

SPOSITO, G.
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

SRIKANTHAN, R.
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

STACHEL, B.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

STANLEY, C. W.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

STANNERS, D. A.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

STAVSKAYA, S. S.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

STOL'BERG, F. B.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

STOLLENWERK, K. G.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

STOLZY, L. H.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

STORTZ, K. R.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

STRATHMANN, H.
Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

STRAUB, C. P.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

STRELKOFF, T.
Development of Solutions for Level-Basin Design,
W82-01976 3F

STUDNICKI, M.
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

SUCHER, J.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

SUJARITTANONTA, S.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

SUMMERS, J. K.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

SUZUKI, S.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

SWANK, W. T.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

SWANSON, N. P.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

SWIFT, L. W. JR.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

SYDOR, M.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

TAKALA, S.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

TAKAMA, N.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

TAKASE, K.
Integrated Agricultural Development in the Philippines,
W82-01725 6B

TALSMA, T.
Transport of Salts in Catchments and Soils,
W82-01880 2G

TANAKA, K.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

TARAPCHAK, S. J.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

TAYLOR, B. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

TAYLOR, F. J. R.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

TAYLOR, J.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

TEED, J. C.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

TENNANT, D.
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

THAYER, G. W.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

THINGVOLD, D. A.
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

THOMPSON, G. B.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

THOMPSON, J. B.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

THOMSEN, A. G.
Spatial Simulation of Snow Processes,
W82-01887 2C

THOMSEN, T.
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

THOMSON, L. J.
Bromide in Canterbury Ground Water,
W82-02056 5B

THURSTON, R. V.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

TIMERKAYEVA, A. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

TOMLINSON, L. M.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

TORDIFFE, E. A. W.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

TORGERSEN, T.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

TOWNS, D. R.
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

TREADWELL, B. D.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

TRISKA, F. J.
Denitrification Associated With Periphyton Communities,
W82-01814 5B

TRUITT, R. E.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

TSCHETTER, P.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

TSEYEB, YA. YA.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

TUCKER, W. G.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

TUFFLEY, R. E.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

TULEPOVA, G. B.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

TURNER, M. A.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

TURNPENNY, A. W. H.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

TUZHIKHIN, G. G.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

UHLMANN, D.
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

ULKEN, A.
On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

UNCLES, R. J.
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

USTACH, J. F.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

VALENTA, P.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

VALENTIN, P.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

VAN DE KREEKE, J.
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

VAN DER MARK, H.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

VAN DUIVEDIJK, J.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

VAN EVERDINGEN, R. O.
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

VAN HEEK, L.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

VAN RENSBURG, J. F. J.
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

VANDERPLOEG, H. A.
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

VANMARCKE, E. H.
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

VASIL'YEVA, G. L.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

VASIUKOVITCH, L. J.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

VIJAN, P. N.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

VINCENT, W. F.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

VINIKOUR, W. S.
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

VINK, J. S. L.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

VOGEL, J. C.
Excess Air in Groundwater,
W82-02099 2F

VOROB'YEV, V. I.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

WALDESTAM, S.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

WALKER, D. R.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

WALKER, W. R.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

WALLEN, D. G.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WANG, L. K.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

WARD, P. R. B.
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

WARSH, C. E.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

WATSON, K.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

WATSON, S.
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

WATSON, W. D.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

WEBB, M. G.
Charging Policies for Water Services,
W82-01734 6C

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

WEBER, H. W.
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

WEBER, J. H.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

WEFRING, D. R.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

WEINER, R. M.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

WELBY, C. W.
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

WELLS, M. R.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

WELSH, F. W.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

WEN, C-G.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

WESTALL, J.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

WHEELER, R. P.
Pollution from Farms,
W82-02039 5D

WHITTON, B. A.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

WIANCKO, P. M.
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

WILKINSON, L. F.
Bromide in Canterbury Ground Water,
W82-02056 5B

WILLIAMS, D. T.
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

WILLIAMS, J.
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

WILLIAMS, R.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

WILLSON, K. E.
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

WILSON, D. J.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

WILSON, J.
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

WINNER, J. M.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WISE, H. E. JR.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

WOLANSKI, E. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

WOLDENBERG, M. J.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

WONG, A.
Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

WONG, M-H.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

WOODFIELD, R.
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

WOODHOUSE, R. A.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

WRIGHT, K. R.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WRIGHT, S. G.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

WU, I. P.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

WYETH, R. K.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

YADAV, J. S.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

YANG, C. T.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

YAPIJAKIS, C.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

YATES, R.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

YESHOV, YU. V.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

YEVTUSHENKO, N. YU.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

YOKSAS, T.
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

YOUNG, R. A.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

ZALL, R. R.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

ZAYCEV, L. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

ZEKTSER, I. S.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

ZHDANOVA, G. A.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

ZHOLDAKOVA, Z. I.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

ZIMNY, H.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ZUKOWSKA-WIESZCZEK, D.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ZULLIG, H.
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

ZURAWSKI, A.
Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

ZVIBLEMAN, B.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

ZWAHLEN, F.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

ORGANIZATIONAL INDEX

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC.
Remote Sensing in Development,
W82-01719 7B

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC. BUREAU FOR AFRICA.
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Upland Marsh for Water Quality Control,
W82-01962 5B

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE, WASHINGTON, DC.
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF AGRICULTURAL ENGINEERING.
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

AKADEMIA ROLNICZEJ, WARSAW (POLAND). INST. OF ENVIRONMENTAL PROTECTION.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

AKADEMIYA NAUK SSSR, BOROK. INST. BIOLOGII VNUTRENNYKH VOD.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

AKADEMIYA NAUK SSSR, LENINGRAD. INST. OF LAKE STUDIES.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

AKADEMIYA NAUK SSSR, NOVOSIBIRSK. INST. FIZIKI.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

AKADEMIYA NAUK SSSR, PETROZAVODSK. KARELSKII FILIAL.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

AKADEMIYA NAUK URSR, KIEV. INST. BOTANIKI.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

AKADEMIYA NAUK URSR, KIEV. INST. HIDOBIOLOGII.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROLOGII.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

AKADEMIYA NAUK URSR, KIEV. INST. HYDROBIOLOGII.
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

AKADEMIYA NAUK URSR, KIEV. INST. KIBERNETIKI.
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

ALASKA UNIV., FAIRBANKS. INST. OF MARINE SCIENCE.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

ARGONNE NATIONAL LAB., IL.
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

ARIZONA UNIV., TUCSON. DEPT. OF ECONOMICS.
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

ARIZONA UNIV., TUCSON. INST. OF ATMOSPHERIC PHYSICS.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

ARIZONA UNIV., TUCSON. OFFICE OF ARID LANDS STUDIES.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

ASIAN DEVELOPMENT BANK, MANILA (PHILIPPINES). AGRICULTURE AND RURAL DEVELOPMENT DEPT.
Integrated Agricultural Development in the Philippines,
W82-01725 6B

AUBURN UNIV., AL. DEPT. OF ECONOMICS.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

AUCKLAND REGIONAL AUTHORITY (NEW ZEALAND). WATER LAB.
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

AUCKLAND UNIV., (NEW ZEALAND). DEPT. OF BOTANY.
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

AUCKLAND UNIV., (NEW ZEALAND). DEPT. OF ZOOLOGY.
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

AUSTRALIAN NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF EARTH SCIENCES.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

AYRES, LEWIS, NORRIS AND MAY, INC., ANN ARBOR, MI.
Tying Up TCE,
W82-01866 5G

BANSILAL AMRITLAL COLL. OF AGRICULTURE, ANAND (INDIA).
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

BATTELLE PACIFIC NORTHWEST LAB., RICHLAND, WA.
Sediment-Contaminant Transport Model,
W82-01614 5B

BAYREUTH UNIV. (GERMANY, F.R.).
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

BECHTEL, INC., SAN FRANCISCO, CA.
Statistical Determination of Design Low Flows,
W82-01858 2E

BIDHAN CHANDRA KRISHI VISHWA VIDYALAYA, KALYANI (INDIA).
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

BREMEN UNIV. (GERMANY, F.R.). DEPT. OF CHEMISTRY.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF MATHEMATICS.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

BRITISH METEOROLOGICAL OFFICE, BRACKNELL (ENGLAND).
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

BROCK UNIV., ST. CATHARINES (ONTARIO). INST. OF URBAN AND ENVIRONMENTAL STUDIES.
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

BROOKHAVEN NATIONAL LAB., UPTON, NY. DEPT. OF ENERGY AND ENVIRONMENT.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

BYELORUSSIA UNIV., MINSK (USSR). EXPERIMENTAL BIOLOGICAL SPECIAL TOPICS RESEARCH LAB.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

CALIFORNIA STATE DEPT. OF FISH AND GAME, SACRAMENTO. WATER POLLUTION CONTROL LAB.
Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

CALIFORNIA STATE DEPT. OF WATER RESOURCES, SACRAMENTO.
The California State Water Project--Current Activities and Future Management Plans,
W82-01851 6E

CALIFORNIA UNIV., BERKELEY.
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

CALIFORNIA UNIV., BERKELEY. DEPT. OF CIVIL ENGINEERING.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

CALIFORNIA UNIV. DAVIS.
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR, AND WATER RESOURCES.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR. GREAT LAKES ENVIRONMENTAL LAB.
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

CARNEGIE INSTITUTION OF WASHINGTON, DC. GEOPHYSICAL LAB.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF SYSTEMS ENGINEERING.
Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

CENTER OF ADVANCED STUDY IN MARINE BIOLOGY, PORTO NOVO (INDIA).
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

CENTRAL INLAND FISHERIES RESEARCH INST., BARRACKPORE (INDIA).
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

CENTRAL SOIL SALINITY RESEARCH INST., KARNAL (INDIA).
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

CHANDRA SHEKHAR AZAD UNIV. OF AGRICULTURE AND TECHNOLOGY, KANPUR (INDIA).
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

CHEST CLINIC, BRISBANE (AUSTRALIA).
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

CHICAGO UNIV., IL. DEPT. OF MEDICINE.
Thermophilic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

CHINESE UNIV. OF HONG KONG, SHATIN. DEPT. OF BIOLOGY.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

CHIYODA CHEMICAL ENGINEERING AND CONSTRUCTION CO. LTD., YOKOHAMA (JAPAN).
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

CHULALONGKORN UNIV., BANGKOK (THAILAND). INST. OF ENVIRONMENTAL RESEARCH.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA. DEPT. OF MARINE SCIENCE.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

COLORADO STATE UNIV., FORT COLLINS.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CHEMISTRY.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

Optimal Design of Border Irrigation Systems,
W82-01977 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF FOREST AND WOOD SCIENCES.
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

COLORADO UNIV AT BOULDER. DEPT. OF GEOLOGICAL SCIENCES.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

COLUMBIA NATIONAL FISHERY RESEARCH LAB., MO.
Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF FOREST RESEARCH.
Transport of Salts in Catchments and Soils,
W82-01880 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF MATHEMATICS AND STATISTICS.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, NORTH RYDE (AUSTRALIA). DIV. OF FOOD RESEARCH.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

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W82-01893 2J

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Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

CORNELL UNIV., ITHACA, NY. DEPT. OF FOOD SCIENCE.
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W82-01627 5D

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W82-02099 2F

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Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

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W82-01887 2C

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A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

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W82-01696 3A

DEPARTMENT OF AGRICULTURE AND FISHERIES, STELLENBOSCH (SOUTH AFRICA).
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

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W82-01868 5B

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W82-02016 5A

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Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

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Influence on Groundwater from the Bermed Infiltration Pond,
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W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

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Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

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W82-01630 5E

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W82-01609 2A

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A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
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Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

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Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

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W82-01764 6D

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Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

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Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

FEDERAL ENERGY REGULATORY COMMISSION, NEW YORK. NEW YORK REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine,
W82-01755 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

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Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing; Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing; Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
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On the Values and Variability of Degree-Day Melting Factor in Finland,
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Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
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Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

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The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

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Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
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W82-01789 3A

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W82-01961 5B

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W82-01840 2H

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W82-02072 2H

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W82-02042 2I

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Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
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HEALTH AND WELFARE CANADA, OTTAWA (ONTARIO).
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
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The Economics of Cooperation Over Collective Bads,
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W82-01802 5B

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Accuracy of Suspended Sediment Measurements in Natural Streamflows,
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Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

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W82-01655 6B

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W82-01654 5B

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Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
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Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

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Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

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W82-02096 7B

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Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

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W82-01939 7B

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Summer Ice and Carbon Dioxide,
W82-01843 2C

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W82-01646 7A

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W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

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W82-02011 5E

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Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

LOZIER ENGINEERS, INC., ROCHESTER, NY.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

LULEA UNIV. (SWEDEN). DIV. OF WATER RESOURCES ENGINEERING.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

LUXEMBOURG FOUNDATION UNIV., ARLON.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

LYON-1 UNIV., VILLEURBANNE (FRANCE). DEPT. DE BIOLOGIE ANIMAUX ET ZOOLOGIE.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

MADHYA PRADESH IRRIGATION DEPT., BHOPAL (INDIA).
The Chambal Project: Problems and Solutions,
W82-01739 4A

MADRAS UNIV. (INDIA). CENTRE OF ADVANCED STUDY IN BOTANY.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MAINE UNIV. AT ORONO. DEPT. OF ZOOLOGY AND COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

MARYLAND DEPT. OF NATURAL RESOURCES, ANNAPOLIS.
The Hazards of Hazardous Waste Management,
W82-01940 6E

MARYLAND TECHNICAL ADVISORY SERVICE, COLLEGE PARK.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

MARYLAND UNIV., COLLEGE PARK.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CHEMISTRY.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF MICROBIOLOGY.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

MASSACHUSETTS UNIV., WALTHAM. DEPARTMENT OF ENVIRONMENTAL SCIENCE.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF CIVIL ENGINEERING AND APPLIED MECHANICS.
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF AGRICULTURAL ENGINEERING.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCES.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

MICHIGAN STATE UNIV., HICKORY CORNERS, KELLOGG BIOLOGICAL STATION.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ATMOSPHERIC AND OCEANIC SCIENCE.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND INDUSTRIAL HEALTH.
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W82-01832 2H

MICHIGAN UNIV., ANN ARBOR. GREAT LAKES AND MARINE WATERS CENTER.
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W82-01959 2H

MIDDLE TENNESSEE STATE UNIV., MURFREESBORO.
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W82-01817 5B

MIDDLESEX POLYTECHNIC, LONDON (ENGLAND).
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W82-01994 5G

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W82-01801 5B

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Morocco's Largest Multipurpose Scheme,
W82-01724 8A

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Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

MINISTRY OF AGRICULTURE, STOCKHOLM (SWEDEN). ENVIRONMENTAL DIV.
International Cooperation to Protect the Baltic,
W82-02087 6E

MINISTRY OF TRANSPORT AND PUBLIC WORKS, MIDDELBURG (NETHERLANDS). ENVIRONMENTAL RESEARCH DIV.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

MINNESOTA UNIV., DULUTH. DEPT. OF PHYSICS.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF GEOLOGY AND GEOPHYSICS.
Contourites in Lake Superior,
W82-01935 2H

MINNESOTA UNIV., MINNEAPOLIS. SCHOOL OF PUBLIC HEALTH.
Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 2K

MISSOURI UNIV.-COLUMBIA. SCHOOL OF FORESTRY, FISHERIES AND WILDLIFE.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

MOBAY CHEMICAL CORP., KANSAS CITY, MO. DIV. OF AGRICULTURAL CHEMICALS.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

MODO-CHEMETICS, A. B., ORNSKOLDSVIK (SWEDEN).
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MONTANA STATE UNIV., BOZEMAN. FISHERIES BIOASSAY LAB.
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W82-01629 5C

MOSCOW STATE UNIV. (USSR).
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

MOTOR-COLUMBUS CONSULTING ENGINEERS, INC., BADEN (SWITZERLAND).
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

MURDOCH UNIV. (WESTERN AUSTRALIA).
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W82-02061 6C

NALCO ENVIRONMENTAL SCIENCES, NORTHBROOK, IL.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

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W82-01995 7B

NATIONAL COAL BOARD, STOKE ORCHARD (ENGLAND). COAL RESEARCH ESTABLISHMENT.
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W82-01628 5D

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Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

NATIONAL HURRICANE AND EXPERIMENTAL METEOROLOGY LAB., CORAL GABLES, FL.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

NATIONAL HYDROLOGY RESEARCH INST., CALGARY (ALBERTA).
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W82-01904 2F

NATIONAL HYDROLOGY RESEARCH INST., OTTAWA (ONTARIO).
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

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W82-01712 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

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Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

NATIONAL MARINE FISHERIES SERVICE, BEAUFORT, NC. SOUTHEAST FISHERIES CENTER.
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W82-01902 2L

NATIONAL OCEAN SURVEY, ROCKVILLE, MD. OCEAN DUMPING AND MONITORING DIV.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

NATIONAL RESEARCH INST. FOR OCEANOGRAPHY, STELLENBOSCH (SOUTH AFRICA).
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

NATIONAL WATER COUNCIL, LONDON (ENGLAND).
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

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W82-01852 5A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). WATER QUALITY BRANCH.
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W82-01854 5A

NATIONAL WATER RESEARCH INST., BURLINGTON, (ONTARIO). WATER RESOURCES BRANCH.
Glacier Surveys in Alberta - 1979,
W82-01855 2C

NATIONAL WATER RESEARCH INST., VANCOUVER (BRITISH COLUMBIA). PACIFIC AND YUKON REGION.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

NEBRASKA UNIV., LINCOLN.
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W82-01659 6E

NEBRASKA UNIV., LINCOLN. SCHOOL OF LIFE SCIENCES.
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W82-01653 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

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Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

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Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

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W82-01931 5C

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W82-02060 2L

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK.
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W82-01891 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

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W82-01748 2F

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF MARINE EARTH, AND ATMOSPHERIC SCIENCES.
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

NORTH CAROLINA STATE UNIV. AT RALEIGH. PESTICIDE RESIDUE RESEARCH LAB.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

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Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

OKLAHOMA STATE UNIV., STILLWATER.
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W82-01672 2E

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRONOMY.
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W82-01862 2I

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W82-01674 2L

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W82-01661 5A

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W82-02091 5F

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W82-01907 5D

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W82-02005 5B

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W82-01828 5A

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF GEOLOGY.
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W82-01718 2F

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Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

OREGON GRADUATE CENTER, BEAVERTON.
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W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

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W82-01681 5A

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W82-01879 2F

OTAGO UNIV., DUNEDIN (NEW ZEALAND). DEPT. OF ZOOLOGY.
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W82-01700 2H

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W82-02032 2B

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING.
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W82-01664 2E

PENNWALT LTD. (ENGLAND).
Centrifugal Dewatering,
W82-01912 5E

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W82-02051 5C

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W82-01836 5A

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W82-01914 6B

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W82-01965 5D

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
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W82-01849 2J

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W82-01651 2B

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W82-01938 2L

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Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

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W82-01915 5C

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W82-01847 6E

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W82-02070 2H

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W82-01736 2J

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W82-02029 5A

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W82-02057 2L

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Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

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W82-02003 2L

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W82-01695 5A

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W82-01648 5G

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W82-01611 2G

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W82-01771 7B

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W82-02013 5B

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W82-01769 5G

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W82-01770 2J

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W82-01976 3F

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W82-02023 2H

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W82-01892 2B

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W82-02035 5G

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W82-01960 5B

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W82-01857 2A

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W82-01636 5E

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W82-02046 2F

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W82-01730 4D

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

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W82-01667 3F

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W82-01375 2L

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W82-01656 5A

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W82-01742 6A

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W82-01610 4C

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W82-01694 6A

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

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W82-01684 1A

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W82-02006 5D

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A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

SWEDISH WATER AND AIR POLLUTION RESEARCH LAB., GOETEBORG (SWEDEN).
The Mercury Cycle,
W82-01869 5B

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

TECHNICAL UNIV. OF DENMARK, LYNGBY. INST. OF HYDRODYNAMICS AND HYDRAULIC ENGINEERING.
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

TECHNION-ISRAEL INST. OF TECH., HAIFA. FACULTY OF CIVIL ENGINEERING.
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.).
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.). BEREICH HYDROBIOLOGIE.
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

TENNESSEE UNIV., KNOXVILLE. DEPT. OF MICROBIOLOGY.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

TERRAQUA APS, KALUNDBORG (DENMARK).
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

TEXAS AGRICULTURAL EXPERIMENTAL STATION, LUBBOCK.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

TEXAS UNIV. AT DALLAS, RICHARDSON.
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

THAMES WATER ADVISORY SERVICE (ENGLAND).
Reviving the Rio Reconquista,
W82-02014 5G

THAMES WATER AUTHORITY (ENGLAND).
The Sewerage Policy of Thames Water,
W82-02040 6E

THAMES WATER AUTHORITY, LONDON (ENGLAND).
Pollution from Farms,
W82-02039 5D

THAMES WATER AUTHORITY, LONDON (ENGLAND). METROPOLITAN PUBLIC HEALTH DIV.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

THEMAG ENGENHARIA LTDA., SAO PAOLO (BRAZIL).
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

THOMPSON (BOYCE) INST., ITHACA, NY.
Acid Rain and Environmental Policy,
W82-01987 5B

TOKYO METROPOLITAN UNIV (JAPAN). DEPT. OF INDUSTRIAL CHEMISTRY.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

TRINITY COLL., DUBLIN (IRELAND).
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

TROMSO UNIV. (NORWAY). INST. FOR FISKERIFAG.
Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

UKRAINIAN ACADEMY OF SCIENCES, KIEV (USSR). INSTITUTE OF HYDROBIOLOGY.
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO CITY. CENTRO DE CIENCIAS DEL MAR Y LIMNOLOGIA.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO CITY. CENTRO DE INVESTIGACIONES EN MATEMATICAS APPLICADAS Y EN SISTEMAS.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA). DEPT. OF CHEMICAL ENGINEERING.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF. DEPT. OF APPLIED BIOLOGY.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

UNIVERSITY OF WEST FLORIDA, PENSACOLA.
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

UNIVERSITY OF WEST INDIES, KINGSTON (JAMAICA). DEPT. OF BOTANY.
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

URANERZ AUSTRALIA PARTY, LTD., SUBIACO.
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

UTAH STATE UNIV., LOGAN.
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

UTAH STATE UNIV., LOGAN. COLL. OF ENGINEERING.
The Flowering of Wastewater Treatment,
W82-02015 5D

UTAH STATE UNIV., LOGAN. DEPT. OF AGRICULTURE AND IRRIGATION ENGINEERING.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Simplified Method for Rainfall Intensities,
W82-01978 2B

UTAH STATE UNIV., LOGAN. DEPT. OF SOIL SCIENCE AND BIOMETEOROLOGY.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

VANDERBILT UNIV., NASHVILLE, TN.
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CHEMISTRY.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

VERBAND DER DEUTSCHEN GAS- UND WASSERWIRTSHCHAFT E.V./DEUTSCHER VEREIN DES GAS UND WASSERFACHES E.V., BONN (GERMANY, F.R.).
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

VERMONT HOUSE OF REPRESENTATIVES, MONTPELIER.
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

VICTORIA DEPT. OF AGRICULTURE, TATURA (AUSTRALIA). IRRIGATION RESEARCH INST.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ENGINEERING.
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

VISVA-BHARATI UNIV., SANTINIKETAN (INDIA). DEPT. OF ZOOLOGY.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL).
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DEPT. OF SOIL PHYSICS.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN ISRAEL). DIV. OF SUBTROPICAL HORTICULTURE.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

WAIKATO UNIV., HAMILTON (NEW ZEALAND). DEPT. OF EARTH SCIENCES.
Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

WAIKATO UNIV., HAMILTON (NEW ZEALAND). SCHOOL OF SCIENCE.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRONOMY AND SOILS.
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

WASHINGTON UNIV., SEATTLE. DEPT. OF ATMOSPHERIC SCIENCES.
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

WATERLOO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF SOIL SCIENCE AND PLANT NUTRITION.
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

WESTERN MICHIGAN UNIV., KALAMAZOO.
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

WINDSOR UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WISCONSIN UNIV.-MADISON.
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

Pollution Permits and Markets for Water Quality,
W82-01699 6A

WISCONSIN UNIV.-MILWAUKEE. CENTER FOR GREAT LAKES STUDIES.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF CIVIL ENGINEERING.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF GEOLOGICAL SCIENCES.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

WRIGHT WATER ENGINEERS, INC., DENVER, CO.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WYOMING UNIV., LARAMIE. DEPT. OF ATMOSPHERIC SCIENCE.
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

WYOMING UNIV., LARAMIE. DEPT. OF ZOOLOGY AND PHYSIOLOGY.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

YORK UNIVERSITY, HESLINGTON (ENGLAND). INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH.
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

YORK WATER CO., PA.
Perseverance Produces County Park,
W82-01932 6D

YORKSHIRE WATER AUTHORITY (ENGLAND).
Recording Underground,
W82-02036 8A

ZURICH SERVICE DES EAUX (SWITZERLAND).
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Pollues' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

ACCESSION NUMBER INDEX

W82-01601 5D
W82-01602 7B
W82-01603 6E
W82-01604 4D
W82-01605 2G
W82-01606 5A
W82-01607 5C
W82-01608 5G
W82-01609 2A
W82-01610 4C
W82-01611 2G
W82-01612 3F
W82-01613 8G
W82-01614 5B
W82-01615 2L
W82-01616 2H
W82-01617 2A
W82-01618 5D
W82-01619 5A
W82-01620 5A
W82-01621 5A
W82-01622 5D
W82-01623 5C
W82-01624 5D
W82-01625 5B
W82-01626 5D
W82-01627 5D
W82-01628 5D
W82-01629 5C
W82-01630 5E
W82-01631 2K
W82-01632 5F
W82-01633 2D
W82-01634 5B
W82-01635 5E
W82-01636 5E
W82-01637 5A
W82-01638 2H
W82-01639 5B
W82-01640 5C
W82-01641 5C
W82-01642 6B
W82-01643 2J
W82-01644 2J
W82-01645 5C
W82-01646 7A
W82-01647 2F
W82-01648 5G
W82-01649 2E
W82-01650 2E
W82-01651 2B
W82-01652 5D
W82-01653 5C
W82-01654 5B
W82-01655 6B
W82-01656 5A
W82-01657 2A
W82-01658 5C
W82-01659 6E
W82-01660 5E
W82-01661 5A
W82-01662 5B
W82-01663 5C
W82-01664 2E
W82-01665 6F
W82-01666 2G
W82-01667 3F
W82-01668 2G
W82-01669 6B
W82-01670 1A
W82-01671 3F
W82-01672 2E
W82-01673 2F
W82-01674 2L
W82-01675 6A
W82-01676 5B
W82-01677 6A
W82-01678 5B
W82-01679 5C
W82-01680 6A
W82-01681 5A
W82-01682 5G
W82-01683 5G
W82-01684 1A
W82-01685 6A
W82-01686 2A
W82-01687 5G
W82-01688 6A
W82-01689 5A
W82-01690 2C
W82-01691 5G
W82-01692 5D
W82-01693 2F
W82-01694 6A
W82-01695 5A
W82-01696 3A
W82-01697 5F
W82-01698 6B
W82-01699 6A
W82-01700 2H
W82-01701 5C
W82-01702 2H
W82-01703 4C
W82-01704 5C
W82-01705 2H
W82-01706 2H
W82-01707 2E
W82-01708 2G
W82-01709 4C
W82-01710 2F
W82-01711 4A
W82-01712 5A
W82-01713 2I
W82-01714 2J
W82-01715 5B
W82-01716 5B
W82-01717 6C
W82-01718 2F
W82-01719 7B
W82-01720 2L
W82-01721 2G
W82-01722 6C
W82-01723 2I
W82-01724 8A
W82-01725 6B
W82-01726 8A
W82-01727 5D
W82-01728 5F
W82-01729 4D
W82-01730 4D
W82-01731 2E
W82-01732 2B
W82-01733 5D
W82-01734 6C
W82-01735 2C
W82-01736 2J
W82-01737 5A
W82-01738 6D
W82-01739 4A
W82-01740 6G
W82-01741 4B
W82-01742 6A
W82-01743 4A
W82-01744 3F
W82-01745 2I
W82-01746 2L
W82-01747 8A
W82-01748 2F
W82-01749 2L
W82-01750 5C
W82-01751 6D
W82-01752 6D
W82-01753 6D
W82-01754 6D
W82-01755 6D
W82-01756 6D
W82-01757 6D
W82-01758 6D
W82-01759 6D
W82-01760 6D
W82-01761 6D
W82-01762 6D
W82-01763 6D
W82-01764 6D
W82-01765 6D
W82-01766 6D
W82-01767 6D
W82-01768 6G
W82-01769 5G
W82-01770 2J
W82-01771 7B
W82-01772 2A
W82-01773 6B
W82-01774 7C
W82-01775 7C
W82-01776 2J
W82-01777 7C
W82-01778 10C
W82-01779 2E
W82-01780 6A
W82-01781 2E
W82-01782 2F
W82-01783 5A
W82-01784 5A
W82-01785 2F
W82-01786 5C
W82-01787 7C
W82-01788 7C
W82-01789 3A
W82-01790 5B
W82-01791 7C
W82-01792 7C
W82-01793 4A
W82-01794 5C
W82-01795 2K
W82-01796 4A
W82-01797 5C
W82-01798 5B
W82-01799 5F
W82-01800 5D
W82-01801 5B
W82-01802 5B
W82-01803 9A
W82-01804 6E
W82-01805 2L
W82-01806 2K
W82-01807 6A
W82-01808 5B
W82-01809 5B
W82-01810 5B
W82-01811 5C
W82-01812 5A
W82-01813 5B
W82-01814 5B
W82-01815 5A
W82-01816 5B
W82-01817 5B
W82-01818 5C
W82-01819 5A
W82-01820 5B
W82-01821 5A
W82-01822 5C
W82-01823 7B
W82-01824 2H
W82-01825 5C
W82-01826 7B
W82-01827 2D
W82-01828 5A
W82-01829 5B
W82-01830 5C
W82-01831 2H
W82-01832 2H
W82-01833 5F
W82-01834 2G
W82-01835 5A
W82-01836 5A
W82-01837 2H
W82-01838 2H
W82-01839 2H
W82-01840 2H
W82-01841 2H
W82-01842 2J
W82-01843 2C
W82-01844 5A
W82-01845 5B
W82-01846 2I
W82-01847 6E
W82-01848 6A
W82-01849 2J
W82-01850 2J
W82-01851 6E
W82-01852 5A
W82-01853 5A
W82-01854 5A
W82-01855 2C
W82-01856 3C
W82-01857 2A
W82-01858 2E
W82-01859 3F
W82-01860 3F
W82-01861 2G
W82-01862 2I
W82-01863 5D
W82-01864 6A
W82-01865 5D
W82-01866 5G
W82-01867 5B
W82-01868 5B
W82-01869 5B
W82-01870 6E
W82-01871 6E
W82-01872 6F
W82-01873 5B
W82-01874 5F
W82-01875 2L
W82-01876 5D
W82-01877 5B
W82-01878 3F
W82-01879 2F
W82-01880 2G
W82-01881 5C
W82-01882 5C
W82-01883 2I
W82-01884 6A
W82-01885 2C
W82-01886 2G
W82-01887 2C
W82-01888 2D
W82-01889 2C
W82-01890 2F
W82-01891 7B
W82-01892 2B
W82-01893 2J
W82-01894 7B
W82-01895 5D
W82-01896 5D
W82-01897 2G
W82-01898 2G
W82-01899 5D
W82-01900 5D
W82-01901 6B
W82-01902 2L
W82-01903 5E
W82-01904 2F
W82-01905 5A
W82-01906 3C
W82-01907 5D
W82-01908 6G
W82-01909 6A
W82-01910 7B
W82-01911 5A
W82-01912 5E
W82-01913 5G
W82-01914 6B
W82-01915 5C
W82-01916 3F
W82-01917 2H
W82-01918 2J
W82-01919 5C
W82-01920 5C
W82-01921 2H
W82-01922 5C
W82-01923 2H
W82-01924 2H
W82-01925 5B
W82-01926 2F
W82-01927 2F
W82-01928 5B
W82-01929 5D
W82-01930 2L
W82-01931 5C
W82-01932 6D
W82-01933 5B
W82-01934 4D
W82-01935 2H
W82-01936 2K

W82-01937	5C
W82-01938	2L
W82-01939	7B
W82-01940	6E
W82-01941	5B
W82-01942	6D
W82-01943	3C
W82-01944	3F
W82-01945	3F
W82-01946	2H
W82-01947	7B
W82-01948	4A
W82-01949	5C
W82-01950	7B
W82-01951	8E
W82-01952	8D
W82-01953	8D
W82-01954	8D
W82-01955	1B
W82-01956	1B
W82-01957	2H
W82-01958	2J
W82-01959	2H
W82-01960	5B
W82-01961	5B
W82-01962	5B
W82-01963	2J
W82-01964	5D
W82-01965	5D
W82-01966	2B
W82-01967	2B
W82-01968	2B
W82-01969	5A
W82-01970	5C
W82-01971	5C
W82-01972	5B
W82-01973	8A
W82-01974	5D
W82-01975	2B
W82-01976	3F
W82-01977	3F
W82-01978	2B
W82-01979	8C
W82-01980	2A
W82-01981	2E
W82-01982	2F
W82-01983	2F
W82-01984	2F
W82-01985	5C
W82-01986	2F
W82-01987	5B
W82-01988	7B
W82-01989	5B
W82-01990	6E
W82-01991	5G
W82-01992	5D
W82-01993	5C
W82-01994	5G
W82-01995	7B
W82-01996	5C
W82-01997	2H
W82-01998	5C
W82-01999	2H
W82-02000	4A
W82-02001	3F
W82-02002	2J
W82-02003	2L
W82-02004	2H
W82-02005	5B
W82-02006	5D
W82-02007	5A
W82-02008	5A
W82-02009	5A
W82-02010	2F
W82-02011	5E
W82-02012	5A
W82-02013	5B
W82-02014	5G
W82-02015	5D
W82-02016	5A
W82-02017	2F
W82-02018	5B
W82-02019	3F
W82-02020	2K
W82-02021	6G
W82-02022	2G
W82-02023	2H
W82-02024	6E
W82-02025	5A
W82-02026	5D
W82-02027	2H
W82-02028	5B
W82-02029	5A
W82-02030	2H
W82-02031	3F
W82-02032	2B
W82-02033	5C
W82-02034	2G
W82-02035	5G
W82-02036	8A
W82-02037	6A
W82-02038	2L
W82-02039	5D
W82-02040	6E
W82-02041	5D
W82-02042	2I
W82-02043	5D
W82-02044	5D
W82-02045	2I
W82-02046	2F
W82-02047	5D
W82-02048	5A
W82-02049	5D
W82-02050	5D
W82-02051	5C
W82-02052	2H
W82-02053	5C
W82-02054	2H
W82-02055	2H
W82-02056	5B
W82-02057	2L
W82-02058	5B
W82-02059	5C
W82-02060	2L
W82-02061	6C
W82-02062	6G
W82-02063	2E
W82-02064	2E
W82-02065	2K
W82-02066	6E
W82-02067	5G
W82-02068	8A
W82-02069	5A
W82-02070	2H
W82-02071	5B
W82-02072	2H
W82-02073	5B
W82-02074	7A
W82-02075	5A
W82-02076	5B
W82-02077	2H
W82-02078	2H
W82-02079	2H
W82-02080	2H
W82-02081	2H
W82-02082	2H
W82-02083	5C
W82-02084	5B
W82-02085	2B
W82-02086	7A
W82-02087	6E
W82-02088	6D
W82-02089	6B
W82-02090	5C
W82-02091	5F
W82-02092	5G
W82-02093	3F
W82-02094	2D
W82-02095	5C
W82-02096	7B
W82-02097	5B
W82-02098	5B
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W82-02100	2H

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Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSSION NUMBER INDEX

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 5
MAY 1, 1982

W82-02101 -- W82-02600

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus**. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

METABOLISM OF A DESERT STREAM,
Arizona State Univ., Tempe. Dept. of Zoology.
D. E. Busch, and S. G. Fisher.
Freshwater Biology, Vol 11, No 4, p 301-307, August, 1981. 1 Fig, 1 Tab, 24 Ref.

Descriptors: *Arid lands, *Aquatic life, Deserts, Benthos, Streams, Arizona, Watersheds, Photosynthesis, Floods, Sycamore Creek, *Arizona.

An initial examination was made of photosynthesis and community respiration in a central Arizona stream, Sycamore Creek, which drains a watershed of 505 square kilometers ranging in elevation from 427 to 2164 meters. Benthos in the creek in July and August 1978 could be separated into two types, mats of a filamentous green alga, Cladophora glomerata (L.) Keutz., and microorganisms free living on the sediment (epipelon). Community respiration and net photosynthesis were measured for these assemblages using submerged light/dark chambers in situ. Multiple regression analysis was used to predict gross photosynthesis as a function of photosynthetically active radiation, temperature and chlorophyll-a concentration and community respiration as a function of temperature and biomass. The calculations suggest that the creek is autotrophic during the summer and that the rates of gross photosynthesis and community respiration are high for a small stream. Considerable differences were noted between the Cladophora mat assemblages and the epipelic assemblages. The high rate of gross photosynthesis, low litter inputs, high biomass of algae, and the intermittent but severe floods that characterize Sycamore Creek indicate that this stream and other similar desert streams are net exporters of organic matter and are thus truly autotrophic stream ecosystems. (Baker-FRC)
W82-02349

1B. Aqueous Solutions and Suspensions

THE DOWNSTREAM TRANSPORT OF FINE MATERIAL AND THE ORGANIC MATTER BALANCE FOR A SECTION OF A SMALL CHALK STREAM IN SOUTHERN ENGLAND,
Freshwater Biological Association, East Stoke (England). River Lab.
F. H. Dawson.
Journal of Ecology, Vol 69, No 2, p 367-380, July, 1981. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Natural streams, *Suspended solids, *Organic matter, Seasonal variation, Vegetation effects, Sediment load, England.

The seasonal variations in the concentration of fine particulate material transport downstream for two sites along a small chalk stream (Dorset, England) were determined. One site was shaded with deciduous trees and with a few plants growing in the water; the other was shaded and dominated by submerged macrophytes. Aquatic plants were a factor in promoting the settlement and seasonal accumulation of suspended materials as banks of sediments. The mean monthly concentration of organic matter in the summer was 1-2 mg/liter dry weight, but it rose in the winter to 10 to 12 mg/liter. The large plant material resulted from in situ macrophyte production and from terrestrial leaf fall and was quickly broken down. The accumulation of organic material was predicted by summing the difference between the monthly totals of import and export for a section of stream between two sites. (Small-FRC)
W82-02192

2. WATER CYCLE

2A. General

WATER ROUTING ON DIVERGING-CONVERGING WATERSHEDS,
Technical Univ. of Instanbul (Turkey).
N. Agiralioglu.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY8, p 1003-1017, August, 1981. 10 Fig, 3 Tab, 15 Ref.

Descriptors: *Hydrographs, *Kinematic wave theory, *Diverging-converging watersheds, *Overland flow, Model studies, Rainfall-runoff relationships, Watersheds, Streamflow, *routing.

The overland flow equations depending on the kinematic wave theory are solved by using an implicit finite difference method for the diverging-converging watershed. The flow model is applied to impervious surfaces which preserve the area and length of the watershed and fix the kinematic parameters for each event. Depending on geometric parameters, the model gives hydrograph values between those of diverging and converging models, with values for the rectangular configuration in between. Different geometric representations give runoff hydrographs with different shapes under the same conditions. The diverging representation gave the longest time of concentration, the converging representation, the shortest one. The reverse is true for lag time. (Cassar-FRC)
W82-02200

USE OF CUMULANTS TO ESTIMATE COEFFICIENTS IN CHOW-KULANDAISWAMY'S GHS MODEL,
Mississippi State Univ., Mississippi State.
V. P. Singh, and R. C. McCann.
Nordic Hydrology, Vol 11, No 2, p 83-92, 1980. 3 Fig, 1 Tab.

Descriptors: *Mathematical models, *Watersheds, *Cumulative runoff, *Floods, Water storage, Hydrograph analysis, Laplace equation, Runoff, Least squares method, Mathematical studies, Infiltration, Flood hydrographs, Discharge hydrographs.

The coefficients on the General Hydrologic System model of Chow and Kulandaiswamy are estimated using the method of cumulants. The model hypothesizes that storage in the watershed can be expressed as a linear sum of surface runoff, rainfall excess, and their time derivatives. The coefficients are functions of runoff and rainfall excess. They are finite nonnegative integers. The method of cumulants estimates the coefficients independently of the derivatives of runoff and rainfall excess. The cumulants method was found to yield comparable values to those obtained by the common least squares method. The cumulants method may be more reliable if the derivatives of runoff are not estimated accurately. (Titus-FRC)
W82-02208

ANALYSIS OF THE RAINFALL-RUNOFF TRANSFORMATION PROCESS,
Benin National Univ., Cotonou.
A. A. Afouda.
Nordic Hydrology, Vol 11, No 2, p 93-112, 1980. 4 Fig, 21 Ref.

Descriptors: *Rainfall, *Runoff, *Mathematical models, *Hydrologic roughness, *Flow, Watersheds, Kinematic wave theory, Roughness coefficients, Hydraulic friction, Boundaries, Boundary conditions, Shear stress, Reynolds number, Froude number, Stokes law.

A generalized friction factor has been introduced to describe resistance to storm water flow over a natural watershed. This theoretical relationship has been proved to be valid for smooth surface flow, rough surface flow, and flow through porous medium. A kinematic relation which accounts for the roughness of the water shed surface has been proposed. The similarity between this kinematic relation and the friction factor has been underlined. This kinematic relationship determines the applicability of the kinematic flow theory and the approximation of the friction slope. When the kinematic approximation applies, an analytical solution can be obtained in the form of integral series. (Titus-FRC)
W82-02210

RUNOFF CURVE NUMBERS FOR NORTHERN PLAINS RANGELANDS,
Science and Education Administration, Boise, ID.
C. L. Hanson, E. L. Neff, J. T. Doyle, and T. L. Gilbert.
Journal of Soil and Water Conservation, Vol 36, No 5, p 302-305, September-October, 1981. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Range management, Erosion, Runoff, Mathematical studies, Soil types, Comparison studies, Runoff forecasting.

After reviewing the various methods for estimating runoff curve number (CN) values for rangeland watersheds, a comparison was made of the values for CN prepared by the Soil Conservation Service (SCS) in Wyoming with actual records in the area. Precipitation and runoff data from several small watersheds in western South Dakota, northeastern Wyoming, and southeastern Montana were used for this evaluation. Examples of two range sites are illustrated. The maximum summer runoff event, plus any summer runoff event of 6 millimeters or more, were used to compute the optimized CN for each watershed. The optimized CN was obtained by minimizing the sum of the squared deviations of observed and predicted runoff. Precipitation and runoff were plotted and analyzed by event. The optimized CN as well as the low and high values were computed so that the procedures outlined in the National Engineering Handbook could be expanded to Northern Plains rangeland. The computed CN values were integrated into the original Wyoming table. Optimized CN values ranged from 50 for a sandy watershed to 93 for a saline upland watershed in low-fair condition. Optimized values from the watersheds varied considerably, but their range included the value from the original table in all cases. Claypan watersheds had optimized CN values of 87 and 89, slightly lower than the values of the original table. Shallow loamy range sites had slightly higher CN values than on the original table, while three clayey watersheds had values similar to those in the table. Values similar to those on the original table were obtained for medium-textured soils, fine-textured soils with steep slopes, and primarily clayey range site watersheds. (Baker-FRC)
W82-02245

SNOWMELT, GLACIER MELT, AND HIGH ARCTIC STREAMFLOW REGIMES,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
P. Marsh, and W. Ming-ko.
Canadian Journal of Earth Sciences, Vol 18, No 8, p 1380-1384, August, 1981. 4 Fig, 6 Ref.

Descriptors: *Streamflow, *Arctic, *Snowmelt, Thaw, Glaciers, Seasonal variation.

The major sources of streamflow in high arctic basins were analyzed, and the flow generating process was examined. The study was carried out in an area characterized by a dissected plateau ranging in altitude from 120 to 425 m. Streamflow was the result of rainfall, spring snowmelt, and the melting of semi-permanent snowbanks and glaciers. When spring snowmelt dominated, a simple arctic nival regime resulted. When spring melt was followed by glacier melt, a typical proglacial regime resulted. Flows from year to year were highly variable, depending upon weather conditions and the rates of various sources of runoff. A complex range of regime types can be defined, and the simple classification of nival or proglacial can be used. (Small-FRC)
W82-02249

Field 2—WATER CYCLE

Group 2A—General

FLOOD EVENT MODELING - A STUDY OF TWO METHODS,

Institute of Hydrology, Wallingford (England).
M. J. Lowing, and R. G. Mein.
Water Resources Bulletin, Vol 17, No 4, p 599-606, August, 1981. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Mathematical models, *Design floods, *Runoff forecasting, Hydraulic design, Floods, Maximum probable floods, Surface runoff, Hydrographs, Comparison studies, Watersheds.

Two methods for the estimation of design flood hydrographs for gaged catchments were applied to five gaged catchments in the United Kingdom. The unit hydrograph model and a runoff routing model used in Australia were evaluated. Both models acted on rainfall excess to produce estimates of surface runoff. Both models performed well, but for many situations, the unit hydrograph procedure was more suitable. It is simple to apply and can be computed by hand. The runoff routing model has the advantage of allowing for nonuniformity within the catchment in rainfall depth or pattern, losses due to different soils or land use, or the existence of significant storages or retarding basins. This model, however, requires a computer. Alternative ways of describing the within-event distribution of losses are an important factor in the success of a model. (Small-FRC)
W82-02291

CHEMISTRY OF INTERSTITIAL WATER AND BOTTOM SEDIMENTS AS INDICATORS OF SEEPAGE PATTERNS IN PERCH LAKE, CHALK RIVER, ONTARIO,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. K. Frape, and R. J. Patterson.
Limnology and Oceanography, Vol 26, No 3, p 500-517, May, 1981. 11 Fig, 29 Ref.

Descriptors: *Groundwater movement, *Seepage, *Lakes, Interstitial water, Sediment-water interfaces, Chemical properties, Tritium, Tracers, *Perch Lake, Ontario, *Chalk River.

Theoretical subsurface, nearshore flow models were tested, and information was obtained on seepage water and the chemical processes that may occur during the passage of groundwater through lake bottom sediments in a study of Perch Lake (Chalk River, Ontario). The groundwater flow system in this lake basin has been extensively monitored, and an aquifer near the lake was contaminated with tritium, acting as a good tracer. Tritium analyses of interstitial water samples and well waters near the lake indicated a pattern of groundwater discharge or seepage consistent with the predictions of the mathematical models. Groundwater discharge deposited metals such as iron and manganese in lake sediments. Interstitial waters in sediments were mixtures of groundwater and lake water, with the resultant chemistry. Nests of piezometers adjacent to the lake are needed to define the types of groundwaters moving toward the lake. (Small-FRC)
W82-02304

FLASH FLOOD IN ARIZONA - OBSERVATIONS AND THEIR APPLICATION TO THE IDENTIFICATION OF FLASH-FLOOD DEPOSITS IN THE GEOLOGIC RECORD,

Geological Survey, Flagstaff, AZ.
I. Lucchitta, and N. Suneson.
Geology, Vol 9, p 414-418, September, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Sediment transport, *Flash floods, Floods, Rainfall-runoff relationships, *Arizona, Sediments.

A description is offered of a flash flood which occurred in west central Arizona in the spring of 1979. The flood occurred in the area of a major branch of Rupley Wash, which is one of the principal washes of the area and a tributary of the Big Sandy River. This branch drains an area of about 18 square kilometers underlain by Quaternary pediments, badland hills cut into upper Tertiary basin-fill deposits, and highlands underlain by Precambrian granite, Cenozoic sedimentary rocks, and Cenozoic rhyolite and basalt. The branch is a typical braided desert wash, consisting of many unvegetated, sandy and pebbly, active braid channels separated by vegetated, inactive areas. Ten to 15 minutes after the torrential rain started (shortly afternoon) the pediment surface was completely saturated and water 1 to 2 cm deep was moving in sheetflow. A few minutes later the depth was 10-20 cm. The most active part of the braid channel soon contained muddy, turbulent water 20-50 cm deep. The maximum velocity for the water was estimated at 2.5 to 3.8 meters/second. After about 30 minutes the flood was gone and the rain had almost stopped. The flood in the main channel left two kinds of deposits: widespread coarse to medium grained quartz feldspar sand, and less widespread but conspicuous medium- to fine grained sand composed of magnetite with a little ilmenite, termed black sand. It was not certain whether the flood resulted in a net accumulation or removal of material in the channel. (Baker-FRC)
W82-02350

A METHOD FOR OBTAINING SLOPE INFORMATION FOR HYDROLOGIC MODELS,

Ball State Univ., Muncie, IN. Dept. of Geography.
B. N. Haack.
Water Resources Bulletin, Vol 17, No 4, p 704-707, August, 1981. 2 Fig, 6 Ref.

Descriptors: *Nonpoint pollution sources, *Hydrologic models, *Slopes, Water pollution sources, Model studies, Watersheds, *Runoff, Data collections, Pollution load, Sediment, Erosion, Topography, Topographic mapping, Contours.

A method is presented for collecting surface slope information for a regional land resources information system. Slope is a necessary and important factor in water quality and soil loss models and is often difficult to obtain. The method described requires a point sampling scheme, topographic maps, and a coordinate digitizer. Sample point evaluation, slope direction, and slope magnitude are calculated from locations of the sample point and the nearest upper and lower contour lines. Slope gradient can be a useful addition to a point sampled land resources information system for the correlation of water quality data and simultaneously occurring land resource data for watershed runoff and nonpoint source water pollution analysis. Slope length, while also useful, cannot be obtained from the method presented here. One possible problem with the method is cost. In the Honey Creek project, a two person collection team averaged about 100 sample points per hour for slope data collection. Monetary restraints restricted this method to the Honey Creek watershed for the Lake Erie Wastewater Management Study. One possible source of error in the method proposed is digitizer limitations in measuring short distances. This is of particular concern when measurement distances are small, for example when a sample point is on a steep slope, as indicated by closely spaced contour lines. As long as the contour lines are uniformly spaced, the distance for digitizer measurements could be increased and small distance measurement errors decreased by selecting contour lines for slope determination other than those immediately adjacent to the sample point. (Baker-FRC)
W82-02364

METHODS OF CALCULATING INFILTRATION OF MELTWATERS INTO FROZEN SOIL,

I. L. Kalyuzhnyi, and K. K. Pavlova.
Hydrotechnical Construction, No 4, p 375-379, April, 1980. 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 4, p 29-32, April, 1980.

Descriptors: *Snowmelt, *Infiltration capacity, Infiltration, Melting, Leaching, Free water, Soil properties, Frozen ground, Freezing, Catchment areas, Soil moisture, *Mathematical studies, Runoff, Floods, Spring flood runoff, Freeze-thaw tests.

An analysis was made on the formation of the spring flood runoff which demonstrated that for certain relationships of the temperature and moisture content of the soil, and impermeable layer can form at one depth or another. Its formation is most probable near the surface. Given the existence of an impermeable layer, its widespread distribution on the drainage basin, and lengthy existence, the losses of the spring flood runoff are as a rule small. On field drainage basins of the forest and forest-steppe zones an impermeable layer is formed rather often in the soil, and on forest drainage basins only rarely, due to the difference in the hydrophysical properties of field and forest soils. The duration of the existence of an impermeable layer depends primarily on the soil temperature or freezing depth, but the portion of the area of the drainage basin occupied by this layer depends primarily on the soil moisture content in the upper 20 centimeters. The thickness of the impermeable layer is related to the soil impermeability index, and the portion of the area of the drainage basin occupied by this layer is related to the average moisture supply in the 20 centimeter layer. The product of permeability and moisture content in this layer was taken as the integral index of meltwater runoff losses. Close relations between spring flood runoff coefficient and the loss index were obtained for field drainage basins of forest and forest-steppe zones. (Baker-FRC)
W82-02386

POINT PROCESS MODELS OF RAINFALL,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
J. A. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157959, Price codes: A09 in paper copy, A01 in microfiche. Ph.D. Dissertation, 1980. 182 p, 17 Fig, 19 Tab, 72 Ref. OWRT-B-027-MD(2) and C-90308-C(0407)(1), 14-34-0001-0407, 14-34-0001-8089.

Descriptors: Simulated rainfall, Prediction, Stochastic process, *Model studies, Precipitation, Rainfall, Drought, Forecasting, Probabilistic process, *Rainfall-runoff relationships, *Low flow, *Streamflow forecasting, *Potomac River basin.

Point process models of summer rainfall for the Potomac River basin are developed for application to streamflow prediction during drought periods. The point process models that are developed include (1) a univariate point process model of rainfall occurrences at a site, (2) a marked point process model of rainfall occurrences and storm depths at a site, and (3) a bivariate point process model of rainfall occurrences at two sites. The univariate point process model of rainfall occurrences, which is denoted an RCM process (for Renewal Cox process with Markovian intensity), is the centerpiece of this dissertation. An RCM process can be described as a point process for which the rate of occurrence of events alternates randomly between two states, one of which is 0, the other positive. The notion of clustering of rainfall occurrences plays an important role in this dissertation. The form of the RCM process suggests an interpretation of clustering of rainfall occurrences based on the alternation of wet and dry periods. This interpretation is supported by presenting evidence which indicates that periods of deficit summer rainfall in the Potomac basin are closely associated with the advection of cool, dry, stable Canadian air masses.
W82-02452

RAINFALL-RUNOFF MODELING AND PRELIMINARY REGIONAL FLOOD CHARACTERISTICS OF SMALL RURAL WATERSHEDS IN THE ARKANSAS RIVER BASIN IN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
R. K. Livingston.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224313, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-112, 1981. 43 p, 7 Fig, 9 Tab, 43 Ref.

Descriptors: *Model studies, *Flood data, *Small watersheds, *Rainfall-runoff relationships, Storm runoff, Runoff forecasting, Flood flow, Streamflow, Flood peak, Flood frequency, Regional analysis, Frequency analysis, Estimating, Hydrographs, *Colorado, *Arkansas River basin.

Both recorded and synthetic rainfall-runoff and annual peak-discharge data for 17 rural watersheds were analyzed to evaluate the magnitude, frequency, and volume of floods in the plains region of the Arkansas River basin in Colorado. Flood-frequency relations from analysis of recorded data were weighted or combined with flood-frequency relations from analysis of synthetic data to provide improved estimates of selected flood characteristics for 15 of these watersheds. The 10-, 25-, 50-, and 100-year peak discharges were regionalized using multiple-regression and station-year methods. Regression relations were developed to determine peak discharge from effective drainage area (standard error of estimate 30 to 50 percent) and flood volume from peak discharge (standard error of estimate 62 percent) for ungaged basins between 0.5 and 15 square miles in size. Using these two flood characteristics, a dimensionless hydrograph method provides synthetic hydrographs very similar in shape to recorded flood hydrographs. (USGS)
W82-02462

SELECTING SEASONAL STREAMFLOW MODELS,

Idaho Univ., Moscow. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 2E.
W82-02502

COMPARISON OF BEHAVIOR OF TWO SUB-BASINS IN THE TURTLE CREEK DRAINAGE SYSTEM,

Beloit Coll., WI. Dept. of Geology.
R. C. Stenstrom, and A. Witmer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157819, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin, Madison, Technical Report WIS-WRC-81-04, 1981. 29 p, 26 Fig, 1 Tab, 10 Ref. OWRT-A-091-WIS(1), 14-34-0001-0153.

Descriptors: *Agricultural watersheds, Basins, Drainage area, Drainage systems, Flood control, Floods, Precipitation, Rain gages, Rainfall, Rainstorms, *Urban watersheds, Watersheds, *Rainfall-runoff relationships, *Little Turtle basin, *Spring Brook basin, Wisconsin.

During the summer and fall of 1980 the Little Turtle and Spring Brook Sub-basins of the Turtle Creek Drainage in southern Wisconsin were studied for the response to rainfall events. Surface and subsurface characteristics of the two basins were similar, however, the shape and drainage features differed markedly. Each basin was monitored by 10 rain gauges and two recording rain gauges placed at the ends of a line running approximately east-west through the basin. Observations of three events show that in urbanized areas of Spring Brook the reduced lag time for storm runoff leads to multiple peaks from a single rainfall. Preliminary calculations indicate a larger discharge from the storm-sewered area than from the unurbanized segment of the basin, even though it represents only about 25% of the area. The response of the unurbanized segment is not as complex. However, the Little Turtle Basin, with its many tributaries, produces a multiple peaked flow from three various lag times for tributary arrivals. Because of the complexity involved, the behavior of the basins in a number of storms must be examined before a valid model can be attempted.
W82-02528

MATHEMATICAL MODELS OF WATER YIELD WITH PARTICULAR REFERENCE TO MISSISSIPPI WATERSHEDS, INTERIM REPORT NO. 2: MATHEMATICAL MODELING OF WATERSHED YIELD,

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
V. P. Singh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157868, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute, Mississippi State University Report, October, 1981. 50 p, 12 Fig, 5 Tab, 58 Ref. OWRT-A-129-MISS(2), 14-34-0001-1126.

Descriptors: *Watersheds, *Mathematical models, *Water yield, Antecedent moisture content, Evapotranspiration, Effective precipitation, Infiltration, Rainfall-runoff relationships, Deep percolation, Base flow, Meteorology, Soil moisture, *Mississippi, Hamon model, Haan model, TVA model, Water balance model, SCS curve number model, Singh-Dickinson model.

The objective of this project is to develop procedures for determination of daily, monthly and yearly yields of water for small natural watersheds with particular reference to the State of Mississippi. These procedures will employ simple systems analysis techniques so that they can be readily utilized in solution of practical problems relating to water resources management and development. An important aspect of this study pertains to determination of sediment yield and sediment discharge graph for a given rainfall episode. In the second year of this study an attempt was made to develop simple mathematical tools for establishing a relationship between storm runoff and the resulting sediment yield for small upland watersheds. These tools can be useful in planning and management of water resources. Currently there exists a multitude of water yield models developed in various parts of the U.S.A. A survey of these models has been made which indicates that one model is not uniformly better than the other. Each model has its strengths and weaknesses. Our aim is to synthesize those components of the models which are particularly suited for this project.
W82-02533

NUTRIENT CONTENTS OF PRECIPITATION AND CANOPY THROUGHFALL UNDER CORN, SOYBEANS, AND OATS,

South Dakota State Univ., Brookings. Dept. of Plant Science.
For primary bibliographic entry see Field 2I.
W82-02574

2B. Precipitation

PRECIPITATION TRENDS AND VARIABILITY IN THE VICINITY OF NORTHWEST GULF COAST: 1900-1990,

Texas A and I Univ., Kingsville. Dept. of Geography and Geology.
For primary bibliographic entry see Field 2L.
W82-02159

RAINFALL-RELATED TRENDS IN THE STRUCTURE OF A FISH-CRUSTACEAN COMMUNITY IN TEXAS' GALVESTON BAY SYSTEM,

Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
For primary bibliographic entry see Field 2L.
W82-02160

ACCURACY OF POINT PRECIPITATION MEASUREMENTS,

Danish Meteorological Inst., Copenhagen.
P. Allerup, and H. Madsen.
Nordic Hydrology, Vol 11, No 2, p 57-80, 1980. 4 Fig, 5 Tab, 12 Ref.

Descriptors: *Precipitation, *Rainfall rate, *Rainfall distribution, Gages, Wind, Rainfall area, Net rainfall, Rain gages, Measuring instruments, Wind gages, Windbreaks.

The normal-exposed Hellmann raingauge only catches 85 per cent of the true precipitation on a yearly basis. This is mainly due to aerodynamic effects. A statistical model analyzing the ratio of daily amounts of precipitation measured at ground level and at standard height is set up for describing this influence. This model relates the ratio between liquid precipitation measured at ground level and at standard height to wind speed during rain and rain intensity. It is well-suited for automatic weather stations where simultaneous measurements of wind speed and rain intensity are performed. Corrections due to liquid and solid precipitation are presented, as are corrections for different sheltered and unsheltered exposures. (Titus-FRC)
W82-02209

DENDROCLIMATIC ESTIMATES OF A DROUGHT INDEX FOR NORTHERN VIRGINIA,

Geological Survey, Reston, VA. Water Resources Div.
L. J. Puckett.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00 in paper copy. Geological Survey Water-Supply Paper 2080, 1981. 39 p, 7 Fig, 7 Tab, 39 Ref.

Descriptors: *Dendrochronology, *Climatology, *Drought, *Precipitation, Evapotranspiration, Estimating, Hemlock trees, Sampling, Sites, Temperature, Regression analysis, Moisture stress, Moisture deficiency, Water shortage, Climatic data, *Virginia, Northern Virginia, Palmer drought severity index.

Tree-ring widths were used to calculate a 230-year estimate of the July Palmer drought severity index (PDSI) for northern Virginia. Samples of eastern hemlock were collected at three locations in northern Virginia. Annual growth increments were measured and converted to standardized indices. The response of growth to climate was determined to be positively correlated with precipitation and negatively correlated with temperature during the May-July growing season. Multiple regression was used to calculate a mathematical formula for the growth-climate relationship. Growth accounted for 20-30 percent of the PDSI variance, using the standardized indices. Factor scores of the standardized indices were only slightly better predictors of PDSI. Greatest improvement was made by using factor scores of individual trees. With this procedure 64 percent of the July PDSI variance was accounted for. Comparison of the results with a 279-year estimate of July PDSI from New York, showed agreement between low-frequency climatic trends. Analysis of the Central Mountain climatic division PDSI estimate indicated that dry years occurred most frequently during the last half the 19th and mid-20th centuries. These results are considered as first generation products, and suggest that with refined techniques more accurate estimates of prior climatic conditions will be possible. (USGS)
W82-02468

2C. Snow, Ice, and Frost

MEAN CHARACTERISTICS OF ASYMMETRIC FLOWS: APPLICATION TO FLOW BELOW ICE JAMS,

Iowa Univ., Iowa City. Inst. of Hydraulic Research.
M. Gogus, and J-C. Tatinclaux.
Canedian Journal of Civil Engineering, Vol 8, No 3, p 342-350, September, 1981. 12 Fig, 13 Ref.

Descriptors: *Ice jams, *River flow, Rivers, Ice, Hydraulics, Model studies, Simulation.

This study attempts to quantify the interaction between two parallel flow boundaries with different roughness characteristics. Only rigid and essentially plane boundaries are considered, to eliminate the complicating factors of sediment transport and bed form that a movable bed would have introduced. Parameters to be identified are the friction factors at both boundaries, the relative extent of the zones of influence of the boundaries as delimited by the location of the maximum velocity, average velocities in these two zones, and the shear stress or friction factors at the interface between these two zones. The study was performed in a laboratory flume. Contrary to common assumption, the location of the maximum velocity was not a point of zero shear stress when the bed and the cover had different roughness characteristics.

Semi-empirical and graphical relationships between bed and cover friction factors, relative location of maximum velocity, and bed and cover roughness sizes are presented which are sufficient to estimate the mean flow characteristics below the cover for a given flow discharge and flow depth below cover. The results of this study may be significant in calculating characteristics of river ice jams in their initial stage of formation when their roughness is significantly greater than that of the river bed. (Baker-FRC)
W82-02237

CLIMATIC RELATIONSHIPS OF PERMAFROST ZONES IN AREAS OF LOW WINTER SNOW-COVER,

Calgary Univ. (Alberta). Dept. of Geography.
S. A. Harris.
Arctic, Vol 34, No 1, p 64-70, March, 1981. 10 Fig, 34 Ref.

Descriptors: *Permafrost, *Snow cover, *Cold regions, Arctic, Arctic zones, Frozen ground, *Climatology, Seasonal variation, Climates, Norway, Iceland, Spitzbergen, Canada, Mongolia, Prediction, Climatic zones, Semiarid climates, Spatial variation.

This paper discusses a new method of climatic prediction for specific conditions which are fairly widespread in permafrost regions. It then examines the spatial variation of some climatic data from semi-desert to permafrost regions in parts of western North America. In areas with under 50 cm snow cover in winter, the permafrost zones show diagnostic long term freezing indices and thawing indices. The warmer boundary of the zone of continuous permafrost traverses the mean annual air temperature (MAAT) isotherm. The boundary between discontinuous and sporadic permafrost lies just on the cold side of zero degrees centigrade MAAT. The sporadic permafrost zone includes the zone of ice caves and the regions with patches of ice beneath ponds and peat bogs, extending to 5 degrees C MAAT at a thawing index of 4000 degree days per year. The relationship is applicable to Norway, Iceland, Spitzbergen, Canada and the People's Republic of Mongolia. (Baker-FRC)
W82-02239

ESTIMATES OF THE MAGNITUDE OF GLACIER OUTBURST FLOODS FROM LAKE DONJEK, YUKON TERRITORY, CANADA,

British Columbia University, Vancouver. Dept. of Geophysics and Astronomy.
G. K. C. Clarke, and W. H. Mathews.
Canadian Journal of Earth Sciences, Vol 18, No 9, p 1452-1463, September, 1981. 5 Fig, 7 Tab, 26 Ref.

Descriptors: *Glacial lakes, *Flood forecasting, Ice, Donjek River, Rivers, *Canada, Melt water, Runoff, *Lake Donjek.

A close examination of the probable magnitude of outburst floods which may be expected from Lake Donjek in the next 50 years has been made. Few tools exist for determining the flood potential of glacier-dammed lakes. This study began by selecting an outburst flood from a reservoir of comparable size to Lake Donjek and using this flood as a reference against which to compare predictions for Lake Donjek. In the simulation model constructed, water volume was one of several factors which influenced flood magnitude. The flood data employed resulted from the event in September 1967 when Summit Lake emptied. This lake is dammed by Salmon Glacier and empties through a 12 kilometer ice tunnel into the Salmon River. A transition occurred from stable surface drainage to unstable subglacial drainage. The December 1961 outburst flood from Summit Lake damaged the Ninemile bridge across Salmon River and an access road. There are 15 recorded outburst floods from Summit Lake. The simulation model constructed was able to reproduce the essential features of the discharge hydrogen for the September 1967 outburst from Summit Lake. The volume of Lake Donjek reservoir is currently roughly 234,000,000 cubic meters, depending on the point to which the ice margin moves during a glacier advance. The empirical Clague-Mathews formula predicts a peak discharge of 2900 cubic meters per second for Lake Donjek floods. The simulation model predicts that outburst floods from Lake Donjek are likely to be more severe than those from Summit Lake. A maximum discharge in the range of 677 to 5968 cubic meters per second is predicted. The most probable range is 3968-5938 cubic meters/second. (Baker-FRC)
W82-02241

SNOWMELT, GLACIER MELT, AND HIGH ARCTIC STREAMFLOW REGIMES,

McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W82-02249

SUMMER REAERATION AND WINTER ICE REMOVAL FROM LAKES AND RESERVOIRS,

Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2H.
W82-02526

SNOW BARRIER POTENTIAL FOR HARVESTING MOISTURE IN TRANSECTS ACROSS CHINOOK AREAS IN MONTANA--SUMMARY REPORT,

Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
J. M. Caprio, G. K. Grunwald, and R. D. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157926, Price codes: A06 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Montana State University, Report No 115, September, 1981. 92 p, 24 Fig, 18 Tab, 15 Ref. OWRT-B-046-MONT(1).

Descriptors: *Soil moisture, Snow cover, Climatology, Field investigations, Lysimeters, Soil moisture retention, *Water harvesting, *Snow traps, Snowmelt, *Chinook belt, *Montana, Stubble fields.

The differential effects of snow barriers for trapping moisture in the chinook region of Montana were evaluated on standing small-grain stubble. During each of three winters treatments at each of 4 to 6 experimental sites on each of two transects included fallow and adjacent stubble areas situated in alternating north-south strips approximately 50 meters wide. Observations at each site included depth and density of snow cover, precipitation, near-surface soil moisture, depth of frozen ground, and moisture collected in mini-lysimeters. The results indicated that (1) ground froze about 20 to 30% deeper in fallow fields, (2) soil moisture in the 0-15 cm surface layer averaged slightly greater during the winter in stubble fields, (3) snow depth was greater in standing stubble and varied from 80% more during the driest winter to only about 30% more during wettest winters, (4) mini-lysimeters caught about 75% more water in standing stubble fields during the dry winter, but differences of only a few percent were noted during the wet winter, (5) snowmelt recharge efficiency (SRE) for mini-lysimeters was about 20% less in chinook areas compared to non-chinook areas during the dry year. Data from saturated mini-lysimeters in late summer indicated that evaporation is reduced about 40% by the presence of standing stubble. A model using lysimeter SRE suggests that both stubble efficiency and non-chinook efficiency vary inversely as the amount of winter precipitation. (Hunt-Mont)
W82-02539

COMPARISON OF AREAL SNOW STORAGE SAMPLING PROCEDURES FOR RANGELAND WATERSHEDS,

Science and Education Administration, Beltsville, MD. Hydrology Lab.
W. J. Rawls, T. J. Jackson, and J. F. Zuzel.
Nordic Hydrology, Vol 11, No 2, p 71-82, 1980. 2 Tab, 7 Fig, 15 Ref.

Descriptors: *Watersheds, *Range management, Snow sampling, Snow, *Snow surveys, Snow storage, Sampling, Snow accumulation, Old snow, Snow management, Snow depth, Snow samples, Remote sensing, Photogrammetry, Comparison studies, Reynolds Creek Experimental Watershed, *Idaho.

The accuracy of photogrammetry in determining snow depth in mountainous reangland watersheds was evaluated on a subbasin of the reynolds Creek Experimental Watershed in southwestern Idaho. Random checking of points indicated that snow depths were determined with a standard error of + or - 15 cm for a mean snow depth of 1.2 m. The lag time between the photography and the usable result and the need for a coordinated field survey make the technique a research tool. As the total watershed snow cover decreased, more samples were needed to produce the same level of accuracy. Accurately could be improved by setting a grid perpendicular to the direction of the predominant wind. (Titus-FRC)
W82-02555

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION AND LEAF WATER STATUS OF ALFALFA GROWING UNDER ADVECTIVE CONDITIONS,

British Columbia Ministry of Environment, Kamloops.
R. J. Williams, and D. G. Stout.
Canadian Journal of Plant Science, Vol 61, No 3, p 601-607, July, 1981. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Alfalfa, *Advection, *Water potentials, Leaves, Crop yield, Plant growth, Evapotranspiration control, Evapotranspiration potential, *Evapotranspiration.

The objectives of this study were to examine the contribution of advection to evapotranspiration from alfalfa and to determine the influence of evapotranspiration on alfalfa water status. Measurements were conducted during the 1978 growing season in a field of irrigated alfalfa located near Kamloops, British Columbia, in the Thompson River valley. A potentially large heat source in the form of an oil refinery was situated to the south. Percent soil moisture data were determined gravimetrically throughout the summer at depths of 2.5, 10, 20, and 50 cm. The two sampling periods, early August and early October, both followed irrigation of the entire field. During periods of advection, actual evapotranspiration (LE) as measured by the Bowen ratio energy balance method exceeded both the net radiation and the potential evapotranspiration (PE) calculated by the physically based formula of Priestly and Taylor. During advection the net radiation was a better approximation of LE than was PE. During nonadvection periods LE was about equal to PE. It was noted that a modification of PE as designed by Jury and Tanner in 1975 for advective conditions gave favorable results during priods immediately following irrigation. Diurnal measurements revealed that the leaf osmotic potential reached a minimum by about 1200 hr and then remained constant even though LE continued at a high rate. Leaf osmotic potential measured at 0900 hr reflected soil moisture conditions. At 1400 hr, leaf osmotic potential reflected both soil moisture conditions and environmental demand. (Baker-FRC)
W82-02295

PRACTICAL PREDICTION OF ACTUAL EVAPOTRANSPIRATION,

International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
P. J. Slabbers.
Irrigation Science, Vol 1, No 3, p 185-196, 1980. 7 Fig, 1 Tab, 41 Ref.

Descriptors: *Evapotranspiration, *Water potential, *Soil-water-plant relationships, Prediction, Irrigation requirements, Leaves, Soil moisture deficiency, Water use, Developing countries, Corn, Alfalfa, Soybeans, Sorghum, Wheat, Potatoes.

A simplified method is presented for predicting actual evapotranspiration. It is suitable for use in

developing countries lacking the necessary data for sophisticated techniques. A relationship is developed between a crop-dependent critical leaf water potential, potential evapotranspiration rates, and the fraction of available soil moisture at which a reduction in evapotranspiration occurs. Several simplifying assumptions are made to reduce the amount of field data required for calculations. The calculated and measured rates of evapotranspiration agreed well for maize, alfalfa, sorghum, wheat, and soybean crops, but not for potato. For crops with critical leaf water potentials above -7.5 bars, there was a 10% error in estimating the fraction of available soil moisture at which reduction in evaporation occurs. The method is not applicable for crops grown in greenhouses, hydroponics, saline conditions, root asphyxia, or extreme moisture regimes. (Cassar-FRC)
W82-02308

2E. Streamflow and Runoff

SURFACE WATER FLOW FROM A SOUTH FLORIDA WETLAND AREA,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL. Div. of Ocean Engineering.
J. van de Kreeke, and E. Daddio.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in papercopy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol. I, October, 1981. p 232-240, 5 Fig, 4 Ref.

Descriptors: *Wetlands, *Surface flow, *Rainfall-runoff relationships, Mangrove swamps, Marshes, Water discharge, Elevation, Evapotranspiration, *Florida, Runoff.

The study site is a wetland region of approximately 5,300 acres near Marco Island in southwest Florida. Vegetation ranges from impounded mangrove wetlands on the south, to freshwater marsh, to pine, palmetto, and farm areas on the north. Elevations grade from about 0.6 m a.s.l. along the southern boundary to 1.5 m on the north. The basin has been divided into two separate hydrologic units by construction of the Belle Mead Grade. Water export was determined with a semi-empirical relationship between discharge and water elevation differences across culverts which convey surface runoff out of the study area. Monthly water export ranges from 270,000 cu m/month for November 1977 to 3,510,000 cu m/month for July 1977. The total rainfall for the one year period beginning June 1977 is 144 cm or 31,100,000 cu m for the drainage basin, of which 16,600,000 cu m was discharged through the culverts. This yields a runoff ratio of 0.53. Assuming no net water storage over a period of a year, the remaining 47% of rainfall is lost largely by evapotranspiration. (Moore-SRC)
W82-02121

FRESHWATER FLOW RATES AND DISTRIBUTION WITHIN THE EVERGLADES MARSH,
National Park Service, Homestead, FL.
P. C. Rosendahl, and P. W. Rose.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 385-401. 9 Fig, 1 Tab, 6 Ref.

Descriptors: *Shark River Slough, Florida, *Flow rates, *Flow discharge, *Remote sensing, Laminar flow, Spatial distribution, Water storage, Seasonal variation, Flooding, Aquatic productivity, Everglades.

The Shark River Slough originates outside and flows into the Everglades National Park. A minimum annual flow rate of 260,000 acre-feet into the park has been mandated, and, because of the slough dimensions and low hydraulic gradients, new techniques for discharge and distribution were required. A tracer dye was used in conjunction with Landsat imagery to determine sheet flow rates, spatial distribution and volumetric storage. Velocities of 0-0.035 ft/s were measured, below the detection limits of conventional instruction. When coupled with cross-sectional area calculations, a reasonable estimate of the slough's contributions to the estuarine region was 200-2000 cu ft/s. Freshwater distribution within the slough was subject to seasonal inundation fluctuating between 93,000 - 245,000 acres, providing storage estimates between 26,000 - 208,000 acre-feet for the dry and wet seasons, respectively. Such shifts in available surface water play a significant role in driving the productivity of the Everglades ecosystem. (Brambley-SRC)
W82-02163

AQUIFER RESPONSE DUE TO ZONES OF HIGHER PERMEABILITY AND STORAGE COEFFICIENT,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-02190

DISTRIBUTION OF JOINT RUN-LENGTHS OF BIVARIATE MARKOV PROCESSES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulic and Water Power.
M. Bayazit.
Journal of Hydrology, Vol 50, No 1-3, p 35-43, March, 1981. 3 Fig, 4 Tab, 5 Ref.

Descriptors: *Drought, *Streamflow, *Joint negative run lengths, Markov process, Rivers, Hydrology, Stochastic process, Mathematical studies, Monte Carlo method.

A theoretical expression is derived for the probability distribution of joint negative run lengths of stationary, mutually and serially dependent bivariate Markov processes. Negative run length, defined as the length of the period during which a stream flow remains continuously below a certain truncation level, characterizes a drought or dry period occurring at two locations simultaneously. It was found that the joint negative run lengths are distributed geometrically with a parameter that depends on the correlation coefficient and the truncation level. The derived equations were applied to monthly and annual flow records from two pairs of rivers (Gota and Vuoksi, Danube and Elbe) with reasonable agreement. (Cassar-FRC)
W82-02191

MEAN CHARACTERISTICS OF ASYMMETRIC FLOWS: APPLICATION TO FLOW BELOW ICE JAMS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 2C.
W82-02237

ESTIMATES OF THE MAGNITUDE OF GLACIER OUTBURST FLOODS FROM LAKE LONJEK, YUKON TERRITORY, CANADA,
British Columbia University, Vancouver. Dept. of Geophysics and Astronomy.
For primary bibliographic entry see Field 2C.
W82-02241

FLOOD EVENT MODELING - A STUDY OF TWO METHODS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2A.
W82-02291

PERIPHYTON PRODUCTION IN AN APPALACHIAN MOUNTAIN TROUT STREAM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-02335

METABOLISM OF A DESERT STREAM,
Arizona State Univ., Tempe. Dept. of Zoology.
For primary bibliographic entry see Field 1A.
W82-02349

A REVIEW OF SINGLE-SITE MODELS FOR MONTHLY STREAMFLOW GENERATION,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and W. Ruksasilp.
Journal of Hydrology, Vol 52, No 1/2, p 1-12, June, 1981. 3 Tab, 18 Ref.

Descriptors: *Streamflow, *Model studies, Simulation, Computers, Standard deviation, Mathematical studies, Monthly distribution.

Models for the generation of monthly streamflows are considered and modified with a view to preserving the three important descriptors, the mean, standard deviation and skewness coefficient of each monthly sequence. In order to evaluate the four models used, the number of negative values generated and the computer time required are also considered. The four models were the Thomas-Fiering model, the First Spolia-Chander model, the Second Spolia-Chander model, and the Sen model. It was noted that monthly means and standard deviations of the historical sequences were preserved very well by all the models under study, even though a moderate size of 1000 yr was used for generated sequences. The historical records of the Mekong River are negatively skew for several months, while those of the Ping and Pasak Rivers are always positively skew. For the second model of Spolia and Chander, an unacceptable value for the skewness coefficient was obtained from the 1000 yr generated sequence. The skewness coefficient of the random component in the modified model of Spolia and Chander with a second-order autoregressive process for the residul series can be computed. In addition to being able to preserve the aforementioned descriptors of historical records, the Thomas-Fiering model is simple in parameter estimation and thus produces less negative values and consumes less computer time. Thus it is recommended for use as long as one is concerned with the preservation of the mean, standard deviation, and skewness coefficient of historical data. (Baker-FRC)
W82-02368

RELATIONSHIP OF THE ROUGHNESS COEFFICIENT MANNING'S N AND DISCHARGE IN AN URBAN RIVER,
University Coll., London (England). Dept. of Geography.
G. Richards, and G. E. Hollis.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 357-360, July, 1980. 2 Fig, 5 Ref.

Descriptors: *Flow discharge, *Rivers, *Field tests, *Channel flow, *Roughness coefficients, Channel morphology, Velocity, Mathematical models, Mathematical equations, Cross sections, Electronic equipment, Brent River, London, England.

Recent work has shown that the widely used Manning formula employing published values of the roughness coefficient, n, can be misleading. In a study of five large natural channels, Sargent found that as discharge increased, Manning's n decreased toward an asymptotic value as bankfull discharge was approached. In three of five reaches the observed values of n were consistently below those that would have been assumed in the absence of experimental evidence. Data from the river Brent in London is presented which confirms these criticisms and highlights the problems of characterizing channel roughness with a single value. (Titus-FRC)
W82-02376

POSSIBILITY OF INVESTIGATING OPEN-CHANNEL FLOWS ON AN ANALOG COMPUTER,
For primary bibliographic entry see Field 6A.
W82-02389

THE RELATIVE INFLUENCE OF DAMS AND SECULAR CLIMATIC CHANGE ON DOWNSTREAM FLOODING, AUSTRALIA,
Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
S. J. Riley.
Water Resources Bulletin, Vol 17, No 3, p 361-366, June, 1981. 2 Fig, 5 Tab, 20 Ref.

Descriptors: *Dams, *Flood frequency, *Rainfall, Flood peak, Flood recurrence interval, Warragamba Dam, Hawkesbury River, *Australia, Precipitation.

The Warragamba Dam has negligible effect on downstream flooding in the Hawkesbury River catchment, eastern Australia, according to examination of 100 years of flood records at Windsor. This dam, completed in 1960, includes 62% of the catchment and has a capacity of 2092 million cu meters. Four smaller dams (81-214 million cu meters) were built on the river in 1907, 1926, 1927, and 1935. For statistical analysis, the 100 year period was divided into five 20 year periods to detect the effect of these dams. It was established that there were no significant changes in channel depth or configuration during the past 100 years. Flood frequency was twice as great for 1939-1978 (26 yearly) as for 1879-1938 (10-17 yearly), reflecting the well-known change in seasonality and increase in total annual precipitation starting in 1940. This increased rainfall is the most important variable in determining flood regime. No significant differences in mean peak flood height or variance of flood heights were seen among the five 20 year periods. (Cassar-FRC)
W82-02425

POINT PROCESS MODELS OF RAINFALL,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W82-02452

RAINFALL-RUNOFF MODELING AND PRELIMINARY REGIONAL FLOOD CHARACTERISTICS OF SMALL RURAL WATERSHEDS IN THE ARKANSAS RIVER BASIN IN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2A.
W82-02462

PRELIMINARY APPRAISAL OF EPHEMERAL-STREAMFLOW CHARACTERISTICS AS RELATED TO DRAINAGE AREA, ACTIVE-CHANNEL WIDTH, AND SOILS IN NORTHWESTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
H. R. Hejl, Jr.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Prices: $2.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-64, 1980. 15 p, 1 Fig, 3 Tab, 6 Ref.

Descriptors: *Surface drainage, *Flood discharge, *Ephemeral streams, *Flood forecasting, *Mathematical studies, Regression analysis, Channel morphology, Gaging stations, Estimating, Runoff, Flood recurrence interval, *New Mexico, San Juan Basin.

Regression equations are presented to predict ephemeral streamflow characteristics in the San Juan Basin in northwestern New Mexico. The standard error of estimate for predicting runoff for water year 1978 using drainage area as the independent variable was 152 percent. Indications are that reliable equations for predicating annual runoff can be developed and the standard error of estimate might be reduced significantly with additional years of record. The coefficient of regression when relating drainage area to runoff for water year 1978 was significant at the 1-percent level. Preliminary results also indicate it is feasible to predict streamflow characteristics using hyrologic soil-group classifications based on runoff potential. The standard error of estimate for predicting peak discharges with recurrence intervals of 2, 5, 10, 25, 50, and 100 years using active-channel width as the independent variable averaged about 50 percent, and the regression coefficient was significant at the 1-percent level. Using drainage area to predict peak discharges resulted in a standard error of estimate that averaged about 60 percent and a regression coefficient significant at the 5-percent level. The standard error of estimate averaged about 45 percent when active-channel width and drainage area were related to peak discharges in multiple regression analyses. (USGS)
W82-02476

HYDRAULIC ANALYSIS OF CHENANGO RIVER, BROOME COUNTY, NEW YORK, IN RELATION TO STATE HIGHWAY PLAN,
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W82-02477

FLOOD OF NOVEMBER 26-27, 1979, IN ESSEX COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. J. Zembrzuski, Jr.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $1.75, Microfiche $3.50. Geological Survey Open-File Report 80-1024, 1981. 10 p, 3 Tab, 4 Fig, 5 Ref.

Descriptors: *Floods, Flash floods, *Storm runoff, *Washouts, Streams, Flood damage, Flood peak, Flood recurrence interval, Flood frequency, Indirect flood measurement, Flood data, *New York, *Essex County.

On November 26-27, 1979, flash flooding of several streams in Essex County, N.Y., resulted in five deaths and millions of dollars of property damage. The most severe flooding was in the headwaters of the Bouquet and East Branch Ausable river basins. Peak discharge of The Branch, the Bouquet River tributary on which a section of highway washed out, was 6,600 cubic feet per second at a measurement site 1 mile west of Elizabethtown. The exceedance probability of this discharge is estimated to be less than 0.01 (recurrence interval greater than 100 years). (USGS)
W82-02483

FLOODS OF MARCH 1978 IN THE MAUMEE RIVER BASIN, NORTHEASTERN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
R. E. Hoggatt.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $2.50, Microfiche $3.50. Geological Survey Open-File Report 81-695, 1981. 81 p, 2 Fig, 2 Tab, 3 Ref.

Descriptors: *Floods, *Flood damage, Flood peak, *Flood data, Flood discharge, Flood recurrence interval, Flood flow, Precipitation, *Indiana, *Maumee River basin, *Fort Wayne.

Floods in the Maumee River basin in northeastern Indiana in March 1978 resulted in heavy damage in Fort Wayne and surrounding areas. Flood damage in Fort Wayne was estimated by the Mayor to be 11 million dollars. Approximately 15 percent of the city was inundated, and 2,400 of its 190,000 residents were forced to leave their homes. The estimate of damage in Adams and Allen Counties by Civil Defense officials was 44 million dollars. The Maumee River at New Haven exceeded the peak stage of record, 21.4 feet, by 2.2 feet. The peak discharge at this stream-gaging station, 22,400 cubic feet per second, was about equal to that of a 75-year flood. Recurrence intervals of peak flows on streams tributary to the Maumee River ranged from 5 to 50 years. Records of peak and daily discharges and some precipitation data are given in this report. (USGS)
W82-02485

SELECTING SEASONAL STREAMFLOW MODELS,
Idaho Univ., Moscow. Dept. of Electrical Engineering.
T. B. Cline.
Water Resources Research, Vol 17, No 4, p 975-984, August, 1981. 8 Fig, 7 Tab, 28 Ref. OWRT-A-065-IDA(2).

Descriptors: *Streamflow forecasting, *Model studies, *Boise River, Idaho, Correlation analysis.

Akaike's information criterion (AIC) and Kashyap's posterior probability criterion (PP) are useful in selecting a final candidate from a group of seasonal autoregressive integrated moving average models for forecasting streamflows. The criteria solve the problem of comparing models with different transformations of the observations. Monthly average streamflow on the Boise River, Idaho, is modeled using the described criteria. Results indicate that no single model selection method should be used for model building. Ideally, the correlation methods should be used for preliminary model identification and either the AIC or PP used to choose the final model. They are especially valuable for choosing between transformational classes and for resolving the trade-off between goodness of fit and parsimony. Some guidelines are: (1) for seasonal models, count parameter redundances due to cross products as unknown parameters, and (2) validate parameter estimates and candidate structures before making a final selection on the basis of minimizing the crierion. For moderate sample sizes (600 in this study) the difference between AIC and PP is consistent but small, and should not affect the ranking of candidate models. (Cassar-FRC)
W82-02502

HYDRAULICS OF FLOW AND SEDIMENT TRANSPORT IN THE KANKAKEE RIVER IN ILLINOIS,
Illinois State Water Survey, Champaign.
For primary bibliographic entry see Field 2J.
W82-02512

COMPARISON OF BEHAVIOR OF TWO SUBBASINS IN THE TURTLE CREEK DRAINAGE SYSTEM,
Beloit Coll., WI. Dept. of Geology.
For primary bibliographic entry see Field 2A.
W82-02528

MATHEMATICAL MODELS OF WATER YIELD WITH PARTICULAR REFERENCE TO MISSISSIPPI WATERSHEDS, INTERIM REPORT NO. 2: MATHEMATICAL MODELING OF WATERSHED YIELD,
Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-02533

THE EFFECT OF CURRENT ON THE DISTRIBUTION OF DIATOMS SETTLING ON SUBMERGED GLASS SLIDES,
For primary bibliographic entry see Field 7B.
W82-02567

2F. Groundwater

PROCEEDINGS AND RECOMMENDATIONS OF THE WORKSHOP ON GROUNDWATER PROBLEMS IN THE OHIO RIVER BASIN, APRIL 28-29, 1981. CINCINNATI, OHIO.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153354, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center, Purdue University, West Lafayette, Indiana, Report, 1981. 104 p, 22 Fig, 20 Tab, Append. OWRT-C-90054-T(9615)(2).

Descriptors: *Surface-groundwater relations, *Groundwater potential, *Ohio River Basin, Aquifer, Groundwater management, Groundwater pollution, Symposium.

The workshop was an outgrowth of an activity by the Ohio River Basin Commission's Task Force on ground and surface water interrelationships. The task force, composed of representatives of the eleven Ohio River Basin states' Water Resources Research Centers, organized the workshop to provide an opportunity for state and federal water resource professionals to come together with the university community and representatives of industry and the private sector to examine state and regional ground water management problems and needs in the 160,000 square-mile Ohio River Basin drainage area. Presentations by state, federal, university and industry representatives focused on identification and discussion of the full range of state and regional technical and policy-related ground water management problems, provided information on related federal agency programs and research activities, and examined developments in ground water quality and quantity modeling. The principal activity of the workshop surrounded the four work group sessions held to discuss the details of specific needs and problems and to develop recommendations for action. The work groups were made up of (1) legal/institutional, (2) monitoring, (3) methods, and (4) groundwater interrelationship. The proceedings presents recommendations for action by the Commission or subsequent river basin institution.
W82-02106

THE GROUND WATER FLOW SYSTEM IN THE VICINITY OF MARCO ISLAND, FLORIDA,

Geraghty and Miller, Inc., West Palm Beach, FL.
V. P. Amy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, Oct. 1981. p 252-263, 4 Fig, 11 Ref.

Descriptors: *Saline water, *Groundwater movement, *Chlorides, *Unconfined aquifers, Artificial lakes, Seawater, Wetlands, Geohydrology, Evaporation, Marco Island area, *Florida.

The planned development of a coastal area near Marco Island includes the creation of a series of interconnecting lakes ranging in depth from a few feet to as much as 30 feet. Construction of these lakes will penetrate the water table aquifer in an area that is a mix of coastal wetlands and uplands. The principal goals of this study were to estimate groundwater input to the property and to investigate fresh-salt ground water relationships in the vicinity of Lake Marco Shores. Data was collected from a variety of sources: an existing network of multi-zone monitor wells on the property, new multi-zone wells, exploratory and observation wells installed by the South Florida Waters Management District, and published reports. The Pamilico Sand and the underlying limestone formations respond hydrologically as a single unit, forming a water table aquifer in the area. With the exception of the sample from well 7, water from wells tapping the principal water-bearing zone and the deep portion of the lake contained chlorides well in excess of the normal concentration of sea water. Water from wells tapping the principal zone north of the Belle Meade Grade in salty to brackish. Proceedings northeast from the Belle Meade Grade, the chloride concentration of the ground water lessens. South of the grade, water from the shallow wells ranges from 616 to 23,100 mg/l, while the shallow portions of the lake had chlorides of 3,661 mg/l. The average groundwater flow was calculated as 39.44 gallons per day per linear foot of aquifer width, or 208,000 gallons per day per linear mile. Evaporation is considered to be one of the mechanisms resulting in the formation of hypersaline groundwater. (Moore-SRC)
W82-02123

AQUIFER RESPONSE DUE TO ZONES OF HIGHER PERMEABILITY AND STORAGE COEFFICIENT,

Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and K. S. Rathod.
Journal of Hydrology, Vol 50, No 1-3, p 299-316, March, 1981. 11 Fig, 10 Ref.

Descriptors: *Permeability, *Aquifers, *Storage coefficients, *Groundwater movement, Streamflow, Recharge, Groundwater recharge, Groundwater storage, Candover Chalk catchment, Water table, Model studies, United Kingdom, *Surface-groundwater relations.

The groundwater velocities in an aquifer may be several times higher than background levels in regions of higher permeability (for example, fissures). A backward-difference finite-difference approach was developed to study these situations. A steady state problem was used to illustrate the manner in which groundwater recharge flows through the aquifer and enters a stream. the Interaction between storage and flow in an aquifer is complex, as illustrated by a one-dimensional time variant example. It is shown that a partially penetrating river can draw water from the aquifer. The Candover chalk catchment, United Kingdom, is used as an example in the model. Although the equations used do not directly include vertical flow components, the flow analysis of separate zones indicates that vertical flow components exist and are important for understanding aquifer behavior. Thus the standard regional groundwater flow equation stated in terms of transmissivity, takem as an integral of the horizontal permeabilities, infers the existence of vertical components of flow. (Cassar-FRC)
W82-02190

EFFECTS OF WATER-TABLE CONFIGURATION ON SEEPAGE THROUGH LAKEBEDS,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2H.
W82-02281

A TWO-DIMENSIONAL FINITE-ELEMENT SOLUTION SCHEME FOR THE SATURATED-UNSATURATED FLOW WITH APPLICATIONS TO FLOW THROUGH DITCH-DRAINED SOILS,

Argonne National Lab., IL. Div. of Environmental Impact Studies.
A. B. Gureghian.
Journal of Hydrology, Vol 50, No 1-3, p 333-353, March, 1981. 16 Fig, 19 Ref.

Descriptors: *Water table, *Drainage, *Soil water, Aquifers, Ditches, Model studies, *Groundwater movement, Saturated flow, Unsaturated flow.

A 2-dimensional Galerkin finite element model was designed to predict the steady and transient saturated-unsaturated movement of water in homogeneous and nonhomogeneous ditch-drained aquifers. The parallel, equidistant ditches extend to an impermeable floor. A method for handling the nonhomogeneous boundary conditions at the seepage face for a quasi-correct prediction of the water table is discussed. Examples are presented and compared with numerical solutions for cases with incident rainfall under steady state conditions for homogeneous and layered soils. (Cassar-FRC)
W82-02283

THERMAL CONVECTION IN A NONHOMOGENEOUS AQUIFER,

Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
H. Rubin.
Journal of Hydrology, Vol 50, No 1-3, p 317-331, March, 1981. 7 Fig, 14 Ref.

Descriptors: *Aquifers, *Homogeneity, *Thermal properties, Thermal convection, Permeability, Geothermal studies, Heat transfer, Convection, Thermal conductivity, *Nonhomogeneous aquifers.

The effect of aquifer nonhomogeneity on thermal convection was investigated mathematically. Nonhomogeneity leads to variations in permeability and thermal conductivity of the aquifer. A large temperature difference between bottom and top of the aquifer can induce nonhomogeneity by affecting fluid viscosity and thermal conductivity of the saturated formation. Heat transfer, studied by numerical simulations, showed that the structure of the flow field and the dimensionless parameters characterizing the thermal convection may vary considerably due to aquifer nonhomogeneity. (Cassar-FRC)
W82-02288

EFFECT OF COLD WATER ENTRY INTO A LIQUID-DOMINATED TWO-PHASE GEOTHERMAL RESERVOIR,

Department of Scientific and Industrial Research, Wellington (New Zealand). Applied Mathematics Div.
M. A. Grant.
Water Resources Research, Vol 17, No 4, p 1033-1043, August, 1981. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Geothermal studies, *Injection, *Resources development, Geothermal resources, Pressure distribution, Saturation, Stability.

An analysis is presented of the effect of fluid withdrawal and injection into a two-phase geothermal reservoir, considering pure water-steam mixtures only. A model is presented of the geothermal reservoir matrix treated as a homogeneous medium with injected fluid mixing fully into two-phase fluid. A pressure drop is caused by withdrawal of fluid. Fluid injection causes a pressure change dependent on the fluid enthalpy and rate of injection. For cold fluid injection this is nearly always a pressure drop. The pressure disturbance and change in saturation that occur near the injection point spread through the system. A stability criterion is derived which stabilizes the two-phase fluid. Cold water intrusions occur during exploitation or can occur naturally. For example, at Wairakei, exploitation produced a sub-hydrostatic pressure profile in the two-phase zone and the vapor dominated zone. The two-phase condition is usually absent in the natural state. (Small-FRC)
W82-02314

GEOTHERMAL ENERGY: AN OLD ALLY,

E. Laszlo.
Ambio, Vol 10, No 5, p 248-249, 1981. 2 Fig.

Descriptors: *Geothermal power, *Reviews, Water pollution sources, Sulfates, Chlorides, Silica, Drilling, Hot springs, Powerplants, *Thermal powerplants.

The first geothermal power production experiment began in Larderello, Italy in 1904, with steam emerging from fissures in the earth being used to generate electricity. By 1980 the total installed power capacity from geothermal sources in the world amounted to 2.5 GW. Geothermal energy arises from the radioactive decay of an isotope of potassium and other elements spread about in the earth's crust. As groundwater rarely circulates naturally below 4000 meters deep, the temperature of geothermal hot water and steam is usually below 300 degrees C, and is normally much less. Drilling and heat extraction are currently economically profitable down to about 3000 meters, but techniques should improve that figure down to as much as 5000 meters depth, thus increasing the reachable supply of available energy. High thermal gradients that ensure a heat flow to the surface are found in about 10% of the land area of the world. Low-temperature thermal energy has several uses and has the added benefit of producing only minor environmental effects compared to other energy sources when used. Even so, groundwater may become polluted with chlorides, sulfates and carbonates or silica. If the casting of geothermal boreholes is badly installed, the danger of connecting the geothermal aquifer with a freshwater horizon is greatly increased. Further problems include the release of sulfurous gases to the atmosphere and the discharge of warm water to rivers. The potential of geothermal energy would be greatly increased if heat were to be extracted from hot, dry rocks which do not naturally contain water. (Baker-FRC)
W82-02333

Field 2—WATER CYCLE

Group 2F—Groundwater

UNSTEADY FREE FLOW TO A DITCH FROM AN ARTESIAN AQUIFER,

Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Civil Engineering.
M. A. Gill.
Journal of Hydrology, Vol 52, No 1/2, p 39-45, June, 1981. 4 Fig, 4 Ref.

Descriptors: *Flow, *Confined aquifers, *Groundwater movement, Ditches, Steady flow, Unsteady flow, Mathematical studies, Water level, Wells, Artesian pressure.

A mathematical model has been formulated for a freely flowing ditch under artesian conditions. A solution is obtained for the unsteady condition of flow which reduces to steady state after the lapse of theoretical infinite time. A formula for transient discharge is also given. Such a problem was first introduced in 1969 to predict the future groundwater resources of the African Sahara. At the time a system of wells was considered to be arranged in a line and well spacing was assumed to be small, so that the line of wells was replaced by a two-dimensional ditch for the sake of analysis. A similar problem was formulated in which the water level was suddenly raised at one end of the ditch while at the other end the pressure remained unaltered. In practice, the raising of water level or pressure at one end can be visualized to have been caused by the construction of a dam. The solution proposed in 1969 for the ditch problem was found inconsistent with some of the initial and boundary conditions used. The correct solution is given in this brief communication. (Baker-FRC)
W82-02369

ORIGIN OF ISOTOPIC AND GEOCHEMICAL RATIO GRADIENTS IN KARST WATER OF THE JURA MOUNTAINS. (SUR L'ORIGINE DES GRADIENTS DE TENEURS ISOTOPIQUES ET GEOCHIMIQUES DANS LES EAUX KARSTIQUES DU JURA (FRANCE)),

Franche-Comte Univ., Besancon (France). Lab. de Geologie Structurale et Appliquee.
J. Mudry.
Journal of Hydrology, Vol 50, No 1-3, p 167-178, March, 1981. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Chemical properties, *Geochemistry, *Karst hydrology, Groundwater, Isotope studies, *Jura Mountains, *France, Aquifers, Conductivity.

Isotopic gradients (O18 and tritium) and geochemical gradients (temperature, conductivity, silica, Ca, Mg, Na, K, Cl, sulfates, bicarbonates, and nitrates) were studied in the karst water of the Jura Mountains, France. Climate affected the emergent water temperature and O18 content. Lithology and pollution were responsible for geochemical gradients: K and sulfates deriving from marls and Mg from dolomites. Gradients connected with hydrodynamic properties (ionic activity, silica, and tritium) differed in aquifers with high transmissivity and aquifers with long residence time. Further, they closely followed the geologic structure (a folded zone with large structural gradient and weakly inclined table land). (Cassar-FRC)
W82-02422

THE IMPORTANCE OF DRIFT DEPOSIT INFLUENCES ON THE HYDROGEOLOGY OF MAJOR BRITISH AQUIFERS,

Birmingham Univ. (England). Dept. of Geological Sciences.
J. W. Lloyd.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 346-356, July, 1980. 8 Fig, 16 Ref.

Descriptors: *Hydrogeology, *Aquifers, *Deposition, *Groundwater, Base flow, Geological formations, Wells, Stratigraphy, Rivers, Sand, Gravel, Hydraulic properties, Zones, Field tests, *Great Britain.

The role of drift deposits in major aquifer hydrogeology is examined. Examples are given, indicating important hydrogeological influences exercised by drift deposits on the Chalk aquifer in Essex, Norfolk, and Lincolnshire and on the Triassic Sandstone aquifer in Lancashire and Yorkshire. In drift successions such as in Essex the frequency of lithological change in the vertical sequence is so great that the bulk horizontal permeability is orders of magnitude greater than the bulk vertical permeability. In consequence, groundwater transfer is predominantly horizontal. The gravels exercise an important storage function for the Chalk aquifer. Blow-wells are present in the Lincolnshire aquifer. These are artesian springs which enhance permeability while providing hydraulic control on saline waters. Indirect recharge through Pleistocene sands and gravels in the drift is a significant mechanism in the Triassic sandstones. Permeable drift should be considered in assessments of recharge and supply well locations. (Titus-FRC)
W82-02437

APPROXIMATE ALTITUDE OF WATER LEVELS IN WELLS IN THE CHICOT AND EVANGELINE AQUIFERS IN THE HOUSTON AREA, TEXAS, SPRING 1981,

Geological Survey, Austin, TX. Water Resources Div.
R. K. Gabrysch.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $2.25, Microfiche $1.00. Geological Survey Open-File Report 81-676, June, 1981. 2 Sheets, 1 Ref.

Descriptors: *Groundwater, *Wells, *Water level, *Potentiometric level, Water level fluctuations, Maps, Contours, Aquifers, *Texas, Houston area, Chicot aquifer, Evangeline aquifer.

Two maps show water levels in wells in the Houston, Texas, area in (1) the Chicot aquifer, spring 1981 and (2) the Evangeline aquifer, spring 1981. Both the Chicot and Evangeline aquifers are composed of several sand layers with different potentiometric surfaces. These maps, however, show approximations of single potentiometric surfaces that represent composite hydraulic heads. (USGS)
W82-02459

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1981,

Geological Survey, Tampa, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-02464

SIMULATION OF AN AQUIFER TEST ON THE TESUQUE PUEBLO GRANT, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
G. A. Hearne.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Papcer copy $6.00, Microfiche $3.50. Geological Survey Open-File Report 80-1022, September, 1980. 41 p, 17 Fig, 3 Tab, 14 Ref.

Descriptors: *Model studies, *Aquifer testing, *Simulation, *Water quality, Aquifer characteristics, Geohydrology, Wells, Withdrawal, Hydraulic conductivity, Specific yield, Storage, Chemical analysis, *New Mexico, Tesuque Formation.

An aquifer test was designed and conducted in the anisotropic dipping beds of the Tesuque Formation on the Tesuque Pueblo Grant, N.M. The three-dimensional digital model used to analyze the test approximated the response to the test. The analysis of the geohydrology of the test site in combination with the model calibration has provided estimates of average aquifer characteristics for the group of beds penetrated at the test site; the hydraulic conductivity parallel to the beds is about 2 feet per day, the hydraulic conductivity normal to the beds is about 0.0001 foot per day or lower, the specific yield is about 0.15, and the specific storage is about 0.000002 per foot. (USGS)
W82-02465

WATER LEVELS IN BEDROCK AQUIFERS IN SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
W. L. Bradford.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $19.75, Microfiche $3.50. Geological Survey Open-File Report 81-627, May, 1981. 152 p, 3 Fig, 1 Tab.

Descriptors: *Groundwater, *Water level, *Wells, *Data collections, Bedrock, Aquifers, Water supply, Confined groundwater, Observation wells, Sites, Hydrographs, *South Dakota.

This report on water levels in bedrock aquifers in South Dakota is the result of a continuing investigation begun in 1959 by the U.S. Geological Survey in cooperation with the South Dakota Department of Water and Natural Resources. The purpose of the investigation is to collect data on the artesian water supply in the bedrock aquifers and to present these data in data reports that will aid in planning the use and conservation of water from these aquifers in South Dakota. The locations of wells were data have been collected are included. (USGS)
W82-02466

GROUND-WATER DATA FOR MICHIGAN 1980,

Geological Survey, Lansing, MI. Water Resources Div.
G. C. Huffman.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $7.75, Microfiche $3.50. Geological Survey Open-File Report 81-811, 1981. 57 p, 4 Fig, 3 Tab, 88 Ref.

Descriptors: *Groundwater, *Aquifers, *Water quality, *Wells, *Water level, Water yield, Water use, Well data, Geohydrology, Hydrographs, Water level fluctuations, Water analysis, Chemical analysis, *Michigan.

This report summarizes data on water levels in 133 observation wells and provides information on water quality, well locations, depths, altitudes, and aquifers that they tap. Tabulated data include extremes of water levels for 1980 and for the period of record. Also tabulated is the pumpage of most major ground-water users in Michigan and quality data on selected wells sampled during 1980. Ground water levels were below average in the southcentral and southeastern part of the State, but above average elsewhere. (USGS)
W82-02467

WATER RESOURCES OF THE KISATCHIE WELL-FIELD AREA NEAR ALEXANDRIA, LOUISIANA,

Geological Survey, Alexandria, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-02480

THE AVAILABILITY OF GROUND WATER IN WESTERN MONTGOMERY COUNTY, MARYLAND,

Geological Survey, Towson, MD. Water Resources Div.
E. G. Otton.
Maryland Geological Survey Report of Investigations No 34, 1981. 76 p, 30 Fig, 13 Tab, 35 Ref.

Descriptors: *Groundwater availability, *Hydrologic budget, *Water table, *Aquifers, Crystalline rocks, Sedimentary rocks, Groundwater movement, Geology, Observation wells, Water level, Recharge, Potentiometric level, Well yield, Precipitation, Water use, Water quality, Water management, *Maryland, *Montgomery County.

Western Montgomery County, Md., is underlain by phyllite and schist and by shale, siltstone, and sandstone. Water occurs chiefly in fractures and crevices in the rocks under water-table or modified artesian conditions. The source of all ground water is local precipitation, amounting annually to about 42 inches. Yields of several hundred wells range

from a few to 900 gallons per minute. Specific capacity, a better index of well productivity, ranges widely. The median specific capacity of 21 crystalline-rock wells is 0.18 gallons per minute per foot, and the median specific capacity of 80 wells in the consolidated sediments is 0.15, suggesting little significant difference between the two major rock types. Median transmissivity of the crystalline rocks is 35 square feet per day and the median transmissivity of the Triassic sediment is 17 square feet per day. Storage coefficients range widely, but the mean value for the Triassic sediment at the Poolesville well field is about 0.01. In 1978, well pumpage at the National Institute of Health Animal Center averaged 28,000 gallons per day; pumpage from four wells at Poolesville during 1978 averaged 246,000 gallons per day. Groundwater use in the remainder of the area is estimated to have been 250,000 gallons per day. Chemical quality of the water is suitable for most uses. Water from the crystalline rocks is mildly acidic and soft and water from the Triassic sediments is commonly mildly alkaline and has a greater hardness. Because of the relatively thin soil zone and the fractured nature of the underlying rocks, chances of polluting the aquifer are relatively great. Possible pollutants might be septic-tank effluent, road salt, chemical fertilizers, insecticides, and herbicides. (USGS)
W82-02481

GROUND-WATER-LEVEL MONITORING NETWORK, HOLLISTER AND SAN JUAN VALLEYS, SAN BENITO COUNTY, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W82-02487

SELECTED HYDROGEOLOGIC DATA FROM THE JUDITH BASIN, CENTRAL MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-02490

ALTITUDE OF THE WATER TABLE IN THE ALLUVIAL AND OTHER SHALLOW AQUIFERS ALONG THE COLORADO RIVER NEAR LA GRANGE, TEXAS, DECEMBER 1980,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-02491

ASSESSMENT OF EIGHTEEN PUBLIC GROUNDWATER SUPPLIES IN ILLINOIS,

Illinois State Geological Survey, Champaign.
R. W. Ringler, R. D. Brower, H. A. Wehrmann,
A. P. Visocky, and C. B. Burris.
Illinois Institute of Natural Resources State Water Survey Division Contract Report No 237, July 31, 1980. 185 p. 87 Fig, 13 Tab, 5 Ref.

Descriptors: *Aquifers, *Pumpage, *Geohydrology, Groundwater storage, Data collections, Areal hydrology, Geography, Water-bearing formations, Optimal yield, Water supply development, *Aquifer management, Groundwater availability, *Illinois.

Aquifers in Illinois furnish approximately 233 mgd of water to 677 public water supplies outside the six-county area of northeastern Illinois. A total of 42 supplies known to have experienced difficulty recently in meeting water demands were selected for a detailed study of quantities pumped, aquifers developed, water resource availability, and anticipated water demand. Twenty-four were covered in an earlier report and eighteen are described here. Supplies were assessed according to the following criteria: (1) adequate supplies were those that usually required 10 hours or less pumpage to produce average daily consumption; (2) marginal supplies were those that required 10-18 hours of pumpage, or consisted of several wells with pumping rates of less than 30 gpm; (3) deficient supplies were those that required more than 18 hours, were shallow and limited in areal extent, or indicated need of additional sources of water. The detailed area-by-area narratives include geographic and geologic descriptions of the communities and their groundwater supplies, along with estimates of individual aquifer sustained yields. The most favorable groundwater conditions are in the northern third and southern tip of the state. In the central part of the state, major aquifers are sand and gravel deposits in the Mississippi and Illinois River Valleys and the buried bedrock valleys of the Mahomet, Wabash, Ohio, Kaskaskia, and Embarras rivers. (Garrison-Omniplan)
W82-02510

GROUND WATER IN WASHINGTON,

Washington State Univ., Pullman. Water Research Center.
L. J. Martin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157892, Price codes: A03 in paper copy, A01 in microfiche. Report 40, September, 1981. 44 p, 10 Fig, 1 Tab. OWRT-A-999-WASH(7), 14-34-0001-1151.

Descriptors: *Washington, *Groundwater, *Aquifer characteristics, *Irrigation, Drawdown, Surface-groundwater relations, Water quality, Groundwater pollution, Saline water intrusion, Reviews.

This report is not intended to be a comprehensive report on ground water in the State of Washington. Nor does it represent the results of original research. Rather, it is a review of basic groundwater information for the State and a summary of some of the more serious problems occurring and anticipated in the State. Ground water is an important source of water in the State. In the more arid eastern part of the State, ground water is a major source of irrigation water for many farmers. In some of the more heavily irrigated areas, withdrawals of ground water now exceed the rate of recharge, creating serious problems as a result of the decline of ground-water levels in those areas. Throughout the State, people in rural areas depend on near surface ground water as a source of potable water. In recent years, increased concerns about protecting the integrity of the ground-water resource has fostered an increase in research on ground-water quality and protection, particularly with regard to waste disposal. There are many areas of concern to people working with the ground-water resources in the State of Washington that have either not been addressed in this report or discussed only briefly. These areas include: ground-water law and management, Indian and federal-reserved water rights, and the effects of mining and oil and gas exploration on groundwater quality. Hopefully, this report will help to point out the need for continuing and expanding research of the ground-water resources of the State.
W82-02536

INVESTIGATIONS OF HIGH GROUNDWATER IN POLSON TERMINAL MORAINE,

Montana Univ., Missoula. School of Geology.
G. A. Kennett, and R. R. Curry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157918, Price codes: A04 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Montana State University, Report No 116, Bozeman, August, 1981. 33 p, 7 Fig, 25 Ref, 14 Append. OWRT-A-119-MONT(1), 14-34-0001-9028.

Descriptors: *Groundwater, *Groundwater movement, Glacial aquifers, Glacial soils, *Moraines, Permeability, Porosity, Planning, Land development, Water table fluctuations, Water level, *Polson Moraine, Flathead Lake, Pablo Reservoir, *Montana.

High groundwater areas in Polson, Montana, are located approximately 1 mile north of a terminal moraine and 3 miles north of a storage reservoir constructed in glacial outwash. The complexities of glacially deposited material and its associated permeabilities and porosities affect groundwater movement, shrinkswell of soils and soil drainage. The intensive development of regions south of Polson will need to address potential problems relating to high groundwater. (Hunt-Mont)
W82-02538

GEOTHERMALLY POWERED FOOD-PROCESSING SYSTEMS,

For primary bibliographic entry see Field 3E.
W82-02543

REGIONAL HYDROGEOLOGIC CONCEPTS OF HOMOCLINAL FLANKS,

H. E. LeGrand, and W. A. Pettyjohn.
Ground Water, Vol 19, No 3, p 303-310, May/June, 1981. 5 Fig, 14 Ref.

Descriptors: *Homoclinal flanks, *Geohydrology, *Consequent streams, Geological formations, Artesian springs, Artesian aquifers, Thermal springs, Springs, Sedimentary rocks, Coastal plains, Coastal streams, Topography, Permeability, Aquifer characteristics, Water table aquifers, Streams, Savannah River, Georgia, Aquitards, Cone of depression, Stream discharge, Structural geology, Geomorphology, Groundwater divide, *Groundwater movement, Groundwater runoff.

Homoclinal flanks, sedimentary rocks with minimum deformation, are widwspread and common hydrogeological systems. They are characterized by alternating permeable and impermeable formations, which influence regional groundwater and surface water systems in distinctive ways. Groundwater and surface water in a homoclinal flank are related by four factors: (1) agrologic structure (slightly inclined), (2) distributed of permeability (alternating bands), (3) topography (Head differences to allow water to move), and (4) climate (only humid and semiarid regions are involved). Many of the major artesian systems are associated with homoclinal flanks. Where streams cut into artesian aquifers, discharge to the stream can be considerable. It is the upper artesian aquifers which most greatly influence the hydrology of the system underlying a homoclinal flank, because water moves very slowly (several meters per century) in the lower zones. Consequent streams are especially significant. A natural cone of depression is formed at the location of a concentrated discharge area. At varying distances downstream is a stagnation zone or small groundwater divide. An example of a consequent stream is the Savannah river, Georgia. Aquifers in homoclinal flanks may feature thermal springs and artesian springs if a sufficient dip is present. The geological setting of stream stretches may shed light on the behavior of groundwater doscjarge into streams, whereas streamflow data alone is insufficient. (Casser-FRC)
W82-02548

THE USE OF GROUND-WATER FLOW MODELS FOR ESTIMATING LAKE SEEPAGE RATES,

Geological Survey, Iowa city, IA.
J. A. Munter, and M. P. Anderson.
Ground Water, Vol 19, No 6, p 608-616, November/December, 1981. 11 Fig, 1 Tab, 13 Ref.

Descriptors: *Seepage, *Hydraulic conductivity, *Model studies, *Groundwater movement, Lakes, Bass Lake, Nepco Lake, Wisconsin, Lake sediments, Sediments, Aquifers, Estimating, Lake seepage rate.

Two- and three-dimensional groundwater flow models were developed to estimate seepage rates for Bass Lake and Nepco Lake, wisconsin. Bass Lake, groundwater controlled with no surface water inlet or outlet, was described by a two-dimensional profile model. Results showed that the ratio of horizontal to vertical hydraulic conductivity of the aquifer around the lake is related to both the magnitude of vertical hydraulic gradients near the lake and the distribution of seepage from the lake as a function of distance from the shore. The presence of fine-grained sediments in the littoral area can have a significant effect on lake seepage rates, but the presence or absence of fine sediments in the deep parts of the lake is relatively unimportant. Nepco Lake, created by construction of an

earthen dam, has an anomalous groundwater flow system. A three-dimensional model was far superior to a two-dimensional model for simulating the flow system around this lake. It showed that much of the lake bottom loses water. The three-dimensional model produces a much lower water table slope at a point where the influence of two creeks, receiving groundwater discharge, is noticeable. (Casser-FRC)
W82-02549

SUBDOMAIN INTEGRATION MODEL OF GROUND-WATER FLOW,

California Univ., Irvine. School of Engineering.
T. V. Hromadka, II, and G. L. Guymon.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil engineers, Vol 107, No IR2, p 187-195, June, 1981. 5 Fig, 12 Ref.

Descriptors: *Groundwater, *Mathematical studies, *Finite element method, *Quantitative analysis, *Piezometric head, Flow, Unconfined aquifer, Porosity, Transmissivity, Aquifer, Mathematical equations, Confined aquifer, systems analysis, Groundwater movement.

The subdomain integration version of the weighted residuals method is applied to the linear and nonlinear equations of one-dimensional confined and unconfined groundwater flow, respectively. The approach used is to determine the spatial coordinates as a function of piezometric or free groundwater surface profiles. A simplified version of the numerical model can be accommodated by current programmable calculators. Good results are obtained when applying the proposed numerical model to the problems considered. However, several simulations were required for each problem tested, progressively reducing timestep sizes until negligible differences in computed results were observed. (Titus-FRC)
W82-02550

2G. Water In Soils

PREDICTION OF THE ADVANCING WETTING FRONT IN BORDER STRIP IRRIGATION,

Nairobi Univ. (Kenya). Dept. of Agricultural Engineering.
A. K. Katyal, and J. W. Kijne.
Irrigation Science, Vol 1, No 3, p 177-184, 1980. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Border irrigation, *Irrigation, *Soil water, Infiltration, Wetting, Surface irrigation, Mathematical equations, Graphical analysis.

Four methods for predicting the advance of a water front in border irrigation are compared using nine sets of published data. The Katopodes and Strelkoff (1977) method is based on the zero inertia solution and presents graphical solutions in terms of dimensionless parameters. Michael's method (1978) is based on a Laplace transformation of the water balance equation and requires values of gamma functions for solution. The Bishop et al., 1967, method uses a simple water balance equation. A new method described in this paper predicts the advance as a power-law polynomial and gives results for values of the coefficient of the exponential advance equation. The K and S method was superior to all other methods tested. The Bishop method and newly-proposed graphical approaches were fairly accurate and simple to calculate, but are not recommended for predicting advance on the wetting fronts in nearly flat border strips. The Michael method requires the most computation time. Reliable infiltration parameters are necessary for all four methods. (Casser-FRC)
W82-02309

RELATIONSHIP OF ELECTRICAL DISPERSION TO SOIL PROPERTIES,

Battelle Memorial Inst., Columbus, OH.
For primary bibliographic entry see Field 8D.
W82-02561

2H. Lakes

MEROMIXIS IN A COASTAL ZONE EXCAVATION,

Applied Environmental Services, Marco Island, FL.
C. M. Courtney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 219-231, 8 Fig, 11 Ref.

Descriptors: *Meromictic lakes, *Chemocline, *Mixolimnion, *Monimolimnion, *Artificial lakes, Aquifers, Stratification, Water temperature, Saline water, Storm water, Groundwater movement, Seasonal variation, *Lake Marco, Florida.

Lake Marco Shores was created as a dredge and dragline excavation in 1972, and is of particular interest beceuse of its use as a prototype of additional proposed excavations. Over the period 28 October 1976 to 21 June 1977, seven preliminary profiles of temperature, conductivity, salinity, and dissolved oxygen were conducted in the lake. Observations indicated that Lake Marco Shores was developing a meromictic type of stability composed of three vertical strata: the mixolimnion, the chemocline, and monimolimnion. Because each of the three layers was easily definable by in situ measurement, an intensive sampling program was employed from January to December 1978 to describe changes within these layers over an annual cycle. The chemocline is formed at the depth determined by the relative rates of surface and ground water net inputs, the density difference between the mixolimnion and the monimolimnion, and the amount of energy available for mixing. The seasonal changes in temperature relative to salinity did not permit a turnover of the water column. Results suggest that coastal transition zone excavations in the area of the proposed Marco Island development can become meromictic if they are sufficiently deep so as to intersect the intruding saline ground water and if they intersect seaward discharging surface aquifers. The stability of the lake has permitted the lowest layer to accumulate nutrients, and prevented the expected stimulation of productivity. Such excavated lakes, if properly designed and located in this unique area, may represent an interesting alternative for urban stormwater treatment. (Moore-SRC)
W82-02120

THE EFFECT OF ENVIRONMENTAL FACTORS ON PHYTOPLANKTON GROWTH: TEMPERATURE AND THE INTERACTIONS OF TEMPERATURE WITH NUTRIENT LIMITATION,

New York State Dept. of Health, Albany. Div. of Labs. and Research.
G. Y. Rhee, and I. J. Gotham.
Limnology and Oceanography, Vol 26, No 4, p 635-648, July, 1981. 12 Fig, 3 Tab, 40 Ref.

Descriptors: *Nutrient requirements, *Temperature, *Phytoplankton, *Growth kinetics, Algae, Scenedesmus, Asterionella, Nitrogen, Phosphorus, Algal growth, Chlorophyll a, *Lakes.

The simultaneous effects of nutrient limitation and suboptimel temperatures on growth and nutrient uptake were investigated using continuous culture techniques and the algae, Scenedesmus sp. and Asterionella formosa. Phytoplankton were also grown with sufficient nutrients to provide a baseline. The combined effects of temperature and nutrient limitation were greater than the sum of the individual effects. Decreasing the temperature increased the cell quotas of limiting and non-limiting nutrients in N- and P- limited cells, i.e., cells required more nutrient at lower temperatures. At constant temperature, cell quotas of limiting nutrients increased with the growth rate and followed a saturation function. The critical temperature (at which the growth rate is determined solely by temperature, unaffected by nutrients) was 9 C for N-limited Scenedesmus growing at 0.5 per day and 12 C for A. Formosa growing at 0.4 per day. The change of cell quota with temperature varied with the type of nutrient. These changes suggest that the ratio at which one limitation changes to the other is higher at suboptimal temperatures. In nutrient-sufficient cultures, cell quotas for C, N, and P and for chlorophyll a concentrations increased with decreasing temperature. The rate of protein synthesis per unit RNA decreased with temperature. Optimal growth range for Scenedesmus was 20-25 C and for A. formosa, 19-20 C. The highest apparent maximum N uptake occurred at 15 C for Scenedesmus growing at 0.5 per day, and for A. formosa growing at 0.4 per day, at 19-20 C. (Casser-FRC)
W82-02221

SOME TYPES OF TEMPERATURE INVERSION ENCOUNTERED IN A FRESHWATER LAKE WITH SHORT RESIDENCE TIME,

National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
R. C. Wiegand, and E. C. Carmack.
Limnology and Oceanography, Vol 26, No 3, p 565-571, May, 1981. 3 Fig, 1 Tab, 27 Ref.

Descriptors: *Thermal stratification, *Lakes, *Temperature effects, Mixing, Turbidity, Seasonal variation, *Kamloops Lake, *British Columbia, Water circulation, Temperature inversion.

Temperature inversions in freshwater lakes can be distinguished by lake location, season, and the physical mechanism of generation. A year-long study was made of Kamloops Lake, British Columbia, a short residence time lake whose seasonal circulation patterns are dominated by the Thompson River. Some 1650 temperature/turbidity profiles were taken. About 230 of these exhibited inversions greater than 0.05 deg C and of vertical thickness greater than 1 m. Inversions fell in these general categories: inlet region, turbidity currents, cabbeling, open lake (shear effects), open lake (surface effects), and outlet region (summer). For one example, potential energy considerations were used to calculate the minimum amount of work done on the water column to produce the observed deformation. (Small-FRC)
W82-02224

FREQUENCIES OF DEVELOPMENTAL MORPHS OF CHAOBORUS AMERICANUS IN FOUR FISHLESS BOG LAKES,

Northern Illinois Univ., DeKalb. Dept. of Biological Science.
C. N. Van Ende.
American Midland Naturalist, Vol 105, No 2, p 401-404, April, 1981.

Descriptors: *Zooplankton, *Bogs, *Lakes, *Temperature effects, Wetlands, Midges, Plankton, Population dynamics, Ecology.

Four bog lakes, located at the University of Notre Dame Environmental Research Center, were sampled for fourth instar larvae of the phantom midge Chaoborus americanus. The percentages of fast-developing morphs found were 92.9, 98.3, 19.6 and 39.2 in the different lakes. These values did not correlate with lake temperature regimes. Lake temperatures were, however, correlated with the rate of pupation of fast developing morphs. The inconsistency of the pupation patterns in these lakes suggests that the system is complex and that factors other than the previous spring's weather may be equally important in determining the frequency of morphs in a lake. For example, cannibalism may be important. Community structure may also be significant in determining the amount of cannibalism. (Baker-FRC)
W82-02238

FACTORS CONTRIBUTING TO THE MAINTENANCE OF OLIGOTROPHY IN AN ALPINE GLACIAL MORAINE LAKE (WALLOWA LAKE) IN NORTHEAST OREGON,

Corps of Engineers, Portland, OR.
D. W. Larson.
Northwest Science, Vol 55, No 2, p 95-107, 1981. 1 Fig, 7 Tab, 24 Ref.

Descriptors: *Limnology, *Wallowa Lake, *Oligotrophic lakes, Alpine regions, Water quality, *Oregon, Irrigation effects, Recreation demand, Salmon.

The limnology of Wallowa Lake, Oregon, was studied, and lake quality and eutrophication were investigated by yearly surveys in 1966-1972. Wallowa Lake is fed chiefly by the Wallowa River; it is about 6.5 km long and 1.0 to 1.5 km wide, with a surface area of 7.9 sq km. The lake and the river are relatively unpolluted and do not suffer dense, sustained algae blooms. Concentrations of nitrogen, phosphorus and BOD were found to be relatively low, and dissolved oxygen was abundant. Major ion concentrations, total alkalinity, total hardness, and specific conductivity all were low. The pH was 7.4-7.8 at four stations sampled in June and August, 1973. The lake may experience problems in the future if not managed carefully. It is subjected to intense recreational use. Also, the watershed is relatively barren, with nutrient impoverished soils. The climate is rigorous and the lake has a steep, deep morphometry. Area subdivisions generally lack proper sewage treatment, but sewage inputs are few and widely spaced. Irrigation releases cause nutrient removal by substantial lake drawdown in summer. The lake is replenished with low temperature, low nutrient water, which may contribute to its pristine, oligotrophic environment. (Small-FRC)
W82-02250

METABOLISM OF A FLORIDA LAKE ECOSYSTEM,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
T. D. Fontaine, III, and K. C. Ewel.
Limnology and Oceanography, Vol 26, No 4, p 754-763, 1981. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Productivity, Respiration, *Aquatic plants, Phytoplankton, Algae, Lakes, *Plankton, *Little Lake Conway, *Florida, Macrophytes, Photosynthesis, Seasonal variation, Tropical regions, Ecosystems.

The ecosystem and plankton metabolism were studied for a year during 1976 in Little Lake Conway, Florida. This lake, part of a multilobed lake system near Orlando, is enriched in nutrients and has an organic bottom sediment and zones of rich macrophyte growth. Ecosystem production and respiration did not vary much throughout the year. Gross production and respiration were 3071 and 3180 g O2 per sq meter per year, respectively. Plankton accounted for 44% of the gross production and 54% of the annual respiration, submersible macrophytes and epiphyton for the remainder. Maximum productivity in this lake occurred near the hydrosoil. During June-July respiration and production in submersed plants and epiphytes were minimal, possibly due to the higher temperatures. This data does not contradict the hypothesis that cycles of ecosystem gross production and 24-hour respiration become increasingly balanced and synchronous with decreasing latitude. (Cassar-FRC)
W82-02268

THE DILUTION/FLUSHING TECHNIQUE IN LAKE RESTORATION,

Washington Univ., Seattle. Dept. of Civil Engineering.
E. B. Welch.
Water Resources Bulletin, Vol 17, No 4, p 558-564, August, 1981. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Lake restoration, *Flushing, *Costs, Nutrients, Algae, Rehabilitation, Eutrophication, Moses Lake, Green Lake, *Washington.

The theoretical basis for dilution/flushing techniques is discussed, followed by a summary of results of applications at Moses Lake and Green Lake, Washington. These eutrophic lakes were diluted with water low in nitrogen and phosphorus, and lake nutrient content dropped. Dilution or flushing rates were about 10 times normal during the spring and summer period in Moses Lake and three times the annual rate for Green Lake. Moses Lake experienced a 50% improvement in water quality, and even greater improvement resulted in Green Lake. In this case, the cost of water transport was minimal, but this cost could be very important at a different application site. If only high nutrient water is available for flushing, improvement may still result from algal cell washout and water column instability. Dilution/flushing can be considered as an effective technique for restoring eutrophic lakes, especially if low nutrient water is available. (Small-FRC)
W82-02270

SEASONAL AND DIURNAL FLUCTUATIONS OF OOMYCETE PROAGULE NUMBERS IN THE FREE WATER OF A FRESHWATER LAKE,

Reading Univ. (England). Plant Science Lab.
I. C. Hallett, and M. W. Dick.
Journal of Ecology, Vol 69, No 2, p 671-692, July, 1981. 12 Fig, 5 Tab, 47 Ref.

Descriptors: *Seasonal variation, *Aquatic fungi, *Lakes, Water quality, Microbiological analysis, Diurnal distribution.

The reliability and amplitude of oomycete propagule numbers in a natural environment were determined by constant flow centrifugation. A method of estimating the numbers of fungal propagules using continuous flow centrifugation, pour plating and scanning was tested on samples collected from a small freshwater lake. The loss of viable propagules for zoospores and zoospore cysts ranged from 5 to 26%. In the lake samples, there was a seasonal periodicity in propagule numbers, with maxima in spring, early summer, and autumn. There were diurnal maxima in early afternoon and late evening. No single factor was isolated that could explain the variations. Lakewater zoospores have a short lifespan; thus the per unit volume of zoospores recovered may be indicative of the activity of the fungi. (Small-FRC)
W82-02274

EFFECTS OF WATER-TABLE CONFIGURATION ON SEEPAGE THROUGH LAKEBEDS,

Geological Survey, Denver, CO.
T. C. Winter.
Limnology and Oceanography, Vol 26, No 5, p 925-934, September, 1981. 6 Fig, 18 Ref.

Descriptors: *Water table, Groundwater movement, *Lakes, Mathematical models, *Lake beds, Influent seepage, *Seepage, Wetlands.

The importance of the slope of the water table near a lake and beyond the lake's immediate watershed on the role of groundwater in the hydrologic and chemical balances of lakes was investigated. The finite-difference groundwater flow model of the US Geological Survey was used. The numerical analysis indicated that the slope of the water table beyond a lake's immediate drainage basin, particularly between a water-table mound on the lake's downgradient side and a regional groundwater discharge area, can have a significant effect on seepage. In two hypothetical settings, water-table slopes greater than or equal to 0.010 in this segment of the water table can cause seepage from the lake. Groundwater discharge may be a mechanism for the occurrence of upland-type wetlands near breaks in the water-table slope. In the glacial Lake Agassiz plain in northwestern Minnesota, groundwater discharge occurs along the east edge of the lake plain where the steep water-table slope in the end moraine meets the very low slope of the water table. (Small-FRC)
W82-02281

SUMMER POPULATION FLUCTUATIONS, FEEDING, AND GROWTH OF HYDRA IN AN ARCTIC LAKE,

North Carolina State Univ., Raleigh. Dept. of Zoology.
B. E. Cuker, and S. C. Mozley.
Limnology and Oceanography, Vol 26, No 4, p 697-708, July, 1981. 9 Fig, 22 Ref.

Descriptors: *Hydra, *Arctic, *Population dynamics, Lakes, *Toolik Lake, *Alaska, Invertebrates, Crustaceans, Copepods, Adaptation, Predation.

Population dynamics of Hydra in the rocky littoral zone of Toolik Lake, Alaska, were similar to those of Hydra in temperate lakes with the exception of a higher rate of increase in biomass at comparable temperatures (0.53 mg per mg per day at 10 C and 0.31 mg per mg per day at 11 C). This indicates a metabolic adaptation to Arctic conditions. During the 1977 study, the population density increased from June to a maximum in late July or early August, corresponding to the availability of food (Bosmina and copepods). Although food resources continued to increase in August, Hydra populations stabilized or decreased, probably as a result of predation, displacement by epilithic algae, and/or emigration. The peak population of Hydra (135 per sq meter) consumed 1620 Bosmina per sq m per day, or 12 Bosmina per Hydra per day. This accounted for 10% of the standing crop in the lake. Bosmina comprised 93% of the food found in Hydra guts. (Cassar-FRC)
W82-02287

SOME ANALYSES OF AQUATIC PLANTS AND THEIR WATERS,

Crewe and Alsagar Coll. of Higher Education (England).
K. G. Allenby.
Hydrobiologia, Vol 77, No 2, p 177-189, 1981. 9 Tab, 7 Ref.

Descriptors: *Aquatic plants, *Chemical composition, *Minerals, Water analysis, Chlorides, Sulfates, Phosphates, Potassium, Calcium, Sodium, Nitrogen.

Several inorganic components of internal tissue and external incrustations of aquatic plants and their surrounding waters were determined. Dilute HCl was used to remove the external incrustations. Average analyses were: chloride, 0.76-4.8%; sulfate, 0.70-2.23% (total) and 0.50-1.65% (internal); phosphate, 0.68-2.56% (total) and 1.47-1.83% (internal); Ca, 0.63-3.86% (total) and 0.76-2.24% (internal); Na, 0.44-1.13 (total) and 0.25-1.17% (internal); K, 1.69-3.30% (total) and 0.88-3.1% (internal); and total N, 2.4-4.3%. There was no correlation between concentrations of the minerals in the water and concentrations in the plant for chloride, sulfate, phosphate, Ca, K, or Na. Generally, aquatic species were two to three times higher in chloride, sulfate, and phosphate content than terrestrial species. The average external incrustation was 50% Ca, 19% K, 14% phosphate, 11% sulfate, and 5% Na. (Cassar-FRC)
W82-02293

QUANTITATIVE DIFFERENCES BETWEEN BENTHIC ALGAL COMMUNITIES ALONG A DEPTH GRADIENT IN LAKE MICHIGAN,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. J. Stevenson, and E. F. Stoermer.
Journal of Phycology, Vol 17, No 1, p 29-36, March, 1981. 10 Fig, 1 Tab, 27 Ref.

Descriptors: *Algae, *Benthic flora, *Distribution patterns, Lakes, Phytoplankton, *Lake Michigan, Wave action, Cyanophyta, Diatoms, Population density, Water depth, Water analysis, Vertical distribution.

Benthic algae were examined at five depths in eastern Lake Michigan. Three zones were obvious on the basis of community composition, structure, and abundance: shallow (6.5 m), mid-depth (9.1 and 14.6 m), and deep (22.6 and 27.4 m). There was a diverse algal assemblage with 255 taxa representing 36 genera. Only live cells were counted, according to a technique developed as part of this study. It used a mounting medium of high refractive index. Diatoms were dominant, and substantial numbers of blue-green algae were present in the benthic algal communities. The shallow communities showed dominance of benthic species, high diversity, and low abundance, reflecting the disturbance of wave action. The mid-depth communities were also dominated by benthic species and had high diversity, but abundance was high because wave effects were less. The deep communities featured planktonic algae because light intensi-

ty limited growth of benthic species; diversity and abundance were low. (Cassar-FRC)
W82-02299

THE PATTERNED MIRES OF THE RED LAKE PEATLAND, NORTHERN MINNESOTA: VEGETATION, WATER CHEMISTRY, AND LANDFORMS,

Minnesota Univ., Minneapolis. Limnological Research Center.
P. H. Glaser, G. A. Wheeler, E. Gorham, and H. E. Wright, Jr.
Journal of Ecology, Vol 69, No 2, p 575-599, July, 1981. 5 Fig, 2 Tab, 74 Ref.

Descriptors: *Vegetation, *Water quality, *Peat bogs, *Fens, Chemical composition, Hydrogen ion concentration, Conductivity, Calcium, *Red Lake, *Minnesota, Drainage effects.

A study was performed to classify the major vegetational types of the Red Lake Peatland (Minnesota), to determine the relationships of the vegetation to major landforms and their water chemistry, and to investigate the possibility of currently changing vegetational forms. In raised bogs and ovoid islands where waters were of low pH, low Ca(+2) concentration, and low conductivity, two types of vegetation occurred. On strings, flats and teardrop islands which were characterized by high pH, low Ca(+2) concentration, and low conductivity, three types of fen vegetation were found. Poor fens occurred where waters had intermediate pH ranges, Ca(+2) concentrations, and conductivities. Surface drainage seemed to be important in the maintenance of mire patterns, as drainage ditches had localized effects on vegetation and landforms. (Small-FRC)
W82-02300

THE RECOLONIZATION OF LAKE TAHOE BY BOSMINA LONGIROSTRIS: EVALUATING THE IMPORTANCE OF REDUCED MYSIS RELICTA POPULATIONS,

Oklahoma Univ., Kingston. Biological Station.
S. T. Threlkeld.
Limnology and Oceanography, Vol 26, No 3, p 433-444, May, 1981. 6 Fig, 3 Tab, 30 Ref.

Descriptors: *Zooplankton, *Population dynamics, *Lake Tahoe, Predation, Annual distribution, Aquatic animals, Aquatic populations, *Bosmina longirostris.

Bosmina longirostris reappeared in Lake Tahoe after an absence of more than three years. Demographic analyses and feeding experiments suggested that predation by Mysis relicta, which was introduced to the lake, may have been responsible for Bosmina's decline and disappearance. Bosmina reappeared when there was a reduction in Mysis relicta from about 380/sq m. Other factors including biological and physical influences may have had more to do with the reappearance of Bosmina than the reduction in Mysis. Considerable annual variation occurs in Lake Tahoe plankton dynamics, predator assemblages, and in interactions between the littoral and pelagial. Bosmina may have been reintroduced by wind-induced advection from Emerald Bay. (Small-FRC)
W82-02305

THE EFFECT OF ENVIRONMENTAL FACTORS ON PHYTOPLANKTON GROWTH: LIGHT AND THE INTERACTIONS OF LIGHT WITH NITRATE LIMITATION,

New York State Dept. of Health, Albany. Division of Labs. and Research.
G. Y. Rhee, and I. J. Gotham.
Limnology and Oceanography, Vol 26, No 4, p 649-659, Jul, 1981. 9 Fig, 2 Tab, 26 Ref.

Descriptors: *Nutrient requirements, *Light intensity, *Phytoplankton, *Growth kinetics, Lakes, Algae, Algal growth, Nitrates, Scenedesmus, Fragilaria, Nitrogen, Phosphorus, Chlorophyll a.

The combined effects of light and nutrient limitation in growth of Scenedesmus sp. and Fragilaria crotonensis were studied with continuous culture systems. The combined effects were greater than the sum of the individual effects. Nutrient requirements increased with decreasing irradiance. When N was limiting, the cell quota of the limiting nutrient increased as irradiance decreased for a constant growth rate and subsistence quota. Thus, within a certain range of growth rates, light and nitrogen cell quota can compensate for each other in maintaining the growth rate. When nutrients were not limited, decreasing light below saturation increased the cell quotas of C, N, and P and the chlorophyll a concentration. Cell quotas of nonlimiting nutrients in nutrient-limited cultures are the maximum that can be reached at a given irradiance. (Cassar-FRC)
W82-02331

SUMMER INTERNAL PHOSPHORUS SUPPLIES IN SHAGAWA LAKE, MINNESOTA,

Corvallis Environmental Protection Agency, OH.
For primary bibliographic entry see Field 5B.
W82-02332

PRODUCTIVITY OF FOUR MARSH SITES SURROUNDING LAKE PONTCHARTRAIN, LOUISIANA,

Louisiana State Univ., Baton Rouge. Coastal Ecology Lab.
G. W. Cramer, J. W. Day, Jr., and W. H. Conner.
American Midland Naturalist, Vol 106, No 1, p 65-72, July, 1981. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Marshes, *Primary productivity, *Aquatic plants, Wetlands, Lake Pontchartrain, *Louisiana, Productivity, Nutrients, Spartina, Vegetation, Decomposition, Tidal marshes, Salinity.

Net primary production and nutrient concentrations were studied from February 1978 to March 1979 at Spartina patens marshes near Lake Pontchartrain, Louisiana. The four sites varied in salinity (< 1-4.5 ppt), mean tidal range (0-12 cm), and nutrient levels. Vegetation was harvested over the annual cycle at 3-6 week intervals from five 0.1 sq meter quadrats chosen at random in each marsh. Primary production was calculated at 2541-4411 g dry weight per sq meter per year using Smalley's method based on changes in live and dead standing crop between sampling times and 3053-5509 g dry weight per sq meter per year by the Weigert and Evans method based on weight loss of vegetation exposed in nylon mesh bags. Live standing biomass increased from a low in February at all sites to a peak occurring from as early as June to as late as November, depending on the site. After 6 months 35-47% of the vegetation had decomposed. Higher productivity and decomposition rates occurred at sites with higher nutrient levels and free tidal flushing. Salinity was not a factor in productivity. (Cassar-FRC)
W82-02334

HYPOLIMNETIC AERATION OF A SMALL EUTROPHIC KETTLE LAKE: PHYSICAL AND CHEMICAL CHANGES,

McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5G.
W82-02341

THE THERMAL RESPONSE OF LAKE OHRID, YUGOSLAVIA TO METEOROLOGICAL CONDITIONS,

Michigan Univ., Ann Arbor. Dept. of Geography.
S. I. Outcalt, and H. L. Allen.
Archiv fur Hydrobiologie, Vol 91, No 1, p 181-191, May, 1981. 1 Fig, 17 Ref.

Descriptors: *Temperature gradient, *Water circulation, *Meteorological data collection, Lakes, *Lake Ohrid, *Yugoslavia, Epilimnion, Hypolimnion, Water temperature, Stratification, Thermal stratification, Mixing, Lake circulation, Wind, Model studies.

The thermal regime of Lake Ohrid, Yugoslavia, was modeled from meteorological data (daily sunshine duration, mean daily wind velocity, air temperature, relative humidity, and cloud cover). Predicted data were compared with measured water temperature profiles at 13 depths to 240 m. The model, which uses a simple thermal-diffusion-density mixing algorithm, predicted the thermal regime of the lake to a considerable degree. However, there were significant discrepancies between predicted and measured structures in the epilimnion and thermocline during spring-summer warming, the thermocline depth and epilimnion temperatures being underestimated. The simulated hypolimnion temperatures were several tenths of a degree colder than the observed temperatures. The thermal regime of this lake is probably the product of a thermal-density mixing mechanism similar to the proposed model. Wind mixing does not appear important in establishing the annual thermal regime. (Cassar-FRC)
W82-02342

INFRARED ABSORPTION STUDY OF HUMIC SUBSTANCES FROM LAKE APOPKA SEDIMENT, PLANKTON AND THE SURROUNDING DRAINAGE BASIN,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Engineering and Science.
T. V. Belanger.
Florida Scientist, Vol 44, No 2, p 72-78, 1981. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Eutrophication, *Measuring instruments, Infrared spectroscopy, Spectroscopy, Absorption, Humic acids, Organic matter, Catchment areas, *Plankton, Lakes, *Lake Apopka, *Florida, Muck soils.

Infrared methods were used as a limnological tool to evaluate characteristics of humic substances from bottom sediments and sediment from the watershed surroundng Lake Apopka, 24 km west of Orlando, Florida. The lake is large (12,140 ha) and shallow (2 meters), and was once known for its clear waters and good bass fishing. The lake has become hypereutrophic and is now populated by blue-green algae, floating mats of water hyacinths, shad, and brown bullheads. Unconsolidated silt, muck, and peat cover over 90% of the lake bottom. The muck and decaying organic matter is very flocculent and ranges in depth from 0.3 to 12.3 meters throughout the lake. Most of the soils surrounding the lake are well-drained sands suited for citrus production. A muck farm area is located primarily on the north shore of the lake, below lake level, and was once lake bottom. This muck farm area comprises 7.280 ha of nutrient-rich organic soil devoted to vegetable cropping agriculture. The nutrient rich irrigation water must be periodically pumped from the muck farm into the lake, and has been blamed for much of the lake's rapid deterioration. Infrared absorption spectra of 1540 and 1650 cm(-1) peaks in plankton and lake sediment samples, in addition to other spectral similarities, indicate that plankton is the probable precursor of the lake sediment humic substances. These absorption bands are thought to be due to peptide bonds in protein, with amide I absorption occurring at 1650 and amide II at 1540 cm(-1). The spectra from the muck farm soil and citrus soil differ to a greater extent from the spectrum of the lake sediment than do the plankton spectra. (Baker-FRC)
W82-02348

TROPHIC CHANGES WITHOUT CHANGES IN THE EXTERNAL NUTRIENT LOADING,

Goeteborg Univ. (Sweden). Dept. of Zoology.
L. Henrikson, H. G. Nyman, H. G. Oscarson, and J. A. E. Stenson.
Hydrobiologia, Vol 68, No 3, p 257-263, February, 1980. 7 Fig, 23 Ref.

Descriptors: *Oligotrophic lakes, *Productivity, *Nutrients, Trophic level, Fish, Grazing, Predation, Zooplankton, Phytoplankton, Lilla Stockelidsvatten, *Sweden, *Water quality, Fish removal.

Removal of the fish population from an oligotrophic lake produced biotic changes and abiotic changes which altered water quality parameters in an oligotrophic direction. The dominant zooplankton changed from cladocerans to large copepods;

dominant phytoplanktons changed from smaller to larger species. Abiotic changes from 1973 to 1973 to 1977 were as follows: limnetic primary production, 10.7 to 1.5 mg per cu meter; transparency, 1-3 meters to 4-7 meters; pH, 8 to 7; total phosphorus, 13.5 to 7 micrograms per liter; and total nitrogen, 640 to 450 micrograms per liter. The transparency and pH of a control lake remained stable during the study period, which transparency and pH of a control lake remained stable during the study period, which eliminated the possibility of large scale environmental effects. Some of the reasons for the biotic changes were: the lower productivity of larger-celled phytoplankton compared with smaller-celled phytoplankton, increased grazing pressure from the larger herbivores on the smaller phytoplankton size interval, lowered rate of mineralization via zooplankton, and decreased impact of nutrients from areas outside the pelagic zone. pH decreases resulted from changes in CO2 content. Transparency increases and N and P decreases reflect the decrease in organic particulate matter. (Cassar-FRC)
W82-02367

WIND-INDUCED MIXING IN STRATIFIED FLUID,

Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
C. Kranenburg.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY5, p 632-637, May, 1981. 21 Ref.

Descriptors: *Mixing, *Wind, *Stratification, Model studies, Mathematical models, Hypolimnion.

A simple model is presented for mixed-layer deepening caused by wind action at the free surface of a density-stratified fluid. A streamwise pressure gradient is considered; solar radiation, cooling, advection, and Coriolis effects are disregarded. When certain modeling assumptions are used, the turbulent energy equation yields a dimensionless entrainment rate inversely proportional to the overall Richardson number. One of these assumptions, that the net kinetic energy input is proportional to the cube of the friction velocity related to the shear stress exerted by the wind, has been criticized. According to a new assumption, the overall Richardson number was assumed to be constant. The findings obtained may be explained, starting from a two-layer-structure of the mixed layer, wherein the upper layer is homogeneous and the lower transition layer displays near-critical conditions, i.e., the turbulence is nearly collapsing. The results obtained from the mathematical considerations agree at least qualitatively with observations, and corroborate the concept that density distributions alone can cause the difference between the layers. The flow in the mixed layer was found to be supercritical. (Cassar-FRC)
W82-02371

INTERACTIONS BETWEEN LUGOL'S FIXATIVE AND ETHYLENE IN THE ACETYLENE-REDUCTION ASSAY FOR NITROGENASE ACTIVITY IN LAKE WATER,

Lund Univ. (Sweden). Limnological Inst.
For primary bibliographic entry see Field 2K.
W82-02380

TROPHIC STRUCTURE AND ENERGY FLOW IN A TEXAS POND,

PETRA Inc., Denton, TX.
W. M. Childress, L. C. Fitzpatrick, and W. D. Pearson.
Hydrobiologia, Vol 76, No 1/2, p 135-143, 1981. 3 fig, 5 Tab, 33 Ref.

Descriptors: *Trophic level, *Ponds, Energy, Annual distribution, *Texas, Primary productivity, Food chains, Aquatic organisms, Respiration.

The trophic structure of a Texas pond is described, and a general model of energy flow through the community is presented. The pond is located on the southwest edge of Denton, Texas. Water sources are runoff from a 10 ha watershed and a well, 200 meters deep into the Trinity sandstone. Surface area during the study ranged from 8,313 to 10,566 square meters. Mean and maximum depths were 2.5 and 3.5 meters, respectively. Water temperature ranged from 4 to 33 degrees C, with mean of about 20 degrees C. Runoff from an adjacent golf course contained grass clippings, leaves and fertilizers together with dust from a nearby unpaved road, yielding abundant allochthonous materials to the pond. Preliminary work identified four major components of the pond community: primary producers such as algae and vascular plants, microcrustacean zooplankton, benthic invertebrates, and fish. These four major groups were described in terms of energies of consumption, respiration, predation, losses to sediments and decomposers, and emigration. Annual primary production was 7,780 kcal/square meter/year for a production-respiration ratio of 1.49. Climax communities are usually thought to have a production-respiration ratio close to 1.0. A new surplus of about one third of the primary production was apparently deposited on the substrate. Energetics were partitioned into four trophic levels for determination of ecological efficiencies. Resulting efficiencies were 26.6% for primary producers, 4.69% for primary consumers, and 7.34% for secondary consumers. The pond ecosystem had greater energy flow through the upper levels than reported for other systems in the literature. (Baker-FRC)
W82-02397

THE IMPACT OF URBANIZATION ON SEASONAL HYDROLOGIC AND NUTRIENT BUDGETS OF A SMALL NORTH AMERICAN WATERSHED,

Wisconsin Univ.-Madison. Inst. of Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-02400

DIEL CHANGES IN PLANKTON AND WATER CHEMISTRY IN WICKEN BRICKPIT,

Cambridge Univ. (England). Dept. of Applied Biology.
S. A. Corbet, R. M. S. Perrin, D. r. Hartley, P. D. Lancashire, and H. A. F. Mace.
Hydrobiologia, Vol 74, No 3, p 249-271, September, 1980. 10 Fig, 5 Tab, 45 Ref.

Descriptors: *Zooplankton, *Nutrients, *Diel variations, Plankton, Phytoplankton, Ponds, Water quality, Vertical distribution, Migration, Wicken Brickpit, Copepods, Cladocerans, Water depth, Dinobryon, Lake Poukawa, *New Zealand.

Diel variations in plankton activity and water chemistry were studied with water samples taken at 1.5 to 3 hour intervals for a 24 hour period starting at noon (1200 hours) August 1, 1977 at Wicken Fen, Cambridgeshire. Supplemental observations were taken on other dates. The marked variations with depth and time suggest that conclusions based on single water samples should be evaluated with caution. Temperatures at 25 cm ranged from 20C to 24C and at 225 cm, from 17.5 to 18C. Dissolved oxygen at 25 cm was highest at 1820-2230 hours and lowest in the morning; it varied greatly with photosynthetic activity. Dinobryon and dinoflagellates were dominant down to 190 cm and remained within this zone throughout the study. Dinobryon spent the day at 50 cm and at 1800-2100 hours moved 20 cm deeper, ascending again at 0600 to 0900 to the daytime level. Dinoflagellates remained at 50 cm from 1800 to 2400, moving down to 150 cm between 0600 and 0900 hours and rising at midday to 50 cm. Zooplankton, mainly copepods and cladocerans, migrated vertically according to time of day and species. The temporal segregation at a given level implies interspecific competition. Inorganic constituents (ammonium N, total oxidized N, reactive phosphate, and silica) had greater variations at the 225 cm depth than at 25 cm depth. The transient peaks in nutrient concentrations observed near the surface may be attributed to nutrient release by zooplankton feeding at greater depths. Similar results were obtained from a 24 hour study of water in Lake Poukawa, New Zealand, on January 9-10, 1979. (Cassar-FRC)
W82-02411

ON THE TROPHIC STATUS AND CONSERVATION OF KASHMIR LAKES,

Central Inland Fisheries Research Inst., Harwan (India).
For primary bibliographic entry see Field 5C.
W82-02412

PRIMARY PRODUCTIVITY AND TROPHIC STATUS OF A KASHMIR HIMALAYAN LAKE,

Kashmir Univ., Srinagar (India). Dept. of Botany.
M. A. Khan, and D. P. Zutshi.
Hydrobiologia, Vol 68, No 1, p 3-8, January, 1980. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Trophic level, *Lake classification, *Primary productivity, Mesotrophic lakes, Lakes, Himalayan Mountains, Naranbagh Lake, *Kashmir, *India, Phytoplankton, Productivity, Water quality.

Naranbagh Lake (34 degrees 12 min N and 74 degrees 41 min E; altitude 1587 meters; area 24.3 ha) in the Kashmir Himalayan Mountains is still mesotrophic according to the 1975-76 yearly phytoplankton production rates, estimated at 134 g C per sq meter. Primary production of phytoplankton, measured by the C14 technique, ranged from 36 mg C per sq meter per day in December to 906 mg C per sq meter per day in July. Photosynthetic efficiency was 0.02-0.48%. Secchi transparency varied from 1.25 to 4.0 meters, and extinction coefficient, from 0.42 to 1.36. Phosphate levels were 6.5-24.5 micrograms per liter and nitrates, 30-55 micrograms per liter. (Cassar-FRC)
W82-02414

THE MIXING LAYER OF LOCH NESS,

Institute of Oceanographic Sciences, Wormley (England).
S. A. Thorpe, and A. J. Hall.
Journal of Fluid Mechanics, Vol 101, No 4, p 687-703, December, 1980. 6 Fig, 32 Ref.

Descriptors: *Lakes, *Mixing, *Turbulent flow, Thermocline, Water circulation, Weather, Boundary layers, Temperature effects, *Loch Ness, Scotland.

The near-surface mixing layer was examined in one of the largest freshwater lakes in Scotland, Loch Ness. Large-scale coherent structures were identified in the turbulent mixing layer. Data collected by several sensors indicated the presence of downward-moving warm water of near surface origin with greater than average horizontal velocity separated by narrow tilted interfaces or fronts, from slower moving, colder water. Turbulent diffusion is indicated by the presence of frequent inversions in the vertical temperature profiles in the region between the fronts. Local Richardson numbers indicate that the fronts are only marginally unstable, if unstable at all, and it is not clear whether the descent of fluid towards the thermocline at increased speed will so increase the shear that the thermocline will become locally unstable. More careful observations of mixing layers are needed to determine the mechanisms at work. It is clear that in many respects, this mixing layer is similar to the near-surface atmospheric boundary layer. (Small-FRC)
W82-02421

ON THE DYNAMICS OF FEEDING OF YOUNG FISH FROM MOZHAYSK RESERVOIR IN VARIOUS YEARS,

Moscow State Univ. (USSR). Dept. of Ichthyology.
V. D. Spanovskaya, V. A. Grigorash, T. V. Lebedeva, and V. A. Rekubratskiy.
Journal of Ichthyology, Vol 20, No 1, p 74-83, January, 1980. 8 Tab, 15 Ref.

Descriptors: *Reservoirs, *Lakes, *Biomass, Fish, Fish populations, Feeding rates, *Mozhaysk Reservoir, *USSR, Limnology, Fish food.

Qualitative and quantitative changes in the feeding of young fish of the limnophilous association were studied in one of the sections of the Mozhaysk Reservoir in different years. The extent of the

effect of varying biomass in the food supply on the young was also assessed. The study was conducted in Khotilov inlet, which is a spawning ground for many species of fish and the foraging place of their young. It is felt that the behavior of the young of the roach, i.e., their distribution in the inlet at different times of the day, is closely connected with the nature of their feeding. In second-year roach and bream, feeding during the day and night occurs with varying intensity, as a rule decreases during the night. The daily consumption calculated for second-year roach from the Uchinskoye Reservoir in 1958 was 5% of body weight, which was close to that of the roach in the Mozhaysk Reservoir. The species and age composition, abundance and biomass of young fish in one of the inlets of the Mozhaysk Reservoir change in different years due to the appearance of strong year-classes and spawning times. The nature of the daily feeding rhythm, its stability and lability, depend on the amount of food, its accessibility and the ecology of the components constituting it. With the increase in the fish biomass in the inlet, food requirements increase, the influence of the fish on the food supply intensifies, and mechanisms ensuring its fuller use and at the same time reducing feeding competition between the various species are set in motion. (Baker-FRC)
W82-02434

LIMNOLOGICAL AND GEOCHEMICAL SURVEY OF WILLIAMS LAKE, HUBBARD COUNTY, MINNESOTA,

Geological Survey, Lakewood, CO. Water Resources Div.
J. W. LaBaugh, G. E. Groschen, and T. C. Winter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123068, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-41, 1981. 38 p, 14 Fig, 8 Tab, 39 Ref.

Descriptors: *Lakes, *Limnology, *Geochemistry, *Mineralogy, Sediments, Groundwater, Nutrients, Phytoplankton, Zooplankton, Aquatic plants, *Minnesota, Hubbard County, *Williams Lake.

A limnological and geochemical survey of Williams Lake, Minn., was made in 1979 to provide an initial interpretative description of the lake and the contiguous ground-water system. This survey was made as part of a continuing research program related to the investigation of the interaction of lakes and their contiguous groundwater systems at Williams Lake, Minn., as well as other sites within the continental United States. During 1979, Williams Lake was dimictic, and the lake had high optical transparency; light penetrated to the lakebed throughout most of the lake. Aquatic macrophytes were present along the western shore and in the southern bay of the lake. Although the lake had clinograde-oxygen distributions during part of this survey, anaerobic conditions were not observed. The lake is moderately fertile with respect to its total phosphorus content. Nutrient data indicate phosphorus limits phytoplankton biomass levels in Williams Lake. Blue-green algae were the dominant group of the phytoplankton community and copepods were the dominant group of the zooplankton community when the lake was thermally stratified during the open-water season. Calcium and bicarbonate represent more than 90 percent of the dissolved constituents in Williams Lake and the contiguous ground-water system. Major mineralogical constituents of the lake sediments are quartz, dolomite, and calcite. Marl is present only in the littoral zone of the lake. Organic sediments in the lake consist of loose organic floc and gyttja. (USGS)
W82-02471

SUMMER REAERATION AND WINTER ICE REMOVAL FROM LAKES AND RESERVOIRS,

Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
J. E. Garton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157793, Price codes: A04 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute, Oklahoma State University Technical Completion Report, November, 1981. 63 p, 28 Fig, 12 Tab, 12 Ref. OWRT-B-043-OKLA(2), 14-34-001-9091.

Descriptors: *Lakes, Destratification, *Ice removal, Garton pump, Water quality, Fish kills, *Reaeration, Aeration, *Phosphorus removal, *Lake Texoma, Texas, Oklahoma.

This report has three parts. Part one concerns an experiment conducted on Lake Texoma with an eight-foot propeller. Outflows ranged from 50 to 600 cubic feet per second. Maximum improvement for the various parameters occurred at different release rates. Maximum improvements observed were a 83-percent reduction in turbidity, a 68-percent reduction in sulfides, a 49-percent reduction in manganese, and a 53-percent reduction in phosphorus. Part two concerns experiments conducted at Pine Creek Reservoir near Valliant, Oklahoma. These experiments were with outflows ranging from 30 to 90. Experiments were conducted with various sizes of propellers pumping surface water downward to the vicinity of the outlet. Reductions of the levels of iron and manganese in the outlet releases of 60 to 70 percent have been achieved with less than 2 horsepower input. Part three concerned winter ice removal on a 100-acre lake with a six-foot propeller pumping water upward. During a severe winter for Oklahoma when ice thickness was approximately nine inches, an open area of approximately one acre was maintained. This should be of benefit to waterfowl and should prevent winter fish kills under snow covered lakes.
W82-02526

THE USE OF GROUND-WATER FLOW MODELS FOR ESTIMATING LAKE SEEPAGE RATES,

Geological Survey, Iowa city, IA.
For primary bibliographic entry see Field 2F.
W82-02549

NITROUS OXIDE CONCENTRATIONS IN LAKES: VARIATIONS WITH DEPTH AND TIME,

McGill Univ., Montreal (Quebec). Dept. of Microbiology.
R. Knowles, D. R. S. Lean, and Y. K. Chan.
Limnology and Oceanography, Vol 26, No 5, p 855-866, September, 1981. 8 Fig, 27 Ref.

Descriptors: *Nitrous oxide, *Lakes, *Sinks, Water depth, Air pollution, Denitrification, Nitrification, Trophic level, Path of pollutants.

Depth profiles of N20 were compared to other variables for several Ontario lakes which differ in size, depth, and trophic state. Water samples were collected, and the following were determined: chlorophyll alpha, dissolved total Kjeldahl nitrogen, NH4(+), NO2(-), NO3(-), and dissolved N20. Profiles of concentrations of 02 and nitrogen compounds in the different lakes indicated that the lakes can act as either net sources or sinks for atmospheric N20. High concentrations of N20 in Thompson Lake, a eutrophic lake, were found in the metalimnion during spring stratification when hypolimnetic 02 and NO3(-) were already being depleted. Up to 4 micrograms of N20 per liter were determined in oxygenated NO3(-)-containing bottom waters where both nitrification and denitrification were probably occurring. A third type of N20 distribution occurred in mesotrophic Lake St. George where an N20 maximum occurred in the metalimnion, with relatively low concentrations above and below this depth. (Small-FRC)
W82-02553

ON THE OCCURRENCE OF BIMODAL DIEL DISSOLVED OXYGEN CURVES IN AQUATIC SYSTEMS,

Amsterdam Univ. (Netherlands). Lab. of Aquatic Ecology.
R. Lingeman, and P. Ruardij.
Hydrobiologia, Vol 78, No 3, p 267-272, 1981. 2 Fig, 13 Ref.

Descriptors: *Dissolved oxygen, *Irradiation, *Water temperature, *Aquatic habitats, Ponds, Productivity, Primary productivity, Oxygen, Temperature.

A two-year study of biomodal diel dissolved oxygen curves in an artificial pond suggested that a persistent high irradiation level and/or a high rate of temperature increase and/or a simultaneous high rate of primary production may induce this phenomenon. About 28% of the diel oxygen curves were bimodal, usually with a first maximum in the afternoon and a second in the evening (separated by 1 to 4 hours). About 60% of the bimodal curves appeared in May and June, but never in October through March. Bimodal curves were observed at different levels of under- and super-saturation (between 65 and 150%). Both types of curves started and ended at the same level. The first maximum of the bimodal curve was the same height as the maximum of the unimodal one. There were no significant differences between unimodal and bimodal curves in the following: temperature at the moment of oxygen maximum, daily mean temperature, moment of minimum temperature and its value, moment of maximum temperature and its value, diurnal net production and respiration, daily range of concentration values, moment of the first oxygen minimum, and oxygen concentration at the minimum. (Cassar-FRC)
W82-02565

INTERACTIONS POTENTIALLY AFFECTING THE SEASONAL ABUNDANCE OF SELECTED AQUATIC INVERTEBRATES IN A RICE FIELD HABITAT,

Minnesota Univ., St. Paul.
For primary bibliographic entry see Field 6G.
W82-02568

MAJOR PHYSICAL FEATURES OF LONG POINT BAY AND ITS WATERSHED,

Ontario Ministry of the Environment, Toronto. Water Resources Branch.
I. W. Heathcote.
Journal of Great Lakes Research, Vol 7, No 2, p 89-95, 1981. 3 Fig, 13 Ref.

Descriptors: *Watersheds, *Physical properties, *Long Point Bay, Geologic history, Lakes, Lake Ontario, Sedimentation, Shores, Climates, Land use, Water resources development, *Ontario, *Lake morphology.

A summary of background information on the Long Point Bay area in Ontario, Canada is presented. The Bay itself is situated on a band of bedrock and surficial deposits which has similar characteristics from Buffalo to Port Stanley. The area is characterized by Devonian bedrock with overlying tilles, lacustrine sands or clays. There are some dynamic areas of soil erosion where the overburden is thick, with steep bluffs of 30 or more meters height dropping to lake level. Sediment transport is extensive here, with eastward accretion occurring at the top of Long Point. Several small streams drain the narrow Long Point Bay watershed. Most flow directly to the lake. Some of the smaller ones are periodically dry, thus posing problems for water supply and sewage effluent discharge throughout the area. Main lake currents influence the circulation in the bay as well as shoreline and bottom configuration. Extensive agricultural loadings do occur in the bay, but the water quality is the best in the nearshore Lake Erie area. Chemical parameters are fairly evenly dispersed over the bay area. Physical parameters such as turbidity do register local variations. The combination of relatively clean water, long sandy beaches, and extensive marshland makes the Long Point area attractive for recreational purposes also. These purposes serve to enhance the local economy. Long term environmental monitoring programs are underway, conducted by the local industries and the Ontario Ministries of the Environmental and Natural Resources. (Baker-FRC)
W82-02579

LARM TWO-DIMENSIONAL MODEL: AN EVALUATION,

Tennessee Technological Univ., Cookeville.
For primary bibliographic entry see Field 4A.
W82-02597

2I. Water In Plants

DIURNAL VARIATION IN WATER POTENTIAL COMPONENTS AND STOMATAL RESISTANCE OF IRRIGATED PEACH SEEDLINGS,

New Jersey Agricultural Experimental Station, New Brunswick.
E. Young, J. M. Hand, and S. C. Wiest.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 337-340, May, 1981. 4 Fig, 12 Ref.

Descriptors: *Diurnal distribution, *Water potentials, *Irrigation, Plant water potential, *Peach, Stomatal transpiration.

The objectives of this study were to explore the diurnal changes in total water potential and the osmotic and turgor potential components, and to determine the relationship of turgor potential with stomatal resistance in irrigated peach seedlings. Open-pollinated 'Halford' peach seeds were sown in a greenhouse bed in August, 1970, and allowed to grow for 3 months, until they were about 1 meter tall. A significant positive correlation was noted between turgor potential and total water potential, while osmotic potential remained fairly constant. There also appeared to be no rapid diurnal osmotic adjustment to maintain constant turgor, although there may have been some slight, long-term osmotic adjustment over the two week experimental period. When turgor approached zero, a depression of osmotic potential due to water loss through transpiration maintained turgor above zero. Stomatal resistance remained low throughout the day, even though total water potential dropped below -16 bars and turgor potential was below 2 bars. Stomatal resistance was negatively correlated with irradiance level but not with turgor potential. (Baker-FRC)
W82-02202

THE EVALUATION OF A LEAF-WATER POTENTIAL FUNCTION FOR CORN,

Kansas Agricultural Experiment Station, Colby.
F. R. Lamm, J. M. Gregory, and H. S. Cengiz.
Transactions of the ASAE, Vol 24, No 5, p 1172-1176, September-October, 1981. 3 Fig, 2 Tab, 40 Ref.

Descriptors: *Leaves, *Water potentials, Mathematical studies, Water availability, Irrigation, Soil water potential, Soil water, *Corn, Farming, Model studies.

An attempt was made to develop a simple model for leaf-water potential that could be used in scheduling irrigation. An equation relating leaf-water potential to vapor pressure deficit and soil water potential was developed for corn in Missouri. The soil water potential at the 30 cm depth was used to keep calculations relatively simple. The equation gave reasonable predictions over the range of observed data. The theoretical basis of the equation also satisfied many of the boundary conditions. The soil water potential at the 30 cm depth never fell below minus 5 bars in the two years of study on this northeast Missouri claypan soil. This limited range of soil moisture probably represented only a minor concern, as a soil water potential of minus 5 bars would probably not be permitted under irrigation. Many of the constants and functional relationships were evaluated by regression techniques. Some or all of the constants may be specific to one soil type and/or location. Although the constants may vary, the procedure used in the development should be applicable to other climates and soil types. (Baker-FRC)
W82-02226

WHEAT RESPONSE TO DROUGHT,

Science and Education Administration, Florence, SC.
R. E. Sojka, and L. H. Stolzy.
California Agriculture, Vol 35, No 9/10, p 14-15, September/October, 1981. 4 Fig.

Descriptors: *Wheat, *Drought, Moisture stress, Available water, Water stress, *Soil water, Plant water potentials, *Crop yield, Experimental farms, *Sonoran Desert, *Mexico.

Field experiments on wheat stress physiology and yield interrelationships were conducted for two years by scientists in Mexico, on the Sonoran Desert. Numerous soil and plant water status measurements were made to characterize the severity of the treatments imposed. Of special importance were measurements of xylem pressure potentials for plant water status, soil water content, and yield. Cultivars in any given stress treatment did not differ markedly in water use, but well-irrigated controls required about 3.5 times as much water as did plants in any of the stressed treatments. Soil water regimes were nearly identical for all the cultivars in any given stress treatment. The daily stress patterns could be expressed statistically as three linear phases of the xylem pressure potential response. In the morning this response began to drop until about 10 AM. After 11 AM the response ceased to drop, stabilizing until about 4 PM, after which stress relief was evident and the resonse began to rise. As the season progressed, the daily responses during the stable midday periods resulted in several relationships. Daily responses reflected the increased severity of stress in the nonirrigated treatments. Eventually a point was reached when the xylem pressure potential did not return to near zero values before dawn. Instead, plants were forced to enter succeeding daily cycles without full recovery. When presunrise recovery values fell to minus 7 bars, the yield loss was about 80% compared to controls. Plant water status measurements have a genuinely important role in evaluating wheat cultivars for response to drought. (Baker-FRC)
W82-02242

EFFECT OF CORN AND SOYBEAN ROW SPACING ON PLANT CANOPY, EROSION, AND RUNOFF,

Science and Education Administration, Ames, IA.
T. S. Colvin, and J. M. Laflen.
Transactions of the ASAE, Vol 24, No 5, p 1227-1229, September/October, 1981. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Agricultural engineering, *Runoff, Erosion, Plant growth, Corn, Soybeans, *Erosion control.

The effects of row spacing on the development of plant canopy cover were determined, and the effects of row spacing on erosion hazard were considered. Two Iowa experimental sites of nearly uniform slope, previously in row crops, were chosen to contrast soils and slopes. A randomized complete-block design with two replications was used at each location. There were six treatments: fallow; soybean row widths of 250, 510, and 760 mm; and corn row widths of 510 and 760 mm. The corn row widths showed less effect on canopy development than the row width of soybeans. The 510 and 760 mm wide corn rows did not show much difference in canopy development at either location up to 50% cover, but the 510 mm wide corn rows reached 75% cover about 10 days earlier than the 760 mm wide corn rows at Castana. Row width had no significant effect on runoff volume. As the season progressed, runoff volumes from the fallow plots were significantly greater than those from the cropped areas at Castana. There was little if any observable effect of kind of crop or row width on soil erosion at any crop stage. This was apparently caused by two factors. First, very little difference was expected between the treatments, based on soil loss predictions using the Universal Soil Loss Equation, and second, the precision in this study and likely in most studies dealing with soil, plants, and topography was not sufficient to detect the small difference expected. Narrow row cropping should have only a minor effect on field soil losses, if surface conditions are no different for narrow row crops than for wide row crops. The effect of the narrower rows, if observable, should be to reduce field soil losses. (Baker-FRC)
W82-02264

EVAPOTRANSPIRATION AND LEAF WATER STATUS OF ALFALFA GROWING UNDER ADVECTIVE CONDITIONS,

British Columbia Ministry of Environment, Kamloops.
For primary bibliographic entry see Field 2D.
W82-02295

ESTIMATING CONTRIBUTION OF OVERSTORY VEGETATION TO STREAM SURFACE SHADE,

Pacific Northwest Forest and Range Experiment Station, La Grand, OR.
T. M. Quigley.
Wildlife Society Bulletin, Vol 9, No 1, p 22-27, 1981. 1 Fig, 4 Tab, 11 Ref.

Descriptors: *Vegetation effects, *Natural streams, *Solar radiation, Water quality, Temperature effects, Environmental effects, Shaded streams.

A method was developed for estimating the contribution of forest overstory to stream surface shade to aid in the prediction of solar heating of streams. Average stream width, average vegetation to stream distance, and stream orientation are inputs. Vegetation contributes to stream shade through overstory height, vegetation density, and crown size. The information needed to calculate stream shade can be gathered when stream inventory data are collected. The method was illustrated using an example. The method can aid managers in estimating stream surface shade and thus help in managing stream water quality, particularly water temperature. (Small-FRC)
W82-02301

SEASONAL PATTERNS OF PLANT AND SOIL WATER POTENTIAL ON AN IRREGULARLY-FLOODED TIDAL MARSH,

Smithsonian Institution, Rockville, MD. Radiation Biology Lab.
T. M. De Jong, and B. G. Drake.
Aquatic Botany, Vol 11, No 1, p 1-9, July, 1981. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Water potentials, *Aquatic plants, *Tidal marshes, Soil-water-plant relationships, Soil water potential, Plant water potential, Species composition, Salinity, Rhode River, *Chesapeake Bay, Marshes.

Plant water potential and soil water potential were measured in four salt marsh plant communities to determine whether there were correlations between the water potentials of the species and the soils in which they grew. Measurements were taken before dawn once a week throughout the 1978 growing season in a tidal marsh near Rhode River, Chesapeake Bay. Two species, Scirpus olneyi Gray and Scirpus robustus Pursh, had water potentials > or = -5 bar throughout the season and showed no seasonal trends. Mean seasonal dawn water potentials were -3.3 and -2.6 bar, respectively. Three species, Iva frutescens L., Spartina cynosuroides L. Roth, and Panicum virgatum L., had water potentials that ranged between nearly zero to -16 bar, with values generally decreasing as the season progressed. Mean seasonal dawn water potential values were -5.3, -6.0, and -7.5 bar, respectively. Soil water potentials at 50 cm depth did not vary more than 3 bar for any given community. Mixed communities always had the most negative mean soil water potential; creek bank communities, intermediate; and forest margin, the least negative. Measurements at 10 cm, the root zone, became more negative as the season progressed and reversed slightly at the very end of the sampling period. Contrary to expectations, plant species with the lowest dawn plant water potentials occurred in communities having the highest soil water potentials and vice versa. Therefore, no clear correlation between plant and soil water potentials could be made. Salinity and root systems are possible factors in plant species distribution. (Casser-FRC)
W82-02340

LEAF PHOTOSYNTHESIS, LEAF PERMEABILITY, CROP GROWTH, AND YIELD OF

Group 2I—Water in Plants

SHORT SPRING WHEAT GENOTYPES UNDER IRRIGATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
R. A. Fischer, F. Bidinger, J. R. Syme, and P. C. Wall.
Crop Science, Vol 21, No 3, p 367-373, May/June, 1981. 2 Fig, 5 Tab, 23 Ref.

Descriptors: *Irrigation, *Wheat, *Crop yield, Photosynthesis.

Forty-eight genotypes of spring wheat were flood irrigated at seeding and 6 times during the growing season to determine the relationships of leaf photosynthesis to crop growth rate and yield. Wheats investigated were 3 tall and 33 short (Norin 10-derived) bread wheats (Triticum aestivum L.), 8 short durum wheats (T. Turgidum L.,) and 4 triticales (X Tritosecale Wittmack). Species effects were not significant. However, genotypic effects on photosynthetic activity ranged from 14.7 to 20.4 mg CO2 per sq dm per hr and leaf permeability to viscous airflow, from 5.6 to 11.1 permeability units. In the short bread wheat group photosynthesis was not related to specific leaf weight or to leaf permeability. AT 4 weeks before anthesis, photosynthesis and preanthesis crop growth rate were weakly correlated, and both these traits were positively correlated with mature plant height. Photosynthesis was also positively correlated with crop growth rate during grain filling and with yield. Yield was positively correlated with leaf permeability. Effects of dwarfing genes on these relationships are discussed. Highest crop yields (767 g per sq meter) were in a Rht 2 gene group, genotypes Cajeme 71, Ferc 4A, Ferc 3, Yaqui 50E, Vicam 71, Kal-Bp, S948-A1. (Cassar-FRC)
W82-02373

IRRIGATION REQUIREMENTS OF FIELD-PEA FOR GRAIN,
Indian Council of Agricultural Research, New Delhi.
S. B. Hukkeri, and A. K. Sharma.
Indian Journal of Agricultural Sciences, Vol 50, No 2, p 157-160, February, 1980. 1 Tab, 4 Ref.

Descriptors: *Moisture availability, *Crop yield, Drought, Water stress, Frost, Farming, Frost protection, Soil moisture, Water table, *Irrigation requirements, Loam, *Soil-water-plant relationships, Field pea.

The distribution of rainfall and the availability of soil water before irrigations were evaluated. Field experiments were conducted in the winter of 1972-73 and 1973-74 on a sandy-loam soil of medium fertility. The field was high-lying, with the water table located more than 3 to 4 meters below the surface. The available water content in 0-60 cm depths of soil layer was 106 mm. In 1972-73 a total of 114 mm rainfall was received in three periods. In 1973-74 rainfall was negligible, only 6.3 mm of rain being received. Irrigation treatments varied according to the physiological stages of the crop. In 1972-73 the crop did not respond to the differential irrigation treatments due to the fact that rainfall was received three times during the growth period. The rains coincided with the initiation of flowering and pod formation, thus fulfilling the water needs of the crop. In 1973-74 the crop responded to differential irrigations. One irrigation given either at the vegetative stage or at the initiation of the flowering stage produced significantly higher yield as compared with the treatment with no irrigation after sowing. Two irrigations applied at the initiation of flowering and the pod development stages or at the initiation of flowering and pod formation further increased the yield. Irrigation at the vegetative stage caused the crop to yellow and reduced yields. This low yield may be due to an impeded oxygen supply to the crop due to the sealing effect or surface irrigation. The maintenance of high available moisture in the active root zone during flower initiation to early podding also helped plants tolerate frost. (Baker-FRC)
W82-02395

SOIL MOISTURE USE BY MIXED CONIFER FOREST IN A SUMMER-DRY CLIMATE,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
R. J. Arkley.
Soil Science Society of America Journal, Vol 45, No 2, p 423-427, March/April, 1981. 4 Fig, 7 Tab, 5 Ref.

Descriptors: *Forest soils, *Moisture availability, California, Water use, Soil water, Streamflow, Hydrologic budget, Trees, Forests, Pine trees, Seasonal variations, *Soil-water-plant relationships, *San Bernardino Mountains.

Soil moisture regimes were studied at 16 sites in the San Bernardino Mountains, an east-west ranged dominated by granitic rock types. All sites were within a mixed conifer forest dominated by ponderosa pine with associated sugar pine, incense-ceder, and California black oak and by Jeffrey pine with white fir. Soil moisture depletion occurred to depths of 274 cm from coarse loamy and sandy-skeletal soils and underlying decomposed granite. Available soil moisture storage ranged from 129 mm, where hard rock was encountered at 121 cm, to as high as 496 mm, where the underlying material was grus. Water use during the growing season appeared equal to available moisture storage during long dry summers, but was considerably increased in years with summer precipitation. Water use by the trees extends to depths considerably deeper than the 274 cm sampled. Productivity, and in fact survival, of the forest trees in this summer-dry climate appear to depend on moisture stored at considerable depth in fractured or decomposed rock. Tree use of such deep moisture may explain the relatively small runoff measured in southern California streams compared with that estimated by the water balance method. (Baker-FRC)
W82-02558

NUTRIENT CONTENTS OF PRECIPITATION AND CANOPY THROUGHFALL UNDER CORN, SOYBEANS, AND OATS,
South Dakota State Univ., Brookings. Dept. of Plant Science.
E. M. White.
Water Resources Bulletin, Vol 17, No 4, p 708-712, August, 1981. 4 Tab, 17 Ref.

Descriptors: *Nutrients, *Rainfall, *Soil-water-plant relationships, Crops, Ammonia, Nitrogen, Phosphorus, Nitrates, Runoff, Storm events, Soil water, Rainfall-runoff relationships, Corn, Soybeans, Oats, Throughfall, Canopy, Cycling nutrients, Water pollution sources.

Nutrients in meteoric precipitation (MP) and throughfall precipitation (TFP) were studied to determine their potential effects on runoff quality. Corn, soybean, and oat canopy TFP and MP were collected, respectively, at 10 cm and 1.5 meters above ground level. MP, TFP, and runoff samples were collected as soon as possible after an event, usually within 18 hrs. Differences in the bulk ammonia-nitrogen concentration in MP and TFP were slight for corn and oats, but soybean canopies enriched the MP with ammonia-nitrogen. Canopies of the three crops enriched MP with nitrate-nitrogen, particularly near the row for corn. Plant canopies increased the soluble and total phosphate-phosphorus concentrations, particularly near the corn rows. Soybeans had a similar effect on soluble phosphate-phosphorus but not on total phosphate-phosphorus. When the concentrations of nutrients found in MP, TFP, and in runoff from soil were calculated, the average ammonia-nitrogen concentrations decreased from MP to TFP to runoff. It was concluded that PM falling on soybeans loses ammonia-nitrogen and soluble phosphate-phosphorus to the vegetation, but gains nitrate-nitrogen, total phosphate-phosphorus and soluble potassium. With corn, ammonia-nitrogen is lost if the MP content is high otherwise MP gains ammonia-nitrogen, nitrate-nitrogen, soluble phosphate-phosphorus, total phosphate-phosphorus and soluble potassium from the canopy. Oat canopies enrich MP with the five ions. TFP concentrations were not large enough to determine the nutrient content of soil runoff water. (Baker-FRC)
W82-02574

2J. Erosion and Sedimentation

FLOW REGIME AND SEDIMENT LOAD AFFECTED BY ALTERATIONS OF THE MISSISSIPPI RIVER,
For primary bibliographic entry see Field 4C.
W82-02125

ATCHAFALAYA DELTA: SUBAERIAL DEVELOPMENT; ENVIRONMENTAL IMPLICATIONS AND RESOURCE POTENTIAL,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. Cunningham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, Oct. 1981. p 349-364, 11 Fig, 1 Tab, 11 Ref.

Descriptors: *Estuaries, *Deltas, *Wetlands, *Floods, Sediment transport, Hydrodynamics, Marshes, Mudflats, Habitats, Mississippi delta, Louisiana.

A major geologic event in the history of the Mississippi delta system is now in progress along the central Louisiana coast. Because of a distinct gradient advantage, the main distributary of the Mississippi River, the Atchafalaya River, is rapidly developing a subaerial delta in Atchafalaya Bay, 130 miles (200 km.) west of the modern bird-foot delta. The subaerial growth of the new delta is being monitored with remote sensing techniques, land and hydrographic surveys and a sediment sampling program. Initial formation of new land in the Atchafalaya Delta has been found to occur sporadically with accretional periods coinciding with flood pulses of the river. Approximately 12.39 sq mi (32 sq km) of new land had been formed by 1976 with additional accumulations following the 1979 flood. A prototype data collection program is currently underway to provide data for a study of estuarine hydrodynamics and sediment transport in the bays and near offshore areas of the Atchafalaya-Vermillion estuarine complex. Accretional impact lines include subaerial deltaic sedimentation, subaqueous bay fill and mudflat-marsh building in a region formerly characterized by shoreline retreat. These impacts are presently producing negative effects on open water habitats, but the potential for improved marsh and aquatic nursery ground environments and expansion of human habitats in the vicinity of Morgan City far outweighs loss of open bay habitats. The Corps of Engineers is considering several project alternatives for mitigation of present impacts and management of future delta growth. (Author's abstract)
W82-02126

SEDIMENT--ASSET OR LIABILITY,
Coastal Environments, Inc., Baton Rouge, LA.
For primary bibliographic entry see Field 6B.
W82-02150

THE RIVER CONTINUUM: A THEORETICAL CONSTRUCT FOR ANALYSIS OF RIVER ECOSYSTEMS,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 6G.
W82-02157

THE DOWNSTREAM TRANSPORT OF FINE MATERIAL AND THE ORGANIC MATTER BALANCE FOR A SECTION OF A SMALL CHALK STREAM IN SOUTHERN ENGLAND,
Freshwater Biological Association, East Stoke (England). River Lab.
For primary bibliographic entry see Field 1B.
W82-02192

SEDIMENT TRANSPORT DURING A CONTROLLED RESERVOIR RELEASE,

Oregon State Univ., Corvallis. School of Forestry.
R. L. Beschta, W. L. Jackson, and K. D. Knoop.
Water Resources Bulletin, Vol 17, No 4, p 635-641, August, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Sediment transport, *Reservoir releases, Tractive forces, Sediment distribution, Utah, Flow control, Reservoir fisheries, Streams.

A controlled release of water from Electric Lake Reservoir, in central Utah, was undertaken for the purpose of improving the downstream fisheries habitat by removing fine sediments from the Huntington Creek stream channel. The Electric Lake Dam was constructed from 172 to 174. During this same time period State Highway 31 was upgraded. Both activities increased sediment delivery along much of Huntington Creek. The controlled release was planned for early August 1979, with a peak discharge of 5.7 cubic meters/second or more. The release was to last for 75 hr, beginning with a series of incremental increases over a six-hour period, culminating in a peak discharge to be held for 18 hr, but then rapidly dropped and finally returned to a flow slightly less than the original peak for the remainder of the release. In practice, however, the peak flow was 4.9 cubic meters/second. No changes in the armour layer occurred, and thus no changes in cross sectional profiles at the riffles were noted and no differences were found in the frozen streambed cores obtained before and after the release. A considerable amount of sediment was apparently available from other in channel locations, including fine sediments scoured from pools and along channel banks as well as deposits on stable riffles and from beaver ponds. It is not known as yet whether this flushing of fine sediments from channels and riffles actually improved the aquatic habitat for the fish. (Baker-FRC)
W82-02196

FORMATION OF A BOTTOM FLOW IN A NATURAL WATER BODY WITH VARIOUS TYPES OF DENSITY STRATIFICATION,

Moscow State Univ. (USSR).
Yu. G. Pyrkin, B. I. Samolubov, and E. I. Debol'skaya.
Water Resources (English Translation), Vol 7, No 4, p 365-374, July-August, 1980. 6 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 4, p 144-155, July-August, 1980.

Descriptors: *Bottom currents, *Density currents, *Stratification, Flow characteristics, Suspended sediments, Sediments, *Sediment transport.

Knowledge of density current structures and formation is needed to improve methods of predicting siltation of water bodies, controlling alluviation, and discharging high-density wastewaters. Density currents were investigated in a canyon-like water body about 50 km long, up to 5 km wide, and up to 300 meters deep. It receives a powerful river sediment load composed of very fine (less than 50 micrometers) suspended particles. Average sediment concentration is 4 kg per cu meter; river water temperature is 1-6 C less than in the basin; and a plume up to 30 km forms. The following were recorded: the vertical distribution of the concentration of the suspended material, water temperature, current velocity on sections along the axis of the flow, and the temporal variation of these flow parameters at the initial points on the longitudinal-axial sections of the current. A decrease in the velocity of the streamflow upon increase of the cross-sectional area at the river mouth led to deposition of the suspended particles and formation of a high-density bottom fluid layer with a well-defined upper boundary. Separation of the bottom stratified flow into two vertical zones with a maximum density gradient and minimum flow velocity in the region of their boundary occurs. This process is accompanied by decreases in the concentration of suspended material in the flow and in its thickness. Thus, separation of suspended particles by size occurs during formation of the stratified bottom flow. the two-layer structure is a metastable, transient state of the density current during its formation; nevertheless, the stability of the upper boundary of the forming stratified flow is no less than in the case of a turbidity (mechanically stratified) current. (Cassar-FRC)
W82-02205

DERIVING SEDIMENT YIELD PROBABILITIES FOR EVALUATING CONSERVATION PRACTICES,

Science and Education Administration, Tifton, GA. Southeast Watershed Research Center.
W. C. Mills.
Transactions of the ASAE, Vol 24, No 5, p 1199-1203, 1210, September-October, 1981. 2 Fig, 28 Ref.

Descriptors: *Agricultural engineering, *Soil management, *Soil erosion, Erosion, Sedimentation, Farming, Soil engineering, Soil conservation, Conservation, Model studies, Mathematical models, Rainfall, runoff, *Sediment yield, Sediment distribution, *Probability distribution.

Probability distributions of annual sediment yield are derived for both conventional and minimum tillage of watershed cropland. These sediment yield distributions are needed to adequately evaluate future effects of alternative conservation practices. They can be derived by coupling stochastic models of rainfall and watershed state to a deterministic model of the sediment yield process. Such coupling transforms rainfall and state probabilities to sediment yield probability distributions. Several deterministic event based models that predict watershed sediment output for given rainfall event characteristics and watershed state have been proposed and are briefly noted. One of these, which is readily available, was used to demonstrate sediment yield probability computations. A bivariate rainfall model, consisting of a Weibull distribution for rainfall event duration and a log-normal distribution for event depth with given duration, was demonstrated. A watershed state model giving probabilities for three classes of antecedent moisture conditions was used. A coupling technique derived from probability generating function was used to provide accurate transformation of rainfall and state probabilities. Probability distribution of annual sediment yield from Ahoskie Creek watershed near Ahoskie, North Carolina were computed for conventional and minimum tillage. The sediment yield probability distribution computed for conventional tillage was checked by comparing computed values with the average and range of reservoir sediment measurements. (Baker-FRC)
W82-02225

RUNOFF CURVE NUMBERS FOR NORTHERN PLAINS RANGELANDS,

Science and Education Administration, Boise, ID.
For primary bibliographic entry see Field 2A.
W82-02245

VERIFICATION OF THE SLOPE FACTOR IN THE UNIVERSAL SOIL LOSS EQUATION FOR LOW SLOPES,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. E. Murphree, and C. K. Mutchler.
Journal of Soil and Water Conservation, Vol 36, No 5, p 300-302, September-October, 1981. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Erosion, *Slopes, Slope stability, Farming, Erosion rates, Erosion control, Simulation, Model studies, Rainfall, *Soil erosion, Mississippi Delta.

A site in the Mississippi Delta near Jonestown, Mississippi, was selected for a study of soil loss under rainfall conditions. On the chosen plots the soil was deep enough so that cutting and filling could be done to establish the desired slopes on adjacent rainulator plots. Six plots were duplicated, with slopes of 0.1, 0.2, 0.5, 1, 2, and 3%. Soil samples were taken before each run to determine the antecedent soil water content. Sediment samples were taken during the runs at 3 minute intervals. Continuous records of runoff were computed. The slope-factor equation of the universal soil loss equation (USLE) was based primarily on data from slopes greater than 3%. Thus it is reasonable to suspect some discrepancy in soil loss estimates for flatter slopes. Soil losses from 75 foot plots were less than half that predicted by the USLE for slopes less than 0.2%. This discrepancy approached zero for slopes of about 3%. It is also noted that the greater surface water depths found on flat lands under high rainfall intensities reflected in the R-factor would reasonably be expected to reduce erosion more extensively on flatlands than on steeper land. This expectation was supported by the data of this study. However, the irregularity of farm-field surfaces exposed only a portion of the surfaces to raindrop impact. This portion was estimated to be about one-half. It was recommended that the use of the present slope factor equation used in the USLE be continued, but the soil loss estimates for flatlands be reduced by an R-factor coefficient. (Baker-FRC)
W82-02246

MAJOR- AND TRACE-ELEMENT COMPOSITION OF SUSPENDED MATTER IN THE NORTH-EAST GULF OF ALASKA: RELATIONSHIPS WITH MAJOR SOURCES,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W82-02259

ESTIMATING SEDIMENT TRANSPORT CAPACITY IN WATERSHED MODELING,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. V. Alonso, W. H. Neibling, and G. R. Foster.
Transactions of the ASAE, Vol 24, No 5, p 1211-1220, 1226, September/October, 1981. 1 Fig, 4 Tab, 33 Ref.

Descriptors: *Sediment transport, *Model studies, Tractive forces, Mathematical studies, Watersheds, *Sediment-carrying capacity, Estimating.

Attempts were made to evaluate, using available data, a number of the sediment transport formulas suitable for watershed modeling. The first part of the paper describes the criteria followed in selecting the formulas. The second part lists the characteristics of these data, which included 739 tests from natural streams, laboratory flumes, and erosion plots. The third part examines how well each formula fits the data when it is used directly, without modification or readjustment of its coefficients. Recommendations are made regarding the applicability of the formulas within different ranges of the data. Of the nine sediment transport formulas compared with flume field data, the Yang formula best estimated streamflow carrying capacity in the range of fine to coarse sands. The Laursen formula reasonably predicted small streamflows carrying very fine sands and silts. However, it should be used with some reservations for computing transport of lighter materials. The Yalin formula can be used to compute sediment transport capacities for overland flows. It gave satisfactory results for the range of sizes and densities characteristic of field situations, and can also be used with confidence to predict transport rates of light materials in streamflows. The other formulas considered included: Ackers-White, EM-1, EM-2, Engelund-Hansen, Laursen, Bagnold, and Meyer-Peter Muller. (Baker-FRC)
W82-02265

NUTRIENT AND SEDIMENT LOADINGS FROM A SUBSURFACE DRAINAGE SYSTEM,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-02266

SEDIMENT YIELD FROM A MISSISSIPPI DELTA COTTON FIELD,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
F. E. Dendy.
Journal of Environmental Quality, Vol 10, No 4, p 482-486, October/December, 1981. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Sediment yield, *Erosion rates, *Soil erosion, Cotton, Mississippi, Sediment distribution, Sediment sorting, Particle size, Sediment concentration, *Agricultural runoff, Runoff, Vegetation effects.

Sediment yields from flat (0.2%) delta fields in Mississippi were higher than expected, from a low of 5.1 metric tons per ha per year in 1978, a year of below normal rainfall, to 12.0 metric tons per ha per year in 1979, a year of above-normal rainfall. Mean monthly concentrations of sediment in runoff varied from 164 ppm in October to 2750 ppm in April. This shows the effects of the vegetation-bare fields during seedbed preparation in April-May and after harvest and fall plowing in November. Using these cultural practices, fields are highly susceptible to erosion in January, April, May, and November. During August-October vegetation protects the soil from severe erosion. Particle size distributions of sediments washed from the fields were > 62 microns, (sand) none; and < 2 microns (clay), 83%. 98% of the material was < 16 microns in diameter. The proportion of fine material (clay) was the same for large and small storms (0.5-3.6 cm per hour). Field soils were composed of 24% particles < 2 microns, 47% < 53 microns, and 53% > 53 microns. The particles removed by erosion were largely finer materials, producing a gradual enrichment of coarse particles in the soil over long periods of time. (Casser-FRC)
W82-02324

BANK FAILURE AND EROSION ON THE OHIO RIVER,

Louisville Univ., Kentucky. Dept. of Civil Engineering.
D. J. Hagerty, M. F. Spoor, and C. R. Ullrich.
Engineering Geology, Vol 17, No 3, p 141-158, 1981. 9 Fig, 3 Tab, 6 Ref.

Descriptors: *Bank erosion, *Rivers, *Flood damage, Erosion, *Ohio River, Currents, Navigation, Wave action, Internal water, Alluvial soils.

The construction and operation of navigation dams and towboat traffic on the Ohio River have been blamed for bank erosion and failures. However, examination of historical information and monitoring and mapping investigations have shown that bank failure is not caused by these processes but is a function of bank materials, topography, land use, river morphology, and weather cycles. Review of historical illustrations, photographs, and literature dating back to 1770 reveals that severe bank erosion has been common during this entire period. Although bank failure and erosion are episodic and complex, the most important mechanism appears to be removal of bank material by current forces during floods and internal erosion of bank materials by bank discharge after floods. Age of navigation pools, water level fluctuations within a pool, waves generated by vessels, and boat traffic volume showed no correlation with bank failure. The coarse alluvial soils, common along the Ohio, are especially subject to erosion. (Casser-FRC)
W82-02343

FLASH FLOOD IN ARIZONA - OBSERVATIONS AND THEIR APPLICATION TO THE IDENTIFICATION OF FLASH-FLOOD DEPOSITS IN THE GEOLOGIC RECORD,

Geological Survey, Flagstaff, AZ.
For primary bibliographic entry see Field 2A.
W82-02330

TWO BED-LOAD FORMULAS: AN EVALUATION,

Ain Shams Univ., Cairo (Egypt).
M. I. Amin, and P. J. Murphy.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY8, p 961-972, August, 1981. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Sediment transport, *Bed load, *Sand, Channel scour, Bed load discharge, Suspended sediments, *Fish Creek, *New York, Shear stress, Flow velocity, Meyer-Peter-Muller equation, Toffaleti equation, Mathematical equations.

Two bed load equations were evaluated in sand-bottomed channels by measuring the hydraulic data required for the formulas and the actual sediment transport rate and comparing the calculated values with values observed in the Fish Creek, Rome, New York. Over a two year period 81 samples were collected. Data was smoothed by placing the samples in order of their sediment transport rates and averaging each set of five neighboring values. The Toffaleti (1969) equation produced the better agreement between predicted and measured bed loads. The data showed a scatter of a factor of 2.5, probably a result of the effects of grain size, water depth, and temperature on the shape of the local energy grade line used in the procedure or the randomness of the bed load. The Meyer-Peter and Muller (1948) equation, a threshold type, was not suitable for sand-bed channels. Predictions were significantly higher than measured sediment transport rates. In some cases movement was observed where zero movement was predicted. (Casser-FRC)
W82-02375

SEDIMENT TRANSPORT IN THE TANANA RIVER NEAR FAIRBANKS, ALASKA, 1977-79,

Geological Survey, Anchorage, AK. Water Resources Div.
R. L. Burrows, W. W. Emmett, and B. Parks.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A105363, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-20, 1981. 56 p, 20 Fig, 29 Tab, 9 Ref.

Descriptors: *Sediment transport, *Bed load, *Particle size, Streamflow, Suspended sediments, Sediment discharge, Flow rates, Hydrologic data, *Alaska, Fairbanks, *Tanana River.

Suspended sediment and bedload transport rates for the Tanana River near Fairbanks, Alaska, can be related to water discharge, and annual sediment loads can be computed using these relations. For a site near Fairbanks, the average annual (1974-79) load is 24 million metric tons of suspended sediment and 321,000 metric tons of bedload. Upstream, near North Pole, the average annual load is 20.7 million metric tons of suspended sediment and 298,000 metric tons of bedload. For both sites bedload is usually 1 to 1.5 percent of suspended sediment load. Particle size distribution of suspended sediment is similar at Fairbanks and North Pole. Median particle size is generally in the silt range, but at some low-water discharges, it is in the very fine sand range. Median particle size of bedload near North Pole is generally in the gravel range, but at some low transport rates, it is in the medium sand range. In 1977 median bedload particle size was comparable at the two sites, but in 1978 the median size was markedly smaller at Fairbanks. In 1979, generally coarser material was transported at both sites, but the decrease in bedload particle size was even greater between the sites. At both sites and at all water discharge and sediment transport rates, suspended load particles are significantly smaller than bedload particles. At North Pole in 1979, median bed material particle size was in the course gravel range; at Fairbanks it was in the medium gravel range in the main channel but in the fine sand range in the overflow part of the channel. (USGS)
W82-02472

CUMULATIVE EFFECTS OF LOGGING ROAD SEDIMENT ON SALMONID POPULATIONS IN THE CLEARWATER RIVER, JEFFERSON COUNTY, WASHINGTON,

Washington Univ., Seattle. Fisheries Research Inst.
C. J. Cederholm, L. M. Reid, and E. O. Salo.
In: Proceedings from the Conference, Salmon Spawning Gravel: A Renewable Resource in the Pacific Northwest, October 6-7, 1980, Seattle, State of Washington Water Research Center, Washington State Univ., Pullman, Rept No 39, March, 1981. p 38-74, 10 Fig, 7 Tab, 44 Ref.

Descriptors: *Sediment control, *Rivers, *Spawning, *Salmon, *Gravel, Fish management, Logging, Detritus, Catchment areas, Ecological effects, Landslides, Forestry, Road construction, Access routes.

In 1971 a series of massive landslides on the west coast of the Olympic Peninsula, which included both logging and road sidecast failures, prompted research on the sedimentation of salmonid spawning habitats. The sedimentation from logging road activities has caused long-term concern for fisheries resources of the Clearwater River. This study included analyses of field situations supplemented by controlled experiments. Significant amounts (15-25 percent) of fine sediments (less than 0.85 mm diameter material) are accumulating in spawning gravels of some heavily roaded tributary basins. This accumulation is highest where the road area exceeds 2.5 percent of the basin area. Tributaries of relatively steep gradient are less likely to accumulate high levels of fines. The survival of salmonid eggs to emergence is inversely correlated with percent fines when the percentage of fines exceeds the natural level of 10 percent. The presence of 2.5 km/km-squared of gravel-surfaced roads undergoing an average distribution of road uses is found to be responsible for producing sediment at 2.6 to 4.3 times the natural rate in a drainage basin. Sixty percent of the road-related sediment production is caused by landslides, while 18-26 percent is caused by erosion on road surfaces. However, if fine sediment alone is considered, the production from road surfaces and landslides is nearly equal. (Garrison-Omniplan)
W82-02507

MT. ST. HELENS AND THE FISH,

Washington State Dept. of Fisheries, Olympia.
W. Rees.
In: Proceedings from the Conference, Salmon Spawning Gravel: A Renewable Resource in the Pacific Northwest. Oct 6-7, 1980, Seattle. State of Washington Water Research Center, Washington State Univ., Pullman. Rept. No 39, March, 1981. p 168-175. 1 Fig, 1 Tab.

Descriptors: *Volcanoes, *Fishkill, *Salmon, *Stream fisheries, *Sediment concentration, Economic aspects, Landslides, Gills, Fish hatcheries, Mudflows, Turbidity, Sediment control.

The Mt. St. Helens eruption in May 1980, signalled by an earthquake of magnitude 5, was a direct lateral explosion—the worst of all types of volcanic eruptions. The blast was followed by pyroclastic flows that in turn touched off mudslides affecting rivers up to twenty miles away. Observations in the Cowlitz River indicated that the new sediment deposit was 12 to 15 feet deep throughout the Cowlitz channel and had reduced the channel's capacity by about 85 percent. Significant quantities of sediment were also carried out into the Columbia River, destroying the navigational channel in some locations. All fish were killed in the mainstem Toutle River and its North and South Forks, as well as in the lower 20 miles of the Cowlitz River. In addition, the Toutle Hatchery was inundated and suffered a loss of juvenile salmon. This loss of salmon represents a direct economic loss of over $7.5 million to fisheries. Seven major hatcheries in the area have been affected by the eruption. Mortalities to juvenile salmon held in live boxes since the eruption have ranged from 100 percent mortality in less than six hours to 100 percent survival in some areas during a low flow period. Mortality to juveniles and adults is due to gill abrasion, and increases with higher turbidity. Temporary rehabilitation efforts are underway, but long-term effects cannot be quantified at this time. (Garrison-Omniplan)
W82-02508

CHARACTERIZATION OF SPAWNING GRAVEL AND STREAM SYSTEM EVALUATION,

Corvallis Environmental Research Lab., OR.
M. A. Shirazi, W. K. Seim, and D. H. Lewis.
In: Proceedings from the Conference Salmon Spawning Gravel: A Renewable Resource in the Pacific Northwest. Oct 6-7, 1980, Seattle. State of Washington Water Research Center, Washington State Univ., Pullman. Rept No 39, March 1981. p 227-278. 5 Fig, 8 tab, 18 Ref, Append.

Descriptors: *Sediment control, *Stream fisheries, *Salmon, *Spawning, *Gravel, Stream erosion, Particle size, Landslides, On-site data collections, Forestry, Logging, Detritus, Ecological effects, Streams, *Pacific Northwest.

As a result of silviculture activities in the Pacific Northwest, various levels of sediments and debris enter the streams, degrading spawning substrate of salmonid fishes. To provide a unifying methodology for monitoring and assessing stream gravel composition, an experiment was conducted in the summer of 1978 that addressed gravel composition differences at a variety of spawning substrates, using sites from ten to several hundred square meters in size. Included in the study were streams in the Siuslaw National Forest in Oregon, a segment of the Rogue River in Oregon, and a small salmon stream in southeast Alaska. It was found that the mean geometric particle diameter provides a convenient and theoretically sound parameter that expresses the entire range of the particle distribution and effectively relates particle size to salmonid embryo survival. Thus, the mean geometric particle diameter is preferable to percent fines. Either manual core or freezecore samplers are adequate when properly used. Sample depth should be 25 cm; single freezecores or manual cores less than 15 cm in diameter may give inadequate sample size in coarse substrates. Sieve series should follow the series in millimeters from 64 to .063. Also recommended is a combination of visual estimation and actual sampling. Comparison between existing and expected normal background sediment characteristics will provide the basis of assessing spawning habitats. (Garrison-Omniplan)
W82-02509

HYDRAULICS OF FLOW AND SEDIMENT TRANSPORT IN THE KANKAKEE RIVER IN ILLINOIS,

Illinois State Water Survey, Champaign.
N. G. Bhowmik, A. P. Bonini, W. C. Bogner, and R. P. Byrne.
Illinois Institute of Natural Resources Report of Investigation 98, 1980. 132 p, 80 Fig, 14 Tab, 92 Ref, 17 Append.

Descriptors: *Sediment transport, *River basins, *Flow measurement, *Flow rates, Deposition, Rivers, Gaging stations, Low flow, Scour, Sedimentation, Flood peak, Sandbars, Channeling, Streamflow, Flood flow, *Kakakee River, Illinois.

Detailed hydraulic and geometric data were collected from various locations along the Kankakee River to study the mechanics of flow and the sediment transport capability of the river. An historical review of the river basin over the last few hundred years showed the progression of the river channelization in Indiana about 65 years ago, as well as the behavior of the river in the straigtened portion in Indiana and the nonstraigtened portion in Illinois. An analysis of the historical data related to peak flows, average flows, and low flows for six gaging stations showed a trend of increasing peak flows at Shelby and Momence, with a similar trend of increasing average flows at Momence and Wilmington. Deposition and scour occurred at various places in the main stem of the river in Illinois between 1968-1978. An analysis of more than 300 bed material samples indicated that the median diameters of the bed materials of the river range in size from 0.2 to 0.4 mm. During flood season, for a period of about 60 to 80 days, the river carries 70 to 80 percent of the yearly sediment load at all the gaging stations. The Iroquois River watershed contributed more suspended sediment load per square mile of drainage area than the main stem of the Kankakee River. A number of active sand bars were surveyed, and one near the state line appears to be forming and crossing the state line once a year. A number of preventive and remedial measures were suggested, with preference for the preventive approach, to reduce the sediment load in the river. (Garrison-Omniplan)
W82-02512

VELOCITY PROFILES WITH SUSPENDED SEDIMENT,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
N. L. Coleman.
Journal of Hydraulic Research, Vol 19, No 3, p 211-229, 1981. 10 Fig, 3 Tab, 27 Ref.

Descriptors: *Velocity coefficients, *Suspended sediments, Karman coefficient, Channel flow, Open channels, Richardson number, *Open channel flow.

Experiments were conducted on the effect of suspended sediment on velocity profiles. The findings indicate that the Karman coefficient does not decrease with increasing suspended sediment concentration, even though the velocity profile does respond to the presence of suspended sediment by changing shape. The currently accepted forms of the law of the wall and the velocity defect law contain wake flow terms in addition to the original Prandtl-Karman forms. These terms account for the deviation of the velocity defect laws from the logarithmic form in the outer part of the boundary layer in an open channel flow. The existence of these terms emphasizes the need to evaluate the Karman coefficient from straight line fits to experimental velocity profiles in the lower 15% of the flow, in the region where the wake flow terms are negligible, and not out in the more central regions of the flow. The Karman coefficient remained essentially constant over a range of conditions from flows with no sediment in suspension to flows carrying a near capacity load of suspended sediment. The new data also shows that the wake strength coefficient, for uniform nonseparating flows, varies directly with the gross-flow Richardson number. This indicates the presence of suspended sediment capable of reducing turbulence effects in the outer part of the flow. (Baker-FRC)
W82-02581

2K. Chemical Processes

LAKE ERIE NEARSHORE WATER CHEMISTRY AT NANTICOKE, ONTARIO, 1969-1978,

Ontario Ministry of the Environment, Toronto. Water Resources Branch.
I. W. Heathcote, R. R. Weiler, and J. W. Tanner.
Journal of Great Lakes Research, Vol 7, No 2, p 130-135, 1981. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Water analysis, *Lakes, *Lake Erie, Ontario, *Nanticoke, Nearshore processes, Water chemistry, Phosphorus, Nitrogen, Seasonal variation, Environmental effects, *Chemical analysis.

The results and conclusions of the first 10 years of the Nanticoke water chemistry program are reviewed. The authors of the Nanticoke water chemistry reports used a fixed-factor, two-way analysis of variance without replication to assess the significance of between-date and between-station variability in the levels of water chemistry parameters. Additional statistical methods were employed in this study to elucidate spatial variability in the Nanticoke water chemistry data. No significant long-term trends were found in phosphorus levels in the nearshore waters of Lake Erie at Nanticoke. Despite total phosphorus concentrations of almost 20 micrograms/liter, the area around Nanticoke and Long Point Bay is the only region in Lake Erie that is classified as being in the oligotrophic to mesotrophic range on the basis of total phosphorus, chlorophyll a, and Secchi disk transparency. This is attributed to the influence of the open lake circulation east of Long Point and to a drainage basin that does not contribute much phosphorus and sediment to the lake. All the water quality parameters measured at Nanticoke have met the Ontario and IJC water quality objectives for at least the four years from 1975 to 1978. While water chemistry was similar at all the Nanticoke sampling stations, the stations fell into offshore and nearshore groups on the basis of differences in Secchi disk transparency and total Kheldahl nitrogen. Levels of most water chemistry parameters varied with the seasons. Specific conductance, chloride, and turbidity decreased over the 10 yr study. Phytoplankton density increased. Temperature, dissolved oxygen, pH, nitrate plus nitrate, Kjeldahl nitrogen, ammonia, total phosphorus and filtered reactive phosphorus did not change significantly. (Baker-FRC)
W82-02228

CHEMICAL AVAILABILITY OF CADMIUM IN MISSISSIPPI RIVER SEDIMENT,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5B.
W82-02267

SOME ANALYSES OF AQUATIC PLANTS AND THEIR WATERS,

Crewe and Alsagar Coll. of Higher Education (England).
For primary bibliographic entry see Field 2H.
W82-02293

CHEMISTRY OF INTERSTITIAL WATER AND BOTTOM SEDIMENTS AS INDICATORS OF SEEPAGE PATTERNS IN PERCH LAKE, CHALK RIVER, ONTARIO,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2A.
W82-02304

INTERACTIONS BETWEEN LUGOL'S FIXATIVE AND ETHYLENE IN THE ACETYLENE-REDUCTION ASSAY FOR NITROGENASE ACTIVITY IN LAKE WATER,

Lund Univ. (Sweden). Limnological Inst.
L. Leonardson.
Canadian Journal of Microbiology, Vol 26, No 5, p 599-605, 1980. 5 Fig, 5 Tab, 11 Ref.

Descriptors: *Chemical analysis, Sample preservation, Nitrogen fixation, Nitrogen, Enzymes, *Lakes, Chemical reactions, *Ethylene, *Phytoplankton, Byajon Lake, *Sweden.

For performing the acetylene-reduction assay of nitrogenase activity in aquatic organisms, Lugol's solution is a practical and efficient fixative. However, correction must be made for the solubility of ethylene in the liquid phase and reactions between Lugol's solution and ethylene. The purpose of this study was to determine the extent of the loss of ethylene and the effects of phytoplankton concentrations and storage conditions. Water for the study was taken from Lake Byajon in Scania, Sweden. The studies indicated that the solubility of ethylene in the liquid phase of samples cannot be neglected if a realistic assessment of aquatic nitrogen fixation is desired. Since ethylene is unsaturated and highly reactive, care must be taken to use reagents that will inhibit the nitrogenase enzyme. Both solubility and chemical reactions contribute to the decrease of the ethylene content of the vapor phase during long-term storage. The loss of ethylene to mixtures of water and Lugol's solution can be overcome by using a standardized technique and storing samples under defined conditions until analysis. The true ethylene production in the incubation vessel can then be calculated after determination of solubility and long-term reaction patterns for the actual experimental design. (Baker-FRC)
W82-02380

MAJOR ION CHEMISTRY IN A TROPICAL AFRICAN LAKE BASIN,

Nairobi Univ. (Kenya). Dept. of Botany.
J. J. Gaudet, and J. M. Melack.
Freshwater Biology, Vol 11, No 4, p 309-333, August, 1981. 10 Fig, 14 Tab, 64 Ref.

Descriptors: *Lake basins, *Chemical analysis, Sodium, Chemistry of precipitation, Africa, Calcium, Sulfates, Chlorides, Water analysis, Precipitation, Sediments, Tropical zone, Tropical regions, Climatic zones, Rainwater, *Lake Naivasha, *Kenya, *Chemical composition.

The object of this research was to quantify differences in chemical composition of waters of the Naivasha basin. The basin lies between the two flanks of the Eastern or Gregory Rift Valley. Lake beds are composed of reworked volcanic material

or subsequently deposited pyroclastics and organic matter produced locally. The climate is warm and semi-arid. The lake area has become an important area for intensive vegetable production under irrigation. The Naivasha basin contains four topographically distinct bodies of water. The mean chemical composition in mg/liter of bulk precipitation collected on two transects across the rift valley near Lake Naivasha and at three stations near Nairobi was: Na, 0.54; K, 0.31; Ca, 0.19; Mg, 0.23; sulfate, 0.72; and chloride, 0.41. The major inflow was largely a solution of bicarbonate, sodium, and calcium and carried a total dissolved solids load of 62 kg/ha in 1973 and 120 kg/ha in 1974. Among standing waters sodium and bicarbonate predominated; the total dissolved solute content increased from a low under the northern papyrus swamp to intermediate in Lake Naivasha to a high in Oloidien Lake. The freshness of Lake Naivasha was due to a large fraction of water in the lake coming from dilute rivers and rain. The fact that the lake does not lie in a closed basin but loses water and solutes through seepage, and that exchange with sediments in both the pelagic and littoral regions is a major route for solute movement leading to accumulation on the lake bottom. (Baker-FRC)
W82-02440

GEOCHEMICAL EVIDENCE ON THE NATURE OF THE BASEMENT ROCKS OF THE SIERRA NEVADA, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
I. Barnes, R. W. Kistler, R. H. Mariner, and T. S. Presser.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $2.25 in paper copy. Geological Survey Water-Supply Paper 2181, 1981. 13 p, 6 Fig, 7 Tab, 70 Ref.

Descriptors: *Geochemistry, *Foundation rocks, *Springs, *Carbon dioxide, Geohydrology, Geologic formations, Geologic control, Stable isotopes, Water analysis, Chlorides, Water quality, Chemical analysis, *California, Sierra Nevada Mountains, Klamath Mountains, Batholith.

Carbon dioxide-rich waters from 10 of 17 sampled Sierra Nevada soda springs have high concentrations of magnesium, are saturated with amorphous silica, and have temperatures near the mean annual air temperature. This combination is unique to the phase assemblage serpentine-water-carbon dioxide and requires either an isothermal gradient in the ground water and adjacent rocks or shallow depth to the serpentinite. Magnesium concentrations are lower than those found in soda spring water under similar physical and chemical conditions in lizardite-chrysotile serpentinite terranes; therefore, the serpentinites under the Sierra Nevada may be antigorite. Calcium concentrations are in the range of 120 to 620 mg/L probably from calcite-bearing rocks being dissolved by the water; the strontium-isotope values for some of the spring waters are consistent with the calcite being of Middle Devonian to early Mesozoic age. Low strontium-isotope values suggest that the metamorphic rocks beneath the plutons are free of muscovite because carbon dioxide-rich waters that issue from metamorphic rocks containing both biotite and muscovite have much higher strontium-isotope values than waters that issue from granitic rocks containing biotite but no muscovite. The waters have deuterium and oxygen-18 values identical with modern meteoric water but contain high chloride concentrations (up to 2500 mg/L). This combination requires mixing of meteoric waters with a brine of at least 100,000 mg/L chloride. Such brines are usually found in clastic rocks of marine origin. High boron (up to 33 mg/L) and readily detectable bromide and iodide confirm the presence of marine clastic rocks (now metamorphosed) beneath 11 of the springs. (USGS)
W82-02460

GROUND-WATER DATA FOR MICHIGAN 1980,

Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-02467

CHEMICAL QUALITY OF GROUND WATER IN SAN JOAQUIN AND PART OF CONTRA COSTA COUNTIES, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
S. K. Sorenson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-124330, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-26, June, 1981. 32 p, 9 Fig, 8 Tab, 14 Ref.

Descriptors: *Water quality, *Groundwater, *Chemical analysis, *Wells, Water sampling, Geohydrology, Water use, Water quality standards, Trace elements, Water types, *California, Sacramento Valley, San Joaquin County, Contra Costa County.

Chemical water-quality conditions were investigated in San Joaquin and part of Contra Costa Counties by canvassing available wells and sampling water from 324 representative wells. Chemical water types varied, with 73 percent of the wells sampled containing either calcium-magnesium bicarbonate, or calcium-sodium bicarbonate type water. Substantial areas contain ground water exceeding water-quality standards for boron, manganese, and nitrate. Trace elements, with the exception of boron and manganese, were present in negligible amounts. (USGS)
W82-02470

130,000-YR CONTINUOUS POLLEN RECORD FROM CLEAR LAKE, LAKE COUNTY, CALIFORNIA,

Geological Survey, Menlo Park, CA.
D. P. Adam, J. D. Sims, and C. K. Throckmorton.
Geology, Vol 9, No 8, p 373-377, August, 1981. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Lake sediments, *History, *Climatology, Trees, *Pollen, Sediments, Sampling, Cores, Clear Lake, California.

A pollen analysis of core 4 (a 115 m core) sediment from Clear Lake, California, revealed a climatic record that was continuous for 130,000 years. Migrations of the tree species of the california coast Ranges were seen in response to climatic changes due to the glacial cycle. The 165 samples from the 115-m core indicated that during interglacials, pollen in rain was dominated by oak, while in cooler periods it was dominated by pine. The natural vegetation in the area at present is a blue oak-digger pine forest. The curve for oak pollen over the 130,000 years resembled and can be correlated with both deep-sea oxygen-isotope curves and the climatic record from certain European pollen studies. (Small-FRC)
W82-02544

GEOCHEMISTRY OF AMINO ACIDS IN SEDIMENTS FROM CLEAR LAKE, CALIFORNIA,

Geological Survey, Menlo Park, CA.
D. J. Blunt, K. A. Kvenvolden, and J. D. Sims.
Geology, Vol 9, No 8, p 378-382, August, 1981. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Lake sediments, *Geochemistry, *Amino acids, Geologic history, *Pollen, Clear Lake, California, Sampling, Sediments, Cores.

The results of amino acid geochemistry are reported with application to deochronology in core 4 sediments of Clear Lake (California). Aspartic acid and alanine were considered in detail to clarify uncertainties in correlations of ash beds and pollen spectra in lacustrine sediment. Relative concentrations of aspartic acid decreased with depth, probably due to diagenesis and to preferential adsorption and hydrolysis in clay. Alanine increased with depth, probably because of the generation of alanine during diagenesis of other amino acids. When age assessment is based on alanine, results support a time-depth curve obtained from oak pollen and oxygen isotopes over a span of about 130,000 years. (Small-FRC)
W82-02545

ELECTRON INTENSITY, THE ROLE OF HUMIC ACIDS IN EXTRACELLULAR ELECTRON TRANSPORT AND CHEMICAL DETERMINATION OF PE IN NATURAL WATERS,

Toronto Univ. (Ontario). Dept. of Zoology.
A. P. Zimmerman.
Hydrobiologia, Vol 78, No 3, p 259-265, 1981. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Humic acids, *Oxidation-reduction potential, Electron transport, Organic matter, Organic acids, Chemical potential, Lake sediments, Lakes, Sediments, Chelation, Mercury, *Georgia.

Humic acids were capable of accepting and donating electrons across a wide range of potentials (-1.2 to +0.8 V), including the entire range encountered in aquatic systems. Evolution of Hg, using Hg(NO3)2 as the terminal electron acceptor, was highest, 60%, in the combination, humic acid plus SnC12. Hg evolution in other flasks was as follows: control (Hg alone), sediments, humic acids, sediment plus NaBH4, and humic acids plus NaBH4, all < 10%; SnC12, NaBH4, ascorbic acid, each 10-20%; sediment plus ascorbic acid, 35%; and sediment plus SnC12 and humic acids plus ascorbic acid, 30-40%. In biological systems Hg evolution after 168 hours varied between 2 and 12% in the increasing order: low Hg, high Hg, low Hg plus sucrose, low Hg plus humic acids, high Hg plus humic acids, high Hg plus sucrose, low Hg plus humic acids plus sucrose, and high Hp plus humic acids plus sucrose. In the case of humic acid complexes with 2-p-iodophenyl-3-nitrophenyl-5-phenyltetrazolium chloride (INT), an electron sensitive dye, the pE is dependent only on the negative log of the ratio of oxidized to reduced dye. PE's were chemically determined for sediments in 3 Georgia lakes. They were: Jackson (highly productive, heavy sediment loads), -10 to +4; Burton (dilute, low ionic strength), 0 to +5; and louise (acidic, with organic ligands), 0 to +4. (Cassar-FRC)
W82-02566

WATER QUALITY OF A SOUTHEAST TEXAS STREAM,

Lamar Univ., Beaumont, TX. Dept. of Biology.
D. Bass, and R. C. Harrel.
Hydrobiologia, Vol 76, 1/2, p 69-79, 1981. 1 Fig, 5 Tab, 21 Ref.

Descriptors: *Water quality, *Streams, Chlorides, Bacteria, Coliforms, Feces, Benthos, Runoff, Rainfall, Dissolved oxygen, Seasonal variation, Baseline studies, *Menard Creek, Polk County, *Texas.

A determination was made of baseline water quality data in Menard Creek, with attempts to establish downstream and seasonal trends in water quality and locate existing and potential sites of pollution. Menard Creek originates in central Polk County of southeast Texas and flows 77 km through Hardin and Liberty counties into the Trinity River. The vegetation is that characteristic of the river floodplain forest and slope forest of the Big Thicket, a National Preserve. Samples were taken from Menard Creek during July 1978 to June 1979. In general the physicochemical conditions indicated good water quality. Menard Creek was characterized by an intermediate number of taxa (12) and intermediate to high species diversity. Depression in diversity was directly related to high discharge and not to poor water quality. The fauna was composed of large numbers of pollution intolerant taxa and many more insects than oligochaetes. Numbers of fecal bacteria were higher than acceptable for contact recreation at all sampling stations during much of the study period. Highest numbers were generally found after heavy rains and surface runoff. Fecal coliform to fecal streptococci ratios indicated human contamination in 53% of the 60 samples, while non-human contaminations were found in 12% of the samples. Dissolved oxygen concentrations were always high, and all other parameters were within the expected ranges for small streams in the area. Conductivity and chlorides indicated low concentrations of oil field brines at two sampling sites. (Baker-FRC)
W82-02570

2L. Estuaries

FRESHWATER INPUTS AND ESTUARINE PRODUCTIVITY,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
S. W. Nixon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol I, October, 1981. p 31-57, 8 Fig, 5 Tab, 86 Ref.

Descriptors: *Estuarine environment, *Primary productivity, *Eutrophication, *Nutrients, Water circulation, River flow, Wetlands, Salt marshes, Secondary productivity.

The processes responsible for the high level of production characteristic of estuarine systems are not yet well understood. There are at least five major hypotheses which have been put forward to account for estuarine production, including the fertilizing effect of nutrients in fresh water, advection of nutrient rich offshore water, the trapping of nutrients in estuarine circulation, the outwelling of nutrients from salt marshes and other wetlands, and the rapid recycling of nutrients within the estuary. The remarkable similarity of primary and (to a lesser degree) secondary production levels among estuaries with widely varying fresh water inputs, hydrodynamic properties, and geographical and geological characteristics suggests that a more general feature of estuarine systems is most important in enhancing production in these areas. While river inputs may contribute to the spring bloom, most of the production in many estuaries appears to take place during the warmer months and to be supported by recycled nutrients. Because remineralization appears to be a slower process than the formation of new organic matter, it may be that heterotrophic processes play an important role in regulating the primary production of estuaries, and that the similarity of carbon fixation rates in various estuaries arises because of some common limit on the rate of nutrient recycling. More attention also needs to be given to the problem of understanding the relationship between short-term processes, such as annual production or regeneration, and longer term processes, such as the continuous input of nutrients from rivers and anthropogenic sources. (Moore-SRC)
W82-02110

CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY,

Corps of Engineers, Baltimore, MD. Baltimore District.
For primary bibliographic entry see Field 6G.
W82-02114

ASPECTS OF IMPACTS ASSESSMENT OF LOW FRESHWATER INFLOWS TO CHESAPEAKE BAY,

Western Ecosystems Technology, Laurel, MD.
For primary bibliographic entry see Field 6G.
W82-02115

FRESHWATER INFLUENCES ON STRIPED BASS POPULATION DYNAMICS,

Maryland University, Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 6G.
W82-02116

EFFECTS OF FRESHWATER FLOW ON SALINITY AND PHYTOPLANKTON BIOMASS IN THE LOWER HUDSON ESTUARY,

Lamont-Doherty Geological Observatory, Palisades, NY.
P. J. Neale, T. C. Malone, and D. C. Boardman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 168-184, 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Estuarine environment, *Salinity, *Phytoplankton, *River flow, *Model studies, Water currents, Low flow, High flow, Biomass, Chlorophyll a, Tidal effects, *Hudson River estuary.

Phytoplankton biomass variations in estuaries are primarily the result of material fluxes due to estuarine circulation and fluxes due to biological and particulate processes (growth, sinking, and grazing). Thus freshwater effects on estuarine circulation can be translated to effects on phytoplankton biomass if the relative contribution of circulation-related fluxes is known. A two dimensional box model was used to describe variation of phytoplankton biomass in the lower Hudson Estuary under different flow conditions. Both the flux contribution of estuarine circulation and other gain or loss processes are quantified by the model. Lag between gauging data and freshwater flow in the estuary, the vertical structure of current velocity and salinity, and the tidal variation of salinity in each layer were considered in the estimation of model parameters. Results indicate that estuarine circulation was strong and flushing times relatively short under both high and low flow conditions. Biomass fluxes in terms of chlorophyll a were dominated by boundary inputs during high flow and by growth and grazing during low flow. The good agreement found between independent measurements of specific rates and specific rates estimated from the model indicates that the model gives a reasonable description of estuarine phytoplankton processes, and may be applicable in other estuaries. (Moore-SRC)
W82-02117

ATCHAFALAYA DELTA: SUBAERIAL DEVELOPMENT; ENVIRONMENTAL IMPLICATIONS AND RESOURCE POTENTIAL,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2J.
W82-02126

A NEW APPROACH TO DETERMINING THE QUANTITATIVE RELATIONSHIP BETWEEN FISHERY PRODUCTION AND THE FLOW OF FRESH WATER TO ESTUARIES,

National Marine Fisheries Service, Miami, FL. Southeast Fisheries Center.
For primary bibliographic entry see Field 4C.
W82-02130

AN EVALUATION OF AQUATIC LIFE FOUND AT HYDRAULIC SCOUR SITES IN THE COLUMBIA RIVER ESTUARY SELECTED FOR POTENTIAL SEDIMENT DEPOSITION,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
J. T. Durkin, T. C. Coley, K. Verner, and R. L. Emmett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, Texas, Sept. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol. I, October, 1981, p 436-452. 7 Fig, 4 Tab, 8 Ref.

Descriptors: *Aquatic animals, *Estuarine environment, *Scour, *Sediment erosion, *Flushing, Spoil disposal, Tidal effects, Fish, River flow, *Columbia River estuary.

Substantial scouring of estuarine sediment occurs from flushing of the Columbia River, which has an annual spring freshet of 20,300 cu m/s. The effect is heightened by diurnal marine water intrusion combined with spring tides having ranges exceeding 3 M. Estuarine depth is maintained by these forces at the end of jetties, promontories, and adjacent bridge openings. Hydraulic stress in these areas suggests biological instability, a low standing crop and occupancy by species tolerant of such physical conditions. Because inwater sediment disposal at sites with low biological activity is preferable to deposition at biologically rich and stable sites, scour sites were investigated for potential dredge deposition. Biological inventories of aquatic life were conducted in October-November 1978 and May 1979, at four diverse scour sites in the Columbia River Estuary. Benthic fauna, epifauna, and pelagic fish were studied as well as food utilization of dominant finfish. Inventory studies indicated low suitability for sediment deposition due to biological richness at the Tonuge point and Interstate Bridge sites. Jetty A site was biologically poor, and has potential suitability as a deposition site. Tansy Point site may be suitable for deposition at predetermined times. Inventory evaluation studies should be tested under controlled deposition conditions preceding sustained usage. (Moore-SRC)
W82-02132

THE EFFECTS OF FRESHWATER INFLOW ON SALINITY AND ZOOPLANKTON POPULATIONS AT FOUR STATIONS IN THE NUECES-CORPUS CHRISTI AND COPANO-ARANSAS BAY SYSTEMS, TEXAS FROM OCTOBER 1972-MAY 1975,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
For primary bibliographic entry see Field 6G.
W82-02133

NUTRIENT FLUX BETWEEN THE NUECES DELTAIC MARSH AND THE NUECES ESTUARY ON THE TEXAS GULF COAST,

North Texas State Univ., Denton. Inst. of Applied Sciences.
D. P. Wilcox, and W. M. Childress.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the Nat'l Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Serv., Office of Biological Svs. Rept FWS/OBS-81/04, Vol I, Oct. 1981, p 472-487. 5 Fig, 2 Tab, 19 Ref. 14-16-0009-77-074.

Descriptors: *Nutrients, *Estuaries, *Tidal marshes, *Tidal effects, Carbon Nitrogen, Phosphorus, Seiches, Seasonal variation, Fluctuations, *Texas.

Movements of carbon, nitrogen, and phosphorus in the surface waters between a tidal marsh and the Nueces estuary, Nueces County, Texas, were studied over an 8-month period (October 1978-June 1979). Nutrient transport in the Nueces marsh appears to be rather atypical when compared to other high salinity riverine marsh systems. It is characterized by infrequent and incomplete inundation by both flood and tidal waters and tends to serve as a nutrient sink. Seasonal patterns in nutrient flux were evident throughout the study period. Net fluxes of virtually all nutrient parameters were directed out of the marsh during the fall and winter, but were directed into the marsh during the spring. Combined net input of C, N, and P in the spring and summer ranged from 33 to 571 kg/hr. Tidal fluctuations in the Nueces estuary are normally low (0-60 cm). Nutrient concentrations within a tide are not as critical to the determination of net flux as is the flow rate between flood and ebb tides. Flows in and out of the marsh are for the most part attributable to tidal action, and to a lesser extent to wind seiche. (Moore-SRC)
W82-02134

ESTUARINE BENTHIC COMMUNITY DYNAMICS RELATED TO FRESHWATER INFLOW TO THE CORPUS CHRISTI BAY ESTUARY,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
R. W. Flint, and S. C. Rabalais.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Fresh-

water Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol I, Oct. 1981, p 489-508. 11 Fig, 15 Ref.

Descriptors: *Estuarine environment, *Salinity, *Rainfall, *Benthic fauna, Shrimp, Streamflow, Runoff, Biomass, Productivity, Nutrients, *Corpus christi Bay estuary Texas.

During the 24-hr period beginning with the evening of 18 September 1979, an extensive low pressure system engulfed the south Texas coast and heavily impacted the Corpus Christi area with tropical storm-intensity rains that reached as much as 33 cm accumulation in 24 hr. This produced a large amount of riverine input and land runoff to Corpus Christi Bay, dramatically decreasing salinity below normal levels for more than a month. The existence of an historical data base on benthic infauna for this estuary allowed an investigation to be conducted concerning effects of this intensive freshwater inflow on the estuarine benthos. Several months after the inflow event, densities of dominant infaunal populations increased to levels never observed, and productivity of the benthos, as represented by biomass changes, increased substantially over previous years. The nutrients associated with the intense freshwater inflow may have increased the primary productivity of the estuarine ecosystem. The increased productivity was, in turn, eventually reflected by the benthos. These data may provide a missing link in the correlations between freshwater inflow events in south Texas estuaries and yields of some of the important fisheries, such as shrimp. (Moore-SRC)
W82-02135

THE EFFECTS OF FLOODS ON THE ZOOPLANKTON ASSEMBLAGE OF SAN ANTONIO BAY, TEXAS DURING 1972 AND 1973,

National Marine Fisheries Service, Galveston, TX.
G. A. Matthews.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol I, Oct. 1981, p 509-525. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Zooplankton, *Estuarine environment, *Floods, *Salinity, Flushing, Aquatic animals, Environmental effects, Floodwater, Population density, *San Antonio Bay, Texas.

With the increasing use of estuaries for various economic purposes, it has become essential to know what to expect when certain environmental factors change. In order to study the effects of floods on an estuary, plankton tows and hydrographic measurements were taken encompassing a single flood in 1972, and three floods in 1973 in San Antonio Bay, Texas. The shallow bay was rapidly flushed by influx of flood waters as was indicated by reductions in salinity and in the densities of the dominant cpecies, Acartia tonsa. Floods replaced the typical estuarine zooplankters with freshwater ones. During the 1972 flood, total zooplankton densities fell from 10,800/cu m before the flood to 3,400/cu m after the flood, but they increased rapidly when the river flow returned to base level. After the three floods in 1973, a cumulative decrease in total density of over two orders of magnitude was found. There had been insufficient time to reestablish pre-flood densities between each flood. The rapidity with which densities were reestablished and the areas in which these increases were first found indicates the majority of the density changes were due to influx of zooplankton-rich bay water from Espiritu Santo Bay, rather than from population explosion by surviving refuge populations. The seasonal occurrence of a flood may severely reduce the survival of a bay's annual recruitment of economically important species whose larval stages are members of the zooplankton or which depend on zooplankton as food. It is important to note the interdependency of these estuaries, as currents carry life from one into the next. (Moore-SRC)
W82-02136

THE INFLUENCE OF SALINITY TRANSITION ON BENTHIC NUTRIENT REGENERATION IN ESTUARIES,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
R. E. Edwards.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service. Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 2-16. 78 Ref.

Descriptors: *Salinity, *Nutrients, *Regeneration, *Benthic environment, *Estuaries, Mineralization, Cycling nutrients, Sediments.

Sediment nutrient regeneration can be divided into three categories of processes: mineralization, mobilization, and release. Mineralization occurs primarily through biological processes, so any salinity effect on benthic metabolism will affect mineralization. Salinity transition can influence mobilization directly through physical/chemical mechanisms or indirectly through its effects on biological functioning. The predominant release process is molecular diffucion which is affected only indirectly by salinity transition, but it does significantly affect the release processes of convective overturn, bioturbation, and ebullition. Because of the complexity of the interrelationships and the lack of data few generalizations can be made. The effects of salinity transition should be a function of the absolute value of the salinity change, and the rate of change. Transition to increased salinity should cause more rapid change and more immediate changes in nutrient regeneration. Salinity transition is expected to have the greatest impact in the oligohaline (0.5 - 5.0 ppt) portion of the estuary, as the benthic organisms in this environment are the most sensitive to salinity changes. (Brambley-SRC)
W82-02137

MONITORING FRESHWATER INFLOW TO ESTUARIES BY REMOTE SENSING,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 7A.
W82-02138

CONCENTRATION, EXTENT, AND DURATION OF SALINITY INTRUSION INTO THE COLUMBIA RIVER ESTUARY, SEPTEMBER-OCTOBER, 1977-1978,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
R. J. McConnell, G. R. Snyder, J. T. Durkin, and T. H. Blahm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 41-53. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Saline water intrusion, *Columbia River estuary, *River flow, *Tides, *Estuaries, Data acquisition, Dredging, Environmental effects, Aquatic life, Estuaries.

Salinity intrusion studies were conducted in 1977 because of the predicted record low flows of the Columbia River, the removal of 6.9 million cu m of sediment from the Columbia River bar, and the need for data for model verification. The 1978 studies were for comparison purposes. Monthly neap tides produced the highest concentrations with the longest durations and furthest upstream intrusions of saline waters. The maximum intrusion of salinity at 2 ppt was 26.5 miles, and it exceeded 20 miles in all of the eight surveys. The highest salt concentration measured was 34.2 ppt at Tongue Point, a record level for the estuary. The concentration, extent and duration of salt water intrusion into the middle and upper Columbia River exceeded previous measurements, and salinities were higher on the south side of the channel rather than on the north. These changes may have effects on the distribution of benthic and pelagic fish and shellfish, with subsequent environmental and economic effects. Continued investigations are necessary to monitor any changes and predict their effects. (Brambley-SRC)
W82-02139

THE NUTRITIONAL SIGNIFICANCE OF THE DISTRIBUTION OF SUSPENDED PARTICULATE MATERIAL IN THE UPPER SAN-FRANCISCO BAY-ESTUARY,

California Univ., Davis. Dept. of Land, Air and Water Resources.
W. R. Barclay, and A. W. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 55-70. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Estuaries, *Suspended solids, *San Francisco Bay, California, *Nutrients, Salinity, Particulates, Carbohydrates, Proteins, Detritus, Zooplankton, Distribution.

A study was conducted to investigate the relationship between the distribution of nutritionally important suspended particulate matter and the area of the entrapment zone in upper San Francisco Bay estuary. The biochemical characteristics of the particulate material were measured monthly for a year at salinities of 0, 2, 4, 6, and 10 ppt. The particulate matter was size fractioned into two categories: 0.5 to 15 microns and 0.5 to 120 microns. Samples were analyzed for chlorophyl a, ATP, protein, carbohydrate, and particulate organic and inorganic carbon concentrations. At all salinities evaluated, an average of 78% of the protein and 75% of the carbohydrate was found in the 0.5 to 15 microns size fraction. From July through December the highest concentrations of suspended particulate matter were reported for the intermediate salinities of 4 and 6 ppt, indicating the presence of an entrapment zone at these salinities. The highest concentrations, of the biochemical components analyzed, occurred in the entrapment zone, except for carbohydrate and detrital carbon. The nutritional quality of the particulate matter, as measured by the protein/carbohydrate ratio, was higher in the entrapment zone than in adjacent upstream or downstream locations. The distribution of filter-feeding zooplankton over the same salinity range indicated rotifers and calanoid copepods were not significantly different between the salinities evaluated. Eurytemora hirundoides was the dominant adult copepod in the entrapment zone. The results indicate the entrapment zone is a nutritionally enhanced area for filter feeders in the estuary. Not all species studied appeared to be able to utilize this resource due to physiological requirements which restrict them to salinities higher or lower than the entrapment zone location. (Brambley-SRC)
W82-02140

EFFECTS OF FRESHWATER FLOW ON FISHERY RESOURCES IN THE SACRAMENTO-SAN JOAQUIN ESTUARY,

California State Dept. of Fish and Game, Stockton.
For primary bibliographic entry see Field 4C.
W82-02141

INFLUENCES OF FRESHWATER INFLOW ON CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) IN THE SACRAMENTO-SAN JOAQUIN ESTUARY,

Fish and Wildlife Service, Stockton, CA.
For primary bibliographic entry see Field 6G.
W82-02142

SOME EFFECTS OF FRESH WATER ON THE ATCHAFALAYA BAY SYSTEM,

University of Southwestern Louisiana, Lafayette. Dept. of Botany.
For primary bibliographic entry see Field 6G.
W82-02143

ESTABLISHMENT OF CONTROLLED FRESHWATER DIVERSIONS OF THE MISSISSIPPI RIVER INTO THE LOUISIANA COASTAL ZONE,

Department of Natural Resources, Baton Rouge, LA.
For primary bibliographic entry see Field 4A.
W82-02145

FRESHWATER INFLOW TO ESTUARIES, SHORT AND LONG TERM PERSPECTIVES,

Delaware Univ., Newark. Dept. of Geology.
R. B. Biggs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 305-321. 2 Fig, 7 Tab, 16 Ref.

Descriptors: *Estuaries, *River flow, *Salinity, *Saline water intrusion, Oysters, Sea level, Land use, Water demand, Climates, *Chesapeake Bay, Freshwater inflow.

Evidence, from fauna buried beneath the upper Chesapeake Bay and from the presence of Crassostrea shell middens upstream from the low salinity limit of oysters, demonstrates that salinity in the estuary has been higher than it is at present. The salinity of the water was deduced from the presence and type of boring sponge holes. The age of the zone 1-2 m below the bottom was radiocarbon dated as 545 plus or minus 90 yr BP. Below this zone the sponge borings increase and then decrease. This is not consistent with a uniform rising sea level-rising estuarine salinity model. Changing land use in the upstream basins of both the Susquehanna and Delaware Rivers can be shown to produce significant modifications in peak and low freshwater discharges. The cause of the salinity excursion is not known, but changing land use, climate and competing demands for fresh water are suggested. (Brambley-SRC)
W82-02158

PRECIPITATION TRENDS AND VARIABILITY IN THE VICINITY OF NORTHWEST GULF COAST: 1900-1980,

Texas A and I Univ., Kingsville. Dept. of Geography and Geology.
J. Norwine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 322-334. 7 Fig, 7 Ref.

Descriptors: *Estuaries, *Estuarine environment, *Salinity, *Rainfall distribution, *Climates, Drought, Ecosystems, Climatic zones.

This study investigated the semiarid region of south Texas and northeastern Mexico to determine any detectable cycles or climatic periodicities, and whether they have been significant. Since there were no discernible trends in temperature, precipitation figures were studied. Both south Texas and northeastern Mexico showed precipitation trends. In south Texas there was a 25-year moist period starting in 1922, and a drought during the 1950's. In Mexico the years 1927-1945 were consistently moist, and there was a 20-year dry period starting in 1945, followed by a 10-year moist period. The rainfall in the Baffin Bay area was found to be variable and nonuniform in distribution. This results in the estuarine water being either hypersaline in dry conditions or hyposaline in wet conditions and in an extraordinarily dynamic complex estuarine ecosystem. (Brambley-SRC)
W82-02159

RAINFALL-RELATED TRENDS IN THE STRUCTURE OF A FISH-CRUSTACEAN COMMUNITY IN TEXAS' GALVESTON BAY SYSTEM,

Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
D. R. Johnson, K. Strawn, and W. H. Neill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 335-349. 7 Fig, 25 Ref.

Descriptors: *Estuarine environment, *Ecosystems, *Rainfall, *Fish, *Crustaceans, Salinity, Predation, Statistical models, Temperature, Fishkill.

Between 1972 and 1978, changes in fish and crustacean populations of Cedar Bayou Electric Generating Station's cooling lake on upper Galveston Bay seemed related to rainfall rates during winter and spring. Wetter years favored populations of young migratory fishes and crustaceans; larger, predatory fishes tended to be more abundant during dry years than during wet years. This pattern is consistent with the hypothesis that part of the upper bay's value as nursery grounds derives from their low salinities which repulse larger fishes, thereby protecting juvenile organisms from intense predation. Dynamics of the cooling-lake community responded also to variation in the power plant's T (the difference between upper discharge-canal and intake-area temperatures) and to the occurrence of infrequent fish kills. A trend model of system dynamics was formulated and tested for internal consistency. There was greater agreement among the biotic elements than for the model as a whole. Complexity is added by the selective filtering action of the steam-electric power plant through which all immigrants to the community must pass, and by the occurrence of fish kills. (Brambley-SRC)
W82-02160

EFFECTS OF UPLAND DRAINAGE ON ESTUARINE NURSERY AREAS OF PAMLICO SOUND, NORTH CAROLINA,

North Carolina Office of Coastal Management, Morehead City.
P. P. Pate, and R. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 402-418. 8 Fig, 1 Tab, 1 Ref.

Descriptors: *Estuarine environment, *Estuarine fisheries, *Shrimp, *Habitats, *Drainage ditches, *Rainfall, Salinity, Juvenile growth stage, Environmental effects, Aquatic productivity, Drainage effects, Ecological effects.

Four sampling stations were established in tributaries of northern Pamlico Sound, to measure the effects of upland drainage on primary nursery areas. The four stations received either heavy, moderate, or no drainage through man-made water courses. All stations functioned as primary nursery areas during periods of low rainfall and high salinity (1977). Brown shrimp production at all sites was depressed during periods of extremely high rainfall and low salinities (1978). Salinities at the unaltered sites were more stable during periods of high runoff than those recorded at two sites receiving drainage through ditches. Recovery times at the altered sites were approximately 10 days. The most significant reduction in production of juvenile brown shrimp occurred at the extensively ditched site during periods of moderate to heavy rainfall. There were no mass or complete movements of juvenile shrimp from the nursery areas as a response to rapid changes in salinity. The most serious effects of drainage into nursery areas appear to be the degree of alteration and the danger that alteration will be severe enough to create an unsuitable habitat during periods of normal rainfall. (Brambley-SRC)
W82-02164

A DYNAMIC METHODOLOGY FOR CHARACTERIZING AND MONITORING ESTUARINE ECOSYSTEMS,

Gulf Universities Research Consortium, Houston, TX.
For primary bibliographic entry see Field 7A.
W82-02167

A NUMERICAL SIMULATION OF THE VERTICAL AND HORIZONTAL M2 TIDE IN THE BRISTOL CHANNEL AND COMPARISONS WITH OBSERVED DATA,

Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles.
Limnology and Oceanography, Vol 26, No 3, p 571-577, May, 1981. 2 Fig, 27 Ref.

Descriptors: *Mathematical models, *Tidal currents, *Estuaries, Tidal rivers, Water currents, Tidal effects, Mathematical studies, *Bristol channel, *Severn Estuary, United Kingdom, Comparison studies.

Observed and modeled currents are compared for the M2 tide in the Bristol channel and Severn Estuary (United Kingdom). Currents were measured; data were analyzed in terms of the M2 tidal ellipses, and depth averaged values were estimated. A depth-averaged hydrodynamical numerical model was used to simulate the M2 tide. When computed and observed vertical M2 tides were compared, the amplitudes were accurate to within 4%. Computed and observed current ellipse phases were not significantly different. The computed tidal currents can be used to estimate the magnitude of the tidally averaged frictional stress at the seabed. Also, the rate of dissipation of tidal energy per unit mass of water column can measure the vertical mixing due to tidal flow. This can be used to parameterize the location of frontal regions separating thermally mixed and thermally stratified water masses during the summer. (Small-FRC)
W82-02193

SEASONAL VARIATION OF VITAMIN B12, B12 ANALOGS, AND PHYTOPLANKTON IN A LONG ISLAND ESTUARY,

New York Ocean Science Lab., Montauk.
S. F. Bruno, R. D. Staker, and L. L. Curtis.
Journal of Marine Research, Vol 39, No 2, p 335-352, May, 1981. 4 Fig, 5 Tab, 40 Ref.

Descriptors: *Seasonal variation, *Vitamins, *Phytoplankton, *Estuaries, Bioassay, Diatoms, Regression analysis, Peconic Bay, Vitamin B12, *Peconic Bay estuary, Long Island, New York.

The seasonal distribution of dissolved vitamin B12 and its analogs was determined in Peconic Bay estuary, Long Island, New York, and the significance of these cobalamins with respect to phytoplankton populations is discussed. Water samples were collected from nine stations from August 1976 to April 1978. Phytoplankton cell counts and identifications were made using a nanoplankton counting chamber, and concentrations of dissolved B12 and B12 analogs were determined by bioassay using the diatom Thalassiosira pseudonana Hasle et Heimdal, Clones 3H and 13-1. Regression analyses did not show any consistent correlation of phytoplankton population parameters with dissolved B12 or B12 analogs. Vitamin B12 is probably not important in limiting phytoplankton growth rates, and this explains the lack of correlation between B12 and phytoplankton parameters. There are possible autocthonous and allocthonous mechanisms for the introduction of cobalamins into the bay system. (Small-FRC)
W82-02282

ZOOPLANKTON SAMPLE VARIABILITY IN A TIDAL ESTUARY: AN INTERPRETATIVE MODEL,

Laval Univ., Quebec. Dept. of Biologie.
M. Gagnon, and G. Lacroix.
Limnology and Oceanography, Vol 26, No 3, p 401-413, 1981. 8 Fig, 2 Tab, 22 Ref.

Descriptors: *Tidal effects, *Zooplankton, *Estuaries, Mathematical models, Sampling, Tidal rivers, Statistical analysis, *St. Lawrence River, Quebec.

The effects of tide-related advection processes on zooplankton sample variability were examined in a series of vertical hauls collected at a high sampling rate at an estuarine anchor station during part of a neap-to-spring tide cycle. A mathematical model was used to establish relations between the importance of short term temporal variability and the characteristics and displacements of the zooplankton field in the sampling area. Zooplankton was collected in the upper St. Lawrence River from July 2 to 12, 1975, once every 30 min to yield 347 samples. Data were analyzed using time series analysis, and sample variability was determined. Most of the variability was caused by periodic horizontal advection of zooplankton gradients. Thus, tidal effects on sampling must be considered when designing experiments. (Small-FRC)
W82-02306

THE EARLY DIAGENESIS OF ALIPHATIC HYDROCARBONS AND ORGANIC MATTER IN SEDIMENTARY PARTICULATES FROM DABOB BAY, WASHINGTON,

Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W82-02310

ON THE ADVECTION OF TURBIDITY IN THE SAINT LAWRENCE MIDDLE ESTUARY,

McGill Univ., Montreal (Quebec). Inst. of Oceanography.
B. D'Anglejan.
Estuaries, Vol 4, No 1, p 2-15, March, 1981. 13 Fig, 22 Ref.

Descriptors: *Estuaries, *Turbidity, *St. Lawrence Estuary, Suspended sediment, Sedimentation, Tidal currents, Particulate matter, Sediment transport, Advection.

Some physical characteristics of a middle estuary are discussed which influence the advective transport of the particulate suspended matter (PSM). The study area was the region of main turbidity gradient over the South Channel of the middle estuary in the St. Lawrence, between Quebec City and the Saguenay River entrance. The space and time distribution of the turbidity in this estuary appears to be largely determined by its channel physiography, fluctuations in the river discharges, and the tidal wave asymmetry. Three main regions are distinguishable within the broad turbid zone. The geometry of the South Channel consists of a succession of constrictions and widenings which modulate the flow velocity and creates considerable increases in the energy available for sediment transport in regions of constriction. A tidal phase difference across the estuary creates strong shears at the turn of the tide on the crest of the English Banks, facilitating erosion of the plume along its northern boundary and the cross-channel transport of suspended matter from the South into the North channel. Upstream of the main front, tidal fluctuations in the turbidity take place within the plume, with brief intense maxima near low water slack. They coincide with a considerable reduction in stratification, facilitating the upward dispersion of the turbidity from the bottom into the upper layer. The plume is reinforced by the introduction during the ebb of suspended material from inshore waters, and particularly from Sainte Anne Bay. This area provides an important local source of PSM to the plume and helps stabilize the main frontal zone. (Baker-FRC)
W82-02344

THE DYNAMICS OF CONSERVATIVE MIXING IN ESTUARIES,

New Hampshire Univ., Durham. Ocean Processes Analysis Lab.
T. C. Loder, and R. P. Reichard.
Estuaries, Vol 4, No 1, p 64-69, March, 1981. 4 Fig, 16 Ref.

Descriptors: *Estuaries, *Mixing, Dynamics, Mathematical studies, Model studies, *Saline water intrusion, Destratification, Salinity, Chemical composition, Estuarine environment, Flushing.

This paper demonstrates that salinity-constituent mixing curves, produced under conservative or non-reactive mixing conditions in an estuary, may not be linear due to temporal variation in end-member constituent concentrations. Thus the use of mixing curves for the interpretation of estuarine processes must be undertaken with an understanding of the river and ocean constituent variability and their relationship to the estuary's mixing properties and flushing time. A one-dimensional dispersion equation was used to calculate the distribution of salinity and a conservative constituent in a model estuary. Both straight and bent mixing curves are shown, resulting simply from changing the variability of the river constituent concentration. For no variability, the curve is straight. For variability with a period much less than the flushing time, the average curve for a general data set is straight, whereas the curve for a synoptic data set is bent. For variability with a period greater than the flushing time, a bent curve results. (Baker-FRC)
W82-02345

COMPOSITION AND VERTICAL FLUX OF ORGANIC MATTER IN A LARGE ALASKAN ESTUARY,

National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
A. J. Chester, and J. D. Larrance.
Estuaries, Vol 4, No 1, p 42-52, March, 1981. 5 Fig, 3 Tab, 28 Ref.

Descriptors: *Estuaries, *Organic matter, Sediments, Sedimentation, Bottom sediments, Carbon, Nitrogen, Benthos, Chlorophyll, Estuarine environment, Vertical distribution, Lower Cook Inlet, *Alaska.

The natural and vertical flux of organic particles as they contribute to the benthic food web of a large Alaskan estuary are examined. Sediment traps were used to sample organic detritus settling to the bottom of lower Cook Inlet. Composition and downward flux of this detritus were related to phytoplankton standing stock and primary productivity measured in the ambient water. It supports an extremely productive benthic community rich in commercially harvested populations of snow, king, and dungeness crabs, shrimp, razor clams, scallops and halibut. The most productive region was Kachemak Bay, which also experienced the largest downward flux of organic detritus. The greatest fluxes of fecal pellets, carbon, nitrogen, and plant pigments were measured there. The Bay is noted for abundant benthic populations and is a center for sport and commercial trawling activities. Chlorophyll and chlorophyll degradation products in the water column and sediment traps indicated that about 8.5% of the phytoplankton standing stock was sedimented to the bottom each day in Kamishak and Kachemak Bays. In the central inlet the average loss rate was lower and more variable. The chief mechanism for the downward transport of the material was traced to zooplankton grazing and subsequent fecal pellet production. An increase in carbon:nitrogen ratios from the water column to the sediments suggests that easily digested nutritive compounds are preferentially used as organic matter is transferred through the food web. (Baker-FRC)
W82-02347

SEWAGE OUTFALL LOCATION REDUCES ENVIRONMENTAL DAMAGE IN THE THAMES ESTUARY,

Metropolitan Pollution Control-Thames Water, London (England).
For primary bibliographic entry see Field 5G.
W82-02404

EFFECT OF PEMBROKE POWER STATION ON THE TEMPERATURES IN MILFORD HAVEN, WALES,

Central Electricity Generating Board, Bristol (England).
For primary bibliographic entry see Field 5C.
W82-02406

CADMIUM, COPPER, LEAD, ZINC AND MANGANESE IN THE POLYCHAETE ARENICOLA MARINA FROM SEDIMENTS AROUND THE COAST OF WALES,

University Coll. of Wales, Aberystwyth. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W82-02416

SEASONAL VARIATION IN THE PREVALENCE OF 'RED SPOT' DISEASE IN ESTUARINE FISH WITH PARTICULAR REFERENCE TO THE SEA MULLET, MUGIL CEPHALUS L.,

Southern Fisheries Research Center, Deception Bay (Australia).
L. J. Rodgers, and J. B. Burke.
Journal of Fish Diseases, Vol 4, No 4, p 297-307, January, 1981. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Fish diseases, *Fish, *Estuaries, Seasonal variation, Diseases, Bacteria, *Australia, Temperatures, Mullet.

The Nossa River arises directly south of Tin Can Bay and flows through a largely undeveloped region to discharge into Laguna Bay, Australia. Two large shallow lakes, Lake Cootharaba and Lake Cooroibah, damp the flow of the river. Lake Cootharaba acts as a freshwater reservoir which prolongs the period of flood run-off. Sampling of fish was made at two sites, the first near the mouth of the Noosa River and the second at the northern end of Lake Cootharaba. The presence of lesions on the fish was taken as an indication of the occurrence of red spot disease. Infected fish usually displayed a single lesion on the flank or dorsal surface. Multiple lesions were observed upon individual fish. The occurrence of epizootics of vibriosis and other bacterial diseases has in other studies been linked with significant environmental changes. Such a period of significant change was induced by heavy rainfall and associated run-off during the early months of this study. The salinity of the river mouth was depressed to below 5 ppm at a time when low, declining temperatures were also present. Simultaneously, significant levels of infection were present during this period. These levels of infection contrast markedly with those low levels present at the river mouth during the period of November 1976 to February 1977 when relatively high, stable salinities (27 ppm) and temperatures prevailed. The study indicates the significance of factors such as temperature fluctuations, salinity, host movement, spawning and schooling behavior in epizootic occurrences. (Baker-FRC)
W82-02426

GROWTH OF MYTILUS EDULIS IN NET BAGS TRANSFERRED TO DIFFERENT LOCALITIES IN A EUTROPHICATED DANISH FJORD,

Miljostyrelsen, Charlottenlund (Denmark). Marine Pollution Lab.
For primary bibliographic entry see Field 5C.
W82-02428

DISCUSSION OF TRACE METALS IN THE WATERS OF A PARTIALLY-MIXED ESTUARY,

Washington Univ., Seattle. Dept. of Oceanography.
M. Rattray, Jr., and C. B. Officer.
Estuarine, Coastal and Shelf Science, Vol 12, No 3, p 251-266, March, 1981. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Estuaries, *Trace metals, *Path of pollutants, Metals, Model studies, *San Fracisco Bay, Bays, Mixing, Advection, Fluctuations, Tidal currents, Salinity.

A generalization is presented of methods commonly used for calculating the estuarine loss (or gain) of a constituent based on the relationship of its distribution to that of salinity. Included in the formulation are the effects of arbitrary cross-sectional shape, tidal drift, gravitational circulation and longitudinal tidal diffusion. Its application depends upon obtaining the sectional distributions of the constituent and of the salinity at two adjacent cross-sections, estimating the magnitude and con-

stituent concentration of the river inputs, and the tide and tidal current data for the region under study. Three cross-sections of the numerical simulation model of San Francisco Bay were used to carry out the calculations and test the results. The results compared favorably wth results from direct flux calculations using the accompanying mean current information. A considerable range in the governing parameters was spanned by these three sections, thus providing good insight into the general applicability of the new formulation. An unusually good data set is provided by these examples. By reducing their spatial coverage it becomes apparent that large errors can possibly occur in the calculated loss rate when the data coverage is less ideal. When the net flux through a section is relatively large compared to the loss rate, this problem is particularly severe. It is at this point nearly in balance with the river supply. When applying this formulation it is suggested that the sensitivity of the final results be assessed as to the accuracy with which the relevant constituent and salinity fields are known. (Baker-FRC)
W82-02542

VARIATION IN LIFE-HISTORY PATTERNS BETWEEN INTERTIDAL AND SUBTIDAL POPULATIONS OF THE MEIOBENTHIC COPEPOD MICROARTHRIDION LITTORALE,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
M. A. Palmer.
Marine Biology, Vol 60, No 2/3, p 159-163, 1980. 6 fig, 1 Tab, 35 Ref.

Descriptors: *Benthic fauna, *Population density, *South Carolina, *Copepods, Microarthridion littorale, Estuarines, *Estuarine environment, Tides, Intertidal areas, Meiofauna.

Reproductive patterns of intertidal and subtidal populations of Microarthridion littorale were compared to ascertain the significance of the following parameters: population density and age structure, adult size, timing of reproduction, number of eggs per gravid female and number of eggs per adult female, and birth and death rates. Densities of M. littorale were significantly greater intertidally during the summer and fall. For the remaining seasons, the population densities did not significantly differ between intertidal and subtidal groups. Intertidal maximum densities occurred in July, whereas maximum densities subtidally were in October. Far greater numbers of eggs per gravid female were recorded in the subtidal populations at all times. Birth and death rates paralleled each other but were high subtidally with the exception of August. It is suggested that these differences resulted from differences in food quality and quantity, increased exposure to potential epibenthic predators subtidally, and exposure to differential competitive pressure in the two areas. (Baker-FRC)
W82-02560

LARGE VERTICAL SALINITY GRADIENTS IN THE FT. PIERCE INLET ASSOCIATED WITH HURRICANE DAVID,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
G. H. Kierspe.
Florida Scientist, Vol 44, No 2, p 104-109, 1981. 4 Fig, 5 Ref.

Descriptors: *Hurricanes, *Estuarine environment, Storms, Salinity, Environment, Coasts, Estuaries, Floods, *Fort Pierce Inlet, *Florida, Saline water intrusion.

The effects of Hurricane David on the vertical salinity gradient in an ordinarily well-mixed inlet are reported. Salinity was measured at different depths in the inlet about 1 wk before and after the passage of the storm, on September 3, 1979. Associated with the hurricane were 22.7 cm of rain and maximum winds of 153 km/hr. The water level at the Ft. Pierce Inlet was about 95 cm above the mean water level recorded prior to the passage of the hurricane. The major freshwater influence on the Inlet is from Taylor Creek, a drainage canal regulated by a series of locks. Vertical mixing is evident in the Inlet by large eddies and upwelling areas caused by bottom irregularities. The prestorm sampling showed the water column to be well mixed. At the end of the ebb, the surface salinity was 34.5 ppt and the bottom was 35.2 ppt, a difference of only 0.7 ppt. After the hurricane, the surface-to-bottom salinity gradient was large during all of the ebb, and the first part of the flood. At slack water after the flood, the water column was homogeneous with a salinity of 34.6 ppt. During the ebb the bottom salinity dropped to 31.0 ppt and the surface salinity reached a minimum of 19.1 ppt, a difference of 11.0 ppt. After the flood tide began, the surface and bottom salinities climbed rapidly to 34.6 ppt. The water column was again homogeneous about 2 hr into the flood tide. The significance of this study is great when one considers the general lack of information on posthurricane effects for an estuarine location. (Baker-FRC)
W82-02569

VERTICAL MIXING RATES IN FJORDS DETERMINED USING RADON AND SALINITY AS TRACERS,
Lamont-Doherty Geological Observatory, Palisades, NY.
W. M. Smethie, Jr.
Estuarine, Coastal and Shelf Science, Vol 12, No 2, p 131-153, 1981. 10 Fig, 4 Tab, 39 Ref.

Descriptors: *Fjords, *Salinity, *Radon, *Mixing, Tidal energy, Tidal effects, Tracers, Tidal hydraulics, Runoff, Saline-freshwater interfaces, Coastal waters, Washington, British Columbia.

The excess radon-222 profiles of several Washington State and British Columbia fjords were measured in attempts to understand the vertical mixing processes of these embayments. During periods of bottom water stagnation, exponential profiles were generally observed. Salinity changes and exponential excess radon profiles of the stagnant bottom water were utilized to calculate values of the vertical eddy diffusivity. Variations in these values which ranged from 0.16 to 36 sq cm/sec among fjords were attributed to different inputs of tidal energy into the vertical mixing process. Excess radon due to freshwater runoff was also found in the surface water of some fjords. For Narrows Inlet, values of the vertical eddy diffusivity were 0.23 to 0.47 sq cm/sec in the surface waters and 0.9 to 3.1 sq cm/sec between 5 and 35 m depth. (Geiger-FRC)
W82-02576

BENTHIC ENRICHMENT IN THE GEORGIA BIGHT RELATED TO GULF STREAM INTRUSIONS AND ESTUARINE OUTWELLING,
Skidaway Inst. of Oceanography, Savannah, GA.
R. B. Hanson, K. R. Tenore, S. Bishop, C. Chamberlain, and M. M. Pamatmat.
Journal of Marine Research, Vol 39, No 3, p 417-441, August, 1981. 1 Fig, 11 Tab, 73 Ref.

Descriptors: *Benthic fauna, *Nutrients, *Distribution patterns, Gulf Stream, *Georgia Bight, Florida, Ocean currents, Estuaries, Particulate matter, Continental shelf, Biomass, Rivers, Organic matter, Deposition, *Coastal waters.

The distribution patterns of benthic life in the Georgia Bight, sampled at 12 sites between the Savannah River, Georgia, and Daytona Beach, Florida, indicated that constant intrusions of nutrient-rich Gulf Stream water at the shelf break are important to the offshore benthic communities. Estuaries, often considered as major nutrient sources to outer continental shelf systems, are probably not effective beyond 20 km off the Georgia coast. Although the presence of Spartina marshes and a large number of major rivers in Georgia would be expected to enrich benthic life off the coast to a greater degree than off the Florida coast, this is not the case. Possible explanations are the low nitrogen content of detritus and the restriction of offshore transport of nutrients by salinity fronts and alongshore currents. Microbiota were 2-3 times more numerous at the shelf break than at the mid shelf and inner shelf and increased southward along the shelf break. Densities were highest in areas of frequent intrusions. (Cassar-FRC)
W82-02583

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING DEMONSTRATION PLANT FEASIBILITY STUDY AT LAGUNA PUEBLO, NEW MEXICO.
MetaMetrics Inc., Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153362, Price codes: A07 in paper copy, A01 in microfiche. Technical Report submitted to Office of Water Research and Technology, March 31, 1981. 124 p, 19 Fig, 39 Tab, 98 Ref. OWRT-C-00255-D(0452)(1), 14-34-0001-0452.

Descriptors: Feasibility study, *Desalination, Desalination plant, *Water supply development, Water quality, Water rights, Water use, Capital costs, Operating costs, Maintenance costs, Project benefits, Regional development, *Cost-benefit analysis, *Laguna Pueblo, Indian reservation, Laguna, *New Mexico, Canoncito, *Groundwater availability.

Water of drinking quality is scarce on the Laguna Reservation, located 20 miles west of Albuquerque, New Mexico. The feasibility of developing a demonstration desalting plant to provide for the water requirements of 2,000 members of the Laguna Pueblo included a review of the existing water resources. Four desalting and three nondesalting alternatives were evaluated. The study included legal, political and socio-economic factors important to developing water supplies in the water scarce environment. Of the brackish water sources, the Rio Puerco was the lowest cost alternative. The fresh water alternatives could provide water at $1.93 per 1,000 gallons of water as compared to $4.01 per 1,000 gallons for desalting. The development of the Rio Grande fresh water aquifer would require the purchase of water rights and the City of Albuquerque could oppose such action.
W82-02104

OPERATING CHARACTERISTICS OF VARIOUS COMBINATIONS OF WORKING SUBSTANCES AND FEEDS IN THE SCHROEDER DESALTING PROCESS.
Schroeder Process Corp., Santa Ana, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153560, Price codes: A06 in paper copy, A01 in microfiche. Final Report prepared for Office of Water Research and Technology, 1981. 123 p, 21 Fig, 4 Ref, 2 Append. OWRT-C-00135-S(0450)(1), 14-34-001-0450.

Descriptors: *Distillation processes, *Vapor compression evaporation, *Vertical tube evaporation, *Freeze process, Waste disposal, Research results, Bench scale, Energy costs, Fixed costs, Water costs estimate, *Desalination, *Desalination apparatus.

A novel process has been discovered which has the potential to combine the advantages of both distillation and freezing processes, without the disadvantages. The process uses a working substance (WS), such as a high melting organic compound, at its freezing point, to effect direct contact evaporation. The purpose of this project was to investigate the operating characteristics of various WSs in the laboratory and a bench scale plant (BSP). A WS screening program tested melting range, solubility, tendency to entrain or emulsify, and stability, in the laboratory program. The BSP program satisfactorily simulated the operation of major pieces of equipment, using WSs that passed the screening program with seawater, and other saline water

foods. The process is ready for pilot plant design, construction, and operation.
W82-02105

NON-ACID PRETREATMENT AND MANAGEMENT OF MICROORGANISMS IN SEAWATER DESALINATION BY REVERSE OSMOSIS,

Permutit Co., Inc., Paramus, NJ.
A. B. Mindler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153396, Price codes: A05 in paper copy, A01 in microfiche. Report submitted to Office of Water Research and Technology, November, 1981. 91 p, 9 Fig, 3 Tab, 5 Ref. OWRT-C-00093-D(0466)(1), 14-34-0001-0466.

Descriptors: *Desalination, *Reverse osmosis, *Seawater, *Scale prevention, *Fouling, *Microorganisms, *Pretreatment of water, Bacteria, Algae, Protozoa, Diatoms, Chlorination, Tannins.

Non-acid pretreatment was studied in a seawater reverse osmosis pilot plant for one year with particular attention to biological aspects. Pretreatment of the tropical surface seawater by in-line coagulation/filtration reduced the Silt Density Index (SDI) consistently below 3.0 in the polishing filter effluent. Subsequent biological activity of periphytic organisms on piping surfaces after addition of organic antiscalants increased SDI by one unit or more. Slough-off of the organisms' polysaccharide sheaths resulted in fouling of the hollow fiber permeators. A 2000 hour run was made with 3 ppm polyacrylate antiscalant at ambient pH of 7.9 on one RO system in parallel with another system at pH 7.5, reduced by addition of 15 ppm sodium bisulfite. A 3000 hour run was made with Quebracho tannin as combined antiscalant/antifoulant under similar conditions. For the last 1500 hours tannin was employed in place of starvation chlorination for intake protection. Both polyacrylate and tannin antiscalants were found to serve as nutrient for bacterial growth and both impaired RO performance. Tannin uniquely decreased the attachment ability of periphytic bacteria. No hard scale was found during autopsy, but a small amount of amorphous calcium salt was detected in potted fiber ends of the permeators and in piggy-back spiral wound elements. Analyses of foulants are reported.
W82-02108

DEVELOPMENT OF HIGH SALT REJECTION REVERSE OSMOSIS MEMBRANES--FINAL REPORT, JULY 1, 1978 THROUGH DECEMBER 31, 1980,

UOP, Inc., San Diego, CA. Fluid Systems Div.
C. E. Milstead, and R. L. Riley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153370, Price codes: A05 in paper copy, A01 in microfiche. January, 1981. 74 p, 17 Fig, 20 Tab. OWRT-C-00163-D(7529)(1), 14-34-0001-7529.

Descriptors: Composite membranes, *Reverse osmosis, Brackish water, *Desalination, *Spiral-wound elements, *Membrane processes, *Roswell, New Mexico, *Yuma, Arizona.

The objective of this three-phase program was to develop a high-salt rejection thin-film composite membrane for incorporation into 8- and 12-in. diam. x 40-in. wide spiral-wound elements suitable for replacement elements for the 75 MGD Yuma Desalting Plant. Four types of thin-film composite membranes, prepared by interfacial polycondensation techniques on a fabric-reinforced porous polysulfone support, were evaluated. The optimum membrane, a polyamide, designated TFC-402, was successfully produced in large quantities for spiral-wound element fabrication. This membrane, yielding 22-25 gal/ft2-day and greater than 99% TDS rejection from a Yuma Plant 70% recovery brine at 400 psi applied pressure, was fabricated into 2 1/2-, 4-, 8-, and 12-in. diam. x 40 in. wide elements for field testing at the OWRT Test Facility at Roswell, N.M. Testing of the 8- and 12-in. elements, prior to shipment to Roswell, in San Diego on a 4500 ppm TDS brackish well water feed showed that both element types gave about 99% rejections with high product fluxes.
W82-02109

DRAFT ENVIRONMENTAL ASSESSMENT DESALTING DEMONSTRATION PLANT, LAGUNA, NEW MEXICO.

MetaMetrics Inc., Washington, DC.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153735, Price codes: A05 in paper copy, A01 in microfiche. Technical Report submitted to Office of Water Research and Technology, March 31, 1981. 72 p, 8 Fig, 12 Tab, 98 Ref. OWRT-C-00255-D(0452)(2), 14-34-0001-0452.

Descriptors: *Desalination, *Environmental effects, Environmental impact statement, *Wastewater lagoons, Wastewater disposal, Desalination wastes, Ecological effects, Land use, Air pollution, Noise, Feasibility study, *Water supply development, *Laguna Pueblo, Indian Reservation, Laguna, *New Mexico, Canoncito.

The environmental consequences of the construction and operation of a desalting demonstration plant were assessed. A desalting demonstration plant using brackish well water could supply a Laguna community which had been proposed for the site and the nearby Canoncito Navajo Reservation with potable water. A well field located at the plant site would withdraw approximately 400,000 gallons per day to produce 300,000 gallons per day of potable water. Yields of individual wells were estimated to be 50 gpm and as many as six wells would be required. Transmission of water from the well field to the plant site would require 1,000 feet of pipeline. The major waste products which will result from the operation of the desalting plant are a high TDS brine and sludges. Evaporation ponds would dispose of the brine. A design was specified to present leakage from the ponds. Multi-cell, sludge drying beds were specified for disposal of sludge. The environmental effects and impacts of construction and start-up of the plant were assessed along with those of the proposed new community.
W82-02171

POST-TREATMENT PROCESS FOR REVERSE OSMOSIS MEMBRANES,

FilmTec Corp., Minneapolis, MN.
J. E. Cadotte, R. S. King, R. J. Majerles, C. Hultman, and R. J. Petersen.
Available from the National Technical Infoumation Service, Springfield, VA 22161 as PB82-157975, Price codes: A03 in paper copy, A01 in microfiche. Final Report to Office of Water Research and Technology, January, 1981. 35 p, 2 Fig, 10 Tab, Append. OWRT-C-90090-S(9415)(1), 14-34-0001-9415.

Descriptors: *Colloids, *Sealants, *Desalination, *Reverse osmosis, *Membranes, Thin films.

Reverse osmosis membranes capable of producing potable water from seawater by single-pass desalination processes are difficult to make. Small defects in the thin film barrier layer are introduced during various stages of production of desalination devices. This report covers research on synthetic and natural organic colloidal preparations that seal membrane defects. Types of colloids synthesized and tested included: polyamine-aldehyde,melamine-aldehyde, and polyphenol-aldehyde condensation products; piperazine-epoxy adducts; sulfonated polysulfone; oxidized polyamines, and crosslinked polyacrylic acid. Tannic acid was also tested for comparison. Colloidal preparations with 0.1-0.2 micrometers in thin film composite membranes. Spiral-wound membrane elements with as low as 93 percent salt rejection were improved to single-pass desalination quality by treatment with selected colloids. Sequential treatment with a cationic colloid, then an anionic colloid, produced some dramatically increased salt rejections in spiral elements initially showing only 68-85 percent salt rejection.
W82-02454

3B. Water Yield Improvement

AN INITIAL APPLICATION OF POLARIZATION LIDAR FOR OROGRAPHIC CLOUD SEEDING OPERATIONS,

Utah Univ., Salt Lake City. Dept. of Meteorology.
For primary bibliographic entry see Field 7B.
W82-02217

MANAGEMENT OF BLOWING SNOW ON SAGEBRUSH RANGELANDS,

Rocky Mountain Forest and Range Experimental Station, Laramie, WY.
D. L. Sturges, and R. D. Tabler.
Journal of Soil and Water Conservation, Vol 36, No 5, p 287-292, September-October, 1981. 7 Fig, 3 Tab, 15 Ref.

Descriptors: *Snow management, *Range management, Water resources, Range grasses, Vegetation, Fences, Snow storage, Snowmelt, Snow accumulation, Water supply, Snow traps.

Snow management on rangelands can increase forage production, make more water available for livestock and irrigation, and improve wildlife habitat. A procedure for estimating the volume of blowing snow arriving at specific locations is especially important for successful snow management. Two equations are offered which make it possible to design successful snow management projects. Measured snow storage was in reasonable agreement with predicted transport at both a snow fence and snow harvest areas where these predictions were tested. At the Dodge Creek Ranch 54 cubic meters per meter (581 cubic feet/foot) of additional water stored by snow fencing represented 'new' water for the rancher, since most of it would otherwise have evaporated as it was transported across the watershed. At Boundary ridge, a snow harvest area was created by chopping sagebrush on the windward side of a ridge, providing 24 cubic meters per meter (258 cubic feet/foot) of additional water equivalent in the leeward drift. However, little water reached the stock water pond it was intended to recharge. This result underlines the importance of incorporating water collection and conveyance facilities into snow management projects. Water losses to evaporation, soil recharge, and deep seepage usually comprise a large percentage of water stored in large drifts. Increasing the roughness height of vegetation by planting crested wheatgrass in strips doubled on-site snow retention compared with that retained on untreated sagebrush rangeland. Increasing the retention of snow should increase soil water recharge and improve site productivity. (Baker-FRC)
W82-02247

3C. Use Of Water Of Impaired Quality

LEGAL, ECONOMIC AND INSTITUTIONAL BARRIERS TO WATER REUSE IN NORTHERN NEW ENGLAND, BOSTON, MASSACHUSETTS,

Bracken and Baram, Boston, MA.
M. S. Baram.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153388, Price codes: A08 in paper copy, A01 in microfiche. Office of Water Research and Technology Report OWRT/RU-81/6, September, 1980. 150 p, 2 Fig, 1 Tab. OWRT-C-90186-R(9424)(1), 14-34-0001-9424.

Descriptors: *Water reuse. *Legal aspects, *Institutional constraints, *Common law, *Public investment, *Effluent limitations, Water supply, Water conservation, Taxes, Economic aspects, Navigable waters, Groundwater, Surface water, Financing, Industrial water, Agriculture, Recycling, Water quality, *New England, Maine, New Hampshire, Massachusetts, Vermont.

Legal and institutional reforms at federal, state and local levels of government are needed to remove major obstructions to water reuse as a conservation strategy in northern New England. Legal

research and seven case studies on municipal, industrial, energy and agricultural users of water in Massachusetts, New Hampshire, Maine and Vermont reveal that the obstructions to water reuse call for immediate legal reforms in four areas: (1) availability of public funds under federal construction grant program for wastewater treatment; (2) use of environmental controls on current practices to force adoption of reuse technology; (3) modification of property rights in water doctrines of the common law; and (4) modification of water rates and rate structures now in use. Further, institutional reforms are needed. The networking of fragmented authorities is needed to promote coherent regional strategies for conservation and reuse. Thus, future water management in northern New England could begin to cope with growing water shortages by adopting conservation principles and reuse practices.
W82-02107

ECONOMIC AND TECHNICAL EVALUATIONS OF SWINE MANURE MANAGEMENT SYSTEMS WHICH USE LAND APPLICATIONS,

North Carolina State Univ. at Raleigh. Dept. of Economics and Business.
For primary bibliographic entry see Field 5E.
W82-02175

EFFECTS OF SCHEDULING MUNICIPAL WASTE-WATER EFFLUENT IRRIGATION OF REED CANARYGRASS ON NITROGEN RENOVATION AND GRASS PRODUCTION,

Minnesota Univ., St. Paul. Dept. of Soil Science.
D. R. Linden, C. E. Clapp, and J. R. Gilley.
Journal of Environmental Quality, Vol 10, No 4, p 507-510, October/December, 1981. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Wastewater irrigation, *Irrigation water, *Grasses, *Nitrogen removal, Wastewater disposal, Reed canarygrass, Soil water, Effluents, Water pollution effects, Fate of pollutants, Reclaimed water, *Impaired water use, Municipal wastewater.

Municipal wastewater applied to a 12 x 12 meter field of reed canarygrass (Phalaria arundinacea L.) produced yields of 10.2 and 15.0 metric tons per ha during 1975 and 1976, respectively. Effluent was obtained from the Apple Valley Wastewater Treatment Plant, Minneapolis-St. Paul, Minnesota, an activated sludge treatment facility serving a domestic suburban population. Soil was a Waukegan silt loam with a water table at 140 cm. The first year total application was 170 cm of effluent containing 320 kg per ha N, primarily as ammonium. The second year total application was 290 cm containing 530 kg per ha N. Varying the sprinkler irrigation schedules (1,2, or 5 irrigations per week) did not affect yields. Effluent contained 17-18 mg per liter N. Soil water concentrations averaged 1.0 and 2.4 mg per liter in 1975 and 1976, respectively. Crop uptake of N was abourt 80%. It is expected that the long-term soil water N levels would not increase much beyond the level measured in the second year. (Cassar-FRC)
W82-02219

VIRAL TRANSPORT TO GROUND WATER AT A WASTEWATER LAND APPLICATION SITE,

Texas Univ. at San Antonio.
B. E. Moore, B. P. Sagik, and C. A. Sorber.
Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1492-1502, October, 1981. 1 Fig, 9 Tab, 13 Ref.

Descriptors: *Water reuse, *Wastewater irrigation, *Path of pollutants, *Viruses, Water pollution sources, Fate of pollutants, Wastewater disposal, Irrigation water, Irrigation wells, Coliforms, Enteroviruses, Percolation, Bacteriophage, Texas.

The survival and transport of human enteric viruses through soil at an operating waste water irrigation site at Kerrville in South Central Texas were studied. Water sampling was carried out at three specially designed lysimeter sites and five monitoring wells. Bacterial and physical/chemical analyses as well as studies on the effects of more intensive irrigation were also carried out. In general, bacteria and coliphage densities were highest in the water collected at Lysimeter 1, which was closest to the irrigation pond. Although enteric virus isolations were made from each site, the most frequent recoveries occurred at Lysimeter 2 at an average depth of 1.37 m. Fecal coliforms and fecal streptococci were found with relatively high frequency at all monitoring wells, while no positive virus isolations from well water samples were made. Results of the intensive irrigation program showed that fecal coliforms and fecal streptococci were generally reduced by more than 90% in lysimeter waters within the 0.46 m depth. The isolation of enteroviruses in water from lysimeters, but not from monitoring wells, suggests that depth to ground water should be an important consideration in selecting irrigation sites. (Geiger-FRC)
W82-02317

REDUCING GROUND-WATER POLLUTION FROM MUNICIPAL WASTE-WATER IRRIGATION OF RHODES GRASS GROWN ON SAND DUNES,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
I. Vaisman, J. Shalhevet, T. Kipnis, and A. Feigin.
Journal of Environmental Quality, Vol 10, No 4, p 434-439, October/December, 1981. 9 Fig, 2 Tab, 9 Ref.

Descriptors: *Wastewater irrigation, *Irrigation water, *Nutrient removal, Nitrogen, Phosphorus, Fertilizers, Rhodes grass, Grasses, Water pollution control, Fate of pollutants, Wastewater treatment, Secondary wastewater treatment, Wastewater disposal, Impaired water use.

Application of secondary municipal effluent from settling ponds to sandy dune soil established with Rhodes grass (Chloris gayana Kunth) produced a high yield of animal feed without polluting groundwater with nitrate and P. The irrigation experiments were carried out during 1978 and 1979 in Israel. There were 4 treatments, 60, 80, 100, and 120% of Class A pan evaporation, using 5510, 6540, 8190, and 9580 cu m per ha of water, respectively. Fertilizers applied were either 0 or 700 kg N in 1978 and 250 or 500 kg N in 1979. Maximum yield of grass (12.2 Mg per has) was attained at the 80% irrigation treatment with 250 kg N fertilization. Higher quantities of water or fertilizer did not improve yields further. P in lysimeter drainage water did not exceed 0.5 mg per liter. Ammonium-N was not detected; nitrates were 0.5 mg per liter in drainage from the 250 kg-fertilized plot and 3-150 from the 500 kg fertilized plot. BOD was reduced from 53-72 mg per liter in the effluent to 3.2 mg per liter in the drainage water. Some salt leaching occurred, but winter rains removed most of the excess salts left in the soil after the irrigation season. (Cassar-FRC)
W82-02391

ACCUMULATION OF HEAVY METALS IN ARID-ZONE SOILS IRRIGATED WITH TREATED SEWAGE EFFLUENTS AND THEIR UPTAKE BY RHODES GRASS,

Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Sciences.
For primary bibliographic entry see Field 5B.
W82-02392

EFFECT OF SALINE IRRIGATION WATER ON THE YIELD OF POTATO,

Indian Agricultural Research Inst., New Delhi.
K. V. Paliwal, and B. R. Yadav.
Indian Journal of Agricultural Sciences, Vol 50, No 1, p 31-33, January, 1980. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Crop yields, *Irrigation practices, Salinity, Chemical properties, *Saline water, *Potatoes, *Impaired water use.

A study was conducted to determine the effect on yield, size, and number of potato tubers and the development of soil salinity in the root zone when saline water is used for irrigation. In both years of the study the yield of potato showed an abrupt, significant decrease with the application of saline water even of a salt concentration of 20 meq/liter. However, the significance of this reduction was not increased at 40 meq/liter concentrations. At a salinity of 80 meq/liter the yield was reduced by about 45% of that of the control. The effect of salinity on the total tuber number was significant at all salinity levels in the first year. In the second year, however, it was significant only at a salinity of 40 meq/liter and above. This minor variation was primarily due to the fact that canal water used as a control in the first year was of slightly better quality than the tubewell water used in the second year for control crops. Saline water irrigation significantly reduced the yield of tubers of all sizes, and reduced the sizes as well. In general the percentage reduction was due more to decrease in total yield and tuber size than in tuber number, particularly at the highest salinity level. (Baker-FRC)
W82-02396

COMMUNITY EVALUATION OF ADOPTED USES OF RECLAIMED WATER,

California Univ., Berkeley. School of Public Health.
W. H. Bruvold.
Water Resources Research, Vol 17, No 3, p 487-490, June, 1981. 3 Tab, 11 Ref. (California Water Resources Center Project UCAL-WRC-W-553).

Descriptors: *Water reuse, *Attitudes, *Reclaimed water, Surveys, Social aspects, Irrigation, Planning, Irvine, *California.

Irvine, California, currently uses reclaimed water for an ornamental lake, for golf course irrigation, for agricultural irrigation, for park and playground irrigation, and for common residential lawn irrigation. A survey of 140 residents determined that 75% were aware of the use of reclaimed water in the city, but about 50% were not familiar with details such as type of treatment, environmental changes, health risks, and costs. About 93% of the people had a favorable response to golf course, commons area, and park and school year irrigation; 88.6% for the ornamental lake; and 75.7% for food crop irrigation. Only 27.9% favored hypothetical use as drinking water. Recommendations for future local use were: add new uses, 24.3% in favor; expand existing uses, 5% in favor; maintain existing uses, 56.4%; and eliminate existing uses, 5%. Results were similar to those in a 1972 survey of attitudes toward possible future uses of reclaimed water in 10 California cities. (Cassar-FRC)
W82-02551

3D. Conservation In Domestic and Municipal Use

A FIELD EVALUATION OF SELECTED WATER CONSERVATION AND WASTEWATER REDUCTION SYSTEMS FOR RESIDENTIAL APPLICATIONS,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
R. L. Siegrist, W. C. Boyle, and D. L. Anderson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153651, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Center, University of Wisconsin Technical Report WIS WRC 81-02, 1981. 119 p, 23 Fig, 67 Tab, 36 Ref, 4 Append. OWRT-B-105-WISC(1), 14-34-0001-1153.

Descriptors: Potable water, *Reclaimed water, Recycling, Wash water, Wastewater, *Wastewater irrigation, *Water conservation, Water treatment.

In-house water-using activities in residential dwellings throughout the United States contribute to a yearly per capita consumption of potable water that exceeds 18,000 gallons. Numerous strategies have been proposed for reducing domestic water demands and wastewater loadings. A demonstration study was performed at the University of Wisconsin-Madison to evaluate the performance of several technologies under field conditions. The technologies offer the potential for major reductions in residential water demands and wasteflows.

The project was accomplished in three distinct phases. Commercial low-flush toilet systems were studied in Phase I. Inhouse water use and wasteflow characteristics were measured on a daily and hourly basis and water use impacts of the low-flush systems were assessed. Single-home washwater recycle systems were investigated in Phase II. Inhouse water use and wasteflow were characterized and the water use impacts of the recycle systems were assessed. The final phase of the project investigated the reclamation of residential greywater (non-toilet water) by conventional onsite treatment processes--a septic tank--sand filter system. Characterization of the raw greywater flow and the effluent from the septic tank and intermittent sand filter was accomplished.
W82-02180

WATER CONSERVATION PROGRAM OF THE CITY OF GREENSBORO,

Greensboro Public Works Dept., NC. Water and Sewer Administration.
R. Shaw.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 64-67. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Water conservation, *Water supply, *Water use, Leakage, *Water loss, Conservation, Public opinion, Attitudes, Water treatment, Water purification, Water shortage, Plumbing, Public policy, Long-term planning, *Greensboro, North Carolina.

There are three major requirements in the 'Resolution of Assurance to Continue Water Conservation Program of the City of Greensboro,' adopted in 1979: that the water loss prevention program will continue to operate, that the City will continue to enforce the State Plumbing Code, and that the City will continue its Program of Water Conservation Education. Education has emphasized pamphlets on policies for new customers, and meter-reading. The continuous leak-control program is costly but reduces water loss. Leak detection is done in part using the Heath-Sonic kit, with the goal of detecting 150,000 to 200,000 gallons per day of leakage during the year. Water accountability is a major part of the program: the goal is to sell 85 percent of the available water, while achieving accurate and adequate metering of water leaving the treatment plant. Inaccuracies exist because of leakage, underregistration of small meters, unmetered flushing of hydrants to clear impurities, and water used in fire emergencies. Every service in Greensboro, totaling 50,000, is metered. A meter-maintenance plan replaces old meters to improve accountability. Additions to the State Plumbing Cod adopted by the City in 1954 now include provisions regarding the capacity of commodes and showerheads. A closed washwater-recycle system at the treatment plant saves pumping costs for 125 million gallons a year. (Garrison-Omniplan)
W82-02518

WATER SAVINGS IN THE ORANGE WATER AND SEWER AUTHORITY,

Orange Water and Sewer Authority, Carrboro, NC.
E. Billingsley.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 68-73. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Water conservation, Long-term planning, *Water supply, *Cost-sharing, Aquifers, Water deficit, Water use, Public policy, Economic aspects, Jurisdiction, Public opinion, Local governments, *Water metering, *Hillsborough, North Carolina.

To augment a marginal supply of water, the Organge Water and Sewer Authority (OWASA) developed the Cane Creek Reservoir, constructed a 10-mile tie line to connect with the Town of Hillsborough, and acquired an abandoned stone quarry to provide 200 million gallons of additional raw water storage. More importantly, structural and nonstructural conservation measures were instituted. Among the structural conservation measures were: storage of filter washwater and sedimentation basin wastewater at the Water Filter Plant and recycling the supernatant back to the head of the treatment process; emphasizing leak detection and repair to reduce losses; ensuring accurate and reliable metering; and requiring low-flow showerheads and water-saving toilets on new construction. Nonstructural conservation methods emphasized rates, consumer education, and awareness. A rate structure was adopted with a monthly service charge based on the size of the meter and a uniform commodity charge of $1 per thousand gallons used. Consumer education has been facilitated by use of the media, bill inserts, brochures, speakers' bureaus, plant tours, newsletters, information presentations on such topics as how to read a meter, and restaurant table cards explaining water conservation in the restaurant. Five progressively more stringent stages of mandatory conservation were enacted by city ordinance, with their use dependent on level of water supply. Constant community awareness of the current state of the water supply has also been considered important. As a result of all these measures, watcr demand is at the same level as it was five years ago, even with normal community growth. (Mantius-Omniplan)
W82-02519

LEAK DETECTION - TWO METHODS THAT WORK,

G. B. Cole.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance. 1980. p 78-83, 5 Ref. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Water loss, *Leakage, *Flow measurement, Federal jurisdiction, *Measuring instruments, *Sound waves, Economic aspects, Grants, Water metering, Water shortage, Flowmeters, Gages, Flow profiles, Water conservation, Pipelines, Water supply systems, Maintenance.

The major activity in reducing the amount of unaccounted-for water in utilities is the detection, location and repair of hidden underground leakage. This has been assigned a high priority by many utilities. Recognizing the need for developing and disseminating information on leak detection, AWWA formed a Leak Detection Committee to help educate operators across the U.S. In an effort to reduce costs, federal and state officials have also focused on this issue when reviewing requests for capital improvement funds for waste treatment facilities. Two approaches to reducing leakage are (1) listening and (2) a combination of flow measurements and listening, sometimes referred to as a 'water audit.' Listening involves the systematic use of sound-intensifying equipment to locate leaks. The sound waves can be picked up by sensitive instruments to help locate leaks with great accuracy. The water audit is a two-phase survey using flow measurements in the pitot tube flow meter, which can be attached to a photo recording device capable of recording continuous flow rates for 12, 24, or 48 hours. With a field accuracy of plus or minus 2%, this meter can measure flows over a wide range from a few thousand to over 200 million gallons per day. The advantage of just listening is that no excavations are needed to tap the mains; a disadvantage is its limited scope and inability to detect faulty metering. The water audit is comprehensive, and some gauging points must be excavated when necessary. (Garrison-Omniplan)
W82-02521

IN-HOME CONSERVATION AND WASTEWATER MANAGEMENT,

Battelle Pacific Northwest Labs., Richland, WA.
W. J. Hopp, and W. P. Darby.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 401-418, October, 1981. 6 Fig, 7 Tab, 18 Ref.

Descriptors: *Water conservation, *Wastewater management, *Cost-benefit analysis, *Domestic water, Maintenance costs, Construction costs, Operating costs, Grants, Mathematical models, Model studies, Wastewater treatment, Water consumption, Water management, Municipal water.

Household water conservation is a cost effective flow reduction measure to include in the overall strategy of a wastewater utility, according to results of a mathematical model. However, the Federal Construction Grants Program, which funds 75% of construction costs, but none of the costs of conservation devices, is a disincentive. As a result, the maximum cost per conservation device to achieve a 10% reduction in household water flow and still have a positive net present savings is $14.00, versus $46.00 without the grant program. It is suggested that 75% of the conservation device costs be funded to encourage conservation. This would be an important factor in marginal cases. The mathematical analysis uses a net present equivalent method and considers time value of money, inflation, population growth rate, public acceptance of household conservation practices, residential contribution to the treatment plant effluent, and wastewater facility costs (construction, operating, and maintenance). (Caesar-FRC)
W82-02591

3E. Conservation In Industry

AN EVALUATION OF THE POTENTIAL FOR WATER CONSERVATION AND REUSZ IN THE GEORGIA PULP AND PAPER INDUSTRY,

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
G. Battaglia, E. Hartley, W. Himes, G. Valentine, and C. Wyvill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157991, Price codes: A05 in paper copy, A01 in microfiche. Environmental Resources Center, Georgia Institute of Technology. Report ERC 04-81. June, 1981. 71 p, 20 Fig, 2 Tab, 65 Ref. OWRT-C-90303-C(9453)(1), 14-34-0001-9453.

Descriptors: *Water conservation, *Water reuse, Water consumption, Water use efficiency, Industrial water, Pulp, Paper, *Pulp and paper industry, Surveys, *Georgia.

This study contains an in-depth investigation of water usage patterns in 14 of the largest pulp and paper mills in Georgia responsible for nearly 85 percent of all production in the State. Consideration is given to water supply and water quality which the industry must address, and an identification is made of feasible conservation and reuse techniques the industry should consider. The report contains a tabulation of potential water withdrawal savings in Georgia, if mills practice both normal and potentially feasible conservation and reuse measures.
W82-02456

GEOTHERMALLY POWERED FOOD-PROCESSING SYSTEMS,

Food Engineering, Vol 53, No 10, p 97-100, October, 1981. 4 Fig, 1 Tab.

Descriptors: *Food processing industry, *Heated water, *Geothermal resources, Heating, Wells, Heat exchangers, Energy sources, Groundwater mining.

Geothermal energy can be applied to the food processing industry, according to studies on a hypothetical new corn wet milling plant in East Mesa, California, and an operating frozen food plant in Salisbury, Maryland. In the California plant a 6.6% energy savings could be attained using geothermal heat to preheat the waste gas stream before incineration, the air entering the starch dryer, and the makeup water entering the deaerator. A geothermal/cogeneration system, saving 17.1% energy, would use geothermal water to replace the waste heat used to generate electricity. In the frozen food plant, geothermal water at about 130 F would provide heat for process water by means of a heat exchanger and heat pumps.

Water would leave the heat exchanger at 110-140 F. Energy savings would be 52-80%, depending on the actual well temperature, and steam requirements would be reduced to 0-15% of present steam demands. (Cassar-FRC)
W82-02543

3F. Conservation In Agriculture

PUBLIC PERCEPTION OF GROUNDWATER DEPLETION IN SOUTHWESTERN KANSAS,

Kansas Water Resources Research Inst., Manhattan.
D. E. Kromm, and S. E. White.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153719, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, 1981. 62 p, 4 Fig, 21 Tab, 42 Ref, Append. OWRT-A-097-KAN(1), 14-34-0001-0118.

Descriptors: *Attitudes, *Groundwater mining, *Irrigation practices, *Water management, Agriculture, Dry farming, Great Plains, *Kansas, Water policy, *Ogallala Aquifer, Perception of groundwater depletion, Water resource agencies.

Reports the awareness, response, and preferred adjustments of various socioeconomic groups with respect to groundwater depletion in southwest Kansas. Occupational differences account for greater variation in knowledge and response than do personal, locational, educational, length of residency, and other characteristics of regional residents. Farmers and those in agribusiness know more about state water law and the proportion of groundwater used to irrigate crops. However, they are significantly less concerned about groundwater depletion, have a much narrower range of regional concerns, and are more pessimistic about the economic future of southwestern Kansas. Most residents, with the exception of irrigators, have not yet had to significantly alter their behavior because of depletion. Respondents seemed especially concerned about future problems, however, and appear highly receptive to an active groundwater conservation program. Irrigators had more divergent preferences for various adjustments than any other socioeconomic group. Large-scale irrigators report significantly greater changes in water use practices than smaller operators and appear more receptive to new programs. Although measuring preferences for all groups reveals a wide range of acceptable adjustments to groundwater depletion, there is not a regional consensus on a viable management program or the governmental agencies that should have responsibility.
W82-02174

AERATED DRIP IRRIGATION,

Bonniville County Farm Bureau, Idaho Falls, ID.
W. Anderson.
In: Farm Bureau Energy Idea Symposium Proceedings, November 18-19, 1980, Des Plaines, Illinois. P 12-28. 10 Fig. (1980). American Farm Bureau Federation, Park Ridge, Illinois.

Descriptors: *Drip irrigation, Agricultural hydrology, *Irrigation, Water use, Crop yield, *Crop production, *Potatoes, Corn, Carrots, Farming, Water conservation, Sand filters, *Idaho.

An aerated drip irrigation system is described by a potato farmer in Idaho as having nearly doubled his potato yields and hastened their maturity. Even though the cost per acre of drip irrigation is higher than other methods in the potato industry, the cost per bag is lower and the net return is over four times as high. The system uses T-tapes involving quarter-mile-long-runs—far longer than the typical drip irrigation of 200-300 foot runs, and perhaps the longest in the world. The tape, which lies flat and can be driven over with tractors, runs on a 36-inch row, and costs approximately $350 per acre. Filters are filled with No. 20 blasting sand, and are used in pairs so that clean water coming through one will backflush and float all the debris out of that filter onto the ground or into a settling pond. Each filter will handle approximately 125-150 gallons per minute. The system saves 75 percent of energy costs and reduces water need for irrigation by 50 percent. Since the water is applied at the root zone, there is an estimated 50 percent reduction in fertilizer use. The pH of the water can be changed with sulphuric acid, phosphoric acid, or whatever acid the plant needs, and can be applied right in the root zone. The water pressure throughout the system is 8 PSI. In addition to potatoes, aerated drip irrigation was used on carrots and corn. Some of the carrots grew to two feet in length, and the yield of sweet corn on several acres was double, with twice as many ears as expected. Another farmer has been pleased with the yield from drip-irrigated raspberries. (Garrison-Omniplan)
W82-02186

SOLAR HEAT POND SYSTEM,

Howard County Farm Bureau, Nashville, AR.
B. Kreal.
In: Farm Bureau Energy Idea Symposium Proceedings, November 18-19, 1980, Des Plaines, Illinois. P 65-68. 1 Fig. (1980) American Farm Bureau Federation, Park Ridge, Illinois.

Descriptors: *Solar energy, Solar radiation, Energy, *Heated water, *Crop yield, Tomatoes, *Greenhouses, Heat, Farming, Cold resistance, Insulation, Heating, *Experimental design, Costs.

A prototype solar collector, in the process of being built for use at a greenhouse, has a 3,000-gallon reservoir for the heat storage mass and a corrugated aluminum collector plate. The system's total maximum heat collection during an average year is approximately 26 million Btus. Thus, while it cost $1,700 to construct, it will probably save $300-$600 per year in fuel costs. The capacity of the system could be doubled at a probable cost of $2,300. The water pit itself is earth-formed and double-lined with plastic and insulating material. The cover is operated by an electric winch that closes it at night. While the designers call it a 'solar pond' system, there is no salt layer as in typical solar ponds. Instead, there is a film of ultraviolet-resistant polyethylene over the pond to prevent thermal convection losses from the surface. The plans also call for a simple thermostatic system that shuts the system down when the water temperature cools down to a certain point, such as 60 degrees; at that point, the gas-fired system thermostats activate to provide heat. Pipes distribute the water from the reservoir to the collector plate surface, and the cool water is returned to the pond. Convection tubing distributes the warm air down the length of the greenhouse. The collector plate will be elevated out of the water and the water will circulate over it by means of a pump. The system was constructed from materials available at hardware stores. Other kinds of reflectors that could also work would be spherical or parabolic sections. (Garrison-Omniplan)
W82-02187

LOOP EQUATIONS WITH UNKNOWN PIPE CHARACTERISTICS,

IBM Scientific Center, Haifa (Israel).
E. Gofman, and M. Rodeh.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY9, p 1047-1060, September, 1981. 6 Fig, 7 Ref.

Descriptors: *Water distribution, *Irrigation operation, *Computer programs, Networks, Head generators, Loop equations, Pipes, Hydraulic engineering, Water pressure, Pressure head.

Water distribution networks, such as irrigation systems, may be easily analyzed with an interactive computer program using the concept of loop oriented hydraulic network solvers rather than node equations. The concept of head generators is introduced to describe the resistance in a pipe of unknown characteristics. A positive resistance might indicate that a regulating valve should be partially closed and a negative resistance may show the need for a booster. The method was extensively tested during 1978-80 in Israel and found useful for both design and operation of water distribution networks. Large networks with 300 pipes and 25 loops were efficiently solved on a portable computer. The program was easily used by engineers, students, and farm managers. (Cassar-FRC)
W82-02258

SOLID SET IRRIGATION SYSTEM DESIGN USING LINEAR PROGRAMMING,

Ben-Gurion Univ. of the Negev, Sde-Boker (Israel). Inst. for Desert Research.
For primary bibliographic entry see Field 6A.
W82-02273

LEAF PHOTOSYNTHESIS, LEAF PERMEABILITY, CROP GROWTH, AND YIELD OF SHORT SPRING WHEAT GENOTYPES UNDER IRRIGATION,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W82-02373

EFFECTS OF SALINIZATION TREATMENTS ON GROWTH AND SOME RELATED PHYSIOLOGICAL ACTIVITIES OF SOME LEGUMINOUS PLANTS,

Assiut Univ. (Egypt). Dept. of Botany.
A. M. Ahmed, M. M. Heikal, and M. A. Zidan.
Canadian Journal of Plant Science, Vol 60, No 2, p 713-720, April, 1980. 5 Tab, 29 Ref.

Descriptors: *Saline soils, *Crops, Sodium, Transpiration, Water supply, *Legumes, Vegetation, Farming, Salinity, Chemical properties, Soil properties, Soil types.

A study was conducted on the effect of various NaCl concentrations on plant-water relationships, mineral composition, pigment content, photosynthetic activity and dry matter production in legumes. When subjected to salinization levels of 20, 40 and 60 meq NaCl/liter the kidney bean cultivars Harvester and Contender and cowpea cultivars Asmarly and Creamy 7 exhibited significant changes in their physiological activities. The trends and magnitudes of these changes depended on the plant variety and on the level of salinization. In general, while stomatal frequency and transpiration rate were significantly reduced, water content was considerably elevated. Biosynthesis of pigments and photosynthetic activity and consequently leaf area and dry matter accumulation were considerably reduced as the concentration of NaCl in the nutrient medium increased. Mineral composition also exhibited significant changes, but the dominant feature was the high accumulation of sodium in salinized plant tissues. These cultivars should be regarded as saline sensitive and not as suitable for cultivation in saline soils. Water content in the different organs of each of the four treated cultivars was elevated with the rise in salinization level, except for Asmarly roots, in which it was reduced. This increase in water content was attributed to a decrease in the rate of transpiration. (Baker-FRC)
W82-02381

WATER FOR NEW ZEALAND'S PLAINS,

UOP Inc., Kirrawee (Australia). Johnson Div.
R. McCallum.
Johnson Driller's Journal, Vol 53, No 1, p 10, 1981.

Descriptors: *Irrigation wells, *Wells, *Irrigation engineering, *New Zealand, Water resources development.

Drilled wells in the prolific sand-gravel aquifers in New Zealand's Canterbury plains supply irrigation water for the extensive agricultural area. A typical recent installation consisted of a 12 inch well, 130 feet deep, developed with a solid surge block yielding 336 igpm. It was fitted with a 60 kw Pleuger electric submersible pump at 80 ft. A 6 inch PVC buried pipe supplies 6 hydrant take-off points. A 4-span Rotogator center pivot unit applies 3 inches per pass every 25-30 days. (Cassar-FRC)
W82-02402

A MANAGEMENT SYSTEM FOR THE CONJUNCTIVE USE OF RAINFALL AND LIMITED IRRIGATION OF GRADED FURROWS,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
B. A. Stewart, D. A. Dusek, and J. T. Musick.
Soil Science Society of America Journal, Vol 45, No 2, p 413-419, March/April, 1981. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Irrigation design, *Furrow irrigation, Irrigation efficiency, Irrigation operation, Furrows, Irrigation, Furrow drainage, Water use efficiency.

An effective management system was sought which would meet various requirements, such as permitting application of irrigation water without allowing water to leave the field; permit conjunctive use of rainfall by eliminating or minimizing runoff, even when rainfall closely follows irrigation; and permit efficient utilization of applied water for crop production. Under this plan a 600 meter field was divided into three water management sections. The upper half of the field was managed as fully irrigated. The next fourth was a tail-water-runoff section that used furrow from the fully irrigated section. The lower one-fourth section was designed as a dryland section, retaining and using any runoff, generated either by irrigation or by rainfall, from the water, fully irrigated or tailwater-runoff sections. Furrow dams were an important part of the system design. Seeding rates were reduced down the field from 6 kg/ha in the fully irrigated section to 3 kg/ha on the tailwater section, to 1.5 kg/ha on the dryland section. Nitrogen applications were similarly reduced. For 1979, a year with near average rainfall, the system successfully prevented runoff from both irrigation and rainfall. (Baker-FRC)
W82-02556

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

HISTORICAL BACKGROUND AND OVERVIEW OF PLAN FOR RESTORING FRESHWATER INFLOW TO AN ESTUARY IN CONJUNCTION WITH URBAN DEVELOPMENT,
Larsen and Associates, Miami, FL.
P. Larsen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche.
In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981, p 201-211, 7 Fig, 3 Ref.

Descriptors: *Estuaries, *Wetlands, *Mangrove swamps, *Land development, Construction, Drainage effects, Laminar flow, Flow pattern, Flood control, Urbanization, *Florida.

Marco Island is located in a mangrove estuarine area on the southwest coast of Florida. When the project started in 1964, State and Federal regulations encouraged the development of waterfront communities in mangrove areas. Initial plans called for dredging and filling large portions of the 19,500 acre original ownership area. The Marco Island development proceeded concurrently with changing wetlands regulations, and eventually permits to develop 31% of the Marco Island plan were denied. The developer has proposed a substitute plan for development of 1,500 acres of uplands and 2,500 acres of wetlands located near the estuary. A key feature of the new plan is the proposed restoration of freshwater inflow to fringing estuarine wetlands impacted by prior construction of roads and drainage works. The proposed plan for restoring freshwater inputs to the estuary is based upon blocking all channelized flows that presently leave the site. Real estate lakes will be constructed in uplands and in impacted freshwater wetlands immediately upgradient. Freshwater outflow from the lakes will be delivered to the estuary via sheet flow across preservation wetlands. The lake system is designed to initially retain a 100-year, 24-hour storm. During dry periods groundwater inputs to the lake will be routed to spreader ditches and then to wetland surface flow instead of lost to drainage ditches. (Moore-SRC)
W82-02119

FRESHWATER INTRODUCTION INTO LOUISIANA COASTAL AREAS,
Army Engineer District, New Orleans, LA.
J. C. Weber, and R. A. Buisson, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche.
In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81-04, Vol I, Oct. 1981. p 366-375, 3 Fig, 4 Ref.

Descriptors: *Wildlife conservation, *Salinity, *Estuaries, *Diversion structures, Planning, Coastal waters, Local governments, Benefits, Freshwater inflow, *Louisiana.

The conservation and enhancement of fish and wildlife resources through the control of salinities in portions of the estuarine area of Louisiana are the purposes of one authorized project and two ongoing studies in the U. S. Army Engineering District, New Orleans. The primary measure identified for controlling salinities is to divert water from the Mississippi River near the delta to adjacent estuarine areas. Planning and implementing this type of project presents a challenge from both technical and institutional standpoints. Technically, the state-of-the-art for quantifying benefits and impacts must rely on expert judgment and assumptions. From the institutional aspect, freshwater diversion is supported by many Federal, State, and local agencies and organizations. However, obtaining local cooperation and support for specific diversion sites may be the most difficult problem to solve because the local areas where diversion facilities would be located are not necessarily the areas receiving significant benefits from diversion. In some areas, benefits may not outweigh adverse impacts involved with constructing and operating diversion facilities. For the most part, benefits would be widespread and would accrue to interests not directly participating in the project.
W82-02127

ESTABLISHMENT OF CONTROLLED FRESHWATER DIVERSIONS OF THE MISSISSIPPI RIVER INTO THE LOUISIANA COASTAL ZONE,
Department of Natural Resources, Baton Rouge, LA.
M. E. Crandall, and J. L. Lindsey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche.
In: Proc. of the National Smyposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 139-146. 3 Fig, 6 Ref.

Descriptors: *Estuaries, *Erosion, *Wetlands, *Coastal zone management, Regulations, Diversions, Costs, Planning, Estuarine fisheries, Productivity, Resources management, Mississippi River, Louisiana.

Dredging of the channel and construction of levees along the Mississippi River, together with the absence of freshwater introduction at the upper ends of the hydrologic basins, have set up a positive feedback loop leading to increased land loss. Coastal wetland is being lost at a rate of 16.5 sq miles per year. This land loss is a cause of reduced productivity of area fisheries. There are two approaches to alleviate the problem: regulation, and programs to restore or mimic the natural processes of the system. Regulations have been developed, but their use can only retard the aggravation of the deterioration process. Freshwater diversions to restore natural conditions may be large or small scale. The small scale diversions are more practical because of their smaller cost and shorter-term planning. Both are likely to face problems of local funding difficulties, user conflicts, land user changes, and general distrust of projected results. A combined local, state and federal effort is necessary for the positive effects of freshwater diversions into Louisiana's estuarine system can become a reality. (Brambley-SRC)
W82-02145

THE MOUTH OF THE COLORADO RIVER PROJECT; AN ECONOMIC DEVELOPMENT ENVIRONMENTAL ENHANCEMENT PROJECT,
Army Engineer District, Galveston, TX. Engineering Div.
J. C. Trahan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche.
In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 166-178. 2 Fig, 5 Ref.

Descriptors: *Colorado River, *Texas, *Estuaries, *Navigation, *Channel improvement, *Diversion channels, Dams, Planning, Economic evaluation, Fisheries, Deltas, Marshes, Land development, Water management.

The Mouth of the Colorado River (Texas) Project was originally intended to be only a navigation project but was expanded to include a diversion project. The Project will provide a jettied entrance channel in the Gulf of Mexico at the mouth of the river; a navigation channel to Matagorda; a diversion channel and dam to divert the flow of the river into Matagorda Bay; and related improvements. A history of project planning is presented to illustrate both interagency conflicts over data needs and proper reporting procedures and interagency cooperation on the studies finally conducted. The studies, which include an economic evaluation of the benefits of river diversion and a delta growth projection based on an in situ sediment study, mathematical modeling, a bay-bottom coring program, and a hydrographic survey are described, and the results of the study are presented. Because the studies show that a river delta of valuable intertidal marsh habitat would form and that additional freshwater inflow would significantly enhance the fishery, construction of the river diversion project is recommended. The project described illustrates the conflicting needs involved in freshwater inflow decisions and the complex data requirements of the decision process, and emphasizes that, because definitive scientific answers to inflow issues are often unavailable, a cooperative attitude among the affected parties is essential if results are to be achieved. (Brambley-SRC)
W82-02148

LOSS OF COLORADO RIVER INFLOWS TO MATAGORDA BAY, TEXAS, AND EFFORTS FOR RESTORATION,
W. J. Sheffield, and M. T. Walton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche.
In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 216-229. 1 Fig, 2 Tab, 37 Ref.

Descriptors: *Diversion channels, *Colorado River, *Texas, *Environmental effects, *Shellfish, *Estuarine environment, Cost-benefit analysis, Planning, Navigation, Estuarine fisheries, Channelization.

Major disturbances to the Matagorda Bay system have included diversion of the Colorado River to the Gulf of Mexico and loss of supporting marshes. Supporting marshes have been reduced from

18,623 ha (46,000 acres) to 15,789 ha (39,000 acres) and oyster reefs have been reduced in area from 11,660 ha (28,800 acres) in the late 1800's to 8,291 ha (20,480 acres) at present with only one-fourth of this area consistently productive. Oyster production has decreased because parasitic infestations have increased in response to increases in salinity. Production of shellfish in West Matagorda Bay is estimated to be only 20% of that possible through utilization of environmental management. Methodologies for calculating potential changes in shellfish production due to rediversion of the Colorado River are presented. Annual economic benefits for increased shellfish production in West Matagorda Bay and Gulf of Mexico attributable to rediversion are estimated to be in excess of $17.1 million. Significant actions relating to the Mouth of Colorado River Texas Project, sanctioned by Section 101 of the Rivers and Harbor Act of 1968, include separation of project features by the Crops of Engineers, restoration of the diversion feature to the project, and delay in navigation feature construction due to threats of legal action. A project to link East Matagorda Bay to the Colorado River Channel is suggested, to provide permanent access from East Matagorda Bay to the Gulf of Mexico. (Brambley-SRC)
W82-02151

SANTEE-COOPER REDIVERSION: PROJECTED IMPACTS ON FISHERY RESOURCES AND WILDLIFE HABITATS,

Fish and Wildlife Service, Cookierville, TN.
L. A. Barclay, Jr., and V. G. Burrell, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 463-473. 1 Fig, 20 Ref.

Descriptors: *Environmental effects, *Partial diversion, *Santee River, South Carolina, *Sediment control, *Fisheries, *Wildlife habitats, Oysters, Clams, Shrimp, Salt marshes, Brackish water, Population dynamics.

The fresh water from the Santee River drainage basin was diverted through the Santee-Cooper hydroelectric plant into the Cooper River in 1942. This increased the average flow in the Cooper River from 72 cfs to 15,600 cfs, and concomitant sediment resulted in a tremendous increase in shoaling in Charleston Harbor. The U.S. Army Corps of Engineers has initiated a project to alleviate this shoaling problem by rediverting most of this fresh water back into the Santee channel and reducing the average weekly flow in the Cooper River to approximately 3,000 cfs. This rediversion is scheduled to be completed in 1982. It is projected that fish and wildlife resources will be subjected to substantial impacts as a result of rediversion. Highly productive oyster and clam beds will be displaced or destroyed, as will valuable shrimp and finfish nursery areas. Severe reduction of freshwater flows into the Cooper River drainage will result in the displacement of freshwater and brackish marsh vegetation by saltmarsh plants; conversely, increases in freshwater flows into the Santee River drainage will cause salt marsh and brackish marsh vegetation to be succeeded by freshwater plants. These vegetative changes will cause profound changes in the wildlife populations of these two river drainages.
W82-02168

SEDIMENT TRANSPORT DURING A CONTROLLED RESERVOIR RELEASE,

Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 2J.
W82-02196

BIOLOGICAL CONTROL OF AQUATIC WEEDS IN SOUTHWEST FLORIDA,

Lee County Hyacinth Control District, Fort Myers, FL.
J. R. Cassani, and T. Y. Miller, Jr.
Journal of Aquatic Plant Management, Vol 19, p 49-50, July, 1981. 1 Fig, 6 Ref.

Descriptors: *Aquatic weed control, Weed control, *Florida, Water hyacinth, Alligatorweed, Aquatic plants, Insects, Arthropods, Fish, Herbicides, Plant diseases, Carp.

The biological aquatic weed control program in the Lee County Hyacinth Control District is described. Three major types of biotic agents being used or investigated are phytophagous arthropods, herbivorous fish, and pathogens. Water hyacinth weevil (Neochetina eichhornia Warner) and a related species were released in 1974, but only the former is distributed and destroying weeds extensively. Sameodes albiguttalis Warner has produced a severe infestation on water hyacinth in the Manatee River. Alligatorweed flea beetle (Agasicles hydrophila) populations are highest in December-April, and dormant in hot weather. At least 16 sites in southwest Florida have been stocked with grass carp or with a hybrid fish (female grass carp and male hybrid bighead carp). These are monitored quarterly and have been found partially successful. Limited research on bacterial and fungal pathogens is underway. (Cassar-FRC)
W82-02285

CONTROL OF AQUATIC WEEDS WITH HEXAZINONE,

Science and Education Administration, Davis, CA.
L. W. J. Anderson.
Journal of Aquatic Plant Management, Vol 19, p 9-14, July, 1981. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Aquatic weed control, *Herbicides, *Hexazinone, Weed control, Toxicity, Ponds, Algae, Phytoplankton, Macroinvertebrates, Invertebrates, Fate of pollutants, Water quality, Species diversity, Aquatic plants, Water pollution effects.

In an aquatic weed control trial, 0.97 kg of the herbicide hexazinone was applied to a 0.08 ha pond to produce a 1 ppm concentration in water. The following weeds were completely controlled: American pondweed (Potamogeton nodosus Poir.), Sago pondweed (P. pectinatus L.), elodea (Elodea canadensis Michx.), cattail (Typha sp.), Spirogyra sp, slender spikerush (Eleocharis ocicularis L.), and Chara sp. Root to shoot translocation was observed in cattails and Russian olive trees. Decaying vegetation caused a drop in dissolved oxygen from 8 ppm to 0.2 ppm within 5 days after treatment, causing a fish kill. Oxygen levels remained at 1-4 ppm during the remainder of the 4-month study. Decomposing plant tissue also released P and N compounds into the water. The species diversity index of periphyton fell to a low of 0.2 by 98 days post treatment (control pont, 1.5-2.0) and recovered to 0.5 by 119 days. The species diversity index of macroinvertebrates deteriorated to 0.4 by the 52nd day and recovered to 1.3-1.5 by the end of the study. The control pond index was 1.5-2.5. Observations 1 year after herbicide application indicated no regrowth of plants except for phytoplankton and benthic algae. A bioassay showed no residual phytotoxicity in water or sediment. (Cassar-FRC)
W82-02326

DIQUAT AND SODIUM ALGINATE FOR WEED CONTROL IN RIVERS,

Agricultural Research Council, Oxford (England). Weed Research Organization.
P. R. F. Barrett.
Journal of Aquatic Plant Management, Vol 19, p 51-52, July, 1981.

Descriptors: *Herbicides, *Aquatic weed control, *Diquat, Weed control, Rivers, Aquatic plants, *Eden River, *England, Sodium alginate, Gels, Invertebrates, Benthic fauna, Water quality.

Diquat in a sodium alginate carrier allowed local control of aquatic weeds in the River Eden, Cumbria, England, with little apparent adverse effect on the invertebrate fauna. Experiments were conducted during low water (discharge 7 cu m per sec) in June of 1977 and 1978. A viscous solution of 100 g diquat cation in 1 liter sodium alginate solution (30 g per liter) completely destroyed weed beds (largely Ranunculus fluitans Lam. and Ranunculus penicillatus Butcher C D K Cook) and created clear channels up to 40 min or 120 min. The other treatments were: 100 g diquat in 5 liters water (no carrier) and 100 g diquat-sodium alginate diluted with river water to 5 or 10 liters. Of these, only the diluted diquat-alginate applied over the 120 min period produced nearly complete weed removal. Very few or no weeds were killed by the other procedures. It is likely that the alginate method will be acceptable in regions where high water quality is a concern. (Cassar-FRC)
W82-02328

PRELIMINARY EVALUATION OF HYDROGEN PEROXIDE AS A POTENTIAL HERBICIDE FOR AQUATIC WEEDS,

Science and Education Administration, Stoneville, MS. Southern Weed Science Lab.
P. C. Quimby, Jr.
Journal of Aquatic Plant Management, Vol 19, p 53-55, July, 1981. 1 Tab, 11 Ref.

Descriptors: *Hydrogen peroxide, *Aquatic weed control, *Herbicides, Weed control, Aquatic plants, Alligatorweed, Water hyacinth, Coontail, Hydrilla, Toxicity, Fish.

Hydrogen peroxide proved effective as a herbicide for aquatic weeds. Coontail and hydrilla were exposed in the laboratory to 1, 2, 3, and 4 nM of H2O2 for 1, 30, and 60 min and 5 days. Acceptable weed suppression (90-100%) was seen at 1 nM for the 5-day exposure. Guppies in the water were not injured during this test. Other treatments which were > 80% effective were the 60 min exposure to the 3 and 4 nM concentrations. A 1 min exposure at the highest peroxide concentration produced 0-20% suppression, and a 30 min exposure, 70-80%. No effects on emersed alligatorweed or floating water hyacinth were seen at the concentrations used in this study, showing its selectivity toward submerged weeds. (Cassar-FRC)
W82-02329

GROWTH AND PHOTOSYNTHESIS OF NAJAS MARINA L. AS AFFECTED BY LIGHT INTENSITY,

Tel Aviv Univ. (Israel). Dept. of Botany.
M. Agami, S. Beer, and Y. Waisel.
Aquatic Biology, Vol 9, No 3, p 285-289, 1980. 3 Fig, 6 Ref.

Descriptors: *Aquatic plants, *Plant growth, *Photosynthesis, *Light intensity, *Najas marina, Reservoirs, Light penetration, Water pollution control, Water levels, Water supply, Aquatic weed control, *Israel.

Marked reduction in growth of Najas marina was observed in slightly increased water depths, suggesting that short periods of water level alteration could control this nuisance plant in reservoirs without the use of polluting chemicals. Najas plants grew uniformly in the upper 50 cm of water and increased their net weight to a lesser degree between 50 and 100 cm depth. At depths of 200-250 cm the plants grew for the first week (probably from stored carbohydrate reserves), kept the same weight for the second week, and deteriorated during the third week. Studies were conducted in August, the optimum growth season of the plant. Light intensities were 360 micro-units per sq m-sec at 50 cm depth, 60 micro-units at 100 cm, and below the compensation point, 1.5 micro-units, at 200-250 cm. Light saturation was reached at 280 micro-units per sq m-sec, and the light compensation point for net photosynthesis was 5 micro-units per sq m-sec (depth of 170 cm). Najas growth may be affected by the month of the growing season, changes in water level or turbidity, or algal blooms. (Cassar-FRC)
W82-02365

METHODS OF RESTORING THE DELIVERY OF DRAINAGE WELLS,

V. S. Alekseev, and V. T. Grebennikov.
Hydrotechnical Construction, No 1, p 24-28, January, 1980. 2 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 15-17, January, 1980

Descriptors: *Drainage systems, *Flood control, Flood protection, Permeability, Maintenance, *Drainage wells, Wells.

Field studies were conducted to determine the effectiveness of different methods of restoring the yield of drainage wells. The drainage system examined is a linear row of wells with a total length of 7.9 km located parallel to and at a distance of 150 meters from a protective dike. The distance between wells is 12-25 m. The wells drain the pressure-free aquifer of ancient alluvial deposits both above and in the Volga River terrace. The permeability of the stratum increases from 5-20 m/day in the south to 60-80 m/day in the north. The waters contain calcium hydrocarbonates, with a mineral content of up to 900 mg/liter. The pH varies from 7.3 to 8.2, and the total iron concentration reached 30 mg/cu dm. During the operation of a drainage system, the reduction in well productivity is governed by chemical silting processes, the rate of which is determined by the design of the permeable portion of the well. Use of the pneumatic-impulse treatment of wells with an interrepair period of not more than 6 months is possible in wells that have been in service not longer than 3-4 years. Wells in service for 5-10 years can be treated by detonation of a blasting fuse to restore 45-65% of initial yield. Solution of silting formation for a 6-7 year old well is ensured by concentrated hydrochloric acid and powdered reagents. Interrepair periods for this treatment method range from 18-24 months. Combined treatment methods are expedient in wells in service for more than 7-8 years where interrepair periods of 24-30 months have been observed. Experience acquired with massive restoration of drainage productivity in wells in this flood-control system can be used to develop measures which will stabilize the effect of verticle drainage of terrace dams and flood-protection systems under similar hydrogeologic conditions. (Baker-FRC)
W82-02385

WATERLOGGING CONTROL FOR IMPROVED WATER AND LAND USE EFFICIENCIES: A SYSTEMATIC ANALYSIS,

Colorado State Univ., Fort Collins. Water Resources Research Inst.
For primary bibliographic entry see Field 6A.
W82-02455

REASSESSMENT OF THE EFFECTS OF CONSTRUCTION DEWATERING ON GROUNDWATER LEVELS IN THE COWLES UNIT, INDIANA DUNES NATIONAL LAKESHORE, INDIANA. SUPPLEMENT TO GEOLOGICAL SURVEY WATER-RESOURCES INVESTIGATIONS 78-138,

Geological Survey, Indianapolis, IN. Water Resources Div.
D. C. Gillies, and W. W. Lapham.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $7.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1105, September, 1980. 50 p, 23 Fig, 3 Tab, 4 Ref.

Descriptors: *Settling basins, *Ponds, *Fly ash, *Seepage, Water level, *Dewatering, Groundwater, Groundwater movement, Aquifers, Construction, Model studies, Hydrogen, Surface-groundwater relations, *Indiana, Indiana Dunes National Lakeshore.

A revised dewatering plan for the construction of a nuclear power plant at the Northern Indiana Public Service Company's (NIPSCO) Bailly Generating Station and evidence that suggests that a change in the characteristics of the confining unit 2 in and near Cowles Bog National Landmark may exist have resulted in a reassessment of the effects of construction dewatering on ground-water levels in the Indiana Dunes National Lakeshore. Model results indicate that the revision in the dewatering plan produces water-level declines that do not differ significantly from those described previously. However, when the change in the confining unit beneath Cowles Bog is considered, simulations of the simultaneous decline of a seepage mound after sealing of the fly-ash-ponds and the second phase of construction dewatering indicate that the simulated water-level declines in the aquifer unit 1 at Cowles Bog may be below the water levels tolerated by the National Park Service after 18 months. The water levels may even decline below the tolerable levels in spite of NIPSCO's proposed plan of artificially recharging the aquifer unit 1 near the excavation site at 400 gal/min. The magnitude of the simulated water-level declines in unit 1 within the Lakeshore, caused by pumping from the excavation, depends on the relation in time between the second phase of dewatering and the decline of the seepage mound after sealing of the fly-ash-ponds, but not on the duration of dewatering beyond 18 months. (USGS)
W82-02478

OPERATION POLICY ANALYSIS: SAM RAYBURN RESERVOIR,

Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 6A.
W82-02589

WETLANDS USE FOR WATER MANAGEMENT IN FLORIDA,

Corvallis Environmental Research Lab., Cincinnati, OH.
D. C. Ammon, W. C. Huber, and J. P. Heaney.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 315-327, October, 1981. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Wetlands, *Water management, *Runoff, *Florida, *Kissimmee River Basin, Lake Okeechobee, Flood control, Marshes, Swamps, River basins, Drainage, Phosphorus, Water quality, Water resources, Weirs, Water supply, Nutrient removal, Outlets, Runoff, Detention dams.

A basin-wide water management scheme has been proposed for the Kissimmee River basin, Florida. This 2300 sq mi area contributes a major portion of surface inflow and nutrient loads to Lake Okeechobee, which is the primary water resource for southern Florida (irrigation water, maintenance of Everglades National Park, aquifer recharge, municipal supply, recreation, wildlife habitat, and flood control). By 1972 the basin hydrology had been altered by a 53 mile channel so that rapid runoff was characteristic. The management plan is based on detention of runoff, restrictions of surface water discharge rates, and routing flow through marshes. A representative wetland, Chandler Slough Marsh (1000 acres) was chosen as the study area. Simulation analyses showed it to be moderately effective as a quality and quantity control unit. Detaining surface runoff would increase detention time and produce a larger proportion of subsurface pathways, reducing inflow peaks and nutrient concentrations to the downstream marsh. Construction of a weir system would produce greater nutrient removal from the water but more frequent inundation of surrounding areas. In addition, it would bar the periodic flushing of nutrients and dead vegetation that prevents nutrient buildup. (Caesar-FRC)
W82-02590

COMPARISON OF DETENTION BASIN PLANNING AND DESIGN MODELS,

Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-02592

LARM TWO-DIMENSIONAL MODEL: AN EVALUATION,

Tennessee Technological Univ., Cookeville.
J. A. Gordon.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 877-886, October, 1981. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Reservoir management, *Water temperature, *Flow patterns, Water management, Model studies, LARM model, *Center Hill Lake, *Tennessee, Lakes, Temperature, Water quality, Dissolved oxygen, Oxygen, Hydrodynamics, Stratification, Weirs, Simulation analysis, Flow control, Flow velocity, Outlets.

A laterally averaged reservoir model (LARM) was used to investigate the flow regimes of Center Hill Lake, Tennessee, during the dry year 1972 and the wet year 1973. This numerical, two-dimensional model combines the mass continuity, momentum, and energy equations and computes temperature and flow velocity vectors resulting from raised or multilevel power outlets. Predicted outflow temperatures for 9 dates (April to September) were very close to measured temperatures. The model realistically handled periods of isothermal to spring stratification, fall overturn, and flood conditions. Outflows, inflows, and reverse flows were all depicted by the model. Different outlet levels were simulated to predict effects on hydraulic residence time and dissolved oxygen levels. Using a raised outlet kept the hypolimnion cooler, discharge waters about 5C warmer, and inflow patterns the same as the normal level outlet. Hydraulic retention time in the metalimnion was 98 days with the raised outlet and > 155 days with the normal outlet. Simulation of a submerged weir from the bottom to 12 meters below the surface showed temperature discontinuities much smaller than expected. (Caesar-FRC)
W82-02597

4B. Groundwater Management

PUBLIC PERCEPTION OF GROUNDWATER DEPLETION IN SOUTHWESTERN KANSAS,

Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 3F.
W82-02174

HYDROLOGIC MAPS OF OGALLALA AQUIFER, WEST-CENTRAL KANSAS,

Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-02475

REASONABLE GROUNDWATER PUMPING LEVELS UNDER THE APPROPRIATION DOCTRINE: THE LAW AND UNDERLYING ECONOMIC GOALS,

For primary bibliographic entry see Field 6E.
W82-02503

INDUCED SINKHOLES: AN ENGINEERING PROBLEM,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
J. G. Newton.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR2, p 175-185, June, 1981. 3 Fig, 13 Ref.

Descriptors: *Sinks, *Carbonate rocks, *Geohydrology, *Water table profiles, *Drawdown, Engineering, Project planning, Groundwater, Geologic joints, Geologic fractures, Faults, Fissures, Geologic formations, Bedrock, Pumpage.

Conditions under which man-made sinkholes develop are described. Induced sinkholes are divided into two types: those resulting from a decline in the water table due to groundwater withdrawls and those resulting from construction. Most induced sinkholes occur where cavities develop in residual or other unconsolidated deposits overlying openings in carbonate rocks. Thd downward migration of the deposits into underlying openings in bedrock and the formation and collapse of resulting cavities are caused by a decline in the water table resulting in induced recharge and other changes in groundwater movement. Most sinkholes from construction are related to the diversion of drainage over openings in bedrock. (Titus-FRC)
W82-02559

MANAGEMENT OF INTERSTATE AQUIFER SYSTEMS,
Camp Dresser and McKee, Inc., Walnut Creek, CA. Water Resources Div.
H. O. Banks.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 563-577, October, 1981. 2 Fig, 10 Ref.

Descriptors: *Groundwater management, *Water law, *Aquifers, *Aquifer management, *Interstate compacts, Water resources development, Water supply development, Water management, Legal aspects, Economic aspects, International agreements, Management planning, Local governments.

The management of interstate aquifers, specifically, the Ogallala Aquifer and the Rio Grande Valley is examined. Regional models that could be expanded to include comprehensive groundwater resources management include federal interstate compacts, interstate compacts, river basin commissions, regional federal agencies, and regional federal-state commissions. Local gencies formed under statutory authority in Colorado, Kansas, Texas and Nebraska have taken limited interstate management actions for the Ogallala Aquifer. The management of groundwater resources by smaller districts is often hampered by limited financial resources. There is little public support for interstate management programs. The Six-State High Plains-Ogallala Aquifer Regional Resources Study was begun to improve the water supply situation of the areas served by the Ogallala Aquifer. The use and allocation of surface waters of the Rio Grande below Elephant Butte are governed by a treaty with Mexico, court decisions, interstate compacts and the water sales contract under the Rio Grande Project. Nine factors relevant to the development of an interstate management program are discussed. The legal and institutional factors that must be considered in formulating a groundwater resource management structure are influenced by social, environmental, and economic goals. A management program formulated and implemented under a regional water resource management commission is recommended to handle the specific aquifer interests of the states involved. (Geiger-FRC)
W82-02578

4C. Effects On Water Of Man's Non-Water Activities

FLOW REGIME AND SEDIMENT LOAD AFFECTED BY ALTERATIONS OF THE MISSISSIPPI RIVER,
J. R. Tuttle, and A. J. Combe, III.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, Oct. 1981. p 334-348, 8 Fig, 6 Ref.

Descriptors: *Sediment load, *Flow discharge, *Channel improvement, *Navigation, *Estuaries, Flood flow, Diversion losses, Sediment transport, Overland flow, *Mississippi River.

Alterations of the Mississippi and Atchafalaya Rivers over the past 140 years have significantly affected the distribution of flow and sediment loads entering the estuaries of south Louisiana. The most significant alterations were: removal of the Atchafalaya River log raft and subsequent alterations which hastened natural processes; confinement of flood flows by levees limiting discharges to three specific outlets; and those alterations that caused a 50% reduction in average annual suspended sediment loads transported by the Mississippi and Atchafalaya Rivers. The average volume of flow delivered annually to south Louisiana has not been affected by alterations. The average annual volume of water transported by the Mississippi below the latitude of Red River Landing has decreased due to increased diversions to the Atchafalaya River since the middle 1800's. Developments in the Atchafalaya Basin, following actions of the State of Louisiana to establish navigation in the middle 1800's, have significantly hastened the natural enlargement processes in the Atchafalaya Basin and Atchafalaya Bay. Channel enlargements in the middle and lower reaches of the Atchafalaya Basin have been instrumental in channeling sediments to the Atchafalaya Bay, reducing the potential for overbank sedimentation in the acceleration of a significant marsh area in Atchafalaya Bay. (Moore-SRC)
W82-02125

BIOLOGICAL CONSIDERATIONS RELATED TO FRESHWATER INTRODUCTION IN COASTAL LOUISIANA,
Army Engineer District, New Orleans, LA.
D. L. Chew, and F. J. Cali.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of biological Services Rept FWS/OBS-81/04, Vol I, Oct. 1981. p 376-386, 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Estuarine environment, *Salinity, *Wetlands, *Wildlife, *Saline water intrusion, Environmental effects, Floods, Sediments, Nutrients, Fish, Shellfish, Marshes, Salt marshes, Coastal marshes, *Louisiana.

Louisiana has experienced a rapid loss of coastal wetlands due to natural processes such as subsidence and erosion, as well as man's engineering activities including leveeing, channelization and petroleum exploration. These activities have led to a reduction in overbank flooding and natural distributary flow which historically provided fresh water, sediments and nutrients to estuarine areas. In addition, construction of large navigation channels has caused progressive intrusion of saline waters. This has resulted in conversion of fresh, intermediate and brackish marshes to intermediate, brackish and saline marshes, respectively, as well as loss of some areas of wooded swamp. Saltwater intrusion and loss of wetlands have adversely affected productivity of wildlife and fishery resources and have led to declines in populations of waterfowl, furbearers and important shellfish and finfish species. Influx of saline waters is particularly harmful to the American oyster, due to increased predation. Juvenile stages of shrimp, menhaden and blue crabs are estuarine-dependent and utilize near-shore estuaries and adjacent wetlands as nursery areas. One way to ameliorate loss of wetland nursery areas and rate of saltwater intrusion is timely introduction of fresh water to provide sediments and nutrients vital to coastal wetlands. Major constraints to freshwater introduction in Louisiana are poor water quality and lower temperatures in the Mississippi River as compared to adjacent estuaries.
W82-02128

EFFECTS OF WETLAND CHANGES ON THE FISH AND WILDLIFE RESOURCES OF COASTAL LOUISIANA,
Fish and Wildlife Service, Lafayette, LA.
D. W. Fruge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, Oct. 1981. p 387-398, 1 Fig, 44 Ref.

Descriptors: *Wetlands, *Habitats, *Wildlife, *Diversion, *Estuarine environment, Environmental effects, Sediments, Coastal marshes, Shellfish, Fish, Economic aspects, Estuarine fisheries, *Louisiana.

The vast wetlands of the Louisiana Coastal Region (LCR) are of national importance to fish and wildlife. Prior studies documented an annual land-loss rate of over 16.5 sq mi/yr in the LCR. More recent investigations indicate that this rate of wetland loss more than doubled since 1956. Wetland deterioration, which is partially attributable to natural causes, has been greatly accelerated by human influences such as navigation channel excavation, agricultural drainage, and construction of mainline Mississippi River levees that have prevented freshwater and sediment overflow into adjacent subdelta marshes. Continued wetland deterioration may lead to serious declines in estuarine-dependent fish and shellfish harvest, fur catch, waterfowl habitat, and related fish and wildlife productivity. Preliminary estimates indicate that the monetary value of fish and wildlife productivity can be increased by more than $4.5 million/yr with a single large-scale freshwater diversion structure that would introduce Mississippi River water into the Lake Pontchartrain-Lake Borgne Basin of southeast Louisiana. Because federally financed public works projects have played a major role in wetland deterioration in the LCR, mitigation of these losses through the federal public works program would seem appropriate. (Moore-SRC)
W82-02129

A NEW APPROACH TO DETERMINING THE QUANTITATIVE RELATIONSHIP BETWEEN FISHERY PRODUCTION AND THE FLOW OF FRESH WATER TO ESTUARIES,
National Marine Fisheries Service, Miami, FL. Southeast Fisheries Center.
J. A. Browder, and D. Moore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office, of Biological Services Rept FWS/OBS-81/04, Vol I, Oct. 1981. p 403-430, 2 Fig, 85 Ref.

Descriptors: *Estuaries, *Estuarine fisheries, *Sediment transport, *Detritus, *Nutrients, Environmental effects, Model studies, Salinity, Estuarine environment, River flow, Mixing, Wetlands, Fish, Invertebrates, Microorganisms, Freshwater inflow.

Freshwater inputs to estuaries appear to enhance the production of marine organisms, because the highest standing stocks along shorelines are found in or near estuaries, which receive freshwater inputs. Activities of man that affect the quantity or timing of the flow of fresh water to estuaries include: dams for irrigation and power; diversions; canals in uplands; deforestation; clearcutting; grazing; road construction; and paving. The flow of fresh water into estuaries may influence fishery production, either directly or indirectly, in at least five ways: transport of nutrients; transport of detritus; transport and deposition of sediments; reduction of salinity; and mixing and transport of water masses. Diverse estuarine systems found along the gulf coast from Florida to Texas have similar problems as a result of changes in the quantity and seasonal patterns of the freshwater flow they receive. In a conceptual model, direct river inputs are sediments, nutrients, and fresh water. Sediments build and maintain tidal wetlands, counteracting both natural and anthropogenic processes that destroy wetlands. Nutrients in river water stimulate productivity of wetland vegetation. The physical force of runoff flushes decaying vegetation into tidal creeks and open waters, where it is processed by microorganisms into food for benthic animals, which are fed on by juvenile fish and invertebrates. Nutrients released to open water stimulate productivity of phytoplankton and seagrasses. Freshwater inputs establish chemical potential energy that sometimes drives the mixing of the estuary. (Moore-SRC)
W82-02130

EFFECTS OF FRESHWATER FLOW ON FISHERY RESOURCES IN THE SACRAMENTO-SAN JOAQUIN ESTUARY,
California State Dept. of Fish and Game, Stockton.
P. L. Herrgesell, D. W. Kohlhorst, L. W. Miller, and D. E. Stevens.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434,

Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX. Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct.1981, p 71-87. 6 Fig, 1 Tab, 19 Ref.

Descriptors: *River flow, *Fish populations, *Estuaries, *Low flow, *Environmental effects, Water level, Diversion losses, Growth stages, Saline water intrusion, Aquatic habitats, Freshwater inflow, *Sacramento-San Joaquin estuary, California.

The freshwater flows into the Sacramento-San Joaquin Estuary have been declining for many years and are likely to continue to do so. This decline, with the annual variations in flow, affects the fishery resources of the estuary. Diversions from the San Joaquin River are directly responsible for the loss of millions of fish, and are indirectly responsible for the loss of many more because of the effects of flow reversal on fish behavior, and because of the reduction in food supply. Annual abundance indices for striped bass, young fall run chinook salmon, American shad, and longfin smelt show an increase with increases in flow rates during the spawning and early stages of life. High flows increase dispersal of young fish which may decrease density dependent mortality. Overall abundance of opossum shrimp appears to be reduced by salinity-incursion and increased water diversions. Salinity intrusion stimulates dispersal of salt-water species into more of the estuary, while habitat for freshwater species is reduced. Conversely, at the time of high spring runoff the salt-water habitat is reduced. This is thought to be the cause of the movement of juvenile dungeness crab out of the bay. (Brambley-SRC)
W82-02141

VALUES OF ECOLOGICAL CHARACTERIZATION STUDIES TO ASSESS EFFECTS OF FRESHWATER INFLOW TO ESTUARIES,

Fish and Wildlife Service, Slidell, LA.
For primary bibliographic entry see Field 6G.
W82-02147

THE EFFECT OF FOREST CLEARCUTTING IN NEW ENGLAND ON STREAM-WATER CHEMISTRY AND BIOLOGY,

New Hampshire Univ., Durham. Northeastern Forest Experiment Station.
C. W. Martin, D. S. Noel, and C. A. Federer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153627, Price codes: A05 in paper copy, A01 in microfiche. Water Resource Research Center, University of New Hampshire, Research Report 34, July, 1981. 88 p, 13 Fig, 10 Tab, 52 Ref. OWRT-A-051-NH(1), 14-34-0001-8031.

Descriptors: *Clear-cutting, *Environmental effects, *Water quality, *Ecological effects, Algal growth, Invertebrates, Streamflow, *New England, Forest hydrology, Logging, Nutrient cycling, Water pollution, *Watershed management.

Changes in stream chemistry following clearcutting were sought in 56 streams at 15 locations throughout New England. Streams draining clear-cut areas were compared with nearby streams in uncut watersheds over periods of up to 2 years. In general, concentrations of all elements studies (inorganic N, SO4 - S, Cl, Ca, Mg, K, Na), as well as pH and specific conductivity, varied as much among uncut streams at a location as between uncut and cutover streams. However, at most locations, at least one of these variables differed between uncut and cutover streams. The greatest differences occurred with nitrogen in northern hardwood forests in the White Mountains of New Hampshire. At 4 of the locations the effect of cutting on algae and invertebrates in the streams were also examined. Both algal and invertebrate densities were greated in cutover streams by factors of 2 to 4, probably because of increased light and temperature. The taxonomic composition of both algal and invertebrate populations was also changed by cutting. Partial cuts and sufficiently wide buffer strips can minimize both chemical and biological changes.
W82-02178

USE OF HORIZONTAL DRAINS: CASE HISTORIES FROM THE COLORADO DIVISION OF HIGHWAYS,

For primary bibliographic entry see Field 8A.
W82-02211

LONG TERM PERFORMANCE OF HORIZONTAL DRAINS,

For primary bibliographic entry see Field 8A.
W82-02212

MISSISSIPPI'S EXPERIENCE WITH HORIZONTALLY DRILLED DRAINS AND CONDUITS IN SOIL,

For primary bibliographic entry see Field 8A.
W82-02213

ROCKWOOD EMBANKMENT SLIDE BETWEEN STATIONS 2001+00 AND 2018+00: A HORIZONTAL DRAIN CASE HISTORY,

For primary bibliographic entry see Field 8A.
W82-02214

WATER RESOURCES PROTECTION MEASURES IN LAND DEVELOPMENT - A HANDBOOK - REVISED EDITION,

Delaware Univ., Newark. Water Resources Center.
For primary bibliographic entry see Field 4D.
W82-02453

IMPACT OF SUBURBAN RESIDENTIAL DEVELOPMENT ON WATER RESOURCES IN THE AREA OF WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY,

Geological Survey, Trenton, NJ. Water Resources Div.
T. V. Fusillo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-124850, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-27, 1981. 38 p, 16 Fig, 7 Tab, 19 Ref.

Descriptors: *Urbanization, *Groundwater, *Water quality, *Surface water, Geohydrology, Urban runoff, Rainfall, Storm runoff, Detention reservoirs, Wastewater treatment, Chemical analysis, Observation wells, Water level, Unit hydrographs, Artificial recharge, Water analysis, *New Jersey, *Camden County, Great Egg Harbor River.

Changes in land use as a result of large-scale residential development can have significant impact on water resources. Data on the quality and quantity of surface water and ground water in the vicinity of the Winslow Crossing residential development, in Winslow Township, New Jersey, were collected from 1972 to 1979. Pumpage for water supply from the Cohansey Sand averaged 0.48 million gallons per day during 1978 and had little effect on water levels in the aquifer. Water quality was variable in the observation wells sampled. High levels of dissolved solids, nitrate-nitrogen, and phosphorus were found in the shallow ground water surrounding the effluent infiltration ponds of a wastewater treatment plant. A treatment process change in 1974 reduced nitrate-nitrogen levels. The development of 14 percent of a 1.64-square-mile drainage area resulted in an increase in the peak discharge of a 60-minute unit hydrograph from approximately 150 cubic feet per second to 270 cubic feet per second. Installation of a stormwater retention basin reduced this peak discharge to 220 cubic feet per second. Streams draining two highly developed drainage areas had significantly higher levels of calcium, magnesium, bicarbonate, and pH than streams draining less developed areas. Winslow Crossing's development had only a slight effect on Great Egg Harbor River in comparison with sources of contamination upstream from the study area. (USGS)
W82-02461

STORMWATER QUALITY PROCESSES FOR THREE LAND-USE AREAS IN BROWARD COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-02469

HYDRAULIC ANALYSIS OF CHENANGO RIVER, BROOME COUNTY, NEW YORK, IN RELATION TO STATE HIGHWAY PLAN,

Geological Survey, Albany, NY. Water Resources Div.
B. Dunn.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $1.50, Microfiche $3.50. Geological Survey Open-File Report 81-1020, 1981. 10 p, 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Flood profiles, *Flood frequency, *Flood recurrence interval, *Bridge design, Hydraulic properties, Flood flow, Flood discharge, Flood forecasting, Planning, *New York, Broome County, Chenango River.

Hydraulic analyses of the 50- and 100-year floods in a 3.2 mile reach of the Chenango River in the towns of Fenton and Chenango in New York were made to determine the effects of two alternative bridge designs on flood levels. Neither design would cause more than a 0.1-foot increase in water level of the 50-year flood nor more than a 0.2-foot increase in water level of the 100-year flood above levels that would occur during these floods under present channel conditions. The discharges used in the analyses were 55,200 cubic feet per second for the 50-year flood and 63,000 cubic feet per second for the 100-year flood. Mean flow velocities and water-surface elevations at 17 cross sections are given for both bridge designs and are compared with those that would occur under present conditions. (USGS)
W82-02477

AQUATIC BIOLOGY OF THE REDWOOD CREEK AND MILL CREEK DRAINAGE BASINS, REDWOOD NATIONAL PARK, HUMBOLDT AND DEL NORTE COUNTIES, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
R. T. Iwatsubo, and R. C. Averett.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Price codes $15.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-143, May, 1981. 115 p, 10 Fig, 30 Tab, 72 Ref.

Descriptors: *Aquatic life, *Benthic fauna, *Biological properties, *Water sampling, *Pollutant identification, Coliforms, Streams, Sediments, Ecosystems, National parks, Water quality, Water analysis, Hydrologic data, Seston, Phytoplankton, Periphyton, *California, Redwood National Park, Del Norte County, Humboldt County, Redwood Creek, Mill Creek, Logging.

A 2-year study of the aquatic biota in the Redwood Creek and Mill Creek drainage basins of Redwood National Park indicated that the aquatic productivity is low. Densities of coliform bacteria were low except in Prairie Creek, a tributary to Redwood Creek, where a State park, county fish hatchery, grazing land, lumber mill, and scattered residential areas are potential sources of fecal coliform bacteria. Benthic invertebrate data indicated a diverse fauna which varied considerably between streams and among stream sections. Noteworthy findings include: (1) benthic invertebrates rapidly recolonized the streambed following a major storm, and (2) man-caused disruption or sedimentation of the streambed during low flow can result in drastic reductions of the benthic invertebrate community. Seven species of fish representing species typically found in northern California coastal streams were captured during the study. Nonparametric statistical tests indicate that condition factors of steelhead trout were significantly larger at sampling stations with more insolation, regardless of drainage basin land-use history. Periphyton and phytoplankton communities were diverse, variable

in numbers, and dominated by diatoms. Seston concentrations were extremely variable between stations and at each station sampled. The seston is influenced seasonally by aquatic productivity at each station and amount of allochthonous material from the terrestrial ecosystem. Time-series analysis of some seston data indicated larger and sharper peak concentrations being flushed from the logged drainage basin than from the control drainage basin. (USGS)
W82-024[illegible]4

THE USE OF GEOLOGIC, HYDROLOGIC, AND GEOCHEMICAL MAPPING TECHNIQUES IN ENVIRONMENTAL ASSESSMENT,
For primary bibliographic entry see Field 7C.
W82-02546

4D. Watershed Protection

SANTEE-COOPER REDIVERSION: PROJECTED IMPACTS ON FISHERY RESOURCES AND WILDLIFE HABITATS,
Fish and Wildlife Service, Cookierville, TN.
For primary bibliographic entry see Field 4A.
W82-02168

DERIVING SEDIMENT YIELD PROBABILITIES FOR EVALUATING CONSERVATION PRACTICES,
Science and Education Administration, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 2J.
W82-02225

EFFECT OF CORN AND SOYBEAN ROW SPACING ON PLANT CANOPY, EROSION, AND RUNOFF,
Science and Education Administration, Ames, IA.
For primary bibliographic entry see Field 2I.
W82-02264

WATER RESOURCES PROTECTION MEASURES IN LAND DEVELOPMENT - A HANDBOOK - REVISED EDITION,
Delaware Univ., Newark. Water Resources Center.
J. T. Tourbier, and R. Westmacott.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157967, Price codes: A10 in paper copy, A01 in microfiche. Office of Water Research and Technology Report OWRT TT/81 5, August, 1980. 196 p, 34 Fig. 14-34-0001-8707.

Descriptors: *Handbooks, *Watershed management, *Urbanization, Environmental protection, Land development, *Erosion control, Urban runoff.

This handbook contains descriptions of measures in urban development to prevent, reduce or ameliorate potential problems that would otherwise adversely affect water resources. These problems consist of runoff increases and decreases in infiltration and a greater degree of erosion and sedimentation, flooding, runoff pollution and discharge of sewage effluent. Issues have been analyzed individually in the Christina River Basin and, where possible, quantified. Measures are presented in groups and related directly to the problems listed above. Each group is preceded by a flow chart that relates measures and can aid in the selection of alternative techniques. Each measure is described, and site characteristics to which it is applicable identified. The application, advantages and disadvantages, design criteria and outline specifications, cost guidelines and maintenance, and legal implementation of each measure are individually covered. Illustrated case studies give examples of measures which have been constructed in the field.
W82-02453

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DEVELOPMENT OF IMMUNOENZYMATIC METHODS FOR DETECTION AND QUANTITATION OF POLIOVIRUS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
F. K. Pfaender, and G. K. Whitmyre.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153743, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, University of North Carolina, Raleigh, Report No 174, October, 1981. 66 p, 10 Fig, 6 Tab, 190 Ref. OWRT-A-084-NC(1), 14-34-0001-7070.

Descriptors: *Viruses, *Enteroviruses, Shellfish, *Assay, Monitoring, Wastewater, Wastewater treatment, Enteric viruses, Immunoenzymatic assay, Poliovirus, *Pollutant identification, Bacterial analyses, Water analysis, Sediments.

A major problem that must be faced in assessing the microbiological quality of a wide variety of water sources is the identification of human enteric viruses. Monitoring programs based on estimating bacteriological contamination of water are of questionable value in predicting virus concentrations. Routine monitoring of surface, drinking, and recreational waters for virus content is severely hampered by the absence of a reliable, specific, and simple procedure for quantification of the number of virus particles present. This research was directed toward development of a methodology useful for assessing entero-virus contamination. The method is based on an immunoenzymatic assay in which virus specific antibody, to which is bound other antibodies and enzymes, is reacted with the virus. The complex can subsequently be visualized by addition of enzyme reagents which produce a color change in the presence of virus particles. Two forms of this assay have been developed, one using a microscopic visualization of the colored particles and the other based on reactions in a test tube with total color produced being used to quantify virus. Both methods offer promise of being able to count virus particles in moderately contaminated waters. Further development offers the promise of greater sensitivity. (Kiger, NC)
W82-02176

ALGAL-BACTERIAL SYMBIOSIS IN THE CHOWAN RIVER, NC,
North Carolina Univ. at Chapel Hill.
K. K. Gallucci.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153669, Price codes: A04 in paper copy, A01 in microfiche. MS Thesis, 1981. 63 p, 19 Fig, 4 Tab. OWRT-B-127-NC(3), 14-34-0001-0274.

Descriptors: *Nitrogen fixing bacteria, *Aquatic bacteria, Nutrients, Blue-green algae, Nuisance algae, Nitrogen fixation, Cycling nutrients, *Radioactive techniques, Bacteria, *Cyanophyta, Amino acids, *Chowan River, North Carolina.

Bacteria from the Chowan River, NC, were counted and isolated during the summer of 1980 and the significant species in the bloom area was identified as Pseudomonas aeruginosa (Schroeter) Migula. When this organism was added to axenic cultures of the blue-green alga Anabaena flosaquae (Lyng.) Breb., the total amount of nitrogen fixed (as determined by acetylene reduction) by the alga was substantially greater than that fixed by axenic controls. A radio-active assay was used to determine the chemotactic response of Pseudomonas aeruginosa to several amino acids, the primary units of blue-green algal nitrogenous exudates. Chemotaxis was observed, to some degree, towards all of the amino acids tested, although the bacterium did not utilize all of them for growth. Thus, in the Chowan River, chemotaxis is the likely mechanism whereby this bacterium detects nutrient-rich microzones along the algal filaments. Other studies have demonstrated that bacteria recycle nutrients in the algal microenvironment and enhance algal nitrogen fixation. Algal-bacterial symbiosis, based on nutrient exchanges, may be a significant factor in the proliferation of blue-green algal nuisance blooms such as those which have appeared on the Chowan River.
W82-02177

DETERMINATION OF DISSOLVED ORGANIC CARBON IN WATER,
National Inst. for Water Research, Pretoria (South Africa).
R. A. van Steenderen, and J. S. Lin.
Analytical Chemistry, Vol 53, No 13, p 2157-2158, November, 1981. 3 Fig, 4 Ref.

Descriptors: *Carbon, *Organic carbon, *Water analysis, Pollutant identification, Dissolved organic carbon, Organic compounds.

A published method for determination of dissolved organic carbon in water by oxidation to CO2 using a silica coil, ultraviolet radiation, and potassium persulfate catalyst has been modified. Optimum effective oxidant conditions for ethylenediamine tetraacetic acid, potassium biphthalate, and valine in water were 0.25% potassium persulfate catalyst and a 3 mm i.d. silica tube 1.8 meters long coiled around a 150 W ultraviolet lamp. Residence time in the coil was 1.5 min. No improvement in oxidation efficiency was produced by increasing digestion temperature, length of silica coil, ultraviolet lamp intensity, or silver or mercury salts as catalysts. Use of excessive acid for removal of inorganic carbon prior to analysis reduced recovey of dissolved organic carbon. (Cassar-FRC)
W82-02194

CONTINUOUS-FLOW INJECTION ANALYSIS OF AQUEOUS ENVIRONMENTAL SAMPLES FOR CHEMICAL OXYGEN DEMAND,
Okayama Univ. (Japan). School of Engineering.
T. Korenaga, and H. Ikatsu.
Analyst, vol 106, No 1263, p 653-662, June, 1981. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Water analysis, *Chemical oxygen demand, *Wastewater, Oxygen demand, Monitoring, Industrial effluents, Municipal wastes, Domestic wastes, Continuous flow.

A method suitable for measuring chemical oxygen demand in various industrial wastewater samples down to levels of 5 micrograms/liter is presented and compared with results obtained using the Japanese Industrial Standard (JIS) method and conventional manual and automatic methods for the determination of organic pollutants. The method is based on flow injection analysis and uses acidic potassium permanganate solution as both an oxidant and a spectrophotometric reagent, and glucose as a standard. Chemical oxygen demand values for aqueous environmental samples, such as industrial wastewaters, are within an error range of plus or minus 30%. The method is comparable to other manual and automatic methods and has several advantages. A sampling rate of 20 samples per hour can be achieved, and the precision is 0.6%. Chloride ion up to levels of 6000 mg/liter does not interfere, even in the absence of silver salts. The major advantages include the following: the volume of sample used is only 20 microliters, the redox reaction can occur smoothly as the temperature of the reaction manifold can easily be controlled at 100 degrees C, an inexpensive and readily available spectrophotometer can be used for detection of the redox reaction products so that maintenance of apparatus is easily achieved, and the sampling of 20 samples/hr based on the principle of continuous flow injection analysis allows rapid analyses to take place. (Baker-FRC)
W82-02203

DISSOLVED HUMIC SUBSTANCES: A MAJOR SOURCE OF ERROR IN FLUOROMETRIC ANALYSES INVOLVING LAKE WATERS,
Kent State Univ., OH. Dept. of Biological Sciences.
R. E. Carlson, and J. Shapiro.

Limnology and Oceanography, Vol 26, No 4, p 785-790, July, 1981. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Fluorescence, *Humic acids, *Chlorophyll, Pollutant identification, Organic matter, *Lakes, Errors, Algae, Color.

Dissolved humic substances in fresh waters may be an important source of error in fluorometric analyses such as the in vivo measurement of chlorophyll (Lorenzen, 1966). Fluorescence measurements were taken in lake water samples passed through millipore filters. These tests determined that soluble fluorescence was not a result of: (1) the filter, (2) algal cell breakage, or (3) passage of small particles of chlorophyll through the filter. Water from three lakes, high in dissolved color and low in chlorophyll, had errors of 1.05 to 1.77 per unit of fluorescence. In one case, fluorescence estimated 59 mg per liter chlorophyll where only 5.6 mg per liter was present. A second peak at 730 nm was found in a spectrofluorometric scan of a dried sphagnum peat filtered extract. This peak is probably responsible for the soluble fluorescence found with the in vivo chlorophyll technique. Humic extracts from lake water also fluoresced strongly, the soluble fluorescence decreasing at lower pH. The method may be corrected by subtracting soluble fluorescence from total fluorescence before calculating in vivo chlorophyll or possibly by using an appropriate narrow-spectrum secondary filter. (Cassar-FRC)
W82-02223

COMPOSITE SAMPLING OF HIGHWAY RUNOFF,

Brown and Caldwell, Seattle, WA.
For primary bibliographic entry see Field 7B.
W82-02230

PCBS IN THE HOUSATONIC RIVER: DETERMINATION AND DISTRIBUTION,

Connecticut Agricultural Experiment Station, New Haven.
B. L. Sawhney, C. R. Frink, and W. Glowa.
Journal of Environmental Quality, Vol 10, No 4, p 444-448, October/December, 1981. 3 Fig, 1 Tab, 27 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Sorption, Fate of pollutants, Pollutant identification, *Housatonic River, Lake Lillinonah, *Connecticut, Chlorinated hydrocarbons, Humic acid, Organic matter, Clays, Aroclors, River beds, Bottom sediments, Organic compounds.

Individual polychlorinated biphenyls (PCBs) were estimated in samples of sediments from the Housatonic River using multiple linear regression of peak heights (or areas) from gas chromatograms. Proportions of Aroclors 1248, 1254, and 1260 were 1.0:0.6:1.9. Analysis of sediments in a 20 km section of the river forming Lake Lillinonah showed high correlation between PCB concentrations and clay and organic matter, suggesting that the primary means of PCB retention and transport is fine particles consisting of clay-organic matter complexes. Concentrations of PCBs in different fractions of one sediment sample were: fine clay size (< 0.2 microns), 9.7 ppm; coarse clay (0.2-2 microns), 4.6 ppm; and silt (2-50 microns), 0.5 ppm. Laboratory sorption experiments with different materials indicated that humic acid adsorbed the most PCBs, followed by river sediment, river sediment with organic matter removed, and clays. Of the clays, illite sorbed the most PCB, kaolinite the least, with vermiculite and montmorillonite, intermediate. (Cassar-FRC)
W82-02255

SEASONAL AND DIURNAL FLUCTUATIONS OF OOMYCETE PROAGULE NUMBERS IN THE FREE WATER OF A FRESHWATER LAKE,

Reading Univ. (England). Plant Science Lab.
For primary bibliographic entry see Field 2H.
W82-02274

PRECONCENTRATION OF PHENYLMERCURY, METHYLMERCURY AND INORGANIC MERCURY FROM NATURAL WATERS WITH DIETHYLAMMONIUM DIETHYLDITHIOCARBAMATE-LOADED POLYURETHANE FOAM,

Eotovs Lorand Univ., Budapest (Hungary). Inst. of Inorganic and Analytical Chemistry.
T. Braun, M. N. Abbas, L. Bakos, and A. Elek.
Analytica Chimica Acta, Vol 131, p 311-314, 1981. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Mercury, *Natural waters, Water analysis, Chemical analysis, Polyurethane foam, Methylmercury, Phenylmercury.

Stable dithiocarbamate-loaded polyurethane foam is easily prepared and allows a very fast extraction of inorganic mercury and organomercurials even from high volumes of solution. These loaded foams are suggested as a universally available preconcentrating sorbent for inorganic mercury (II) ions and also for methyl- and phenyl-mercurials. The diethyldithiocarbamate-loaded foam was prepared by soaking the foam in the appropriate amount of reagent solution to yield a concentration of 30% on the foam. Sulfuric acid or sodium hydroxide was used to adjust the pH to the required values. The sampl solution was percolated through the DDC-foam column at a flow rate of 50 ml/min. Mercury (II) ions were extracted over a wide pH range; the extraction was almost quantitative, even at very low pH values. Due to the very low concentration of mercury in natural waters, preconcentration from sample volumes of 10 liters or more is usually needed. The extraction rate of organomercurials was slower than that of inorganic mercury. Mercury was quite firmly held on the DDC-foam. Less than 0.3% of the total amount retained on the foam was washed out by percolation of 1 liter of water through the column. Inorganic mercury, the organomercurials and the reagent itself were completely eluted from the foam with 100 ml of acetone. (Baker-FRC)
W82-02297

DETERMINATION OF 2,4-DICHLOROPHENOXYACETIC ACID AND SILVEX IN WATER WITH HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,

Calgon Corp., Pittsburgh, PA.
C. W. Vaughan.
Analytica Chimica Acta, Vol 131, p 307-310, 1981. 2 Tab, 6 Ref.

Descriptors: *Chemical analysis, *Water, Organic compounds, Herbicides, Pesticides, *Drinking water, Chromatography, Measuring instruments, Silvex, 2-4-D, *Pollutant identification.

A method is proposed for the determination of 2,4-D and silvex in drinking water supplies at the microgram/liter level. The method is based on liquid/liquid extraction and high performance liquid chromatography. Sample preparation for water samples is simplified. The ranges of linear response are 50 - 60 nanograms to 60 micrograms for 2,4-D and 30 nanograms to 60 micrograms for silvex. The average recoveries of 2,4-D at the 10 microgram/liter and 1 microgram/liter levels are 91 and 120%, respectively. The average recoveries of silvex at the 10 microgram/liter and 1 microgram/liter levels are 85 and 110%, respectively. This method obviates the need for three steps: filtration of the sample extract through acidified sodium sulfate, esterification of the herbicide acids, and clean-up of the esterified sample extract with a micro-Florisil column. These steps are major contributors to the poor precision of the gas chromatography based method. (Baker-FRC)
W82-02298

DETERMINING MAXIMUM INFLUENT CONCENTRATIONS OF PRIORITY POLLUTANTS FOR TREATMENT PLANTS,

Enviroscience Inc., Minneapolis, MN.
R. M. Anthony, and L. H. Breimburst.
Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1457-1468, October, 1981. 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Water treatment, *Water quality standards, *Wastewater analysis, *Physicochemical treatment, Sludge disposal, Pollutants, *Pollutant identification, Sludge digestion, Nitrification, Water analysis, Sludge drying, Influent streams, Wastewater treatment, Industrial wastes, Mathematical studies.

A general analytical method used to arrive at maximum influent priority pollutant levels for water treatment plants is described. The priority pollutants present in the collection system should be determined, and available information on industrial processes, industrial waste water analyses, and waste water treatment plant and sludge analyses should be obtained. Limiting concentrations should be studied with respect to inhibition of wastewater and sludge treatment processes, effluent standards and sludge disposal. These concentrations may be determined from past plant data, from data from similar plants, and from state and federal requirements. Analytical methods are given for secondary treatment with sludge digestion and disposal, secondary treatment with nitrification, effluent filtration, sludge digestion and disposal, and physical-chemical treatment with sludge dewatering and disposal. Procedures are outlined for determining the limiting influent concentrations of priority pollutants. Maximum influent priority pollutant concentrations for the facility are recommended based on these limiting influent concentrations. (Geiger-FRC)
W82-02307

EVALUATION OF AUTOMATIC SUSPENDED SOLIDS SAMPLING PROCEDURES,

Tennessee Univ., Knoxville.
G. D. Reed.
Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1481-1491, October, 1981. 8 Fig, 1 Tab, 9 Ref.

Descriptors: *Suspended solids, *Water sampling, *Wastewater, Wastewater treatment, Sampling, Stokes law, Streamflow, Particle size, Synthetic hydrology, Municipal wastewater, Flow velocity, Sedimentation.

A synthetic waste water solid was devised to test the validity of a suspended solids sampling technique to decide on a representative point for the collection of samples from a wastewater stream. Results showed that as the particle sizes of the solids increased, their rate of recovery at smaller depths decreased within a sampling stream. Since the particle distribution was a function of settling and stream flow velocity, a nearly direct relationship resulted between the recovery of non-filterable solids (NFS) and flow velocities. The inlet to a waste treatment system is not always the best site for collecting a representative sample for solids in a raw wastewater. The hydraulic jump site, which provides a high degree of mixing by natural causes, produced NFS values that were 26% too low. A good sampling point must feature thorough mixing, or else data must be calibrated to reflect true parameter magnitudes. Further investigations are suggested to discover sampling techniques which would be applicable to various type of wastewaters. (Geiger-FRC)
W82-02316

POSITIVELY CHARGED FILTERS FOR VIRUS RECOVERY FROM WASTEWATER TREATMENT PLANT EFFLUENTS,

Wisconsin Univ.-Madison. Dept. of Veterinary Science.
L. T. Chang, S. R. Farrah, and G. Bitton.
Applied and Environmental Microbiology, Vol 42, No 5, p 921-924, November, 1981. 2 Tab, 20 Ref.

Descriptors: *Virus, *Membrane filters, *Wastewater analysis, Pollutant identification, Effluents, Coxsackie virus, Poliovirus, Micro-organisms, Filters.

Enteroviruses from activated sludge effluent were collected on positively charged Zeta Plus membrane filters and eluted with a solution of 4 M urea buffered at pH 9 with 0.05 M lysine. No salt or acid addition was necessary to enhance virus adsorption onto the filters. 40-56% of the poliovirus Type 1 (LSc) and coxsackievirus B3 added to 19

liters of effluent were recovered and concentrated to final volumes of 1 or 2 ml using flocculation. The economical, efficient, simple method was used on seven effluent samples from two sewage treatment plants. Three types of poliovirus and one coxsackievirus were identified. One sample contained no detectable virus. (Cassar-FRC)
W82-02338

A-1 MEDIUM: ALTERNATIVE TECHNIQUE FOR FECAL COLIFORM ORGANISM ENUMERATION IN CHLORINATED WASTEWATERS,

Wisconsin Univ.-Madison. Lab. of Hygiene.
J. H. Standridge, and J. J. Delfino.
Applied and Environmental Microbiology, Vol 42, No 5, p 918-920, November, 1981. 3 Tab, 8 Ref.

Descriptors: *Most Probable Number tests, *Coliforms, *Wastewater analysis, Pollutant identification, *Bacterial analysis, Microbiological studies, Culture media, Incubation, Chlorination.

The 24-hour Most Probable Number technique, using 3 hours pre-incubation at 35 C and A-1 medium for detecting fecal coliforms in chlorinated wastewater, gave results statistically equivalent to those obtained with the longer two-step Most Probable Number technique described in Standard Methods for the Examination of Water and Wastewater. Tests with a 2-hour preincubation at room temperature (22 C) produced fewer positive tubes (53) than the standard method (62) and the 3 hour, 35 C method (60). (Cassar-FRC)
W82-02339

A CLOSE-INTERVAL SAMPLER FOR COLLECTION OF SEDIMENT PORE WATERS FOR NUTRIENT ANALYSES,

Harbor Branch Foundation, Inc., Ft. Pierce, FL.
J. R. Montgomery, M. T. Price, J. Holt, and C. Zimmermann.
Estuaries, Vol 4, No 1, p 75-77, March, 1981. 2 Fig, 7 Ref.

Descriptors: *Sedimentation, *Sampling, Measuring instruments, Bottom sampling, Acidity, *Pore water, Sulfates, Sulfides, Ammonia, Nutrients, Trace metals, Organic matter, Salinity, Dissolved oxygen, Interstitial water, *Pollutant identification.

This paper describes a single, in situ sampler which simultaneously samples four 1 cm sampling surfaces at 2 cm intervals. This sampler requires minimal sample manipulation, minimizes sediment disturbance, maintains an anaerobic sample environment, and can be used over extended periods of time to sample at one location. The sampler is composed of a tube with a nose cone which facilitates insertion into the sediment. The tube is separated into a layered filter section, a tubular extension to facilitate handling, and a top section which provides the needed connections to the internal sample chambers. Laboratory tests indicate 98 to 100% recoveries for ammonium, silicate, reactive phosphate, nitrate and nitrite. Vertical profiles for ammonium, reactive phosphate and silicate are shown from field studies. Potential applications include analysis of pore waters for trace metals, dissolved organic carbon, sulfides, sulfates, salinity, Eh, dissolved oxygen, and pH. (Baker-FRC)
W82-02346

ENUMERATION OF HETEROTROPHIC BACTERIA IN RIVER WATERS BY USING A LOW NUTRIENT MEDIUM (IN JAPANESE),

Osaka City Inst. of Public Health and Environmental Sciences (Japan).
T. Yoshikura, K. Oda, and S. Iida.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 47, No 2, p 183-189, February, 1981. 6 Fig, 1 Tab, 12 Ref. (English summary).

Descriptors: *Bacteria, *Rivers, Eutrophication, *Nutrients, Culture media, Agars, Microbial analysis, Seasonal variation.

Agar media containing different concentrations of organic nutrients were used to enumerate heterotrophic bacteria in river waters of various degrees of eutrophication. Low nutrient agar medium (0.5 g polypeptone, 0.25 g yeast extract, 0.1 g glucose, and 15 g agar in 1,000 ml distilled water) revealed higher counts of bacteria in any station at any season than did the high nutrient media. This suggests that for recovering heterotrophic bacteria inhabiting river waters the low nutrient medium is superior. Bacteria isolated from less polluted waters were more sensitive to high nutrient concentrations than those from highly polluted waters. This was determined in experiments on the growth response of bacteria to the concentration of organic nutrients. It appeared that the incubation temperature for counting must be selected in accordance with water temperature in the river as the higher counts of bacteria in river waters were obtained at about 35 degrees C in the summer and at about 20 degrees C in the winter. (Baker-FRC)
W82-02352

THE SPECTROPHOTOMETRIC DETERMINATION OF ANTIMONY IN WATER, EFFLUENTS, MARINE PLANTS AND SILICATES,

Liverpool Univ. (England). Dept. of Oceanography.
A. H. Abu-Hilal, and J. P. Riley.
Analytica Chimica Acta, Vol 131, p 175-186, 1981. 3 Fig, 7 Tab, 43 Ref.

Descriptors: *Chemical analysis, *Antimony, Water analysis, Sea water, Effluents, Silicates, Spectrophotometry.

A procedure is developed which concentrates antimony by precipitation with hydrous zirconium oxide prior to solvent extraction and spectrophotometry. The technique has also been applied to the determination of traces of antimony in digesters from marine algae and silicates. After a preliminary oxidative digestion for waters, or acid attack for algae and silicates, the element is quantitatively coprecipitated at pH 5.90 with hydrous zirconium oxide. The precipitate is dissolved in acid and reduced with titanium(III) chloride. Subsequently the antimony is oxidized to antimony (V) with sodium nitrite. The ion pair of the antimony chloride ion with crystal violet is extracted with benzene, and its absorbance is measured at 610 nm. Extraction with toluene causes some loss of sensitivity. The detection limit is 0.005 micrograms/liter. Relative standard deviations are 0.5% and 1.1% for spiked distilled water and sea water, respectively. A wide range of anions and cations caused no interference at levels many times those in natural waters. The technique can be adapted for application to marine algae and silicates. Relative standard deviations were 1.8% and 2% for samples of Pelvetia canaliculata and a Pacific Ocean red clay, respectively. Results for the US Geological Survey Standard rocks GSP1 (2.7 ppm) and DTS1 (0.53 ppm) are in good agreement with those of earlier workers. (Baker-FRC)
W82-02355

DETECTION OF CHLOROFORM IN THE TISSUES OF FRESHLY EVISCERATED POULTRY CARCASSES EXPOSED TO WATER CONTAINING ADDED CHLORINE OR CHLORINE DIOXIDE,

Agricultural Research Council, Norwich (England). Food Research Inst.
D. Robinson, G. C. Mead, and K. A. Barnes.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 2, p 145-150, 1981. 2 Tab, 10 Ref.

Descriptors: *Chlorination, *Chloroform, *Poultry, Food processing industry, Foods, *Bioassay, Sodium hypochorite, Chlorine dioxide, Chlorine, Industrial water, Water treatment.

The effects of super-chlorinated process water on poultry carcasses were investigated. Concentrations of 5-20 mg/liter free available chlorine may be used for in-plant chlorination of the water of immersion chilling systems. Chlorine is added, usually in the form of sodium hypochlorite, to significantly reduce the bacterial load of the chill-water and to extend the shelf-life of the chill-stored carcasses. Chlorine dioxide was also investigated; it may be used more in the future, as it reduces the formation of trihalomethanes. Twenty-eight chickens were used in the study: five were controls, and batches of three received varying treatments. Birds treated with chlorinated water were tested after cooking for chloroform formation and persistence of chlorine at the point of consumption. The highest concentrations of chlorine occurred in birds immersed in water containing 50 mg/liter of chlorine, especially those held at 15-16 deg C. (Small-FRC)
W82-02374

MODEL EXPERIMENTS ON THE GROWTH OF ENTERIC BACTERIA IN FRESH AND SEA WATER,

Toyama Univ. (Japan).
T. Yanagita, and M. Takagi.
Journal of General and Applied Microbiology, Vol 26, No 4, p 299-305, August, 1980. 4 Fig, 6 Ref.

Descriptors: *Bacteria, *Sea water, *Aquatic environments, *Enteric bacteria, *Experimental design, Oligotrophic lakes, Escherichia coli, Nutrients, Laboratory equipment, Dilution, Salinity, Rivers, Marine bacteria.

The growth of some enteric bacteria with and without added sodium chloride at the concentration of sea water was measured. An apparatus capable of making exponential changes in nutrient and salt concentrations was employed. Growing cultures of E. coli were subjected to nutrient dilutions and to salt solutions over a three week period. Cell densities came to be maintained at a steady-state level preceded by a transitional process related to the changes in environment. This suggests that E. coli cells are able to grow under extreme conditions, though at a restricted rate. (Titus-FRC)
W82-02377

DETERMINATION OF AMMONIA IN ESTUARY,

Tokai Regional Fisheries Research Lab., Tokyo (Japan). Div. of Oceanography.
K. Sasaki, and Y. Sawada.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 46, No 3, p 319-321, March, 1980. 6 Fig, 2 Tab, 2 Ref.

Descriptors: *Ammonia, *Estuaries, *Colorimetry, Color, Salts, Detection times, Temperature effects, Seawater, Salinity.

The development of a blue color with indophenol was investigated as a method for the determination of ammonia in estuaries. The effects of temperature and salt concentration on the color development were examined. Reaction temperature influenced the time required for the completion of the color development and the absorbance upon completion. Salt concentration also affected color development and absorbance. Color development at 40 deg C was complete even in seawater and the differences in absorbance was small. In contrast, the salt error was 60 in freshwater and 73 in seawater when the temperature was 20 deg C. The reasons for the effects of temperature and salt concentration are not known. (Small-FRC)
W82-02390

NEW SUPPLEMENTARY DPD PROCEDURES USING SODIUM NITRITE FOR (A) BROMINE-BROMAMINE SEPARATION AND (B) CORRECTION OF CHLORINE DIOXIDE READINGS FOR ANY BROMINE DERIVED FROM NATURAL BROMIDE IN WATERS,

Newcastle and Gateshead Water Co. (England).
A. T. Palin.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 383-385, July, 1980. 1 Tab, 4 Ref.

Descriptors: *Bromine, *Bromamines, *Colorimetry, Disinfection, Trace elements, Nitrite, Chemical reactions, Chlorine, Dilution, Laboratory equipment, Water sampling, Chemical analysis, Residual chlorine, Reagents.

A separate determination of bromine and bromamines may be accomplished by the use of sodium nitrite as a supplementary reagent. Free chlorine, chlorine dioxide, bromine, and bromamines all respond in the first step of the DPD method for determining residual disinfectants in water. With the use of sodium nitrite, the chlorine dioxide readings may also be corrected for any associated traces of free or combined bromine. Following the first step of the normal DPD procedure, addition of sodium nitrite at 50 mg NaNo2/100 ml sample destroyed free bromine without alteration of bromamine readings. However, the presence of nitrite led to fading of the developed colors at the rate of about 4%/min at 20 C. (Titus-FRC)
W82-02394

CADMIUM, COPPER, LEAD, ZINC AND MANGANESE IN THE POLYCHAETE ARENICOLA MARINA FROM SEDIMENTS AROUND THE COAST OF WALES,

University Coll. of Wales, Aberystwyth. Dept. of Zoology.
D. M. Packer, M. P. Ireland, and R. J. Wootton.
Environmental Pollution (Series A), Vol 22, No 4, p 309-321, August, 1980. 6 Fig, 2 Tab, 38 Ref.

Descriptors: *Heavy metals, *Polychaetes, *Absorption, Marine animals, Sediments, Coastal waters, *Pollutant identification, Metals, Mine wastes, *Wales, Bristol Channel, Liverpool Bay, Cardigan Bay, Arenicola marina, Cadmium, Zinc, Copper, Lead, Manganese, Estuarine environment.

Metal concentrations in the marine polychaete Arenicola marina and the sediments it inhabits were studied at 24 sites along the coast of Wales, Liverpool Bay (polluted from domestic and industrial outfalls), Cardigan Bay (industry-free, but receiving runoff from former mining operations), and Bristol Channel (domestic and industrial sewage plus minerals from mining wastes). Eight of the sites were estuarine in nature; six of these were located along the Bristol Channel. Highest concentrations (in ppm) in A. marina found were in the upper region of Bristol Channel as follows: Cd, 32; Pb, 90; Zn, 430; and Mn, 320. Highest Cu levels were 40 ppm at Dullas Bay in the north. Mean body weight and mean concentration of individual metals in A. marina were negatively correlated. A positive correlation was seen between concentration of metals in A. marina and sediment for Zn and Cd. Mn was far less concentrated in tissues than in the sediment, Pb was similar in both, Cu and Zn were 2 to 3 times more concentrated, and Cd 11 more times concentrated. (Cassar-FRC)
W82-02416

GROUNDWATER QUALITY IN THE SEVERN-TRENT REGION,

Severn-Trent Water Authority, Birmingham (England). Directorate of Scientific Services.
J. L. Lucas, and R. I. G. Simm.
Water Pollution Control, Vol 80, No 3, p 317-332, 1981. 5 Fig, 1 Tab, 27 Ref.

Descriptors: *Groundwater, *Water quality, *Monitoring, Chlorides, Nitrogen, Sulfates, Acidity, Calcium, Magnesium, Sodium, Potassium, Groundwater pollution, Boreholes, Wells, Aquifers, *United Kingdom, Severn-Trent Water Authority.

The Severn-Trent Water Authority's program for monitoring the quality of groundwater is reviewed. The aquifer protection policy is based on the identification of groundwater resource vulnerability in terms of hydrogeology and the classification of practices likely to be unacceptable within each resource risk area. A Groundwater Chemistry Network was established to provide baseline data essential to the understanding of the mechanisms and processes controlling groundwater quality and the establishment of long term trends, to provide a reference against which possible sources of pollution may be revealed, to facilitate full and proper exploitation of groundwater reserves, and to provide data for existing and potential abstractors. Samples from selected sites are taken quarterly and analyzed for temperature, pH, ammonium N, total oxidized nitrogen, chloride, sulfate, alkalinity, total hardness, calcium, magnesium, sodium, potassium, and electrical conductivity. Total organic carbon, fluoride, orthophosphate, and total iron, manganese, cadmium, chromium, copper, lead, nickel, zinc and barium are analyzed annually. The site selections are made in such a manner that they are not immediately adjacent to any obvious potential source of pollution, that the groundwater sample pumped shall be representative of water from a significant volume of the aquifer and not be influenced by chemical changes due to standing for long periods, and that the sample shall be from a borehole or deep well so that as great a thickness of the aquifer as possible is sampled. (Baker-FRC)
W82-02423

DISTRIBUTION ON VIABLE MARINE BACTERIA IN NERITIC SEAWATER AROUND JAPAN,

Tokyo Univ. (Japan). Ocean Research Inst.
K. Kogure, U. Simidu, and N. Taga.
Canadian Journal of Microbiology, Vol 26, No 3, p 318-323, 1980. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Water analysis, *Bacteria, *Bacterial analysis, Measuring instruments, Eutrophication, Temperature effects, Stratification, Sea water, Marine bacteria, Marine plants, Marine biology, Marine environment, *Tokyo Bay.

A new direct viable count (DVC) method has been reported which is aimed at counting the living bacterial cells using a relatively simple procedure for routine work in neritic seawater. This method was applied to various marine samples from environments with different degrees of eutrophication. The temperature and salinity profiles in Tokyo Bay show typical stratification during the summer season. At several stations the particulate organic carbon exceeded the dissolved organic carbon, indicating the continuous input of large amounts of particulate matter from the rivers or abundant growth of various organisms in the seawater. High nutrient concentrations resulted in dense, flourishing phytoplankton populations throughout most of the year in the bay. Almost complete vertical mixing of the water column at one station was due to the proximity of a typhoon just before the day of sampling. The distribution of bacteria reflects the extent of eutrophication in the bay. A gradual decrease in bacterial numbers was noted toward the outer part of the bay. In offshore waters the majority of DVC cells were free-living, and it was very rare to find particles which were heavily colonized with bacterial cells. In Tokyo Bay, however, such particles were often found at several sample stations. They appeared to be freshly produced detrital particles and usually contained degrading algal cells or fibrous structures. These findings suggest that the DVC technique may be used for various aquatic environments as a relatively simple counting technique for living bacteria. (Baker-FRC)
W82-02427

DISTRIBUTION OF RIBONUCLEIC ACID COLIPHAGES IN RAW SEWAGE FROM TREATMENT PLANTS IN JAPAN,

Keio Univ., Tokyo (Japan). Dept. of Molecular Biology.
K. Furuse, A. Ando, S. Osawa, and I. Watanabe.
Applied and Environmental Microbiology, Vol 41, No 5, p 1139-1143, May, 1981. 2 Tab, 11 Ref.

Descriptors: *Wastewater, *Viruses, *Japan, Coliforms, Wastewater composition, Wastewater analysis, *Coliphages, Ribonucleic acid, Feces, Water pollution sources, Microbiological studies, Raw wastewater.

Raw sewage samples were collected from wastewater treatment plants in 16 Japanese cities and analyzed for content of Groups I-IV RNA coliphages. The raw sewage contained human wastes, slaughterhouse wastes, municipal wastewater, and industrial wastewater. Two-milliliter sewage samples were mixed with an equal volume of peptone-glucose medium. Bacteria were killed with chloroform, and the samples were centrifuged. The supernatants were plated onto E. coli strains. The resultant plaques were collected for use as phage stocks and grouped by the serological method. Total coliphage densities were fairly high, ranging from 10 to 1,000,000 plaque-forming units per ml of original phage samples. Group III phages predominated over group II phages. Appreciable amounts of group I phages were also present, suggesting the presence of animal feces in the samples. Reported RNA phage distribution patterns in raw sewage collected from Mexico, Saudi Arabia, Australia, the United States, Brazil, the Philippines, and West Germany followed patterns similar to those for Japan, indicating an absence of special phage-host relationships between RNA phage groups and human races. A complete transmission cycle of group I phages in animals appeared to be present. A similar cycle is possible for the groups II and III phages, but the frequencies of isolation of these phages in human feces appeared to be low. (Carroll-FRC)
W82-02443

ENCHYTRAEID OLIGOCHAETES AS MARINE POLLUTION INDICATORS,

Victoria Univ. (British Columbia). Dept. of Biology.
K. Coates, and D. V. Ellis.
Marine Pollution Bulletin, Vol 11, No 6, p 171-174, June, 1980. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Indicators, *Oligochaetes, *Pollutants, Bioindicators, Marine environment, Industrial wastewater, *Pulp wastes, Feasibility studies, Water pollution effects, Distribution patterns, Estuarine environment.

The possibility of using enchytraeid oligochaetes as indicators of pulp mill pollution in the littoral zone has been investigated as part of a project at the Port Alice (Vancouver Island) pulp mill designed to develop measures for monitoring ecosystem recovery following the application of pollution control procedures. Analyses of sediment core samples from several locations within a pulp mill waste receiving area, including the Cayuse and Cayeghle estuaries, resulted in the identification of 15 species of enchytraeid oligochaetes. One of these, Lumbricillus lineatus, which is a known stress-resistant intertidal form not normally found along the coasts of British Columbia, was found to be predominant within 1.5 kilometers of the pulp mill outfall. Beyond that distance, a variable association of 14 other species from the genera Lumbricillus, Marionina, and Enchytraeus was dominant. L. lineatus has only been collected adjacent to three pulp mills in British Columbia. It was not collected at five other pulp mills or at ten undisturbed intertidal stations where other diverse associations of Enchytraeid species were found. L. lineatus has apparently been introduced to these sites in the Pacific Northwest by international ship traffic. The spatial distribution of L. lineatus close to the mill was found to correspond with oxygen levels reduced well below saturation and with visible but fluctuating levels of mill effluent, indicating that the species has the potential to index the area showing substantial impact of the dicharges on the coastal environment. The most practical index is the percentage of total adult enchytraeids, represented L. lineatus. (Carroll-FRC)
W82-02445

BIOASSAYS OF WATERS FROM THE SEVERN AND THAMES RIVER SYSTEMS,

Northwest Water Authority (England).
A. Collie, and J. W. G. Lund.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 2, p 180-188, March, 1980. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Rivers, *Bioassay, *Bioindicators, *Plankton, Hydrological data, Growth rates, Assay, Algae, Nutrients, Water treatment, Growth kinetics, Aquatic environment, Aquatic organisms, Dilution, Mixing, Flow, Water sampling, *Thames River, *Severn River, England.

A diatom and a green alga were used as test organisms to assess the potential fertility of water from parts of the Severn and Thames Rivers in England. Water samples were taken monthly at a

constant depth and results for the two rivers were compared. Growth rates in the Severn were significantly lower than in the Thames. However, both waters were highly fertile. Results suggest that limitations of algal numbers are due to physical and biological factors rather than chemical ones. A transfer of water from the Severn to the Thames would not significantly alter the algal regime. (Titus-FRC)
W82-02448

WATER-QUALITY RECONNAISSANCE OF THE LARKIN CREEK WATERSHED, LEE AND ST. FRANCIS COUNTIES, ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
J. C. Petersen.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Prices: $3.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-819, 1981. 20 p, 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Water quality, *Surface water, *Streams, *Pollutant identification, *Data collections, Streamflow, Water measurement, Water sampling, Bottom sampling, Bottom sediments, Dissolved solids, Bacteria, Nutrients, Metals, Pesticides, Water analysis, *Arkansas, Lee County, St. Francis County, Larkin Creek watershed.

A reconnaissance of the Larkin Creek watershed in Arkansas was made during April through September 1980 to assess the water quality of streams in the watershed. Streamflow was measured and water samples were collected three times during the study period. Samples of bottom material were collected in September. Concentrations of dissolved solids ranged from 45 to 391 milligrams per liter. Water hardness ranged from 31 milligrams per liter (soft) to 280 milligrams per liter (very hard). Fecal-coliform bacteria densities ranged from 40 to an estimated 540 colonies per 100 milliliters and may have exceeded the U.S. Environmental Protection Agency criterion for bathing waters. Total nitrogen concentrations ranged from 0.90 to 2.2 milligrams per liter. Total phosphorus concentrations often exceeded the State standard and ranged from 0.08 to 0.46 milligrams per liter. Low dissolved-oxygen concentrations (2.5 to 5.4 milligrams per liter at midday) were measured in Larkin Creek and a major tributary. Iron (290 to 9,800 micrograms per liter), manganese (60 to 3,100 micrograms per liter), and mercury (0.0 to 0.2 micrograms per liter) concentrations at times exceeded Environmental Protection Agency criteria for domestic use or freshwater aquatic life. High concentrations of toxaphene (20 to 170 micrograms per kilogram dry weight) were present in all bottom-material samples. In two water samples, concentrations of dieldrin (0.01 micrograms per liter) exceeded the Environmental Protection Agency criterion for freshwater aquatic life. Polychlorinated biphenyls, several insecticides, and several herbicides (including 2, 4, 5-T) were present in water or bottom-material samples. (USGS)
W82-02489

COMPARISON OF GROUNDWATER AND SURFACE WATER FOR PATTERNS AND LEVELS OF CONTAMINATION BY TOXIC SUBSTANCES,

Wisconsin Univ.-Milwaukee. Dept. of Urban Planning.
G. W. Page.
Environmental Science and Technology, Vol 15, No 12, p 1475-1481, December, 1981. 1 Fig, 7 Tab, 30 Ref.

Descriptors: *Groundwater pollution, *Chemical wastes, *Surface-groundwater relations, *Toxins, Chlorinated hydrocarbons, Organic compounds, Pesticides, Insecticides, Heavy metals, Metals, Carcinogens, New Jersey, Surface water, Fate of pollutants, Pollutant identification, Water pollution, Drinking water, Wells.

Groundwater is as contaminated with toxic substances as surface water throughout New Jersey. This conclusion is contrary to most of the scientific literature, which indicates that surface waters are more polluted than groundwater, except in isolated cases. Water samples from 1000 wells and 600 surface water sites in areas representing all counties and all types of land use were analyzed for 56 toxic substances: 27 light chlorinated hydrocarbons, 20 heavy chlorinated hydrocarbons, and 9 heavy metals. Comparisons of maximum concentrations show that for 64% of the toxic substances the highest concentration is in groundwater and for 36% the highest concentration is in surface water. The probability of detection was greater in surface water for 54% of the toxics. For 44% there was no significant difference, and for 2% the probability of detection was greater in groundwater. Comparing only those samples with detectable concentrations of the toxic material being tested, 78% of the toxic materials have an average concentration at least as great in groundwater as in surface water. (Cassar-FRC)
W82-02541

CERIOMETRY, A COMBINED METHOD FOR CHEMICAL OXYGEN DEMAND AND DISSOLVED OXYGEN (WITH A DISCUSSION ON THE PRECISION OF THE WINKLER TECHNIQUE),

Station Biologique de la Tour du Valat, Arles (France).
H. L. Golterman, and A. G. Wisselo.
Hydrobiologia, Vol 77, No 1, p 37-42, 1981. 5 Tab, 11 Ref.

Descriptors: *Dissolved oxygen, *Chemical oxygen demand, *Cerium compounds, Winkler method, Pollutant identification, Colorimetry, Oxygen.

A rapid colorimetric method for determination of dissolved oxygen and COD uses Ce(3+) salts and Ce(4+) salts, respectively. This is an improvement over the Winkler method for dissolved oxygen determination, which does not distinguish between oxygen and COD. the interfering organic matter may be treated with Ce(4+) at low or high temperatures, depending on the oxidizability of the substances. The method was tested on oxygen saturated solutions high in COD, using oxalic acid, glycine, polluted lake water, or lake water high in chlorophyll a. The standard deviation is typically 1% of the mean, and accuracy is comparable to that of the Winkler method. (Cassar-FRC)
W82-02562

WATER QUALITY OF A SOUTHEAST TEXAS STREAM,

Lamar Univ., Beaumont, TX. Dept. of Biology.
For primary bibliographic entry see Field 2K.
W82-02570

5B. Sources Of Pollution

ASSESSMENT METHODOLOGIES FOR FRESHWATER INFLOWS TO CHESAPEAKE BAY,

Environmental Protection Agency, Annapolis, MD.
C. J. Klein, O. P. Bricker, D. A. Flemer, T. H. Pheiffer, and J. T. Smullen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/004, Vol I, October, 1981, p 185-199, 4 Fig, 9 Ref.

Descriptors: *Estuarine environment, *Model studies, *Water quality, *Nonpoint pollution sources, Runoff rates, Simulation, Nutrients, Land use, Mathematical models, Consumptive use, *Chesapeake Bay, Freshwater inflow.

The EPA Chesapeake Bay program is conducting an in-depth study to assess the principal factors having adverse impacts on the water quality of the bay. The program focuses on the point and nonpoint sources of pollution including nutrients and toxic chemicals that are associated with various land use practices. Water quality data will be evaluated through use of stochastic and deterministic models. Field data collected on specific land uses from five test basins will be the basis for research to verify nonpoint source runoff rates. The field data will be used to calibrate and verify mathematical models in the test basins including nonpoint source loading, stream transport and estuarine processes. In particular, the estuarine models will simulate the impacts of nutrients on water quality. Fall line water quality data will serve as an independent data set to compare the point and nonpoint source projections associated with various land use activities. Mathematical models will be employed on a bay-wide scale to generate nonpoint source loadings basin-wide and to assess the impact from those loading on the tidal bay for the present (1980) and future (2000) conditions. Several growth scenarios that include consumptive freshwater use will be evaluated for their impact on water quality in the bay.
W82-02118

WATER BUDGET AND PROJECTED WATER QUALITY IN PROPOSED MAN-MADE LAKES NEAR ESTUARIES IN THE MARCO ISLAND AREA, FLORIDA,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
W. C. Huber, and P. L. Brezonik.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81-04, Vol I, Oct. 1981. p 241-251, 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Hydrologic budget, *Water quality, *Artificial lakes, *Nutrients, Eutrophication, Saline water, Chemocline, Runoff, Phosphorus, Nitrogen, Transparency, Marco Island area, *Florida.

The proposed Marco Island developement plan calls for the excavation of a large group of interconnected lakes near Marco Island, Florida. The quality of the proposed lakes is of considerable importance, both to the riparian owners and to the nearby estuarine areas that will receive surface discharges. The deep lakes will be stratified due to the influx of hypersaline ground water below a depth of 2.0 m. Density differences are so great across the chemocline that the possibility of overturn is nil. The lakes receive water from surface runoff from the various land uses; from inflow, from regional ground water flow in the shallow fresh water layer, and from direct rainfall. Water is lost by surface runoff, ground water outflows and evaporation. Annual precipitation in the area is about 50 inches. Residence times of 0.42 and 0.65 years have been calculated for two units of the development. On the basis of phosphorus loading rates, the lakes are expected to be mesotrophic with fair to good water quality. On the whole, predicted water quality is good with Secchi disk transparencies on the order of 1.2 to 1.5 m, and total nitrogen of about 1.3 mg/l. On the basis of nutrient loads, the urban development is expected to have little impact on the estuaries. (Moore-SRC)
W82-02122

TRIHALOMETHANE FORMATION IN NORTH CAROLINA DRINKING WATERS,

North Carolina Univ. at Chapel Hill. School of Public Health.
P. C. Singer, J. J. Barry, G. M. Palen, and A. E. Scrivner.
Journal of the American Water Works Association, Vol 73, No 8, p 392-401, August, 1981. 9 Fig, 9 Tab, 17 Ref.

Descriptors: *Potable water, *Trihalomethanes, Water pollution sources, Chlorination, Filtration, Water treatment facilities, Drinking water, Chlorine, Chloroform, *North Carolina.

A two year research project was initiated in September 1978 to assess trihalomethane (THM) formation in North Carolina drinking waters. The objectives of the study were: to analyze the quality

of raw and treated water at major water treatment facilities in North Carolina: to analyze data collected at these facilities by comparing THM concentrations with the 100 microg/liter standard, with organic carbon content, and with other physical and chemical water quality and treatment parameters to ascertain significant correlations between these parameters and THM formation: to perform laboratory treatability studies of methods for reducing and controlling THM formation at facilities not in compliance with the maximum contaminant level: and to use the results of the bench scale studies to recommend plant scale modifications to bring these plants into compliance. It was concluded that THMs were formed during the water treatment process at all locations. The average concentration in finished waters was 72 microg/liter and the median concentration was 58 microg/liter. Chloroform was the most predominant species. Raw water total organic carbon (TOC) and seven day chlorine demand correlated well with the THM formation potential of raw water and seemed useful as indicators of the THM concentration in finished water. THM concentrations increased during the course of treatment. Coagulation and settling and filtration reduced terminal THM concentrations an average of 42% and 54%, respectively. Both seasonal and temperature variations in THM formation were noted. A geographic distribution of THM formation and raw water TOC was noted. Elimination of prechlorination and applying chlorine during post-sedimentation or post-filtration reduced THM formation significantly. (Baker-FRC)
W82-02195

ENVIRONMENTAL CONTROL TECHNOLOGY DEVELOPMENT FOR GEOTHERMAL ENERGY,

Department of Energy, Oakland, CA. Geothermal Energy Div.
For primary bibliographic entry see Field 5C.
W82-02197

FATE OF DIFLUBENZURON IN WATER,

Science and Education Administration, College Station, TX. Veterinary Toxicology and Entomology Research Lab.
G. W. Ivie, D. L. Bull, and J. A. Veech,
Journal of Agricultural and Food Chemistry, Vol 28, No 2, p 330-337, 1980. 1 Fig, 5 Tab, 29 Ref.

Descriptors: *Diflubenzuron, *Insect control, *Insecticides, *Degradation, Fate of pollutants, Dimilin, Pesticides, Natural waters, Hydrogen ion concentration.

The insect growth regulator, diflubenzuron (Dimilin), at a concentration of 0.1 ppm had a half life of 7 days in distilled water (pH 6), and less than 3 days at pH 10.0; no degradation was observed even after 56 days at pH 4.0. Major degradation products were (4-chlorophenyl) urea and 2,6-difluorobenzoic acid, with small amounts of 2,6-difluorobenzamide and the quinazolinedione product. The use of diflubenzuron as an insect control agent should should not result in persistent residues in natural waters unless the water is quite acid. (Cassar-FRC)
W82-02216

TRANSPORT AND FATE OF SELECTED ORGANIC POLLUTANTS IN A SANDY SOIL,

Environmental Protection Agency, Ada, OK.
J. T. Wilson, C. G. Enfield, W. J. Dunlap, R. L. Cosby, and D. A. Foster.
Journal of Environmental Quality, Vol 10, No 4, p 501-506, October/December, 1981. 3 Fig, 4 Tab, 34 Ref.

Descriptors: *Chlorinated hydrocarbons, *Organic compounds, Fate of pollutants, Adsorption, Biodegradation, Degradation, Chloroform, Hydrocarbons, Solute transport, Path of pollutants, Organic matter, Sandy soils, *Groundwater pollution.

Organic compounds, chosen to represent serious groundwater pollutants, were applied to glass columns containing sandy soil profiles (low organic C, 0.087%). Water containing 1.0 or 0.2 mg per liter of the organic compound was applied at the rate of 14 cm per day for 45 days. Concentrations of compounds in the effluents and the amounts volatilized were determined and the mass balances calculated. Chemicals which percolated rapidly through the soil without degradation were chloroform, 1,2-dibromo-3-chloropropene, dichlorobromomethane, 1,2-dichloroethane, tetrachloroethene, 1,1,2-trichloroethane, and trichloroethene; retardation factors (velocity of tritiated water through the soil divided by the apparent velocity of pollutant through soil) were 2.5 or less. Little or no biodegradation was observed. From 19 to 65% of chemical applied to the surface reached the 140 cm depth, and the rest volatilized. Retardation of chlorinated benzenes generally increased with decreasing water solubility. Some degradation occurred in this group of compounds. Bis(2-chloroethyl) ether did not degrade, and its retardation factor was < 1.5. A method was developed to predict the retardation factors on the basis of water solubility of the chemical and soil organic C content. Soils containing low organic matter are more pollution-vulnerable. (Cassar-FRC)
W82-02220

PATHWAYS AND MECHANISMS FOR REMOVAL OF DISSOLVED ORGANIC CARBON FROM LEAF LEACHATE IN STREAMS,

Oregon State Univ., Corvallis. School of Oceanography.
C. N. Dahm.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 1, p 68-76, January, 1981. 4 Fig, 2 Tab, 50 Ref.

Descriptors: *Organic carbon, *Microbial degradation, *Adsorption, Organic matter, Clays, Iron oxide, Aluminum oxide, Leaves, Alder, Streams, Sediments, Degradation.

Leachate from alder (Alnus rubra) leaves was used to measure the removal of dissolved organic carbon (DOC) by adsorption and by microbial uptake. Over a 48-hour period 97% of added C14 labeled leachate was removed, 20% by adsorption and 77% by microbial utilization. Only a specific fraction of the DOC, probably containing specific chemical groups, was adsorbed. At pH 7 montmorillonite was the most adsorbent of the clay materials tested (0.8% of available DOC), followed by chlorite, 0.6%, and kaolinite, 0.5%. Fine detritus, thought to consist of uncrystallized aluminoscilicate clays and hydrous oxides of Fe and Al, adsorbed 7.9 to 27.4%. Hydrous Al oxide alone removed 33% of the DOC, hydrous iron oxide, 26%, and montmorillonite clay prefused with amorphous iron, 26%. Adsorption by the organic fraction of the sediment was measured by treating leachate in chambers unpoisoned, poisoned with Hg2C12, and poisoned plus oxidation of organic matter. After 2 hours the DOC removals were 34, 25, and 21%, respectively. Although microbial uptake of DOC was kinetically slower (14 mg C per sq meter per hour), than adsorptive uptake, it was more effective over a longer period. (Cassar-FRC)
W82-02222

BIODEGRADABILITY STUDIES WITH ORGANIC PRIORITY POLLUTANT COMPOUNDS,

Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5D.
W82-02231

PHYSICAL AND GEOCHEMICAL CHARACTERISTICS OF SUSPENDED SOLIDS, WILTON CREEK, ONTARIO,

Queens Unit., Kingston (Ontario). Dept. of Geography.
E. D. Ongley, M. C. Bynoe, and J. B. Percival.
Canadian Journal of Earth Sciences, Vol 18, No 8, p 1365-1379, August, 1981. 9 Fig, 1 Tab, 65 Ref.

Descriptors: *Storm runoff, *Suspended solids, *Nutrients, Rural areas, Catchment areas, Seasonal variations, Metals, Particle size, Path of pollutants, *Wilton Creek, *Ontario.

Spatial and seasonal characteristics of suspended solids, phosphorus, and heavy metal associations were quantified in a study of stormflow events in a representative rural nonpoint source catchment of southeastern Ontario. The purpose of the study was to learn more about the principles of nutrient and contaminant transport in relatively uncontaminated fluvial systems. Field portable continuous flow centrifuge apparatus was used to collect bulk samples of subsieve solids. No significant spatial difference in physical or chemical properties of suspended solids was found between the four sample sites, which were located 1500-2000 m apart. There were profound seasonal shifts relating to hydrodynamic and biological factors. Particle-size distributions changed systematically throughout the year. Concentrations of P, Ca, and Mn increased in summer, while Al, Ti, Fe, and K peaked early in the year. (Small-FRC)
W82-02236

STREAM PHOSPHORUS EXPORTS FROM WATERSHEDS WITH CONTRASTING LAND USES IN SOUTHERN ONTARIO,

York Univ., Downsview (Ontario). Dept. of Geography.
A. R. Hill.
Water Resources Bulletin, Vol 17, No 4, p 627-634, August, 1981. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Phosphorus, *Land use, *Watersheds, Rivers, Agriculture, Topography, Wastewater, Environmental effects, Water quality, Duffin Creek basin, *Ontario.

Factors were analyzed which influence the concentration and loss of phosphorus from 22 watersheds within the Duffin Creek drainage basin. The roles of agriculture and urban land use were considered, as well as the influence of soil type and topographical characteristics. Over the 25 month period of the study, the annual average loss varied from 0.027 to 2.11 kg P/ha. Effluent from a sewage treatment plant contributed about 68% of the annual input of dissolved molybdate reactive phosphorus. There were also strong correlations with phosphorus content and crop areas and negative correlations with forests, abandoned farmland, and sandy loam soils. There was considerable retention of phosphorus in the stream channel, particularly during low summer flows. (Small-FRC)
W82-02251

PCBS IN THE HOUSATONIC RIVER: DETERMINATION AND DISTRIBUTION,

Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 5A.
W82-02255

MAJOR- AND TRACE-ELEMENT COMPOSITION OF SUSPENDED MATTER IN THE NORTH-EAST GULF OF ALASKA: RELATIONSHIPS WITH MAJOR SOURCES,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. A. Feely, and G. J. Massoth.
Marine Chemistry, Vol 10, No 5, p 431-453, 1981. 4 Fig, 6 Tab, 49 Ref.

Descriptors: *Suspended load, *Gulfs, *Gulf of Alaska, *Alaska, *Water pollution sources, Trace elements, Chemical analysis, Water analysis, Water currents, Copper River, Rivers, Streamflow, Aluminum, Copper, Calcium, Potassium, Manganese, Iron, Nickel, Zinc, Silicon, Calcium, Carbon, Nitrogen, Seasonal variation.

The spatial and temporal variations of major and trace elements associated with suspended matter from the north-east Gulf of Alaska are described with a view to understanding their relation to major sources. The north-east Gulf of Alaska is bordered by a mountainous coastline containing numerous glaciers, rivers, and streams which deliver large quantities of suspended material to the Gulf during the summer months when maximum discharge occurs. The major sediment dicharge is from the Copper River. Coastal circulation in the

gulf is dominated by the westward-flowing Alaska Current, which generally parallels the coastline. Particulate matter samples were collected from 51 stations in the north-east Gulf during each of three cruises. The results showed that suspended material from the Copper River and coastal streams was carried westward along the coast and deposited in nearshore environments. However, near Kayak Island, significant quantities of suspended material of terrestrial oigin were deflected to the southwest, past the edge of the outer shelf, by an anticyclonic gyre. The distribution patterns of the major and trace elements in the particulate matter and their elemental ratios with aluminum indicated that K, Ti, Mn, and Fe were primarily associated with aluminosilicate material, C and N with organic material, and Si, Ca, Cr, Ni, Cu and Zn with aluminosilicate material in near-shore surface and near-bottom samples and with organic material in offshore surface samples. Only C, N, Ca, Cu, and Zn showed significant seasonal variations which appeared related to biological production of organic matter. (Baker-FRC)
W82-02259

INCREASES IN SODIUM AND CHLORIDE IN THE MOHAWK RIVER, NEW YORK, FROM THE 1950'S TO THE 1970'S ATTRIBUTED TO ROAD SALT,

Geological Survey, Albany, NY.
N. E. Peters, and J. T. Turk.
Water Resources Bulletin, Vol 17, No 4, p 586-598, August, 1981. 2 Fig, 6 Tab, 31 Ref.

Descriptors: *Sodium, *Chloride, *Deicers, Rivers, Water quality, *Water pollution sources, Salts, Ions, Chemical content, Mohawk River, New York, Roads, Road deicers.

A study to relate the chemical quality of the Mohawk River in 1951-53 and 1970-74 to chemical weathering rates within the basin was performed, using regression analysis of major ion concentrations. Sodium and chloride had consistently higher yields in kg/sq km/yr than other ions, although there was a 20% increase in all ions. The general increase in ion content was attributed to accelerated transport of ions out of the basin because of a 19% increase in stream discharge. Analysis of sources of sodium and chloride indicated that rock salt used as a deicer on roads may be a primary source. Transport rates of these chemicals have increased by 72% for sodium and 145% for chloride over the two decades studied. Forty percent of the sodium and 41% of the chloride was judged to result from rock salt use. Other major sources included natural weathering, domestic sewage, and atmospheric precipitation. (Small-FRC)
W82-02262

NUTRIENT AND SEDIMENT LOADINGS FROM A SUBSURFACE DRAINAGE SYSTEM,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. B. Bottcher, E. J. Monke, and L. F. Huggins.
Transactions of the ASAE, Vol 24, No 5, p 1221-1226, September/October, 1981. 9 Fig, 4 Tab, 4 Ref.

Descriptors: Sediment load, *Subsurface drainage, Drainage, Groundwater movement, *Sediment transport, Drains, Water quality, *Nutrients, Sediments, Path of pollutants.

The overall water quality impact associated with the waters discharged from a subsurface drainage system on a field with minimum surface runoff was determined. The drainage system was installed in the early 1950's at a depth of 1 to 2 meters. The drain lines are clay tile with topsoil blinding except under observed wet spots, where stone envelopes exist. The system outlet was monitored for flow and water quality parameters using automatic sampling and recording equipment. Flow was determined by recording the depth of water behind a weir crest with a bubble-tube stage recorder. The majority of the subsurface drainage from the field occurred as the result of the winter moisture accumulation. Hydraulic conductivity of a soil profile might be increased by long term good soil management including subsurface drainage. Over 70% of the nitrogen lost in the drainage water was in nitrate form. About 70% of the phosphorus losses were in the form of sediment-bound phosphorus. Sediment, sediment-bound phosphorus and pesticides were all able to move through the soil profile, indicating the presence of direct flow channels. Heavy rainfalls occurring shortly after fertilizer application can greatly increase losses of both nitrogen and phosphorus through a subsurface drainage system. Better fertilization management can reduce the amount of soluble nutrients reaching tile drains. (Baker-FRC)
W82-02266

CHEMICAL AVAILABILITY OF CADMIUM IN MISSISSIPPI RIVER SEDIMENT,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. A. Khalid, R. P. Gambrell, and W. H. Patrick, Jr.
Journal of Environmental Quality, Vol 10, No 4, p 523-528, October/December, 1981. 4 Fig, 2 Tab, 35 Ref.

Descriptors: *Cadmium, *Oxidation-reduction potential, *Hydrogen ion concentration, *Dredging, *Sediments, Fate of pollutants, Water pollution sources, *Mississippi River,. Chelation, Chemical reactions, Food chains, Organic matter, Sulfides.

The distribution of Cd among various chemical forms (water-soluble, exchangeable, reducible, DTPA-extractable or chelated, and insoluble organic-bound) at different pH and redox potentials (Eh) were studied in the laboratory using Mississippi River sediments. The sediment suspensions, spiked with 0.2 micro Ci Cd109 per g solids, were incubated at 4 redox poential levels from strongly reduced to well-oxidized (-150, +50, +250, and +500 mV) at each of 3 pH levels (5.0, 6.5, and 8.9). Water soluble Cd109 generally increased with pH decreases, especially in the +250 and +500 treatments, and was little changed by Eh changes at neutral or alkaline pH. Exchangeable Cd109 levels increased with Eh from 2.0 to 57.5% at pH 5.0 and from 1.3 to 20.6% at pH 6.5. At pH 8.0 the Cd109 varied from 1.5 to 3.5%. The reducible fraction (adsorbed on Fe/Mn hydrous oxides) ranged from 6.4 to 21.6% of added Cd109 and was not significantly affected by pH or Eh changes. Cd109 levels in the chelated fraction were 12.9-18.2% at pH 8.0, 10.8-23.6% at pH 6.5, increasing with Eh, and 10.9-20.6% at pH 5.0, showing no trend. Insoluble organic bound Cd109 was highest at strongly reduced sediment conditions and decreased with increased oxidation at all pH levels. Disposal of dredged material containing Cd in open water would not release much Cd to the water under the typical very reduced, alkaline to neutral conditions. However, Cd could be readily mobilized from dredged material dumped on land high in organic matter or sulfides. Reduced sulfide-rich sediments exposed to air oxidize to sulfuric acid, producing pH levels as low as 2 to 4, and releasing Cd to runoff, groundwater, and the food chain. (Cassar-FRC)
W82-02267

NITRATE-NITROGEN IN TILE DRAINAGE AS AFFECTED BY FERTILIZATION,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. L. Baker, and H. P. Johnson.
Journal of Environmental Quality, Vol 10, No 4, p 519-522, October/December, 1981. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Fertilizers, *Nitrates, *Tile drainage, Nutrients, Nitrogen compounds, Corn, Soybeans, Oats, Agriculture, Drainage effects, Leaching, Water quality, Water pollution sources, Fate of pollutants, Agricultural runoff.

Tile-drained corn fields in Iowa lost significant nitrate-N to streamflows under moderate and high fertilizer applications. In a before and after study, the two plots, grown to corn in rotation with oats or soybeans, received 112 kg N per ha in 1970 and again in 1972 (first phase). In the second phase one plot received 100 kg N per ha in 1974 and 90 kg per ha in 1976; the second plot, 250 kg per ha in 1974 and 240 kg per ha in 1976. In 1978 both plots were fertilized with 90 kg N per ha. Nitrate-N levels in drainage water samples from the higher fertility plot exceeded those from the lower fertility plot by two fold in 1974 and four fold in 1976. There was a 2-month lag after fertilizer application before the excess N appeared in the tile drainage water. Even 3 years after the last differential fertilizer application the higher fertility plot was contributing more N to drainage waters than the lower fertility plot. The low fertility plot drainage water averaged concentrations of 20 micrograms per ml for a total loss of 27 kg N per ha; the higher fertility plot, 40 micrograms per ml concentration and 48 kg N per ha total loss. Heavy rains caused temporary high concentrations (up to 92 micrograms per ml) of nitrate-N in drainage waters. (Cassar-FRC)
W82-02269

CONTINUOUS SIMULATION OF RECEIVING WATER QUALITY TRANSIENTS,

Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina, Jr., and J. Buzun.
Water Resources Bulletin, Vol 17, No 4, p 549-557, August, 1981. 10 Fig, 2 Tab, 19 Ref.

Descriptors: *Mathematical models, *Urban runoff, *Biochemical oxygen demand, *Dissolved oxygen, Runoff, *Water quality, Storm water, Water pollution sources.

A continuous simulation model was derived which solves the one-dimensional transient conservation of mass equations for coupled biochemical oxygen demand-dissolved oxygen reactions for urban stormwater runoff. The solution is based on the principle of superposition for continuously discharging plane sources. The model permits the derivation of water quality frequency curves and frequency histograms of consecutive hourly dissolved oxygen violations at any set standard. The scheme is applied to the Des Moines River to determine the urban storm impacts of Des Moines, Iowa. Urban stormwater impacts can be masked by the cumulative frequency curve representation, but the frequency histograms clearly showed the duration of consecutive water quality standard violations. The application also revealed the inadequacy of fixed magnitude water quality standards. Most waste allocation studies are based on arbitrary (7-day, 10-year low flow) conditions, and the probability of occurrence cannot be established. (Small-FRC)
W82-02271

THE SUSPENDED SEDIMENT-WATER PARTITIONING COEFFICIENT FOR KEPONE IN THE JAMES RIVER, VIRGINIA,

William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
C. J. Strobel, R. E. Croonenberghs, and R. J. Huggett.
Environmental Pollution, Series B, Vol 2, No 5, p 367-372, 1981. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Suspended sediments, Rivers, *Kepone, *James River, Pesticides, Pollutants, Contamination, Storm surges, Storm tides, Waves, Water pollution control, Monitoring, Virginia.

Attempts were made to verify, in the field, laboratory estimates of the suspended sediment-water partitioning coefficient for Kepone. Attempts were also made to determine the effect of tropical storm David on this value. Surface water samples were collected on September 4, 6, and 12 at three stations on the James River, Virginia. Two samples were obtained from each station on each sampling date at about 1 hr before low tide. No significant differences in calculated partitioning coefficients were found between stations or between dates. The concentration of Kepone dissolved in the water was not significantly different before and after storm David. Salinity decreased after the storm and remained depressed for at least a week. The concentration of suspended sediment in the water increased significantly after the storm at two stations and decreased at the third. The three stations chosen for the study represent different degrees of

sediment loading. The rapid equilibration of Kepone between water and suspended sediment suggests that the major impact on Kepone movement from a storm might lie in the physical movement of sediments and water, without changes in their respective Kepone concentrations. (Baker-FRC)
W82-02284

NITRATE AND AMMONIA UPTAKE IN THE APEX OF THE NEW YORK BIGHT,

Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
For primary bibliographic entry see Field 5C.
W82-02286

HEAVY METALS IN RIVER SEDIMENTS - CALCULATION OF METAL ADSORPTION MAXIMA USING LANGMUIR AND FREUNDLICH ISOTHERMS,

Shefield Univ. (England). Dept. of Microbiology.
J. E. Duddridge, and M. Wainwright.
Environmental Pollution, Series B, Vol 2, No 5, p 387-397, 1981. 6 Tab, 14 Ref.

Descriptors: *Sediments, *Heavy metals, Metals, Rivers, Adsorption, Isotherms, Chemical analysis, England, Path of pollutants, *Bottom sediments.

The use of various extractants to determine the concentrations of biologically available heavy metals in diverse river sediments is reported. Whether heavy metal adsorption to these sediments can be adequately described using Langmuir and Freundlich isotherms was also investigated. Four English rivers, the Lathkill, Wye, Swale and the Porter Brook, were chosen for the study. At each site several river sediment cores were collected randomly at a water depth of more than 0.5 meters. River water samples were also collected. The pH of the sediments was near neutrality, ranging from pH 6.8 for the River Swale to pH 7.4 for the River Wye. The top 1.5 cm of sediments were oxidizing. The particle size distribution of the sediments showed that the River Swale and Porter Brook sediments were predominantly sandy in texture. The River Lathkill and River Sye sediments tended toward a silt and clay texture, reflecting the superficial deposits over which they flow. A relatively low concentration of metal was found in the river water samples, compared to the sediment samples. Less than 10% of the total metal concentration was extractable by extractants used to predict plant uptake of these elements from soils. The most effective extractant was EDTA, followed by ammonium acetate, while distilled water proved inefficient. In the majority of cases the adsorption of heavy metals to the sediments fitted the Langmuir isotherm or, where they did not, the results fitted a Freundlich isotherm. (Baker-FRC)
W82-02290

THE EARLY DIAGENESIS OF ALIPHATIC HYDROCARBONS AND ORGANIC MATTER IN SEDIMENTARY PARTICULATES FROM DABOB BAY, WASHINGTON,

Washington Univ., Seattle. Dept. of Oceanography.
F. G. Prahl, J. T. Bennett, and R. Carpenter.
Geochimica et Cosmochimica Acta, Vol 44, No 12, p 1967-1976, 1980. 3 Fig, 3 Tab, 37 Ref.

Descriptors: *Sediments, *Hydrocarbons, Aliphatic hydrocarbons, *Dabob Bay, *Washington, Estuarine environment, *Estuaries, Sediment-water interfaces, Interfaces, Plankton.

Results are presented of analyses of aliphatic hydrocarbon compositions and bulk organic matter in sediment trap-collected particulate material and bottom sediments from Dabob Bay, Washington. High resolution glass capillary gas chromatography was used in the analysis. A comparison was made between the average net accumulation of individual hydrocarbons measured in a 1 year series of sediment traps and the net accumulation of corresponding compounds measured in three depth intervals of Pb-210 dated bottom samples. The net accumulation of individual hydrocarbons registered systematic and rapid decreases from the sediment traps to the sediments. The most pronounced decreases were noted for planktonically derived hydrocarbon constituents such as pristane and two unsaturated compounds which were rapidly remineralized at or near the sediment-water interface. It was concluded that the amount of each compound as measured in deposited sediments is not necessarily a quantitative indication of its initial flux to the sediments. The hydrocarbons of terrestrial plant wax origin were the predominant ones measured by the 4-6 cm depth in these sediments, and they demonstrated a reasonably constant net accumulation below this interval. Diagenetic alteration of the bulk organic matter contained in the average sediment trap particulate material was noted through comparison with bottom sediments. Organic matter elementally similar to marine plankton was preferentially remineralized on deposition of the sedimentary particulates. The organic matter remaining and buried in the bottom sediments closely resembled terrestrial organic matter. (Baker-FRC)
W82-02310

INTERNATIONAL CONFERENCE ON THE EFFECTS OF ACID RAIN URGES MORE RESEARCH IN CRITICAL AREAS,

Swedish Natural Science Research Council, Stockholm.
For primary bibliographic entry see Field 5C.
W82-02311

VIRAL TRANSPORT TO GROUND WATER AT A WASTEWATER LAND APPLICATION SITE,

Texas Univ. at San Antonio.
For primary bibliographic entry see Field 3C.
W82-02317

PERMETHRIN CONCENTRATION ON COTTON PLANTS, PERSISTENCE IN SOIL, AND LOSS IN RUNOFF,

Science and Education Administration, Baton Rouge, LA.
B. R. Carroll, G. H. Willis, and J. B. Graves.
Journal of Environmental Quality, Vol 10, No 4, p 497-500, October/December, 1981. 4 Tab, 14 Ref.

Descriptors: *Insecticides, *Permethrin, *Runoff, Fate of pollutants, Pesticide residues, Cotton, Degradation, Agricultural runoff.

The synthetic pyrethroid insecticide permethrin, applied to cotton plants at the rate of 0.112 kg per ha on 10 days during August and September 1976 and 1977, did not appear in runoff in concentrations of more than 0.20 ppg in 1976. However, in 1977, a high rainfall year, 3 of 28 runoff samples contai[illegible]ver the 0.39 ppb LC50 value for crawfish (3.[illegible].9, and 0.44 ppb). Most other samples collected in 1977 remained below the 1 ppb level. Analysis of cis and trans isomers on plants and leaf litter and in soil and runoff indicated that permethrin disappeared within 3-6 months after the last application. Although the ratio of cis to trans isomer was near unity in the applied insecticide and on the plants and leaf litter, there was a higher proportion of cis isomer in the soil. Even under severe runoff conditions, permethrin is not likely to be harmful to aquatic species. (Cassar-FRC)
W82-02322

COMPARATIVE UPTAKE OF ACTINIDES BY PLANTS AND RATS FROM THE SHORELINE OF A RADIOACTIVE POND,

Oak Ridge National Lab., TN. Environmental Science Div.
C. T. Garten, Jr.
Journal of Environmental Quality, Vol 10, No 4, p 487-491, October/December, 1981. 4 Tab, 22 Ref.

Descriptors: *Radioactive wastes, *Bioaccumulation, *Food chains, Plutonium, Americium, Uranium, Curium, *Fate of pollutants, Aquatic plants, Rats, Accumulation, Sediments.

Relative uptakes of actinides by plants and rats from the shoreline of a former low-level liquid radioactive waste pond were Pu < Am < or = Cm < U233 = U238. Analyses of emergent macrophytes (Eliocharis and others), rat carcasses and gastrointestinal tracts, and shoreline sediments indicated that shoreline plants contained 2-150 times the actinide concentrations of fescue collected at the top of the bank. The ranges of actinide levels (in fCi per g dry weight) were: plants, 4.1-1311; rat carcasses, 1.2-71; rat gastrointestinal tracts, 18-35510; and shoreline sediment, 4100-869,400. From a comparison of plant/sediment, rat carcass/sediment, and rat carcass/plant concentration ratios, the relative uptakes listed above were inferred. Sediment leachability studies and patterns of uptake by plants and rats indicate that the valence states of the actinides at this site are Pu(4+), Am(3+), Cm(3+), and U(6+). (Cassar-FRC)
W82-02323

SPATIAL AND TEMPORAL VARIATION OF FECAL COLIFORM MOVEMENT SURROUNDING SEPTIC TANK-SOIL ABSORPTION SYSTEMS IN TWO ATLANTIC COASTAL PLAIN SOILS,

Virginia Polytechnic Inst. and State Univ., Blacksburg.
L. W. Stewart, and R. B. Reneau, Jr.
Journal of Environmental Quality, Vol 10, No 4, p 528-531, October/December, 1981. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Septic tanks, *Soil absorption capacity, *Water table gradient, *Path of pollutants, Coliforms, Effluents, Drainage, Wastewater treatment, Coastal plains, Bacteria, Soil disposal fields.

Locating conventional septic tank-soil absorption systems in high-water-table soils may produce shallow groundwater pollution. The movement of fecal coliforms was studied at two private sites in Chesapeake, Virginia, elevated 5 and 6.7 meters above sea level in loamy, mixed thermic Typic Ochraquults, one fine and one coarse. Monitoring wells were at 152 cm (shallow) and 305 cm (deep). Sampling was done every 2 or 3 weeks from January 1977 to September 1979. This site with a nearby drainage ditch (water table gradient 3.2%) showed fecal coliform movement in a predominantly horizontal direction. Shallow well lognormal coliform levels were 340 MPN per 100 ml, and deep well levels, < 3 per 100 ml. The second site, with poor drainage, had lognormal fecal coliform densities of 25-150 per 100 ml in the shallow wells and 10 per 100 ml in the deep wells. These values indicate a greater vertical movement of effluent at the second site. Coliform counts in wells varied widely through the year, being low when the water table level was below the drain field (August-December) and high the rest of the year. Nonuniform distribution of effluent was seen in soils at both locations. (Cassar-FRC)
W82-02325

EVALUATION OF WATER QUALITY DURING HERBICIDE APPLICATIONS TO KERR LAKE, OK,

Oklahoma Water Resources Board, Oklahoma City. Water Quality Div.
K. Morris, and R. Jarman.
Journal of Aquatic Plant Management, Vol 19, p 15-18, July, 1981. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Herbicides, *Water quality standards, *Aquatic weed control, Weed control, Nutrients, 2,4-D, Ammonia, Phosphorus, Nitrogen, *Fate of pollutants, Reservoirs, Kerr Lake, Oklahoma, Monitoring.

State water quality standards were not violated during herbicide treatment of Eurasian watermilfoil in the Robert S. Kerr Reservoir, Oklahoma, during 1977 and 1978. In 1977 five sites were treated (158.1 ha) with the butoxyethanol ester of 2,4-dichlorophenoxy acetic acid (2,4-D BEE). In 39 water samples analyzed, the herbicide was detected only once in the Little Sans Bois Creek area. However, nutrient levels were significantly increased. The 1978 program involved treatment of 463.3 ha of water with 4218 kg of granular 2,4-D BEE in June and 3833 kg applied to 202.6 ha in August. Water quality monitoring of 809 water samples resulted in herbicide detection (3 micrograms per liter) 4 hours after treatment at one site.

This is far less than the 100 micrograms per liter standard. No 2,4-dichlorophenol, a by-product, was detected in samples. There were statistically significant increases in total P at three sites and a decrease in ammonia at one site. (Cassar-FRC)
W82-02327

RELATIONSHIPS BETWEEN POND SEDIMENTS AND SIMAZINE LOSS FROM WATERS OF LABORATORY SYSTEMS,

Delta Experiment Station, Stoneville, MS.
C. S. Tucker, and C. E. Boyd.
Journal of Aquatic Plant Management, Vol 19, p 55-57, July, 1981. 2 Tab, 14 Ref.

Descriptors: *Herbicides, *Aquatic weed control, *Degradation, *Simazine, Weed control, Fate of pollutants, Sediments, Ponds, Adsorption, Sinks.

Pond sediments were the major sink for simazine applied to fish ponds. In flasks containing pond water alone, 20% of the simazine was lost from the water 32 days after application; in water-sediment systems, 75%. Organic content was positively correlated and pH was negatively correlated with the rate of simazine disappearance. Simazine half-lives for sediments containing < 0.5% organic matter and 15-30% clays were 61.2-72.5 days; for soils with 8.7-9.0% organic matter and 26-37% clay, 7.8-7.9 days. Soils with intermediate amount of organic matter had simazine half lives of 10.8-43.4 days. There were 16 samples of sediment investigated. (Cassar-FRC)
W82-02330

SUMMER INTERNAL PHOSPHORUS SUPPLIES IN SHAGAWA LAKE, MINNESOTA,

Corvallis Environmental Protection Agency, OH.
D. P. Larsen, D. W. Schults, and K. W. Malueg.
Limnology and Oceanography, Vol 26, No 4, p 740-753, July, 1981. 5 Fig, 7 Tab, 50 Ref.

Descriptors: *Phosphorus, *Lake sediments, *Eutrophication, Fate of pollutants, Water pollution effects, Water pollution control, Tertiary wastewater treatment, Sediments, Glacial lakes, Lakes, *Shagawa Lake, *Minnesota, Anaerobic conditions.

Installation of a tertiary wastewater treatment plant at Ely, Minnesota, in 1973 was expected to reduce mean P concentration in Lake Sagawa, a small, shallow, soft water glacial forest lake. Although wastewater P loading was reduced by 99% and loading from all external sources by 80%, the lake continues to be highly productive, especially during July and August. The source of P was internal, corresponding to internal supply rates of 240-680 kg per week over a 3-9 week interval in summer. The P release took place during anaerobic conditions, the time of which varied from year to year (1971-1975). The P content of the surface sediments was 0.2-0.5% dry weight, and a large proportion was potentially mobile, 27.7 to 72.8% (NaOH extractable). The upper 10 cm of sediments was estimated to contain 50,000 kg of potentially mobile P, enough to supply P to lake water for about 20 years at the present release rate. (Cassar-FRC)
W82-02332

GEOTHERMAL ENERGY: AN OLD ALLY,

For primary bibliographic entry see Field 2F.
W82-02333

SOURCE AND EXTENT OF KLEBSIELLA PNEUMONIAE IN THE PAPER INDUSTRY,

Wisconsin Univ.-Madison. Dept. of Veterinary Science.
N. R. Caplenas, M. S. Kanarek, and A. P. Dufour.
Applied and Environmental Microbiology, Vol 42, No 5, p 779-785, November, 1981. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Bacteria, *Pulp and paper industry, *Wastewater analysis, Fate of pollutants, Water pollution sources, Coliforms, Klebsiella pneumoniae, Water reuse, Wastewater treatment, Water quality, Effluents.

The fates of fecal coliform and Klebsiella pneumoniae, an opportunistic pathogen, were traced through the pulp and paper manufacturing process. Fresh water used in 3 types of mills (groundwood pulp, sulfite pulp and fine paper, and drinking pulp and fine paper) contained up to 490 per 100 ml fecal coliforms and < 10 per 100 ml total K. pneumoniae. Bacterial concentrations were high throughout the pulping process and increased during water recycling, up to 3 million total K. pneumoniae per 100 ml. Although wastewater treatment produced some reduction in total fecal coliforms in some samples, total K. pneumoniae, especially the thermotolerant type, was little affected. The paper industry is a source of pathogens, both within the plant and in the receiving waters. (Cassar-FRC)
W82-02337

SIMULATION OF NUTRIENT BALANCES IN A SHALLOW AND POLLUTED RIVER: A STRATEGY FOR ENVIRONMENTAL CONTROL,

Osaka Univ. (Japan). Dept. of Fermentation Technology.
S. Aiba, and H. Ohtake.
Annals of the New York Academy of Sciences, Vol 369, p 219-233, 1981. 9 Fig, 22 Ref.

Descriptors: *Simulation, *Nutrients, Cycling nutrients, Rivers, *Environmental control, Dissolved oxygen, Biological oxygen demand, Phosphorus, Phosphates, Enrichment, Eutrophication.

A model developed for simulation of biological oxygen demand, dissolved oxygen and phosphate-phosphorus in a shallow river (Tama-gawa) demonstrates the significant role of periphytic algae in the nutrient balance. This role of periphytic algae is significant not only in shallow rivers, but also in polluted ones. Phosphorus fixed by algal photosynthesis and that precipitated onto the river bottom amounted in total to about 33% of the daily input of phosphorus to the water body. The algal growth was inevitably accompanied by secondary biological oxygen demand (BOD) loading. About 35% of the daily input of BOD into the river originated from algal decay. It was concluded that increasing the water quantity was effective in greatly improving the water quality, but that inflow of nutrients from tributaries was the main cause of the progressive enrichment in the selected example. The new procedure used in this study to solve the partial differential equations appearing in the one dimensional model was more advisable than either the multi-step or the conventional implicit procedures used in earlier studies, as it minimized the computation time while guaranteeing good accuracy. (Baker-FRC)
W82-02354

FATE AND EFFECTS OF A HEAVY FUEL OIL SPILL ON A GEORGIA SALT MARSH,

Skidaway Inst. of Oceanography, Savannah, GA.
R. F. Lee, B. Dornseif, F. Gonsoulin, K. Tenore, and R. Hanson.
Marine Environmental Research, Vol 5, No 2, p 125-143, 1981. 11 Fig, 1 Tab, 30 Ref.

Descriptors: *Salt marshes, *Oil spills, Tidal marshes, Fate of pollutants, Aquatic life, *Water pollution effects, Oily waters, Sediments, Oysters, Periwinkle, Snails, *Georgia.

On November 13, 1978, 40 gal of a No. 5 fuel oil were added to 1 acre of a Spartina alterniflora salt marsh bordering the Wilmington River in Georgia. Fluoranthene, phenanthrene, and chrysene were dissolved in the fuel oil before the oil was added to the marsh. On December 5, 1978, an additional 20 gal of the fuel oil were added to a 10 meter by 3 meter section within the previously oiled area. The oil was sprayed on the surface of the marsh at low tide. Animals were collected at various times after the oil additions and analyzed for polycyclic aromatic hydrocarbons by high pressure liquid chromatography. The marsh sediment consisted of 61% sand, 12% silt, and 26% clay. The highest concentrations of phenanthrene, chyrsene and fluoranthene in the sediment were 112, 105 and 75 ng/g sediment, respectively. These concentrations decreased rapidly during the 20 week period after the spill. The times for these hydrocarbons to decrease to 50% their original concentration were about 100, 70, and 30 days in sediment, mussels, and oysters, respectively. Benthic macrofauna species showed no chage in some cases, and in others either an increase or decrease in population. No changes were noted in populations of fiddler crabs, oysters, or mussels. Mud snails increased in density after the spill due to immigration of adult snails from untreated areas to scavenge on animals killed by the oil. Many of the adult periwinkles were killed by the oil. In the spring, juvenile periwinkles recolonized to oil areas as a result of larvae settling. (Baker-FRC)
W82-02358

KEPONE DISTRIBUTION IN THE WATER COLUMN OF THE JAMES RIVER ESTUARY - 1976-78,

Virginia State Water Control Board, Richmond. Div. of Ecological Studies.
C. A. Lunsford.
Pesticides Monitoring Journal, Vol 14, No 4, p 119-124, March, 1981. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Organic pesticides, Rivers, *Kepone, *James River, Organic compounds, Pesticides, Sediments, Stratification, Thermal stratification, Temperature effects, Estuaries, Coastal waters, Virginia.

The results of Kepone water column monitoring in the James River estuary during the period 1976-1978 are reported. The James River discharges at an average rate of 212 cubic meters per second. Samples were collected quarterly at 75 stations from four areas of the estuary. The analysis of kepone residues showed a range of concentrations from 0 to 1.20 ppb. Concentrations in James River sediment samples ranged from 0 to 5 ppm. Differences in kepone concentrations at the surface and at the bottom of the water column were not significant. Concentrations were highest during July through September. It was felt that temperature may affect the partition coefficient of kepone in water/sediments. The peak in kepone concentrations may be due to increased numbers of phytoplankton in the water column. These summer increases may require imposing restrictions on summer dredging in kepone contaminated areas of the estuary. Spatial variations in water column residue concentrations were also noted, with residues averaging higher in the middle reach of the estuary. It is urged that future studies include investigations of dissolved and suspended solids phases of kepone in the water column. (Baker-FRC)
W82-02360

A METHOD FOR OBTAINING SLOPE INFORMATION FOR HYDROLOGIC MODELS,

Ball State Univ., Muncie, IN. Dept. of Geography.
For primary bibliographic entry see Field 2A.
W82-02364

SOURCES OF TWELVE TRACE METALS IN ANTARCTIC SNOWS DETERMINED BY PRINCIPAL COMPONENT ANALYSIS,

Centre National de la Recherche Scientifique, Grenoble (France). Lab. de Glaciologie.
C. Boutron, and S. Martin.
Journal of Geophysical Research, Vol 85, No C10, p 5631-5638, October, 1980. 5 Fig, 4 Tab, 26 Ref.

Descriptors: *Trace metals, *Snow, *Aerosols, Air pollution, Statistical analysis, Snow sampling, Water pollution sources, *Antarctic.

Sources of Antarctic aerosols were investigated by a statistical analysis of the trace metals concentrations measured in the snow layers deposited at various sites of the ice cap. The method used was principal components factor analysis of the observed temporal and geographical variations of the measured concentrations. Two hundred and fifty surface snow samples were collected for trace metal analysis, and 12 elements were determined (Na, Mg, K, Ca, Fe, Al, Mn, Pb, Cd, Cu, Zn, and Ag). Typically, three areas were delimited accord-

ing to the observed variations. The first one was near the coast (5-35 km), the second 43-173 km, and the last one at 173-1070 km. Some trace metals have an oceanic source, while others may have a crustal continental source (Al, Fe, and Mn). This technique should be applied to larger set of data, including concentrations data for numerous other elements. When method results are proven, they can be used in mathematical models. (Small-FRC)
W82-02378

A STUDY ON THE ACCUMULATION OF COPPER AND ZINC IN THE MID-GUT GLAND OF CULTURED SCALLOP FOR ENVIRONMENTAL MONITORING, (IN JAPANESE),

Iwate Univ., Morioka (Japan). Div. of Forestry and Fishery.
S. Kamimura.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 46, No 10, p 1245-1248, October, 1980. 4 Fig, 3 Tab, 6 Ref. (English summary).

Descriptors: *Bioaccumulation, *Copper, *Zinc, Mollusks, Marine animals, Bioindicators, *Scallop, Accumulation, Heavy metals, Monitoring, Mathematical studies, Statistical analysis.

A statistical analysis of the accumulation profiles of copper and zinc in the mid-gut glands of cultured scallops was performed to determine their ambient levels. The levels of both copper and zinc in the gland were found to increase as the organ weight increased. A linear relationship between copper and zinc levels and organ weight was observed. The coefficient of the correlation was characteristic for the ambient level. The analysis confirmed the usefulness of the profile analysis of the heavy metals accumulation in the mid-gut gland for estimating the trend of their levels in the environment. This study also indicated that cultured scallops could be a suitable indicator organism for use in environmental monitoring. (Carroll-FRC)
W82-02379

ACCUMULATION OF HEAVY METALS IN ARID-ZONE SOILS IRRIGATED WITH TREATED SEWAGE EFFLUENTS AND THEIR UPTAKE BY RHODES GRASS,

Hebrew Univ., Rehovot (Israel). Dept. of Soil and Water Sciences.
A. Banin, J. Navrot, Y. Noi, and D. Yoles.
Journal of Environmental Quality, Vol 10, No 4, p 536-540, October/December, 1981. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Heavy metals, *Irrigation water, *Wastewater irrigation, Impaired water use, Metals, Rhodes grass, Grasses, Sprinkler irrigation, Secondary wastewater, Clays, *Soil chemistry, Fate of pollutants, Cadmium, Chromium, Lead, Zinc, Copper, Nickel.

Heavy metal accumulation was determined in soils of commercial fields of Rhodes grass with 12 to 28 year histories of sewage effluent irrigation. Plots in three soils (a loamy sand, a sandy loam, and a clay loam) were irrigated with sewage effluent or tap water at the rate of 7000-8000 cu meters per ha per year. There were no statistically significant differences in levels of Cr or Zn in all soils and in both treatments. Cd levels were significantly higher than in controls in all three soils. Cu, Ni, and Pb levels were higher than controls in the clay soils. Concentrations of available or acid-extractable metals were generally higher (except for Cr) in effluent-irrigated fields than in tap water-irrigated fields. Rhodes grass samples grown in effluent-treated soils were higher in metals (except for Cr) than tap water-treated crops. As the surface area (or clay content) of the soil increased, the enrichment factor (micrograms element per g plant/micrograms element per g soil) increased, being more pronounced with the more labile metals, Cd, Cu, and Ni. The relative magnitude of the enrichment factor was Cu > Cd > Pb > Ni > or = Cr. This relationship depends on the solubility in water, which is in turn dependent on ionic potential. (Cassar-FRC)
W82-02392

CHARACTERIZATION OF OIL SPILLS ON INLAND AND ESTUARINE WATERS,

North West Water Authority, Warrington (England).
P. J. Whittle, and M. W. Horne.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 1, p 50-60, January, 1980. 8 Fig, 3 Tab, 2 Ref.

Descriptors: *Oil spills, *Chemical analysis, *Oil-water interfaces, *Oil pollution, *Tracers, Estuaries, Streams, Gas chromatography, Hydrocarbons, Dyes, Fuel, Laboratories, Dye concentrations, Reservoirs.

The techniques used in the analysis of polluting oils are discussed. Capillary chromatographic columns have been used to advantage, and may increase in efficiency with future developments. If inorganic based phases are developed, this technology coupled with mass spectrometry would provide an improved method of analysis. Infra-red spectrometry has limited application. Other techniques will include the quantitative detection of other elements present in the oil by means of plasma source spectrometry. Future advances will include microprocessed controlled instrumentation and data-handling systems. Chromatographic analysis of an oil of unknown origin which entered a reservoir via a feeder stream after a heavy rain revealed a peak corresponding to cis-cis double bonds, found in rubber. A search of the source area revealed old quarry workings in which an estimated 60,000 tons of used tires had been dumped and burned. Since the pollution incident about 85,000 gallons of oil have been removed from this reservoir, but heavy rain still occasionally washes out more oil from underground. (Titus-FRC)
W82-02393

THE IMPACT OF URBANIZATION ON SEASONAL HYDROLOGIC AND NUTRIENT BUDGETS OF A SMALL NORTH AMERICAN WATERSHED,

Wisconsin Univ.-Madison. Inst. of Environmental Studies.
V. J. Watson, O. L. Loucks, and W. Wojner.
Hydrobiologia, Vol 77, No 1, p 87-96, 1981. 2 Fig, 5 Tab, 16 Ref.

Descriptors: *Nutrients, *Hydrologic budget, *Urbanization, Fate of pollutants, Lakes, Water quality control, Phosphorus, Nitrogen, Runoff, Seasonal variation, *Lake Wingra, *Wisconsin, Small watersheds, Watersheds, Lake morphometry.

The effects of urbanization on the nutrient, and hydrologic budgets of Lake Wingra, a small shallow lake in Madison, Wisconsin, was determined by comparing seasonal water inputs, nutrient yields, and N:P ratios before and after urbanization. Seepage contributes 69% of the water input to the lake. The total hydrologic budget and the springs and groundwater and the rainfall components of the budget were similar for pre- and post-settlement eras. However, in pre-settlement times spring runoff was 85% of total runoff and summer runoff, 0.58%. Modern runoff is 48% in spring, 20% in summer. Most of the N input to the lake is from the groundwater, 68% pre-settlement and 60% present; from runoff, 10% presettlement and 17% present. Most of the P input is from runoff, 42% pre-settlement and 71% present. This increase in runoff with resultant decreases in evapotranspiration and subsurface flow has increased annual P loadings (680 to 1000 kg P) and decreased the N:P ratio of total loading (40 to 26, a 35% change). The annual N budget did not change significantly, 27,000 kg N in pre-settlement times and 26,000 kg N in the present. The pre-settlement lake area was 1.75 times the present area and the volume was 1.5 times the present volume. These changes, produced by dredging, filling and damming, contributed substantially to the increased concentration of nutrients. Water quality control measures suggested are: (1) concentrate on reducing P in runoff in spring and summer by diversion of runoff into marshes not bordering lakes or into detention ponds, and (2) minimize lake modifications which reduce water volume. (Cassar-FRC)
W82-02400

DENMARK'S STATE OF THE ENVIRONMENT,

B. Wilder.
Ambio, Vol 9, No 2, p 104-106, 1980. 3 Fig, 3 Ref.

Descriptors: *Water quality, *Water pollution control, *Denmark, Reviews, Mercury, Heavy metals, Streams, Seas, Coastal waters, Recreation demand.

The degree of improvement in environmental conditions in Denmark since the passage of the 1974 Environmental Protection Act was investigated. Denmark has vast quantities of clean groundwater as a resource, but a number of potential threats to its clean condition exist. Characteristics of seepage and underground waterflow tend to cloud future predictions, as the effects of surface pollution may not appear in groundwater for decades. Improvement has been noted in the quality of Denmark's lakes and streams. In spite of confusing factors of crop watering, silage disposal and contamination by pesticides and ochre, the Danish streams were rated cleaner than they had been 10 years ago. Seas and coastal areas around Denmark have been threatened by sewage and oil spills. The mercury load is particularly high in certain areas. In the open seas precipitation is the major source of heavy metal pollution. The quality of the water for recreational purposes has improved. (Baker-FRC)
W82-02401

ESTUARINE AND MARINE COASTAL POLLUTION IN THE REPUBLIC OF IRELAND,

University Coll., Cork (Ireland). Dept. of Zoology.
A. Myers.
Marine Pollution Bulletin, Vol 12, No 8, p 260-264, August, 1981. 1 Fig, 3 Tab.

Descriptors: *Reviews, *Ireland, *Estuaries, Coasts, Fisheries, Cork Harbour, Bantry Bay, Harbors, Bays, *Industrial wastes, Environmental protection, Coastal waters, *Water pollution sources.

Industrial development in Ireland has been concentrated in the vicinity of coastal towns, where almost one half of the population resides. The increase in population plus industry in coastal towns has escalated the volume of waste materials entering Irish coastal waters. The volume of waste materials entering Irish coastal waters has been estimated to be increasing at about 10% per year. Much of the recent work in pollution of waters has been centered around assessment in organisms of heavy metals, organic poisons, sewage, and radioactive materials. A multivariate approach has been carried out in studies at Trinity College to study intertidal and peritidal zones of east coast estuaries. Particular emphasis is placed on eutrophication by phosphorus and nitrogen, the addition of organic matter including hydrocarbons, and the distribution of heavy metals. Pollution in Cork Harbour, an area undergoing rapid industrial development, has also been the object of several studies. Possible effects of an oil transhipment terminal in Bantry Bay have been considered. Pollution research with an emphasis on marine studies at the universities has largely been funded on an ad hoc basis from national funds, but with the establishment in 1977 of the National Board for Science and Technology, a National Environmental Sciences Program was initiated which had as one of its priorities the development of a research program in estuarine and marine coastal pollution. The need for long term base-line research on unpolluted coasts and estuaries in the Republic is pressing, not only to safeguard Ireland's marine environment, but to gain a better understanding of the behavior of animal communities in pristine marine environments in temperate regions. (Baker-FRC)
W82-02418

GROUNDWATER QUALITY IN THE SEVERN-TRENT REGION,

Severn-Trent Water Authority, Birmingham (England). Directorate of Scientific Services.
For primary bibliographic entry see Field 5A.
W82-02423

DISTRIBUTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS FROM

ESTUARIES OF SOUTHEASTERN AUSTRALIA,

Melbourne Univ., Parkville (Australia). Dept. of Industrial Science.
J. Bagg, J. D. Smith, and W. A. Maher.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 65-73, 1981. 1 Fig, 3 Tab, 16 Ref.

Descriptors: *Aromatic compounds, *Sediments, Path of pollutants, Water pollution sources, Polynuclear aromatic hydrocarbons, Organic compounds, *Australia, Estuaries, Rivers, Benzo(a)pyrene, Urban areas, Industrial development, Aerosols.

Levels of the polycyclic aromatic hydrocarbons (PAH), benzo(a) pyrene (BAP) and perylene, were determined in sediments from 23 sites in 3 locations in southeast Australia. Minimum BAP values of 20-60 micrograms per kg dry weight were found at Mallacoota Inlet, remote from urban activity. The maximum concentration, 6800 kg micrograms per kg, was from a Yarra River tributary (Melbourne region) where sediment was contaminated with an oily material. Other levels in the Yarra estuary system ranged from 60 micrograms per kg at the station farthest upstream to 850 micrograms per kg downstream. In Corio Bay, a marine bay near a small city, concentrations of BAP were 180-260 micrograms per kg, except for near a storm water drain inlet, 2000 micrograms per kg. The ratio of BAP: perylene was 1-2, significantly lower than PAH deposited by aerosol. This suggests that the major source of PAH is industrial activity. (Casser-FRC)
W82-02438

THE SEASONAL VARIATION IN SILICON CONCENTRATION IN CHALK-STREAMS IN RELATION TO DIATOM GROWTH,

Freshwater Biological Association, Warham (England).
H. Casey, R. T. Clarke, and A. F. H. Marker.
Freshwater Biology, Vol 11, No 4, p 335-344, August, 1981. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Silicon, *Streams, Seasonal variation, Benthos, Diatoms, Chlorophyll A, Rivers, Water chemistry, *Path of pollutants.

Changes in silicon concentration were exained over a relatively long time scale in order to separate regular seasonal cycles from erratic between-year variations. These concentrations were then used to calculate diatom production. The first study site was a bore-hole at a commercial watercress farm. The second was at a point 5 km downstream on the Bere Stream, and the third site was on the River Frome. These water courses are nutrient-rich hardwater streams dominated by macrophytes. Weekly water samples were taken at each site. No apparent seasonal variation was noted in silicon concentration at the bore-hole. In contrast, 5 km downstream there was marked reduction in silicon concentration during the spring but only irregular changes during the rest of the year. Silicon concentrations in the River Frome between 1965 and 1977 showed considerable variations, apart from the substantial reductions in the spring. A negative correlation between suspended chlorophyll-a and silicon concentrations confirms that suspended chlorophyll-a concentrations respond more closely to changes in the loosely attached diatom flora than to other sources of chlorophyll-a. However, neither variable is always suitable for monitoring changes in benthic diatoms. Estimates of diatom production, based on changes in silicon concentration, gave rates of 1-2 grams of silicon/square meter/day in a small headwater chalk stream during the spring. (Baker-FRC)
W82-02439

STORMWATER QUALITY PROCESSES FOR THREE LAND-USE AREAS IN BROWARD COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
H. C. Mattraw, Jr., and R. A. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-119595, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-23, 1981. 56 p, 13 Fig, 16 Tab, 22 Ref.

Descriptors: *Storm runoff, *Urban runoff, *Water quality, Rainfall-runoff relationships, Fallout, Urban hydrology, Data collections, Hydrologic data, *Florida, *Broward County.

Systematic collection and chemical analysis of stormwater runoff samples from three small urban areas in Broward County, Florida, were obtained between 1974 and 1977. Thirty or more runoff-constituent loads were computed for each of the homogeneous land-use areas. The areas sampled were single family residential, highway, and a commercial shopping center. Rainfall, runoff, and nutrient and metal analyses were stored in a data-management system. The data-management system permitted computation of loads, publication of basic-data reports and the interface of environmental and load information with a comprehensive statistical analysis system. Seven regression models relating water quality loads to characteristics of peak discharge, antecedent conditions, season, storm duration and rainfall intensity were constructed for each of the three sites. Total water-quality loads were computed for the collection period by summing loads for individual storms. Loads for unsampled storms were estimated by using regression models and records of storm precipitation. Loadings, pounds per day per acre of hydraulically effective impervious area, were computed for the three land-use types. Total nitrogen, total phosphorus, and total residue loadings were highest in the residential area. Chemical oxygen demand and total lead loadings were highest in the commercial area. Loadings of atmospheric fallout on each watershed were estimated by bulk precipitation samples collected at the highway and commercial site. (USGS)
W82-02469

SIMULATION MODEL FOR AGRICULTURAL NON-POINT-SOURCE POLLUTION,

Montgomery (J. M.), Walnut Creek, CA.
L. J. Tubbs, and D. A. Haith.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1425-1433, September, 1981. 6 Fig, 7 Tab, 28 Ref. OWRT-B-055-NY(5), 14-34-0001-7169.

Descriptors: *Model studies, *Nonpoint pollution sources, Pollution load, *Agricultural runoff, Mathematical studies, Phosphorus, Nitrogen, *Nutrients, Simulation, Runoff.

A mathematical simulation model, referred to as the Cornell Nutrient Simulation (CNS) model, is presented which is suitable for estimating dissolved and solid-phase nitrogen and phosphorus in runoff, and dissolved N in percolation from cropped fields with well-drained soils. The CNS model consists of two basic components: a daily soil moisture/erosion submodel that predicts runoff, percolation and soil loss; and a monthly submodel of soil nutrient levels. Validation studies for several small fields in Georgia and New York are included. The nutrient component has a monthly time step. The nutrient balance model estimates monthly losses of dissolved and solid-phase N in runoff, dissolved N in percolation, dissolved P in runoff, and solid-phase P in runoff. Validation studies in Georgia were performed in two small fields that were monitored for runoff, sediment and nutrient loss in runoff from May, 1974 through September, 1975. The New York testing sites are six 0.3 ha plots in Aurora, New York, from which runoff, percolation, and nutrient loss data were collected from January 1972 through December 1973. Measured nutrient, water, and sediment losses were compared with those predicted by the CNS model. Runoff predictions exceeded observations by substantial amounts on both fields in Georgia, although errors were smaller on one. Dissolved N and P were over-predicted by about the same degree as runoff on one field. The most critical problem is in the simulated losses of dissolved P in runoff. In New York there were additional problems which made comparisons of the predictions and the observations meaningless. The principal weakness of the model is in its handling of organic matter such as manures and fresh plant residues. (Baker-FRC)
W82-02504

EFFECT OF DRAINAGE SYSTEM DESIGN AND OPERATION ON NITRATE TRANSPORT,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, and J. W. Gilliam.
Transactions of the ASAE, Vol 24, No 4, p 929-934, July/August, 1981. 9 Fig, 3 Tab, 20 Ref. OWRT-A-086-NC(7), OWRT-B-063-NC(6), 14-34-0001-7070, 14-31-0001-4111.

Descriptors: *Drainage, *Nitrates, Surface drainage, Drainage practices, Subsurface drainage, DRAINMOD, Model studies, Simulation, Resources management, Water pollution sources, Water table, Surface runoff, *Agricultural runoff, Groundwater management.

A study was made to simulate soil water conditions and nitrate outflow from artificially drained soils using a water management computer model. Simulations were conducted for various drainage system designs and operational criteria for a poorly drained soil. The simulation model used is an extension of the water management model, DRAINMOD, developed for drainage and water table control on shallow water table soils. The simulation model predicts water table position, water content distribution, surface runoff, subsurface drainage volume, and seepage volumes at the end of each time increment. If the nutrient concentration of each of the outflow sources is known or can be predicted, total mass outflows can calculated on a day to day basis for a given drainage system design and mode of operation. The performance of the water management system design was evaluated in terms of total annual nitrate outflow and its ability to satisfy trafficability and crop protection requirements. Drain spacing and the quality of surface drainage both have large effects on total annual outflows via surface runoff, subsurface drainage and seepage. Nitrate outflows for the experimental soil are heavily dependent on the drainage system design, and nitrate movement from the field can be minimized by using good surface drainage and wide subsurface drain spacings. While controlled drainage can be used to reduce nitrate outflows when surface drainage is poor, there are potential detrimental effects of designing controlled drainage systems for this purpose. Maintenance of a high water table over the winter months may cause breakdown of soil structure, which would reduce hydraulic conductivity and complicate the drainage problem. A decrease in nitrate may be accompanied by increased phosphorus or pesticide movement in the drainage waters. (Baker-FRC)
W82-02505

PHOTOSYNTHETIC PIGMENTS AS INDICATORS OF ALGAL ACTIVITY IN THE UPPER POTOMAC ESTUARY,

Georgetown Univ., Washington, DC. Dept. of Biology.
P. Sze.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157827, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of the District of Columbia Report No 30, October, 1981. 19 p, 6 Fig, 2 Tab, 12 Ref. OWRT-A-015-DC(1), 14-34-0001-0109.

Descriptors: *Nutrients, Photosynthetic pigments, Chlorophyll A, Centric diatoms, Algae, Chlorococcalean green algae, *Potomac River, *District of Columbia, *Photoplankton, Water temperature, Sampling.

The Potomac River was monitored at Key Bridge from May - September, 1981. Temperature, major nutrients, photosynthetic pigments, abundance of major groups of photoplankton (direct counts), and potential photosynthetic production (oxygen method) were measured weekly in surface samples collected near mid-river. Chlorophyll A showed the same general trends as the cell counts and

production with greatest algal activity in late May and August and a minimum in June. Centric diatoms and chlorococcalean green algae were the major planktonic algae in 1981, as in previous years. The accessory pigments were relatively insensitive measures of algal composition. Overall, the activity of phytoplankton did not show any significant from previous years, and there was no evidence for prolonged nutrient depletion as a result of algal activity in the river.
W82-02529

DELINEATION OF ACID MINE DRAINAGE POTENTIAL OF COAL-BEARING STRATA OF THE POTTSVILLE AND ALLEGHENY GROUPS IN WESTERN PENNSYLVANIA,

The Pennsylvania State Univ., University Park. Dept. of Geosciences.
For primary bibliographic entry see Field 6A.
W82-02534

THE EFFECTS OF RAPID INFILTRATION OF MUNICIPAL WASTEWATER ON GROUNDWATER QUALITY,

Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
H. S. Peavy, P. E. Stark, and T. G. Schwendeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157900, Price codes: A05 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Montana State University, Report No 117, September, 1981. 72 p, 3 Fig, 8 Tab, 11 Ref, Append. OWRT-A-127-MONT(1), 14-34-0001-0128.

Descriptors: *Groundwater pollution, *Wastewater lagoons, *Water pollution sources, Aquifer characteristics, Soil chemistry, Water quality control, Water analysis, Wastewater disposal, Path of pollutants, *Infiltration, Rapid infiltration, West Yellowstone, *Montana.

The purpose of the research project was to compile and summarize the available information on groundwater quality changes due to rapid infiltration of wastewaters, and to add to that body of knowledge by a field investigation of a rapid infiltration site. A wastewater disposal system practicing rapid infiltration was selected and instrumented. Data was gathered by analyzing samples drawn from wells installed downstream from the infiltration basins. Background data was obtained by sampling existing water supply wells in the same aquifer but upstream from the disposal facility. The data indicated a several fold increase in Total Dissolved Solids, nitrate and ammonia in the groundwater near the infiltration basins. The elevated concentrations attenuated as the groundwater moved away from the area. Other parameters (pH, phosphates, chlorides, COD, fecal coliform bacteria) were not significantly affected by the infiltration of the wastewater. Conclusions are reached that groundwater quality will be affected on a local basis by rapid infiltration of wastewater. The extent of adverse impacts will depend on several variables relating to the volume and character of the wastewater and on infiltration site characteristics. (Hunt-Mont)
W82-02537

DISCUSSION OF TRACE METALS IN THE WATERS OF A PARTIALLY-MIXED ESTUARY,

Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W82-02542

SALT-WATER INTRUSION IN THE COSTA DE HERMOSILLO, MEXICO: A NUMERICAL ANALYSIS OF WATER MANAGEMENT PROPOSALS,

Connecticut Univ., Storrs. Dept. of geology and Geophysics.
R. W. Andrews.
Ground Water, Vol. 19, No 6, p 635-647, November/December, 1981. 11 Fig, 38 Ref.

Descriptors: *Saline water intrusion, *Irrigation wells, *Water management, Path of pollutants, *Coastal aquifers, Aquifers, Groundwater recharge, Recharge, Aquifer management, Irrigation water, Model studies, Solute transport, Hydraulic gradient, Wells, Chlorides, Simulation analysis, *Costa de Hermosillo, *Mexico.

The Costa de Hermosillo aquifer, Sonora, Mexico, is being actively intruded by salt water because groundwater withdrawls in this agricultural region are much greater than natural recharge. Total discharge varies between 760 and 1140 million cu meters per year. There have been overdrafts of 450 to 900 million cu meters per year since 1954, with a resulting water table decline up to 40 meters. A model is developed to simulate the hydrologic conditions and water quality to assess the areal and temporal variations in head velocity and concentration as a result of changes in the groundwater withdrawal. Major salt water intrusion has occurred in 2 areas, where total dissolved solids are now 1200 mg per liter. Buried alluvial channels allow rapid transport of salt water inland. Some of the proposals for managing the salt water intrusion problem are: (1) relocating 92 wells further inland to redistribute discharge, and (2) reducing the amount of water pumped from the aquifer by improving irrigation efficiency. No matter which management strategy is chosen, the salt water intrusion is irreversible. Simulated chloride distributions after 34 years depict the 300 and 3000 mg per liter isochlors for both management methods. The reduced pumping scheme is slightly less effective in slowing salt water intrusion because it specifies gradual withdrawal of wells from production over 15 years. The uncertainty in parameter identification permits only a qualitative analysis of these proposals. (Cassar-FRC)
W82-02547

HISTORY OF HUMAN-USE IMPACTS ON LONG POINT BAY,

H. B. Barrett.
Journal of Great Lakes Research, Vol 7, No 2, p 81-88, 1981. 7 Ref.

Descriptors: *Human population, *Environmental effects, Water pollution effects, *Long Point Bay, Canada, *Ontario, Farming, Industrial wastes, Pesticides, Silting, Erosion, Sedimentation, Hunting, Wildlife, Wilderness areas, Wildlife management, Wildlife conservation, Lakes, Lake Ontario, Water pollution sources.

The first detrimental impacts of man appeared on Long Point Bay regions during Indians times, when erosion took place in areas which had been cleared for farming and left after the crops failed to thrive in succeeding years. Even so, the general impact on the environment caused by the Indian was minimal for almost 1,000 years. The arrival of the white man brought cultivation to various tracts of land. By the first half of the 19th century, activities were many and varied, with the greatest impact being felt due to uncontrolled and illegal lumbering. Wherever a cut was made, wind and water combined to destroy the thin topsoil, create blowouts, and in many cases wash the fragile exposed ridges into the surrounding water. Large parts of Long Point were lost wherever lumbering was carried out. In August of 1866 the Long Point Company was formed for the purpose of controlling the activities in that area which were leading rapidly toward environmental destruction. Almost complete removal of virgin forests in the 1830's and afterward caused the loss of the protective humus from the forest soils. The sediment load of Norfolk's streams increased dramatically and spawning and feeding areas for trout and other species were destroyed. Increased contamination with herbicides and pesticides have been noted in the Inner Bay due to increased agricultural activities. Added to the siltation from agriculture, commercial and urban growth was a great variety of complex pollutants. Toxic wastes from industry, vessels, and vehicles add additional stresses to the area. (Baker-FRC)
W82-02580

MULTIPORT DIFFUSER MIXING ZONES IN RIVERS,

Kansas Univ., Lawrence. Dept. of Civil Engineering.
A. D. Parr, and W. W. Sayre.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 903-917, October, 1981. 12 Fig, 1 Tab, 6 Ref.

Descriptors: *Mixing, *Diffusers, *Thermal pollution, *Fate of pollutants, *Effluents, Effluent standards, Rivers, Heated water, Thermal water, Multiport diffusers, Temperature, Water temperature, Powerplants.

Empirical equations relating the cross-sectional area and discharge of an individual multiport diffuser mixing zone to effluent and ambient river conditions are developed. These are used with expressions for jet spreading and dilution to obtain mixing zone equations. The area enclosed in the isotherm defining the boundary of a single port mixing zone is determined as a function of downstream distance from port, velocity ratio, and critical dilution ratio. Agreement between predicted and measured mixing zone characteristics were reasonably good. This procedure can be used to estimate the river discharge below which environmental mixing zone limitations will be violated for particular multiport diffuser installations. (Cassar-FRC)
W82-02594

MODELING SUSPENDED SOLIDS AND BACTERIA IN FORD LAKE,

Rutgers - The State Univ., Piscataway, NJ.
C. G. Urchin, and W. J. Weber, Jr.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 975-993, October, 1981. 22 Fig, 3 Tab, 26 Ref.

Descriptors: *Bacteria, *Suspended sediments, *Sediment transport, Lakes, Coliforms, Model studies, Mathematical models, *Ford Lake, *Michigan, Turbulent flow, Open channels, Channel flow, Fate of pollutants, Suspended solids, Feces, Water quality.

Transport of suspended solids and associated pollutants is modeled for inclusion in a water quality model. Sediment dynamics is particularly important for nonreactive substances such as polychlorinated biphenyls. The submodel, developed for the case of turbulent open channels, uses a two-dimensional equation for suspended particles in a turbulent flowing medium. A procedure is developed to determine particle fall velocity distributions and a bottom boundary condition calibrated to three sets of flume data. The resulting numerical solution is shown in graphical form as a function of particle fall velocity, channel shear velocity, and channel depth. The model is applied in a system model for Ford Lake, Michigan, with fecal coliforms as the pollutant associated with the suspended sediments. Sedimentation proved to be a major removal mechanism for fecal coliforms in this lake. (Cassar-FRC)
W82-02595

GUIDELINES FOR CONTROL OF SEPTIC TANK SYSTEMS,

California Regional Water Quality Control Board, Oakland.
A. W. Olivieri, R. J. Roche, and G. L. Johnston.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 1025-1034, October, 1981. 2 Fig, 17 Ref.

Descriptors: *Septic tanks, *Wastewater disposal, *Water quality control, Regulations, Water policy, San Francisco, California, Population density, Urban areas, Inspection, Maintenance, Nitrates, Bacteria, Percolation, Infiltration, San Francisco Bay area.

The San Francisco Bay Regional Water Quality Control Board, in response to rapid development in the jurisdiction, has set forth guidelines for individual or community sewer systems serving new residential development. This paper reviews

their recommendations with respect to design and construction of septic tank systems, operation and maintenance, and cumulative impacts. Since the half life of properly maintained septic tank systems is 25 years, dual systems are recommended to allow resting and restoration of percolation rates. Periodic inspection of individual septic tank systems is recommended to ensure proper maintenance and correlation of system failures. This is currently being conducted in the Stinson Beach area and includes biennial inspection of all private systems for pumping need, odor, and surfacing effluent. A new law allows small communities to build and maintain on-site wastewater treatment systems, where appropriate, with the technical assistance of public agencies. It was found that septic tank effluent may contaminate domestic water supplies, particularly private wells, and that nitrates may adversely affect coastal waters. Recommendations derived from the study were: (1) the bottom of drainfields and water supply wells should be vertically separated by at least 30-40 ft in decomposing granite soils and 10-20 ft in alluvial soils, (2) one housing unit per 1.4 acres will minimize nitrate contamination in local groundwaters, and (3) septic tank systems should be inspected periodically. (Casser-FRC)
W82-02599

5C. Effects Of Pollution

BIOLOGICAL CONSIDERATIONS RELATED TO FRESHWATER INTRODUCTION IN COASTAL LOUISIANA,

Army Engineer District, New Orleans, LA.
For primary bibliographic entry see Field 4C.
W82-02128

HISTORICAL OVERVIEW OF THE FRESHWATER INFLOW AND SEWAGE TREATMENT PLANT DISCHARGES TO THE POTOMAC RIVER ESTUARY WITH RESULTANT NUTRIENT AND WATER QUALITY TRENDS,

National Oceanographic Atmospheric and Administration, Rockville, MD. Office of Marine Pollution Assessment.
M. A. Champ, O. Villa, and R. C. Bubeck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 350-373. 4 Fig, 11 Tab, 31 Ref.

Descriptors: *Potomac River estuary, *Nutrients, *Water quality, *Pollution load, *Wastewater disposal, River flow, Phosphorus removal, Limiting nutrients, Estuarine environment, Algal growth, Water pollution, Eutrophication.

Nitrogen, phosphorus and carbon loadings in the estuary have increased since the early 1920's. Algal and plant vegetation have undergone three major population and community shifts during the period of increased nutrient loading. Carbon loadings began to decline in the late 1950's with phosphorus decreasing in 1970. Nitrogen loadings have remained elevated with a small decline in the mid-70's. Extensive wastewater phosphate removal processes were initiated in 1974. During the summer of 1977 (a below-average flow period), the maximum was 80 micrograms/l for a 14-km reach of the estuary. The algal populations in 1979 were mixed, indicating that the water quality in the upper estuary is improving due to phosphorus being reduced by extensive removal from wastewater discharges. The Potomac River Estuary received in 1980 approximately 440 mgd of wastewater discharges from 8 sewage treatment plants in the upper estuary, which during low flow periods contribute significantly to the freshwater flow into the estuary. The removal of phosphorus has made it the limiting nutrient in the upper reaches of the estuary while in the lower reaches nitrogen or light penetration may be limiting. (Brambley-SRC)
W82-02161

EFFECTS OF UPLAND DRAINAGE ON ESTUARINE NURSERY AREAS OF PAMLICO SOUND, NORTH CAROLINA,

North Carolina Office of Coastal Management, Morehead City.
For primary bibliographic entry see Field 2L.
W82-02164

ENDANGERED ESTUARINE RECEIVING WATERS: THE EFFECTS OF LOW-FLOW LAND RUNOFF ON HEADWATERS BIOTA,

Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
D. L. Correll.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II. Oct. 1981, p 419-432. 4 Fig, 3 Tab, 4 Ref.

Descriptors: *Estuarine environment, *Estuarine fisheries, *Perch, *Rhode River, Maryland, *Nutrients, Agricultural runoff, River flow, Eutrophication, Chlorophyll, Phytoplankton, Seasonal variation, Dissolved oxygen, Water temperature, Habitats, Nitrogen, Phosphorus, *Low flow, Environmental effects.

The Rhode River, Maryland, was studied over the course of one year to investigate a number of environmental parameters on the spawning and nursery ground activities of white and yellow perch. Total and nitrate-nitrogen, and total and orthophosphate-phosphorus were determined in the estuary and upstream, and land runoff and chlorophyll were determined. Most of the flow occurred in the winter, early spring, and mid to late fall. Phosphorus concentrations reached 2.4 mg/l in mid-July, and remained high through the autumn. Nitrogen levels were highest over this same period, with a maximum of 5.57 mg/l in mid-July. Dissolved oxygen levels seemed to correlate inversely with water temperature, although there were diurnal variations in dissolved oxygen levels. Chlorophyll in phytoplankton reached a maximum in mid-September of 12 mg/l. Cropland was the most important source of both nitrogen and phosphorus, and the nitrogen: phosphorus ratio was high enough for nitrogen to become limiting and eutrophication occurred. Reducing the nutrients in agricultural runoff would prevent eutrophication and produce a more favorable habitat for the perch. (Brambley-SRC)
W82-02165

THE EFFECT OF FOREST CLEARCUTTING IN NEW ENGLAND ON STREAM-WATER CHEMISTRY AND BIOLOGY,

New Hampshire Univ., Durham. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 4C.
W82-02178

PHYTOPLANKTON PRODUCTION AND COMMUNITY COMPOSITION IN A MARSH-DOMINATED ESTUARY WHICH RECEIVES SEWAGE WASTE,

Delaware Univ., Newark. Coll. of Marine Studies.
F. C. Daiber, and E. M. Simek, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153685, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Center, University of Delaware, Technical Completion Report, October, 1981. 73 p, 14 Fig, 6 Tab, 66 Ref, 3 Append. OWRT-A-052-DEL(1), 14-34-0001-1108.

Descriptors: *Phytoplankton, *Tidal marshes, Tidal streams, Productivity, Primary productivity, Aquatic productivity, Organic carbon, Diatoms, Dinoflagellates, Estuaries, Nutrients, *Eutrophication, Sewage, *Murderkill River estuary, *Delaware.

An investigation of the Muderkill River estuary, Delaware was conducted to describe the phytoplankton community, measure phytoplankton production and evaluate this production relative to other sources of organic carbon. Phytoplankton cell counts were highest in March, decreased to low levels by July, then increased and remained fairly uniform at high levels throughout late summer, autumn and winter. The community was dominated by diatoms in winter and spring, and small microflagellates in late summer and early autumn. Phytoplankton production averaged 380 gC/m2/yr, and the average water column respiration rate was 280 gC/m2/yr. During the year, phytoplankton produced an estimated 340 million grams of organic carbon, but water column respiration required 250 million grams of organic carbon. Phytoplankton production was sufficient to account for planktonic respiration from April through mid-October, but the plankton community was not self-sustaining during the rest of the year. Nutrient concentrations, augmented measurably by a wastewater treatment plant, supported high rates of production but the estuary as a whole does not appear to be distinctly eutrophic. A shallow eutrophic zone appeared to limit phytoplankton production. Phytoplankton produced less organic carbon than either the edaphic algae or emergent macrophytes in this marsh system. The phytoplankton contribution to the organic carbon pool in this estuary is considerably less than that from the marsh surface or upstream sources. Despite its relatively small quantitative contribution, phytoplankton carbon is of high quality and its importance in this system must not be discounted.
W82-02179

ENVIRONMENTAL CONTROL TECHNOLOGY DEVELOPMENT FOR GEOTHERMAL ENERGY,

Department of Energy, Oakland, CA. Geothermal Energy Div.
G. Katz.
Journal of the Water Pollution Control Federation Vol 53, No 10, p 1447-1451, October, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Water pollution effects, *Environmental control, *Geothermal resources, *Water pollution prevention, Water pollution sources, Ecological effects, Environmental effects, Geothermal power, Geysers, Springs, Thermal springs, Power plants, Thermal power plants, Air pollution.

Some environmental impacts from the use of geothermal energy in the United States and other nations are discussed. Surface water impacts include chemical degradation of domestic, recreational, agricultural and ecosystem resources. Subsurface impact is usually limited to chemical degradation of groundwater supplies. Water pollution sources connected with the harnessing of geothermal energy include well drilling muds, well effluents, power plant effluents and thermal stresses, spills of stored and transported chemicals, and wastes associated with pipeline breaks and power plant operation. Most environmental impact analysis work in the United States has been carried out at the Geysers, a vapor-dominated resource unit in California. With the development of liquid geothermal resources, new environmental issues have arisen. So far, the environmental impacts from geothermal energy utilization have been controllable by present technology. Careful effluent monitoring and a willingness to develop new control technologies when needed are required on a specific site/application approach basis. (Geiger-FRC)
W82-02197

CHEMICAL AND BIOLOGICAL PROCESSES CONTROLLING THE RESPONSE OF A FRESHWATER ECOSYSTEM TO COPPER STRESS: A FIELD STUDY OF THE CUSO4 TREATMENT OF MILL POND RESERVOIR, BURLINGTON, MASSACHUSETTS,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
D. McKnight.
Limnology and Oceanography, Vol 26, No 3, p 518-531, May, 1981. 8 Fig, 4 Tab, 45 Ref.

Descriptors: *Reservoirs, *Copper sulfate, *Algal control, Copper, Eutrophication, Phytoplankton, Primary productivity, Toxicity, Ions.

The phytoplankton succession in Mill Pond (Burlington, Massachusetts) after treatment with CuSO4 was compared to the copper sensitivities of three important species from the pond. Also, the biological response of the aquatic environment to trace metal stress was evaluated. The CuSO4 treatment was performed to control a late summer bloom of Ceratium hirundinella. Initially, the treatment was toxic to C. hirundinella but not to Nannochloris sp. and Ourococcus sp. Initially primary production decreased, but returned to pretreatment levels. After two months, the total copper concentration in the epilimnion returned to background levels, and the phytoplankton was no longer dominated by copper tolerant species. Data indicated that the concentration of free copper ion determined the toxic response of the phytoplankton in the reservoir. (Small-FRC)
W82-02233

HEAVY METALS AND MARINE PHYTOPLANKTON: CORRELATION OF TOXICITY AND SULFHYDRYL-BINDING,

Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
N. S. Fisher, and G. J. Jones.
Journal of Phycology, Vol 17, No 1, p 108-111, 1981. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Algae, *Toxicity, *Heavy metals, Metals, *Phytoplankton, Asterionella, Mercury, Lead, Copper, Cadmium, Mangangese, Zinc, Water pollution effects, Sulfhydryl groups, Amino acids, *Diatoms, Sulfur compounds, *Australia.

The toxicities of 6 heavy metals to the marine diatom Asterionella japonica Cleve were correlated with the solubility products of the corresponding metal sulfides. Depression of growth rates by sublethal concentrations of the metals was greatest for Hg, which has the greatest affinity for sulfur. The EC50s (in micromoles) were as follows: Hg, 0.019; Cu, 0.2; Zn, 0.9; Pb, 1.0; Cd, 2.1; and Mn, 88.3. There was high correlation between log EC50 values and the stability constants of these metals for cysteine or methionine and with stability constants for non-sulfurous amino acids (glycine). However, the stability constants of metal-cysteine complexes were orders of magnitude greater than any metal-amide complex (metal-glycine). These results and those of other workers suggest that the mechanism of metal toxicity to algae is SH group binding, whereupon metabolic processes such as silica deposition are disrupted. (Cassar-FRC)
W82-02272

HYDROPOWER: UNTAPPED RESOURCE AND ENVIRONMENTAL HAZARD,

B. Dampier.
Ambio, Vol 10, No 5, p 252-253, 1981. 1 Fig, 1 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, Water supply development, River basin development, Resources development, Dams, *Environmental effects, Powerplants, Hydroelectric power.

Currently hydropower generates roughly 23% of the world's energy supply. By the year 2020 that figure is expected to be almost quintupled. Perhaps the greatest experience with small scale hydropower is in China, where some 88,000 hydropower plants, averaging about 70 kW each, have been built in the past two decades. Most of the remaining unexploited hydropower reserves are located in the developing nations. Africa, Asia and Latin America together account for about 60% of the world's technically usable hydropower potential. How quickly these hydropower reserves are exploited depends on economic considerations such as construction and fuel costs and the costs of meeting increasingly stringent environmental protection requirements. It is also anticipated that both pumped storage and modifications to existing plants will increase the world's generating capacity. One of the most serious stumbling blocks for the unimpeded proliferation of large hydroprojects is the problem of siltation. Furthermore, large reservoirs created by dams encourage the spread of waterborne diseases such as malaria, schistosomiasis and sleeping sickness. (Baker-FRC)
W82-02277

NITRATE AND AMMONIA UPTAKE IN THE APEX OF THE NEW YORK BIGHT,

Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, ME.
C. Garside.
Limnology and Oceanography, Vol 26, No 4, p 731-739, July, 1981. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Nitrates, *Ammonia, *Productivity, Phytoplankton, *New York Bight, Nitrogen, Seasonal variation, Eutrophication, Algae, Light intensity, Nutrients, Fate of pollutants, Water pollution effects.

Nitrate and ammonia uptake were measured in the apex of the New York Bight during spring, summer, fall, and winter, 1977-78. Most of the sewage-derived N loading, up to 160 tons per day, reaches this area. Uptake was highest during spring and summer blooms (total nitrate plus ammonia uptake, 1.2 microgram atoms per liter), lowest in fall (total nitrate plus ammonia uptake, about 0.04 microgram atoms per liter). Uptake was a maximum at 50 microEinst per sq meter per sec and was inhibited at higher light intensities. In general, increasing ammonia concentrations caused decreases in nitrate uptake, which amounted to 50% of total inorganic N uptake at a concentration of 2 microgram atoms per liter ammonia. Doubling time of particulate N decreased as blooms developed (from 101 to 17 hours), and depletion times of nitrate and ammonia pools decreased from 7000 to 30 hours and 170 to 1 hour, respectively. At the onset of silicate- or nitrogen-limitation, doubling time and depletion times abruptly increased. Calculation of seasonal productivities gave the following results (in mg N per sq m per day): summer, 125 plus or minus 87; winter, 82 plus or minus 29; and fall, 22 plus or minus 5. (Cassar-FRC)
W82-02286

THE TOXICITY OF 2,4-D TO CYPRINUS CARPIO VAR. COMMUNIS IN RELATION TO THE SEASONAL VARIATION IN THE TEMPERATURE,

Udaipur Univ. (India). Dept. of Limnology and Fisheries.
H. K. Vardia, and V. S. Durve.
Hydrobiologia, Vol 77, No 2, p 155-159, 1981. 4 Tab, 21 Ref.

Descriptors: *Herbicides, *Toxicity, *Fish, Carp, 2,4-D, Seasonal variation, Temperature, Water temperature, Water pollution effects, *Weed control, Aquatic weed control.

The toxicity of 2,4-D, used for aquatic weed control, to carp (Cyprinus carpio) varied with water temperature. Jar tests with fish averaging 6.5 cm in length were performed with 2,4-D at concentrations of 3.2 to 45 ppm for up to 96 hours exposure at temperatures ranging from 17 to 39 C. At the highest temperature, 18 ppm of 2,4-D killed 100% of the fish within 24 hours. At the lowest temperature, 45 ppm of 2,4-D produced 60% mortality after 96 hours. The median tolerance limits (in ppm) at 96 hours were 5.10 at 39 C, 15.30 at 33 C, 20.00 at 28.5 C, 24.15 at 25 C, 31.25 at 20 C, and 35.00 at 17 C. There were no mortalities after 96 hours at 3.2 ppm (39 C), 5.6 ppm (33 C), 18 ppm (28.5 C), 20 ppm (25 C), and 25 ppm (20 and 17 C). (Cassar-FRC)
W82-02294

INTERNATIONAL CONFERENCE ON THE EFFECTS OF ACID RAIN URGES MORE RESEARCH IN CRITICAL AREAS,

Swedish Natural Science Research Council, Stockholm.
M. Falkenmark.
Ambio, Vol 9, No 3/4, p 198-199, 1980.

Descriptors: *Acid rain, *Conferences, *Chemistry of precipitation, Air pollution, Chemical reactions, Vegetation effects, Soil chemistry, Research priorities, Water pollution sources, Water pollution effects.

The International Conference on the Ecological Impact of Acid Precipitation attracted 300 scientists from 17 countries and included the following six main sessions: Transport and deposition, movement through vegetation and direct effects on vegetation, impact on soil and indirect effects on vegetation, effects on water quality, effects on aquatic biota, and integrated studies. The chemical composition of rain is affected by atmospheric pollution. As the rain filters down to groundwater supplies it is further modified by chemical interactions with vegetation and the soil. Catchment hydrology is a crucial factor, and the new Henriksen's acidification predictor diagram for lakes received much attention. This diagram summarized the hydrochemical conditions observed in numerous lakes in terms of pH in precipitation and Ca and Mg in river runoff. A number of research priorities were set, including an increasing focus on the aluminum set free by soil processes and integrated studies with a holistic view. (Small-FRC)
W82-02311

SEASONAL VARIATION IN THE TRACE METAL CONTENT OF MYTILUS EDULIS,

Portsmouth Polytechnic (England). Dept. of Chemistry.
R. Boalch, S. Chan, and D. Taylor.
Marine Pollution Bulletin, Vol 12, No 8, p 276-280, August, 1981. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Trace metals, *Mussels, Metals, Seasonal variation, Cadmium, Cobalt, Copper, Lead, Manganese, Mercury, Nickel, Zinc, Monitoring, Water pollution effects, *Coastal waters, Paignton, *England.

Data was sought on metal concentration in mussels in an uncontaminated environment at different times during the year. Mussels were obtained from a well established mussel bed in an uncontaminated coastal area at Paignton, South Devon. Thirteen consecutive monthly collections were made from February 1977 through February 1978, and an additional sample was taken in January 1979. The 'normal' values for trace metal content of individual Mytilus edulis covered a wide range, approaching three orders of magnitude in some cases. Although fairly dramatic changes occurred in the concentrations of some metals such as cobalt, manganese and mercury between August and September, there was little evidence of any overall seasonal pattern. Since the 'natural' range of trace metal concentrations varied so widely in this sample population, it is suggested that interpretations of changes in such parameters be made with great care. (Baker-FRC)
W82-02312

CONTROL OF AQUATIC WEEDS WITH HEXAZINONE,

Science and Education Administration, Davis, CA.
For primary bibliographic entry see Field 4A.
W82-02326

PERIPHYTON PRODUCTION IN AN APPALACHIAN MOUNTAIN TROUT STREAM,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
L. E. Hornick, J. R. Webster, and E. F. Benfield.
American Midland Naturalist, Vol 106, No 1, p 22-36, July, 1981. 4 Fig, 5 Tab, 79 Ref.

Descriptors: *Periphyton, *Primary productivity, *Algae, Productivity, Guys Run, Virginia, Streamflow, Light intensity, Carbon, Nutrients, Seasonal variation, Aquatic environment.

Periphyton primary production was studied in Guys Run, Virginia, a second-order Appalachian Mountain stream, and in two of its tributaries during April 1977 to April 1978. Mainstream primary production averaged 2.27 mg C per sq m per hour (range, 0.4207.16) and in the tributaries, 1.37 mg C per sq m per hour (range, 0.15-5.46). Measurements were obtained in situ, using C14 fixation

in recirculating chambers. In all three streams primary production rates were highest in spring and early summer and declined during summer and autumn. Light, streamflow, and inorganic C influenced primary production. Correlations between primary production and nutrient levels were variable. Mean allochthonous input at five sites was 347 g per sq m per year vertical fallout and 113 g per sq m per year lateral movement or 230 g C per sq m per year. This gives an autochthonous primary production amounting to 3% of allochthonous inputs for the main stream and 2% for the tributaries. This autochthonous output may be underestimated because of sampling techniques. Autochthonous primary production may be of significant importance as a food source for macroinvertebrates in low-order streams during the spring and summer when leaf detritus availability is low. (Cassar-FRC)
W82-02335

INFRARED ABSORPTION STUDY OF HUMIC SUBSTANCES FROM LAKE APOPKA SEDIMENT, PLANKTON AND THE SURROUNDING DRAINAGE BASIN,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Engineering and Science.
For primary bibliographic entry see Field 2H.
W82-02348

THE EFFECT OF AQUATIC HUMUS ON THE BIOLOGICAL AVAILABILITY OF CADMIUM,

Norsk Inst. for Vannforskning, Oslo.
E. T. Gjessing.
Archiv fur Hydrobiologie, Vol 91, No 2, p 144-149, May, 1981. 3 Fig, 7 Ref.

Descriptors: *Toxicity, *Cadmium, *Humic acids, Water pollution effects, Fish, Salmon, Algae, Chelation, Heavy metals, Metals, Aquatic life, Fate of pollutants.

Cadmium was less toxic to salmon and algae in waters containing aquatic humus than in plain tapwater. Atlantic salmon exposed to 1 mg Cd per liter showed 100% mortality at 32 hours in tapwater, at 47 hours in diluted humus water, and 80% mortality at 90 hours in concentrated humus water. 50% of algae cells were present after 4 days exposure using 5 micrograms Cd per liter in tapwater and about 60-70 micrograms Cd per liter with addition of humus water in the ratios 1:2 and 1:5. Curves were plotted for tapwater and humus concentrations of 1:2 and 1:5 and Cd concentrations from 1 to 500 micrograms per liter. At 10 micrograms Cd per liter about 20% of cells remained after 4 days in tapwater, about 65% in water with added humus at the 1:5 ratio, and over 100% in water with added humus at the 1:2 ratio. (Cassar-FRC)
W82-02353

PRODUCTIVITY AND SPECIES COMPOSITION OF ALGAL MAT COMMUNITIES EXPOSED TO A FLUCTUATING THERMAL REGIME,

Rensselaer Polytechnic Inst., Troy, NY.
D. L. Tison, E. W. Wilde, D. H. Pope, and C. B. Fliermans.
Microbial Ecology, Vol 7, No 2, p 151-165, 1981. 9 Fig, 6 Tab, 25 Ref.

Descriptors: *Aquatic life, *Thermal pollution, Heated water, *Temperature effects, Waste heat, Powerplants, Nuclear reactors, Nuclear powerplants, Nuclear wastes, Swamps, *Algal growth, Algae.

Attempts were made to determine the effect of large fluctuations in thermal regime on algal physiology and species composition at various temperatures in the thermal effluent from the Savannah River Plant. Nuclear production reactors from this plant discharge thermal effluents at 40-45 degrees C above ambient temperatures. Two of the reactors on the site have once-through cooling systems which take in water from the Savannah River and discharge thermal effluents into swamp areas, where temperatures cool to ambient before the waters return to the river. The thermophilic algal flora of this unique swamp habitat was compared with the thermophilic algae of natural hot springs. Rates of primary production and species composition were monitored at four sites along a thermal gradient in a trough microcosm. Blue-green (cyanobacter) were the only phototrophic primary producers growing in water above 45 degrees C. These thermophiles survived and apparently adapted to ambient temperatures when the reactor was shut down. The communities of the algal mat exposed to less than 45 degrees C were composed of blue-green and eukaryotic algae which adapted rapidly to ambient temperatures. During periods of thermal fluctuation an increase was noted in the percentage extracellular release of C-14 labeled dissolved organic compounds and a decrease in primary production. The study suggests that dominant phototrophs in this artificially heated aquatic habitat have been selected for their ability to survive large temperature variations and are similar to those found in natural hot springs. (Baker-FRC)
W82-02356

A COMPARISON OF THE INCIDENCE OF FIVE PATHOLOGICAL CONDITIONS IN SOFT-SHELL CLAMS, MYA ARENARIA, FROM ENVIRONMENTS WITH VARIOUS POLLUTION HISTORIES,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
H. A. Walker, E. Lorda, and S. B. Saila.
Marine Environmental Research, Vol 5, No 2, p 109-123, 1981. 3 Fig, 4 Tab, 20 Ref.

Descriptors: *Clams, *Water pollution effects, Industrial wastes, Organic compounds, Monitoring, Water analysis, Oil refineries, Industrial plants, Oil industry, Oily water, Oil pollution, Rivers, Coastal waters, Estuarine environment, Comparison studies.

Two different analytical techniques were used to compare the distribution of occurrences and cooccurrences of five pathological conditions in samples of the soft-shell clam, Mya arenaria, collected at 17 locations on the east coast of the United States. In the first technique the relative fits of Poisson and Lagrange-Poisson distributions to the data were related to the mortality rate and spread of the pathological conditions. In the second technique, a severity index based on a matrix of occurrences and cooccurrences and the analysis of its eigenvectors were used to measure and to characterize the severity of the spread. The data suggested a possible relationship between the pollution history of the area and the incidence of pathological conditions in the populations surveyed. The occurrence of both neoplasia and hyperplasia affecting more than 10% of a given clam population was more often found in areas impacted with refined petrochemicals. It is suggested that crude oils and heavy metals had less effect on the incidence of hyperplasia and neoplasia than more refined petrochemicals. These two analytical methods demonstrated great utility for the intended comparisons and should find broad application to environmental monitoring and impact assessment studies in general. (Baker-FRC)
W82-02357

FATE AND EFFECTS OF A HEAVY FUEL OIL SPILL ON A GEORGIA SALT MARSH,

Skidaway Inst. of Oceanography, Savannah, GA.
For primary bibliographic entry see Field 5B.
W82-02358

ENVIRONMENTAL REPERCUSSIONS OF IRRIGATION DEVELOPMENT IN HOT CLIMATES,

Ahmadu-Bello Univ., Zaria (Nigeria). Dept. of Environmental Health.
For primary bibliographic entry see Field 6G.
W82-02366

AN ASSESSMENT OF CURRENT STANDARDS FOR SELENIUM IN DRINKING WATER,

Kirkham Michael and Associates, Omaha, NE.
For primary bibliographic entry see Field 6F.
W82-02372

EFFECTS OF PH, PHOSPHATE, AND AMMONIA ON THE RATE OF UPTAKE OF NITRATE AND AMMONIA BY FRESHWATER PHYTOPLANKTON,

Oklahoma State Univ., Stillwater. School of Biological Sciences.
D. W. Toetz.
Hydrobiologia, Vol 76, No 1/2, p 23-26, 1981. 1 Fig, 4 Tab, 13 Ref.

Descriptors: *Nitrogen, *Phytoplankton, Absorption, Nitrates, Phosphates, Acidity, Ammonia, Natural waters, Algal growth, Nutrients, *Lake Carl Blackwell, *Oklahoma, *Hydrogen ion concentration.

During the summer of 1974 observations were made at Lake Carl Blackwell, Oklahoma, on the effect of phosphate and pH in regulating nitrate and ammonia uptake by phytoplankton using N-13 tracers. The high pH of the lake water noted during 1974 suggested that dissolved inorganic carbon (DIC) was a limiting factor. During 1975 the pH of the water was altered in efforts to vary the quantity of available DIC and added phosphate to see if DIC and phosphate interacted. At ambient pH there was little enhancement of nitrate uptake by additions of phosphate. Similarly nitrate uptake was not markedly changed by pH at any concentration of phosphate. Algal flora in the lake water during the 1975 experiments was a heterogeneous mixture of green algae, diatoms and bluegreen algae, predominantly the latter two groups. During July and August of 1973 the ambient concentration of ammonium limited nitrate uptake. The regression analysis indicates that nitrate uptake approached zero at a concentration of about 210 micrograms ammonium-nitrogen. (Baker-FRC)
W82-02398

STRUCTURAL CHARACTERISTICS OF ALGAL COMMUNITIES IN THERMAL ALTERED ARTIFICIAL STREAMS,

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
E. W. Wilde, and L. J. Tilly.
Hydrobiologia, Vol 76, No 1/2, p 57-63, 1981. 1 Fig, 2 Tab, 35 Ref.

Descriptors: *Streams, *Temperature effects, *Algal growth, Algae, Seasonal variations, Simulation, Bottom sediments, Sedimentation, Sediments, *Thermal pollution, Stream biota.

Differences in algal communities developed and maintained under different temperature regimes are described, aong with some characterizations of the substrate affinities and associations of abundant taxa in a South Carolina blackwater stream system. The study site consisted of six artificial streams housed in a greenhouse on the banks of Upper Three Runs Creek near Aiken, South Carolina. Preliminary studies indicated that the algae in the artificial streams could be conveniently distinguished into the following five groups: rocky rapids algae, silty sediment algae, surface scum algae, sandy sediment algae, and miscellaneous attached algae. Thirty-two taxa were raked as abundant in at least one sample during the study. Temperature related shifts in the abundance of major species were demonstrated. Red algae were absent from a stream heated 12.5 degrees C above ambient, but remained abundant in streams heated 7.5 degrees C or less. Water temperatures above 30 degrees C produced blue-green algal dominance and eliminated several indigenous species. Substrate specificity was exhibited by all major taxa. Several taxa were abundant only on the bottom sediments, and others showed a distinct affinity for either sand or silt, which were the principal bottom types. The most obvious observed effect of chronic temperature elevations was the replacement of Vaucheria by Schizothrix. (Baker-FRC)
W82-02399

EFFECT OF PEMBROKE POWER STATION ON THE TEMPERATURES IN MILFORD HAVEN, WALES,

Central Electricity Generating Board, Bristol (England).
R. T. Jarman, and C. M. de Turville.

Water Science and Technology, Vol 13, No 7, p 295-304, 1981. 7 Fig, 5 Tab, 4 Ref.

Descriptors: *Temperature effects, *Electric powerplants, Thermal pollution, *Estuaries, Plumes, Water pollution effects, Powerplants, Water temperature, Cooling water, Outfall, Waste heat, Thermal stress, Model studies, *Milford Haven estuary, *Wales.

The effects of the heat discharge from the Pembroke Electric Power Station on Milford Haven Estuary, Wales, were examined using thermographs, boat surveys, and aerial infrared surveys of the outfall plume. Strong mid-channel currents tended to confine the plume to the southern section of the estuary during most of the tidal cycle. Plume impingement effects were noted at the two southern sample points closest to the outfall. A mean temperature rise of about 0.5 degrees/gigawatt generated/tidal cycle was observed at the Texaco Jetty site, with general warming creating an additional rise of approximately 0.7 degrees/gigawatt/tidal cycle. No significant correlations between temperature rise and electricity generation were found at any of the other sampling sites. A model of the long term heating of the estuary showed that the natural fluctuations in temperature were comparable to the temperature rises recorded at distances of 3 kilometers from the outfall. (Geiger-FRC)
W82-02406

ON THE TROPHIC STATUS AND CONSERVATION OF KASHMIR LAKES,

Central Inland Fisheries Research Inst., Harwen (India).
K. K. Vass.
Hydrobiologia, Vol 68, No 1, p 9-15, January, 1980. 5 Fig, 2 Tab, 22 Ref.

Descriptors: *Trophic level, *Lake classification, *Eutrophication, *Kashmir Valley, Water quality, Phytoplankton, Water pollution effects, Algae, Aquatic life, Aquatic plants, Water pollution control, India.

Limnologic data, especially trophic state, was documented for 3 lakes in the Kashmir Valley. The lakes (Dal, consisting of 3 sub-basins, Anchar, and Manasbal) lie in the Jhelum River flood plain and are shallow, mean depth 0.6-3.0 meters. Tendencies toward eutrophication were seen in the lakes' morphometry, increased oxygen in the surface layer, hypolimnetic oxygen deficit, increased specific conductivity (200-500 micro s at 25 C), pattern of assimilation curve, and increased phytoplankton production (185-600 mg C per sq meter per day). However, nitrates (20-25 micrograms per liter) and phosphates (5-10 micrograms per liter) were low, plankton blooms have not been observed, and plankton density was low. Dominant phytoplankton groups were Cyanophyta, Pyrrophyta, Chlorophyta, and Chrysophyta. Recommendations for slowing eutrophication in these lakes are: (1) zoning to prevent further development near the lakes, (2) elimination of sewage discharges into the lake from villages and houseboats, (3) controlling dredging, which releases nutrients from sediments, (4) removing weeds and algae by cutting, manatees, or grass carp, and (5) removing nutrients from wastewater before discharge into the lake. (Cassar-FRC)
W82-02412

GROWTH OF MYTILUS EDULIS IN NET BAGS TRANSFERRED TO DIFFERENT LOCALITIES IN A EUTROPHICATED DANISH FJORD,

Miljostyrelsen, Charlottenlund (Denmark). Marine Pollution Lab.
H. U. Riisgard, and E. Poulsen.
Marine Pollution Bulletin, Vol 12, No 8, p 272-276, August, 1981. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Eutrophication, *Mussels, *Fjords, Oxygen depletion, Algae, Wind, Brackish water, Seawater, Growth, Hydrogen sulfide, *Denmark.

Growth has been measured in mussels transferred in net bags to different localities in the brackish Danish fjord, Limfjorden, in which certain areas are heavily eutrophicated. Large areas in the fjord suffer each summer from oxygen from the sediments. The increase in flesh dry weight ranged from twice the starting weight at one station to four times as much at another. The net growth efficiency in most cases was about 60% and in two cases above 70%. This indicates that more than 2.3 of the absorbed food energy was used for growth by the mussels. Low growth rates in Mytilus were noted at two stations located in areas with seasonal oxygen depletion. Thus these growth experiments demonstrated that certain conditions of pollution can reduce the growth ability of Mytilus, these being conditions under which low oxygen tension or toxic hydrogen sulfide is released from the sediments on days without strong wind and efficient vertical mixing of the water. It is felt that monitoring Mytilus edulis grown in net bags under standardized conditions in marine recipients can be a useful tool in unveiling biological effects in monitoring programs. (Baker-FRC)
W82-02428

DISCHARGE AND CHEMICAL CHANGES IN A CHALK STREAM HEADWATER AFFECTED BY THE OUTFLOW OF A COMMERCIAL WATERCRESS-BED,

Freshwater Biological Association, Wareham (England). River Lab.
H. Casey.
Environmental Pollution, Series,B, Vol 2, No 5, p 373-385, 1981. 6 Fig, 2 Tab, 17 Ref.

Descriptors: *Streams, *Chemical composition, Farming, Phosphates, Flow discharge, Chemical reactions, Discharge measurement, Effluents, Watercress bed, Chalk stream.

The effects of an outflow from a commercial watercress bed were studied on the discharge and chemistry of a natural chalk stream headwater. The study area was the headwaters of the Bere Stream at Millum Head. The size, shape and management of watercress beds varies between regions and users. Stream discharges were high in the winter and low in late summer and autumn. The increase in discharge between sites 1 and 2 (0.191 and 0.20 cu m/sec respectively) was due to a small input from a side stream and chalk springs feeding water into the bed of the stream. Discharge from the outflow of the watercress bed had a mean value of 0.046 cubic meter/second. In November of 1978 the outflow from the watercress-bed was providing twice as much water to Bere Stream as the natural source at Millum Head. Weedcutting caused large variations in water depths, and a late autumn weedcut reduced the stream to a shallow trickle of water. The chemical composition of the Millum Head stream was stable except in times of heavy rain. The water is well buffered with respect to pH and calcium bicarbonate. The chemical composition of the watercress bed outflow showed much greater variation, due to human management. It was concluded that the discharge from the watercress bed outflow would have a beneficial effect upon the chalk stream headwater in low flow periods. The high concentration of reactive phosphate in the bed outflow water will raise stream reactive phosphate concentrations, as the bed is responsible for 39.3% of all reactive phosphate throughput. (Baker-FRC)
W82-02429

WATERBORNE DISEASE IS PREVALENT IN EGYPT,

C. L. Senn.
Journal of Environmental Health, Vol 43, No 1, p 30-31, July/August, 1980, 4 Tab.

Descriptors: *Water quality, *Human diseases, Diseases, Regulations, Standards, *Egypt, Regional development, Water supply, Water supply development, Waterborne diseases.

In a special study at the Children's Hospital and Cairo University involving 100 diseased infants age 3 months to 2 years, bacillary dysentery organisms were recovered from 22 cases. The suspected causes of illness in the remaining cases included viruses and other organisms. The infant death rate for Egypt is about 114 per 1000 live births, comparable to other countries in that region. Mothers are advised to breast feed their infants as long as possible. Mothers are advised to boil bottle milk, but probably many do not. Mothers in poor communities are supplied with powdered milk, but it is often reconstituted with contaminated water. Control of infant disease calls for education to minimize urine and fecal contamination of streams, and snail control by natural and chemical means. It is extremely important that water be piped into the homes, thus avoiding contamination of a common water supply by handling and dipping. This also facilitates washing of vegetables and fruits, dishes and utensils. Having water within the living unit promotes better personal hygiene and has caused reductions in several diseases. The existing water system of the Greater Cairo Region has been greatly over-taxed. Pressure is inadequate to carry water continuously to higher than the second floor in many places. Programs are needed to reduce leakage and wastage and which can offer adequate protection and enforcement programs to safeguard the water. (Baker-FRC)
W82-02435

ASPECTS OF WATER POLLUTION IN LAKE NAINI TAL, U.P., INDIA,

Kumaun Univ., Naini Tal (India). Dept. of Zoology.
M. C. Pant, P. K. Gupta, J. Pande, P. C. Sharma, and A. P. Sharma.
Environmental Conservation, Vol 8, No 2, p 113-117, Summer, 1981. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Lake Naini Tal, *Water pollution effects, *Coliforms, Water quality, Aquatic life, Lead, Manganese, Biochemical oxygen demand, Dissolved oxygen, Eutrophication, *India.

The water quality of Lake Naini Tal, India, was analyzed in a year long study which tested lake water samples for coliform bacteria, metallic ions, physico-chemical features, and biological characteristics. The most probable number of coliform bacteria varied from 0.59 times 10 to the 5th power per 100 ml during the spring to 3.61 times 10 to the 5th power per 100 ml during the monsoon. Dissolved oxygen concentrations were high near the surface and low near the bottom, and BOD values always exceeded 6.0 mg/liter. Concentrations of NO3-N and PO4-P were high enough to cause phytoplankton blooms upon occasion. Lead and manganese were found at higher than permissible levels. Most of the carp fish were infected with Saprolegnia or other fungi or with trematodes. Phytoplankton and zooplankton were abundant. Macrobenthic species were absent from the profundal zone of the lake, which was severely polluted. (Small-FRC)
W82-02442

RELATIONSHIP BETWEEN POPULATIONS OF AMPHIPODS AND POLLUTION,

Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume.
D. Bellan-Santini.
Marine Pollution Bulletin, Vol 11, No 8, p 224-227, August, 1980. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Amphipods, *Water pollution effects, *Aquatic populations, Aquatic animals, Crustaceans, Population dynamics, Population density, *Mediterranean Sea, *France, *Coastal waters, Gammarus.

The effects of pollution on the composition and distribution of amphipod populations inhabiting rocky environments in the French Mediterranean coastal waters have been investigated over an 18-year period. Nineteen series of between 10 and 15 samples of 400 square centimeters each were analyzed as to species, number of individuals, partial dominance, Shannon-Weaver and Margalef Index of diversity, and similarity index of Sanders. The area studied ranges from the Rhone delta to the peninsula of Embiez and includes the Gulf of Fos, which experiences strong industrial pollution, and the Cove of Cortiou, which receives mainly domestic wastes from the City of Marseille. The global study of the amphipod population showed

that the mean number of amphipod species decreased with increasing pollution; that the mean number on individuals decreased with increasing pollution; that the Margalef diversity index decreased when pollution increased; and that there appear to be two amphipod subpopulations: one in pure or very pure water and one in more or less polluted water. Eleven of the 39 amphipod species inventoried represented 74.9 percent of the total specimens. A total of 35 species of gammarids and 4 species of caprellids were represented by over 90,000 individuals. Although no characteristic group of species was found to be typical of areas affected by pollution, certain species were excluded by more severe pollution. The species of the genous Hyale, a grazing species, led the dominant group in pure or very pure water, while Jassa falcata and Podocerus variegatus, both suspension feeders, comprised the essential elements of the dominant group found in more or less strongly polluted waters. (Carroll-FRC)
W82-02444

AQUATIC BIOLOGY OF THE REDWOOD CREEK AND MILL CREEK DRAINAGE BASINS, REDWOOD NATIONAL PARK, HUMBOLDT AND DEL NORTE COUNTIES, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4C.
W82-02484

CUMULATIVE EFFECTS OF LOGGING ROAD SEDIMENT ON SALMONID POPULATIONS IN THE CLEARWATER RIVER, JEFFERSON COUNTY, WASHINGTON,

Washington Univ., Seattle. Fisheries Research Inst.
For primary bibliographic entry see Field 2J.
W82-02507

CHARACTERIZATION OF SPAWNING GRAVEL AND STREAM SYSTEM EVALUATION,

Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 2J.
W82-02509

AGGLUTINATION AND BACTERICIDAL RESPONSES OF THE CHANNEL CATFISH TO SALMONELLA PARATYPHI,

Memphis State Univ., TN. Dept. of Biology.
D. D. Outh, and E. A. Wilson.
Developmental and Comparative Immunology, Vol 5, No 2, p 261-270, 1981. 2 Fig, 2 Tab, 20 Ref. OWRT-A-056-TENN(3), 14-34-0001-9045.

Descriptors: *Channel catfish, *Commercial fish, Fish farming, Agriculture, Recirculated water, Water reuse, *Catfish, *Bacteria, *Immunization, Salmonella paratyphi, *Antibiotics.

Intraperitoneal immunization of channel catfish, Ictalurus punctatus, with Salmonella paratyphi in Freund's complete adjuvant produced persistent agglutinating antibody titers of hundreds of thousands during a 1-year response. Bactericidal activity of 2 high-titered sera averaged 30% and 20%. Post-immunization bactericidal activity varied little and remained within 10% of pre-immunization bactericidal activity. Fresh channel catfish serum from unimmunized catfish exhibited 100% bactericidal activity against S. paratyphi. Lysozyme was present in fresh channel catfish serum at 1.8 micrograms/ml serum or 34 ng lysozyme/mg protein.
W82-02524

THE STUDY OF PHOSPHORUS AND NITROGEN FLUXES IN ENRICHED ISOLATION COLUMNS,

Natal Univ., Pietermaritzburg (South Africa). Dept. of Botany.
A. J. Twinch, and C. M. Breen.
Hydrobiologia, Vol 77, No 1, p 49-60, 1981. 6 Fig, 44 Ref.

Descriptors: *Nutrients, *Algae, *Eutrophication, Periphyton, Phosphates, Nitrates, Seasonal variation, Sediments, Chlorophyll a, Water pollution effects, *Midmar Dam, *South Africa.

Nutrient fluxes were studied in 4 isolation columns placed in 3.5 m of water in Midmar Dam, South Africa, a turbid oligotrophic impoundment. The columns were enriched weekly to add the following (in micrograms per liter): P, 150; N, 200; and P, 150, plus N, 200. One column was left unenriched as a control. All enrichment treatments caused increased chlorophyll concentrations. Large seasonal variations were observed. Addition of phosphate alone only increased chlorophyll concentrations to the point of nitrate limitation. Most of the phosphate was adsorbed by sediments. Nevertheless, soluble reactive P concentrations were high in August-October. This was probably a result of P mobilization from the sediments. Addition of nitrate produced no response in chlorophyll levels between April and early August, but in summer (January-March) a bloom of Microcystis sp. occurred. Enrichment with both phosphate and nitrate produced eutrophic conditions in January-March. (Cassar-FRC)
W82-02563

HISTORY OF HUMAN-USE IMPACTS ON LONG POINT BAY,

For primary bibliographic entry see Field 5B.
W82-02580

5D. Waste Treatment Processes

MICROBIAL PURIFICATION OF RECYCLED WASTEWATER IN A CLOSED SYSTEM,

West Virginia Univ., Morgantown. Water Research Inst.
W. J. Shoupp, J. M. Dingess, and P. G. Moe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153693, Price codes: A04 in paper copy, A01 in microfiche. Information Report 15, 1981. 64 p, 18 Fig, 11 Tab, 98 Ref. OWRT-A-034-WVA(2), 14-34-0001-9052.

Descriptors: *Domestic wastes, *Microorganisms, *Reclaimed water, *Recycling, *Sewage bacteria, *Wastewater disposal, *Wastewater treatment, Biodegradation, Ecological balance, Ecological distribution, Ecosystems, Microbial degradation, Microbiology, Septic tanks, Wastewater pollution.

A recycling sanitary-waste disposal system was developed and tested in the laboratory by using a synthetic fecal-urinous waste material. The system was capable of supporting an aerobic microbial population with an organic loading equivalent to the waste of three adults by using an aeration rate of 12 liters of air per minute. Increasing the temperature of the digestion tank from 23 C to 34 C reduced the rates of sludge and ammonia-nitrogen accumulation but had little effect on BOD-reduction efficiency. Reducing retention time of the waste in the digestion tank increased the rate of mineral-salt accumulation but had no deleterious effect on the microbial population during an eight-week period. Shock loads of feed up to seven times normal rate caused temporary perturbations, but the microbial population in the system showed remarkable stability and rapid recovery. Indicator organisms were unable to establish themselves in the microbial population and perished within a few hours indicating no serious health hazards in a home. The BOD-reduction efficiency was generally better than 85 percent, and the total carbon (carbon dioxide) lost was better than 95 percent. The main limiting factors were inadequate aeration and mineral-salt accumulation.
W82-02172

A FIELD EVALUATION OF SELECTED WATER CONSERVATION AND WASTEWATER REDUCTION SYSTEMS FOR RESIDENTIAL APPLICATIONS,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 3D.
W82-02180

THE EFFECT OF PH AND HALOGENS ON THE STABILITY OF REVERSE OSMOSIS MEMBRANES,

California Univ., Los Angeles. Dept. of Chemical, Nuclear, and Thermal Engineering.
S. B. McCray, J. Glater, and J. W. McCutchan.
Report UCLA-ENG-8115, WRC 73, July, 1981. 115 p 60 Fig, 10 Tab, 40 Ref, 2 Append.

Descriptors: *Reverse osmosis, *Halogens, *Hydrogen ion concentration, *Membrane processes, *Wastewater treatment, Salt rejection, Cellulose acetate membranes, Fluctuations, Polymers, Disinfection, Bromine, Chlorine, Iodine, Membranes.

Recently there has been an increase in the number of reverse osmosis plants built for the reclamation of wastewater, agricultural water, and industrial cooling water. Crucial to the operation of a reverse osmosis plant is the pretreatment of the feed water. To control microbiological growth, water disinfectants such as chlorine, iodine, bromine chloride, and chlorine dioxide are used. This study examines the response of certain commercial reverse osmosis membranes, including cellulose acetate and various types of polyamide homogeneous and composite films, to various chemical environments. For cellulose acetate, product flux is found to increase exponentially with time, while salt rejection decreases linearly. Rate constants describing these processes have been calculated at various temperatures. Results indicate that product flux and salt rejection follow first order and zero order kinetics, respectively. Activation energies have also been calculated for flux increase and salt rejection decline for cellulose acetate at pH 2.0 and 8.6. Apparently water flux and salt rejection are controlled by different mechanisms. In general, cellulose acetate membranes are resistant to halogens for up to three weeks at concentration levels equivalent to 30 ppm C1-2. All other membranes tested, however, are attacked by halogen agents under certain conditions, depending on solution pH and polymer type. The agents showing greatest promise for disinfection of polyamide membranes are chlorine dioxide at near-neutral pH and iodine at any pH level from 3.0 to 8.6. (Garrison-Omniplan)
W82-02188

ECONOMIC IMPACT OF EXISTING AMMONIA NITROGEN WATER QUALITY STANDARD, IPCB CHAPTER 3, RULE 203 (F),

Southern Illinois Univ. at Carbondale. Dept. of Thermal and Environmental Engineering.
C. B. Muchmore, W. M. Lewis, R. C. Heidinger, M. H. Poller, and L. J. Wawronowicz.
Illinois Institute of Natural Resources, Chicago, Document No 81/23, July, 1981. 202 p. 42 Fig, 28 Tab, 68 Ref, 8 Append.

Descriptors: *Ammonia, *Water quality standards, *Nitrogen compounds, *Water treatment facilities, *Ammonium compounds, Ionization, Nitrogen, Nitrification, Fish populations, Economic aspects, Operating costs, Capital costs, Stream pollution, *Economic impact, *Illinois.

This economic impact study was designed to provide additional information on existing ammonia nitrogen water quality standards by determining the actual effect of ammonia nitrogen on fish diversity and number based on measurements at selected sites in Illinois. In addition, further cost data were desired. The results of the study support the importance of considering concentrations of un-ionized ammonia, rather than total ammonia, in establishing allowable levels for Illinois streams. A previously suggested value of 0.04 mg/l un-ionized ammonia is consistent with the results of this study for the higher-diversity streams studied. For those streams that are not capable of supporting a diverse fish population, somewhat higher ammonia levels would probably not produce adverse effects. The major economic impact of attaining the current 1.5 mg/l ammonia nitrogen water quality standard would be on local government. The current evaluation confirmed the estimate of a previous study that municipal facilities would require about $180 million for capital investment, and $12 million in annual costs. Private dischargers would require $100 million in capital investment and $6 million in annual operating costs. Available cost

estimates to provide nitrification facilities for some of the treatment plants in this study indicated annual operating costs alone to be in the range of $0.83 to $2 per person. The economic impact of enforcement of the existing standard on industry was estimated to be $33.6 million in capital investment and $1.8 million in annual operating costs. The economic burden on agriculture is estimated to be small. (Garrison-Omniplan)
W82-02189

INDUSTRIAL PRETREATMENT NEEDS TO BE OVERHAULED AT THE NATIONAL LEVEL.

Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1452-1456, October, 1981.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Sewage, *Water quality standards, Municipal wastewater, Wastewater management, Hazardous materials, Pretreatment of water, Water pollution control, Environmental protection, Guidelines, Standards, Regulations.

The Federal Water Pollution Control Act of 1972 requires pretreatment of industrial wastewater before discharge to municipal systems. Although most municipal treatment authorities have sewer use ordinances, many metropolitan regions do not have active discharge control programs. Progress in the implementation of industrial sewerage plans has been slow due to complex pretreatment regulations as result of court actions and administrative decisions within the environmental Protection Agency. Also, more research is needed on the types of toxic wastes controlled under certain pretreatment schemes. The current state of the national pretreatment policy is discussed, along with five steps recommended by the Water Pollution Control Federation to improve the program. The five recommendations advocate distinguishing between direct and indirect industrial dischargers, establishing uniform pretreatment requirements for old and new indirect dischargers, eliminating the concepts of 'indicator pollutants' and removal credits, and encouraging stronger state and local pretreatment programs through federal actions. (Geiger-FRC)
W82-02198

ENGINEERING DESIGN VARIABLES FOR THE ACTIVATED SLUDGE PROCESS.

American Society of Civil Engineers, New York. Committee on Water Pollution Management.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE3, p 473-503, June, 1980. 12 Fig, 16 Tab, 19 Ref.

Descriptors: *Design criteria, *Wastewater treatment, Effluents, Nutrients, Sludge disposal, Lagoons, Nitrogen, Phosphorus, *Activated sludge process, Aerated lagoons, Oxidation ditch.

Operational criteria of a specific biological process and its modifications which are often used in secondary waste treatment of predominantely domestic wastewaters are reviewed. Variations of the activated sludge process considered include the conventional process, step aeration, tapered aeration, complete mix, aerated oxidation lagoon, oxidation ditch, high purity oxygen, contact stabilization, Draus process, high rate extended aeration, and modified or combination processes. Factors such as efficiency of biological oxygen demand removal, efficiency of suspended solids removal, cost of construction, efficiency of operation, quantity of sludge production, and nutrient removal must be considered for each variation of the overall method in selecting what is best for use in a particular situation. Operational data was obtained from waste treatment plants in Florida, Maine, New York, Pennsylvania and Virginia. It appeared in general that plants with 0-1 mgd flows achieved higher percentages of BOD and SS removals than did the larger facilities. In most cases where actual performance fell short of design performance, this was due to combinations of design and operation shortcomings. Common design faults include peak flow wash-out rates in final settling tanks, hopper slopes less than 60 degrees, settling velocities in channels and piping carrying activated sludge solids, insufficient return sludge capacity and control, and insufficient oxygen available and distributed to meet demand. This review also considered the characteristics of raw wastewater, nutrient requirements of aerobic processes, toxic and shock load sensitivity, sludge handling and disposal, and nitrogen and phosphorus removal. (Baker-FRC)
W82-02199

PROCESSES--NOT PRODUCTS--BIGGEST ENERGY-SAVING FACTORS.

Water and Sewage Works, Vol 127, No 11, p 43, 62, November, 1980. 1 Fig.

Descriptors: *Energy conservation, *Wastewater treatment, *Water treatment, Costs, Cost analysis, Conferences, Reviews.

This article reviews in general the emphasis placed on energy conservation measures in water and wastewater treatment fields. One major emphasis of recent energy seminars is to analyze treatment plants not only from the standpoint of how the industry's use of energy compares with total energy requirements of the nation, but also how different parts of the total treatment system rate comparatively. Much effort has been put into extracting the last measure of efficiency from a particular system component, when vastly greater energy savings might be gained from other areas of the treatment train. Since treatment phases are interrelated, it is often necessary to work back and forth between different phases to gain an understanding of the entire picture. The performance of the treatment facility can also be affected by the quality of the wastewater itself. Emphasis in the seminars was also given to overland flow, infiltration, and spray irrigation. Energy conserving peripheral devices such as heat exchangers, automatic and computer controls and active and passive solar energy collectors were discussed. (Baker-FRC)
W82-02218

BIODEGRADABILITY STUDIES WITH ORGANIC PRIORITY POLLUTANT COMPOUNDS,

Municipal Environmental Research Lab., Cincinnati, OH.
H. H. Tabak, S. A. Quave, C. I. Mashni, and E. F. Barth.
Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1503-1518, October, 1981. 2 Fig, 7 Tab, 37 Ref.

Descriptors: *Biological wastewater treatment, *Microbial degradation, *Pollutants, *Wastewater treatment, Biodegradation, Pesticides, Polychlorinated biphenyls, Organic compounds, Organic wastes, Gas chromatography, Dissolved solids, Organic carbon.

The microbial degradation and acclimation of 96 of the 114 organic priority pollutants included in the US EPA Consent decree list were studied by a static-culture flask-screening procedure using gas chromatoraphy, dissolved organic carbon (DOC) and total organic carbon (TOC) analysis. Phenol was used as a control compound in each biodegradability evaluation series. For incubation and unmetabolized substrate recovery, various techniques were used for phenols, phthalate esters, naphthalenes, monocyclic aromatics, polycyclic aromatics, polychlorinated biphenyls, halogenated ethers, nitrogenous organics, halogenated aliphatics, and organochlorine insecticides. Good agreement was noted for results obtained using the present technique and those found in the literature, utilizing a variety of biodegradation procedures. Priority pollutants that showed no significant degradation under the static-culture-flask methodology cannot be presumed to be completely recalcitrant to microbial action. More rigorous methods are recommended to ascertain the microbial biodegradability of pollutants that did not pass the static-culture-flask screening tests. (Geiger-FRC)
W82-02231

DUPONT'S WASTEWATER TREATMENT APPROACH,

DuPont Co., Wilmington, DE.
D. C. Hubinger, and D. G. Hutton.
Industrial Wastes, Vol 27, No 5, p 41-43, September/October, 1981. 2 Fig, 3 Tab.

Descriptors: *Chemical wastewater, *Activated carbon, *DuPont Company, *Wastewater treatment, Industrial wastewater, Biological treatment, Organic compounds, Chemical industry.

The DuPont Co. uses the PACT process (powdered activated carbon/biological treatment) to treat 35 mgd of wastewater from its Chambers Works, a complex chemical manufacturing plant, as well as 30-40 tank loads trucked in daily from other waste generators. The two-step process includes primary treatment by lime neutralization and settling (removes heavy metals, acids, and solids) and the patented PACT process (removes organics and color). Primary sludge of 45% solis is disposed of in a lined landfill. Powdered activated carbon is added to the primary clarifier effluent as it is fed to biological aeration tanks. After final clarification with polyelectrolytes, the effluent is lagooned and then discharged to the Delaware River. Sludge from the biological treatment process is treated in a multiple hearth furnace where biomass and organics are destroyed and carbon removal, 65%, in spite of the variable composition of the feed. The PACT process is available for licensing by other companies. (Cassar-FRC)
W82-02254

ENVIRONMENTAL PHENOTYPIC VARIATION OF SCENEDESMUS DIMORPHUS IN HIGH-RATE ALGAE PONDS AND ITS RELATIONSHIP TO WASTEWATER TREATMENT AND BIOMASS PRODUCTION,

Ben-Gurion Univ., Sde Boker (Israel). Inst. for Desert Research.
G. Oron, G. Shelef, and A. Levi.
Biotechnology and Bioengineering, Vol 23, No 10, p 2185-2198, October, 1981. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Algae harvesting, Proteins, Algal growth, Algae, Biological oxygen demand, Ponds, Aerated lagoons, Nutrients.

The practical and economic aspects of high rate algae pond operation for wastewater treatment and protein production were investigated using two pilot ponds and two fields, each of about 0.1 hectare, continuously fed with raw sewage for a total biological oxygen demand (BOD) of about 300 mg/liter, from an adjacent residential quarter. The pond effluent depth was kept at 35-45 cm, and an average flow rate of 10 cm/second was maintained. The predominant species was Scenedesmus dimorphus. although during certain periods Micractinium pusillum and M. quadrisetum were dominant. On monitoring the ponds it was noted that S. dimorphus was capable of appearing in at least four identifiable forms. Studies of these changes in form were conducted in a series of miniponds, each 110 liters in volume and 40 cm in depth, with different mixing and aeration methods applied. Effluent samples were drawn from the miniponds twice a week and analyzed for BOD and chemical oxygen demand. The conditions under which each form of S. dimorphus was grown were categorized. The relationship between the algal biomass and treatment efficiency and operational conditions was then examined in a set of experiments which included continuous and periodic mixing and aeration methods. The findings indicated that changes in the appearance of S. dimorphus were affected by variations of climatic conditions and operating regime, as well as by the nuritional fertility of the medium. These changes morphologically included types of colony arrangements, cell shapes, and chloroplast distributions. Wastewater treatment efficiency and algal yield were also correlated with the S. dimorphus type produced. (Baker-FRC)
W82-02275

PILOT-SCALE INVESTIGATIONS WITH GRANULAR ACTIVATED CARBON,

Thames Water Authority (England).
R. J. Vincent.

Effluent and Water Treatment Journal, Vol 21, No 8, p 351-354, 356, 357, August, 1981. 6 Fig, 3 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, Carbon, Adsorbents, Trace metals, Industrial wastes, England, Filtration, Water treatment, Water supply.

Use of granular activated carbon for treatment of a sewage effluent is discussed. GAC treatment was studied at two distinct points in the water supply progression: first from sewage effluent at the Deephams sewage works, and second from slow sand filtered water at the Coppermills filtration station. Deephams has a dry weather discharge of 185,000 cubic meters/day and treats a sewage derived from the industrialized area of northeast London, using the activated sludge process. Coppermills filtration station is able to supply 491,000 cubic meters/day to a large area of eastern London, with raw water obtained from the River Lee or the River Thames. After long term storage, usually 100 days in artificial reservoirs, the water is treated by rapid sand filtration and slow sand filtration prior to chlorination and distribution. Application of GAC filtration to the Deephams effluent clearly produced an improved effluent quality in terms of total organic carbon, biological oxygen demand, and color, with efficiencies dependent on empty bed contact time. The lifetime of the filter with regard to adequate removal of trace organic compounds is not known. The Deephams effluent also contained significant amounts of certain trace metals. These were reduced during GAC filtration, but only during the first operational period of the GAC. For the second operational period, the GAC was reactivated and returned to the filter. No significant reduction of zinc or cadmium occurred during this operational priod. This change was attributed to the failure of the reactivation process to remove refractory adsorbates. (Baker-FRC)
W82-02289

SIMULATION OF A TIME DEPENDENT ACTIVATED SLUDGE WASTEWATER TREATMENT PLANT,

Texas Univ. at Austin. Dept. of Civil Engineering.
W. Tanthapanichakoon, and D. M. Himmelblau.
Water Research, Vol 15, No 10, p 1185-1195, October, 1981. 9 Fig, 1 Tab, 30 Ref.

Descriptors: *Model studies, *Wastewater treatment, Mathematical models, *Activated sludge process, Simulation, Monitoring, Clarifiers, Aeration, Water treatment facilities.

A dynamic model of an activated sludge waste treatment plant is described, examples of typical simulation results are offered, and a sensitivity analysis of an example plant is given. The model consists of three components, a primary settler, an activated sludge aeration tank, and a final clarifier-thickener. Particular care was taken in modeling the plant components to properly represent the mixing of materials that occurs within each of its units. The dynamic model compiled represents the operation of a typical plant reasonably well and in considerable detail. The model is general enough so that the values of the model parameters can be replaced with those applicable to a specific plant with little effort on the part of the analyst. Such models can be used in the design of new plants and in the analysis of the operations of existing ones. With the aid of this model it was posible to simulate simultaneously the diurnal response of a number of significant variables, including dissolved biological oxygen demand, suspended solids, dissolved volatile solids, active mass, inert mass, soluble nonbiodegradable mass, Nitrosomonas mass, Nitrobacter mass, ammonia, nitrite, nitrate and dissolved oxygen. The equations for the model as well as the results of simulations are presented. (Baker-FRC)
W82-02303

PHOSPHORUS REMOVAL BY ACTIVATED ALUMINA,

Technion-Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
N. Narkis, and M. Meiri.
Environmental Pollution, Series B, Vol 2, No 5, p 327-343, 1981. 10 Fig, 1 Tab, 19 Ref.

Descriptors: *Water treatment, *Phosphorus removal, Acidity, *Wastewater treatment, Phosphates, Adsorption, Activated alumina.

The use of activated alumina for removal of phosphorus from sewage treatment plant effluents and from synthetic aqueous solutions was investigated. Analysis of various phosphorus compounds in biological treatment effluents showed that 99.4% of the total phosphorus is soluble, and 98% of this is present as inorganic orthophosphates. There are a number of forms of orthophosphates in equilibrium, with the predominant form changing as pH changes. Synthetic aqueous solutions of orthophosphates were prepared in distilled water at concentrations typical for sewage treatment plant effluents. In batch experiments, aeration biological treatment effluents containing 36.4 mg/liter of phosphate were treated with 1.5 g/liter of Merck acidic activated alumina. The pH was held at 5.7 and the temperature was 26 degrees C. Equilibrium was reached after 6.5 hr. When using various pH levels, maximum phosphate removal was achieved from distilled water solution at 4.5 in both acidic and basic activated aluminas. Acidic Merck activated alumina showed a better removal capacity than basic alumina when tested on biological sewage treatment plant effluent. The presence of calcium or magnesium in sewage treatment plant effluent increases the alumina capacity for phosphate removal at pH 8.0, typical for effluents. The use of activated aluminas adds no salts to the treated water, nor does it produce a nuisance of sludge handling or treatment before ultimate disposal. The activated alumina can be easily regenerated with sodium hydroxide solution. The process is applicable to phosphorus removal from waste treatment effluent and clear wastewaters containing orthophosphates and polyphosphates with an efficiency higher than that obtainable by chemical precipitation or flocculation. (Baker-FRC)
W82-02313

COUPLED TRICKLING FILTER-ROTATING BIOLOGICAL CONTACTOR NITRIFICATION PROCESS,

Union Carbide Corp., South Charleston, WV.
D. Marsh, L. Benefield, E. Bennett, D. Linstedt, and R. Hartman.
Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1469-1480, October, 1981. 25 Fig, 1 Tab, 12 Ref.

Descriptors: *Nitrification, *Wastewater treatment, *Biological filters, *Trickling filters, Mathematical studies, Design criteria, Ammonia, Biological oxygen demand, Biological wastewater treatment, Hydraulic loading, Pilot plants, Suspended solids.

Pilot plant studies were used to determine the effectiveness of a rotating biological contactor system for the nitrification of trickling filter effluent. To quantify the relationship between effluent ammonia concentration, influent ammonia concentration and total BOD concentration, wastewater temperature, and media surface area for the Boulder, Colorado Waste Water Treatment Plant, an equation was developed. This expression showed that the effluent ammonia concentration varied directly with the influent ammonia concentration and the influent total BOD concentration, but varied inversely with the temperature and media surface area of the wastewater. For any RBC nitrification system, the change in the effluent ammonia concentration as a result of hydraulic surging was an important design criterion. An equation was developed to quantify the relationship between the surge effluent ammonia concentration, design loading factor, hydraulic loading and influent ammonia concentration. Results showed that the influent suspended solids concentration was essentially the same as the effluent suspended solids concentration, suggesting that little excess sludge will be generated during nitrification in a separate-stage RBC system. Settling column tests showed that the effluent suspended solids settle rapidly and should be easily removable in well-designed clarifiers. (Geiger-FRC)
W82-02315

SHALLOW-DEPTH SEDIMENTATION OF BIOLOGICAL MATERIALS,

Rensselaer Polytechnic Inst., Troy, NY.
H. R. Bungay.
Annals of the New York Academy of Sciences, Vol 369, p 335-340, 1981. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Sedimentation, *Biological samples, Separation techniques, *Water treatment, Wastewater, Wastewater treatment.

Performance of conventional sedimentation equipment for the sedimentation of biological materials is generally poor. However, sedimentation is of practical value in biological waste treatment processes, since costs are relatively low and subsequent processing steps benefit from lessening of their input loads. If collection efficiencies could be improved to over 90%, there would be highly significant savings on new plants due to smaller sized steps for biological oxidation. Conventional, shallow-depth, and cross-flow plate sedimentation offer different advantages. Lamellar sedimentation is gravity collection with a short sedimentation path. Designs tubes or closely spaced plates are finding practical use. Since shallow-depth sedimentation achieves high performance at low cost, it should be much widely used with biological systems. It may be possible to incorporate the settlers into other equipment such as industrial fermentors or biological waste treatment units. Potential uses include collection of algae, collection of particles less dense than the liquid, classification of different particles in a series of lamellar settlers with varying detention periods, and separation of particles that rise from those that settle. (Baker-FRC)
W82-02336

A COMPENDIUM OF EXPERIMENTAL WORK ON CHEMICAL PRECIPITATION OF SEWAGE,

T. Stones.
Water Pollution Control, Vol 80, No 3, p 421-432, 1981. 11 Fig, 25 Ref.

Descriptors: *Wastewater treatment, Water treatment facilities, Primary wastewater treatment, Aluminum sulfate, Lime, Acidity, Sludge, *Chemical precipitation, *Suspended solids.

The process of chemical precipitation consists of adding to the sewage prior to settlement a suitable chemical or mixture of chemicals with the object of coagulating colloidal matter and producing a flocculent precipitate which, as it settles, enmeshes and carries down the finely divided suspended matter and thus forms an adjunct to settlement. Optimum precipitation had been achieved with aluminum sulfate at pH 5.0 due to the formation of aluminum hydroxide by hydrolysis. In order to achieve good results, the pH had to be closely controlled. Rapid settlement of the precipitated matter was promoted by mechanical flocculation, regardless of what precipitant was used. Unless a sufficient dose of the chemical added is used, such treatment may not only be useless and expensive, but may actually hinder rather than assist purification. No significant precipitation occurs with aluminum sulfate unless a dose larger than 50 mg/liter is used. The precipitating effect of small doses of lime and acid may be more than offset by the suppression of the biological purification that would otherwise occur. The doses of precipitants which have been shown to be necessary for effective precipitation also give rise to the formation of bulky sludges, and the disposal of these is another factor to be considered. (Baker-FRC)
W82-02370

TREATMENT OF EFFLUENT WATERS CONTAINING CHLORIDES BY REVERSE OSMOSIS DYNAMICALLY FORMED MEMBRANES,

Kuwait Univ. Dept. of Chemical Engineering.
H. I. Shaban.
Journal of Environmental Science and Health, Part A, Vol 16, No 4, p 359-372, 1981. 6 Fig, 12 Ref.

Descriptors: *Chlorides, *Reverse osmosis, *Wastewater treatment, *Membranes, Semipermeable membranes, Salt rejection, Membrane filters, Lithium, Sodium, Magnesium, Feasibility studies.

Theories proposed for the semipermeability of membranes in the past have all been based on cellulose acetate membranes, which are currently used for the treatment of effluents. This study investigated the feasibility of using a new type of hydrous zirconium oxide dynamically formed membrane in the reverse osmosis process. A cell was constructed to accommodate the membrane. Various experiments conducted with solutions of sodium chloride, lithium chloride, and magnesium chloride were designed to investigate membrane surface density, pressure and feed concentration variations, the effects of solute rejections, and water permeation across the membranes. The hydrous zirconium oxide dynamically formed membranes were found to be reasonably successful in obtaining salt rejection for the solutions tested. Salt solutions were rejected according to their molecular weights. Pressure increases from 200 to 800 PSI resulted in increases in the permeation rate for the three salt solutions tested. (Carroll-FRC)
W82-02382

MAIN COMPOUNDS BEHAVIOR IN KRAFT WASTES CLEANING BY ACID COAGULATION AND CARBON ADSORPTION,

Universidad Complutense de Madrid (Spain). Dept. de Quimica Industrial.
J. Aguado, J. J. Rodriguez, and J. Tijero.
Journal of Environmental Science and Health, Part A, Vol 16, No 4, p 405-418, 1981. 4 Fig, 1 Tab, 19 Ref.

Descriptors: *Pulp wastes, *Chemical coagulation, *Adsorption, Carbon, *Kraft mills, Industrial wastewater, *Wastewater treatment, Gels, Chromatography.

Kraft mill liquid wastes present many treatment problems and pose a significant threat to the environment. A treatment method developed by Vian and coworkers involves dividing kraft mill effluent into three waste streams based on their chemical compositions and treating the most problematic waste stream with acid coagulation at pH 4 followed by carbon adsorption. The waste stream, composed of wastewaters from the final steps of pulp washing, alkaline extractions from bleaching, and accidental black liquor overflows from the recovery section, includes lignin, alpha-cellulose and hemicellulose degradation products, and the remaining inorganics from white liquor. Acid coagulation reduces the concentration of lignin compounds considerably, but significant amounts of these compounds remain in solution. The precipitate from the coagulation treatment is comprised mostly of lignin compounds, with some adsorption of carbohydrates in the flocs. Partial acidolysis of large polymers occurs during either acid coagulation or redissolution with NaOH. Subsequent treatment by carbon adsorption drastically reduces the remaining lignin compounds, although carbohydrates are still present to some extent in the effluent from this treatment. Increasing the carbon dose results in substantially higher decreases in the final organic matter concentration. (Carroll-FRC)
W82-02383

THE EFFECT OF NITRIFICATION IN THE BOD TEST,

Anglian Water Authority, Peterborough (England). Peterborough Sewage Div.
P. G. Bird.
Water Pollution Control, Vol 80, No 3, p 378-389, 1981. 12 Fig, 2 Tab, 18 Ref.

Descriptors: *Nitrification, *Biological oxygen demand, Oxygen demand, Wastewater treatment, Water treatment facilities, Sludge, Bacteria, Acidity, Ammonia.

The five-day biological oxygen demand (BOD) test attempts to quantify the extent of the many different biochemical reactions which are taking place in the purification of water in a single test. In any BOD test, the basal oxygen demand will be provided by the oxidation of organic matter present by heterotrophic bacteria. However, contributions to the total oxygen demand may be expected from the oxidation of nitrogenous material by certain chemoautotrophic bacteria; the magnitude of these contributions was investigated in this study. It was concluded that the extent of nitrification in the BOD test is dependent on the initial number of viable nitrifying bacteria. These bacteria will be associated with suspended particles in the sample. Nitrification proceeds more rapidly in the presence of suspended solids and heterotrophic bacteria. Under normal conditions, the difference between the normal BOD and the BOD(ATU) (allylthiourea) of the final effluent of a conventional biological filter sewage treatment plant can be small due to the long doubling period of the bacteria and the small number of viable nitrifying bacteria associated with the suspended solids. A partially nitrifying activated sludge sewage treatment plant will give large differences between the BOD and the BOD(ATU) due to the large number of viable nitrifying bacteria and the presence of significant amounts of ammonia. At periods during which the biological filter is sloughing off excessive growth, the difference would be high due to the large number of viable nitrifying bacteria associated with the suspended solids. The BOD test has been shown unsuitable for control purposes and unreliable when used for forecasting. The BOD test modified for suppressing nitrification is recommended for predicting the biochemical degradability of a sample.
W82-02384

DISPOSAL OF INDUSTRIAL EFFLUENTS - SOME FUTURE PROBLEMS,

Binnie and Partners, London (England).
G. E. Eden.
Water Science and Technology, Vol 13, No 7, p 337-346, 1981. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Industrial development, *Policy making, *Regulations, *Industrial wastewater, Environmental effects, Water resources development, Water quality management, Biological wastewater treatment, Environmental protection, Future planning, Industrial wastes, *United Kingdom.

In the United Kingdom, industrial effluents may be treated by individual industries before discharge into rivers or may be handled by local sewage treatment facilities. Organic materials of essentially natural origin and some synthetic organic materials may be handled by biological wastewater treatment processes. Toxic organics including pesticides and chlorinated solvents may be detrimental to biological sewage treatment operations and cause even greater problems when they appear in sludges. Inorganic compounds may be removed to some extent in the biological treatment of wastewater and also are present in sludges. National and international pressures are being exerted on the United Kingdom to change existing methods of waste water treatment. Some regional, national and international regulations that have been adopted as a result of these pressures are reviewed. The balance between environmental protection and the freedom to pollute is presently favoring the industrialists, who claim that too much restraint on industry will hamper manufacturing and economic prosperity. (Geiger-FRC)
W82-02405

BEDDINGTON SEWAGE-TREATMENT WORKS, CANYON: SOME OPERATING EXPERIENCES 1969-79,

Thames Water Authority, London (England).
D. I. J. Booker.
Water Pollution Control, Vol 80, No 3, p 356-377, 1981. 3 Fig, 7 Tab, 6 Ref.

Descriptors: *Wastewater facilities, Administration, Operating costs, Management planning, Primary wastewater treatment, Wastewater treatment, *England, Thames Water Authority.

Significant effects that have occurred since October of 1969 in the operation of the Beddington Sewage Treatment Works at Croydon are reviewed. The originally planned tertiary treatment plant has not been constructed. Flows resulting from the proposed closures of Sutton and Wandle Valley works have not been diverted to Beddington. Under specific conditions, flows from the works pumphouse and a pumping station on arrival at the works inlet tend to dam-off the sewage which flows by gravity from central and southern Croydon, causing this flow to back up and overflow the inlet weir of the inverted siphon which is intended to bring in gravity storm flows. This situation has been temporarily corrected through the raising of the inlet weir using a Coplastic sheet attached to brickwork, pending a permanent alteration of the weir level. The control system, governing the operation of duty pumps and capable of variable speed to deliver sewage at varying rates, proved very unreliable. Modifications found necessary for the pumping station included a piped supply of effluent under pressure to enable the pumps to be flushed out prior to maintenance and the re-routing of the discharge pipework from the sump of the dry well. The greatest changes since beginning operation have occurred in the sludge treatment and disposal system. A program of emptying and cleaning the digesters was begun in 1969-70, as they had not been cleaned out since start-up in 1936. An entirely new digestion plant was constructed. The new digesters operate on a draw and fill basis by remote control. Each tank was equipped with bubble guns for heating and mixing. These have not functioned well, as they frequently become blocked. Specific problems are also noted in the aeration plant, return-sludge pumping, final sedimentation, effluent recirculation, air supply and power generation.
W82-02410

UPWARD FLOW CLARIFICATION OF SECONDARY SEWAGE EFFLUENT USING LIME,

Portsmouth Polytechnic (England).
R. Irwin, B. A. Winfield, and P. A. Stead.
Effluent and Water Treatment Journal, Vol 20, No 5, p 222, 224, May, 1980. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Lime, *Clarifiers, *Wastewater treatment, Coagulation, Sedimentation, Tertiary wastewater treatment.

Lime coagulation in an upward flow, hopper-bottomed clarification unit was used to polish secondary effluents. The clarifier has a surface area of 1.56 sq meters and an overall depth of 2.13 meters. Lime is injected as a 0.1-1.0% calcium hydroxide suspension and forms a calcium carbonate floc. Suspended particles and other material are trapped as the water flows upward through the floc blanket. The continuously operating unit allows water to be drawn out at the top by a series of V-notched launders. Under almost all operating conditions studied, this clarification process removed twice as much BOD, suspended solids, and turbidity as did a normal sedimentation unit treating the same liquid. At lime doses of 100 mg per liter, up to 75% soluble P and 99% of coliforms were removed. Advantages of the process are small sludge volume, smaller tank volume, better effluent quality, and higher hydraulic loadings per unit surface area. (Cassar-FRC)
W82-02413

APPLICATION OF THE EXPANDED BED TECHNIQUE FOR THE DENITRIFICATION OF A SEWAGE EFFLUENT,

Thames Water Authority, London (England).
J. E. Hawkins, D. A. Stott, R. L. Stokes, and C. Clennett.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 361-373, July, 1980. 5 Fig, 3 Tab, 10 Ref.

Descriptors: Sewage treatment, *Denitrification, *Industrial wastes, *Flow discharge, *Streams, Nitrates, Runoff, Seasonal variation, Dilution, Hydrologic data, Oxidation, Fluidized bed process, *Wastewater treatment, Chemical analysis, Water pollution, Filtered wastewater.

The feasibility of using an expanded bed filter for denitrification of sewage effluent on a full scale is demonstrated. On the average the filter removed over 50 percent of the nitrate from a flow of 9000 m3 per day. The average rate of denitrification was 3.6 kilograms per cubic meter filter bed per day, while the average ratio of the weights of methanol consumed to nitrate removed was approximately

2.5:1. There were no significant instances of pollution of the river Lee due to the discharge of methanol from the works. The washing of the filter bed had to be carefully controlled to prevent clogging yet avoid excessive loss of biomass. (Titus-FRC)
W82-02436

AN EXPERIMENTAL PROJECT TO DETERMINE THE PARAMETERS OF SILICA SCALING IN REVERSE OSMOSIS SYSTEMS,

Coury and Associates, Inc., Lakewood, CO.
M. C. Mickley, and W. M. Straley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157942, Price codes: A05 in paper copy, A01 in microfiche. Technical Completion Report, 1981. 75 p, 30 Fig, 4 Tab. OWRT-C-90169-S(9526)(1), 14-34-0001-9526.

Descriptors: *Silica, *Scaling, *Reverse osmosis, Chemistry of precipitation, Metal complexes, *Silica scaling, Silica chemistry, Membrane scaling, Reverse osmosis systems, Silica solubility, Scaling mechanism kinetics, Silica precipitation, Silica supersaturation, Colloidal scaling, Silica complexing.

The objective of this work was to better define, on the basis of literature research and laboratory experiments in glassware and small reverse osmosis systems, how various parameters affect the concentration limits at which silica scaling occurs, and what the mechanisms of scaling are. The specific parameters studied were silica supersaturation, temperature, pH, and brine composition and concentration. Silica chemistry was found to be extremely complex, involving several different silica species and several mechanisms for removal of silica from solution. In addition, a wide variety of parameters were found to have effects on silica scaling, by affecting solubility, scaling mechanism, the kinetics of the mechanism, or a combination of these. This report provides a conceptual model of the types of silica scaling which may occur, and the situations in which they may occur, and presents experimental data consistent with the model.
W82-02451

EVALUATION OF MEMBRANE PROCESSES AND THEIR ROLE IN WASTEWATER RECLAMATION: VOLUME II,

Orange County Water District, Fountain Valley, CA.
D. G. Argo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-158007, Price codes: A12 in paper copy, A01 in microfiche. Report prepared for Office of Water Research and Technology, November 30, 1980. 255 p. OWRT-C-80159-R(852[illegible]3), 14-34-0001-8520.

Descriptors: *Advanced wastewater treatment, *Wastewater renovation, *Water reuse, Reverse osmosis, Electrodialysis, Ultrafiltration, Ozonation, Costs, Water Factory 21, *Orange County Water District, California.

Water Factory 21 (WF-21) in Orange County, California, is a 15-mgd advanced wastewater treatment (AWT) plant designed to reclaim biologically treated municipal wastewater for injection into a seawater barrier system. Processes included are lime treatment, air stripping, filtration, activated carbon adsorption, reverse osmosis (RO), and chlorination. This study was undertaken because of increasing interest in use of reclaimed water to augment domestic water supplies. This report presents operating data from WF-21 collected during the second year of a three-year project. The effectiveness of each treatment process is presented, with emphasis on several AWT processes, including RO demineralization, ozone and biologically activated carbon, ultrafiltration, and electrodialysis. The data collected show that the combined processes, including RO, used at WF-21 are capable of producing a very high quality water. Treatment reduced all contaminants, with a very high degree of reliability, to levels below national interim primary drinking water regulation maximum contaminant levels. It was found that lime clarified secondary effluent can be used as feedwater to a RO demineralizer. This lime/RO process substantially reduces the pretreatment requirements and cost of reclamation. Experiments with new low pressure membranes (250 psi) show great potential for reducing RO costs. Pilot studies showed the membrane to be stable and not subject to rapid deterioration. The cost of AWT at WF-21 is $1,038 per million gallons. The cost of RO demineralization is $819 per million gallons. These costs include all operation and maintenance as well as amortization of capital.
W82-02457

IMPACT OF SUBURBAN RESIDENTIAL DEVELOPMENT ON WATER RESOURCES IN THE AREA OF WINSLOW TOWNSHIP, CAMDEN COUNTY, NEW JERSEY,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 4C.
W82-02461

WASTEWATER MANAGEMENT IN COASTAL NORTH CAROLINA,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. J. Nierstedt, D. A. Okun, C. R. O'Melia, J. K. Sherwani, and M. S. Heath, Jr.
Water Resources Research Institute, University of North Carolina, Raleigh. Report No 165, December, 1980. 214 p, 13 Fig, 50 Tab, 15 Maps, 78 Ref, 23 Append.

Descriptors: *Wastewater treatment, Wastewater outfall, *Wastewater management, *Wastewater disposal, *Economic aspects, Ocean dumping, Coliforms, Waste disposal, Sewers, Aquatic environment, Federal jurisdiction, Cost-benefit analysis, Outfall sewers, Septic tanks, *North Carolina, Coastal zone management.

Rapid growth and development in coastal North Carolina, particularly as related to tourism and the building of second homes, have done serious damage to the aquatic environment. To assess options for sound wastewater management, two areas were selected for study: the Dare County area in the north, and the Carteret County area, with a small portion of Onslow County, in the south. The options examined were (1) discharge to inland coastal waters, (2) disposal on the land, and (3) discharge to the ocean. Ocean outfalls were found to be the best option because they exhibited economies of scale. Not only would disposal to inland waters be more costly than ocean disposal, but it would also pose a threat to shellfish growing areas. Land disposal is relatively safe, as long as care is taken to avoid contamination of potable water wells. Despite the high cost of sewerage for ocean disposal, this option is generally less costly than the others. Ocean disposal for the northern area can conveniently and economically serve the entire population. In the southern area, the mainland communities are so located that the most economical solution is a combination of an ocean outfall with land disposal for the inland communities. However, adequate data on the drift of wastewater with the currents and the dispersion of wastewaters in the offshore waters is not available. Length of outfalls and depths to place outfall dispersers must be conservatively determined. The report addresses issues of implementation and legal issues to be resolved. (Garrison-Omniplan)
W82-02511

RECYCLING,

North Carolina Department of Natural Resources and Community Development, Division of Environmental Management.
For primary bibliographic entry see Field 6E.
W82-02514

SOME ECONOMIC IMPACTS OF FRESHWATER STREAM EFFLUENT DISCHARGE LIMITS ON SELECTED SMALL COMMUNITIES IN MISSISSIPPI,

Mississippi State Univ., Mississippi State. Div. of Business Research.
L. R. Cheatham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157835, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Institute, Mississippi State University Report, September, 1981. 115 p, 27 Tab, 18 Ref. OWRT-A-131-MISS(1), 14-34-0001-1126.

Descriptors: *Federal Water Pollution Control Act, *Pollution abatement, Wastewater pollution, *Water pollution control, Water pollution sources, *Capital costs, Operating costs, Construction costs, Effluent streams, Industrial effluents, Sewage effluents, *Wastewater treatment, Secondary treatment, Pre-treatment, Sewage systems, *Mississippi, Effluent discharge limits, Regulations compliance costs, Public Law 92-500, Industrial profitability, Compliance impacts, Water pollution abatement regulations.

Wastewater effluent discharge limitations in Mississippi implemented under authority of Public Law 92-500 and other legislation, in general, have not produced compliance costs of a sufficient magnitude to affect the levels of employment, income, and output of the classifications of manufacturing firms incurring the largest costs. Capital expenditures for water pollution abatement, however, have been large enough to present a potential source for problems in selected firms in SIC groups 20, 22, 24, 25, 26, 28, 29, 30, 33 and 34. Firms in which compliance costs are most likely to affect profitability comprise only 3% of the state's manufacturing firms yet supply 10% of manufacturing employment and 15% of payrolls. Operating costs which result from compliance activities are far more significant to profitability than costs of compliance equipment. Compliance costs incurred by public sewage disposal systems in the state are having a much greater economic impact than industrial compliance costs. The most obvious effect is in the form of increases in system user rates. One reason regulations have not had more impact on industry is that over 90% are discharging some wastewater through public systems. Over 41% of surveyed system managers reported average household bills had already increased 100% or more because of construction costs and increases in operating costs.
W82-02530

WASTEWATER COLLECTION AND TREATMENT IN WAYNE COUNTY,

Wayne County Board of Public Works, MI.
R. E. Smith.
Water/Engineering and Management, Vol 128, No 9, p 41-42, 44, September, 1981.

Descriptors: *Rural areas, *Drains, *Wastewater facilities, *Costs, Wastewater treatment, Secondary wastewater treatment, Interceptor sewers, Flood control, Project planning, Administration, Financing, *Wayne County, Michigan.

As population shifted from the city of Detroit to rural areas, Wayne County, as suburb of Detroit, had to establish drainage districts to solve the sewerage problems of the new communities. Major projects which have been completed or are under construction include six drain projects and one treatment plant. These and other projects being handled under the supervision of the Wayne County Drain Commissioner's Office will cost a total of $270 million. Projects to prevent flooding are especially needed in the western, southeastern and downriver sections of the county. The estimated cost of all proposed projects is about $325 million. Community financing of such large projects is discussed. Cooperation between the Wayne County Drain Commissioner's Office, the Wayne county Department of Public Works and the Detroit Water and Sewerage Department helps in the managementof rural waste water problems. The Department of Public Works must remove three satellite plants from the Huron river and provide a facility for primary and secondary treatment to serve the growing populations of western and southern Wayne County. A 40 mgd waste water treatment plant is set to be constructed at the mouth of the Huron River. An interceptor to serve this facility will cost an estimated $250 million. Users should be assessed fees to assure that funds

are available to replace entire projects when their useful life has been exhausted. (Geiger-FRC)
W82-02554

ALGAL POLYMORPHISM IN HIGH RATE WASTEWATER TREATMENT PONDS,

Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
G. Oron, G. Shelef, and A. Levi.
Hydrobiologia, Vol 77, No 2, p 167-175, 1981. 2 Fig, 6 Tab, 26 Ref.

Descriptors: *Algae, *Wastewater lagoons, *Morphology, Wastewater treatment, Organic loading, Aeration ponds, Nutrients.

Two main algal species (Scenedesmus dimorphus and Micractinum) were found in high rate algae ponds used for wastewater treatment, effluent reclamation, and protein production. The external changes observed over a 3-year period were morphological, not species changes. These changes (colony separation, loss of setae, various types of aggregation, and changes in chloroplast distribution in the cells) were responses to variations in climate and operating regime, such as organic loading, retention time, aeration, mixing, radiation, ambient temperature, and effluent depth. Four forms of S. dimorphus were identified at different times: regular or classic, single cell (spring and summer), pseudo S. obliquus (late winter and early spring under overloaded conditions), and rounded single cell (under extended overload conditions). Micractinum also showed four forms: regular or classic M. pusillum and M. quadrisetum, floccy M. pusillum (under underloading conditions and nutrient shortage), and single cell M. pusillum (during overload conditions). (Cassar-FRC)
W82-02564

INFLUENCE OF DISSOLVED OXYGEN ON ACTIVATED SLUDGE VIABILITY,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
K. J. Williamson, and P. O. Nelson.
Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1533-1540, October, 1981. 6 Fig, 26 Ref.

Descriptors: *Biological wastewater treatment, *Model studies, *Dissolved oxygen, *Activated sludge, Wastewater treatment, Suspended solids, Sludge, Microorganisms, Mixed liquor solids, Volatile solids, Biological oxygen demand, Organic loading.

The specific viability of microorganisms in laboratory air and oxygen systems was measured by ATP methods to determine whether oxygen limitation occurs inside activated sludge flocs. Results of three separate experiments showed that increased dissolved oxygen (DO) levels of up to about 15 milligrams/liter in activated sludge yielded increases in viability, probably due to DO limitations inside flocs, changes in organism metabolism, or other factors. Increased viability can cause higher allowable food:microorganism (F:M) loadings while maintaining equal degrees of treatment if the F:M is determined from total volatile suspended solid levels and steady state solid retention times are greater than one day. At equal F:M ratios, the systems with greater viability will show significantly lower effluent substrate levels only at very short solid state retention times. At higher DO levels with increased endogenous respiration, lower sludge production occurs in activated sludge systems. A model of the activated sludge process which contains a nonviable component of the TVSS is presented. This can predict observed differences in ATP viability, allowable F:M loadings, and sludge production between air and oxygen systems. (Geiger-FRC)
W82-02582

CONCEPTS IN AQUATIC TREATMENT SYSTEM DESIGN,

Dewante and Stowell, Sacramento, CA.
R. Stowell, R. Ludwig, J. Colt, and G. Tchobanoglous.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 919-940, October, 1981. 5 Fig, 6 Tab, 45 Ref.

Descriptors: *Nutrient removal, *Wetlands, *Aquatic plants, *Wastewater treatment, Reviews, Nitrogen, Phosphorus, Aquatic animals, Aquatic environment, Biological oxygen demand, Effluents, Design criteria, Suspended solids, Bacteria, Viruses, Heavy metals, Organic compounds.

The present status of aquatic treatment systems (untreated wastewater applied to natural or man-made wetlands) is reviewed with respect to mechanisms and design. These systems are slower in action, use more land area, and are more subject to environmental influences than conventional treatment. A conceptual model for an aquatic processing unit is described. This combines plants (floating, emergent, and/or submerged) and animals (zooplankton and certain fish). Plant harvesting removes nutrients. Other factors to consider are climate (temperature, winds, and rain), unfavorable environmental effects (odor, fog, and disease), wastewater characteristics, and process reliability. Published data from 24 observations of operating aquatic treatment systems are presented. Generally, 80% of BOD can be removed at loading rates of 100 lb per acre per day. There should be about 8 inches of clear water between the root zone of floating plants and settled matter on the bottom. For emergent plants, water depth should be about 3 feet or less. The data available to date is insufficient to develop design criteria. Pilot plant tests and other investigative studies are necessary before any full-scale system is constructed. (Cassar-FRC)
W82-02593

THIOCYANATE BIO-OXIDATION KINETICS,

Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. D. Neufeld, L. Mattson, and P. Lubon.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE-5, p 1035-1049, October, 1981. 11 Fig, 1 Tab, 21 Ref.

Descriptors: *Thiocyanates, *Kinetics, *Wastewater treatment, *Coal gasification, Industrial wastewater, Aerobic treatment, Nitrogen compounds, Sulfur compounds, Ammonia, Sulfates, Biodegradation, Degradation, Activated sludge process, Biological treatment, Water pollution control.

A kinetic expression and material balance for nitrogen and sulfur was developed for biological degradation of thiocyanates in coal conversion process wastewaters. Batch and continuous culture experiments using an activated sludge system and thiocyanate-specific organisms showed that the specific utilization rate for thiocyanate degradation followed a substrate inhibition biokinetic relationship. The rate rose with increasing thiocyanate level to a maximum at about 470 mg per liter and decreased with a further increase in thiocyanate level. Critical sludge age was 4.14 days. Biodegradation of thiocyanate produced sulfate and ammonia. Thiocyanate removal at concentrations up to 1000 mg per liter was virtually complete in continuous culture systems at pH 5-7, but was poor at pH 8. (Cassar-FRC)
W82-02596

5E. Ultimate Disposal Of Wastes

ECONOMIC AND TECHNICAL EVALUATIONS OF SWINE MANURE MANAGEMENT SYSTEMS WHICH USE LAND APPLICATIONS,

North Carolina State Univ. at Raleigh. Dept. of Economics and Business.
R. G. Drynan, J. C. Williamson, P. W. Westerman, and S. R. Crane.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153727, Price codes: A09 in paper copy, A01 in microfiche. Water Resource Research Institute, University of North Carolina, Report No 173, September, 1981. 174 p, 15 Fig, 62 Tab, 20 Ref. OWRT-A-098-NC(1), 14-34-0001-8035.

Descriptors: Agricultural wastes, *Animal wastes, Farm wastes, Economic evaluation, Land disposal, Waste management, Costs, *Cost analysis, *Land application, Agriculture, Hogs, *Manure, *Swine waste, Manure management alternatives, Least-cost system.

The trend towards more and larger confinement swine production operations has meant that larger quantities of localized manure have to be dissipated in cost-efficient and environmentally acceptable ways. Land application of the manure to agricultural crops represents an excellent manure utilization scheme as well as sound environmental management when application rates are based on crop nutrient requirements. Evaluations of which manure management alternatives for storage, treatment, handling and land applications are best for particular situations depend upon several factors, such as ease of management, labor constraints, capital available, land and crops available, and environmental considerations. Collection of waste management technical data and evaluation of the economics of the various feasible alternative manure management systems were the major objectives of this project. In this study, the major facilities, treatment, and land application options for liquid swine manure were identified and investment and operating costs were estimated. A mathematical integer linear programming model was developed to estimate costs of manure management systems and to determine which of the systems was the optimal or least-cost system. Also, subsidiary models were developed to compute various technical and cost coefficients for use in the main model. Examples include the model for calculating the time and labor requirements for spreading liquid manure with a tank wagon, and the model for determining the nutrients made available by manure applications at various times and rates.
W82-02175

SURFACE WATER HYDROLOGIC CRITERIA FOR URANIUM MINE TAILINGS IMPOUNDMENTS IN ONTARIO,

MacLaren (James F.) Ltd., Willowdale (Ontario).
C. T. Bishop, and R. Bishop.
Canadian Journal of Civil Engineering, Vol 8, No 3, p 364-369, September, 1981. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Impoundments, *Design criteria, Uranium, *Radioactive wastes, Mine wastes, Mine drainage, Flood control, *Ontario.

The selection and implementation of surface water hydrologic criteria related to uranium tailings impoundments in Ontario were investigated. The mining and milling of uranium produces large quantities of low level radioactively contaminated waste rock, tailings, and process water. Regulatory agencies have set water quality standards for water discharged from tailings basins in Ontario. A closely monitored constituent of water from uranium tailings basins is radium. The existing hydrologic criteria for tailings impoundments in Ontario are rather vague. Existing guidelines do not stipulate a hydrologic criterion for the design of an emergency spillway specifically for this type of impoundment. Hydrologic criteria for such impoundments should be a function of the economic and environmental consequences of a failure. A guideline based on risk recognizes explicitly that a design flood of given return period bears a specific probability of being equalled or exceeded during the service life of the mine. Hydrologic analysis of a tailings impoundment must determine values for the following parameters: the design treatment rate, the crest elevation of the emergency spillway, and the crest evaluation of other perimeter structures. The impoundment should be able to store and susequently treat all the runoff from the regional storms. The impoundment should be equipped with a spillway capable of passing the runoff from the probable maximum precipitation, assuming the water level prior to the storm to be equal to the mean annual level. (Baker-FRC)
W82-02240

MANAGING HAZARDOUS WASTES,

Weston (Roy F.), Inc., West Chester, PA.
P. B. Lederman, and M. D. LaGrega.
Industrial Wastes, Vol 27, No 5, p 36-38, 40, September/October, 1981. 2 Fig, 3 Tab.

Descriptors: *Water pollution prevention, *Landfills, *Waste management, Leachates, *Hazardous materials, Incineration, *Waste disposal, Solid waste disposal, Waste burial, Waste dumps, Chemical wastes, Industrial wastes, Organic wastes, Organic compounds, Land disposal.

Several methods of hazardous waste disposal are available for the interim period until the gap between waste disposal technology and new product development is narrowed. Landfills, land farming, and incineration are in widespread use in both acceptable and nonacceptable forms. Proper landfilling includes leachate management and monitoring, separation of noncompatible wastes, proper site selection (never penetrating an aquifer, and preferably not over a drinking water aquifer), and solidification of liquid wastes. Ordinary incinerators do not provide the 3-5 sec residence time and 2000 F temperatures necessary for complete waste destruction. Several good incineration systems are available: horizontal incinerators, multiple hearth, and rotary kiln. Land farming of wastes is successful if the site is actively plowed and not overloaded with respect to the material being dumped. The potential for groundwater contamination must be minimized by runoff control. Other methods of waste disposal in more limited use include waste reduction by modifying the manufacturing process, volume reduction of wastes (segregation of the most hazardous wastes from the innocuous material and concentration of liquids), chemical detoxification, and chemical destruction (hydrocarbons and chlorinated hydrocarbons). (Casser-FRC)
W82-02252

INDUSTRIAL WASTEWATER PRETREATMENT SERVICE,

Chem-Clear, Inc., Wayne, PA.
J. K. Wittle, and B. W. Dunkel.
Industrial Wastes, Vol 27, No 5, p 46-49, September/October, 1981. 1 Fig, 2 Tab.

Descriptors: *Industrial wastewater, *Chemical wastewater, Wastewater treatment, Organic compounds, Chem-Clear Inc., Phenols, Chromium, Cyanide, *Wastewater disposal.

Chem-Clear, Inc., operates four regional facilities for pretreating liquid industrial wastes prior to disposal to sewers or landfills and detoxifies materials such as cyanide, hexavalent Cr, phenols, acids, and bases. There are six basic steps in the process: analysis of raw waste, primary settling, mixing and blending, chemical treatment, and dewatering/discharge. Safety precautions include earthen berms to isolate tank spills, large capacity emergency gasoline driven portable pumps, and treatment of floor spills. Pickling liquors and strong acids are neutralized. Cyanide is oxidized to the cyanate, which is further decomposed to CO_2 and ammonia. Hexavalent Cr wastes are acidified and reduced to the trivalent state. Phenolic wastes are oxidized. The various pretreated wastes are combined for a chemical treatment which occurs in seven individual compartments. Resulting sludge is dewatered in a filter press and landfilled. Clarified effluent is discharged to the municipal sewer system according to the effluent limitations and hours specified by the local sewer district. Waters containing the following materials are not accepted for treatment: pesticides, insecticides, polychlorinated biphenyls, and PBB's. (Casser-FRC)
W82-02253

ANALYSIS OF ROCK STRESS AROUND A LIQUID WASTE INJECTION SYSTEM IN ILLINOIS,

Kansas Univ., Lawrence.
M. Heidari, and K. Cartwright.
Water Resources Bulletin, Vol 17, No 4, p 614-622, August, 1981. 6 Fig, 15 Ref.

Descriptors: *Injection wells, *Underground waste disposal, *Stress analysis, Stress, Rocks, Aquitards, Aquifer management, Water quality, Mathematical studies, Hydraulic fracturing.

A simple analytical solution to the transport equation was used to investigate the injection of liquid industrial wastes into deep subsurface formations. The problem of lateral movement of injected fluid due to dispersion, diffusion, and convection was investigated, and dispersion and diffusion were found to be of minor importance. Convection was the major transporting agent, and its effects can only be evaluated after a long period of injection. Stress distribution in the vicinity of the well may be the cause of hydraulic fracturing of the aquitards, which would threaten aquifers containing potable water. A disposal well in Putnam County, Illinois, was simulated to demonstrate stress around the well, and stress was found to be below the danger point after long, continuous injection. (Small-FRC)
W82-02280

PVC COVER CAUSES LEACHATE RETREAT,

SMC-Martin, King of Prussia, PA.
G. H. Emrich.
American City and County, Vol 96, No 10, p 61-62, October, 1981. 2 Fig.

Descriptors: *Groundwater pollution, *Water pollution control, Water pollution sources, Plumes, Landfills, Waste dumps, Leachates.

Groundwater was contaminated by leachate from an illegal dump in the area of Windham, Connecticut. Further downgradient and threatened by the leachate was the reservoir that supplied drinking water to portions of the town of Windham, as well as to the entire city of Willimantic, which lay within the town boundaries. The state ordered the landfill closed, and an infiltration-preventing closure was to be designed. Regrading was done such that runoff from the surface of the hill was maximized and a minimum of about a foot of material was left atop all wastes. Atop the native soil was placed a minimum of four inches of washed fine sand. The entire top of the landfill was next covered with a 20-mil layer of polyvinyl chloride. Groundwater samples were collected and the specific conductivities determined before and after application of the seal. According to the initial conductivity contour map, a major contamination plume was moving toward the reservoir. One year after seal placement, measurements showed that the plume had receded. (Baker-FRC)
W82-02321

EFFECT OF THE EARTHWORM, EISENIA FOETIDA (OLIGOCHAETA), ON FLUXES OF VOLATILE CARBON AND SULFUR COMPOUNDS FROM SEWAGE SLUDGE,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
S. G. Hornor, and M. J. Mitchell.
Soil Biology and Biochemistry, Vol 13, No 5, p 367-373, 1981. 2 Fig, 3 Tab, 33 Ref.

Descriptors: *Activated sludge, *Decomposition, *Oligochaetes, Sludge disposal, Land application, Sulfur compounds, Macroinvertebrates, *Earthworms, Bacteria, Anaerobic bacteria, Methane bacteria, Odor control, Aerobic treatment, Biodegradation, Organic compounds, Nitrogen compounds, Hydrogen sulfide, Sulfides, Feces, Moisture content, Soil amendments, Mineralization.

Activated sludge was fed to earthworms, Eisenia foetida, to determine the effects on aerobic decomposition. Rates of decomposition were measured by flux rates of gases in undigested and digested sludge. Feces always showed higher fluxes of CO_2 and O_2 and lower fluxes of methane, H_2S CH_3SH, and $(CH_3)_2S$ than undigested sludge, indicating that earthworm feeding stimulated aerobic decomposition of sludge. Gas flux rates for CO_2 and O_2 in both sludge and feces were directly proportional to their moisture content. Methanogenesis never accounted for more than 0.06% of the gas atmosphere, an indication of aerobic respiration. Volatile sulfur accounted for 0.02-0.08% of total S present. CH_3SH and $(CH_3)_2S$ evaluation from feces were significantly correlated with moisture content. H_2S accounted for 97-100% of total evolved S from sludge and a lesser percentage from feces. Earthworm feeding or moisture content did not affect populations of total anaerobes, nitrate reducers, sulfate reducers, and methanogens. Malodorous S compounds were less noticeable when feeding earthworms partially dried sludge, but sludge of > 3:1 moisture to dry weight ratio could stimulate volatile S production. (Casser-FRC)
W82-02362

REDUCING GROUND-WATER POLLUTION FROM MUNICIPAL WASTE-WATER IRRIGATION OF RHODES GRASS GROWN ON SAND DUNES,

Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
For primary bibliographic entry see Field 3C.
W82-02391

AN INVESTIGATION OF THE INFLUENCE OF BACTERIOPHAGES ON THE BACTERIAL FLORA AND PURIFICATION POWERS OF ACTIVATED SLUDGE,

Kyushu Univ., Fukuoka (Japan). Dept. of Agricultural Chemistry.
S. Ogata, H. Miyamoto, and S. Hayashida.
Journal of General and Applied Microbiology, Vol 26, No 2, p 97-108, April, 1980. 8 Fig, 3 Tab, 9 Ref.

Descriptors: *Activated sludge, *Bacteria, *Biochemical oxygen demand, *Seasonal variation, *Sewage, Bacteriophage, Incubation, Temperature effects, Air temperature, Sedimentation rates, Viruses, Morphology, *Wastewater disposal.

Bacteriophages in the activated sludge of a public sewage disposal plant were isolated, and the influence of the phages on the bacterial flora and the purification powers and sludge volume index of the sludge were examined. Two groups of dominant bacteria were isolated during a 30 month investigation. At the time of the isolation, a disturbance in the normal bacterial flora was observed. Such disturbance was considered to cause a decrease in the purification powers. The disturbances occurred in spring and autumn, and may be caused by phage infection. (Titus-FRC)
W82-02433

THE DESIGN OF SEA OUTFALLS WITH REFERENCE TO EEC AMENITY WATER POLLUTION CRITERIA,

Dundee Univ. (Scotland). Dept. of Civil Engineering.
J. A. Charlton.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 1, p 33-41, January, 1980. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Seawater, *Water pollution, *Outfalls, *Effluent limitations, *Beaches, Design criteria, Wastewater outfall, Outfall sewers, Bacteria, Sewage, Water quality, Tidal effects, Environmental effects, Coastal waters, Turbulence, Dispersion, Swimming, Public health, Great Britain, Europe.

Water quality criteria for bathing waters are discussed. The criteria were established by the European Economic Community (EEC), and are intended for use in the design of sea sewer outfalls. Meteorological data are analyzed to determine threshold wind conditions corresponding to the exceedance percentage. In situ current and dispersion studies are then used to establish dilution rates and normal boundaries, which are then wind shifted to their limiting position. These boundaries must remain clear of the bathing area for the outfall design to be acceptable. Additional precautions are recommended for the discharge of industrial effluents. (Titus-FRC)
W82-02449

TREATED PIT FLUIDS MEET WATER SPECIFICATIONS,

Oil and Gas Journal, Vol 78, No 48 p 138-139, December 1, 1980.

Descriptors: *Pit recharge, *Drilling fluids, Wastewater treatment, *Drilling, Clarifiers, Industrial wastes, *Waste disposal.

The need to haul reserve pit fluids used in land drilling and workover operations to another location in a vacuum truck or find a suitable subsurface disposal site can be eliminated through the chemical and mechanical treatment of the fluids. Treatment is practical during drilling or after the rig moves off location. After treatment the fluids to meet water quality standards, the effluent can be discharged into surface waters or natural drainage. Remaining solids are backfilled or buried for disposal. Most jobs have certain common characteristics. The average pit has 20,000 to 30,000 bbl of effluent, of which 60-90% can be discharged. Pits included contaminated rain water, wash down and drilling wastes. The least expensive treatment of this type to date costs 10 cents/bbl, and the most expensive costs $1/bbl. Average treatment cost is in the range of 40-50 cents/bbl. The customer is charged only for the clean water measured upon discharge. The average job requires about 3 days. The bioassay for water quality involves placing 12 medium tolerant bait fish in a 100% concentration of the treated effluent for at least 24 hr. If 70% survive, discharge is allowed at a specific rate. Equipment needed includes large centrifugal pumps for transferring water, chemical mixing tanks with 1,000-2,000 gal capacity, and chemical lines and hoses. Clarifiers and centrifuges are used for extremely tough jobs. (Baker-FRC)
W82-02557

SLUDGE: BACK INTO THE OCEAN,

D. V. Feliciano.
Journal of the Water Pollution Control Federation, Vol 53, No 10, p 1442-1446, October, 1981.

Descriptors: *Sludge disposal, *Ocean dumping, *Legal aspects, *Environmental effects, Wastewater treatment, Wastewater disposal, Waste disposal, Land disposal, Outlets, Waste management, Recycling, Waste recovery, Permits, Jurisdiction, Regulations, Water pollution effects, Ecological effects.

The issue of the ocean dumping of sludge has been reviewed by the U.S. courts. Much overlap exists when regulating the ocean dumping of wastes; the principal legislation is included under the Marine Protection, Research, and Sanctuaries Act (MPRSA), the Federal Water Pollution Control Act (FWPCA), and regulations of the Army Corps of Engineers, EPA, and the National Oceanic and Atmospheric Administration (NOAA). The production of waste water sludge by the nation's publicly owned treatment works is expected to nearly double by 1990. The role of the MPRSA, the politics of ocean dumping, and some environmental effects of ocean dumping are considered. NOAA has extensively studied the New York Bight in connection with ocean dumping and favors ocean dumping of sludge only when it is the most favorable option. The advisory committee to this agency supports the reuse and recycling of wastes as a priority goal for sludge disposal. Two cases which came up in court concerning the EPA regulations and ocean dumping are examined. In June of 1981, President Reagan authorized increased research on ocean dumping under MPRSA. NOAA intends to sponsor with EPA projects that will assess the relative risks posed to the environment by various ocean dumping options and develop new strategies for ocean dumping. (Geiger-FRC)
W82-02577

5F. Water Treatment and Quality Alteration

TRIHALOMETHANE FORMATION IN NORTH CAROLINA DRINKING WATERS,

North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5B.
W82-02195

PROCESSES--NOT PRODUCTS--BIGGEST ENERGY-SAVING FACTORS.

For primary bibliographic entry see Field 5D.
W82-02218

CHEMICAL PRETREATMENT FOR ACTIVATED-CARBON ADSORPTION,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. J. Randtke, and C. P. Jepsen.
Journal of the American Water Works Association, Vol 73, No 8, p 411-419, August, 1981. 17 Fig, 3 Tab, 36 Ref.

Descriptors: *Water treatment, *Activated carbon, *Adsorption, Water treatment facilities, Drinking water, Potable water, Coagulation, Chemical coagulation, Groundwater, Fulvic acids.

A research project was undertaken to investigate the removal of organic contaminants by coagulation and softening and to explore the interactions of these processes with subsequent activated-carbon adsorption. The results of this project are reported as they relate to the removal of organic contaminants by metal-salt coagulation and the effects of coagulation and softening on activated-carbon adsorption. Five sources of organic matter were used: a local groundwater supply, a humic acid, and three preparations of fulvic acid. The effectiveness of the removal process was related to the dosage of coagulant relative to the amount of organic matter present, the inorganic composition of the water, and the type of organic matter present. The predominant mechanism for organic matter removal by coagulation appeared to be the precipitation of insoluble organo-aluminum complexes. Pretreatment by coagulation significantly increased the adsorptive capacity of activated carbon for the remaining total organic carbon, except when little or no total organic carbon removal occurred during the coagulation process. This increase was not an artifact, but was primarily the result of an interaction between aluminum species and the organic molecules. A minor portion of the increase was attributable to a decrease in the initial total organic carbon concentration for the adsorption process. Neither coagulation nor softening preferentially removed either strongly adsorbing or weakly adsorbing organic molecules. (Baker-FRC)
W82-02234

NEW JERSEY COMMUNITY DECONTAMINATES WELL WATER.

Water Well Journal, Vol 35, No 9, p 58-59, September, 1981.

Descriptors: *Well water, *Decontamination, Adsorbents, Carbon, Water treatment facilities, Organic compounds, *Industrial wastes, Activated carbon, Potable water, Groundwater pollution, Trichloroethylene, Tetrachloroethylene, *Rockaway Township, *New Jersey.

Rockaway Township discovered in the fall of 1980 that all three of its public wells were contaminated with hazardous organic chemicals. A granular activated carbon system was installed in November of 1980 to treat its groundwater. Tetrachlorethylene was found in the groundwater pumped from all three wells. Well number 1 had levels as high as 650 ppb. Another well was also contaminated with 40ppb trichlorethylene. Granular activated carbon removes dissolved organic pollutants from water by a process of adsorption. As water passes through the porous granules of activated carbon, molecules of the organic pollutants are attracted to the surface of the pores and are held there by weak physical forces. The ability of granular activated carbon to remove large quantities of organic impurities is a function of its highly developed internal pore structure, which is created during the manufacturing process. A single handful of activated carbon has a total surface area equal to that of a football field. After the carbon has adsorbed all it can, it is reactivated through treatment in a multiple-hearth furnace. The organic impurities are burned from the internal surfaces of the individual carbon granules. More than 90% of the original carbon is recovered in the reactivation process. Rockaway Borough has also received cooperation from the state in attempting to locate the source of the contamination. (Baker-FRC)
W82-02243

SEASONAL EVALUATION OF ORGANICS REMOVAL AT A CONVENTIONAL WATER TREATMENT PLANT,

CH2M Hill, Reston, VA.
B. Gong, and J. K. Edzwald.
Aqua, No 4, p 0300-0304, 1981. 12 Fig, 4 Tab, 2 Ref.

Descriptors: *Water treatment facilities, *Seasonal variation, Organic compounds, Trihalomethanes, *Organic matter, Rivers, Grasse River, Raw water.

The seasonal variation of organic matter and trihalomethane (THM) precursors were studied in a raw river water supply. Seasonal performance of a conventional water treatment plant was also investigated with regard to the removal of organic matter and THM precursors. The correlations between terminal total trihalomethanes (Term-TTHMs) and surrogate parameters such as non-volatile total organic carbon, UV, absorbance, and color were also investigated. The water supply studied was the Grasse River at Canton, New York. The River is characterized by low turbidity, low alkalinity, and colored surface water. Raw water was collected on nine occasions between January 1980 and October 1980. Process samples were collected at five locations from the Canton water treatment plant. A definite seasonal trend in organic matter and THM precursors was noted in samples taken from the Grasse River. The lowest concentrations for non-volatile total organic carbon and TTHM formation potentials occurred in the winter when the river was covered with ice. The highest concentrations were noted in late July and August. The Canton water treatment plant was found to be performing well with regard to removal of non-volatile total organic carbon and THM precursors, with average removals of 66 and 68% being noted. The Canton plant uses alum coagulation with a nonionic polymer to aid floc formation. Pre-chlorination is practiced. An important characteristic of the plant is the short hydraulic detention time through the treatment plant, which is about 1 hr. This allows THM precursors to be removed prior to THM formation. Apparent color proved to be a gross measure of naturally occurring organic material in rivers. It also had good correlation with Term-TTHMs. (Baker-FRC)
W82-02248

SPECIFIC ORGANIC REMOVALS BY GRANULAR ACTIVATED CARBON PILOT CONTACTORS,

Philadelphia Suburban Water Co., Bryn Mawr, PA.
T. L. Yohe, I. H. Suffet, and P. R. Cairo.
Journal of the American Water Works Association, Vol 73, No 8, p 402-410, August, 1981. 16 Fig, 6 Tab, 27 Ref.

Descriptors: *Water treatment facilities, *Activated carbon, *Organic compounds, Chloroform, Philadelphia, Drinking water, Potable water, Water treatment.

The behavior of granular activated carbon during removal of specific organics from drinking water is discussed. Data are taken from a 15 week pilot study designed to ascertain the effects of aqueous chlorine on the GAC adsorption unit process. More than 100 specific organics were followed. For five specific compounds, the effects of mechanisms of surface oxidation and adsorption are detailed. These five compounds are chloroform, p-dichlorobenzene, 1,2-bis-(2-chloroethoxy)ethane, diacetone-L-sorbose, and dibutyl phthalate. The study showed that the concentrations of trace organics in Philadelphia drinking water fluctuate greatly. When applied to carbon filters these variable influents are reflected in the carbon beds and ultimately in the effluents. Pilot column effluent concentrations can exceed and have exceeded influent levels. Chloroform precursors exhibit adsorption behavior independent of the adsorption behavior exhibited by the surrogate total organic carbon parameter. Organics present in concentrations less than 1 microgram per liter are subject to displacement-desorption from GAC. Chlorine changes GAC properties chemically, physically,

and biologically. The greatest changes occur in uppermost bed regions, where chlorine increases surface oxides on the GAC. Alterations of upper bed properties appear to influence adsorption and subsequent desorption by creating broader initial adsorption bands. This results in broader readsorption bands within the column and causes initial breakthrough to he attenuated due to less severe displacement; this can slough a larger mass to the column effluent. (Baker-FRC)
W82-02260

HOW COMPUTERS HAVE CHANGED WATER WORKS OPERATIONS,

Water and Pollution Control, Vol 119, No 7, p 22, 31, 32, July, 1981.

Descriptors: *Water management, *Computers, Water supply, Toronto, Municipal water, Monitoring, Drinking water, Management, Decision making, *Water distribution, *Automation.

The amount of data required to efficiently operate a water works utility has made the use of computers for process control very appropriate. Practical installations in this area of distribution system operation began about 15 years ago. Central pumping control is a supervisory system operated over Bell Telephone signal circuits to monitor pumping stations and the distribution system and determine the status of valves, pumps and power supplies, reservoir levels, suction, discharge and district pressures and flows. It provides printouts of the data for the operator's information. New stations, when built, can be readily added to existing computer networks. The system as employed in Metropolitan Toronto is at present, due to age, showing signs of potential malfunction, and a new computer and updating of the supervisory system are planned. The process control computer serves to alert the operator immediately by means of an alarm display and with a hard copy alarm printout of any unusual occurrences in the plant's operation. The memory allows the creation of permanent records. Operators have communication with the computer through the operating console. Pushbuttons are presently dedicated to such items as level, flow,pressure, turbidity, chlorine residual and others of significance for water plant operations. The Metropolitan Toronto system has four filtration plants, currently undergoing computerization. (Baker-FRC)
W82-02276

PILOT-SCALE INVESTIGATIONS WITH GRANULAR ACTIVATED CARBON,

Thames Water Authority (England).
For primary bibliographic entry see Field 5D.
W82-02289

DETERMINING MAXIMUM INFLUENT CONCENTRATIONS OF PRIORITY POLLUTANTS FOR TREATMENT PLANTS,

Enviroscience Inc., Minneapolis, MN.
For primary bibliographic entry see Field 5A.
W82-02307

COST OF SMALL WATER SUPPLY TREATMENT SYSTEMS,

Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark, and J. M. Morand.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 1051-1065, October, 1981. 4 Fig, 12 Tab, 10 Ref.

Descriptors: *Cost analysis, *Water costs, *Water supply systems, *Water treatment, Water quality, Package plants, Reverse osmosis, Ion exchange, Maintenance costs, Operating costs, Technology, Chlorinated hydrocarbons, Trihalomethanes, Heavy metals, Metals, Turbidity, Water softening, Water treatment facilities.

Three water treatment alternatives for small systems are compared: conventional (flocculation, sedimentation, and filtration), direct filtration (without sedimentation), and package plants. Conventional treatment production costs were highest and package plants lowest up to 2 mgd. Direct filtration costs were lowest from 2 to 5 mgd. Costs of conventional treatment and package plants were equal at 9.5 mgd. 19 municipal and 17 recreational package plants were studied in Kentucky, West Virginia, and Tennessee. Coliforms were detected at 3 of 31 plants; 8 did not meet the 1 NTU turbidity standards; and 5 of 31 exceeded the 100 micrograms per liter total trihalomethanes standard. Pesticides were not detected in any samples. Heavy metals were detected in a few samples, in small concentrations except for a 19.6 microgram per liter Hg level in one sample. Other possible treatment methods for small systems (0.5 to 2.0 mgd) are (in decreasing order of cost): reverse osmosis, conventional treatment with softening, package plants with softening, and ion exchange with softening. At very small flows, reverse osmosis ranks third in cost, whereas at very high capacity, ion exchange becomes more expensive per unit. Still another possibility for reducing water costs in small communities is to form a regional compact. (Casar-FRC)
W82-02318

WATER CLARIFICATION AND DECOLORIZATION WITH REGENERABLE MAGNETIC PARTICLES,

Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
D. E. Weiss, and W. G. C. Raper.
Effluent and Water Treatment Journal, Vol 21, No 8, p 359-363, 365, 366, August, 1981. 3 Fig, 6 Tab, 11 Ref.

Descriptors: *Clarification, *Water treatment, Clarifiers, Turbidity, Color removal, Iron compounds, Drinking water.

Magnetic materials have recently been incorporated into alum flocs, which may then be removed by means of a high gradient magnetic separator. Once it was understood that color and turbidity could be removed from water using performed particles, which were initially magnetic ion-exchange resins in a positively-charged form, a cheap magnetic particle was sought with the surface charge needed for removing impurities from water. A reversible positive charge was needed to allow regeneration and recycling. Ferric hydroxide coated onto very fine particles of magnetic ore was shown to perform well and was regenerable by treatment with hydroxide solution. However, it was not suitable for prolonged use. A very fine magnetite ore alone, after treatment with sodium hydroxide, was then used as an effective remover of color and turbidity. The surface charge is reversible under alkaline conditions to regenerate the particle for reuse. To achieve the charge reversal needed for regeneration, calcium must not be added in the alkaline stage. Hence, caustic soda rather than lime is employed as the regenerant. Laboratory and pilot plant tests using the principles outlined above are reported. The results of water quality tests at the highest rate tested to date, 25 Ml/d, indicate that turbidity has been lowered from 15 NTU to 0.6-1.0 NTU; color from 45 PT-Co to 3.5-5 PT-Co; total soluble iron from 3 mg/l to 0.04 mg/l; and hydrogen sulfide from 1 mg/l to a negligible amount. (Baker-FRC)
W82-02351

DETECTION OF CHLOROFORM IN THE TISSUES OF FRESHLY EVISCERATED POULTRY CARCASSES EXPOSED TO WATER CONTAINING ADDED CHLORINE OR CHLORINE DIOXIDE,

Agricultural Research Council, Norwich (England). Food Research Inst.
For primary bibliographic entry see Field 5A.
W82-02374

OPTIMIZING COAGULANTS AND FLOCCULANT AIDS FOR SETTLING,

Servico de Engenharia Emilio Baumgart Ltd., Belo Horizonte (Brazil).
J. R. Bratby.
Journal of the American Water Works Association, Vol 73, No 6, p 312-318, June, 1981. 10 Fig, 3 Tab, 10 Ref.

Descriptors: *Alum, *Coagulation, *Flocculation, *Water treatment, Nalco 8182, Turbidity, Settling velocity, Costs, Polyelectrolytes, Brazil, Pilot plants.

A method for choosing an optimum primary coagulant dosage, applied alone or with flocculant aids, is illustrated using raw water from Lago Descoberto, the water supply for the city of Brasilia. Preliminary studies showed that alum was the most desirable primary coagulant. A set of curves was developed to relate the overflow rate and coagulant dosage for the effluent qualities, 0.5, 0.6, 0.7, and 0.8 ftu, using raw water of average 3,24 ftu. Using the present worth method by Pilcher and considering costs of alum, costs of lime required to maintain optimum pH, and capital costs, the optimum dosage for alum alone was calculated at 15 mg per liter, with settling as the solid-liquid separation option. However, when flocculant aids are also used, the primary coagulant dosage is considerably lower. For determining optimum dosages in this case, the clogging of the filter surface, rather than costs, is the major consideration. Pilot plant experiments with 14 flocculants resulted in an optimum dosage of 3 mg per liter alum and 0.15 mg per liter polyelectrolyte (Nalco 8182) at pH 6.4. Total chemical costs using this treatment were estimated at 4.5 million Cruzeiros a year. (Casar-FRC)
W82-02409

JONKOPING'S WATER SUPPLY,

Vattenbyggnadsbyran Ltd., Stockholm (Sweden). Water and Environment Engineering Dept.
S. Bergling.
Aqua, No 4, p 3-5, 1981. 5 Fig.

Descriptors: *Water treatment facilities, *Lakes, Drinking water, Reservoirs, *Lake Vattern, *Sweden, Jonkoping, Filtration, Chlorination, Ammonia, Water supply.

Jonkoping is situated on the southern end of Lake Vattern, Sweden's second largest lake, with a surface area of almost 2000 square kilometers, an average runoff of 35 cubic meters/second, and a total water volume of about 70,000 million cubic meters, corresponding to an average water period of about 60 years. This long detention period is one of the major factors in the high quality of water, with low plankton content and an average water transparency of 12 meters in the lake. Except for a combination of technical factors and the general conditions prevailing during the mid-nineteenth century, Jonkoping's water supply would have been based on this lake. In 1953 investigations regarding Jonkoping's future water supply proposed a new water treatment plant, to be sited on the west bank of the lake at Haggeberg, 1 km north of the Eklundshov plant, with sufficient capacity to meet the water demands of the entire town. Water was to be abstracted from the lake at such a depth that temperature variations would be minimal, and that treatment should consist of slow sand filtration, followed by alkalinization with lime water and chlorination accompanied by ammonia dosing. The plant became operational in 1957. The major parts of the plant include the lake water intake, lake water pipe, lake water pumping station, lake water pipe to slow sand filters, slow and filtration unit, low level reservoir sited in rock, drinking water pumping plant sited in rock, high and low voltage equipment, standby power plant, and main pipe to town. Slow sand filtration has proved an effective method of treatment, and an estimated filter speed of 0.30 meters/hr has been maintained. Long-term expansion of the Haggeberg plant is discussed. (Baker-FRC)
W82-02419

NEW EUROPEAN EXPERIENCES IN REMOVAL OF ORGANICS IN SURFACE WATER TREATMENT,

Water Supply, Zurich (Switzerland).
M. Schalekamp.
Aqua, No 4, p 0279-0289, 1981. 6 Fig, 12 Ref.

Descriptors: *Water treatment, *Quality control, Flocculation, Filtration, Adsorption, Lakes, Chlorination, Ozonation, Disinfection, Chlorine dioxide, *Switzerland.

Increased pollution of the environment has forced water treatment authorities in Switzerland to take further measures to protect and improve the quality of water being supplied to the citizens. Lakes in the area have passed from oligotrophic conditions to eutrophic ones. International cooperation has been good on improving matters concerned with the Rhine. Waterworks on the Lower Rhine have used practically all available possibilities for water treatment, including river bank filtration, ozonation, multi-layer filtration, GAC-filtration, neutralization and safety chlorination. In the future the following treatment processes will be employed on Swiss lake water plants: prechlorination, flocculation, double-layer rapid filtration with sand and pumice, neutralization, ozonation, GAC filtration, slow sand filtration and chlorine dioxide treatment. On practically every Swiss lake which is being used for drinking water production, the new treatment technique is already in operation or will shortly be in operation. The addition of chlorine dioxide does not act as an actual water treatment, but does serve as pipeline protection so that the water in the supply and distribution network remains hygienically perfect. The dosage is only 0.05 mg of chlorine dioxide per liter, so no difficulties arise with chlorite and chlorate. This entire cleaning process reduced organic substances by 90%, allowing a very high standard of water quality to be attained. Further work is now in order on wastewater cleanup. (Baker-FRC)
W82-02420

WATERBORNE DISEASE IS PREVALENT IN EGYPT,

For primary bibliographic entry see Field 5C.
W82-02435

REDUCING PLUMBOSOLVENCY - THE EFFECT OF ADDED LIME ON THE LOCH KATRINE SUPPLY TO GLASGOW,

Strathclyde Regional Council (Scotland).
W. N. Richards, A. Britton, and A. Cochrane.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 315-333, July, 1980. 11 Fig, 4 Tab, 21 Ref.

Descriptors: *Solubility, *Lead, *Drinking water, *Glasgow, Scotland, Hydrogen ion concentration, *Water treatment, Lime, Alkalinity, Water supply, Corrosion, *Pipes.

Increasing the pH of Loch Katrine reservoir waters from 6.3 to 7.8 by the addition of lime has reduced the plumbosolvent nature of the water. The addition of lime has increased the number of random daytime samples complying with the international health standards for lead of 0.1 mg per liter from less than 50 to over 80 percent. Unsatisfactory samples continue to be obtained from premises with lead lined storage tanks, properties with copper to lead runs of piping, properties built before 1919, and properties with a single occupant. Lead solubility calculations indicate that further reductions in plumbosolvency should be possible if high pH values can be maintained at consumers' taps. (Titus-FRC)
W82-02446

PH CORRECTION: TECHNICAL ASPECTS OF A 50° TCMD TREATMENT WORKS,

Quest Automatron Research, Ltd., Dorset (England).
P. L. G. Pharaoh.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 4, p 334-345, July, 1980.

Descriptors: *Hydrogen ion concentration, *Water sampling, *Water treatment, *Water supply, Chemical analysis, Lead, Contamination, Technology, Solvents, Economic effects, Engineering, Storage, *Lime, Flow discharge, Chlorination, Electronic equipment, Design criteria, Design standards.

Electronic control was capable of maintaining the desired pH level by liming during major fluctuations of the slurry solution strength in a water treatment plant in Glasgow. Control and instrumentation in general proved to operate well within the initial specifications. Step functions induced in the control system either by manual means or by sudden high flow rates can be countered by the three term controllers and the swift response of the stroke and speed control equipment to the pumps. This system has enhanced plant operation and maintenance as well as reducing the incidence of blocked pipes normally experienced in other works in the region. (Titus-FRC)
W82-02447

THE INTEGRITY OF EXISTING DISTRIBUTION SYSTEMS,

Severn-Trent Water Authority (England).
D. W. Lackington, and J. M. Large.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 1, p 15-32, January, 1980. 12 Fig, 8 Ref.

Descriptors: *Distribution, *Water supply, *Drinking water, *Statistical models, *Pipelines, Sewers, Cost analysis, Corrosion, Deterioration, Monitoring, Maintenance, Boreholes, Chemical properties, Water treatment, Engineering, Technology, Climate data, *United Kingdom.

The integrity of the Leicestershire water distribution network is evaluated. A variety of parameters affecting the Leicestershire network were monitored. Investigations so far indicate that problems of burst frequency, discolored water, low residual pressure, and, to some extent, waste water are linked. The common factor is corrosion of unlined iron mains. This situation appears to be aggravated when new waters are introduced into old mains. Chemical treatment adding sodium silicate at the source is not considered a suitable alternative to physical repair of the network. (Titus-FRC)
W82-02450

METHODS FOR TREATMENT OF COLOR IN GROUNDWATER,

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
G. F. Mitchell, and D. O. Hill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157850, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute, Mississippi State University. Report, September, 1981. 87 p, 43 Fig, 25 Tab, 61 Ref. OWRT-A-132-MISS(2), 14-34-0001-1126.

Descriptors: Ion exchange, Membrane processes, Oxidation, Coagulation, UV-radiation, Adsorption, *Color removal, *Groundwater, *Water treatment, Strong base ion exchangers, Weak base anion exchangers, Ultrafiltration, UV-radiation.

Ion exchange, ultrafiltration, coagulation, oxidation and other techniques were investigated for treatment of a groundwater containing organic color in the range of 20 to 60 units as platinum cobalt. Treatment with coagulation was often incomplete and required high dosages of coagulates. Oxidation was generally ineffective except with uv-radiation and hydrogen peroxide. Ultrafiltration was effective with a UM type membrane of 10,000 molecular weight cutoff providing over 90 percent color removal. A commercially available PM type membrane did not provide this removal except with pH adjustment of the feed to 5. Color removal was affected by membrane characteristics. Ion exchange on a macroporous strong base anion exchanger provided excellent color removal; however, upon regeneration and subsequent cycles of use the capacity of the exchanger was reduced by 70 to 80%. Additional study indicated that the regenerate could be reused and that a flow rate of 3 gpm/cu ft provided similar color removal to that achieved at 1 gpm/cu ft.
W82-02532

ENERGY COSTS AND PORTLAND WATER SUPPLY SYSTEM,

Bureau of Water Works, Portland, OR.
W. M. Elliot, and R. P. Hawley.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 365-374, October, 1981. 7 Fig, 2 Ref.

Descriptors: *Water management, *Energy, *Costs, *Water distribution, Pumps, Hydroelectric plants, Conduits, Electric power, Gravity flow, Water mains, *Portland, *Oregon, Operating policies, Water policy, Municipal water.

Rising energy costs, over 600% in the last 10 years, have led the city of Portland, Oregon, to adopt new policies for managing its water supply system. Major energy savings are provided by: (1) installing a 50 million gal buried reservoir on Powell Butte, including conduits for interconnecting the entire water system, (2) constructing a gravity conduit to supply eastern Washington County, (3) retrofitting two existing dams to produce a total of 36 megawatts, (4) pump replacement and modification, and (5) improving pump operation. It is expected that energy costs will be reduced by 50% when all phases of the project have been completed. (Cassar-FRC)
W82-02586

TRIHALOMETHANE PRECURSOR CONTROL BY ADSORPTION,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.
G. D. Reed, and A. F. Zey.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 1095-1099, October, 1981. 5 Fig, 10 Ref.

Descriptors: *Adsorption, *Activated carbon, *Chlorinated hydrocarbons, *Water treatment, Ion exchange resins, Anion exchange, Organic compounds, Trihalomethanes, Organic matter.

Activated carbon (granular bituminous based Nuchar WVG) was effective in removing trihalomethanes and their precursors from prechlorinated, treated Missouri River water in pilot plant studies over the period September 1 to October 25. A weak base anion exchange resin (Diamond Shamrock ES-561), designed to adsorb high molecular weight organics, removed only small amounts of precursors, and the effluent concentration rose significantly with increasing run time. A carbonaceous resin (Ambersorb XE-340), designed to adsorb low molecular weight organics, had no capacity for removing trihalomethane precursors; effluent concentrations were often higher than influent concentrations. (Cassar-FRC)
W82-02598

5G. Water Quality Control

FEDERAL AND STATE COASTAL ZONE MANAGEMENT EFFORTS DIRECTED AT ESTUARIES AND FRESHWATER INFLOW,

National Oceanographic and Atmospheric Administration, Washington, DC. Office of Coastal Zone Management.
For primary bibliographic entry see Field 6E.
W82-02113

STRATEGIES FOR THE MANAGEMENT OF ESTUARIES,

Texas A and M Univ., College Station. Dept. of Oceanography.
For primary bibliographic entry see Field 6F.
W82-02166

METHODS OF COMPUTATION AND ECOLOGICAL REGULATION OF THE SALINITY REGIME IN ESTUARIES AND SHALLOW SEAS IN CONNECTION WITH WATER REGULATION FOR HUMAN REQUIREMENTS,

M. Rozengurt, and I. Haydock.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche.

In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 474-506. 10 Fig, 7 Tab, 37 Ref.

Descriptors: *Estuaries, *River flow, *Saline water intrusion, *Environmental effects, *Environmental protection, *Diversion losses, Pollution load, Fisheries, Dams, Canals, Water demand, Aquatic life.

Estuaries around the world are experiencing reduced freshwater inflows because of human actions such as damming and consumptive withdrawals, and natural causes. The low flow results in increased salinity in the estuary and salt water intrusion into previously freshwater stretches of the river. Research has shown that if freshwater flows are decreased by 25-30%, severe environmental disturbances result. Studies of some Russian rivers show that up to 50% of their flow is being diverted, and similar figures are available for flows into the San Francisco Bay-Delta. The freshwater flow reductions are aggravated by increasing pollution loads which reduce sustaining biota and hence reduce fish and shellfish populations. Two projects are being developed in Russia to prevent salinity intrusions into the rivers of the Black Sea and Azov Sea. A fixed sea water check dam will completely prevent the entrance of sea water into the delta and change the delta into a freshwater lake. A dam with a built-in restraining canal will assure a constant connection with the sea but limit the entrance of sea water to acceptable levels. The former is preferable from the point of freshwater supply and the latter assures a better preservation of natural conditions and unimpeded navigation. Such a system is proposed for the San Francisco Bay-Delta, in the Carquinez Strait between Suisun and San Pablo Bays. (Brambley-SRC)
W82-02169

THE DILUTION/FLUSHING TECHNIQUE IN LAKE RESTORATION,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W82-02270

HYPOLIMNETIC AERATION OF A SMALL EUTROPHIC KETTLE LAKE: PHYSICAL AND CHEMICAL CHANGES,

McGill Univ., Montreal (Quebec). Dept. of Biology.
C. T. Taggart, and D. J. McQueen.
Archiv fur Hydrobiologie, Vol 91, No 2, p 150-180, May, 1981. 15 Fig, 5 Tab, 51 Ref.

Descriptors: *Lake restoration, *Aeration, *Water quality management, Dissolved oxygen, Oxygen, Hypolimnion, Metalimnion, Stratification, Eutrophic lakes, Tory Lake, *Ontario, Nitrogen, Phosphorus, Hydrogen sulfide, Manganese.

A small hypolimnetic aerator effectively removed Mn, P, and H2S from a small hypereutrophic lake, Tory Lake, Ontario, but was ineffective for nitrogen and CO2 removal. Aeration studies were conducted on two successive summers. The average dissolved oxygen concentrations in the hypolimnion were raised by 2.42 mg per liter in 1978 and by 1.47 mg per liter in 1979 from values < 1 mg per liter. The aerator was not capable of raising hypolimnetic dissolved oxygen above 5 mg per liter during the summer. Hypolimnetic cycling time was 4.15 days in 1978 and 3.07 days in 1979. Air flow rates in 1979 were increased to compensate for the increased hypolimnion volume, which was 2.5 times that of 1978. Stratification was not disturbed by the treatment. The metalimnion had increased H2S and was virtually anoxic by July in both summers. This condition would be a barrier to zooplankton and fish movements. (Casser-FRC)
W82-02341

DENMARK'S STATE OF THE ENVIRONMENT,

For primary bibliographic entry see Field 5B.
W82-02401

SEWAGE OUTFALL LOCATION REDUCES ENVIRONMENTAL DAMAGE IN THE THAMES ESTUARY,

Metropolitan Pollution Control-Thames Water, London (England).
M. J. Andrews.
Water Science and Technology, Vol 13, No 7, p 265-270, 1981. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Estuaries, *Water pollution prevention, *Outfall sewers, Water quality control, Water quality management, Salinity, Wastewater outfall, Environmental effects, Ecological effects, Aquatic life, *Thames estuary, England.

The placement of major sewage outfalls in estuaries may be an important factor in minimizing environmental pollution. The least damage will occur where there are fewer species at risk. In estuaries, the junctions of mesohaline and oligohaline waters contain the smallest numbers of species. This area is unattractive to fishermen and is rarely used for swimming, since the average salinity is about five parts per thousand. In the Thames estuary, the minimal environmental damage would probably occur in areas where shellfish beds would not be destroyed, fish spawning affected, or bathing beaches made unfit for public recreation. The siting of London's major sewage outfalls at the five parts per thousands area of salinity has helped in accelerating the rehabilitation of the once polluted estuary by plants and animals. The principal disadvantage of locating outfalls at the five parts per thousand area is that both freshwater and marine components of the fauna are at risk. (Geiger-FRC)
W82-02404

THE DESIGN OF SEA OUTFALLS WITH REFERENCE TO EEC AMENITY WATER POLLUTION CRITERIA,

Dundee Univ. (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W82-02449

AN ESTIMATION OF THE REAERATION COEFFICIENT IN NATURAL STREAMS BY SPECTRAL ANALYSIS OF TIME SERIES DATA,

Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
T. Matsuo, and N. Yotsukura.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $6.75, Microfiche $3.50. Geological Survey Open-File Report 81-648, 1981. 47 p, 18 Fig, 4 Tab, 21 Ref.

Descriptors: *Model studies, Estimating, *Natural streams, *Spectral analysis, *Time series analysis, Mathematical models, Aeration, Dissolved oxygen, Biochemical oxygen demand, Light intensity, Water temperature, Streamflow, Flow characteristics, Reaeration coefficient, Mass transfer, *Water quality control.

Spectral analysis of time series data for the dissolved oxygen concentration (DO), water temperature, and sunlight intensity is used to estimate the reaeration coefficient of a natural stream. The streamflow is assumed to be steady and uniform hydraulically and homogeneous biologically. Under such conditions, the temporal variation of DO may be caused solely by that of the sunlight intensity. The DO mass balance equation becomes a first-order linear differential equation, which can be solved by means of the Fourier series. The reaeration coefficient is then expressed as a function of the phase shift between the sunlight intensity and DO, and between the sunlight intensity and saturation concentration of DO, and of the Fourier coefficients for the fluctuating portion of the DO and the saturation concentration of DO. Computing these parameters from data obtained at a single measurement station, the reaeration coefficient of the Cuyahoga River, Ohio, was estimated to range from 2.6 to 7.7 per day during selected periods in 1976 and 1977. (USGS)
W82-02458

EFFECT OF DRAINAGE SYSTEM DESIGN AND OPERATION ON NITRATE TRANSPORT,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-02505

COMPARISON OF METALS AS CATALYSTS FOR THE PHOTOLYSIS OF WATER,

Auburn Univ., AL. Dept. of Chemistry.
T. R. Webb.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157801, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, November 30, 1980. 8 p, 11 Ref. OWRT-A-080-ALA(1), 14-34-0001-1101.

Descriptors: *Hydrogenation, *Photolysis, *Catalysts, *Metals, Rhodium, Platinum, Comparison studies, Chemical reactions, Water quality control.

A study of the platinum-catalyzed photolysis of water to produce hydrogen is described. Experiments indicated that rhodium could be substituted for platinum as catalyst, that palladium was feebly effective, and that ruthenium, gold, iridium, and silver were not effective. Studies of related ruthenium and iron complexes showed that ruthenium-phenanthroline and iron-phenanthroline complexes could work as light-absorbing species in place of a more-studied ruthenium-bipyridine complex; europium ion showed some promise as an electron-transfer reagent. Preliminary experiments suggest that hydrogenation of double bonds occurs in the system.
W82-02527

WATER LAW, WATER CONSERVATION AND THE DEVELOPMENT OF ENERGY RESOURCES IN THE COASTAL, OFFSHORE AND FLOOD PLAIN AREAS OF ALABAMA,

Alabama Univ., University. School of Law.
H. Cohen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157884, Price codes: A05 in paper copy, A01 in microfiche. Natural Resources Center, University of Alabama, Research Report, 1981. 93 p. OWRT-B-080-ALA(1), 14-34-0001-1201.

Descriptors: *Water law, Environment, *Oil and gas production, Pollution, *Coastal zone management, Wetlands, Flood plains, *Environmental control, *Water quality control, *Alabama.

This Report is about mineral development and water conservation in the coastal areas. It is not a discussion of the general problems of land and water uses in the coastal zones. It does not deal with the problems of residential housing along the beach fronts or dredging and filling for subdivision or condominium development. The coastal environment has always been thought to be hardy one, able to withstand a great deal of burdensome human activity, but it has recently been realized than man's various coastal projects bring significant environmental or ecological problems. The wetlands and the estuarine areas, including so called swamplands once considered wastelands, are now known to be vital to the balance of nature and essential to the plant and fish life as well as water quality in the area. The coastlines and wetlands are also flood plains. When great storms rage, as they inevitably do, the tides overcome the coastal areas. The Congress and numerous states have reacted to these dilemmas. Flood plain controls were created to prohibit construction which may damage property and endanger lives downstream. Wetland and coastal management legislation has been aimed at trying to preserve delicate ecological systems which affect the future of wildlife and the entire chain of natural phenomenon in the area. Out short term interests demand that we intensify our exploration for, and our production of oil and gas. Long term interests demand that we keep intrusion into our coastal areas and possible resultant pollution at a minimum. Out challenge is to conduct our mineral development in such a manner as to keep the environment as clean as possible.
W82-02535

THE PHYSICO-CHEMICAL AND PLANKTONIC RESPONSE OF AN ALGICIDE-TREATED SHALLOW MOUNTAIN LAKE IN ARIZONA,
Northern Arizona Univ., Flagstaff. Dept. of Biological Sciences.
S. S. Schwartz, D. W. Blinn, and G. Johnson.
Internationale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 245-262, 1981. 2 Fig, 1 Tab, 37 Ref.

Descriptors: *Algicides, *Plankton, Lakes, *Arizona, Mountain lakes, Eutrophication, *Water quality control, Physicochemical properties, Algae, *Ashurst Lake, Ecosystems, Ecological effects.

The response and recovery of a mountain lake ecosystem was followed after treatment with an algicide. The physico-chemical parameters and phytoplankton and zooplankton populations were monitored during the course of the study in Ashurst Lake. Frequent winds, shallow depth and the exposed nature of the basin insure that the lake's water column remains nearly homogeneous throughout the year. The lake was treated with Aquazine (simazine) on 9 July 1975 at an active concentration of 0.45 mg/liter to analyze its effectiveness for controlling nuisance blue-green algal blooms. Sampling was initiated on 25 May 1975 and continued at biweekly intervals until 9 November, with the remainder of the sampling done at monthly intervals for a total of 2.5 years. Within 3 days of treatment a minor bloom of Anabaena circinalis was reduced by 30%, and after 14 days to negligible cell numbers. This species failed to be a major component of the phytoplankton for the next 2.5 years. The usual late summer bloom species, A. flos-aquae, appeared at reduced densities about 1 month after treatment. In the summer of 1976, A. flos-aquae appeared during about the same period as recorded for years prior to treatment. Algicide concentrations of more than 3.0 mg/liter were adequate to control blue-green bloom species. The following September the lake was treated with rotenone to remove trash fish. Surface blooms of A. flos-aquae disappeared within 12 hr of treatment. Cryptophyta appeared to benefit during this time. (Baker-FRC)
W82-02571

LIMING ACID PONDS IN NEW YORK,
New York State Dept. of Environment Conservation, Watertown.
L. M. Blake.
New York Fish and Game Journal, Vol 28, No 2, p 208-214, 1981. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Lime, *Acidic water, Water, Acid rain, Fishing, *New York, *Lakes, Ponds, Water quality, Hydrogen ion concentration, *Fish populations.

This paper reviews various treatments, considering changes in pH, alkalinity and fish populations as a result of liming ponds to neutralize acid conditions. Cost-benefit ratios are considered. Application of hydrated lime in New York State is limited to open-water periods for economic reasons. Hydrated lime is superior to the less potent agricultural lime, calcium carbonate, although the latter permits a longer time between treatments. No matter which type of lime is used, the lime is dumped from bags from a slowly moving boat. More lime is spread in shallow water areas than over deep water areas so that the lime is placed where the fish live and it is exposed more effectively to wave action and currents. The use of lime in remote areas is more difficult due to the high cost of transport. Possible increases in mercury content of fish after lime treatment were studied. Mercury levels were determined in brook trout from selected lakes, limed and unlimed. No increase in mercury levels was apparent in either limed or unlimed control waters. Costs for liming remote ponds range as high as $297 per acre. Experience with the dry dispersal method has shown that lime can be moved at a rate of 5 tons per hour. The average cost of this method should be about $100 per acre. It was concluded that for both accessible and remote ponds, liming is an effective and economically feasible tool which can be used to counteract the adverse impact of acid precipitation and maintain selected fisheries. (Baker-FRC)
W82-02572

WETLANDS USE FOR WATER MANAGEMENT IN FLORIDA,
Corvallis Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 4A.
W82-02590

GUIDELINES FOR CONTROL OF SEPTIC TANK SYSTEMS,
California Regional Water Quality Control Board, Oakland.
For primary bibliographic entry see Field 5B.
W82-02599

AUTOMATED STREAM DIVERSION FOR RESERVOIR PROTECTION,
Fraser (J. Kenneth) and Associates, Rensselaer, NY.
J. A. Besha, V. C. McGuffey, M. R. Rafferty, and M. P. Brown.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 1085-1089, October, 1981. 1 Fig, 1 Tab, 2 Ref.

Descriptors: *Diversion structures, *Automation, *Storm water, Water quality control, Diversion, Reservoirs, Streams, Highway effects, Construction, Soil erosion, Erosion, Monitoring, Control systems, Turbidity, *Reservoir protection.

Control of water quality during highway construction in the Richmondville, New York, watershed was accomplished with an automated monitoring and stream diversion system. Turbidity, pH, and conductivity of the two influent streams are continuously monitored by electric probes. When these parameters exceed 20 NTU, pH 8.5, or 350 micromho 15 times during a 10 min period, the stream diversion sequence is activated. A programmable controller initiates opening of valves which release nitrogen gas into inflatable bladder dams at the points where streams enter the reservoir. Thus the flood is rerouted to the streams below the reservoir. The controller also controls sampling pumps, backwashing of sensing lines, data input and output, and a telephone communication system. Programmability allows fine adjustments for such perturbations as animals walking in the stream. In the first two years of operation 52 water diversion sequences were initiated by high turbidity, and four each by pH and conductivity excesses. Installation costs were $125,000, and annual operating costs, $20,000. (Caesar-FRC)
W82-02600

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

THE MOUTH OF THE COLORADO RIVER PROJECT; AN ECONOMIC DEVELOPMENT ENVIRONMENTAL ENHANCEMENT PROJECT,
Army Engineer District, Galveston, TX. Engineering Div.
For primary bibliographic entry see Field 4A.
W82-02148

COLORADO RIVER SIMULATION SYSTEM; AN EXECUTIVE SUMMARY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
M. S. Cowan, R. W. Cheney, and J. C. Addiego.
October, 1981. 16 p, 5 Fig, 1 Tab.

Descriptors: *Computer models, *Simulation, *Water management, *Colorado River, Water resources development, Water supply, Water demand, Hydrology, River flow, Water quality.

The CRSS (Colorado River Simulation System) is a deterministic digital computerized simulation model that has been developed by the Bureau of Reclamation in accordance with all the 'Laws of the River'. With CRSS, proposed changes to the operation or alternative development schemes of the river system can be modeled and their effect on the future quantity and quality of water in the river may be evaluated. The CRSS comprises seven programs and data bases: CRSM (Colorado River Simulation Model); operational control data; demand data base; demand input generation program (SMDID); natural flow and salt data base; hydrology input data generation program (MHYDRO); and output summary program (TAPEDIT). The basin as presently modeled consists of 24 reaches, each of which represents a specific geographic area, and within which up to 10 inflows and 10 different demands can be identified. The model simulates river basin flows on a monthly time frame, starting at the top of the basin and proceeding to the bottom. River flows are calculated at each inflow, demand, and reservoir sequence point. With the demand data base as input, SMDID generates the demand data for CRSM, and summaries of projected depletion by water use, state, and basin. The hydrology data input to CRSM is generated by running the program MHYDRO with the hydrology data base and control data as input. (Brambley-SRC)
W82-02170

SOLID SET IRRIGATION SYSTEM DESIGN USING LINEAR PROGRAMMING,
Ben-Gurion Univ. of the Negev, Sde-Boker (Israel). Inst. for Desert Research.
G. Oron, and D. Karmeli.
Water Resources Bulletin, Vol 17, No 4, p 565-570, August, 1981. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Linear programming, *Sprinkler irrigation, *Design criteria, Systems analysis, Costs, Pipes, Optimization, *Irrigation design, Case studies.

The formulation of a solid set irrigation system (sprinkler or trickle) using linear programming is presented. The formulation is based on an objective function for the minimum system cost and the various hydraulic and operational constraints. Given the characteristics of the water resource, the linear programming analysis will minimize the cost of a solid set system and obtain optimum pipe diameters and related sections lengths. The objective function consists of equipment, energy and labor components. The pipe network is optimized with the aim of determining optimal diameters for various pipe sections. A capital recovery factor assumes similar interest rates and longevity of all components. A case study is presented which develops a solid set under tree sprinkler system for an orchard (176 m x 144 m). (Small-FRC)
W82-02273

WEEKLY MULTIPURPOSE PLANNING MODEL FOR TVA RESERVOIR SYSTEM,
Tennessee Valley Authority, Norris.
J. E. Giles, and W. O. Wunderlich.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 495-511, October, 1981. 8 Fig, 7 Ref.

Descriptors: *Computer models, *Reservoir operation, *Dynamic programming, Mode studies, Decision making, Future planning, Planning, Economic aspects, Evaluation, Systems analyses, Fortran, Tennessee Valley Authority.

A weekly planning model for planning and operational studies of the Tennessee Valley Authority (TVA) reservoir system is described. The model simulates the operation of a multipurpose, multireservoir system by weekly time procedures up to one year and evaluates an objective function comprised of five cost functions. The model, which uses dynamic programming by successive approximations, was applied to various planning problems with influential system-wide impacts. Results showed the model to be a powerful computerized planning tool with an updatable system as applica-

tion experience increases. The effect of foresight has been evaluated in applications of the model to several case studies. Foresight may be limited by reducing the planning period, using constraints within the planning period, using overlapping planning periods and discounting future costs. The capabilities and limitations of the model have not yet been fully explored. Although the rigid constraint approach was found to be the most expedient technique for the decision makers of the TVA organization, the model is not limited to this approach and may be used when policies are based on direct measures. (Geiger-FRC)
W82-02319

POSSIBILITY OF INVESTIGATING OPEN-CHANNEL FLOWS ON AN ANALOG COMPUTER,

K. N. Koida.
Hydrotechnical Construction, No 3, p 268-269, March, 1980. 3 Fig, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 34-35, March, 1980.

Descriptors: Open channels, *Computers, *Analog computers, Flow measurement, *Flow characteristics, Flow discharge, Flood discharge, Stream discharge, *Model studies, *Open-channel flow.

The differential equation of a uniform gradually varied flow with a constant discharge in an open cyclindrical channel is considered. This equation is usually solved numerically on a digital computer in plotting the curves of the free surface. Analog computers have not generally been used for this type of problem. However, through some manipulations, this matter can be handled on the analog computer as well, which deals quite adequately with a system of nonlinear equations. Use of the analog computer permits the investigator to change the initial depth and bottom slope during modeling, to determine the critical and normal depths and critical slope, and to investigate any type of curves of the free surface. Investigations of flows in open channels on an analog computer are distinguished by clarity. A cathode-ray tube display is used to observe the solution. The accuracy of the solution depends on the type of computer used. With modeling on the MN-7M it was possible to find the normal depth, determined preliminarily on a digital computer with a high accuracy, with an error of 7%. Flows in channels with a variable slope of the bottom can also be investigated on the analog computer. (Baker-FRC)
W82-02389

EMPHASIS ON DISTRIBUTION: STRATEGIES FOR SMALL SCALE WATER RESOURCES DEVELOPMENT IN THAILAND,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. Arbhabhirama, S. Angel, and M. R. Brewster.
Water Resources Bulletin, Vol 17, No 3, p 483-493, June, 1981. 2 Fig, 4 Tab, 15 Ref.

Descriptors: *Water distribution, *Water resources development, *Water policy, *Thailand, Reservoirs, Irrigation systems, Planning, Short-term planning, Canals, Rivers, Water supply development, Economic aspects, Developing countries, Subsidies.

Water resources development for northeast Thailand, the poorest region in the country, should shift its emphasis from construction of large storage reservoirs which benefit a few farms to construction of water distribution systems which reach a large number of farms. The water policy for this area should entail: effective distribution of water from existing large reservoirs and reliable rivers to people adjacent to these sources, and development of small water resource projects (small reservoirs, weirs, ponds, and wells) to meet the needs of farms out of reach of the large reservoirs and rivers. Three zones were defined, based on access to water supply sources. A 5-year plan (1980-85) for implementing these strategies has been formulated. There are six key recommendations: (1) move rapidly to adopt a water resources development strategy for this area by establishing the appropriate agencies, (2) support and improve existing distribution systems, (3) increase provincial involvement in the small water projects, (4) initiate a provincial water survey to identify the best water projects for each village, (5) allocate subsidies for village water projects based on a fixed subsidy per family, average $250 per family or $500 million total, and (6) encourage villagers to own and operate their own water projects. (Cassar-FRC)
W82-02408

THE USE OF MATHEMATICAL MODELLING AS A DECISION-MAKING TOOL IN THE WATER AUTHORITIES OF ENGLAND AND WALES FOR WATER-QUALITY MANAGEMENT,

Newcastle upon Tyne Univ. (England).
K. D. Russell, and M. B. Pescod.
Water Pollution Control, Vol 80, No 3, p 390-397, 1981. 4 Tab, 9 Ref.

Descriptors: *Water quality management, *Mathematical models, Model studies, Planning, Decision making, Administrative decisions, *Great Britain.

This paper reviews experience gained in England using mathematical modelling techniques as decision making tools in water quality management. Information was collected through questionnaires sent to all water authorities of England and Wales in December 1978. It appeared that 27 models are available for use in the ten water authorities. Most authorities have two models. Roughly half of the available models are for the freshwater regime, and the other half are for tidal applications. The most popular model language in use was Fortran. Due to the high cost of model production, many authorities have adopted the Water Research Center inland water quality model for use in freshwater regimes. Running costs and CPU times were variable, depending on computer installation, computer operating system, complexity of the system modelled and optimality of the solution. The most common application for modelling was in setting consent conditions for discharges. Other important uses included dealing with alterations in flows due to regulation or abstraction. Five models were used in planning new treatment works. Two models have direct economic connotations. In general it appeared that insufficient data are used, which will necessarily result in unrealistic predictions when the models are applied where conditions are outside those of the calibration range. It was felt that techniques used to generate water quality data need to be evolved to assist in overcoming the resource restrictions of real data collection. Synthetic flow generation has been used for some time in the field of hydrology, and this approach would be of use if applied to water quality. (Baker-FRC)
W82-02424

SYSTEMS ANALYSIS APPLIED TO WATER MANAGEMENT IN DEVELOPING COUNTRIES: PROBLEMS AND PROSPECTS,

Biswas and Associates, Oxford (England).
A. K. Biswas.
Environmental Conservation, Vol 8, No 2, p 107-112, Summer, 1981. 7 Ref.

Descriptors: *Developing countries, *Systems analysis, *Water management, Regional development, Computers, Model studies.

Third world countries have not generally made use of systems analysis and the application of computer technology for planning water resources development and management processes. Because water management is so complex, it is important to utilize any available tool such as systems analysis to analyze all possible strategies and viable alternatives. Models do not fail because of lack of technical expertise or inadequate computer technology. Failure is usually the result of managerial problems. Models can be used in developing countries, although some models of this type are rather crude and are dependent upon the judgment and expertise of the analyst. (Small-FRC)
W82-02441

WATERLOGGING CONTROL FOR IMPROVED WATER AND LAND USE EFFICIENCIES: A SYSTEMATIC ANALYSIS,

Colorado State Univ., Fort Collins. Water Resources Research Inst.
A. Simpson, H. J. Morel-Seytoux, R. A. Young, G. E. Radosevich, and W. T. Franklin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157983, Price codes: A08 in paper copy, A01 in microfiche. Completion Report No 108, December, 1980. 138 p, 41 Fig, 3 Tab, 46 Ref, Append. OWRT-C-7144(6211)(2), 14-34-0001-6211.

Descriptors: Pump drainage, Reclamation of waterlogged lands, Surface-groundwater simulation, Drainage of waterlogged lands, *Waterlogging, *Salinity, *Irrigation practices, *Groundwater management, *Land management, Drainage, Surface-groundwater relations, Model studies, *San Luis Valley, *Colorado, Rio Grande River.

The problems of waterlogging and salinization are often associated with irrigated agriculture. Both these problems exist in the San Luis Valley, in southern Colorado. This study considers a 500 square mile study area south of the Rio Grande River in the San Luis Valley. Many thousands of acres of the study area are subject to waterlogging each year. A Fortran IV computer simulation model of the stream-aquifer-irrigation system in the study areas was developed. The computer simulation model is used to investigate two alternative management strategies and to compare effects with past water management programs (the 'historic strategy'). These strategies aim to lower the water table in the waterlogged area to enable the growing of crops using center-pivot sprinkler irrigation. The report is divided into two main parts. The first part describes the study area and the components and interactions considered in the development of the hydrologic computer model, including a detailed description of the actual computer program. The second part of the report concerns an analysis of the management strategies aimed at reducing the waterlogging problem. The historic strategy and two alternative management strategies were subject to analysis. The first alternative management strategy involves a 16 square mile well field called the La Jara Creek well field development. The second alternative strategy is the 10 square mile Rock Creek well field development. A comparison of the effects of the historic management strategy and the two alternative well field development strategies is provided.
W82-02455

ANALYSIS OF FIRM WATER SUPPLY UNDER COMPLEX INSTITUTIONAL CONSTRAINTS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. M. Shafer, J. W. Labadie, and E. B. Jones.
Water Resources Bulletin, Vol 17, No 3, p 373-380, June, 1981. 5 Fig, 2 Tab, 8 Ref. OWRT-B-201-COLO(3).

Descriptors: *Water rights, *Reservoir operation, *Institutional constraints, Water allocation, Water policy, Water supply, Water management, Water users, Water use efficiency, Water reuse, Cooling ponds, Legal aspects, Rawhide project, *Colorado, Powerplants, *Model studies, River basins, Diversion.

Legal and institutional factors (such as formal and informal water rights) governing water allocation were included in a river basin simulation study of the Cache la Poudre River basin, Colorado, site of the planned Rawhide coal fired steam electric generation facility. Objectives for this study were to determine if the cooling pond at the plant could be filled prior to the beginning of power generation in 1985 and if a minimum 4200 acre-feet of reusable water could be provided at a uniform rate after filling. The MODSIM model was calibrated by adjusting physical parameters until they reasonably fit historical operational priorities. These priorities included water quality, flood control, recreation, and hydropower. Alternatives for reservoir operation and diversions were evaluated, dividing the water system into links and nodes representing reservoirs, ponds, municipal use, wastewater treat-

ment plants, rivers, canals, and effluents. This determined the optimum scheme for filling and maintaining the cooling pond without causing harm to present water users in the basin. A prior agreement had decreed an 8038 acre feet per year reservoir release; the model reached a figure of 8122 acre feet. (Cassar-FRC)
W82-02501

DELINEATION OF ACID MINE DRAINAGE POTENTIAL OF COAL-BEARING STRATA OF THE POTTSVILLE AND ALLEGHENY GROUPS IN WESTERN PENNSYLVANIA,

The Pennsylvania State Univ., University Park. Dept. of Geosciences.
R. J. Hornberger, R. R. Parizek, and E. G. Williams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157876, Price codes: A17 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources, The Pennsylvania State University, Research Project Technical Completion Report, November, 1981. 359 p, 159 Fig, 18 Tab, 197 Ref. OWRT-B-097-PA(1), 14-34-0001-7182.

Descriptors: *Acid mine drainage, Mine drainage, Stratigraphy, Hydrogeology, *Path of pollutants, Forecasting, *Model studies, *Coal mining, *Pennsylvania, *Paleoenvironment, Water quality, Groundwater quality.

The goal of the research was to test the relationship between paleoenvironment and acid mine drainage production on a regional basis. Coal mining data from 23 counties, or approximately 225 quadrangles, were obtained from mine drainage permit records, and a computer program was written to map these data. More than 150,000 lines of water-quality data were retrieved from the STORET data base, from which contour maps and trend surface maps were constructed. A computer program was developed to compare the water-quality and coal mining data using a grid cell structure. Five subregions of differing geologic setting were delineated within the study area, and variations in acid production of specific stratigraphic intervals across the subregions were examined using deep-mine drainage data, ground-water data and data obtained from leaching experiments, sulfur analyses, and microscopy of coal samples. There appeared to be significant relationship between the presence of calcareous strata and the lack of acid mine drainage from associated underlying coals. However in non-calcareous facies, no significant relationship between variations in paleoenvironment and variations in acid production could be determined from regional water quality patterns, or deep mine drainage data, or laboratory leaching tests.
W82-02534

DEVELOPMENT OF A PROTOTYPE METHOD FOR TRAINING USERS OF WATER RESOURCES PLANNING MODELS: PHASE I,

Montana State Univ., Bozeman. Dept. of Industrial and Management Engineering.
D. W. Boyd, and T. G. Plaggemeyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157934, Price codes: A05 in paper copy, A01 in microfiche. Montana Water Resources Research Center, Montana State University, Report No 118, September, 1981. 102 p, 4 Ref, 2 Append. OWRT-A-124-MONT(1), 14-34-0001-0128.

Descriptors: *Computer models, *Education, River basin development, *Management planning, Interactive computing, *Montana Water Planning Model, Self-instruction method.

The once operational Montana water planning model has been lost to the Montana Department of Natural Resources and Conservation due to personnel turnover. Upon implementation in 1973, the model demonstrated its utility as a planning tool during the 1973-1976 moratorium on the Yellowstone River Basin. The cost in time and effort for new personnel to learn how to use the model by reading the original technical reports is prohibitive. Alternatively, learning could be accomplished at a much lower cost if a computerized training method were available. Accordingly, a prototype method for training users of water resources planning models was developed. The program (called PLANNER) is accessed from a terminal connected to a mainframe computer. The program operates in the interactive mode and features a step-by-step development of a macro model of the Yellowstone River Basin. A companion user's manual is provided. From experience with the prototype to date, it is recommended that water planning agencies adopt a computerized training program for its water planning personnel. In addition, the program should be installed on a minicomputer dedicated to water planning rather than on a mainframe computer system which is subject to constant change. (Hunt-Mont)
W82-02540

OPTIMAL STREAM-AQUIFER DEVELOPMENT,

Illinois Univ. at Urbana-Champaign. Dept. of General Engineering.
O. Coskunoglu, and C. M. Shetty.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 513-531, October, 1981. 4 Fig, 2 Tab, 40 Ref.

Descriptors: *Computer models, *Water management, *Water resources development, *Design criteria, Model studies, Aquifer management, Groundwater management, Water supply development, Groundwater recharge, Water use, Mathematical models.

A large, nonlinear, nonconvex mathematical model was formulated to optimize the conjunctive use of surface and groundwater resources for irrigation, hydropower generation, aquifer recharge and other mandatory requirements. The designing of solution procedures offered a more realistic approach to engineering problems. The solution procedure, programmed in FORTRAN, was tested with realistic data to obtain an optimal solution for a problem with 394 variables and 390 constraints. The total execution time required to compute the optimal design and operation would cost about $200. With experienced practitioners, better starting points for computation may be achieved, making the convergence to the optimal solution more rapid. Calculations of optimal operations revealed that in wet periods, the surface water usage rate increases, while the groundwater usage rate decreases. The opposite occurs in dry periods. The reservoir detention requirements would decrease as a result of this synergism, while the overall net benefits increase. The refinement achieved in solving dynamic programming problems is also discussed. (Geiger-FRC)
W82-02575

OPERATION POLICY ANALYSIS: SAM RAYBURN RESERVOIR,

Hydrologic Engineering Center, Davis, CA.
D. T. Ford, R. Garland, and C. Sullivan.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 339-350, October, 1981. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Operating policies, *Reservoir operation, Systems analysis, Model studies, Simulation analysis, *Sam Rayburn Reservoir, *Texas, Saline water intrusion, Multipurpose reservoirs, Optimization, Water allocation, Water storage, Water use, Reservoir storage.

A combined optimization-simulation method was developed and used to solve management problems at the two-reservoir Sam Rayburn system, Texas. The major concerns at this installation are salt water intrusion, hydropower production, recreational use, and flood control. The simulation model is a single reservoir model that accounts for water use throughout the system, satisfying demands and allocating water according to specific priorities. The simulation model is linked with a nonlinear programming algorithm that selects the optimal operating policy. The resulting operating policy is smoothed using the engineering judgment of persons involved in daily operation of the system, and system response with this smoothed policy is simulated. Reiteration of this step is performed to obtain the final operating policy. (Cassar-FRC)
W82-02589

COMPARISON OF DETENTION BASIN PLANNING AND DESIGN MODELS,

Maryland Univ., College Park. Dept. of Civil Engineering.
J. R. Donahue, R. H. McCuen, and T. R. Bondelid.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 385-400, October, 1981. 3 Fig, 6 Tab, 12 Ref.

Descriptors: *Storm water, *Urban drainage, *Detention reservoirs, Model studies, Design criteria, Planning, Runoff, Rainfall-runoff relationships, Drainage, Storage capacity, Water management, Flood control, Comparison studies, Land use.

Significant differences in storage volume were obtained using seven different methods of designing storm water detention basins. It is suggested that planners select a method most representative of the local hydrology. Comparisons of two design methods and five planning methods on watersheds of 50, 200, and 500 acres; for residential, commercial, and industrial land uses; and for 10 and 100 year return periods indicated that two of the models were most suitable. The Bondelid method, a computerized optimization method, was recommended for design purposes. The Soil Conservation Service TR-55 method, using input similar to the Bondelid method, was recommended for planning purposes. Other methods considered were: Baker, Illinois Urban Drainage Area Simulator (ILLUDAS), Abt and Grigg, Wycoff and Singh, and Loss of Natural Storage. (Cassar-FRC)
W82-02592

6B. Evaluation Process

INSTITUTIONAL BARRIERS TO WATER QUALITY PLANNING AND MANAGEMENT IN THE SOUTHEAST - VOL II - TECHNICAL REPORT, PART II - ISSUES, PROBLEMS, AND DATA,

Tennessee Univ., Knoxville. Graduate School of Planning.
For primary bibliographic entry see Field 6E.
W82-02102

SEDIMENT--ASSET OR LIABILITY,

Coastal Environments, Inc., Baton Rouge, LA.
J. L. van Beek, and K. Meyer-Arendt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 197-215. 9 Fig, 15 Ref.

Descriptors: *Sediments, *Sedimentation, *Estuaries, *Navigation, *Flow separation, Estuarine environment, Aquatic habitats, Wetlands, Cost-benefit analysis, Dredging, Wildlife, Fish, Colorado River, Atchafalaya River, Comparison studies.

Sediment introduction is a corollary of river-associated freshwater inflow in many estuaries. These sediments represent an asset relative to delta building and associated estuarine wetlands, a liability in maintaining navigation access. A multipurpose approach to resolving this conflict is the separation of navigation from sediment-laden freshwater inflow. Such a separation, as authorized for the Colorado River, provides dual benefits: reduced maintenance dredging and increased fish and wildlife resources. In contrast, failure to do so at the Lower Atchafalaya River, Louisiana, increasingly results in dual cost. Comparison of the two projects raises serious questions about the consistency of project evaluation and cost/benefit analysis.
W82-02150

LOSS OF COLORADO RIVER INFLOWS TO MATAGORDA BAY, TEXAS, AND EFFORTS FOR RESTORATION,

For primary bibliographic entry see Field 4A.
W82-02151

MANAGEMENT, PLANNING, AND ORGANIZATION IN INITIATING, SUPPORTING AND COORDINATING AN ONGOING FRESHWATER DIVERSION PROJECT,

University of Southern Mississippi, Hattiesburg.
D. J. Etzold.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 248-254. 3 Ref.

Descriptors: *Estuarine fisheries, *Diversion, *Planning, *Management, Public participation, Evaluation, *Cost benefit analysis, Marshes. Erosion, Seafood productivity, Louisiana, Mississippi.

Seafood productivity declines in Louisiana and Mississippi have resulted from the lack of freshwater inputs on a controlled basis into the marine estuaries. This decline prompted people in the industry to seek help in developing a project to obtain the needed freshwater inflows. A task force was established in 1973 for preliminary planning purposes, which recognized the need for evaluation of the technical, environmental, economic, financial, social, and political and legal factors involved. The task force worked with many agencies involved with water resources and obtained the support of 12 organizations and agencies representing a broad base of public support. The plans submitted to Congress were approved and referred to the Corps of Engineers for studies to be conducted. The studies are now in progress, being combined with two other freshwater studies. An initial report indicates that the monetary benefits to fish and wildlife range from $4.4-5.2 million, and that the freshwater input will substantially reduce the serious loss of Louisiana marshes. The work of the task force is to monitor progress and continue support of the project, which has been in progress for 7 years and will need a further 8-10 years before freshwater flows are obtained. (Brambley-SRC)
W82-02153

FRESHWATER INFLOW TO THE COLUMBIA RIVER ESTUARY; A NORTHWEST REGIONAL MANAGEMENT ISSUE,

Pacific Northwest River Basins Commission, Vancouver, WA.
For primary bibliographic entry see Field 6D.
W82-02155

ECONOMIC IMPACT OF EXISTING AMMONIA NITROGEN WATER QUALITY STANDARD, IPCB CHAPTER 3, RULE 203 (F),

Southern Illinois Univ. at Carbondale. Dept. of Thermal and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W82-02189

THE ECONOMIC SIGNIFICANCE OF THE LONG POINT MARSH, LAKE ERIE, AS A RECREATIONAL RESOURCE,

Guelph Univ. (Ontario). Dept. of Geography.
R. Kreutzwiser.
Journal of Great Lakes Research, Vol 7, No 2, p 105-110, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Wetlands, *Economic aspects, Marshes, *Long Point Marsh, *Ontario, Canada, Wilderness areas, Wildlife, Hunting, Recreation demand, *Lake Erie.

A study was made of the recreational significance of public marshes at Long Point and Point Pelee on the north shore of Lake Erie. Emphasis was placed on estimating the economic value of the Long Point marsh as a recreational resource. The marshes under consideration occupy about 12% of the estimated 12,200 hectares of public and private marsh land on the north shore of Lake Erie. In 1978 the Long Point marsh provided opportunities for nature viewing, photography, fishing, waterfowl hunting, and canoeing for about 17,000 users. About 70% of the respondents to a questionnaire indicated that a wetland recreational activity was their primary purpose for visiting the Long Point area. In pursuing these activities, the users had a direct economic impact on the local communities through money spent there. Recreational users of the Long Point marsh spent in excess of $250,000 on gas, food, lodging and other items associated with their visit, of which about $120,000 was spent in the local area. This estimated $120,000 in local spending seems insignificant in terms of total sales in tourist-serving businesses in the area. However, tourist spending generates additional economic activity as tourist dollars work their way through the economy. In Ontario it is estimated that every dollar of tourist spending generates an additional 88 cents. On this basis, some $225,000 in local business income was generated directly and indirectly by recreational users of the Long Point marsh. (Baker-FRC)
W82-02229

WATER-RESOURCES INFORMATION FOR THE WITHLACOOCHEE RIVER REGION, WEST-CENTRAL FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
R. A. Miller, W. Anderson, A. S. Navoy, J. L. Smoot, and R. G. Belles.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A106929, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-11, 1981. 130 p, 39 Fig, 20 Tab, 94 Ref.

Descriptors: *Surface water, *Groundwater, *Water use, *Streamflow, Aquifer characteristics, Lakes, Springs, Salinity, Wells, Water yield, Transmissivity, Water level fluctuations, Water quality, Data collections, *Florida, West-central Florida, *Withlacoochee River.

Daily water use in the Withlacoochee River region in 1977 averaged about 2,005 million gallons per day, 94 percent being saline surface water used in thermoelectric power-generation cooling. The largest user of freshwater was Hernando County, using 43.02 million gallons per day. The Floridan aquifer in the region consists mostly of limestones and dolomites, and is as much as 1,500 feet thick. Transmissivities are known to be as high as 25 million feet squared per day. Yields of 2,000 gallons per minutes from 12-inch wells are possible. Although the range in fluctuations of the potentiometric surface is as great as 20 feet, no significant change has occurred since the 1930's when data were first collected. The quality of water in the Floridan aquifer is generally excellent. Saltwater is present in the aquifer near the Gulf Coast and in extreme east Marion County, near the St. Johns River. The predominant chemical type for both streams and springs is calcium and magnesium bicarbonate due to the dissolution process of the carbonate rocks. The majority of the streams have average dissolved-solid concentrations between 100 and 200 milligrams per liter, maximum-observed specific conductance between 250 and 750 micromhos per centimeter, and average total nitrogen concentrations of less than 1.2 milligrams per liter. (USGS)
W82-02473

WASTEWATER COLLECTION AND TREATMENT IN WAYNE COUNTY,

Wayne County Board of Public Works, MI.
For primary bibliographic entry see Field 5D.
W82-02554

IN-HOME CONSERVATION AND WASTEWATER MANAGEMENT,

Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 3D.
W82-02591

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DESALTING DEMONSTRATION PLANT FEASIBILITY STUDY AT LAGUNA PUEBLO, NEW MEXICO.

MetaMetrics Inc., Washington, DC.
For primary bibliographic entry see Field 3A.
W82-02104

THE ECONOMIC SIGNIFICANCE OF THE LONG POINT MARSH, LAKE ERIE, AS A RECREATIONAL RESOURCE,

Guelph Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6B.
W82-02229

TEXAS TO VOTE ON WATER TRUST FUND.

Southwest and Texas Water Works Journal, Vol 63, No 7, p 16, October, 1981.

Descriptors: *Financing, *Water policy, *Local governments, *Texas, Water law, Legal aspects, Loans, Water resources development.

The Texas legislature has proposed an amendment to the state constitution for establishing a water trust fund to guarantee repayment of local government water bonds and to increase the maximum interest rate on state bonds to 12%. This amendment would provide funds for badly needed water supply and flood control projects at a modest cost to the state government. Half of the excess state revenue would be placed in the water trust fund for dispersal in three forms: a loan fund, a storage and acquisition fund, and a research and planning fund. The proposal was scheduled for a vote on November 3, 1981. (Cassar-FRC)
W82-02302

COST OF SMALL WATER SUPPLY TREATMENT SYSTEMS,

Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W82-02318

EFFLUENT CHARGING SYSTEMS AND THEIR ADMINISTRATIVE IMPLICATIONS,

Environmental Resources Ltd., London (England).
R. Bidwell, and S. Mason.
Water Science and Technology, Vol 13, No 7, p 393-411, 1981. 3 Fig, 3 Tab.

Descriptors: *Effluent charges, *Administration, *Costs, *Water pollution control, Water quality control, Permits, Pollution taxes, Waste discharge, Wastewater discharge, Monitoring, Reviews, France, Germany, Netherlands, United Kingdom.

The present and proposed effluent charging systems in France, Germany, the Netherlands, and the United Kingdom are reviewed with attention to characteristics of effluent treatment charges and characteristics of pollution charges. Types of dischargers, methods used to levy charges, links with the permit system, and use of collected revenue are considered. A hypothetical region with 1 million population, 2000 large industrial dischargers, 8000 other non-domestic dischargers, and 25 treatment plants is used to evaluate the effects of several water pollution control programs on administrative costs. A table summarizes the administrative costs in $ million (U.S.) as follows: permit system only, 0.9-5.8; permit and charging with existing samples and analyses, 1.1-6.0; and permit and charging with additional samples and analyses, 1.2-9.8. Additional charges (in $ million U.S.) produced by the following modifications will be incurred with the above permit systems: separate effluent treatment charging and pollution charging systems, 0.07; inclusion of both large and small industrial users, 0.06; inclusion of domestic premises, 1.0: increasing the 50 water quality monitoring points to 200, 1.0. (Cassar-FRC)
W82-02403

RATE STRUCTURES AND DEMAND REDUCTION,
Washington Suburban Sanitary Commission, Hyattsville, MD.
R. McGarry.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 52-58. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Water rates, *Drought, Long-term planning, *Water deficit, Water shortage, *Economic aspects, *Water conservation, Industrial water use, Water supply, Water use, River forecasting, Public policy, River flow, Maryland, Prince George's County, Montgomery County.

The Washington Suburban Sanitary Commission is a state water agency that serves two counties in Maryland. It began in 1970 with an emphasis on water conservation, which was unusual at that time. The public wanted conservation planning, and the Commission responded with a four-phase program: publicity and education, plumbing code changes, a rate structure that supports conservation, and the incorporation of drought and risk management in water-supply planning. A citizen's advisory group recommended that the rate structure increase with the amount used, with the result that some people on fixed incomes now have quarterly bills of only $6-8. Drought management planning involved a careful analysis of demand and a decision that the 100-gallon per person per day concept was wrong, and that usage should be based on hookups, not population. Water records were converted to probabilities, and a three-phase emergency action plan was developed for shortages. The system was planned so that drastic measures would be incurred less than 1 percent of the time. Results of conservation program are mixed: while residential conservation has been widely practiced, participation from the industrial sector has been disappointing. Drought management and conservation broke a planning stalemate that had been in existence for 18 years. Some problems have been encountered; e.g., a public misunderstanding that water bills would decrease, a difficulty for utilities in predicting revenue, and remaining uncertainty with reservoir-operating/river flow forecast management. (Garrison-Omniplan)
W82-02517

WATER SAVINGS IN THE ORANGE WATER AND SEWER AUTHORITY,
Orange Water and Sewer Authority, Carrboro, NC.
For primary bibliographic entry see Field 3D.
W82-02519

ANALYTICAL COST MODEL FOR URBAN WATER SUPPLY,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark, and R. G. Stevie.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 437-452, October, 1981. 4 Fig, 6 Tab, 14 Ref.

Descriptors: *Water distribution, *Urban areas, *Economies of scale, *Water costs, *Water supply, Water consumption, Water treatment, Water transport, Regional planning, Planning, Population density, Cost analysis, Economic aspects, Drinking water, Municipal water, Utilities.

This paper emphasizes the tradeoffs that must be considered in developing regional water distribution systems. Economies of scale of the acquisition/treatment component may be offset by diseconomies in transportation/distribution. Using the cost functions for each component, equations are developed to show the relationship between the minimum cost point for a water distribution system and the distance from the point of production. Before this point the average cost with respect to distance decreases, and after this point, it increases. Per capita consumption and absolute levels of population density have little effect on least cost system size. However, the minimum cost solution is very sensitive to population distribution. In many cases the minimum cost point is approximately 8 miles. (Casner-FRC)
W82-02584

ENERGY COSTS AND PORTLAND WATER SUPPLY SYSTEM,
Bureau of Water Works, Portland, OR.
For primary bibliographic entry see Field 5F.
W82-02586

6D. Water Demand

WATER MANAGEMENT ON THE COLUMBIA RIVER,
Columbia River Basin Commission, Portland, OR.
D. Kent.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 79-83.

Descriptors: *Water management, *Competing use, *Estuaries, *Water supply, *Water demand, Fisheries, Irrigation water, Hydroelectric plants, Recreation, Navigation, Judridiction, Water policy, *Columbia River, Pacific Northwest.

The Columbia River, with its estuary and its tributaries, is the dominant Pacific Northwest water resources system. Discharges on an annual average are about a quarter of a million cubic feet per second of water at its mouth. The regions water problems stem largely from the competing uses to which the river is put. The river supplies hydroelectric power, supports ever-increasing agricultural production with irrigation development, provides transportation, maintains fishery resources, and provides recreational opportunities for everyone. Already, competition between hydroelectric generation and irrigation is intense. Meanwhile, hydropower and irrigation demands are putting pressure on a third use, the fish runs. For maintaining fish runs, water must be available in adequate quantity and quality at the proper times for both the upstream and downstream passage of the fish. Jurisdiction is another source of difficulty: the Columbia River system waters within the U. S. are controlled by seven states, at least nine Federal agencies, several state organizations, and multitude of public entities, local jurisdictions, and private individuals (under permit). The result is a variety of piecemeal and conflicting policies for the use of the Columbia River water. The uses which are economically most profitable are the ones which receive the greatest consideration by the decision-makers. In the case of the Columbia, hydropower is the most important, followed by irrigation, transportation, and fisheries and conservation. (Moore-SRC)
W82-02112

OVERVIEW OF FRESHWATER INFLOW DEPLETIONS,
Fish and Wildlife Service, Fort Collins, CO.
K. Bayha.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 231-247. 9 Fig, 2 Tab, 2 Ref.

Descriptors: *Water resources development, *Streamflow depletion, *Water demand, *Water supply, *Estuaries, Groundwater mining, Groundwater depletion, Environmental effects, Planning, River flow.

An analysis of the accumulated depletion of streamflow in the nation's major watersheds was attempted for the first time as part of the Second National Water Assessment conducted by the U.S. Water Resources Council. This paper utilizes that data base to demonstrate the relative reduction of freshwater inflow to estuaries due to upstream water resource development. Data for normal (average) and dry (80% exceedance) year conditions are presented for 106 assessment subregions, including 30 coastal estuarine complexes. The data show that greater water use in the year 2000 will result in reduced flows to the estuaries. An exception is the Texas coast where groundwater mining augments the surface water supply. In general groundwater mining will decrease, because of the lowering of the water table and increased pumping costs. The further depletion of flows to estuaries will produce additional environmental impacts. Data should be developed so that water resource planner could link estuarine needs for freshwater inflow with instream flow needs to permit meaningful evaluation of impacts of water projects proposed in the headwaters. (Brambley-SRC)
W82-02152

FRESHWATER INFLOW TO THE COLUMBIA RIVER ESTUARY; A NORTHWEST REGIONAL MANAGEMENT ISSUE,
Pacific Northwest River Basins Commission, Vancouver, WA.
D. H. Kent.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 270-276. 1 Fig, 6 Ref.

Descriptors: *Columbia River, *Estuaries, *Water demand, *Water supply, *River flow, Data acquisition, Water resources development, Planning, *Cost-benefit analysis.

The Columbia River is the largest freshwater drainage system on the Pacific coast of North America, yet less is known about its estuary than about any other of comparable size in the United States. With many conflicting uses for its water (agriculture, power generation, navigation, and fisheries), the Columbia River system is unable to meet all the demands for water during periods of reduced discharge, when demand is greatest. The Pacific Northwest River Basins Commission, as the interagency regional planning organization dealing with water resource planning in the Columbia River system, has undertaken two programs designed to deal directly with this issue of instream flows. The Regional Tradeoffs Analysis Program will be evaluating and documenting competition among various water uses and the economic, environmental, and social benefits and costs (tradeoffs) which would result from alternative levels of use for competing purposes. The Columbia River Estuary Data Development Program is a $6.2 million special program with a dual purpose: to increase the understanding of the Columbia river estuary as a system, and to acquire information needed for making specific land/water management decisions. It is anticipated that the inclusion of information provided by this interdisciplinary research effort in the Regional Tradeoffs Analysis Program will provide a solid basis for predicting impacts of varying instream flows on the Columbia River estuary. (Brambley-SRC)
W82-02155

COLORADO RIVER SIMULATION SYSTEM; AN EXECUTIVE SUMMARY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 6A.
W82-02170

A MONTHLY TIME SERIES MODEL OF MUNICIPAL WATER DEMAND,
Water and Power Resources Service, Provo, UT.
R. D. Hansen, and R. Narayanan.
Water Resources Bulletin, Vol 17, No 4, p 578-585, August, 1981. 3 Fig, 5 Tab, 16 Ref.

Descriptors: *Statistical models, *Water demand, *Time series analysis, Drinking water, Water distribution, Management planning, *Salt Lake City, Utah, Model studies.

The procedures and results of a time series analysis of factors which influence municipal water use in Salt Lake City, Utah, are presented. A multivariate time series model was formulated to study the monthly variation in municipal water demand, and a high multiple correlation coefficient and F-statistic were determined for the Salt Lake City application. Municipal water demand is determined by explanatory variables including price, average temperature, total precipitation, and percentage of daylight hours. In an ex post forecast, the model accurately predicted monthly variations. The model was also useful for predicting and studying the impact of non-structural management decisions such as the effects of price changes, peak load pricing methods, and other water conservation programs. When disaggregated time series water use data are available, the model can be applied to sector water demand data. (Small-FRC)
W82-02263

HYDROPOWER: UNTAPPED RESOURCE AND ENVIRONMENTAL HAZARD,

For primary bibliographic entry see Field 5C.
W82-02277

USER REACTION TO WILD AND SCENIC RIVER DESIGNATION,

Clemson Univ., SC. Coll. of Forest and Recreation Resources.
For primary bibliographic entry see Field 6G.
W82-02278

42-MILE WATER PIPELINE FOR COAL BOOM TOWN.

Public Works, Vol 112, No 2, p 82-83, February, 1981.

Descriptors: *Pipelines, *Steel pipes, *Water transport, Conveyance structures, Hydraulic structures, Water supply development, Water demand, Wells, Pumping plants, Water distribution, *Gillette, *Wyoming.

A 42-mile steel pipeline is under construction to supply water to 35,000 residents of the coal boom town of Gillette, Wyoming. Of the $23 million needed for the project, $12 million goes to construction, $7-$8-million is for materials, and the remainder will be used to drill eight water supply wells and construct two pump stations. The 30-inch diameter pipeline will be able to deliver 7,000 gpm to accommodate peak demands. Wall thicknesses of the 48-foot lengths range from 10-gauge to 1/4-inch. Sections of the piping are available in more than 5,500 lengths, determined by a computer system. The pipe will be shipped overland 1,150 miles from the Beall Pipe Division of Portland by truck. The contractor will use three construction crews in a leap-frogging maneuver for the bulk of the project. The average excavation depth is 8 to 10 feet, and in some spots V-shaped trenching is used. Color-coding of pipe ends provides for swift and errorless transporting and laying of pipe sections. (Geiger-FRC)
W82-02359

EMPHASIS ON DISTRIBUTION: STRATEGIES FOR SMALL SCALE WATER RESOURCES DEVELOPMENT IN THAILAND,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 6A.
W82-02406

AN EVALUATION OF THE POTENTIAL FOR WATER CONSERVATION AND REUSE IN THE GEORGIA PULP AND PAPER INDUSTRY,

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
For primary bibliographic entry see Field 3E.
W82-02456

ESTIMATED WATER USE IN THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT AND ADJACENT AREAS, 1980,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-02482

ASSESSMENT OF EIGHTEEN PUBLIC GROUNDWATER SUPPLIES IN ILLINOIS,

Illinois State Geological Survey, Champaign.
For primary bibliographic entry see Field 2F.
W82-02510

RATE STRUCTURES AND DEMAND REDUCTION,

Washington Suburban Sanitary Commission, Hyattsville, MD.
For primary bibliographic entry see Field 6C.
W82-02517

EFFICIENT GROUNDWATER UTILIZATION,

R. C. Heath.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 74-77. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Groundwater management, *Water supply development, *Long-term planning, Surface-groundwater relations, Aquifers, *Water supply, Aquifer management, Grants, Cost sharing, Economic aspects, Groundwater recharge, Water costs, *North Carolina, Projections, *Water demand.

The eastern half of North Carolina is occupied by the Coastal Plain, which contains abundant groundwater in sand and limestone aquifers and abundant surface water in major rivers that originate in the Piedmont to the west. However, groundwater levels in the deeper aquifers have been declining for more than two decades, which indicates that withdrawals and natural discharge are exceeding recharge. The development of a water management plan for the deep Coastal Plain aquifers will be one of the critical water issues in the eighties. In the Piedmont and Mountain area, there has been increasing dependence on surface-water supplies: the area's population is expected to double in the next 40 years and water use to triple. Water needs of North Carolina population and industry will require expansion of existing water supplies and the development of new supplies, both of which require federal and state assistance. In addition, conservation is needed to ensure reasonable water costs. Resources are necessary to determine how much groundwater can be developed and how to construct and test the wells needed to supply it. Assistance is available from the U.S. Geological Survey, which collects data on streamflow, groundwater, and water quality for use in the design of water systems. (Garrison-Omniplan)
W82-02520

6E. Water Law and Institutions

INSTITUTIONAL BARRIERS TO WATER QUALITY PLANNING AND MANAGEMENT IN THE SOUTHEAST - VOL I - TECHNICAL REPORT, PART I - INSTITUTIONAL BARRIERS,

Tennessee Univ., Knoxville. Graduate School of Planning.
G. E. Bowen, and T. R. Gangaware.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153537, Price codes: A09 in paper copy, A01 in microfiche. Report prepared for Office of Water Research and Technology, May, 1981. 184 p, 1 Fig, 12 Tab. OWRT-C-90234-U(9434)(1), 14-34-0001-9434.

Descriptors: *Urban planning, *Water quality management, *Legal aspects, *Economic aspects, *Institutional constraints, Local governments, Water pollution, Legislation.

The primary objective of the study was to make comparisons and assessments of institutional barriers and inter-agency relationships which impaired the ability of 208 areawide agencies to develop acceptable comprehensive water quality management plans within the southeastern United States. A secondary objective of the study focused on an analysis of citizen participation mechanisms employed in the development of the 208 programs, in order to develop alternative approaches for enhancing general public input into water quality management programs. The study consisted of four interrelated phases: a comprehensive literature review, a questionnaire administered to 208 areawide agencies in the southeast, a series of case studies of selected 208 areawide agencies and the administration of a delphi process questionnaire to selected individuals. The seven 208 planning areas participating in the case study phase included: Asheville, NC; Columbia, SC; Chattanooga, TN; Miami, FL; Myrtle Beach, SC; Knoxville, TN; and Orlando, FL. The major institutional barriers identified fell under four major categories: legal, political/governmental, cultural, and economic. (Gangaware-Tenn)
W82-02101

INSTITUTIONAL BARRIERS TO WATER QUALITY PLANNING AND MANAGEMENT IN THE SOUTHEAST - VOL II - TECHNICAL REPORT, PART II - ISSUES, PROBLEMS, AND DATA,

Tennessee Univ., Knoxville. Graduate School of Planning.
G. E. Bowen, and T. R. Gangaware.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153545, Price codes: A09 in paper copy, A01 in microfiche. Report prepared for Office of Water Research and Technology, May, 1981. 181 p, 1 Fig, 3 Tab, 8 Append. OWRT-C-90234-U(9434)(1), 14-34-0001-9434.

Descriptors: *Urban planning, *Water quality management, *Legal aspects, *Institutional constraints, Local government, Legislation, Water pollution, Citizen participation.

The second volume of the technical report contains eight appendices. This volume was intended to be a reference document for persons unfamiliar with many of the issues and problems associated with water quality planning and management. As a reference document, it contains information on regulatory features of the 208 program, legal background for water quality planning, a description of citizen participation techniques and a summary of the case studies. Also included in this volume are the results of the questionnaire and the delphi process. (Gangaware-Tenn)
W82-02102

LEGAL, ECONOMIC AND INSTITUTIONAL BARRIERS TO WATER REUSE IN NORTHERN NEW ENGLAND, BOSTON, MASSACHUSETTS,

Bracken and Baram, Boston, MA.
For primary bibliographic entry see Field 3C.
W82-02107

MANAGEMENT OF FRESHWATER INFLOW TO ESTUARIES: A LAWYER'S PERSPECTIVE,

Environmental Defense Fund, Inc., New York.
J. B. Tripp.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 65-76, 1 Tab, 14 Ref.

Descriptors: *Water management, *Legal aspects, *Estuarine environment, *Water resource development, River flow, Flow discharge, Flood plain management, Groundwater runoff, Sediments, Wetlands.

The condition of surface and ground water inflows is of critical importance where the maintenance of restoration of the chemical, physical, and biologi-

cal functioning of an estuary is a recognized objective. Maintenance of freshwater inflow systems as part of an estuarine management program is hampered by three factors: Federal statutory programs which fail to recognize the interrelationships between riverine and estuarine systems; inadequate scientific knowledge of these relationships; and Federal water resource development programs that continue to promote massive alterations of riverine systems, including floodplain vegetation. Although existing statutory programs can be effective in controlling discharges of some pollutants into surface or ground waters entering estuaries, they are not so effective at controlling major alterations of fresh-water inflows, such as hydrologic modifications, alterations in sediment patterns and loss of riverine wetland floodplain vegetation, which affect estuaries. These legal constraints are also a reflection of the state of scientific knowledge about riverine-estuarine relationships. Increased scientific knowledge about these relationships will be useful in strengthening the effectiveness of existing programs to combat degradation of freshwater flows to estuaries. (Moore-SRC)
W82-02111

FEDERAL AND STATE COASTAL ZONE MANAGEMENT EFFORTS DIRECTED AT ESTUARIES AND FRESHWATER INFLOW,

National Oceanographic and Atmospheric Administration, Washington, DC. Office of Coastal Zone Management.
R. B. Mieremet.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 96-102, 1 Ref.

Descriptors: *Estuaries, *Water management, *Coastal zone management, *Government interrelations, Economic aspects, River flow, Environmental effects, Salinity, Priorities.

The Coastal Zone Management Act was passed because of concerns over estuaries and other coastal resources. Financial assistance and management tools are providing incentives to state and local governments to begin to address problems associated with freshwater inflows or the lack thereof. Special area management planning, enforceable policies, and improved coordination are being brought to bear on the decisionmaking process. Mitigation and restoration projects can help alleviate some of the past problems. While coastal zone management has many significant tools which are being used and will be used in the future to address problems relating to freshwater inflows to estuaries, it obviously can not cure them all. Some states have included all or almost all of their state as the coastal zone because of the watershed principle, while others stop at the 5 ppt salinity line of the estuary. Extra efforts are needed to ensure good coordination of government actions. Coastal zone management often requires some compromises between preservation and development. It is likely that there will be times when the importance of freshwater inflow will get lost in the priorities where there are conflicting interests. (Moore-SRC)
W82-02113

REVIEW OF ESTUARINE-RELATED PROJECTS BY THE GULF OF MEXICO FISHERY MANAGEMENT COUNCIL,

Gulf of Mexico Fishery Management Council, Tampa, FL.
For primary bibliographic entry see Field 6G.
W82-02146

AN OVERVIEW OF TEXAS LAW, POLICY, AND AGENCY ACTIONS CONCERNING ESTUARINE INFLOW,

Wildlife Management Inst., Dripping Springs, TX.
M. T. Walton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 255-269. 52 Ref.

Descriptors: *Estuaries, *Legislation, *Jurisdiction, *Environmental protection, *Water demand, *Water use, Environmental policy, Permits, Priorities, Water management, Appropriation, *Texas, Water law.

Texas water law has been influenced by several legal traditions, but only in 1975 was a law passed which recognized the need to preserve estuarine inflow and authorized studies to determine inflow needs. The law is administered by the Water Rights Commission. However, the law has not been applied towards the development of an active policy or in strong agency action to preserve estuarine inflows. In three cases the Commission allowed permits for projects in which estuarine inflows were not assured. The Texas Parks and Wildlife Department has participated in permit hearings and adjudication this participation has declined, and to some extent has been taken over by the Department of Water Resources. This department has provided a data base on which to base reservation of freshwater inflos. These inflows have the lowest priority of all demands on water resources. Neither the Texas Water Plan nor the Texas Coastal Management Plan has definite provisions for estuarine inflow preservation. Since some basins are already overappropriated, and each new appropriation has an environmental effect, strong defense of the present law and additional regulations would seem to be necessary. (Brambley-SRC)
W82-02154

SCIENTIFIC PROGRESS AND DETERIORATING ECOSYSTEMS; SAN FRANCISCO BAY AND THE 1970'S,

Fish and Wildlife Service, Sacramento, CA.
P. A. Meyer, and W. T. Davoren.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 277-287. 27 Ref.

Descriptors: *San Francisco Bay, California, *Ecosystems, *Estuaries, *Bays, *Water supply, *River flow, Environmental effects, Selective withdrawal, Legislation, Water quality, Shore protection, Data acquisition, Prediction.

Considerable progress has been made by planners, scientists, and environmental managers of the 1970's in identifying the uncertain and to a considerable degree unquantifiable, nature of bay/estuary ecosystems, and in offering improved prescriptions for their protection. At the same time, this progress in understanding theory and making prescriptions has been accompanied by continued stressing of the bay systems and in some instances by their further deterioration. In the San Francisco Bay area these stresses have resulted from continued and increased upstream withdrawals, and it is projected that these withdrawals will continue. No gains were made in the bay fill and shoreline control programs, and San Francisco Bay was excluded from jurisdiction of applicable legislation. Municipal and industrial discharges to the bay were reduced as a result of applying national and state programs, rather than as a response to the needs of the bay. It is proposed that studies be conducted with emphasis on the metaphysical or value relationships of the bay, instead of the procedural or practical, and that studies be sponsored by persons other than those who have a direct interest in the outcome. (Brambley-SRC)
W82-02156

DECISION-MAKING CONSTRAINTS IN THE POLICY DEVELOPMENT AND ADMINISTRATION OF WATER RESOURCES IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Water Research Inst.
D. G. Williams, and D. C. Menzel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153701, Price codes: A04 in paper copy, A01 in microfiche. Information Report 16, 1981. 65 p, 2 Fig, 20 Tab, 37 Ref, 2 Append. OWRT-A-032-WVA(4), 14-34-0001-7103.

Descriptors: *Administrative decisions, Attitudes, *Decision making, *Judicial decisions, Motivation, *Policy making, *Political constraints, *West Virginia, Administrative regulation, Institutional constraints, Law enforcement, Legal aspects, Legislation, Political aspects, Public policy, Social aspects, Water law, Water policy.

This study investigated the decision-making constraints of water-resource policy and administration in West Virginia. The findings indicate that internal administrative processes and organizational arrangements often tend to hamper coordination and fragment responsibility. Much of the policy enforcement machinery is dependent on those who operate in a context not supportive of the policy and over whom the responsible organization has no direction. The findings also indicate that water-quality management is in competition with many other policy areas at the gubernatorial level. A survey of state lawmakers revealed that legislators perceive the state to place a lower priority on environmental protection compared to education, highways, health, and labor. Legislators perceived the state executive to assign water-pollution control in particular to the middle of other environmental priorities. With respect to the priorities of the legislators themselves, environmental problems and water pollution were ranked higher. Legislators evaluated water-pollution-control laws as adequate but enforcement as less than adequate. The survey of state legislators also indicated that legislative expertise and leadership are not well developed in the water-resource field.
W82-02173

ASSESSMENT OF THE NATIONAL WATER QUALITY MANAGEMENT PROGRAM, VOL. I, 106 PROGRAM OVERVIEW, PLANNING AND STANDARDS.

Association of State and Interstate Water Pollution Control Administrators, Washington, DC.
August 1981. 38 p, 1 Fig, 3 Tab.

Descriptors: *State jurisdiction, *Water quality standards, *Federal jurisdiction, *Waterpollution prevention, Public policy, Dredging, Political aspects, Hazardous materials, Law enforcement, Legal aspects, Water quality.

This report recommends reforms in the Federal Clean Water Act as a means of coping with declining program resources and increasing requirements. The ASIWPCA recommends that administration of the Clean Water Act be delegated to states, and federal efforts should focus on results, not procedures, but should continue to provide $118 million in the funding estimated to be needed for the states to administer the Act. In terms of water quality, it is recommended that there be a simplified standards-setting process to expedite the development of reasonable standards at minimal costs. States should have the primary role in establishing standards, with the burden of proof for disapproval of state water quality standards resting with the U.S. Environmental Protection Agency. Water quality standards should be reviewed and revised on a five-year cycle, and toxicity criteria should be established in cases where there are harmful presences and when public health is endangered. States should have the opportunity for input to federally negotiated international treaties where they will be expected to implement the agreements. The water quality management planning process, supported under Section 208 of the Clean Water Act, should be integrated with other elements of the water program, e.g., 303(e) of the Act, which concerns basin planning. Regarding clean lakes, funding emphasis should be placed on lake restoration to preserve lakes identified in each state. Section 404, which establishes a permit program for discharge of dredge and fill materials, is

viable only with adequate funding to ascertain environmental, water quality and economic needs. (Garrison-Omniplan)
W82-02181

ASSESSMENT OF THE NATIONAL WATER QUALITY MANAGEMENT PROGRAM, VOLUME 2: CONSTRUCTION GRANTS.

Association of State and Interstate Water Pollution Control Administrators, Washington, DC.
August, 1981. 71 p, 7 Fig, 7 Tab.

Descriptors: *Grants, *Wastewater treatment, *Engineering, *Sanitary engineering, *Government finance, Project planning, Government supports, Municipal wastes, Municipal wastewater, Wastewater treatment, Economic justification, Economic aspects.

The Construction Grants Program grew out of the recognition that inadequate municipal sewage treatment was a major cause of the nation's water pollution. However, the program has been plagued with financial instability. The Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) recommends that Congress provide adequate multi-year authorizations and advance appropriations consistent with the rate of progress desired, mandated cleanup deadlines and national fiscal constraints. The Association also recommends that the multi-year funding system should consider actual overall water pollution control needs within each state and the rate at which locally developed projects are expected to need funding. ASIWPCA advocates maintaining 205(g) funding at a level of at least $100 million per year and limiting use to those activities currently eligible for 205(g) funding. These funds should not be required by the Federal government to be used as a substitute for inadequate 106 or 208 funds. Other recommendations are: (1) delegated states should be provided more freedom and flexibility in determining and approving construction grant projects; (2) the U.S. Environmental Protection Agency should delegate to the regional level the authority to approve deviations to grant regulations upon justification from states; (3) advanced treatment review should be conducted at the state level rather than the federal level; (4) statistics used for formula data must have proven validity; (5) reserve treatment plant capacity to year 2000 population should remain eligible for federal financing. (Garrison-Omniplan)
W82-02182

ASSESSMENT OF THE NATIONAL WATER QUALITY MANAGEMENT PROGRAM, VOLUME 3: INDUSTRIAL AND MUNICIPAL CONTROL.

Association of State and Interstate Water Pollution Control Administrators, Washington, DC.
August, 1981. 35 p.

Descriptors: Municipal wastes, Industrial wastes, *Wastewater treatment, *State jurisdiction, *Federal jurisdiction, *Political aspects, Municipal wastewater, Legal aspects, Government finance, Economic aspects, Administrative agencies, Administrative decisions, Effluents.

Control of municipal and industrial point sources of pollution, together with Construction Grants Management, comprise the major part of the State water programs. The Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) examined the status of the water program regulated by the Clean Water Act and concluded that coordination of the National Pollutant Discharge Elimination System (NPDES) between the states and the U.S. Environmental Protection Agency is in need of reform. The recommendations are: (1) the 1983 goal of fishable/swimmable waters should be extended to the year 1990, and zero discharge should be considered an unrealistic goal; (2) EPA review of individual state actions should be replaced with auditing for results; (3) substantial streamlining of the NPDES program should include deregulation of deminimous sources, elimination of national public participation requirements, and streamlining of EPA compliance and enforcement procedures; (4) primary enforcement authority should be exercised by states; (5) local governments that have attempted to comply with current deadlines should not be penalized for delays encountered for lack of construction grant funds; (5) compliance evaluation should focus on substantial violations of water quality standards and effluent limitations; (6) the EPA should continue developing national categorical standards for pretreatment to be imposed only when states do not choose to use their own program equivalent; (7) influent, effluent and sludge from publicly owned treatment works (POTWs) should be characterized by states and POTWs, and the baseline industrial survey continued. (Garrison-Omniplan)
W82-02183

SUPERFUND: WHAT A MESS,

Chelsea International Corp., Washington, DC.
W. C. Savage.
Association of State and Interstate Water Pollution Control Administrators, Washington, DC., August 12, 1980. 12 p, Append.

Descriptors: *Hazardous materials, Pollutants, *Legislation, *Liability, *Federal jurisdiction, *State jurisdiction, Decontamination, Economic aspects, legal aspects, Cleaning, Cleanup, Political aspects, Contamination.

On June 13, 1979, the Carter Administration released a proposal to amend the Clean Water Act and the Solid Waste Disposal Act. The proposal would establish liability and compensation systems to respond to health and environmental damages caused by oil and hazardous waste spills. The administration's proposal along with initiatives introduced by other congressmen have been partially included into three 'Superfund' bills now seriously being considered by Congress: HR 85, HR 7020, and S 1480. All three bills proposed the establishment of a large fund to assure swift response to pollution incidents using funds from chemical and oil company fees or taxes on production, and all allow delegation of authority to the states. Important differences are that HR 85 establishes two funds--one for oil spills and one for hazardous substance spills; HR 7020 and S 1480 limit liability to the proportional share of causation; S 1480 does notinclude oil spills and has no limits on liability, but provides victims access to Federal courts with initial presumption in their favor to avoid premature dismissal of cases. The bills vary widely in the level of autyority delegated to states. Liability provisions, fund size, and mechanisms for disbursing the funds are being debated. EPA's estimates to clean up abandoned sites alone range from $38 to $44 B. At the time of writing, it appeared unlikely that Superfund legislation would be passed in the Congressional session in progress, since only 35 days remained and jurisdictional disagreements might not be settled in time. Whatever legislation is passed, the question is raised whether the EPA can handle another major law. (Garrison-Omniplan)
W82-02184

COMPLIANCE STRATEGY FOR CLEAN WATER.

Association of State and Interstate Water Pollution Control Administrators, Washington, DC.
May, 1981. 8 p.

Descriptors: *Legislation, *Federal jurisdiction, *Water quality standards, Water pollution prevention, Waste treatment facilities, Wastewater facilities, Pretreatment of water, Industrial wastes, Water treatment, Economic aspects, Grants, Hazardous materials, Pretreatment standards.

This paper presents ASIWPCA's compliance strategy for three principal aspects of the Federal Clean Water Act: (1) publicly owned treatment works (POTWs), (2) industrial dischargers, and (3) pretreatment (indirect industrial sources). The suggested strategy for POTWs includes maintaining the funding for construction grants through the FY82 appropriation period, and allowing states the option of reducing the federal cost share to less than 75 percent of the eligible project cost. The EPA should redefine 'secondary treatment' to eliminate the present 85-percent removal of pollutant requirement and allow the maximum range of treatment technologies to be utilized. Provisions in Section 205(g) should be structured so that states continue to receive funding under state management assistance grants of at least $100 million per year. POTWs should be able to derive their compliance requirements of effluent limitations and schedules from approved state strategies to ensure coordination with the permit process and the availability of construction grant funds. Industrial dischargers should continue to be required to follow 'BTP' based controls as the minimum national treatment requirement. However, the approach for 'BCT' should be modified for conventional pollutants to include water quality based equivalency determinations for treatment. EPA should develop national categorical standards for 'BAT' to improve control of toxic pollutants. National categorical standards for pretreatment should be developed by EPA, but some states should be waived from pretreatment requirements when other controls are adequate. (Garrison-Omniplan)
W82-02185

INDUSTRIAL PRETREATMENT NEEDS TO BE OVERHAULED AT THE NATIONAL LEVEL.

For primary bibliographic entry see Field 5D.
W82-02198

LAKE TAHOE PRESERVATION BILL ENACTED.

National Parks, Vol 55, No 2, p 23, February, 1981.

Descriptors: *Lake Tahoe, *Legislation, *Watershed management, Legal aspects, Water law.

Legislation was enacted to preserve Lake Tahoe (PL96-586) during the closing days of the 96th Congress. The bill provided for the sale of Bureau of Land Management property around Las Vegas, with 85% of the proceeds from the sales to be used to buy land in the Lake Tahoe Basin. The bill was weakened by two amendments. The first removed the Secretary of Agriculture's authority to acquire lands to protect air and visual qualities. The second required that before any land could be condemned, the Tahoe Regional Planning Agency would have to concur. The bill is a positive step toward resolving the lake's problems. (Small-FRC)
W82-02244

ADJUSTING GOVERNMENT ROLE IN WATER LAW.

Southwest and Texas Water Works Journal, Vol 63, No 7, p 10-11, October, 1981.

Descriptors: *Water policy, *Government supports, *Financing, Water quality control, Water law, Government finance, Grants, *Arkansas.

Changing water policy as applied to Arkansas was the subject of a talk by Congressman J. P. Hammerschmidt before the Arkansas Water Managers Association August 1981 meeting. The Water Policy Board proposed in H. R. 3432 is intended to enhance state-federal cooperation for all water policy issues. A major help in meeting national and Arkansas water quality goals has been the Clean Water Act's Contruction Grants Program, which helps fund sewage treatment works up to 75% (formerly limited to 30%). Under this program Arkansas received $114 million toward compltion of 193 projects, with another $114 proposed for 147 active projects. Under the new administration, regulatory reform and cost cutting have begun. Less money will be availale from the federal government. Therefore local governments willhave to consider other long-term options for local projects. Grants for Arkansas for 1982 have been cut from $5.2 million to $2.3 million and loans from $17 million to $6.9 million. The Congressman pledged cooperation in developing workable, reasonable, practical federal water policy during the national period of reevaluation. (Cassar-FRC)
W82-02256

SUPREME COURT CLARIFIES WATER ACT REQUIREMENT,
M. E. Higgins.
Natural Resources Journal, Vol 21, No 3, p 607-616, July, 1981.

Descriptors: *Judicial decisions, *Water pollution control, *Effluent standards, Federal Water Pollution Control Act, Legal aspects, Water law, Water pollution prevention, Quarries, Environmental Protection Agency v. National Crushed Stone Association, Supreme Court.

In EPA v. National Crushed Stone Association, the Supreme Court upheld that the EPA was not required to consider the economic effect of the effluent limitation standards on the individual plants requesting variances from the first-phase or Best Practicable Technology (BPT) standards. The Court supported Congress' conclusion that water pollution prevention and control must be accomplished in spite of some possible plant closings. The Court decision narrows the possibilities for obtaining BPT variances while allowing enough flexibility to handle individual situations not considered when the EPA drew up the first-phase regulations. (Cassar-FRC)
W82-02257

DO STATE WATER ANTI-EXPORTATION STATUTES VIOLATE THE COMMERCE CLAUSE, OR WILL NEW MEXICO'S EMBARGO LAW HOLD WATER,
C. B. Stetson.
Natural Resources Journal, Vol 21, No 3, p 617-630, July, 1981. 93 Ref.

Descriptors: *Water resources development, *State jurisdiction, Legal aspects, Export, Water demand, Water supply, *New Mexico, Water transfer.

At least 14 states and the District of Columbia have statutes directly prohibiting or regulating the export of state water, while other statutes indirectly regulate such export by narrow definitions of beneficial use or by legislation designed to protect the needs of the area in which the water originates. Increased demands for water and conflicting water law principles of neighboring states lend an element of tension to the water confrontation. The outcome of a suit filed by the city of El Paso against the New Mexico State Engineer, may be a landmark decision in the field of natural resources law as water supplies continue to dwindle, demands continue to increase, and states become even more concerned with protecting their citizens and conserving their local resources. After reviewing several other decisions as well as state property rights, it is concluded that any water rights in New Mexico which were vested prior to the passage of the non-exportation statute of 1953 could not be retroactively changed or controlled without state proof that such control is needed for the public good. However, prospective non-exportation statutes may be valid if they meet the following criteria: the sovereign power encompasses state waters, there is strong local interest in restricting exports, the legislation is non-discriminatory, and the Congress has not pre-empted the field. The New Mexico statute being challenged at present does not prohibit the exportation of all water, merely groundwater, and even that prohibition is not absolute, as it allows for the exportation of groundwater for designated uses. (Baker-FRC)
W82-02279

WATER RIGHTS ON INDIAN ALLOTMENTS,
D. H. Getches.
South Dakota Law Review, Vol 26, No 3, p 405-433, Summer, 1981.

Descriptors: *Water rights, *Allotments, *Indians, Water law, Water policy, Reservation doctrine, Political aspects, Social aspects, Legal aspects, Appropriation, Treaties, Judicial decisions, Leases.

Water rights on parcels of Indian reservation land allotted or leased to individuals are not expressly defined by any statute or other source. A problem developed when individual lots were leased to Indians for agricultural development, lease, or sale. Surplus lands on the reservations were opened to non-Indians for homesteading. The courts have long recognized that Indian tribes have special reserved water rights, exempt from state law and the requirements for continuous use. This paper concludes that no reserved rights may be held by individuals, but the allotees may use some of the rights during the period of trust. A solution in harmony with the objective of the General Alotment Act and Indian treaties would recognize that allotted land passing out of a trust period has water rights based on the dates and quantities of appropriations made on the land during the trust period. (Cassar-FRC)
W82-02363

DISPOSAL OF INDUSTRIAL EFFLUENTS - SOME FUTURE PROBLEMS,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 5D.
W82-02405

THE EFFECT OF EEC DIRECTIVES ON WATER SUPPLIES,
A. W. Kenny.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 1, p 42-49, January, 1980. 8 Ref.

Descriptors: *Water supply, *Administration, *Operating policies, *Economic effects, *Water pollution, Rivers, Effluent limitations, Water quality, Drinking water, Trace elements, Pollutants, Contamination, Water treatment, Cost analysis, *Europe.

The First Environmental Programme of the EEC (European Economic Community) is described. In regard to the aqueous environment, it provides for (1) standardization of methods of sampling and analysis; (2) preparation of objectives; (3) determination of standards for pollutants; (4) harmonization of measures to combat pollution from certain industries; (5) measures to eliminate toxic or persistent waste; and (6) measures to combat pollution in certain zones of common interest. Additional directives address trace substances, drinking waters, and industrial effluents. These are areas where agreement among the member States has been relatively easy and unpublicized. More controversial measures will be dealt with in the future. (Titus-FRC)
W82-02432

ANALYSIS OF FIRM WATER SUPPLY UNDER COMPLEX INSTITUTIONAL CONSTRAINTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-02501

REASONABLE GROUNDWATER PUMPING LEVELS UNDER THE APPROPRIATION DOCTRINE: THE LAW AND UNDERLYING ECONOMIC GOALS,
D. L. Grant.
Natural Resources Journal, Vol 21, No 1, p 1-36, 1981. 170 Ref. OWRT-A-066-IDA(2), 14-34-0001-0114.

Descriptors: *Legal aspects, *Water rights, Legislation, Cost-benefit analysis, *Groundwater management, Wells, *Pumping, Groundwater.

Two extreme approaches exist to the groundwater pumping level issue. The first is that well owners have no protection whatsoever in their diversion systems and each must pay his own cost of coping with declining levels. According to the second, existing appropriators are absolutely protected in their historic diversion systems and have injunctive or damage remedies against interference by junior users. Today, the appropriation doctrine states (western United States) have opted for a middle ground of reasonable pumping level standard. Modern resource allocation literature recognizes the impact on allocation decisions of social goals, as well as the economic efficiency considerations. Hydrologic aspects of the pumping level issue must be considered along with available groundwater management tools and the diverse factual situations in which pumping level problems can arise. Overall, the existing pumping level statutes are incomplete in listing factors, weighting them, and declaring specific policy. Further guidance on economic and other factors must be obtained by searching for the goals that underlie the statutes and by drawing on ancillary statutes. (Baker-FRC)
W82-02503

MUNICIPAL NEEDS,
North Carolina League of Municipalities, Raleigh.
D. Reynolds.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 6-9. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Municipal water, *Long-term planning, *Regional planning, Projections, Jurisdiction, Administrative decisions, Decision making, Water resources development, Potential water supply, Economic aspects, Site selection, Groundwater management, *North Carolina.

Local governments need the assistance of state and federal agencies to provide clean water, to protect and preserve current water supply sources, and to regenerate those that are below standard. Five major municipal needs are: (1) State-wide planning. Local governments depend on states to provide comprehensive water resource planning programs with a mechanism to reserve prime impoundment sites for future use and a coordination of groundwater resources. (2) An advocacy role regarding local municipalities. When the state adopts this stance rather than one of a regulator, problems can be solved more quickly and costly delays in project schedules can be avoided. (3) Project scoping and planning. States can develop broad plans of action with individual steps identified to assist local government decision makers who may have limited staff or lack of knowledge of state and federal agencies. This type of broad outline will greatly increase the probability of success of projects. (4) Technical assistance. This could include training of water treatment plant operators to assist them in keeping pace with changing technology, or assistance in meeting the requirements of the Safe Drinking Water Act, in identifying conservation benefits, and in developing programs to implement conservation. (5) Funding assistance. Municipalities need help in identifying sources of grants and funds and making maximum use of those available. (Garrison-Omniplan)
W82-02513

RECYCLING,
North Carolina Department of Natural Resources and Community Development, Division of Environmental Management.
C. Batten.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 25-27. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Recycling, Waste recovery, *Water reuse, *Wastewater renovation, Municipal wastewater, Industrial wastewater, Water use, Grants, Economic aspects, Planning, Political aspects, Reclaimed water, Water reclamation, *North Carolina.

Water conservation and wastewater reuse and recycling have generated great interest in recent years because of a shortage in water supply, the high cost of wastewater treatment and disposal, and federal funding incentives for recycling and reuse. In the 1977 Amendments to the Federal Water Pollution Control Act of 1972, 2 percent of funding was set aside to provide a 10 percent bonus grant for 'innovative' and 'alternative' projects; the latter were defined as proven methods for reclaiming and reusing water, recycling wastewater constituents, eliminating pollution discharge, or recovering energy. The alternative process most used in North Carolina has been the land application of wastewater. Two projects are

in operation, three or four are funded, and about twelve more are in the proposal stage. The recycling of wastewater involves the need for an administrative and legal framework, economics in recycling and reuse, the risk to public health, and the social impact. A project under review for recycling in North Carolina would cost about $350,000 and involve the use of wastewater effluent as a scrubber for an incinerator. A possible type of project for the future is deep-well injection to reduce salt-water encroachment. Industrial wastewater recycling has had a better record than that of municipal wastewater. (Garrison-Omniplan)
W82-02514

APPALACHIAN REGIONAL COMMISSION AND THE COASTAL PLAINS REGIONAL COMMISSION,

North Carolina Department of Natural Resources and Community Development, Office of Intergovernmental Relations.
J. Booth.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 33-35. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Grants, *Financing, *Municipal water, *State jurisdiction, *Economic feasibility, Public investment, Legislation, Federal jurisdiction, Political aspects, Economic aspects, Regional planning, Planning, *North Carolina.

This report summarizes the federal grant programs administered by the Office of Intergovernmental Relations in North Carolina. Four major programs are: the HUD 701 Comprehensive Planning Program, which encompasses the regional planning activities of Councils of Government and regional planning commissions; the Appalachian Regional Commission (ARC), which operates in 29 western counties; the Coastal Plains Regional Commission, which operates in 45 eastern counties; and Section 304 of the Economic Development Administration (EDA), which makes a small discretionary fund available to each state governor to supplement selected EDA grants. Federal budget cuts may seriously affect some of these, such as the ARC, which was funded for $41 million in FY 81 but is marked for zero funding in FY 82, although a funding extension may carry them until September 1981. The CPRC is tied in with EDA legislation that is in effect only until December 1980; its future is also unclear. In all of the programs, the basic philosophy and priorities are for projects related to economic development, such as waterline extensions to an industrial park or a future industrial site. Both the ARC and CPRC programs supplement community development activities by providing a maximum of 80 percent total federal funding after other sources are already signed on to a local project. (Garrison-Omniplan)
W82-02515

TRENDS IN STATE AND FEDERAL POLICY ON WATER SUPPLY MANAGEMENT,

North Carolina Department of Natural Resources and Community Development, Office of Water Resources.
J. Morris.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance. 1980. p 43-51. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: Grants, Long-term planning, Economic aspects, *Cost-sharing, *Regional planning, *Resources development, Federal jurisdiction, Public policy, *Water policy, Jurisdiction, River basins, River regulations, Political aspects, *North Carolina, Water supply, *Water management.

The manner in which state and federal assistance is given to local water supply agencies is very much under re-examination. On the state level, a study carried out in North Carolina by the Legislative Commission on Alternatives for Water Management yielded the conclusion that regional water management has many benefits and can be organized in two ways: A state water authority could develop water supplies and provide wholesale supplies to local governments, or a river basin commission could be created in each of the state's major river basins which would have water management responsibilities and some taxing or revenue-raising powers. Another priority on the state wells is for the legislature to review the future of the Clean Water Bond program, so communities know what funding they might expect. On the federal level, President Carter's water policy incorporated water conservation regulations and incentives in almost all federal programs that have any impact on water supply or water storage. The current picture on water policy is uncertain because there is a difference of opinion as to the value of grants to local agencies. One view is that local agencies need to be self-sufficient. Another is reflected in the Domenici-Moynihan bill, S.1641, which provides flexibility on the state level and perhaps less red tape in Washington. The paper reviews pending legislation in Congress and possibilities for federal funding of local projects, as well as changing attitudes about various approaches to water management at the federal level.
W82-02516

NEW DEVELOPMENTS IN WATER RESOURCES MANAGEMENT FOR LOCAL GOVERNMENTS AND INDUSTRIES,

North Carolina State Univ. at Raleigh. Dept. of Psychology.
F. J. Smith.
In: Proceedings of North Carolina Conference on Water Savings and Water Supply Assistance, 1980. p 84-94, 6 Tab. North Carolina Department of Natural Resources and Community Development, Raleigh.

Descriptors: *Water resources development, *Administrative regulations, *Public opinion, Public policy, Water quality management, Water supply development, *Water conservation, Grants, Water permits, Federal jurisdiction, Quality control, Management planning, State jurisdiction, *North Carolina, *Water management.

Surveys of water managers and industrial and residential users in 54 North Carolina communities reveal that the highest-ranking problem for users is water quality; management is more concerned with water-supply expansion and difficulties with state and federal water authorities. While it is not entirely surprising that water professionals have a different view of water problems than water users, it is important that water management understand those differences. There were some misperceptions by water managers regarding community attitudes on fundamental issues of water management; with training, managers can identify citizen priorities. Conservation activities were numerous in the communities surveyed. The most welcome and useful technical assistance provided to local water managers is nonstructural in nature, such as for grantsmanship, regulatory compliance, permit applications, personnel training, and general system improvements such as leak detection and quality control. There is some wariness among water users toward inviting such assistance, particularly from public agencies that also have regulatory functions. A modern water management information system was developed that (1) enumerated information elements relevant to water system planning and operations, (2) categorized information in general systems concepts, and (3) submitted categorized information to the 54 water system managers for evaluation. It was found that overall information to support comprehensive water management planning is most needed. (Garrison-Omniplan)
W82-02522

SOME ECONOMIC IMPACTS OF FRESHWATER STREAM EFFLUENT DISCHARGE LIMITS ON SELECTED SMALL COMMUNITIES IN MISSISSIPPI,

Mississippi State Univ., Mississippi State. Div. of Business Research.
For primary bibliographic entry see Field 5D.
W82-02530

WATER LAW, WATER CONSERVATION AND THE DEVELOPMENT OF ENERGY RESOURCES IN THE COASTAL, OFFSHORE AND FLOOD PLAIN AREAS OF ALABAMA,

Alabama Univ., University. School of Law.
For primary bibliographic entry see Field 5G.
W82-02535

MANAGEMENT OF INTERSTATE AQUIFER SYSTEMS,

Camp Dresser and McKee, Inc., Walnut Creek, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-02578

SALINITY FORUM: WHAT. HOW. WHY,

Utah Div. of Water Resources, Salt Lake City.
D. F. Lawrence, and B. C. Saunders.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 453-459, October, 1981. 1 Fig.

Descriptors: *Saline water, *Water policy, *Water quality control, *Colorado River Basin, Political aspects, Legal aspects, Institutions, Irrigation water, Mexican Water Treaty, Water quality standards, Legislation, Regional planning, Planning, River basins, Water management.

The Colorado River Basin Salinity Forum, an interstate organization, was created in 1972 to consider the problem of salinity, experienced in the lower basin but caused by withdrawals and return irrigation water in the upper basin. The forum's initial task was to establish numerical criteria for salinity in the basin and to develop a plan of implementation to meet the water quality criteria. It became apparent that the goal could be reached by: (1) minimizing salt pickup from future developments and (2) reducing present salt inflow to the system from natural and man-made sources. Although future development can be easily regulated by design criteria, alteration of existing projects would require substantial funds. The Salinity Control Act authorized construction of salinity control projects with 75% federal money and 25% from the states. The forum-recommended water quality standards and implementation plan were adopted by the states and approved by the EPA. Presently the forum monitors all salinity control programs, develops policy statements, and assists the EPA in defense of state salinity standards. The forum has been successful in spite of the conflicting interests of the seven states involved because all members are committed to a clearly-defined mission. (Cassar-FRC)
W82-02587

6F. Nonstructural Alternatives

STRATEGIES FOR THE MANAGEMENT OF ESTUARIES,

Texas A and M Univ., College Station. Dept. of Oceanography.
R. M. Darnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche.
In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 434-447. 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Estuarine environment, *Environmental policy, *Management planning, *Ecosystems, Salinity, Institutional constraints, Legislation, Jurisdiction, Environmental effects, Water quality.

Nationwide, the quality of estuaries has declined, and management strategies are required to restore their quality to past levels. The estuarine manager is the central figure in the system, receiving information from a variety of sources to formulate policy decisions and operation decisions, and initiating action which may be regulation (passive) or intervention (active). Both regulation and intervention may be directed to local or upstream conditions. These actions may be in the form of zoning, permits, or lease and purchase. The goal of a

healthy estuarine environment requires that conditions be maintained for those organisms that require low salinity, high salinity, are intermediate or tolerant of a range of salinities, and those which migrate through the estuary. The achieving of these goals is hindered by the absence of authorities with unambiguous control over estuaries, absence of legal tools for use by agencies, and absence of information on individual estuaries and watersheds. Because of the interstate nature of estuaries, there must be strong Federal involvement in their management. In the absence of such involvement, it is essential that the estuarine effects of upstream developments be considered in environmental impact statements, and that the cumulative effects of many small projects be considered. (Brambley-SRC)
W82-02166

INTERACTIVE NONSTRUCTURAL FLOOD-CONTROL PLANNING,

Hydrologic Engineering Center, Davis, CA.
D. T. Ford.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No. WR-2, p 351-363, October, 1981. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Alternative planning, *Flood control, *Computer programs, Flood damage, Flood plain management, Flood protection, Data storage and retrieval, Information systems, Planning, Flood insurance, Nonstructural alternatives, Cost-benefit analysis, Santa Fe, New Mexico.

The Nonstructural Analysis Package, developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, reduces the data handling time in the evaluation of nonstructural flood control alternatives. The package consists of two computer programs. The preprocessor program manipulates hydrologic, hydraulic, economic, and engineering data to derive indices that quantify the existing flood hazard for each structure or group of structures, as well as creates a random access data bank organized by stream reaches. The Interactive Analysis program retrieves, displays, and manipulates data and recomputes the flood hazard indices for evaluation. The method is illustrated with the Santa Fe, New Mexico, nonstructural flood control plan. It was easily used by persons with little computer utilization experience. The rapidly-produced alternatives were evaluated for social and political feasibility by the user, based on information gathered from persons living in the affected area. The recommended flood control plan obtained from this procedure is: (1) remove certain flood plain structures and covert property to park land, (2) replace two bridges, (3) clear the river channel in selected places, (4) construct a park walking wall, (5) construct small walls around certain structures, (6) buy flood insurance, (7) regulate flood plain land, and (8) plan for assistance in future floods. Although the expected cost of implementing the measures is $540,000 and the present value of damages is $266,000, elements of the plan were recommended for implementation. (Cassar-FRC)
W82-02320

AN ASSESSMENT OF CURRENT STANDARDS FOR SELENIUM IN DRINKING WATER,

Kirkham Michael and Associates, Omaha, NE.
M. J. Hammer.
Ground Water, Vol 19, No 4, p 366-369, July/August, 1981. 22 Ref.

Descriptors: *Selenium, *Drinking water, *Water quality standards, Reviews, Standards, Trace metals, Water treatment, Toxicity, Public health, Water pollution effects, Water pollution sources.

Current standards for selenium in drinking water, 10 micrograms per liter, are too stringent, according to a study of published literature on health effects of Se and the distribution of Se in natural waters. Although both deficiency and toxicity of Se are possible, neither is apparent in the U.S. population. The National Academy of Sciences recommends a provisional daily allowance of 50-200 micrograms per day. The average daily intake of Se by the American population is estimated at 200 micrograms per day. Minor health affects may appear at an intake of 500 micrograms per liter per day. The only known case of human poisoning from Se in drinking water occurred in an isolated family whose water supply contained 9 mg per liter Se. Their symptoms of lassitude, hair loss, and fingernail abnormalities disappeared upon changing water supplies. Se occurs naturally in foods, e.g., at up to 5 mg per kg in bread. In 43 samples of municipal water, Se levels ranged from 0.1 to 400 micrograms per liter. One well in Nebraska had a concentration of 480 micrograms per liter. Se cannot be effectively removed from water by conventional treatment methods; ion exchange, reverse osmosis, and electrodialysis are satisfactory, but prohibitively expensive. (Cassar-FRC)
W82-02372

EFFLUENT CHARGING SYSTEMS AND THEIR ADMINISTRATIVE IMPLICATIONS,

Environmental Resources Ltd., London (England).
For primary bibliographic entry see Field 6C.
W82-02403

DEVELOPING DAM-BREAK FLOOD ZONE ORDINANCE,

Corps of Engineers, Savannah, GA.
G. F. McMahon.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 461-476, October, 1981. 3 Tab, 29 Ref.

Descriptors: *Flood plain zoning, *Model studies, *Flood forecasting, *Ordinances, Flood plain management, Flood plains, Flood hydrographs, Dams, Flood routing, Flood waves, Flood spreading, Legal aspects, Nonstructural alternatives, Planning, Dam failure.

The formulation and enforcement of dam-break flood zone ordinances in Gwinett County, Georgia, will entail new problems not usually found in typical flood-zone regulations. The problems will occur as a result of inexperience in developing and interpreting ordinances, nonstandardization of methods and assumptions utilized to delineate dam-break flood zones, and conflicts of interest in the zoning process. The Georgia Safe Dams Task Force has tried to implement practical standards for estimating dam-break flood zones for a number of dams. Guidelines for determining flood areas are presented which apply to six important aspects of dam-break flood forecasting. These guidelines concern mode of failure, computation of the outflow discharge hydrograph produced by the breach, routing of the outflow hydrograph, determination of realistic initial and boundary conditions for dam-break flood-wave propagation, assumptions to be made in the case of domino-type failures, and data required by various methods. The Task Force has also sought to simplify the model ordinance to facilitate its adoption and enforcement. (Geiger-FRC)
W82-02585

6G. Ecologic Impact Of Water Development

INSTITUTIONAL BARRIERS TO WATER QUALITY PLANNING AND MANAGEMENT IN THE SOUTHEAST - VOL I - TECHNICAL REPORT, PART I - INSTITUTIONAL BARRIERS,

Tennessee Univ., Knoxville. Graduate School of Planning.
For primary bibliographic entry see Field 6E.
W82-02101

CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY,

Corps of Engineers, Baltimore, MD. Baltimore District.
A. E. Robinson, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 114-127, 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Consumptive use, *Estuarine environment, *Salinity, *Water circulation, Model studies, Hydraulic models, Simulation, Drought, *Chesapeake Bay, Freshwater inflow.

Chesapeake Bay is the largest estuary on the Atlantic coast of the U. S. and one of the more important estuaries in the world. It is nearly 200 miles long and varies in width from 3 miles to 30 miles. Like all estuaries, it depends upon the inflow of freshwater to maintain its salinity regime. Salinity variations, spatial and temporal, constitute the most significant physical parameter influencing the circulation dynamics of the estuary and the types of aquatic species which reside in it. The quantity of fresh water flowing into the Chesapeake may be substantially reduced in the future due to a marked increase in the consumptive use of water. The Corps of Engineers Low Freshwater Inflow Study was conceived as a result of the concern over this increased consumptive use. The objectives of this study are to assess the environmental, economic, and social consequences of these reduced flows and if appropriate, to formulate criteria for minimum freshwater inflows. A major portion of this work will be based on the results of a series of tests conducted on the Chesapeake Bay Model. A drought or depressed freshwater inflows can be simulated at any time on the model. It will be necessary to conduct a series of three tests on the hydraulic model: a problem identification test, a sensitivity test, and a plan formulation test. (Moore-SRC)
W82-02114

ASPECTS OF IMPACTS ASSESSMENT OF LOW FRESHWATER INFLOWS TO CHESAPAPEAKE BAY,

Western Ecosystems Technology, Laurel, MD.
G. B. Shea, G. B. Mackiernan, L. C. Athanas, and D. F. Bleil.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 128-148, 14 Fig, 8 Ref.

Descriptors: *Estuarine environment, *Low flow, *Environmental effects, *Salinity, Model studies, Computer models, Simulation, Consumptive use, Drought, Ecosystems, Habitats, Water circulation, *Chesapeake Bay, Freshwater inflow.

Modification of the Chesapeake Bay hydrologic environment has occurred over the past several decades, and is expected to continue at least until the end of the century. An attempt to assess the impact of low freshwater inflows (due to drought and consumptive losses) upon the Chesapeake Bay biota is currently underway. Some of the tools being used in this assessment are: distribution, tolerance, and life history studies of selected estuarine species; hydraulic modeling of salinity and circulation regimes; and computer simulation of representative segments of the ecosystem. Critical life history stages, habitat and food requirements, and tolerance to physical stress have been used to select representative study speces for evaluation of effects of reduced freshwater flows. Information on community structure and trophic relationships has been used to develop a conceptual model of major energy flows within the Chesapeake Bay ecosystem. A computer simulation model will be used to provide insight into the effects of low flow, and the propagation of these effects throughout the ecosystem. The results of this study will aid managers in planning consumptive use patterns of freshwater flows into the estuary. (Moore-SRC)
W82-02115

FRESHWATER INFLUENCES ON STRIPED BASS POPULATION DYNAMICS,

Maryland University, Solomons. Chesapeake Biological Lab.
J. A. Mihursky, W. R. Boynton, E. M. Setzler-Hamilton, K. V. Wood, and T. T. Polgar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, October, 1981. p 149-167, 5 Fig, 3 Tab, 45 Ref.

Descriptors: *Estuaries, *Environmental effects, *Bass, *Growth stages, Water resources development, Water quality, Hydrodynamics, Larval growth stages, River flow, Seasonal variation, Runoff, Climates, *Potomac River estuary.

In order to provide projected freshwater supplies for human activities in the Washington, D.C., metropolitan area a number of engineering devices have been proposed, including a number which have the potential to change hydraulic regimes in the Potomac River. A population dynamics study of striped bass was conducted in the Potomac Estuary from 1974-1977 to determine the effects of these changes. Investigations included measurement of hydrodynamic characteristics; water quality; phytoplankton; zooplankton; and striped bass egg, larval, juvenile, and adult stages. Larval and juvenile food habit data were also developed. Biological data indicated that striped bass year-class success, as measured by juvenile abundance, was not closely correlated to abundance of spawning stock, number of eggs deposited or early, non-feeding larval stages. These results suggested that density-independent mechanisms controlled the eratic patterns of year-class success of the this species. Climatic data were compared to available juvenile abundance data for a 25-year period. Strong year-classes were correlated with colder than average winters (December) which were followed by above average spring (April) freshwater runoff to the estuary. High densities of zooplankton at the time of first larval feeding and the spatial distribution of the spawning stock contributed to larval survivorship and consequent establishment of year-class strength. Evidence suggests that any significant diminution of springtime freshwater discharge to the estuary would tend to decrease the probability of substantial recruitment success. (Moore-SRC)
W82-02116

THE EFFECTS OF FRESHWATER DISCHARGES ON SPORTFISHING CATCH RATES IN THE ST. LUCIE ESTUARY, MARTIN COUNTY, FLORIDA,

Fish and Wildlife Service, Vero Beach, FL. Ecological Services.
E. Van Os, J. D. Carroll, Jr., and J. Dunn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980, Fish and Wildlife Service, Office of Biological Services Rept FWS/OBS-81/04, Vol I, Oct. 1981. p 269-281, 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Sport fishing, *Flow dishcarge, *Fish behavior, *Estuarine fisheries, Flood control, Environmental effects, *St Lucie estuary, Martin County, Florida.

The St. Lucie River is a 6,000 acre estuary located on the east coast of Florida. It is the eastern outlet of fresh water released from Lake Okeechobee through the St. Lucie Canal. The primary purpose of the releases is for flood control. Neighboring communities depend heavily on tourism and are concerned about the effect that the freshwater discharges and associated silt loads have on fishing success. A creel census was conducted for one year. Multiple-source, stepwise regression analysis and ridge regression analyses were performed on the freshwater discharges and creel data to determine if catch rates are affected by the St. Lucie Canal discharges, and if so, in what part of the estuary they are affected. The catch rates of nine important fish species were found to be significantly influenced by the moderate freshwater discharges from the canal. The nine species were snook, croaker, sheepshead, mullet, black drum, weakfish, gafftopsail cafish, gray snapper, and Irish pompano. The discharges from the St. Lucie Canal over the survey period amounted to 440,000 acre-feet. During discharges, species habits are less predictable, and the augmented freshwater releases cause fish movements. Long-term analyses show an actual drop in angler usage of the estuary in the face of great increases in human populations. (Moore-SRC)
W82-02124

FRESHWATER INTRODUCTION INTO LOUISIANA COASTAL AREAS,

Army Engineer District, New Orleans, LA.
For primary bibliographic entry see Field 4A.
W82-02127

EFFECTS OF WETLAND CHANGES ON THE FISH AND WILDLIFE RESOURCES OF COASTAL LOUISIANA,

Fish and Wildlife Service, Lafayette, LA.
For primary bibliographic entry see Field 4C.
W82-02129

TEXAS SHRIMP FISHERIES AND FRESHWATER INFLOW,

Texas Shrimp Association, Austin.
R. Rayburn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, September 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol I, October 1981, p 431-435. 10 Ref.

Descriptors: *Shrimp, *Estuarine fisheries, *Salinity, *Water management, River flow, Sediment transport, Nutrient, Commercial fisheries, Estuarine environment, Environmental effects, *Texas.

The economic impact of the shrimp industry to Texas was approximately one-half billion dollars in 1979. There are three species of shrimp which basically support the commercial shrimp fishery: the brown shrimp, the white shrimp, and the pink shrimp. The annual catches of these dominant species tend often to be highly variable, associated to a great degree with environmental conditions. Freshwater inflows and the resulting marsh area vitality are important to the shrimp, particularly during their critical estuarine-growth phase. During the estuarine growth phase, local fluctuations in temperature and salinity can drastically affect both the availability of marsh suitable for growth and the actual growth rate of the shrimp. Man-made alterations such as impoundments, bulkheading and alterations in freshwater discharges can accentuate the fluctuations causing considerably more detrimental impact. While ever-increasing requirements are being placed on the surface water resources, the need for balanced salinity regimes as well as sufficient nutrients and sediments to maintain a sound habitat should be paramount in the allocation process. Water management agencies, fishery resource protection agencies, and the fishing industry should maintain a close working relationship to insure vitality of the estuaries and the significant fisheries resource. (Moore-SRC)
W82-02131

AN EVALUATION OF AQUATIC LIFE FOUND AT HYDRAULIC SCOUR SITES IN THE COLUMBIA RIVER ESTUARY SELECTED FOR POTENTIAL SEDIMENT DEPOSITION,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 2L.
W82-02132

THE EFFECTS OF FRESHWATER INFLOW ON SALINITY AND ZOOPLANKTON POPULATIONS AT FOUR STATIONS IN THE NUECES-CORPUS CHRISTI AND COPANO-ARANSAS BAY SYSTEMS, TEXAS FROM OCTOBER 1972-MAY 1975,

Texas Univ. at Austin, Port Aransas. Port Aransas Marine Lab.
R. D. Kalke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131426, Price Codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., September 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol I, October 1981, p 454-471. 9 Fig, 1 Tab, 18 Ref.

Descriptors: *Salinity, *Estuarine environment, *Zooplankton, *Rainfall, *Streamflow, Water use, Flushing, Nutrients, Foods, Predation, Copepods, *Texas, Bays, Freshwater inflow.

Increased municipal, agricultural, and industrial usage of fresh water prompted the need for research in determining requirements for freshwater inflow into Texas estuaries. Between October 1972 and May 1975, two periods of major freshwater inflow (June-November 1973 and August-September 1974) affected zooplankton populations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems. Salinity fluctuations in the study area were negatively correlated with local rainfall. Stronger negative correlations were observed for salinity with streamflow. Major freshwater incursions physically flush out estuarine zooplankton populations and replace them with freshwater species. Increased salinities even as low as 1.0 ppt to 3.0 ppt result in a rapid return of estuarine species, especially the euryhaline copepod Acartia tonsa. It is speculated that the success of large populations of A. tonsa following peak inflows can probably be attributed to influx of nutrients, food, and a decrease in higher salinity predators. The higher overall salinities recorded during this study in the Nueces-Corpus Christi Bay system indicate that this area is affected by tidal incursions of higher salinity Gulf water more than the Copano-Aransas Area. (Moore-SRC)
W82-02133

INFLUENCES OF FRESHWATER INFLOW ON CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) IN THE SACRAMENTO-SAN JOAQUIN ESTUARY,

Fish and Wildlife Service, Stockton, CA.
M. A. Kjelson, P. F. Raquel, and F. W. Fisher.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonia, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 88-108. 6 Fig, 23 Ref.

Descriptors: *Salmon, *Environmental effects, *Estuaries, *River flow, *Anadromous fish, Survival, Fish migration, Diversion losses, Flow pattern, Dissolved oxygen, Water temperature, Water resources development, Freshwater inflow, *Sacramento-San Joaquin estuary, California.

Changes in freshwater influence the survival, abundance, migration and rearing of chinook salmon in the delta portion of the estuary. Low flows in the upper Sacramento and San Joaquin Rivers result in decreases in fry migration to the estuary, and juvenile abundance and survival in the delta. Both adult and juvenile migration are adversely affected by diversions from the San Joaquin River. Young salmon are caught on the screens while smaller fish pass through, and additional fish are lost at unscreened diversions. Adult fish are prevented from using some channels for migration because of the flow reversals caused by pumping. Low flows in the rivers result in higher water temperatures which discourage adult salmon migration. Low dissolved oxygen levels caused by high levels of organic materials in the rivers also discourage adult migration. These observations are based on seine and trawl surveys, collections at water diversion fish screens, and mark-recapture techniques. Many of the present and potential flow-related

problems are largely attributed to water development operations upstream and within the estuary. Management plans have been designed to correct some of these problems. (Brambley-SRC)
W82-02142

SOME EFFECTS OF FRESH WATER ON THE ATCHAFALAYA BAY SYSTEM,

University of Southwestern Louisiana, Lafayette. Dept. of Botany.
H. D. Hoese.
Available from the National Technical Information Service, Springfield, VA 22161 as PB32-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 110-124. 3 Fig, 6 Tab, 7 Ref.

Descriptors: *Atchafalaya Bay, Louisiana, *Ecosystems, *Aquatic animals, *Environmental effects, *River flow, *Estuaries, Salinity, Water temperature, Productivity, Floods, Flood control, Freshwater inflow.

Diversion of water from the Mississippi River to the Atchafalaya River has caused reduced salinity in Atchafalaya Bay, becoming practically freshwater under flood conditions. Salinity ranged from 0.1 - 0.9 ppt over the year, while in Vermilion Bay, furthest from the river mouth the range was 0.2 - 9.3 ppt. There were significant differences in water temperature between the two bays with temperatures up to 5C warmer in Vermilion Bay. Significant variations occurred in air and water temperature differences between the two bays. The fauna of Atchafalaya Bay was characterized by river shrimp, gars and catfish, while that of Vermilion Bay was characterized by white shrimp, anchovies and bull sharks. Productivity decreases are suggested to be a result of the decreased temperature caused by increased flows of cold river water, particularly during the winter and spring floods. This effect of flood flows should be considered when flood management systems are designed. (Brambly-SRC)
W82-02143

FRESHWATER INFLOW AND SALT WATER BARRIERS FOR MANAGEMENT OF COASTAL WILDLIFE AND PLANTS IN LOUISIANA,

Louisiana State Univ., Baton Rouge. School of Forestry and Wildlife Management.
R. H. Chabreck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in papercopy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 125-138. 3 Tab, 22 Ref.

Descriptors: *Coastal marshes, *Coastal zone management, *Saline water intrusion, *Saline water barriers, *Ecosystems, Channeling, Levees, Subsidence, Erosion, Salt marshes, Brackish water, Wetlands, Ducks, Muskrats, Alligators, Freshwater inflow, Louisiana.

The Louisiana coastal marsh is subdivided into four types: saline, brackish, intermediate, and fresh. They occur in bands generally paralleling the coastline and contain characteristic water salinity levels and plant and animal communities. The boundaries of the marsh types have changed as a result of human activities and natural events. The northern boundary of the salt marsh has moved inland an average of 3.4 km in the period 1943-1968, largely as a response to leveeing, canal dredging and stream channelization, and subsidence and erosion. The various characteristics of each marsh and its plant life provide for habitats for different animal species which use one or more preferentially. The saline marsh supports fewest plant species, and the fresh marsh the most. Dabbling ducks favor the intermediate and fresh marshes, muskrats prefer the saline and brackish marshes, and alligators prefer the brackish and intermediate marshes. Nutria populations tend to decrease as salinity increases. The tendency to increased salt marsh results in decreases in wildlife. Two methods are available to prevent the advance of salt-water: artificial barriers, and freshwater introduction into the headquarters of the drainage basin. Both methods have application in Louisiana, and a recommended goal is to restore the marshes to their conditions in 1943. (Brambley-SRC)
W82-02144

REVIEW OF ESTUARINE-RELATED PROJECTS BY THE GULF OF MEXICO FISHERY MANAGEMENT COUNCIL,

Gulf of Mexico Fishery Management Council, Tampa, FL.
V. J. Blomo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 147-154. 6 Ref. 2 Append.

Descriptors: *Estuarine environment, *Federal jurisdiction, *Gulf of Mexico, *Fisheries, *Fish management, *Shellfish, Estuaries, River flow, Channelization, Dredging, Spoil disposal, Wetlands, Land development, Planning, Permits.

The enactment of the Fishery Conservation and Management Act of 1976 provided for the stewardship, by regional fishery management councils, of the fishery resources beyond state jurisdiction to 200 miles. The councils develop management plans for fish and shellfish which consider fishery resources in their entire range of habitat. In the Gulf of Mexico, most of the fishery resources are estuarine-dependent, and the Gulf Council therefore has taken a keen interest in alterations to this habitat. Council input to projects affecting freshwater inflow to estuaries is proper because of its responsibility and effective because of the diverse interests represented on the council. Input made to date relates to diversion of freshwater; channelization, dredging and spoils disposal; residential development; and private use of a wetland area affecting public resources. In the one case which has been decided a permit for the development was denied. (Brambley-SRC)
W82-02146

VALUES OF ECOLOGICAL CHARACTERIZATION STUDIES TO ASSESS EFFECTS OF FRESHWATER INFLOW TO ESTUARIES,

Fish and Wildlife Service, Slidell, LA.
J. B. Johnston, N. G. Benson, and B. D. King, III.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 155-164. 2 Fig, 10 Ref.

Descriptors: *Ecosystems, *Coasts, *Estuaries, *Planning, *Coastal zone management, Environmental effects, River flow, Channelization, Reservoirs, Marshes, Chenier Plain, Mississippi Deltaic Plain, Wetlands, Erosion, Ecological effects, Freshwater inflow.

Ecological characterization studies compile existing information (utilizing a holistic approach) that identifies functional relationships among natural processes and components of coastal ecosystems. Some studies have mapped habitat changes from aerial photographs over a 20- to 25-year time period. The studies integrate environmental and socioeconomic information in a form useful for planning, impact assessment and analysis. Studies completed or underway include the Chenier Plain of Southwestern Louisiana and Southeastern Texas, Sea Islands Region of South Carolina and Georgia, Pacific Northwest, Northern and Central California, Mississippi Deltaic Plain, Texas Barrier Islands Region, Rocky Coast of Maine, Northeastern Gulf of Mexico, and Southwestern Florida. Data from the Sabine basin of the Chenier Plain study demonstrated the quantified effects of modifying natural river flow on Sabine Lake and the associated estuarine area. Navigation channel developments, construction of reservoirs on the incoming rivers, and impoundment of marshes were the primary causes of ecological changes. The Mississippi Deltaic Plain study mapped habitat changes from the mid-1950's to 1978. Many of the habitat changes resulted from the modification of freshwater inflow. The study indicated that over 500,000 acres (202,000 ha) of Louisiana coastal wetlands were lost or altered during the period. The information developed from the ecological characterizations will enable planners to understand and predict the consequences of future alterations in the coastal zone.
W82-02147

EFFECTS OF ALTERATIONS OF FRESHWATER INFLOWS INTO MATAGORDA BAY, TEXAS,

Texas Univ. at Austin. Dept. of Civil Engineering.
N. E. Armstrong, and G. H. Ward, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX, Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Rept. FWS/OBS-81/04, Vol II, Oct. 1981, p 179-196. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Matagorda Bay, *Texas, *Environmental effects, *Water resources development, *Seawater, *Diversion channels, Estuarine environment, Water demand, Salinity, Model studies, Nutrients, Habitats, Navigation, Sedimentation, Water circulation, Freshwater inflow.

The Matagorda Bay, Texas, region is experiencing increased development on its periphery and in its drainage basin. The Matagorda Bay Project is a three-year study focusing primarily on the effects of altered freshwater inflows on the living resources of the bay. Freshwater inflows will be reduced because of increased withdrawls of water from the Colorado, Lavaca, and Navidad Rivers for agricultural, industrial, and municipal purposes. The reduced inflows will cause an increase in salinity, but model studies show that this will be less than 1 ppt. Nutrient concentrations may be increased or reduced depending on upstream practices. The biological effects are expected to be the result of loss of nursery areas in secondary and tertiary bays, and the possible loss of nutrients. A navigation and diversion project is planned for the Colorado River, in which water from the river will be diverted into Matagorda Bay, and a navigation channel will be maintained to the Gulf of Mexico. The major effect of the diversion channel will be to alter the circulation in Matagorda Bay and increase sedimentation. The increased sedimentation will eliminate some shallow bay habitat, but at the same time, build up new marsh habitat. These results are preliminary; biological and hydrological studies are continuing. (Brambley-SRC)
W82-02149

OVERVIEW OF FRESHWATER INFLOW DEPLETIONS,

Fish and Wildlife Service, Fort Collins, CO.
For primary bibliographic entry see Field 6D.
W82-02152

THE RIVER CONTINUUM: A THEORETICAL CONSTRUCT FOR ANALYSIS OF RIVER ECOSYSTEMS,

Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
R. L. Vannote.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 289-304. 5 Fig, 31 Ref.

Descriptors: *Rivers, *Ecosystems, *Environmental effects, Headwaters, Estuaries, Stream profiles, Particulates, Suspended solids, Habitats, Light quality.

The river continuum concept suggests that a natural river system, from headwaters to estuary, can be considered a gradient of process zones ranging from a strongly detrital based system in headwater streams to a seasonal, or perhaps annual, autotrophic regime in moderate-sized streams and then, a gradual return to predominately heterotropic processes in large river systems. The structural and functional properties of stream communities tend to be selected to conform to the dynamic pattens of physical energy expenditure and the most probable physical state as proposed by fluvial geomophologists. Each stream reach along the continuum has local inputs in the form of light energy and particulate material from the terrestrial landscape and the partially processed materials transported from upstream reaches. Particle size of organic material in transport becomes progressively smaller as it passes down the continuum and biotic communities structured on the transport system become progressively more efficient in processing smaller particles towards downstream areas. Consumer communites in rivers are considered to be structured by local inputs, autochthonous and allochthous; materials in the transport system; and gradients in fluvial geomorphic processes throughout the drainage network. The concept may be used to predict changes resulting from upstream perturbations such as channelization, impoundments, logging, and waste inputs and in the management of rivers. (Brambley-SRC)
W82-02157

CHARACTERIZATION OF FRESHWATER INFLOW MODIFICATION TO ESTUARIES RESULTING FROM RIVER BASIN DEVELOPMENT,

Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
M. E. Jennings.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 375-384. 6 Fig, 9 Ref.

Descriptors: *River flow, *Estuaries, *Model studies, *Water resources development, Statistical analysis, Climatology, Simulation, Hydroelectric power, Reservoir operation, Freshwater inflow, *Ecological effects.

There are three approaches for determining quantity and modification of freshwater inflow to estuaries: continental-scale assessment, statistical studies of long-term records at the mouth of a river, and river basin modeling. Continental-scale assessments are of limited use in determining modifications of freshwater flows. The statistical approach is illustrated using long-term streamflow records for the Brazos River, Texas, and the Santee River, South Carolina. For both rivers, the influence of upstream impoundments is obvious, and for the Brazos River, the 9-year moving averages show the dominance of the long-term regional climatic effect on the flow pattern. River basin modeling, illustrated using data from the lower Santee River Basin, is believed to be the best approach for general field studies. The Large River Basin Transport Model is being developed, which will make long-term (20-50yr) simulations. The model was used with the Santee River data to optimize power production through a study of reservoir operating rules. The observed and computed flows were in good agreement for flow in the river and discharges used in power production. (Brambley-SRC)
W82-02162

DRAFT ENVIRONMENTAL ASSESSMENT DESALTING DEMONSTRATION PLANT, LAGUNA, NEW MEXICO.

MetaMetrics Inc., Washington, DC.
For primary bibliographic entry see Field 3A.
W82-02171

EFFECTS OF LAKE MICHIGAN DIVERSION ON THE WATER CHEMISTRY OF THE ILLINOIS WATERWAY,

Illinois State Water Survey, Peoria. Water Quality Section.
V. Kothandaraman, and R. L. Evans.
Water Resources Bulletin, Vol 17, No 4, p 607-613, August, 1981. 3 Fig, 6 Tab, 4 Ref.

Descriptors: *Diversion, *Illinois waterway, *Environmental effects, Mathematical models, Mathematical studies, *Water quality, Chemical composition, *Lake Michigan.

Baseline water chemistry data were developed for the Illinois Waterway to assess the probable extent and magnitude of the impact of diverted Lake Michigan waters on the water chemistry of the Illinois Waterway. Two hundred and seventy miles of the Illinois Waterway were monitored at 10 mile intervals, and a statistical method was used to define the interstation relationships for the chemical parameters. Mathematical models were used to predict the effects of the Lake Michigan diversion. Two diversion schemes, increased diversions of 3400 cfs or 6800 cfs under three different flow conditions, were examined. The diversion of Lake Michigan water was predicted to improve the chemical quality of the waterway. The mineral content of the mixed flow resulting from increased diversion under average, wet, and dry flow conditions would not affect the osmotic balance of the waterway's fauna and flora. (Small-FRC)
W82-02261

USER REACTION TO WILD AND SCENIC RIVER DESIGNATION,

Clemson Univ., SC. Coll. of Forest and Recreation Resources.
R. H. Becker.
Water Resources Bulletin, Vol 17, No 4, p 623-626, August, 1981. 4 Tab, 10 Ref.

Descriptors: *Recreation demand, *Wild rivers, *Environmental protection, Recreation, Wilderness areas, Legal aspects.

Problems have arisen when new users are attracted to rivers which have been designated as wild and scenic, as the recreational behavior of the new users may be unacceptable. The designation as wild and scenic under the National Wild and Scenic Rivers Act of 1968 may actually attract more users and negatively affect the area the designation was designed to protect. Studies of use patterns on the northwest Wisconsin River and the Lower St. Croix/Mississippi indicated that increased use was associated with publicity and exposure to the general public. The national program reduces structural development, but there is a loss of low density recreational opportunities on the rivers. Legislation designating a specific river to the Wild and Scenic River System should include actions to preserve the social quality and recreational experiences that make the river special. (Small-FRC)
W82-02278

ENVIRONMENTAL REPERCUSSIONS OF IRRIGATION DEVELOPMENT IN HOT CLIMATES,

Ahmadu-Bello Univ., Zaria (Nigeria). Dept. of Environmental Health.
B. Z. Diamant.
Environmental Conservation, Vol 7, No 1, p 53-58, Spring, 1980. 2 Fig, 14 Ref.

Descriptors: *Irrigation programs, *Environmental effects, *Developing countries, Irrigation effects, Water resources development, Public health, Sprinkler irrigation, Diseases, *Human diseases, Social aspects, Economic aspects, Reservoirs, Vegetation effects, Water level fluctuation, Legislation.

Irrigation projects intended to improve food supplies and the quality of life in third world countries have caused severe problems: spread of waterborne diseases and social upheavals among the peoples resettled by flooding impoundments. Malaria and/or schistosomiasis have appeared or increased in the areas near Lake Akosombo, Ghana; Lake Nasser, Egypt; the Indus River Basin, Pakistan; and Helmand River project, Afghanistan. Environmental health aspects should be included in the planning, construction, and operation of large-scale irrigation projects. Vector control measures, which break the three-part cycle (sick carrier, transmitting vector, and recipient), can be accomplished by proper engineering to produce a habitat unfit for snails and mosquitos. Chemical, biological, and genetic control are not as effective or are still in the research stage. Some suggestions for destroying habitats for disease vectors are: controlling vegetation, straightening banks, producing frequent changes in water levels, reducing evaporation, eliminating wastewater influx, installing snail screens, using closed channels, sprinkling irrigation water, and choosing crops which do not need flooding. The complicated social and economic changes produced by these projects require a prior sociological survey. The population should be consulted before the fact on allocation of new farming plots, methods of cultivation, types of crops, and housing. Operation and maintenance of the water projects should be regularly surveyed by teams of ecologists, environmental engineers, entomologists, and health workers. (Cassar-FRC)
W82-02366

AN INDUSTRIAL VIEW. TREATMENT VIS-A-VIS DISCHARGE TO SEWERS,

Confederation of British Industry, London (England).
A. I. Biggs.
Water Science and Technology, Vol 13, No 7, p 331-335, 1981.

Descriptors: *Policy making, *Future planning, *Industrial development, *Ecological effects, Water resources development, Water use, Nonconsumptive use, Administrative decisions, Water quality management, Economic effects, Environmental effects, *United Kingdom.

The effect of industry and commerce on the environment is considered, with special focus on the use and protection of water resources and the economic aspects thereof. In the United Kingdom, commerce and industry account for most of the major discharges of used water into the rivers and estuaries. The Confederation of British Industry (CBI) has issued a policy statement asking governments to consider the benefits of industrial development when planning laws concerning the protection or use of natural waters. CBI has also urged industry to consult with government policymakers when planning for increased development. CBI maintains that well managed industrial and commercial growth should be compatible with careful use of environmental resources. (Geiger-FRC)
W82-02407

SOME ENVIRONMENTAL IMPACTS OF A STORM SURGE BARRIER,

Koninklijke Nederlandse Akademie van Wetenschappen, Amsterdam.
J. H. B. W. Elgershuizen.
Marine Pollution Bulletin, vol 12, No 8, p 265-271, August, 1981. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Flood control, *Barriers, *Environmental effects, Netherlands, *Holland, Storm surges, Estuaries, Scheldt Estuary, Salt marshes, Ecosystems, *Baseline studies.

In 1985 the newly designed storm surge barrier (SSB) will be constructed across the mouth of the eastern Scheldt in the Netherlands to seal off most of the large inlets in the southwestern part of the land. The project was launched in answer to drastic flood losses in 1953. A complete closure of most of the inlets and also the Eastern Scheldt was envisaged, except for the New Waterway and the Western Scheldt, which are important to shipping. The original study had called for the construction of a dam, but this was changed in 1976 to the construction of a storm surge barrier to close the Eastern Scheldt estuary, and thus buy safety for the polders and preserve the ecological system of the Eastern Scheldt. The SSB will cause the for-

mation of a new, unnatural ecosystem. To make the appropriate decisions to manage this area in as natural a way as possible, a sound knowledge of the Eastern Scheldt ecology is urgently needed. From the evaluation studies this far conducted it appears that one closure per year for 12 hr would not have any significant effect, but if closure times are long or if frequent complete closures occur, problems may arise. Thus it is suggested that, in place of complete closures, partly closing the barrier may avoid a concentrated attack of flood waters on sand and mud flats, dikes and salt marshes. This may result in the maintenance of a reduced tide in the Eastern Scheldt, and appears to offer a good compromise between safety and ecology. (Baker-FRC)
W82-02417

THE RELATIVE INFLUENCE OF DAMS AND SECULAR CLIMATIC CHANGE ON DOWNSTREAM FLOODING, AUSTRALIA,

Macquarie Univ., North Ryde (Australia). School of Earth Sciences.
For primary bibliographic entry see Field 2E.
W82-02425

RECENT TRENDS IN ENVIRONMENTAL IMPACT ASSESSMENT,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. M. Rosenberg, V. H. Resh, S. S. Balling, M. A. Barnby, and J. N. Collins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 5, p 591-624, 1981. 5 Fig, 8 Tab, 225 Ref. (California Water Resources Center Project UCAL-WRC-W-519). OWRT-A-063-CAL(2).

Descriptors: *Environmental impact statement, *Assessments, *Aquatic environment, *Ecosystems, Powerplants, Fossil fuels, Recreation, Reservoirs, Wastewater treatment, Forestry, Dredging, Estuaries.

The overall objective of this paper is to examine the use that research based on the scientific method can have in assessing environmental impacts. Emphasis has been placed on environmental impacts that involve aquatic ecosystems. The specific objectives are to characterize an 'ideal' environmental impact assessment for several major types of developments, mainly in North America; and to identify successes, failures, and future needs in environmental impact assessment (e.i.a.). Environmental impact assessment has had the following successes; increased environmental awareness due to public involvement in e.i.a., some environmental protection, and elucidation of intruguing research problems. The list of failures of e.i.a. is, however longer: 'tokenism,' unrealistic time constraints, uncertainty of program or development schedules, difficult access to e.i.a. literature, questionable ethics, lack of coordination among studies, and poor research design.
W82-02525

RELATIONSHIP BETWEEN WATER QUALITY AND THE COMMUNITY STRUCTURE OF EPIPHYTIC DIATOMS IN A MISSISSIPPI BAYOU,

Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
M. J. Sullivan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-157843, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Institute, Mississippi State University, Report, September, 1981. 27 p, 11 Tab, 14 Ref. OWRT-A-133-MISS(2), 14-34-0001-1126.

Descriptors: *Diatoms, Rooted aquatic plants, Sessile algae, Nitrogen compounds, Phosphorus compounds, *Water quality, *Bayous, Biological communities, Aquatic habitats, Marine algae, Rhodophyta, Chlorophyta, Cyanophyta, Submerged plants, Pondweeds, Salt marshes, *Mississippi, *Algae, Salinity, Comparison studies, Heavy rainfall effects, *Epiphytic algae, Grand Plains Bayou, Cocconeis, Bacillaria, Bostrychia.

Epiphytic diatoms were collected from the leaves of submerged angiosperms belonging to the genera Potamogeton, Zannichellia, and Najas in Grand Plains Bayou, Hancock County, Mississippi from March through September 1980. Extremely heavy rainfall caused this bayou to be an essentially freshwater system for the first five months of the study. Salinity finally rose to 6 o/oo in August and to 13 o/oo in September. The bayou waters were acidic to neutral for most of the study and concentrations of dissolved nitrogen and phosphorus were low, indicating that the system was relatively unproductive. Only seven species of red, blue-green, and green algae were collected and the epiphytic diatom flora was represented by a total of 50 taxa. The dominant diatom was Cocconeis placentula var. euglypta (Ehr.) Grun. which accounted for 84.1% of all valves counted. During the freshwater period species diversity (H') and the number of taxa in a sample (S) were very low, rarely exceeding 0.82 bits/individual and 10 taxa. After saltwater intrusion H' increased beyond 2.0 and S exceeded 20. Multiple regression involving H', S, or the relative abundances of seven taxa as the dependent variable and selected water quality measures as the independent variables demonstrated a significantly statistical relationship between Cocconeis fluviatilis Wallace and Bacillaria paradoxa Gmelin and water quality in Grand Plains Bayou. The abundance of the former could be predicted by knowledge of the concentrations of ammonia nitrogen, orthophosphate, and total dissolved phosphorus, while that of the latter could be predicted by salinity alone.
W82-02531

INTERACTIONS POTENTIALLY AFFECTING THE SEASONAL ABUNDANCE OF SELECTED AQUATIC INVERTEBRATES IN A RICE FIELD HABITAT,

Minnesota Univ., St. Paul.
F. G. Zalom.
Hydrobiologia, Vol 80, No 3, p 251-255, 1981. 3 Fig, 12 Ref.

Descriptors: *Population dynamics, *Invertebrates, *Predation, Rice, Seasonal variation, Water temperature, Vegetation effects, Midges, Crustaceans, Copepods, Species diversity, Corixidae, Belostomatidae, Dytiscidae, Hydrophilidae, Notonectidae, Aquatic animals, Paddies, Wetlands, California, *Rice farming.

The seasonal abundance of aquatic invertebrates in California rice fields depended on water temperature and plant stand. Predator-prey interactions further modified the observed seasonal patterns. Sampling was conducted weekly, May to August 1977 and 1978. Data was subjected to multiple regression analysis. Prey organisms were Chironomidae larvae, Corixidae, and Crustacea; predators were Belostomatidae, Dystiscidae adults, Hydrophilidae larvae, and Notonectidae. Prey populations peaked in mid to late June and to a lesser degree in late July. Predator populations displayed more variable peaks. Average water temperatures increased during the first 5 weeks after initial flooding of the rice paddies and decreased slightly as the plant stand grew denser in July. (Cassar-FRC)
W82-02568

7. RESOURCES DATA

7A. Network Design

MONITORING FRESHWATER INFLOW TO ESTUARIES BY REMOTE SENSING,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
R. W. Johnson, and B. M. Kendall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 17-40. 10 Fig, 3 Tab, 19 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Estuaries, *River flow, Tidal rivers, Plumes, Temperature, Salinity, Suspended solids, Chlorophyll, Spatial distribution, Temporal distribution, Aerial photography, *Freshwater inflow.

Experiments conducted in the United States coastal zone indicate that features such as plumes from freshwater inflow have distinctive spectral characteristics. These spectral characteristics have been correlated with concentrations and/or distributions of temperature, salinity, suspended solids, and chlorophyll a in plumes and surrounding estuarine water. Remotely sensed wide area synoptic coverage of surface estuarine features provides a perspective on spatial and temporal distributions that is not readily available by shipboard measurements. Data outputs from remote sensors, to date, include high resolution measurements to determine concentrations and distributions of total suspended particulates, temperature, salinity, and chlorophyll a from airborne and/or satellite platforms; and low resolution measurements of total suspended solids, temperature, and possibly chlorophyll from satellite platforms. Archived data (such as from Landsat) may be used for historical studies of river plumes and other estuarine features. Examples are presented in which remotely sensed optical and microwave spectral range data, with and without concurrent surface measurements, are used to study spatial and temporal characteristics of plumes. In general, qualitative assessments may be made without concurrent surface measurements based on differences of water color, temperature, and salinity within the plume or between the plume and the receiving water. Quantitative distribution of suspended solids, temperature, salinity, and chlorophyll a require concurrent surface measurements to calibrate the remotely sensed data.
W82-02138

A DYNAMIC METHODOLOGY FOR CHARACTERIZING AND MONITORING ESTUARINE ECOSYSTEMS,

Gulf Universities Research Consortium, Houston, TX.
T. L. Linton, and S. G. Appan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-131434, Price codes: A23 in paper copy, A01 in microfiche. In: Proc. of the National Symposium on Freshwater Inflow to Estuaries, San Antonio, TX., Sep. 9-11, 1980. Fish and Wildlife Service, Office of Biological Services Report FWS/OBS-81/04, Vol II, Oct. 1981, p 448-462. 5 Fig, 12 Ref.

Descriptors: *Estuarine environment, *Estuaries, *Data acquisition, *Variability, *Prediction, Environmental effects, Monitoring, Water temperature, Salinity, Polychaetes, Species diversity, Substrates, Ecosystems.

A methodology is proposed that utilizes extant data from disparate sources for the purpose of determining or predicting transitory and/or permanent effects that natural and/or man-made changes will cause in an estuarine ecosystem. Data on estuaries in Alabama, Louisiana and Texas were used to construct a computer file, from which the natural variability of the estuary may be defined. Temperature and salinity changes were recorded for one year, and substrate type and polychaete species were determined for the following estuaries: Timbalier, Lavaca, Aransas, Copano, and Mobile. The Lavaca estuary characteristics were used to select monitoring stations, and the principal months for seasonal monitoring. The spatial, temporal, and species-level variability for polychaetes, and seasonal variability of temperature and salinity were determined. Data from the monitoring program that fall within these ranges would indicate that activities are not derimental to the estuary. This method provides a direct way to measure actual impacts, can be updated as more data becomes available, provides for prediction of impacts in similar estuaries, can aid in the design of monitoring programs, and detect the cumulative effects of many activities. (Brambley-SRC)
W82-02167

THE WARMWATER SPORT FISHERY OF EASTERN LAKE ONTARIO,

New York State Dept. of Environmental Conservation, Watertown.
F. M. Panek.
New York Fish and Game Journal, Vol 28, No 2, p 178-190, July, 1981. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Sport fishing, *Lakes, *Lake Ontario, Fish harvest, Surveys, Fish populations, Surveys, New York.

Findings of a creel census in New York waters of the eastern basin are reported. The study area comprised the waters of Lake Ontario from Stony Point to Tibbets Point. The census consisted of counting the number of anglers and interviewing some of them for specific information. It was conducted on 78 days between June 17 and October 27, 1978. Within the study area, 16 sampling stations were selected on the basis of their suitability for obtaining reliable counts of shore anglers and boat anglers. A total of 1,676 counts of shore anglers and boats were recorded, and 372 anglers were interviewed. Fishing pressure was estimated as 274,073 angler hours, with 91% of it being associated with boat fishery and 55% with the time spent on weekends and holidays. The estimated total fish harvest of 394,529 fish included 13 species, of which small mouth bass, yellow perch and rock bass comprised 98%. Catch rates for legal sized smallmouth bass averaged 0.47 fish per hour in the boat fishers. Catch rates were similar to those of earlier studies, indicating that the bass fishery in the eastern basin is both stable and of high quality. (Baker-FRC)
W82-02296

GROUND-WATER-LEVEL MONITORING NETWORK, HOLLISTER AND SAN JUAN VALLEYS, SAN BENITO COUNTY, CALIFORNIA,

Geological Survey, Menlo Park, CA. Water Resources Div.
C. D. Farrar.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $4.25, Microfiche $4.00. Geological Survey Open-File Report 81-66 (WRI), March, 1981. 9 p, 1 Fig, 1 Plate, 1 Tab, 4 Ref.

Descriptors: *Groundwater, *Network design, *Wells, *Water level, *Monitoring, Sites, Well data, Artificial recharge, Geology, *California, San Benito County, San Juan Valley, Hollister Valley.

The addition of 17 wells to the existing 86-well network is proposed to improve the ground-water monitoring in the Hollister and San Juan Valleys in California. The new wells were selected on the basis of well-construction data, availability, location, accessibility, use, and condition, either to replace wells that are no longer accessible or to furnish needed additional data for planning artificial recharge, preparing water-level-contour maps, and digital ground-water modeling. (USGS)
W82-02487

REAL-TIME RAINFALL MONITORING-PREDICTION SYSTEM AND URBAN HYDROLOGIC OPERATIONS,

F. A. Huff, J. L. Vogel, and S. A. Changnon, Jr.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 419-435, October, 1981. 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Urban hydrology, *Weather forecasting, *Storm water, *Chicago, Illinois, Meteorological data collection, Forecasting, Storm sewers, Rainfall distribution, Rain gages, Radar, Rainfall-runoff relationships, Remote sensing, Combined sewers, Monitoring, Water management.

A 4-year (1975-79) comprehensive hydrometeorological research program carried out in the Chicago metropolitan area was designed to expand the use of meteorological information in the real-time operation of urban hydrological systems to protect people, property, and the environment during moderate to heavy rains. A real-time monitoring-prediction rainfall system was developed. This monitors rainfall from storms crossing the urban area and predicts the rainfall distribution for the upcoming 30, 60, and 120 min. The system employs weather radar and a computer output when necessary. This man-machine combination produced more accurate rain monitoring data (accurate within 0.1 inch 76% of the time) than both unadjusted radar rainfall measurements (48%) and a dense network of recording rain gages (73%). With real-time rainfall data input from the Metropolitan Sanitary District network, predictions by the man-machine combination were accurate to within 0.1 inch 82% of the time. These improvements were most noticeable in heavier rainfall. (Cassar-FRC)
W82-02588

7B. Data Acquisition

AN INITIAL APPLICATION OF POLARIZATION LIDAR FOR OROGRAPHIC CLOUD SEEDING OPERATIONS,

Utah Univ., Salt Lake City. Dept. of Meteorology.
K. Sassen.
Journal of Applied Meteorology, Vol 19, No 3, p 298-304, March, 1980. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Cloud seeding, *Remote sensing, Weather modification, Artificial precipitation, Lidar, Radar, Wasatch Mountains, *Utah.

Preliminary field application was made of polarization lidar in conjunction with commercial cloud seeding operations in the Wasatch Mountains of northern Utah. The lidar system transmits a vertically polarized lasar pulse and measures the returned energy in the planes of polarization both orthogonal and parallel to that of the source. Linear depolarization ratios are derived from the two-channel lidar data displays to characterize the change in the polarization state of the backscattered energy and provide an indication of cloud composition. The use of polarization lidar proved helpful in this study. Background observations of unseeded cloud layers could be obtained through the method to provide better knowledge of local orographic precipitation formation and to determine a measure of cloud ice water balance to aid in the establishment of generalized seeding criteria specific to a mountain barrier. The observed local dependence of cloud ice water balance on cloud top temperature shows support for the less than minus 30 degrees C cloud-top temperature seeding window. The ability to monitor cloud ice water balance can be applied to the real-time seed/no-seed decision. The combined use of radar and lidar data can remove some of the ambiguity in the interpretation of rawinsonde data for the derivation of seeding criteria. Direct observations of the modifications produced by seeding operations can be employed as part of a physical evaluation method to predict snowfall augmentation and targeting. Thus it was concluded that, despite the range limitations of lidar, the application of the remote sensing techniques can make important contributions to orographic cloud seeding operations and research. (Baker-FRC)
W82-02217

SOME MEASUREMENTS ON NEAR SURFACE TURBULENCE IN THE DEPTH DIRECTION AND SOME PHYTOPLANKTON DISTRIBUTION IMPLICATIONS,

Gore and Storrie Ltd., Toronto (Ontario).
M. D. Palmer.
Journal of Great Lakes Research, Vol 7, p 171-181, 1981. 11 Fig, 4 Tab, 26 Ref.

Descriptors: *Turbulent flow, *Phytoplankton, Aquatic plants, Plankton, *Harbors, Surface flow, *Hamilton Harbor, *Toronto Harbor, Diatoms, Surface water, Comparison studies.

Microphysical turbulence measurements taken near the water surface in Hamilton and Toronto harbors are presented along with some concurrent phytoplankton community structure data. The physical turbulence characteristics of the two harbors are compared. Also presented are some measurements of the depth turbulence at 0.5 and 3.0 meters below the water surface for a well stratified, partially stratified, and well-mixed water column in Hamilton Harbor. Concurrent with hot film measurements, horizontal velocity depth profiles were also measured periodically with drogues. Prevailing wind conditions, light attenuation, temperature, and biomass vs. depth were also measured. The light attenuation curves were used to provide data on the photic zone depth. The turbulence structure of the two harbors was different. The depth length scales were estimated to be 3.7 - 5.7 cm and 10.8 - 20 cm in the stratified and well-mixed cases, respectively. Depth dispersion coefficients were estimated to be 4.8 to 8.6 square centimeters per second and 22.7 to 44 square centimeters per second in the stratified and well mixed cases, respectively. In the well mixed case, depth phytoplankton patchiness did not occur. The mean depth patch size for green algae and Cryptomonads showed some relationship with turbulence integral scales and the most predominant periodicities. Greens were a larger portion of the biomass when the length and time scales were small, while diatoms were more prevalent with larger length and time scales. (Baker-FRC)
W82-02227

COMPOSITE SAMPLING OF HIGHWAY RUNOFF,

Brown and Caldwell, Seattle, WA.
D. L. Clark, R. Asplund, J. Ferguson, and B. W. Mar.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 1067-1081, October, 1981. 10 Fig, 4 Tab, 12 Ref.

Descriptors: *Flow measurement, *Highways, Pollutant identification, Composite samples, Runoff, Storm water, Storm runoff, Field tests, Flow rates, Rainfall-runoff relationships, Water measurement, Sampling techniques.

A composite sampler has been developed to collect characteristic samples of storm water runoff from highways. It consists of a rectangular cross section open channel with a flow splitter placed parallel to the direction of flow. The device samples in proportion to the flow rate. The approach to the flow splitting dividers is at a supercritical slope, so that turbulent flow is maintained. This allows suspended solids to be sampled and prevents debris from clogging the flow splitter. The dimensions and materials of construction can be varied to fit the situation. In sampling a 1.22 acre area of Highway I-5 near Seattle, Washington, the equipment was designed to collect 1% of the total flow (about 50 cu ft for 1 incy of rainfall) with a 25 inch wide channel and an initial divider opening of 1 inch to collect 1/25 of the flow. Two additional flow splitting dividers produced the desired 1%. The composite sampling method has several advantages over the discrete sampling method. In addition to lower capital and operating costs and greater accuracy, it requires little attnetion and can be used at remote stations. It is checked only after a storm, when the depth of water is measured, a single sample collected, and a new plastic liner inserted. (Cassar-FRC)
W82-02230

AERIAL PHOTOGRAPHY TO DETECT RILL EROSION,

Washington State Univ., Pullman. Dept. of Agronomy and Soils.
B. E. Frazier, and D. K. McCool.
Transactions of the ASAE, Vol 24, No 5, p 1168-1171, 1176, September-October, 1981. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Erosion, *Remote sensing, Aerial photography, Photography, Infrared imagery, Farming, Rills, Rainfall, *Rill erosion, Palouse region, *Pacific Northwest.

The potential of low-level, large-scale aerial photography coupled with selective ground sampling to identify erosion in the Palouse region of the Pacific Northwest was investigated. A determination was also made as to which film (color or color-infrared) and viewing instruments were most

useful. The Palouse region includes large areas of silty loessial soils on roughly parallel hills with north and east facing slopes of 30 to 45% and south and west facing slopes of 0 to 30%. The climate is characterized by humid winters and dry summers. Most of the precipitation is received as low intensity rain or snow during the winter, when the soil is generally unprotected. Most water-caused erosion occurs between November and April. Implement patterns from chisel plowing, harrowing, double-disk drilling, and combining can be seen in the photographs with the naked eye. Furrow-spacing can be used as an indicator of surface roughness. Rills were the most common erosional features recognizable. These were documentable to various degrees, depending on the instrument used and the scale of photography. The contrast between dry soil and rill shadows was sufficient for easy detection of rills. There was little perceptible contrast in wet areas, making rills there hard to identify. Slope length and steepness can be measured with stereoscopic instruments, and crop management systems as well as some conservation practices may be identified. (Baker-FRC)
W82-02232

CONTINUOUS MONITORING AT MINWORTH WATER RECLAMATION WORKS,

Severn-Trent Water Authority (England).
X. M. V. Snaddon, J. Dee, F. Lax, M. Augustine, and H. Smith.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 1, p 77-92, January, 1980. 7 Fig.

Descriptors: *Monitoring, *Reclaimed water, *Sludge, *Water treatment, *Sewage effluent, *Biodegradation, Activated sludge, Construction materials, Electronic equipment, Biochemical oxygen demand, Organic carbon, Filtration, Water sampling, Calibration, Technology.

Minworth is a large water reclamation works which was used as a test site in an evaluation of the worth of continuous effluent monitoring. Long-term reliability of the monitoring system is limited by the finite life of both the pH and ammonia probes. Information to date indicates that the probes work satisfactorily for at least one month. The life of each probe is determined by the quality of effluent being examined. The system can run satisfactorily for a minimum of a week at a time. It has been in operation for over one year. Data obtained is conveyed to the central control room by a private wire telemetry system. The overall costs and benefits of this test project have not yet been calculated. (Titus-FRC)
W82-02431

A MORE VERSATILE SOIL WATER SAMPLER,

North Central Forest Experiment Station, Grand Rapids, MN.
M. D. Knighton, and D. E. Streblow.
Soil Science Society of America Journal, Vol 45, No 1, p 158-159, January-February, 1981. 1 Fig, 3 Ref.

Descriptors: *Soil water, *Instrumentation, *Sampling, Nutrients, Water quality, Leaching, *Ceramic cup, *Porous cup, Soil solution, Nutrient cycling, Nutrient budget.

The design and fabrication of a new versatile ceramic-cup soil water sampler are described. The new sampler may be installed prior to disruptive plot treatments that would destroy earlier models. The new sampler prevents the reverse flow of collected soil water that otherwise occurs if the soil dries during the sampling interval. In addition, the ceramic cup may be positioned very near the soil surface without the problems of instability that occur with earlier models.
W82-02523

STREAM SYSTEM EVALUATION WITH EMPHASIS ON SPAWNING HABITAT FOR SALMONIDS,

Corvallis Environmental Research Lab., OR.
M. A. Shirazi, and W. K. Seim.
Water Resources Research, Vol 17, No 3, p 592-594, June, 1981. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Spawning, *Fish eggs, *Streambeds, Aquatic habitats, Gravel, Salmon, Trout, Sediments, Ecological effects, Sediment grading, Land use.

A procedure for evaluating sedimentation impact on streambed gravel used for spawning by salmonids is presented. A visual estimation of the gravel composition, considering the requirements of the particular species, helps reduce the number of samples needed. A graph relates the mean diameter of the substrate to the estimated embryo survival. As an illustration, two Orgon creeks were studied: 2 km of Canal Creek (impacted by logging) and 1 km of Rock Creek (in an undisturbed area). The visual survey took two hours per km. Two persons worked an additional four hours each in sampling and field analysis of gravel at each site. Results indicated that 50% of Canal Creek and 20% of Rock Creek were suitable for spawning. Total spawning areas that would support greater than 80% survival are 860 sq m per km for Rock Creek and 160 sq m per km for Canal Creek. (Cassar-FRC)
W82-02552

COMPARISON OF AREAL SNOW STORAGE SAMPLING PROCEDURES FOR RANGELAND WATERSHEDS,

Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2C.
W82-02555

THE EFFECT OF CURRENT ON THE DISTRIBUTION OF DIATOMS SETTLING ON SUBMERGED GLASS SLIDES,

N. Munteanu, and E. J. Maly.
Hydrobiologia, Vol 78, No 3, p 273-282, 1981. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Water currents, *Diatoms, *Distribution patterns, Streams, Algae, Lennoxville, Quebec, Periphyton, Substrates.

Glass slides oriented parallel and perpendicular to the current in a small stream near Lennoxville, Quebec, were submerged for 2-6 weeks to observed diatom growth patterns. Cocconeis placentula, Achnanthes linearis, and A. minutissima were the most abundant of the 98 species identified on the slides. Early colonization took place on the upstream and/or downstream edges of slides placed parallel to the current, followed by growth on the face of the slides. The slides placed perpendicular to the current showed even, random growth of algae. Slides at rocky sites contained more cells at the top edge than slides at muddy sites. The diatoms' preference for upstream and downstream edges on parallel slides is ascribed to current, which probably induces a higher invasion rate and higher reproduction rate. Diagrams illustrate how the slide edges are exposed to microturbulent flow and the increased possibility of algae collision with such a surface compared with the slide surface where laminar flow is present. Light has no apparent effect on spatial preference of diatoms in lotic environments. (Cassar-FRC)
W82-02567

REAL-TIME RAINFALL MONITORING-PREDICTION SYSTEM AND URBAN HYDROLOGIC OPERATIONS,

For primary bibliographic entry see Field 7A.
W82-02588

7C. Evaluation, Processing and Publication

AUTOMATIC CAPTURE AND PROCESSING OF ANALYTICAL DATA IN A WATER INDUSTRY LABORATORY,

Severn-Trent Water Authority, Birmingham (England).
P. J. Morley, P. R. Musty, and J. Cope.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 3, p 256-264, May, 1980. 4 Fig, 4 Tab.

Descriptors: *Water analysis, *Data processing, *Computers, Automation, Pollutant identification, Water quality, Data acquisition.

The Wang 2200C Basic programmable calculator is the basis of an automatic analytical data handling system chosen by the Severn-Trent Water authority laboratory in 1975. The parameters determined by Auto Analyzer are anionic detergent, soluble phosphate, total phosphate, ammonia-N, total N, total oxidized N, nitrate-N, and COD. Other parameters are measured and input manually. The system compares well with manual data evaluation methods in accuracy, giving a mean difference of less than 0.1 at the average concentration of 6.9 mg per liter. A sample reception system was developed to provide a test tracking system and to permit printout of results and management statistics. Use of the computer saves 7 man-hours per work day and reduces human error. (Cassar-FRC)
W82-02207

CURRENT WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN NORTH DAKOTA--FISCAL YEAR 1981.

Geological Survey, Bismarck, ND. Water Resources Div.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $7.00, Microfiche $3.50. Geological Survey Open-File Report 81-923, July, 1981. 50 p, 4 Fig. (Compiled by Martin, C. R., and Albright, L. L.).

Descriptors: *Data collections, *Groundwater, *Water quality, *Surface water, Streamflow, Runoff, Streams, Networks, Aquifers, Regional analysis, Energy, Snow surveys, *North Dakota.

Water-resources studies and investigations in North Dakota made by the U.S. Geological Survey in cooperation with State and Federal agencies are summarized. The investigations include data-collection projects, county groundwater studies, regional water-resource studies, aquifer evaluations, energy-related water-resource studies, and special investigations. The special investigations include snow survey research, groundwater quality sampling technique research and hydrologic response changes on a major stream. (USGS)
W82-02463

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1981,

Geological Survey, Tampa, FL. Water Resources Div.
D. K. Yobbi, W. M. Woodham, and G. R. Schiner.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $1.75, Microfiche $0.50. Geological Survey Open-File Report 81-1006, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, Aquifers, Water table, Wells, Water level fluctuations, Pumping, Irrigation, *Florida, Southwest Florida Water Management.

A May 1981 potentiometric-surface map of the Southwest Florida Water Management District depicts the annual low water-level period. Potentiometric levels decreased 10 to 45 feet between September 1980 and May 1981 in the citrus and farming sections of southern Hillsborough, northern Hardee, southwestern Polk, northwestern DeSoto, and Manatee Counties. Water levels in these areas are widely affected by pumping for irrigation and have the greatest range in fluctuations. Water-level decreases ranged from 0 to 1 feet in coastal, northern, and southern areas of the Water Management District. Water levels in all of the approximate 700 wells measured in May 1981 are lower than May 1980 because of the virtual absence of rainfall in April and May. (USGS)
W82-02464

WATER-RESOURCES INFORMATION FOR THE WITHLACOOCHEE RIVER REGION, WEST-CENTRAL FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-02473

WATER RESOURCES DATA FOR UTAH, WATER YEAR 1979.

Geological Survey, Salt Lake City, UT. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-158981, Price codes: A99 in paper copy ($42.00), A01 in microfiche. Geological Survey Water-Data Report UT-79-1, 1980. 604 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Utah.

Water resources data for the 1979 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 276 gaging stations; stage and contents for 21 lakes and reservoirs; water quality for 64 hydrologic stations, 183 partial-record stations, and 303 wells; and water levels for 36 observation wells. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Utah. (USGS)
W82-02474

HYDROLOGIC MAPS OF OGALLALA AQUIFER, WEST-CENTRAL KANSAS,

Geological Survey, Garden City, KS. Water Resources Div.
L. E. Dunlap, and J. M. Spinazola.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Prices: $18.00 in paper copy, $2.00 in microfiche. Geological Survey Open-File Report 81-098, 1981. 4 Sheets.

Descriptors: *Maps, *Groundwater, *Approximation method, *Mathematical analysis, Hydrologic data, Water distribution, *Groundwater management, Irrigation, Aquifers, Water table, Kriging, *Kansas, Ogallala aquifer, Western Kansas Grundwater Management District No 1.

A mathematical technique, called kriging, was programmed for a computer to interpolate hydrologic data based on a network of measured values in west-central Kansas. The computer program generated estimated values at the center of each 1-mile section in the Western Kansas Groundwater Management District No. 1 and facilitated contouring of selected values that are needed in the effective management of ground water for irrigation. The kriging technique produced objective and reproducible maps that illustrated hydrologic conditions in the Ogallala aquifer, the principal source of water in west-central Kansas. Maps of the aquifer, which use a 3-year average, included the 1978-80 water-table altitudes, which ranged from about 2,580 to 3,720 feet; the 1978-80 saturated thicknesses, which ranged from about 0 to 250 feet; and the percentage changes in saturated thickness from 1950 to 1978-80, which ranged from about a 50-percent increase to a 100-percent decrease. A map showing errors of estimate also was provided as a measure of reliability for the 1978-80 water-table altitudes. Errors of estimate ranged from 2 to 24 feet. (USGS)
W82-02475

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, ST. JOHN'S RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, MAY 1981,

Geological Survey, Orlando, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $3.50, Microfiche $0.50. Geological Survey Open-File Report 81-1052, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Pumping, Geohydrology, *Florida, East-central Florida, St. Johns River Water Management District.

This map presents the potentiometric surface of the Floridan aquifer in the St. Johns River Water Management District and vicinity for May 1981. The Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made in approximately 1,000 wells and at several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area 20 and 40-foot intervals are used to show a deep cone of depression. The potentiometric surface ranged from 122 feet above NGVD (National Geodetic Vertical Datum of 1929) in Polk County to 125 feet below NGVD in Nassau County. Water levels were at record lows in many counties due to lack of rainfall. Declines were as much as 10 feet and commonly 5 feet from the May 1980 levels. (USGS)
W82-02479

WATER RESOURCES OF THE KISATCHIE WELL-FIELD AREA NEAR ALEXANDRIA, LOUISIANA,

Geological Survey, Alexandria, LA. Water Resources Div.
J. E. Rogers.
Louisiana Department of Transportation and Development. Office of Public Works Water Resources Technical Report No 26, 1981. 57 p, 7 Fig, 6 Plates, 11 Tab, 35 Ref.

Descriptors: *Groundwater, *Permeability, *Transmissivity, *Specific capacity, *Water yield, Water quality, Surface-groundwater relations, Aquifer characteristics, Aquifer testing, Water level, Wells, Infiltration, Base flow, Evapotranspiration, Chemical analysis, Hydrologic data, *Louisiana, Alexandria, Rapides Parish, Kisatchie Forest.

Sands of Miocene, Pliocene, and Pleistocene age contain freshwater in central Rapides Parish, La. In this area the base of fresh ground water ranges from 900 feet to more than 2,500 feet below National Geodetic Vertical Datum of 1929. Hydraulic conductivity of the aquifers ranges from 20 to 200 feet per day, and storage coefficient ranges from 0.0001 to 0.2. Production of water from the Kisatchie well field has been as high as 25 million gallons per day for municipal and industrial uses. The 35 wells (90-2,078 feet deep) that produce the water have yields ranging from 190 to 1,100 gallons per minute. Specific capacities range from 1.3 to 46.5 gallons per minute per foot of drawdown. Water from these wells is soft and low in dissolved solids. The pH of water from the deeper wells is greater than 7; that of water from the shallow wells is lower than 7. Additional water can be produced from the aquifers in the project area or from Spring Creek and the Calcasieu River, which have high base flow sustained by outflow from the Pleistocene deposits. The streams are an alternate source rather than an additional source of water. (USGS)
W82-02480

ESTIMATED WATER USE IN THE SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT AND ADJACENT AREAS, 1980,

Geological Survey, Tallahassee, FL. Water Resources Div.
A. D. Duerr, and J. T. Trommer.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $8.25, Microfiche $3.50. Geological Survey Open-File Report 81-1060, 1981. 60 p, 26 Fig, 7 Tab, 17 Ref.

Descriptors: *Water use, *Data collections, *Water management, *Water demand, Groundwater, Surface water, Water supply, Municipal water, Industrial water, Irrigation water, Withdrawal, Saline water, *Florida, Southwest Florida Management District.

Water-use data for 1980 are summarized in this report for 16 counties in the Southwest Florida Water Management District. Data include total use of ground water and surface water for each of five water-use categories. The 1980 withdrawals for each category were as follows: 290 million gallons per day for public supply, 63 million gallons per day for rural, 325 million gallons per day for industry, 416 million gallons per day for irrigation, and 6,605 million gallons per day for thermoelectric power generation. Withdrawals totaled 7,699 million gallons per day and included 983 million gallons per day of ground water and 6,716 million gallons per day of surface water. Excluding thermoelectric power generation, all water withdrawn was freshwater except 38 million gallons per day of saline ground water withdrawn for industrial use in Hillsborough County. (USGS)
W82-02482

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN MISSOURI--FISCAL YEAR 1981.

Geological Survey, Rolla, MO. Water Resources Div.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $8.00, Microfiche $3.50. Geological Survey Open-File Report 81-683, August, 1981. 60 p, 2 Fig. (Compiled by Kratzer, W. M.).

Descriptors: *Water quality, *Surface water, *Groundwater, *Data collections, Sites, Publications, Bibliographies, Hydrologic data, Networks, Gaging stations, Crest gages, Low flow, Urban runoff, Reviews, *Missouri.

Water-resources investigations of the U.S. Geological Survey in Missouri consist of collecting hydrologic data and making interpretative investigations. The data and the results of the investigations are published or released by either the U.S. Geological Survey or by cooperating agencies. The report describes the data-collection activities and investigations in Missouri for the 1981 fiscal year and provides an extensive list of water-resources references for the State. (USGS)
W82-02488

WATER-QUALITY RECONNAISSANCE OF THE LARKIN CREEK WATERSHED, LEE AND ST. FRANCIS COUNTIES, ARKANSAS,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-02489

SELECTED HYDROGEOLOGIC DATA FROM THE JUDITH BASIN, CENTRAL MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
J. F. Levings, and K. A. Dodge.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $14.25, Microfiche $4.00. Geological Survey Open-File Report 81-1015, September, 1981. 98 p, 2 Fig, 1 Plate, 5 Tab, 6 Ref.

Descriptors: *Groundwater, *Water quality, *Data collections, *Geohydrology, Aquifers, Wells, Springs, Well logs, Water sampling, Chemical analysis, Sites, Maps, *Central Montana, Judith basin, Great Plains.

Selected hydrogeologic data from the Judith basin, central Montana, have been compiled for use as the physical basis of a ground-water model prepared as part of a 4-year study of Cenozoic and Mesozoic aquifers of the northern Great Plains area of Montana. Records of Cenozoic and Mesozoic aquifers of the northern Great Plains area of Montana. Records of 1,124 wells and 640 springs are tabulated in the report; most of these data have been collected since 1959. Lithologic logs of 68 wells are also included. Chemical data for wells and

springs include 290 water samples analyzed for major cation and anion concentrations and 282 water samples analyzed for miscellaneous-constituent concentrations. The locations of wells and springs listed in the report are shown on a map at a scale of 1:250,000. (USGS)
W82-02490

ALTITUDE OF THE WATER TABLE IN THE ALLUVIAL AND OTHER SHALLOW AQUIFERS ALONG THE COLORADO RIVER NEAR LA GRANGE, TEXAS, DECEMBER 1980,

Geological Survey, Austin, TX. Water Resources Div.
P. Rettman.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Prices: $1.00 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-1063, September, 1981. 1 Sheet, 1 Ref.

Descriptors: *Water table, *Maps, *Aquifers, Contours, Water level, Springs, Wells, Water yield, Groundwater movement, *Texas, La Grange, Colorado River.

The water-table contours on this map were constructed from water-level control derived from an inventory of springs and wells in the area, U.S. Geological Survey topographic maps, and from data presented by Rogers (1967). Because of the available water-level control and the rough terrain throughout the area, the delineation of the water table was limited to 20-foot contour intervals. On the basis of recent river-stage and precipitation records, this delineation should represent near or slightly below average conditions. In addition to the alluvium, several other geologic formations crop out in the areas. These formations are capable of producing small to large quantities of water to wells, but the current (1981) pumping demand is small. The pressure heads in each of these formations appear to be in continuity, and the contours indicate that no barriers restrict ground-water movement from one formation to another. Several water-producing horizons may be present at many locations. The water-table map was constructed by using the head in the horizon that is nearest the land surface. The configuration of the water table closely approximates the topography. The water table slopes from the highland areas toward the Colorado River and small creeks. The delineation of the water table in the alluvium of the Colorado River is fairly well defined, and 10-feet contour intervals may be interpreted with confidence in the area called 'potential lignite-mining area.' The water table in the bedrock aquifers is more difficult to delineate with the available data; therefore, the contours are only estimates of the position of the water table in the hilly bedrock area adjacent to the Colorado River alluvium. (USGS)
W82-02491

WATER RESOURCES DATA FOR INDIANA, WATER YEAR 1980.

Geological Survey, Indianapolis, IN. Water Resources Div.
Geological Survey Water-Data Report IN-80-1, June, 1981. 416 p, 4 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collection, Sites, *Indiana.

Water resources data for the 1980 water year for Indiana consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 185 gaging stations, stage and contents for 12 lakes and reservoirs, releases from 6 flood-control reservoirs, water quality for 51 gaging stations, and water levels for 79 observation wells. Also included are 97 crest-stage partial-record stations and 69 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Indiana. (USGS)
W82-02492

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 4. NORTHWEST FLORIDA.

Geological Survey, Tallahassee, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-136128, Price codes: $48.00 in paper copy, A01 in microfiche. Geological Survey Water-Data Report FL-80-4, August, 1981. 697 p, 46 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Florida, *Northwest Florida.

Water resources data for the 1980 water year in Florida consists of continuous or daily discharge for 271 streams, periodic discharge for 47 streams, continuous or daily stage for 67 streams, periodic stage for 49 streams, peak discharge for 76 streams and peak stage for 23 streams; continuous or daily elevations for 75 lakes, periodic elevations for 128 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; quality of water data for 301 surface water sites and 842 wells. The data for northwest Florida include continuous or daily discharge for 64 streams, periodic discharge for 18 streams, peak discharge for 36 streams, and continuous or daily stage for 4 streams; continuous elevations for 4 lakes and periodic elevations for 18 lakes; continuous ground water levels for 40 wells, periodic ground water levels for 115 wells, and miscellaneous water level measurements for 295 wells; and quality of water for 36 surface water sites and for 113 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-02493

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1980--VOLUME 3. OHIO RIVER AND ST. LAWRENCE RIVER BASINS.

Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142688, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-80-3, October, 1981. 304 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, Ohio River basin, St. Lawrence River basin.

Water resources data for the 1980 water year for Pennsylvania consist of records of discharge and water quality of streams; elevation and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 82 gaging stations, elevations and contents at 22 lakes and reservoirs, water quality at 28 gaging stations, and water levels as 20 observation wells. Also included are data for 11 crest-stage, 11 low-flow, and 322 water-quality partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program ard are published as miscellaneous measurements and analyses. These data together with the data in Volumes 1 and 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W82-02494

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1980--VOLUME 2. GREEN RIVER BASIN, BEAR RIVER BASIN, AND SNAKE RIVER BASIN.

Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-154337, Price codes: A09 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WY-80-2, 1981. 269 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Wyoming, Green River basin, Bear River basin, Snake River basin.

Water resources data for the 1980 water year for Wyoming consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. Volume 2 of this report contains discharge records for 62 gaging stations, stage and contents for 3 lakes and reservoirs, water quality for 38 gaging stations and 20 ungaged stations, and water levels for 7 observation wells. Also included are 24 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (USGS)
W82-02495

WATER RESOURCES DATA FOR MINNESOTA, WATER YEAR 1980--VOLUME 1. GREAT LAKES AND SOURIS-RED-RAINY RIVER BASINS.

Geological Survey, St. Paul, MN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-130485, Price codes: A11 in paper copy, A01 in microfiche. Geological Survey Water-Data Report MN-80-1, August, 1981. 234 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Minnesota, Great Lakes basin, Souris-Red-Rainy River basin.

Water-resources data for the 1980 water year for Minnesota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume contains discharge records for 54 gaging stations; stage-only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 9 gaging stations, 1 stage station, 14 partial-record lake stations, and 5 wells; and water levels for 45 observation wells. Also included are 51 high-flow partial-record stations and 86 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data, together with the data in Volume 2, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota. (USGS)
W82-02496

WATER RESOURCES DATA FOR MINNESOTA, WATER YEAR 1980--VOLUME 2. UPPER MISSISSIPPI AND MISSOURI RIVER BASINS.

Geological Survey, St. Paul, MN. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-130493, Price codes: A19 in paper copy, A01 in microfiche. Geological Survey Water-Data Report MN-80-2, August, 1981. 435 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Minnesota, Mississippi River basin, Missouri River basin.

Water-resources data for the 1980 water year for Minnesota consist of records of stage, discharge, water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume contains discharge records for 66 gaging stations; stage and contents for 8 lakes and reservoirs; water quality for 35 stream stations, 3 partial-record stream stations, 1 partial-record lake station, and 67 wells; and water levels for 255 observation wells. Also included are 112 high-flow partial record stations and 181 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data, together with the data in Volume 1, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota. (USGS)
W82-02497

WATER RESOURCES DATA FOR NEW MEXICO, WATER YEAR 1980.

Geological Survey, Albuquerque, NM. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-148206, Price codes: A99 in paper copy ($46.50), A01 in microfiche. Geological Survey Water-Data Report NM-80-1, 1981. 679 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *New Mexico.

Water resources data for the 1980 water year for New Mexico consist of records of discharge and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 226 gaging stations, stage and contents for 24 lakes and reservoirs, water quality for 91 gaging stations and 97 observation wells. Also included are 138 crest-stage partial-record stations. Additional water data were collected at various sites, not involved in the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in New Mexico. (USGS)
W82-02498

WATER RESOURCES DATA FOR KENTUCKY, WATER YEAR 1979.

Geological Survey, Louisville, KY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-145053, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report KY-79-1, 1980. 582 p, 6 Fig, 3 Tab, 7 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Kentucky.

Water resources data for the 1979 water year for Kentucky consist of records of stage, discharge, and water quality of streams; stage and contents of lakes; and water levels and water quality of wells and springs. This report contains discharge records from 112 gaging stations; stage and contents for 15 lakes; water-quality for 39 stations; suspended-sediment data for 43 stations (6 daily); daily temperature for 35 stations; daily specific conductance for 23 stations; ground water levels for 70 recording, 117 partial, and 1 flowing well; water-quality data from 225 coal hydrology sites (27 partial, 198 miscellaneous), 4 springs and 29 wells; and miscellaneous temperature and specific conductance data from the 114 gaging stations. Also included are data for 124 partial-record crest-stage and 91 partial-record low-flow sites. Data collected at various miscellaneous sites is also published. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Kentucky. (USGS)
W82-02499

HYDROLOGIC RECONNAISSANCE OF THE WASATCH PLATEAU-BOOK CLIFFS COAL-FIELDS AREA, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
K. M. Waddell, P. K. Contratto, C. T. Sumsion, and J. Butler.
Geological Survey Water-Supply Paper 2068, 1981. 45 p, 10 Fig, 9 Plates, 8 Tab, 19 Ref.

Descriptors: *Hydrologic data, *Maps, *Coal mines, *Groundwater, *Surface water, *Water quality, Geology, Precipitation, Evaporation, Streamflow, Stream discharge, Water temperature, Monitoring, Low flow, Dissolved solids, Springs, Wells, Water analysis, Chemical analysis, *Utah, Wasatch Plateau, Book Cliffs, Coal fields.

Data obtained during a hydrologic reconnaissance in 1975-77 in the Wasatch Plateau-Book Cliffs coal area of Utah were correlated with existing long-term data. Maps were prepared showing average precipitation, average streamflow, stream temperature, ground- and surface-water quality, sediment yield, and geology. Recommendations were made for suggested approaches for continued monitoring in the coal areas. During the 1931-75 water years, the minimum discharges for the five major streams that head in the area ranged from about 12,000 to 26,000 acre-feet per year, and the maximum discharges ranged from about 59,000 to 315,000 acre-feet per year. Correlations indicate that 3 years of low-flow records at stream sites in the Wasatch Plateau would allow the development of relationships with long-term sites that can be used to estimate future low-flow records within a standard error of about 20 percent. Most water-quality degradation in streams occurs along the flanks of the Wasatch Plateau and Book Cliffs. In the uplands, dissolved-solids concentrations generally ranged from less than 100 to about 250 mg/L (milligrams per liter), and in the lowlands the concentrations ranged from about 250 to more than 6,000 mg/L. Most springs in the Wasatch Plateau and Book Cliffs discharge from the Star Point Sandstone or younger formations, and the water generally contains less than about 1,000 mg/L of dissolved solids. The discharges of 65 springs ranged from about 2.0 to 2000 gallons per minute. The Blackhawk Formation, which is the principal coalbearing formation, produces water in many of the mines. The dissolved-solids concentration in water discharging from springs and mines in the Blackhawk ranged from about 60 to 800 mg/L. (USGS)
W82-02500

WATER QUALITY DATA, MACKENZIE RIVER BASIN 1960-1979.

Inland Waters Directorate, Ottawa (Ontario). Water Quality Branch.
Report prepared for the Mackenzie River Basin Committee, 1981, 1081 p.

Descriptors: *Water quality, *Data collections, *Water analyses, Turbidity, Physical parameters, Alkalinity, Major ions, Numerical index, Nutrients. Metals, Percentiles, *Mackenzie River Basin, Athabasca River, NAQUADAT, Peace River, Color, Alberta, British Columbia.

The water quality data presented in this repot have been collected from federal agencies and the provinces of Alberta and British Columbia. The provincial data were reformatted to be compatible with the federal data on the NAQUADAT system. The computerized National Water Quality Data Bank (NAQUADAT) is a repository for water quality information which includes chemical, physical, biological and hydrometric data for surface water, groundwater, wastewater and precipitation. Analytical methods used by the provincial agencies were compared with the analytical procedures described in the NAQUADAT Dictionary. This report presents summary data of water quality samples collected from 1960 to 1979. Since many stations were not sampled for the entire period, the sampling period (period of record) is indicated for each individual station. The data summary is organized according to the seven major sub-basins of the Mackenzie River Basin, namely: (1) Athabasca River Drainage, (2) Peace River Drainage, (3) Liard River Drainage, (4) Hay River Drainage, (5) Great Slave Lake Drainage, (6) Great Bear Lake Drainage, (7) Mackenzie River Drainage. (WATDOC)
W82-02506

GROUND WATER IN WASHINGTON,

Washington State Univ., Pullman. Water Research Center.
For primary bibliographic entry see Field 2F.
W82-02536

THE USE OF GEOLOGIC, HYDROLOGIC, AND GEOCHEMICAL MAPPING TECHNIQUES IN ENVIRONMENTAL ASSESSMENT,

C. J. Coe.
Ground Water, Vol 19, No 6, p 626-634, November/December, 1981. 14 Fig, 13 Ref.

Descriptors: *Environmental effects, *Coal mining, *Mapping, Mining engineering, Manganese, Iron, Sulfate, Hydrogen ion concentration, Specific conductivity, Water quality, Path of pollutats, Groundwater movemant, Water pollution effects, Drainage, Mine drainage, Hydrologic maps, Geologic mapping, Subsurface mapping, Topographic mapping, Water level, Wells, Dewatering, Dry wells, Overburden, Acidic water, Economic aspects, Legal aspects.

The environmental and economic impacts of mining can be described before, during, and after operations by using three types of maps: geologic, hydrologic, and geochemical. Geologic maps include cross-section (to define ore veins, aquifers, water-bearing zones, perched water tables, recharge areas, and groundwater movement) and structure contour maps. Static water level maps determine the configuration and transmissivity of the groundwater table. Isoconcentration maps for the desired water quality parameters define the extent of concentration fields, point source locations, and concentration gradients. Considered in tis paper are sulfate, Mn, Fe, pH, and specific conductance. Two Appalachian coal mine sites are given as illustrations. In the first case, the maps showed the location and extent of the coal seams and water bearing zones. Toxic and non-toxic strata were identified. Three groups of people complained that mining had dewatered their wells. The maps helped show that in two locations well levels were lowered by too close spacing in a new development and by new municipal wells. However, mining activities were responsible for well dewatering along the northern area of the mining site. These wells were located on a perched water table. It was predicted that as mining progresses to the east, more residents would lose their water supplies. In the second case groundwater movement was very complex, beng partially affected by previous surface mining. The isoconcentration maps helped define water quality as affected by mining activities. (Cassar-FRC)
W82-02546

8. ENGINEERING WORKS

8A. Structures

PASSING FLOODWATERS OVER EMBANKMENT DAMS,

Moskovskii Inzhenerno-Fizicheskii Inst. (USSR). Dynamics Lab.
Y. P. Pravidivets, and S. M. Slissky.
International Water Power and Dam Construction, Vol 33, No 7, p 30-32, July, 1981. 2 Fig, 13 Ref.

Descriptors: *Dam construction, *Floodwater, Flood control, Cofferdams, Earth dams, Flooding, *Spillways, Overflow channels, Embankments.

A specially developed facing which allows flood waters to be passed over the face of an earth dam has been found to considerably reduce the costs of embankment dam construction. To provide stability and to protect the dam faces against erosion, riprap, wire mesh, anchored beams, or concrete slabs are used. There have been some cases where unit discharges over protected low-head embankments were as large as 40-70 cubic meters/sec/meter. With the increase of embankment height, the unit discharge over rockfill dams decreases. Protecting the slopes with packed edge-to-edge concrete cubes increases the unit discharge over an embankment structure by up to 2.5-3 times as compared with facing with crushed rock of the same size and specific gravity. Substantial economic advantages have been achieved using precast reinforced concrete wedge-shaped slabs with drainage holes as protective facing. The presence of additional hydrodynamic force on the upper slab surface brought about almost 3-5 times the reduction of the slab thickness, compared with concrete cubes of the same size. A spillway of limited width built in the river channel section of the dam has been developed which allows dimping to continue in the rest of the dam during the flood. The underlying drainage filter, drain holes, their dimensions and spacing play a substantial part in providing the stability of the slabs. The drain holes in the slabs are round and 4-5 cm in diameter, but not larger than the uppermost grain size of the filter material. The stepped toe of the spillway chute protects the embankment dam from erosion and provides the surface type conjunction of the jet and the tailwater. (Baker-FRC)
W82-02204

USE OF HORIZONTAL DRAINS: CASE HISTORIES FROM THE COLORADO DIVISION OF HIGHWAYS,

R. K. Barrett.
Transportation Research Record, No 783, p 20-25, 1980. 5 Fig, 4 Ref.

Descriptors: Drains, *Highway effects, *Case studies, *Drainage, *Drilling, Highways, Drain practices, Drain spacing, Drilling equipment, *Subsurface drainage, Controlled drainage, Interstitial water, Pipes, Erosion, Soil stability, Construction methods, *Drainage engineering, Colorado.

Four case histories of horizontal drains installed on Interstate 70 in the Vail, Colorado vicinity are described. In the first case, horizontal drains were used as a postconstruction alternative to a deep underdrain trench that would have cut across the roadway. In the second case, horizontal drains were used to improve drainage behind a cut slope. At the third site, horizontal drains were used to improve slope stability prior to construction of a major reinforced-earth wall. Two series of holes were drilled. Water levels were reduced to about 17 m below the ground surface. At the fourth site, the drains were used for correction of a major cut-slope failure that occurred during construction. In every case, horizontal drains contributed to the successful completion of construction, at a lower cost than many of the alternative methods of correcting for soil instability. (Titus-FRC)
W82-02211

LONG TERM PERFORMANCE OF HORIZONTAL DRAINS,

D. D. Smith.
Transportation Research Record, No 783, p 39-45, 1980. 10 Fig, 2 Tab, 1 Ref.

Descriptors: Drains, *Highway effects, Case studies, *Drainage, Drilling, Highways, Drain practices, Drain spacing, Drilling equipment, Subsurface drainage, Controlled drainage, Interstitial water, *Pipes, Erosion, Soil stability, Construction methods, *Drainage engineering.

Major factors that influence the performance of horizontal drains are discussed. These include location and installation methods, the frequency and quality of inspections, cleaning and maintenance programs, the types of casing used, the lithologic characteristics of the site, the pH and mineral content of the groundwater, and the protective measures necessary to preserve external features such as outlets and collector systems. The long-term performance of three drainage projects is evaluated. After 20 years, major problems encountered with the drains were rusted pipes, root growth, and the sloughing of weathered slopes which buried the outlets. (Titus-FRC)
W82-02212

MISSISSIPPI'S EXPERIENCE WITH HORIZONTALLY DRILLED DRAINS AND CONDUITS IN SOIL,

W. T. Ruff.
Transportation Research Record, No 783, p 35-38, 1980. 6 Fig, 2 Ref.

Descriptors: *Conduits, *Landslides, *Highway effects, *Case studies, *Drainage, Drilling, Trench drains, Highways, Drain practices, Drain spacing, Drilling equipment, Subsurface drainage, Controlled drainage, Interstitial water, Pipes, Erosion, Soil stability, Construction methods, *Drainage engineering, Mississippi.

The experience of the Mississippi Highway Department in accomplishing subsurface drainage by using horizontally drilled drains and conduits is described. Horizontal drilling plans were found to be more flexible and less risky than excavation plans. Alterations in a drilling plan can be made without affecting the completed portions. At one site, large-diameter interconnecting vertically-drilled shafts were constructed to create a drainable reservoir in a deep irregular formation. These were installed for forty percent of the cost of a braced excavation. At a second site, long horizontally drilled perforated drains were used to reduce the water table in an active landslide. Some of the major deficiencies with this technique include difficulty of maintaining a desired slope and the problem of clogged drains. (Titus-FRC)
W82-02213

ROCKWOOD EMBANKMENT SLIDE BETWEEN STATIONS 2001+00 AND 2018+00: A HORIZONTAL DRAIN CASE HISTORY,

W. D. Trolinger.
Transportation Research Record, No 783, p 26-30, 1980. 1 Tab.

Descriptors: *Embankments, *Water table, *Highway effects, *Case studies, *Drainage, Drilling, Trench drains, Highways, Drain practices, Drain spacing, Drilling equipment, Subsurface drainage, Controlled drainage, Interstitial water, Pipes, Erosion, Soil stability, Construction methods, *Drainage engineering, Tennessee.

Horizontal drains were installed along a highway construction site to alleviate the soil instability which produced frequent landslides on Interstate 40 in Tennessee. Areas with perched water table and zones of deep failure were located with the aid of piezometers. Horizontal drains were installed along the toe of the embankment. Vertical movement at the scarp has been reduced from 152-203 mm per year to 7.5 mm per year. (Titus-FRC)
W82-02214

HORIZONTAL DRAINS AND HORIZONTAL DRILLING: AN OVERVIEW,

D. L. Royster.
Transportation Research Record, No 783, p 16-20, 1980. 5 Fig, 10 Ref.

Descriptors: Drain practices, *Drain spacing, Drilling, *Interstitial water, *Pipes, Drainage, Drains, Drilling equipment, *Subsurface drainage, Controlled drainage, Water transport, Erosion, Soil stability, Construction equipment, Construction methods, *Drainage engineering.

The use of horizontal drains to remove subsurface water is reviewed. Development of polyvinyl chloride pipe, improvements in drill bits and drill stem, and the development of drilling machines capable of producing high thrust and torque have made subsurface drainage a significant and economical alternative in the repair and prevention of some types of landslides. Little is known about the effectiveness of horizontal drains in various geologic materials or about the capabilities of the drilling equipment. Use of horizontal drains is more frequent in the western region of the United States. (Titus-FRC)
W82-02215

SURFACE WATER HYDROLOGIC CRITERIA FOR URANIUM MINE TAILINGS IMPOUNDMENTS IN ONTARIO,

MacLaren (James F.) Ltd., Willowdale (Ontario).
For primary bibliographic entry see Field 5E.
W82-02240

LOOP EQUATIONS WITH UNKNOWN PIPE CHARACTERISTICS,

IBM Scientific Center, Haifa (Israel).
For primary bibliographic entry see Field 3F.
W82-02258

42-MILE WATER PIPELINE FOR COAL BOOM TOWN.

For primary bibliographic entry see Field 6D.
W82-02359

FIELD STUDIES OF THE TEMPERATURE REGIME AND STRESS STATE OF THE CONCRETE IN ARCH DAMS SUBJECTED TO VARIOUS METHODS OF COOLING,

I. F. Blinov, Yu. P. Shaikin, and I. R. Gal'perin.
Hydrotechnical Construction, No 1, p 19-23, January, 1980. 2 Fig, 2 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 12-15, January, 1980.

Descriptors: *Concrete technology, *Arch dams, Construction, Construction methods, Cooling, *Temperature effects, Dams, Concrete testing, Stress analysis.

During the planning stages of dam construction, the temperature requirements for the concreting of blocks are determined so that the negative effect of temperature deformations can be reduced and the appearance of thermal cracks eliminated. The temperature-stress state of concrete blocks depends on the temperature regime, the physicomechanical characteristics of the concrete, the dimensions of the block, the ratio of the elastic moduli of the elastic moduli of the block concrete and foundation bed, and additional factors. The Kasseb Dam in Tunis and the Mansur Eddakhbi Dam in Morocco are provided with monitoring and measuring instruments to study the temperature regime and deformations of the concrete in the blocks and to investigate their stress-strain state due to live loads. According to design requirements the maximum temperature of the concrete blocks in the rock zone should not exceed 36 degrees C for the Kasseb Dam or 32 degrees C for the Mansur Dam. Concrete at both dams was cooled by the continuous surface spraying of the horizontal and lateral faces, while concrete in the Mansur Dam was cooled additionally using tubes in which water cooled to 10-13 degrees C was circulated. Chilled water was also used in batching the concrete. The large differences in the structural parameters of the two dams and in the climatic conditions under which they were constructed made it possible to compare the strains of the concrete cooled by various methods such as surface spraying or tube cooling. Analysis of the data made it possible to conclude the feasibility of constructing arch dams with the parameters under consideration without use of tube cooling of the concrete in a hot climate where certain requirements are met. (Baker-FRC)
W82-02387

HIGH-HEAD VERTICAL LIFT GATES,

K. I. Mel'nichenko.

Hydrotechnical Construction, No 3, p 237-240, March, 1980. 3 Fig, 1 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 3, p 16-18, March, 1980.

Descriptors: *Gates, *Hydroelectric plants, Powerplants, Spillway gates, Dams, Hydraulic gates, Construction, *Design criteria.

A caterpillar gate with a span of 3.5 meters and height of 9.0 meters was constructed for a head of 120 meters at the Nurek hydroelectric station. Use of such gates can improve the layout, reduce the cost, and increase the reliability of hydroelectric plants, especially plants of the Nurek or Rogun type, where construction involves the driving of numerous tunnels during the entire construction period. Much has been accomplished in recent studies concerning the creation of high-head vertical lift gates, as a result of which it was possible to use them in the large construction at Nurek hydroelectric. A qualitatively new approach in the manufacture and assembly of these gates was required. Means and resources must not be dispersed for the creation of numerous new types of gates. Careful study must be made in each instance to determine which type is the best. The emergency-guard ring-follower gate of the spillway of the Inguri hydroestation should be considered the most reliable and most perfect of the gates designed by special designs departments in this area. The gate is suitable for use in conduits in both the construction and operating periods. (Baker-FRC)
W82-02388

FLEXIBLE OUTFALL AT ALDEBURGH,
Anglian Water Authority (England).
A. L. Davis.
Effluent and Water Treatment Journal, Vol 20, No 7, p 338-340, 342, July, 1980. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Outfall sewers, *Flexibility, *Pipes, Underwater, Wastewater disposal, Design criteria, *Aldeburgh, *England, Costs.

A flexible sewage sea outfall was designed and installed at Aldeburgh, Suffolk, a town whose population ranges from 3500 to 5000 depending on the season. The pipe, constructed of high density polyethylene with layers of cotton tape, steel tape, polyvinyl chloride tape, galvanized steel wires, jute and asphalt, and an outside coat of helical-wound, asphalt-coated 2 mm steel wires, has a 202 mm internal diameter and is 1.3 km long. The discharge point is 10-12 meters deep and in a relatively level area of the sea bed. There are two diffusers, each 125 mm in diameter. Modeling pollution data revealed that the probable E. coli count would be 900 per 100 ml when the sewage field was under the influence of strong on-shore winds. Float tests indicated that beaching of floats may occur upon release of sewage shortly before a combination of high tide and easterly on-shore winds. Costs of pipe supply, laying, and burial were 250,000 pounds sterling, or 192 pounds sterling per meter. (Cassar-FRC)
W82-02415

SKI-JUMP SPILLWAY FOR INDIA'S UKAI DAM,
Central Designs Organisation, Gujarat State (India). Irrigation Dept.
V. N. Kulkarni, and I. C. Patel.
International Water Power and Dam Construction, Vol 33, No 9, p 44-48, September, 1981. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Dams, *Spillways, Overflow channels, Construction methods, *Ukai dam, *India, Scour, Erosion, *Performance evaluation.

The Ukai earth dam across the Tapi River in Gujarat, India, has a masonry spillway and incorporates a powerhouse. The dam is part of a multipurpose scheme designed to provide irrigation, flood control and 300 MV of hydropower. The spillway with 22 radial gates is on the left bank of the river. The discharge rate of the spillway is about 97.6 cubic meters/second/meter. The occurrence of Deccan traps in the impact area and the availability of a standing pool of water created by the Kalkrapar weir 30 kilometers downstream favored the provision of a ski-jump type of bucket rather than a stilling basin. The spillway has been in operation since 1971. The maximum scour, about 29 meters deep, was noted in the tail channel opposite spillway gates 8, 9, and 10, and more scour about 12 meters deep was noted downstream of spillway gates 18 and 19. The pattern is being watched; it now appears to be stabilizing, so that no further scour or retrogression is anticipated that might need large-scale protective measures. Model studies of the erosion of rock from the impact area of the ski-jump were performed. It is believed that the mobile bed consisting of sand or gravel effectively represented the rocky condition found at the site. The benefit of the ski-jump as opposed to stilling basins or roller buckets is that with the ski-jump, erosion takes place away from the structure. Considering the usual tendency of the scour pocket to form away from the dam, the performance of the bucket thus far is rated satisfactory. (Baker-FRC)
W82-02430

8B. Hydraulics

TURBULENCE MODEL FOR FLOW OVER DREDGED CHANNELS,
Thessaloniki Univ., Salonika (Greece). Dept. of Hydraulics.
C. Koutitas, and B. O'Connor.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY8, p 989-1002, August, 1981. 12 Fig, 11 Ref.

Descriptors: *Turbulent flow, *Channels, *Flow characteristics, Model studies, Dredging, Silting, Sediment transport, Computer models.

Computer methods were used to reproduce flow and mixing patterns in a steep-sided channel dredged at right angles to the main direction of flow and sediment transport. The mixed finite-difference/finite-element method was acceptable for modeling both uniform and nonuniform steady flows. These computer methods, based on fundamental flow equations, used a hydrostatic pressure approximation, which worked better where main flow was nearly horizontal than where flow converged and was more vertical. The method can be used either with mixing length models or with one-equation turbulence models. The one-equation turbulence model produced a better fit to laboratory data and obviated the problem of singular kinematic eddy viscosity values. (Cassar-FRC)
W82-02201

VELOCITY PROFILES WITH SUSPENDED SEDIMENT,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W82-02581

8C. Hydraulic Machinery

HYDRAULIC GATES,
J. Lewin.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 3, p 237-255, May, 1980. 9 Fig, 1 Tab, 51 Ref.

Descriptors: *Hydraulic gates, *Design criteria, *Radial gates, Gates, Bibliographies, Reviews, Roller gates, Spillway gates, Sluice gates, Ice, Vibrations, Seals, Control system.

This paper summarizes design aspects of low head and vertical lift hydraulic gates, commonly used in rivers, canals, and reservoir spillways. Radial gates are actuated by the water level upstream or downstream of the gate. Forces exerted on the gate by changes in the displacers in each side pier cause the gate to open and close. Vertical lift gates are usually of the fixed roller type, with either side guide rollers or water lubricated slippers to provide transverse stability. Bottom hinged flap gates are used to prevent intrusion of saline water into a fresh water course. Design of bottom and side seals is important to prevent excess leakage and interference of debris. Design considerations discussed are coefficient of discharge (0.3-0.6 for submerged discharge and 0.5 to 0.7 for free discharge), jet contraction coefficient for the discharge under a vertical flat sluice gate, hydraulic downpull forces, guide roller grooves, structural analysis to avoid vibrations, and methods of removing debris and ice. Operating machinery is described. Seals for top, bottom, and sides of the gates are of many types: bulb seals in the shape of musical notes (usually solid), L-shaped seals (used in one-plane movement), double-stem or center bulb seals (for face contact and sealing the top edge of submerged vertical lift gates and radial culvert gates), vibrations--preventing self-exciting vibrations, reduction of the rate of self-control and sufficient structural strength and rigidity to withstand the hydrodynamic load. (Cassar-FRC)
W82-02206

8D. Soil Mechanics

THE STEADY STATE OF DEFORMATION,
Geothechnical Engineers Inc., Winchester, MA.
S. J. Poulos.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT5, p 553-562, May, 1981. 2 Fig, 15 Ref.

Descriptors: *Deformation, *Soil properties, Soil mechanics, Soil horizons, Soil profiles, Soil dynamics, Shear stress, Strength, Stress, Shear tests, Soil types, Liquefaction, Interstitial water, Drainage.

The concept of steady-state deformation in particulate media is defined and explained with special reference to soils. The steady state deformation for any mass of particles is that state in which the mass is continuously deforming at constant volume, constant normal effective stress, constant shear stress, and constant velocity. This steady state is achieved only after all particle orientation has reached a statistically steady-state condition and after all particle breakage, if any, is complete, so that the shear stress needed to continue deformation and the velocity of deformation remain constant. Several practical applications of the concept of steady-state deformation include the understanding of pore pressures measured in situ before, during and well after a failure to more clearly understand the causes of the failure, the selection of shear strength when analyzing the stability of slopes and the selection of an appropriate factor of safety based on improved knowledge, the correct selection of apparatus for particular applications as they relate to the shape of the stress-strain curve, and understanding the relatonship between the stress-strain curves of sands and those of clays in clearer terms. Terminology such as 'normally consolidated' and 'loose' can be understood in terms of soil behavior as opposed to 'over-consolidated' and 'dense'. (Baker-FRC)
W82-02235

RELATIONSHIP OF ELECTRICAL DISPERSION TO SOIL PROPERTIES,
Battelle Memorial Inst., Columbus, OH.
S. S. Smith, and K. Arulanandan.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT5, p 591-604, May, 1981. 8 Fig, 3 Tab, 15 Ref.

Descriptors: *Soil properties, *Electric currents, *Hydraulic permeability, Permeability, Permeability coefficient, Soil texture, Pore size, Pores, Soil porosity, Model studies, Minerals.

In an effort to develop a nondestructive method for studying and predicting engineering properties of fine grained soils, a simplified three element electrical model is presented to represent the complicated soil-water system. The model exhibits a theoretical apparent dielectric and conductivity dispersion in the radio frequency range. The parameters of the model are both compositional and heterogeneous (structural). For a particular soil system, the numerical values of the model param-

eters can be determined by computer curve fitting the theoretical equations of the model to the experimentally determined radio frequency apparent dielectric and conductivity dispersion curves of the soil. The fundamental nature of electrical dispersion in fine grained soils and the three numerical parameters of the model present an effective nondestructive tool for studying the engineering behavior of soils in a fundamental, quantitative manner. The pertinent results of three studies are included in the paper. The three studies included evaluate the model's ability to monitor structural changes during the hydration of soil cement, the relationship between dielectric constant of wet soil cluster and swell potential, and the relationship between the size and distribution of intercluster pores and hydraulic permeability. (Baker-FRC)
W82-02561

8E. Rock Mechanics and Geology

A FORMULA FOR ESTIMATING FISSURE TRANSMISSIVITIES FROM STEADY-STATE INJECTION-TEST DATA,
Institute of Geological Sciences, Wallingford (England).
J. A. Barker.
Journal of Hydrology, Vol 52, No 3/4, p 337-346, July, 1981. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Transmissivity, *Geologic fractures, *Permeability coefficient, *Hydraulic conductivity, Hydraulic engineering, Mathematical studies, Estimating equations, Injection.

A formula was developed for estimating fissure transmissivities in a rock formation from steady-state injection-testing between two inflated packers in a borehole. Sample data for injection into a fissure is used to demonstrate practical application of the formula. In most cases transmissivity can be calculated by an iterative procedure. Errors introduced by non-Darcian flow and finite packer-separation can be calculated by extrapolation. Two equations are presented which can estimate errors resulting from inaccuracies in the measurements. Thus, local hydraulic conductivity can be determined fairly simply for a rock formation. (Small-FRC)
W82-02292

8G. Materials

SOLAR HEAT POND SYSTEM,
Howard County Farm Bureau, Nashville, AR.
For primary bibliographic entry see Field 3F.
W82-02187

MEMBRANE LINER SEALS 278-ACRE RESERVOIR.
Public Works, Vol 112, No 2, p 72-74, February, 1981.

Descriptors: *Reservoir linings, *Hydroelectric plants, *Forebays, Materials engineering, Materials testing, Seepage, Seepage control, Environmental effects, Penstocks, *Plastics, Powerplants, Leadville, Colorado.

The world's largest single-cell membrane reservoir liner was installed in a 278-acre forebay reservoir near Leadville, Colorado by B. F. Goodrich. The reservoir will be part of the Mt. Elbert Power Plant which will service Colorado customers during peak load hours. Water will be released from the forebay through two 180-inch diameter penstocks, and drop 445 feet to drive two 100-megawatt turbine generators. The water is released to Twin Lakes where it may be pumped back to the forebay reservoir during periods of low demand. Before the liner was installed, indications of seepage of water through the soil from the reservoir caused project engineers to decide on the installation of the liner. The contract price for installation of the liner was set at $17.8 million. Complication earth-moving and processing operations were required before liner installation. The liner is made of chlorinated polyethylene of three ply construction with a total thickness of 45 mils. Each panel was laboratory tested for integrity before installation. Environmental impact tests by the Federal Government on the Mt. Elbert installation and the Fryingpan-Arkansas Project started several years ago. Possible dispersion of sediments into the water due to turbulence is expected to be minimal, as are dangers to public safety. (Geiger-FRC)
W82-02361

TRENDS IN WASTEWATER COLLECTION SYSTEMS,
G. E. Symons.
Water/Engineering and Management, Vol 128, No 4, p 10, 90, April, 1981.

Descriptors: *Wastewater management, *Reviews, Regulations, Catchment basins, Design criteria, Pipes, Flow measurement, *Construction materials, *Sewer systems, Costs.

Large increases in cost of sewer construction have been noted over the past 20 years in the wastewater collection systems industry. The cost of sewer construction in 1980 was 4 times the cost in 1957-59. Other trends have also occurred, but have been less obvious. Changes have occurred in materials of construction and in problems of management. Sewers were constructed of brick and cement mortar or tile, concrete poured in wooden forms, monolithic concrete sewer, and finally prestressed concrete pipes of almost any size, evolving to the presently used materials. Forcemains changed from cast-iron through cement-lined steel, to concrete and plastic. Wastewater treatment processes also became more sophisticated. Flow measurement has increased in accuracy. Federal legislation, regulations and implementation policies have forced designers, managers, and operators to improve the sampling of sewers to determine the character of the wastes. Of large current interest is the matter of combined-sewer overflows and how to control them. The use of stormwater detention is under study. Surface detention areas such as athletic fields, parking lots, and rooftops have been considered, but problems with water stagnation and mosquitoes may be experienced. Minimization of safety hazards in sewers caused by hydrogen sulfide is receiving increased attention. Computer management is being investigated. A sewer maintenance program is not required by EPA regulations as a condition for treatment plant construction awards. (Baker-FRC)
W82-02573

8I. Fisheries Engineering

ON THE DYNAMICS OF FEEDING OF YOUNG FISH FROM MOZHAYSK RESERVOIR IN VARIOUS YEARS,
Moscow State Univ. (USSR). Dept. of Ichthyology.
For primary bibliographic entry see Field 2H.
W82-02434

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

INSTITUTIONAL BARRIERS TO WATER QUALITY PLANNING AND MANAGEMENT IN THE SOUTHEAST, VOL III - ANNOTATED BIBLIOGRAPHY,
Tennessee Univ., Knoxville. Graduate School of Planning.
G. E. Bowen, and T. R. Gangaware.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153552, Price codes: A03 in paper copy, A01 in microfiche. Report prepared for Office of Water Research and Technology, May, 1981. 43 p. OWRT-C-90234-U(9434)(1), 14-34-0001-9434.

Descriptors: *Bibliographies, *Water quality management, *Institutional constraints, Urban planning, Water pollution, *Information retrieval, Publications.

This volume of the report, the annotated bibliography, was intended to be a basic reference source for persons engaged in water quality planning, management, and research. The annotations are divided into six basic categories: books, periodicals, government publications, conference proceedings, water resource center reports and others. (Gangaware-Tenn)
W82-02103

10D. Specialized Information Center Services

IDENTIFICATION CODES FOR ORGANIZATIONS LISTED IN COMPUTERIZED DATA SYSTEMS OF THE U.S. GEOLOGICAL SURVEY,
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards, and B. M. Myers.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Paper copy $14.00, Microfiche $3.50. Geological Survey Open-File Report 81-904 (supersedes Open-File Report 80-555), 1981. 102 p, 1 Fig, 2 Ref.

Descriptors: *Data storage and retrieval, *Information exchange, *Organizations, Indexing, Data transmission, *Organization identification code, Computerized data systems, *U.S. Geological Survey, National Water Data Exchange(NAWDEX).

This report contains codes for the identification of public and private organizations listed in computerized data systems. These codes are used by the U.S. Geological Survey's National Water Data Exchange (NAWDEX), National Water Data Storage and Retrieval System (WATSTORE), National Cartographic Information Center (NCIC), and Office of Water Data Coordination (OWDC). The format structure of the codes is discussed and instructions are given for requesting new codes. (USGS)
W82-02486

SUBJECT INDEX

ABSORPTION
Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

ACID MINE DRAINAGE
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

ACID RAIN
International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 5C

ACIDIC WATER
Liming Acid Ponds in New York,
W82-02572 5G

ACTIVATED CARBON
Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 5F

Dupont's Wastewater Treatment Approach,
W82-02254 5D

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 5F

Pilot-Scale Investigations with Granular Activated Carbon,
W82-02289 5D

Trihalomethane Precursor Control by Adsorption,
W82-02598 5F

ACTIVATED SLUDGE
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 5E

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 5D

ACTIVATED SLUDGE PROCESS
Engineering Design Variables for the Activated Sludge Process.
W82-02199 5D

Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 5D

ADMINISTRATION
Effluent Charging Systems and Their Administrative Implications,
W82-02403 6C

The Effect of EEC Directives on Water Supplies,
W82-02432 6E

ADMINISTRATIVE DECISIONS
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

ADMINISTRATIVE REGULATIONS
New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

ADSORPTION
Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 5B

Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 5F

Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 5D

Trihalomethane Precursor Control by Adsorption,
W82-02598 5F

ADVANCED WASTEWATER TREATMENT
Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 5D

ADVECTION
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 2D

AERATION
Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 5G

AEROSOLS
Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 5B

AGRICULTURAL ENGINEERING
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 2J

Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 2I

AGRICULTURAL RUNOFF
Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 2J

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 5B

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 5B

AGRICULTURAL WATERSHEDS
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

ALABAMA
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 5G

ALASKA
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 2L

Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

ALDEBURGH
Flexible Outfall at Aldeburgh,
W82-02415 8A

ALFALFA
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 2D

ALGAE
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 2H

Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 5C

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 6G

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 5C

Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 5D

ALGAE HARVESTING
Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 5D

ALGAL CONTROL
Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 5C

ALGAL GROWTH
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 5C

ALGICIDES
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 5G

ALLOTMENTS
Water Rights on Indian Allotments,
W82-02363 6E

ALTERNATIVE PLANNING
Interactive Nonstructural Flood-Control Planning,
W82-02320 6F

ALUM
Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 5F

AMINO ACIDS
Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

AMMONIA
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 5C

Determination of Ammonia in Estuary,
W82-02390 5A

AMMONIUM COMPOUNDS
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

AMPHIPODS
Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

ANADROMOUS FISH
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

ANALOG COMPUTERS
Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 6A

ANIMAL WASTES
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02173 5E

ANTARCTIC
Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 5B

ANTIBIOTICS
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

ANTIMONY
The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 5A

APPROXIMATION METHOD
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

AQUATIC ANIMALS
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 6G

AQUATIC BACTERIA
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 5A

AQUATIC ENVIRONMENT
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

AQUATIC ENVIRONMENTS
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 5A

AQUATIC FUNGI
Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 2H

AQUATIC HABITATS
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 2H

AQUATIC LIFE
Metabolism of a Desert Stream,
W82-02349 1A

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

AQUATIC PLANTS
Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

Some Analyses of Aquatic Plants and Their Waters,
W82-02293 2H

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 2H

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 2I

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

Concepts in Aquatic Treatment System Design,
W82-02593 5D

AQUATIC POPULATIONS
Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

AQUATIC WEED CONTROL
Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 4A

Control of Aquatic Weeds with Hexazinone,
W82-02326 4A

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 5B

Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 4A

Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 4A

Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 5B

AQUIFER CHARACTERISTICS
Ground Water in Washington,
W82-02536 2F

AQUIFER MANAGEMENT
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

Management of Interstate Aquifer Systems,
W82-02578 4B

AQUIFER TESTING
Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 2F

AQUIFERS
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 2F

Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 2F

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 2F

Ground-Water Data for Michigan 1980,
W82-02467 2F

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 7C

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 7C

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

Management of Interstate Aquifer Systems,
W82-02578 4B

ARCH DAMS
Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 8A

ARCTIC
Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 2A

Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

ARID LANDS
Metabolism of a Desert Stream,
W82-02349 1A

ARIZONA
Metabolism of a Desert Stream,
W82-02349 1A

Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 2A

The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 5G

ARKANSAS
Adjusting Government Role in Water Law.
W82-02256 6E

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A

ARKANSAS RIVER BASIN
Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

AROMATIC COMPOUNDS
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 5B

ARTIFICIAL LAKES
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

ASHURST LAKE
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 5G

ASSAY
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 5A

ASSESSMENTS
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

ATCHAFALAYA BAY
Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 6G

ATTITUDES
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 3C

AUSTRALIA
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 2E

Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 2L

Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 5B

AUTOMATION
How Computers Have Changed Water Works Operations,
W82-02276 5F

Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

BACTERIA
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 5B

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 5A

Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 5A

Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 5A

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 5B

BACTERIAL ANALYSIS
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 5A

Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 5A

BANK EROSION
Bank Failure and Erosion on the Ohio River,
W82-02343 2J

BARRIERS
Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 6G

BASELINE STUDIES
Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 6G

BASS
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

BAYOUS
Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 6G

BAYS
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

BEACHES
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 5E

BED LOAD
Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

BENTHIC ENVIRONMENT
The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 2L

BENTHIC FAUNA
Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 2L

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 2L

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

BENTHIC FLORA
Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 2H

BIBLIOGRAPHIES
Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 10C

BIOACCUMULATION
Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 5B

A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 5B

BIOASSAY
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 5A

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

BIOCHEMICAL OXYGEN DEMAND
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

BIODEGRADATION
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

BIOINDICATORS
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

BIOLOGICAL FILTERS
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

BIOLOGICAL OXYGEN DEMAND
The Effect of Nitrification in the BOD Test,
W82-02384 5D

BIOLOGICAL PROPERTIES
Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

BIOLOGICAL SAMPLES
Shallow-Depth Sedimentation of Biological Materials,
W82-02336 5D

BIOLOGICAL WASTEWATER TREATMENT
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 5D

BIOMASS
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

BOGS
Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 2H

BOISE RIVER
Selecting Seasonal Streamflow Models,
W82-02502 2E

BORDER IRRIGATION
Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 2G

BOSMINA LONGIROSTRIS
The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 2H

BOTTOM CURRENTS
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 2J

BOTTOM SEDIMENTS
Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 5B

BRIDGE DESIGN
Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 4C

BRISTOL CHANNEL
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 2L

BRITISH COLUMBIA
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

BROMAMINES
New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 5A

BROMINE
New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 5A

BROWARD COUNTY
Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B

CADMIUM
Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 5C

CALIFORNIA
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 2K

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 3C

CAMDEN COUNTY
Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C

CANADA
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 2C

CAPITAL COSTS
Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 5D

CARBON
Determination of Dissolved Organic Carbon in Water,
W82-02194 5A

CARBON DIOXIDE
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

CARBONATE ROCKS
Induced Sinkholes: An Engineering Problem,
W82-02559 4B

CASE STUDIES
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 8A

CATALYSTS
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 5G

CATFISH
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

CENTER HILL LAKE
LARM Two-Dimensional Model: An Evaluation,
W82-02597 4A

CENTRAL MONTANA
Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

CERAMIC CUP
A More Versatile Soil Water Sampler,
W82-02523 7B

CERIUM COMPOUNDS
Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 5A

CHALK RIVER
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

CHANNEL CATFISH
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

CHANNEL FLOW
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 2E

CHANNEL IMPROVEMENT
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

CHANNELS
Turbulence Model for Flow Over Dredged Channels,
W82-02201 8B

CHEMICAL ANALYSIS
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 2K

Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 5A

The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 5A

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 2K

Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 5B

Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 2K

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 2K

CHEMICAL COAGULATION
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 5D

CHEMICAL COMPOSITION
Some Analyses of Aquatic Plants and Their Waters,
W82-02293 2H

Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 5C

Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 2K

CHEMICAL OXYGEN DEMAND
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 5A

Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 5A

CHEMICAL PRECIPITATION
A Compendium of Experimental Work on Chemical Precipitation of Sewage,
W82-02370 5D

CHEMICAL PROPERTIES
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 2F

CHEMICAL WASTES
Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 5A

CHEMICAL WASTEWATER
Industrial Wastewater Pretreatment Service,
W82-02253 5E

Dupont's Wastewater Treatment Approach,
W82-02254 5D

CHEMISTRY OF PRECIPITATION
International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 5C

CHEMOCLINE
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

CHESAPEAKE BAY
Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 6G

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
W82-02115 6G

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 2L

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 2I

CHICAGO
Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 7A

CHINOOK BELT
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 2C

CHLORIDE
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 5B

CHLORIDES
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 2F

Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 5D

CHLORINATED HYDROCARBONS
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

Trihalomethane Precursor Control by Adsorption,
W82-02598 5F

CHLORINATION
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 5A

CHLOROFORM
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 5A

CHLOROPHYLL
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 5A

CHOWAN RIVER
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 5A

CLAMS
A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 5C

CLARIFICATION
Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 5F

CLARIFIERS
Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 5D

CLEAR-CUTTING
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

CLIMATES
Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 2L

CLIMATOLOGY
Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 2C

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 2B

130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

CLOUD SEEDING
An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 7B

COAGULATION
Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 5F

COAL GASIFICATION
Thiocyanate Bio-Oxidation Kinetics,
W82-02596 5D

COAL MINES
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

COAL MINING
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 7C

COASTAL AQUIFERS
Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 5B

COASTAL MARSHES
Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 6G

COASTAL WATERS
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 5C

Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

COASTAL ZONE MANAGEMENT
Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 6E

Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 6G

Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 4A

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 5G

COASTS

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

COLD REGIONS

Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 2C

COLIFORMS

A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 5A

Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

COLIPHAGES

Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 5A

COLLOIDS

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

COLOR REMOVAL

Methods for Treatment of Color in Groundwater,
W82-02532 5F

COLORADO

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 6A

COLORADO RIVER

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 4A

Colorado River Simulation System; An Executive Summary,
W82-02170 6A

COLORADO RIVER BASIN

Salinity Forum: What. How. Why,
W82-02587 6E

COLORIMETRY

Determination of Ammonia in Estuary,
W82-02390 5A

New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 5A

COLUMBIA RIVER

Water Management on the Columbia River,
W82-02112 6D

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 6D

COLUMBIA RIVER ESTUARY

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

COMMERCIAL FISH

Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

COMMON LAW

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 3C

COMPETING USE

Water Management on the Columbia River,
W82-02112 6D

COMPUTER MODELS

Colorado River Simulation System; An Executive Summary,
W82-02170 6A

Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 6A

Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 6A

Optimal Stream-Aquifer Development,
W82-02575 6A

COMPUTER PROGRAMS

Loop Equations with Unknown Pipe Characteristics,
W82-02258 3F

Interactive Nonstructural Flood-Control Planning,
W82-02320 6F

COMPUTERS

Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 7C

How Computers Have Changed Water Works Operations,
W82-02276 5F

Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 6A

CONCRETE TECHNOLOGY

Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 8A

CONDUITS

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 8A

CONFERENCES

International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 5C

CONFINED AQUIFERS

Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 2F

CONNECTICUT

PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

CONSEQUENT STREAMS

Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 2F

CONSTRUCTION MATERIALS

Trends in Wastewater Collection Systems,
W82-02573 8G

CONSUMPTIVE USE

Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 6G

COPEPODS

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 2L

COPPER

A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 5B

COPPER SULFATE

Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 5C

CORN

The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 2I

CORPUS CHRISTI BAY ESTUARY TEXAS

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 2L

COST ANALYSIS

Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

Cost of Small Water Supply Treatment Systems,
W82-02318 5F

COST-BENEFIT ANALYSIS

Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 3A

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 6B

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 6D

In-Home Conservation and Wastewater Management,
W82-02591 3D

COST-SHARING

Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

Water Savings in the Orange Water and Sewer Authority,
W82-02519 3D

COSTA DE HERMOSILLO
Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 5B

COSTS
The Dilution/Flushing Technique in Lake Restoration,
W82-02270 2H

Effluent Charging Systems and Their Administrative Implications,
W82-02403 6C

Wastewater Collection and Treatment in Wayne County,
W82-02554 5D

Energy Costs and Portland Water Supply System,
W82-02586 5F

CROP PRODUCTION
Aerated Drip Irrigation,
W82-02186 3F

CROP YIELD
Solar Heat Pond System,
W82-02187 3F

Wheat Response to Drought,
W82-02242 2I

Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 2I

Irrigation Requirements of Field-Pea for Grain,
W82-02395 2I

CROP YIELDS
Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 3C

CROPS
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 3F

CRUSTACEANS
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 2L

CUMULATIVE RUNOFF
Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 2A

CYANOPHYTA
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 5A

DABOB BAY
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

DAM CONSTRUCTION
Passing Floodwaters Over Embankment Dams,
W82-02204 8A

DAMS
The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 2E

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

DATA ACQUISITION
A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

DATA COLLECTIONS
Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 7C

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 2F

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 7C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

Water Quality Data, Mackenzie River Basin 1960-1979.
W82-02506 7C

DATA PROCESSING
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 7C

DATA STORAGE AND RETRIEVAL
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 10D

DECISION MAKING
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

DECOMPOSITION
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 5E

DECONTAMINATION
New Jersey Community Decontaminates Well Water.
W82-02243 5F

DEFORMATION
The Steady State of Deformation,
W82-02235 8D

DEGRADATION
Fate of Diflubenzuron in Water,
W82-02216 5B

Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 5B

DEICERS
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 5B

DELAWARE
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

DELTAS
Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 2J

DENDROCHRONOLOGY
Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 2B

DENITRIFICATION
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D

DENMARK
Denmark's State of the Environment,
W82-02401 5B

Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 5C

DENSITY CURRENTS
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 2J

DEPOSITION
The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 2F

DESALINATION
Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 3A

Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 3A

Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 3A

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

DESALINATION APPARATUS
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 3A

DESIGN CRITERIA
Engineering Design Variables for the Activated Sludge Process.
W82-02199 5D

Hydraulic Gates,
W82-02206 8C

Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 5E

Solid Set Irrigation System Design Using Linear Programming,
W82-02273 6A

High-Head Vertical Lift Gates,
W82-02388 8A

Optimal Stream-Aquifer Development,
W82-02575 6A

DESIGN FLOODS
Flood Event Modeling - A Study of Two Methods,
W82-02291 2A

DETENTION RESERVOIRS
Comparison of Detention Basin Planning and Design Models,
W82-02592 6A

DETRITUS
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

DEVELOPING COUNTRIES
Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 6G

Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 6A

DEWATERING
Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

DIATOMS
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 6G

The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 7B

DIEL VARIATIONS
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

DIFFUSERS
Multiport Diffuser Mixing Zones in Rivers,
W82-02594 5B

DIFLUBENZURON
Fate of Diflubenzuron in Water,
W82-02216 5B

DIQUAT
Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 4A

DISSOLVED OXYGEN
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 5A

On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 2H

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 5D

DISTILLATION PROCESSES
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process,
W82-02105 3A

DISTRIBUTION
The Integrity of Existing Distribution Systems,
W82-02450 5F

DISTRIBUTION PATTERNS
Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 2H

The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 7B

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

DISTRICT OF COLUMBIA
Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 5B

DIURNAL DISTRIBUTION
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 2I

DIVERGING-CONVERGING WATERSHEDS
Water Routing on Diverging-Converging Watersheds,
W82-02200 2A

DIVERSION
Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 6B

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

DIVERSION CHANNELS
The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 4A

DIVERSION LOSSES
Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 5G

DIVERSION STRUCTURES
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

DOMESTIC WASTES
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

DOMESTIC WATER
In-Home Conservation and Wastewater Management,
W82-02591 3D

DRAIN SPACING
Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 8A

DRAINAGE
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 8A

Long Term Performance of Horizontal Drains,
W82-02212 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 8A

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 2F

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 5B

DRAINAGE DITCHES
Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

DRAINAGE ENGINEERING
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 8A

Long Term Performance of Horizontal Drains,
W82-02212 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 8A

Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 8A

DRAINAGE SYSTEMS
Methods of Restoring the Delivery of Drainage Wells,
W82-02385 4A

DRAINAGE WELLS
Methods of Restoring the Delivery of Drainage Wells,
W82-02385 4A

DRAINS
Wastewater Collection and Treatment in Wayne County,
W82-02554 5D

DRAWDOWN
Induced Sinkholes: An Engineering Problem,
W82-02559 4B

DREDGING
Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

DRILLING
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways, W82-02211 8A
Treated Pit Fluids Meet Water Specifications. W82-02557 5E

DRILLING FLUIDS
Treated Pit Fluids Meet Water Specifications. W82-02557 5E

DRINKING WATER
Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography, W82-02298 5A
An Assessment of Current Standards for Selenium in Drinking Water, W82-02372 6F
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow, W82-02446 5F
The Integrity of Existing Distribution Systems, W82-02450 5F

DRIP IRRIGATION
Aerated Drip Irrigation, W82-02186 3F

DROUGHT
Distribution of Joint Run-Lengths of Bivariate Markov Processes, W82-02191 2E
Wheat Response to Drought, W82-02242 2I
Dendroclimatic Estimates of a Drought Index for Northern Virginia, W82-02468 2B
Rate Structures and Demand Reduction, W82-02517 6C

DUPONT COMPANY
Dupont's Wastewater Treatment Approach, W82-02254 5D

DYNAMIC PROGRAMMING
Weekly Multipurpose Planning Model for TVA Reservoir System, W82-02319 6A

EARTHWORMS
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge, W82-02362 5E

ECOLOGICAL EFFECTS
Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development, W82-02162 6G
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology, W82-02178 4C
An Industrial View. Treatment Vis-A-Vis Discharge to Sewers, W82-02407 6G

ECONOMIC ASPECTS
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers, W82-02101 6E
The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource, W82-02229 6B
Wastewater Management in Coastal North Carolina, W82-02511 5D
Rate Structures and Demand Reduction, W82-02517 6C

ECONOMIC EFFECTS
The Effect of EEC Directives on Water Supplies, W82-02432 6E

ECONOMIC FEASIBILITY
Appalachian Regional Commission and the Coastal Plains Regional Commission, W82-02515 6E

ECONOMIC IMPACT
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F), W82-02189 5D

ECONOMIES OF SCALE
Analytical Cost Model for Urban Water Supply, W82-02584 6C

ECOSYSTEMS
Some Effects of Fresh Water on the Atchafalaya Bay System, W82-02143 6G
Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana, W82-02144 6G
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries, W82-02147 6G
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's, W82-02156 6E
The River Continuum: A Theoretical Construct for Analysis of River Ecosystems, W82-02157 6G
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System, W82-02160 2L
Strategies for the Management of Estuaries, W82-02166 6F
Recent Trends in Environmental Impact Assessment, W82-02525 6G

EDEN RIVER
Diquat and Sodium Alginate for Weed Control in Rivers, W82-02328 4A

EDUCATION
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I, W82-02540 6A

EFFLUENT CHARGES
Effluent Charging Systems and Their Administrative Implications, W82-02403 6C

EFFLUENT LIMITATIONS
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts, W82-02107 3C
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria, W82-02449 5E

EFFLUENT STANDARDS
Supreme Court Clarifies Water Act Requirement, W82-02257 6E

EFFLUENTS
Multiport Diffuser Mixing Zones in Rivers, W82-02594 5B

EGYPT
Waterborne Disease Is Prevalent in Egypt, W82-02435 5C

ELECTRIC CURRENTS
Relationship of Electrical Dispersion to Soil Properties, W82-02561 8D

ELECTRIC POWERPLANTS
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales, W82-02406 5C

EMBANKMENTS
Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History, W82-02214 8A

ENERGY
Energy Costs and Portland Water Supply System, W82-02586 5F

ENERGY CONSERVATION
Processes--Not Products--Biggest Energy-Saving Factors. W82-02218 5D

ENGINEERING
Assessment of the National Water Quality Management Program, Volume 2: Construction Grants. W82-02182 6E

ENGLAND
Seasonal Variation in the Trace Metal Content of Mytilus Edulis, W82-02312 5C
Diquat and Sodium Alginate for Weed Control in Rivers, W82-02328 4A
Beddington Sewage-Treatment Works, Canyon: Some Operating Experiences 1969-79, W82-02410 5D
Flexible Outfall at Aldeburgh, W82-02415 8A

ENTERIC BACTERIA
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water, W82-02377 5A

ENTEROVIRUSES
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus, W82-02176 5A

ENVIRONMENTAL CONTROL
Environmental Control Technology Development for Geothermal Energy, W82-02197 5C
Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control, W82-02354 5B
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama, W82-02535 5G

ENVIRONMENTAL EFFECTS
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeake Bay,
W82-02115 6G

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 6G

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 4A

The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 6G

Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 5G

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 3A

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 5C

Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 6G

Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 6G

The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 7C

Sludge: Back into the Ocean,
W82-02577 5E

History of Human-Use Impacts on Long Point Bay,
W82-02580 5B

ENVIRONMENTAL IMPACT STATEMENT
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

ENVIRONMENTAL POLICY
Strategies for the Management of Estuaries,
W82-02166 6F

ENVIRONMENTAL PROTECTION
An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 5G

User Reaction to Wild and Scenic River Designation,
W82-02278 6G

EPHEMERAL STREAMS
Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

EPIPHYTIC ALGAE
Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 6G

EROSION
Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 4A

Aerial Photography to Detect Rill Erosion,
W82-02232 7B

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 2J

EROSION CONTROL
Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 2I

Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 4D

EROSION RATES
Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 2J

ESSEX COUNTY
Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 2E

ESTUARIES
Water Management on the Columbia River,
W82-02112 6D

Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 6E

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 4A

Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 2J

Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 2L

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 2L

Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 2L

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 6G

Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 4A

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

Sediment--Asset or Liability,
W82-02150 6B

Overview of Freshwater Inflow Depletions,
W82-02152 6D

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 6D

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 2L

Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 2L

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 6G

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 5G

A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 2L

Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 2L

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 2L

The Dynamics of Conservative Mixing in Estuaries,
W82-02345 2L

Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 2L

Determination of Ammonia in Estuary,
W82-02390 5A

Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 5G

Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 5C

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 5B

Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 2L

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 2L

ESTUARINE ENVIRONMENT

Freshwater Inputs and Estuarine Productivity,
W82-02110 2L

Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 6E

Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 6G

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeapeake Bay,
W82-02115 6G

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 6G

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 2L

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 2L

Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 4A

Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 2L

Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 2L

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 5C

Strategies for the Management of Estuaries,
W82-02166 6F

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 2L

Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 2L

ESTUARINE FISHERIES

The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 6G

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 6B

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 5C

ETHYLENE

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 2K

EUROPE

The Effect of EEC Directives on Water Supplies,
W82-02432 6E

EUTROPHICATION

Freshwater Inputs and Estuarine Productivity,
W82-02110 2L

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 2H

On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 5C

Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 5C

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 5C

EVAPOTRANSPIRATION

Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 2D

Practical Prediction of Actual Evapotranspiration,
W82-02308 2D

EXPERIMENTAL DESIGN

Solar Heat Pond System,
W82-02187 3F

Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 5A

FATE OF POLLUTANTS

Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 5B

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 5B

Multiport Diffuser Mixing Zones in Rivers,
W82-02594 5B

FEDERAL JURISDICTION

Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 6G

Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 6E

Superfund: What a Mess,
W82-02184 6E

Compliance Strategy for Clean Water.
W82-02185 6E

FEDERAL WATER POLLUTION CONTROL ACT
Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 5D

FENS
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

FERTILIZERS
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 5B

FIELD TESTS
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 2E

FINANCING
Adjusting Government Role in Water Law.
W82-02256 6E

Texas to Vote on Water Trust Fund.
W82-02302 6C

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 6E

FINITE ELEMENT METHOD
Subdomain Integration Model of Ground-Water Flow,
W82-02550 2F

FISH
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 2L

The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 5C

Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 2L

FISH BEHAVIOR
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

FISH CREEK
Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

FISH DISEASES
Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 2L

FISH EGGS
Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 7B

FISH MANAGEMENT
Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 6G

FISH POPULATIONS
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

Liming Acid Ponds in New York,
W82-02572 5G

FISHERIES
Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 6G

Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

FISHKILL
Mt. St. Helens and the Fish,
W82-02508 2J

FJORDS
Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 5C

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 2L

FLASH FLOODS
Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 2A

FLEXIBILITY
Flexible Outfall at Aldeburgh,
W82-02415 8A

FLOCCULATION
Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 5F

FLOOD CONTROL
Interactive Nonstructural Flood-Control Planning,
W82-02320 6F

Methods of Restoring the Delivery of Drainage Wells,
W82-02385 4A

Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 6G

FLOOD DAMAGE
Bank Failure and Erosion on the Ohio River,
W82-02343 2J

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 2E

FLOOD DATA
Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 2E

FLOOD DISCHARGE
Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

FLOOD FORECASTING
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 2C

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

Developing Dam-Break Flood Zone Ordinance,
W82-02585 6F

FLOOD FREQUENCY
The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 2E

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 4C

FLOOD PLAIN ZONING
Developing Dam-Break Flood Zone Ordinance,
W82-02585 6F

FLOOD PROFILES
Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 4C

FLOOD RECURRENCE INTERVAL
Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 4C

FLOODS
Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 2J

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 2L

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 2A

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 2E

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 2E

FLOODWATER
Passing Floodwaters Over Embankment Dams,
W82-02204 8A

FLORIDA
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 4A

Surface Water Flow from a South Florida Wetland Area,
W82-02121 2E

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 2F

Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 4A

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 2H

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 7C

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 7C

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 7C

Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 2L

Wetlands Use for Water Management in Florida,
W82-02590 4A

FLOW
Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 2A

Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 2F

FLOW CHARACTERISTICS
Turbulence Model for Flow Over Dredged Channels,
W82-02201 8B

Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 6A

FLOW DISCHARGE
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 2E

Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 2E

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D

FLOW DISHCARGE
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

FLOW MEASUREMENT
Composite Sampling of Highway Runoff,
W82-02230 7B

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

Leak Detection - Two Methods That Work,
W82-02521 3D

FLOW PATTERNS
LARM Two-Dimensional Model: An Evaluation,
W82-02597 4A

FLOW RATES
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 2E

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

FLOW SEPARATION
Sediment--Asset or Liability,
W82-02150 6B

FLUORESCENCE
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 5A

FLUSHING
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

The Dilution/Flushing Technique in Lake Restoration,
W82-02270 2H

FLY ASH
Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

FOOD CHAINS
Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 5B

FOOD PROCESSING INDUSTRY
Geothermally Powered Food-Processing Systems.
W82-02543 3E

FORD LAKE
Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 5B

FOREBAYS
Membrane Liner Seals 278-Acre Reservoir.
W82-02361 8G

FOREST SOILS
Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 2I

FORT PIERCE INLET
Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 2L

FORT WAYNE
Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 2E

FOULING
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

FOUNDATION ROCKS
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

FRANCE
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 2F

Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

FREEZE PROCESS
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 3A

FRESHWATER INFLOW
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

FURROW IRRIGATION
A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 3F

FUTURE PLANNING
An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 6G

GATES
High-Head Vertical Lift Gates,
W82-02388 8A

GEOCHEMISTRY
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 2F

Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

GEOHYDROLOGY
Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 2F

Induced Sinkholes: An Engineering Problem.
W82-02559 4B

GEOLOGIC FRACTURES
A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 8E

GEORGIA
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 2K

GEORGIA BIGHT
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

GEOTHERMAL POWER
Geothermal Energy: An Old Ally,
W82-02333 2F

GEOTHERMAL RESOURCES
Environmental Control Technology Development for Geothermal Energy,
W82-02197 5C

Geothermally Powered Food-Processing Systems.
W82-02543 3E

GEOTHERMAL STUDIES
Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 2F

GILLETTE
42-Mile Water Pipeline for Coal Boom Town.
W82-02359 6D

GLACIAL LAKES
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 2C

GLASGOW
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

GOVERNMENT FINANCE
Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 6E

GOVERNMENT INTERRELATIONS
Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 6E

GOVERNMENT SUPPORTS
Adjusting Government Role in Water Law.
W82-02256 6E

GRANTS
Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 6E

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 6E

GRASSES
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 3C

GRAVEL
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

GREAT BRITAIN
The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 6A

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 2F

GREENHOUSES
Solar Heat Pond System,
W82-02187 3F

GREENSBORO
Water Conservation Program of the City of Greensboro,
W82-02518 3D

GROUNDWATER
Groundwater Quality in the Severn-Trent Region,
W82-02423 5A

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 2F

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 2F

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 7C

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 2F

Ground-Water Data for Michigan 1980,
W82-02467 2F

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 2K

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

Water Resources Data for Utah, Water Year 1979.
W82-02474 7C

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 7C

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 7C

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 7C

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

Water Resources Data for Indiana, Water Year 1980.
W82-02492 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

Methods for Treatment of Color in Groundwater,
W82-02532 5F

Ground Water in Washington,
W82-02536 2F

Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 2F

Subdomain Integration Model of Ground-Water Flow,
W82-02550 2F

GROUNDWATER AVAILABILITY
Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 3A

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

GROUNDWATER MANAGEMENT
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 6E

Efficient Groundwater Utilization,
W82-02520 6D

Management of Interstate Aquifer Systems,
W82-02578 4B

GROUNDWATER MINING
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

GROUNDWATER MOVEMENT
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 2F

Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 2F

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 2F

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 2F

Investigations of High Groundwater in Polson Terminal Moraine,
W32-02538 2F

Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 2F

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 2F

GROUNDWATER POLLUTION
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

PVC Cover Causes Leachate Retreat,
W82-02321 5E

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 5B

Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 5A

GROUNDWATER POTENTIAL
Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, April 28-29, 1981. Cincinnati, Ohio.
W82-02106 2F

GROWTH KINETICS
The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 2H

The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 2H

GROWTH STAGES
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

GULF OF ALASKA
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

GULF OF MEXICO
Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 6G

GULFS
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

HABITATS
Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

HALOGENS
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

HAMILTON HARBOR
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 7B

HANDBOOKS
Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 4D

HARBORS
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 7B

HAZARDOUS MATERIALS
Superfund: What a Mess,
W82-02184 6E

Managing Hazardous Wastes,
W82-02252 5E

HEATED WATER
Solar Heat Pond System,
W82-02187 3F

Geothermally Powered Food-Processing Systems.
W82-02543 3E

HEAVY METALS
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 5B

Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

HERBICIDES
The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 5C

Control of Aquatic Weeds with Hexazinone,
W82-02326 4A

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 5B

Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 4A

Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 4A

Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 5B

HEXAZINONE
Control of Aquatic Weeds with Hexazinone,
W82-02326 4A

HIGHWAY EFFECTS
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 8A

Long Term Performance of Horizontal Drains,
W82-02212 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 8A

HIGHWAYS
Composite Sampling of Highway Runoff,
W82-02230 7B

HILLSBOROUGH
Water Savings in the Orange Water and Sewer Authority,
W82-02519 3D

HISTORY
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

HOLLAND
Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 6G

HOMOCLINAL FLANKS
Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 2F

HOMOGENEITY
Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 2F

HOUSATONIC RIVER
PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

HUDSON RIVER ESTUARY
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

HUMAN DISEASES
Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 6G

Waterborne Disease Is Prevalent in Egypt,
W82-02435 5C

HUMAN POPULATION
History of Human-Use Impacts on Long Point Bay,
W82-02580 5B

HUMIC ACIDS
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 5A

The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 5C

Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 2K

HURRICANES
Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 2L

HYDRA
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

HYDRAULIC CONDUCTIVITY
A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 8E

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 2F

HYDRAULIC GATES
Hydraulic Gates,
W82-02206 8C

HYDRAULIC PERMEABILITY
Relationship of Electrical Dispersion to Soil Properties,
W82-02561 8D

HYDROCARBONS
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

HYDROELECTRIC PLANTS
Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 5C

Membrane Liner Seals 278-Acre Reservoir,
W82-02361 8G

High-Head Vertical Lift Gates,
W82-02388 8A

HYDROGEN ION CONCENTRATION
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 5C

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 5F

HYDROGEN PEROXIDE
Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 4A

HYDROGENATION
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 5G

HYDROGEOLOGY
The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 2F

HYDROGRAPHS
Water Routing on Diverging-Converging Watersheds,
W82-02200 2A

HYDROLOGIC BUDGET
Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

HYDROLOGIC DATA
Water Resources Data for Utah, Water Year 1979.
W82-02474 7C

Water Resources Data for Indiana, Water Year 1980.
W82-02492 7C

Water Resources Data for Florida, Water Year 1980–Volume 4. Northwest Florida.
W82-02493 7C

Water Resources Data for Pennsylvania, Water Year 1980–Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 7C

Water Resources Data for Wyoming, Water Year 1980–Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 7C

Water Resources Data for Minnesota, Water Year 1980–Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 7C

Water Resources Data for Minnesota, Water Year 1980–Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

HYDROLOGIC MODELS
A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 2A

HYDROLOGIC ROUGHNESS
Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 2A

ICE JAMS
Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 2C

ICE REMOVAL
Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 2H

IDAHO
Aerated Drip Irrigation,
W82-02186 3F

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 2C

ILLINOIS
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

ILLINOIS WATERWAY
Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

IMMUNIZATION
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

IMPAIRED WATER USE
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 3C

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 3C

IMPOUNDMENTS
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 5E

INDIA
Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

INDIANA
Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana, W82-02485 2E

Water Resources Data for Indiana, Water Year 1980. W82-02492 7C

INDIANS
Water Rights on Indian Allotments, W82-02363 6E

INDICATORS
Enchytraeid Oligochaetes as Marine Pollution Indicators, W82-02445 5A

INDUSTRIAL DEVELOPMENT
Disposal of Industrial Effluents - Some Future Problems, W82-02405 5D

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers, W82-02407 6G

INDUSTRIAL WASTES
New Jersey Community Decontaminates Well Water. W82-02243 5F

Estuarine and Marine Coastal Pollution in the Republic of Ireland, W82-02418 5B

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent, W82-02436 5D

INDUSTRIAL WASTEWATER
Industrial Pretreatment Needs to Be Overhauled at the National Level. W82-02198 5D

Industrial Wastewater Pretreatment Service, W82-02253 5E

Disposal of Industrial Effluents - Some Future Problems, W82-02405 5D

INFILTRATION
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality, W82-02537 5B

INFILTRATION CAPACITY
Methods of Calculating Infiltration of Meltwaters into Frozen Soil, W82-02386 2A

INFORMATION EXCHANGE
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey, W82-02486 10D

INFORMATION RETRIEVAL
Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography, W82-02103 10C

INJECTION
Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir, W82-02314 2F

INJECTION WELLS
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois, W82-02280 5E

INSECT CONTROL
Fate of Diflubenzuron in Water, W82-02216 5B

INSECTICIDES
Fate of Diflubenzuron in Water, W82-02216 5B

Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff, W82-02322 5B

INSTITUTIONAL CONSTRAINTS
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers, W82-02101 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data, W82-02102 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography, W82-02103 10C

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts, W82-02107 3C

Analysis of Firm Water Supply Under Complex Institutional Constraints, W82-02501 6A

INSTRUMENTATION
A More Versatile Soil Water Sampler, W82-02523 7B

INTERSTATE COMPACTS
Management of Interstate Aquifer Systems, W82-02578 4B

INTERSTITIAL WATER
Horizontal Drains and Horizontal Drilling: An Overview, W82-02215 8A

INVERTEBRATES
Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat, W82-02568 6G

IRELAND
Estuarine and Marine Coastal Pollution in the Republic of Ireland, W82-02418 5B

IRRADIATION
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems, W82-02565 2H

IRRIGATION
Aerated Drip Irrigation, W82-02186 3F

Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings, W82-02202 2I

Prediction of the Advancing Wetting Front in Border Strip Irrigation, W82-02309 2G

Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation, W82-02373 2I

Ground Water in Washington, W82-02536 2F

IRRIGATION DESIGN
Solid Set Irrigation System Design Using Linear Programming, W82-02273 6A

A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows, W82-02556 3F

IRRIGATION ENGINEERING
Water for New Zealand's Plains, W82-02402 3F

IRRIGATION OPERATION
Loop Equations with Unknown Pipe Characteristics, W82-02258 3F

IRRIGATION PRACTICES
Public Perception of Groundwater Depletion in Southwestern Kansas, W82-02174 3F

Effect of Saline Irrigation Water on the Yield of Potato, W82-02396 3C

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis, W82-02455 6A

IRRIGATION PROGRAMS
Environmental Repercussions of Irrigation Development in Hot Climates, W82-02366 6G

IRRIGATION REQUIREMENTS
Irrigation Requirements of Field-Pea for Grain, W82-02395 2I

IRRIGATION WATER
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production, W82-02219 3C

Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes, W82-02391 3C

Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass, W82-02392 5B

IRRIGATION WELLS
Water for New Zealand's Plains, W82-02402 3F

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals, W82-02547 5B

ISRAEL
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity, W82-02365 4A

JAMES RIVER
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia, W82-02284 5B

Kepone Distribution in the Water Column of the James River Estuary - 1976-78, W82-02360 5B

JAPAN
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan, W82-02443 5A

JOINT NEGATIVE RUN LENGTHS
Distribution of Joint Run-Lengths of Bivariate Markov Processes, W82-02191 2E

JUDICIAL DECISIONS
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

Supreme Court Clarifies Water Act Requirement,
W82-02257 6E

JURA MOUNTAINS
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 2F

JURISDICTION
An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

KAKAKEE RIVER
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

KAMLOOPS LAKE
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

KANSAS
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

KARST HYDROLOGY
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 2F

KASHMIR
Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

KASHMIR VALLEY
On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 5C

KENTUCKY
Water Resources Data for Kentucky, Water Year 1979.
W82-02499 7C

KENYA
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 2K

KEPONE
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 5B

Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 5B

KINEMATIC WAVE THEORY
Water Routing on Diverging-Converging Watersheds,
W82-02200 2A

KINETICS
Thiocyanate Bio-Oxidation Kinetics,
W82-02596 5D

KISSISSIMMEE RIVER BASIN
Wetlands Use for Water Management in Florida,
W82-02590 4A

KRAFT MILLS
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 5D

LAGUNA PUEBLO
Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 3A

LAKE APOPKA
Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 2H

LAKE BASINS
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 2K

LAKE BEDS
Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 2H

LAKE CARL BLACKWELL
Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 5C

LAKE CLASSIFICATION
On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 5C

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

LAKE DONJEK
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 2C

LAKE ERIE
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 2K

The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 6B

LAKE MARCO
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

LAKE MICHIGAN
Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 2H

LAKE MORPHOLOGY
Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 2H

LAKE NAINI TAL
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

LAKE NAIVASHA
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 2K

LAKE OHRID
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 2H

LAKE ONTARIO
The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 7A

LAKE RESTORATION
The Dilution/Flushing Technique in Lake Restoration,
W82-02270 2H

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 5G

LAKE SEDIMENTS
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

LAKE TAHOE
Lake Tahoe Preservation Bill Enacted.
W82-02244 6E

The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 2H

LAKE TEXOMA
Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 2H

LAKE VATTERN
Jonkoping's Water Supply,
W82-02419 5F

LAKE WINGRA
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

LAKES
The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 2H

Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 5A

Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 2K

Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 2H

Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 2H

Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 2H

The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 7A

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 2K

Jonkoping's Water Supply,
W82-02419 5F

The Mixing Layer of Loch Ness,
W82-02421 2H

On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 2H

Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 2H

Liming Acid Ponds in New York,
W82-02572 5G

LAND APPLICATION
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

LAND DEVELOPMENT
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 4A

LAND MANAGEMENT
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

LAND USE
Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 5B

LANDFILLS
Managing Hazardous Wastes,
W82-02252 5E

LANDSLIDES
Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 8A

LEAD
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

LEAKAGE
Leak Detection - Two Methods That Work,
W82-02521 3D

LEAVES
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 2I

LEGAL ASPECTS
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 6E

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 3C

Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 6E

Reasonable Groundwater - Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 6E

Sludge: Back into the Ocean,
W82-02577 5E

LEGISLATION
An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

Superfund: What a Mess,
W82-02184 6E

Compliance Strategy for Clean Water.
W82-02185 6E

Lake Tahoe Preservation Bill Enacted.
W82-02244 6E

LEGUMES
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 3F

LIABILITY
Superfund: What a Mess,
W82-02184 6E

LIGHT INTENSITY
The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 2H

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

LIME
Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 5D

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 5F

Liming Acid Ponds in New York,
W82-02572 5G

LIMNOLOGY
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 2H

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

LINEAR PROGRAMMING
Solid Set Irrigation System Design Using Linear Programming,
W82-02273 6A

LITTLE LAKE CONWAY
Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

LITTLE TURTLE BASIN
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

LOCAL GOVERNMENTS
Texas to Vote on Water Trust Fund.
W82-02302 6C

LOCH NESS
The Mixing Layer of Loch Ness,
W82-02421 2H

LONG POINT BAY
Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 2H

History of Human-Use Impacts on Long Point Bay,
W82-02580 5B

LONG POINT MARSH
The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 6B

LONG-TERM PLANNING
Municipal Needs,
W82-02513 6E

Efficient Groundwater Utilization,
W82-02520 6D

LOUISIANA
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 2H

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 7C

LOW FLOW
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeake Bay,
W82-02115 6G

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 5C

Point Process Models of Rainfall,
W82-02452 2A

MACKENZIE RIVER BASIN
Water Quality Data, Mackenzie River Basin 1960-1979,
W82-02306 7C

MANAGEMENT
Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 6B

MANAGEMENT PLANNING
Strategies for the Management of Estuaries,
W82-02166 6F

Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 6A

MANGROVE SWAMPS
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 4A

MANURE
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

MAPPING
The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 7C

MAPS
Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 7C

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 7C

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

MARSHES
Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 2H

MARYLAND
The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

MATAGORDA BAY
Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

MATHEMATICAL ANALYSIS
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

MATHEMATICAL MODELS
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 2L

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 2A

Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 2A

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

Flood Event Modeling - A Study of Two Methods,
W82-02291 2A

The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 6A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 2A

MATHEMATICAL STUDIES
Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 2A

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

Subdomain Integration Model of Ground-Water Flow,
W82-02550 2F

MAUMEE RIVER BASIN
Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 2E

MEASURING INSTRUMENTS
Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 2H

Leak Detection - Two Methods That Work,
W82-02521 3D

MEDITERRANEAN SEA
Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

MEMBRANE FILTERS
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 5A

MEMBRANE PROCESSES
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

MEMBRANES
Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 5D

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

MENARD CREEK
Water Quality of a Southeast Texas Stream,
W82-02570 2K

MERCURY
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 3A

MEROMICTIC LAKES
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

METALS
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 5G

METEOROLOGICAL DATA COLLECTION
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 2H

MEXICO
Wheat Response to Drought,
W82-02242 2I

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 5B

MICHIGAN
Ground-Water Data for Michigan 1980,
W82-02467 2F

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 5B

MICROBIAL DEGRADATION
Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 5B

Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

MICROORGANISMS
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

MIDMAR DAM
The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 5C

MILFORD HAVEN ESTUARY
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 5C

MINERALOGY
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

MINERALS
Some Analyses of Aquatic Plants and Their Waters,
W82-02293 2H

MINNESOTA
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

Water Resources Data for Minnesota, Water Year 1980–Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 7C

Water Resources Data for Minnesota, Water Year 1980–Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 7C

MISSISSIPPI
Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 5D

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 6G

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 2A

MISSISSIPPI RIVER
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

MISSOURI
Water-Resources Investigations of the U.S. Geological Survey in Missouri–Fiscal Year 1981.
W82-02488 7C

MIXING
The Dynamics of Conservative Mixing in Estuaries,
W82-02345 2L

Wind-Induced Mixing in Stratified Fluid,
W82-02371 2H

The Mixing Layer of Loch Ness,
W82-02421 2H

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 2L

Multiport Diffuser Mixing Zones in Rivers,
W82-02594 5B

MIXOLIMNION
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

MODEL STUDIES
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 6G

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 2J

Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 5D

A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02366 2E

Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 6A

Point Process Models of Rainfall,
W82-02452 2A

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 5G

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 2F

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 6A

Selecting Seasonal Streamflow Models,
W82-02502 2E

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 5B

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 2F

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 5D

Developing Dam-Break Flood Zone Ordinance,
W82-02585 6F

MOISTURE AVAILABILITY
Irrigation Requirements of Field-Pea for Grain,
W82-02395 2I

Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 2I

MONIMOLIMNION
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

MONITORING
Groundwater Quality in the Severn-Trent Region,
W82-02423 5A

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

MONTANA
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 5B

Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 2F

Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana–Summary Report,
W82-02539 2C

MONTANA WATER PLANNING MODEL
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 6A

MONTGOMERY COUNTY
The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

MORAINES
Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 2F

MORPHOLOGY
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 5D

MOST PROBABLE NUMBER TESTS
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 5A

MOZHAYSK RESERVOIR
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

MUNICIPAL WATER
Municipal Needs,
W82-02513 6E

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 6E

MURDERKILL RIVER ESTUARY
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

MUSSELS
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 5C

Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 5C

NAJAS MARINA
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

NANTICOKE
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 2K

NATURAL STREAMS
The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1B

Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 2I

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 5G

NATURAL WATERS
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural

Water with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 5A

NAVIGATION
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

Sediment--Asset or Liability,
W82-02150 6B

NETWORK DESIGN
Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

NEW ENGLAND
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 3C

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

NEW JERSEY
New Jersey Community Decontaminates Well Water.
W82-02243 5F

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C

NEW MEXICO
Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 3A

Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 6E

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 2F

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 7C

NEW YORK
Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 4C

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 2E

Liming Acid Ponds in New York,
W82-02572 5G

NEW YORK BIGHT
Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 5C

NEW ZEALAND
Water for New Zealand's Plains,
W82-02402 3F

Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

NITRATES
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 5B

Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 5C

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 5B

NITRIFICATION
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

The Effect of Nitrification in the BOD Test,
W82-02384 5D

NITROGEN
Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 5C

NITROGEN COMPOUNDS
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

NITROGEN FIXING BACTERIA
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 5A

NITROGEN REMOVAL
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 3C

NITROUS OXIDE
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 2H

NONHOMOGENEOUS AQUIFERS
Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 2F

NONPOINT POLLUTION SOURCES
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 2A

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 5B

NORTH CAROLINA
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 5B

Wastewater Management in Coastal North Carolina,
W82-02511 5D

Municipal Needs,
W82-02513 6E

Recycling,
W82-02514 6E

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 6E

Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

Efficient Groundwater Utilization,
W82-02520 6D

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

NORTH DAKOTA
Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 7C

NORTHWEST FLORIDA
Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 7C

NUTRIENT REMOVAL
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 3C

Concepts in Aquatic Treatment System Design,
W82-02593 5D

NUTRIENT REQUIREMENTS
The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 2H

The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 2H

NUTRIENTS
Freshwater Inputs and Estuarine Productivity,
W82-02110 2L

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 2L

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 2L

The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 2L

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 5C

Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B

Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 5B

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 5A

Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 5B

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 5B

Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 5B

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 5C

Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 2I

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

OCEAN DUMPING
Sludge: Back into the Ocean,
W82-02577 5E

OG/.LLALA AQUIFER
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

OHIO RIVER
Bank Failure and Erosion on the Ohio River,
W82-02343 2J

OHIO RIVER BASIN
Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, April 28-29, 1981. Cincinnati, Ohio.
W82-02106 2F

OIL AND GAS PRODUCTION
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 5G

OIL POLLUTION
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 5B

OIL SPILLS
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 5B

OIL-WATER INTERFACES
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 5B

OKLAHOMA
Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 5C

OLIGOCHAETES
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 5E

Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 5A

OLIGOTROPHIC LAKES
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 2H

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

ONTARIO
The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 6B

Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B

Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 5E

Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 5B

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 5G

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 2H

History of Human-Use Impacts on Long Point Bay,
W82-02580 5B

OPEN-CHANNEL FLOW
Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 6A

Velocity Profiles with Suspended Sediment,
W82-02581 2J

OPERATING POLICIES
The Effect of EEC Directives on Water Supplies,
W82-02432 6E

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

ORANGE COUNTY WATER DISTRICT
Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 5D

ORDINANCES
Developing Dam-Break Flood Zone Ordinance,
W82-02585 6F

OREGON
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 2H

Energy Costs and Portland Water Supply System,
W82-02586 5F

ORGANIC CARBON
Determination of Dissolved Organic Carbon in Water,
W82-02194 5A

Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 5B

ORGANIC COMPOUNDS
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 5F

ORGANIC MATTER
The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1B

Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 5F

Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 2L

ORGANIC PESTICIDES
Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 5B

ORGANIZATION IDENTIFICATION CODE
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 10D

ORGANIZATIONS
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 10D

OUTFALL SEWERS
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 5G

Flexible Outfall at Aldeburgh,
W82-02415 8A

OUTFALLS
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 5E

OVERLAND FLOW
Water Routing on Diverging-Converging Watersheds,
W82-02200 2A

OXIDATION-REDUCTION POTENTIAL
Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 2K

PACIFIC NORTHWEST
Aerial Photography to Detect Rill Erosion,
W82-02232 7B

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

PALEOENVIRONMENT
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

PARTIAL DIVERSION
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

PARTICLE SIZE
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

PATH OF POLLUTANTS
Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 3C

Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 5B

The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 5B

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 2L

PEACH
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 2I

PEAT BOGS
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

PECONIC BAY ESTUARY
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

PENNSYLVANIA
Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 7C

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

PERCH
Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 5C

PERCH LAKE
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

PERFORMANCE EVALUATION
Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

PERIPHYTON
Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 5C

PERMAFROST
Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 2C

PERMEABILITY
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 2F

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 7C

PERMEABILITY COEFFICIENT
A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 8E

PERMETHRIN
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 5B

PHOSPHORUS
Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 5B

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

PHOSPHORUS REMOVAL
Phosphorus Removal by Activated Alumina,
W82-02313 5D

Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 2H

PHOTOLYSIS
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 5G

PHOTOPLANKTON
Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 5B

PHOTOSYNTHESIS
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

PHYSICAL PROPERTIES
Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 2H

PHYSICOCHEMICAL TREATMENT
Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

PHYTOPLANKTON
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 2H

Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 7B

Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 2H

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 2K

Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 5C

PIEZOMETRIC HEAD
Subdomain Integration Model of Ground-Water Flow,
W82-02550 2F

PIPELINES
42-Mile Water Pipeline for Coal Boom Town.
W82-02359 6D

The Integrity of Existing Distribution Systems,
W82-02450 5F

PIPES
Long Term Performance of Horizontal Drains,
W82-02212 8A

Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 8A

Flexible Outfall at Aldeburgh,
W82-02415 8A

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

PIT RECHARGE
Treated Pit Fluids Meet Water Specifications.
W82-02557 5E

PLANKTON
Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 2H

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 5G

PLANNING

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 6B

PLANT GROWTH

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

PLASTICS

Membrane Liner Seals 278-Acre Reservoir.
W82-02361 8G

POLICY MAKING

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

Disposal of Industrial Effluents - Some Future Problems,
W82-02405 5D

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 6G

POLITICAL ASPECTS

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 6E

POLITICAL CONSTRAINTS

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

POLLEN

130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

POLLUTANT IDENTIFICATION

Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 5A

Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 5A

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A

POLLUTANTS

Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 5A

POLLUTION ABATEMENT

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 5D

POLLUTION LOAD

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

POLSON MORAINE

Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 2F

POLYCHAETES

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

POLYCHLORINATED BIPHENYLS

PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

PONDS

Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 2H

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

POPULATION DENSITY

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 2L

POPULATION DYNAMICS

Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 2H

Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 6G

PORE WATER

A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

POROUS CUP

A More Versatile Soil Water Sampler,
W82-02523 7B

PORTLAND

Energy Costs and Portland Water Supply System,
W82-02586 5F

POTABLE WATER

Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 5B

POTATOES

Aerated Drip Irrigation,
W82-02186 3F

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 3C

POTENTIOMETRIC LEVEL

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 2F

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 7C

POTOMAC RIVER

Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 5B

POTOMAC RIVER BASIN

Point Process Models of Rainfall,
W82-02452 2A

POTOMAC RIVER ESTUARY

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

POULTRY

Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 5A

PRECIPITATION

Accuracy of Point Precipitation Measurements,
W82-02209 2B

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 2B

PREDATION

Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 6G

PREDICTION

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

PRETREATMENT OF WATER

Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

PRIMARY PRODUCTIVITY

Freshwater Inputs and Estuarine Productivity,
W82-02110 2L

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 2H

Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 5C

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

PROBABILITY DISTRIBUTION
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 2J

PRODUCTIVITY
Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 5C

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

PUBLIC INVESTMENT
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 3C

PUBLIC OPINION
New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

PULP AND PAPER INDUSTRY
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 5B

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

PULP WASTES
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 5D

Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 5A

PUMPAGE
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

PUMPING
Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 6E

QUALITY CONTROL
New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 5F

QUANTITATIVE ANALYSIS
Subdomain Integration Model of Ground-Water Flow,
W82-02350 2F

RADIAL GATES
Hydraulic Gates,
W82-02206 8C

RADIOACTIVE TECHNIQUES
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 5A

RADIOACTIVE WASTES
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 5E

Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 5B

RADON
Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 2L

RAINFALL
The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 6G

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 2L

Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 2L

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 2A

The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 2E

Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 2I

RAINFALL DISTRIBUTION
Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 2L

Accuracy of Point Precipitation Measurements,
W82-02209 2B

RAINFALL RATE
Accuracy of Point Precipitation Measurements,
W82-02209 2B

RAINFALL-RUNOFF RELATIONSHIPS
Surface Water Flow from a South Florida Wetland Area,
W82-02121 2E

Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 2A

Point Process Models of Rainfall,
W82-02452 2A

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

RANGE MANAGEMENT
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 2A

Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 3B

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 2C

REAERATION
Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 2H

RECLAIMED WATER
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 3D

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 3C

RECREATION DEMAND
User Reaction to Wild and Scenic River Designation,
W82-02278 6G

RECYCLING
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

Recycling,
W82-02514 6E

RED LAKE
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

REGENERATION
The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 2L

REGIONAL PLANNING
Municipal Needs,
W82-02513 6E

Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

REGULATIONS
Disposal of Industrial Effluents - Some Future Problems,
W82-02405 5D

REMOTE SENSING
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 2E

An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 7B

Aerial Photography to Detect Rill Erosion,
W82-02232 7B

RESERVOIR LININGS
Membrane Liner Seals 278-Acre Reservoir.
W82-02361 8G

RESERVOIR MANAGEMENT
LARM Two-Dimensional Model: An Evaluation,
W82-02597 4A

RESERVOIR OPERATION
Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 6A

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 6A

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

RESERVOIR PROTECTION
Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

RESERVOIR RELEASES
Sediment Transport During a Controlled Reservoir Release,
W82-02196 2J

RESERVOIRS
Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 5C

On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

RESOURCES DEVELOPMENT
Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 2F

Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

REVERSE OSMOSIS
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 5D

An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 5D

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

REVERSE OSMSOSIS
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

REVIEWS
Geothermal Energy: An Old Ally,
W82-02333 2F

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 5B

Trends in Wastewater Collection Systems,
W82-02573 8G

RHODE RIVER
Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 5C

RICE FARMING
Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 6G

RILL EROSION
Aerial Photography to Detect Rill Erosion,
W82-02232 7B

RIVER BASINS
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

RIVER FLOW
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 6G

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 6D

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 2L

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 6G

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 5G

Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 2C

RIVERS
The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 6G

Bank Failure and Erosion on the Ohio River,
W82-02343 2J

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 5A

Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 2E

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

ROCKAWAY TOWNSHIP
New Jersey Community Decontaminates Well Water,
W82-02243 5F

ROSWELL
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

ROUGHNESS COEFFICIENTS
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 2E

ROUTING
Water Routing on Diverging-Converging Watersheds,
W82-02200 2A

RUNOFF
Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 2A

Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 2I

Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 5B

A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 2A

Wetlands Use for Water Management in Florida,
W82-02590 4A

RUNOFF FORECASTING
Flood Event Modeling - A Study of Two Methods,
W82-02291 2A

RURAL AREAS
Wastewater Collection and Treatment in Wayne County,
W82-02554 5D

SACRAMENTO-SAN JOAQUIN ESTUARY
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

SALINE SOILS
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 3F

SALINE WATER
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 2F

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 3C

Salinity Forum: What. How. Why,
W82-02587 6E

SALINE WATER BARRIERS
Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 6G

SALINE WATER INTRUSION
Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 6G

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 2L

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 5G

The Dynamics of Conservative Mixing in Estuaries,
W82-02345 2L

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 5B

SALINITY
Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 6G

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapepeake Bay,
W82-02115 6G

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 6G

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 6G

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 2L

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 2L

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 2L

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 2L

Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 2L

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 2L

SALMON
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

Mt. St. Helens and the Fish,
W82-02508 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

SALT LAKE CITY
A Montly Time Series Model of Municipal Water Demand,
W82-02263 6D

SALT MARSHES
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

SAM RAYBURN RESERVOIR
Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

SAMPLING
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

A More Versatile Soil Water Sampler,
W82-02523 7B

SAN ANTONIO BAY
The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 2L

SAN BERNARDINO MOUNTAINS
Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 2I

SAN FRACISCO BAY
Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 2L

SAN FRANCISCO BAY
The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 2L

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

SAN LUIS VALLEY
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

SAND
Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

SANITARY ENGINEERING
Assessment of the National Water Quality Management Program, Volume 2: Construction Grants,
W82-02182 6E

SANTEE RIVER
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

SATELLITE TECHNOLOGY
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

SCALE PREVENTION
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

SCALING
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 5D

SCALLOP
A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 5B

SCOUR
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

SEA WATER
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 5A

SEALANTS
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

SEASONAL VARIATION
Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 5F

Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 2H

Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

SEAWATER
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 5E

SEDIMENT-CARRYING CAPACITY
Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 2J

SEDIMENT CONCENTRATION
Mt. St. Helens and the Fish,
W82-02508 2J

SEDIMENT CONTROL
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

SEDIMENT EROSION
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

SEDIMENT LOAD
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

SEDIMENT TRANSPORT
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

Sediment Transport During a Controlled Reservoir Release,
W82-02196 2J

Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 2J

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 2J

Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 5B

Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 2A

Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 5B

SEDIMENT YIELD
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 2J

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 2J

SEDIMENTATION
Sediment--Asset or Liability,
W82-02150 6B

Shallow-Depth Sedimentation of Biological Materials,
W82-02336 5D

A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

SEDIMENTS
Sediment--Asset or Liability,
W82-02150 6B

PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 5B

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 5B

SEEPAGE
Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 2H

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 2F

SELENIUM
An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 6F

SEPTIC TANKS
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 5B

Guidelines for Control of Septic Tank Systems,
W82-02599 5B

SETTLING BASINS
Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

SEVERN ESTUARY
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 2L

SEVERN RIVER
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

SEWAGE
Industrial Pretreatment Needs to Be Overhauled at the National Level.
W82-02198 5D

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

SEWAGE BACTERIA
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

SEWAGE EFFLUENT
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

SEWER SYSTEMS
Trends in Wastewater Collection Systems,
W82-02573 8G

SHAGAWA LAKE
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

SHARK RIVER SLOUGH
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 2E

SHELLFISH
Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 4A

SHRIMP
Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 6G

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

SILICA
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 5D

SILICA SCALING
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 5D

SILICON
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 5B

SIMAZINE
Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 5B

SIMULATION
Colorado River Simulation System; An Executive Summary,
W82-02170 6A

Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 5B

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 2F

SINKS
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 2H

Induced Sinkholes: An Engineering Problem,
W82-02559 4B

SLOPES
Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 2J

A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 2A

SLUDGE
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

SLUDGE DISPOSAL
Sludge: Back into the Ocean,
W82-02577 5E

SMALL WATERSHEDS
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 2A

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

SNOW
Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 5B

SNOW COVER
Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 2C

SNOW MANAGEMENT
Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 3B

SNOW SURVEYS
Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 2C

SNOW TRAPS
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 2C

SNOWMELT
Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 2A

Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 2A

SODIUM
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 5B

SOIL ABSORPTION CAPACITY
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 5B

SOIL CHEMISTRY
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

SOIL EROSION
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 2J

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 2J

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 2J

SOIL MANAGEMENT
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 2J

SOIL MOISTURE
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 2C

SOIL PROPERTIES
The Steady State of Deformation,
W82-02235 8D

Relationship of Electrical Dispersion to Soil Properties,
W82-02561 8D

SOIL WATER
Wheat Response to Drought,
W82-02242 2I

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 2F

Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 2G

A More Versatile Soil Water Sampler,
W82-02523 7B

SOIL-WATER-PLANT RELATIONSHIPS
Practical Prediction of Actual Evapotranspiration,
W82-02308 2D

Irrigation Requirements of Field-Pea for Grain,
W82-02395 2I

Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 2I

Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 2I

SOLAR ENERGY
Solar Heat Pond System,
W82-02187 3F

SOLAR RADIATION
Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 2I

SOLUBILITY
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

SONORAN DESERT
Wheat Response to Drought,
W82-02242 2I

SORPTION
PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

SOUND WAVES
Leak Detection - Two Methods That Work,
W82-02521 3D

SOUTH AFRICA
The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 5C

SOUTH CAROLINA
Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 2L

SOUTH DAKOTA
Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 2F

SPAWNING
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 7B

SPECIFIC CAPACITY
Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 7C

SPECTRAL ANALYSIS
An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 5G

SPILLWAYS
Passing Floodwaters Over Embankment Dams,
W82-02204 8A

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

SPIRAL-WOUND ELEMENTS
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

SPORT FISHING
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 7A

SPRING BROOK BASIN
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

SPRINGS
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

SPRINKLER IRRIGATION
Solid Set Irrigation System Design Using Linear Programming,
W82-02273 6A

ST. LAWRENCE ESTUARY
On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 2L

ST. LAWRENCE RIVER
Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 2L

ST LUCIE ESTUARY
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

STATE JURISDICTION
Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 6E
Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 6E
Superfund: What a Mess,
W82-02184 6E
Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 6E
Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 6E

STATISTICAL MODELS
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 6D
The Integrity of Existing Distribution Systems,
W82-02450 5F

STEEL PIPES
42-Mile Water Pipeline for Coal Boom Town.
W82-02359 6D

STORAGE COEFFICIENTS
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 2F

STORM RUNOFF
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B
Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B
Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 2E

STORM WATER
Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 7A
Comparison of Detention Basin Planning and Design Models,
W82-02592 6A
Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

STRATIFICATION
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 2J
Wind-Induced Mixing in Stratified Fluid,
W82-02371 2H

STREAM FISHERIES
Mt. St. Helens and the Fish,
W82-02508 2J
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

STREAMBEDS
Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 7B

STREAMFLOW
The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 6G
Distribution of Joint Run-Lengths of Bivariate Markov Processes,
W82-02191 2E
Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 2A
A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 2E
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

STREAMFLOW DEPLETION
Overview of Freshwater Inflow Depletions,
W82-02152 6D

STREAMFLOW FORECASTING
Point Process Models of Rainfall,
W82-02452 2A
Selecting Seasonal Streamflow Models,
W82-02502 2E

STREAMS
Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 5C
Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 5C
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 5B
Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A
Water Quality of a Southeast Texas Stream,
W82-02570 2K

STRESS ANALYSIS
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 5E

SUBSURFACE DRAINAGE
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 8A
Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 8A
Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 5B

SURFACE DRAINAGE
Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

SURFACE FLOW
Surface Water Flow from a South Florida Wetland Area,
W82-02121 2E

SURFACE-GROUNDWATER RELATIONS
Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, April 28-29, 1981. Cincinnati, Ohio.
W82-02106 2F
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 2F
Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 5A

SURFACE WATER
Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C
Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 7C
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B
Water Resources Data for Utah, Water Year 1979.
W82-02474 7C
Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 7C
Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A
Water Resources Data for Indiana, Water Year 1980.
W82-02492 7C
Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 7C
Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 7C
Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 7C
Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

SUSPENDED LOAD
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

SUSPENDED SEDIMENTS
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 5B

Velocity Profiles with Suspended Sediment,
W82-02581 2J

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 5B

SUSPENDED SOLIDS
The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 2L

The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1B

Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B

Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 5A

A Compendium of Experimental Work on Chemical Precipitation of Sewage,
W82-02370 5D

SWEDEN
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 2K

Jonkoping's Water Supply,
W82-02419 5F

SWINE WASTE
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

SWITZERLAND
New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 5F

SYSTEMS ANALYSIS
Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 6A

TANANA RIVER
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

TEMPERATURE
The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 2H

TEMPERATURE EFFECTS
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 2H

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 8A

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 5C

Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 5C

TEMPERATURE GRADIENT
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 2H

TENNESSEE
LARM Two-Dimensional Model: An Evaluation,
W82-02597 4A

TEXAS
Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 6G

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 6G

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 2L

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 4A

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

Texas to Vote on Water Trust Fund.
W82-02302 6C

Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 2H

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 2F

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 7C

Water Quality of a Southeast Texas Stream,
W82-02570 2K

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

THAILAND
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

THAMES ESTUARY
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 5G

THAMES RIVER
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

THERMAL POLLUTION
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 5C

Multiport Diffuser Mixing Zones in Rivers,
W82-02594 5B

THERMAL POWERPLANTS
Geothermal Energy: An Old Ally,
W82-02333 2F

THERMAL PROPERTIES
Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 2F

THERMAL STRATIFICATION
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

THIOCYANATES
Thiocyanate Bio-Oxidation Kinetics,
W82-02596 5D

TIDAL CURRENTS
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 2L

TIDAL EFFECTS
Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 2L

Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 2L

TIDAL MARSHES
Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 2L

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 2I

TIDES
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

TILE DRAINAGE
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 5B

TIME SERIES ANALYSIS
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 6D

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 5G

TOKYO BAY
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 5A

TOOLIK LAKE
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

TORONTO HARBOR
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 7B

TOXICITY
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 5C

The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 5C

TOXINS
Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 5A

TRACE METALS
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 5C

Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 5B

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 2L

TRACERS
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 5B

TRANSMISSIVITY
A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 8E

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 7C

TRICKLING FILTERS
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

TRIHALOMETHANES
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 5B

TROPHIC LEVEL
Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 2H

On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 5C

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

TURBIDITY
On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 2L

TURBULENT FLOW
Turbulence Model for Flow Over Dredged Channels,
W82-02201 8B

Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 7B

The Mixing Layer of Loch Ness,
W82-02421 2H

U.S. GEOLOGICAL SURVEY
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 10D

UKAI DAM
Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

UNCONFINED AQUIFERS
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 2F

UNDERGROUND WASTE DISPOSAL
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 5E

UNITED KINGDOM
Disposal of Industrial Effluents - Some Future Problems,
W82-02405 5D

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 6G

Groundwater Quality in the Severn-Trent Region,
W82-02423 5A

The Integrity of Existing Distribution Systems,
W82-02450 5F

URBAN AREAS
Analytical Cost Model for Urban Water Supply,
W82-02584 6C

URBAN DRAINAGE
Comparison of Detention Basin Planning and Design Models,
W82-02592 6A

URBAN HYDROLOGY
Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 7A

URBAN PLANNING
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 6E

URBAN RUNOFF
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B

URBAN WATERSHEDS
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

URBANIZATION
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 4D

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C

USSR
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

UTAH
An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 7B

Water Resources Data for Utah, Water Year 1979.
W82-02474 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

VAPOR COMPRESSION EVAPORATION
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 3A

VARIABILITY
A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

VEGETATION
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

VEGETATION EFFECTS
Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 2I

VELOCITY COEFFICIENTS
Velocity Profiles with Suspended Sediment,
W82-02581 2J

VERTICAL TUBE EVAPORATION
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 3A

VIRGINIA
Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 2B

VIRUS
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 5A

VIRUSES
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 5A

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 3C

Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 5A

VITAMINS
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

VOLCANOES
Mt. St. Helens and the Fish,
W82-02508 2J

WALES
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 5C

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

WALLOWA LAKE
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 2H

WASHINGTON
The Dilution/Flushing Technique in Lake Restoration,
W82-02270 2H

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

Ground Water in Washington,
W82-02536 2F

WASHOUTS
Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 2E

WASTE DISPOSAL
Managing Hazardous Wastes,
W82-02252 5E

Treated Pit Fluids Meet Water Specifications.
W82-02557 5E

WASTE MANAGEMENT
Managing Hazardous Wastes,
W82-02252 5E

WASTEWATER
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 5A

Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 5A

Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 5A

WASTEWATER ANALYSIS
Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 5B

Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 5A

A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 5A

WASTEWATER DISPOSAL
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

Industrial Wastewater Pretreatment Service,
W82-02253 5E

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

Wastewater Management in Coastal North Carolina,
W82-02511 5D

Guidelines for Control of Septic Tank Systems,
W82-02599 5B

WASTEWATER FACILITIES
Beddington Sewage-Treatment Works, Canyon: Some Operating Experiences 1969-79,
W82-02410 5D

Wastewater Collection and Treatment in Wayne County,
W82-02554 5D

WASTEWATER IRRIGATION
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 3D

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 3C

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 3C

Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 3C

Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

WASTEWATER LAGOONS
Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 3A

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 5B

Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 5D

WASTEWATER MANAGEMENT
Wastewater Management in Coastal North Carolina,
W82-02511 5D

Trends in Wastewater Collection Systems,
W82-02573 8G

In-Home Conservation and Wastewater Management,
W82-02591 3D

WASTEWATER RENOVATION
Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 5D

Recycling,
W82-02514 6E

WASTEWATER TREATMENT
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 6E

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

Industrial Pretreatment Needs to Be Overhauled at the National Level.
W82-02198 5D

Engineering Design Variables for the Activated Sludge Process.
W82-02199 5D

Processes--Not Products--Biggest Energy-Saving Factors.
W82-02218 5D

Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

Dupont's Wastewater Treatment Approach,
W82-02254 5D

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 5D

Pilot-Scale Investigations with Granular Activated Carbon,
W82-02289 5D

Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 5D

Phosphorus Removal by Activated Alumina,
W82-02313 5D

Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

A Compendium of Experimental Work on Chemical Precipitation of Sewage,
W82-02370 5D

Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 5D

Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 5D

Disposal of Industrial Effluents - Some Future Problems,
W82-02405 5D

Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 5D

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D

Wastewater Management in Coastal North Carolina,
W82-02511 5D

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 5D

Concepts in Aquatic Treatment System Design,
W82-02593 5D

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 5D

WATER
Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 5A

WATER ANALYSES
Water Quality Data, Mackenzie River Basin 1960-1979.
W82-02506 7C

WATER ANALYSIS
Determination of Dissolved Organic Carbon in Water,
W82-02194 5A

Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 5A

Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 7C

Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 2K

Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 5A

WATER CIRCULATION
Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 6G

The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 2H

WATER CONSERVATION
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 3D

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

Rate Structures and Demand Reduction,
W82-02517 6C

Water Conservation Program of the City of Greensboro,
W82-02518 3D

Water Savings in the Orange Water and Sewer Authority,
W82-02519 3D

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

In-Home Conservation and Wastewater Management,
W82-02591 3D

WATER COSTS
Cost of Small Water Supply Treatment Systems,
W82-02318 5F

Analytical Cost Model for Urban Water Supply,
W82-02584 6C

WATER CURRENTS
The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 7B

WATER DEFICIT
Rate Structures and Demand Reduction,
W82-02517 6C

WATER DEMAND
Water Management on the Columbia River,
W82-02112 6D

Overview of Freshwater Inflow Depletions,
W82-02152 6D

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 6D

A Monthly Time Series Model of Municipal Water Demand,
W82-02263 6D

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

Efficient Groundwater Utilization,
W82-02520 6D

WATER DISTRIBUTION
Loop Equations with Unknown Pipe Characteristics,
W82-02258 3F

How Computers Have Changed Water Works Operations,
W82-02276 5F

Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

Analytical Cost Model for Urban Water Supply,
W82-02584 6C

Energy Costs and Portland Water Supply System,
W82-02586 5F

WATER HARVESTING
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 2C

WATER LAW
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 5G

Management of Interstate Aquifer Systems,
W82-02578 4B

WATER LEVEL
Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 2F

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 2F

Ground-Water Data for Michigan 1980,
W82-02467 2F

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

WATER LOSS
Water Conservation Program of the City of Greensboro,
W82-02518 3D

Leak Detection - Two Methods That Work,
W82-02521 3D

WATER MANAGEMENT
Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 6E

Water Management on the Columbia River,
W82-02112 6D

Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 6E

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 6G

Colorado River Simulation System; An Executive Summary,
W82-02170 6A

Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

How Computers Have Changed Water Works Operations,
W82-02276 5F

Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 6A

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 5B

Optimal Stream-Aquifer Development,
W82-02575 6A

Energy Costs and Portland Water Supply System,
W82-02586 5F

Wetlands Use for Water Management in Florida,
W82-02590 4A

WATER METERING

Water Savings in the Orange Water and Sewer Authority,
W82-02519 3D

WATER POLICY

Adjusting Government Role in Water Law,
W82-02256 6E

Texas to Vote on Water Trust Fund,
W82-02302 6C

Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

Salinity Forum: What. How. Why,
W82-02587 6E

WATER POLLUTION

The Effect of EEC Directives on Water Supplies,
W82-02432 6E

The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 5E

WATER POLLUTION CONTROL

Supreme Court Clarifies Water Act Requirement,
W82-02257 6E

PVC Cover Causes Leachate Retreat,
W82-02321 5E

Denmark's State of the Environment,
W82-02401 5B

Effluent Charging Systems and Their Administrative Implications,
W82-02403 6C

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 5D

WATER POLLUTION EFFECTS

Environmental Control Technology Development for Geothermal Energy,
W82-02197 5C

A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 5C

Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

WATER POLLUTION PREVENTION

Environmental Control Technology Development for Geothermal Energy,
W82-02197 5C

Managing Hazardous Wastes,
W82-02252 5E

Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 5G

WATER POLLUTION SOURCES

Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 5B

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 5B

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 5B

WATER POTENTIAL

Practical Prediction of Actual Evapotranspiration,
W82-02308 2D

WATER POTENTIALS

Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 2I

The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 2I

Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 2D

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 2I

WATER QUALITY

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

Denmark's State of the Environment,
W82-02401 5B

Groundwater Quality in the Severn-Trent Region,
W82-02423 5A

Waterborne Disease Is Prevalent in Egypt,
W82-02435 5C

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 7C

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 2F

Ground-Water Data for Michigan 1980,
W82-02467 2F

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 2K

Water Resources Data for Utah, Water Year 1979.
W82-02474 7C

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 7C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

Water Quality Data, Mackenzie River Basin 1960-1979.
W82-02506 7C

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 6G

Water Quality of a Southeast Texas Stream,
W82-02570 2K

WATER QUALITY CONTROL
An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 5G

Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 5G

The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 5G

Salinity Forum: What. How. Why,
W82-02587 6E

Guidelines for Control of Septic Tank Systems,
W82-02599 5B

WATER QUALITY MANAGEMENT
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 10C

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 5G

The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 6A

WATER QUALITY STANDARDS
Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 6E

Compliance Strategy for Clean Water.
W82-02185 6E

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

Industrial Pretreatment Needs to Be Overhauled at the National Level.
W82-02198 5D

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 5B

An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 6F

WATER RATES
Rate Structures and Demand Reduction,
W82-02517 6C

WATER RESOURCE DEVELOPMENT
Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 6E

WATER RESOURCES DEVELOPMENT
Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

Overview of Freshwater Inflow Depletions,
W82-02152 6D

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 6G

Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 5C

Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 6E

Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

Optimal Stream-Aquifer Development,
W82-02575 6A

WATER REUSE
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 3C

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 3C

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 5D

Recycling,
W82-02514 6E

Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 3C

WATER RIGHTS
Water Rights on Indian Allotments,
W82-02363 6E

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 6A

Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 6E

WATER SAMPLING
Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 5A

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 5F

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

WATER SUPPLY
Water Management on the Columbia River,
W82-02112 6D

Overview of Freshwater Inflow Depletions,
W82-02152 6D

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 6D

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

The Effect of EEC Directives on Water Supplies,
W82-02432 6E

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 5F

The Integrity of Existing Distribution Systems,
W82-02450 5F

Water Conservation Program of the City of Greensboro,
W82-02518 3D

Water Savings in the Orange Water and Sewer Authority,
W82-02519 3D

Efficient Groundwater Utilization,
W82-02520 6D

Analytical Cost Model for Urban Water Supply,
W82-02584 6C

WATER SUPPLY DEVELOPMENT
Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 3A

Efficient Groundwater Utilization,
W82-02520 6D

WATER SUPPLY SYSTEMS
Cost of Small Water Supply Treatment Systems,
W82-02318 5F

WATER TABLE
Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 8A

Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 2H

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow

with Applications to Flow Through Ditch-Drained Soils,
W82-02283 2F

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 7C

WATER TABLE GRADIENT
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 5B

WATER TABLE PROFILES
Induced Sinkholes: An Engineering Problem,
W82-02559 4B

WATER TEMPERATURE
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 2H

LARM Two-Dimensional Model: An Evaluation,
W82-02597 4A

WATER TRANSPORT
42-Mile Water Pipeline for Coal Boom Town.
W82-02359 6D

WATER TREATMENT
Processes--Not Products--Biggest Energy-Saving Factors.
W82-02218 5D

Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 5F

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

Phosphorus Removal by Activated Alumina,
W82-02313 5D

Cost of Small Water Supply Treatment Systems,
W82-02318 5F

Shallow-Depth Sedimentation of Biological Materials,
W82-02336 5D

Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 5F

Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 5F

New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 5F

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 5F

Methods for Treatment of Color in Groundwater,
W82-02532 5F

Trihalomethane Precursor Control by Adsorption,
W82-02598 5F

WATER TREATMENT FACILITIES
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 5F

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 5F

Jonkoping's Water Supply,
W82-02419 5F

WATER USE
An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

Water Conservation Program of the City of Greensboro,
W82-02518 3D

WATER YIELD
Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 7C

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 2A

WATERLOGGING
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

WATERPOLLUTION PREVENTION
Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 6E

WATERSHED MANAGEMENT
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

Lake Tahoe Preservation Bill Enacted.
W82-02244 6E

Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 4D

WATERSHEDS
Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 2A

Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 5B

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 2A

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 2C

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 2H

WAYNE COUNTY
Wastewater Collection and Treatment in Wayne County,
W82-02554 5D

WEATHER FORECASTING
Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 7A

WEED CONTROL
The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 5C

WELL WATER
New Jersey Community Decontaminates Well Water.
W82-02243 5F

WELLS
Water for New Zealand's Plains,
W82-02402 3F

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 2F

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 2F

Ground-Water Data for Michigan 1980,
W82-02467 2F

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 2K

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

WEST VIRGINIA
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

WETLANDS
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 4A

Surface Water Flow from a South Florida Wetland Area,
W82-02121 2E

Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 2J

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 4A

The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 6B

Wetlands Use for Water Management in Florida,
W82-02590 4A

Concepts in Aquatic Treatment System Design,
W82-02593 5D

WHEAT
Wheat Response to Drought,
W82-02242 2I

Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 2I

WILD RIVERS
User Reaction to Wild and Scenic River Designation,
W82-02278 6G

WILDLIFE
Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

WILDLIFE CONSERVATION
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

WILDLIFE HABITATS
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

WILLIAMS LAKE
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

WILTON CREEK
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B

WIND
Wind-Induced Mixing in Stratified Fluid,
W82-02371 2H

WISCONSIN
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

WITHLACOOCHEE RIVER
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

WYOMING
42-Mile Water Pipeline for Coal Boom Town.
W82-02359 6D

Water Resources Data for Wyoming, Water Year 1980–Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 7C

YUGOSLAVIA
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 2H

YUMA
Development of High Salt Rejection Reverse Osmosis Membranes–Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

ZINC
A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 5B

ZOOPLANKTON
The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 6G

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 2L

Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 2H

The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 2H

Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 2L

Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

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AUTHOR INDEX

ABBAS, M. N.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 5A

ABU-HILAL, A. H.
The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 5A

ADAM, D. P.
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

ADDIEGO, J. C.
Colorado River Simulation System; An Executive Summary,
W82-02170 6A

AFOUDA, A. A.
Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 2A

AGAMI, M.
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

AGIRALIOGLU, N.
Water Routing on Diverging-Converging Watersheds,
W82-02200 2A

AGUADO, J.
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 5D

AHMED, A. M.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 3F

AIBA, S.
Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 5B

ALEKSEEV, V. S.
Methods of Restoring the Delivery of Drainage Wells,
W82-02385 4A

ALLEN, H. L.
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 2H

ALLENBY, K. G.
Some Analyses of Aquatic Plants and Their Waters,
W82-02293 2H

ALLERUP, P.
Accuracy of Point Precipitation Measurements,
W82-02209 2B

ALONSO, C. V.
Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 2J

AMIN, M. I.
Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

AMMON, D. C.
Wetlands Use for Water Management in Florida,
W82-02590 4A

AMY, V. P.
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 2F

ANDERSON, D. L.
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 3D

ANDERSON, L. W. J.
Control of Aquatic Weeds with Hexazinone,
W82-02326 4A

ANDERSON, M. P.
The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 2F

ANDERSON, W.
Aerated Drip Irrigation,
W82-02186 3F

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

ANDO, A.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 5A

ANDREWS, M. J.
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 5G

ANDREWS, R. W.
Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 5B

ANGEL, S.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

ANTHONY, R. M.
Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

APPAN, S. G.
A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

ARBHABHIRAMA, A.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

ARGO, D. G.
Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 5D

ARKLEY, R. J.
Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 2I

ARMSTRONG, N. E.
Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

ARULANANDAN, K.
Relationship of Electrical Dispersion to Soil Properties,
W82-02561 8D

ASPLUND, R.
Composite Sampling of Highway Runoff,
W82-02230 7B

ATHANAS, L. C.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeake Bay,
W82-02115 6G

AUGUSTINE, M.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

AVERETT, R. C.
Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

BAGG, J.
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 5B

BAKER, J. L.
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 5B

BAKOS, L.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 5A

BALLING, S. S.
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

BANIN, A.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

BANKS, H. O.
Management of Interstate Aquifer Systems,
W82-02578 4B

BARAM, M. S.
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 3C

BARCLAY, L. A. JR.
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

BARCLAY, W. R.
The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 2L

BARKER, J. A.
A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 8E

BARNBY, M. A.
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

BARNES, I.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

BARNES, K. A.
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 5A

BARRETT, H. B.
History of Human-Use Impacts on Long Point Bay,
W82-02580 5B

BARRETT, P. R. F.
Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 4A

BARRETT, R. K.
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 8A

BARRY, J. J.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 5B

BARTH, E. F.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

BASS, D.
Water Quality of a Southeast Texas Stream,
W82-02570 2K

BATTAGLIA, G.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

BATTEN, C.
Recycling,
W82-02514 6E

BAYAZIT, M.
Distribution of Joint Run-Lengths of Bivariate Markov Processes,
W82-02191 2E

BAYHA, K.
Overview of Freshwater Inflow Depletions,
W82-02152 6D

BECKER, R. H.
User Reaction to Wild and Scenic River Designation,
W82-02278 6G

BEER, S.
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

BELANGER, T. V.
Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 2H

BELLAN-SANTINI, D.
Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

BELLES, R. G.
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

BENEFIELD, L.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

BENFIELD, E. F.
Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 5C

BENNETT, E.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

BENNETT, J. T.
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

BENSON, N. G.
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

BERGLING, S.
Jonkoping's Water Supply,
W82-02419 5F

BESCHTA, R. L.
Sediment Transport During a Controlled Reservoir Release,
W82-02196 2J

BESHA, J. A.
Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

BHOWMIK, N. G.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

BIDINGER, F.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 2I

BIDWELL, R.
Effluent Charging Systems and Their Administrative Implications,
W82-02403 6C

BIGGS, A. I.
An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 6G

BIGGS, R. B.
Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 2L

BILLINGSLEY, E.
Water Savings in the Orange Water and Sewer Authority,
W82-02519 3D

BININI, A. P.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

BIRD, P. G.
The Effect of Nitrification in the BOD Test,
W82-02384 5D

BISHOP, C. T.
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 5E

BISHOP, R.
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 5E

BISHOP, S.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

BISWAS, A. K.
Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 6A

BITTON, G.
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 5A

BLAHM, T. H.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

BLAKE, L. M.
Liming Acid Ponds in New York,
W82-02572 5G

BLEIL, D. F.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeapeake Bay,
W82-02115 6G

BLINN, D. W.
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 5G

BLINOV, I. F.
Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 8A

BLOMO, V. J.
Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 6G

BLUNT, D. J.
Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

BOALCH, R.
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 5C

BOARDMAN, D. C.
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

BOGNER, W. C.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

BONDELID, T. R.
Comparison of Detention Basin Planning and Design Models,
W82-02592 6A

BOOKER, D. I. J.
Beddington Sewage-Treatment Works, Canyon: Some Operating Experiences 1969-79,
W82-02410 5D

BOOTH, J.
Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 6E

BOTTCHER, A. B.
Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 5B

BOUTRON, C.
Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 5B

BOWEN, G. E.
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 10C

BOYD, C. E.
Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 5B

BOYD, D. W.
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 6A

BOYLE, W. C.
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 3D

BOYNTON, W. R.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

BRADFORD, W. L.
Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 2F

BRATBY, J. R.
Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 5F

BRAUN, T.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 5A

BREEN, C. M.
The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 5C

BREIMBURST, L. H.
Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

BREWSTER, M. R.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

BREZONIK, P. L.
Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

BRICKER, O. P.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

BRITTON, A.
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

BROWDER, J. A.
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

BROWER, R. D.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

BROWN, M. P.
Automated Stream Diversion for Reservoir Protection,
W82-02600 3G

BRUNO, S. F.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

BRUVOLD, W. H.
Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 3C

BUBECK, R. C.
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

BUISSON, R. A. JR.
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

BULL, D. L.
Fate of Diflubenzuron in Water,
W82-02216 5B

BUNGAY, H. R.
Shallow-Depth Sedimentation of Biological Materials,
W82-02336 5D

BURKE, J. B.
Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 2L

BURRELL, V. G. JR.
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

BURRIS, C. B.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

BURROWS, R. L.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

BUSCH, D. E.
Metabolism of a Desert Stream,
W82-02349 1A

BUTLER, J.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

BUZUN, J.
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

BYNOE, M. C.
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B

BYRNE, R. P.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

CADOTTE, J. E.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

CAIRO, P. R.
Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 5F

CALL, F. J.
Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

CAPLENAS, N. R.
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 5B

CAPRIO, J. M.
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 2C

CARLSON, R. E.
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 5A

CARMACK, E. C.
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

CARPENTER, R.
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

CARROLL, B. R.
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 5B

CARROLL, J. D. JR.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

CARTWRIGHT, K.
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 5E

CASEY, H.
Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 5C

The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 5B

CASSANI, J. R.
Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 4A

CEDARHOLM, C. J.
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

CENGIZ, H. S.
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 2I

CHABRECK, R. H.
Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 6G

CHAMBERLAIN, C.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

CHAMP, M. A.
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the

Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

CHAN, S.
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 5C

CHAN, Y. K.
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 2H

CHANG, L. T.
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 5A

CHANGNON, S. A. JR.
Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 7A

CHARLTON, J. A.
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 5E

CHEATHAM, L. R.
Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 5D

CHENEY, R. W.
Colorado River Simulation System; An Executive Summary,
W82-02170 6A

CHESTER, A. J.
Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 2L

CHEW, D. L.
Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

CHILDRESS, W. M.
Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 2L

Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 2H

CLAPP, C. E.
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 3C

CLARK, D. L.
Composite Sampling of Highway Runoff,
W82-02230 7B

CLARK, R. M.
Analytical Cost Model for Urban Water Supply,
W82-02584 6C

Cost of Small Water Supply Treatment Systems,
W82-02318 5F

CLARKE, G. K. C.
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 2C

CLARKE, R. T.
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 5B

CLENNETT, C.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D

CLINE, T. B.
Selecting Seasonal Streamflow Models,
W82-02502 2E

COATES, K.
Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 5A

COCHRANE, A.
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

COE, C. J.
The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 7C

COHEN, H.
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 5G

COLE, G. B.
Leak Detection - Two Methods That Work,
W82-02521 3D

COLEMAN, N. L.
Velocity Profiles with Suspended Sediment,
W82-02581 2J

COLEY, T. C.
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

COLLIE, A.
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

COLLINS, J. N.
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

COLT, J.
Concepts in Aquatic Treatment System Design,
W82-02593 5D

COLVIN, T. S.
Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 2I

COMBE, A. J. III.
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

CONNER, W. H.
Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 2H

CONTRATTO, P. K.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

COPE, J.
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 7C

CORBET, S. A.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

CORRELL, D. L.
Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 5C

COSBY, R. L.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

COSKUNOGLU, O.
Optimal Stream-Aquifer Development,
W82-02575 6A

COURTNEY, C. M.
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

COWAN, M. S.
Colorado River Simulation System; An Executive Summary,
W82-02170 6A

CRAMER, G. W.
Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 2H

CRANDALL, M. E.
Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 4A

CRANE, S. R.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

CROONENBERGHS, R. E.
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 5B

CUKER, B. E.
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

CUNNINGHAM, R.
Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 2J

CURRY, R. R.
Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 2F

CURTIS, L. L.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

D'ANGLEJAN, B.
On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 2L

DADDIO, E.
Surface Water Flow from a South Florida Wetland Area,
W82-02121 2E

DAHM, C. N.
Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 5B

DAIBER, F. C.
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

DAMPIER, B.
Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 5C

DARBY, W. P.
In-Home Conservation and Wastewater Management,
W82-02591 3D

DARNELL, R. M.
Strategies for the Management of Estuaries,
W82-02166 6F

DAVIS, A. L.
Flexible Outfall at Aldeburgh,
W82-02415 8A

DAVOREN, W. T.
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

DAWSON, F. H.
The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1B

DAY, J. W. JR.
Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 2H

DE JONG, T. M.
Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 2I

DE TURVILLE, C. M.
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 5C

DEBOL'SKAYA, E. I.
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 2J

DEE, J.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

DELFINO, J. J.
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 5A

DENDY, F. E.
Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 2J

DIAMANT, B. Z.
Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 6G

DICK, M. W.
Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 2H

DINGESS, J. M.
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

DODGE, K. A.
Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

DONAHUE, J. R.
Comparison of Detention Basin Planning and Design Models,
W82-02592 6A

DORNSEIF, B.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

DOYLE, J. T.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 2A

DRAKE, B. G.
Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 2I

DRYNAN, R. G.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

DUDDRIDGE, J. E.
Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 5B

DUERR, A. D.
Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

DUFOUR, A. P.
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 5B

DUNKEL, B. W.
Industrial Wastewater Pretreatment Service,
W82-02253 5E

DUNLAP, L. E.
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

DUNLAP, W. J.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

DUNN, B.
Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 4C

DUNN, J.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

DURKIN, J. T.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

DURVE, V. S.
The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 5C

DUSEK, D. A.
A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 3F

EDEN, G. E.
Disposal of Industrial Effluents - Some Future Problems,
W82-02405 5D

EDWARDS, M. D.
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 10D

EDWARDS, R. E.
The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 2L

EDZWALD, J. K.
Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 5F

ELEK, A.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 5A

ELGERSHUIZEN, J. H. B. W.
Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 6G

ELLIOT, W. M.
Energy Costs and Portland Water Supply System,
W82-02586 5F

ELLIS, D. V.
Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 5A

EMMETT, R. L.
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

EMMETT, W. W.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

EMRICH, G. H.
PVC Cover Causes Leachate Retreat,
W82-02321 5E

ENFIELD, C. G.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

ETZOLD, D. J.
Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 6B

EVANS, R. L.
Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

EWEL, K. C.
Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

FALKENMARK, M.
International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 5C

FARRAH, S. R.
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 5A

FARRAR, C. D.
Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

FEDERER, C. A.
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

FEELY, R. A.
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

FEIGIN, A.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 3C

FELICIANO, D. V.
Sludge: Back into the Ocean,
W82-02577 5E

FERGUSON, J.
Composite Sampling of Highway Runoff,
W82-02230 7B

FISCHER, R. A.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 2I

FISHER, F. W.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

FISHER, N. S.
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

FISHER, S. G.
Metabolism of a Desert Stream,
W82-02349 1A

FITZPATRICK, L. C.
Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 2H

FLEMER, D. A.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

FLIERMANS, C. B.
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

FLINT, R. W.
Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 2L

FONTAINE, T. D. III
Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

FORD, D. T.
Interactive Nonstructural Flood-Control Planning,
W82-02320 6F

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

FOSTER, D. A.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

FOSTER, G. R.
Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 2J

FRANKLIN, W. T.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02435 6A

FRAPE, S. K.
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

FRAZIER, B. E.
Aerial Photography to Detect Rill Erosion,
W82-02232 7B

FRINK, C. R.
PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

FRUGE, D. W.
Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

FURUSE, K.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 5A

FUSILLO, T. V.
Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C

GABRYSCH, R. K.
Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area. Texas, Spring 1981,
W82-02459 2F

GAL'PERIN, I. R.
Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 8A

GALLUCCI, K. K.
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 5A

GAMBRELL, R. P.
Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

GANGAWARE, T. R.
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 10C

GANGNON, M.
Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 2L

GARLAND, B.
Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

GARSIDE, C.
Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 5C

GARTEN, C. T. JR.
Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 5B

GARTON, J. E.
Summer Reseration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 2H

GAUDET, J. J.
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 2K

GETCHES, D. H.
Water Rights on Indian Allotments,
W82-02363 6E

GILBERT, T. L.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 2A

GILES, J. E.
Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 6A

GILL, M. A.
Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 2F

GILLEY, J. R.
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 3C

GILLIAM, J. W.
Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 5B

GILLIES, D. C.
Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

GJESSING, E. T.
The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 5C

GLASER, P. H.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

GLATER, J.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

GLOWA, W.
PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

GOFMAN, E.
Loop Equations with Unknown Pipe Characteristics,
W82-02258 3F

GOGUS, M.
Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 2C

GOLTERMAN, H. L.
Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 5A

GONG, B.
Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 5F

GONSOULIN, F.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

GORDON, J. A.
LARM Two-Dimensional Model: An Evaluation,
W82-02597 4A

GORHAM, E.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

GOTHAM, I. J.
The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 2H

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 2H

GRANT, D. L.
Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 6E

GRANT, M. A.
Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 2F

GRAVES, J. B.
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 5B

GREBENNIKOV, V. T.
Methods of Restoring the Delivery of Drainage Wells,
W82-02385 4A

GREGORY, J. M.
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 2I

GRIGORASH, V. A.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

GROSCHEN, G. E.
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

GRUNWALD, G. K.
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 2C

GUPTA, P. K.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

GUREGHIAN, A. B.
A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 2F

GUYMON, G. L.
Subdomain Integration Model of Ground-Water Flow,
W82-02550 2F

HAACK, B. N.
A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 2A

HAGERTY, D. J.
Bank Failure and Erosion on the Ohio River,
W82-02343 2J

HAITH, D. A.
Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 5B

HALL, A. J.
The Mixing Layer of Loch Ness,
W82-02421 2H

HALLETT, I. C.
Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 2H

HAMMER, M. J.
An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 6F

HAND, J. M.
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 2I

HANSEN, R. D.
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 6D

HANSON, C. L.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 2A

HANSON, R.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

HANSON, R. B.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

HARREL, R. C.
Water Quality of a Southeast Texas Stream,
W82-02570 2K

HARRIS, S. A.
Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 2C

HARTLEY, D. R.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

HARTLEY, E.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

HARTMAN, R.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

HAWKINS, J. E.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D

HAWLEY, R. P.
Energy Costs and Portland Water Supply System,
W82-02586 5F

HAYASHIDA, S.
An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

HAYDOCK, I.
Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 5G

HAYES, E. C.
Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 7C

HEANEY, J. P.
Wetlands Use for Water Management in Florida,
W82-02590 4A

HEARNE, G. A.
Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 2F

HEATH, M. S. JR.
Wastewater Management in Coastal North Carolina,
W82-02511 5D

HEATH, R. C.
Efficient Groundwater Utilization,
W82-02520 6D

HEATHCOTE, I. W.
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 2K

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 2H

HEIDARI, M.
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 5E

HEIDINGER, R. C.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

HEIKAL, M. M.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 3F

HEJL, H. R. JR.
Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

HENRIKSON, L.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

HERRGESELL, P. L.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

HIGGINS, M. R.
Supreme Court Clarifies Water Act Requirement,
W82-02257 6E

HILL, A. R.
Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 5B

HILL, D. O.
Methods for Treatment of Color in Groundwater,
W82-02532 5F

HIMES, W.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

HIMMELBLAU, D. M.
Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 5D

HOESE, H. D.
Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 6G

HOGGATT, R. E.
Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 2E

HOLLIS, G. E.
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 2E

HOLT, J.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

HOPP, W. J.
In-Home Conservation and Wastewater Management,
W82-02591 3D

HORNBERGER, R. J.
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

HORNE, M. W.
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 5B

HORNICK, L. E.
Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 5C

HORNOR, S. G.
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 5E

HROMADKA, T. V. II
Subdomain Integration Model of Ground-Water Flow,
W82-02550 2F

HUBER, W. C.
Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

Wetlands Use for Water Management in Florida,
W82-02590 4A

HUBINGER, D. C.
Dupont's Wastewater Treatment Approach,
W82-02254 5D

HUFF, F. A.
Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 7A

HUFFMAN, G. C.
Ground-Water Data for Michigan 1980,
W82-02467 2F

HUGGETT, R. J.
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 5B

HUGGINS, L. F.
Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 5B

HUKKERI, S. B.
Irrigation Requirements of Field-Pea for Grain,
W82-02395 2I

HULTMAN, C.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

HUTTON, D. G.
Dupont's Wastewater Treatment Approach,
W82-02254 5D

IIDA, S.
Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 5A

IKATSU, H.
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 5A

IRELAND, M. P.
Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

IRWIN, R.
Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 5D

IVIE, G. W.
Fate of Diflubenzuron in Water,
W82-02216 5B

IWATSUBO, R. T.
Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

JACKSON, T. J.
Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 2C

JACKSON, W. L.
Sediment Transport During a Controlled Reservoir Release,
W82-02196 2J

JARMAN, R.
Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 5B

JARMAN, R. T.
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 5C

JENNINGS, M. E.
Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 6G

JEPSEN, C. P.
Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 5F

JOHNSON, D. R.
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 2L

JOHNSON, G.
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 5G

JOHNSON, H. P.
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 5B

JOHNSON, R. W.
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

JOHNSTON, G. L.
Guidelines for Control of Septic Tank Systems,
W82-02599 5B

JOHNSTON, J. B.
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

JONES, E. B.
Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 6A

JONES, G. J.
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

JONES, R.
Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

KALKE, R. D.
The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 6G

KALYUZHNYI, I. L.
Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 2A

KAMIMURA, S.
A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 5B

KANAREK, M. S.
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 5B

KARMELI, D.
Solid Set Irrigation System Design Using Linear Programming,
W82-02273 6A

KATYAL, A. K.
Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 2G

KATZ, G.
Environmental Control Technology Development for Geothermal Energy,
W82-02197 5C

KENDALL, B. M.
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

KENNETT, G. A.
Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 2F

KENNY, A. W.
The Effect of EEC Directives on Water Supplies,
W82-02432 6E

KENT, D.
Water Management on the Columbia River,
W82-02112 6D

KENT, D. H.
Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 6D

KHALID, R. A.
Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

KHAN, M. A.
Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

KIERSPE, G. H.
Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 2L

KIJNE, J. W.
Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 2G

KING, B. D. III.
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

KING, R. S.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

KIPNIS, T.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 3C

KISTLER, R. W.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

KJELSON, M. A.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

KLEIN, C. J.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

KNIGHT, A. W.
The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 2L

KNIGHTON, M. D.
A More Versatile Soil Water Sampler,
W82-02523 7B

KNOOP, K. D.
Sediment Transport During a Controlled Reservoir Release,
W82-02196 2J

KNOWLES, R.
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 2H

KOGURE, K.
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 5A

KOHLHORST, D. W.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

KOIDA, K. N.
Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 6A

KORENAGA, T.
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 5A

KOTHANDARAMAN, V.
Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

KOUTITAS, C.
Turbulence Model for Flow Over Dredged Channels,
W82-02201 8B

KRANENBURG, C.
Wind-Induced Mixing in Stratified Fluid,
W82-02371 2H

KREUL, B.
Solar Heat Pond System,
W82-02187 3F

KREUTZWISER, R.
The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 6B

KROMM, D. E.
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

KULKARNI, V. N.
Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

KVENVOLDEN, K. A.
Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

LABADIE, J. W.
Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 6A

LABAUGH, J. W.
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

LACKINGTON, D. W.
The Integrity of Existing Distribution Systems,
W82-02450 5F

LACROIX, G.
Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 2L

LAFLEN, J. M.
Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 2I

LAGREGA, M. D.
Managing Hazardous Wastes,
W82-02252 5E

LAMM, F. R.
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 2I

LANCASHIRE, P. D.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

LAPHAM, W. W.
Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 4A

LARGE, J. M.
The Integrity of Existing Distribution Systems,
W82-02450 5F

LARRANCE, J. D.
Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 2L

LARSEN, D. P.
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

LARSEN, P.
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 4A

LARSON, D. W.
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 2H

LASZLO, E.
Geothermal Energy: An Old Ally,
W82-02333 2F

LAWRENCE, D. F.
Salinity Forum: What. How. Why,
W82-02587 6E

LAX, F.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

LEAN, D. R. S.
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 2H

LEBEDEVA, T. V.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

LEDERMAN, P. B.
Managing Hazardous Wastes,
W82-02252 5E

LEE, R. F.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

LEGRAND, H. E.
Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 2F

LEONARDSON, L.
Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 2K

LEVI, A.
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 5D

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 5D

LEVINGS, J. F.
Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

LEWIN, J.
Hydraulic Gates,
W82-02206 8C

LEWIS, D. H.
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

LEWIS, W. M.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

LIN, J. S.
Determination of Dissolved Organic Carbon in Water,
W82-02194 5A

LINDEN, D. R.
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 3C

LINDSEY, J. L.
Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 4A

LINGEMAN, R.
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 2H

LINSTEDT, D.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

LINTON, T. L.
A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

LIVINGSTON, R. K.
Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

LLOYD, J. W.
The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 2F

LODER, T. C.
The Dynamics of Conservative Mixing in Estuaries,
W82-02345 2L

LORDA, E.
A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 5C

LOUCKS, O. L.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

LOWING, M. J.
Flood Event Modeling - A Study of Two Methods,
W82-02291 2A

LUBON, P.
Thiocyanate Bio-Oxidation Kinetics,
W82-02596 5D

LUCAS, J. L.
Groundwater Quality in the Severn-Trent Region,
W82-02423 5A

LUCCHITTA, I.
Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 2A

LUDWIG, R.
Concepts in Aquatic Treatment System Design,
W82-02593 5D

LUND, J. W. G.
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 5A

LUNSFORD, C. A.
Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 5B

MACE, H. A. F.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

MACKIERNAN, G. B.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeake Bay,
W82-02115 6G

MADSEN, H.
Accuracy of Point Precipitation Measurements,
W82-02209 2B

MAHER, W. A.
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 5B

MAJERLES, R. J.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

MALONE, T. C.
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

MALUEG, K. W.
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

MALY, E. J.
The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 7B

MAR, B. W.
Composite Sampling of Highway Runoff,
W82-02230 7B

MARINER, R. H.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

MARKER, A. F. H.
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 5B

MARSH, D.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 5D

MARSH, P.
Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 2A

MARTIN, C. W.
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

MARTIN, L. J.
Ground Water in Washington,
W82-02536 2F

MARTIN, S.
Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 5B

MASHNI, C. I.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

MASON, S.
Effluent Charging Systems and Their Administrative Implications,
W82-02403 6C

MASSOTH, G. J.
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

MATHEWS, W. H.
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 2C

MATSUO, T.
An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 5G

MATTHEWS, G. A.
The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 2L

MATTRAW, H. C. JR.
Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B

MATTSON, L.
Thiocyanate Bio-Oxidation Kinetics,
W82-02596 5D

MCCALLUM, R.
Water for New Zealand's Plains,
W82-02402 3F

MCCANN, R. C.
Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 2A

MCCONNELL, R. J.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

MCCOOL, D. K.
Aerial Photography to Detect Rill Erosion,
W82-02232 7B

MCCRAY, S. B.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

MCCUEN, R. H.
Comparison of Detention Basin Planning and Design Models,
W82-02592 6A

MCCUTCHAN, J. W.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

MCGARRY, R.
Rate Structures and Demand Reduction,
W82-02517 6C

MCGUFFEY, V. C.
Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

MCKNIGHT, D.
Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 5C

MCMAHON, G. F.
Developing Dam-Break Flood Zone Ordinance,
W82-02585 6F

MCQUEEN, D. J.
Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 5G

MEAD, G. C.
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 5A

MEDINA, M. A. JR.
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

MEIN, R. G.
Flood Event Modeling - A Study of Two Methods,
W82-02291 2A

MEIRI, M.
Phosphorus Removal by Activated Alumina,
W82-02313 5D

MEL'NICHENKO, K. I.
High-Head Vertical Lift Gates,
W82-02388 8A

MELACK, J. M.
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 2K

MENZEL, D. C.
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

MEYER-ARENDT, K.
Sediment--Asset or Liability,
W82-02150 6B

MEYER, P. A.
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

MICKLEY, M. C.
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 5D

MIEREMET, R. B.
Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 6E

MIHURSKY, J. A.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

MILLER, L. W.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

MILLER, R. A.
Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

MILLER, T. Y. JR.
Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 4A

MILLS, W. C.
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 2J

MILSTEAD, C. E.
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

MINDLER, A. B.
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 3A

MING-KO, W.
Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 2A

MITCHELL, G. F.
Methods for Treatment of Color in Groundwater,
W82-02532 5F

MITCHELL, M. J.
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 5E

MIYAMOTO, H.
An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

MOE, P. G.
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

MONKE, E. J.
Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 5B

MONTGOMERY, J. R.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

MOORE, B. E.
Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 3C

MOORE, D.
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

MORAND, J. M.
Cost of Small Water Supply Treatment Systems,
W82-02318 5F

MOREL-SEYTOUX, H. J.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

MORLEY, P. J.
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 7C

MORRIS, J.
Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

MORRIS, K.
Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 5B

MOZLEY, S. C.
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

MUCHMORE, C. B.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

MUDRY, J.
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 2F

MUNTEANU, N.
The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 7B

MUNTER, J. A.
The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 2F

MURPHREE, C. E.
Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 2J

MURPHY, P. J.
Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

MUSICK, J. T.
A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 3F

MUSTY, P. R.
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 7C

MUTCHLER, C. K.
Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 2J

MYERS, A.
Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 5B

MYERS, B. M.
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 10D

NARAYANAN, R.
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 6D

NARKIS, N.
Phosphorus Removal by Activated Alumina,
W82-02313 5D

NAVOY, A. S.
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

NAVROT, J.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

NEALE, P. J.
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

NEFF, E. L.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 2A

NEIBLING, W. H.
Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 2J

NEILL, W. H.
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 2L

NELSON, P. O.
Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 5D

NEUFELD, R. D.
Thiocyanate Bio-Oxidation Kinetics,
W82-02596 5D

NEWTON, J. G.
Induced Sinkholes: An Engineering Problem,
W82-02559 4B

NIERSTEDT, R. J.
Wastewater Management in Coastal North Carolina,
W82-02511 5D

NIXON, S. W.
Freshwater Inputs and Estuarine Productivity,
W82-02110 2L

NOEL, D. S.
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

NOI, Y.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

NORWINE, J.
Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 2L

NYMAN, H. G.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

O'CONNOR, B.
Turbulence Model for Flow Over Dredged Channels,
W82-02201 8B

O'MELIA, C. R.
Wastewater Management in Coastal North Carolina,
W82-02511 5D

ODA, K.
Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 5A

OFFICER, C. B.
Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 2L

OGATA, S.
An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

OHTAKE, H.
Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 5B

OKUN, D. A.
Wastewater Management in Coastal North Carolina,
W82-02511 5D

OLIVIERI, A. W.
Guidelines for Control of Septic Tank Systems,
W82-02599 5B

ONGLEY, E. D.
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B

ORON, G.
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 5D

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 5D

Solid Set Irrigation System Design Using Linear Programming,
W82-02273 6A

OSAWA, S.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 5A

OSCARSON, H. G.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

OTTON, E. G.
The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

OUTCALT, S. I.
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 2H

OUTH, D. D.
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

PACKER, D. M.
Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

PAGE, G. W.
Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 5A

PALEN, G. M.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 5B

PALIN, A. T.
New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 5A

PALIWAL, K. V.
Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 3C

PALMER, M. A.
Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 2L

PALMER, M. D.
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 7B

PAMATMAT, M. M.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

PANDE, J.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

PANEK, F. M.
The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 7A

PANT, M. C.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

PARIZEK, R. R.
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

PARKS, B.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

PARR, A. D.
Multiport Diffuser Mixing Zones in Rivers,
W82-02594 5B

PATE, P. P.
Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

PATEL, I. C.
Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

PATRICK, W. H. JR.
Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

PATTERSON, R. J.
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

PAVLOVA, K. K.
Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 2A

PEARSON, W. D.
Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 2H

PEAVY, H. S.
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 5B

PERCIVAL, J. B.
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 5B

PERRIN, R. M. S.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

PESCOD, M. B.
The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 6A

PETERS, N. E.
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 5B

PETERSEN, J. C.
Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A

PETERSEN, R. J.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

PETTYJOHN, W. A.
Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 2F

PFAENDER, F. K.
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 5A

PHARAOH, P. L. G.
pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 5F

PHEIFFER, T. H.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

PHIEN, H. N.
A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 2E

PLAGGEMEYER, T. G.
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 6A

POLGAR, T. T.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

POLLER, M. H.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

POPE, D. H.
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

POULOS, S. J.
The Steady State of Deformation,
W82-02235 8D

POULSEN, E.
Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 5C

PRAHL, F. G.
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

PRAVIDIVETS, Y. P.
Passing Floodwaters Over Embankment Dams,
W82-02204 8A

PRESSER, T. S.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

PRICE, M. T.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

PUCKETT, L. J.
Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 2B

PYRKIN, YU. G.
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 2J

QUAVE, S. A.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

QUIGLEY, T. M.
Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 2I

QUIMBY, P. C. JR.
Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 4A

RABALAIS, S. C.
Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 2L

RADOSEVICH, G. E.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

RAFFERTY, M. R.
Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

RANDTKE, S. J.
Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 5F

RAPER, W. G. C.
Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 5F

RAQUEL, P. F.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

RATHOD, K. S.
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 2F

RATTRAY, M. JR.
Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 2L

RAWLS, W. J.
Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 2C

RAYBURN, R.
Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 6G

REED, G. D.
Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 5A

Trihalomethane Precursor Control by Adsorption,
W82-02598 5F

REES, W.
Mt. St. Helens and the Fish,
W82-02508 2J

REICHARD, R. P.
The Dynamics of Conservative Mixing in Estuaries,
W82-02345 2L

REID, L. M.
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

REKUBRATSKIY, V. A.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

RENEAU, R. B. JR.
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 5B

RESH, V. H.
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

RETTMAN, P.
Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 7C

REYNOLDS, D.
Municipal Needs,
W82-02513 6E

RHEE, G. Y.
The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 2H

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 2H

RICHARDS, G.
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 2E

RICHARDS, W. N.
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 5F

RIISGARD, H. U.
Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 5C

RILEY, J. P.
The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 5A

RILEY, R. L.
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 3A

RILEY, S. J.
The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425
2E

RINGLER, R. W.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510
2F

ROBINSON, A. E. JR.
Chesapeake Bay Low Freshwater Inflow Study,
W82-02114
6G

ROBINSON, D.
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374
5A

ROCHE, R. J.
Guidelines for Control of Septic Tank Systems,
W82-02599
5B

RODEH, M.
Loop Equations with Unknown Pipe Characteristics,
W82-02258
3F

RODGERS, L. J.
Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426
2L

RODRIGUEZ, J. J.
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383
5D

ROGERS, J. E.
Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480
7C

ROSE, P. W.
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163
2E

ROSENBERG, D. M.
Recent Trends in Environmental Impact Assessment,
W82-02525
6G

ROSENDAHL, P. C.
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163
2E

ROYSTER, D. L.
Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215
8A

ROZENGURT, M.
Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169
5G

RUARDIJ, P.
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565
2H

RUBIN, H.
Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288
2F

RUFF, W. T.
Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213
8A

RUKSASILP, W.
A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368
2E

RUSHTON, K. R.
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190
2F

RUSSELL, K. D.
The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424
6A

SAGIK, B. P.
Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317
3C

SAILA, S. B.
A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357
5C

SALO, E. O.
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507
2J

SAMOLUBOV, B. I.
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205
2J

SASAKI, K.
Determination of Ammonia in Estuary,
W82-02390
5A

SASSEN, K.
An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217
7B

SAUNDERS, B. C.
Salinity Forum: What. How. Why,
W82-02587
6E

SAVAGE, W. C.
Superfund: What a Mess,
W82-02184
6E

SAWADA, Y.
Determination of Ammonia in Estuary,
W82-02390
5A

SAWHNEY, B. L.
PCBs in the Housatonic River: Determination and Distribution,
W82-02255
5A

SAYRE, W. W.
Multiport Diffuser Mixing Zones in Rivers,
W82-02594
5B

SCHALEKAMP, M.
New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420
5F

SCHINER, G. R.
Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464
7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479
7C

SCHULTS, D. W.
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332
5B

SCHWARTZ, S. S.
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571
5G

SCHWENDEMAN, T. G.
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537
5B

SCRIVNER, A. E.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195
5B

SEIM, W. K.
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509
2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552
7B

SENN, C. L.
Waterborne Disease Is Prevalent in Egypt,
W82-02435
5C

SETZLER-HAMILTON, E. M.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116
6G

SHABAN, H. I.
Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382
5D

SHAFER, J. M.
Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501
6A

SHAIKIN, YU. P.
Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387
8A

SHALHEVET, J.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391
3C

SHAPIRO, J.
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223
5A

SHARMA, A. K.
Irrigation Requirements of Field-Pea for Grain,
W82-02395
2I

SHARMA, A. P.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442
5C

SHARMA, P. C.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442
5C

SHAW, R.
Water Conservation Program of the City of Greensboro,
W82-02518
3D

SHEA, G. B.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapepeake Bay,
W82-02115
6G

SHEFFIELD, W. J.
Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151
4A

SHELEF, G.
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 5D

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 5D

SHERWANI, J. K.
Wastewater Management in Coastal North Carolina,
W82-02511 5D

SHETTY, C. M.
Optimal Stream-Aquifer Development,
W82-02575 6A

SHIRAZI, M. A.
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 7B

SHOUPP, W. J.
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

SIEGRIST, R. L.
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 3D

SIMEK, E. M. JR.
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

SIMIDU, U.
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 5A

SIMM, R. I. G.
Groundwater Quality in the Severn-Trent Region,
W82-02423 5A

SIMPSON, A.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

SIMS, J. D.
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

SINGER, P. C.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 5B

SINGH, V. P.
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 2A

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 2A

SKAGGS, R. W.
Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 5B

SLABBERS, P. J.
Practical Prediction of Actual Evapotranspiration,
W82-02308 2D

SLISSKY, S. M.
Passing Floodwaters Over Embankment Dams,
W82-02204 8A

SMETHIE, W. M. JR.
Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 2L

SMITH, D. D.
Long Term Performance of Horizontal Drains,
W82-02212 8A

SMITH, F. J.
New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

SMITH, H.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

SMITH, J. A.
Point Process Models of Rainfall,
W82-02452 2A

SMITH, J. D.
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 5B

SMITH, R. E.
Wastewater Collection and Treatment in Wayne County,
W82-02554 5D

SMITH, S. S.
Relationship of Electrical Dispersion to Soil Properties,
W82-02561 8D

SMOOT, J. L.
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

SMULLEN, J. T.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

SNADDON, X. M. V.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 7B

SNYDER, G. R.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

SNYDER, R. D.
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 2C

SOJKA, R. E.
Wheat Response to Drought,
W82-02242 2I

SORBER, C. A.
Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 3C

SORENSON, S. K.
Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 2K

SPANOVSKAYA, V. D.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 2H

SPINAZOLA, J. M.
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

SPOOR, M. F.
Bank Failure and Erosion on the Ohio River,
W82-02343 2J

STAKER, R. D.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

STANDRIDGE, J. H.
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 5A

STARK, P. E.
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 5B

STEAD, P. A.
Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 5D

STENSON, J. A. E.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

STENSTROM, R. C.
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

STETSON, C. B.
Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 6E

STEVENS, D. E.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

STEVENSON, R. J.
Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 2H

STEVIE, R. G.
Analytical Cost Model for Urban Water Supply,
W82-02584 6C

STEWART, B. A.
A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 3F

STEWART, L. W.
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 5B

STOERMER, E. F.
Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 2H

STOKES, R. L.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D

STOLZY, L. H.
Wheat Response to Drought,
W82-02242 2I

STONES, T.
A Compendium of Experimental Work on Chemical Precipitation of Sewage,
W82-02370 5D

STOTT, D. A.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 5D

STOUT, D. G.
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 2D

STOWELL, R.
Concepts in Aquatic Treatment System Design,
W82-02593 5D

STRALEY, W. M.
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 5D

STRAWN, K.
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 2L

STREBLOW, D. E.
A More Versatile Soil Water Sampler,
W82-02523 7B

STROBEL, C. J.
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 5B

STURGES, D. L.
Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 3B

SUFFET, I. H.
Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 5F

SULLIVAN, C.
Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

SULLIVAN, M. J.
Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 6G

SUMSION, C. T.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

SUNESON, N.
Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 2A

SYME, J. R.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 2I

SYMONS, G. E.
Trends in Wastewater Collection Systems,
W82-02573 8G

SZE, P.
Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 5B

TABAK, H. H.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 5D

TABLER, R. D.
Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 3B

TAGA, N.
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 5A

TAGGART, C. T.
Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 5G

TAKAGI, M.
Mode: Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 5A

TANNER, J. W.
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 2K

TANTHAPANICHAKOON, W.
Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 5D

TATINCLAUX, J-C.
Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 2C

TAYLOR, D.
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 5C

TCHOBANOGLOUS, G.
Concepts in Aquatic Treatment System Design,
W82-02593 5D

TENORE, K.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 5B

TENORE, K. R.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

[illegible]ORPE, S. A.
The Mixing Layer of Loch Ness,
W82-02421 2H

THRELKELD, S. T.
The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 2H

THROCKMORTON, C. K.
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

TIJERO, J.
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 5D

TILLY, L. J.
Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 5C

TISON, D. L.
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

TOETZ, D. W.
Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 5C

TOURBIER, J. T.
Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 4D

TRAHAN, J. C.
The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

TRIPP, J. B.
Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 6E

TROLINGER, W. D.
Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 8A

TROMMER, J. T.
Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

TUBBS, L. J.
Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 5B

TUCKER, C. S.
Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 5B

TURK, J. T.
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 5B

TUTTLE, J. R.
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 4C

TWINCH, A. J.
The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 5C

ULLRICH, C. R.
Bank Failure and Erosion on the Ohio River,
W82-02343 2J

UNCLES, R. J.
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 2L

URCHIN, C. G.
Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 5B

VAISMAN, I.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 3C

VALENTINE, G.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 3E

VAN BEEK, J. L.
Sediment--Asset or Liability,
W82-02150 6B

VAN DE KREEKE, J.
Surface Water Flow from a South Florida Wetland Area,
W82-02121 2E

VAN ENDE, C. N.
Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 2H

VAN OS, E.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

VAN STEENDEREN, R. A.
Determination of Dissolved Organic Carbon in Water,
W82-02194 5A

VANNOTE, R. L.
The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 6G

VARDIA, H. K.
The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 5C

VASS, K. K.
On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 5C

VAUGHAN, C. W.
Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 5A

VEECH, J. A.
Fate of Diflubenzuron in Water,
W82-02216 5B

VERNER, K.
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

VILLA, O.
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

VINCENT, R. J.
Pilot-Scale Investigations with Granular Activated Carbon,
W82-02289 5D

VISOCKY, A. P.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

VOGEL, J. L.
Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 7A

WADDELL, K. M.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

WAINWRIGHT, M.
Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 5B

WAISEL, Y.
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 4A

WALKER, H. A.
A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 5C

WALL, P. C.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 2I

WALTON, M. T.
Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 4A

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

WARD, G. H. JR.
Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 6G

WATANABE, I.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 5A

WATSON, V. J.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

WAWRONOWICZ, L. J.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 5D

WEBB, T. R.
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 5G

WEBER, J. C.
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

WEBER, W. J. JR.
Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 5B

WEBSTER, J. R.
Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 5C

WEHRMANN, H. A.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

WEILER, R. R.
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1976,
W82-02228 2K

WEISS, D. E.
Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 5F

WELCH, E. B.
The Dilution/Flushing Technique in Lake Restoration,
W82-02270 2H

WESTERMAN, P. W.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

WESTMACOTT, R.
Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 4D

WHEELER, G. A.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

WHITE, E. M.
Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 2I

WHITE, S. E.
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

WHITMYRE, G. K.
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 5A

WHITTLE, P. J.
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 5B

WIEGAND, R. C.
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

WIEST, S. C.
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 2I

WILCOX, D. P.
Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 2L

WILDE, E. W.
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 5C

WILDER, B.
Denmark's State of the Environment,
W82-02401 5B

WILLIAMS, D. G.
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

WILLIAMS, E. G.
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 6A

WILLIAMS, R. J.
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 2D

WILLIAMSON, J. C.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

WILLIAMSON, K. J.
Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 5D

WILLIS, G. H.
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 5B

WILSON, E. A.
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 5C

WILSON, J. T.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

WINFIELD, B. A.
Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 5D

WINTER, T. C.
Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 2H

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

WISSELO, A. G.
Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 5A

WITMER, A.
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

WITTLE, J. K.
Industrial Wastewater Pretreatment Service,
W82-02253 5E

WOJNER, W.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

WOOD, K. V.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

WOODHAM, W. M.
Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 7C

WOOTTON, R. J.
Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 5A

WRIGHT, H. E. JR.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 2H

WUNDERLICH, W. O.
Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 6A

WYVILL, C.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02436 3E

YADAV, B. R.
Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 3C

YANAGITA, T.
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 5A

YOBBI, D. K.
Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 7C

YOHE, T. L.
Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 5F

YOLES, D.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

YOSHIKURA, T.
Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 5A

YOTSUKURA, N.
An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 5G

YOUNG, E.
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 2I

YOUNG, R. A.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

ZALOM, F. G.
Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 6G

ZEMBRZUSKI, T. J. JR.
Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 2E

ZEY, A. F.
Trihalomethane Precursor Control by Adsorption,
W82-02598 5F

ZIDAN, M. A.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 3F

ZIMMERMAN, A. P.
Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 2K

ZIMMERMANN, C.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

ZUTSHI, D. P.
Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

ZUZEL, J. F.
Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 2C

ORGANIZATIONAL INDEX

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, AVONDALE, PA. STROUD WATER RESEARCH CENTER.
The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 6G

AGRICULTURAL RESEARCH COUNCIL, NORWICH (ENGLAND). FOOD RESEARCH INST.
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 5A

AGRICULTURAL RESEARCH COUNCIL, OXFORD (ENGLAND). WEED RESEARCH ORGANIZATION.
Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 4A

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF CIVIL ENGINEERING.
Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 2F

AHMADU-BELLO UNIV., ZARIA (NIGERIA). DEPT. OF ENVIRONMENTAL HEALTH.
Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 6G

AIN SHAMS UNIV., CAIRO (EGYPT).
Two Bed-Load Formulas: An Evaluation,
W82-02375 2J

ALABAMA UNIV., UNIVERSITY. SCHOOL OF LAW.
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 5G

AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK. COMMITTEE ON WATER POLLUTION MANAGEMENT.
Engineering Design Variables for the Activated Sludge Process.
W82-02199 5D

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF AQUATIC ECOLOGY.
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 2H

ANGLIAN WATER AUTHORITY (ENGLAND).
Flexible Outfall at Aldeburgh,
W82-02415 8A

ANGLIAN WATER AUTHORITY, PETERSBOROUGH (ENGLAND). PETERSBOROUGH SEWAGE DIV.
The Effect of Nitrification in the BOD Test,
W82-02384 5D

APPLIED ENVIRONMENTAL SERVICES, MARCO ISLAND, FL.
Meromixis in a Coastal Zone Excavation,
W82-02120 2H

ARGONNE NATIONAL LAB., IL. DIV. OF ENVIRONMENTAL IMPACT STUDIES.
A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 2F

ARIZONA STATE UNIV., TEMPE. DEPT. OF ZOOLOGY.
Metabolism of a Desert Stream,
W82-02349 1A

ARMY ENGINEER DISTRICT, GALVESTON, TX. ENGINEERING DIV.
The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 4A

ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 4A

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 4C

ASIAN INST. OF TECH., BANGKOK (THAILAND).
A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 2E

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF WATER RESOURCES ENGINEERING.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 6A

ASSIUT UNIV. (EGYPT). DEPT. OF BOTANY.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 3F

ASSOCIATION OF STATE AND INTERSTATE WATER POLLUTION CONTROL ADMINISTRATORS, WASHINGTON, DC.
Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 6E

Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 6E

Compliance Strategy for Clean Water.
W82-02185 6E

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 5G

BALL STATE UNIV., MUNCIE, IN. DEPT. OF GEOGRAPHY.
A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 2A

BATTELLE MEMORIAL INST., COLUMBUS, OH.
Relationship of Electrical Dispersion to Soil Properties,
W82-02561 8D

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA.
In-Home Conservation and Wastewater Management,
W82-02591 3D

BELOIT COLL., WI. DEPT. OF GEOLOGY.
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 2A

BEN-GURION UNIV. OF THE NEGEV, SDE-BOKER (ISRAEL). INST. FOR DESERT RESEARCH.
Solid Set Irrigation System Design Using Linear Programming,
W82-02273 6A

BEN-GURION UNIV., SDE BOKER (ISRAEL). INST. FOR DESERT RESEARCH.
Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 5D

BENIN NATIONAL UNIV., COTONOU.
Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 2A

BIGELOW LAB. FOR OCEAN SCIENCES, WEST BOOTHBAY HARBOR, ME.
Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 5C

BINNIE AND PARTNERS, LONDON (ENGLAND).
Disposal of Industrial Effluents - Some Future Problems,
W82-02405 5D

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 2F

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF GEOLOGICAL SCIENCES.
The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 2F

BISWAS AND ASSOCIATES, OXFORD (ENGLAND).
Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 6A

BONNIVILLE COUNTY FARM BUREAU, IDAHO FALLS, ID.
Aerated Drip Irrigation,
W82-02186 3F

BRACKEN AND BARAM, BOSTON, MA.
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 3C

BRITISH COLUMBIA MINISTRY OF ENVIRONMENT, KAMLOOPS.
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 2D

BRITISH COLUMBIA UNIVERSITY, VANCOUVER. DEPT. OF GEOPHYSICS AND ASTRONOMY.
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 2C

BROWN AND CALDWELL, SEATTLE, WA.
Composite Sampling of Highway Runoff,
W82-02230 7B

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Colorado River Simulation System; An Executive Summary,
W82-02170 6A

BUREAU OF WATER WORKS, PORTLAND, OR.
Energy Costs and Portland Water Supply System,
W82-02586 5F

CALGARY UNIV. (ALBERTA). DEPT. OF GEOGRAPHY.
Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 2C

CALGON CORP., PITTSBURGH, PA.
Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 5A

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, OAKLAND.
Guidelines for Control of Septic Tank Systems,
W82-02599 5B

CALIFORNIA STATE DEPT. OF FISH AND GAME, STOCKTON.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 4C

CALIFORNIA UNIV., BERKELEY. DEPT. OF PLANT AND SOIL BIOLOGY.
Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 2I

CALIFORNIA UNIV., BERKELEY. SCHOOL OF PUBLIC HEALTH.
Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 3C

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.
The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 2L

CALIFORNIA UNIV., IRVINE. SCHOOL OF ENGINEERING.
Subdomain Integration Model of Ground-Water Flow,
W82-02550 2F

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF CHEMICAL, NUCLEAR, AND THERMAL ENGINEERING.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 5D

CAMBRIDGE UNIV. (ENGLAND). DEPT. OF APPLIED BIOLOGY.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 2H

CAMP DRESSER AND MCKEE, INC., WALNUT CREEK, CA. WATER RESOURCES DIV.
Management of Interstate Aquifer Systems,
W82-02578 4B

CENTRAL DESIGNS ORGANISATION, GUJARAT STATE (INDIA). IRRIGATION DEPT.
Ski-Jump Spillway for India's Ukai Dam,
W82-02430 8A

CENTRAL ELECTRICITY GENERATING BOARD, BRISTOL (ENGLAND).
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 5C

CENTRAL INLAND FISHERIES RESEARCH INST., HARWAN (INDIA).
On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 5C

CENTRE D'OCEANOGRAPHIE, MARSEILLE (FRANCE). STATION MARINE D'ENDOUME.
Relationship Between Populations of Amphipods and Pollution,
W82-02444 5C

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, GRENOBLE (FRANCE). LAB. DE GLACIOLOGIE.
Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 5B

CH2M HILL, RESTON, VA.
Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 5F

CHELSEA INTERNATIONAL CORP., WASHINGTON, DC.
Superfund: What a Mess,
W82-02184 6E

CHEM-CLEAR, INC., WAYNE, PA.
Industrial Wastewater Pretreatment Service,
W82-02253 5E

CLEMSON UNIV., SC. COLL. OF FOREST AND RECREATION RESOURCES.
User Reaction to Wild and Scenic River Designation,
W82-02278 6G

COASTAL ENVIRONMENTS, INC., BATON ROUGE, LA.
Sediment--Asset or Liability,
W82-02150 6B

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 6A

COLORADO STATE UNIV., FORT COLLINS. WATER RESOURCES RESEARCH INST.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 6A

COLUMBIA RIVER BASIN COMMISSION, PORTLAND, OR.
Water Management on the Columbia River,
W82-02112 6D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF PLANT INDUSTRY.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 2I

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, SOUTH MELBOURNE (AUSTRALIA). DIV. OF CHEMICAL TECHNOLOGY.
Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 5F

CONFEDERATION OF BRITISH INDUSTRY, LONDON (ENGLAND).
An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 6G

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN.
PCBs in the Housatonic River: Determination and Distribution,
W82-02255 5A

CONNECTICUT UNIV., STORRS. DEPT. OF GEOLOGY AND GEOPHYSICS.
Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 5B

CORPS OF ENGINEERS, BALTIMORE, MD. BALTIMORE DISTRICT.
Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 6G

CORPS OF ENGINEERS, PORTLAND, OR.
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 2H

CORPS OF ENGINEERS, SAVANNAH, GA.
Developing Dam-Break Flood Zone Ordinance,
W82-02585 6F

CORVALLIS ENVIRONMENTAL PROTECTION AGENCY, OH.
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 5B

CORVALLIS ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
Wetlands Use for Water Management in Florida,
W82-02590 4A

CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 7B

COURY AND ASSOCIATES, INC., LAKEWOOD, CO.
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 5D

CREWE AND ALSAGAR COLL. OF HIGHER EDUCATION (ENGLAND).
Some Analyses of Aquatic Plants and Their Waters,
W82-02293 2H

DANISH METEOROLOGICAL INST., COPENHAGEN.
Accuracy of Point Precipitation Measurements,
W82-02209 2B

DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 5C

DELAWARE UNIV., NEWARK. DEPT. OF GEOLOGY.
Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 2L

DELAWARE UNIV., NEWARK. WATER RESOURCES CENTER.
Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 4D

DELTA EXPERIMENT STATION, STONEVILLE, MS.
Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 5B

DEPARTMENT OF ENERGY, OAKLAND, CA. GEOTHERMAL ENERGY DIV.
Environmental Control Technology Development for Geothermal Energy,
W82-02197 5C

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Recent Trends in Environmental Impact Assessment,
W82-02525 6G

DEPARTMENT OF NATURAL RESOURCES, BATON ROUGE, LA.
Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 4A

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON (NEW ZEALAND). APPLIED MATHEMATICS DIV.
Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 2F

DEWANTE AND STOWELL, SACRAMENTO, CA.
Concepts in Aquatic Treatment System Design,
W82-02593 5D

DU PONT DE NEMOURS (E.I.) AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 5C

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL ENGINEERING.
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 5B

DUNDEE UNIV. (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 5E

DUPONT CO., WILMINGTON, DE.
Dupont's Wastewater Treatment Approach,
W82-02254 5D

ENVIRONMENTAL DEFENSE FUND, INC., NEW YORK.
Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 6E

ENVIRONMENTAL PROTECTION AGENCY, ADA, OK.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 5B

ENVIRONMENTAL PROTECTION AGENCY, ANNAPOLIS, MD.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 5B

ENVIRONMENTAL RESOURCES LTD., LONDON (ENGLAND).
Effluent Charging Systems and Their Administrative Implications,
W82-02403 6C

ENVIROSCIENCE INC., MINNEAPOLIS, MN.
Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 5A

EOTOVS LORAND UNIV., BUDAPEST (HUNGARY). INST. OF INORGANIC AND ANALYTICAL CHEMISTRY.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 5A

FILMTEC CORP., MINNEAPOLIS, MN.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 3A

FISH AND WILDLIFE SERVICE, COOKIERVILLE, TN.
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 4A

FISH AND WILDLIFE SERVICE, FORT COLLINS, CO.
Overview of Freshwater Inflow Depletions,
W82-02152 6D

FISH AND WILDLIFE SERVICE, LAFAYETTE, LA.
Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 4C

FISH AND WILDLIFE SERVICE, SACRAMENTO, CA.
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 6E

FISH AND WILDLIFE SERVICE, SLIDELL, LA.
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 6G

FISH AND WILDLIFE SERVICE, STOCKTON, CA.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 6G

FISH AND WILDLIFE SERVICE, VERO BEACH, FL. ECOLOGICAL SERVICES.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 6G

FLORIDA INST. OF TECH., MELBOURNE. DEPT. OF ENVIRONMENTAL ENGINEERING AND SCIENCE.
Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 2H

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 5B

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.
Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 5B

Metabolism of a Florida Lake Ecosystem,
W82-02268 2H

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W82-02422 2F

FRASER (J. KENNETH) AND ASSOCIATES, RENSSELAER, NY.
Automated Stream Diversion for Reservoir Protection,
W82-02600 5G

FRESHWATER BIOLOGICAL ASSOCIATION, EAST STOKE (ENGLAND). RIVER LAB.
The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1B

FRESHWATER BIOLOGICAL ASSOCIATION, WAREHAM (ENGLAND). RIVER LAB.
Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 5C

FRESHWATER BIOLOGICAL ASSOCIATION, WARHAM (ENGLAND).
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 5B

GEOLOGICAL SURVEY, ALBANY, NY.
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 5B

GEOLOGICAL SURVEY, ALBANY, NY. WATER RESOURCES DIV.
Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 4C

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 2E

GEOLOGICAL SURVEY, ALBUQUERQUE, NM. WATER RESOURCES DIV.
Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 2F

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 2E

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 7C

GEOLOGICAL SURVEY, ALEXANDRIA, LA. WATER RESOURCES DIV.
Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 7C

GEOLOGICAL SURVEY, ANCHORAGE, AK. WATER RESOURCES DIV.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 2J

GEOLOGICAL SURVEY, AUSTIN, TX. WATER RESOURCES DIV.
Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 2F

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 7C

GEOLOGICAL SURVEY, BISMARCK, ND. WATER RESOURCES DIV.
Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 7C

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GEOLOGICAL SURVEY, DENVER, CO.
Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 2H

GEOLOGICAL SURVEY, FLAGSTAFF, AZ.
Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 2A

GEOLOGICAL SURVEY, GARDEN CITY, KS. WATER RESOURCES DIV.
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 7C

GEOLOGICAL SURVEY, HARRISBURG, PA. WATER RESOURCES DIV.
Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 7C

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.
Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 7C

GEOLOGICAL SURVEY, HURON, SD. WATER RESOURCES DIV.
Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 2F

GEOLOGICAL SURVEY, INDIANAPOLIS, IN. WATER RESOURCES DIV.
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W82-02478 4A

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 2E

Water Resources Data for Indiana, Water Year 1980.
W82-02492 7C

GEOLOGICAL SURVEY, IOWA CITY, IA.
The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 2F

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 2A

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 2H

GEOLOGICAL SURVEY, LANSING, MI. WATER RESOURCES DIV.
Ground-Water Data for Michigan 1980,
W82-02467 2F

GEOLOGICAL SURVEY, LITTLE ROCK, AR. WATER RESOURCES DIV.
Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 5A

GEOLOGICAL SURVEY, LOUISVILLE, KY. WATER RESOURCES DIV.
Water Resources Data for Kentucky, Water Year 1979.
W82-02499 7C

GEOLOGICAL SURVEY, MENLO PARK, CA.
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 2K

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 2K

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 2K

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 4C

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 7A

GEOLOGICAL SURVEY, NSTL STATION, MS. GULF COAST HYDROSCIENCE CENTER.
Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 6G

GEOLOGICAL SURVEY, ORLANDO, FL. WATER RESOURCES DIV.
Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 7C

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 2B

Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 10D

GEOLOGICAL SURVEY, ROLLA, MO. WATER RESOURCES DIV.
Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 7C

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Water Resources Data for Utah, Water Year 1979.
W82-02474 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 7C

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Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 7C

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W82-02497 7C

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Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 5B

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 6B

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 7C

GEOLOGICAL SURVEY, TAMPA, FL. WATER RESOURCES DIV.
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W82-02464 7C

GEOLOGICAL SURVEY, TOWSON, MD. WATER RESOURCES DIV.
The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 2F

GEOLOGICAL SURVEY, TRENTON, NJ. WATER RESOURCES DIV.
Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 4C

GEOLOGICAL SURVEY, TUSCALOOSA, AL. WATER RESOURCES DIV.
Induced Sinkholes: An Engineering Problem,
W82-02559 4B

GEORGETOWN UNIV., WASHINGTON, DC. DEPT. OF BIOLOGY.
Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 5B

GEORGIA INST. OF TECH., ATLANTA. ENGINEERING EXPERIMENT STATION.
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W82-02456 3E

GEOTHECHNICAL ENGINEERS INC., WINCHESTER, MA.
The Steady State of Deformation,
W82-02235 8D

GERAGHTY AND MILLER, INC., WEST PALM BEACH, FL.
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 2F

GOETEBORG UNIV. (SWEDEN). DEPT. OF ZOOLOGY.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 2H

GORE AND STORRIE LTD., TORONTO (ONTARIO).
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W82-02227 7B

GREENSBORO PUBLIC WORKS DEPT., NC. WATER AND SEWER ADMINISTRATION.
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W82-02518 3D

GUELPH UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 6B

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL, TAMPA, FL.
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W82-02146 6G

GULF UNIVERSITIES RESEARCH CONSORTIUM, HOUSTON, TX.
A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 7A

HARBOR BRANCH FOUNDATION, INC., FORT PIERCE, FL.
Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 2L

HARBOR BRANCH FOUNDATION, INC., FT. PIERCE, FL.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 5A

HEBREW UNIV., REHOVOT (ISRAEL). DEPT. OF SOIL AND WATER SCIENCES.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 5B

HOWARD COUNTY FARM BUREAU, NASHVILLE, AR.
Solar Heat Pond System,
W82-02187 3F

HYDROLOGIC ENGINEERING CENTER, DAVIS, CA.
Interactive Nonstructural Flood-Control Planning,
W82-02320 6F

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 6A

IBM SCIENTIFIC CENTER, HAIFA (ISRAEL).
Loop Equations with Unknown Pipe Characteristics,
W82-02258 3F

IDAHO UNIV., MOSCOW. DEPT. OF ELECTRICAL ENGINEERING.
Selecting Seasonal Streamflow Models,
W82-02502 2E

ILLINOIS STATE GEOLOGICAL SURVEY, CHAMPAIGN.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 2F

ILLINOIS STATE WATER SURVEY, CHAMPAIGN.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 2J

ILLINOIS STATE WATER SURVEY, PEORIA. WATER QUALITY SECTION.
Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 6G

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 5F

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF GENERAL ENGINEERING.
Optimal Stream-Aquifer Development,
W82-02575 6A

INDIAN AGRICULTURAL RESEARCH INST., NEW DELHI.
Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 3C

INDIAN COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.
Irrigation Requirements of Field-Pea for Grain,
W82-02395 2I

INLAND WATERS DIRECTORATE, OTTAWA (ONTARIO). WATER QUALITY BRANCH.
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W82-02506 7C

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W82-02193 2L

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W82-02292 8E

INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).
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W82-02291 2A

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W82-02421 2H

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W82-02308 2D

IOWA STATE UNIV., AMES. DEPT. OF AGRICULTURAL ENGINEERING.
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W82-02269 5B

IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
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W82-02237 2C

IWATE UNIV., MORIOKA (JAPAN). DIV. OF FORESTRY AND FISHERY.
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W82-02379 5B

JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF GEOGRAPHY AND ENVIRONMENTAL ENGINEERING.
Point Process Models of Rainfall,
W82-02452 2A

KANSAS AGRICULTURAL EXPERIMENT STATION, COLBY.
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 2I

KANSAS UNIV., LAWRENCE.
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 5E

KANSAS UNIV., LAWRENCE. DEPT. OF CIVIL ENGINEERING.
Multiport Diffuser Mixing Zones in Rivers,
W82-02594 5B

KANSAS WATER RESOURCES RESEARCH INST., MANHATTAN.
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 3F

KASHMIR UNIV., SRINAGAR (INDIA). DEPT. OF BOTANY.
Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 2H

KEIO UNIV., TOKYO (JAPAN). DEPT. OF MOLECULAR BIOLOGY.
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W82-02443 5A

KENT STATE UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 5A

KIRKHAM MICHAEL AND ASSOCIATES, OMAHA, NE.
An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 6F

KONINKLIJKE NEDERLANDSE AKADEMIE VAN WETENSCHAPPEN, AMSTERDAM.
Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 6G

KUMAUN UNIV., NAINI TAL (INDIA). DEPT. OF ZOOLOGY.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 5C

KUWAIT UNIV. DEPT. OF CHEMICAL ENGINEERING.
Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 5D

KYUSHU UNIV., FUKUOKA (JAPAN). DEPT. OF AGRICULTURAL CHEMISTRY.
An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 5E

LAMAR UNIV., BEAUMONT, TX. DEPT. OF BIOLOGY.
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W82-02570 2K

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 2L

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 2L

LARSEN AND ASSOCIATES, MIAMI, FL.
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 4A

LAVAL UNIV., QUEBEC. DEPT. OF BIOLOGIE.
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W82-02306 2L

LEE COUNTY HYACINTH CONTROL DISTRICT, FORT MYERS, FL.
Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 4A

LIVERPOOL UNIV. (ENGLAND). DEPT. OF OCEANOGRAPHY.
The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 5A

LOUISIANA STATE UNIV., BATON ROUGE. CENTER FOR WETLAND RESOURCES.
Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 2J

LOUISIANA STATE UNIV., BATON ROUGE. COASTAL ECOLOGY LAB.
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W82-02334 2H

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Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 5B

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W82-02144 6G

LOUISVILLE UNIV., KENTUCKY. DEPT. OF CIVIL ENGINEERING.
Bank Failure and Erosion on the Ohio River,
W82-02343 2J

LUND UNIV. (SWEDEN). LIMNOLOGICAL INST.
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W82-02380 2K

MACLAREN (JAMES F.) LTD., WILLOWDALE (ONTARIO).
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W82-02240 5E

MACQUARIE UNIV., NORTH RYDE (AUSTRALIA). SCHOOL OF EARTH SCIENCES.
The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 2E

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CIVIL ENGINEERING.
Comparison of Detention Basin Planning and Design Models,
W82-02592 6A

MARYLAND UNIVERSITY, SOLOMONS. CHESAPEAKE BIOLOGICAL LAB.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 6G

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W82-02233 5C

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 5G

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W82-02553 2H

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W82-02344 2L

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF GEOGRAPHY.
Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 2A

MELBOURNE UNIV., PARKVILLE (AUSTRALIA). DEPT. OF INDUSTRIAL SCIENCE.
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W82-02438 5B

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W82-02524 5C

METAMETRICS INC., WASHINGTON, DC.
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W82-02104 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 3A

METROPOLITAN POLLUTION CONTROL-THAMES WATER, LONDON (ENGLAND).
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 5G

MICHIGAN UNIV., ANN ARBOR. DEPT. OF GEOGRAPHY.
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W82-02342 2H

MICHIGAN UNIV., ANN ARBOR. GREAT LAKES RESEARCH DIV.
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W82-02299 2H

MILJOSTYRELSEN, CHARLOTTENLUND (DENMARK). MARINE POLLUTION LAB.
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W82-02428 5C

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W82-02300 2H

MINNESOTA UNIV., ST. PAUL.
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W82-02568 6G

MINNESOTA UNIV., ST. PAUL. DEPT. OF SOIL SCIENCE.
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W82-02219 3C

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE.
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W82-02208 2A

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF BIOLOGICAL SCIENCES.
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W82-02531 6G

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF CIVIL ENGINEERING.
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W82-02532 5F

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W82-02533 2A

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W82-02530 5D

MONTANA STATE UNIV., BOZEMAN. DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 5B

MONTANA STATE UNIV., BOZEMAN. DEPT. OF INDUSTRIAL AND MANAGEMENT ENGINEERING.
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 6A

MONTANA STATE UNIV., BOZEMAN. DEPT. OF PLANT AND SOIL SCIENCE.
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W82-02539 2C

MONTANA UNIV., MISSOULA. SCHOOL OF GEOLOGY.
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W82-02538 2F

MONTGOMERY (J. M.), WALNUT CREEK, CA.
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W82-02504 5B

MOSCOW STATE UNIV. (USSR).
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W82-02205 2J

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W82-02434 2H

MOSKOVSKII INZHENERNO-FIZICHESKII INST. (USSR). DYNAMICS LAB.
Passing Floodwaters Over Embankment Dams,
W82-02204 8A

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
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W82-02231 5D

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
Cost of Small Water Supply Treatment Systems,
W82-02518 5F

Analytical Cost Model for Urban Water Supply,
W82-02584 6C

NAIROBI UNIV. (KENYA). DEPT. OF AGRICULTURAL ENGINEERING.
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W82-02309 2G

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W82-02440 2K

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W82-02563 5C

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, HAMPTON, VA. LANGLEY RESEARCH CENTER.
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 7A

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Determination of Dissolved Organic Carbon in Water,
W82-02194 5A

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W82-02347 2L

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W82-02136 2L

NATIONAL MARINE FISHERIES SERVICE, MIAMI, FL. SOUTHEAST FISHERIES CENTER.
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 4C

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An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 2L

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 2L

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Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 5B

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Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 6E

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Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 5C

NATIONAL PARK SERVICE, HOMESTEAD, FL.
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 2E

NATIONAL WATER RESEARCH INST., VANCOUVER (BRITISH COLUMBIA). PACIFIC AND YUKON REGION.
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 2H

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The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 4C

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The Dynamics of Conservative Mixing in Estuaries,
W82-02345 2L

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W82-02202 2I

NEW YORK OCEAN SCIENCE LAB., MONTAUK.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 2L

NEW YORK STATE DEPT. OF ENVIRONMENT CONSERVATION, WATERTOWN.
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W82-02572 5G

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W82-02296 7A

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W82-02221 2H

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W82-02331 2H

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W82-02394 5A

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The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 6A

NORSK INST. FOR VANNFORSKNING, OSLO.
The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 5C

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, DIVISION OF ENVIRONMENTAL MANAGEMENT.
Recycling,
W82-02514 6E

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, OFFICE OF INTERGOVERNMENTAL RELATIONS.
Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 6E

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, OFFICE OF WATER RESOURCES.
Trends in State and Federal Policy on Water Supply Management,
W82-02516 6E

NORTH CAROLINA LEAGUE OF MUNICIPALITIES, RALEIGH.
Municipal Needs,
W82-02513 6E

NORTH CAROLINA OFFICE OF COASTAL MANAGEMENT, MOREHEAD CITY.
Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 2L

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 5B

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF ECONOMICS AND BUSINESS.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 5E

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF PSYCHOLOGY.
New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 6E

NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF ZOOLOGY.
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 2H

NORTH CAROLINA UNIV. AT CHAPEL HILL.
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 5A

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 5A

Wastewater Management in Coastal North Carolina,
W82-02511 5D

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Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 5B

NORTH CENTRAL FOREST EXPERIMENT STATION, GRAND RAPIDS, MN.
A More Versatile Soil Water Sampler,
W82-02523 7B

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W82-02134 2L

NORTH WEST WATER AUTHORITY, WARRINGTON (ENGLAND).
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W82-02393 5B

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W82-02571 5G

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Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 2H

NORTHWEST WATER AUTHORITY (ENGLAND).
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W82-02448 5A

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W82-02323 5B

OKAYAMA UNIV. (JAPAN). SCHOOL OF ENGINEERING.
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 5A

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRICULTURAL ENGINEERING.
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W82-02526 2H

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OKLAHOMA UNIV., KINGSTON. BIOLOGICAL STATION.
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W82-02305 2H

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W82-02327 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO. WATER RESOURCES BRANCH.
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W82-02582 5D

OREGON STATE UNIV., CORVALLIS. SCHOOL OF FORESTRY.
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W82-02196 2J

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OSAKA CITY INST. OF PUBLIC HEALTH AND ENVIRONMENTAL SCIENCES (JAPAN).
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W82-02108 3A

PETRA INC., DENTON, TX.
Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 2H

PHILADELPHIA SUBURBAN WATER CO., BRYN MAWR, PA.
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W82-02260 5F

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Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 5C

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W82-02110 2L

A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 5C

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENTAL STATION, LARAMIE, WY.
Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 3B

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE, MIAMI, FL.
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W82-02137 2L

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W82-02121 2E

RUTGERS - THE STATE UNIV., PISCATAWAY, NJ.
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W82-02595 5B

SCHROEDER PROCESS CORP., SANTA ANA, CA.
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W82-02105 3A

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W82-02264 2I

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W82-02322 5B

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W82-02555 2C

SCIENCE AND EDUCATION ADMINISTRATION, BOISE, ID.
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W82-02245 2A

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A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02536 3F

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Fate of Diflubenzuron in Water,
W82-02216 5B

SCIENCE AND EDUCATION ADMINISTRATION, DAVIS, CA.
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W82-02326 4A

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Wheat Response to Drought,
W82-02242 2I

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 2J

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 2J

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 2J

Velocity Profiles with Suspended Sediment,
W82-02581 2J

SCIENCE AND EDUCATION ADMINISTRATION, STONEVILLE, MS. SOUTHERN WEED SCIENCE LAB.
Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 4A

SCIENCE AND EDUCATION ADMINISTRATION, TIFTON, GA. SOUTHEAST WATERSHED RESEARCH CENTER.
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 2J

SERVICO DE ENGENHARIA EMILIO BAUMGART LTD., BELO HORIZONTE (BRAZIL).
Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 5F

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W82-02207 7C

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W82-02423 5A

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W82-02431 7B

The Integrity of Existing Distribution Systems,
W82-02450 5F

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W82-02358 5B

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 2L

SMC-MARTIN, KING OF PRUSSIA, PA.
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W82-02321 5E

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W82-02562 5A

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W82-02446 5F

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W82-02311 5C

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W82-02200 2A

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W82-02191 2E

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W82-02364 5D

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W82-02288 2F

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W82-02371 2H

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W82-02597 4A

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W82-02316 5A

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Jonkoping's Water Supply,
W82-02419 5F

VICTORIA MINISTRY FOR CONSERVATION, QUEENSCLIFF (AUSTRALIA). MARINE SCIENCE LABS.
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 5C

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOLOGY.
Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 5A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 5C

Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 5E

VIRGINIA STATE WATER CONTROL BOARD, RICHMOND. DIV. OF ECOLOGICAL STUDIES.
Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 5B

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL).
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 3C

WASHINGTON STATE DEPT. OF FISHERIES, OLYMPIA.
Mt. St. Helens and the Fish,
W82-02508 2J

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRONOMY AND SOILS.
Aerial Photography to Detect Rill Erosion,
W82-02232 7B

WASHINGTON STATE UNIV., PULLMAN. WATER RESEARCH CENTER.
Ground Water in Washington,
W82-02536 2F

WASHINGTON SUBURBAN SANITARY COMMISSION, HYATTSVILLE, MD.
Rate Structures and Demand Reduction,
W82-02517 6C

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
The Dilution/Flushing Technique in Lake Restoration,
W82-02270 2H

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 5B

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 2L

WASHINGTON UNIV., SEATTLE. FISHERIES RESEARCH INST.
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 2J

WATER AND POWER RESOURCES SERVICE, PROVO, UT.
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 6D

WATER SUPPLY, ZURICH (SWITZERLAND).
New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 5F

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 2A

WAYNE COUNTY BOARD OF PUBLIC WORKS, MI.
Wastewater Collection and Treatment in Wayne County,
W82-02554 5D

WEST VIRGINIA UNIV., MORGANTOWN. WATER RESEARCH INST.
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 5D

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 6E

WESTERN ECOSYSTEMS TECHNOLOGY, LAUREL, MD.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeake Bay,
W82-02115 6G

WESTON (ROY F.), INC., WEST CHESTER, PA.
Managing Hazardous Wastes,
W82-02252 5E

WILDLIFE MANAGEMENT INST., DRIPPING SPRINGS, TX.
An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 6E

WILLIAM AND MARY COLL., GLOUCESTER POINT, VA. INST. OF MARINE SCIENCE.
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 5B

WISCONSIN UNIV.-MADISON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 3D

WISCONSIN UNIV.-MADISON. DEPT. OF VETERINARY SCIENCE.
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 5B

Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 5A

WISCONSIN UNIV.-MADISON. INST. OF ENVIRONMENTAL STUDIES.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 5B

WISCONSIN UNIV.-MADISON. LAB. OF HYGIENE.
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 5A

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF URBAN PLANNING.
Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 5A

YORK UNIV., DOWNSVIEW (ONTARIO). DEPT. OF GEOGRAPHY.
Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 5B

ACCESSION NUMBER INDEX

W82-02101	6E
W82-02102	6E
W82-02103	10C
W82-02104	3A
W82-02105	3A
W82-02106	2F
W82-02107	3C
W82-02108	3A
W82-02109	3A
W82-02110	2L
W82-02111	6E
W82-02112	6D
W82-02113	6E
W82-02114	6G
W82-02115	6G
W82-02116	6G
W82-02117	2L
W82-02118	5B
W82-02119	4A
W82-02120	2H
W82-02121	2E
W82-02122	5B
W82-02123	2F
W82-02124	6G
W82-02125	4C
W82-02126	2J
W82-02127	4A
W82-02128	4C
W82-02129	4C
W82-02130	4C
W82-02131	6G
W82-02132	2L
W82-02133	6G
W82-02134	2L
W82-02135	2L
W82-02136	2L
W82-02137	2L
W82-02138	7A
W82-02139	2L
W82-02140	2L
W82-02141	4C
W82-02142	6G
W82-02143	6G
W82-02144	6G
W82-02145	4A
W82-02146	6G
W82-02147	6G
W82-02148	4A
W82-02149	6G
W82-02150	6B
W82-02151	4A
W82-02152	6D
W82-02153	6B
W82-02154	6E
W82-02155	6D
W82-02156	6E
W82-02157	6G
W82-02158	2L
W82-02159	2L
W82-02160	2L
W82-02161	5C
W82-02162	6G
W82-02163	2E
W82-02164	2L
W82-02165	5C
W82-02166	6F
W82-02167	7A
W82-02168	4A
W82-02169	5G
W82-02170	6A
W82-02171	3A
W82-02172	5D
W82-02173	6E
W82-02174	3F
W82-02175	5E
W82-02176	5A
W82-02177	5A
W82-02178	4C
W82-02179	5C
W82-02180	3D
W82-02181	6E
W82-02182	6E
W82-02183	6E
W82-02184	6E
W82-02185	6E
W82-02186	3F
W82-02187	3F
W82-02188	5D
W82-02189	5D
W82-02190	2F
W82-02191	2E
W82-02192	1B
W82-02193	2L
W82-02194	5A
W82-02195	5B
W82-02196	2J
W82-02197	5C
W82-02198	5D
W82-02199	5D
W82-02200	2A
W82-02201	8B
W82-02202	2I
W82-02203	5A
W82-02204	8A
W82-02205	2J
W82-02206	8C
W82-02207	7C
W82-02208	2A
W82-02209	2B
W82-02210	2A
W82-02211	8A
W82-02212	8A
W82-02213	8A
W82-02214	8A
W82-02215	8A
W82-02216	5B
W82-02217	7B
W82-02218	5D
W82-02219	3C
W82-02220	5B
W82-02221	2H
W82-02222	5B
W82-02223	5A
W82-02224	2H
W82-02225	2J
W82-02226	2I
W82-02227	7B
W82-02228	2K
W82-02229	6F
W82-02230	7B
W82-02231	5D
W82-02232	7B
W82-02233	5C
W82-02234	5F
W82-02235	8D
W82-02236	5B
W82-02237	2C
W82-02238	2H
W82-02239	2C
W82-02240	5E
W82-02241	2C
W82-02242	2I
W82-02243	5F
W82-02244	6E
W82-02245	2A
W82-02246	2J
W82-02247	3B
W82-02248	5F
W82-02249	2A
W82-02250	2H
W82-02251	5B
W82-02252	5E
W82-02253	5E
W82-02254	5D
W82-02255	5A
W82-02256	6E
W82-02257	6E
W82-02258	3F
W82-02259	5B
W82-02260	5F
W82-02261	6G
W82-02262	5B
W82-02263	6D
W82-02264	2I
W82-02265	2J
W82-02266	5B
W82-02267	5B
W82-02268	2H
W82-02269	5B
W82-02270	2H
W82-02271	5B
W82-02272	5C
W82-02273	6A
W82-02274	2H
W82-02275	5D
W82-02276	5F
W82-02277	5C
W82-02278	6G
W82-02279	6E
W82-02280	5E
W82-02281	2H
W82-02282	2L
W82-02283	2F
W82-02284	5B
W82-02285	4A
W82-02286	5C
W82-02287	2H
W82-02288	2F
W82-02289	5D
W82-02290	5B
W82-02291	2A
W82-02292	8E
W82-02293	2H
W82-02294	5C
W82-02295	2D
W82-02296	7A
W82-02297	5A
W82-02298	5A
W82-02299	2H
W82-02300	2H
W82-02301	2I
W82-02302	6C
W82-02303	5D
W82-02304	2A
W82-02305	2H
W82-02306	2L
W82-02307	5A
W82-02308	2D
W82-02309	2G
W82-02310	5B
W82-02311	5C
W82-02312	5C
W82-02313	5D
W82-02314	2F
W82-02315	5D
W82-02316	5A
W82-02317	3C
W82-02318	5F
W82-02319	6A
W82-02320	6F
W82-02321	5E
W82-02322	5B
W82-02323	5B
W82-02324	2J
W82-02325	5B
W82-02326	4A
W82-02327	5B
W82-02328	4A
W82-02329	4A
W82-02330	5B
W82-02331	2H
W82-02332	5B
W82-02333	2F
W82-02334	2H
W82-02335	5C
W82-02336	5D
W82-02337	5B
W82-02338	5A
W82-02339	5A
W82-02340	2I
W82-02341	5G
W82-02342	2H
W82-02343	2J
W82-02344	2L
W82-02345	2L
W82-02346	5A
W82-02347	2L
W82-02348	2H
W82-02349	1A
W82-02350	2A
W82-02351	5F
W82-02352	5A
W82-02353	5C
W82-02354	5B
W82-02355	5A
W82-02356	5C
W82-02357	5C
W82-02358	5B
W82-02359	6D
W82-02360	5B
W82-02361	8G
W82-02362	5E
W82-02363	6E
W82-02364	2A
W82-02365	4A
W82-02366	6G
W82-02367	2H
W82-02368	2E
W82-02369	2F
W82-02370	5D
W82-02371	2H
W82-02372	6F
W82-02373	2I
W82-02374	5A
W82-02375	2J
W82-02376	7E
W82-02377	5A
W82-02378	5B
W82-02379	5B
W82-02380	2K
W82-02381	3F
W82-02382	5D
W82-02383	5D
W82-02384	5D
W82-02385	4A
W82-02386	2A
W82-02387	8A
W82-02388	8A
W82-02389	6A
W82-02390	5A
W82-02391	3C
W82-02392	5B
W82-02393	5B
W82-02394	5A
W82-02395	2I
W82-02396	3C
W82-02397	2H
W82-02398	5C
W82-02399	5C
W82-02400	5B
W82-02401	5B
W82-02402	3F
W82-02403	6C
W82-02404	5G
W82-02405	5D
W82-02406	5C
W82-02407	6G
W82-02408	6A
W82-02409	5F
W82-02410	5D
W82-02411	2H
W82-02412	5C
W82-02413	5D
W82-02414	2H
W82-02415	8A
W82-02416	5A
W82-02417	6G
W82-02418	5B
W82-02419	5F
W82-02420	5F
W82-02421	2H
W82-02422	2F
W82-02423	5A
W82-02424	6A
W82-02425	2E
W82-02426	2L
W82-02427	5A
W82-02428	5C
W82-02429	5C
W82-02430	8A
W82-02431	7B
W82-02432	6E
W82-02433	5E
W82-02434	2H
W82-02435	5C
W82-02436	5D

W82-02437	2F
W82-02438	5B
W82-02439	5B
W82-02440	2K
W82-02441	6A
W82-02442	5C
W82-02443	5A
W82-02444	5C
W82-02445	5A
W82-02446	5F
W82-02447	5F
W82-02448	5A
W82-02449	5E
W82-02450	5F
W82-02451	5D
W82-02452	2A
W82-02453	4D
W82-02454	3A
W82-02455	6A
W82-02456	3E
W82-02457	5D
W82-02458	5G
W82-02459	2F
W82-02460	2K
W82-02461	4C
W82-02462	2A
W82-02463	7C
W82-02464	7C
W82-02465	2F
W82-02466	2F
W82-02467	2F
W82-02468	2B
W82-02469	5B
W82-02470	2K
W82-02471	2H
W82-02472	2J
W82-02473	6B
W82-02474	7C
W82-02475	7C
W82-02476	2E
W82-02477	4C
W82-02478	4A
W82-02479	7C
W82-02480	7C
W82-02481	2F
W82-02482	7C
W82-02483	2E
W82-02484	4C
W82-02485	2E
W82-02486	10D
W82-02487	7A
W82-02488	7C
W82-02489	5A
W82-02490	7C
W82-02491	7C
W82-02492	7C
W82-02493	7C
W82-02494	7C
W82-02495	7C
W82-02496	7C
W82-02497	7C
W82-02498	7C
W82-02499	7C
W82-02500	7C
W82-02501	6A
W82-02502	2E
W82-02503	6E
W82-02504	5B
W82-02505	5B
W82-02506	7C
W82-02507	2J
W82-02508	2J
W82-02509	2J
W82-02510	2F
W82-02511	5D
W82-02512	2J
W82-02513	6E
W82-02514	6E
W82-02515	6E
W82-02516	6E
W82-02517	6C
W82-02518	3D
W82-02519	3D
W82-02520	6D
W82-02521	3D
W82-02522	6E
W82-02523	7B
W82-02524	5C
W82-02525	6G
W82-02526	2H
W82-02527	5G
W82-02528	2A
W82-02529	5B
W82-02530	5D
W82-02531	6G
W82-02532	5F
W82-02533	2A
W82-02534	6A
W82-02535	5G
W82-02536	2F
W82-02537	5B
W82-02538	2F
W82-02539	2C
W82-02540	6A
W82-02541	5A
W82-02542	2L
W82-02543	3E
W82-02544	2K
W82-02545	2K
W82-02546	7C
W82-02547	5B
W82-02548	2F
W82-02549	2F
W82-02550	2F
W82-02551	3C
W82-02552	7B
W82-02553	2H
W82-02554	5D
W82-02555	2C
W82-02556	3F
W82-02557	5E
W82-02558	2I
W82-02559	4B
W82-02560	2L
W82-02561	8D
W82-02562	5A
W82-02563	5C
W82-02564	5D
W82-02565	2H
W82-02566	2K
W82-02567	7B
W82-02568	6G
W82-02569	2L
W82-02570	2K
W82-02571	5G
W82-02572	5G
W82-02573	8G
W82-02574	2I
W82-02575	6A
W82-02576	2L
W82-02577	5E
W82-02578	4B
W82-02579	2H
W82-02580	5B
W82-02581	2J
W82-02582	5D
W82-02583	2L
W82-02584	6C
W82-02585	6F
W82-02586	5F
W82-02587	6E
W82-02588	7A
W82-02589	6A
W82-02590	4A
W82-02591	3D
W82-02592	6A
W82-02593	5D
W82-02594	5B
W82-02595	5B
W82-02596	5D
W82-02597	4A
W82-02598	5F
W82-02599	5B
W82-02600	5G

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 6
JUNE 1, 1982

W82-02601 -- W82-03000

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

RECONNAISSANCE OF THE HOT SPRINGS MOUNTAINS AND ADJACENT AREAS, CHURCHILL COUNTY, NEVADA,
Geological Survey, Menlo Park, CA. Water Resources Div.
N. E. Voegtly.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $3.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-134, 1981. 10 p, 1 Plate, 13 Ref.

Descriptors: Structural geology, *Geologic fractures, Rocks, Mountains, *Stratigraphy, *Geohydrology, Test wells, *Geothermal studies, *Nevada, *Churchill County, Hot Springs Mountains, Thermal water, Geologic mapping.

A geologic reconnaissance of the Hot Springs Mountains and adjacent areas, which include parts of the Brady-Hazen and the Stillwater-Soda Lake Known Geothermal Resource Areas, during June-December 1975, resulted in a reinterpretation of the nature and location of some Basin and Range faults. In addition, the late Cenozoic stratigraphy has been modified, chiefly on the basis of radiometric dates of volcanic rocks by U.S. Geological Survey personnel and others. The Hot Springs Mountains are in the western part of the Basin and Range province, which is characterized by east-west crustal extension and associated normal faulting. In the surrounding Trinity, West Humboldt, Stillwater, and Desert Mountains, Cenozoic rocks overlie 'basement' rocks of the Paleozoic and Mesozoic age. A similar relation is inferred in the Hot Springs Mountains. Folding and faulting have taken place from the late Tertiary to the present. (USGS)
W82-02830

1B. Aqueous Solutions and Suspensions

TRANSFER OF VOLATILE SUBSTANCES FROM WATER TO THE ATMOSPHERE,
Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
C. Matter-Muller, W. Gujer, and W. Giger.
Water Research, Vol 15, No 11, p 1271-1279, November, 1981. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Aeration, *Mass transfer, *Organic compounds, Surfactants, Diffusion coefficient, Trickling filters, Air stripping, Wastewater treatment, Activated sludge process, Bubbles, Volatile compounds, Air-water interfaces, Air pollution.

Surface aeration systems and trickling filters can efficiently strip volatile compounds during wastewater treatment. Bubble aeration systems are less efficient, and pure oxygen activated sludge plants are inefficient. Theory and experimental data on aerator systems in batch and continuous flow reactors are analyzed. Equations are given for three ranges of the degree of saturation of the exit gas (far from saturated, partially saturated with the volatile compound, and in equilibrium with the liquid). The ratios of the molecular diffusion coefficient of a compound and oxygen in the water were as follows: oxygen, 1.00; 1,1-dichloroethylene, 0.62; tetrachloroethylene, 0.55; benzene, 0.53; toluene, 0.53; 1,2,4-trimethylbenzene, 0.39; and 1,4-dichlorobenzene, 0.39. The surface active agents tested (Marlon A, bactopeptone, and palmitic acid) had variable effects on the mass transfer coefficients of tetrachloroethylene. (Cassar-FRC)
W82-02902

WATER-PHOSPHORIC ACID MEDIA: ELECTROCHEMICAL PROPERTIES,
Nancy-1 Univ. (France). Lab. de Chimie et 'Electrochimie Analytique.
C. Louis, and J. Bessiere.
Analytical Letters, Vol 13, No A 11, p 937-946, 1980. 1 Fig, 8 Ref.

Descriptors: *Electrochemistry, *Phosphoric acid, Chemical reactions, Electrolysis, Solutes, Acidity, Chemical properties.

Electroactivity ranges of water-phosphoric acid media were determined at various electrodes. The behavior of the ferricinium/ferrocene comparison system was studied. Electrodes used included polished platinum, various carbon, and mercury. The aqueous saturated calomel electrode was used as a reference system. The oxidizing properties of water-phosphoric acid media increased with increasing phosphoric acid concentration. Reducing properties in water-phosphoric acid mixtures depend on the acidity level and water activity. In the different mixtures used the thermodynamic range extended over 1.23 V. The electrochemical properties of the 5.5 M and 11.5 M phosphoric acid industrial mixtures could be compared. (Baker-FRC)
W82-02943

SETTLING VELOCITY OF SPHERICAL PARTICLES IN CALM WATER,
Ecole Polytechnique Federale de Lausanne (Switzerland).
J. L. Boillat, and W. H. Graf.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY 10, p 1123-1131, October, 1981. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Settling velocity, *Sediments, *Drag, Particulate matter, Physical properties, Water properties, *Particle size, Calm water.

The settling velocity of spherical particles 0.200 to 1.905 cm in diameter and 1.018 to 2.700 g per cu cm in density in calm water were measured by video techniques at a precision of 1/40 sec. The results were about 20% higher than the standard CTS=f(R) curve, which was developed from fixed spheres tested in wind tunnels. This preliminary data is not sufficient to propose a new drag coefficient for freely falling spheres. Further research is suggested, perhaps concerning the effects of the Strouhal number on the drag of freely falling spheres. (Cassar-FRC)
W82-02958

2. WATER CYCLE

2A. General

LAND SURFACE AND LAKE STORAGE DURING SNOWMELT RUNOFF IN A SUBARCTIC DRAINAGE SYSTEM,
Saskatchewan Univ., Saskatoon. Dept. of Geography.
For primary bibliographic entry see Field 2C.
W82-02624

APPROXIMATE ERROR BOUNDS FOR SIMULATED HYDROGRAPHS,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. C. Garen, and S. J. Burges.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1519-1534, 1981. 2 Fig, 6 Tab, 25 Ref.

Descriptors: *Hydrographs, *Error analysis, Simulation, Errors, *Rainfall-runoff relationships, Rainfall, Storms, Rain, Model studies, Monte Carlo method, Mathematical studies, *Watersheds.

The applicability of first-order uncertainty analysis to a complex watershed model to quantify parameter error propagation and to gain an appreciation of the approximate magnitudes of model output uncertainty caused by different levels of parameter uncertainty was investigated. The study focuses on the estimation of error bounds for simulated hydrographs, assuming the model to be perfect and accounting only for output uncertainty caused by uncertainty in parameter values. First-order uncertainty analysis is applid to the Stanford Watershed Model to calculate the effects of parameter uncertainty as it propagates through the model. The first order approximations to the mean and standard deviation of model output are compared to estimates of the same quantities, using Monte Carlo analysis. This was done to identify the degree of parameter error for which the first order approximations are valid. First order analysis was found to give good approximations if the coefficients of variation on sensitive parameters were less than about 0.25. First order analysis allows a large reduction in computation over Monte Carlo methods for estimating error bounds on simulated hydrographs. Based upon storm types and initial moisture contents examined here it is clear that different streamflow uncertainty levels can be expected at different times of the year in any catchment. While the findings given here were developed for the particular watershed model, the method should be applicable to all complex moisture accounting rainfall-runoff models. (Baker-FRC)
W82-02678

ANALYSIS OF FLOOD HYDROGRAPHS FROM WETLAND AREAS,
G. L. Fagan, Jr.
PhD Dissertation, June, 1981. 301 p, 25 Fig, 28 Tab, 119 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-18869.

Descriptors: *Hydrograph analysis, *Flood hydrographs, *Wetlands, *Unit hydrographs, Flood discharge, Precipitation, Runoff, Great Swamp, Passaic River basin, *New Jersey.

Many natural wetlands and water courses serve the valuable function of reducing flood peaks and lessening high flood stages. Such effects may be substantially altered or eliminated by man's activities. This research presents the results of a project to predict flood discharges from wetland areas. Hydrographs from several non-winter flood events resulting solely from precipitation, in the Great Swamp in the Passaic River Basin in New Jersey, were studied in an attempt to explain the runoff regimen that exists. Examination of the hydrographs showed that for a given precipitation volume, the volume of surface runoff during the flood event decreased with increasingly wetter antecedent precipitation conditions. This finding is contrary to what would generally be expected for a non-wetland area. In addition, a statistical analysis determined that the loss, which is the difference between the total precipitation volume and the runoff volume, was significantly correlated with the total precipitation volume and antecedent precipitation conditions. Unit hydrographs developed from flood hydrographs were studied and found to be inadequate as a means of predicting peak discharges for specified precipitation patterns. However it was found that the unit hydrograph peak generally decreased with increasing volume of precipitation excess and the duration of this excess. The analyses provided the basis of a statistical approach for predicting flood discharges with limited precipitation and flow data. The results of the research should be of significance in the planning and design of flood control works, the conservation and development of wetland areas, and the evaluation of flood risks for areas downstream of wetland areas. (Sinha-OEIS)
W82-02733

STUDIES OF BIOLOGICAL NITROGEN CYCLE PROCESSES IN THE UPPER WATERS OF THE OCEAN, WITH SPECIAL REFERENCE TO THE PRIMARY NITRITE MAXIMUM,
Scripps Institution of Oceanography, La Jolla, CA.
R. J. Olson.
PhD Dissertation, 1980. 264 p, 53 Fig, 15 Tab, Numerous Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-00032.

Descriptors: *Nitrogen cycle, *Marine biology, *Metabolism, Nitrates, Nitrites, Photosynthesis, Phytoplankton, Bacteria, Bioindicators, Biological properties, North Pacific Ocean.

Group 2A—General

An investigation of components of the marine nitrogen cycle in oxygenated waters was undertaken. Experiments with pure cultures of phytoplankton and natural populations of phytoplankton and bacteria were used to relate metabolic activities to observed distributions of nitrogenous nutrients. Two studies of the central North Pacific Gyre were done to determine the depth profiles of biologically important parameters in upper and deep waters. On the basis of observed nitrate and nitrite distributions, a simple box model was constructed which showed that the amount of nitrate entering the euphotic zone via mixing was sufficient to account for the appearance of nitrite in the primary nitrite maximum. Laboratory culture experiments with a marine diatom gave results consistent with the proposed nitrite loss during nitrate assimilation by phytoplankton. (Sinha-OEIS)
W82-02742

OUTFLOW OF VOLCANIC ROCK AND GAS DURING OPENING OF THE ARPA-SEVAN TUNNEL,

V. I. Nikolin, E. S. Matlak, A. V. Sarkisyan, and M. G. Bikineev.
Hydrotechnical Construction, No 6, p '81-586, June, 1980. 2 Fig, 2 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 24-27, June, 1980.

Descriptors: *Tunnel construction, *Geologic formations, Drilling, Volcanoes, Carbon dioxide, Water, Rocks, Rapid excavation, *Diversion structures, Arpa River, Sevan Lake, *Russia.

A 48.3 kilometer tunnel is being built to divert a portion of the Arpa River into Lake Sevan. The region through which the tunnel will pass is listed as seismically dangerous due to the tectonic processes which continue there even though volcanic activity in this region terminated in the Quaternary period. Rocks are basically magmatic varieties. The tunnel is being opened by the drill-and-blast method. During the opening of the tunnel, an influx of hot gasified water and long- and short-term active blower gas liberations occurred in significant amounts in virtually all tunnel cuts. The first such gas-dynamic phenomenon occurred on March 13, 1977, and was determined to belong to a class of porphyrite and carbon dioxide ejections. Overflows of mineral groundwater were found, saturated with carbon dioxide, associated with the large tectonic cracks and crushing zones. After the first heavy liberation of gas and water, outflows of carbon dioxide and water occurred at other stations. As a result of the gas-dynamic phenomena, rock debris was strewn over a distance of up to 150 meters from the cut, severely impairing the safety of the workers and leading to increased costs and construction time. The situation was investigated through the drilling of several boreholes. The following conclusions were drawn. All outflows occurred in porphyrites which were classed as water- and gas-water-bearing rocks at a depth of over 600 meters. Basic signs of porphyrite proneness to outflow include reduced strength and the extent to which the porphyrites are disturbed, increased venting of gas from blast holes during drilling, presence of circular macrocracks in cores, and separation of the core into thin disks or disintegration to a state of sand. (Baker-FRC)
W82-02772

MATHEMATICAL MODELS OF WATER YIELD WITH PARTICULAR REFERENCE TO MISSISSIPPI WATERSHEDS: INTERIM REPORT NO. 1, A STUDY OF SOME EMPIRICAL METHODS OF DETERMINING THE UNIT HYDROGRAPH,

Mississippi State Univ., Mississippi State.
V. P. Singh, and A. Baniukiewicz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168485, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute, Mississippi State University Report, September, 1980. 198 p, 121 Fig, 22 Tab, 13 Ref. OWRT-A-129-MISS(1), 14-34-0001-0126.

Descriptors: Unit hydrographs, Matrix methods, Transform methods, Time series methods, Linear programming, Error analysis, Sensitivity analysis, Reproduction, Regeneration, *Prediction, *Statistical measures, *Ranking, *Small watersheds, Agricultural watersheds, *Mississippi, *Water yield, *Model studies, Linear theory, Statistical methods.

An attempt was made to evaluate, compare and rank nine different methods of deriving the unit hydrograph (UH) on a small agricultural watershed, which included (1) matrix methods, (2) transform methods, (3) time series methods, and (4) linear programming methods. Although the matrix methods, except for the least squares method, yield exact solution for the UH, these methods are not suitable for deriving the representative UH for a given watershed. However, transform, time series and linear programming methods can be used as effective tools in the UH derivation. Based on the results of this study the least squares, Laguerre and harmonic methods are probably the best methods. This is particularly true if rainfall-runoff data is subject to error. However, if the errors in data are large, the Simplex method may be the best. Also this is the only method which is capable of yielding the representative UH, whereas the other methods are not. Meixner polynomials, time series and Simplex methods can also be used as effective tools in the UH derivation. It must be noted that these conclusions are based on a small rural watershed. Whether these will be valid for a larger watershed in a different hydrometeorologic setting remains an interesting question for investigation.
W82-02803

EFFECT OF IRRIGATION ON GROUNDWATER RESOURCES WITH SPECIAL REFERENCE TO THE VAKHSH VALLEY,

All-Union Scientific-Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
V. A. Baron, and K. K. Bisembaeva.
Water Resources (English Translation), Vol 7, No 6, p 545-555, November/December, 1980. 1 Fig, 2 Tab, 16 Ref. Translated from Vodnye Resursy, No 6, p 120-126, November-December, 1980.

Descriptors: *Irrigation effects, *Groundwater recharge, *Hydrologic balance, Infiltration, Irrigation, Agriculture, Terracing, Groundwater management, *USSR, Vakhsh Valley.

The development of irrigated farmland causes an increase in groundwater which in turn requires increased drainage. The formation of the water balance of the Vakhsh Valley, a typical large valley in southern Tadzhikistan, was examined. Substantial changes have occurred in this semi-desert region, and a model was constructed to study the changes. It considered groundwater recharge under natural conditions, the amount of groundwater runoff into the Vakhsh River, and recent changes in groundwater runoff and recharge. In the area where irrigation was increased by 50% due to the development of additional terraces, the average value of the resultant recharge increased from 17 to 48 mm/yr. Under undisturbed conditions, natural groundwater resources were 40 mm/yr or 1.52 cu m/sec. Natural resources have been increased by the irrigation projects. (Small-FRC)
W82-02851

TIDES AND TIDAL DATUMS IN THE UNITED STATES,

Coastal Engineering Research Center, Fort Belvoir, VA.
D. L. Harris.
Special Report No 7, February, 1981. 382 p, 32 Fig, 17 Tab, 67 Ref, 3 Append.

Descriptors: *Tides, *Tidal range, *Sea level, *Elevation, Great Lakes, Tidal hydraulics, Navigation, Lakes.

This report was developed to provide engineers with a ready reference to information about tidal datums and tide characteristics, and to provide information about the statistical distribution of astronomical tidal heights which can be used in setting and measuring the elevation of proposed engineering works or combined with similar statistics for storm surges and tsunamis to estimate the probability of extreme water levels. Tidal datums of practical importance include: mean sea level, mean low water or mean lower low water for most navigation-related activities, mean high water or mean higher high water for developments of land above mean sea level, and the National Geodetic Vertical Datum (NGVD) for comparing land elevations where no tide observations are available and at interior locations where tide observations are impossible. Special datums for the Great Lakes region, based on the assumption that the mean water level in each lake defines a level surface, have been in use for more than a century. An international coordination committee adopted a Great Lakes datum called the International Great Lakes Datum (IGLD) of 1955, which has gained wide acceptance in both the United States and Canada. Statistical characteristics of the astronomical tides at various ports were investigated. The distribution function for astronomical tide heights is found to be nearly symmetric at many stations. At many other continental tide stations, the astronomical tide remains above mean sea level more than half the time, but departs farther from mean sea level in a negative rather than in a positive direction. At Honolulu, Hawaii, the predicted tide is below the mean sea level more than half the time and positive departures are larger than negative departures. (Moore-SRC)
W82-02982

2C. Snow, Ice, and Frost

LAND SURFACE AND LAKE STORAGE DURING SNOWMELT RUNOFF IN A SUBARCTIC DRAINAGE SYSTEM,

Saskatchewan Univ., Saskatoon. Dept. of Geography.
J. E. FitzGibbon, and T. Dunne.
Arctic and Alpine Research, Vol 13, No 3, p 277-285, August, 1981. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Snowmelt, *Subarctic zone, *Drainage area, *Daily hydrographs, *Surface runoff, Lakes, Runoff plot, Runoff, Watersheds, Hydrographs, Seasonal storage, Surface water, Surface drainage, Topology, Topography, Knob Lake basin, Quebec.

The hydrographs of the inflow, outflow and storage capacity of the snowmelt runoff channels of the Knob Lake Basin at Schefferville, Quebec were studied. This basin is characteristic of the complex but glacially deranged drainage systems of the Canadian Subarctic Lowlands. Lake hydrographs were taken by measuring lake storage and discharge directly for each of the lakes in the study area, while discharge hydrographs for the land surface element were determined mathematically through a water balance equation. The land surface elements were the most important component of the Knob Lake Basin drainage system due to the large storage capacity (5-15 cm) on the land surface and the 3 to 4 day delay of the runoff from the land surfaces. The hydrograph that resulted reflected seasonal rather than daily patterns in response to snowmelt runoff. (Geiger-FRC)
W82-02624

THE MASS BALANCE OF PEYTO GLACIER, ALBERTA, CANADA, 1965 TO 1978,

Department of the Environment, Ottawa (Ontario). Inland Waters Directorate.
G. J. Young.
Arctic and Alpine Research, Vol 13, No 3, p 307-318, August, 1981. 6 Fig, 2 Tab, 17 Ref.

Descriptors: Topography, *Hydrologic budget, *Glaciohydrology, Glacier balance, *Glacier mass balance, Mathematical studies, Ablation, Snowmelt, Glaciers, Seasonal variation, Elevation, Meteorological data collection, Annual distribution, Accumulation, Snowline, *Peyto Glacier, Alberta.

Water, ice and heat mass balance records for Peyto Glacier, Alberta for 1965 to 1978 were examined as a continuation of the studies begun during the International Hydrological Decade and International Hydrological Program. Over the entire period studied, a specific loss in mass of 0.21 m/

year water equivalent was noted, while on a year-to-year basis, slightly positive or negative balances were recorded. Both accumulation and ablation patterns were repeated yearly over short distances of the glacier, but repetitive patterns were unusual on a larger scale. Different combinations of summer ablation and winter accumulation may achieve the same net annual balance. On moderately sloping glaciers such as Peyto, the health of the glacier may be determined by the position of the transient snowline. Some relations between the net annual balance and the meteorology of the area are also discussed. (Geiger-FRC)
W82-02638

MICROWAVE MEASUREMENTS OF SNOWPACK PROPERTIES,

Kansas Univ./Center for Research, Inc., Lawrence.
W. H. Stiles, F. T. Ulaby, and A. Rango.
Nordic Hydrology, Vol 12, No 3, p 143-166, 1981. 10 Fig, 2 Tab, 44 Ref.

Descriptors: Snowpack, *Microwaves, Field tests, Remote sensing, Scattering coefficient, Water content, *Snow water equivalent, Colorado.

Active and passive microwave responses to snow parameters were measured during the winter of 1977 to correlate the data with changing snowpack properties. The study area was a hayfield near Steamboat Springs, Colorado. The three types of measurements were: temporal (daily, morning and afternoon over 6 weeks), diurnal, and snowpile (to determine the effects of piling up snow to 170 cm in 20 cm increments). The scattering coefficient and the apparent radiometric temperature were sensitive to changes in snow water equivalent and liquid water content. The scattering coefficient showed an exponential-like increase with increasing water equivalent, and the readiometric temperature, an exponential-like decrease. Increasing liquid water in the snowpack caused a decrease in scattering coefficient and an increase in radiometric temperature. These minima and maxima were seen at 4 pm, as measured by the diurnal data sets. The snow water equivalent at which the microwave response began to saturate decreased with decreasing wavelength. The scattering coefficient and radiometric temperature variations were greatest at 35 and 37 GHz, and much less at lower frequencies. This paper also reviews methods of measuring snow water equivalent and liquid water content by manual means and by microwave methods. Three basic techniques are available; bistatic reflection-coefficient measurements, measurements of snow vertical stratigraphy using high range resolution radar, and measurements of the backscattering coefficient. (Cassar-FRC)
W82-02646

QUANTITATIVE COMPOSITION, DISTRIBUTION, COMMUNITY STRUCTURE AND STANDING STOCK OF SEA ICE MICROALGAE IN THE CANADIAN ARCTIC,

Department of Fisheries and Marine Service, Ste Anne De Bellevue (Quebec). Arctic Biological Station.
S. I. C. Hsiao.
Arctic, Vol 33, No 4, p 768-793, December, 1980. 2 Fig, 5 Tab, 65 Ref.

Descriptors: *Sea ice, *Microorganisms, Algal growth, *Algae, Arctic, Polar regions, *Arctic zone, Microbiological studies, Canadian Arctic.

The quantitative composition, vertical distribution and standing stock of microalgae in Canadian arctic sea ice were investigated, and some environmental factors controlling their distribution were explored. A total of 196 species in 46 genera of microalgae was identified from the Canadian arctic sea ice. Among them the diatoms were represented by 189 species, the flagellates by 3, and the dinoflagellates and chrysophytes by 2 species each. No blue-green algae were found. Eleven, 24, and 44 species of microalgae were found exclusively in the Eskimo Lakes, Eclipse Sound and Frobisher Bay, respectively. The sea ice microalgal communities and standing stock started to develop in late fall at the time of ice formation. They grew very slowly through the winter months, increasing exponentially in early spring, reached a peak just prior to the thaw period in late spring or early summer, and declined during summer quite rapidly as the ice melting occurred. Standing stock was greatest at the bottom of the sea ice, where it was one to two orders of magnitude larger than in other parts of the ice column, and 50 to 500 times greater than in the phytoplankton in the underlying waters. The sea ice microalgae grew and spread in the continuously low temperature, variable salinities, and a quite remarkable set of light fields, together with spatially and temporally variable and discountinuous physical-chemical conditions. (Baker-FRC)
W82-02649

THE EFFECT OF WIND ON ICE PRESSURE ON RIVER STRUCTURES,

D. F. Panfilov.
Hydrotechnical Construction, No 3, p 284-289, March, 1980. 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 43-46, March, 1980.

Descriptors: *Ice pressure, *Hydraulic structures, *Wind velocity, Wind, Ice loads, Ice run, Estimating equations, Mathematical studies, Rivers.

The role of wind in the calculation of ice pressure on structures was explored. This depends primarily upon the relation between wind speed and current velocity. For ratios of wind speed over velocity that are less than 10 (free rivers and shallow impounded pools) the effects are small and can be ignored. For large reservoirs, the ratio is generally greater than 100 and affects the extent of the ice loads, especially during the spring ice run. Reduced equations are derived which can be used in the case of deep reservoirs with a ratio greater than 100. Movement of the ice cover in these reservoirs occurs to a considerable extent under the effect of wind. (Small-FRC)
W82-02668

ICE COVER EFFECTS ON STREAM FLOWS AND MIXING,

Canada Centre for Inland Waters, Burlington (Ontario).
Y. L. Lau, and B. G. Krishnappan.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1225-1242, October, 1981. 12 Fig, 14 Ref.

Descriptors: *Ice cover, *Stream discharge, *Flow pattern, Mathematical studies, Turbulent flow, Flow velocity.

An alternate method was used to analyze flow structure in an ice covered stream. A turbulence model (Launder and Spalding) was used to calculate the depth, velocity distribution, the bed slope, and bottom roughness. Then these results were used in the two-dimensional mass transport equation to simulate concentration distributions due to sources placed at different heights in the flow. Three different fully developed flows were calculated for open water and ice covered conditons. The equivalent ice-covered flows had larger flow depths and smaller bed shears than the free-surface flows. The resulting eddy viscosity was smaller; however, it did not go to zero. When a neutrally buoyant tracer was computed for all runs, the distributions indicated reduced mixing rates in ice-covered flows when compared to open-water flows. (Small-FRC)
W82-02698

PRODUCTION STRATEGIES IN ANTARCTIC INLAND WATERS: PHYTOPLANKTON ECOPHYSIOLOGY IN A PERMANENTLY ICE-COVERED LAKE,

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
W. F. Vincent.
Ecology, Vol 62, No 5, p 1215-1224, October, 1981. 5 Fig, 6 Tab, 32 Ref.

Descriptors: *Phytoplankton, *Ice cover, *Antarctic, Polar regions, Lakes, Lake ice, Primary productivity, Nutrients, Temperature effects, Light penetration.

The relative importance of light, temperature, and nutrient supply for strategies of primary production by antarctic phytoplankton was examined experimentally in Lake Fryxell, a relatively productive water in the Taylor Valley (South Victoria Land). The lake is permanently covered by 3.8-4.6 m of ice and is 7 sq km in area. Three distinct layers of algal production were distinguished. Immediately under the ice, phytoplankton were adapted to relatively bright light and were limited by nitrogen availability. There was a deep maximum of Chroomonas and Pyramimonas at the bottom of the eutrophic zone in a highly shaded area. Mid-eutrophic populations continued to grow throughout midsummer. Nutrient supply seemed to determine lake-to-lake and depth variations in primary productivity when results from several lakes were compared. Low light rather than low temperature damped algal photosynthesis. (Small-FRC)
W82-02862

A SOLUTION TO SPRING ICE-JAM FLOODING,

J. C. Loffredo.
Public Works, Vol 111, No 3, p 82-83, March, 1980.

Descriptors: *Ice jams, *Ice breakup, *Flood control, *Flood protection, Flooding, Regional floods, Floodproofing, Streamflow, Streams, *Cazenovia Creek, Buffalo, New York.

To alleviate spring ice-jam flooding on Cazenovia Creek, the city of Buffalo employs three World War II vehicles (LVTs) to act as small ice breakers. To aid in the ice breaking efforts where dynamite has failed, track powered, amphibious LVTs were developed that could operate in only 5 feet of water. These modified vehicles are 27 feet long by 10 feet wide and can handle ice up to 2 feet thick. When used in conjunction with dynamite, the new LTVs can break ice up to 5 feet thick. Sometimes a large stationary ice field will cause flooding on Cazenovia Creek. The LVTs are used in breaking up the ice field before the heavy spring runoff to prevent the flooding before it has a chance to occur. Two of these new vehicles were used to break ice fields on Owasco Outlet, Port Byron, a non-navigable stream downstream from a dam whose reservoir was in danger of topping. During the Port Byron mission their lack of power and speed in reverse caused the LVTs to become stuck in the ice field. Federal grants are being sought to design new transmissions for the vehicles to overcome this problem. (Geiger-FRC)
W82-02908

2D. Evaporation and Transpiration

STOMATAL RESPONSE TO ENVIRONMENTAL VARIABLES IN TWO TROPICAL FOREST SPECIES DURING THE DRY SEASON IN NIGERIA,

Ibadan Univ. (Nigeria). Dept. of Forest Resources Management.
D. Whitehead, D. U. U. Okali, and F. E. Fasehun.
Journal of Applied Ecology, Vol 18, No 2, p 571-587, August, 1981. 10 Fig, 2 Tab, 30 Ref.

Descriptors: *Stomatal transpiration, *Water potentials, *Forest hydrology, Transpiration, Leaves, Teak, Gmelina, Trees, *Nigeria, Plant water potential, Tropical regions, Soil-water-plant relationships.

The stomatal responses of two fast-growing exotic trees of commercial value were determined as part of a study on prediction of transpiration rates. Gmelina arborea Roxb. is planted for pulpwood, and teak (Tectona grandis L.), for poles and saw timber. A null-balance diffusion porometer was used to measure stomatal conductance on 6 days during the dry season, January 1978, near Ibadan, Nigeria. In both species stomatal conductance increased rapidly in early morning from a low of 2.0-2.5 mm per sec and decreased after midday. Maxi-

mum Gmelina values (10-15 mm per sec) were less than those for teak (20-30 mm per sec). Generally, stomatal conductance increased with increasing irradiance and decreased with increasing air saturation deficit. Maximum conductances were at 400 and 800 micro Einstein per sq meter per sec in Gmelina and teak, respectively. Although temperature effects were not altogether clear, there was indication that conductances were higher at 20-28 C for Gmelina and 27-31 C for teak. There was no evidence that leaf water potential and conductance were related. Transpiration rates calculated from the Penman-Monteith equation using observed stomatal conductances and environmental variables agreed closely with transpiration rates calculated from conductances predicted by the Jarvis (1976) model. Mean hydraulic resistances were (in MPs per m): Gmelina, 6 million, and teak, 5.3 million. (Cassar-FRC)
W82-02884

THE IRRIGATION SCHEDULING PROBLEM AND EVAPOTRANSPIRATION UNCERTAINTY,

Massachusetts Inst. of Tech., Cambridge.
A. E. Rhenals, and R. L. Bras.
Water Resources Research, Vol 17, No 5, p 1328-1338, October, 1981. 11 Tab. 29 Ref.

Descriptors: *Evapotranspiration, *Model studies, Mathematical models, Consumptive use, *Irrigation practices, Irrigation, Crop yield.

The purpose of this paper is to present an optimization model for scheduling in which the natural uncertainty of potential evapotranspiration (PET) has been explicitly included. A hypothetical case study is presented in order to gain insight into the behavior of the global model, to determine its computational feasibility, and to provide an example of the effect of PET uncertainty on the measures of performance of irrigation scheduling. The model presented is based on stochastic dynamic programming and is formulated to maximize net benefits from a crop facing uncertain, correlated evapotranspiration demands. Weekly irrigation decisions are made after observing current soil moisture and available irrigation water, as well as PET during the past week. The model is similar to the traditional reservoir control algorithms popular in the surface water investigations. Although the model formulation is useful and feasible, the case study example points out that the effect of uncertain evapotranspiration on irrigation performance measures is apparently minimal. Computer programs used for this analysis are available. A major limitation of the global model was seen to be that the crop model utilized has not been field tested. (Baker-FRC)
W82-02900

2E. Streamflow and Runoff

HOW ABIOTIC FACTORS AFFECT THE DISTRIBUTION OF TWO SPECIES OF TROPICAL PREDACEOUS AQUATIC BUGS (FAMILY: NAUCORIDAE),

Michigan Univ., Ann Arbor. Div. of Biological Sciences.
For primary bibliographic entry see Field 7A.
W82-02633

RIVER AND SUSPENDED SEDIMENT DISCHARGE INTO BYAM CHANNEL, QUEEN ELIZABETH ISLANDS, NORTHWEST TERRITORIES, CANADA,

Pacific Geoscience Centre, Sidney (British Columbia).
P. McLaren.
Arctic, Vol 34, No 2, p 141-146, June, 1981. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Sediment transport, *Alluvial channels, Channels, Suspended sediments, Runoff, Catchment areas, Drainage, Arctic zone, Arctic, Alluvial deposits, Ice, Cold regions, *Northwest Territories, Canada.

River and suspended sediment discharge into Byam Channel, which intervenes between the eastern Melville and western Byam Martin islands in the Northwest Territory of Canada, was investigated during 1973 and 1974. There are 32 drainage basins on the two coasts, of which seven enter Viscount Melville Sound, three flow north into Byam Martin Channel, and the other 22 empty into Byam Channel. They range in size from 11 square kilometers to 1136 square kilometers, each basin discharging onto a delta that begins at the point where the river is no longer confined within valley walls and is characterized by a braided stream pattern. Continuous ice persists in Byam Channel for at least 9 months of the year. River sediments are frequently deposited on nearshore ice during breakup, resulting in a decreased albedo and a more rapid melting at the delta fronts. Flow and suspended sediment discharge were measured 15 times between 30 June and 1 August 1974. Stream flow began on 29 June. On 1 July discontinuous sand was being deposited on an ice stream bottom, and by 3 July the stream had cut down to the channel bottom. Peak discharge occurred on 10 July and by 16 July no snowbanks remained. From 30 June to 6 July suspended sediment concentration increased steadily with increasing discharge, peaking at 3.36 kg/cubic meter and dropping by 16 July to 0.44 kg/cubic meter. Much of the sediment is apparently not deposited in the channels, but rather is incorporated into the active delta fronts or possibly transported out of Byam Channel above a pycnocline. (Baker-FRC)
W82-02637

MODELING CIRCULATION IN DEPTH-AVERAGED FLOW,

San Diego State Univ.. CA. Dept. of Civil Engineering.
V. M. Ponce, and S. B. Yabusaki.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1501-1518, November, 1981. 5 Fig, 15 Ref.

Descriptors: *Circulation, *Model studies, Mathematical studies, Turbulence, Flow, Hydrodynamics, Channels, *Open channels, Multiphase flow, Water circulation.

A fundamental investigation of the circulation phenomena in open channels is performed using a depth-average mathematical model. Circulation has been observed to have a primary influence on erosion and accretion processes, heat diffusion, and contaminant dispersion. Therefore, the clarification of the physical mechanisms leading to the generation of circulation in free surface flow is a much needed endeavor. The depth-averaged two-dimensional governing equation set is used as a basis for the development of a finite difference model employing a multi-operational procedure to advance the values of the dependent variables in time. Two geometric onfigurations are extensively tested regarding the mathematical model itself and the boundary conditions. It was found that proper modeling of the effective stresses is a necessary condition for the resolution of steady, closed-streamline circulation in depth averaged mathematical models. Additionally, a competition exists between convective inertia and bed resistance. Circulating flow is inhibited when bed resistance predominates. The type of boundary condition specification is found to have a significant effect in the resulting flow pattern. It is noted that the greatest source of uncertainty in such studies is the modeling of the effective stresses. It is surmised that a higher level of sophistication is needed to handle complex flow patterns. A separate account of the three components of the effective stresses may be warranted. At present, individual closure assumptions are not available. (Baker-FRC)
W82-02679

ICE COVER EFFECTS ON STREAM FLOWS AND MIXING,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2C.
W82-02698

ANALYSIS OF FLOOD HYDROGRAPHS FROM WETLAND AREAS,

For primary bibliographic entry see Field 2A.
W82-02733

LOCAL FLOW ACCELERATIONS IN RIVERS,

Canterbury Univ. Christchurch (New Zealand). Dept. of Agricultural Engineering.
B. D. Van't Woudt.
Water Resources Bulletin, Vol 17, No 4, p 571-577, August, 1981. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Rivers, *Flow rates, *Alteration of flow, Flow characteristics, Fluctuations, Streamflow, Braided rivers, *New Zealand, Flow control, Roughness, Flow accelerations.

A field study of local flow accelerations in rivers was undertaken to provide background information for the control of many braided rivers in New Zealand. The study area was 3000 m x 800 m along the floodplain of the Waimakariri river. Flow accelerations were found to form sequentially on the downstream face of a bar across a channel when the bar approached a given water surface grade line. The bar formation occurred within a pattern of deep and shallow subreaches that can coincide with narrow and wide ones. Also, nonsequential flow accelerations can be induced by a bankslide or be formed through channel capture, channel abandonment, or channelslide deposits. Flow accelerations can be intensified through time, and can be obliterated by washout or sediment swamping. (Small-FRC)
W82-02758

CHANNEL FORM AND FLOW CHARACTERISTICS OF SUPRAGLACIAL STREAMS, AUSTRE OKSTINDBREEN, NORWAY,

Sheffield Univ. (England). Dept. of Geography.
A. D. Knighton.
Arctic and Alpine Research, Vol 13, No 3, p 295-306, August, 1981. 6 Fig, 1 Tab, 27 Ref.

Descriptors: *Streamflow, *Glacial streams, *Flow velocity, *Flow discharge, Rapid flow, Alluvial plains, Alluvial rivers, Flow pattern, Stream discharge, Topography, Water depth, Ablation, Glaciohydrology, Comparison studies, *Norway.

The characteristics of supraglacial streams and the similarity in behavior of these streams to those in alluvial environments were studied in three streams of the ablation area of Austre Okstindbreen, Norway. Two supraglacial streams were found to adjust their width and depth nearly equally but increase their velocity at the highest rate in response to a rapid downstream increase in discharge. A stream with a less regular pattern of downstream discharge showed similar width adjustments but different depth and velocity responses. The downstream relations of the first two streams differed from alluvial streams, showing responses which might be expected in the absence of declining slope and sediment load. Fluctuations in streamflow behavior were attributed in part to bed topography. The supercritical flow which aids in meander formation is related to the generation of traveling waves in one stream, with significant differences in wave frequency in various parts of the stream. (Geiger-FRC)
W82-02787

THE RELATION BETWEEN 'HYDRAULIC STRESS' AND MICRODISTRIBUTION OF BENTHIC MACROINVERTEBRATES IN A LOWLAND RUNNING WATER SYSTEM, THE SCHIERENSEEBROKS (NORTH GERMANY),

Karlsruhe Univ. (Germany, F.R.) Inst. fuer Zoologisches.
For primary bibliographic entry see Field 5C.
W82-02790

MATHEMATICAL MODELS OF WATER YIELD WITH PARTICULAR REFERENCE TO MISSISSIPPI WATERSHEDS: INTERIM REPORT NO. 1, A STUDY OF SOME EMPIRICAL METHODS OF DETERMINING THE UNIT HYDROGRAPH,

Mississippi State Univ., Mississippi State.
For primary bibliographic entry see Field 2A.
W82-02803

LOW-FLOW CHARACTERISTICS OF KENTUCKY STREAMS, 1980,

Geological Survey, Louisville, KY. Water Resources Div.
J. N. Sullavan.
Geological Survey Open-File Report 80-1225, 1980. 1 Sheet, 2 Fig, 2 Ref.

Descriptors: *Low flow, *Base flow, *Flow characteristics, Surface water, *Streamflow, Hydrologic data, Gaging stations, Sites, *Kentucky, Log-Pearson type III.

The low-flow characteristics, including the 7-day 2-year and the 7-day 10-year low flows, were determined at 127 stations in Kentucky. The log-Pearson type III distribution was used to fit the field data, from which low-flow frequencies were obtained. An additional 127 sites are active throughout the State. (USGS)
W82-02826

LOW-FLOW FREQUENCY DATA FOR SELECTED STREAM-GAGING STATIONS IN FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
G. H. Hughes.
Geological Survey Open-File Report 81-69 (WRI), 1981. 110 p, 17 Fig, 2 Ref.

Descriptors: *Low flow, Data collections, *Streamflow, *Flow rates, Frequency analysis, Average flow, Gaging stations, Sites, *Florida, Low-flow frequency, Recurrence interval.

This report contains tables of low-flow frequency data for 161 stream-gaging stations in Florida. The selected stations represent those having suitable flow records spanning 7 or more years. Flow values representing the annual minimum average flow for selected periods ranging from 1 to 183 days are presented for recurrence intervals ranging from 2 to 50 years. The low-flow frequency data of relatively short-term stations were adjusted where possible on basis of records of long-term stations to reduce the possible bias introduced by short-term climatic trends. (USGS)
W82-02834

DRAINAGE AREAS OF STREAMS AT SELECTED LOCATIONS IN KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-02835

FLOW DURATION AT SELECTED STREAM-SITES IN KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.
F. Quinones, J. Kiesler, and J. Macy.
Geological Survey Open-File Report 80-1221, 1980. 143 p, 3 Fig, 5 Ref.

Descriptors: *Flow duration, *Flow characteristics, *Frequency analysis, *Streamflow, Hydrologic data, Regulated flow, Runoff forecasting, Gaging stations, Sites, *Kentucky, Natural flow.

Flow duration characteristics were determined for 195 streamflow stations in Kentucky. The data includes flow duration tables for the period of record of the stations based on mean daily discharges. Seasonal flow durations are also presented from monthly analysis of the data. At sites affected by regulation, tables are published showing both the before and after regulation flow duration data. (USGS)
W82-02837

DISCHARGE CHARACTERISTICS OF TRIANGULAR-NOTCH THIN-PLATE WEIRS,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 8B.
W82-02842

SPACE-TIME VARIABILITY OF THE RUNOFF OF EUROPEAN RIVERS,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. K. Fotnchenkov.
Water Resources (English Translation), Vol 7, No 6, p 500-509, November/December, 1980. 3 Fig, 3 Tab, 13 Ref. Translated from Vodnye Resursy, No 6, p 52-63, November-December, 1980.

Descriptors: *Water level fluctuations, *Rivers, *Correlation analysis, Mathematical studies, *Runoff, Hydrologic data collections, *Europe, Temperature effects, Stream flow, River basins.

Space-time variability of European rivers was studied using data on runoff collected at 89 gaging stations of which 50 have an observation period greater than 70 years. The change in correlation coefficients was analyzed as a function of the duration of the investigated runoff series. There were small variations of the correlation coefficients over the 60-year period, 1911-1970. This technique was used to isolate regions with synchronous variations, and 14 regions were determined using a minimum intraregional correlation greater than or equal to 0.4. To determine large territories with similar runoff variations, five areas with a positive runoff correlation were isolated on the basis of an analysis of the correlation matrix. When atmospheric circulation indices were studied, the maximum relation in 12 of the 14 regions was observed either with purely western circulation indices or with western circulation indices in combination with the southern circulation index. (Small-FRC)
W82-02848

HYDRAULIC RESISTANCE OF FLOODPLAINS,

Odessa State Univ. (USSR).
Y. N. Sokolov.
Water Resources (English Translation), Vol 7, No 6, p 563-572, November/December, 1980. 3 Fig, 2 Tab, 24 Ref. Translated from Vodnye Resursy, No 6, p 143-154, November-December, 1980.

Descriptors: *Flood plains, *Flood flow, *Terrain analysis, *Roughness coefficient, Flow, Mathematical models, Vegetation effects, Topography, Hydrology, Hydraulic roughness, Hydraulic resistance.

Calculation of the roughness coefficient for floodplains and determination of the hydraulic resistance of floodplains are outlined. The hydraulic resistance determines the characteristics of flow and depends mainly on the standard deviations of averaged elevations in the direction of the flow. It also depends on functions characterizing the correlation between the elevations of the relief along the flow but averaged in a transverse direction. An example of such a description of a floodplain is presented. A statistical model of vegetation can be constructed by analogy with the representation of the floodplain relief as a random field of heights. The main dimensions of the plants depend upon whether they are single or multi-trunked. Data from aerial photographs and ground topography and botanical information can be used to construct parameters characterizing the roughness of relief and vegetation of a floodplain. (Small-FRC)
W82-02850

CALCULATION OF THE ANNUAL DISTRIBUTION OF RIVER RUNOFF WHEN OBSERVATION DATA ARE AVAILABLE,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
E. G. Ivanov.
Water Resources (English Translation), Vol 7, No 6, p 510-515, November/December, 1980. 2 Fig, 1 Tab, 5 Ref. Translated from Vodnye Resursy, No 6, p 64-70, November-December, 1980.

Descriptors: *Water level fluctuations, Rivers, *Mathematical studies, Probability distribution, High water mark, Low water mark, Runoff, *USSR, *Streamflow, *Annual distribution.

A method which is a refinement of the standard Andreyanov technique for determining the annual distribution of river runoff is presented. The new method selects more than two high and low water periods during the year if this is appropriate. The available series of runoff observations is divided into annual time intervals starting from the wettest (driest) month according to long-term data. Empirical probability distribution curves are plotted, and month minima (maxima) and annual minima (maxima) are determined. The method was checked using water data, and good agreement was found. The method overcomes the problem of the Andreyanov technique which divided the years into common hydrologic periods and seasons, when the actual duration of hydrologic periods and seasons varies rather widely from year to year. The new method can give more accurate results. (Small-FRC)
W82-02854

FLOW RESISTANCE IN COARSE GRAVEL BED RIVERS,

Ministry of Works and Development, Christchurch (New Zealand).
For primary bibliographic entry see Field 2J.
W82-02879

STOCHASTIC HYDROLOGIC MODEL FOR DROUGHT MANAGEMENT,

Geological Survey, Reston, VA. Water Resources Div.
R. M. Hirsch.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 303-313, October, 1981. 5 Fig, 3 Tab, 6 Ref.

Descriptors: *Drought, *Streamflow forecasting, *Stochastic process, Model studies, Hydrologic models, Water supply, Reservoir storage, *Potomac River, Rivers, Forecasting, Risks, Water management.

The ARMA (1,1) cyclic stochastic flow model was used to produce long range water supply forecasts. It generates conditional cumulative distribution functions for monthly streamflow volumes and produces a set of equiprobable streamflow traces. With this information the conditional distribution functions of reservoir storage can be evaluated for a future month, and the probability of storage falling below a given level can be forecast. The 81-year streamflow record at Point of Rocks, Maryland, was used to illustrate the model. The ARMA (1,1) cyclic model was the best of a group of six models fit to the data. The second-ranking model was ARMA (1,0) cyclic. Four ARMA stationary models, fit using maximum likelihood estimation, were less satisfactory. (Caesar-FRC)
W82-02897

REGIONALIZATION AND PREDICTION OF ANNUAL FLOODS IN THE FRASER RIVER CATCHMENT, BRITISH COLUMBIA,

McMaster Univ., Hamilton (Ontario). Dept. of Geography.
P. Waylen, and M-K. Woo.
Water Resources Bulletin, Vol 17, No 4, p 655-661, August, 1981. 3 Fig, 20 Ref.

Descriptors: *Flood forecasting, *Mathematical studies, Flood control, Forecasting, *Fraser River Catchment, Canada, *British Columbia, Rivers.

A method is presented for predicting probability distributions of annual floods. The method is applied to the Fraser River catchment area of British Columbia. The technique of discriminant analysis provides a statistical distinction between two or more groups of basins affected by different flood generating processes such as snowmelt, glacier melt or rainfall. These groups are considered as hydrologic regions of differing flood characteristics. In this study discriminant functions are obtained using the means and standard deviations of the flood series, since both measures are related to the parameters alpha and beta of the Gumbel distribution. At the initial trial for regionalization, individual basins are assigned to different regions a priori, and the discriminant functions are computed using a program from the Statistical Package for

the Social Sciences. This program calculates the probabilities that a basin should be assigned to each of the a priori regions. The regions are thus reconstituted to obtain a new set of discriminant functions. Subsequently the basins are located on a map, and their disposition allows the regions to be delineated. The method was applied to the Fraser catchment, above the town of Hope, covering an area of 217,000 square kilometers. The two-parameter Gumbel distribution sufficiently described the annual floods of the selected rivers in this catchment. Through stepwise regression major climatic and physiographic variables can be identified in various regions, and the resulting equations successfully predict the flood characteristics for basins within the region. (Baker-FRC)
W82-02910

CONSTRUCTION OF A GAMMA-DISTRIBUTION PROBABILITY PAPER FOR STRAIGHTENING DISCHARGE PROBABILITY CURVES,

For primary bibliographic entry see Field 7B.
W82-02925

2F. Groundwater

ESTIMATION OF CALCIUM SULFATE SOLUTION RATE AND EFFECTIVE AQUIFER SURFACE AREA IN A GROUND-WATER SYSTEM NEAR CARLSBAD, NEW MEXICO,

Geological Survey, Lakewood, CO.
H. C. Claassen.
Ground Water, Vol 19, No 3, p 287-297, May/June, 1981. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Calcium sulfate, *Solubility, *Aquifer characteristics, Hydraulic conductivity, Leakage, Pecos River, Lake McMillan, Brantley Dam, *New Mexico, Reservoirs, Geohydrology, Minerals, Dissolved solids, Recharge, Groundwater recharge, Gypsum, Anhydrite, Water quality, Chemical composition, Groundwater movement, Dam stability, Dam effects.

Leakage from Lake McMillan, New Mexico, has raised question about the ability of the proposed Brantley Dam, downstream, to hold water. These sites are in a region of evaporite facies, consisting mainly of gypsum and anhydrite. The formation has a large hydraulic conductivity, 2 million meters per day. Major recharge is from the Pecos River. The minimum amount of calcium sulfate being dissolved at present, about 6 millimol per liter, was calculated from differences in the chemical composition of the water recharging the system and the composition of the groundwater in the system. The total mass of calcium sulfate dissolving is 29 times 10 to the 10th power g per year (volume, 9900 cu m as anhydrite or 16,000 cu m as gypsum) at a minimum flow of 1.13 cu m per sec. All computations depend on the accuracy of the uncertain value of the equilibrium constant for gypsum. The estimated ratio of aquifer gypsum surface area to groundwater volume is very small, indicating that the hydraulic conductivity is secondary (fracture or conduit). These conduits widen at rates of a few tens of mm per year. If the Brantley Dam is built, changes in hydrology could result. The degree of change is dependendent on the location of the dam site, the quality of water impounded in the reservoir, effects of reservoir filling on hydraulic gradients, and the amount and distribution of calcium sulfate minerals in the currently unsaturated zone. This study cannot answer the question of whether potential increases in gypsum removal rate would threaten the stability of the Brantley Dam. (Cassar-FRC)
W82-02612

ATOLL ISLAND HYDROLOGY,

Nevada Univ. System, Reno, NV. Desert Research Inst.
S. W. Wheatcraft, and R. W. Buddemeier.
Ground Water, Vol 19, No 3, p 311-320, May/June, 1981. 6 Fig, 3 Tab, 26 Ref.

Descriptors: *Atolls, *Tidal effects, *Aquifer systems, Geohydrology, Groundwater movement, Model studies, Mathematical models, Enewetak Atoll, *Marshall Islands, Enjebi Island, Unconsolidated aquifers, Carbonate aquifers.

An important feature of atoll groundwater hydrology in the northern Marshall Islands is vertical coupling between the unconsolidated Holocene surface aquifer and an underlying, more permeable Pleistocene limestone aquifer at a depth of several tens of meters. Tidal lag, tidal efficiency, and water levels were measured in 24 wells, 1 to 90 m deep, on Enjebi Island on Enewetak Atoll. Hydraulic conductivity measurements were obtained from laboratory and field testing. Data were used in a model based on horizontal propagation of tidal signals. Results indicated that horizontal transport and tidal signal propagation were not operative in this region. This agreed with results from other atoll islands in the area. A simple mathematical model of groundwater dynamics based on the assumption of one-dimensional radial flow and tidal boundary conditions was developed. The implications of the vertical transport mechanism are: (1) fresh water reserves are more limited than predicted, (2) water reserves recover more quickly from overexploitation or contamination, (3) radionuclides are carried downward into the deeper aquifers instead of horizontally toward the sea, and (4) a deep transition zone with a high throughout of fresh and salt water may be important for rates and mechanisms of diagenetic changes in the sediments. (Cassar-FRC)
W82-02617

GEOELECTRIC SOUNDINGS FOR PREDICTING AQUIFER PROPERTIES,

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
W. K. Kosinski, and W. E. Kelly.
Ground Water, Vol 19, No 2, p 163-171, March/April, 1981. 5 Fig, 3 Tab, 39 Ref.

Descriptors: *Transmissivity, *Aquifer properties, *Resistivity, *Rhode Island, Electrical properties, Permeability, *Glacial aquifers, Aquifer characteristics.

A study was conducted to develop surface resistivity techniques for making quantitative estimates of the water transmitting properties of glacial outwash materials. Two bedrock valleys filled with glacial outwash material and located in the Pawcatuck River Basin, Rhode Island, were investigated with Schlumberger resistivity soundings. Data from previous pumping tests were also available. Resistivities for the different aquifer materials were derived with boring log control. The auxiliary point methods were used to reduce the aquifer layering to a single representative resistivity value. Electrical properties of individual layers within the aquifer cannot be obtained without bore hole control because of equivalence and suppression. The relation between normalized resistivity and permeability observed in this study is opposite to what has been observed in some earlier laboratory studies and is attributed in part to the high resistivity of the ground water. Relationships derived between aquifer hydraulic and electrical properties were applicable only to this area. However, the methodology is useful for other situations. (Cassar-FRC)
W82-02619

BOISE LOOKS UNDERGROUND FOR HEAT,

American City and County, Vol 95, No 8, p 59-61, August, 1980. 1 Fig, 1 Tab.

Descriptors: *Geothermal resources, *Heating, *Wells, *Boise, Idaho, Energy sources, Groundwater mining, Injection wells.

Geothermal water will be used to heat 1 million sq ft of space in commercial and municipal buildings in Boise, Idaho, after completion of a $16.1 million geothermal resources development project. The Warm Springs Water District and the Boise Water Corporation will drill seven production wells and extend and renovate present pipe systems. Wells will be 14 inches in diameter and about 1200 ft below the surface, with a planned production rate of 800-1500 gpm per well. Pumps will be continuous-duty vertical turbine pumps capable of operating with 170F water. The supply main will be 16 inches diameter preinsulated asbestos-cement pipe. The collection line, between 12 and 18 inches in diameter, will run parallel to the supply main to injection wells. Water will enter buildings at about 165F and leave at about 120F, providing 80% of total heating needs. Fixed operating costs will be $132,500 in 1982 and rise to $235,800 by 1990. Energy costs per therm (100,000 BTU) will be 28.1 cents in 1982, 38.1 cents in 1995, and drop to 29.2 cents in 2000 after debts are paid. (Cassar-FRC)
W82-02636

INTEGRAL EQUATION FORMULATION FOR GROUND-WATER FLOW,

Canterbury Univ., Christchurch (New Zealand).
B. Hunt, and L. T. Isaacs.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1197-1209, October, 1981. 8 Fig, 10 Ref.

Descriptors: *Groundwater movement, *Estimating equations, *Porous media, Flow velocity, Computers, Mathematical studies.

An alternative integral equation formulation for the two-dimensional mixed problems of groundwater flow was investigated. This formulation yields a simultaneous set of integral equations with boundary values of the velocity potential and the stream function as unknowns. This method, based on the Cauchy integral theorem, can be used in a general purpose computer program for the analysis of multizone, anisotropic, two-dimensional flows in porous media. The formulation is simple and compact and leads to a well-conditioned set of equations. It allows nodes to be closely spaced in the region of singularities. The computer program has many practical applications. (Small-FRC)
W82-02716

ANALYSIS OF PUMPING TEST DATA USING MARQUARDT ALGORITHM,

Indian Inst. of Tech., New Delhi. Dept. of Civil Engineering.
S. Chander, P. N. Kapoor, and S. K. Goyal.
Ground Water, Vol 19, No 3, p 275-278, May/June, 1981. 2 Tab, 6 Ref.

Descriptors: *Marquardt algorithm, *Aquifer characteristics, *Pumping tests, Algorithms, Groundwater movement, Mathematical studies, Drawdown, Leaky aquifers, Graphical analysis, Transmissivity.

The Marquardt algorithm was the best method of estimating aquifer parameters from pump test data in a comparison of several methods. The residual square error was smaller than that obtained by known methods: theis curve, Jacob, Chow, and Kirz for nonleaky aquifers, and Hantush I, Walton's curve, and Rushton's discrete numerical model for leaky aquifers. The Marquardt algorithm is not sensitive to initial estimates, and convergence is fast. This method also avoids the subjectivity of the conventional graphical techniques. (Cassar-FRC)
W82-02721

GROUNDWATER SYSTEMS ASSOCIATED WITH SECONDARY SALINITY IN WESTERN AUSTRALIA,

Western Australia Dept. of Agriculture, South Perth. Div. of Resource Management.
R. A. Nulsen, and C. J. Henschke.
Agricultural Water Management, Vol 4, No 1/3, p 173-186, 1981. 7 Fig, 3 Tab, 41 Ref.

Descriptors: *Salinity, *Groundwater, *Surface-groundwater relations, *Australia, Soil properties, Salts, Hydrology, Water pollution sources, Groundwater movement, Aquifer characteristics, Geochemistry.

The Western Australian landscape is characterized by a peneplain developed by subaerial weathering of Archean rocks. Except on the margins of the peneplain, surface drainage is limited to a series of interconnected salinas, and subsurface drainage is restricted by a relatively shallow, impermeable

bedrock and an absence of sedimentary aquifers. The simplest model of a catchment consists of an intake area, a flow path and a discharge area. Information currently available about each of these three major components is reviewed. Skeletal soils often are present immediately below rock outcrops, and it is supposed that these areas are recharge zones for the confined aquifer in the Belka Valley. Relatively high infiltration rates measured in the upper pediments indicate that these areas may act as preferential intake areas for the seepages that occur downslope. The flow path in most of the groundwater systems in Western Australia consists of a shallow unconfined aquifer and a deeper semi-confined aquifer. The thickness of the aquifers varies with the surface topography and contours of the bedrock. In most cases the length of the flow path is much greater than the thickness. Only a few measurements have been made of the transmission characteristics of aquifers associated with land and stream salinity in Western Australia. The discharge of saline water from the groundwater system can take place either by flow into a stream system or by capillary rise and subsequent evaporation from the soil surface. Subsurface water flow in discrete channels in the discharge area is a common observation. The occurrence of secondary soil salinity is usually associated with a rise in the level of the water table, and only by reversing the trend and significantly reducing the level of the water table can any amelioration of surfce salinity be achieved. (Baker-FRC)
W82-02770

GROUND-WATER RECHARGE FROM RECTANGULAR AREAS,

Indian Agricultural Research Inst., New Delhi (India). Water Technology Center.
N. H. Rao, and P. B. S. Sarma.
Ground Water, Vol 19, No 3, p 271-274, May/June, 1981. 2 Fig, 8 Ref.

Descriptors: *Water table profiles, *Confined aquifers, *Groundwater recharge, Aquifers, Unconfined aquifers, Prediction, Equations, Groundwater mound profiles.

An analytical solution for the formation of groundwater mounds beneath rectangular recharge areas for finite aquifers has been developed. Data of Bianchi and Haskell (1975) for the same situation in infinite aquifers was used in the equation after fixing boundaries at large, but finite, distances. The predicted groundwater mound profiles generally agree well with the observed profiles. During initial recharge (5.15 days) the predicted profile is above the observed profile at all distances from the center to the limit studied, 300 ft. At higher values of time (25 days) and distances close to the center (0.175 ft) the predicted profile is lower than the observed profile. At higher values of time (25 days) and distances greater from the center (175-300 ft) the predicted profile is slightly higher than the observed profile. The Glover equation for infinite aquifers gives results about a foot higher than observed values under all conditions of time and distance from the center. Differences between profiles obtained from the method developed in this paper and the observed profiles are on the order of 0.5 ft. (Cassar-FRC)
W82-02791

PROBABLE HIGH GROUND-WATER LEVELS IN MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
M. H. Frimpter.
Geological Survey Open-File Report 80-1205 (WRI), March, 1981. 19 p, 12 fig, 1 Tab, 7 Ref.

Descriptors: Groundwater, *Water table, *Observation wells, Water level fluctuations, Estimating, *Massachusetts, *Groundwater level.

Water-level records from an observation-well network are analyzed for utility in estimating probable high ground-water levels in three different geohydrologic environments in Massachusetts. Analyses were made of 83 observation wells with between 8 and 37 years of records. Maximum annual water levels occur most frequently in March and April. The maximum range of water levels equaled or exceeded at 10 percent of randomly selected sites is estimated to be 16 feet in till, 9.2 feet in sand and gravel on terraces, and 4.0 feet in sand and gravel in valleys. An approach to estimating probable high ground-water levels at construction sites is suggested. An estimate of the high water level at a site may be derived by solving the proportion in which the ratio of the potential water-level rise at a test site to the potential water-level rise at an observation well is equal to the ratio of the water-level range at the site to the historic water-level range at an observation well in a similar geohydrologic environment. Precise description of the probabilities of exceedence of estimates made by this approach with the data available has not been made. Assuming that the data are representative of the future, estimates would not be expected to be exceeded at more than 1 in 10 sites over a period of 10 years or longer. (USGS)
W82-02829

GEOLOGY AND WATER AVAILABILITY OF DALLAS COUNTY, ALABAMA,

Geological Survey, Univ., AL. Water Resources Div.
For primary bibliographic entry see Field 6D.
W82-02833

DIGITAL-MODEL SIMULATION OF THE HYDROLOGIC FLOW SYSTEM, WITH EMPHASIS ON GROUND WATER, IN THE SPOKANE VALLEY, WASHINGTON AND IDAHO,

Geological Survey, Tacoma, WA. Water Resources Div.
E. L. Bolke, and J. J. Vaccaro.
Geological Survey Open-File Report 80-1300 (WRI), 1981. 43 p, 16 Fig, 21 Ref.

Descriptors: *Mathematical models, *Groundwater, Flow system, *Aquifer, Aquifer characteristics, Wells, Hydrologic data, Geohydrology, Precipitation, Evapotranspiration, Pumping, *Groundwater movement, Water level fluctuations, Hydraulic conductivity, Surface-groundwater relations, *Washington, *Idaho, Spokane Valley.

A digital-computer model of the hydrologic flow system, with emphasis on ground water, was developed for the Spokane Valley, Washington and Idaho. The current rate of ground water pumping has little effect on water levels in the Spokane aquifer, although short-term water-level declines occur locally. The model was used to show the effects of increased ground-water pumping on aquifer heads and streamflow. Increasing the pumping rates, by a factor of 2 from the 1977 rates, lowered water levels in the Spokane aquifer less than 3 feet during a 1-year simulation. Doubling the ground-water pumping caused a decrease in discharge of the Spokane River, as measured at Spokane, of about 150 cubic feet per second during the summer months and about 50 cubic feet per second during the rest of the year. The leakage from the aquifer to the Little Spokane River was decreased by less than 10 cubic feet per second by doubling the ground-water pumping. (USGS)
W82-02836

GROUND-WATER APPRAISAL OF SAND PLAINS IN BENTON, SHERBURNE, STEARNS, AND WRIGHT COUNTIES, CENTRAL MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
G. F. Lindholm.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $28.75 in paper copy, $5.50 in microfiche. Geological Survey Open-File Report 80-1285 (WRI), 1980. 103 p, 49 Fig, 4 plates, 12 Tab, 32 Ref.

Descriptors: *Groundwater, *Aquifers, *Groundwater availability, *Aquifer charcteristics, Sand aquifers, Groundwater recharge, Precipitation, Surface-groundwater relations, Irrigation, Drawdown, Water yield, Water quality, Lithologic logs, Hydrologic models, Mathematical models, Forecasting, *Minnesota, Benton County, Sherburne County, Sterns County, Wright County.

Surficial-sand aquifers in 960 square miles of central Minnesota were studied to determine the occurrence, availability, and suitability of the surficial aquifer as a source of water. The aquifer, which is being increasingly developed for irrigation, is predominantly medium to coarse sand with lesser amounts of gravel. Saturated-sand aquifers in the Maine Prairie area locally exceed 100 feet in thickness, and transmissivity exceeds 40,000 feet squared per day. Similar valley-fill deposits in Sherburne County exceed 80 feet in thickness, transmissivity exceeds 30,000 feet squared per day, and expected well yields are from 2,000 to 3,000 gallons per minute. Water is of the calcium bicarbonate type and suitable for most uses. Relatively high nitrate and chloride concentrations occur in a heavily irrigated area in Sherburne County. Surficial aquifers in Sherburne County and the Maine Prairie area of Stearns county were simulated by two-dimensional digital ground-water flow models. Both modeled areas will support additional withdrawals, but caution must be exercised because lowering ground-water levels will also lower the lake levels and reduce streamflow. In some areas, aquifer dewatering will reduce individual well yields. (USGS)
W82-02838

POTENTIOMETRIC SURFACE MAPS OF THE SPARTA SAND: NORTHERN LOUISIANA AND SOUTHERN ARKANSAS, 1900, 1965, 1975, AND 1980,

Geological Survey, Alexandria, LA. Water Resources Div.
G. N. Ryals.
Geological Survey Open-File Report 80-1180, August, 1980. 1 Sheet.

Descriptors: *Maps, *Potentiometric level, *Groundwater, *Aquifers, Contours, Wells, Water level, Pumping, *Louisiana, *Arkansas, Sparta Sand.

The potentiometric surface of the Sparta Sand in northern Louisiana is shown by contours on four maps. Maps for 1900, 1965, and spring 1975 are generalized, small-scale maps from previously published reports. The spring 1980 map (1:500,000) is based on measurements in 144 wells and includes the southern tier of counties in southern Arkansas. The map shows regional effects of pumping from the Sparta Sand and effects of local pumping centers at Magnolia and El Dorado, Ark., and at Minden, Ruston, Jonesboro-Hodge, Winnfield, Bastrop, and in the Monroe area of Louisiana. (USGS)
W82-02839

WATER-LEVEL RECORDS FOR THE BIG SIOUX AQUIFER, MINNEHAHA COUNTY, SOUTH DAKOTA,

Geological Survey, Huron, SD. Water Resources Div.
W. L. Bradford.
Geological Survey Open-File Report 81-222, January, 1981. 50 p, 2 Fig, 1 Tab.

Descriptors: *Water level, *Wells, *Aquifers, Data collections, Hydrologic data, *South Dakota, Minnehaha County, *Big Sioux aquifer.

This report contains a tabulation of water levels in wells tapping the Big Sioux aquifer in Minnehaha County, S. Dak. Included is a compilation of all water levels in 43 wells measured by the U.S. Geological Survey and State agencies during the period 1957-80. The data are presented in tabular and graphic form. (USGS)
W82-02844

RADIOTRACER EVALUATION OF GROUNDWATER DISPERSION IN A MULTI-LAYERED AQUIFER,

Southern Universities Nuclear Inst., Faure (South Africa). Atomic Energy Board Isotope Unit.
B. R. Meyer, C. A. R. Bain, A. S. M. De Jesus, and D. Stephenson.
Journal of Hydrology, Vol 50, No 1-3, p 259-271, March, 1981. 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Tracers, *Saline water intrusion, Groundwater movement, Iodine radioisotopes, Aquifers, Model studies, Nuclear powerplants, Cape Town area, *South Africa.

In order to assess the possibility of seawater permeating inland to the foundations of the Koeberg Nuclear Power Station near Cape Town, South Africa, the groundwater flow conditions were investigated. The dispersion coefficient of the sandy aquifer had to be determined in order to model the effect of dispersion across the seawater/fresh groundwater interface. Iodine-131 was used as a tracer to obtain the dispersion coefficient and the velocity of fresh groundwater. A mathematical model was developed to describe the groundwater flow and intermixing in several layers. The largest effect on dispersion was due to the different flow speeds of water in the different layers. (Cassar-FRC)
W82-02870

RADIOCARBON DATING OF GROUNDWATER OF THE AQUIFER CONFINED IN THE LOWER TRIASSIC SANDSTONES OF THE LORRAINE REGION, FRANCE,

Paris Univ., Thonon-les-Bains (France). Center for Geodynamic Research.
B. Blavoux, and P. Olive.
Journal of Hydrology, Vol 54, No 1-3, p 167-183, December, 1981. 10 Fig, 11 Ref.

Descriptors: *Groundwater dating, *Aquifer characteristics, *Radioactive dating, Groundwater, Radiochemical analysis, Sandstones, Isotope studies, *Lorraine, *France.

An isotopic study was carried out on groundwater trapped below a confining bed to determine the tritium, radiocarbon, 13-C, 18-O, and deuterium contents of the aquifer confined in the Lower Triassic sandstones of the Lorraine Region of France. Using 40 boreholes, samples were collected and the temperature, pH, alkalinity, and total dissolved carbon were determined. In the laboratory, the major elements were estimated: 3-H, 18-O, 2-H, 13-C, and 14-C. A significant relationship was determined between total dissolved carbon and 13-C, which indicated a gradual enrichment of the total dissolved carbon with 13-C resulting from the escape of dissolved CO2. The stable isotope study indicated two water families. The radiometric rates were lower than rates calculated by means of current hydraulic parameters. This makes the hypothesis of a permanent flow regime questionable. (Small-FRC)
W82-02877

A METHOD OF PERFORMING RESPONSE TESTS ON HIGHLY PERMEABLE AQUIFERS,

Department of the Environment, Edmonton. Div. of Earth Sciences.
D. W. Prosser.
Ground Water, Vol 19, No 6, p 588-592, November/December, 1981. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Hydraulic conductivity, *Aquifer testing, Permeability, Groundwater movement, Pressure head.

Electronic pressure transducers and pneumatically induced head differences were used to accurately measure response time in small diameter (2 inch) standpipes under conditions of very high hydraulic conductivity. Values of hydraulic conductivity obtained in nine tests using three types of slugs were as follows: solid plastic slug, 0.0053 cm per sec; water slug, 0.0076-0.012 cm per sec; and pneumatic, 0.018-0.021 cm per sec. Response times in seconds ranged from 26 with the solid slug to 6.5 in the pneumatic method. The procedure relies on increasing air pressure in the standpipe to displace the water column. Then the air pressure is suddenly released and the head difference measured. Data can be recorded digitally or by analog chart recorder with fast paper speed. Time lags down to 1.6 sec, corresponding to a hydraulic conductivity of 0.1 cm per sec, have been measured successfully. The inertia of the air and water columns and well losses at the screen put a practical upper limit on the system. (Cassar-FRC)
W82-02916

DETERMINATION OF AQUIFER PARAMETERS FROM LARGE-DIAMETER DUG WELL PUMPING TESTS,

Institute of Geological Science, Wallingford (England).
R. Herbert, and R Kitching.
Ground Water, Vol 19, No 6, p 593-599, November/December, 1981. 7 Fig, 1 Tab, 6 Ref.

Descriptors: *Transmissivity, *Pumping tests, *Aquifer testing, Hydraulic conductivity, Dug wells, Shallow wells, Wells, Partially penetrating wells, Anisotropy, Model studies, Groundwater movement, Drawdown, Water level, *Aquifer characteristics.

Transmissivities of aquifers were determined in dug wells by recovery to 50% and 90% of the maximum drawdown levels. These two methods were developed using a digital model to simulate flow to a partially penetrating large-diameter well. In the 50% test a well is pumped for an hour and the time to recover to the 50% level is noted. Transmissivity is predicted using a given equation. Transmissivity may be in error, high or low, by a factor of 2. Longer pumping times produce more accurate results. In the 90% test the well is pumped for a period of time, and a shape factor is obtained from a graph, knowing the aquifer and well dimensions. The slope of the recovery at 90% recovery level is read from a plot of log drawdown against time. These figures are used in an equation to calculate hydraulic conductivity. Variations are given to account for vertical anisotropy. Neither of these methods can be used if there are nearby hydrogeological boundaries to flow. The recovery test methods are illustrated in two examples. In the second case transmissivity is deduced from both the 50% and the 90% methods (8.4 sq m per day) and the anisotropy determined, 2.8. (Cassar-FRC)
W82-02917

INFLUENCE OF HEAT DISPERSION ON STEADY CONVECTION IN ANISOTROPIC POROUS MEDIA,

Oslo Univ. (Norway). Dept. of Mechanics.
P. A. Tyvand.
Journal of Hydrology, Vol 52, No 1/2, p 13-23, June, 1981. 13 Ref.

Descriptors: *Convection, *Conduction, *Heat transfer, *Thermal conductivity, *Porous media, Capillary water, Permeability, Anisotrophy, Boundaries, Boundary conditions, Flow, Buoyancy, Mathematical studies.

A theoretical investigation of heat dispersion on steady buoyancy-driven convection is described. Buoyancy-driven convection in fluid-saturated porous layers has important applications in insulation techniques and flows in soils, snow layers, and oil reservoirs. This type of flow is primarily caused by vertical density gradients. In the investigation, hydrodynamic dispersion was taken into account at small Peclet numbers. An amplitude expansion was applied to solve the nonlinear problem, and the solution to the second order in the amplitude expansion and in the ratio of grain diameter to layer depth was found. Results of the investigation indicate that uniform basic flow does not influence the Nusselt number to the second order. The combination of anisotropy and dispersion effects may have profound influence on the heat transfer through a porous layer. This influence is believed to be stronger than the individual effects, due to the nonlinear character of the phenomena. (Titus-FRC)
W82-02924

URANIUM ISOTOPES AND 226RA CONTENT IN THE DEEP GROUNDWATERS OF THE TRI-STATE REGION, U.S.A.,

Florida State Univ., Tallahassee. Dept. of Geology.
For primary bibliographic entry see Field 5A.
W82-02939

A GEOCHEMICAL METHOD OF DETERMINING DISPERSIVITY IN REGIONAL GROUNDWATER SYSTEMS,

Texas Tech Univ., Lubbock. Dept. of Geoscience.
W. W. Wood.
Journal of Hydrology, Vol 54, No 1-3, p 209-224, December, 1981. 7 Fig, 28 Ref.

Descriptors: *Aquifer characteristics, *Geochemistry, *Groundwater movement, Aquifers, Groundwater reservoirs, Flow, Solutes, Dispersants, Dispersion.

Some easily obtained chemical observations of natural aquifer systems are used to determine numerical values for dispersivity that are regionally valid. The aquifer system is viewed as a large imaginary column, and analysis of hydrodynamic dispersion is made by observing the relative positions of solute contours in space. Curves relating concentration contour and pore volume of fluids are compared to theoretically developed curves. When a conservative solute is used, a true value of dispersivity is yielded, but the use of reacting solutes limits the separation of mechanical mixing from that caused by inhomogeneity of reaction sites. (Small-FRC)
W82-02941

PREPARATION OF FRIABLE AQUIFEROUS SPECIMENS,

Humphreys (Howard) and Partners, Reading (England).
P. F. Worthington.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY2, p 333-337, February, 1980. 2 Fig, 7 Ref.

Descriptors: *Sample preparation, *Sediments, Cores, Soil water, Sample preservation, *Aquifer characteristics, Sedimentary rocks, Sedimentary petrology, Petrology, Petrography, *Groundwater availability.

Laboratory examination of granular aquifer specimens plays an important role in groundwater resource evaluation. Previous studies had not yielded a suitable method for examining the effective porosity, specific yield, and intergranular permeability of loosely consolidated sedimentary strata without destruction of the specimen. As part of regional groundwater resource evaluation program, a procedure was developed for preparing friable limestone and sandstone specimens from the Kalahari Basin. Cubic specimens with a linear dimension up to 37 mm were cut with a diamond-bladed saw, minimizing the application of water. Before saturation studies were attempted, the specimens were cast in a retaining medium, making sure to avoid contaminating the opposite pair of faces which were to remain exposed. The optimum mixture was found to represent a 10:4:1 ratio of epoxy resin, kaolin filler and hardener. Specimens were mounted in cylindrical perspex rins in two phases. Mounted specimens could be readily fixed into permeameter cells for measurement of permeability and electrical resistivity. Except for the invasion zone (from about 0.5 mm in less permeable samples to about 1 mm in the more permeable samples) the specimen is preserved in the same state as in the original core sample. No loss of specimens took place by disintegration during saturation, flushing and drying or due to uncontrolled contamination by the casting mixture. If necessary, the invasion zone can be measured following completion of all petrophysical measurements by slicing through the specimen perpendicular to the cell axis. The optimum casting mixture may vary for different rock formations. (Baker-FRC)
W82-02955

2G. Water In Soils

COUPLED HEAT AND WATER FLOWS AROUND BURIED CABLES,

Geotechnical Consultants, Inc., San Francisco, CA.
O. N. Abdel-Hadi, and J. K. Mitchell.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT11, p 1461-1487, November, 1981. 20 Fig, 20 Ref.

Descriptors: *Temperature effects, *Soil water, *Electrical equipment, Soil types, Flow, Mathematical studies, Buried cables.

A field test program was designed to provide a basis of comparison between predicted and actual values of moisture and temperature distributions in a study of the transient flow of water in unsaturated soils under thermal gradients. The Philip and DeVries theory was used. A theoretical analysis of moisture movement and important parameters associated with it indicated that the most important parameters were cable temperature and soil type. Gravitational flow, surface evaporation, and isothermal diffusion effect moisture changes in the backfill and are primarily responsible for early changes of moisture content in the trench backfill. There was excellent agreement between measured and predicted temperature contours up to 40 days and good agreement between contours from 40 days to 100 days. (Small-FRC)
W82-02680

ANALYSES OF SOLUTE DISTRIBUTIONS IN DEEPLY WEATHERED SOILS,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
For primary bibliographic entry see Field 2K.
W82-02764

AN ANALYSIS OF AREAL INFILTRATION CONSIDERING SPATIAL VARIABILITY,

Commonwealth Scientific and Industrial Research Organisation, Wembley (Australia). Div. of Mathematics and Statistics.
R. A. Maller, and M. L. Sharma.
Journal of Hydrology, Vol 52, No 1/2, p 25-37, June, 1981. 6 Fig, 18 Ref.

Descriptors: *Infiltration, *Groundwater movement, *Fluctuations, *Frequency distribution, *Statistical methods, Seepage, Prediction, Forecasting, Projections, Monte Carlo method, Mathematical models, Model studies, Soil water.

A direct mathematical procedure for studying the effect of spatial variability on areal infiltration flux and average ponding time is presented. This procedure requires less computer time than conventional Monte Carlo simulation and produces results which are free of sampling errors. The distributions of infiltration flux and of time to ponding are derived. These calculations assume bivariate normality of the log of sorptivity and a parameter from the Philips equation. Under the assumption that the parameters were normally distributed rather than lognormal, the expected infiltration was not significantly different, although the standard deviation was increased. (Titus-FRC)
W82-02927

2H. Lakes

SPATIAL AND TEMPORAL OVERLAP IN LAKE PHYTOPLANKTON COMMUNITIES,

Ottawa Univ. (Ontario). Dept. of Botany.
D. Wall, and F. Briand.
Archiv fur Hydrobiologie, Vol 88, No 1, p 45-57, February, 1980. 5 Fig, 2 Tab, 38 Ref.

Descriptors: Nutrients, Species diversity, Eutrophication, Niches, *Ecological effects, Plankton, Water pollution effects, Lakes, Nitrogen, Phosphorus, Algal growth, *Phytoplankton, Aquatic animals, Temporal distribution, Water depth, Species composition, *Heney Lake, *Quebec.

Field studies of niche overlap in enclosed lake phytoplankton communities were conducted in Heney Lake, Quebec, from June to November, 1976. Planktonic communities studied were enclosed in four polyethyelene tubes, each 1 m in diameter and 10 m deep, two of which were freely connected with sediments while the others were sealed at the bottom. In each set of containers, one was enriched with N and P, while the other was not. Phytoplankton densities and species composition were monitored weekly at 0, 3, 6, and 9 m. Overlap in depth was determined quantitatively, while overlap in time was calculated on the basis of presence and absence data within each water column over the 5 month period. Results showed that depth played a major role in separating the dominant species, while partitioning of dominant species' niches by time periods was of little importance. Addition of nutrients generally decreased niche overlap, probably due to increased interspecific competition. Fragilaria crotonensis and Synedra delicatissima expanded their niches in the presence of N and P nutrients and were regarded as superior exploitive competitors. The relationships of eutrophication to reduced diversity and niche overlaps are discussed. (Geiger-FRC)
W82-02610

CHIRONOMIDAE (DIPTERA) OF BALDWIN LAKE, ILLINOIS, A COOLING RESERVOIR,

Southern Illinois Univ. at Carbondale. Dept. of Zoology.
R. B. Parkin, and J. B. Stahl.
Hydrobiologia, Vol 76, No 1/2, p 119-128, 1981. 2 Fig, 8 Tab, 32 Ref.

Descriptors: *Cooling ponds, *Midges, *Temperature effects, Reservoirs, Ponds, *Baldwin Lake, Illinois, Benthos, Powerplants, Lake sediments.

The effects of water temperature and sediment type were studied on the composition, distribution, and abundance of the chironomid fauna of Baldwin Lake, which is a relatively shallow, rectangular lake with a very regular shoreline consisting largely of levees, and a small watershed. The watershed area is only about 0.7 times the lake area, and it is estimated that is supplies only about one-third of the water in the lake. The lake is a closed-cycle cooling reservoir for a power plant. Samples were taken monthly to semi-monthly for one year at four stations, two in the discharge channel and two in the main basin. Twenty-four species were collected. The annual mean population density was less than 100 larvae per square meter in the channel, and 1037/square meter in the main basin. Three species of Tanypodinae formed over 96% of the larval population in the main basin: Tanypus stellatus, Procladius bellus, and COeflotanypus concinnus. Principal species found on multiple plate samplers were Dicrotendipes nervosus, Gluptotendipes lobiferus, and Parachironomus monochromus. Chironomids were virtually eliminated from the channel at temperatures over 35 degrees C. The numbers of generations of T. stellatus were increased from the usual two to four in the main basin at temperatures of 32 degrees C. The sediments in Baldwin Lake were coarse-grained and low in organic carbon. (Baker-FRC)
W82-02620

THE INFLUENCE OF FLATWORM PREDATION ON ZOOPLANKTON INHABITING SMALL PONDS,

Concordia Univ., Montreal (Quebec). Dept. of Biology.
E. J. Maly, S. Schoenholtz, and M. T. Arts.
Hydrobiologia, Vol 76, No 3, p 233-240, 1980. 1 Fig, 6 Tab, 23 Ref.

Descriptors: *Predation, *Shallow water, *Feeding rates, Daphnia, Invertebrates, Ponds, *Zooplankton, Aquatic life, Population dynamics, *Flatworms, Mesostoma, Colorado.

Predation of a predatory flatworm, Mesostoma ehrenbergii, on zooplankton was studied in laboratory beakers, 30 liter tubs, and small shallow ponds at Mexican Cut, western Colorado. The beaker tests in 1977 revealed that M. ehrenbergii consumes Daphnia at a high rate, fairy shrimp (Branchinecta) at a low rate, and does not consume Diaptomus. The tub tests (1978) showed that the predation rate is correlated with surface to volume ratio of the containers. Feeding rates in 8 natural ponds with surface/volume ratios of 1.90 to 6.26 were flat at high surface/volume ratios of because flatworms are satiated. Rates were low at low surface/volume ratios because prey are unavailable to the predator. Flatworms have definite effects on Daphnia population dynamics in some water bodies, especially in shallow ponds. Evidence also suggests that flatworms are attracted to high densities of Daphnia. (Cassar-FRC)
W82-02655

THE RESPONSE OF MACROINVERTEBRATES TO AQUATIC MACROPHYTE DECOMPOSITION,

Virginia Commonwealth Univ., Richmond. Dept. of Biology.
L. A. Smock, and D. L. Stoneburner.
Oikos, Vol 35, No 3, p 397-403, November, 1980. 3 Fig, 2 Tab, 38 Ref.

Descriptors: *Littoral zone, *Macrophytes, *Macroinvertebrates, Brown water, *Barrier islands, Limnology, Aquatic life, Decomposition, Aquatic plants, Ponds, Lakes, Leaves, Lake Whitney, *Georgia, Decomposing organic matter.

The data presented describe the relationship between the degree of decomposition of an aquatic macrophyte and the densities of associated macroinvertebrates in Lake Whitney, Georgia. A significant increase in macroinvertebrate density was noted with the onset and progressive senescence of the leaves, as reflected by decreasing chlorophyll a concentrations. The chironomid Polypedilum nymphaeroum Maschwitz and three species of Naididae exhibited positive responses to presumably increasing levels of food as leaf decomposition progressed. P. nymphaeorum larvae probably switched from feeding on periphyton to utlization of decomposing plant tissue and associated microbial decomposers once the Nelumbo leaves began to decompose. Naididae did not become abundant on the leaves until the onset of initial leaf decomposition. Densities of the carnivorous chironomid Ablabesmyia philosphagnos Beck and Beck were more closely related to the age of the leaves than to prey availability, older leaves having been colonized by several generations of individuals while the younger leaves had been colonized by only one generation of individuals. The findings indicate that all stages in the life of macrophytes must be considered before their full importance to macroinvertebrates can be assessed. Both their abundance in a system and their seasonal cycles of growth and decay can be an important regulator of macroinvertebrate densities in the littoral zones of ponds and lakes. (Baker-FRC)
W82-02664

THE FRESHWATER AND BRACKISH-WATER DIATOMS OF PENIKESE ISLAND, MASSACHUSETTS: 1923-1973,

Southeastern Massachusetts Univ., North Dartmouth.
R. K. Edgar.
Rhodora, Vol 82, No 830, p 305-319, April, 1980. 1 Fig, 23 Ref.

Descriptors: *Ponds, *Marshes, *Plankton, *Diatoms, Species composition, *Aquatic populations, Water quality, Lakes, Seasonal variation, Navidula, Gomphonema, Species diversity, Ecology, Succession, Nitzschia, *Penikese Island, *Massachusetts.

The planktonic, epilithic, epipelic and epiphytic diatom assemblages of the ponds and marsh of Penikese Island were examined along with physicochemical parameters and water quality data. In the ponds, 79 diatom species and subspecific taxa were identified. The marsh contained large populations of Gomphonema paravulum, Navicula calida, N. cuspidata, Nitzschia palea, and Pinnularia viridis in 1973. The northernmost reservoir on the hilltop at the southern end of the island contained mostly planktonic populations of Nitzschia kutzingiana and Navicula cuspidata. Notes on eight selected taxa are included as supplemental descriptions of the species identified. Major qualitative differences were found in the diatom flora of Penikese over a 50 year period. No evaluations have been made to determine to what extent these differences are functions of the seasonally variable nature of the ponds and the successional changes in the environment over the past few decades. (Geiger-FRC)
W82-02696

CHEMISTRY OF A 7.5-M SEDIMENT CORE FROM LAKE VALENCIA, VENEZUELA,

Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, Jr., and F. H. Weibezahn.
Limnology and Oceanography, Vol 26, No 5, p 907-924, September, 1981. 11 Fig, 1 Tab, 55 Ref.

Descriptors: *Sediments, *Geologic history, *Lakes, Salinity, *Chemical composition, Eutrophication, *Lake Valencia, Venezuela, Chemistry of precipitation.

The chemistry of the upper 7.5 m of sediment taken from the middle of Lake Valencia in 37 m of water was studied. This midlake core provides a record of changes in the lake and its watershed over about 13,000 years. The lake began as a dry or seasonal lakebed, accumulating fine clastic materials low in organic matter and essentially devoid of aquatic microfossils. The lake then became permanent, saline, and rather deep. The trend toward freshness and high lake level peaked about 8000 BP, but this moisture peak was brief. There was a return to more saline conditions about 7400 BP, accompanied by high Mg:Ca ratios. The lake is now subject to major artificial eutrophication. Lakes of the lowland tropics have shown radical changes in chemistry, nutrient budgets, and water level over the relatively recent past. The general sequence of events in the lake is similar to sequences documented in the African lowland tropics over the last 13,000 years. (Small-FRC)
W82-02745

COMPARISON OF THE CHEMICAL COMPOSITION OF THE WATERS OF LAKE PIASECZNO (LECZYNSKO-WLODAWSKIE LAKE DISTRICT) AND OF THE SHALLOW GROUND WATERS IN ITS CATCHMENT AREA,

Akademia Rolnicza, Lubin (Poland), Inst. Gleboznawstwa i Chemii Rolnej.
M. Misztal.
Acta Hydrobiologica, Vol 22, No 3, p 239-247, 1980. 3 Fig, 7 Ref.

Descriptors: *Water analysis, *Chemical composition, *Poland, Chemical analysis, *Lakes, *Wells, Potassium, Phosphorus, Sodium, Calcium, Manganese, Seasonal variations, Acidity, Shallow wells.

Water samples were collected from farm wells in the territory of the catchment area of Lake Piaseczno. Lake water samples were also taken. The Lake is small, with part of the catchment territory being covered with forests and others consisting of arable land and a small peat bog. Water level in the wells was highest in the spring of 1975 and subsequently decreased systematically until November. In December and January of the next year a rise in water level was noted, reaching a maximum in April. Lake waters demonstrated rather significant changes in pH, with boundary pH values for waters of the lake taken from the sector adjoining arable land from 6.1 to 8.4 and in the sector bound by forests from 5.8 to 8.6. Variations in the pH of ground waters ranged from 5.8 to 7.8. Phosphorus concentrations also varied considerably, while potassium concentrations remained about the same. Variations in calcium, sodium, and manganese were more similar to the slight changes noted in potassium concentrations. The water from the lake was about 10 times poorer in phosphorus, sodium, calcium, and manganese, and about 5 times poorer in potassium in comparison with the water from the farm wells. The inflow of sodium into the ground water was particularly dependent on the magnitude of rainfall. (Baker-FRC)
W82-02752

SOME HYDROBIOLOGICAL CHARACTERISTICS IN AMVRAKIA LAKE, WESTERN GREECE,

Institute of Oceanographic and Fisheries Researches, Athens (Greece).
T. S. Koussouris, and J. D. Photis.
Acta Hydrobiologica, Vol 22, No 3, p 337-344, 1980. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Lakes, *Hydrobiology, Tectonics, Thermoclines, *Greece, Aquatic fauna, Plankton, Zooplankton, Phytoplankton, *Amvrakia Lake.

Amvrakia lake is situated in Western Greece and is of tectonic origin, with a northwestern direction. Its water level depends mainly on surface drains, karstic springs, possible underground inlets and invisible discharges. High to mean values of dissolved oxygen were recorded in the lake in the homogenous water column in February, while by June its low values at deep waters were accompanied by hydrogen sulfide. In June fairly stable thermal stratification occurred. The thermocline was between 11 and 13 meters deep. The pH was generally mean to high in the southern basin and high in the northern basin. A vertical variation in pH was noted, probably caused by consumption of carbon dioxide in the epilimnion and release in the hypolimnion. Aquatic macrovegetation was lacking along the shoreline of the lake. The main components of plankton were Cyclotella ocellata (Ehr.) Kutz. and Closterium, Scenedesmus, Prediastrum, Ankistrodesmus species in February, while in June the dominant species comprise some Pennales diatoms and the Chlorophyceae Elakatothrix gelatinosa Wille, Staurastrum leptocladum Wille and Closterium spp. Among the zooplankters the appearance of tintinnopsis lacustris (Entz) Kahl and of Brachionus angularis Gosse, Br. calyciflorus Pall, Polyarthra vulgaris Carl., Filinia longiesta (Ehr.) and Keratella quadrata (Mull.) were characteristic. (Baker-FRC)
W82-02753

LAKE VATTERN,

S. A. Svensson.
Aqua, No 4, p 9-10, 1981.

Descriptors: *Lakes, *Water pollution control, Phosphorus, *Lake Vattern, *Sweden, Nutrients.

Lake Vattern is Sweden's second largest lake and possesses clear, cold water. The biological and chemical studies made of the lake indicate that it contains few nutrients, while it is also a valuable recreational and raw-water source for the area. Vattern contains at least 28 different species of fish, with the principal species being whitefish and char. The question of safeguarding Vattern was raised at the end of the 1950s, when repeated indications regarding changes in the catch of char, increased vegetation, and other changes indicated pollution patterns were occurring. An investigation then showed that in the inflow of organic substances, particularly phosphorus, must decrease if Vattern was not to become a protein-rich lake with accelerated aging. The measures adopted included the requirement that the majority of local authority sewage treatment works be extended to include biological and chemical purification and that effluent treatment and other internal measures be taken within appropriate industries. More natural conditions are now reappearing in the lake. (Baker-FRC)
W82-02755

STANDING CROP DENSITIES AND DISTRIBUTION OF SPIRULINA AND BENTHIC DIATOMS IN EAST AFRICAN ALKALINE SALINE LAKES,

Bristol Univ. (England). Dept. of Zoology.
C. H. Tuite.
Freshwater Biology, Vol 11, No 4, p 345-360, 1981. 7 Fig, 3 Tab, 38 Ref.

Descriptors: *Saline lakes, *Diatoms, Algae, Benthos, Aquatic life, East Africa, *Africa, Spirulina, Lakes, Standing crops.

Information is given about the structure of the primary producer communities in East African alkaline saline lakes and their temporal changes. Measurements were taken of the standing crop densities of phytoplanktonic blue-green algae of the genus spirulina and benthic diatoms. Spirulina abundance was measured as dry mass density, and the validity of the gravimetric estimates was determined by chlorophyll analysis and microscopic counting. Benthic diatom standing crops were assessed by chlorophyll determinations. Spirulina density was extremely variable in time and may appear to fluctuate over more than an order of magnitude. It was not common to see high density blooms of Spirulina as a feature in the lakes. The causes of changes in Spirulina standing crop and the associated alterations in the structure of the primary producer community are discussed. Three qualitative states which may occur are described. Similar standing crops of benthic diatoms were noted in all lakes wherever the water depth was shallow enough to allow light penetration to the sediment surface. (Baker-FRC)
W82-02759

STUDIES ON THE SEASONAL CHANGES OF DISSOLVED ORGANIC CARBON, NITROGEN, PHOSPHORUS AND UREA CONCENTRATIONS IN LAKE BIWA,

Osaka Kyoiku Univ. (Japan). Lab. of Environmental Science.
O. Mitamura, and Y. Saijo.
Archiv fur Hydrobiologie, Vol 91, No 1, p 1-14, March, 1981. 3 Fig, 4 Tab, 35 Ref.

Descriptors: *Seasonal variation, *Dissolved solids, *Lakes, *Japan, Lake Biwa, *Organic carbon, Phosphorus, Nitrogen, Carbon, Urea, Phytoplankton, Algae.

Although there have been many studies of the distribution of dissolved organic matter in the sea, few studies have investigated the concentrations of dissolved nitrogen, carbon, and phosphorus in freshwater. The seasonal variations in dissolved organic carbon (COD), dissolved organic nitrogen (DON), dissolved organic phosphorus (DOP), and urea concentrations in Lake Biwa were investigated in relationship to changes in the thermal stratification of the lake and in the blooming of phytoplankton. Lake Biwa, the largest lake in Japan, has an area of 674.8 square kilometers and a maximum depth of 104 meters. Observations were made at one station in the northern basin (72 meters depth) and one in the southern basin (4 meters depth). The mean DOC values in the upper level layer in the northern basin were consistently higher than those in the lower layer during the thermal stratification period, giving values of 143 and 119 micrograms carbon per liter, respectively. DON, DOP, and urea concentrations showed smilar tendencies, giving values of 6.2 and 5.2 micrograms nitrogen per liter, 0.20 and 0.16 micrograms phosphorus per liter, and 0.40 and 0.29 micromoles urea per liter, respectively. The lowest mean values of DON, DOP, and urea in the upper layer were found in November, when the green alga, Staurastrum sp., was blooming profusely. High correlation coefficients were obtained among DOC, DON, and DOP in the lower layer. (Carroll-FRC)
W82-02768

EFFECTS OF SHORT-TERM CHANGES IN RAIN WATER SUPPLY ON THE IONIC COMPOSITION OF ACID MOORLAND POOLS IN THE CAMPINE OF ANTWERP (BELGIUM),

J. H. D. Vangenechten, F. Bosmans, and H. Deckers.
Hydrobiologia, Vol 76, No 1/2, p 149-159, 1981. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Chemical composition, *Pools, Seasonal variation, Temperature effects, *Belgium, Acidity, Rainfall, *Bogs, Snowmelt, Evaporation, Water level, Rainwater, Water supply.

Physico-chemical characteristics of acid bog lakes were investigated in direct relation to some changes in water supply. During a 3.5 yr survey of 27 bog lakes, very marked changes in water levels were noted as a consequence of climatic conditions. Except for the summer and autumn of 1976, which were very dry and hot, the changes in ionic concentrations from September 1975 through March 1979 were very slight. Most ions exhibited a peak concentration during a few months of 1976. The pH in all pools remained fairly constant. In pools which dried out completely, strongly increased calcium, magnesium and sulfate concentrations were noted during the first months of refilling in autumn. In contrast, pH, potassium and chloride were not changed as compared to values in spring. Only a small increase in sodium was noted. A very high correlation was noted between sulfate and the sum of calcium, magnesium, and sodium, during this time. In pools in which the bottom layer

remained wet during the hot summer, the ionic concentration ratios remained fairly constant. The pH did not change, remaining very acid. It was concluded that during periods of evaporation and subsequent refilling, marked changes in the ionic concentrations and composition can occur. These changes can induce severe stress situations for the aquatic organisms. (Baker-FRC)
W82-02775

ALLOCHTHONOUS PLANT LITTER AS A SOURCE OF ORGANIC MATERIAL IN AN OLIGOTROPHIC LAKE (LLYN FRONGOCH),

University Coll. of Wales, Aberystwyth. Dept. of Zoology.
R. D. G. Hanlon.
Hydrobiologia, Vol 80, No 3, p 257-261, 1981. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Organic matter, *Oligotrophic lakes, *Litter, Lakes, *Llyn Frongoch, Forest litter, Nutrients, Energy sources, Productivity, *Wales, Carbon cycle.

Planting trees along the shoreline of small oligotrophic lakes with low surface area: shoreline length ratios could provide organic carbon for benthic invertebrates and microorganisms. The contribution of airborne plant litter to Llyn Frongoch, Wales, was estimated to be 100 kg per year (45 kg C per year), equivalent to 5% of the phytoplankton productivity. This lake has an area of 7.2 ha and 23% of the 1450 meters of shoreline is tree-covered. Most of the airborne plant litter was deposited within 10 meters of shore, and the amount of litterfall declined exponentially with distance from the shore. (Cassar-FRC)
W82-02778

THE GAMMARIDAE AND CORIXIDAE OF AN INLAND SALINE LAKE FROM 1975 TO 1978,

Crewe and Alsager Coll., Alsager (England).
A. A. Savage.
Hydrobiologia, Vol 76, No 1/2, p 33-44, 1981. 4 Fig, 5 Tab, 17 Ref.

Descriptors: *Saline lakes, *Benthos, Temperature effects, Seasonal variation, Population dynamics, Vegetation, *Aquatic vegetation, Chemical composition, Salinity, Aquatic organisms.

Changes in the populations of Gammaridae and Corixidae were investigated together with data on sub-aquatic vegetation, chemical conditions and temperature in an inland saline pond, Watch Lane Flash. Comparisons were made with two immediately adjacent pools, Ilse Pool and Red Lane Flash. In 1975, when subaquatic vegetation was virtually absent and summer temperatures and salinities were high, the population consisted almost entirely of Gammarus duebeni and Sigara lateralis. G. tigrinus was first recorded in September. During 1976, when summer temperatures and salinities were again high, G. tigrinus increased rapidly, G. duebeni and fifth instar nymphs of S. lateralis decreased to zero, but adults of the latter species were present. When summer temperatures and salinities were lower during 1977, G. tigrinus increased further; G. duebeni and nymphs and adults of S. lateralis were virtually absent. Subaquatic vegetation redeveloped and nymphs and adults of Sigara concinna were found. The initial success of G. tigrinus coincided with high summer temperatures and salinities. Evidence is presented which suggests that high summer temperatures rather than high salinities especially favor G. tigrinus. It is felt that the exclusion of G. duebeni and S. lateralis was caused by both predation and competition for similar food resources. (Baker-FRC)
W82-02779

ABSORPTION BY CHLORELLA VULGARIS BEIJER. OF PHOSPHORUS COMPOUNDS RELEASED BY THE SUBMERGED MACROPHYTE POTAMOGETON PECTINATUS L.,

Rand Afrikaans Univ., Johannesburg (South Africa). Research Group for Freshwater Biology.
I. S. Van Aswegen, J. H. Swanepoel, and H. J. Schoonbee.
Water SA, Vol 7, No 2, p 76-78, April, 1981. 2 Tab, 9 Ref.

Descriptors: *Phosphorus, *Algal growth, Lakes, Eutrophication, Nutrients, Macrophytes, Algae, Absorption, Accumulation, Chlorella, Phytoplankton, Natural waters, *Phosphorous absorption.

Chlorella vulgaris was used as a test organism to determine the ability of this alga to absorb phosphorus released by both the foliage and the roots of Potamogeton pectinatus. The plants were grown in an aquarium from tubers collected from a lab stream ecosystem. Phosphorus compounds released by both the foliage and roots of the submerged macrophyte were absorbed by Chlorella vulgaris under both light and dark conditions. Chlorella absorbed more phosphorus compounds when incubated in the light than in the dark, which may be related to photosynthetic activity. The P-32 activity of the Chlorella incubation medium derived from the roots of Potamogeton was substantially higher than that derived from the foliage of this hydrophtye. During both light and dark incubation, Chlorella absorbed more or less 40 times more root phosphorus than foliar phosphorus. This may be partly attributed to the higher phosphorus concentration of the incubation medium derived from the root compartment of the culture vessel. It is suggested that in freshwater lakes phosphorus compounds released by the foliage of submerged macrophytes may well be an important source of phosphorus to phytoplankton and epiphytes associated with submerged macrophytes. The ready accessibility of phosphorus released by the roots of aquatic macrophytes for algal absorption may account for the frequent development of dense mats of benthic algae observed on the substrate in water bodies such as Germiston Lake in the Witwatersrand area. (Baker-FRC)
W82-02780

PRODUCTION OF GAMMARUS LACUSTRIS (AMPHIPODA, GAMMARIDAE) IN LAKE SEVAN,

Akademiya Nauk Armyanskoi SSR, Hydrobiological Station.
S. G. Nikolayev.
Hydrobiological Journal, Vol 16, No 4, p 40-44, 1980. 2 Tab, 19 Ref.

Descriptors: *Lakes, *Gammarus, *Amphipods, *Population dynamics, Aquatic life, *Lake Sevan, USSR, Productivity, Water level fluctuations.

The production of Gammarus lacustris in one of the foraging areas of Lake Sevan was determined. The Lake had undergone a reduction in level, which had led to alterations of the thermal regime and appreciably affected hydrobiological processes in the lake. Records of the zoobenthos of one of the main foraging areas of the lake, Noraduzskiy Bay, made between April 1975 and November 1976 were used for calculations. Samples were taken in the moss beds at depths between 6 and 12 meters. Eighty such samples were processed. A single sample usually contained the collections of 2 bottom grabs. Changes in the lake have occurred over the years since 1938. As a result of these changes, especially of the more intensive heating of the water in comparison with the period before level reduction and the intensified pressure of predators as a result of the enlargement of the fish stock in the lake, changes were also expected in the production features of the gammarid population. The annual production/biomass (P/B) coefficient recalculated from the 1938 data proved fairly close to the annual P/B coefficient for 15, although it was lower. The data for comparison are the results of year-long observations seperated by an appreciable time interval. They cannot be used to characterize two long periods in the history of the lake in view of annual fluctuations in the production indices of amphipods. It is expected, however, that the mean annual values of the P/B coefficient for the 1938-1939 and 1975-1976 periods would be of similar magnitude. It was concluded that the rate of production of the gammarid population in this area of the lake has apparently remained at the 1938-1939 level. (Baker-FRC)
W82-02781

ON THE SAMPLING SIZE OF ZOOBENTHOS ALONG A LAKE SHORE (IN JANPANESE),

Shibukawa Senior Girls High School, Gunma (Japan).
H. Kurita, and H. Minemura.
Japanese Journal of Limnology, Vol 42, No 1, p 46-51, 1981. 3 Fig, 3 Tab.

Descriptors: *Lakes, *Benthos, Zooplankton, *Lake Haruna, Measuring instruments, Bottom sediments, Sampling, *Japan, Bottom sampling.

A new type of bottom sampler with a circular quadrat was used to analyze the number of replicate samples required to estimate the species number, density and biomass of zoobenthos along a shallow shore of Lake Haruna, Gunma Prefecture, in August of 1978. A very large number of replicate samples were required to estimate the total number of taxa and individuals, and the total biomass, in the shallow part of the stony zone, where the samples presented a poor fauna and a large variation. In the deeper stony and aquatic plant zone, with an abundant fauna and a smaller variation of samples, about six replicate samples were required to estimate the number and the biomass at the permissible 30% error level and the 95% level of confidence of the mean. A large number of samples are required to identify species showing a low density and an aggregated distribution. (Baker-FRC)
W82-02796

THREE COASTAL LAKES ON KAMIKOSHIKI ISLAND, KAGOSHIMA PREFECTURE,

Nagasaki Univ. (Japan). Faculty of Fisheries.
M. Matsuyama.
Japanese Journal of Limnology, Vol 42, No 1, p 52-57, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Lakes, *Stratification, Bottom sediments, Chlorine, Coastal waters, *Japan, *Lake Kaiike, Saline water intrusion, Limnology.

An outline of Lake Kaiike and two adjacent lakes, Namakoike and Kazakiike, is offered, and the stratified condition of Lake Kaiike is considered in relation to these other two lakes. All these lakes are cut off from the sea by a long gravel bar about 3.5 km long, 50 meters wide, and 2-5 meters high. At present, the leeward half of the gravel bar which faces the lake is overgrown with scrub about 4 meters high except in areas of erosion. The lakes receive little inflow of fresh water except for rainwater runoff, and they have no surface outlet across the bar. Intrusion of seawater into Lake Kaiike is slight compared with Lake Namakoike. The littoral zone is dominated by submerged plants, and the sublittoral area is vegetated by plants such as Cyperaceae and Gramineae. On the southeast side of the lake, a swamp called Suguchiike is present. In Lake Namakoike both temperature and dissolved oxygen decreased with depth, but chlorinity exhibited only a slight increase with depth. Hydrogen sulfide was restricted to the bottom water, and a significant exchange of water with the sea through the gravel bar was important in preventing the lake from becoming stratified like Lake Kaiike. Chlorinity was low in Lake Kazakiike and there is no indication of stratification. It is important to clarify whether a stratified stage occurs only in Lake Kaiike or is ubiquitous in basins produced by deposition of a gravel bar across the indentations of sea coast. (Baker-FRC)
W82-02798

FUNCTIONAL RELATIONSHIPS BETWEEN NUTRIENT DYNAMICS, OXIDATION-REDUCTION CAPACITY, AND EUTROPHICATION IN A SOFT-WATER LAKE,

Connecticut Univ., Storrs. Dept. of Biological Sciences.
R. W. Kortmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168550, Price codes: A08 in paper copy, A01 in microfiche. PhD Dissertation, June, 1981. 140 p, 17 Fig, 17 Tab, 69 Ref. OWRT-A-071-CONN(6), 14-31-0007-6007.

Descriptors: Nutrient behavior, Dissolved nitrogen, Phosphorus budgets, Benthic fluxes, *Lakes, *Limnology, *Nutrients, Phosphorus, Benthos, Hypolimnion, Epilimnion, Inflow, Oxidation-reduction potential, *Eutrophication.

The net nutrient behavior (Net System Flux) of a softwater lake was determined on a weekly schedule using steady-state compartment modeling. The watershed hydrology (upon which budget accuracy depends) was defined using storm event sampling, unit-hydrograph simulation, groundwater simulation and in situ seepometers. Highly significant correlation was found between flowrates predicted by unit hydrograph simulation and observed flow-rates. Phosphorus concentration and hydrograph flowstage exhibited a significant relationship (prepeak postpeak baseflow). Chemical and hydrological data were combined using 'flow-interval' and 'typical concentration' techniques, resulting in dissolved nitrogen and phosphorus budgets of high resolution. Hypolimnetic-epilimnetic and benthic fluxes of nutrients and reduced chemical compounds (products of anaerobic respiration) were determined by in situ incubation and application of eddy diffusion coefficient estimates. Transport of ferrous iron, methane (dissolved gas) and total sulfide across the sediment-water interface was about 50, 700, and 10, x10exp-7 moles per square centimeter per year, respectively. Transport of ferrous iron, total phosphorus, ammonia, carbon dioxide, oxygen and silica across the 2.5 meter plane was about +0.0237, +0.016, +0.432, +0.0015, -3.71, and +0.368 micromoles per square meter per day, respectively, while the hypolimnion was anoxic. Benthic flux of total phosphorus, determined by in situ incubation was about 30.6 (+ or - 15%) milligrams per square meter per day, which compared well with literature values. Nutrient cycling between sediments and epilimnetic water represents a significant budget contribution.
W82-02810

EFFECTS OF WHOLE LAKE MIXING ON WATER QUALITY AND PHYTOPLANKTON,

Oklahoma State Univ., Stillwater. School of Biological Sciences.
For primary bibliographic entry see Field 5G.
W82-02823

HYDROLOGIC DESCRIPTION OF LAKE HANCOCK, POLK COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
K. M. Hammett, L. J. Snell, and B. F. Joyner.
Geological Survey Open-File Report 81-131 (WRI), 1981. 1 Sheet, 13 Fig, 2 Tab, 21 Ref.

Descriptors: *Lakes, *Limnology, *Lake morphometry, Hydrologic budget, Lake stages, Eutrophication, Surface-groundwater relations, Water quality, Chemical analysis, Water analysis, Data collections, *Florida, Polk County, *Lake Hancock.

Available data were evaluated to document hydrologic conditions in the Lake Hancock basin. Bathymetric data indicate that Lake Hancock is very shallow, having a maximum depth of about 3 feet. The lake bottom is covered by a layer of organic material that may be more than 5 feet thick near the center of the lake. Lake Hancock's stage fluctuates within 0.5 foot of average stage about 40 percent of the time. Lake outflow is through an operable control. There are many days with no outflow in some years. A water-budget analysis of the lake indicates that substantial lake stage declines in 1968 and 1975 followed successive years of deficient precipitation and were primarily the result of a net loss of water from the lake to the ground-water system. During a period in 1971-72 when lake stage remained relatively stable, the ground-water system contributed a significant volume of water to the lake. Water-quality data indicate that Lake Hancock is in a eutrophic state. The eutrophication process appears to have been accelerated through the addition of nutrients from inflow of wastewater effluent from secondary treatment plants. (USGS)
W82-02843

SOME ECOLOGICAL ASPECTS OF LAKE QARUN, FAYOUM, EGYPT. PART I. PHYSICO-CHEMICAL ENVIRONMENT,

Institute of Oceanography and Fisheries, Cairo (Egypt). Inland Waters and Fish Culture Div.
M. M. Ishak, and S. A. Abdel-Malek.
Hydrobiologia, Vol 74, No 2, p 173-178, September, 1980. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Salinity, *Nutrients, *Water quality, Lakes, *Lake Qarun, *Egypt, Saline lakes, Drainage canals, Fertilizers, Nitrogen compounds, Nitrates, Nitrites, Phosphates, Water pollution sources, Physicochemical properties.

Physicochemical changes in Lake Qarun, Egypt, are described. The 235 sq km lake is 40 km long and 9.25 km at the widest point. Mean depth is 4.2 meters and the lake level is 44 meters below sea level. The lake receives 390 million cu meters of water annually from two drainage canals. An equal amount evaporates, leaving 430,000 tons of salts from two drainage canals. An equal amount evaporates, leaving 430,000 tons of salts each year and thus increasing salinity with time. Construction of the Aswan Dam in 1965 has decreased suspended matter in Nile water, necessitating use of artificial fertilizers, which also increases salinity. Salinity has increased from 10.65-11.26 o/oo in 1906 to 30.6 o/oo in 1955 and 30.9-34.5 o/oo in 1974-76. Present values are 26-29 o/oo in winter and 33-34 o/oo in summer. Other water quality parameters are: transparency, 60 cm near the drainage canal to 200-300 cm in the western part; nitrates, 36.83-55.92 mg-atom per liter nitrate-N; nitrates, 0-0.125 mg-atom per liter nitrate-N; and phosphates, 0-0.7 mg-atom per liter phosphate-P. (Cassar-FRC)
W82-02859

THE PRODUCTION ECOLOGY OF BENTHIC PLANTS IN SOME ANTARCTIC LAKES. I. IN SITU PRODUCTION STUDIES,

Natural Environment Research Council, Cambridge (England). British Antarctic Survey.
J. Priddle.
Journal of Ecology, Vol 68, No 1, p 141-153, March, 1980. 4 Fig, 2 Tab, 38 Ref.

Descriptors: *Antarctic, *Lakes, *Benthic flora, Aquatic plants, Productivity, Algae, Polar regions, Phytoplankton, Ice cover, Iced lakes, Seasonal, Aquatic productivity, Limnology, Oxygen, Respiration, Mosses, Signy Island, Light intensity.

Three oligotrophic lakes on Signy Island, Antarctica, were studied May 1976 to March 1977 to characterize their productivity. Phytoplankton was sparse; benthic plants predominated. This community had adapted to the low light intensity under the ice cover, so that growth stops only during early winter (June to early August) when plants are below the compensation point. Irradiance at the bottom of the lakes ranged from 1 in midwinter to 2600 kJ per sq meter per day in early summer. Production rates were no higher during the open water period, and no photo-inhibition was observed. Annual production (carbon in g per sq meter) for three benthic communities was: Tolypothrix-Plectonema (Sombre Lake), 9; Phormidium dominated algal felt (Changing Lake), 3.3; and aquatic mosses Calliergon and Drepanocladus (Moss Lake), 4. Maximum productivity rates of the above three communities (measured as oxygen evolution rate per unit ash-free dry weight, micrograms per mg per day) were 10.8, 4.2, and 7.7, respectively. More eutrophic lakes on the same island have a seasonal phytoplankton growth as well as the benthic and mixed vegetation. (Cassar-FRC)
W82-02860

THE PRODUCTION ECOLOGY OF BENTHIC PLANTS IN SOME ANTARCTIC LAKES. II. LABORATORY PHYSIOLOGY STUDIES,

Natural Environment Research Council, Cambridge (England). British Antarctic Survey.
J. Priddle.
Journal of Ecology, Vol 68, No 1, p 155-166, March, 1980. 5 Fig, 1 Tab, 23 Ref.

Descriptors: *Iced lakes, *Photosynthesis, *Algae, *Mosses, *Water temperature, *Antarctic, Polar regions, Lakes, Aquatic plants, Respiration, Light penetration, Light intensity, Irradiation, Plant physiology, Oxygen uptake, Oxygen, Temperature effects.

The photosynthetic physiology of two algal communities and two aquatic mosses from the Antarctic lakes of Signy Island were studied in laboratory tests. Blue-green algae Tolypothrix and Plectonema displayed a light compensation point of 0.17 W/sq m. These algae had a maximum net rate of oxygen production per unit ash-free weight of about 0.6 micrograms/milligram/hour, with a high and variable rate of respiratory oxygen uptake. A predominantly Phormidium community with a compensation point of 0.09 W/sq m had a lower maximum net rate of oxygen production and respiration rate. The mosses Calliergon sarmentosum and Drepanocladus sp. had similar respiration rates (about 0.3 micrograms/milligram hour per unit ash-free dry weight) at normal lake temperatures. Between 1.2 and 30 degrees, respiration rate increased linearly with temperature at different rates for the two mosses. Drepanocladus displayed a compensation point similar to the algal communities studied, while Calliergon had a higher compensation point. When temperature was increased in the experimental range of irradiance, the compensation point also shifted to a higher irradiance, especially in the Calliergon mosses. (Geiger-FRC)
W82-02861

PRODUCTION STRATEGIES IN ANTARCTIC INLAND WATERS: PHYTOPLANKTON ECOPHYSIOLOGY IN A PERMANENTLY ICE-COVERED LAKE,

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
For primary bibliographic entry see Field 2C.
W82-02862

IRON AND MANGANESE IN LAKE VECHTEN (THE NETHERLANDS): DYNAMICS AND ROLE IN THE CYCLE OF REDUCING POWER,

Institute of Limnology, Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2K.
W82-02864

CYCLOPS SCUTIFER SARS - ONE AND TWO-YEAR LIFE CYCLES WITH DIAPAUSE IN THE MEROMICTIC LAKE BLANKVATN,

Oslo Univ. (Norway). Inst. of Zoology.
K. Elgmork, and A. Langeland.
Archiv fur Hydrobiologie, Vol 88, No 2, p 178-201, March, 1980. 15 Fig, 45 Ref.

Descriptors: *Cyclops, *Meromictic lakes, *Life cycles, Lakes, *Copepods, Aquatic animals, Crustaceans, Mixolimnion, Chemocline, Plankton, Lake sediments, Seasonal distribution, Monimolimnion, Limnology, Hydrobiology, Aquatic populations, *Lake Blankvatn, *Norway.

A detailed life history study of a freshwater copepod population of Cyclops scutifer Sars was undertaken at the 55 m deep, meromictic lake Blankvatn just north of Oslo, Norway. The copepod life cycle consists of both a one- and a two-year developmental sequence with diapause in the sediment lasting from September to April. Members in the plankton and in diapause in the sediment are restricted to the mixolimnion, with greatest numbers close to the sediment are restricted to the mixolimnion, with greatest numbers close to the surface and to the chemocline for the planktonic phase and near the chemocline for the diapause phase. C. scutifer exhibits three main reproductive periods, one in spring, one in late summer, and one in winter. Part of the diapause population was also found in sediments of the monimolimnion. A long residence near the chemocline was noted for copepods preparing for diapause. No vertical migration was observed. (Geiger-FRC)
W82-02865

THE USE OF DIALYZING SACKS IN ESTIMATION OF PRODUCTION OF BACTERIOPLANKTON AND PHYTOPLANKTON,

Eotvos Lorand Univ., Budapest (Hungary). Dept. of Plant Systematics and Ecology.
For primary bibliographic entry see Field 7B.
W82-02866

POST-GLACIAL SEDIMENTS IN LAKE LINNEVATN, SPITSBERGEN,

Oslo Univ. (Norway). Inst. of Limnology.
A. Boyum, and J. Kjensmo.
Archiv fur Hydrobiologie, Vol 88, No 2, p 232-249, March, 1980. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Lake sediments, *Sedimentology, *Paleolimnology, Core logging, Glacial sediments, Bottom sedimentation, Sedimentation basins, Limnology, Radioactive dating, Carbon radioisotopes, Carbon, Carbonates, Leaching, *Lake Linnevatn, *Norway.

A sediment core of 560 cm from Lake Linnevatn, Spitsbergen, Norway was studied in efforts to reveal the post-glacial history of the lake basin which once was part of the Isfjorden. Chemical studies on sediment clearly showed the seawater and freshwater periods of the basin. The entire post-glacial history of the lake was characterized by highly inorganic sediments. In sediments of the seawater period, total carbon content was high, and carbonate fractions caused severe errors when radiocarbon dating was used. Examinations of the transition sediments, a sandy layer at 300 cm marking the change from seawater to freshwater, resulted in calculations of 3,300 years as the freshwater period of Lake Linnevatn. Leaching in a freshwater environment caused increases in sediment aluminum levels. Additional changes in the composition of sediments at 300 cm in the core were attributed to a shift in the parent rocks from which the sediments were derived. (Geiger-FRC)
W82-02869

PERIPHYTON IN THE VOLTA LAKE. I. SEASONAL CHANGES ON THE TRUNKS OF FLOODED TREES,

Volta Lake Research and Development Project, Akosombo (Ghana).
E. K. Obeng-Asamoa, D. M. John, and H. N. Appler.
Hydrobiologia, Vol 76, No 3, p 191-200, 1980. 7 Fig, 1 Tab, 16 Ref.

Descriptors: *Periphyton, *Population dynamics, *Seasonal variation, *Volta Lake, *Ghana, Lakes, Nutrients, Algae, Cyanophyta, Chlorophyta, Diatoms, Species diversity, Water level, Nitrates, Ammonia.

The seasonal changes in periphyton growing on four flooded trees in the Volta Lake, Ghana, were studied for a year starting in October 1974. The quantitatively most important species of the 47 found were Navidula, Synedra, and Melosira (diatoms); Spirogyra, Oedogonium, and Stigeoclonium (green algae); and Oscillatoria and Anabaena (blue-green algae). The species diversity and cell numbers of diatoms and green algae were high in October and November, corresponding to a period of lake stabilization after the flood period. Species diversity and cell numbers rapidly declined with the drop in lake level over the dry season to a low in June-July. The blue-green algae and diatoms peaked in March-May, the early part of the wet season, when water was warmest (29.7 C) and pH was highest, 7.2. At this time the green algae were at a minimum. Nitrate was high during October-November (0.5 mg per liter) and during March-April (0.8 mg per liter), while ammonia was high in December-January (0.2 mg per liter). At the period of minimum lake level (July) some green filamentous algae began significant increases in cell number until September and declined with a rise in lake level. (Cassar-FRC)
W82-02882

PERIPHYTON IN THE VOLTA LAKE. II. SEASONAL CHANGES ON WOODEN BLOCKS WITH DEPTH,

British Museum of Natural History London (England). Dept. of Botany.
D. M. John, E. K. Obeng-Asamoa, and H. N. Appler.
Hydrobiologia, Vol 76, No 3, p 207-215, 1980. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Periphyton, *Population dynamics, *Seasonal variation, *Volta Lake, *Ghana, Algae, Cyanophyta, Chlorophyta, Diatoms, Species diversity, Water depth, Nitrates.

Periphyton were allowed to colonize and grow for one year on wooden blocks suspended at 0, 0.5, 1, 2, and 5 m in the Volta Lake, Ghana. Forty-seven species were recorded (26 diatoms, 9 green algae, and 10 blue-green algae). Diatoms were most numerous in the first 3 months (October to December, 1974) and again in the last month of the study. Green and blue-green algae, nearly absent for the first 3 months, increased in number as the year progressed. Green algae were the most numerous group after a year's growth. All numbers decreased with depth, especially below 2 m. species diversity of the 3 types of algae generally followed the cell number seasonal and depth patterns. Blue-green algae and diatom numbers increased in April-May with the higher levels of nitrate during the early rains. (Cassar-FRC)
W32-02883

OBSERVATIONS ON SOME COMMON PARASITES OF BAGRUS DOCMAC FORSKAHL (PISCES: SILUROIDEA) OF LAKE VICTORIA,

East African Freshwater Fisheries Research Organization, Jinja (Uganda).
G. B. Mbahinzireki.
Hydrobiologia, Vol 75, No 3, p 273-280, November, 1980. 5 Fig, 30 Ref.

Descriptors: *Lake fisheries, *Fish parasites, *Parasites, *Lake Victoria, Bagrus docmac, Fihseries, Leeches, Nematodes, Crustaceans, Invertebrates, Fish farming, Catfish.

Specimens (1340) of Bagrus docmac Forskahl, an important commercial catfish in Lake Victoria, were examined for 3 common parasites: external crustaceans and leeches and internal nematode larvae. Almost every fish in the susceptible size group (16.0 cm) was infected with 1 or more types of parasites. Argulids were recovered from 36% of the samples. However, 88% carried 6 or less argulid parasites per fish. There was a positive correlation between fish size and argulid incidence; maximum was 37 on a 110.3 cm fish. Leeches occurred on only 4% of fish, but those infected had as many as 50. Leeches were especially common on fish living in water less than 10 m deep. Eustrongylides sp. and Contracaecum sp. were the most common nematodes, infecting 57% of the fish. Smaller fish ($<$ 16.0 cm) had none or few of these parasites. Fish probably acquire the nematode larvae by ingesting prey. Possible pathological effects are: inflammation and sores on the skin and gills, poisoning from toxins, damage to internal organs, and impairment of digestion. Infected fish in the lake were in good condition ($K = 3.12$), but the overcrowded conditions common in fish farms could cause serious mortality. (Cassar-FRC)
W82-02887

ZOOPLANKTON OF LAKE TAUPO,

Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
D. J. Forsyth, and I. D. McCallum.
New Zealand Journal of Marine and Freshwater Research, Vol 14, No 1, p 65-69, 1980. 6 Fig, 16 Ref.

Descriptors: *Zooplankton, *Lakes, *Lake Taupo, *New Zealand, Rotifers, Aquatic animals, Seasonal variation, Trophic level.

Seasonal changes in species composition and abundance of zooplankton were measured in Lake taupo at three sites each month from August 1974 to January 1976. The zooplankton were dominated by adult and immature stages of Boeckella propinqua Sars at 38.0%, the cladocerans Ceriodaphnia dubia Richard at 8.4% and Bosmina meridionalis Sars at 3.6%, and the cyclopoid copepod Macrocyclops albidus (Jurine) at 1.0%. These crustaceans made up 50.3% of the zooplankton, with the remaining 49.7% being rotifers. The most common rotifers were Polyarthra vulgaris (carlin) at 36.0% of the total zooplankton numbers, Conochilus coenobasis (Skorilow) at 10.3%, Asplachna brightwelli Gosse at 2.2%, and Hexarthra sp at 1.1%. Zooplankton populations were generally low in winter, increasing in spring and declining in autumn, in other parts of New Zealand. In Lake Taupo, however, numbers tended to be highest in autumn, mainly due to the greater number of rotifers caught with the small mesh size net used in this study. (Baker-FRC)
W82-02888

OCCURRENCE, DISTRIBUTION AND SEASONAL PERIODICITY OF SOME AQUATIC FUNGI OF SAT-TAL (NAINITAL), INDIA,

Kuman Univ., Naini Tal (India). Dept. of Botany.
G. S. Mer, S. C. Sati, and R. D. Khulbe.
Hydrobiologia, Vol 76, No 3, p 201-205, 1980. 2 Tab, 22 Ref.

Descriptors: *Fungi, *Seasonal variations, Aquatic fungi, Soil fungi, Distribution patterns, Microorganisms, *India, *Lakes.

Aquatic fungi (Blastocladiales, Saprolegnailes, Lagenidiales, and Peronosporales) were studied in 3 lakes and their surrounding soils in the Sat-Tal area of India. The 23 species were grouped into three categories according to occurrence (aquatic, amphibious, and terricolous) and three categories with respect to temperature range (low temperature, below 18C; moderate temperature, 18.1-26.8C; and constant species, 8-26.8C). The aquatic molds varied seasonally according to temperature. In water the highest number of species was observed in the rainy season and the minimum in other seasons, according to site. In soils, the aquatic fungi were most numerous in spring, summer, or the rainy season and least numerous in winter. (Cassar-FRC)
W82-02894

FACTORS INFLUENCING THE COMPOSITION, STRUCTURE AND DENSITY OF A POPULATION OF BENTHIC INVERTEBRATES,

Alberta Environmental Center, Vegreville.
J. W. Moore.
Archiv fur Hydrobiologie, Vol 88, No 2, p 202-218, March, 1980. 5 Fig, 2 Tab, 46 Ref.

Descriptors: *Eutrophication, *Lakes, *Seasonal variation, *Species composition, *Benthic fauna, *Ecological effects, Algal growth, Aquatic animals, Aquatic populations, Midges, Oligochaetes, Molluscs, Subarctic zone, Water quality, Population density, Species diversity, Food chains, Littoral zone, Bays.

The composition, structure, and seasonal abundance of benthic invertebrate populations were studied in a eutrophic bay on the north shore of Great Slave Lake in the Canadian subarctic between May 1977 and May 1978. Shoreline communities consisted of 55 species, with predominant representations of chironomids, molluscs, and oligochaetes. During winter months, chironomids were most abundant, with maximum densities of 1500 larvae/sq m, while molluscs and oligochaetes nearly equaled each other in number throughout the year. Gut content analyses showed that there were few algae-eating microfaunal species in the summer. Offshore communities contained 46 species, of which chironomids and molluscs were predominant. Most offshore chironomids emerged 2 weeks later than their nearshore counterparts. Offshore herbivores subsisted mainly on detritus. It was concluded that the density of oligochaetes was correlated with algal abundance, and that the quantities of food ingested had little effect on benthic populations. Water quality had noticeable effects on species composition, while water temperature and sediment organic content affected emergence times of some species. (Geiger-FRC)
W82-02909

A CARLSON-TYPE TROPHIC STATE INDEX FOR NITROGEN IN FLORIDA LAKES,

California Univ., Los Angeles. Office of Environmental Science and Engineering.

Group 2H—Lakes

For primary bibliographic entry see Field 5C.
W82-02911

SCREEN MESH SIZE AFFECTS ESTIMATES OF MACRO- AND MEIO-BENTHOS ABUNDANCE AND BIOMASS IN THE GREAT LAKES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. F. Nalepa, and A. Robertson.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 9, p 1027-1034, September, 1981. 2 Fig, 7 Tab, 25 Ref.

Descriptors: *Benthos, *Lakes, *Great Lakes, *Biomass, Aquatic life. Measuring instruments, Sampling.

A study was performed to determine the relation of mesh size to sampling efficiency for Great Lakes benthic animals. The efficiencies of screens with meshes of two different sizes, 595 micrometers and 106 micrometers, in retaining the macro- and meiobenthos from Lake Michigan sediment samples have been determined. Samples were taken at nine stations in southeastern Lake Michigan near the mouth of the Grand River. The 595-micrometer screen was much less efficient in retaining chironomids and oligochaetes other than mature Limnodrilus. This coarse screen retained only about half of all chironomids. Obviously, the mesh size used to quantify the macrobenthos should vary with the purpose of the study. Retention of certain macrobenthic taxa was significantly related to sampling date and water depth, indicating that future studies concerned with these variables should use mesh sizes small enough to retain all of the individuals from the taxa of interest. (Baker-FRC)
W82-02912

BLUE-GREEN ALGAL AMMONIA UPTAKE IN HYPERTROPHIC PRAIRIE LAKES,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
T. P. Murphy, and B. G. Brownlee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 9, p 1040-1044, September, 1981. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Lakes, *Trophic level, *Ammonia, Nitrogen, Nutrients, Algal growth, Absorption, Prairies, *Manitoba, Canada, Kinetics.

It is proposed that N-uptake experiments can determine the degree of algal N demand and thus confirm that N limitation in the hypertrophic prairie lakes occurs only for short periods. The lakes chosen for this kinetic study are located in the Erickson-Elphinstone area of southwestern Manitoba, Canada. They have virtually unialgal compositions. The Aphanizomenon samples were at least 98% pure, and the Microcystis samples were at least 90% pure. Two types of ammonia uptake were noted in this study. Active uptake kinetics, a hyperbolic response to increased ammonia ion concentration, was encountered in water samples with low ambient ammonia. Saturation kinetics, a linear response to increased ammonium ion levels, was measured in samples collected with high ambient concentrations of ammonia. When the in situ ammonia-uptake velocity per unit particulate nitrogen of each Michaelis-Menten experiment was plotted as a function of the lake ambient ammonia concentration, the algal ammonia uptake was shown to adapt to the new nutrient levels. The adaptation shown by Aphanizomenon and Microcystis to changing ammonia ion concentrations has important ecological consequences. The ability to take up large quantities of ammonia when or where it is concentrated and either grow quickly or use it later in ammonia-deficient water would give these algae a great competitive advantage. This could explain why blue-green algae dominate lakes with large but ephemeral supplies of ammonia but are unimportant in lakes with little ammonia. (Baker-FRC)
W82-02914

AMMONIA VOLATILIZATION IN A HYPERTROPHIC PRAIRIE LAKE,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
T. P. Murphy, and B. G. Brownlee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 9, p 1035-1039, September, 1981. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Trophic level, *Ammonia, Absorption, *Lakes, Volatility, Nitrogen cycle, Prairies, *Manitoba, Canada, Eutrophication, Kinetics, Storms, Water quality management, *Fishkill, Algal growth.

This paper proposes that some processes of the ammonia cycle can be mediated by weather, and that this is an important factor in the development or decline of phytoplantkton biomass. Lake 885 in the Erickson-Elphinstone area of southwest Manitoba, Canada was used, as it has a history of many algal bloom collapses. The lake has an area of 2.4 ha and a maximum depth of 2.9 meters. Ammonia uptake was measured with Michaelis-Menten kinetic analysis. The first storm event sampled was in a phosphorus-enriched limnocorral. The storm resulted in high ammonia concentrations only in the P limnocorral. There was a large increase in the number of akinetes and many of the Aphanizomenon flakes had separated into individual filaments. During two periods of high pH and high ammonia concentrations, ammonia disappearance rates of 20-30 micrograms N/liter/hour were noted. At these times rates of ammonia uptake by phytoplankton were 2.6-4.3 microgram N/liter/hour as measured by a N-15 method. The high excess rates of ammonia disappearance are best explained by volatilization of ammonia from the lake surface. The loss of ammonia induced nitrogen fixation; however, much larger quantities of ammonia were lost via ammonia volatilization after the algal bloom collapsed than the algae could fix in one season. (Baker-FRC)
W82-02915

THE EFFECT OF ALPHA-HYDROXYBENZYLMETHANESULFONATE ON PHOTOSYNTHESIS AND EXCRETION OF CHLORELLA AND NATURAL PHYTOPLANKTON IN A LAKE,

Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-02918

PHYSICOCHEMICAL INFLUENCES ON PHYTOPLANKTON PRODUCTION IN A TROPICAL ALPINE LAKE,

Hawaii Univ., Honolulu. Dept. of Botany.
J. E. Massey.
Archiv fur Hydrobiologie, Vol 91, No 2, p 133-143, May, 1981. 2 Fig, 5 Tab, 23 Ref.

Descriptors: *Phytoplankton, *Alpine regions, *Lakes, Tropic zone, Population dynamics, Nitrogen, Light intensity, Cycling nutrients, Nutrients, Eutrophication, *Hawaii.

The roles of the physical and chemical environments in primary production were explored, using a small tropical alpine lake as the study site. The lake was monitored during May through September of 1977 and is located at 3969 meters on the summit plateau of an extinct Hawaiian volcano. Lake Waiau is moderately productive by alpine standards. The shoreline was heart shaped with a maximum diameter of 73 meters and a total surface area of 0.60 ha. Maximum depth was 2 meters. Acidity ranged from 8.4 to 9.8. Water temperatures varied from 4.5 to 13.0 degrees C. Thermal stratification was not noted. Primary phytoplankton production ranged from 59.3 to 350.0 mgC/square meter/day. The maximum volumetric rate of carbon assimilation was 38.0 mg C/cubic meter/hour. Algal population composition was determined by chlorophyll concentrations and silicon depletion rates. The flora consisted of a few species of planktonic algae and an epilithic mat composed of Cyanophyta and some Chlorophytes. The photosynthetic capacity of the system did not vary significantly over the five month study period. Three regression models were developed to assess specific physical or nutritional influences and their interactive effects on production. Light levels, rate of nutrient cycling, and nitrogen concentrations appear to limit, whereas nickel may act to inhibit, phytoplankton production. (Baker-FRC)
W82-02921

COMPARISON OF STATISTICAL PHOSPHORUS-RETENTION MODELS,

National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5G.
W82-02930

THE SCHOOLING MECHANISM OF YOUNG PERCH (PERCA FLUVIATILIS) IN THE OPEN PART OF LAKE-TYPE RESERVOIRS (AS EXEMPLIFIED BY RYBINSK RESERVOIR),

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. K. Konobeyeva, A. G. Konobeyev, and A. G. Poddubnyy.
Journal of Ichthyology, Vol 20, No 2, p 49-62, 1980. 7 Fig, 3 Tab, 29 Ref.

Descriptors: *Fish behavior, *Intakes, *Reservoirs, Rybinsk, *USSR, *Perch, Lakes, Wind-driven currents.

A method of predicting the distribution of young fish was developed and tested on data from the Rybinsk Reservoir, USSR. The distribution of larvae is determined by wind currents and the bottom contour. The fish young, which move passively with water masses, are widely and evenly distributed during June and July. At the end of summer, fingerlings are passively carried into the sedimentation zones, where they remain with the maximum biomass of benthic invertebrates and plankton. The main areas where young fish aggregate may be predicted knowing the spawning places, time of mass hatching of the young, the velocity and direction of the wind currents, and the bottom contour at the time of aggregation. This information is helpful in placing water intakes to minimize fish mortality. Intakes must not be set up in zones of ooze accumulation, in the sheltered coastal zone with vegetation, in river mouths, or near main routes along which young fish are moved by the currents. (Cassar-FRC)
W82-02954

2I. Water In Plants

WINTER WATER RELATIONS OF RED SPRUCE ON MOUNT MONADNOCK, NEW HAMPSHIRE,

Harvard Univ., Cambridge.
D. T. Kincaid, and E. E. Lyons.
Ecology, Vol 62, No 5, p 1155-1162, October, 1981. 3 Fig, 1 Tab, 36 Ref.

Descriptors: *Water potentials, *Spruce trees, *Altitude, Seasonal variation, Temperature effects, *Mount Monadnock, *New Hampshire.

This study was designed to test the hypothesis of Baldwin (1977) that severe water deficits occur for red spruce and to determine whether stem water potential decreases with altitude and decreases cumulatively during winter. Also, the level (shoot, tree, altitude, season) where the greatest variability occurs in water status was determined, and the temperatures of tree tissues and microenvironments were measured at different altitudes. In addition, an electron scanning microscope was used to xamine old, dead, or exposed needles to determine cuticular damage. Water potential averaged -1.14 MPa for 545 shoots over two winters, indicating that severe dehydration did not occur. No clear trends were found between altitude and water potential, and the coldest collection days did not correspond to the lowest water potentials. A study of water potential variations of modular parts of single trees may be more useful. (Small-FRC)
W82-02634

MANAGEMENT OF SOIL WATER BUDGETS OF RECHARGE AREAS FOR CONTROL OF SALINITY IN SOUTH-WESTERN AUSTRALIA,

Western Australia Univ., Nedlands. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W82-02754

MINERAL NUTRIENT AVAILABILITY IN WATERCRESS BED SUBSTRATES,

Bath Univ. (England). School of Biological Sciences.
I. P. Cumbus, L. W. Robinson, and R. G. Clare.
Aquatic Botany, Vol 9, No 4, p 343-349, December, 1980. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Aquaculture, *Nutrients, *Watercress, *Substrates, Phosphates, Manganese, Nitrates, Calcium, Potassium, Magnesium, Iron, Zinc, Minerals.

Three commercial watercress beds were selected as experimental sites for a preliminary survey of mineral nutrient availability. Substrate water samples contained low levels of nitrate-nitrogen in comparison with surface waters at each site. This supports the finding that watercress crops are almost entirely dependent on surface irrigating water for their nitrate supply and therefore the water throughput must be maintained at a high level. Total nitrogen in shoot and root tissues from all three sites were above the tissue critical levels. Phosphorus concentrations in substrate waters were at least a factor of 10 greater than those in surface waters. Potassium levels were similar in both surface and substrate waters. Levels of calcium and magnesium at each site were higher in the substrate than in surface waters. Root systems of watercress penetrate the bed substrates and may use mineral nutrients within this environment. (Baker-FRC)
W82-02769

VERTICAL VARIATION IN STEMFLOW GENERATION,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
I. Hutchinson, and M. C. Roberts.
Journal of Applied Ecology, Vol 18, No 2, p 521-527, August, 1981. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Interception, *Stemflow, *Canopy, Trees, *Fir trees, Conifers, Simulated rainfall, Rainfall, Precipitation, Throughfall.

Stemflow resulting from simulated rainfall was measured at four heights (about 0, 1, 2, and 4 m from the base) on a 15-year old open grown Douglas fir tree, 9 m high. The branch interception area increased exponentially with the branch length, yielding a total interception area of 37.4 sq m. Total stemflow was less than 2% of the total precipitation (0.61 cm per hour for 1 hour, 0.77 cm per hour for 2 hours, and 0.41 cm per hour for 4 hours). Although the branches on the lower 2 m of trunk would be expected to produce 31% of the stemflow according to interception capacity, they were actually responsibile for only 1.7%. The branches attached between 2 and 4 meters on the trunk and the branches attached between 4 meters and the top contributed 58.2% and 40.1% of total stemflow, respectively. This pattern is caused by differences in the stem-branch angles, which are 70-80 degrees near the top and 80-90 degrees near the bottom. Lower branches are horizontal or drooping and thus contribute more to throughfall than to stemflow. (Cassar-FRC)
W82-02959

2J. Erosion and Sedimentation

MODELING RILL DENSITY,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R-M. Li, V. M. Ponce, and D. B. Simons.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 106, No IR1, p 63-67, March, 1980. 1 Fig, 4 Ref.

Descriptors: *Rills, *Turbulent flow, *Laminar flow, Model studies, Rainfall-runoff relationships, Channel flow, Erosion, Sediment yield, *Agricultural engineering, Erosion control.

The development of a rill density model would permit a quantitative estimate to be made of the factors influencing soil erosion and sediment yield, with important potential applications. Rill development is a complex physical process involving the interaction of hydrologic, geomorphic, and geotechnical components of the agricultural landscape. A mathematical formulation of rill density was developed, based on stream morphology concepts. The equations derived give the rilling density in laminar and turbulent flow as a function of the slope of the plane measured along a specific distance, threshold rainfall intensity, armoring diameter, and several constants for friction, transport and morphology. These equations agree with statements in the literature that rilling density increases with increasing threshold runoff rate and decreasing particle diameter. (Cassar-FRC)
W82-02604

RIVER AND SUSPENDED SEDIMENT DISCHARGE INTO BYAM CHANNEL, QUEEN ELIZABETH ISLANDS, NORTHWEST TERRITORIES, CANADA,

Pacific Geoscience Centre, Sidney (British Columbia).
For primary bibliographic entry see Field 2E.
W82-02637

EROSION RESISTANCE OF COHESIVE SOILS,

Rhode Island Univ., Kingston. Dept. of Civil Engineering.
W. E. Kelly, and R. C. Gularte.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1211-1224, October, 1981. 8 Fig, 3 Tab, 31 Ref.

Descriptors: *Erosion, *Soil stability, *Cohesive soils, Creep strength, Shear stress, Mathematical studies.

The applicability of both the rate process and double layer theories to the erosion of cohesive soils was investigated. The results demonstrated the applicability and utility of the rate process theory for qualitatively describing surface erosion of cohesive soils. Interparticle bonds in both erosion and creep were found to be similar. Flow volumes depended primarily on salinity. Resistance to erosion was measured by the critical shear stress and exhibited the same dependency on the number of interparticle bonds per unit area as soil strength did. This interpretation may explain in part why attempts to relate erosion resistance to undrained shear strength have had only limited success. (Small-FRC)
W82-02676

RECENT INSHORE SEDIMENTS IN MUSANDAM, OMAN,

University Coll., London (England).
C. Vita-Finzi, and S. J. Phethean.
Marine Geology, Vol 36, No 3/4, p 241-251, July, 1980. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Organic carbon, *Sediments, Chemical composition, *Musandam Peninsula, North Oman, Carbon, Coasts, Sediment transport, Sediment distribution, Ephemeral streams.

The organic carbon content was investigated in sediments recovered from an expedition to North Oman on which grab samples were taken of some of the inlets and bays of the Musandam Peninsula. This peninsula forms the northern tip of Oman, in eastern Arabia, and is separated from Iran by the narrow Strait of Hormuz. It consists of a series of plateaus and headlands, separated by bays and fjord-like gulfs. The coast is bounded by steep cliffs which in places exceed 200 m in height. The bulk of the peninsula is underlain by the massive, gently-dipping limestones and dolomitic limestones of the Musandam Series, ranging in age from Triassic to Lower Cretaceous. The deepest parts of the Persian Gulf lie close to the Iranian shore, with depths of over 100 m occurring in the Strait of Hormuz. The samples were dominated by clay- and silt-sized particles with subordinate fine to coarse sand. Much of the silt consisted of comminuted skeletal material. The sand was partly skeletal in origin and contained foraminifers, ostracods, serpulid tubes and bivalve fragments. The organic carbon content ranged from 0.15 to 3.34% and is related to median grain size. Although in general texture it is related to water depth, the content of organic carbon is also influenced by distance from the open sea. The effect of terrigenous sedimentation is confined to the mouth of the area's major watercourse, the ephemeral Wadi al'Ayn, and to inshore areas supplied by the products of bioerosion. It is suggested that differential preservation, rather than supply, of organic carbon accounts for the observed distribution pattern. (Baker-FRC)
W82-02857

PALEOLIMNOLOGY OF LAKE KIZAKI,

Kyoto Univ. (Japan). Inst. of Paleolimnology and Paleoenvironment on Lake Biwa.
S. Horie, K. Yaskawa, A. Yamamoto, T. Yokoyama, and M. Hyodo.
Archiv fur Hydrobiologie, Vol 89, No 4, p 407-415, August, 1980. 6 Fig, 9 Ref.

Descriptors: *Sedimentology, *Paleolimnology, Sediment deposition, Volcanoes, *Lake Kizaki, *Japan, *Lake sediments, Glacial lakes.

Sediment cores of Lake Kizaki, Japan, revealed that this mesotrophic lake was once a closed body of water having a low deposition rate. At the 28 meter depth (at least 20,000 years old) a gravel bed, probably of glacial origin, was located. In the lower half of the core, 12 layers of volcanic ash were found by geomagnetic industry and bulk density measurements. Nine of the ash layers were 0.1-0.5 cm thick; the others ranged from 2 to 23 cm thick. (Cassar-FRC)
W82-02863

POST-GLACIAL SEDIMENTS IN LAKE LINNEVATN, SPITSBERGEN,

Oslo Univ. (Norway). Inst. of Limnology.
For primary bibliographic entry see Field 2H.
W82-02869

SOIL EROSION AND TOTAL DENUDATION DUE TO FLASH FLOODS IN THE EGYPTIAN EASTERN DESERT,

Cairo Univ., Giza (Egypt). Dept. of Natural Resources.
T. M. Labib.
Journal of Arid Environments, Vol 4, No 3, p 191-202, September, 1981. 6 Fig, 4 Tab, 31 Ref.

Descriptors: *Floods, *Soil erosion, *Denudation, Erosion, Sediment load, Sediment discharge, *Nile River, Egypt, Solute transport, *Flash floods, Deserts, Arid lands, Runoff, Suspended sediments, Deltas.

A sudden rain that fell on the whole eastern desert of Egypt on February 19 and 20, 1975, caused the Nile River to rise 2 meters and the suspended matter to increase to 3040 ppm (Feb. 23). Total precipitation input was estimated at 539,361 million cu meters. Flash flood water input to the river during the 20 day flood period was estimated at 454,200 million cu meters; total suspended load during the flood period, 1,850,811 tons; and total discharge of sediment carried to the Nile by the flash flood water 2,790,189 tons. Average solutes during the flood were 595 ppm, vs. 320 ppm non-flood. Dissolved solutes attributed to flash flood waters were 692,787 tons. The total sediment discharge for the 98,506 sq km area (3/4 of sediments reaching the Nile, 1/4 deposited in wadi) was 37.8 tons per sq km, higher than the average for the African continent (27 tons per sq km). Chemical denudation in the eastern desert was 9.4 tons per sq km; total denudation 42,858 cu meters per sq km per storm or 4 cm per 1000 years. The volume of the Nile cone was estimated, considering flash flood contributions over the last 25 million years, at a total of 191,760 cu km, with flash floods accounting for 16,000 cu km of this. The soil

erodibility factor was calculated at 0.05 tons per ha per storm. Only 8% of the precipitation reached the groundwater reservoir. Water conservation, diversion, and storage, as well as soil conservation including planting trees and crops and controlled grazing, are urgently recommended for the eastern desert region. (Cassar-FRC)
W82-02875

FLOW RESISTANCE IN COARSE GRAVEL BED RIVERS,
Ministry of Works and Development, Christchurch (New Zealand).
G. A. Griffiths.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 899-918, July, 1981. 2 Fig, 5 Tab, 41 Ref.

Descriptors: Flow, Rivers, *Channel flow, *River flow, *Friction loss, Hydraulics, Fluid mechanics, Critical flow, Gravel, Sand, River beds, *Sediment transport, *Bed load, Experimental design, Roughness, *Flow resistance.

Results of the study of two sediment transport regimes are presented. In one regime, the channel boundary is rigid, and in the other, the boundary is deformable. The study included a dimensional analysis of the two regimes, calibrated by linear multiple regression. It also included the collection of 136 field data sets from 72 reaches on 46 New Zealand gravel bed rivers. Results indicate that resistance to turbulent flow is primarily dependent on roughness under the rigid channel regime, and that resistance is primarily dependent on a mobility parameter under the deformable boundary regime. (Titus-FRC)
W82-02879

MAPPING SEDIMENT SOURCES IN A NEW ZEALAND MOUNTAIN WATERSHED,
Forest Research Inst., Christchurch (New Zealand).
M. P. Mosley.
Environmental Geology, Vol 3, No 2, p 85-95, 1980. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Sediment control, *Mapping, *Surveys, Watershed management, Sediment loads, *Sedimentology, Sediment distribution, Mountain lakes, New Zealand.

A survey technique was developed to provide an inventory of sediment sources, where sediment sources are classified in terms of geomorphic type and degree of activity or severity. The procedure, originally developed by the New Zealand Ministry of Works, was refined, tested for validity and reproducibility, and evaluated for research and management purposes. The Harper-Avoca River, Canterbury, was studied, as this is a major water supply source for the Lake Coleridge power scheme and has had problems with sediment load. Over 700 individual sediment sources were identified and mapped in the watershed, requiring 15 days in the field. The techniques provided useful information on the locations of major sources of sediment and on the relative importance of each feature. Thus, sites whose treatment or control would bring the most benefit in reducing sediment loads were identified. (Small-FRC)
W82-02885

THE VARIATION IN SUSPENDED SEDIMENT AND WATER PROPERTIES IN THE FLOODWATER FRONT TRAVERSING THE TIDAL FLAT,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
For primary bibliographic entry see Field 2L.
W82-02928

EROSION CONTROL ALONG TRANSPORTATION ROUTES IN NORTHERN CLIMATES,
Komex Consultants, Ltd., Calgary (Alberta).
F. B. Claridge, and A. M. Mirza.
Arctic, Vol 34, No 2, p 147-157, June, 1981. 12 Fig, 1 Tab, 3 Ref.

Descriptors: *Erosion, *Engineering, Permafrost, Erosion control, Erosion rates, Revegetation, Frozen ground, North America, Cold regions.

Erosion problems encountered in the planning of roads and pipelines for the transmission of natural gas and oil along routes in Northern climates in North America are considered. Erosion involves the physical and chemical weathering of rock and the transport and deposition of unconsolidated materials by water and wind action, gravity and thermal processes. The rate of erosion is affected by soil type, climate, vegetation, and drainage basin characteristics. Various construction activities contribute directly to erosion. Hydraulic erosion is caused by rainfall and flowing water. The loosening and transport of soil particles results from surface runoff occurring as channelized flow or sheet flow. Susceptibility of an exposed site to hydraulic erosion depends primarily on the soil properties, slope and corresponding flow velocities. Silts and fine sands low in cohesion are most susceptible to erosion. Gravels are much less susceptible because of the large sizes of particles. Although clays are finer in grain size, they are often less susceptible to erosion than are silts and sands, owing to their structure and cohesion. Most instances of severe erosion occur when drainage is uncontrolled through an area of ground disturbance. Where the ground cover has been disturbed or removed, subsidence and entrapment of water may follow, leading to ponding which can accelerate the degradation of permafrost. If water begins to flow, hydraulic erosion may follow and result in the formation of erosion gullies. Erosion control efforts are discussed, including granular blankets, channel liners, ditch checks, rock aprons and energy dissipators, and siltation basins. (Baker-FRC)
W82-02933

BED LOAD DISCHARGE COEFFICIENT,
National Water Research Inst., Burlington (Ontario). Hydraulic Research Div.
P. Engel, and Y. L. Lau.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1445-1454, November, 1981. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Bed load, *Discharge coefficient, Flow discharge, Sediment load, *Sediment transport, Sedimentation, Bottom sediments, Dunes, Dimensional analysis, Flow separation, Flow velocity, Flow pattern, Flow measurement, Sand, Multiphase flow.

The bed-load discharge coefficient for the case of two-dimensional flow over dunes is expressed in terms of bed-form geometry and the sand size of the bed material using dimensional analysis. Experiments were conducted in a rectangular flume using artificial dunes and a flow visualization method to measure the flow separation length, from which the bed-load coefficients were determined. The results of the study indicated that the position of zero transport on the back of a dune varies with the steepness of the dunes and the grain size of the bed material. The bed load coefficient is quite sensitive to changes in dune steepness and, to a lesser degree, to changes in grain size of the bed material. When dunes are flat, the effect of grain size on the bed load coefficient is significant. When dunes are steep, the coefficient depends on dune steepness only. The use of the bed load coefficient resulted in some improvement by decreasing the overall average error in a set of 10 separate flume tests. The value of the bed load coefficient K = 1.32 as used by Engel and Lau appears to be a special case representing the value for maximum dune steepness of 0.006. The application of the bed-load coefficient results in some improvement in estimating bed load. (Baker-FRC)
W82-02936

2K. Chemical Processes

FLUORESCENCE SPECTRA OF WATER-SOLUBLE HUMIC MATERIALS AND SOME POTENTIAL PRECURSORS,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
R. A. Larson, and A. L. Rockwell.
Archiv fur Hydrobiologie, Vol 89, No 4, p 416-425, August, 1980. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Streams, *Fluorescence, *Humic acids, *White Clay Creek, *Pennsylvania, Springs, Microbial degradation, Degradation, Organic matter, Chemical reactions, Lignin, Coumarin, Dissolved organic matter.

Fluorescence characteristics of water samples from White Clay Creek, Pennsylvania, and its tributaries differed among the 6 sites studied. Water from the spring at the source showed fluorescence spectra similar to those of substituted cinnamic acids and partly degraded lignins. Further downstream in the third-order stream reach, samples had spectra characteristic of coumarins. Photooxidation of caffeic acid (3,4-dihydroxy cinnamic acid), concentration 0.18-18 ppm, produced a 36% yield of esculetin (6,7-dihydroxy coumarin) within 1.5 hours. A combination of biotic processes, such as lignin degradation, and abiotic processes, such as sediment adsorption, may contribute to the changes in dissolved organic matter fluorescence in the downstream direction. Lignin biodegradation forms catechols, which may undergo radical coupling, ring cleavage, quinone formation, and other chemical reactions to produce cis-cinnamic derivatives, which lactonize to coumarins. (Cassar-FRC)
W82-02648

DISSOLVED IODINE FLUX FROM ESTUARINE SEDIMENTS AND IMPLICATIONS FOR THE ENRICHMENT OF IODINE AT THE SEDIMENT WATER INTERFACE,
Chicago Univ., IL. Dept. of Geophysical Sciences.
W. J. Ullman, and R. C. Aller.
Geochimica et Cosmochimica Acta, Vol 44, No 8, p 1177-1184, 1980. 5 Fig, 1 Tab, 50 Ref.

Descriptors: *Iodine, *Sediment-water interfaces, Interfaces, Halogens, Fluctuations, *Estuaries, Chemical reactions, Sediments.

Some of the diagenetic redistribution processes are examined which influence the distribution of iodine in surficial earth environments, with emphasis on the sediment-water interface. Rates of exchange of dissolved iodine between sediment and overlying water are determined, and the transport-reaction regime that these rates must reflect is elucidated. Sediment and water samples used in the study were obtained from a station in Mud Bay, South Carolina. Mud Bay is a shallow, muddy embayment on the north side of the larger and deeper Winyah Bay of 10 to 12 meters in maximum depth. Surface water salinity is highly variable, but a mean chlorinity of about 0.25M is evident from pore water profiles taken from 1 meter length cores. The yearly temperature range is about 6-30 degrees C. The results show that the flux, pore water and production rate data are consistent with the release of iodine into solution during the anaerobic decomposition of organic matter. The exponential decrease of the production rate with depth in sediment is similar to that found for the release rates of other mineralized organic constituents such as nitrogen and with the general distribution of microbial metabolic activity in sediments. Flux estimates ranged between about 5 and 41 micromoles per square meter per day. These estimates, predicted from either the pore water iodine concentration gradient across the sediment-water interface or the dissolved iodine production rate, were higher than the apparent flux measured directly at the same site. This suggests that iodine which is released to the pore water under the anoxic conditions below the sediment surface reacts with a sedimentary component at or near the sediment-water interface and is lost from solution. (Baker-FRC)
W82-02656

MULTIVARIATE ANALYSIS AND GEOCHEMICAL INTERPRETATION OF SPATIAL VARIABILITY OF THE WATER QUALITY OF SOUTHERN QUEBEC RIVERS. (ANALYSE MULTIVARIEE ET INTERPRETATION GEO-

CHIMIQUE DE LA VARIABILITE SPATIALE DE LA QUALITE DE L'EAU DES RIVIERES DU QUEBEC MERIDIONAL),

Quebec Univ., Sainte-Foy.
B. Bobee, M. Lachance, and L. Potvin.
Journal of Hydrology, Vol 53, No 1/2, p 95-116, September, 1981. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Statistical analysis, *Geochemistry, *Rivers, Water analysis, Variability, *Chemical analysis, *Quebec, Water pollution sources, Chemical composition, Solutes, Water quality.

Correspondence analysis was used to analyse the spatial variability of a group of parameters measured at 62 sampling sites along southern Quebec (Canada) rivers. The parameters were conductivity and content of calcium, magnesium, sodium, potassium, sulphate, chloride, and silica. A clustering method was applied to the results of correspondence analysis, which led to the definition of four homogeneous zones. Three of the zones corresponded to the Laurentian Plateau, the Appalachian Mountains, and the St. Lawrence Lowlands. The fourth overlaps the appalachian Mountains and the St. Lawrence Lowlands. The behavior of each zone was related to the topography and geological characteristics of its geographical location. (Small-FRC)
W82-02662

DETERMINATION OF THE SOLUBILITY OF FERROUS SULFIDE IN A SEASONALLY ANOXIC MARINE BASIN,

Freshwater Biological Association, Windermere (England).
W. Davison, and S. I. Heaney.
Limnology and Oceanography, Vol 25, No 1, p 153-156, January, 1980. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Marine environment, *Sulfides, Basins, Limnology, *Iron, Seasonal variation, Temperature effects, Ferrous sulfide.

Measurements were made of iron (II) and sulfide levels for a seasonally anoxic marine basin. Water samples were taken at a moored site over the deepest part of the basin in September of 1978. Dissolved oxygen, temperature and turbidity were measured on site. Sulfide was measured polarographically and spectrophotometrically. Total iron was measured by acid digestion and spectrophotometric measurement of the iron chloride complex, and alkalinity was determined by Gran titration. The pH of the residue was measured with an electrode system. The field observations suggested that ferrous sulfide saturation would most probably be achieved in waters deeper than 19 meters. Sampled water initially looked clear, but on standing for 1 to 2 hr, developed a fine black precipitate. This change in appearance could be due either to the fine colloidal ferrous sulfide originally present becoming visible as its particle size increased or to fresh precipitation of ferrous sulfide. The latter would result from either a genuine solubility change on exposure to atmospheric temperature and pressure or shock-induced precipitation of a slightly supersaturated water. It was concluded that in dynamic seasonally mixed systems, irrespective of the ionic strength, the effective solubility of ferrous sulfide is similar to the measured value for freshly formed amorphous ferrous sulfide. (Baker-FRC)
W82-02665

CHEMISTRY OF A 7.5-M SEDIMENT CORE FROM LAKE VALENCIA, VENEZUELA,

Colorado Univ., Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2H.
W82-02745

ANALYSES OF SOLUTE DISTRIBUTIONS IN DEEPLY WEATHERED SOILS,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
A. J. Peck, C. D. Johnston, and D. R. Williamson.
Agricultural Water Management, Vol 4, No 1/3, p 83-102, 1981. 8 Fig, 1 Tab, 25 Ref.

Descriptors: *Solute transport, *Salinity, Water quality, Water resources development, Soil properties, Erosion, Chlorine, Salts, Farming, Chemical analysis, Saline soils, *Australia.

The storage and distribution of solutes in lateritic soils and deeply weathered materials which blanket the Archean shield of granitic and gneissic rocks in Western Australia are discussed. Methods for the analysis of solute distributions in soil profiles are considered and applied to the examination of data from boreholes representative of those in the area. At borehole sites 1551 and 8251 there is evidence to support chloride ion flux densities at depths between 11 and 17 meters which are less by factors 6 and 12 respectively than the local average rates of chloride ion deposition in rainfall. In these regions it is concluded that there are spatially uniform water flux densities. This flux density is negligible at site 8251, so that diffusion is the dominant chloride ion transport mechanism in this part of the profile. At site 1551 the water flux density between 10 and 18 meters is estimated to be -0.5 mm per year. The small upward flux of water at this site reflects net discharge from the permanent groundwater which is consistent with the site location in a gentle saddle. (Baker-FRC)
W82-02764

EFFECTS OF SHORT-TERM CHANGES IN RAIN WATER SUPPLY ON THE IONIC COMPOSITION OF ACID MOORLAND POOLS IN THE CAMPINE OF ANTWERP (BELGIUM),

For primary bibliographic entry see Field 2H.
W82-02775

IRON AND MANGANESE IN LAKE VECHTEN (THE NETHERLANDS): DYNAMICS AND ROLE IN THE CYCLE OF REDUCING POWER,

Institute of Limnology, Nieuwersluis (Netherlands).
H. Verdouw, and E. M. J. Dekkers.
Archiv fur Hydrobiologie, Vol 89, No 4, p 509-532, August, 1980. 12 Fig, 8 Tab, 22 Ref.

Descriptors: *Iron, *Manganese, *Chemical reactions, Heavy metals, Metals, Sediments, Lake sediments, *Lake Vechten, *Netherlands, Lakes, Hypolimnion, Deposition, Sediment transport, Chemical precipitation, Solubility, Chaoborus, Stratification.

Concentrations of iron and manganese were measured in the hypolimnion and sediments of Lake Vechten, The Netherlands, maximum depth 10.5 m, during March-November 1973, 1974, and 1975. Fe levels in the hypolimnion ranged from zero at the beginning and end of the sampling season to 20-22 mg per liter in September at the 10 m depth. Mn levels in the hypolimnion ranged from a low of 0.5 mg per liter to 4.5-7.5 mg per liter in September at the 10 m depth, and from 0-6.5 mg per liter at 9 m. The water was supersaturated with respect to FeCO3 from the bottom to 9 m and for MnCO3 up to 8 m. Total Fe concentrations in the sediments were 7.2-14.1 mg per g wt weight; Mn concentrations, 0.19-0.41 mg per g wet weight. Lowest levels of total metals were found in the surface sediments, 0-3 cm, and highest levels in the deepest, 9-12 cm. About 4-6% of Fe and 10-20% Mn were in exchangeable form, and 0.3-0.5% Fe and 1.2-2.0% Mn were dissolved in the interstitial water. Of the total Fe and Mn found in the 0.12 cm sediment layer, only 1% Fe and 25% mN were released to the hypolimnion. It was concluded that at least 12 cm of the upper sediment must be involved in interaction with the overlying water. A probable mechanism is perturbation by Chaoborus flavicans larvae. The reducing power represented by the Fe/Mn system was about 0.5% of primary production, and sulfate reduction, about 1%. (Cassar-FRC)
W82-02864

METEOROLOGICAL INTERPRETATION OF THE CHEMICAL COMPOSITION OF RAINWATER AT ONE MEASURING SITE,

Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
W. A. H. Asman, J. Slanina, and J. H. Baard.
Water, Air, and Soil Pollution, Vol 16, No 2, p 159-175, August, 1981. 5 Fig, 6 Tab, 19 Ref.

Descriptors: *Rainfall, *Mathematical studies, Wind, Coasts, Meteorological data collection, Coastal waters, Rain, Nitrogen compounds, Hydrogen ion concentration, Air masses, Rainfall rate, *Water pollution sources, *Netherlands, Rain water, Chemical composition.

During 42 periods of 2 or 3 days each at one coastal site of the Netherlands, rainwater levels of H, NH4, Ca, Mg, K, Na, SO4, NO3, Cl, F, Pb, Fe, Br, Mn, V and Al were determined. No clear correlations were found between the coefficients of variation in the amounts of rainfall and the wind speed. When the air mass originates from the land (continental period), rainwater shows a larger concentration of terrestrial components. When the air mass comes from the sea (maritime period), the concentration of marine components is greater. Other meteorological factors had only minor effects on the chemical composition of rainwater. Nitrate and nitrite compounds were responsible for generating about 36% of the H-ions in rainwater. The most important neutralizing agent was NH3. When there was no neutralization by NH3 during continental periods, levels of H were about 2.55 times greater. A chemical definition of the continentality of rain is given and applied to rain samples collected during a meteorological event. (Geiger-FRC)
W82-02874

A SEDIMENT TRAP EXPERIMENT IN FUNKA BAY, JAPAN: 'UPWARD FLUX' OF PARTICULATE MATTER IN SEAWATER,

Hokkaido Univ., Hakodate (Japan). Dept. of Chemistry.
S. Tsunogai, M. Uematsu, N. tanaka, K. Harada, and E. Tanque.
Marine Chemistry, Vol 9, No 4, p 321-334, August, 1980. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Marine sediments, *Suspended sediments, *Bottom sediments, Bays, Fluctuations, Sampling, Sedimentology, *Funka Bay, Japan.

Settling matter was collected from Funka Bay, Japan, and the results were compared with other particles found in sea water, such as suspended particles and plankton. Analysis of this data lead to the development of an hypothesis for the transport of suspended substances in the marine environment. The existence of an upward flux of particulate matter is proposed, where the ascending paticles are not resuspended old bottom sediments. When the material obtained in the traps was analyzed for metals, organic elements, and radionuclides together with the suspended material in the water column, tow groups with different downward fluxes were determined. One group had a small flux that increased with depth, while the other had a rather constant large flux which was observed only in winter. The specific activity of 243Th did not decrease in winter, indicating that the large winter flux was not caused by resuspension of bottom sediments. Thus, the downward flux is not a net removal rate, and there must be an upward particulate flux in the bay. (Small-FRC)
W82-02893

KINETICS AND PRODUCT OF FERROUS IRON OXYGENATION IN AQUEOUS SYSTEMS,

California Inst. of Tech., Pasadena. W. M. Keck Lab. of Environmental Engineering Science.
W. Sung, and J. J. Morgan.
Envimonmental Science and Technology, Vol 14, No 5, p 561-568, May, 1980. 9 Fig, 5 Tab, 28 Ref.

Descriptors: *Iron compounds, *Oxidation, *Kinetics, Chemical reactions, Oxygenation, Saline water, Seawater, Lepidocrocite.

The effects of ionic media, alkalinity, and temperature on the kinetics of ferrous iron oxygenation and the chemical nature of oxidation products were studied. This knowledge is of interest to the fields of water supply and treatment, wastewater, limnology, and oceanography. Solutions of NaClO4,

NaCl, and Na2SO4, each buffered with bicarbonate-CO2, were used. For solutions of pH less than 7, the general rate law was found to be consistent with earlier work: -d times concentration of ferrous ion/dt = k times concentration of hydroxyl ions squared times P02 times concentration of ferrous ion, where k is the rate constant and PO2 is the oxygen pressure in atmospheres. Increases in ionic strength increase oxidation times, and increases in temperature decrease oxidation times. At pH 6.5-7.2 oxygenation half times are in the sequence SO4 > Cl > ClO4 for constant ionic strength. This explains the observation that ferrous ion oxidation in seawater is usually 100 times slower than in fresh water compositions. For pH greater than 7, kinetic data show catalysis of aqueous ferrous ion disappearance by the reaction product, which was identified by infrared spectra and X-ray diffraction as gamma-FeOOH, or lepidocrocite. These findings help explain the reported differences in ferrous ion behavior in fresh, estuarine, and marine waters. (Cassar-FRC)
W82-02923

AN ANALYSIS OF THE FIRST YEAR OF MAP3S RAIN CHEMISTRY MEASUREMENTS,

Washington Univ., Seattle. Dept. of Civil Engineering.
M. B. Baker, D. Caniparoli, and H. Harrison.
Atmospheric Environment, Vol 15, No 1, p 43-55, 1981. 11 Fig, 1 Tab, 13 Ref.

Descriptors: *Rain, *Chemical analysis, Model studies, Sulfates, Nitrates, *Water pollution sources, *Acid rain, Acidity, Sampling, Meteorological data collection, Data collection.

General considerations are presented of the sampling problems inherent in rain chemistry measurements, along with an analysis of preliminary data from four stations of the Multistate Atmospheric Power Production Pollution Study (MAP3S). A primitive theoretical model of the scavenging of certain kinds of pollutants, notably sulfates, is reviewed, in which the variable nature of the removal processes is explicitly considered and from which are derived certain measurement priorities. A description of the MAP3S data from the first year of operation is offered, along with an analysis of the available data and conclusions and recommendations for improved network design. The analysis of rain chemistry measurements from the MAP3S program has given numerical values for parameters of theoretical models of wet deposition of sulfur in general agreement with values estimated earlier for Western Europe. Thus, the probability of rain is about equal to 0.12, the characteristic rainout rate is about 0.3/hr, and the residence time for atmospheric sulfur species is about 100 hr. Both sulfate and nitrate affect the pH readings at all stations. Factor analyses and meteorological analysis of selected high deposition events revealed inadequacies in the present reporting and collecting procedures. Without adequate meteorological data and ambient vertical concentration profiles, the rain chemistry data will be of only limited value. (Baker-FRC)
W82-02934

2L. Estuaries

DISSOLVED IODINE FLUX FROM ESTUARINE SEDIMENTS AND IMPLICATIONS FOR THE ENRICHMENT OF IODINE AT THE SEDIMENT WATER INTERFACE,

Chicago Univ., IL. Dept. of Geophysical Sciences.
For primary bibliographic entry see Field 2K.
W82-02656

NONTIDAL CIRCULATION AND MIXING PROCESSES IN THE LOWER POTOMAC ESTUARY,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
A. D. Hamilton, and R. E. Wilson.
Estuaries, Vol 3, No 1, p 11-19, March, 1980. 10 Fig, 4 Tab, 10 Ref.

Descriptors: *Estuaries, *Nontidal currents, *Mixing, Destratification, Currents, Salinity, Potomac River estuary, Rivers, Eddies, Water currents.

Current meter and hydrographic data collected over a 60 kilometer reach of the lower Potomac River Estuary from Dahlgren to Lewisetta, Virginia were analyzed. Attempts were made to relate variations in estimates for vertical eddy viscosity and eddy diffusivity to variations in Richardson number and to relate variations in the shear effect to variations in Richardson number. Over the length of this reach there is both a marked increase in stratification and a substantial decrease in tidal current amplitude toward the seaward end. The analysis suggests that values for vertical eddy viscosity and eddy diffusivity scale with water depth, tidal current amplitude and bulk Richarson number according to conventional empirical formulas. However, the constant which relates the vertical eddy coefficients under conditions of neutral stability to the product of water depth and tidal current amplitude is found to be an order of magnitude less than that expected for tidal conditions. Analyses also suggest that the degree of enhancement of longitudinal dispersion by the shear effect associated with the nontidal currents is a strong function of bulk Richardson number. (Baker-FRC)
W82-02657

ON MODELING THE TURBULENT TRANSPORT OF PASSIVE BIOLOGICAL VARIABLES IN AQUATIC ECOSYSTEMS,

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
J. S. Wroblewski, and J. J. O'Brien.
Ecological Modelling, Vol 12, No 1, p 29-44, March, 1981. 10 Fig, 38 Ref.

Descriptors: *Turbulent flow, *Hydrologic models, *Cycling nutrients, *Eddy diffusion, *Upwelling, *Ocean circulation, Phytoplankton, Ecosystems, Mixing, Limiting nutrients, Euphotic zone, Advection, Aquatic drift, Velocity, Vertical flow, Model studies.

Turbulence in aquatic ecosystems is recognized as an important factor for nutrient and phytoplankton mixing to enhance primary production in the lighted zone. The present work demonstrates that plankton models which incorporate time-dependent, mixed layer dynamics in their velocity fields give rise to an implicit turbulent flux of passive scalars, making complex formulations of the eddy diffusivity unnecessary. An Oregon upwelling ecosystem model is used to calculate the complex eddy diffusivity which would be needed to replace incorporations of realistic advection. The use of this substitution is not recommended. Ways in which an apparent negative eddy diffusivity may arise in advective plankton models and create gradients in biological fields are illustrated. (Geiger-FRC)
W82-02661

ACOUSTIC REFLECTION FROM ESTUARINE PYCNOCLINES,

Western Australian Inst. of Tech., South Bentley. Dept. of Physics.
J. D. Penrose, and T. Beer.
Estuarine, Coastal and Shelf Science, Vol 12, No 3, p 237-249, March, 1981. 3 Fig, 1 Tab, 24 Ref.

Descriptors: *Estuarine environment, *Acoustics, Stratification, Estuaries, Pycnocline, *Plankton, Zooplankton, Salinity, Temperature effects, Remote sensing, Sounding, Population density, Sound waves, Moore River, Australia.

The nature of acoustic back scattering from pycnoclines and appropriate scattering centers was investigated in order to comment on the performance of echo sounding as a sensing tool for mid-water layered plankton populations in an estuarine environment. The Moor River was used as a test site, as it is one of a number of Western Australian river-estuary systems which form well defined pycnoclines during at least part of the year. Several trips were made to the site, where acoustic reflection from a mid-water layer was noted on an echo sounder, measurements were made of temperature and salinity in the water column, and an assessment of plankton density was formed. The site yielded a relatively sharp, well defined pycnocline with a backscatter signal equivalent in magnitude to that expected from a single -86 dB target in the beam center, at the level of the pycnocline. Such a target strength could arise, at 200 kHz, from large zooplankton and at higher frequencies, from smaller organisms. The acoustic reflectivity from an estuarine pycnocline which is diffusion-controlled could be expected to drop with frequency because of the graded interface mechanism discussed. These findings suggest that by the use of very high sounder frequencies, the contribution of zooplanktonic scatters to the return echo can be made to exceed that due to the impedance contrast provided by temperature salinity variation with depth. In many estuarine situations, some degree of turbulence of various origins may be compatible with a recognizable pycnocline structure. The effect of such turbulence on acoustic echo formation needs further study. (Baker-FRC)
W82-02722

ON THE ALGAL ECOLOGY OF THE LOWLAND IRAQI MARSHES,

Sulaimaniyah Univ. (Iraq). Dept. of Biology.
For primary bibliographic entry see Field 6G.
W82-02777

SOME FIELD MEASUREMENTS CONCERNED WITH THE BEHAVIOR OF RESISTANCE COEFFICIENTS IN A TIDAL CHANNEL,

Birmingham Univ. (England). Dept. of Civil Engineering.
D. W. Knight.
Estuarine, Coastal and Shelf Science, Vol 12, No 3, p 303-322, March, 1981. 20 Fig, 20 Ref.

Descriptors: *Estuaries, *Shear stress, Resistance, Tidal effects, Tidal rivers, Coastal waters, Mathematical models.

Analytical, field and laboratory studies were undertaken of the nature of resistance in unsteady open channel flow. The studies were carried out on a 1.2 km reach of the Conwy Estuary, North Wales, and were measurements made of the local resistance and dispersion parameters under varying tidal and fluvial conditions. Along the entire length of the estuary additional measurements of water level, velocity, salinity and water quality parameters were also taken for the purpose of modeling the entire system. The variations in the five terms of the unsteady flow equation throughout a tidal cycle were illustrated and an assessment made of their relative importance. The water surface slope term was the dominant one except for an hour either side of high slack water. The Manning and Darcy-Weisbach resistance coefficients for the 1.2 km test reach varied significantly with stage, particularly towards low water. At high values of stage, Manning's n was approximately constant around 0.028. The longitudinal density gradient term was important in that without it a marked hysteresis effect was noted on certain tides. The Nikuradse roughness height varied with stage, increasing from 0.2 meters at high water to a value comparable to the depth at low water. Computed values of shear velocity and boundary shear stress were within generally accepted values. It is advised that selecting a single roughness parameter to represent conditions in an individual element of a one-dimensional model is not wise. A stage-dependent resistance coefficient would represent a wide range of tidal conditions. (Baker-FRC)
W82-02792

PLANKTON STUDIES IN SAN FRANCISCO BAY. I. CHLOROPHYLL DISTRIBUTIONS AND HYDROGRAPHIC PROPERTIES OF THE SAN FRANCISCO BAY ESTUARY, JULY 1977 - DECEMBER 1979,

Geological Survey, Menlo Park, CA. Water Resources Div.
A. E. Alpine, J. E. Cloern, and B. E. Cole.
Available from OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225. Price: $19.50 in paper copy, $3.50 in microfiche. Geological Survey

Open-File Report 81-213, February, 1981. 150 p, 1 Fig, 5 Tab, 8 Ref, Append.

Descriptors: *Estuaries, *Phytoplankton, *Chlorophyll, Biomass, Population dynamics, Data collections, Sampling, Sites, *San Francisco Bay, California, Water quality, Salinity, Turbidity, Water temperature.

This report summarizes the distribution of phytoplankton biomass and selected hydrographic properties measured in the San Francisco Bay Estuary, on a near-monthly basis, from July 1977 through December 1979. Parameters measured were: chlorophyll a, phaeopigments, in-vivo fluorescence, turbidity, size distribution of phytoplankton, salinity and temperature. (USGS)
W82-02831

PLANKTON STUDIES IN SAN FRANCISCO BAY. II. PHYTOPLANKTON ABUNDANCE AND SPECIES COMPOSITION, JULY 1977 - DECEMBER 1979,

Geological Survey, Menlo Park, CA. Water Resources Div.
R. L. J. Wong, and J. E. Cloern.
Available from OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225. Price: $13.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-214, February, 1981. 103 p, 1 Fig, 3 Tab, 20 Ref, 5 Append.

Descriptors: *Estuaries, *Phytoplankton, *Taxonomy, Biomass, Population dynamics, Data collections, Sampling, Sites, *San Francisco Bay, California, Nutrients, *Ecological effects, Fish, Invertebrates, Hydrogen ion concentration, Dissolved oxygen, Water quality.

Data are presented on the phytoplankton species composition and abundance in San Francisco Bay from July 1977 through December 1979. Phytoplankton identification and enumerations were made at selected stations. Sample collections were made at selected stations in the main channel of the Bay from Rio Vista on the Sacramento River to Calaveras Point in South San Francisco Bay, and at shoal stations in the central portion of South San Francisco Bay, San Pablo Bay, and Suisun Bay. Also reported, from October 1978 through December 1979, are the calculated phytoplankton carbon and percent nondiatom carbon, and the species list. This study is one component of an ongoing interdisciplinary study of San Francisco Bay. (USGS)
W82-02832

DEVELOPMENT OF THE RIVER SEINE ESTUARY: CASE STUDY,

Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).
F. Parthiot.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1283-1301, November, 1981. 5 Fig, 10 Ref.

Descriptors: *Model studies, *Estuaries, Estuarine environment, Rivers, *Seine River, France, Tides, Water currents, Waves, Field studies, Mathematical models, Case studies.

The study of an estuary is described on a movable bed scale model; the study began in 1950 and still continues. In spite of the schematic way in which this movable bed model represents the actual phenomena of nature, it is a true measuring apparatus, which is altogether accurate, sensitive and representative. The designing, building, calibrating and operation of the model are described to provide valuable information for designing of the channel training works completed in 1963. After the first success, a new version of the model was built in 1967 with certain changes in detail; this continues to serve for studies of development works in the estuary up to the present time. Hydraulic and sedimentological characteristics of the estuary are described, as well as the model design criteria which led to the choice of scales and bed material. Other modeled features include waves, tides, and offshore current. The calibration tests included the successful reproduction of the natural evolution of the estuary, observed over a period of almost 100 years. The conclusion demonstrated how optimum efficiency can be achieved by using a mathematical model of estuary tides and currents in combination with a movable bed scale model. (Baker-FRC)
W82-02867

SEASONAL SALINITY VARIATIONS IN CLEVELAND BAY, NORTHERN QUEENSLAND,

James Cook Univ. of North Queensland, Townsville (Australia). School of Biological Sciences.
T. Walker.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 143-149, 1981. 5 Fig, 11 Ref.

Descriptors: *Salinity, *Runoff volume, *Evaporation, Estuaries, *Cleveland Bay, Burdekin River, *Australia, Great Barrier Reef, Lagoons, Rivers, *Seasonal variation.

Salinity was determined weekly on the surface and at 1 meter from the bottom at various stations in Cleveland Bay, Australia, during the period July 1976 to August 1979. Salinity varied from year to year and from season to season. There was a correlation between minimum salinity (27 to 33 o/oo) and high river discharge during rainy periods, generally January-March. Salinities remained high (35-36 o/oo) during the dry months from about September to the beginning of the rainy period. Maximum differences between surface and bottom salinities were no greater than 1 o/oo in a wet year and 0.1 o/oo in a dry year. During the dry months the surface salinity in near-shore, shallow water was 1 o/oo more saline than offshore, deeper water, as a result of evaporation. (Cassar-FRC)
W82-02878

FINE STRUCTURE OF SALINITY IN THE WATER OFF THE DANUBE ESTUARY,

Institute of Biology of the Southern Seas, Sevastopol (USSR).
V. I. timoshchuk, and N. S. Risik.
Hydrobiological Journal, Vol 16, No 4, p 80-85, 1980. 7 Fig, 7 Ref.

Descriptors: *Salinity, *Estuaries, *Danube estuary, Chemical properties, Salinity currents, Water currents, Water quality, Rivers, Europe.

The object of the study was to establish the fine structure of salinity in the sea area off the Danube estuary and to determine its principal variables. Water temperature and salinity were determined at depths of 0.5, 7, 10, and 15 meters, and currents were recorded at depths of 0, 5, and 10 meters. At the start of the observation period a 2-layered current was recorded. The surface current, the velocity of which was 5-20 cm/sec, coincided with the direction of the wind, but its direction was reversed in the thermohalocline (5-7 meters), where its velocity was 5-20 cm/sec. A current of compensational origin, the velocity of which varied between 5 and 13 cm/sec, was noted in the benthopelagic zone. When wind direction changed, the change was accompanied by an appreciable reconstruction of the currents in a definite sequence. Upon comparing the vertical profiles of salinity obtained by gradient water bottle and by standard procedures the values were found to coincide at depths of 0.5, 10, and 15 meters. The action of the wind on the surface of the water caused a current coinciding in direction with the wind and induced a counterflow in the pycnocline. Movement of the water toward the wind also develops immediately beneath the pycnocline. The study concluded that the main fine structure elements in the sea in front of the Danube are distinguishable on vertical salinity profiles from gradient water bottle data. The formation and variability of vertical structural heterogeneities is connected with the effect of the wind. There is a statistically significant reduction in the effect of the varisbility of structural heterogeneities between the surface and the bottom. (Baker-FRC)
W82-02892

THE VARIATION IN SUSPENDED SEDIMENT AND WATER PROPERTIES IN THE FLOODWATER FRONT TRAVERSING THE TIDAL FLAT,

New Hampshire Univ., Durham. Jackson Estuarine Lab.
F. E. Anderson.
Estuaries, Vol 3, No 1, p 28-37, March, 1980. 9 Fig, 2 Tab, 41 Ref.

Descriptors: *Tidal flats, *Floods, Sedimentation, *New Hampshire, *Sediment transport, Physicochemical properties, Water properties, Temperature effects, Salinity, Chemical analysis, Chemical properties, Suspended sediments, Estuarine environment.

The changes in water and sediment properties were examined in an estuarine environment with progressive flooding of the intertidal zone. Day-today changes in water temperatures, salinities, and particulate matter concentrations were examined, and changes in sediment concentrations occurring across the tidal flat during flooding were examined. The study site was a tidal flat adjacent to the Jackson Estuarine Laboratory of the University of New Hampshire. The study revealed that heat was gained or lost from the flood front during its passage across the tidal flat, depending on the time of flooding as well as on insolation. While water temperature changes were great across the middle and upper intertidal zones, there was little relationship between water temperature and the particulate matter concentration. Salinities increased from the middle to upper intertidal zones in the flood front, regardless of sampling time or insolation. The particulate matter concentration appeared related to the interaction of small ripples with varying bottom slopes in the intertidal zone. The amount of particulate matter between stations was extremely variable and appeared related to coarser sediment alternately being resuspended and settling during flooding. The size of the particulate matter appeared coarser in the upper intertidal zone, where the bottom slopes were steeper and wave resuspension was more effective. (Baker-FRC)
W82-02928

CARBON DIOXIDE ASSIMILATION, PHOTOSYNTHETIC EFFICIENCY, AND RESPIRATION OF A CHESAPEAKE BAY SALT MARSH,

Smithsonian Institution, Rockville, MD. Radiation Biology Lab.
B. G. Drake, and M. Read.
Journal of Ecology, Vol 69, No 2, p 405-423, July, 1981. 9 Fig, 2 Tab, 44 Ref.

Descriptors: *Salt marshes, *Assimilative capacity, *Carbon dioxide, Diurnal distribution, Mathematical models, Photosynthesis, Respiration, *Chesapeake Bay, Estuarine environment.

The difference between net community CO2 accumulated during the day and the amount lost at night were determined for two Chesapeake Bay salt marshes during a typical season. A model for net community CO2 assimilation was constructed, based on the seasonal patterns of solar radiation, community photosynthetic efficiency, and respiration. The maximum value for day-time net CO2 assimilation per unit area of salt marsh between sunrise and sunset was 0.95 mol/m in June. Net CO2 assimilation by both communities during the summer accounted for 3.5 plus or minus 0.9% of the incident photosynthetically active radiation. The model estimated total CO2 assimilation for the entire growing season to be 62 mol/sq m. Photosynthetic efficiency from June to August was 1.9% but the net ecosystem efficiency was 0.8%, equivalent to 0.4% of total solar radiation. (Small-FRC)
W82-02937

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SEA WATER DISTILLATION IN JERSEY AND ITS USE TO AUGMENT CONVENTIONAL WATER RESOURCES,

Jersey New Waterworks Co. (England).
J. M. Hobbs.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 2, p 115-128, March, 1980. 8 Fig, 3 Tab.

Descriptors: *Seawater, *Water supply, *Water treatment, *Desalination, *Distillation, Coastal waters, Distilled water, Reservoirs, Boreholes, Long-term planning, Management planning, Projections, Technology, Design criteria, Cost analysis, Urban planning.

The factors that led to the building of a 6.8 million liter per day distillation plant in Jersey in 1969 are outlined. Operational problems and the costs of the plant and the water produced are discussed. Construction of a desalination plant was in response to projected water demands and to the popularity of desalination procedures in 1965, when the plant was first proposed. Operational problems have been relatively routine. The evaporator has scaling and corrosion problems. Abrasion of the pump impellers, jamming of motor seals in the sea water intake, and difficulties with feed water pumps are among the most significant problems. The largest expense is for fuel oil, the price of which has increased sharply due to international decisions. Unless there are substantial environmental considerations to take into account, less expensive means of storing surplus winter rain would be preferable to desalination. (Titus-FRC)
W82-02748

SCANNING ELECTRON MICROSCOPY STUDY ON REVERSE OSMOSIS MEMBRANES PREPARED FROM INDIAN CELLULOSIC POLYMERS,
Water Pollution Control Board, Baroda (India). Gujarat Regional Lab.
R. N. Kapadia, and V. P. Pandya.
Desalination, Vol 34, p 199-215, 1980. 12 Fig, 2 Tab, 9 Ref.

Descriptors: *Reverse osmosis, *Membrane processes, Membrane filters, *Cellulose acetate membranes, Desalination.

Indigenous cellulosic polymers were used to prepare five different reverse osmosis (RO) membranes under optimized conditions. The casting solutions were prepared by dissolving the polymer in a known quantity of the solvent and subsequently adding swelling agents in specific proportions. The entire mass was mixed to prevent acetone from escaping. Casting solutions were pressure filtered to remove undissolved particles and fibers. Membranes were cast in a flat sheet. In cross sectional studies, membranes were fixed vertically; for top surface studies, membranes were fixed horizontally on the sample holder. They were then immpersed in liquid nitrogen and coated with an Au-Pd alloy by evaporation under vacuum. Silver paint was applied to ensure that the specimen was at ground potential. The membranes prepared were cellulose diacetate, cellulose triacetate, cellulose indigenous acetate blend, cellulose di-tri acetate blend, and cellulose diacetate-polymethyl methacrylate blended membranes. Studies of the morphology and performance suggest that optimization conditions should be established so that the scanning micrograph shows a uniform top layer and the cross section shows a thin dense layer. The layer below the dense layer should have graded layers communicating with a large number of pores of inter-cellulose triacetate, either separately or blended in the component system, may lead to RO membranes showing product water flux above 10 fgd and solute rejection above 92%. (Baker-FRC)
W82-02929

3C. Use Of Water Of Impaired Quality

ESTIMATION OF PRIMARY PRODUCTIVITY FROM DIEL NITRATE UPTAKE MEASUREMENTS OF THE WATER HYACINTH EICHHORNIA CRASSIPES IN AN AQUACULTURE SYSTEM,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
For primary bibliographic entry see Field 5D.
W82-02635

SELECTION OF IRRIGATION SYSTEMS FOR LAND APPLICATION OF MUNICIPAL WASTEWATER,
Williams and Works, Grand Rapids, MI.
J. C. Sutherland, and E. A. Myers.
Public Works, Vol 112, No 10, p 69-72, 91-92, October, 1981. 3 Fig.

Descriptors: *Wastewater irrigation, *Soil types, *Drainage, *Agriculture, Water table, Groundwater, Discharge, Watersheds, Flow, Seasonal variation, Sprinkler irrigation, Surface irrigation, Irrigation design, Land disposal, Land management, Water reuse, Land application, Municipal wastewater, Impaired water use.

Criteria for the selection of irrigation systems for land application of municipal wastewater are discussed. The major considerations are land costs, climate, and soil and groundwater characteristics. Soil texture must be evaluated along with the expected management practices and types of crop production. Groundwater quality, depth and direction of flow must be considered, in addition to potential seasonal fluctuations and the potential for manipulation. Three general irrigation processes are described. Rapid infiltration, slow-rate infiltration, and overland flow differ in their annual application amounts, averaging 80, 6, and 10 feet, respectively, where wastewater is applied for 6 months of the year. (Titus-FRC)
W82-02643

PP AND L USES DISCHARGE WATER FOR FISH FARMING.
Power Engineering, Vol 85, No 10, p 96, October, 1981. 1 Fig.

Descriptors: *Aquaculture, *Fish, *Powerplants, Water reuse, Heated water, Wastewater, Wastewater disposal, *Fish farming, *Catfish, Pennsylvania.

An aquaculture plant is being opened by Pennsylvania Power and Light Co. at its Brunner Island powerplant along the Susquehanna River south of Harrisburg. Catfish are being grown in an atmosphere enhanced by the warm water discharging from the plant. The commercial success of the project can be realized in two ways. First, a good use has been found for the waste heat from the powerplant. Second, a good source of food energy has been found at low cost. Under normal conditions in that area catfish may grow to about one pound in two to three years. Under the enhanced warmth, this same size can be attained in 32 to 36 weeks. The water is maintained between 80 and 85 degrees F, a temperature at which catfish thrive. By the time the project is completed, it is estimated that 500,000 lb of fish can be produced in a year. It is felt that the catfish may be used by the fast food chains now serving increasing amounts of fish. Other species than catfish may also be attempted. (Baker-FRC)
W82-02645

LAND APPLICATION OF WASTEWATERS: AN OVERVIEW.
D. B. Aulenbach.
Clearwaters, Vol 10, No 1, p 9-10, March, 1980.

Descriptors: *Wastewater disposal, *Land disposal, *Wastewater irrigation, Spray irrigation, Heavy metals, Overland flow, Infiltration.

The use of wastewaters for irrigation and fertilization of growing crops was practiced at least 400 years ago. At present, the concept of land application of wastewater takes on three major ideas: spray techniques used for irrigation, overland flow used for both crop production and wastewater renovation, and rapid infiltration used for treatment and recharge of groundwater. In spray irrigation the basic principle is to provide just enough liquid to support the roots of the crops to be grown and gain some fertilizer value from the wastewaters applied. Chlorination is recommended for any wastewaters applied to a food crop that is consumed without cooking. The overflow technique involves applying a thin sheet of water over a gently sloping field. The liquid flows over the surface of the ground, providing moisture to the roots and using the stem as a surface for attachment of bacteria that will consume the organic material in the applied wastewater. The rapid infiltration technique requires the use of relatively coarse soil or sands for the disposal system. A basin is carved into a sandy soil to above 1 meter depth. Wastewater is applied to a depth of 0.3 to 0.7 meters and the liquid allowed to infiltrate the soil, followed by about one day's drying prior to the next application. In general these treatments are inexpensive. The uptake of undesirable materials by the plants may be overcome by growing a non-edible crop such as trees or grass. (Baker-FRC)
W82-02650

WATER RECLAMATION BY THE USE OF SOIL-TURFGRASS SYSTEMS IN THE SOUTHWEST USA,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
I. L. Pepper, W. R. Kneebone, and P. R. Ludovici.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168626, Price codes: A04 in paper copy, A01 in microfiche. Project Completion Report, 1981. 49 p, 40 Tab, 9 Ref. OWRT-B-072-ARIZ(1), 14-34-0001-9106.

Descriptors: *Reclaimed water, *Secondary wastewater treatment, *Groundwater recharge, *Land disposal, *Turfgrasses, Filtration soil-water-plant relationships, Water pollution control, Water reuse.

Application of wastewater to a soil-turf filter in excess of consumptive use allows reclamation of wastewater in the form of leachate into ground waters. This study investigated the maximum rates of effluent which could be applied to soil-turf filters without harming turfgrass or water quality of leachate. Recharge increased with rates of application and decreasing clay content of soil. Overall recharge was affected little by the type of grass grown as long as the grass was actively growing. Recharge was at a maximum in the winter and a minimum in the summer. Linear regression equations relating recharge to effluent loading rates were developed allowing prediction of recharge for a given rate with a given clay content. Nitrate nitrogen leachate concentrations are likely to be the limiting factor in determining the maximum loading rate for any given filter. Nitrate values increased with increased rate of application and decreased clay content. Values peaked during the cold months of December, January and February, and the hot summer months of June and July. Linear regression equations for each soil, and for different seasons were developed. These equations allow prediction of the maximum effluent loading rate which can be applied and still keep leachate NO3-N concentration less than 10 ppm. Boron, P and Na, Ca and Mg values of leachate were low, and not hazardous to water quality or turfgrass. Both virus particles and coliform bacteria were effectively removed by all soil filters listed.
W82-02817

3E. Conservation In Industry

COMBINED FLUE GAS DESULFURIZATION AND WATER TREATMENT IN COAL-FIRED POWER PLANTS,
Environmental Protection Agency, Research Triangle Park, NC. Utilities and Industrial Power Div.
R. H. Borgward.
Environmental Science and Technology, Vol 14, No 3, p 294-298, March, 1980. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Water reuse, *Powerplants, *Cooling water, *Wastewater treatment, Water treatment, Water conservation, Air pollution, Coal, Fuel, Boiler water, Industrial water, Water pollution control, Sulfur, Electric powerplants.

An improvement in powerplant water reuse efficiency and a reduction in the uncontrolled discharge of soluble salts and trace elements were attained by adding sodium sulfate to the flue gas desulfurization (FGD) limestone scrubbers and including a water treatment unit such as the vapor compression evaporator. It was possible to replace all the makeup water with cooling water blowdown containing up to 690 ppm Na+ (for low-sulfur coal) when operating under appropriate conditions (less than 2500 ppm SO2 in flue gas at a Na+ level of 15,000 ppm in the scrubbing liquor or 3000 ppm SO2 and 8000 ppm Na+). By integrating the water treatment system into the FGD, rather than into the cooling water blowdown stream, water recovery was increased 50% because the FGD scrubber preconcentrates the blowdown prior to water treatment. In addition, the evaporator produces high-quality condensate usable as boiler makeup water. (Cassar-FRC)
W82-02606

3F. Conservation In Agriculture

PLANTING DATE AND WATER DEFICIT EFFECTS ON DEVELOPMENT AND YIELD OF IRRIGATED WINTER WHEAT,

Southwestern Great Plains Research Center, Bushland, TX.
J. T. Musick, and D. A. Dusek.
Agronomy Journal, Vol 72, p 45-52, January/February, 1980. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Water stress, *Wheat, *Irrigation effects, Crop yield, Grain crops, Water deficit, Plant growth.

Three planting dates (Sept. 15, early; Oct. 12, normal; and Nov. 7, late) and 4 to 6 water deficit treatments were evaluated with 2 short winter wheats, TAM W-101 and Vona. Early and normal planting as compared with late planting increased dry matter and grain yield and favored development at all stages: phenological level, vegetative period, blooming period, and tillering. Plant water deficits were selected to cause water stress at 1 or more of the following stages: leaf and tiller vegetative growth, spikelet differentiation to late boot-heading, and flowering through grain filling. Plant water deficits reduced yields of wheat by increasing tiller and stem senescence and grain numbers. The yields of both varieties were similar, but Vona had smaller and more numerous grains. TAM W-101 was more resistant than Vona to severe desiccation and tiller stem senescence under severe water deficits. (Cassar-FRC)
W82-02607

RESPONSE FUNCTIONS OF CROPS YIELD TO SOIL MOISTURE STRESS,

Escuela Nacional de Agricultura, Chapingo (Mexico). Colegio de Postgraduados.
E. V. Palacios.
Water Resources Bulletin, Vol 17, No 4, p 699-703, August, 1981. 10 Ref.

Descriptors: *Soil moisture deficiency, *Crop yield, Estimating equations, Mathematical studies, Economic aspects, Plant growth, Available water, Irrigation, *Irrigation efficiency, Irrigation practices.

Efforts were made to define a methodology for determining an optimal irrigation policy to attain a maximum economic yield of crops or, in rain fed farming, to forecast the effect of various precipitation regimes on crop yield by means of a simulation model of the soil-plant-atmosphere system. The method is based on an empirical response function, relating crop yield to soil moisture stress in different stages of plant growth. The function was developed from data obtained during field experiments on several crops and may be useful in determining when and how much to irrigate. A mathematical expression was also derived from that function which estimates the economic loss if irrigation is not applied at the opportune moment. (Baker-FRC)
W82-02725

WATER MANAGEMENT IN THE NORTH DESCHUTES UNIT IRRIGATION DISTRICT: GEOGRAPHIC PERSPECTIVES AND REMOTE SENSING APPLICATIONS,

Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 7B.
W82-02739

INFLUENCE OF IRRIGATION RHYTHM AND WATER SUPPLY ON GROWTH, WATER STATUS AND YIELD OF EGG-PLANT (SOLANUM MELONGENA L.),

Institut National de la Recherche Agronomique, Paris (France).
P. Cornillon, and P. Dauple.
Plant and soil, Vol 59, No 3, p 365-379, 1981. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Irrigation requirements, *Eggplants, *Crop yield, Evapotranspiration, Water use, Water requirements, Consumptive use, Trickle irrigation, Furrow irrigation, Plant growth, Soil-water-plant relationships, France.

Irrigation regimes were tested on two varieties of eggplant grown in France on St. Paul silt loam during 1975 and 1976. Best marketable fruit yield was produced by irrigation amounting to 80% of the potential evapotranspiration. Daily trickle irrigation produced better fruit yields than did biweekly furrow irrigation. The cultivar Violette de Barbentane produced 20% more fruit and used less water than Ronde de Valence. Violette, of tropical origin, responded better to trickle irrigation, and Ronde de Valence, a northern variety, responded better to furrow irrigation. (Cassar-FRC)
W82-02746

WATER LEVELS AND LOSSES AND CLEANING IN WATERCOURSES,

Pakistan Water and Power Development Authority, Lahore.
M. Akram, W. D. Kemper, and J. D. Sabey.
Transactions of the ASAE, Vol 24, No 3, p 643-650, May/June, 1981. 16 Fig, 1 Tab, 8 Ref.

Descriptors: *Water loss, *Irrigation ditches, *Vegetation effects, Revegetation, Cleaning, Water level, Hydraulic roughness, Water conservation.

The role of cleaning in reducing earthen watercourse water loss was explored. First, an operating level was determined for two waterways. The rate of flow in the watercourse was determined, and the water width was determined at 3 cm above operating level. The watercourses were cleaned by removing the grass from the sides and bottom of the channels along with a little sediment. After cleaning, the water level was determined with respect to the datum marks (3 cm above operating level before cleaning). Earthen watercourses are generally designed by assuming a roughness coefficient in Manning's equation of 0.04, and the roughness coefficient of a smooth earthen ditch is closer to 0.03. Thus, the water level in a clean watercourse will be a few centimeters lower than the designed level. Economically, the optimum time for cleaning will depend on the value of the water that will be saved, the cleaning cost, and the functional relation between loss rate and water surface level. Ponding and recession measurement of water loss are simple and economic ways to help determine the optimum schedule for cleaning. (Small-FRC)
W82-02747

MANAGEMENT OF SOIL WATER BUDGETS OF RECHARGE AREAS FOR CONTROL OF SALINITY IN SOUTH-WESTERN AUSTRALIA,

Western Australia Univ., Nedlands. Dept. of Agronomy.
R. H. Sedgley, R. E. Smith, and D. Tennant.
Agricultural Water Management, Vol 4, No 1/3, p 313-334, 1981. 4 Fig, 2 Tab, 35 Ref.

Descriptors: *Soil water, *Water conservation, *Salinity, Cropland, Water resources development, Farming, Cereal crops, Grain crops, Farm management, *Australia.

Theory relating to analysis and simulation of soil water budgets in recharge areas is outlined. Ways in which their components may be affected by the interaction between weather patterns and changes caused by clearing of the original deep-rooted flora are summarized. Limited local data from the cereal belt are presented to indicate the scope for minimizing recharge by agronomic approaches. Recharge is simulated as a function of rainfall patterns in a first step toward a systematic analysis of the control of salinization by management of recharge. The objective in controlling salinity by better management of recharge areas is to increase evapotranspiration. This largely involves increasing the duration and extent of plant cover. Management of water budgets in recharge areas involves two processes. First, recharge must be minimized below root zones of agricultural species by careful selection and cultivation of deeper-rooted agricultural types. Secondly, interception and extraction of recharge below the root zone of agricultural species must be carried out by strategic placement of deep-rooted indigenous or exotic tree species. Water budgets in recharge areas can be modified through better management of subterranean clover pastures, replacement of such pastures with a grain legume phase using lupins, or with cereal-legume mixtures. Better adapted and higher yielding wheat cultivars for closer rotations and the development of cereal cultivars and clover strains with root systems better able to extract water at depth will also help. (Baker-FRC)
W82-02754

RESOURCE ALLOCATION IN A SIERRA-NEVADA FOOTHILL BEEF COW-CALF OPERATION THROUGH LINEAR PROGRAMMING,

California Univ., Davis. Dept. of Agronomy and Range Sciences.
D. M. Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168543, Price codes: A11 in paper copy, A01 in microfiche. PhD Dissertation, March, 1981, 221 p, 14 Fig, 31 Tab, 3 Append. (California Water Resources Center Project UCAL-W-495). OWRT-B-175-CAL(9).

Descriptors: *Range management, *Cattle, *Ranges, *Grazing, Forages, Fodder, Economics, Model studies, Sensitivity analysis, Productivity.

Using a Sierra-Nevada foothill beef cow-calf operation as a case study, two methods of developing the production coefficients needed to develop a profit maximizing linear programming model were compared. One method, called the grazing record method, used existing grazing records and historical stocking rates as a data base for deriving production coefficients. The other method, called the forage production method, used estimates of seasonal forage production from the literature augmented by the results of a dynamic simulation model (ELMAGE) to derive needed production coefficients. In both models a cow-calf operation producing weaner calves was selected over purchased stocker steers or calcus held over and seed or yearlings. In the grazing record model none of the possible range improvements were chosen. Sensitivity analysis showed the optimal solution to be robust to both decreases in the price of various improvements and increases in cattle prices. The optimal solution of the forage production model included nitrogen fertilization of open rangeland and the purchase of alfalfa har or profitable sources of additional feed. Sensitivity analysis indicated that these two fed sources were economically interchangeable. But both models showed a shortage of feed in the inadequate green feed period to be limiting to beef production and ranch income. It was concluded that until a much larger data base is accumulated for seasonal forage production and nutrient requirements for cattle on range, the grazing record method is as illiminating to the ranch operator decision maker as the more demanding forage production model. (Snyder-California)
W82-02809

MULTIOBJECTIVE ANALYSIS OF IRRIGATION PLANNING IN RIVER BASIN DEVELOPMENT,

Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-02855

THE IRRIGATION SCHEDULING PROBLEM AND EVAPOTRANSPIRATION UNCERTAINTY,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 2D.
W82-02900

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

COMPUTERIZED CONTROL OF AN OPEN-CHANNEL WATER DISTRIBUTION SYSTEM,
Arizona State Univ., Tempe.
D. D. Zimbelman.
PhD Dissertation, May, 1981. 316 p, 55 Fig, 10 Tab, 44 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-17192.

Descriptors: *Water distribution, *Open channel flow, *Algorithms, Water demand, Automation, Computers, Water control, Water level.

The objective of this research was to develop an algorithm for the computerized control of an open-channel water distribution system that would allow the system to be operated on a demand basis rather than on a scheduled basis. Downstream control introduces water into the system in direct proportion to the amount of water withdrawn. The input to the algorithm is the water surface upstream of each control structure. The output from the algorithm is an adjustment in gate opening to be implemented at the adjacent upstream control structure. The adequacy of the algorithm was verified by simulating the interaction between the algorithm and two different typical canal systems. On each canal, six cases representing automated control and four cases representing manual control were simulated. These simulations were used to first establish viability of the algorithm in an automated control environment, and secondly to compare automated control to manual. It is the conclusion of this research that the control algorithm is capable of controlling an open-channel water distribution system at a higher level of efficiency than manual control, where efficiency is measured in terms of the stability of the water surface elevations within the system. (Sinha-OEIS)
W82-02732

SUPPLEMENT TO PREDICTIVE MODELING OF EFFECTS OF THE PLANNED KINDRED LAKE ON GROUND-WATER LEVELS AND DISCHARGE, SOUTHEASTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
C. A. Armstrong.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $8.25 in paper copy, $6.00 in microfiche. Geological Survey Open-File Report 81-646, June 1981. 15 p, 1 Fig, 3 Plates, 39 Ref.

Descriptors: *Model studies, *Preimpoundment, *Reservoir sites, Dam construction, Planning, Forecasting, *Groundwater level, Groundwater movement, Aquifer characteristics, Surface groundwater relations, Water table, Hydraulic conductivity, Recharge, Evapotranspiration, Computer models, Water level fluctuations, *North Dakota, *Sheyenne River.

A digital model was used to describe a groundwater system in glacial deltaic deposits near Kindred, N.D., and to predict the effects on groundwater levels of a planned lake at the 950-, 960-, 970-, 984-, and 995-foot stages. Model analysis indicates that only the area within a radius of about 2 miles of the dam on the present Sheyenne River would be affected by rising water levels as a result of a lake stage at 995 feet. The rise of water levels depends on time and hydraulic properties of the aquifer. The maximum projected rise in water levels at the various stages should occur in about 50 to 100 years. Evapotranspiration and existing drains will be effective in limiting the extent of water-level rise. (USGS)
W82-02828

FLOW DURATION AT SELECTED STREAM-SITES IN KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-02837

TECHNICAL AND ECOLOGICAL IMPACTS OF THE HIGH ASWAN DAM,
Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
A-A. I. Kashef.
Journal of Hydrology, Vol 53, No 1-2, p 73-84, September, 1981. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Dams, *Environmental effects, *Erosion control, Weirs, *Nile River, *High Aswan Dam, *Irrigation effects, Water resources development, Ecological effects, Channel erosion, Beach erosion, Bank erosion, Silting, Reservoir silting, Human diseases, Fishing, Watershed management.

The High Aswan Dam was constructed in 1952 to provide for the irrigation demands of agricultural expansion, to generate electricity, to supplement the water supply during low-stage years and to protect the land from high floods. Channels from the reservoir downstream of the dam are to be used in a new irrigation project to feed the Western Desert areas. A proposed submerged weir could improve the performance of the channel by diverting lost silts back to Egypt. The diverted silts would lessen the need for chemical fertilizers, prevent erosion along the Nile and other waterways, and hinder the advance of the Mediterranean shoreline. Other environmental impacts that have been associated with the High Aswan Dam since its building include the deterioration of Mediterranean summer resorts due to beach erosion, the spread of water-borne diseases, the flooding of villages near the dam reservoir, and losses suffered by the fishing industry due to the lack of silting along salmonid spawning areas. (Geiger-FRC)
W82-02856

A SOLUTION TO SPRING ICE-JAM FLOODING,
For primary bibliographic entry see Field 2C.
W82-02908

REGIONALIZATION AND PREDICTION OF ANNUAL FLOODS IN THE FRASER RIVER CATCHMENT, BRITISH COLUMBIA,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2E.
W82-02910

CLOSURE OF THE KAMA RIVER AT THE SITE OF THE LOWER KAMA HYDROELECTRIC PLANT,
For primary bibliographic entry see Field 8A.
W82-02951

4B. Groundwater Management

AN ECONOMIC ANALYSIS OF GROUND WATER MANAGEMENT ALTERNATIVES,
Nebraska Univ., Lincoln. Dept. of Agricultural Economics.
D. A. D. Comer.
PhD Dissertation, 1981. 147 p, 11 Fig, 24 Tab, 37 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13280.

Descriptors: *Groundwater management, Groundwater storage, *Economic aspects, *Model studies, Groundwater mining, Water resources development, Income, Agriculture, Aquifers, *Nebraska, Upper Big Blue Natural Resources District.

Alternatives for managing existing ground water are similar for all areas facing ground water mining problems. The specific impact of an option will depend upon the specific hydrologic and soil characteristics of the area, the cropping patterns, and climatic conditions. These factors lend themselves well to a case study approach. Within Nebraska, there are several areas with ground water mining problems and one of these areas, the Upper Big Blue Natural resources District has been selected as the study area. Several options are examined to see how they impact on farm and regional income over time. The objectives were to evaluate the impacts of options on farm level income, on aggregate farm income and on the aquifer. The model was structured to determine how producers might respond to three-year allocations. A recursive, polyperiod linear program formed the basis of the farmer's decisions. The polyperiod component was necessary to reflect the opportunity cost of using water in year one rather than year two or three. It was recursive to allow for reflection of the impact of action in earlier years on costs in subsequent years. Producers were assumed to plan based on average values but could adjust their intentions according to the weather conditions. A 400-node, three dimensional finite element hydrologic ground water model was used to simulate the impact of annual pumpage on the aquifer. New pump costs were estimated annually to reflect changing aquifer conditions. (Sinha-OEIS)
W82-02740

WATER RECLAMATION BY THE USE OF SOIL-TURFGRASS SYSTEMS IN THE SOUTH-WEST USA,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 3C.
W82-02817

MANAGING CRISIS: THE EFFECTIVENESS OF LOCAL DISTRICTS FOR CONTROL OF GROUND WATER MINING,
Colorado Univ., Denver. Graduate School of Public Affairs.
L. F. Keller, C. G. Heatwole, and J. W. Weber.
Water Resources Bulletin, Vol 17, No 4, p 647-654, August, 1981. 8 Fig, 3 Tab, 10 Ref. OWRT-B-046-KAN(3).

Descriptors: *Groundwater mining, Management, Decision making, Water supply development, Water management, *Groundwater management, Water supply, Available water, Design criteria, *Ogallala Aquifer, Legal aspects, Public opinion, Political aspects, Surveys.

The willingness and ability of local districts to control groundwater mining of the Ogallala Aquifer in the High Plains has been studied. A survey was conducted among district officials, irrigators, and citizens. While the assessment is preliminary in nature, it is possible to highlight critical issues concerning effectiveness of districts in dealing with the problem. Most of the states experiencing groundwater mining are using local groundwater districts or more broadly based Natural Resource Districts. Though the exact authority granted to districts varies, their importance as the policy focus for dealing with groundwater mining will probably continue to expand. Districts do appear to have potential effecuiveness. A local consensus has developed that ground water mining problems are serious, and that controls such as metering and well spacing are needed. District officials appear to have some expertise in the area and are dedicated to service to the local community. However, there does not appear to be a similar feeling of agreement regarding additional regulatory policies. Most of those surveyed appear willing to change

some behavior, but there does not seem to be much interest in going beyond the minimum change. It may be difficult to mobilize popular support for regulatory policies, as district officials oppose regulation more strongly than does the general population. In New Mexico, however, more extensively planned and regulated use of groundwater is taking place. In this area the management district becomes more of a service agency, maintaining meters and brokering marketable permits, rather than conducting research or making basic policy. (Baker-FRC)
W82-02819

METHOD OF CONSTRUCTING A SYSTEM FOR CONTROLLING REGIONAL EXPLOITABLE GROUNDWATER RESOURCES,
Moscow State Univ. (USSR).
V. S. Zil'berg, and M. S. Krass.
Water Resources (English Translation), Vol 7, No 6, p 536-545, November/December, 1980. 8 Ref. Translated from Vodnye Resursy, No 6, p 108-119, November-December, 1980.

Descriptors: *Groundwater management, *Control systems, *Linear programming, Computers, Computer models, Groundwater availability.

A control system for regional exploitable groundwater resources is an algorithm which should provide for determination of the capacity of any number of operating and planned intakes arbitrarily arranged within the investigated territory. It will deal with three things: initial information, prediction of the capacity of oriented intakes, and optimization of the number of intakes, their capacity, and location. Problems can be formulated and reduced to linear programming. They can be solved using computers. High speed computers can solve the problems quickly; this facilitates the optimization of the number of intakes, their capacity, and location within a large region. In the future, real time programming can be used in control systems. (Small-FRC)
W82-02849

EFFECT OF IRRIGATION ON GROUNDWATER RESOURCES WITH SPECIAL REFERENCE TO THE VAKHSH VALLEY,
All-Union Scientific-Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 2A.
W82-02851

SCIENTIFIC AND TECHNICAL ASPECTS OF THE RATIONAL USE AND CONSERVATION OF GROUNDWATERS IN THE UKRAINIAN SSR,
Ministerstvo Geologii, Moscow (USSR).
N. I. Beseda, and P. I. Yakovenko.
Water Resources (English Translation), Vol 7, No 6, p 528-536, November-December, 1980. 5 Tab, 7 Ref. Translated from Vodnye Resursy, No 6, p 97-107, November-December, 1980.

Descriptors: *Groundwater management, *Water conservation, *Groundwater potential, Water management, Groundwater depletion, Ukrainian SSR.

Management of groundwater resources in the Ukrainian SSR was investigated because about 23% of the resource has been used in each of recent years. The first step is the estimation of exploitable groundwater supplies, which requires a regional study and the quantitative evaluation of exchange between ground and surface waters. A survey of the Ukrainian SSR indicated that about 30% of all resources are confined to the Dnepr-Donets artesian basin, and about 24% are concentrated in the Volyn-Podolia basin. Current groundwater withdrawals amount to about 12.9 million cu m/day. Groundwater resources in 30% of the Ukraine are insufficient to meet future needs, but when the Ukraine is looked at as a whole, if use of surface water is reduced in the northern regions, there should be sufficient groundwater in the southern regions. Suggestions are presented for promoting rational use and conservation measures in the arrea. (Small-FRC)
W82-02852

AQUIFER THERMAL ENERGY STORAGE: A NUMERICAL SIMULATION OF AUBURN UNIVERSITY FIELD EXPERIMENTS,
California Univ., Berkeley. Lawrence Berkeley Lab.
C. F. Tsang, T. Buscheck, and C. Doughty.
Water Resources Research, Vol 17, No 3, p 647-658, June, 1981. 20 Fig, 5 Tab, 36 Ref.

Descriptors: *Aquifer management, *Energy storage, Geothermal studies, Computer models, Model studies, Groundwater management, *Thermal water, Wells, *Injection wells, Water storage, Auburn University, Confined aquifers.

A computer simulation of two 6-month cycles of injection-storage-production of hot water in confined aquifers, the Auburn University Thermal Energy Storage Project, agreed very well with field data. The first cycle involved the injection and recovery of about 55,000 cu m of water, heated to an average of 55.2 degrees C, in 79 days. The warm water was stored for 52 days, then pumped out until the recovered water temperature fell to 32.8 degrees C. By that time, 66% of the water had been recovered. The second cycle was similar, although somewhat more prolonged, and 76% of the energy injected was recoverd. Although there were discrepancies between calculated and experimental data in the detailed temperature distribution comparisons, some cancelled themselves during the injection-production process, so that final prdduction temperatures were very well simulated. (Cassar-FRC)
W82-02919

INJECTION, RECHARGE AND RETURN WELLS,
T. Gass.
Water Well Journal, Vol 35, No 10, p 36-37, October, 1981.

Descriptors: *Wells, *Groundwater management, Injection wells, Recharge wells, Return wells, Water pollution sources, *Groundwater recharge, Groundwater contamination, Aquifer management.

Definitions are proposed for three types of wells (injection, recharge, and return) in order to alleviate the confusion caused by interchangeable use of these terms. An injection well is a well into which water, gas, or liquid waste is injected under pressure or gravity flow to dispose of wastes and/or maintain formation pressures. These wells pose the highest risk to the environment. A recharge well is a well into which water is allowed to flow by gravity or injected under pressure for the purpose of aquifer management. The recharge water must be of sufficient quality so that the groundwater quality is not degraded. A return well is a well into which water that was previously withdrawn for heating or cooling purposes is returned to the same aquifer. Water quality of return water should be comparable to that of the water originally drawn. (Cassar-FRC)
W82-02920

4C. Effects On Water Of Man's Non-Water Activities

THE EFFECTS OF URBANIZATION ON SMALL WATERSHEDS AND GROUNDWATER,
Rochester Univ., NY. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5C.
W82-02738

THE INFLUENCE OF STREAM SALINITY ON RESERVOIR WATER QUALITY,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. Imberger.
Agricultural Water Management, Vol 4, No 1/3, p 255-273, 1981. 9 Fig, 1 Tab, 19 Ref.

Descriptors: *Salinity, *Reservoirs, Lakes, Water quality, *Australia, Land management, Water supply, Water pollution sources, Catchments, Solute transport, Model studies, Land use, *Saline water intrusion.

The salt content of the Wellington Reservoir is examined as it may relate to the increased salinity of drylands in Western Australia. During periods of rain, the perched aquifer builds up, causing leaching of the salt accumulated by direct water ponding during the end of the previous winter and that accumulated by the upward percolation. In areas of saturation of the perched aquifer, direct runoff will occur, leading to a very rapid response of the streams. The salt stored on the surface and in the perched aquifer will be flushed out once the water has travelled a distance characterized by the width of the contributing area. Deep-rooted vegetation may prevent the buildup of the upward flows into the contributing areas and may also drain much of the perched aquifer during the winter months. The dynamic reservoir simulation model, DYRSEM, is a one-dimensional numerical simulation model for the prediction of temperature and salinity in small to medium lakes. It is based on the assumption that in such lakes the thermal structure plays a dominant role, and the isotherms are mostly horizontal planes. These assumptions place some restrictions on the applicability of the model. The major evaluation of the model was made using the Wellington Reservoir. An examination of the salinity variations in the Collie River revealed a structure dependent on the peak and base flow salinity, the phase during storms and the flushing time of the whole system. This variation was used to modify an existing salinity record to simulate possible future trends. The exact nature of salinity variations is not the most significant prediction, but the mixing in the reservoir which acts as a strong filter is important. Without drastic action, the salinity in the Wellington reservoir will become excessive in the near future. A by-pass strategy is suggested. (Baker-FRC)
W82-02762

URBAN CATCHMENT MODELS: A BRIEF EXAMINATION,
George Washington Univ., Washington, DC.
F. O. Agyei, K. Mahmood, and M. I. Haque.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168584, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of the District of Columbia, Report No 28, May, 1981. 34 p, 3 Fig, 3 Tab, 43 Ref. OWRT-A-008-DC(1), 14-34-001-0109.

Descriptors: *Computer models, *Hydrologic models, Hydrology, Hydrographs, *Urban runoff, Drainage basins, Runoff, Routing, Streamflow routing, Flood routing, *Storm runoff, Urban watersheds.

Guidelines for the use of various commonly available urban catchment models are provided. The models described in this report include (1) Chicago Hydrologic Model, (2) Road Research Laboratory Model, (3) University of Cincinnati Urban Runoff Model, and (4) University of Florida's Storm Water Management Model. Only the salient features of these models are described and no attempt is made to provide a comprehensive comparison between these models. Nevertheless, capabilities and limitations of each model are described to aid the potential user in making the proper choice.
W82-02813

4D. Watershed Protection

MODELING RILL DENSITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W82-02604

ROLE OF ORGANIC DEBRIS DAMS IN REGULATING THE EXPORT OF DISSOLVED AND PARTICULATE MATTER FROM A FORESTED WATERSHED,

Cornell Univ., Ithaca, NY. Div. of Biological Sciences.
R. E. Bilby.
Ecology, Vol 62, No 5, p 1234-1243, October, 1981. 5 Fig, 5 Tab, 31 Ref.

Descriptors: *Streamflow, *Detritus, *Dams, Particulate matter, Runoff, Erosion, *Forest watersheds.

This experiment was designed to quantify the effect of organic debris dams on the export of materials from a small forested watershed ecosystem. All debris dams were removed from a 175-m section of a second-order stream, just above a gauging weir. The material being exported from the watershed was collected for one year before dam removal and for one year following removal. Export of dissolved material increased slightly following dam removal, while fine particulate matter export increased dramatically at high discharges. Coarse particulate matter export was also increased. Dam removal brought about a 6% increase in the export of dissolved matter and a 500% increase in the export of fine and coarse particulate matter. (Small-FRC)
W82-02653

THE EVOLUTION OF A REGIONAL APPROACH TO SALINITY MANAGEMENT IN WESTERN AUSTRALIA,

Perth Public Works Dept. (Australia).
B. S. Sadler, and P. J. Williams.
Agricultural Water Management, Vol 4, No 1/3, p 353-381, 1981. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Salinity, *Water resources development, Water management, *Australia, Land use, Groundwater management, River basins, Catchment areas, Revegetation, Reforestation, Vegetation establishment, *Water pollution control, Saline water intrusion, Saline diversions.

Efforts to contain and minimize the risk of increasing areas of dryland salinity in Western Australia are needed. To define the regional variations of the problem, south-west Australia has been divided into four zones: the coastal zone between the coast and the Darling Scarp, the high rainfall zone from the scarpeastwards to the 1100 mm rainfall isohyet, the intermediate zone with about 1100 to 900 mm of rainfall, and the low rainfall zone inland from the 900 mm isohyet. In this fourth zone salt storage is high and clearing almost invariably causes salt release. The third zone has highly variable potentials for salt release. Management strategies to control the release of salts include the prevention or limitation of clearing of the land and the restoration or amelioration of areas already cleared. Adaptation of land and water use is viewed as one means of adapting to the release of salts. Another method of adaptation may be abandonment of seeps through substitution of developed sources for alternatives. Salt disposal, reservoir management, seasonal withdrawals, saline diversions and desalination are possible means of adjusting to the release of salts by salt disposal. Dilution of salts can be obtained by blending fresh and brackish water, or by increasing runoff in salt free areas. Salt tolerant vegetation can be planted in efforts to cope with the situation. While partial reforestation, deep-rooted vegetation and deep drainage have all been proposed as possible control measures, none has yet been developed to provide economical control of salt seeps. (Baker-FRC)
W82-02763

MAPPING SEDIMENT SOURCES IN A NEW ZEALAND MOUNTAIN WATERSHED,

Forest Research Inst., Christchurch (New Zealand).
For primary bibliographic entry see Field 2J.
W82-02885

EROSION CONTROL ALONG TRANSPORTATION ROUTES IN NORTHERN CLIMATES,

Komex Consultants, Ltd., Calgary (Alberta).
For primary bibliographic entry see Field 2J.
W82-02933

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

RAINWATER ACIDITY MEASUREMENT PROBLEMS,

William and Mary Coll., Williamsburg, VA. Dept. of Chemistry.
S. Y. Tyree, Jr.
Atmospheric Environment, Vol 5, No 1, p 57-60, January, 1981. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Acid rain, *Measuring instruments, Chemical analysis, Water analysis, Rainfall, Acidity, Air pollution, Water pollution sources, Titration.

Three methods which are currently used to determine the acidity of rainwater have been studied. The first method relies on pH measurement, the second on titration, and the third assumes that any charge discrepancy in favor of anions is due to hydronium ion concentration. In this third method only strong acid is measured, and the method is used only for those solutions at or below a pH value of 5.6. The method requires the determination of concentrations of all principal ions in the rainwater sample, usually considered to be chloride, nitrate, sulfate, ammonium, sodium, potassium, calcium, and magnesium. The accuracy and reproducibility of such a method are no better than the properly combined accuracy and reproducibility of each of the principal solute ion values. The first method, the pH measurement, measures the concentration of strong acids plus some of the weak acids in rainwater. However, the accuracy and reproducibility are not sufficient. Similarly, the accuracy and reproducibility of the titration method are also unacceptable. The results of two collaborative intercomparison laboratory studies on simulated rainwater show that adequate analytical reproducibility is not being attained at present. (Baker-FRC)
W82-02627

ON THE VAN BELLE-FISHER STATISTIC FOR WATER POLLUTION MONITORING VIA ECOLOGICAL CHANGE,

Washington Univ., Seattle.
E. P. Smith, and L. L. Conquest.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1648-1650, November, 1981. 2 Fig, 3 Tab, 2 Ref.

Descriptors: *Statistical analysis, *Water pollution effects, Population dynamics, Monitoring, Ecological effects, Mathematical studies, Water pollution.

The van Belle-Fisher statistic indicates only changes in the rank of species count and not the direction of change. When used for water pollution monitoring via ecological change a modified test statistic indicating increases in abundance of pollution tolerant species and decreases in pollution-sensitive ones would be useful. The interpretation of the results of van Belle and Fisher's application of the test statistic to Green Bay is questioned, and mistakes in computations are detailed. (Small-FRC)
W82-02671

TO INHIBIT OR NOT TO INHIBIT: THAT IS THE QUESTION,

E. F. Barth.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1651-1652, November, 1981.

Descriptors: *Biochemical oxygen demand, *Water analysis, *Nitrification, Ammonium nitrogen, Water quality, Water quality standards, Evaluation.

The Federal discharge standard for BOD5 content may not be achieved if ammonium nitrogen in the sample is biologically oxidized to nitrite or nitrate nitrogen. Techniques to inhibit this reaction and allow the BOD5 test to respond only to carbonaceous material are available, and the extent of this nitrification reaction is erratic and nonpredictable under conditions of the standard test. Regulatory agencies should endorse the inhibited BOD5 test to more accurately reflect carbonaceous removal efficiency in regard to municipal compliance with secondary treatment standards. The inhibited BOD5 test can be supplemented with a separate determination of total Kjeldahl nitrogen. (Small-FRC)
W82-02672

CONCENTRATION OF VIRUS FROM TAP WATER AT AMBIENT SALT AND PH LEVELS USING POSITIVELY CHARGED FILTER MEDIA,

University Coll., London (England). Dept. of Civil Engineering.
H. Garelick, and J. E. Scutt.
Water Research, Vol 15, No 7, p 815-816, July, 1981. 2 Tab, 18 Ref.

Descriptors: *Viruses, *Filter media, *Asbestos, *Pollutant identification, Water analysis, Water purification, Adsorption.

Positively charged asbestos filters (Carlson-Ford type 4) were investigated for the detection of coliphage f2 and poliovirus 1 from tap water at low concentrations. The adsorption was performed at ambient pH 7.8, without addition of multivalent cations. Water samples inoculated with stock virus were pressure filtered. Adsorbed viruses were eluted by passing through the filter three sucessive 25 ml volumes of concentrated nutrient broth. Eluates were neutralized with glycine and assayed individually for virus. Average recoveries of coliphage f2 from 50 ml and 20 liter volumes were 64 and 65% respectively; the average recovery of poliovirus 1 in 20 liter volume was 68%. The large variability of coliphage results may have been due to virus aggregation or disaggregation in the course of the experiments. Other nominally positive media including alumina fibers and glass fibers coated with cationic polymers were also investigated for phase recovering ability, but were much less efficient than asbestos. (Cassar-FRC)
W82-02712

APPLICATION OF HYDRIDE GENERATION TO THE DETERMINATION OF TRACE CONCENTRATIONS OF ARSENIC BY INDUCTIVELY-COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY,

Osaka Prefecture Univ. (Japan). Dept. of Applied Chemistry.
T. Nakahara.
Analytica Chimica Acta, Vol 131, p 73-82, 1981. 3 Fig, 5 Tab, 34 Ref.

Descriptors: *Arsenic, *Detection limits, *Water analysis, Wastewater treatment, Water pollution control, Emission spectroscopy.

A proposed method for the determination of traces of arsenic was applied to the determination of ng/ml levels of arsenic in wastewaters. The detection method is based on sodium tetrahydroborate reduction of arsenic, followed by introduction of the arsine formed to a relatively low-powered inductively-coupled plasma. The method was applied to water samples collected at the inlet of the Wastewater Treatment Facility, University of Osaka Prefecture. Results indicated good agreement between the proposed method and hydride-generation-non-dispersive atomic fluorescence spectrometry. Thus, the sensitivity of the method is adequate for the determination of arsenic in wastewater. The method has a detection limit of 0.1 ng As/ml and the linear calibration range spans almost four orders of magnitude. (Small-FRC)
W82-02718

VOLATILE ORGANIC ACIDS IN LAKE WATER; THEIR GAS CHROMATOGRAPHIC DETERMINATION AND ECOLOGICAL SIGNIFICANCE,

Nagoya Univ. (Japan). Water Research Inst.
T. Hama, and N. Handa.

Japanese Journal of Limnology, Vol 42, No 1, p 8-19, January, 1981. 9 Fig, 2 Tab, 27 Ref.

Descriptors: *Lakes, *Volatile acids, Organic compounds, Water analysis, Chemical analysis, Chromatography, Organic acids, *Pollutant identification.

A study was conducted in an attempt to establish analytical procedures for volatile organic acids by gas chromatography after conversion of the acids to corresponding benzyl esters on the basis of the method developed by Bethge and Lindstrom, to apply this procedure to the analysis of volatile organic acids dissolved in lake water, and to understand the significance of volatile organic acids in terms of the dynamics of organic matter in lake water. Using this method only 50-250 ml of lake water was needed for determination of the volatile organic acids. The identification of benzyl esters was conducted by combined gas chromatography-mass spectrometry. Acetic, propionic, n-butyric and lactic acids were found in the water samples from Lake Kizaki. However, formic acid was identified only by the retention time in gas chromatography. Formic, acetic and propionic acids measured were in the range of 0-30 microg C/1, 30-120 microgC/1 and 0-90 microgC/1, respectively, in the various depths of Lake Kizaki. To determine the molecular weight distribution of dissolved organic matter in the water samples from Lake Kizaki, gel-filtration using Sephadex G-25 was applied. Volatile organic acids consisting of formic, acetic and propionic acids accounted for 59% of the dissolved organic carbon in the fraction of organic matter with a molecular weight of less than 200. The volatile organic acids were suggested to be the most ecologically significant materials in the matter cycle in the waters of the lake. (Baker-FRC)
W82-02720

PARTICULATE AND DISSOLVED LIPIDS IN SEA WATER,

Texas A and M University, College Station. Department of Oceanography.
M. C. Kennicutt, II.
PhD Dissertation, 1980. 239 p, 69 Fig, 44 Tab, 190 Ref, 7 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-23041.

Descriptors: *Seawater, Water properties, Organic compounds, Variability, *Lipids, *Water chemistry, Gulf of Mexico, Scotia Sea, Cariaco Trench.

Dissolved and particulate lipid extracts were collected at a number of locations in the Gulf of Mexico, the Scotia sea, and in and near the Cariaco trench. All concentrations of lipids measured were extremely low and apparently of biogenic origin. Seasonal, diurnal, vertical, and areal variations were observed in lipid content. The dissolved lipids were less variable than the particulate lipids. The lipid content of particulate organic carbon decreased with depth. Lipid concentrations reflected variations in routine oceanographic parameters such as salinity and temperature and the aperiodicity of sources. Anoxic conditions appeared to preserve lipid materials in the particulate phase. N-alkanes may have two sources (marine and terrestrial) superimposed on a low fairly constant background of hydrocarbons caused by lowlevel chronic oil pollution in the Gulf of Mexico. Fatty acid alkyl esters may be the product of the degradation of humic substances and glycerides; as such their distribution may indicate rates of degradation and the stability of the organic matter present in aquatic environments. Indanes, phenols, benzoates, and other compounds detected in this study may prove to be useful indicators of source. Lipids of temperate climates (Gulf of Mexico) and polar climates (Scotia Sea) had similar gravimetric concentrations and similar dominant compounds. The fractionated lipids had different distributions for the two locations. (Sinha-OEIS)
W82-02727

ECOLOGICAL MAGNIFICATION OF PERSISTENT ORGANOCHLORINE PESTICIDES IN AN ILLINOIS WATERSHED,

Illinois Univ. at Urbana-Champaign.
J. C. Marlin.
PhD Thesis, 1980. 114 p, 2 Fig, 49 Tab, 60 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-26556.

Descriptors: *Water pollution, *Watersheds, *Pollutant identification, Insecticides, *Pesticides, Aquatic life, Ecology, Agriculture, Data collections, Fungicides, *Lake Decatur watershed, Illinois.

Data is provided on the accumulation of selected organochlorine insecticides in aquatic organisms in the heavily agricultural Lake Decatur watershed. Emphasis was placed on the collection of a wide vaariety of organisms in order to add to the data base on bioaccumulation within an ecosystem. DDT and DDE were chosen because they are known to be ubiquitous in the environment. Aldrin and heptachlor and their products, dieldrin and heptachlor epoxide, were selected because they have been widely used in the watershed to control soil insects, particularly corn rootworms. The fungicide HCB (hexachlorobenzene) was included since it was present in unexpectedly high concentrations in the first samples analyzed. The data show that aquatic organisms in the Lake Decatur watershed contain an abundance of organochlorine insecticide residues. Relatively high residues of aldrin and heptachlor were expected since their use was prevalent during the time data were collected. The ubiquitous presence of HCB was not anticipated. It provides another warning that the ultimate fate of chemicals in the environment should be studied prior to their use. The failure of insecticides to provide a permanent solution to insect pest problems as well as their threats to the environment and public health have prompted renewed interest in alternate control methods. Integrated pest management (IPM) combines cultural and biological control techniques with insect scouting, the judicious use of pesticides, and the acceptance of a limited amount of crop damage. (Sinha-OEIS)
W82-02741

STUDIES OF BIOLOGICAL NITROGEN CYCLE PROCESSES IN THE UPPER WATERS OF THE OCEAN, WITH SPECIAL REFERENCE TO THE PRIMARY NITRITE MAXIMUM,

Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2A.
W82-02742

THE DISTRIBUTION AND SEASONAL FLUCTUATIONS OF HETEROTROPHIC BACTERIA AND COLIFORM BACTERIA IN THE RIVERS AND ESTUARIES IN OSAKA CITY, JAPAN (IN JAPANESE),

Osaka City Inst. of Public Health and Environmental Sciences (Japan).
T. Yoshikura, K. Oda, and S. Iida.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 46, No 2, p 231-236, February, 1980. 6 Fig, 7 Ref. (English summary).

Descriptors: *Coliforms, *Bacteria, *Water pollution effects, Rivers, Estuaries, Seasonal distribution, Temperature effects, *Japan, Microbial analysis, Fate of pollutants.

Water samples were collected at several stations in the rivers and estuaries in Osaka City and analyzed for microbial and chemical content. The waters were sampled monthly from April 1974 through March 1977. Heterotrophic bacteria were determined by the standard plate count at 37 deg C. Fluctuations in heterotrophic bacteria and coliform bacteria depended upon the concentrations of organic pollutants and on water temperature. Both bacteria concentrations reached a maximum at the most polluted station. When river water was diluted in the estuaries, coliform levels were higher than other bacterial levels. The maximum number of heterotrophic bacteria occurred during the summer. (Small-FRC)
W82-02774

NUTRIENT LOADING - TROPHIC STATE RELATIONSHIPS IN FLORIDA LAKES,

Florida Univ., Gainesville. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W82-02811

DETECTION OF OIL POLLUTANTS ON THE SURFACE OF INLAND WATERS BY A PROJECTOR-BASED OPTICAL DETECTOR,

Leningrad Electrical Engineering Inst. (USSR).
M. A. Kropotkin, T. Yu. Sheveleva, and V. A. Ivanov.
Water Resources (English Translation), Vol 7, No 6, p 582-585, November/December, 1980. 2 Fig, 2 Ref. Translated from Vodnye Resursy, No 6, p 167-171, November-December, 1980.

Descriptors: *Measuring instruments, *Oil pollution, *Optical properties, Oil spills, Oily water, Water pollution, Water properties, Weather.

An optical detector based on a light projector was evaluated on the Volga for the detection of oil spills. The detector was installed on a projecting boom mounted on the bow of the research ship so that the axis of the light beam was oriented to the water's surface. Direct and reflected solar radiation, changes in ambient air temperature, cloud cover, and light fog had no effects on the operation of the instrument. The detector operated successfully at ship speeds up to 15 knots and on fairly rough seas (wave height = 20-50 cm, wind speed to 10 m/sec). The minimum oil slick detectable was about 1.0 sq m. The optimal angle of incidence was 3-5 deg for the detection of oil pollution. The detector was used to determine the degree of oil pollution in the Volga and on Lake Baikal. (Small-FRC)
W82-02853

THE APPLICATION OF A WATER-QUALITY MODEL TO THE RIVER WYE, WALES,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
A. C. Oborne.
Journal of Hydrology, Vol 52, No 1/2, p 59-70, June, 1981. 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Model studies, *Water quality, Rivers, Aquifers, Runoff, Flow, Chlorides, Phosphates, Hardness, Recharge, Chemical properties, Water pollution sources, *Wye River, *Wales.

The application of a simplified version of a flow separation model to modeling concentration changes of four water-quality determininands in the lower reaches of the River Wye was investigated. Mean daily river flows and levels of chloride, orthophosphate, total hardness and alkalinity for 1970-1977 were used to develop the model. Total river flow was assumed to consist of at least one baseflow component, a runoff component, and effluent return flows. The total mass flow of a given water quality determinand was assumed to represent the sum of the mass flows from all of these components, with correlation for the effect of storage in the river channel. A computer program with an iterative algorithm was used to obtain optimal values for the set of parameters. Performance of the model was assessed by comparing generated concentrations with observations from a data set other than that used for calibration. At least 79% of the test data variance was explained by the model for orthophosphate, alkalinity and total hardness, but only 59% for chloride. Prediction was significantly improved over that of the simple regression equation. The major source of error in the water quality model is the separation of flow into baseflow and runoff. The use of more than one baseflow component may have better represented this system. Further improvements in the quality model may also be achieved by using a longer flow record for calibration and a more complex approach to aquifer-recharge response than the present fixed recharge period approach. (Baker-FRC)
W82-02876

DIFFERENTIAL PULSE POLAROGRAPHIC DETERMINATION OF INORGANIC AND ORGANIC ARSENIC IN NATURAL WATERS,

Consiglio Nazional dele Ricerche, Bologna (Italy).
P. L. Buldini, D. Ferri, and Q. Zini.
Mikrochimica Acta, Vol 1, No 1-2, p 71-78, 1980. 1 Fig, 1 Tab.

Descriptors: *Pollutant identification, *Arsenic compounds, *Polarographic analysis, *Arsenic, Water analysis, Natural streams, Natural waters, Heavy metals, Oxidation, Anion exchange, Electrolysis.

A method for the determination of inorganic arsenic (III), arsenic (V), and organic arsenic at the microgram/liter level in natural waters by differential pulse polarography is described. For the determination of As(III), 4.2 ml of sample are transferred into a 5-ml standard flask and diluted to the mark with concentrated hydrochloric acid. After the solution is transferred to a polarographic cell and deaerated for 2 minutes, the peak heights are recorded and compared with a standard curve. For the determination of total inorganic arsenic, 100 ml of sample are placed in a 150-ml test tube to which 10 milligrams of potassium permanganate are added. The mixture is heated in the aluminum block until the volume is reduced to 2 ml. After anhydrous sodium sulfite and concentrated hydrochloric acid are added, the solution is heated for 1 hour at 90 degrees, cooled, then diluted to 5 ml in a standard flask. Polarographic analysis procedures are the same as those used for As(III). For determinations of total arsenic, 4 grams of magnesium nitrate hexahydrate and 20-50 milligrams of potassium permanganate are added to 100 ml of sample in a 150 ml test tube. The sample is subjected to nitrate removal steps. After the addition of anhydrous sodium sulfite and concentrated hydrochloric acid to the dry residue, polarographic procedures are the same as for total inorganic arsenic. Techniques to overcome Cu(II) and Pb(II) interferences are described. The overall efficiency of the method is 70-80%. (Geiger-FRC)
W82-02903

POLYCHLORINATED BIPHENYLS IN SEWAGE SLUDGE AND SEDIMENTS OF THE NEW YORK BIGHT,

National Oceanic and Atmospheric Administration, Miami, FL. Atlantic Oceanographic and Meteorological Labs.
R. H. West, and P. G. Hatcher.
Marine Pollution Bulletin, Vol 11, No 5, p 126-129, May, 1980. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Polychlorinated biphenyls, *Sludge, *Marine sediments, Bottom sediments, Sediments, *New York Bight, Pollutants, *Ocean dumping, Waste disposal, Spoil banks, Municipal wastewater, Bights.

The horizontal and vertical distribution of PCBs in sediments in the New York Bight were measured, and particulate and dissolved PCB concentrations were monitored over several hours following the dumping of sewage sludge in the Bight. Analyses of four sewage sludge samples demonstrated the presence of high concentrations of PCBs, in spite of the current limited use of these substances. Sampling of the surface plume shortly after ocean dumping of sewage sludge revealed dramatic increases in dissolved and particulate PCB levels. After the initial increase, an overall decrease in dissolved PCBs and increase in particulate PCBs was observed as a function of time. Large quantities of PCBs are rapidly removed from the water column by scavenging particulate matter and transported to surficial sediments over a relatively limited area, usually less than 1 to 2 kilometers in breadth. A significant concentration of PCBs is retained in the water column and remains in suspension in the mixed layer for longer periods of time. Concentration of the sedimentary PCBs in the Christiaensen Basin, where sewage sludge is known to accumulate, suggests that this sludge is the primary source of PCBs in the Bight. High PCB levels appear to be restricted to a very small area typified by mud accumulation, and widespread transport of PCBs out of the Bight is not evident. Analysis of the vertical concentrations of PCBs in a box core taken from the most heavily contaminated areas shows that the surface PCB concentration is significantly higher than concentrations detected further down in the core. The analyses indicate that high PCB levels have existed ever since widespread use of the compounds began in 1955, and that the levels of PCBs are correlated with dramatic increases in the volume of sludge dumped in the Bight since 1952. (Carroll-FRC)
W82-02904

MORPHOLOGICAL CHANGES IN TOXIC AND NON-TOXIC MICROCYSTIS ISOLATES AT DIFFERENT IRRADIANCE LEVELS,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-02906

URANIUM ISOTOPES AND 226RA CONTENT IN THE DEEP GROUNDWATERS OF THE TRI-STATE REGION, U.S.A.,

Florida State Univ., Tallahassee. Dept. of Geology.
J. B. Cowart.
Journal of Hydrology, Vol 54, No 1-3, p 185-193, December, 1981. 3 Fig, 3 Tab, 10 Ref.

Descriptors: *Isotope studies, *Radium, *Drinking water, *Groundwater, Deep wells, Public health, Brines, Missouri, Oklahoma, Kansas.

Uranium isotopes 238U and 234U, precursors of 226Ra, were studied in an investigation of the unacceptably high radium concentration (greater than 5 pCi/liter) in public water supply wells in the Missouri, Kansas, and Oklahoma area. The high-C1 brine in the area may be the source of the radium. There are no appropriate samples presently available from the area, although high radioactivity has been reported from oil-field wells further west in Kansas and Oklahoma. At least part of the dissolved uranium in the westward flowing water is precipitated in the zone of mixing. The waters mix, then flow southwestward. Thus, the radium is not due to present day accumulation. (Small-FRC)
W82-02939

DEVELOPMENT OF A MULTIDETECTOR PETROLEUM OIL-IN-WATER MONITOR,

Rockwell International, Newburg Park, California.
R. W. Melvold.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105206, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-206, October, 1981. 3 Fig, 1 Tab.

Descriptors: *Monitoring, *Petroleum products, *Oil, Water pollution, Fluorescence, *Oil pollution, Brackish water, Seawater, Pollutant identification.

No satisfactory commercially available instrument or concept presently exists for continuously measuring all types of oil in various physical states (free, suspended, dissolved, or emulsified) in water containing various types and concentrations of matrix materials. The complex chemical composition of petroleum-derived oils and the similarities of oil components to nonpetroleum water contaminants dictate the use of a multidetector monitoring system for the improved measurement of petroleum oil in water containing nonpetroleum contaminants. To determine the feasibility of developing a multidetector monitoring system, a survey was conducted of commercially available oil monitors. Three monitors were recommended for inclusion in the multidetector system: the Sigrist Fluorescence Monitor Model FLJ (UV fluorescence) the CE Invalco D.O. W. Monitor (UV absorbance), and the Horiba OCMA-32A Oil Content Monitor (infrared absorbance). A comprehensive evaluation of the selected oil meters was critically conducted under laboratory conditions to identify their ability to detect and quantify petroleum oil in fresh, brackish, or sea water. The multidetector concept has been demonstrated as a viable technique for the measurement of petroleum oil in water containing nonpetroleum contaminants. A preprototype multidetector system has been assembled and tested; it is a definite improvement over any single commercially available detector. (Moore-SRC)
W82-02964

DETERMINATION OF PHTHALATES IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,

Southwest Research Inst., San Antonio, TX.
J. W. Rhoades, R. E. Thomas, D. E. Johnson, and J. B. Tillery.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-232167, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-063, October, 1981. 5 p, 3 Tab.

Descriptors: *Pollutant identification, *Municipal wastewater, *Industrial wastewater, *Phthalates, *Gas chromatography, Electron capture gas chromatography, Sample preservation, Water sampling.

As part of a series of investigations of the analytical behavior of selected priority pollutants and suitable test procedures for their measurement, the following compounds were studied: dimethyl phthalate (DMP); diethyl phthalate (DEP); dibutyl phthalate (DBP); benzyl butyl phthalate (BBP); diethylexyl phthalate (DEHP); and dioctyl phthalate (DOP). All six phthalates have been chromatographed on two columns. Column 1 is packed with 1.5% SP-2250 plus 1.95% SP 2401 on 100/120 mesh Supelcoport. Column 2 has 3% OV-1 as its liquid phase but is otherwise the same as Column 1. Investigations with both columns gave comparable results. The electron capture detector is preferred over the flame ionization detector on the bases of the greater sensitivity and selectivity. Based on extraction studies using clean water, 15% dichloromethane in hexane should be used as the solvent for extracting wastewaters. Acceptable recovery was obtained for phthalate esters when the background of electron capture sensitive materials was low. When interferences were present, clean-up procedures did not allow the phthalates to be quantitated in microgram/l concentrations. The recoveries that can be expected for the compounds studied ranged from 40 to 100%, depending upon the compound and the wastewater studied. Storage frequently resulted in significant losses of the study materials and in less precise determinations. (Moore-SRC)
W82-02999

5B. Sources Of Pollution

MANAGEMENT OF GROUND WATER CONTAMINATED BY AROMATIC HYDROCARBONS IN THE AQUIFER SUPPLYING AMES, IOWA,

Southern Illinois Univ. at Carbondale. Coal Extraction and Utilization Research Center.
H. Yazicigil, and L. V. A. Sendlein.
Ground Water, Vol 19, No 6, p 648-665, November/December, 1981. 12 Fig, 3 Tab, 34 Ref.

Descriptors: *Aromatic compounds, *Coal gasification, *Water pollution treatment, Path of pollutants, Water pollution sources, Hydrocarbons, Organic compounds, Ames, Iowa, Model studies, Water pollution control, Waste disposal, Chemical wastes, Industrial wastes, Waste dumps, *Groundwater pollution.

A digital model and field monitoring data were used to evaluate alternatives for handling a coal tar residues dump and the resulting pollution of the unconsolidated buried channel aquifer supplying Ames, Iowa. Wastes from a coal gasification plant were deposited in a pit from 1910 to the late 1920's. Several city wells were abandoned and some are presently threatened because of tastes and odors from the chemicals. A variety of hydrocarbons and other organic compounds, mostly aromatic, have been identified in contaminated well water: benzenes, indenes, naphthalenes, styrenes, indoles, and many others. Management practices considered were: (1) removal of the residue with maintenance of the present pumping practices, (2) construction

of a pump trough barrier and a protective pump well, (3) regulation of drawdown and recovery periods in municipal wells, (4) regulation of pumping in city wells, (5) expansion of the well field to the northeast, and (6) a new well field to the southeast. None of the alternatives, used alone, offered a practical solution to the problem. It was recommended that two localized coal tar residue sources be excavated and a pumping trough barrier with protective pumping well be constructed. If no remedial measures are taken, the well field must be expanded to the west or the water system connected with the Iowa State University well system. (Cassar-FRC)
W82-02611

AQUIFER DECONTAMINATION FOR VOLATILE ORGANICS: A CASE HISTORY,

New Jersey Bureau of Ground Water Management.
For primary bibliographic entry see Field 5F.
W82-02613

IMPACT OF DREDGED MATERIAL DISPOSAL UPON GROUND-WATER QUALITY,

Calscience Research, Inc., Huntington Beach, CA.
R. D. Morrison, and K. Y. Yu.
Ground Water, Vol 19, No 3, p 265-270, May/June, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Water quality, *Dredging, *Land disposal, Fate of pollutants, Water pollution sources, *Leachates, Solute transport, Sodium, Chlorides, Potassium, Sediments, Dilution, Chelation, Chemical precipitation, Sulfides, Manganese, Iron, Alkalinity, Water hardness, *Groundwater pollution, Adsorption, Weathering, Chemical reactions, Trace metals.

Groundwater was monitored over a 2-yr period at three dredge disposal sites: Grandhaven, Michigan (freshwater); Mobile, Alabama; and Sayreville, New Jersey (both estuarine). Leachate samples collected from monitoring wells and vacuum/pressure lysimeters were analyzed for 27 water quality parameters. Na, Cl, and K concentrations were high (maximum 4310, 8330, and 250 mg per liter, respectively) in groundwater sites where saline dredge material was deposited. Dilution is the major mechanism regulating transport of these ions. Mg and Ca maxima were 720 and 380 mg per liter, respectively, representing significant increases in water hardness over background levels. Mechanisms for transport of Mg and Ca are dilution, precipitation/dissolution, and ion exchange. Alkalinity ranged from undetectable to 1000 mg per liter and was controlled by dissolution of carbonates, weathering, and oxidation-reduction reactions. Total organic carbon was highly correlated with alkalinity. Maximum iron and manganese levels were 538 and 12 mg per liter, respectively, above the recommended EPA drinking water quality standards. Sulfides were generally below 20 mg/kg. Phosphate, Cd, Cu, Pb, Ni, Hg, and Zn occurred in concentrations too small to have significant effects on groundwater quality. Major controlling factors for these ions are complexation, adsorption, and precipitation/dissolution. (Cassar-FRC)
W82-02615

THE PREDICTION OF RAIN ACIDITY AND SO2 SCAVENGING IN EASTERN NORTH AMERICA,

Atmospheric Environment Service, Downsview (Ontario).
L. A. Barrie.
Atmospheric Environment, Vol 15, No 1, p 31-41, 1981. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Acid rain, North America, Rainfall, Model studies, Prediction, *Hydrogen ion concentration, *Sulfur compounds, Air pollution, Water pollution sources, Forecasting, Acidity, Projections, Sulfates, Aerosols, Path of pollutants.

The role of sulfur dioxide as a rainwater acidifying agent is examined. A quantitative relationship between the sulfur (IV) content of rain, rainwater pH and temperature is derived which can be used in long-range transport models to simulate the sulfate scavenging process mathematically. Methods of calculating precipitation acidity and thus sulfur dioxide washout are demonstrated for various rainwater chemistry data sets. Based on the equilibrium solution chemistry of sulfur dioxide, it is concluded that, for the purposes of long-range transport models, sulfur dioxide scavenging by rain can be calculated using a washout ratio approach, provided that the temperature and acidity of rain are taken into account. It is also concluded that dissolved sulfur dioxide can contribute a significant fraction of the total hydrogen ions deposited in rainfall, particularly at near zero degrees C, in air containing aerosols of low acidity such as ammonia neutralized sulfuric acid particles. If long term trends in the acidity of rain are to be explained, dissolved sulfur dioxide should be measured in precipitation. The sulfur dioxide scavenging process must also be realistically simulated in models. To accomplish this one must be able to predict precipitation acidity. The strong relation between the hydrogen ion and sulfate ion contents of rain in acid sensitive areas of eastern North America enables one to predict precipitation acidity from models of the sulfur cycle. Nitrogen oxides are also important, but their cycles are not so well known. More study is also needed in order to parameterize sulfate aerosol washout. (Baker-FRC)
W82-02628

FARM, URBAN DRAINAGE POLLUTING GREAT LAKES.

Water and Pollution Control, Vol 118, No 7, p 26, July, 1980.

Descriptors: *Lakes, *Nonpoint pollution sources, *Great Lakes, Farming, Urban runoff, Lead, Mercury, Phosphorus, Eutrophication, Algal growth, Drainage effects, Environmental effects, Urban drainage, Agricultural runoff, Industrial wastes.

A comprehensive study was conducted over 11 years of pollution problems in the Great Lakes area. A new approach was seen as needed for controlling land drainage non-point pollution. The approach recommended calls for closer coordination between and within the Governments of the two joining countries, Canada and the United States. Such cooperation is necessary to overcome gaps and inconsistencies in the several government programs that affect the actions of individual firms, urban dwellers, cottagers and farmers, all of whom contribute to this type of pollution. Considerable attention must be given to the local level implementation of the programs. Specific instances where regulation is needed include the disposal of hazardous industrial wastes, sediment control in urban areas, and the spreading of manure on frozen agricultural land during the winter. At present agricultural practices are responsible for the majority of phosphorus which finds its way into water bodies and causes excessive algal growth. Toxic and hazardous chemicals are also of great concern, and while some have been declining in their presence in water and fish, other problems are emerging. Lead, largely from vehicle exhausts carried through the air, is now found throughout the Great Lakes sediments and could present a problem similar to that of mercury contamination. Hazardous waste disposal must be more closely controlled. Conservation of resources and recycling of many products are urged. (Baker-FRC)
W82-02647

KINETICS OF MONOCHLORAMINE DECOMPOSITION IN THE PRESENCE OF BROMIDE,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
T. W. Trofe, G. W. Inman, Jr., and J. D. Johnson.
Environmental Science and Technology, Vol 14, No 5, p 544-549, May, 1980. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Chlorine, *Monochloramine, *Cooling water, Electric powerplants, Chemical reactions, Toxicity, *Bromides, Seawater, Estuarine environment, Kinetics, Organic compounds, Biocides, Water treatment, Fate of pollutants, *Cape Fear River estuary, North Carolina.

Monochloramine, a reaction product of chlorine and natural waters (especially estuarine and marine) found in cooling waters discharged from electric powerplants, is persistent and toxic to aquatic life. Decomposition in the presence of bromide, which occurs naturally in seawater, produced a previously unidentified product, NHBrCl. In artificial seawater, the reaction between monochloramine and bromide ion was first order with respect to monochloramine, bromide ion, and hydrogen ion concentration over the pH range 6.8-8.2. The overall empirical rate constant at 25C was evaluated as 2.8 times 10 to the 6th power M squared/sec. Bromide oxidation is the primary pathway for monochloramine removal in highly saline waters. This conclusion was confirmed by spiking a sample of unfiltered water from the Cape Fear River estuary with monochloramine and measuring the concentration by UV absorbance. The water salinity was 33.6 parts per thousand. The observed half-life of monochloramine, 3-4 hr, was in good agreement with the predicted half-life of 5 hr. Bromochloramine (NHBrCl) is expected to be less stable in aqueous solution than monochloramine. However, research is needed on NHBrCl toxicity to marine organisms. (Cassar-FRC)
W82-02651

SEEPAGE FROM FREE WATER ABOVE IMPERMEABLE TAILINGS,

Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.
L. T. Isaacs, and B. Hunt.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT11, p 1563-1577, November, 1981. 8 Fig, 14 Ref.

Descriptors: *Seepage, *Mine wastes, *Mathematical models, Spoil banks, Dams, Stability analysis, Water pollution sources, Mathematical studies.

A model is proposed for the entry region of the discharge from free water above impermeable tailings, and an analytical solution is presented. Seepage analysis was performed to estimate the amount of water leaving a tailing structure as seepage, to determine pore pressures for stability analysis, to estimate the exit point, and to estimate the seepage velocities. Experimental results indicated that the theory will yield reasonably accurate estimates of the discharge when field conditions are close to those assumed in the model. Results were compared to those of Thomson and Rodin and with the half triangular ditch solution. (Small-FRC)
W82-02714

FORMS OF HEAVY METALS IN THE SETTLING MATTER FROM A MAN MADE LAKE (IN JAPANESE),

Aichi Environmental Research Center, Nagoya (Japan).
H. Otsuka.
Japanese Journal of Limnology, Vol 42, No 1, p 28-39, 1981. 6 Fig, 8 Tab, 20 Ref.

Descriptors: *Heavy metals, *Sedimentation, *Fate of pollutants, *Organic matter, *Adsorption, Iron, Manganese, Copper, Nickel, Cadmium, Zinc, Metals, Metal complexes, Artificial lakes, Separation techniques, *Lakes, Suspended sediments, Suspended solids, Path of pollutants.

Heavy metal settling in a productive man-made lake was examined by selective extraction of water samples collected at various depths each month for an 18 month period. The largest amount of metals was extracted with hydrochloric acid. More than 80% of the Fe recovered was by extraction with hydrofluoric acid. A small amount of Cu was extracted with hydrogen peroxide. The quantities of metals extracted varied seasonally, with distinctive patterns among metals and fractions. The most important form of metals in lake water appeared as adsorbed or coprecipitated forms on organic matter or as hydrous Fe/Mn oxides. Significant amounts of Cu were bound to organic matter. Zn, Ni, and Cd were associated with Mn oxides and organic matter, while Cu was found frequently with Fe and Mn oxides. It was suggested that the sedimentation of metals within the lake was closely related to the cyclic patterns of Fe, Mn, and organic matter. (Ceiger-FRC)
W82-02719

STUDIES ON THE ABILITY OF A POTAMOGETON PECTINATUS COMMUNITY TO REMOVE DISSOLVED NITROGEN AND PHOSPHORUS COMPOUNDS FROM LAKE WATER,

Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.
C. Howard-Williams.
Journal of Applied Ecology, Vol 18, No 2, p 619-637, August, 1981. 5 Fig, 9 Tab, 41 Ref.

Descriptors: *Aquatic plants, *Algae, *Nutrient removal, Fate of pollutants, Wastewater treatment, Macrophytes, Potamogeton, Nitrogen, Phosphorus, Submerged plants, Sediments, *Lakes, Lake Sediments, Chlorophyll a, Phytoplenkton, Epiphytes.

Enclosures containing dense growths of Potamogeton pectinatus were enriched weekly for 15-23 weeks with the following amounts of P and N (in mg per cu meter), respectively: low, 5 and 50; medium, 10 and 100; high, 25 and 250; and extra high, 100 and 1000. Chlorophyll a levels remained low in all treatments, but filamentous epiphytic algae (predominantly Cladophore sp.) developed in proportion to the degree of enrichment. After 9 weeks nutrients added at all levels were utilized within 1 day. Potamogeton plants were not adversely affected by these dense algal mats. P32 tracer experiments showed that most of added P was absorbed within 2 hours by the filamentous algae. N and P levels were increased in algae by the extra high treatment only. Enrichment resulted in increased N concentrations in leaf, stem, root, and rhizome of Potamogeton at high and extra high treatment levels; increased P absorption was seen only in the extra high treatment. Organic matter, N, and P were significantly higher in the top 1 cm of sediments with the extra high treatment only. Beds of dense submerged macrophytes with associated algae may be useful as nutrient filters at fairly low P loads (100 micrograms per liter per week soluble P) in large water bodies, for example, septic tank flows or agricultural runoffs which drain into lakes or rivers. (cassar-FRC)
W82-02724

CROPLAND, BUFFER, AND STREAM: A CASE STUDY IN AGRICULTURAL NONPOINT SOURCE WATER POLLUTION,

Michigan State University, Department of Agricultural Engineering.
For primary bibliographic entry see Field 5G.
W82-02728

HYDROCHEMICAL CHARACTERISTICS OF THE STREAM DRWINKA AND ESTIMATE OF ITS SELF-PURIFICATION ABILITY,

Jagellonian Univ., Krakow (Poland). Dept. of Hydrobiology.
K. Jop.
Acta Hydrobiologica, Vol 22, No 3, p 249-262, 1980. 4 Fig, 5 Tab, 16 Ref.

Descriptors: *Rivers, *Chemical properties, *Industrial wastes, *Poland, Municipal wastes, Water pollution sources, Self-purification, Aquatic plants, Biological oxidation, *Fate of pollutants.

The hydrochemical character of the stream Drwinka, the degree of its pollution, and the process of its self-purification were examined. The Drwinka basin lies in the River Vistula's dead channel. A distinct depression of the terrain is noted along the course of the Drwinka, parallel to the Vistula. This depression is lined with a layer of sandy-gravelly quaternary sediment covered with silts and with formations of marshy accumulation. The ground water is very rich owing to the great thickness of quaternary alluvial sediments. The present bed of the Drwinka and its tributaries are modified by trimming and by land reclamation of the neighboring areas. The chief and constant sources of pollution are municipal sewage and wastes from a poultry farm at Niepolomice. Both are fed directly to the stream through five collectors located in Niepolomice. Pollution also arrives here from the Lenin Steel Works. The self-purification for this river occurs mainly in a 5 kilometer sector below Niepolomice. In the first 5 kilometers below the inflow of wastes the biochemical oxidation or organic matter occurred. For the next section of the river vascular plants played a marked role by assimilating great amounts of nutritive compounds. A 35% decrease in the mean concentration of most macroelements occurred in this area. Even with this cleaning process, the content of nutritive compounds in the water at the last measurement station was significantly higher than that occurring in natural waters. (Baker-FRC)
W82-02750

COMPARISON OF THE CHEMICAL COMPOSITION OF THE WATERS OF LAKE PIASECZNO (LECZYNSKO-WLODAWSKIE LAKE DISTRICT) AND OF THE SHALLOW GROUND WATERS IN ITS CATCHMENT AREA,

Akademia Rolnicza, Lubin (Poland), Inst. Gleboznawstwa i Chemii Rolnej.
For primary bibliographic entry see Field 2H.
W82-02752

PLUTONIUM OCCURRENCE AND PHASE DISTRIBUTION IN SEDIMENTS OF THE WYRE ESTUARY, NORTHWEST ENGLAND,

International Lab. of Marine Radioactivity, Monte carlo (Monaco). Oceanographic Museum.
S. R. Aston, D. J. Assinder, D. A. Stanners, and J. E. Rae.
Marine Pollution Bulletin, Vol 12, No 9, p 308-314, September, 1981. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Plutonium, *Estuaries, *Path of pollutants, Fate of pollutants, Mercury, Sediments, *Wyre Estuary, Ravenglass Estuary, *England, Windscale, Nuclear fuel processing plants, Isotope studies, Organic matter, Particle size.

Distributions of plutonium isotopes were determined in Wyre Estuary, northwest England, about 60 km south of the Windscale nuclear fuel reprocessing plant. In surface samples Pu238 concentrations were 0.25-2.9 pCi per g and Pu239+240, 1.15-27.5 pCi per g. These levels are < 25% of typical values found in surface sediment samples at Ravenglass Estuary, 10 km south of Windscale. Ratios of Pu238:Pu239 were almost constant, 0.23, which indicates that Pu is deposited in surface sediments about 4 years after deposition at Ravenglass, or a total of 6-7 years after release in effluents and fallout at Windscale. Pu concentrations were correlated with total organic carbon, which may be a function of grain size. Leaching studies showed that only 20% of Pu was associated with Fe and Mn hydrous oxides, considerably less than in Ravenglass samples. This lends further support to the hypothesis that Pu is associated with organic matter (but not humic substances) in this site. Examination of 30 cm sediment cores showed that Pu239 levels were well correlated with Hg and total organic carbon throughout the core depth. (Cassar-FRC)
W82-02760

THE INFLUENCE OF STREAM SALINITY ON RESERVOIR WATER QUALITY,

Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W82-02762

GROUNDWATER SYSTEMS ASSOCIATED WITH SECONDARY SALINITY IN WESTERN AUSTRALIA.

Western Australia Dept. of Agriculture, South Perth. Div. of Resource Management.
For primary bibliographic entry see Field 2F.
W82-02770

THE DISTRIBUTION AND SEASONAL FLUCTUATIONS OF HETEROTROPHIC BACTERIA AND COLIFORM BACTERIA IN THE RIVERS AND ESTUARIES IN OSAKA CITY, JAPAN (IN JAPANESE),

Osaka City Inst. of Public Health and Environmental Sciences (Japan).
For primary bibliographic entry see Field 5A.
W82-02774

RUNOFF AND POLLUTION ABATEMENT CHARACTERISTICS OF CONCRETE GRID PAVEMENTS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Architecture and Urban Studies.
G. E. Day, D. R. Smith, and J. Bowers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168469, Price codes: A04 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Virginia Polytechnic Inst. and State Univ. Bulletin 135, October, 1981. 59 p, 6 Fig, 21 Tab, 22 Ref. OWRT-A-090-VA(1).

Descriptors: *Concretes, *Urban runoff, Storm runoff, Stormwater management, Heavy metals, Nitrogen, Nutrients, Phosphorus, Plant nutrients, *Water pollution control, *Comparison studies, *Pavement, Concrete pavement, Concrete grid pavement.

Problems of water quality and quantity have forced many communities to redefine the approaches to local stormwater management. New approaches-alternatives to the conventional means of piping a problem downstream--focus on maintaining predevelopment runoff levels by increasing opportunities for runoff infiltration, by controlling runoff velocities and volumes, and by reducing nonpoint pollutants. Concrete grid pavements have potential as a technology capable of performing these functions, but they have not yet been evaluated to the satisfaction of officials who must endorse or implement stormwater management strategies. This research measured, in a laboratory setting, runoff volume and pollutant load reductions associated with three types of grid pavements. A concrete slab was used as a control. Reductions in pollutant concentration and mass in water that percolated through the grids in the pavements were also measured. Runoff from the surface of the pavements and from water within the soils beneath the pavements was analyzed for phosphorus, nitrogen, organic carbon chromium, lead, and zinc. Results show that the grid pavements greatly reduced runoff volume, as compared to the concrete slab. The masses of 10 pollutants found in the runoff from this slab were much greater than those in the runoff from the grid pavements. The soils beneath the grid pavements acted effectively in removing significant quantities of pollutants from the water that infiltrated into them.
W82-02801

A REEXAMINATION OF THE ZOOPLANKTON COMMUNITY OF A DELAWARE TIDAL STREAM,

Delaware Univ., Newark. Coll. of Marine Studies.
M. P. Van House.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168501, Price codes: A06 in paper copy, A01 in microfiche. MS Thesis, August, 1981. 96 p, 7 Fig, 29 Tab, 94 Ref, Append. OWRT-A-044-DEL(2), 14-34-0001-9008.

Descriptors: *Zooplankton, *Tidal rivers, Estuaries, *Wastewater disposal, Water pollution sources, *Water pollution effects, Murderkill River, Broadkill River, *Delaware, Water quality.

The zooplankton community of the Murderkill River, a shallow estuary in southeastern Delaware, was studied in an earlier comparison of two rivers of differing water quality. At that time the Murderkill was an unperturbed system and the nearby Broadkill received considerable point source pollution. Since that time a regional wastewater treatment plant began operation, discharging its effluent through a tiny creek into the Murderkill, and several studies have documented water quality changes in the river. The present study is a qualitative and quantitative survey of the present zooplankton community in an attempt to detect changes that were predicted to accompany changes in water quality. Three indices of community analysis, percent similarity, rank correlation coefficient and diversity of change indicated that samples in the present study were similar to those collected before the treatment plant opened in relative abundance of dominants, rank and frequency of dominants and number and magnitude of

species changes. Analysis of individual groups of zooplankters such as rotifers, calanoid copepods, cyclopoid copepods and cladocerans revealed some shifts in species and relative abundances but the changes appeared to reflect differences in parameters such as a salinity rather than water quality. At present effluent levels, the zooplankton of the Murderkill River does not appear to have changed significantly following changes in water quality.
W82-02805

NUTRIENT LOADING - TROPHIC STATE RELATIONSHIPS IN FLORIDA LAKES,

Florida Univ., Gainesville. Water Resources Research Center.
L. A. Baker, P. L. Brezonik, and C. R. Kratzer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168568, Price codes: A07 in paper copy, A01 in microfiche. Publication No 56, 1981. 126 p, 43 Fig, 23 Tab, 88 Ref, 4 Append. OWRT-A-038-FLA(1), 14-34-0001-9010, 14-34-0001-0110.

Descriptors: Trophic state indicators, Watershed enrichment factors, *Nutrients, *Land use, *Trophic level, Nitrogen, Phosphorus, *Lakes, *Florida, Model studies, Nutrient loading.

Relationships among trophic state indicators and watershed enrichment factors were examined for 101 Florida lakes. Regression analysis was used to examine the relationship between land use and NPS nutrient loadings. The best model to predict NPS P loading included three land use variables while total drainage area alone was a good predictor of NPS N loading. Florida lakes were found to be shallow; few exhibit stable stratification or seasonal trends in chlorophyll a or nutrient concentrations. Many are N-limited; there is less chlorophyll a for a given level of P (even for P-limited lakes) than found in temperate lakes. The best predictions of N and P in Florida lakes are made using a modified Dillon-type model; the best predictions or chlorophyll a are made using Jones and Bachman-type model. The 1975 Vollenweider criteria and the Dillon criteria were modified to improve their predictive capabilities: in both cases the revisions resulted in higher critical loading rates. N loading criteria were developed; the best N loading criteria were based on a Dillon-type model. The correct response of a lake to alterations in nutrient loading will be obtained using the criteria (N or P) that predicts the lower trophic status. (Heaney-FLA)
W82-02811

PHYSICAL CHARACTERIZATION OF EXTRACHROMOSOMAL DNA IN CHESAPEAKE BAY BACTERIA FROM POLLUTED AND NON-POLLUTED SITES,

Maryland Univ., College Park. Water Resources Research Center.
D. L. Glassman, and L. A. McNicol.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168592, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 66, 1980. 78 p, 14 Fig, 15 Tab, 109 Ref, 4 Append. OWRT-A-050-MD(1), 14-34-0001-0122.

Descriptors: *Bacteria, *Ecosystems, *Chesapeake Bay, Estuarine environment, *Plasmids, Extrachromosomal DNA elements, Ecological effects.

The significance of extrachromosomal elements in natural populations of estuarine bacteria has not been determined. To obtain measure of the frequency of plasmids in this ecosystem, a random sample of the total aerobic heterotrophic community was collected from the Chesapeake Bay. Two hundred eighteen strains were examined by agarose gel electrophoresis, using an in-the-well lysis procedure. Forty four percent of these isolates carried at least one plasmic. This proportion did not vary significantly between three different sampling locations which span an enormous range of water quality. In general, organisms isolated from cleaner stations contained predominantly single, small plasmids with a molecular weight of three to five megadaltons. A significantly large percentage of bacteria isolated from Baltimore's inner harbor tended to carry multiple plasmids and plasmids greater than 30 x 10 degrees molecular weight. Plasmids were identified in organisms representing all the major taxonomic components of the estuarine aerobic heterotrophic community. Plasmids of the three to five megadalton size class were found to be extremely ubiquitous. DNA-DNA hydridization analysis between plasmid DNA from several isolates indicate that within a group of heterogeneous small cryptic plasmids may exist several groups of structurally related plasmids of both narrow and broad host range. Future work will be needed to further determine the extent of these homologies.
W82-02814

WATERSHED IMPACT ON STREAM WATER QUALITY: A TECHNIQUE FOR REGIONAL ASSESSMENT,

Wisconsin Univ., La Crosse. River Studies Center.
M. M. Smart, T. W. Barney, and J. R. Jones.
Journal of Soil and Water Conservation, Vol 36, No 5, p 297-300, September-October, 1981. 2 Fig, 3 Tab, 16 Ref. OWRT-A-111-MO(3).

Descriptors: *Water quality, *Land use, *Watersheds, Water pollution sources, Forests, Missouri, Urban areas, Farming, Chemical analysis, Streams, Ozarks, Baseline studies.

The use of general watershed data has been demonstrated in assessing the influence of watersheds on stream water chemistry. The Spring Creek watershed in Douglas County, Missouri, serves as an example of how such an assessment can be made. A total of 21 watersheds and streams were studied in an 11 county region of south central Missouri. Spring Creek is typical of watersheds in the Salem Plateau. There are no known point sources of chemicals. Land use consists of 86.3% forest, 13.6% pasture and 0.1% urban. Stream water samples were collected every 10 days from June 1978 to September 1979. Regression equations were developed to assess the relationships between the characteristics of the watershed. The areas of urban land and pasture on a watershed were associated with increased concentrations of most chemicals in streams. Inverse relations were noted between forest land use and the concentration of most chemicals in the streams. As the area of forest land on a watershed increased, stream chemical concentrations declined. Concentrations of chemicals and chlorophyll a in Spring Creek were generally low. Depending on the season, total phosphorus ranged from 7.6 to 19.9 milligrams per cubic meter. What effect land use changes in the Spring Creek watershed might have on water chemistry and algal biomass can be assessed using the empirical regression equations developed from the watershed-stream data base for late summer. Streams draining forest areas unaffected by human activity likely represent the background level of stream chemical concentrations in the Missouri Ozarks. (Baker-FRC)
W82-02818

KINETICS OF TRACE METAL PARTITIONING IN MODEL ANOXIC MARINE SEDIMENTS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
S. M. Oakley, C. E. Delphey, K. J. Williamson, and P. O. Nelson.
Water Research, Vol 14, No 8, p 1067-1072, August, 1980. 6 Fig, 2 Tab, 12 Ref. OWRT-A-044-ORE(2), 14-34-0001-9039.

Descriptors: *Marine sediments, *Trace metals, *Anaerobic conditions, *Estuaries, *Kinetics, Sediments, Interstitial water, Geochemistry, Seawater, Salt water, Brackish water, Saline water, Spectrophotometry, Solubility, Leaching, Equilibrium, Copper, Cadmium, Lead, Zinc, Heavy metals.

A model anaerobic sediment consisting of humic acid, clay, ferrous, sulfide, sand, and seawater was utilized to study the partitioning of copper, cadmium, lead, and zinc between different geochemical phases. An extraction scheme was developed that was selective for each phase. The scheme involved separating the humic material and treating the remaining clays with nitric acid to strip the metals and to disolve the ferrous sulfide. Centrifuging then isolates the solid fraction, which contains trace metals associated with the ferrous sulfide. Metals dosed on sediment phases were extracted and analyzed using spectrophotometry. Results indicate that the kinetics of partitioning were rapid, regardless of which phase was dosed. Equilibrium was reached within two to five days. The final metal distributions show that adsorbing surfaces can significantly increase the quantities of metals that exist outside the sulfide phase. Thus, the metal sulfide phase may not be the dominant sink for trace metals in anaerobic sediments. (Titus-FRC)
W82-02820

EFFECTS OF RECREATION ON WATER QUALITY IN GUADALUPE MOUNTAINS NATIONAL PARK,

Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
D. H. Dasher, L. V. Urban, M. J. Dvoracek, and E. B. Fish.
Transactions of the ASAE, Vol 24, No 5, p 1181-1187, September-October, 1981. 4 Fig, 36 Ref. OWRT-B-206-TEX(3).

Descriptors: *Water pollution sources, *Recreation facilities, McKittrick Canyon, Streams, *Texas, *Guadalupe Mountains National Park, Water quality, Sediments, Water analysis, Chemical composition, Leaves, Cesspools, Wastewater disposal.

Water quality was studied in the Guadalupe Mountains National Park, Texas. Livestock and wildlife have been the most frequent users of some areas. Guadalupe Spring was developed as a major source of water for both livestock and human needs of park service personnel living below Guadalupe Pass. In 1979 this spring flow was diverted to a natural water supply for wildlife following the development of a deep well at the park service housing site. Sewage effluents from both North and South McKittrick Canyons were disposed of in cesspools on alluvial terraces near the channel. Seventeen sampling sites were selected for periodic water quality analysis, including springs, surface water sampling stations and a well. All sampling was conducted during steady state base flow conditions. The chemistry of the waters reflected the sedimentary geology of the region. The water reflected a well buffered calcium carbonate-magnesium carbonate system. The principal ion was usually bicarbonate, while sulfate was the second most prevalent anion. These results accord well with water chemistry data from different areas of sedimentary deposits. Nutrient levels of nitrate-nitrogen and orthophosphate do not appear excessive considering the natural inputs, such as autumn leaf litter. Recreational use at present has not significantly affected or degraded water quality of the springs. There may have been some impact on quality in McKittrick Canyon stream. The actively used cesspool at the Pratt area may represent a present and certainly a future source of pollutants to this stream. (Baker-FRC)
W82-02821

NITROGEN RECYCLING IN A NORTH CAROLINA COASTAL RIVER,

North Carolina State Univ. at Raleigh. Dept. of Zoology.
D. W. Stanley, and J. E. Hobbie.
Limnology and Oceanography, Vol 26, No 1, p 30-42, January, 1981. 7 Fig, 2 Tab, 39 Ref. OWRT-B-077-NC(2).

Descriptors: *Nitrogen, *Coastal streams, *Water chemistry, Ammonium, Nirogen compounds, Dissolved solids, *North Carolina, Rivers, Particulate matter, Cycling nutrients, Path of pollutants, *Chowan River.

An experimental study of nitrogen cycling near the mouth of Chowan River, a Noth Carolina coastal river, was designed to investigate the validity of several assumptions frequently made about this process. The measured (bi-weekly) rates of ammonium assimilation by plankton were compared with

the rates of ammonium input (by runoff) into the system over a year. An estimation of the amount of nitrogen recycling was made from the differences between the assimilation rates and the rate of ammonium input into the system. High wintertime flow rates and concentrations of particulate and dissolved inorganic nitrogen resulted in much higher winter inflows, e.g., 1,127 tons of nitrogen in January, than summer inflows, e.g., 185 tons in August. Dissolved organic nitrogen comprised about 69 percent of the total annual nitrogen inflow, particulate nitrogen comprised 13 percent, and the remaining 18 percent was mostly ammonium. The lower section of the river is responsible for the breakdown of as much as 33 percent of the incoming dissolved organic nitrogen. Assimilation of ammonium by river plankton, computed by the short term uptake of tagged carbon and nitrogen, averaged about 100 grams of carbon per square meter per year and 32 grams of nitrogen per square meter per year. The seasonal patterns of inflow and uptake of dissolved inorganic nitrogen were completely out of phase. Over the period of the whole year, as much as 65 percent of the dissolved inorganic nitrogen assimilated by river plankton may have come from regeneration, mostly of ammonium, within the river. (Carroll-FRC)
W82-02822

MODEL OF TRACE-METAL PARTITIONING IN MARINE SEDIMENTS,

Oregon State Univ., Corvallis. Dept. of Civil Engineering.
S. M. Oakley, P. O. Nelson, and K. J. Williamson.
Environmental Science and Technology, Vol 15, No 4, p 474-480, April, 1981. 11 Fig, 2 Tab, 41 Ref.
OWRT-A-044-ORE(3), 14-34-0001-9039.

Descriptors: *Trace elements, *Metals, *Sediments, Model studies, Adsorption, Sea water, Humic acids, Clays, Path of pollutants, Bentonite, Manganese oxides, Iron oxides, Copper, Cadmium, Trace metals.

An equilibrium adsorption model was developed to predict the partitioning of trace metals between different geochemical phases in aquatic sediments. The conditional equilibrium constants are determined from linear portions of adsorption isotherms. Partitioning of Cu and Cd was studied using bentonite clay, ferric hydroxide, manganese dioxide and humic acid in sea water, simulating a natural marine environment. Adsorption constants were much higher for Cu than for Cd for all the solid phases: Cu on bentonite clay, 43 liters per g; ferric hydroxide, 205; manganese dioxide, 7,339; and humic acid, 366. Constants for Cd were as follows (liters per g): bentonite clay, 1.1; ferric hydroxide, 4.4; manganese dioxide, 15.0; and humic acid, the lowest, 0.2. Since clay can account for up to 75% of many marine sediments; humic acid, 1.4-1.7%; and manganese dioxide, 0.003%, the model predicts that clay is the major sink for both Cu and Cd using the artificial geochemical phases described. Since the materials used in the laboratory studies were purified, results should not be extrapolated to the more complicated natural environment. (Cassar-FRC)
W82-02824

PLANKTON STUDIES IN SAN FRANCISCO BAY. I. CHLOROPHYLL DISTRIBUTIONS AND HYDROGRAPHIC PROPERTIES OF THE SAN FRANCISCO BAY ESTUARY, JULY 1977 - DECEMBER 1979,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W82-02831

DIEL OXYGEN VARIATIONS IN THE RHODE RIVER ESTUARY, MARYLAND, 1970-1978,

Geological Survey, Edgewater, MD. Water Resources Div.
R. L. Cory, and P. V. Dresler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-225484, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-10, March, 1981. 14 p, 5 Fig, 2 Tab, 22 Ref.

Descriptors: *Dissolved oxygen, *Water quality, *Estuaries, *Rivers, Water temperature, Salinity, Water pollution effects, *Maryland, *Rhode River Estuary, Chesapeake Bay, Diurnal variations.

Since April 1970 the U.S. Geological Survey has operated an estuarine water quality monitor in the upper reach of Rhode River, a small embayment on the northwestern shore of Chesapeake Bay. This report analyzes variations in diel oxygen over the period April 1970 through January 1979. The diel oxygen range is used as an indicator of open-water metabolism. Polygons of temperature versus salinity portray the monthly variations of the two dominant environmental factors which influence biological metabolism and reveal effects of events such as a cool versus a warm spring or salinity reduction due to tropical storm freshwater runoff. Seasonally the average daily oxygen pulse range increased from a winter low of 1.6 mg/L to summer high of 5.3 mg/L. Annually highest daily ranges occurred the summer of 1972 when nutrient laden runoff from tropical storm Agnes stimulated open-water metabolism to produce an average diel range of 6.3 mg/L. Spearman's ranked correlation coefficients were used to compare seasonal and annual variations in temperature and salinity versus diel oxygen range. There was high agreement between annual variations in spring temperatures and diel oxygen ranges and an inverse correlation between summer and autumn salinity and diel oxygen range. (USGS)
W82-02841

METEOROLOGICAL INTERPRETATION OF THE CHEMICAL COMPOSITION OF RAINWATER AT ONE MEASURING SITE,

Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
For primary bibliographic entry see Field 2K.
W82-02874

VINYL LINED ASBESTOS CEMENT PIPE PROBLEMS, OPERATOR ASPECTS,

Champlain Water District, South Burlington, VT.
R. L. Gardner.
Journal of the New England Water Works Association, Vol 95, No 3, p 220-223, 1981.

Descriptors: *Pipes, *Linings, Drinking water, Water pollution sources, *Carcinogens, *Asbestos, Chemical compounds, Decision making, Public relations, *Vermont, Public rights, Public policy, Public opinion, Trichloroethylene.

A potential problem of TCE (trichloroethylene) leaching out from vinyl linings of asbestos/cement pipes with its potential effect on human health was recognized in the Champlain Water District in April of 1980. A survey of the three water systems (South Burlington, Shelburne and Williston) was requested by the State Health Department of Vermont. Particular attention was to be given to pipe installed after 1974. TCE is listed as a suspected carcinogen; 40 ppb is the recommended maximum exposure over the long term. The maximum TCE level found in drinking water was 14 ppb. While the studies revealed that there was no cause for alarm over the drinking water in this area, the experience brought out two major points to be considered in dealing with a potential crisis in a department which involves public health. These two challenges are dealing with the water user's anxiety for his well being, and maintaining public confidence in the ability of the Department to handle the problem. Two essential means of maintaining control and accountability are described. The first is to call a staff meeting and inform the employees about the nature of the problem and the steps being taken to deal with it. The second item suggested is to remain available and communicative with the press. (Baker-FRC)
W82-02898

THE RELATIVE CONTRIBUTIONS OF SULFURIC AND NITRIC ACIDS IN ACID RAIN TO THE ACIDIFICATION OF THE ECOSYSTEM. IMPLICATIONS FOR CONTROL STRATEGIES,

Domtar Ltd. Research Centre, Senneville (Ontario).
For primary bibliographic entry see Field 5C.
W82-02913

LEACHING OF A SORBED SOLUTE: A MODEL FOR PEAK CONCENTRATION DISPLACEMENT,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
P. W. A. Dayananda, F. P. W. Winteringham, C. W. Rose, and J. Y. Parlange.
Irrigation Science, Vol 1, No 3, p 169-175, 1980. 3 Fig, 1 Tab, 27 Ref.

Descriptors: *Leaching, *Irrigation effects, *Solute tramport, *Fate of pollutants, Fertilizers, Soil profiles, Model studies, Raats model, Evapotranspiration, Rainfall infiltration, Infiltration, Absorption.

A simple model is developed for calculating the peak solute concentration depth in the case of a solute applied to the soil surface and subjected to alternating irrigation/rainfall and evaporation. This is compared with the Raats model (1975), which considers the distribution of salts in the root zone when irrigation and evapotranspiration rates are time invariant or change suddenly. Unlike the Raats model, the model presented here includes chemical and biochemical transformations, has no restrictions on evaporation or irrigation history, does not assume a constant water content, and is more readily applied to field situations. However, the Raats model can analyze the whole profile, whereas the present model is limited to predictions of peak movement. Field data on chloride and nitrate ion transport in Wisconsin (Saffigna et al., 1977) were compared with model predictions. The predicted and observed times for solute peak concentrations to reach the bottom of a 150 cm lysimeter after fertilizer application agreed well. (Cassar-FRC).
W82-02922

AN ANALYSIS OF THE FIRST YEAR OF MAP3S RAIN CHEMISTRY MEASUREMENTS,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W82-02934

KD'S--CAN THEY BE USED TO DESCRIBE REVERSIBLE ION SORPTION REACTIONS IN CONTAMINANT MIGRATION,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
E. J. Reardon.
Ground Water, Vol 19, No 3, p 279-286, May/June, 1981. 7 Fig, 3 Tab, 10 Ref.

Descriptors: *Distribution coefficient, *Sorption, *Chemical reactions, Ion transport, Fate of pollutants, *Solute transport, Groundwater pollution, Leachates, Model studies, Equilibrium, Chemical precipitation, Radioactive waste disposal, Waste disposal, *Path of pollutants.

A constant charge model for reversible ionic sorption was used to demonstrate that distribution coefficients (Kd) of an ionic species vary in the case of contaminant migration in groundwater systems. In this dynamic situation the sorbed site populations at any point along the flow path are not in equilibrium with the way groundwater will evolve from mineral dissolution/precipitation, redox reactions, and prior sorption reactions during flow when it reaches this point. This work showed that Kd cannot be used to describe reactions in landfill leachate studies or deep well injections of liquid wastes where the chemistry of contaminated water is significantly different from the natural groundwater in the aquifer. It is doubtful that Kd's can be used to study trace element contamination in high level radioactive waste disposal studies because heating at the disposal site can change the chemical reaction rates. (Cassar-FRC)
W82-02942

OXYGEN-CONSUMING ORGANICS IN NON-POINT SOURCE RUNOFF,

Corvallis Environmental Research Lab., OR.
A. R. Abernathy.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-205981, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-033, July, 1981. 2 p.

Descriptors: *Nonpoint pollution sources, *Water pollution sources, *Biochemical oxygen demand, *Urban runoff, *Dissolved oxygen, Nutrients, Sediments, Pesticides, Runoff, Fish, Oxygen demand.

A comprehensive survey and review of recent literature, especially EPA Research Reports, relating to nonpoint source (NPS) runoff from both urban and rural sources was carried out. Urban NPS runoff has been shown to contain large quantities of oxygen-demanding materials. Modeling studies have indicated that the dissolved oxygen (DO) demand from urban NPS runoff can result in low DO concentrations, either alone or in combination with point source discharges. The most serious rural NPS pollutants seem to be sediments from soil erosion, plant nutrients, and toxic materials such as pesticides. Continuous exposure to DO concentrations significantly lower than air saturation concentrations seems to be harmful to fish, both salmonids and warmwater species. Exposure to fluctuating DO concentrations between air saturation and 60-65% of saturation can reduce the growth rate of fish if the high and low concentration exposure periods are approximately equal (12 hours each) during each day. Efforts should be made to achieve the appropriate DO standards by reducing the loads of BOD in NPS runoff as well as point source discharges. Reduction of the BOD loadings from NPS runoff should result in other improvements in receiving water quality by reducing the loadings of suspended solids, plant nutrients, and potentially toxic materials. (Moore-SRC)
W82-02966

ORIGIN AND CHEMICAL COMPOSITION OF ANDROSCOGGIN RIVER FOAM,

Jordan (Edward C.) Co., Inc., Portland, ME.
B. K. Wallin, and B. T. Bisson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-208167, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-087, July, 1981. 5 p, 1 Tab.

Descriptors: *Foaming, *Surfactants, *Water pollution effects, *Effluents, Pulp and paper industry, Municipal wastewater, Resins, Fatty acids, Nonpoint pollution sources, Aromatic compounds, Foaming, *Androscoggin River, Maine.

For some time the rivers of northern New England have been known to be prone to foaming. In order for foam to occur, a critical concentration of a surface active substance must be present. A sampling and analysis program on the Androscoggin River and at International Paper Company's Androscoggin Mill in Jay, Maine investigated the origin and chemical composition of foam. Foaming has been an historical problem within pulp, paper, and paperboard mills, due to resin and fatty acids in mill effluent. Publicly owned treatment works and nonpoint sources may also be a source of surfactants. River foam downstream of Topsham was found to contain a plethora of organic matter, including neutrals, weak acids, polyaromatic pulping products, as well as inorganics. Foam upstream of all point sources lacked certain components, such as resin acids and chloroguaiacols, but was also found to be extremely complex. An attempt to mass balance a downstream sample of foam accounts for approximately 50% of both organic and inorganic matter. Municipal treatment plant effluents did not produce collectible quantities of foam when subjected to pneumatic treatment, but most of the pulp, paper, and paperboard mill treatment plant effluent samples did produce foam. Collectible foam was found to be enriched in methylene blue active substances, while polyaromatic pulping products were not concentrated in the foam. It could not be determined whether any of the industrial or municipal point sources acted alone, or in combination with one another and ambient conditions to cause the foaming conditions. (Moore-SRC)
W82-02970

FIELD INVESTIGATION OF CONTAMINANT LOSS FROM CHEMICALLY STABILIZED INDUSTRIAL SLUDGES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246332, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-163, September, 1981. 6 p, 1 Fig, 2 Tab, 2 Ref. EPA-IAG-D4-0569.

Descriptors: *Groundwater pollution, *Leaching, *Sludge disposal, *Industrial wastes, Metal-finishing wastes, Soil contamination, Heavy metals.

In order to determine the effects of stabilized waste sludges on surrounding soils and groundwater, four sites where stabilized industrial wastes had been disposed were examined. All areas selected for study were in the humid eastern or southern United States where rainfall was sufficient to produce abundant leachate. The sludges had all been fixed using the same proprietary process involved addition of cementitious materials to form a stable, soil-like product. Two of the industrial waste sites contained auto assembly (metal finishing) wastes, one contained electroplating wastes, and the fourth contained refinery sludges. The physical properties of soils under the disposal sites were affected little, if at all, by the disposal operation. At one of the auto assembly waste disposal sites, high background levels of certain groundwater constituents masked any escape of pollutants from the fixed sludge. Elevated levels of chloride, calcium, and sodium were found in groundwater under and down gradient from the second auto assembly waste disposal site. Elevated levels of sulfate and boron were found under and down the groundwater gradient from the electroplating waste site. Elevated levels of sulfite, nitrite, cyanide, phenols, and arsenic were noted in groundwater under and down dip from the disposal area at the refinery site. High levels of soils collected beneath the stabilized wastes suggest that contaminants from the waste could be leaching into the groundwater. (Moore-SRC)
W82-02990

SOURCES OF HALOGENATED HYDROCARBONS IN AN URBAN WATER SUPPLY,

Municipal Environmental Research Lab., Cincinnati, OH.
W. C. Elbert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-208191, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-089, July, 1981. 3 p, 3 Tab. R804394.

Descriptors: *Halogenated pesticides, *Halogenated hydrocarbons, *Water pollution, *Drinking water, Chloroform, Effluents, Trihalomethanes, Polychlorinated biphenyls, Chlorination, Stream pollution, Water quality, Water treatment.

One of the major water quality problems is the presence of halogenated organics in water supplies, and the formation of certain halocarbons. The Passaic River in Little Falls, New Jersey, was selected for investigation of the sources and nature of such halocarbons in a highly urbanized watershed. The distribution and concentration of high-boiling and low-boiling halogenated hydrocarbons and halogenated pesticides were determined in the following surveys: general stream; sewage treatment plant effluent; industrial waste treatment plant effluent; and source, finished and delivered drinking water. During summer samplings, chloroform was the predominant purgeable halogenated hydrocarbon observed in the Passaic River and its tributaries. During colder months (all under ice cover), methylene chloride was the predominant halomethane. Dominant pesticides observed were alpha- and beta-BHC, and some polychlorinated biphenyls were frequently detected. Of the chlorophenols, trichlorophenol had the greatest distribution followed by 2,4-dichlorophenol, 2,6-dichlorophenol, tetrachlorophenol, and pentachlorophenol. Trihalomethane concentrations always increased in the water samples after chlorination, and trihalomethane formation potentials in stream samples ranged from 66 to 282 micro g/L total trihalomethanes. (Moore-SRC)
W82-02991

5C. Effects Of Pollution

SPATIAL AND TEMPORAL OVERLAP IN LAKE PHYTOPLANKTON COMMUNITIES,

Ottawa Univ. (Ontario). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W82-02610

CHIRONOMIDAE (DIPTERA) OF BALDWIN LAKE, ILLINOIS, A COOLING RESERVOIR,

Southern Illinois Univ. at Carbondale. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W82-02620

EFFECT OF N-BENZOQUINONE AND OF SOME POLYPHENOLS ON THE MEMBRANE POTENTIAL OF NITELLA SP. MEASURED BY THE OPEN-VACUOLE METHOD,

Irkutsk Univ. (USSR). Biological Research Inst.
M. N. Saksonov, M. S. Apartsin, M. P. Grudinin, and D. I. Stom.
Hydrobiological Journal, Vol 16, No 4, p 72-76, 1980. 3 Fig, 14 Ref.

Descriptors: *Water pollution effects, *Phenols, *Algae, Toxicity, Organic compounds, Membrane processes.

A study was made to compare changes in the membrane potential (MP) of cells of Nitella sp. at the time of cessation of the movement of the protoplasm under the influence of phenolic components of effluents differing in the mechanism of their toxic effect on cells. MP was measured without inserting the microelectrode into the cell by the open-vacuole method. The study revealed that the alteration of MP under the influence of n-benzoquinone, pyrocatechol and resorcinol by the time of cessation of cyclosis was negligible when compared with the initial potential, and that in guaiacol and 2,4-DNP the drop of MP was respectively 130 and 86 mV. On the basis of these findings, cessation of the motion of the protoplasm apparently occurs owing to structural disruption of the hydrophobic environment of the protein of the operator and repression of the latter due to changes in its conformation resulting from the alteration of protein-lipid bonds. Cessation of the motion of the protoplasm is a secondary reaction consequent upon damage to the plasmalemma. The more expressive nature of the MP is to be expected in this case. The cessation of cyclosis and the appreciable drop of MP justify the assumption that the effect of 2,4-DNP is also connected in the given case with a direct influence on the architectonics of the plasmalemma and thus on the state of the operators. The findings show fairly clearly that the reaction of MP and of the motion of the protoplasm to the compounds tested is closely connected with the way in which their toxic effect is exerted on the cells, and must be taken into consideration when devising biological tests. (Baker-FRC)
W82-02626

A CHIRONOMUS TENTANS BIOASSAY FOR TESTING SYNTHETIC FUEL PRODUCTS AND EFFLUENTS, WITH DATA ON ACRIDINE AND QUINOLINE,

Oak Ridge National Lab., TN. Environmental Sciences Div.
R. M. Cushman, and M. I. McKamey.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 5, p 601-605, May, 1981. 2 Tab, 18 Ref.

Descriptors: *Coal gasification, *Midges, *Toxicity, Water pollution effects, Testing procedures, Bioassay, Industrial wastewater, Acridine, Quinoline, Organic compounds, *Synthetic fuels.

As part of a program to evaluate the environmental effects of synthetic fuel products and effluents,

a series of tests is being used to measure the toxicity of these products and of representative pure compounds to aquatic organisms. A method for toxicity testing of synthetic fuel products and wastewater was developed for the midge, Chironomus tentans. Unlike previous C. tentans bioassays, this procedure excludes effects of organic substrates, feeding, aeration, and light. The midges were tested in glass beakers of filtered well water on a glass wool substrate. Calculated 48 hour LC50 values for typical synthetic fuel products were: acridine, 1.96 mg per liter, and quinoline, 57.2 mg per liter. (Cassar-FRC)
W82-02630

TOXICITY OF ENVIRONMENTAL ACID TO THE RAINBOW TROUT: INTERACTIONS OF WATER HARDNESS, ACID TYPE, AND EXERCISE,

McMaster Univ., Hamilton (Ontario). Dept. of Biology.
M. S. Graham, and C. M. Wood.
Canadian Journal of Zoology, Vol 59, No 8, p 1518-1526, August, 1981. 4 Fig, 1 Tab, 47 Ref.

Descriptors: *Water hardness, *Acidic water, *Fish, Water pollution effects, Toxicity, Acid rain, Hydrogen ion concentration, Sulfuric acid, Hydrochloric acid, Trout, Fish behavior.

The effects of water hardness (14 or 140 mg per liter CaCO3), acid type (HCl vs. H2SO4), and activity level (rest vs. exercise) on acid toxicity to rainbow trout fingerlings were studied at 15C in 7-day exposures. The 7-day LC50 pH levels were 4.1-4.5. H2SO4 was less toxic in hard water than in soft water at all pH levels during rest and exercise. Hard water decreased toxicity of HCl at pH less than 3.5 and increased toxicity at pH above 3.8. H2SO4 was less toxic than HCl in hard and soft weters except for soft waters above pH 3.8. Exercise increased H2SO4 toxicity in both hard and soft waters except in soft water at pH $<$ 3.3. Critical swimming speeds were not significantly different between hard and soft water at the same pH in the ranges of 3.5-4.2 and neutral. However, below pH 4.6 in soft water and 4.4 in hard water, critical swimming speeds decreased 4% per 0.1 pH units. Any extrapolation from laboratory toxicity data to field survival criteria should consider the interactions described above. (Cassar-FRC)
W82-02631

EFFECTS OF FINE SEDIMENTS ON GROWTH OF JUVENILE COHO SALMON IN LABORATORY STREAMS,

Corvallis Environmental Research Lab., OR.
M. R. Crouse, C. A. Callahan, K. W. Malueg, and S. E. Dominguez.
Transactions of the American Fisheries Society, Vol 110, No 2, p 281-286, 1981. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Salmon, *Sediment concentration, Streams, Spawning, Aquatic productivity, Sedimentation, Sediment load, Fish eggs, Particle size, Habitats, Aquatic habitats, Substrates, Stream erosion, Stream degradation, Water pollution effects, *Fish physiology, Fish growth.

Previous studies have shown that sedimentation can affect salmon and trout streams by decreasing embryo survival and by reducing food organisms and habitat for juvenile and adult fish. Production by juvenile coho salmon (Oncorhyncus kisutch) was studies in 12 laboratory streams under six levels of fine sedimentation. Fish production was measured as a product of the mean number of fish in the channel and the difference in their mean initial and mean terminal weights. The production of juvenile coho salmon for each growth period was inversely related to quantities of fine sediment. Since increasing the sedimentation suppressed fish production, it was recommended that the habitats of salmonid juveniles as well as spawning areas should be protected against fine sediments. A visual technique for evaluating stream substrate quality, the Substrate Score, correlated closely with both the geometric mean particle size of the substrate and fish production. This method may also be used in field studies. (Geiger-FRC)
W82-02639

FARM, URBAN DRAINAGE POLLUTING GREAT LAKES,

For primary bibliographic entry see Field 5B.
W82-02647

DECOMPOSITION AND MICROBIAL COLONIZATION OF LEAVES IN A STREAM MODIFIED BY COAL ASH EFFLUENT,

Wisconsin Univ.-Madison. Lab. of Limnology.
A. M. Forbes, and J. J. Magnuson.
Hydrobiologia, Vol 76, No 3, p 263-267, 1980. 3 Fig, 17 Ref.

Descriptors: *Macroinvertebrates, *Leaves, *Decomposition, Coal ash, *Water pollution effects, Invertebrates, Streams, Biodegradation, Degradation, Microbial degradation, Organic matter, Fungi, Aquatic fungi, Aquatic habitats, Food habits.

Leaves of sugar maple (Acer saccharinum) were submerged in a stream contaminated with coal ash effluent and in a reference stream on December 5, 1977. After 96 days immersion the ash-exposed leaves showed little decomposition beyond leaching of soluble organic material. Leaf surface area was almost unchanged, at about 55 sq cm per leaf (control 40 sq cm per leaf); ash free dry weight of a 15 mm disc was 4 mg per disc (control, 3 mg per disc); and ATP content was almost unchanged at about 50 nmol per g (control quadrupled from 100 nmol per g at 27 days to 400 at 96 days). No macroinvertebrates were found in the ash pit drain leaves, but 150 individuals per leaf pack from 19 taxa (predominantly grazers) were present in the control. Ash-exposed leaves were stiff and yellow-brown; control leaves were very thin and dark brown. The effluent stream was 2.7 + over - 1.9C warmer than the control stream and was higher in conductivity and lower in pH. Apparently the ash effluent indirectly reduced the quality of the environment for aquatic macroinvertebrates by inhibiting microbial growth on the leaves. (Cassar-FRC)
W82-02654

AGGREGATION OF SPOTTAIL SHINERS IN THE HEATED DISCHARGE OF A NUCLEAR POWER STATION,

National Marine Fisheries Service, Miami, FL.
E. D. Prince, and L. J. Mengel.
Transactions of the American Fisheries Society, Vol 110, No 2, p 221-225, March, 1981. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Water pollution effects, *Shiner, *Fish populations, *Nuclear powerplants, *Thermal pollution, Reservoirs, Ecological effects, Population dynamics, Aquatic populations, Population density, Distribution, Thermal water, Heated water, Powerplants, Electric powerplants, Keowee Reservoir, South Carolina.

Fish populations from five shoreline sites of Keowee Reservoir, South Carolina were sampled by bag seine for five consecutive summers from 1973 to 1978 to assess the impact of the Oconee Nuclear electric powerplant on fish distribution and abundance. Spottail shiners (Notropis hudsonius) were significantly more abundant in the waters affected by the heated discharge of the nuclear powerplant than in the other four areas. N. hudsonius first appeared near the nuclear station in 1975, and by 1977 was the most abundant species in this section of the reservoir. Spottail shiners increased annually during the study period in other areas of the reservoir, but their abundance decreased as distance from the powerplant increased. Increases in temperature and macrophyte populations were associated with increased numbers of spottail shiners and were considered to be regulating factors in the population dynamics of this species in Keowee Reservoir. (Geiger-FRC)
W82-02686

DETOXIFICATION OF CHLORINATED SEWAGE EFFLUENT BY DECHLORINATION IN ESTUARINE WATERS,

William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
M. H. Roberts, Jr.
Estuaries, Vol 3, No 3, p 184-191, September, 1980, 1 Fig, 3 Tab, 32 Ref.

Descriptors: *Wastewater treatment, *Dechlorination, Chlorination, *Estuarine environment, Water pollution sources, Chlorine, Toxicity, Detoxification, Decontamination, Secondary wastewater treatment, Advanced wastewater treatment, *Water pollution effects, Oysters, Shrimp, Fish, *James River, Virginia.

The dechlorination of chlorinated sewage effluent was studied to demonstrate that such a process would effectively eliminate toxicity attributable to the chlorine produced oxidants (CPO). The design of the study stipulated that the simulated effluent chlorine concentration should be the same as that in an actual plant effluent, 2 mg/l, as occurs at the James River Sewage Treatment Plant. A portion of the chlorinated sewage effluent was dechlorinated with sodium thiosulfate, and the dechlorinated waste was diluted with estuarine water in the same proportions as the clorinated waste. Menidia menidia, Palaemonetes pugio, and Crassostrea virginica were exposed to both the chlorinated and dechlorinated wastewater. Mortalities were noted in M. menidia and P. pugio due to high concentrations of chlorinated effluent, whereas similar concentrations of dechlorinated wastes did not cause mortalities. Mortalities in the chlorinated waste were correlated with chlorine residuals. The chlorinated wastes depressed the shell deposition rate of C. virginica below 50% of controls at all doses. Dechlorinated waste allowed shell deposition greater than 50% of controls. The occurrence of some growth inhibition, however, was noted in C. virginica exposed to dechlorinated waste, which suggests the presence of toxic material other than chlorine in the waste. (Baker-FRC)
W82-02688

RESPONSE OF SUBTROPICAL PHYTOPLANKTON TO POWER PLANT ENTRAINMENT,

Oceanic Inst., Waimanalo, HI.
P. Bienfang, and W. Johnson.
Environmental Pollution Series A, Vol 22, No 3, p 165-178, July, 1980. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Phytoplankton, *Cooling water, *Thermal stress, *Powerplants, Kahe, *Hawaii, Chlorophyll a, Adenosine triphosphate, Water pollution effects, Thermal pollution, Seawater, Primary productivity, Productivity, Entrainment, Photosynthesis, Biomass, Seasonal variation.

Phytoplankton entrained in the cooling waters of the Kahe, Hawaii, oil-fired power plant showed a temporary 30% decrease in primary productivity. Chlorophyll a and ATP levels were not significantly affected. Organisms were exposed to a 5-6 degrees C increase over the ambient 24-26 degrees C levels during the 4 min transit time. Rapid mixing returned the discharged water to ambient temperature within minutes. Sampling was done at different seasons during a 20-month period. Laboratory tests confirmed the field data and supported the conclusion that no seasonal variation was apparent. Thermal stress, rather than mechanical or pressure stress, was primarily responsible for the observed effects on the phytoplankton. (Cassar-FRC)
W82-02708

TOXICITY OF TEXTILE MILL EFFLUENTS TO FRESHWATER AND ESTUARINE ALGAE, CRUSTACEANS AND FISHES,

Environmental Protection Agency, Gulf Breeze, FL.
G. E. Walsh, L. H. Bahner, and W. B. Horning.
Environmental Pollution (Series A), Vol 21, No 3, p 169-179, March, 1980. 1 Fig, 5 Tab, 8 Ref.

Descriptors: *Textile mill wastes, *Algae, *Crustaceans, *Fish, *Toxicity, Water pollution effects, Effluents, Shrimp, Daphnia, Aquatic life, Invertebrates, Estuarine environment, Shrimp organic compounds, Heavy metals, Metals, Nutrients, Industrial wastes.

Algae and aquatic animals were exposed in the laboratory to secondary effluents from 23 textile

mills. There were wide variations in chemical compositions, but all contained heavy metals, organic chemicals, and nutrients. Algae, particularly Selenastrum capricornutum (freshwater) and Selenastrum costatum (estuarine), were most responsive to all wastes; some effluents were stimulatory at concentrations of less than 1% but inhibitory at concentrations greater than 50%. Overall, 61% of the effluents were toxic to Daphnia pulex, 40% to fathead minnows (Pimephales promelas), and 53% to grass shrimp (Palaemonetes pugio) and sheepshead minnows (Cyprinodon variegatus). There was no obvious relationship between biological effects and the many parameters of effluent quality. Both growth stimulants and toxicants were present in some wastes. The impact of complex wastes on aquatic systems was calculated using the discharge rate and the LC50, EC50, or SC20. Thus Waste X with low SC20 and high discharge rate was judged most toxic of the group. Waste W, with a low SC20 and low discharge rate, had a low potential for adverse effects. (Cassar-FRC)
W82-02710

ALUMINUM TOXICITY TO FISH AS RELATED TO ACID PRECIPITATION AND ADIRONDACK SURFACE WATER QUALITY,

Cornell University, Ithaca, NY.
J. P. Baker.
PhD Thesis, January, 1981. 458 p, 55 Fig, 40 tab, 152 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-10995.

Descriptors: *Water pollution effects, *Acid rain, Acidity, Aluminum, Water quality, *Fish, Toxicity, Surface water, Seasonal variation, Hydrogen ion concentration, Lakes, Lake fisheries, New York, *Adirondack Mountains.

The Adirondack Region of New York State contains over 2000 lakes. Many of these lakes are experiencing acidification and declines or loss of fish populations. The objective of this investigation was to improve the understanding of effects of acidification of surface waters on Adirondack fish populations. It was found that on the average, aluminum complexed with organic ligand was the dominant aluminum form in the dilute acidified Adirondack surface waters studied. In laboratory bioassays, speciation of aluminum was shown to have a substantial effect on aluminum toxicity to early life history stages of fish. Based upon available field and laboratory data, concentrations of inorganic aluminum and hydrogen ions appear to be important factors determining fish survival in Adirondack surface waters affected by acidification. For the range of pH and aluminum levels, and fish species and life history stages studied, sensitivity to low pH levels decreased with increasing age while sensitivity to elevated inorganic aluminum levels increased with increasing age (through the post-swim-up fry stage). Water quality in Adirondack lakes and streams sampled was temporally highly variable. In general, in streams affected by acidification pH level was at a minimum (and conversely inorganic aluminum level at a maximum) during early phases of snowmelt in the spring and also during long periods of heavy rainfall, often concentrated in the fall season. Temporal water quality fluctuations in lakes were dampened by the larger water volume and longer water retention times within the system. (Sinha-OEIS)
W82-02726

EFFECTS OF HYDROLOGICAL AND BIOLOGICAL VARIABLES ON THE SURVIVAL, GROWTH, AND FOOD UTILIZATION OF ESTUARINE FISHES CAGE-CULTURED IN A HEATED WATER SYSTEM,

Texas A and M University, College Station.
F. V. Jones.
PhD Dissertation, May, 1981. 328 p, 47 Fig, 2 Tab, 154 Ref, 10 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-18271.

Descriptors: *Aquaculture, *Estuarine fisheries, *Heated water, Powerplants, Cooling water, Cooling ponds, Fish, Growth, Survival, Salinity, Temperature effects, Texas.

Estuarine fishes were cultured in cages in the intake area and at four locations in the cooling lake of a power plant near Baytown, Texas from 1 September 1976 through 1 September 1978 to determine the effects of heated water on the dynamics of growth. Evaluation of data was based on eight hydrological variables. survival, growth and food-conversion efficiency of pinfish (Lagodon rhomboides), spot (Leiostomus xanthurus), Atlantic croaker (Micropogonias undulatus), black drum (Pogonias cromis) and striped mullet (Mugil cephalus). Survival of fishes was low in the intake area and increased progressively through the cooling lake. Mortality was related to temperature, handling stress (especially in small fish) and rapid drops in salinity. The most important relationship relating to mortality was the temperature-salinity-size interaction. During winter periods of low temperature when salinity dropped rapidly, mortality rates were greatest; small fish were better able to tolerate stressful conditions than large fish. Percent growth was highest during warm months when fish were small and lowest in the winter. Instantaneous growth rates were correlated to temperature, salinity, feeding rate, size of fish and, to a lesser extent, station location, DO and pH. Mean food conversion efficiently (FCE) was highest when temperatures were high and fish small. (Sinha-OEIS)
W82-02730

THE EFFECTS OF URBANIZATION ON SMALL WATERSHEDS AND GROUNDWATER,

Rochester Univ., NY. Dept. of Geological Sciences.
R. L. Davis.
PhD Dissertation, 1980. 377 p, 80 Fig, 36 Tab, 77 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13608.

Descriptors: *Water quality, *Water pollution effects, *Groundwater, *Urbanization, Watersheds, Urban runoff, Flooding, Erosion, Environmental effects, Chlorides, *Penfield, New York.

A study was undertaken in Penfield, New York, to examine the effects that development was having on the small streams and ground water in the town. The ground water quality data collected from Penfield was analyzed by comparing it to data from the 1930's (when the town was not developed), by comparing groups of wells in rural and urban parts of the town, and by comparing wells grouped by their distance to the nearest road. The surface water data was analyzed by grouping watersheds as to their degree of urbanization. In addition seasonal changes in water quality were examined, as were effects of rainfall and snow fall on surface water quality. Substantially elevated levels of chloride ion concentrations were found in both the surface and ground waters of the town. In the surface waters, the increases in concentration were largest in the most urbanized watersheds, however, all watersheds appear to have been affected. In the ground waters the increases were greatest in ground water samples taken at locations close to roads. The implications suggested by the results of the study included the likelihood of a substantial decrease in quality of the town of Webster's water supply, and by extension, decreased water quality for the entire aquifer that supplies it. In addition, deterioration of surface water quality in Penfield and the other towns with streams tributary to Irondequoit Bay is likely to cause continued deterioration of the Bay environment. Strategies for minimizing the changes accompanying development included the use of less de-icing salt and the use of zoning to channel development into those areas whose development would cause the least damage. (Sinha-OEIS)
W82-02738

THE RESPONSE OF THE INVERTEBRATE FAUNA TO ORGANIC POLLUTION IN A WELL OXYGENATED KARST STREAM EXEMPLIFIED BY THE PRADNIK STREAM (SOUTH POLAND),

Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody.
E. Dratnal, and K. Kasprzak.
Acta Hydrobiologica, Vol 22, No 3, p 263-278, 1980. 9 Fig, 2 Tab, 6 Ref.

Descriptors: *Karst hydrology, *Organic wastes, *Poland, Decomposing organic matter, Organic carbon, Waste load, Oxygen, Dissolved oxygen, Sedimentation, Sediments, Rivers, Bed load, *Benthic fauna, *Water pollution effects.

Results of three studies made on the benthic invertebrate communities of the Pradnik stream affected by waste waters from a dairy are presented. The three studies were conducted in 1968, 1969 and 1973-74. Samples were taken from the stream above the influx of wastes and below it as well, from the whole stretch of the stream affected by pollution. During 1969 a new waste water treatment plant in the vicinity broke down several times and the effectiveness of effluents disposal was not sufficient. In spite of some common features in the reaction of animals to organic pollution, marked differences also were in that reaction in the particular periods connected mainly with the varying efficiency of the waste treatment plant. Two zones emerged within the polluted section of the stream. The first zone was situated immediately below the influx of organic wastes. This zone was a zone of sedimentation and initial decomposition of organic matter. The bottom resembled a silty habitat, while the decomposition of the organic part caused a decline in oxygen content in the upper layer and its disappearance in the deeper silt layer. The second zone seemed to be a zone of total decomposition of organic matter and drawing of nutrients released into the process of primary production, expressed by the regulation of oxygen conditions and a high primary production yielding intense growth of algae covering stream-bed zones. (Baker-FRC)
W82-02751

STUDIES ON THE PRIMARY PRODUCTION OF THE RIVER SHATT AL-ARAB AT BASRAH, IRAQ,

Universidad de Oriente, Cumana (Venezuela). Inst. of Oceanography.
M. F. Huq, H. A. Al-Saad, and H. A. Hameed.
Hydrobiologia, Vol 77, No 1, p 25-29, 1981. 3 Fig, 2 Tab, 27 Ref.

Descriptors: *Chlorophyll a, *Productivity, *Rivers, Water pollution effects, Shatt al-Arab River, Basrah, *Iraq, Primary productivity, Eutrophication, Wastewater pollution.

Primary production at three stations in the Shatt Al-Arab River near Basrah, Iraq, was investigated from September 1976 to August 1977. Chlorophyll a levels ranged from 0.52 to 3.25 mg per cu meter and peaked in late February and in September-October. The station upstream of the city had the lowest chlorophyll a values, and the mid-city station, the highest. Gross primary production varied from 6.03 to 37.02 mg C per cu meter per hour with a maximum in August and a minimum in winter at all stations. The mid-city station was most productive. Chlorophyll a concentrations and gross primary production were positively correlated. (Cassar-FRC)
W82-02776

STUDIES ON THE ACUTE TOXICITY OF SOME HEAVY METALS TO AN INDIAN FRESHWATER POND SNAIL VIVIPARUS BENGALENSIS L.,

Udaipur Univ. (India). Dept. of Limnology and Fisheries.
P. K. Gupta, B. S. Khangarot, and V. S. Durve.
Archiv fur Hydrobiolgie, Vol 91, No 2, p 259-264, May, 1981. 2 Tab, 19 Ref.

Descriptors: *Snails, *Water pollution effects, *Heavy metals, Copper, Zinc, Chromium, Nickel, *Toxicity, Cadmium, Ponds, Lakes, *India.

The acute toxicity of salts of copper, zinc, chromium, cadmium and nickel to the freshwater pond snail V. bengalensis was investigated. Snails were collected from FatehSagar Lake, Udaipur, and exposed to the salts under laboratory conditions. The heavy metallic ions were ranked according to the results in 96 hr median lethal dose studies as fol-

lows from the most toxic to the least toxic: copper, zinc, chromium, cadmium, and nickel. The acute toxicity of zinc varied greatly with the changing water quality. The deposition of a white precipitate at the bottom along with an increase in pH was noted in the zinc solution after 24 hr of exposure. This has also been noted in similar studies by other researchers. The 96 hr median lethal values for the metallic ions were 0.088 for copper, 2.83 for zinc, 6.27 for chromium, 8.40 for cadmium, and 39.83 for nickel, in ppm. The cadmium solution also showed a white precipitate and a milky appearance. (Baker-FRC)
W82-02789

THE RELATION BETWEEN 'HYDRAULIC STRESS' AND MICRODISTRIBUTION OF BENTHIC MACROINVERTEBRATES IN A LOWLAND RUNNING WATER SYSTEM, THE SCHIERENSEEBROKS (NORTH GERMANY),

Karlsruhe Univ. (Germany, F.R.) Inst. fuer Zoologisches.
B. Statzner.
Archiv fur Hydrobiologie, Vol 91, No 2, p 192-218, May, 1981. 1 Fig, 5 Tab, 67 Ref.

Descriptors: *Population dynamics, *Running waters, Stress, *Benthos, *Macroinvertebrates, Gastropods, Insects, Crustaceans, Flow characteristics, Hydrodynamics, Flow pattern, *Germany.

During a field study on the production ecology of two lowland brooks in North Germany, the sizing of the specimens sampled indicated a relation between specific size distribution and some hydrodynamic factor. The field data collected was then reviewed in relation to hydrodynamic effects. The study was carried out in the Upper and Lower Schierenseebrook, which are situated between three eutrophic lakes near Kiel. Both brooks are relatively short, with lengths of about 400 and 800 meters respectively. During the sampling period from spring of 1974 through autumn of 1975, discharges reached a maximum in winter and minimum from June to October. The substratum was sampled to a depth of about 5 cm. Parallel to each benthic sample the current speed, water depth, and character of the substratum occurring immediately at the sampling place were noted. The study demonstrated that mean size and abundance of benthic macroinvertebrates may be related to both the index of hydraulic stress and the thickness of the laminar sublayer. While the latter parameter is expected to describe the character of the forces acting immediately above the bottom more realistically than the former, both can be regarded as indices for the specific hydraulic stress. The use of hydraulic stress is favored in studies on running waters. (Baker-FRC)
W82-02790

DISTRIBUTION OF CHROMOBACTERIA IN A LOWLAND RIVER,

Surrey Univ., Guildford (England). Dept. of Microbiology.
M. O. Moss, and C. Ryall.
Microbial Ecology, Vol 7, No 2, p 139-149, 1981. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Rivers, *Bacteria, Silt, Organic matter, Temperature effects, Rainfall, Turbidity, *Wey River, *England.

The numbers of purple pigmented bacteria in the River Wey were estimated by use of a selective medium. Chromobacteria were not isolated from the springs at the source of the river. However, they were found within a short distance, and their numbers generally increased over the first 30 km. While the counts were always on the low side, they generally increased over the winter as opposed to summer. Water temperature and turbidity measurements, along with rainfall, were recorded during the time of sampling. Much of the variability in the counts of chromobacteria was correlated with turbidity. A significant inverse correlation with temperature was noted after turbidity effects were allowed for. These two factors, temperature and turbidity, together accounted for 64.7% of the variation in counts. A significant correlation was also noted with rainfall during the previous four days. Together these three factors accounted for 67.2% of the variability in counts. Samples of silt, soil and storm overflow effluents were studied in an attempt to discover the source of chromobacteria. The soil or silt which contained substantial quantities of organic material also contained the higher values of chromobacteria. (Baker-FRC)
W82-02795

SEASONAL CHANGE IN CILIATE POPULATIONS IN THE BOTTOM SEDIMENT OF A POLLUTED RIVER,

Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
S. Suehiro, and Y. Tezuka.
Japanese Journal of Limnology, Vol 42, No 1, p 1-7, January, 1981. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Seasonal variation, *Protozoa, *Sediments, Bacteria, Temperature effects, Light intensity, Bottom sediments, *Water pollution effects, Rivers, Municipal wastewater, *Tamagawa River, *Japan, Population dynamics.

Species composition and the number of individuals of each species of ciliates were investigated for two years in the bottom sediment of a river polluted with municipal sewage. Emphasis was placed on the seasonal change in ciliates, because the seasonal change in river environment was felt to facilitate the study of the relationship between the ciliate community and environmental factors. The study was conducted 2 km upstream from the Marukobaski Bridge of the Tamagawa River, in the southwest part of Tokyo Metropolitan Prefecture, which has been polluted with a large amount of municipal sewage. A similar pattern of the seasonal change in ciliate populations was noted for two years. In winter, Paramecium caudatum, P. trichium, Colpidium colpoda and Chilodonella cucullulus dominated. From summer to autumn Loxodes spp. and P. caudatum were predominant. Frontinia leucas also appeared in the summer. Stentor, Metopus es, Litonotus and Acineria did not change seasonally. A bacterial density of approximately 10 to the 8th power cells per ml was observed in the sediment; thus prey availability does not account for the observed fluctuations. Interspecific relations such as predation and competition may be important factors controlling the seasonal changes in ciliate populations. (Baker-FRC)
W82-02797

BACTERICIDAL EFFECT OF SEAWATER CONTAINING DIGESTED NIGHT SOIL AND MARINE PLANKTON AGAINST INTESTINAL BACTERIA, (IN JAPANESE),

Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5E.
W82-02799

A REEXAMINATION OF THE ZOOPLANKTON COMMUNITY OF A DELAWARE TIDAL STREAM,

Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 5B.
W82-02805

FUNCTIONAL RELATIONSHIPS BETWEEN NUTRIENT DYNAMICS, OXIDATION-REDUCTION CAPACITY, AND EUTROPHICATION IN A SOFT-WATER LAKE,

Connecticut Univ., Storrs. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W82-02810

PHYSICAL CHARACTERIZATION OF EXTRA-CHROMOSOMAL DNA IN CHESAPEAKE BAY BACTERIA FROM POLLUTED AND NON-POLLUTED SITES,

Maryland Univ., College Park. Water Resources Research Center.
For primery bibliographic entry see Field 5B.
W82-02814

PLANKTON STUDIES IN SAN FRANCISCO BAY. II. PHYTOPLANKTON ABUNDANCE AND SPECIES COMPOSITION, JULY 1977 - DECEMBER 1979,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2L.
W82-02832

POLLUTION EFFECTS ON THE PHYTOPLANKTON-ZOOPLANKTON RELATIONSHIPS IN AN INSHORE ENVIRONMENT,

Athens Univ. (Greece). Zoological Lab. and Museum.
M. Moraitou-Apostolopoulou, and L. Ignatiades.
Hydrobiologia, Vol 75, No 3, p 259-266, 1980. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Plankton, *Population dynamics, *Eutrophication, Water pollution effects, Coastal waters, Phytoplankton, Zooplankton, Bays, *Aegean Sea.

Water samples were collected from sites in the Aegean Sea area at about 1 meter depth between 10 and 11 AM at two week intervals from July 1977 through June 1978. The seasonal variation of phytoplankton at a station, where the effects of eutrophication from sewage were minimal, was similar in periodicity to the corresponding cycle in lower Saronicos Gulf, with characteristic peaks in spring and autumn. At a second station, where sharp eutrophication conditions prevailed, the annual cycle showed some discrepancies in periodicity, having maximum growth in August. The species the first station diversity at this station was also depressed. The zooplankton annual cycle at the first station was characterized by a period of lower abundance in May-October, followed by an increase in population from November through April, with characteristic peaks in November and March. At the second station the zooplankton cycle showed remarkable changes in periodicity, since maximum abundance occurred in July-September, followed by consequent decreases and increases in the population size during the rest of the year. The quantitative relationship between the principal grazers in the zooplankton population and the phytoplankton dominant species upon which these copepods were believed to graze was tested, but the correlation coefficient was nonsignificant, indicating that the grazers did not feed exclusively on the dominant flagellate. (Baker-FRC)
W82-02886

OBSERVATIONS ON SOME COMMON PARASITES OF BAGRUS DOCMAC FORSKAHL (PISCES: SILUROIDEA) OF LAKE VICTORIA,

East African Freshwater Fisheries Research Organization, Jinja (Uganda).
For primary bibliographic entry see Field 2H.
W82-02887

MORPHOLOGICAL CHANGES IN TOXIC AND NON-TOXIC MICROCYSTIS ISOLATES AT DIFFERENT IRRADIANCE LEVELS,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
G. H. J. Kruger, J. N. Eloff, and J. A. Pretorius.
Journal of Phycology, Vol 17, No 1, p 52-56, March, 1981. 4 Fig, 2 Tab, 28 Ref.

Descriptors: *Algae, *Morphology, *Light intensity, Pollutant identification, Phytoplankton, Cyanophyta, Eutrophication, Plent morphology, Microsystis.

Light intensity (4.5-40.0 microEin per sq meter per sec) and culture age produced variations in cell size in 2 isolates of Microcystis aeruginosa, one nontoxic (probably forma flos-aquae) and one toxic (probably forma aeruginosa). Average cell volumes were 33-119 cu microns and 21-74 cu microns, respectively. The rate of cell volume increase in cu microns per day was expressed by 1.03 times light intensity minus 6.49. Highest maximum average cell volume was at 17 micro Ein per sq meter per sec, above which cell growth was disrupted. Cell diameters ranged widely, from 3.4 to

7.2 microns for the nontoxic isolate and 1.8 to 6.4 microns for the toxic isolate. These results show that cell size as a method of distinguishing between the 2 isolates is not reliable unless environmental conditions are carefully considered. (Cassar-FRC)
W82-02906

FACTORS INFLUENCING THE COMPOSITION, STRUCTURE AND DENSITY OF A POPULATION OF BENTHIC INVERTEBRATES,

Alberta Environmental Center, Vegreville.
For primary bibliographic entry see Field 2H.
W82-02909

A CARLSON-TYPE TROPHIC STATE INDEX FOR NITROGEN IN FLORIDA LAKES,

California Univ., Los Angeles. Office of Environmental Science and Engineering.
C. R. Kratzer, and P. L. Brezonik.
Water Resources Bulletin, Vol 17, No 4, p 713-715, August, 1981. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Nitrogen, *Lakes, Trophic level, *Eutrophication, Water quality, Monitoring, Mathematical studies.

A trophic state index was developed based on total nitrogen concentration. Information for building the index was taken from a data base consisting of predominantly nitrogen limited Florida lakes studied in the National Eutrophication Survey. The new index was compared with Carlson's index of 1977, which was based on total phosphorus concentration, and the lesser of the two values for each lake was averaged with indices based on Secchi disk transparency and chlorophyll a concentration to assess the trophic state of the 40 Florida lakes mentioned in the National Eutrophication Survey. Trophic state is a multidimensional phenomenon, and it is agreed in general that no single trophic indicator adequately measures the underlying concept. Combining the major physical, chemical, and biological expressions of trophic state into a single index smooths out the variability associated with individual indicators and provides a reasonable composite measure of trophic conditions in a lake. (Baker-FRC)
W82-02911

THE RELATIVE CONTRIBUTIONS OF SULFURIC AND NITRIC ACIDS IN ACID RAIN TO THE ACIDIFICATION OF THE ECOSYSTEM. IMPLICATIONS FOR CONTROL STRATEGIES,

Domtar Ltd. Research Centre, Senneville (Ontario).
R. A. N. McLean.
Journal of the Air Pollution Control Association, Vol 31, No 11, p 1184-1187, November, 1981. 1 Tab, 34 Ref.

Descriptors: *Acid rain, *Sulfuric acid, *Nitric acid, Snowmelt, Thaw, Aquatic life, Sulfur dioxide, Water pollution sources.

It is proposed that the contributions of nitric acid and sulfuric acid in atmospheric deposition to the acidification of the terrestrial and aquatic escosystems are not equivalent and that, except possibly during the spring thaw, nitric acid contributes considerably less to the acidification of the ecosystem. A major part of the assessment of the impact of acid rain on aquatic and terrestrial ecosystems involves the examination, by means of ion budgets, of the fate of each of the ionic constituents in atmospheric deposition in soils, surface waters, and other places. It was concluded that much of the nitric acid in acid rain is decomposed in the soils and waterways, and in the process acid is consumed. Therefore, unlike sulfuric acid in acid rain, nitric acid is not a significant contributor to long term acidification of the environment. Even so, during the spring thaw, in areas which have been heavily impacted by acid rain for a number of years, nitric acid which has concentrated in the snow pack over the winter may cause ecological damage, especially to fish populations. Though there is little doubt that tighter control strategies are needed to diminish the effects of acid rain on remote ecosystems, the existing control strategies, which have put more emphasis on the control of emissions of sulfur oxides than nitrogen oxides, have a reasonable scientific basis given present limited knowledge of their effects on the ecosystem. (Baker-FRC)
W82-02913

AMMONIA VOLATILIZATION IN A HYPERTROPHIC PRAIRIE LAKE,

National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2H.
W82-02915

THE EFFECT OF ALPHA-HYDROXYBENZYLMETHANESULFONATE ON PHOTOSYNTHESIS AND EXCRETION OF CHLORELLA AND NATURAL PHYTOPLANKTON IN A LAKE,

Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
Y. Watanabe.
Archiv fur Hydrobiologie, Vol 91, No 2, p 219-230, May, 1981. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Aquatic life, *Water pollution effects, Aquatic plants, *Phytoplankton, Chlorella, Chlorophtya, Algae, Lakes, Organic compounds, Stratification, Oxidation, *Hydroxybenzylmethanesulfonate.

The effect of alpha-hydroxybenzylmethanesulfonate on the photosynthesis and excretion of cultured Chlorella ellipsoidea and the natural phytoplankton populations in a lake was investigated to further the understanding of the role of glycolate excretion by phytoplankton in the carbon cycle in an aquatic ecosystem. HBMS stimulated the glycolate excretion of Chlorella in culture under a wide range of temperatures and light intensities. Similar effects were ascertained for the phytoplankton of a stratified eutrophic lake, Lake Nakanuma, in various seasons and at different depths of the photic zone. HBMS did not enhance the excretion of high molecular weight substances. The dark fixation of carbon dioxide by both samples was inhibited by HBMS. Total photosynthesis by Chlorella was slightly enhanced by HBMS. For the phytoplankton samples, the effect of HBMS on total photosynthesis was indefinite. The variability of the effect was apparently influenced by the nutritional state of the phytoplankton cells. (Baker-FRC)
W82-02918

CHANGES IN FLORA DOWN A STREAM SHOWING A ZINC GRADIENT,

Durham Univ. (England). Dept. of Botany.
P. J. Say, and B. A. Whitton.
Hydrobiologia, Vol 76, No 3, p 255-262, 1980. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Zinc, *Mine wastes, *Algae, *Aquatic plants, *Water pollution effects, Water quality, Gillgill Burn, England, Heavy metals, Streams, Species distribution, Diatoms, Cyanophyta, Chlorophyta, Chrysophyta.

The effects of zinc from lead mines abandoned in 1921 on the flora and water chemistry of a small stream were studied. Samples from 30 reaches, each 10 m long, of Gillgill Burn and its four tributaries contained from 0.24 to 25.6 mg per liter Zn (means for any one reach). There was a negative correlation between the number of photosynthetic species in a reach and the logarithm of Zn concentration. A nonpolluted stream contained 61 species, 11 not seen in Zn-contaminated waters. The water with the highest Zn level (25.6 mg per liter) had 25 species. Up to 41 species were recorded in water containing low levels of Zn (1-2 mg per liter). The species composition changed with Zn levels. Some species were present only at higher levels of Zn (less than 3 mg per liter): Schizothrix delicatissima, Synechococcus sp., Eunotia tenella, Pinnularia borealis, and Euglena mutabilis. Others were not observed in polluted waters: Microspora amoena, Synedra ulna, and Tabellaria flocculosa. (Cassar-FRC)
W82-02946

GROWTH CHARACTERISTICS OF THE HETEROTROPHIC BACTERIAL POPULATION OF WATER AND BOTTOM SEDIMENTS IN TANKS UNDER DIFFERENT TROPHIC CONDITIONS,

Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, G. N. Patel, S. K. Roy, and U. K. De.
Hydrobiologia, Vol 75, No 3, p 231-239, 1980. 2 Fig, 5 Tab, 14 Ref.

Descriptors: *Population dynamics, *Bacteria, *Sediments, Bottom sediments, Nutrients, Trophic level, Eutrophication, Temperature effects, Fertilizers, Microbiological studies, Water pollution effects, Field tests.

The growth characteristics of the heterotrophic bacterial community of water and bottom sediments in field-study tanks were studied under the influence of various doses of inorganic and organic fertilizers. The study was carried out in six cemented tanks of three trophic types in duplicate for twice-normal, normal and zero concentrations of superphosphate, urea and cow manure. Surface water and mud samples were collected at intervals of four hours during a day, once after 7 days and once after 32 days of fertilizer application, in order to determine the generation time of heterotrophic bacteria. The results indicated that the application of single and double doses of fertilizers in these tanks caused distinct changes in the heterotrophic microbial population of water and bottom sediments in the early phase of treatment. Since the organic matter and inorganic nutrients in the double dose tanks had been utilized at a faster rate than the single dose treatment, the population decline was much higher in the former than in the latter treatment for the same passage of time. The population growth of bacteria of water in the tanks was inversely linked with the diurnal changes of water temperature recorded after 32 days of treatment and with dissolved oxygen level. No significant relationship between the heterotrophic bacterial population and the content of water was observed, but an inverse relationship between P and bacterial population in sediment was noted in the early phase of treatment. The growth curve of the heterotrophic bacterial population was independent of the physicochemical processes such as pH, carbonate, bicarbonate, nitrite nitrogen and specific conductivity. (Baker-FRC)
W82-02953

PREDATOR-PREY RELATIONSHIPS AMONG WATER-MITES (HYDRACARINA) AND OTHER FRESHWATER ORGANISMS,

Goeteborg Univ. (Sweden). Dept. of Zoology.
M. O. G. Eriksson, L. Henrikson, and H. G. Oscarson.
Archiv fur Hydrobiologie, Vol 88, No 2, p 146-154, March, 1980. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Ecological effects, *Fish, *Predation, *Population dynamics, *Mites, Aquatic insects, Perch, Oligotrophic lakes, Acidic water, Acidity, Animal populations, Aquatic animals, Water pollution effects, Food chains, Zooplankton, Lakes, Field tests, Parasites, Sweden.

Predator-prey relationships among perch, water-mites (Piona carnea L.) and other aquatic species were investigated in field and laboratory tests. Significant relationships were noted between occurrence of fish and water mites in 16 oligotrophic lakes of Southwest Sweden. In a field experiment that kept perch only on one side of a lake by a net barrier, significantly more water mites were observed in the section containing fish. Laboratory tests showed that mites were eaten by perch only when no other food was available. In lakes devoid of fish, predation from insects kept water-mite populations in check. Water-mite populations may benefit from the presence of fish because increased predation of insects by fish may remove many of the natural predators of water mites. Some other factors such as lake acidification and the presence of more suitable zooplankton prey for water-mites might also account for correlations between fish and mite populations of the same lake. (Geiger-FRC)
W82-02963

OXYGEN-CONSUMING ORGANICS IN NON-POINT SOURCE RUNOFF,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5B.
W82-02966

REDUCTION OF TOXICITY TO AQUATIC ORGANISMS BY INDUSTRIAL WASTEWATER TREATMENT,
EG and G, Bionomics, Wareham, MA.
G. A. Cary, and M. E. Barrows.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-222366, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-043, August, 1981. 5 p, 1 Tab, 3 Ref.

Descriptors: *Toxicity, *Industrial wastewater, *Bioassay, *Effluent, Pesticide industry, Pulp and paper industry, Chemical industry, *Fathead minnows, Daphnia, Aquatic animals, Environmental effects, Wastewater treatment.

In order to biologically evaluate the effectiveness of industrial wastewater facilities in reducing effluent toxicity to aquatic organisms, 24-hour static acute bioassays with untreated influent and treated effluent were conducted using fathead minnows and water fleas. Of primary interest was an evaluation of the capacity of the wastewater treatment facilities of the pesticide industry for reducing toxicity. On-site 24-hour static acute toxicity tests were performed during 10 consecutive workdays at seven industrial sites. Five of the test sites are defined as pesticide manufacturers, while the remaining sites consisted of an organochemical manufacturer and a bleached-kraft papermill. The data from those studies indicate that the wastewater treatment plants provided an average efficiency of 98% in reducing the toxicity of untreated wastewaters. The results of 10 consecutive days of biological testing at each site indicate that the toxicity of the treated effluent samples remained relatively constant from day to day. The average number of lethal units present in the treated effluent, as determined from tests with fathead minnows, was 2.1 with a range of 0-6 lethal units. Water flea tests provide a mean of 6.5 lethal units with a range of 0-34. The toxicity of the untreated influent samples was extremely variable on a day to day basis. Neither species tested proved to be a more sensitive indicator of toxicity, though a larger data base is required to make a valid appraisal. (Moore-SRC)
W82-02971

ALTERATIONS IN THE FREQUENCY OF SISTER CHROMATID EXCHANGES IN FLATFISH FROM PUGET SOUND, WASHINGTON, FOLLOWING EXPERIMENTAL AND NATURAL EXPOSURE TO MUTAGENIC CHEMICALS,
Washington Univ., Seattle. Coll of Fisheries.
P. T. Stromberg, M. L. Landolt, and R. M. Kocan.
National Oceanic and Atmospheric Administration Technical Memorandum OMPA-10, June, 1981. 50 p, 13 Fig, 8 Tab, 70 Ref.

Descriptors: *Water pollution effects, *Mutagens, *Toxicity, Bioindicators, Fish, Carcinogens, Estuarine environmental, Sublethal effects, Puget Sound, Washington.

Contamination of the aquatic environment by chemical pollutants has become a serious environmental problem which is heightened by the fact that a number of these contaminants have been demonstrated to be mutagenic or carcinogenic. One method that has been used recently to assess the effects of mutagenic chemicals on various organisms measures the rate of sister chromatid exchanges (SCE). The technique of SCE was applied to English sole collected from Puget Sound, Washington. SCE were observed 5.5 days after in vivo exposure to a thymidine analogue, bromodeoxyuridine (50 mg/g body wt) which allows for differentiation in the staining affinity of chromatids and visualization of exchanges between them. A baseline SCE rate of 2.6 exchanges per cell was determined. The sensitivity of this test was examined by subjecting the fish to benzo(a)pyrene (B(a)P). The SCE rates of cells from fish exposed to three concentrations (0.05, 1.5, and 5 micro g/g body wt) of intaperitoneally injected B(a)P were 2.99, 4.07, and 5.93 SCE/cell, respectively. The response was found to be dose-related and significantly higher than the baseline frequency. To test the efficacy of this technique as a useful tool in screening fish for evidence of exposure to mutagenic chemicals, the chromosomes of English sole from a polluted site (Duwamish River, Seattle) were examined and found to have a significantly higher SCE rate (3.25 per cell) than the baseline. (Moore-SRC)
W82-02979

RECREATIONAL WATER QUALITY AND HEALTH,
Illinois Univ. at the Medical Center, Chicago.
R. L. Northrop, G. R. Brenniman, S. H. Rosenberg, R. B. Byington, and C. S. Hesse.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-103599, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S1-81-059, September, 1981. 3 p.

Descriptors: *Public health, *Water quality, *Swimming, *Recreation, Water pollution effects, Microbiological studies, Bacteria, Coliforms, Sampling, Beaches, Water analysis.

The overall objective of this pilot study was to develop and evaluate methods to determine the effect of recreational water quality on the health of persons bathing in fresh waters. Two beaches in the Cleveland, Ohio metropolitan area on Lake Erie were chosen for study: Edgewater Beach, near two sources of pollution; and Headlands State Park Beach, with no known point sources of pollution. One hundred families from each beach were selected to participate in the study over three weekends in July 1977. Five water samples were collected in a systematic pattern at each beach at 0900, 1200 and 1500 hours on each test day. Each sample was analyzed for total coliforms, fecal coliforms, E. coli, fecal streptococci, Pseudomonas aeruginosa, total staphylococci, pH, chloride, BOD5, turbidity, specific conductivity, suspended solids, total solids, and temperature. Results indicate that it is possible to recruit and follow families via telephone interviews over a three-week period with low attrition rates. The demographic characteristics of bathers and nonbathers at the two study beaches were generally similar. Families at the beach with poor water quality had a slightly lower socioeconomic status than families at the beach having good water quality. The concentrations of the water variables were found to be significantly different depending on the time of day and day of weekend that they were collected. Quality of recreational water can be adequately monitored by sampling the water for microbiological variables at one central location in the bathing area instead of the five locations used in this study, as long as time of day and day of weekend are considered. (Moore-SRC)
W82-02997

5D. Waste Treatment Processes

SPIRAL CLASSIFIERS HELP ONE MANUFACTURER MEET ENVIRONMENTAL STANDARDS MORE EASILY,
T. Bhagat.
Water and Pollution Control, Vol 118, No 7, p 15, 1980. 1 Fig.

Descriptors: *Industrial wastewater, *Wastewater treatment, Suspended solids, Abrasion, Solids, Settleable solids, Sedimentation, Separation techniques.

Wastewater from the General Motors facility at St. Catharines, Ontario, is treated by the plant's wastewater treatment facility, which handles more than 17,000,000 gallons a day, excluding sanitary waste. The solids content is high in grit and abrasive material, amounting to about 27% sand and iron filings. Severe wear and stoppages were occurring at the plant due to grit in the system. Several methods of cleaning the wastewater before it entered the two 130 ft diameter clarifiers were considered. The solution selected involved the installation of three 72 inch diameter spiral classifiers. The spiral classifier combines settling out of solids and physical removal of larger material. It builds a bed beneath its spiral conveyor so that coarser material and tramp items can be raked up and out the top. Pump and equipment maintenance problems have diminished with the use of spiral classifiers, as there are fewer solids to settle. GM is now meeting environmental standards more easily. Downtime at the company has been lessened. Plans are now being made to cover the classifiers with an insulated enlcosure and pass warm air (24 degrees C) over the surfaces to combat winter freeze-up possibilities. (Baker-FRC)
W82-02602

COMBINED FLUE GAS DESULFURIZATION AND WATER TREATMENT IN COAL-FIRED POWER PLANTS,
Environmental Protection Agency, Research Triangle Park, NC. Utilities and Industrial Power Div.
For primary bibliographic entry see Field 3E.
W82-02606

SUBMERGED DEMINERALIZATION SYSTEM TO BE USED TO PROCESS TMI WASTEWATER,
Industrial Water Engineering, Vol 18, No 4, p 12-13, July/August, 1981.

Descriptors: *Radioactive wastes, *Demineralization, Ion exchange, *Wastewater treatment, *Nuclear powerplants, Cooling water, *Three Mile Island.

The submerged demineralization system originated by Chem-Nuclear Systems, Inc., was scheduled to treat highly radioactive wastewater at the Three Mile Island nuclear plant, starting late in 1981. Basic innovations include: (1) silicon-based zeolite ion exchange resins, which can be loaded to 9500 curies without breakthrough, with organic resins for secondary treatment; (2) a leakage containment system to return leaking water to the decontamination operation; (3) remote control of submerged operating equipment using mechanical linkages; (4) underwater cask loading and storage of spent ion exchange material; (5) a reactor coolant system manifold; and (6) a polishing bed to remove remaining trace fission products. (Cassar-FRC)
W82-02621

APPLICATION OF ADSORPTION TO WASTEWATER TREATMENT,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
W. J. Weber, Jr.
Industrial Water Engineering, Vol 18, No 4, p 19-25, July/August, 1981.

Descriptors: *Activated carbon, *Adsorption, *Organic compounds, Benzene, Carbon tetrachloride, Chlorinated hydrocarbons, *Wastewater treatment, Industrial wastewater, Model studies, Reviews.

The use of adsorption, specifically by activated carbon, for pretreatment of industrial wastes for priority pollutant removal is reviewed. Although activated carbon is an effective adsorbent for most of the 114 organic priority pollutants, the capacities and adsorption rates vary significantly among commercial carbons and among pollutants, and are affected by other substances and conditions. Therefore, it is impossible to generalize or extrapolate system design parameters; each situation requires a separate design. Tables list Freundlich adsorption isotherm parameters for selected pollutants and Freundlich isotherm constants for selected pollutants on four granular and four powdered commercial carbons. The Michigan Adsorption Design and Application Model (MADAM) is discussed and illustrated to show the application of modeling techniques to cost-effective and efficient adsorber design. The two representative cases in-

volve rate data in completely mixed batch reactors containing granular activated carbon for carbon tetrachloride and for benzene. (Cassar-FRC)
W82-02622

ESTIMATION OF PRIMARY PRODUCTIVITY FROM DIEL NITRATE UPTAKE MEASUREMENTS OF THE WATER HYACINTH EICHHORNIA CRASSIPES IN AN AQUACULTURE SYSTEM,

Harbor Branch Foundation, Inc., Fort Pierce, FL.
M. D. Hanisak.
Aquaculture, Vol 19, No 1, p 75-86, January, 1980. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Nitrates, *Aquaculture, Nitrogen, *Tertiary wastewater treatment, Water hyacinth, Macrophytes, Natural waters.

Eleven diel experiments were conducted from January to July 1978 for Eichhornia crassipes. The primary productivity of the water hyacinth was estimated from the nitrate-nitrogen uptake in an aquaculture system using a continuous, automated nutrient analyzer apparatus. Values determined by directly harvesting the biomass agreed with those obtained by this new method. The use of diel nutrient uptake measurements would be a significant improvement for the proper management of aquatic macrophytes in an aquaculture system where measurements based on harvesting methods would be impractical. There were few diel changes in nitrate-nitrogen uptake by Eichhornia, which is beneficial to this species not only in terms of its ecological success in the natural ecosystem, but also in its ability to remove nutrients from tertiary sewage treatment. However, the applicability of this technique for measuring the primary productivity of natural systems is not clear due to potential problems such as reduced ambient nutrient levels, lack of a steady state, not very homogeneous plant population, greater nutrient regeneration, and lack of clearly defined and measurable nutrient inputs and outputs of the system. However, the method would probably be appropriate in circumstances similar to those that permit the use of diurnal oxygen or 'upstream-downstream' methods of measuring productivity. (Baker-FRC)
W82-02635

REVERSE OSMOSIS SEPARATION OF SULFATE, NITRATE, AND AMMONIA FROM MINING EFFLUENTS,

Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
M. Malaiyandi, and V. S. Sastri.
Separation Science and Technology, Vol 16, No 4, p 371-376, May, 1981. 3 Tab, 16 Ref.

Descriptors: *Reverse osmosis, *Membranes, *Mine wastes, Iron, Magnesium, Copper, Zinc, Calcium, Nitrates, Sulfates, Ammonia, Water treatment, *Wastewater treatment, Inorganic compounds, Ion exchange, Quirke Lake, Separation techniques, Cellulose acetate, Water reuse, *Demineralization.

Cellulose acetate membranes were used to study the reverse osmosis behavior of several inorganic ions commonly found in mining effluents. The membranes were first characterized with 1425 mg per liter NaCl solution. The percentage separation increased linearly from 100 to 300 psig and reached a maximum at about 300 psig. The maximum separations for several salts were: sodium sulfate, 1034 ppm, 94.1%; magnesium perchlorate, 830 ppm, 94.7%; magnesium chloride, 1010 ppm, 87.1%; magnesium sulfate, 1020 ppm, 88.2%; calcium chloride, 820 ppm, 89.5%; calcium nitrate, 910 ppm, 94.7% and ammonium nitrate, 3470 ppm, 55.0%. A sample of mining effluent from the Quirke Lake operation, subjected to reverse osmosis at 300 psig, reduced levels of Ca, Zn, Fe, Cu, Mg, nitrate, sulfate, and ammonia from 2.6 to 16 fold. Further second stage reverse osmosis treatment produced a water suitable for recycling purposes. (Cassar-FRC)
W82-02640

SEPARATION OF TOXIC ORGANOTIN COMPOUNDS FROM AQUEOUS SOLUTION BY ADSORPTION,

Kentucky Univ., Lexington. Dept. of Chemical Engineering.
D. Bhattacharyya, C. Adema, and D. Jackson.
Separation Science and Technology, Vol 16, No 5, p 495-503, 1981. 4 Fig, 3 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Organic compounds, *Activated carbon, Adsorbents, *Separation techniques, Organic pesticides, Fungicides, Tin, *Adsorption, Carbon filters, Polymers, Pore size, Toxins, Insecticides.

Organotin compounds are used as insecticides, fungicides, wood preservatives, acid corrosion inhibitors and additives to many products such as antifouling paints. They often appear as contaminants in wastewaters due to the wet blasting of boats during overhaul. The adsorption characteristics of aqueous solutions of tributyltin oxide onto activated carbons, polymeric adsorbents and synthetic carbonaceous substances was studied in a column with the aid of flameless atomic absorption spectrophotometry. The best adsorptive capacities were displayed by OL20X50 and Filtrasorb 300 which both contain a high percentage of macropores. At breakpoint, the adosrptive capacity for this carbon was 0.30 and the capacity at exhaustion with 30 milligrams/liter organotin solution is 0.50. The high capacity of this activated carbon would allow long-term operation without the need of any regeneration. (Geiger-FRC)
W82-02641

WASTEWATER TREATMENT WITH POWDERED ACTIVATED CARBON,

Water Pollution Control Authority, Vernon, CT.
C. Pitkat, and C. Berndt.
Public Works, Vol 112, No 10, p 54-56, October, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Solids, *Chlorination, *Carbon, *Sludge, Suspended solids, *Activated carbon, Aeration, Activated sludge, Biomass, Effluent standards, Digested sludge, Slurries, Sludge filters, Biochemical oxygen demand, Vernon, Connecticut.

Wastewater treatment using powdered activated carbon and a wet air oxidation process for carbon regeneration has met with success in Vernon, Connecticut. The treatment facility receives both domestic and industrial wastes. Wastes from a synthetic textiles plant contain dyes and chemicals which produce high color, BOD and COD levels. The carbon regeneration unit has demonstrated autogenous operation, requiring no outside fuel or heat source once up to operation temperatures of over 400 degrees. Simultaneously with carbon regeneration, the wet oxidation unit has reduced the associated biological solids to a small amount of inert ash, disposable by landfilling. The wet oxidation unit has successfully regenerated spent carbon slurry, and carbon recoveries for the regeneration system have averaged greater than 95 percent. (Titus-FRC)
W82-02642

TREATMENT PLANT FEATURES ULTRAVIOLET DISINFECTION,

C. F. Guarino, and W. C. Wren.
Public Works, Vol 112, No 10, p 82-83, October, 1981. 2 Fig.

Descriptors: *Wastewater treatment, *Disinfection, *Ultraviolet radiation, Solids, *Biodegradation, Anaerobic digestion, Solar energy, Peak flow, Seasonal variation, Discharge, Hydraulics, Design criteria, *Wastewater facilities, Pella, Iowa.

The design of a wastewater treatment plant soon to be installed in Pella, Iowa, is described. It uses solar energy to aid in anaerobic digestion and features one of the first full-scale wastewater disinfection systems using ultraviolet light. Each ultraviolet lamp and jacket is made of high grade natural quartz that allows a minimum 95 percent transmission of 2537 angstrom wave length light through the wastewater. Lamps are rated for 7500 hours of life with an output of 40 watts at the germicidal frequency. Safety, avoidance of generation of toxic byproducts, virus inactivation and space requirements were important considerations in selecting the design. (Titus-FRC)
W82-02644

LAND APPLICATION OF WASTEWATERS: AN OVERVIEW.

For primary bibliographic entry see Field 3C.
W82-02650

ADSORPTION ON CARBON: THEORETICAL CONSIDERATIONS,

S. Miller.
Environmental Science and Technology, Vol 14, No 8, p 910-914, August, 1980. 1 Fig, 2 Tab, 1 Ref.

Descriptors: *Adsorption, *Carbon, Reviews, Theoretical analysis, Pollution control, *Activated carbon, Water treatment, *Wastewater treatment, Mathematical equations.

The scientific basis for various theories and models concerned with the removal of organic solutes from dilute aqueous solution on granular activated carbon is discussed. The equilibrium and dynamic aspects of adsorption, the variables affecting adsorption, and the best-known adsorption models for single- and multicomponent systems are presented in detail. Characteristics of activated carbon are also reviewed. (Baker-FRC)
W82-02658

UPGRADING WITH ROTATING BIOLOGICAL CONTRACTORS FOR AMMONIA NITROGEN REMOVAL,

Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
C. P. C. Poon, H. K. Chin, E. D. Smith, and W. J. Mikucki.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1158-1165, July, 1981. 4 Fig, 17 Ref.

Descriptors: *Biological treatment, *Ammonia, *Effluents, Trickling filters, *Wastewater treatment, Water quality standards, Nitrogen, Nitrification, *Nitrogen removal.

A pilot plant was used to evaluate the utility of a rotating biological contractor process in upgrading a trickling filter system for biochemical oxygen demand reduction and nitrification. The rotating biological contactor system was designed to treat substandard trickling filter effluent. The pilot plant consisted mainly of a 0.5 cm-diameter, four-stage RBC module and a 0.51 m-diameter clarifier. The unit rate of NH3-N removal was low compared to the same RBC process used specifically for NH3-N removal and followed a logistic-S curve or second-order kinetics. The biofilm on the rotating media was very thin, thus a high-density media should be used. Average sludge retention time was 19.8 days, and 0.31 g MLSS/g soluble BOD5 was removed. Nitrification rather than BOD removal controlled the size of the unit selected for application. (Small-FRC)
W82-02673

INFILTRATION/INFLOW SOURCE IDENTIFICATION BY COMPREHENSIVE FLOW MONITORING,

Montgomery (James M.) Inc., Walnut Creek, VA.
D. C. W. DeCoite, R. A. Tsugita, and R. Petroff.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1620-1626, November, 1981. 7 Fig, 4 Tab.

Descriptors: *Sewer infiltration, *Flow measurement, *Monitoring, Infiltration, Rainfall, Computers, Rainfall infiltration, Sewers, Massachusetts, *Sewer systems.

Procedures are presented for the comprehensive flow monitoring program for the Fairfield-Suisun District's (California) sewer system evaluation survey. The flow monitoring program was designed to accurately measure wastewater flows

before, during, and after a significant rainfall event. Areas of significant infiltration/inflow were to be further isolated by smoke testing and television inspection. A computerized flow monitoring program was utilized which was capable of providing synchronized flow readings every 15 minutes within a 15% range of accuracy. The program identified excessive and nonexcessive infiltration/inflow areas, and non-critical areas were quickly eliminated from investigation. Potential savings included reduced costs for smoke testing and television testing programs. (Small-FRC)
W82-02674

RECOMMENDATIONS FOR REGULATORY MODIFICATIONS: THE USE OF WASTE STABILIZATION POND SYSTEMS,

Texas Univ. at Austin. Engineering Department. Dept. of Engineering.
E. F. Gloyna, and L. F. Tischler.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1559-1563, November, 1931.

Descriptors: *Stabilization ponds, *Algae, *Organic carbon, *Wastewater treatment, *Biochemical oxygen demand, Performance evaluation, Water pollution control.

A position on the regulation of waste stabilization pond systems, including limitations on suspended solids, is presented. The position was developed through the evaluation of existing waste stabilization pond systems, the comparison of waste stabilization systems with exemplary activated sludge systems, and studies of algal metabolism as it relates to teceiving waters. A study of four stabilization ponds in Texas indicated that the highest long-term average effluent total BOD5 was 25 mg/liter, and more than 83% of the influent total organic carbon was removed. Waste stabilizetion ponds were found to remove essentially all priority pollutants and were as effective as high-rate systems. Algal cells in the effluent from properly designed and operated stabilization pond systems did not significantly impact receiving waters. (Small-FRC)
W82-02675

STOCHASTIC MODELING OF AN INDUSTRIAL ACTIVATED SLUDGE PROCESS,

Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
K. A. Debelak, and C. A. Sims.
Water Research, Vol 15, No 10, p 1173-1183, October, 1981. 14 Fig, 7 Tab, 22 Ref.

Descriptors: *Stochastic process, *Activated sludge process, Mathematical studies, Probabilistic process, Model studies, *Wastewater treatment, Water treatment facilities, Industrial wastes, Biological oxygen demand, Chemical oxygen demand, Oxygen demand.

A Box-Jenkins time series transfer function model was developed for the effluent chemical oxygen demand (COD) using the influent COD, from a sewage treatment process. The data for the study came from an industrial waste treatment plant. The COD data are reported on a daily basis and cover a 14 month period. Typical plant operating conditions are as follows: influent flow, 1.8 GPM; recycle flow, 1.4 GPM; food to microorganisms ratio (loading factor) BOD, 0.15/day, COD, 0.34/day; dissolved oxygen, 3.3 mg/liter; mixed liquor total suspended solids 4600 mg/liter; volatile suspended solids 2850 mg/liter; recycle total suspended solids 18,300 mg/liter; volatile suspended solids 10,300 mg/liter. The outcome of this study and the reanalysis of Berthouex's results in light of the Akaike information criterion (AIC) seem to indicate that a transfer function model based on influent and effluent BOD or COD data alone is not sufficient to accurately predict the behavior of activated sludge plants. While improvement in the prediction of the outputs was achieved with a single difference model even though the two studies were performed on plants with highly different characteristics, it may be possible to improve the outcome still further by including other parameters such as flow, loading, or temperature as inputs to a transfer function model which would improve the model performance. The Box-Jenkins techniques to study the dynamics of activated sludge is useful in determining whether a plant exhibits process instabilities and could benefit from automatic process control. The plant studied here does not fall into that category. (Baker-FRC)
W82-02683

METHODS FOR EVALUATING PERFORMANCE OF FILTER MEDIA,

Metcalf and Eddy, Inc., Boston, MA.
S. L. Bishop.
Water/Engineering and Management, Vol. 128, No 2, p 64, February, 1981.

Descriptors: *Filter media, *Evaluation, Filtration, Separation techniques, Turbiditv, Testing procedures, Water treatment, Silt, Head loss, *Performance evaluation.

Various techniques exist for evaluating the performance of a given filter media. These include use of turbidity as a method for evaluating performance and use of microscopic counts as a supplemental procedure to determine the suspended solids passing through the filter and not picked up as turbidity. Head loss data are also useful, since head loss results as a function of the rate of flow and the solids contained in the water. Thus it is an excellent means of determining the responsiveness of the media for a particular water quality. Another process is the net unit production determination. Yet another involves the determination of the silt density index developed for the reverse osmosis process to determine the magnitude of the solids contained in the feed water to the desalting process. (Baker-FRC)
W82-02684

DETOXIFICATION OF CHLORINATED SEWAGE EFFLUENT BY DECHLORINATION IN ESTUARINE WATERS,

William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
For primary bibliographic entry see Field 5C.
W82-02688

COMPARATIVE PERFORMANCE OF SYNTHETIC ADSORBENTS AND ACTIVATED CARBON FOR SPECIFIC COMPOUND REMOVAL FROM WASTEWATERS,

Michigan Univ., Ann Arbor.
B. M. van Vliet, and W. J. Weber, Jr.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1585-1598, November, 1981. 8 Fig, 5 Tab, 7 Ref.

Descriptors: *Activated carbon, *Adsorbents, *p-Toluene sulfonate, *p-Chlorophenol, *Wastewater treatment, Performance evaluation, Pollutants, Organic compounds.

The performance characteristics of a selection of eight synthetic adsorbents and two activated carbons were compared with respect to removal of an array of organic compounds. The compounds were: p-toluenesulfonate, p-chlorophenol, dodecylbenesulfonate, phenol, lindane, and carbon tetrachloride. When the equilibria and dynamics of adsorption of p-toluenesulfonate and p-chlorophenol were evaluated for the ten substances, significant differences were found. The carbons generally performed best, followed by the carbonaceous adsorbents and the polymeric and resinous adsorbents. Intraparticle transport dynamics differed widely. The carbonaceous adsorbents exhibited the lowest intraparticle diffusivities, and the macroporous polymeric and resinous adsorbents demonstrated the highest values. (Small-FRC)
W82-02702

TRACE METAL CONCENTRATIONS IN OXIDATION PONDS,

Ecological Analysts, Inc., Oak Ridge, TN.
J. S. Suffern, C. M. Fitzgerald, and A. T. Szluha.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1599-1608, November, 1981. 1 Fig, 9 Tab, 44 Ref.

Descriptors: *Heavy metals, *Tilapia, *Oxidation ponds, Food, Fish, Bioaccumulation, Trace metals, Cadmium, Copper, Zinc, Lead, Nickel, Chromium.

The levels of the heavy metals cadmium, chromium, copper, nickel, lead, and zinc in the muscle and liver tissues of tilapia grown in wastewater oxidation ponds were determined. Also, the heavy metal concentrations of the wastewater, sludge, and other biotic components of the system were determined. Metal levels in the wastewater were lower than those found in most secondary effluents, and concentrations in the biotic components of the system indicated minimal metal accumulation. The tilapia grown in the ponds did not accumulate heavy metals, and concentrations observed were below levels set for foodstuffs. Thus, heavy metals may not be a limiting factor in the use of wastewater as a nutrient when growing tilapia for human consumption. (Small-FRC)
W82-02703

COMBINED EFFECTS OF CADMIUM AND NICKEL ON ACTIVATED SLUDGE PROCESS,

Virginia State Health Dept., Richmond.
M. M. Bagby, and J. H. Sherrard.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1609-1619, November, 1981. 9 Fig, 1 Tab, 44 Ref.

Descriptors: *Cadmium, *Nickel, *Activated sludge process, Heavy metals, Biological wastewater treatment, Chemical oxygen demand.

The effects of heavy metals on biological wastewater treatment were determined in this study of the combined effect of cadmium and nickel on the performance of bench-scale, continuous flow activated sludge units. At given influent COD concentrations, higher concentrations of cadmium and nickel resulted in decreased COD removal efficiency at a given mean cell residence time. COD removal efficiency decreased as the ratio of total influent metal concentration to total system suspended solids increased. The toxic effects of heavy metals were stronger on nitrifying organisms than on heterotrophic organisms. Thus, heavy metals can cause reduced system efficiency under some conditions. (Small-FRC)
W82-02704

REDUCED ENERGY USAGE WITH BIOLOGICAL PHOSPHORUS REMOVAL,

Metcalf and Eddy, Inc., NY.
J. Dedyo, and R. Doan, Jr.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1166-1171, July, 1981. 3 Fig, 3 Tab, 1 Ref.

Descriptors: *Biological treatment, *Phosphorus removal, *Costs, Energy, Lime, *Wastewater treatment, Landfilis.

The energy-use reductions and resulting cost reductions made possible by replacing a conventional lime post-precipitation phosphorus removal system with a biological phosphorus removal system are discussed. The proprietary process was retrofitted to the existing lime post precipitation phosphorus plant at the Amherst, New York, Water Pollution Control Facility. The plant was about 80% complete, so the flow scheme was revised to incorporate the biological phosphorus removal process with the least possible impact on piping, etc. Two alternatives for handling the lime sludge from the reactor clarifier were examined: recalcining and landfilling. With only minor piping modifications, either alternative would be possible. Energy reductions exceeded 70% for each alternate, with an annual decrease in operating costs of about $958,000 for the recalcining alternative and $1.05 million for the landfill alternative. Thus, the biological phosphorus removal system can be incorporated into an activated sludge treatment system to reduce energy and chemical usage. (Small-FRC)
W82-02705

OBTAINING HIGH-LEVEL WASTEWATER DISINFECTION WITH OZONE,

Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
E. L. Stover, and R. W. Jarnis.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1637-1647, November, 1981. 10 Fig, 7 Ref.

Descriptors: *Ozonetion, *Coliforms, *Disinfection, Ozone, *Wastewater treatment, Performance evaluation, Massachusetts.

Ozone was evaluated as a wastewater disinfectant under stringent bacteriological standards typical of those required of wastewater discharges. The evaluation was conducted at the Marlborough Easterly Wastewater Treatment Plant (Massachusetts), and included process control, reliability, and pretreatment requirements. Over a wide range of operating conditions, good correlation was obtained btweeen total coliform reduction and absorbed ozone dose and between total coliform reduction and effluent total residual oxidants. The log total coliform reduction was a function of the ozone utilized: the more ozone was transferred into the wastewaters, the more bacteria were removed. The amount of absorbed ozone necessary to achieve a certain disinfection level was different for different wastewater qualities. The required ozone dose should be determined experimentally prior to the design of the disinfection system. (Small-FRC)
W82-02706

OPERATION REPORTS: EAST BAY MUNICIPAL DISTRICT (SD NO 1), CALIFORNIA.

Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1660-1664, November, 1981, 1 Tab.

Descriptors: *Treatment plants, *Operating costs, *Maintenance, Wastewater treatment, Sludge treatment, East Bay Municipal Utility District, California.

An operations report is presented on wastewater treatment at the Special District No. 1 of the East Bay Municipal Utility District, which serves the California cities of Alameda, Berkeley, Emeryville, Oakland, and Piedmont. Activities during the year in the wastewater treatment section included cleaning the vacuum filter-filtrate system of struvite deposits. A major problem developed with the waste sludge thickening centrifuge when the conveyor scroll shaft broke and was out of service for 15 days. The primary sedimentation tanks became overloaded until the unit was rebuilt. Odor monitoring and control programs were carried out, and an energy conservation program reduced power usage by 20%. In the maintenance section, activities included overhauling one of the five 42-in influent pumps and development of new shaft sleeves. The processing unit removed a total of 2750 cu m of grit, sand, and silt, and treated plant flows of up to 636,000 cu m/day. (Small-FRC)
W82-02707

PREVENTION OF PUTREFACTION IN ORGANIC SLUDGE BY CO-PRECIPITATION OF BACTERICIDE AND COAGULANT,

Tokyo Science Univ. (Japan). Faculty of Pharmaceutical Science.
S. Suzuki, and K. Kobayashi.
Environmental Pollution (Series A) Vol 26, No 3, p 187-192, 1981. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Flood processing industry, *Bactericides, *Coagulants, Fermentation, Meat processing industry, *Wastewater treatment, Industrial wastewater, Carbamate pesticides, Sodium dimethyldithiocarbamate, Iron compounds, Sedimentation, Organic matter.

Precipitated organic sludge produced during chemical treatment of fish-meat processing effluent was prevented from generating gas and floating to the surface by the addition of 60 mg per liter sodium dimethyldithiocarbarmate, a bactericide, and ferrous sulfate, a coagulant. Other bactericides tested, in decreasing order of performance in conjunction with ferrous sulfate, were ammonium ethylenebisdithiocarbamate, sodium pentachlorophenol, and 8-hydroxyquinoline. Precipitation decreased with increasing pH from 5 to 9. In fermentation tests sodium dimethyldithiocarbamate and ammonium ethylenebisdithiocarbamate were more effective than the other two bactericides in suppressing gas formation in the sludge. The coagulant ferrous sulfate, ferric sulfate, aluminum sulfate, and polyaluminum chloride were tested with sodium dimethyldithiocarbamate at a 1:1 molar ratio of metal to bactericide. All but the polyaluminum chloride showed precipitation of 90% or higher at neutral pH, indicating that the bactericide can be safely removed from the effluent. Varying the metal: bactericide ratio from 0.5 to 5 showed that over 90% precipitation occurred, even with 1 to 0.5 ratios of metal: bactericide. (Cassar-FRC)
W82-02717

A NEW METHOD OF REGENERATION OF ANION EXCHANGERS USED FOR RECOVERING CHROMATES FROM WASTEWATER,

Maria-Curie Sklodowska Univ., Lublin (Poland). Dept. of Chemical Technology.
L. Pawlowski, B. Klepacka, and R. Zalewski.
Water Research, Vol 15, No 10, p 1153-1156, October, 1981. 6 Fig, 1 Tab,

Descriptors: *Waste recovery, *Chromates, *Wastewater treatment, Recycling, Regeneration, Anion exchange.

A new and economically attractive method for the recovery of water and chromates from wastewater is presented. By cutting off the frontal and tail parts of the regeneration effluent and returning them to the raw wastewater, a significant increase in concentration of the regeneration effluent can be obtained. Not only is this possibility considered, but also the relations between dose of sodium hydroxide used for regeneration, flow rate of sodium hydroxide solution, average concentration of regeneration effluent, recirculation ratio and apparent ion exchange capacity. The application of highly concentrated sodium hydroxide for regeneration of the weakly basic anion exchanger bed resulted in a significant increase in the concentration of the recovered solution of chromates. A further increase in the concentration of the regeneration effluent can be obtained by recycling a certain part of the front and tail regeneration effluent to raw wastewater. However, this recirculation caused a decrease in the effective sodium hydroxide utilization ratio. From the data offered in this report, one can choose the optimal parameters for particular requirements. (Baker-FRC)
W82-02723

STUDIES ON THE ABILITY OF A POTAMOGETON PECTINATUS COMMUNITY TO REMOVE DISSOLVED NITROGEN AND PHOSPHORUS COMPOUNDS FROM LAKE WATER,

Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.
For primary bibliographic entry see Field 5B.
W82-02724

PERFORMANCE PREDICTIONS FOR REMOVAL OF TOXIC AND CARCINOGENIC COMPOUNDS FROM WATER SUPPLIES BY ADSORPTION,

Michigan University.
M. Pirbazari.
PhD Dissertation, 1980. 477 p, 171 fig, 33 Tab, 168 Ref, 12 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-29039.

Descriptors: *Water pollution treatment, *Model studies, *Mathematical models, Activated carbon, Adsorbtion, Organic compounds, Polychlorinated biphenyls, *Carcinogens, Pollutants, Trace levels, Dieldrin, Carbon tetrachloride, Benzene.

Treatment with granular activated carbon is a technically and economically viable technology for removal of a broad spectrum of compounds of concern from public water supplies. The efficiency and cost effectiveness of the design and operation of this process, however, are markedly dependent upon optimum utilization of the adsorption capacity of the carbon, consistent with treatment objectives. To accomplish efficiency and cost effectiveness, it is necessary to develop appropriate data regarding system dynamics, and to synthesize the body of this data in such a manner as to render it incorporable in actual plant design and operation. Mathematical modeling and simulation of the dynamics of granular carbon systems can be a particularly effective means for syntheses of data regarding adsorption dynamics, and resultant models can be employed to good advantage in prediction of system performance under a variety of conditions. The research described has focused on development of rate and equilibrium data relative to the adsorption of several representative compounds of natural, industrial, and agricultural origin from water by actived carbon. Further, the Michigan Adsorption Design and Applications Model (MADAM) - which has indicated substantial potential for use in the design and operation of granular carbon systems for wastewater treatment, has been used for simulation and prediction of the dynamic performance of carbon beds for removal of trace quantities of these compounds under conditions approximating those encountered in water treatment practice. (Sinha-OEIS)
W82-02729

OPTIMAL WATER REUSE PLANNING,

Texas Univ. at Austin.
For primary bibliographic entry see Field 6A.
W82-02736

BY-PRODUCT RECOVERY FINANCES TREATMENT,

Unitata Berhad, Teluk Anson (Malaysia).
J. Svensson, P. B. Sorensen, and C. M. Peterson.
Industrial Wastes, Vol 27, No 5, p 22-25, September/October, 1981. 1 Fig, 2 Tab.

Descriptors: *Oil wastes, *Industrial wastewater, *Flotation, Wastewater treatment, Oily water, Aminodan system, Unitata Berhard, *Malaysia, *Palm oil, Flocculation, Byproducts.

The Aminodan system for treating wastewaters containing suspended solids, grease, fat, oils, and proteins converts removed solids into a usable byproduct. The Unitata Berhad plant in Malaysia processes 125,000 tons of palm oil annually, using 29 million gal of process water. The Aminodan system recovers 90% of the solid material, which is converted to acid oil to use in the manufacture of detergents and plastics. Hot, acid effluent is collected in a pit and mixed with cooler water before the dissolved air flotation process, which removes 92% of total fatty matter. Remaining emulsified effluent is clarified with polyelectrolyte and alum flocculation and pumped to anaerobic ponds, where it remains for 5 months until effluent standards are reached. Fatty sludge is deposited in a dump site. In 1980 the company realized a net return of $167,547 over the total operating costs. The system cost $226,160 to install in 1979. (Cassar-FRC)
W82-02756

FIELD REPORT ON A NONPOLLUTING BLEACH PLANT,

Billerud-Uddeholm A. B., Skoghall (Sweden).
H. B. Borjeson, and S. Lindberg.
Tappi, Vol 64, No 10, p 89-93, October, 1981. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Pulp and paper industry, *Bleaching wastes, *Ion exchange, Adsorption, Costs, Kraft mills, Wastewater treatment, Industrial wastewater, *Color removal, Sweden.

A second generation treatment plant for bleached kraft mill effluent went on stream in 1981 at the Billerud works near Lake Vanern, Sweden. Evolved from a 1973 plant in which colored matter was adsorbed on ion exchange columns followed by elution with alkali, the new plant is semicontinuous. The effluent flow is continuous, but the resin is intermittently transferred to separate columns, each designed for a given unit operation. Advantages of the system are adaptability to varying bleaching conditions, more efficient

design, minimum amount of resin needed, and lower cost. Discharges from the plant per ton of pulp are: color, 18 kg Pt; organic chloride, 1.5 kg, inorganic chloride, 76 kg; COD, 34 kg 02; BOD, 10 kg 02, and chlorophenols and chloroguaiacols, 3 g. In most categories there are considerable reductions in pollutants compared with conventional plants. Costs for this pioneering installation are $4.5 million for construction, $650,000-$900,000 for annual operating costs, and $125,000 for maintenance and labor. The annual production of bleached pulp is 100,000 tons. (Cassar-FRC)
W82-02793

A MULTIMEDIA INFORMATION PACKAGE REGARDING LAND APPLICATION OF WASTEWATER AND SLUDGE: A STUDY OF TRAINING DISSEMINATION SPECIALISTS, EVALUATION METHODS, AND COST-EFFECTIVENESS,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
L. A. Phillips, R. H. Downing, J. C. Frey, and C. H. Sink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168600, Price codes: A07 in paper copy, A01 in microfiche. Research Project Technical Completion Report, November, 1981. 127 p, 1 Fig, 44 Tab, 5 Ref. OWRT-B-116-PA(4), 14-34-0001-8112.

Descriptors: *Training, Education, Instruction, Wastewater, Sludge, *Wastewater treatment, *Technology transfer, Information dissemination, *Land application, Information package, Cost analysis.

It is not always feasible for a research team to participate in the information dissemination process by attending meetings. This project attempted to provide an alternative means of disseminating information by producing, and evaluating the effectiveness of, a multimedia technology transfer package on land application of wastewater and sludge. The package did not require the scientists to be at the presentation. Video and printed materials were produced and discussion leaders trained. Presentations were made in 14 Pennsylvania communities to 310 registered participants. Evaluations were obtained from 136 participants and 12 discussion leaders. Results indicated that the program reached community decision-makers. Overall reaction was favorable although some participants indicated the program's content was too general. The video method of presentation met with mixed reactions. Some participants indicated a need for 'live' experts on the scene. Presentations that combine the use of video materials with a scientist present would be worth considering. The cost-effectiveness of the LAWWS program was determined by comparing its planning, production and delivery costs with those for a similar program presented live by research scientists. The cost of the LAWWS package was found to be greater for the first 43 presentations. After that, LAWWS was the more economical program. (Fisher-PA)
W82-02815

BRITAIN'S SEWERS - RESEARCHING FOR THE FUTURE,

Water Research Centre Engineering Centre, Swindon (England).
D. Fiddes.
Water Services, Vol 85, No 1026, p 431-432, 435, August, 1981. 2 Fig, 9 Ref.

Descriptors: *Sewer systems, *Maintenance, *Research priorities, Sewers, Rehabilitation, Planning, *United Kingdom.

The objectives of the Water Research Centre's sewerage research program are discussed, and the principal features of the program are described. The program was designed to establish the condition and rate of deterioration of sewers to help develop cost effective strategies for replacement and rehabilitation programs as well as to aid in planning. The program will evaluate renovation techniques and provide guidance and develop methods for the assessment and improvement of the hydraulic performance of sewer systems. Guidance will also be provided in materials, design, and construction of new sewers. The main outstanding technical problem with sewer renovation is that of dealing with drain connections in non-man-entry sewers. (Small-FRC)
W82-02871

TOTNES SEWAGE TREATMENT, RESEWERAGE AND FLOOD PREVENTION SCHEME.

Water Services, Vol 85, No 1026, p 418, 421-422, 424-425, August, 1981. 4 Fig.

Descriptors: *Wastewater facilities, *Flood control, *Activated sludge process, Wastewater treatment, Domestic wastes, Food processing wastes, Stream stabilization, Sludge digestion, Methane, *United Kingdom.

The Totnes sewage treatment works was inadequate and located on a frequently flooded site. The decision was made to build a completely new facility and implement a joint resewerage and flood prevention scheme. The existing foul sewerage system was improved, and major water courses which outfall in culverts throughout the town were culverted and controlled. The new treatment works includes an oxygenated activated sludge plant to treat domestic wastes and wastes from a nearby creamery and pig slaughtering and processing plant. Sludge is treated by anaerobic digestion and dewatering. Methane gas produced during the digestion is used to burn screenings and heat the buildings. The project was begun in 1978, and completion was expected in July 1981. (Small-FRC)
W82-02872

ADVANCED SLUDGE TREATMENT FOR MODERN WATERWORKS,

East Surrey Water Co. (England).
K. Sharp, and J. H. Warden.
Water and Waste Treatment, Vol 23, No 9, p 36, 39, September, 1980. 2 Fig, 5 Ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Sludge thickening, Design criteria, Dewatering, Sludge drying, Sludge solids, Sludge filters, Polymers, Polyelectrolytes, Training, Bough Beach Waterworks, England.

Methods explored by the Bough Beach Waterworks of the East Surrey Water Company to treat, eventually, up to 10 mgd of impounded surface water are examined. Gravity thickening of sludge was introduced to improve treatment of sludge on drying beds. The effectiveness of polymer thickening of several coagulant sludges was demonstrated as long as certain criteria were met. The Water Research Center was asked to design a new sludge treatment plant at Bough Beach that could be built as quickly and as cheaply as possible and be operated within existing manning schedules. The resultant facility can handle about 20 milligrams of sludge solids/liter of raw water treated. A hopper-bottomed sludge tank was used as a balancing tank to buffer batch flows of settled wash water. A single thickener with mechanical backups and two main feed pumps was installed. Sludge pressing was most feasible for sludge dewatering, and a second hopper-bottomed tank can provide storage for up to three days capacity of 125 inch cakes. A flowsheet of the new plant operations is given, and the teamwork used in the training of personnel is discussed. (Geiger-FRC)
W82-02889

BIODEGRADATION OF AROCLOR 1221 TYPE PCBS IN SEWAGE WASTEWATER,

National Water Research Inst., Burlington (Ontario).
D. Liu.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 695-703, November, 1981. 5 Fig, 20 Ref.

Descriptors: *Polychlorinated biphenyls, *Biodegradation, Bacteria, *Wastewater treatment, Water treatment facilities, Temperature, Dissolved oxygen, Acidity.

The objective of this study was to assess the biodegradation of commercial PCB formulations in municipal sewage, including the factors affecting the degradation. A selected PCB-degrading bacterium, Pseudomonas sp. 7509, was added as inoculant. The bench scale test of PCB biodegradation was carried out in a 14-liter fermentor equipped with automatic temperature, pH, dissolved oxygen and agitation speed controls. In a typical batch operation, the fermentor was charged with 10 liters of fresh raw sewage which was fortified with 20 ppm each of phosphorus and nitrogen. The temperature was automatically controlled at 20 degrees C, agitation at 400 rpm, and 2 ppm dissolved oxygen in the fermentor broth. Results indicate that Pseudomonas sp. 7509 could oxidize commercial PCB formulations at a rapid rate. If this bacterium is to be considered as a seeding culture for wastewater treatment, it is essential that the bacterium be able to degrade PCBs in the presence of other organic nutrients normally found in wastewater. Since the temperatures of sewage treatment plants in Canada vary considerably with the seasons, it was decided to test the ability of P. sp. 7509 to oxidize PCBs at different temperatures. Even at a temperature as low as 4 degrees C this bacterium was still able to oxidize the Aroclor 1221. The rate of Aroclor 1221 degradation was intimately dependent on the agitation speed of the fermentor's impeller. (Baker-FRC)
W82-02899

TRANSFER OF VOLATILE SUBSTANCES FROM WATER TO THE ATMOSPHERE,

Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 1B.
W82-02902

PREDICTING REACTOR BIOMASS CONCENTRATION IN A FLUIDIZED-BED SYSTEM,

Dorr-Oliver, Inc., Stamford, CT.
W. K. Shieh, P. M. Sutton, and P. Kos.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1574-1584, November, 1981. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Fluidized bed process, *Mathematical models, *Biomass, Particle size, Particle shape, Mathematical studies, *Wastewater treatment.

A hydraulic model was developed and used to predict the biomass concentration observed during the operation of two fluidized-bed pilot plants. Media size and biofilm thickness are important variables in biomass concentration. The irregularity in particle shape can be accounted for by the 'volume-equivalent spherical diameter, while the irregularity in particle size can be accounted for by the Sauter mean diameter. Biofilm dry density is a function of biofilm thickness and decreases with increasing biofilm thickness at a given bulk liquid substrate and compared to measured values. Biofilm dry density, biofilm wet density, and the biofilm moisture content were calculated and compared to the values predicted by the model. Relative errors were less than 10%. (Small-FRC)
W82-02932

ENGINEERING RESPONDS TO ECOLOGY,

Whitman and Howard, Inc., Wellesley, MA.
R. E. Hickman.
Water/Engineering and Management, Vol 128, No 10, p 33-34, 36, October, 1981. 3 Fig, 1 Tab.

Descriptors: *Sewer systems, *Construction, Mill River Valley, Environmental engineering, Civil engineering, Engineering, Environmental protection.

A description is offered of the Mill River Valley Sewer Program for Fairfield, Connecticut. The system called for the installation of 35 miles of sewers in an extremely sensitive ecological area. This area included residential neighborhoods with beautifully landscaped lawns, was in a possible national historic site, was near inland and coastal wetlands which were abundant with flora and fauna, and was within a public watershed with

swimming beaches, recreational waterways, and groundwater public well fields. However, the area had suffered for years from inadequate septic systems which gave forth such problems as odors, overflows, and limited household water use. Septic runoff was also seeping into the Mill River and its impoundments, polluting waters used by residents for fishing, swimming, canoeing, and ecological education. The $18,000,000 Mill River Valley Sewer Program brought sewerage service to about 2,000 Fairfield homes and is capable of serving portions of the neighboring town of Easton. The program required close coordination of local commissions, citizen groups, federal and state agencies, and environmental and engineering consultants. The use of town owned land avoided the cost and complications of purchasing private property. The program demonstrated that engineers and environmentalists can work together to economically and practically clean up the environment without sacrificing either technical expertise or ecological concern. (Baker-FRC)
W82-02935

WIND AERATION IN MODEL WASTE TREATMENT SYSTEM,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, P. A. Kahn, and N. C. Thanh.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 1089-1094, October, 1981. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Aeration, *Wind, *Mixing, *Wastewater treatment, Oxidation, Chemical oxygen demand.

The potential of wind aeration in aerobic wastewater treatment was studied in a laboratory scale oxidation ditch. After deaerating the samples with sodium sulfite and cobalt chloride, an air blower was turned on to stimulate wind up to a velocity of 20 m per sec. Good mixing was obtained in tap water at wind velocities above 15 m per sec. At 20 m per sec the water velocity was 50 cm per sec on the surface and at the 12 and 17 cm depths, and 35 cm per sec at the 7 cm depth. Using mixed liquor suspended solids and wind velocities of 10-20 m per sec, the overall oxygen transfer rate coefficient was 1.2-9.5 per hour, the concentration of mixed liquor suspended solids was 1140-1610 mg per liter, and the oxygen utilization rate was 2-16 mg per liter per hour. COD removal efficiency at a wind velocity of 20 m per sec was tested at residence times of 2-20 days and influent COD concentrations of 280-620 mg per liter. At residence times of 10 days or longer, effluent CODs were less than 20 mg per liter (95% removal). (Cassar-FRC)
W82-02944

DISTRIBUTION OF WASTEWATER IN DRAIN FIELD PIPES,

Cowiconsult, Virum (Denmark).
For primary bibliographic entry see Field 8B.
W82-02945

NEW DEVELOPMENTS IN PAPERMAKING IN WESTERN EUROPE,

Technical Univ. of Denmark, Copenhagen. Inst. fuer Papierfabrikation.
L. Gottsching.
Tappi, Vol 63, No 3, p 50-54, March, 1980. 4 Tab, 38 Ref.

Descriptors: *Industrial wastewater, *Pulp and paper industry, Biological oxygen demand, Oxygen demand, Chemical oxygen demand, Wastewater, Wastewater treatment, *Water pollution control, *Water law, *Europe.

Restrictions regarding environmental pollution, combined with other factors, have caused a slowdown in the economic growth of the paper making industry in Western European countries. National authorities of various countries are imposing increasingly strict regulations concerning effluents. Some mills have to meet individual restrictions depending on the capacity of the recipient, while in other countries the restrictions are the same for all mills or certain groups of mills producing the same paper grades, independent of the capacity of the recipient. In some countries mills must pay a direct or indirect tax or duty to the government for the effluents. In Germany an effluent duty will be introduced during 1981. The duty is calculated from the following parameters: effluent volume, suspended solids, COD, mercury and cadmium contents, and toxicity to fish. The average fresh water input in the German paper industry is about 45 cubic meters per ton of paper. The Schongau paper mill has a specific effluent volume of 8 cubic meters/ton of newsprint despite the fact that it operates a groundwood mill and deinking plants. Separation methods are highly efficient, settled solids are normally fed back into the stock preparation system, and the wastewater emitted to the recipient is clarified mechanically, mostly through sedimentation. (Baker-FRC)
W82-02947

CONTROL OF A PUMPING STATION BY MINI COMPUTER - A PROGRESS REPORT,

Mouchel (L.G.) and Partners, Bath (England).
For primary bibliographic entry see Field 6B.
W82-02956

THE MICROFAUNA OF ACTIVATED SLUDGES. STUDY OF AN OBSERVATION METHOD AND APPLICATION TO MONITOR A PILOT PLANT DURING THE START-UP PHASE. (LA MICROFAUNA DES BOUES ACTIVEES. ETUDE D'UNE METHODE D'OBSERVATION ET APPLICATION AU SUIVI D'UN PILOTE EN PHASE DE DEMARRAGE,

Montpellier-2 Univ. (France). Lab. de Genie Chimique, Traitement et Epuration des Eaux.
C. Drakides.
Water Research, Vol 14, No 9, p 1199-1207, September, 1980. 5 Fig, 6 Tab, 26 Ref.

Descriptors: *Activated sludge, *Fauna, *Microorganisms, *Pilot plants, *France, Population dynamics, Wastewater treatment, Activated sludge process, Species composition.

A method of quantitative observation of the microfauna used for operational monitoring of purification plants was studied. A simple experiment was performed to monitor the start-up of the pilot purification station of the University of Sciences and Engineering of Languedoc, fed with municipal waste water from Montpellier. The density of microfauna was evaluated using a counting chamber technique, and the results correlated with physicochemical factors. The technique was quite reliable when the investigated volume reached 10 mm to the third power. Grouping the microfauna by trophic characteristics made the observation easier without losing too much information. The evolution of microfauna was determined by a set of parameters for which purification yield does not play a major role. The study of the daily evolution of microfauna showed 3 periods: a decrease and disappearance of some species in the first six days, a very unstable period in the next three days, and a more stable period in the next nine days. The set of parameters which do influence the evolution includes recirculation, extraction of sludges, oxygen share and the charge and nature of the effluent. (Hertzoff-FRC)
W82-02960

NONLINEAR PROGRAMMING DESIGN OF WASTEWATER TREATMENT PLANT,

Louvain Univ. (Belgium). Inst. d'Administration et de Gestion.
D. Tyteca, and Y. Smeers.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 767-779, August, 1981. 1 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Mathematical models, *Mathematical equations, Algorithms, Nonlinear programming, Optimization.

A complete mathematical model has been developed for a wastewater treatment plant comprised of six treatment units, including primary settler, activated sludge reactor, final settler, thickener, anaerobic digester, and vacuum filter. The model includes 43 equations with 51 variables and 12 inequality constraints. A nonlinear programming procedure has been set up for use in studying the optimal design of the plant. This procedure combines the advantages of geometric programming as a general and easy transcription mode for various types of models with the generalized reduced gradient as an efficient algorithm for solving large-scale highly nonlinear problems. The process for transcribing the model as a geometric pattern is demonstrated. A sample situation is used to demonstrate application of the model and the optimization method. Results can be obtained in moderate computer times, significantly reducing the costs associated with conventional design methods. The flexibility and interactivity of this method also allow for easy modification, replacement, or addition of constraints in the model. (Carroll-FRC)
W82-02961

NONLINEAR PROGRAMMING MODEL OF WASTEWATER TREATMENT PLANT,

Louvain Univ. (Belgium). Inst. d'Administration et de Gestion.
D. Tyteca.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 747-766, August, 1981. 1 Fig, 3 Tab, 40 Ref.

Descriptors: *Mathematical models, *Wastewater facilites, *Mathematical equations, Wastewater treatment, Nonlinear programming, Optimization, Anaerobic digestion, Activated sludge process, Vacuum filtration, Sedimentation, Pollutants, Suspended solids, Dissolved solids, Biomass.

Least cost design studies are intended to result in bringing the total discounted cost of the wastewater treatment plant to the lowest possible level while satisfying a set of constraints relating to effluent quality, performance relationships, and various biological and physical contraints limiting operational ranges of treatment units. This paper presents a complete mathematical model for a wastewater treatment plant which includes six treatment units: a primary settler, an activated sludge reactor, a final settler, a thickener, an anaerobic digester, and a vacuum filter. New equations developed for use in this model include a set of equations which permit description of the distribution of biodegradable materials into suspended and dissolved materials in the aerator and other modifications of classical relationships permitting disaggregation of the global polluting load into biodegradable suspended solids, biodegradable dissolved materials, and biomass. The global model is comprised of 43 equations and 51 variables (and therefore eight degrees of freedom) and 12 inequality constraints. To use the model properly, values must be given to the constants and parameters appearing in the equation. Data from the literature were used for testing this model. (Carroll-FRC)
W82-02962

EVALUATION OF THE FULL-SCALE APPLICATION OF ANAEROBIC SLUDGE DIGESTION AT THE BLUE PLAINS WASTEWATER TREATMENT FACILITY - WASHINGTON, D.C.,

W. Torpey, J. Andrews, and N. Mignone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-219123, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-105, July, 1981. 6 p, 1 Fig, 4 Tab.

Descriptors: *Anaerobic digestion, *Sludge digestion, *Cost analysis, Thermophilic bacteria, Municipal wastewater, Pathogens, Microorganisms, Biodegradation, *District of Columbia.

The mesophilic-thermophilic digestion process is a new two-step concept for treating municipal wastewater sludges. The first step operates under mesophilic process conditions (digestion with anaerobic microorganisms at 90 to 100 F). The

second step operates under thermophilic process conditions (digestion with anaerobic microorganisms that thrive at 120 to 130 F). The existing Blue Plains wastewater treatment plant in Washington, D.C. treats approximately 330 mgd and much of the sludge generated is disposed of without digestion. It has been found possible to process the total waste sludge flow at the Blue Plains plant by adopting the thermophilic anaerobic digestion process to the present digestion facilities. Adoption of the thermophilic option at Blue Plains requires the least capital expenditure, would be the most expedient solution to the sludge management problem, and would yield substantial operational cost savings. It also offers the potential of eliminating the need for composting because of the pathogen kill. A limited expansion of digester capacity is required to handle the entire sludge stream. Digester gas would be available for sale to outside interests after internal heating requirements were satisfied. (Moore-SRC)
W82-02965

EVALUATION OF ION EXCHANGE TECHNOLOGY FOR TOXIC AND NON-CONVENTIONAL POLLUTANT REDUCTION IN BLEACH PLANT EFFLUENTS,

Jordan (Edward C.) Co., Inc., Portland, ME.
J. H. Fitch, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-208175, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-086, July, 1981. 6 p, 1 Fig, 3 Tab.

Descriptors: *Pulp and paper industry, *Bleaching wastes, *Ion exchange, *Wastewater treatment, Chlorinated hydrocarbons, Industrial wastewater, Resins, Cost analysis, Zinc, Copper, Cadmium, Nickel, Color removal, Chemical oxygen demand.

A literature review revealed that weakly basic ion exchange resins, based on a phenolformaldehyde matrix, are superior in treating pulp and paper bleach plant effluents. Prior to resin treatment, it is advantageous to adjust the pH and pretreat the wastestream. Screening and filtration remove macromolecular organics, which tend to foul the resin irreversibly. Batch and pilot plant ion exchange installations at Billerud Uddeholm AB in Skoghall, Sweden were evaluated in order to ascertain actual operation parameters and removal efficiencies, as well as associated problems and costs. The batch and pilot scale plants effectively remove color, COD, chlorinated guaiacols and some complexed metals. These treatment plants do not remove resin, fatty acids and phthalates. Inorganic chloride is removed initially but drops off shortly after the cycle starts. Zinc and copper are removed through complexation and chelation processes. Cadmium and nickel appear to be removed effectively in the second column but are virtually untouched in the first. Extended contact time yielded no benefits. Estimated capital cost for installing a full-scale plant to treat bleach plant wastes at a 100,000 metric ton/year plant (Kappa 35) is $4.78 million. Operation and maintenance costs are estimated to be $675,000/year, giving an annual cost (assuming a ten year investment at 10% interest) of about $1.15 million. (Moore-SRC)
W82-02967

REDUCTION OF TOXICITY TO AQUATIC ORGANISMS BY INDUSTRIAL WASTEWATER TREATMENT,

EG and G, Bionomics, Wareham, MA.
For primary bibliographic entry see Field 5C.
W82-02971

PILOT-SCALE ANAEROBIC FILTER TREATMENT OF HEAT TREATMENT LIQUOR,

Hydroscience, Inc., Westwood, NJ.
E. Donovan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-218323, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-114, August, 1981. 5 p, 1 Fig, 4 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Sludge, *Cost analysis, *Anaerobic digestion, Biological treatment, Anaerobic filters, *Heat treatment, Municipal wastewaters.

The anaerobic filter's capability of removing large amounts of soluble organic matter with no oxygen required, at relatively low hydraulic detention times and low solids production, can result in distinct advantages for the pretreatment of high strength organic wastes. The liquor waste resulting from heat treatment of raw sludge in municipal sewage treatment plants contains high concentrations of soluble wastes, and is often returned to the head end of the plant where it can impose an additional load on the plant's operation and reduce its efficiency. A pilot plant study was conducted on the anaerobic filter treatment of heat treatment liquor. Significant removal of soluble organics from a high strength sludge heat treatment liquor can be achieved at hydraulic retention times of 0.5 to 2 days. The generated gas contained 65% to 70% methane. Based on the pilot column studies, a suggested design and costs for an anaerobic filter unit were developed. These costs were compared with costs of other means of treatment such as the aerobic alternative. The anaerobic filter process had lower capital and operating costs than other modes of treatment. The gas produced would be sufficient to maintain the temperature of the filter at 35 C and provide additional fuel for other uses. These calculations show a net profit in operating costs. (Moore-SRC)
W82-02972

WASTEWATER TREATMENT BY A PROTOTYPE SLOW RATE LAND TREATMENT SYSTEM,

Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, and A. J. Palazzo.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A106 975, Price codes: A04 in paper copy, A01 in microfiche. Army Corps of Engineers CRREL Report 81-14, August, 1981. 52 p, 15 Fig, 26 Tab, 68 Ref.

Descriptors: *Municipal wastewater, *Land disposal, *Wastewater disposal, *Spray irrigation, *Nutrient removal, Forages, Coliforms, Biochemical oxygen demand, Suspended solids, Organic carbon, Nitrogen, Phosphorus, Crop yield, Heavy metals, Percolation, Fertilization.

Six slow rate land treatment prototypes, three containing a Windsor sandy loam and three containing Charlton silt loam, were studied from June 1974-May 1980. The systems were spray irrigated with either primary or secondary wastewater at application rates ranging from 2.5 cm/wk to 15 cm/wk. Application schedules were also varied. The performance of forage grasses was studied to determine the yield and nutrient uptake under the various application regimes. On a mass basis, an average of 91% of the nitrogen (N) applied could be attributed to either plant uptake or percolation of soluble N, mainly nitrate. Nitrate concentrations in the percolate correlated with N loading rate. An N loading rate of 800 kg/ha resulted in a mean concentration of about 10 mg/L of nitrate-N in the percolate. Plant uptake of N was linearly related to N loading rate at loading rates less than 800 kg/ha. In this range, plant uptake accounted for about 60% of the N applied. Plant yields averaged 13.1 tonnes/ha, three times the average for the area. Mean phosphorus (P) concentrations in the percolate ranged from 0.03 to 0.07 mg/L and depended only slightly on application rate. Removal of P averaged greater than 99% for all application regimes. Water balance measurements indicated that evapotranspiration exceeded pan evaporation by a factor ranging from 0.86 to 1.17 over a 6-year period. Treatment of biochemical oxygen demand (BOD5), suspended solids, total organic carbon (TOC), and fecal coliform were excellent. Residual levels of BOD5, suspended solids, and TOC in the percolate averaged 1.3, 1.2 and 1.8 mg/L, respectively. Fecal coliform bacteria in the percolate were reduced to detection limits independent of whether the wastewater was pretreated or disinfected before application. A significant reduction in chloroform and other volatile trace organics was also found. Mean concentrations of chloroform were reduced from 9.6 microgram/L in the chlorinated primary wastewater to about 0.2 microgram/L in the test cell percolates. No significant downward movement of heavy metals was found 5 years after suspension of heavy metal application. Potassium (K) fertilization was necessary to balance the low K/N ratio of the wastewater. (Brambley-SRC)
W82-02981

ULTRAVIOLET DISINFECTION OF A SECONDARY WASTEWATER TREATMENT PLANT EFFLUENT,

HydroQual, Inc., Mahwah, NJ.
O. K. Scheible, and C. D. Bassell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-242125, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-152, September, 1981. 8 p, 5 Fig, 2 Tab.

Descriptors: *Ultraviolet radiation, *Disinfection, *Coliforms, *Wastewater treatment, Microbiological studies, Secondary wastewater, Photoreactivation, Cost analysis.

Although ultraviolet (UV) light has been an accepted disinfection technique for potable waters, its application to lower-grade waters has not been widely practiced, primarily because of a lack of efficient system design. Recent improvements have made the UV process a viable alternative to chlorindation for the disinfection of wastewater treatment plant effluents. UV disinfection of a full-scale secondary effluent was investigated during a 13-month field study at Waldwick, New Jersey. Second order does response relationships were developed and were found to provide a rational expression of the microbial response to UV dose. The UV absorbance coefficient was found to be an excellent parameter for use in the dose expression and in the design sizing of UV systems. Photoreactivation was observed and was significantly dependent on temperature. The phenomenon could result in an order of magnitude increase in coliform density at a temperature of 20 degrees C. In operation, the process was flexible and simple, requiring minimal maintenance. Estimated costs ranged between 1.2 and 0.8 cents/cu m for typical secondary treatment plants with flows between 0.044 and 4.4 cu m/sec, respectively. (Moore-SRC)
W82-02985

CHARACTERIZATION OF BOLIDEN'S SULFIDE-LIME PRECIPITATION SYSTEM,

Kentucky Univ., Lexington. Dept. of Chemical Engineering.
M. Blythe, K. Schwitzgebel, J. C. Terry, C. Sund-Hagelberg, and D. Bhattacharyya.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-209272, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-081, August, 1981. 8 p, 5 Fig, 5 Tab, 6 Ref. R804568.

Descriptors: *Wastewater treatment, *Sulfides, *Heavy metals, *Arsenic, *Industrial wastewater, Chemical treatment, Chemical precipitation, Copper, Cadmium, Mercury, Lime.

Sulfide precipitation is an effective process for the treatment of industrial wastes containing highly toxic heavy metals. The attractive features of the sulfide precipitation process are: attainment of a high degree of metal removals over a broad pH range, effective precipitation of certain metals (such as As, Cu, Cd, Hg) even at very low pH, low detention time requirement in the reaction tank because of the high reactivity of sulfides, and the feasibility of selective metal recovery. Bench-scale studies were conducted with actual scrubber wastewaters obtained from a non-ferrous metal production plant. Full-scale data were obtained at Boliden Metall Corporation, Skelleftehamn, Sweden. A high degree of separation of heavy metals and arsenic was achieved using a combination of hydroxide-sulfide precipitation (at pH 8-9) process, and a process involving sulfide precipita-

tion (at pH 3-5) followed by lime precipitation. The combination hydroxide-sulfide process required only 60% of the theoretical sodium sulfide dosage to provide effective separations of heavy metals and arsenic. Simple sulfide precipitation at pH 3-4 also provide excellent removals for Cu, Cd, Hg, and Pb. For precipitation of arsenic and zinc sulfide at less than pH 5, the side reaction between sulfite (if present in wastewater) and sulfide must be considered. Hydrogen sulfide gas formation was never found to be a problem during precipitation because of the high reactivity of sulfides and heavy metals. (Moore-SRC)
W82-02988

CHLORINE DIOXIDE FOR WASTEWATER DISINFECTION: A FEASIBILITY EVALUATION,

Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, E. M. Aieta, J. D. Berg, and B. M. Chow.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-213357, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-092, July, 1981. 4 p, 3 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Disinfection, *Chlorine dioxide, *Chlorination, Chlorinated hydrocarbons, Coliforms, Viruses, Effluent, Residual chlorine, Sludge.

Chlorine dioxide was compared with chlorine for disinfecting wastewater in laboratory experiments. Chlorine dioxide disinfection was also demonstrated at a full-scale wastewater treatment plant. The criteria compared included coliform kill, inactivation of poliovirus and other indicators, and formation of halogenated organic byproducts. In general, chlorine dioxide accomplished a given fractional kill of total coliforms with a smaller product (residual x time) than did chlorine. For a given contact time, the residual required to achieve a given fraction kill of coliforms was 2 to 70 times smaller for chlorine dioxide than for chlorine. Considering both required residual and disinfectant demand, the required doses of the disinfectants were estimated to satisfy three assumed coliform disinfection levels with two types of effluents: conventional activated sludge and filtered, nitrified activated sludge. The required mass doses of the disinfectants were approximately equal for treating conventional activated sludge effluent. The required dose of chlorine was approximately 2 to 10 times greater than that of chlorine dioxide for treating filtered, nitrified effluent, depending on the coliform standard. The results of studies conducted at a full-scale plant generally agreed within a factor of two with the predictions from laboratory studies. For typical cases, chlorine dioxide is approximately 2 to 5 times as expensive as chlorine for disinfection, but chlorine dioxide forms much lower quantities of halogenated by-products and is more effective in inactivating viruses than is chlorine. (Moore-SRC)
W82-02989

OVERLAND FLOW TREATMENT OF POULTRY PROCESSING WASTEWATER IN COLD CLIMATES,

Notre Dame Univ., IN.
L. H. Ketchum, Jr., J. L. Witherow, A. J. Cunningham, and R. L. Irvine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-213225, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-093, July, 1981. 6 p. 1 Fig, 6 Tab.

Descriptors: *Food-processing wastes, *Wastewater treatment, *Overland flow, *Land disposal, Weather, Temperature effects, Industrial wastewater, Biological treatment, Evapotranspiration, Snow cover.

Land treatment of wastewater using overland flow methods has been effectively used in warm climates. A full scale wastewater treatment facility, including overland flow, was evaluated in northern Indiana, a cold climate. The treatment system included mechanical pretreatment facilities, a storage lagoon, a lagoon for batch chemical treatment of the overland flow effluent and rapid infiltration for effluent disposal. The facility treated wastewater from a duck processing plant. The wastewater was as amenable to biological treatment as domestic sewage and had similar concentrations of nutrients. Overload flow systems typically are limited to low permeability soils, but this system was located on a sandy loam soil with very high permeability. Bentonite was used to provide a percolation barrier below the grass covered surface. Total effluent flow averaged about 40% of the total influent, except during the winter. The high winter effluent flows resulted from low evapotranspiration rates, because the fields were snow covered, and low infiltration rates, because the ground was frozen. During all warm-weather periods, and under widely varying wastewater application schemes, the overland flow plots alone met the 1983 EPA limitations, except when algae problems were encountered. Some degree of treatment is possible in the winter, but the loading rate must be reduced, and unsatisfactory effluent returned for further treatment. Application of lagoon wastewater to an overland flow plot should be avoided if possible. (Moore-SRC)
W82-02992

WOOD PRESERVING INDUSTRY MULTIMEDIA EMISSION INVENTORY,

Acurex Corp., Mountain View, CA.
B. DaRos, B. Fitch, C. Franklin, M. Friedman, and R. Merrill.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-205999, Price codes: A12 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-066, September, 1981. 7 p, 2 Tab.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Evaporation, *Organic compounds, Sludge disposal, Surface runoff, Air pollution, Evaporation pans, Recycling, Water pollution control, *Wood preserving industry.

There are approximately 475 wood preserving plants in the United States. Wastewaters are generated as a result of the preservatives used, plant operations, surface runoff, and excess process water discharge. Solid residues include waste sludges from wastewater treatment, insoluble inorganic materials from waterborne salts, and contaminated soils from spills or drippage. Air emissions occur during wastewater evaporation processes. Industry's technical response to requirements for control of process wastewater has included increased recycling and evaporation of water using thermal evaporators, spray and solar ponds, and cooling towers to decrease aqueous discharges. Organic compounds are emitted to the atmosphere during evaporation. The rate of release is based on the type of evaporation system used: solar ponds, thermal (pan) evaporators, spray ponds, or cooling towers; the temperature (thermal) driving force used; the molecular weight and volatility of the substances; and the concentration of each component in solution following wastewater pretreatment. Eleven plants are likely to shut down and 10 others face potential shutdown if zero discharge regulations are implemented. (Moore-SRC)
W82-02993

PROTEIN RECOVERY FROM BEEF PACKING EFFLUENT,

Colorado State Univ., Fort Collins.
J. C. Ward, W. Adams, and H. C. Isaksen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-224362, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-112, August, 1981. 4 p, 2 Tab.

Descriptors: *Wastewater treatment, *Meat processing industry, Physicochemical treatment, *Waste recovery, *Proteins, Industrial wastewater, Biochemical oxygen demand, Suspended solids, Grease, *Cost analysis, *Protein recovery.

The wastewater from a large beef packing plant, containing 3,000 mg/l BOD5 and 2,500 mg/l of suspended solids was treated in a physicochemical process that recovers protein. This process removed 58% of the total nitrogen, 80% of the oxygen demand and suspended solids, and 94% of the fat, oil and grease. The discharge of BOD5 was reduced to less than 3 pounds per head of beef slaughtered. For every pound of BOD5 entering the wastewater treatment plant, 0.77 pounds of product was recovered with a composition of 38% protein, 11% grease and oil, 27% inorganic solids, and 24% other solids (dry weight basis). About 2 pounds of protein were recovered per head. Total cost was $3 per 1,000 gallons (44% capital costs). A price of 42 cents per pound of protein would pay all costs. The figures given above were observed in a full scale plant and should not change significantly with different size wastewater treatment plants. This wastewater treatment process can be used as a pretreatment process for beef packing effluent prior to discharge to a sewage treatment plant. (Moore-SRC)
W82-02994

GROUP TREATMENT EVALUATION FOR METAL FINISHERS,

Centec Corp., Reston, VA.
E. Comfort, D. Harrison, and D. Sherman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-232506, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-143, September, 1981. 2 p, 2 Tab.

Descriptors: *Metal-finishing wastes, *Wastewater treatment, *Economic aspects, *Sewers, Regulations, Industrial wastes, Financing, Cost analysis.

Group treatment is one alternative for firms faced with the problem of compliance with pretreatment regulations. A preliminary study of the concept as applied to the plating firms within Huntington Industrial Park, Providence, Rhode Island, was conducted. Each potential participant was surved and wastewater sampled. Results were entered into a joint treatment model used to size the Group Treatment Facility. It was found that, with the assumed 10 participating firms, substantial savings could be realized. Installation of an industrial sewer system within the park, while more than doubling the demands for initial capital, would be cost-effective in the long run. The capital required was estimated at $300,000 to $500,000. The SPA Pollution Control Financing Guarantee Program was shown to be very attractive for such amounts, particularly when combined with an issue of tax-exempt bonds. Relatively small additional investment would allow process capacities to be increased so that the same facility could accept similar wastes from some of the very small job shops in the region, those which otherwise would be most severely impacted by pretreatment regulations. (Moore-SRC)
W82-02995

NITROGEN AND PHOSPHORUS REACTIONS IN OVERLAND FLOW OF WASTEWATER,

Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. A. Khalid, I. C. R. Holford, M. N. Mixon, and W. H. Patrick, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-239311, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-150, September, 1981. 6 p, 6 Fig, 1 Tab.

Descriptors: *Overland flow, *Wastewater treatment, *Phosphorus removal, *Nitrogen removal, Soil chemistry, Municipal wastewater, Land disposal, Model studies, Nitrification, Flooding, Vegetation effects.

Biochemical transformations of labelled ammonium-nitrogen resulting from the overland flow treatment of simulated wastewater were studied in small scale test models established with vegetated soils. Water movement in the system was primarily

controlled by the application rate the friction slope, the slope angle, the hydraulic characteristics of soils, and the evapotranspiration. Aerobic-anaerobic zones in the soil mass facilitate nitrification denitrification processes and enhance nitrogen losses to the atmosphere. The incomplete nitrification of ammonium nitrogen in the simulated wastewater applied to overland flow models suggests that nitrification reactions may be limiting the proportion of nitrate-nitrogen available for denitrification reactions. The loss of applied ammonium-nitrogen attributed to denitrification reactions ranged from 3 to 35%. The plant uptake of nitrogen in the overland flow and growth chamber studies accounted for 23 to 62% of applied ammonium-nitrogen. The results of laboratory studies indicated that initial flooding of aerated soil for about three weeks was accompanied by a large increase in phosphorus sorption capacity and decrease in phosphorus mobility. Longer periods of flooding caused a marked decrease in phosphorus sorption capacity and a corresponding increase in phosphorus mobility and leaching losses in acid soils. Calcium phosphate precipitation under alkaline soil conditions increased phosphorus sorption capacity of soils. The results of the overland flow experiment also demonstrated that the efficiency of phosphorus removal from municipal wastewater was greatly enhanced by lime addition to the soil compared to nonlimed flooded soil. (Moore-SRC)
W82-02996

FATE OF TOXIC AND NONCONVENTIONAL POLLUTANTS IN WASTEWATER TREATMENT SYSTEMS WITHIN THE PULP, PAPER, AND PAPERBOARD INDUSTRY,

Jordan (Edward C.) Co., Inc., Portland, ME.
B. K. Wallin, and A. J. Condren.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-247405, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-158, September, 1981. 4 p, 2 Tab.

Descriptors: *Pulp and paper industry, *Industrial wastewaters, *Wastewater treatment, *Sludge, Pollutants, Air pollution, Organic compounds, Wastewater analysis, Biological wastewater treatment.

A sampling and analysis program was conducted at two deink mills and a groundwood fine papers mill. Each mill employed a wastewater treatment system which included primary clarification, high rate biological treatment, secondary clarification, and combined primary/secondary sludge dewatering. An attempt was made to complete a mass balance of the pollutants under study through a sampling program including primary clarifier influent, biological treatment effluent, air emissions above the aeration tanks, and dewatered sludge solids. In general, 50% of the mass of each pollutant found in the mill's raw wastewaters were accounted for in the program. The accountability of the volatile organic pollutants ranged from 27 to 55%. The accountability of semivolatile pollutants ranged from 6 to 933% with three pollutants accounted for in excess of 100%. The objective of accountability was not achieved due to several factors, including: biochemical transformation; quantity of pollutants, detection limits, sample matrix, and analytical procedures; sampling procedures; and capability to accurately estimate air and sludge emissions. It is unrealistic to anticipate 100% accountability; however, through more controlled conditions, more advanced sampling techniques, and higher resolution analytical techniques, improved accountability should be a realistic goal. (Moore-SRC)
W82-02998

NICKEL RECOVERY FROM ELECTROPLATING RINSEWATERS BY ELECTRODIALYSIS,

Chemical Recovery Systems, Hanover, MA.
J. L. Eisenmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-227209, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-130, October, 1981. 4 p, 2 Fig, 1 Tab.

Descriptors: *Metal-finishing wastes, *Electrodialysis, *Wastewater treatment, *Industrial wastewater, Cost analysis, Water use, Nickel, Waste recovery, Recycling.

A program to demonstrate the feasibility of metal salt recovery and pollution control on a Watts-type nickel plating line by electrodialysis was conducted at Risdon Manufacturing Co., Waterbury, Connecticut. Each of two reclaim rinse tanks was treated by recirculating the rinse solutions through separate electrodialysis stacks. The first rinse solution was maintained at 2-5 g/l nickel and the second rinse held at 0.3-0.4 g/l nickel over several months of plating operations. The nickel salts recovered from the rinse solutions were concentrated 20-fold by the electrodialysis treatment and could be returned directly to the plate tanks for reuse. The process is capable of reducing nickel content in plating line effluents to the ppm range, can recover 95% of the nickel salts lost with conventional rinsing techniques and substantially reduce other raw material usage, and can minimize the effort and space required for operation of standard destruct equipment. For plating operations similar to the demonstration line yearly savings are estimated to be at least $16,000 in raw materials with a concomitant decrease of about 2,300 kg in sludge from pollution control facilities. Net cost savings should increase as chemicals become more expensive and pollution regulations more stringent. Depending on the operation of the plating line, additional savings may be realized on water usage, storing and handling of chemicals, improved rinsing, and additive recovery. (Moore-SRC)
W82-03000

5E. Ultimate Disposal Of Wastes

ONTARIO'S SEVEN-POINT PLAN FOR THE TREATMENT AND DISPOSAL OF INDUSTRIAL WASTE LIQUIDS AND SLUDGES,

J. Donnan.
Water and Pollution Control, Vol 118, No 7, p 28, 34, July, 1980.

Descriptors: *Wastewater treatment, *Effluents, Planning, Sludges, Ontario, Industrial wastes, Decision making, *Wastewater disposal.

As of November of 1979 three firms in Ontario were certified to deal with the disposal of organic wastes. Tricil operates an incinerator at Corunna which can burn about 15 million gallons annually. Frontenac Chemical Waste Services Ltd in Hamilton recovers oils and solvents as well as operating an experimental solidification facility. Woodington Systems Inc. operates an oil and water separation facility and landfills industrial sludges. No facilities exist in the province that are fully approved to accept all types of chemical wastes, although 23 landfill sites are able to accept specific kinds of organic and inorganic wastes. Thousands of liters of waste liquids and sludges each year find their way to landfills that are not specifically approved to handle them. Even so there are few reported instances of damages of any kind resulting from the improper disposal of these materials. A 'Seven-Point Program' has been devised for the treatment and disposal of industrial waste liquids and sludges. Included in these seven elements are: way-bill monitoring, classification of wastes, water disposal guidelines, regulations, perpetual care, transboundary movement of wastes, and facilities and site selection. However, the program has some drawbacks. The impact of the program cannot be reviewed, as the data has not been disclosed publically. No emphasis on incentives to waste generators to change their processes was included in the program. No explicit consideration was given to the costs to the participating firms of meeting the new changes. (Baker-FRC)
W82-02603

CURRENT POLICIES ON LAND APPLICATION,

N. Goldstein.
BioCycle, Vol 22, No 5, p 39-41, September/October, 1981.

Descriptors: *Land application, *Sludge disposal, *Political constraints, Philadelphia, New York, Political aspects, Ocean dumping, Composting, Water law, Water policy, Policy making, Legal aspects, Water pollution control.

Lack of firm policies for municipal sludge disposal results in confusion and waste in the waste treatment industry and municipal budgets. An example was seen in the City of New York, which developed a plan for sludge composting on sites within city limits. A complex court action involving the EPA and local officials, as well as public opposition, allowed continuation of ocean dumping of sludge past the December 31, 1981, deadline. As a result, Nassau County's new $15 million sludge dewatering plant, in the final stages of completion, will not be used in the foreseeable future. Hauing the sludge to the proposed dump site 106 miles offshore will cost $5-10 per wet ton, vs. $1.41 for the present 12 mile site. In contrast, Philadelphia dumped its last bargeload of sludge into the ocean on November 26, 1980. The city has begun a sludge utilization program, which involves land application near the city and in strip mined land 250 miles away. Trucks transport sludge to the dump sites and return filled with coal. In this case strict Region III EPA enforcement plus public support for land application gave Philadelphia the opportunity to develop a successful program. (Cassar-FRC)
W82-02629

THE STATUS OF NUCLEAR WASTE MANAGEMENT,

Argonne National Lab., IL.
J. H. Kittel.
Journal of Environmental Sciences, Vol 23, No 5, p 28-32, September/October, 1980. 9 Fig, 13 Ref.

Descriptors: *Radioactive wastes, *Nuclear engineering, *Toxicity, *Metals, *Fuel reprocessing, Nuclear reactors, Powerplants, Wastes, Waste storage, *Waste management, Waste characteristics, Liquid wastes, Plutonium, Plutonic water.

The status of nuclear waste management is discussed. High-level nuclear waste can be safely stored and isolated through a multiple barrier approach. Although it is a hazardous material, its toxicity diminishes rapidly. It then becomes less hazardous than other materials that are dealt with routinely. Detailed studies are needed regarding the geologic structures used as possible high-level waste repositories, especially studies of groundwater conditions. The geologic structure selected must either be free of groundwater or be one in which groundwater is moving very slowly and not into any aquifers from which drinking water might be obtained. Natural demonstrations of radioactive waste isolation exist at some groundwater-saturated ore deposits, and observations of these natural formations have been very encouraging with regard to the low migration of radioactive elements. Low-level waste has not attracted very much public attention. The technical strategy for disposal involves reducing the volume of the waste, packaging it in steel barrels, and storing the barrels in earth-covered trenches. 100 to 200 years of isolation are required. The management of uranium mill tailings is similar in many technical respects to the management of low-level wastes. (Titus-FRC)
W82-02659

BACTERICIDAL EFFECT OF SEAWATER CONTAINING DIGESTED NIGHT SOIL AND MARINE PLANKTON AGAINST INTESTINAL BACTERIA, (IN JAPANESE),

Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
O. Nakayama, and M. Ohno.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 47, No 2, p 165-169, 1981. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Bacteria, *Ocean dumping, *Waste disposal, Plankton, Wastewater, Wastewater disposal, Enteric bacteria, Path of Pollutants, Bacterial analysis, Light intensity.

In order to estimate the sanitary problems of ocean fertilization with night soil, the effect of digested night soil, marine plankton and light on the viable count of intestinal bacteria in sea water was examined. One hundred ml each of aged seawater with or without digested night soil (1%), phytoplankton and zooplankton were inoculated with Escherichia coli, Salmonella typhimurium or Vibrio parahaemolyticus. The samples were then shaken with or without illumination for several days at 20 degrees C. The phytoplankton used included Nitzschia closterium, Phaeodactyllum tricornutum, Dunaliella tertiolecta, Brachiomonas sp., Chlamydomonas sp., Platymonas sp., Nannochloris sp., and Chlorella sp. The zooplankton was Tigriopus japonicus. Selective media were used each day to count the bacterial cells. E. coli and S. typhimurium survived more than 6 and 15 days, respectively, in dark, clean seawater, and V. haemolyticus propagated. In illuminated seawater containing digested night soil and marine plankton E. coli, S. typhimurium and V. haemolyticus died off within 1 to 3 days. (Baker-FRC)
W82-02799

THE DEVELOPMENT OF A VILLAGE WATER SUPPLY SYSTEM ON TRUK,

Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5F.
W82-02816

FLUE GAS DESULFURIZATION SLUDGE DISPOSAL PRACTICES FOR COAL-FIRED STEAM AND POWER PLANTS,

Gibbs and Hill, Inc., New York.
H. A. Schlesinger.
Mining Engineering, Vol 32, No 10, p 1516-1520, October, 1980. 3 Fig, 10 Ref.

Descriptors: *Industrial wastes, *Waste disposal, *Sludge disposal, *Sludge treatment, Chemical wastes, Solid wastes, Sulfur, Fly ash, Landfills, Mine drainage, Regulations, Water quality control, Ponding, Lime, Limestone, Oxidation, Land disposal, Solid waste disposal.

Some of the alternatives for the handling and diposal of throw-away lime, limestone and dual alkali process solid wastes are discussed in view of the increasing number of sulfur emitting power plants that use lime or limestone as sulfur reducers. The advantages, disadvantages and economics of such methods as wet ponding without thickener, wet ponding with separate thickener, dewatering plus landfill, wet blending plus pipelining to disposal area, dry blending plus landfill, wet fixation plus pipelining to disposal area and mine disposal are considered. Plant size, the forced oxidation of sludge, and operating problems with sludge disposal are examined, along with sludge disposal regulations under the Resource Conservation and Recovery Act. It was concluded from the study that costs for sludge disposal are site specific. Some low cost disposal options include ponding and blending plus mine disposal and forced oxidation. Since deep mine disposal of some sludges may cause environmental problems of gas generation and impaired water quality, future land use should be considered when selecting the disposal site. The order of magnitude area requirement for a 3.5% sulfur, 14% ash, 27.9 MJ/kg coal, 30 year life, and 70% average capacity factory is about 40.5 sq dam/MW power or equivalent steam. The stabilization of scrubber sludge by fixation or blending is recommended to improve the properties and decrease leachability. (Geiger-FRC)
W82-02907

EVALUATION OF HIGH- AND LOW- SPEED CENTRIFUGES,

Water Pollution Control Plants, Philadelphia, PA.
W. Wankoff, T. Lauletta, and R. Shah.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1568-1573, November, 1981. 5 Tab.

Descriptors: *Centrifugation, *Dewatering, *Sludge drying, Sludge, Sludge disposal, Mechanical equipment, Philadelphia.

The development of sludge dewatering facilities in Philadelphia gave the water department experience in the design and operation facilities utilizing centrifuges. Presently, a low-speed/low-G machine is being used to dewater anaerobically digested primary sludge. Higher speed/higher-G machines are used to dewater a mixed 60%-primary/40%-secondary anaerobically digested material. The centrifuges have operated satisfactorily although there have been problems with peripheral equipment. When sludge dewatering is required on a continuous basis, there must be sufficient duplication within the system to permit down-time of equipment such as sludge grinding equipment, feed pumps, etc. (Small-FRC)
W82-02931

5F. Water Treatment and Quality Alteration

ENERGY MANAGEMENT IN THE WATER WORKS INDUSTRY,

Metcalf and Eddy, Inc., Boston, MA.
D. Brailey, and A. Jacobs.
Journal of the New England Water Works Association, Vol 94, No 3, p 216-239, September, 1980. 9 Fig, 8 Tab, 10 Ref.

Descriptors: *Water treatment, *Water treatment facilities, *Electric power costs, *Cost analysis, Utilities, Chemical treatment, Coagulation, Alum, Fuel, Energy, Water distribution, Water management, Electric power rates, Electric power demand, Operating costs.

Methods to optimize energy use in the treatment and distribution of water are explored. In general, 1200-1800 KWH of energy, usually in the form of electricity, per million gallons of water are required to drive motor operated pumps and equipment, to effectively acquire, treat, and distribute water. Rate structures vary among utility companies and usually combine a mixture of connection demand, reactive demand, standy, basic energy, time-of day, and fuel adjustment charges. A hypothetical electric rate schedule and utility were used to calculate the savings available from various electrical energy management measures. The utility serves a population of 75,000 with 10 MGD. The total estimated electricity usage of the facility is 450,000 KWH per month. Several ways to reduce the demand charge on the electric bill are listed. To reduce basic energy costs, several measures are recommended, such as using high-efficiency motors, improvement of pump efficiency, increasing system storage, reducing unaccounted for water, checking distribution system valves, and cleaning and lining pipes. The time of day charge effect may be optimized by running scheduled equipment during non-peak hours. The conservation of chemicals used in water treatment is illustrated in methods of coagulation control and alum recovery. (Geiger-FRC)
W82-02608

AQUIFER DECONTAMINATION FOR VOLATILE ORGANICS: A CASE HISTORY,

New Jersey Bureau of Ground Water Management.
W. F. Althoff, R. W. Cleary, and P. H. Roux.
Ground Water, Vol 19, No 5, p 495-504, September/October, 1981. 4 Fig, 2 Tab, 3 Ref.

Descriptors: *Chlorinated hydrocarbons, *Water pollution treatment, *Industrial wastes, Solvents, Plumes, Aquifers, *Groundwater pollution, Organic compounds, Trichloroethane, Tetrachloroethylene, Path of pollutants, Water pollution sources, Chemical wastes, Water quality control.

In December 1977 organic solvents, including 1,1,1-trichloroethane and tetrachloroethylene, were found in a municipal well in South Brunswick Township, New Jersey, at concentrations of 150-1500 ppb and 100-300 ppb, respectively. A hydrologic study determined that the source was an industrial plant. Under the plant site the Old Bridge aquifer was contaminated with as high as 40,000 ppb trichloroethane. Concentrations greater than 100 ppb extended 1000 ft downgradient of the plant. To protect a municipal well located 2500 ft from the plant, the industrial site was inspected and tanks, drains, sumps, etc., cleaned and repaired. A pollution abatement system with design rate of 198,000 gpd was installed. This consists of seven extraction wells, a treatment facility, two cooling towers in series to air strip volatile organics from the water, and two half acre, 10 ft deep infiltration ponds to return the water to the aquifer. During the 10 months of operation, there have been contaminant reductions of 87% and 93% in two of the decontamination wells, noticeable reductions in two other wells, and no improvement in three wells. The contamination plume has been substantially reduced in extent and concentration. The aquifer is expected to be decontaminated within several years, after which the treatment process will be discontinued. (Cassar-FRC)
W82-02613

CHEMICAL COAGULATION OF SURFACE WATER,

Johnson (C.C.) and Associates, Inc., Silver Spring, MD.
J. A. Susan, and R. M. Gruninger.
Industrial Water Engineering, Vol 18, No 4, p 14-18, July/August, 1981. 4 Tab, 2 Ref.

Descriptors: *Coagulation, *Chemical coagulation, *Surface water, Alum, *Water treatment, Polymers, Lakes, Ferric chloride, Magnesium carbonate.

This paper reviews some of the factors relating to chemical treatment of surface waters as experienced in field and laboratory studies at several water treatment plants processing Lake Erie and Lake Ontario water. In one plant an automatic coagulation control center closely regulates chemical dosages. In another facility plant scale tests with ferric chloride in place of alum produced finished water of similar quality, but caused higher Fe concentrations, more turbid water before filtration, rusty filter backwash water, difficulty in handling, and 20% higher cost. Alternative coagulants or coagulant aids suggested are magnesium carbonate (uneconomical for plants smaller than 20 mgd) and organic polymers. Sludge considerations include alum recovery (by sulfuric acid addition or solvent extraction), dewatering properties, and disposal. (Cassar-FRC)
W82-02623

METHOD AND APPARATUS FOR SUPPLYING DISSOLVED CHEMICALS INTO WATER,

Metallgesellschaft, A.G., Frankfurt am Main (Germany, F.R.). (Assignee).
K. Lohrberg, R. Pfohl, J. Schubert, M. Gritschke, and J. Freytag.
U.S. Patent No 4,230,569, 4 p, 1 Fig, 14 Ref; Official Gazette of the United States Patent Office, Vol 999, No 4, p 1538-1539, October 28, 1980.

Descriptors: *Patents, *Water treatment, *Industrial water, *Stream flow, Application equipment, Chemicals, *Dissolved solids, Horizontal flow.

An apparatus is provided for supplying dissolved chemicals into horizontally flowing streams of sea water or river water which are to be chlorinated for use as cooling water, e.g., for power plants. The apparatus comprises a horizontal conduit through which the water passes. A stationary manifold placed above the level of flowing liquid has vertical discharge hoses of differing lengths, each of which has an outlet opening below the level of the flowing water. The outlet openings are evenly distributed throughout the cross-section of the flowing water. The chemicals can be readily introduced into the aqueous streams with a particularly high degree of even distribution owing to the disposition of the discharge hoses which promote the distribution of the chemicals by oscillation. (Sinha-OEIS)
W82-02625

THE CLEAR LAKE EXAMPLE: AN ECOLOGICAL APPROACH TO PEST MANAGEMENT,

S. F. Cooke.
Environment, Vol 23, No 10, p 25-30, December, 1981. 1 Tab, 11 Ref.

Descriptors: *Midges, *Aquatic weed control, *Algal control, *Ecological effects, *Insecticides, Insect control, Lakes, Weed control, Biological magnification, Fish, Fish establishment, Fish populations, Pesticides, Larvicides, DDD, DDE, DDT, Parathion, Copper sulfate, Aquatic insects, Toxicity.

In efforts to control the populations of Chaoborus astictopus (termed gnats, although actually midges) and blue-green algae in Clear Lake, Lake County, California, ecological investigations were initiated in 1961. Prior to these studies, chemical control programs for C. astictopus using DDD, methyl parathion, and copper sulfate were tried but caused problems when the midges developed resistance to the chemical agents, and non-target species were affected by biomagnification of the pesticides through the food chain. In August of 1967, a few thousand Mississippi silverside fish (Menidia audens) were released into Clear Lake, and by 1969, they became the dominant fish in the lake. Also in 1969, a dramatic reduction in blue-green algae was noted over previous years. Gnat populations seemed to also be affected by the new fish in the lake, showing no signs of recovery to former densities even when chemical pesticide treatment of the lake was discontinued. No detrimental effects on sport fishing in Clear Lake have been observed since the introduction of M. audens, and the ecological approach to pest management in this case was regarded as successful. (Geiger-FRC)
W82-02660

NEW CONCEPTS IN FILTRATION PLANT DESIGN AND REHABILITATION,

Southern California Metropolitan Water District, Los Angeles.
A. E. Bowers, and J. D. Beard, II.
Journal of the American Water Works Association, Vol 73, No 9, p 457-463, September, 1981. 9 Fig, 12 Ref.

Descriptors: *Filtration, Water treatment, Coagulation, Control systems, Sedimentation, Backwash, *Water treatment facilities, Design criteria, *Southern California.

Changes in the Metropolitan Water District of Southern California's five water filtration plants (total 63,240 ML per day) have been both subtle and radical. All are presently of conventional design (coagulation, flocculation, sedimentation, dual-media filtration, and disinfection). Some of the modifications used in the District's plants are introduction of coagulants into the turbulent wake produced by an energy dissipation device, traveling bridges for sedimentation basin sludge removal, a single wash trough to collect used filter wash water, three-way valves in filter equipment, optimum design configuration for surface wash water jets, large storage tanks for preliminary settling and to buffer major fluctuations in raw water quality, and computer-based process control. (Cassar-FRC)
W82-02681

OZONE WATER TREATMENT,

S. Smith.
Water Well Journal, Vol 35, No 10, p 70-71, October, 1981. 1 Fig, 1 Tab.

Descriptors: *Ozonation, *Disinfection, *Water treatment, Ozone, Economic aspects, Construction costs, Operating costs, Chlorination, Costs, Well water.

Ozonation, used in over 1000 European and Asian cities as a primary water treatment, is not as common in North America: 20 plants in Canada and a handful in the U.S. Some advantages of ozonation are: (1) destruction of organic precursors of trihalomethanes, (2) destruction of hydrogen sulfide, (3) precipitation of dissolved Fe and some other metals, and (4) no chlorine taste. Ozonators are more expensive to construct and operate than chlorination systems, but are long-lasting, simpler to operate, and do not require chemicals. (Cassar-FRC)
W82-02682

METHODS FOR EVALUATING PERFORMANCE OF FILTER MEDIA,

Metcalf and Eddy, Inc., Boston, MA.
For primary bibliographic entry see Field 5D.
W82-02684

RESTORING AN ANTIQUE WATER SYSTEM.

Water/Engineering and Management, Vol 128, No 10, p 31-32, 1981.

Descriptors: *Water distribution, *Water conveyance, Water supply, Pipes, Rehabilitation, Conveyance structures, Linings, *Burlington, *New Jersey, Water treatment, Water quality control, Iron, Manganese.

Iron and manganese content of water in the city of Burlington, New Jersey increased to levels which made the water unacceptable. The system serving the city was very old and repairs were difficult and costly. While sequestering was able to bring some relief to the situation, a study was conducted which yielded several conclusions. Treatment for iron and manganese removal was going to be necessary. The old water treatment plant could not treat the water without major modification and in all probability it would be less costly to construct a new plant. The old distribution system piping was probably contributing to the problem, but correcting it would have to be deferred until proper water treatment was provided. A major feasibility study was undertaken. The program devised called for construction of the new treatment plant, addition of elevated storage, and restoration of the very old water distribution system. Estimated cost of the entire project was between 10 and 15 million dollars. Cleaning and cement mortar lining of existing pipe was done to restore the pipe to like new condition with an estimated additional life in excess of 50 years. Two separate pipe rehabilitation contracts were involved. Elapsed time for the work was four years. The job was accomplished with a minimum of excavation, repaving and service interruption. (Baker-FRC)
W82-02685

COST ESTIMATES FOR WATER TREATMENT PLANT OPERATION AND MAINTENANCE.

For primary bibliographic entry see Field 6C.
W82-02697

WATER REGULATION IN AN INFLATIONARY ENVIRONMENT,

R. E. Hammond.
Journal of the New England Water Works Association, Vol 95, No 3, p 187-192, 1981.

Descriptors: *Planning, *Financial aspects, Water treatment, Water treatment facilities, Wastewater treatment, Drinking water, Financing, Costs, Case studies.

Various case histories are briefly cited which exemplify lack of proper financial consideration used in water supply problem solving steps. Cases involving meter reading, pH adjustment for water treatment processes, installation of a flash mixer, improper use of carbon filters, replacement tanks, and improperly conceived plant design are each considered. The general outcome of improper and incomplete planning is lack of public support and trust. The author stresses the need for a more complete understanding of the problems in any given area and a thorough investigation of proper solutions to the problems, including a thorough study of any monies needed to execute the plans and keep the system operable. (Baker-FRC)
W82-02701

A DYNAMIC PROGRAM FOR COAGULATION AND FILTRATION AT CHICAGO'S JARDINE WATER TREATMENT PLANT,

Illinois Inst. of Tech., Chicago.
A. E. Burgarino.
PhD Dissertation, 1980. 369 p, 52 Fig, 20 Tab, 114 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06292.

Descriptors: *Water treatment, *Water purification, *Coagulation, Statistical methods, Filtration, Automation, Turbidity, *Chicago, Jardine Water Purification Plant.

A computerized optimization program is developed for the Jardine Water Purification Plant at Chicago, Illinois. The purpose of the program is to calculate the required alum and polymer doses that not only yield an acceptable effluent turbidity, but also effect the lowest operating cost. The solution is complicated by the interaction of coagulation and filtration. There are two main perspectives. One is the systems approach of integrating the coagulation and filtration process by the solution framework of dynamic programming. The second is the development of a set of equations which predict (or simulate) turbidity removal and the rate of increase of filter headloss as functions of coagulant doses. These equations are used in the dynamic program to avoid a coagulant dose that results in an unacceptable filtered effluent turbidity or excessive headloss. It is shown how an optimization procedure based on statistical analysis of historic data can be used as part of a control algorithm for automated plant control. (Sinha-OEIS)
W82-02731

THE ROMAN WAY,

S. Lucas.
Water, No 40, p 13-15, September, 1981.

Descriptors: *Water quality management, *Sewer systems, *Water pollution prevention, Water quality control, Wastewater treatment, Water pollution control, *Water treatment, Water supply, Water resources development, Water supply development, Water management, *Rome, Future planning.

The city of Rome supplies 10% of its users with private connections to mostly nonpotable water sources. Azienda Comunale Electtricita' ed Acque (ACEA) is in charge of sterilizing water for users in Rome. Only small treatment plants are needed to remove hardness from water supplies from the Appenine Mountains. The Peschiera aqueduct supplies most of the water from the mountains. Long range plans include the building of a dam, a new aqueduct, and a sewerage system around Lake Bracciano to protect it as a water supply source. Metering systems help to curb water use, but plans are being implemented to phase out metering over the next 10 years. The consumers will soon be charged a nominal fee for sewage disposal. No general laws exist at present for sewage disposal. ACEA has been asked to organize district sewerage systems for outlying areas. The main purpose of these systems will be to protect water supplies. A plan is proposed to divide the Lazio region into three smaller sections to manage water pollution problems. The time needed for integration of water supply, sewage disposal and pollution control management will probably be extensive due to unstable conditions in the Italian government. (Geiger-FRC)
W82-02744

WATER SUPPLY AND SANITATION DECADE PROGRAMME,

National Environmental Engineering Research Inst., Nagpur (India).
B. B. Sundaresan, and S. T. Khare.
Aqua, No 5, p 16-18, 1981. 4 Fig, 2 Tab.

Descriptors: *Water supply development, *Sanitation, *India, Human diseases, Water scarcity, Water shortage, Administrative decisions, Decision making, International agreements, Financial aspects, Drinking water, Potable water.

Efforts underway in India to achieve the goal of the United Nations Water Conference of providing safe drinking water and effective sanitation for all people of the world during the decade 1981-1990 are cited. Awareness of the need to provide an adequate and wholesome water supply was recognized with the establishment of the Bhore Committee as early as 1944. A report from the Union Ministry of Health in 1964-65 indicated that about 66% of the Indian rural population lived in areas where it was easy to provide safe drinking water from local sources such as wells. The remaining

35% lived in villages where water scarcity was a way of life and in which engineering skills, extra financial outlays and time consuming work would be required to deliver proper water amounts. Comprehensive planning and large scale financial allocations were deemed necessary for implementation of water supply and sanitation programs at the state level. Administrative decisions and public support were lacking. The vast numbers of villages and people affected by various waterborne and water related diseases indicated the seriousness of the environmental health problem. Rapid assessment of the status of drinking water supply and sanitation in India was undertaken during 1977-80. In 1980 the government of India pledged support to the UN program. Almost all the equipment and materials required for water supply systems are currently available in India. Administration action has been initiated at various levels. Sufficient professionals are available to enable the work to proceed. (Baker-FRC)
W82-02757

PRACTICAL EXPERIENCES IN PLANTS USING ACTIVATED CARBON,

Gentofte Water Supply (Denmark).
P. K. Jensen.
Aqua, No 5, p 0321-0329, 1981. 13 Fig.

Descriptors: *Water treatment, *Activated carbon, Surface waters, Chlorination, Ozonation, Manganese, Organic matter, Algal growth, Eutrophication, Denmark, Filtration, *Lake Sjaelsoe, *Denmark.

Experience at a waterworks in Denmark is reviewed which led to the decision to use ozone plus activated carbon filtration as the last step in treatment of water from lake Sjaelsoe for drinking purposes. This plant is operational during March through November, with shutdown during winter when consumption is low, and to allow a complete overhaul. A seasonal bloom of algae occurs, which gives rise to taste and odor problems. Experiments to treat lakewater began in 1956 and included chemical treatment with sedimentation and filtration through rapid sand filters and ordinary slow sand filters. It was later discovered that blowing through with ozine before the filtration step gave additional improvement of taste and odor and gave the water a clear appearance as well. This treatment gave a solution to the problem of manganese removal from the lake water. While activated carbon filters are needed to provide acceptable taste and odor control, even if the water at the inlet to the activated carbon filters has a free chlorine content of about 1 mg/liter, there is a risk of bacterial growth across the filters. Post-chlorination has been instituted to obtain successful elimination of the organisms produced. In this case, where water production is based upon lake water for 15-25% of the total production, the economy of the situation is acceptable in relation to the influence on the cost price and the price which consumers must pay. (Baker-FRC)
W82-02788

BACTERIA FROM A SUSPENDED GROWTH SYSTEM AS ORGANIC PRECURSORS TO THE FORMATION OF TRIHALOMETHANES,

Missouri Univ-Rolla. Dept. of Civil Engineering.
F. Dolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168519, Price codes: A05 in paper copy, A01 in microfiche. Master of Science Thesis, 1981. 71 p, 12 Fig, 8 Tab, 31 Ref. OWRT- A-116-MO(2), 14-34-0001-0127.

Descriptors: *Bacteria, Ferric iron, *Chlorine, Chloroform production, *Water treatment, *Trihalomethanes, *Organic precursors, *Bacterial physiology.

The objective of this research was to study the bacteria from a suspended growth system as organic precursors to the formation of THMs. THM production was monitored as a function of initial chlorine dose and the concentration of bacterial mass as measured by turbidity. All tests were conducted on a batch basis. Ferric iron was also examined for its potential to act as a catalyst for THM production during the chlorination of bacterial cells. In a system saturated with chlorine, chloroform formation was found to increase linearly with the amount of cell mass used as an organic precursor. Chloroform production was also found to increase in relation to a greater exposure of cell surface area (e.g. dispersed cells vs. flocculated cells). Ferric iron appeared to catalyze chlorination reactions in water, causing increased chlorine consumption, but did not increase THM production.
W82-02806

NEW ANTIMICROBIAL AGENTS FOR TREATMENT OF WATER,

Auburn Univ., AL. Dept. of Chemistry.
S. D. Worley, H. H. Kohl, and W. B. Wheatley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168535, Price codes: A02 in paper copy, A01 in microfiche. Completion Report, November 30, 1981. 10 p. OWRT-A-072-ALA(1), 14-34-0001-1101.

Descriptors: *Bactericides, *Disinfectants, *Water treatment, Water supply.

Several N-chloramine agents have been tested for their efficacy as bactericides in water. The compound 3-chloro-4,4-dimethyl-2-oxazolidinone (agent I) has proved to be the best of those tested, and in fact, definitely holds promise as an all-purpose water disinfectant for swimming pools, cooling towers, wells, military field units, the poultry industry, hospitals, and possibly even municipal water-treatment plants. It has been shown to be effective against a broad vicinity of bacteria and in a laboratory water treatment plant. It is a solid with appreciable solubility in water which retains its chlorine content in a demand-free situation almost indefinitely. It is stable in dry storage and in water solution, and it releases chlorine as necessary to kill bacteria upon demand. Preliminary tests indicate that it will not be toxic toward animal life. Furthermore, it should not cause the formation of toxic haloforms in water containing organic material.
W82-02808

THE DEVELOPMENT OF A VILLAGE WATER SUPPLY SYSTEM ON TRUK,

Guam Univ., Agana. Water and Energy Research Inst.
S. J. Winter, and R. A. Stephenson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168618, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 28, 1981. 45 p, 27 Fig, 1 Tab, 4 Ref, Append. OWRT-B-003-GUAM(1), 14-34-0001-0261.

Descriptors: Water conveyance, *Developing countries, *Water supply development, *Water treatment, Wastewater treatment, Wastewater disposal, Public health, Potable water, Micronesia, *Truk, Caroline Islands.

The islands of Micronesia encompass only a little more than 1,000 square miles of land area in an arc lying across the face of the northwest and central Pacific. At present, the centralized water supply and wastewater treatment and disposal systems are located primarily in the various district centers. Most households in Micronesia obtain their fresh water from streams, springs, and household rainwater catchment systems. Toilet wastes are generally disposed of by means of privys over shallow shore waters, streams, or pits dug in the ground. Diseases associated with poor sanitary conditions are common. The objectives of this project are to improve the water utilization scheme of a typical Micronesian village in a manner that provides minimal disruption of normal cultural practices and to train Micronesians in these improvement procedures.
W82-02816

THE COST OF QUALITY,

Yorkshire Water Authority (England).
P. G. Clark.
Water, No 40, p 2-5, September, 1981. 4 Fig.

Descriptors: *Water supply, *Sewers, *Rivers, *Pipes, *Water quality, Potable water, Disinfection, Leakage, Networks, water loss, Distribution, Dams, *Water treatment, Filtration, Flow, Channels, Costs.

The Yorkshire Water Authority has reduced its annual capital expenditures since 1974. The reductions were a result of reorganization, customer demands, and the regional economic climate. Due to the cutbacks in spending, the Water Authority has adopted a maintenance policy which responds only to the most severe problems on an ad hoc basis. Projections of future maintenance problems and costs have been prepared. These include repairs to dams and service reservoirs, upgrading water quality, and replacing unlined cast iron pipes. (Titus-FRC)
W82-02881

EVALUATING A PLANT'S POTENTIAL FOR UPGRADING,

Freese and Nichols, Inc., Austin, TX.
A. J. Huckabee, and J. T. Garrett, Jr.
Journal of the American Water Works Association, Vol 73, No 9, p 478-483, September, 1981.

Descriptors: *Water treatment facilities, *Design criteria, Systems engineering, Alternative planning, Planning, Hydraulic equipment, Construction.

A three-phase method is suggested to evaluate the feasibility of upgrading an existing water treatment plant. In Phase 1, documentation, all available physical data on the plant are collected and facilities inspected to gather any missing information. Phase 2, analysis, is concerned with treatment effectiveness, capacities, and serviceability of the following: raw water intake, low-lift pumps, flow splitting and distribution, rapid mix equipment, flow distribution, flocculation basins, settling basins, settled water collection, transport to filters, filter boxes and media, piping systems, and backwash system. Phase 3, synthesis, proposes several plant layout alternatives. The most cost effective proposal is selected, presented to the client, and described in a final report. (Cassar-FRC)
W82-02895

ADSORPTION OF DISSOLVED ORGANICS IN LAKE WATER BY ALUMINUM OXIDE. EFFECT OF MOLECULAR WEIGHT,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
J. A. Davis, and R. Gloor.
Environmental Science and Technology, Vol 15, No 10, p 1223-1229, October, 1981. 8 Fig, 57 Ref.

Descriptors: *Adsorption, *Water treatment, *Organic compounds, *Lakes, *Aluminum oxide, Disinfectants, Chlorine, Organic carbon, Suspended solids, Hydrogen ion concentration, Separation techniques, Electrophoresis, Drinking water, Chromatography, Dissolved solids, Geochemistry.

The role of adsorption in the geochemical cycle of organic carbon in lacustrine environments and the binding of polar organic compounds at the oxide surface were studied in laboratory experiments with water samples from Lake Greifensee, Switzerland. Dissolved organic compounds were fractionated by gel exclusion chromatography into three molecular size classes. The adsorption of each fraction onto colloidal alumina was studied as a function of pH. Low molecular weight compounds were weakly absorbed, while organic compounds with molecular weights over 1000 formed strong complexes with the alumina surface. Measurements of electrophoretic mobility showed that alumina particles suspended in the original lake water had high negative charges due to adsorbed organic matter with molecular weights usually in the range of 1000 to 3000. During alum coagulation in the treatment of drinking water, the preferential removal of trihalomethane precursors may be caused by the adsorption of the high molecular weight organic compounds. Adsorption may also

affect the molecular-weight distribution of dissolved organic material in lakes. (Geiger-FRC)
W82-02940

THE EQUILIBRIUM FLUORIDE CAPACITY OF ACTIVATED ALUMINA,

Houston Univ. at Texas.
G. Singh, and D. A. Clifford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-124075, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-082, July, 1981. 5 p, 5 Fig, 2 Tab.

Descriptors: *Water treatment, *Fluoride, *Activated alumina, *Adsorption, Ionic interference, Equilibrium, Hydrogen ion concentration, Municipal water.

Current estimates are that there are several thousand public water supplies in the U.S. with excessive fluorides, especially in the 1.4 to 5.0 mg/l range. Many of these communities may eventually install activated alumina treatment systems to remove the excess fluoride. Because design limitations for a defluoridation process were unavailable, laboratory studies were performed to establish the maximum (equilibrium) fluoride capacities for activated alumina as a function of pH and competing ions. Fluoride adsorption tests were run using mini-columns containing 1g of acid-treated Alcoa F-1 activated alumina equilibrated for 6 to 10 days with a continuous flow of fluoride solution at a constant pH. Maximum fluoride adsorption capacities in distilled water solutions of sodium fluoride were found to be 8000 g F/cu m at 3.0 mg F/L and 9100 F/cu m at 6.0 mg F/L. The optimum pH range for fluoride adsorption was 5 to 6. Less than 50% of these capacities are estimated to be attainable in actual municipal defluoridation practice because of poor kinetics and competing ion effects. Fluoride capacities were not significantly reduced by competition from chloride or bicarbonate; however, at a typical sulfate concentration (250 mg/L) the fluoride adsorption capacity was reduced 28% at pH 6. It was observed that as pH increased from 6 to 8, the rate of fluoride adsorption also increased. (Moore-SRC)
W82-02968

INORGANIC CONTAMINANT REMOVAL FROM DRINKING WATER BY REVERSE OSMOSIS,

Charlotte Harbor Water Association, Inc., Harbour Heights, FL.
M. R. Huxstep.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-224420, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-115, October, 1981. 2 p, 1 Tab.

Descriptors: *Water treatment, *Reverse osmosis, *Fluoride, *Nitrate, *Arsenic, Hardness, Groundwater, Dissolved solids, Calcium, Magnesium, Chloride, Sodium, Sulfate, Inorganic contaminants.

The removal of inorganic contaminants from drinking water was studied using two reverse osmosis (RO) treatment systems. A high pressure (400 psi) and low pressure system (200 psi), each having a rated capacity of 1.82 L/sec (28.9 gpm) of product water, were used to evaluate their capability for removing various inorganic contaminants. A groundwater was spiked with varying concentrations of fluoride, nitrate, arsenic III, and arsenic V, and runs of 2 to 5 days were conducted to determine rejections. Removal data were also collected on the natural constituents in the feed water of total dissolved solids, hardness, calcium, magnesium, chloride, sodium, and sulfate. For all contaminants and natural constituents measured, the high pressure system operated at 265 to 359 psig more effectively removed the inorganic contaminants than did the low pressure system operated at 163 to 187 psig. High pressure system removals ranged from 80 to 99%; low pressure, from 10 to 85%. Percent removals varied with the ion measured, but the order, from best to worst, was about the same for each system. The order for the high pressure system was: (1) arsenic V, (2) fluoride, (3) arsenic III, and (4) nitrate. Percent removal was also independent of the initial concentration.
W82-02969

REMOVING TRACE ORGANICS FROM DRINKING WATER USING ACTIVATED CARBON AND POLYMERIC ADSORBENTS,

Iowa State Univ., Ames.
C. S. Oulman, V. L. Snoeyink, J. T. O'Connor, and M. J. Taras.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-119768, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-077,078,079, 53 p, July, 1981. 5 p, 1 Tab.

Descriptors: *Adsorbents, *Activated carbon, *Drinking water, *Trihalomethanes, *Chloroform, Fulvic acids, Humic acids, Resins, Organic carbon, Water treatment, Chlorinated hydrocarbons, Halogenated hydrocarbons.

Adsorption isotherms and bench-scale column studies were used to compare the performance of five types of commercially available activated carbons and four types of resins for removing humic acids, fulvic acids, 2-methylisoborneol (MIB), and chloroform from water. For adsorbing humic materials, some of the activated carbons and the weak base phenol-formaldehyde resins performed satisfactorily. The same activated carbons provided satisfactory removal of MIB, although the capacity was reduced somewhat in the presence of humic acid. The carbonaceous resin and one of the activated carbons had about the same capacity for chloroform removal at concentrations under 0.5 mg/l. The presence of 10 mg/l of humic acid had little effect on their capacity for adsorbing chloroform. In studies using pilot plant adsorption columns to adsorb halogenated organic substances from softened, filtered Kansas City water, activated carbon and carbonaceous resin were able to remove trihalomethanes (TTHM) for extended periods. Conversely, strong and weak-base anion exchange resins were not able to remove the TTHM. Only the granular activated carbons were effective in removing significant amounts of the total organic carbon (TOC) present. Periodic steaming of the activated carbon columns reduced bacterial growth and enhanced TTHM and TOC removal. Regular backwashing of the activated carbon columns was also effective in reducing the accumulation of bacterial growth. (Moore-SRC)
W82-02987

SOURCES OF HALOGENATED HYDROCARBONS IN AN URBAN WATER SUPPLY,

Municipal Environmental Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W82-02991

5G. Water Quality Control

MANAGEMENT OF GROUND WATER CONTAMINATED BY AROMATIC HYDROCARBONS IN THE AQUIFER SUPPLYING AMES, IOWA,

Southern Illinois Univ. at Carbondale. Coal Extraction and Utilization Research Center.
For primary bibliographic entry see Field 5B.
W82-02611

THE STATUS OF NUCLEAR WASTE MANAGEMENT,

Argonne National Lab., IL.
For primary bibliographic entry see Field 5E.
W82-02659

CROPLAND, BUFFER, AND STREAM: A CASE STUDY IN AGRICULTURAL NONPOINT SOURCE WATER POLLUTION,

Michigan State University, Department of Agricultural Engineering.
G. H. Aull, III.
PhD Dissertation, 1980. 235 p, 100 Fig, 19 Tab, 48 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-01076.

Descriptors: *Water pollution control, *Water quality control, *Agricultural runoff, Agricultural engineering, *Nonpoint pollution sources, Vegetation, Buffer areas, Filter areas, *Michigan.

Agricultural cropland runoff, a type of nonpoint source water pollution, can degrade the quality of surface waters. Several related programs are directed at reducing nonpoint source water quality problems. One of the newer practices is the streamside grassed buffer or filter strip. A field-scale research project utilizing a vegetated filter area was planned. The three-year study began in January 1978. This dissertation presents conclusions concerning the vegetated buffer area based on one year of data collection and six major runoff occurrences. Statistically significant differences in water quality constituent concentrations and loads were measured in the runoff from the control and buffered fields. The data indicate that the vegetated buffer area reduced common agricultural water polluted (nutrients, sediment, and oxygen demand) in the cropland runoff by about 25%. The runoff flows were found to have a fairly substantial impact on stream pollutant loads and a lesser, though quite variable, impact on stream pollutant concentrations. The water quality of the stream was marginal, though very few water quality standards violations were noted. The viability of the practice is best determined by personal values associated with such a pollutant reduction, when compared to the cost. The potential exists for reducing these costs through farmer design and/or installation of vegetated buffer areas, though the impact of such on pollutant reduction is unknown. (Sinha-OEIS)
W82-02728

THE ROMAN WAY,

For primary bibliographic entry see Field 5F.
W82-02744

LAKE VATTERN,

For primary bibliographic entry see Field 2H.
W82-02755

SOUTH AUSTRALIA'S APPROACH TO SALINITY MANAGEMENT IN THE RIVER MURRAY,

South Australia Engineering and Water Supply Dept., Adelaide.
K. J. Shepherd.
Agricultural Water Management, Vol 4, No 1/3, p 335-352, 1981. 5 Fig, 8 Ref.

Descriptors: *Salinity, *Water quality management, Rivers, *River Murray, *Australia, Cropland, Irrigation practices, Groundwater, Groundwater pollution, Water pollution sources, Farming, Water quality, *Saline water intrusion.

The three River Murray States and the Commonwealth of South Australia have developed a coordinated program for controlling drainage and salinity problems in South Australia. This area of Australia receives less than 8 inches of rainfall a year, which means that no local river can be relied upon for substantial water supplies. The River Murray is the area's most reliable and important water resource. The most immediate threat to water quality in the river is salinity. Much of the groundwater in the area has a high salinity level, which passes to the river, which in turn increases in salinity levels as it passes downstream. Salinity enters the Murray River from the natural inflow of groundwater, from river structures such as locks and weirs, and from irrigation practices. High salinity levels increase the hardness of water supplied to domestic users, limit the types of crops which can be grown by the farmers, and cause corrosion, scale and poor steam quality for industrial water users. The South Australia salinity control program calls for the establishment of the Noora Drainage Disposal Scheme, which involves the pumping of irrigation drainage water from existing evaporation basins at Berri and Renmark to an out

of the valley basin some 20 km east of Loxton. Upgrading control works on existing evaporation basins, the Rufus River Interception Scheme, replacement of furrow irrigation with improved irrigation methods, technical support for conversion of overhead to undertree irrigation and the installation of adequate drainage, and advances on monthly entitlements which are used for dilution are all part of the program to decrease the salinity problem. (Baker-FRC)
W82-02761

THE EVOLUTION OF A REGIONAL APPROACH TO SALINITY MANAGEMENT IN WESTERN AUSTRALIA,

Perth Public Works Dept. (Australia).
For primary bibliographic entry see Field 4D.
W82-02763

FRENCH EXPERIENCE IN WATER POLLUTION CONTROL,

Compagnie Generale des Eaux, Paris (France).
P-L. Girardot.
Aqua, No 2, p 7-10, 1981. 12 Fig.

Descriptors: *Water pollution control, *Planning, *France, Water quality, *Watercourses, Administrative decisions, Management, Governmental interrelations.

A strong policy has been enforced in France over the past 15 years in efforts to restore watercourses. One of the major areas of effort has been in developing measures against pollution. The River Basin Financial Agency has been established, and the water policy within the Ministry of the Environment has been reorganized. The results obtained by the largest river basin financial agency, the Seine-Normandie basin, are good examples of the work of these agencies. Programs for dams, reservoirs, implementation of quality objectives, financial incentives compelling polluters to pay considerable taxes, and improvement of treatment facilities have all been areas of endeavor by these agencies. An essential complement of these administrative actions is the development of techniques enabling reduction of the pollutant load. The security of the water supply has been improved by setting up extensive networks of cross connections between treatment plants, relocation of water intakes and construction of storage basins. Through the establishment of these various administrative agencies and through the development of acceptable techniques, means for control of the pollution situation will become apparent. Continuous control of raw water quality and early detection of occasional pollution are the only effective means. Continuously operating stations have been set up in the Paris area to monitor water quality and detect the arrival of occasional pollution. A plan known as Seine Security has been devised whereby activation of all means of immediate reaction to a pollution problem will occur as soon as an alarm is set off. (Baker-FRC)
W82-02765

RUNOFF AND POLLUTION ABATEMENT CHARACTERISTICS OF CONCRETE GRID PAVEMENTS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Architecture and Urban Studies.
For primary bibliographic entry see Field 5B.
W82-02801

SECURING SUPPORT FOR NONPOINT POLLUTION CONTROL WITH LOCAL COMPENSATION,

Tennessee Univ., Knoxville. Dept. of Agricultural Economics.
W. Park, and L. Shabman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168527, Price codes: A04 in paper copy, A01 in microfiche. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University Bulletin 134, August, 1981. 61 p, 5 Fig, 14 Tab, 42 Ref. OWRT-A-085-VA(2).

Descriptors: *Nonpoint pollution control, Planning, Cost distribution, Benefit distribution, Water quality, *Nonpoint pollution sources, *Water pollution control, *Cost allocation, *Occoquan Basin, Fairfax County, Virginia.

In areas designated as having complex water quality problems, the challenge for 208 planning is to develop nonpoint pollution control strategies that are acceptable to the affected political jurisdictions and interest groups. This study's thesis is that acceptance of a nonpoint pollution control strategy by an individual jurisdiction requires the expectation of receiving positive net benefits. The overall objective of this research, therefore, was to investigate how local compensation payments can be used to encourage acceptance of nonpoint pollution control strategies to ensure that no jurisdiction incurs costs in excess of benefits. Using a linear programming (LP) framework that allows the integration of physical, economic, and political aspects of pollution control policy, the report uses Northern Virginia's Occoquan Basin as a case study to illustrate the potential of distributional factors in discouraging acceptance of pollution control strategies that maximize net benefits. Also illustrated within the LP framework is the cost of encouraging acceptance of strategies by allocating nonpoint control according to other criteria. The findings of the research should encourage planners and researchers to consider explicitly the distributional impediments to successful implementation of nonpoint pollution control. The report calls for the development of regional water quality management agencies with authority to raise revenues and offer compensation payments.
W82-02807

EFFECTS OF WHOLE LAKE MIXING ON WATER QUALITY AND PHYTOPLANKTON,

Oklahoma State Univ., Stillwater. School of Biological Sciences.
D. W. Toetz.
Water Research, Vol 15, No 10, p 1205-1210, October, 1981. 7 Fig, 2 Tab, 19 Ref. OWRT-A-078-OKLA(2).

Descriptors: *Water quality management, *Phytoplankton, *Lakes, Mixing, Artificial mixing, Destratification, Dissolved oxygen, *Oklahoma, Biomass, Manganese, Chlorophyll A, Turbidity, Algal growth.

The effects of artificially mixing two Oklahoma lakes for two seasons or more are described. The lakes were mixed with a downflow pump, and changes in water quality and algal biomass were monitored. During 1976, prior to any pumping, the depth of the thermocline in Arbuckle Lake gradually increased during the course of the summer. Artificial pumping during 1977 and 1978 increased the rate at which the depth of the thermocline increased. Pumping advanced turnover of the lake in the autumn of 1977. The thermal profile revealed deeper stratification than had been revealed prior to mixing, but also strong mixing below 10 meters. The volume of the lake containing 1 mg/liter dissolved oxygen or above also increased during the years of mixing; the increase was probably the result of mechanical pumping. The most significant effect of the pump was to decrease ammonia in the epilimnion and hydrogen sulfide in the hypolimnion. In all years the flora was dominated by diatoms, blue-green algae, green algae, and flagellates. The second lake, Ham's Lake, remained destratified due to the pumping, but seldom produced completely isothermal conditions or isochemical concentrations of disslved oxygen. There was no drastic change in other water quality parameters. However, artificial mixing decreased water clarity and increased algal biomass by a factor of about 2.5, probably by reducing sinking rates of the phytoplankton. Artificial mixing apparently eliminated a fall pulse of Microcystis. (Baker-FRC)
W82-02823

UNSTEADY WATER QUALITY MODEL FOR RIVER NETWORK,

Instituto de Pesquisas Hydraulicas, Porto Alegre (Brazil).
C. E. M. Tucci, and Y. H. Chen.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 477-493, October, 1981. 9 Fig, 1 Tab, 10 Ref.

Descriptors: *Model studies, *Water quality management, *Mathematical studies, *River systems, Water quality, Water quality control, Water pollution, Oil industry, Industrial wastes, Mathematical equations, Hydraulic models, Decision making.

A mathematical model designed to predict water quality for a river network under unsteady flow conditions was applied to the Jacui Delta in Brazil. Two of the four rivers feeding the delta are highly polluted, and a third river, receiving the wastes of a petrochemical complex, is in danger of becoming polluted in a few years. Available hydraulic data was used to calibrate the hydraulic part of the model. The model was limited in handling one-dimensional assumptions, but good in handling large river systems at minimal computer costs. The data input can be easily applied to other river systems, while the computer program, which is in modular form, can be easily modified to study other water quality variables. Other researchers have used the hydraulic part of the model with a sediment continuity expression to study water and sediment related problems. Where possible, a model should be calibrated to simulate field conditions. However, where field data is not available, models based on sound physical processes may still be used to evaluate responses of a system to changes and aid in decision making. (Geiger-FRC)
W82-02873

THE APPLICATION OF A WATER-QUALITY MODEL TO THE RIVER WYE, WALES,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5A.
W82-02876

ON THE ROLE OF UNDERWATER PARKS AND SANCTUARIES IN THE MANAGEMENT OF COASTAL RESOURCES IN THE SOUTHEASTERN UNITED STATES,

National Park Service, Homestead, FL.
G. E. Davis.
Environmental Conservation, Vol 8, No 1, p 67-70, Spring, 1981. 1 Fig, 1 Tab, 25 Ref.

Descriptors: *Parks, *Underwater, *Coastal zone management, *Coastal waters, Environmental effects, Ecological effects, Commercial fishing, Sport fishing, Consumptive use, Estuaries, Everglades, *Southeastern United States.

The seven underwater parks or sanctuaries in Florida and the US Virgin Islands exhibit wide variations in the degree of protection of aquatic resources. Protection ranges from almost complete protection in the first parks established to almost no protection in the most recently established parks. Coral reef ecosystems are dynamic and change dramatically in response to natural short-term environmental variations such as unusually low temperatures. Fisheries harvests may reduce the size at which exploited species mature, and reduce the amount and variability of genetic material produced by exploited populations. The consequences of permitting consumptive uses of aquatic resources in parks and preserves need to be evaluated. Natural areas must be protected to serve as standards which will allow distinctions to be drawn between effects of exploitation or pollution and normal variation. Unless consumptive uses are severely limited, the primary values of parks and reserves may not be realized. (Small-FRC)
W82-02905

COMPARISON OF STATISTICAL PHOSPHORUS-RETENTION MODELS,

National Board of Waters, Helsinki (Finland).
T. Frisk, J. S. Niemi, and K. A. I. Kinnunen.
Ecological Modelling, Vol 12, No 1, p 11-27, March, 1981. 2 Fig, 9 Tab, 24 Ref.

Descriptors: *Phosphorus, *Water quality management, *Statistical models, *Decision making, *Lakes, Nutrients, Water quality control, Model studies, Mathematical models, Mathematical studies, Statistical methods, Planning, Management planning, Eutrophication, Eutrophic lakes, Water pollution control.

Statistical phosphorus-retention models may be used in water quality management programs for predicting the average phosphorus levels of a lake. The suitability of a model may be evaluated by comparisons with experimental reference data. Two sets of previously recorded data, one from Lake Paijanne, the other from 85 global lakes, were used in a number of statistical phosphorus-retention models described in the literature. Accessory models were generated from the original models by parameter estimation. Results showed that phosphorus-retention models are not general enough to be accurately applied to any desired lake. The range of these models which should be considered depends upon the relationship between the phosphorus concentration of the outflowing water and the total phosphorus input/volume of lake water. In very eutrophic lakes, where the phosphorus concentration of the outflowing water is over 40 milligrams/cu m, application of the models does not give reliable results. Application of phosphorus-retention models to the estimation of the phosphorus loading capacity of a lake is also considered. (Geiger-FRC)
W82-02930

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ESTIMATION OF CALCIUM SULFATE SOLUTION RATE AND EFFECTIVE AQUIFER SURFACE AREA IN A GROUND-WATER SYSTEM NEAR CARLSBAD, NEW MEXICO,

Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2F.
W82-02612

THE COMBINATION OF INPUT-OUTPUT ANALYSIS AND LINEAR PROGRAMMING FOR WATER RESOURCE MANAGEMENT: AN APPLICATION TO NORTHWEST IOWA,

Iowa State Univ., Ames. Dept. of Economics.
J. J. Rhee.
PhD Dissertation, 1980. 180 p, 5 Fig, 26 Tab, 86 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-12981.

Descriptors: *Model studies, *Economic aspects, *Water resources development, Linear programming, Systems analysis, Management planning, Water users, Irrigation, Iowa.

The first objective of this study sought to develop an analytical framework integrating both competitive and interdependent dimensions of resource uses. To achieve this objective, a linear programming model that consists of an input-output system and resource constraints, was formulated. The second objective was to apply the model to Northwest Iowa. Because of the difficulty in predicting the future of irrigation in Northwest Iowa, despite an expectation of a substantial increase in irrigation, some upper limits to irrigation were established in terms of land and water availability for irrigation. The results of the application show that the level of final demands that can be achieved subject to the water supply constraints of Northwest Iowa coincided with the target level of final demands that was imposed in the model, implying that the available water supplies of Northwest Iowa do not constitute a limiting factor to achieving the target level of final demands which was based on income and population growth projected for the region to the year 2020. It was concluded that Northwest Iowa as a whole holds potentially sufficient water supplies to depend on for the region's population and economic growth, which is not much out of line with the projection series made by the State of Iowa. The third objective of this study was to suggest an extended model for the future application to state and regions. Based on the resulting model, an impact analysis shows the effects of a change in demand and supply of certain resources on production, resource uses, and income. (Sinha-OEIS)
W82-02734

OPTIMAL WATER REUSE PLANNING,

Texas Univ. at Austin.
G. Ocanas Sanchez.
PhD Dissertation, 1980. 567 p, 59 Fig, 52 Tab, 61 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-00950.

Descriptors: *Wastewater treatment, *Water reuse, *Mathematical models, Planning, Economic aspects, Texas, Resource allocation, Model studies.

Current water and wastewater treatment technology allows the reclamation of almost any type of wastewater. Implementing water reuse practices within the framework of water allocation is an important aspect of the planning process. Mathematical models to assess various conjunctive water and wastewater system alternatives are developed. A single period model was first developed to determine the optimal water allocation within the region, and to assess the impact of various legal and environmental restrictions upon the system. This model was then expanded to incorporate the growing nature of the system. The resulting multi-period model considers the capacity expansion of the treatment facilities while assessing the impact of different planning scenarios. The mathematical optimization models consist of both linear and non-linear constraints and a non-linear objective function. The objective of the research was to develop and solve the mathematical planning models. Application of the models is illustrated by a series of hypothetical examples that were solved using the large scale generalized reduced gradient (LSGRG) code. A real world application is also presented using the San Antonio region as the study area. Both LSGRG and successive linear programming with rejection (SLPR) methods were used to obtain solutions to the models. The performance of both solution methods are briefly analyzed. (Sinha-OEIS)
W82-02736

ROBUSTNESS, RELIABILITY, RESILIENCE AND VULNERABILITY CRITERIA FOR PLANNING WATER RESOURCES SYSTEMS,

Cornell Univ., Ithaca, NY.
T. Hashimoto.
PhD Thesis, May, 1980. 125 p, 19 Fig, 10 Tab, 53 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-20833.

Descriptors: *Water resources development, *Planning, Future planning, Economic aspects, *Economic evaluation.

The ability of a water resource system to serve changing needs over time can be measured using a variety of criteria. The objective of this study is to define some criteria for evaluating possible system performance given uncertain future conditions and the likely variation in inputs and demand, and to show their applicability to specific management problems. For these purposes, robustness, resilience, reliability and vulnerability are defined and quantitative measures of them are given. Some conventional methods of dealing with uncertain and varying events involved in water resources planning are critically reviewed. Discussion on the need for the alternative criteria follow and their relevance and usefulness in water resources systems planning are emphasized. Robustness is defined as an economic measure. It represents variability involved in total costs of a system under uncertain future conditions, and supplements the conventional optimality criterion of cost-effectiveness. Definitions of resilience, reliability and vulnerability are given and quantitative measures are developed and then applied to planning the operation of a water supply reservoir. Conclusions are then drawn on the validity and applicability of the new methodology. (Sinha-OEIS)
W82-02737

ESTIMATION AND OPTIMIZATION OF THE SERVICEABILITY OF UNDERGROUND WATER TRANSMISSION NETWORK SYSTEMS UNDER SEISMIC RISK,

Columbia Univ., New York.
For primary bibliographic entry see Field 8A.
W82-02743

RELIABILITY OF WATER RESOURCES,

Anglian Water Authority (England).
K. F. Clarke, C. Page, and J. S. Brew.
Journal of the Institution of Water Engineers and Scientists, Vol 34, No 1, p 61-73, January, 1980. 6 Fig, 2 Tab, 3 Ref.

Descriptors: *Water supply, *Management planning, *Water conservation, *Storage, *Long-term planning, Conservation, Flow discharge, Administration, Operating policies, Drought, Projection, Hydrologic data, Optimization, System analysis, Pumpage, Groundwater, Reservoirs, *United Kingdom.

An alternative method for defining the reliability of water resources is proposed. This method defines reliability in terms of the level of service to consumers, rather than in terms of the frequency of failure. It entails identification of conservation measures for drought periods and estimation of resultant savings; development of an operating strategy and defining a level of risk; and assessment of the level of service when a given output is met. The new method will provide a consistent basis for the planning of water resources and their operation. The use of computer-based mathematical models enables a wide range of levels of service to be calculated. (Titus-FRC)
W82-02749

URBAN CATCHMENT MODELS: A BRIEF EXAMINATION,

George Washington Univ., Washington, DC.
For primary bibliographic entry see Field 4C.
W82-02813

SUPPLEMENT TO PREDICTIVE MODELING OF EFFECTS OF THE PLANNED KINDRED LAKE ON GROUND-WATER LEVELS AND DISCHARGE, SOUTHEASTERN NORTH DAKOTA,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-02828

MULTIOBJECTIVE ANALYSIS OF IRRIGATION PLANNING IN RIVER BASIN DEVELOPMENT,

Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
S. Vedula, and P. P. Rogers.
Water Resources Research, Vol 17, No 5, p 1304-1310, October, 1981. 2 Fig, 12 Tab, 18 Ref.

Descriptors: *River basin development, *Model studies, Mathematical models, Planning, *Irrigation practices, Irrigation, *Multiobjective planning, *India.

The historical development of a river basin is considered in which extensive irrigation is practiced in the lower reaches of the basin, while an expansion of irrigation development in the upper reaches is proposed. A 12-season (monthly) linear programing model is formulated to evolve optimum cropping patterns in the proposed areas of development. A tradeoff analysis between two conflicting objectives is made by developing the transformation curve for the objectives. The river basin selected for study is the Cauvery River Basin, with a total drainage area of 81,200 square km, located in the States of Kerala, Karnataka, and Tamil Nadu in Southern India. The monthly deterministic model was applied to this four-reservoir system to maximize the net economic benefits and the irrigated cropped area, subject to water, land, and downstream release constraints. The objectives of maximizing net benefits and irrigated cropped area are found to conflict with each other. The transformation curve between the two objectives was developed and the tradeoff was estimated

at the level of irrigation development as proposed by the planning agency. (Baker-FRC)
W82-02855

DEMAND FORECASTING IN WATER SUPPLY NETWORKS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W82-02926

CASCADED TRADEOFFS: A MULTIPLE-OBJECTIVE, MULTIPLE-PUBLICS METHOD FOR ALTERNATIVES EVALUATION IN WATER RESOURCES PLANNING,
Portland State Univ., OR.
For primary bibliographic entry see Field 6B.
W82-02980

6B. Evaluation Process

THE REED AFFAIR: A CANADIAN LOGGING AND POLLUTION CONTROVERSY,
Waterloo Univ. (Ontario). School of Urban and Regional Planning.
R. Suffling, and G. Michalenko.
Biological Conservation, Vol 17, No 1, p 5-23, January, 1980. 4 Fig, 1 Tab, 40 Ref.

Descriptors: *Social aspects, *Political aspects, *Forest management, Economic aspects, Logging, *Ontario, Canada, Reed Paper Company, Treaties, Environmental effects, Water pollution sources, Mercury, Licenses, *Pulp and paper industry, Water quality, Legal aspects.

Events and biological, economic, and social issues in an Ontario pollution and forestry controversy are summarized. The native Ojibwa people of northern Ontario were given hunting and fishing rights by Treaty 9 (1906) in return for the title to their lands and their allegiance to the government. A controversy arose following the installation of a mercury cell chlor-alkali plant at the Reed Paper Co. mill in 1962. A total of 9000 kg, or 4.5-9 kg per day, of Hg were discharged into the Wabigoon River between 1962 and 1970. Another 13,600 kg are unaccounted for. Although the Hg cell plant was replaced by a permionic membrane process in 1975, the river remains contaminated. Subsequently, forest management practices in Ontario and their effects on the environment (including water quality) were closely examined. It was determined that the tree harvesting schemes proposed by the company would not allow management on a sustained yield basis. The Reed Controversy became a catalyst for political change. The Hartt Commission (The Royal Commission on the Northern Environment) was established to deal with three tasks: determine environmental (social, economic, and cultural) effects of major enterprises north of the 50th parallel, investigate feasibility of alternative uses of natural resources, and suggest means of assessing environmental aspects of major enterprises. (Casar-FRC)
W82-02605

PROJECT OUTCOMES CORRELATE WITH PUBLIC PARTICIPATION VARIABLES,
Ohio State Univ., Columbus. Dept. of Natural Resources.
R. A. Ellis, and J. F. Disinger.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1564-1567, November, 1981. 1 Tab, 6 Ref.

Descriptors: *Public participation, *Project planning, Public hearings, Administration, Wastewater facilities, *Wastewater management.

The relationship between public participation variables and project outcome variables was analyzed for wastewater treatment projects. Variables were identified from 105 case studies of project planning in wastewater management, water development such as flood control projects, and highway or roads construction. Projects resulting from redistributive policy were associated with undesirable outcomes and tended to have poor information flows. Problems were also experienced by small projects characterized by high social significance. On highly technical projects, it was found to be necessary to educate the public to avoid court battles or other legal actions resulting from misunderstandings. While formal hearings are usually antithetical to good two-way communication, workshops and more informal meetings showed promise of producing successful citizen inputs. (Small-FRC)
W82-02663

ROBUSTNESS, RELIABILITY, RESILIENCE AND VULNERABILITY CRITERIA FOR PLANNING WATER RESOURCES SYSTEMS,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 6A.
W82-02737

ESTIMATION OF THE ECONOMIC VALUE OF WETLANDS: METHODOLOGY AND APPLICATION TO SOUTHEASTERN MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Agricultural Economics.
C. W. Abdalla, and L. W. Libby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168493, Price codes: A03 in paper copy, A01 in microfiche. Institute of Water Research, Michigan State University Technical Completion Report, September, 1981. 25 p, 1 Fig, 22 Ref, 3 Append. OWRT-A-116-MICH(1).

Descriptors: *Wetlands, *Freshwater marshes, Economic evaluation, Benefits, Costs, Decision making, *Michigan.

Greater understanding and awareness of wetland functions has led to enactment of wetland protection laws in many states. Michigan legislation requires a permit for wetland alteration. Permit decisions are based on the balancing of benefits and costs of proposed wetland uses. Economic concepts are used in this research to structure wetland permit decisions and improve policy choices. Benefit and cost estimation is attempted. A methodology is developed and applied to estimate the value of wetlands in waterfront residential use in southeastern Michigan. The results indicate that location is an important variable influencing development value making estimates site-specific and not generalizable. Strengths, weakness, and limitations of the methodology are assessed. The estimation of development and natural wetland values is a complicated task requiring careful economic analysis and much reliable informational input.
W82-02804

SECURING SUPPORT FOR NONPOINT POLLUTION CONTROL WITH LOCAL COMPENSATION,
Tennessee Univ., Knoxville. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W82-02807

PLANNING LEVEL ESTIMATES OF THE VALUE OF RESERVOIRS FOR WATER SUPPLY AND FLOW AUGMENTATION IN NEW HAMPSHIRE,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
S. L. Dingman.
Water Resources Bulletin, Vol 17, No 4, p 684-690, August, 1981. 7 Fig, 3 Tab, 10 Ref. OWRT-A-050-NH(2).

Descriptors: *Decision making, *Water supply development, New England, *New Hampshire, *Reservoirs, Water supply, Potential water supply, Water resources development, Estimating equations, Estimating.

When projected water use exceeds the safe yield of the existing supply system some decisions must be made. In general, the choice among reservoirs for water supply or flow augmentation is a multiobjective problem. Two of the objectives, the cost per unit of yield and the period of time over which a given reservoir will satisfy projected demand, require estimates of the increase in yield that potential reservoirs will provide. Methods are presented which permit such estimates to be made for direct supply and flow augmentation reservoirs in New Hampshire. An equation is given which can be used to calculate the increase in yield for direct supply reservoirs when the active storage capacity and mean flow at the reservoir site are known. The downstream increase in yield can also be estimated for flow augmentation reservoirs. The required input data for this computation are the active storage and mean flow at the downstream reach. The major uncertainties in the estimates are due to the difficulty in generalizing the influences of operating policies on the relation between regulation and downstream flow distributions. However, these methods appear to provide a rational and empirically supported basis for planning level estimates of the value of reservoirs for water supply and flow augmentation in central New England. (Baker-FRC)
W82-02825

HYDROLOGIC EVALUATION OF A HYPOTHETICAL COAL-MINING SITE NEAR CHRISNEY, SPENCER COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
J. S. Zogorski, D. S. Ramey, P. W. Lambert, J. D. Martin, and R. E. Warner.
Available from the OFSS, USGS Box 25425, Fed Ctr, Denver, CO 80225, Price: $19.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-1107, October, 1981. 133 p, 34 Fig, 26 Tab, 32 Ref.

Descriptors: *Evaluation, *Hydrologic data, *Groundwater, *Surface water, Streamflow, Runoff, Coal mines, *Coal mining, Strip mines, Soil horizons, Land use, Water quality, Chemical analysis, Legal aspects, *Indiana, Spencer County, Little Pidgeon Creek, Crooked Creek, Surcace Mining control and Reclamation Act (PL 95-87), Projections.

Protecting the nation's water resources is a major emphasis of the Surface Mining Control and Reclamation Act, PL 95-87. Permanent regulations established for this Act by the Office of Surface Mining (OSM) require the issuance of a permit before mining begins. An application for a mining permit must include an assessment of the hydrologic characteristics of the mining site and adjacent area, and a projection of the potential impacts of mining activities on surface water and ground water. OSM's permanent regulations and guidelines provide little insight on the 'how to' aspect of making the required hydrologic assessment. This investigation was completed to improve the understanding of the kinds of information needed to make such assessments by: (a) reviewing the regulations to determine what hydrologic information is required; (b) preparing an example hydrologic assessment using the regulations as a guideline; and (c) using the experience gained in (a) and (b) to identify areas lacking or needing additional data to make the required assessment. Hydrologic data for the study area were obtained from published and unpublished reports, maps, aerial photographs, personal interviews with residents in the area of the hypothetical mine site, and discussions with experts in the field. Where data were unavailable, 'synthetic' data were generated by extrapolation from proximate or similar watersheds and (or) by assumptions based on experience or theory. A limited amount of field data was collected to corroborate and augment information originating from all these sources. (USGS)
W82-02840

ENVIRONMENTAL IMPLICATIONS AND ASSESSMENTS OF HYDROELECTRIC PROJECTS,
Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 6G.
W82-02896

CONTROL OF A PUMPING STATION BY MINI COMPUTER - A PROGRESS REPORT,
Mouchel (L.G.) and Partners, Bath (England).
C. Martin, and D. King.
Water Services, Vol 85, No 1026, p 409-410, 413-414, 417, August, 1981. 4 Fig, 2 Tab, 1 Ref.

Descriptors: *Control systems, *Computers, *Pumping plants, Automation, Wastewater treatment, *Cost-benefit analysis, Weymouth, *United Kingdom.

The current status of the control system for Radipole Lake Pumping Station is described, including the tendering procedure and cost-benefit analysis. The control system and operating methods are described. The system is based on the Texas Instruments 990/5 micro computer, and a cost-benefit analysis indicates that the control system will pay for itself in five years. All equipment will have manual overrides so operation can continue in the event of a computer failure. Mathematical models of the control system have been developed, and a prediction control program has also been developed. When installed, the system will represent a large fully instrumented catchment and will be usedful in future research projects. (Small-FRC)
W82-02956

COMPUTER MODELING OF FLOOD ALLEVIATION BENEFITS,
Severn-Trent Water Authority, Birmingham (England).
J. B. Chatterton, and E. C. Penning-Rowsell.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 533-547, October, 1981. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Storm runoff, *Flood protection, *Economic aspects, *Future planning, *Computer models, Model studies, Flood proofing, Decision making, Cost analysis, Computer programs, Hydraulic models, Sensitivity analysis, Bristol, England.

When planning storm drainage or flood protection schemes, it is economically beneficial to evaluate several alternative design standards by computer modeling. A computer model is presented which allows the decision maker to select that calculation of discounted benefits most appropriate to the proposed scheme and the design flood conditions. The computer model incorporates national data on flood damage along with programmable site-specific damage data obtained from surveys or questionnaires. Alternative techniques are also available for relating properties at risk to flood profile information. Optional sub-routines are featured which generate a full discounted cash flow analysis of both scheme cost and benefits. The data sets and the control options fixing the economic and hydrologic assumptions for each assessment may be interchanged to allow for sensitivity analysis. The model may be utilized to evaluate many different design standards with minimum economic errors. The assumptions on calculated benefits most crucial to the final results can be explored in great detail while excluding the less important factors to allow a more comprehensive, accurate and faster evaluation of both structural and nonstructural flood alleviation schemes. Application of the model in Ashton Vale, Bristo, England is illustrated. (Geiger-FRC)
W82-02957

WEST SACRAMENTO CANAL UNIT REFORMULATION,
Bureau of Reclamation, Sacrameto, CA. Mid-Pacific Region.
--Concluding Report on the feasibility investigation, June, 1981. 18 p, 1 Fig, 2 Tab.

Descriptors: *Feasibility studies, *Cost-benefit analysis, *Water resources development, Water supply development, Economic feasibility, Canals, Reservoirs, Water storage, Reservoir storage, *Tehama-Colusa Canal, California.

The 1964 feasibility investigation proposed extending the Tehama-Colusa Canal, then newly under construction, through Yolo County to a terminal reservoir just northeast of Fairfield in Solano County, California. The extension, the West Sacramento Valley Canal, would provide a supplemental water supply to portions of Napa, Solano, and Yolo Counties. An exchange arrangement with Yolo County would also permit Lake County to obtain a supply from the unit. Events occurring after the publication of the 1964 document delayed further work on the ivestigation, but in the late 1970's, interest in the unit was renewed, and a reformulation to update the 1964 plan was initiated. Comparison of benefits and costs indicates that the national economic development plan for the proposed West Sacramento Canal Unit has an unfavorable benefit-cost ratio. While the municipal and industrial portion of the plan is economically justified, the irrigation portion is not. Middletown Dam and Reservoir in Lake County now has an unfavorable economic justification. A need does exist, however, for Central Valley Project (CVP) water storage. Sites Reservoir is capable of conserving surplus flows for later CVP uses, thereby increasing basin water supply efficiency. Extra yield and interim water available while unit needs were increasing could be utilized in the San Joaquin Valley. (Moore-SRC)
W82-02974

SUMMARY; LOWER COLORADO RIVER RECREATION RESEARCH, 1974-1980,
Arizona State Univ., Tempe. Dept. of Leisure Studies.
G. W. Greey, and G. W. Cheatham.
Report prepared for Bureau of Reclamation, August, 1981. 109 p, 67 Tab, 2 Append.

Descriptors: *Colorado River, *Recreation, *Recreation demand, Prediction, Resources management, Water resources development, Camping, Swimming, Boating, Lake Mead, Fishing, Arizona.

This report presents a summary of research data on outdoor recreation use and visitor use patterns within the Lower Colorado River from Pierce Ferry, Arizona, to San Luis on the Mexican border. Each of the ten divisions was studied for a one year period during 1974-77, and a replicate study was completed in 1977-78. The Lake Mead National Recreation Area was studied during the calendar year 1979. Visitor number and recreational activities were quantified by direct observation, and are presented on a quarterly basis for the study/year. Land based activities recorded were: camping, hunting, picnicking, hiking/related, driving for pleasure, motorcycling/horseback riding, off-the-road vehicle use, and other, and water based activities included: swimming/related, fishing, motor boating, water skiing, non-motor boating, canoe/kayak, house boating, tubing, and sailing. There was much variation between divisions, but overall there was a significant increase in visitors, recreation units and recreation participants throughout the lower Colorado River. The activities with the largest percentage increases were driving for pleasure, sailing, canoe/kayak, and picnicking, while house boating, hiking, motorcycling, off-the-road vehicle use and other decreased. The most popular activities in the replication study year were picnicking, camping, swimming/related, motor boating, and driving for pleasure. The information will be used in long-term projections of use, and in management planning. (Brambley-SRC)
W82-02976

CASCADED TRADEOFFS: A MULTIPLE-OBJECTIVE, MULTIPLE-PUBLICS METHOD FOR ALTERNATIVES EVALUATION IN WATER RESOURCES PLANNING,
Portland State Univ., OR.
B. F. Anderson.
Bureau of Reclamation Report, August, 1981, 123 p, 23 Fig, 157 Ref, Append.

Descriptors: *Decision making, *Planning, *Public participation, Water resources development, *Multiobjective planning, Alternative planning, Economic impact, Social impact.

Cascaded Tradeoffs is a method for arriving at an overall ranking of planning alternatives on the basis of public values. The key feature of the method is that it provides for making tradeoffs across both issues, or dimensions of impact, and publics, in a two-step cascade. A scale of commensuration is established on the basis of value judgements from both representatives of the impacted population and agency decision makers. Commensuration is the process of determining what impact on one dimension is equivalent to a given impact on another, or what impact to one public is equivalent to a given impact to another. The method begins by identifying publics across which the greatest value differences occur and within which value differences can be assumed to be negligible. Commensuration is then accomplsihed in two cascaded steps: first across dimensions of impact within each public, in terms of the values of that public; then across publics, on the basis of a judgement by agency decionmakers about a tradeoff dimension. Traditional economic analyses of market values can be helpful in the first step, but not always in the second. There appears to be no generally applicable alternative to human judgement for comparing the values of different publics. The method provides for examination of the extent to which the overall ranking of the alternatives is sensitive to the addition of mitigation measures and to uncertainty in the data. (Moore-SRC)
W82-02980

PROTEIN RECOVERY FROM BEEF PACKING EFFLUENT,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 5D.
W82-02994

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COST ESTIMATES FOR WATER TREATMENT PLANT OPERATION AND MAINTENANCE.
Public Works, Vol 111, No 8, p 81-83, August, 1980. 5 Tab.

Descriptors: *Cost analysis, *Operation and maintenance, *Potable water, Water quality standards, *Water treatment facilities, Estimated costs.

Information contained in a four-volume report on estimation of water treatment costs (EPA-600/2-79-162a (August)) is presented in summary form. The report considers unit processes and combinations of unit processes that are capable of removing contaminants included in the National Interim Primary Drinking Water Regulations. Conceptual designs are formulated and costs are estimated for each unit process. Estimated cost factors include labor, electrical energy, natural gas, diesel fuel, chemicals, maintenance material, sludge disposal, and amortized capital. Package complete treatment plants, conventional treatment plants, direct filtration plants, reverse osmosis systems, pressure ion exchange softening systems, lime softening systems, pressure filtration plants, and granular activated carbon plants are discussed, and at least one example is presented for each. Corrosion control is also considered. (Small-FRC)
W82-02697

WATER REGULATION IN AN INFLATIONARY ENVIRONMENT,
For primary bibliographic entry see Field 5F.
W82-02701

AN ECONOMIC ANALYSIS OF GROUND WATER MANAGEMENT ALTERNATIVES,
Nebraska Univ., Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4B.
W82-02740

6D. Water Demand

THE COMBINATION OF INPUT-OUTPUT ANALYSIS AND LINEAR PROGRAMMING FOR WATER RESOURCE MANAGEMENT: AN APPLICATION TO NORTHWEST IOWA,

Iowa State Univ., Ames. Dept. of Economics.
For primary bibliographic entry see Field 6A.
W82-02734

AN ECONOMIC ANALYSIS OF WATER RESOURCES DEVELOPMENT IN DELTAIC REGIONS OF ASIA: THE CASE OF CENTRAL THAILAND,

Wisconsin Univ.-Madison.
Q-T. Ngo.
PhD Thesis, 1980. 302 p, 20 Fig, 33 Tab, 4 Map, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-15222.

Descriptors: *Water resources development, *Irrigation, *Economic aspects, *Deltas, Agriculture, Saline water intrusion, Flooding, *Thailand.

In the large deltaic regions of Burma, Thailand and Vietnam large rivers which drain the entire basin yearly overflow their banks to flood large tracts of the vast and flat deltas. In the dry season, saline waters from the sea intrude large areas upstream. Water resource development for such an area requires an integrated approach with complementary facilities to distribute and drain water, to store flood flows during the wet season, and to coordinate releases from surface storage for dry season irrigation, for waterway transport, and for repelling saline water at the estuary. When translated in economic terms, the features of this development program dictate the mobilization of enormous amounts of resources for the provision of land improvement infrastructure. A preliminary objective is to analyze the patterns of agricultural development with the purpose of identifying the relevant constraints to growth. Where under heavy population pressure, the arable land frontier has approached exhaustion, intensification of cultivation by raising output per cultivated area may prove to be the most efficient strategy for development. The focus of this study on the importance of irrigation and drainage is only meant to bring out the magnitude of resource requirements needed for the intensification of cultivation in large alluvial plains. (Sinha-OEIS)
W82-02735

WATER FOR INDUSTRY,

Tata Consulting Engineers (India).
B. V. Chitnis.
Aqua, No 2, p 22-24, 1981.

Descriptors: *Water demand, *Water use, *Water resources development, Political aspects, Water supply development, *India, Economic aspects, Governmental interrelations, Government supports, Water quality, Irrigation, Domestic water, Energy, Industrial water.

India is considered well endowed with water supply. Of the current annual supply, 0.16% is used for energy production, 92.5% for irrigation, 1.2% for industrial needs and 6.2% for domestic purposes. In 1975 India withdrew for its total usage about 21% of the probable maximum developable supply. It is expected that in the year 2000 AD, India will use about 54% of the probable maximum, or nearly 68% of the dependable maximum with storage. The percent usage figures for 2000 AD will be 0.5% for non-hydro power, 88.6% for irrigation, 3.6% for industry and 7.3% for domestic purposes. Irrigation is not only the biggest user in terms of quantity, it is also the most powerful user in terms of political leverage. Irrigation returns only 10% of the water it withdraws. The irrigation departments have been pioneers in developing many of the water storage projects in the country. Irrigation has built an extensive water transport network which could be conveniently used by the nonhydro power, industrial and domestic users. Domestic and industrial users are in competition in the larger cities, as their population growth continues to expand rapidly. The recycling of solid water and its subsequent use by either industrial and/or irrigation consumers is being considered for future benefits. Not only must water conservation be increasingly important, a cooperative solution to the treatment of industrial effluents must also be established. The Government's role in the development of water resources will be seen as critical in the coming years as India approaches the limits of the water availability. (Baker-FRC)
W82-02767

GEOLOGY AND WATER AVAILABILITY OF DALLAS COUNTY, ALABAMA,

Geological Survey, Univ., AL. Water Resources Div.
J. C. Scott, H. G. Golden, and J. G. Newton.
Alabama Geological Survey Map 180, 1981. 94 p, 3 plates, 14 Fig, 6 Tab, 30 Ref.

Descriptors: *Available water, *Surface water, *Groundwater, *Water quality, Water yield, Streamflow, Wells, Aquifers, Hydrologic budget, Geohydrology, *Well data, Chemical analysis, Potential water supply, Hydrologic data, Maps, Evaluation, *Alabama, Dallas County.

Geologic units underlying Dallas County, Ala., include deposits in the Upper Cretaceous, Paleocene, Pleistocene, and Holocene Series. The deposits range in thickness from 750 to 2,600 feet and consist of sand, gravel, clay, chalk, sandstone, and limestone. Strata in the Upper Cretaceous and Paleocene Series strike southeastward and dip southwestward 30 to 50 feet per mile. The Alabama River, the largest source of surface water, has an average flow of 17,100 mgd (million gallons per day) and a median low flow of 5,000 mgd at Selma. Other significant sources include the Cahaba River and Mulberry, Pine Barren, Oakmulgee, Boguechitto, and Cedar Creeks. The Gordo and Eutaw Formations, the major sources of ground water, will yield 1 to 2 mgd to individual wells in the northeast part of the county and are potential sources of similar supplies in central and southern parts. Potential sources of large quantities of ground water are the Coker Formation and alluvium and low terrace deposits. Water of suitable quality for most uses is available from streams and aquifers. Water in the Alabama River and Cahaba River is soft and generally contains less than 100 mg/L (milligrams per liter) of dissolved solids. Water in tributary streams draining areas underlain by calcareous deposits is generally moderately hard to hard and contains less than 250 mg/L of dissolved solid. Water in the Eutaw Formation in the southeast part of the county has a chloride content that exceeds 1,000 mg/L, and, in that area, water in the underlying Gordo and Coker Formations is probably sufficiently mineralized to be objectionable. (USGS)
W82-02833

DEMAND FORECASTING IN WATER SUPPLY NETWORKS,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. F. Perry.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY9, p 1077-1087, September, 1981. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Water demand, *Pumping stations, *Forecasting, Model studies, Planning, Water distribution, Kalman filter, Prediction, Networks, Water supply systems, Reservoir operation, Automatic control, *United Kingdom.

An accurate hour-by-hour forecast of water demand is determined with data from an advanced telecontrolled water supply network in the United Kingdom. This type of forecast, more difficult than an aggregate 24-hour forecast, is important for achieving energy savings for reservoir systems which have off-peak pumping stations with variable speed drives. The Kalman filter approach is more attractive than the Karhunen-Loeve spectral expansion method because the state estimates of residuals demand, required for the forecast calculations, can also be used directly for optimal pump control. In addition, the Kalman filter method allows easy updating of the model (15 sec computer time) once parameters have been estimated from historic data (5 min computer time). The spectral expansion method is accurate for the 24-hour prediction period, takes little computer time, and needs only past values of water demand as data. However, it requires substantial storage and completely new calculations for updating on-line pump controls as new observations are received. (Cassar-FRC)
W82-02926

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: ALASKA RIVER BASINS, ALASKA.

Federal Energy Regulatory Commission, San Francisco, CA. San Francisco Regional Office.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0068, Price codes: A03 in paper copy, A01 in microfiche. Planning Status Report FERC-0068, Revised January, 1981. 32 p, 4 Fig, 6 Tab.

Descriptors: *Water resources development, *Alaska, *Rivers, *Hydroelectric plants, Federal jurisdiction, Wilderness areas, Wild rivers, National parks, Land use, Cooling water, Planning, River basins, *River basin development.

This revised report presents updated information on the water resources of the river basins of Alaska, and information on new and planned developments. There are 20 hydroelectric projects, existing or under construction, with a total installed capacity of 157,780 kw. An additional 10 projects are in the preliminary and planning stages. Large areas of Alaska have been placed under wilderness protection (56.4 million acres), and national parks or wildlife refuges (49 million acres), and 25 streams have been added to the National Wild and Scenic Rivers System, with a further twelve to be considered. Of the 98 potential hydroelectric power projects, 15 have potential conflicts with the Federal lands designations, and their development would seem to be impossible. The environmental impacts of other developments are not known and may be significant. There is considerable potential for pumped storgage hydroelectric and tidal power development, but practical factors, environmental impacts, and lack of markets render development impractical. Cooling water requirements for steam-electric generating plants are projected to be 431 mgd withdrawn and 7 mgd consumed by 2000. (Brambley-SRC)
W82-02975

6E. Water Law and Institutions

A PRELIMINARY SURVEY OF STATE GROUND-WATER LAWS,

National Center for Ground Water Research, Oklahoma City, OK.
G. Wickersham.
Ground Water, Vol 19, No 3, p 321-327, May/June, 1981. 1 Tab, 15 Ref.

Descriptors: *Water law, *State jurisdiction, *Groundwater management, Water policy, Legal aspects, Arizona, Water management, Water conservation, Regulations, Permits, Well permits, Water quality standards, Water quality control.

A survey of groundwater laws in 24 states showed several control measures common to many states--licensing of water well drillers, requirement of well permits before drilling, and establishment of groundwater management districts. Four states and Guam have groundwater quality standards. New York has the most complete list of chemical parameters, 83. New Jersey sets stricter limits for the Central Pine Barrens than for other areas of the state. Western states are active in new comprehensive groundwater legislation. No one law can be used as a model for all states because hydrology and development are so variable. However, Arizona's new groundwater laws are nearly a model. The 1980 Groundwater Management Act created a statewide management and conservation program, to be implemented over 5 years. It requires registration of all water wells and filing of annual pumpage reports. The four driest regions have a pump tax, mandatory conservation for farmers and industry, and per capita consumption limits for cities. No new irrigated agriculture is allowed. The goal is safe yield by 2025. (Cassar-FRC)
W82-02616

SECONDARY TREATMENT WAIVERS ISSUED, CONTROVERSY CONTINUES,
C. Dalpra.
Journal of the Water Pollution Control Federation, Vol 53, No 11, p 1554-1557, November, 1981. 1 Tab.

Descriptors: *Legal aspects, *Secondary wastewater treatment, *Wastewater facilities, *Coastal waters, Water quality standards, Environmental effects, Environmental protection, Ocean dumping, Pacific Ocean.

Controversy over the United States Environmental Protection Agency's waivers of secondary treatment to six communities discharging wastes and wastewater into the Pacific Ocean is discussed. The EPA has had to make these decisions with little historical or environmental procedent. Some opponents of the program feel it is too lax, while others find it too restrictive. The General Accounting Office has criticized the program, stating that hundreds of communities have been prevented from applying for waivers because of restrictive EPA regulations and Congressional legislative restraints. The report estimated a potential savings of up to $10 billion if waivers were granted to the 846 communities within one-half mile of a coastline. Recent litigation may force the EPA to reopen the waiver application process. (Sm[illegible]-FRC)
W82-02652

WATER POLLUTION CONTROL IN THE FEDERAL REPUBLIC OF GERMANY,
H. Hornef.
Aqua, No 2, p 11-16, 1981. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Germany, *Water pollution control, *Legal aspects, Governmental interrelations, Political aspects, Sanitation, Wastewater treatment, Effluents, Clarification, Industrial effluents.

The water resources policy of the Federal Republic of Germany places foremost emphasis on water pollution control. Its objectives are to maintain or re-establish the ecological balance of waters, to maintain secure water supplies to the population and industry, and to preserve on a long term basis other uses of water resources serving the public welfare. The Federal Government has the overall power to enact laws concerning management of water resources. Various legal instruments were established during the 1970's to provide for more efficient water pollution control. Although efforts have been made, the poor quality of several reaches of waters, including the Rhine, continues to speed efforts for improvement. The use of recycled water by industry and public power utilities is increasing. One of the major tasks at hand is the reduction of the pollution load on waters caused by biodegradable substances. In addition to the encouraging developments in the construction of clarification plants, it has become increasingly obvious that selective retention of critical pollutants must be pursued. Finally, water pollution control must be directed toward preventing the formation of harmful effluents from the outset. Development work must continue on pollution-controlled manufacturing processes and products. The problem of pollutants can only be solved if even closer and more trusting cooperation is attained between public authorities and industry, particularly the chemical industry. (Baker-FRC)
W82-02766

LEGAL QUESTIONS AND PROBLEMS OF KANSAS GROUNDWATER MANAGEMENT DISTRICTS,
Kansas Water Resources Research Inst., Manhattan.
J. C. Peck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168477, Price codes: A04 in paper copy, A01 in microfiche. Contribution No 218, September, 1980. 53 p. OWRT-A-099-KAN(1), 14-34-0001-0118.

Descriptors: Water management, *Water law, Water policy, Water allocation, Groundwater management districts, *Kansas, Legal aspects.

The 1972 Kansas Groundwater Management District Act provided a mechanism for local control of groundwater resources. The five groundwater management districts (GMD's) established to date are following the statutory procedure of establishing management programs and recommending rules and regulations to the Chief Engineer of the Division of Water Resources of the State Board of Agriculture, the key water rights administrator of the state. The enabling act itself may have a constitutionality problem because of Art. 2, S 21 of the Kansas Constitution which provides that matters of local legislation may be conferred on political subdivisions by the legislature. Groundwater problems, being larger than a local concern, might be deemed to be in the purview of the legislature, not local units of government. The right granted the Chief Engineer to declare 'intensive groundwater use control area' within GMD's, insofar as he may shut down appropriators without regard to priority dates, may have consistitutional problems. GMD's may sue and be sued, but they should have express statutory causes of action before they can bring the suit. Thus, only the Chief Engineer is able to bring suit for a violation of the regulations, notwithstanding sections in these regulations that purport to give GMD's that power. GMD's may sue to enforce 'policies and standards' of the GMD. The well spacing, safe yield and depletion regulations passed to date may be contested by unsuccessful permit applicants on several grounds. To insure their validity, the GMD's should be sure that the various figures used in the requirements have a supportable basis.
W82-02802

MANAGING CRISIS: THE EFFECTIVENESS OF LOCAL DISTRICTS FOR CONTROL OF GROUND WATER MINING,
Colorado Univ., Denver. Graduate School of Public Affairs.
For primary bibliographic entry see Field 4B.
W82-02819

HYDROLOGIC EVALUATION OF A HYPOTHETICAL COAL-MINING SITE NEAR CHRISNEY, SPENCER COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-02840

NEW DEVELOPMENTS IN PAPERMAKING IN WESTERN EUROPE,
Technical Univ. of Denmark, Copenhagen. Inst. fuer Papierfabrikation.
For primary bibliographic entry see Field 5D.
W82-02947

DIGEST OF WATER RESOURCES POLICIES AND AUTHORITIES.
Office of the Chief of Engineers (Army), Washington, D.C.
Pamphlet No 1165-2-1, March, 1981. 268 p, 5 Tab.

Descriptors: *Legal aspects, *Public policy, *Water resources development, *Construction, Civil engineering, Water supply, Water quality, Wildlife, Conservation, Navigation, Flood control, Erosion control, Hydroelectric power, Recreation, Wetlands, Environmental effects.

It is the policy of the Corps of Engineers to develop, control maintain, and conserve the Nation's water resources in accordance with the laws and policies established by Congress and The Administration. Actions taken comply with all relevant environmental statutes, have no significant safety problem, and are in the overall public interest. A summary is presented of the existing administrative and legislative water resources policies and authorities pertinent to the civil works activities of the Corps. The Federal responsibility in water resources; legislative, executive, judicial roles and policies; general policies; management of the civil works program; planning investigations; report preparation, processing and project authorization; programming, budgeting and appropriations; post authorization studies and engineering design; construction; and operations, maintenance and project management are aspects of the Corps programs. Corps civil works projects include those concerning navigation, flood damage reduction, beach erosion control, hurricane protection, stream bank erosion control, hydroelectric power, recreation, water supply and quality management, fish and wildlife conservation, wetlands conservation, and aquatic plant control. The Corps also has regulatory functions concerned with navigable waters and the disposal of dredged or fill materials into the waters of the U.S. (Moore-SRC)
W82-02973

6F. Nonstructural Alternatives

TO INHIBIT OR NOT TO INHIBIT: THAT IS THE QUESTION,
For primary bibliographic entry see Field 5A.
W82-02672

6G. Ecologic Impact Of Water Development

THE ENVIRONMENTAL EFFECTS OF HYDROELECTRIC PROJECTS,
G. F. Kenyon.
Canadian Water Resources Journal, Vol 6, No 3, p 309-314, 1981.

Descriptors: *Hydroelectric power, *Environmental effects, *Water level fluctuations, Water resources development, Dam effects, Reservoir operation, Wildlife habitats, Fish barriers, Social impact, Water quality, Recreation facilities, Fluctuations, Scour, Flood damage, Forests.

The advantages of hydroelectric power--simple, renewable, and nonpolluting--must be balanced against the environmental impacts, particularly of large projects. Flooding behind a dam takes fertile bottomland out of production; destroys prime forest land; disturbs wildlife, fish, and human habitats; increases water temperature; changes water quality; and inundates scenic rivers. Fluctuating water levels and changes in flow regimes during operation of a hydroelectric station create a dead littoral zone around the reservoir, drown forests, affect recreational use, disturb waterfowl nesting sites, cause scour and flushing downstream, and can produce nitrogen supersaturation in thespillway area. Small hydroelectric projects may retain many of the benefits without the unfavorable environmental effects produced by megaprojects. (Cassar-FRC)
W82-02632

ON THE ALGAL ECOLOGY OF THE LOWLAND IRAQI MARSHES,
Sulaimaniyah Univ. (Iraq). Dept. of Biology.
B. K. Maulood, G. C. F. Hinton, B. A. Whitton, and H. A. Al-Saadi.
Hydrobiologia, Vol 80, No 3, p 269-276, 1981. 3 Fig, 4 Tab, 20 Ref.

Descriptors: *Marshes, *Algae, Phytoplankton, Tigris River, Euphrates River, *Iraq, Deltas, Diatoms, Water quality, Cyanophyta, Epiphytes, Chlorophyta, *Ecology.

The marshes of the Tigris-Euphrates delta, Iraq, little changed in recent historical times, now face environmental effects from drainage projects, three dams, reed-harvesting, water transfers, and oil field development. A documentation of the algal community in boat channels during February 1978 and September 1979 showed that epiphytes, especially the filamentous type, were abundant. Filamentous green algae were more common in February, and blue-greens in September. Diatoms dominated the phytoplankton. Planktonic blue-green algae were mainly coccoid form; bloom-formers were rare. Heterocystous blue-green algae from boat hulls showed distinct laminations made of different species. Water in this region was slightly saline (0.2 0/00 to 1.33 0/00), varied widely in temperature (15 to 28.5 C), and was relatively turbid, calcerous,

and mesotrophic with respect to P and N. (Cassar-FRC)
W82-02777

TECHNICAL AND ECOLOGICAL IMPACTS OF THE HIGH ASWAN DAM,

Yarmouk Univ., Irbid (Jordan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-02856

ENVIRONMENTAL IMPLICATIONS AND ASSESSMENTS OF HYDROELECTRIC PROJECTS,

Inland Waters Directorate, Ottawa (Ontario).
P. J. Reynolds, and S. H. Ujjainwalla.
Canadian Water Resources Journal, Vol 6, No 3, p 5-19, 1981. 35 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, Planning, Monitoring, Ecological effects, Forests, Fish, Wildlife, Recreation, *Canada, *Cost-benefit analysis, Social impact, Water quality, Transmission lines, *Water resources development.

Hydroelectric power development can be compatible with the environment if projects are planned properly with input from the public and government agencies. Possible benefits of power development are construction of roads, communications, and services; new jobs and industry; possible opportunities for hunting and fishing; reforestation; increases in tourist activities; and building of new communities. The many 'disbenefits' include damage of fishing, wildlife, forests, shorelines, and water quality; flooding; recreational losses; dislocation of people; and disturbance by high voltage transmission lines. Even after 10 years of formal environmental impact assessments in Canada problem areas remain: (1) inadequate analytical techniques, (2) lack of assessment review procedures and manuals, (3) hurried environmental assessment reviews, and (4) absence of a detailed monitoring program supervised by a regulatory agency. It is suggested that cost-benefit analyses of environmental investigations be conducted. (Cassar-FRC)
W82-02896

HYDROACOUSTIC SURVEYS OF FISH ABUNDANCE AND DISTRIBUTION IN TWIN LAKES, COLORADO,

Washington Univ., Seattle. Coll. of Fisheries.
R. E. Thorne, and G. L. Thomas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-122250, Price codes: A02 in paper copy, A01 in microfiche. Water and Power Resources Service Report REC-ERC-81-4, April, 1981. 19 p, 8 Fig, 3 Tab, 15 Ref.

Descriptors: *Trout, *Fish populations, *Spatial distribution, *Pumped storage, Hydroelectric plants, Environmental effects, Reservoirs, Preimpoundment, Limnology, Juvenile growth stage, *Twin Lakes, Colorado.

Twin lakes are a pair of montane drainage lakes of glacial origin located on Lake Creek in central Colorado. The northwest corner of the lower lake is the site of the Mt. Elbert Pumped-Storage Powerplant, which is scheduled to begin operation during 1981. Water will be pumped from the lower lake up into a newly constructed forebay reservoir. A scheduled increase in the water surface elevation will inundate the isthmus between the two lakes, creating one larger reservoir. Concern exists over the effects of the powerplant on the ecology of the lakes, and especially on lake trout. Hydroacoustic surveys were conducted on Twin Lakes during September 1980 in order to measure the size and distribution of the resident fish population. Two distinct size groups of fish were observed: large fish below the thermocline (about 12 m) and small fish in the epilimnion. Net samples indicated that the large fish were predominately lake trout. Their estimated population size was 14,600, with 95% confidence limits of 4,100 to 25,000. The relatively large confidence intervals were the result of the relatively low fish density and its contagious distribution. The small fish were not identified, but may have been juvenile lake trout. Data presented in this report will be used along with those collected from other preoperational studies at Twin Lakes to form a pool of information for comparison with data collected following commencement of powerplant operations. (Moore-SRC)
W82-02977

WATER QUALITY OF THE PROPOSED NORDEN RESERVOIR, NEBRASKA, AND ITS IMPLICATIONS FOR FISHERY MANAGEMENT,

Bureau of Reclamation, Denver, CO. Lower Missouri Region.
J. W. Yahnke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-149345, Price codes: A04 in paper copy, A01 in microfiche. Bureau of Reclamation Report REC-ERC-81-8, May, 1981. 56 p, 6 Fig, 7 Tab, 62 Ref, Append.

Descriptors: *Eutrophication, *Dissolved oxygen, *Reservoirs, *Water quality, *Environmental effects, Thermal stratification, *Fisheries, Cyanophyta, Reservoir releases, Simulation, Model studies, Nutrients, *Norden Reservoir, Nebraska.

After the filing of the Final Supplement to the Environmental Impact Statement on the O'Neill Unit, the Environmental Protection Agency expressed concern over the potential for excess productivity in Norden Reservoir, a major feature of the O'Neill Unit, and consequent hypolimnetic oxygen depletion in the reservoir if it should become thermally stratified for an extended period of time. A combination of nutrient loading models and a temperature simulation model were used to project the trophic state, productivity, and duration of stratification of the reservoir. The trophic state index indicated that the reservoir would be eutrophic; the estimated mean annual chlorophyll a concentration indicated a high likelihood that algal blooms would occur A classification function was applied to the reservoir to evaluate whether the blooms would consist of blue-green or nonblue-green algae. The results show a 98% probability that blue-green algal blooms will occur. Dissolved oxygen curves for the reservoir were then developed for the period immediately prior to fall overturn. Curves were developed based on a reservoir with similar nutrient loadings and on theoretical curves. From these and the temperature model, oxygen concentrations in the reservoir discharge were estimated. The dissolved oxygen may be sufficient to support aquatic life but may fall below the Nebraska standard under certain circumstances. The reservoir and the river downstream are expected to support a cold-water fishery; most species now present in the river will be eliminated. The methods developed for this study may have application to other impoundments where an analysis is required to answer questions concerning the potential for such problems. (Moore-SRC)
W82-02983

RESULTS OF FISHERIES INVESTIGATIONS AT TWIN LAKES, COLORADO; 1973-76,

Colorado Div. of Wildlife, Fort Collins. Research Center.
L. M. Finnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-145129, Price codes: A04 in paper copy, A01 in microfiche. Bureau of Reclamation, Report REC-ERC-80-5, August, 1981. 52 p, 21 Fig, 8 Tab, 25 Ref, 4 Append.

Descriptors: *Pumped storage, *Trout, *Environmental effects, *Lake fisheries, Sport fishing, Crustaceans, Hydroelectric plants, Supersaturation, Limnology, Turbines, Fish food, Turbidity, *Twin Lakes, *Colorado.

Construction and operation of the pumping-generator plant project at Twin Lakes, as well as the enlargement of the lakes, could have detrimental effects on the sport fishery in the lakes. Preoperational studies were conducted at Twin Lakes during 1973-1976 to estimate fisherman use and harvest of both naturally reproduced lake trout, and stocked creel-sized rainbow trout; and to document relative abundance and spatial distribution of lake trout and opossum shrimp (Mysis relicta). An estimated 100,000 man-hours of fishing effort were expended yearly during the summer, with an additional 4000-5000 hours recorded on the lower lake in December-January. Game fish harvest ranged from 25,000 to 43,000 rainbow trout and 1200-1500 lake trout over 380 mm long. Gill-netting operations conducted during May, August, and November 1974-1975 revealed no significant differences in lake trout abundance between months or years, but a majority of the lake trout were captured from depths exceeding 15 m. Monthly benthic trawls for opossum shrimp during ice-free months showed that mean population numbers increased over the summer from 20/sq m to a peak of 96/sq m in late August to early September. Powerplant operations may result in a loss of game fish through the pump-turbines, and a loss through the Twin Lakes Dam outlet works. There may be a buildup of gases in the water during generating cycles, which could cause heavy fish mortality. Operation of the powerplant may also change the lake temperature and increase the turbidity. (Moore-SRC)
W82-02984

7. RESOURCES DATA

7A. Network Design

STATISTICAL CONSIDERATIONS AND SAMPLING TECHNIQUES FOR GROUND-WATER QUALITY MONITORING,

Louisiana Technical Univ., Ruston. Dept. of Agricultural Engineering.
J. D. Nelson, and R. C. Ward.
Ground Water, Vol 19, No 6, p 617-625, November/December, 1981. 1 Fig, 22 Ref.

Descriptors: *Monitoring, *Sampling, *Statistical methods, Water quality, Water sampling, Groundwater.

Statistical techniques are incorporated into groundwater sampling to obtain the optimum information from a minimum number of samples for both special studies and routine monitoring. The optimum number of required samples is based on a specified confidence interval about the mean of the variable under consideration. If the observations are independent in space and time, the number of samples can be determined. However, if the samples are spatially or serially correlated, the sample size must be increased to obtain the same amount of information that would be obtained in uncorrelated observations. The advantages and disadvantages of several sampling techniques are discussed. Simple random sampling can be applied to sampling in space and in time. The population must be defined according to the objective of the study. The primary use of systematic sampling is sampling in time, because it collects a sample every certain number of units or every designated interval. In cases of periodic variation the sampling interval must be carefully chosen to give reliable results. In stratified random sampling the total population is divided into nonoverlapping subpopulations, referred to as strata. This stratification may be by area, time, or season. The variance for simple random sampling is greater than for systematic or stratified random sampling. For serially correlated populations stratified random sampling is better than simple random sampling. Systematic sampling is more precise than stratified random sampling in some cases, possibly in groundwater monitoring. (Cassar-FRC)
W82-02618

HOW ABIOTIC FACTORS AFFECT THE DISTRIBUTION OF TWO SPECIES OF TROPICAL PREDACEOUS AQUATIC BUGS (FAMILY: NAUCORIDAE),

Michigan Univ., Ann Arbor. Div. of Biological Sciences.
R. J. Stout.
Ecology, Vol 62, No 5, p 1170-1178, October, 1981. 6 Fig, 8 Tab, 9 Ref.

Descriptors: *Aquatic insects, *Population dynamics, Flood flow, Flow velocity, Streamflow, Flood discharge, Natural streams, Costa Rica.

This study of contrasting Costa Rican stream sites determined how two types of stream hydrolocoris insularis Chapman and Cryphocricos latus Usinger. The two streams, the Sabalo and the Sura, had different maximum velocities and direction of flow during floods,different flood frequencies, different flood substrata type, and different mobility of substrata during floods. Backflooding in the Sura had no subsequent effect on the abundance or distribution of either species. In the Sabalo, nymphal populations of L. insularis decreased significantly after a spate because of loss of numbers and loss of previous habitat. Nymphs and adults of C. latus were more abundant under conditions of fast currents, large rocks, and coarse-grained pebbles. Population distribution patterns for the two species were explained by differences in flooding characteristics of the streams. (Small-FRC)
W82-02633

7B. Data Acquisition

MICROWAVE MEASUREMENTS OF SNOWPACK PROPERTIES,

Kansas Univ./Center for Research, Inc., Lawrence.
For primary bibliographic entry see Field 2C.
W82-02646

REMOTE DETECTION OF NUTRIENT AND WATER DEFICIENCIES IN SUGARCANE UNDER VARIABLE CLOUDINESS,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
R. D. Jackson, C. A. Jones, G. Uehara, and L. T. Santo.
Remote Sensing of Environment, Vol 11, No 4, p 327-331, September, 1981. 1 Fig, 2 Tab, 2 Ref.

Descriptors: *Remote sensing, *Sugarcane, *Nutrients, Infrared radiation, Water stress, Cloud cover, Irradiance, Potassium, Nitrogen, Vegetation.

Nitrogen, potassium, and water deficiencies in sugarcane crops were detected by spectral measurements in the infrared band (0.76-0.90 microns) and red band (0.63-0.69 microns) taken with a radiometer mounted on a 4 meter aluminum pole. The infrared/red ratios of a well nourished and adequately watered sugarcane field (averaged 17.4) were significantly higher than those measured over a N-deficient plot (9.3), a K-deficient plot (16.2), and a waterstressed plot (15.1). Although radiance values varied by a factor of 5 in both bands over a range from direct sunlight to full shade, the infrared/red ratios under the same conditions were fairly constant, 15.8-16.5. This technique is reliable only after the ground is completely covered with vegetation, usually 3 to 4 months after planting. (Cassar-FRC)
W82-02709

WATER MANAGEMENT IN THE NORTH DESCHUTES UNIT IRRIGATION DISTRICT: GEOGRAPHIC PERSPECTIVES AND REMOTE SENSING APPLICATIONS,

Oregon State Univ., Corvallis. Dept. of Geography.
M. D. Nellis.
PhD Thesis, 1980. 270 p, 24 Fig, 34 Tab, 99 Ref, 12 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-18944.

Descriptors: *Water management, *Irrigation, *Remote sensing, Aerial photography, Infrared imagery, Irrigation districts, *Oregon, Thermal infrared imagery, Color infrared photography.

The North Unit Irrigation District of Central Oregon is characterized by limited water and the need for efficient utilization and control of the irrigation system. The primary objective of this research was to determine the practicality of utilizing thermal infrared imagery and color infrared photography for assessing irrigation water management problems. A field survey of the area covered by the overflights was used to map patterns of fields and irrigation methods. Data gathered through farm interviews, ground-based measurements, and imagery and aerial photographic interpretation were statistically treated. The results of this research demonstrate the practicality of using thermal infrared imagery and color infrared photography for detecting problems associated with the irrigation water management system. The thermal infrared imagery was useful for detecting canal leakage, non-uniformity of water distribution at all stages of crop growth, and apparent crop canopy temperatures as an indicator of crop stress. The color infrared photography was useful for detecting crop stress resulting from a variety of field conditions. (Sinha-OEIS)
W82-02739

RECONNAISSANCE OF THE HOT SPRINGS MOUNTAINS AND ADJACENT AREAS, CHURCHILL COUNTY, NEVADA,

Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 1A.
W82-02830

CALCULATION OF THE ANNUAL DISTRIBUTION OF RIVER RUNOFF WHEN OBSERVATION DATA ARE AVAILABLE,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2E.
W82-02854

THE USE OF DIALYZING SACKS IN ESTIMATION OF PRODUCTION OF BACTERIOPLANKTON AND PHYTOPLANKTON,

Eotvos Lorand Univ., Budapest (Hungary). Dept. of Plant Systematics and Ecology.
L. G. Toth.
Archiv fur Hydrobiologie, Vol 89, No 4, p 474-482, August, 1980. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Phytoplankton, *Bacteria, *Productivity, Dialyzing sacks, Plankton, Zooplankton, Population dynamics, Incubation, Mortality, Predation, Lakes, *Lake Balaton, *Hungary.

Semipermeable dialyzing sacks and glass bottles were compared as means of estimating production of pelagic microflora in Lake Balaton, Hungary, during the summer of 1978. The glass bottle technique produced underestimates of 6.9% in bacterial cells alone, 60.0% in colonized bacteria, 45.5% in total bacterioplankton, 27.2% in microalgae, 42.4% in algae larger than 10 microns, and 40% in total phytoplankton. The matter balance of phytoplankton was determined for the period between 10 a.m. and 4 p.m. as follows: loss to predation, 11.1%; residual mortality, 27.4%; fraction of biomass appearing in actual biomass, 61.5%. The matter balance of bacterioplankton was as follows: loss to predation, 10.1%; residual mortality, 67.5%; and fraction appearing in actual biomass, 22.4%. A schematic representation of the matter-energy flow system between the phytoplankton and bacteria is depicted. (Cassar-FRC)
W82-02866

INSTRUMENTATION FOR AERATED FLOW ON SPILLWAYS,

Ministry of Energy, Wellington (New Zealand).
P. Cain, and I. R. Wood.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1407-1424, November, 1981. 11 Fig, 2 Tab, 13 Ref.

Descriptors: *Spillways, *Measuring instruments, Aeration, Dams, Aviemore Dam, New Zealand, Bubbles.

A study was made of instruments used for measuring air concentration and velocities in self-aerated flow on the spillway of Aviemore Dam. Self-aeration in open channel flow is the natural phenomenon whereby atmospheric air is drawn into and mixed with the water, creating a characteristic white appearance. Measurements in very aerated regions of flow on the spillway of Aviemore dam indicate that surface regions are very highly aerated, with air concentrations in the range of 0.5 to 0.9 (defined as the volume of air/unit volume). Largest bubbles in this surface region are about 10 mm - 20 mm in diameter. Away from the surface the flow is less aerated and bubbles are smaller. Methods for measuring stagnation pressure and air concentration are considered. Descriptions are offered of the operation of a bubble size probe and a correlation velocity probe. The most accurate and reliable measurements obtained at Aviemore were those made using the conductivity portion of the combined probe for air concentration and the correlation probe for velocity. However, in future measurements a single resistivity probe would be used for air concentration. (Baker-FRC)
W82-02880

CONSTRUCTION OF A GAMMA-DISTRIBUTION PROBABILITY PAPER FOR STRAIGHTENING DISCHARGE PROBABILITY CURVES,

F. F. Razzorenov.
Hydrotechnical Construction, No 5, p 471-474, May, 1980. 3 Fig, 2 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 23-25, May, 1980.

Descriptors: *Probability distribution, *Hydrologic data, *Flow discharge, Flow rates, Mathematical studies, Discharge measurement, *Streamflow forecasting, *Discharge hydrographs.

The Hazen probability method used to plot discharge probability curves makes it possible to represent the probability curve as a straight line only in the case of a normal distribution of the series. When the data are skewed, the curve is bent. For skewed data, a special gamma-distribution probability method should be used. With this method, it is possible to present the probability curve as a straight line for any values of the coefficeints of variation and skewness. The gamma-distribution method is particularly useful for hydrologic data, as data for large discharges are almost always skewed. Probability curves are presented for the maximum discharges of the Kura River at Likani Village plotted using the Hazen method and the gamma-distribution method. The gamma-distribution method is judged more successful. (Small-FRC)
W82-02925

A RATE OF RISE CONTROLLER FOR AUTOMATIC WATER SAMPLERS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
E. M. O'Loughlin.
Journal of Hydrology, Vol 50, No 1-3, p 383-387, March, 1981. 1 Fig, 1 Ref.

Descriptors: *Sampling, *Water sampling, *Control systems, *Automation, Water quality, Streams.

A controller was developed to actuate an automatic water sampler for streams such that the sampling interval increases in direct proportion to the rate of change of water level and is independent of absolute discharge. This results in more frequent sampling during periods of more variable water quality. The controller features simple construction, low power consumption, variable sensitivity, and low cost. (Cassar-FRC)
W82-02938

EVALUATION OF REMOTE SENSING DATA FOR INPUT INTO HYDROLOGICAL SIMULATION PROGRAM-FORTRAN (HSPF),

Hydrocomp, Inc., Mountain View, CA.
D. D. Franz, and S. M. Lieu.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-209561, Price codes: A06 in paper copy, A01 in microfiche. Environmental Prutection Agency Project Summary EPA-600/S3-81-037, July, 1981. 2 p.

Descriptors: *Hydrologic models, *Remote sensing, *Satellite technology, *Computer models, Model studies, Simulation, Land use, Flow rate, Water temperature, Dissolved oxygen.

Remotely sensed data from the LANDSAT satellite and conventionally obtained data were used to set up the input parameters of HSPF. Simulations were then run to compare the model outputs from the two sets of input data. The remotely sensed data set performed at least as well as the conventional one when model results were compared with observed data. Differences in land-use distribution had little effect on the overall outcome of HSPF modeling. Both the conventional and the remotely sensed parameter sets performed well for certain simulations. The results for flow rate, water temperature, and dissolved oxygen are comparable to observed data. Neither parameter set seemed to perform well in nutrient simulations. Assessing the accuracy of these results, however, was difficult because of inadequacies in the observed data and the modeling approach. Refinement of information on urban and water areas in the remotely sensed land-use classification would result in better segment definition. Use of a remotely sensed database offers significant savings in cost (about 30 to 50%) in comparison with use of a conventional database. A remotely sensed database offers advantages of repeatability, relative rapidity and ease of information collection. It would be particularly advantageous in large or inaccessible areas or in areas requiring frequent database updates. The Image Based Information System (IBIS) used to manipulate the Landsat data was found to contribute significantly to the data collection and handling process. (Moore-SRC)
W82-02986

7C. Evaluation, Processing and Publication

LOW-FLOW CHARACTERISTICS OF KENTUCKY STREAMS, 1980,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-02826

MISCELLANEOUS SURFACE-WATER DATA, PECOS RIVER BASIN, NEW MEXICO,
Geological Survey, Pasco, WA. Water Resources Div.
C. C. Cranston, G. E. Kues, and G. E. Welder.
Geological Survey, Open-File Report 81-218, February, 1981. 8 p, 1 Fig, 1 Tab.

Descriptors: *Surface water, *Surface runoff, *Hydrologic data, Tributaries, Streamflow, Discharge measurement, Springs, Canals, Pumping, *New Mexico, *Pecos River basins, Mapping.

Miscellaneous surface-water data from the Pecos River basin of New Mexico are assembled into one table. Measurements and estimates of the discharge of streams, springs, and diversion canals and pumps that are not readily available to the public are given. The principal sources of information are published and unpublished reports and various records of the U.S. Geological Survey and the New Mexico State Engineer Office. Many thousands of surface-water discharge values are given. (USGS)
W82-02827

DRAINAGE AREAS OF STREAMS AT SELECTED LOCATIONS IN KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
D. E. Bower, and W. H. Jackson.
Geological Survey Open-File Report 81-61, 1981. 118 p, 1 Fig, 12 Tab.

Descriptors: *Hydrologic data, *Surface water, *River basins, *Drainage area, Streams, Streamflow, Sites, Sinks, *Kentucky, Ohio River basin, Lower Mississippi River basin, Watersheds.

The drainage areas for more than 2,000 selected sites throughout Kentucky were determined. Areas of limestone terrain characterized by sinkholes are indicated in basins where they have been determined. Each location is referenced by U.S. Geological Survey station number (where assigned), latitude, longitude, county code, topographic quadrangle, river distance, and in some cases by nearby town or landmark. All values are given in both English and metric units and an alphabetical index by stream name is provided. (USGS)
W82-02835

POTENTIOMETRIC SURFACE MAPS OF THE SPARTA SAND: NORTHERN LOUISIANA AND SOUTHERN ARKANSAS, 1900, 1965, 1975, AND 1980,
Geological Survey, Alexandria, LA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-02839

WATER RESOURCES DATA FOR ALASKA, WATER YEAR 1960.
Geological Survey, Anchorage, AK. Water Resources Div.
Geological Survey Water-Data Report AK-80-1, 1981. 373 p, 4 Fig.

Descriptors: *Hydrologic data, *Surface water, Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Alaska.

Water resources data for the 1980 water year for Alaska consist of records of stage, discharge, and water quality of streams; stage and water quality of lakes; and water levels and water quality in wells and springs. This report contains discharge records for 114 gaging stations, stage only record for 1 gaging station, water quality for 55 stations, and water levels for 33 observation wells. Also included are 56 low-flow, 8 crest-stage, and 2 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements of discharge, lake stage, or water quality. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alaska. (USGS)
W82-02845

WATER RESOURCES DATA FOR WYOMING, WATER YEAR 1980--VOLUME 1. MISSOURI RIVER BASIN.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153024, Price codes: A99 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report WY-80-1, 1981. 621 p, 9 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Wyoming, *Missouri River Basin.

Water Resources data for the 1980 water year for Wyoming consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. Volume 1 of this report contains discharge records for 161 gaging stations; stage only records for 1 lake; stage and contents for 11 lakes and reservoirs; water quality for 93 gaging stations, 44 ungaged stations, 100 wells and springs; and water levels for 36 observation wells. Also included are 74 crest-stage partial-record stations and 2 precipitation monitoring sites. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. This data represents that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Wyoming. (USGS)
W82-02846

WATER RESOURCES DATA FOR MISSISSIPPI, WATER YEAR 1980.
Geological Survey, Jackson, MS. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-149006, Price codes: A18 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report MS-80-1, 1981. 414 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Mississippi.

Water resources data for the 1980 water year for Mississippi consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report contains records of water discharge at 82 gaging stations, stage records for 17 of these gaging stations, stage only at 4 gaging stations, contents for 4 lakes, water quality for 32 gaging stations and 105 wells, and water levels for 360 observation wells. Also included are peak-discharge data for 94 crest-stage partial-record stations and water quality data at 19 partial record or miscellaneous sites. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Mississippi. (USGS)
W82-02847

8. ENGINEERING WORKS

8A. Structures

FUNDAMENTAL CONCEPTS OF WELL DESIGN,
Ground Water Associates, Inc., Westerville, OH.
E. B. Williams.
Ground Water, Vol 19, No 5, p 527-542, September/October, 1981. 7 Fig, 1 Tab, 28 Ref.

Descriptors: *Well hydraulics, *Design criteria, *Well design, Groundwater movement, Well screens, Screened wells, Geohydrology, Hydraulic conductivity, Reynolds Number, Turbulent flow, Aquifer characteristics, Filters.

Proper well design should rely on more than a knowledge of aquifer properties and screen entrance velocity. The most important factor is proper sizing of the artificial gravel filter materials and screen slot openings. The critical approach velocity, valuable in determining the borehole diameter, may be obtained from the relationship between the hydraulic conductivity and the gradient in the aquifer and from aquifer grain size. The tendency for turbulent flow, described by the Reynolds Number, is used to determine screen diameter. Screen entrance velocity is useful in evaluating open area in regard to screen construction. Graphs and tables are presented to help in the design process. (Cassar-FRC)
W82-02614

RATIONAL DIMENSIONS OF AN EARTH BLANKET AND ITS SEEPAGE CALCULATION,
N. S. Chyong.
Hydrotechnical Construction, No 3, p 256-262, March, 1980. 4 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 28-31, March, 1980.

Descriptors: *Earthworks, *Hydraulic structures, *Estimating equations, *Seepage, Mathematical studies, Permeability, Earth dams, Dam construction.

A method for determining the optimal thickness and length of a rational earth blanket for hydraulic

structures is presented. This method considers preservation of a prescribed seepage discharge and a permissible value of the gradient of seepage head in the foundation of the structure. The use of a blanket of constant or almost constant thickness is irrational because in one region the cutoff capacity of the blanket may be excessive and in another the gradient of the head may be greater than the permissible limit. Thus piping can occur. Equations are presented for determining the thickness of the blanket over its entire length. (Small-FRC)
W82-02666

IMPROVEMENT OF THE SEALS OF EXPANSION JOINTS OF HYDRAULIC STRUCTURES,

N. F. Shchavelev.
Hydrotechnical Construction, No 3, p 230-236, March, 1980. 4 Fig, 2 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 12-16, March, 1980.

Descriptors: *Construction joints, *Hydraulic structures, *Performance evaluction, *Sealants, Leakage, Dam construction.

The degree of reliability of existing seals of expansion joints was established by analyzing data on seal performance at 220 operating Soviet and other hydraulic structures. This investigation led to the development of several fundamentally different new seal designs. In expansion and filled expansion-settlement joints, the penetration of the asphalt material from the cavity of the water stop into the joint is a slow process. If the joint is filled flowing from the water stop, water-tightness is increased. There are frequently problems with the installation of contour seals at locations where the joints intersect various service rooms in an underground part. If the existing main seal in the joint protects these rooms from water entry, additional seals are not necessary. These suggestions can increase the efficiency of seals used in the expansion joints of large concrete and reinforced concrete hydraulic structures. (Small-FRC)
W82-02669

USE OF CRACK-RESISTANT LININGS OF HYDRAULIC TUNNELS WITH CONSOLIDATION GROUTING OF THE ROCK,

E. I. Zhokhov, and A. K. Fedulov.
Hydrotechnical Construction, No 3, p 225-229, March, 1980. 1 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 9-12, March, 1980.

Descriptors: *Tunnel linings, *Tunnel construction, *Grouting, Tunneling, Tunnels, Seepage control.

High-pressure grouting can be used to create crack-resistant linings in hydraulic pressure tunnels. This method uses less materials than other lining techniques, decreases seepage leaks from the tunnel, and prevents hydrostation production losses. It is best to use the method in circular tunnels of not more than 5-6 m diameter. Many holes can be simultaneously grouted as the grout flows along the return pipeline. Laboratory and on-site investigations are necessary to select the optimum grout formula and to evaluate the effectiveness of grouting under the specific geological conditions of the tunnel. A disadvantage of the method is the large amount of labor required. (Small-FRC)
W82-02670

BITUMINOUS CONCRETE ANTISEEPAGE CURTAIN FOR CONCRETE DAMS,

N. F. Shchavelev.
Hydrotechnical Construction, No 6, p 561-566, June, 1980. 4 Fig, 2 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 12-15, June, 1980.

Descriptors: *Asphaltic concrete, *Seepage control, *Dam design, Concrete dams, *Materials engineering, Hydraulic structures, Waterproofing, Insulation, Fiberglass, Pressure distribution, Deformation, *USSR.

A poured porous clay-asphalt concrete is suggested as a waterproofing curtain to protect the upstream face of a dam. The material is a mixture of asphalt (17.4%) with 5-10 mm porous clayey gravel (25%), 0-5 mm porous clay sand (20.5%), rubber crumb (0.6%), and a powdered mineral filler (36.5%) composed of limestone, dolomite, and waste cement. The mixture is self-sealing, easy to handle during construction, and also serves as thermal insulation. The deformation and pressure propagation in the asphaltic material was investigated. For a curtain with a 10 cm thick reinforced concrete wall and anchors 28 mm in diameter, 60 x 60 cm on centers, the internal presure in the insulating layer is adequate when the structure is first placed in service and increases by 0.025 MPa at 5 years and by 0.220 MPa at 100 years after filling. With a thinner reinforced concrete wall, smaller anchors, or fiberglass insulation, internal pressure increases are smaller or imperceptible. (Cassar-FRC)
W82-02690

PROSPECTS OF USING RADIAL GATES ON OVERFLOW DAMS OF LARGE HYDROELECTRIC STATIONS,

D. M. Savin.
Hydrotechnical Construction, No 3, p 241-244, March, 1980. 2 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 19-21, March, 1980.

Descriptors: *Hydraulic gates, *Hydroelectric plants, *Dam design, Gates, *Radial gates, Piers, Overflow, Design criteria, Hydraulic structures, Mechanical equipment, Spillways.

Radial gates have several advantages over vertical lift gates in overflow dams: smaller forces required for maneuvering, more reliable seating on the sill, absence of grooves which may fill with ice, and better conditions for passage of ice. However, the large concentrated loads transmitted from the main pivots to the concrete limit the load on each hinge of 5000 kN unless other design modifications are made (larger piers, longer spillways). In several dams throughout the world transmission of larger loads, on the order of 15,000-20,000 kN from each gate hinge, has been accomplished with prestressed cables. A load of 50,000 kN per hinge can be handled by a double-cantilever radial gate supported on intermediate piers without using any prestressed cables, according to a design for the Bureya hydroelectric station. (Cassar-FRC)
W82-02693

IMPULSE TECHNOLOGY FOR SURFACE COMPACTION OF CONCRETE MIXES IN CONSTRUCTION OF SLOPE REVETMENTS,

For primary bibliographic entry see Field 8B.
W82-02695

ESTIMATION AND OPTIMIZATION OF THE SERVICEABILITY OF UNDERGROUND WATER TRANSMISSION NETWORK SYSTEMS UNDER SEISMIC RISK,

Columbia Univ., New York.
R. Y. Tan.
PhD Dissertaion, 1980. 81 p, 22 Fig, 7 Tab, 21 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-13563.

Descriptors: *Water distribution, *Water conveyance, *Water mains, Network design, Seismic waves, Earthquakes, California, Underground water transmission system.

The purpose of this research is (a) to develop a methodology for the assessment of the risk underground water transmission systems in seismically active areas are subjected to in terms of the degree of possible unserviceability resulting from destructive earthquakes and also (b) to develop procedures for the optimum design of systems to be newly constructed as well as for the optimum improvement of existing systems on the basis of cost-effectiveness considerations. For the analysis, a water transmission system adapted from the actual Los Angeles City system was used, taking into account the existence of the major faults surrounding and penetrating the system, the topological and structural characteristics of the water transmission network, conditions of the soil and ground in which the system is imbedded, and the probabilistic nature of the location, frequency and magnitude of future earthquakes. A Monte Carlo technique was used to simulate a sample of damaged states of the transmission network. The Newton-Raphson method was then utilized to analyze each of the damaged states of the network for its flow characteristics. The result of this analysis determines whether or not the network remains serviceable under each simulated state of damage and hence leads to a Monte Carlo estimation of the probability of system serviceability. Procedures for optimizing the total cost are developed in which the pipe diameters and the network topology are parameters which can be varied to achieve a maximum total cost under certain realistic constraints. (Sinha-OEIS)
W82-02743

CONSTRUCTION OF A BASIC-GATE UNIT FOR THE DEEP CATASTROPHIC SLUICE AT THE NUREK HYDROELECTRIC PLANT,

F. I. Gurtovnik, S. V. Shutenkov, and A. K. Mel'nikov.
Hydrotechnical Construction, No 6, p 556-560, June, 1980. 4 Fig, 6 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 6, p 9-12, June, 1980.

Descriptors: *Sluice gates, *Hydroelectric plants, Power plants, Sluices, *Flood control, Channels, Conduits, Electric power, Hydraulic engineering, Reinforced concrete, *Reservoir releases, Construction, Design criteria, Nurek hydroelectric plant, *Russia.

The deep catastrophic sluice at the Nurek hydroelectric plant is a 1337 meter long trough-shaped tunnel with a section varying from 90 to 115 square meters and an inlet portal 100 meters below the reservoir's normal support level. The sluice is designed to discharge flood flows of up to 2000 cubic meters per second, with a full reservoir during the period when the hydraulic facility is in operation. The sluice will also discharge construction flows during the concluding stages of construction on the basic structures. Due to special conditions prevailing at the time of construction, a temporary scheme for maneuvering the basic sluice gates was devised. The temporary scheme was needed primarily to ensure operation to some degree when the flood season was imminent. Construction was completed in time for the floods due to a reduction in the volume of construction-assembly work and a shortening of construction times. The construction of supports for the underground working-gate unit in sectional reinforced concrete made it possible to reduce the time needed for construction of the unit due to the concurrent construction-assembly operations. The adoption of reinforced-concrete support designs in combination with anchors enabled the builders to deviate from the traditional method employed to build similar units using reinforced concrete arches. (Baker-FRC)
W82-02771

ON-SITE INVESTIGATIONS OF THE CONTACT ZONE OF THE UPSTREAM FACE OF THE CONCRETE DAM ON THE UST-ILIM HYDROELECTRIC STATION,

V. N. Durcheva, and S. M. Puchkova.
Hydrotechnical Construction, No 6, p 595-600, June, 1980. 3 Fig, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 32-35, June, 1980.

Descriptors: *Dams, *Hydroelectric plants, *Concrete, Powerplants, Construction, Spillways, Strain measurement, Reservoir filling, *Temperature effects, Dam design, Ust-Ilim Dam, *Russia.

The Ust-Ilim concrete dam has a maximum height of 105 meters, slope of the downstream face 1:0.7, and was constructed on a strong diabase foundation. The channel part of the upstream face of the dam is formed by 36 sections: 18 powerhouse, 11 spillway, and 7 nonoverflow. Vertical strain

gauges were installed at a distance of 0.5 meters from the upstream face in the axial cross section along the base of each half-section. The conditions present at the contact zone under the upstream face depend on the design features of the sections and temperature regime during filling of the reservoir. The maximum propagation of the contact crack to 13 meters occurred in the powerhouse sections before linking to the powerhouse with open conduits that communicated with the outside air. For theoretical studies of the boundaries of decompression of the foundation of the contact zone under the upstream face of a gravity dam it is necessary to consider stresses during the construction period, the effect of the shape of the offset profile, and the temperature regime of various types of sections. Vertical cracks in the concrete of the contact slab of temporary dewatering outlets can become paths of concentrated seepage. The design features of spillway sections caused a state of three-dimensional stress of the contact zone, with transmission of the loads of the construction period and during filling of the reservoir. In the majority of drain wells, the water level is at the level of the rock-concrete contact joint. Flowing wells and flow of water through transverse drainage galleries are observed only in several powerhouse sections. Wells are also flowing in several spillway sections. Seepage flow through the rock foundation is not being monitored. (Baker-FRC)
W82-02773

STUDY OF THE EXPERIENCE IN OPERATING HYDRAULIC TUNNELS,

V. M. Mostkov, and V. S. Serkov.
Hydrotechnical Construction, No 1, p 44-49, January, 1980. 4 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 1, p 26-28, January, 1980.

Descriptors: *Tunnel linings, *Hydroelectric plants, *Inspection, Hydraulic structures, Tunnel failure, Design criteria, Concrete construction, Linings, Cracks, Damage, Diversion structures, Grouting, Corrosion, *USSR.

Most of the 300 km of pressure and free flow hydraulic tunnels operating in the Soviet Union have been in satisfactory condition, according to inspections begun in 1972. Several cases of deterioration are reported. Typical is the Tereblya-Rika pressure diversion tunnel, which showed waterlogging and slope deformation along the tunnel route. These conditions were caused by cracks in the concrete lining and a circular crack at the connection with the metal lining of the penstock. Repairs included injection of cement grout, sealing of the circular crack, and reinforcement of the cracked lining with a 70 m metal sleeve. There are three main causes of damage to tunnels: incorrect evaluation of rock mass properties during design, deviations from specifications during construction, and corrosion during operation. Since the physical properties of rock masses are very difficult to predict, it is suggested that characteristics of the same rock mass be measured before and after operation of the tunnel. The differences can be used in design of analogous tunnels. Common construction deviations from specification include insufficient cleaning of the rock surface before concreting the lining, errors and low-quality ingredients in mixing concrete, untimely placement of concrete, inadequate compacting of the concrete mix, inadequate grouting, and unclean reinforcement material. A systematic analysis of tunnel operating experiences is needed. (Cassar-FRC)
W82-02782

CALCULATION OF DIVERSION TUNNELS OF SPECIAL PROFILES OPERATING UNDER CONDITIONS OF A FREE UNIFORM FLOW,

V. N. Kozin.
Hydrotechnical Construction, No 4, p 392-394, April, 1980. 1 Fig, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 4, p 40-41, April, 1980.

Descriptors: *Tunnel hydraulics, *Diversion structures, Graphical methods, Mathematical equations, Discharge capacity, Uniform flow, Turbulent flow, Design criteria, Diversion structures, *USSR.

The dimensions and the velocity and depth of a uniform flow in a horseshoe diversion tunnel are calculated from the height, discharge, degree of filling, and roughness coefficient. This is a more difficult computation than the inverse solution, determining discharge capacity from tunnel dimensions. The determination is based on a classification of diversion tunnels into 5 profiles by the USSR agency concerned with hydroelectric station construction. A graph represents characteristics of the cross-section and hydraulic radius for different degrees of filling. These values are used in equations to calculate the desired parameters. This procedure may be used to develop graphs for other tunnel profiles. (Cassar-FRC)
W82-02785

STRESS RELAXATION IN CONCRETE OF MASSIVE HYDRAULIC STRUCTURES,

E. A. Kogan.
Hydrotechnical Construction, No 9, p 916-920, September, 1980. 4 Fig, 2 Tab, 12 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 24-27, September, 1980.

Descriptors: *Concrete technology, *Stress relaxation coefficient, Hydraulic structures, Materials enginering, Dam design, Hydroelectric plants, *Dam construction, *USSR.

Experimental values of the stress relaxation coefficient (Kr) were obtained by testing large-scale concrete specimens, 50-70 cm wide and 200-220 cm high. These were prepared with concrete mixes (grades 200, 300 and 450) from dams under construction in the USSR. Families of curves are presented for Kr at different ages of concrete, up to 200 days. A table gives coefficients for 300 grade concrete of ages 1 to 900 days at concrete ages of 1 to 720 days at the time of stress increase. Concrete age substantially affects the degree of stress relaxation, differing by a factor of 2-3 between 3 and 500 days, and must be considered up to at least 180 days. At an age of 3 days, limiting values of Kr for concrete of all three grades are close to 0.25. Mature concrete is characterized by Kr limiting values of 0.54 for grade 200 and 0.64-0.67 for grades 300 and 450. (Cassar-FRC)
W82-02786

ARGENTINA'S HYDROELECTRIC-BASED ENERGY PLAN,

B. Bronstein.
Power Engineering, Vol 85, No 1, p 50-51, January, 1981. 1 Fig, 1 Tab.

Descriptors: *Electrical networks, *Hydroelectric power, *Water resources development, Dams, Electric power production, Nuclear energy, Electric powerplants, Thermal power plants, Hydroelectric plants, Thermal power, *Argentina.

Argentina's new energy program, designed to reduce dependence on petroleum, will rely on 21 planned hydroelectric powerplants. The new plants are expected to be built at a cost of $22 billion by the year 2000. Six nuclear powerplants will be constructed as a backup system, and the country's present transmission system will expand to 10,900 miles by 1995. Argentina's rivers have a potential electric power source of about 140,000 GWh. Hydroelectric power will account for 25,000 additional MW by the year 2000; the current production is 9300 MW. In 1995 conventional thermal plants will supply 61% of the electricity needs while nuclear power will provide 10%. The $5.7-billion Yacyreta project and the Corpus project are joint Argentine-Paraguayan ventures. The Parana Medio complex, downstream from the Yacyreta, will contain two hydroplants with a combined installed capacity of 5600 MW. Other projects are being planned at the Pati section, Chapeton. The five hydro projects are slated for the Limay River. Eight smaller hydroelectric projects having a total installed capacity of 2200 MW will supply electricity to the western provinces of Mendoza and San Juan. Most of the projects will be financed from supplier creditors and maintained by semi-private utilities. The government hopes to generate international interest in expanding its water resources through international public tenders for these projects. (Geiger-FRC)
W82-02794

STAGES OF PROGRESS IN THE ORGANIZATION OF HYDRAULIC CONSTRUCTION,

Main Administration for Construction and Installation of Hydroelectric Power Plants in the East (USSR).
V. L. Kuperman.
Hydrotechnical Construction, No 10, p 1027-1035, October, 1980. 3 Fig, 31 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 10, p 23-27, October, 1980.

Descriptors: *Construction, *Hydraulic engineerings, *USSR, Dam construction, Reservoir construction, Construction materials, Hydraulic design, Hydraulic structures, Permafrost, Frozen ground, Earth dams.

In the initial period of water-power construction in the USSR, water power was based on fundamental studies of prominent Russian scientists of the prerevolutionary period and on foreign experience and techniques in practical matters. Later development differed markedly from experiences gained elsewhere. Considering the complexity of the construction problems, the subdivision on water power construction was created in the system of the Main Administration for the Electrification of Russia. Initially hydroelectric plants were built on small mountain rivers in Central Asia, Caucasia, the Kola Peninsula, and in other regions on the basis of the derivation scheme. Later, highly economical derivation hydroelectric plants and networks were built on mountain rivers. The experience gained with the construction of the first relatively low-head hydroelectric plants in Siberia, the Ust-Kamenogorsk, Novosibirsk, and Irkutsk plants, has made it possible to proceed with the construction of hydroelectric plants with dams built of local materials in permafrost regions. Especially in regions with permafrost, dams built of local earthen materials with the underground disposition of power structures have been found most economical. The world's largest arch dams were designed for the Inguri and Chirkey hydroelectric plants. The presence of complex geologic conditions and local building materials made it possible to derive the optimum solution using dams constructed of earthen materials. The 300 meter high dam for the Nurek hydroelectric plant is being constructed of a gravelly conglomerate material with an antiseepage core formed from a sandy-loam material. (Baker-FRC)
W82-02858

UMFOLOZI ROAD BRIDGE HYDRAULIC MODEL INVESTIGATION,

National Research Inst. for Oceanology, Stellenbosch (South Africa).
J. A. Zwamborn.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1317-1333, November, 1981. 15 Fig, 11 Ref.

Descriptors: *Model studies, *Bridges, Hydraulic models, Rivers, Sediments, Scour, Abrasion, Erosion, *Bridge design, *Umfolozi River, Zululand, *South Africa.

A movable-bed hydraulic model study is described which was made to determine the optimum position, length, and pier alignment of a new road bridge across the Umfolozi River in Zululand, South Africa. The model scaling techniques were proved efficiently correct by reproducing, in the model, recorded scour depths and general river bed changes caused by a major flood. The study showed that the originally proposed bridge site had serious disadvantages, and a much better site was established. The required bridge length was reduced from 1,200 ft to 700 ft. In addition to the savings in bridge length, the study resulted in a considerable saving on the foundation depth, due to the reliable scour depth predictions obtained from the movable-bed model. The model was designed in accordance with the shear/settling velocity criterion, and crushed anthracite was used as

bed material. The horizontal and vertical scales were 1 in 250 and 1 in 100 respectively. The velocity scale was based on Froude's law and, with the large tractive force in this steep river, it was necessary to deviate from the criterion. (Baker-FRC)
W82-02868

ENGINEERING RESPONDS TO ECOLOGY,

Whitman and Howard, Inc., Wellesley, MA.
For primary bibliographic entry see Field 5D.
W82-02935

EXPERIENCE WITH AND THE EFFECTIVENESS OF AUTOMATIC SYSTEMS FOR CONTROL OF LOADING-HAULING OPERATIONS DURING CONSTRUCTION OF THE DAM FOR NUREK HYDROELECTRIC PLANT,

S. Ya. Lashchenov, V. I. Rymarevich, V. V. Vil'vovskii, and M. Yu. Gornshtein.
Hydrotechnical Construction, No 11, p 1109-1114, November, 1980. 2 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 11, p 6-9, November, 1980.

Descriptors: *Hydroelectric plants, *Dam construction, *Control systems, Construction, Rock fill, Earth dams, Automation, Computers, Data processing, Hydraulic engineering, Quarries, *Nurek hydroelectric plant, *USSR.

The Karat automatic system for control of loading-hauling operations was used effectively in the construction of the high earth dam for the Nurek hydroelectric plant (300 m high and 52 million cu m in volume). The system is designed for 256 dump trucks, 3 weighing stations, and 19 loading-unloading stations. It secures trucks for the loading-unloading stations, automatically weighs vehicles in transit, conveys loading-unloading locations to drivers, totals volumes loaded and discharged, and records statistics connected with each truck. All data is stored on perforated tape, which is processed in a computer to provide further information on performance, wages, materials handled, etc. The control method improved efficiency by 88-98%. (Cassar-FRC)
W82-02948

CONSTRUCTION OF THE DIVERSION PRESSURE TUNNEL OF THE INGURI HYDROELECTRIC STATION,

L. S. Gabuniya, and G. Ya. Zarandiya.
Hydrotechnical Construction, No 2, p 122-130, February, 1980. 4 Fig, 1 Tab. Translated from Gidroteknicheskoe Stroitel'stvo, No 2, p 9-13, February, 1980.

Descriptors: *Tunnel construction, *Hydroelectric plants, Tunnel linings, Tunneling, Concrete construction, Linings, Karst hydrology, *Inguri River, Diversion structures, Construction, Engineering, Civil engineering, *USSR.

The Inguri hydroelectric station tunnel is unique among Soviet hydraulic tunnels with respect to size and head. The diversion pressure tunnel, 15.05 km long and 9.5 m in diameter, has a head at the start of 105 m and at the end, 165 m. Design discharge is 450 cu m per sec and slope 0.0038. Two arch bridges convey metal conduits across two gorges. Construction began in 1963 and was completed in 1978. The work was slowed during the first years by 43 karst formations, inflow of subsurface waters at up to 800 liters per sec, and heavy precipitation. As work proceeded, methods and equipment were modified to improve efficiency. In strong, slightly fractured rocks, the lining was lightly reinforced concrete 0.5 m thick, with grouting of rocks to 6-10 m at a pressure of 4 MPa. Severely fractured rocks were lined with load bearing reinforced concrete 0.5-0.8 m thick with grouting of rocks to 6 m under 3.5-4MPa pressure. In crushed rocks a combined lining was used, with an outside concrete ring 0.8-1 m thick and inside steel shell 25-40 mm thick. Rock grouting was done to 3 m under 3.5 MPa. Drilling, blasting, installation of linings, and grouting are described in detail. Techniques especially useful for this project were use of a drilling frame, increased depth of shot holes, mechanized travelling concrete form units, drilling-grouting frames, and assembling the metal facing without a turnover device. (Cassar-FRC)
W82-02949

PROGRESSIVE SOLUTIONS IN THE DESIGN OF UNDER-GROUND STRUCTURES FOR THE ROGUN HYDROELECTRIC PLANT,

L. G. Osadchii, V. F. Ilyushin, and I. S. Bubman.
Hydrotechnical Construction, No 6, p 546-555, June, 1980. 5 Fig, 3 Tab, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 3-9, June, 1980.

Descriptors: *Hydroelectric plants, *Underground structures, Excavation, Design criteria, Construction, Mechanical equipment, *Tunnel construction, Sluices, Conduits, Tunnel linings, Intakes, Seepage control, Explosives.

Plans for construction of the Rogun hydroelectric plant underground complex were modified to produce a proposed savings of 30% in construction rate. The 60 km of underground structures included a powerhouse, construction tunnels, sluices, structures to protect the salt stratum, structures to protect agricultural land, and service tunnels. Some of the innovative solutions were spiral motor transport tunnels, auxiliary galleries built in connection with large span excavations, a truck fleet composed of both light and heavy duty vehicles, preliminary strengthening of disturbed rock sections, protection of the salt stratum by freezing, contour blasting, two-stage opening of vertical excavations, mechanization of mining and tunneling, and central concrete mixing plant. (Cassar-FRC)
W82-02950

CLOSURE OF THE KAMA RIVER AT THE SITE OF THE LOWER KAMA HYDROELECTRIC PLANT,

V. I. Astafichev, M. L. Neminskii, S. V. Novatorov, and K. V. Korchits.
Hydrotechnical Construction, No 4, p 351-358, April, 1980. 4 Fig, 1 Tab. Translated from Gidroteknicheskoe Stroitel'stvo, No 4, p 15-20, April, 1980.

Descriptors: *Dam construction, *Channel scour, *Hydroelectric plants, Rivers, *Kama River, *USSR, Channels, Engineering, Civil engineering.

The Kama River (500 m wide, 7-11 m deep, and 5 m sandy bottom) was closed in three stages. In the first stage the channel was stabilized with a rock lining 1 m thick, 22,800 sq m in area, and 17,700 cu m in volume. This material was dropped from dump trucks through 512 holes in the ice during the winters of 1977 and 1978. The second stage involved narrowing the channel with a pervious core composed of sand, rock and concrete blocks, with concurrent hydraulicking of the channel dam. Unusually high flows in June and October caused considerable channel scour and slides in the pervious core material. During this period average velocities were 3.4 m per sec: maximum velocity, 4 m per sec at the core. River flows attained 9170 cu meters per sec during the June flood. The trench for the hydroelectric plant was flooded October 25, 1978. Final channel closure began Oct. 17, at which time the opening was 218 meters in the downstream cofferdam, and the river flow was 5360 cu m per sec. On Oct 30 navigation was suspended and the third stage began. The closure, lasting 56 hours, proceeded from both banks at an average of 2.5 m per sec. Crest width averaged 12 m. During this period the river flow was 5000 cu m per sec, twice the design flow. To reduce flow to a reasonable limit, an upstream reservoir output was reduced. As the work progressed, it was obvious that the pervious core method was indeed the most suitable for closure in this situation. The frontal method and closure without a pervious core would have been inexpedient. (Cassar-FRC)
W82-02951

EXPERIENCE IN THE CONSTRUCTION AND FIRST YEARS OF OPERATION OF THE ZEYA DAM,

A. P. Epifanov, V. N. Vagner, V. V. Kos'ko, V. I. Sil'nitskii, and A. M. Chaika.
Hydrotechnical Construction, No 8, p 759-764, August, 1980. 3 Fig, 1 Tab, 4 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 8, p 2-5, August, 1980.

Descriptors: *Hydroelectric plants, *Dam construction, *Grouting, Construction, Buttress dams, Hydraulic structures, Concrete construction, Freezing, Temperature.

The Zeya Dam was constructed in 1970-1978 at temperatures from -2.5 to +0.4 C. Mean annual air temperature was -4.1 C, mean January temperature -30.1 C. The butress dam contains hollow sections, which limit penetration of negative temperatures into the concrete. Grouting was facilitated because the concrete quickly cooled to the desired temperatures. Reinforced concrete insulated forms prevented large differences in temperature between the core and exterior face. When the spillway was constructed in 1978, the formwork was left in place for 12-18 hours and then removed so that overdrying and cracking of the surface were minimized. Proper grouting temperatures were achieved by cooling in summer and heating in winter. A method of grouting was worked out so that a stress was maintained on the dam, forcing the support head toward the upper pool. It was found that minimum winterization, to a height of 12-15 m of the contact zone, produced a favorable stress which improved contact between the columns during cooling of the concrete. Maximum water levels were 55.2 m in 1975, 61.2 m in 1976, 69.9 m in 1977, and 76.9 m in 1978. The freeboard is 102 m. (Cassar-FRC)
W82-02952

8B. Hydraulics

SELECTING PIPELINES TO ACHIEVE EFFECTIVE ENERGY CONSERVATION,

Freese and Nichols, Fort Worth, TX.
T. A. Reid.
Water and Sewage Works, Vol 127, No 11, p 53, 54, 64, 65, 74, November, 1980. 3 Fig, 2 Tab.

Descriptors: *Cost analysis, *Pipelines, *Energy loss, *Flow friction, Hydraulics, Pipes, Pipe flow, Mathematical studies, Flow, Flow characteristics, Pressure distribution, Water distribution, Friction loss.

A mathematical expression for calculating the 'demand characteristics' of pipelines is presented to examine their energy requirements over their total lifetime. The demand characteristic concept was used to calculate a more realistic estimate of annual energy requirements for the Fort Worth Holly pressure plane and the South Side IIIs pressure plane. By assuming comparable maintenance and labor costs for the pipelines of these two pressure planes and calculating (from unit energy costs and estimated construction costs) an optimum operating flow rate for each particular pipe, the optimum average flow rates for a range of pipe diameters were compared. When the demand characteristic was increased, the magnitude of the optimum flow ranges was decreased. The cost per unit of flow at the optimum flow rate decreased as pipe diameter increased. Frictional head losses were also calculated for each annual optimum flow range. The velocity and frictional head losses associated with maximum flows for the Holly and South Side pressure planes tended to be higher than those designated as acceptable from past experience. Larger pipe diameters were recommended for more satisfactory system operation in both of the Fort Worth study areas. (Geiger-FRC)
W82-02609

THE EFFECT OF WIND ON ICE PRESSURE ON RIVER STRUCTURES,

For primary bibliographic entry see Field 2C.
W82-02668

BOUNDARY CALCULATIONS OF SLUICE AND SPILLWAY FLOWS,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
A. H. D. Cheng, J. Liggett, and P. L. F. Liu.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1163-1178, October, 1981. 10 Fig, 3 Tab, 21 Ref.

Descriptors: *Estimating equations, *Boundaries, *Spillways, *Sluices, Flows, Mathematical studies, Hydraulic structures.

The Boundary Integral equation Method (BIEM) was applied in a scheme based on a perturbation principle to provide rapid convergence of the solution to problems of sluice gates and spillways. This technique is a step towards the replacement of physical models with numerical calculations. The procedure for the solution of the sluice gate problem is outlined, and the accuracy and efficiency of the BIEM solution is compared with a recent FEM solution. The efficiency of the BIEM solution in terms of the number of iterations, number of elements, and computation time is clearly superior to the FEM for comparable accuracy. The spillway solution procedure is also outlined. The BIEM results for a standard WES spillway conform closely to the experimental curve. (Small-FRC)
W82-02677

PROSPECTS OF USING RADIAL GATES ON OVERFLOW DAMS OF LARGE HYDROELECTRIC STATIONS,

For primary bibliographic entry see Field 8A.
W82-02693

EFFECT OF WAVE SLOPE ON A ROCK MASS IN A REVETMENT,

M. E. Plakida.
Hydrotechnical construction, No 9, p 931-936, September, 1980. 1 Fig, 1 Tab, 13 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 33-36, September, 1980.

Descriptors: *Wave action, *Retaining walls, *Shore protection, Revetments, Riprap, Breakwaters, Mathematical equations, Hydraulic structures, Rock fill, Slope stabilization.

Fifteen existing formulas for calculating the mass of rock in a riprap revetment of a slope under the effect of waves were analyzed. It was concluded that the rock mass in question is directly proportional to the square root of the wavelength, other conditions being equal. Corrections to the standard equations were suggested for use with wave slopes between 10 and 25, the most commonly encountered values. The corrected equation produced 22-33% smaller estimates of the required rock masses than did the standard equations, especially in the case of short, steep waves. (Cassar-FRC)
W82-02694

IMPULSE TECHNOLOGY FOR SURFACE COMPACTION OF CONCRETE MIXES IN CONSTRUCTION OF SLOPE REVETMENTS,

A. A. Afanas'ev, A. I. Boikov, Yu. G. Trakhin, and V. I. Il'in.
Hydrotechnical Construction, No 11, p 1126-1129, November, 1980. 3 Fig, 2 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 11, p 16-18, November, 1980.

Descriptors: *Concrete technology, *Compaction, *Slope stabilization, Construction, Revetments, Impulse compaction, Retaining walls, Hydraulic structures, Mechanical equipment, Dams, Dikes.

A method for compaction of stiff concrete mixes using an impulse vibration system has saved time and improved concrete strength in construction of slope revetments. Essentially the procedure consists of transmitting energy impulses to the concrete mix from the top through a live element in the form of plates connected by elastic links. The low-frequency impulses propagated through the mix carry a large energy reserve and cause the mix to be in a state of flow and compaction. Tests showed that maximum compaction effects were reached in the frequency range 15-20 Hz for pulsation amplitudes of 3-5 mm. compaction depth for mixes with a stiffness index of 30 sec was 40-50, and for 60-90 sec stiffness, 30 cm. Examination of samples taken from an experimental concrete strip, weathered for 2 years, showed a porosity of less than 1.4% and an increase in strength of 40%. A 46.8 ton machine was developed for mechanized placement and compaction of concrete mixes on slopes of up to 1:4. This apparatus reduced labor by a factor of 8-10 and reached the required quantity of cement by 5-8%. (Cassar-FRC)
W82-02695

APPLICATION OF RELIABILITY THEORY TO HYDRAULIC ENGINEERING DESIGN,

Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
L. Duckstein, and I. Bogardi.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 799-815, July, 1981. 3 Fig, 2 Tab, 36 Ref.

Descriptors: *Hydraulics, *Floods, *Probabilistic process, *Statistical analysis, Hydraulic engineering, *Systems analysis, Rivers, Levees, Earthworks, Soil properties, Gaging stations, Peak flow, Soil mechanics, Time series analysis, Carrying capacity, Velocity, Regression models.

The safety of complex hydraulic structures, such as river dams, is analyzed using a probabilistic approach. The approach combines the work of Freudenthal with the work of Cornell and Lind. The proposed approach takes into consideration the stochastic character of flood load, the various degrees of protection along the levee, and the different modes of failure. The probability of failure in a given cross section is calculated, as well as the probability of failure of a levee reach. Both load and resistance are considered as random variables. The probability of failure is then a function of two random variables. High values calculated for the probability of levee failure are in agreement with observed values. (Titus-FRC)
W82-02699

MODELING CAVITATION FOR CLOSED CONDUIT FLOW,

Utah State Univ., Logan. Water Research Lab.
J. P. Tullis.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, HY11, p 1335-1349, 1981. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Model studies, *Cavitation, Flow, Fluid mechanics, *Closed-conduit flow, Closed systems, Hydraulics, Pipes, Scaling.

A procedure is demonstrated for modeling cavitation for closed conduit flow. A portion of a model study is presented which described the procedure for determining four cavitation limits and how to evaluate and adjust for scale effects. The item tested was a long radius elbow, but the procedure applies to any pipe component or valve used in closed conduit flow. Cavitation limits evaluated are incipient, critical, incipient damage, and choking cavitation. Scale effects associated with change in size and velocity of pressure are evaluated and used to adjust the model data to the prototype conditions. No scale effects related to changes in velocity or pressure are found for any of the four cavitation limits. Incipient and critical cavitation are found to change significantly with size of elbow. For most systems the practical design limit lies between the critical and incipient damage. As one operates beyond the value of the cavitation index, the noise and vibrations increase rapidly. This study determined that the velocities through the prototype system were sufficient to cause the elbows to operate in choking cavitation. (Baker-FRC)
W82-02700

BOUNDARY SHEAR IN SMOOTH AND ROUGH CHANNELS,

Birmingham Univ. (England). Dept. of Civil Engineering.
D. W. Knight.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY7, p 839-851, July, 1981. 11 Fig, 1 Tab, 9 Ref.

Descriptors: *Shear stress, *Channel flow, *Flumes, Flow, Boundary processes, Open-channel flow, Roughness coefficient, Hydraulics.

Equations for calculating the mean wall or bed shear stress for flows in a rectangular channel over a wide range of differential roughness and breadth to depth ratios are given. The data, derived from two previous papers, is now in a more useful form for persons involved in flume studies. It is expected that the equations, especially for smooth channel conditions, will be improved as further data becomes available. (Cassar-FRC)
W82-02711

MEASUREMENTS OF SELF-AERATED FLOW ON A SPILLWAY,

Pearson Bridge Ltd, St. Leonards. (Australia).
P. Cain, and I. R. Wood.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1425-1444, November, 1981. 16 Fig, 3 Tab, 10 Ref.

Descriptors: *Spillways, *Aeration, Dams, Bubbles, Aviemore Dam, Cavitation, Hydraulics, Channels.

Measurements were made on the spillway of a 36 meter high concrete gravity dam. Measurements taken included the point of inception, the velocity distribution and air concentration distribution, as well as bubble size in the developing region of the flow. There appeared to be a universal velocity distribution which was independent of the mean air concentration for average air concentrations of between 0 and 0.5; the air concentration becomes progressively more uniform with distance downstream. At 100 times the depth at the point of inception a significant air concentration has reached the spillway floor. It is noted that, provided the point of inception of air entrainment occurs sufficiently far downstream of the crest, a minor modification of Bauer's work gives direct design formulas. (Baker-FRC)
W82-02715

DISCHARGE CHARACTERISTICS OF TRIANGULAR-NOTCH THIN-PLATE WEIRS,

Geological Survey, Reston, VA. Water Resources Div.
J. Shen.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price: $3.75. Geological Survey Water-Supply Paper 1617-B, 1981. 45 p, 43 Fig, 3 Tab, 32 Ref.

Descriptors: *Weirs, *Hydraulics, *Flow measurement, Discharge coefficient, Natural streams, Laboratories, Mathematical studies, Triangular weirs, V-notch weirs, Streamflow.

The triangular-notch thin-plate weir is a convenient, relatively precise flow-measuring instrument frequently used to measure the flow of water in laboratories and in small streams. A comprehensive analysis of the discharge characteristics of triangular-notch weirs is presented, previously published data are analyzed in the light of the effective-head concept, and a new weir discharge formula is proposed. Coefficients are recommended, requirements for precise measurements are described, and limits of applicability are discussed. An extensive review of the literature of triangular weirs is included. (USGS)
W82-02842

INSTRUMENTATION FOR AERATED FLOW ON SPILLWAYS,

Ministry of Energy, Wellington (New Zealand).
For primary bibliographic entry see Field 7B.
W82-02880

COEFFICIENT OF FRICTION IN CONDUITS WITH LARGE ROUGHNESS,
Hawksley (Watson), High Wycombe (England).
R. Pyle, and P. Novak.
Journal of Hydraulic Research, Vol 19, No 2, p 119-140, 1981. 16 fig, 1 Tab, 18 Ref.

Descriptors: *Friction loss, *Conduits, *Roughness coefficient, Drag, Head loss, Model studies, Mathematical models, Hydraulics, Channel flow.

A mathematical model is presented for computing the friction coefficient of a conduit with roughness elements of any size or shape. No further hydraulic experiments are required to use this method, which is based on coefficient of drag. To gather reference data three conduits with different types of roughness elements (single size spheres, 16.5 mm diameter; single size hemispheres, 33 mm diameter; and natural river stones up to 150 mm) were used. A total of 13 element concentrations were included. A further modification of the model enabled computation of the friction coefficient for the above element shapes as well as for cylinders or prisms of varying sizes and testing on top of each other. The friction coefficient of natural river stones was greater than that obtained from a series of cylinders and less than that obtained from a series of prisms. (Cassar-FRC)
W82-02901

DISTRIBUTION OF WASTEWATER IN DRAIN FIELD PIPES,
Cowiconsult, Virum (Denmark).
R. Wiuff.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 1009-1024, October, 1981. 19 Fig, 1 Tab, 7 Ref.

Descriptors: *Septic tanks, *Drainage engineering, *Wastewater disposal, Percolation, Pipe flow, Hydraulics, Sanitary engineering.

The outflow from a septic tank drain field pipe, fitted with evenly spaced circular holes along the bottom, was analyzed for steady flow conditions and unsteady flow conditions produced by lavatory flushes or bath water disposal. Experiments were carried out on a pipe 10 meters long, 0.094 m diameter, with 18 evenly spaced holes 0.011 m in diameter, and slope up to 2.5%. Under steady flow with maximum discharge and maximum slope, only the first 15 holes discharged. A drain field was designed to accomodate a 210 liter per person per day wastewater system. At a slope of 1% and a pipe length of 12 meters, it was calculated that even spacing of 28 drain holes in the pipe would cause most of the water to drain out within the first 3 or 4 meters. A more even distribution of water would be obtained with 3 holes in the first third, 6 holes in the second third, and 19 holes in the last third. This arrangement would eliminate the need for pumps and siphons. (Cassar-FRC)
W82-02945

8C. Hydraulic Machinery

NEW JET-GATE DESIGN,
I. E. Mikhailov, and V. I. Bobrov.
Hydrotechnical Construction, No 6, p 571-574, June, 1980. 3 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 19-21, June, 1980.

Descriptors: *Flow regulators, *Energy dissipation, *Hydraulic gates, Hydroelectric plants, Flow characteristics, Flow control, Flow discharge, *Gates, Hydraulic structures, High pressure gates, Jet gates, Mixing, Nozzles, Fluid mechanics, Regulated flow, Sluice gates, Construction engineering, Design criteria.

The high head, high capacity jet regulating gate was evaluated in a laboratory model. This type of gate operates at heads of 300 m and greater and dissipates excess energy in the discharge by impacting the jets together in the flow merging chamber. Flow regulation can be accomplished by adjusting the position of the nozzles. Installation of jet gates can substantially reduce costs of hydroelectric plant construction. A model with a cylindrical flow merging chamber, 240 mm in diameter and 250 mm in length, was fitted with 2 nozzles. The two series of runs were done with nozzles wither 30 mm or 40 mm in diameter. Heads ranged from 4 to 200 m, outflows from 2 to 10 m. A family of curves was developed to describe the flow characteristics at each nozzle diameter with different heads and relative gate openings. Smooth flow regulation was obtained at relative gate openings < or = 1.2-1.4. Further increases in gate openings did not change the flow. Gate capacity was not affected by variations in outflow within the range 2-10 m under constant head. Almost all the excess energy of the discharge (> 99%) was dissipated in the flow merging chamber. (Cassar-FRC)
W82-02691

THE CONE PUMP,
Weir Pumps Ltd., Glasgow (Scotland).
M. Ryall.
Water Services, Vol 85, No 1026, p 394-396, August, 1981.

Descriptors: *Pumps, *Design criteria, Wastewater treatment, Drainage.

A new type of pump is described which is useful for a wide range of low head duties, particularly in land drainage and handling and treatment of sewage. The pump was designed to consider several needs, including minimizing hydraulic friction losses, avoidance of excessive immersion levels in the suction sump at maximum flow, achievement of stable self-regulating flow, reduction of overall diameter to minimize construction cost, simplification of component shapes to reduce tooling costs, pumping of liquids containing solids, and making powder consumption as closely proportional to flow as possible. The pump design is based on the concept of centrifugal force acting on a liquid, which cannot escape in any direction but upwards. The Cone pump performs its required duties reliably over a range of heads and flows similar to the commonly used screw pumps and is lighter, more compact and easier to install. (Baker-FRC)
W82-02713

8D. Soil Mechanics

RATIONAL DIMENSIONS OF AN EARTH BLANKET AND ITS SEEPAGE CALCULATION,
For primary bibliographic entry see Field 8A.
W82-02666

CALCULATION OF THE STRENGTH OF RIGID DIAPHRAGMS IN EARTH DAMS,
P. D. Evdokimov.
Hydrotechnical Construction, No 3, p 263-267, March, 1980. 2 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 31-33, March, 1980.

Descriptors: *Earth dams, *Dam stability, *Friction, Strength, Mathematical studies, Estimating equations.

The effect of the earth's frictional forces on the diaphragm surface of earth dams was calculated. All of the normal and tangential forces that act on the diaphragm surface were considered. The first case considered was the horizontal reaction in the foot of the diaphragm, which is less than or equal to the frictional force where the foot is not displaced. The second case considered the horizontal reaction in the foot of the diaphragm when the foot is displaced. In both cases, the frictional forces of the earth on the diaphragm reduced the horizontal reaction of the earth of the downstream shoulder. There was resistance to the horizontal displacement of the diaphragm toward the downstream shoulder of the dam. This increases the stability of the downstream slope of the dam and improves the state of stress of the diaphragm. (Small-FRC)
W82-02667

CALCULATION OF FOUNDATIONS AND EARTH DAMS,
P. D. Evdokimov.
Hydrotechnical Construction, No 4, p 395-398, April, 1980. 4 Fig, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 4, p 41-43, April, 1980.

Descriptors: *Dam stability, *Earth pressure, Soil mechanics, Shear stress, *Earth dams, Clays, Deformation, Pressure distribution.

The forces acting on an earth-rock dam with a clay core are analyzed for three situations: completely stabilized, incompletely stabilized, and completely unstabilized. The resulting diagrams of earth pressure of the downstream shoulder can be used to construct the diagram of moment over the height of the core and the diagram of shearing forces. From these the stressed state of the core can be determined from the equation of nonuniform compression. The degree of stability of the dam can be obtained from the earth pressure of the downstream shoulder and the passive earth pressure of the downstream shoulder. (Cassar-FRC)
W82-02689

COMPUTING THE SETTLEMENT OF THIN ANTISEEPAGE WALLS FORMED FROM CLAYEY SOILS,
V. P. Nedriga, A. M. Gladilin, and I. P. Chernyi.
Hydrotechnical Construction, No 1, p 29-32, January, 1980. 1 Fig, 3 Ref. Tranalated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 17-19, January, 1980.

Descriptors: *Seepage control, *Clays, Soil mechanics, Hydraulic structures, Dams, Mathematical equations.

Expressions are developed to calculate the settlement of fluid clay in an antiseepage wall built within a dam or other hydraulic structures. Settlement in the upper boundary area results from the lateral outflow of filtrate through the edge of the curtain. The properties of the clay material used for filler and of the soil surrounding the structure significantly affected the amount of settlement. The mathematical equation was used on a clay wall 10 m high and 0.15 m thick, with other specified parameters (density of clay, porosity of clay, coefficient of friction between clay and the edge of the curtain, etc.). The computed height after settlement was 9.13 m, or about 9%. This agreed with observations reported in the literature. (Cassar-FRC)
W82-02692

SLOPE FAILURES AND TAILING DAM DAMAGE IN THE 1978 IZU-OHSHIMA-KINKAI EARTHQUAKE,
Tokai Univ., Shizouka (Japan). Faculty of Marine Science and Technology.
S. Okusa, and S. Anma.
Engineering Geology, Vol 16, No 3/4, p 195-224, November, 1980. 24 Fig, 7 Tab, 15 Ref.

Descriptors: *Earthquake engineering, *Slope stability, *Dam failure, *Earthquakes, Landslides, Avalanches, Hazards, *Japan, Izu-Ohshima-Kinkai earthquake.

The general characteristics are described of the failures of natural slopes and embankments which occurred during the Izu-Ohshima-Kinkai earthquake (7.0 on the Richter scale, January 14, 1978). Most of the hazards caused by the quake related to the slope failures of sea cliffs, river cliffs, and road cuttings of convex vertical section with the upper parts sloping gently and the lower parts sloping steeply. Large slope failures occurred close to the activated faults. Damage to high concrete retaining walls was due to insufficient bearing capacity of the foundation soil. Buildings in the meizoseismal zone were damaged due to sliding of the underlying embankments and ground displacement due to the activated faults. Deaths and injuries were caused by falling rock blocks and sliding soil masses which struck homes and cars at the foot of steep slopes. Heavy rain may cause secondary failures, rockfalls, and avalanches due to tension

cracks in the middle and upper part of steep slopes. (Small-FRC)
W82-02891

8E. Rock Mechanics and Geology

OUTFLOW OF VOLCANIC ROCK AND GAS DURING OPENING OF THE ARPA-SEVAN TUNNEL,
For primary bibliographic entry see Field 2A.
W82-02772

GEOTECHNICAL INVESTIGATIONS AT THE KALYANI DAM SITE, CHITTOOR DISTRICT, ANDHRA-PRADESH INDIA,
National Geophysical Research Inst., Hyderabad (India).
S. Balakrishna, B. Venkatanarayana, and Y. V. Ramana.
Engineering Geology, Vol 15, No 3/4, p 205-222, March, 1980. 6 Fig, 4 Tab, 14 Ref.

Descriptors: *Dam design, *Rock properties, *Foundation rocks, Dam construction, *Kalyani Dam, *India, Grouting, Rock mechanics, Tectonics.

The Kalyani Dam site, India, required extensive geophysical studies because it is in a tectonically distured region. Several fault and shear zones are present. There were significant differences between the sheared rocks and the undisturbed samples. The sheared rocks had high porosity and elastic anisotropy; low values for density, elastic wave velocity, elastic moduli, and fracture strength; and high absorption. The undisturbed samples showed the reverse characteristics. Shear zone samples also varied in compressional velocity and amplitude, signs of compressive stress. These studies identified the sound and weak rock formations and aided in economical siting of the dam, in proper design (deepening the foundation in fault zones, for example), and in planning the grouting. (Cassar-FRC)
W82-02890

8G. Materials

GALVANIZED PIPE VIES FOR EQUAL ALTERNATIVE STATUS IN STORM SEWER PROJECTS.
Water and Pollution Control, Vol 118, No 7, p 16-17, 1980.

Descriptors: *Pipes, *Storm sewers, Sewers, Construction materials, Galvanized steel, *British Columbia.

Corrugated steel pipe has been used over 8 or 9 years as an alternative for concrete storm sewers. With the successes of the past in mind, it was suggested that Prince George City, British Columbia, could benefit by the use of a second system of corrugated steel sewer pipe. Two critical objections have been raised: optimum water capacity and durability. A formula has been devised that takes into account the hydraulics of smooth bore pipe. To meet the need for maximum capacity, the Hel-Cor Smooth-Flo pipe is prepared with a full circumferential lining of asphalt spun on at high speed in the manufacturing process. The result is a Manning 'n' factor of 0.012. While severe frosts have rippled some sections of pipe over the last few years, other sections are in mint condition. Corrugated steel pipe is now required for catch basin leads because steel will not shatter when blasted with steam to thaw frozen catch basin leads and does not crack under the stress of expansion during freezing. Corrugated steel pipe has a built-in flexibility through the use of 0-ring gaskets and hugger-band joints. Rubber gaskets were used to limit infiltration in this particular project, as the water table north of Prince George is particularly high, and the storm system is needed to direct water during the spring runoff to the Nechako River. Corrugated steel pipe weighs about one tenth as much as comparable concrete pipe. It is flexible and has high compressive strength. (Baker-FRC)
W82-02601

IMPROVEMENT OF THE SEALS OF EXPANSION JOINTS OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8A.
W82-02669

USE OF CRACK-RESISTANT LININGS OF HYDRAULIC TUNNELS WITH CONSOLIDATION GROUTING OF THE ROCK,
For primary bibliographic entry see Field 8A.
W82-02670

BITUMINOUS CONCRETE ANTISEEPAGE CURTAIN FOR CONCRETE DAMS,
For primary bibliographic entry see Field 8A.
W82-02690

SCROLL CASINGS OF STEEL AND REINFORCED-CONCRETE CONSTRUCTION,
A. N. Mordovina.
Hydrotechnical Construction, No 3, p 245-251, March, 1980. 4 Fig, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 3, p 21-25, March, 1980.

Descriptors: *Casings, *Hydroelectric plants, *Concrete construction, Scroll casings, Steel, Reinforced concrete, Water conveyance, Conduits, *Materials engineering, *USSR.

A combined steel and reinforced concrete scroll casing for hydraulic stations was the most reliable construction of several models tested--steel with ribs, cast metal, banded constructions, reinforced concrete prestressed in an annular meridional direction, and precast monolithic concrete reinforced by prestressed bars. The steel-reinforced concrete construction consisted of a scroll-shaped metal shell imbedded in a reinforced concrete block. The steel and concrete interact elastically to reduce stress on the metal. The stresses were 186 MPa, compared with 560 MPa in the all-metal scroll casing. Scroll casings using this type of construction have been intalled at the Nurek hydrostation, and similar casings are being installed in the Inguri, Sayano-Shushenskoe, and Rogun plants. (Cassar-FRC)
W82-02784

STRESS RELAXATION IN CONCRETE OF MASSIVE HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8A.
W82-02786

VINYL LINED ASBESTOS CEMENT PIPE PROBLEMS, OPERATOR ASPECTS,
Champlain Water District, South Burlington, VT.
For primary bibliographic entry see Field 5B.
W82-02898

DESIGN AND DEVELOPMENT OF AN AUTOMATED HYDROSTATIC FLEXIBLE MEMBRANE TEST FACILITY,
Water and Power Resources Services, Denver, CO. Engineering and Research Center.
R. K. Frobel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-210809, Price codes: A03 in paper copy, A01 in microfiche. Report REC-ERC-80-9, January, 1981. 28 p, 12 Fig, 1 Tab, 2 Ref, 2 Append.

Descriptors: *Linings, *Membranes, *Testing procedures, *Materials testings, Automation, Computers, *Hydrostatic pressure, Polymers.

An automated hydrostatic test facility was designed and fabricated for testing flexible membrane liners over variable subgrade conditions. The test facility is composed of pressure vessels which are controlled and monitored by a computer. Selected flexible membranes are placed over subgrades in the vessels, the vessels are charge with water, and hydrostatic head is varied using air pressure. The equipment is versatile, easy to use, and adaptable to future research on other hydraulic barrier materials, geotechnical fabrics, or soils. Preliminary testing of a 0.25 mm polyvinyl chloride lining material on the hydrostatic test facility showed that the equipment functioned as designed. The test results indicate that failures, pressures, and time to failure were reasonably reproducible from test to test over the same type of subgrade. Failures over the roughest subgrade occurred in a depression between large aggregates, whereas failure over the finer subgrades occurred predominantly over small sharp aggregate. (Moore-SRC)
W82-02978

8H. Rapid Excavation

APPLICABILITY AND DESIGN CRITERIA OF A BLASTING METHOD FOR CONSTRUCTING DEEP-CUT SECTIONS OF A CANAL FOR TRANSFERRING PART OF THE FLOW OF SIBERIAN RIVERS,
A. E. Azarkovich, and P. P. Chatalbashev.
Hydrotechnical Construction, No 1, p 6-11, January, 1980. 2 Fig, 2 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 5-8, January, 1980.

Descriptors: *Explosives, *Excavation, *Canal construction, *Siberia, Water transfer, Hydraulic structures, Diversion structures, Design criteria, Soil engineering, Water conveyance.

The sidecasting blast technique is discussed as a method of soil excavation for deep cut sections of a proposed 2273 km water transfer canal in Siberia. Explosives are set in trenches to excavate non-rock material. The method is not applicable in saturated soils with high groundwater tables and in quicksand-type soils. Two alternatives are described: first, a design canal depth 15% greater than when using earth excavation techniques, with bank trimming over the whole bank height (including below the water level); and second, a design cross-section of excavation below the given water level with bank trimming above the canal water level. This blasting method is considered for 279 km of deep cut sections, amounting to 12% of the total length and 800 million cu m (25% of the total excavation volume). Total explosive requirements (ammonium nitrate-diesel fuel) are 2-3 million tons over a 6 year period. The second alternative as compared with earth excavation without blasting would reduce capital and labor by 50%, length of construction by 2 years, adjusted expenditure by 17%, and the need for earth moving equipment. However, blasting on this large scale has not been attempted to date. (Cassar-FRC)
W82-02783

EXPERIENCE WITH AND THE EFFECTIVENESS OF AUTOMATIC SYSTEMS FOR CONTROL OF LOADING-HAULING OPERATIONS DURING CONSTRUCTION OF THE DAM FOR NUREK HYDROELECTRIC PLANT,
For primary bibliographic entry see Field 8A.
W82-02948

8I. Fisheries Engineering

PP AND L USES DISCHARGE WATER FOR FISH FARMING.
For primary bibliographic entry see Field 3C.
W82-02645

USE OF FISH LARVA MORPHOMETRY TO PREDICT EXCLUSION CAPABILITIES OF SMALL-MESH SCREENS AT COOLING-WATER INTAKES,
Michigan Univ., Ann Arbor. Inst. of Science and Technology.
P. J. Schneeberger, and D. J. Jude.
Transactions of the American Fisheries Society, Vol 110, No 2, p 246-252, March, 1981. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Entrainment, *Mathematical studies, *Screens, *Intakes, Powerplants, Cooling water, *Fish eggs, Regression analysis, Fishkill, *Fish barriers.

Water used for cooling powerplants often contains large numbers of fish larvae that may sometimes be saved by small mesh screens over intake systems. A relationship between total length and body depth and width of fish larvae was used to calculate the efficiency of small-mesh screens in preventing the entrainment of fish larvae at cooling water intakes of powerplants. Regression analyses were used to calculate total lengths of larvae corresponding to body depths of 0.5, 1.0 and 2.0 mm for each species. These lengths were then compared to cumulative length frequencies for the most commonly entrained larvae at the Campbell Powerplant on Lake Michigan in 1978. Results showed that 35-100% (depending on species) of the larvae during this year would not have been entrained if 0.5-mm mesh screening had been used instead of the 9.5-mm bar mesh vertical traveling screens that were used at the intake system. These figures do not consider approach velocities of the intake water, avoidance behavior of larvae or mortality of impinged or extruded larvae. (Geiger-FRC)
W82-02687

EFFECTS OF HYDROLOGICAL AND BIOLOGICAL VARIABLES ON THE SURVIVAL, GROWTH, AND FOOD UTILIZATION OF ESTUARINE FISHES CAGE-CULTURED IN A HEATED WATER SYSTEM,

Texas A and M University, College Station.
For primary bibliographic entry see Field 5C.
W82-02730

FISH MOVEMENT UPSTREAM THROUGH A CENTRAL QUEENSLAND (FITZROY RIVER) COASTAL FISHWAY,

Capricornia Inst. of Advanced Education, Rockhampton (Australia). Dept. of Biology.
J. Kowarsky, and A. H. Ross.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 93-109, 1981. 9 Fig, 4 Tab, 27 Ref.

Descriptors: *Fish passages, *Tidal rivers, *Water level, Dams, Fish barriers, Barriers, *Fitzroy River, Rockhampton, *Australia, Weirs, Rivers, Tailwater, Headwater control, Saline water barriers, Estuaries.

The present fishway at the Fitzroy River barrage, Rockhampton, Australia, did not permit free passage of fish swimming upstream during the sampling period, August 1978 to October 1979. Fish were monitored with a V-trap located above the highest weir in the series of 15 weirs and pools, which form an L-shaped passage. Sixteen species of fish over a wide size range were caught. Species diversity was greatest in summer. Numbers, sizes, and species of fish were affected by tailwater level (peak catches at high tide peak), headwater level, and velocity of the water. Fish accumulated below open barrage gates. Two alternate ways of passing the barrage--via the occasionally inundated flood plain or under open barrage gates-- were not believed feasible. Suggested structural changes were: (1) replacement of the pool and weir design with submerged orifice or vertical slot arrangements, (2) modification of the entrance configuration, (3) installation of telescoping wiers above the fishing exit, (4) extension of the fishway length, and (5) changes in operating policies to account for known effects of tailwater and headwater levels and seasonal variation in species and abundance. (Cassar-FRC)
W82-02800

URBAN AQUACULTURE OF THE RAINBOW TROUT (SALMO GAIRDNERI),

District of Columbia Univ., Washington. Dept. of Environmental Science.
A. J. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168576, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center, University of the District of Columbia, Report No 29, September, 1981. 15 p, 3 Fig, 4 Tab, 10 Ref. OWRT-A-007-DC(1). 14-34-001-9009.

Descriptors: *Aquaculture, *Recycling, Closed water systems, Aquaria, *Trout, *Fish farming, Temperature effects, Fish food, Vitamins, Amino acids, Rainbow trout, Closed systems.

The raising of the rainbow trout (Salmo gairdneri) in a closed recycling water system in an urban environment is described. Germ-free fingerling trout were raised on a controlled diet over a period of nine (9) months in specially constructed, refrigerated aquaria maintained at 10C and 15C. The results show that this trout adapts well to the environment provided for it and increases in weight and length comparable to or at a more accelerated rate than those raised by conventional fish-farming methods. Rainbow trout raised at 10C have a somewhat slower rate of growth than those raised at 15C. Oxygen concentrations, temperature, and bacterial counts were constantly monitored. This process, with slight modifications, could be used to launch a commercial venture in the urban aquculture of the rainbow trout.
W82-02812

THE SCHOOLING MECHANISM OF YOUNG PERCH (PERCA FLUVIATILIS) IN THE OPEN PART OF LAKE-TYPE RESERVOIRS (AS EXEMPLIFIED BY RYBINSK RESERVOIR),

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
For primary bibliographic entry see Field 2H.
W82-02954

WATER QUALITY OF THE PROPOSED NORDEN RESERVOIR, NEBRASKA, AND ITS IMPLICATIONS FOR FISHERY MANAGEMENT,

Bureau of Reclamation, Denver, CO. Lower Missouri Region.
For primary bibliographic entry see Field 6G.
W82-02983

RESULTS OF FISHERIES INVESTIGATIONS AT TWIN LAKES, COLORADO; 1973-76,

Colorado Div. of Wildlife, Fort Collins. Research Center.
For primary bibliographic entry see Field 6G.
W82-02984

SUBJECT INDEX

ACID RAIN
Rainwater Acidity Measurement Problems,
W82-02627 5A

The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 5B

Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 5C

The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 5C

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

ACIDIC WATER
Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 5C

ACOUSTICS
Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 2L

ACTIVATED ALUMINA
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 5F

ACTIVATED CARBON
Application of Adsorption to Wastewater Treatment,
W82-02622 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 5D

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 5D

Practical Experiences in Plants Using Activated Carbon,
W82-02788 5F

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

ACTIVATED SLUDGE
The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 5D

ACTIVATED SLUDGE PROCESS
Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 5D

Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 5D

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme.
W82-02872 5D

ADIRONDACK MOUNTAINS
Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 5C

ADSORBENTS
Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 5D

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

ADSORPTION
Application of Adsorption to Wastewater Treatment,
W82-02622 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 5D

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 5F

AEGEAN SEA
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 5C

AERATION
Measurements of Self-Aerated Flow on a Spillway,
W82-02715 8B

Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1B

Wind Aeration in Model Waste Treatment System,
W82-02944 5D

AFRICA
Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 2H

AGRICULTURAL ENGINEERING
Modeling Rill Density,
W82-02604 2J

AGRICULTURAL RUNOFF
Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 5G

AGRICULTURE
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 3C

ALABAMA
Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

ALASKA
Water Resources Data for Alaska, Water Year 1980.
W82-02845 7C

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 6D

ALGAE
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 2C

Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 5B

On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 2H

Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 5C

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

ALGAL CONTROL
The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 5F

ALGAL GROWTH
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 2H

ALGORITHMS
Computerized Control of an Open-Channel Water Distribution System,
W82-02732 4A

ALLUVIAL CHANNELS
River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 2E

ALPINE REGIONS
Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 2H

ALTERATION OF FLOW
Local Flow Accelerations in Rivers,
W82-02758 2E

ALTITUDE
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

ALUMINUM OXIDE
Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

AMMONIA
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 2H

AMPHIPODS
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 2H

AMVRAKIA LAKE
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 2H

ANAEROBIC CONDITIONS
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

ANAEROBIC DIGESTION
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 5D

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 5D

ANDROSCOGGIN RIVER
Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

ANNUAL DISTRIBUTION
Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 2E

ANTARCTIC
The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 2H

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 2C

AQUACULTURE
Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 5D

PP and L Uses Discharge Water for Fish Farming,
W82-02645 3C

Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 5C

Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 8I

AQUATIC INSECTS
How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 7A

AQUATIC LIFE
The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 5C

AQUATIC PLANTS
Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 5B

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

AQUATIC POPULATIONS
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H

AQUATIC VEGETATION
The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 2H

AQUATIC WEED CONTROL
The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 5F

AQUIFER
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

AQUIFER CHARACTERISTICS
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 2F

Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 2F

Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 2F

A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 2F

Preparation of Friable Aquiferous Specimens,
W82-02955 2F

AQUIFER CHARCTERISTICS
Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 2F

AQUIFER MANAGEMENT
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

AQUIFER PROPERTIES
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

AQUIFER SYSTEMS
Atoll Island Hydrology,
W82-02617 2F

AQUIFER TESTING
A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 2F

AQUIFERS
Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 2F

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 2F

ARCTIC ZONE
Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 2C

ARGENTINA
Argentina's Hydroelectric-Based Energy Plan,
W82-02794 8A

ARKANSAS
Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

AROMATIC COMPOUNDS
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 5B

ARSENIC
Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 5A

Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 5F

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

ARSENIC COMPOUNDS
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

ASBESTOS
Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 5A
Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 5B

ASPHALTIC CONCRETE
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 8A

ASSIMILATIVE CAPACITY
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 2L

ATOLLS
Atoll Island Hydrology,
W82-02617 2F

AUSTRALIA
Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 3F
South Australia's Approach to Salinity Management in the River Murray,
W82-02761 5G
The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 4C
The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 4D
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 2K
Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 2F
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 2L

AUTOMATION
A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 7B

AVAILABLE WATER
Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

BACTERIA
The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 5A
Distribution of Chromobacteria in a Lowland River,
W82-02795 5C
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 5E
Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 5F
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 5B
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 7B
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

BACTERIAL PHYSIOLOGY
Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 5F

BACTERICIDES
Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 5D
New Antimicrobial Agents for Treatment of Water,
W82-02808 5F

BALDWIN LAKE
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 2H

BARRIER ISLANDS
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H

BASE FLOW
Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 2E

BED LOAD
Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 2J
Bed Load Discharge Coefficient,
W82-02936 2J

BELGIUM
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 2H

BENTHIC FAUNA
The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 5C
Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

BENTHIC FLORA
The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 2H

BENTHOS
The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 2H
The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 5C
On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 2H
Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 2H

BIG SIOUX AQUIFER
Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 2F

BIOASSAY
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

BIOCHEMICAL OXYGEN DEMAND
To Inhibit or Not to Inhibit: That is The Question,
W82-02672 5A
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D
Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 5B

BIODEGRADATION
Treatment Plant Features Ultraviolet Disinfection,
W82-02644 5D
Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 5D

BIOLOGICAL TREATMENT
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 5D

BIOMASS
Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 2H
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

BLEACHING WASTES
Field Report on a Nonpolluting Bleach Plant,
W82-02793 5D
Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 5D

BOGS
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 2H

BOISE
Boise Looks Underground for Heat,
W82-02636 2F

BOTTOM SEDIMENTS
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

BOUNDARIES
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

BRIDGE DESIGN
Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 8A

BRIDGES
Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 8A

BRITISH COLUMBIA
Galvanized Pipe Vies for Equal Alternative Status in Storm Sewer Projects.
W82-02601 8G

Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 2E

BROMIDES
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

BURLINGTON
Restoring an Antique Water System.
W82-02685 5F

CADMIUM
Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 5D

CALCIUM SULFATE
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 2F

CANADA
Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 6G

CANAL CONSTRUCTION
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 8H

CANOPY
Vertical Variation in Stemflow Generation,
W82-02959 2I

CAPE FEAR RIVER ESTUARY
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

CARBON
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 5D

CARBON DIOXIDE
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 2L

CARCINOGENS
Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 5D

Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 5B

CASINGS
Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 8G

CATFISH
PP and L Uses Discharge Water for Fish Farming.
W82-02645 3C

CATTLE
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 3F

CAVITATION
Modeling Cavitation for Closed Conduit Flow,
W82-02700 8B

CAZENOVIA CREEK
A Solution to Spring Ice-Jam Flooding,
W82-02908 2C

CELLULOSE ACETATE MEMBRANES
Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 3A

CENTRIFUGATION
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 5E

CHANNEL FLOW
Boundary Shear in Smooth and Rough Channels,
W82-02711 8B

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 2J

CHANNEL SCOUR
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

CHEMICAL ANALYSIS
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

CHEMICAL COAGULATION
Chemical Coagulation of Surface Water,
W82-02623 5F

CHEMICAL COMPOSITION
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 2H

Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 2H

CHEMICAL PROPERTIES
Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 5B

CHEMICAL REACTIONS
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 2K

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 5B

CHESAPEAKE BAY
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 5B

Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 2L

CHICAGO
A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 5F

CHLORINATED HYDROCARBONS
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 5F

CHLORINATION
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

CHLORINE
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 5F

CHLORINE DIOXIDE
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

CHLOROFORM
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

CHLOROPHYLL
Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L

CHLOROPHYLL A
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 5C

CHOWAN RIVER
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 5B

CHROMATES
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 5D

CHURCHILL COUNTY
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

CIRCULATION
Modeling Circulation in Depth-Averaged Flow,
W82-02679 2E

CLAYS
Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 8D

CLEVELAND BAY
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 2L

CLOSED-CONDUIT FLOW
Modeling Cavitation for Closed Conduit Flow,
W82-02700 8B

COAGULANTS
Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 5D

COAGULATION
Chemical Coagulation of Surface Water,
W82-02623 5F

A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 5F

COAL GASIFICATION
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 5B

A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 5C

COAL MINING
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

COASTAL STREAMS
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 5B

COASTAL WATERS
Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 6E

On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 5G

COASTAL ZONE MANAGEMENT
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 5G

COHESIVE SOILS
Erosion Resistance of Cohesive Soils,
W82-02676 2J

COLIFORMS
Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 5D

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 5A

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 5D

COLOR REMOVAL
Field Report on a Nonpolluting Bleach Plant,
W82-02793 5D

COLORADO
Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

COLORADO RIVER
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 6B

COMPACTION
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 8B

COMPARISON STUDIES
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

COMPUTER MODELS
Urban Catchment Models: A Brief Examination,
W82-02813 4C

Computer Modeling of Flood Alleviation Benefits,
W82-02957 6B

Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 7B

COMPUTERS
Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 6B

CONCRETE
On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 8A

CONCRETE CONSTRUCTION
Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 8G

CONCRETE TECHNOLOGY
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 8B

Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 8A

CONCRETES
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

CONDUCTION
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 2F

CONDUITS
Coefficient of Friction in Conduits with Large Roughness,
W82-02901 8B

CONFINED AQUIFERS
Ground-Water Recharge from Rectangular Areas,
W82-02791 2F

CONSTRUCTION
Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 8A

Engineering Responds to Ecology,
W82-02935 5D

Digest of Water Resources Policies and Authorities.
W82-02973 6E

CONSTRUCTION JOINTS
Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 8A

CONTROL SYSTEMS
Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 4B

A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 7B

Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 6B

CONVECTION
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 2F

COOLING PONDS
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 2H

COOLING WATER
Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 3E

Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 5C

COPEPODS
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

CORRELATION ANALYSIS
Space-Time Variability of the Runoff of European Rivers,
W82-02848 2E

COST ALLOCATION
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

COST ANALYSIS
Energy Management in the Water Works Industry,
W82-02608 5F

Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 8B

Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 6C

Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 5D

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 5D

Protein Recovery from Beef Packing Effluent,
W82-02994 5D

COST-BENEFIT ANALYSIS
Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 6G

Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 6B

West Sacramento Canal Unit Reformulation.
W82-02974 6B

COSTS
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 5D

CROP YIELD
Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 3F

Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 3F

CRUSTACEANS
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

CYCLING NUTRIENTS
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

CYCLOPS
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

DAILY HYDROGRAPHS
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 2C

DAM CONSTRUCTION
Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 8A

Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

DAM DESIGN
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 8A

Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 8A

Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

DAM FAILURE
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

DAM STABILITY
Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 8D

Calculation of Foundations and Earth Dams,
W82-02689 8D

DAMS
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 4D

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 8A

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

DANUBE ESTUARY
Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 2L

DECHLORINATION
Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 5C

DECISION MAKING
Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 6B

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 6B

DECOMPOSITION
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 5C

DELAWARE
A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 5B

DELTAS
An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 6D

DEMINERALIZATION
Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 5D

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

DENMARK
Practical Experiences in Plants Using Activated Carbon,
W82-02788 5F

DENUDATION
Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 2J

DESALINATION
Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 3A

DESIGN CRITERIA
Fundamental Concepts of Well Design,
W82-02614 8A

The Cone Pump,
W82-02713 8C

Evaluating a Plant's Potential for Upgrading,
W82-02895 5F

DETECTION LIMITS
Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 5A

DETRITUS
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 4D

DEVELOPING COUNTRIES
The Development of a Village Water Supply System on Truk,
W82-02816 5F

DEWATERING
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 5E

DIATOMS
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H

Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 2H

DISCHARGE COEFFICIENT
Bed Load Discharge Coefficient,
W82-02936 2J

DISCHARGE HYDROGRAPHS
Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02935 7B

DISINFECTANTS
New Antimicrobial Agents for Treatment of Water,
W82-02808 5F

DISINFECTION
Treatment Plant Features Ultraviolet Disinfection,
W82-02644 5D

Ozone Water Treatment,
W82-02682 5F

Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 5D

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 5D

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

DISSOLVED OXYGEN
Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 5B

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

DISSOLVED SOLIDS
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 2H

DISTILLATION
Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 3A

DISTRIBUTION COEFFICIENT
Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 5B

DISTRICT OF COLUMBIA
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 5D

DIVERSION STRUCTURES
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 8A

DRAG
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1B

DRAINAGE
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 3C

DRAINAGE AREA
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 2C

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

DRAINAGE ENGINEERING
Distribution of Wastewater in Drain Field Pipes,
W82-02945 8B

DREDGING
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

DRINKING WATER
Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 5A

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 5B

DROUGHT
Stochastic Hydrologic Model for Drought Management,
W82-02897 2E

EARTH DAMS
Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 8D

Calculation of Foundations and Earth Dams,
W82-02689 8D

EARTH PRESSURE
Calculation of Foundations and Earth Dams,
W82-02689 8D

EARTHQUAKE ENGINEERING
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

EARTHQUAKES
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

EARTHWORKS
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 8A

ECOLOGICAL EFFECTS
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 2H

The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 5F

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

ECOLOGY
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

ECONOMIC ASPECTS
The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 6A

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 6D

An Economic Analysis of Ground Water Management Alternatives,
W82-02740 4B

Computer Modeling of Flood Alleviation Benefits,
W82-02957 6B

Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

ECONOMIC EVALUATION
Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 6A

ECOSYSTEMS
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 5B

EDDY DIFFUSION
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

EFFLUENT
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

EFFLUENTS
Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 5E

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

EGGPLANTS
Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 3F

EGYPT
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

ELECTRIC POWER COSTS
Energy Management in the Water Works Industry,
W82-02608 5F

ELECTRICAL EQUIPMENT
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 2G

ELECTRICAL NETWORKS
Argentina's Hydroelectric-Based Energy Plan,
W82-02794 8A

ELECTROCHEMISTRY
Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1B

ELECTRODIALYSIS
Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 5D

ELEVATION
Tides and Tidal Datums in the United States,
W82-02982 2A

ENERGY DISSIPATION
New Jet-Gate Design,
W82-02691 8C

ENERGY LOSS
Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 8B

ENERGY STORAGE
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

ENGINEERING
Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 2J

ENGLAND
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

Distribution of Chromobacteria in a Lowland River,
W82-02795 5C

ENTRAINMENT
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

ENVIRONMENTAL EFFECTS
The Environmental Effects of Hydroelectric Projects,
W82-02632 6G

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 6G

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

EROSION
Erosion Resistance of Cohesive Soils,
W82-02676 2J

Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 2J

EROSION CONTROL
Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

ERROR ANALYSIS
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 2A

ESTIMATING EQUATIONS
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 8A

Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

Integral Equation Formulation for Ground-Water Flow,
W82-02716 2F

ESTUARIES
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 2K

Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 2L

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel,
W82-02792 2L

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

Development of the River Seine Estuary: Case Study,
W82-02867 2L

Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 2L

ESTUARINE ENVIRONMENT
Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 5C

Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 2L

ESTUARINE FISHERIES
Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 5C

EUROPE
Space-Time Variability of the Runoff of European Rivers,
W82-02848 2E

New Developments in Papermaking in Western Europe,
W82-02947 5D

EUTROPHICATION
Functional Relationships Between Nutrient Dynamics, Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 2H

Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 5C

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 5C

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

EVALUATION
Methods for Evaluating Performance of Filter Media,
W82-02684 5D

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

EVAPORATION
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 2L

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

EVAPOTRANSPIRATION
The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 2D

EXCAVATION
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 8H

EXPLOSIVES
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 8H

FATE OF POLLUTANTS
Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 5B

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

FATHEAD MINNOWS
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

FAUNA
The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 5D

FEASIBILITY STUDIES
West Sacramento Canal Unit Reformulation.
W82-02974 6B

FEEDING RATES
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

FILTER MEDIA
Methods for Evaluating Performance of Filter Media,
W82-02684 5D

Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 5A

FILTRATION
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 5F

FINANCIAL ASPECTS
Water Regulation in an Inflationary Environment,
W82-02701 5F

FIR TREES
Vertical Variation in Stemflow Generation,
W82-02959 2I

FISH
Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 5C

PP and L Uses Discharge Water for Fish Farming.
W82-02645 3C

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 5C

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

FISH BARRIERS
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

FISH BEHAVIOR
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

FISH EGGS
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

FISH FARMING
PP and L Uses Discharge Water for Fish Farming.
W82-02645 3C

Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 8I

FISH PARASITES
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 2H

FISH PASSAGES
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I

FISH PHYSIOLOGY
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

FISH POPULATIONS
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 5C

Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 6G

FISHERIES
Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

FISHKILL
Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 2H

FITZROY RIVER
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I

FLASH FLOODS
Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 2J

FLATWORMS
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

FLOOD CONTROL
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme.
W82-02872 5D

A Solution to Spring Ice-Jam Flooding,
W82-02908 2C

FLOOD FLOW
How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 7A

Hydraulic Resistance of Floodplains,
W82-02850 2E

FLOOD FORECASTING
Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 2E

FLOOD HYDROGRAPHS
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 2A

FLOOD PLAINS
Hydraulic Resistance of Floodplains,
W82-02850 2E

FLOOD PROCESSING INDUSTRY
Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 5D

FLOOD PROTECTION
A Solution to Spring Ice-Jam Flooding,
W82-02908 2C

Computer Modeling of Flood Alleviation Benefits,
W82-02957 6B

FLOODS
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 2J

The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 2L

FLORIDA
Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 2E

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

FLOTATION
By-Product Recovery Finances Treatment,
W82-02756 5D

FLOW CHARACTERISTICS
Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 2E

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

FLOW DISCHARGE
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 2E

Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 7B

FLOW DURATION
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

FLOW FRICTION
Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 8B

FLOW MEASUREMENT
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 5D

Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 8B

FLOW PATTERN
Ice Cover Effects on Stream Flows and Mixing,
W82-02698 2C

FLOW RATES
Local Flow Accelerations in Rivers,
W82-02758 2E

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 2E

FLOW REGULATORS
New Jet-Gate Design,
W82-02691 8C

FLOW RESISTANCE
Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 2J

FLOW VELOCITY
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 2E

FLUCTUATIONS
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

FLUIDIZED BED PROCESS
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

FLUMES
Boundary Shear in Smooth and Rough Channels,
W82-02711 8B

FLUORESCENCE
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 2K

FLUORIDE
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 5F

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 5F

FOAMING
Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

FOOD-PROCESSING WASTES
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

FORECASTING
Demand Forecasting in Water Supply Networks,
W82-02926 6D

FOREST HYDROLOGY
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

FOREST MANAGEMENT
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 6E

FOREST WATERSHEDS
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 4D

FOUNDATION ROCKS
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

FRANCE
French Experience in Water Pollution Control,
W82-02765 5G

Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 2F

The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 5D

FRASER RIVER CATCHMENT
Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 2E

FREQUENCY ANALYSIS
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

FREQUENCY DISTRIBUTION
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

FRESHWATER MARSHES
Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 6B

FRICTION
Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 8D

FRICTION LOSS
Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 2J

Coefficient of Friction in Conduits with Large Roughness,
W82-02901 8B

FUEL REPROCESSING
The Status of Nuclear Waste Management,
W82-02659 5E

FUNGI
Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 2H

FUNKA BAY
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

FUTURE PLANNING
Computer Modeling of Flood Alleviation Benefits,
W82-02957 6B

GAMMARUS
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 2H

GAS CHROMATOGRAPHY
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

GATES
New Jet-Gate Design,
W82-02691 8C

GEOCHEMISTRY
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 2F

GEOHYDROLOGY
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

GEOLOGIC FORMATIONS
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

GEOLOGIC FRACTURES
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

GEOLOGIC HISTORY
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

GEORGIA
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H

GEOTHERMAL RESOURCES
Boise Looks Underground for Heat,
W82-02636 2F

GEOTHERMAL STUDIES
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

GERMANY
Water Pollution Control in the Federal Republic of Germany,
W82-02766 6E

The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 5C

GHANA
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

GLACIAL AQUIFERS
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

GLACIAL STREAMS
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 2E

GLACIER MASS BALANCE
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 2C

GLACIOHYDROLOGY
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 2C

GRAZING
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 3F

GREAT LAKES
Farm, Urban Drainage Polluting Great Lakes,
W82-02647 5B

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 2H

GREECE
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 2H

GROUNDWATER
The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 5C

Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 2F

Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 2F

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 7C

Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 5A

GROUNDWATER AVAILABILITY
Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 2F

Preparation of Friable Aquiferous Specimens,
W82-02955 2F

GROUNDWATER DATING
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 2F

GROUNDWATER LEVEL
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

Probable High Ground-Water Levels in Massachusetts,
W82-02829 2F

GROUNDWATER MANAGEMENT
A Preliminary Survey of State Ground-Water Laws,
W82-02616 6E

An Economic Analysis of Ground Water Management Alternatives,
W82-02740 4B

Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 4B

Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 4B

Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 4B

Injection, Recharge and Return Wells,
W82-02920 4B

GROUNDWATER MINING
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 4B

GROUNDWATER MOVEMENT
Integral Equation Formulation for Ground-Water Flow,
W82-02716 2F

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 2F

GROUNDWATER POLLUTION
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 5B

Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 5F

Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 5B

GROUNDWATER POTENTIAL
Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 4B

GROUNDWATER RECHARGE
Ground-Water Recharge from Rectangular Areas,
W82-02791 2F

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 2A

Injection, Recharge and Return Wells,
W82-02920 4B

GROUTING
Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 8A

Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

GUADALUPE MOUNTAINS NATIONAL PARK
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

HALOGENATED HYDROCARBONS
Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 5B

HALOGENATED PESTICIDES
Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 5B

HAWAII
Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 5C

Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 2H

HEAT TRANSFER
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 2F

HEAT TREATMENT
Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 5D

HEATED WATER
Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 5C

HEATING
Boise Looks Underground for Heat.
W82-02636 2F

HEAVY METALS
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 5D

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

HENEY LAKE
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 2H

HIGH ASWAN DAM
Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

HUMIC ACIDS
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 2K

HUNGARY
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 7B

HYDRAULIC CONDUCTIVITY
A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 2F

HYDRAULIC ENGINEERINGS
Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 8A

HYDRAULIC GATES
New Jet-Gate Design,
W82-02691 8C

Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 8A

HYDRAULIC STRUCTURES
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 8A

The Effect of Wind on Ice Pressure on River Structures,
W82-02668 2C

Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 8A

HYDRAULICS
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 8B

HYDROBIOLOGY
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 2H

HYDROELECTRIC PLANTS
Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 8A

Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 8A

Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 8A

Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 8G

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 6G

Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 8A

Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 8A

Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 6D

HYDROELECTRIC POWER
The Environmental Effects of Hydroelectric Projects,
W82-02632 6G

Argentina's Hydroelectric-Based Energy Plan,
W82-02794 8A

HYDROGEN ION CONCENTRATION
The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 5B

HYDROGRAPH ANALYSIS
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 2A

HYDROGRAPHS
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 2A

HYDROLOGIC BALANCE
Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 2A

HYDROLOGIC BUDGET
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 2C

HYDROLOGIC DATA
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

Water Resources Data for Alaska, Water Year 1980.
W82-02845 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 7C

Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 7B

HYDROLOGIC MODELS
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

Urban Catchment Models: A Brief Examination,
W82-02813 4C

Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 7B

HYDROSTATIC PRESSURE
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 8G

HYDROXYBENZYLMETHANESULFONATE
The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 5C

ICE BREAKUP
A Solution to Spring Ice-Jam Flooding,
W82-02908 2C

ICE COVER
Ice Cover Effects on Stream Flows and Mixing,
W82-02698 2C

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 2C

ICE JAMS
A Solution to Spring Ice-Jam Flooding,
W82-02908 2C

ICE PRESSURE
The Effect of Wind on Ice Pressure on River Structures,
W82-02668 2C

ICED LAKES
The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 2H

IDAHO
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

INDIA
Water Supply and Sanitation Decade Programme,
W82-02757 5F

Water for Industry,
W82-02767 6D

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 2H

INDIANA
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

INDUSTRIAL WASTES
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 5F

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 5B

Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 5E

Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 5B

INDUSTRIAL WASTEWATER
Spiral Classifiers Help One Manufacturer Meet Environmental Standards More Easily,
W82-02602 5D

By-Product Recovery Finances Treatment,
W82-02756 5D

New Developments in Papermaking in Western Europe,
W82-02947 5D

Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 5D

INDUSTRIAL WASTEWATERS
Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 5D

INDUSTRIAL WATER
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

INFILTRATION
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

INGURI RIVER
Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 8A

INJECTION WELLS
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

INSECTICIDES
The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 5F

INSPECTION
Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 8A

INTAKES
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

INTERCEPTION
Vertical Variation in Stemflow Generation,
W82-02959 2I

IODINE
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 2K

ION EXCHANGE
Field Report on a Nonpolluting Bleach Plant,
W82-02793 5D

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 5D

IRAQ
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 5C

On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

IRON
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 2K

Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 2K

IRON COMPOUNDS
Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 2K

IRRIGATION
An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 6D

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 7B

IRRIGATION DITCHES
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 3F

IRRIGATION EFFECTS
Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 3F

Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 2A

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

IRRIGATION EFFICIENCY
Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 3F

IRRIGATION PRACTICES
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 2D

IRRIGATION REQUIREMENTS
Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 3F

ISOTOPE STUDIES
Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 5A

JAMES RIVER
Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 5C

JAPAN
Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 2H

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 5A

On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 2H

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 2H

Paleolimnology of Lake Kizaki,
W82-02863 2J

Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

KALYANI DAM
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

KAMA RIVER
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

KANSAS
Legal Questions and Problems of Kansas Groundwater Management Districts,
W82-02802 6E

KARST HYDROLOGY
The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 5C

KENTUCKY
Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 2E

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

KINETICS
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 2K

LAKE BALATON
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 7B

LAKE BLANKVATN
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

LAKE DECATUR WATERSHED
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 5A

LAKE FISHERIES
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 2H

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

LAKE HANCOCK
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

LAKE HARUNA
On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 2H

LAKE KAIIKE
Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 2H

LAKE KIZAKI
Paleolimnology of Lake Kizaki,
W82-02863 2J

LAKE LINNEVATN
Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 2H

LAKE MORPHOMETRY
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

LAKE QARUN
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

LAKE SEDIMENTS
Paleolimnology of Lake Kizaki,
W82-02863 2J

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 2H

LAKE SEVAN
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 2H

LAKE SJAELSOE
Practical Experiences in Plants Using Activated Carbon,
W82-02788 5F

LAKE TAUPO
Zooplankton of Lake Taupo,
W82-02888 2H

LAKE VALENCIA
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

LAKE VATTERN
Lake Vattern,
W82-02755 2H

LAKE VECHTEN
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 2K

LAKE VICTORIA
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 2H

LAKES
Farm, Urban Drainage Polluting Great Lakes.
W82-02647 5B

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 5A

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 5B

Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 2H

Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 2H

Lake Vattern,
W82-02755 2H

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 2H

Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 2H

On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 2H

Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 2H

Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 2H

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 5G

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 2H

Zooplankton of Lake Taupo,
W82-02888 2H

Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 2H

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 5C

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 2H

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 2H

Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 2H

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

LAMINAR FLOW
Modeling Rill Density,
W82-02604 2J

LAND APPLICATION
Current Policies on Land Application,
W82-02629 5E

A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

LAND DISPOSAL
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

Land Application of Wastewaters: An Overview,
W82-02650 3C

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

LAND USE
Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 5B

LEACHATES
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

LEACHING
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B
Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 5B

LEAVES
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 5C

LEGAL ASPECTS
Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 6E
Water Pollution Control in the Federal Republic of Germany,
W82-02766 6E
Digest of Water Resources Policies and Authorities.
W82-02973 6E

LIFE CYCLES
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

LIGHT INTENSITY
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 5C

LIMNOLOGY
Functional Relationships Between Nutrient Dynamics, Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 2H
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

LINEAR PROGRAMMING
Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 4B

LININGS
Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 5B
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 8G

LIPIDS
Particulate and Dissolved Lipids in Sea Water,
W82-02727 5A

LITTER
Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 2H

LITTORAL ZONE
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H

LLYN FRONGOCH
Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 2H

LONG-TERM PLANNING
Reliability of Water Resources,
W82-02749 6A

LORRAINE
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 2F

LOUISIANA
Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

LOW FLOW
Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 2E
Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 2E

MACROINVERTEBRATES
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 5C
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H
The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 5C

MACROPHYTES
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H

MAINTENANCE
Operation Reports: East Bay Municipal District (SD No 1), California.
W82-02707 5D
Britain's Sewers - Researching for the Future,
W82-02871 5D

MALAYSIA
By-Product Recovery Finances Treatment,
W82-02756 5D

MANAGEMENT PLANNING
Reliability of Water Resources,
W82-02749 6A

MANGANESE
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 2K

MANITOBA
Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 2H
Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 2H

MAPPING
Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 2J

MAPS
Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

MARINE BIOLOGY
Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 2A

MARINE ENVIRONMENT
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 2K

MARINE SEDIMENTS
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K
Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 5A

MARQUARDT ALGORITHM
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 2F

MARSHALL ISLANDS
Atoll Island Hydrology,
W82-02617 2F

MARSHES
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

MARYLAND
Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

MASS TRANSFER
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1B

MASSACHUSETTS
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H
Probable High Ground-Water Levels in Massachusetts,
W82-02829 2F

MATERIALS ENGINEERING
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 8A
Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 8G

MATERIALS TESTINGS
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 8G

MATHEMATICAL EQUATIONS
Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 5D
Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 5D

MATHEMATICAL MODELS
Seepage from Free Water Above Impermeable Tailings,
W82-02714 5B
Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 5D

Optimal Water Reuse Planning,
W82-02736 6A

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 5D

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 5D

MATHEMATICAL STUDIES

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 2E

Unsteady Water Quality Model for River Network,
W82-02873 5G

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 2K

Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 2E

MEASURING INSTRUMENTS

Rainwater Acidity Measurement Problems,
W82-02627 5A

Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 5A

Instrumentation for Aerated Flow on Spillways,
W82-02880 7B

MEAT PROCESSING INDUSTRY

Protein Recovery from Beef Packing Effluent,
W82-02994 5D

MEMBRANE PROCESSES

Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 3A

MEMBRANES

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 8G

MEROMICTIC LAKES

Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

METABOLISM

Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 2A

METAL-FINISHING WASTES

Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 5D

METALS

The Status of Nuclear Waste Management,
W82-02659 5E

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 5B

MICHIGAN

Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 5G

Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 6B

MICROORGANISMS

Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 2C

The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 5D

MICROWAVES

Microwave Measurements of Snowpack Properties,
W82-02646 2C

MIDGES

Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 2H

A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 5C

The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 5F

MINE WASTES

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

Seepage from Free Water Above Impermeable Tailings,
W82-02714 5B

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

MINNESOTA

Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 2F

MISSISSIPPI

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 7C

MISSOURI RIVER BASIN

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 7C

MITES

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

MIXING

Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 2L

Wind Aeration in Model Waste Treatment System,
W82-02944 5D

MODEL STUDIES

Modeling Circulation in Depth-Averaged Flow,
W82-02679 2E

Modeling Cavitation for Closed Conduit Flow,
W82-02700 8B

Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 5D

The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 6A

An Economic Analysis of Ground Water Management Alternatives,
W82-02740 4B

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

Development of the River Seine Estuary: Case Study,
W82-02867 2L

Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 8A

Unsteady Water Quality Model for River Network,
W82-02873 5G

The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 5A

The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 2D

MONITORING

Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 7A

Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 5D

Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 5A

MONOCHLORAMINE
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

MORPHOLOGY
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 5C

MOSSES
The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 2H

MOUNT MONADNOCK
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

MULTIOBJECTIVE PLANNING
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 6B

MUNICIPAL WASTEWATER
Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

MUSANDAM PENINSULA
Recent Inshore Sediments in Musandam, Oman,
W82-02857 2J

MUTAGENS
Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 5C

NEBRASKA
An Economic Analysis of Ground Water Management Alternatives,
W82-02740 4B

NETHERLANDS
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 2K

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 2K

NEVADA
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

NEW HAMPSHIRE
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 6B

The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 2L

NEW JERSEY
Restoring an Antique Water System.
W82-02685 5F

Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 2A

NEW MEXICO
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 2F

Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

NEW YORK BIGHT
Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 5A

NEW ZEALAND
Local Flow Accelerations in Rivers,
W82-02758 2E

Zooplankton of Lake Taupo,
W82-02888 2H

NICKEL
Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 5D

NIGERIA
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

NILE RIVER
Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 2J

NITRATE
Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 5F

NITRATES
Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 5D

NITRIC ACID
The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 5C

NITRIFICATION
To Inhibit or Not to Inhibit: That is The Question,
W82-02672 5A

NITROGEN
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 5B

A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 5C

NITROGEN CYCLE
Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 2A

NITROGEN REMOVAL
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

NONPOINT POLLUTION CONTROL
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

NONPOINT POLLUTION SOURCES
Farm, Urban Drainage Polluting Great Lakes.
W82-02647 5B

Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 5G

Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 5B

NONTIDAL CURRENTS
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 2L

NORDEN RESERVOIR
Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

NORTH CAROLINA
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 5B

NORTH DAKOTA
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

NORTHWEST TERRITORIES
River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 2E

NORWAY
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 2E

Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 2H

NUCLEAR ENGINEERING
The Status of Nuclear Waste Management,
W82-02659 5E

NUCLEAR POWERPLANTS
Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 5D

Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 5C

NUREK HYDROELECTRIC PLANT
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

NUTRIENT REMOVAL
Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 5B

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

NUTRIENTS
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 7B

Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 2H

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

OBSERVATION WELLS
Probable High Ground-Water Levels in Massachusetts,
W82-02829 2F

OCCOQUAN BASIN
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

OCEAN CIRCULATION
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

OCEAN DUMPING
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 5E

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 5A

OGALLALA AQUIFER
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 4B

OIL
Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 5A

OIL POLLUTION
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 5A

Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 5A

OIL WASTES
By-Product Recovery Finances Treatment,
W82-02756 5D

OKLAHOMA
Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 5G

OLIGOTROPHIC LAKES
Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 2H

ONTARIO
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 6B

OPEN CHANNEL FLOW
Computerized Control of an Open-Channel Water Distribution System,
W82-02732 4A

OPEN CHANNELS
Modeling Circulation in Depth-Averaged Flow,
W82-02679 2E

OPERATING COSTS
Operation Reports: East Bay Municipal District (SD No 1), California.
W82-02707 5D

OPERATION AND MAINTENANCE
Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 6C

OPTICAL PROPERTIES
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 5A

OREGON
Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 7B

ORGANIC CARBON
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 2H

Recent Inshore Sediments in Musandam, Oman,
W82-02857 2J

ORGANIC COMPOUNDS
Application of Adsorption to Wastewater Treatment,
W82-02622 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1B

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

ORGANIC MATTER
Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 2H

ORGANIC PRECURSORS
Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 5F

ORGANIC WASTES
The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 5C

OVERLAND FLOW
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

OXIDATION
Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 2K

OXIDATION PONDS
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 5D

OZONATION
Ozone Water Treatment,
W82-02682 5F

Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 5D

P-CHLOROPHENOL
Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 5D

P-TOLUENE SULFONATE
Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 5D

PALEOLIMNOLOGY
Paleolimnology of Lake Kizaki,
W82-02863 2J

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 2H

PALM OIL
By-Product Recovery Finances Treatment,
W82-02756 5D

PARASITES
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 2H

PARKS
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 5G

PARTICLE SIZE
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1B

PATENTS
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

PATH OF POLLUTANTS
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 5B

PAVEMENT
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

PECOS RIVER BASINS
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

PENFIELD
The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 5C

PENIKESE ISLAND
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H

PENNSYLVANIA
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 2K

PERCH
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

PERFORMANCE EVALUATION
Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 8A

Methods for Evaluating Performance of Filter Media,
W82-02684 5D

PERIPHYTON
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

PESTICIDES
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 5A

PETROLEUM PRODUCTS
Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 5A

PEYTO GLACIER
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 2C

PHENOLS
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

PHOSPHORIC ACID
Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1B

PHOSPHOROUS ABSORPTION
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 2H

PHOSPHORUS
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 2H

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

PHOSPHORUS REMOVAL
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

PHOTOSYNTHESIS
The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 2H

PHTHALATES
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

PHYTOPLANKTON
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 2H

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 5C

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 5C

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 2C

The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 7B

The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 5C

Physicochemical Influence on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 2H

PILOT PLANTS
The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 5D

PIPELINES
Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 8B

PIPES
Galvanized Pipe Vies for Equal Alternative Status in Storm Sewer Projects.
W82-02601 8G

The Cost of Quality,
W82-02881 5F

Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 5B

PLANKTON
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H

Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 2L

Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 5C

PLANNING
Water Regulation in an Inflationary Environment,
W82-02701 5F

Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 6A

French Experience in Water Pollution Control,
W82-02765 5G

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 6B

PLASMIDS
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 5B

PLUTONIUM
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

POLAND
Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 5B

The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 5C

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 2H

POLAROGRAPHIC ANALYSIS
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

POLITICAL ASPECTS
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 6B

POLITICAL CONSTRAINTS
Current Policies on Land Application,
W82-02629 5E

POLLUTANT IDENTIFICATION
Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 5A

Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 5A

Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 5A

Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

POLYCHLORINATED BIPHENYLS
Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 5D

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 5A

PONDS
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H

POOLS
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 2H

POPULATION DYNAMICS
How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 7A

Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 2H

The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 5C

Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 5C

Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

POROUS MEDIA
Integral Equation Formulation for Ground-Water Flow,
W82-02716 2F

Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 2F

POTABLE WATER
Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 6C

POTENTIOMETRIC LEVEL
Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

POTOMAC RIVER
Stochastic Hydrologic Model for Drought Management,
W82-02897 2E

POWERPLANTS
Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 3E

PP and L Uses Discharge Water for Fish Farming.
W82-02645 3C

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 5C

PREDATION
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

PREDICTION
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

PREIMPOUNDMENT
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

PROBABILISTIC PROCESS
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

PROBABILITY DISTRIBUTION
Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02923 7B

PRODUCTIVITY
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 5C

The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 7B

PROJECT PLANNING
Project Outcomes Correlate with Public Participation Variables,
W82-02663 6B

PROTEIN RECOVERY
Protein Recovery from Beef Packing Effluent,
W82-02994 5D

PROTEINS
Protein Recovery from Beef Packing Effluent,
W82-02994 5D

PROTOZOA
Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

PUBLIC HEALTH
Recreational Water Quality and Health,
W82-02997 5C

PUBLIC PARTICIPATION
Project Outcomes Correlate with Public Participation Variables,
W82-02663 6B

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 6B

PUBLIC POLICY
Digest of Water Resources Policies and Authorities.
W82-02973 6E

PULP AND PAPER INDUSTRY
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 6B

Field Report on a Nonpolluting Bleach Plant,
W82-02793 5D

New Developments in Papermaking in Western Europe,
W82-02947 5D

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 5D

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 5D

PUMPED STORAGE
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

PUMPING PLANTS
Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 6B

PUMPING STATIONS
Demand Forecasting in Water Supply Networks,
W82-02926 6D

PUMPING TESTS
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 2F

PUMPS
The Cone Pump,
W82-02713 8C

QUEBEC
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 2H

Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

RADIAL GATES
Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 8A

RADIOACTIVE DATING
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 2F

RADIOACTIVE WASTES
Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 5D

The Status of Nuclear Waste Management,
W82-02659 5E

RADIUM
Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 5A

RAIN
An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

RAINFALL
Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 2K

RAINFALL-RUNOFF RELATIONSHIPS
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 2A

RANGE MANAGEMENT
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 3F

RANGES
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 3F

RANKING
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

RECLAIMED WATER
Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

RECREATION
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 6B

Recreational Water Quality and Health,
W82-02997 5C

RECREATION DEMAND
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 6B

RECREATION FACILITIES
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

RECYCLING
Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 8I

REMOTE SENSING
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 7B

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 7B

Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 7B

RESEARCH PRIORITIES
Britain's Sewers - Researching for the Future,
W82-02871 5D

RESERVOIR RELEASES
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

RESERVOIR SITES
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

RESERVOIRS
The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 4C

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 6B

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

RESISTIVITY
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

RETAINING WALLS
Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 8B

REVERSE OSMOSIS
Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 3A

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 5F

RHODE ISLAND
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

RHODE RIVER ESTUARY
Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

RILLS
Modeling Rill Density,
W82-02604 2J

RIVER BASIN DEVELOPMENT
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 6D

RIVER BASINS
Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

RIVER FLOW
Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 2J

RIVER MURRAY
South Australia's Approach to Salinity Management in the River Murray,
W82-02761 5G

RIVER SYSTEMS
Unsteady Water Quality Model for River Network,
W82-02873 5G

RIVERS
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 5B

Local Flow Accelerations in Rivers,
W82-02758 2E

Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 5C

Distribution of Chromobacteria in a Lowland River,
W82-02795 5C

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

Space Time Variability of the Runoff of European Rivers,
W82-02848 2E

RIVERS

The Cost of Quality,
W82-02881 5F

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 6D

ROCK PROPERTIES
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

ROME
The Roman Way,
W82-02744 5F

ROUGHNESS COEFFICIENT
Hydraulic Resistance of Floodplains,
W82-02850 2E

Coefficient of Friction in Conduits with Large Roughness,
W82-02901 8B

RUNNING WATERS
The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 5C

RUNOFF
Space-Time Variability of the Runoff of European Rivers,
W82-02848 2E

RUNOFF VOLUME
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 2L

RUSSIA
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 8A

SALINE LAKES
Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 2H

The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 2H

SALINE WATER INTRUSION
South Australia's Approach to Salinity Management in the River Murray,
W82-02761 5G

The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 4C

Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 2F

SALINITY
Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 3F

South Australia's Approach to Salinity Management in the River Murray,
W82-02761 5G

The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 4C

The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 4D

Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 2K

Groundwater Systems Associated with Secondary Salinity in Western Australia,
W82-02770 2F

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 2L

Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 2L

SALMON
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

SALT MARSHES
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 2L

SAMPLE PREPARATION
Preparation of Friable Aquiferous Specimens,
W82-02955 2F

SAMPLING
Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 7A

A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 7B

SAN FRANCISCO BAY
Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

SANITATION
Water Supply and Sanitation Decade Programme,
W82-02757 5F

SATELLITE TECHNOLOGY
Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 7B

SCREENS
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

SEA ICE
Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 2C

SEA LEVEL
Tides and Tidal Datums in the United States,
W82-02982 2A

SEALANTS
Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 8A

SEASONAL VARIATION
Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 2H

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 2L

Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

SEASONAL VARIATIONS
Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 2H

SEAWATER
Particulate and Dissolved Lipids in Sea Water,
W82-02727 5A

Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 3A

SECONDARY WASTEWATER TREATMENT
Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 6E

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

SEDIMENT CONCENTRATION
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

SEDIMENT CONTROL
Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 2J

SEDIMENT TRANSPORT
River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 2E

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 2J

The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 2L

Bed Load Discharge Coefficient,
W82-02936 2J

SEDIMENT-WATER INTERFACES
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 2K

SEDIMENTATION
Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

SEDIMENTOLOGY
Paleolimnology of Lake Kizaki,
W82-02863 2J

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 2H

Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 2J

SEDIMENTS
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 5B

Recent Inshore Sediments in Musandam, Oman,
W82-02857 2J

Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

Preparation of Friable Aquiferous Specimens,
W82-02955 2F

Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1B

SEEPAGE
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 8A

Seepage from Free Water Above Impermeable Tailings,
W82-02714 5B

SEEPAGE CONTROL
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 8A

Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 8D

SEINE RIVER
Development of the River Seine Estuary: Case Study,
W82-02867 2L

SEPARATION TECHNIQUES
Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

SEPTIC TANKS
Distribution of Wastewater in Drain Field Pipes,
W82-02945 8B

SETTLING VELOCITY
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1B

SEWER INFILTRATION
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 5D

SEWER SYSTEMS
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 5D

The Roman Way,
W82-02744 5F

Britain's Sewers - Researching for the Future,
W82-02871 5D

Engineering Responds to Ecology,
W82-02935 5D

SEWERS
The Cost of Quality,
W82-02881 5F

Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

SHALLOW WATER
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

SHEAR STRESS
Boundary Shear in Smooth and Rough Channels,
W82-02711 8B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel,
W82-02792 2L

SHEYENNE RIVER
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

SHINER
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 5C

SHORE PROTECTION
Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 8B

SIBERIA
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 8H

SLOPE STABILITY
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

SLOPE STABILIZATION
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 8B

SLUDGE
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 5A

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 5D

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 5D

SLUDGE DIGESTION
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 5D

SLUDGE DISPOSAL
Current Policies on Land Application,
W82-02629 5E

Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 5E

Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 5B

SLUDGE DRYING
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 5E

SLUDGE THICKENING
Advanced Sludge Treatment for Modern Waterworks,
W82-02889 5D

SLUDGE TREATMENT
Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 5E

SLUICE GATES
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

SLUICES
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

SMALL WATERSHEDS
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

SNAILS
Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

SNOW WATER EQUIVALENT
Microwave Measurements of Snowpack Properties,
W82-02646 2C

SNOWMELT
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 2C

SOCIAL ASPECTS
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 6B

SOIL EROSION
Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 2J

SOIL MOISTURE DEFICIENCY
Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 3F

SOIL STABILITY
Erosion Resistance of Cohesive Soils,
W82-02676 2J

SOIL TYPES
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 3C

SOIL WATER
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 2G

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 3F

SOLIDS
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

SOLUBILITY
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 2F

SOLUTE TRANSPORT
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 2K

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 5B

SORPTION
Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 5B

SOUTH AFRICA
Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 8A

Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 2F

SOUTH DAKOTA
Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 2F

SOUTHEASTERN UNITED STATES
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 5G

SOUTHERN CALIFORNIA
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 5F

SPATIAL DISTRIBUTION
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 6G

SPECIES COMPOSITION
Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

SPILLWAYS
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

Measurements of Self-Aerated Flow on a Spillway,
W82-02715 8B

Instrumentation for Aerated Flow on Spillways,
W82-02880 7B

SPRAY IRRIGATION
Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

SPRUCE TREES
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

STABILIZATION PONDS
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D

STATE JURISDICTION
A Preliminary Survey of State Ground-Water Laws,
W82-02616 6E

STATISTICAL ANALYSIS
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 5A

Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

STATISTICAL MEASURES
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

STATISTICAL METHODS
Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 7A

An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

STATISTICAL MODELS
Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

STEMFLOW
Vertical Variation in Stemflow Generation,
W82-02959 2I

STOCHASTIC PROCESS
Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 5D

Stochastic Hydrologic Model for Drought Management,
W82-02897 2E

STOMATAL TRANSPIRATION
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

STORAGE
Reliability of Water Resources,
W82-02749 6A

STORM RUNOFF
Urban Catchment Models: A Brief Examination,
W82-02813 4C

Computer Modeling of Flood Alleviation Benefits,
W82-02957 6B

STORM SEWERS
Galvanized Pipe Vies for Equal Alternative Status in Storm Sewer Projects,
W82-02601 8G

STRATIFICATION
Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 2H

STRATIGRAPHY
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

STREAM DISCHARGE
Ice Cover Effects on Stream Flows and Mixing,
W82-02698 2C

STREAM FLOW
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

STREAMFLOW
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 4D

Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 2E

Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 2E

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 2E

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 2E

STREAMFLOW FORECASTING
Stochastic Hydrologic Model for Drought Management,
W82-02897 2E

Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 7B

STREAMS
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02646 2K

STRESS RELAXATION COEFFICIENT
Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 8A

SUBARCTIC ZONE
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 2C

SUBSTRATES
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

SUGARCANE
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 7B

SULFIDES
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 2K

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

SULFUR COMPOUNDS
The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 5B

SULFURIC ACID
The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 5C

SURFACE-GROUNDWATER RELATIONS
Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 2F

SURFACE RUNOFF
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 2C

Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

SURFACE WATER
Chemical Coagulation of Surface Water,
W82-02623 5F

Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

Water Resources Data for Alaska, Water Year 1980.
W82-02845 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 7C

SURFACTANTS
Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

SURVEYS
Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 2J

SUSPENDED SEDIMENTS
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

SWEDEN
Lake Vattern,
W82-02755 2H

SWIMMING
Recreational Water Quality and Health,
W82-02997 5C

SYNTHETIC FUELS
A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 5C

SYSTEMS ANALYSIS
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

TAMAGAWA RIVER
Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

TAXONOMY
Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

TECHNOLOGY TRANSFER
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

TEHAMA-COLUSA CANAL
West Sacramento Canal Unit Reformulation.
W82-02974 6B

TEMPERATURE EFFECTS
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 2H

Coupled Heat and Water Flows Around Buried Cables,
W82-02680 2G

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 8A

TERRAIN ANALYSIS
Hydraulic Resistance of Floodplains,
W82-02850 2E

TERTIARY WASTEWATER TREATMENT
Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 5D

TESTING PROCEDURES
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 8G

TEXAS
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

TEXTILE MILL WASTES
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

THAILAND
An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 6D

THERMAL CONDUCTIVITY
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 2F

THERMAL POLLUTION
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 5C

THERMAL STRESS
Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 5C

THERMAL WATER
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

THREE MILE ISLAND
Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 5D

TIDAL EFFECTS
Atoll Island Hydrology,
W82-02617 2F

TIDAL FLATS
The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 2L

TIDAL RANGE
Tides and Tidal Datums in the United States,
W82-02982 2A

TIDAL RIVERS
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 5B

TIDES
Tides and Tidal Datums in the United States,
W82-02982 2A

TILAPIA
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 5D

TOXICITY
A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 5C

The Status of Nuclear Waste Management,
W82-02659 5E

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound,

Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 5C

TRACE ELEMENTS
Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 5B

TRACE METALS
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

TRACERS
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 2F

TRAINING
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

TRANSMISSIVITY
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 2F

TREATMENT PLANTS
Operation Reports: East Bay Municipal District (SD No 1), California.
W82-02707 5D

TRIHALOMETHANES
Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 5F

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

TROPHIC LEVEL
Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 2H

TROUT
Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 8I

Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

TRUK
The Development of a Village Water Supply System on Truk,
W82-02816 5F

TUNNEL CONSTRUCTION
Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 8A

Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 8A

Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 8A

TUNNEL HYDRAULICS
Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 8A

TUNNEL LININGS
Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 8A

Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 8A

TURBULENT FLOW
Modeling Rill Density,
W82-02604 2J

On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

TURFGRASSES
Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

TWIN LAKES
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

ULTRAVIOLET RADIATION
Treatment Plant Features Ultraviolet Disinfection,
W82-02644 5D

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 5D

UMFOLOZI RIVER
Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 8A

UNDERGROUND STRUCTURES
Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 8A

UNDERWATER
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 5G

UNIT HYDROGRAPHS
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 2A

UNITED KINGDOM
Reliability of Water Resources,
W82-02749 6A

Britain's Sewers - Researching for the Future,
W82-02871 5D

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme.
W82-02872 5D

Demand Forecasting in Water Supply Networks,
W82-02926 6D

Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 6B

UPWELLING
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

URBAN RUNOFF
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

Urban Catchment Models: A Brief Examination,
W82-02813 4C

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 5B

URBANIZATION
The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 5C

USSR
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 8A

Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 8A

Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 8G

Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 8A

Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 8A

Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 2A

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 2E

Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 8A

Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 8A

Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

VEGETATION EFFECTS
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 3F

VERMONT
Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 5B

VIRUSES
Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 5A

VOLATILE ACIDS
Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 5A

VOLTA LAKE
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

WALES
Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 2H

The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 5A

WASHINGTON
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

WASTE DISPOSAL
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 5E

Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 5E

WASTE MANAGEMENT
The Status of Nuclear Waste Management,
W82-02659 5E

WASTE RECOVERY
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 5D

Protein Recovery from Beef Packing Effluent,
W82-02994 5D

WASTEWATER DISPOSAL
Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 5E

Land Application of Wastewaters: An Overview.
W82-02650 3C

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 5B

Distribution of Wastewater in Drain Field Pipes,
W82-02945 8B

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

WASTEWATER FACILITES
Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 5D

WASTEWATER FACILITIES
Treatment Plant Features Ultraviolet Disinfection,
W82-02644 5D

Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 6E

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme.
W82-02872 5D

Advanced Sludge Treatment for Modern Waterworks,
W82-02889 5D

Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 5D

WASTEWATER IRRIGATION
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 3C

Land Application of Wastewaters: An Overview.
W82-02650 3C

WASTEWATER MANAGEMENT
Project Outcomes Correlate with Public Participation Variables,
W82-02663 6B

WASTEWATER TREATMENT
Spiral Classifiers Help One Manufacturer Meet Environmental Standards More Easily,
W82-02602 5D

Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 5E

Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 3E

Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 5D

Application of Adsorption to Wastewater Treatment,
W82-02622 5D

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

Treatment Plant Features Ultraviolet Disinfection,
W82-02644 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 5D

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D

Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 5D

Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 5C

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 5D

Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 5D

Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 5D

Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 5D

A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 5D

Optimal Water Reuse Planning,
W82-02736 6A

A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

Advanced Sludge Treatment for Modern Waterworks,
W82-02889 5D

Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 5D

Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

Wind Aeration in Model Waste Treatment System,
W82-02944 5D

Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 5D

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 5D

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 5D

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 5D

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

Protein Recovery from Beef Packing Effluent,
W82-02994 5D

Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 5D

Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 5D

WATER ANALYSIS
To Inhibit or Not to Inhibit: That is The Question,
W82-02672 5A

Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 5A

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 2H

WATER CHEMISTRY
Particulate and Dissolved Lipids in Sea Water,
W82-02727 5A

Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 5B

WATER CONSERVATION
Reliability of Water Resources,
W82-02749 6A

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 3F

Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 4B

WATER CONVEYANCE
Restoring an Antique Water System.
W82-02685 5F

Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 8A

WATER DEMAND
Water for Industry,
W82-02767 6D

Demand Forecasting in Water Supply Networks,
W82-02926 6D

WATER DISTRIBUTION
Restoring an Antique Water System.
W82-02685 5F

Computerized Control of an Open-Channel Water Distribution System,
W82-02732 4A

Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 8A

WATER HARDNESS
Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 5C

WATER LAW
A Preliminary Survey of State Ground-Water Laws,
W82-02616 6E

Legal Questions and Problems of Kansas Groundwater Management Districts,
W82-02802 6E

New Developments in Papermaking in Western Europe,
W82-02947 5D

WATER LEVEL
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 2F

WATER LEVEL FLUCTUATIONS
The Environmental Effects of Hydroelectric Projects,
W82-02632 6G

Space-Time Variability of the Runoff of European Rivers,
W82-02848 2E

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 2E

WATER LOSS
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 3F

WATER MAINS
Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 8A

WATER MANAGEMENT
Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 7B

WATER POLLUTION
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 5A

Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 5B

WATER POLLUTION CONTROL
Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 5G

Lake Vattern,
W82-02755 2H

The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 4D

French Experience in Water Pollution Control,
W82-02765 5G

Water Pollution Control in the Federal Republic of Germany,
W82-02766 6E

Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

New Developments in Papermaking in Western Europe,
W82-02947 5D

WATER POLLUTION EFFECTS
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 5C

On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 5A

Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 5C

Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 5C

Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 5C

The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 5C

The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 5C

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 5A

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 5B

The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 5C

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound,

Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 9C

WATER POLLUTION PREVENTION
The Roman Way,
W82-02744 5F

WATER POLLUTION SOURCES
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02674 2K

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 5B

WATER POLLUTION TREATMENT
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 5B

Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 5F

Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 5D

WATER POTENTIALS
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

WATER PURIFICATION
A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 5F

WATER QUALITY
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 5C

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 5B

Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

Water Resources Data for Alaska, Water Year 1980.
W82-02845 7C

Water Resources Data for Wyoming, Water Year 1980--Volume I. Missouri River Basin.
W82-02846 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 7C

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 5A

The Cost of Quality,
W82-02881 5F

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

Recreational Water Quality and Health,
W82-02997 5C

WATER QUALITY CONTROL
Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 5G

WATER QUALITY MANAGEMENT
The Roman Way,
W82-02744 5F

South Australia's Approach to Salinity Management in the River Murray,
W82-02761 5G

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 5G

Unsteady Water Quality Model for River Network,
W82-02873 5G

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

WATER RESOURCES DEVELOPMENT
The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 6A

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 6D

Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 6A

The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 4D

Water for Industry,
W82-02767 6D

Argentina's Hydroelectric-Based Energy Plan,
W82-02794 8A

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 6G

Digest of Water Resources Policies and Authorities.
W82-02973 6E

West Sacramento Canal Unit Reformulation.
W82-02974 6B

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 6D

WATER REUSE
Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 3E

Optimal Water Reuse Planning,
W82-02736 6A

WATER SAMPLING
A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 7B

WATER STRESS
Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 3F

WATER SUPPLY
Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 3A

Reliability of Water Resources,
W82-02749 6A

The Cost of Quality,
W82-02881 5F

WATER SUPPLY DEVELOPMENT
Water Supply and Sanitation Decade Programme,
W82-02757 5F

The Development of a Village Water Supply System on Truk,
W82-02816 5F

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 6B

WATER TABLE
Probable High Ground-Water Levels in Massachusetts,
W82-02829 2F

WATER TABLE PROFILES
Ground-Water Recharge from Rectangular Areas,
W82-02791 2F

WATER TEMPERATURE
The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 2H

WATER TREATMENT
Energy Management in the Water Works Industry,
W82-02608 5F

Chemical Coagulation of Surface Water,
W82-02623 5F

Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

Ozone Water Treatment,
W82-02682 5F

A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 5F

The Roman Way,
W82-02744 5F

Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 3A

Practical Experiences in Plants Using Activated Carbon,
W82-02788 5F

Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 5F

New Antimicrobial Agents for Treatment of Water,
W82-02808 5F

The Development of a Village Water Supply System on Truk,
W82-02816 5F

The Cost of Quality,
W82-02881 5F

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 5F

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 5F

WATER TREATMENT FACILITIES
Energy Management in the Water Works Industry,
W82-02608 5F

New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 5F

Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 6C

Evaluating a Plant's Potential for Upgrading,
W82-02895 5F

WATER USE
Water for Industry,
W82-02767 6D

WATER YIELD
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

WATERCOURSES
French Experience in Water Pollution Control,
W82-02765 5G

WATERCRESS
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

WATERSHEDS
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 2A

Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 5A

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 5B

WAVE ACTION
Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 8B

WEIRS
Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 8B

WELL DATA
Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

WELL DESIGN
Fundamental Concepts of Well Design,
W82-02614 8A

WELL HYDRAULICS
Fundamental Concepts of Well Design,
W82-02614 8A

WELLS
Boise Looks Underground for Heat.
W82-02636 2F

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 2H

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 2F

Injection, Recharge and Return Wells,
W82-02920 4D

WETLANDS
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 2A

Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 6B

WEY RIVER
Distribution of Chromobacteria in a Lowland River,
W82-02795 5C

WHEAT
Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 3F

WHITE CLAY CREEK
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 2K

WIND
Wind Aeration in Model Waste Treatment System,
W82-02944 5D

WIND VELOCITY
The Effect of Wind on Ice Pressure on River Structures,
W82-02668 2C

WOOD PRESERVING INDUSTRY
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

WYE RIVER
The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 5A

WYOMING
Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 7C

WYRE ESTUARY
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

ZINC
Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

ZOOPLANKTON
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 5B

Zooplankton of Lake Taupo,
W82-02888 2H

AUTHOR INDEX

ABDALLA, C. W.
Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 6B

ABDEL-HADI, O. N.
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 2G

ABDEL-MALEK, S. A.
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

ABERNATHY, A. R.
Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 5B

ADAMS, W.
Protein Recovery from Beef Packing Effluent,
W82-02994 5D

ADEMA, C.
Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

AFANAS'EV, A. A.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 8B

AGYEI, F. O.
Urban Catchment Models: A Brief Examination,
W82-02813 4C

AIETA, E. M.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

AKRAM, M.
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 3F

AL-SAAD, H. A.
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 5C

AL-SAADI, H. A.
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

ALLER, R. C.
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 2K

ALPINE, A. E.
Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L

ALTHOFF, W. F.
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 5F

ANDERSON, B. F.
Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 6B

ANDERSON, F. E.
The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 2L

ANDREWS, J.
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 5D

ANMA, S.
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

APARTSIN, M. S.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

APPLER, H. N.
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

ARMSTRONG, C. A.
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

ARTS, M. T.
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

ASMAN, W. A. H.
Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 2K

ASSINDER, D. J.
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

ASTAFICHEV, V. I.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

ASTON, S. R.
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

AULENBACH, D. B.
Land Application of Wastewaters: An Overview.
W82-02650 3C

AULL, G. H. III.
Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 5G

AZARKOVICH, A. E.
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 8H

BAARD, J. H.
Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 2K

BAGBY, M. M.
Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 5D

BAHNER, L. H.
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

BAIN, C. A. R.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 2F

BAKER, J. P.
Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 5C

BAKER, L. A.
Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

BAKER, M. B.
An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

BALAKRISHNA, S.
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

BANIUKIEWICZ, A.
Mathematical Models of Water Yield with Particular Reference to Missisippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

BARNEY, T. W.
Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 5B

BARON, V. A.
Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 2A

BARRIE, L. A.
The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 5B

BARROWS, M. E.
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

BARTH, E. F.
To Inhibit or Not to Inhibit: That is The Question,
W82-02672 5A

BASSELL, C. D.
Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 5D

BEARD, J. D. II.
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 5F

BEER, T.
Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 2L

BERG, J. D.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

BERNDT, C.
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

BESEDA, N. I.
Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 4B

BESSIERE, J.
Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1B

BHAGAT, T.
Spiral Classifiers Help One Manufacturer Meet Environmental Standards More Easily,
W82-02602 5D

BHATTACHARYYA, D.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

BIENFANG, P.
Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 5C

BIKINEEV, M. G.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

BILBY, R. E.
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 4D

BISEMBAEVA, K. K.
Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 2A

BISHOP, S. L.
Methods for Evaluating Performance of Filter Media,
W82-02684 5D

BISSON, B. T.
Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

BLAVOUX, B.
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 2F

BLYTHE, M.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

BOBEE, B.
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

BOBROV, V. I.
New Jet-Gate Design,
W82-02691 8C

BOGARDI, I.
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

BOIKOV, A. I.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 8D

BOILLAT, J. L.
Settling Velocity of Spherical Particles in Calm Water,
W82-02938 1B

BOLKE, E. L.
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

BORGWARDT, R. H.
Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 3E

BORJESON, H. B.
Field Report on a Nonpolluting Bleach Plant,
W82-02793 5D

BOSMANS, F.
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 2H

BOWER, D. E.
Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

BOWERS, A. E.
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 5F

BOWERS, J.
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

BOYUM, A.
Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 2H

BRADFORD, W. L.
Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 2F

BRAILEY, D.
Energy Management in the Water Works Industry,
W82-02608 5F

BRAS, R. L.
The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 2D

BRENNIMAN, G. R.
Recreational Water Quality and Health,
W82-02997 5C

BREW, J. S.
Reliability of Water Resources,
W82-02749 6A

BREZONIK, P. L.
A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 5C

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

BRIAND, F.
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 2H

BRONSTEIN, B.
Argentina's Hydroelectric-Based Energy Plan,
W82-02794 8A

BROWNLEE, B. G.
Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 2H

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 2H

BUBMAN, I. S.
Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 8A

BUDDEMEIER, R. W.
Atoll Island Hydrology,
W82-02617 2F

BULDINI, P. L.
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

BURGARINO, A. E.
A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 5F

BURGES, S. J.
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 2A

BUSCHECK, T.
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

BYINGTON, R. B.
Recreational Water Quality and Health,
W82-02997 5C

CAIN, P.
Instrumentation for Aerated Flow on Spillways,
W82-02880 7B

Measurements of Self-Aerated Flow on a Spillway,
W82-02715 8B

CALLAHAN, C. A.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

CANIPAROLI, D.
An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

CARY, G. A.
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

CENTER, D. M.
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 3F

CHAIKA, A. M.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

CHANDER, S.
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 2F

CHATALBASHEV, P. P.
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 8H

CHATTERTON, J. B.
Computer Modeling of Flood Alleviation Benefits,
W82-02957 6B

CHEATHAM, G. W.
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 6B

CHEN, Y. H.
Unsteady Water Quality Model for River Network,
W82-02873 5G

CHENG, A. H. D.
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

CHERNYI, I. P.
Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 8D

CHIN, H. K.
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

CHITNIS, B. V.
Water for Industry,
W82-02767 6D

CHOW, B. M.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

CHYONG, N. S.
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 8A

CLAASSEN, H. C.
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 2F

CLARE, R. G.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

CLARIDGE, F. B.
Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 2J

CLARK, P. G.
The Cost of Quality,
W82-02881 5F

CLARKE, K. F.
Reliability of Water Resources,
W82-02749 6A

CLEARY, R. W.
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 5F

CLIFFORD, D. A.
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 5F

CLOERN, J. E.
Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L
Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

COLE, B. E.
Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L

COMER, D. A. D.
An Economic Analysis of Ground Water Management Alternatives,
W82-02740 4B

COMFORT, E.
Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

CONDREN, A. J.
Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 5D

CONQUEST, L. L.
On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 5A

COOKE, S. F.
The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 5F

CORNILLON, P.
Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 3F

CORY, R. L.
Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

COWART, J. B.
Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 5A

CRANSTON, C. C.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

CROUSE, M. R.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

CUMBUS, I. P.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

CUNNINGHAM, A. J.
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

CUSHMAN, R. M.
A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 5C

DALPRA, C.
Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 6E

DAROS, B.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

DASHER, D. H.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

DAUPLE, P.
Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 3F

DAVIS, G. E.
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 5G

DAVIS, J. A.
Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

DAVIS, R. L.
The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 5C

DAVISON, W.
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 2K

DAY, G. E.
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

DAYANANDA, P. W. A.
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

DE JESUS, A. S. M.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 2F

DE, U. K.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

DEBELAK, K. A.
Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 5D

DECKERS, H.
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 2H

DECOITE, D. C. W.
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 5D

DEDYO, J.
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 5D

DEKKERS, E. M. J.
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 2K

DELPHEY, C. E.
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

DINGMAN, S. L.
Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 6B

DISINGER, J. F.
Project Outcomes Correlate with Public Participation Variables,
W82-02663 6B

DOAN, R. JR.
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 5D

DOLAN, F.
Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 5F

DOMINGUEZ, S. E.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

DONNAN, J.
Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 5E

DONOVAN, E.
Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 5D

DOUGHTY, C.
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

DOWNING, R. H.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

DRAKE, B. G.
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 2L

DRAKIDES, C.
The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 5D

DRATNAL, E.
The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 5C

DRESLER, P. V.
Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

DUCKSTEIN, L.
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

DUNNE, T.
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 2C

DURCHEVA, V. N.
On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 8A

DURVE, V. S.
Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

DUSEK, D. A.
Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 3F

DVORACEK, M. J.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

EDGAR, R. K.
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 2H

EISENMANN, J. L.
Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 5D

ELBERT, W. C.
Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 5B

ELGMORK, K.
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

ELLIS, R. A.
Project Outcomes Correlate with Public Participation Variables,
W82-02663 6B

ELOFF, J. N.
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 5C

ENGEL, P.
Bed Load Discharge Coefficient,
W82-02936 2J

EPIFANOV, A. P.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

ERIKSSON, M. O. G.
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

EVDOKIMOV, P. D.
Calculation of Foundations and Earth Dams,
W82-02689 8D

Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 8D

FAGAN, G. L. JR.
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 2A

FASEHUN, F. E.
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

FEDULOV, A. K.
Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 8A

FERRI, D.
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

FIDDES, D.
Britain's Sewers - Researching for the Future,
W82-02871 5D

FINNELL, L. M.
Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

FISH, E. B.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

FITCH, B.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

FITCH, J. H. JR.
Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 5D

FITZGERALD, C. M.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 5D

FITZGIBBON, J. E.
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 2C

FOMCHENKOV, A. K.
Space-Time Variability of the Runoff of European Rivers,
W82-02848 2E

FORBES, A. M.
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 5C

FORSYTH, D. J.
Zooplankton of Lake Taupo,
W82-02888 2H

FRANKLIN, C.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

FRANZ, D. D.
Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 7B

FREY, J. C.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

FREYTAG, J.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

FRIEDMAN, M.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

FRIMPTER, M. H.
Probable High Ground-Water Levels in Massachusetts,
W82-02829 2F

FRISK, T.
Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

FROBEL, R. K.
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 8G

GABUNIYA, L. S.
Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 8A

GARDNER, R. L.
Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 5B

GARELICK, H.
Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 5A

GAREN, D. C.
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 2A

GARRETT, J. T. JR.
Evaluating a Plant's Potential for Upgrading,
W82-02895 5F

GASS, T.
Injection, Recharge and Return Wells,
W82-02920 4B

GIGER, W.
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1B

GIRARDOT, P-L.
French Experience in Water Pollution Control,
W82-02765 5G

GLADILIN, A. M.
Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 8D

GLASSMAN, D. L.
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 5B

GLOOR, R.
Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

GLOYNA, E. F.
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D

GOLDEN, H. G.
Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

GOLDSTEIN, N.
Current Policies on Land Application,
W82-02629 5E

GORNSHTEIN, M. YU.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

GOTTSCHING, L.
New Developments in Papermaking in Western Europe,
W82-02947 5D

GOYAL, S. K.
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 2F

GRAF, W. H.
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1B

GRAHAM, M. S.
Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 5C

GREEY, G. W.
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 6B

GRIFFITHS, G. A.
Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 2J

GRITSCHKE, M.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

GRUDININ, M. P.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

GRUNINGER, R. M.
Chemical Coagulation of Surface Water,
W82-02623 5F

GUARINO, C. F.
Treatment Plant Features Ultraviolet Disinfection,
W82-02644 5D

GUJER, W.
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1B

GULARTE, R. C.
Erosion Resistance of Cohesive Soils,
W82-02676 2J

GUPTA, P. K.
Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

GURTOVNIK, F. I.
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

HAMA, T.
Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 5A

HAMEED, H. A.
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 5C

HAMILTON, A. D.
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 2L

HAMMETT, K. M.
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

HAMMOND, R. E.
Water Regulation in an Inflationary Environment,
W82-02701 5F

HANDA, N.
Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 5A

HANISAK, M. D.
Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 5D

HANLON, R. D. G.
Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 2H

HAQUE, M. I.
Urban Catchment Models: A Brief Examination,
W82-02813 4C

HARADA, E.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

HARRIS, D. L.
Tides and Tidal Datums in the United States,
W82-02982 2A

HARRISON, D.
Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

HARRISON, H.
An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

HASHIMOTO, T.
Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 6A

HATCHER, P. G.
Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 5A

HEANEY, S. I.
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 2K

HEATWOLE, C. G.
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 4B

HENRIKSON, L.
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

HENSCHKE, C. J.
Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 2F

HERBERT, R.
Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 2F

HESSE, C. S.
Recreational Water Quality and Health,
W82-02997 5C

HICKMAN, R. E.
Engineering Responds to Ecology,
W82-02935 5D

HINTON, G. C. F.
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

HIRSCH, R. M.
Stochastic Hydrologic Model for Drought Management,
W82-02897 2E

HOBBIE, J. E.
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 5B

HOBBS, J. M.
Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 3A

HOLFORD, I. C. R.
Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

HORIE, S.
Paleolimnology of Lake Kizaki,
W82-02863 2J

HORNEF, H.
Water Pollution Control in the Federal Republic of Germany,
W82-02766 6E

HORNING, W. B.
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

HOWARD-WILLIAMS, C.
Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 5B

HSIAO, S. I. C.
Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 2C

HUCKABEE, A. J.
Evaluating a Plant's Potential for Upgrading,
W82-02895 5F

HUGHES, G. H.
Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 2E

HUNT, B.
Integral Equation Formulation for Ground-Water Flow,
W82-02716 2F

Seepage from Free Water Above Impermeable Tailings,
W82-02714 5B

HUQ, M. F.
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 5C

HUTCHINSON, I.
Vertical Variation in Stemflow Generation,
W82-02959 2I

HUXSTEP, M. R.
Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 5F

HYODO, M.
Paleolimnology of Lake Kizaki,
W82-02863 2J

IGNATIADES, L.
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02986 5C

IIDA, S.
The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 5A

IL'IN, V. I.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 8D

ILYUSHIN, V. F.
Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 8A

IMBERGER, J.
The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 4C

INMAN, G. W. JR.
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

IRVINE, R. L.
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

ISAACS, L. T.
Integral Equation Formulation for Ground-Water Flow,
W82-02716 2F

Seepage from Free Water Above Impermeable Tailings,
W82-02714 5B

ISAKSEN, H. C.
Protein Recovery from Beef Packing Effluent,
W82-02994 5D

ISHAK, M. M.
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

IVANOV, E. G.
Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 2E

IVANOV, V. A.
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 5A

JACKSON, D.
Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

JACKSON, R. D.
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 7B

JACKSON, W. H.
Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

JACOBS, A.
Energy Management in the Water Works Industry,
W82-02608 5F

JANA, B. B.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

JARNIS, R. W.
Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 5D

JENKINS, T. F.
Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

JENSEN, P. K.
Practical Experiences in Plants Using Activated Carbon,
W82-02788 5F

JOHN, D. M.
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

JOHNSON, D. E.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

JOHNSON, J. D.
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

JOHNSON, W.
Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 5C

JOHNSTON, C. D.
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 2K

JONES, A. J.
Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 8I

JONES, C. A.
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 7B

JONES, F. V.
Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 5C

JONES, J. R.
Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 5B

JOP, K.
Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 5B

JOYNER, B. F.
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

JUDE, D. J.
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

KAHN, P. A.
Wind Aeration in Model Waste Treatment System,
W82-02944 5D

KAPADIA, R. N.
Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 3A

KAPOOR, P. N.
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 2F

KASHEF, A-A. I.
Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

KASPRZAK, K.
The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 5C

KELLER, L. F.
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 4B

KELLY, W. E.
Erosion Resistance of Cohesive Soils,
W82-02676 2J

Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

KEMPER, W. D.
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 3F

KENNICUTT, M. C. II.
Particulate and Dissolved Lipids in Sea Water,
W82-02727 5A

KENYON, G. F.
The Environmental Effects of Hydroelectric Projects,
W82-02632 6G

KETCHUM, L. H. JR.
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

KHALID, R. A.
Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

KHANGAROT, B. S.
Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 5C

KHARE, S. T.
Water Supply and Sanitation Decade Programme,
W82-02757 5F

KHULBE, R. D.
Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 2H

KIESLER, J.
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

KINCAID, D. T.
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

KING, D.
Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 6B

KINNUNEN, K. A. I.
Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

KITCHING, R
Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 2F

KITTEL, J. H.
The Status of Nuclear Waste Management,
W82-02659 5E

KJENSMO, J.
Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 2H

KLEPACKA, B.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 5D

KNEEBONE, W. R.
Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

KNIGHT, D. W.
Boundary Shear in Smooth and Rough Channels,
W82-02711 8B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel,
W82-02792 2L

KNIGHTON, A. D.
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 2E

KOBAYASHI, K.
Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 5D

KOCAN, R. M.
Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 5C

KOGAN, E. A.
Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 8A

KOHL, H. H.
New Antimicrobial Agents for Treatment of Water,
W82-02808 5F

KON'KO, V. V.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

KONOBEYEV, A. G.
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

KONOBEYEVA, V. K.
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

KORCHITS, K. V.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

KORTMANN, R. W.
Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 2H

KOS, P.
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

KOSINSKI, W. K.
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

KOUSSOURIS, T. S.
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 2H

KOWARSKY, J.
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I

KOZIN, V. N.
Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 8A

KRASS, M. S.
Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 4B

KRATZER, C. R.
A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 5C

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

KRISHNAPPAN, B. G.
Ice Cover Effects on Stream Flows and Mixing,
W82-02698 2C

KROPOTKIN, M. A.
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 5A

KRUGER, G. H. J.
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 5C

KUES, G. E.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

KUPERMAN, V. L.
Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 8A

KURITA, H.
On the Sampling Size of Zoobenthos Along a Lake Shore (In Japanese),
W82-02796 2H

LABIB, T. M.
Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 2J

LACHANCE, M.
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

LAMBERT, P. W.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

LANDOLT, M. L.
Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 5C

LANGELAND, A.
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 2H

LARSON, R. A.
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 2K

LASHCHENOV, S. YA.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

LAU, Y. L.
Bed Load Discharge Coefficient,
W82-02936 2J

Ice Cover Effects on Stream Flows and Mixing,
W82-02698 2C

LAULETTA, T.
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 5E

LEWIS, W. M. JR.
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

LI, R-M.
Modeling Rill Density,
W82-02604 2J

LIBBY, L. W.
Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 6B

LIEU, S. M.
Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 7B

LIGGETT, J.
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

LINDBERG, S.
Field Report on a Nonpolluting Bleach Plant,
W82-02793 5D

LINDHOLM, G. F.
Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 2F

LIU, D.
Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 5D

LIU, P. L. F.
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

LOFFREDO, J. C.
A Solution to Spring Ice-Jam Flooding,
W82-02908 2C

LOHRBERG, K.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

LOUIS, C.
Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1B

LUCAS, S.
The Roman Way,
W82-02744 5F

LUDOVICI, P. R.
Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

LYONS, E. E.
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

MACY, J.
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

MAGNUSON, J. J.
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 5C

MAHMOOD, K.
Urban Catchment Models: A Brief Examination,
W82-02813 4C

MALAIYANDI, M.
Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

MALLER, R. A.
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

MALUEG, K. W.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

MALY, E. J.
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

MARLIN, J. C.
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 5A

MARTIN, C.
Control of a Pumping Station by Mini Computer -A Progress Report,
W82-02956 6B

MARTIN, J. D.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

MASSEY, J. E.
Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 2H

MATLAK, E. S.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

MATSUYAMA, M.
Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 2H

MATTER-MULLER, C.
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1B

MAULOOD, B. K.
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

MBAHINZIREKI, G. B.
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 2H

MCCALLUM, I. D.
Zooplankton of Lake Taupo,
W82-02888 2H

MCKAMEY, M. I.
A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 5C

MCLAREN, P.
River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 2E

MCLEAN, R. A. N.
The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 5C

MCNICOL, L. A.
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 5B

MEL'NIKOV, A. K.
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

MELVOLD, R. W.
Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 5A

MENGEL, L. J.
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 5C

MER, G. S.
Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 2H

MERRILL, R.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

MEYER, B. R.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 2F

MICHALENKO, G.
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 6B

MIGNONE, N.
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 5D

MIKHAILOV, I. E.
New Jet-Gate Design,
W82-02691 8C

MIKUCKI, W. J.
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

MILLER, S.
Adsorption on Carbon: Theoretical Considerations,
W82-02658 5D

MINEMURA, H.
On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 2H

MIRZA, A. M.
Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 2J

MISZTAL, M.
Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlo-

dewskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 2H

MITAMURA, O.
Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 2H

MITCHELL, J. K.
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 2G

MIXON, M. N.
Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

MOORE, J. W.
Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

MORAITOU-APOSTOLOPOULOU, M.
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 5C

MORDOVINA, A. N.
Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 8G

MORGAN, J. J.
Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 2K

MORRISON, R. D.
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

MOSLEY, M. P.
Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 2J

MOSS, M. O.
Distribution of Chromobacteria in a Lowland River,
W82-02795 5C

MOSTKOV, V. M.
Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 8A

MURPHY, T. P.
Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 2H

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 2H

MUSICK, J. T.
Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 3F

MYERS, E. A.
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 3C

NAKAHARA, T.
Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 5A

NAKAYAMA, O.
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 5E

NALEPA, T. F.
Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 2H

NEDRIGA, V. P.
Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 8D

NELLIS, M. D.
Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 7B

NELSON, J. D.
Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 7A

NELSON, P. O.
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 5B

NEMINSKII, M. L.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

NEWTON, J. G.
Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

NGO, Q-T.
An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 6D

NIEMI, J. S.
Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

NIKOLAYEV, S. G.
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 2H

NIKOLIN, V. I.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

NORTHROP, R. L.
Recreational Water Quality and Health,
W82-02997 5C

NOVAK, P.
Coefficient of Friction in Conduits with Large Roughness,
W82-02901 8B

NOVATOROV, S. V.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 8A

NULSEN, R. A.
Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 2F

O'BRIEN, J. J.
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

O'CONNOR, J. T.
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

O'LOUGHLIN, E. M.
A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 7B

OAKLEY, S. M.
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 5B

OBENG-ASAMOA, E. K.
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

OBORNE, A. C.
The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 5A

OCANAS SANCHEZ, G.
Optimal Water Reuse Planning,
W82-02736 6A

ODA, K.
The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 5A

OHNO, M.
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 5E

OKALI, D. U. U.
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

OKUSA, S.
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

OLIVE, P.
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 2F

OLSON, R. J.
Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 2A

OSADCHII, L. G.
Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 8A

OSCARSON, H. G.
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

OTSUKA, H.
Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

OULMAN, C. S.
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

PAGE, C.
Reliability of Water Resources,
W82-02749 6A

PALACIOS, E. V.
Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 3F

PALAZZO, A. J.
Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

PANDYA, V. P.
Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 3A

PANFILOV, D. F.
The Effect of Wind on Ice Pressure on River Structures,
W82-02668 2C

PARK, W.
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

PARKIN, R. B.
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 2H

PARLANGE, J. Y.
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

PARTHIOT, F.
Development of the River Seine Estuary: Case Study,
W82-02867 2L

PATEL, G. N.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

PATRICK, W. H. JR.
Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 5D

PAWLOWSKI, L.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 5D

PECK, A. J.
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 2K

PECK, J. C.
Legal Questions and Problems of Kansas Groundwater Management Districts,
W82-02802 6E

PENNING-ROWSELL, E. C.
Computer Modeling of Flood Alleviation Benefits,
W82-02957 6B

PENROSE, J. D.
Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 2L

PEPPER, I. L.
Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

PERRY, P. F.
Demand Forecasting in Water Supply Networks,
W82-02926 6D

PETERSON, C. M.
By-Product Recovery Finances Treatment,
W82-02756 5D

PETROFF, R.
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 5D

PFOHL, R.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

PHETHEAN, S. J.
Recent Inshore Sediments in Musandam, Oman,
W82-02857 2J

PHILLIPS, L. A.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

PHOTIS, J. D.
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 2H

PIRBAZARI, M.
Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 5D

PITKAT, C.
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

PLAKIDA, M. E.
Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 8B

PODDUBNYY, A. G.
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

POLPRASERT, C.
Wind Aeration in Model Waste Treatment System,
W82-02944 5D

PONCE, V. M.
Modeling Circulation in Depth-Averaged Flow,
W82-02679 2E

Modeling Rill Density,
W82-02604 2J

POON, C. P. C.
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

POTVIN, L.
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 2K

PRETORIUS, J. A.
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 5C

PRIDDLE, J.
The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 2H

PRINCE, E. D.
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 5C

PROSSER, D. W.
A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 2F

PUCHKOVA, S. M.
On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 8A

PYLE, R.
Coefficient of Friction in Conduits with Large Roughness,
W82-02901 8B

QUINONES, F.
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

RAE, J. E.
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

RAMANA, Y. V.
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

RAMEY, D. S.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

RANGO, A.
Microwave Measurements of Snowpack Properties,
W82-02646 2C

RAO, N. H.
Ground-Water Recharge from Rectangular Areas,
W82-02791 2F

RAZZORENOV, F. F.
Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 7B

READ, M.
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 2L

REARDON, E. J.
Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 5B

REID, T. A.
Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 8B

REYNOLDS, P. J.
Environmental Implications and Assessments of Hydroelectric Projects,
W82-02596 6G

RHEE, J. J.
The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 6A

RHENALS, A. E.
The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 2D

RHOADES, J. W.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

RISIK, N. S.
Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 2L

ROBERTS, M. C.
Vertical Variation in Stemflow Generation,
W82-02959 2I

ROBERTS, M. H. JR.
Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 5C

ROBERTS, P. V.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 5D

ROBERTSON, A.
Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 2H

ROBINSON, L. W.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

ROCKWELL, A. L.
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 2K

ROGERS, P. P.
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

ROSE, C. W.
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

ROSENBERG, S. H.
Recreational Water Quality and Health,
W82-02997 5C

ROSS, A. H.
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I

ROUX, P. H.
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 5F

ROY, S. K.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

RYALL, C.
Distribution of Chromobacteria in a Lowland River,
W82-02795 5C

RYALL, M.
The Cone Pump,
W82-02713 8C

RYALS, G. N.
Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

RYMAREVICH, V. I.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

SABEY, J. D.
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 3F

SADLER, B. S.
The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 4D

SAIJO, Y.
Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 2H

SAKSONOV, M. N.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

SANTO, L. T.
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 7B

SARKISYAN, A. V.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 2A

SARMA, P. B. S.
Ground-Water Recharge from Rectangular Areas,
W82-02791 2F

SASTRI, V. S.
Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

SATI, S. C.
Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 2H

SAVAGE, A. A.
The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 2H

SAVIN, D. M.
Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 8A

SAY, P. J.
Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

SCHEIBLE, O. K.
Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 5D

SCHLESINGER, H. A.
Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 5E

SCHNEEBERGER, P. J.
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 8I

SCHOENHOLTZ, S.
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

SCHOONBEE, H. J.
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 2H

SCHUBERT, J.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 5F

SCHWITZGEBEL, K.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

SCOTT, J. C.
Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

SCUTT, J. E.
Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 5A

SEDGLEY, R. H.
Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 3F

SENDLEIN, L. V. A.
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 5B

SERKOV, V. S.
Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 8A

SHABMAN, L.
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

SHAH, R.
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 5E

SHARMA, M. L.
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

SHARP, K.
Advanced Sludge Treatment for Modern Waterworks,
W82-02889 5D

SHCHAVELEV, N. F.
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 8A

Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 8A

SHEN, J.
Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 8B

SHEPHERD, K. J.
South Australia's Approach to Salinity Management in the River Murray,
W82-02761 5G

SHERMAN, D.
Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

SHERRARD, J. H.
Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 5D

AUTHOR INDEX

SHEVELEVA, T. YU.
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 5A

SHIEH, W. K.
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

SHUTENKOV, S. V.
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 8A

SIL'NITSKII, V. I.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

SIMONS, D. B.
Modeling Rill Density,
W82-02604 2J

SIMS, C. A.
Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 5D

SINGH, G.
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 5F

SINGH, V. P.
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 2A

SINK, C. H.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 5D

SLANINA, J.
Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 2K

SMART, M. M.
Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 5B

SMEERS, Y.
Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 5D

SMITH, D. R.
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 5B

SMITH, E. D.
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

SMITH, E. P.
On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 5A

SMITH, R. E.
Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 3F

SMITH, S.
Ozone Water Treatment,
W82-02682 5F

SMOCK, L. A.
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H

SNELL, L. J.
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

SNOEYINK, V. L.
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

SOKOLOV, Y. N.
Hydraulic Resistance of Floodplains,
W82-02850 2E

SORENSEN, P. B.
By-Product Recovery Finances Treatment,
W82-02756 5D

STAHL, J. B.
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 2H

STANLEY, D. W.
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 5B

STANNERS, D. A.
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 5B

STATZNER, B.
The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 5C

STEPHENSON, D.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 2F

STEPHENSON, R. A.
The Development of a Village Water Supply System on Truk,
W82-02816 5F

STILES, W. H.
Microwave Measurements of Snowpack Properties,
W82-02646 2C

STOM, D. I.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

STONEBURNER, D. L.
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H

STOUT, R. J.
How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 7A

STOVER, E. L.
Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 5D

STROMBERG, P. T.
Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 5C

SUEHIRO, S.
Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

SUFFERN, J. S.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 5D

SUFFLING, R.
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 6B

SULLAVAN, J. N.
Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 2E

SUND-HAGELBERG, C.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

SUNDARESAN, B. B.
Water Supply and Sanitation Decade Programme,
W82-02757 5F

SUNG, W.
Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 2K

SUSAN, J. A.
Chemical Coagulation of Surface Water,
W82-02623 5F

SUTHERLAND, J. C.
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 3C

SUTTON, P. M.
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

SUZUKI, S.
Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 5D

SVENSSON, J.
By-Product Recovery Finances Treatment,
W82-02756 5D

SVENSSON, S. A.
Lake Vattern,
W82-02755 2H

SWANEPOEL, J. H.
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 2H

SZLUHA, A. T.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 5D

TAN, R. Y.
Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 8A

TANAKA, N.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

TANQUE, E.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

TARAS, M. J.
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

TENNANT, D.
Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 3F

TERRY, J. C.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

TEZUKA, Y.
Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 5C

THANH, N. C.
Wind Aeration in Model Waste Treatment System,
W82-02944 5D

THOMAS, G. L.
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 6G

THOMAS, R. E.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

THORNE, R. E.
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 6G

TILLERY, J. B.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 5A

TIMOSHCHUK, V. I.
Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 2L

TISCHLER, L. F.
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D

TOETZ, D. W.
Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 5G

TORPEY, W.
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 5D

TOTH, L. G.
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 7B

TROFE, T. W.
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 5B

TRUKHIN, YU. G.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 8B

TSANG, C. F.
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

TSUGITA, R. A.
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 5D

TSUNOGAI, S.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

TUCCI, C. E. M.
Unsteady Water Quality Model for River Network,
W82-02873 5G

TUITE, C. H.
Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 2H

TULLIS, J. P.
Modeling Cavitation for Closed Conduit Flow,
W82-02700 8B

TYREE, S. Y. JR.
Rainwater Acidity Measurement Problems,
W82-02627 5A

TYTECA, D.
Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 5D

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 5D

TYVAND, P. A.
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 2F

UEHARA, G.
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 7B

UEMATSU, M.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

UJJAINWALLA, S. H.
Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 6G

ULABY, F. T.
Microwave Measurements of Snowpack Properties,
W82-02646 2C

ULLMAN, W. J.
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 2K

URBAN, L. V.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

VACCARO, J. J.
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

VAGNER, V. N.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 8A

VAN ASWEGEN, I. S.
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 2H

VAN HOUSE, M. P.
A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 5B

VAN'T WOUDT, B. D.
Local Flow Accelerations in Rivers,
W82-02758 2E

VAN VLIET, B. M.
Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 5D

VANGENECHTEN, J. H. D.
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 2H

VEDULA, S.
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

VENKATANARAYANA, B.
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 8E

VERDOUW, H.
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 2K

VIL'VOVSKII, V. V.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 8A

VINCENT, W. F.
Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 2C

VITA-FINZI, C.
Recent Inshore Sediments in Musandam, Oman,
W82-02857 2J

VOEGTLY, N. E.
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

WALKER, T.
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 2L

WALL, D.
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 2H

WALLIN, B. K.
Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 5D

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

WALSH, G. E.
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

WANKOFF, W.
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 5E

WARD, J. C.
Protein Recovery from Beef Packing Effluent,
W82-02994 5D

WARD, R. C.
Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 7A

WARDEN, J. H.
Advanced Sludge Treatment for Modern Waterworks,
W82-02889 5D

WARNER, R. E.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

WATANABE, Y.
The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 5C

WAYLEN, P.
Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 2E

WEBER, J. W.
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 4B

WEBER, W. J. JR.
Application of Adsorption to Wastewater Treatment,
W82-02622 5D

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 5D

WEIBEZAHN, F. H.
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

WELDER, G. E.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

WEST, R. H.
Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 5A

WHEATCRAFT, S. W.
Atoll Island Hydrology,
W82-02617 2F

WHEATLEY, W. B.
New Antimicrobial Agents for Treatment of Water,
W82-02808 5F

WHITEHEAD, D.
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

WHITTON, B. A.
Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 6G

WICKERSHAM, G.
A Preliminary Survey of State Ground-Water Laws,
W82-02616 6E

WILLIAMS, E. B.
Fundamental Concepts of Well Design,
W82-02614 8A

WILLIAMS, P. J.
The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 4D

WILLIAMSON, D. R.
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 2K

WILLIAMSON, K. J.
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 5B

WILSON, R. E.
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 2L

WINTER, S. J.
The Development of a Village Water Supply System on Truk,
W82-02816 5F

WINTERINGHAM, F. P. W.
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

WITHEROW, J. L.
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 5D

WIUFF, R.
Distribution of Wastewater in Drain Field Pipes,
W82-02945 8B

WONG, R. L. J.
Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

WOO, M-K.
Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 2E

WOOD, C. M.
Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 5C

WOOD, I. R.
Instrumentation for Aerated Flow on Spillways,
W82-02880 7B

Measurements of Self-Aerated Flow on a Spillway,
W82-02715 8B

WOOD, W. W.
A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 2F

WORLEY, S. D.
New Antimicrobial Agents for Treatment of Water,
W82-02808 5F

WORTHINGTON, P. F.
Preparation of Friable Aquiferous Specimens,
W82-02955 2F

WREN, W. C.
Treatment Plant Features Ultraviolet Disinfection,
W82-02644 5D

WROBLEWSKI, J. S.
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

YABUSAKI, S. B.
Modeling Circulation in Depth-Averaged Flow,
W82-02679 2E

YAHNKE, J. W.
Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

YAKOVENKO, P. I.
Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 4B

YAMAMOTO, A.
Paleolimnology of Lake Kizaki,
W82-02863 2J

YASKAWA, K.
Paleolimnology of Lake Kizaki,
W82-02863 2J

YAZICIGIL, H.
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 5B

YOKOYAMA, T.
Paleolimnology of Lake Kizaki,
W82-02863 2J

YOSHIKURA, T.
The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 5A

YOUNG, G. J.
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 2C

YU, K. Y.
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

ZALEWSKI, R.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 5D

ZARANDIYA, G. YA.
Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 8A

ZHOKHOV, E. I.
Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 8A

ZIL'BERG, V. S.
Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 4B

ZIMBELMAN, D. D.
Computerized Control of an Open-Channel Water Distribution System,
W82-02732 4A

ZINI, Q.
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

ZOGORSKI, J. S.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

ZWAMBORN, J. A.
Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 8A

[illegible]

[illegible]
A Preliminary Survey [illegible]
[illegible]

[illegible]

ORGANIZATIONAL INDEX

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, AVONDALE, PA. STROUD WATER RESEARCH CENTER.
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 2K

ACUREX CORP., MOUNTAIN VIEW, CA.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 5D

AICHI ENVIRONMENTAL RESEARCH CENTER, NAGOYA (JAPAN).
Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 5B

AKADEMIA ROLNICZA, LUBIN (POLAND), INST. GLEBOZNAWSTWA I CHEMII ROLNEJ.
Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area
W82-02752 2H

AKADEMIYA NAUK ARMYANSKOI SSR, HYDROBIOLOGICAL STATION.
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 2H

AKADEMIYA NAUK SSSR, BOROK. INST. BIOLOGII VNUTRENNYKH VOD.
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Space-Time Variability of the Runoff of European Rivers,
W82-02848 2E

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 2E

ALBERTA ENVIRONMENTAL CENTER, VEGREVILLE.
Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 2H

ALL-UNION SCIENTIFIC-RESEARCH INST. OF HYDROGEOLOGY AND ENGINEERING GEOLOGY, MOSCOW (USSR).
Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 2A

ANGLIAN WATER AUTHORITY (ENGLAND).
Reliability of Water Resources,
W82-02749 6A

ARGONNE NATIONAL LAB., IL.
The Status of Nuclear Waste Management,
W82-02659 5E

ARIZONA STATE UNIV., TEMPE.
Computerized Control of an Open-Channel Water Distribution System,
W82-02732 4A

ARIZONA STATE UNIV., TEMPE. DEPT. OF LEISURE STUDIES.
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 6B

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER AND ENGINEERING.
Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 3C

ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS AND INDUSTRIAL ENGINEERING.
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 8B

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL LAB.
Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 5B

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Wind Aeration in Model Waste Treatment System,
W82-02944 5D

ATHENS UNIV. (GREECE). ZOOLOGICAL LAB. AND MUSEUM.
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 5C

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 5B

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
New Antimicrobial Agents for Treatment of Water,
W82-02808 5F

BATH UNIV. (ENGLAND). SCHOOL OF BIOLOGICAL SCIENCES.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 2I

BILLERUD-UDDEHOLM A. B., SKOGHALL (SWEDEN).
Field Report on a Nonpolluting Bleach Plant,
W82-02793 5D

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Boundary Shear in Smooth and Rough Channels,
W82-02711 8B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel,
W82-02792 2L

BRISTOL UNIV. (ENGLAND). DEPT. OF ZOOLOGY.
Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 2H

BRITISH MUSEUM OF NATURAL HISTORY LONDON (ENGLAND). DEPT. OF BOTANY.
Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 2H

BUREAU OF RECLAMATION, DENVER, CO. LOWER MISSOURI REGION.
Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 6G

BUREAU OF RECLAMATION, SACRAMETO, CA. MID-PACIFIC REGION.
West Sacramento Canal Unit Reformulation.
W82-02974 6B

CAIRO UNIV., GIZA (EGYPT). DEPT. OF NATURAL RESOURCES.
Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 2J

CALIFORNIA INST. OF TECH., PASADENA. W. M. KECK LAB. OF ENVIRONMENTAL ENGINEERING SCIENCE.
Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 2K

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 4B

CALIFORNIA UNIV., DAVIS. DEPT. OF AGRONOMY AND RANGE SCIENCES.
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 3F

CALIFORNIA UNIV., LOS ANGELES. OFFICE OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 5C

CALSCIENCE RESEARCH, INC., HUNTINGTON BEACH, CA.
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 5B

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Ice Cover Effects on Stream Flows and Mixing,
W82-02698 2C

CANTERBURY UNIV., CHRISTCHURCH (NEW ZEALAND).
Integral Equation Formulation for Ground-Water Flow,
W82-02716 2F

CANTERBURY UNIV. CHRISTCHURCH (NEW ZEALAND). DEPT. OF AGRICULTURAL ENGINEERING.
Local Flow Accelerations in Rivers,
W82-02758 2E

CAPRICORNIA INST. OF ADVANCED EDUCATION, ROCKHAMPTON (AUSTRALIA). DEPT. OF BIOLOGY.
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 8I

CENTEC CORP., RESTON, VA.
Group Treatment Evaluation for Metal Finishers,
W82-02995 5D

CHAMPLAIN WATER DISTRICT, SOUTH BURLINGTON, VT.
Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 5B

CHARLOTTE HARBOR WATER ASSOCIATION, INC., HARBOUR HEIGHTS, FL.
Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 5F

CHEMICAL RECOVERY SYSTEMS, HANOVER, MA.
Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 5D

CHICAGO UNIV., IL. DEPT. OF GEOPHYSICAL SCIENCES.
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 2K

COASTAL ENGINEERING RESEARCH CENTER, FORT BELVOIR, VA.
Tides and Tidal Datums in the United States,
W82-02982 2A

COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 5D

COLORADO DIV. OF WILDLIFE, FORT COLLINS. RESEARCH CENTER.
Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 6G

COLORADO STATE UNIV., FORT COLLINS.
Protein Recovery from Beef Packing Effluent,
W82-02994 5D

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Modeling Rill Density,
W82-02604 2J

COLORADO UNIV., BOULDER. DEPT. OF ENVIRONMENTAL, POPULATION, AND ORGANISMIC BIOLOGY.
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 2H

COLORADO UNIV., DENVER. GRADUATE SCHOOL OF PUBLIC AFFAIRS.
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 4B

COLUMBIA UNIV., NEW YORK.
Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 8A

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An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF FOREST RESEARCH.
A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 7B

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, WEMBLEY (AUSTRALIA). DIV. OF LAND RESOURCES MANAGEMENT.
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 2K

COMPAGNIE GENERALE DES EAUX, PARIS (FRANCE).
French Experience in Water Pollution Control,
W82-02765 5G

CONCORDIA UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 2H

CONNECTICUT UNIV., STORRS. DEPT. OF BIOLOGICAL SCIENCES.
Functional Relationships Between Nutrient Dynamics, Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 2H

CONSIGLIO NAZIONAL DELE RICERCHE, BOLOGNA (ITALY).
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 5A

CORNELL UNIV., ITHACA, NY.
Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 6A

CORNELL UNIV., ITHACA, NY. DIV. OF BIOLOGICAL SCIENCES.
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 4D

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 8B

CORNELL UNIVERSITY, ITHACA, NY.
Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 5C

CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 5C

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 5B

COWICONSULT, VIRUM (DENMARK).
Distribution of Wastewater in Drain Field Pipes,
W82-02945 8B

CREWE AND ALSAGER COLL., ALSAGER (ENGLAND).
The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 2H

DALHOUSIE UNIV., HALIFAX (NOVA SCOTIA). DEPT. OF OCEANOGRAPHY.
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 2L

DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.
A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 5B

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Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
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Zooplankton of Lake Taupo,
W82-02888 2H

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). FRESHWATER SECTION.
Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
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A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 2F

DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO). INLAND WATERS DIRECTORATE.
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 2C

DISTRICT OF COLUMBIA UNIV., WASHINGTON. DEPT. OF ENVIRONMENTAL SCIENCE.
Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 8I

DOMTAR LTD. RESEARCH CENTRE, SENNEVILLE (ONTARIO).
The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 5C

DORR-OLIVER, INC., STAMFORD, CT.
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 5D

DURHAM UNIV. (ENGLAND). DEPT. OF BOTANY.
Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 5C

EAST AFRICAN FRESHWATER FISHERIES RESEARCH ORGANIZATION, JINJA (UGANDA).
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 2H

EAST SURREY WATER CO. (ENGLAND).
Advanced Sludge Treatment for Modern Waterworks,
W82-02889 5D

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (SWITZERLAND).
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1B

ECOLOGICAL ANALYSTS, INC., OAK RIDGE, TN.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 5D

EG AND G, BIONOMICS, WAREHAM, MA.
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 5C

EIDGENOESSESCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU, HYDROLOGIE UND GLAZIOLOGIE.
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1B

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 5F

ENVIRONMENTAL PROTECTION AGENCY, GULF BREEZE, FL.
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 5C

ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, NC. UTILITIES AND INDUSTRIAL POWER DIV.
Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 3E

EOTVOS LORAND UNIV., BUDAPEST (HUNGARY). DEPT. OF PLANT SYSTEMATICS AND ECOLOGY.
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 7B

ESCUELA NACIONAL DE AGRICULTURA, CHAPINGO (MEXICO). COLEGIO DE POSTGRADUADOS.
Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 3F

FEDERAL ENERGY REGULATORY COMMISSION, SAN FRANCISCO, CA. SAN FRANCISCO REGIONAL OFFICE.
Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 6D

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF GEOLOGY.
Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 5A

FLORIDA UNIV., GAINESVILLE. WATER RESOURCES RESEARCH CENTER.
Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 5B

FOREST RESEARCH INST., CHRISTCHURCH (NEW ZEALAND).
Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 2J

FREESE AND NICHOLS, FORT WORTH, TX.
Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 8B

FREESE AND NICHOLS, INC., AUSTIN, TX.
Evaluating a Plant's Potential for Upgrading,
W82-02895 5F

FRESHWATER BIOLOGICAL ASSOCIATION, WINDERMERE (ENGLAND).
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 2K

GENTOFTE WATER SUPPLY (DENMARK).
Practical Experiences in Plants Using Activated Carbon,
W82-02788 5F

GEOLOGICAL SURVEY, ALEXANDRIA, LA. WATER RESOURCES DIV.
Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 2F

GEOLOGICAL SURVEY, ANCHORAGE, AK. WATER RESOURCES DIV.
Water Resources Data for Alaska, Water Year 1980.
W82-02845 7C

GEOLOGICAL SURVEY, BISMARCK, ND. WATER RESOURCES DIV.
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 4A

GEOLOGICAL SURVEY, BOSTON, MA. WATER RESOURCES DIV.
Probable High Ground-Water Levels in Massachusetts,
W82-02829 2F

GEOLOGICAL SURVEY, CHEYENNE, WY. WATER RESOURCES DIV.
Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 7C

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Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 5B

GEOLOGICAL SURVEY, HURON, SD. WATER RESOURCES DIV.
Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 2F

GEOLOGICAL SURVEY, INDIANAPOLIS, IN. WATER RESOURCES DIV.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 6B

GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.
Water Resources Data for Mississippi, Water Year 1980.
W82-02847 7C

GEOLOGICAL SURVEY, LAKEWOOD, CO.
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 2F

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Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 2E

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 7C

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 2E

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Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1A

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 2L

GEOLOGICAL SURVEY, PASCO, WA. WATER RESOURCES DIV.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 7C

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 8B

Stochastic Hydrologic Model for Drought Management,
W82-02897 2E

GEOLOGICAL SURVEY, ST. PAUL, MN. WATER RESOURCES DIV.
Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 2F

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 2F

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 2E

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 2H

GEOLOGICAL SURVEY, UNIV., AL. WATER RESOURCES DIV.
Geology and Water Availability of Dallas County, Alabama,
W82-02833 6D

GEORGE WASHINGTON UNIV., WASHINGTON, DC.
Urban Catchment Models: A Brief Examination,
W82-02813 4C

GEOTECHNICAL CONSULTANTS, INC., SAN FRANCISCO, CA.
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 2G

GIBBS AND HILL, INC., NEW YORK.
Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 5E

GOETEBORG UNIV. (SWEDEN). DEPT. OF ZOOLOGY.
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 5C

GRIFFITH UNIV., NATHAN (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 5B

GROUND WATER ASSOCIATES, INC., WESTERVILLE, OH.
Fundamental Concepts of Well Design,
W82-02614 8A

GUAM UNIV., AGANA. WATER AND ENERGY RESEARCH INST.
The Development of a Village Water Supply System on Truk,
W82-02816 5F

HARBOR BRANCH FOUNDATION, INC., FORT PIERCE, FL.
Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 5D

HARVARD UNIV., CAMBRIDGE.
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 2I

HAWAII UNIV., HONOLULU. DEPT. OF BOTANY.
Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 2H

HAWKSLEY (WATSON), HIGH WYCOMBE (ENGLAND).
Coefficient of Friction in Conduits with Large Roughness,
W82-02901 8B

HEALTH AND WELFARE CANADA, OTTAWA (ONTARIO). HEALTH PROTECTION BRANCH.
Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 5D

HOKKAIDO UNIV., HAKODATE (JAPAN). DEPT. OF CHEMISTRY.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 2K

HOUSTON UNIV. AT TEXAS.
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 5F

HUMPHREYS (HOWARD) AND PARTNERS, READING (ENGLAND).
Preparation of Friable Aquiferous Specimens,
W82-02955 2F

HYDROCOMP, INC., MOUNTAIN VIEW, CA.
Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 7B

HYDROQUAL, INC., MAHWAH, NJ.
Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 5D

HYDROSCIENCE, INC., WESTWOOD, NJ.
Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 5D

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Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 2D

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A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 5F

ILLINOIS UNIV. AT THE MEDICAL CENTER, CHICAGO.
Recreational Water Quality and Health,
W82-02997 5C

ILLINOIS UNIV. AT URBANA-CHAMPAIGN.
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 5A

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Demand Forecasting in Water Supply Networks,
W82-02926 6D

INDIAN AGRICULTURAL RESEARCH INST., NEW DELHI (INDIA). WATER TECHNOLOGY CENTER.
Ground-Water Recharge from Rectangular Areas,
W82-02791 2F

INDIAN INST. OF SCIENCE, BANGALORE. DEPT. OF CIVIL ENGINEERING.
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 6A

INDIAN INST. OF TECH., NEW DELHI. DEPT. OF CIVIL ENGINEERING.
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 2F

INLAND WATERS DIRECTORATE, OTTAWA (ONTARIO).
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W82-02896 6G

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W82-02746 3F

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W82-02892 2L

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W82-02917 2F

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W82-02864 2K

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Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 2H

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Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 2H

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Unsteady Water Quality Model for River Network,
W82-02873 5G

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W82-02760 5B

IOWA STATE UNIV., AMES.
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 5F

IOWA STATE UNIV., AMES. DEPT. OF ECONOMICS.
The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 6A

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Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 5C

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W82-02750 5B

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W82-02878 2L

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W82-02748 3A

JOHNSON (C.C.) AND ASSOCIATES, INC., SILVER SPRING, MD.
Chemical Coagulation of Surface Water,
W82-02623 5F

JORDAN (EDWARD C.) CO., INC., PORTLAND, ME.
Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 5D

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 5B

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 5D

KALYANI UNIV. (INDIA). DEPT. OF ZOOLOGY.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 5C

KANSAS UNIV./CENTER FOR RESEARCH, INC., LAWRENCE.
Microwave Measurements of Snowpack Properties,
W82-02646 2C

KANSAS WATER RESOURCES RESEARCH INST., MANHATTAN.
Legal Questions and Problems of Kansas Groundwater Management Districts,
W82-02802 6E

KARLSRUHE UNIV. (GERMANY, F.R.) INST. FUER ZOOLOGISCHES.
The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 5C

KENTUCKY UNIV., LEXINGTON. DEPT. OF CHEMICAL ENGINEERING.
Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 5D

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 5D

KOMEX CONSULTANTS, LTD., CALGARY (ALBERTA).
Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 2J

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W82-02894 2H

KYOTO UNIV. (JAPAN). INST. OF PALEOLIMNOLOGY AND PALEOENVIRONMENT ON LAKE BIWA.
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W82-02863 2J

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W82-02853 5A

LOUISIANA STATE UNIV., BATON ROUGE. LAB. FOR WETLAND SOILS AND SEDIMENTS.
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W82-02996 5D

LOUISIANA TECHNICAL UNIV., RUSTON. DEPT. OF AGRICULTURAL ENGINEERING.
Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 7A

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Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 5D

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 5D

MAIN ADMINISTRATION FOR CONSTRUCTION AND INSTALLATION OF HYDROELECTRIC POWER PLANTS IN THE EAST (USSR).
Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 8A

MARIA-CURIE SKLODOWSKA UNIV., LUBLIN (POLAND). DEPT. OF CHEMICAL TECHNOLOGY.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 5D

MARYLAND UNIV., COLLEGE PARK. WATER RESOURCES RESEARCH CENTER.
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W82-02814 5B

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
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W82-02900 2D

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W82-02631 5C

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W82-02910 2E

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W82-02625 5F

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W82-02608 5F

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W82-02702 5D

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W82-02622 5D

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W82-02633 7A

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Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
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MICHIGAN UNIVERSITY.
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W82-02943 1B

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Comparison of Statistical Phosphorus-Retention Models,
W82-02930 5G

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A Preliminary Survey of State Ground-Water Laws,
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Water Supply and Sanitation Decade Programme,
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W82-02914 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
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Bed Load Discharge Coefficient,
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W82-02850 2E

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Project Outcomes Correlate with Public Participation Variables,
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Obtaining High-Level Wastewater Disinfection with Ozone,
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OREGON STATE UNIV., CORVALLIS. DEPT. OF CIVIL ENGINEERING.
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 5B

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Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
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Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
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W82-02610 2H

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PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY, LAHORE.
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W82-02747 3F

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W82-02877 2F

PEARSON BRIDGE LTD, ST. LEONARDS. (AUSTRALIA).
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W82-02980 6B

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W82-02662 2K

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Seepage from Free Water Above Impermeable Tailings,
W82-02714 5B

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W82-02780 2H

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 2F

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 5D

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL ENGINEERING.
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W82-02676 2J

RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). INST. FOR FRESHWATER STUDIES.
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W82-02724 5B

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The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 5C

ROCKWELL INTERNATIONAL, NEWBURG PARK, CALIFORNIA.
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W82-02964 5A

SAN DIEGO STATE UNIV., CA. DEPT. OF CIVIL ENGINEERING.
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W82-02679 2E

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF GEOGRAPHY.
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W82-02624 2C

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W82-02709 7B

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CA.
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W82-02742 2A

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
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W82-02957 6B

SHEFFIELD UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
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W82-02787 2E

SHIBUKAWA SENIOR GIRLS HIGH SCHOOL, GUNMA (JAPAN).
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W82-02959 2I

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Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
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The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
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Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 5B

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF ZOOLOGY.
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W82-02620 2H

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W82-02870 2F

SOUTHWEST RESEARCH INST., SAN ANTONIO, TX.
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W82-02999 5A

SOUTHWESTERN GREAT PLAINS RESEARCH CENTER, BUSHLAND, TX.
Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 3F

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
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W82-02989 5D

STATE UNIV. OF NEW YORK AT STONY BROOK. MARINE SCIENCES RESEARCH CENTER.
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W82-02657 2L

SULAIMANIYAH UNIV. (IRAQ). DEPT. OF BIOLOGY.
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W82-02777 6G

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W82-02795 5C

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W82-02767 6D

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Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 5G

TEXAS A AND M UNIVERSITY, COLLEGE STATION.
Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 5C

TEXAS A AND M UNIVERSITY, COLLEGE STATION. DEPARTMENT OF OCEANOGRAPHY.
Particulate and Dissolved Lipids in Sea Water,
W82-02727 5A

TEXAS TECH UNIV., LUBBOCK. DEPT. OF CIVIL ENGINEERING.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 5B

TEXAS TECH UNIV., LUBBOCK. DEPT. OF GEOSCIENCE.
A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 2F

TEXAS UNIV. AT AUSTIN.
Optimal Water Reuse Planning,
W82-02736 6A

TEXAS UNIV. AT AUSTIN. ENGINEERING DEPARTMENT. DEPT. OF ENGINEERING.
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 5D

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Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 8D

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W82-02797 5C

The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 5C

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W82-02717 5D

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W82-02776 5C

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W82-02857 2J

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W82-02712 5A

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W82-02778 2H

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W82-02876 5A

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W82-02700 8B

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). INST. VOOR METEOROLOGIE EN OCEANOGRAFIE.
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W82-02874 2K

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W82-02683 5D

VIRGINIA COMMONWEALTH UNIV., RICHMOND. DEPT. OF BIOLOGY.
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 2H

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. COLL. OF ARCHITECTURE AND URBAN STUDIES.
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W82-02801 5B

VIRGINIA STATE HEALTH DEPT., RICHMOND.
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W82-02704 5D

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W82-02882 2H

WASHINGTON UNIV., SEATTLE.
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W82-02671 5A

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W82-02977 6G

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W82-02979 5C

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 2A

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 2K

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Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 8G

WATER POLLUTION CONTROL AUTHORITY, VERNON, CT.
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 5D

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Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 3A

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W82-02931 5E

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WEIR PUMPS LTD., GLASGOW (SCOTLAND).
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W82-02713 8C

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W82-02754 3F

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W82-02762 4C

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Acoustic Reflection from Estuarine Pycnoclines,
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Engineering Responds to Ecology,
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Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 5C

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Rainwater Acidity Measurement Problems,
W82-02627 5A

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Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 3C

WISCONSIN UNIV., LA CROSSE. RIVER STUDIES CENTER.
Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 5B

WISCONSIN UNIV.-MADISON.
An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 6D

WISCONSIN UNIV.-MADISON. LAB. OF LIMNOLOGY.
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 5C

YAMANASHI UNIV., KOFU (JAPAN). DEPT. OF ENVIRONMENTAL ENGINEERING.
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 5E

YARMOUK UNIV., IRBID (JORDAN). DEPT. OF CIVIL ENGINEERING.
Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 4A

YORKSHIRE WATER AUTHORITY (ENGLAND).
The Cost of Quality,
W82-02881 5F

ACCESSION NUMBER INDEX

W82-02601 8G
W82-02602 5D
W82-02603 5E
W82-02604 2J
W82-02605 6B
W82-02606 3E
W82-02607 3F
W82-02608 5F
W82-02609 8B
W82-02610 2H
W82-02611 5B
W82-02612 2F
W82-02613 5F
W82-02614 8A
W82-02615 5B
W82-02616 6E
W82-02617 2F
W82-02618 7A
W82-02619 2F
W82-02620 2H
W82-02621 5D
W82-02622 5D
W82-02623 5F
W82-02624 2C
W82-02625 5F
W82-02626 5C
W82-02627 5A
W82-02628 5B
W82-02629 5E
W82-02630 5C
W82-02631 5C
W82-02632 6G
W82-02633 7A
W82-02634 2I
W82-02635 5D
W82-02636 2F
W82-02637 2E
W82-02638 2C
W82-02639 5C
W82-02640 5D
W82-02641 5D
W82-02642 5D
W82-02643 3C
W82-02644 5D
W82-02645 3C
W82-02646 2C
W82-02647 5B
W82-02648 2K
W82-02649 2C
W82-02650 3C
W82-02651 5B
W82-02652 6E
W82-02653 4D
W82-02654 5C
W82-02655 2H
W82-02656 2K
W82-02657 2L
W82-02658 5D
W82-02659 5E
W82-02660 5F
W82-02661 2L
W82-02662 2K
W82-02663 6B
W82-02664 2H
W82-02665 2K
W82-02666 8A
W82-02667 8D
W82-02668 2C
W82-02669 8A
W82-02670 8A
W82-02671 5A
W82-02672 5A
W82-02673 5D
W82-02674 5D
W82-02675 5D
W82-02676 2J
W82-02677 8B
W82-02678 2A
W82-02679 2E
W82-02680 2G
W82-02681 5F
W82-02682 5F
W82-02683 5D
W82-02684 5D
W82-02685 5F
W82-02686 5C
W82-02687 8I
W82-02688 5C
W82-02689 8D
W82-02690 8A
W82-02691 8C
W82-02692 8D
W82-02693 8A
W82-02694 8B
W82-02695 8B
W82-02696 2H
W82-02697 6C
W82-02698 2C
W82-02699 8B
W82-02700 8B
W82-02701 5F
W82-02702 5D
W82-02703 5D
W82-02704 5D
W82-02705 5D
W82-02706 5D
W82-02707 5D
W82-02708 5C
W82-02709 7B
W82-02710 5C
W82-02711 8B
W82-02712 5A
W82-02713 8C
W82-02714 5B
W82-02715 8B
W82-02716 2F
W82-02717 5D
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W82-02721 2F
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W82-02727 5A
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W82-02729 5D
W82-02730 5C
W82-02731 5F
W82-02732 4A
W82-02733 2A
W82-02734 6A
W82-02735 6D
W82-02736 6A
W82-02737 6A
W82-02738 5C
W82-02739 7B
W82-02740 4B
W82-02741 5A
W82-02742 2A
W82-02743 8A
W82-02744 5F
W82-02745 2H
W82-02746 3F
W82-02747 3F
W82-02748 3A
W82-02749 6A
W82-02750 5B
W82-02751 5C
W82-02752 2H
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W82-02754 3F
W82-02755 2H
W82-02756 5D
W82-02757 5F
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W82-02759 2H
W82-02760 5B
W82-02761 5G
W82-02762 4C
W82-02763 4D
W82-02764 2K
W82-02765 5G
W82-02766 6E
W82-02767 6D
W82-02768 2H
W82-02769 2I
W82-02770 2F
W82-02771 8A
W82-02772 2A
W82-02773 8A
W82-02774 5A
W82-02775 2H
W82-02776 5C
W82-02777 6G
W82-02778 2H
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W82-02789 5C
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W82-02791 2F
W82-02792 2L
W82-02793 5D
W82-02794 8A
W82-02795 5C
W82-02796 2H
W82-02797 5C
W82-02798 2H
W82-02799 5E
W82-02800 8I
W82-02801 5B
W82-02802 6E
W82-02803 2A
W82-02804 6B
W82-02805 5B
W82-02806 5F
W82-02807 5G
W82-02808 5F
W82-02809 3F
W82-02810 2H
W82-02811 5B
W82-02812 8I
W82-02813 4C
W82-02814 5B
W82-02815 5D
W82-02816 5F
W82-02817 3C
W82-02818 5B
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W82-02820 5B
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W82-02822 5B
W82-02823 5G
W82-02824 5B
W82-02825 6B
W82-02826 2E
W82-02827 7C
W82-02828 4A
W82-02829 2F
W82-02830 1A
W82-02831 2L
W82-02832 2L
W82-02833 6D
W82-02834 2E
W82-02835 7C
W82-02836 2F
W82-02837 2E
W82-02838 2F
W82-02839 2F
W82-02840 6B
W82-02841 5B
W82-02842 8B
W82-02843 2H
W82-02844 2F
W82-02845 7C
W82-02846 7C
W82-02847 7C
W82-02848 2E
W82-02849 4B
W82-02850 2E
W82-02851 2A
W82-02852 4B
W82-02853 5A
W82-02854 2E
W82-02855 6A
W82-02856 4A
W82-02857 2J
W82-02858 8A
W82-02859 2H
W82-02860 2H
W82-02861 2H
W82-02862 2C
W82-02863 2J
W82-02864 2K
W82-02865 2H
W82-02866 7B
W82-02867 2L
W82-02868 8A
W82-02869 2H
W82-02870 2F
W82-02871 5D
W82-02872 5D
W82-02873 5G
W82-02874 2K
W82-02875 2J
W82-02876 5A
W82-02877 2F
W82-02878 2L
W82-02879 2J
W82-02880 7B
W82-02881 5F
W82-02882 2H
W82-02883 2H
W82-02884 2D
W82-02885 2J
W82-02886 5C
W82-02887 2H
W82-02888 2H
W82-02889 5D
W82-02890 8E
W82-02891 8D
W82-02892 2L
W82-02893 2K
W82-02894 2H
W82-02895 5F
W82-02896 6G
W82-02897 2E
W82-02898 5B
W82-02899 5D
W82-02900 2D
W82-02901 8B
W82-02902 1B
W82-02903 5A
W82-02904 5A
W82-02905 5G
W82-02906 5C
W82-02907 5E
W82-02908 2C
W82-02909 2H
W82-02910 2E
W82-02911 5C
W82-02912 2H
W82-02913 5C
W82-02914 2H
W82-02915 2H
W82-02916 2F
W82-02917 2F
W82-02918 5C
W82-02919 4B
W82-02920 4B
W82-02921 2H
W82-02922 5B
W82-02923 2K
W82-02924 2F
W82-02925 7B
W82-02926 6D
W82-02927 2G
W82-02928 2L
W82-02929 3A
W82-02930 5G
W82-02931 5E
W82-02932 5D
W82-02933 2J
W82-02934 2K
W82-02935 5D
W82-02936 2J

*U.S. GOVERNMENT PRINTING OFFICE: 1982 O - 361-011(123)

W82-02937	2L
W82-02938	7B
W82-02939	5A
W82-02940	5F
W82-02941	2F
W82-02942	5B
W82-02943	1B
W82-02944	5D
W82-02945	8B
W82-02946	5C
W82-02947	5D
W82-02948	8A
W82-02949	8A
W82-02950	8A
W82-02951	8A
W82-02952	8A
W82-02953	5C
W82-02954	2H
W82-02955	2F
W82-02956	6B
W82-02957	6B
W82-02958	1B
W82-02959	2I
W82-02960	5D
W82-02961	5D
W82-02962	5D
W82-02963	5C
W82-02964	5A
W82-02965	5D
W82-02966	5B
W82-02967	5D
W82-02968	5F
W82-02969	5F
W82-02970	5B
W82-02971	5C
W82-02972	5D
W82-02973	6E
W82-02974	6B
W82-02975	6D
W82-02976	6B
W82-02977	6G
W82-02978	8G
W82-02979	5C
W82-02980	6B
W82-02981	5D
W82-02982	2A
W82-02983	6G
W82-02984	6G
W82-02985	5D
W82-02986	7B
W82-02987	5F
W82-02988	5D
W82-02989	5D
W82-02990	5B
W82-02991	5B
W82-02992	5D
W82-02993	5D
W82-02994	5D
W82-02995	5D
W82-02996	5D
W82-02997	5C
W82-02998	5D
W82-02999	5A
W82-03000	5D

Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSSION NUMBER INDEX

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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 7
JULY 1, 1982

W82-03001 -- W82-03400

March 3, 1849

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus**. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

WATER TEMPERATURE DYNAMICS IN EXPERIMENTAL FIELD CHANNELS: ANALYSIS AND MODELING,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. G. Stefan, J. Gulliver, A. Y. Fu, and M. G. Hahn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-218349, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-008, July, 1981. 6 p, 2 Fig, 1 Tab.

Descriptors: *Water temperature, *Simulation analysis, *Weather, *Channels, Heat transfer, *Thermodynamics, Wind, Microenvironment, Computer models, *Thermal pollution, Model studies, Ecological effects.

The hydraulic and temperature environment in the shallow field channels of the Monticello Ecological Research Station (MERS) was measured and simulated to provide some background for several biological studies, including one on the effects of artificially high water temperatures. An analysis of the temperature measurement problem, the channel temperature regime, microhabitat conditions, and temporal and spatial water temperature dynamics was essential. A dynamic stream temperature simulation model (MNSTREM) with a 3-hour time resolution was developed and verified to give predictions with a standard error of only 0.2 to 0.3 degrees C. A data-bank of 3-hour water temperature data was developed and analyzed statistically. A wind speed function, essential for the correct prediction of water temperature, was developed from on-site meterological and water temperature data. Longitudinal dispersion in the channels and heat transfer into the bed material below the pools of the experimental channels were measured. A computer simulation program (TSOIL) to predict the unsteady water temperature distribution in the three-layered system was also developed. The results of this study are also applicable to the study of temperature dynamics in thermally polluted shallow streams, to the design of canals for cooling water disposal, and to the study of natural water temperature regimes of small streams. (Moore-SRC)
W82-03025

A PROBLEM POSED BY VAPOUR-DOMINATED GEOTHERMAL SYSTEMS,
California Univ., Los Angeles. Dept. of Earth Sciences.
G. Schubert, J. M. Straus, and M. A. Grant.
Nature (London), Vol 287, No 5781, p 423-425, October, 2, 1980. 2 Fig, 8 Ref.

Descriptors: *Geothermal studies, *Steam, *Permeability, *Thermal water, Geothermal resources, Water vapor, Rocks, Condensates, Groundwater, Perched groundwater, Kamojang geothermal field, *Indonesia.

An analysis is presented of the gravitational stability of water over steam in a porous medium. Pressure measurements in wells drilled to different depths have revealed the basic structure of vapor-dominated systems. The near surface condensate layer of a vapor-dominated geothermal system can be stably maintained above the main steam reservoir by restoring forces associated with the displacement of the phase-change interface. Relatively low permeability is required near the condensate layer-steam zone interface to keep the water from falling down into the underlying region of steam. Any stabilization is possible for a non-zero permeability value. If the interface behaved in a manner similar to the boundary between immiscible fluids, the rocks would have to be impermeable to keep the condensate layer from falling down. Under typical conditions, the stability can be maintained, provided that the permeability of the rocks at the depth of the steam-water boundary does not exceed about 40 sq nm. This stability requirement is what determines the thickness of the condensate layer or the distance between the steam reservoir and the surface. (Small-FRC)
W82-03200

COMPLETE VITRIFICATION IN PURE LIQUID WATER AND DILUTE AQUEOUS SOLUTIONS,
Innsbruck Univ. (Austria). Inst. for Inorganic and Analytic Chemistry.
P. Bruggeller, and E. Mayer.
Nature, Vol 288, No 5791, p 569-571, December 11, 1980. 4 Fig, 16 Ref.

Descriptors: *Ice, *Freezing, *Vitrified water, Physical properties, Emulsions, *Aqueous solutions, *Pure water, Comparison studies.

Pure liquid water was vitrified by jet-freezing 1-5 micrometer aqueous droplets of emulsion made by sonifying 0.03 g Span 65 (surfactant), 9 ml n-heptane, and (1) 1 ml pure liquid water or (2) 1 ml 0.10 M aqueous CuC12 solution. 5 ml emulsion were jetted through a glass tube with 50 micrometer aperture at 100 atmospheres working pressure into 120 ml vigorously stirred liquid ethane at 90 K. The essential 40 K supercooling effect was achieved. The vitrification of both water and CuC12 solution was demonstrated by differential thermal analysis warm-up curves as well as by X-ray diffraction and ESR spectroscopy. The exothermic peak occurred at 150 K, the temperature reported for the devitrification of amorphous ice prepared from water vapor. (Cassar-FRC)
W82-03361

WAKE COLLAPSE IN THE THERMOCLINE AND INTERNAL SOLITARY WAVES,
Catholic Univ. of America, Washington, DC. Dept. of Civil Engineering.
T. W. Kao, and H-P. Pao.
Journal of Fluid Mechanics, Vol 97, No 1, 115-127, March, 1980. 9 Fig, 3 Tab, 9 Ref.

Descriptors: *Thermocline, *Waves, *Wave velocity, Wavelengths, Mixing, Stratification, Wave action, Wave direction.

The collapse of a mixed region at mid-depth of a thermocline-type stratification was investigated experimentally, in which the extent of the mixed region was generally larger than the scale of the thermocline thickness. Following the collapse, two solitary wave-like disturbances were created, one propagating to the right and the other to the left. Detailed measurements were made of the propagation speed and structure of these waves and their collisions with others were noted. Hot-film anemometry and streak pictures were used. Using Benney's method, an analytical solution was obtained for a solitary wave in a thermocline stratification for a medium of finite total depth. The solution was valid for shallow water. There was excellent agreement between experimental and calculated results, which confirmed that the disturbances were solitary waves obeying the Korteweg-de Vries equation. (Small-FRC)
W82-03365

1B. Aqueous Solutions and Suspensions

AN ION-ASSOCIATION MODEL FOR ESTIMATING ACIDITY CONSTANTS (AT 25 C AND 1 ATM PRESSURE) IN ELECTROLYTE MIXTURES RELATED TO SEAWATER (IONIC STRENGTH < 1 MOL/KG H20),
Marine Biological Association of the United Kingdom, Plymouth (England).
A. G. Dickson, and M. Whitfield.
Environmental Science and Technology, Vol 15, No 10, p 1155-1164, October, 1981. 5 Fig, 4 Tab, 66 Ref.

Descriptors: *Model studies, *Seawater, *Ions, Equilibrium, Natural waters, Acids, Bases, Chemical reactions, Chemical properties, Salinity, Thermodynamics, Electrolytes.

In addition to interpreting the electrolytic properties of seawater, the Garrels and Thompson ion-association model has been modified to explain the major acid-base systems present in seawater. The data for the activity coefficients of the species examined are presented as a function of ionic strength. The model may be applied to solutions with ionic strengths ranging from 0 to 1 mol/kg H20, allowing the prediction of various equilibrium thermodynamic parameters for natural waters. The model was used under conditions simulating a variety of ionic strengths to estimate the stoichiometric acidity constants of the major weak acids which are found in seawater. Results showed good agreement (all within 10%) between experimental and model estimates. Improvement of the model through a combined interaction and association approach is recommended. (Geiger-FRC)
W82-03194

THE CONCENTRATION AND ISOTOPIC FRACTIONATION OF GASES DISSOLVED IN FRESHWATER IN EQUILIBRIUM WITH THE ATMOSPHERE. 1. OXYGEN,
Amherst Coll., MA. Dept. of Physics.
B. B. Benson, and D. Krause, Jr.
Limnology and Oceanography, Vol 25, No 4, p 662-671, July, 1980. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Dissolved oxygen, *Isotope fractionation, *Solubility coefficient, Oxygen, Equilibrium, Physical properties.

Concentrations of oxygen dissolved in freshwater in equilibrium with the atmosphere from 0 to 40 C and 0.5 to 1.1 atmosphere may be obtained from the equations and tables presented. The values are based on values for the Henry coefficient of oxygen, which have an accuracy of 0.02%. Equations which relate the Henry coefficient to equilibrium concentrations in natural waters include corrections for molecular interactions in the vapor phase. Estimated accuracy of these derived values is 0.07% at 0 C and 0.04% at 40 C, more accurate than values in UNESCO tables. An equation is given to determine the difference between the 034:032 abundance ratio in the dissolved gas and the air under equilibrium conditions between 0 and 60 C. (Cassar-FRC)
W82-03325

2. WATER CYCLE

2A. General

EXPERIMENTAL STUDIES OF THE EFFECTS OF EPHEMERAL STREAMFLOW DEPTHS ON INFILTRATION,
Stanford Univ., CA.
J. W. Reeder.
PhD Dissertation, 1981. 197 p, 42 Fig, 108 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-15823.

Descriptors: *Ephemeral streams, *Model studies, *Mathematical models, *Infiltration, Stream discharge, Soil water, Infiltration rate, Surface-groundwater relations, Green-Ampt Model.

The objectives were to gain insight into the complex interactions between ephemeral stream flow and subsurface hydrology, and to develop an understanding and tools necessary to permit the management of ephemeral stream systems and the aquifers they recharge. The Green-Ampt model in comparison with the Richards numerical model was shown to be a workable tool for representing one-dimensional infiltration under the action of fluctuating water depths. It was found that the value of the effective suction head at the lower end of the Green-Ampt saturated slug decreases with respect to time, decreases with respect to greater initial uniform soil-moisture content, and increases with respect to water depth. A theoretical basis for the Green-Ampt model was derived, where the vertical flux in a wetting soil-moisture profile was assumed not to be a function of vertical position. The errors in total infiltration or infiltration rate caused by using constant effective suction heads in the Green-Ampt model may be reduced to accept-

able levels by using appropriate suction values. The range of these errors are larger for smaller or zero surface-water depths than for larger surface-water depths for a given range of effective suction heads. The Green-Ampt model may be used successfully to represent one-dimensional infiltration under rapidly varying surface-water depths; where the best choice of a constant effective suction head depends upon the particular problem or application of the model. (Sinha-OEIS)
W82-03013

WORTH OF SHORT-TERM RAINFALL FORECASTING FOR COMBINED SEWER OVERFLOW CONTROL,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. W. Labadie, R. C. Lazaro, and D. M. Morrow.
Water Resources Research, Vol 17, No 5, p 1489-1497, October, 1981. 10 Fig, 4 Tab, 21 Ref.

Descriptors: *Model studies, *Storm-overflow sewers, Sewers, Combined sewer overflows, Storms, Storm water, Storm runoff, Rainfall-runoff relationships, Mathematical models, *Rainfall forecasting, *Sewer overflow control, Case studies, San Francisco.

The San Francisco Master Plan for Wastewater Management was used as a case study to evaluate real-time, short-term rainfall forecasting as a valuable input to more effective performance of a variety of urban water management activities such as controlling the incidence of untreated combined sewer overflows. The forecasting model is described, and an indication is offered of what kinds of forecast errors can be expected for the San Francisco area. An attempt is then made to tie these results to some concurrent work on measuring the performance of a simulated real time automatic control system as a function of degree of forecast error. For this last task inflow hydrographs with a range of error deviations from the real event input to the control model in order to determine what effect these errors would have on the performance of the resulting control strategies. A split data technique was used to gain insight into expected forecast errors for selected overflow producing storms varying from high intensity-low duration to low intensity-high duration. These results were compared with the performance of the planned system. The results of a limited number of simulation runs indicated that expected forecast model errors are generally lower than the error threshold above which reactive policies become more attractive. (Baker-FRC)
W82-03075

CORRELATION OF OXYGEN 18 IN PRECIPITATION WITH TEMPERATURE AND ALTITUDE,

Bern Univ. (Switzerland). Physikalisches Inst.
U. Siegenthaler, and H. Oeschger.
Nature (London), Vol 285, NO 5763, p 314-316, May 29, 1980. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Oxygen, *Precipitation, *Temperature, Altitude, *Switzerland, Chemistry of precipitation, Oxygen isotopes, Climates, *Isotopes studies, Water vapor, Rainfall, Alps.

Although the O18/O16 ratio in precipitation is correlated to climatic parameters, the meteorological processes determining the stable isotope composition of precipitation are complex and not fully understood. Monthly samples collected at five stations in the network of the Swiss Meteorological Service permit correlation of meteorological data with O18/O16 results. Three of the stations are located at various altitudes in a valley, one is located away from the direct influence of the mountains, and one is on the southern side of the Alps. The long-term mean values of O18 variations were relatively well correlated with temperature at different stations. There is also a good correlation between the variation in O18 and altitude for locations on the Swiss plateau and in the Western Alps. Lower isotopic values were found on the lee side of a mountain range than on the weather side. Analysis of monthly data demonstrates that temperature alone cannot explain the whole variability of O18. O18 enrichment due to evaporation of the falling raindrops depends on the prevailing vapor pressure and is therefore more effective at higher temperatures. The evaporative altitude effect is expected to be larger in summer than in winter as a result of the assumed poor O18 enrichment of snowflakes. The relationship between the variation in O18 and temperature can be partly explained by considering the formation of precipitation as a Rayleigh process. Additional studies over larger geographical areas are needed to increase understanding of the processes affecting 108 variation in precipitation. (Carroll-FRC)
W82-03203

SIZING OF URBAN FLOOD CONTROL PONDS,

University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
M. D. Watson.
Civil Engineer in South Africa, Vol 23, No 5, p 183-189, May, 1981. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Flood-control storage, *Model studies, Flood protection, Floodproofing, Ponds, Flood hydrographs, Flood control, Urban watersheds.

Proper usage of ponds for flood control is discussed. The storage volume in the pond is usually designed to reduce the peak discharge of a given recurrence interval to a predetermined level. Given the available pond volume, perhaps predetermined by site conditions, the reduction in peak flow that can be achieved for various recurrence intervals may be assessed. If the outflow rate is assumed to be constant, then for an inflow of a given duration, the required storage volume needed may be determined. As a final step in flood control structure design, an analysis should be made of the continuous record of stream flows, routing them through the proposed storage structure and determining the frequency of functional failure. If flow data are not available, continuous simulation of a long rainfall record may be used to synthesize inflows. In most cases, however, continuous records of neither flow nor rainfall are readily available, and the designer has to resort to synthesizing a design storm which must then be routed through the catchment. After satisfying depression and infiltration losses, it will yield the inflow hydrograph of a certain recurrence interval. This procedure is repeated for different storm durations and storm types to determine the critical inflow hydrograph. Implicit in this procedure is the assumption that storm and runoff recurrence intervals are the same. This method neglects catchment routing and in this respect is conservative. It also assumes that outflow rate is constant. Despite these limitations, the method is a valuable tool for preliminary designs. It allows assessment of the feasibility of a flood control pond without excessive calculations. Its application for final design should be limited to small ponds and applied with conservative estimation of the runoff coefficient. (Baker-FRC)
W82-03297

2B. Precipitation

RAINFALL PREDICTION-MEASUREMENT SYSTEMS AND RAINFALL DESIGN INFORMATION FOR URBAN AREAS,

Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W82-03008

RAINFALL CATCH ERRORS ASSOCIATED WITH CIRCUMAMBIENT OBSTRUCTIONS,

West Virginia Univ., Morgantown.
E. W. Repa.
PhD Dissertation, 1981. 186 p, 33 Fig, 25 Tab, 40 Ref, 7 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-18414.

Descriptors: *Rainfall, *Rain gages, Rainfall distribution, Rainfall intensity, Measuring instruments, Circumambient obstruction.

Point measurements of rainfall are inherently inaccurate because of numerous and interacting observational. instrumental, and gage exposure errors. When openings in the forest canopy are made for the purpose of establishing a surface gaging station, rainfall distribution at ground level is not the same as it would have been at canopy level, and site related errors of additional unknown magnitude are introduced. The magnitude of these site errors has remained a matter of opinion because there is not any reliable experimental data from comparative observations in closely spaced forest openings of various dimensions. It was the purpose of this study to determine the effects of circumambient obstructions on rainfall catch. Results showed that gage catch was a function of screening angle, where the average maximum catch occurred at an angle of 26.57 deg. Rainfall catch decreased sharply as screening angles increased from 26.57 deg, and decreased slightly as screening angle decreases. Increased wind speeds, and decreased rainfall intensities, resulted in larger rainfall catch deficits especially for larger screening angles. Theoretical catch, as determined from Weiss' (1963) and Best's (1950) equations, was found to accurately predict actual catch except for very high intensities. (Sinha-OEIS)
W82-03021

METEOROLOGY OF IMPORTANT RAINSTORMS IN THE COLORADO RIVER AND GREAT BASIN DRAINAGES,

National Weather Service, Silver Spring, MD. Office of Hydrology.
E. M. Hansen, F. K. Schwarz, and J. T. Riedel.
National Oceanic and Atmospheric Administration Hydrometeorological Report No 50, December, 1981. 188 p, 121 Fig, 16 Tab, 53 Ref, 3 Append.

Descriptors: *Probable maximum precipitation, *Rainstorms, *Rainfall distribution, *Tropical cyclones, Atmospheric water, Rainfall intensity, Seasonal variation, Spatial distribution, *Meteorology, *Colorado River basin, *Great Basin.

Significant meteorological characteristics of storms, both general and local, and moisture sources that contribute to the understanding of extreme precipitation in the Colorado River and Great Basin drainages, and to the development of probable maximum precipitation (PMP) estimates were studied. A general storm produces significant precipitation over at least several hundred square miles and lasts at least a day. Significant general storms for this report can be classified into two groups: tropical storms, and extratropical storms. Based on general storms of record, it is considered that a hypothetical more extreme tropical cyclone could be the most extreme rain-producer over a larger portion of the southwestern states during August or September. The extratropical storms, in addition to being the controlling storm type for some portions of the Southwest, are also important for producing maximum precipitation in all areas of the Southwest for months other than those when tropical storms control. The general storm PMP for southwest Wyoming is most likely a storm with moisture from the Gulf of Mexico. A local storm is defined as unusually heavy rains exceeding 3.0 inches in 3.0 hr or less, that are reasonably isolated from surrounding rains. Terrain is considered to be a major factor in local storms in the Southwest, but mesoscale conditions leading to local storm PMP are likely to occur to some degree throughout the entire Southwest. Moisture availability and its geographic and seasonal distribution are important for PMP studies in this area. (Moore-SRC)
W82-03047

LARGE RAIN DROPS IN THE BRIGHT BAND,

Rome Air Development Center, Hanscom AFB, MA. Electromagnetic Sciences Div.
For primary bibliographic entry see Field 7B.
W82-03065

WILL THE SAHELIAN DROUGHT END IN 1985,

Centre National de la Recherche Scientifique, Marseille (France).
H. Faure, and J-Y. Gac.

Nature, Vol 291, No 5815, p 475-478, June 11, 1981. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Drought, *Rainfall, *Sahel region, Variability, Lake Chad, Senegal River, Weather patterns, Deserts, Arid regions, History, Geologic history, *Africa.

Analysis of rainfall variability in the Sahel region since the Quaternary period indicates a mean 31.3 year period between the last three droughts, with extreme conditions every 10.3 plus or minus 4 years. Extrapolating this data shows that the present drought should end in 1985, with a gradual return to maximum wet conditions about 1992. Another severe drought is likely about 2005. Data used for the background are variations in the levels of Lake Chad for the past 1,000 years, major famines and droughts for the past 300 years, and mean annual runoff and maximum height of the River Senegal at Bakel from 1903 to the present. (Cassar-FRC)
W82-03167

RECIPROCATING HAIL PROCESSES IN THE ALPS,
Consiglio Nazionale delle Ricerche, Rome (Italy). Inst. for Aerosol Nucleation.
H. M. Papee, G. L. Petriconi, and F. Ferrari.
Water, Air, and Soil Pollution, Vol 16, No 1, p 115-122, July, 1981. 4 Fig, 5 Ref.

Descriptors: *Hail, *Air pollution effects, *Thermal pollution, Statistical analysis, Precipitation, Storms, Agriculture, *Alps, *Italy.

Precipitation patterns in the Alps have demonstrated an inverse correlation between sume adverse weather events which occurred in two adjacent zones. The possible effects of air pollution and thermal pollution on the weather in this area are discussed, and a model is proposed which fits the available data on agricultural losses due to hail in the Bolzano and Trento Provinces. The model makes many assumptions, including the assumption that Trento's loss is inversely proportional to Bolzano's. Also, it is assumed that surface hail effects in Trento are proportional to an exponential of the intensity of the storm which is directly proportional to the losses sustained by both Provinces or to the territory affected. While the model is simple, correlations obtained for all parameters were highly significant. More research is needed to establish precipitation anomalies due to a boom in industrialization and urbanization. (Small-FRC)
W82-03227

THE RELATIONSHIP BETWEEN TOTAL PRECIPITABLE WATER AND SURFACE DEW POINT,
Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).
Y. Viswanadham.
Journal of Applied Meteorology, Vol 20, No 1, p 3-8, January, 1981. 8 Tab, 15 Ref.

Descriptors: *Atmospheric water, *Estimating equations, *Dewpoint, Water vapor, Precipitation, Probable maximum precipitation, Correlation analysis, *Southern hemisphere.

A method is provided for estimating the large-scale distribution of Southern Hemisphere atmospheric water vapor that is comparable to one previously developed for Northern Hemisphere data. Mean monthly and annual values of total precipitable water were compared with similar values of surface dew point for each 5 deg latitude circle from the equator to 85 deg S. The correlation coefficients were always positive but widely variable (0.21-0.99). The estimates of precipitable water from mean monthly surface dew-point temperature were not sufficiently reliable to justify making surface measurements to infer existing precipitable water. For some areas and seasons, large errors were found. Thus, the predicting equation has no value for those stations where a significant correlation does not exist between the two variables. There is no satisfactory substitute for direct measurement, and much more data collection is needed in the Southern Hemisphere. (Small-FRC)
W82-03257

QUANTIFICATION OF RAINFALL AND ITS UTILIZATION EFFICIENCY IN RAJASTHAN,
Central Arid Zone Research Inst., Jodhpur (India).
H. S. Mann, B. V. Ramana Rao, and G. G. S. N. Rao.
Journal of Arid Environments, Vol 4, No 2, p 107-113, June, 1981. 3 Fig, 6 Tab, 8 Ref.

Descriptors: *Water use efficiency, *Arid lands, *Water requirements, Rainfall-runoff relationships, Agriculture, *Rajasthan, *India, Semiarid lands, Runoff.

Rainfall utilization efficiency averaged 52.3% for Rajasthan, India, an arid to semi-arid region. Efficiency was low (< 30%) in the arid districts with low and erratic rainfall and 30-50% in semi-arid districts with unbalanced land use. The total amount of water not used for productive purposes in Rajasthan was 64055.76 million cu meters per year. The theoretical crop yield if all this water used is 3.71 million metric tons of pearl millet. These figures were obtained by adding the water requirements for livestock, humans, crops and vegetation, water lost through runoff and deep drainage, and subtracting from annual rainfall, 154168.64 million cu meters. Average annual flow of rivers in the region is 20505 million cu meters. (Cassar-FRC)
W82-03276

DEW FALL IN THE DRY CLIMATIC ZONES OF INDIA,
Andhra Univ., Waltair (India). Dept. of Meteorology and Oceanography.
A. R. Subramaniam, and A. V. R. K. Rao.
Journal of Arid Environments, Vol 4, No 2. p 103-106, June, 1981. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Dew, *Arid regions, *India, Precipitation, Rainfall, Seasonal variation, *Humid areas, *Semiarid climates, Comparison studies, Meteorological data collection.

Dew fall, an important meteorological factor in dry regions, was studied at six stations throughout India (in arid, semi-arid, and dry sub-humid areas). Measurements were recorded at four heights (5, 25, 50, and 100 cm). Maximum dew fall at Bikaner (humid), Arogyavaram (semi-arid), and Raipur (dry sub-humid) was in November-December; for Bellary (arid), September; Kota (arid), October; and Surat (sub-humid), October and February. Mean monthly dew falls during the dew season were: Bellary, 4.7 mm; Arogyavaram, 10.4 mm; and Raipur, 23.2 mm. At these 3 stations more than 80% of total dew fell from November to January, and the maximum amount of dew was deposited at the 100 cm height. During 1975-76 no rain fell during the dew season at Raipur; dew fall, the sole source of moisture, was 106% of normal rainfall. (Cassar-FRC)
W82-03278

ACID PRECIPITATION IN THE PITTSBURGH, PENNSYLVANIA AREA,
Pittsburgh Univ., PA. School of Public Health.
A. Roffman.
Journal of Environmental Sciences, Vol 23, No 2, p 33-37, March, 1980. 1 Tab, 1 Fig, 24 Ref.

Descriptors: *Acid rain, *Rainfall, *Air pollution, *Hydrogen ion concentration, *Lakes, Precipitation, Atmosphere, sulfuric acid, Nitrogen, Fertilizers, Ecosystems, International commissions, Organizations, Fish populations, Coniferous forests.

A survey of the pH levels of precipitation in the Pittsburgh area was conducted. Supplementary climatological data was collected. Results indicate that the pH values of samples in pollution-free areas were lower than those obtained at polluted stations. The industrial mills along the principal rivers seem to have had little or no effect on the pH values measured. The coal-burning power plants appear to have influnced the pH of precipitation. The data imply that pollution-carrying winds from the Ohio River Valley Basin contribute acidity to the stations. (Titus-FRC)
W82-03368

2C. Snow, Ice, and Frost

FLOW CHARACTERISTICS BELOW FLOATING COVERS WITH APPLICATION TO ICE JAMS,
Iowa Univ., Iowa City.
M. Gogus.
PhD Thesis, December, 1980. 186 p, 47 Fig, 1 Tab, 38 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-14257.

Descriptors: *Flow characteristics, *Ice jams, Mathematical models, Rivers, Interfaces, Friction, Roughness coefficient, Model studies.

Mathematical models for wide-river jams have been developed. Besides two mechanisms (i.e., floe submergence and partial collapse) for the control of the jam equilibrium thickness, there is a third one - instability of floes along the jam underside. This flow instability phenomenon was the subject of a laboratory investigation, the results of which are presented in the first part of this study. The second part of the study is concerned with the characteristics of flow between boundaries of different roughness, with the upper one floating at the surface of an otherwise open channel, and focuses on the effect of one boundary on the friction characteristic of the other. Jam calculations must include computation of the resulting backwater curve, and require estimates of the shear stresses exerted both on the channel bed and on the jam underside. The goals of the study on flow characteristics between boundaries of different roughness is two-fold: to investigate the interaction between boundaries as far as the friction factor is concerned; and to devise a procedure for estimating the friction parameters at both boundaries for given flow conditions and roughness characteristics. (Sinha-OEIS)
W82-03011

USE OF ENVIRONMENTAL SATELLITE DATA FOR INPUT TO ENERGY BALANCE SNOWMELT MODELS,
California Univ., Santa Barbara. Computer Systems Lab.
For primary bibliographic entry see Field 7B.
W82-03048

ON ANTARCTIC GLACIOLOGY: ICE SHEETS--AND ICE CORES,
Northwestern Univ., Evanston, IL.
J. Weertman, and D. A. Peel.
Nature (London), Vol 294, No 5838, p 210-212, November 19, 1981. 2 Fig.

Descriptors: *Ice, *Chemical analysis, Carbon dioxide, Nitrates, Polar regions, *Antarctic, Glaciology, Cryology, Sulfates.

At the International Symposium on Antarctic glaciology, results were reported from research projects concerned with virtually all parts of the Antarctic continent, in oceanic islands neaar the continent, and on sea ice that surrounds it. The topography of the Antarctic ice sheets has been partially surveyed from satellites, by seismic sounding and by radar sounding. The symposium opened with sessions addressed to the problem of ice sheet stability. Other research was directed toward the effects of a carbon dioxide buildup and whether it will make the Antarctic ice more or less stable. Carbon dioxide concentrations in the air were lower during the last ice age than they are now. The major impurity of Antarctic ice is sulfate, and the mechanism by which it reaches the region is not yet fully explained. Difficulties are also being presented by the presence of nitrates in the ice. Elevated nitrate-nitrogen levels appear to coincide with years of solar flare activity peaks which are assocised with high auroral activity. Pronounced seasonal variations with maxima in winter months could be due to summer photochemical destruction of much of the nitrates. (Baker-FRC)
W82-03170

THEORY OF THE DIELECTRIC CONSTANT OF ICE,

Southampton Univ. (England). Dept. of Chemistry.
D. J. Adams.
Nature (London), Vol 293, No 5832, p 447-449, October 8, 1981. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Electrical properties, *Ice, Water, Physical properties, Mathematical studies, Mathematical models, *Model studies, *Comparison studies.

The theory of the dielectric constant of ice is discussed and a resolution of the internal field problem is proposed. Two rival theorteical expressions for the dielectric constant in terms of the dipole moment deal with different physical situations. The theory proposed here is that the correlations found in the perfect ice-rules model are to a good approximation the same as those that long-range dipole-dipole interactions will produce. It is demonstrated that the Fowler-Pauling ice-rules model of ice behaves like a dielectric material; matching the results of calculations on this model to experiment gives a dipole moment of 3.0 D. (Small-FRC)
W82-03176

SOME BASIC EXPERIMENTS WITH A VERTICALLY-INTEGRATED ICE SHEET MODEL,

Royal Netherlands Meteorological Inst. De Bilt.
J. Oerlemans.
Tellus, Vol 33, p 1-11, 1981. 12 Fig, 1 Tab, 17 Ref.

Descriptors: *Ice, *Actic, *Model studies, Glaciers, Climates, *Climatology.

Large scale behavior of ice sheets is investigated, as it is immediately relevant from the viewpoint of dynamic climatology. A simple 1 1/2 dimensional continental ice sheet model is presented, using as a basis Nye's proposal to express the vertical mean horizontal ice velocity. The results are theoretical; real case studies have yet to be carried out. The findings give insight into the effects of geometry and orography which can be applied to real situations. The diffusivity increases with both ice thickness and surface slope. Using various boundary conditions and parameterization of the annual mass balance, a series of experiments was carried out. It appeared that the boundedness of continents and bedrock elevations created a strongly nonlinear response of ice sheets to climatic variations. The behavior of Northern Hemisphere ice sheets as computed with the numerical model is compared to that predicted by a perfect-plasticity model. Including bedrock sinking in a simple way reveals that this causes Northern Hemisphere ice sheets to dissappear spontaneously within 15,000 years, after about 50,000 years of growth, initiated by a cold period. (Baker-FRC)
W82-03209

WEST ANTARCTIC ICE SHEET FLUCTUATIONS IN THE ANTARCTIC PENINSULA AREA,

Aberdeen Univ. (Scotland). Dept. of Geography.
D. E. Sugden, and C. M. Clapperton.
Nature (London), Vol 286, No 5771, p 378–381, July 24, 1980. 3 Fig, 17 Ref.

Descriptors: *Antarctic, *Glacial drift, *Geomorphology, Glaciers, Polar regions, Ice formation, Moraines, Prediction, *West Antarctic ice sheet.

Previous studies have concluded that the West Antarctic ice sheet is inherently unstable since much of it is grounded below sea level. It has been suggested that the ice sheet has withdrawn from its late Wisconsin maximum position, grounded at the edge of the continental shelf, and is currently undergoing collapse as a delayed response to the warming trend and rising sea levels of the Holocene. Rising carbon dioxide levels in the atmosphere are seen as likely to cause the ice sheet to collapse in the near future. A variety of geomorphologic evidence from Alexander Island and the Antarctic Peninsula does not support either of these hypotheses. Examination of moraines on the island and peninsula indicate that there was less ice on Alexander Island and the Antarctic Peninsula following the Wisconsin maximum about 8,000 years ago than there is now. The ice shelf in George VI Sound, which lies between these two bodies of land, has built up subsequent to this period. These findings indicate that the ice sheet has expanded during the last 8,000 years and that the West Antarctic ice sheet is able to survive without the presence of the George VI ice shelf. There is no reason to fear imminent collapse of the West Antarctic ice sheet due to climatic warming as long as the ice shelf survives. (Carroll-FRC)
W82-03362

2D. Evaporation and Transpiration

OPERATIONAL ESTIMATES OF LAKE SUPERIOR EVAPORATION BASED ON IFYGL FINDINGS,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. A. Derecki.
Water Resources Research, Vol 17, No 5, p 1453-1462, October, 1981. 4 Fig, 8 Tab, 16 Ref.

Descriptors: Lakes, *Evaporation, *Lake evaporation, *Lake Superior, Great Lakes, Water loss, Mass transfer, Estimating.

This paper tests the findings of studies of the International Field Year for the Great Lakes (IFYGL) on evaporation in Lake Superior and describes an improved mass transfer technique, based on atmospheric stability considerations, that can be applied to any large lake in different climatic conditions. Due to the extensive ice cover on Lake Superior during winter, the method includes ice cover reduction of standard overwater mass transfer evaporation to indicate actual winter evaporation from the lake. Method improvements consist of refinements in the mass transfer coefficient and the land-to-lake data adjustments derived from extensive investigations. Mass transfer evaporation estimates were verified by the water budget determinations, which for Lake Superior offer firm estimates of evaporation but are impractical for operational applications because of the long delays which occur in the availability of data. All hydrologic components of the Lake Superior water budget were of the same order of magnitude, with comparable errors, eliminating the possibility of large residual errors in computed evaporation. Evaporation values as determined by the two methods agree reasonably well for both seasonal distribution and the annual total, with a resulting long term annual value of approximately 500 mm. The ice cover adjustment reduced the average annual mass transfer overwater evaporation by 13% and produced much better agreement with the water budget seasonal distributions and annual values. In general the ice cover reduction of evaporation could be estimated by reducing the lake area by appropriate ice cover. (Baker-FRC)
W82-03074

EVAPORATION FROM VEGETATION IN LANDSCAPES DEVELOPING SECONDARY SALINITY USING THE VENTILATED CHAMBER TECHNIQUE, III. EVAPORATION FROM A PINUS RADIATA TREE AND THE SURROUNDING PASTURE IN AN AGROFORESTRY PLANTATION,

Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Land Resources Management.
E. A. N. Greenwood, J. D. Beresford, and J. R. Bartle.
Journal of Hydrology, Vol 50, No 1/3, p 155-166, March, 1981. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Evaporation, *Soil-water-plant relationships, *Trees, Evapotranspiration, Transpiration, *Pinus radiata, Pastures.

Evaporation was measured one day a month over 14 months on a 16 meter Pinus radiata tree enclosed in a ventilated chamber and on underlying pasture enclosed in a horizontal chamber. Evaporation from the tree ranged from 10 liters per day (0.6 mm per day) in April, May, and June to 170 liters per day (3.3 mm per day) in September. The pasture evaporation ranged from zero during the dry season to 1.4 mm per day in October. Xylem pressure potentials, measured on the enclosed tree and a nearby tree, were always within 1 bar of each other, limiting transpiration during the 6 month dry season. (Cassar-FRC)
W82-03213

THE INFLUENCE OF PLANT WATER STRESS ON STOMATAL CONTROL OF GAS EXCHANGE AT DIFFERENT LEVELS OF ATMOSPHERIC HUMIDITY,

Lancaster Univ., Bailrigg (England). Dept. of Biological Sciences.
O. Osonubi, and W. J. Davies.
Oecologia, Vol 46, No 1, p 1-6, July, 1980. 5 Fig, 27 Ref.

Descriptors: *Soil-water-plant relationships, *Stomatal transpiration, *Water stress, Transpiration, Birch, Gmelina, Plant water potential, Drought, Vapor pressure, Humidity.

The influence of plant water stress on stomatal humidity responses of two woody species was studied. Leaves of well-watered and mildly water stressed seedlings of birch (Betula pendula Roth) and Gmelina aroborea L. were subjected to vapor pressure deficits between 10 and 24 kPa. An increase in vapor pressure deficit in mildly stressed birch plants decreased stomatal conductance, maintained bulk leaf turgor, and increased efficiency of water use. Stomatal conductance of Gmelina seedlings, well watered or mildly stressed, showed no significant change when humidity of the air was varied. In Gmelina water use efficiency was high when stomata were open. Stomata of Gmelina seedlings began closing at a water potential of -1.0 MPa; birch, at -1.4 MPa. Closure was complete in Gmelina at -1.5 MPa and in birch at -1.8 MPa. Under conditions of water stress, growth of Gmelina is markedly reduced, but birch is capable of some growth under mild drought. (Cassar-FRC)
W82-03272

2E. Streamflow and Runoff

A MODEL OF DISCONTINUOUS MEASUREMENT ERROR AND ITS EFFECTS ON THE PROBABILITY DISTRIBUTION OF FLOOD DISCHARGE MEASUREMENTS,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
K. W. Potter, and J. F. Walker.
Water Resources Research, Vol 17, No 5, p 1505-1509, October, 1981. 3 Fig, 15 Ref.

Descriptors: *Model studies, *Error analysis, Floods, Errors, Flood frequency, *Flood discharge, Flood forecasting, Mathematical models, *Flow rates.

In this paper a very simple model of discontinuous measurement error (dme) is developed and used to demonstrate that as a result of dme the probability distribution of measured floods can be greatly distorted with respect to the parent population. In particular, the population coefficients of variation, skewness, and kurtosis of the measured discharges can be significantly higher than the corresponding population coefficients of the actual flood discharges. This can be extremely important in flood frequency analysis. (Baker-FRC)
W82-03076

PROGRAMMING MANUAL FOR MOBED - AN UNSTEADY, NONUNIFORM, MOBILE BOUNDARY FLOW MODEL,

Canada Center for Inland Waters, Burlington (Ontario).
B. G. Krishnappan.
1981. 107 p, 22 Fig, 5 Tab, 3 Append.

Descriptors: *Sediment transport, *Mathematical models, *Unsteady flow, *Uniform flow, Hydraulic models, Manuals, MOBED, Hydraulic structures, Sediments, Dredging, Input data cards, *Channel flow.

In this manual, a mathematical model to predict the unsteady flow characteristics in mobile boundary channel flows (MOBED) is described. This manual is intended for potential users of this model and it contains descriptions of the underlying theory, numerical technique, program structure, input data requirement and format, model listing and an example of the model application. The model MOBED can be used for predicting both the short and long term effects of changes to the regime of a natural stream imposed by man and/or nature and hence could form a useful tool in the field of water resource management. (WATDOC)
W82-03109

A PERSPECTIVE STUDY OF DROUGHTS IN MEXICO,

National Water Planning Commission, Mexico City.
J. Sancho, and D. Perez Gavilan.
Journal of Hydrology, Vol 51, No 1/4, p 41-55. May, 1981. 4 Fig, 12 Ref.

Descriptors: *Drought, *Agriculture, History, Statistical analysis, Social aspects, Social impact, Economic aspects, *Mexico.

A historic study was conducted to outline the manifestations and consequences of droughts during the entire history of Mexico, followed by a statistical analysis to investigate the extent, duration, frequency and magnitude of droughts in that country. Historically, droughts affected not only the health of the people, but their economic and social structures as well. In every case of poor harvests and rising costs of basic foods, the consequences of the natural phenomena were aggravated by social factors. Scarcity and high costs were increased by speculation and market monopolies. Large migratory movements occurred. The partial or total suspension of non-agricultural activities such as mining, manufacturing and textile crafts, along with migration and unemployment, increased criminality and social tensions. The statistical analysis has yielded some inferences about drought behavior, although it is still not possible to predict the occurrence of a drought on an annual or seasonal basis. A base network of 157 rainfall gauging stations was established throughout the country, and a minimum of twenty years of records were maintained. The variability of precipitation was found to be a good indicator of drought risk; the greater the risk, the greater the variability. It was observed that different percentages of normal precipitation were recorded for 1, 2, 3 or 5 continuous years at each station. Curves were constructed for the entire country which define the characteristics of extent, magnitude, duration and frequency of precipitation deficiency. Varying intensity classifications were able to be applied to droughts occuring over the past 40 yr. (Baker-FRC)
W82-03358

COMMUNICATION ON 'VARIATION OF MANNING'S N ROUGHNESS COEFFICIENT WITH FLOW IN OPEN RIVER CHANNELS'.

Journal of the Institution of Water Engineers and Scientists, Vol 35, No 1, p 94-95, January, 1981.

Descriptors: *Mannings equation, *Roughness coefficient, *Streamflow, Sediment transport, Channel morphology, Flows, Rivers, *Open-channel flow.

A paper by Sargent on variation of Manning's n computed for five gaging stations on 5 different rivers showed substantial increase in n at low stages and a smaller constant value at higher stages at bankfull conditions were approached. The author recommended extending gaging station calibration curves beyond the highest measured level for flow contained within the channel banks. These conclusions aroused several comments that their value would be enhanced by considering changes in channel shape, sediment transport, and bed configuration changes. (Casser-FRC)
W82-03382

2F. Groundwater

THE MADRID BASIN AQUIFER: PRELIMINARY ISOTOPIC RECONNAISSANCE,

Madrid Univ. (Spain). Dept. of Geology and Geochemistry.
F. L. Vera, J. C. Lerman, and A. B. Muller.
Journal of Hydrology, Vol 54, No 1-3, p 151-166, December, 1981. 5 Fig, 6 Tab, 23 Ref.

Descriptors: *Aquifers, *Isotopic tracers, *Model studies, *Flow profiles, *Groundwater dating, Groundwater movement, Isotope studies, Carbon, Oxygen, Flow pattern, Radioisotopes, Water analysis, Groundwater basins, Groundwater recharge, Geohydrology, *Madrid Basin aquifer, Spain.

C and O isotopic studies were carried out on the Madrid Basin aquifer to corroborate a three-dimensional groundwater flow model of this groundwater system. Results showed that both recharge and discharge have sigma-values close enough to indicate that climatic conditions of the basin have been relatively stable. Local analyses done by aquifer tests showed that hydraulic conductivities calculated from the radiocarbon ages are of the correct order of magnitude. No evidence was found to support the previous hypothesis of large regional flow. On the contrary, the radiocarbon ages of the waters in the wells analyzed seem to support the existence of local flow in the Madrid aquifer. Other factors such as carbon precipitation or dilution and subsurface radiocarbon production which might influence the radiocarbon ages are also being studied. (Geiger-FRC)
W82-03059

NUMERICAL STABILITY AND ACCURACY OF IMPLICIT INTEGRATION OF FREE SURFACE GROUNDWATER EQUATIONS,

Cornell Univ., Ithaca, NY.
P. L-F. Liu. and J. A. Liggett.
Water Resources Research, Vol 16, No 5, p 897-900, October, 1980. 7 fig, 4 Ref.

Descriptors: *Darcys Law, *Laplace equation, *Mathematical studies, *Flow, *Groundwater, Algorithms, Numerical analysis, Fourier analysis, Finite difference equation, *Groundwater movement, Porous media.

In the solution of two- or three-dimensional free surface flow the time-dependent boundary condition is represented in an implicit finite difference form. The numerical solution may damp or amplify the real solution or contain oscillations, either stable or unstable, about the real solution, depending on the weighting factor and the wave number of the solution mode. Zero numerical damping occurs when the weighting factor has a value between 0.5 and 0.6. The exact value depends on the wave number and length of the time step. The weighting factor and time step are chosen by performing stability analysis on a linearized system of equations and extrapolating the results to the nonlinear system. (Titus-FRC)
W82-03060

A NUMERICAL METHOD FOR THE CALCULATION OF THE AVERAGE DRAWDOWN IN A FULLY PENETRATING OBSERVATION WELL IN AN UNCONFINED AQUIFER,

Council for Scientific and Industrial Research, Pretoria (South Africa).
L. Rolfes.
Water Resources Research, Vol 16, No 5, p 887-890, October, 1980. 2 Tab, 4 Ref.

Descriptors: *Aquifers, *Drawdown, *Unconfined aquifers, *Permeability, *Numerical analysis, Mathematical methods, Computer applications, Computer models, Algorithms, Wells. Observation wells.

A numerical method which is numerically stable and makes use of a convergence acceleration algorithm is proposed for the calculation of Neuman's formula for the average drawdown in an observation well completely penetrating an unconfined aquifer. The unconfined aquifer integral was evaluated for various values of three parameters, and results were compared with those of the Neumann method in terms of accuracy and computer execution time. The results of both methods are comparable in accuracy, but the proposed method requires less computer time. (Titus-FRC)
W82-03061

MODELING DOUBLE AQUIFER FLOW USING A COMPREHENSIVE POTENTIAL AND DISTRIBUTED SINGULARITIES 1. SOLUTION FOR HOMOGENEOUS PERMEABILITY,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
O. D. L. Strack, and H. M. Haitjema.
Water Resources Research, Vol 17, No 5, p 1535-1549, October, 1981. 17 Fig, 23 Ref.

Descriptors: *Model studies, *Permeability, Aquifers, Aquifer characteristics, Flow, *Aquifer systems, Groundwater flow, *Groundwater movement.

A technique is presented for modeling two-dimensional horizontal flow in a system of two infinite aquifers. The technique proposed is based upon the use of line sinks for incorporating creeks, lake boundaries, rivers, and canals into the model. The potentials for the elements are used as functions of a complex variable and are Cauchy integrals along finite line elements of the type discussed by Muskelishvili. The method is incorporated into the computer program SYLENS (steady flow with a lens) that is used to model a system of two aquifers divided by a thin impervious bed and hydraulically connected through the openings in the separating layer. The analysis in this paper is restricted to the case that the permeabilities in the two aquifers may be different from each other but do not vary with position. The aquifers are separated by a thin impermeable layer and are hydraulically connected through openings in the separating bed. The upper aquifer is unconfined, and the flow in the lower aquifer is confined in some regions and unconfined in others. The method is validated against various exact solutions, and some examples of applications of the method are discussed. (Baker-FRC)
W82-03078

BIEM SOLUTIONS TO COMBINATIONS OF LEAKY, LAYERED, CONFINED, UNCONFINED, NONISOTROPIC AQUIFERS,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
O. E. Lage, J. A. Liggett, and P. L-F. Liu.
Water Resources Research, Vol 17, No 5, p 1431-1444, October, 1981. 17 Fig, 1 Tab, 16 Ref.

Descriptors: *Aquifers, *Mathematical models, Model studies, Water table aquifers, *Aquifer characteristics, Leaky aquifers, Layered aquifers, *Groundwater movement, Aquifer systems, Confined aquifer, Unconfined aquifers, Nonisotropic aquifers.

A study was made to develop a program which could solve a variety of groundwater problems, including many of the complexities found in actual aquifers, while retaining insofar as possible the advantages of the boundary integral equation method (BIEM). In complex aquifers it is necessary to solve nonlinear equations and equations with nonconstant coefficients. The nonhomogeneous equations are solved by use of efficient and automatic area integrations. Matrix substructuring is used to decrease computer requirements for large, complex problems and also to maintain efficiency. Solutions in leaky, layered aquifers are found by iteration. Thus the advantages of the BIEM are available for the solution of complex systems. In the calculations presented here the effective dimension of an aquifer system is reduced to two by the use of the Dupuit assumption. The BIEM further reduces the computational dimension by one. Thus a three-dimensional problem is solvable by line integration. An additional major advantage of the BIEM method is the ease of data preparation in that the analyst needs to supply a minimum of data. The total storage requirements for the BIEM are also less than they would be for

domain methods. The program may thus be more available for use on small computing systems. (Baker-FRC)
W82-03079

ON THE COMPUTATION OF DARCIAN VELOCITY AND MASS BALANCE IN THE FINITE ELEMENT MODELING OF GROUNDWATER FLOW,

Oak Ridge National Lab., TN. Environmental Sciences Div.
G-T. Yeh.
Water Resources Research, Vol 17, No 5, p 1529-1534, October, 1981. 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Model studies, *Groundwater movement, Flow, Mathematical models, Darcy's law, Mathematical studies, *Finite element method, Velocity.

Darcian velocity has been conventionally calculated in the finite element modeling of groundwater flow by taking the derivatives of the computed pressure field. Since a continuous velocity field is required for the simulation of waste transport in the subsurface aquifer system, the conventional approach used in finite element modeling results in discontinuity of velocity at element boundaries and nodal points. It may also yield large errors in the overall mass balance computation. Thus it is necessary that the same finite element method which is employed to simulate the pressure field be applied to Darcy's law to obtain the velocity field. This will ensure a continuous velocity field and greatly reduce the overall mass balance error. The central difference Galerkin scheme yields the lowest error, as the governing equation is basically of the Laplacian type in spatial coordinates. It is proposed in this paper that the finite element procedure that is used to simulate the pressure field or the moisture content field also be applied to Darcy's law with the derivatives of the computed pressure field as the load function, thus eliminating the problem of discontinuity. (Baker-FRC)
W82-03083

MODELING DOUBLE AQUIFER FLOW USING A COMPREHENSIVE POTENTIAL AND DISTRIBUTED SINGULARITIES 2. SOLUTION FOR INHOMOGENEOUS PERMEABILITIES,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
O. D. L. Strack, and H. M. Haitjema.
Water Resources Research, Vol 17, No 5, p 1551-1560, October, 1981. 15 Fig, 25 Ref.

Descriptors: *Model studies, *Permeability, *Aquifer characteristics, Aquifers, Flow, *Groundwater movement.

A technique is presented for modeling two-dimensional horizontal flow in a system of two infinite aquifers. In this paper the technique is generalized to the case of inhomogeneous permeabilities. The aquifer is subdivided into regions of homogeneous permeability, with discontinuities of the permeability occurring across the boundaries of these regions. The potentials are discontinuous across the common boundaries, which are represented as polygons. Line doublets are used to create the discontinuities in the potentials without violating the condition of continuity of flow. The strengths of the line doublets are determined from the condition that the head is continuous across the boundaries of the subregions. The method is validated against exact solutions, and some applications are considered. The modeling of inhomogeneous situations by the use of line doublets is presented for a Dupuit-Forchheimer analysis, but is equally well applied to problems of three-dimensional flow and two-dimensional flow in the vertical plane. The potential to be used for the latter applications equals the permeability times the head. (Baker-FRC)
W82-03084

VERIFICATION OF THE POTENTIAL YIELD AND CHEMICAL QUALITY OF THE SHALLOW DOLOMITE AQUIFER IN DUPAGE COUNTY, ILLINOIS,

Illinois State Water Survey Div., Champaign.
R. T. Sasman, R. J. Schicht, J. P. Gibb, M. O'Hearn, and C. R. Benson.
Circular 149, 1981. 46 p, 26 Fig, 1 Tab, 10 Ref.

Descriptors: *Aquifers, *Dolomite, Water level, Water yield, Groundwater, *Potential water supply, Groundwater depletion, Groundwater pollution, Dewatering, Piezometers, Pumping, Chemical properties, Dissolved solids, Hardness, Sulfate, Chlorides, Sodium, Iron, DuPage County, *Illinois.

As an alternative to pumping water from Lake Michigan, the Illinois Division of Water Resources looked to the dolomite aquifer in DuPage County. Data collected over a 700-square-mile area was used to analyze the impact of continually increasing pumpage, to locate existing and potential trouble areas, and to identify areas suitable for additional pumpage. From 1966 to 1978, pumpage in DuPage County increased 91 percent from 24 to 45.8 mgd; 95 percent of the 1978 shallow aquifer pumpage, 43.5 mgd, was from the dolomite. Estimates of the potential yield of these shallow aquifers is 44.4 mgd, so the 1978 pumpage of 45.8 mgd was 103 percent of the total. Because of the heavy pumpage, water levels have lowered considerably and major sections of the aquifer system have been dewatered. The decline in water levels has resulted in their being lowered below the bedrock surface over about 9.5 square miles of DuPage County since 1966. If pumpage continues at the 1978 ratio, shallow aquifer pumpage would be about 63 mgd by the year 2000, and would cause major decreases in yields in wells and well fields countywide. The study also showed that the highest chemical concentrations in the aquifer are generally found in areas with the greatest development of aquifer pumpage and of the overlying land surface. Concentrations of total dissolved solids, hardness, sulfate, chloride, sodium, and total iron in samples from the area are quite high. Periodic studies are recommended to assess water quality programs and to keep abreast of the chemical state of the groundwater from this aquifer. (Atkins-Omniplan)
W82-03100

SALT-WATER INTRUSION IN A LAYERED COASTAL AQUIFER AT YORK POINT, PRINCE EDWARD ISLAND,

National Hydrology Research Inst., Ottawa (Ontario).
G. van der Kamp.
NHRI Paper No 14, IWD Scientific Series No 121, 11 p, 1981. 21 Ref, 8 Fig, 2 Tab.

Descriptors: *Water levels, *Salinity, Measurements, *Coastal aquifers, Brackish water, Freshwater, Tidal fluctuations, Hydrology, Intrusion patterns, North River Estuary, Prince Edward Island, Canada, *Saline water intrusion, Aquifers, Groundwater movement.

Detailed measurements of water levels and salinities have been carried out in a layered coastal aquifer, undisturbed by pumping, at York Point, Prince Edward Island. The position and movements of the sea water in the aquifer are analyzed in relation to density differences, and tidal, seasonal and secular changes of water levels. Separate 'wedges' of salt water were encountered in each permeable layer. In the deeper beds, fresh water has been encountered in association with anomalously low heads. This phenomenon is at least in part due to the entrainment of salt water by the seaward flow of fresh water, but the rising sea level in the area can also lead to such an effect and, in fact, may have an important bearing on the pattern of salt-water intrusion at depth. (WATDOC)
W82-03108

FINAL REPORT, GROUND WATER STUDY, AMES-CAMBRIDGE REACH OF THE SKUNK RIVER, STORY COUNTY, IOWA,

Iowa State Water Resources Research Inst., Ames.
M. D. Dougal.
ISWRRI-119, June, 1980. 58 p. 13 Fig, 3 Tab, 20 Ref, 3 Append.

Descriptors: *Groundwater movement, Water quality control, Data collections, *Groundwater potential, *Aquifers, Subsurface drainage, Groundwater pollution, Water table fluctuations, Land disposal, Wastewater disposal, *Water pollution control, Alternative planning, Well water.

A study of the downstream continuation of the Ames Buried Channel Aquifer from Ames to Cambridge, Iowa, was made to determine the movement of water in the flood plain area and to provide a preliminary evaluation of the potential impact of the new water pollution control plant on the community of Cambridge. Cambridge has ground water wells drilled into the buried channel aquifer. Three sites evaluated were found to be suitable as to potential impact on ground water and land suitability for disposal of digested sludge. Site 5, which consists of silts, clays, and clayey sands to a depth of 12 to 15 feet, remains the most isolated site and land disposal would affect the least number of persons and housing units. The surficial soil profile implies slow infiltration and good retention of soil moisture. The ground water levels at Cambridge are greater than the river level during normal or low flow periods, and future evaluation may be needed if increased well withdrawals reverse the positive riverward ground water gradient. One more costly alternative would be to continue the outfall five miles southward to a point about two miles south of Cambridge; however, that would require a regional scope to water quality control. Groundwater quality studies made at observation wells showed that the water quality in the aquifer is similar to that measured at Ames, and that the Buried Channel Aquifer is a valuable source of water supply. During flood periods the Ames River may cause more of a pressure wave effect and less of a water movement recharge phenomenon. If Site 5 is selected, several recommendations must be considered, such as flood protection and various monitoring programs. (Garrison-Omniplan)
W82-03112

RECHARGE MECHANISMS AND GROUNDWATER FLOW IN THE CHALK AND DRIFT DEPOSITS OF SOUTHERN EAST ANGLIA,

Birmingham Univ. (England). Dept. of Geological Sciences.
J. W. Lloyd, D. Harker, and R. A. Baxendale.
Quarterly Journal of Engineering Geology, Vol 14, No 2, p 87-96, 1981. 8 Fig, 5 Tab, 18 Ref.

Descriptors: *Aquifers, *Groundwater movement, *Groundwater recharge, Mathematical models, Geologic formations, Flow, Underground storage, Gravel, Anglian Water Authority, *England, Chalk deposits.

An extensive study of the hydrochemistry of groundwaters in the Chalk and drift deposits of southern East Anglia was carried out to obtain a qualitative understanding of the recharge and flow mechanisms operating in the two aquifer units. Five main water types were identified for the Chalk aquifer, and three drift environments were determined. These results were used to define a model of recharge and flow mechanisms. Recharge to the aquifer north of the London Clay boundary was concentrated along the major river valleys. Modern water containing nitrate was found only where the aquifer had a high permeability and where the flow is consequently high. Significant storage for the water abstracted from the Chalk aquifer was provided by the adjacent drift sands and gravels. South of the London Clay boundary, the drift acted as a storage reservoir and supplied an important base-flow component to the rivers. (Small-FRC)
W82-03182

CARBON ISOTOPE FRACTIONATION DURING MICROBIAL METHANE OXIDATION,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5A.
W82-03188

A PROBLEM POSED BY VAPOUR-DOMINATED GEOTHERMAL SYSTEMS,

California Univ., Los Angeles. Dept. of Earth Sciences.
For primary bibliographic entry see Field 1A.
W82-03200

PROGRAMMABLE HAND CALCULATOR PROGRAMS FOR PUMPING AND INJECTION WELLS: III. CONSTANT PUMPING (INJECTION) RATE, FULLY CONFINED AQUIFER, PARTIALLY PENETRATING WELL,

Missouri Univ.-Rolla.
D. L. Warner, and M. G. Yow.
Ground Water, Vol 18, No 5, p 438-443, September-October, 1980. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Computer programs, *Aquifers, Confined aquifers, Injection wells, *Wells, *Pressure head, Pumping head.

Two previous articles by the authors presented programmable hand calculator programs for calculation of head or pressure changes resulting from the pumping from or injection into wells completely penetrating fully confined and simiconfined aquifers. The appendices of this paper provide programs for the Texas Instrument TI 59 card programmable calculator to solve the same head or pressure changes in wells partially penetrating a fully confined aquifer or wells that fully penetrate, but are incomplete or partially screened. (Cassar-FRC)
W82-03225

FLOW IN AQUIFERS WITH CLAY LAMINAE 2. EXACT SOLUTIONS,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
O. D. L. Strack.
Water Resources Research, Vol 17, No 4, p 993-1004, August, 1981. 12 Fig, 6 Tab, 5 Ref.

Descriptors: *Error analysis, *Aquifers, *Impervious beds, *Steady flow, *Groundwater movement, *Clays, Laminar flow.

The method of determining steady flow in clay laminae-containing aquifers, developed in Part 1 of this work, is used to obtain approximate solutions of two cases. Exact solutions are also obtained, using standard complex variable techniques. The first case is confined flow in an aquifer system with an infinite lamina with a slot. The second is unconfined flow in an aquifer system with a semi-infinite lamina. In the first case there is significant error in discharge, up to plus or minus 25%. An acceptable error is found in the situation where boundary conditions are applied at distances of 15 times the aquifer thickness, or more, away from the slot. The error in the second example is less, maximum 12.7%, and may be explained by the differences in geometry. (Cassar-FRC)
W82-03232

FLOW IN AQUIFERS WITH CLAY LAMINAE 1. THE COMPREHENSIVE POTENTIAL,

Minnesota Univ., Minneapolis, Dept. of Civil and Mineral Engineering.
O. D. L. Strack.
Water Resources Research, Vol 17, No 4, p 985-992, August, 1981. 9 Fig, 10 Ref.

Descriptors: *Aquifers, *Steady flow, *Impervious beds, Groundwater movement, *Clays, Laminar flow, Groundwater potential, Comprehensive potential, Model studies, Permeability.

Steady flow of fresh water in an aquifer system containing thin impervious clay laminae is described. It is assumed that the laminae do not overlap. A steady state two-dimensional Dupuit-Forchheimer model predicts piezometric heads in the system. Conditions of confined, unconfined, confined interface, and unconfined interface flow may be considered in the aquifer above and below the laminae. A new potential (called the comprehensive potential) is introduced with a gradient equal to minus the vectorial sum of the discharges in the upper and lower aquifers. It is determined by solving a boundary value of the Poisson equation. Heads can be established along the edges of the clay lamina without using an iterative procedure. The analysis is applied to two cases, both involving two infinite aquifers separated by an infinite lamina. The aquifers are hydraulically connected through a circular opening in the lamina. No rainfall infiltration is present. In the first case, flows are unconfined, with a well in the lower aquifer and a recharge well in the upper. The second case has confined flows and no wells. To apply the analysis to multiple laminae the comprehensive potential technique is applied in steps, working to the innermost boundary. The method can be used when permeabilities in the upper and lower aquifers are different if the potentials in terms of heads are properly defined. (Cassar-FRC)
W82-03242

MOLECULAR APPROACH TO THE FOUNDATIONS OF THE THEORY OF SOLUTE TRANSPORT IN POROUS MEDIA. I. CONSERVATIVE SOLUTES IN HOMOGENEOUS ISOTROPIC SATURATED MEDIA,

Mississippi Univ., University. Dept. of Civil Engineering.
V. K. Gupta, R. N. Bhattacharya, and G. Sposito.
Journal of Hydrology, Vol 50, No 1/3. p 355-370, March, 1981. 22 Ref.

Descriptors: *Porous media, *Solute transport, *Diffusion coefficient, Model studies, Path of pollutants.

A molecular model is developed for the transport of low concentrations of a conservative solute in a homogeneous isotropic water-saturated porous medium. In this model, a solute molecule randomly collides with the solid grains in the medium and is scattered in a random direction. A parabolic differential equation for the solute concentration at the macroscopic level is derived from the molecular model. When solute connection is absent, the coefficient of molecular diffusion in a porous medium is less than the coefficient of molecular diffusion in bulk solution. For convection greater than zero the medium is assumed to be isotropic to prove that the solute dispersion tensor is diagonal. For small values of liquid velocity, the isotropicity assumption implies that the coefficients of longitudinal and transverse dispersion are approximately parabolic functions of the liquid velocity. Comparisons of derived dispersion coefficients with observed values suggest that solute-liquid molecular collisions, rather than solute molecules-solid phase grains collisions, account for the relationship between dispersion coefficients and liquid velocity. The solute convective velocity is less than or equal to the liquid velocity. (Cassar-FRC)
W82-03316

ANALYSIS OF FLOW THROUGH HETEROGENEOUS RANDOM AQUIFERS BY THE METHOD OF EMBEDDING MATRIX. 1. STEADY FLOW,

Tel-Aviv Univ. (Israel). School of Engineering.
G. Dagan.
Water Resources Research, Vol 17, No 1, p 107-121, February, 1981. 4 Fig, 19 Ref.

Descriptors: *Aquifers, *Flow, *Statistical models, Hydraulic conductivity, Non-uniform flow, Boundaries (Surfaces), Model studies, Hydrology, Monte Carlo method, Porous media, Earth-water interfaces, Mathematical models, *Groundwater movement, Aquifer characteristics.

This paper is a continuation and extension of Dagan's (1979) work on flow through aquifers whose properties vary in space in a random fashion. The statistical structures of the hydraulic conductivity, head gradient, specific discharge, and head fields are analyzed using a model consisting of a collection of spherical and cylindrical blocks with different conductivity and diameter, set randomly and independently in space. The influence of boundaries (regions not statistically homogeneous) and nonuniform average flows are analyzed for the first time. The growth of head variance with distance from the boundary in 2-dimensional flows is analyzed and compared with the Smith and Freeze (1979) Monte Carlo simulations. (Cassar-FRC)
W82-03320

STUDIES ON THE SALINIZATION OF COASTAL GROUND WATER. I. CONFINED GROUND WATER IN THE NAKA RIVER ESTUARY (IN JAPANESE),

Nara Coll. of Education (Japan). Dept. of Geoscience.
For primary bibliographic entry see Field 2L.
W82-03326

FIRST ORDER ANALYSIS OF UNCERTAINTY IN NUMERICAL MODELS OF GROUNDWATER FLOW. PART I. MATHEMATICAL DEVELOPMENT,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
M. D. Dettinger, and J. L. Wilson.
Water Resources Research, Vol 17, No 1, p 149-161, February, 1981. 31 Ref, 3 Append.

Descriptors: *Groundwater movement, *Mathematical studies, *Model studies, Piezometry, Hydrology, Aquifers, Flow measurement.

Part 1 of this paper includes a discucsion of the nature and sources of uncertainty encountered in groundwater flow models, especially numerical models. The models are cast in state-space form, with boundary conditions and inputs that are functionally dependent on, but statistically independent of, time. First and second order Taylor series expansions of the model equations are derived and used to estimate the mean and variance-covariance properties of piezometric head predictions, given corresponding statistics for aquifer parameters: material properties, initial conditions, boundary conditions, and inputs. The first order estimate of the piezometric head is identical to the deterministic result. Prediction uncertainty is a function of the magnitude of the parameter uncertainty and sensitivity of the predictions to the parameters. Part 2, to be presented later, will illustrate the effects of parameter uncertainty on predictions of heads for 1 and 2 dimensional aquifer flows. (Cassar-FRC)
W82-03329

2G. Water In Soils

FORECASTING SUBSURFACE WATER FLOW AND STORAGE ON FORESTED SLOPES USING A FINITE-ELEMENT MODEL,

M. Mohsenisaravi.
PhD Dissertation, January, 1981. 179 p, 39 Fig, 13 Tab, 151 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19892.

Descriptors: *Model studies, *Watershed management, *Forest watersheds, Storm seepage, Forecasting, Snowmelt, Permeability coefficient, *Idaho, Finite element method.

Subsurface flow in a three soil layer vertical cross section of the Pine Creek watershed in the Idaho Batholith of central Idaho was simulated using the finite element model, UNSAT2, under uncut, clearcut, and wildfire conditions. The model was based on a two-dimensional transient saturated-unsaturated analysis of the subsurface flow at the field site. The sensitivity of subsurface outflow to various input parameters indicated that subsurface outflow was most sensitive to the magnitude of saturated hydraulic conductivity. The simulations indicated that different snowmelt events require different saturated hydraulic conductivity to simulate subsurface outflow adequately. Nomographs were made showing the changes of saturated hydraulic conductivities on control and treated watersheds under harvesting and burning situations. (Sinha-OEIS)
W82-03018

NODAL DOMAIN INTEGRATION MODEL OF UNSATURATED TWO-DIMENSIONAL SOIL-WATER FLOW: DEVELOPMENT,

California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03080

SOIL MORPHOLOGY AND PREFERENTIAL FLOW ALONG MACROPORES,

Soil Survey Inst., Wageningen (Netherlands).
J. Bouma.
Agricultural Water Management, Vol 3, No 4, p 235-250, 1981. 6 Fig, 53 Ref.

Descriptors: *Soil structure, *Pores, *Morphology, *Soil water, Soil physics, Soil physical properties, Soil porosity, Macropores, Flow characteristics, Tracers, Infiltration, Hydraulic conductivity, Methylene blue, Clays.

Preferential flow in saturated soil involves rapid displacement of water from macropores; and in saturated soil, flow into air-filled macropores (short-circuiting), followed by lateral absorption. Macropores, defined as pores significantly larger than those which result from packing of individual soil particles, occur in three major forms: cylindrical channels, planes, and irregular. Macropores may be studied by several methods. Field descriptions are good only for identifying major differences in soils. Schematized structure models and use of stains such as methylene blue are useful in seeing infiltration into cracked soils. Pedological features such as mottling patterns can be used as indicators for preferential flow along macropores. Micromorphology measures the features very accurately, but results apply only to the thin sections studied; techniques are expensive. (Cassar-FRC)
W82-03175

SOLUTION OF THE CONTINUITY EQUATION FOR THE KARNAK AREA,

Toronto Univ. (Ontario). Dept. of Chemistry.
T. C. Billard, and G. Burns.
Nature (London), Vol 285, No 5767, p 654-655, June 26, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Saline soils, *Simulation analysis, *Continuity equation, Mathematical analysis, Mathematical equations, *Egypt, Nile River, Land management, Salinity, Soil water table, Irrigation, Soil water, Environmental effects.

A computer simulation of the flow of saline water in the area of the Great Temple of Karnak (Egypt) was devised to determine whether salinization presents a serious threat to the antiquities in that region. The physical system used in the simulation is represented by a river valley between two rows of mountains impermeable to water. The temples are situated in an unirrigated region between the river and an irrigated area. Water and soluble salts from the irrigated fields are driven into the river by the difference in the levels of the Nile and the water table under the irrigated fields. Since there is no irrigation in the temple area, the evaporation of moisture at the soil surface constitutes another driving force which moves saline water from the water table to the surface, where the salts are deposited. Solution of the steady-state continuity equation provides information on the relative importance and the approximate rates of these processes for the water saturated region. A computer program, which can be used on a mini-computer, was developed and yielded a solution for the equation which was stable, consistent, and convergent. The flow results, including the amounts of salt deposited in unirrigated areas, were found to be directly proportional to the hydraulic conductivity. The height of the water table was found to be the key boundary condition. About 92 percent of the water draining from the irrigated land is evaporated on or near the surface of the unirrigated land. These results indicate that new physiochemical processes operating since the Aswan Dam was built are causing salinization of land, endangering the foundations of the temples and unexcavated antiquities. (Carroll-FRC)
W82-03196

FIELD APPLICATION OF THE FOUR-ELECTRODE TECHNIQUE FOR DETERMINING SOIL SOLUTION CONDUCTIVITY,

Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
A. Nadler.
Soil Science Society of America Journal, Vol 45, No 1, p 30-34, 1981. 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Conductivity, *Soil solution, *Measurement techniques, Soil water, Calibrations, Salinity.

The four-electrode resistivity technique is used to obtain measurements of the in situ actual soil solution electrical conductivity by measuring bulk soil electrical conductivity. A procedure for determining the in situ soil solution conductivity from bulk soil electrical conductivity measurements is proposed. It comprises the preparation of calibration curves for soil solution and bulk soil conductivity in each soil under consideration using the electrical conductivity of the free draining solution instead of that of the soil solution extracts. The contributions of surface conductance to bulk soil electrical conductivity are calculated as a function of soil solution electrical conductivity using an iterative procedure. A correction factor is used that considers the relative soil volumetric water content rather than the absolute value in order to permit field measurements under a variety of soil moisture values. In situ electrical conductivity of a soil solution was calculated using the four-elctrode technique and this suggested calibration procedure, and the resultant values were compared to those for the electrical conductivity of soil solution extracts. The electrical conductivity of in situ soil solution calculated using this method was close to that of irrigation water and was always equal to or smaller than that estimated from the electrical conductivity of 1:1 soil extracts and back calculation to field water content. The electrical conductivity of soil surface ions may be greater than the electrical conductivity of soil solution ions, leading to unreasonable results when the electrical conductivity of surface ions is not properly considered. A commonly used soil extraction method for estimating soil solution electrical conductivity was shown to be highly influenced by total salt content and by soil moisture levels, emphasizing the advantages of the four-electrode method for measuring in situ soil water salinity. (Carroll-FRC)
W82-03260

SOIL HYDRAULIC PROPERTIES AS STOCHASTIC PROCESSES: I. AN ANALYSIS OF FIELD SPATIAL VARIABILITY,

Agricultural Research Organization, Volcani Center, Bet Dagan (Israel). Div. of Soil Physics.
D. Russo, and E. Bresler.
Soil Science Society of America Journal, Vol 45, No 4, p 682-687, July/August, 1981. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Soil properties, *Stochastic hydrology, *Permeability coefficient, Soil engineering, Stochastic processes, Statistical analysis, Spatial distribution, *Soil water, Hydraulic conductivity.

The spatial variability of certain soil hydraulic properties was examined in the field, and the spatial structures of these properties are presented in terms of the probability density functions, autocorrelation functions, and integral scales. The parameters were: saturated hydraulic conductivity, water entry value, saturated and residual water contents, and a constant which characterizes the pore size distribution of the soil. Each parameter is described at a given depth as a realization of a stationary two-dimensional isotropic and random process. The integral scale value was calculated from the autocorrelation functions for each parameter, and generally decreased with depth. The spatial variabilities of the hydraulic functions are described by the probability density functions and the autocorrelation functions. The results of integral scales and coefficients of variation from this study can be applied to evaluate errors in estimating average values of several hydraulic properties. (Small-FRC)
W82-03315

ANALYSIS OF LONGITUDINAL DISPERSION IN UNSATURATED FLOW I. THE ANALYTICAL METHOD,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
J. L. Wilson.
Water Resources Research, Vol 17, No 1, p 122-130, February, 1981. 10 Fig, 23 Ref.

Descriptors: *Unsaturated flow, *Soil moisture, *Solutes, Dispersion, *Solute transport, Infiltration, Mathematical studies, Mixing.

Analysis of solute displacement in unsaturated soils involves one-, two-, or three-dimensional flow with fixed streamlines. The transport processes are separated into 2 parts: convection with mean flow and dispersive mixing. The convection process is solved exactly, and the dispersive process approximated by singular perturbation techniques. Comparison of theoretical results and field data showed agreement. When the analytical technique is applied to solute transport during steady and transient one-dimensional infiltration, it is observed that nonuniform moisture content in space results in stretching or contracting of a solute pulse as it travels through the soil, whether or not dispersive mixing is present. In addition, for transient infiltration into initially moist unsaturated systems, the rate of solute movement in an unsaturated system is usually smaller than the rate of movement of a moisture change. (Cassar-FRC)
W82-03321

PONDED INFILTRATION INTO SIMPLE SOIL SYSTEMS: 1. THE SATURATION AND TRANSITION ZONES IN THE MOISTURE CONTENT PROFILES,

Sydney Univ. (Australia). Dept. of Soil Science.
W. J. Bond, and N. Collis-George.
Soil Science, Vol 131, No 4, p 202-209, April, 1981. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Moisture content, *Soil water, *Infiltration, Physical properties, Saturation zone, Saturated soils, Transition zone, Free water, Sand, Air entrainment.

Early experimental work involving both moisture content and total potential profiles conducted by Bodman and Colman (1943) resulted in the identification of five features of soil moisture content profiles: saturation zone, transition zone, transmission zone, wetting zone, and wetting front. This study was designed to measure as accurately as possible the basic physical properties of soil during ponded infiltration in simple soil systems and to describe the phenomena occurring during this process. A fine sand from which silt and clay fractions had been removed was used for this study. The experiments demonstrated that saturation and transition zones do exist in the moisture content profiles during ponded infiltration of this simple soil. The saturation zone was not found to be associated with a zone of high total potential gradient. Accepted notions concerning the encapsulation of air when porous materials containing air are wetted and the continual solution of encapsulated air by the infiltration water are used to propose a mechanism for the formation of the saturation and transition zones in simple soil systems. (Carroll-FRC)
W82-03323

MODELING NITROGEN TRANSPORT AND TRANSFORMATIONS IN SOILS: 1. THEORETICAL CONSIDERATIONS,

Louisiana State Univ., Baton Rouge. Dept. of Agronomy.
H. M. Selim, and I. K. Iskandar.
Soil Science, Vol 131, No 4, p 233-241, April, 1981. 7 Fig, 24 Ref.

Descriptors: *Nitrogen, *Soil profiles, Mathematical models, Finite difference methods, Nitrification, Denitrification, *Soil water, Ammonium, Flow characteristics, Soil water movement.

Soil water movement directly affects the transport of the water-soluble nitrogen species in the soil, while various organic and inorganic soil nitrogen species influence the chemical and microbiological processes responsible for the various reversible and irreversible nitrogen transformations in the soil.

Mathematical modeling of nitrogen behavior in the soil system has either considered the transport and transformation of nitrogen under steady-state water flow conditions or described the fate of soil nitrogen under nonsteady or transient water flows. The numerical model presented here simulates the transient water flow and nitrogen transport and transformations in multilayered or stratified unsaturated soil profiles. The nitrogen submodel considers nitrification, denitrification, immobilization, mineralization, and ionic exchange of ammonium, as well as uptake of nitrogen by plants. Finite difference approximation of the nitrogen transport and transformation equations is used simultaneously with the water flow equation for transient-unsaturated flow conditions in this model. Model evaluation and sensitivity analyses were conducted for a wide range of values for the rate of nitrification, distribution coefficient for ammonium exchange, and rate of nitrogen uptake. (Carrol-FRC)
W82-03324

ZINC DEFICIENCY IN WETLAND RICE ALONG A TOPOSEQUENCE OF HYDROMORPHIC SOILS IN THE PHILIPPINES. I. SOIL CONDITIONS AND HYDROLOGY,

International Rice Research Inst., Los Banos, Laguna (Phillippines).
N. V Van Breemen, D. D. Quijano, and L. N. Sen.
Plant and Soil, Vol 57, No 2/3, p 203-214, 1980. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Zinc, *Rice, *Philippines, *Drainage, *Soil-water-plant relationships, Hydrology, Bicarbonate, Calcium, Magnesium, Carbon dioxide, Soil gases, Hydrogen ion concentration, Arable land, Artesian wells, Subsurface waters, Percolation.

Zinc deficiency was studied along a 500 meter toposequence in volcanic soil in the Philippines. There were noticeable differences between crops and conditions in the upper and lower fields. In the higher fields (45 meters) above sea level, rice grew well. Zn content of dry soil was 0.15 mg per kg, and percolation was dominant. Dissolved Mg(2+) and bicarbonate in wet soil samples were (given as ionic equivalents in moles per cu meter):19 for 1/2Mg(2+) and 22 for bicarbonate in the highest field. In contrast, the poorly drained fields on the footslope (43 meters above sea level), with Zn levels of 0.10-0.12 mg per kg, grew poor crops. Upwelling of groundwater was present: 1/2Mg(2+) was 26-30, and bicarbonate 29-33. In the toeslope area, only grass and shrubs grew. Here, upwelling artesian well water high in dissolved CO2 (pH 6.5) produced CaCO3 precipitation. A subsequent paper will explain the relationship of these peculiar physical, chemical, and mineralogical characteristics with Zn deficiency. (Cassar-FRC)
W82-03328

PONDED INFILTRATION INTO SIMPLE SOIL SYSTEMS: 3, THE BEHAVIOR OF INFILTRATION RATE WITH TIME,

Sydney Univ. (Australia). Dept. of Soil Science.
W. J. Bond, and N. Collis-George.
Soil Science, Vol 131, No 6, p 327-333, June, 1981. 3 Fig, 15 Ref.

Descriptors: *Infiltration rate, *Ponding, *Soils, Mathematical studies, Soil water, Infiltration, Soil absorption capacity.

The behavior of infiltration rate with time during ponded infiltration into simple soil systems is examined using experimental results previously reported by the present authors. Equations defining the infiltration rate for the saturation zone and for the transmission zone are applied to data from infiltration experiments. this analysis indicates that the infiltration rate is proportional to the total potential gradient in the transmission zone throughout infiltration and that steady-state infiltration will be completely achieved only when the total potential gradient has become constant with time in the transmission zone. The apparent linearity of a measured cumulative infiltration-time relationship is shown not to be a reliable indicator of steady state. An equation based on Darcy's law, which relates the infiltration rate to the total potential gradient in the transmission zone, is derived and experimentally tested. This equation is used to demonstrate that it is impossible to achieve steady state infiltration in simple soil systems. The effect of the saturation and transition zones on the infiltration rate, and errors that occur when infiltration models neglect the existence of these zones, are illustrated using this equation. (Carroll-FRC)
W82-03366

2H. Lakes

THE INFLUENCE OF HYDRODYNAMIC TRANSPORT ON PHYTOPLANKTON DYNAMICS IN HOMOGENEOUS LAKES,

Cornel Univ., Ithaca, NY.
J-T. Kuo.
PhD Thesis, January 1981. 177 p, 55 Fig, 6 Tab, 72 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-10910.

Descriptors: *Model studies, *Water quality, *Lakes, *Hydrodynamics, Nutrients, Water currents, Flow characteristics, *Phytoplankton, Hydrodynamic transport, Circulation.

This research explores the influence of hydrodynamic transport on phytoplankton dynamics in lakes through the use of hydrodynamic and phytoplankton modeling. Variable horizontal and vertical dispersion (or exchange) coefficients in a finite-segment water quality model induced by large scale turbulent flow across segment boundaries may be estimated from the outputs of a lake hydrodynamic model. A steady-state lake circulation model has been demonstrated to be able to generate mean circulation patterns in homogeneous lakes. Both direction and magnitude of currents influence the distribution of phytoplankton and nutrient in the 'fine grid' model of lakes or embayment. The effect of Saginaw River inflow is of importance in the constituents distribution in Saginaw Bay, including phytoplankton. The influence of Genessee River discharge is relatively insignificant to the constituents simulation the Rochester embayment. Calculated results using a time-variable transport regime from a series of steady-state calculations with a circulation model show more variation in constituents concentration when compared to those using temporally constant flows in previous modeling analyses. The importance of hydrodynamic transport on the distribution of phytoplankton chlorophyll in lakes is dependent on the space and time scales of interest. This research demonstrates that as the horizontal grid size of a finite-segment or finite-difference large lake model increases to a certain level, the general biochemical kinetics of plankton and nutrients would dominate over the physical transport process in determining the distribution of phytoplankton and nutrients. (Sinha-OEIS)
W82-03023

LAKE TROPHIC STATE AND ALGAL GROWTH AS INFLUENCED BY CATION CONCENTRATIONS,

Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 5C.
W82-03038

SOME ECOLOGICAL ASPECTS OF LAKE QARUN, FAYOUM, EGYPT, PART II. PRODUCTION OF PLANKTON AND BENTHIC ORGANISMS,

Institute of Oceanography and Fisheries, Cairo (Egypt). Inland Waters and Fish Culture Div.
S. A. Abdel-Malek, and M. M. Ishak.
Hydrobiologia, Vol 75, No 3, p 201-208, November, 1980. 5 Fig, 7 Tab, 14 Ref.

Descriptors: *Benthos, *Lakes, *Plankton, Eutrophic lakes, Aquatic life, Benthic fauna, Benthic flora, Biomass, *Lake Qarun, *Egypt, Salinity.

Changes were investigated in the species composition, distribution and abundance of phytoplankton, zooplankton, and benthic organisms inhabiting Lake Qarun in relation to variations in the salinity of the water in different parts of the lake during the period from January 1974 to December 1977. Sampling was conducted monthly from 11 stations. The average number of phytoplankton cells was 152,300 cells/L, and its biomass was 0.365 g C/cubic meter. The average number of zooplankton was 31440/cubic meter and its biomass was 194.19 mg/cubic meter. The average number of benthic fauna was 19889/square meter and its biomass was 400.22 g/square meter. Thus Lake Qarun is a highly eutrophic body of water. When the salinity of the lake reached 30-34%, freshwater planktonic species such as Diaptomus salinus that used to inhabit the lake along with the cladoceran Moina salinarum disappeared completely. Some Rotatoria were able to withstand the high salinity. The new composition of the zooplankton community showed that the marine zooplankton species included not only Acartia latisetosa and Cirripedia nauplii, but also other species such as Polychaeta, Obelia medusae, and others. The benthos of Lake Qarun is characterized by an intensive growth of a few species. The majority of bottom fauna in the lake are Mollusca, mainly Cerastoderma glaucum, 69.84% by weight. (Baker-FRC)
W82-03052

EFFECTS OF DILUTION ON THE BENTHOS OF AN ALKALINE LAKE,

National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
T. Wiederholm.
Hydrobiologia, Vol 68, No 3, p 199-208, February 16, 1980. 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Saline lakes, *Benthic fauna, *Irrigation effects, Lakes, *Lake Lenore, Soap Lake, *Washington, Species diversity, Eutrophic lakes, Freshwater intrusion, Ecological effects, Irrigation water, Leakage.

The salinity of Lake Lenore, in semi-arid central Washington, declined from about 17 g per liter in 1950 to 1.5 g per liter in 1975 because fresh water leaked into the lake from nearby irrigation projects. Dilution of the lake greatly increased species diversity, from a single halobiontic chironomid species in 1950 (inferred from sampling adjacent, undiluted Soap Lake) to 8 taxa in 1957 (salinity 6.7 g per liter), 10 in 1962 (salinity 2.6 g per liter), 26 in 1971 (salinity 1.9 g per liter), and 29 in 1975 (salinity 1.6 g per liter). The lake at present is well mixed, highly productive, and lacking a reproducing fish population. Concurrent increases in abundance and biomass suggest that the carrying capacity of the lake at earlier, higher salinities was not fully used by the benthic fauna. The sodium bicarbonate containing Lake Lenore at > 2-3 g per liter salinity did not support some of the taxa found in Na-Mg sulfate-type lakes at salinities up to 10 g per liter, demonstrating the importance of ion composition. (Cassar-FRC)
W82-03064

THE STRUCTURE OF FRESHWATER HUMIC SUBSTANCES AS REVEALED BY 13C-NMR SPECTROSCOPY,

Lincoln Coll. (New Zealand).
M. A. Wilson, P. F. Barron, and A. H. Gillam.
Geochimica et Cosmochimica Acta, Vol 45, No 10, p 1743-1750, October, 1981. 4 Fig, 2 Tab, 44 Ref.

Descriptors: *Humic acids, *Natural waters, *Nuclear magnetic resonance, Spectroscopy, Chemical analysis, Carbon, Sediments, Soils, Fate of pollutants, Metals, Chelation.

The 13C-NMR spectra of freshwater aquatic humic substances were determined so that a comparison of aromaticity could be made between marine, freshwater and terrestrial sources. Because aquatic plants do not normally contain large amounts of lignin the results should shed light on the origin of freshwater aquatic humic substances and indicate why the materials are such excellent complexing agents for metal ions. The humic substances examined were taken from Lake Celyn, Gwynedd, North Wales. Carboxyl, aromatic, o-alkyl and alkyl resonances were recognizable.

Varying pulse delay from 0.43 to 2.5 sec had little effect on the magnitude of the signal ascribed to aromatic carbon, but there was a small nuclear Overhauser effect. The results indicate that 24% of Lake Celyn humic acid carbon was carboxyl and 40% was aromatic. The high proportion of aromatic carbon suggests that the Lake Celyn humic acid is largely formed from terrestrial humic substances from the surrounding peaty watershed. The paper presents evidence which suggests that the relative mobilities of the individual humic substances are also important. (Baker-FRC)
W82-03095

EUTROPHICATION OF THE LAKE-RESERVOIR SIDI MOHAMED BEN ABDELLAH, RABAT, MOROCCO (L'EUTROPHISATION DU LAC-RESERVOIR SIDI MOHAMED BEN ABDELLAH PRES DE RABAT, MAROCO),

Service Controle de Qualite des Eaux, Rabat (Morocco).
H. Abouzaid, and L. landner.
Aqua, No 6, p 345-347, 1981. 1 Fig, 1 Tab.

Descriptors: *Eutrophication, *Reservoirs, Lakes, Water quality, *Nutrients, Mathematical models, Model studies, *Morocco, Rabat.

The Lake-Reservoir Sidi Mohamed Ben Abdellah was built for the purpose of supplying water for the coastal zone between Kenitra and Casablanca. The reservoir has a volume of 550 million cubic meters with an average depth of 17 meters. The quality of the water in the reservoir has deteriorated due to eutrophication. This is clearly demonstrated by the difficulties being experienced at the water treatment plant. An intensive study has been undertaken by the National Water Office, with the help of the World Health Organization, to determine what factors are responsible for the harmful effects on water quality in the reservoir. Some of the factors studied include liquid and solid inputs, assessment of nutrients, primary production and supply chain. The study has permitted the optimization of the level of raw water intake and the linking of the hydraulic system of the dam to changes in water quality. Currently a mathematical model of the water quality of the reservoir is being developed. The model should enable the feasibility of diferent methods for fighting eutrophication to be studied. The model will also be able to predict water quality in the short and long term. The model will probably be adaptable to other reservoirs in Morocco as well. (Baker-FRC)
W82-03118

DYNAMICS OF BACTERIAL SULFATE REDUCTION IN A EUTROPHIC LAKE,

Wisconsin Univ., Madison. Dept. of Bacteriology.
K. Kingvorsen, J. G. Zeikus, and T. D. Brock.
Applied and Environmental Microbiology, Vol 42, No 6, p 1029-1036, December, 1981. 4 Fig, 2 Tab, 36 Ref.

Descriptors: *Sulfates, *Bacteria, *Growth kinetics, Lakes, *Lake Mendota, Wisconsin, Sulfur bacteria, Sediments, Lake sediments, Kinetics, Trophic state, *Sulfate reduction.

Sulfate reduction by bacteria in the surface sediments and water of Lake Mendota, Wisconsin, was studied with S35 labeled sulfate. Sulfate was reduced rapidly at the sediment surface, having a turnover time of 10-24 hours. Daily sulfate reduction rates ranged from 50 to 600 nM sulfate per cu cm. Much less sulfate reduction took place in the water; rates were 1000 times lower than in the surface sediments. Rates of bacterial sulfate reduction in the sediments were not sulfate-limited at sulfate concentrations > 0.1 nM. Optimum temperature for sulfate reduction was 36-37 C. Lake temperatures were 1 to 13 C during the study. Adding electron donors to laboratory cultures gave the following growth stimulation: hydrogen, 73% n-butanol, 59%; n-propanol, 50%; ethanol, 39%; yeast extract, 32%; glucose, 32%; n-butyrate, 32%; n-propionate, 23%; glycerol, 14%; choline chloride, 14%; acetate, zero; and lactate, zero. Bacterial sulfate reduction is very active in this lake even though it is severely temperature limited. Michaelis-Menton kinetics did not apply to the bacterial population in this lake. (Cassar-FRC)
W82-03119

PHOSPHORUS-LIMITED GROWTH OF A GREEN ALGA AND A BLUE-GREEN ALGA,

Alaska Univ., Fairbanks. Inst. of Water Resources.
D. S. Lang, and E. J. Brown.
Applied and Environmental Microbiology, Vol 42, No 6, p 1002-1009, December, 1981. 5 Fig, 1 Tab, 44 Ref.

Descriptors: *Phosphorus, *Algae, *Oligotrophic lakes, Lakes, Cyanophyta, Chlorophyta, Nutrients, Phosphates, Kinetics, *Growth kinetics.

A cyanophyte, Synechococcus Nageli, was better suited for growth in phosphorus-limited oligotrophic waters than a chlorophyte, Scenedesmus quadricauda. The growth kinetics were studied in batch and continuous cultures. The cyanophyte had greater steady-state phosphate transport capability and phosphorus storage capability. It also depleted phosphate to much lower levels than S. quadricauda. In a dual species continuous culture under limited phosphorus the cell dry weights for Scenedesmus reached a peak at 5 days and declined to zero by 28 days. Synechococcus cell dry weights increased from nearly zero at 7 days to a peak at 17 days, followed by a slight decline to 25 days and a slight increase to 35 days, the end of the study. (Cassar-FRC)
W82-03120

OBSERVATION ON THE OCCURRENCE OF MICROBIAL AGENTS WHICH CAUSE LYSIS OF BLUE-GREEN ALGAE IN LAKE KASUMIGAURA,

Y. Yamamoto.
Japanese Journal of Limnology, Vol 42, No 1, p 20-27, 1981. 7 Fig, 5 Tab, 28 Ref.

Descriptors: *Microbial degradation, *Algal growth, Eutrophication, Lakes, Bacteria, Microorganisms, Toxicity, Seasonal variation, Distribution patterns, Vertical distribution, *Lake Kasumigaura, *Japan.

Attempts were made to determine the seasonal distribution of microbial agents which cause lysis of blue-green algae in Lake Kasumigaura and to ascertain whether these agents have a major role in the decline of algal blooms. The lake is euphotic; Microcystis are the dominant phytoplankton from June to September. The lake is about 168 square km in surface area with a maximum depth of 7.5 meters and average depth of 4 meters. Samples were taken from four sites at monthly intervals from August 1975 through October 1977. Water pH ranged from 6.8 in the winter to 9.6 in summer and fall. Water temperatures showed seasonal variation, with the lowest at 3.8 degrees C in winter and the highest at 29.2 degrees C in summer. The horizontal distribution patterns of plaques showed increases from July to October 1976 and decreased in February 1977, with high concentrations of chlorophyll a generally preceding the peaks of agents and the occurrence of algal-lysis agents being closely correlated with chlorophyll a contents. Many of the plaques were caused by amebas, bacteria and fungi. It was suggested that perhaps amebas are always present in association with some algae which are preferentially ingested, begin to grow rapidly in such an algal bloom as to increase the chance of feeding, attain to maximum population, and subsequently survive, possibly in cyst-like form, under unfavorable conditions. It is not clear from this study whether there is any significant relationship between the amebal population and the occurrence of bacteria or levels of gram-negative bacteria. (Baker-FRC)
W82-03177

CONTRIBUTION TO THE LIMNOLOGY OF LAKE PAVIN (FRANCE) II. RELATIONSHIPS BETWEEN NONBIOLOGICAL PARAMETERS--PHYTO AND ZOOPLANKTON IN THE 0-20 METER ZONE (CONTRIBUTION A L'ETUDE LIMNOLOGIQUE DU LAC PAVIN (FRANCE). II. RELATIONS ENTRE PARAMETRES ABIOTIQUES-PHYTO ET ZOOPLANCTON DANS LA ZONE 0-20 METRES),

Biological Station, Besse-en-Chandesse (France).
J. Devaux.
Hydrobiologia, Vol 68, No 1, p 17-34, January, 1980. 10 Fig, 4 Tab, 21 Ref.

Descriptors: *Zooplankton, *Primary productivity, Lakes, Phytoplankton, *Lake Pavin, *France, Copepods, Cladocerans, Daphnia, Ceriodaphnia, Model studies, Productivity, Limnology, Water quality, Nutrients.

Zooplankton were collected bimonthly from May 1973 to April 1974 at six depths from 0 to 20 meters in Lake Pavin, located in the French Massif Central. The volcanic-origin lake is meromictic, 44 hectares in area, and 98 meters deep. The species studied were: Daphnia longispina, Ceriodaphnia quadrangula, Acanthodiaptomus denticornis, and Cyclops abyssorum. Copepods were present all year, with 2 principal reproduction periods, March-April and October-November. Nauplius larvae of A. denticornus died in winter. A mathematical model illustrated the relationships between phytoplankton and zooplankton and the biophysico-chemical parameters of the lake. The highest values of phytoplankton primary production and of the activity coefficient were found when herbivorous zooplankton development was significant and nutrient concentrations were at their minimum. (Cassar-FRC)
W82-03178

RELATIONSHIP BETWEEN CHLOROPHYLL-A CONCENTRATION AND PHYTOPLANKTON BIOMASS IN SEVERAL RESERVOIRS IN CZECHOSLOVAKIA,

Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
B. Desortova.
Internationale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 153-169, 1981. 10 Fig, 4 Tab, 30 Ref.

Descriptors: *Reservoirs, *Biomass, *Chlorophyll a, Nutrients, Light intensity, *Phytoplankton, Plankton.

The results of parallel determinations of phytoplankton biomass and chlorophyll concentration, the relations between these two parameters, and the effect of several factors such as species composition, light, and nutrients on the chlorophyll content in algal biomass are reported. The data were obtained during several years at five continuously studied reservoirs: the Slapy, Hubenov, Vrchlice, Klicava and Orlik. The relationship between phytoplankton biomass and chlorophyll concentration determined on the basis of results obtained from several reservoirs was in all cases positive. The statistical significance of the relationship was usually high, even though there was considerable variability within the mentioned relationship. This was mainly due to the fact that the changes in chlorophyll concentration did not always take place in parallel with the changes in total phytoplankton biomass. The chlorophyll content per unit biomass varied by more than two orders in the same locality in the course of the year. A negative relationship was noted between the phytoplankton biomass and the percentage chlorophyll content. Its closeness was affected by the great variations in chlorophyll content per unit biomass during the year. The percentage chlorophyll content in algal biomass was evidently affected by incident light. No significant effects from the species composition of algae or from nutrient concentration on the chlorophyll content per unit phytoplankton biomass have become evident thus far. (Baker-FRC)
W82-03185

LIMNOLOGICAL STUDIES OF A FRESHWATER FISH POND AT BURDWAN, WEST BENGAL, INDIA,

ICAR Research Complex, Shillong (India).
B. K. Mandal.
Japanese Journal of Limnology, Vol 41, No 1, p 10-18, January, 1980. 3 Tab, 22 Ref.

Descriptors: *Limnology, *Ponds, *Lakes, Fish, Plankton, Phytoplankton, Zooplankton, Rotifers, Crustaceans, Biomass, Aquatic life, Population dynamics, Seasonal variation, Algal blooms, *India.

The seasonal variations of the physico-chemical factors and plankton community of a freshwater fish pond were studied at Burdwan, West Bengal, India, during January to December of 1971. The pond is rectangular in shape, with an area of 4.2 ha. Its seasonal average depth varies from 3.5 meters during the rainy season to 2.0 meters during the dry season. Pond water is transparent for most of the year except the winter months, when a dense growth of Eichornia crassipes SOLMS and Potamogeton nodosus appears. The seasonal variation of pH value ranged from 6.5 to 8.3, with the peak in April and the low point in August. Dissolved oxygen varied from 5.5 to 17.5 mg/liter, high in December and low in May. Free carbon dioxide ranged from 1.5 to 12.0 mg/liter. Chloride content ranged from 80.0 to 180.0 mg/liter, peaking in March. Nitrate content ranged from 0.45 to 1.2 mg/l nitrate-nitrogen, peaking in July. Phosphate ranged from 0.25 to 0.95 mg/liter, peaking in July. Total plankton ranged from 8.7 to 14.2 ml, with a bimodal pattern of seasonal change. Peaks were recorded in February and July. Zooplankton occupied 21.8 to 82.6% of the total plankton volume, with rotifers and crustaceans being the dominant forms. The phytoplankton population in the total plankton varied from 17.4 to 78.2% and was composed of Chlorophyceae, Myxophyceae and Bacillariophyceae. Water blooms lasting until autumn were developed after the monsoon months. The components of the bloom were Microcystis and Anacystis in association with Anabaena. Diatoms were represented by 10 species only and were abundant during the monsoon season. Synedra ulna and Melosira granulata constituted the bulk of the diatom population and were present throughout the year. (Baker-FRC)
W82-03186

EXPLOITING PAPYRUS,

King's Coll., London (England). Dept. of Plant Sciences.
P. D. Moore.
Nature (London), Vol 284, No 5756, p 510, April 10, 1980.

Descriptors: *Eutrophication, *Aquatic weeds, Swamps, Papyrus, Nutrient removal, Performance evaluation, Nutrients, *Aquatic plants, Weeds, Nitrogen, Magnesium, Potassium, Phosphorus, *Lakes, Tropical lakes.

Papyrus forms floating swamps in the peripheral zones of tropical lakes which may be effective in absorbing nutrients from lakes in danger of eutrophication. The plant, which is robust and productive, absorbs considerable quantities of nutrient ions during swamp growth. Nutrient losses from death, decay, and leaching of older plants are believed to amount to about 65 percent of the material absorbed. The swamp acts as an effective extractor of nutrients, but much of the extracted material is transported as detritus by the flow-through below the mat. Nutrient absorption is also less when water movement is rapid. There is a high degree of nitrogen fixation within the swamp system. Periodic harvesting and removal of the biomass would increase the efficiency of papyrus swamps as nutrient extractors. Since the most rapid accumulation of nutrients occurs in the early growth stages, frequent cropping of the papyrus should result in a maximum nutrient drain on the lake system. In addition, the harvested papyrus can be used as a fuel. It is recommended that tropical swamps be conserved until their usefulness has been assessed and appropriate management regimes developed. (Carroll-FRC)
W82-03202

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-1973. II. CHANGES IN PHYSICAL AND CHEMICAL PARAMETERS OF EUTROPHICATION,

Nebraska Univ.-Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W82-03214

THE COMPOSITION AND ECOLOGY OF PERIPHYTON COMMUNITIES IN FRESHWATERS. II. INTER-RELATIONSHIPS BETWEEN WATER CHEMISTRY, PHYTOPLANKTON POPULATIONS AND PERIPHYTON POPULATIONS IN A SHALLOW LAKE AND ASSOCIATED EXPERIMENTAL RESERVOIRS ('LUND TUBES'),

University of East Anglia Univ., Norwich (England). School of Environmental Sciences.
B. Moss.
British Phycological Journal, Vol 16, No 1, p 59-76, March, 1981. 9 Fig, 30 Ref.

Descriptors: *Phytoplankton, *Population dynamics, *Water chemistry, Nitrogen, Aquatic populations, Diatoms, *Lakes, Eutrophic lakes, *Algae, Seasonal variation, Phosphorus, Plankton.

Previous studies of eutrophication have shown that shading by increasing populations of periphyton algae may reduce macrophyte vigor prior to shading by increasing phytoplankton populations, which proliferate later in the process, resulting in the elimination of submerged macrophytes. Seasonal changes in the populations of both periphyton algae and phytoplankton were examined both in two experimental 20 meter diameter 'Lund tubes' placed in the Hickling Broad and in the Broad itself. Agriculture land drainage and roosting gull populations have contributed to the increasing eutrophication of the lake. Gulls perching on the rims of the Lund tubes have caused these reservoirs to experience even greater eutrophication. The water in the tubes experienced persistent domination by colonial blue-green algae, absence of a spring diatom pulse, severe nitrogen limitation, and scanty periphyton on Potamogeton pectinatus. Phytoplankton chlorophyll a levels were lower in the lake than in the tubes, but an alteration of spring diatom annd summer colonial blue-green algae was found in the lake. The lake also showed less severe nitrogen limitation than the tubes, and abundant periphyton crops, especially of diatoms, developed on P. pectinatus and other macrophytes. Periphyton development in the tubes and in the lake was related to nigrogen availability in these phosphorus-enriched waters. The absence of seasonal variations in the phytoplankton population in the tubes was related to the absence of flushing of the water body in the autumn and winter. (Carroll-FRC)
W82-03217

STUDIES OF THE HYDROBIOLOGY OF A TROPICAL LAKE IN NORTHWESTERN QUEENSLAND. II. SEASONAL CHANGES IN THERMAL AND DISSOLVED OXYGEN CHARACTERISTICS,

James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
C. M. Finlayson, T. P. Farrell, and D. J. Griffiths.
Australian Journal of Marine and Freshwater Research, Vol 31, No 5, p 579-569, October, 1980. 5 Fig, 11 Ref.

Descriptors: *Tropical regions, *Lakes, *Australia, New South Wales, Lake Moondarra, Stratification, *Thermal stratification, Seasonal variations, *Dissolved oxygen, Rainstorms, Precipitation, Hydrobiology.

Seasonal changes in vertical distribution of heat and oxygen in lake waters of Lake Moondarra were revealed by a sampling program extending from April 1976 to August 1978. The lake is man-made and located in northwestern Queensland. Evidence suggests that the lake approximates the warm polymictic type in which no persistent thermal stratification ever develops. During the cooler months, thermal stratification breaks down during the night. In the warmer months, the intense rainstorms prevent the establishment of a persistently stratified water column. The shallowness of the lake relative to its surface area and the prevailing environmental conditions ensure that extensive periods of oxygen depletion do not develop in the water column. A strong, prolonged period of thermal stratification would develop, with subsequent serious effects on the availability of dissolved oxygen in the deeper layers, only in the case in which there were no significant rainstorms within a given year's time. The stratification characteristics of Lake Moondarra set it apart from most Australian lakes, which belong to the warm monomictic type, with complete mixing occurring only in winter. The difference can be attributed to those features of the lake and of the local climatic conditions which prevent the establishment of a stable thermal stratification in the summer months. (Baker-FRC)
W82-03218

LIMNOLOGIC STUDY OF LAKE PAVIN (FRANCE) 1: ABIOTIC FACTORS AND PHYTOPLANKTON (CONTRIBUTION A L'ETUDE LIMNOLOGIQUE DU LAC PAVIN (FRANCE) 1: FACTEURS ABIOTIQUES ET PHYTOPLANCTON),

Biological Station, Besse-en-Chandesse (France).
J. Deveaux.
Hydrobiologia, Vol 68, No 2, p 167-189, January, 1980. 17 Fig, 5 Tab, 72 Ref.

Descriptors: *Lakes, *Phytoplankton, Temperature effects, Acidity, Mathematical models, Model studies, Carbon, Nitrogen, Oxygen, Physicochemical properties, *Lake Pavin, *France.

A synthetic mathematical model has been devised to summarize the physico-chemical parameters and phytoplankton relationships in Lake Pavin. The Lake itself is located at 1197 meters in the Massif Central Francais. The lake is a dimictic and meromictic lake of 44 ha in area and 92 meters depth. Bimonthly samples were taken at 8 depths ranging from surface to 40 meters. Sampling was performed between May 1973 and April 1974. The following physicochemical parameters were examined: light energy, temperature, pH, conductivity, available oxygen, nitrogen, phosphorus, silica, and carbon. Dynamics of the phytoplankton populations were also considered, such as cell counts, standing crop, primary production, and photosynthetic pigments. Lake waters are clear, with low conductivity and high concentrations of oxygen in the first 40 meters. The means of nitrogen concentration were between 45 and 279 microg/liter and between 0 and 161 microg/liter for phosphorus in a water column ranging from 0 to 40 meters. In winter and spring the phytoplankton are characterized by the development of Diatoms such as Melosira italica subsp. subarctica and Asterionella formosa, as opposed to low standing crops of Chlorophycea such as Coenococcus, Sphaerocystis, and Chlamydomonas which appear in summer. Photosynthetic activity is maximum during winter for diatom populations. (Baker-FRC)
W82-03219

ANALYTICAL REFERENCE MATERIALS. III. PREPARATION AND HOMOGENEITY TEST OF LARGE QUANTITIES OF WET AND DRY SEDIMENT REFERENCE MATERIALS FOR LONG TERM POLYCHLORINATED BIPHENYL QUALITY CONTROL STUDIES,

Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-03224

PHYSICAL VARIABILITY AND PHYTOPLANKTON COMMUNITIES IV. TEMPORAL CHANGES IN THE PHYTOPLANKTON COMMUNITY OF A PHYSICALLY VARIABLE LAKE,

McMaster Univ., Hamilton (Ontario). Dept. of Biology.
G. P. Harris, and B. B. Piccinin.
Archiv fur Hydrobiologie, Vol 89, No 4, p 447-473, August, 1980. 11 Fig, 1 Tab, 23 Ref.

Descriptors: *Phytoplankton, *Species composition, *Temporal distribution, *Lakes, Seasonal variation, Algae, Diatoms, Chlorophyta, *Hamilton Harbor, *Lake Ontario, Environmental effects, Euphotic zone, Thermocline, Mixing, Lake circulation, Water circulation, Turbulent flow.

Phytoplankton communities were investigated weekly in Hamilton Harbor, Lake Ontario, during the ice free periods of 1975, 1976, and 1977. The

principal component analysis ordination method proved comparable to the non-metric scaling technique for analysis. The phytoplankton species distribution displayed a broad seasonal pattern each year, varying with the seasonal thermocline. Mixing depth and physical environment affected the precise timing of seasonal succession of species. The week by week plot ordinations showing changes in species assemblages over time indicated periods of stability and periods of change. The changes in species composition were not as rapid as environmental changes, showing an averaging effect. However, these changes were a more sensitive indicator of environmental changes than the absence or presence of a species because the reaction to physical perturbations was not complete until 1-4 weeks afterwards. A critical ratio of euphotic zone depth:mixing zone depth of 0.35 was identified. Below this value diatom growth was favored and green algae performance reduced. On the other hand, abundant green algae were associated with ratios of 0.2 to 1.0. A threshold of 8-9 meters mixing depth was noted in many cases. (Cassar-FRC)
W82-03229

IMPACT OF NUTRIENT ENRICHMENT IN A WATERCHESTNUT ECOSYSTEM AT TAKAHAMA-IRI BAY OF LAKE KASUMIGAURA, JAPAN. V. DYNAMICS OF ORGANIC DEBRIS,

Meikei High School, Ibaraki (Japan).
H. Nakono, and H. Seki.
Water, Air and Soil Pollution, Vol 15, No 2, p 215-227, 1981. 10 Fig, 1 Tab, 13 Ref.

Descriptors: *Eutrophication, *Lakes, *Bacteria, *Organic matter, Phytoplankton, Nutrients, Cyanophyta, Water pollution effects, *Lake Kasumigaura, *Japan, Detritus, Decomposing organic matter, Nitrogen compounds, Ecosystems.

Organic debris in the hypereutrophied Lake Kasumigaura, Japan, waterchestnut ecosystem showed dynamic fluctuations throughout the year. Profiles of particulate and dissolved organic matter were similar--high concentrations in summer and low in winter. Particulate organic matter, primarily detritus formed from phytoplankton and heterotrophic microorganisms, was present in 2 to 40 times greater concentrations than dissolved organic carbon. Dissolved organic carbon was dependent on excretion of extracellular products by living phytoplankton and by decomposition of phytoplankton. This material was utilized by heterotrophs, such as procaryotic bacteria. Turnover rate of dissolved organic matter, the time required for organic matter to be entirely removed by heterotrophs, was 52 days during blue-green algal bloom in summer, 61 days after the summer bloom in autumn, 101 days during the eucaryotic phytoplankton bloom in spring, and 188 days after the spring bloom in early summer. This is very rapid compared with a few thousand years in the deep oceanic region. Dissolved organic carbon concentration was 100 micrograms per liter at the end of autumn when heterotrophic activity was greatest. In this lake the relative distribution of total organic matter was as follows: during blue-green algal bloom--organic solute 100, detritus particle 200, phytoplankton 2,000, bacteria 40; during non-bloom period--organic solute 100, detritus particle 100, phytoplankton 400, bacteria 60. For comparison, the distribution of oligotrophic ocean water is: organic solute 100, detritus particle 10, phytoplankton 2, and bacteria 0.2 (Cassar-FRC)
W82-03231

THE PHOSPHORUS CYCLE IN GERMINSTON LAKE. 1. INVESTIGATIONAL OBJECTIVES AND ASPECTS OF THE LIMNOLOGY OF THE LAKE,

Rand Afrikaans Univ., Johannesburg (South Africa). Research Group for Freshwater Biology.
J. F. Vermaak, J. H. Swanepoel, and H. J. Schoonbee.
Water SA, Vol 7, No 3, p 160-165, July, 1981. 3 Fig, 3 Tab, 29 Ref.

Descriptors: *Phosphorus, *Limnology, *Lake restoration, Mine drainage, Hydrogen ion concentration, Alkalinity, Aquatic plants, Sago pondweeds, Germiston Lake, *South Africa, Cycling nutrients.

The fate of P32 in a freshwater lake, Lake Germinston, invaded by the submerged macrophyte P. pectinatus, was investigated as part of a study on the limnology of the lake and aspects of the history of its recovery from severe mine pollution. The lake has a catchment area of 1174 ha and a maximum water capacity of 2839 x 10 to the 6th power cu m. It is in a highly industrialized area and receives mineralized seepage water from a gold mine. Industrial inputs to the lake were stopped; its water was alkalinized, and the pH buffered. In this study, the water in the lake was analyzed and the biomass of Potamogeton was determined. Excessive growth of water weeds developed during the lake's recovery from pollution. P. pectinatus biomass reached peaks during the summer, autumn, winter, and spring respectively in the order: 1:2:4:8. Phosphorus contents of the plant tissue for the same periods were related as 1:1:2:1.4. P. pectinatus may be playing a controlling role in the lake ecosystem with respect to the phosphorus cycle. (Small-FRC)
W82-03234

PALAEOECOLOGICAL STUDIES OF LAKES IN THE HIGHLANDS OF PAPUA NEW GUINEA. I. THE CHRONOLOGY OF SEDIMENTATION,

Liverpool Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-03235

MECHANISMS OF RAPID PHOTOSYNTHETIC ADAPTATION IN NATURAL PHOTOPLANKTON COMMUNITIES. II. CHANGES IN PHOTOCHEMICAL CAPACITY AS MEASURED BY DCMU-INDUCED CHLOROPHYLL FLUORESCENCE,

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
W. F. Vincent.
Journal of Phycology, Vol 16, No 4, p 568-577, 1980. 10 Fig, 3 Tab, 45 Ref.

Descriptors: *Phytoplankton, *Photosynthesis, *Lake Taupo, *New Zealand, Nutrients, Light intensity, Chlorophyll, Fluorescence, Ecology, Lake District, England, Lake Rotorua.

The study examines the time-response of photosynthetic capacity and fluorescence characteristics of three dissimilar phytoplankton communities exposed to changing light or nutrient levels. Diel variation in photochemical capacity under natural and controlled conditions was measured by DCMU-induced fluorescence in oligotrophic Lake Taupo, New Zealand. The effects of Langmuir circulation on photosynthesis were examined in an oligotrophic water body in the English Lake District. Finally, the extent of photosynthetic and fluorescence response to increased nutrient availability and the probable effect of such photosynthetic regulation for growth were assessed with several bioassays on Lake Rotorua, a eutrophic water body with pronounced nitrogen limitation. The results from the three separate plankton communities demonstrated that photochemical capacity may vary markedly both over the 24 hr cycle and in response to changing light and nutrient conditions. Taupo plankton incubated under a controlled light/dark cycle demonstrated a much greater variation in cellular fluorescence capacity than could be explained by the circadian rhythm detected in low light cells. The pattern and amplitude of circadian rhythms of cellular fluorescence capacity appear to be highly dependent on species composition. These variations may in part reflect rapid tuning of electron transport capacity to changed environmental conditions. (Baker-FRC)
W82-03244

THE EFFECT OF SUSPENDED MATERIALS ON THE ZOOPLANKTON, I. NATURAL ENVIRONMENTS,

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
R. Zurek.
Acta Hydrobiologica, Vol 22, No 4, p 449-471, 1980. 2 Tab, 55 Ref.

Descriptors: *Turbidity, *Suspended solids, *Zooplankton, Ponds, Reservoirs, Phytoplankton, Toxicity, Water quality.

The significance of suspension upon zooplankton populations was investigated in a pond and two reservoirs. Water samples were analyzed for heterotrophic bacteria, turbidity, oxygen, chlorophyll alpha, organic matter and mineral composition. The pond contained a great deal of phytoplankton with a maximum turbidity of 1200 mg SiO2/cu dm or 123 mg of mineral fixed residue. The suspension was significantly noxious for Kerantella cochlearis, K. quadrata, Trichocerca cylindrica, Ceriodaphnia pulchella, Daphnia pulex and Chaoborus/crystallinus. Seston from the lowland reservoir had a maximum turbidity of 119.5 mg SiO2/cu dm. It had a significant negative effect on Daphnia cucullata, cladocerans and copepods. However, it stimulated the development of rotifers. The upland reservoir had a turbidity of over 300 mg SiO2/cu dm, and zooplankton was practically absent. There was a negative relationship with turbidity for all species. (Small-FRC)
W82-03313

CONTRIBUTION TO HIGH ALTITUDE LIMNOLOGY OF THE HIMALAYAN SYSTEM I. LIMNOLOGY AND PRIMARY PRODUCTIVITY OF THE PLANKTON COMMUNITY OF NILNAG LAKE, KASHMIR,

Kashmir Univ., Srinagar (India). Dept. of Botany.
M. A. Khan, and D. P. Zutshi.
Hydrobiologia, Vol 75, No 2, p 103-112, October, 1980. 7 Fig, 3 Tab, 25 Ref.

Descriptors: *Lake classification, *Water quality, *Mountain lakes, *Nilnag Lake, *Kashmir, India, *Himalaya Mountains, Eutrophication, Nutrients, Phytoplankton, Zooplankton, Aquatic plants, Mesotrophic lakes, Dimictic lakes, Primary productivity, Light penetration, Secchi disks.

Dimictic Nilnag Lake (altitude 2180 meters, area 6.3 ha) in the Kashmir Himalayas at 33 degrees 52 min N and 74 degrees 42 min E was studied during 1974-76. Secchi transparencies ranged from 1 meter in November 1974 to 2.3 meters in April 1976. Vertical extinction coefficients were 0.73-1.7. The pH varied from 7.8 to 8.4, with little difference between surface and bottom waters. Dissolved oxygen levels of surface water varied from 5.1 mg per liter in summer to 10 mg per liter in autumn. Ca(2+) was the dominant cation and bicarbonate, the dominant anion. Specific conductivity ranged between 232 and 370 micro s at 25 C; total alkalinity, 147-220 mg per liter as CaCO3; nitrates, 19.0-30.5 micrograms per liter; and phosphates, 6.0-12.5 micrograms per liter. Annual production of the lake was estimated at 90-100 g carbon per sq meter. Macrophyte life was rich and varied. Most abundant phytoplankton were Cyanophyceae, Chlorophyceae, Bacillariophyceae and Chrysophyceae. Rotifers, cladocerans, and copepods were the most abundant zooplankton. This lake, classified as mesotrophic, shows the effects of human activity in the catchment. (Cassar-FRC)
W82-03314

IRON-MANGANESE BANDING IN ONEIDA LAKE FERROMANGANESE NODULES,

South Carolina Univ., Columbia. Dept. of Geology.
W. S. Moore.
Nature (London), Vol 292, No 5820, p 233-235, July 16, 1981. 2 Tab, 10 Ref.

Descriptors: *Lake sediments, *Iron, *Manganese, *Oneida Lake, New York, *Chemical composition, Oxides, Iron compounds, Metals, Ferromanganese nodules, Oxygen depletion.

Ferromanganese nodules in the oceans and in freshwater lakes usually develop layers rich in manganese oxides alternating with layers rich in iron oxides. The process producing this layering pattern is unknown, as is the process producing the nodules. Field studies and laboratory experiments were conducted to investigate these phenomena in Oneida Lake, a freshwater lake near Syracuse, New York. Both freshly precipitated ferromangan-

ese deposits and the surfaces of nodules exposed to the lake water are rich in manganese. Nodules buried in lake sediments have surface layers enriched in iron. Laboratory experiments demonstrated that burying a nodule in lake sediments for several months results in the formation of a skin rich in iron and depleted in manganese. Manganese oxide on the nodule surface appears to accept electrons from carbon oxidation in the sediments, mobilizing manganese ions. This reduction and mobilization of manganese from the nodule surfaces during periods of anoxic sediment cover seems to produce the high iron layers observed in the nodules. (Carroll-FRC)
W82-03342

ACIDIFICATION IN 50 NORWEGIAN LAKES,
Oslo Univ. (Norway).
J. Okland.
Nordic Hydrology, Vol 11, No 4, p 25-32, 1980. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Acid water, *Norway, *Water analysis, *Lakes, Hydrogen ion concentration, Hardness, Acid rain, Air pollution, Fallout.

Since the 1950's significant acidification has taken place in southeastern Norway lakes. There were two observation periods, 1953-57 and 1963-70. For the 50 lakes studied, the average pH dropped from 7.0 to 6.8, a statistically significant change; total hardness showed no significant change. In the low total hardness group (less than or equal to 1 degree dH) average pH changed from 6.6 to 6.3 and average H+ concentration increased by 4.33 times 10 to the minus 7th power mol per liter, equivalent to a 233% change. For the high total hardness lakes (greater than 1 degree dH) there was no statistically significant change in acidity. Lakes with low total hardness appear vulnerable to acidification. Such lakes are located all over Norway and predominate in some areas. (Cassar-FRC)
W82-03344

2I. Water In Plants

WATER USE EFFICIENCY IN DOUGLAS FIR: THE NATURE OF PLANT RESPONSE TO SELECTED ENVIRONMENTAL VARIABLES,
Washington Univ., Seattle. Dept. of Botany.
F. C. Meinzer.
PhD Dissertation, 1981. 173 p, 27 Fig, 3 TAb, 4 Plates, 113 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13464.

Descriptors: *Water use efficiency, *Irradiation, *Trees, Vapor pressure, Stomatol transpiration, Adaptation, Environment, *Douglas fir, *Pacific Northwest, Stomatal behavior.

Potted, four-year-old, 80 to 100 cm tall Douglas fir plants were used to assess the effects of changes in irradiance and ambient vapor pressure on stomatal behavior and gas exchange. The role of the observed stomatal responses in the regulation of efficiency of water use, and the physiological bases of the responses were examined. Observed plant performance in relation to changing environmental variables was used as an empirical estimate of the relative importance of regulation of water use efficiency as a component of adaptive stomatal behavior for Douglas fir. Stomatal responsiveness of Douglas fir to light and humidity was observed to vary according to the season of the year and degree of maturity of the foliage. The observed patterns of stomatal behavior and gas exchange are discussed in the context of ecologically adaptive behavior under the prevailing climatic regimes west of the Cascade Mountains in the Pacific Northwest. (Sinha-OEIS)
W82-03019

MODELS OF WATER TRANSPORT IN THE SOIL-PLANT SYSTEM: A REVIEW,
Auburn Univ., AL. School of Engineering.
F. J. Molz.
Water Resources Research, Vol 17, No 5, p 1245-1260, October, 1981. 11 Fig, 127 Ref.

Descriptors: *Model studies, *Soil-water-plant relationships, Water transport, Plant water potential, Soil moisture, Reviews.

Information is presented on water movement in plant and soil-plant systems. Emphasis is placed on water movement in soil containing roots and on a general approach to water transport in living plant tissue. Detailed quantitative studies of water extraction by plant roots date back to studies by Gardner published in 1960. Many contemporary models have been built around extraction functions in the Darcy-Richards equation. Several such functions are listed, along with their applications, relative advantages, and limitations. In a series of papers appearing in 1958 the first detailed quantitative description of water transport in plant tissue was published. The approach developed then resulted in a diffusion equation, which could be written with water potential as the dependent variable. The derivation assumed that water movement was primarily from vacuole to vacuole. Subsequent workers have refined and extended the development to include water movement in cell walls and plasmodesmata. The development, interpretation, and application of these models over the past decade is presented. It can be stated that contemporary models of water transport in plant tissue are oversimplified. However, they have been subjected to some successful testing and they provide a framework within which to devise experiments. Moreover, the recent development of sophisticated experimental techniques should result in more detailed model testing during the 1980's. (Baker-FRC)
W82-03066

STRUCTURE AND FUNCTION OF MYCORRHIZAL RHIZOMORPHS WITH SPECIAL REFERENCE TO THEIR ROLE IN WATER TRANSPORT,
Sheffield Univ. (England). Dept. of Botany.
J. A. Duddridge, A. Malibari, and D. J. Read.
Nature, Vol 287, No 5785, p 834-836, October, 1980. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Rhizosphere, *Water transport, *Plant physiology, *Soil-water-plant relationships, Absorption, Plant water potential, Soil water, Forests, Root zone, Pine trees, Trees, Arid climates.

The potential of mycorrhizal rhizomorphs to absorb and transport water was examined in laboratory tests. Mycorrhiza cultures were synthesized under aseptic conditions and inoculated with Suillus bovinus fungus. Three seedlings were transferred to peat and exposed to tritiated water supplies. Rhizomorphs emerging from the cup were sliced into sections from top to root. Scintillation counting of each section revealed that the water had moved from both the upper and lower source cups through rhizomorphs to mycorrhizal roots and shoots in just 1 hour. Water movement was dependent on the presence of a rhizomorph connection from source cup to seedling. Ultrastructural analysis showed great differentiation in this type of rhizomorph. Their diameters were between 6 and 20 micrometers and resembled the xylem vessels of higher plants. These rhizomorphs may absorb water and facilitate its transport over ecologically significant distances. Investigations are being conducted to select mycorrhizal associates which are capable of improving the performance of forest crops, especially in semiarid regions. (Geiger-FRC)
W82-03190

CEREAL YIELDS AND DROUGHT RESISTANCE,
Agricultural Research Council, Trumpington (England). Plant Breeding Inst.
S. A. Quarrie.
Nature (London), Vol 285, No 5767, p 612-612, June 26, 1980.

Descriptors: *Cereal crops, *Drought resistance, *Crop yield, *Great Britain, Water use efficiency, Plant growth, Plant morphology.

Cereal yields in the United Kingdom have been increasing for the past 30 years and are now 80 percent higher than they were in 1950. Studies of the effectiveness of breeders in improving cereal yields have shown that the best of the new varieties of winter wheat consistently provided yields about 40 percent higher than those of old varieties, dating back to 1908. The new varieties, which are much shorter than the older varieties, have experienced reductions in stem weight which have been exactly balanced by increases in grain weight. However, since there is a limit to how far stem weights can be reduced with matching increases in grain yield, varieties capable of giving a greater biomass yield must be developed if the trend of increasing yields is to be continued. Since an increase in biomass yield would probably require increased water use, emphasis must be placed on more efficient use of available rainfall and stored water. Several studies have suggested strategies for improving the drought resistance of new varieties through breeding. Studies have investigated the effects of stomatal frequency on transpiration in related lines of barley, the genetic variability in the length and number of wheat roots, the biochemistry of water stress, and the effect of the plant hormone abscisic acid on drought resistance. Although many physiological and morphological characters are significant for water use efficiency, the useful variation for a given character within a cereal species may be limited. (Carroll-FRC)
W82-03195

POSSIBLE ROLE OF ABSCISIC ACID IN REDUCING SEED SET IN WATER-STRESSED WHEAT PLANT,
New South Wales Dept. of Agriculture, Tamworth. Tamworth Agricultural Research Center.
J. M. Morgan.
Nature (London), Vol 285, No 5767, p 655-657, June 26, 1980. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Seeds, *Crop yield, *Wheat, Soil-water-plant relationships, Water stress, Plant growth, Plant morphology, Leaves, Water deficit, Turgidity, *Abscisic acid.

A reduction in the number of seeds set per spikelet as a result of an increase in male sterility is one of the major effects of water stress on grain yield in wheat. Little is known about the relationship between the loss of pollen viability and the water relations of the developing spikelets, so the mechanisms of this effect of water deficits are not known. The relationship between leaf turgor and seed set was investigated in wheat plants. These studies indicated that seed set may be reduced by water deficits which cause leaf wilting but have no effect on spikelet turgor or relative water content, suggesting that abscisic acid may be involved in the processes causing floret infertility. Abscisic acid content is known to increase substantially when leaves wilt and to modify developmental processes in plants. Laboratory experiments showed that reductions in the seed set due to water stress were accompanied by increases in endogenous abscisic acid in both leaf and spikelet and that foliar application of synthetic abscisic acid at the stage of meiosis also reduced seed set and caused malformation of pollen grains and anthers. The data did not provide sufficient information to determine the precise stage of microsporogenesis at which the abscisic acid acts. However, the results do inicate that mechanisms which maintain leaf turgor during periods of declining water potential are important in reducing yield losses in crop plants growing in semi-arid areas. (Carroll-FRC)
W82-03197

RESPONSE OF SORGHUM TO MOISTURE STRESS USING LINE SOURCE SPRINKLER IRRIGATION I. PLANT-WATER RELATIONS,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
M. V. K. Sivakumar, N. Seetharama, K. S. Gill, and R. C. Sachan.
Agricultural Water Management, Vol 3, No 4, p 279-289, 1981. 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Sprinkler irrigation, *Soil-water-plant relationships, *Sorghum, *Moisture stress, Water stress, Irrigation, Soil moisture, Stomatal transpiration, Leaves, Water potentials, Plant water potential, *India, Semiarid lands.

A line source sprinkler irrigation system was useful in determining the response of sorghum (Sorghum bicolor L.) to different levels of moisture stress. Data on water use, stomatal conductance, leaf water potential, and leaf temperature showed that water stress varied as a function of the distance from the line source. Since sorghum, an important post-rainy season crop in India, depends on residual soil moisture, it was desirable to have varying levels of soil moisture for quantitative studies under field conditions. Cumulative water use, which increased throughout the season, was always higher in the first four beds closest to the line source, intermediate in beds 5-8, and lowest in beds 9-12. The maximum difference in water depletion (34 mm) occurred 65 days after planting. Both leaf conductance and mean daily leaf water potential decreased continuously throughout the season in all beds and were always highest in beds 1-4. Mean daily leaf temperature steadily increased until about 70 days after planting, then dropped sharply at 75 days and increased thereafter. (Cassar-FRC)
W82-03265

WHEAT YIELD ESTIMATION IN NORTHWEST IRAN,

International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
P. J. Slabbers, and F. X. Dunin.
Agricultural Water Management, Vol 3, No 4, p 291-304, 1981. 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Wheat, *Crop yield, *Soil moisture, Agriculture, Model studies, Simulation analysis, *Iran, Semiarid lands, Fallowing, Soil-water-plant relationships, Water management.

A two-stage model was developed to predict the wheat yield for different forms of crop management in an area near Tabriz, Iran, where subsistence farming is practiced. Simulation covered nine soil moisture regimes and two lvels of management (existing and improved). Model results agreed reasonably with the available information on water balance, streamflow, and wheat production. Predicted soil moisture storage before the November sowing varied between 14 mm for a shallow soil in a dry fallow year to 84 mm in a deep soil following a wet fallow year. Evapotranspiration is reported for the critical six week period starting in mid-May. The proportion of fallow storage used by crops decreases with increasing rainfall in the cropping year and with decreasing soil depth. Simulated wheat yields varied between 290 and 895 kg per ha. Improved management practices will produce the greatest yield increases in deeper soils (750 cm) over a wide range of precipitation conditions, especially when fallow is included in the rotation. This model can be applied to any semiarid region where agriculture is marginal. However, the benefits and negative aspects of long-established practices, in this case, the grazing of animals during the fallow season, must be weighed. Allowing animals to graze provides animal feed and weed control but depletes stored soil moisture. (Cassar-FRC)
W82-03267

PATTERNS OF WATER POTENTIAL AND PHOTOSYNTHESIS OF DESERT SAND DUNE PLANTS, EUREKA VALLEY, CALIFORNIA,

California Univ., Davis. Dept. of Botany.
B. M. Pavlik.
Oecologia, Vol 46, No 2, p 147-154, 1980. 8 Fig, 2 Tab, 29 Ref.

Descriptors: *Plant water potential, *Photosynthesis, *Desert plants, Sand, *Deserts, Water use efficiency, Ecology, *California.

Patterns of water status and photosynthetic productivity were examined in dune and non-dune desert habitats. Eureka dunes were chosen as a field site because the presence of two perennial endemics suggested a close relationship between the desert sand dune habitat and its restricted taxa. Plants were investigated for mode of photosynthesis (C3 or C4), daily and seasonal patterns of xylem water potential, seasonal patterns of field photosynthesis, and laboratory gas exchange characteristics. All plants surveyed except Swallenia alexandrae used C3 photosynthesis. Dune plants had significantly lower xylem water potentials, dampened seasonal changes in predawn water potentials, and smaller seasonal amplitudes of water potential than plants of the adjoining flats. Moisture conserving traits were observed in the endemic perennials, such as stomal closure at relatively high water potentials and high water use efficiency. Swallenia minimum water potentials during the summer months were a third of those endured by adjacent non-dune larrea. High photosynthetic productivity, high water use efficiency, and carbon allocation to the longitudinal growth of roots and shoots seemed to be important adaptations for plants in the shifting sand and substrate moisture depletion atmosphere of the dunes. (Small-FRC)
W82-03271

SEMINAL ROOT MORPHOLOGY AND WATER USE OF WHEAT. I. ENVIRONMENTAL EFFECTS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
R. A. Richards, and J. B. Passioura.
Crop Science, Vol 21, No 2, p 240-252, April, 1981. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Crop yield, *Moisture availability, Drought, *Wheat, Soil moisture, Resistance, Farming, Climatology, Water use efficiency, *Soil-water-plant relationship.

Possible influence of environmental conditions on the morphology of the seminal root system is investigated in wheat. When wheat was grown mainly on a limited supply of stored soil water, an increase was noted in the axial resistance to water flow in the roots, which served to conserve some of the water for the critical periods during flowering and grain filling. This increase in axial resistance to water flow is accomplished by either decreasing the diameter of the main xylem vessel in the seminal axes or decreasing the number of seminal axes. The effects of different environments, or seed characters which are influenced by the environment, on both these seminal root characters are reported. Few of the many factors studied exhibited an effect. The most notable were grain size, drought and temperature between germination and emergence, and drought when the seed was being produced. Neither root character showed any genotype/environment interactions when contrasting genotypes were grown in different environments. This gives promise that selection for increased resistance could be done under controlled conditions. (Baker-FRC)
W82-03307

COMPLETION OF THE LIST OF ANALYTICAL SOLUTIONS FOR NUTRIENT TRANSPORT TO ROOTS 1. EXACT LINEAR MODELS,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 5E.
W82-03327

CONSUMPTIVE WATER USE BY OPIUM POPPY,

Indian Agricultural Research Inst., New Delhi.
B. B. Turkhede, R. De, and R. K. Singh.
Indian Journal of Agricultural Sciences, Vol 51, No 2, p 102-107, February, 1981. 3 Tab, 5 Ref.

Descriptors: *Consumptive use, *Water use efficiency, *Crop yield, Irrigation effects, Water stress, Crop production, Agriculture, *Opium poppy.

An experiment was conducted for two consecutive years to determine the critical stages of water requirement for opium poppy, total consumptive use, water use efficiency, and seed yield and morphine content. Fourteen treatments were evaluated, of which 12 represented irrigation at different phenological stages of crop growth. The maximum opium yield and the lowest morphine content in opium were recorded in plots subjected to no stress at any stage of plant growth and receiving all seven irrigations. Morphine yield per hectare was generally higher when the plants were not subjected to prolonged water stress. Opium yield reduction occurred when irrigation was skipped during the rosette and flowering stages. Stress during the flowering stage seemed to encourage seed yield. The water use efficiency of the seven-irrigation treatment was rather low. Water use efficiency was highest when irrigation occurred at 50% ASM (22.2 g opium/cu m water). (Small-FRC)
W82-03356

PERFORMANCE OF DIFFERENT CROPS WITH RESIDUAL MOISTURE IN VERTISOLS,

Andhra Pradesh Agricultural Univ. Hyderabad (India).
T. C. Jain, and G. R. Reddy.
Indian Journal of Agricultural Sciences, Vol 51, No 3, p 181-184, March, 1981. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Crop production, *Soil water, *Water use efficiency, Moisture stress, Soil types, Crop yield, *India.

The capacity of black soils (vertisols) to store sufficient moisture in southern India to support crop production was evaluated in a field study in which different crops were grown in sequence or in relay. The crops depend upon stored soil moisture and on 27 mm of rainfall received during the experimental period. Twelve crops were grown in relay on September 28 and in sequence on October 12, following the rainy season. Pigeonpea was the most successful crop; studies at the time of harvest indicated that the roots of pigeonpea entered deep (107 cm) and could extract water from the deeper, wet layer of soil. Blackgram, cowpea, and greengram gave successful yields when they were sown in later September and early October. Wheat, chickpea, and coriander were recommended for sowing in late October or November only. In economic terms, pigeonpea gave the higest return, while coriander was second due to its high market price. (Small-FRC)
W82-03357

2J. Erosion and Sedimentation

COPING WITH INCREASED STREAM EROSION IN URBANIZING AREAS,

Rutgers-The State Univ., New Brunswick, NJ. Water Resources Research Inst.
W. Whipple, Jr., and J. DiLouie.
Water Resources Research, Vol 17, No 5, p 1561-1564, October, 1981. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Uran areas, *Stream erosion, Erosion, Channel erosion, Channel improvement, Model studies, Bed load, Sediment, Bed-load discharge, *Sediment transport, *Uranization.

The increasing channel degradation being experienced in many urbanizing area streams is discussed. Increased flooding caused by intensive land development is related to stream erosion through bed load transport theory. Analysis of these relationships leads to conclusions as to channel design criteria. Current design criteria for culverts crossing such streams should be modified. The modeling of potential bed load carrying capacity for urbanizing area streams by means of the Schoklitsch bed load formula and a standard runoff model shows results which corresponded to the widely observed stream erosion tendency in urban streams. When the models were applied to a partially developed watershed in Princeton Township, New Jersey, it was noted that the bed load carrying capacity at the peak of a 15 year flood has been greatly increased. It is apparent that the criteria for approving stream encroachments should discourage any action to increase channel velocity in areas where bed load capacity has been increased by processes of urbanization. Results regarding culverts suggest that the detention provided during floods by backwater in streams passing through small culverts has a significant flood retardation effect. The replacement of these culverts with those specified by usual design criteria would more than double the detention capacity needed to com-

pensate for future development in the two cases studied. Each culvert provided a significant reduction in stream velocity during floods and constituted an anchor limiting the progress upstream of channel scour. (Baker-FRC)
W82-03067

SEDIMENT REGULATION PROBLEMS IN SANMENXIA RESERVOIR,

Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
L. Yuqian, and Z. Qishun.
Water Supply and Management, Vol 5, No 4/5, p 351-360, 1981. 5 Fig.

Descriptors: *Reservoirs, *Sedimentation, *China, *Yellow River, Rivers, *Sanmenxia Reservoir, Design criteria, Flood control, Runoff, Construction, Storage reservoirs, Multipurpose reservoirs.

The Sanmentia Reservoir is a multipurpose hydroproject mainly used for flood control, controlling a drainage area of 684,000 square kilometers, or 92% of the entire Yellow River Basin in China. Dam construction began in 1957 and the river was closed in November 1958. The concrete gravity dam was completed in September 1960, with a maximum height of 96 meters and a total length of 908 meters. There are 12 deep sluices at the 300 meter elevation and two spillways at 338 meters. After the reservoir began to function as a storage basin, serious defects were noted. Backwater deposits extended upstream with remarkable rapidity, endangering the industrial and agricultural activities in the vicinities of the reservoir, and, with the speedy depletion of the storage capacity of the reservoir, the security of the protection against floods in the Lower Yellow River could no longer be assured. Steps were taken to reconstruct the dam. The key problem of reservoir operation is to prolong the life of the reservoir for a long time so that multipurpose benefits may be developed as much as possible. To retain a usable storage capacity it is necessary that the upstream extension of the backwater deposits be controlled and that the aggradation in the downstream of the Yellow River be minimized. The reservoir must regulate not only the runoff but also the sediment. In the reservoir operation, due consideration must be given to the control of upstream extension of backwater deposits and to avoid the disadvantageous effects on the downstream reach of the Yellow River due to the detention of floods in the reservoir. (Baker-FRC)
W82-03072

A NEW SEDIMENT TRAP EFFICIENCY CURVE FOR SMALL RESERVOIRS,

Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 8A.
W82-03086

MOLECULAR DIFFUSION AND THE SEDIMENTARY ENVIRONMENT: RESULTS FROM THE IN SITU DETERMINATION OF WHOLE SEDIMENT DIFFUSION COEFFICIENTS,

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
P. E. Kepkay, R. C. Cooke, and A. J. Bowen.
Geochimica et Cosmochimica Acta, Vol 45, No 9, p 1401-1409, September, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Diffusion coefficient, *Sediments, Dialysis, *Sulfates, *Carbon dioxide, Microbiological studies, Porosity, Solute transport, Pore water, *Halifax Harbor, *Nova Scotia.

A dialysis technique which includes the effects of microbial action was developed for in situ determination of whole sediment diffusion coefficients. This apparatus was used to measure the diffusion of sulfate and total dissolved carbon dioxide (transported primarily as bicarbonate) in sediments of Halifax Harbor, Nova Scotia. Diffusion was related to the porosity of the sediment. Two zones of sediment porosity and diffusion rates were observed, 0-16 cm, and 60-120 cm. Diffusion of total dissolved CO2 was not affected by microbial activity, but transport of dissolved sulfate was significantly affected by microbial reduction of the sulfate pool available for diffusion. The whole sediment diffusion coefficient for dissolved sulfate at the 60 cm level was 16.6% greater in the sterilized core than in the unsterilized core and the in situ sediment. Sulfate could not be detected below the 60 cm horizon. (Cassar-FRC)
W82-03091

PROGRAMMING MANUAL FOR MOBED - AN UNSTEADY, NONUNIFORM, MOBILE BOUNDARY FLOW MODEL,

Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2E.
W82-03109

PALAEOECOLOGICAL STUDIES OF LAKES IN THE HIGHLANDS OF PAPUA NEW GUINEA. I. THE CHRONOLOGY OF SEDIMENTATION,

Liverpool Univ. (England). Dept. of Geography.
F. Oldfield, P. G. Appleby, and R. Thompson.
Journal of Ecology, Vol 68, No 2, p 457-477, July, 1980. 12 Fig, 3 Tab, 46 Ref.

Descriptors: *Lakes, *Agriculture, *Erosion, *Sedimentation, Papua New Guinea, Bottom sediments, Human population, Ecology, Environmental effects, Sweet potatoes, Crops.

Sediments from three small lakes in the highlands of Papua New Guinea were studied to determine the effects of man's activities on erosion. The volcanic ash bands common to all three lakes aided dating by various methods: sedimentary trace of geomagnetic secular variation, radiocarbon, Pb210, Cs137, and historical evidence. A chronology of 10,000 years of sedimentation was established. Evidence suggests little or no sedimentation occurred during the periods 10,000 to 5,000 and 4,000 to 1,600 years B.P. At Lake Pipiak, still forested at the time of the study in 1973, little variation in sedimentation has occurred in the distant or recent past. However, at Lakes Egari and Ipea, sites of extensive agriculture, mostly sweet potatoes, sedimentation started to increase 150-300 years ago and has increased more rapidly since 1950, when extensive Western contact began. (Cassar-FRC)
W82-03235

2K. Chemical Processes

PRECIPITATION KINETICS OF CALCIUM CARBONATE AND MAGNESIUM HYDROXIDE IN A SCALING SYSTEM,

Iowa State Univ., Ames. Engineering Research Inst.
R. W. Peters, L. D. Swinney, and J. D. Stevens,.
AIChE Symposium Series, Vol 77, No 209, p 49-66, 1981. 10 Fig, 12 Tab, 14 Ref.

Descriptors: *Chemical reactions, *Water softening, *Chemistry of precipitation, *Scaling, *Hardness, Chemical properties, Water treatment, Wastewater treatment, Kinetics, Industrial water, Thermodynamics, Mathematical equations, Hydrogen ion concentration, Alkalinity.

Experimental studies are described which were performed to determine the precipitation kinetics of calcium carbonate and of the combined calcium carbonate-magnesium hydroxide system. A brief review of the water chemistry, steady state crystallization theory, and thermodynamic fundamentals involved is presented. The kinetics of calcium carbonate and magnesium hydroxide are a sensitive function of pH. The growth rate, nucleation rate, and kinetic order were measured for various alkalinity distributions caused by the addition of lime as the chemical treating agent. Both systems were scale depositing, usually existing in nonstoichiometric ratios of ions. The phase transformation of calcium carbonate from aragonite to calcite is discussed. The growth rate for the simultaneous precipitations of calcium carbonate and magnesium hydroxide was correlated with the residence time and the respective growth rates of the separate precipitations of calcium carbonate and magnesium hydroxide. (Baker-FRC)
W82-03136

AN ION-ASSOCIATION MODEL FOR ESTIMATING ACIDITY CONSTANTS (AT 25 C AND 1 ATM PRESSURE) IN ELECTROLYTE MIXTURES RELATED TO SEAWATER (IONIC STRENGTH < 1 MOL/KG H20),

Marine Biological Association of the United Kingdom, Plymouth (England).
For primary bibliographic entry see Field 1B.
W82-03194

BIOGEOCHEMICAL CYCLING IN AN ORGANIC-RICH COASTAL MARINE BASIN - I. METHANE SEDIMENT-WATER EXCHANGE PROCESSES,

North Carolina Univ. at Chapel Hill. Dept. of Geology.
C. S. Martens, and J. Van Klump.
Geochimica et Cosmochimica Acta, Vol 44, No 3, p 471-490, 1980. 12 Fig, 7 Tab, 60 Ref.

Descriptors: *Methane, *Sediment-water interfaces, Interfaces, Hydrocarbons, Sediments, Seawater, Bights, Bays, Sounds, Oxidation, *Organic compounds, Seasonal, *Chemical reactions, Bubbles, Coastal waters, *Cape Lookout Bight, North Carolina.

Samples of anoxic organic-rich sediments of Cape Lookout Bight, North Carolina, were secured by gravity coring. Water samples were also taken to establish depth-concentration profiles for dissolved chemical species at depths of 5, 7, and 8 m using Niskin bottles. Methane produced in the sediments was found to enter the water column in two seasonally dependent manners. During November-May and again between June-October the diffusive transport of methane in situ with benthic chambers averaged 49 and 163 micromol/square meter/hour, respectively. High summer sediment methane production caused saturation concentrations, and this resulted in the formation of bubbles near the sediment-water interface. Low-tide hydrostatic pressure release then triggers bubble ebullition. Bubbling maintains open bubble tubes, which apparently enhance diffusive transport. When tubes are present, apparent sediment diffusivities are 1.2-3.1 fold higher than theoretical molecular values. Dissolution of 15% of the rising bubble flux containing 86% methane supplies 170 micromol/square meter/hour or methane to the bight water column during the summer months. The remainder is lost to the troposphere. During bubbling the bottom water methane concentration increases can be predicted using a 5-15 micrometer stagnant boundary layer dissolution model. Advective transport to surrounding waters is the major dissolved methane sink. Aerobic oxidation and diffusive atmospheric evasion are minor within the bight. (Baker-FRC)
W82-03308

2L. Estuaries

DIEL FLUX OF DISSOLVED CARBOHYDRATE IN A SALT MARSH AND A SIMULATED ESTUARINE ECOSYSTEM,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
C. M. Burney, K. M. Johnson, and J. M. Sieburth.
Marine Biology (Berlin), Vol 63, No 2, p 175-187, July, 1981. 6 Fig, 5 Tab, 57 Ref.

Descriptors: *Salt marshes, *Carbohydrates, Estuaries, Marshes, Tidal marshes, Saline water, Seawater, Estuarine environment, Coasts, Narragansett Bay, Ecosystems, Model studies, Diel flux.

The purpose of this study was to estimate net dissolved carbohydrates (CHO) release and uptake rates and to look for evidence of biological regulation of the CHO dynamics using measurements made at 2 or 3 hr intervals over diel cycles from a New England salt marsh and a 5 meter deep seawater tank designed to simulate the Narragansett Bay estuary. Results from each of the salt marsh studies showed evidence of highly signifi-

cant total CHO (TCHO) accumulation, primarily due to net polysaccharide (PCHO) release, commencing in the late morning or early afternoon and continuing through at least two sampling periods into the early evening. TCHO and PCHO usually reached their daily maxima at the end of this period. Maximum rates of PCHO accumulation in this time period occurred during or just after the period of maximum net system production indicated by the oxygen, acidity, and total carbon dioxide data. No period of PCHO accumulation was sustained over more than one sampling interval during a cloudy day in August. However, a very pronounced PCHO increase occurred on the following clear day, suggesting an association between the photosynthetic rate and PCHO release. PCHO release on the cloudy day was curtailed due to light limitation of photosynthesis. The mechanism connecting photosynthesis with PCHO release is not known. The monosaccharide cycles in the marsh show much smaller net fluctuations relative to PCHO. In the tank study, large PCHO and TCHO excursions were not shown as in the marsh study. There was also a lack of sustained afternoon PCHO increases which were characteristic of the marsh. The multi-parameter diel sampling of confined water masses can yield useful information on the interaction of ecosystem components as well as on their net rates of change. (Baker-FRC)
W82-03168

VARIATIONS IN BENTHIC COMMUNITY STRUCTURE IN A SUB-TROPICAL ESTUARY,

Fisheries Research Station, Aberdeen (Hong Kong).
R. S. S. Wu, and J. Richards.
Marine Biology (Berlin), Vol 64, No 2, p 191-198, September, 1981. 9 Fig, 2 Tab, 37 Ref.

Descriptors: *Benthic environment, *Estuarine environment, Estuaries, Coasts, Benthos, Aquatic life, Growth, Population dynamics, Salinity, Sediments, *Hong Kong estuary.

Results are presented of a one year study on the shallow water, benthic community at three stations along an environmental gradient of changing salinity and sediment silt-clay fraction in the Hong Kong estuary. The aims of the study were to provide further information on sub-tropical soft bottom communities and to examine the spatial and temporal variations in the communities in relation to the prevailing environmental gradient. Three sampling sites were established along the north coast of Lantau Island in depths of less than 10 meters. A clear increase in both the total numbers of animals and their biomass was registered when moving from station 1 to 3. The number of different species was highest in March-April and tended to decline over the summer months until September, with a slight increase in October and November. Murex trapa and Portunus hastatoides were abundant at all three stations throughout the year. Salinity was shown to increase from station 3 to station 1. A large decrease in bottom salinity was noted at all stations in the summer months. The proportion of silt-clay fraction in the sediment increased from station 1 to station 3. No significant difference in the organic content of the sediments was noted between the three stations. It was concluded that the total number of animals, biomass as well as the dominance of Turritella terebra in the community decreased, while species diversity increased along a gradient of increasing salinity and decreasing silt-clay fraction of the sediment. (Baker-FRC)
W82-03169

THE EFFECT OF TIDAL HEIGHTS ON THE DISTRIBUTION AND ABUNDANCE OF COLIFORM BACTERIA IN THE SEDIMENTS OF TWO SITES IN THE MERSEY ESTUARY,

Manchester Univ. (England). Dept. of Bacteriology.
J. Karthegisan, and M. P. Thomas.
International Journal of Environmental Studies, Vol 14, No 4, p 299-308, 1980. 6 Fig, 5 Tab, 15 Ref.

Descriptors: *Tidal effects, *Coliforms, *Bacteria, Estuaries, *Mersey estuary, United Kingdom, Fate of pollutants, Sewage bacteria, Intertidal areas, Sediments.

Total coliform counts, E. coli type I counts, and viable counts in estuarine sediments were positively correlated with tidal heights in the River Mersey, United Kingdom, as measured during 1976. Chloride levels in the sediments were also highest during the high tide periods. Low tide counts (per 100 ml) were 170-540 total coliforms, 33-240 fecal coliforms, and 100,000 viable. High tide counts were 540-1600 total coliforms, 140-330 fecal coliforms, and 74,000-110,000 viable. (Cassar-FRC)
W82-03180

STUDIES ON THE SALINIZATION OF COASTAL GROUND WATER. I. CONFINED GROUND WATER IN THE NAKA RIVER ESTUARY (IN JAPANESE),

Nara Coll. of Education (Japan). Dept. of Geoscience.
Y. Fukuo, T. Kakinuma, Y. Kishi, and M. Ifuku.
Japanese Journal of Limnology, Vol 41, No 4, p 235-248, 1980. 15 Fig, 14 Ref.

Descriptors: *Saline-freshwater interfaces, *Coastal aquifers, Interfaces, Model studies, Saline water intrusion, Aquifers, Groundwater movement, Coasts, Estuaries, Naka River, *Japan, Pumping, Inflow, Mathematical models.

A model was developed to study the problem of sea water intrusion into coastal aquifers. Spatial distribution of the fresh-salt water interface in the steady state is easily determined in either a confined or an unconfined aquifer with arbitrary plane boundaries. The model is applied to the confined groundwater in the Naka River Estuary, Japan, and the spatial distribution of the fresh-salt water interface investigated for changes in pumping volume or in the inflow rate of groundwater. The calculated contours of chloride ion concentrations were in fairly good agreement with those observed in water from deep test wells. (Cassar-FRC)
W82-03326

DISTRIBUTION OF ANOPLOSTOMA VIVIPARUM (NEMATODA) IN SOUTHAMPTON WATER SEDIMENTS,

Southampton Univ. (England). Dept. of Oceanography.
S. C. Surey-Gent.
Marine Biology (Berlin), Vol 62, No 2/3, p 157-160, May, 1981. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Estuarine environment, *Nematodes, *Estuaries, Coasts, *Sediments, Aquatic animals, Distribution patterns, Southampton Water, England.

In March of 1975, 36 sediment cores were collected from 12 sites in Southampton Water. These sites ranged from 2 meters above mean low water to 9 meters below mean low water. The flocculant layer over each sample was carefully removed, and then the remainder of the sample was sectioned into 0.5 cm segments. The juveniles, non-gravid females, gravid females and males of the free-living marine nematode Anoplostoma viviparum Bastian showed markedly different distributions within layers of mud from these samples. Of the total population, 92% of the gravid females occurred in the anoxic layer, and 73% of the juveniles occurred in the flocculant layer; non-gravid females and males were found in about equal numbers in both the flocculant and oxidized layers, but none were found in the anoxic layer. The tidal flow pattern appears to represent the main influence on the horizontal distribution of A. viviparum. The vertical distribution suggests that the gravid females remain in the anoxic layer while they produce their young. Movement of the flocculant layer serves as the means of distributing the nematode throughout the estuary. (Baker-FRC)
W82-03343

ALPHA-PARTICLE RADIOACTIVITY OF HOT PARTICLES FROM THE ESK ESTUARY,

Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5A.
W82-03345

GRAPHS FOR SALINE WEDGES IN ESTUARIES,

Florida Univ., Gainesville. Dept. of Engineering Sciences.
E. Parthenaides, V. Dermisis, and A. J. Mehta.
Civil Engineering (New York), Vol 50, No 1, p 90-92, January, 1980. 2 Fig, 3 Ref.

Descriptors: *Saline water intrusion, *Channel improvement, *Dredging, Estuaries, Mississippi River, Saline-freshwater interfaces, Case studies, Salinity forecasting, *Graphical analysis.

The shape and longitudinal extent of salt water intrusion in a stratified estuary may be predicted using graphs derived and depicted in this paper. The procedure is illustrated by a case of dredging in the south pass of the Mississippi River. Given values are the freshwater discharge, width, total depth, mean fresh water velocity upstream of the toe of the wedge, fresh water density, and difference between densities of the river and sea water. It was calculated that within the main zone of salinity intrusion for the 45 ft depth, the interface level with respect to the fresh water surface would increase from 1.1 to 3.36 ft for a channel deepening to 50 ft. (Cassar-FRC)
W82-03351

AVAILABILITY OF DISSOLVED FREE GLUCOSE TO HETEROTROPHIC MICROORGANISMS,

Kiel Univ., (Germany, F.R.). Inst. fur Meereskunde.
K. Gocke, R. Dawson, and G. Liebezeit.
Marine Biology (Berlin), Vol 62, No 2/3, p 209-216, May, 1981. 2 Fig, 3 Tab, 53 Ref.

Descriptors: *Heterotrophic bacteria, *Chemical analysis, *Estuaries, *Glucose, Bacteria, Microbiological studies, Water analysis, Water analysis, Eutrophication.

The concentration of dissolved free glucose was measured in five aquatic biotopes, differing widely in salinity as well as in degree of eutrophication and pollution. The glucose was measured using ion exchange chromatography of sugar-borate complexes, which disclosed glucose concentrations ranging from 4.99 to 9.63 micrograms carbon/liter. No correlation was noted between the amounts of glucose and the trophic characteristics of the biotope. The sum of the transport 'constant' and the natural concentration of glucose was determined as a parameter, using a microbiological method. Instead of being larger, the parameter values were smaller than the concentrations obtained chemically. The range was between 0.62 and 2.72 micrograms glucose-C/liter. Expressed as percentages, the parameter values were between 6.4 and 30.5% of the concentrations of glucose alone. Two reasons might account for the discrepancy. First, not all of the dissolved free glucose may be available to the heterotrophic microorganisms. Second, during the relatively short duration of the experiments, the added C-14 labeled glucose may not be proportionally distributed between the different fractions of the dissolved free glucose. Instead, the fraction of the truly free glucose might be more highly specifically labelled than the absorbed and complexed ones. This would lead to overrepresentation of the presumably small fraction of the truly free form. It is concluded that using the concentration of the dissolved free substances obtained by chemical analysis to calculate flux might be misleading. (Baker-FRC)
W82-03359

RADAR MEASUREMENTS OF ESTUARINE CURRENTS AND TIDES,

Birmingham Univ., (England). Dept. of Electronic and Electrical Engineering.
E. D. R. Shearman.
Nature (London), Vol 286, No 5771, p 333-334, July 24, 1980. 4 Fig, 12 Ref.

Descriptors: *Radar, *Remote sensing, *Estuaries, *Water currents, *Tides, Estuarine environment.

A technique for surface current measurement by high frequency radar in the dekametric band, described by A. S. Frisch and B. L. Weber, has now been used to provide area surveillance data in a form directly comparable with theoretical models. The wavelength spectrum and the directional spectrum of sea waves, both wind-driven and swell, can be measured by using a number of radar frequencies and by directing the radar beam in different directions. The wavelength and the directional spectra of sea waves can be deduced by inversion of the second order features in the radar ECHM spectra from a single patch of ocean at a single radio frequency, promising the capability to characterize sea state over a large area of ocean. The coastal-sited 'ground-wave radar' technique developed by Crombie can give coverage up to about 300 kilometers with suitable power and frequency, while a 'sky-wave radar' using ionospheric reaction covers the area between 1,000 and 3,000 kilometers from the radar. The current measuring technique used by the National Oceanic and Atmospheric Administration uses the Doppler effect to analyze the echoes, sorting returns from each direction by frequency. The direction of arrival is then measured by simple relative phase measurement at separated antennas. Application of this technique to the Cook Inlet in Alaska is discussed. (Carroll-FRC)
W82-03360

A TWO-DIMENSIONAL NUMERICAL MODEL OF THE VERTICAL CIRCULATION OF TIDES IN THE ST. LAWRENCE ESTUARY,

Quebec Univ., Rimouski. Dept. of Oceanography.
C. De Borne de Grandpre, M. I. El-Sabh, and J. C. Salomon.
Estuarine, Coastal and Shelf Science, Vol 12, No 4, p 375-387, April, 1981. 10 Fig, 20 Ref.

Descriptors: *Tides, *Water circulation, *Water currents, Model studies, Estuaries, *St. Lawrence estuary, Rivers, Salinity, *Vertical distribution, Salinity.

The vertical circulation of tides in the St. Lawrence estuary was studied with a two-dimensional model with a vertical grid. The equations were solved by a finite difference initial-value method. The data needed were topographical data of the estuary, relevant tidal heights, and salinity levels at the estuary mouth and landward boundaries. The model produced water height, vertical and longitudinal salinity and velocity distributions. The model was tested by varying the friction and turbulence coefficients. Model results agreed well with observed values. Although the model has limitations, it can be considered a step toward the development of a three-dimensional numerical model for this estuary. (Cassar-FRC)
W82-03386

TRACE METAL SPECIATION IN THE FRESHWATER AND ESTUARINE REGIONS OF THE YARRA RIVER, VICTORIA,

Caulfield Inst. of Tech. (Australia). Water Studies Center.
For primary bibliographic entry see Field 5B.
W82-03387

THE MEASUREMENT OF DIFFUSION COEFFICIENTS IN THE CONWY ESTUARY,

Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, and A. P. Cotton.
Estuarine, Coastal and Shelf Science, Vol 12, No 3, p 323-336, March, 1981. 10 Fig, 2 Tab, 14 Ref.

Descriptors: *Estuaries, *Diffusion coefficient, Tidal rivers, Tidal effects, Conwy estuary, *Salinity, Tracers, Dye releases, Flow measurement.

The application of the continuous source dye tracing technique to a tidal flow in a saline selection of the Conwy estuary is examined. Specific objectives were to define the problems of the experimental technique, to estimate the values of the transverse and vertical diffusion coefficients, and to investigate the possibility of defining their functional dependence on hydraulic parameters. The reach of the Conwy estuary was chosen because it was hydraulically relatively simple when compared with most estuarine channels. The reach used for the diffusion experiments was straight and about 500 meters long, 80 meters wide, and 5 meters deep. The salinity was generally between 15 and 30 kg/cubic meter during injection periods. Suspended solids concentrations were usually low, at less than 100 mg/liter. The dye plume was traversed at least three times at each depth, and at depth intervals of 1 meter at each of three sections located at about 120, 240, and 360 meters from the injection point. A total of two flood and seven ebb experimental runs were suitable for analysis. The accuracy of the experiments could be improved by additional hydrodynamic data, shorter fluorometer response time and better fixing. The transverse diffusion coefficient, which includes secondary flow effects, was dependent on flow direction and tidal range for the low river flow conditions at the site being investigated. Transverse diffusion coefficients agree fairly well with other laboratory and field data for open channel flow having a large width to depth ratio. Tentative results for the transverse Lagrangian integral time scale have been obtained. The vertical diffusion coefficient was larger for the flood tides than for the ebb tides. The values were smaller for the homogeneous flow but were compatible with the small vertical salinity gradients. (Baker-FRC)
W82-03388

NITROGEN AND PHOSPHORUS NUTRITION OF CLADOPHORA IN THE PEEL-HARVEY ESTUARINE SYSTEM, WESTERN AUSTRALIA,

Western Australia Univ., Nedlands. Dept. of Botany.
P. B. Birch, D. M. Gordon, and A. J. McComb.
Botanica Marina, Vol 24, No 7, p 381-387, July, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Algae, *Nutrients, Cladophora, Benthic flora, *Peel-Harvey Estuary, *Australia, *Estuarine environment, Nitrogen, Phosphorus, Seasonal variation, Growth rates, Eutrophication, Estuaries.

Cladophora aff. albida (Huds.) Kutz, a nuisance benthic alga growing in the Peel-Harvey estuary system, Australia, appears to store nutrients during winter and spring, periods of high nutrient input, for use in summer and autumn. Tissue nutrient values were usually above the critical concentrations of 21 mg per g dry weight for nitrogen and always below the critical concentration of 33 mg per g dry weight for phosphorus. Nutrient sources are surface sediments and decomposing Cladophora and phytoplankton. The few weeks of high river flow in winter do not allow the Cladophora to reach full storage potential of nutrients. Phosphorus regulation may be an important factor in control of this alga in the estuary. (Cassar-FRC)
W82-03398

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HEALTH ASPECTS OF WATER DESALINATION,

Institute of General and Municipal Hygiene, Moscow (USSR).
G. I. Sidorenki, Y. A. Rachamanin, and E. K. Strijak.
Aqua, No 6, p 339-343, 1981. 4 Ref.

Descriptors: *Desalination, *Public health, *Water quality, Drinking water, *Potable water, Demineralization, Ion exchange, Membrane processes, Reverse osmosis, Electrodialysis, Freezing, Distillation, Water properties, Physical properties.

At present five main methods are used in water desalination programs to provide water for domestic and drinking purposes: distillation, freezing, electrodialysis, reverse osmosis (hyperfiltration) and ion-exchange. Freezing and distillation involve profound structural transformations of the water and changes in its gaseous composition, i.e. the composition of the elements present in it, and in the content of organic matter and microorganisms. The distillate from commercial desalination plants is unsafe and cannot be used in public domestic and drinking water supply systems without further treatment. Water desalinated by distillation is practically lacking in mineral salts. The absence or low content of the salts that make water hard leads to changes in the phosphorus and calcium metabolism, to a reduction in the alkaline phosphatase activity of the blood serum, and to a change in the functional state of the thyroid gland. The biologically important trace element fluorine is almost totally absent from distilled water. The ion-exchange and electrodialysis processes of water desalination have a definite bactericidal and virucidal effect, but a buildup of organic matter on the membranes may be problematic. Water desalinated by electrodialysis must be disinfected. Reverse osmosis methods achieve a higher level of purification. The high alkalinity of water softened by sodium cation exchange is a health drawback, as it leads to shifts in the acid-alkali balance and water-salt metabolism of the organism. A thorough sanitary appraisal must be made of all reagents and structural and process materials, including polymers, used in the various water desalination methods. Recommendations for quality control are offered. (Baker-FRC)
W82-03116

ARTIFICIAL PARTICULATE FOULING OF HYPERFILTRATION MEMBRANES IV. DYNAMIC PROTECTION FROM FOULING,

Rensselaer Polytechnic Inst. Dept. of Chemical and Environmental Engineering.
G. Belfort.
Desalination, Vol 34, No 3, p 159-169, September, 1980. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Membrane filters, *Cellulose acetate membranes, *Fouling, Particulate matter, Colloids, *Desalination, Wastewater treatment, Wastewater renovation.

Previous studies have demonstrated that the use of a fixed membrane protective cover above the desalting membrane and facing the colloid and salt feed solution can significantly improve fluxes and reduce salt rejections. However, the cost of using the microporous Nuclepore or Millipore membranes as protective covers is prohibitive. This study reports experimental results for a new inexpensive method to reduce submicron colloidal fouling for hyperfiltration membranes. An inexpensive dynamic precoat protective cover using diatomaceous earth is placed on the high pressure feed water side of the asymmetric cellulose acetate membrane. Use of this cover resulted in increased flux ratios as high as 2.3 with decreased salt rejection ratios of 0.49 over unprotected membranes. Other significant benefits include reduced flux-decline with the protective cover as compared to without the cover and significantly easier removal of the colloidal cake/protective cover than of the cake itself. This method of protection is most attractive for high-flux and medium salt rejection applications for colloidal containing feed solutions. Such applications include the treatment of municipal, industrial, and agricultural wastewaters for reuse and possibly pretreatment for sea water reverse osmosis desalination. The use of the protective cover method in pilot and large-scale plant operations is being investigated. (Carroll-FRC)
W82-03288

3B. Water Yield Improvement

EVALUATIONS OF ILLINOIS WEATHER MODIFICATION PROJECTS OF 1976-1980: A SUMMARY,

Illinois State Water Survey Div., Champaign.
S. A. Changnon Jr., and C. F. Hsu.
Circular 148, 1981, 31 p, 8 Fig, 9 Tab, 10 Ref.

Descriptors: *Weather modification, *Rainfall, *Cloud seeding, *Radar, *Weather data collections, Evaluation, Statistics, Meteorology, Rainfall intensity, Rain gages, Rainfall distribution, *Illinois.

This report summarizes the key results of statistical and meteorological assessments of five summer weather modification projects in Illinois. One of the primary goals of this effort is to determine whether summer cloud seeding, using silver iodide, can produce agriculturally beneficial increases in rainfall under varying summer conditions. The basic approach involved a target vs. control area, plus a seeding period vs. historical period evaluations. Data were collected from non-recording raingages, from radar echoes, and from daily rainfall values provided by the National Weather Service. All of the projects involved seeding cumulus clouds during selected periods from mid-June through early September, and were two months or less in duration. The percentage differences (increases or decreases) between the seeded rain and echo values and control values are not statistically or physically significant. In general, the results are mixed. Two projects (years) indicate increases in the target rainfall and/or echoes, one year shows a decrease, and the remainder show no definitive trend. The results also indicate that for various reasons, such as poor photography, the project radar data are often unusable for a meaningful evaluation of possible seeding effects. In addition, all of the projects were of too short a duration to draw significant conclusions. (Atkins-Omnipian)
W82-03006

APPLICATION OF A SINGLE RESERVOIR OPERATION POLICY TO A RAIN WATER CISTERN SYSTEM,
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.
A. Lo, and Y. S. Fok.
Water Resources Bulletin, Vol 17, No 5, p 868-873, October, 1981. 7 Fig, 1 Tab, 3 Ref.

Descriptors: *Reservoir operation, *Cisterns, *Water storage, Water consumption, Water harvesting, Rainfall, Tantalus, *Hawaii, Storage capacity, Rain water, Capacity, Feasibility studies, Risks, Water supply.

Rain water cisterns, used in some regions of Hawaii as a primary or supplementary water supply, are economically feasible with proper maintenance and use of a single reservoir operation policy. Dynamic programming analysis was used to study the effects of probable weekly rainfall at Tantalus, Hawaii, and the storage capacity of the cistern on the water consumption policy. A cistern with maximum volume of 37.85 cu m and catchment area of 148.64 sq m receives 4 cu m (1000 gal) for each inch of rainfall. A table summarizes the best combinations of catchment area, storage capacity, optimal draft target, and percent risk for residents of the Tantalus area. A catchment area of 1200 sq ft with 8000 gal cistern has an optimal draft of 2200 gal per week at a 3.5% risk. At the other extreme of the table, a catchment area of 1600 sq ft with 16,000 gal cistern, has an optimal draft of 3000 gal per week at 1.5% risk. The water consumption rate should be lowered if the storage level is low or if the rainfall is low. (Cassar-FRC)
W82-03088

REANALYSIS OF 'GENERALIZED CRITERIA FOR SEEDING WINTER OROGRAPHIC CLOUDS',
Water and Power Resources Service, Denver, CO.
D. Rottner, L. Vardiman, and J. A. Moore.
Journal of Applied Meteorology, Vol 19, No 5, p 622-626, May, 1980. 8 Tab, 1 Ref.

Descriptors: *Cloud seeding, *Statistical analysis, Mathematical studies, Weather modification, Clouds, Orographic precipitation.

Vardiman and Moore (1978) presented the results of a study designed to develop generalized criteria for the seeding of winter orographic clouds. That paper discussed various physical stratifications which indicated the bounds of those meteorological and topographical conditions which were likely to produce positive and negative seeding results (seeding windows). However, continuing investigations of seeding windows using these data revealed a serious systematic bias of the original data set. This bias occurred because the Climax I and Climax II data sets included a large number of no-seed cases which were not within the original strict randomization. When this systematic bias was removed, significant changes were found in both the overall and the stratified results. Use of the corrected data set led to mostly non-significant results. The only window that remained significant was one indicating a decrease when unstable clouds with a blow-over trajectory, low moisture, and cloud-top temperatures less than -30C were seeded. (Carroll-FRC)
W82-03173

3C. Use Of Water Of Impaired Quality

DEMONSTRATION OF ANAEROBIC BIOGAS DIGESTERS IN DEVELOPING COUNTRIES. PART III: THE PHILIPPINES,
Philippines Univ., Manila. Inst. of Public Health.
For primary bibliographic entry see Field 5D.
W82-03226

OSMOTIC POTENTIALS OF ROOTS OF ONIONS AND THEIR RHIZOSPHERIC SOIL SOLUTIONS WHEN IRRIGATED WITH SALINE DRAINAGE WATERS,
Technische Univ., Brunswick (Germany, F.R.). Liechtweiss Inst. for Water Research.
U. Schleiff.
Agricultural Water Management, Vol 3, No 4, p 317-323, 1981. 2 Fig, 2 Tab, 13 Ref.

Descriptors: *Irrigation water, *Root zone, *Water reuse, Onions, Saline water, Drainage water, Salts, Agriculture, Osmotic pressure, Impaired water use, *Saudi Arabia.

The reuse of saline drainage water for irrigation of onions in Saudi Arabia was tested by determining the chloride concentration in rhizospheric soil (the layer immediately surrounding the roots, less than 1 mm thick) directly after watering and after 4 days of water depletion. Electrical conductivities of irrigation waters used were 2.4, 4.0, 6.0, and 8.0 mS per cm, obtained by mixing fresh (2.4 mS per cm) with more saline drainage water. Four hours after irrigation, rhizospheric soil contained 3-4.5 meq chloride per 100 g, 3-5 times greater than nonrhizospheric soil; after 4 days, 9-11 meq per 100 g. Nonrhizospheric soil remained at 0.6-1.5 meq chloride per 100 g during the experiment. The osmotic potentials of the rhizospheric soil were -0.5 MPa to -0.9 MPa upon irrigation and -2.0 to 3.0 MPa after 4 days. The concentration of chloride in rhizospheric soil did not reflect the different chloride concentrations of the irrigation waters. When the chloride level of added water increased 300%, the increase of chloride concentration in rhizospheric soil was 150% initially, 50% after 4 hours, and 20% after 4 days. These results contrast with previous findings that salt concentration of rhizospheric soil increased with salt concentration of applied water. Probably, salt concentration reached a critical maximum which was not exceeded. At this point roots may have stopped absorbing soil water, and translocation of salts from the nonrhizospheric soil ceased. (Cassar-FRC)
W82-03263

ON THE DEPENDENCE OF SALT TOLERANCE OF BEANS (PHASEOLUS VULGARIS L.) ON SOIL WATER MATRIC POTENTIALS,
Escuela Tecnia Superior de Ingenieros Agronomis, Madrid (Spain). Catedra de Edafologia.
M. A. Parra, and G. C. Romero.
Plant and Soil, Vol 56, No 1, p 3-16, 1980. 10 Fig, 17 Ref.

Descriptors: *Irrigation effects, *Salt tolerance, *Conductivity, Saline water, Irrigation, Crop yield, Water quality, Beans, *Impaired water use.

The salt tolerance of green beans was evaluated in a pot experiment using two irrigation regimes. Saline irrigation waters were prepared by adding increasing amounts of NaCl and CaCl2 to tap water to obtain waters with an electrical conductivity of 0.3, 0.5, and 0.7 mmol/liter and sodium adsorption ratio of 4 mmol/liter. Soil salinization was begun on the 20th day and completed on the 30th day by applying 500 and 1000 ml of saline water per pot at intervals. Thereafter, in the wet treatment, plants were irrigated when the water matric potential ranged from -20 to -30 kPa, and in the dry treatment, plants were irrigated when the water matric potential ranged from -40 to -60 kPa. When soil salinity increased and soil moisture decreased, transpiration rates and leaf extension rates decreased. Leaf extension rates were affected more by decreases in soil moisture. Under wet treatment, crop yields were as much as one and one half times larger than dry treatment yields. The common practice of evaluating the salt tolerance of crops by electrical conductivity alone is not as useful as when irrigation regimes are also considered. (Small-FRC)
W82-03273

WATER COST ENCOURAGES REUSE AND CONSERVATION,
Pirnie (Malcolm) Inc., White Plains, NY.
For primary bibliographic entry see Field 5D.
W82-03295

3D. Conservation In Domestic and Municipal Use

AN ECONOMIC ANALYSIS OF WATER CONSERVATION POLICY,
Rutgers - The State Univ., New Brunswick, NJ.
For primary bibliographic entry see Field 6B.
W82-03090

REPORT OF COMMITTEE ON CONSERVATION, DEVELOPMENT AND UTILIZATION OF WATER RESOURCES.
Journal of the New England Water Works Association, Vol 95, No 1, p 66-71, March, 1981.

Descriptors: *Water conservation, *Water policy, *Regional planning, *New England, Federal jurisdiction, Planning, Water resources development, Water use efficiency.

A synopsis was prepared on water conservation activities at the federal, interstate and state levels as of September 1980, and the relationships of the New England Waterworks Association to these activities was discussed. Activities in water conservation on the federal, interstate, state, and local levels point to increased emphasis on evaluation and use of water saving measures wherever practicable. A study report published on water conservation program development and implementation at the state level is intended to provide guidance in this development, but also contains information on responses of specific states to the need to conserve water. Two studies on evaluation and implementation of water conservation measures in New England have been undertaken by the New England River Basins Ccommission, an interstate/federal planning agency, Massachusetts has taken the lead among the New England states in promoting broad application of conservation principles and technology. The New England Water Works Association may involve itself directly in deliberations on water conservation measures. (Cassar-FRC)
W82-03374

3E. Conservation In Industry

TEXTILE WARP SIZE RECLAMATION USING THERMAL PRECIPITATION,
Auburn Univ., AL.
For primary bibliographic entry see Field 5D.
W82-03034

WATER POLICY AT INCO METALS COMPANY, ONTARIO DIVISION MILLS,
Water and Pollution Control, Vol 118, No 5, p 20, May, 1980.

Descriptors: *Water policy, *Water reuse, *Industrial wastewater, Ontario, Canada, Wastewater renovation, Mine wastes, Effluents, Water quality control.

This column presents excerpts from a paper by H. R. Butler, Supervisor, Environmental Control, Ontario Division, Inco Metals Company, presented at a conference of the Canadian Mineral Processors. Inco Metals Company operates 10 mines, three mills, two refineries, a smelter, and an iron ore recovery plant within a 50-kilometer radius of Sudbury, Ontario, and a mine-mill complex on the shore of Lake Shebandowan. The use rate of recycled water in the company's milling operations is more than 95 percent at each mill, both reducing the need for fresh water at the mills and improving the pollutant level of downstream aquatic environments. Effluents from the several facilities are collected in a common receptor, permitting treatment of excess and runoff waters and provision of a process water having a consistent quality. This system also minimizes operating expenses. The mill-mine complex at Lake Shebandowan uses about 330 cubic meters of fresh water per day, with an overall water recycle of 550 cubic meters per day. Mine water is used as flusing water for backfill operations or discharged to the tailings area. The combined tailing supernatant and mine water is used as process water in the mill. (Carroll-FRC)
W82-03251

3F. Conservation In Agriculture

ESTIMATING DISTRIBUTION UNIFORMITY IN LEVEL BASINS,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and A. R. Dedrick.
Transactions of the ASAE, Vol 24, No 5, p 1177-1180, 1187, September-October, 1981. 7 Fig, 7 Ref.

Descriptors: *Distribution patterns, *Basins, *Irrigation practices, Mathematical studies, Model studies, Streamflow, Irrigation design, Soil properties, Infiltration rate, Infiltration coefficient, Infiltration.

Factors that control the distribution uniformity of irrigation water applied to level basins were sought, and procedures for estimating the distribution uniformity were presented. Depending on the soil infiltration properties, two types of infiltration functions were studied: a power function for soils that do not reach a constant infiltration rate during an irrigation, and a branch infiltration function for soils that do reach a constant infiltration rate. Of the two methods presented for analyzing the distribution uniformity, the one utilizing a branch infiltration with a constant final infiltration rate is by far the easiest and most straightforward to use. However, the infiltration properties of the soil determine which of the methods is appropriate. For the branch infiltration function, the distribution uniformity is calculated directly. For the power infiltration function, the distribution uniformity has been displayed graphically, since it cannot be computed directly. Both methods for computing distribution uniformity require values for the advance exponent and the advance time. The power function method requires values for the recession time and the infiltration exponent. The branch function method requires values for the final infiltration rate and the average depth of water infiltrated. (Baker-FRC)
W82-03058

DESIGN PROCEDURE OF SPRINKLING LATERALS: THE MATHEMATICAL BACKGROUND OF A COMPUTERIZED AID,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
S. Pleban, and I. Amir.
Agricultural Water Management, Vol 3, No 4, p 269-278, 1981. 2 Fig, 6 Ref.

Descriptors: *Sprinkler irrigation, *Irrigation design, *Conveyance structures, Computer programs, Design criteria, Mathematical studies.

This paper presents the mathematical background of an interactive computer program to aid in designing sprinkling irrigation laterals. Several computer programs are used to solve four cases: (1) discharge and pressure distribution along the lateral, (2) pressure at inflow node + Case 1, (3) lateral diameter + Case 2, and (4) maximum permissible number of sprinklers on the lateral + Case 2. Also introduced as needed are: topography, lateral type and diameter, type of sprinklers and riser, spray between sprinklers, number of sprinklers, pressure at inflow node and maximum discharge differences between extreme sprinklers. The conversational mode and rapid response of the programs allows even unskilled users to run the programs correctly. Computational limits permit a 30-sprinkler maximum. (Cassar-FRC)
W82-03174

EVALUATION OF INFILTRATION MEASUREMENTS FOR BORDER IRRIGATION,
Science and Education Administration, Phoenix, AZ. Conservation Lab.
For primary bibliographic entry see Field 7B.
W82-03264

WATER USE AND WATER-USE EFFICIENCY OF WHEAT AND BARLEY IN RELATION TO SEEDING DATES, LEVELS OF IRRIGATION AND NITROGEN FERTILIZATION,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
K. P. Singh, and V. Kumar.
Agricultural Water Management, Vol 3, No 4, p 305-316, 1981. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Water use efficiency, *Irrigation efficiency, *Grain crops, Wheat, Barley, Fertilizers, Water use, Consumptive use, Evapotranspiration, Agriculture, *India.

Under water stress, barley was more productive than wheat, especially under late seeding conditions. Wheat (Triticum aestivum L.) and barley (Hordeum vulgare L.) were studied in India under timely (mid-November) and late (mid-December) seeding conditions, three irrigation levels (I, one irrigation at crown rooting in wheat and at active tillering in barley; II, as in I plus one irrigation at flowering in wheat and flag-leaf in barley; and III, at 25% available soil water in the active root zone), and four rates of nitrogen application (0, 30, 60, and 90 kg per ha N as calcium ammonium nitrate, divided into two applications). All crops were irrigated to field capacity prior to seeding. Under identical soil water stress barley showed a more favorable leaf water potential and more rapid recovery than wheat. Wheat had a higher transpiration rate than did barley. In irrigation regimes I and II barley used 9 and 21 mm less water, respectively, and outyielded wheat by 27% and 9%, respectively. A 100 mm savings for barley was realized with irrigation regimes I and II as compared with III. In general, water use efficiency decreased with increase in irrigation frequency and delay in seeding. Fertilization increased water consumption by wheat and barley 9% and 8%, respectively, and yield 90% and 100%, respectively, thus increasing water use efficiency. (Cassar-FRC)
W82-03266

MULTIMILLION-ACRE TEA BAG,
Svensson and Associates, Watsonville, CA.
G. Svensson.
Civil Engineering (New York), Vol 50, No 2, p 47-50, February, 1980.

Descriptors: *Irrigation efficiency, *Salts, *Irrigation-return flow, Irrigation practices, Irrigation, Agriculture, Water quality, Water conservation, Crop yield.

On-farm irrigation techniques that reduce return flow and thus reduce the salt concentrates deposited by return-flow water are discussed. Improved irrigation efficiency can reduce salt in the water supply, alleviate shortages of water used for other purposes, and prevent over-irrigation, which is detrimental to crops. One development to aid farmers is the lightweight neutron probe, which can measure soil moisture levels accurately in the field. It can be used to read up to 100 sites per day. A method has been developed for applying the data produced by the probe to the various needs of each field and crop under different weather conditions. A scheduling technique is used which identifies the refill point at which irrigation should occur. This simple method was evaluated on a sprinkler-irrigated 1500 acre potato and grain farm, and yield increases well above the 20-year record were experienced. It is difficult to get farmers to cooperate with the new program, however, because there are no incentives in the water allotment system for conserving water. (Small-FRC)
W82-03352

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

1980 PROGRESS REPORT ON BASELINE AQUATIC VEGETATION STUDIES TO DETERMINE THE EFFICACY OF HYBRID CARP (GRASS CARP FEMALE X BIGHEAD CARP MALE) IN TWO CALIFORNIA IRRIGATION CANALS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
F. L. Nibling, Jr., and J. S. Thullen.
Bureau of Reclamation Report GR-81-11, May 1981. 84 p, 32 Fig, 11 Tab, 10 Ref, 1 Append.

Descriptors: *Aquatic weeds, *Irrigation canals, *Hydrophytes, *Aquatic weed control, Biomass, Myriophyllum, Seasonal distribution, Sago pondweed, Fish, Carp, Hybrid carp, Imperial Irrigation District, California, Baseline studies, Vegetation.

During the 1980 growing season, six field trips were made to develop field techniques and gather information that will eventually be used to document the efficacy of this hybrid carp for controlling aquatic plants (hydrophytes) in irrigation canals. These studies were conducted in the Coachella Valley Water District and the Imperial Irrigation District in southern California. Baseline data were collected on hydrophyte distribution, biomass, and density; root and rhizome biomass; tuber density; and soil composition. In the Coachella Canal, the dominant hydrophyte, Myriophyllum spicatum, was sparse in April, but increased in biomass in each test section throughout the growing season. The hydrophytes in the Wormwood Lateral 3 varied considerably between the test sections. In April, the dominant hydrophyte, Hydrilla verticillata, was sparse throughout the lateral, but by July it had reduced the water-carrying capacity in one section by 50%. Other sections in Wormwood Lateral 3 remained low in biomass throughout the season, with the exception of one section which was dominated by Potamogeton pectinatus and Najas guadalupensis from October through November. The most promising parameters for evaluating the sterile hybrid carp efficacy will likely be hydrophyte biomass, areal coverage, and estimates of relative abundance. (Moore-SRC)
W82-03024

SEDIMENT REGULATION PROBLEMS IN SANMENXIA RESERVOIR,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
For primary bibliographic entry see Field 2J.
W82-03072

A PLANNING METHOD FOR EVALUATING DOWNSTREAM EFFECTS OF DETENTION BASINS,
Maryland Univ., College Park. Dept. of Civil Engineering.
M. E. Hawley, T. R. Bondelid, and R. H. McCuen.
Water Resources Bulletin, Vol 17, No 5, p 806-813, October, 1981. 2 Fig, 4 Tab, 4 Ref.

Descriptors: *Detention reservoirs, *Flood control, *Storm runoff, Runoff, *Model studies, Planning, Storm water, Hydrologic models, Reservoirs, Flood peak, Urban hydrology.

A simple, reasonably accurate method for evaluating the potential for adverse downstream effects of storm water detention basins is presented. It does not require a computer or a large data base. The time coordinates of runoff hydrographs are estimated using the time-of-concentration and the Soil Conservation Service runoff curve number. The discharge coordinates are obtained from a simple peak discharge equation. When results of this analysis show that downstream flooding would not be increased by the detention basins, further costly hydrologic analyses may be avoided. This method was applied to the Crabbs Branch watershed, Maryland. Results indicated a 15% increase in peak discharge rate, in good agreement with results from a more detailed modeling method. (Cassar-FRC)
W82-03089

RELIABILITY PROGRAMING IN RESERVOIR MANAGEMENT 1. SINGLE MULTIPURPOSE RESERVOIR,

California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03148

SALINITY AND BIOGENIC MATERIAL IN THE NORTH CASPIAN,

Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
D. N. Kutunin, and A. N. Kosarev.
Water Resources, Vol 8, No 1, p 19-28, January/February, 1981. 5 Fig, 7 Tab, 12 Ref. Translated from Vodnye Resursy, No 1, p 77-88, January/February, 1981.

Descriptors: *Salinity, *Nutrients, *Environmental effects, Flow regulation, Reservoir releases, *Caspian Sea, *Volga River, USSR, Rivers, Runoff, Phosphorus, Nitrogen, Silica.

Regulation of Volga River runoff has changed the salinity and nutrient distributions in the North Caspian Sea. The spring flood volume decreased by 11% and the fall-winter discharge increased, causing salinity increases up to 1.6 parts per thousand in summer. Maximum freshening has been shifted from July to June, and the area of freshened waters reduced. Vertical salinity gradients decreased in July-August, improving oxygen saturation, and increased in winter. Relative stability in salinity was observed in 1970-75. Marked salinization, up to 11.5 parts per thousand, occurred in the very dry period of 1975-77. Inorganic P decreased by 20% by 1977. Organic P has varied noticeably but is presently at its 1954-59 level. Silicon has also fluctuated widely. Total nitrogen inflow has increased by 180% in 1971-76 as compared with pre-regulation years. The proportion of inorganic to organic N has decreased. Ammonium N levels have decreased in the sea as a whole but increased in some shallow areas. Organic N levels have decreased slightly since regulation. (Cassar-FRC)
W82-03155

AQUATIC WEED RESEARCH IN BRITAIN,

Agricultural Research Council, Oxford (England). Weed Research Organization.
T. O. Robson.
Journal of Aquatic Plant Management, Vol 19, p 47-48, July, 1980. 3 Ref.

Descriptors: *Aquatic weed control, *Weed control, *Drainage systems, Herbicides, Aquatic plants, Water quality control, *England, Fish habitats.

Aquatic weed control in British ditches and rivers is essential to properly drain 3 million acres of valuable agricultural land. Methods of weed control must consider the stringent effluent standards in force and the desirability of maintaining enough aquatic vegetation to support recreational fish habitats. The major problems are not with exotic plants, but with indigenous ones. Mechanical control by cutting is labor intensive, but it does not add chemicals to the environment. Use of newly developed weed cutting machinery is limited because of high costs and difficulties of access on farmed land. Biological control may be possible with the herbivorous grass carp, plant competition, and shade trees on the bank. Herbicides are valuable when total eradication is desired. Newer application methods allow treatments to be selective for a target species and reduce the amount of chemical introduced. (Cassar-FRC)
W82-03187

TRANSLATORY CHARACTERISTICS OF THE MUSKINGUM METHOD OF FLOOD ROUTING--REPLY,

Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Civil Engineering.
M. A. Gill.
Journal of Hydrology, Vol 48, No 3/4, p 369-372, November, 1980. 1 Fig, 4 Ref.

Descriptors: *Mathematical studies, *Hydrodynamics, *Flood routing, Flow characteristics, Mathematical equations, Mathematical models.

This response by the author of the article Translatory Characteristics of the Muskingum Method of Flood Routing to comments by Strupczewski and Kundzewicz argues that the conclusions made by the commentors are not relevant to the substance of the original paper. Gill argues that the conclusions and arguments reached by the commentors were based on results obtained by using the Laplace operator, which is applicable in cases in which the lower limit of the integral is zero. However, the lower limit is not zero in the case of the Muskingum equation, so use of the Laplace operator is not appropriate. Gill argues that if the equation he used to define the initial condition is accepted, the arguments put forth by the commentors have no basis. The physical meaning of the time lag and the initial condition are clarified. Gill suggests that if the system approach predicts negative outflows, in which case the discharge would go upstream, then there must be something wrong with the method in which the system approach was used. (Carrol-FRC)
W82-03204

THE LINEAR DECISION RULE (LDR) RESERVOIR PROBLEM WITH CORRELATED INFLOWS. I. MODEL DEVELOPMENT,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
E. F. Joeres, G. J. Seus, and H. M. Engelmann.
Water Resources Research, Vol 17, No 1, p 18-24, February, 1981. 16 Ref.

Descriptors: *Flow control, *Reservoir releases, *Model studies, Linear decision rule, Streamflow, Mathematical studies, Reservoirs, *Inflow.

A chance-constrained reservoir optimization model (linear decision rule) has been extended to allow explicit consideration of correlated inflows. A decision rule including predicted flow as a state variable (predictive rule) is contrasted with the rule assuming uncorrelated monthly flows (independent rule) and the rule which uses knowledge of the upcoming period inflow (utopian or perfect hindsight rule). Previous opinions that the linear decision rule models are conservative are contrasted with the ability to make reliable release commitments with the predictive rule. The new rule consistently gives more total scheduled release. (Cassar-FRC)
W82-03237

RELIABILITY PROGRAMMING IN RESERVOIR MANAGEMENT 2. RISK-LOSS FUNCTIONS,

Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 6A.
W82-03245

FLOOD ROUTING PROGRAM,

Howard, Needles, Tammen and Bergendoff, Orlando, FL.
B. L. Golding.
Civil Engineering (New York), Vol 51, No 6, p 74-75, June, 1981. 1 Fig.

Descriptors: *Flood routing, *Computers, Routing, *Flood control, Runoff, Storm runoff, Reservoirs, Computer programs, Detention reservoirs.

A BASIC language program is presented for routing floods through storage reservoirs or detention basins by the storage-indication working curve method. The program for doing flood routing as described follows the general hand computation procedures for reservoir flood routing - utilizing the Storage-Indication Working Curve Method or Modified Puls Method. This procedure assumes that the outflow or discharge from the basin is directly proportional to the storage in the basin. This program required the same initial input information as required by hand computation: a rating curve for the outlet pipe or structure with discharge in cfs for each successively higher water surface elevation, where the basin's water surface elevation is the head on the outlet pipe or structure; and an elevation-storage curve for the detention basin where storage is in acre-feet. Knowing these two relationships, the discharge can be computed which is the actual input to the computer. The program can be easily modified to allow direct entrance of both the rating and storage curves, thus eliminating the hand computation of the discharge-storage relationship. This program is also useful for routing major floods through the large reservoirs. An example is given which indicates all necessary input to route a typical inflow hydrograph through the Brad Creek Reservoir. Discharge through the reservoir outlet structure and storage at each discharge are determined and printed using a user specified routing time of one hour. (Baker-FRC)
W82-03286

SIZING OF URBAN FLOOD CONTROL PONDS,

University of the Witwatersrand, Johannesburg (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 2A.
W82-03297

DIVERSION OF THE RIVER NEVA,

Technical Univ. of Denmark, Copenhagen. Inst. of Hydrodynamics and Hydraulic Engineering.
F. B. Pedersen, and J. S. Moller.
Nordic Hydrology, Vol 12, No 1, p 1-20, 1981. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Salinity, *Diversion losses, *Rivers, Water level, Mathematical models, Equations, Estuaries, River Neva, Baltic Sea, *Denmark.

The extent to which the diversion of the Neva River will influence hydrographic conditions in the Baltic Sea and the Danish inland waters was investigated mathematically. Part of the Neva will be diverted into dry regions in the southern USSR to meet an increasing demand for irrigation water. The Baltic estuary system is divided into eight subareas, each characterized by an equation for the mass, the volume, and the dynamic balance (the mixing). The proposed change in river flow is introduced into the equations, and the equations are solved with respect to changes in salinity, discharge, and layer depths in the system. For example, a 25% reduction in Neva discharge would increase salinities by 0.2 to 0.4% throughout the system. If the river diversion had been enacted 80 years ago, a 30-40% higher salinity would now exist in the Baltic Sea. The river diversion would reduce the dynamic stability of the estuary system, making the system more sensitive to changes in external forces such as variations in meteorology. The reduced stability would be caused by the combined effects of an increased salinity and a decreased upper layer depth. (Small-FRC)
W82-03304

THE ECOLOGY OF A LAND DRAINAGE CHANNEL--I. OXYGEN BALANCE,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
E. J. P. Marshall.
Water Research, Vol 15, No 9, p 1075-1085, September, 1981. 8 Fig, 3 Tab, 26 Ref.

Descriptors: *Weed control, *Oxygen, *Drainage ditches, Diquat, Herbicides, Pesticides, Dissolved oxygen, Respiration, Aquatic plants, Photosynthesis, Thermal stratification, Ditches, Channels, Ecology.

The ecology of land drainage channels and the effect of weed control using diquat was investigated at 4 stations of varying depth (0.49-1.55 meters) and width (4.6-7.2 meters) within a drainage ditch near Goldcliff, Wales. During summer days considerable vertical differences in temperature (16-28 degrees C) were recorded. Oxygen levels were always low (less than 2 mg per liter) directly above the sediments and up to 20 mg per liter near the surface. Ratios of photosynthesis: respiration varied with the season, from greater than 1 early in the year to lower in August and September. Diquat (maximum concentration 1.0 mg per liter) applied to 2 sites reduced photosynthetic oxygen production to 2.9 g per sq meter per day compared with the control, 15.0 g per sq meter per day. Community respiration declined from 9.1 g per sq meter per day to 6.1 g per sq meter per day. The photosynthesis:respiration ratio dropped from 1.0 to 0.5 soon after spraying but returned to normal 10 days later. Production and respiration increased to normal levels within 15 days. Liquid herbicide applied to the surface of thermally stratified channels will likely remain on the surface until vertical mixing occurs during the night. If the water flows before mixing takes place, some herbicide may be lost, reducing the efficiency of the weed control program. (Cassar-FRC)
W82-03306

STORMWATER DETENTION IN DEVELOPING WATERSHEDS,

Espey Huston and Associates, Inc., Houston, TX.
C. B. Amandes, and P. B. Bedient.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No EE2, p 403-419, April, 1981. 8 Fig, 4 Tab, 17 Ref.

Descriptors: *Watershed management, *Detention reservoirs, Watersheds, Catchment areas, Drainage area, Storm runoff, Urban runoff, Reservoirs, Retention time, Water pollution control.

A simple procedure is presented for the analysis of stormwater detention storage at the planning stage of watershed development. Effects of various storage volumes on peak storm flows and sediment export were investigated for small residential areas. Impacts on the overall watershed of design rainfall frequency, land use patterns, and the volumes of detention storage provided were evaluated. An actual test watershed was studied under varying design conditions for the calculation of peak flow reductions and suspended solids. The study site was Keegans Bayou in Houston, Texas. The channel is about 7 miles long and drains an area of 12.4 square miles into Brays Bayou and ultimately to Galveston Bay. Dry weather flow is less than 5 cfs and is mainly treated sewage effluent. The lower watershed has been the site of significant urban development, while the upper watershed remains largely undeveloped. Soil in the area is primarily heavy clay falling into the soil conservation Service's Hydrologic Group D. The high runoff potential and prevailing ground slopes of less than 1% make drainage improvements necessary if flood damage is to be prevented. Using a design control level of 12 acre-ft/200 acres, the effects of detention storage on the Keegans Bayou watershed were evaluated for rainfall events of 1 and 2 inches. Results indicated that some reductions in flood peaks and sediment transport are seen with detention controls in only 14% of the developed area. Ten-fold reductions over the uncontrolled case are observed for the fully urbanized, fully controlled scenario. (Baker-FRC)
W82-03363

4B. Groundwater Management

DESIGN AND ECONOMICS OF A SOLAR HEATER AQUIFER STORAGE SYSTEM,

Texas A and M Univ., College Station. Dept. of Chemical Engineering.
S. Tostengard, W. B. Harris, and R. R. Davison.
AIChE Symposium Series, Vol 77, No 210, p 12-20, 1981. 13 Fig, 5 Tab, 8 Ref.

Descriptors: *Solar energy, *Storage, *Aquifer systems, *Heat transfer, *Energy sources, New Mexico, North Dakota, Wells, Design criteria, Economic aspects, Heated water, Groundwater management.

Storage of solar heat in aquifers is simulated for climatic conditions of central New Mexico and North Dakota. The system consists of solar heat collectors, surface storage cells, supply wells, and storage wells. Although efficiency is low in the first year while the aquifer is being heated, it can rise to over 80% after 3-5 years. In warm weather water from the supply well is withdrawn, heated, and injected into the storage well. In cold weather the flow is reversed. Hot water is pumped from the storage well, used for building heating, and injected into the supply well. Efficiency rises with aquifer thickness, with temperature of location, and with total volume. It is desirable to drill more wells (unless well costs are very high) rather than to operate wells at peak load. Surface storage is valuable at high ratios of heater area to well flow volume. With existing federal tax credits, the system is competitive with oil under most circumstances and with gas under favorable circumstances. (Cassar-FRC)
W82-03143

4C. Effects On Water Of Man's Non-Water Activities

ASSESSMENT OF UPPER MISSISSIPPI RIVER FLOODPLAIN CHANGES WITH SEQUENTIAL AERIAL PHOTOGRAPHY,

K. N. Olson.
PhD Thesis, July, 1980. 284 p, 42 Fig, 10 Tab, 108 Ref, 13 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-15024.

Descriptors: *Flood plains, *Land use, *Aerial photography, Sedimentation, Erosion, Spoil banks, *Upper Mississippi River, Environmental alteration, Mississippi River, Minnesota, Iowa.

This study was designed to determine the types and extent of natural and man-influenced changes in floodplain features in the Upper Mississippi River Valley from Minneapolis, Minnesota, to Guttenberg, Iowa, over the 35-year period following completion of the 9-foot navigation project in 1938. The following areal changes have occurred in land cover and land use: Water areas have decreased 4% within the study area due to the sedimentation in backwater areas, deposition of dredged material, and plant colonization and succession. Marsh areas have increased quite uniformly, the increase averaging 7.59% throughout the area. Meadows have decreased and forest increased due to decreased agricultural activity and lower incidence of fire. Emergent aquatics do not show a clearcut case of having uniformly increased or decreased in area. Altered flow patterns, turbidity, and the expansion of marsh vegetation have caused some areas to decrease. Sedimentation has allowed emergent aquatics to become established in other areas. Agriculture has decreased in all pools due to the raised water-tables and lowland flooding and land purchase by the federal government. Residential areas have increased slightly overall, but will probably remain static due to the pattern of federal land ownership and flooding potential. The area of disposal sites of dredged material has increased in all pools due to the continued maintenance activities of the Corps of Engineers. Due to the complexity and difficulties of field access to floodplain areas, a technique involving the comparison of sequential aerial photography is the only practical method of determining precisely and accurately the changes which have occurred over time in land and water surface areas and in land use. (Sinha-OEIS)
W82-03015

FORECASTING SUBSURFACE WATER FLOW AND STORAGE ON FORESTED SLOPES USING A FINITE-ELEMENT MODEL,

For primary bibliographic entry see Field 2G.
W82-03018

COPING WITH INCREASED STREAM EROSION IN URBANIZING AREAS,

Rutgers-The State Univ., New Brunswick, NJ. Water Resources Research Inst.
For primary bibliographic entry see Field 2J.
W82-03067

4D. Watershed Protection

HOW ABOUT REVERSE FILTERS,

Connecticut Univ., Storrs. Dept. of Civil Engineering.
C. J. Posey.
Civil Engineering (New York), Vol 50, No 4, p 78-79, April, 1980. 2 Fig, 3 Ref.

Descriptors: *Reverse filters, *Filters, *Erosion control, Sand, Fabrics, Storm drains, Waterways, Dams, Embankments.

Reverse filters may be used to control erosion in embankments and storm drains. These are constructed with the fine material below the coarse. Granular materials of the proper sizes are difficult to obtain because commercial materials have very narrow size ranges. Sometimes natural deposits of the different sized materials in the desired proportions can be found. Often 2 or 3 commercial materials are mixed as desired. Instructions for choosing grain sizes are given. Usually sand can be used for the first layer, and material directly from the rock crusher (if it does not contain too many fines) can be used to protect the sand. (Cassar-FRC)
W82-03247

STORMWATER DETENTION IN DEVELOPING WATERSHEDS,

Espey Huston and Associates, Inc., Houston, TX.
For primary bibliographic entry see Field 4A.
W82-03363

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

WATER QUALITY ANALYSES OF THE COLORADO RIVER CORRIDOR OF GRAND CANYON,

B. M. Tunnicliff.
PhD Dissertation, 1980. 183 p, 29 Fig, 21 Tab, 25 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX17772.

Descriptors: *Water quality, *Pollutant Identification, *Recreation, *Enteric bacteria, Bottom sediments, Hazards, Coliforms, Surface water, *Grand Canyon, *Colorado River, River runners.

Water quality analyses in Grand Canyon examined Colorado River and tributary baseline water quality status in relation to recreational float trip use of the river corridor. During the 1972 and 1979 float trip seasons, outbreaks of gastroenteritis occurred among river runners in Grand Canyon. Potentially, the Colorado River or a tributary served as a source or carrier of a pathogen, though this has not been confirmed. Water quality analyses of the Colorado River corridor occurred during the 1978 and 1979 river running seasons. Examination of the extensive river corridor necessitated analyses in the field. A total of 497 water quality samples were

collected over the two seasons. Selected microbial, physical, and chemical parameters were measured to determine baseline water quality status. Data from 1978 and 1979 show that the Colorado River and tributaries have similar bacterial water quality profiles. Surface waters show predominantly low FC densities, indicating high quality waters for recreational activities, however treatment of river and tributary surface water is necessary to assure drinking water quality standards. Bottom sediment analyses modify considerably the water quality status represented by surface water analyses alone. Significant densities of enteric organisms are present in the river and tributary environments, representing an important water quality hazard. Associated with resuspension of bottom sediments is the probability of surface water contamination by enteric organisms. Recreational activities, particularly water play in confined tributary pools, can bring river runners in direct contact with concentrated sediment suspension in surface waters. (Sinha-OEIS)
W82-03017

1981 ANNUAL REPORT - COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY.

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
November, 1981. 142 p, 6 Tab, 102 Ref, 1 Append.

Descriptors: *Water quality, *Chemical wastes, *Toxicity, *Hazardous materials, *Lakes, Carcinogens, Toxins, Human population, Enteroviruses, Chlorination, Industrial wastes, Monitoring, Microbiological studies, Fish populations, *Great Lakes.

The Committee's 1980 report contained a preliminary review of the toxicological data base for the chemicals listed in the 1978 Great Lakes Water Quality Board Report, and indicated those of concern from an acute and chronic toxicity perspective. The Committee reexamined the data base in 1981 and categorized the chemicals as follows: (1) those posing a threat to man from acute exposure; (2) those causing chronic effects which are subject to regulatory monitoring; (3) those causing chronic effects which are not monitored but should be considered for it; (4) those of minimal health concern; and (5) those having insufficient data to conduct a health hazard assessment. Toxicity was based on six key elements: acute toxicity, carcinogenicity, reproductive effects, heritable mutagenicity, neurobehavioral effects, and chronic adverse effects. Exposure potential, persistence in the environment, and potential for bioaccumulation were also considered in determining if a compound was of actual or potential concern. Careful monitoring and environmental surveillance, using the specific criteria outlined, are recommended to reduce the subjectivity in human health risk assessment. Microbiological monitoring should be continued to reveal trends in water quality as a result of new treatment technologies and to identify industrial byproducts discharged into the Basin. Areas of future concern, such as health impacts of energy production, methods to collect epidemiological data, and exposure to air pollutants are discussed. The appendix lists exposure and toxicity profiles of 91 chemicals found in the Great Lakes. (Atkins-Omniplan)
W82-03104

SURVEY OF POLYCHLORINATED BIPHENYLS IN INDUSTRIAL EFFLUENTS IN CANADA.

Environmental Protection Service, Ottawa (Ontario).
Economic and Technical Review Report EPS 3-WP-81-1, 1981. 19 p, 26 Ref, 5 Tab.

Descriptors: *Polychlorinated biphenyls, *Industrial effluents, *Sediments, *Aquatic environment, *Contaminants, Discharges, Analytical methods, Sampling, Sewage treatment plants, Pulp and paper mills, Steel plants, Aluminum smelter effluents, Chemical plants, Industrial wastewater, Canada, Pollutant identification.

A survey of polychlorinated biphenyls (PCBs) in industrial effluents and process streams in Canada was conducted in two phases. Phase I was an overall screening study with samples taken from various industrial sectors, while in Phase II only those industrial plants identified in Phase I as discharging significant quantities of PCBs in their effluents were sampled. In Phase I, a total of 308 samples were collected and analyzed for PCB concentration. Of the 308 samples tested, 48 were found to contain more than 0.1 ppb of PCBs. Industries identified as having samples containing PCBs were: (1) those using PCBs in their products, (2) those using PCB-containing materials in the operation of equipment, and (3) those using recycled materials contaminated with PCBs in their processes. Samples containing PCBs were also obtained from a number of other industrial facilities and from sewage treatment plants. The Phase II study included sampling a total of 45 effluents from seven selected plants. The results confirmed the findings of the Phase I study. The sources of PCB contamination and the formation of PCBs as inadvertent byproducts of various operations are discussed. (WATDOC)
W82-03107

OCCURRENCE OF RHODOCOCCUS COPROPHILUS AND ASSOCIATED ACTINOMYCETES IN FECES, SEWAGE, AND FRESHWATER,

Leeds Univ. (England). Dept. of Civil Engineering.
D. D. Mara, and J. I. Oragui.
Applied and Environmental Microbiology, Vol 42, No 6, p 1037-1042, December, 1981. 5 Tab, 19 Ref.

Descriptors: *Bioindicators, *Feces, *Animal wastes, Microbiological studies, Indicators, Water pollution sources, Rhodococcus coprophilus, *Actincmyces, Sewage bacteria, Farm wastes, Bacteria, Pollutant identification.

Rhodococcus coprophilus was consistently isolated from animal wastes and water polluted by animal wastes but not from human feces. This actinomycete may have potential as a specific indicator organism for pollution from farm animal wastes. In examinations of 97 samples of feces, R. coprophilus was not recovered from humans, cats, rabbits, rats, mice, or turkeys. In feces from farm animals (cattle, sheep, horses, pigs, hens, ducks, and geese) R. coprophilus numbers ranged from 3900 to 2.5 million per g of feces. R. coprophilus was detected in 100% of feces samples from cattle, sheep, pigs, and horses, but not in laboratory-raised fowls. Stream water contaminated with farm wastes and raw sewage contained average R. coprophilus counts of 13,000-16,000 per 100 ml and 140 to 3700 per 100 ml, respectively. Ratios of fecal coliforms to fecal streptococci could not distinguish between human and animal feces. The ratio of R. coprophilus to total actinomycetes (0.40-0.76) was higher in feces from cattle, sheep, ducks and geese than in feces from pigs (0.43) and fowl (0.13). (Cassar-FRC)
W82-03122

EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF SUB-MICROGRAM AMOUNTS OF NITRITE USING 4-NITROANILINE AND NAPHTH-1-OL,

Ravishankar Univ., Raipur (India). Dept. of Chemistry.
A. K. Baveja, J. Nair, and V. K. Gupta.
Analyst, Vol 106, No 1266, p 955-959, September, 1981. 1 Fig, 3 Tab, 13 Ref.

Descriptors: *Nitrites, Water analysis, Nitrogen compounds, *Pollutant identification, Rivers, Spectrophotometry, *Trace levels.

Trace levels of nitrite in river water were successfully determined with a method involving a two-step reaction to form an azo dye, followed by hexanol extraction and spectrophotometric measurement at 610 nm. The two-step reaction consists of: (1) reaction of the nitrite with 4-nitroaniline in the presence of 0.1 M HCl to form 4-nitrophenyldiazonium chloride, and (2) reaction of the diazonium ion with naphth-l-ol to form a purple azo dye. This dye is extracted with hexanol, which is more suitable than butanol, pentanol, isopentanol, or octanol. Absorbance is constant from 15 to 40 C and does not change more than + or - 2% up to 30 hours. The practical range for determination of nitrite by this method is 0.035-0.123 ppm. The 12 river water samples, all diluted from 4 ml to 50 ml prior to analysis, contained 0.36 to 0.83 ppm nitrite, which agreed well with results from the conventional sulfonamide-N-(l-naphthyl)-ethylenediamine dihydrochloride method. Ethylenediaminetetraacetic acid or tartrate masking agents prevented interference from a variety of ions, including Fe, Bi, and Cu. A complete table of tolerances is presented. (Cassar-FRC)
W82-03123

CARBON ISOTOPE FRACTIONATION DURING MICROBIAL METHANE OXIDATION,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. F. Barker, and P. Fritz.
Nature (London), Vol 293, No 5830, p 289-291, September 24, 1981. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Methane, *Isotope fractionation, *Bacteria, *Carbon isotopes, Methane bacteria, Oxidation, *Groundwater, Carbon dioxide.

Carbon isotope (C12:C13) ratios were investigated in mixed cultures of methane-utilizing bacteria producing CO2 from CH4. The respired CO2 was depleted in C12 relative to the residual CH4 by 2.96% to 0.5%, with the depletion diminishing as the CH4 content decreased. The isotopic fractionation factor varied from 1.0313 to 1.0052. The variation could not be related to temperature, rate of CH4 consumption, or variation in CH4/02 ratios. Although the experiments were carried out at higher temperatures than are found in most groundwaters, the results helped explain observations in three groundwaters from shallow aquifers on the nothern shore of Lake Erie. They all contained small, variable quantities of CH4 (0.4 to 9 cu cm at STP per liter of water). The delta C13 methane ranged from -2.98% to -3.70%. Comparing these values with biogenic methane (delta below -5.0%) and methane in underlying gas deposits (delta -3.68% to -4.44%) it is evident that the methane did not come directly from either methanogenesis or the gas deposits. A possible explanation is that the groundwater contained methane from natural gas which had been partially oxidized by bacteria. Wherever bacterial methane oxidation is posible, the carbon isotope ratio of residual methane may not be a reliable indicator of the origin of the gas. (Cassar-FRC)
W82-03188

RNA SYNTHESIS AS A MEASURE OF MICROBIAL GROWTH IN AQUATIC ENVIRONMENTS, II. FIELD APPLICATIONS,

Hawaii Univ., Honolulu. Dept. of Oceanography.
D. M. Karl, C. D. Winn, and D. C. L. Wong.
Marine Biology (Berlin), Vol 64, No 1, p 13-21, September, 1981. 4 Fig, 6 Tab, 28 Ref.

Descriptors: *Microbiological studies, *Aquatic habitats, Environments, Aquatic life, Eutrophic lakes, Microorganisms, Growth, Bacteria, Freshwater, Seawater, Coastal waters, Hawaii, Ribonucleic acid.

Field applications are considered of the tritium-labeled adenine technique used to study microbial growth in freshwater and marine habitats. Freshwater samples were collected from Krauss Pond, a eutrophic environment dominated by the green alga, Chlorella sp., located at Manoa. Freshwater was also collected from two prawn ponds located in Kahuku, Hawaii. Coastal seawater samples were collected from Kewalo Basin, Kaneohe Bay, on Oahu, Hawaii. Rates of stable ribonucleic acid (RNA) synthesis were calculated from time-series measurements of the uptake of tritium-labeled adenine and labeling of the intracellular adenosine triphosphate (ATP) and stable RNA pools for microbial communities. Most of the variation in total rates of microbial RNA synthesis was attributable to differences in microbial biomass. If total rate data are normalized to living microbial carbon

as based on ATP measurements, the variation in specific rates of RNA synthesis is decreased by a factor of 100 to 1000 for microbial communities from diverse environments. Experiments to determine the importance of light or dark conditions indicated that the uptake and incorporation of tritium-labeled adenine are uncoupled from photophosphorylation. The measurement of rates of stable RNA synthesis of microbial assemblages in nature can provide information which is helpful in studying the in situ growth rates and the response of communities to changes in environmental conditions such as nutrient additions. (Baker-FRC)
W82-03191

RNA SYNTHESIS AS A MEASURE OF MICROBIAL GROWTH IN AQUATIC ENVIRONMENTS. I. EVALUATION, VERIFICATION AND OPTIMIZATION OF METHODS,

Hawaii Univ., Honolulu. Dept. of Oceanography.
D. M. Karl, C. D. Winn, and D. C. L. Wong.
Marine Biology (Berlin), Vol 64, No 1, p 1-12, September, 1981. 7 Fig, 3 Tab, 31 Ref.

Descriptors: *Microbiological studies, *Aquatic habitats, Environment, Aquatic life, Eutrophic lakes, Microorganisms, Growth, Bacteria, Freshwater, Seawater, Coastal waters, Hawaii, Ribonucleic acid.

Laboratory and field experiments are described which were designed to evaluate the validity of the stable RNA synthesis technique as a probe for evaluating the growth rates of microorganisms in nature. Coastal seawater samples were collected from Kewalo Basin, Kaneohe Bay and Waikiki Beach, Oahu, Hawaii. Some samples were also taken from a eutrophic freshwater pond located on the University of Hawaii at Manoa campus. This pond, Krauss Pond, was dominated throughout most of the year by the alga Chlorella sp., and contained a high concentration of particulate organic detritus. Bacteria were frequently associated with particles larger than 5 micrometers. Additional freshwater samples were taken from aquaculture ponds on Oahu, Hawaii. Following addition of tritium-labeled adenine to water samples, microorganisms assimilate it either without any luxury uptake or without any expansion of intracellular adenine nucleotide pools. The calculated rate of stable RNA synthesis tends to be overestimated during the initial time periods of labeling due to kinetic compartmentalization of the nucleic acid precursor pool. Time series analyses decrease the effects of compartmentalization with increasing incubation. Mass-balance radioactivity inventories greatly facilitate the interpretation of nucleic acid precursor assimilation. It was concluded that independent measurements of precursor specific radioactivity are necessary for any elucidation of rates of stable RNA synthesis, and thus microbial growth, in nature. (Baker-FRC)
W82-03192

FOSSIL CARBON IN COASTAL SEDIMENTS,

Glasgow Univ. (Scotland). Dept. of Chemistry.
M. S. Baxter, M. J. Stenhouse, and N. Drndarski.
Nature (London), Vol 287, No 5777, p 35-36, September 4, 1980. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Carbon, *Marine sediments, *Coastal waters, Coal, Carbon radioisotopes, Fuel, *Pollutant identification, Sediments, Estuaries, Scotland, Clyde River, Firth of Clyde, Municipal wastes, Path of pollutants, Radioactive dating.

There is no radioactive carbon-14 in fossil carbon as it occurs in coal, oil, and their derivatives. If even small concentrations of fossil carbon are present within sedimentary materials, anomalously old radiocarbon ages may result. Findings of artificially high carbon-14 ages in the upper 20 centimeters of Baltic Sea sediments in correlation with increased heavy metal concentrations are consistent with the growth of industrial activity in this area. In the past, this increase in radiocarbon age has been regarded as an approximate measure of the extent of pollution of sediment organics by industrial fossil fuels. Analysis of surface sediments from the Clyde Sea area in south-west Scotland shows that natural fossil carbon contributes about 30 percent and industrial fossil fuels about 20 percent of the total carbon. These results indicate that natural fossil carbon contamination must be considered a potential and significant source of error in dating sediments. This natural component occurs at all sediment depths and, if constant, does not preclude estimation of deposition rates. However, the natural input may be added to and masked by anthropogenic releases in recent surficial samples. The two natural fossil components cannot be differentiated unless long cores are available, and considerable errors may occur in evaluating data from surface samples alone. (Carroll-FRC)
W82-03201

GENERAL METHOD FOR DETERMINATION OF PESTICIDE RESIDUES IN SAMPLES OF PLANT ORIGIN, SOIL, AND WATER. III. GAS CHROMATOGRAPHIC ANALYSIS AND CONFIRMATION,

Plant Protection and Agrochemistry Centre, Budapest (Hungary).
A. Ambrus, E. Visi, F. Zakar, E. Hargitai, and L. Szabo.
Journal of the Association of Official Analytical Chemists, Vol 64, No 3, p 749-768, 1981. 8 Fig, 4 Tab, 5 Ref.

Descriptors: *Pesticide residues, *Chromatography, *Water analysis, Pollutant identification, Herbicides, Insecticides.

Pesticide residue analysis methods using only one gas chromatograph in combination with thin layer chromatography and column chromatography were developed. The main criteria for the optimum method were that it be reliable, quick and usable for both screening and confirmation. Many packings of various polarities were tested. The most suitable for general purposes were OV-22 and OV-101. Others tested were NPGS, SE-30 (3% on Gas-Chrom Q), and 1.95% SP-2401/1.5 SP-2250 on Supelcoport. A study on thermionic detector performance suggested that each detector should be optimized individually. Short columns, 45-90 cm, were suitable for screening purposes. Although their resolving power was less than that of longer columns, the time of analysis was much shorter, the MDQ values with the same detector were 5-10 times lower, and lower column temperatures were possible. For confirmation of peak identities, silica gel column chromatography combined with gas-liquid chromatographic analysis on a short column proved useful. A table lists the detectability, recovery, and limit of detection for 163 pesticides. (Cassar-FRC)
W82-03215

GENERAL METHOD FOR DETERMINATION OF PESTICIDE RESIDUES IN SAMPLES OF PLANT ORIGIN, SOIL, AND WATER. II. THIN LAYER CHROMATOGRAPHIC DETERMINATION,

Plant Protection and Agrochemistry Centre, Budapest (Hungary).
A. Ambrus, E. Karoly, A. Fulop, and J. Lantos.
Journal of the Association of Official Analytical Chemists, Vol 64, No 3, p 743-748, 1981. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Thin layer chromatography, *Pesticide residues, *Water analysis, *Pollutant identification, Chromatography, Carbamate pesticides, Halogenated pesticides, Triazine pesticides, Urea pesticides.

The applicability of thin layer chromatography in screening pesticide residues of unknown origin was tested using several modes of detection. Most practical eluting solvents were methylene chloride and ethyl acetate. Minimum detectable quantities and retention factors are given for 99 pesticides. o-Toluidine and potassium iodide detected carbamates, ureas, triazines, and some other pesticides. p-Nitrobenzenediazonium fluoroborate selectively detected certain carbomates. Bioassay with fungi spores was useful for detection of fungicides; plant extracts did not interfere. Enzyme inhibition was affected by some natural plant materials. Silver nitrate and ultraviolet radiation nonselectively detected halogen-containing compounds and required careful sample cleanup. p-Dimethyl aminobenzaldehyde was good for all ureas and some carbamates. (Cassar-FRC)
W82-03216

ANALYTICAL REFERENCE MATERIALS. III. PREPARATION AND HOMOGENEITY TEST OF LARGE QUANTITIES OF WET AND DRY SEDIMENT REFERENCE MATERIALS FOR LONG TERM POLYCHLORINATED BIPHENYL QUALITY CONTROL STUDIES,

Canada Centre for Inland Water, Burlington (Ontario).
A. S. Y. Chau, and H-B. Lee.
Journal of the Association of Official Analytical Chemists, Vol 63, No 5, p 947-951, September, 1980. 3 Tab, 9 Ref.

Descriptors: *Polychlorinated biphenyls, *Sample preparation, *Lake sediments, Sediments, Sedimentology, Sample preservation, Sampling.

Preparation of large quantities of wet and dried lake sediments to be used as analytical reference materials for long term polychlorinated biphenyl (PCB) quality control studies is described. Over 500 subsamples, 15 to 20 g each, of well-homogenized and characterized, wet spiked sediment reference material were prepared. For wet samples, about 12 kg of water-saturated sediment was added to three liters of water and 150 gm concentrated HCl and blended for two minutes. For a spiked specimen, the PCB spiking solution in 10 ml of acetone is added to the slurry. This sample can be subdivided. For dry samples, sediment is frozen and then thawed in garbage cans. Water is drained out through holes during the thawing process. The sediment is then freeze-dried, crushed, screened, blended, and blotted. Homogeneity was determined for subsamples in each group. These procedures can be used to prepare wet or dry samples that are either natural or spiked with PCB. (Small-FRC)
W82-03224

TRACE ANALYSIS OF TOXIC METALS. I. DETERMINATION OF LEAD, MERCURY, CADMIUM AND THALLIUM BY AMPEROMETRIC TITRATION,

Singapore Univ. Dept. of Chemistry.
S. A. K. Hsieh, and T. S. Ma.
Mikrochimica Acta, Vol 2, No 3/4, p 291-300, 1980. 11 Fig, 2 Tab, 15 Ref.

Descriptors: *Heavy metals, *Metals, *Volumetric analysis, *Pollutant identification, Lead, Mercury, Cadmium, Thallium, Trace elements.

Lead, Mercury, cadmium, and thallium were determined in the microgram range by micro-amperometric titration with ethylenediamine tetraacetic acid, using a dropping Hg electrode. This method, applicable to small establishments, has a detection limit of about 1 ppm and is accurate to plus or minus 5%. Titrant volume was read by digital voltmeter to minimize human error. (Cassar-FRC)
W82-03236

IMPROVED MICROBE DETECTION IN WATER SAMPLES.

Public Works, Vol 112, No 6, p 134, 136, June, 1981. 1 Fig.

Descriptors: *Microorganisms, *Microbiological studies, *Filtration, *Electrochemistry, *Escherichia coli, Microscopic analysis, Experimental data, Data interpretation, Bacteria, Water sampling, Sample preparation.

Two techniques, membrane filtration and electrochemical microbial detection, are combined in a new method for detecting microorganisms in water samples. Cells are collected by the filter placed on an absorbent pad moistened with 2.0 ml of trypticase soy broth. The electrodes are positioned on the surface of the filter. The other pad, moistened with soy broth, is placed on top of the electrodes and filter. A retainer ring at right angles to the electrodes maintains constant pressure and close

contact between pads, filter, and electrodes. The dish is sealed with parafilm to reduce moisture. For Escherichia coli, favorable results were obtained with 50 estuarine and 46 water samples tested with the combined technique. Results with Staphylococcus aureus, however, were erratic and not reproducible. (Titus-FRC)
W82-03258

SODIUM REGULATION IN THE TIDEPOOL COPEPOD TIGRIOPUS CALIFORNICUS,

California State Polytechnic Univ., Pomona. Dept. of Biological Sciences.
P. M. McDonough, and D. F. Stiffler.
Comparative Biochemistry and Physiology. A: Comparative Physiology, Vol 69A, No 2, p 273-277, 1981. 5 Fig, 19 Ref.

Descriptors: *Copepods, *Salt balance, *Sodium, *Physiological ecology, Salinity, Crustaceans, Evaporation, Tidal marshes, Tidal flats, Saline water, Seawater, Salt tolerance.

The copepod Tigriopus californicus, which inhabits tidepool areas along rocky coasts of North America, is able to survive a wide range of salinities caused by sudden evaporation or dilution of the media. A study was conducted to see if T. californicus regulates its ionic content by examining the sodium content of whole animal samples over an external range of 0.26-1.45 M sodium. Whole body sodium content increased gradually from 0.2 to 4.0 micromoles/milligram of dry weight with increases in external salinity. Body water content remained constant at 87.5% of body weight. Mean internal levels of sodium and upper and lower limits of extracellular sodium were below the limit of conformity with the external environment. Possible sites of sodium transport were identified on the ventral sides of the copepods through silver staining methods. However, these sites did not stain in the presence of sodium-free medium, ouabain or 2,4-dinitrophenol. These findings suggest a hypoionic regulation of sodium by active transport over the salinity levels tested. (Geiger-FRC)
W82-03262

PRECONCENTRATION OF INORGANIC MERCURY WITH AN ANION-EXCHANGE RESIN AND DIRECT REDUCTION-AERATION MEASUREMENTS BY COLD-VAPOUR ATOMIC ABSORPTION SPECTROMETRY,

Kumamoto Univ. (Japan). Dept. of Chemistry.
I. Sanemasa, E. Takagi, T. Deguchi, and H. Nagai.
Analytica Chimica Acta, Vol 130, No 1, p 149-156, 1981. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Mercury, *Ion exchange resins, *Sample preparation, Pollutant identification, Atomic absorption spectroscopy, Water analysis, Spectroscopy.

Inorganic mercury ions present at concentrations of 5-50 ng per liter in natural water samples (500 ml) were concentrated by adsorption on 0.2 g of chloride-type anion exchange resin. An ammonium thiocyanate-nitric acid medium was used to ensure a higher oxidation state of Hg and to prevent adsorption onto the container walls. After the resin was filtered, it was transferred to a cylindrical gas bubbler containing sulfuric acid and Sn(2+) solution. The Hg ions adsorbed on the resin were reduced to metallic Hg, which was vaporized by the air stream and measured by atomic absorption at 254 nm. The maximum steady peak was observed 6 min after beginning aeration. (Cassar-FRC)
W82-03268

FLUORIDE DETERMINATION IN WATER: AN OPTIMUM BUFFER SYSTEM FOR USE WITH THE FLUORIDE-SELECTIVE ELECTRODE,

Victoria Univ. of Manchester (England). Dept. of Child Dental Health.
K. Nicholson, and E. J. Duff.
Analytical Letters, Vol 14, No 12, p 887-912, 1981. 1 Fig, 7 Tab.

Descriptors: *Fluorides, *Buffers, Pollutant identification, Water analysis, Potentiometers, Fluoridation, Chemical analysis, Electrodes.

TISAB III M. triammonium citrate was the best in terms of masking ability of 11 buffer systems tested in the determination of fluoride in water using the direct potentiometric electrode method. This buffer was prepared from 58 g NaCl, 57 ml glacial acetic acid, 4 g N,N,N',N'-tetraacetic acid, and 243 g triammonium citrate, adjusted to pH 5.4 with 10 M NaOH and made up to 1 liter. Al and Mg interfered, but BO2, BO3, Ca, H2BO3, and phosphate did not. Not less than 20 min, preferably 24 hours, decomplexing time should be allowed after buffer addition. A temperature of 20 C was preferable to 50 C for analysis. Deterioration on storage suggests that buffers be discarded a week, and not more than 2 weeks, after preparation. (Cassar-FRC)
W82-03269

A NEW VOLTAMMETRIC METHOD FOR THE DETERMINATION OF SILICA TRACES IN WATER,

Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.).
C. S. P. Iyer, P. Valenta, and H. W. Nurnberg.
Analytical Letters, Vol 14, No 12, p 921-931, 1981. 4 Fig, 2 Tab.

Descriptors: *Silica, *Water analysis, Pollutant identification, Voltammetry, Molybdate method, Drinking water, Boiler water, Seawater.

Silica traces were determined in drinking, sea, and boiler water down to the level of 6.4 micrograms per liter by preconcentration of silicomolybdate at the electrode and subsequent voltammetric determination. Ammonium molybdate (1% solution) is added to the sample solution, and the pH adjusted to 1.6 with 0.1 M HCl. After 30 min methylethyl ketone plus citrate buffer is added. The ketone suppresses the alpha form of the silicomolybdate, ensuring that all is in the beta form; the citrate buffer masks interferences from phosphate and excess molybdate. The silicomolybdate is accumulated at the electrode by adsorption at the interface by keeping the initial potential at 0.2V for 2 min and then measuring the peak height at 0.36V. The voltammetric method is more sensitive and simpler than the spectrophotometric molybdenum blue method in comparison analyses using drinking water, seawater, and boiler water. Precision is + or - 10% at a 15 microgram per liter level. (Cassar-FRC)
W82-03270

A SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF ANIONIC SURFACTANTS AT MICROG/LITER LEVELS,

Sydney Univ. (Australia). Dept. of Inorganic Chemistry.
S. R. Bhat, P. T. Crisp, J. M. Eckert, and N. A. Gibson.
Analytica Chimica Acta, Vol 116, No 1, p 191-193, April, 1980. 2 Tab, 4 Ref.

Descriptors: *Surfactants, *Chemical analysis, Water analysis, Saline water, Seawater, Lakes, Rivers, Freshwater, *Spectrophotometry, Photometry, Spectral analysis.

A more sensitive spectrophotometric version of a method for the determination of anionic surfactants based on the extraction of surfactant anions into chloroform as an inner-sphere complex with the bis(ethylenediamine)copper(II) cation is presented. A single extraction is required, and the method is insensitive to ionic interferences. It is applicable to fresh, estuarine and sea water samples. After extraction, 1-(2-pyridylazo)-2-naphthol and diethylamine are added, and copper(II) is subsequently determined spectrophotometrically. With a 200 ml water sample, the detection limit is 5 micrograms/liter, as linear alkyl sulfonic acids. (Baker-FRC)
W82-03289

LEMNA (DUCKWEED) AS AN INDICATOR OF WATER POLLUTION. I. THE SENSITIVITY OF LEMNA PAUCICOSTATA TO HEAVY METALS,

Shinshu Univ., Matsumoto (Japan). Dept. of Public Health.
Y. Nasu, and M. Kugimoto.
Archives of Environmental Contamination and Toxicology, Vol 10, No 2, p 159-169, 1981. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Duckweed, *Heavy metals, *Water pollution effects, Toxicity, Phytometers, Measurement techniques, Path of pollutants.

The indicator plant method, or phytometer method, may be used to measure the amount of a certain pollutant using a specific plant sensitive to the pollutant. This method requires many plants that are similar in size and character at the time of measurement. In order to serve as an indicator, the plant must be sensitive to the pollutants, the sample of polluted water must be easily taken into the plant, and the condition at which the plant is most sensitive must be known. The environmental conditions affecting the growth and multiplication of Lemna paucicostata (duckweed) in the presence of heavy metals were examined in order to establish a phytometer method for water pollution using the duckweed. The pH of the medium, the concentration and composition of the nutrient in the medium, and the temperature at which cultures were maintained were all found to affect the sensitivity of Lemna to heavy metals. Multiplication of Lemna paucicostata 6746 was highly sensitive to heavy metals when cultured aseptically in a Bonner-Devirian medium (pH 6.1) containing 1 percent sucrose at 25C to 30C, so that many of the heavy metals which occur as pollutants can be detected at a concentration lower than those officially permitted in Japanese waters. (Carroll-FRC)
W82-03318

ANALYSIS OF TRACE ELEMENTS IN SEAWATER. PART II. DETERMINATION OF HEAVY METAL TRACES IN SEA WATER BY X-RAY FLUORESCENCE ANALYSIS WITH TOTALLY REFLECTING SAMPLE HOLDERS,

Institut fuer Anorganische und Angewandte Chemie. Hamburg (Germany, F.R.).
A. Knochel, and A. Prange.
Mikrochimica Acta, Vol 2, No 5/6, p 395-408, 1980. 5 Fig, 4 Tab, 6 Ref.

Descriptors: *X-ray fluorescence, *Heavy metals, *Seawater, Water analysis, Trace elements, Performance evaluation, Pollutant identification.

X-ray fluorescence analysis (XFA) was used to determine many trace elements in seawater using the methods developed in the GKSS-Forschungszentrum, Geesthacht. A special sampling device for deep seawater was used to collect samples in the Baltic Sea. The samples were worked up and analyzed directly on board or were acidified and preserved for analysis in the laboratory. A small chromosorb column was used to separate the elements Fe, Co, Ni, Cu, Zn, Hg, and Pb from the sea-salt matrix as the dithiocarbamates. Then, the heavy metal complexes were eluted with chloroform. Aliquots of the eluate yielded suitable measuring samples for the XRF apparatus. This procedure had detection limits 2 to 3 orders of magnitude better than conventional systems. Also, the reproducibility of results was about 10%. Purity criteria and sources of contamination were discussed for every step of the analytic procedure. (Small-FRC)
W82-03333

ALPHA-PARTICLE RADIOACTIVITY OF HOT PARTICLES FROM THE ESK ESTUARY,

Institute for Marine Environmental Research, Plymouth (England).
E. I. Hamilton.
Nature (London), Vol 290, No 5808, p 690-693, April 23, 1981. 3 Fig, 2 Tab, 21 Ref.

Descriptors: Radioactivity, *Estuaries, *Esk estuary, *Radioactive wastes, Effluents, Estuarine environment, Coasts, Irish Sea, Particulates, *Sediments, Aquatic life.

Studies of the sediment and biota of the Esk Estuary indicate the presence of transuranium radicenuclides, which are found in the effluents discharged into the north-east Irish Sea at the Windecale nuclear fuel processing plant, 10 km to the north. Suspendrd particulate debris samples at the sea surface, bottom sediments and some forms of biota were collected for study in September of 1977. Methods of analysis used in this study were a new dielectric alpha-track detector, CR-39, in association with conventional chemical separation techniques, and alpha-particle spectrometry using surface barrier detectors. Analyses revealed fewer hot particles in buried sediments than in the top 10 cm of sediments, and lower specific activity. Data for Fucus vesiculosus indicates some degree of Pu enrichment. Significant levels of short-lived nuclides were found in undisturbed sediments of the Esk estuary. Dissolution of the hot particles in the Esk is aided by interactions with freshwater and flocculation processes which occur at the salt-freshwater interface. The hot particles associated with particulate water sampled at the sea surface, and thus available for transfer to marine aerosols, have a mean particle diameter suitable for entry into the human lung. (Baker-FRC)
W82-03345

SEPHADEX LH-20 CHROMATOGRAPHY OF EXTRACTS OF MARINE SEDIMENT AND BIOLOGICAL SAMPLES FOR THE ISOLATION OF POLYNUCLEAR AROMATIC HYDROCARBONS,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
L. S. Ramos, and P. G. Prohaska.
Journal of Chromatography, Vol 211, No 2, p 284-289, July 3, 1981. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Hydrocarbons, *Marine sediments, *Chromatography, Marine environment, Tissue analysis, Chemical interference, Crabs, Polynuclear aromatic hydrocarbons.

A two-step procedure is described to isolate polynuclear aromatic hydrocarbons (PAHs) from extracts of sediments and tissues from the marine environment. The procedure combines silica gel chromatography and Sephadex LH-20 chromatography using contaminant-free solvent systems that are safer than benzene. The relatively simple gas chromatograms of PAH fractions isolated by this procedure permit direct quantitation. The gas chromatographic analysis of the unsaturated hydrocarbon fraction of both a sediment extract and a crab hepatopancreas extract following silica gel chromatography revealed a substantial number of compounds that coelute with PAHs and thus interfere with their determination. These interfering large polysaturated aliphatic hydrocarbons were removed on a Sephadex LH-20 column. The method yielded high PAH recoveries and eliminated the need for mass spectrophotometric techniques to separate target compounds from coeluting compounds. (Small-FRC)
W82-03370

CHELATING RESIN CATCHER FOR CAPTURE, PRECONCENTRATION AND DETERMINATION OF TOXIC METAL TRACES (ZN, CD, HG, PB) IN WATERS (CAPTEUR DE RESINE CHELATANTE POUR LE PRELEVEMENT LA PRECONCENTRATION ET LA DETERMINATION DE METAUX TRACES TOXIQUES (ZN, CD, HG, PB) DANS LES EAUX,

Tours Univ. (France). Lab. de Chimie Minerale et d'Hydrologie.
F. Clanet, R. Deloncle, and G. Popoff.
Water Research, Vol 15, No 5, p 591-598, May, 1981. 6 Fig, 3 Tab, 32 Ref.

Descriptors: *Heavy metals, *Ion exchange resins, *Chelation, Metals, Zinc, Cadmium, Mercury, Lead, *Pollutant identification, Chemical analysis, Water analysis, Water sampling, Sample preservation.

Trace metals at the microgram per liter level may be concentrated without alteration using a field collector. The apparatus consists of a Lexan cyclindrical capsule 29 mm in diameter and 10 mm thick, containing Chelex 100 chelating resin. The collector is connected with a detachable filtering apparatus, and the sample water is percolated through. A 1-liter water sample is acidified to pH 1 with concentrated nitric acid and filtered through a 0.45 micrometer membrane. This solid residue is examined by x-ray fluorescence spectrometry. To the filtrate is added 100 ml of soda-citrate buffer and NaOH to change the pH to seven. This solution is percolated through the Chelex-100 resin collector at 1.5 ml per min. The toxic metals (Zn, Cd, Hg, Pb) are eluted with 2 M nitric acid and determined by atomic absorption spectrophotometry or anodic stripping voltammetry or by drying and pelletizing the resin and examination by x-ray fluorescence spectrometry or activation analysis. (Cassar-FRC)
W82-03379

GROUND WATER MONITORING: PART II,

For primary bibliographic entry see Field 5B.
W82-03380

PRACTICAL TECHNIQUES OF RIVER MONITORING AND POLLUTION FORECASTING, PART 1: CONTINUOUS QUALITY MONITORING AND DATA ACQUISITION,

Anglian Water Authority (England).
D. E. Caddy, and P. G. Whitehead.
Effluent and Water Treatment Journal, Vol 21, No 9, p 407-409, 411, 414, September, 1981. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Monitoring, Pollution control, Rivers, Water quality, Measuring instruments, Data acquisition, Data processing, Forecasting, *Water pollution sources, Forecasting, *Great Ouse River basin, England.

The present article is the first in a series of three, and describes some features of the instrumentation used in the Great Ouse River basin in eastern England for monitoring and forecasting pollution. The high cost of equipment and the limited range of reliable measurements which can be made impose distinct restrictions on the use of continuous monitoring. In many cases the data obtained from monitoring networks is not fully utilized. Data handling is often inefficient, being based on recorder chart or paper tape systems, or else is performed on expensive but inflexible computer systems. A significant advance in data handling would be provided by the ability to manage and process the data automatically, thus providing data summaries and analyses for management, and to forecast water quality and flow conditions. With the availability of relatively low cost microcomputers it is now possible to develop inexpensive data management and forecasting systems which will make full use of acquired data. In general, instrument reliability can be improved by sample filtration and by automatic cleaning and self calibration of instruments. Greater use of microprocessor control can enhance reliability, and advances in this area are being studied. The modelling of real time data from flow gauges and water quality monitors is being used in operational practice. Such techniques enable operational managers to forecast flow and quality conditions and thereby assess the impact of discharges along critical reaches of rivers. (Baker-FRC)
W82-03390

5B. Sources Of Pollution

A 'RANDOM WALK' SOLUTE TRANSPORT MODEL FOR SELECTED GROUNDWATER QUALITY EVALUATIONS,

Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 6A.
W82-03007

METHODS OF DISCHARGE COMPENSATION AS AN AID TO THE EVALUATION OF WATER QUALITY TRENDS,

Geological Survey, Raleigh, NC.
For primary bibliographic entry see Field 7B.
W82-03056

SIMULATION OF THE TRANSPORT OF ION-EXCHANGING SOLUTES USING LABORATORY-DETERMINED CHEMICAL PARAMETER VALUES,

Illinois Univ. at Urbana. Champaign. Dept. of Civil Engineering.
A. J. Valocchi, P. V. Roberts, G. A. Parks, and R. L. Street.
Ground Water, Vol 19, No 6, p 600-607, November/December, 1981. 9 Fig, 3 Tab, 18 Ref.

Descriptors: *Solute transport, *Ion exchange, *Wastewater disposal, Fate of pollutants, Model studies, Injection wells, Groundwater pollution, Aquifer characteristics, Disposal wells, Wells, *Palo Alto area, California.

Laboratory-determined chemical parameter values (selectivity coefficient and cation exchange capacity) were successfully substituted for expensive field measurements in simulation of the transport of ion-exchanging solutes in groundwater. The model was applied to the direct injection of municipal effluents into an alluvial aquifer in the Palo Alto, California, Baylands region. Analysis of observation well logs and core samples determined porosity, bulk density, and aquifer thickness. Tracer tests with chloride in observation wells produced an approximate velocity field and dispersivity values. Incorporating the above parameter values, the model was used to predict the breakthrough of major cations at the observation wells. Observed and calculated values for sodium, potassium, magnesium, and calcium agreed well, but predicted ammonia breakthrough was earlier and at a higher concentration than observed in the field. (Cassar-FRC)
W82-03057

INCREASING HYDROGEN ION ACTIVITY OF WATER IN TWO RESERVOIRS SUPPLYING THE SAN FRANCISCO BAY AREA, CALIFORNIA,

California Univ., Berkeley. Dept. of Plant and Soil Biology.
J. G. McColl.
Water Resources Research, Vol 17, No 5, p 1510-1516, October, 1981. 4 Fig, 2 Tab, 26 Ref.

Descriptors: *Reservoirs, *Acidity, Water pollution sources, *San Francisco Bay area, Nitrogen oxides, Air pollution, Chemical composition, *Hydrogen ion concentration, *Hydrocarbons, Nitrous oxides.

A study was conducted to determine if changes had taken place in hydrogen ion concentration over the last 25 years in untreated water of two reservoirs in different watersheds supplying the large, urban complex of the San Francisco Bay area. While no direct link between the chemical characteristics of atmospheric precipitation and reservoir waters can be drawn from the available data, changes in reservoir waters might well be related to broad trends in atmospheric pollution or to other causes such as changes in land use practices. The two Sierra Nevada reservoirs studied were the Pardee and Hetch Hetchy. Weekly measurements taken at the two reservoirs indicate increases in hydrogen ion concentrations during this time period. Based on linear models, the rate of increasing hydrogen ion concentration was the same at both reservoirs and varied concomitantly from year to year. This suggests a common, general cause for the increase. The most likely cause appears to be the increased acidity of atmospheric depositions, especially those resulting from emissions of nitrous oxides by automobiles. Both watersheds are large, and while there have been localized disturbances within each such as mining and logging, these have had only minor effects on the composition of the reservoir waters. It may also be suggested that the increases resulted from carbonic acid, a product of the emission of carbon dioxide from combustion of fossil fuels. However, the magnitude of acidity increase in the reservoirs renders this conclusion unlikely. (Baker-FRC)
W82-03081

TRANSPORT OF ION-EXCHANGING SOLUTES IN GROUNDWATER: CHROMATO-

GRAPHIC THEORY AND FIELD SIMULATION,

Stanford Univ., CA. Dept. of Civil Engineering.
A. J. Valocchi, R. L. Street, and P. V. Roberts.
Water Resources Research, Vol 17, No 5, p 1517-1527, October, 1981. 13 Fig, 2 Tab, 24 Ref.

Descriptors: *Groundwater movement, *Model studies, Simulation, *Solute transport, Chromatography, *Ion exchange, Chromatography, Case studies.

This paper presents an analytical framework based upon the theory of chromatography which permits a priori characterization of certain key concentration profile features. The cases studied include both homovalent and heterovalent exchange in binary and ternary systems. In order to test its validity, the chromatographic analysis is applied to a field project involving direct injection of advanced treated municipal effluent into an aquifer. All of the major features observed in the available field data are accurately predicted by the chromatographic theory. While only binary and ternary systems were considered, it is suggested that many multispecies problems could often be approximated by two or three major components. The close agreement achieved between the simulated and the actual breakthrough curves also indicates that laboratory-determined chemical parameter values can be used in field-scale transport simulations, if the hydrologic and hydrodynamic parameters are chosen to simulate reliably the movement of a conservative tracer. In applying the simulation model to a field transport problem it is anticipated that the most troublesome and expensive effort will be devoted to estimating values of velocity and dispersivity. One drawback of the analysis as presented here is that it provides no information regarding the time required for the theoretical concentration profiles to develop. (Baker-FRC)
W82-03082

EFFECTS OF CLEARCUTTING AND SLASH-BURNING ON STREAM TEMPERATURE IN SOUTHWESTERN BRITISH COLUMBIA,

British Columbia Univ., Vancouver. Faculty of Forestry.
For primary bibliographic entry see Field 5C.
W82-03087

MOLECULAR DIFFUSION AND THE SEDIMENTARY ENVIRONMENT: RESULTS FROM THE IN SITU DETERMINATION OF WHOLE SEDIMENT DIFFUSION COEFFICIENTS,

Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.
For primary bibliographic entry see Field 2J.
W82-03091

CADMIUM IN GAMMARIDAE (AMPHIPODA: CRUSTACEA) OF THE RIVERS WERRA AND WESER: GEOGRAPHICAL VARIATION AND CORRELATION TO CADMIUM IN SEDIMENTS,

Oldenburg Univ. (Germany, F.R.).
G. P. Zauke.
Environmental Pollution, Series B, Vol 2, No 6, p 465-474, 1981. 3 Fig, 3 Tab, 21 Ref.

Descriptors: Sedimentation, *Cadmium, Rivers, *Sediments, Amphipods, Path of pollutants, *Crustaceans, Gammarus, *Werra River, *Weser River, Germany.

The geographical variation of cadmium in Gammarus tigrinus is evaluated as a pre-condition for monitoring the availability of this metal for an important component of the food web of the rivers Werra and Weser. Cadmium concentrations in sediments were analyzed using different sediment fractions and extraction techniques. The animals were collected from stones beneath the water surface so as to ensure comparable environmental conditions. A comparison of the cadmium concentrations in sediment obtained by the application of two different extraction procedures indicates a good agreement between the results. Distinct geographical variations of cadmium in G. tigrinus from the two rivers are a precondition for the study of the availability of cadmium to the organisms within the river system. Since cadmium levels in the sediments may be regarded as an expression of the environmental cadmium supply, the investigation of correlations between cadmium in amphipods and in sediments provides information on cadmium available to the amphipods. The algebraic value of the correlation coefficient supports the hypothesis of a linear relationship between cadmium in gammarids and cadmium in the total sediment. The algebraic value of the correlation coefficient does not support the hypothesis of a linear relationship between cadmium in G. tigrinus and cadmium in the silt fraction of the sediment. Although the relative enrichment factor found for cadmium in G. tigrinus from the river Werra indicates a slightly elevated availability of cadmium in this ecosystem, the literature survey on cadmium in other organisms shows that the rivers Werra and Weser are not highly contaminated by cadmium at present in terms of its availability to amphipods. (Baker-FRC)
W82-03094

THE STRUCTURE OF FRESHWATER HUMIC SUBSTANCES AS REVEALED BY 13C-NMR SPECTROSCOPY,

Lincoln Coll. (New Zealand).
For primary bibliographic entry see Field 2H.
W82-03095

1981 REPORT ON GREAT LAKES WATER QUALITY.

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
For primary bibliographic entry see Field 5G.
W82-03102

SALT-WATER INTRUSION IN A LAYERED COASTAL AQUIFER AT YORK POINT, PRINCE EDWARD ISLAND,

National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2F.
W82-03108

ZINC IN SEAWATER AND SEDIMENTS,

Athens Univ. (Greece). Inorganic Chemistry Lab.
M. J. Scoullos.
Water, Air, and Soil Pollution, Vol 16, No 2, p 187-207, August, 1981. 6 Fig, 5 Tab, 78 Ref.

Descriptors: *Fate of pollutants, *Zinc, *Industrial wastes, *Gulfs, Path of pollutants, Heavy metals, Water pollution, Seawater, Sediment transport, Marine sediments, Ocean circulation, Organic carbon, Oxidation-reduction potential, Seasonal variation, Aegean Sea, Mediterranean Sea, Gulf of Elefsis.

Particulate and dissolved Zn were measured for one year in sea water of the Gulf of Elefsis near Athens, Greece, and results were compared to Zn levels of other Aegean and Mediterranean Sea areas. Particulate Zn was linearly correlated with the magnetic activity of sediments. The distribution of Zn in the bottom sediments reflected the industrial pollution and its history in the Gulf. Zinc levels in sediments were comparable with those of other known polluted areas of the world, including the Severn Estuary in Britain. A deep part of the Gulf with high organic C levels and seasonal periods of anoxia also had high Zn levels, showing that the acidity of the lower part of the water column acts as a trap for Zn, depending on the seasonal circulation or redox reactions. The top 5 to 10 cm of the sediment column showed great enrichment with Zn due to the non-lattice held inorganic and, to a lesser extent, the organically bound Zn. (Geiger-FRC)
W82-03166

CHEMICAL ALKYLATION OF LEAD(II) SALTS TO TETRAALKYLLEAD (IV) IN AQUEOUS SOLUTION,

Canada Center for Inland Waters, Burlington (Ontario).
I. Ahmad, Y. K. Chau, P. T. S. Wong, A. J. Carty, and L. Taylor.
Nature, Vol 287, No 5784, p 716-717, October 23, 1980. 2 Tab, 17 Ref.

Descriptors: *Lead, *Water pollution sources, *Methylation, *Fate of pollutants, Heavy metals, Chemical reactions, Synthesis, Toxins, Water pollution, Water quality, Microbiological studies, Organic compounds.

The methylation of lead in the environment poses serious threats to water quality and aquatic life. Previous studies have proven the high toxicity of tetraalkyleads, the end products of lead alkylation. Increasing levels of inorganic lead in land waterways and sediments will increase the problem of possible lead methylation. In the belief that biological lead(II) methylation of the reactions of methyl ion donors with neutral and anionic lead compounds were initiated. The synthesis of volatile tetramethyllead and other tetraalkylleads from the reaction of lead(II) salts and other simple reagents in aqueous solution is demonstrated. Me4Pb was readily synthesized in aqueous solutions containing lead(II) salts and methyl iodide, a compound known to occur in natural waters. This finding is significant to the understanding of the chemical synthesis of toxic organoleads as well as mechanisms of microbial methylation. (Geiger-FRC)
W82-03171

ORTHOPHOSPHATE UPTAKE BY PHYTOPLANKTON AND BACTERIOPLANKTON FROM THE LOS ANGELES HARBOR AND SOUTHERN CALIFORNIA COASTAL WATERS,

University of Southern California, Los Angeles. Dept. of Biological Sciences.
D. W. Krempin, S. M. McGrath, J. B. SooHoo, and C. W. Sullivan.
Marine Biology (Berlin), Vol 64, No 1, p23-33, September, 1981. 6 Fig, 2 Tab, 57 Ref.

Descriptors: *Plankton, *Harbors, *Los Angeles Harbor, Phosphates, Bacteria, Absorption, *Coastal waters, Phytoplankton, Aquatic plants, Orthophosphates, Seasonal variation.

Sea water samples were collected 1 meter below the surface from four stations in the outer Los Angeles Harbor and one station located 1.5 km outside the harbor breakwater upcurrent of the harbor excurrent plume. Additional samples were taken at a station, SPC-15, which is 15 km offshore in the San Pedro Channel and at Station RB, 0.5 km offshore from Santa Catalina Island in Isthmus Cove. A phytoplankton-enriched size fraction was retained on a 1 micrometer pore-size filter and accounted for 83% of the total chlorophyll a but only 18% of the total bacteria. A bacterioplankton enriched size fraction passed the 1 micrometer filter but was retained on a 0.2 micrometer filter and was found to contain 82% of the total bacteria but only 17% of the total chlorophyll a. These two fractions accounted for 91 and 9% of the microbial carbon, respectively. P-33 uptake by both size fractions was inhibited by low concentrations of 2,4-dinitrophenol, N-ethylameimide, carbonyl cyanide and m-chlorophenylhydrazone. Low levels of 3-(3,4-dichlorophenyl)-1,1-dimentylurea selectively inhibited the uptake of P-33 by the plankton-enriched fraction, while valinomycin selectively inhibited P-33 uptake by the bacterioplankton-enriched size fraction. Consideration of relative surface areas of phytoplankton and bacterioplankton, their P-33 uptake rates in light and dark, and estimates of the population turnover times emphasized the potential importance of bacterioplankton in community phosphorus metabolism. (Baker-FRC)
W82-03172

UPTAKE OF VIBRIO CHOLERAE BIOTYPE ELTOR FROM CONTAMINATED WATER BY WATER HYACINTH (EICHORNIA CRASSIPES),

Johns Hopkins Univ., Baltimore, MD. Div. of Geographic Medicine.
W. M. Spira, A. Huq, Q. S. Ahmed, and Y. A. Saeed.
Applied and Environmental Microbiology, Vol 42, No 3, p 550-553, September, 1981. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Water hyacinth, *Human diseases, *Vibrio, Bacteria, Accumulation, Public health, Bangladesh, Path of pollutants.

The association between V. cholerae biotype eltor and the water hyacinth was examined under controlled conditions. The association had been noted in study of the transmission of epidemic cholera in rural Bangladesh. Tanks of 100 liter capacity that were exposed to full sunlight were inoculated and water and plant samples were removed at regular intervals. The association between the plant and contaminant was apparent after a few hours, and by five days the concentration on the plants was 300-fold greater than that of the surrounding water. This is the time period of concern, as almost 80% of detectable cholera infections occur within six days of the index case. Water hyacinth is not eaten by people, but it is free-floating and may be a vehicle for the transmission of V. cholerae biotype eltor through waterways of cholera endemic regions such as Bangladesh. (Small-FRC)
W82-03179

ARSENO-SUGARS FROM BROWN KELP (ECKLONIA RADIATA) AS INTERMEDIATES IN CYCLING OF ARSENIC IN A MARINE ECOSYSTEM,

Western Australian Marine Research Lab., North Beach.
J. S. Edmonds, and K. A. Francesconi.
Nature, Vol 289, No 5798, p 602-604, February, 1980. 2 Tab, 16 Ref.

Descriptors: *Arsenic, *Kelps, *Fish, *Lobsters, Sugars, Marine environment, Foods, Fate of pollutants, Metabolism, Food chains.

Two main arsenical constituents of the brown kelp, Ecklonia radiata, were isolated and identified. Interest in this study was stimulated by the high concentration of arsenic in edible sea animals, which cannot be attributed to seawater arsenic levels. Arsenic is present as arsenobetaine in the western rock lobster and the school whiting. Ecklonia is the major organism that concentrates arsenic in the coastal ecosystem of the western rock lobster and school whiting. The two main arsenical constituents of the kelp were 2-hydroxy-3-sulfopropyl-5-deoxy-5-(dimethylarsenoso)furanoside and 2,3-dihydropropyl-5-deoxy-5-(dimethylarsenoso)furanoside. Each compound seems to have a beta-ribo structure for the sugar system. Evidently, Ecklonia is processing its arsenate uptake by conversion to the sugar derivatives described. (Small-FRC)
W82-03183

REACTOR-RELEASED RADIONUCLIDES IN SUSQUEHANNA RIVER SEDIMENTS,

Oak Ridge National Lab., TN.
C. R. Olsen, I. L. Larsen, N. H. Cutshall, J. F. Donoghue, and O. P. Bricker.
Nature (London), Vol 294, No 5838, p 242-245, November 19, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Radiation, *Rivers, Sediments, Sedimentation, Water pollution sources, Powerplants, *Nuclear powerplants, *Susquehanna River, Chesapeake Bay.

Radionuclide activities were measured in surface sediment samples collected from the Susquehanna River and Upper Chesapeake Bay in May and September 1979. The sediment area sampled by each grab was 15 to 20 cm, and the depth of sample was above 10 cm. No evidence was found in the river sediments for gamma-emitting radionuclides which would characterize a rupture of the fuel elements. Although measurable activities of cesium-137 were noted throughout the entire lengths of cores H-3, C-4, E and 14, the activity of reactor produced cesium-134 was generally confirmed within the top 10-15 cm. The deepest appearance of cesium-137 in the sediment core indicates the beginning of significant fallout in 1954, and the deepest appearance of cesium-134 indicates the beginning of significant releases from the reactors. Peaks in the radionuclide profiles may be correlated with the history of fallout or reactor releases to provide additional time stratigraphical reference levels. The reported distributions also document the fate of reactor-released radionuclides and their extent of environmental contamination in the Susquehanna-Upper Chesapeake Bay System. (Baker-FRC)
W82-03189

PHYSIOCHEMICAL SPECIATION OF LEAD IN DRINKING WATER,

Lancaster Univ. Bailrigg (England). Dept. of Envirnomental Sciences.
For primary bibliographic entry see Field 5F.
W82-03198

241AM FROM THE DECAY OF 241PU IN THE IRISH SEA,

Manchester Univ. (England). Dept. of Chemistry.
J. P. Day, and J. E. Cross.
Nature (London), Vol 292, No 5818, p 43-45, July, 1981. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Radioactive wastes, *Fuel reprocessing, Effluents, Americium-241, Plutonium, Sediments, Coastal waters *Irish Sea, Plumes, *Nuclear powerplants, Powerplants, Path of pollutants.

Americium-241 is a long-lived alpha-emitting nuclide which has become one of the more important marine contaminants arising from the discharge of effluents to the Irish Sea from the nuclear fuel reprocessing plant at Windscale, Cumbria. Both americium and plutonium seem to be largely retained in sediments relatively close to Windscale, and a reservoir of 241Am is building up both from direct deposition and from the radioactive decay of sedimented 241Pu. Attempts were made to estimate quantitatively the size and rate of growth of this reservoir. Using data from Windscale discharges, estimates were made of the probable sedimentary deposition of 241Am and 241Pu over the past 20 years, and calculations were then carried out of the consequent additional ingrowth of 241Am. The latter is now about 600 Ci/year, rising towards a steady state of about 1,200 Ci/year if present rates of discharge of 241Pu are maintained. The present sedimentary reservoir of 241Am is about 18,000 Ci, of which about 4,800 have resulted from 241Pu decay in situ. Measurement of the 241Pu/Pu-alpha isotope ratio in coastal sediments confirms the estimates of 241Pu deposition. Outside the Irish Sea, in the dispersal plume into Scottish waters, the observed 241Am concentration can be accounted for largely by ingrowth from the 241Pu transported in the water mass. (Baker-FRC)
W82-03199

EFFECTS OF EUTROPHICATION ON THE INTERTIDAL ECOLOGY OF LANGSTONE HARBOUR, U.K. AND PROPOSED CONTROL MEASURES,

Southern Water Authority, Worthing (England).
For primary bibliographic entry see Field 5C.
W82-03207

A FINITE ELEMENT MODEL FOR THE MIGRATION OF LEACHATE FROM A SANITARY LANDFILL IN LONG ISLAND, NEW YORK - PART II: APPLICATION,

Argonne National Lab., IL.
A. B. Gureghian, D. S. Ward, and R. W. Cleary.
Water Resources Bulletin, Vol 17, No 1, p 62-66, February, 1981. 2 Tab, 5 Fig, 20 Ref.

Descriptors: *Leaching, *Sanitary landfills, *Finite element analysis, *Groundwater, *Water pollution sources, Soil solution, Mathematical studies, Mathematical models, Mass transfer, Calibrations, Flow wells, Prediction, On-site investigations, Areal hydrogeology, *Long Island, New York.

A two-dimensional mathematical model for the migration of ground water contamination was developed. The model uses isoparametric elements, based on the Galerkin formulation and on weighting functions of nonsymmetric form, in formulating the convective-dispersive mass transport equation. The model requires the establishment of initial and boundary contaminant concentrations. In a simulation of leachate migration from a sanitary landfill in Long Island, New York, the chloride ion was chosen as the dispersion tracer, since it is relatively free of chemical reactions which could influence the simulation. Sampling data and extrapolations of chloride concentrations measured from nearby wells were used in the simulation. The model parameters derived in the calibration of the model provided good agreement with the observed field concentrations in the verification period. Further research is necessary to rigorously define the optimal weighting in transient simulations. (Titus-FRC)
W82-03220

THE PHOSPHORUS CYCLE IN GERMINSTON LAKE. 1. INVESTIGATIONAL OBJECTIVES AND ASPECTS OF THE LIMNOLOGY OF THE LAKE,

Rand Afrikaans Univ., Johannesburg (South Africa). Research Group for Freshwater Biology.
For primary bibliographic entry see Field 2H.
W82-03234

HYDROCARBON GEOCHEMISTRY OF THE PUGET SOUND REGION-I. SEDIMENTARY ACYCLIC HYDROCARBONS,

Washington Univ., Seattle. Dept. of Oceanography.
R. C. Barrick, J. E. Hedges, and M. L. Peterson.
Geochimica et Cosmochimica Acta, Vol 4 , No 9, p 1349-1362, 1980. 9 Fig, 3 Tab, 41 Ref.

Descriptors: *Sediments, *Hydrocarbons, Aliphatic hydrocarbons, *Puget Sound, *Washington, Sediment-water interfaces, Interfaces, Plankton.

Sediment cores were collected at 23 sites within the inland marine waters of northwestern Washington State in efforts to determine the origins, pathways, and fates of hydrocarbon contamination in the relatively uncontaminated modern coastal environment. Aliphatic hydrocarbon compositions were determined for 79 samples during 1975 and 1976 at 23 mid-channel stations. The top and bottom 2 cm sections were analyzed to determine geographic hydrocarbon distributions and compositional trends. Five additional cores were subsampled at a greater number of depth intervals to provide detailed vertical profiles. A predominant assemblage of primarily odd-numbered high molecular weight n-alkanes derived from the leaf waves of vascular land plants was among the groups of acyclic hydrocarbons noted in the sediment samples. Also found was a suite of naturally-derived fossil hydrocarbons which includes regular C15, C16, C18 and C20 isoprenoid alkanes and n-alkanes over the range n-C14 to n-C35. Although the origin of this particular assemplage of hydrocarbons is not known, it is second in abundance only to the plant wax n-alkanes in Puget Sound sediments. An assemblage of plankton-derived hydrocarbons such as pristane, phytadienes, n-C15 and n-C17 was also found. The low concentrations of these suggest that plankton remains may be rapidly and preferentially destroyed near the sea-sediment interface. The final resolved assemblage consisted of seven different multibranched C20 and C25 compounds, which probably have a common, but as yet unknown, origin. As unresolved complex mixture of anthropogenic hydrocarbons was also noted to be prevalent in most sediments deposited since 1875. (Baker-FRC)
W82-03241

A SYSTEMS MODEL OF STREAMFLOW AND WATER QUALITY IN THE BEDFORD OUSE RIVER SYSTEM – II. WATER QUALITY MODELLING,

Institute of Hydrology, Wallingford (England).
P. Whitehead, B. Beck, and E. O'Connell.
Water Research, Vol 15, No 10, p 1157-1171, October, 1981. 12 Fig, 3 Tab, 42 Ref.

Descriptors: *Water quality, *Stochastic processes, Mathematical studies, Probabilistic process, Monte Carlo Method, Model studies, *Bedford Ouse River, Effluents, Telemetry, Remote sensing, Monitoring, Data processing, *United Kingdom, *Water management.

Water quality modeling is discussed as it relates to the Bedford Ouse Study. In order to assess the likely impact of effluent on the river system and the operational management problems that may thereby arise, dynamic stochastic models of water quality were developed. Realistic dynamic water quality models were seen to be feasible for non-tidal river systems. In particular the models described provided a potentially useful and computationally efficient characterization of the flow and water quality phenomena in a river, a characterization which explained the dynamic behavior of chloride, nitrate, dissolved oxygen, and biological oxygen demand and so provided a firm foundation on which to base the investigation of other water quality states. The particular utility of time series analysis techniques was also demonstrated for the identification and estimation of water resource models. The techniques have been applied to a wide range of models from the purely black-box rainfall-runoff models, multivariable 'grey box' models of water quality, to the more detailed differential equation models of water quality. The extended Kalman filter (EKF) and Instrumental Variable methods of recursive estimation provided a powerful general method of data processing well suited to the sort of modelling problems encountered by hydrologists, water quality and water resource engineers. The models presented are intended for use mainly by management. (Baker-FRC)
W82-03243

MICROBIAL ACTIVITY OF TRENCH LEACHATES FROM SHALLOW-LAND, LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITES,

Brookhaven National Laboratory, Upton, NY.
A. J. Francis, S. Dobbs, and B. J. Nine.
Applied and Environmental Microbiology, Vol 40, No 1, p 108-113, July, 1980. 2 Fig, 5 Tab, 12 Ref.

Descriptors: *Radioactive wastes, *Microorganisms, *Leachates, Microbial degradation, Degradation, Bacteria, Methane bacteria, Denitrification, Anaerobic conditions, Aerobic bacteria, Bacillus, Pseudomonas, Citrobacter, Clostridium.

The abundance, distribution, and growth of microorganisms in waste leachates containing a variety of radionuclides and organics are described so as to begin to evaluate the role of microorganisms in the transformation of radioactive wastes. Water samples were collected from trenches at the disposal sites of Maxey Flats, Kentucky; West Valley, New York; Sheffield, Illinois; and Barnwell, South Carolina. Among the several aerobic and anaerobic bacteria isolated, only Bacillus sp., Pseudomonas sp., Citrobacter sp., and Clostridium sp. were identified. Mixed bacterial cultures isolated from the trench leachates were able to grow anaerobically in trench leachates, which indicates that the radionuclides and organic chemicals present were not toxic to these bacteria. Changes in concentrations of several of the organic constituents of the waste leachate samples were observed due to anaerobic microbial activity. Growth of a mixed culture of trench-water bacteria in media containing a mixture of radionuclides, Co-60, Sr-85, and Cs-134/137, was not affected at total activity concentrations of 260 and 2700 pCi/ml. The finding of active microflora in the trench leachates strongly suggests that they may play a significant role in the transformation of radionuclides and the organic constituents of the waste and thus affect the long-term storage, mobility, and migration of radionuclides from the waste disposal sites into the biosphere. (Baker-FRC)
W82-03261

GROUNDWATER CONTAMINATION BY CHLORINATED HYDROCARBONS: CAUSES AND PREVENTION,

Environmental Protection Agency, Philadelphia, PA.

For primary bibliographic entry see Field 5E.
W82-03300

COMMUNITY METABOLISM OF ADENYLATES BY MICROHETEROTROPHS FROM THE LOS ANGELES HARBOR AND SOUTHERN CALIFORNIA COASTAL WATERS,

University of Southern California, Los Angeles. Dept. of Biological Sciences.
S. M. McGrath, and C. W. Sullivan.
Marine Biology (Berlin), Vol 62, No 2/3, p 217-226, May, 1981. 5 Fig, 3 Tab, 41 Ref.

Descriptors: *Seawater, *Plankton, Harbors, Coastal waters, Adenosine, Triphosphate, *Carbon cycle, Eutrophication, Nutrients, *Los Angeles, California.

Adenylates are considered good model compounds for studying carbon cycling in aquatic ecosystems because of their high uptake by microheterotrophs, stability in seawater, and ease of measurement. Identification was made of fluxes and compartments involved in the cycling of total adenylates by a planktonic seawater community. Cell number, biomass and uptake rates for natural microbial populations were measured at in situ substrate concentrations to estimate heterotrophic activity. Seawater was sampled from a depth of 1 meter at intervals, monthly to quarterly, from four stations within the Los Angeles Harbor and from one station about 1.5 km outside the harbor breakwater in San Pedro Channel. The natural concentration of dissolved total adenylates (TA) in coastal seawater had a mean value of 2.8 nmol TA/liter. Within the harbor the specific uptake rate at normal TA concentrations varied 10-fold, from 0.028 in December to 0.28 in August. Half-saturation constant values always exceeded the natural TA concentrations in any given month, and were greater in the harbor than in the channel. Assuming a steady-state condition for the dissolved adenylate pool, a model is proposed in which losses from this pool are balanced by inputs to the pool through inefficient feeding, lysis and decomposition of particulate adenylates. Adenylate input from sewage and activated sludge processing. High adenylate pool input is seen during the summer algal bloom periods. (Baker-FRC)
W82-03301

STUDY OF THE EXPERIMENTAL CONTAMINATION OF THE MARINE PHANEROGAM POSIDONIA OCEANICA (L.) DELILE BY MERCURY COMPOUNDS I. MODALITIES OF THE CONTAMINATION BY MERCURY CHLORIDE. (ETUDE DE LA CONTAMINATION EXPERIMENTALE DE LA PHANEROGAME MARINE POSIDONIA OCEANICA (L.) DELILE PAR LES COMPOSES MERCURIQUES: PARTIE I-MODALITES DE LA CONTAMINATION PAR LE CHLORURE MERCURIQUE,

Aix-Marseille-2 Univ. (France). Lab. de Biologie Marine.
G. Cristiani, R. Gassend, and H. Augier.
Environmental Pollution (Series A), Vol 23, No 2, p 153-162, October, 1980. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Path of pollutants, *Mercury, *Marine flora, Accumulation, Industrial wastes, Biomagnification, Laboratory studies, Posidonia, Ecosystems, Chemical spills.

Mercuric chloride contamination in the case of a simulated accidental pollution was studied in controlled laboratory in vitro cultures of the fragile marine phanerogam, Posidonia oceanica (L.) Delile, collected near Carry-le-Rouet, France. Atomic absorption spectroscopy showed that rhizomes and especially leaves had a very high capacity for mercury concentration, but with different patterns. The mercury concentration in Posidonia changed with time and depended on the amount of Hg in the culture medium. After a variable time in the water with the initial Hg concentration, the Posidonia released part of the mercury they initially took up into the culture medium. Some physiological and histological disorders were also recorded in the most polluted aquaria. The very high concentration rate of Hg by Posidonia leaves makes these plants very dangerous sources of mercury pollution for numerous marine organisms, especially first-level consumers in the trophic chain. The results cannot be applied to natural media, where concurrent or synergistic operation of physical, chemical and biological factors modify Posidonia behavior. The results indicate the need to study the behavior of Posidonia under chronic pollution, which often occurs in nature, and to test other mercury compounds and the cytological, histological and biochemical changes caused by different types of mercury pollution. (Hertzoff-FRC)
W82-03312

SIMULATION OF FLOW PATTERNS AND ION-EXCHANGE IN SOIL PERCOLATION EXPERIMENTS. PART II. ION-EXCHANGE PROCESSES,

Central Inst. for Industrial Research, Oslo (Norway).
N. Christophersen, and H. M. Seip.
Water, Air, and Soil Pollution, Vol 14, p 159-170, 1980. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Adsorption, *Ion exchange, *Percolation, Model studies, *Path of pollutants, Organic matter, Chelation, Humic acids, Heavy metals, Chemical reactions, Metals, Copper, Lead, Zinc, Cadmium, Magnesium, Calcium, Hydrogen ion concentration, Mathematical models, Soil water movement, Laboratory studies.

The ion exchange processes in raw humus were studied in the laboratory and by simulation analysis. Solutions of sulfuric acid, nitric acid, hydrochloric acid, and sodium chloride, all at 0.01 N, were percolated through 4 cm thick humus samples at a rate of 1 mm per min. The cation-exchange reactions were the most significant processes for the chemical composition of the runoff. Only 1 out of 4 models tried gave results consistent with the laboratory observations. This model has 5 independent parameters and consists of first and second order chemical processes. This is a tentative model, and variations in initial parameter values greater than an order of 2 or 3 produce poor performance. Further experimental work is necessary to confirm the reaction rates, which are slower than those obtained from previous work. Since the curves' minima life within the pH range encountered in natural systems, a small change in pH could affect the solubility and availability of metal ions. The humic acid component can be dominant in systems high in organic matter. (Cassar-FRC)
W82-03335

MAJOR EVAPORITE DEPOSITION FROM GROUNDWATER REMOBILIZED SALTS,

Institute of Geological Sciences, London (England). Geochemistry and Petrology Div.
J. E. Rouse, and N. Sherif.
Nature (London), Vol 285, No 5765, p 470-472, June, 1980. 2 Fig, 10 Ref.

Descriptors: *Groundwater movement, *Salts, *Deposition, Saltation, Brines, Sedimentation, Surface-groundwater relations, Coastal waters, Sulfur, Sediments, Aquifers, *Libya, *Gulf of Sirte, Evaporation, Geohydrology.

The physiography and the sedimentary pattern of the western coastal plain of the Gulf of Sirte was formed by two major transgressive events. Coastal sabkhas developed behind a barrier-ridge complex following sea level rises during the late Pleistocene age, when a barrier island and lagoon were formed, and during the Flandrian transgression, when the sea reached its present level and a second, outer lagoon was established. Isolation of the coastal lagoons by a seaward sand ridge followed the stabilization of the sea level, resulting in the formation of isolated basins in which evaporites have been and are being deposited. A sulfur isotopic study was conducted to determine the sources of the brines being deposited in the sabkhas. This study demonstrated that the extensive supply of sulfur to the sabkhas originates primarily from remobilized sulfate brought to the surface and distributed into the groundwater by several

springs of sulfate or sulfate-chloride facies water. The rate of sedimentation in the lagoons is dependent on the rate and salinity of water flowing from the aquifer and on the aridity of the climate to ensure a sufficiently high evaporation rate. An extensive north-south fault and its satellite fissures provide karstic channels through which deep artesian waters from the sediments of the Upper Cretaceous reach the Miocene strata, following which the water is brought to the surface, as springs and sub-surface flow, into the groundwaters of the sabkha. Current gypsum deposition rates demonstrate the remarkably large amounts of sulfate that can be remobilized in a geologically short period of time and show that significant evaporite deposits associated with marine sediments can be formed from water derived from continental sources. (Carroll-FRC)
W82-03339

ACIDIFICATION IN 50 NORWEGIAN LAKES,

Oslo Univ. (Norway).
For primary bibliographic entry see Field 2H.
W82-03344

PRELIMINARY POLLUTION SURVEYS AROUND THE SOUTH-WESTERN CAPE COAST. PART 4: SALT RIVER MOUTH, TABLE BAY,

National Research Inst. for Oceanology, Stellenbosch (South Africa).
M. J. Orren, G. A. Eagle, A. H. Fricke, P. J. Greenwood, and H. F-K. O. Henning.
South African Journal of Science, Vol 77, No 4, p 183-188, April, 1981. 4 Fig, 7 Tab, 19 Ref.

Descriptors: *Nutrient, *Wastewater pollution, *Bacteria, Path of pollutants, *Salt River, Table Bay, *South Africa, Dissolved oxygen, Aquatic animals, Invertebrates.

Pollution surveys were conducted in the area of the Salt River, which flows into Table Bay, South Africa. In the 1975 survey, concentrations of nutrients and organics in surface water were very high in the river discharge: 15.1 micromol per cu dm total P, 57.4 micromol per cu dm silicate, 23.0 micromol per cu dm nitrite, 48.0 micromol per cu dm nitrate, and 0.026 mg per cu dm oxygen absorbed from alkaline permanganate. Comparable values for 1980 were much lower: 3.1 micromol per cu dm total P, 7.1 micromol per cu dm silicate, 4.7 micromol per cu dm nitrate, and 0.007 mg per g oxygen absorbed from alkaline permanganate. Both surface water and interstitial water samples were analyzed at 8 points between 100 and 4000 meters from the river mouth. Interstitial waters, more variable than surface waters, were higher in levels of nutrients and organic matter and were near zero, in dissolved oxygen at many sites impacted by the river discharges. Metal levels in sediments collected at these beaches were lower than at unpolluted, control beaches. The meiofaunal population was abnormal up to 4 km from the mouth; the absence of harpacticoid copepods in the first 2 km was indicative of organic pollution. There were more nematodes and harpacticoids in the next 2 km. Total bacterial counts were high, exceeding 10,000 per cu cm in the river mouth and 100 meters north of the mouth. Although the saline environment killed many coliforms, the E. coli count was 200 per 100 cu cm at 200 meters from the mouth, showing substantial sewage pollution. (Cassar-FRC)
W82-03367

ACID PRECIPITATION IN THE PITTSBURGH, PENNSYLVANIA AREA,

Pittsburgh Univ., PA. School of Public Health.
For primary bibliographic entry see Field 2B.
W82-03368

SEPTIC SEWAGE SYSTEMS CONTAMINATE GROUND WATER,

Ground Water Age, p 36-37, 40, June, 1981. 1 Fig.

Descriptors: *Septic tanks, *Groundwater pollution, Wastewater treatment, Septic wastewater, Wastewater, Water pollution sources, Wastewater renovation, Wastewater management, Wastewater facilities.

Problems and possible solutions to the use of the septic tank as an onsite wastewater disposal system are reviewed. Percolation systems such as septic systems have two basic components; the settling tank and the soil absorption field. Wastewater flows from the house to the settling tank and then to the soil absorption field. Percolation systems rely on three natural processes: filtration, biological degradation, and adsorption. When systems malfunction, wastewater can back up into the home, rise to the surface in the form of surface breakout, or short circuit and move directly into groundwater without adequate purification. Bacteria, viruses, degradable organic compounds, synthetic detergents, and chlorides may contaminate groundwater when conditions lead to failure. Nitrates can accumulate over time and result in relatively high concentrations in the groundwater as well. Systems can fail for a number of reasons. The initial setting, design, or construction could have been faulty or necessary maintenance may be neglected. The best solution to groundwater contamination lies in prevention. However, when systems have failed near urban areas, the usual solution is to abandon the onlot system and extend sewers to an existing, expanded or new treatment plant. Prevention of the problem requires comprehensive wastewater management planning and proper siting, design, construction, and maintenance of all small alternative systems. Regulations have been established concerning inspection and system design evaluation. However, maintenance is not usually a requirement. Some states are taking steps to improve the monitoring and maintenance situations. (Baker-FRC)
W82-03378

GROUND WATER MONITORING: PART II,

T. E. Gass.
Water Well Journal, Vol 34, No 9, p 36-37, September, 1980.

Descriptors: *Groundwater, *Monitoring, *Observation wells, Wells, Subsurface water, Groundwater pollution, Contamination, Pollutants, Borehole geophysics, Geophysics, Boreholes, Resistivity, Path of pollutants.

The use of monitoring wells to study the spread of contamination is described. Such wells may be either pumped or unpumped wells. Active monitoring involves the pumping of wells that intercept potentially contaminated ground water flow. This type of monitoring is best suited for point source contamination. Passive monitoring involves the periodic sampling of wells located in the path of ground water to determination changes in the concentrations of chemical constituents of ground water. The positioning of monitoring wells depends primarily on local hydrogeology and ground water use. All construction materials should be resistant to suspected contaminants. Sampling must be done in such a way as to minimize or eliminate sample contact with the atmosphere. Geophysical techniques used to establish monitoring wells include the borehole methods, electrical resistivity surveying, and seismic surveys. Remote sensing is also useful. (Baker-FRC)
W82-03380

TRACE METAL SPECIATION IN THE FRESHWATER AND ESTUARINE REGIONS OF THE YARRA RIVER, VICTORIA,

Caulfield Inst. of Tech. (Australia). Water Studies Center.
B. T.. Hart, and S. H. R. Davies.
Estuarine, Coastal and Shelf Science, Vol 12, No 4, p 353-374, April, 1981. 6 Fig, 4 Tab, 51 Ref.

Descriptors: *Trace metals, *Heavy metals, *Speciation, Metals, *Estuaries, *Yarra River, *Australia, Rivers, Chelation, Coagulation, Cadmium, Copper, Lead, Zinc, Iron, Fate of pollutants.

Speciation of trace metals was investigated at the freshwater and estuarine sites in the Yarra River, Australia. The metals Cd, Cu, Pb, Zn, and Fe were separated into the following fractions: particulate, filterable, ion-exchangeable, dialysable, and bound. Fe was in bound and particulate form throughout the river system. Cd was predominantly in the ion exchangeable form in both river sections. Filterable Cu existed in ion exchangeable forms--organic complexes in the freshwater and either organic complexes or $CuCO_3$ in the salt water. Pb was largely in the form of $PbCO_3$, and Zn as Zn(2+). Pb and Zn did not form appreciable complexes with organic matter. Between the freshwater and estuarine sections Fe and bound Cd were lost by coagulation. There was little change between the two sections in filterable Cu and ion exchangeable Pb and Zn. However, particulate Pb and Zn increased in the estuarine section. A strong linear relationship was seen for Fe, Pb, Zn and to a lesser extent, Cd, between the total metal and the total bound metal. (Cassar-FRC)
W82-03387

PRACTICAL TECHNIQUES OF RIVER MONITORING AND POLLUTION FORECASTING, PART 1: CONTINUOUS QUALITY MONITORING AND DATA ACQUISITION,

Anglian Water Authority (England).
For primary bibliographic entry see Field 5A.
W82-03390

MATHEMATICAL MODELING AND COMPUTER SIMULATION OF RADIOACTIVE AND TOXIC CHEMICAL SPECIES DISPERSION IN POROUS MEDIA IN THE VICINITY OF URANIUM RECOVERY OPERATIONS,

Tennessee Univ., Knoxville. Dept. of Engineering Science and Mechanics.
E. V. Kalmaz, and J. L. Barbieri.
Ecological Modelling, Vol 13, No 3, p 159-181, August, 1981. 5 Fig, 2 Tab, 54 Ref.

Descriptors: *Uranium, *Radioactive wastes, *Mining engineering, Model studies, *Mathematical models, *Path of pollutants, Fate of pollutants, Porous media, Ponds, Chelation, Adsorption, Solute transport, Groundwater pollution, Chemical precipitation, Arsenic, Radium, Thorium, Polonium.

Uranium recovery operations have great potential for releasing radioactive and toxic chemicals to surface and ground waters. About 80% of water used in mill production is lost by seepage. Holding and tailings ponds, chemical storage sites, and transportation may also be sources of contamination to water. Contaminants associated with uranium recovery are radium 226, thorium 230, lead 210, polonium 210, uranium, arsenic, iron, manganese, and sulfate. The mobility of these materials depends on the characteristics of the chemical species and/or the ions and material through which the solution migrates. Oxidized uranium compounds, likely to occur in acid solutions, are extremely mobile. Thorium activity decreases at greater distances from tailings ponds as a result of sorption and coprecipitation with metal oxyhydroxides. Polonium, very stable in the Po(4+) state in solution, is also removed from the system by adsorption or coprecipitation with metal hydroxides. Radium, which forms few complexes, occurs mostly in solution as Ra(2+) ion and precipitates with sulfate. Lead forms several stable complexes and precipitates as the sulfate and carbonate. Arsenic acid (H3As04) is the most common as species in tailings ponds. Iron and manganese oxyhydroxides are active in removing other trace metals from solution. A mathematical model is used to simulate the hydrodynamic dispersion, migration, and prediction of movement for pollutants in supersaturated porous earth. The impacts on water quality associated with in-situ uranium mining, as compared with open pit and underground mining, are more serious. In addition, migration of toxic materials of this type is favored by acidic soils, anaerobic conditions, waterlogged soils, disturbed soils, and coarse soils. (Cassar-FRC)
W82-03392

KINETICS OF PHENOL OXIDATION BY WASHED CELLS,

University Coll. of Swansea (Wales). Dept. of Chemical Engineering.

For primary bibliographic entry see Field 5D.
W82-03399

5C. Effects Of Pollution

WATER QUALITY AND MANGROVE ECOSYSTEM DYNAMICS,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
S. C. Snedaker, and M. S. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-204109, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-022, August, 1981. 5 p, 1 Fig.

Descriptors: *Water quality, *Mangrove swamps, *Water pollution effects, *Model studies, Heavy metals, Copper, Ecosystems, Dynamics, Sulfates, Nitrates, Tidal effects, Flushing, Flooding, Pesticides, Runoff, Powerplants, Agricultural runoff.

Many of the ecological and physiological mechanisms that permit the mangrove ecosystem to thrive in intertidal coastal environments that are influenced by freshwater inflow from upland areas are poorly understood. From surveys of mangrove stands, it was found that mangrove ecosystem dynamics could not be related to current theory. The poorest mangrove forest development occurs in arid climates with relatively little ground water or freshewater inflow, and in sedimentary carbonate environments. Highly developed forests occur where tidal amplitude and freshwater inflow assure frequent and extensive inundation and flushing. Synthetic organic pesticides were never found in water, sediment, or plant tissues, but low to moderate concentrations of heavy metals were ubiquitous. Heavy metals were concentrated in sediments and plant tissues. Highest concentrations of metals were associated with fossil-fuel burning power plants, agriculture, and highway runoff. Nitrate and sulfate are key components of water and sediments required for development of mangrove. Nitrate may be most important as an oxidant in anaerobic decomposition of reduced organic matter accompanied by release of nutrients to the rhizosphere and the formation of ammonia. Sulfate appears to act as an oxidant that penetrates deeply into anaerobic sediments during flushing. It can also combine with metals, making them unavailable for uptake by mangroves. A model for the pathway, storage, uptake, and turnover rates of copper is given as an example of the dynamics of a pollutant as it relates to the dynamics of a mangrove ecosystem. (Moore-SRC)
W82-03003

AN AERIAL TECHNIQUE FOR ASSESSING THE IMPACT OF COOLING WATER DISCHARGES ON RECEIVING WATER,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
For primary bibliographic entry see Field 7B.
W82-03016

HISTOPATHOLOGICAL CHANGES IN TWO ESTUARINE FISHES EXPOSED TO CRUDE OIL AND ITS WATER-SOLUBLE FRACTIONS,

M. A. Solangi.
PhD Dissertation, August, 1980. 93 p, 78 Fig, 4 Tab, 63 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-09900.

Descriptors: *Water pollution effects, *Pathology, *Sublethal effects, *Oil pollution, Behavior, Mortality, *Fish, Estuaries, Crude oil, Histopathology, Chronic exposure, Hydrocarbon analysis, Menidia beryllina, Trinectes maculatus, Brackish-water fish.

Pathological changes in the liver, olfactory organ, gills, and anterior kidneys of two estuarine fishes, Menidia beryllina (Cope), and Trinectes maculatus (Bloch and Schneider), exposed to different concentrations of both whole crude oil (WCO) and its water-soluble fractions (WSF) are described. Also examined was the status of the sublethal pathological changes of exposed fish after they were returned to an oil-free environment. Results indicate that south Louisiana crude oil and at least some of its components cause sublethal to lethal pathological changes in the gills, olfactory organ and liver. Tissue alterations in these vital organs apparently induced hypoxia, reduced chemoreception, altered schooling behavior, and decreased resistance in stress. Sublethal pathological changes in the gills, olfactory organ, and pancreas such as hyperplasia and hypertrophy of gill epithelium, degenerated neurosensory and sustentacular cells, and degenerated pancreatic tissue appear to be temporary, and once fish return to an oil-free environment they have the ability to recover. Therefore, adult fish exposed to a single oil spill in the northern Gulf of Mexico, in contrast to those chronically exposed or maybe from other geographical areas, have the potential to recover from some degenerative changes. (Sinha-OEIS)
W82-03020

COOLING WATER DISCHARGE INTO FLOODPLAIN MEADOWS AND MARSHES: EFFECTS, MECHANISMS, AND IMPLICATIONS FOR ENVIRONMENTAL ANALYSIS,

Wisconsin Univ.-Madison.
B. L. Bedford.
PhD Thesis, 1980. 191 p, 33 Fig, 4 Tab, 212 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-10062.

Descriptors: *Environmental effects, *Wetlands, *Flood plains, *Cooling water, Water temperature, Aquatic plants, Aquatic populations, Seasonal variation, *Thermal pollution, Powerplants.

The environmental impact statement for the Columbia Electric Generating Station raised but did not answer the question of significant change occurring in wetland plant communities on the site as a result of water leaking from the station's cooling lake. The results of research conducted on the Columbia site from 1974 to 1980 are presented. The Columbia station and associated facilities are located adjacent to and in the floodplain of the Wisconsin River. Most of the site was wetland in its preconstruction state. The major impact on wetland vegetation of discharge from the Columbia cooling lake appears to be the displacement of previously dominant populations. The extent of displacement is complete over approximately one-third of the study area, where environmental changes due to discharge have been greatest. Intermediate level changes in dominant populations have occurred over a larger area covering another third of the study site. Knowledge of the sensitivity of a community's dominant species to a disturbance is likely to provide a better predictor of response to disturbance than either community type or diversity value prior to disturbance. Unlike large open bodies of water where biological effects may be hard to detect or separate from natural variability, the effects of cooling water discharge on communities of emergent aquatic vegetation are obvious and can be monitored and measured as phenological and physiological change at the population level. Results show that species differ in their sensitivity to seasonal changes in temperature, that the mechanisms regulating population response differ among emerging aquatic species, and that relatively minor temperature changes and other environmental factors associated with increased discharge of water, and not necessarily with waste heat, can produce more subtle effects. (Sinha-EIS)
W82-03022

WATER TEMPERATURE DYNAMICS IN EXPERIMENTAL FIELD CHANNELS: ANALYSIS AND MODELING,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 1A.
W82-03025

MICROCOSMS AS TEST SYSTEMS FOR THE ECOLOGICAL EFFECTS OF TOXIC SUBSTANCES: AN APPRAISAL WITH CADMIUM,

Georgia Univ., Athens. Inst. of Ecology.
P. F. Hendrix, C. L. Langner, E. P. Odum, and C. L. Thomas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-209595, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-036, July, 1981. 4 p. R805860010.

Descriptors: *Toxicity, *Cadmium, *Aquatic environment, *Microcosms, *Ecosystems, Nutrients, Biomass, Environmental effects, Ecological effects.

A two-phase set of experiments was conducted to address some of the problems inherent in ecological screening of toxic substances in aquatic mirocosms, and to test two hypotheses concerning the response of ecosystems to perturbations. Phase I was a 4 x 4 factorial experiment (four levels of cadmium versus four levels of nutrient enrichment) with static microcosms designed to test the subsidy-stress hypothesis. Phase II was a 2 x 4 factorial experiment (continuous and pulsed cadmium inputs versus phosphorus biomass increment hypothesis. Phase I results supported the subsidy-stress hypothesis with respect to cadmium inputs: increasing cadmium concentrations (0, 1, 10, 100 ppb) caused a decrease in the P/R ratio, a decrease in grazing herbivores, increase in nighttime respiration and fungi, all indicators of system stress. Since net daytime production and nighttime respiration increased with nutrient enrichment, there was no nutrient stress effect even at the highest level. There was a significant interaction effect of cadmium and nutrients with high nutrient levels reducing, somewhat, the stress effect of cadmium. Phase II results generally supported the biomass increment hypothesis and suggested a retention pattern for continuous, low concentration cadmium inputs similar to that of essential elements. Cadmium may have accumulated to a toxic threshold in some of the microcosms. Pulsed, high concentration cadmium inputs had significant effects on system behavior, depending on timing of inputs. For screening a suspected toxic substance, a hierarchy of microcosm experiments including static microcosms (with and without sediments), flowthrough microcosms (with and without sediments), and microcosm subsamples from specific natural ecosystems is recommended. (Moore-SRC)
W82-03026

EPIDEMIOLOGICAL STUDIES OF OTITIS EXTERNA: REPOT OF A PROSPECTIVE AND OF A RETROSPECTIVE STUDY OF OTITIS EXTERNA AMONG SWIMMERS,

Yale Univ., New Haven, CT. Dept. of Epidemiology and Public Health.
R. L. Calderon, and E. W. Mood.
Environmental Protection Agency Project Summary EPA-600/S1-81-053, August, 1981. 3 p.

Descriptors: *Swimming, *Water quality, *Epidemiology, *Public health, Coliforms, Pseudomonas, Staphylococcus, Bacteria, *Swimming pools.

Two epidemiological studies of otitis externa were conducted as part of a series of studies to determine if there is a direct relationship between the incidence of otitis externa and the quality of recreational water. One was a prospective study conducted in the summer of 1979 comparing boy scouts at camp who swam in a fresh water lake with boy scouts at another camp who swam in a chlorinated swimming pool. The other was a retrospective study conducted during the summer of 1980. In the prospective study, 3% of the children reported ear complaints in the week following camp, but none had otitis externa confirmed by a physician; the retrospective study compared 29 cases with 29 controls matched by sex and age. In the prospective study, a higher relative humidity at the camp where the boy scouts swam in a chlorinated pool was associated with a greater degree of abnormal flora colonization of the ear (Gram-negative bacteria and Staphylococcus aureus). In the retrospective study, positive association was demonstrated with cases of otitis externa for ambient air temperatures, water temperature, less than 18 years of age, being female, swimming, and length of time spent swimming. There was no association between cases of otitis externa and water quality as measured by fecal coliforms, enterococci, and Pseudomonas aeruginosa or between abnormal

flora colonization of the ear with bacterial indices of water quality. (Moore-SRC)
W82-03027

RESPONSE OF PHYTOPLANKTON TO ACIDIFICATION IN EXPERIMENTAL STREAMS,

Minnesota Univ., Minneapolis.
T. W. Weber, II.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-216822, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-042, August, 1981. 2 p.

Descriptors: *Phytoplankton, *Acidity, *Stream pollution, *Algae, *Diatoms, Species diversity, Biomass, Acid streams, Hydrogen ion concentration, Experimental data, Ecological effects.

The response of stream phytoplankton communities to acidification was studied in three experimental streams at the Monticello Ecological Research Station in Minnesota at two-week intervals from May 30 to July 11, 1979, Mississippi River water was pumped into three streams; one with an ambient pH of 8.1 and two streams maintained at pH 6.3 and 5.3 by the addition of sulfuric acid. The streams provided a unique replicate system whereby physical and chemical parameters could be controlled and continually monitored in a field situation. The density of phytoplankton in the pH 8.1 and 6.3 streams was highest during the first month of sampling, whereas, in the pH 5.3 stream it was highest in the second month. Phytoplankton density was low in all streams at the end of the sampling periods. The diversity of phytoplankton was similar throughout all three pH regimes. However, phytoplankton community similarity decreased over the course of the experimental period. Species composition was nearly identical across the pH range, dominated by diatoms in each stream. The most extreme pH value, pH 5.3, seemed to be a sublethal value for the diatoms existing there. (Moore-SRC)
W82-03036

LAKE TROPHIC STATE AND ALGAL GROWTH AS INFLUENCED BY CATION CONCENTRATIONS,

Science and Education Administration, Fort Collins, CO.
A. R. Batchelder.
Agricultural Research Service Technical Bulletin No 1649, November, 1981. 8 p, 2 Fig, 7 Tab, 19 Ref.

Descriptors: *Eutrophication, *Algal growth, Calcium, Magnesium, Sodium, *Cations, Standing crops, Eutrophic Lakes, Anabaena, Selenastrum, Chlorella, Trophic level, Saline water, Hardness.

Laboratory experiments were conducted to evaluate the effects of variations in the Ca, Mg, and Na concentrations in eutrophic waters on the standing crop and growth rates of three algal species; Chlorella ellipsoidea, Selenastrum capricornutum, and Anabaena subcylindrica. Each species was grown in a standard nutrient medium enriched with Ca, Mg, and Na in varying combinations and at concentrations of 2 and 8 milliequivalents per liter (meq/L) each. The dry weights of A. subcylindrica and S. capricornutum were reduced by the 8 meg/L Mg treatment but the toxic effects were overcome by adding Ca to the A. subcylindrica and Ca and Na to the S. capricornutum. None of the cation concentration variations affected the standing crop of C. ellipsoidea. The addition of Na alone to the culturesproduced little or no effect, but in combination with added Ca and Mg, it enhanced the growth rates of A. subcylindrica and S. capricornutum. Neither pH, monovalent to divalent cation ratio, or ionic strength of the media affected the algal growth. Based on data for 85 U.S. lakes that were complied from literature, concentration of 0.5 meg/L of Ca, Mg, or Na appears to be a threshold above which the lakes were usually eutrophic. Results demonstrated that Ca, Mg, and Na concentrations need to be considered as factors in saline and hard water eutrophication. (Moore-SRC)
W82-03038

SOME ECOLOGICAL ASPECTS OF LAKE QARUN, FAYOUM, EGYPT, PART II. PRODUCTION OF PLANKTON AND BENTHIC ORGANISMS,

Institute of Oceanography and Fisheries, Cairo (Egypt). Inland Waters and Fish Culture Div.
For primary bibliographic entry see Field 2H.
W82-03052

OBSERVATIONS ON A GYRODINIUM AUREOLUM (DINOPHYTA) BLOOM OFF THE SOUTH COAST OF IRELAND,

University Coll., Galway (Ireland). Dept. of Oceanography.
C. Pybus.
Journal of the Marine Biological Association of the United Kingdom, Vol 60, No 3, p 661-674, August, 1980. 7 Fig, 7 Tab, 40 Ref.

Descriptors: *Red tide, *Phytoplankton, *Ireland, Eutrophication, Nutrients, Water quality, Chemical analysis, Nitrogen, *Coastal waters, Phosphorus, Silicon.

Data collected during routine monitoring of the water quality in the vicinity of Kinsale Harbour in waters off the south coast of Ireland are presented. Sampling was performed on August 26 and 30, and September 7 and 19, with an abbreviated sampling on October 15, 1978. Surface phytoplankton samples were also collected on September 2, 5, and 12. During the sampling period the water column was generally well mixed, particularly at the seaward stations. Some stratification was apparent within Kinsale Harbour, and along the coast, reflecting the predominantly coastal flow of the River Bandon. Although several dinoflagellate and diatom species were found, only a few were common throughout the red tide. These were Gyrodinium spirale, and Oxytocum species, Prorocentrum micans, Scripsiella trochoidea, Cerataulina pelagica, Nitzschia spp., Skeletonema costatum and Thalassiosira gravida. The inorganic forms of nitrogen were all present at low concentrations at the beginning of the sampling period. By the second sampling in September these levels approached those of other coastal waters. An upward trend was noted for phosphate-phosphorus. No pattern was noted in the silicate-silicon levels. (Baker-FRC)
W82-03053

EFFECTS OF CLEARCUTTING AND SLASHBURNING ON STREAM TEMPERATURE IN SOUTHWESTERN BRITISH COLUMBIA,

British Columbia Univ., Vancouver. Faculty of Forestry.
M. C. Feller.
Water Resources Bulletin, Vol 17, No 5, p 863-867, October, 1981. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Stream degradation, *Water temperature, Forest management, *Logging, Watersheds, Forest watersheds, *Clear-cutting, Slashburning, Environmental effects, Stream temperature, Temperature, *British Columbia.

The effects of clearcutting and clearcutting plus slashburning on stream water temperatures were studied in paired forest watersheds in British Columbia. The predominant trees were western hemlock, western red cedar, and Douglas fir. The streams were designated A (61% clearcut), B (19% clearcut and slashburned), and C (undisturbed-control). The harvested watersheds were planted with Douglas fir seedings. Summer water temperatures and daily temperature fluctuations were increased by both treatments. However, after 6-7 years the temperature of the clearcut stream returned to its pretreatment state, whereas the clearcut plus slashburned stream showed no improvement. Although the control stream temperature never exceeded 17 C, the disturbed streams registered maximum temperatures of 21.8 and 20.3 C for A and B, respectively, and exceeded 19 C at other times. Winter temperatures recovered normal values after only 2 years. Clearcutting with slashburning had greater effects than did clearcutting alone. (Cassar-FRC)
W82-03087

DETERGENT BUILDERS AND WATER QUALITY - A CHANGING SCENE,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
R. Perry.
Effluent and Water Treatment Journal, Vol 21, No 10, p 446-449, October, 1981.

Descriptors: *Water quality, *Detergents, Eutrophication, Lakes, Water pollution sources, Phosphorus, Nitrilotriacetic acid, *Zeolites, *Water pollution effects.

The current state of affairs regarding the effect of detergents on water quality is reviewed. In various studies, phosphorus has been cited as the limiting nutrient in most surface waters in the northern hemisphere with eutrophication problems. Laundry detergent is made up mainly of two ingredients: a surfactant to remove soils, and a builder to alleviate the effect of the hardness ions present in the water. The most effective builder from the formulation and performance standpoint is sodium tripolyphosphate (STPP), which was in continuous use for more than 30 years. This has become a major component of domestic sewage phosphorus loading and has attracted attention and political regulation in some countries. Utilization of alternative materials could involve vast tonnages of the products concerned. The viable alternatives, namely zeolites and nitrilotriacetic acids, are reviewed in relation to both their performance in the washing cycle and their effect with respect to water quality. Current use of zeolite in detergents worldwide now amounts to about 250 thousand tons, with about 75% of this in North America. Formulations containing zeolites require certain minimum levels of STPP; typical combinations now in use are 18% zeolite and 20% STPP. Nitrilotriacetic acid (NTA) is biodegradable under ideal conditions. However, upon a moderate change of temperature, even down to 5 degrees C, non-degraded NTA is in the position to mobilize heavy metals, forming stable complexes of cadmium and lead. The behavior of this material in the water cycle must be scientifically evaluated, particularly since large quantities of material will be involved. (Baker-FRC)
W82-03093

1981 ANNUAL REPORT - COMMITTEE ON THE ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY.

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
For primary bibliographic entry see Field 5A.
W82-03104

SUSCEPTIBILITY OF AQUATIC ECOSYSTEMS TO THE EFFECTS OF ATMOSPHERIC POLLUTANT FALLOUT IN QUEBEC.

Scientific Series No 118, 1981. 46 p, Fig, Tab, Ref, 2 Append.

Descriptors: Aquatic ecosystems, Atmospheric pollutants, Alkalinity, Calcium, Susceptibility, Lake water, Chemistry, Analyses, Aquatic environment, *Air pollution effects, *Acid rain, *Lakes, *Ecological effects, *Quebec.

The Quebec Region of the Inland Waters Directorate has a special interest in the evaluation of the sensitivity of aquatic ecosystems to airborne pollutants. The impacts on the aquatic ecosystem have been summarized in a general way in terms of productivity and natural cycles as well as more specifically in terms of water quality, primary food chain (fungi, phytoplankton and macrophytes) and predators (zooplankton, macroinvertebrates, fish, amphibians). By critical review of the various methods used to determine the degree of acidification of surface waters, it is shown that in order to evaluate the sensitivity of Quebec waters one must take into account several integrating parameters such as the pH, calcium, the calcium saturation index, alkalinity, sulphates and minor ions. It is noted that prior to 1979 there is a lack of data for most of these parameters. Interpretative methods are chosen and applied to the available data prior to 1979 for a series of 194 lakes in the province of

Quebec. Also, it is shown that the sensitivity of Quebec lakes can only be determined by combining two different interpretative methods: (1) a method to differentiate between acidified and non-acidified lakes and (2) a method which allows one to evaluate the calcium saturation index of the lakes studied. (WATDOC)
W82-03106

LAKE DEOXYGENATION AFTER HERBICIDE USE: A SIMULATION MODEL ANALYSIS,

Notre Dame Univ., IN. Dept. of Biology.
S. R. Carpenter, and J. K. Greenlee.
Aquatic Botany, Vol 11, No 2, p 173-186, September, 1981. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Lakes, *Oxygen depletion, *Herbicides, Water pollution effects, *Model studies, Simulation analysis, Dissolved oxygen, Littoral zone, Macrophytes, Aquatic plants, Water temperature, Water circulation.

A model was developed to simulate the effects of herbicide treatment of macrophytes on the oxygen concentrations in the littoral zones of shallow unstratified lakes. Oxygen dynamics were governed by four processes: diffusion, advection, respiration, and photosynthesis. Several factors in deoxygenation were considered: average water temperature, turnover rate of littoral water, depth of the littoral zone, depth of the pelagic zone, biomass of macrophytes, macrophyte shoot nitrogen concentration, and the source of advective inputs to the littoral zone. None of these factors adequately predicted deoxygenation when considered alone. However, deoxygenation was less likely at low water temperatures, rapid littoral flushing rates, greater littoral depths, low levels of macrophyte biomass, and low tissue nitrogen concentrations. If weather conditions change toward calmer and warmer weather after herbicide application, there is a serious risk of deoxygenation even though conditions during application were optimal. (Cassar-FRC)
W82-03113

EUTROPHICATION OF THE LAKE-RESERVOIR SIDI MOHAMED BEN ABDELLAH, RABAT, MOROCCO (L'EUTROPHISATION DU LAC-RESERVOIR SIDI MOHAMED BEN ABDELLAH PRES DE RABAT, MAROCO),

Service Controle de Qualite des Eaux, Rabat (Morocco).
For primary bibliographic entry see Field 2H.
W82-03118

A MODEL RIVER TEST TO DESCRIBE THE VARIOUS IMPACTS OF CHEMICAL SUBSTANCES ON MICROBIAL BIOCOMMUNITIES,

Karlsruhe Univ. (Germany, F.R.). Inst. of Bioengineering and Biotechnology of Wastewater.
P. Wilderer.
AIChE Symposium Series, Vol 77, No 209, p 205-213, 1981. 15 Fig, 9 Ref.

Descriptors: *Water pollution effects, *Model studies, Rivers, Biodegradation, Toxicity, Organic compounds, Microorganisms, *Microbiological studies, Biochemistry, Chemical reactions, *Ecological effects.

A test method is described which was used to study the effects of chemical substances on aquatic microbial systems. The test method contains both continuous flow experiments to simulate the chain of ecological elements in biological wastewater treatment and self purification systems and batch experiments to quantify the impacts of particular substances on specific biocommunities in the various ecological elements. The test is based on a series of ecological systems developed in a laboratory model river consisting of a number of small aerated reactor vessels connected in series to form a reactor cascade. Subsequently the wastewater constituents and the metabolities produced are degraded by a series of biocommunities established throughout the course of the cascade. The study concluded that criteria such as biodegradability, persistence or toxicity are not primarily properties of any chemical substance, but properties of ecological systems. Of the four test substances used, diethyleneglycol, 4-nitrophenol, 2-methyl-2-,4-pentanediol, and thioglycolic acid, all were persistent before adaptation and two were toxic. After an adaptation period, all were biodegradable and less toxic. To eliminate these four substances, two mutually exclusive operating conditions are needed. A high F/M ratio is needed to remove 4-nitrophenol and thioglycolic acid, whereas low loading conditions must be maintained to eliminate the other two. (Baker-FRC)
W82-03147

PARAMETRIC MODEL AND OPTIMAL PREDICTION OF THE AVERAGE SALINITY OF THE AZOV SEA,

Academiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 5G.
W82-03154

SALINITY AND BIOGENIC MATERIAL IN THE NORTH CASPIAN,

Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
For primary bibliographic entry see Field 4A.
W82-03155

PHOSPHORUS AND NITROGEN BUDGETS OF BARTON BROAD AND PREDICTED EFFECTS OF A REDUCTION IN NUTRIENT LOADING ON PHYTOPLANKTON BIOMASS IN BARTON, SUTTON AND STALHAM BROADS, NORFOLK, UNITED KINGDOM,

University of East Anglia, Norwich (England). School of Environmental Sciences.
P. L. Osborne.
Internationale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 171-202, 1981. 16 Fig, 5 Tab, 49 Ref.

Descriptors: *Lakes, *Eutrophication, Phytoplankton, Phosphorus, Nitrogen, *Nutrients, Biomass, Macrophytes, Wastewater, Drainage water, Water pollution effects, Barton Broad, *England.

Seasonal variations in phytoplankton standing crops and the sources, seasonal cycles and supply of phosphorus and nitrogen were studied in three shallow, eutrophic lakes and their inter-connecting river. The Norfolk Broads are a series of shallow lakes associated with five main rivers. The lakes were formed during flooding of peat excavations. They are shallow freshwater lakes in which nutrient enrichment has resulted in replacement of a diverse macrophyte flora with large populations of phytoplankton. Phytoplankton pigment concentrations were relatively low at all stations during the winter, but concentrations increased at all stations in spring in response to increased temperatures and light intensities and a reduced flushing rate. Chlorophyll a concentrations were very high in summer: a maximum of 584 mg/cubic meter was recorded in Barton Broad. Nitrogen loadings on Barton Broad were estimated at 186-202 g N/sq m/year, of which 116 g was attributed to land drainage and the balance to sewage effluent sources. Total phosphorus loading was 18-22 g/sq m/year; over 80% of this was derived from sewage sources. About half of the P entering the River Ant-Broads system is stored in sediments, while 7-10 g/sq m/year enters Barton Broad dissolved and suspended in the water. It is suggested that an 80% reduction in the phosphorus content of sewage effluents entering the River Ant above Barton Broad would allow restoration of submerged macrophytes. (Baker-FRC)
W82-03184

RELATIONSHIP BETWEEN CHLOROPHYLL-A CONCENTRATION AND PHYTOPLANKTON BIOMASS IN SEVERAL RESERVOIRS IN CZECHOSLOVAKIA,

Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 2H.
W82-03185

EUTROPHICATION, ACCELERATED BY POLLUTION,

Societe Lyonnaise des Eaux et de l ' Eclairage (France). Lab.
M. M. Rizet.
Aqua, Vol 5, p 9-10, 13-15, 1981. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Eutrophication, *Water pollution control, Water pollution sources, Water pollution treatment, Nitrogen, Phosphorus, Drinking water, Potable water, Organic compounds.

Consideration is given to the problems of a eutrophic and dystrophic aqueous environment that is too highly nourished by exogenous intake. Oligotrophy can be considered to be the initial state of an aquatic biotope in a zone poor in nutrients. Such a biotope is itself inescapably liable to eutrophication. The essential point is the kinetics of this process, which is extremely variable. The process can be noticeably accelerated by natural or artificial happenings. Human activity, urbanization, industry, and intensive agriculture can significantly accelerate the eutrophication of receiving water. The specific impact of mineral elements brought to the water area can be direct, by metabolism of the dissolved elements. Considerable density of biomass complicates the preparation of drinking water. Taste and smell are the result of the presence of living algae or the products of their decomposition. Toxicity of metabolities emitted by certain algae has been the cause of acute mammalian intoxications. The fight against eutrophication must be waged where pollution sources enter the environment. The non-point input arising from agriculture can be reduced by more rational use of fertilizer products. The chemical industry is proposing substitutes for phosphate detergents. Nitrogen and phosphorus carried by domestic or industrial wastewater can be eliminated from water by physico-chemical or biological precipitation, by bioconsumption in lagoons, or by decomposition of nitrogen to the gaseous state. The limitation of excessive richness in nutritive elements and especially the limitation of algae development can be obtained by causing effective mixing of influent water. (Baker-FRC)
W82-03193

THE STRUCTURE OF BENTHIC COMMUNITIES IN AN AREA OF THERMAL DISCHARGE FROM A COASTAL POWER STATION,

Modena Univ. (Italy). Inst. of Zoology.
R. Crema, and A. M. B. Pagliai.
Marine Pollution Bulletin, Vol 11, No 8, p 221-224, August, 1980. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Benthic fauna, *Thermal pollution, *Coastal waters, *Powerplants, Polychaetes, Population density, Aquatic populations, Mollusks, Crustaceans, Echinoderms, *Italy, Gulf of Follonica, Piombino.

The increasing use of seawater for cooling powerplants has raised many questions regarding the effects of heated effluents discharged from these facilities on the marine environment. The Piombino power station, located at Torre del Sale in the center of the Gulf of Follonica in Italy, currently consists of two sections, each producing 320 megawatts and using 22 cubic meters of seawater per second for cooling. With a temperature gradient of 9 degrees C across the plant, about 190 megacalorie of heat per second is discharged into the sea. A sampling plan was devised to allow comparison of the benthic communities of zones in proximity to the effluent outlet with those of zones unaffected by heated effluent. Polychaetes were the predominant taxa at all of the sampling sites, followed by mollusks and crustaceans. Typical infralittoral forms of polychaetes were found at the different depths. The numerical distribution of individuals per species was found to be log-normal in all samples. Previous studies have demonstrated that the log-normal model describes the distribution of a community in equilibrium and that the distribution deviates from the log-normal when the community is evolving towards a new equilibrium in response to pollution. The sampling method was found to be sensitive to the differences in commu-

nities related to depth, but showed no differences connected with proximity to the heated effluent. Comparison of these data with data collected at subsequent stages in the development of the full plant capacity is expected to provide some information on the amounts of heat the environment can receive without damage. (Carroll-FRC)
W82-03205

EFFECTS OF EUTROPHICATION ON THE INTERTIDAL ECOLOGY OF LANGSTONE HARBOUR, U.K. AND PROPOSED CONTROL MEASURES,

Southern Water Authority, Worthing (England).
H. A. C. Montgomery, and P. G. Soulsby.
Water Science and Technology, Vol 13, No 7, p 287-294, 1981. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Wastewater pollution, *Water pollution effects, *Eutrophication, *Nutrients, *Harbors, Wastewater disposal, Wastewater discharge, Algal growth, Algal control, Benthic fauna, Biomass, Biological wastewater treatment, Nutrient removal, Nitrogen, Phosphorus, Phosphates, *Langstone Harbor, England.

Eutrophic conditions have developed in Langstone Harbor, a natural saline tidal basin off the South Coast of England. The disposal of about 40 megaliters/day of biologically treated sewage effluent into the north end of the harbor and an input of crude sewage on the ebb tide at the south end of the harbor have caused an overgrowth of the alga, Enteromorpha spp. on the intertidal mudflats. Manual and aerial photographs of the area were taken to estimate the coverage by the macroalgae from 1973 to 1979. Measurements of the algal biomass and benthic fauna were also taken. Algal biomass was significantly reduced in 1979 compared to 1978 data. The biomass of benthic from areas of high wood cover was significantly higher than that from areas with no weed cover. Seasonal studies of nutrient levels in harbor water are needed to clarify nitrate, nitrogen phosphate, and ammonia-nitrogen data. Preliminary samplings showed a clear pattern of dilution of these nutrients from the head to the mouth of the harbor. Plans to prevent further eutrophication include the adoption of nutrient removal measures at the sewage treatment works at the Budds Farm facility at the north end of the harbor. (Geiger-FRC)
W82-03207

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-1973. II. CHANGES IN PHYSICAL AND CHEMICAL PARAMETERS OF EUTROPHICATION,

Nebraska Univ.-Lincoln. School of Life Sciences.
G. L. Hergenrader.
Hydrobiologia, Vol 74, No 3, p 225-240, September 21, 1980. 16 Fig, 2 Tab, 31 Ref.

Descriptors: *Reservoirs, *Eutrophication, Water pollution effects, *Salt Valley, *Nebraska, Phytoplankton, Nutrients, Nitrogen compounds, Phosphates, Sulfates, Chlorides, Turbidity, Suspended solids, Alkalinity, Hardness, Calcium, Dissolved solids, Iron.

Eutrophication indicators were studied in four new, small, shallow, holomictic, eutrophic flood control reservoirs in Nebraska's Salt Valley. Weekly samples were taken during the summers of 1968-1973. Secchi disk transparencies decreased with time from 200 cm to 100 cm and were lowest in the oldest reservoir. (One reservoir with unusually high inorganic turbidity was not considered in this aspect.) As the reservoirs became more eutrophic over the study period, mean turbidity and mean suspended solids increased. Total alkalinity, total hardness, calcium, and phosphates (total unfiltered, total filtrate, and orthophosphate) all decreased during the 6 year period. These decreases were caused by intensive phytoplankton photosynthesis, which promoted more formation. Phosphorus coprecipitated with the marl. Parameters which were unreliable as eutrophication indicators were temperature, dissolved oxygen, dissolved solids, nitrate and ammonia nitrogen, and total iron. Although chloride and sulfate increased with progressive eutrophication, they were not considered reliable indicators. Chloride cannot be related to human activities. Sulfate data needs a longer observation period to determine the correlations. (Cassar-FRC)
W82-03214

THE COMPOSITION AND ECOLOGY OF PERIPHYTON COMMUNITIES IN FRESHWATERS. II. INTER-RELATIONSHIPS BETWEEN WATER CHEMISTRY, PHYTOPLANKTON POPULATIONS AND PERIPHYTON POPULATIONS IN A SHALLOW LAKE AND ASSOCIATED EXPERIMENTAL RESERVOIRS ('LUND TUBES'),

University of East Anglia Univ., Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W82-03217

BIOLOGICAL MONITORING PART VI - FUTURE NEEDS,

Virginia Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns Jr.
Water Research, Vol 15, No 8, p 941-952, August, 1981. 1 Fig, 55 Ref.

Descriptors: *Monitoring, *Chemical properties, *Toxicity, *Environmental effects, Risks, Ecosystems, Research priorities, Water pollution effects, *Biological samples.

System level tests rather than single species toxicity tests are urged as a more satisfactory way to determine the environmental effects of contaminants. The suggestion that at least multispecies tests should be required in biological monitoring studies is scientifically sound, but may be economically impractical. However, this type of test should be done for all chemicals that find their way into the environment. The appropriate mix of evidence required can be determined on a case-by-case basis using protocols developed for this purpose. When the cost of proceeding without an adequate risk assessment exceeds the cost of getting the necessary information through system tests and advanced monitoring, the cost of getting a more reliable estimate of risk seems more reasonable. New monitoring methods, particularly those geared to system and multispecies tests, are needed to perform monitoring methods on the scale that is necessary today. Numerous applications of these concepts in the field of water research are cited. Significant toxicity of polychlorinated biphenyls was determined in multispecies tests on aquatic invertebrates as contrasted to single species tests. Benefits of improved wastewater treatment systems and reduced industrial discharges have been demonstrated in the Wabash, Shenandoah, and South Rivers in the United States and the Thames and Clyde Rivers in England, among others. The importance of drainage basin management and determination of ecosystem assimilative capacity are illustrated. (Small-FRC)
W82-03230

IMPACT OF NUTRIENT ENRICHMENT IN A WATERCHESTNUT ECOSYSTEM AT TAKAHAMA-IRI BAY OF LAKE KASUMIGAURA, JAPAN. V. DYNAMICS OF ORGANIC DEBRIS,

Meikei High School, Ibaraki (Japan).
For primary bibliographic entry see Field 2H.
W82-03231

PERSISTENT BLOOMS OF SURF DIATOMS ALONG THE PACIFIC COAST, U.S.A. I. PHYSICAL CHARACTERISTICS OF THE COASTAL REGION IN RELATION TO THE DISTRIBUTION AND ABUNDANCE OF THE SPECIES,

Washington Univ., Seattle. Dept. of Oceanography.
J. L. Garver, and J. Lewin.
Estuarine, Coastal and Shelf Science, Vol 12, p 217-229, 1981. 7 Fig, 2 Tab, 21 Ref.

Descriptors: *Algae, *Eutrophication *Population dynamics, *Coastal waters, Diatoms, Beaches, Chlorite, Montmorillonite, Seasonal variation, Physical properties, Pacific Ocean, Washington, Oregon.

A study was undertaken to establish the ranges of the two surf diatoms along the Pacific coast and to characterize the types of beaches and coastline associated with algal blooms. Water samples were taken every three weeks at Copalis Beach on the southern Washington coast and monthly at 12 beaches on the Oregon coastline. Only samples collected during daylight hours were included in the study. Chaetoceros armatum was present in surf samples at Copalis Beach and at all beaches on the Oregon coast with the exception of two at the southern end. A seasonal trend was not evident, but higher cell nubers were seen from October to January and during April and May. Asterionella socialis was present over the same geographical range as C. armatum. The abundance of A. socialis followed a more seasonal trend, with low numbers from June to September 1977, higher densities from October through May, and lower numbers again during the succeeding summer months. The northern beaches had high cell counts of both species, often exceeding 10,000 cells/ml. Five beaches per ml most of the time, but these blooms were not as persistent as those found along the northern group of beaches. Depressed numbers of both species remaining around 100 cells/ml were found at the next two beaches moving southward, and at the two southernmost beaches sampled the two surf species were absent. Discriminant analysis showed that the four groups could be completely separated by three discriminant functions composed of four physical variables: offshore bottom slope, percent chlorite, percent montmorillonite and beach length. (Baker-FRC)
W82-03233

STUDY ON THE SCARCITY OF RED TIDE IN THE EUTROPHICATED WATERS OF ARIAKE BAY I. DISSOLUTION OF PHOSPHATE ION FROM BOTTOM MUD BY HYDROGEN SULFIDE,

Kyushu Univ., Fukuoka (Japan). Lab. of Fisheries and Chemistry.
S. Ishio, and K. Kondo.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 46, No 8, p 977-989, August, 1980. 2 Fig, 9 Tab, 14 Ref.

Descriptors: *Eutrophication, *Red tide, *Nutrients, Water pollution effects, Fate of pollutants, Ariake Bay, Hakata Bay, *Japan, Dinoflagellates, Bottom sediments, Marine sediments, Bays, Phytoplankton, Phosphates, Nitrogen, Sulfides, Hydrogen sulfide, Benthos, Iron compounds, Tidal effects, Oxidation.

Although Araike Bay and Hakata Bay, Japan, are similarly eutrophied, red tide is a serious problem only in Hakata. Examination of the bottom muds of both bays showed similar levels of total C, total N, and total P, but differences in phosphate-P removal by 1% NaS solution were remarkable--236 plus or minus 227 mg per kg dry mud in Ariake and 80 plus or minus 50 mg per kg in Hakata. Average content of slufide-S in Hakata (0.654 g per kg dry mud) was 3.5 times that in Ariake (0.185 g per kg dry mud). The difference in sulfide concentrations is caused by a rapid tidal current and oxidizing conditions present in Ariake, but not in Hakata. In Hakata, soluble sulfides react with the available ferric phosphate to precipitate FeS and rapidly release phosphates into water, where this nutrient supports late summer dinoflagellate blooms. In Ariake, the FeP04 remains in the mud and is released more gradually. (Cassar-FRC)
W82-03240

EFFECTS OF POLLUTION ON HUMIC SUBSTANCES,

Department of Agriculture, Ottawa (Ontario). Chemistry and Biology Research Inst.
M. Schnitzer, and H. Kerndorff.
Journal of Environmental Science and Health, Part B, Vol 15, No 4, p 431-456, 1980. 6 Fig, 8 Tab, 12 Ref.

Descriptors: *Decomposing organic matter, *Water pollution effects, *Humic acids, Fulvic acids, Acidity, Chemical properties, Nitrogen, Sulfur, Sediments, Metals.

Humic acids and fulvic acids were isolated from unpolluted and polluted soils and sediments in an effort to assess the effects of industrial and environmental pollution on analytical characteristics of humic substances. The humic acids and fulvic acids were characterized by elemental and functional group analyses, by infrared spectrophotometry, by differential thermal analysis, and by analyses for 13 metals. Silicon was also determined in all samples. Soil and sediment samples were taken from six heavily polluted environments and from six pristine, isolated locations where little pollution was expected to occur. The polluted humic acids and fulvic acids contained more nitrogen and sulfur than unpolluted samples, while unpolluted samples contained more oxygen than polluted ones. Polluted samples were also richer than unpolluted samples in all of the 13 metals and in silicon. Increases in COO(-) groups, secondary non-cyclic amides, and possibly S03H groups were found in the polluted humic acids and fulvic acids. Differential thermal analyses showed that polluted humic materials were more thermostable than unpolluted humic acids and fulvic acids. The study results indicate that unusually high concentrations of nitrogen, sulfur, copper, chromium, zinc, and mercury in humic materials may be useful indicators of soil and sediment pollution. (Carroll-FRC)
W82-03253

METHYLMERCURY CONTAMINATION OF AN EXPERIMENTAL TROPHIC CHAIN: IMPORTANCE OF THE PRIMARY PRODUCER-CONSUMER SYSTEM. (CONTAMINATION D'UNE CHAINE TROPHIQUE EXPERIMENTALE PAR LE METHYLMERCURE: IMPORTANCE DU SYSTEME 'PRODUCTEUR-CONSOMMATEUR PRIMAIRE'),

Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie et Ecophysiologie Animales.
F. Robeyre, A. Boudou, and A. Delarche.
Environmental Pollution, Vol 24, No 3, p 193-206, March, 1981. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Mercury, *Bioaccumulation, *Algae, Toxicology, Food chains, Heavy metals, *Ecosystems, Water pollution.

Within the framework of methylmercury bioaccumulation and bioamplification along an experimental food chain with four links, the contamination procedure of the first two trophic levels, Chlorella vulgaris and Daphnia magna, is accurately defined. After developing the chosen methodology and the constraints inherent in each link, the main results showing the primary producer are presented from the toxicological point of view (inhibition rate of Chlorella growth). A sublethal concentration is defined for each species in the model and the dynamics of mercury fixation for Chlorella vulgaris and Daphnia magna are quantified at three temperatures over contamination periods of 24 hours and 96 hours, respectively. The study demonstrates the great fixation capacity of algae for mercury. Therefore, the first consumer level is essentially contaminated trophically. The study results underline the temperature factor effect on Daphnia magna accumulation processes; moulting, in relation to temperature, partly explaining the differences observed. The high values of the pollutant concentration factors relative to the water-Chlorella-Daphnia system confirm the importance of the inclusion of an autotrophic link at the base of an experimental trophic chain. On the other hand, the accuracy of the measurement shows the high level of reliability and reproducibility of the procedure chosen. (Carroll-FRC)
W82-03303

SESSILE ALGAE IN EUROPEAN MOUNTAIN STREAMS. I. THE ECOLOGICAL CHARACTERISTICS OF COMMUNITIES,

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
B. Kawecka.
Acta Hydrobiologica, Vol 22, No 4, p 361-420, 1980. 16 Fig, 4 Tab, 79 Ref.

Descriptors: *Algae, *Stream degradation, *Mountains, Wastewater pollution, Reviews, Water pollution effects, Tourism, Wastewater disposal, Diatoms, Stream biota, Mountain streams, Europe.

The structure and ecology of sessile algae communities were investigated, and the changes in these characteristics caused by water pollution were determined. The investigation was carried out in pure high mountain streams which were polluted by sewage from tourist centers at various locations: Kebnekaise Mountains, Swedish Lapland; Tatra Mountains, Poland; Alps, Austria; Fagaras Mountains, Rumania; and Rila Mountains, Bulgaria. Seven algae communities were identified as being characteristic of unpolluted streams and three communities were found characteristic of streams polluted chiefly by domestic sewage. Algae developing in glacier streams had poor development of diatoms, while outflows from mountain lakes had abundant development of Cyanophyceae and lichens. A glacier stream below the inflow of domestic sewage in winter had a marked increase in diatoms. This may be due to increases in nitrate content. Domestic wastes influenced algae communities, whose structure was considerably changed as compared to communities of pure environments. (Small-FRC)
W82-03309

LEMNA (DUCKWEED) AS AN INDICATOR OF WATER POLLUTION. I. THE SENSITIVITY OF LEMNA PAUCICOSTATA TO HEAVY METALS,

Shinshu Univ., Matsumoto (Japan). Dept. of Public Health.
For primary bibliographic entry see Field 5A.
W82-03318

ECOLOGICAL EFFECTS OF MINE EFFLUENTS ON THE SOUTH ESK RIVER, NORTH-EASTERN TASMANIA. I. STUDY AREA AND BASIC WATER CHARACTERISTICS,

National Museum of Victoria, Melbourne (Australia).
R. H. Norris, P. S. Lake, and R. Swain.
Australian Journal of Marine and Freshwater Research, Vol 31, No 6, p 817-827, December, 1980. 8 Fig, 5 Tab, 30 Ref.

Descriptors: *Industrial wastes, *Rivers, *Tasmania, South Esk River, Mine wastes, Effluents, Acidity, Acid mine drainage, Cations, Phosphates, Chlorides, Nitrates, Seasonal variation, Rainfall, Temperature effects.

A study was made of the effects of mine effluents on the environment of the South Esk River in northeastern Tasmania. The study was conducted along 180 km of the river, over which distance it falls 20 meters, terminating at the Tamar estuary. The total catchment area is 8972 square kilometers, of which 7142 wquare kilometers is over the main sampling area. Land uses on the catchment include forestry, hydroelectric power generation and mixed farming. Effluents arise from mining operations in the area, which produce tin and tungsten. The dissolved oxygen concentrations of the river were at, or near, saturation levels. pH was slightly acid and was constant along the river course at any one time, indicating a reasonably well-buffered natural water. pH correlated positively with alkalinity and calcium, magnesium and sodium concentrations, all reaching their highest levels in the summer of 1975-76 after heavy rainfall during 1975. Dissolved carbon dioxide concentrations were generally above saturation levels. The major cation concentrations increased down-river. Low levels of phosphate, chloride, and nitrate indicate that the South Esk River is free of organic contamination by domestic and agricultural effluents. (Baker-FRC)
W82-03322

BACTERIAL UTILIZATION OF ALGAL EXTRACELLULAR PRODUCTS. I. THE KINETIC APPROACH,

Middlebury Coll., VT. Dept. of Biology.
W. H. Bell.
Limnology and Oceanography, Vol 25, No 6, p 1007-1020, November, 1980. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Algae, *Heterotrophic bacteria, *Kinetics, *Model studies, Bacteria, Experimental data, Eutrophication, Organic compounds, Water pollution effects, Skeletonema costatum, Chaetoceros affinis.

Equations for linear kinetic analysis of the utilization of algal extracellular products by bacteria were developed from a model for estimating heterotrophic potential originally proposed by Parsons and Strickland (1961) and subsequently modified. Laboratory studies using marine diatoms Skeletonema costatum and Chaetoceros affinis and a marine bacteria agreed with theoretical predictions below a substrate concentration of 400 micrograms C per liter. Thus changes in heterotrophic population size and concentration of extracellular products can be predicted. Deviations from linear predictions of the model may show the specificity of algal-bacterial interactions mediated by extracellular products. Application of the mixed substrate model may allow qualitative evaluation of the ecological significance of a phycosphere effect produced by algal blooms. (Cassar-FRC)
W82-03330

BACTERIAL UTILIZATION OF ALGAL EXTRACELLULAR PRODUCTS. 2. A KINETIC STUDY OF NATURAL POPULATIONS,

Middlebury Coll., VT. Dept. of Biology.
W. H. Bell, and E. Sakshaug.
Limnology and Oceanography, Vol 25, No 6, p 1021-1033, November, 1980. 6 Fig, 1 Tab, 36 Ref.

Descriptors: *Algae, *Heterotrophic bacteria, *Kinetics, Eutrophication, Model studies, *Bacteria, Organic compounds, Water pollution effects, Skeletonema costatum, Chaetoceros affinis, *Norway.

The model for bacterial utilization of algal extracellular products was applied to a study of the uptake of C14-labeled extracellular products from Skeletonema costatum by native populations during an algal bloom in Trondheimsfjord, Norway, in 1977. Data obtained on 10 separate dates showed agreement with the linear predictions of the mixed substrate model. A 4-fold increase in bacterial activity was enough to prevent a large accumulation of extracellular products. During the later exponential phase of the bloom temporary inhibition of bacterial activity occurred. Chaetoceros affinis, a native alga not represented in the bloom, was used to evaluate the specificity of the algal-bacterial system. Results indicated that the bacterial population was not adapted to use C. affinis extracellular products during this bloom but was stimulated by the bloom to specifically use S. costatum extracellular products. (Cassar-FRC)
W82-03331

DETOXIFICATION OF ZINC AND CADMIUM BY THE FRESHWATER PROTOZOAN TETRAHYMENA PYRIFORMIS. II. GROWTH EXPERIMENTS AND ULTRASTRUCTURAL STUDIES ON SEQUESTRATION OF HEAVY METALS,

Queen Elizabeth Coll., London (England). Dept. of Biology.
For primary bibliographic entry see Field 5G.
W82-03334

PHYSICAL VARIABILITY AND PHYTOPLANKTON COMMUNITIES: II. PRIMARY PRODUCTIVITY BY PHYTOPLANKTON IN A PHYSICALLY VARIABLE ENVIRONMENT,

McMaster Univ., Hamilton (Ontario). Dept. of Biology.
G. P. Harris, G. D. Haffner, and B. B. Piccinin.
Archiv fur Hydrobiologie, Vol 88, No 4, p 393-425, June, 1980. 11 Fig, 3 Tab, 113 Ref.

Descriptors: *Phytoplankton, *Photosynthesis, *Temperature, Water pollution effects, Eutrophication, Aquatic life, *Lake Ontario.

This paper describes the week-by-week changes in the primary productivity of phytoplankton communities in Hamilton Harbor during the ice-free periods of 1975, 1976, and 1977. Measurements were made by the carbon-14 technique. Integral photosynthesis was lower than had been expected in a highly eutrophic water body. A significant

portion of the variability associated with the integral photosynthesis can be accounted for by the changes in the photosynthetic capacity of the phytoplankton. The variability in the photosynthetic saturation parameter correlated with thermal stability in the top 5 m of the water column. Significant self-shading by the phytoplankton was only recorded in 1975 and 1977. Physical changes in 1976 appeared to preclude any self-shading in that year. In this physically variable situation, the phytoplankton communities exhibited reduced photosynthetic capacity and reduced growth rates. Thus the total algal biomass in Hamilton Harbor did not reach levels predicted by phosphorus loading models. The usefulness of such data for management strategies is briefly discussed. (Baker-FRC)
W82-03336

CHEMICAL FLUX IN AN ACID-STRESSED STREAM,

Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
R. J. Hall, and G. E. Likens.
Nature, Vol 292, No 5821, p 329-331, July 23, 1981. 1 Fig, 1 Tab, 35 Ref.

Descriptors: *Acidic water, *Streams, *Ecological effects, Water pollution effects, Snowmelt, *Acid rain, Nutrients, Invertebrates, Aluminum, Organic matter, Aquatic life, Hydrogen ion concentration, Norris Brook, Hubbard Brook, *New Hampshire, Sulfuric acid.

The pH of a third-order stream, Norris Brook, New Hampshire, which normally is slightly acidic (pH 5.4-6.4) was maintained at pH 3.9-4.2 with sulfuric acid additions from April 18 to September 22, 1977. Effects were divided into acute (5-day, simulating spring snowmelt) and chronic (25-day, simulating chronic effects of acid rain). Invertebrates decreased 285% during the first five days and 58% at 25 days. This may have been a result of a decrease in collector organisms. Aluminum decreased 160% in five days and 86% after 25 days. Coarse particulate matter (leaves, tiny branches, etc.) decreased by 107% after five days but increased 18% after 25 days. Little or no change was seen in fine particulate organic matter, dissolved organic carbon, Ca, or N. Significant amounts of C, N, and P were lost from the ecosystem in the biologically bound form and in the particulate organic fraction. This has a detrimental effect on the acidified area and can be either beneficial or detrimental further downstream. (Cassar-FRC)
W82-03338

ACID PRECIPITATION--A NEW STUDY FROM NORWAY,

Imperial Coll. of Science and Technology, London (England). Centre for Environmental Technology.
J. N. B. Bell.
Nature (London), Vol 292, No 5820, p 199-200, July 16, 1981.

Descriptors: *Acid rain, *Norway, *Precipitation, *Ecological effects, Environmental effects, Aquatic life, Water pollution effects, Air pollution effects, Water pollution sources, *Lakes.

An accelerating decline in fish stocks which resulted in the extinction of fish populations in an area of 13,000 square kilometers and severe problems over another 20,000 square kilometers led to the establishment in 1972 of a major Norwegian research program (the SNSF project) into the biological effects of acid precipitation. The final report of this project, published in 1980, demonstrates that precipition in southern Scandinavia has become more acidic as a result of long-distance transport of air pollution. Nitrogen oxides are contributing an increasing proportion of the acidity. While routine analysis of precipitation samples provides estimates of the inputs of hydrogen ions, sulfur oxides, and nitrogen oxides, the importance of the dry deposition of gaseous and particulate sulfur and nitrogen compounds directly onto vegetation and soils is less well defined. Lake waters have become significantly more acidic in areas subject to acid precipitation. Acid precipitation also mobilizes aluminum in soils, which is a major factor in the destruction of fish populations. In southern Norway, where much of the precipitation falls as snow, particularly severe problems result from the flush of acid water into lakes during snow melt. Intensive studies failed to reveal any consistent effects of acid precipitation on forest productivity. Also, the effects of changes in land use on lake acidification are not fully understood. The SNSF project predicted that a reduction of at least 70 percent in hydrogen ions and sulfate concentrations in precipitation is necessary to restore lakes to their previous conditions. (Carroll-FRC)
W82-03341

5D. Waste Treatment Processes

ASSESSMENT OF EMERGING TECHNOLOGIES FOR METAL FINISHING POLLUTION CONTROL: THREE CASE STUDIES,

Centex Corp., Reston, VA.
P. Militello.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-244485, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-153, October, 1981. 4 p, 3 Fig, 3 Tab.

Descriptors: *Metal-finishing wastes, *Wastewater treatment, *Ozone, *Ion exchange, *Waste recovery, Industrial wastewater, Chromium, Cyanide, Metals, Suspended solids, Sludge drying.

Many novel approaches to treatment of electroplating wastewater have been evaluated based on available information under an earlier effort. The most promising of these were selected for further investigation to include sampling, performance verification, and cost analysis. The treatment methods studied included a system for treatment of electroplating wastes with ozone, a technique for chrome recovery by ion transfer, and a method of treating mixed wastestreams using ion exchange. The Ozodyne System at San Diego Plating exhibited reliable performance when operated on mixed wastewaters, reducing effluent concentrations of cyanide, metals, and total suspended soils to very low levels, often less than the limits of detectability. The vacuum filter employed as part of the system was able to dewater the resulting sludge to 75% solids content. The system should become highly competitive on a cost basis with conventional treatment as sludge disposal costs escalate. The ChromeNapper chrome recovery system at U.S. Plating exhibited reliable performance on a continuous unattended basis over several days of monitoring, successfully recovering and returning to the plating tank all chrome other than that plated on the workpiece. Economic comparison with conventional evaporative recovery shows the system to be highly attractive. Although the Rinse-Loop System at Chicago Modern Plating was plagued with operational difficulties from ancillary equipment, the basic ion exchange technology operated satisfactorily on the mixed wastewaters during those limited periods when it was possible to pay sufficient attention to maintenance. (Moore-SRC)
W82-03001

TREATMENT OF METAL FINISHING WASTES BY USE OF FERROUS SULFIDE,

Permutit Co., Inc., Monmouth Junction, NJ.
M. B. Yeligar, G. Bagenski, and R. M. Schlauch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-233579, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-142, September, 1981. 4 p, 1 Fig, 1 Tab.

Descriptors: *Metal-finishing wastes, *Wastewater treatment, *Sulfide precipitation, Suspended solids, Cost analysis, Metals, Industrial wastes, Heavy metals, Chromium, Zinc, Process control.

The demonstration of a new patented sulfide precipitation process ('Sulfex') which removes heavy metals from metal finishing wastewaters, was performed to verify its operational practicability and performance quality. The study was performed at a carburetor manufacturing plant in Paris, Tennessee. 'Udylite' processes are used for chromate conversion coatings on aluminum and zinc carburetor castings before assembly. The sulfide precipitation system removes chromium and zinc from the plant's combined metal finishing process wastewater. It also removes suspended material such as precipitated aluminum, iron, and phosphates. Major steps in the system are: equalization and neutralization of untreated wastewater, precipitation of metals and sedimentation of suspended solids, polishing of settler effluent with dual media filtration, and final dewatering of settled sludge. All metals and suspended solids were removed to levels well below both the City of Paris sewer system limitations and the Tennessee guidelines for indirect discharge to sewer systems. Jar tests were demonstrated to be a valuable tool for maintaining good process control and economical operation. The chemical cost of sulfide precipitation has been found to be directly dependent upon the concentrations of combined zinc and hexavalent chromium present during the process. Sulfide precipitation was shown to be an economical as well as effective treatment for this type of wastewater. (Moore-SRC)
W82-03002

SOIL FILTRATION OF SEWAGE EFFLUENT OF A RURAL AREA,

Colorado State Univ., Fort Collins. Dept. of Agronomy.
B. R. Sabey, K. A. Barbarick, and N. A. Evans.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-238073, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-151, September, 1981. 4 p, 1 Fig, 1 Tab, 2 Ref.

Descriptors: *Wastewater irrigation, *Snow cover, *Weather, *Sprinkler irrigation, Soil filters, Municipal wastewater, Tile drainage, Groundwater pollution, Water quality, Wastewater treatment, Soil properties.

The effects of sprinkler-irrigated municipal sewage effluent and of surface tile drainage on a mountain meadow were investigated in the summer of 1977 and 1978. The treatments consisted of combinations of irrigations with effluent or ditch water at the rate of 7.5 cm/week and of drainage tiles or natural drainage. The drainage tiles were effective in lowering the groundwater elevations for about 85% and 10% of the season in 1977 and 1978, respectively. Higher plant concentrations of sodium and manganese in 1977 and plant yields and Mn concentration in 1978 were found in the plants harvested from the plots that were irrigated with sewage effluent. The influence of the effluent on groundwater quality and soil characteristics did not pose serious health or environmental problems. Another study to determine the feasibility of adding sewage effluent to mountain meadow land during winter was inititated in 1977 at Hayden, Colorado, near the summer effluent application site. It was determined that 7.5 cm/week of effluent could be added to the plots under an ice or snow cover if the soil profile was not frozen prior to ice and snow cover formation in the late fall and early winter. The size of ridge and furrow configuration did not influence any of the biological and chemical parameters measured in the study. The winter soil filtration system was effective in decreasing the concentrations of some chemical constituents including ammonium and potassium, as well as decreasing biochemical oxygen demand, chemical oxygen demand, and indicator organisms. The decrease in indicator organism numbers was not as great the second year of the study as it was the first. In general, the effluent distribution system worked reasonably well even in the winter as long as rapid drainage of the pipes was provided at the conclusion of the application period of each day. (Moore-SRC)
W82-03004

VIRUS INACTIVATION IN WASTEWATER EFFLUENTS BY CHLORINE, OZONE, AND ULTRAVIOLET LIGHT,

Radian Corp., Austin, TX.
R. A. Fluegge, T. G. Metcalf, and C. Wallis.

Available from the National Technical Information Service, Springfield, VA 22161 as PB81-208183, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-088, July 1981. 3 p. R804991

Descriptors: *Viruses, *Disinfection, *Chlorination, *Ozonation, *Ultraviolet radiation, *Wastewater treatment, Effluent, Coxsackie virus, Polio virus, Diurnal variation.

Virus levels before and after disinfection were studied in four full-scale wastewater treatment plants: two used chlorine as the disinfectant, one used ozone, and one used ultraviolet light. A second ozone study was conducted on a pilot scale at one of the treatment plants. Results for the viral content in wastewater effluents indicated no consistent correlation between virus concentrations and any of the traditionally measured indicators of pollution. No seasonal variation of virus concentration was detected in this four-season study. A diurnal variation, however, was noted in one of the plants during two separate samplings: one in December and one in July. Maximum virus concentrations occured in this effluent between 2:00 and 4:00 a.m. for each of these two sampling periods. All three types of polioviruses (1,2 and 3) were shown to be present in the effluents, with poliovirus 1 being the predominant virus type found in both the treated and treated plus disinfected effluents. Coxsackie A9, B1, B2, B3, B4, B5, and B6 were also isolated and identified. Except for coxsackie B5, all virus types were found in the treated as well as the treated plus disinfected effluent. Significantly lower virus isolation rates were encountered after disinfection. Experiments with pure strains and known quantities of attenuated viruses to determine recovery efficiencies indicated that variability in viral seed recovery data, although fairly small in a controlled laboratory environment, is more marked in a field situation. (Moore-SRC)
W82-03005

TWO-STAGE BIOLOGICAL TREATMENT OF COKE PLANT WASTEWATER,

Rexnord, Inc., Milwaukee, WI.
R. Osantowski, A. Geinopolos, J. Meverden, and J. Milanowski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-240798, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-052, September, 1981. 4 p, 3 Fig, 1 Ref.

Descriptors: *Industrial wastewater, *Advanced wastewater treatment, *Biological wastewater treatment, *Activated sludge process, Filtration, Nitrogen removal, Activated carbon, Ammonia, Coke plant wastewater, *Byproducts, Wastewater treatment.

A pilot-plant study of the use of advanced waste treatment methods in upgrading metallurgical cokemaking wastewaters to Best Available Technology (BAT) levels was carried out using mobile treatment units. Three wastewater treatment trains were investigated. In the first treatment train, plant wastewater from downstream of the coke plant cooling tower was passed through a mixing tank, through the first-stage activated sludge system (carbonaceous removal), and then through the second-stage activated sludge system (nitrogen removal). The second treatment train consisted of the first treatment train (bio-oxidation) followed by activated carbon adsorption. The third treatment train included the components of the first treatment train followed by dual-media filtration. Abnormal operating conditions in the coke plant wastewater pretreatment system during the test resulted in ammonia levels as high as 2000 mg/l, making it necessary to dilute the second stage feed before nitrification could be achieved. Ammonia reductions of more than 97% were achieved in the second stage. Activated carbon and filtration effectively removed suspended solids, total organic carbon, color, and thiocyanate. (Moore-SRC)
W82-03029

LABORATORY STUDIES OF PRIORITY POLLUTANT TREATABILITY,

Walk, Haydel and Associates, Inc., New Orleans, LA.
J. K. Smith, R. J. Planchet, E. J. Westbrook, and F. J. Zak.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-231235, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-129. September, 1981. 4 Fig, 2 Tab, 2 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Adsorption, *Steam stripping, Benzenes, Phenols, Chlorinated hydrocarbons, Petroleum industry, Chemical industry, *Cost analysis, Aniline, Priorities.

A wastewater grab sample from a typical medium sized petrochemical manufacturing complex was used for laboratory bench scale treatment tests on five priority pollutants present at significant concentrations. The study focused on carbon adsorption, resin adsorption and steam stripping technologies and developed order-of-magnitude cost relationships for each technology. The results indicate high removal efficiency for the priority pollutants nitrobenzene, p-dichlorobenzene, chlorobenzene, phenol and dinitrotoluene by both carbon adsorption and resin adsorption. Steam stripping was not effective under the test conditions for removal of phenol or dinitrotoluene. The steam stripping data also indicated that removal of the non-conventional pollutant aniline was ineffective. Operating costs for treating streams similar to the stream tested are estimated to be on the order of $2 to $3 per 1000 l for flows of about 1130 l/min. Cost effectiveness may favor use of carbon adsorption over resin adsorption and combination systems appear to offer no economic advantage at pollutant levels present in the sample. (Moore-SRC)
W82-03030

FEASIBILITY STUDY OF OPEN TANK OXYGEN ACTIVATED SLUDGE WASTEWATER TREATMENT,

FMC Corporation, Englewood, CO.
K. R. Rakness.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-213274, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-095, July, 1981. 7 p, 1 Fig, 5 Tab.

Descriptors: *Oxygenation, *Activated sludge process, *Wastewater treatment, Municipal wastewater, Effluent, Biochemical oxygen demand, Sludge.

To date, there is one known open tank high purity oxygen activated sludge system on the market, the MAROX system. The system uses a unique bubble shear method for dissolution of pure oxygen to the mixed liquor. The pilot plant used consisted of one oxygenation basin and two clarifiers capable of treating 151 L/min. The system treated primary effluent from a municipal wastewater treatment facility. The influent flow rate was adjusted to attain average aeration reactor detention times ranging from 0.94 to 3.3 hr. The pilot plant operation was conducted in two phases. Treatment performance during both phases was excellent. Final effluent BOD5 concentrations and secondary BOD5 removals averaged less than 20 mg/L and greater than 90%, respectively. No degradation in process removal efficiency occurred, even at organic loadings as high as 1.23 kg BOD5 applied/day/kg mixed liquor suspended solids (MLSS) and volumetric loadings as high as 4.07 kg BOD5 applied/day/cu m of reactor capacity. Better effluent quality was attained by operating at return flow/influent flow ratios between 50 and 60 as opposed to ratios between 30 and 40. No significant nitrification occurred during the test program. Analysis of operations indicated that somewhat less sludge was produced with the oxygen system when compared with typical air sludge production. (Moore-SRC)
W82-03032

PHYSICAL/CHEMICAL TREATMENT OF COKE PLANT WASTEWATER,

Rexnord, Inc., Milwaukee, WI.
R. Osantowski, A. Geinopolos, and G. Rollinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-206021, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-053, July, 1981. 2 p.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Physicochemical treatment, Chlorination, Filtration, Dechlorination, Activated carbon, Suspended solids, Organic compounds, *Coke plant wastewater.

Selected advanced waste treatment technologies for treating metallurgical cokemaking wastewaters to Best Available Technology (BAT) levels were investigated in a pilot-plant study. Mobile treatment units, operable at a flow rate of 19 l/min, were used. Two physical/chemical treatment trains were studied: alkaline-chlorination/filtration/activated-carbon, and alkaline-chlorination/sodium-bisulfite-dechlorination/filtration. Chlorination was effective in consistently reducing pollutant concentrations to below BAT levels, except for total cyanide. Filtration provided effective polishing of the alkaline chlorinated coke plant wastewater, removing 71% of the influent suspended solids. Suspended solids removal could be increased to 93% of the incoming total chlorine, while sodium bisulfite provided 100% chlorine removal at a bisulfite:chlorine ratio of 2:1. The treatment trains created several volatile organic priority pollutants. Train 1 technologies removed 73% of the volatile organic priority pollutants to non-detectable limits; train 2 technologies were effective in treating only 17% of incoming volatile organic toxics to non-detectable levels. Semivolatile organics were all effectively reduced for train 1. Train 2 also reduced all semivolatile organics to less than 100 micro g/l except for naphthalene. (Moore-SRC)
W82-03033

TEXTILE WARP SIZE RECLAMATION USING THERMAL PRECIPITATION,

Auburn Univ., AL.
W. S. Perkins, R. P. Walker, and L. J. Hirth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-129041, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-80-209, July, 1981. 4 p, 1 Fig.

Descriptors: Textiles, *Recycling, *Water pollution control, *Wastewater renovation, Cost analysis, Waste recovery, Industrial wastewater, Water reuse, Size material removal, *Textile mill wastes.

Virtually all textile yarns which are to be woven into the warp in a fabric are coated with a protective material, called size, during the slashing process, in order to improve the performance of the yarn in the weaving process. In most cases the size material is removed from the woven fabric in the finishing plant. A process to recover and recycle the warp size has the potential to lower the BOD and COD of textile finishing plant effluents more than any other single change in textile processing. A novel method for reclaiming size is based on precipitation of the size material by heating the desize washwater. The method uses hydroxypropyl cellulose (HPC) or hydroxypropyl methylcellulose (HPMC) which are soluble in cool water but insoluble in warm water. Water used for desizing and subsequently separated from the HPC in a recovery system is suitable for reuse in desizing. Strength and elongation of yarns sized with virgin HPC and with reclaimed HPC were not significantly different from those of yarns sized with conventional size. Weaving of HPC-sized yarns in the laboratory was successful. The capital investment for reclaiming HPC using thermal precipitation is much lower than for recovering polyvinyl alcohol size using ultrafiltration. Size reclamation is considered to be an economical approach to chemical and water conservation and will reduce pollution load. (Moore-SRC)
W82-03034

REMOVAL OF HEAVY METALS AND SUSPENDED SOLIDS FROM BATTERY WASTEWATERS: APPLICATION OF HYDROPERM CROSS-FLOW MICROFILTRATION,

Hydronautics, Inc., Laurel, MD.
N. I. Shapiro, H. L. Liu, J. Baranski, and D. Kurzweg.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-234833, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-147, September, 1981. 5 p, 3 Fig.

Descriptors: *Heavy metals, *Suspended solids, *Wastewater treatment, *Filtration, *Industrial wastewater, Lead, Neutralization, Lime, Battery wastewater.

The microfiltration system is a treatment process which employs a physical principle of treatment for suspended solids removal after chemical precipitation. The principal element of the system is a thermoplastic tubular filter constructed with a controlled porosity in the micron-size range. Relatively low feed pressures are employed. Laboratory and full-scale field demonstrations were conducted to demonstrate the applicability of the microfiltration system to lead-acid battery production wastewaters. The waste from the battery manufacturing facility is a mixture of sulfuric acid from occasional dumping of open-tank formation of the anode and cathode battery plates, rinse water from the plate washing facilities, and floor drains from throughout the plant. The combined total daily waste production is approximately 75,000 1/day. The waste acid and rinse water mixture is neutralized with high calcium lime to convert the soluble metals to a suspended hydroxide form. Suspended solids in the feed which exceeded 150,000 ppm were typically reduced to 3 ppm in the permeate. Lead in the feed in the range of several hundred parts per million was typically reduced to 0.02-0.1 ppm. Other toxic heavy metals were removed with comparable effectiveness. (Moore-SRC)
W82-03037

FINE COAL-REFUSE SLURRY DEWATERING,

Bureau of Mines, Spokane, WA. Spokane Research Center.
R. R. Backer, and R. A. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-160268, Price codes: A02 in paper copy, A01 in microfiche. Bureau of Mines Report of Investigation 8581, 1981. 21 p, 11 Fig, 7 Tab.

Descriptors: *Slurries, *Dewatering, *Mine wastes, *Coal, Flocculation, *Wastewater treatment, Polymers, Drains, Lime.

Under normal operating conditions and with state-of-the-art decant construction, current impoundments never achieve adequate dewatering and stabilization of fine coal-refuse slurry. Bench-scale and field tests were carried out to evaluate dewatering using chemicals and various types and combinations of drains in natural earth impoundments. About 40 lb of lime and 2 lb of polymer per ton of dry solids were mixed with the underflow from preparation-plant thickener. Clear, free water was immediately liberated from the slurry. The percent solids by weight of the slurry increased from about 17 to 30 immediately, and after 5 days increased to 45%. In contrast, untreated slurry took weeks to settle, and the surface water remained turbid. The low permeability of the flocculated slurry precludes rapid dewatering without some type of drainage system and supplemental surface decanting to remove the clear water at a rate that would permit continuous operation. Vertical fabric drains seemed to be a little more effective than vertical sand drains: on the basis of comparative permeabilities, it is assumed that their advantage was derived from a larger surface-area contact with the slurry. To insure reclamation of water and prevent possible ground-water contamination it would be advisable to have an impervious soil base with a bottom drain of sand or bottom ash. (Moore-SRC)
W82-03049

RESTORING GROUND WATER QUALITY FOLLOWING IN SITU LEACHING,

Bureau of Mines, Twin Cities, MN. Twin Cities Research Center.
D. R. Tweeton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-104753, Price codes: A06 in paper copy, A01 in microfiche. In: In Situ Mining Research, Proceedings: Bureau of Mines Technology Transfer Seminar, Denver, CO, August 5, 1981, Bureau of Mines Information Circular 8852, 1981. p 27-37, 9 Tab, 2 Ref.

Descriptors: *Groundwater pollution, *Water pollution control, *Wastewater treatment, *Leaching, Sludge, Reverse osmosis, Injection wells, Evaporation ponds, Uranium.

The waste solution from in situ uranium leaching and from postleaching restoration can be disposed of in either a deep disposal well or an evaporation pond. Generally, deep disposal wells have been used in Texas and evaporation ponds in Wyoming. Injection of waste through a deep well into a zone that does not contain useful water offers the advantage that the waste is completely removed from the biosphere. Deep well disposal is limited to waste solutions that will not plug the injection zone by the precipitation of solids in reactions between the solution and the matrix of the host aquifer. An important disadvantage of solar evaporation ponds is that as evaporation occurs, a sludge remains and there are stringent regulations governing the disposal of the sludge. The waste stream from leaching or from restoration can be treated to produce two streams: purified water, and a concentrated brine. The purified water can be reused, thereby reducing the total consumption of water, and the disposal system does not require as large a capacity. The surface treatment technique that has been used for in situ leaching wastes is reverse osmosis. Other treatment methods that are potentially useful are electrodialysis, distillation, ion exchange, foam separation, and freeze separation. Ground water restoration appears to be a bigger problem than was previously thought. Field testing has shown that complete restoration, as defined by State regulatory agencies, has not been attained with reasonable degrees of flushing at any of the sites studied. (Moore-SRC)
W82-03050

FULL-SCALE EVALUATION OF HIGH RATE SCREENING DEVICES FOR TREATMENT OF SANITARY SEWAGE BY-PASS FLOW,

Ontario Ministry of the Environment, Toronto.
H. Kronis, and F. Tonelli.
1980. 145 p, Fig, Tab, 11 Ref, Append.

Descriptors: *Suspended solids, *Nutrients, *Water quality, *Sewage, Centrifugal wastewater concentrator, BOD5, Hydrasieve, Rotostrainer, Primary treatment, Secondary treatment, Urban drainage, Canada, *Ontario, *Wastewater treatment.

The performance of four fine-mesh high-rate screening devices treating combined sewage under wet and dry weather conditions were evaluated. The units tested were: a 1.5-m (60-inch) diameter Centrifugal Wastewater Concentrator (CWC) with 105-micrometre apertures; a 1.5-m (60-inch) long rotating horizontal drum screen (Rotostrainer) with 500-micrometre apertures; and two stationary inclined screens, a 0.6-m (24-inch) wide DSM and a 1.8-m (72-inch) wide Hydrasieve, having 305 and 762-micrometre apertures, respectively. The study was conducted during 1974/75 at the Belleville, Ontario, Water Pollution Control Plant, where influent sewage is subject to substantial infiltration, dilution, and flow peaking during wet weather. Hydraulic capacity and pollutant removal depended largely on the type of screening device, the screen aperture size, and the availability of an effective backwash system. Hydraulic capacities were between 0.78 to 2.4 cu m/sq m per min (16 and 50 gal/min per sq ft). Typical mean pollutant removals obtained during storm events with first flush conditions were between 5 and 32 percent for suspended solids, 5 and 24 percent for BOD5, and 23 and 79 percent for settleable solids. In general, pollutant reductions were substantially less in dry weather. Operating costs were estimated to be between 0.13 and 4.2 cents per cubic metre (0.6 and 19 cents per 1000 gallons) treated depending on, among other factors, installed capacity, the number of hours of operation, and the device evaluated. It was concluded that screening had potential for the reduction of pollutants in combined sewer flows. (WATDOC)
W82-03110

MASS PRODUCTION OF FRESHWATER ROTIFERS ON LIQUID WASTES I. THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON POPULATION GROWTH OF BRACHIONUS RUBENS EHRENBERG 1838,

Kernforschungsanlage, Juelich (Germany, F.R.) Inst. fuer Biotechnologie III.
M. Schluter, and J. Groeneweg.
Aquaculture, Vol 25, No 1, p 17-24, July, 1981. 4 Fig, 10 Ref.

Descriptors: *Rotifers, *Animal wastes, *Aquaculture, *Wastewater treatment, Ponds, Algae, Manure, *Farm wastes, Nitrites, Dissolved oxygen, Oxygen, Growth rates, Hydrogen ion concentration.

The effects of environmental factors on the rotifer Brachionus rubens were studied for two reasons: to control the undesirable growth of rotifers in an algal pond for treatment of pig manure and to test the possibility of continuous mass production of rotifers in algal pond effluents. Results indicate that rotifers tolerated oxygen concentrations as low as 1.5 mg per liter for long periods. Rotifers adapted to nitrites had population growth rates of 70-90% of controls at nitrite concentrations of 15 mg per liter or less. These growth rates declined steadily to 15% at 30 mg per liter. Addition of sodium chloride showed that some animals survived at levels of 4 g per liter. Growth was greater than 85% at 1 mg per liter NaCl or less. Rotifers did not survive at $pH < 4.5$ or > 9.5. Growth reached a peak at pH 7. Rotifer growth could be controlled by stopping the wastewater inflow to the pond on sunny summer days, when pH levels of 11 are possible. Conversely, pH must be maintained at 6-8 for optimum rotifer growth. (Cassar-FRC)
W82-03114

USE OF A FRACTIONAL DESIGN TO EVALUATE INTERACTIONS OF ENVIRONMENTAL FACTORS AFFECTING BIODEGRADATION RATES,

Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
T. E. Fannin, M. D. Marcus, D. A. Anderson, and H. L. Bergman.
Applied and Environmental Microbiology, Vol 42, No 6, p 936-943, December, 1981. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Phenol, *Biodegradation, *Factor analysis, Degradation, *Wastewater treatment, Experimental design.

Fractional factorial design was used to evaluate the main and interactive effects of six environmental factors on biodegradation of phenol. This procedure reduced the number of shake-flask experiments to 81, compared with the 324 necessary with conventional factorial designs. The six factors investigated were: (1) amount of phenol substrate, (2) amount of bacterial inoculum, (3) filtration of inoculum, (4) type of basal salts medium, (5) initial pH of basal salts medium, and (6) flask closure. Factors (1), (2), and (4) had significant single effects on biodegradation. Increasing phenol concentrations in the substrate decreased the maximum degradation rate. Increasing the amount of bacterial inoculum increased the maximum degradation rate. The highest maximum degradation rates were observed in R and V medium, used for determining phenol-degradation bacteria. Interactive effects were found for factors (2) and (3) and for factors (2) and (5). (Cassar-FRC)
W82-03117

RECOVERY OF INDIGENOUS ENTEROVIRUSES FROM RAW AND DIGESTED SEWAGE SLUDGES,

Surrey Univ., Guildford (England). Dept. of Microbiology.
M. R. Goddard, J. Bates, and M. Butler.
Applied and Environmental Microbiology, Vol 42, No 6, p 1023-1028, December, 1981. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Viruses, *Sludge digestion, Digestion, Fate of pollutants, Sludge disposal, Mesophilic digestion, Thermophilic digestion, Anaerobic digestion, *Raw wastewater.

Removal of enteroviruses by three types of raw sewage sludge digestion was determined. Treatments were: (A) 30-35 days of anaerobic-mesophilic digestion, followed by 30 days consolidation; (B) 24 hours consolidation, 30-35 days anaerobic-mesophilic digestion, followed by 30-40 days of consolidation; (C) 25-30 days of anaerobic-mesophilic digestion followed by 3-4 years of drying in beds; and (D) a pilot plant thermophilic-aerobic digestion treatment. The pilot plant was most effective and fastest in reducing titers of infectious viruses. Reductions of viruses after consolidation (75th day) were (A), 88.5%, and (B), 84.2%. Little reduction in virus titer took place in Treatment (C) by the 35th day, when sludge was applied to land. Mesophilic digestion alone did not reliably reduce virus titers, possibly as a result of inadequate mixing during daily sludge additions. However, the consolidation process decreased viruses to a greater extent. (Cassar-FRC)
W82-03121

THE EFFECT OF NI(II) ON NITRIFICATION IN THE ACTIVATED SLUDGE PROCESS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
P. G. Trahern, W. R. Knocke, and J. H. Sherrard.
AIChE Symposium Series, Vol 77, No 209, p 171-176, 1981. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Nitrification, Activated sludge, Sludge, *Activated sludge process, *Wastewater treatment, *Nickel, Heavy metals, Biological treatment.

The study was accomplished by operating continuous flow, laboratory scale activated sludge units over a wide range of process operating conditions. The units were fed a soluble, reproducible wastewater in which the COD:TKN ratio was varied and the concentration of Ni(II) was varied. Data were collected under steady state conditions and were analyzed to assess the effect of Ni(II) on the degree of nitrification, COD removal efficiency, microbial yield coefficient and microbial maintenance coefficient. Nitrification was inhibited at an influent Ni(II) of 1.0 mg/l, a COD:TKN ratio of 3.7:1 and influent COD of 400 mg/l. Efficiency of organic removal as measured by the COD test was not affected by the presence of an influent Ni(II) concentration of 1 mg/l. This indicates that the threshold toxicity concentration is higher than 1 mg/l. No effect on nitrification or COD removal efficiency was noted with an influent Ni(II) concentration of 0.5 mg/l for substrates containing COD:TKN ratios between 2.4:1 and 7.3:1 with an influent COD of 400 mg/l. This observation, coupled with that of the prior conclusion, indicates that the nitrification threshold toxicity concentration proceeded at a very high efficiency at pH values as low as 4.9. The presence of Ni(II) was found to influence the values of the biokinetic coefficients. (Baker-FRC)
W82-03124

TREATMENT OF METAL CONTAINING WASTEWATER WITH CALCIUM SULFIDE,

General Electric Co., Schenectady, NY.
B. M. Kim.
AIChE Symposium Series, Vol 77, No 209, p 39-48, 1981. 5 Fig, 5 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Heavy metals, Sulfides, Precipitation, Industrial wastes, *Calcium sulfide.

This paper discusses sulfide precipitation methods, process development, results of treatability studies using wastewater samples, and examples of process applications in wastewater treatment plants. Sulfide precipitation is very effective for the removal of heavy metals such as cadmium, copper, lead, silver and zinc. The method works in the presence of chelating agents and removes metals to extremely low concentrations. The calcium sulfide slurries, prepared by reacting lime with hydrogen sulfide or sodium hydrosulfide, are effective sulfide sources. The addition of calcium sulfide can be controlled simply in most cases by measuring the pH. The processes employing such techniques have been demonstrated in bench scale experiments using wastewater samples. The two stage process may be employed when the wastewater contains a large amount of iron and nontoxic suspended solids. The major advantage of the process is the significant reduction achieved in toxic sludge volume when a large amount of nontoxic materials is present in the wastewater. The two stage process requires a capital cost higher than the single stage process. Since the solid/liquid separation in the first stage is not as critical as the second stage, a less expensive clarification system may be employed in the first stage. (Baker-FRC)
W82-03125

TREATMENT OF COOLING TOWER BLOWDOWN,

Bechtel Corp., San Francisco, CA.
A. N. Rogers, M. C. Weekes, S. C. May, and E. H. Houle.
AIChE Symposium Series, Vol 77, No 209, p 239-248, 1981. 3 Fig, 6 Tab, 9 Ref.

Descriptors: *Cooling water, *Reverse osmosis, *Vapor compression distillation, *Wastewater treatment, Dissolved solids, Crystallization, Evaporation, Ponds, Scaling, *Powerplants, Distillation, Steam, Surfactants, Brines.

Three processes for treatment of powerplant cooling tower blowdown are described and compared: reverse osmosis, vapor compression, and vertical tube evaporation. Dissolved salts are concentrated and wasted to ponds. In reverse osmosis the feed must be pretreated to reduce the concentration of scale-formers. This involves addition of sodium carbonate-lime slurry for precipitation of salts, Cl for controlling bacterial growth, acid for pH adjustment, sodium bisulfite for dechlorination, and sodium hexametaphosphate to obstruct the growth of scale crystals. About 75% of the original feed is recovered as usable water, containing 6-7% of the initial salt concentration. Vapor compression evaporation uses a vertical tube evaporator in which the liquid descends as a thin film on the inside of tubes. Compressed steam in contact with the outside of these tubes evaporates the feed water. Brine is recycled to the top for further evaporation. A vapor compressor withdraws the vapor generated and condenses it on the outside of the evaporation tubes. The process is highly energy-effective. The vertical tube foaming evaporator, not yet in commercial operation, consists of a conventional vertical tube evaporator followed by a smaller evaporator to concentrate the brine to the crystallizing stage. The small amount of surfactant added to the feed reduces scale formation, lowers hydrostatic losses, and improves heat transfer. No process was superior to the other two in all respects--energy use, product water quality, operating costs, ponding requirements, sensitivity to upsets, or ease of construction. (Cassar-FRC)
W82-03126

TREATABILITY OF TOXIC WASTEWATER POLLUTANTS BY SOLVENT EXTRACTION,

Environmental Protection Agency, Washington, DC.
S. T. Hwang.
AIChE Symposium Series, Vol 77, No 209, p 304-315, 1981. 1 Tab, 14 Ref.

Descriptors: *Organic compounds, *Solvent extraction, *Distribution coefficients, *Wastewater treatment, Chlorinated hydrocarbons, Pesticides, Amines, Phthalates, Aromatic compounds, Phenols, Polynuclear aromatic hydrocarbons, Activated carbon, Reviews, Toxins.

A review of the literature on solvent extraction of organic priority pollutants from wastewater is presented. This method can remove up to 99.9% of some organic toxic pollutants which are difficult to remove by steam or inert gas stripping or activated carbon adsorption. Capital expenditures for a 400 gpm solvent extraction system are given as $2 million. Part of this cost may be offset by recovery of marketable organic compounds. Tables give distribution coefficients for 89 organic pollutants in the following solvents: tricresyl phosphate, undecane, methyl isobutyl ketone, tridecane, benzene, isobutylene, isobutane, n-butyl acetate, isobutyl acetate, diisopropyl ether, octanol, cumene, mesityl oxide, methyl ethyl ketone, ethyl acetate, ethyl ether, ethyl benzene, n-hexanol, EDC, toluene, xylene, and n-hexane. The pollutants include chlorinated hydrocarbons, phenols, aromatic compounds, polycyclic aromatic compounds, amines, phthalates, and pesticides. (Cassar-FRC)
W82-03127

FREEZE CRYSTALLIZATION APPLICATIONS FOR WASTEWATER RECYCLE AND REUSE,

Heist Engineering Corp., Wilmington, NC.
J. A. Heist.
AIChE Symposium Series, Vol 77, No 209, p 259-272, 1981. 4 Fig, 6 Tab, 29 Ref.

Descriptors: *Industrial wastewater, *Crystallization, *Water reuse, *Wastewater treatment, Freeze crystallization, Chemical wastewater, Solubility, Cooling water, Acids, Metal-finishing wastes, Organic compounds, Separation techniques.

Industrial wastewater treatment by freeze crystallization has many advantages: no pretreatment, minimal corrosion of equipment, high level of water recovery, enhanced byproduct recovery, small volume of final waste, and thermodynamics favorable to energy savings. The versatile process may be adapted to many conditions. The basic process steps are: crystallization by direct or indirect contact with the refrigerant, crystal separation (often in a wash column), melting for energy conservation, and heat recovery from the melted product for additional energy savings. Steps are described for adapting freeze crystallization to a new application: determining solid-liquid equilibria, developing flow diagrams and mass and energy balances, and analyzing economic feasibility. This planning process is illustrated for freeze crystallization treatment of wastewaters from three applications: cooling tower blowdown, pickle liquor for preparing metal surfaces, and wash waters from terephthalic acid manufacture. (Cassar-FRC)
W82-03128

SLUDGE MANAGEMENT PROCESS INTEGRATION,

Cornell Univ., Ithaca, NY.
R. I. Dick.
AIChE Symposium Series, Vol 77, No 209, p 214-219, 1981. 5 Fig, 4 Ref.

Descriptors: *Sludge disposal, *Economic aspects, *Wastewater treatment, Sludge thickening, Sludge drying, Sludge, Activated sludge, Waste management.

Means for rationally integrating processes for sludge management are considered. Categories of processes include those for thickening, conditioning, dewatering, stabilizing, inactivating, combusting, reusing, storing, transporting, and disposing of sludge. A variety of different individual processes can be used within each category. Several advantages can be gained in designing a management scheme by considering important interactions between sludge management processes and designing and operating sludge management facilities to minimize adverse interactions and maximize favorable interactions to achieve overall least cost. The physical properties of sludges are principal factors influencing the cost of sludge management. Given the properties of sludge as they are currently produced, substantial attention to physical properties is warranted in process design, and research is needed on means for controlling and improving the physical properties of sludge at its source and for altering physical properties following sludge

production. Specific findings suggest that gravity thickeners should be built larger than is generally the practice, whereas the optimum size of anaerobic digesters is usually the minimum required for operational stability. Sludge irradiation results in improvement in sludge dewatering properties, and thus a reduction in the net costs. (Baker-FRC)
W82-03130

BIOLOGICAL NITROGEN CONTROL OF INDUSTRIAL WASTEWATER,

Dorr-Oliver Inc., Stamford, CT.
P. M. Sutton, and T. R. Bridle.
AIChE Symposium Series, Vol 77, No 209, p 177-185, 1981. 9 Fig, 3 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Denitrification, *Industrial wastewater, Nitrogen, Nitrification, Carbon, Sludge, Activated sludge process, Coke plant wastewater, Organic compounds, Steel industry, Plastics wastewater.

Results are presented from studies undertaken as part of the Canadian federal government regulation development activities for the organic chemical industry and the iron and steel industry involving the application of the pre-denitrification-nitrification process configuration. This configuration will be the most economical alternative for the biological treatment of industrial wastewaters such as nylon intermediates wastewater containing high concentrations of organic carbon and inorganic nitrogen. Organic carbon and nitrate reduction are accomplished in an anoxic first stage reactor, with the organics present in the wastewater providing the carbon and energy for denitrification. The conversion of ammonia to nitrate, or nitrification, and oxidation of any biodegradable organics not removed in the first stage, is accomplished in the aerobic second stage. In demonstration studies the single sludge pre-denitrification-nitrification system was able to achieve complete nitrification and denitrification of coke plant wastewater from Dominion Foundries and Steel Limited, provided dilution is practiced or powdered activated carbon is added at 33 to 50 mg/liter. The minimum aerobic solids retention time required to achieve complete nitrification of diluted wastewater at 22 to 24 degrees C was 22 days. In the treatment of high strength wastewater, Nitrobacter inhibition can be overcome by addition of 50 mg/liter of PAC to the feed. Dilution of the wastewater did not eliminate Nitrobacter inhibition. The organic carbon present in the wastewater can be used as the carbon and energy source for the denitrification reaction. No supplemental organic carbon is needed if the feed FOC/TN ratio is greater than 3.5. (Baker-FRC)
W82-03131

NITRIFICATION USING THE ROTATING BIOLOGICAL CONTACTOR,

Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
R. D. Miller, J. A. Hitdlebaugh, C. I. Noss, and E. D. Smith.
AIChE Symposium Series, Vol 77, No 209, p 186-195, 1981. 7 Fig, 33 Ref.

Descriptors: *Nitrification, *Wastewater treatment, Acidity, Temperature effects, Biological oxygen demand, Oxidation, Rotating biological contactor.

This paper reports on nitrification using the rotating biological contactor (RBC) process based on both pilot and full scale experiences with domestic wastewaters. It offers a literature review and a discussion of the nitrification reaction. Selection of design criteria is detailed, and scale-up problems are outlined. The importance of environmental conditions such as pH and temperature as well as other variables is discussed for treatment plant design relative to any wastewater. A list of specific conclusions regarding the RBC process for nitrification is presented. The RBC process can be an effective design for combined secondary treatment and nitrification when the following facts are considered. First, pH levels influence the rate of nitrification and the location where it begins. Adjusting chemical feed to increase pH levels to at least 7.0 in all RBC stages increases the rate of nitrification and decreases RBC surface area requirements. This produces more effective design and consistent ammonia removal. Wastewater temperature affects both secondary treatment and nitrification within RBC stages. Nitrification rates are more sensitive to low temperatures than organic removal rates. Dissolved oxygen, which may be a limiting condition, can be easily corrected by supplemental aeration during organic removal. Filtration after the RBC process will be needed to meet total BOD limits of 10 mg/liter or less. (Baker-FRC)
W82-03132

PREDICTION OF THE FATE OF ORGANIC COMPOUNDS IN BIOLOGICAL WASTEWATER TREATMENT SYSTEMS,

Purdue Univ., Lafayette, IN. School of Civil Engineering.
R. F. Wukasch, C. P. L. Grady Jr., and E. J. Kirsch.
AIChE Symposium Series, Vol 77, No 209, p 137-143, 1981. 11 Fig, 4 Ref.

Descriptors: *Wastewater treatment, *Organic compounds, *Biological wastewater treatment, Model studies, Municipal wastewater, Degradation, Sludge, Toxicity, Testing procedures.

A testing protocol was developed and evaluated which would determine and predict the fate of specific organic compounds in conventional biological wastewater treatment systems. This protocol was designed to determine the toxicity to aerobic biological systems and anaerobic sludge digestion systems of the specific compound; to quantitate the adsorption and stripping losses of the compound; to develop kinetic information allowing prediction of effluent quality as a function of the solids retention time of the biological treatment system; and to estimate the extent of biodegradation of the compound. A description is offered of the protocol using pentachlorophenol as the test compound. The protocol focuses on the toxicity to activated sludge systems and anaerobic digestion, partitioning and intermediate transport including volatilization and sorption, and the biodegradability, including kinetics and effluent quality, as a function of solids retention time. If the organic compound being tested is biodegradable, the protocol can be used to develop kinetic data which are useful in predicting the effluent concentration of the specific compound from a given wastewater treatment plant as a function of the cell residence time. Also included in the protocol are methods for determining the amount of a compound which can be adsorbed onto biomass solids or air stripped, and methods for predicting losses of the compound from full-scale installations. (Baker-FRC)
W82-03133

FACTORS INFLUENCING BIOLOGICAL NITRIFICATION OF STEEL INDUSTRY WASTEWATERS,

Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. D. Neufeld, A. J. Hill, and J. H. Greenfield.
AIChE Symposium Series, Vol 77, No 77, No 209, p 151-158, 1981. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Nitrification, *Biological wastewater treatment, Acidity, Temperature effects, Industrial wastes, *Steel industry, Industrial plants.

Basic studies were conducted into possible causes of biological nitrification process instability as currently observed in many industrial wastewater operations in order to eventually propose rational and pragmatic process operational alternatives for the biological oxidation of ammonia. It is noted that pH acts in conjunction with total ammonia levels to cause the free ammonia concentration in solution to act as a master variable influencing nitrification biokinetics. Free ammonia level acts as a substrate inhibitor to nitrification biokinetics, with a maximum in specific nitrification removal rates existing at free ammonia levels of about 10 mg/liter. Free ammonia begins to inhibit nitrification at 10 mg/1. Suggested sludge ages to maintain effective nitrification when free ammonia is neither limiting or inhibitory are 15-18 days for a pH of 7.0; 9-12 days for a pH of 8.0; and 12-15 days for a pH of 9.0. Nitrification biokinetics are very sensitive to elevated temperatures. Wastewater temperatures should be kept below 30 degrees C to assure stable nitrification, producing effluents of 10 mg/liter ammonia or less. Trace organics act as toxic inhibitors to nitrification biokinetics. Phenol, for example inhibited the maximum rate of specific ammonia utilization in a manner proportional to the square root of the phenol concentration. (Baker-FRC)
W82-03134

TROUBLESHOOTING AND CONTROL OF NITRIFICATION WASTEWATER TREATMENT SYSTEMS,

Engineering-Science, Inc., Austin, TX.
D. L. Ford.
AIChE Symposium Series, Vol 77, No 209, p 159-170, 1981. 10 Fig, 4 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Nitrification, *Design criteria, Operating policies, Management planning, *Biological wastewater treatment.

The concepts of biological nitrification are discussed, design aspects are considered, and operational techniques needed for troubleshooting and process control are outlined. Biological nitrification systems include both fluidized, activated sludge type reactors and fixed growth reactors, the latter including trickling filters and rotating biological contactors. Some of the more prevalent factors which influence nitrification include temperature, dissolved oxygen levels, pH, alkalinity, substrate loading, and sludge age and inhibition of nitrifiers. Many design concepts for nitrification systems have been developed over the years, but most have centered around some modification of fluidized activated sludge systems. Many approaches have been proposed in defining nitrification kinetics to establish basic criteria for design of fluidized nitrifying systems. Nitrification can be achieved in a single stage carbonaceous/nitrification system. The retention time or sludge age must be sufficient to enable the nitrification reactions to approach completion. The use of side stream aeration and two stage aeration has been shown to be nitrification-effective, with perhaps greater process reliability during cold weather periods and upset conditions. The most significant factors which relate to operational control and troubleshooting include defining and maintaining nitrifying population, dissolved oxygen control, alkalinity and pH control, influent transients, and the detection and control of inhibitory substances. It is important in any treatment system to detect process problems and offer remedies in the shortest time possible. (Baker-FRC)
W82-03135

THE REDUCTIVE TREATMENT OF INDUSTRIAL WASTEWATERS. I. PROCESS DESCRIPTION,

Envirogenics Systems Co., El Monte, CA.
K. H. Sweeny.
AIChE Symposium Series, Vol 77, No 209, p 67-71, 1981. 4 Fig, 2 Ref.

Descriptors: *Wastewater treatment, *Chemical reduction, Economic aspects, Management planning, Industrial wastes, Toxicity, Chemical reactions, Organic compounds, *Industrial wastewater.

Many toxicants found in waste streams from chemical industry plants can be successfully degraded by chemical reduction using a catalyzed metal powder as the reductant. In particular the process is useful for toxicants dissolved in water, which cannot be removed by physical means. It is common to achieve degradation to 1 microgram/liter or less. This level of contamination is safe for discharging the waters. The process is simple, effective and economical. Catalyzed iron, zinc, or aluminum powders have been effectively employed as reductants by such mechanisms as hydrogenolysis, hydroxylation, saturation of aromatic structure, condensation, ring opening, and rearrangement to change the toxicants to an innocuous form. Wastewater to be so treated may be trickled through a bed of the reductant which is diluted with an inert solid so as to give suitable retention

and flow properties, or preferably with a bed of the reductant fluidized by the aqueous waste solution. Retention times of about 5 minutes at ambient temperatures and flow rates as high as 0.9 cubic meters per minute per square meter have been achieved. The degradation of hexachlorocyclopentadiene and nitrophenol are cited as examples of the process. The process may be designed using a pump, flow control system and fluidized bed reactor. The treatment cost is estimated to be significantly lower than that of carbon sorption methods. (Baker-FRC)
W82-03137

THE REDUCTIVE TREATMENT OF INDUSTRIAL WASTEWATERS. II. PROCESS APPLICATIONS,

Envirogenics Systems Co., El Monte, CA.
K. H. Sweeny.
AIChE Symposium Series, Vol 77, No 209, p 72-78, 1981. 7 Tab, 6 Ref.

Descriptors: *Industrial wastes, *Chemical reduction, *Wastewater treatment, Chemical reactions, Toxicity, Organic compounds, *Industrial wastewater.

Several applications of chemical reduction in the treatment of chemical plant toxic waste streams are described. In general the toxicants are chemically changed to a form which is innocuous to the environment, rather than remaining in a concentrated solution or being discharged to the air. Trihalomethanes such as chloroform and bromoform and their intermediates were degraded in a 6 month program, from an average of 242 micrograms per liter to well below the control level set by the Environmental Protection Agency, with 75% of the tested samples reading below 5 micrograms per liter. Trichloroethylene reduction was accomplished, with a decrease in contaminant content from 280 to 3.9 micrograms/liter. Similar reductions were noted for trichloroethane and tetrachloroethane and tetrachloroethylene. Reductive tests with aqueous solutions of chlorobenzene appear to demonstrate both that the material is substantially degraded and that the product is mainly cyclohexanol. Successful degradation of a PCB waste to detection limits was shown, as well as degradation of chlordane. The chlorinated phenoxyacetic acid derivatives were substantially degraded, as was Kepone. The s-triazine derivative atrazine was 90% degraded. N-Nitrosodimethylamine was degraded to detection limits, and di- and trinitrophenols were substantially reduced. The wide range of applicability of the process, the low operating and capital costs, and its effectiveness suggest that reductive degradation may be a promising solution to many waste problems. (Baker-FRC)
W82-03138

OZONE FOR THE TREATMENT OF HAZARDOUS MATERIALS,

Jacobs Engineering Group, Washington, DC.
R. G. Rice.
AIChE Symposium Series, Vol 77, No 209, p 79-107, 1981. 7 Fig, 14 Tab, 83 Ref.

Descriptors: *Hazardous materials, *Ozonation, Disinfection, Water treatment, Industrial wastes, *Heavy metals, Oxidation, Cyanides, Sulfides, Industrial wastes, Wastewater treatment, Wastewater disposal.

The known aqueous reactions of ozone with both organic and inorganic chemicals listed on the hazardous materials list are discussed in terms of the ability of ozone to destroy the hazardous compound. Other reactions are considered in which ozone is known to simply convert one specific hazardous material into another. Ozone oxidations in aqueous media are usually dependent on pH. At higher pH ranges of 8 to 9 the ozone decomposes to form hydroxyl free radicals. At low pH, ozone reacts as the free ozone molecule, usually oxidizing at slower rates than at elevated pH. At low pH, amine-nitrogen atoms are protonated and stabilized to oxidation at this point in the molecular structure. Unsaturated aliphatics are generally readily reactive with ozone unless halogenated to high levels. Saturated aliphatics are unreactive. Benzene is slowly oxidized and other aromatics are generally easily oxidized by ozone except when electron-withdrawing substituents are present on the ring. Heavy metals can be oxidized to their highest state by ozone. Easily oxidized hazardous inorganic anions such as cyanide, sulfide, and thiocyanate can be destroyed by ozonation. Ozonation in the presence of UV radiation, ultrasound and/or hydrogen peroxide causes organic oxidations to proceed at significantly increased rates. Ozonation of organics rarely proceeds completely to carbon dioxide and water. Ozonation of some pesticides yields other hazardous products, some of which are stable to further ozonation. (Baker-FRC)
W82-03139

EVALUATION OF TEMPERATURE EFFECTS IN AERATED BIOTREATERS,

McKinsey and Co., Amsterdam, (Netherlands).
M. M. Friedman, and H. van Doesburg.
AIChE Symposium Series, Vol 77, No 209, p 112-121, 1981. 7 Fig, 4 Ref.

Descriptors: *Wastewater treatment, *Model studies, *Temperature effects, Aeration, Aerators, *Biological treatment, Biological wastewater treatment, Mathematical model.

To better quantify the temperature phenomenon in biotreating of wastewater, the factors that determine the temperature in the aeration basin have been studied, using a literature model. Testing of this model on data from eight different industrial biotreating systems gave evidence that the measured aerator temperatures could be adequately predicted by the model to within 1 to 3 degrees C. A subsequent parameter sensitivity analysis of the model led to a general, simplified correlation of the heat exchange characteristics of the eight treatment systems. Analysis of the non-steady-state version of the model showed that seven of the eight systems respond fairly quickly to changes in ambient or operating conditions, these changes being noted in less than one day's time. Such analysis can be used to determine various temperature control operating strategies as well as to provide guidance in the design of biotreatment systems. Seasonal changes in temperatures should be taken into account in setting up wastewater effluent quality standards. (Baker-FRC)
W82-03140

INTERMITTENT BIOLOGICAL WASTE TREATMENT SYSTEMS-PROCESS CONSIDERATIONS,

New South Wales Univ., Kensington (Australia).
M. C. Goronsky, D. Barnes, and R. L. Irvine.
AIChE Symposium Series, Vol 77, No 209, p 129-136, 1981. 10 Fig, 5 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Sludge, Design criteria, Operating policies, Maintenance, Management planning, Oxygen uptake, *Biological wastewater treatment.

This paper reports on full scale activated sludge systems which are operated over a range of loading conditions. Conventional activated sludge and continuously fed, sequentially aerated and decanted plants were studied under similar overall loading conditions. The performance of each system was measured in terms of oxygen utilization rate and effluent quality and was related to the short term loading on the plants as expressed by an instantaneous food to microorganisms ratio. Laboratory studies supplemented the full scale plant results. Continuously fed, intermittently aerated and decanted activated sludge systems provide an effective method of damping organic and hydraulic load transients. The biomass response of these completely mixed systems was significantly lower than that determined in the continuous conventional activated sludge plant. Single tank treatment systems contain a high mass of sludge available to adsorb and metabolize the influent organic loads. In a conventional continuous activated sludge plant the system is designed such that the capacity of the aerobic biological reactor corresponds to only 4 to 8 hr retention. Additionally, a proportion of the total sludge is contained in the secondary sedimentation tank, so that it can be removed from the wastewater. In the single tank systems retention, and sludge is not removed for separate clarification. Thus the response of these systems to increased organic loads will be well damped due to the capacity of the system. (Baker-FRC)
W82-03141

ENERGY MINIMIZATION AT METRO DENVER SEWAGE DISTRICT,

Metropolitan Denver Sewage Disposal District No. 1, CO.
W. E. Korbitz.
AIChE Symposium Series, Vol 77, No 209, p 21-24, 1981.

Descriptors: *Wastewater treatment, *Management planning, Economic aspects, *Energy conservation, Fuel, Design criteria, Planning, Water quality, Standards, Municipal wastewater, *Denver, Colorado.

Energy minimization efforts undertaken by the Metro Denver Sewage District are described. One of the major accomplishments lies in the secondary treatment process, where the original 370 million liters per day diffused air system was supplemented with a 272 million liters per day high purity oxygen system secondary treatment complex. The high oxygen transfer efficiency and lower total electrical power requirements have resulted in substantial savings. In the operation of the two secondary treatment complexes, flow has been sent to the high purity oxygen system at a rate such that it will be operated at capacity. The energy savings realized from close control over flow proportioning to the two secondary treatment complexes are considerable. Many cost savings as well as energy savings have also been made possible with the computer process control. Changes in operational procedures similar to the secondary treatment flow proportioning and consideration of electric motor retrofitting with capacitance equipment are methods of reducing demand. Other major successes are seen in the processing and disposal of sludge. Since 1971 sludge disposal has been in the form of land application. Anaerobic digestion of primary and waste activated sludge started in 1979 and is now part of the sludge processing line. There have also been revisions in water quality standards and treatment requirements so as to provide not only cost effective treatment but also energy effective treatment. (Baker-FRC)
W82-03142

RETROFIT CONSERVES ENERGY AT A WATER POLLUTION CONTROL FACILITY,

Velzy (Charles R.). Associates, Armonk, NY.
A. S. Haimes, and J. Dedyo.
AIChE Symposium Series, Vol 77, No 209, p 25-30, 1981. 2 Fig, 4 Tab.

Descriptors: *Wastewater treatment, *Phosphorus removal, Water pollution control, Activated sludge process, Lime, Microorganisms, *Energy conservation, Phosphorus, PhoStrip process.

In order to replace the existing chemical phosphorus removal process at a wastewater treatment plant in Amherst, New York, a major retrofit of process structures and incorporation of additional mechanical equipment was undertaken. Replacement was by a biological phosphorus removal process which will reduce energy use up to 81% and lime use up to 86% at thhe water pollution control facility. Such a major undertaking was an unusual step during the final stages of plant construction. The PhoStrip process will result in an operational cost savings of almost one million dollars annually. The removal of phosphorus is accomplished as follows. A portion of the phosphorus rich sludge from stage 1 clarifiers is diverted to a phosphorus stripper tank. The rest of the sludge either returns to the stage 1 oxygen transfer basins or is wasted. The sludge in the stripper tank is held in an anoxic environment, during which time the microorganisms release stored soluble phosphorus to the supernatant. The phosphorus stripped sludge is then returned to the stage 1 oxygen transfer basins. At this point, the microorganisms are returning to an aerobic environment and will take up

phosphorus in excess of that required for growth. Dilution of the influent sludge to the stripper is required to help maintain a proper sludge blanket depth and improve the stripping process. This stripper influent dilution flow is taken from the effluent of the stage 1 clarifiers. Phosphorus enriched supernatant is conveyed to the reactor clarifier, where it is limed. Reactor clarifier effluent is returned to stripper tank as an elutriation stream which is low in phosphorus concentration. (Baker-FRC)
W82-03144

BIOLOGICAL NITROGEN REMOVAL SYSTEM DESIGN,

Utah Univ., Salt Lake City.
H. D. Stensel.
AIChE Symposium Series, Vol 77, No 209, p 327-338, 1981. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Nitrogen removal, *Denitrification, *Respiration, *Wastewater treatment, Nitrification, Biological treatment, Design criteria, Nitrates.

Biological nitrogen removal systems which do not require an outside carbon source are discribed. Two types of nitrate reduction can occur: substrate nitrate respiration, where nitrate is reduced during the assimilation and oxidation of waste organic material (anoxic-aerobic system), and endogenous nitrate respiration, where nitrate is reduced during the respiration of the system biomass (channel flow system). There are also systems which alternate the anoxic and aerobic cells, ending with an aerobic zone. In substrate nitrate respiration the factors affecting nitrification rates are anoxic zone food to mass ratio, type of wastewater, nonbiodegradable solids present, and temperature. Endogenous respiration is affected by system mean cell residence time, specific carbonaceous oxygen uptake rate, net oxygen utilization coefficient, and net solids yield. Examples are given for design of an anoxic-aerobic system and an endogenous nitrate respiration system. (Cassar-FRC)
W82-03145

INHIBITION OF NITRIFYING ACTIVATED SLUDGE SYSTEMS BY ORGANIC SHOCK LOADS,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
A. Esfandi, and D. F. Kincannon.
AIChE Symposium Series, Vol 77, No 209, p 339-344, 1981. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Shock loads, Nitrification, *Organic loading, *Wastewater treatment, Chemical oxygen demand, Ammonia, Pilot plants, *Activated sludge process.

The effect of organic shock loads on nitrification was investigated in a pilot plant on-stage activated sludge unit. A synthetic wastewater containing 500 mg per liter glucose and 250 mg per liter ammonium sulfate was treated at different COD and NH3 loadings: 2-, 3-, and 4- fold increases in both glucose and ammonia levels, 2-fold increase in glucose with constant ammonia concentration, and 2-fold increase in ammonia with constant glucose constant concentration. The 3- and 4-fold shock loads inhibited nitrification and caused slight increases in effluent COD. Nitrification activity recovered after 25-35 days, but effluent NH3 remained higher (60-120 mg per liter) than before the shock loads. Doubling COD, NH3, or both suppressed nitrification. NH3 levels returned to zero, except in the 2-fold NH3 shock load, where they remained slightly elevated (20 mg per liter). Effluent COD showed a slight, temporary increase in the 2-fold COD shock load experiment, but was constant in the other two 2-fold runs. (Cassar-FRC)
W82-03146

ICI BRIXHAM - ENVIRONMENTAL RESEARCH IN THE PRIVATE SECTOR.

Water Services, Vol 85, No 1026, p 403-405, 1981. 2 Fig, 9 Ref.

Descriptors: *Environmental protection, *Research facilities, Water treatment, Effluents, Water treatment facilities, *Wastewater treatment, Laboratories.

Brixham Laboratory is the major ICI environmental center serving the company by investigating the effects of chemical discharges in both liquid and gaseous form and in developing new ways of treating the problems and testing products for their effect on the environment. The company also has produced products helpful in treatment of different types of effluents. The Deep Shaft was originally developed as a highly efficient and space saving effluent treatment plant. The process involves the passing of raw but screened effluent through a U-shaped pipe some 120 meters long, set 60 meters into the ground. At a certain point on the down tube air is injected into the flow and the force of the effluent carries this down to the U of the pipe. As the pressure increases, the oxygen is given up from the air more easily and absorbed by the bacteria. The air also gives buoyancy to the effluent and encourages it to rise up the next part of the tube. Once at the surface, the effluent is passed through a bubble stripping device and passed to the final treatment. The company also produced Flocor plastic filtration media. Brixham Labs has been engaged in studies of site investigation for outfalls into estuarine and coastal waters, and has designed many successful plants for the treatment of effluents before discharge. Considerable effort has gone into developing analytical techniques to meet the needs of the water industry. (Baker-FRC)
W82-03153

REMOVAL OF TOXIC HEAVY METAL IONS FROM WASTEWATERS USING MODIFIED AGRICULTURAL WASTE MATERIALS,

Visvesvaraya Regional Coll. of Engineering, Nagpur (India). Dept. of Chemistry.
P. Kumar, and S. S. Dara.
Water Science and Technology, Vol 13, No 7, p 353-361, 1981. 2 Fig, 6 Tab, 17 Ref.

Descriptors: *Industrial wastes, *Heavy metals, *Wastewater treatment, *Food processing wastes, Industrial wastewater, Onions, Copper, Lead, Zinc, Cadmium, Farm wastes, Plant tissues, Sorption, Adsorption, Cations.

The toxic heavy metal binding capacities of agricultural byproducts such as bagasse, flour waste, paddy husk, paddy straw, onion skin and garlic skin were determined in equilibrium experiments. Onion skins were found to be the most efficient in binding heavy metal cations from solution. The onion skins were treated with sulfuric acid and formaldehyde to improve the physical characteristics of the substrate and minimize color leaching into the solution. The effect of contact time, temperature, pH and various anions on the uptake of metal ious by the modified onion skins was investigated in both equilibrium and column experiments. The residual metal ion concentration in the effluent was reduced to less than 0.1 ppm under steady state conditions using a column of the substrate. The scavenging capacity of the substrate for the cations was 1.6 meq/grams of substrate for Cu, 1.55 meq/gram for Cd, 1.35 meq/gram for Pb and 1.23 meq/gram for Zn. Methods for metal cation recovery and probable mechanisms of sorption are indicated. The implications of using modified onion skins for scavenging heavy metal ions from industrial wastes are discussed. (Geiger-FRC)
W82-03206

BIOENGINEERING ASPECTS OF AEROBIC MICROBIAL PIGGERY WASTE TREATMENT, PART II. EFFECT OF CONTROLLED CONDITIONS ON GROWTH OF MICROFLORA AND EFFICIENCY OF BIODEGRADATION,

Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
J. Paca.
Process Biochemistry, Vol 15, No 2, p 7-10, February, 1980. 1 Tab, 8 Fig, 23 Ref.

Descriptors: *Biodegradation, *Aerobic bacteria, *Waste treatment, *Aerobic digestion, Agricultural wastes, Aerobic conditions, Aerobic treatment, Hogs, Biological treatment, Feedlot runoff, Manure, Farming, Agricultural watersheds, Microorganisms, Dilution, *Feedlot wastes.

Experiments were performed in batch and semi-continuous systems to determine the rate of biodegradation of piggery wastes. Based on these results and those obtained in a pilot plant, a plant capable of processing wastes of over 20,000 pigs was designed. Chemical analysis of fresh piggery wastes showed that this material contains high concentrations of copper salts which are added to commercial pig feed. Antibiotics are also added. These potentially toxic compounds for the metabolic activity of microorganisms decrease both the growth rate and the ability of microorganisms to degrade organic compounds. Longer times are necessary for biological treatment to overcome the chemical inhibitors. Aerobically treated wastes are preheated by vapor condensation. Volatile odor compounds are separated from the condensate, and the condensate is further treated in a multiple effect evaporator. (Titus-FRC)
W82-03212

TYPE A ZEOLITE IN THE ACTIVATED SLUDGE PROCESS--II: HEAVY METAL REMOVAL,

Plano-Empresa de Projectos, Lda., Lisboa (Portugal).
J. J. T. Carrondo, J. N. Lester, and R. Perry.
Journal of the Water Pollution Control Federation, Vol 53, No 3, p 344-351, March, 1981. 7 Fig, 5 Tab, 22 Ref.

Descriptors: *Heavy metals, *Activated sludge process, *Zeolites, *Wastewater treatment, Water softening, Hardness, Chemical properties.

Type A zeolite is an insoluble aluminosilicate capable of removing calcium hardness and, to a lesser extent, magnesium hardness from washing solutions and thus is used as a detergent builder. This study investigated the influence of type A zeolite on the removal of heavy metals in the activated sludge process using two pilot plants, one of which had no zeolite added to the influent wastewater. Primary settled wastewater fed to the treatment units contained nominal type A zeolite concentrations of 15 and 30 milligrams per liter, with two levels of calcium exchange for sodium in the zeolite (25 percent and 75 percent of maximum exchange capacity). The initial heavy metal concentrations in the wastewater in this hardwater area were low. No effect on heavy metal removals was noted for the metals tested at the 75 percent rate of calcium exchange, which is the normal exchange level expected to have been reached by the time the zeolite reaches a wastewater treatment plant. No effect was detected on cadmium, chromium, nickel, or lead removals in activated sludge at the lower rate of calcium exchange, which represents the level of exchange expected to have occurred after a washing program. Small but significant differences were noted for copper and zinc removals during two of the sampling periods, indicating a slight improvement in copper removal in the presence of zeolite. The removal of iron appeared to be unaffected by the presence of zeolite. No adverse effects were detected in the removal of heavy metals in the activated sludge process at either the normal or the high concentrations expected to occur in wastewaters when zeolite is used in detergents. (Carroll-FRC)
W82-03222

THE ACTIVATED SLUDGE PROCESS--3. SINGLE SLUDGE DENITRIFICATION,

Cape Town Univ. (South Africa). Dept. of Civil Engineering.
A. C. Van Haandel, G. A. Ekama, and G. V. R. Marais.
Water Research, Vol 15, No 10, p 1135-1152, October, 1981. 11 Fig, 1 Tab, 22 Ref.

Descriptors: *Activated sludge process, *Denitrification, Model studies, Mathematical studies, Nitrification, *Wastewater treatment, Wastewater facilities.

It is demonstrated that in the single sludge nitrification-denitrification process when the organisms are in the anoxic phase it is necessary to change the value of only one of the kinetic constants in order to model the nitrification-denitrification single

sludge system in terms of the bi-substrate active-site death-regeneration model of Dold. This change allows the Dold model to be extended so as to simulate very closely the response of the multi-reactor nitrification-denitrification process configurations under both constant and cyclic flow and load conditions. The denitrification response predicted under constant flow and load conditions can be reduced to that approximated by a zero order reaction with two rates in the primary and one in the secondary anoxic reactor respectively. The fundamental kinetic constants in the expressions for substrate utilization and nitrification are affected by the wastewater characteristics. The variability of the constants for nitrification is greater than that for substrate utilization. A single reactor system operated under sequential anoxic and aerobic periods constitutes a convenient experimental setup for determining the values of the kinetic constants of nitrification and substrate utilization and of denitrification in the anoxic phases. (Baker-FRC)
W82-03223

DEMONSTRATION OF ANAEROBIC BIOGAS DIGESTERS IN DEVELOPING COUNTRIES. PART III: THE PHILIPPINES,

Philippines Univ., Manila. Inst. of Public Health.
M. H. Simpson, and E. C. Morales.
Journal of Environmental Sciences, Vol 23, No 2, p 20-24, March, 1980. 8 Tab, 4 Fig, 6 Ref.

Descriptors: *Anaerobic digestion, *Biodegradation, *Biological treatment, *Wastewater treatment, *Energy sources, Technology, Anaerobic conditions, Dissolved oxygen, Waste management, Gasification, Farm wastes, Agricultural engineering, Manure, Agriculture, Sludge, *Philippines.

Waste management in the Phillippines also provides an energy source. Biogas plants, which have been widely established since 1977, turn waste products into energy sources. Effluent water is used for production of algae for livestock and poultry feed as well as production of fish and fertilizing-irrigating of pasture and vegetable plots. Because the Philippines is an agricultural country, there are large supplies of locally available raw materials for biogas production. The use of biogas digesters in sewage disposal systems in housing developments is now under consideration. However, the efficiency of biogas production from human waste is relatively low. (Titus-FRC)
W82-03226

THE TERTIARY TREATMENT OF SEWAGES. CONCLUSION,

Loughborough Univ. of Technology (England).
K. V. Ellis.
Effluent and Water Treatment Journal, Vol 20, No 11, p 527-529, 531-533, 535, 537, November, 1980. 1 Tab, 41 Ref.

Descriptors: *Sewage treatment, *Tertiary treatment, Filtration, Flotation, Reviews, *Great Britain.

The tertiary treatment of sewages is reviewed. Specific attention is given to the moving bed filter, microstrainers, maturation ponds, and other tertiary treatment methods, including nitrifying filters. Use of the moving-bed filter eliminates the necessity of periodically removing the filter from operation in order to clean it. Microstrainers are hollow cylinders, with the cylindrical surfaces covered with a fine stainless steel fabric. In general a microstrainer can be expected to remove between 50 and 60% of the suspended solids from a secondary effluent together with somewhat over 30% of the remaining BOD. Microstrainers have been used in the treatment of industrial wastewaters and to strain storm waters. Maturation ponds are widely used as the third stage in the progression through the stabilization pond process. The principal disadvantages are the area of land required and the possibility of discharging an effluent with a high algae content. Dissolved-air flotation can deal with periodic excessive loss of solids from secondary settlement tanks. (Baker-FRC)
W82-03228

SAND-FILTER TRENCHES FOR PURIFICATION OF SEPTIC TANK EFFLUENT: I. CLOGGING MECHANISM AND SOIL PHYSICAL ENVIRONMENT,

Norges Landbrukshoegskole, Vollebekk. Dept. of Microbiology.
R. Kristiansen.
Journal of Environmental Quality, Vol 10, No 3, p 353-357, July-September, 1981. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Sand filters, *Wastewater treatment, *Clogging, Filters, Sand, Physical properties, Soil physical properties, Soil chemistry, Ponding, Temperature effects, Soil water, Carbon, Nitrogen, Oxidation-reduction potential, *Septic wastewater, *Norway.

The Norwegian manual of septic tank practice prescribes a 20-meter artificial sand-filter trench per family-house for areas in which the soil is not suitable for direct disposal of septic tank effluent. Although the phenomenon of clogging in such disposal systems has been studied, the effects of clogging on purification efficiency have not been stressed. The relationship between clogging and soil physical and chemical environment in sand filter trenches was investigated over a 17-month period. Trenches were loaded with septic tank effluent at a rate of 4 to 6 cm/day (A and C) or 12 to 18 cm/day (B). Ambient temperatures of 4 to 16 C were maintained in trenches B and C, while the temperature in A was 12 to 15 C. Sand surface clogging and ponding occurred in the end of the filters where septic tank effluent concentrated. Ponding rates and crust resistances were highest for trench A, at 0.33 square meters per month and 35 days, respectively, and lowest for trench C, at 0.16 square meters per month and 4 days, respectively. The carbon/nitrogen ratio in the crust zone was similar to that in the rest of the sandfill. About 0.74 percent of the pore volume in the clogged layer of trench A was occupied by bacterial cells. Production of extracellular slimy material was probably dependent on temperature. Soil water content below the crust zone decreased with increasing clogging intensity. The increased clogging led to improved aeration, as shown by gas and redox measurements. Low redox potential values of less than 0 mV and oxygen contents below 2 percent were found mostly in the crusted zone of unit A, although they were also regularly found down to 30 centimeters in the clogged end of unit C. Nitrogen contents of up to 93 percent were found in sand filter zones containing less than 1 percent oxygen. N20 contents above the detection limit of 200 parts per million were not found in any of the filters. (Carroll-FRC)
W82-03238

SAND-FILTER TRENCHES FOR PURIFICATION OF SEPTIC TANK EFFLUENT: II. THE FATE O[illegible]TROGEN,

Norway [illegible]cultural Research Council, Aas.
R. Kristiansen.
Journal of Environmental Quality, Vol 10, No 3, p 358-361, July-Septmeber, 1981. 2 Fig, 1 Tab, 20 Ref.

Descriptors: *Nitrogen, *Sand filters, *Wastewater treatment, Filters, Sand, Oxidation-reduction potential, Soil properties, Nitrification, Temperature effects, Clogging, Biomass, *Septic wastewater, *Norway.

It has been suggested that septic systems in some areas contribute to the nitrogen content of groundwater. Nitrogen turnover in sand-filter trenches, important factors affecting nitrogen turnover, and the potentials of these filters for nitrogen removal were investigated as part of a 17-month study of sand-filter trenches. Trenches were loaded with septic tank effluent at a rate of 4 to 6 centimeters per day (A and C) or 12 to 18 centimeters per day (B). Ambient temperatures of 4 to 16 C were maintained in trenches B and C, while the temperature in A was 12 to 15 C. This study found that only insignificant amounts of nitrogen were removed from the effluent passing through the filters. During the cold seasons nitrification was significantly affected by the sand temperature. In trenches B and C, which had the lowest clogging intensities, nitrate was mostly found near the bottom air vent, while in A, which had the highest clogging intensity, nitrification occurred between 7.5 and 27 centimeters below the crust. Nitrogen bound in the microbial biomass, absorbed to the cation exchange complex, and bound in dead organic material could amount to about 3 months of nitrogen loading from a single-family home to a standard 20-meter sand filter trench. This nitrogen is only temporarily removed and will be subsequently nitrified and leached out. It appears that denitrification does not occur in continuously loaded sand filters. Potential means of improving denitrification in septic systems include intermittent loading or recycling of nitrified effluent. (Carrol-FRC)
W82-03239

DULUTH SANITARY DISTRICT FIRST IN U.S. TO TAKE CHARGE OF BOTH SEWAGE AND REFUSE.

For primary bibliographic entry see Field 5E.
W82-03249

MUNICIPAL WASTEWATER TREATMENT PLANT PIONEERS IN CONSERVATION APPROACH,

Pirnie (Malcolm) Inc., White Plains, NY.
R. F. Bonner, Jr.
Civil Engineering (New York), Vol 50, No 7, p 57-59, July, 1980. 3 Fig.

Descriptors: *Energy conservation, *Waste heat, Heat budget, Wastewater treatment facilities, Skimming, Fuel oil, Design criteria.

Energy conservation equipment has been incorporated into the expansion designs for the Southerly Wastewater Treatment Plant in the Northeast Regional Sewer District, Cleveland. Although the conservation technology used at this plant is not new, it is believed that this is the first municipal treatment plant to use this combination of features. Designs include 10 treated effluent water-to-water heat pumps and 6 exhaust air energy wheels to provide heat for 13 buildings, saving 450,000 gal of fuel oil annually. The skimmings recovery is expected to save 2.75 million gal of oil annually, and the waste heat recovery system, 1.18 million gal. (Cassar-FRC)
W82-03255

IMPROVED PERFORMANCE IN COMBINED NITRIFICATION/DENITRIFICATION OF TANNERY WASTE,

Science and Education Administration, Philadelphia, PA. Eastern Regional Research Center.
C. C. Panzer, M. Komanowsky, and G. E. Senske.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1434-1439, September, 1981. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Tannery wastes, *Nitrification, *Denitrification, *Nitrogen removal, Industrial wastewater, Wastewater treatment, Biological treatment, Nitrates.

Over of 97% total Kjeldahl nitrogen (TKN) and 93% of soluble COD were removed from a lime sulfide unhairing effluent, which had been physically and chemically pretreated, in a laboratory scale combined nitrification/denitrification process. In six test runs, influent TKNs were 171-240 mg per liter; influent COD, 1039-1649 mg per liter. In the process the waste is nitrified in the aerobic zone and then returned to the anoxic zone for denitrification. The higher the rate at which the aeronic mixed liquor is returned to the anoxic zone, the greater the degree of nitrate removal, which in these runs ranged from 0.13 - 0.17 mg N per mg per day. A high influent COD produced better nitrate removal. The high rate and degree of nitrate removal in the first stage was enhanced in the laboratory system by limiting the rate of aeration in the last aerobic stage and sparging the anoxic zone with nitrogen gas. Although this would not be practical on a commercial scale, several possible alternatives are suggested. (Cassar-FRC)
W82-03277

MUNICIPAL SEWAGE: THREE COMMUNITIES TRY TO COPE,

A. Morrison.
Civil Engineering (New York), Vol 50, No 9, p 90-94, September, 1980. 3 Fig.

Descriptors: *Municipal wastewater, *Wastewater facilities, *Combined sewers, Milwaukee, Wisconsin, San Francisco, California, Winnipesaukee River, New Hampshire, Wastewater treatment, Sewer systems, Overflow, Legal aspects, Judicial decisions, Wastewater disposal, Effluent standards, Water pollution prevention, Water quality control, Cost-benefit analysis.

The City of Milwaukee is appealing to the Supreme Court for relief from the stringent antipollution requirements imposed by the Federal District Court. The decision ordered the city to upgrade its treatment system to the tertiary level and abate all combined sewer overflows by 1989, with all other overflows abated by 1986. The $1.6 billion master plan, which the city hopes will not have to be fully implemented, includes a collection, storage, and treatment plan to handle combined and separate sewer overflows. In addition to rehabilitating existing sewers and treatment plant, the plan calls for 460 miles of new storm sewers, 2 miles of new sanitary sewers, storage facilities, 2 major interceptor sewers, smaller interceptor and relief sewers, and a storage cavern built under the municipal stadium. San Francisco is working on a $2.3 billion three-stage plan for treatment and combination of primary and secondary effluents to discharge into the ocean. New Hampshire's Winnipesaukee River Basin project ($65 million) is designed to improve lakes for tourist and recreation purposes. At the project's completion in 1982, all secondary effluent will be discharged into the Merrimac River rather than into lakes where algal blooms have been troublesome. (Cassar-FRC)
W82-03284

EFFICIENCIES OF ADVANCED WASTE TREATMENT OBTAINED WITH UPGRADED TRICKLING FILTERS,

Brown and Caldwell, Eugene, OR.
D. P. Norris, D. S. Parker, M. L. Daniels, and E. L. Owens.
Civil Engineering (New York), Vol 50, No 9, p 96-101, September, 1980. 5 Fig, 3 Tab, 2 Ref.

Descriptors: *Trickling filters, *Solids contact processes, *Advanced wastewater treatment, Wastewater treatment, Corvallis, Oregon, Effluents, Biological oxygen demand, Suspended solids, Sludge, Clarification.

The trickling filter process, combined with solids contact clarification, can consistently produce an effluent quality meeting EPA's definition of secondary treatment. In plant-scale tests at Corvallis, Oregon, BOD5 and suspended solids of less than 10 mg per liter were obtained at filter loadings of 30 lb BOD5 per 1000 cu ft per day or less and 15 mg per liter at 40 lb BOD5 per 1000 cu ft per day. The waste secondary sludge is exceptionally dense and can be wasted directly to primary sedimentation, eliminating thickening. Optimum mixed liquor solids concentration is 1500 mg per liter. This low-cost, trouble-free, low-energy process may enable many existing trickling filter plants to upgrade their efficiency to meet today's standards with minimum capital outlay. (Cassar-FRC)
W82-03285

ARTIFICIAL PARTICULATE FOULING OF HYPERFILTRATION MEMBRANES IV. DYNAMIC PROTECTION FROM FOULING,

Rensselaer Polytechnic Inst. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 3A.
W82-03288

WATER COST ENCOURAGES REUSE AND CONSERVATION,

Pirnie (Malcolm) Inc., White Plains, NY.
G. P. Westerhoff.
Consulting Engineer (St. Joseph), Vol 57, No 3, p 87-90, September, 1981. 1 Fig.

Descriptors: *Water reuse, *Reclaimed water, *Water costs, Water management, Water conservation, Wastewater reuse, Water supply, Water shortage, Cooling water, Irrigation water, Steel industry, Prices, Industrial water, Legislation.

Water reuse is practiced extensively in the U.S. and other countries and can be expected to receive more attention as water supply problems and higher water prices occur. Water is directly reused in irrigation, recreation, groundwater recharge, and industry. Reclaimed wastewater is used in treatment plants for addition to potable supplies and for cooling water. Current industrial reusers are steel manufacturers, refineries, power plants, and chemical manufacturers. Water reuse projects are often difficult to implement because so many government agencies are involved. Computer models are helpful in formulating regional plans, which are more effective than local plans. Dual or plural water quality schemes offer economic advantages and stretch the supply. Water prices should more closely reflect actual costs of treatment, storage, and transmission to encourage reclamation and conservation. The Office of Water Recycling, created in 1977, sponsors research and development on major industrial reuse applications. However, funds for this office are expected to be reduced in future budgets. (Cassar-FRC)
W82-03295

GAO FINDS MASSIVE FAILURE OF WASTEWATER TREATMENT PLANTS,

A. Morrison.
Civil Engineering (New York), Vol 51, No 4, p 74-76, April, 1981. 1 Tab.

Descriptors: *Effluents, *Discharge(Water), *Water pollution, *Design, *Wastewater treatment facilities, Wastewater treatment, Legislation, Regulations, Governments, Engineering.

A recent report from the General Accounting Office of Congress states that more than half of America's municipal waste water treatment plants are not functioning according to design. Effluents from 242 randomly selected plants were monitored. Between 1978 and 1979, 87% of these plants violated their discharge permits, 31% seriously. There are many reasons for plant failure: inferior equipment substituted under the federal procurement regulations 'or equal' clause, inadequately trained operations personnel, infiltration/inflow, and design failures. Accountability for these failures is difficult to fix, and the EPA has been reluctant to encourage legal action for several reasons. The final result is that Federal and State governments spend millions of dollars to bring treatment plants up to standard. (Cassar-FRC)
W82-03299

USE OF ADENOSINE TRIPHOSPHATE IN BIOLOGICAL PURIFICATION SYSTEMS (IN FRENCH),

Rennes Ecole Nationale Superieure de Chimie (France).
G. Martin, S. H. Nam, O. Vitrac, and M. Reinbold.
Water Research, Vol 14, No 4, p 379-387, April, 1980. 8 Fig, 1 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Adenosine triphosphate, *Activated sludge, Activated sludge process, Suspended solids, Biological wastewater treatment, Biomass, Organic loading.

The variation in adenosine triphosphate (ATP) of an activated, aerobic non-nitrifying sludge was determined as a function of the bulk loading under constant conditions. The study was intended to resolve the difficulty caused by different biological activity of microorganisms and the inactive particles included in determining biomass in purification units. Under steady state conditions the ATP content per unit of volatile suspended substances (VSS) of the sludges is a function of the bulk loading. The ATP amount is connected to the rate of active biomass, and is an indicator of the elimination of organic pollution. With organic supplementation the ATP level is relatively constant, but otherwise the variation is significant. A system functioning with a bulk loading of 0.5 based on COD can tolerate an organic or hydraulic overload of at least three-fold for a short time without difficulty. The ATP/VSS ratio was determined under a constant bulk loading and at a charge which varied from 0.44 to 9.4 kg COD/day/kg VSS. Measurements of ATP can be used to predict effects of biological accidents at a station, e.g., aeration interruption, a sudden load variation, or accidental arrival of contaminants. (Hertzoff-FRC)
W82-03302

DIRECT INFLUENCE OF WASTEWATER POLLUTANTS ON FLOCCULATION AND SEDIMENTATION BEHAVIOR IN BIOLOGICAL WASTEWATER TREATMENT-I. MODEL SYSTEM E. COLI B,

Swedish Inst. for Surface Chemistry, Stockholm.
L. Eriksson, and C. Axberg.
Water Research, Vol 15, No 4, p 421-431, April, 1981. 15 Fig, 2 Tab, 50 Ref.

Descriptors: *Sedimentation, *Escherichia coli, *Activated sludge, Flocculation, *Wastewater treatment, Colloids, Coagulation, Model studies, Pollutants, Biological treatment, Metabolism.

To obtain a high quality effluent when using the activated sludge process of waste water treatment, effective sedimentation is required. the rate of sedimentation depends upon the composition of pollutants in the waste water, the composition of the microbial flora, and the operational parameters of the treatment system. The metabolic activities, surface properties of the cells, and their release of polymeric materials should also be considered. A study was conducted on the effects of selected pollutants in waste water on the flocculation process to clarify the colloid chemical processes using the model system, Escherichia coli B. The amount of extracellular polymeric material present in the system affected the coagulation by neutral salts and the degree of influence of the model pollutants tested. For several of the pollutants tested, marked effects on sedimentation were noted when the cells were undergoing slow coagulation close to the critical coagulation concentration. These findings were attributed to the interactions between extracellular polymers and pollutants affecting the cellular bridging. (Geiger-FRC)
W82-03319

INDUSTRIAL WASTEWATER AUDIT,

Donohue and Associates, Inc., Sheboygan, WI.
M. L. Crosser, and J. Turk.
Industrial Wastes, Vol 26, No 3, p 22-24, 36, May/June, 1980. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Industrial wastes, *Steel industry, *Wastewater treatment, Aerated lagoons, Lagoons, Suspended solids, Heavy metals, Phosphorus, Evaluation, Wastewater analysis.

An industrial wastewater audit is an organized determination of the source, quantity, composition and chemistry of each wastewater stream at an industrial facility. The purpose of the audit is to develop the data base required to decide which combination of actions, including process changes, process water recycling and final treatment, will provide compliance with discharge standards at minimum cost and with minimum disruption of production. The requirements for such an audit and a case history of an audit are presented. The example cited is a stainless steel products manufacturing company. Five major steps compose an audit: understanding the processes and staff relationships, planning the flow monitoring sampling and analysis program, conducting the actual program, evaluating the data obtained, and writing the report. Wastewater treatment at this particular audit site was provided by an aerated lagoon, and waste loads were reduced by installing an evaporator to concentrate electropolishing rinsewater for chemical recovery. The audit results suggested that a program be devised to repair the plumbing, reduce process water usage, and divert clean water from the process wastewater sewer, resulting in a reduction of process wastewater from 80,000 to about 55,000 Gpd. An alternative to the phosphorus-containing alkali cleaning compound was selected. Methods for dealing with heavy metals

were reevaluated. A method to capture overflow from the alkaline washers was placed under study. (Baker-FRC)
W82-03337

OPERATION REPORTS--CITY OF PUEBLO, COLORADO DEPARTMENT OF PUBLIC WORKS.

Journal of the Water Pollution Control Federation, Vol 53, No 6, p 1149-1150, June, 1981. 4 Tab.

Descriptors: *Operating costs, *Wastewater treatment, *Pueblo, *Colorado, Anaerobic digestion, Municipal wastewater, Energy conservation, Methane, Sludge disposal, Stormwater.

The City of Pueblo, Colorado, treated 18.47 million cu meters (4.88 billion gallons) of wastewater at an average daily rate of 50,400 cu meters during 1980. An average of 2500 cu meters of methane was produced daily in the anaerobic digestion process. Effluent contained an average 21.8 mg per liter suspended solids, 32.5 mg per liter BOD, 6.74 mg per liter dissolved oxygen, 7.6 pH, 18.3 mg per liter ammonia, and 301.4 per 100 ml fecal coliforms. Cost per million gallons treated was $118. (Cassar-FRC)
W82-03348

WASTEWATER TREATMENT: CORROSION SOLUTION ARE AS VARIED AS PROBLEMS,

Engineering Science, Inc., Atlanta, GA.
For primary bibliographic entry see Field 8G.
W82-03350

ENGINEERS ASSESS AQUACULTURE SYSTEMS FOR WASTEWATER TREATMENT,

Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Reed, R. K. Bastian, and W. J. Jewell.
Civil Engineering (New York), Vol 51, No 7, p 64-67, July, 1981. 4 Fig.

Descriptors: *Aquaculture, *Wastewater treatment, Water treatment facilities, Water hyacinth, Duckweed, Wetlands.

An overview of wetland processes and aquatic plant systems is presented. Wetlands are defined as land where the water table is at or above the surface of the land long enough each year to maintain saturated soil conditions and growth of related vegetation. At present, wetland systems are generally limited to further treatment of secondary effluents. In a few cases primary effluent has been applied in constructed systems. Bacteria attached to plant stems and humic deposits are assumed to be the major factor for biological oxygen demand and nitrogen removal when plant harvesting is not practiced. Plant production plays a more significant role in nutrient removal when harvesting is included. For natural wetlands, major costs and energy requirements involved are significantly lower than if a wetland is constructed. One drawback of natural wetlands is that it is more difficult to control the process because of natural variability within the system. Health risks for wetland systems are probably not higher than for conventional treatments, assuming that insect vectors are controlled and harvested materials are not used for direct human consumption. Information on systems that use free floating aquatic plants for treating wastewater is limited to the use of either water hyacinths or duckweeds. Such systems are generally similar in concept to wastewater treatment-pond technology. Water hyacinth systems are able to remove high levels of BOD, suspended solids, metals and nitrogen, plus significant removal of refractory trace organics. The root systems support a very active mass of organisms that assist in treatment. (Baker-FRC)
W82-03354

THE FATE OF ORGANIC MICROPOLLUTANTS THROUGH AN INTEGRATED WASTEWATER TREATMENT WATER RECLAMATION SYSTEM,

National Inst. for Water Research, Pretoria (South Africa).
J. F. J. Van Rensburg, A. Hassett, S. Theron, and S. G. Wiechers.
Water Science and Technology, Vol 13, No 1, p 537-552, 1981. 3 Fig, 7 Tab, 20 Ref.

Descriptors: *Organic compounds, *Water reclamation, *Fate of pollutants, Wastewater treatment, Water treatment, Trihalomethanes, Pesticides, Insecticides, Trace levels, Polynuclear aromatic hydrocarbons, Phenols, Chlorinated hydrocarbons, Activated carbon, Adsorption, *South Africa.

An integrated wastewater treatment/water reclamation system (a modified lime flotation biological pilot plant), produced a final water superior in quality to water supplies in three South African cities as well as to the final effluent from a nonintegrated system. Potentially hazardous organic micropollutants were added to the feedwater at concentrations of 40 micrograms per cu dm for each compound. Effluents from each process step were analyzed to monitor the removal. The final effluent contained 0.8 micrograms per cu dm dibutyl phthalate (probably from the plastic pipe used in the pilot plant) and 2.6 micrograms per cu dm of total volatile halogenated hydrocarbons. Each step in the treatment process removed a percentage of the organic pollutants from the effluent of the preceding step as follows: dentrification, 37%; chemical clarification, 35%; nitrification pond and biological clarifier, 69%; prechlorination, 21%; roughing filter and dual media filter, 34%; activated carbon adsorption, 89%. Certain materials were removed selectively in certain steps of the process. Denitrification and chemical clarification removed a large percentage of most compounds. The biological clarifier reduced remaining naphthalene, dichlorvos, anthracene, m-cresol, chlorophenol, and beta-naphthol to nondetectable concentrations. Prechlorination removed the residual trichlorophenol; and filtration, the residual acenaphthene and hexadecane. Activated carbon served as a safety barrier to remove final traces of other organic compounds. Shock loads of 40 micrograms per cu dm of each of the 19 compounds for 30 hours resulted in complete removal of these compounds with no apparent ill effects on the plant. (Cassar-FRC)
W82-03364

THE DEEP-SHAFT PROCESS: BRIGHT FUTURE FOR TREATING HIGH-STRENGTH WASTEWATERS,

Civil Engineering (New York), Vol 51, No 5, p 74-76, May, 1981. 1 Fig.

Descriptors: *Wastewater treatment, Deep-shaft process, *Economic aspects, Primary treatment, Secondary treatment, Bacteria, Industrial wastes, Municipal wastes.

A new wastewater treatment process is described which makes use of a deep shaft, a process promising to cut land use 10-30% and power cost as well. Raw wastewater is injected into this deep shaft, where the high water pressure forces air bubbles into solution. The method is being tried at a New York wastewater treatment plant. In these underground aeration tanks air is added to the wastewater and bacteria break down the wastes. In the deep shaft process primary treatment is usually eliminated. Raw sewage is injected directly into the deep shaft, 40% of the way down, or at a depth of 200 feet. The wastewater travels down the inside of the downcomer pipe to the bottom of the shaft and then up through the annual space between pipe and shaft walls. The wastewater is moved round and round inside the shaft by compressed air bubbles injected about 40% of the way down the shaft. An individual slug of wastewater makes several cycles before being drawn off to the surface for clarification. Virtually all of the air that is injected into the wastewater column goes into solution, as dissolved oxygen, dissolved nitrogen, and other gases. Chief advantages are space saved, lack of need for primary treatment, production of a floated sludge that is much higher in solids concentrations than the sludge that settles out in a gravity clarifier, and apparent quick recovery from shock loadings. (Baker-FRC)
W82-03376

SEPTIC SEWAGE SYSTEMS CONTAMINATE GROUND WATER.

For primary bibliographic entry see Field 5B.
W82-03378

ANAEROBIC SLUDGE DIGESTION--NEED IT BE EXPENSIVE,

Severn Trent Water Authority (England).
C. E. Brade, and G. P. Noone.
Effluent and Water Treatment Journal, Vol 21, No 9, p 391-393, 395-397, 399-401, 403-406, September, 1981. 6 Fig, 5 Tab, 52 Ref.

Descriptors: *Sludge digestion, *Cost analysis, *Anaerobic digestion, Biodegradation, Digestion, Sludge, Anaerobic conditions, Biological treatment, *Wastewater treatment, Severn-Trent Waterway, United Kingdom.

Recent work carried out within the Severn-Trent Water Authority with the aim of improving and extending treatment processes while minimizing the resultant capital and revenue requirements is reported. The work resulted in several conclusions. It appeared that in the case of anaerobic digestion, failure to operate at maximum process efficiency was not due to biological overload, but rather to an inability within current operation to exploit the activities of the microorganisms. The approaches have been to uprate the processing input so that the biological process becomes rate limiting, rather than the physical factors of mixing, temperatures or seeding. Full scale plant investigations demonstrated that great scope exists to reduce the cost of anaerobic digestion by several methods. The first method calls for uprating the existing digestion plant, principally by improved mixing and heating, where examination shows the plant to be inadequate. Another method indicates that small to medium sized digestion centers can be cheaply acquired by changing the use of various available tanks, especially in semi-rural works. Finally, new green-field digestion plants should have much lower volumetric provisions, with more emphasis placed on process equipment and higher levels of standby equipment than is currently provided. Digestion improvement is not restricted to the primary reactor. Attention should also be given to the increase of input solids level and subsequent consolidation. One requirement for a more efficient process is closer plant control, involving more process analyses. (Baker-FRC)
W82-03389

CONTINUOUS ION EXCHANGE: A SURVEY OF RECENT APPLICATIONS,

M. J. Slater.
Effluent and Water Treatment Journal, Vol 21, No 9, p 416-418, 420-422, September, 1981. 8 Fig, 16 Ref.

Descriptors: *Ion exchange, *Wastewater treatment, Resins, Water treatment, Industrial wastes, Radioactive wastes, Design criteria, Wastewater facilities.

This article surveys the main types of apparatus and their important design features for continuous ion exchange systems. The major industrial types of moving packed bed and fluidized bed plants are described. While various industrial applications of moving packed bed plants have been planned, the impact on the water treatment industry is not marked. The chemical efficiency of fixed bed plants can be made to approach that of continuous plants by using counter-flow regeneration or the merry-go-round principle. Continous plants need to be made cheaper so that they can be used on a smaller scale, and the reliability, although high, perhaps needs to be demonstrated more clearly and improved further. Fluidized bed plants have a part to play in treating dirty waste streams or ore leach solutions and have become accepted, but further simplification is desired to make recovery of low value solutes economically worthwhile. (Baker-FRC)
W82-03391

KINETICS OF PHENOL OXIDATION BY WASHED CELLS,

University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
W. Sokol, and J. A. Howell.
Biotechnology and Bioengineering, Vol 23, No 9, 2 fig, 6 Tab, 13 Ref.

Descriptors: *Phenol, *Oxidation, *Bacteria, Pseudomonas putida, *Fate of pollutants, *Wastewater treatment, Model studies, Microorganisms, Fermentation, Kinetics, Monod-Haldane equation.

A model was developed to predict the uptake of phenol by organisms growing in continuous culture on phenol in the high conversion range. Uptake rates of Pseudomonas putida per unit biomass per unit time were determined at phenol concentrations of 5 to 1000 mg per liter at intervals of 2.7 to 8 hours. The best fitting model was a 2-parameter simplification of the Monod-Haldane model. One parameter remained fairly constant with changes in growth conditions, while the other increased monotonically with phenol concentrations in the chemostat. The apparent threshold for induction was 0.1 mg per liter phenol. (Cassar-FRC)
W82-03399

5E. Ultimate Disposal Of Wastes

SLUDGE MANAGEMENT PROCESS INTEGRATION,

Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5D.
W82-03130

OZONE FOR THE TREATMENT OF HAZARDOUS MATERIALS,

Jacobs Engineering Group, Washington, DC.
For primary bibliographic entry see Field 5D.
W82-03139

DULUTH SANITARY DISTRICT FIRST IN U.S. TO TAKE CHARGE OF BOTH SEWAGE AND REFUSE.

Civil Engineering (New York), Vol 50, No 6, p 60-63, June, 1980. 2 Fig.

Descriptors: *Fluidized bed process, *Incineration, *Solid wastes, Wastewater treatment facilities, *Diluth, Minnesota, Activated sludge process, *Waste disposal, Advanced wastewater treatment, Oxygenation, Water quality, Wastewater disposal.

The Western Lake Superior Sanitary District, serving Duluth, Minnesota, is the first sanitary district in the U.S. to handle disposal of both wastewater and municipal refuse. A pure oxygen activated sludge process is used. Since the 45 mgd central advanced wastewater treatment plant went on stream in 1978, the water quality in the St. Louis River and St. Louis Bay has improved dramatically. Effluent from the plant has 10-12 mg per liter BOD and 10-12 mg per liter suspended solids, a higher quality than the state requires. Refuse is chopped to a final size of 1.5 in. and is air-separated into light and heavy fractions. The light, combustible fraction is coincinerated with sludge in a fluidized bed reactor, saving over $3 million in fuel costs alone. (Cassar-FRC)
W82-03249

GROUNDWATER CONTAMINATION BY CHLORINATED HYDROCARBONS: CAUSES AND PREVENTION,

Environmental Protection Agency, Philadelphia, PA.
H. G. Byer, W. Blankenship, and R. Allen.
Civil Engineering (New York), Vol 51, No 3, p 54-55, March, 1981. 3 Fig, 1 Tab.

Descriptors: *Chlorinated hydrocarbons, *Industrial wastes, *Water pollution control, Nitroglycerine trap, *Waste disposal, Ultimate disposal, Organic compounds, Aquifers, Path of pollutants, Soil contamination, Disposal, Waste storage, Landfills.

Chlorinated hydrocarbons, such as trichloroethylene, chloroform, and tetrachloroethane, have wide use in the U. S. in industry and in the home as solvents, degreasers, cleaning agents, etc. Waste treatment and disposal of these organic compounds, 4.6 million tons of which were produced in 1978, is difficult because of their high density and limited solubility in water. Unlike lighter oils, these dense compounds sink to the bottom of a stream, lake, pond, or landfill, thus becoming readily available for penetration into the underground aquifer. To prevent such contamination, industrial work places should have concrete floors, sloped to direct spills, and a 'nitroglycerine trap' to prevent material from escaping into sewers, streams, and the ground surface. Any wastewater holding pond or lagoon should be lined with impervious material to prevent groundwater contamination. Improper disposal or spills of chlorinated hydrocarbons may violate the Safe Drinking Water Act, the Toxic Substance and Control Act, the Solid Waste Management Act, the Resource Conservation and Recovery Act, and the Clean Water Act Amendment. (Cassar-FRC)
W82-03300

MODERN MANAGEMENT TECHNIQUES, PART II A: CASE HISTORY OF PRODUCTION IMPROVEMENT,

LWFW, Inc., Dallas, TX.
For primary bibliographic entry see Field 6A.
W82-03310

COMPLETION OF THE LIST OF ANALYTICAL SOLUTIONS FOR NUTRIENT TRANSPORT TO ROOTS 1. EXACT LINEAR MODELS,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
J. H. Cushman.
Water Resources Research, Vol 16, No 5, p 891-896, October, 1980. 4 Fig, 27 Ref.

Descriptors: *Model studies, *Soil-water-plant relationships, *Nutrient transport, *Root systems, Nutrients, Mathematical models, Ultimate disposal, Disposal, Waste disposal, Solutes.

Solutions to a linear transport model for nutrient or waste flow to roots are presented in connection with solid and liquid waste storage in the ground and protection of water supplies. A root is imagined as a cylinder with large length compared to its radius and is studied individually. The solutions include no interroot competition and various types of interroot competition. They extend to nutrient flow at high and low concentrations. A subsequent paper will examine the sensitivity of these solutions to various parameters. (Cassar-FRC)
W82-03327

NOTE ON DESIGN OF DIFFUSERS FOR SEWAGE OUTFALLS BASED ON THE WORK OF RAWN ET AL.,

Waterloo Univ. (Ontario). Dept. of Man-Environment Studies.
E. J. Farkas.
Journal of Environmental Science and Health, Part A, Environmental Science and Engineering, Vol 16, No 2, p 251-257, 1981. 2 Tab, 11 Ref.

Descriptors: *Outfall sewers, *Wastewater disposal, *Design criteria, Lakes, Lake Ontario, Effluents, Sewage, Water currents.

A specific case is reviewed in which the design of a diffuser for a sewage outfall was based on the work of Rawn et al., in the hopes that future designers may benefit from certain questionable aspects of this design. The diffuser and sewer outfall in question were designed in 1974 and 1975. The outfall was intended to serve a new sewage treatment plant which was to accept sewage from a large area east and north of Toronto, Canada. The outfall takes sewage treatment plant effluent out into Lake Ontario via a 1000 meter tunnel bored in rock on the bed of Lake Ontario. Diffuser ports are arranged along the outer 150 meters of the tunnel. Vertical borings were made at even spacings along the tunnel, and the sewage effluent is released horizontally at the floor of the lake via nozzles, more than 6 meters below the lake surface. The first question which arises concerns the adaptability of the work of Rawn to fresh water, since the original work was designed for sea water. Another question pertains to the presence or absence of currents in the receiving water body. A very large margin of safety must be incorporated for cases in which there is any period of low- or no-current conditions in the receiving water. (Baker-FRC)
W82-03347

ENTRENCHMENT OF SEWAGE SLUDGE–A DISPOSAL-USE ALTERNATIVE,

Science and Education Administration, Washington, DC.
L. J. Sifora, and D. Colacicco.
Civil Engineering (New York), Vol 50, No 4, p 80-82, April, 1980. 2 Fig, 5 Tab, 6 Ref.

Descriptors: *Trenches, *Sludge disposal, *Land application, Metals, Food chains, Microorganisms, Crop production, Environmental effects, Bacteria, Fate of pollutants, *District of Columbia area.

An alternative disposal method for sewage sludge from the Washington, D.C., metropolitan area involves placing undigested sludge in trenches. The disposal rate is 1000-1300 wet tons per acre. Little odor and no surface runoff results. A sludge volume of 200-400 wet tons per day is handled using concrete mixer trucks, trenching machines, and pumping equipment. Sludge at 22% solids content is placed in a trench about 24 inches wide and 3 ft deep, on 3.9 ft centers. An interval of 4.9 ft or more between sludge and highest groundwater level is necessary. The trenching machine immediately follows the disposal trucks, covering the filled trench with soil dug from an adjacent trench. The surface is stabilized by leveling and applying lime, fertilizer, and grass seed. Corn grown on one of these sites 1 year after entrenchment had slightly higher Zn and Cu, but metal levels were within the range of levels found in corn grown with commercial fertilizers. However, sludges and crops vary, and no general statement on metal uptake or crop yield can be made. Trench plots monitored over a 5 year period showed little metal leaching. After 3 months fecal coliforms decreased by 5 to 7 log reduction and total coliforms by 2-3 log reduction. Salmonella and indicator virus (f2) were undetectable. Total coliforms remained elevated in the soil near the sludge-soil interface for 1 year. Estimated cost for the 400 ton per day operation in Washington is $24.40 per wet ton (1978 dollars). (Cassar-FRC)
W82-03353

COMPOSTING RESULTS IN LOS ANGELES,

R. T. Haug, and B. Davis.
BioCycle, Vol 22, No 6, p 19-24, November-December, 1981. 9 Fig, 7 Ref.

Descriptors: *Sludge, *Composting, Land disposal, Odors, *Sludge disposal, Organoleptic properties, *Wastewater treatment, Energy conservation, Municipal wastewater, Planning, Design criteria, Incineration, *Los Angeles, California.

The composting systems which will be a major part of the planned program for sludge management in the Los Angeles/Orange County Metropolitan area are discussed. When the LA/OMA project started, windrow composting was thought to offer many advantages, with the major disadvantage being the need for large land areas. Initial efforts were therefore directed at cutting back the needed land areas and reducing the dependence on other bulking agents or amendments. Four years later air drying of digested, dewatered sludge was tested on about 20 acres of land. Dewatered sludge was placed into long piles about 0.3 meters deep and turned periodically to enhance air drying and reduce the moisture content to less than 50% prior to landfill disposal. Actual operating experiences during wet weather confirmed the expected problems and emphasized the importance of wet weather operation. The LA/OMA operating agencies have substantial anaerobic digestion facilities and use the resultant digester gas to partially satisfy treatment plant power demands. Continued use of digester gas is a cost-effective approach to meeting treatment plant power demands. The feasibility of

composting digested sludge in rectangular bins about 3 meters deep was studied. A fully equipped, pilot scale, enclosed reactor composter was also studied. Composting and reuse was judged to have good prospects for inclusion in an overall sludge managment program. However, wet weather problems and odor and dust problems are still to be overcome. (Baker-FRC)
W82-03400

5F. Water Treatment and Quality Alteration

ON WATER AVAILABILITY AND DEMAND IN NIGERIA,

Ibadan Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 6D.
W82-03062

AN INTRODUCTION TO INDUSTRIAL WATER TREATMENT,

R. Hill.
Water Services, Vol 85, No 1026, p 399-402, 1981. 4 Fig.

Descriptors: *Water treatment, *Industrial water, Scale, Corrosion, Water quality, Quality control, Chemical reactions, Water hardness, Cooling towers, Sludge.

Water has a variety of uses in industry; for many of these uses it requires additional treatment beyond that received at the municipal water works. Problems arising out of the impurities remaining in the water after regular treatment fall mainly into the category of scale and corrosion. Scale occurs extensively in heating and steam raising plants and also in cooling towers. Scale is the result of the presence in the water of salts of calcium and magnesium, and hardness salts. Corrosion is the loss of metal from the structure containing the water and can happen through erosion, dissolving, and galvanic corrosion. The two distinct areas of water treatment are internal and external. Internal involves the addition of chemicals to a system to inhibit the reactions which cause scale and corrosion. External methods use specially designed items of equipment to remove the impurities which cause the problems. Scale inhibiting chemicals act by allowing hardness salts to precipitate as microcrystals and then adsorbing onto the surface of the crystals to prevent them growing into scale. Corrosion inhibitors work by preventing either or both of the half cell reactions from proceeding. For external processes which remove the impurities, the problem of disposing of them still remains. Sludge from settling tanks, backwash water from filters, and regenerant streams from ion exchange units all contain a high concentration of the impurities that the unit was removing. These effluents have to be disposed of, and this may well create a whole new field of problems to be considered. (Baker-FRC)
W82-03071

DESIGN AND FABRICATION OF A LOW COST PACKAGE WATER TREATMENT PLANT FOR RURAL AREAS IN INDIA,

Visvesvaraya Regional Coll. of Engineering, Nagpur (India). Dept. of Public Health Engineering.
A. G. Bhole.
Aqua, No 5, p 315-320, 1981. 10 Fig, 5 Tab, 18 Ref.

Descriptors: *Developing countries, Package plants, *Rural areas, *India, *Water treatment facilities, Design criteria, Pebble bed flocculators, Flocculation, Plate settlers, Settling tanks, Filtration, Chlorination.

A low cost package plant for treating surface waters is presented. Its operation requires no mechanical equipment or electric power except for a diesel pump. The plant does not need a skilled operator, because it is simple to operate and maintain. The design includes an alum dosing unit (large plastic bucket), a tapered pebble bed flocculator which subjects the water flow to decreasing velocity gradients, plate settlers (require one tenth the detention time of conventional clarifiers), a rapid sand filter unit, and a bleaching powder chlorination unit (plastic bucket). The plant, which costs about 1150 pounds sterling, may be easily transported to the desired site. Design for this plant was based on a population of 1000 using 90 liters per hour per day, raw water with average turbidity of 100 NTU, and operation for 8 hours a day initially. (Casser-FRC)
W82-03115

NEW TECHNIQUES TO REMOVE RADON FROM GROUND WATER.

Water Well Journal, Vol 35, No 11, p 16, 18, November, 1981.

Descriptors: *Groundwater, *Water treatment, Activated carbon, Drinking water, *Well water, *Potable water, Carbon, Adsorbents, Aeration, *Radon removal, Radioactivity.

Two methods have been developed for removing the radioactive gas radon from well water. These methods are thought to be 95% or more effective. The two methods, granular activated carbon adsorption and diffused aeration, have been incorporated into commercial units that may be installed in homes at reasonable costs. The methods are augmented by a third process developed by the state, called spray aeration. The activated carbon unit is really nothing more than a commercially available home water softener unit in which the water softening resin is replaced with granular activated carbon. The carbon will remain effective over an indefinite period of time, a priod of years. The diffusion aeration method involves a 40-gallon pressure tank in which a ceramic diffuser creates fine air bubbles in the water. The clean air from the atmosphere in the bubbles will strip the radon from the water; the gas is then vented from the house and released harmlessly into the atmosphere. (Baker-FRC)
W82-03157

PHYSIOCHEMICAL SPECIATION OF LEAD IN DRINKING WATER,

Lancaster Univ. Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and D. P. H. Laxen.
Nature (London), Vol 286, No 5775, p 791-793, August 21, 1980. 2 Tab, 16 Ref.

Descriptors: *Drinking water, *Lead, *Speciation, *Heavy metals, Metals, Physical properties, Chemical properties, Solubility, Plumbing, Water conveyance, Pipes, Flushing.

The speciation of lead was investigated in two tapwater samples consisting of morning first draw water and in one sample taken after thorough flushing of the pipes. The first two samples came from a house in Glasgow with a lead-lined tank and lead piping and a house in Bentham with internal copper piping but a lead service pipe; the sample after flushing came from the University of Lancaster, which had copper piping with high-lead soldered capillary joints. The University sample had a total lead concentration of only 3.3 nanograms per milliliter, most of which was filterable. The water supply for the University had a substantial organic content and showed considerable capacity to complex lead, which was lost following ultraviolet irradiation of the sample water. In the Bentham sample, where the water supply has a low organic content, 53 percent of the lead and 33 percent of the copper were associated with colloidal particles of between 0.015 and 1.0 micrometers, while 19 percent of the lead was in colloids between 1 and 12 micrometers. The Glasgow sample contained the highest concentrations of total lead, most of which was associated with colloidal size fractions between 0.015 and 0.08 micrometers. The three samples each appeared to have little or no free ionic lead. Lead in these samples did not appear to be the result of particles flaking off the basic lead carbonate lining of lead water pipes. Since the solubility of the plumbing depends on the adsorption and complexation capacity of the hydrous oxides and organic complexing agents in the water supply, techniques to control this solvency depend on increasing the pH of the water and its hardness/alkalinity. (Carroll-FRC)
W82-03198

INACTIVATION OF ENTEROVIRUSES BY OZONE,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
D. Roy, R. S. Engelbrecht, P. K. Y. Wong, and E. S. K. Chian.
Water Science and Technology, Vol 13, No 2, p 819-836, 1981. 11 Fig, 44 Ref.

Descriptors: *Disinfection, *Viruses, *Ozone, Laboratory studies, Water treatment, Wastewater treatment, Kinetics, Microbiological studies, Temperature effects, Hydrogen ion concentration, Mass transfer, Poliovirus, *Enteroviruses.

The effects of pH, temperature, and residual ozone concentration on the inactivation of poliovirus 1 (Mahoney) were studied using a precisely controlled continuous flow reactor. With other parameters constant, the rate of viral inactivation increased as residual ozone increased between 0.1 and 0.2 mg/1 (O.1, 0.12, 0.15, and 0.21 mg/1 at pH 7.2 and 20 C). Inactivation at a given ozone level was rapid during the initial contact period (up to about 25 sec), then slower to the end of the experiment (140 sec). Viral inactivation was greater at high pH (7.2) than at low pH (4.3 or 5.9). The shape of the survival curve at pH 4.3 suggested that increased resistance to ozone at high pH was due to inherent properties of the virus and was not the result of increased aggregation of the viral particles. The percentage inactivation increased with temperature at the three levels tested (5, 10, and 20 C). Calculation of the activation energy for ozone disinfection (3.6 kcal) from the temperature experiments indicated that mass transfer of ozone into the viral particle, rather than the chemical reaction rate, was the rate-limiting element in viral inactivation. The all-or-none effect reported by previous researchers was notably absent in all the experiments, and thus has probably been a result of experimental error. (Carroll-FRC)
W82-03208

EMERGENCY WATER SUPPLY GENERAL REPORT NO. 2, CONCEPT FOR AN EMERGENCY WATER SUPPLY IN SWITZERLAND,

Waterworks, Zurich (Switzerland).
M. Schalekamp.
Aqua, No 4, p 8-14, April, 1980. 16 Fig.

Descriptors: *Disasters, *Water supply systems, *Protection, Nuclear explosions, Electromagnetic waves, Water scarcity, Water storage, Water distribution, *Switzerland.

Switzerland has plans for assuring a water supply in case of catastrophe such as sabotage, natural disaster, war, or nuclear destruction. Water requirements per person per day are three liters for Stage 1 (first three days), 5-15 liters for Stage Two (to the end of the third month), and 25-100 liters during Stage Three (the reconstruction period lasting another nine months). For Stage One supplies, water is being packaged in plastic containers, good for five years storage. For Stage Two, 110 emergency supply points are set up to draw groundwater and spring water. The third stage water supplies will come from three pumping stations built to withstand nuclear attack, electromagnetic pulse (EMP) from nuclear explosions, and other disasters. Protection against EMP is obtained by encasing the whole building in a Faraday's cage, a metal sheath at least three mm thick. RFI doors are used at entrances. Power cables are equipped with excess voltage conductors and must respond seven to ten times faster than normal lightning conductors. Undisclosed security measures to prevent unauthorized entry are also in force. (Casser-FRC)
W82-03221

FLUORIDE DETERMINATION IN WATER: AN OPTIMUM BUFFER SYSTEM FOR USE WITH THE FLUORIDE-SELECTIVE ELECTRODE,

University of Strathclyde, Glasgow (Scotland). Dept. of Applied Geology.
K. Nicholson, and E. J. Duff.
Analytical Letters, Vol 14, No 7, p 493-517, 1981. 1 Fig, 7 Tab, 21 Ref.

Descriptors: *Fluoride, *Water analysis, *Ion-selective electrodes, Reproducibility, *Drinking water, Performance evaluation, Water quality.

Methods used for the determination of fluoride in water analysis were investigated to ensure that the methods were sufficiently sensitive and reproducible for routine use, as long as there is strict control of fluoride levels in fluoridated water supplies. Eleven buffered systems were examined, and maximum complexing ability with optimum reproducibility and sensitivity were determined. Tisab III M.-triammonium citrate was the best of the eleven systems in terms of masking ability. Only Al and Mg pose interference problems. For full decomplexing capacity of the buffer to be exploited, a minimum decomplexing time of 20 minutes, preferably 24 hr, after buffer addition is required. The masking ability and stability of the complex formed by the buffer deteriorates on storage. Buffers should be discarded after two weeks of storage. (Small-FRC)
W82-03259

WATER SUPPLY IN DENMARK,

Copenhagen Water Supply (Denmark).
For primary bibliographic entry see Field 6D.
W82-03274

THE RISK BUSINESS,

Thames Water Authority (England).
For primary bibliographic entry see Field 6E.
W82-03281

UPDATING ANTIQUATED CITY WATER SYSTEMS,

Bogert (Clinton) Associates, Fort Lee, NJ.
W. Wheeler.
Consulting Engineer (St Joseph), Vol 57, No 3, p 101-105, September, 1981, 3 Fig.

Descriptors: *Water supply, *Utility extension, *Water shortage, Water distribution, *Water supply systems, Filtration, Water treatment, Lynn, Massachusetts, Newark, New Jersey, Pipes, Water mains, Pumping plants, Reservoirs, Planning, Maintenance.

The process of expanding old city water systems is illustrated by two examples. In Lynn, Massachusetts, the water supply for this 6800 acre city was insufficient and of poor quality after the droughts of the 1960's. The first phase improvements involved the high service distribution system: pipe cleaning and lining, redistribution of water by installation of valves, and installation of parallel pipes. Pilot plant studies indicated that rapid coagulation-direct filtration would be most suitable and cost effective for a proposed treatment plant. Two 3-million gal storage tanks were built. In the low service distribution system, 60-year old pipes were cleaned and relined with cement. Daily average demand was calculated at 15.5 mgd, but safe yield from existing facilities was only 12.5 mgd. Improvements in pumping capacity and impoundments increased the yield to 17 mgd. An eventual 30 mgd was accounted for in the design. A similar staged program is planned for Newark, New Jersey, to improve the water supply and distribtion system, which is awaiting construction. This consists of a rapid coagulation-direct filtration system with initial 94 mgd capacity and ultimate 136 mgd capacity. A major interconnection project will combine the supply systems of Jersey City, Newark, and the Passaic Valley. (Cassar-FRC)
W82-03293

AN INTEGRATED MESH-NODAL METHOD FOR STEADY-STATE WATER DISTRIBUTION NETWORK ANALYSIS,

Victoria Univ. of Manchester (England). Power Systems Lab.
K. R. Stimson, and A. Brameller.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 2, p 186-187, March, 1981.

Descriptors: *Water distribution, *Systems analysis, Computers, Networks, Computer programs, Algorithms, Mathematical studies, *Water supply systems.

An abstract was formulated of an algorithm and computer program for steady-state analysis of water distribution networks. The algorithm is designed as a mesh method, but is solved by techniques common to nodal methods to produce a fast, reliable, and efficient solution. The inclusion of pumps and control valves and the ability to determine the status of the control valves are also useful. Pumps are modeled as pseudo-pipes, using a given characteristic equation. Pressure reducing valves, pressure sustaining valves, and non-return valves are modeled according to their status. They are modeled in terms of nodes, fixed head nodes, and pseudo-pipes to ensure consistency with the basic formulation. In particular a sub-algorithm is used to determine the status of a control valve when that status is not initially known or is uncertain. The program has been tested on real and hypothetical networks of up to 1600 nodes/2500 pipes with good convergence in every case. This fast analysis method is applicable for interactive simulation and design of water distribution networks. (Baker-FRC)
W82-03305

MODERN MANAGEMENT TECHNIQUES. PART I: NEED FOR, AND IMPORTANCE OF, PRODUCTIVITY IMPROVEMENT,

LWFW, Inc., Dallas, TX.
For primary bibliographic entry see Field 6A.
W82-03311

A CENTURY OF WATER FOR ANTWERP,

Antwerpse Waterwerken (Belgium).
I. J. Dirickx.
Aqua, No 3, p 10-13, 1981. 1 Tab.

Descriptors: *Utilities, *History, Water treatment, *Antwerp, Belgium, Public utility districts, *Water supply, *Water distribution.

Although the City of Antwerp recognized a need for public water treatment works as early as the cholera epidemic of 1866, it was not successful in establishing a system until 1881, when 7,000 subscribers consuming 2.3 million cu meters a year were served. The distribution system slowly expanded to the 1980 level of 124 million cu meters of water per year and 142,000 subscribers. The water is abstracted from the Albert Canal or the Nete Canal and enters five large storage reservoirs with a total capacity of 2.7 million cu meters. Treatment plants include Notmeir-Walem (165,000 cu meters per day): alum treatment aeration, and sand filtration; Notmeir (220,000 cu meters per day): chlorination, alum and activated silica, dual bed filtration, ozonation, and activated carbon treatment; and Oelegem (135,000 cu meters per day): pumping and purification. (Cassar-FRC)
W82-03355

5G. Water Quality Control

THE AGRICULTURAL IMPACT OF WATER QUALITY STANDARDS: A MATHEMATICAL PROGRAMMING APPROACH,

R. A. Solove.
PhD Dissertation, 1980. 211 p, 2 Fig, 17 Tab, 83 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-25397.

Descriptors: *Water quality control, *Agricultural runoff, *Mathematical models, Cost analysis, Nutrients, Water pollution, Economic aspects, Social values, Pollution taxes, *Florida, Everglades Agricultural Area.

High levels of nutrient pollutants enter water runoff into Lake Okeechobee and the Conservation Areas from the South Florida Everglades Agricultural Area. Lowering the level of nitrogen and phosphorus into these areas will result in both benefits and costs, with expected differential distributive effects across affected groups. Federal and State laws mandating a correction to this externality problem will be associated with varying costs of compliance to the agricultural sector, depending on the specific form of regulation implemented. An agricultural sector, multi-product, price equilibrium mode, which introduces risk into the decision process, was chosen as the tool of analysis. The model allowed achievement of a standard by readjusting crop growing seasons, readjusting water tables, changing relative cropping patterns, and/or readjusting the relative intensity of production in the different subregions. The effluent tax system gave the least reduction in the various social value measures. Compared to the direct regulation approach, the effluent tax yielded nearly $1 M more net farm income at low water quality standards increasing to $32 M at high restriction levels. Results indicate that the effluent tax system may be the least costly method for achieving water quality standards in the Everglades Agricultural Area, increasing in efficiency as standards are made more severe. The implementation, enforcement, monitoring, and transactions costs of various regulatory policies would have to be considered before a charge or tax policy is adopted. (Sinha-OEIS)
W82-03014

LINERS OF NATURAL POROUS MATERIALS TO MINIMIZE POLLUTANT MIGRATION,

Arizona Agricultural Experiment Station, Tucson.
W. H. Fuller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-221863, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-122, July, 1981. 5 p, 2 Fig, 2 Tab. R 803988.

Descriptors: *Water pollution prevention, *Linings, *Leachates, *Landfills, Metals, Total organic carbon, Groundwater pollution, Municipal wastes, Solid wastes.

When landfills are not completely impermeable, then underlying groundwater may be contaminated by leachate constituents if these are not adequately retained by soils between the landfill and groundwater. The relative effectiveness of natural low-cost liners, including crushed limestone, clayey soil, hydrous oxides of iron, and crushed pecan hulls, for minimizing the migration of beryllium, cadmium, chromium, iron, nickel, zinc, and total organic carbon constituents of municipal solid waste landfill leachates was investigated in the laboratory. Layers of crushed limestone retarded movement of contaminants through soil. Iron hydrous oxide applied as iron rust was an effective barrier, retarding movement of contaminants so that they appeared much later in effluents. Waste ferrous sulfate treated soils likewise retained metals from leachate, but increased levels of iron were noted in column effluents. There was a significant positive correlation between amounts of iron, manganese and aluminum hydrous oxides in soils and attenuation of metals by these soils. The composition of municipal solid waste leachate exercises a profound influence on retention of metals. Barriers of crushed pecan hulls do not cause retention of sufficient amounts of heavy metals to warrant the effort and expense involved in placement of such barriers. (Moore-SRC)
W82-03028

USING COHERENT WATER JETS TO CONTROL OIL SPILLS,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
M. K. Breslin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-232720, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-141. August, 1981. 6 p, 1 Tab. 68-03-2642.

Descriptors: *Oil spills, *Cleanup operations, *Water pollution control, *Jets, Wave action, Water currents, Entrainment, Oil pollution, Oil slicks, Water jets.

The ability of coherent water streams to induce a surface current in a body of water and thus control a floating oil slick was examined in a number of test programs. The objective of the tests was to determine whether coherent water streams could serve as an alternative to fabric booms and water sprays in concentrating, diverting, and containing oil slicks. The water jets were constructed from standard pipefittings and supplied with water from common centrifugal water pumps. The jets were mounted at one of three location; some on the main test tank towing bridge, others onto small floats, and others extending from the bow of a catamaran. Control of oil slicks in 6-knot currents, with water jets, was evaluated by towing the jets with the bridge system at 6 knots. Coherent jets could induce a significant surface current and move an oil slick with litle oil entrainment. Nonbreaking waves produced by a wave generator did not greatly affect performance, except where the jet nozzles were cantilevered off the front of the catamaran and the pitch of the vessel caused significant changes in the height and attitude of the jet outlet. The best position for an unmanned water jet of the sizes and at the pressures tested was determined to be vertically directed at the surface of the water with the outlet 0.4 to 1.0 m above the surface. The vertical component of the coherent water stream was as useful, if not more so, as the horizontal component. (Moore-SRC)
W82-03031

COMBINED SEWER OVERFLOW ABATEMENT PROGRAM, ROCHESTER, N.Y. - VOLUME I. ABATEMENT ANALYSIS,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
F. J. Drehwing, C. B. Murphy, Jr., D. J. Carleo, and T. A. Jordan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-219602, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-113, July, 1981. 4 p. Y-005141.

Descriptors: *Water pollution control, *Combined sewer overflows, *Nonstructural alternatives, *Model studies, *Cost-benefit analysis, Storm water, Water quality management, Storm runoff, Wastewater treatment, *Rochester, New York.

In response to the transient water quality problems induced by periodic overflows from the Rochester Pure Waters District's combined sewer system, a project was undertaken to develop an abatement and management program necessary to achieve a cost effective solution to the combined sewer overflow (CSO) induced impairment of the Genessee River, Irondequoit Bay, and Lake Ontario. The USEPA Stormwater Management Model - Version II, Simplified Stormwater Model, and receiving water models were used to evaluate various CSO pollution abatement alternatives. Nonstructural, minimal structural, and structurally intensive alternatives were defined and evaluated by these models. The nonstructural approach applied Best Management Practices (BMP). Structural alternatives involved evaluation of conventional storage and treatment options. Cost benefit analyses of all structurally intensive alternatives were conducted using optimum treatment process train configurations developed from pilot plant evaluations. Preliminary analysis of BMP and minimal structural alternatives indicated that by addressing the major sources of pollution and by eliminating throttling constraints within the existing sewerage system, a substantial decrease in the total annual load of contaminants to the receiving waters from rainfall induced CSO can be achieved for relatively small capital expenditures. Those measures can be initiated within a short period of time, thereby immediately reducing pollution to the receiving waters, while long term design and construction of more structurally intensive alternatives are undertaken. (Moore-SRC)
W82-03035

THE DEVELOPMENT OF WATER QUALITY MANAGEMENT PLANS USING DATA FROM AUTOMATIC STORMWATER MONITORING NETWORKS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
T. J. Grizzard, J. P. Hartigan, and C. W. Randall.
Water Science and Technology, Vol 13, No 8, p 95-102, 1981. 6 Fig, 11 Ref.

Descriptors: Data collections, *Mathematical models, *Water quality management, *Stormwater, *Nonpoint pollution sources, Network design, Networks, Multireservoir networks, Hydrologic data collections, Data processing, Model studies, Water pollution prevention, Water pollution control, Pollution load, *Occoquan Watershed, Virginia.

Data bases constructed at a micro- and macro-watershed in the Occoquan Watershed, Virginia, were used to develop a mathematical model for use as a water quality management aid. This nonpoint pollution source approach provides separate data sets for the necessary calibration and verification studies. Periodic testing of model predictions was carried out through on-going macro-basin data collection to expand the utility of the automatic stormwater monitoring network data base. Thus, the model is equipped to reflect pollution loadings from changing land use patterns. Based on model predictions for present and future land use impacts, the governmental divisions drained by the Occoquan River basin implemented a basinwide nonpoint pollution management program in 1978. This multijurisdictional advisory program depended upon annual reviews of monitoring data and model predictions to calculate cumulative water quality impacts and local reforms in the field of nonpoint water pollution control. (Geiger-FRC)
W82-03069

1981 REPORT ON GREAT LAKES WATER QUALITY, APPENDIX GREAT LAKES SURVEILLANCE.

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
November, 1981. 174 p. 31 Fig, 77 Tab.

Descriptors: *Water quality, *Water quality management, *Water quality standards, Lake basins, *Eutrophication, Phosphorus, Fisheries, DDT, Toxicity, Degradation, Contamination, Biological oxygen demand, Effluents, Environmental protection, Trout, Alewife, *Toxins, Herring, *Great Lakes.

In this 1981 report the major issues are accelerated eutrophication of the Great Lakes and toxic materials in the ecosystem. Eutrophication impairs recreation, water supply, fishing, and destroys wildlife. Phosphorus was the primary nutrient considered and its control could significantly impede or reverse the eutrophication process. Some success in phosphorus control has been noted, and has resulted in improved drinking water quality, improved recreational use, and some changes in the composition and abundance of fish populations. Total phosphorus levels in Lake Erie's western basin have declined because of decreased loadings from the Detroit River. There has been a possible species change in the phytoplankton as oligotrophic indicator species are more abundant, while the eutrophic species (Scenedesmus spp.) have declined. Total phosphorus levels in Lake Ontario changed little between 1979 and 1980 but a general decline in the last decade is evident. Lake Michigan's total phosphorus levels have been correlated with ice cover vs. year-to-year changes in phosphorus loading. Monitoring programs and surveillance studies in 1980 also revealed the following: DDT and PCBs have declined in bloater chubs and herring gull eggs in Lake Michigan, while dieldrin levels in chubs have increased; the Lake Superior Basin area showed elevated levels of toxaphene in trout but declines in PCBs, DDT, and dieldrin; and dioxin levels in Lake Ontario have been decreasing (from over 1,000 ng/g to under 60 ng/g) over the past ten years. Coordination of surveillance activities needs to be improved and should include the application of resources to priority issues rather than to general basin monitoring. (Atkins-Omaiplan)
W82-03101

1981 REPORT ON GREAT LAKES WATER QUALITY.

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
1981. 74 p. 2 Fig, 3 Tab.

Descriptors: *Water quality, *Water quality management, *Water quality standards, Water pollution control, Effluent limitations, Phosphorus, Pulp and paper industry, Operating policies, Eutrophication, Degradation, Contamination, Biological oxygen demand, Effluents, Environmental protection, *Great Lakes, *Toxins.

The Great Lakes Water Quality Board annually reviews and evaluates the environmental quality of the lakes and the progress made in implementing programs required by the 1978 Great Lakes Water Quality Agreement. This report makes recommendations concerning toxic substances, control programs, phosphorus inputs, the pulp and paper industry, and resources commitments. There is no specific management strategy for directing toxic substances activities. The Board recommends sixteen specific measures to abate toxic health and environmental threats, including establishing inventories of toxic substances and their characteristics, establishing monitoring programs, planning hazard and risk assessment programs, and implementing control programs. Phosphorus removal at municipal treatment plants, in conjunction with limitations on the phosphorus content in detergents, has resulted in an average phosphorus effluent limitation of 1.0 mg/L at all Lower Lakes facilities---a goal not expected to have been met until 1986. The pulp and paper industry has also made progress in reducing its loading of BOD and suspended solids into the lakes. Environmental quality problems may be local, lakewide, or systemwide. The Board has identified 39 areas of concern divided into two categories: areas with significant degradation (Class A) and those with impaired use (Class B). There is a discussion of eutrophication and the contaminants in each lake. Progress has been made in implementing the Agreements's programs, but for continued progress resources must be committed in a cost-effective manner according to the priorities that the Board has established. (Atkins-Omniplan)
W82-03102

TOXIC SUBSTANCES CONTROL PROGRAMS IN THE GREAT LAKES BASIN.

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Water Quality Board.
1981. 94 p. 1 Fig, 6 Tab, 1 Append.

Descriptors: *Lakes, *Water quality control, *Water quality standards, *Ecosystems, *Toxicity, Environmental policy, Policy making, International agreements, Chemical wastes, Hazards, Assessments, *Great Lakes basin.

Annex 12 of the 1978 Great Lakes Water Quality Agreement calls for programs to inventory toxic substances, to coordinate air, water and solid waste control programs, and for joint programs to manage hazardous materials. The Toxic Substances Committee established a framework of four basic components to evaluate the toxic substances program management. The first component, an information base, includes source inventories, characteristics of toxic substances, and environmental measurements on actual incidence and accumulation of specific chemical substances. The second element is hazard and risk assessment to decide which chemicals should be most closely monitored and which ones are most likely to cause adverse effects in humans and other environmental sectors. The third component is a set of programs to control the release of toxic substances into the environment, and the fourth is a methodology to evaluate the program's effectiveness and identify any changes or adjustments to the management program. The underlying problem identified by the Committee is the absence of an overall Great Lakes ecosystem strategy for toxic substances control activities that are carried out under various jurisdictions and various pieces of legislation. This fragmentation has caused duplication of effort in

some areas, no coverage in others, and an overall limited management capacity. The U.S. and Canada are working toward a more coordinated effort but since the programs are just developing, the extent to which they will be able to effectively coordinate the toxic substances programs remains to be seen. A full description of the programs, the agencies implementing them, and their objectives is in an appendix. (Atkins-Omniplan)
W82-03103

REPORT OF THE AQUATIC ECOSYSTEM OBJECTIVES COMMITTEE,

International Joint Commission-United States and Canada, Windsor (Ontario). Great Lakes Science Advisory Board.
November, 1981. 48 p, 7 Tab, 75 Ref, 1 Append.

Descriptors: *Lakes, *Water quality control, *Water quality standards, *Selenium, *Ecosystems, Toxicity, Fish populations, Drinking water, Water pollution effects, Lake sediments, Fish diets, International agreements, *Great Lakes.

The Aquatic Ecosystem Objectives Committee (AEOC) is responsible for keeping current Annex 1 of the 1978 Great Lakes Water Quality Agreement. In 1980, the Committee recommended that concentrations of total selenium in unfiltered water samples not exceed one microgram/liter to protect aquatic life, concentrations in sediments not exceed five micrograms/gram dry weight to protect aquatic life, and that concentrations in aquatic biota not exceed three micrograms/gram wet weight for predatory fish and mammal protection. Recent studies have confirmed the acute lethality of waterborne selenium to fish; however, dietary selenium may be even more toxic. Water consumed by humans rarely constitutes a health hazard. The AEOC also reconfirmed that mirex and its degradation products should be undetectable in water and aquatic organisms to protect aquatic organisms, fish-consuming birds and animals. The best detection levels for mirex are 0.005 micrograms/liter for water and 0.005 micrograms/gram for biological tissues. The Committee also made recommendations relative to limited use zones, mixing zones, problem areas and/or areas of concern. Mixing zones are the physical expression of water quality objectives and represent within the zone a loss of beneficial use, and, at the edge of the zone, the maximum limit of that loss. Merely identifying a problem area does not describe the extent, severity or significance of the problem and abdicates responsibility for actively limiting its impact. This report outlines the considerations required to formulate mixing zone objectives and the mechanics of establishing a mixing zone. Needs to be considered for 1981-82 are also listed. (Atkins-Omniplan)
W82-03105

FINAL REPORT, GROUND WATER STUDY, AMES-CAMBRIDGE REACH OF THE SKUNK RIVER, STORY COUNTY, IOWA,

Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 2F.
W82-03112

PARAMETRIC MODEL AND OPTIMAL PREDICTION OF THE AVERAGE SALINITY OF THE AZOV SEA,

Academiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. E. Prival'skii.
Water Resources, Vol 7, No 4, p 321-333, July/August, 1980. 4 Fig, 3 Tab, 13 Ref. Translated from Vodnye Resursy, No 4, p 40-54, July/August, 1980.

Descriptors: *Salinity, *Water consumption, *Water management, *Azov Sea, USSR, Model studies, Prediction, Monte Carlo method, Mathematical models, Planning, Ecological effects, *Water quality control.

Nonreturnable water consumption in the Azov Sea basin has increased salinity in the sea from the desired 9.5-11 parts per thousand to 13.9 parts per thousand in 1976. Effective implementation of water-management measures requires a model for predicting average salinity under application of the management variants. A model to predict the salinity on the basis of nonreturnable withdrawals and additional delivery of fresh water was developed and tested. For nonreturnable withdrawals of 25.5 km per year in 2000, salinity would be about 17 parts per thousand, increasing to 19 parts per thousand by 2010. (Cassar-FRC)
W82-03154

NEW THRUST IN THE 1980S FOR U.S. WATER-QUALITY PROGRAMS,

Civil Engineering (New York), Vol 50, No 9, p 78-81, September, 1980.

Descriptors: *Water quality, *Policy making, Administration, Standards, Regulations, Water quality standards, Human disease, *Water pollution control.

Changes expected in the water quality program of the United States for the 1980s are discussed. In the 1970s major concern was demonstrated for surface waters such as rivers and lakes. Groundwater and small lakes were for the most part neglected. Now concern over ground water contamination is causing a re-thinking in priorities for the 80s. Progress has been made in controlling point-source pollution. A major problem in this area, however, remains with the municipalities and their low rate of compliance with regulations. Non-point source pollution, however, has been more difficult than point source pollution to control. Controlling turbidity or chemicals entering river water that flows through an area of numerous farms has proven hard to handle in that the source cannot be so readily determined and in many cases is not a single source at all. An important change in thinking has occurred as the move was made away from ambient water quality standards to some kind of technology-based effluent standards. Public opinion is also shifting from the desire to have clean water in the lakes for the sake of healthy fish to the idea that clean water in lakes is healthy for humans. (Baker-FRC)
W82-03252

RIVER CLEAN-UP PLAN DEVELOPED WITH CITIZENS AND INDUSTRY,

Fox Valley Water Quality Planning Agency, Neenah, WI.
H. J. Day, W. Elman, D. Theiler, and R. Christianson.
Civil Engineering (New York), Vol 50, No 3, p 78-81, March, 1980. 2 Fig.

Descriptors: *Water quality management, *Public participation, *Industrial wastes, Planning, Alternative planning, *Fox River, *Wisconsin, Pulp and paper industry, Water pollution prevention, Water pollution control, Political aspects, Model studies, Dissolved oxygen, Waste treatment, Low-flow augmentation, Instream aeration, Rivers.

Citizens, state environmental planners, and paper industry representatives have worked together to plan pollution abatement for the lower Fox River, Wisconsin, formerly one of the ten most polluted rivers in the U.S. Organic wastes have been reduced by 90% and final cleanup to meet Clean Water Act standards is in the planning stage. The first step was formation of the Fox Valley Water Quality Planning Agency, comprising three citizens'groups. The second step identified point source pollution and provided for modeling of the river's dissolved oxygen profile. A daily average dissolved oxygen standard of 5.5-6.2 ppm was chosen. An allowable discharge was set for each municipal and industrial discharger. It was decided to use the full assimilative capacity of the river as long as the required water quality standard is maintained. This permits tailor-made discharges but requires more complex stream monitoring and management. Stream management alternatives under consideration are end-of-pipe treatment, low-flow augmentation, and instream aeration. Outfall relocation and instream alteration (removing dams) were rejected as alternatives. (Cassar-FRC)
W82-03283

EPA MOVING TO CONTROL INDUSTRIAL TOXIC POLLUTANTS WITH NEW NPDES PERMITS,

Environmental Protection Agency, Boston, MA. Region I.
For primary bibliographic entry see Field 6E.
W82-03296

DETOXIFICATION OF ZINC AND CADMIUM BY THE FRESHWATER PROTOZOAN TETRAHYMENA PYRIFORMIS. II. GROWTH EXPERIMENTS AND ULTRASTRUCTURAL STUDIES ON SEQUESTRATION OF HEAVY METALS,

Queen Elizabeth Coll., London (England). Dept. of Biology.
S. Dunlop, and G. Chapman.
Environmental Research, Vol 24, No 2, p 264-274, 1981. 4 Fig, 3 Tab, 22 Ref.

Descriptors: *Protozoa, *Heavy metals, Zinc, Cadmium, Industrial wastes, Aquatic animals, *Detoxification, Decontamination.

Cells of Tetrahymena pyriformis (strain W) were exposed to various concentrations of zinc and cadmium. While 120 ppm zinc or 4 ppm cadmium killed the cells, they survived in 60 ppm zinc or 2 ppm cadmium. The sublethal concentrations of zinc and cadmium limited the cumulative effect of growth as shown by reduced cell numbers. Zinc and cadmium suppressed cell division initially. Zinc-treated cultures recovered somewhat. Growth rates in the cadmium treated cultures were between only 18% and 58% of the controls, giving low cell densities at 40 hr. A slow recovery was noted hereafter. Low zinc (6 ppm) or low cadmium (2 ppm) concentrations did not greatly alter growth characteristics. Zinc at 6 ppm partly annulled the detrimental effect of 2 ppm cadmium. Ultrastructural observations and electron-probe analysis showed that zinc induced the formation of many cytoplasmic granules into which the metal was sequestered and thereby detoxicated. Cadmium was more widely distributed throughout the cells and therefore inflicted more damage. (Baker-FRC)
W82-03334

A LARGE INTERATIONAL RIVER: THE DANUBE,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary). Inst. for Water Pollution Control.
P. Benedek, and F. Laszlo.
Water Science and Technology, Vol 13, No 3, p 61-76, 1981. 8 Fig, 2 Tab, 11 Ref.

Descriptors: *Water quality control, *River basins, *International agreements, Water pollution control, Water management, *Danube River, Rivers, Heavy metals, Self-purification, Bottom sediments, Wastewater disposal, Budapest, Hungary, Water policy, International waters.

The Danube, flowing through eight European countries, is a multipurpose use river of vital importance for 70 million inhabitants. The navigation aspect will increase in the 1980's with the opening of the Rhine-Maine-Danube navigational canal. The Danube, which is suitable for drinking water purposes with simple treatment over almost the entire 2800 km length, is used for hydropower, drinking water, and cooling water. It provides 70% of surface water sources in Hungary, which lies entirely within the Danube basin. Downstream of Budapest, water quality has shown deterioration with increasing levels of Hg, Cd, lubricating oil, and lignin-sulfonic acid. Fortunately, the bank-filtered wells are still of good quality, and bottom sediment analysis shows non-serious levels of heavy metals. Self-purification improves the water quality so that it enters Yugoslavia with a lighter pollutant load. Proposed sewage treatment plants at Budapest and Vienna are expected to improve the water futher. Rapid industrialization and population growth require a comprehensive monitoring and water quality control program on an international scale. (Cassar-FRC)
W82-03369

REMOVAL OF OIL POLLUTANTS FROM WATER BODIES BY MEANS OF HYDROPHOBIC SORBENTS,

Akademiya Nauk SSSR, Moscow. Inst. Okeanologii.
M. P. Nesterova, N. M. Anufrieva, A. B. Gorlitskii, L. M. Shuter, and R. M. Verlinskaya.
Water Resources (English Translation), Vol 7, No 4, p 375-379, July-August, 1980. 2 Tab, 19 Ref. Translated from Vodnye Resursy, No 4, p 156-160, July-August, 1980.

Descriptors: *Water pollution control, *Sorption, *Oil spills, Oil pollution, Water treatment, Sawdust, Perlite.

Hydrophobic sorbents for cleaning up oil spills in surface waters were prepared from perlite or sawdust mixed with dimethyl formaldehyde resin and a latex copolymer of divinyl and methyl methacrylate in a heated vessel, followed by filtration and drying at 100C. Field tests of the products in barriers floating in the Black Sea showed that hydrophobic expanded perlite and dry pine sawdust removed the oil from the water's surface to a degree of 98.5 and 98.2%, respectively, using a sorbent:oil ratio of 1:2. The same conditions, applied to diesel oil removal, produced similar results. Increasing the ratio of sorbent to fuel to 1:1 improved removal to 99.88%. (Cassar-FRC)
W82-03371

THE RIVER RHINE--TRANS-NATIONAL RIVER BASIN MANAGEMENT DEVELOPING PROGRAMME TO MEET NEW CHALLENGES,

Nordrhein-Westfalen Landesamt fur Wasser und Abfall, Dusseldorf (Germany, F.R.).
H. Massing.
Water Science and Technology, Vol 13, No 3, p 77-91, 1981. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Water quality control, *International agreements, River basins, Water pollution control, *Rhine River, Federal Republic of Germany, Water law, Oil pollution, Legal aspects, Water policy, Industrial wastes, Rivers, Self-purification, Water transport, *Industrial wastes.

The Rhine River and its tributaries, flowing through 10 European countries, have been used for centuries for navigation, drinking, and more recently for industry, cooling water, hydropower, irrigation, wastewater discharge, fishing, and recreation. The 1975 status map gives an indication of water quality. Upstream of Lake Constance, the Alp-Rhine water is moderately loaded, Class II. In the High Rhine and Upper Rhine, quality alternates between Class II and Class III, critically loaded. Recovery takes place in the mountains, and Class II-III again prevails until the beginning of the Lower Rhine. Heavy industry and municipal discharges produce heavily, very heavily, and excessively polluted water which exists until the border of Germany and the Netherlands, where it is again Class II-III. Although some improvement in water quality has occurred during the 1970's, further corrective steps are necessary. Control measures, based on the attitude that the drinking water supply is of first importance, are in operation, including treatment of combined sewage overflows, international agreements, and national regulations on discharge of wastewater and individual pollutants, closed cooling systems for power plants, regulation of pollution by ships, artificial aeration, and computerized emission information processing. (Cassar-FRC)
W82-03372

IN-STREAM AERATION: A POSSIBLE ALTERNATIVE TO AWT,

Civil Engineering (New York), Vol 50, No 3, p 81-82, March, 1980. 1 Fig.

Descriptors: *Instream aeration, *Aeration, *Advanced wastewater treatment, Fish, Aquatic life, Wastewater treatment, Fox River, Wisconsin, Dissolved oxygen, Oxygenation, Water pollution control.

Instream aeration could achieve the required dissolved oxygen levels in the Fox River, Wisconsin, for an estimated annual cost of $120,000 compared with the $10 million anual cost of additional advanced wastewater treatment. Sidestream pressurization using liquid oxygen is being considered for this river. Advantages include a high transfer rate and an uncluttered surface that would not interfere with recreational boating. There are several unknowns in this field: the effects of aeration on fish and on fish spawning places and the effects of reduced buoyancy. One instream aeration station has been in operation in the Chicago Metropolitan Sanitary District. It pumps diffused air through carborundum plates at the waterway bottom. (Cassar-FRC)
W82-03375

VACUUM SEWERS--THE FUTURE FOR SEWAGE COLLECTION,

Willis, Cunliffe, Tait and Delcan, New Westminister (British Columbia).
F. R. King.
Civil Engineering (New York), Vol 51, No 12, p 54-55, December, 1981. 1 Fig.

Descriptors: *Wastewater collection, *Sewers, *Vacuum sewers, Bridgeview, *British Columbia, Sewage collection.

Vacuum sewage collection was the most feasible alternative for Bridgeview, near Vancouver, British Columbia. Located in a flood plain rich in peat, the town had serious sewage contamination from septic tanks and raw sewage leaks. The project, completed in 1980, was 30% cheaper than any other alternative. It included the vacuum collecting network, 2 collecting stations, drainage improvements, installation of ductile iron water mains in place of old wooden mains, and elimination of septic tanks. (Cassar-FRC)
W82-03394

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

A 'RANDOM WALK' SOLUTE TRANSPORT MODEL FOR SELECTED GROUNDWATER QUALITY EVALUATIONS,

Illinois State Water Survey Div., Champaign.
T. A. Prickett, T. G. Naymik, and C. G. Lonnquist.
Bulletin 65, 1981. 103 p. 68 Fig, 3 Tab, 18 Ref.

Descriptors: Groundwater, *Groundwater movement, Groundwater quality, *Solute transport, *Model studies, *Computer programs, Case studies, Aquifers, Plumes, Groundwater contamination, Finite difference methods, Water pollution, Evaluation, *Surface-groundwater relations.

A generalized computer code is given that can simulate a large class of solute transport problems in groundwater. The effects of convection, dispersion, and chemical reactions are included. The solutions for groundwater flow include a finite difference formulation. The solute transport portion of the code is based on a particle-in-a-cell technique for the convective mechanisms, and a random-walk technique for the dispersion effects. The code can simulate one- or two-dimensional nonsteady/steady flow problems in heterogeneous aquifers under water table and/or artesian or leaky artesian conditions. The program covers time-varying pumpage or injection by wells, natural or artificial recharge, the flow relationships of water exchange between surface waters and groundwater, the process of groundwater evapotranspiration, the mechanism of possible conversion of storage coefficients from artesian to water table conditions, and the flow from springs. It also allows specification of chemical constituent concentrations of any segment of the model. Further features of the program include variable finite difference grid sizes and printouts of input data, time series of heads, sequential plots of solute concentration distributions, concentrations of water flowing into sinks, and the effects of dispersion and dilution or mixing of waters having various solute concentrations.
W82-03007

OPTIMAL OPERATING POLICIES FOR WATER SUPPLY AND DISTRIBUTION SYSTEMS,

California Univ., Los Angeles.
J. R. VanWinkle.
PhD Dissertation, 1980. 149 p, 27 Fig, 1 Tab, 34 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-16055.

Descriptors: *Water supply, *Water distribution, *Water management, Mathematical studies, Operating policies, Operating costs, Economic aspects, *Inglewood, California.

A method of optimizing the operating policy of a water supply and distribution system using mixed binary programming is presented. The operating policy consists of a set of specific control actions including water treatment levels, the selection of alternative water sources and the determination of pumping schedules which specify the pump flow rates and the timing of the pumping operations. Nonlinear relationships such as the pump characteristic curves and aquifer draw-down are modeled by a linearization technique. A second degree polynominal equation is derived for these nonlinear relationships, and a variable transformation yields a set of equations that are similar in structure to the linearized energy balance equations. These transformed variables are then determined iteratively, in the same manner as the flow rates in the water distribution network. The method was applied to the water supply and distribution system of the City of Inglewood, California. The optimal operating policy developed for this water system resulted in a 13% reduction in operating costs. The case study demonstrated the validity of the method and its rapid convergence towards a balanced solution. (Sinha-OEIS)
W82-03010

THE INPUT-OUTPUT WATER TRANSACTIONS MODEL OF SUPPLY AND DEMAND,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6D.
W82-03055

NODAL DOMAIN INTEGRATION MODEL OF UNSATURATED TWO-DIMENSIONAL SOIL-WATER FLOW: DEVELOPMENT,

California Univ., Irvine. Dept. of Civil Engineering.
T. V. Hromadka, G. L. Guymon, and G. C. Pardoen.
Water Resources Research, Vol 17, No 5, p 1425-1430, October, 1981. 7 Fig, 8 Ref.

Descriptors: *Soil water, *Model studies, Flow, Mathematical studies, Unsaturated flow, Soil moisture, *Flow characteristics, Computer programs, Numerical analysis, Comparison studies.

A basic description of the nodal domain integration procedure is provided, as applied to the class of partial differential equctions generally encountered in the theory of unsaturated groundwater flow. Another objective was to develop a numerical statement which represents the finite element Galerkin statement, subdomain numerical statement, finite difference integrated control volume statement, and the nodal domain integration statement by specifying a single parameter in the resulting triangular element matrix system. The resulting statement involves the same computational requirements as does the Galerkin finite element procedure. Thus computer programs may be prepared based on the nodal domain integration procedure, which inherently contains the Galerkin finite element, subdomain, and finite difference techniques. A powerful method of comparing the accuracy of various numerical techniques is provided which eliminates uncertainty of effects between codes used for comparison. The so-called nodal domain integration method theoretically contains all numerical subsets in addition to those derived. For

example, the method would include linear basis function approximations of higher order basis functions. The method proposed in this paper can be extended to include the case where a single computational problem can be allowed to select a spatially and temporarily varying n function to achieve optimal spatial accuracy. (Baker-FRC)
W82-03080

A PLANNING METHOD FOR EVALUATING DOWNSTREAM EFFECTS OF DETENTION BASINS,

Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-03089

RELIABILITY PROGRAMING IN RESERVOIR MANAGEMENT 1. SINGLE MULTIPURPOSE RESERVOIR,

California Univ., Davis. Dept. of Civil Engineering.
S. P. Simonovic, and M. A. Marino.
Water Resources Research, Vol 16, No 5, p 844-848, October, 1980. 3 Tab, 3 Fig, 5 Ref.

Descriptors: *Reservoir operation, *Reservoir construction, *Reservoirs, *Statistical analysis, *Mathematical models, Reservoir releases, Multipurpose reservoirs, Algorithms, Optimization, Systems analysis, Cost-benefit analysis.

Reliability programming was applied to a single multipurpose reservoir to determine the maximum difference between net benefits and yearly risk losses. Constraints include the probabilities of not exceeding specified limits of storage and inequalities which represent constraints on releases and reliability. The input data consist of sequences of monthly inflow, municipal and industrial water demands, and sequences of monthly irrigation demand. The frequency distribution functions of inflows and irrigation demands are obtained by fitting the data with a Pearson type 3 distribution function. A two-dimensional Fibonacci search procedure was developed as a solution algorithm. However, for a larger number of risk variable, this algorithm would not be economical. (Titus-FRC)
W82-03148

REGIONAL MULTIOBJECTIVE PLANNING OF WATER SUPPLY AND THE DISPOSAL OF RESIDUALS WITH DUE REGARD TO INTRAREGIONAL POPULATION DISTRIBUTION,

National Inst. for Environmental Studies, Ibaraki (Japan).
Y. Kitabatake, T. Miyazaki, and M. Takahashi.
Environment and Planning A, Vol 12, No 6, p 627-648, June, 1980. 9 Fig, 16 Tab, 18 Ref.

Descriptors: *Water supply, *Population density, *Regional planning, Model studies, Planning, Long-term planning, *Multiobjective planning, Urban planning, Waste disposal, Wastewater treatment, Water quality control, Economic aspects, *Tokyo, Japan, Land use, Costs, Water management.

A model is developed to determine the optimum intraregional population distribution for managing water supply and disposal of residuals. The resulting information is helpful in long-term planning for developing regions. The three objectives of the model are considered in hierarchical order: first, maximum water quality; then, maximum land quality; and finally, minimum economic cost. The three constraints are total population of the several subregions (to be distributed among the subregions), governmental resources (capital and labor), and water intake at the water supply plant necessary to provide a given water quality. The model is applied to the Tama River basin in the Tokyo Metropolitan area. The study region consists of 15 cities, 4 towns, and a 1976 population of 1,711,298. Results show that the most important objective, water quality, determines the spatial allocation of waste disposal activities and that the economic cost factor influences the spatial arrangement of the population. (Cassar-FRC)
W82-03210

CALCULATOR PROGRAM AIDS LAGOON DESIGN,

Gutierrez-Palmenberg, Inc., Phoenix, AZ.
R. E. Palmenberg.
Water/Engineering and Management, Vol 128, No 10, p 49-52, 1981. 3 Fig, 2 Tab.

Descriptors: *Lagoons, *Design criteria, Computers, Planning, Decision making, Ponds, Construction.

A program has been developed which gives a trial and error solution to earthwork volumes for lagoons. The program was written for programmable calculators. The program provides the depth of cut, cut volume, fill volume, and net earthwork volume for the balanced cut and fill construction approach. A procedure was worked out for an actual case for two lagoons sharing a common center embankment. The single lagoon and multiple lagoon cases are easily derived from the two-lagoon case and have been left to the reader to develop. The balance cut and fill earthwork calculation represents a good starting point for estimating earthwork quantities for the construction of earthen lagoons. There are several assumptions in the method, including the existence of level ground on the site, that all material excavated in the cut is suitable for use in construction of embankments, and that the lagoons have a rectangular geometry without allowance for large radius curves in corners. It is possible to apply the balanced cut and fill method to obtain a rapid estimate of earthwork quantities and cut depths for the two-lagoon system. (Baker-FRC)
W82-03211

A SYSTEMS MODEL OF STREAMFLOW AND WATER QUALITY IN THE BEDFORD OUSE RIVER SYSTEM -- II. WATER QUALITY MODELLING,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5B.
W82-03243

RELIABILITY PROGRAMMING IN RESERVOIR MANAGEMENT 2. RISK-LOSS FUNCTIONS,

Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
S. P. Simonovic, and M. A. Marino.
Water Resources Research, Vol 17, No 4, p 822-826, August, 1981. 6 Fig, 4 Tab, 11 Ref.

Descriptors: *Reservoir operation, *Risks, *Flood damage, *Drought, Reservoir releases, Economic aspects, Water supply, Water shortage, Reliability programming, Blue Marsh Reservoir, Pennsylvania, Multipurpose reservoirs.

A method for deriving risk-loss functions associated with floods and droughts was determined from existing hydrologic, hydraulic, and economic data using a reliability programming approach. First, a relationship was established between the amount of water excess or shortage and its corresponding reliability level (risk-quantity relations). Second, the excesses or shortages were related to damages (quantity-loss relations). The results of these two steps are combined to form the risk-loss relation. Both flood and water supply risk-loss functions were determined for the Blue Marsh Reservoir, Schuylkill River basin, Pennsylvania, a multipurpose reservoir built for flood control and municipal water supply. This method, concerned only with economic efficiency, does not include loss of life during floods. Necessary input data for calculating the flood risk-loss function are initial reservoir storage, reservoir capacity, water demands from the reservoir pool, reservoir losses, distribution function of the reservoir inflows, convoluted sums of the cumulative distribution functions of reservoir inflows, and reservoir releases (target releases). Necessary input data for determining the water supply risk-loss functions are initial reservoir storage, reservoir capacity, water supply storage, water demands from the reservoir pool, reservoir losses, convoluted sums of the cumulative distribution functions of reservoir inflows, reservoir releases (target releases), average annual water demand for water supply, cumulative distribution functions of streamflow at the intake, and shortage-loss relationships. This approach can also be used in developing the risk-loss functions associated with other reservoir uses: recreation, navigation, and water quality enhancement. (Cassar-FRC)
W82-03245

THE COMPUTER: WATER MANAGEMENT TOOL,

Camp, Dresser and McKee, Inc., Clearwater, FL.
R. N. Armstrong, and R. S. Taylor.
Consulting Engineer (St. Joseph), Vol 57, No 3, p 97-100, September, 1981.

Descriptors: *Computer models, *Planning, *Water management, Model studies, Water supply, Water pollution effects, Water shortage, Wells, Combined sewer overflows, Cross Bar Ranch well field, Florida.

Computer models are being used effectively for water supply management. They are effective in prediction, planning, and monitoring supplies; in simulation of the water cycle; in predicting effects of drought, pollution, and salt water intrusion; and in evaluating the role of socioeconomic factors. Several examples of innovative computer modeling for water resources management are described. In Florida the Cross Bar Ranch well field near Tampa Bay was designed, developed, monitored, and managed by computer to ultimately yield 30 mgd for average demand and 45 mgd for peak demand without violating regulations or damaging the aquifer. Water demand and economic impacts of water restrictions were studied in the Metropolitan Washington, D.C. area. Computer analysis of many variables in population, employment, housing, user type, etc. allowed formulation of an effective water management program for this area. Computer models are also used in studying combined sewer overflows, river flows, flood control alternatives, and basic data on the Chesapeake Bay and its tributaries. (Cassar-FRC)
W82-03290

MODERN MANAGEMENT TECHNIQUES, PART II A: CASE HISTORY OF PRODUCTION IMPROVEMENT,

LWFW, Inc., Dallas, TX.
G. S. Thompson, and T. G. McCoy.
Water/Engineering and Management, Vol 128, No 3, p 88-89, 100, March, 1981. 8 Fig.

Descriptors: *Management planning, *Sewer systems, *Water conveyance, Performance evaluation, Economic aspects, Political aspects, Mechanical equipment, Needs assessment, Productivity, Wastewater managment.

An outside consultant was hired to conduct an operation audit of the field operations group of the water and sewer utilities department of a major Texas city in order to obtain an objective review of productive levels, to design and implement a management reporting system that would include productivity performance reporting, and to ensure that the best available management techniques were being used by the field operations group. Initial activities included interviews with key management and supervisory personnel and detailed field observations of the work crews. Later activities included review of planning, scheduling, and reporting functions. Detailed analyses of crew time in the water and sewer construction section revealed severe work imbalances, resulting in low job site productivity. The acquisition of larger back-hoe equipment was recommended and implemented, resulting in productivity improvements between 75 and 90 percent. Analysis and optimization of the size and number of dump trucks used at each site resulted in truck utilization of 83 percent and backhoe utilization of 100 percent, compared to 100 percent and 50 percent, respectively, prior to the evaluation. (Carroll-FRC)
W82-03310

MODERN MANAGEMENT TECHNIQUES, PART I: NEED FOR, AND IMPORTANCE OF, PRODUCTIVITY IMPROVEMENT,

LWFW, Inc., Dallas, TX.
G. S. Thompson, and T. G. McCoy.

Water/Engineering and Management, Vol 128, No 2, p 52-54, 64, February, 1981. 2 Ref.

Descriptors: *Water treatment facilities, *Management planning, *Productivity, Labor, Wastewater management, Sewer systems, Supervisory control, Operating policies, Decision making, Administration, Utilities.

Problems caused by declining productivity in the public sector become manifest through increased costs of service, declining service levels, and inability to adequately maintain and replace existing capital systems and equipment. When planning productivity improvements in the field operations area of water and sewer utilities, it is first necessary to define productivity and to determine who in the organization can implement its improvement. Labor productivity should be the major focus, since field operations activities are labor intensive and because labor productivity can be significantly influenced by management action. Major factors affecting field operations productivity include work methods, scheduling, materials availability, equipment, proper management information, tactical planning, and strategic planning. Because of the importance and complexity of productivity in this area, its improvement requires the best available management techniques, including productivity performance reporting as an integral part of a management information system, the use of the critical success factors approach to organizational design and management, and periodic operations audits. Productivity performance reporting is the reporting through all levels of supervision and management of the productivity of each segment of the operation. Critical success factors are those important factors requiring special management attention. Individuals should be charged with accountability for each of the identified factors. Operations audits provide a tool for focusing on the review of the operation as a whole, for evaluating the effects of management actions on productivity, and for early identification of problem areas. (Carrol-FRC)
W82-03311

JERSEY DROUGHT HASTENS WATER SUPPLY PROJECT,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 6D.
W82-03385

6B. Evaluation Process

ALTERNATIVE COSTS AND TOTAL ECONOMIC BENEFITS: AN INPUT-OUTPUT STUDY OF THE ASWAN DAM (EGYPT),
Northeastern Univ., Boston, MA. Dept. of Economics.
M. E. S. Abdel Rahman.
PhD Dissertation, July, 1980. 163 p, 25 Tab, 62 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAZ81-07001.

Descriptors: *Economic aspects, *Model studies, *Cost-benefit analysis, *Dams, Electric power, Irrigation, *Aswan Dam, Egypt.

This study empirically assesses the alternative costs and total (direct and indirect) economic benefits of the Aswan Dam to the Egyptian economy. The chief analytical tool is a static version of Leontief's Input-Output model. The alternative costs are the net drain on the economy of using other methods to produce an amount equal in value to the electrical power and agricultural output made possible by the water supply of the Dam. The estimated alternative costs show the Dam to be a very efficient source of electric power and of water for irrigating additional land and hence to be economically justified in these terms alone. The total benefits encompass the expected increase in the demand for the Dam's extra electric power and agricultural production. The total benefits from the additional electricity can be analyzed in terms of the increases in domestic sector's output, employment, and contribution to the balance of payments position of the country. National policy implications of the study are that the Aswan Dam is the basis for future economic development in Egypt. If the maximum benefits of its electric power are to be realized, Egypt's development policy should emphasize the allocation of the country's limited investment funds to the creation and/or expansion of a 'growth industry' in each of the economy's key processing sectors with the strongest forward linkages. These sectors are found to be: chemicals; food processing; spinning and weaving; iron and steel. Two other key primary sectors should continue to be developed, namely transportation and agriculture. (Sinha-OEIS)
W82-03009

OPTIMAL OPERATING POLICIES FOR WATER SUPPLY AND DISTRIBUTION SYSTEMS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 6A.
W82-03010

LABORATORY STUDIES OF PRIORITY POLLUTANT TREATABILITY,
Walk, Haydel and Associates, Inc., New Orleans, LA.
For primary bibliographic entry see Field 5D.
W82-03030

COMBINED SEWER OVERFLOW ABATEMENT PROGRAM, ROCHESTER, N.Y. - VOLUME I. ABATEMENT ANALYSIS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5G.
W82-03035

COST-BENEFIT ANALYSIS OF THE EUPHRATES DAM,
Norfolk State Univ., VA.
N. Samman.
Water Suply and Management, Vol 5, No 4/5, p 331-338, 1981. 1 Fig, 1 Tab, 29 Ref.

Descriptors: *Dams, *Decision making, Management, Planning, *Euphrates Dam, *Syria, *Euphrates river, Rivers, Dam construction, Construction, Irrigation, *Cost-benefit analysis, Economic aspects, Cost analysis, Multipurpose reservoirs.

In Syria, the economy is primarily agricultural. Agricultural production varies due to the annual rainfall, which at present is only 350 mm/year. However, an abundance of natural water resources are available for agricultural use. A dam was constructed across the Euphrates River in 1975 and has increased actual and potential irrigation in the river basin. With completion of the dam, irrigation objectives of 640,000 hectares can be developed over the next 20-30 years in the Euphrates Basin. Considering the costs and benefits of the project involves making certain assumptions. First, the project life is 35 years, even though the economic benefits extend to a century. Secondly the social infrastructure costs associated with farmer resettlement in the project area, including public buildings, roads and public utilities are not imputable to the project, as these facilities have to be provided by the government with or without the project. Third, the investment stream in the economic analysis comprises the following five items: initial fixed investment, investment imputable to the project, operation and maintenance costs, investment for removal of appropriate items which depreciate, and annual costs at the farm level. Fourth, the social opportunity cost of family labor was assumed to be zero. Analysis revealed that the project was economically sound and justified its priority consideration by the Syrian Government. However, it also seemed that the project will not transform the Syrian economy to the extent expected by the planners. (Baker-FRC)
W82-03054

ESTIMATING THE COSTS IN LOST POWER OF ALTERNATIVE SNAKE-COLUMBIA BASIN MANAGEMENT POLICIES,
Sandia National Labs., Albuquerque, NM.
R. J. Hanson, and C. B. Millham.
Water Resources Research, Vol 17, No 5, p 1293-1303, October, 1981. 3 Fig, 6 Ref.

Descriptors: *Cost analysis, *Model studies, Benefits, *Water management, Water use, Water resources development, Basins, Watersheds, Powerplants, Project planning, Alternative planning, *Snake River basin, *Columbia River basin.

Competition exists between optimal hydropower generation on the one hand, and recreation, fisheries, navigation and irrigation on the other. Specific questions resulting from this conflict deal with the costs of replacing hydropower lost under alternative basin management schemes designed to benefit uses other than power generation. A 51 dam, 56 time period long range simulation model of the hydropower system in the Snake-Columbia basin, including projects on those two rivers and on major tributaries thereof is presented. The model is then applied to study a series of alternative basin management scenarios, and the consequences in lost power of these scenarios are evaluated economically. Efficiency in this model was achieved using 'French Curve' cubic spline data fits together with fast pointers to carefully define data structures. Care was taken to couch the model in a setting making it accessible to use by nonprogramers. It was concluded that competition between power production and other uses of the basin's water can be expected to increase as energy shortages increase. Trade-offs between power production and the other uses and interests must be evaluated and decisions made as to which interests to favor. The results given herein are linear in terms of changes in costs for either base-load or peaking. For example, an error of two mills in peaking costs would result in a change of about $4,000,000, for a deficit of 3000 megawatt-months. The power deficits, in megawatt months, are felt to be reasonably good estimates. There is some room for discussion of the split between baseload and peaking. (Baker-FRC)
W82-03073

ECONOMIC APPRAISAL OF A GROUNDWATER DEVELOPMENT PROJECT,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Industrial Engineering and Management.
J. C. S. Tankg, and S. Tanthimakabut.
Water Resources Bulletin, Vol 17, No 5, p 783-788, October, 1981. 7 Tab, 3 Ref.

Descriptors: *Cost-benefit analysis, *Irrigation water, *Groundwater irrigation, *Irrigation operation, *Thailand, Water distribution, Feasibility studies, Pipes, Economic aspects, Water resources development, Development countries.

A cost-benefit analysis of a groundwater irrigation water development project in northern Thailand indicated that the project is economically feasible. It is designed to provide water for dry season cropping. Major products are soybeans, mung beans, maize, groundnuts, cotton, rice, vegetables, fruits, and sugar cane. Benefit-cost ratios for two cropping patterns were 1.42 and 1.35 (financial) and 1.94 and 2.07 (economic with selective shadow pricing). Underground PVC pipes are more economical than a lined open ditch system if the ditches must be redone four times over the project life. (Cassar-FRC)
W82-03077

AN ECONOMIC ANALYSIS OF WATER CONSERVATION POLICY,
Rutgers - The State Univ., New Brunswick, NJ.
W. Whipple, Jr.
Water Resources Bulletin, Vol 17, No 5, p 814-819, October, 1981. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Water conservation, *Drought, *Economic evaluation, Water demand, Water supply, Water resources, New Jersey, Water policy, Water reuse, Water prices, Groundwater management.

Disagreement is expressed with Federal policies which encourage water conservation as an end in itself. Although water conservation in drought situations is advantageous and often necessary, it is not a substitute for improved structural systems. Water conservation should be used only when the value of the water saved exceeds the cost of pro-

ducing the savings. A community can be caught unprepared for drought or growth in water demand if it relies on conservation measures during normal rainfall. This policy applies where water is a renewable resource, not where groundwater is mined, such as the Ogallala Aquifer, the Tucson basin, and the Libyan desert. New Jersey is used in an example of an economic analysis. (Cassar-FRC)
W82-03090

POTENTIAL WATER USE AND AGRICULTURAL PRODUCTION PATTERNS UNDER ALTERNATIVE WATER PRICES,
Iowa State Univ., Ames. Center for Agricultural and Rural Development.
D. A. Christensen, E. O. Heady, and A. S. Morton.
Water Resources Bulletin, Vol 17, No 5, p 844-850, October, 1981. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Water demand, Water price, *Agriculture, *Irrigation, Water consumption, *Water cost, Water conservation, Water use, Prices, Crop yield, Model studies, Elasticity of demand, Groundwater irrigation, Surface water, Land use.

The effects of varying prices of surface and groundwater on agricultural land use patterns were determined by normative analysis. Using four levels of prices for both surface water and groundwater and ignoring constraints such as subsidies and water rights, the model produced different amounts of water used and different mixes of crops, livestock, and production technology for each price level. At the highest water prices (4 times 1975 prices for both surface water and groundwater) total water demand is half that of the 1975 base level; irrigated acreage is reduced to 8.4 million from 19.6 million. In practice, marginal dryland regions would be added to the total dryland cropping area. Although irrigated crop yields are reduced and commodity shadow prices are increased by up to 15% at the high water prices, total agricultural production would remain somewhat constant. (Cassar-FRC)
W82-03092

WHO WILL PAY THE WORLD'S WATER BILL,
Earthscan, London (England).
J. Tinker.
Aqua, No 3, p 17-20, 1981.

Descriptors: *Developing countries, *Water supply development, International Drinking Water Supply and Sanitation Decade, Water policy, Costs, Planning, Financing, Public health, Rural areas.

A minimum of $300 billion total or $80 million a day is required to meet the goals of the International Drinking Water Supply and Sanitation Decade by 1990. Although agencies and governments are highly in favor of the project, money will apparently come from reducing expenditures in agriculture, health, education, etc. Progress varies according to the country and depends on motivation. For example, Bangladesh expects to reach its 100% coverage goal by 1985, having already sunk half a million tubewells and supplied 70% of the people with a hand pump within 200 meters of their homes. (Cassar-FRC)
W82-03280

THE GEZIRA SCHEME–A STUDY IN FAILURE,
N. Pollard.
Ecologist, Vol 11, No 1, p 21-31, January-February, 1981. 1 Fig, 117 Footnotes.

Descriptors: *Social impact, *Human diseases, *Irrigation, Water resources development, Gezira, *Sudan, Cotton, Water management, Agriculture, Developing countries, Environmental effects.

Water resources were developed for irrigation of cotton in the Gezira region, Sudan, starting with the construction of the Sennar dam and canals in 1914. The project has increased in incidence of waterborne disease and disrupted the cultural life of the population without producing much economic gain. Schistosomiasis, malaria, and yellow fever became major problems. Byssinosis affected many cotton gin workers. Simple irrigation has been in use here since 3000 B. C. Before British colonial intervention the population lived in balance with the environment. The family unit and the Muslim religion were the basis of cultural stability. Cotton had been grown, spun, and woven in family units. This practice declined as cotton was sent directly to gins. Land was divided into small plots of 12-16 hectares for working by tenant families. This was not successful because of burdensome government regulations on crop allocation and water management. Proceeds from the cotton crop rarely reach 100 pounds per tenant per year. Although the colonialists have left the area, the Gezira people have a legacy, a technology unsuitable for the cultural environment. (Cassar-FRC)
W82-03393

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

BETTER WAYS TO FINANCE STORMWATER MANAGEMENT,
Stormwater Consultants, Bolingbrook, IL.
H. G. Poertner.
Civil Engineering (New York), Vol 51, No 4, p 67-69, April, 1981. 2 Tab.

Descriptors: *User charges, *Storm water, *Urban runoff, Financing, Management, Utilities, Storm drains, Institutions, Storm runoff, Urban drainage, Runoff, Planning, Surface drainage, Surface runoff, Cities, Economics, Public utilities, Impervious soils, Legal aspects.

Annual losses and damages from surface runoff in the U.S. were estimated at $3 billion in 1978. Innovative financing methods are frequently needed for preventive and corrective programs. Some cities have adopted the user charge concept, which in Denver, Colorado, uses the ratio of impervious area to total area of a land parcel to determine the rate ($0.37 to $1.17) per 100 sq ft, billed annually, needed to raise $4.7 million a year. Other cities charge according to amount of impervious area or according to land use. The separate stormwater utility is popular in many western U.S. cities. Before establishing any of these systems, legal and public relations efforts should be initiated. (Cassar-FRC)
W82-03298

MAJOR CHANGES AHEAD IN THE NATION'S WATER CLEAN-UP PROGRAM,
G. Dallaire.
Civil Engineering (New York), Vol 51, No 12, p 50-53, December, 1981.

Descriptors: *Grants, *Wastewater treatment, *Water pollution control, Water policy, Regulations, Federal jurisdiction, Construction costs, Water quality standards, Effluent standards, Utilities, Standards, Municipal wastewater, Secondary wastewater treatment, Financing, Water quality control.

Changes in federal policies indicate that the construction grants program will be discontinued. The Water Pollution Control Federation urges an orderly phaseout over 10 years to allow municipalities time to adjust to self-reliance. The wastewater treatment plants will have to operate as utilities, charging rates high enough to cover operation and maintenance costs plus replacement costs. With less federal money available officials must concentrate on projects probably in urban areas, which give the most benefit for the least cost. Effluent standards and water quality standards must also become more flexible, perhaps allowing a limited mixing zone in a receiving stream where dissolved oxygen would be permitted to fall to 3 mg per liter instead of 5 mg per liter. Such policies would prevent spending large amounts of money for very small improvements in water quality. Since $120 billion is needed for municipalities to meet the goal of fishable, swimmable waters throughout the U.S., it may be advisable to set up a priority system to first clean up important rivers rather than inadequately deal with many rivers. Policies toward ocean dumping and secondary treatment for effluents disposed of into the ocean may be relaxed. (Cassar-FRC)
W82-03395

6D. Water Demand

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; PIGEON RIVER BASIN; NORTH CAROLINA, TENNESSEE,
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-003537, Price codes: A03 in paper copy, A01 in microfiche. Federal Energy Regulatory Commission Report FERC-0087, September, 1981. 45 p, 8 Fig, 11 Tab.

Descriptors: *Water resources development, *River basin development, *Water demand, *Hydroelectric plants, Water quality, Streamflow, Recreation, Water supply, Water storage, Reservoirs, *Pigeon River basin, North Carolina, Tennessee, Licensing.

The Pigeon River basin extends generally northward from the western slopes of the mountains in the Pisgah National Forest in Haywood County, North Carolina, into Cocke County, Tennessee, where the Pigeon River flows into the French Broad River. The Pigeon River drains an area of 666 sq mi. The average annual precipitation is about 45 inches, and the average streamflow of the Pigeon River at its mouth is approximately 1,250 cfs. The area is predominantly agricultural, and sparsely populated. The 108,600 kw Walters hydroelectric project is the only utility generating facility in the basin. Champion Papers, Inc., operates a 51,000 kw industrial steam-electric facility in the upper reaches of the basin. The water resources of the basin have been developed to provide a moderate amount of hydroelectric power with small incidental flood control, municipal and industrial water supplies, and limited fishing and recreation. There are no navigational facilities in the basin. The Walters project consists of a reservoir, dam, and powerplant connected to the reservoir by a 6.2 mi penstock tunnel. The 340-acre reservoir, Waterville Lake, has a total storage capacity of 25,000 acre-ft. Hydroelectric power development potential exists at two sites in the basin, but these projects have not been evaluated for economic feasibility. The Walters project, for which an application for a new license is pending, is in good condition and continued operation of the project appears to be economically justified and would have little impact on the environment. (Moore-SRC)
W82-03039

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; CAPE FEAR RIVER BASIN; NORTH CAROLINA - SOUTH CAROLINA,
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
M. Maslia.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-003334, Price codes: A02 in paper copy, A01 in microfiche. Federal Energy Regulatory Commission Report FERC-0088, September, 1981. 14 p, 2 Fig, 7 Tab.

Descriptors: *Water resources development, *River basin development, *Water demand, *Hydroelectric plants, Cooling water, Powerplants, Flood control, Navigation, Nuclear powerplants, Thermal powerplants, *Cape Fear River basin, North Carolina, South Carolina, Licensing.

The Cape Fear River basin covers a drainage area of 8,570 sq mi, and this report also includes 1,814 sq mi of the coastal area between the Neuse and Pee-Dee River basins. The average annual rainfall over the basin is about 48 inches. The maximum flow at Lillington is 150,000 cfs, while the minimum flow is 11 cfs. There is one existing Federal flood control project in the basin, and 35 retired

hydroelectric projects. Navigation facilities consist of three channels and three locks and dams. There are two fossil-fueled steam-electric generating plants and one nuclear-fueled steam-electric generating plant operating in the basin; all three use the Cape Fear River as their source of cooling water. The estimated 1977 total cooling water withdrawn was 153 MGD and the estimated consumption was 6 MGD. There is substantial undeveloped hydroelectric power potential in the basin. Potential hydroelectric projects with an existing dam would provide 50,296 kw of additional hydroelectric capacity. Potential hydroelectric projects with no present development at the site would provide more than 144,372 kw of additional hydroelectric capacity. Hydroelectric power development potential also exists at the retired projects. (Moore-SRC)
W82-03040

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; MERRIMACK RIVER BASIN; NEW HAMPSHIRE, MASSACHUSETTS,

Federal Energy Regulatory Commission, New York. New York Regional Office.
P. Valeri.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-00356, Price codes: A02 in paper copy, A01 in microfiche. Federal Energy Regulatory Commission Report FERC-0091, September, 1981. 21 p, 2 Fig, 7 Tab.

Descriptors: *Water resources development, *River basin development, *Hydroelectric plants, Licensing, *Water demand, Eutrophication, Water quality, Water storage, Flood control, *Merrimack River basin, New Hampshire, Massachusetts.

The Merrimack River basin is located in south-central New Hampshire and north-eastern Massachusetts, and drains 5,010 sq mi. The average annual precipitation in the basin is 43 inches. The average annual flow of the Merrimack River at Lowell, Massachusetts is 7,490 cfs. The economy of the basin is based largely on manufacturing and service industries. Many segments of the Merrimack River and its tributaries have been seriously polluted, and lake eutrophication is a basinwide problem. There are about 458,000 acre-ft of usable water storage capacity. Five major flood control reservoir projects with a total storage capacity of 370,000 acre-ft have been constructed in the New Hampshire portion of the basin. There are 22 existing hydroelectric plants operating in the basin, with a total installed capacity of 58,048 kw. There are also two steam-electric, three internal combustion, and two combustion turbine generating plants in the basin. There are 46 hydroelectric sites in the basin with a total potential capacity of 323,871 kw, and five existing developments having a potential of increasing their capacity by 51,900 kw. Construction of the new Lawrence powerplant and the proposed Lowell powerplant will provide a total of 29,800 kw. The development of 14 new sites would account for 212,544 kw. Rehabilitation of 25 retired sites currently under license or preliminary permit action accounts for 29,627 kw of potential capacity. There are 309 known retired plants. (Moore-SRC)
W82-03041

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; YADKIN-PEE DEE RIVER BASIN; NORTH CAROLINA, SOUTH CAROLINA, AND VIRGINIA,

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
H. D. Patrick.
Federal Energy Regulatory Commission Report FERC-0090, September, 1981. 15 p, 2 Fig, 6 Tab.

Descriptors: *Water resources development, *River basin development, *Water demand, Licensing, *Hydroelectric plants, Recreation, Consumptive water use, Cooling water, Water supply, Powerplants, Wild rivers, Wildlife, *Yadkin River basin, *Pee Dee River basin, North Carolina, South Carolina, Virginia.

The Yadkin-Pee Dee River basin covers approximately 17,890 sq mi in Virginia, North Carolina, and South Carolina. Precipitation averages about 47 inches per year over the basin. There are eight existing hydroelectric projects with a combined total capacity of 311,329 kw. In addition, there are 16 retired small hydro plants located in the basin. The W. Kerr Scott reservoir on the upper portion of the Yadkin River is the only existing Federal reservoir project in the basin. At present, the project has no power facilities. Water supply for domestic purposes, industry, and agriculture is a major resource use. Over 200 water supply systems have been identified in the basin, of which 60 use surface water. Previous recreational use of the basin has been limited, but the use of the basin for recreational and wildlife is expanding. There are five steam-electric plants which withdraw 1,020.7 MGD for cooling water use, of which 23.7 MGD is consumed. There are 25 potential hydroelectric power developments in the basin, with a total installed capacity of 467,922 kw. Demand for water by public water systems, industrial plants, and for irrigation is expected to rise from approximately 287 MGD at present to 625 MGD by 2010. Potential water supply projects include two dams in North Carolina. Certain segments of rivers within the Yadkin-Pee Dee River basin have been selected as having potential for further consideration for the National Wild and Scenic Rivers System. (Moore-SRC)
W82-03042

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; PAYETTE RIVER BASIN, IDAHO.

Federal Energy Regulatory Commission, San Francisco, CA. San Francisco Regional Office.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-003535, Price codes: A03 in paper copy, A01 in microfiche. Federal Energy Regulatory Commission Report FERC-0089, September, 1981. 52 p, 6 Fig, 10 Tab, 10 Ref.

Descriptors: *River basin development, *Water demand, *Water resources development, *Hydroelectric plants, *Irrigation, Water storage, Reservoirs, Dams, Flood control, Pumped storage, Licensing, *Payette River basin, Idaho.

The Payette River basin is a major tributary of the Snake River draining about 3,240 sq mi in west central Idaho. The average streamflow of the Payette River near Payette is 3,078 cu ft/sec. Annual precipitation varies from 13 inches at Emmett to 22 inches at Cascade and 33 inches at Deadwood Dam. The population in the basin is estimated to increase from 33,427 to 41,962 during the period 1980-2000. There are only two existing hydroelectric developments in the basin: the 8,000 kw Black Canyon plant located downstream of Black Canyon Dam and the unlicensed 300 kw Cascade plant located about 1,000 ft downstream of Cascade Dam. A license has been issued for a 12,800 kw hydroelectric project to be located downstream from the Cascade Dam and Reservoir, replacing the existing powerplant. There are five existing water storage reservoirs, with an aggregate usable storage capacity of 912,000 acre-ft. In 1976 there were about 152,000 acres of irrigated cropland. An additional 10,000 acres of new irrigation development and 23,000 acres requiring supplemental irrigation water supply are proposed by the year 2000. The total potential undeveloped conventional hydroelectric capacity in the basin is estimated to be 1,270 mw. There are two potential pumped storage developments in the basin with an estimated capacity of 1,000 to 3,000 mw and 1,000 to 9,000 mw, respectively. Structural development for the exclusive purpose of flood control cannot be justified under existing evaluation criteria. (Moore-SRC)
W82-03043

WATER RESOURCES APPARISALS FOR HYDROELECTRIC LICENSING; ST. JOSEPH - KALAMAZOO RIVER BASIN; INDIANA - MICHIGAN,

Federal Energy Regulatory Commission, Chicago, IL. Chicago Regional Office.
T. P. Mabini.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-003333, Price codes: A02 in paper copy, A01 in microfiche. Federal Energy Regulatory Commission Report FERC-0093, September, 1981. 18 p, 4 Fig, 6 Tab.

Descriptors: *Water resources development, *River basin development, *Hydroelectric plants, Licensing, *Water use, Flood control, Cooling water, Wild rivers, Powerplants, Streamflow, *St. Joseph River basin, *Kalamazoo River basin, Indiana, Michigan.

The basin includes the drainage areas of the St. Joseph and the Kalamazoo Rivers, with a total area of 6,665 sq mi. Springs and small lakes sustain the flow of the St. Joseph River, and therefore it is not subject to extremely low flows. The streamflow, about 45 mi above Niles, Michigan, averages about 3,100 cu ft/s. The flow of the Kalamazoo River near Fennville, Michigan averages about 1,400 cu ft/s. There are about 15 hydroelectric projects in the basin, with a total installed capacity of 32,478 kw. There are six authorized navigation projects and one local flood control project in the basin. There are five steam-electric plants which rely on surface waters for condenser cooling. One undeveloped hydroelectric site and five developed sites have potential for capacity additions. There are numerous sites within the basin where hydropower was generated but operations have been suspended and the powerhouse either abandoned or removed. A portion of the Paw Paw River, beginning 2 mi downstream of the Berrien-Van Buren County line was studied for inclusion in the National Wild and Scenic Rivers system. The retired Paw Paw hydroelectric projected may be affected by the proposed inclusion. Projected cooling water needs for steam-electric generation decreased due to reduction of plant capacities utilizing once-through cooling systems and an increase of plants utilizing cooling tower systems. (Moore-SRC)
W82-03044

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; YAMPA RIVER BASIN; COLORADO, WYOMING.

Federal Energy Regulatory Commission, San Francisco, CA. San Francisco Regional Office.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-003538, Price codes: A03 in paper copy, A01 in microfiche. Federal Energy Regulatory Commission Report FERC-0086, September, 1981. 51 p, 4 Fig, 5 Tab, 8 Ref.

Descriptors: *Water resources development, *River basin development, *Water damand, *Hydroelectric plants, Dams, Irrigation, Water supply, Cooling water, Powerplants, Reservoirs, Wild rivers, Coal mining, Oil shale, Licensing, *Yampa River basin, Colorado, Wyoming.

The Yampa River basin, encompassing approximately 9,530 sq mi, lies in the northwest corner of Colorado and southcentral part of Wyoming. The major use of water in the basin is irrigation. The municipal systems derive their water from the nearby stream or, in one case, from a ground water reservoir. The only significant industrial water use is for steam-electric generation. As a part of the Colorado River system, flows are subject to requirements imposed by the Upper Colorado basin compact of 1948. The six major reservoirs in the basin are used for irrigation, fishery, domestic consumption, and recreation. The Yampa River basin is undergoing substantial economic development, spurred mainly by the mining, transport and conversion of coal resources. If the oil shale industry develops in the area, large amounts of water would be needed for industrial and domestic purposes. The proposed Juniper-Cross Mountain project would consist of two separate hydroelectric developments, each having a dam, reservoir, powerplant, and associated facilities. The Juniper unit would have an installed capacity of 98,000 kw, while the Cross Mountain unit would have an installed capacity of 50,000 kw. Four additional potential conventional hydroelectric powersites have been identified in the basin. The combined installed capacity potential for these sites is less than 50 megawatts. The reach of the Yampa River within Dinosaur National Monument is being stud-

ied for inclusion in the National Wild and Scenic Rivers System. (Moore-SRC)
W82-03045

THE INPUT-OUTPUT WATER TRANSACTIONS MODEL OF SUPPLY AND DEMAND,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. W. Hendricks, and R. W. Dehaan.
Water Supply and Management, Vol 5, No 4/5, p 317-330, 1981. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Water supply, *Model studies, *Water demand, Planning, Decision making, *Input-output analysis, Water supply systems, Case studies, South Platte Basin, Colorado.

This paper focuses on the basic guidelines for input-output water planning and the general application of the model in basin-wide planning. The major purposes are to demonstrate how a simple tabular display, the input-output water transactions table, can be constructed to represent a complex water system, and to indicate the utility of the table in water planning. The 1970 input-output table of the South Platte Basin depicts the system structure for innumerable transfers of water. These transfers give the 'fits' between the sources of supply and the demand sectors shown. The structure, implicit in the matrix, is formed by the water rights priorities and the commensurate physical facilities for water storage, conveyance, and distribution. The input-output table ties together all of the diverse components of a water resource system such that the relationships between the parts and the whole can be discerned. Such a display provides a framework for making judgments about alternative water supply alternatives in the context of political, environmental, and legal questions, as well as physical ones. It is, at the same time, a planning methodology and a core of information. (Baker-FRC)
W82-03055

ON WATER AVAILABILITY AND DEMAND IN NIGERIA,

Ibadan Univ. (Nigeria). Dept. of Geography.
J. O. Ayoade.
Water Supply and Management, Vol 5, No 4/5, p 361-372, 1981. 2 Fig, 8 Tab, 3 Ref.

Descriptors: *Water resources development, *Management planning, Resources development, Water quality, *Water supply development, River basin development, Decision making, Planning, Water demand, Water supply, *Nigeria.

A broad assessment of water resources in Nigeria is presented along with strategies for developing and managing the country's water resources to avert the danger of a serious water crisis in the future. Rainfall represents the gross water income of the country, and it is the ultimate source of water found in rivers, streams, ponds, lakes or wells. Rainfall is seasonal in its incidence all over the country, but the duration of the rainy season varies from about 10 months to about three months in specific regions. The country has three major watersheds. In terms of quality, most Nigeria rivers are generally turbid; they carry a high sediment load in suspension, particularly during the wet season. Unpolluted water is generally acidic and moderately hard. It is good for drinking and irrigation, though it must be purged of the suspended sediment load to make it potable, particularly during the rainy season. The chemical quality of much of Nigeria's groundwater is relatively high. Traditional means of water exploitation include direct collection of rainwater from roofs of buildings and extraction of water from spring streams, ponds and hand dug wells. The major problem in meeting water demands is that of development and management rather than of water availability. Efficient management is beset with problems, including finance, equipment, personnel and the institutional framework for managing water resources. These problems can only be solved by planning and wise use of resources based on sound knowledge of the nature and distribution of the nation's water resources potential. (Baker-FRC)
W82-03062

AIRY HOLM DAM - KIELDER WATER SCHEME,

Babtie, Shaw and Morton, Glasgow (Scotland).
For primary bibliographic entry see Field 8A.
W82-03070

POTENTIAL WATER USE AND AGRICULTURAL PRODUCTION PATTERNS UNDER ALTERNATIVE WATER PRICES,

Iowa State Univ., Ames. Center for Agricultural and Rural Development.
For primary bibliographic entry see Field 6B.
W82-03092

POLICIES AND GOALS FOR CALIFORNIA WATER MANAGEMENT: THE NEXT 20 YEARS,

California State Dept. of Water Resources, Sacramento; and the California State Water Resources Control Board, Sacramento.
Public Review Draft, Bulletin 4, June, 1981. 54 p, 13 Fig, 4 Tab.

Descriptors: *Water management, *Long-term planning, *Resources management, Groundwater management, *Comprehensive planning, *Project planning, *Water policy, Public policy, Water quality control, Water quality management, Projections, Regional planning, Regional development, *California.

Annual net water use in California is now about 29 million acre-feet. Drops in runoff and increased water transport costs have reduced the total usable surface water runoff to 26 million acre-feet per year from 71 million acre-feet. The California Water Resources Management Policy has been drawn up to guide federal, state, and local agencies to ensure that enough water of proper quality is available to meet the state's reasonable needs until the year 2000. The nine policy components are: (1) use of existing water resources before developing new sources; (2) consideration of water quality objectives as an integral part of water resources management; (3) encouragement of conjunctive water use and avoidance of ground water overdraft; (4) encouragement of water conservation; (5) encouragement of water reclamation and reuse; (6) control of point and nonpoint pollution sources; (7) enhancement of instream beneficial use; (8) control of floods by construction of facilities and by flood plain zoning, flood proofing and flood warning systems; and (9) encouragement of energy considerations as part of water resources planning. Present water supplies, along with authorized and proposed additions to the Central Valley Project and the State Water Project, will satisfy water needs in California until 2000 during years of normal and above-normal runoff, but local and regional water management agencies need to accelerate their efforts for more effective water management. More attention must be given to planning for water-short years, managing ground water supply and quality, protection of instream use, and monitoring 13 significant conflict areas in the state. (Garrison-Omniplan)
W82-03111

WATER SUPPLY IN DENMARK,

Copenhagen Water Supply (Denmark).
J. A. Husen.
Aqua, No 2, p 25, 26, 28, 1981. 1 Fig, 1 Tab.

Descriptors: *Water supply, *Groundwater budget, *Denmark, Groundwater management, Groundwater reservoirs, Wells, Boreholes, Irrigation, Potable water, *Groundwater availability.

While Denmark does not have any large rivers or inflowing watercourses, easy access to groundwater is possible almost everywhere. Thus the main part of the water supply is based on groundwater abstraction. Surface water is used only as a supplement in the area of the Capital. The average annual precipitation is 760 mm, and the average actual transpiration is estimated at about 410 mm per year, leaving about 350 mm per year for infiltration and run-off. Public water supply delivers less than half of the total consumption figure for the country. About 90% of the population are supplied from public water supplies organized either as municipal waterworks or as private cooperative waterworks owned by the consumers. About 3 million inhabitants are supplied from 150-200 municipal waterworks, for a total production of about 360 million cubic meters per year. Total consumption breaks down to about 63% for households and small firms, 27% to industry and about 10% to institutions. During recent years a special demand has risen for abstraction of groundwater for irrigation by drilling on individual farms. This has resulted in a considerable exploitation of the groundwater resource. For the country in general the groundwater resources are still sufficient, but careful planning of resources has been established, as it is necessary to keep a balance between standards of quality and quantity required and the effect on the environment. (Baker-FRC)
W82-03274

QUANTIFICATION OF RAINFALL AND ITS UTILIZATION EFFICIENCY IN RAJASTHAN,

Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 2B.
W82-03276

WATER: TOO MUCH, TOO LITTLE, TOO BAD,

Johns Hopkins Univ., Baltimore, MD. Dept. of Sanitary Engineering and Water Resources.
A. Wolman.
Consulting Engineer (St. Joseph), Vol 57, No 3, p 83-86, September, 1981. 3 Ref.

Descriptors: *Water reuse, *Water supply, *Planning, *Water management, Water conservation, Water transfer, Water resources development, Water demand, Water policy, Water shortage, Irrigation, Drip irrigation, Agriculture, Hydroelectric power, Floods, Drought, Industrial water, Wastewater, Future planning, Long-term planning, Political aspects, Social aspects, Municipal water.

A bird's-eye view of water resources points out the $160 billion investment in 60,000 water systems in the U.S., the low price ($1 or $2 per 1000 gal, residential use), and the problems of sufficient water at the desired locations. Agriculture, the largest user of water in the U.S. is rapidly adopting drip irrigation, especially in drier regions. Industry has traditionally used water according to availability. For example, steel making uses 5000 gal per ton of steel produced where water is in short supply and up to 50,000 gal per ton where ample cheap water is available. New plants and process modifications are increasingly designed to conserve water. Cooling water continues to be a high-volume use, and further research is needed to develop a technology for conservation in this application. With higher oil costs, hydropower is regaining favor and many inactive dams are being considered for retrofitting to produce power. Floods and droughts continue to plague planners, zoning officials, and government officials. Efforts to prepare for or prevent these disasters are often ineffective and last only as long as a threat is perceived. Measures which may conserve water now and for the future are: water reuse, wastewater reuse, more effective irrigation, estuarine impoundments, and desalination. Systems analysis, operations research, computer intelligence data, and automation are among the tools available for confronting the problems of water management. (Cassar-FRC)
W82-03291

WILL SYNFUEL DEVELOPMENT DRAIN THE WEST DRY,

CH2M/Hill, Denver, CO.
M. R. Stansbury, and J. E. Patten.
Consulting Engineer (St. Joseph), Vol 57, No 3, p 91-96, September, 1981. 2 Fig, 1 Tab.

Descriptors: *Water requirements, *Synthetic fuels, *Coal gasification, *Oil shale, Water users, Water conservation, Water allocation, Water consumption, Water transfer, Water deficit, Water demand, Water law, Water management, Water policy, Water resources development, Water rights, Water scarcity, Water supply, Fuel, Coal mining, Slurries.

Large scale development of synthetic fuels in the water-short western U.S. would require large volumes of water. Oil shale production uses water for processing spent shale, cooling, dust control, and irrigation of revegetated areas. An average of 8500 acre feet of water per year is required for a 50,000 barrel per day facility. Water sources for this oil shale producing region are the Green, White, Yampa, and Colorado Rivers. With proper management and development of water a moderate level of oil shale development could be sustained. Synthetic fuels from coal also have large water requirements, depending on the extraction and pyrolysis methods used (4000-9000) acre feet per year for a standard size 15,000-30,000 tons per day high Btu coal gasification plant; 13,000-15,000 acre feet per year for a low Btu plant, standard size; and 4000-15000 acre feet per year for coal liquefaction plants). Transport of coal slurries would require 15,000-20,000 acre feet of Wyoming water to move 30-40 million tons of coal to Louisiana, and the water would be lost to the source state. Energy developments in the Upper Missouri Basin have and will continue to affect the agricultural community via declining water tables and the like. Possible solutions to the water deficit are: wastewater recycling, conjunctive use of groundwater and surface waters, conservation and reuse of irrigation return flow, and interstate and interbasin transfers. To prevent water supply crises the synthetic fuels industry should be limited to a moderate level of development over a long period. (Cassar-FRC)
W82-03292

A PERSPECTIVE STUDY OF DROUGHTS IN MEXICO,
National Water Planning Commission, Mexico City.
For primary bibliographic entry see Field 2E.
W82-03358

JERSEY DROUGHT HASTENS WATER SUPPLY PROJECT,
American Society of Civil Engineers, New York.
H. N. Tuvel.
Civil Engineering (New York), Vol 51, No 2, p 51-52, February, 1981. 1 Fig.

Descriptors: *Water supply development, *Water shortage, *Regional planning, *Drought, Water resources development, Water conveyance, Potential water supply, Planning, *New Jersey, Municipal water, Drinking water.

One of the areas of the northeastern United States hardest hit by water supply shortages in early 1981 is northern New Jersey, where a water emergency has been declared. Water suppliers and municipalities may impose penalties and fines for excess water usage. The Round Valley Reservoir, which is owned by the State of New Jersey, has about 75 percent of its water capacity available but is unable to relieve water suppliers in northern New Jersey due to the lack of interconnecting distribution systems. A comprehensive study of new sources of water supplies in the northeast was conducted in the late 1960s by the Army Corps of Engineers. However, no major water supply project in the Delaware River area was undertaken at that time, partially due to heavy rainfall and abundant water supplies in the seventies. The suppliers of water to northern New Jersey consist primarily of six purveyors, whose combined yields leave the area about 25 percent short of what is considered a safe yield. The mix of State, city, andprivately-owned purveyors with no central water planning and development agency with the authority to make resources development decisions resulted in the failure of the region to respond to the known need for additional water supplies. Although the North Jersey district Water Supply Commission is planning to build a new reservoir which will provide water to other purveyors, much of the current shortfall could have been avoided with adequate water resources management and development. (Carroll-FRC)
W82-03385

6E. Water Law and Institutions

THE EVOLUTION OF TEXAS WATER LAW AND THE IMPACT OF ADJUDICATION,
Texas Tech Univ., Lubbock. Dept. of Geography.
O. W. Templer.
Water Resources Bulletin, Vol 17, No 5, p 789-798, October, 1981. 5 Fig, 38 Ref.

Descriptors: *Water rights, *Adjudication procedure, *Riparian rights, *Texas, Legal aspects, *Water law, Institutional constraints, Irrigation water, Claims, Permits, Planning, Appropriation, Surface water, Water allocation, Water policy, Water management.

Texas' water law was first influenced by Hispanic legal principles. Lands granted by Spain and Mexico carried comprehensive riparian rights, including the implied right to use streams for irrigation. During 1840-1889 English riparian doctrines were superimposed on the existing water law, resulting in the popular assumption that riparian land owners could use as much water as desired for any purpose. This doctrine, unsuitable for arid and semi-arid regions, prompted the Appropriation Acts of 1889 and 1895. Under these acts, newly acquired land carried no riparian rights; individuals had to obtain water rights through statutory procedures. Loose administration of these procedures led to a stricter permit system introduced in 1913. With the mixture of conflicting laws and the uncertain riparian element, efficient management of the state's water resources was impossible. Finally, the Water Rights Adjudication Act (1967) was passed to merge all surface water rights claims (riparian and appropriative) into the permit system and to finally adjudicate all surface water rights. Over 11,600 previously unrecorded claims (7 million acre-feet) were filed as of 1974. Some of the expected benefits of water rights adjudication are: (1) riparian rights are limited to a maximum quantity of water, (2) unclaimed surface water will be discovered and made available for appropriation, and (3) reduction of unused paper rights will reduce claims to the amount of water actually being used, preventing waste flow into the Gulf of Mexico. After several more years of expensive adjudication procedures, Texas surface water rights will be well established, making efficient administration and planning possible. (Cassar-FRC)
W82-03085

THE CANADA WATER ACT, ANNUAL REPORT 1980-1981.
Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W82-03098

EPA'S APPROACH TO REGULATING NEW ENERGY TECHNOLOGIES,
Environmental Protection Agency, Cincinnati, OH.
D. G. Stephan.
AIChE Symposium Series, Vol 77, No 209, p 196-204, 1981. 4 Ref.

Descriptors: *Environmental policy, *Regulations, Environmental protection, Environmental effects, Administrative regulations, Standards, Water quality, Water management, Waste management, Fuel, Gasification, Coal gasification, *Energy technology.

The current approach of the EPA toward regulating new energy technologies is summarized, with the major emphasis being on water quality issues. EPA takes a great interest in the environmental implications of the manufacture of synthetic fuels, including coal liquefaction and gasification, retorting of oil shale, and the production of alcohol for fuel. Interest is also expressed in geothermal, solar, wind and tidal energy, combustion modification, coal and oil shale mining, energy conservation, fuel and energy transport and transmission, and new energy conversion systems such as ocean thermal gradients, magnetohydrodynamics, and fuel cells. In the area of pollution control guidance, the focal point of each regulation is intended to be a set of available control alternatives for each environmental discharge along with associated performance expectations and the basis for the alternatives presented. For most of the new energy technologies, exemplary full-scale and even pilot-scale waste treatment installations do not yet exist. A novel possibility now available is that of influencing in an environmentally productive way the choice by industry of the actual process technology to be commercialized and the overall designs of new plants, such that the most cost-effective environmental protection methods can be incorporated into the process design from the start. Specific energy technologies for which pollution control documents are now planned include low Btu coal gasification, indirect coal liquefaction, oil shale mining and processing, direct coal liquefaction, geothermal, medium Btu coal gasification, and high Btu coal gasification. Water-related environmental problems with synthetic fuels are also being studied, including the management of solid wastes from the production processes. (Baker-FRC)
W82-03129

DON'T DAMN THE STANISLAUS,
Lycoming County Planning Commission, Williamsport, PA.
T. Palmer.
National Parks, Vol 54, No 3, p 17-20, March, 1980. 4 Fig.

Descriptors: *Wild rivers, *Recreation, *Environmental effects, *Stanislaus River, *California, Legislation, White water, Rivers, Dams, *Reservoirs, Water resources development, Wildlife, Political aspects, Public opinion.

Construction of the New Melones Dam, completed in 1978 on the Stanislaus River, California, may drown the wildest remaining stretch of this popular white water stream. Already filled for 16 miles, the reservoir has not reached the white water stretch because a clear demonstration of public benefit and necessity has not been made and public pressure to stop filling at the present level has been great. Conservationists have disclosed many reasons for preserving this stretch of river. About 90 000 people annually use the area for rafting, hiking, fishing, and exploring the limestone caves. There are 600 identified archeological sites connected with the Miwok Indians and the Gold Rush era. A rare cave spider is among the 200 species of wildlife inhabiting the river environment. As of March 1980 a bill, HR 4223, to prevent further flooding of the valley was expected to reach the House floor. (Cassar-FRC)
W82-03275

THE RISK BUSINESS,
Thames Water Authority (England).
C. Sinnott.
Water, Vol 39, p 2-4, July, 1981. 4 Fig.

Descriptors: *Water policy, *Capital costs, *Budgeting, *Thames Water Authority, Planning, Institutional constraints, Expenditures, Utilities, Risks, Public utility districts, England.

When regional water authorities were formed in England in 1973-74, they inherited their predecessors' liberal capital spending aspirations. Government policy mandated a more restrained investment program, starting in 1979. In the Thames Water Authority these budget cuts caused increases in charges and decreased services. Four examples of water projects, now deferred to 1982, illustrate how this policy affects the consumers: insufficient water supplies in some areas, continued flooding of foul sewage during heavy rain, hazards of operating dilapidated sewage treatment plants which exceed pollution discharge standards, and disruption of navigation and irrigation from possible failure of a corroded and eroded weir. Sudden changes in investment levels, felt throughout the entire capital program, disturb long-term scheduling of construction, waste design effort, and may cause large fluctuations in work and expenditures. (Cassar-FRC)
W82-03281

RIVER CLEAN-UP PLAN DEVELOPED WITH CITIZENS AND INDUSTRY,
Fox Valley Water Quality Planning Agency, Neenah, WI.
For primary bibliographic entry see Field 5G.
W82-03283

MUNICIPAL SEWAGE: THREE COMMUNITIES TRY TO COPE,
For primary bibliographic entry see Field 5D.
W82-03284

ENGINEERING U.S. WATER POLICY,
V. Fairweather.
Civil Engineering (New York), Vol 51, No 9, p 148, September, 1981.

Descriptors: *Water policy, *Administrative decisions, *Federal jurisdiction, Public policy, Administrative agencies, Administration, Administrative regulations, Regulations, Operating policies, Policy making, Decision making, United States.

The future of water policy in the United States is summarized. Programs which are proposed for action must have cost recovery built into them. Matters of national economic interest will play an increasingly strong role in obtaining project approval. Recommendations to the cabinet from the group working on water priorities will probably include rescission of the current 'Principles and Standards' which govern water project assessment. New guidelines will be proposed. These guidelines will emphasize national economic objectives. Cost sharing and user charges will definitely be part of the water projects that win approval in the future. Fifty-two water projects that have been languishing at the Water Resources Council will probably be returned to their originating agencies to be reprioritized. The water working group will also probably recommend elimination of the independent review that had been sought by the previous Administration. The Assistant Secretary of the Army forecasts greater power on the part of the states in selecting water projects. Even so, regional projects or those with national interest must not be overlooked. Port development projects should get underway in this decade. Flood control projects are not viewed as of highest priority. The Assistant Secretary also hopes to get the Army Corps of Engineers out of the business of regulating permits in wetlands. (Baker-FRC)
W82-03294

EPA MOVING TO CONTROL INDUSTRIAL TOXIC POLLUTANTS WITH NEW NPDES PERMITS,
Environmental Protection Agency, Boston, MA. Region I.
S. J. Silva.
Civil Engineering (New York), Vol 51, No 9, p 76-78, September, 1981. 2 Tab.

Descriptors: *Industrial wastes, *Permits, Hazardous materials, *Wastewater treatment, Legal aspects, Regulations, *Wastewater disposal, *Water pollution control.

NPDES permits are generally written for a specific period of time, 5 to 10 years, and contain effluent limitations and monitoring requirements for each discharge point. For the most part these permits limited the conventional pollutants: biochemical oxygen demand (BOD), total suspended solids (TSS), oil and grease, pH, as well as ammonia, metals, and phenols. In 1977 the Clean Water Act was passed to focus attention on controlling toxic pollutants. By July 1, 1984, industry is to meet minimum technology requirements, which means the best available technology economically achievable must be used for controlling toxic pollutants, and best conventional pollutant control technology used to control conventional pollutants. Permit issuance procedures have changed little since 1973. The law requires the EPA to consider more stringent limits for conventional pollutants in the second round permits, but such limits will only be imposed where additional required facilities meet a cost-reasonableness test. EPA will review the treatment facilities employed to meet present requirements and then determine what logical modifications or additions might further reduce conventional pollutant levels. Major emphases of new permits will be the control of toxic pollutants. Reductions in pollutants will most likely be achieved by: optimization of existing treatment systems most industries installed to meet current requirements; isolation at the source and separate treatment; process chemical substitution; or housekeeping improvements. Large scale application of advanced wastewater treatment techniques is not expected. (Baker-FRC)
W82-03296

THE RIVER RHINE–TRANS-NATIONAL RIVER BASIN MANAGEMENT DEVELOPING PROGRAMME TO MEET NEW CHALLENGES,
Nordrhein-Westfalen Landesamt fur Wasser und Abfall, Dusseldorf (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W82-03372

CZ '80: COASTAL QUANDARIES PERSIST,
V. Fairweather.
Civil Engineering (New York), Vol 51, No 2, p 57-58, February, 1981.

Descriptors: *Coastal zone management, *Governmental interrelations, Environmental policy, Environmental protection, Barrier islands, Interagency cooperation, Planning, State jurisdiction, Economic aspects, Ocean dumping.

Coastal Zone '80, a specialty conference sponsored by the American Society of Civil Engineers (ASCE), was held in November, 1980, to provide a forum for the discussion of ideas about the conflicting interests and overlapping jurisdictions involved in coastal zone management in the United States. Major issues discussed at the conference included the future of environmental protection efforts with respect to coastal zones, expected changes in Federal government regulations with respect to coastal zone management and development under the Reagan administration, the conflicts between states' rights and national interest, ocean dumping, development of the outer continental shelf, port expansion efforts, and fishing interests. The debate over the stabilization of barrier reefs where shifting sands and erosion have taken their toll was particularly intense. Means of balancing state and Federal interests were discussed. (Carroll-FRC)
W82-03383

6F. Nonstructural Alternatives

NEW THRUST IN THE 1980S FOR U.S. WATER-QUALITY PROGRAMS,
For primary bibliographic entry see Field 5G.
W82-03252

DO WE NEED A NATIONAL WATER POLICY PROCESS. PRELIMINARY CRITERIA FOR DESIGNING A CONSTITUENCY-BASED WATER POLICY STRUCTURE,
National Academy of Public Administration. Washington, DC.
D. C. Harrison.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-172206, Price codes: A07 in paper copy, A01 in microfiche. Report to National Academy of Public Administration, Washington, DC 20036. December, 1981. 173 p, 1 Fig, 140 Ref. 3 Append. 14-34-0001-1414.

Descriptors: *Water policy, Public policy, Planning, River basin planning, Regional planning, Comprehensive planning, Long term planning, Future planning, Management planning, *Governmental interrelations, Interagency cooperation, Political aspects, Institutional constraints, Institutions, Organizations, Local governments, State jurisdiction, Federal jurisdiction-governmental interrelations, Public participation, Constituency development.

The nation appears to have neither an integrated water policy process nor an institutional support structure that can make it work. This paper addresses institutional barriers to national water policy. It concludes that we cannot govern integrated surface and groundwater systems that flow across political boundaries and affect a multitude of competing interests with a fragmented, inefficient policy guidance structure that encourages division rather than sharing of our water resources. This paper offers preliminary conceptual guidance on how to reexamine intergovermental roles and relationships in the field of water policy. It describes a holistic conceptual model of the national water policy process and institutional support structure that will help to guide the design and evaluation of incremental improvements. Criteria for designing a 'constituency-based' water policy structure are taken from the interpretation and analysis of conflicts between management agencies and constituencies; between regions; and between other major institutional perspectives. The process that resolves these conflicts must provide lower levels of goverament with competence and with adequate representation in national water policy, and build the capacity to govern water resource systems. First priority must be given to the creation of a consitituency for an integrated water policy process. (Harrison-NAPA)
W82-03340

BARRIER ISLANDS: SHOULD ENGINEERS INTERFERE WITH NATURE,
V. Fairweather.
Civil Engineering (New York), Vol 51, No 5, p 64-67, May, 1981.

Descriptors: *Barrier islands, *Protection, Shores, Engineering, Regional development.

Questions concerning the construction of protection for barrier islands are presented. One major concern is with the cost of such protection and the question of who should pay for it. A second question deals with whether or not barrier islands can really be protected at all. Two environmentalist-backed bills in Congress call for an official no-development policy on undeveloped barrier islands and also for funds for government acquisition of undeveloped barrier islands. Currently, there appears to be a trend toward nonstructural approaches to coastal storm and erosion control. The most obvious nonstructural approach calls for no development whatsoever. Barrier island protection plans are discussed for Atlantic City, Cape May, San Francisco Bay area, North Carolina's Oregon Inlet, and others. Some engineers have suggested the use of dredging in certain situations, as opposed to other barrier island protective devices. It appears that barrier islands which have been developed will be protected, since they have economically viable communities. It is suggested that further development of barrier islands be stopped. (Baker-FRC)
W82-03377

6G. Ecologic Impact Of Water Development

FINAL ENVIRONMENTAL IMPACT STATEMENT; NORTH FORK PAYETTE RIVER PROJECT FERC NO. 2930-IDAHO.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-001984, Price codes: A12 in paper copy, A01 in microfiche. Report FERC/EIS-0027, October, 1981. 251 p, 18 Fig, 22 Tab, 58 Ref, 6 Append.

Descriptors: *Hydroelectric plants, *Environmental effects, *Recreation, *Dam effects, Alternative planning, Wild rivers, Boating, Scenery, Aesthetics, *Environmental impact statement, *North Fork Payette River Project, Idaho.

Idaho Power Company proposes to construct a 273-MW hydroelectric development that would be located on the North Fork Payette River, approximately 45 mi north of Boise, Idaho. The development would encompass a 15-mile reach of the river, and would include: two diversion dams, each

155 ft wide and 30 ft high, with a radial gate and flap gate; two pools, 600 to 700 in length; two 16-ft underground power tunnels; two surge tanks; two penstocks; two underground powerhouses; two tailrace tunnels, 3,600 and 760 ft long, returning water from the power houses to the North Fork Payette River, just upstream of the confluence with the South Fork; two switchyards; and a 230-kV transmission line. The energy generated by the proposed North Fork Payette River Project would make a significant contribution after 1986 to meeting projected energy requirements. An analysis of the feasibility of two hydroelectric and seven non-hydroelectric alternatives indicates that there are no reasonable hydroelectric alternatives, and that coal-fired steam-electric generation is the only reasonable non-hydroelectric alternative. Development of the proposed North Fork Payette Project would result in the following unmitigated environmental impacts: the loss of the recreational experiences, including boating opportunities, dependent on continuous whitewater for 15 miles of the river; a lessening of visual quality in the 15-mile reach of the river; the possible disqualification of the river as a potential candidate for inclusion in the National Wild and Scenic River System; and the removal of approximately 90 acres of timberland from production. (Moore-SRC)
W82-03046

DON'T DAMN THE STANISLAUS,
Lycoming County Planning Commission, Williamsport, PA.
For primary bibliographic entry see Field 6E.
W82-03275

VERTICAL MIGRATION AND MORTALITY OF BENTHOS IN DREDGED MATERIAL. PART I: MOLLUSCA,
Delaware Univ., Lewes. Coll. of Marine Studies.
D. Maurer, R. T. Keck, J. C. Tinsman, and W. A. Leathem.
Marine Environmental Research, Vol 4, No 4, p 299-319, 1981. 6 Tab, 36 Ref.

Descriptors: *Mollusks, *Migration, *Mortality, Dredging, *Spoil banks, Benthic fauna, Benthos, Invertebrates, Aquatic animals, Sediments, Estuaries, Temperature effects.

Benthic invertebrates have many characteristics which make them prime candidates for burial studies in dredged material. A major concern in dredging and disposal projects is the effect of burial on the survival of benthic invertebrates. The purpose of this study was to determine the ability of estuarine benthos, and in particular three species of mollusks (Mercenaria mercenaria, Nucula proxima, and Illyanassa obsoleta), to migrate vertically in natural and exotic sediments and to determine the survival of benthos when exposed to particular amounts of simulated dredged material. Mortalities generally increased with increased sediment depth, with increased burial time, and with overlying sediments whose particle size distribution differed from that of the species' native sediment. Temperature affected mortalities and vertical migration, with both being greater in summer temperatures than in winter temperatures. It was concluded that vertical migration is a viable process which can significantly affect rehabilitation of a dredged disposal area. Under certain conditions, vertical migration should be considered, together with larval settling and immigration from outside impacted areas, as a mechanism of recruiting a dredge-dump site. (Carroll-FRC)
W82-03317

7. RESOURCES DATA

7A. Network Design

THE DEVELOPMENT OF WATER QUALITY MANAGEMENT PLANS USING DATA FROM AUTOMATIC STORMWATER MONITORING NETWORKS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-03069

7B. Data Acquisition

RAINFALL PREDICTION-MEASUREMENT SYSTEMS AND RAINFALL DESIGN INFORMATION FOR URBAN AREAS,
Illinois State Water Survey Div., Champaign.
S. A. Changnon Jr., F. A. Huff, J. L. Vogel, D. A. Brunkow, and D. W. Staggs.
Circular 146, 1980. 63 p. 9 Fig, 14 Tab, 87 Ref, Append.

Descriptors: *Weather forecasting, Rain gages, Monitoring, *Rainfall, *Prediction, Precipitation, Computers, *Radar, Flood forecasting, Net rainfall, Weather data collections, Rainstorms, Site selection, *Remote sensing, Climatology,*Urban areas.

This report examines various systems for rainfall forecasting in urban areas and developes guidelines for their use by water management authorities. Most of the data were gathered from the Chicago Hydrometeorological Area Project (CHAP), which began in 1976 and concluded in 1979 with a 2 1/2-month demonstration program. Key elements in rain prediction systems are a radar system, recording raingages, a computer system, and a communication system to connect the components. A radar system provides a more accurate portrayal of storm rainfall than dense raingage networks and also yields data on approaching short-term (30-180 minute) forecasts. However, radar signals can make large errors, particularly with 5-cm equipment, so data in real-time from telemetered recording raingages are needed to adjust the radar-indicated rainfall. The types of gages and their optimal siting and installation are reviewed. A computer system translates digital radar data into rainfall estimates by integrating the raingage-indicated rainfall with the radar signal. It also calculates motion and rain change fields needed to predict urban rainfall. These data can be converted to a cartesian grid for analysis. Several types of communication links may be required, such as radar-raingage communication and radar system to user. A final section of the report covers the possible range of data analysis and interpretation needs that are available and applicable today as well as some future capabilities. A further discussion outlines the time constraints of objective forecasting techniques using radar observational data, and the role people and objective techniques play in rain forecasting for time frames over 3 hours. (Atkins-Omniplan)
W82-03008

REMOTE SYNOPTIC SURFACE FLOW MEASUREMENTS IN SMALL BODIES OF WATER,
Scripps Institution of Oceanography, La Jolla, CA.
D. Sheres.
PhD Dissertation, 1980. 110 p, 25 Fig, 5 Tab, 25 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-00037.

Descriptors: *Flow measurement, *Remote sensing, *Surface water, Aerial photography, Flow profiles, Wavelengths, Wave-Current interactions, Surface circulation.

A new approach to remote and synoptic surface flow measurements in small bodies of water is described and the investigation to determine the practicality of this technique is included. The approach is based on imaging monochromatic wavetrains, of known frequency, propagating over surface flows. It is shown that the wavelength and direction of two monochromatic wave trains of known frequency, at a region of interest, carry all the necessary information to determine the surface flow in that region. Experimental tests, conducted both in a wavetank and in a lagoon, utilizing inexpensive and readily available equipment, are described as well. These tests have shown the viability of this remote and synoptic surface flow measurement. Practical aspects of the measurements, such as vertically nonhomogeneous flow profiles, data processing of the aerial photos via 2D Fourier transforms, and the measurement of wavelength by photography of specular reflection of sun light from waves, are discussed. The extension of this measurement to coastal regions in the open ocean is briefly explored together with a preliminary experiment that tests the possibility of obtaining quantitative flow data from boat wave measurements. Such utilization of boat waves may enable surface flow measurements in areas otherwise inaccessible. (Sinha-OEIS)
W82-03012

AN AERIAL TECHNIQUE FOR ASSESSING THE IMPACT OF COOLING WATER DISCHARGES ON RECEIVING WATER,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
J. R. Schott.
PhD Thesis, January, 1980. 142 p, 35 Fig, 10 Tab, 25 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-19081.

Descriptors: *Remote sensing, Aerial photography, *Water temperature, Thermal pollution, *Temperature effects, Thermal plumes, *Cooling water, *Ecosystems, Environmental effects, Powerplants, Water quality.

This research demonstrated that aerial remote sensing could be a useful tool in studying the effect of power plant cooling water discharges on certain aspects of aquatic systems. Thermal infrared imagery, aerial color photography and laboratory models were combined to study the effects of cooling water discharges on aquatic ecosystems. A new technique for wholly airborne calibration of aerial infrared data was utilized permitting remote measurement of water surface temperatures to within 0.4 C plus or minus 0.3 C of actual values. In addition, color photography was used to monitor chlorophyll, lignin and yellowing organic concentrations in the vicinity of the power plant. This was accomplished using models developed in the laboratory relating the optical properties of water to the concentration values of various parameters in the water. The theory, testing and evaluation of the approach at a particular site are discussed. (Sinha-OEIS)
W82-03016

USE OF ENVIRONMENTAL SATELLITE DATA FOR INPUT TO ENERGY BALANCE SNOWMELT MODELS,
California Univ., Santa Barbara. Computer Systems Lab.
J. Dozier.
National Oceanic and Atmospheric Administration, National Earth Satellite Service, Washington, DC, December, 1980. 118 p, 24 Fig, 2 Tab, 73 Ref. 04-8-MO.

Descriptors: *Snowmelt, *Remote sensing, *Satellite technology, *Energy, Model studies, Canopy, Forests, Runoff rates, Temperature, Meteorological data collection, Snowmelt runoff.

Mapping snow surface temperature over a large alpine area is a useful tool for snowmelt runoff investigations. Tiros-N satellite data used to measure snow surface temperature over a large area have been calibrated with micrometeorological data from two remote stations in the southern Sierra Nevada, and from active field measurement of snow surface temperature using a radiant thermometer. Performance of the system under isolated alpine conditions has been satisfactory. Models for clear sky solar and longwave radiation have been developed and tested. The clear sky solar radiation model has been extended to calculate the necessary corrections for radiometric data over rugged terrain. A procedure for deriving an estimate of the spectral albedo of an extensive alpine snow cover from satellite spectral radiance measurements was demonstrated with Landsat digital imagery of the southern Sierra Nevada. The resultant spectral albedo measurements are adequate for input to an areally extensive energy-balance snowmelt model. Extensive point measurements of forest canopy densities were made during both winter and summer conditions. These will be extended over the area by correlation to satellite

brightness data. This information will then be used to model the effect of canopy cover on the snow surface radiation budget. (Moore-SRC)
W82-03048

METHODS OF DISCHARGE COMPENSATION AS AN AID TO THE EVALUATION OF WATER QUALITY TRENDS,
Geological Survey, Raleigh, NC.
D. A. Harned, C. C. Daniel, III, and J. K. Crawford.
Water Resources Research, Vol 17, No 5, p 1389-1400, October, 1981. 17 Fig, 1 Tab, 23 Ref.

Descriptors: *Water quality, *Discharge measurement, Flow rates, Water quality management, *Solute transport, Data acquisition, Lakes, Streams, Water analysis, *Streamflow-water quality relations.

This paper presents two new approaches to evaluating trends in stream water quality and tests the performance of the new methods against existing methods. One method, discharge normalization, adjusts daily discharges using a central value calculated for the period of record and recalculates daily specific conductance from the adjusted discharges and discharge versus specific conductance regressions. Normalized concentrations for many constituents can then be calculated from linear relationships between specific conductance and constituent concentrations. The second method, discharge-frequency weighting, weights each observed concentration by a fraction of the total area underneath the discharge-frequency distribution of the period of record. The weighted concentrations are summed for each year. Both normalized values and weighted values can be plotted against time to produce trends essentially independent from discharge effects. Results from the methods are statistically similar to each other and to results from other trend detection techniques. However, each method also has limitations. Both are limited to use of water quality data collected in conjunction with a continuous record of streamflow. Normalization also requires daily specific conductance records. (Baker-FRC)
W82-03056

LARGE RAIN DROPS IN THE BRIGHT BAND,
Rome Air Development Center, Hanscom AFB, MA. Electromagnetic Sciences Div.
E. E. Altshuler.
Nature, Vol 288, No 5790, p 464-465, December 4, 1980. 2 Fig, 6 Ref.

Descriptors: *Measuring instruments, *Fluid drops, Rain, Ice, Precipitation, Radar, Remote sensing, Rainfall rate, Rain drops, *Rain-drop size analysis, Distribution patterns.

A technique is described for inferring rain-drop sizes which produces results in support of the bright band model. Slant-path attenuation measurements at frequencies of 15 and 35 GHz were made in the Boston area during 8 storms of various intensities. A dual-frequency radiometer was the detector. Antenna beamwidths were about 9 and 4 arc min, respectively, and the center of the Sun was tracked with an accuracy of at least 0.5 arc min. Over 10,000 simultaneous measurements of attenauations at 15 and 35 GHz were made, and the ratios of these attenuations were plotted against the 15-GHz attenuations. If the rain drop size distributions along the slant path were similar to those measured on the ground, the attenuation ratios would have been of the order of 6 or 7 for low rain rates and decrease to about 4 or 5 for the higher rain rates, corresponding to higher 15-GHz attenuations. However, the bulk of the points plotted had ratios between 2 and 4 and occur for low 15-GHz attenuations. These results are thus not consistent with ground level rain drop size distributions. Instead they suggest that somewhere along the slant path there is a significant contribution to the attenuation which results from precipitation with characteristics of rain drops having very large effective drop diameters. Since most of the rain along the path occurs below the bright band, the attenuation contribution from the bright band would be expected to be relatively small. However, drop diameters of the order of 10-200 mm are certainly possible. It may be helpful to conduct both dual frequency attenuation and dual polarized reflectivity measurements to differentiate between rain and ice. The attenuation measurement easily distinguishes rain and ice, but this is not always the case with radar. (Baker-FRC)
W82-03065

CONTINUOUS DISCHARGE MEASUREMENT FOR THE TRANSITION BETWEEN PARTLY FILLED AND PRESSURIZED CONDUIT FLOW IN SEWERAGE SYSTEMS,
Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulik und Gewasserkunde.
F. Valentin.
Water Science and Technology, Vol 13, No 8, p 95-102, 1981. 3 Fig, 2 Ref.

Descriptors: *Sewer hydraulics, *Flow discharge, *Flow measurement, *Pressure measuring instruments, *Flowmeters, Sewers, *Sewer systems, Flow profiles, Flow rates, Discharge measurement, Conduits, Measuring instruments, Venturi meters, Gages.

Conventional sewerage discharge measurement devices often are inadequate for control measurements in the sewerage system itself and may reduce channel width lowering upstream capacity. To improve upon this situation, hydraulic events occurring during the changeover from free flow to pressurized flow conditions and the possibility of continuous flow measurements under such circumstances were studied in simulated unsteady flow conditions. Maximum propagation velocities of over 200 m/sec during self priming were used while paying special attention to the self priming of the pipe in relation to sewage flow. Various commercially available instruments were tested with free surface flow and pressurized flow in the experimental pipe. During transient flow conditions, the Venturi flume was found to be inadequate. However, an electromagnetic flowmeter gave sufficiently accurate discharge measurements while allowing better knowledge of the transient flow itself. Improvement in the field of discharge measuring devices for the management of sewerage systems is still needed. (Geiger-FRC)
W82-03152

REMOTE SENSING FROM SPACE-II.
Civil Engineering (New York), Vol 50, No 4, p 63-65, April 1980. 2 Fig.

Descriptors: *Remote sensing, *Irrigation efficiency, *Aquifer management, Agriculture, Landsat, Ogallala Aquifer, *Satellite technology.

Landsat data are being used to improve estimations of irrigated crop acreage. The data can be used to regulate drawdown of the Ogallala Aquifer, which extends over north Texas and states north. To date the irrigated areas in two countries have been mapped by Landsat, and the procedure was found only 3-4% less accurate than higher-resolution 'classified' military imagery. In process is a study of using Landsat data for more efficient irrigation by detecting crop stress or soil dryness. (Cassar-FRC)
W82-03248

EVALUATION OF INFILTRATION MEASUREMENTS FOR BORDER IRRIGATION,
Science and Education Administration, Phoenix, AZ. Conservation Lab.
A. J. Clemmens.
Agricultural Water Management, Vol 3, No 4, p 251-267, 1981. 4 Fig, 8 Tab, 12 Ref.

Descriptors: *Infiltration, *Irrigation, *Border irrigation, Data collections, Soil moisture, Surface irrigation, Bouwer's method, Model studies, Ring infiltrometers, Agriculture.

Several methods for measuring infiltration in irrigation borders were evaluated--the ring infiltration method. Bouwer's method, and the zero-inertia border irrigation model. Ring infiltrometers, in use for many years, give good results if the ring is properly installed and operated, if measurements are made during an irrigation, and if a volume balance is maintained in the border. Data from ring infiltrometers are fitted to power functions for infiltration rate and cumulative infiltration rate vs. time and to a branch function where the infiltration rate is not allowed to drop below a minimum (final infiltration rate). Cumulative infiltration data are not reliable in sandy soils, but in general are less subject to error and fluctuation. Bouwer's method, using a series of borders as infiltrometers, is good in borders with uniform infiltration and within a large number of borders, but not when infiltration varies spatially. The zero-inertia border irrigation model, useful when good infiltration information is available, was used to study two cases of surface irrigation. (Cassar-FRC)
W82-03264

REMOTE SENSING APPLICATIONS FOR RESOURCE MANAGEMENT,
California Univ., Davis. Dept. of Land, Air and Water Resources.
C. J. Johannsen, and T. W. Barney.
Journal of Soil and Water Conservation, Vol 26, No 3, p 128-131, May-June, 1981. 8 Ref.

Descriptors: *Water management, *Remote sensing, *Data collection, Resources management, *Satellite technology, Aerial photography, Infrared imagery, Telemetry, Land management, Data interpretation, Erosion control, Watershed management, Data storage and retrieval, Data processing.

Remote sensing is the science and art of acquiring information about material objects from measurements made at a distance without coming into physical contact with the objects. Some applications of remote sensing devices to land and water management are described. Data bases can be used to analyze remotely sensed information. Geographic information systems are useful in gathering, storing, analyzing and disseminating data on natural resources and socioeconomic data. The use of remote sensing devices in the study of agriculture, rangelands, forestry, hydrology, geology, cartography, land use, thermography, environmental protection, oceanography, disaster warning, and human and animal health is examined. Remotely sensed data from satellites can provide a continuous flow of information about land cover and land use conditions to aid in soil erosion control in watersheds. Transfer of technology in remote sensing must increase to be of more value to resource managers. (Geiger-FRC)
W82-03279

BACTERIAL UTILIZATION OF ALGAL EXTRACELLULAR PRODUCTS. I. THE KINETIC APPROACH,
Middlebury Coll., VT. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-03330

RADAR MEASUREMENTS OF ESTUARINE CURRENTS AND TIDES,
Birmingham Univ., (England). Dept. of Electronic and Electrical Engineering.
For primary bibliographic entry see Field 2L.
W82-03360

7C. Evaluation, Processing and Publication

CANADA WATER YEAR BOOK 1979-1980, WATER RESEARCH DIVISION,
Department of the Environment, Ottawa (Ontario).
Available from Canadian Government Publishing Centre, Hull Quebec, 132 p, 1981. Photos, Charts. ISBN 0-660-10878-X.

Descriptors: *Canada, *Water resources development, *Research, *Aquatic environment, Physical analysis, Wastewater treatment, Water quality, *Water management, Chemical properties, Biological properties, Wastewater disposal.

This is the fourth in the series of the Canada Water Year Book and reviews the principal activities in water research across Canada. Other years covered: water resources, water management, and water data. Water Research is explored through the nature and goals, research and development, and hydrological research. Major topics include: physical properties; chemical and biological processes in the aquatic environment; water quality; wastewater treatment and ultimate disposal; and water quality and water resources planning. (WATDOC)
W82-03096

THE CANADA WATER ACT, ANNUAL REPORT 1980-1981.
Department of the Environment, Ottawa (Ontario).
Available from Ministry of Supply and Services, Hull, Quebec, 1981, 44 p. ISBN 0-662-51561-7.

Descriptors: *Water resources management, *Water quality, *Nutrients, Public information program, Management, Regulations, Research, *Canada Water Act, Projects.

The report highlights the provisions of the Canada Water Act and briefly discusses the individual programs which have been or will be undertaken to meet these provisions. (WATDOC)
W82-03098

CANADA WATER YEAR BOOK 1977-1978.
Available from Canadian Government Publishing Center, Hull, Quebec, 120 p, 1978, Photos, Tab, Maps. ISBN 0-660-10142-4.

Descriptors: *Canada, *Hydrologic data, *Water resources development, *Data collections, Snow, Ice, Rivers, Streams, Lakes, Reservoirs, Groundwater, Navigable waters, Charting, Pollutants, Water uses, Information systems, WATDOC, Programs, *Water management.

This edition of the Canada Water Year Book provides a brief report on the numerous water data monitoring programs. It provides some background on most programs, explains when and why the programs were initiated, how they are conducted, what types of data are available and where the data can be obtained. The edition is presented under the following main topics: (1) Water Data Fills an Important Roll in Society; (2) Canada's Water Resources Range Between Wide Extremes; (3) Basic Programs for Collecting Water Data, ie. Water in the Atmosphere, Snow and Ice, Rivers and Streams, Lakes and Reservoirs, Ground Water, Charting Navigable Waters, Inventory of Water Pollutants and Information Systems, WATDOC; (5) Water Data of General Interest, ie. The Flood Damage Reduction Program, Water Power Development, Large Water Diversions in Canada and International Programs. Shore Damage Survey of the Great Lakes and Hydrological Atlas of Canada; and, (6) Water Resources Data Research. (WATDOC)
W82-03099

PROGRAMMABLE HAND CALCULATOR PROGRAMS FOR PUMPING AND INJECTION WELLS: III. CONSTANT PUMPING (INJECTION) RATE, FULLY CONFINED AQUIFER, PARTIALLY PENETRATING WELL,
Missouri Univ.-Rolla.
For primary bibliographic entry see Field 2F.
W82-03225

8. ENGINEERING WORKS

8A. Structures

HYDRAULIC MODEL STUDIES OF THEODORE ROOSEVELT DAM - SOUTH SPILLWAY,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
M. F. Young.
Report GR-81-10, May, 1981. 41 p, 24 Fig, 1 Append.

Descriptors: *Hydraulic models, *Spillways, *Overflow, *Flood damage, Erosion, Flood discharge, Flood protection, Dams, Spillway capacity, Model studies, Radial gates, *Theodore Roosevelt Dam, Salt River, Arizona.

Roosevelt Dam originally had two uncontrolled overflow spillways. During the 1930's, radial gates were installed on both spillways to provide extra reservoir storage. The spillways were cut into each abutment with each spillway crest oriented to continue the arch shape of the dam. This alinement creates many problems because the south spillway channels its flow directly toward the upper right training wall instead of downstream. During a flood in February 1980, the spillways operated with a combined discharge of approximately 73,500 cu ft/s. The south spillway overtopped the right training wall, cascaded down the slope, and entered the powerhouse. A downstream training wall that protected the highly jointed canyon walls from erosion was damaged, and a converted warehouse was also damaged by mud and water entering the lower floors. A 1:36 scale model was used to develop protective measures for this powerplant, the highly jointed downstream canyon wall, and other structures. Also determined from the model study were spillway and radial gate discharge capacity curves. The model showed that a 15-ft high extension to the right training wall would provide full protection for the powerhouse. A 200-ft long wall was found necessary to provide adequate protection for the lower canyon wall. An extension to this wall, angled toward the river channel, was also recommended to protect the warehouse. (Moore-SRC)
W82-03051

COST-BENEFIT ANALYSIS OF THE EUPHRATES DAM,
Norfolk State Univ., VA.
For primary bibliographic entry see Field 6B.
W82-03054

AIRY HOLM DAM - KIELDER WATER SCHEME,
Babtie, Shaw and Morton, Glasgow (Scotland).
H. G. Perfect.
Water Services, Vol 85, No 1026, p 389-392, August, 1981. 7 Fig, 2 Tab, 1 Ref.

Descriptors: *Dams, *Water supply, Water demand, *Scotland, Planning, Decision making, Water resources development, Water supply development, *Airy Holm Dam.

The Kielder Water Scheme has been devised to enable the Northumbrian Water Authority to meet expected increases in water demands in that section of Scotland well into the next century. The scheme will increase river abstractions on the Rivers Tyne, Wear and Tees by up to 900 tcmd. Water flow in the River North Tyne will be regulated by releases from Kielder Water. Nearly 60 km downstream on the River Tyne, water will be abstracted at Riding Mill Pumping Station. Total pumping capacity at Riding Mill Station will be 1092 tcmd, including standby. Transfer of water to the Rivers Wear and Tees will be through a 6 km long steel pipeline, 2 m in diameter, to a surge tank at Letch House. From here, water will flow by gravity through a 32 km long aqueduct, 2.9 m in diameter, constructed mainly in tunnel and capable of carrying up to 1180 tcmd. Airy Holm Dam will form a 250,000 cubic centimeter capacity reservoir to provide balancing storage for the operation of the transfer works. Construction is nearing completion, and it is anticipated that full commissioning will take place during 1981. Information is provided on the actual construction of the dam, including concrete mixes, grouting, embankment flanks, and instrumentation. (Baker-FRC)
W82-03070

A NEW SEDIMENT TRAP EFFICIENCY CURVE FOR SMALL RESERVOIRS,
Science and Education Administration, Beltsville, MD.
H. G. Heinemann.
Water Resources Bulletin, Vol 17, No 5, p 825-830, October, 1981. 6 Fig, 1 Tab, 11 Ref.

Descriptors: Reservoir deposition, *Trap efficiency, *Sedimentation, Design criteria, Reservoir design, Reservoir storage, Small watersheds, *Agricultural watersheds, Ponds, Reservoir capacity, *Reservoir silting, Agricultural reservoirs.

A new sediment trap efficiency curve was developed by analyzing data on 20 small agricultural reservoirs of 3,000 to 4 million cu m capacity. Only reservoirs with drainage areas of 15 sq miles or less were considered. Reservoirs of this type are built for flood control, small water supply, recreation, sediment control, or a combination of these. The new curve, which plots % sediment trap efficiency vs capacity:inflow ratio, is slightly different from the Brune (1953) curve in common use. The volume allotted in reservoir storage for trapped sediment could be reduced by 4-10% according to the new curve, saving construction costs. (Casser-FRC)
W82-03086

PROVISION OF ENERGY REQUIREMENTS FOR REMOTE COMMUNITIES BY SMALL-SCALE HYDRO DEVELOPMENT,
R. A. Everdell, and F. M. Near.
Canadian Water Resources Journal, Vol 6, No 3, p 143-162, 1981. 7 Fig.

Descriptors: *Hydroelectric plants, *Environmental effects, Water resources development, Dams, Powerplants, *Ontario, Small-scale hydroelectric plants, *Remote communities.

Small prefabricated hydroelectric generating stations have been installed at two sites in Ontario. The Mini Hydel stations are designed to operate at heads from 3 to 8 meters. Water is delivered to turbines via open flumes at lower heads and pressure casings at higher heads. Plant outputs are 100-400 kw. Francis turbines are used with a speed increaser gearbox and a standard generator. Generally, small hydro projects are compatible with the environment. Air quality and noise effects are negligible. Water quality is affected considerably during construction but minimally in the long term. The projects produce little impact on fish, wildlife, society, or esthetics. The Wasdell Falls Project and the Sultan plant are described in detail. Future developers of small hydro plants are advised to select sites needing minimal civil work, bypass excess flows, conduct thorough preconstruction surveys, seek permits a year before planned construction, schedule construction for a single summer season, choose easy-to-build designs, minimize custom modifications, and accurately estimate required resources and work schedules. (Casser-FRC)
W82-03151

WARMING UP TO GEOTHERMAL,
P. A. Robbibaro, and A. O. Watson.
Drilling, Vol 41, No 13, p 180, 183, 186, 188, October, 1981.

Descriptors: *Geothermal resources, *Drilling equipment, *Well drilling, Hot brines, Heat, Corrosion, Wells, Steam, Geohydrology, Deep wells, Water circulation, Water resources development, Energy sources, Exploration, *Energy conversion, Hydraulic systems, *Design criteria, Materials, Engineering.

Exploration in geothermal resources imposes great demands on conventional drilling equipment. Four problems are high temperatures, abrasive formations, lost circulation, and highly corrosive fluids. Hydrothermal systems, the most abundant geothermal resources, produce high temperatures, 350-700 F, and high mineral concentrations, up to 300,000 ppm. These extreme conditions are responsible for collapsed or parted casings, cementing, metal fatigue, severe corrosion, and scale buildup. Mud heat exchange towers can lower temperatures in drilling fluids. An example of a vapor-dominated

system is the Geysers, north of San Francisco. Problems in this steam-producing field are disintegration of serpentine and well collapse, loss of circulation, low reservoir pressure, erosion, and corrosion. Methods for combating these difficulties include sealing compounds for fractures, air drilling (dust, mist, aerated mud, and stiff foam), and use of corrosion resistant materials. A major problem in hot dry rock exploration is the 300-400 F temperature range. This type of drilling is in the development stage. Conventional drilling, improved with more durable bits and more efficient techniques, and unconventional methods (pressurized water jet drilling and percussion drilling) are useful in development of wells in hot rock. Geopressured resources, also in initial development stages, range from 250 to 450 F. Scaling and corrosion of metal equipment and deterioration of rubber materials result from the heat and high mineral concentrations. (Cassar-FRC)
W82-03156

CONCRETE OF THE DAM OF THE KIROVSKOE RESERVOIR,

For primary bibliographic entry see Field 8F.
W82-03159

EVALUATION OF THE EFFECTIVENESS AND RELIABILITY OF DRAINS OF THE TAILRACE OF THE PLYAVINYAS HYDROELECTRIC STATION,

M. F. Rogal.
Hydrotechnical Construction, No 1, p 50-58, January, 1980. 6 Fig, 1 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 28-34, January, 1980.

Descriptors: *Drainage engineering, *Well function, *Seepage, Hydroelectric plants, Drainage wells, Drainage systems, Drains, Wells, Well seepage, Soil engineering, Soil mechanics, Corrosion, Soil stability, Tailrace, Dams, Reservoir design, Plyavinyas Hydroelectric Station, USSR.

The drainage system of the Plyavinyas hydroelectric station was evaluated. The geology of the site is complex, consisting of stratified inhomogeneous soils with interconnecting artesian horizons. This paper concerns the drains in the right wall of the tailrace. It was necessary to drain this area because 30-40 m of soil, a natural surcharge, had been removed. A series of drain wells was constructed to prevent expansion of the sand foundation soils upon reservoir filling. Monitoring and inspection indicated that the seepage regime changed considerably after filling the reservoir. Some former discharge areas became recharge areas. Two cones of depression formed in connection with the drain wells. The capacities of most of the drain wells were 5-10 times lower than maximum design specifications. Sand filling and severe pipe corrosion in wells draining one wall created a flooding threat. Pumping of relief wells did not substantially lower the head in the malfunctioning wells because of seepage inhomogeneity. Evaluation of several variant drain schemes showed that 7 of the 17 wells in the problem area could be closed without danger of upward movement of the soil. (Cassar-FRC)
W82-03161

GROUTING WORKS IN THE DIVERSION TUNNEL OF THE INGURI HYDROELECTRIC STATION,

N. V. Dmitriev, E. S. Baranos, and V. A. Ashikhmen.
Hydrotechnical Construction, No 9, p 879-884, September, 1980. 3 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, p 3-6, September, 1980.

Descriptors: *Tunnel construction, *Grouting, *Concrete technology, Productivity, Water transport, Hydroelectric plants, *Inguri hydroelectric plant, Hydraulic structures, Diversion structures, USSR.

Consolidation grouting in the 15 km diversion tunnel of the Inguri hydroelectric station amounted to 617,000 cu m using 113,000 holes. Fill-in grouting of 158,000 sq m was done in the tunnel crown. It was necessary to increase the monthly grouting output from 2000-3000 m to 20,000-25,000 m during the later phase of the project. Drilling-grouting frames and semiautomatic central grout plants in combination with concrete placing units coordinated the general construction with grouting so that the tunnel was completed on schedule. The record grouting output was 55,500 m in the month of September 1978. (Cassar-FRC)
W82-03164

INFLUENCE OF GEOLOGY ON TUNNELLING CONDITIONS AND DEFORMATIONAL BEHAVIOR OF SUPPORTS IN FAULTED ZONES A CASE HISTORY OF THE CHHIBRO-KHODRI TUNNEL IN INDIA,

Central Mining Research Station, Dhanbad (India).
J. L. Jethwa, B. Singh, B. Singh, and R. S. Mithal.
Engineering Geology, Vol 16, No 3/4, p 291-319, November, 1980. 16 Fig, 6 Tab, 29 Ref.

Descriptors: *Tunnel construction, *Tunnel linings, *Tunnel failure, Tunneling, Geologic fractures, Rocks, *India, Hydroelectric plants, Dam construction, Chhibro-Khodri Tunnel.

Problems associated with highly squeezing rock masses found in recurring faulted zones have delayed the construction of the Chhibro-Khodri Tunnel, part of the Yamuna Hydroelectric Scheme near Dehradun in the lower Himalayan region of India. Attempts were made to measure the tectonic slip along a fault zone running across the tunnel, and the suitability of a flexible lining for this region was evaluated. Inadequate surface and subsurface geological investigations contributed to inappropriate site selection for the tunnel. The elasto-plastic theory was used to provide an assessment of rock pressure, and a flexible support system consisting of steel arches with loose backfill caused significant load shedding. The heading supports underwent severe buckling and bending under the influence of side pressure in squeezing rock conditions when invert struts were not provided. This contributed to delays in the project. The monthly rate of tunnel radial closure at the time of stabilization ranged from 0.05 to 0.10% of the radium of the opening. (Small-FRC)
W82-03181

RECENT WATER TOWERS IN NORFOLK,

Anglian Water Authority, Norwich (England). Norwich Sewage Div.
K. Rowe.
Water Services, Vol 85, No 1023, p 236, 241, 242, May, 1981. 1 Tab.

Descriptors: *Hydraulic structures, *Water tanks, *Storage tanks, Design criteria, Economic aspects, Concrete construction, Norfolk, *United Kingdom.

A review is presented of the design of modern water towers in Norfolk, United Kingdom. There is a lack of standardization in the water industry in the design process and efforts are sometimes lacking to be economical in construction methods or to reduce required maintenance costs. Five towers are described which vary in size from 220 cu m to 2200 cu m. Three were constructed of reinforced concrete, one of reinforced stressed concrete, and one of steel. Total costs ranged from 38,000 British Pounds Sterling to 367,093 British Pounds Sterling. In a tower, the depth of water should be less than 20 m, and it is better to use a rubber water bar at critical joints. Watertightness is of fundamental importance, and no corners should be cut in this regard. Future designs should consider other potential development on the site such as office space. Radio towers can be located on roofs, which will provide additional income. If public access is necessary at the site, the security of the water must be considered. (Small-FRC)
W82-03246

TVA'S PUMPED-STORAGE PLANT.

Civil Engineering (New York), Vol 50, No 6, p 84-87, June, 1980. 1 Fig.

Descriptors: *Pumped storage, *Rockfill dams, *Hydroelectric plants, Dams, Hydroelectric power, Powerplants, *Tennessee Valley Authority, Raccoon Mountain, Tennessee.

The Raccoon Mountain pumped storage plant near Chattanooga, Tennessee, is capable of generating 1530 MW of electricity for 20 hours before the upper reservoir needs to be refilled. The 230 ft high compacted rockfill dam, using 10 million cu yards of material, is TVA's largest rockfill dam. The silo-like intake structure is designed to eliminate vortex action during generation. The pump/turbines are the most powerful in operation--525,000 hp as turbines and 3850 cfs at 1000 ft as pumps. The generator motors are the highest capacity reversibles in the world--425,000 kVA as generators and 547,000 hp as motors. The 35,000 acre-ft storage capacity of the upper reservoir gives the plant flexibilty in operation. (Cassar-FRC)
W82-03250

RESEARCH NEEDS: HYDRAULICS, COASTAL ENGINEERING AND IRRIGATION,

Civil Engineering (New York), Vol 50, No 4, p 83-87, April, 1980. 1 Fig.

Descriptors: *Civil engineering, *Research priorities, Erosion control, Dam failure, Risks, Benthic fauna, Water pollution effects, High flow, *Irrigation, Shore protection, Water use, Wastewater treatment, *Coastal engineering.

The hydraulics-coastal irrigation-engineering subgroup of the American Society of Civil Engineers-National Science Foundation held a workshop on research needs in civil engineering. At the workshop a number of research priorities were determined: processes involved in scour and deposition in rivers, predicting dam failures, design criteria for high velocity flows, risk analysis for dams, impact of sediments in waste plumes on benthic fauna, physical modeling of shore protection structures, conflicts between irigation and western energy projects, necessary treatment level of municipal wastewater for ocean disposal, irrigation methods in humid areas, and irrigation energy efficiency. (Cassar-FRC)
W82-03254

DON'T ALWAYS PUT DAM IN NARROWEST PART OF VALLEY,

Laboratorio Nacional de Engenharia Civil Lisbon (Portugal). Dept. of Hydraulics.
F. Abecasis.
Civil Engineering (New York), Vol 50, No 6, p 93-94, June, 1980. 2 Fig.

Descriptors: *Dams, *Erosion, *Hydroelectric plants, Structural engineering, Spillways, Design criteria, Sediment deposition, Energy dissipation.

The hydraulic problems encountered in high arch dams built in narrow valleys may offset the cost savings in construction. Potential difficulties are: river bed erosion in the jet-impingement zone, eroded material in the tailrace tunnels, and bar formation downstream of tunnels. A hydropower project on the Douro River between Spain and Portugal is an example. The 330 ft Picote Dam, put into operation in 1958, is a double curvature arch with a 456 ft long crest. The water discharges along the spillway surface and passes over a ski jump energy dissipator. A pit 65 ft deep and a bar 50 ft high have formed downstream, causing the upstream water level to rise and reduce the head at the turbines. Repair and maintenance work required a $1 million tunnel to divert flow from the work area. Bar removal and river bed repair is difficult and has interfered with power production. The five-year old Cabora-Bassa project, 490 ft high, 755 ft crest dam, has shown no serious problems as yet, but modeling studies indicate potential erosion and bar formation. These problems might have been avoided by building the dam in a wider reach of the valley or using gravity or buttress construction. (Cassar-FRC)
W82-03282

VALUE ENGINEERING SAVES DAM PROJECT,

Field 8—ENGINEERING WORKS

Group 8A—Structures

Converse Ward Davis Dixon, Inc., San Francisco, CA.
E. A. Miller, and G. S. Salzman.
Civil Engineering (New York), Vol 50, No 8, p 51-55, August, 1980. 1 Fig, 1 Tab.

Descriptors: *Construction costs, *Dams, *Seepage control, Engineering, Rockfill dams, Spillways, Bentonite, *Elgo Dam, Dam sites, Slurries, Water resources development, *Arizona.

The Elgo Dam, east of Phoenix, Arizona, was built after value engineering reduced the projected costs by 25% or $1 million. Revised plans required relocation of the dam site 750 ft upstream to take advantage of a natural rock ridge for the spillway site and using local materials for the 71 ft high, 1000 ft long earth and rockfill dam. The new design also provided for a central impervious core with a wider cross sectional area and flatter upstream and downstream slopes. Although the volume of embankment materials was double that of the original design, transportation costs were greatly reduced. Water seepage under the embankment was controlled by a cement-bentonite cutoff wall. (Cassar-FRC)
W82-03287

GAO FINDS MASSIVE FAILURE OF WASTEWATER TREATMENT PLANTS,
For primary bibliographic entry see Field 5D.
W82-03299

THE EL CAJON HYDRO PROJECT IN HONDURAS, PART TWO,
Empresa Nacional de Energia Electrica, Tegucigalpa (Honduras).
A. Diaz Arrivillaga, and H. Kreuzer.
International Water Power and Dam Construction, Vol 33, No 3, p 37-39, March, 1981. 7 Fig, 5 Tab.

Descriptors: *Dam design, *Spillways, *Diversion, *Financing, El Cajon Project, *Honduras, Rivers, Hydroelectric plants, Powerplants, Construction.

This paper, a continuation of a description of the El Cajon hydroelectric project, Honduras, concentrates on spillway facilities, river diversion, and financing. The spillway has a design inflow of 14,300 cu meters per sec into the reservoir. Spillway facilities include three components: a tunnel spillway, a crest spillway, and bottom outlets. During the 2.5 years of construction, the Humuya River will be diverted by an arrangement of two cofferdams and one diversion tunnel. An underground power station will be located next to the canyon wall. Systematic rock supporting, impermeabilization treatment, and leakage drainage are planned. A 600 meter tunnel will provide access from the road to the power station. Financing for the $582.7 million project will be provided by international financial institutions, the Honduras government, suppliers, and commercial banks. (Cassar-FRC)
W82-03332

PUMPED-STORAGE DEVELOPMENT IN BRAZIL, PART III,
Centrais Eletricas Brasilieras S. A., Rio de Janeiro (Brazil).
R. M. Cierlini, and W. Jordao.
International Water Power and Dam Construction, Vol 33, No 3, p 40-42, March, 1981. 2 Fig, 3 Tab.

Descriptors: *Pumped storage, *Hydroelectric plants, *Peak loads, Powerplants, *Brazil, Planning, Electric powerplants, Dam design, Reservoir design.

In the final part of a three-part series, four sites for proposed pumped storage plants for peak power supply in Brazil are described. These projects, Pacatuba (near Fortaleza), Amaraji (near Recife), Podra do Cavalo (near Salvador), and Primavera, vary from 500 to 1000 MW. Some plan to use existing upper or lower reservoirs and spillways to reduce capital costs. Since all available heads in existing hydroelectric plants are under 100 meters, it is not economical to convert from base load to peak load plants. The excellent pumped-storage potential in Southeastern Brazil ensures a good selection of inexpensive projects with investment costs in the range of $200-260/kw. At some of the proposed sites, slow reservoir filling or pumping of water from nearby rivers may be necessary in order to avoid depleting local stream and groundwater. Pumped storage facilities can provide low cost energy for peak consumption periods, reducing the needed capacity of future hydroelectric plants. (Cassar-FRC)
W82-03381

WHY BOTHER WITH HISTORIC PRESERVATION,
National Trust for Historic Preservation, Washington, DC.
R. Wilson, and D. C. Jackson.
Civil Engineering (New York), Vol 51, No 2, p 66-67, February, 1981.

Descriptors: *Construction, *Archaeology, *History, Preservation, Civil engineering, Engineering, *Dams, Earthquakes, Check structures.

Just as the excavation of prehistoric remains has been thought to delay construction projects, it has also been argued that the avoidance of historical engineering structures or their removal to safety is a waste of time and money. Archeological resources within a construction project area will almost always be adversely affected by the construction activity. Once they are destroyed, they cannot be replaced or reconstructed. If there is no alternative to destruction of an important archeological site, time and access should be provided for scientific study before the site is destroyed. The Archeological and Historic Preservation Act of 1974 incorporates specific language which ensures that future archeological study will not unduly delay construction without recompense. Two examples of historical dams are used to illustrate how an understanding of and appreciation for engineering history helped to resolve a modern problem. In one case, a contractor exposed a large wooden structure during excavation for a sewer line. After the Advisory Council on Historic Preservation halted construction, it was discovered that the structure was part of a timber dam built to impound the waters of a lake only 25 feet from the sewer trench. The trench was realigned to avoid any direct impact on the dam. The Littlerock Dam is a reinforced concrete, multiple arch dam constructed in 1923-1924. The California Department of Water Resources attempted to force drainage of the dam in 1977 on the basis of earlier studies suggesting the dam was unsafe. An independent in-depth study of the design employed showed that the engineering characteristic of the dam, when considered as a whole, made it safe in withstanding earthquakes and capable of handling heavy rains. Court action has resulted in the continued operation of the dam, which operated successfully during heavy floods in 1978. (Carroll-FRC)
W82-03384

8B. Hydraulics

POWER CHARACTERISTIC CURVE OF HYDRAULIC TURBINE SET,
Yu. U. Edel, L. P. Mikhailov, A. M. Chistyakov, and Yu. A. Kharlamov.
Hydrotechnical Construction, No 9, p 941-944, September, 1980. 3 Fig, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 38-40, September, 1980.

Descriptors: *Turbines, *Head loss, *Design criteria, Hydraulic design, Hydraulic structures, Hydraulic turbines, Penstocks, Corrosion, Nozzles, Operating policies, Power characteristic curves.

The power characteristic curve of a hydraulic turbine, furnished by the manufacturer, reflects the relation among turbine efficiency, allowable draft head, capacity, and head acting on the turbine. This curve does not consider the head losses in the head and tailrace conduits (turbine set). The operating characteristic curves for a 3-turbine high head plant are shown as follows: (1) turbine efficiency for 1 turbine, (2) turbine efficiency for 3 turbines, (3) turbine set efficiency for 1 turbine with new penstock, (4) the same, with a corroded penstock, (5) turbine set efficiency for 3 turbines with new penstock, (6) the same, with a corroded penstock, and (7) efficiency of turbine and turbine set for turbines operating on 3 out of 6 nozzles. The first 4 curves were close, differing by no more than 1.5% at full capacity (54.6 MW each turbine), and less at partial capacity. There was a 5% difference in efficiency at full capacity between curves (2) and 85) and 10% between curves (2) and (6). Maximum efficiencies for each turbine were about 91% at 26-40 MW for the first 4 curves, 90% at 24-30 MW for (5), 89% at 20-28 MW for (6), and 91% at 20 MW for (7). At low heads, differences between optimal regimes of the turbine and turbine set are small enough to ignore. The operating curve of the turbine set should be included in the design procedure. It may show that the turbine dimensions and/or specific speeds should be increased. (Cassar-FRC)
W82-03163

ABSOLUTE ROUGHNESS OF CONCRETE-LINED CHANNELS,
Department of Water Affairs, Pretoria (South Africa).
J. P. Pansegrouw.
Civil Engineer in South Africa, Vol 23, No 7, p 307, 309, 311, 313, 316, July, 1981. 8 fig, 3 Tab, 10 Ref.

Descriptors: *Roughness coefficient, *Channels, Mannings equation, *Linings, Concrete technology, *Concretes, Hydraulics, *South Africa, Concrete lined channels.

Observations were made at four major schemes of the South African Department of Water Affairs, Forestry and Environmental Conservation on absolute roughness and Manning n values in concrete-lined canals. During the study a number of important advantages of the method using roughness measurements to determine friction coefficients such as Manning n values were observed on site. When compared with the method of estimating Manning n values from the general appearance of cross-sections or from illustrations in textbooks, the roughness method has the advantage of minimizing errors due to faulty or subjective misinterpretations. This is particularly the case when friction coefficients are to be appraised for complex sections with composite roughness characteristics. No major disadvantages of the roughness method could be reported, except that roughness measurements can only be taken during dry or virtually dry periods. This could not be considered to be a real obstacle, however, as it is always advisable to inspect the wetted perimeter of any conveyor on site and to take actual measurements of the cross-sections to establish the hydraulic radius, regardless of the method used to determine friction coefficients in practice. (Baker-FRC)
W82-03397

8C. Hydraulic Machinery

INFLOW PREDICTION AND COOPERATIVE OPERATION OF PUMPS, VALVES AND GATES IN STORM WATER DRAINAGE SYSTEM,
Hitachi Ltd. Kawasaki (Japan). Systems Development Lab.
M. Shioya, S. Shimauchi, H. Ogasawara, and T. Ohto.
Water Science and Technology, Vol 13, No 8, p 61-67, 1981. 6 Fig, 3 Tab, 2 Ref.

Descriptors: Regression analysis, *Drainage systems, Prediction, *Control systems, Pumps, Valves, Combined sewer overflows, Storm drains, *Storm sewers, Storm water, Storm runoff, Mathematical studies, Forecasting, Intake gates, Sewer systems, Combined sewers, Overflow control.

The possibility of inflow prediction using data from an actual pump station and the simultaneous operation of control pumps, valves and gates to prevent overflows during storm conditions are examined. A multiple regression analysis was used to

assess the potential accuracies of short time range inflow predictions. For time ranges of 10, 20 and 30 min, the means of the absolute values of the relative prediction errors were 0.24, 0.35 and 0.36, respectively, corresponding to 43.0, 52.5 and 53.3% of the discharge quantity of a pump handling 200 cu m/min. Short time range predictions were deemed adequate for pump operation control when a stand-by pump was provided. To handle excess stormwater, a control system of gates, pumps and valves was devised which determines the opening angle of gates or valves and the number of pumps required to prevent overflow. This control scheme may also function during partial failure of routine drainage operations. The present technology is recommended for future total control systems for entire combined storm drainage-sewer systems. (Geiger-FRC)
W82-03068

TVA'S PUMPED-STORAGE PLANT.
For primary bibliographic entry see Field 8A.
W82-03250

MUNICIPAL WASTEWATER TREATMENT PLANT PIONEERS IN CONSERVATION APPROACH,
Pirnie (Malcolm) Inc., White Plains, NY.
For primary bibliographic entry see Field 5D.
W82-03255

8D. Soil Mechanics

CRACKING, LEAKAGE, AND EROSION OF EARTH DAM MATERIALS,
Trondheim Univ. (Norway).
E. I. Hjeldnes, and B. V. K. Lavania.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 106, No GT2, p 113-135, February, 1980. 1 Tab, 13 Fig, 15 Ref.

Descriptors: *Erosion, *Construction methods, *Dams, *Earth dams, *Rockfill dams, Tension, Finite element analysis, Soil properties, Soil tests, Soil types, Soil stability, Hydraulics, Fluid mechanics, Flow characteristics, Experimental design, Design criteria, Dam stability.

A laboratory approach to determining the cracking, leakage, and erosion properties of soil simultaneously is described. This approach is intended for use in studies of the stability of earth dams and for selection of suitable core materials. With this method, a soil sample is encased in a hollow cylindrical apparatus. It is given a vertical pull, at a predicted rate of tensile deformation, to develop cracking in a horizontal plane at the center height. The desired hydraulic gradient is applied through it at the fracture plane; the leak discharge and the soil contents in the discharge are measured during the tests. The observations are then plotted to characterize the properties. The applicability of the approach has been demonstrated by testing two soil types, a silty-gravelly sand and a silty-clayey fine sand. Results showed that the silty-gravelly sand is superior to the silty-clayey fine sand for use in an earth dam because it has self-healing response to erosion and is more leak and crack resistant. (Titus-FRC)
W82-03149

METHOD OF DETERMINING MECHANICAL CHARACTERISTICS OF COARSE SOILS,
O. A. Pakhomov.
Hydrotechnical Construction, No 4, p 370-374, April, 1980. 5 Fig, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 4, p 26-29, April, 1980.

Descriptors: *Soil physical properties, *Cohesionless soils, Soil mechanics, Soil physics, Model studies, Particle size, Shear tests, Compressibility, Dam construction, Earth dams, Rockfill dams, *Hydraulic structures.

A successive approximation method was developed to determine the mechanical characteristics of coarse soils used in constructing foundations for hydraulic structures. The new method does not have the limitations of commonly used procedures, which can only be used for soils with small differences in grain size. Five or six prototype mixtures of coarse soil are analyzed for particle size distribution and curves are prepared. Laboratory tests on specimens are conducted using consolidometer, stabilometer, shear apparatus, etc. A graphic relation between the investigated characteristics and the uniformity coefficient is plotted and an empirical equation selected. Extrapolation of the investigated relation produces the desired characteristic of the soil from the prototype particle size distribution for various load increments. Increases in modeling scale increase the error, but an accuracy of 5% may be attained with proper selection of the test unit dimensions. The method is illustrated by determination of compressibility and shear strength of a gravel-pebble soil. Specimens were 620 mm in diameter; the maximum size of prototype material was 200-500 mm. Five model mixtures were prepared by successive screening of fractions larger than 80, 40, 20, 10, and 5 mm. (Cassar-FRC)
W82-03160

CALCULATION OF EARTH DAMS BEING UNDERMINED,
A. K. Bugrov, and V. F. Markevich.
Hydrotechnical Construction, No 4, p 366-369, April, 1980. 3 Fig, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 4, p 24-26, April, 1980.

Descriptors: *Subsidence, *Dam stability, *Stress analysis, *Soil mechanics, *Earth dams, Soil dynamics, Mining engineering, Deformation, Strain, Elastic properties, Plasticity, Dam foundations.

The mixed problem of plane strain is solved for a 30 meter high earth dam located within the marginal part of a subsidence trough caused by mining of a potassium mineral deposit. Spreading of the ground surface is the characteristic form of deformation in the marginal areas. The stress and strain of earth fills can be calculated by considering elasticity and plasticity. A figure shows the plastic regions for various values of spreading (horizontal extension strains). The mixed problem gives a more realistic picture of strains than a linear solution. The mixed problem is also applied to calculating the parameters of a subsidence trough. (Cassar-FRC)
W82-03162

CALCULATOR PROGRAM AIDS LAGOON DESIGN,
Gutierrez-Palmenberg, Inc., Phoenix, AZ.
For primary bibliographic entry see Field 6A.
W82-03211

EARTH-FILLED SLURRY WALLS PROVIDE ECONOMICAL SEEPAGE CONTROL,
R. A. Antonino.
Civil Engineering (New York), Vol 50, No 4, p 72-74, April, 1980. 3 Fig.

Descriptors: *Trenches, *Slurries, *Seepage control, Bentonite, Cofferdams, Backfill, Dewatering, Tombigbee River, Dam construction, Construction, Locks, Earth dams, Soil mechanics, Excavation, Waterways.

Slurry trench cutoff walls have been efficient, effective, and economical at two sites under construction at the Tennessee-Tombigbee Waterway for excluding groundwater during excavation and subsequent concrete construction. Although this technique is often used for seepage control after construction, it is unusual to use it during both excavation and construction. In addition, the slurry is unusual--a mixture of graded, select fill material and bentonite. At the Aliceville Lock and Dam site a cofferdam 2 km in circumference encircling 64 acres has an earth slurry wall 3 ft wide and 30 ft long extending from inside the cofferdam to an impervious underlying clay stratum. After building the cofferdam 6 ft high, the slurry trench was dug down to the impervious layer and filled with the mixture. The trench was then backfilled with slurry and soil until the wall extended along the perimeter of the circumferential trench. The remainder of the cofferdam fill was added to the working surface to bring the embankment to full height. The earth-slurry walls, in place for two years, have shown excellent seepage control. Costs are limited to the installation cost. There are no operating costs as in dewatering systems using pumps and wells. (Cassar-FRC)
W82-03256

VALUE ENGINEERING SAVES DAM PROJECT,
Converse Ward Davis Dixon, Inc., San Francisco, CA.
For primary bibliographic entry see Field 8A.
W82-03287

RESPONSE OF BURIED STRUCTURES TO TRAVELING WAVES,
California Univ., Berkeley. Dept. of Civil Engineering.
R. N. Hwang, and J. Lysmer.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No GT2, p 183-200, 1981. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Seismic waves, *Pipelines, *Underground structures, Waves, Construction, Strain, Strain measurement.

The response of underground structures such as pipelines to traveling seismic waves is discussed. A new approach is presented for computing the response of these structures using the finite element method. Soil structure systems are represented by three-dimensional finite elements. Using a special type of wave-transmitting element, a three-dimensional system can be reduced to a plane of finite elements with three degrees of freedom at each node while the traveling effects of waves are retained. Large structures were found to significantly reduce computed strains, probably because the rigidity of the structures provides resistance to deformation. Thus, large structures should not necessarily be designed based on strains developed in the free field. Also, the assumption of vertically propagating waves was found inadequate for predicting stresses and strains induced in underground structures. Proper consideration must be given to the traveling effects of waves in the design. (Small-FRC)
W82-03346

8F. Concrete

NEW TECHNICAL SOLUTIONS USED FOR CONCRETING TUNNELS OF THE NUREK HYDROELECTRIC PLANT,
G. P. Kopyshev, S. V. Shutenkov, A. S. Efimov, V. A. Serebryakov, and I. I. Mel'nikov.
Hydrotechnical Construction, No 9, p 885-891, September, 1980. 5 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 7-10, September, 1980.

Descriptors: *Underground structures, *Hydroelectric plants, *Tunnel linings, Water transport, Concrete technology, *Hydraulic structures, Linings, *Nurek Hydroelectric plant, USSR, Diversion structures.

New concrete technology was developed for constructing the reinforced concrete linings of three 10 m diameter headrace tunnels and the troughs of the horseshoe-section diversion tunnels in the Nurek hydroelectric plant, U.S.S.R. A OKSh-10 circular walking formwork increased productivity because a railway track was not necessary and because placing and replacing of the formwork was mechanized. A special trough concreting UBL installation permitted mechanized railway track placement. These technical solutions increased the quality and efficiency of the construction. (Cassar-FRC)
W82-03150

CONCRETE OF THE DAM OF THE KIROVSKOE RESERVOIR,

L. M. Garkun, T. S. Vorotsvova, E. S. Zhirkov, and T. E. Nikitina.
Hydrotechnical Construction, No 2, p 153-157, February, 1980. 3 Fig, 4 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 2, p 27-29, February, 1980.

Descriptors: *Dam construction, *Concrete technology, *Kirovskoe Reservoir, *Buttress dams, Comparison studies, Design, Construction materials, Technology, USSR.

Kirovskoe, the concrete buttress dam constructed in 1971-75 on the Talas River, U.S.S.R., used 2 grades of concrete: 279,000 cu meters of 25 MPa and 50,000 cu meters of 20 MPa. The latter was used in buttresses and downstream heads of the sections. Tests of the concrete after construction showed that it conformed to design specifications with respect to compressive strength and cleavage tensile strength. Laboratory tests showed that concrete homogeneity improved as the project progressed because of improvements in preparing the aggregates and in manufacturing and installing the concrete mix. (Cassar-FRC)
W82-03159

CAVITATION RESISTANCE OF CONCRETE,

Y. P. Inozemtsev.
Hydrotechnical Construction, No 2, p 158-160, February, 1980. 1 Fig, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 2, p 30-31, February, 1980.

Descriptors: *Cavitation, *Concrete mixes, *Aggregates, Erosion, Gravel, *Hydraulic structures, Design criteria.

Comments on a paper by Moskin (1978) on cavitation erosion of concrete hydraulic structures are given. Moskin advocated use of broken stone instead of gravel to improve cavitation resistance. This is criticized on 3 grounds: (1) broken stone in place of gravel does not improve cavitation resistance, (2) more cement is required and the resulting higher heat produced increases the likelihood of thermal cracking, and (3) broken stone is scarce in remote regions. (Cassar-FRC)
W82-03165

8G. Materials

LINERS OF NATURAL POROUS MATERIALS TO MINIMIZE POLLUTANT MIGRATION,

Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 5G.
W82-03028

A SUITABLE LINING TECHNIQUE FOR EXISTING DISTRIBUTARIES,

Irrigation and Power Research Station, Amritsar (India).
G. S. Dhillon, and T. Singh.
Water Supply and Management, Vol 5, No 4/5, p 339-349, 1981. 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Linings, *Channel improvement, Polymers, Plastics, Canal linings, Canals, *Seepage control, Materials, *India, Punjab area.

Seepage losses have been observed from various distributaries and watercourses in different areas of Punjab, India. The losses observed after lining showed that considerable savings in seepage losses were effected due to the application of the lining. A combination type of lining was developed which is quite suitable for lining the existing distributaries and minors. The time needed to line pipes with this method is short, and lining can be executed during short closures of the channel. The combination lining fulfills the requirements of durability, impermeability and hydraulic efficiency. The lining is not affected by animal traffic nor by weathering conditions. The cost of the lining is low compared with other types of linings. The lining is a 400 gauge polythene film under 30.0 cm thick soil cover for lining at the bed. In the case of channels which are not in regime, polythene film at the bed is also overlaid with brick masonry. To improve the bond between the PE film and the brick masonry, bitumen emulsion was applied cold on the PE film and sand was sprayed before laying the brick masonry. (Baker-FRC)
W82-03063

WARMING UP TO GEOTHERMAL,

For primary bibliographic entry see Field 8A.
W82-03156

EVALUATION OF THE MECHANICAL PROPERTIES OF THE MASS OF A CONCRETE DAM WITH INTERBLOCK JOINTS,

K. A. Abedzhyan, E. S. Argal, and V. M. Korolev.
Hydrotechnical Construction, No 9, p 901-909, September, 1980. 5 Fig, 7 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 9, p 15-20, September, 1980.

Descriptors: *Concrete testing, *Deformation, *Grouting, Dam stability, Physical properties, Stress analysis, Strain measurement, Compressibility, Materials engineering, Strength, Cracks, *Hydraulic structures.

The deformability and character of fracture of interblock (nongrouted) and grouted joints were investigated on plaster-sand and concrete specimens using resistance strain gages. A mass with undisturbed joints in compression across the joints is as strong as or stronger than a monolith. Cracks in monolithic specimens develop parallel to the direction of action of the compressive forces. When cracks form in a jointed mass, they develop in the same direction but usually end at a joint, promoting better redistribution of stresses. Masonry with joints, either grouted or nongrouted, has increased deformability, but the average modulus of deformation under compression can be assumed equal to the modulus of deformation of the concrete. (Cassar-FRC)
W82-03158

UNDERGROUND AND OFFSHORE: WHEN TO CONSIDER CATHODIC PROTECTION,

Hinchman Corp., Detroit, MI.
A. L. Claes.
Consulting Engineer, Vol 54, No 3, p 89-92, March, 1980. 9 Fig.

Descriptors: *Corrosion control, *Cathodes, *Underground structures, Conveyance structures, *Pipelines, Water mains, Storage tanks, Coatings, Protective coatings, Anodes, Electrodes, Inspection, Maintenance.

Cathodic protection is an effective corrosion control method for structures immersed in water or buried in earth, such as pipelines, water lines and tanks, and sewage lines and outfalls. Direct current discharged through anodes travels through soil or water to the structure (the cathode) to be protected. Corrosion occurs only at the anode, which is periodically replaced, sparing the structure. The battery operated, low amperage and voltage galvanic anode system is used for structures with small current requirements--small coated pipes, sewage lift stations, etc. The impressed current system, externally powered and more flexible, can handle several hundred amperes and is used for structures with large current requirements, bare pipes and large cast iron water lines. Cathodic protection works most efficiently when coordinated with protective coatings and other corrosion control methods. Proper maintenance includes anode replacements and regular inspections, especially after any structural changes. (Cassar-FRC)
W82-03349

WASTEWATER TREATMENT: CORROSION SOLUTION ARE AS VARIED AS PROBLEMS,

Engineering Science, Inc., Atlanta, GA.
D. Burstein, and T. Franklin.
Consulting Engineer, Vol 54, No 3, p 83-88, March, 1980. 2 Tab.

Descriptors: *Corrosion control, *Hydrogen sulfide, *Industrial wastes, Wastewater treatment, Sulfuric acid, Cavitation, Aeration, Metals, Maintenance, Coatings, Plastics, *Wastewater treatment facilities.

A major maintenance problem in industrial wastewater treatment facilities is corrosion, caused by three basic mechanisms: erosion and cavitation, chemical attack, and galvanic and electrochemical attack. Corrosion attacks not only metal equipment, but also concrete, especially in material alternately wet and dry. Factors promoting corrosion are: low pH, high temperature, dissolved oxygen, dissolved salts, and high fluid velocity. A common corrosive material in the treatment process is sulfuric acid, formed from hydrogen sulfide in contact with wet equipment, Four basic methods are used in corrosion control in wastewater facilities: elimination of the corrosive agent or environment, use of protective liners and coatings, use of galvanic and impressed current protection devices, and use of corrosion resistant materials. H2S formation may be prevented by maintaining sufficient oxygen in the sewers entering the plant by injecting air into the wastewater or by adding chlorine. Corrosive vapors may be exhausted. Many specialized coatings are available for corrosion protection--painting, epoxy coatings, and plastic base liners and coatings. Corrosion resistant materials which may be used are: plastics (lowest cost), nonferrous metals, stainless steel (usually AISI Types 302, 304, and 316), and acid-resistant concrete. (Cassar-FRC)
W82-03350

CORROSION ROUNDTABLE--OPPORTUNITIES/PITFALLS FOR NEW MATERIALS,

M. Garbrecht.
Consulting Engineer (St. Joseph), Vol 54, No 3, p 70-80, March, 1980.

Descriptors: *Resins, *Corrosion control, *Materials engineering, Standards, Quality control, Wastewater treatment facilities, Engineering, Research priorities, Design standards, Legal aspects.

A panel discussion on new materials for corrosion prevention centered on fiberglass reinforced polyester resins (FRP) and included several points relevant to the water and wastewater industry. One problem in selecting materials for water plants is that the users often resist the idea of spending extra money for long term corrosion prevention. The uncertainty in the performance of unproven materials and the lack of sophistication of many clients causes engineers to use tried and true materials, rather than the innovative alternatives. There are many similar FRP plastic materials available, and as yet no standards and codes to give confidence to the users. Quality assurance is difficult. Newer wastewater process and complex industrial sludges present more exotic corrosion problems than in the past. In some cases, historically used materials are not applicable and FRP appears promising. Nevertheless, the tendency toward litigation in the case of failure makes engineers very cautious in specifying polyester resins. The record of FRP has been mixed to date. In one instance it was found that a piping system with 23,000 feet of pipe, many turns and bends, and thousands of fittings had only three leaks. In another case, a chemical waste storage tank failed because the designers did not consider the fact that benzene in the waste would destroy the resins. The panel urged more education and information dissemination, codes and standards, and more innovative applications of FRP. (Cassar-FRC)
W82-03373

STOPPING WATER WITH CHEMICAL GROUT,

Avanti International, Houston, TX.
W. B. Jaques.
Civil Engineering (New York), Vol 51, No 12, p 59-62, December, 1981. 1 Fig, 1 Tab.

Descriptors: *Waterproofing, *Oil sealants, *Grouting, Tunnels, Acrylamide grouts, Urethane grouts.

Chemical grouts are available to control water movement in soils, to repair sewer leaks, for waterproofing structures, and to stabilize incompetent soils. Unlike cements or epoxy resins applied to the inside of tunnels or foundations, the chemical grouts treat the water problem on the wet side of the structure. Several basic families are available. The most common is acrylamide grout, which requires three chemicals mixed at the time of use to form a solid material after a predetermined gel period. Although acrylamide grouts are not currently manufactured in the U.S., they are legal to use and may be imported. Urethanes may form stiff gels or foams. These materials have a wide range of applications, including one approved for potable water applications. Polyacrylamides include Injectite-80, a sewer sealing grout. AC-400, an acrylate, is specifically designed for controlling infiltration in sewer joints, but has also been used in tunnel sealing. Chemical grouts start as thin solutions which flow like water into very fine spaces between soil particles. Zones of any desired shape may be constructed--vertical walls, horizontal layers, and surrounding tunnels. (Cassar-FRC)
W82-03396

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

CANADA WATER YEAR BOOK 1979-1980, REFERENCES.
Department of the Environment, Ottawa (Ontario).
Available from Inland Waters Directorate, Ottawa, 1981. 69 p, ISBN 0-662-51566-8.

Descriptors: *Bibliographies, *Canada, Aquatic environment, *Water quality, *Water resources development, Planning, Wastewater treatment, Wastewater disposal, Chemical properties, Biological properties, Water management.

Many of the authors contributing to the 1979-1980 Year Book provided numerous references to the literature to document their findings and to help indicate some of the important areas of research related to their discipline. These references have been arranged herein by chapter and section corresponding to the layout of the subject matter in the Year Book itself. The references are produced in English, French or German, according to the language in which the original report was produced. (WATDOC)
W82-03097

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SUBJECT INDEX

ABSCISIC ACID
Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 2I

ACID RAIN
Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 5C

Chemical Flux in an Acid-Stressed Stream,
W82-03338 5C

Acid Precipitation--A New Study from Norway,
W82-03341 5C

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 2B

ACID WATER
Acidification in 50 Norwegian Lakes,
W82-03344 2H

ACIDIC WATER
Chemical Flux in an Acid-Stressed Stream,
W82-03338 5C

ACIDITY
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 5C

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 5B

ACTIC
Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 2C

ACTINOMYCES
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 5A

ACTIVATED SLUDGE
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 5D

ACTIVATED SLUDGE PROCESS
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment,
W82-03032 5D

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 5D

Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 5D

ADENOSINE TRIPHOSPHATE
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

ADJUDICATION PROCEDURE
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 6E

ADMINISTRATIVE DECISIONS
Engineering U.S. Water Policy,
W82-03294 6E

ADSORPTION
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 5B

ADVANCED WASTEWATER TREATMENT
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 5D

In-Stream Aeration: A Possible Alternative to AWT.
W82-03375 5G

AERATION
In-Stream Aeration: A Possible Alternative to AWT.
W82-03375 5G

AERIAL PHOTOGRAPHY
Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 4C

AEROBIC BACTERIA
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 5D

AEROBIC DIGESTION
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 5D

AFRICA
Will the Sahelian Drought End in 1985,
W82-03167 2B

AGGREGATES
Cavitation Resistance of Concrete,
W82-03165 8F

AGRICULTURAL RUNOFF
The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 5G

AGRICULTURAL WATERSHEDS
A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 8A

AGRICULTURE
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 6B

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

A Perspective Study of Droughts in Mexico,
W82-03358 2E

AIR POLLUTION
Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 2B

AIR POLLUTION EFFECTS
Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 5C

Reciprocating Hail Processes in the Alps,
W82-03227 2B

AIRY HOLM DAM
Airy Holm Dam - Kielder Water Scheme,
W82-03070 8A

ALGAE
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 5C

Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 2H

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 2H

Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 5C

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 5C

Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 5C

Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

ALGAL GROWTH
Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 5C

Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 2H

ALPS
Reciprocating Hail Processes in the Alps,
W82-03227 2B

ANAEROBIC DIGESTION
Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 5D

ANIMAL WASTES
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 5A

ANTARCTIC
On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 2C

West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 2C

ANTWERP
A Century of Water for Antwerp,
W82-03355 5F

AQUACULTURE
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 5D

AQUATIC ENVIRONMENT
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 7C

Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 5A

AQUATIC HABITATS
RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 5A

AQUATIC PLANTS
Exploiting Papyrus,
W82-03202 2H

AQUATIC WEED CONTROL
1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 4A

Aquatic Weed Research in Britain,
W82-03187 4A

AQUATIC WEEDS
1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 4A

Exploiting Papyrus,
W82-03202 2H

AQUEOUS SOLUTIONS
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1A

AQUIFER CHARACTERISTICS
BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 2F

AQUIFER MANAGEMENT
Remote Sensing from Space-II.
W82-03248 7B

AQUIFER SYSTEMS
Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 2F

Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

AQUIFERS
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 2F

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 2F

Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 2F

Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 2F

Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 2F

Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 2F

ARCHAEOLOGY
Why Bother with Historic Preservation,
W82-03384 8A

ARID LANDS
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

ARID REGIONS
Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

ARIZONA
Value Engineering Saves Dam Project,
W82-03287 8A

ARSENIC
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 5B

ASWAN DAM
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 6B

ATMOSPHERIC WATER
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 2B

AUSTRALIA
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

AZOV SEA
Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 5G

BACTERIA
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 2L

Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 5D

BARRIER ISLANDS
Barrier Islands: Should Engineers Interfere with Nature,
W82-03377 6F

BASINS
Estimating Distribution Uniformity in Level Basins,
W82-03058 3F

BEDFORD OUSE RIVER
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 5B

BENTHIC ENVIRONMENT
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 2L

BENTHIC FAUNA
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 2H

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

BENTHOS
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 2H

BIBLIOGRAPHIES
Canada Water Year Book 1979-1980, References.
W82-03097 10C

BIOACCUMULATION
Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 5C

BIODEGRADATION
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 5D

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

BIOINDICATORS
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 5A

BIOLOGICAL SAMPLES
Biological Monitoring Part VI - Future Needs,
W82-03230 5C

BIOLOGICAL TREATMENT
Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 5D

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

BIOLOGICAL WASTEWATER TREATMENT
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 5D

Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 5D

BIOMASS
Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 2H

BORDER IRRIGATION
Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 7B

BRAZIL
Pumped-Storage Development in Brazil. Part III,
W82-03381 8A

BRITISH COLUMBIA
Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 5C

Vacuum Sewers--The Future for Sewage Collection,
W82-03394 5G

BUDGETING
The Risk Business,
W82-03281 6E

BUFFERS
Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 5A

BUTTRESS DAMS
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

BYPRODUCTS
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

CADMIUM
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 5B

CALCIUM SULFIDE
Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 5D

CALIFORNIA
Policies and Goals for California Water Management: The Next 20 Years,
W82-03111 6D

Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 2I

Don't Damn the Stanislaus,
W82-03275 6E

CANADA
Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 7C

Canada Water Year Book 1979-1980, References.
W82-03097 10C

Canada Water Year Book 1977-1978.
W82-03099 7C

CANADA WATER ACT
The Canada Water Act, Annual Report 1980-1981.
W82-03098 7C

CAPE FEAR RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 6D

CAPE LOOKOUT BIGHT
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

CAPITAL COSTS
The Risk Business,
W82-03281 6E

CARBOHYDRATES
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 2L

CARBON
Fossil Carbon in Coastal Sediments,
W82-03201 5A

CARBON CYCLE
Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 5B

CARBON DIOXIDE
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

CARBON ISOTOPES
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

CASPIAN SEA
Salinity and Biogenic Material in the North Caspian,
W82-03155 4A

CATHODES
Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 8G

CATIONS
Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 5C

CAVITATION
Cavitation Resistance of Concrete,
W82-03165 8F

CELLULOSE ACETATE MEMBRANES
Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 3A

CEREAL CROPS
Cereal Yields and Drought Resistance,
W82-03195 2I

CHANNEL FLOW
Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 2E

CHANNEL IMPROVEMENT
A Suitable Lining Technique for Existing Distributaries,
W82-03063 8G

Graphs for Saline Wedges in Estuaries,
W82-03351 2L

CHANNELS
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

Absolute Roughness of Concrete-Lined Channels,
W82-03397 8B

CHELATION
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 5A

CHEMICAL ANALYSIS
On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 2C

A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 5A

Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

CHEMICAL COMPOSITION
Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 2H

CHEMICAL PROPERTIES
Biological Monitoring Part VI - Future Needs,
W82-03230 5C

CHEMICAL REACTIONS
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

CHEMICAL REDUCTION
The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 5D

CHEMICAL WASTES
1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 5A

CHEMISTRY OF PRECIPITATION
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

CHINA
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 2J

CHLORINATED HYDROCARBONS
Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 5E

CHLORINATION
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

CHLOROPHYLL A
Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 2H

CHROMATOGRAPHY
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 5A

CISTERNS
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 3B

CIVIL ENGINEERING
Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 8A

CLAYS
Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 2F

CLEANUP OPERATIONS
Using Coherent Water Jets to Control Oil Spills,
W82-03031 5G

CLEAR-CUTTING
Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 5C

CLIMATOLOGY
Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 2C

CLOGGING
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 5D

CLOUD SEEDING
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 3B

COAL
Fine Coal-Refuse Slurry Dewatering,
W82-03049 5D

COAL GASIFICATION
Will Synfuel Development Drain the West Dry,
W82-03292 6D

COASTAL AQUIFERS
Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 2F

Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

COASTAL ENGINEERING
Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 8A

COASTAL WATERS
Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 5C

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

Fossil Carbon in Coastal Sediments,
W82-03201 5A

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 5C

COASTAL ZONE MANAGEMENT
CZ '80: Coastal Quandaries Persist,
W82-03383 6E

COHESIONLESS SOILS
Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 8D

COKE PLANT WASTEWATER
Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

COLIFORMS
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 2L

COLORADO
Operation Reports--City of Pueblo, Colorado Department of Public Works.
W82-03348 5D

COLORADO RIVER
Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 5A

COLORADO RIVER BASIN
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

COLUMBIA RIVER BASIN
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

COMBINED SEWER OVERFLOWS
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

COMBINED SEWERS
Municipal Sewage: Three Communities Try to Cope,
W82-03284 5D

COMPARISON STUDIES
Theory of the Dielectric Constant of Ice,
W82-03176 2C

COMPOSTING
Composting Results in Los Angeles,
W82-03400 5E

COMPREHENSIVE PLANNING
Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 6D

COMPUTER MODELS
The Computer: Water Management Tool,
W82-03290 6A

COMPUTER PROGRAMS
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 2F

COMPUTERS
Flood Routing Program,
W82-03286 4A

CONCRETE MIXES
Cavitation Resistance of Concrete,
W82-03165 8F

CONCRETE TECHNOLOGY
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 8A

CONCRETE TESTING
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 8G

CONCRETES
Absolute Roughness of Concrete-Lined Channels,
W82-03397 8B

CONDUCTIVITY
Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 2G

On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 3C

CONSTRUCTION
Why Bother with Historic Preservation,
W82-03384 8A

CONSTRUCTION COSTS
Value Engineering Saves Dam Project,
W82-03287 8A

CONSTRUCTION METHODS
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

CONSUMPTIVE USE
Consumptive Water Use by Opium Poppy,
W82-03356 2I

CONTAMINANTS
Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 5A

CONTINUITY EQUATION
Solution of the Continuity Equation for the Karnak Area,
W82-03196 2G

CONTROL SYSTEMS
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 8C

CONVEYANCE STRUCTURES
Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 3F

COOLING WATER
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 7B

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 5C

Treatment of Cooling Tower Blowdown,
W82-03126 5D

COPEPODS
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 5A

CORROSION CONTROL
Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 8G

Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 8G

Corrosion Roundtable--Opportunities/Pitfalls for New Materials,
W82-03373 8G

COST ANALYSIS
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 5D

COST-BENEFIT ANALYSIS
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 6B

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

Economic Appraisal of a Groundwater Development Project,
W82-03077 6B

CROP PRODUCTION
Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 2I

CROP YIELD
Cereal Yields and Drought Resistance,
W82-03195 2I

Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 2I

Wheat Yield Estimation in Northwest Iran,
W82-03267 2I

Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 2I

Consumptive Water Use by Opium Poppy,
W82-03356 2I

CRUSTACEANS
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 5B

CRYSTALLIZATION
Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 5D

DAM CONSTRUCTION
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

DAM DESIGN
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 8A

DAM EFFECTS
Final Environmental Impact Statement; North Fork Payette River Project FERC No. 7330-IDAHO.
W82-03046 6G

DAM STABILITY
Calculation of Earth Dams Being Undermined,
W82-03162 8D

DAMS
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 6B

Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

Airy Holm Dam - Kielder Water Scheme,
W82-03070 8A

Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 8A

Value Engineering Saves Dam Project,
W82-03287 8A

Why Bother with Historic Preservation,
W82-03384 8A

DANUBE RIVER
A Large International River: The Danube,
W82-03369 5G

DARCYS LAW
Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

DATA COLLECTION
Remote Sensing Applications for Resource Management,
W82-03279 7B

DATA COLLECTIONS
Canada Water Year Book 1977-1978,
W82-03099 7C

DECISION MAKING
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

DECOMPOSING ORGANIC MATTER
Effects of Pollution on Humic Substances,
W82-03253 5C

DEFORMATION
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 8G

DENITRIFICATION
Biological Nitrogen Control of Industrial Wastewater,
W82-03131 5D

Biological Nitrogen Removal System Design,
W82-03145 5D

The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 5D

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

DENMARK
Water Supply in Denmark,
W82-03274 6D

Diversion of the River Neva,
W82-03304 4A

DENVER
Energy Minimization at Metro Denver Sewage District,
W82-03142 5D

DEPOSITION
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 5B

DESALINATION
Health Aspects of Water Desalination,
W82-03116 3A

Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 3A

DESERT PLANTS
Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 2I

DESERTS
Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 2I

DESIGN
GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 5D

DESIGN CRITERIA
Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 5D

Warming Up to Geothermal,
W82-03156 8A

Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 8B

Calculator Program Aids Lagoon Design,
W82-03211 6A

Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al,
W82-03347 5E

DETENTION RESERVOIRS
A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

Stormwater Detention in Developing Watersheds,
W82-03363 4A

DETERGENTS
Detergent Builders and Water Quality - A Changing Scene,
W82-03093 5C

DETOXIFICATION
Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 5G

DEVELOPING COUNTRIES
Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 5F

Who Will Pay the World's Water Bill,
W82-03280 6B

DEW
Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

DEWATERING
Fine Coal-Refuse Slurry Dewatering,
W82-03049 5D

DEWPOINT
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 2B

DIATOMS
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 5C

DIFFUSION COEFFICIENT
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 2F

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 2L

DULUTH
Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse,
W82-03249 5E

DISASTERS
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 5F

DISCHARGE MEASUREMENT
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 7B

DISCHARGE (WATER)
GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 5D

DISINFECTION
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

Inactivation of Enteroviruses by Ozone,
W82-03208 5F

DISSOLVED OXYGEN
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1B

DISTRIBUTION COEFFICIENTS
Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 5D

DISTRIBUTION PATTERNS
Estimating Distribution Uniformity in Level Basins,
W82-03058 3F

DISTRICT OF COLUMBIA AREA
Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 5E

DIVERSION
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 8A

DIVERSION LOSSES
Diversion of the River Neva,
W82-03304 4A

DOLOMITE
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

DOUGLAS FIR
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 2I

DRAINAGE
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

DRAINAGE DITCHES
The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 4A

DRAINAGE ENGINEERING
Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 8A

DRAINAGE SYSTEMS
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 8C

Aquatic Weed Research in Britain,
W82-03187 4A

DRAWDOWN
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 2F

DREDGING
Graphs for Saline Wedges in Estuaries,
W82-03351 2L

DRILLING EQUIPMENT
Warming Up to Geothermal,
W82-03156 8A

DRINKING WATER
Physiochemical Speciation of Lead in Drinking Water,
W82-03198 5F

Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 5F

DROUGHT
An Economic Analysis of Water Conservation Policy,
W82-03090 6B

Will the Sahelian Drought End in 1985,
W82-03157 2B

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 6A

A Perspective Study of Droughts in Mexico,
W82-03358 2E

Jersey Drought Hastens Water Supply Project,
W82-03385 6D

DROUGHT RESISTANCE
Cereal Yields and Drought Resistance,
W82-03195 2I

DUCKWEED
Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 5A

EARTH DAMS
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

Calculation of Earth Dams Being Undermined,
W82-03162 8D

ECOLOGICAL EFFECTS
Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 5C

A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 5C

Chemical Flux in an Acid-Stressed Stream,
W82-03338 5C

Acid Precipitation–A New Study from Norway,
W82-03341 5C

ECONOMIC ASPECTS
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 6B

Sludge Management Process Integration,
W82-03130 5D

The Deep-Shaft Process: Bright Future for Treating High-Strength Wastewaters.
W82-03376 5D

ECONOMIC EVALUATION
An Economic Analysis of Water Conservation Policy,
W82-03090 6B

ECOSYSTEMS
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 7B

Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 5G

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 5G

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 5C

EFFLUENTS
GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 5D

EGYPT
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 2H

Solution of the Continuity Equation for the Karnak Area,
W82-03196 2G

ELECTRICAL PROPERTIES
Theory of the Dielectric Constant of Ice,
W82-03176 2C

ELECTROCHEMISTRY
Improved Microbe Detection in Water Samples.
W82-03258 5A

FLGO DAM
Value Engineering Saves Dam Project,
W82-03287 8A

ENERGY
Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 7B

ENERGY CONSERVATION
Energy Minimization at Metro Denver Sewage District,
W82-03142 5D

Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 5D

Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 5D

ENERGY CONVERSION
Warming Up to Geothermal,
W82-03156 8A

ENERGY SOURCES
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

ENERGY TECHNOLOGY
EPA's Approach to Regulating New Energy Technologies,
W82-03129 6E

ENGLAND
Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 2F

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 5C

Aquatic Weed Research in Britain,
W82-03187 4A

ENTERIC BACTERIA
Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 5A

ENTEROVIRUSES
Inactivation of Enteroviruses by Ozone,
W82-03208 5F

ENVIRONMENTAL EFFECTS
Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 5C

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 6G

Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 8A

Salinity and Biogenic Material in the North Caspian,
W82-03155 4A

Biological Monitoring Part VI - Future Needs,
W82-03230 5C

Don't Damn the Stanislaus,
W82-03275 6E

ENVIRONMENTAL IMPACT STATEMENT
Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 6G

ENVIRONMENTAL POLICY
EPA's Approach to Regulating New Energy Technologies,
W82-03129 6E

ENVIRONMENTAL PROTECTION
ICI Brixham - Environmental Research in the Private Sector.
W82-03153 5D

EPHEMERAL STREAMS
Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 2A

EPIDEMIOLOGY
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

EROSION
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 8A

EROSION CONTROL
How About Reverse Filters,
W82-03247 4D

ERROR ANALYSIS
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 2E

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

ESCHERICHIA COLI
Improved Microbe Detection in Water Samples.
W82-03258 5A

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 5D

ESK ESTUARY
Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 5A

ESTIMATING EQUATIONS
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 2B

ESTUARIES
Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 2L

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 5A

Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

Radar Measurements of Estuarine Currents and Tides,
W82-03360 2L

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 2L

ESTUARINE ENVIRONMENT
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 2L

Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 2L

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

EUPHRATES DAM
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

EUPHRATES RIVER
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

EUTROPHICATION
Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 5C

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 5G

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 2H

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 5C

Eutrophication, Accelerated by Pollution,
W82-03193 5C

Exploiting Papyrus,
W82-03202 2H

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 5C

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bey I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 5C

EUTROPHICATION *POPULATION DYNAMICS
Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 5C

EVAPORATION
Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 2D

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 2D

FACTOR ANALYSIS
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

FARM WASTES
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

FATE OF POLLUTANTS
Zinc in Seawater and Sediments,
W82-03166 5B

Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 5D

FECES
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 5A

FEDERAL JURISDICTION
Engineering U.S. Water Policy,
W82-03294 6E

FEEDLOT WASTES
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 5D

FILTERS
How About Reverse Filters,
W82-03247 4D

FILTRATION
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

Improved Microbe Detection in Water Samples.
W82-03258 5A

FINANCING
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 8A

FINITE ELEMENT ANALYSIS
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

FINITE ELEMENT METHOD
On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 2F

FISH
Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 5C

Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 5B

FLOOD CONTROL
A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

Flood Routing Program,
W82-03286 4A

FLOOD-CONTROL STORAGE
Sizing of Urban Flood Control Ponds,
W82-03297 2A

FLOOD DAMAGE
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 8A

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 6A

FLOOD DISCHARGE
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 2E

FLOOD PLAINS
Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 4C

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 5C

FLOOD ROUTING
Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 4A

Flood Routing Program,
W82-03286 4A

FLORIDA
The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 5G

FLOW
Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 2F

FLOW CHARACTERISTICS
Flow Characteristics Below Floating Covers with Application to Ice Jams,
W82-03011 2C

Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 6A

FLOW CONTROL
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

FLOW DISCHARGE
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 7B

FLOW MEASUREMENT
Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 7B

Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 7B

FLOW PROFILES
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

FLOW RATES
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 2E

FLOWMETERS
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 7B

FLUID DROPS
Large Rain Drops in the Bright Band,
W82-03065 7B

FLUIDIZED BED PROCESS
Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse.
W82-03249 5E

FLUORIDE
Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 5F

FLUORIDES
Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 5A

FOOD PROCESSING WASTES
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 5D

FOREST WATERSHEDS
Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 2G

FOULING
Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 3A

FOX RIVER
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

FRANCE
Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 2H

Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplancton),
W82-03219 2H

FREEZING
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1A

FUEL REPROCESSING
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 5B

GEOMORPHOLOGY
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 2C

GEOTHERMAL RESOURCES
Warming Up to Geothermal,
W82-03156 8A

GEOTHERMAL STUDIES
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

GLACIAL DRIFT
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 2C

GLUCOSE
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

GOVERNMENTAL INTERRELATIONS
Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 6F

CZ '80: Coastal Quandaries Persist,
W82-03383 6E

GRAIN CROPS
Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 3F

GRAND CANYON
Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 5A

GRANTS
Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 6C

GRAPHICAL ANALYSIS
Graphs for Saline Wedges in Estuaries,
W82-03351 2L

GREAT BASIN
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

GREAT BRITAIN
Cereal Yields and Drought Resistance,
W82-03195 2I

The Tertiary Treatment of Sewages. Conclusion,
W82-03228 5D

GREAT LAKES
1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 5G

1981 Report on Great Lakes Water Quality.
W82-03102 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 5A

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 5G

GREAT LAKES BASIN
Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 5G

GREAT OUSE RIVER BASIN
Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 5A

GROUNDWATER
Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

New Techniques to Remove Radon from Ground Water.
W82-03157 5F

Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

Ground Water Monitoring: Part II,
W82-03380 5B

GROUNDWATER AVAILABILITY
Water Supply in Denmark,
W82-03274 6D

GROUNDWATER BUDGET
Water Supply in Denmark,
W82-03274 6D

GROUNDWATER DATING
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

GROUNDWATER IRRIGATION
Economic Appraisal of a Groundwater Development Project,
W82-03077 6B

GROUNDWATER MOVEMENT
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 2F

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 2F

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 2F

Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 2F

Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 2F

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 2F

Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 5B

GROUNDWATER POLLUTION
Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 5D

Septic Sewage Systems Contaminate Ground Water.
W82-03378 5B

GROUNDWATER POTENTIAL
Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 2F

GROUNDWATER RECHARGE
Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 2F

GROUTING
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 8G

Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 8A

Stopping Water with Chemical Grout,
W82-03396 8G

GROWTH KINETICS
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 2H

GULF OF SIRTE
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 5B

GULFS
Zinc in Seawater and Sediments,
W82-03166 5B

HAIL
Reciprocating Hail Processes in the Alps,
W82-03227 2B

HALIFAX HARBOR
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

HAMILTON HARBOR
Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

HARBORS
Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

HARDNESS
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

HAWAII
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 3B

HAZARDOUS MATERIALS
1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 5A

Ozone for the Treatment of Hazardous Materials,
W82-03139 5D

HEAD LOSS
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 8B

HEAT TRANSFER
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

HEAVY METALS
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 5D

Ozone for the Treatment of Hazardous Materials,
W82-03139 5D

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 5F

Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 5A

Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 5A

Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 5A

Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 5G

Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 5A

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

HERBICIDES
Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 5C

HETEROTROPHIC BACTERIA
Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

HIMALAYA MOUNTAINS
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

HISTORY
A Century of Water for Antwerp,
W82-03355 5F

Why Bother with Historic Preservation,
W82-03384 8A

HONDURAS
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 8A

HONG KONG ESTUARY
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 2L

HUMAN DISEASES
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 5B

The Gezira Scheme--A Study in Failure,
W82-03393 6B

HUMIC ACIDS
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 2H

Effects of Pollution on Humic Substances,
W82-03253 5C

HUMID AREAS
Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

HYDRAULIC MODELS
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 8A

HYDRAULIC STRUCTURES
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 8G

Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 8D

Cavitation Resistance of Concrete,
W82-03165 8F

Recent Water Towers in Norfolk,
W82-03246 8A

HYDROCARBONS
Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 5B

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 5A

HYDRODYNAMICS
The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 2H

Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 4A

HYDROELECTRIC PLANTS
Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 6D

Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 6D

Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 6D

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 6G

New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 8A

TVA's Pumped-Storage Plant.
W82-03250 8A

Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 8A

Pumped-Storage Development in Brazil. Part III,
W82-03381 8A

HYDROGEN ION CONCENTRATION
Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 5B

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 2B

HYDROGEN SULFIDE
Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 8G

HYDROLOGIC DATA
Canada Water Year Book 1977-1978.
W82-03099 7C

HYDROPHYTES
1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 4A

ICE
On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 2C

Theory of the Dielectric Constant of Ice,
W82-03176 2C

Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 2C

Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1A

ICE JAMS
Flow Characteristics Below Floating Covers with Application to Ice Jams,
W82-03011 2C

IDAHO
Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 2G

ILLINOIS
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

IMPAIRED WATER USE
On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 3C

IMPERVIOUS BEDS
Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 2F

INCINERATION
Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse,
W82-03249 5E

INDIA
A Suitable Lining Technique for Existing Distributaries,
W82-03063 8G

Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 5F

Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 8A

Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 2H

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 3F

Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 2I

INDONESIA
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

INDUSTRIAL EFFLUENTS
Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 5A

INDUSTRIAL WASTES
The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 5D

Zinc in Seawater and Sediments,
W82-03166 5B

Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 5D

River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 6E

Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 5E

Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 5C

Industrial Wastewater Audit,
W82-03337 5D

Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 8G

The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 5G

INDUSTRIAL WASTEWATER
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 5D

Biological Nitrogen Control of Industrial Wastewater,
W82-03131 5D

The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 5D

Water Policy at Inco Metals Company, Ontario Division Mills,
W82-03251 3E

INDUSTRIAL WATER
An Introduction to Industrial Water Treatment,
W82-03071 5F

INFILTRATION
Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 2A

Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 7B

Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 2G

INFILTRATION RATE
Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 2G

INFLOW
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

INGLEWOOD
Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 6A

INGURI HYDROELECTRIC PLANT
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 8A

INPUT-OUTPUT ANALYSIS
The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 6D

INSTREAM AERATION
In-Stream Aeration: A Possible Alternative to AWT.
W82-03375 5G

INTERNATIONAL AGREEMENTS
A Large International River: The Danube,
W82-03369 5G

The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 5G

ION EXCHANGE
Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 5D

Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 5B

Continuous Ion Exchange: A Survey of Recent Applications,
W82-03391 5D

ION EXCHANGE RESINS
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 5A

ION-SELECTIVE ELECTRODES
Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 5F

IONS
An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1B

IRAN
Wheat Yield Estimation in Northwest Iran,
W82-03267 2I

IRELAND
Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 5C

IRISH SEA
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 5B

IRON
Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 2H

IRRADIATION
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 2I

IRRIGATION
Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 6D

Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 6B

Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 8A

Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 7B

The Gezira Scheme--A Study in Failure,
W82-03393 6B

IRRIGATION CANALS
1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 4A

IRRIGATION DESIGN
Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 3F

IRRIGATION EFFECTS
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 2H

On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 3C

IRRIGATION EFFICIENCY
Remote Sensing from Space-II.
W82-03248 7B

Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 3F

Multimillion-Acre Tea Bag,
W82-03352 3F

IRRIGATION OPERATION
Economic Appraisal of a Groundwater Development Project,
W82-03077 6B

IRRIGATION PRACTICES
Estimating Distribution Uniformity in Level Basins,
W82-03058 3F

IRRIGATION-RETURN FLOW
Multimillion-Acre Tea Bag,
W82-03352 3F

IRRIGATION WATER
Economic Appraisal of a Groundwater Development Project,
W82-03077 6B

Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 3C

ISOTOPE FRACTIONATION
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1B

ISOTOPES STUDIES
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 2A

ISOTOPIC TRACERS
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

ITALY
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

Reciprocating Hail Processes in the Alps,
W82-03227 2B

JAPAN
Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 2H

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 5C

Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

JETS
Using Coherent Water Jets to Control Oil Spills,
W82-03031 5G

KALAMAZOO RIVER BASIN
Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 6D

KASHMIR
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

KELPS
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 5B

KINETICS
Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

KIROVSKOE RESERVOIR
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

LAGOONS
Calculator Program Aids Lagoon Design,
W82-03211 6A

LAKE CLASSIFICATION
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

LAKE EVAPORATION
Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 2D

LAKE KASUMIGAURA
Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 2H

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

LAKE LENORE
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 2H

LAKE MENDOTA
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

LAKE ONTARIO
Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C

LAKE PAVIN
Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 2H

Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplancton),
W82-03219 2H

LAKE QARUN
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 2H

LAKE RESTORATION
The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

LAKE SEDIMENTS
Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for

Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 5A

Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 2H

LAKE SUPERIOR

Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 2D

LAKE TAUPO

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 2H

LAKES

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 2H

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 5A

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 5G

Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 5C

Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 5C

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 5C

Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 2H

Exploiting Papyrus,
W82-03202 2H

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 2H

Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplanctons),
W82-03219 2H

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

Acid Precipitation--A New Study from Norway,
W82-03341 5C

Acidification in 50 Norwegian Lakes,
W82-03344 2H

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 2B

LAND APPLICATION

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 5E

LAND USE

Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 4C

LANDFILLS

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 5G

LANGSTONE HARBOR

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

LAPLACE EQUATION

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

LEACHATES

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 5G

Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 5B

LEACHING

Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 5D

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

LEAD

Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 5F

LIBYA

Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 5B

LIMNOLOGY

Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 2H

The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

LININGS

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 5G

A Suitable Lining Technique for Existing Distributaries,
W82-03063 8G

Absolute Roughness of Concrete-Lined Channels,
W82-03397 8B

LOBSTERS

Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 5B

LOGGING

Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 5C

LONG ISLAND

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

LONG-TERM PLANNING

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 6D

LOS ANGELES

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 5B

Composting Results in Los Angeles,
W82-03400 5E

LOS ANGELES HARBOR

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

MADRID BASIN AQUIFER

The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

MANAGEMENT PLANNING

On Water Availability and Demand in Nigeria,
W82-03062 6D

Energy Minimization at Metro Denver Sewage District,
W82-03142 5D

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 6A

Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 6A

MANGANESE

Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 2H

MANGROVE SWAMPS
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 5C

MANNINGS EQUATION
Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels'.
W82-03382 2E

MARINE FLORA
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 5B

MARINE SEDIMENTS
Fossil Carbon in Coastal Sediments,
W82-03201 5A

Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 5A

MATERIALS ENGINEERING
Corrosion Roundtable--Opportunities/Pitfalls for New Materials,
W82-03373 8G

MATHEMATICAL MODELS
Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 2A

The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 5G

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 2F

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 2E

Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 6A

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

MATHEMATICAL STUDIES
Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 4A

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 2F

MEASUREMENT TECHNIQUES
Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 2G

MEASURING INSTRUMENTS
Large Rain Drops in the Bright Band,
W82-03065 7B

MEMBRANE FILTERS
Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 3A

MERCURY
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 5C

Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 5B

MERRIMACK RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 6D

MERSEY ESTUARY
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 2L

METAL-FINISHING WASTES
Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 5D

Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 5D

METALS
Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 5A

METEOROLOGY
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

METHANE
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

METHYLATION
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

MEXICO
A Perspective Study of Droughts in Mexico,
W82-03358 2E

MICROBIAL DEGRADATION
Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 2H

MICROBIOLOGICAL STUDIES
A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 5C

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 5A

Improved Microbe Detection in Water Samples.
W82-03258 5A

MICROCOSMS
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

MICROORGANISMS
Improved Microbe Detection in Water Samples.
W82-03258 5A

Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 5B

MIGRATION
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

MINE WASTES
Fine Coal-Refuse Slurry Dewatering,
W82-03049 5D

MINING ENGINEERING
Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

MODEL STUDIES
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 5C

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 6B

Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 2A

Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 2G

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 2H

MODEL STUDIES

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 6D

The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

Models of Water Transport in the Soil-Plant System: A Review,
W82-03066 2I

Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 2A

A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 2E

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 2F

Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 6A

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 2F

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 5C

Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 5D

A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 5C

Theory of the Dielectric Constant of Ice,
W82-03176 2C

An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1B

Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 2C

The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

Sizing of Urban Flood Control Ponds,
W82-03297 2A

Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 5E

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 2F

Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 5C

MOISTURE AVAILABILITY

Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 2I

MOISTURE CONTENT

Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 2G

MOISTURE STRESS

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

MOLLUSKS

Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

MONITORING

Biological Monitoring Part VI - Future Needs,
W82-03230 5C

Ground Water Monitoring: Part II,
W82-03380 5B

Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 5A

MOROCCO

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 2H

MORPHOLOGY

Soil Morphology and Preferential Flow Along Macropores,
W82-03175 2G

MORTALITY

Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

MOUNTAIN LAKES

Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

MOUNTAINS

Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 5C

MULTIOBJECTIVE PLANNING

Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

MUNICIPAL WASTEWATER

Municipal Sewage: Three Communities Try to Cope,
W82-03284 5D

NATURAL WATERS

The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 2H

NEBRASKA

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 5C

NEMATODES

Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 2L

NEW ENGLAND

Report of Committee on Conservation, Development and Utilization of Water Resources,
W82-03374 3D

NEW HAMPSHIRE

Chemical Flux in an Acid-Stressed Stream,
W82-03338 5C

NEW JERSEY

Jersey Drought Hastens Water Supply Project,
W82-03385 6D

NEW ZEALAND

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 2H

NICKEL

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

NIGERIA

On Water Availability and Demand in Nigeria,
W82-03062 6D

NILNAG LAKE

Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

NITRIFICATION

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

Nitrification Using the Rotating Biological Contactor,
W82-03132 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 5D

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

NITRITES
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 5A

NITROGEN
Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 5D

Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 2G

NITROGEN REMOVAL
Biological Nitrogen Removal System Design,
W82-03145 5D

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

NONPOINT POLLUTION SOURCES
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

NONSTRUCTURAL ALTERNATIVES
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

NORTH FORK PAYETTE RIVER PROJECT
Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 6G

NORWAY
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 5D

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

Acid Precipitation--A New Study from Norway,
W82-03341 5C

Acidification in 50 Norwegian Lakes,
W82-03344 2H

NOVA SCOTIA
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

NUCLEAR MAGNETIC RESONANCE
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 2H

NUCLEAR POWERPLANTS
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 5B

NUMERICAL ANALYSIS
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 2F

NUREK HYDROELECTRIC PLANT
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

NUTRIENT
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

NUTRIENT TRANSPORT
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 5E

NUTRIENTS
The Canada Water Act, Annual Report 1980-1981.
W82-03098 7C

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 2H

Salinity and Biogenic Material in the North Caspian,
W82-03155 4A

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 5C

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 5C

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

OBSERVATION WELLS
Ground Water Monitoring: Part II,
W82-03380 5B

OCCOQUAN WATERSHED
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

OIL POLLUTION
Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 5C

OIL SEALANTS
Stopping Water with Chemical Grout,
W82-03396 8G

OIL SHALE
Will Synfuel Development Drain the West Dry,
W82-03292 6D

OIL SPILLS
Using Coherent Water Jets to Control Oil Spills,
W82-03031 5G

Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

OLIGOTROPHIC LAKES
Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 2H

ONEIDA LAKE
Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 2H

ONTARIO
Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 8A

OPEN-CHANNEL FLOW
Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels'.
W82-03382 2E

OPERATING COSTS
Operation Reports--City of Pueblo, Colorado Department of Public Works.
W82-03348 5D

OPIUM POPPY
Consumptive Water Use by Opium Poppy,
W82-03356 2I

ORGANIC COMPOUNDS
Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 5D

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 5D

Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

ORGANIC LOADING
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 5D

ORGANIC MATTER
Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

OUTFALL SEWERS
Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 5E

OVERFLOW
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 8A

OXIDATION
Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 5D

OXYGEN
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 2A

The Ecology of a Land Drainage Channel–I. Oxygen Balance,
W82-03306 4A

OXYGEN DEPLETION
Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 5C

OXYGENATION
Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment,
W82-03032 5D

OZONATION
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

Ozone for the Treatment of Hazardous Materials,
W82-03139 5D

OZONE
Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 5D
Inactivation of Enteroviruses by Ozone,
W82-03208 5F

PACIFIC NORTHWEST
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 2I

PALO ALTO AREA
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

PATH OF POLLUTANTS
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 5B

Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 5B

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

PATHOLOGY
Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 5C

PAYETTE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 6D

PEAK LOADS
Pumped-Storage Development in Brazil. Part III,
W82-03381 8A

PEE DEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 6D

PEEL-HARVEY ESTUARY
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

PERCOLATION
Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 5B

PERMEABILITY
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 2F

A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

PERMEABILITY COEFFICIENT
Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 2G

PERMITS
EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 6E

PESTICIDE RESIDUES
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

PHENOL
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 5D

PHILIPPINES
Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

PHOSPHORUS
Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 2H

The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

PHOSPHORUS REMOVAL
Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 5D

PHOTOSYNTHESIS
Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 2H

Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 2I

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C

PHYSICOCHEMICAL TREATMENT
Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

PHYSIOLOGICAL ECOLOGY
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 5A

PHYTOPLANKTON
The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 2H

Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 5C

Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 5C

Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 2H

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 2H

Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplancton),
W82-03219 2H

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 2H

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C

PIGEON RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 6D

PINUS RADIATA
Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 2D

PIPELINES
Response of Buried Structures to Traveling Waves,
W82-03346 8D

Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 8G

PLANKTON
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 2H

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 5B

PLANNING
The Computer: Water Management Tool,
W82-03290 6A

Water: Too Much, Too Little, Too Bad,
W82-03291 6D

PLANT PHYSIOLOGY
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 2I

PLANT WATER POTENTIAL
Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 2I

POLICY MAKING
New Thrust in the 1980s for U.S. Water-Quality Programs,
W82-03252 5G

POLLUTANT IDENTIFICATION
Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 5A

Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 5A

Fossil Carbon in Coastal Sediments,
W82-03201 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 5A

Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 5A

POLYCHLORINATED BIPHENYLS
Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 5A

Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 5A

PONDING
Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 2G

PONDS
Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 2H

POPULATION DENSITY
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

POPULATION DYNAMICS
The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 2H

PORES
Soil Morphology and Preferential Flow Along Macropores,
W82-03175 2G

POROUS MEDIA
Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 2F

POTABLE WATER
Health Aspects of Water Desalination,
W82-03116 3A

New Techniques to Remove Radon from Ground Water.
W82-03157 5F

POTENTIAL WATER SUPPLY
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

POWERPLANTS
Treatment of Cooling Tower Blowdown,
W82-03126 5D

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

PRECIPITATION
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 2A

Acid Precipitation--A New Study from Norway,
W82-03341 5C

PREDICTION
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

PRESSURE HEAD
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 2F

PRESSURE MEASURING INSTRUMENTS
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 7B

PRIMARY PRODUCTIVITY
Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 2H

PROBABLE MAXIMUM PRECIPITATION
Meteorology of Important Rainstorms in the Colorado River and Greet Basin Drainages,
W82-03047 2B

PRODUCTIVITY
Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 6A

PROJECT PLANNING
Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 6D

PROTECTION
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 5F

Barrier Islands: Should Engineers Interfere with Nature,
W82-03377 6F

PROTOZOA
Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 5G

PUBLIC HEALTH
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

Health Aspects of Water Desalination,
W82-03116 3A

PUBLIC PARTICIPATION
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

PUEBLO
Operation Reports--City of Pueblo, Colorado Department of Public Works.
W82-03348 5D

PUGET SOUND
Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

PUMPED STORAGE
TVA's Pumped-Storage Plant.
W82-03250 8A

Pumped-Storage Development in Brazil. Part III,
W82-03381 8A

PURE WATER
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1A

QUEBEC
Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 5C

RADAR
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

Radar Measurements of Estuarine Currents and Tides,
W82-03360 2L

RADIATION
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

RADIOACTIVE WASTES
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 5B

Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 5B

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 5A

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

RADON REMOVAL
New Techniques to Remove Radon from Ground Water.
W82-03157 5F

RAIN-DROP SIZE ANALYSIS
Large Rain Drops in the Bright Band,
W82-03065 7B

RAIN GAGES
Rainfall Catch Errors Associated with Circumambient Obstructions,
W82-03021 2B

RAINFALL
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

Rainfall Catch Errors Associated with Circumambient Obstructions,
W82-03021 2B

Will the Sahelian Drought End in 1985,
W82-03167 2B

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 2B

RAINFALL DISTRIBUTION
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

RAINFALL FORECASTING
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 2A

RAINSTORMS
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

RAJASTHAN
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

RAW WASTEWATER
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 5D

RECLAIMED WATER
Water Cost Encourages Reuse and Conservation,
W82-03295 5D

RECREATION
Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 5A

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 6G

Don't Damn the Stanislaus,
W82-03275 6E

RECYCLING
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 5D

RED TIDE
Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 5C

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 5C

REGIONAL PLANNING
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

Report of Committee on Conservation, Development and Utilization of Water Resources.
W82-03376 3D

Jersey Drought Hastens Water Supply Project,
W82-03385 6D

REGULATIONS
EPA's Approach to Regulating New Energy Technologies,
W82-03129 6E

REMOTE COMMUNITIES
Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 8A

REMOTE SENSING
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 7B

An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 7B

Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 7B

Remote Sensing from Space-II.
W82-03248 7B

Remote Sensing Applications for Resource Management,
W82-03279 7B

Radar Measurements of Estuarine Currents and Tides,
W82-03360 2L

RESEARCH
Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 7C

RESEARCH FACILITIES
ICI Brixham - Environmental Research in the Private Sector.
W82-03153 5D

RESEARCH PRIORITIES
Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 8A

RESERVOIR CONSTRUCTION
Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 6A

RESERVOIR OPERATION
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 3B

Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 6A

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 6A

RESERVOIR RELEASES
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

RESERVOIR SILTING
A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 8A

RESERVOIRS
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 2J

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 5B

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 2H

Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 6A

Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 2H

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 5C

Don't Damn the Stanislaus,
W82-03275 6E

RESINS
Corrosion Roundtable--Opportunities/Pitfalls for New Materials,
W82-03373 8G

RESOURCES MANAGEMENT
Policies and Goals for California Water Management: The Next 20 Years,
W82-03111 6D

RESPIRATION
Biological Nitrogen Removal System Design,
W82-03145 5D

REVERSE FILTERS
How About Reverse Filters,
W82-03247 4D

REVERSE OSMOSIS
Treatment of Cooling Tower Blowdown,
W82-03126 5D

RHINE RIVER
The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 5G

RHIZOSPHERE
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 2I

RICE
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

RIPARIAN RIGHTS
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 6E

RISKS
Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 6A

RIVER BASIN DEVELOPMENT
Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 6D

Water Resources Apprisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 6D

Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 6D

RIVER BASINS
A Large International River: The Danube,
W82-03369 5G

RIVERS
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

Diversion of the River Neva,
W82-03304 4A

Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 5C

ROCHESTER
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

ROCKFILL DAMS
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

TVA's Pumped-Storage Plant.
W82-03250 8A

ROOT SYSTEMS
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 5E

ROOT ZONE
Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 3C

ROTIFERS
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

ROUGHNESS COEFFICIENT
Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels'.
W82-03382 2E

Absolute Roughness of Concrete-Lined Channels,
W82-03397 8B

RURAL AREAS
Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 5F

SAHEL REGION
Will the Sahelian Drought End in 1985,
W82-03167 2B

SALINE-FRESHWATER INTERFACES
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

SALINE LAKES
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 2H

SALINE SOILS
Solution of the Continuity Equation for the Karnak Area,
W82-03196 2G

SALINE WATER INTRUSION
Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 2F

Graphs for Saline Wedges in Estuaries,
W82-03351 2L

SALINITY
Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 2F

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 5G

Salinity and Biogenic Material in the North Caspian,
W82-03155 4A

Diversion of the River Neva,
W82-03304 4A

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 2L

SALT BALANCE
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 5A

SALT MARSHES
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 2L

SALT RIVER
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

SALT TOLERANCE
On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 3C

SALT VALLEY
Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 5C

SALTS
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 5B

Multimillion-Acre Tea Bag,
W82-03352 3F

SAMPLE PREPARATION
Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 5A

Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

SAN FRANCISCO BAY AREA
Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 5B

SAND FILTERS
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 5D

SANITARY LANDFILLS
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

SANMENXIA RESERVOIR
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 2J

SATELLITE TECHNOLOGY
Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 7B

Remote Sensing from Space-II.
W82-03248 7B

Remote Sensing Applications for Resource Management,
W82-03279 7B

SAUDI ARABIA
Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 3C

SCALING
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

SCOTLAND
Airy Holm Dam - Kielder Water Scheme,
W82-03070 8A

SEAWATER
An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1B

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 5B

Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 5A

SEDIMENT TRANSPORT
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 2J

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 2E

SEDIMENT-WATER INTERFACES
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

SEDIMENTATION
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 2J

A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 8A

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 5D

SEDIMENTS
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 5B

Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 5A

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 2L

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 5A

SEEDS
Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 2I

SEEPAGE
Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 8A

SEEPAGE CONTROL
A Suitable Lining Technique for Existing Distributaries,
W82-03063 8G

Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 8D

Value Engineering Saves Dam Project,
W82-03287 8A

SEISMIC WAVES
Response of Buried Structures to Traveling Waves,
W82-03346 8D

SELENIUM
Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 5G

SEMIARID CLIMATES
Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

SEPTIC TANKS
Septic Sewage Systems Contaminate Ground Water.
W82-03378 5B

SEPTIC WASTEWATER
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 5D

SEWAGE
Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

SEWAGE TREATMENT
The Tertiary Treatment of Sewages. Conclusion,
W82-03228 5D

SEWER HYDRAULICS
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 7B

SEWER OVERFLOW CONTROL
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 2A

SEWER SYSTEMS
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 7B

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 6A

SEWERS
Vacuum Sewers--The Future for Sewage Collection,
W82-03394 5G

SHOCK LOADS
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 5D

SILICA
A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 5A

SIMULATION ANALYSIS
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

Solution of the Continuity Equation for the Karnak Area,
W82-03196 2G

SLUDGE
Composting Results in Los Angeles,
W82-03400 5E

SLUDGE DIGESTION
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 5D

Anaer[illegible]ge Digestion--Need It Be Expensive,
W82-03389 5D

SLUDGE DISPOSAL
Sludge Management Process Integration,
W82-03130 5D

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 5E

Composting Results in Los Angeles,
W82-03400 5E

SLURRIES
Fine Coal-Refuse Slurry Dewatering,
W82-03049 5D

Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 8D

SNAKE RIVER BASIN
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

SNOW COVER
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 5D

SNOWMELT
Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 7B

SOCIAL IMPACT
The Gezira Scheme--A Study in Failure,
W82-03393 6B

SODIUM
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 5A

SOIL MECHANICS
Calculation of Earth Dams Being Undermined,
W82-03162 8D

SOIL MOISTURE
Wheat Yield Estimation in Northwest Iran,
W82-03267 2I

Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 2G

SOIL PHYSICAL PROPERTIES
Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 8D

SOIL PROFILES
Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 2G

SOIL PROPERTIES
Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 2G

SOIL SOLUTION
Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 2G

SOIL STRUCTURE
Soil Morphology and Preferential Flow Along Macropores,
W82-03175 2G

SOIL WATER
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 6A

Soil Morphology and Preferential Flow Along Macropores,
W82-03175 2G

Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 2G

Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 2G

Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 2G

Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 2I

SOIL-WATER-PLANT RELATIONSHIP
Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 2I

SOIL-WATER-PLANT RELATIONSHIPS
Models of Water Transport in the Soil-Plant System: A Review,
W82-03066 2I

Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 2I

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 2D

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 2D

Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 5E

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

SOILS
Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 2G

SOLAR ENERGY
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

SOLID WASTES
Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse.
W82-03249 5E

SOLIDS CONTACT PROCESSES
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 5D

SOLUBILITY COEFFICIENT
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1B

SOLUTE TRANSPORT
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 7B

Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 2F

Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 2G

SOLUTES
Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 2G

SOLVENT EXTRACTION
Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 5D

SORGHUM
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

SORPTION
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

SOUTH AFRICA
The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

Absolute Roughness of Concrete-Lined Channels,
W82-03397 8B

SOUTHERN HEMISPHERE
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 2B

SPECIATION
Physiochemical Speciation of Lead in Drinking Water,
W82-03198 5F

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

SPECIES COMPOSITION
Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

SPECTROPHOTOMETRY
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 5A

SPILLWAYS
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 8A

The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 8A

SPOIL BANKS
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

SPRINKLER IRRIGATION
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 5D

Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 3F

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

ST. JOSEPH RIVER BASIN
Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 6D

ST. LAWRENCE ESTUARY
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

STANISLAUS RIVER
Don't Damn the Stanislaus,
W82-03275 6E

STATISTICAL ANALYSIS
Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 6A

Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 3B

STATISTICAL MODELS
Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 2F

STEADY FLOW
Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 2F

STEAM
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

STEAM STRIPPING
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

STEEL INDUSTRY
Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

Industrial Wastewater Audit,
W82-03337 5D

STOCHASTIC HYDROLOGY
Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 2G

STOCHASTIC PROCESSES
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 5B

STOMATAL TRANSPIRATION
The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 2D

STORAGE
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

STORAGE TANKS
Recent Water Towers in Norfolk,
W82-03246 8A

STORM-OVERFLOW SEWERS
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 2A

STORM RUNOFF
A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

STORM SEWERS
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 8C

STORM WATER
Better Ways to Finance Stormwater Management,
W82-03298 6C

STORMWATER
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

STREAM DEGRADATION
Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 5C

Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 5C

STREAM EROSION
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 2J

STREAM POLLUTION
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 5C

STREAMFLOW
Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels',
W82-03382 2E

STREAMFLOW-WATER QUALITY RELATIONS
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 7B

STREAMS
Chemical Flux in an Acid-Stressed Stream,
W82-03338 5C

STRESS ANALYSIS
Calculation of Earth Dams Being Undermined,
W82-03162 8D

SUBLETHAL EFFECTS
Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 5C

SUBSIDENCE
Calculation of Earth Dams Being Undermined,
W82-03162 8D

SUDAN
The Gezira Scheme--A Study in Failure,
W82-03393 6B

SULFATE REDUCTION
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

SULFATES
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

SULFIDE PRECIPITATION
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 5D

SURFACE-GROUNDWATER RELATIONS
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

SURFACE WATER
Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 7B

SURFACTANTS
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 5A

SUSPENDED SOLIDS
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 2H

SUSQUEHANNA RIVER
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

SWIMMING
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

SWIMMING POOLS
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

SWITZERLAND
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 2A

Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 5F

SYNTHETIC FUELS
Will Synfuel Development Drain the West Dry,
W82-03292 6D

SYRIA
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

SYSTEMS ANALYSIS
An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 5F

TANNERY WASTES
Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

TASMANIA
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 5C

TEMPERATURE
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 2A

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C

TEMPERATURE EFFECTS
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 7B

Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 5D

TEMPORAL DISTRIBUTION
Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

TENNESSEE VALLEY AUTHORITY
TVA's Pumped-Storage Plant.
W82-03250 8A

TERTIARY TREATMENT
The Tertiary Treatment of Sewages. Conclusion,
W82-03228 5D

TEXAS
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 6E

TEXTILE MILL WASTES
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 5D

THAILAND
Economic Appraisal of a Groundwater Development Project,
W82-03077 6B

THAMES WATER AUTHORITY
The Risk Business,
W82-03281 6E

THEODORE ROOSEVELT DAM
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82 03051 8A

THERMAL POLLUTION
Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 5C

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

Reciprocating Hail Processes in the Alps,
W82-03227 2B

THERMAL STRATIFICATION
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

THERMAL WATER
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

THERMOCLINE
Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1A

THERMODYNAMICS
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

THIN LAYER CHROMATOGRAPHY
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

TIDAL EFFECTS
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 2L

TIDES
Radar Measurements of Estuarine Currents and Tides,
W82-03360 2L

A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

TOKYO
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

TOXICITY
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 5A

Biological Monitoring Part VI - Future Needs,
W82-03230 5C

TOXINS
1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 5G

1981 Report on Great Lakes Water Quality.
W82-03102 5G

TRACE LEVELS
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 5A

TRACE METALS
Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

TRAP EFFICIENCY
A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 8A

TREES
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 2I

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 2D

TRENCHES
Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 8D

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 5E

TRICKLING FILTERS
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 5D

TROPICAL CYCLONES
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

TROPICAL REGIONS
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

TUNNEL CONSTRUCTION
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 8A

Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 8A

TUNNEL FAILURE
Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 8A

TUNNEL LININGS
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in

TUNNEL LININGS
Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 8A

TURBIDITY
The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 2H

TURBINES
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 8B

ULTRAVIOLET RADIATION
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

UNCONFINED AQUIFERS
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 2F

UNDERGROUND STRUCTURES
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

Response of Buried Structures to Traveling Waves,
W82-03346 8D

Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 8G

UNIFORM FLOW
Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 2E

UNITED KINGDOM
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 5B

Recent Water Towers in Norfolk,
W82-03246 8A

UNSATURATED FLOW
Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 2G

UNSTEADY FLOW
Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 2E

UPPER MISSISSIPPI RIVER
Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 4C

URAN AREAS
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 2J

URANIUM
Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

URANIZATION
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 2J

URBAN AREAS
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

URBAN RUNOFF
Better Ways to Finance Stormwater Management,
W82-03298 6C

USER CHARGES
Better Ways to Finance Stormwater Management,
W82-03298 6C

UTILITIES
A Century of Water for Antwerp,
W82-03355 5F

UTILITY EXTENSION
Updating Antiquated City Water Systems,
W82-03293 5F

VACUUM SEWERS
Vacuum Sewers--The Future for Sewage Collection,
W82-03394 5G

VAPOR COMPRESSION DISTILLATION
Treatment of Cooling Tower Blowdown,
W82-03126 5D

VERTICAL DISTRIBUTION
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

VIBRIO
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 5B

VIRUSES
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 5D

Inactivation of Enteroviruses by Ozone,
W82-03208 5F

VITRIFIED WATER
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1A

VOLGA RIVER
Salinity and Biogenic Material in the North Caspian,
W82-03155 4A

VOLUMETRIC ANALYSIS
Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 5A

WASHINGTON
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 2H

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

WASTE DISPOSAL
Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse.
W82-03249 5E

Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 5E

WASTE HEAT
Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 5D

WASTE RECOVERY
Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 5D

WASTE TREATMENT
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 5D

WASTEWATER COLLECTION
Vacuum Sewers--The Future for Sewage Collection,
W82-03394 5G

WASTEWATER DISPOSAL
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 6E

Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 5E

WASTEWATER FACILITIES
Municipal Sewage: Three Communities Try to Cope,
W82-03284 5D

WASTEWATER IRRIGATION
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 5D

WASTEWATER POLLUTION
Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

WASTEWATER RENOVATION
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 5D

WASTEWATER TREATMENT
Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 5D

Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 5D

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment,
W82-03032 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

Fine Coal-Refuse Slurry Dewatering,
W82-03049 5D

Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 5D

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 5D

Treatment of Cooling Tower Blowdown,
W82-03126 5D

Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 5D

Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 5D

Sludge Management Process Integration,
W82-03130 5D

Biological Nitrogen Control of Industrial Wastewater,
W82-03131 5D

Nitrification Using the Rotating Biological Contactor,
W82-03132 5D

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 5D

The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 5D

Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 5D

Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 5D

Energy Minimization at Metro Denver Sewage District,
W82-03142 5D

Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 5D

Biological Nitrogen Removal System Design,
W82-03145 5D

Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 5D

ICI Brixham - Environmental Research in the Private Sector.
W82-03153 5D

Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 5D

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 5D

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 6E

Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 5D

Industrial Wastewater Audit,
W82-03337 5D

Operation Reports--City of Pueblo, Colorado Department of Public Works.
W82-03348 5D

Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 5D

The Deep-Shaft Process: Bright Future for Treating High-Strength Wastewaters.
W82-03376 5D

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 5D

Continuous Ion Exchange: A Survey of Recent Applications,
W82-03391 5D

Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 6C

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 5D

Composting Results in Los Angeles,
W82-03400 5E

WASTEWATER TREATMENT FACILITIES
GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 5D

Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 8G

WATER ANALYSIS
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 5F

A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 5A

Acidification in 50 Norwegian Lakes,
W82-03344 2H

WATER CHEMISTRY
The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 2H

WATER CIRCULATION
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

WATER CONSERVATION
An Economic Analysis of Water Conservation Policy,
W82-03090 6B

Report of Committee on Conservation, Development and Utilization of Water Resources.
W82-03374 3D

WATER CONSUMPTION
Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 5G

WATER CONVEYANCE
Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 6A

WATER COST
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 6B

WATER COSTS
Water Cost Encourages Reuse and Conservation,
W82-03295 5D

WATER CURRENTS
Radar Measurements of Estuarine Currents and Tides,
W82-03360 2L

A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

WATER DAMAND
Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 6D

WATER DEMAND
Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 6D

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 6D

Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 6B

WATER DISTRIBUTION
Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 6A

An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 5F

A Century of Water for Antwerp,
W82-03355 5F

WATER HYACINTH
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 5B

WATER LAW
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 6E

WATER LEVELS
Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 2F

WATER MANAGEMENT
Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 6A

Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 7C

Canada Water Year Book 1977-1978.
W82-03099 7C

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 6D

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 5G

A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 5B

Remote Sensing Applications for Resource Management,
W82-03279 7B

The Computer: Water Management Tool,
W82-03290 6A

Water: Too Much, Too Little, Too Bad,
W82-03291 6D

WATER POLICY
Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 6D

Water Policy at Inco Metals Company, Ontario Division Mills,
W82-03251 3E

The Risk Business,
W82-03281 6E

Engineering U.S. Water Policy,
W82-03294 6E

Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 6F

Report of Committee on Conservation, Development and Utilization of Water Resources.
W82-03374 3D

WATER POLLUTION
GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 5D

WATER POLLUTION CONTROL
Using Coherent Water Jets to Control Oil Spills,
W82-03031 5G

Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 5D

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 5D

Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 2F

Eutrophication, Accelerated by Pollution,
W82-03193 5C

New Thrust in the 1980s for U.S. Water-Quality Programs,
W82-03252 5G

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 6E

Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 5E

Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 6C

WATER POLLUTION EFFECTS
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 5C

Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 5C

Detergent Builders and Water Quality - A Changing Scene,
W82-03093 5C

A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 5C

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

Effects of Pollution on Humic Substances,
W82-03253 5C

Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 5A

WATER POLLUTION PREVENTION
Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 5G

WATER POLLUTION SOURCES
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 5A

WATER QUALITY
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 5C

Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 5A

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 2H

Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 7B

Detergent Builders and Water Quality - A Changing Scene,
W82-03093 5C

Canada Water Year Book 1979-1980, References.
W82-03097 10C

The Canada Water Act, Annual Report 1980-1981.
W82-03098 7C

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 5G

1981 Report on Great Lakes Water Quality.
W82-03102 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 5A

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

Health Aspects of Water Desalination,
W82-03116 3A

A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 5B

New Thrust in the 1980s for U.S. Water-Quality Programs,
W82-03252 5G

Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

WATER QUALITY CONTROL

The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 5G

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 5G

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 5G

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 5G

A Large International River: The Danube,
W82-03369 5G

The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 5G

WATER QUALITY MANAGEMENT

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 5G

1981 Report on Great Lakes Water Quality.
W82-03102 5G

River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

WATER QUALITY STANDARDS

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 5G

1981 Report on Great Lakes Water Quality.
W82-03102 5G

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 5G

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 5G

WATER RECLAMATION

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

WATER REQUIREMENTS

Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

Will Synfuel Development Drain the West Dry,
W82-03292 6D

WATER RESOURCES DEVELOPMENT

Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 6D

Water Resources Appraisal for Hydroelectric Licensing, Payette River Basin, Idaho.
W82-03043 6D

Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 6D

Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 6D

On Water Availability and Demand in Nigeria,
W82-03062 6D

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 7C

Canada Water Year Book 1979-1980, References.
W82-03097 10C

Canada Water Year Book 1977-1978.
W82-03099 7C

WATER RESOURCES MANAGEMENT

The Canada Water Act, Annual Report 1980-1981.
W82-03098 7C

WATER REUSE

Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 5D

Water Policy at Inco Metals Company, Ontario Division Mills,
W82-03251 3E

Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 3C

Water: Too Much, Too Little, Too Bad,
W82-03291 6D

Water Cost Encourages Reuse and Conservation,
W82-03295 5D

WATER RIGHTS

The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 6E

WATER SHORTAGE

Updating Antiquated City Water Systems,
W82-03293 5F

Jersey Drought Hastens Water Supply Project,
W82-03385 6D

WATER SOFTENING

Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

WATER STORAGE

Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 3B

WATER STRESS

The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 2D

WATER SUPPLY

Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 6A

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 6D

Airy Holm Dam - Kielder Water Scheme,
W82-03070 8A

Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

Water Supply in Denmark,
W82-03274 6D

Water: Too Much, Too Little, Too Bad,
W82-03291 6D

Updating Antiquated City Water Systems,
W82-03293 5F

A Century of Water for Antwerp,
W82-03355 5F

WATER SUPPLY DEVELOPMENT

On Water Availability and Demand in Nigeria,
W82-03062 6D

Who Will Pay the World's Water Bill,
W82-03280 6B

Jersey Drought Hastens Water Supply Project,
W82-03385 6D

WATER SUPPLY SYSTEMS

Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 5F

Updating Antiquated City Water Systems,
W82-03293 5F

An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 5F

WATER TANKS

Recent Water Towers in Norfolk,
W82-03246 8A

WATER TEMPERATURE
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 7B

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 5C

WATER TRANSPORT
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 2I

WATER TREATMENT
An Introduction to Industrial Water Treatment,
W82-03071 5F

New Techniques to Remove Radon from Ground Water.
W82-03157 5F

WATER TREATMENT FACILITIES
Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 5F

Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 6A

WATER USE
Water Resources Apprisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 6D

WATER USE EFFICIENCY
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 2I

Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 3F

Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

Consumptive Water Use by Opium Poppy,
W82-03356 2I

Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 2I

WATERPROOFING
Stopping Water with Chemical Grout,
W82-03396 8G

WATERSHED MANAGEMENT
Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 2G

Stormwater Detention in Developing Watersheds,
W82-03363 4A

WAVE VELOCITY
Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1A

WAVES
Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1A

WEATHER
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 5D

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

WEATHER DATA COLLECTIONS
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

WEATHER FORECASTING
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

WEATHER MODIFICATION
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

WEED CONTROL
Aquatic Weed Research in Britain,
W82-03187 4A

The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 4A

WELL DRILLING
Warming Up to Geothermal,
W82-03156 8A

WELL FUNCTION
Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 8A

WELL WATER
New Techniques to Remove Radon from Ground Water.
W82-03157 5F

WELLS
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 2F

WERRA RIVER
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 5B

WESER RIVER
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 5B

WEST ANTARCTIC ICE SHEET
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 2C

WETLANDS
Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 5C

WHEAT
Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 2I

Wheat Yield Estimation in Northwest Iran,
W82-03267 2I

Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 2I

WILD RIVERS
Don't Damn the Stanislaus,
W82-03275 6E

WISCONSIN
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

X-RAY FLUORESCENCE
Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 5A

YADKIN RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 6D

YAMPA RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 6D

YARRA RIVER
Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

YELLOW RIVER
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 2J

ZEOLITES
Detergent Builders and Water Quality - A Changing Scene,
W82-03093 5C

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

ZINC
Zinc in Seawater and Sediments,
W82-03166 5B

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

ZOOPLANKTON
Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 2H

The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 2H

AUTHOR INDEX

ABADZHYAN, K. A.
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 8G

ABDEL-MALEK, S. A.
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 2H

ABDEL RAHMAN, M. E. S.
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 6B

ABECASIS, F.
Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 8A

ABOUZAID, H.
Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 2H

ADAMS, D. J.
Theory of the Dielectric Constant of Ice,
W82-03176 2C

AHMAD, I.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

AHMED, Q. S.
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 5B

ALLEN, R.
Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 5E

ALTSHULER, E. E.
Large Rain Drops in the Bright Band,
W82-03065 7B

AMANDES, C. B.
Stormwater Detention in Developing Watersheds,
W82-03363 4A

AMBRUS, A.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

AMIR, I.
Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 3F

ANDERSON, D. A.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

ANTONINO, R. A.
Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 8D

ANUFRIEVA, N. M.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

APPLEBY, P. G.
Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

ARGAL, E. S.
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 8G

ARMSTRONG, R. N.
The Computer: Water Management Tool,
W82-03290 6A

ASHIKHMEN, V. A.
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 8A

AUGIER, H.
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 5B

AXBERG, C.
Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 5D

AYOADE, J. O.
On Water Availability and Demand in Nigeria,
W82-03062 6D

BACKER, R. R.
Fine Coal-Refuse Slurry Dewatering,
W82-03049 5D

BAGENSKI, G.
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 5D

BARANOS, E. S.
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 8A

BARANSKI, J.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

BARBARICK, K. A.
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 5D

BARBIERI, J. L.
Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

BARKER, J. F.
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

BARNES, D.
Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 5D

BARNEY, T. W.
Remote Sensing Applications for Resource Management,
W82-03279 7B

BARRICK, R. C.
Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

BARRON, P. F.
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 2H

BARTLE, J. R.
Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 2D

BASTIAN, R. K.
Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 5D

BATCHELDER, A. R.
Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 5C

BATES, J.
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 5D

BAVEJA, A. K.
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 5A

BAXENDALE, R. A.
Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 2F

BAXTER, M. S.
Fossil Carbon in Coastal Sediments,
W82-03201 5A

BECK, B.
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System – II. Water Quality Modelling,
W82-03243 5B

BEDFORD, B. L.
Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 5C

BEDIENT, P. B.
Stormwater Detention in Developing Watersheds,
W82-03363 4A

BELFORT, G.
Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 3A

BELL, J. N. B.
Acid Precipitation--A New Study from Norway,
W82-03341 5C

BELL, W. H.
Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

BENEDEK, P.
A Large International River: The Danube,
W82-03369 5G

BENSON, B. B.
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1B

BENSON, C. R.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

BERESFORD, J. D.
Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 2D

BERGMAN, H. L.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

BHAT, S. R.
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 5A

BHATTACHARYA, R. N.
Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 2F

BHOLE, A. G.
Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 5F

BILLARD, T. C.
Solution of the Continuity Equation for the Karnak Area,
W82-03196 2G

BIRCH, P. B.
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

BLANKENSHIP, W.
Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 5E

BOND, W. J.
Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 2G

Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 2G

BONDELID, T. R.
A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

BONNER, R. F. JR.
Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 5D

BOUDOU, A.
Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 5C

BOUMA, J.
Soil Morphology and Preferential Flow Along Macropores,
W82-03175 2G

BOWEN, A. J.
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

BRADE, C. E.
Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 5D

BRAMELLER, A.
An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 5F

BRESLER, E.
Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 2G

BRESLIN, M. K.
Using Coherent Water Jets to Control Oil Spills,
W82-03031 5G

BRICKER, O. P.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

BRIDLE, T. R.
Biological Nitrogen Control of Industrial Wastewater,
W82-03131 5D

BROCK, T. D.
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

BROWN, E. J.
Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 2H

BROWN, M. S.
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 5C

BRUGGELLER, P.
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1A

BRUNKOW, D. A.
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

BUGROV, A. K.
Calculation of Earth Dams Being Undermined,
W82-03162 8D

BURNEY, C. M.
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 2L

BURNS, G.
Solution of the Continuity Equation for the Karnak Area,
W82-03196 2G

BURSTEIN, D.
Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 8G

BUSCH, R. A.
Fine Coal-Refuse Slurry Dewatering,
W82-03049 5D

BUTLER, M.
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 5D

BYER, H. G.
Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 5E

CADDY, D. E.
Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 5A

CAIRNS JR, J.
Biological Monitoring Part VI - Future Needs,
W82-03230 5C

CALDERON, R. L.
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

CARLEO, D. J.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

CARPENTER, S. R.
Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 5C

CARRONDO, J. J. T.
Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

CARTY, A. J.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

CHANGNON JR, S. A.
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

CHAPMAN, G.
Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 5G

CHAU, A. S. Y.
Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 5A

CHAU, Y. K.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

CHIAN, E. S. K.
Inactivation of Enteroviruses by Ozone,
W82-03208 5F

CHISTYAKOV, A. M.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 8B

CHRISTENSEN, D. A.
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 6B

CHRISTIANSON, R.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

CHRISTOPHERSEN, N.
Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 5B

CIARLINI, R. M.
Pumped-Storage Development in Brazil. Part III,
W82-03381 8A

CLAES, A. L.
Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 8G

CLANET, F.
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 5A

CLAPPERTON, C. M.
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 2C

CLEARY, R. W.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

CLEMMENS, A. J.
Estimating Distribution Uniformity in Level Basins,
W82-03058 3F
Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 7B

COLACICCO, D.
Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 5E

COLLIS-GEORGE, N.
Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 2G
Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 2G

COOKE, R. C.
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

COTTON, A. P.
The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 2L

CRAWFORD, J. K.
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 7B

CREMA, R.
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

CRISP, P. T.
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 5A

CRISTIANI, G.
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 5B

CROSS, J. E.
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 5B

CROSSER, M. L.
Industrial Wastewater Audit,
W82-03337 5D

CUSHMAN, J. H.
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 5E

CUTSHALL, N. H.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

DAGAN, G.
Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 2F

DALLAIRE, G.
Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 6C

DANIEL, C. C. III
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 7B

DANIELS, M. L.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 5D

DARA, S. S.
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 5D

DAVIES, S. H. R.
Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

DAVIES, W. J.
The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 2D

DAVIS, B.
Composting Results in Los Angeles,
W82-03400 5E

DAVISON, R. R.
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

DAWSON, R.
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

DAY, H. J.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

DAY, J. P.
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 5B

DE BORNE DE GRANDPRE, C.
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

DE, R.
Consumptive Water Use by Opium Poppy,
W82-03356 2I

DEDRICK, A. R.
Estimating Distribution Uniformity in Level Basins,
W82-03058 3F

DEDYO, J.
Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 5D

DEGUCHI, T.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

DEHAAN, R. W.
The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 6D

DELARCHE, A.
Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 5C

DELONCLE, R.
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 5A

DERECKI, J. A.
Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 2D

DERMISIS, V.
Graphs for Saline Wedges in Estuaries,
W82-03351 2L

DESORTOVA, B.
Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 2H

DETTINGER, M. D.
First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 2F

DEVAUX, J.
Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametre, Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 2H

DEVEAUX, J.
Limnologic Study of Lake Pavin (France) I: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) I: Facteurs Abiotiques et Phytoplancton),
W82-03219 2H

DHILLON, G. S.
A Suitable Lining Technique for Existing Distributaries,
W82-03063 8G

DIAZ ARRIVIALLAGA, A.
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 8A

DICK, R. I.
Sludge Management Process Integration,
W82-03130 5D

DICKSON, A. G.
An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1B

DILOUIE, J.
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 2J

DIRICKX, I. J.
A Century of Water for Antwerp,
W82-03355 5F

DMITRIEV, N. V.
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 8A

DOBBS, S.
Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 5B

DONOGHUE, J. F.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

DOUGAL, M. D.
Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 2F

DOZIER, J.
Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 7B

DREHWING, F. J.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

DRNDARSKI, N.
Fossil Carbon in Coastal Sediments,
W82-03201 5A

DUDDRIDGE, J. A.
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 2I

DUFF, E. J.
Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode.
W82-03259 5F

Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 5A

DUNIN, F. X.
Wheat Yield Estimation in Northwest Iran,
W82-03267 2I

DUNLOP, S.
Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis.
II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 5G

EAGLE, G. A.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

ECKERT, J. M.
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 5A

EDEL, YU. U.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 8B

EDMONDS, J. S.
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 5B

EFIMOV, A. S.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

EKAMA, G. A.
The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 5D

EL-SABH, M. I.
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

ELLIS, K. V.
The Tertiary Treatment of Sewages. Conclusion,
W82-03228 5D

ELMAN, W.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

ENGELBRECHT, R. S.
Inactivation of Enteroviruses by Ozone,
W82-03208 5F

ENGELMANN, H. M.
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

ERIKSSON, L.
Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 5D

ESFANDI, A.
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 5D

EVANS, N. A.
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 5D

EVERDELL, R. A.
Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 8A

FAIRWEATHER, V.
Barrier Islands: Should Engineers Interfere with Nature,
W82-03377 6F

CZ '80: Coastal Quandaries Persist,
W82-03383 6E

Engineering U.S. Water Policy,
W82-03294 6E

FANNIN, T. E.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

FARKAS, E. J.
Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 5E

FARRELL, T. P.
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

FAURE, H.
Will the Sahelian Drought End in 1985,
W82-03167 2B

FELLER, M. C.
Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 5C

FERRARI, P.
Reciprocating Hail Processes in the Alps,
W82-03227 2B

FINLAYSON, C. M.
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

FLUEGGE, R. A.
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

FOK, Y. S.
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 3B

FORD, D. L.
Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 5D

FRANCESCONI, K. A.
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 5B

FRANCIS, A. J.
Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 5B

FRANKLIN, T.
Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 8G

FRICKE, A. H.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

FRIEDMAN, M. M.
Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 5D

FRITZ, P.
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

FU, A. Y.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

FUKUO, Y.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

FULLER, W. H.
Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 5G

FULOP, A.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

GAC, J-Y.
Will the Sahelian Drought End in 1985,
W82-03167 2B

GARBRECHT, M.
Corrosion Roundtable--Opportunities/Pitfalls for New Materials,
W82-03373 8G

GARKUN, L. M.
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

GARVER, J. L.
Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 5C

GASS, T. E.
Ground Water Monitoring: Part II,
W82-03380 5B

GASSEND, R.
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 5B

GEINOPOLOS, A.
Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

GIBB, J. P.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

GIBSON, N. A.
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 3A

GILL, K. S.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

GILL, M. A.
Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 4A

GILLAM, A. H.
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 2H

GOCKE, K.
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

GODDARD, M. R.
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 5D

GOGUS, M.
Flow Characteristics Below Floating Covers with Application to Ice Jams,
W82-03011 2C

GOLDING, B. L.
Flood Routing Program,
W82-03286 4A

GORDON, D. M.
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

GORITSKII, A. B.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

GORONSKY, M. C.
Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 5D

GRADY JR, C. P. L.
Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 5D

GRANT, M. A.
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

GREENFIELD, J. H.
Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

GREENLEE, J. K.
Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 5C

GREENWOOD, E. A. N.
Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 2D

GREENWOOD, P. J.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

GRIFFITHS, D. J.
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 2H

GRIZZARD, T. J.
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

GROENEWEG, J.
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

GULLIVER, J.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

GUPTA, V. K.
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 5A

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 2F

GUREGHIAN, A. B.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

GUYMON, G. L.
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 6A

HAFFNER, G. D.
Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C

HAHN, M. G.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

HAIMES, A. S.
Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 5D

HAITJEMA, H. M.
Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 2F

HALL, R. J.
Chemical Flux in an Acid-Stressed Stream,
W82-03338 5C

HAMILTON, E. I.
Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 5A

HANSEN, E. M.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

HANSON, R. J.
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

HARGITAI, E.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

HARKER, D.
Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 2F

HARNED, D. A.
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 7B

HARRIS, G. P.
Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C
Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

HARRIS, W. B.
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

HARRISON, D. C.
Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 6F

HARRISON, R. M.
Physiochemical Speciation of Lead in Drinking Water,
W82-03198 5F

HART, B. T..
Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 5B

HARTIGAN, J. P.
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

HASSETT, A.
The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

HAUG, R. T.
Composting Results in Los Angeles,
W82-03400 5E

HAWLEY, M. E.
A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

HEADY, E. O.
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 6B

HEDGES, J. E.
Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

HEINEMANN, H. G.
A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 8A

HEIST, J. A.
Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 5D

HENDRICKS, D. W.
The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 6D

HENDRIX, P. F.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

HENNING, H. F-K. O.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

HERGENRADER, G. L.
Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 5C

HILL, A. J.
Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

HILL, R.
An Introduction to Industrial Water Treatment,
W82-03071 5F

HIRTH, L. J.
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 5D

HITDLEBAUGH, J. A.
Nitrification Using the Rotating Biological Contactor,
W82-03132 5D

HJELDNES, E. I.
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

HOULE, E. H.
Treatment of Cooling Tower Blowdown,
W82-03126 5D

HOWELL, J. A.
Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 5D

HROMADKA, T. V.
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 6A

HSIEH, S. A. K.
Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 5A

HSU, C. F.
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 3B

HUFF, F. A.
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

HUQ, A.
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 5B

HUSEN, J. A.
Water Supply in Denmark,
W82-03274 6D

HWANG, R. N.
Response of Buried Structures to Traveling Waves,
W82-03346 8D

HWANG, S. T.
Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 5D

IFUKU, M.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

INOZEMTSEV, Y. P.
Cavitation Resistance of Concrete,
W82-03165 8F

IRVINE, R. L.
Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 5D

ISHAK, M. M.
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 2H

ISHIO, S.
Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 5C

ISKANDAR, I. K.
Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 2G

IYER, C. S. P.
A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 5A

JACKSON, D. C.
Why Bother with Historic Preservation,
W82-03384 8A

JAIN, T. C.
Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 2I

JAQUES, W. B.
Stopping Water with Chemical Grout,
W82-03396 8G

JETHWAS, J. L.
Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 8A

JEWELL, W. J.
Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 5D

JOERES, E. F.
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

JOHANNSEN, C. J.
Remote Sensing Applications for Resource Management,
W82-03279 7B

JOHNSON, K. M.
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 2L

JORDAN, T. A.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

JORDAO, W.
Pumped-Storage Development in Brazil. Part III,
W82-03381 8A

KAKINUMA, T.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

KALMAZ, E. V.
Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

KAO, T. W.
Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1A

KARL, D. M.
RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 5A

KAROLY, E.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

KARTHEGISAN, J.
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 2L

KAWECKA, B.
Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 5C

KECK, R. T.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

KEPKAY, P. E.
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 2J

KERNDORFF, H.
Effects of Pollution on Humic Substances,
W82-03253 5C

KHAN, M. A.
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

KHARLAMOV, YU. A.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 8B

KIM, B. M.
Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 5D

KINCANNON, D. F.
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 5D

KING, F. R.
Vacuum Sewers--The Future for Sewage Collection,
W82-03394 5G

KINGVORSEN, K.
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

KIRSCH, E. J.
Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 5D

KISHI, Y.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

KITABATAKE, Y.
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

KNOCHEL, A.
Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 5A

KNOCKE, W. R.
The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

KOMANOWSKY, M.
Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

KONDO, K.
Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 5C

KOPYSHEV, G. P.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

KORBITZ, W. E.
Energy Minimization at Metro Denver Sewage District,
W82-03142 5D

KOROLEV, V. M.
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 8G

KOSAREV, A. N.
Salinity and Biogenic Material in the North Caspian,
W82-03155 4A

KRAUSE, D. JR.
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1B

KREMPIN, D. W.
Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

KREUZER, H.
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 8A

KRISHNAPPAN, B. G.
Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 2E

KRISTIANSEN, R.
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 5D

KRONIS, H.
Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

KUGIMOTO, M.
Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 5A

KUMAR, P.
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 5D

KUMAR, V.
Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 3F

KUO, J-T.
The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 2H

KURZWEG, D.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

KUTUNIN, D. N.
Salinity and Biogenic Material in the North Caspian,
W82-03155 4A

LABADIE, J. W.
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 2A

LAGE, O. E.
BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 2F

LAKE, P. S.
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 5C

LANDNER, L.
Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 2H

LANG, D. S.
Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 2H

LANGNER, C. L.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

LANTOS, J.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and

Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

LARSEN, I. L.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

LASZLO, F.
A Large Interational River: The Danube,
W82-03369 5G

LAVANIA, B. V. K.
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

LAXEN, D. P. H.
Physiochemical Speciation of Lead in Drinking Water,
W82-03198 5F

LAZARO, R. C.
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 2A

LEATHEM, W. A.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

LEE, H-B.
Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 5A

LERMAN, J. C.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

LESTER, J. N.
Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

LEWIN, J.
Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 5C

LIEBEZEIT, G.
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

LIGGETT, J. A.
BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 2F

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

LIKENS, G. E.
Chemical Flux in an Acid-Stressed Stream,
W82-03338 5C

LIU, H. L.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

LIU, P. L-F.
BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 2F

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 2F

LLOYD, J. W.
Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 2F

LO, A.
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 3B

LONNQUIST, C. G.
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

LYSMER, J.
Response of Buried Structures to Traveling Waves,
W82-03346 8D

MA, T. S.
Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 5A

MABINI, T. P.
Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 6D

MALIBARI, A.
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 2I

MANDAL, B. K.
Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 2H

MANN, H. S.
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

MARA, D. D.
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 5A

MARAIS, G. V. R.
The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 5D

MARCUS, M. D.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

MARINO, M. A.
Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 6A

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 6A

MARKEVICH, V. F.
Calculation of Earth Dams Being Undermined,
W82-03162 8D

MARSHALL, E. J. P.
The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 4A

MARTENS, C. S.
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

MARTIN, G.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

MASLIA, M.
Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 6D

MASSING, H.
The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 5G

MAURER, D.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

MAY, S. C.
Treatment of Cooling Tower Blowdown,
W82-03126 5D

MAYER, E.
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1A

MCCOLL, J. G.
Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 5B

MCCOMB, A. J.
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

MCCOY, T. G.
Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 6A

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 6A

MCCUEN, R. H.
A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

MCDONOUGH, P. M.
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 5A

MCGRATH, S. M.
Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 5B

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

MEHTA, A. J.
Graphs for Saline Wedges in Estuaries,
W82-03351 2L

MEINZER, F. C.
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 2I

MEL'NIKOV, I. I.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

METCALF, T. G.
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

MEVERDEN, J.
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

MIKHAILOV, L. P.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 8B

MILANOWSKI, J.
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

MILITELLO, P.
Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 5D

MILLER, E. A.
Value Engineering Saves Dam Project,
W82-03287 8A

MILLER, R. D.
Nitrification Using the Rotating Biological Contactor,
W82-03132 5D

MILLHAM, C. B.
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

MITHAL, R. S.
Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 8A

MIYAZAKI, T.
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

MOHSENISARAVI, M.
Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 2G

MOLLER, J. S.
Diversion of the River Neva,
W82-03304 4A

MOLZ, F. J.
Models of Water Transport in the Soil-Plant System: A Review,
W82-03066 2I

MONTGOMERY, H. A. C.
Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

MOOD, E. W.
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

MOORE, J. A.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 3B

MOORE, P. D.
Exploiting Papyrus,
W82-03202 2H

MOORE, W. S.
Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 2H

MORALES, E. C.
Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

MORGAN, J. M.
Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 2I

MORRISON, A.
GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 5D

Municipal Sewage: Three Communities Try to Cope,
W82-03284 5D

MORROW, D. M.
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 2A

MORTON, A. S.
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 6B

MOSS, B.
The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 2H

MULLER, A. B.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

MURPHY, C. B. JR.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

NADLER, A.
Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 2G

NAGAI, H.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

NAIR, J.
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 5A

NAKONO, H.
Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

NAM, S. H.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

NASU, Y.
Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 5A

NAYMIK, T. G.
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

NEAR, F. M.
Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 8A

NESTEROVA, M. P.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

NEUFELD, R. D.
Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

NIBLING, F. L. JR.
1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 4A

NICHOLSON, K.
Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 5F

Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 5A

NIKITINA, T. E.
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

NINE, B. J.
Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 5B

NOONE, G. P.
Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 5D

NORRIS, D. P.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 5D

NORRIS, R. H.
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 5C

NOSS, C. I.
Nitrification Using the Rotating Biological Contactor,
W82-03132 5D

NURNBERG, H. W.
A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 5A

O'CONNELL, E.
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 5B

O'HEARN, M.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

ODUM, E. P.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

OERLEMANS, J.
Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 2C

OESCHGER, H.
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 2A

OGASAWARA, H.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 8C

OHTO, T.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 8C

OKLAND, J.
Acidification in 50 Norwegian Lakes,
W82-03344 2H

OLDFIELD, F.
Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

OLSEN, C. R.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

OLSON, K. N.
Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 4C

ORAGUI, J. I.
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 5A

ORREN, M. J.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

OSANTOWSKI, R.
Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

OSBORNE, P. L.
Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 5C

OSONUBI, O.
The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 2D

OWENS, E. L.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 5D

PACA, J.
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 5D

PAGLIAI, A. M. B.
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

PAKHOMOV, O. A.
Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 8D

PALMENBERG, R. E.
Calculator Program Aids Lagoon Design,
W82-03211 6A

PALMER, T.
Don't Damn the Stanislaus,
W82-03275 6E

PANSEGROUW, J. P.
Absolute Roughness of Concrete-Lined Channels,
W82-03397 8B

PANZER, C. C.
Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

PAO, H-P.
Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1A

PAPEE, H. M.
Reciprocating Hail Processes in the Alps,
W82-03227 2B

PARDOEN, G. C.
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 6A

PARKER, D. S.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 5D

PARKS, G. A.
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

PARRA, M. A.
On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 3C

PARTHENAIDES, E.
Graphs for Saline Wedges in Estuaries,
W82-03351 2L

PASSIOURA, J. B.
Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 2I

PATRICK, H. D.
Water Resources Appraisals for Hydroelectric Licensing: Yadkin-Pee Dee River Basin: North Carolina, South Carolina, and Virginia,
W82-03042 6D

PATTEN, J. E.
Will Synfuel Development Drain the West Dry,
W82-03292 6D

PAVLIK, B. M.
Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 2I

PEDERSEN, F. B.
Diversion of the River Neva,
W82-03304 4A

PEEL, D. A.
On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 2C

PEREZ GAVILAN, D.
A Perspective Study of Droughts in Mexico,
W82-03358 2E

PERFECT, H. G.
Airy Holm Dam - Kielder Water Scheme,
W82-03070 8A

PERKINS, W. S.
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 5D

PERRY, R.
Detergent Builders and Water Quality - A Changing Scene,
W82-03093 5C

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

PETERS, R. W.
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

PETERSON, M. L.
Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

PETRICONI, G. L.
Reciprocating Hail Processes in the Alps,
W82-03227 2B

PICCININ, B. B.
Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

PLANCHET, R. J.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

PLEBAN, S.
Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 3F

POERTNER, H. G.
Better Ways to Finance Stormwater Management,
W82-03298 6C

POLLARD, N.
The Gezira Scheme--A Study in Failure,
W82-03393 6B

POPOFF, G.
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 5A

POSEY, C. J.
How About Reverse Filters,
W82-03247 4D

POTTER, K. W.
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 2E

PRANGE, A.
Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 5A

PRICKETT, T. A.
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 6A

PRIVAL'SKII, V. E.
Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 5G

PROHASKA, P. G.
Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 5A

PYBUS, C.
Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 5C

QISHUN, Z.
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 2J

QUARRIE, S. A.
Cereal Yields and Drought Resistance,
W82-03195 2I

QUIJANO, D. D.
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

RACHAMANIN, Y. A.
Health Aspects of Water Desalination,
W82-03116 3A

RAKNESS, K. R.
Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment,
W82-03032 5D

RAMANA RAO, B. V.
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

RAMOS, L. S.
Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 5A

RANDALL, C. W.
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

RAO, A. V. R. K.
Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

RAO, G. G. S. N.
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 2B

READ, D. J.
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 2I

REDDY, G. R.
Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 2I

REED, S. C.
Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 5D

REEDER, J. W.
Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 2A

REINBOLD, M.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

REPA, E. W.
Rainfall Catch Errors Associated with Circumambient Obstructions,
W82-03021 2B

RICE, R. G.
Ozone for the Treatment of Hazardous Materials,
W82-03139 5D

RICHARDS, J.
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 2L

RICHARDS, R. A.
Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 2I

RIEDEL, J. T.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

RIZET, M. M.
Eutrophication, Accelerated by Pollution,
W82-03193 5C

ROBBIBARO, P. A.
Warming Up to Geothermal,
W82-03156 8A

ROBERTS, P. V.
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

ROBEYRE, F.
Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 5C

ROBSON, T. O.
Aquatic Weed Research in Britain,
W82-03187 4A

ROFFMAN, A.
Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 2B

ROGAL, M. F.
Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 8A

ROGERS, A. N.
Treatment of Cooling Tower Blowdown,
W82-03126 5D

ROLFES, L.
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 2F

ROLLINGER, G.
Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

ROMERO, G. C.
On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 3C

ROTTNER, D.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 3B

ROUSE, J. E.
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 5B

ROWE, K.
Recent Water Towers in Norfolk,
W82-03246 8A

ROY, D.
Inactivation of Enteroviruses by Ozone,
W82-03208 5F

RUSSO, D.
Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 2G

SABEY, B. R.
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 5D

SACHAN, R. C.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

SAEED, Y. A.
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 5B

SAKSHAUG, E.
Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

SALOMON, J. C.
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

SALZMAN, G. S.
Value Engineering Saves Dam Project,
W82-03287 8A

SAMMAN, N.
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

SANCHO, J.
A Perspective Study of Droughts in Mexico,
W82-03358 2E

SANEMASA, I.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-

Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

SASMAN, R. T.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

SCHALEKAMP, M.
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 5F

SCHICHT, R. J.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 2F

SCHLAUCH, R. M.
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 5D

SCHLEIFF, U.
Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 3C

SCHLUTER, M.
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

SCHNITZER, M.
Effects of Pollution on Humic Substances,
W82-03253 5C

SCHOONHEE, H. J.
The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

SCHOTT, J. R.
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03015 7B

SCHUBERT, G.
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

SCHWARZ, F. K.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

SCOULLOS, M. J.
Zinc in Seawater and Sediments,
W82-03166 5B

SEETHARAMA, N.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

SEIP, H. M.
Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 5B

SEKI, H.
Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 2H

SELIM, H. M.
Modeling Nitrogen Transport and Transformations in Soils: I. Theoretical Considerations,
W82-03324 2G

SEN, L. N.
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

SENSKE, G. E.
Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

SEREBRYAKOV, V. A.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

SEUS, G. J.
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

SHAPIRO, N. I.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 5D

SHEARMAN, E. D. R.
Radar Measurements of Estuarine Currents and Tides,
W82-03360 2L

SHERES, D.
Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 7B

SHERIF, N.
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 5B

SHERRARD, J. H.
The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

SHIMAUCHI, S.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 8C

SHIOYA, M.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 8C

SHUTENKOV, S. V.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 8F

SHUTER, L. M.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

SIDORENKI, G. I.
Health Aspects of Water Desalination,
W82-03116 3A

SIEBURTH, J. M.
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 2L

SIEGENTHALER, U.
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 2A

SIFCRA, L. J.
Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 5E

SILVA, S. J.
EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 6E

SIMONOVIC, S. P.
Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 6A

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 6A

SIMPSON, M. H.
Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

SINGH, B.
Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 8A

SINGH, K. P.
Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 3F

SINGH, R. K.
Consumptive Water Use by Opium Poppy,
W82-03356 2I

SINGH, T.
A Suitable Lining Technique for Existing Distributaries,
W82-03063 8G

SINNOTT, C.
The Risk Business,
W82-03281 6E

SIVAKUMAR, M. V. K.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 2I

SLABBERS, P. J.
Wheat Yield Estimation in Northwest Iran,
W82-03267 2I

SLATER, M. J.
Continuous Ion Exchange: A Survey of Recent Applications,
W82-03391 5D

SMITH, E. D.
Nitrification Using the Rotating Biological Contactor,
W82-03132 5D

SMITH, J. K.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

SNEDAKER, S. C.
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 5C

SOKOL, W.
Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 5D

SOLANGI, M. A.
Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 5C

SOLOVE, R. A.
The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 5G

SOOHOO, J. B.
Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

SOULSBY, P. G.
Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 5C

SPIRA, W. M.
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 5B

SPOSITO, G.
Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 2F

STAGGS, D. W.
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

STANSBURY, M. R.
Will Synfuel Development Drain the West Dry,
W82-03292 6D

STEFAN, H. G.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

STENHOUSE, M. J.
Fossil Carbon in Coastal Sediments,
W82-03201 5A

STENSEL, H. D.
Biological Nitrogen Removal System Design,
W82-03145 5D

STEPHAN, D. G.
EPA's Approach to Regulating New Energy Technologies,
W82-03129 6E

STEVENS, J. D.
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

STIFFLER, D. F.
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 5A

STIMSON, K. R.
An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 5F

STRACK, O. D. L.
Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 2F

STRAUS, J. M.
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1A

STREET, R. L.
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

STRIJAK, E. K.
Health Aspects of Water Desalination,
W82-03116 3A

SUBRAMANIAM, A. R.
Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

SUGDEN, D. E.
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 2C

SULLIVAN, C. W.
Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 5B

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

SUREY-GENT, S. C.
Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 2L

SUTTON, P. M.
Biological Nitrogen Control of Industrial Wastewater,
W82-03131 5D

SVENSON, G.
Multimillion-Acre Tea Bag,
W82-03352 3F

SWAIN, R.
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 5C

SWANEPOEL, J. H.
The Phosphorus Cycle in Germiston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

SWEENY, K. H.
The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 5D

SWINNEY, L. D.
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 2K

SZABO, L.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

TAKAGI, E.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

TAKAHASHI, M.
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

TANKG, J. C. S.
Economic Appraisal of a Groundwater Development Project,
W82-03077 6B

TANTHIMAKABUT, S.
Economic Appraisal of a Groundwater Development Project,
W82-03077 6B

TAYLOR, L.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

TAYLOR, R. S.
The Computer: Water Management Tool,
W82-03290 6A

TEMPLER, O. W.
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 6E

THEILER, D.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 5G

THERON, S.
The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

THOMAS, C. L.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 5C

THOMAS, M. P.
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 2L

THOMPSON, G. S.
Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 6A

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 6A

THOMPSON, R.
Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

THULLEN, J. S.
1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 4A

TINKER, J.
Who Will Pay the World's Water Bill,
W82-03280 6B

TINSMAN, J. C.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 6G

TONELLI, F.
Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

TOSTENGARD, S.
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

TRAHERN, P. G.
The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

TUNNICLIFF, B. M.
Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 5A

TURK, J.
Industrial Wastewater Audit,
W82-03337 5D

TURKHEDE, B. B.
Consumptive Water Use by Opium Poppy,
W82-03356 2I

TUVEL, H. N.
Jersey Drought Hastens Water Supply Project,
W82-03385 6D

TWEETON, D. R.
Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 5D

VALENTA, P.
A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 5A

VALENTIN, F.
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 7B

VALERI, P.
Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 6D

VALOCCHI, A. J.
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

VAN BREEMEN, N. V
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 2G

VAN DER KAMP, G.
Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 2F

VAN DOESBURG, H.
Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 5D

VAN HAANDEL, A. C.
The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 5D

VAN KLUMP, J.
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

VAN RENSBURG, J. F. J.
The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

VANWINKLE, J. R.
Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 6A

VARDIMAN, L.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 3B

VERA, F. L.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

VERLINSKAYA, R. M.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

VERMAAK, J. F.
The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

VINCENT, W. F.
Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 2H

VISI, E.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

VISWANADHAM, Y.
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 2B

VITRAC, O.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

VOGEL, J. L.
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 7B

VOROTOVOVA, T. S.
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

WALKER, J. F.
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 2E

WALKER, R. P.
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 5D

WALLIS, C.
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

WARD, D. S.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

WARNER, D. L.
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 2F

WATSON, A. O.
Warming Up to Geothermal,
W82-03156 8A

WATSON, M. D.
Sizing of Urban Flood Control Ponds,
W82-03297 2A

WEBER, T. W. II.
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 5C

WEEKES, M. C.
Treatment of Cooling Tower Blowdown,
W82-03126 5D

WEERTMAN, J.
On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 2C

WEST, J. R.
The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 2L

WESTBROOK, E. J.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

WESTERHOFF, G. P.
Water Cost Encourages Reuse and Conservation,
W82-03295 5D

WHEELER, W.
Updating Antiquated City Water Systems,
W82-03293 5F

WHIPPLE, W. JR.
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 2J

An Economic Analysis of Water Conservation Policy,
W82-03090 6B

WHITEHEAD, P.
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 5B

WHITEHEAD, P. G.
Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 5A

WHITFIELD, M.
An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1B

WIECHERS, S. G.
The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

WIEDERHOLM, T.
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 2H

WILDERER, P.
A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 5C

WILSON, J. L.
Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 2G

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 2F

WILSON, M. A.
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 2H

WILSON, R.
Why Bother with Historic Preservation,
W82-03384 8A

WINN, C. D.
RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 5A

WOLMAN, A.
Water: Too Much, Too Little, Too Bad,
W82-03291 6D

WONG, D. C. L.
RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 5A

WONG, P. K. Y.
Inactivation of Enteroviruses by Ozone,
W82-03208 5F

WONG, P. T. S.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 5B

WU, R. S. S.
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 2L

WUKASCH, R. F.
Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 5D

YAMAMOTO, Y.
Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 2H

YEH, G-T.
On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 2F

YELIGAR, M. B.
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 5D

YOUNG, M. F.
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 8A

YOW, M. G.
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 2F

YUQIAN, L.
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 2J

ZAK, F. J.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

ZAKAR, F.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

ZAUKE, G. P.
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 5B

ZEIKUS, J. G.
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

ZHIRKOV, E. S.
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 8F

ZUREK, R.
The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 2H

ZUTSHI, D. P.
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 2H

[illegible]

[illegible] of High-Rate [illegible] Sewage [illegible]

[illegible]

Design and Development of a [illegible] Sewage System

[illegible]

[illegible]

Water [illegible] of the [illegible] River

[illegible]

[illegible]

ORGANIZATIONAL INDEX

ABERDEEN UNIV. (SCOTLAND). DEPT. OF GEOGRAPHY.
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 2C

ACADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 5G

AGRICULTURAL RESEARCH COUNCIL, OXFORD (ENGLAND). WEED RESEARCH ORGANIZATION.
Aquatic Weed Research in Britain,
W82-03187 4A

AGRICULTURAL RESEARCH COUNCIL, TRUMPINGTON (ENGLAND). PLANT BREEDING INST.
Cereal Yields and Drought Resistance,
W82-03195 2I

AGRICULTURAL RESEARCH ORGANIZATION, BET-DAGAN (ISRAEL). DIV. OF SOIL PHYSICS.
Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 2G

AGRICULTURAL RESEARCH ORGANIZATION, VOLCANI CENTER, BET DAGAN (ISRAEL). DIV. OF SOIL PHYSICS.
Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 2G

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF CIVIL ENGINEERING.
Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 4A

AIX-MARSEILLE-2 UNIV. (FRANCE). LAB. DE BIOLOGIE MARINE.
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 5B

AKADEMIYA NAUK SSSR, MOSCOW. INST. OKEANOLOGII.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 5G

ALASKA UNIV., FAIRBANKS. INST. OF WATER RESOURCES.
Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 2H

AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK.
Jersey Drought Hastens Water Supply Project,
W82-03385 6D

AMHERST COLL., MA. DEPT. OF PHYSICS.
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1B

ANDHRA PRADESH AGRICULTURAL UNIV. HYDERAHAD (INDIA).
Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 2I

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF METEOROLOGY AND OCEANOGRAPHY.
Dew Fall in the Dry Climatic Zones of India,
W82-03278 2B

ANGLIAN WATER AUTHORITY (ENGLAND).
Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 5A

ANGLIAN WATER AUTHORITY, NORWICH (ENGLAND). NORWICH SEWAGE DIV.
Recent Water Towers in Norfolk,
W82-03246 8A

ANTWERPSE WATERWERKEN (BELGIUM).
A Century of Water for Antwerp,
W82-03355 5F

ARGONNE NATIONAL LAB., IL.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 5B

ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON.
Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 5G

ARMY ENVIRONMENTAL HYGIENE AGENCY, ABERDEEN PROVING GROUND, MD.
Nitrification Using the Rotating Biological Contactor,
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W82-03070 8A

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W82-03279 7B

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W82-03010 6A

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W82-03032 5D

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W82-03007 6A

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W82-03008 7B

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W82-03270 5A

KERNFORSCHUNGSANLAGE, JUELICH (GERMANY, F.R.) INST. FUER BIOTECHNOLOGIE III.
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 5D

KIEL UNIV., (GERMANY, F.R.). INST. FUR MEERESKUNDE.
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 2L

KING'S COLL., LONDON (ENGLAND). DEPT. OF PLANT SCIENCES.
Exploiting Papyrus,
W82-03202 2H

KUMAMOTO UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 5A

KYUSHU UNIV., FUKUOKA (JAPAN). LAB. OF FISHERIES AND CHEMISTRY.
Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 5C

LABORATORIO NACIONAL DE ENGENHARIA CIVIL LISBON (PORTUGAL). DEPT. OF HYDRAULICS.
Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 8A

LANCASTER UNIV., BAILRIGG (ENGLAND). DEPT. OF BIOLOGICAL SCIENCES.
The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 2D

LANCASTER UNIV. BAILRIGG (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
Physiochemical Speciation of Lead in Drinking Water,
W82-03198 5F

LEEDS UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 5A

LINCOLN COLL. (NEW ZEALAND).
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 2H

LIVERPOOL UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 2J

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The Tertiary Treatment of Sewages. Conclusion,
W82-03228 5D

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF AGRONOMY.
Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 2G

LWFW, INC., DALLAS, TX.
Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 6A

Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 6A

LYCOMING COUNTY PLANNING COMMISSION, WILLIAMSPORT, PA.
Don't Damn the Stanislaus,
W82-03275 6E

MADRID UNIV. (SPAIN). DEPT. OF GEOLOGY AND GEOCHEMISTRY.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 2F

MANCHESTER UNIV. (ENGLAND). DEPT. OF BACTERIOLOGY.
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 2L

MANCHESTER UNIV. (ENGLAND). DEPT. OF CHEMISTRY.
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 5B

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM, PLYMOUTH (ENGLAND).
An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1B

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CIVIL ENGINEERING.
A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 4A

MASON AND HANGER-SILAS MASON CO., INC., LEONARDO, NJ.
Using Coherent Water Jets to Control Oil Spills,
W82-03031 5G

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 2G

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 2F

MCKINSEY AND CO., AMSTERDAM, (NETHERLANDS).
Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 5D

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF BIOLOGY.
Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 2H

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 5C

MEIKEI HIGH SCHOOL, IBARAKI (JAPAN).
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W82-03231 2H

METROPOLITAN DENVER SEWAGE DISPOSAL DISTRICT NO. 1, CO.
Energy Minimization at Metro Denver Sewage District,
W82-03142 5D

MIDDLEBURY COLL., VT. DEPT. OF BIOLOGY.
Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 5C

MINNESOTA UNIV., MINNEAPOLIS.
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 5C

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINERAL ENGINEERING.
Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 2F

MINNESOTA UNIV., MINNEAPOLIS. ST. ANTHONY FALLS HYDRAULIC LAB.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1A

MISSISSIPPI UNIV., UNIVERSITY. DEPT. OF CIVIL ENGINEERING.
Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 2F

MISSOURI UNIV.-ROLLA.
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 2F

MODENA UNIV. (ITALY). INST. OF ZOOLOGY.
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 5C

NARA COLL. OF EDUCATION (JAPAN). DEPT. OF GEOSCIENCE.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 2L

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION, WASHINGTON, DC.
Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 6F

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Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 2F

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Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 6A

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The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 5D

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W82-03370 5A

NATIONAL MUSEUM OF VICTORIA, MELBOURNE (AUSTRALIA).
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 5C

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Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 2D

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Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 5B

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, UPPSALA (SWEDEN). WATER QUALITY LAB.
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 2H

NATIONAL TRUST FOR HISTORIC PRESERVATION, WASHINGTON, DC.
Why Bother with Historic Preservation,
W82-03384 8A

NATIONAL WATER PLANNING COMMISSION, MEXICO CITY.
A Perspective Study of Droughts in Mexico,
W82-03358 2E

NATIONAL WEATHER SERVICE, SILVER SPRING, MD. OFFICE OF HYDROLOGY.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 2B

NEBRASKA UNIV.-LINCOLN. SCHOOL OF LIFE SCIENCES.
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W82-03214 5C

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Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 2I

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).
Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 5D

NORDRHEIN-WESTFALEN LANDESAMT FUR WASSER UND ABFALL, DUSSELDORF (GERMANY, F.R.).
The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 5G

NORFOLK STATE UNIV., VA.
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 6B

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK. DEPT. OF MICROBIOLOGY.
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 5D

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF GEOLOGY.
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 2K

NORTHEASTERN UNIV., BOSTON, MA. DEPT. OF ECONOMICS.
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 6B

NORTHWESTERN UNIV., EVANSTON, IL.
On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 2C

NORWAY AGRICULTURAL RESEARCH COUNCIL, AAS.
Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 5D

NOTRE DAME UNIV., IN. DEPT. OF BIOLOGY.
Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 5C

O'BRIEN AND GERE ENGINEERS, INC., SYRACUSE, NY.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 5G

OAK RIDGE NATIONAL LAB., TN.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 5B

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 2F

OKLAHOMA STATE UNIV., STILLWATER. SCHOOL OF CIVIL ENGINEERING.
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 5D

OLDENBURG UNIV. (GERMANY, F.R.).
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO.
Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 5D

OSLO UNIV. (NORWAY).
Acidification in 50 Norwegian Lakes,
W82-03344 2H

PERMUTIT CO., INC., MONMOUTH JUNCTION, NJ.
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 5D

PHILIPPINES UNIV., MANILA. INST. OF PUBLIC HEALTH.
Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 5D

PIRNIE (MALCOLM) INC., WHITE PLAINS, NY.
Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 5D

Water Cost Encourages Reuse and Conservation,
W82-03295 5D

PITTSBURGH UNIV., PA. DEPT. OF CIVIL ENGINEERING.
Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 5D

PITTSBURGH UNIV., PA. SCHOOL OF PUBLIC HEALTH.
Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 2B

PLANO-EMPRESA DE PROJECTOS, LDA., LISBOA (PORTUGAL).
Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 5D

PLANT PROTECTION AND AGROCHEMISTRY CENTRE, BUDAPEST (HUNGARY).
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 5A

POLISH ACADEMY OF SCIENCES, KRAKOW. ZAKLAD BIOLOGII WOD.
Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 5C

The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 2H

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRONOMY.
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 5E

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF CIVIL ENGINEERING.
Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 5D

QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 2L

QUEEN ELIZABETH COLL., LONDON (ENGLAND). DEPT. OF BIOLOGY.
Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 5G

RADIAN CORP., AUSTIN, TX.
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 5D

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The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 2H

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Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 5A

RENNES ECOLE NATIONALE SUPERIEURE DE CHIMIE (FRANCE).
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 5D

RENSSELAER POLYTECHNIC INST. DEPT. OF CHEMICAL AND ENVIRONMENTAL ENGINEERING.
Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 3A

REXNORD, INC., MILWAUKEE, WI.
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 5D

RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY.
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 2L

ROME AIR DEVELOPMENT CENTER, HANSCOM AFB, MA. ELECTROMAGNETIC SCIENCES DIV.
Large Rain Drops in the Bright Band,
W82-03065 7B

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE, MIAMI, FL.
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 5C

ROYAL NETHERLANDS METEOROLOGICAL INST. DE BILT.
Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 2C

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ.
An Economic Analysis of Water Conservation Policy,
W82-03090 6B

RUTGERS-THE STATE UNIV., NEW BRUNSWICK, NJ. WATER RESOURCES RESEARCH INST.
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 2J

SANDIA NATIONAL LABS., ALBUQUERQUE, NM.
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 6B

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 8A

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Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 5C

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Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 5D

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. CONSERVATION LAB.
Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 7B

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Estimating Distribution Uniformity in Level Basins,
W82-03058 3F

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Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 5E

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Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 7B

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Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 2H

SEVERN TRENT WATER AUTHORITY (ENGLAND).
Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 5D

SHEFFIELD UNIV. (ENGLAND). DEPT. OF BOTANY.
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W82-03190 2I

SHINSHU UNIV., MATSUMOTO (JAPAN). DEPT. OF PUBLIC HEALTH.
Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 5A

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W82-03236 5A

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W82-03193 5C

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W82-03175 2G

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY.
Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 2H

SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF CHEMISTRY.
Theory of the Dielectric Constant of Ice,
W82-03176 2C

SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF OCEANOGRAPHY.
Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 2L

SOUTHERN WATER AUTHORITY, WORTHING (ENGLAND).
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W82-03207 5C

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W82-03013 2A

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 5B

STATE UNIV. OF NEW YORK COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY, SYRACUSE.
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 7B

STORMWATER CONSULTANTS, BOLINGBROOK, IL.
Better Ways to Finance Stormwater Management,
W82-03298 6C

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Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 5D

SVENSON AND ASSOCIATES, WATSONVILLE, CA.
Multimillion-Acre Tea Bag,
W82-03352 3F

SWEDISH INST. FOR SURFACE CHEMISTRY, STOCKHOLM.
Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 5D

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A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 5A

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Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 2G

Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 2G

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Diversion of the River Neva,
W82-03304 4A

TECHNION - ISRAEL INST. OF TECH., HAIFA. DEPT. OF AGRICULTURAL ENGINEERING.
Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 3F

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Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 3C

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W82-03152 7B

TEL-AVIV UNIV. (ISRAEL). SCHOOL OF ENGINEERING.
Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 2F

TENNESSEE UNIV., KNOXVILLE. DEPT. OF ENGINEERING SCIENCE AND MECHANICS.
Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 5B

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CHEMICAL ENGINEERING.
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 4B

TEXAS TECH UNIV., LUBBOCK. DEPT. OF GEOGRAPHY.
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 6E

THAMES WATER AUTHORITY (ENGLAND).
The Risk Business,
W82-03281 6E

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W82-03196 2G

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W82-03379 5A

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Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 8D

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W82-03053 5C

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W82-03399 5D

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W82-03184 5C

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W82-03217 2H

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES. DEPT. OF BIOLOGICAL SCIENCES.
Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 5B

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 5B

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF APPLIED GEOLOGY.
Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 5F

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA). HYDROLOGICAL RESEARCH UNIT.
Sizing of Urban Flood Control Ponds,
W82-03297 2A

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF. DEPT. OF APPLIED BIOLOGY.
The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 4A

UTAH UNIV., SALT LAKE CITY.
Biological Nitrogen Removal System Design,
W82-03145 5D

VELZY (CHARLES R.). ASSOCIATES, ARMONK, NY.
Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 5D

VICTORIA UNIV. OF MANCHESTER (ENGLAND). DEPT. OF CHILD DENTAL HEALTH.
Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 5A

VICTORIA UNIV. OF MANCHESTER (ENGLAND). POWER SYSTEMS LAB.
An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 5F

VIRGINIA INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Biological Monitoring Part VI - Future Needs,
W82-03230 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 5G

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 5D

VISVESVARAYA REGIONAL COLL. OF ENGINEERING, NAGPUR (INDIA). DEPT. OF CHEMISTRY.
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 5D

VISVESVARAYA REGIONAL COLL. OF ENGINEERING, NAGPUR (INDIA). DEPT. OF PUBLIC HEALTH ENGINEERING.
Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 5F

VIZGAZDALKODASI TUDOMANYOS KUTATO INTEZET, BUDAPEST (HUNGARY). INST. FOR WATER POLLUTION CONTROL.
A Large International River: The Danube,
W82-03369 5G

VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA, PRAGUE (CZECHOSLOVAKIA).
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 5D

WALK, HAYDEL AND ASSOCIATES, INC., NEW ORLEANS, LA.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 5D

WASHINGTON UNIV., SEATTLE. DEPT. OF BOTANY.
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 2I

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 5C

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 5B

WATER AND POWER RESOURCES SERVICE, DENVER, CO.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 3B

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 5A

WATERLOO UNIV. (ONTARIO). DEPT. OF MAN-ENVIRONMENT STUDIES.
Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 5E

WATERWORKS, ZURICH (SWITZERLAND).
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 5F

WEST VIRGINIA UNIV., MORGANTOWN.
Rainfall Catch Errors Associated with Circumambient Obstructions,
W82-03021 2B

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF BOTANY.
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 2L

WESTERN AUSTRALIAN MARINE RESEARCH LAB., NORTH BEACH.
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 5B

WILLIS, CUNLIFFE, TAIT AND DELCAN, NEW WESTMINISTER (BRITISH COLUMBIA).
Vacuum Sewers--The Future for Sewage Collection,
W82-03394 5G

WISCONSIN UNIV.-MADISON.
Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 5C

WISCONSIN UNIV., MADISON. DEPT. OF BACTERIOLOGY.
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 2H

WISCONSIN UNIV.-MADISON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 2E

The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 4A

WYOMING UNIV., LARAMIE. DEPT. OF ZOOLOGY AND PHYSIOLOGY.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 5D

YALE UNIV., NEW HAVEN, CT. DEPT. OF EPIDEMIOLOGY AND PUBLIC HEALTH.
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 5C

ACCESSION NUMBER INDEX

W82-03001 5D
W82-03002 5D
W82-03003 5C
W82-03004 5D
W82-03005 5D
W82-03006 3B
W82-03007 6A
W82-03008 7B
W82-03009 6B
W82-03010 6A
W82-03011 2C
W82-03012 7B
W82-03013 2A
W82-03014 5G
W82-03015 4C
W82-03016 7B
W82-03017 5A
W82-03018 2G
W82-03019 2I
W82-03020 5C
W82-03021 2B
W82-03022 5C
W82-03023 2H
W82-03024 4A
W82-03025 1A
W82-03026 5C
W82-03027 5C
W82-03028 5G
W82-03029 5D
W82-03030 5D
W82-03031 5G
W82-03032 5D
W82-03033 5D
W82-03034 5D
W82-03035 5G
W82-03036 5C
W82-03037 5D
W82-03038 5C
W82-03039 6D
W82-03040 6D
W82-03041 6D
W82-03042 6D
W82-03043 6D
W82-03044 6D
W82-03045 6D
W82-03046 6G
W82-03047 2B
W82-03048 7B
W82-03049 5D
W82-03050 5D
W82-03051 8A
W82-03052 2H
W82-03053 5C
W82-03054 6B
W82-03055 6D
W82-03056 7B
W82-03057 5B
W82-03058 3F
W82-03059 2F
W82-03060 2F
W82-03061 2F
W82-03062 6D
W82-03063 8G
W82-03064 2H
W82-03065 7B
W82-03066 2I
W82-03067 2J
W82-03068 8C
W82-03069 5G
W82-03070 8A
W82-03071 5F
W82-03072 2J
W82-03073 6B
W82-03074 2D
W82-03075 2A
W82-03076 2E
W82-03077 6B
W82-03078 2F
W82-03079 2F
W82-03080 6A
W82-03081 5B
W82-03082 5B
W82-03083 2F
W82-03084 2F
W82-03085 6E
W82-03086 8A
W82-03087 5C
W82-03088 3B
W82-03089 4A
W82-03090 6B
W82-03091 2J
W82-03092 6B
W82-03093 5C
W82-03094 5B
W82-03095 2H
W82-03096 7C
W82-03097 10C
W82-03098 7C
W82-03099 7C
W82-03100 2F
W82-03101 5G
W82-03102 5G
W82-03103 5G
W82-03104 5A
W82-03105 5G
W82-03106 5C
W82-03107 5A
W82-03108 2F
W82-03109 2E
W82-03110 5D
W82-03111 6D
W82-03112 2F
W82-03113 5C
W82-03114 5D
W82-03115 5F
W82-03116 3A
W82-03117 5D
W82-03118 2H
W82-03119 2H
W82-03120 2H
W82-03121 5D
W82-03122 5A
W82-03123 5A
W82-03124 5D
W82-03125 5D
W82-03126 5D
W82-03127 5D
W82-03128 5D
W82-03129 6E
W82-03130 5D
W82-03131 5D
W82-03132 5D
W82-03133 5D
W82-03134 5D
W82-03135 5D
W82-03136 2K
W82-03137 5D
W82-03138 5D
W82-03139 5D
W82-03140 5D
W82-03141 5D
W82-03142 5D
W82-03143 4B
W82-03144 5D
W82-03145 5D
W82-03146 5D
W82-03147 5C
W82-03148 6A
W82-03149 8D
W82-03150 8F
W82-03151 8A
W82-03152 7B
W82-03153 5D
W82-03154 5G
W82-03155 4A
W82-03156 8A
W82-03157 5F
W82-03158 8G
W82-03159 8F
W82-03160 8D
W82-03161 8A
W82-03162 8D
W82-03163 8B
W82-03164 8A
W82-03165 8F
W82-03166 5B
W82-03167 2B
W82-03168 2L
W82-03169 2L
W82-03170 2C
W82-03171 5B
W82-03172 5B
W82-03173 3B
W82-03174 3F
W82-03175 2G
W82-03176 2C
W82-03177 2H
W82-03178 2H
W82-03179 5B
W82-03180 2L
W82-03181 8A
W82-03182 2F
W82-03183 5B
W82-03184 5C
W82-03185 2H
W82-03186 2H
W82-03187 4A
W82-03188 5A
W82-03189 5B
W82-03190 2I
W82-03191 5A
W82-03192 5A
W82-03193 5C
W82-03194 1B
W82-03195 2I
W82-03196 2G
W82-03197 2I
W82-03198 5F
W82-03199 5B
W82-03200 1A
W82-03201 5A
W82-03202 2H
W82-03203 2A
W82-03204 4A
W82-03205 5C
W82-03206 5D
W82-03207 5C
W82-03208 5F
W82-03209 2C
W82-03210 6A
W82-03211 6A
W82-03212 5D
W82-03213 2D
W82-03214 5C
W82-03215 5A
W82-03216 5A
W82-03217 2H
W82-03218 2H
W82-03219 2H
W82-03220 5B
W82-03221 5F
W82-03222 5D
W82-03223 5D
W82-03224 5A
W82-03225 2F
W82-03226 5D
W82-03227 2B
W82-03228 5D
W82-03229 2H
W82-03230 5C
W82-03231 2H
W82-03232 2F
W82-03233 5C
W82-03234 2H
W82-03235 2J
W82-03236 5A
W82-03237 4A
W82-03238 5D
W82-03239 5D
W82-03240 5C
W82-03241 5B
W82-03242 2F
W82-03243 5B
W82-03244 2H
W82-03245 6A
W82-03246 8A
W82-03247 4D
W82-03248 7B
W82-03249 5E
W82-03250 8A
W82-03251 3E
W82-03252 5G
W82-03253 5C
W82-03254 8A
W82-03255 5D
W82-03256 8D
W82-03257 2B
W82-03258 5A
W82-03259 5F
W82-03260 2G
W82-03261 5B
W82-03262 5A
W82-03263 3C
W82-03264 7B
W82-03265 2I
W82-03266 3F
W82-03267 2I
W82-03268 5A
W82-03269 5A
W82-03270 5A
W82-03271 2I
W82-03272 2D
W82-03273 3C
W82-03274 6D
W82-03275 6E
W82-03276 2B
W82-03277 5D
W82-03278 2B
W82-03279 7B
W82-03280 6B
W82-03281 6E
W82-03282 8A
W82-03283 5G
W82-03284 5D
W82-03285 5D
W82-03286 4A
W82-03287 8A
W82-03288 3A
W82-03289 5A
W82-03290 6A
W82-03291 6D
W82-03292 6D
W82-03293 5F
W82-03294 6E
W82-03295 5D
W82-03296 6E
W82-03297 2A
W82-03298 6C
W82-03299 5D
W82-03300 5E
W82-03301 5B
W82-03302 5D
W82-03303 5C
W82-03304 4A
W82-03305 5F
W82-03306 4A
W82-03307 2I
W82-03308 2K
W82-03309 5C
W82-03310 6A
W82-03311 6A
W82-03312 5B
W82-03313 2H
W82-03314 2H
W82-03315 2G
W82-03316 2F
W82-03317 6G
W82-03318 5A
W82-03319 5D
W82-03320 2F
W82-03321 2G
W82-03322 5C
W82-03323 2G
W82-03324 2G
W82-03325 1B
W82-03326 2L
W82-03327 5E
W82-03328 2G
W82-03329 2F
W82-03330 5C
W82-03331 5C
W82-03332 8A
W82-03333 5A
W82-03334 5G
W82-03335 5B
W82-03336 5C

W82-03337	5D
W82-03338	5C
W82-03339	5B
W82-03340	6F
W82-03341	5C
W82-03342	2H
W82-03343	2L
W82-03344	2H
W82-03345	5A
W82-03346	8D
W82-03347	5E
W82-03348	5D
W82-03349	8G
W82-03350	8G
W82-03351	2L
W82-03352	3F
W82-03353	5E
W82-03354	5D
W82-03355	5F
W82-03356	2I
W82-03357	2I
W82-03358	2E
W82-03359	2L
W82-03360	2L
W82-03361	1A
W82-03362	2C
W82-03363	4A
W82-03364	5D
W82-03365	1A
W82-03366	2G
W82-03367	5B
W82-03368	2B
W82-03369	5G
W82-03370	5A
W82-03371	5G
W82-03372	5G
W82-03373	8G
W82-03374	3D
W82-03375	5G
W82-03376	5D
W82-03377	6F
W82-03378	5B
W82-03379	5A
W82-03380	5B
W82-03381	8A
W82-03382	2E
W82-03383	6E
W82-03384	8A
W82-03385	6D
W82-03386	2L
W82-03387	5B
W82-03388	2L
W82-03389	5D
W82-03390	5A
W82-03391	5D
W82-03392	5B
W82-03393	6B
W82-03394	5G
W82-03395	6C
W82-03396	8G
W82-03397	8B
W82-03398	2L
W82-03399	5D
W82-03400	5E

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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A21	34.50	E99	*		
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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 8
AUGUST 1, 1982

W82-03401 -- W82-03750

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus**. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

SURFACE VISCOSITY OF WATER,
Queen's Univ., Belfast (Northern Ireland). Dept. of Pure and Applied Physics.
J. C. Earnshaw.
Nature (London), Vol 292, No 5819, p 138-139, July 9, 1981. 2 Fig, 10 Ref.

Descriptors: *Viscosity, *Physical properties, *Interfaces, *Fluid mechanics, Air-water interfaces, *Surface tension, Mathematical equations, Capillary waves, Waves, Molecular structure.

Recent reports by Goodrich have shown that the molecularly diffuse region between two fluids displays anisotropic momentum transport parallel to and normal to the interface. This anisotropy leads to surface viscosity effects, two of which describe dilational viscosity within and normal to the interface and two describe shear viscosity. Earlier studies have shown that the propagation of capillary waves on the surface of water is not compatible with the predictions of accepted theory for a surface having no abnormal rheological properties. These apparent discrepancies can be resolved in terms of one of the surface shear viscosities predicted by Goodrich. The existence of such surface viscosities for pure water suggests that caution must be exercised in interpreting surface viscosities observed for surface films in terms of molecular structure of, or interactions within, the films. (Carroll-FRC)
W82-03501

FUNCTIONAL RELATIONS BETWEEN GENERAL CHARACTERISTICS OF ORGANIC MATTER IN NATURAL WATERS,
Akademiya Nauk SSSR, Moscow. Inst. Biologii Vnutrennykh Vod.
E. S. Bikbulatov.
Water Resources, Vol 8, No 1, p 53-61, January/February, 1981. 3 Tab, 22 Ref. Translated from Vodnye Resursy, No 1, p 117-127, January/February, 1981.

Descriptors: *Organic matter, *Oxidation, *Chemical oxygen demand, Biological oxygen demand, Oxygen equivalent, Humic acids, Thermodynamics, *Natural waters.

Some of the indices used to describe organic matter in natural waters are elemental and general biochemical composition, oxygen equivalent, ratios of different organic elements, degree of oxidation, stored energy, COD, and BOD. Equations are proposed to relate these known indices to each other. The relationship of average valence of C to oxygen equivalent is revealed. Three types of oxygen equivalent (two new) are established. Formulas are presented for calculating oxygen equivalent from biochemical and elemental analyses. Errors in previous investigations are pointed out and true values of oxygen equivalent given. Expressions are provided to describe energy storage of organic matter with respect to the easily determined parameters, bichromate oxidizability and organic nitrogen content. (Cassar-FRC)
W82-03573

1B. Aqueous Solutions and Suspensions

THE CALCULATION OF ION PAIR DIFFUSION COEFFICIENTS: A COMMENT,
California Univ., Santa Barbara. Marine Science Inst.
K. S. Johnson.
Marine Chemistry, Vol 10, No 3, p 195-208, April, 1981. 1 Fig, 6 Tab, 37 Ref.

Descriptors: *Diffusion coefficients, *Ions, *Electrolytes, Salts, Seawater, Molecular diffusion, Mass transfer, Soil chemistry, Ion transport, Ion exchange.

The values of the diffusion coefficients of MgSO4 ion pairs computed by Harned and Hudson (1951) and Katz and Ben-Yaakov (1980) are too high by a factor of two. The correct value of the ion pair diffusion coefficient at infinite dilution was obtained from the measured mutual diffusion coefficient after applying corrections for incomplete dissociation, the electrophoretic effect, the viscosity of the solution, and the effect of chloride ion pairs. Diffusion coefficients were calculated for the following (all values multiplied by 10 to the minus 5th power): NaSO4(-), 0.81; CaCl(+), 0.78; BaCl(+), 0.85; NaCl, 0.86; KCl, 1.09; NH4Cl, 1.10, and CsCl, 1.27. Diffusion coefficients are generally less than those of the free ions. (Cassar-FRC)
W82-03487

COMPARISON OF FIVE DIFFERENT METHODS FOR MEASURING BIODEGRADABILITY IN AQUEOUS ENVIRONMENTS,
Battelle Columbus Div., OH.
J. L. Means, and S. J. Anderson.
Water, Air, and Soil Pollution, Vol 16, No 3, p 301-315, October, 1981. 5 Fig, 20 Ref.

Descriptors: *Biodegradation, *Organic compounds, Degradation, Ethylene glycol, Benzaldehyde, Aniline, Nitrilotriacetic acid, Nitrophenol, *Fate of pollutants, Biochemical tests, Microbial degradation, Biological oxygen demand, Shake flask test, Carbon dioxide evolution test, Gledhill test, Activated sludge test, Comparison studies, Technology, Analytical techniques.

Five methods for measuring biodegradability (BOD, Shake Flsk, CO2 Evolution, Activated Sludge, and Gedhill, which combines aspects of Shake Flask and CO2 Evolution) were tested using aqueous solutions of aniline, benzaldehyde, ethylene glycol, nitrilotriacetic acid, and p-nitrophenol. The BOD test used concentrations of 1, 2, 4, 8, and 16 ppm; shake test, 20 ppm as organic carbon; CO2 evolution, 10 ppm; activated sludge, 50 or 100 ppm as organic carbon; and Gledhill, 20 ppm as organic carbon. Aniline, benzaldehyde, and ethylene glycol degraded rapidly in all tests. Nitrilotriacetic acid was the slowest biodegrader, and p-nitrophenol was the second slowest. These two compounds behaved variably, according to the test used. Compounds which degrade in the activated sludge and Gledhill tests may not behave similarly in the natural environment. (Cassar-FRC)
W82-03557

2. WATER CYCLE

2A. General

SOME SUSPENDED SEDIMENT YIELDS FROM SOUTH ISLAND CATCHMENTS, NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
For primary bibliographic entry see Field 2J.
W82-03411

WATER LOSS EQUATIONS AND COEFFICIENTS TO ESTIMATE RUNOFF FROM RAINFALL,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
N. Foroud, and R. S. Broughton.
Water Resources Bulletin, Vol 17, No 3, p 387-393, June, 1981. 5 Fig, 4 Tab, 10 Ref.

Descriptors: *Infiltration, *Soil moisture, *Antecedent precipitation index, *Rainfall-runoff relationships, Model studies, Small watersheds, Watersheds, Storms, Excess rainfall.

A computer simulation model for flood runoff systems known as the FH-Model was used to analyze rainfall-runoff data from 39 storms on four small watersheds (17 to 342 sq km) in the Yamaska River Basin, Quebec. The loss parameters A (initial loss rate, cm per hour) and B (for a given soil and initial conditions, liters per hour) were obtained. These parameters were related to the antecedent precipitation index by equations. Using the data from 11 storms in a nearby watershed, the equations produced results in which seven points agreed within less than 10% and four points had errors of 10-40%. All these four storms occurred after a dry period in which soil moisture remained reasonably high. (Cassar-FRC)
W82-03441

RUNOFF PREDICTION AND RAINFALL UTILIZATION IN THE SEMI-ARID TROPICS,
Utah State Univ., Logan. Dept. of Engineering.
J. H. Krishna.
PhD Thesis, 1979. 160 p, 24 Fig, 9 Tab, 77 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19256.

Descriptors: *Rainfall, *Runoff, *Prediction, Watersheds, *Model studies, Land management, Water management, Semiarid lands, Soil water, Tropical regions, Storm runoff, *Small watersheds, *India.

A parametric simulation model was developed to predict storm runoff volumes from small watersheds. It has minimal input data requirements which include daily rainfall amount, storm duration or rainfall intensity, and pan evaporation data. There are only two parameters (related to infiltration) which are determined through an optimization procedure during the calibration process. Hydrologic data was used from three small research watersheds with different land management treatments, located at ICRISAT, Hyderabad, India. A high degree of correlation was obtained between computed and measured runoff volumes in all cases. The model also simulated very well the variation in soil moisture during the test period. It was shown, by using data from another distantly located watershed that the parameter values for the model were transferable. When hydrologic data is not available for calibration purposes, initial estimates of the parameters can be made to provide preliminary runoff estimates even for a new location. The model was shown to be transferable not only to similar sites, but with proper judgment in selecting parameter values, to new locations as well. The water balance computations of the model were used to determine the effective rainfall under traditional and improved methods of land and water management for crop production in India. It was shown that effective rainfall could be increased three-fold by the adoption of improved land and water management technology. Actual yield data was used to show that significantly higher rainfall productivities than those at the present time, can be achieved. (Sinha-OEIS)
W82-03502

SIMULATION OF SOIL MOISTURE, EVAPOTRANSPIRATION AND DEEP PERCOLATION IN AGRICULTURAL WATERSHEDS,
Nebraska Univ., Lincoln.
M. Arbab.
PhD Thesis, December, 1980. 222 p, 51 Fig, 12 Tab, 93 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-11673.

Descriptors: *Model studies, *Agricultural watersheds, Computer models, Groundwater recharge, Simulation analysis, *Percolation, *Soil water, *Evapotranspiration, Big Blue River basin, Nebraska.

The main objective of this study was to develop a set of mathematical relationships and formulate this into a digital computer model to simulate the surface hydrology of an agricultural watershed. The model was to be structured so that it could be applied to the irrigated or non-irrigated areas within any watershed with a minimum of modification and it was to be sufficiently flexible to be combined with a groundwater model to handle a case where the principal interest was either the surface water or groundwater. The model was to be tested by its application to continuous daily records from two weighing lysimeters for the surface hydrologic responses. It was also to be applied to an actual watershed where both surface water and groundwater factors are important and interdependent. The basin hydrology simulator de-

scribed in this study meets and satisfies these objectives. The developed model offers water resource managers a new tool for operational and management planning. One of the integral aspects was the history matching study of the Upper Big Blue River Basin in Nebraska. General conclusions drawn from the results of the application of the model to the Upper Big Blue River basin are: essentially all of the water percolating below the crop root zone in the area contributes to the groundwater system and can be considered as groundwater recharge; and the natural recharge to the groundwater mainly occurs under the irrigated lands and lands covered by native vegetations and pasture. In dry farmed areas, depletion of soil moisture from the crop root zone by evapotranspiration process provides sufficient storage for precipitation and consequently very little or no percolation occurs. (Sinha-OEIS)
W82-03513

GENERALIZED STORAGE-YIELD RELATIONSHIPS FOR SURFACE WATER RESERVOIRS ON NORTHEASTERN UNITED STATES' WATERSHEDS,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03523

CALIBRATING AND VERIFYING THE SSARR MODEL–MISSOURI RIVER WATERSHEDS STUDY,

Utah State Univ., Logan. Coll. of Natural Resources.
T. W. Cunday, and K. N. Brooks.
Water Resources Bulletin, Vol 17, No 5, p 775-782, October, 1981. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Streamflow forecasting, *Runoff, Model studies, Calibrations, Model studies, *Hydrologic models, Streamflow Synthesis and Reservoir Regulation model, *Missouri River basin, Madison River, Gallatin River, Snowmelt, Watersheds, Reservoir operation.

The Streamflow Synthesis and Reservoir Regulation model (SSARR, U.S. Army Corps of Engineers, 1972) was calibrated and verified on two upper Missouri River watersheds, the Madison and the Gallatin. Model calibration was expedited by a procedure which used physical watershed characteristics and parameter sensitivity. Streamflow volumes from snowmelt were within 8% of observed volumes for both watersheds. Simulated volumes for verification years were within 15% in the Madison watershed and 12-28% in the Gallatin watershed. (Cassar-FRC)
W82-03549

DIVERGING OVERLAND FLOW,

Mississippi State Univ., Mississippi State. Dept. of Civil Engineering.
V. P. Singh, and N. Agiralioglu.
Advances in Water Resources, Vol 4, No 3, p 117-124, September, 1981. 7 Fig, 7 Ref.

Descriptors: *Mathematical models, *Overland flow, *Watersheds, *Rainfall-runoff relationships, *Kinematic wave theory, Hydrologic models, Mathematical equations, Rainfall, Spatial distribution, Model studies, Runoff, Hydrographs, Mathematical studies, Approximation methods, Mathematical analysis.

The diverging overland flow of a natural watershed was studied using kinematic wave theory approximations. The mathematical modeling of such a watershed has not been previously performed. The properties of some explicit analytical solutions derived in dimensionless form for constant lateral inflow were examined. These solutions gave good agreement with laboratory data reported in the literature for plane models. For time-variable rainfall, analytical solutions did not appear tractable. The present solutions may be extended, with only minor mathematical complexity, to include spatial variability of rainfall without changing the essential complexity, to include spatial variability of rainfall without changing the essential features. It was concluded that the kinematic wave approximation accurately describes diverging overland flow for most cases of hydrologic interest. (Geiger-FRC)
W82-03676

DAILY PARTITIONING OF RAINFALL TO SURFACE RUNOFF AND SOIL WATER ON COMPLEX LANDSCAPES,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
A. W. Thomas, R. R. Bruce, and W. M. Snyder.
Transactions of the ASAE, VOL 24, No 5, p 1191-1198, September-October, 1981. 9 Fig, 4 Tab, 16 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, Precipitation, Rainfall, Storms, Runoff, *Soil water, Infiltration, Seasonal variation, Watersheds, Climates, *Soil-water-plant relationships.

An approach was sought to incorporate complexities of soils, plants, and climate in order to partition rainfall satisfactorily for some problems. Specific objectives were to mathematically partition rainfall into runoff and soil water in a heterogeneous landscape and to assess the results by comparison with measurements of runoff and soil water over three years. A segment of the landscape in the upper plain of the Southern Piedmont physiographic region was selected for study. The primary surface and subsurface features contribute to the hydrology of the landscape in this area. To maintain a constant soil surface, soil erosion and sedimentation in the study area were minimized by a uniform, dense grass cover. Considerable variation in water partitioning and retention was expected over the area, due in part to past erosion patterns. A single partitioning device was used to predict both runoff and soil water, thus imposing integrity and consistency on the model. This device, known as the retention function, was driven by re-scaled pan evaporation between rain events. The model was used to simulate three years of measured surface runoff and soil-water data from the 1.3 ha watershed. The test period included above and below average rainfall years, wet and dry periods, judged in terms of the dual outputs and the pattern of simulated runoff and soil water rather than specific storms or short periods. Annual summaries and seasonal patterns of measured and predicted water quantities indicated that the model can partition rainfall into runoff and soil water. The model utilizing site characteristics of the heterogeneous land area computed dual outputs for a calendar year on the IBM 370/158+ in about 18 central processor unit seconds. (Baker-FRC)
W82-03681

SURFACE WATER AND GROUNDWATER INTERACTIONS IN A SURFICIAL AQUIFER IN NORTHWEST IOWA,

Iowa State Univ., Ames. Dept. of Civil Engineering.
H. Arfa.
PhD Thesis, 1980. 250 p, 36 Fig, 36 Tab, 123 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19621.

Descriptors: Surface water, Surface runoff, Groundwater, *Mathematical models, Rainfall, *Groundwater recharge, Aquifers, Water requirements, *Surface-groundwater relations, *Iowa, Groundwater fluctuations, *Water level fluctuations.

The objective of this research is to evaluate a surficial aquifer and its interaction with surface runoff, with an objective of constructing a general mathematical model to respond to these interrelations. To evaluate the application of probabilistic laws to surficial groundwater fluctuations, a study of the sequential variation of rainfall in Northwest Iowa was conducted. Rainfall variations were defined, from dry-dry to wet-wet sequences. The interaction between surface water and surficial groundwater is a complicated phenomenon, and a strong tool is needed. The best tool for this situation, to be both practical and reliable, is the use of mathematical models. The basin selected for study is the Floyd River Basin, above Alton, which has the approximate geometry and dimensions of a unit model of interest. Full emphasis is put on recharge concepts of surficial groundwater in the basin, and the capability of the aquifer to withstand temporary mining or over-drafting to meet the beneficial water use requirements of the basin. The text of this dissertation includes the essential scientific theories and definitions, results obtained, and considers the practical laws of interactions with necessary discussion. (Sinha-OEIS)
W82-03718

2B. Precipitation

RAINFALL INTERSTATION CORRELATION FUNCTIONS. II. APPLICATION TO THREE STORM MODELS WITH THE PERCENTAGE OF DRY DAYS AS A NEW PARAMETER,

Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
P. T. Stol.
Journal of Hydrology, Vol 50, No 1-3, p 73-104, March, 1981. 7 Fig, 5 Tab, 16 Ref.

Descriptors: *Correlation functions, *Rainfall, *Gaging stations, Rain gages, Network design, Mathematical studies, Storms, Precipitation, Model studies.

A method was previously published for deriving rainfall interstation correlation functions from storm models. However, this method was incomplete in that dry days had to be skipped. In the present paper, a general formula is derived which has been extended with a parameter to account for the percentage of dry days that may occur in an area. The interstation correlation is a function of the interstation distance. The length and width of the storm are the parameters in the correlation function. The gaged area and the storm passing area must be well defined in order to obtain homogeneity with respect to statistical parameters. The storm model is the starting point in the actual procedure for deriving interstation correlation functions. Storm models suggested in the literature include rectangular, exponential and triangular models. The current analytical procedure was applied to these. The general patterns for the three storm models are similar. The rectangular model has lower correlation coefficients, especially when the fraction of dry days is small. Negative correlation occurs when the storm width has a small value. In practice it is difficult to distinguish between the three storm types. For large storm width values the correlation functions for the triangular and exponential storms are the same. (Cassar-FRC)
W82-03422

RAINFALL INTERSTATION CORRELATION FUNCTIONS. I. AN ANALYTIC APPROACH,

Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
P. T. Stol.
Journal of Hydrology, Vol 50, No 1-3, p 45-71, March, 1981. 4 Fig, 5 Tab, 43 Ref.

Descriptors: *Correlation functions, *Rainfall, *Gaging stations, Rain gages, Network design, Mathematical studies, Storms, Precipitation, Model studies.

Correlations between rainfall amounts measured in gages at various interstation distances are analytically determined for a triangular storm model. Previously, functions describing the relationships between interstation correlation and interstation distance (known as correlation function) were determined empirically from the diagram of estimated correlation coefficients plotted against the corresponding interstation distances. Characteristics of storms and test areas are inserted as parameters. (Cassar-FRC)
W82-03467

COMPARISON OF RESULTS OBTAINED WITH THE VIDIAZ SPECTROPLUVIOMETER AND THE JOSS-WALDVOGEL RAINFALL DISDROMETER IN A 'RAIN OF A THUNDERY TYPE',

Institut et Observatoire de Physique, Clermont-Ferrand (France).
G. Donnadieu.
Journal of Applied Meteorology, Vol 19, No 5, p 593-597, May, 1980. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Rain, *Radar, *Distribution patterns, *Remote sensing, Velocity, Measuring instruments, Spectropluviometer, Disdrometer, Precipitation, Rainfall.

A photoelectric spectropluviometer VIDIAZ, which measures the diameter and fallspeed of each raindrop, was used to determine the mean values of the raindrop size distribution, rainfall rate, liquid water content, and radar reflectivity in thunderstorms. The results were compared with those obtained using a Joss-Waldvogel disdrometer, which gives the diameter by measurement of the force of the impacting drops on a sensor, assuming that they fall at the terminal velocities in still air obtained by Gunn and Kinzer. Fourteen measurements of 1 minute each were made in a rain of a thundery type. The fallspeeds of raindrops were found to be about 13 to 1 percent above the values of Gunn and Kinzer for raindrops with diameters measuring between 0.8 and 2.8 millimeters. This relatively small deviation produces a correction of 12 percent on the rainfall rate and of 17 percent for liquid water content and radar reflectivity for the Joss-Waldvogel disdrometer. Rainfall rate, liquid water content, and radar reflectivity were found to have a common range of values for the two instruments once these corrections for the disdrometer and a correction coming from raindrops unrecorded by the spectropluviometer were included and an allowance was made for the statistical errors resulting from the natural fluctuations of the rain. (Carroll-FRC)
W82-03707

2C. Snow, Ice, and Frost

PROTON MOBILITY IN ICE,

Interuniversitair Reactor Inst., Delft (Netherlands).
M. Kunst, and J. M. Warman.
Nature (London), Vol 288, No 5790, p 465-467, December 4, 1980. 1 Fig, 35 Ref.

Descriptors: *Protons, *Ice, Physicochemical properties, Deuterium, Heavy water, Conductivity, Microwaves.

The vertical mobility of protons in H_2O ice, determined by nanosecond pulse radiolysis microwave conductivity, was 0.0064 sq cm per volt per sec. Mobility of deuterons in D_2O ice was 0.0024 sq cm per volt per sec at -5 C. Decreasing the temperature to -30 C doubled the values, corresponding to a negative activation energy of 0.15 eV. The narrow-band polaron theory predicts a sharp changeover to a thermally activated hopping motion at higher temperatures, with an activation energy which decreases with increasing temperature. At high enough temperatures, a maximum in mobility is predicted. This theory describes the data, with the main charge interaction apparently involving the 200 per cm 0-0 lattice vibration. Over a period of a few hundred nanoseconds the proton conductivity signal decays to 10-20% of the initial value. Temporary complexing of protons with L defects results in effective drift mobilities of 0.0008 and 0.0002 sq cm per volt per sec for H_3O^+ in H_2O and D_3O^+ in D_2O, respectively at -5 C. (Cassar-FRC)
W82-03701

RECRYSTALLISATION AND ELECTRICAL BEHAVIOUR OF GLACIER ICE,

British Antarctic Survey, Cambridge (England).
J. M. Reynolds, and J. G. Paren.
Nature, Vol 283, No 5742, p 63-64, January 3, 1980. 26 Ref.

Descriptors: *Resistivity, *Electrical properties, *Glaciers, Ice, Antarctic, Polar regions, Crystallization.

Previous studies have indicated that the electrical resistivity of ice from temperate glaciers, which is essentially at its pressure melting point, is about 1000 times greater than that of ice from polar regions, which is well below its pressure melting point. Recent studies have sought an explanation for this marked diversity in resistivity. The polar nature of Antarctic ice has been established by georesistivity measurements made on the George VI Ice Shelf, despite its saturation by melt-water from surface melt lakes. Although previous studies have suggested that different impurity concentrations may be responsible for the extremes in resistivity between temperate ice and polar ice, evidence from this study indicates that impurity levels are similar, in spite of the leaching of contaminants by free water in temperate glaciers. Such leaching activity is absent in true polar glaciers. Resistivity appears to be affected only indirectly by free water. The electrical behavior of high density ice formed on a cold glacier by compaction was found to be very similar to that of ice formed by the percolation and refreezing of melt water, implying that the electrical behavior of ice is completely stabilized within a few years after the ice forms. It is suggested that the complete removal of melt water runoff and the extent of recrystallization which occur in response to stress in temperate glaciers, but which are reduced or absent in polar ice masses, may be responsible for the differences in the electrical behaviors of these two ice forms. (Carroll-FRC)
W82-03702

2D. Evaporation and Transpiration

SIMULATION OF SOIL MOISTURE, EVAPOTRANSPIRATION AND DEEP PERCOLATION IN AGRICULTURAL WATERSHEDS,

Nebraska Univ., Lincoln.
For primary bibliographic entry see Field 2A.
W82-03513

2E. Streamflow and Runoff

PARAMETRIC STUDY OF FLOOD WAVE PROPAGATION,

Indian Inst. of Science, Bangalore (India). Dept. of Civil Engineering.
K. Sridharan, and M. S. M. Kumar.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY9, p 1061-1076, September, 1981. 13 Fig, 14 Ref.

Descriptors: *Wave propagation, *Flood waves, *Channel flow, Kinematic waves, Subsidence, Open channel flow, Fluid mechanics, Hydraulics, Flow characteristics, Parametric hydrology, Discharge hydrographs, Froude number, Unsteady flow, Varied flow.

This paper presents a parametric study of flood wave propagation based on numerical solutions of the nondimensionalized unsteady flow equations. The properties of a sinusoidal flood wave in a prismatic channel were studied for uniform initial flow. The uniform flow Froude number, the wave parameters, and the channel shape parameters are varied over a wide range. Several conclusions were derived from this work. Significant subsidence occurs in prismatic open channels, particularly in the cases of narrow channels, smaller initial uniform flow Froude numbers, and inflow hydrographs with smaller wave duration. Lower initial uniform flow Froude numbers are associated with greater subsidence. Lower inflow wave amplitudes give slightly higher subsidence. Lower wave duration values produce significantly lower subsidence. Side slope does not significantly affect the rate of subsidence except in narrow channels. The nondimensional speed of the wave peak is independent of side slope, except in narrow channels. The width of the channel significantly affects subsidence, with the least effect in wide channels. Relative wave amplitude and relative discharge rise decrease exponentially with distance in the initial reaches. The speed of the wave peak and that of the corresponding kinematic wave agree. (Cassar-FRC)
W82-03425

CALIBRATING AND VERIFYING THE SSARR MODEL–MISSOURI RIVER WATERSHEDS STUDY,

Utah State Univ., Logan. Coll. of Natural Resources.
For primary bibliographic entry see Field 2A.
W82-03549

PROBABILISTIC MODEL OF LONG-TERM FLUCTUATIONS ON THE LEVEL OF AN OPEN LAKE,

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
For primary bibliographic entry see Field 2H.
W82-03572

FLOOD AREA MODELLING FROM AN ELEMENTARY DATA BASE,

Leeds Univ. (England). School of Geography.
A. McDonald, and D. Ledger.
Journal of Hydrology, Vol 53, No 1-2, p 85-94, September, 1981. 6 Fig, 9 Ref.

Descriptors: *Flood hydrographs, *Flood damage, Topography, *Model studies, *Nonstructural alternatives, Flood conrol, Floodproofing, Flood peak, Flood profiles, Flooding, Mathematical models, Mathematical studies, Projections, *Flood plain management.

A model for predicting flood area for ultimate use in estimating the long-term losses that are incurred due to flooding treats the floodplain as a storage area for flows in excess of the channel capacity. The flood path is considered to follow a sequence of field inundations determined by topography termed the flood series. The movement of overspills through the flood series and the flood hydrographs having peaks in excess of bankfull discharge are used to estimate the overspill volume. The model was applied to a floodplain area of the River Nith of Southwest Scotland. Model accuracy was 85% for predicting flood area for a 50-year return interval flood. The advantages of using field units as proposed in the present model over channel extension modelling are discussed. More research into the patterns of return flows is needed to examine the duration of standing water or the distribution of floodwater over time following the passage of a hydrograph peak. (Geiger-FRC)
W82-03581

HYDRAULIC EXPONENTS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil and Hydrosystems Engineering.
V. T. Chow.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1489-1499, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Hydraulics, *Mathematical studies, Channels, Channel flow, *Open-channel flow, Flow, Flow discharge, *Flow profiles.

The significance of hydraulic exponents is in their application to the computation of flow profiles of a gradually varied flow in prismatic open channels, where their use will greatly simplify the otherwise complicated computation. This paper clarifies the mathematical derivation of the hydraulic exponents and their implication in application to the computation of flow profiles of gradually varied flow in a prismatic channel. The relationships between these hydraulic exponents, which are assumed to depend only on the average flow depth, and those which are assumed to vary with the flow depth of a given range are also explained. The use of the hydraulic exponents in a flow-profile computation involves an approximation, which is to use the values of these exponents at the average depth of the range of flow depth under consideration. This approximation greatly simplifies the computation by direct integration and has been proven to produce reliable results for practical purposes. The use of these hydraulic exponents would involve the variation of these values within the range of flow under consideration and would not therefore be useful to achieve simplification in a flow-profile computation by the method of direct integration. (Baker-FRC)
W82-03669

SAFE-YIELD ESTIMATES OF A WATER SUPPLY RESERVOIR ON AN UNGAGED STREAM,

Pennsylvania State Univ., University Park.
J. R. Ousey, Jr.
PhD Thesis, March, 1980. 95 p, 6 Fig, 11 Tab, 38 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-15826.

Descriptors: *Streamflow, *Drainage areas, Yield, Safe yield, Water supply, *Reservoir capacity, Hypsometric analysis, Saturated soils, *Low flow, Piedmont terrain, *Streamflow forecasting, Reservoir releases.

This investigation tested the usefulness of two basin parameters in predicting the low-flow streamflow characteristics of drainage basins in the metamorphic Piedmont terrain of southeastern Pennsylvania. The characterization of the low-flow regime developed from basin parameters was used in assessing the safe-yield potential of a water supply reservoir on an ungaged stream where a time-series analysis of collected flow data was not possible. The parameters chosen were the hypsometric integral and the saturated-soil cover of the selected basins. Both are integrative aspects of the numerous influences arising from the primary controls of geology and climate on an eroding stream basin. The characteristics of a number of gaged stream basins which have all formed in the same general geologic and climatologic regime were regressed against the baseflow characteristics of those basins. The results indicate the usefulness of the saturated-soil cover but not the hypsometric integral in predicting the exceedance values within streams formed on similar geology and in the same general area. The water supply capacity of a reservoir was then assessed using the regression formula developed from gaged streams, and was found to be operating at a level consistent with the design estimate of safe-yield under climate conditions that can be considered as normal. (Sinha-OEIS)
W82-03716

2F. Groundwater

INADEQUACIES IN THE TECHNIQUE OF RESISTIVITY METHOD FOR LOCATION OF WATERWELL SITES IN HARD ROCK AREAS,

Center for Water Resources, Madras (India).
For primary bibliographic entry see Field 7B.
W82-03412

ENVIRONMENTAL ISOTOPES AS A TOOL IN HYDROGEOLOGICAL RESEARCH IN AN ARID BASIN,

Ben-Gurion Univ. of the Negev, Sde Boker (Israel). In for Desert Research.
A. Issar, and J. Gat.
Ground Water, Vol 19, No 5, p 490-494, September/October, 1981. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Isotope studies, *Groundwater recharge, Geohydrology, Recharge, Tracking techniques, Groundwater movement, Precipitation, Evaporation, Wadi Feiran, *Isopotic tracers, A-Tor, Infiltration, Chemical composition, Alluvial plains, Paleohydrology, Geologic fractures, Salinity, Arid lands, Deuterium, Tritium, *Israel.

Stable and radioactive isotopes (deuterium, tritium, 018, and C14) were studied in groundwaters of the Wadi Feiran basin, Israel. The isotopic character of the waters allowed classification into four distinct groups. This information, combined with chemical analyses, was used to characterize the groundwater flow in this region. In the upper part of the basin some of the precipitation and snowmelt penetrates the shallow fractures of the crystalline rocks and flows out immediately as small springs. The spring water maintains the isotopic character of the precipitation. The remainder of the water penetrates into deeper fractures, maintaining its deuterium and 018 ratios while part of the tritium decays. This water continues on a longer route, picking up salts and showing evaporation trends. In the middle part of the basin, water which reaches the riverbed is rich in tritium, shows slight evaporation, and is otherwise similar to precipitation in isotopic composition. In the lower part of the basin, groundwater flows into the alluvial plain at A-Tor. Some water mixes with paleowater and emerges as thermal springs. (Cassar-FRC)
W82-03415

INVERSE SOLUTIONS OF THE THEIS EQUATION DETERMINED WITH PROGRAMMABLE CALCULATORS. II. DETERMINATION OF AQUIFER HYDRAULIC CONSTANTS FROM NUMERICAL TEST DATA,

G. Grimestad.
Ground Water, Vol 19, No 4, p 387-391, July/August, 1981. 6 Tab, 7 Ref.

Descriptors: *Theis equation, *Computer programs, *Aquifers, Storage coefficient, Transmissivity, Mathematical equations, Groundwater movement.

In the second of two articles on calculator programs for inverse solution of the Theis equation, Newton's method is used to develop an iteration formula to determine transmissivity and storage coefficient values from a combined Theissian expression that incorporates the information from two independent aquifer test data point sets. The resulting algorithm is used in a polynomial-based program for Hewlett Packard HP 67/97 calculators which is designed to process data corresponding to the full practical range of well function arguments and to accept measurements from 1 or 2 observation wells or from entirely different tests of a given equation. The appendix contains program modifications for series well function calculations. Sample calculations are given. (Cassar-FRC)
W82-03481

THE ORIGIN AND EVOLUTION OF SALINE FORMATION WATER, LOWER CRETACEOUS CARBONATES, SOUTH-CENTRAL TEXAS, U.S.A.,

Texas Univ. at Austin. Dept. of Geological Sciences.
L. S. Land, and D. R. Prezbindowski.
Journal of Hydrology, Vol 54, No 1-3, p 51-74, December, 1981. 7 Fig, 2 Tab, 41 Ref.

Descriptors: *Sedimentary basins, *Model studies, *Brines, *Groundwater movement, Faults, Mineralization, Carbonates, *Sedimentary petrology, Groundwater, Saline water, Aquifers, Minerals, Petrology, Mineral water, Thermal springs, Formation water, Thermal water, Sodium, Calcium, Geohydrology, Chlorine, Geologic fractures, Saline formation water, Gulf of Mexico basin, Texas.

Chemical variation that exists in formation water from a dip section through Lower Cretaceous rock in south-central Texas was explained by an interactive water-rock diagenetic model. Major faults serve as pathways for the vertical movement of basinal brines from the Gulf of Mexico basin into the Lower Cretaceous section. As the brine moves updip out of the Gulf basin and encounters limestone along the Stuart City Reef Trend, galena precipitates in late fractures. As the Ca-rich brine continues its upfault rise, it becomes progressively diluted until it causes dedolomitization along back-reef facies. Although minor amounts of calcite spar are present, no precipitation of authigenic phases has been found. As the brine is diluted and cooled, it also gains in Mg as a result of progressive dedolomitization. The formation water discharges along faults as hot mineral water. (Geiger-FRC)
W82-03540

MINOR - ELEMENT DISTRIBUTION IN MINERAL AND THERMAL WATERS (REPARTITION DES ELEMENTS TRACES DANS LES EAUX THERMO-MINERALS),

Grenoble Univ. (France). Unite de Geologie et de Pharmacie.
J. Sarrot-Reynauld, J. Rochat, and J. Dazy.
Journal of Hydrology, Vol 54, No 1-3, p 33-50, December, 1981. 5 Fig, 1 Tab, 30 Ref. (English Summary).

Descriptors: *Groundwater, *Spring water, *Thermal water, *Mineral water, Petrology, *Geochemistry, *Trace elements, Water analysis, Anions, Cations, Geohydrology, Water properties, Chemical properties, Minerals, Geologic formations, Groundwater recharge, Mineral springs, Mineralization, Sedimentary rocks, Metamorphic rocks, Granites.

Research on spring waters in Southern France and Iran was applied to the study of the origin and mineralization of thermal waters. Characteristic ratios between major and minor water constituents as well as the behavior of trace elements such as B, F, Br, I, Sr, Rb and Li allow distinctions to be made among thermal and mineral waters associated with granitic, metamorphic, or volcanic rocks or with sedimentary evaporates. The distribution of trace elements depends upon magmatic properties, wallrock chemical composition, the presence of large distended fractures and temperature. Eroded-rock types may be identified by the Br/I or Sr/Rb ion ratios of groundwater. Since the occurrence of Cl is relatively independent of the other halogens, this anion is thought to originate from a different source when it is present in mineral water. (Geiger-FRC)
W82-03541

GEOCHEMICAL AND ISOTOPIC CHARACTERISTICS OF SPRING AND GROUNDWATER IN THE STATE OF SAO PAULO, BRAZIL,

Sao Paulo Univ. (Brazil). Inst. de Geociencias.
M. Szikszay, J-M. Teissedre, U. Barner, and E. Matsui.
Journal of Hydrology, Vol 54, No 1-3, p 23-32, December, 1981. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Geohydrology, Groundwater recharge, *Spring water, *Aquifers, *Geochemistry, *Isotope studies, Physicochemical properties, Tectonics, Borehole geophysics, Groundwater, Water properties, Minerals, Chemical analysis, Water analysis, Chemical properties, Crystalline rocks, Aquifer systems, Geologic fractures, Petrology.

Spring water from Precambrian rock strips encompassing the coast of Sao Paulo was studied for relationships between lithology and the physicochemical properties of the water. Water from crystalline rock was classified as Ca-Mg-bicarbonate with low temperature and conductivity. Spring water arising from sediments and/or weathered crystalline rock contained Ca-Mg-chloride-sulfate. Na-bicarbonate water was associated with volcanic rock, diabase and basalt. Monthly isotopic analyses carried out on eight springs and rain water samples from the Aguas da Prata region indicated a local source of recharge. Chemical studies of the waters of the shallow Bauru and Basalto aquifers of the Parana Basin suggest recharge from the confined deep Botucatu-Piramboia aquifer through large fractures and faults. This hypothesis is strengthened by evidence of a tectonic disturbance within the anomaly zone of these aquifers. (Geiger-FRC)
W82-03542

TEMPORARY HYDROLOGIC CHANGES AFTER DEFORESTATION FOR PIONEER HOMESTEADING,

For primary bibliographic entry see Field 4C.
W82-03544

GROUNDWATER QUALITY IN VISAKHAPATNAM BASIN, INDIA,

Andhra Univ., Waltair (India). Dept. of Geophysics.
For primary bibliographic entry see Field 6D.
W82-03552

BOUNDARY INTEGRAL EQUATION SOLUTIONS TO MOVING INTERFACE BETWEEN TWO FLUIDS IN POROUS MEDIA,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
P. L-F. Liu, A. H-D. Cheng, J. A. Liggett, and J. H. Lee.
Water Resources Research, Vol 17, No 5, p 1445-1452, October, 1981. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Interfaces, *Porous media, Saline-freshwater interfaces, Upconing, *Coastal aquifers, *Saline water intrusion, Encroachment, Saline water, Seawater, Aquifers.

The position of the boundary between two immiscible fluids is accurately predicted after a period of time by use of the Dupuit-Forchheimer approximation. For intermediate and short times the use of the boundary integral equation method (BIEM) forms an accurate alternative. The location of a saltwater wedge under conditions of unsteady seaward flow of fresh water is difficult to predict with any technique, but the BIEM appears to do an adequate job. The expansion of this method to three dimensions would aid in the case of complex geometry. Such a program could be developed from the methods cited in this paper combined with those of Lennon. In the BIEM method the mixing between two fluids is assumed to be insignificant, with a sharp interface existing between them. Numerical and experimental results are presented for the tilting of a vertical interface in a Hele-Shaw cell. During the initial stage of the interfacial movement, nonlinear effects are clearly demonstrated. (Baker-FRC)
W82-03577

PATTERNS OF GROUNDWATER SALINITY CHANGES IN A DEEP CONTINENTAL-OCEANIC TRANSECT OFF THE SOUTHEASTERN ATLANTIC COAST OF THE U.S.A.,

Scripps Institution of Oceanography, La Jolla, CA.
F. T. Manheim, and C. K. Paull.
Journal of Hydrology, Vol 54, No 1-3, p 95-105, December, 1981. 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Groundwater pollution, *Brines, Boreholes, Subsurface water, Geohydrology, Sodium chloride, Petrology, *Waste disposal, Subsurface mapping, Saline water, Permeability, Dissolved solids, Sedimentary basins, Chemical properties, Salinity, *Saline water intrusion, *Coastal aquifers, *Georgia coast.

Increased interest in using subsurface strata as waste disposal sites, in problems involving seawater encroachment, and in extension of the concept of 'freshwater resources' to water containing as much as 10 grams/kilogram total dissolved solids has increased interest in the composition and distribution of saline fluids in sedimentary strata. Studies of formation-fluid salinities in a transect from western Georgia to the edge of the Blake Plateau off the Georgia coast reveal similar offshore and onshore hydrochemical properties. A wedge of fresh-brackish groundwater is located about 900 m below the shelf, while on the land, brackish waters extend to a maximum depth of 1,200 m below sea level. In deeper horizons, brines with salinities greater than 100 grams/kilogram are found in what is thought to be Cretaceous strata that are anhydritic in the offshore area. Evaporitic deposits are also found at drill sites beneath the Blake Plateau, as evidenced by strong salinity gradients in interstitial waters. (Geiger-FRC)
W82-03582

CHARACTER OF BRINES FROM THE BELLE ISLE AND WEEKS ISLAND SALT MINES, LOUISIANA, U.S.A.,

Louisiana State Univ., Baton Rouge. Inst. of Environmental Studies.
M. B. Kumar, and J. D. Martinez.
Journal of Hydrology, Vol 54, No 1-3, p 107-140, December, 1981. 20 Fig, 23 Ref.

Descriptors: Geohydrology, *Brines, Water analysis, *Mine drainage, Minerals, *Chemical analysis, *Isotope studies, *Groundwater, Sodium, Calcium, Trace elements, Chemical properties, Salinity, Saline water, Ions, Anions, Cations, Salt mine, Belle Isle, Weeks Island, *Louisiana.

Chemical analyses of 110 samples of brines collected from active leaks, puddles, stalagmites and stalactites from the Belle Isle and Weeks Island salt mines were conducted and compared with the ionic compositions of average seawater, seawater concentrated by evaporation, and oil-field brine formation waters. Salt mine brines were mostly Na-Ca-Cl brine with minor amounts of ionic species, especially K, Br, B, and Sr. The mine brines resembled formation waters in their ionic distributions but showed higher levels of K and Pr, suggesting some genetic relationship to a residual brine. The high concentration of Ca in the water, however, was highly indicative of formation water, and an admixture of a Ca-rich formation water with a K-Br-rich residual brine was hypothesized. Isotopic studies tend to support the theory that the salt mine brines arise from a formation water with unusually high levels of Ca, K and Br. (Geiger-FRC)
W82-03584

DISSOLUTION OF SALT ON THE EAST FLANK OF THE PERMIAN BASIN IN THE SOUTHWESTERN U.S.A.,

Geological Survey, Norman, OK.
K. S. Johnson.
Journal of Hydrology, Vol 54, No 1-3, p 75-93, December, 1981. 8 Fig, 1 Tab, 22 Ref.

Descriptors: *Geohydrology, *Brine, *Groundwater movement, *Sodium chloride, *Saline water, Groundwater, Aquifers, Permeability, Percolation, Minerals, Groundwater recharge, Petrology, Spring water, Hydrostatic level, *Permian Basin, Southwestern United States, Dissolved solids.

Hydrogeologic surveys of the Permian Basin of the southwestern United States show that natural dissolution of bedded salt occurs at shallow depths in many parts of this basin, especially on the Cimarron River, Elm Fork, and the Red River. In order for a salt deposit to dissolve, a supply of water unsaturated with respect to NaCl, an outlet for removal of brine, and energy to cause water to flow through the system are required. Salt is dissolved by groundwater at depths of 10 to 250 m, and the resulting brine moves laterally and upward under hydrostatic pressure through caverns, fractures and aquifers to form salt plains and salt springs on the surface. Groundwater in the Permian Basin is recharged through permeable rocks, alluvium, terrace deposits, karstic features and fractures. The dissolution of salt causes a self-perpetuating cycle in some areas. Cavern development caused by salt dissolution is followed by collapse and subsidence of overlying rock, allowing greater vertical permeability and increased water percolation and additional salt dissolution. (Geiger-FRC)
W82-03586

SEEPAGE FLOW IN EXTREMELY THIN AQUIFERS,

Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenierbau.
G. Schmid.
Advances in Water Resources, Vol 4, No 3, p 134-136, September, 1981. 3 Fig, 2 Ref.

Descriptors: *Groundwater movement, *Solute transport, Model studies, Mathematical studies, Seepage, *Nitrates, Path of pollutants, Flow velocity, Aquifer characteristics, *West Germany.

A groundwater flow model, considering only a vertical cross-section of a thin aquifer, was used to simplify an investigation of the source of 130 ppm nitrate levels at a water-works in West Germany. The stream function approach to describing seepage flow was useful, since the velocity field and flow path were of primary interest. Although the aquifer was only 9 mm thick and 2 km in a horizontal direction, the stream function produced the desired flow field. The potential approach gave a one-dimensional solution, neglecting the vertical components. (Cassar-FRC)
W82-03594

NATURAL TEMPORAL VARIATIONS IN THE CHEMISTRY OF SHALLOW GROUNDWATER, ATHABASCA OIL SANDS AREA, ALBERTA,

Stanley Associates Engineering Ltd., Edmonton (Alberta).
For primary bibliographic entry see Field 2K.
W82-03611

THE ORIGIN AND ISOTOPIC COMPOSITION OF DISSOLVED SULFIDE IN GROUNDWATER FROM CARBONATE AQUIFERS IN FLORIDA AND TEXAS,

Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 2K.
W82-03644

ESTIMATING AQUIFER PARAMETERS FOR LARGE-DIAMETER WELLS,

Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and S. M. Holt.
Ground Water, Vol 19, No 5, p 505-509, September/October, 1981. 4 Fig, 10 Ref.

Descriptors: *Well hydraulics, *Aquifer characteristics, *Model studies, Transmissivity, Pumping tests, Permeability, Confined aquifers, Unconfined aquifers, Shallow wells, India, Drawdown, Storage coefficient, Permeability.

Aquifer parameters were determined from pumping tests in large diameter wells by two methods—the curve matching technique based on analytical solutions and a numerical model. Both methods gave similar results under confined aquifer conditions. However, the curve matching technique was not reliable for use in unconfined aquifers where there is a significant decrease in saturated depth. In a confined aquifer test water was pumped at 691 cu m per day for 135 min from a well with a 2.4 m radius. Transmissivity was calculated at 24-29 sq m per day; storage coefficient, 0.0006 to 0.001; and effective radius, 2.3 m. The unconfined aquifer test used a well with 3.5 m radius and 10.73 m deep. Abstraction rate fell from an initial 1539 cu per day to 930 cu per day over 4 hours. Drawdown was 1.77 m. According to the numerical model, permeability was 105 m per day; storage coefficient, 0.007. The curve matching method gave unrealistic results: permeability of 68 m per day and storage coefficient of 0.0001. (Cassar-FRC)
W82-03647

ANALYSIS OF GROUND-WATER HYDROGRAPHS FOR DEFINING A CRYSTALLINE HYDROGEOLOGICAL ENVIRONMENT,

Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore, and V. L. S. Bhimasankaram.
Ground Water, Vol 19, No 5, p 476-481, September/October, 1981. 8 Fig, 2 Tab, 4 Ref.

Descriptors: *Groundwater, *Geohydrology, Precipitation, Rainfall, Groundwater recharge, Geology, Topography, Terrain analysis, Water wells, Water level, Hydrographs, *India, Shadnagar Basin.

Analysis was made of water levels in wells in a typical weathered and fractured granitic environment of Shadnagar Basin, Andhra Pradesh, India. Each well was 15.24 cm in diameter and ranged in depth from 24 to 60 m bgl (below ground level). It was noted that the level at which water was encountered during drilling was always lower than the stabilized water levels. The level of water striking varied from 5.25 to 21.25 meters. Similarly the static water levels in the wells varied from 0.75 to 16.38 meters, which is higher than the water striking levels in the wells. The rise of water levels to the stabilized levels clearly indicates the pressure heads of the granitic aquifer and reveals the semiconfined nature of the system. Topography had no definite control over the water striking levels, but in the upland areas the water levels are deeper, with relatively low pressure heads as compared to the low-lying areas. Water levels for all the piezometer tubes in different nests were manually recorded at monthly intervals over a period of five years. Data indicate that there is a good hydraulic continuity between ground water in shallow weathered mantle and deep seated fractured zones. The influence of rainfall on the ground water system was also investigated. It was concluded that rainfall on the ground water system was also investigated. It was concluded that rainfall was the main source of recharge, and that there are no substrate inputs to the ground water system in the basin. (Baker-FRC)
W82-03648

STORAGE AND RETRIEVAL OF GROUNDWATER DATA AT THE U.S. GEOLOGICAL SURVEY,

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 10B.
W82-03649

ISOTOPE HYDROLOGY OF GROUNDWATERS IN THE PAMPA DEL TAMARUGAL, CHILE,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
P. Fritz, O. Suzuki, C. Silva, and E. Salati.
Journal of Hydrology, Vol 53, No 1-2, p 161-184, September, 1981. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Isotope studies, *Groundwater dating, *Surface-groundwater relations, *Groundwater recharge, Isotopic tracers, Groundwater depletion, Altitude, Geohydrology, Groundwater level, Boreholes, Meteoric water, Groundwater availability, Spring water, Surface runoff, Semiarid climates, *Chile.

The semi-arid regions of Northern Chile have limited potential for water resources development. The isotope hydrology of the groundwaters of the arid Pampa del Tamarugal was studied to identify present-day groundwater recharge areas. Background studies on precipitation in the high Andes and spring- and surface-water investigations identified a well-defined meteoric water line. Altitude effects which were dependent on air-mass movements could not be defined without a more extensive sampling program. Maximum altitudes of recharge were assignable to springs in the Andes and at the eastern border of the Pampa del Tamarugal which originated from infiltrating surface waters. Certain groundwater systems were traced to specific river valleys, but most of the pumped groundwaters are fossil and their supply is diminishing. Limited subsurface recharge activity was found at the foot of the Andes, but this does not seem to keep up with groundwater depletion in this area. (Geiger-FRC)
W82-03651

HYDROLOGY AND MINING IN THE TUCSON AREAS,

Harshbarger and Associates, Tucson, AZ.
J. W. Harshbarger, and D. R. Hargis.
Mining Engineering, Vol 33, No 11, p 1611-1616, November, 1981. 5 Fig, 9 Ref.

Descriptors: *Groundwater basins, *Water management, Hydrology, Water demand, Water supply, *Arizona, Water supply development, Groundwater mining, Water reuse, Wastewater irrigation, *Tucson area.

The importance of groundwater supplies in the Upper Santa Cruz Valley is extreme. Metropolitan Tucson, surrounding agricultural areas, and the mineral industry are completely dependent on groundwater. Agriculture has been the largest user. Mountains bordering the Tucson Basin are composed predominantly of metamorphic and igneous intrusive rocks. The Tucson Basin comprises a structural depression formed by block faulting. The major fault system occurs along the base of the mountains. Principal surface drainage in the Tucson use area is the Santa Cruz River. In the past, pumpage of groundwater for agricultural use has been the major factor in the decline of basin water levels. As municipal and industrial pumpage in the area increases, a continuing decline in the water level can be expected. Irrigation use probably will not increase significantly, but utilization of effluent from the Tucson sewage treatment facility for agricultural irrigation in the future may decrease the volume of agricultural ground water pumpage. Groundwater law in Arizona developed prior to the accumulation of a body of significant scientific knowledge concerning groundwater occurrence and movement. Much work is needed in this area. (Baker-FRC)
W82-03697

THE ROLE OF PORE PRESSURE IN DEFORMATION IN GEOLOGIC PROCESSES,

T. N. Narasimhan, W. N. Houston, and A. M. Nur.
Geology, Vol 8, No 7, p 349-351, July, 1980.

Descriptors: *Pore pressure, *Deformation, *Hydraulic fracturing, Aquifers, Groundwater movement, Reservoirs, Seismology, Stress, Fluid mechanics, Geothermal studies, Geohydrology, Pressure head, Subsidence, Porous media.

Hydraulic fracturing and seismicity vs. pore pressure were among the areas of discussion at an interdisciplinary Penrose Conference on pore pressure and deformation sponsored by the Geological Society of America, November 9-13, 1979. This subject is important in many fields, for example, development of water resources and geothermal resources. One of the questions discussed was the maximum depth of groundwater circulation, believed to persist down to 20 km. Studies on stress-strain behavior of fluid-saturated rocks suggest that in some rocks (Cosco granite) the bulk modulus is sensitive to saturation, but in others (Solenhofen limestone) it may not be. Reservoir-induced seismicity research is being actively pursued. It is probable that migration of pore pressure transients is critical to induced seismicity. Hydraulic fracturing is used to measure stress in situ and to augment production of water, geothermal fluids, and oil. Fundamental studies on this subject included the nature and disposition of hydraulic fractures, conditions of stable and unstable fracture growth, growth of long elliptical cracks, and the role of the rate of fluid pressurization in controlling fracture disposition. Rapid pressurization tends to produce vertical fractures; slow pressurization, horizontal fractures. The following mechanisms, including some chemical effects, can contribute to abnormally high pore pressures: aquifer head due to natural recharge, fossil head due to exhumationor erosion, tectonic compression, rapid loading and compaction, influx of juvenile water, gas infiltration, phase changes in minerals or hydrocarbons, temperature changes, and osmotic phenomena. (Cassar-FRC)
W82-03706

SURFACE WATER AND GROUNDWATER INTERACTIONS IN A SURFICIAL AQUIFER IN NORTHWEST IOWA,

Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-03718

2G. Water In Soils

RELATION BETWEEN PHC AND SODIUM ADSORPTION RATIO (SAR) AND AN ALTERNATIVE METHOD OF ESTIMATING SAR OF SOIL OR DRAINAGE WATERS,

Science and Education Administration, Riverside, CA. Salinity Lab.
D. L. Suarez.
Soil Science Society of America Journal, Vol 45, No 3, p 469-475, May/June, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Saline water, *Irrigation effects, *Saline soils, Water analysis, Estimating equations, Mathematical studies, Irrigation, Water quality, Soil environment, Soil contamination, Hydrogen ion concentrations, Sodium, Sodium adsorption ratio.

An equation was derived which demonstrates the inter-relationships between the sodium adsorption ratio (SAR) of drainage water, irrigation water composition, pH, and the leaching fraction. SAR is used to predict the exchangeable sodium percentage of a soil. The accuracy of the new equations was evaluated by comparing the predicted SAR for drainage water of different water types and leaching fractions against computer model predictions. This method was found to predict SAR better than existing empirical equations. Satisfactory results can be obtained with rough estimates of P of CO_2, as SAR is not very sensitive to this variable. SAR is also not particularly sensitive to the concentration of Ca under saline conditions and with Mg/Ca ratios greater than 1. Thus, a fair prediction of Ca can result in a good SAR prediction. If soil water SAR is being calculated, SAR surface can be estimated from the irrigation water SAR, or if groundwater is important, some corrections must be made for degassing and $CaCO_3$ precipitation. (Small-FRC)
W82-03445

MASS TRANSPORT. 3. ROLE OF HYDRAULIC CONDUCTIVITY DATA IN PREDICTION,

British Columbia Univ., Vancouver. Dept. of Geological Sciences.
L. Smith, and F. W. Schwartz.
Water Resources Research, Vol 17, No 5, p 1463-1479, October, 1981. 14 Fig, 6 Tab, 13 Ref.

Descriptors: Conductivity, *Model studies, Stochastic process, Mathematical studies, *Mass transfer, Prediction, Stochastic hydrology, Forecasting, *Solute transport, *Hydraulic conductivity.

A stochastic analysis of mass transport has been carried out to investigate various relationships between the number of hydraulic conductivity measurements available to characterize the heterogeneity and the resulting uncertainty in transport predictions. Uncertainties arise both from the unknown spatial variation in hydraulic conductivity and in estimating the parameters of the probability distribution for hydraulic conductivity. Simulations were based on limited sampling of hydraulic conductivity values from a series of hypothetical field sites. Results were interpreted, keeping in mind the uncertainty in determining seepage velocities within the flow system. For the sample grids considered, the mean arrival times obtained in the stochastic simulation can differ significantly from arrival times calculated for the hypothetical section representing the field setting. Measurements of hydraulic conductivity did not lead to large reductions in the uncertainty in the velocity field, as the hydraulic gradient itself was a random variable. Results of the study suggest that given a moderate number of data points, the unknown patterns of spatial variation in hydraulic conductivity were a more important source of uncertainty than errors in estimating the mean and standard deviation of the hydraulic conductivity distribution. (Baker-FRC)
W82-03578

APPLICATION OF SOIL WATER FLOW THEORY IN FIELD SIMULATION,

Technical Univ. of Denmark, Copenhagen.
K. H. Jensen.
Nordic Hydrology, Vol 12, No 3, p 167-184, 1981. 12 Fig, 1 Tab, 9 Ref.

Descriptors: *Soil-water-plant relationships, *Evapotranspiration, *Irrigation practices, Soil moisture, *Model studies, Capillarity, Infiltration, Interception, *Soil water, Evaporation, Grasses, Barley, Soil water movement.

A soil moisture model based on the basic differential equation for soil water flow is developed. It includes terms for interception, transpiration, soil evaporation, and soil water flow. Empirical relationships from the literature are used where mathematical descriptions are unavailable. Input data to the model are hourly precipitation and meteorological data, irrigation treatment, leaf area index, root zone depth, root extraction pattern, and water table fluctuations. Required model parameters are moisture content-capillary pressure relationships and hydraulic conductivity-capillary pressure relationships for each soil layer. Outputs are simulated time variation in soil moisture content, capillary pressure, and soil water flow at different levels. The model results agreed fairly well with field observations on grass and barley plots in Denmark. (Cassar-FRC)
W82-03589

DAILY PARTITIONING OF RAINFALL TO SURFACE RUNOFF AND SOIL WATER ON COMPLEX LANDSCAPES,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
For primary bibliographic entry see Field 2A.
W82-03681

AIRBORNE SOIL MOISTURE MEASUREMENT USING NATURAL TERRESTRIAL GAMMA RADIATION,

National Weather Service, Minneapolis, MN. North Central River Forecast Center.
T. R. Carroll.
Soil Science, Vol 132, No 5, p 358-366, November, 1981. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Remote sensing, *Soil water, Measuring instruments, *Gamma radiation, Radiation, Water availability, Moisture availability, Moisture stress, Drought, Moisture deficiency.

Airborne gamma radiation flux data were collected over a network of 240 flight lines in the upper Midwest. Each flight line was approximately 6 square kilometers. The data were used to calculate real-time, areal soil moisture values. The gamma radiation attenuation technique was able to measure the soil moisture flux in the upper 20 cm of the soil surface with sufficient accuracy for operational applications. A comparison with soil moisture data collected from a network of 240 flight lines in the upper Midwest indicates that mean areal soil moisture values can be calculated with an RMS error of 3.2% soil moisture. Airborne soil moisture values tended to be 1.5% less than the ground sampled values. The airborne gamma radiation technique was able to measure reliable, real-time mean, areal soil moisture values over large areas with the accuracy required for operational hydrologic and agricultural applications. An operational soil moisture survey program could make real-time data available to users interested in soil moisture conditions in the fall prior to snow accumulation, in the spring to assess surface conditions prior to crop planting, or at any time to quantify extremely wet or dry soil moisture conditions over large areas. (Baker-FRC)
W82-03685

NONLINEAR SORPTION OF WATER IN SOIL,

Vanderbilt Univ., Nashville, TN.
A. D. Koussis.
Soil Science, Vol 132, No 4, p 262-266, October, 1981. 3 Tab, 14 Ref.

Descriptors: *Soil water, *Model studies, Mathematical studies, Sorption.

The accuracy of an approximate analytical solution, based on integral requirements, for nonlinear sorption of water in soil has been studied. An earlier solution proposed by Brutsaert has been obtained as a special case through a particular parameter choice. Comparisons with exact solutions have been carried out for a power law soil. Results bear out the expectation that Brutsaert's approach will be simple and accurate over a wide range of diffusivities, from weakly variable to strongly variable. Although the accuracy of Brutsaert's solution is not as high as that of the general integral-approximation solution, its performance is more than adequate for practical purposes and proves it a versatile and flexible tool. Also, suggestions regarding the improvement of the computational efficiency of iterative numerical integration of the one-dimensional diffusion equation are made, which are based on available close estimates for the sorptivity. (Baker-FRC)
W82-03686

DEVELOPMENT OF A SOIL MOISTURE MODEL FOR USE WITH PASSIVE MICROWAVE REMOTE SENSORS,

Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
W. C. Bausch.
PhD Thesis, May, 1980. 187 p, 82 Fig, 10 Tab, 55 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-23014.

Descriptors: *Soil water, *Model studies, *Mathematical models, Soil profiles, *Remote sensing, Prediction, Moisture content, Passive microwave sensors.

Soil moisture profiles were simulated for a hypothetical loam-like soil with a water and heat balance model. Expected X-band and L-band radiometer response to these conditions as simulated by a radiative transfer model. From these simulations, a model was developed to estimate soil water content in two layers of a 1.5 m soil profile. Soil water content in the top 21 cm of the hypothetical soil was related to L-band emissivity over a wide range of soil moisture conditions. Inverted soil moisture profiles which result from small rains were classified by use of the rate of change in L-band emissivity one day after the rain. The amount of water added to the soil profile below the 21 cm depth due to percolation was related to a ratio of the rate of change in X-band and L-band emissivities one day after the rain. These relationships were combined into a comprehensive model that predicts soil moisture in two zones of the soil profile. This model was tested with measurements of soil water content and soil temperature collected during the four seasons of the year in a sandy loam soil contained in an array of lysimeters. X-band and L-band emissivities required in the predictor equations were calculated by the radiative transfer model from measured soil moisture and soil temperature data. The technique developed from simulated results to classify inverted soil moisture profiles was found to be seasonally dependent. It was also found that the second layer algorithm showed seasonal dependence. (Sinha-OEIS)
W82-03715

AERATION STATUS OF A STRATIFIED SOIL WITH A FALLING WATER TABLE,

Utah State Univ., Logan.
M. Z. Ahmadi.
PhD Thesis, 1980. 167 p, 37 Fig, 29 Tab, 72 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19230.

Descriptors: *Soil aeration, *Model studies, *Water table, Mathematical models, Equations, Aeration, Soil water, Moisture content, Oxygen, Soil types, Stratified soils, Soil water pressure.

Two Richards type equations were used to define soil aeration status, one for soil water pressure and one for oxygen concentration. A third equation related the soil water pressure (volumetric water content) with oxygen concentration and oxygen diffusion rate for a one-dimensional vertical stratified soil column. The equations were solved using Brooks-Corey's functional relationship between soil water pressure [illegible] volumetric water content, the Crank-Nicolson method of differencing, general Newton method, successive overrelaxation. The numerical model considers uniform and two-layered soils; plants and no plant; and saturated and unsaturated conditions for a falling water table. The model predicts soil water pressure, volumetric water content and oxygen diffusion rate throughout the column at any time step following an initial static water table location. The no-plant numerical model was tested against laboratory data. Except for the oxygen diffusion rates near the soil surface which are not reliable due to malfunctioning of oxygen diffusion rate meter, the no-plant model, in general agrees with the laboratory data. (Sinha-OEIS)
W82-03717

MOISTURE MOVEMENT IN SOILS IN THE VICINITY OF WASTE DISPOSAL SITES,

Texas Univ. at Austin.
D. E. Daniel, Jr.
PhD Thesis. December, 1980. 256 p, 81 Fig, 6 Tab, 117 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-09151.

Descriptors: *Soil water, *Computer programs, *Waste disposal, Soil properties, Hydraulics, Soil water suction, Saturation, Hydraulic conductivity, *Unsaturated flow, Solute transpot.

Four objectives to the research were: (1) to study methods of measuring the hydraulic properties of unsaturated soil over a broad range in degree of saturation; (2) to develop a computer program for analyzing the transient movement of water through saturated or unsaturated soil; (3) to measure rates of water movement in several unsaturated soils and to compare the measured rates to those predicted by the computer program; and (4) to analyze an example disposal facility in order to illustrate how the program might be used for practical problems. The main conclusions are: The most important hydraulic properties of unsaturated soil are the moisture characteristic curve (plot of degree of saturation versus suction) and the relationship between hydraulic coductivity and degree of saturation. The thermocouple psychrometer is the best device to use for measuring suctions over the range of about 1 to 80 atm. The instataneous profile method, with psychrometric suction probes, was found to be the best method available for measuring hydraulic conductivity of clays over a wide range in degree of saturation. The most useful features of the fnite element program, which was written to calculate the time-dependent change in hydraulic head, and associated variables such as degree of saturation, were found to be the following: dynamic dimensioning, semi-automatic mesh generation, time-dependent or cyclic boundary conditions, automatic time step control, and the capability of tracing the time-dependent movement of water through the ground. Analysis of an example problem showed that the ability of the program to trace the time-dependent movement of water through the soil is the most useful feature of the program. (Sinha-OEIS)
W82-03728

2H. Lakes

PHOTOSYNTHETIC BACTERIAL PRODUCTION AND CARBON MINERALIZATION IN A MEROMICTIC LAKE,

Michigan State Univ., East Lansing. Dept. of Crop and Soil Science.
T. B. Parkin, and T. D. Brock.
Archiv fur Hydrobiologie, Vol 91, No 3, p 366-382, June, 1981. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Carbon cycle, *Meromictic lakes, *Photosynthetic bacteria, Lakes, Bacteria, Primary productivity, Productivity, Sedimentation, Sulfur bacteria, Mineralization, Algae, Phytoplankton.

Primary production, sedimentation, and decomposition were measured in meromictic Knaack Lake, Wisconsin, throughout the annual cycle. During thermal stratification in spring, summer, and early autumn a dense population of photosynthetic sulfur bacteria was present at the oxygen-sulfide boundary. When the lake ice melted in April, bacterial chlorophyll d concentrations increased steadily to over 800 mg per sq m during the summer and decreased in October. Although green and blue-green algae were present in the epilimnion, chlorophyll a concentrations were low (20-90 mg per sq m) during summer. The photosynthetic sulfur bacteria composed 41-92% of the total phytoplankton standing crop on a chlorophyll basis and 8-58% on a carbon basis. However, they were responsible for only 3.3-5.6% of the total primary production in the lake. The algae of the epilimnion showed rapid turnover rates, whereas the green sulfur bacteria of the hypolimnion had slow turnover rates. (Cassar-FRC)
W82-03403

NUTRIENT RELATIONSHIPS IN SHALLOW WATER IN AN AFRICAN LAKE, LAKE NAIVASHA,

Nairobi Univ. (Kenya). Dept. of Botany.
J. J. Gaudet, and F. M. Muthuri.
Oecologia, Vol 49, No 1, p 109-118, 1981. 9 Fig, 3 Tab, 37 Ref.

Descriptors: *Cycling nutrients, *Lakes, Seasonal variations, *Africa, *Lake Naivasha, Littoral zone, Intertidal areas, Littoral environment, Interstitial water, Shallow water, *Nutrients, Phosphorus, Nitrogen, Sulfur.

Total nutrient levels of nitrogen, phosphorus, and sulfur were determined in a shallow water tropical community with emphasis directed toward the macrophyte, water and hydrosoil components. Nutrient release from macrophyte decomposition was studied, and general transfer patterns within this macrophyte-water-hydrosoil system were sought. The area under study was located at the edge of

Lake Naivasha, a closed-basin lake in East Africa. One long permanent transect was set out from land to the open lake, with five stations located along it. One sampling station was located in a zone dominated by Kikuyu grass, stations 2, 3, and 4 were in a sledge zone, and station 5 was in open water. The mean annual conductance and temperature decreased, while pH increased going out from shore as water depth increased. Total P was generally higher during drawdown (June-July), decreasing later in the year. The concentration of particulate P was greater than dissolved F. The ratio of the two forms of P differed from zone to zone. Total nitrogen concentrations were higher than either phosphorus or sulfur, with the highest mean annual concentration occurring in the sledge zone and the least concentration in the open water. Highest mean phosphorus and sulfur levels were generally found in the grass zone. Of the three nutrients, total sulfur was generally at the lowest overall concentration. The main source of plant nutrients in the drawn-down zone of Lake Naivasha would seem to be the interstitial water filling the space among the solid particles of the hydrosoil. (Baker-FRC)
W82-03404

GROWTH AND REPRODUCTION OF POTAMOGETON CRISPUS IN A SOUTH AFRICAN LAKE,

Natal Univ., Pietermaritzburg (South Africa). Dept. of Botany.
K. H. Rogers, and C. M. Breen.
Journal of Ecology, Vol 68, No 2, p 561-571, July, 1980.

Descriptors: *Potamogeton, *Nutrients, *Aquatic plants, *South Africa, *Lakes, Nitrogen, Phosphorus, Plant physiology, Standing crops.

Potamogeton crispus L. plants are involved in the nutrient dynamics of their floodplain lake environment. They grow and take up nutrients from water and sediments from autumn to spring, at which time the vegetative parts decay and release nutrients to the water. Between September 8 and January 9 a mean of 2 mg per sq meter per day of phosphorus and 7 mg per sq meter per day of nitrate-N was released for uptake by other components of the system. During the summer, when P. crispus is dormant, the lakes in this South African floodplain are separated from their river source. If a flood were to occur at this time (an unlikely happening), nutrients would be washed out by the nutrient-poor flood water. (Cassar-FRC)
W82-03406

ALGAL SEDIMENTATION IN RELATION TO PHYTOPLANKTON PERIODICITY IN ROSTHERNE MERE,

Freshwater Biological Association, Amblesi
(England).
D. Livingstone, and C. S. Reynolds.
British Phycological Journal, Vol 16, No 2, p 195-206, June, 1981. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Phytoplankton, *Sedimentation, *Seasonal variation, Algae, *Rostherne Mere, *England, Turbulent flow, Sediment traps, Lakes, Measuring instruments, Diatoms.

Seasonal variations in phytoplankton composition were studied in Rostherne Mere, England, using cylindrical sediment traps and quantitative measurements of standing crops. Trap catches generally reflected the plankton compositon during the preceding trapping period when operated in weakly turbulent waters. Turbulence, which is infrequent in this lake, exaggerated the fluxes. Diatoms were assessed as 2-20 times more numerous using the trap than standing crop estimates. Microcystis and Nitzschia catches were in good agreement with estimated areal fluxes. (Cassar-FRC)
W82-03414

THE PHYTOPLANKTON AND PROTOZOOPLANKTON OF THE EUPHOTIC ZONE OF LAKE TANGANYIKA: SPECIES COMPOSITION, BIOMASS, CHLOROPHYLL CONTENT, AND SPATIO-TEMPORAL DISTRIBUTION,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
R. E. Hecky, and H. J. Kling.
Limnology and Oceanography, Vol 26, No 3, p 548-564, May, 1981. 6 Fig, 6 Tab, 33 Ref.

Descriptors: *Lakes, *Phytoplankton, *Zooplankton, Seasonal variation, Population dynamics, Chlorophyll A, *Lake Tanganyika, *Africa, Biomass, Fish food organisms.

Phytoplankton and protozooplankton were surveyed at two widely separated pelagic stations in the euphotic zone of Lake Tanganyika (Africa) from February through November 1975, and three seasonal phases were determined. During stable stratification, biomass was minimal; it was maximal at the end of the deep mixing period. Diatoms were abundant only during mixing. Filamentous blue-greens were abundant when the lake experienced rapid surface warming, which produced shallow mixed layers following the period of deep mixing. Chlorophyll alapha ranged from 0.1 to 4.3 mg/cu m in the euphotic zone and from 0.2 to 20.4 in surface waters. Phytoplankton biomass ranged from 25 to 1570 mg/cu m in the euphotic zone. Annual means for both phytoplankton and chlorophyll alpha were very low and annual variability was high. This may be because of the lake's steep morphometry, which affects nutrient generation, and the high loss rates, which cause high algal growth rates but low algal masses. (Small-FRC)
W82-03419

PRIMARY PRODUCTION AND RATES OF ALGAL GROWTH IN LAKE TANGANYIKA,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
R. E. Hecky, and E. J. Fee.
Limnology and Oceanography, Vol 26, No 3, p 532-547, 1981. 3 Fig, 3 Tab, 47 Ref.

Descriptors: *Primary productivity, *Algal growth, *Eutrophic lakes, Aquatic productivity, Biomass, *Lake Tanganyika, *Africa, Fish.

Two surveys were conducted over pelagic regions of Lake Tanganyika (Africa) during minimum and maximum standing crop to determine primary production and rates of algal growth. The mean rate of integral primary production was 1.4 g C/sq m/day for cloudless weather. There was no consistent pattern of diurnal variation. The mean annual rate was estimated to be 1 g C/sq m/day. High algal growth rates of 0.1 to 3.0/day with a mean of 0.9 were estimated. There is a high fish population in the lake, which requires either very high trophic efficiency based on measured pelagic primary production or an additional source of energy derived from the anoxic deep water. It is suggested that the long geological history of the lake has allowed the evolution of a biological community consisting of highly efficient species. (Small-FRC)
W82-03420

A FACTOR ANALYSIS OF ELEMENTAL ASSOCIATIONS IN THE SURFACE MICROLAYER OF LAKE MICHIGAN AND ITS FLUVIAL INPUTS,

Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
J. E. Mackin, R. M. Owen, and P. A. Meyers.
Journal of Geophysical Research, Vol 85, No C3, p 1563-1569, March, 1981. 5 Fig, 3 Tab, 52 Ref.

Descriptors: *Water analysis, Lakes, *Rivers, *Lake Michigan, Chemical composition, Particulate matter, Calcium, Copper, Iron, Potassium, Manganese, Factor analysis, Metals, Free surfaces, Fluvial environment, Inflow, Water pollution sources.

The concentrations of Ca, Cu, Fe, K, Mn, and organic carbon in samples of the surface microlayer (125 + or - 5 micrometers) and 1 meter deep subsurface water samples from 10 locations in Lake Michigan and 10 of its river sources were subjected to separate R mode factor analyses. These revealed that the variance in the surface microlayer and subsurface river samples was governed by regional geology and the nature of weathering in individual drainage basins. In the particular phase, Ca, Fe, K, and Mn were higher in microlayer and subsurface river samples than in the lake samples because mineral grains settle out before entering the lake. Concentrations of materials in river subsurface waters are also affected by upward diffusion of sediment pore fluids and resuspension of bottom sediments. The variations in chemical composition of the lake samples were a result of physiochemical interactions such as complexation with organic matter (Fe, Cu), carbonate equilibria (Ca, Mn), precipitation of hydrous oxides (Fe, Mn, Cu), biological uptake (K), and bubble transport of very fine mineral particles to the surface. The bubble transport mechanism obscures the patterns of atmospheric fallout of Fe and Mn. (Cassar-FRC)
W82-03442

SIGNAL ANALYSIS OF IRRADIATION, TEMPERATURE AND PRIMARY PRODUCTION IN A SMALL ARTIFICIAL POND, II. THE RESIDUAL SPECTRA,

Amsterdam Univ. (Netherlands). Lab. of Aquatic Ecology.
R. Lingeman.
Internationale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 203-222, 1981. 6 Fig, 4 Tab, 14 Ref.

Descriptors: *Primary productivity, *Ponds, *Irradiation, Radiation, Temperature effects, Spectrophotometry, Spectral analysis, Dissolved oxygen, Ecosystems.

Methods and results are presented of an extensive spectral analysis applied to the residues of the two-year series of irradiation, temperature and gross production after elimination of the slow components in a small artificial pond. The spectral analysis procedure proposed and executed is for the residual signals of total diurnal irradiation, diel mean temperature and diurnal gross primary production. The residual power spectrum of diurnal irradiation was shown to be essentially that of a white noise. Several higher frequencies were significantly present in both the signals of temperature and production. Some consideration is given to the cross correlation between the latter two parameters. After the detection of possible frequency peaks in the power spectrum had been made, the significance of the periodic components of each signal was tested by least squares fitting to sinusoidal models. Both the spectrum of the temperature and the spectrum of production showed distinct peaks at 2,7, 14, and 21 cy. No peaks were traceable in the power spectrum of irradiation. In the temperature signal, the 2 and 7 cpy periodic components were significant. The production signal had components of 7 and 14 which were significant. The results of spectral estimation and successive model fitting strongly suggest the simultaneous appearance of idnetical frequencies in the residual time series of temperature and production. The synchronous small oscillations superimposed on the annual signals of temperature and primary production may point to a residual effect of temperature on the productive system. (Baker-FRC)
W82-03465

THE EFFECT OF ARTIFICIAL DESTRATIFICATION ON PHYSICO-CHEMICAL PARAMETERS AND PHYTOPLANKTON IN HAM'S LAKE, OKLAHOMA,

Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 5G.
W82-03510

STRATIFICATION AND MIXING IN SHALLOW TROPICAL AFRICAN LAKES,

Duke Univ., Durham, NC. Dept. of Zoology.
S. MacIntyre.
PhD Thesis, 1981. 361 p, 77 Fig, 23 Tab, 134 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19639.

Descriptors: *Lakes, *Stratification, *Chemical stratification, *Mixing, *Water circulation, Shallow water, Sedimentation, Primary productivity, Wind, *Kenya, Africa.

Circulation patterns within a lake have a direct impact on the lake's productivity and sedimentation rates and on the fate of pollutants injected into the lake. Shallow windswept African lakes stratify and mix on a daily basis and are noted for their exceptionally high rates of primary productivity. Measurements of current speeds and temperature profiles were used to characterize daily mixing events in three shallow African lakes of differing morphology and exposure to wind. Reasons for the persistence of chemical stratification were explored in a sheltered crater lake. During limnological investigations spanning the 1970's, chemical stratification was always observed in Lake Sonachi. This indicates that the lake is meromictic. Two factors that can contribute to the maintenance of meromixis are weak wind mixing and biological decomposition below the chemocline. Although Lake Sonachi is sheltered from wind by crater walls 30 to 100 m above the lake's surface, gusty winds were common. Freshening of the surface waters by rain contributed to the increased stability, but the conductivity and volume of water below the chemocline had also increased substantially. It is hypothesized that chemical stratification in Lake Sonachi is enhanced by groundwaters that dissolve evaporites in the lake sediments and seep into the lake. (Sinha-OEIS)
W82-03514

INVESTIGATION OF THE ACCURACY OF WATER LEVEL TRANSFER TO DETERMINE GEODETIC ELEVATION IN LAKE ONTARIO,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
H. W. Stoughton.
PhD Thesis, 1980. 336 p, 17 Fig, 37 Tab, 380 Ref, 12 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-17375.

Descriptors: *Water level, *Lakes, Mathematical studies, *Geodetic levelling, Lake levels, *Lake Ontario.

An investigation of the accuracy of using the mean surface of a large lake for geodetic levelling is reported. This investigation concentrated on Lake Ontario. The data collected for IFYGL provided adequate information to evaluate mean lake level over widely spaced gage sites. The investigations of lake level for both engineering and geological studies noted the influences of wind setup, variations in barometric pressure, storm runoff, precipitation, and gage location, but it was recognized that there was insufficient data to demonstrate their systematic effect on the mean lake level at a gage. The investigation evaluated the accuracy of geodetic levelling accomplished by the use of mean lake level gage readings for the 'water level transfer' of elevations across Lake Ontario. The employment of this technique requires an elevation system expressing differences in elevation in units of work. This investigation employed the equipotential system based on normal gravity (dynamic heights(because gravity had been observed only at bench marks along the United States portion of the level line. The comparisons of the four month mean difference in elevation as determined by the differences in the lake level gage readings compared to the difference in elevation determined by geodetic levelling were in close agreement. (Sinha-OEIS)
W82-03515

SPACE-TIME SCALES OF TEMPERATURE VARIABILITY IN THE SEASONAL THERMOCLINE OF LAKE TAHOE,

Oregon State Univ., Corvallis.
J. M. Brubaker.
PhD Thesis, June, 1980. 114 p, 31 Fig, 5 Tab, 39 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-05611.

Descriptors: *Lakes, *Thermocline, Thermal stratification, Seasonal variation, *Water temperature, Temperial distribution, Spatial distribution, *Lake Tahoe, Space-time scales.

The objectives of this work are to characterize and, when possible, to interpret temperature finestructure and microstructure observations made with vertical profiling instruments in the upper thermocline of Lake Tahoe during late summer stratification. From the finestructure data (observations with the TD instrument) the following characteristics of temperature variability in the Tahoe thermocline were found. Over time scales of days to weeks, or over horizontal scales of several km, relatively large amplitude temperature fluctuations were observed. In contrast, for sampling limited to 2 1/2 hours and to about 200 m horizontally, the ensemble variability was of smaller magnitude. Vertical wavenumber spectra of temperature fluctuations fell steeply. Results on scales of variability represent only a first step toward development of a full frequency-wavenumber spectrum for the temperature field, but should provide some perspective and organization structure for future work. Similarities of some features of the Tahoe spectra (and cross spectra) to oceanic results support the idea that similar dynamics control the small-scale structure in both environments. Thus, Tahoe could find extensive use as a 'laboratory' for studying some oceanic phenomena. (Sinha-OEIS)
W82-03519

ARSENIC IN LAKE LANSING, MICHIGAN,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5B.
W82-03522

MOVEMENT OF COBALT IN FRESHWATER MICRO-ECOSYSTEMS,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
S. S. Tucker.
PhD Thesis, May, 1980. 167 p, 34 Fig, 7 Tab, 115 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-22598.

Descriptors: *Lakes, *Sediments, *Cobalt, *Ecosystems, Aquatic life, Mathematical analysis, Turnover time, Cobalt radioisotopes, *Microorganisms, Path of pollutants, Biotic components, Freshwater environment, Gammarus fasciatus, Nitzschia palea, Celtis occidentalis.

Radiocobalt was used to study the cobalt cycle in aquatic microcosms consisting of five possible compartments. All combinations of lake water, sand, amphipods (Gammarus fasciatus), microflora (Nitzschia palea), and detritus (leaves of Celtis occidentalis) were linked in two, three, four, and five compartment microcosms. The movement of cobalt between water and amphipod, microflora, and detritus compartments was characterized by a set of first order differential equations, while the movement between water and sand compartments was characterized by a partial differential equation due to the slow diffusion of cobalt into the underlying layers of the sand compartment. Cobalt movement in freshwater systems is significantly controlled by the sediment acting as a cobalt sink. Biotic components are capable of turning over cobalt and, in most cases, these turnover rates increase as the number of biotic components increases. Resistance of aquatic systems to perturbation and resilience after perturbation may be found to increase with complexity using certain indices; however, other stability indices show no correlation with system complexity using certain indices; however, other stability indices show no correlation with system complexity. This variable correlation between complexity and stability agrees with other recent ecosystems studies reported in the literature. (Sinha-OEIS)
W82-03524

WATER CHEMISTRY OF ALABAMA PONDS,

Auburn Univ., AL.
For primary bibliographic entry see Field 2K.
W82-03534

GROUND WATER SEEPAGE IN LAKE WASHINGTON AND THE UPPER ST. JOHNS RIVER BASIN, FLORIDA,

New Hampshire Water Supply and Pollution Control Commission, Concord.
J. N. Connor, and T. V. Belanger.
Water Resources Bulletin, Vol 17, No 5, p 799-805, October, 1981. 7 Fig, 6 Tab, 11 Ref.

Descriptors: *Seepage, *Drainage effects, *Chlorides, *Fate of pollutants, Lake Washington, St. Johns River, *Florida, Lakes, Groundwater movement, Water quality, Hydrologic budget, Drainage canals, Aquifers.

Direct groundwater seepage measurements in St. Johns River and Lake Washington, Florida, showed that drainage canals entering the lake had high average seepage rates (17.7 liters per sq m per day). Seepage from the lake shores was 2.01 liters per sq m per day. Total inputs into the lake were: St. Johns River, 88.3%; canal discharge, 5.9%; precipitation, 5.1%; and groundwater seepage, 0.7%. Outputs were: St. Johns River, 92.5%; evaporation and evapotranspiration, 4.6%; treatment plant pumpage, 1.9%; groundwater recharge, 0.6%; and marsh storage, 0.4%. Although the drainage canals represented 6.6% of St. Johns River annual discharge, the canals contributed 20.4% of the annual river chloride loading. Chloride contributions were highest during the dry season. Midlake Cl levels were 71 mg per liter; canal water levels, 108-131 mg per liter. Lake seepage water contained 72 mg per liter Cl; and canal seepage water, 215 mg per liter. This study indicated that rising levels of Cl in the river through the years are attributable to groundwater seepage in the headwaters, which have been subjected to channelization, marsh drainage, and diking. (Cassar-FRC)
W82-03546

BOTTOM SEDIMENTS AS A SOURCE OF NITROGEN AND PHOSPHORUS IN WATER,

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
For primary bibliographic entry see Field 5B.
W82-03571

PROBABILISTIC MODEL OF LONG-TERM FLUCTUATIONS ON THE LEVEL OF AN OPEN LAKE,

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
A. V. Frolov.
Water Resources, Vol 8, No 1, p 1-12, January/February, 1981. 4 Fig, 2 Tab, 32 Ref. Translated from Vodnye Resursy, No 1, p 34-47, January/February, 1981.

Descriptors: *Water level fluctuations, Streamflow, *Lakes, Evaporation, Open lakes, *Surface runoff, *Model studies, Lake Ladoga, Neva River, *USSR, Water budget, Rivers.

A model is presented for long-term fluctuations in levels of humid zone open lakes, where the surface runoff far exceeds other discharges in the water balance. In lakes of this type, evaporation and surface area are of minor importance. Results showed that open lakes normalize level fluctuations more weakly than closed lakes. The lake level and outflow are described by second-order autoregression processes. The model was used on data for Lake Ladoga and the Neva River. There was good agreement between observed and calculated water levels. (Cassar-FRC)
W82-03572

SULFUR AND OXYGEN ISOTOPES AS TRACERS OF THE ORIGIN OF SULFATE IN LAKE CRETEIL (SOUTHEAST OF PARIS, FRANCE),

Paris-6 Univ. (France). Lab. de Geologie Dynamique.
A. Chesterikoff, P. Lecolle, R. Letolle, and J. P. Carbonnel.
Journal of Hydrology, Vol 54, No 1-3, p 141-150, December, 1981. 5 Fig, 3 Tab, i4 Ref.

Descriptors: *Water quality, *Oxygen, *Isotopic tracers, *Sulfur, *Lakes, Geohydrology, Oxygenation, Aquifers, Biological oxygen demand, Groundwater, Sulfates, Groundwater movement, Piezometers, Isotope studies, Minerals, Salinity, *Lake Creteil, *France.

As part of long-term studies to preserve the water quality of Lake Creteil, France, interdisciplinary studies were conducted to uncover the origin, path and history of the waters. Isotopic studies of dissolved sulfate have allowed for the improvement of the hydrogeological model of the Creteil plain by identifying two sources of its water and their mineral content. The first source is an interstitial water or a confined low-conductivity aquifer with high sulfate concentrations. Sulfate from this source has a heavier isotopic composition, possibly through reduction, and may have originated in Paris gypsum. These waters are found to the west of Mt. Mesly down to the piezometric level. The second source consists of waters of low salinity and isotopic light sulfate from oxidation of sulfides or fertilizers. These waters are found down the Bois de la Grange Plateau. It is recommended that isotopic data be used in conjunction with other measurements to prevent false assumptions about the origin and characteristics of natural waters. (Geiger-FRC)
W82-03583

ORTHOPHOSPHATE AND ITS FLUX IN LAKE WATERS,

Department of Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
E. White, G. Payne, S. Pickmere, and F. R. Picks.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 10, p 1215-1219, October, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Lakes, *Phosphates, *Radioactive tracers, *Chromatography, Nutrients, *Orthophosphates, Phosphorus, Particulate matter, Molybdenum, Separation techniques, Tracers, Dissolved solids, *New Zealand.

The relative distribution of reactive high molecular weight phosphorus (RHMW-P) and low molecular weight phosphorus (PO-P) in lake waters as well as the turnover times and presumed flux of phosphate between solution and particulate matter were studied in several New Zealand lakes by molybdenum blue technology and Sephadex gel (G25-150) chromatography. PO4-P is as near to representing orthophosphate as is possible to attain using molybdenum blue technology. Results showed that RHMW-P was not usually the dominant component of dissolved reactive phosphorus and was not solely responsible for incorrect calculations of orthophosphate levels estimated by molybdenum blue and radiotracer technology. Orthophosphate concentrations may be miscalculated when chemically reactive organic phosphorus is present in low molecular weight material (PO-P) and when radiotracer estimates are used. When radioactive PO4-derived turnover times are used to estimate changes in orthophosphate concentrations from solution to particulate matter, errors are likely to occur regardless of the method used to calculate orthophosphate levels. (Geiger-FRC)
W82-03613

A NOTE ON THE DEVELOPMENT OF THE THERMOCLINE IN TEMPERATE LAKES,

Indiana Univ.-Purdue Univ. at Indianapolis. Dept. of Geology.
P. De Caprariis.
Ecological Modelling, Vol 12, No 4, p 213-219, May, 1981. 1 Fig, 9 Ref.

Descriptors: *Lakes, *Mathematical models, *Thermocline, *Temperature gradient, Mathematical studies, Model studies, Mathematical equations, Thermal stratification, Epilimnion, Hypolimnion, Wind, Turbulent flow.

The Sundaram and Rehm model of the development of thermocline in temperate lakes allow vertical heat flux to vary with depth and is based on a balance between thermal buoyant forces and wind induced turbulence. An exact solution to the governing equation set forth by the Sundaram and Rehm model is presented for one assumption about the form of thermal diffusivity. The solution is presented as a transcendental relation between the temperature gradient and water depth, and the development of the thermocline is associated with a singular point of the governing equation. The exact solution shows the qualitative features of the numerical solution, and it may be used by modelers to obtain variations in temperature gradient with depth when a data set for a lake is deficient. The equations may also be manipulated to estimate the depth of the thermocline directly. (Geiger-FRC)
W82-03622

IRON OXIDE FROM A SEASONALLY ANOXIC LAKE,

Freshwater Biological Association, Ambleside (England).
E. Tipping, C. Woof, and D. Cooke.
Geochimica et Cosmochimica Acta, Vol 45, No 9, p 1411-1419, September, 1981. 4 Fig, 1 Tab, 35 Ref.

Descriptors: *Iron oxides, *Particulate matter, *Sedimentation, Metals, *Lakes, Iron compounds, Oxidation, Stratification, Thermal stratification, Chemical reactions, Esthwaite water, Adsorption, Flocculation, Lake sediments, Humic acids, Organic matter, *United Kingdom.

Ferric oxide particles taken from Esthwaite Water, United Kingdom, during the thermal stratification period and accompanying deep water anoxia are amorphous, spherical to ellipsoidal, with diameters 0.05 to 0.5 microns. They occur at levels of 3 mg Fe per liter or about 400 billion particles per liter. The iron oxide particles apparently do not consist of aggregates of primary particles, probably because they form slowly at low supersaturation. The particles are formed by oxidation of Fe(2+) in water and sediments. The role of bacteria in formation of these particles cannot be clearly defined. The chemical analysis of 4 samples showed 32-39% Fe, 14-18 C, 4-7% humic C, 1.5% N, 0.3-1.4% Mn, and 1-3% P with 1% or less each of Ca, Mg, Si, and S. The iron oxide particles are negatively charged because of adsorbed humic matter, phosphate, and silicate. The electrophoretic mobility in lake water (pH 6.7) is -1.3 times 10 to the minus 8th power sq meters per V per sec at 10 C, similar to pure iron oxide samples in lake water. A zeta potential of -27mV accounts for the high degree of dispersion of particles in the water. Adjusting the pH to < 5.5 (zeta potential < 20 mV) produces rapid flocculation. The observed peak of particulate iron at maximum deep water anoxic conditions is a result of ferrous oxidation exceeding ferric oxide sedimentation and reduction of sedimenting oxide. (Cassar-FRC)
W82-03643

NEUSIEDLERSEE: A PUZZLE FOR SCIENTISTS, A CHALLENGE FOR PLANNERS,

Vienna Univ. (Austria). Zoologisches Inst.
H. Loffler.
Nature and Resources, Vol 17, No 3, p 10-14, July-September, 1981. 4 Fig, 2 Tab.

Descriptors: *Nutrients, *Saline lakes, *Aquatic plants, *Neusiedlersee, Austria, Hungary, Lakes, Recreation, Wildlife, Eutrophication, Water level fluctuations, Water management, Water budget, Water pollution effects.

The Neusiedlersee, a large shallow (1.3 m average depth) lake on the Austria-Hungary border, presents problems for planners and managers. The lake level fluctuates widely. Reeds cover vast areas of water. The water budget, which varies with the climate, has not been clearly defined. Water entering the northern and western part of the lake is alkaline; water entering the southern part is saline. Anthropogenic influences (recreation, nutrient input, and commerical fishing) threaten the shoreline, water quality, and wildlife. In 1980 an Austrian-Hungarian commission was established to manage the lake. Limnologists and managers need much more information on this unusual lake: extent of the catchment area, water and salt budgets, tectonic origin of the lake, seiches, movements of the sediments, and the nutrient dynamics of the reed belt. (Cassar-FRC)
W82-03669

FAUNAL ASSEMBLAGES OF SOME SALINE LAKES NEAR MARCHAGEE, WESTERN AUSTRALIA,

Western Australia Univ., Nedlands. Dept. of Surgery.
S. A. Halse.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 133-142, 1981. 1 Fig, 3 Tab, 27 Ref.

Descriptors: *Saline lakes, *Invertebrates, *Salt tolerance, Lakes, *Australia, *Fauna, Benthic fauna, Aquatic fauna, Fish, Species distribution, Species diversity, Ecological effects, Fish populations, Copepoda, Amphipods.

Fauna in five saline lakes in western Australia were sampled 1 to 4 times during the period March to September 1979, an exceptionally dry year. These lakes ranged from 4 to 650 ha in surface area, 0.15 to 1.3 meters in maximum depth, and 10 to 71 o/oo in salinity. The four more saline lakes had similar faunal assemblages consisting of 6 to 8 species. The most weakly saline lake had 13 species (5 crustaceans and 8 insects). Fish (Pseudogobius olorum) were found only in one lake (salinity 55 o/oo). Copepods and occasionally cladocerans were dominant. Only the amphipod Austrochiltonia subtenuis and the dytiscid Necterosoma penicillatus were present in all five lakes. This study discovered that several species were living at greater salinities than was previously known: A. subtennis at 71 o/oo (previous record 44 o/oo) and Mytilocypris mutiloides at 45 o/oo salinity (previous record, about 10 o/oo). N. pensillatus was found at generally lower salinities than in eastern Australia, and at a record low of 10.5 o/oo for the species. (Cassar-FRC)
W82-03704

SOLUBILITIES OF GYPSUM AND HALITE IN THE DEAD SEA AND IN ITS MIXTURES WITH SEAWATER,

Hebrew Univ., Jerusalem (Israel). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-03708

UNCERTAINTY ANALYSIS OF A LAKE EUTROPHICATION MODEL,

Michigan Univ., Ann Arbor.
D. Scavia.
PhD Thesis, 1980. 178 p, 21 Fig, 11 Tab, 88 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-17359.

Descriptors: *Mathematical models, *Error analysis, *Eutrophication, *Lakes, Water quality, Model testing, Monte Carlo method, *Saginaw Bay model.

The work presented is grouped into three areas: (1) comparison of error analysis by Monte Carlo simulation and by first-order error propagation (EKF in the absence of system observations), (2) calculation of error bounds on the Saginaw Bay model simulation output and the evaluation of relative contributions of various error sources (sensitivity analysis), and (3) use of the system model and observations for parameter estimation and system structure identification. Results from each of these three areas are discussed and recommendations for further investigation are given. (Sinha-OEIS)
W82-03711

ENVIRONMENTAL FACTORS AFFECTING THE GROWTH OF PHOTOSYNTHETIC BACTERIA IN LAKES,

Wisconsin Univ.-Madison.
T. B. Parkin.
PhD Thesis, August, 1980. 360 p, 22 Fig, 7 Tab, 164 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28198.

Descriptors: *Environmental effects, *Aquatic habitats, *Lakes, *Light intensity, *Photosynthetic bacteria, Hydrogen sulfide, Light penetration, Light quality, Color, *Primary productivity.

Photosynthetic bacteria are found in a wide variety of aquatic habitats. In the water columns of lakes, purple and green sulfur bacteria can develop large population densities at the depth where two key

requirements for growth, light and hydrogen sulfide, are present. This study was designed to investigate the effects of light and hydrogen sulfide on the activities of photosynthetic bacteria in lakes. It was found that the color of light penetrating to the sulfide-containing waters in lakes has a major role in determining which types of phototrophs develop. In one lake, red light penetrated to the greatest depth and only green sulfur bacteria capable of using red light were present. In the other lakes, primarily green light penetrated to the sulfide-containing waters and the carotenoid-rich purple bacteria capable of using these wavelengths of light predominated. The effects of light intensity were determined by evaluating the extent to which primary production by the photosynthetic bacteria in seven lakes was influenced by light intensity. A high correlation between primary production by these organisms and light intensity was observed. Production by these organisms did not correlate with either standing crop or sulfide concentration. The study of the effects of sulfide was confined to the bacterial population of a single lake. Rates of sulfide turnover at the thermocline region were estimated by monitoring sulfide oxidation and sulfate reduction rates. Also, the effects of sulfide concentration on photosynthesis and the relationships between sulfide oxidation and carbon fixation rates by this population were elucidated. (Sinha-OEIS)
W82-03712

SULFATE REDUCTION IN THE SEDIMENTS OF A EUTROPHIC LAKE,

Michigan State Univ., East Lansing. Dept. of Microbiology.
R. L. Smith.
PhD Thesis, 1981. 142 p, 19 Fig, 11 Tab, 150 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-26554.

Descriptors: *Sediments, *Eutrophic lakes, *Bacteria, *Sulfates, Carbon cycle, Lake sediments, Sulfate-reducing bacteria, *Sulfate reduction.

This study has demonstrated that high rates of sulfate reduction occur in the sediments of eutrophic lakes despite low interstitial sulfate concentrations. Although profiles of organic sulfur and hydrogen sulfide concentrations suggest otherwise, dissimilatory sulfate reduction appears to be the major mechanism of hydrogen sulfate production. Sulfate-reducing bacteria isolated from these sediments can utilize a wide array of substrates for carbon and/or electron donors; substrates that are typically found in eutrophic sediments. Mineralization experiments in the presence and absence of an inhibitor of sulfate reduction also indicate that sulfate reducers utilize an array of substrates as electron donors and are of potential significance to the in situ mineralization of lactate, propionate, and free amino acids. Based on these results a scheme conceptualizing sulfate reduction in anoxic sediments as it relates to carbon flow is given. The figure demonstrates that sulfate-reducing bacteria can be involved with each major step of oxidative carbon metabolism; the magnitude of the involvement is dependent primarily upon the sulfate concentration available. Ample evidence indicates that when the sulfate concentration is sufficient sulfate reduction mediates carbon flow. (Sinha-OEIS)
W82-03722

2I. Water In Plants

A FIELD STUDY WITH NITROGEN-15 OF SOIL AND FERTILIZER NITRATE UPTAKE AND OF WATER WITHDRAWAL BY SPRING WHEAT,

Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (Germany, F.R.).
O. Strebel, H. Grimme, and H. Fleige.
Soil Science, Vol 130, No 4, p 205-210, October, 1980. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Soil water, *Nitrogen, *Wheat, *Uptake, *Soil-water-plant relationships, Nutrients, Nitrates, Cycling nutrients, Fertilizers, Field tests, Crop production, Plant water potential, Loess, Soil solution, *West Germany.

The uptake of nitrate and water by spring wheat as a function of soil depth and time was studied in field tests on a Parabraunerde (Udalf) soil of West Germany, formed from loess. Radioactively-labeled nitrogen fertilizer was applied three times before sowing, and nitrate levels in the soil solution, soil water content, and soil water suction were determined by suction probes, a neutron meter and tensiometers, respectively. Total vertical water flow, capillary water flow, root water flow, labeled fertilizer, total soil nitrate levels and apparent mass flow of nitrate to roots were calculated and compared to nitrogen uptake at four harvests taken at the first node stage, anthesis, milk stage and maturity. Total uptake of nitrogen at the four harvest stages was 85, 134, 164, and 197 kilograms/hectare, of which 82, 71, 57, and 50% respectively were derived from the labeled fertilizer. The arable layer provided 76% of the total nitrogen uptake by mass flow and 62% of the total water uptake. The low contribution of mass flow to nitrogen supply was attributed to relatively low nitrate concentrations and a favorable water regime. (Geiger-FRC)
W82-03410

THE EFFECT OF ORGANIC MATERIAL AND INORGANIC IONS ON THE PHOTOSYNTHETIC RATE OF RED ALGA BOSTRYCHIA BINDERI FROM A FLORIDA ESTUARY,

University of South Florida, Tampa. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W82-03423

DROUGHT RESISTANCE OF SORGHUM BICOLOR L. MOENCH. 3. SEED GERMINATION UNDER OSMOTIC STRESS,

Saskatchewan Univ., Saskatoon. Dept. of Crop Science.
D. G. Stout, G. M. Simpson, and D. M. Flotre.
Canadian Journal of Plant Science, Vol 60, No 1, p 13-24, January, 1980. 8 Fig, 4 Tab, 21 Ref.

Descriptors: *Drought resistance, *Osmotic pressure, *Germination, Salt balance, Seeds, Growth rates, *Sorghum, Drought, Soil-water-plant relationships.

An in-depth study was conducted of the germination characteristics of two sorghum cultivars previously shown to have different germination characteristics. Since plant hormones are believed to affect drought response of seedlings and adult plants, the effect of plant hormones on seed germination under different osmotic conditions was also examined. The germination responses of the two cultivars were also compared in soil and in different osmotic solutions. The findings support the earlier report that cultivar NK300 has better germination ability than the cultivar M35 under conditions of osmotic stress. These findings demonstrate a genuine difference in seed germination under drought stress. The osmotic solutions (D-mannitol, sucrose and polyethylene glycols) had little effect on the total amount of water taken up by sorghum seeds. The slight reduction in water uptake of seeds exposed to osmotica, compared to seeds exposed to water, may be related to the osmotica inhibiting cell wall expansion. NK300 seeds germinated better than M35 seeds at low water potential. Osmotic stress inhibition of germination is not due to decreased water uptake but instead appears to be due to an inhibition of metabolism in cells which have sufficient turgor potential to permit cell expansion. (Baker-FRC)
W82-03479

MOVEMENT OF CADMIUM AND WATER IN SPLIT-ROOT WHEAT PLANTS,

Oklahoma State Univ., Stillwater. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W82-03662

2J. Erosion and Sedimentation

SOME SUSPENDED SEDIMENT YIELDS FROM SOUTH ISLAND CATCHMENTS, NEW ZEALAND,

Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
G. A. Griffiths.
Water Resources Bulletin, Vol 17, No 4, p 662-671, August, 1981. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Suspended sediments, *Precipitation, *New Zealand, South Island, Catchments, Rainfall, Runoff, Mathematical studies, Sedimentation, *Sediment yield.

Instantaneous suspended sediment concentration and water discharge data were collected at 50 sites throughout South Island, New Zealand. Suspended sediment concentration and corresponding water discharge data were plotted on logarithmic paper. Tentative specific annual suspended sediment yield prediction equations were derived for four specific regions of South Island. An absolute error range, together with the factorial standard errors of the yield prediction equations, have been stated so that an appropriate error value may be deduced for the design of sedimentation aspects of engineering works. The yield prediction equations are not applicable to sites located downstream of major sediment storage basins. It is inferred that lakes and reservoirs effect a reduction in sediment yield through attenuation of flood hydrographs, because suspended sediment concentration ratings were observed to recover to their predam or upstream of lake values within tens of kilometers downstream from storage basins. A guide is given for the estimation of bedload yield by assuming it to be a stated proportion of suspended load yield. Rainfall was the most important parameter considered in terms of influence on suspended sediment yield production. Intensity, frequency, and duration of storms appear to explain the differences in specific yield production between regions for basins having similar rainfalls. (Baker-FRC)
W82-03411

AN EVALUATION OF THE SEDIGRAPH AS A STANDARD METHOD OF SEDIMENT PARTICLE SIZE ANALYSIS,

Hydrological Research Inst. Pretoria (South Africa).
For primary bibliographic entry see Field 7B.
W82-03437

SIZE DISTRIBUTION OF AMAZON RIVER BED SEDIMENT,

Geological Survey, Denver, CO.
C. F. Nordin, Jr., R. H. Meade, W. F. Curtis, N. J. Bosio, and P. M. B. Landim.
Nature (London), Vol 286, No 5768, p 52-53, July 3, 1980. 3 Fig, 9 Ref.

Descriptors: *River beds, *Bottom sediments, Size distribution, *Particle size, *Amazon River, South America, Brazil, Sediment transport, *Sediment distribution, Sand.

Samples of streambed material collected from the Amazon River and its major tributaries along a reach of the river from Iquitos, Peru, about 3,300 kilometers above Macapa, Brazil, to a point 220 kilometers above Macapa were subjected to particle size analyses. Samples collected with pipe dredges or with a US BM-54 bed material sampler were dried aboard ship and transported to the United States for particle size analysis by sieving or by pipette-visual accumulation tube methods. Sample analyses showed that the bed of the Amazon is mostly fine sand. The Amazon River does not show the trend of decreasing particle size for bed material in the downstream direction which is usually found in alluvial streams. Samples taken at several cross-sections demonstrated that the cross-channel variation in particle size at many locations was at least as great as the downstream variations for the entire 3,300 kilometer distance. While the median particle size and sorting coefficient were essentially constant along the Amazon mainstream reach examined, the composition of the bottom sands in the same reach varied significantly. Sands collected near Iquitos contained a larger proportion of dark mineral grains and rock fragments, indicating a predominantly Andean source. Sands in the lower 2,000 kilometer stretch studied contained higher proportions of zircon and tour-

matter and fewer unstable minerals, indicating a dilution of the mainstream material by sands brought in by tributaries from the Precambrian shield areas to the north and south of the river. (Carroll-FRC)
W82-03488

MOVEMENT OF BED MATERIAL IN A SMALL REACH OF A PERENNIAL STREAM,

Clark Univ., Worcester, MA. Dept. of Geography.
A. Zahavi.
PhD Thesis, 1981. 184 p, 20 Fig, 16 Tab, 13 Map, 74 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX 81-18828.

Descriptors: *Sediment transport, *Stream discharge, *Bed load, Saltation, Erosion, Sedimentation, Geomorphology, Spatial distribution, Temporal distribution, Discharge capacity, Bedload discharge, New England.

The underlying and fundamental relations determined in this study are presented in the form of general conclusions. The following three general conclusions appear to be highly reliable: (1) Particle movement is an interaction between stream bed macro morphology and the particle physical properties such as the three axes, shape and weight; (2) Movement is related inversely to a particle's three axes and its weight; and (3) The small particles show a smaller mean distance of movement than that which would be expected if the relation of size with movement were continuous for all particles. In New England, generally only smaller bed particles move during the low summer flows. Larger particles would only be moved during the larger flow of the spring snow melt or by the higher magnitude lower frequency events associated with individual severe storms. This study inquires into the relations between the temporal and spatial discharge patterns and how they affect bedload transport within a small New England stream. (Sinha-OEIS)
W82-03516

BEDLOAD TRANSPORT IN AN OREGON COAST RANGE STREAM,

Georgia Pacific Corp., Fort Bragg, CA.
S. J. O'Leary, and R. L. Beschta.
Water Resources Bulletin, Vol 17, No 5, p 886-894, October, 1981. 9 Fig, 23 Ref.

Descriptors: *Bed load, *Sediment sampler, *Sediment transport, *Flynn Creek, *Oregon, Coastal streams, Streambeds, Streamflow, Sampling.

Two types of sediment samplers (vortex tube and Helley-Smith pressure differential) were used to measure bedload transport for three major storms at Flynn Creek, Oregon. The vortex tube was inefficient in trapping particles < 10 mm in diameter. After adjusting transport rates for this deficiency, results were still only 42-47% of those obtained with the Helley-Smith sampler. Problems with plugging in the Helley-Smith 0.2 mm mesh bag were partially overcome by increasing the bag size threefold and reducing the sampling time to less than 15 sec. Generally, bedload transport increased with increased streamflow. There were large and rapid fluctuations in bedload transport rates even during times of constant streamflow. Some of the possible reasons for the nonuniform sediment transport are: (1) nonuniform channel geometry (pool and riffle), (2) nonuniform particle size, and (3) transient flows in response to precipitation. (Cassar-FRC)
W82-03548

PARTICLE COUNTER FOR SEDIMENT TRANSPORT STUDIES,

Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 7B.
W82-03666

SEDIMENT TRANSPORT BY RAINSPLASH,

Washington Univ., Seattle.
C. J. McCarthy.
PhD Thesis, February, 1980, 228 p, 38 Fig, 2 Tab, 117 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-26269.

Descriptors: *Rainfall impact, *Model studies, *Sediment transport, Slopes, Erosion, Particle size, Rainsplash, Single-drop transport law, Sediment size, Raindrop size.

A model is presented of sediment transport by rainsplash which contains substantial improvements over previous models. The model represents the sediment transport by rainstorms as the sum of the transport of the constituent drops. The dynamics of splashing are modeled qualitatively, and the results used to suggest the form of an empirical transport law for single drops. The single-drop transport law is obtained from analysis of data from detailed observations of rainsplash transport. The model connects the single-drop law with rainfall possessing any drop-size distribution, and is unique in its ability to predict rainsplash transport for any rainfall conditions and under a wide range of sediment sizes and slope angles. Hillslope evolution is modeled using the rainsplash transport law. The situations modeled include an isolated ridge, a weak layer between resistant layers, and the effects of changing base level. This is the first study to model hillslope evolution using a realistic transport law developed for a specific process. (Sinha-OEIS)
W82-03709

FACTORS AND MECHANICS OF BLUFF EROSION ON WISCONSIN'S GREAT LAKES SHORELINES,

Wisconsin Univ.-Madison.
R. J. Sterrett.
PhD Thesis, May, 1980. 390 p, 45 Fig, 14 Tab, 53 Ref, 7 Photo, 13 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-20581.

Descriptors: Erosion, *Erosion rates, Groundwater, Water table fluctuations, Groundwater movement, Slope stability, Solifluction, Rill erosion, Creep, *Shores, *Great Lakes, *Wisconsin, Shoreline recession, *Bluff erosion.

The principal objectives of this study were to quantify the rates of erosion and removal of material from the slope by the processes of sheetwash and rill erosion, slumps, and solifluction. The field investigations were conducted at eight sites on Wisconsin's Great Lakes shorelines. The influence of ground water on slope stability was also investigated. This investigation included defining groundwater gradients, position, and water-level fluctuations within the bluffs. The results of the study indicate that most soil loss occurs during the spring thaw. Up to 96% of all soil lost from a bluff face can occur in the spring as the result of slab slides and mudflows. Large rotational slumps are infrequent in occurrence and contribute only a small percentage of material lost. Sheetwash and rill erosion were found to be effective processes in removing material from the bare soil bluff faces. Ground water is an important factor which is significant in understanding slope stability. Field and computer studies showed that there are two minimally interconnected flow systems operating at several sites on Lake Michigan. One system is within the fractured till at the top of the bluff, and the second is within a sand lens. Water-level fluctuations within the upper fractured till are important in overall stability. Water-table fluctuations along one stretch of Lake Michigan's shoreline appear to be the triggering mechanisms for a 10-meter bluff top recession which occurred in six months. (Sinha-OEIS)
W82-03720

2K. Chemical Processes

HYDROCHEMICAL BALANCE OF AN ALPINE WATERSHED IN SOUTHEAST ALASKA,

Tongass National Forest, Ketchikan, AK.
J. D. Stednick.
Arctic and Alpine Research, Vol 13, No 4, p 431-438, November, 1981. 1 Fig, 4 Tab, 21 Ref.

Descriptors: *Water quality, *Alpine regions, *Chemical composition, Watersheds, *Indian River, *Alaska, Weathering, Minerals, Precipitation, Streams, Surface water.

The water quality balance of Upper Indian River, Chicagof Island, Alaska was investigated during 1979 and 1980. The 8 sq km watershed had an average streamflow of 2825 mm and annual precipitation of 3300 mm. There were net increases in orthophosphate (0.4 kg per ha per year) and in sodium (1.4 kg per ha per year). There were losses (expressed in kg per ha per year) in total nitrogen, 5.9; mg, 5.1; Ca, 475.5; silica, 55.2; sulfur, 36.+5; chloride, 71.3; and potassium, 12.4. Total phosphorus output equaled precipitation input. The major sources of most elements were weathering of rocks and deposition of ocean salts with precipitation. (Cassar-FRC)
W82-03402

RELATION BETWEEN PHC AND SODIUM ADSORPTION RATIO (SAR) AND AN ALTERNATIVE METHOD OF ESTIMATING SAR OF SOIL OR DRAINAGE WATERS,

Science and Education Administration, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W82-03445

WATER CHEMISTRY OF ALABAMA PONDS,

Auburn Univ., AL.
R. G. Arce.
PhD Thesis, June, 1980. 47 P, 20 Fig, 9 Tab, 23 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-18173.

Descriptors: *Water analysis, *Chemical analysis, *Ponds, Soil water, Hardness, Alkalinity, Chemical properties, Watershed management, Fish ponds, *Environmental effects, *Alabama.

Waters from Alabama fish ponds from five soils areas were dilute solutions of alkaline earth carbonates and bicarbonates. Waters also contained low concentrations of sodium, potassium, chloride, and sulfate and trace quantities of iron, manganese, zinc, and copper. Nitrogen and phosphorus concentrations were not measured. The total concentration of ions (averages) by soils area were in the following order: Piedmont Plateau to Coastal Plains to Appalachian Plateau to Limestone Valley and Uplands to Prairies. Differences in total ionic concentrations resulted primarily from differences in carbonate and bicarbonate (total alkalinity) and calcium and magnesium (total hardness) concentrations. Waters of a particular soils area often differed considerably in concentration of all variables, resulting in skewed distributions of data. Therefore, data are presented in histograms for each chemical species and each soils area. Means and standard errors are also presented. Many relationships existed between ions, but few were strong enough to be useful in predicting ionic concentrations. The most useful relationship involves the use of the sum of total hardness and total alkalinity to estimate total ionic concentrations. Watershed management practices did not greatly affect concentrations of major ions, but ponds in woods often had organically stained water, those in pastures often had plankton blooms, and the ones filled by runoff from watershed planted to row crops were often turbid with suspended soil particles. (Sinha-OEIS)
W82-03534

THE ORIGIN AND EVOLUTION OF SALINE FORMATION WATER, LOWER CRETACEOUS CARBONATES, SOUTH-CENTRAL TEXAS, U.S.A.,

Texas Univ. at Austin. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W82-03540

MINOR - ELEMENT DISTRIBUTION IN MINERAL AND THERMAL WATERS (REPARTITION DES ELEMENTS TRACES DANS LES EAUX THERMO-MINERALS),

Grenoble Univ. (France). Unite de Geologie et de Pharmacie.
For primary bibliographic entry see Field 2F.
W82-03541

GEOCHEMICAL AND ISOTOPIC CHARACTERISTICS OF SPRING AND GROUNDWATER IN THE STATE OF SAO PAULO, BRAZIL,

Sao Paulo Univ. (Brazil). Inst. de Geociencias.
For primary bibliographic entry see Field 2F.
W82-03542

FACTORS OF THE CHEMICAL COMPOSITION OF SEEPAGE AND GROUNDWATERS IN THE INTERTROPICAL ZONE (WEST AFRICA),

Organisation de Recherche Scientifique-Technique d'Outre-Mer, Paris (France).
E. J. Roose, and F. Lelong.
Journal of Hydrology, Vol 54, No 1-3, p 1-22, December, 1981. 6 Fig, 4 Tab, 20 Ref.

Descriptors: *Minerals, *Groundwater, *Chemical properties, *Seepage, *Tropic zone, Drainage, Surface drainage, Hydrogen ion concentration, Soil profiles, Soil science, Spring water, Runoff, Rainfall, Physicochemical properties, Organic carbon, Cations, Anions, *West Africa.

During four to eleven years of field studies, 5,000 samples of rainfall, throughfall, runoff, drainage, and groundwater were examined as part of a research program on the dynamics of the ferralitic and ferruginous soils of West Africa. All of the water samples analyzed were slightly mineralized, with increasing mineralization from rainfall water to seepage water at 2 m depth. The mineral content generally decreased at the water table level except for Si and Na content. The amounts of dissolved solids varied markedly with flow volumes and seasons. The factors governing the chemical composition of the groundwaters were very complex. The composition of water in the soil layers was affected basically by biological and biochemical processes, while that of the groundwaters was dependent mainly upon physicochemical properties. (Geiger-FRC)
W82-03543

NATURAL TEMPORAL VARIATIONS IN THE CHEMISTRY OF SHALLOW GROUNDWATER, ATHABASCA OIL SANDS AREA, ALBERTA,

Stanley Associates Engineering Ltd., Edmonton (Alberta).
D. A. Hackbarth.
Canadian Journal of Earth Sciences, Vol 18, No 10, p 1599-1608, October, 1981. 6 Fig, 2 Tab, 24 Ref.

Descriptors: *Seasonal variation, *Water quality, *Groundwater level, *Gochemistry, Chemical composition, Athabasca Oil Sands, *Alberta, Calcium, Magnesium, Bicarbonates, Sulfates, Chlorides, Solutes, Sodium, Potassium, Carbonates, Nitrates, Silica, Water table fluctuations, Shallow wells, Groundwater recharge, Recharge.

The chemistry of shallow groundwater in the Athabasca oil sands area, Alberta, showed annual variations during sampling conducted from 1977-1979. Three wells, 5 to 8 m deep, were located in an area with 99% natural vegetation within 30 miles of oil sands mining developments. Coefficients of variation were highest for nitrates, 100-132%, and for all parameters averaged 34% for the well sampled monthly and 11 and 21% for the two wells sampled bimonthly. The annual pattern of variation in chemistry of the shallow groundwater was related to the level of the water table. Calcium, magnesium, and bicarbonate concentration were lowest in spring, highest in summer. This is related to the carbon dioxide in the recharge water, controlled by the muskeg. Sulfates were highest in spring and fall, during periods of significant groundwater recharge. Chloride concentrations were highest in winter, lowest in spring and summer, reflecting the slower groundwater flow in winter and greater residence time in the chloride-bearing minerals. Water chemistry varied less at wells of greater depth. Coefficient of variation at 150 m was 4%. (Cassar-FRC)
W82-03611

'ACID RAIN', DISSOLVED ALUMINUM AND CHEMICAL WEATHERING AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,

Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W82-03641

IDENTIFICATION OF CONNATE WATER IN INTERSTITIAL SOLUTION OF CHALK SEDIMENT,

Institute of Geological Sciences, Wallingford (England).
A. H. Bath, and W. M. Edmunds.
Geochimica et Cosmochimica Acta, Vol 45, No 9, p 1449-1461, September, 1981. 7 Fig, 4 Tab, 21 Ref.

Descriptors: *Connate water, *Geochemistry, *Groundwater dating, Chemical composition, Solute transport, Interstitial water, Pore water, Meteoric water, *Chalk formation, Isotope studies, Dating, Carbonate aquifers, Diagenesis, Geohydrology, Diffusion model.

The interstitial solution chemistry of core samples from a 594 meter borehole (41 m of glacial deposit, 472 m of carbonate) in the Upper Cretaceous Chalk formation near Norfolk, England, was investigated. In general, dissolved species (chloride, Na+, K+, Ca(2+), Mg(2+), bromide, sulfate, and Li+) were most dilute near the surface and increased in concentration with depth to a near-marine composition. Sr(2+) and fluoride concentrations decreased up to 100-200 meters depth and showed anomalous behavior at greater depths. O18 and D values for interstitial water became less negative with increasing depth and were correlated with the changes in salinity. The observed pattern of increasing salinity with depth suggests that meteoric water has diluted the interstitial water. The deepest water is connate, subsequently modified by diagenetic reaction. The same ratio of Na+:Cl- is maintained throughout the entire profile. Departures from the expected dilution trend (K+, Sr+, Li+, and fluoride) are probably a result of diagenetic reactions during burial or a result of freshwater circulation following uplift of the sediments. Analysis of the Chalk itself showed a general uniformity of Mg and Sr, despite a wide variation in interstitial solution compositions, suggesting that there was no general recrystallization of the carbonates. A diffusion model was applied to the dilution of the connate interstitial solution. The beginning of mixing was calculated at 3 million years age (late Tertiary). The discrepancy between stable isotope composition and chemical composition of interstitial solutions can be attributed to different diffusion rates of the water and solute species. (Cassar-FRC)
W82-03642

THE ORIGIN AND ISOTOPIC COMPOSITION OF DISSOLVED SULFIDE IN GROUNDWATER FROM CARBONATE AQUIFERS IN FLORIDA AND TEXAS,

Geological Survey, Lakewood, CO.
R. O. Rye, W. Back, B. B. Hanshaw, C. T. Rightmire, and F. J. Pearson.
Geochimica et Cosmochimica Acta, Vol 45, No 10, p 1941-1950, October, 1981. 5 Fig, 2 Tab, 27 Ref.

Descriptors: *Aquifers, *Sulfides, Chemical composition, Groundwater, *Florida, *Texas, Hydrogen sulfide, Edwards aquifer, Floridan aquifer, *Carbonate aquifers.

Evidence is presented on the co-existing and simultaneously collected reduced sulfur species in a Florida aquifer. The total sulfur values of dissolved sulfide and the sulfur isotope fractionations between dissolved sulfide and sulfate species in the groundwater generally correlated with dissolved sulfate concentrations, which were related to flow patterns and residence time within the aquifer. The dissolved sulfide derives from the slow in situ biogenic reduction of sulfate dissolved from sedimentary gypsum in the aquifer. Where the water is the oldest, the dissolved sulfide apparently had attained isotopic equilibrium with the dissolved sulfate at the temperature of the system, which was 28 degrees C. This approach to equilibrium reflects an extremely slow reduction rate of the dissolved sulfate by bacteria. This slow rate probably results from very low concentrations of organic matter in the aquifer. In the reducing part of the Edwards aquifer, located in Texas, there was a general down-gradient increase in both dissolved sulfide and sulfate concentrations, but neither the total sulfur values of sulfide nor the sulfide-sulfate isotope fractionation correlated with the groundwater flow pattern. The dissolved sulfide species appeared to be derived mainly from biogenic reduction of sulfate ions, whose source is gypsum dissolution, even though upgradient diffusion of hydrogen sulfide gas from deeper oil field brines may be significant in some places. (Baker-FRC)
W82-03644

THE INFLUENCE OF PERIPHERAL SABKHAS ON THE GEOCHEMISTRY AND SEDIMENTOLOGY OF A TUNISIAN LAGOON: BAHIRET EL BIBAN,

K. Medhioub, and J. P. Perthuisot.
Sedimentology, Vol 28, No 5, p 679-688, October, 1981. 13 Fig, 2 Tab, 10 Ref.

Descriptors: Evaporation, *Saline water, *Tidal flats, Arid lands, *Geochemistry, Calcium sulfate, *Sedimentology, Chemical composition, Water circulation, *Lagoons, Sabkhas, Bahiret el Biban, *Tunisia.

Bahiret el Biban, a limited-circulation lagoon on the Tunisian coast, is separated from the Mediterranean by a narrow barrier broken by an inlet. On the inland border of the lagoon are sabkhas, or wide tidal flats now 0-2 m above sea level, which were formed from marine sediments. The chemical behavior of the lagoon was studied March 1976-August 1977. Water is more saline at greater distances from the seawater inlets. Salinity is higher in summer, when evaporation is greater than in winter, when freshwater dilution can take place. Water was more saline in 1977 than in 1976. Bottom waters are more concentrated than surface waters. Calcium sulfate is gradually lost, mostly by evaporitic evolution and sulfate reduction in the adjacent sabkhas. Here the interstitial waters are high in dissolved solids. This lagoon is a possible example of the early stages in evolution of an evaporatic basin. (Cassar-FRC)
W82-03684

SOLUBILITIES OF GYPSUM AND HALITE IN THE DEAD SEA AND IN ITS MIXTURES WITH SEAWATER,

Hebrew Univ., Jerusalem (Israel). Dept. of Geology.
A. Katz, A. Starinsky, N. Taitel-Goldman, and M. Beyth.
Limnology and Oceanography, Vol 26, No 4, p 709-716, July, 1981. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Saline lakes, *Saturation, *Solubility, Chemical precipitation, Lakes, Salts, Saline water, Gypsum, Calcium sulfate, Halite, Sodium chloride, Brines, *Dead Sea, Israel, Seawater.

The entire Dead Sea water column (ionic strength = 9-10) is saturated or slightly oversaturated with respect to both gypsum ($CaSO_4.2H_2O$) and halite ($NaCl$). This was determined by chemical analysis of mixtures of Mediterranean seawater (ionic strength = 0.8) and Dead Sea brines (ionic strength = 9) over the ionic strength range of 3 to 13. Higher ionic strength solutions were produced by evaporation. The practical solubility constants of gypsum were found to be related to the ionic strength by an empirical expression. The average degree of saturation for gypsum was 1.16 (range 1.08-1.43); for halite, 0.95-1.17. Summer temperatures are expected to decrease the gypsum saturation values in the upper 30 meters of water (at

ambient temperatures, 1.22-1.43) by 10-15%. (Caesar-FRC)
W82-03708

2L. Estuaries

ANALYSIS OF TEMPORAL CHANGES IN FISH ASSEMBLAGES IN SERPENTINE CREEK, QUEENSLAND,

Queensland Univ., Brisbane (Australia). Dept. of Zoology.
N. J. Quinn.
Environmental Biology of Fishes, Vol 5 No 2, p 117-133, April 22, 1980. 14 Fig, 4 Tab, 62 Ref.

Descriptors: *Fish populations, *Species diversity, *Seasonal variation, Estuaries, Bramble Bay, Serpentine Creek, *Australia, Temperature, Salinity, Biological communities, Time series analysis.

Nocturnal fish populations at 10 sites in Serpentine Creek and Bramble Bay, near Brisbane, Australia, were surveyed every two weeks from November 1975 to April 1977. Forty-five species from 34 families (14,518 individuals) were obtained. The six most abundant species accounted for 72% of the catch. Creek salinities and temperatures followed an annual cycle, which preceded the bay by 1 month. Minimum salinity was found in February, and maximum temperature in January. The mean number of species and abundance of all fish conformed to a regular annual pattern, with maxima in April and May. Shannon and Gleason diversity indices showed no regular seasonal trends. Of the twenty-two most abundant species, seventeen demonstrated a regular annual cycle of abundance. Number, abundance, and diversity were greatest about 1 km upstream from the creek mouth and gradually declined upstream. Temperature and/or salinity were positively correlated with the abundance of 11 species. Fish were classified into 5 groups: resident (only Spheroides pleurostictus), transient (infrequent, sporadic), annual (possibly tolerant to variable abiotic conditions), abiotically influenced species (dependent on salinity/temperature), and seasonal (related both to abiotic values and to an annual cycle). The low proportion of resident species is consistent with Tyler's (1971) theory that temperature instability is reflected in instability in assemblages of fish species. (Caesar-FRC)
W82-03407

ON THE CONSPECIFICITY OF MARINE AND FRESHWATER BANGIA IN BRITAIN,

Liverpool Univ. (England). Hartley Botanical Labs.
R. H. Reed.
British Phycological Journal, Vol 15, No 4, p 411-416, December 1, 1980. 1 Fig, 22 Ref.

Descriptors: *Salt tolerance, *Algae, *Bangia, Salinity, Estuaries, Marine plants, *United Kingdom, Aquatic plants.

The salinity responses of marine (Port St. Mary, Isle of Man, United Kingdom) and freshwater (Leeds-Liverpool Canal at Wigan) Bangia isolates were studied in laboratory cultures to test the conspecific theory. After two generations immature germlings of the marine isolate were introduced into waters of varying salinity (natural seawater, freshwater and mixtures), where they grew over the whole salinity range. Growth was optimum in full-strength seawater. The freshwater isolates grew best in 1/16 to 1/2 seawater, and least well in 1/32 and full-strength seawater. Although most mature plants of the marine isolate died when placed in fresh water, a few cells in some thalli survived and formed a bottlebrush structure after 8-10 weeks dormance. These produced new plants, which did not reproduce. This evidence suggests a marine origin for freshwater Bangia and adds weight to the argument that the two are not separate taxa. (Caesar-FRC)
W82-03408

THE EFFECT OF ORGANIC MATERIAL AND INORGANIC IONS ON THE PHOTOSYNTHETIC RATE OF RED ALGA BOSTRYCHIA BINDERI FROM A FLORIDA ESTUARY,

University of South Florida, Tampa. Dept. of Biology.
C. J. Dawes, and R. P. McIntosh.
Marine Biology (Berlin), Vol 64, No 2, p 213-218, September, 1981. 6 Fig, 4 Tab, 24 Ref.

Descriptors: *Algal growth, *Estuaries, *Salinity, Photosynthesis, Nutrients, Sea water, Calcium, Spring water, *Florida.

Comparisons of photosynthetic rates were made on Bostrychia binderi held in seawater diluted to various salinities, artificial spring water, and distilled water to determine which components of spring water may be particularly important to the alga's survival in estuarine waters. The rate of photosynthesis increased with decreases in salinity. Higher photosynthetic rates when salinity was 0 and 5 ppt were partially due to increased levels of bicarbonate and various nutrients. When plants were held for three to seven days in spring water of low salinity (0-5 ppt), the higher calcium levels caused a higher photosynthetic rate. When salinity was 5 ppt or higher, the effect of calcium on the photosynthetic rate was not apparent after 2 to 8 weeks due to acclimation. The diverse algal populations characteristic of estuaries on the west coast of Florida may be due at least in part to natural spring water mixing with the seawater and sustaining the algae over short periods of low salinity. (Small-FRC)
W82-03423

ESTUARINE DISTRIBUTION OF SAPROLEGNIACEAE IN THE TAMPA BAY AREA: I,

University of South Florida, Tampa. Dept. of Biology.
D. Tes. Wagner-Merner.
Botanica Marina, Vol 23, No 11, p 707-709, November, 1980. 2 Tab, 14 Ref.

Descriptors: *Estuaries, *Aquatic fungi, Distribution patterns, *Tampa Bay, Salinity, Nutrients, Growth.

This study attempted to determine what Saprolegniaceae are distributed in a small estuary in the Tampa Bay Area. Bullfrog Creek, the area studied, is located in the heart of the county agricultural district but is subject to minimal agricultural drainage. The collecting of Saprolegniaceae from the estuary was carried out by laboratory or in situ hemp seed baiting techniques. It appeared from the findings of the study that some species of Saprolegniaceae are limited in their occurrence in southeastern estuaries. No evidence was forthcoming that a correlation existed in fungal distribution in a natural aquatic habitat between temperature and salinity tolerance. It is suggested that additional studies are needed on competition among water molds on quantified and equal baits in order to understand estuarine mycology more fully. (Baker-FRC)
W82-03469

STUDY OF THE TRANSFER OF CD, PB, CU AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - II. BIOLOGICAL ACCUMULATION IN PLANKTONOPHAGE FISH. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERITIQUES ET ESTUARIENNES-II. ACCUMULATION BIOLOGIQUE CHEZ LES POISSONS PLANCTONOPHAGES),

Institut des Sciences de la Nature, Nantes (France). Lab. d'Ecologie Animale et Biologie Marine; and Nantes Univ. (France). Lab. de Biologie Marine.
C. Amiard-Triquet, C. Metayer, J. C. Amiard, and R. Ferre.
Water Research, Vol 14, No 9, p 1327-1332, September, 1980. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Accumulation, *Heavy metals, *Fish, Metals, *Estuaries, *France, Crustaceans, Bioaccumulation, Copepods, Mysids, Path of pollutants, Food chains, Loire estuary.

Plankton-feeder fish (anchovies, sprats, garfish and herring) and their prey (mainly Copepods and Mysids) were obtained from the banks of Bilho and Pipy in the Loire estuary in August 1977 to October 1978. Trace element (Cd, Pb, Cu and Zn) concentrations in organisms from different levels of the food chains were compared using the transfer factor (the ratio of the concentration in the predator to that in the prey). This factor was generally lower than 1 for Cd, Pb and Cu but often higher than 1 for Zn. This does not conclusively indicate biomagnification of Zn in the food chain, since the level of Zn in the predator used to calculate the transfer factor results from the accumulation of both food and water. The differences observed between the two zoological groups were partly due to the fact that determinations were made after elimination of the digestive content for the fish, while for the crustaceans the digestive content was included. Analysis of the results and literature data indicate that the order of biological accumulation was Cd < Pb = Cu < Zn in fish and Cd < Pb < Cu < Zn in crustaceans. The difference was due to the metabolic role of Cu in crustaceans as a constituent of respiratory pigment. During digestion there was often a slight decrease of metal concentrations between the prey and stomach content, followed by an increase of the metal levels in intestinal contents compared to the stomach. (Hertzoff-FRC)
W82-03491

STUDY OF THE TRANSFER OF CD, PB, CU, AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - I. STATE IN THE INTERNAL ESTUARY OF THE LOIRE (FRANCE) DURING THE SUMMER OF 1978. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERITIQUES ET ESTUARIENNES - I. ETAT DANS L'ESTUAIRE INTERNE DE LA LOIRE (FRANCE) AU COURS DE L'ETE 1978),

Nancy-1 Univ. (France). Lab de Chimie et d'Electrochimie Analytique et d'Hydrologie.
For primary bibliographic entry see Field 5B.
W82-03492

DYNAMICS OF BACTERIOPLANKTON IN THE NEWPORT RIVER ESTUARY,

North Carolina State Univ. at Raleigh. Dept. of Marine Science and Engineering.
A. V. Palumbo.
PhD Thesis, 1980. 124 p, 16 Fig, 29 Tab, 107 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-00809.

Descriptors: *Estuaries, *Organic matter, *Bacteria, Plankton, Particulate matter, Dissolved oxygen, Amino acids, Dissolved organic carbon, *Newport River estuary, *North Carolina.

The numbers of the bacterioplankton and the turnover times of dissolved organic compounds in the Newport River estuary are comparable to the numbers and turnover times observed in other studies, especially those done in estuaries. Bacterial populations which occur in the riverine and estuarine areas respond to changes in pH, salinity, temperature and substrate concentration. Resuspension of benthic bacteria does not seem to be the source of the relatively high biomass and activity of the bacterioplankton in the upper estuary. However, release of DOC from the organic rich anaerobic sediments of the upper estuary could be very important. The data supports the hypothesis that the mid-salinity mixing basin above Cross Rock is the primary area of active bacterial growth. There seems to be much less activity and production of bacteria in the river and in the high salinity water of the lower estuary. The maximum bacterial activity and biomass occur during the warmest months and temperature is correlated positively with ADDC, PAV, and negatively with turnover time. The large quantities of DOC in the river do not seem to stimulate bacterial growth until the fresh water mixes with the salt water. The increased pH and perhaps the increased concentration of readily-degradable organic matter released from the shallow anaerobic sediments and from the phytoplankton results in the increase in bacterial numbers and activity in the upper estuarine mixing zone. The data on the respiration of amino acids by natural bacterial populations and the biomass of bacteria in

marine and estuarine waters support the hypothesis that bacteria are an important source of particular organic matter. (Sinha-OEIS)
W82-03520

REMOVAL OF HEXAVALENT CHROMIUM FROM ESTUARINE WATERS BY MODEL SUBSTRATES AND NATURAL SEDIMENTS,
Maine Univ. at Orono.
For primary bibliographic entry see Field 5G.
W82-03637

PHYSICAL MODELING OF ROTTERDAMSE WATERWEG ESTUARY,
Waterloopkundig Lab., Delft (Netherlands). Basic Research Div.
H. N. C. Breusers, and A. G. van OS.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1351-1370, November, 1981. 9 Fig, 13 Ref.

Descriptors: *Model studies, *Estuaries, Estuarine environment, Hydraulics, Mathematical models, Salinity, Sedimentation, Tides, Water quality, Navigation, *Rotterdamse Waterweg estuary, *Holland.

Modeling techniques are considered for the difficult case of the Rotterdamse Waterweg Estuary, where salt intrusion and water quality modeling impose great demands on the capabilities of the techniques employed. A thorough evaluation of the research possibilities of this area indicated that at present only a complementary approach with hydraulic and mathematical modeling is feasible. It was concluded that mathematical models do not yet yield the possibility to predict in sufficient detail the flow velocity and salinity field. Thus the main tool for estuarine problems is the physical scale model. Mathematical models can be used successfully for the study of transport of pollutants and sediments. A hydraulic scale model with a partial black-box character proves to be the most powerful tool for the study of estuaries, provided certain requirements are met. The hydraulic model should be calibrated very carefully, with special emphasis on the influence of possible scale effects due to distortion and Reynolds number influences. The verification tests of the physical model of this estuary proved that reproduction of water levels and flow pattern is possible to the required accuracy if proper boundary conditions are known. Mathematical models are useful in predicting discharges at model boundaries. The model sea boundary should be operated with discharge control. In this case, where wall roughness was dominant, no additional mixing was needed after calibration of the total roughness on the tidal propagation with bed elements. This model has been useful in providing support for management decisions related to the development of the estuary. (Baker-FRC)
W82-03671

HEATED DISCHARGE IN AN ESTUARY: CASE STUDY,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
J. B. Nystrom, G. E. Hecker, and H. C. Moy.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1371-1406, November, 1981. 26 Fig, 1 Tab, 20 Ref.

Descriptors: *Model studies, *Thermal pollution, *Estuaries, Temperature effects, Flow profiles, Heated water, Powerplants, *Nuclear powerplants, Rivers, Estuarine environment, *Hudson River, *Indian Point Nuclear Powerplant.

Two physical model studies were made to evaluate the thermal patterns produced in the Hudson River by the water discharged from the condenser cooling unit from the Indian Point Nuclear Generating Station. Tidal flows dominate the hydraulics of the receiving water body, the Hudson River, which is classed as a partially stratified estuary. Salt from the ocean intrudes into the estuary past the Indian Point site for freshwater flow rates less than about 20,800 cubic feet/second, and relatively strong vertical mixing causes vertical salinity gradients to be relatively weak. Similitude criteria are developed for the design of models to predict near field temperature patterns. These criteria are applied in conjunction with practical considerations. The undistorted near-field model was constructed to a scale of 1-75. Near-field thermal patterns were obtained to evaluate maximum temperature rises, direct recirculation, and to calibrate the distorted scale model outfall structure. The distorted scale model, constructed to a scale of 1-400 and a vertical scale of 1-800, was used to determine thermal patterns in the intermediate-far-field. Typical results show surface temperature rise patterns near the plant discharge and within a 15 mile reach load, and discharge structure geometries are illustrated. Model results are evaluated with respect to scale effects and limitations due to inability to simulate certain phenomena occurring in the field. Model results are compared to an extensive field survey program and a one-dimensional time averaged mathematical model. (Baker-FRC)
W82-03674

DEEP WATER RENEWAL IN SUBARCTIC FJORD,
Woodward-Clyde Consultants, Anchorage, AL.
J. M. Colonell.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WW4, p 223-231, November, 1981. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Fjords, *Mixing *Water exchange, Subarctic zone, Surface water, Meteorological data collection, Estuaries, *Tidal effects, Tidal currents, Flushing, Current meters, Weather, *Port Valdez, Prince William Sound, *Alaska.

Port Valdez, at the marine terminal of the trans-Alaska Pipeline System, is located on a subarctic fjord. Currents were studied in Valdez Narrows for over 2 years to examine the exchange of water between the port and Prince William Sound. Surges of surface water from Prince William Sound into Port Valdez appear to be related to the passage of weather systems through southcentral Alaska. These events are random and cause variable flushing rates, probably of no more than several days according to outflow volumes recorded on current meter data. These observations suggest that a unique residence time for Port Valdez is inappropriate, but a composite residence time may be estimated at no more than a few weeks. These estimates depend upon assumptions of fairly uniform mixing throughout Port Valdez and should apply to other fjords of southcentral and southeastern Alaska and northern British Columbia. (Geiger-FRC)
W82-03675

MERCURY IN COASTAL AND ESTUARINE SEDIMENTS OF THE NORTHEASTERN IRISH SEA,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-03696

ENRICHMENT OF DISSOLVED PHENOLIC MATERIAL IN THE SURFACE MICROLAYER OF COASTAL WATERS,
Maine Univ. at Orono. Dept. of Oceanography.
D. J. Carlson, and L. M. Mayer.
Nature (London), Vol 286, No 5772, p 482-483, July, 1980. 3 Fig, 40 Ref.

Descriptors: *Estuaries, *Surface water, *Phenols, Bacteria, Microorganisms, Coasts, Enrichment, Dissolved solids, Saco River, *Maine, Damariscotta River, Industrial wastes, Salinity, Chemical properties, Coastal waters.

Ultraviolet absorbance, dissolved organic carbon (DOC), and phenolic material were examined in the bulk and surface microlayer waters of the Damariscotta and Saco River estuaries. The Damariscotta River estuary is a 30 m long, narrow embayment in central Maine with limited fresh-water input, predominantly overflow from Dameriscotta Lake. The Saco River is a major drainage system in southern Maine. Data from these estuaries demonstrate consistent microlayer enrichment of UV absorbance, and hence of phenolic material. DOC levels did not exhibit consistent enrichment. Most samples plot above the line of equal microlayer partitioning of UV absorbance and DOC. This indicates preferential enrichment of phenoloc material relative to other DOC. While the enrichment of phenolic material occurs at all salinities, it is greatest at higher salinities. This trend may be due to three factors. First, terrigenous humic DOC becomes less soluble at high salinities. Second, higher enrichments at high salinities may simply reflect an aging phenomenon. Third, this may be evidence of different partition coefficients for the two different sources of phenols. The surface microlayer may be temporary sink and a reaction site leading to the resolubilization of strongly UV-absorbing molecules in bulk water or their removal to the atmosphere. (Baker-FRC)
W82-03749

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HYGIENIC EVALUATION OF THE POLYAMIDE MEMBRANE PHEYLONE-2S AND PHENOL FORMALDEHYDE RESIN VIAM-B FOR USE IN REVERSE OSMOSIS TREATMENT OF WATER. (GIGIENICHESKAYA OTSENKA POLIAMIDNYKH MEMBRAN FENILON-2S I FENOLFORMAL'DEGIDNOI SMOLY VIAM B, PRIMENENYAEMYKH PRI OBRATNOOSMOTICHESKOM OPRECHNENII VODY),
Institute of General and Municipal Hygiene, Moscow (USSR).
Yu Rakhmanin, T. A. Solokhina, R. V. Merkur'eva, and K. P. Ershova.
Gigiena i Sanitariia, No 10, p 19-22, October, 1981. 4 Tab, 7 Ref. (English Summary).

Descriptors: *Desalination, *Membranes, *Reverse osmosis, Water pollution effects, Polymers, Materials testing, Plastics, Resins, Evaluation, Water treatment, Drinking water, *Water treatment.

New polyamide membranes composed of phenylone-2s were evaluated for use in water supply systems. The membranes consisted of hollow fibers adhered together with phenol-formaldehyde resin VIAM-B. Under certain conditions, both the phenylone-2s and the phenol-formaldehyde resin may release harmful chemicals into the water, which adversely affect warm-blooded animals and water quality. Such adverse effects were not observed under industrial conditions typical of water desalination by reverse osmosis. In view of these findings both polymers are recommended for use in residential water supply systems.
W82-03698

SALT REMOVAL FROM BRACKISH WATER BY CONTINUOUS PROCESSES WITH AMPHOTERIC, THERMALLY REGENERABLE ION-EXCHANGE RESINS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
T-B. Hsu.
PhD Thesis, June, 1981. 367 p, 95 Fig, 10 Tab, 144 Ref, 9 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-23816.

Descriptors: *Desalination, *Separation techniques, *Resins, *Ion exchange, Adsorption, Brackish water, Computer programs, Continuous flow, Thermal regeneration.

Two amphoteric, thermally regenerable ion-exchange resins, Amberlite XD-2 and Amberlite XD-5, have been utilized to remove salt from brackish water by continuous processes. The physical and chemical properties of both resins have been studied, including their resin capacity, density, poros-

ity, swelling phenomena, etc. The kinetic study of mass transfer in these resins has been carried out by means of frequency analysis during forced temperature cycling and also by fixed-bed breakthrough experiments. Amberlite XD-2 has a higher mass transfer rate than Amberlite XD-5. Both the results of theoretical simulation and the experimental results have been used for the evaluation of a 'Truly Countercurrent, Continuous Adsorption' process to remove salt from water. Amberlite XD-2 showed better separation performance than Amberlite XD-5 under the same operation conditions. The linear-equilibrium-line case, which may be important for dilute concentrations, was also simulated theoretically. The concept of a 'Quasi-countercurrent, Continuous Progressive-zone Adsorption' process has been proposed and studied from a theoretical viewpoint for cases with either linear or non-linear Langmuir equilibrium isotherms. A 'Continuous-flow, Stirred-Tank Reactor' theory and a 'Plug-flow, Fixed-bed Reactor' theory were derived to describe the behavior of this process. The more columns a ACPA process has, the closer it can approach the ideal of truly countercurrent operation. A 4-column QCPA process simulates truly countercurrent operation reasonably well. (Sinha-OEIS)
W82-03726

FROM SCREENING TO FILTRATION: TREATING THE WATER SUPPLY,
New Jersey Inst. of Tech., Newark.
H. S. Hundal, R. B. Trattner, and P. N. Cheremisinoff.
Water and Sewage Works, Vol 127, No 1, p 54-55, January, 1980. 9 Fig, 24 Ref.

Descriptors: *Seawater, *Desalination plants, *Reverse osmosis, Freezing, Electrodialysis, Costs.

Methods for obtaining freshwater from seawater are reviewed. Freezing can be used for this purpose because when water is frozen it forms crystals that are structurally free of salt. The salt remains on the surface of the crystal and can be washed off. There is not yet any fully satisfactory method of washing ice crystals, however. Electrodialysis utilizes electricity and ion-selective membranes to remove salt. This process has been used to treat brackish water, but its application to seawater is limited by its high electricity requirements. Reverse osmosis has a low energy requirement and requires relatively simple equipment. About 95% of dissolved solids can be removed in a single unit, but two units would be required to make seawater potable. Fouling of the membrane by salt deposits can be a problem. Costs of desalination vary from about $0.60-$2/1000 gal. (Small-FRC)
W82-03739

3B. Water Yield Improvement

'NADIS', THE VITAL WATER RESOURCES OF THE INDIAN ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, and D. C. Joshi.
Journal of Arid Environments, Vol 4, No 3, p 247-251, September, 1981. 2 Fig, 3 Tab, 1 Ref.

Descriptors: *Catchment basins, *Water supply development, *Construction methods, Design criteria, Nadis, *India, Arid lands, Soil types, Water management, Land management, *Water storage, Water resources, Water harvesting, Runoff, Storage reservoirs, Ponds.

One hundred nadis, ponds excavated in arid regions of India to capture and store precipitation for later use, were studied to provide a scientific basis and to suggest possible improvements in design and construction. At present villagers rely on their experience to select the best nadi sites. The physiographic settings of the five types of nadis in Nagaur district, West Rajasthan, were: dune complex (18 observations), sandy plain with deep soil (15), sandy plain underlain by concretion zone (21), younger alluvial plain (33), and rocky/gravel pediment (13). Their average depths were 2.2, 3.8, 6.0, 4.4, and 3.2 meters, respectively. Average volumes were (in thousands of cu meters): 23.5, 58.1, 192.1, 130.1, and 131.8, respectively. Catchment areas were 55.1, 94.3, 454.1, 313.7, and 300.1 hectares, respectively. Density was lowest in the dune complex (8 per 100 sq km) and highest in rock/gravel sediment (35 per 100 sq km). Average duration of use after filling was : 3.4, 3.8, 9.2, 11.3, and 9.9 months, respectively. Nadi volume was directly related to catchment area irrespective of surface, physiography, and rainfall. Highest nadi volumes were observed on dunes and sandy plains with slopes of 1-2%. It is recommended that nadis should be dug down to the CaC03 concretion zone in sandy soils. In dune and sandy areas, the catchment slope should be less than 2%, and in younger alluvial and rocky/gravel areas, greater than 2%. In dune areas nadi volumes are greater in the 300-350 mm rainfall zone than in higher rainfall areas. (Cassar-FRC)
W82-03413

A NOTE ON MINIMIZING TEMPERATURE RISE BY RESTRICTING EVAPORATION FROM SMALL OPEN WATER SURFACES,
Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Water S A, Vol 7, No 2, p 71-75, April, 1981. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Evaporation control, *Water storage, *Water temperature, Lake evaporation, Reservoir evaporation, Evaporation, Temperature, Energy, Mathematical studies, Dissolved oxygen, Acid climates, Precipitation gages.

A theoretical analysis of the surface energy budget was performed to calculate the effect on water and temperature evaporation of using small, floating polystyrene spheres to cover open water surfaces. The temperature change was found to be related primarily to the reflectivity of the spheres and not to the percent coverage. Only total coverage will prevent evaporation, although if 0.8 of the surface is covered, there is an evaporation savings of 80%. Thus, for a large body of water, considerable savings in evaporative losses can be achieved together with a lowered water temperature even if the spheres are disturbed by, for example, the wind. In areas where there are water shortages, the cost of the covering material may be justified. When stored water is covered, there are higher concentrations of dissolved oxygen at saturation, unwanted plant growth is discouraged, and the water is more palatable. (Small-FRC)
W82-03440

RUNOFF PREDICTION AND RAINFALL UTILIZATION IN THE SEMI-ARID TROPICS,
Utah State Univ., Logan. Dept. of Engineering.
For primary bibliographic entry see Field 2A.
W82-03502

A CENTURY OF EFFORT QUENCHES HONG KONG'S THIRST,
Y. L. V. Sharma.
Aqua, No 6, p 19-23, 1981. 3 Fig, 1 Tab.

Descriptors: *Water supply, *Water resources development, Water demand, Population dynamics, China, *Hong Kong, Resources development, Drinking water, Reservoirs, Channels, Water conveyance, Catchment areas, Desalination.

Hong Kong survives even though it has always had an almost complete lack of natural resources. The water supply problem results from too many people and an inadequate catchment area. The present, efficient water supply system was built over 120 years of effort by the government in conjunction with international consultants and engineers. Since direct catchment areas are limited, extensive catchwaters are a vital feature of the waterworks development, and probably nowhere else in the world have they been so highly developed. Constructed around hillsides, the catchwaters collect water from areas where it would normally drain more or less directly to the sea or into valleys unsuitable for reservoirs. In more modern approaches water is collected from stream courses by means of intakes and shafts discharging into a main tunnel which carries the water to either an impounding reservoir or a treatment works. Hong Kong's water supply system also includes two reservoirs in the sea, 16 conventional reservoirs, one of the world's largest desalination plants, 14 treatment works, and a third of its total 1,060 square kilimeter area as catchment. While developing its own methods of securing water, Hong Kong also made agreements with China which ensure sufficient water supplies for Hong Kong, with an average annual increase in supply of about 35 million cubic meters beginning in 1983. China will be supplying 620 million cubic meters of water per year to Hong Kong by 1995. These close ties with China, constant readiness to develop any possible sources using modern technology, and the close monitoring of the overall water situation have enabled the government to assure its over 5 million inhabitants that reliable water supplies are available. (Baker-FRC)
W82-03743

3C. Use Of Water Of Impaired Quality

MANAGING VEGETATION IN WASTEWATER APPLICATION,
Michigan State Univ., East Lansing. Inst. of Water Research.
For primary bibliographic entry see Field 5D.
W82-03401

MANAGING SPRINKLE IRRIGATION WITH SALINE WATER FOR ZERO LEACHING,
Utah State Univ., Logan. Dept. of Engineering.
R. A. L. Brito.
PhD Thesis, 1980. 168 p, 22 Fig, 43 Tab, 49 Ref, 8 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19236.

Descriptors: *Irrigation, *Sprinkler irrigation, *Saline water, *Leaching, Wastewater irrigation, Resources management, Water management, *Barley, Impaired water use.

A study was conducted with the objectives of (1) evaluating how long a salt-tolerant crop (barley) could resist a zero leaching situation where saline water was applied by irrigation, (2) comparing the effect of different salt composition of the irrigation water in increasing the EC of the soil solution, and (3) defining management strategies necessary to obtain a situation of no leaching under sprinkle irrigation. A greenhouse experiment was carried out that simulated a salt buildup which will take place in 13 years of continuous irrigation in the field for the soil types studied (silty loam and silty clay loam). Two types of irrigation water were used: one (W1) composed predominantly of sulfates and carbonates and the other (W2) composed primarily of chloride salts. The results pointed out that a zero leaching situation can be maintained with W1 and W2 for 13 or more years, for both soils. It was also found that W2 causes a faster increase in the EC of the irrigation water. Most of the results obtained at the end of the experiment agreed with predictions made by Robbin's model which was then used to determine an irrigation schedule that will allow for no leaching. Management strategies were proposed to eliminate deep percolation from a sprinkler source. Values of CU were estimated as the minimum required for different management according to the ratio of the average application to the lower limit of water application for the irrigated area. (Sinha-OEIS)
W82-03521

ENVIRONMENTAL EFFECTS OF APPLYING FEEDLOT RUNOFF TO GRASSLAND PLOTS BY SPRINKLER IRRIGATION,
Tennessee Univ., Knoxville.
N. Al-Masri.
PhD Thesis, March, 1980. 130 p, 23 Fig, 15 Tab, 55 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-18470.

Descriptors: *Feedlot runoff, *Sprinkler irrigation, *Water quality, *Environmental effects, Lagoons, Wastewater disposal, *Wastewater irrigation, Soil properties, Grasslands, Tennessee.

Irrigation of grassland with feedlot runoff appears to be a practical solution to the problem of disposal of such material. The major objectives of this study were: (1) to determine the effects on quality of surface water and groundwater of applying different rates of lagoon effluent on grassland plots, and (2) to determine effects on soil physical properties. A lagoon effluent irrigation system at the University of Tennessee-USDA Dairy Experiment Station at Lewisburg, Tennessee, served about 200 milk cows on a concrete lot from which runoff was collected into drains and delivered by gravity flow into a lagoon. The application of lagoon effluent to plots resulted in a high ammonia nitrogen concentration in surface runoff and groundwater from the plots which exceeded the maximum standard for raw surface water. The chemical oxygen demand concentration of the surface runoff and groundwater was much higher than that of nearby creek water. Factors existing at the time of lagoon effluent application which affected water quality parameters measured in surface runoff from the plots were: rainfall amount and intensities, soil moisture of the root zone, delay in time between lagoon effluent application and the occurrence of rainfall, and the rate at which lagoon effluent was applied to the plots. More reduction in the permeability and bulk density due to application of lagoon effluent occurred in the sandy loam soil than in the clay loam soil. The application of lagoon effluent with high solid fibrous material content caused more reduction in soil permeability and bulk density than lagoon effluent with low solid fibrous material content. (Sinha-OEIS)
W82-03528

CITY SEWAGE AND THE AMERICAN FARMER,
Carnegie-Mellon Univ., Pittsburgh, PA.
J. A. Tarr.
BioCycle, Vol 22, No 5, p 36-38, September/October, 1981.

Descriptors: *Land disposal, *Wastewater farming, *Farming, *Waste disposal, Land reclamation, Nutrients, Municipal wastewater, History, Wastewater irrigation, Public health, Costs, Irrigation, Fertilizers.

Land disposal of human wastes has been practiced for centuries in Europe and Asia. American farmers used wastes from cities for fertilizer during the 19th century. Sewage farming began in Great Britain about 1800 and in the U.S. about 1850, where it was called broad irrigation. In 1899 there were 24 municipal farms serving 280,000 people in New England and the West. Most of the subsequent development took place in the Southwest and Far West, where the prime motivation was irrigation. Although many publications extolled the merits of sewage farming, this process lost favor in the 20th century for 4 reasons: costs, public health and sanitary concerns, labor problems in the politically-run facilities, and large land requirements. Lessons to be learned from the past are: (1) all wastes require an ultimate sink, but sewage farming allows reclamation of vital nutrients, (2) cost accounting must be based on a system that considers long-term environmental impacts of sewage farming and its alternative disposal methods, (3) close monitoring is required to prevent health hazards and nuisances, and (4) sewage farming is most appropriate where sufficient land is available. (Cassar-FRC)
W82-03600

THE MEADOWBROOK ARTIFICIAL-RECHARGE PROJECT IN NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-03630

HYDROLOGY AND MINING IN THE TUCSON AREAS,
Harshbarger and Associates, Tucson, AZ.
For primary bibliographic entry see Field 2F.
W82-03697

YIELD AND DEVELOPMENT OF SOYBEANS (GLYCINE MAX L.) AS AFFECTED BY IRRIGATION WITH MUNICIPAL WASTEWATER AND WELL WATER,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Science.
M. J. Cordonnier.
PhD Thesis, 1981. 98 p, 10 Fig, 16 Tab, 101 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-26486.

Descriptors: Irrigation, *Agriculture, *Wastewater irrigation, *Soybeans, Irrigation effects, Impaired water use, Municipal wastewater, Well water, *Crop yield, Michigan, Glycine max L.

The objectives of this study were to determine if soybean (Glycine max L.) yields in Michigan could be increased with supplemental irrigation and to investigate the feasibility of using secondarily treated municipal wastewater as the water source. The study was conducted on a Miami silt loam soil in 1979 and 1980. Each water treatment was split into eight subplots consisting of two soybean cultivars; three replications were used with either wastewater, well water, or no water assigned to the main plots. Seed yields were significantly different for water treatments in 1979 with 2434, 2580 and 2786 kg/ha for no water, well water, and wastewater, respectively. Yields generally increased as plant population increased, with the greatest yield recorded for both cultivars occurring at the highest plant population. Irrigated plants were taller, matured later, had larger seeds and lodged slightly more than nonirrigated plants. Results of this experiment indicate that Harcor responds much better than Nebsoy to additional water and to the spatial arrangement of plants. Harcor also appears to have a higher water requirement than Nebsoy. The 1980 growing season was wetter than normal, and there was little or no yield response to irrigation. The two cultivars responded differently to the wastewater, with Harcor exhibiting a positive response and Nebsoy responding negatively for such things as leaf area index, leaf weight, and stem weight. Under the conditions of soil, climate and wastewater quality during this experiment, wastewater was generally superior to well water in increasing yields. (Sinha-OEIS)
W82-03723

3D. Conservation In Domestic and Municipal Use

WATER METERING AND CONSERVATION,
Council of Economic Advisors, Washington, DC.
S. H. Hanke.
Water/Engineering and Management, Vol 128, No 10, p 57-59, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Water metering, *Cost-benefit analysis, Water measurement, Water conservation, Water use, *Perth, *Australia, Costs, Water costs, Economic aspects, Mathematical studies, Mathematical models.

To evaluate the benefits and costs of water metering, it is convenient to use a formal water conservation model. The objective of such a study is to maximize the net benefits from the adoption of any given strategy. This is accomplished by pursuing a conservation policy as long as its incremental benefits exceed its incremental costs. A demonstration of the usefulness of such a model can be achieved by evaluating the benefits and costs of a water meter installation program such as the one installed in Perth, Australia. During the period of 1976-77, 14% of the total water produced was used by 17,968 unmetered water connections. Commercial establishments and residences accounted for this unmetered use. Universal metering would have called for the installation of 17,968 water meters. An equation which would allow computation of benefits of such a program is discussed. Factors in this equation include the predicted reduction in consumption, the marginal cost of water, the change in benefits, the costs associated with universal metering, and the resource costs to consumers of metering. Given the original objective of maximizing net benefits and the decision rule, universal metering for Perth turned out to be an economically attractive conservation policy. (Baker-FRC)
W82-03562

3F. Conservation In Agriculture

TRAINING PROGRAMMES FOR BETTER WATER MANAGEMENT IN SURFACE IRRIGATION PROJECTS IN INDIA,
Mahi-Kadana Irrigation Project, Ahmedabad (India).
For primary bibliographic entry see Field 9B.
W82-03434

IRRIGATION, CROP YIELD AND DRAINAGE ON THE VAALHARTS IRRIGATION SCHEME: 1. THE CONTRIBUTION OF FARM WATER USAGE, IRRIGATION MANAGEMENT AND LEAKAGE FROM THE CANAL SYSTEM TO WATERLOGGING. (BESPROEIING, GEWASOPBRENGS EN DREINERING OP DIE VAALHARTS-BESPROEIINGSKEMA: 1. DIE BYDRAE VAN PLAASWATERVERBRUIK, BESPROEIINGSBESTUUR EN KANAALWATERVERLIESE TOT VERSUIPING),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker.
Water SA, Vol 7, No 2, p 97-106, April, 1981. 5 Fig, 7 Tab, 6 Ref.

Descriptors: *Irrigation efficiency, *Irrigation programs, *Water logging, Irrigation practices, Irrigation, Groundwater level, Canal seepage, Crop yield, *South Africa.

To improve irrigation efficiency and reduce leaching losses of fertilizers, water usage, irrigation management, and leakage from a canal system in South Africa were investigated. There had been complaints of waterlogging and salinization by users of the Vaalharts Government Water Scheme. Irrigation management was evaluated on flood irrigated beds with a GWT (groundwater table) at 1.4 to 2 m planted with groundnut. Over-irrigation was common, and leakage from the canals also contributed to waterlogging. Irrigation management contributed 42% of the waterlogging, while 10% was due to soil furrows and 5% to canal leakage. Farms with a deep GWT experienced more waterlogging than did farms with a relatively shallow GWT. Thus, irrigation management of the system could be improved with higher application rates for shorter periods. Subsurface drains would not be required to the extent that they are now, and larger areas could be irrigated during peak demand periods. (Small-FRC)
W82-03438

METHODOLOGY FOR OPTIMIZATION OF AN IRRIGATION SYSTEM WITH STORAGE RESERVOIRS,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. J. Khanjani.
PhD Thesis, August, 1980. 330 p, 25 Fig, 23 Tab, 216 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-08743.

Descriptors: *Irrigation design, *Irrigation requirements, *Water storage, *Storage reservoirs, Model studies, Economic aspects, Optimization.

A procedure was developed to specify optimal plans for an irrigation system with temporary internal storage. The procedure was used to develop plans for 1865 ha using farm service reservoirs. Daily potential and actual evapotranspiration for 25 years were computed. Probability distributions of potential and actual evapotranspiration for 1-30 days duration were estimated. A log-normal probability distribution was found to best fit the data, and probability equations for different durations were computed. These distributions were used to determine possible irrigation intervals for different crops growing in different soil types. A marginal cost and benefit analysis was used to select the best irrigation intervals for all soil-crop combinations.

Water-use information was used to compute the volume of interval storage needed within the system. By utilizing a mixed integer programming model, the locations of farm service reservoirs were optimized; and seven of the original 15 farm service reservoir sites were selected. A linear programming model was then used to compute the optimum capacity of each farm service reservoir, and parametric programming was used to examine the effects of varying water costs of system configuration. The cost and design capacity of the irrigation system with seven farm service reservoirs was computed. The total cost was 32% less than the cost of the irrigation system with the 15 original proposed farm service reservoirs. (Sinha-OEIS)
W82-03530

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ASYNCHRONISM AND UNCORRELATED PHASES OF STREAMFLOW IN THE CASE OF ITS INTERBASIN TRANSFER WITH SPECIAL REFERENCE TO THE GEORGIAN SSR,
M. G. Babutsidze, B. A. Tutarashvili, and T. V. Shvelidze.
Water Resources (English Translation) Vol 7, No 6, p 524-527, November/December, 1980. 2 Ref. Translated from Vodnye Resursy, Vol 7, No 6, p 83-87, November-December, 1980.

Descriptors: *Diversion, *Diversion dams, *Hydroelectric power production, Rivers, Water level fluctuations, Seasonal variation, *USSR, Streamflow, Water transfer, Interbasin transfers.

Gravity flow diversion and diversion of water with pumping are analyzed from the point of view of asynchronism and uncorrelated phases of the streamflow. This study is related to the diversion of runoff from rivers of western Georgia (USSR) to eastern Transcaucasia. The delivery of part of the runoff from the Tskhenistskali River is analyzed as well as several proposed schemes. If the long-term fluctuations and annual distribution of the runoff of rivers coincide, then when water is diverted the amount of water in the basin receiving the runoff increases. When there is noncoincidence of long-term fluctuations, there is an increase in water and hydropower resources after diversion. Long-term asynchronism results in an increase in the minimum total volumes of annual runoff of individual rivers. (Small-FRC)
W82-03457

THE ECONOMICS OF URBAN STORMWATER MANAGEMENT,
Rice Univ., Houston, TX.
M. D. Maher.
PhD Thesis, May, 1980. 373 p, 39 Fig, 114 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-18068.

Descriptors: *Economic aspects, *Watershed management, *Storm runoff, *Urban runoff, Land use, Flooding, Cost-benefit analysis, Channeling, Runoff control.

Urban flooding and water quality problems are due to both natural phenomena and externalities related to urbanization. Development of upstream land increases the rate and amount of stormwater runoff from these areas. The consequences of increased upstream runoff are borne by downstream residents in the form of increased flooding and water pollution. It is shown that for a runoff control policy to be efficient; (1) because of irreversibility, runoff controls should be installed during a subdivision's construction. (2) The degree of a subdivision's detention of runoff should be based on the present value of damages that its runoff, in conjunction with other developments' runoff, will generate in the present and future. (3) The level of detention should reflect the location and timing of a development. Although runoff flows are irreversible, channelization can expand a stream's carrying capacity and reduce flooding without affecting runoff flows. The problems of the timing and sizing of irreversible upstream and downstream controls are explored in depth. It is shown that it is likely to be cost-effective to expand channel capacity to control some but not all future increases in runoff, some detention is likely to be efficient even in periods of excess channel capacity if in future periods runoff flows will increase to such an extent that irreversible 'congestion' of the channel will occur, and the probabilistic nature of rainfall and hence, runoff has significant policy implications. An important policy guideline is that watershed-wide stormwater management is necessary since uncoordinated community by community action cannot simultaneously implement runoff controls upstream and flood controls downstream. (Sinha-OEIS)
W82-03508

THE NILE - ONE RIVER AND NINE COUNTRIES,
High Aswan Dam Authority, Cairo (Egypt).
A-A. I. Kashef.
Journal of Hydrology, Vol 53, No 1-2, p 53-71, September, 1981. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Water resources development, *Water supply development, *Riparian rights, *Hydrologic budget, *Nile River, River basin development, Water reuse, Water requirements, Irrigation requirements, Water supply, Water management, Water demand, Water deficit, Africa.

The highlights of the water resource management efforts made on the Nile River by the nine countries through which the river flows are reviewed. At present, Egypt and Sudan practice modern methods of river control. Other countries drained by the Nile are planning to tap the water supply for expansion of irrigation projects. An estimated 96.57 cu kilometers of water/year will be needed to meet the water needs of the nine riparian countries, assuming that all proposed Nile projects are implemented. Water saving projects among the nations affected include developing groundwater supplies, building flood protection reservoirs, improving irrigation efficiencies by recycling, and utilizing the huge water supplies of Lake Albert and Lake Victoria. If these conservation projects are implemented and proper management authorities for Nile water resources are set up in the co-riparian countries, no shortages should be expected in meeting the water demands of these African nations in the near future. (Geiger-FRC)
W82-03545

FILTER CRITERIA FOR SUB-SURFACE DRAINAGE,
For primary bibliographic entry see Field 8G.
W82-03660

EFFECTS OF A BARRAGE ON FLUSHING AND WATER QUALITY IN THE FITZROY RIVER ESTUARY, QUEENSLAND,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
D. W. Connell, B. M. Bycroft, G. J. Miller, and P. Lather.
Australian Journal of Marine and Freshwater Research, Vol 32, No 1, p 57-63, 1981. 3 Fig, 5 Ref.

Descriptors: *Tidal rivers, Barriers, Water quality, Dams, *Saline water barriers, *Water quality control, Ecological effects, Rivers, *Fitzroy River, Rockhampton, *Australia, Fate of pollutants, Stream discharge, Zero discharge, Estuaries, Flushing.

Construction of a salt water barrier 65 km from the mouth of the Fitzroy River, Australia, increased the residence time of water and pollutants in the lower estuary by decreasing the amount of fresh water flow. At high river discharges in February (2000 million cu meters per month) residence time is 0.2 months; at low discharges in November (100 million cu meters per month), 3.5 months. Comparisons of salinity data indicate that the barrage now retains more fresh water during low river discharges than before construction. It can be inferred that pre-barrage residence times were shorter than post-barrage residence times during dry months and similar during rainy months. Tidal exchange, producing a residence time of 8 months before and after barrage construction, is the principal flushing mechanism during low discharge periods. Water quality parameters are similar upstream and downstream of the barrage during high discharge. Dissolved oxygen reductions and nutrient and chlorophyll a concentration increases are observed downstream during low or zero discharge. (Cassar-FRC)
W82-03705

SAFE-YIELD ESTIMATES OF A WATER SUPPLY RESERVOIR ON AN UNGAGED STREAM,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 2E.
W82-03716

4B. Groundwater Management

SUBSIDENCE–A GEOLOGICAL PROBLEM WITH A POLITICAL SOLUTION.
Civil Engineering (New York), Vol 52, No 5, p 60-63, May, 1980. 2 Fig.

Descriptors: *Subsidence, *Groundwater management, Water management, Water demand, Groundwater mining, Water policy, Political aspects, Groundwater recharge, Flood damage, California, Texas, Population dynamics, Geological fractures, Sewer systems, *Overdraft.

Groundwater overdraft has produced land subsidence in 17 known areas in the U.S. The most serious property damage has occurred in California and Texas. Management approaches usually stress local control. The Harris-Galveston Coastal Subsidence District was created in 1974 to regulate groundwater withdrawl. Although the subsidence has stopped, damage is permanent, causing continued flooding, poor storm drainage, and activation of geologic faults. Santa Clara, California, stored storm water for recharging the aquifer from 1932 to 1960. When the demand for water stripped to supply in 1960, the water district began other preventive measures--water importation, recharging, and weather modification. The overdraft and subsidence was stopped by 1969, but $100 million in damages had occurred, including buckling of well casings, changes in sewer slopes, and flooding from San Francisco Bay. Although subsidence in the agricultural San Joaquin Valley, California, had been under control, a recent drought caused overdrafts that increased subsidence greatly. Comprehensive plans for groundwater management have been thwarted by agricultural interests, by lack of public concern, and by the needs of expanding populations. (Cassar-FRC)
W82-03452

IRRIGATION, CROP YIELD AND DRAINAGE ON THE VAALHARTS IRRIGATION SCHEME: 2. THE OCCURENCE OF AND THE INFLUENCE OF DRAINAGE ON SALINIZED SOIL (IN AFRIKAANS),
Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker, H. W. Molenaar, H. Hamman, C. C. Nel, and J. H. Mulder.
Water SA, Vol 7, No 3, p 175-184, July, 1981. 6 Fig, 4 Tab, 14 Ref. (English Summary).

Descriptors: *Flood irrigation, *Saline soils, *Waterlogging, Irrigation effects, Groundwater recharge, Environmental effects, Drainage systems, Crop yield, *South Africa.

The Vaalharts Irrigation SCheme was investigated for salinization, leaching of salts, and drainage system efficiency. The 30,000 ha have been flood irrigated since before 1940, and the shallow water table combined with sand soil has resulted in waterlogging and severe salinization. By 1976, almost

3,000 ha were saline or saline sodic to a depth of 0.3 m. Five hundred km of subsurface lateral drains (1.5-1.7 m deep) were added in 1975-1977 in an attempt to control the water table and promote the leaching of salts. These drains were successful in keeping the water table below 0.7 m and reducing salinization, but 1500 ha of saline soils remained in 1977 and about 1000 ha in 1980. A shallow drainage system might be able to retain beneficial groundwater supplies while counteracting the salinization of the soil. A system such as this would be acceptable if maintenance of the water table did not require considerable over-irrigation, resulting in river pollution. (Small-FRC)
W82-03466

GROUND WATER MONITORING: PART II,

For primary bibliographic entry see Field 8A.
W82-03484

GROUNDWATER ALLOCATION MECHANISMS: THE CASE OF WESTERN KANSAS,

Kansas Univ., Kansas City. Dept. of Economics.
D. R. Collins.
PhD Thesis, September, 1980. 118 p, 16 Fig, 2 Tab, 47 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-11728.

Descriptors: *Economic aspects, *Groundwater management, Property rights, Decision making, Administrative decisions, Resource allocation, *Water allocation, Water resources development, *Kansas.

The characterization of 'optimal' time paths for the development of groundwater resources within alter-native institutional settings is discussed. Optimality is defined in terms of the objectives of the agent or agents having authority to make decisions and carry out the associated actions relating to the use of the resource and does not imply superiority of one institutional setting relative to others. The institutional setting defines the decision-making authority of agents in the economy and any constraints which may be imposed by the social framework. Conditions relating to the supply of groundwater in western Kansas, economic incentives for its development, and the historical development in Kansas of a framework of property rights relating to groundwater are considered. Alternative institutional settings for groundwater development are formulated in the context of optimal control problems. The implications of operating costs for the comparison of groundwater allocation mechanisms is considered. The results of the study indicate that when decision-making authority is decentralized, the marginal conditions relating to groundwater allocation over time may differ from those selected under central control. It is indicated that significant differences in cost may be associated with operation of the allocation mechanisms under these alternative settings. The restrictions on the economic environment which are required for the groundwater resource allocation problem to be compatible with this method of analysis are outlined. (Sinha-OEIS)
W82-03503

HYDRODYNAMIC RESPONSE OF NAKHON LUANG AQUIFER, BANGKOK, THAILAND,

Asian Inst. of Tech. Bangkok (Thailand). Div. of Water Resources Engineering.
A. Das Gupta, and M. Siddique.
Ground Water, Vol 19, No 5, p 469-475, September/October, 1981. 9 Fig, 1 Tab, 7 Ref.

Descriptors: *Aquifers, *Hydrodynamics, Hydrology, *Thailand, Bangkok, Nakhon Luang Aquifer, Groundwater, Groundwater reservoirs, *Groundwater management, Aquifer characteristics, Water supply, Water demand.

A comprehensive study has been undertaken to maintain the water supply of the Nakhon Luang Aquifer in Bangkok. This paper outlines the existing situation and points out in quantitative terms the future implications of the present trend of pumpage and of some probably controlled pumpage foreseeable at this stage. The Chao Phraya Plain consists of a broad, deep basin filled with Sedimentary soil deposits which form alternating layers of sand, gravel and clay. In the upper 600 meters depth from the ground surface there are eight confined aquifers separated by virtually impervious strata of clay. The Nakhon Luang Aquifer is of prime importance, as it supplies the majority of the wells in the city of Bangkok at the present time. This aquifer consists of permeable sand and gravel with clay lenses and leaky clay beds, and yields excellent quality water except in the southern region and especially in the Phra Pradaeng area where salt water is encountered due to overpumping. In a simulation of the hydrodynamic behavior of this aquifer using information on hydrogeology and hydraulic aspects available, it was determined that with continuation at the present rate of increase in pumpage, a severe decline of piezometric head is predicted for the future. Active initiative is needed from the authorities concerned to increase the surface-water supply facility and to adopt certain control measures to restrict the private and industrial usage of ground water in the area. (Baker-FRC)
W82-03576

THE MEADOWBROOK ARTIFICIAL-RECHARGE PROJECT IN NASSAU COUNTY, LONG ISLAND, NEW YORK,

Geological Survey, Syosset, NY. Water Resources Div.
D. A. Aronson, and M. Beyth.
Long Island Water Resources Bulletin 14, 1980. 23 p 10 Fig, 1 Tab, 33 Ref. Nassau County Department of Public Works.

Descriptors: *Artificial recharge, *Groundwater recharge, *Injection wells, *Reclaimed water, Ponding, Water reuse, Water management, New York, *Long Island, Nassau County, Suffolk County, Land application, Water supply, Wastewater treatment.

In Nassau and Suffolk Counties, where the quality and quantity of potable ground water have declined as a result of urbanization, the use of highly treated wastewater (reclaimed wastewater) to replenish the ground-water supply is technically feasible. Two methods that are particularly well suited to Long Island are surface ponding of the reclaimed water in basins so that it can infiltrate to the water table, and injecting the reclaimed water into the ground through wells. At the Meadowbrook artificial-recharge project site in East Meadow, a system of 11 basins and 5 injection wells will return to the ground-water reservoir 4 million gallons per day of reclaimed wastewater, supplied by the Cedar Creek water-reclamation facilities. This demonstration project is intended to study the effectiveness of using reclaimed wastewater to replenish and improve the chemical quality of Long Island's round-water supply. Knowledge gained in the study will have applicability to other areas where the need to conserve and augment fresh-water supplies has become critical. (USGS)
W82-03630

THE OCCURRENCE AND CONTROL OF LAND SUBSIDENCE DUE TO GROUNDWATER WITHDRAWAL WITH SPECIAL REFERENCE TO THE SAN JOAQUIN AND SANTA CLARA VALLEYS, CALIFORNIA,

Stanford Univ., CA. Dept. of Geology.
J. F. Poland.
PhD Thesis, June, 1981. 176 p, 44 Fig, 5 Tab, 120 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-24135.

Descriptors: *Groundwater depletion, *Subsidence, *Compaction, Groundwater recharge, Groundwater basins, Aquifers, Aquitards, Elastic properties, Aquifer characteristics, *Groundwater management, Injection wells, San Joaquin Valley, Santa Clara Valley, *California, Repressuring, Subsidence control.

The San Joaquin Valley in California is the area of the most intensive land subsidence in the United States. In the Santa Clara Valley at the south end of San Francisco Bay, excessive pumping of ground water between 1917 and 1967 caused as much as 180 ft (50 m) of artesian-head decline and maximum land subsidence of 13 ft (4 m). Wilmington oil field, in the harbor area of Los Angeles and Long Beach, California, is not only the oil field of maximum subsidence in the United States but also the outstanding example of subsidence control by injection and repressuring. Both direct and indirect evidence is accumulating to indicate that, under the total stresses applied to unconsolidated heterogeneous deposits in overdrawn ground-water basins, most of the compaction of the aquifer systems is in the fine-grained aquitards and little is in the coarse-grained aquifers. In a confined system that is compacting because of decrease in fluid pressure, compaction and subsidence can be stopped by raising fluid pressures in the aquifers sufficiently to eliminate excess pore pressure in the aquitards and confining beds (clays or shales). Moreover, the system (both aquifers and aquitards) will expand elastically and the land surface will rise if fluid pressures are increased above preconsolidation conditions. In liquid-waste disposal also, the response of the sediments normally would be in the elastic range. (Sinha-OEIS)
W82-03714

NEW LEGISLATION IN CALIFORNIA AND ITS EFFECTS,

For primary bibliographic entry see Field 6E.
W82-03731

AN ECONOMIC APPROACH TO GROUND WATER QUALITY MANAGEMENT,

California Univ., Davis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W82-03732

MODELING THE ECONOMICS OF GROUND WATER MANAGEMENT,

Aaslam and Associates, Inc., Sacramento, CA.
J. E. Noel.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 92-102. 3 Fig, 2 Tab.

Descriptors: *Groundwater management, Mathematical models, Hydrologic models, Water resources development, Simulation analysis, Value, Surface water, Mathematical studies, Hydrologic data collections, Water balance equation, Water costs, *Economic aspects, *Irrigation, *Crop production, *Model studies.

A hydrologic-economic modeling framework can be a valuable tool when used to evaluate the economic consequences of different groundwater and surface water management scenarios. There are two operational problems associated with developing a hydrologic-economic model of groundwater management: estimating the different economic and hydrologic relationships that make up these components of the problem, and interrelating the economic and hydrologic elements so that each provides information to the other in a continuous and consistent manner. Four mathematical models--two hydrologic, one economic, and one with hydrologic and economic elements--are discussed that make up the San Joaquin Valley Hydrologic-Economic Modeling system (HEM). One hydrologic model is the surface water allocation model (SWAM) which computes a mass water balance (inflows, losses, outflows) so that supply equals demand at every conveyance facility in the Valley's surface supply network. The other hydrologic model is a layered two-dimensional saturated flow groundwater model which can simulate unconfined flow in the top layer of the groundwater basin and confined flow in the bottom layer. The economic non-linear programming model can determine optimal changes in farm income, cropping patterns, irrigation technologies, and land use given changes in crop demand, crop production costs, and water management scenarios. The final model in the HEM system is the Linear Quadratic Control Model: it is a policy model from which optimal pumpage and groundwater depths can be

determined over a specific period under different water management scenarios. (Atkins-Omniplan)
W82-03733

MANAGING WELLS FOR ENERGY EFFICIENCY,
California Univ., Davis. Dept. of Civil Engineering.
O. Helweg.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 119-127. 8 Fig, 4 Ref.

Descriptors: *Wells, *Well yield, *Pump wells, *Optimal yield, Pumping head, Head loss, Discharge capacity, Effective capacity, Benefits, *Groundwater management, Energy efficiency.

Saving energy is advantageous from an economic as well as an ecological viewpoint. When water well yield deteriorates or when the optimal discharge of a pump decreases either or both should be replaced or repaired. A wire-to-water test is used to evaluate electrical driven pumps. Loss in pump efficiency should be measured over time to establish a trend. The results then need to be normalized, i.e., compared to maximum efficiency at the same discharge and head. Correcting pumping inefficiences involves: (1) when to correct the inefficiency, and (2) what the correction should be, i.e., repair or replacement. In economic terms, pump replacement is recommended when the marginal net benefits of the defender equal the maximum amortized net benefits of the challenger. Several tables show how these calculations are made. A similar analysis is made, and a formula given, to determine when to rehabilitate a well. Simply, a well should be rehabilitated when the maximum annualized net benefits of rehabilitation are greater than the old annual (marginal) net benefits. If a well is not affected by rehabilitation, replacement analysis is needed; however, some wells deteriorate so slowly that pumping costs do not increase and the economic life of the well is infinite. Other factors hold in general for wells: pumping costs are usually higher than well construction costs; replacement analysis for municipalities is simpler because there is no tax, whereas a private owner must consider the impact of taxes and depreciation; and the most economical design should be chosen over the cheapest when drilling a new well so as to save future energy. (Atkins-Omniplan)
W82-03734

SB 1391–TOWARDS A PERMIT SYSTEM FOR GROUND WATER. TOWARDS A NEW DEFINITION OF OWNERSHIP OF GROUND WATER,
For primary bibliographic entry see Field 6E.
W82-03736

ARTIFICIAL BASIN RECHARGE,
Water Management Research Laboratory, Fresno, California.
H. L. Nightingale, and W. C. Bianchi.
Water/Engineering and Management, Vol REF, No HB, p R85-87, R89-92, 1981. 4 Fig, 84 Ref.

Descriptors: *Recharge basins, *Artificial recharge, *Planning, Basins, Recharge, Groundwater, Soil profiles, Geology, Surveys, Productivity, *Groundwater management.

Basin-type artificial recharge and preconstruction field surveys are discussed. These surveys are made to evaluate the magnitude of potential problems as related to both a project's recharge rate and its environmental impact. A multidisciplinary approach is needed to plan and operate a successful recharge facility. Assuming that the size of the groundwater basin and amount of storage capacity available are amenable to recharge, seven phases have been identified, in order of priority: precursory site evaluation, soil profile and subsurface geology determinations, recharge water quality determinations, biological considerations, pilot test basin study, construction plants, and the operation, maintenance and performance evaluation plans. In most reports of failures of basin recharge facilities and small experimental sites, soil clogging is to blame. This clogging is caused by sediment in the recharge water. The reason for sediment formation is not always clearly apparent. Sediments can be generated by improper construction techniques. Soil compaction from heavy construction equipment rarely seems to be at fault. The chances of long-term economical basin recharge can be improved by superimposing on the purely engineering aspects of construction and operation the principles of soil chemistry, hydrology, water chemistry, aquatic biology and subsurface geology. Interaction between engineering and environmental factors must be carefully considered to increase the chances for valid decisionmaking and planning which will produce a successful basin recharge facility. (Baker-FRC)
W82-03745

4C. Effects On Water Of Man's Non-Water Activities

INTERSTATE HIGHWAYS VERSUS WATERSHED PROTECTION IN NEW ENGLAND,
Jordan (Perkins), Inc., Reading, MA.
For primary bibliographic entry see Field 5B.
W82-03431

WILL THE WORLD FACE UP TO ITS EVER-WORSENING ENVIRONMENTAL PROBLEMS,
Civil Engineering (New York), Vol 50, No 9, p 71-74, September, 1980.

Descriptors: *Environmental effects, *Soil erosion, *Forest management, Erosion, Acid rain, Deserts, Saline soils, Water quality, Irrigation water, Water pollution effects.

Among the world's most pressing environmental problems are soil deterioration (erosion and salinity buildup), atmospheric changes (including acid rain), and accelerating extinction of plant and animal species (deforestation and wetlands destruction). Results of soil erosion are siltation of rivers and reservoirs, impaired water quality, and a return of agricultural land to desert. Salt buildup in farmed areas is serious both in poorer countries such as India and Pakistan and in the San Joaquin Valley, California. This condition can be alleviated and prevented by using enough irrigation water to flush out the accumulated salts. However, downstream farmers are then faced with higher salt levels in their irrigation water. Acid rain, formed from burning of sulfur-containing fuels, also damages soil. This is now a problem in the eastern and southwestern U.S., northern and eastern Europe, and parts of the Soviet Union and Australia. Deforestation, especially in the tropics, destroys the land's ability to store water, producing rapid runoff during rainfall, intensified flooding, and water shortages during dry spells. (Caesar-FRC)
W82-03459

THE ECONOMICS OF URBAN STORMWATER MANAGEMENT,
Rice Univ., Houston, TX.
For primary bibliographic entry see Field 4A.
W82-03508

TEMPORARY HYDROLOGIC CHANGES AFTER DEFORESTATION FOR PIONEER HOMESTEADING,
H. Ryckborst.
Journal of Hydrology, Vol 53, No 1-2, p 117-133, September, 1981. 10 Fig, 1 Tab, 11 Ref.

Descriptors: *Clear-cutting, Snowmelt, *Geohydrology, *Soil porosity, *Groundwater level, Forest hydrology, Forest soils, Groundwater runoff, Sublimation, Soil profiles, *Groundwater recharge, Evaporation, Radioactive tracers, *Water level fluctuations, *Alberta, Canada.

Modern homestead lands in Central Alberta, Canada that have been cleared of forest and brush experience a temporary disturbance in soil profile and a slight increase in effective porosity of groundwater recharge areas. An 8-year experiment on the impact of deforestation on the hydrology of a research catchment of the homestead lands using radioactive tracers showed that these impacts should be only minor and temporary. In the recharge areas, deforestation caused the groundwater table to drop by 0.2-0.5 m with an average two year recovery period. In the remaining groundwater discharge areas, groundwater table levels rose due to decreases in the effective porosity caused by mechanized deforestation. The main impacts of homesteading deforestation are a slight increase in total snowmelt runoff from 60 to 75 millimeters/year, a shortening of the snowmelt period from 5 to 4 weeks, an increase in snowmelt groundwater runoff from 1.0 to 1.9 millimeters/day and a decrease in snow-cover sublimation and evaporation by 40%. (Geiger-FRC)
W82-03544

EFFECT OF FELLING FORESTS ON FLOOD RUNOFF IN THE CARPATHIAN MOUNTAINS WITH SPECIAL REFERENCE TO BEECH FORESTS,
O. V. Chubatyi.
Water Resources, Vol 8, No 1, p 13-18, January/February, 1981. 5 Tab, 1 Ref. Translated from Vodnye Resursy, No 1, p 48-55, January/February, 1981.

Descriptors: *Logging, *Runoff coefficient, *Clear-cutting, Snowmelt, Precipitation, *Flood discharge, Forest watersheds, Forest management, *Carpathian Mountains, *USSR, Infiltration, Rainfall-runoff relationships, *Forest soils.

Infiltration into forest soils was studied in 3 forested watersheds in the Transcarpathian Mountains, U.S.S.R., a region of high precipitation frequency. After a 5-year calibration period, the first basin was clear-cut; the second, 2-step felled (30% cutting followed by the remainder of the timber cut 8 years later); and the third acted as a control. During the calibration period flood runoff coefficients increased with increasing values of effective precipitation and were similar in the 3 basins (0.03-0.39). After clear-cutting in Basin I and the first stage of cutting in Basin II the coefficients were 0.02-0.91 and 0.02-0.68, respectively. In the 2-year period after the second (final) step of cutting in Basin II, the flood runoff coefficients were: I, 0.05-0.89; II, 0.13-0.71; and III (control), 0.03-0.30. Maximum flood runoff coefficients were seen after melting of snow. When summer cloudbursts overlapped, runoff coefficients increased progressively. The ratio of runoff coefficients for Basin I:Basin III and Basin II:Basin III were higher for the first year after felling than for the fourth year after felling. (Caesar-FRC)
W82-03574

4D. Watershed Protection

SEDIMENTATION CONTROL IN INDIAN RESERVOIRS,
Edinburgh Univ. (Scotland).
For primary bibliographic entry see Field 8A.
W82-03693

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

MINERAL ELEMENT CONTENT IN ULVA LACTUCA L. WITH REFERENCE TO EUTROPHICATION IN HONG KONG COASTAL WATERS,
Hong Kong Univ., Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-03417

AN ORGANICS DETECTION SYSTEM FOR THE OHIO RIVER,

Ohio River Valley Water Sanitation Commission, Cincinnati.
L. Weaver, R. Boes, and G. Moore.
Water Science and Technology, Vol 13, No 3, p 227-236, 1981. 3 Fig, 2 Tab.

Descriptors: *Water quality control, *Monitoring, *Chlorinated hydrocarbons, Water pollution control, Pollutant identification, *Ohio River, Organic compounds, Water analysis, Rivers, Chemical analysis, Carbon tetrachloride, Chloroform, Trihalomethanes, Industrial wastes, Heavy metals, Polychlorinated biphenyls, Sediments, Fish, Pesticides, Industrial spills.

In 1977 the Ohio River Valley Water Sanitation Commission established the Early Warning Organics Detection System to detect organic pollutants in river water after the well-publicized spill of carbon tetrachloride into the Kanawha River, a major Ohio tributary. Local water treatment plants or industrial plants provide laboratory space and personnel for the Commission's gas chromatographic equipment. If any of the daily samples indicate organics levels significantly above the background level, the EPA confirms the analysis with more sophisticated analytical equipment, and downstream water users are promptly notified of the pollutant load. Equipment costs for the program were $300,000, and annual operating costs are $20,000-$25,000. In addition, fish diversity studies and analysis of fish tissue and sediments are conducted. Fish populations have improved in production, diversity, and stability since the 1957-60 baseline study. During the last 9 months of 1979 most of the total 1350 samples contained less than 0.1 micrograms per liter of the 19 purgeable halocarbons under consideration. Compounds found in the amounts greater than 10 micrograms per liter were chloroform, methylene chloride, bromodichloromethane, chlorobenzene, and carbon tetrachloride. Chloroform is found in 70% of the Ohio River samples and 13% of the tributary samples. Chlorobenzene appears primarily in the main river; carbon tetrachloride seems to originate in the Kanawha River. The monitoring program has proved to be an effective safeguard of downstream water supplies, and aid in identifying pollution sources, and a deterrent to potential polluters. (Cassar-FRC)
W82-03436

HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF CARBARYL AND 1-NAPHTHOL AT RESIDUE LEVELS IN VARIOUS WATER SOURCES BY DIRECT INJECTION AND TRACE ENRICHMENT,

Maine Univ., at Orono. Dept. of Food Science.
R. J. Bushway.
Journal of Chromatography, No 211, p 135-143, June, 1981. 3 Fig, 3 Tab, 50 Ref.

Descriptors: *Carbaryl, *Water analysis, *Pesticide residues, Pollutant identification, Insecticides, Herbicides, Chromatography, Naphthol, Organic compounds, Carbamate pesticides.

Carbaryl and its hydrolysis product, 1-naphthol, at low ppb concentrations in water were determined by a high-performance liquid chromatographic method. Water samples were filtered through a 0.45 micrometer Millipore filter and injected directly into the chromatograph system, which used a variable wavelength UV detector reading at 222 nm. No cleanup, concentration, or derivatization were required. Levels less than 1 ppb were determined by first concentrating the sample with an activated C18 Sep-Pak cartridge using a fluid metering pump. Samples of ocean water, stream water, and drinking water were spiked with carbaryl and 1-naphthol at concentrations from 3.78 to 207 ppb. Coefficients of variation ranged from 2.5 to 10.7%. Different types of water with equal amounts of carbaryl did not produce the same peak height; therefore, a working standard should be made up daily with water as near as possible in composition to the sample being analyzed. Other pesticides successfully detected with this system were carbofuran, methomyl, azinphosmethyl, benomyl, monuron, propham, chloropropham, pentachlorophenol, the oxygen analog of azinphosemethyl, and simazine. Atrazine co-chromatographed with carbaryl, and pentachloronitrobenzene, diuron and thiram interfered with the 1-naphthol determination. (Cassar-FRC)
W82-03444

ENUMERATING BACTERIA IN RIVER WATER AND SEWAGE EFFLUENT,

Western Kentucky Univ., Bowling Green. Dept. of Biology.
L. P. Elliott.
Water/Engineering and Management, Vol REF, No HB, p R122-R123, 1981. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Sewage bacteria, *Assay, Bacteria, Rivers, Chlorination, Bacterial analysis, Water quality, River water, Path of pollutants, Wastewater treatment.

A technique is reported for enumerating bacteria in river water and sewage effluent in which the medium was spread-inoculated with calibrated loops delivering 0.01 or 0.001 ml. The results were compared with the standard spread plate-count technique for the enumeration of baceria in river water. The spread plate technique was used inasmuch as there was no reduced growth rate of obligate aerobes and no danger of killing heat sensitive organisms with hot-agar. Five sampling sites were chosen about 1/4 mile apart in the Barren River flowing through Bowling Green, Kentucky. One site was upstream from the sewage disposal plant, another was in the effluent from the plant's discharge pipe, and three were downstream from the discharge outlet. Sampling was done from a boat at midstream, with samples taken semimonthly during March 1978 through February 1979. In a comparison of the standard usual spread plate method versus the plate loop method, the two methods were not significantly different. Sometimes the effluent count was lower than the counts from other sampling stations. The wastewater treatment plant provides primary and secondary treatment by means of an activated biological filter system which is a combination activated sludge and trickle-filter process. All effluent is chlorinated by automated chlorinators. It was concluded that calibrated loops which deliver 0.01 and 0.001 ml, when used as described in this paper, provided a simple, rapid, reliable means of inoculating agar media for estimating populations of bateria in water. (Baker-FRC)
W82-03446

IDENTIFICATION AND DETERMINATION OF AMINOCARB IN NATURAL WATER AND BALSAM FIR FOLIAGE. (RECHERCHE ET DOSAGE DE L'AMINOCARB DANS LES EAUX NATURELLES ET LE FEUILLAGE DU SAPIN BAUMIER PAR CHROMATOGRAPHIE EN PHASE GAZEUSE),

Service de Protection de l'Environnement, Sainte-Foy (Quebec).
G. Mamarbachi.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 3, p 415-422, 1980. 1 Tab, 4 Fig, 10 Ref. (English Summary).

Descriptors: *Pesticides, Agricultural chemicals, *Forestry, *Agricultural hydrology, Environmental effects, Surface waters, Gas chromatography, Vegetation, Vegetation effects, Chemical analysis, Chloroform, Water pollution, Chemical properties, Reagents, Degradation products, Fir trees, Leaves, *Pollutant identification, *Aminocarb.

A method for the determination residues of the insecticide aminocarb in natural waters and balsam fir foliage is described. Average recoveries of more than 90% from foliage and nearly 100% from water can be achieved. The insecticide is extracted from water with chloroform and from foliage with ethyl acetate. The extracts are purified by coagulation with an aqueous solution of ammonium chloride and phosphoric acid. The solution is partitioned with methylene chloride, neutralized with sodium carbonate and then extracted with chloroform. The extract is then concentrated and injected directly into a gas chromatograph equipped with a dual nitrogen-phosphorus detector. (Titus-FRC)
W82-03460

STUDIES OF THE TRANSFORMATIONS OF FORMS OF CARBON, NITROGEN, PHOSPHORUS, SULFUR AND SOME PRINCIPAL MINERAL ELEMENTS DURING THE MEASUREMENT OF THE TOTAL OXYGEN DEMAND - II. TRANSFORMATION OF FORMS OF NITROGEN (IN FRENCH),

Institut National des Sciences Appliquees, Toulouse (France). Lab. de Chimie et Genie de l'Environnement.
B. Capdeville, C. Laffont, and H. Roques.
Water Research, Vol 14, No 5, p 501-509, May, 1980. 12 Fig, 2 Tab, 13 Ref. (English Summary).

Descriptors: *Oxygen demand, *Analytical techniques, *Chemical interferences, Nitrogen compounds, Inorganic compounds, Amino acids, Model studies, Oxidation, Laboratory equipment.

The oxidizability of organic compounds containing nitrogen was studied along with the interferences due to the presence of ammonium, nitrous and nitric nitrogen ions in the water. At a total oxygen demand of 0-250 mg/l the organic and ammonium nitrogen are partially oxidized and transformed into a mixture of N2 and NO. This illustrates the advantage of the TOD (total oxygen demand) meter compared with classic COD and BOD5 oxidation tests, where these elements are rarely taken into account and these forms are oxidized incompletely. Nitrous and nitric nitrogen create important negative interferences, but they can be corrected for by a simple proposed tabular method. Measurements were made using TOD meter to distinguish the stable forms of organic and inorganic nitrogen after high temperature catalytic action. (DL) citrulline, (DL) aspartic acid, creatinine, (L+) glutamine, (DL) threonine, (L-) asparagine, beta-alanine, (L+) arginine and (DL) serine were used as model organic nitrogen compounds. (Hertzoff-FRC)
W82-03485

STUDIES OF THE TRANSFORMATION OF CARBON, NITROGEN, PHOSPHORUS, SULPHUR AND THE PRINCIPAL MINERAL ELEMENTS IN THE COURSE OF MEASURING TOTAL OXYGEN DEMAND--III. TRANSFORMATION OF SULFUR (IN FRENCH),

Institut National des Sciences Appliquees, Toulouse (France). Lab. de Chimie et Genie de l'Environnement.
C. Laffont, B. Capdeville, and H. Roques.
Water Research, Vol 15, No 5, p 561-572, 1981. 8 Fig, 1 Tab, 7 Ref. (English Summary).

Descriptors: *Oxygen demand, *Sulfur compounds, *Wastewater analysis, Pollutant identification, Chemical analysis, Chemical oxygen demand, Seawater, Sulfate, Sulfite, Sulfides, Organic compounds, Chemical reactions, Chemical interference.

Interferences with measuring oxygen demand using the Dow Chemical Ionics 225 TOD (total oxygen demand) meter and the COD method were determined in waters containing inorganic salts (such as industrial wastewaters and seawater). Sulfur-containing organic compounds of the type CxHyOxS were partially oxidized to SO2 and SO3 in a consistent manner in the TOD test and variably in the COD test. Sulfate and sulfite ions were negatively correlated with TOD, and sulfide was positively correlated. Corrective equations were developed to account for these interferences. The TOD test was better than COD for determining organic pollutants in the presence of inorganic salts. (Cassar-FRC)
W82-03486

STUDY OF THE TRANSFER OF CD, PB, CU AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - II. BIOLOGICAL ACCUMULATION IN PLANKTONOPHAGE FISH. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERI-

TIQUES ET ESTUARIENNES-II, ACCUMULATION BIOLOGIQUE CHEZ LES POISSONS PLANCTONOPHAGES),

Institut des Sciences de la Nature, Nantes (France). Lab. d'Ecologie Animale et Biologie Marine; and Nantes Univ. (France). Lab. de Biologie Marine.
For primary bibliographic entry see Field 2L.
W82-03491

CARBON ISOTOPE ANALYSIS OF CARBONACEOUS COMPOUNDS IN PUGET SOUND AND LAKE WASHINGTON,

Washington Univ., Seattle.
J. R. Swanson.
PhD Thesis, August, 1980. 230 p, 34 Fig, 14 Tab, 358 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-09776.

Descriptors: *Biochemistry, *Carbon radioisotopes, *Water pollution, Organic matter, Sediments, Aromatic hydrocarbons, Aliphatic hydrocarbons, Water pollution sources, *Puget Sound, *Lake Washington, Carbonaceous compounds, Biogeochemistry, Carbon Isotope Analysis.

A new method has been developed and tested for determining chronological profiles of organic pollutants. This method, Carbon Isotope Analysis (CIA), involves measurement of 12C, 13C and 14C in carbonaceous compounds found in layers of sediment. Lipids, total aliphatic hydrocarbons (TAHs) and polycyclic aromatic hydrocarbons (PAHs) are separated from kg quantities of sediment. The basic principle of Carbon Isotope Analysis is the fact that natural isotopic differences present in organic compounds are due to their respective sources. Carbon Isotope Analysis uses three levels of 14C in organic compounds to develop a chronological profile of the anthropogenic impact on sedimentary organic compounds. The overall impact of organic pollutants on a given region often cannot be determined by compound identification alone. Most sophisticated analytical instruments often confuse compounds derived from petroleum and coal dust with natural organic degradation products. By using Carbon Isotope Analysis, additional insight to pollution can be obtained and the impact of chronic levels of toxicants can be identified. This investigation reviewed carbon isotopic data and carbon cycling and analyzes organic pollution in two limited ecosystems (Puget Sound and Lake Washington).
W82-03505

SPECIATION OF ENVIRONMENTAL POLLUTANTS BY GC-AA AND BY ESCA. PURIFICATION OF WATER AT ULTRATRACE LEVELS OF HEAVY METALS AND COMPLEXATION STUDIES BY ELECTROCHEMICAL METHODS,

Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
I. A-L. Rhodes.
PhD Thesis, May, 1980. 347 p, 91 Fig, 24 Tab, 225 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-21759.

Descriptors: *Pollutant identification, *Heavy metals, *Water pollution, *Lead, *Speciation, Electrochemistry, Gas chromatography, Spectral analysis, Bibliographies, Air pollution, *Tetraethyl lead(TET), Environmental pollution, Airborne pollutants, Comlexation.

A GC-AA method was developed that allowed the simultaneous determination of $PbEt_4$ and of $PbEt_3Cl$ in gaseous and liquid sampled. This method enabled the study of the behavior of $PbEt_4$ (TEL) and the formation of $PbEt_3Cl$ in sea water under several experimental conditions. From the results obtained, the potential hazard of TEL spills at sea was evaluated as well as the effect of particulate materials present in sea water on TEL concentration levels. Airborne heavy metal pollutants were studied by ESCA and the final chemical form of airborne Pb was found to be PbO_2. The importance of ESCA as a valuable tool for speciation of airborne matter was demonstrated. An electrochemical method was developed to produce a readily available and economic source of ultrapure water. A method was developed for the determination of stability constants of heavy metal complexes and for the study of reaction kinetics of complex formation. The electrochemical technique was illustrated with Cd, Pb and Zn complexes of EDTA. Problems in storing very pure water and very dilute solutions of metal compounds are also discussed. An essentially complete literature review of each subject discussed is included. (Sinha-OEIS)
W82-03526

THE CHARACTERIZATION AND ANALYSIS OF CHLORINATED ORGANIC COMPOUNDS DERIVED FROM CHLORINATION OF HUMIC SUBSTANCES IN SURFACE WATERS,

Massachusetts Univ., Amherst. Dept. of Chemistry.
B. D. Quimby.
PhD Thesis, September, 1980. 199 p, 35 Fig, 5 Tab, 79 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-01385.

Descriptors: *Pollutant identification, *Chemical analysis, *Organic compounds, *Surface water, Chlorination, Drinking water, Phenols, Fulvic acids, Humic acids, Gas chromatography, Trihalomethanes, Microwave emission detection(MED).

Suitable strategies were developed for characterizing the halogenation products of humic materials, both the trihalomethanes and other expected products. To provide element selective detection for gas chromatographic studies, a microwave emission detection system (MED) was developed utilizing an echelle grating spectrometer and a TM sub 010 resonant microwave cavity to sustain a plasma in helium at atmospheric pressure. The MED system was applied to the determination of the trihalomethanes in drinking water. Glass capillary gas chromatography was used in conjunction with the MED system to examine the chlorination products of humic and fulvic acids. The results indicate that in addition to the trihalomethanes, significant numbers of chlorinated phenolic and/or acidic compounds can be formed. The presence of bromide ion in the chlorination mixture was shown to result in bromine-containing compounds as well. Since many of these compounds cannot be gas chromatographed directly, chemical derivatization with diazomethane was employed. The number of halogen-containing substances that appear in the element-selective chromatograms was greatly increased after methylation of the samples. Several halogenated phenols and aromatic carboxylic acids have thus far been tentatively identified by retention times. (Sinha-OEIS)
W82-03529

BALANUS EBURNEUS: A SENSITIVE INDICATOR OF COPPER AND ZINC POLLUTION IN THE COASTAL ZONE,

Florida Inst. of Tech., Melbourne.
S. Barber, and J. H. Trefry.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 654-659, November, 1981. 4 Fig, 11 Ref.

Descriptors: *Bioindicators, *Barnacles, Copper, Zinc, *Pollutant identification, Fate of pollutants, Eau Gallie Harbor, Indian River Lagoon, *Florida, Bioaccumulation, Accumulation, Metals, Heavy metals, Coastal waters.

Barnacles, Balanus eburneus, were a sensitive indicator of copper and zinc pollution in the moderately polluted waters of the Eau Gallie River and Indian River Lagoon, Florida. Tissues accumulated about 36 ppm Cu for each 1 ppb increase in water Cu levels. Barnacle tissue collected at 8 sites contained 11-64 micrograms of Cu per g dry weight; dissolved Cu levels in water at these sites were 0.4 to 1.6 micrograms per liter, and total Cu, 0.8 to 2.7 micrograms per liter. Zn concentrations in barnacle tissues ranged from 360 to 12,000 micrograms per g dry weight. Possible sources of metal pollution in the system were sewage effluent, a railway trestle, and antifouling paints. (Cassar-FRC)
W82-03605

STATISTICAL MODELS FOR ESTIMATING SEAWATER METAL CONCENTRATIONS FROM METAL CONCENTRATIONS IN MUSSELS (MYTILUS EDULIS),

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Chemistry.
J. D. Popham, and J. M. D'Auria.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 660-670, November, 1981. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Mussels, *Heavy metals, *Bioindicators, Model studies, Copper, Zinc, Lead, Pollutant identification, Statistical models, Metals, Regression analysis, Water analysis, Trace metals, British Columbia, Seawater.

Field studies of copper, zinc, and lead concentrations in seawater and mussels were used to develop statistical models for estimating concentrations of trace metals in seawater, knowing the concentrations of metals in mussels. This model accounted for 50% of the variance of the soluble metal and about 20% of the metal as suspended particulate matter. Low concentrations of metals in seawater were consistently overestimated and high values, underestimated. Over 700 mussels and 25 seawater samples were collected in the southeastern coastal waters of British Columbia. These models can probably be improved by adding parameters which reflect the instantaneous effects of salinity and turbidity. (Cassar-FRC)
W82-03608

STREAM MACROINVERTEBRATE BASELINE SURVEYS: A COMPARATIVE ANALYSIS FROM THE OIL-SHALE REGIONS OF COLORADO, USA,

California Univ., Berkeley. Dept. of Forestry and Resources Management.
D. C. Erman.
Environmental Management, Vol 5, No 6, p 531-536, November, 1981. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Macroinvertebrates, *Oil shale, *Colorado, Streams, *Baseline studies, *Mining wastes, Resources development, Environmental effects, Ecosystems.

General surveys of the benthic macroinvertebrates from Piceance Creek and the White River have been conducted for nearly a decade prior to oil shale exploitation in north central Colorado. The taxa collected in four studies on Piceance Creek and in five studies on the White River showed in comparison studies that there was little similarity in results between studies, even though the studies were generally consistent in methodology, site selection, and time of year that collection of samples was made. It is suggested that this lack of agreement among the studies on what constitutes a baseline of common taxa in this area is probably a result of taxonomic difficulties and differences in technique. More emphasis should be placed on testing possible impacts than on repeated, expensive, and inconclusive baseline inventories. At present it would be impossible to identify the effects of oil-shale development, even though four or five separate studies were performed during most of a yearly cycle. (Baker-FRC)
W82-03635

MICROBIOLOGICAL QUALITY OF SELECTED RECREATIONAL WATERS,

Florida Univ., Gainesville. Dept. of Food Science and Human Nutrition.
R. J. Alvarez.
Environmental Research, Vol 26, No 2, p 372-380, December, 1981. 3 Tab, 21 Ref.

Descriptors: *Public health, *Water quality, Water use, Lakes, Streams, Rivers, Ponds, *Bacterial analysis, Pathogens, Microorganisms, Recreation, *Microbiological studies, *Florida.

The microbial quality of 18 recreational waters was evaluated in north-central Florida. These waters included lakes, streams, ponds, and creeks. Total bacterial and fungal counts, total and fecal coliforms, temperature, and pH were monitored in the summer of 1979 and winter of 1980 to observe

ary seasonality associated with the quality and safety of the recreational waters. Since preliminary work had suggested the presence in various waters of lesser pathogens, five were monitored using plate count agar during the current study: Serratia marcescens, Pseudomonas aeruginosa, Yersinia enterocolitica, Edwardiella tarda, and Chromobacterium violaceum. Temperature, pH, and bacterial, fungal, total and fecal coliform counts decreased in all winter samples. However, the distribution of the selected pathogenic microorganisms seemed affected during the winter. Forty-four percent of all the recreational water sampled during the entire study contained S. marcescens, 50% contained P. aeruginosa, 56% C. violaceum, and 11% Y. enterocolitica. No E. tarda was recovered during this study. The presence of high levels of fecal coliforms and the isolation of various pathogenic microorganisms in the various waters indicates a need for closer monitoring. (Baker-FRC)
W82-03636

TRACE ANALYSES FOR WASTEWATERS,

Environmental Monitoring and Support Lab., Cincinnati, OH.
J. A. Glaser, D. L. Foerst, G. D. McKee, S. A. Quave, and W. L. Budde.
Environmental Science and Technology, Vol 15, No 12, p 1426-1435, December, 1981. 5 Tab, 31 Ref.

Descriptors: *Trace levels, *Detection limits, *Wastewater analysis, Performance evaluation, *Pollutant identification, Standard deviation, Chemical analysis, Error analysis, Detection limits, Aromatic compounds, Organic compounds, Hydrocarbons, Pesticides, Chlorinated hydrocarbons, Polychlorinated biphenyls, Insecticides, Benzidenes, Dioxin, Polynuclear aromatic hydrocarbons.

The method detection limit (MDL) is defined as the concentration of the analyte that can be detected at a given confidence level. The definition implies that, on the average, 99% of the trials measuring the analyte concentrations at the MDL must be significantly different from zero analyte concentration. MDL may be depicted as an error distribution. A procedure for determining the MDL with samples is described. The estimate may be tested by spiking the samples at the calculated MDL and repeating the procedure. Tables list MDL data on various analytical methods for organic priority pollutants in wastewater: purgeable aromatics, 0-0.4 micrograms per liter; benzidines, 0.08-0.22 micrograms per liter; organochlorine pesticides and polychlorinated biphenyls, 0.002-0.262 micrograms per liter; polycyclic aromatic hydrocarbons, 0.01-4.0 micrograms per liter; dioxin, 2 ng per liter; and miscellaneous organic compounds. The MDL varies with the analyst, method, composition of wastewater, and analyte. If the relative standard deviation of 7 replicates is 20.5-70.1%, the estimated MDL will be within the 95% confidence level of the calculated MDL. If the relative standard deviation is about 10%, the calculated MDL values can be below instrumental detection limits. (Cassar-FRC)
W82-03639

CONTIUOUS, AUTOMATED, AND LOW-COST MONITORING OF THE ORGANIC CONTENT IN WATER,

Life Systems, Inc., Cleveland, OH.
R. J. Davenport, R. A. Wynveen, and W. J. Cooper.
Journal of the American Water Works Association, Vol 73, No 10, p 555-558, October, 1981. 10 Fig, 8 Ref.

Descriptors: *Water quality, *Monitoring, *Organic compounds, Measuring instruments, Chemical analysis, Water analysis, Electrochemistry, Chemical reactions.

The electrochemical organic content (EOC) analyzer has been shown to be sensitive to individual organic compounds found in water. At present, however, the use of the EOC analyzer is in the experimental phase. The potential exists to apply the analyzer both to monitoring and to controlling operations in water treatment plants. Six organic compounds were selected for use during the feasibility demonstration of the EOC analyzer: acetic acid, methanol, urea, acetone, phenol, and a high-molecular-weight, nonionic surfactant, Triton X-100. The optimum electrode potentials and time periods for the electrode preconditioning sequence were selected on the basis that the optimum conditions would produce maximum interfacial capacitance values at the adsorption potential, without evolving excessive amounts of oxygen and hydrogen. Many organic compounds or classes of compounds exhibit a maximum adsorption at a particular potential. Therefore by lowering the adsorption potential from 0.65 to 0.25V, the methanol response is increased five times and the resultant lower limit of detection is about 2 mg/liter total organic carbon. The fact that all organic compounds do not adsorb equally can be used to advantage in detecting and monitoring certain strongly adsorbing organics when they coexist with other, less strongly adsorbing organics. Another possible use for the EOC analyzer would be monitoring water quality throughout a treatment plant. (Baker-FRC)
W82-03658

ION EXCHANGE IN FLOW INJECTION ANALYSIS DETERMINATION OF AMMONIUM IONS AT THE MICROGRAM PER LITER LEVEL IN NATURAL WATERS WITH PULSED NESSLER REAGENT,

Centro de Energia Nuclear na Agricultura, Sao Paulo (Brazil).
F. H. Bergamin, B. F. Reis, A. O. Jacintho, and E. A. G. Zagatto.
Analytica Chimica Acta, Vol 117, p 81-89, June, 1980. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Ammonium, *Water analysis, Chemical analysis, *Ion exchange, Resins, Flow system, Wastewater analysis.

Conditions for the use of ion exchangers in flow injection systems were investigated in order to develop a method for the determination of ammonium ions in natural waters at the microgram per liter level. A resin column is employed in the sample loop of an electronically operated proportional injector. Effects of sample aspiration, sampling time, eluting agent concentration, pumping rate of the sample carrier stream, resin column size, and sample acidity were studied. Consideration was also given to the possible use of sample buffering before the adsorption step. The proposed method is characterized by a precision of about two percent, a sampling rate of about 40 samples per hour, and a reagent consumption of 40 microliters per sample, and is almost free of interferences. Recoveries from 95 to 105 percent were achieved in analyzing rainwater samples with ammonium contents of less than 200 micrograms per liter. For determinations of ammonium ion in other materials such as soil extracts or wastewaters, a system with a distillation unit can be used. The system can be used for other ions in conjunction with colorimetry, potentiometry, and atomic absorption spectrometry. (Baker-FRC)
W82-03700

CADMIUM IN AN AQUATIC ECOSYSTEM,

New York Univ., NY. Dept. of Environmental Medicine.
R. E. Hazen.
PhD Thesis, February, 1981. 148 p, 28 Fig, 22 Tab, 63 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-15552.

Descriptors: *Water pollution effects, *Cadmium, *Ecosystems, *Sediments, Toxicity, Heavy metals, Aquatic animals, Hazards, *Foundry Cove, Tidal effects, Hudson River, *New York.

Discharge of cadmium into Foundry Cove on the Hudson River from 1953 to 1970 accompanied the production of nickel-cadmium batteries at a nearby plant in Cold Spring, New York. The sediment surrounding the point of discharge was heavily contaminated. It was the purpose of this study to investigate the physical distribution and biological availability of the cadmium in Foundry Cove. Sediment, water and biota samples were collected and analyzed for cadmium. Laboratory exposures were conducted with fish to determine both rate of uptake and the significance of possible routes of exposure. Nine metric tons of cadmium were estimated to be in the cove sediment. Water samples typically contained from 5 to 15 micro gram Cd/liter. Animal and plant tissue samples were found to be elevated in cadmium compared to control areas. The predominant route of exposure to fish in the cove is believed to be via ingestion rather than uptake of cadmium from water through the gill. The major portion of the cadmium contamination was incorporated in the sediments with very limited availability to the water column. Nevertheless, significant elevations in cadmium concentrations were found in plants and animals in the cove. Cadmium in the blue-clay crab taken from the cove was found to be in a sufficient concentration to be a possible human health hazard. (Sinha-OEIS)
W82-03724

DEVELOPMENT OF HEALTH EFFECTS CRITERIA FOR FRESHWATER BATHING BEACHES BY USE OF MICROBIAL INDICATORS,

Oklahoma Univ., Norman.
G. L. McKee.
PhD Thesis, 1980. 219 p, 3 Fig, 18 Tab, 94 Ref, 7 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-16930.

Descriptors: *Water quality standards, *Bioindicators, *Public health, Recreation, Swimming, Pollutant identification, *Epidemiology, Escherichia coli, Microbiological studies, Oklahoma bathing beaches, Freshwater, Enterococcus, Symptomatology, *Lake Keystone.

An epidemiological-microbiological study was conducted at Lake Keystone, Oklahoma, near Tulsa, to help develop recreational water quality criteria based upon health effects. Symptomatology rates among swimmers relative to non-swimmer controls were examined at a 'barely acceptable' (BA) beach, Salt Creek Noth (I), and Keystone Ramp (II), and a 'relatively unpolluted' (RU) beach at Washington Irving South (III). This was accomplished by contacting family groups at the beaches on weekends and obtaining information on bathing activity by the use of interviewers. These beach-goers were questioned by telephone 8-10 days later concerning heath related symptoms. Measurements were made for a number of potential microbial indicators of pollution during the time the interviews were being made. When the data from the BA and RU beaches was examined, the symptom rates categorized as gastrointestinal, respiratory and 'other' were higher among swimmers than non-swimmers. Although the data were not statistically significant, definite trends could be shown in that direction. Good agreement was obtained between geometric means of Escherichia coli and enterococcus densities and the differential (swimmers minus non-swimmers) rate of gastrointestinal symptoms. The objective of relating illness as measured by symptomatology to an indicator of water quality has been addressed. (Sinha-OEIS)
W82-03730

5B. Sources Of Pollution

MINERAL ELEMENT CONTENT IN ULVA LACTUCA L. WITH REFERENCE TO EUTROPHICATION IN HONG KONG COASTAL WATERS,

Hong Kong Univ., Dept. of Botany.
Y. B. Ho.
Hydrobiologia, Vol 77, No 1, p 43-47, 1981. 1 Fig, 3 Tab.

Descriptors: *Algae, *Bioindicators, *Eutrophication, Chlorophyta, Indicators, Ulva lactuca, *Hong Kong, Nitrogen, Phosphorus, Pollutant identification, Fate of pollutants, *Coastal waters.

The green algae Ulva lactuca collected from sewage-contaminated urban sites in marine waters around Hong Kong Island were higher in tissue N

and P (44.9 and 2.7 mg per g dry weight, respectively) than algae from relatively non-polluted rural sites (27.15 and 1.45 mg per g dry weight, respectively). The mean inorganic N and soluble reactive P (in micrograms per cu dm) in seawater were as follows: urban sites, 162 and 37, respectively; rural sites, 12 and 6, respectively. There was a significant, positive correlation between the logarithmic concentration of soluble reactive P in seawater and tissue P. Levels of K and Na in the algal tissue were relatively uniform. Iron varied widely, being generally more concentrated in algae and water from urban sites. Ulva is potentially a good bioindicator for eutrophication and for heavy metal pollution. (Cassar-FRC)
W82-03417

WILL EPA'S NATIONWIDE URBAN RUNOFF STUDY ACHIEVE USEFUL RESULTS,

Colorado State Univ., Fort Collins, Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W82-03424

A WET-WEATHER MODEL FOR EVALUATING THE COMBINED EFFECTS OF STORM-SEWAGE OVERFLOWS AND SEWAGE-WORKS' EFFLUENTS UPON RIVER QUALITY,

Yorkshire Water Authority, Sheffields (England). Southern Div.
D. M. V. Aspinwall.
Water Pollution Control, Vol 80, No 3, p 398-410, 1981. 10 Fig, 2 Tab, 5 Ref.

Descriptors: *Combined sewer overflow, *Storm-overflow sewers, Overflow, Storm sewers, Sewers, Storm drains, Storm wastewater, *Model studies, Mathematical models, Rivers, Water quality, Water pollution sources.

A simple mathematical model is described which examines the way in which the diluting effect of rainwater upon crude sewage affects river pollution caused by storm sewage overflow discharges. The model also allows the input of sewage-treatment works final effluent and storm-sewage tank effluent so that a complete picture can be formed of the combined effects of all these discharges upon river quality. The relevance of the model output is discussed in relation to common problems such as storm-sewage overflows which discharge prematurely, rivers affording little dilution and rivers which are affected by upstream pollution. The application of the model is described for the Sheffield drainage area. In general the river dilution here is low, storm overflow settings are low, and it is to be expected that quite high levels of pollution will occur. The model is based upon steady state conditions, and a sufficient period is required to have elapsed from the start of rainfall for these conditions to be reached. The period required is a function of the time of concentration of the sewerage system together with the flow characteristics of the receiving watercourse. For small drainage areas the period will be short. For larger areas the period will be longer. Storms of short duration will produce lower levels of pollution than are predicted by the model. The situations in which it would be desirable to implement policies of separation of combined sewerage systems are those highest in storm-sewage overflows causing excessively high levels of stream pollution. If separation is unlikely, the effect of providing increased sewer capacity together with higher settings of storm sewage overflows and off line storage tanks should be investigated. Schemes for works abandonment and regionalization should be viewed cautiously, as they may lead to situations in which longer sections of the river become polluted. (Baker-FRC)
W82-03427

OUTBREAKS OF WATERBORNE DISEASE IN THE UNITED STATES, 1971-1978,

Health Effects Research Lab., Cincinnati, OH.
G. F. Craun.
Journal of the American Water Works Association, Vol 73, No 7, p 380-389, July, 1981. 10 Fig, 9 Tab, 22 Ref.

Descriptors: *Human diseases, *Drinking water, *Water distribution, Municipal water, Water quality, Contamination, Public health.

Outbreaks of waterborne disease associated with water used for drinking purposes are discussed for 1971 through 1978. Forty-three states and Puerto Rico reported 224 outbreaks which affected 48,193 individuals, two of whom died. Outbreaks in municipal and community systems naturally affected the largest number of people. These were generally caused by contamination of the distribution system, primarily through cross connections and backsiphonage. Five thousand cases of acute gastroenteritis were thought to be caused by the contamination of an uncovered storage reservoir, and 1400 cases of a similar illness were traced to sewage contamination of a water main under construction. The use of untreated, contaminated groundwater and treatment deficiencies were the primary sources of waterborne disease outbreaks in semipublic or noncommunity systems. Treatment deficiencies were responsible for 33% of all outbreaks. The number of reported outbreaks has been increasing in the United States, but this is attributed to improved surveillance. (Small-FRC)
W82-03430

INTERSTATE HIGHWAYS VERSUS WATERSHED PROTECTION IN NEW ENGLAND,

Jordan (Perkins), Inc., Reading, MA.
W. R. Adams, Jr.
Journal of the American Water Works Association, Vol 73, No 7, p 346-349, July, 1981.

Descriptors: *Watershed management, *Highway effects, *Road construction, Highways, Highway relocation, Runoff, Drinking water, Water quality, Water pollution sources, *New England.

The quality of drinking water supplies is threatened by the construction and use of interstate highways. The construction process may encourage erosion, which can add large quantities of turbid water to a reservoir. Runoff which occurs after other toxic spills that result from highway accidents are a third source of contamination. In addition, interstate highways spur further development, including shopping centers, more streets, and increases in housing construction. An example is presented of the environmental impact of a planned interstate on the Scituate Rreservoir near Providence, Rhode Island. When interstates are constructed outside of watersheds, problems associated with construction and operation are prevented and traffic is taken off the roads within the watershed. This practice is in keeping with the basic New England philosophy that every effort should be made to protect drinking water sources from further degradation. (Small-FRC)
W82-03431

A FACTOR ANALYSIS OF ELEMENTAL ASSOCIATIONS IN THE SURFACE MICROLAYER OF LAKE MICHIGAN AND ITS FLUVIAL INPUTS,

Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
For primary bibliographic entry see Field 2H.
W82-03442

IF YOUR CITY'S WELL WATER HAS CHEMICAL POLLUTANTS, THEN WHAT,

A. Morrison.
Civil Engineering (New York), Vol 51, No 9, p 65-67, September, 1981. 1 Fig.

Descriptors: *Groundwater pollution, *Organic solvents, Solvents, Glen Cove, *New York, Rockaway, *New Jersey, Aeration, Adsorption, Water pollution sources, Activated carbon, Potable water, Wells, Well water, Organic compounds, Trichloroethylene.

The major organic pollutants found in groundwaters are organic solvents; the most common of these are trichloroethylene and 1,1,1-trichloroethane. Recent samplings have revealed solvent contamination of groundwaters in Massachusetts, Connecticut, New Hampshire, New York, New Jersey, Delaware, Rhode Island, Pennsylvania, Florida, Michigan, and California. Other solvents that have been identified in groundwater include vinyl chloride, 1,2-dichloroethane, tetrachloroethylene, cis-1,2-dichloroethane, and carbon tetrachloride. Possible sources for these contaminants include industrial discharges, leachate from improperly managed landfills, septic tank degreasers and similar products used in individual households, sewer leaks, accidental spills, and leaks. Conventional water treatment such as coagulation, settling, precipitative softening, filtration, and perhaps disinfection are ineffective in removing most solvents. Both aeration and adsorption, however, have been found effective in decreasing concentrations of many of these contaminants. The two major adsorption methods used for this purpose are granular activated carbon and a synthetic carbon-based resin called Ambersorb XE-340. Aeration techniques found effective include packed column aeration, small cooling towers, and diffused aeration. A combination of adsorption and aeration is under study. Specific emergency situations are considered, including that in Rockaway Township, New Jersey, which is beset by pollution from two distinct sources, and Glen Cove, New York. (Baker-FRC)
W82-03451

ROCKY MOUNTAIN ARSENAL: LANDMARK CASE OF GROUNDWATER POLLUTED BY ORGANIC CHEMICALS, AND BEING CLEANED UP,

Civil Engineering (New York), Vol 51, No 9, p 68-67, September, 1981. 3 Fig, 1 Tab.

Descriptors: *Groundwater pollution, *Organic compounds, Water pollution, *Rocky Mountain Arsenal, Deep wells, Wastewater treatment, Poisons, Toxicity, Hazardous materials, *Chemical wastes.

In the 1940s chemical wastes were dumped at the Rocky Mountain Arsenal. Dumping techniques were not very sophisticated at that time, involving only placing a small dam across a low place on the Arsenal grounds, adding lime to stabilize the waste, and dumping the waste behind the dam. A problem was evident in the 1950s, when nearby crops irrigated with groundwater that had flowed under the Arsenal were damaged. Groundwater and contamination surveys were conducted, along with engineering studies, which in 1957 resulted in the construction of an asphalt-lined basin into which the above-ground liquid wastes were pumped. By the 1960s the asphalt-lined basin proved insufficient to handle all liquid wastes, so some were deep well injected into geologic strata underlying Denver. When earthquakes were detected in the Denver region, the deep well injection program was stopped. At this point the earthquakes also stopped. In 1975 the problem was taken over by the Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Maryland. Subsequently, wells have been drilled on the Arsenal grounds and used to check groundwater quality; quantity and direction of groundwater flow is being monitored; new technologies for waste treatment and control have been studied; a pilot slurry wall was constructed underground to intercept some of the groundwater flow before it leaves the Arsenal; and the intercepted flow is pumped out, run through granular activated carbon beds, and the cleansed water returned to the ground via other wells downflow of the wall. A team of specialists is now being assembled to help determine the most cost-effective alternatives for addressing the total contaminant problem. (Baker-FRC)
W82-03458

PALAEOECOLOGICAL STUDIES OF THE RECENT DEVELOPMENT OF LAKE VAXJOSJON. III. REASSESSMENT OF RECENT CHRONOLOGY ON THE BASIS OF MODIFIED PB210 DATES,

University Coll., London (England).
R. W. Battarbee, G. Digerfeldt, P. Appleby, and F. Oldfield.
Archiv fur Hydrobiologie, Vol 89, No 4, p 440-446, August, 1980. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Sedimentation, *Lead, *Dating, *Lake sediments, Paleolimnology, Deposition, *Fate of pollutants, Lake Vaxjoejon.

Dates of lead pollution in sediments in Lake Vaxjoejon were recalculated using the assumption of a constant net rate of supply (c.r.s.) of unsupported Pb210 to the sediment. Dates had previously been determined on the assumption that there was a constant initial concentration (c.i.c.) of unsupported Pb210 per unit dry weight of sediment at each sampled depth. For the eight samples down to the 140 cm depth (1880) there was reasonably good agreement between the two calculation methods, suggesting a rather uniform dry mass accumulation rate during this period. The last two samples, 155-160 cm and 175-180 cm, were dated 1898 and 1875, respectively, by the c.i.c. method and 1868 and 1786, respectively, by the c.r.s. method. Sediment accumulation rates determined by the c.r.s. method (0.148 g per sq cm per a) correlated better with historical evidence such as dredging, lake lowering, and pollution inputs than rates determined by c.i.c. (0.135 g per sq cm per a). (Cassar-FRC)
W82-03480

DEGRADATION OF PENTACHLOROPHENOL IN SIMULATED LENTIC ENVIRONMENT,

Fish and Wildlife Service, Columbia, MO.
T. P. Boyle, E. F. Robinson-Wilson, J. D. Petty, and W. Weber.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 177-184, 1980. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Biodegradation, *Aquatic environment, *Ecosystems, *Aerobic bacteria, *Phenols, Organic compounds, Euphotic zone, Zones, Water pollution, Benthic environment, Benthos, Experimental design, Gas chromatography, Lentic environment, Standing waters.

The persistence of pentachlorophenol (PCP) in various aquatic environments was investigated. Four aquaria were established, simulating four lentic environments: the oxygen rich epilimnion, the oxygen rich euphotic littoral zone, and low oxygen, dark hypolimnion, and a benthic hydrosoil-hypolimnion. The degradation of PCP, formation of TCP and PCA, and the distribution of metabolites were observed over a 131 day period. Results suggest that the persistence of PCP was associated with three variables: (1) the absence of light and hydrosoil, (2) a pH near or below the pka of 4.8, and (3) low oxygen concentration. The conversion of PCP to TCP does not appear to be the major pathway in water, but may be more important in hydrosoil. (Titus-FRC)
W82-03489

STUDY OF THE TRANSFER OF CD, PB, CU, AND ZN IN NERITIC AND ESTUARINE TROPHIC CHAINS - I. STATE IN THE INTERNAL ESTUARY OF THE LOIRE (FRANCE) DURING THE SUMMER OF 1978. (ETUDE DU TRANSFERT DE CD, PB, CU ET ZN DANS LES CHAINES TROPHIQUES NERITIQUES ET ESTUARIENNES - I. ETAT DANS L'ESTUAIRE INTERNE DE LA LOIRE (FRANCE) AU COURS DE L'ETE 1978),

Nancy-1 Univ. (France). Lab de Chimie et d'Electrochimie Analytique et d'Hydrologie.
J-C. Amiard, C. Amiard-Triquet, C. Metayer, J. Marchand, and R. Ferre.
Water Research, Vol 14, No 6, p 665-673, June, 1980. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Trace metals, *Food chains, *Estuaries, Bioaccumulation, Heavy metals, Metals, Crustaceans, Fish, Loire, *France, Path of pollutants.

Different species of crustaceans and fish were taken from the Loire estuary on the banks of Bilho and Pipy to determine the behavior of some trace elements (Cd, Pb, Cu, Zn) in estuarine biota. Except for Zn, the accumulation of metals was higher in crustaceans than in fishes, which was particularly pronounced for Cu, a constituent of the crustacean respiratory pigment hemocyanine. The metal concentrations, determined by atomic absorption, were no greater in bottom-feeders than for other fish, indicating that metal transfer from sediments was unimportant. Biological accumulation decreased in the order Zn $>$ Cu $>$ Pb $>$ Cd. The Loire organisms were generally less contaminated than those of the same species taken from heavily polluted estuaries (Severn and Medway, England). Transfers in food chains were determined with the transfer factor, equal to the ratio of the predator concentration to the prey concentration. There was no indication of any biomagnification in food chains for Cd, Pb and Cu, since the amounts observed in the predators were generally less than those of prey or in the digestive content. For Zn the transfer factor was > 1 with one exception (Neyomysis integer - Crangon crangon). The higher concentrations in the intestines than in the stomach were probably due to feces enrichment by unassimilated metals. (Hertzoff-FRC)
W82-03492

IRRIGATED AGRICULTURE AND NITRATE POLLUTION OF RURAL WATER SUPPLIES: ECONOMICS FOR POLICY IN CENTRAL WISCONSIN,

Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W82-03512

ARSENIC IN LAKE LANSING, MICHIGAN,

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
T. R. Batterson.
PhD Thesis, 1980. 94 p, 12 Fig, 4 Tab, 55 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06466.

Descriptors: *Lakes, *Arsenic, *Water pollution, Pollutant identification, Water pollution sources, Aquatic weed control, Sediments, *Lake Lansing, *Michigan.

Lake Lansing, Michigan was treated with sodium arsenite for control of aquatic macrophytes in 1957. The rate of decrease in recently deposited sediments predicted that concentrations near background would exist in surficial sediments in the deep portions of the basin by 1989. One hundred ten samples of the upper 7 cm of littoral sediments were taken along transects. Concentrations two to six times background occurred over 85-90% of the sediment surface. An arsenic mass balance budget was constructed for the lake for the interval June 1978 to June 1979. This showed that the lake lost more arsenic than it received annually. A laboratory experiment was conducted to obtain predictions of arsenic expected in the lake as a result of interactions between contaminated sediments and the water column. Since sediments in the well aerated littoral, as well as those from the periodically anaerobic hypolimnion were contaminated, aerobic and anoxic treatments were compared. It appears that As(V) and phosphate compete for iron as anoxic systems are aerated. Concentrations of arsenic observed in the lake fit expectations from the experimental work. Currents associated with summer storms periodically erode the metalimnion of this shallow lake. Except for infrequent summer periods, sulfide or ferric iron tend to limit total arsenic in the hypolimnion. (Sinha-OEIS)
W82-03522

MOVEMENT OF COBALT IN FRESHWATER MICRO-ECOSYSTEMS,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W82-03524

METHANOGENESIS IN MARINE SEDIMENTS OF THE MISSISSIPPI RIVER DELTA,

Louisiana State Univ., Baton Rouge. Dept. of Microbiology.
L. A. Hook.
PhD Thesis, May, 1981. 167 p, 30 Fig, 9 Tab, 83 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-17631.

Descriptors: *Methane, *Sediments, *Bacteria, *Deltas, Anaerobic conditions, Sulfur bacteria, Environmental effects, Microbiological studies, *Mississippi River, *Methanogenesis, Marine sediments, Sulfate-reducing bacteria.

The final processes of carbon mineralization in anaerobic sediments are chiefly governed by two groups of strictly anaerobid microorganisms: sulfate-reducers and methanogens. The highest most probable numbers (MPNs) of methanogens and sulfate-reducers in unstable, gas-rich, Mississippi River delta sediments occurred together in samples taken 0.2 m below the sediment-water interface. The presence of sulfate-reducers was directly related to dissolved sulfate in the interstitial water. Dissolved methane in the sediments was inversely related to the presence of sulfate-reducing bacteria. The extensive depth distributions of methanogens and sulfate-reducers, plus the occurrence of two sulfate-reducing zones, were the result of sediment mixing during undersea landslides that frequently occurred in the delta. Methanogenesis was sensitive to 2-bromoethanesulfonate, chloroform, nitrate, air, and formaldehyde, but not to added Beta-fluoroacetate, sulfide, or sulfate. The optimum temperature for methanogensis in enrichments and in unadulterated sediments was 35-40 C and 45 C, respectively. The production of methane from choline, in addition to the isolation of desulfovibrios capable of producing trimethylamine from choline, implicated trimethylamine as a possible methane precursor in the delta sediments. (Sinha-OEIS)
W82-03533

DEGRADATION OF POLYCHLORINATED BIPHENYLS IN SEDIMENTS OF THE GREAT LAKES,

Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
M. L. Anderson.
PhD Thesis, 1980. 275 p, 59 Fig, 24 Tab, 162 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-25646.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Degradation, *Microbial degradation, Experimental data, Aeration, Bacteria, Chemical properties, Water quality, Fate of pollutants, *Great Lakes, Saginaw Bay.

The central hypothesis of this research is that microbial degradation of PCBs in the Great Lakes might be significant. Because of the long residence time of PCBs in the Great Lakes, this removal mechanism could be significant even if the rate of degradation is slow. Some conclusions reached are: Bacteria exist in sediments of Saginaw Bay and River which are capable of degrading chlorobiphenyls at rates which are significant. The degradation of chlorobiphenyls in incubated sediments is enhanced by aeration and mixing of the system. The degradation of di- and trichlorobiphenyls is extremely rapid in incubated sediments. Tetra and pentachlorobiphenyls are also degraded but at slower rates. The rate of degradation of 2, 4, 5, 2', 5'-pentachlorobiphenyls has a significant impact upon simulated Aroclor 1254 concentrations in Saginaw Bay. None of the chlorobiphenyls employed were degraded in sediments incubated under anaerobic conditions. And finally, degradation of chlorobiphenyls in the Great Lakes appears to take place predominantly in the aerobic surface layer of sediments. (Sinha-OEIS)
W82-03536

GROUND WATER SEEPAGE IN LAKE WASHINGTON AND THE UPPER ST. JOHNS RIVER BASIN, FLORIDA,

New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 2H.
W82-03546

THE ADSORPTION CHARACTERISTICS OF SOILS AND REMOVAL OF CADMIUM AND NICKEL FROM WASTEWATERS,

College of Petroleum and Minerals, Dhahran (Saudi Arabia).

For primary bibliographic entry see Field 5E.
W82-03553

ACIDIFICATION OF SURFACE WATERS IN TWO AREAS OF THE EASTERN UNITED STATES,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
D. A. Burns, J. N. Galloway, and G. R. Hendrey.
Water, Air, and Soil Pollution, Vol 16, No 3, p 277-285, October, 1981. 2 Tab, 32 Ref.

Descriptors: *Acidic water, *Streams, *Acid rain, *New Hampshire, *North Carolina, Blue Ridge Mountains, White Mountains, Hydrogen ion concentration, Alkalinity, Surface waters, Lakes, Air pollution, Water pollution sources.

Some acidification of surface waters has occurred in 2 undisturbed, upland watersheds in New Hampshire's White Mountains and North Carolina's Blue Ridge Mountains. The New Hampshire waters had a pH of 6.06 in 1979 vs. 6.66 in 1936-39. The North Carolina waters declined in pH from 6.77 in 1961-64 to 6.51 in 1979. Recent determinations of Ca, Mg, Na, and K were compared with bicarbonate alkalinity. The current ratios of bicarbonate alkalinity to the sum of the base cations were 0.312 for New Hampshire and 0.562 for North Carolina. These may be compared with ratios from western lakes receiving no acid precipitation (0.776-0.942) and some acid lakes in Connecticut (0.333), Maine (0.427), and Scandinavia (0.064). Acidification was more pronounced in New Hampshire waters, corresponding with historical data that New Hampshire has been receiving precipitation of average annual pH below 4.5 since at least 1955, whereas North Carolina precipitation in 1955 had a pH of 4.7-5.2, and in 1963, 5.0. (Cassar-FRC)
W82-03554

ANALYTICAL SOLUTIONS FOR TRANSPOT OF CONSERVATIVE AND NONCONSERVATIVE CONTAMINANTS IN GROUNDWATER SYSTEMS,

Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
J. Hoeks.
Water, Air, and Soil Pollution, Vol 16, No 3, p 339-350, October, 1981. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Solute transport, *Waste disposal, Model studies, *Path of pollutants, *Groundwater pollution, Leachates, Landfills, Groundwater movement, Adsorption, Degradation, Water quality, Zinc, Ammonium, Chlorides, Organic compounds.

A simple model for contaminant transport in groundwater is developed to help select sites for waste disposal. Data needed are soil profile, hydrologic parameters, and soil interaction processes (adsorption, decomposition). Equations describing the flow of groundwater along streamlines are combined with equations for interaction processes. Dispersion is neglected. An example is given where a waste tip (200 m in diameter) is in an area of divergent radial groundwater flow with concentric equipotential lines. Infiltration into upper soil and aquifer is 200 mm per year. After 30 years ammonium and Zn have been retarded; organic compounds have been degraded within 100 m. Vertical penetrations are 21 m for Cl, 17 m for ammonium, 2.6 m for Zn, and 10 m for organic compounds. (Cassar-FRC)
W82-03555

LOSSES OF NITROGEN, PHOSPHORUS AND POTASSIUM FROM AGRICULTURAL WATERSHEDS OF MINOR RIVERS IN THE OKA VALLEY,

Akademiya Nauk SSSR, Moscow. Inst. Agrokhimii i Pochvovedeniya.
V. N. Kudeyarov, V. N. Bashkin, and A. Y. Kudeyarova.
Water, Air, and Soil Pollution, Vol 16, No 3, p 267-276, October, 1981. 2 Fig, 4 Tab, 24 Ref.

Descriptors: *Nutrients, *Fertilizers, *Agricultural runoff, Fate of pollutants, Agricultural watersheds, Nitrogen, Phosphorus, Potassium, *Oka Valley, *USSR, Rivers.

Concentrations of nitrogen, phosphorus, and potassium were measured in the rivers and principal tributaries of the Oka Valley, near Moscow, from July 1977 to March 1980, with simultaneous estimation of the water discharge. Nutrient losses in the four tributary valleys of the Oka Valley were highly correlated with the amounts of mineral and organic fertilizers applied to the soil. The four valleys differed in rate and timing of fertilizer application, soil type, crops, and erosion characteristics. Nutrient losses were also higher in regions with greater natural soil fertility, greater erosion, and light-textured soils, and in the flood season. (Cassar-FRC)
W82-03556

COMPARISON OF FIVE DIFFERENT METHODS FOR MEASURING BIODEGRADABILITY IN AQUEOUS ENVIRONMENTS,

Battelle Columbus Div., OH.
For primary bibliographic entry see Field 1B.
W82-03557

SULFUR CONTITUENTS OF SEDIMENTS AND THEIR RELATIONSHIP TO LAKE ACIDIFICATION,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. Dept. of Environmental and Forestry Biology.
M. J. Mitchell, D. H. Landers, and D. F. Brodowski.
Water, Air, and Soil Pollution, Vol 16, No 3, p 351-359, October, 1981. 3 Fig, 3 Tab, 35 Ref.

Descriptors: *Lake sediments, *Sulfur compounds, *Acid rain, Fate of pollutants, Sediments, Acidic water, Sulfates, Decomposition, Lakes, Oneida Lake, Deer Lake, South Lake, *New York, Water pollution effects.

The organic and inorganic sulfur fraction in 3 New York lake sediments were determined. These lakes, subjected to acid precipitation, differed in buffering capacity and pH. pH and acid neutralizing capacity (in meq per liter) respectively were: Oneida, 7.2-9.4 and 1700; South, 4.9-6.5 and 2-10; and Deer, 5.9-6.8 and 90-124. Total sulfur in sediments was lowest in Oneida (0.1-0.3% dry mass). South (0.25-0.65%) and Deer (0.3-0.5%) sediments had higher S levels near the outlets. Sulfides were highest in Oneida (1% of total S) which had the lowest redox potential (-80 to -110 mV). South and Deer contained about 0.2% sulfides. Inorganic S varied from 8% of total S in Deer to 22% in Oneida. Ester sulfates were 80% of total S in Oneida and Deer, and 45% in South. Oxygen consumption was highest in Oneida and lowest in South sediments. The low ester sulfate and higher carbon/nitrogen ratio in South sediments suggest that lake acidification may inhibit decomposition. (Cassar-FRC)
W82-03558

BOTTOM SEDIMENTS AS A SOURCE OF NITROGEN AND PHOSPHORUS IN WATER,

Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
M. V. Martynova.
Water Resources, Vol 8, No 1, p 91-106, January/February, 1981. 2 Fig, 8 Tab, 58 Ref. Translated from Vodnye Resursy, No 1, p 164-182, January/February, 1981.

Descriptors: *Nitrogen removal, *Phosphorus removal, *Sediments, Fate of pollutants, Bottom sediments, *Lake sediments, Nutrients, Eutrophication, Reviews, Adsorption, Phosphates, Ammonium compounds, Model studies, Clays, Chemical reactions.

Literature on bottom sediments and their release of nutrients into the water is reviewed with emphasis on publications of the 1970's. This stage of the investigations is concerned with the role of sediments in the prediction and regulation of water quality, mainly phosphorus levels. Two methods of investigation are common: aquarium experiments and on-site observations. Several factors influence the exchange of N and P between sediments and water. Anaerobic conditions promote P mobilization. Phosphate concentrations greater than 1-2 mg per liter are readily adsorbed into sediments under both aerobic and anaerobic conditions. Oxygen levels do not affect the rate of removal of ammonium N from sediments. Maximum phosphate adsorption takes place at lower pH (4-5) on kaolinite and illite, at higher pH (10+) on montmorillonite, and in clays with higher Fe content. Both P and N removal are greater at higher water temperatures and at higher microbial activity levels. Models describing P and N exchange in sediments are based on mechanisms or on experimentally determined relationships between the release rates of N and P-containing compounds and their content in the sediment. Concentration diffusion is the main method of passage of N from sediments into water. The P removal mechanism is more complex, and not all the processes are completely understood. (Cassar-FRC)
W82-03571

BOUNDARY INTEGRAL EQUATION SOLUTIONS TO MOVING INTERFACE BETWEEN TWO FLUIDS IN POROUS MEDIA,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2F.
W82-03577

MASS TRANSPORT. 3. ROLE OF HYDRAULIC CONDUCTIVITY DATA IN PREDICTION,

British Columbia Univ., Vancouver. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2G.
W82-03578

PATTERNS OF GROUNDWATER SALINITY CHANGES IN A DEEP CONTINENTAL-OCEANIC TRANSECT OFF THE SOUTHEASTERN ATLANTIC COAST OF THE U.S.A.,

Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2F.
W82-03582

SULFUR AND OXYGEN ISOTOPES AS TRACERS OF THE ORIGIN OF SULFATE IN LAKE CRETEIL (SOUTHEAST OF PARIS, FRANCE),

Paris-6 Univ. (France). Lab. de Geologie Dynamique.
For primary bibliographic entry see Field 2H.
W82-03583

CHARACTER OF BRINES FROM THE BELLE ISLE AND WEEKS ISLAND SALT MINES, LOUISIANA, U.S.A.,

Louisiana State Univ., Baton Rouge. Inst. of Environmental Studies.
For primary bibliographic entry see Field 2F.
W82-03584

PERSISTENCE OF DIELDRIN IN WATER AND CHANNEL CATFISH FROM THE DES MOINES RIVER, IOWA, 1971-73 AND 1978,

Minnesota Pollution Control Agency, Roseville.
S.-Y. T. Leung, R. V. Bulkley, and J. J. Richard.
Pesticides Monitoring Journal, Vol 15, No 2, p 98-102, September, 1981. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Fate of pollutants, *Dieldrin, *Catfish, *Water pollution effects, Bioaccumulation, Pesticides, *Insecticides, Water pollution, Rivers, Aldrin, Environmental effects, Ecological effects, Runoff.

The levels of the organochlorine insecticide, dieldrin, in the Des Moines River, Iowa and in channel catfish (Ictalurus punctatus) from the river were compared based on studies done before and after the banning of the parent pesticide aldrin by the Environmental Protection Agency in 1975. In river water, the mean June levels of dieldrin decreased from 50 parts per trillion (ppt) in 1971 to 11 ppt in 1978. In 1971 the average daily transport of dieldrin was 156 g, as compared to a value of 70

g in 1978. Average levels of dieldrin in catfish muscle recorded in July were 75 parts per billion (ppb) in 1973 and 46 ppb in 1978. Three years after the registration of the parent compound aldrin was withdrawn, dieldrin was still found at significant levels in the Des Moines River. The long half-life of this chemical under certain environmental conditions indicates that dieldrin will be present in the river for some years. (Geiger-FRC)
W82-03590

SEEPAGE FLOW IN EXTREMELY THIN AQUIFERS,

Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenierbau.
For primary bibliographic entry see Field 2F.
W82-03594

FIELD OBSERVATIONS OF FRONTS AND HIGH-FREQUENCY TEMPERATURE FLUCTUATIONS IN A THERMAL PLUME,

Wisconsin Univ.-Madison. Marine Studies Center.
T. Green, and S. Roffler.
Advances in Water Resources, Vol 4, No 3, p 137-145, September, 1981. 16 Fig, 1 Tab, 18 Ref.

Descriptors: *Plumes, *Thermal water, *Nuclear powerplants, Thermal pollution, Temperature gradient, Powerplants, Outfall, Turbulent flow, Cooling water, *Lake Michigan, Mixing, Flow pattern, Fate of pollutants.

High frequency temperature variations were measured at seven depths 130 meters from the cooling water outfall of the Point Beach Nuclear Plant on Lake Michigan. Techniques used to analyze the data included temperature spectra, correlation functions, and probability distributions. Sharp, concentric thermal fronts observed in the data compare with those obtained from aircraft infrared imagery and to laboratory studies of instabilities in mixing layers between uniformly flowing and quiescent liquids. This work gives firm evidence of the existence of mature, two-dimensional vortical structures in a high Reynolds number flow in the natural environment. It is believed that the lake bottom is not directly responsible for the observed structures. The mean temperatures at various depths were as follows: 20.7C at the surface, 19.2C at 1 m, 17.4C at 2 m, and 14.3C at 3 m. (Cassar-FRC)
W82-03595

KINETICS OF TRIHALOMETHANE FORMATION IN LYOPHILIZED POTOMAC WATER,

Howard Univ., Washington, DC. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W82-03596

TREATABILITY AND PATHWAYS OF PRIORITY POLLUTANTS IN THE BIOLOGICAL WASTEWATER TREATMENT,

Environmental Protection Agency, Washington, DC.
S. T. Hwang.
AIChE Symposium Series, Vol 77, No 209, p 316-326, 1981. 5 Fig, 26 Ref.

Descriptors: *Kinetics, *Biodegradation, *Air stripping, *Adsorption, *Wastewater treatment, Biological treatment, Sludge, *Fate of pollutants, Mass transfer, Diffusion coefficient, Priority pollutants, Organic compounds, Metals, Activated sludge process.

A review of state-of-the-art literature on biodegradation kinetics, air stripping, and adsorption on sludge of priority pollutants resulted in a unified framework by which to quantify removal of toxic chemicals by multimedia pathways in biological wastewater treatment systems. Biodegradation of toxic chemical substances is best described by Gron kinetics. An estimate of mass transfer coefficients in air stripping can be obtained from the ratio of the diffusion coefficient, molecular weights, or critical volumes in conjunction with a known value of the mass transfer coefficient. Sludge adsorbs some priority pollutants, primarily polynuclear aromatic compounds, metals, and cyanides. The disappearance of a specific toxic pollutant in sludge in nonbiodegradable form can be represented by the multicomponent adsorption equation of Langmuir type based on the binary characterization of wastewater adsorption. (Cassar-FRC)
W82-03599

COMPARATIVE STUDY OF THE TROPHIC TRANSFER OF TWO MERCURY COMPOUNDS--HGCL2 AND CH3HGCL--BETWEEN CHLORELLA VULGARIS AND DAPHNIA MAGNA. INFLUENCE OF TEMPERATURE,

Bordeaux-1 Univ., Talence (France). Lab. d'Ecologie Animale.
A. Boudou, and F. Ribeyre.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 624-629, November, 1981. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Bioaccumulation, *Aquatic life, *Mercury, Algae, Daphnia, Chlorella, Invertebrates, Temperature effects, Water pollution effects, Methylmercury, *Fate of pollutants, Organomercury compounds.

The transfer of two mercury compounds, mercuric chloride and methyl mercury chloride, between a producer level species (Chlorella vulgaris) and a primary consumer (Daphnia magna) was compared at 10 and 18C. Metal concentrations were 1 ppb. Chlorella took up 86% and 96% of initial Hg from mercuric chloride at 10 and 18C, respectively, and 100% and 98% of initial Hg from methyl mercury at 10 and 18C, respectively. Daphnia exposed to the contaminated chlorella for 4 days accumulated 6% Hg at both 10 and 18C in the mercuric chloride flasks and 21% and 58% Hg at 10C and 18C, respectively, in the methyl mercury flasks. At the higher temperature Daphnia ingest more food. The identical Hg accumulation rates of Daphnia in mercuric chloride at both temperatures are explained by some direct contamination at 10C. (Cassar-FRC)
W82-03602

BALANUS EBURNEUS: A SENSITIVE INDICATOR OF COPPER AND ZINC POLLUTION IN THE COASTAL ZONE,

Florida Inst. of Tech., Melbourne.
For primary bibliographic entry see Field 5A.
W82-03605

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOLUME I; GENERAL.

Environmental Protection Agency, DC. Effluent Guidelines Div.
Report EPA-400/1-80/024-b, December, 1980. 463 p, 8 Fig, 65 tab, 153 Ref, 3 Append.

Descriptors: *Steel industry, *Industrial wastes, *Water pollution sources, *Water pollution control, *Wastewater treatment, Effluents, Pollutants, Flow control, Toxicity, Organic compounds, Inorganic compounds, Water quality standards, Costs.

This volume discusses the general issues pertaining to development of BPT, BCT, and BAT effluent limitations, pretreatment standards for new and existing sources (PSNS and PSES) and new source performance standards (NSPS) for the steel industry. Regulations and proposed for twelve recognized subcategories of the industry. For the most part, the BPT effluent limitations promulgated in 1974 and 1976 are practicable and achievable by all steel facilities. The BAT limitations are more stringent, and are expected to reduce process flow by 90%, toxic organics by 92%, and other pollutants by 93% compared with the BPT limitations. In most cases the NSPS are equal to the proposed BAT effluent limitations. In most cases the proposed standards for toxic pollutants for PSES abd PSNS are the same as the limitations proposed for BAT. The costs for implementing the BPT and BAT limitations are estimated. (Brambley-FRC)
W82-03624

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL II: COKE MAKING SUBCATEGORY, SINTERING SUBCATEGORY, IRON MAKING SUBCATEGORY,

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-440/1-80/024b, December, 1980. 457 p, 66 Fig, 122 Tab.

Descriptors: *Steel industry, *Industrial wastes, *Water pollution sources, *Wastewater treatment, Effluents, Pollutants, Suspended solids, Flow control, Oil, Grease, Ammonia, Cyanides, Phenols, Organic compounds, Benzenes, Residual chlorine, Heavy metals, Costs, Water pollution control.

This volume contains the effluent limitations for BPT, BCT and BAT, as well as pretreatment standards for existing and new sources (PSES and PSNS) and new source performance standards (NSPS) for the cokemaking, sintering, and ironmaking subcategories of the steel industry. The cokemaking subcategory has proposed limitations and standards for flow, total suspended solids, oil and grease, ammonia-nitrogen, total cyanide, phenols, benzene, naphthalene, benzo(a)pyrne, and pH. Separate BAT limitations will be proposed for those existing sources which have full scale physical/chemical BAT treatment systems. For the sintering subcategory, limitations are proposed for flow, total suspended solids, oil and grease, ammonia-nitrogen, total cyanide, phenols, total residual chlorine, lead, zinc, and pH. By controlling cyanide and phenols control of other organics is expected, and by controlling lead and zinc control of toxic metals is expected. Similar control is expected by the limitations proposed for the ironmaking category for these pollutants. Limitations for the ironmaking category are proposed for flow, total suspended solids, total cyanide, ammonia-nitrogen, phenols, total residual chlorine, lead, zinc, and pH. Cost estimates for implementing each control strategy for each subcategory are presented. (Brambley-SRC)
W82-03625

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL IV: HOT FORMING SUBCATEGORY.

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Report EPA-440/1-80/024-b, December, 1980. 383 p, 77 Fig, 137 Tab.

Descriptors: *Steel industry, *Industrial waste, *Wastewater treatment, *Water pollution sources, *Water pollution control, Zero discharge, Flow control, Metals, Toxicity, Water reuse, Oil, Grease, Pollutants, Effluents, Suspended solids.

This volume contains the proposed effluent limitations for BPT, BCT, and BAT, pretreatment standards, for new and existing sources (PSNS and PSES) and new source performance standards (NSPS) for the hot forming subcategory of the steel industry. The subcategory has four subdivisions - primary, section, flat, and pipe and tube. Limits are proposed for flow, totals suspended solids, oil and grease, and toxic metals, and cost estimates are given. Extensive recycle of hot forming wastewaters considered as components of the BAT, NSPS and pretreatment alternative treatment system is considered appropriate to minimize toxic pollutant discharge from hot forming operations. The proposed BCT limitations are based on recycle and filtration, which are fully compatible with the technology used to develop the proposed BAT limitations. Some hot forming operations are

achieving zero discharge, using BPT, BAT, and BCT treatment model components. The EPA is soliciting comments on whether zero discharge limitations and standards should be proposed at the BAT, BCT, and NSPS levels. (Brambley-SRC)
W82-03627

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENTS LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL V: SCALE REMOVAL SUBCATEGORY, ACID PICKLING SUBCATEGORY.

Environmental Protection Agency, Washinton, DC. Effluent Guidelines Div.
Report EPA-440/1-80/024-b, December, 1980. 529 p, 121 Fig, 183 Tab.

Descriptors: *Steel industry, *Iron industry, *Industrial wastes, *Wastewater treatment, *Water pollution sources, *Water pollution control, Pollutants, Effluents, Toxicity, Metals, Organic compounds, Flow control, Inorganic acids, Costs, Iron, Fluorides, Suspended solids.

This volume contains the proposed effluent limitations guidelines and standards for the scale removal and acid pickling subcategories of the iron and steel industry. In the scale removalsubcategory the kolene and hydride scale removal subdivisions are retained. Proposed BTP and BAT limitations are given for flow, total suspended solids, toxic metals, toxic organics, and other pollutants for both subdivisions with estimates of their costs. The proposed new source performance standards (NSPS) and the NSPS model treatment system are similar to the proposed BAT limitations and the BAT model tretment system, respectively. Standards intended to minimize the impact of pollutants on publicly owned treatment works (POTW) are proposed for new and existing sources discharging wastewaters to such works. Adequate control of those toxic pollutants not specifically limited is to be attained by controlling the pollutants for which limitations are proposed. The acid pickling subcategory contains three subdivisions - sulfuric, hydrochloric, and combination. BPT and BAT limitations are proposed for flow, total suspended solids, oil and grease, toxic metals, toxic organics, dissolved iron, and fluoride, and the costs are estimated. These standards will also apply to NSPS operations, except sulfuric acid pickling which will have zero discharge. Pretreatment standards are proposed for new and existing sources to limit the amount of toxic and other pollutants dishcarge to POTW's. (Brambley-SRC)
W82-03628

BIODEGRADATION OF LINEAR ALCOHOL ETHOXYLATES IN NATURAL WATERS,

Procter and Gamble Co., Cincinnati, OH.
R. J. Larson, and L. M. Games.
Environmental Science and Technology, Vol 15, No 12, p 1488-1493, December, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Surfactants, *Biodegradation, *Kinetics, Fate of pollutants, Detergents, Organic compounds, Linear alcohol ethoxylates, Degradation, Mineralization, Temperature effects, Thermodynamics, Water pollution control.

Linear alcohol ethoxylates (LAE's), a class of nonionic surfactants, biodegraded rapidly in Ohio River water at concentrations of environmental concern, 1 to 100 micrograms per liter. Degradation was first order with respect to concentration. Two pure-chain-length materials (C12E9 and C16E3) were used in the study. They were uniformly labeled with C14 in the ethoxylate chain or at the alpha carbon in the alkyl chain. Neither the alkyl nor ethoxylate chain length significantly affected the rate or degree of degradation. A C17E22 material showed degradation kinetics similar to these of the shorter-chain-length LAE's. The Arrhenius equation described the temperature effects on the rate of ethoxylate degradation from 3 to 34 C. Calculated activation energy was 9.5 kcal per mol for the C16E3 material. The C12E9 ethoxylate chain showed a somewhat similar pattern with deviations at the high and low temperature extremes. (Cassar-FRC)
W82-03638

MIGRATION THROUGH SOIL OF ORGANIC SOLUTES IN ALJ OIL-SEALE PROCESS WATER,

Geological Survey, Denver, CO.
J. A. Leenheer, and H. A. Stuber.
Environmental Science and Technology, Vol 15, No 12, p 1467-1475, December, 1981. 12 Fig, 3 Tab, 8 Ref.

Descriptors: *Soil adsorption capacity, *Oil shale, *Solute transport, Fate of pollutants, Adsorption, Soil columns, Organic carbon, *Leachates, Organic matter, Ammonium salts, Amines.

Migration of organic solutes in an oil shale retort water was studied in fine loamy soil columns. Dissolved organic carbon fractionation and high performance liquid chromatography were used to analyze leachates. The order of affinity of the fractions in retort water for soil was as follows: hydrophilic neutrals = hydrophilic acids < hydrophobic acids < hydrophilic bases < hydrophobic bases < hydrophobic neutrals. Retort water leached significant amounts of organic acids from the soil columns, and the soil selectively adsorbed some types of organic solutes from the water. Ammonium ions in the retort water extracted organic acids from the soil. A distilled water rinse after retort water leaching produced flush peaks of organic solutes. This was a result of the relaxation of the common ion effect as ammonium concentration decreased during the rinse. Aromatic amines in the hydrophobic and hydrophilic base fractions had the same relative order of rates of migration through the soil column as on a reversed-phase octadecylsilica liquid chromatographic column. Soil is an effective adsorbent for spills of no greater than one void volume. Application of more than one pore volume would produce migration of organic solutes and extraction of soil organic matter. Rain falling on the site of a retort water spill would also enhance migration and extraction of dissolved organics. (Cassar-FRC)
W82-03640

'ACID RAIN', DISSOLVED ALUMINUM AND CHEMICAL WEATHERING AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,

Dartmouth Coll., Hanover, NH. Dept. of Earth Sciences.
N. M. Johnson, C. T. Driscoll, J. S. Eaton, G. E. Likens, and W. H. McDowell.
Geochimica et Cosmochmica Acta, Vol 45, No 9, p 1421-1437, September, 1981. 10 Fig, 7 Tab, 43 Ref.

Descriptors: *Acid rain, *Weathering, *Soil chemistry, Fate of pollutants, *Aluminum, Forests, Stream order, Acid streams, Streams, Chemical reactions, Silicates, Neutralization, Water quality, Hubbard Brook, Falls Brook, *New Hampshire, Fluorides.

The effects of acid rain were studied in Hubbard Brook Experimental Forest, where water quality and hydrologic data has been regularly sampled since 1963. Water samples were also collected at 9 sites along Falls Brook (first through fifth order stream) from February 1975 to February 1978. The watershed contains bedrock of high grade metamorphic rocks and granites overlain with glacial till composed of granites and schists; no carbonates are present. In Falls Brook the upper reaches were more acid, richer in aluminum, ammonia, and nitrate, and diminished in alkali and alkaline earth cations, total fluoride, silica, and polyphenols, compared with the lower reaches. Sulfate and chloride were constant. A study of the aluminum chemistry of the stream showed that the upper reaches contained more inorganic monomeric aluminum and less organically complexed aluminum than the lower reaches. Evidence suggested that neutralization of acid rain occurs by a two-step chemical reaction. First, strong acids are rapidly but incompletely neutralized by dissolution of a reactive aluminum phase in the soil zone. Waters rich in Al with pH 4.7-5.2 are produced. Total acidity, including both hydrogen ion and Al acidity, is then slowly neutralized by basic cations released by decomposition of silicate minerals. Most of the neutralization is accomplished within first and second order basins. (Cassar-FRC)
W82-03641

CHARACTERIZATION OF A CONTAMINANT PLUME IN GROUND WATER, MEREDOSIA, ILLINOIS,

Illinois State Water Survey, Champaign.
T. G. Naymik, and M. J. Barcelona.
Ground Water, Vol 19, No 5, p 517-526, September/October, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Ammonia, *Solute transport, *Groundwater pollution, *Plumes, Nitrates, Fertilizers, Model studies, Path of pollutants, Fate of pollutants, Meredosia, Illinois, Nitrification, Oxidation.

A numerical solute transport model was used to characterize the dynamics of a dissolved inorganic fertilizer plume in a shallow sand and gravel aquifer. The source of the pollution was inorganic fertilizers in an uncovered bin located on a property adjacent to a liquid ammonia fertilizer distribution terminal. Within the plume, ammonia concentrations were 285-2100 mg per liter; nitrate concentrations were 570-1885 mg per liter. Sulfate, K, Cl, PO4, and Fe levels were above background, but Ca and Mg levels were well below background levels. The plume was in a steady-state condition, having begun 3 years prior to the survey. Simulations suggested that the pollutant would be naturally flushed within 420 days once the fertilizer pile was removed. Chemical equilibrium calculations show that Ca solubility is controlled by phosphate and carbonate equilibria. The most significant removal mechanism for ammonia from the groundwater is oxidation by acclimated nitrifying bacteria. (Cassar-FRC)
W82-03645

MOVEMENT OF CADMIUM AND WATER IN SPLIT-ROOT WHEAT PLANTS,

Oklahoma State Univ., Stillwater. Dept. of Agronomy.
M. B. Kirkham.
Soil Science, Vol 129, No 6, p 339-344, 1980. 2 Fig, 3 Tab, 16 Ref.

Descriptors: Capillarity, *Nutrients, Capillary capacity, *Capillary water, Soil water, *Wheat, *Cadmium, Ion transport, Roots, Path of pollutants.

The water status of wheat plants, cadmium content of plants, and soil water content were measured over a period of 50 days. Water was effectively transferred from the roots in the nutrient solution into roots in the unwatered soil, since the latter remained wet during the 50 days of the study. It is suggested that water was probably moved by capillary action from the solution side into the soil side. The part of the roots exposed to the air looked dry, which suggested that the water moved inside the roots, either along the cell wall surface or inside the cells. High concentrations of cadmium were found in the leaves of plants with roots split between uncontaminated soil and soil with cadmium. High concentrations of cadmium were found in the roots not exposed to cadmium. This suggests that cadmium was taken up by roots exposed to cadmium, transported to the shoots, and then transported down the plant to roots not so exposed. If all water had moved directly from one side of the root zone to the other through the crown and had bypassed the shoots, high cadmium concentrations would not have been noted in the shoots. These findings suggest that roots in a poor environment may be kept alive by roots of the same system growing near water in a water table or other body of water. Cultivars could be selected that might transfer more water and ions than other cultivars. (Baker-FRC)
W82-03662

DETOXICATION OF ZINC AND CADMIUM BY THE FRESHWATER PROTOZOAN TETRAHYMENA PYROFORMIS. I. THE EFFECT OF WATER HARDNESS,

Queen Elizabeth Coll., London (England).
For primary bibliographic entry see Field 5C.
W82-03678

THE CASE FOR THE PROTECTION OF MANGROVE SWAMPS: GEOCHEMICAL CONSIDERATIONS,

Adelaide Univ. (Australia). Centre for Environmental Studies.
P. Harbison.
Search, Vol 12, No 8, p 273-276, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Mangrove swamps, *Metals, Adsorption, Acidity, Swamps, Temperature effects, Aquatic life, Estuarine environment, Industrial wastes, Thermal pollution, Heated water, *Sediments, Fish.

A study was made from a geochemical aspect of the correlation between the sedimentary characteristics of the mangrove habitat and the factors which are known to influence the accumulation of heavy metals at the sediment/water interface. In South Africa several major industrial developments have been sited in or near mangrove swamps. The present recognition of the need to conserve these tidal swamps is based on their unique ecology, their contribution to the maintenance of fish populations, and their function in stabilizing the coastline. The most significant inputs to Gulf St. Vincent and Spencer Gulf are probably heated water, treated effluents, lead and zinc smelting wastes, hot water and seepage from fly ash, and steelworks discharge. A significant feature of all these discharges, apart from the heated water, is the content of heavy metals. Mangrove seedlings become established in sheltered, shallow, low-energy environments where the finest sediment fraction accumulates. This fraction contains high proportions of caly minerals, which present a very large surface area for the adsorption of heavy metals. The degree of adsorption or release of metals from fine particulates is highly pH-dependent. Changes in the pH of the water covering the mud surface in the mangrove swamp are strongly influenced by the photosynthetic activity of algal films. The most notorious features of mangrove mud, the black color and strong sulfide smell, are probably most relevant to its potential as a sink for heavy metals. The concentrations of metals in sediment samples collected during this study suggest that the natural physical and chemical characteristics of mangrove swamps do favor the accumulation of heavy metals in sediment. Natural occurrences which may facilitate the release of metals from the mangrove mud could also have a synergistic effect on their toxicity to marine organiams. (Baker-FRC)
W82-03683

TRACE ELEMENTS IN THE HYDROLOGIC CYCLE OF A FOREST ECOSYTEM,

California Univ., Berkeley. Dept. of Plant and Soil Biology.
J. G. McColl.
Plant and Soil, Vol 62, No 3, p 337-349, 1981. 3 Fig, 4 Tab, 19 Ref.

Descriptors: *Forest soils, *Trace elements, *Fate of pollutants, *Soil water, Forest hydrology, Copper, Manganese, Iron, Zinc, Precipitation, Metals, Stemflow, Rainfall, Throughfall, Litter, Toxins, Heavy metals.

Levels of Cu, Fe, Mn, and Zn, sometimes considered toxins, in bulk atmospheric precipitation, throughfall, stemflow, and soil solutions at 10-, 15-, 25-, and 30-cm depths in a Eucalyptus globulus forest of California were measured after each main storm event during the 1974-75 wet season. Metal concentrations in litter and plant samples were also determined. The hydrologic cycles of Cu, Fe, and Zn were similar, but Mn behaved differently. Mn and Zn were found mostly on forest canopy due to dry deposition, while Cu and Fe input occurred mostly on forest canopy due to dry deposition, while Cu and Fe input occurred mostly in rain. Cu, Zn and Fe levels in the soil solution fluctuated with dowaward movement of wetting fronts and were negatively correlated with pH. Fe levels in soil solution were approximately 10 times greater than in stemflow and throughfall. For Cu and Zn, the corresponding relative differences were much less. Mn was taken up by plants to a greater extent than Cu, Zn, or Fe. Since precipitation contained low levels of Mn, the increases in Mn levels from precipitation to throughfall and stemflow were greater than those for Fe, Cu or Zn. Mn levels in soil solution were also negatively correlated with pH. Although Mn accumulates in soil during the dry summer, it is quickly flushed out by the early rains of the wet season. (Geiger-FRC)
W82-03690

SIMULATING COAL PILE RUNOFF AS A DESIGN TOOL,

P. B. Katz, and G. T. Brookman.
Power Engineering, Vol 85, No 11, p 95-96, November, 1981. 1 Fig.

Descriptors: *Water pollution sources, *Runoff, *Model studies, Mathematical models, Utilities, Coal, Simulation, Design criteria, Precipitation, Drainage, Computers, *Coal pile runoff, Water pollution control.

Overdesign of treatment systems and reduction of chemical costs are considered in the simulation of precipitation and coal pile drainage through the use of a newly developed model. Development of the coal pile runoff mathematical model began in 1977 upon completion of an EPA-funded runoff study at two power plants with coal storage. On completion of the modeling program, deficiencies were noted in simulating the following: storm erosion of material from the coal storage pile, stormwater percolation through the coal pile, and pyrite oxidation/acid production in the coal pile. Physical or chemical phenomena associated with coal piles were then studied to determine which were valuable in the characterization of coal pile drainage. These phenomena included precipitation, surface runoff/infiltration, pile percolation and moisture content, snowmelt, and groundwater infiltration. Chemical and physical reactions occurring in the coal pile and thus considered included pyrite oxidation/acid production, freeze-thaw factor, gully erosion and coal pile washoff. The purpose behind simulating coal pile drainage is to design systems to treat acid drainage before discharge. A model allows simulation of several average and worst-case rainfall conditions as well as a plan for coal piles not yet formed. The model is now undergoing calibration and will be ready for use by the utility industry during 1982. (Baker-FRC)
W82-03692

RETENTION AND FATE OF EXPERIMENTALLY ADDED MERCURY IN A MASSACHUSETTS SALT MARSH TREATED WITH SEWAGE SLUDGE,

Woods Hole Oceanographic Institution, MA.
R. J. Breteler, J. M. Teal, and I. Valiela.
Marine Environmental Research, Vol 5, No 3, p 211-225, 1981. 3 Fig, 4 Tab, 41 Ref.

Descriptors: *Salt marshes, *Mercury, Heavy metals, Marshes, Tidal marshes, Municipal wastes, Sludge, Land disposal, Chemical analyses, *Fate of pollutants, Massachusetts.

An adaptation and development of methods for the determination of total mercury in environmental samples is presented. The technique is accurate, reproducible and applicable for peaty sediments, plants and animal tissues. The experimental plots each contained three habitats, characterized by dominant vegetation types. Tall low marsh extended a few meters on each side of the tidal creeks, was flooded twice daily and was covered with a tall form of Spartina alterniflora. Short low marsh contained predominantly a dwarf growth form of Spartina alterniflora and was considered a transitional zone to high marsh, which was covered by tidal water only during spring tides and dominated by Spartina patens and Distichlis spicata. Various amounts of a heavy metal-containing dried sewage sludge were applied to these plots. The treatments resulted in elevation of mercury levels in the surface 5 cm of soil. Discrepancies in the bulk density of marsh sediments corresponded with interparticle spaces and detritus/mineral ratios in the peat matrix. Mass balance calculations showed that wetlands covered with tall Spartina alterniflora lost mercury considerably faster than higher marsh locations, which retained virtually all mercury added. The shortest half-life of mercury calculated was four years. Grain size analyses of peat and sewage sludge suggested that mercury in the higher intertidal range remained associated with sludge components. Biochemical and physical processes affecting the dissipation of mercury from creekside sediments are discussed. (Baker-FRC)
W82-03695

MERCURY IN COASTAL AND ESTUARINE SEDIMENTS OF THE NORTHEASTERN IRISH SEA,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
J. E. Rae, and S. R. Aston.
Marine Pollution Bulletin, Vol 12, No 11, p 367-371, November, 1981. 4 Fig, 2 Tab, 32 Ref.

Descriptors: *Mercury, *Sediments, Organic carbon, *Path of pollutants, *Irish Sea, Mersey Estuary, Wyre Estuary, United Kingdom, Metals, Heavy metals, Industrial wastes, Chemical wastes, Water pollution sources, *Estuaries.

Surface sediments from the Wyre and Mersey estuaries contained 0.1-29.0 and 0.1-8.8 micrograms mercury per g, respectively. Sediments on the nearby Irish Sea coast had lower Hg levels, 0.1-0.4 micrograms per g. Both estuaries receive effluents from chlor-alkali plants. Hg concentrations were highly correlated with percent total organic carbon and percent of the < 63 microns grain size fraction of sediments. (Cassar-FRC)
W82-03696

CADMIUM IN AN AQUATIC ECOSYSTEM,

New York Univ., NY. Dept. of Environmental Medicine.
For primary bibliographic entry see Field 5A.
W82-03724

MOISTURE MOVEMENT IN SOILS IN THE VICINITY OF WASTE DISPOSAL SITES,

Texas Univ. at Austin.
For primary bibliographic entry see Field 2G.
W82-03728

THE FATE OF POLLUTANTS IN THE VADOSE ZONE, MONITORING METHODS AND CASE STUDIES,

Arizona Water Resources Research Center, Tuscon.
L. G. Wilson.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 128-154. 3 Fig, 6 Tab, 39 Ref.

Descriptors: *Vadose water, *Monitoring, *Water analysis, *Soil water table, *Sampling, Water pollution prevention, Water pollution sources, Groundwater movement, Infiltration, Deep percolation, Seepage, Root zone, Saturation zone, Lysimeters, *Fate of pollutants.

The vadose zone is important as a conduit and reservoir of liquids and liquid-borne pollutants. Monitoring in this zone can provide an early warning of pollutant movement. This paper reviews the processes operating in the vadose zone which affect pollutant mobility, describes common techniques of water quality monitoring in the vadose zone, and presents three case studies of vadose zone monitoring. The main processes to attenuate pollutant movement include biological, physical and physiochemical reactions, such as precipitation, surface reactions, chemical degradation, pH effects, oxidation-reduction effects, volatilization, and specific adsorption. Specific adsorption ap-

pears to be the most important process in retarding pollutant movement, particularly metals. The physiochemical processes that mobilize pollutants are dissolution and leaching of salts, cation exchange, oxidation-reduction, and pH effects. Organic matter, such as chelated metals, also causes certain pollutants to move in the vadose zone. Methods for monitoring pollutant flow include direct methods, such as resistivity techniques. Three methods are available for sampling in deeper regions of the vadose zone: solids sampling, suction lysimeters, and perched groundwater sampling. One case study in Illinois used lysimeters to show how pollutants had been attenuated. Another study in Arizona showed that pollutants were en route to the water table, and a third study, also in Arizona, showed that the groundwater system had already been impacted. (Atkins-Omniplan)
W82-03735

DUTCH DUMPS,
C. Schuuring.
Nature, Vol 289, No 5796, p 340, January 29, 1981.

Descriptors: *Chemical wastes, *Waste dumps, *Toxicity, Public health, Groundwater pollution, Drinking water, Industrial wastes, Agricultural chemicals, *Netherlands.

In the Netherlands, 3000 dumps containing chemical wastes have been identified, 500 of which are a recognized threat to public health. The Volgermeerpolder, a marshy area 5 miles from the center of Amsterdam, was found to contain about 10,000 drums of chemical wastes from a 2,4,5-T factory. This pollution scandal, among others, prompted a national inventory of chemical waste sites. The latest problem was when small amounts of methyl bromide were found in the drinking water in the horticultural area between the Hague and Rotterdam. The chemical is used to disinfect the soil at an estimated rate of 2000 tons/year, and the poison apparently seeped through the PVC tubes used for private water distribution. Public water companies have now been made responsible for private water supplies. (Small-FRC)
W82-03738

5C. Effects Of Pollution

OBSERVATIONS ON INFECTIONS ASSOCIATED WITH SOUTH WALES NATURAL WATERS,
University Hospital of Wales, Cardiff. Regional Public Health Lab.
R. W. S. Harvey, and T. H. Price.
Journal of Applied Bacteriology, Vol 51, No 2, p 369-374, October, 1981. 18 Ref.

Descriptors: *Infection, *Surface water, *Human diseases, Pathology, Diseases, Typhoid fever, Wales.

Cases of human disease related to exposure to contaminated surface waters in South Wales were identified through a central reporting system. During the summers of 1927-30 several persons who bathed in Roath Park Lake in Cardiff developed a papular dermatitis caused by skin penetration by the larvae of Carcaria ocellata found in the lake water. Roath Park Lake was treated with copper sulfate to destroy the snails which were the intermediate host of the larvae, but complaints of swimmers itch soon recurred and the lake was eventually closed to swimmers. Infections due to Leptospira icterohaemorrhagiae were diagnosed in the period 1940-1980. Of the 66 persons infected, 37 worked in coal mining, 9 were agricultural workers or small holders, 11 had contact with natural water and 3 were sewer workers. Of those with a history of contact with untreated waters, 9 had been immersed in a stream, pond, river or moat and two were fishermen. Two of those who immersed died of leptospirosis. Typhoid fever was diagnosed in one boy who had drunk water from the Morfa Brook. A young girl also developed typhoid and admitted to playing beside a stream near her house and placing her hands in the running water. In 1946, 48 proven infections of paratyphoid B fever were diagnosed. The cause was traced to a creamery whose supply of water came from a river grossly contaminated with sewage from towns higher up the valley. An outbreak of anthrax in cattle grazing in a field where river dredging spoils had been placed was not satisfactorily explained. (Baker-FRC)
W82-03409

THE CHEMISTRY AND FISHERY STATUS OF ACID LAKES IN NORWAY AND THEIR RELATIONSHIP TO EUROPEAN SULPHUR EMISSIONS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
D. J. A. Brown, and K. Sadler.
Journal of Applied Ecology, Vol 18, No 2, p 433-441, August, 1981. 7 Fig, 12 Ref.

Descriptors: *Lakes, *Fisheries, *Acidic water, Water pollution effects, Acid rain, Air pollution, Sulfates, Sulfur, *Norway, Hydrogen ion concentration, *Sulfur emissions.

The effect of reducing sulfur emissions on the fish populations in southern Norway lakes (below 63 degrees North latitude) is estimated by analyzing the data of Wright and Snekvik (1978). This includes full chemical analyses of the water and fishery status of 471 lakes above 200 m elevation. In this group of lakes 48% have no fish, 43% are sparsely populated, and 9% have good populations. Regression analysis indicated that the pH and excess (non-sea) sulfate concentration were correlated, with a slope of 0.225. Assuming that the excess sulfate is largely derived from the combustion of fossil fuels, a 50% reduction in European sulfur emissions would increase pH by 0.2 units. This would improve the fishery status in lakes with pH above 4.9 (9% of all lakes). No improvement would take place in the 67% of lakes in the pH range 4.3-4.9, where pH and fish status are independent. Lakes north of the severely-impacted region would not be expected to improve in fishery status following a reduction in sulfur emissions. (Cassar-FRC)
W82-03418

OUTBREAKS OF WATERBORNE DISEASE IN THE UNITED STATES: 1971-1978,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W82-03430

CARCINOGENESIS OF SYNTHETIC ORGANIC CHEMICALS IN DRINKING WATER,
National Cancer Inst., Bethesda, MD. Div. of Cancer Cause and Prevention.
H. F. Kraybill.
Journal of the American Water Works Association, Vol 73, No 7, p 370-372, July, 1981. 2 Tab, 9 Ref.

Descriptors: *Carcinogens, *Drinking water, *Bioassay, Research priorities, Chemical wastes, Municipal water, Public health, Environmental effects, Water pollution effects.

The quantification of risk assessment of synthetic organic chemicals in drinking water by five experimental approaches is discussed. Seven hundred and sixty five organic chemicals have been detected in drinking water; of these, 43 are recognized or suspected carcinogens, 56 are mutagenic, and 18 are carcinogenic promoters. The recommended quantification procedures are: carcinogenesis bioassay with the use of rodents on concentrated water samples before and after GAC treatment, synthetic drinking water samples, in vivo bioassays for carcinogenesis and mutagenesis of samples of drinking water concentrates, use of large populations of rodents as control groups in multiple locations that use municipal water supplies, and the use of fish as an animal model to assess carcinogenic activity of a wide spectrum of municipal drinking water samples before and after GAC treatment. Thus, emphasis should be given to experimental approaches which can support epidemiologic studies and provide better leads for population studies. (Small-FRC)
W82-03433

WILL THE WORLD FACE UP TO ITS EVER-WORSENING ENVIRONMENTAL PROBLEMS,
For primary bibliographic entry see Field 4C.
W82-03459

EFFECTS OF SOME REPRESENTATIVE PETROLEUM REFINERY EFFLUENT COMPOUNDS ON PHOTOSYNTHESIS AND GROWTH OF NATURAL MARINE PHYTOPLANKTON ASSEMBLAGES: PART I--CRESOLS,
Scripps Institution of Oceanography, La Jolla, CA.
W. H. Thomas, S. S. Rossi, and D. L. R. Seibert.
Marine Environmental Research, Vol 4, No 3, p 203-215, 1980-81. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Oil pollution, *Cresols, *Phytoplankton, Growth rates, Toxicity, *Water pollution effects, Organic compounds, Aromatic compounds, Diatoms, Dinoflagellates, Algae, Marine algae, Photosynthesis.

Cresols inhibited growth of natural marine phytoplankton from Scripps Pier, La Jolla, California, at levels of 100 micrograms per liter where dinoflagellates were predominant and greater than 10,000 micrograms per liter where diatoms prevailed. Half-maximal photosynthesis concentrations were 10,000 micrograms per liter and 20,000 micrograms per liter, respectively. However, the reverse was true when the algae were studied in cultures. In a longer term experiment with natural algae, there was a 2-day growth lag at 8,500 micrograms per liter, but the algae recovered and grew at rates similar to controls. Complete growth inhibition occurred at 88,000 micrograms per liter in this experiment, during which diatoms grew and dinoflagellates and microflagellates disappeared. Cresols decreased with time, being degraded by bacteria and absorbed by the algae. (Cassar-FRC)
W82-03470

CHLORINATION OF DRINKING WATER AND PREGNANCY OUTCOMES IN NEW YORK VILLAGES, 1968-1977,
Columbia Univ., New York.
L. L. Rausch.
PhD Thesis, 1980. 198 p, 16 Fig, 11 Tab, 205 Ref, 3 Map, 6 Exhib, Append. University Microfilm International, Ann Arbor, MI; Order No GAX81-05095.

Descriptors: *Water quality, *Water treatment, *Chlorination, *Public health, Groundwater, Surface water, *Drinking water, Infection, Statistics, Mortality, Comparison studies, Nonchlorinated water, New York, Pregnancies.

Pregnancy outcomes in 1968-1977 were compared in three sets of predominantly white New York villages--one set using nonchlorinated ground water, one set using chlorinated ground water and one set using chlorinated surface water--closely matched according to geographic location and population size. Rates for prematurely terminated late fetal deaths and neonatal deaths were significantly higher in the villages using nonchlorinated water, despite the absence of a significant association involving gestational age or birthweight given gestational age. The relationship, occurring primarily in the northern part of the state, persisted when several maternal and health care factors were controlled, and was similar for both sexes. A significant interaction involving season was found, with the advantage of chlorination being most pronounced in the late spring and early summer. These findings were interpreted to be consistent with an effect of an unidentified waterborne infectious agent, which was eliminated by chlorination. Rates of anencephaly were found to be significantly higher in villages using surface water, in which organic by-products of chlorination are formed, than in villages using ground water, in which the presence of such compounds is negligible. Unfortunately, sample sizes were too small to permit further analysis. (Sinha-OEIS)
W82-03506

NEUROCHEMICAL AND PHYSIOLOGICAL CHANGES IN A TELEOST FISH INDUCED BY

EXPOSURE TO THE WATER SOLUBLE FRACTION OF SOUTH LOUISIANA CRUDE OIL OR ITS TOXIC AROMATIC COMPONENTS,

Tulane Univ., New Orleans, LA. Dept. of Biology.
L. C. Russel.
PhD Thesis, 1980. 67 p, 4 Fig, 3 Tab, 69 Ref.
University Microfilm International, Ann Arbor, MI; Order No GAX81-09922.

Descriptors: *Oil pollution, *Water pollution effects, *Fish, *Toxicity, South Louisiana crude oil, *Physiology, Aromatic components, Water soluble fraction(WSF), Teleost fish, Fundulus grandus.

The brains of the Gulf killifish, Fundulus grandis, accumulate naphthalenes when this fish is exposed to sublethal concentrations of the water soluble fraction (WSF) of South Louisiana Crude oil, naphthalene or 3,6-dimethylnaphthalene. After 24 hr, the naphthalenes become localized mainly in the prosencephalon and nyelencephalon, the two more external brain regions. The opercular breathing rate is reduced by exposure to the WSF or pure naphthalenes, maximum change occurring 3-6 hr after exposure. The opercular breathing rate is increased by intraperitoneal injection of 1-DOPA and decreased by intraperitoneal injection of reserpine. The pigment in the melanophores of killifish becomes significantly more dispersed after exposure to sublethal concentrations of the WSF or pure naphthalenes. Intraperitoneal injection of 1-DOPA induces melanophore pigment aggregation. Melanophore dispersion is induced by intraperitoneal injection of reserpine. The mean DA concentration in the brains of killifish became reduced by a 24 hr exposure to the sublethal WSF or pure naphthalenes. The mean DA level in the brains of killifish increases after injection of 1-DOPA, and decreases following injection of reserpine. The volatine aromatic hydrocarbons of the WSF may, like reserpine, affect the brain DA level of fish by exerting a toxic action upon the DA-containing storage granules. The breathing rate and degree of melanophore dispersion are related to the level of DA in the brains of Gulf killifish. The preceding data and the discussion thereof are an attempt to provide greater perspective in the overall assessment of the hazards of petroleum pollution in the marine environment. (Sinha-OEIS)
W82-03511

HEALTH AND SAFETY OF WASTEWATER TREATMENT PLANT PERSONNEL,

Oklahoma Univ. Health Sciences Center, Oklahoma City.
For primary bibliographic entry see Field 5D.
W82-03535

PRODUCTION AND DECOMPOSITION OF ORGANIC MATTER AND BACTERIOPLANKTON UNDER EUTROPHICATION CONDITIONS,

Akademiya Nauk SSSR, Moscow. Inst. Biologii Vnutrennykh Vod.
A. K. Stolbunov.
Water Resources, Vol 8, No 1, p 71-84, January/February, 1981. 1 Fig, 8 Tab, 27 Ref. Translated from Vodnye Resursy, No 1, p 140-155, January/February, 1981.

Descriptors: *Organic matter, *Eutrophication, *Thermal pollution, Reservoirs, *USSR, *Ivankovo Reservoir, Bacteria, Primary productivity, Productivity, Macrophytes, Aquatic plants, Biological oxygen demand, Shallow water, Heated water, Powerplants, *Water pollution effects, Water quality, Nutrients, Nonpoint pollution sources.

The eutrophic state of Ivankovo Reservoir, one of the oldest on the Volga River, USSR, was investigated by determining BOD, primary production, decomposition of organic matter, bacterial production, total number of bacteria, and saprophytic bacteria at 15 sites representing shallow, deep, heated, and polluted water. On the whole the reservoir was classified as mesoeutrophic. Most of the eutrophic sections of the reservoir were in shallow bays and waters heated by thermal powerplant discharges. In the Shosha pool, average depth 1.7m, a vast macrophyte stand produces 35,000 tons of organic matter annually. Some areas of the reservoir are relatively non-eutrophic due to self-purification. Although input of nutrients from sewage is expected to decrease, nonpoint source pollution from agricultural land will become more significant. This will produce an increase in higher aquatic vegetation and organic matter, detrimental to water quality. (Cassar-FRC)
W82-03575

TEMPERATURE EFFECTS ON HYDRAZINE TOXICITY TO BLUEGILLS,

Air Force Aerospace Medical Research Lab., Wright-Patterson AFB, OH.
T. P. Hunt, J. W. Fisher, J. M. Livingston, and M. E. Putnam.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 588-595, November, 1981. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Toxicity, *Fish, *Hydrazine, *Bluegills, Water pollution effects, Temperature effects, Nitrogen compounds.

The acute toxicity of hydrazine to bluegill, Lepomis macrochirus, was determined at 10, 15.5 and 21C. LC50's (mg per liter) were as follows for exposures of 1, 6, 24, and 96 hours, respectively: 10C--265, 12.9, 7.7, and 1.6; 15.5C--68.4, 12.4, 3.8, and 1.0; 21C--37.7, 3.8, 1.7, and 1.2. The toxicity of hydrazine depended inversely upon the length of exposure according to a constant LC50 times exposure duration relationship. Toxicity increased with temperature, but water temperature played a more important role for the 1, 6, and 24 hour exposures than for the 96 hour exposures. (Cassar-FRC)
W82-03603

A SIMPLE, RAPID BIOASSAY FOR DETECTING EFFECTS OF POLLUTANTS ON BACTERIA,

Oregon State Univ., Corvallis. Dept. of Microbiology.
N. J. Bauer, R. J. Seidler, and M. D. Knittel.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 577-582, November, 1981. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Toxicity, *Bacteria, *Bioassay, *Water pollution effects, Microbiological studies, Dissolved oxygen, Oxygen depletion, Heavy metals, Metals, Pesticides, Herbicides, Pollutant identification, Cadmium, Copper, Nickel, Sulfates, Diuron, Pentachlorophenol, Atrazine, Trichloroacetic acid, Dimethylformamide, Diazinon.

A screening bioassay test was developed to predict toxicity of hazardous substances. The test measures the kinetics of dissolved oxygen depletion by a mixed microbial population following exposure to a pollutant. Results are available in 40 min. The pollutant is incubated in a bacteria-nutrient broth mixture, and dissolved oxygen depletion is monitored every 2 min. Results are expressed as the ratio of the test T50 (time of 50% dissolved oxygen depletion) to the control T50. This ratio is the activity quotient, which is 1.00 if the pollutant has no toxic effect, > 1.00 if stimulatory, and < 1.00 if toxic (0.8-0.94 designates slightly toxic; 0.5-0.79, moderately toxic; and < 0.5, extremely toxic). The activity coefficients of compounds during a brief exposure (about 30 min) and an extended exposure (22 hours) were as follows: Cd (5 ppm), 0.27 and 0.11; Cu (5 ppm), 0.43 and 0.24; Ni (5 ppm), 0.51 and 0.54; sulfate (50 ppm), 1.00 for both; diuron (40 ppm), 0.83 and 0.56; pentachlorophenol (14 ppm), 0.86 and 0.36; atrazine (33 ppm), 1.0 and 0.76; trichloroacetic acid (50 ppm), 0.96 and 0.88; dimethylformamide (50 ppm), 0.95 and 0.85; and diazinon (40 ppm), 1.01 and 1.03. The rapid, simple dissolved oxygen uptake assay system requires minor capital expenditures. (Cassar-FRC)
W82-03604

EVIDENCE FOR METAL POISONING IN ACUTE DEATHS OF LARGE RED DRUM (SCIAENOPS OCELLATA),

Florida Univ., Gainesville. Coll. of Veterinary Medicine.
P. T. Cardeilhac, C. F. Simpson, F. H. White, N. Thompson, and W. E. Carr.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 639-644, November, 1981. 2 Tab, 14 Ref.

Descriptors: *Toxicity, *Metals, *Fishkill, Water pollution effects, Heavy metals, Copper, Drum, Zinc, Arsenic, Chromi[illegible] Cadmium, Mercury, Gills, Mortality, Indian [illegible]er Lagoon, *Florida, *Red drum.

Metal intoxication was the cause of a fishkill (about 100 large red drum) in the Indian River and Mosquito Lagoon, Florida, June 14-July 7, 1980. Pesticides, biological toxins, and hypoxia were eliminated as possible causes. Analysis of stomach contents showed that Cu, Zn, and As and possibly Cd, Hg, and Cr were responsible for poisoning the fish, which were feeding almost exclusively on large blue crabs at the time of the kill. Metal concentrations in tissues of moribund red drum showed the following increases (in ppm) over controls: Cu--liver 45, gill 8, kidney 10, and stomach contents 2; Zn--liver 132, gill 54, kidney 4, and stomach contents 25; As--liver 5.4; gill 0.5, kidney none, and stomach contents 0.3. Livers of the diseased fish showed increases over controls for Cr, Cd, and Hg of 59, 8.2, and 2.5 ppm, respectively. Gills on the affected fish were edematous and coated with mucus. This condition produced an electrolyte imbalance with dramatic increases of serum Na, Cl, and K. (Cassar-FRC)
W82-03606

HEMOSIDERIN GRANULES: CYTOTOXIC RESPONSE TO ARSENIC EXPOSURE IN CHANNEL CATFISH,

Texas Univ. at Austin. Dept. of Pharmacology.
E.M. B. Sorensen, and N. K. R. Smith.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 645-653, November, 1981. 7 Fig, 19 Ref.

Descriptors: *Arsenic, *Toxicity, *Fish, Water pollution effects, Metals, Channel catfish, Heavy metals, Liver, Hemosiderosis, *Catfish, Sublethal effects.

Adult channel catfish, Ictalurus punctatus, exposed to 15 ppm arsenic as sodium arsenate for 6 months, showed electron microscopic evidence of liver changes. Hepatocytes from affected catfish livers showed proliferated rough endoplasmic reticulum, smaller nuclei, and a great increase in size and number of hemosiderin granules. The probable cause of the hemosiderosis is hemolytic jaundice. Arsenic was found in the hemosiderin granules, suggesting storage of a toxic material in a less toxic, insoluble form. (Cassar-FRC)
W82-03607

RESPONSE OF TROUT HEPATIC MIXED-FUNCTION OXIDASES TO EXPERIMENTAL FEEDING OF TEN KNOWN OR POSSIBLE CHLORINATED ENVIRONMENTAL CONTAMINANTS,

Dalhousie Univ., Halifax (Nova Scotia). Coll. of Pharmacy.
F. C. P. Law, and R. F. Addison.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 605-609, November, 1981. 1 Tab, 15 Ref.

Descriptors: *Chlorinated hydrocarbons, *Toxicity, *Fish, Bioassay, Liver, *Trout, Enzymes, Sublethal effects, Polychlorinated biphenyls, Organic compounds, Aromatic compounds, Water pollution effects.

Brook trout, Salvelinus fontinalis, fed sublethal amounts of chlorinated organic compounds (to produce whole body concentrations of 200 micrograms per g) were studied for effects on mixed-function oxidases. The most useful indicators of MFO induction were benz(a)pyrene hydroxylase and ethoxycoumarin O-de-ethylase activities. Three potential polychlorinated biphenyl replacements (isopropyl chlorobiphenyls mixture, chlorinated naphthalenes mixture, and 1,2,4-trichlorobenzene) produced no apparent MFO induction in the fish. Varying responses were seen in the other materials tested: polychlorinated biphenyl, mirex,

hexachlorobenzene, hexachlorobutadiene, octachlorostyrene, and a brominated biphenyl based fire retardant. (Cassar-FRC)
W82-03609

KRAFT PULP MILL EFFLUENT AND SEDIMENT CAN RETARD DEVELOPMENT AND LYSE SEA URCHIN EGGS,
Shizuoka Coll. of Pharmaceutical Sciences (Japan). Lab. of Health Sciences.
N. Kinae, T. Hashizume, T. Makita, I. Tomita, and I. Kimura.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 616-623, November, 1981. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Sea urchins, *Pulp and paper industry, *Toxicity, Water pollution effects, *Industrial wastewater, Eggs, Kraft mills, Shinguu River, Japan, Invertebrates, Marine animals, Organic compounds, Effluents, Sediments, Carcinogens, Sea urchin eggs.

Sea urchin eggs, Anthocidaris crassispina, were exposed to ether extracts of kraft pulp mill effluent and sediments from the estuary of the Shinguu River, Japan. The extracts were separated into five fractions: neutral, acidic, basic, amphoteric, and phenolic. Of the effluent extracts the basic fraction was most toxic, decreasing the egg fertilization to 35% at 10 ppm concentration. Of the sediment extracts the acidic fraction was most toxic, decreasing fertilization of eggs to 25% at 10 ppm. All five fractions retarded development of eggs at 1 to 10 ppm and caused cytolysis at 100 ppm. Slime controller was the most toxic of nine pulp and paper industry materials similarly tested. (Cassar-FRC)
W82-03610

AN IN SITU STUDY OF CADMIUM AND MERCURY STRESS IN THE PLANKTON COMMUNITY OF LAKE 382, EXPERIMENTAL LAKES AREA, NORTHWESTERN ONTARIO,
Argonne National Lab., IL.
J. S. Marshall, J. I. Parker, D. L. Mellinger, and S. G. Lawrence.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, 2 Fig, 4 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Cadmium, *Mercury, *Plankton, Heavy metals, Inorganic compounds, Zooplankton, Phytoplankton, *Lakes, Species diversity, Ecological effects, Species composition, Crustaceans, Aquatic populations, Aquatic productivity, Primary productivity, *Ontario.

In the Experimental Lakes Area (ELA) Lake 382 of Northwestern Ontario, in situ experiments were carried out in 28-liter carboys at various depths to assess the effects of inorganic Hg and Cd on planktonic communities. Over a three-week period, additions of 9 nanomoles Cd/liter or 10 nanomoles Hg/liter caused significant reductions of crustacean zooplankton density, zooplankton community similarity and diversity, and levels of dissolved oxygen. Primary productivity of phytoplankton was decreased by additions of 20 nanomoles Hg/liter, but not by 10 nanomoles Hg/liter. The toxicities of inorganic Hg and Cd to lake plankton were similar on a molar concentration basis. At molar concentrations above 2 nanomoles/liter, Hg and Cd may cause significant changes in lake plankton communities. Close agreement of results was found for Cd levels over 0.2 micrograms/liter in experiments on ELA lakes and on Lake Michigan. However, toxic levels of inorganic Hg have not yet been documented in lake waters. (Geiger-FRC)
W82-03612

DETOXICATION OF ZINC AND CADMIUM BY THE FRESHWATER PROTOZOAN TETRAHYMENA PYROFORMIS. I. THE EFFECT OF WATER HARDNESS,
Queen Elizabeth Coll., London (England).
G. Chapman, and S. Dunlop.
Environmental Research, Vol 26, No 1, p 81-86, 1981. 2 Fig, 21 Ref.

Descriptors: *Zinc, *Cadmium, *Toxicity, Heavy metals, Metals, Calcium, Magnesium, Protozoa, Water pollution effects, Absorption, Path of pollutants, Metabolism, Chemical interactions, Hardness.

Zinc and cadmium toxicity to the protozoan Tetrahymena pyriformis were reduced in the presence of Ca and Mg ions in concentrations characteristic of very hard water. The 8-hour LC50 values (in ppm) for Zn were: < 1 ppm with no Ca or Mg, 14 with 500 ppm Ca, 28 with 500 ppm Mg, and 24 with 500 ppm Ca + Mg. LC50 values for Cd were generally lower: < 1 ppm with no Ca or Mg, 16 with 500 ppm Ca, 9 with 500 ppm Mg, and 19 with 500 ppm Ca + Mg. Experiments with Zn65 indicated that the uptake of this element from sublethal concentrations, 0.1 ppm, by 1 million cells were reduced from 0.5 micrograms per liter to 0.1 micrograms per liter by adding 500 ppm Ca alone or 500 ppm Ca + Mg. Mg alone was about half as effective in reducing toxicity. The mechanism of protection against Zn and Cd is thought to be reduced uptake at the cell membrane in the presence of Ca and Mg. (Cassar-FRC)
W82-03678

THE CASE FOR THE PROTECTION OF MANGROVE SWAMPS: GEOCHEMICAL CONSIDERATIONS,
Adelaide Univ. (Australia). Centre for Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-03683

EFFECT OF WATERS OF VARIOUS HARDNESS ON THE CARDIOVASCULAR SYSTEM. (O VLIYANII VOD RAZNOI ZHESTKOSTI NA SERDECHNO SOSUDISTUYU SISTEMU),
Nauchno-Issledovatelskii Inst. Gigieny, Moscow (USSR).
A. I. Levin, Yu Novikov, S. I. Plitman, Yu. A. Noarov, and K. O. Lastochkina.
Gigiena i Sanitariia, No 10, p 16-19, October, 1981. 2 Tab, 8 Ref. (English Summary).

Descriptors: *Water pollution effects, *Magnesium, *Calcium, *Drinking water, *Human physiology, *Hardness, Phsiological ecology, Public health, Potable water, Human pathology, Human population, Minerals.

Studies were made on the cardiovascular systems of women aged 20-49 years living in three study areas and a control area supplied with drinking water of different degrees of hardness and varying amounts of calcium and magnesium. Abnormal ausculatory sounds were observed more frequently in women in two of the three study areas. Electrocardiographic studies revealed a significantly decreased QRS voltage in study areas A and C. Sinus arrhythmia and reduced S-T interval were found more frequently in study areas A and B. Women from the three study areas also displayed electrocardiographic signs indicative of changes in electrophysiologic processes in the myocardium. A high positive correlation was discovered between the level of magnesium in drinking water and the amplitude of wave I. A high negative correlation was found between the overall hardness of the water, the quantity of magnesium in it, and the frequenncy of maximum arterial blood pressure in the danger zone in women aged 20-29 years. (Geiger-FRC)
W82-03699

FAUNAL ASSEMBLAGES OF SOME SALINE LAKES NEAR MARCHAGEE, WESTERN AUSTRALIA,
Western Australia Univ., Nedlands. Dept. of Surgery.
For primary bibliographic entry see Field 2H.
W82-03704

DEVELOPMENT OF HEALTH EFFECTS CRITERIA FOR FRESHWATER BATHING BEACHES BY USE OF MICROBIAL INDICATORS,
Oklahoma Univ., Norman.
For primary bibliographic entry see Field 5A.
W82-03730

5D. Waste Treatment Processes

MANAGING VEGETATION IN WASTEWATER APPLICATION,
Michigan State Univ., East Lansing. Inst. of Water Research.
F. M. D'Itri.
BioCycle, Vol 22, No 6, p 30-35, November-December, 1981.

Descriptors: *Land disposal, *Wastewater treatment, *Wastewater renovation, Vegetation regrowth, Vegetation establishment, Vegetation, Corn, Forest management, *Spray irrigation.

The proper selection and management of vegetation for the efficient renovation of municipal wastewater by slow rate, overland flow, or spray irrigation systems is discussed. The selection of land treatment relative to other methods depends on the size of the community and the expertise of local system operators, as well as the cost, quantity and type of land available. Once land treatment has been determined to be feasible, guidelines for operating and managing the system can be produced. Protecting the groundwater is a primary consideration. Spray irrigation has been the most common land treatment method in the north central United States. The responses of crops to slow rate wastewater application have been quite similar on all types of soil. The limited amount of leachate which does occur may contain nitrate concentrations greater than 10 mg/liter as nitrogen due to the absence of plant growth. Row crops such as corn are attractive, since their potential of economic return is high. However, the limited root biomass early in the season and limited period of rapid nutrient uptake can present problems. The tradeoff between good renovation and a cash return can best be attained by mixing corn and forage crops. Land application has proven excellent for phosphorus and nitrogen removal. Harvesting schedules are important for forage crops. Maximum crop yields and nutrient removals result when forage grasses are harvested three or more times per year with the first harvest in late May or early June. Forestry studies indicate that coniferous and hardwood forest ecosystems can be effective living filters to improve the quality of wastewater by removing the nutrients. Forest productivity was also increased by this process. (Baker-FRC)
W82-03401

PHOSPHORUS REDUCTION STUDIES,
A. V. Gray.
Water Pollution Control, Vol 80, No 3, p 333-340, 1981. 5 Fig, 20 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, Phosphorus, Filtration, Lime, Effluents, Industrial wastes, Domestic wastes, Municipal wastes.

Waterborne phosphorus enters sewage treatment plants from three main sources. The domestic contribution is split between the phosphorus originating from detergents and that from human excreta. The third source is industrial. Influent sewage contains a mixture of phosphorus compounds including dissolved orthophosphate, dissolved and particulate organic phosphates, inorganic condensed phosphates, and particulate inorganic phosphates, either precipitated or adsorbed onto other solids. Detergent formulations include polyphosphates as builders and water conditioners such as sodium tripolyphosphate, trisodium phosphate, tetrasodium pyrophosphate, sodium tetraphosphate, and sodium hexametaphosphate. The use of the split-effluent lime process to achieve phosphorous reduction was investigated by treatment of secondary effluent at biological filtration works. Laboratory studies were conducted to determine the dose rates, floc settlement characteristics, and the size of flocculation tank required so that a pilot-scale plant could be made. Results indicate that different lime doses were required, depending on the character of the sewage. Higher alkalinity sewage required higher lime doses to attain the same degree of phosphorus removal, as the process appeared to be pH dependent. Best removal was obtained after the precipitation of magnesium hydroxide at pH

greater than 11.3. By using filtration, lower lime doses could be used, and consequently a less alkaline effluent would result, requiring less neutralization prior to dischare. Much lower sludge volumes would also result. The split-effluent practice was then tried, which splits the sewage into two unequal parts, adding the total lime to the smaller volume and mixing, followed by reuniting the parts and mixing again. This resulted in considerable monetary savings during neutralization steps. (Baker-FRC)
W82-03426

PRIMARY SEDIMENTATION OF SEWAGE,

Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
J. A. Anderson.
Water Pollution Control, Vol 80, No 3, p 413-420, 1981. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Sedimentation, Flow rates, *Suspended solids, Overflow, Flow, *Wastewater treatment, Primary wastewater treatment, *Settling tanks.

A new method is proposed which assesses the efficiency of primary sedimentation tanks in terms of the removal of settleable solids. From the results of tests on experimental and pilot-scale tanks and from data obtained for full-scale works, the non-settleable solids appear to be constant for a given works, being independent of both influent suspended solids concentrations and retention period or overflow rate. Factors which affect sedimentation tank design and performance include hydraulic behavior, inlet design, shape and depth of tank, effluent weir design and associated floc paths, design and operation of sludge scraper, arrangements for sludge storage and removal, variations in the influent flow rate and suspended solids, and physical, chemical and biological characteristics of the influent. While the effect of increasing the hydraulic loading at a particular works is difficult to predict accurately, it is suggested that for typical retention periods of around 6 hr, the effect of doubling the flow rate will probably cause only a slight reduction in efficiency of removal of settleable solids. It is suggested that the design of future sedimentation tanks be based on existing tanks whose efficiency of removal of settleable solids is high, possibly with increased overflow rates. (Baker-FRC)
W82-03429

ELIMINATION OF TOXIC METALS FROM WASTEWATER BY AN INTEGRATED WASTEWATER TREATMENT/WATER RECLAMATION,

National Inst. for Water Research, Pretoria (South Africa).
R. Smith, and S. G. Wiechers.
Water S A, Vol 7, No 2, p 65-70, April, 1981. 1 Fig, 8 Tab, 15 Ref.

Descriptors: *Water reuse, *Metals, *Toxicity, Denitrification, Clarification, *Wastewater treatment, Filtration, Chlorination, Activated carbon, Drinking water, Municipal wastes.

A pilot-scale integrated wastewater treatment/water reclamation plant was investigated for the removal of eight toxic metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The plant includes combinations of biological and chemical-physical processes, and is operated on screened raw sewage at a flow of 2.4 cu m/hr. Treatment stages include denitrification, chemical mixing and clarification, nitrification and secondary clarification, filtration, active carbon adsorption, and final chlorination. Solutions containing the metals were fed into the system, and with the exception of barium, concentrations of all metals were reduced to values below their respective atomic absorption detection limits at or before the secondary clarification stage. Cadmium, chromium, mercury, and arsenic were completely removed at the chemical mixing/clarification stages. The active carbon treatment stage was also effective in removing metals. A system such as this could be used to prepare high quality water directly from raw sewage. (Small-FRC)
W82-03439

INNOVATIONS IN WASTEWATER TREATMENT PROCESSES: DESIGN BACKGROUND DOCUMENTS DUE IN 1981,

K. A. Godfrey, Jr.
Civil Engineering (New York), Vol 50, No 9, p 67-69, September, 1980.

Descriptors: *Publications, *Design criteria, Environmental Protection Agency, American Society of Civil Engineers, Water Pollution Control Federation, *Wastewater treatment, Organizations, Professional societies, *Water treatment facilities.

The EPA, the American Society of Civil Engineers, and the Water Pollution Control Federation are publishing the 'Design Information Series' to encourage use of innovative ideas in wastewater treatment process design. Typical subjects among the first of about 25 40-60 page reports are dry weather peaking, suspended-growth biological treatment performance, fixed-film biological treatment performance, mechanical reliability, and sidestreams. In addition, the 3 groups plan design documents of their own. the WPCF has scheduled 10 manuals for fall 1980 (sludge thickening, energy conservation, pumping stations, pretreatment, sewer design, sampling, etc.). The ASCE has 4 manuals of practice in preparation on environmental assessment, sewer design, nonpoint sources of pollution, and water treatment plant design management. The EPA also has several more documents on innovative technologies. (Cassar-FRC)
W82-03453

REPUBLIC STEEL RECYCLING 80% OF STEEL-MILL WASTEWATER.

Civil Engineering (New York), Vol 50, No 6, p 102-104, June, 1980. 1 Fig.

Descriptors: *Steel industry, *Industrial wastewater, Water reuse, *Wastewater treatment, Water pollution control, Recycling.

A $19 million 14 mgd wastewater treatment plant at Republic Steel's Canton, Ohio, plant makes possible an 80% wastewater reuse. The technology for coagulation and clarification is not unique, but the idea of a single, central wastewater treatment plant and its underground distribution system is unusual. The plant is constructed on pile foundations on poor soil in a flood plain. To further reduce treatment requirements, scale on steel bars is removed by mechanical grinding rather than by pickling liquor. A small percentage of makeup water prevents damage to the pipes from the high-Ca-Mg groundwater. (Cassar-FRC)
W82-03454

TAMPA'S HOOKERS POINT AWT PLANT WORKING WELL.

Civil Engineering (New York), Vol 51, No 6, p 56-58, June, 1981.

Descriptors: *Advanced wastewater treatment, *Design considerations, *Tampa, Florida, Wastewater treatment, Suspended solids, Biological oxygen demand, Dissolved oxygen, Oxygen, Nitrogen, Dentrification.

The Hookers Point advanced wastewater treatment plant near Tampa, Florida is described. The plant incorporates a number of innovations to achieve a high level of removal of BOD, suspended solids, and nitrogen from the wastewater. It is also designed to remove phosphorus. The receiving waters (Hillsborough River and Bay) appear to be improving. The plant has a flexibility of process which permits operation with a capacity of 60 mgd as an advanced wastewater treatment facility, or with a capacity of 120 mgd as a secondary treatment facility. The operation depends on how many of the oxygen reactors are devoted to carbonaceous BOD removal, and how many to conversion of ammonia to nitrate. There was no need for new primary clarifiers to be constructed, as the existing clarifiers were used to handle part of the raw wastewater, the rest being channeled directly to the oxygen reactors. Provision was made for the use of brewery waste as a food for bacteria prior to nitrification at some time in the future, replacing methanol. Total reactor tankage for BPD removal, nitrification, and denitrification is less than 3.5 hrs retention time. The filtration and denitrification processes were combined into one step. A low capital cost phosphate removal system is another of the innovations, whereby phosphate is removed by adding a precipitating chemical to the reactor. The final innovation is the use of low-energy sludge drying beds, in which a polymer is added to the sludge just before it flows into the bed. (Baker-FRC)
W82-03455

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM CH2M HILL, CORVALLIS, OR,

J. W. Filbert.
Water/Engineering and Management, Vol 128, No 3, p 62, March, 1981.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Management planning, Equipment, Projections, Federal regulations.

A major problem in the area of water and wastewater treatment is the poor quality of much of the equipment being utilized, as a result of Environmental Protection Agency (EPA) 'or equal' requirements for procurement. Although the EPA's new equipment prequalification procedure may bring significant improvement to the quality of major process equipment and systems supplied, the quality of most minor equipment and systems incorporated into plants will not be affected. The increasing realization that much of the equipment delivered to new construction is of poor quality should lead to revision of the regulations to permit owners to use cost-competitive but owner-selected process equipment procurement procedures. Systems and equipment brought on the market in the future should feature quality as well as performance and should become more popular. The demand for sludge thickening, conditioning, and dewatering equipment should also increase. Continued expansion and quality improvement in the instrumentation and control systems field as related to wastewater treatment is also expected. (Carroll-FRC)
W82-03463

UTILIZATION OF THE ALGAE OOCYSTIS SP. FOR TERTIARY TREATMENT OF WASTEWATERS - II. EFFECT OF PRELIMINARY CONDITIONING OF THE CELLS IN A CYCLOSTAT ON THEIR NITROGEN UPTAKE RATE DURING PROLONGED INCUBATIONS (IN FRENCH),

Laval Univ., Quebec. Center for Nutrition Studies.
J. de la Noue, G. A. Picard, J. P. Piette, and C. Kirouac.
Water Research, Vol 14, No 8, p 1125-1130, August, 1980. 5 Tab, 16 Ref. (English Summary).

Descriptors: *Wastewater treatment, *Algae, *Nutrients, Nitrogen, Tertiary wastewater treatment, Oocystis, Aquaculture, Kinetics.

Ammonia uptake rates by Oocystis sp. were compared in the preconditioning phase (phase I) and in the incubation phase (phase II) of wastewater treatment. In the preconditioning phase, the cells are conditioned with wastewater which has previously been subjected to primary and secondary treatment with activated sludge and diluted to give a low nitrogen concentration (10 micromolar ammonium nitrogen). In the incubation phase, the cells are inoculated into a more or less dilute secondary effluent, rich in nitrogen and phoshporus nutrients. This comparison was made in order to determine whether rapid uptake of nitrogen nutrients by 'starved' cells occurs during the prolonged incubations required for complete removal of nutrient from wastewater. At equilibrium in Phase I the phytoplankton cells had a relatively constant ammonium nitrogen uptake rate per cell. This rate varied in the six water stocks with different inorganic nutrient concentrations, but it was always 2.4-6 times lower than the uptake rate by these cells in Phase II. At the end of Phase II (12 hr) the cell nitrogen content was up to 3.5 times higher than the initial content. The results show

the potential of algal tertiary treatment for the purification of wastewater as well as for production of a biomass. (Hertzoff-FRC)
W82-03464

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM MALCOLM PIRNIE, INC., WHITE PLAINS, NY,

For primary bibliographic entry see Field 6A.
W82-03474

DESIGNING AN ENERGY-EFFICIENT WASTEWATER TREATMENT PLANT.

Water and Sewage Works, Vol 127, No 2, p 40-44, February, 1980. 7 Fig, 16 Tab.

Descriptors: *Water treatment facilities, *Design criteria, *Pumps, Wastewater treatment, Waste heat, Efficiency, Energy loss, Energy transfer, Energy conservation, Costs.

Various heat pump options believed to represent energy-saving methods for wastewater treatment plants are considered. These options include pumping heat from final effluent to heat the building by installing an evaporator section in the chlorine contact chamber. Annual savings would be about $860 in natural gas purchases, and the operating cost would be $760 annually. The pumping of heat from final effluent to heat the aeration tanks is also considered, along with pumping heat from compressor room to heat the main building, digester gas heating of primary digester and main building, digester gas fueling of an internal combustion engine directly coupled to an air compressor in the diffused aeration plant, and digester-gas fueling of the engine-generator set in the mechanical aeration plant. A summary of the various energy conservation methods and their costs and benefits is presented. (Baker-FRC)
W82-03477

DESIGNING FOR COARSE SAND FILTRATION SYSTEMS,

J. G. Walters.
Water and Sewage Works, Vol 127, No 2, p 28, February, 1980. 2 Fig.

Descriptors: *Filtration, *Design criteria, *Wastewater treatment, *Sand filters, Filters, Backwash, Pilot plants.

Backwash considerations when designing coarse sand filtration systems are discussed. Solids must be removed from the top of the filter to the wash water waste gullet. The dirty water is removed by means of wash troughs or a backwash weir and surface sweep. Additional horizontal velocity is imparted to the surface of the filter so that the solids flushed from the media can be efficiently swept into the gullet without wash troughs. During the filtering cycle wastewater flows into the filter bay through the surface sweep distributor. During backwash, unfiltered wastewater continues through the distributor at a rate of 2-3 Gpm/sq ft and sweeps dirty water toward the wastewater gullet. Loss of media from the system can be controlled by keeping the flow of air and water at such a rate as to avoid surges. Use of pilot plant studies may be profitable, but these must be carefully designed to yield constructive and useful results. (Baker-FRC)
W82-03478

MICROORGANISM INVENTORY IN ACTIVATED SLUDGE CONTROL,

Montgomery County Sanitary Dept., Dayton, OH.
R. R. Himebaugh.
Water/Engineering and Management, Vol REF, No HB, p R26-R30, 1981. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Activated sludge process, *Monitoring, Wastewater treatment, Protozoa, Bacteria, Sludge, Monitoring, *Microorganisms, Flagellates, Rotifers, Montgomery County, *Ohio.

A quick, easy method of assessing the biological status of the activated sludge system in operation at a wastewater treatment plant needs to be designed and incorporated as a daily parameter in plant operation. At the Montgomery County Western Regional Wastewater Treatment Plant, several levels of data are collected that allow immediate assessment of the activated sludge bio-system. Since this plant operates both a carbonaceous and a nitrogenous activated sludge process, it is highly susceptible to toxic material, especially in the nitrification process. In this assessment system, protozoa types are classified into four groups, and rotifers are included as a fifth group. Included in each general group are more specific organism types. A percentage of microorganism group types is calculated from a sample count. When 100 or 50 organisms total are tallied the count ends, and each group's percentage of the total organisms is calculated. This inventory provides information concerning the decrease in biomass due to toxic materials and also the changes occurring in the maturity or evolution of the microorganism population. The five groups are so defined that group 1 organisms are very primitive protozoa which would indicate an immature sludge, while group 5 organisms are a more highly evolved, mature group. Information on the biomass changes can be followed on a time graph. After collecting a sufficient amount of data, a break point can be established which signals to the operators of the system that some imbalance or toxicity in the system has occurred. Using this protozoa count parameter one measures the living condition of the activated sludge, thus allowing predictable information for operating the wastewater treatment plant, which is not offered by most other physical and chemical parameters currently being monitored. (Baker-FRC)
W82-03483

CONTROL OF THE ACTIVATED SLUDGE PROCESS,

New Hampshire Dept. of Highways.
R. P. Carter.
Water/Engineering and Management (Reference Number) p R131-2, R135-6, 1981. 2 Fig, 7 Ref.

Descriptors: *Activated sludge, *Mathematical models, Wastewater, *Microorganisms, *Aeration, *Wastewater treatment, Solids, Solid wastes, Digested sludge, Biodegradation, Effluent standards, Activated sludge process.

With the 'Al West' method of cotrolling the activated sludge process, it is difficult to maintain a steady state condition. This is attributed to the nature of the clarifier sludge flow demand formula, which does not take wasting into account and therefore leads to cycles of overwasting of the sludge. A mathematical solution to this problem is presented. It is based on the use of a centrifuge test to measure volume rather than weight as a control parameter. Such a test should provide a more accurate estimate of the number of microorganisms in the activated sludge system. (Titus-FRC)
W82-03499

IMPROVING TREATMENT WORKS EFFICIENCY.

Civil Engineering (London), p 45, October, 1981. 1 Fig.

Descriptors: *Control systems, *Monitoring, *Computers, Automation, *Wastewater facilities, Electric power production, Methane, *United Kingdom, Wastewater treatment.

A computer-based monitoring and control system is described which will control general plant functions and the generation of electrical power from processed sewage gas. This distributed system uses a series of microprocessors to carry out data collection and control functions which are linked to a PDP-11/23 microcomputer. Software comprises a set of modular programs to carry out data collection and analysis routines as well as the appropriate display, alarm, and control functions. The generators at the station run on a dual-fuel mixture of collected sludge gases (methane) and 10% diesel fuel. The system is being installed at the Wessex Water Authority's Avonmouth recovery facility. (Small-FRC)
W82-03500

TRIHALOMETHANE FORMATION FROM HUMIC MATERIALS IN CHLORINATED RECLAIMED WASTEWATER,

California Univ., Berkeley.
M. G. Richard.
PhD Thesis, June, 1980. 416 p, 51 Fig, 73 Tab, 217 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-29557.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Reclaimed water, *Chlorination, Halogens, Bromides, *Organic compounds, Disinfection, Humic acids, Microorganisms, Potable water, Public health, *Trihalomethane(THM), San Francisco Bay area.

Trihalomethane (THM) and other unidentified volatile halogenated organic compounds were formed in relatively large concentrations under conditions of normal wastewater disinfection in nine secondary and post-secondary wastewater effluents examined. Chlorination of treated wastewater under drinking water conditions as would occur in wastewater reclamation, to yield a long-term free chlorine residual, resulted in substantial increases in THM formation over that observed in chlorinated drinking waters. The formation of volatile halogenated organic compounds in chlorinated treated wastewater also differed from chlorinated drinking water in the following important ways: Bromine-substituted THM compounds predominated in most chlorinated treated wastewaters examined, accounting for from 50 to 89% of total THM products, while chloroform predominated in most chlorinated drinking waters. Non-THM volatile halogenated organic compounds were formed in much higher concentrations in chlorinated treated wastewater compared with chlorinated drinking waters. It is concluded that the use of treated reclaimed wastewater as a source of potable water supply, either directly or indirectly due to water supply contamination, could increase human exposure to halogenated organic compounds, unless remedial action is taken. (Sinha-OEIS)
W82-03517

PROJECT REPORT, PLANNING AND DESIGN DEVELOPMENT KAW POINT WASTEWATER TREATMENT PLANT, KANSAS CITY, KANSAS,

S Kansas Univ., Lawrence. School of Engineering and Architecture.
J. C. Roth.
PhD Thesis, April, 1980. 332 p, 23 Fig, 9 Tab, 10 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-26740.

Descriptors: *Engineering, *Wastewater treatment facilities, *Design criteria, Municipal wastewater, Industrial wastes, Secondary wastewater treatment, *Kansas City, Kansas.

This report is a systematic documentation of the inception, design development, design, and finally, the partial construction of additions to Municipal Wastewater Treatment Plant No. 1 (Kaw Point) in Kansas City, Kansas. The report demonstrates the relationship between engineering practices and non-engineering influences on a large-scale, multidisciplined treatment plant design project. The subject is the design of secondary treatment facilities for an existing 36 million gallons per day primary wastewater treatment plant. A brief description of the three-phase project is presented in a table. Background information is provided on the community and existing facilities to aid in understanding specific reported actions. (Sinha-OEIS)
W82-03525

HEALTH AND SAFETY OF WASTEWATER TREATMENT PLANT PERSONNEL,

Oklahoma Univ. Health Sciences Center, Oklahoma City.
T. J. Carpenter.
PhD, Thesis, 1980. 97 p, 11 Fig, 6 Tab, 65 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-17740.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Safety, Hazards, Public health, Microorganisms, Environmental effects, *Gases, Vapors, Occupational health hazards.

This investigation was designed to identify and evaluate the occupational health hazards of the total plant environment of a municipally operated wastewater treatment facility. During the 24-month study, a 25-mgd trickling filter plant was subjected to a comprehensive industrial hygiene investigation followed by a detailed analysis of the health hazard considered to be the most significant. It was concluded that the facility studied and potentially all others having similar unit operations, contained many serious physical, chemical, and biological hazards to the health and safety of those employed in and around such facilities. The following summary of findings is offered: Violations of good safety practices were numerous and included improper location of chlorine gas masks, improperly mounted and outdated fire extinguishers, unprotected pit openings, insufficient ventilation, unsecured cylinders of compressed gas, exposed v-belts, inadequate showering and eating facilities, and poor general housekeeping. Exposure to physical hazards ranged from noise levels in the blower room and in the engine room to heat stress. Hazardous gases and vapors were frequently detected. Marked increases in airborne microorganisms were observed in both in-door and ambient environments. The alarmingly high counts observed in enclosed buildings where sewage was agitated was considered to be the most significant health hazard observed during the study. (Sinha-OEIS)
W82-03535

DESIGN MANUAL; ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEMS,

Rural Systems Engineering, Madison, WI.
R. J. Otis, W. C. Boyle, E. V. Clements, and C. J. Schmidt.
Environmental Protection Agency Report EPA-625/1-80-012, October, 1980. 412 p, 86 Fig, 82 Tab, 204 Ref. 1 Append.

Descriptors: *Design criteria, *Wastewater treatment, *Wastewater disposal, *Domestic wastes, Septic tanks, Intermittent filters, Nutrient removal, Disinfection, Recycling, Water pollution prevention, Groundwater pollution.

Approximately 18 million housing units, or 25% of all housing units in the United States, dispose of their wastewater using onsite wastewater treatment and disposal systems. These systems include a variety of components and configurations, the most common being the septic tank/soil absorption system. The number of onsite systems is increasing, with about one-half million new systems being installed each year. This manual provides information on generic types of onsite wastewater treatment and disposal systems, and is intended for those involved in the design, construction, operation, maintenance, and regulation of onsite systems. Treatment methods considered include: septic tanks; intermittent sand filters; aerobic treatment units; disinfection; nutrient removal; waste segregation and recycle systems. Disposal methods include: subsurface soil absorption; evaporation systems; and outfall to surface waters. Groundwater and surface water pollution are major environmental considerations when onsite systems are used. All wastewater treatment and disposal systems must be designed, constructed, operated, and maintained to prevent degradation of both groundwater and surface water quality. Secondary criteria for selection of a design are cost and ease of operating and maintaining the system. The fate of any residuals resulting from the treatment and disposal system must be considered in the selection process. (Moore-SRC)
W82-03538

UNSLAKED LIME - ITS DIRECT USE IN PHOSPHORUS REMOVAL PROCESSES.

Environmental Protection Service, Burlington (Ontario). Wastewater Technology Center.
Canada-Ontario Agreement on Great Lakes Water Quality Research Report No 105, 1980, 24 p. 6 Fig, 14 Tab, 18 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Lime, *Nitrification, *Hydration, Quicklime, Slaker, Experimental methods, Sewage, Sludge production, Slaking reactor, *Great Lakes, Water quality control, Canada.

This study, designed to evaluate the use of quicklime for phosphorus removal, was supported under the Canada-Ontario Agreement on Great Lakes Water Quality. The study was carried out in a 1.5 L/s (20 Igpm) pilot plant operated at the Wastewater Technology Centre. The experimental work occurred over a seven month period from October, 1972 to April, 1973. The study determined that quicklime may be used in place of hydrated lime without an increase in the lime requirement provided that the lime slaking temperature was within 60 to 82 degrees C and the water/quicklime ratio (weight basis) 6 to 10 at a slaking reactor detention time range of 5 to 50 minutes. A quicklime feed preparation system was developed and the full scale system design is presented. (WATDOC)
W82-03539

OZONE FOR MUNICIPAL WASTEWATER DISINFECTION,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover.
Water/Engineering and Management, Vol 128, No 10, p 74-76, 1981. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Disinfection, *Ozonation, Ozone, Costs, Water quality, Potable water, Municipal wastewater.

Applications of ozone for wastewater treatment are few at the present time in European countries. In the United States, disinfection of treated municipal wastewater is common practice and substantial research has gone into methods using ozone for this purpose. Absorbed ozone doses in the range of 4 to 8 mg/liter have been found to achieve disinfection levels of 200 fecal coliforms per 100 ml. At the operating plants tertiary and/or advanced wastewater treatment is accomplished prior to ozonation, resulting in clean effluents with suspended solids concentrations usually less than 10 mg/liter. Electrical power is the major source of operating expense for ozone production and application. About 10% of the total power required can be accounted for in the amount of gas produced, with the remainder consumed by air handling, air preparation, and waste heat production. Utilization of ozone must be accomplished as efficiently as possible since the production process is relatively expensive. The key element of an efficient process is the reactor or ozone contacting system. This must be designed for optimal ozone transfer or utilization by employing established principles of mass transfer and reaction kinetics. The amount of absorbed ozone required to achieve disinfection will vary from plant to plant depending on the characteristics of the influent. (Baker-FRC)
W82-03559

TREATING INFILTRATION AT ITS SOURCE REDUCES CAPITAL COSTS.

Water and Pollution Control, Vol 119, No 10, p 16, October, 1981.

Descriptors: *Sanitary engineering, *Storm seepage, *Sewer infiltration, *Overflow, *Capital costs, Wastewater treatment, Sanitation, Sewer systems, Storm runoff, Storm sewers, Future planning, Pipes, Decision making, Monitoring, Wastewater facilities.

To cope with problems caused by the infiltration of groundwater or stormwater runoff into sanitary sewers, Knox Martin Kretch Limited (KMKL) has devised a priority order for systematic investigations to help municipalities solve their sewer overflow difficulties. First, available flow analysis must be verified by field measurements and pump metering. When designing new sewage treatment facilities, negligence in treating the causes of unnecessary infiltration could result in increased capital costs of between $4320 and $7200/gallon/min of unnecessary flow. Gravity sewer systems should be divided into subcatchments for metering purposes. Areas of high infiltration should be monitored by closed circuit television to inspect pipe conditions and ensure the quality of joints. Dye and smoke testing of subcatchments can identify areas where catchbasins, roof leaders and perhaps storm sewers are cross connected to the sanitary system. Such flaws should be corrected to avoid damage to public areas and private residences as a result of sewer flow and gas backup. These investigations will point to areas where improvements may be made for future construction and where the emphasis of financing should be placed. (Geiger-FRC)
W82-03564

TEXANS CLAIM BREAKTHROUGH IN ANAEROBIC WASTE TREATMENT,

T. Davey.
Water and Pollution Control, Vol 119, No 10, p 10, October, 1981.

Descriptors: *Methane, *Anaerobic bacteria, *Activated sludge, Wastewater management, Sludge, Wastewater facilities, *Wastewater treatment, Effluent limitations, *Industrial wastes, Carbon dioxide, Anaerobic treatment, Bacteria, Oxidation process.

A new low energy anaerobic process for treating high strength industrial wastes has been developed. It is suitable for wastes from the petrochemical, pulp and paper, and food and beverage industries. The method offers a return on investment by reducing the amount of chemicals and electricity required in the treatment. It produces one tenth of the sludge produced by conventional methods and lessens the space requirements. Gas produced in the anaerobic reactor is compressed and burned. The effluent produced by the anaerobic reactor is separated, and aerobic bacteria are added and then returned to aeration basins. The aeration system is monitored by an automatic control system which maintains filter temperature at 99 degrees Farenheit and pH at 7. (Titus-FRC)
W82-03565

CLOSED CYCLE SYSTEM A BOON TO PULP AND PAPER INDUSTRY,

T. Davey.
Water and Pollution Control, Vol 119, No 10, p 18-19, October, 1981. 1 Tab.

Descriptors: *Water pollution control, *Pulp wastes, *Kraft mill wastes, *Pulp and paper industry, Industrial wastes, Bleaching wastes, Chlorine, Steam, Scaling, Corrosion, Biochemical oxygen demand, Capital costs, Estimated costs, Effluent limitations, Wastewater treatment, *Ontario.

A closed-cycle system for bleached kraft pulp mills has been developed and installed in Ontario, Canada. The design of this system includes: (1) reduced mill water usage, (2) countercurrent recycle of bleaching process streams, (3) 70 percent substitution of chlorine dioxide for chlorine in the first bleaching stage, (4) evaporation of the cooking liquor until the sodium chloride crystallizes and is removed by filtration, and (5) steam stripping of foul evaporator condensates. The mill has achieved its goal of reducing the need for mill effluent treatment. There is no apparent difference in the quality of the bleached pulp compared to the conventional process. Full closure of the water cycle has not yet been achieved because of corrosion in the recovery boiler superheater. Trials with full closure gave BOD5 discharges of 7.5 kg/tonne of pulp, compared to the normal kraft mill effluent of 40 kg/tonne and the value for partial closure of 15.4 kg/tonne. (Titus-FRC)
W82-03566

A COMPREHENSIVE STUDY ON THE BIOLOGICAL TREATABILITIES OF PHENOL AND METHANOL--I. ANALYSIS OF BACTERIAL GROWTH AND SUBSTRATE REMOVAL KINETICS BY A STATISTICAL METHOD,

Korea Inst. of Science and Technology, Seoul.
J. W. Kim, M. J. Humenick, and N. E. Armstrong.
Water Research, Vol 15, No 11, p 1221-1231, November, 1981. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Bacteria, *Kinetics, *Oxidation, *Wastewater treatment, Phenol, Methyl alcohol, Statistical methods, Biological treatment, Substrates, Decomposition, Degradation, Biodegradation, *Industrial wastewater, Chemical wastewater.

A statistical method is developed for the evaluation of kinetic coefficients in biological wastewater treatment. Equations describe the bacterial growth and substrate removal kinetics. The Michaelis-Menten constant (Ks) and cell yield coefficient are not significantly dependent on temperature, but substrate removal coefficient and cell decay coefficient are closely dependent on temperature. Ks and cell yield coefficient are 236 + or - 70 mg per liter and 1.21 + or - 0.06 respectively for phenol and 2330 + or - 1410 mg per liter and 1.25 + or - 0.45 respectively for methanol, based on total organic carbon and volatile suspended solids. A formula is given for oxygen utilization rate. In this expression the coefficient for oxygen requirement per substrate utilized is 1.39 for phenol and 2.23 for methanol; the coefficient for oxygen requirement per unit biomass for endogenous respiration is 1.42 times cell decay coefficient for both substances, based on total organic carbon and volatile suspended solids. (Cassar-FRC)
W82-03567

A COMPREHENSIVE STUDY ON THE BIOLOGICAL TREATABILITIES OF PHENOL AND METHANOL--III. TREATMENT SYSTEM DESIGN,

Korea Inst. of Science and Technology, Seoul.
J. W. Kim, and N. E. Armstrong.
Water Research, Vol 15, No 11, p 1249-1257, November, 1981. 12 Fig, 2 Ref.

Descriptors: Kinetics, *Biological treatment, Design criteria, *Phenol, Oxidation, *Methanol, *Wastewater treatment, Decomposition, Degradation, *Industrial wastewater, Chemical wastewater.

Systems for biological treatment of wastewater can be designed using mass balance equations for continuous stirred tank reactors (CSTR) and numerical methods and batch kinetic diagrams for batch systems. Batch systems require less aeration time to achieve a given effluent quality than CSTR systems. The relative efficiency of the CSTR systems to that of the batch systems, based on aeration time, rapidly decreases as the influent to effluent quality ratio increases. For example, a relative efficiency of 0.7 is obtained for 10 mg per liter influent, 0.27 for 50 mg per liter influent, and 0.05 for 500 mg per liter influent in the case of phenol, with a desired effluent level of 5 mg per liter total organic carbon and 3000 mg per liter initial volatile suspended solids. (Cassar-FRC)
W82-03568

COMPREHENSIVE STUDY ON THE BIOLOGICAL TREATABILITIES OF PHENOL AND METHANOL--II. THE EFFECTS OF TEMPERATURE, PH, SALINITY AND NUTRIENTS,

Korea Inst. of Science and Technology, Seoul.
J. W. Kim, and N. E. Armstrong.
Water Research, Vol 15, No 11, p 1233-1247, November, 1981. 20 Fig, 7 Tab, 9 Ref.

Descriptors: *Bacteria, *Oxidation, Kinetics, *Wastewater treatment, Methyl alcohol, *Phenol, *Methanol, Temperature effects, Hydrogen ion concentration, Salinity, Biological treatment, Statistical methods, Nutrients, Metals, Nitrogen, Phosphorus, Decomposition, Degradation, Biodegradation, *Industrial wastewater, Chemical wastewater.

A statistical method developed in a previous study was used to investigate the effects of temperature, pH, salinity, and nutrients on biological decomposition of wastewater. The optimum pH range for bacterial growth was near neutral. With phenol the optimum pH range in fresh water was 6.5-8.0. As salinity increased, the optimum pH range was 6-7 at 5C, 6.5-8 at 21C, and 7-8.5 at 28C. With methanol in fresh water, the optimum was 8-9 at 5C, and 9 at higher temperatures. Increasing salinity narrowed the tolerable pH range. The endogenous respiration rate was closely related to the substrate utilization rate coefficient and was affected by pH, temperature, and salinity. In batch biological treatments of 770 mg per liter phenol and 1000 mg per liter methanol, as total organic carbon, N and P had no recognizable effects on the substrate utilization rate coefficient, but Fe(2+), Mg(2+), Mn(2+), and Zn(2+) showed a slightly perceptible effect on it. In phenol treatments the absence of extracellular N and P produced a greater cell yield, but the cells decayed more rapidly than normal cells. In natural systems pH had significant effects on the substrate decomposition rate. Phenol decomposition decreased the pH considerably, so that in low alkalinity waters the bacterial action was delayed. The initial pH of the water was the most important factor in decomposition of methanol, which did not affect pH. An average initial lag in decomposition of 8 hours was seen in 8 of 115 phenol tests and 9 hours for 31 of 66 methanol tests. This produced average aeration lags of 5 hours for phenol and 6 hours for methanol. (Cassar-FRC)
W82-03569

COLIFORM AND CHEMICAL OXYGEN DEMAND REMOVAL FROM MEATWORKS EFFLUENTS BY DIFFERENT TREATMENT PROCESSES,

Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). Animal Research Labs.
S. P. Moodie, B. V. Kavanagh, and M. G. Smith.
Water Research, Vol 15, No 11, p 1259-1263, November, 1981. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Meat processing industry, *Bacteria, *Chemical oxygen demand, *Wastewater treatment, Coliforms, Aerobic bacteria, *Activated sludge process, Alum, Coagulation, Physicochemical treatment, *Lagoons, Trickling filters.

Meat processing plant wastewaters with high bacterial levels (about 50 million per ml total aerobes and about 20 million per ml total coliforms) were subjected to treatment with 4 processes. The lagoon system and activated sludge system were most efficient, removing 89% and 96% COD, respectively, and 71% and 96% suspended solids, respectively. Bacteria were reduced by factors of 10 to 100 for anaerobes and 1000 to 10,000 for coliforms. The physicochemical treatment (alum coagulation) and high rate trickling filtration were less effective. COD removals were 61% and 39%, respectively, and suspended solids removals, 88% and 59%, respectively. Physicochemical treatment reduced bacterial counts by 10 times. Trickling filter treatment had little effect on bacterial counts. (Cassar-FRC)
W82-03570

EFFECT OF SLIME STUCK INSIDE SAMPLING PIPINGS ON WATER QUALITY AND HOW TO REMOVE IT,

Hitachi Ltd., Yokohama (Japan). Production Engineering Research Lab.
Y. Hiratsuka, K. Odajima, and H. Kihana.
Water Science and Technology, Vol 13, No 8, p 69-74, 1981. 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Slime, *Process control, *Maintenance, *Cleaning, *Pipelines, Wastewater facilities, Water treatment, Water quality standards, Process water, Monitoring, Water analysis, Materials engineering.

Slime sometimes becomes stuck inside the sampling pipes of water quality measuring equipment in water purification and wastewater treatment plants, affecting the analysis of such water quality process parameters as turbidity, residual chlorine, dissolved oxygen, total organic carbon, and ammoniacal nitrogen. Conventional mechanical or chemical means of pipe cleaning are usually inadequate for slime removal. Washing with hypochlorite was time consuming and interrupted routine measurements. With a cannon-ball shaped elastic pig, washing through bends and small pipings was difficult. A system for cleaning with a small sponge ball driven through the piping by clean water under pressure was devised. The sponge ball can easily clean bends, elbows and branches set in a zig-zag pattern. The automatic sponge device was tested in a water purification plant. Results proved this pipe cleaning system satisfactory for keeping water clean for process monitoring purposes. (Geiger-FRC)
W82-03585

TERTIARY WASTEWATER TREATMENT TO REMOVE NITROGEN COMPOUNDS IN AERATED OXIDATION PONDS,

Academy of Municipal Economy, Moscow (USSR).
L. I. Gyunter, E. V. Grebenevich, V. A. Vavilin, and V. B. Vasil'ev.
Water Resources, Vol 8, No 1, p 61-71, January/February, 1981. 4 Fig, 8 Ref. Translated from Vodnye Resursy, No 1, p 128-139, January/February, 1981.

Descriptors: *Tertiary wastewater treatment, *Algal growth, *Oxidation ponds, *Wastewater treatment, Ponds, Nitrogen compounds, Aeration, Temperature effects, Nutrients, Model studies, Light quality, Carbon dioxide.

Tertiary treatment of wastewaters in algal ponds was studied in the laboratory and with a model to determine the effects of illumination, temperature, concentration of nitrogen compounds, and aeration. Illumination was the main factor limiting algal development in aerated ponds. Nonlimiting factors were dissolved in organic nitrogen (never less than 0.5 mg per liter) and CO2 shortage. Temperature produced retardation of growth only at 5-9C. The model indicated that the effectiveness of the treatment process depended on depth of pond, flow velocity, temperature, and illumination. Little oxidation would take place in fall and winter in the middle latitudes of the USSR. A three-section pond is 10% more effective than a one-section pond. Algae must be removed as formed to prevent secondary pollution from mineralization of dead algae. (Cassar-FRC)
W82-03587

ELECTROPLATING WASTES: HISTORY AND CURRENT STATUS,

C. F. Gurnham, and L. A. Ganzel.
Industrial Finishing, Vol 57, No 11, p 14-17, November, 1981.

Descriptors: *Electroplating, *Metal-finishing wastes, *Industrial wastewater, *Wastewater treatment, Chromium, Cyanide, History, Ion exchange, Evaporation, Membrane processes, Chemical precipitation, Reverse osmosis, Ultrafiltration.

The electroplating industry has been active in pollution control since the mid-1940's. By 1949 several treatment systems were in use--chlorination of cyanides, barium sulfide for chromium reduction and precipitation and sulfuric acid treatment followed by aeration to disperse HCN into the air. During the 1950's a metals reclamation plant was in operation. Historically, electroplaters have followed a three-phase treatment program: (1) destruction of cyanide by alkaline chlorination, (2) reduction of chromates to trivalent Cr, and (3) metal precipitation of the combined streams. There are several newer technologies. Ion exchange processes are useful in metal recovery and to prolong plating bath life. Evaporation techniques produce water suitable for reuse but are energy intensive. Improved metal precipitation methods use sulfides, hydrosulfides, or xanthates of starch or cellulose. Membrane processes are continuous and have low operating costs. These include ultrafiltration, good for alkaline cleaning solutions; reverse oxmosis, which produces water for reuse and a concentrated solution return to the plating bath; and electrodialysis, for saline waters. Donnan dialysis, an experimental countercurrent process, uses the concentration gradient across the membrane as the driving force. (Cassar-FRC)
W82-03588

WASTEWATER TREATMENT PLANT FEATURES NEW TECHNOLOGY,

Wade, Trim and Associates, Taylor, MI.
M. L. Alexander.

Public Works, Vol 112, No 11, p 50-52, November, 1981. 2 Fig.

Descriptors: *Wastewater treatment, *Sludge, Construction, *Activated sludge process, *Aeration, Wastewater facilities, Flow, Infiltration, Incineration, Energy, Dewatering, Sludge drying, Sludge thickening, Polymers, Filtered wastewater, Bay City, *Michigan.

Design of an advanced sludge handling sewage treatment plant for Bangor Township, Bay City, Michigan, is discussed. The plant uses three special features: (1) a jet aeration system in the activated sludge process, (2) a membrane type plate and frame filter press to produce sludge cakes which are 50% dewatered, and (3) an incinerator designed to burn the sludge in an autogenous mode using sludge as an energy source. The incinerator can be turned on and off to save energy. During the first year of operation, the facility has performed successfully. Influent biological oxygen demand and suspended solids average 136 mg/liter and 174 mg/liter respectively. (Titus-FRC)
W82-03591

HOW DO YOU BUILD WHEN SEWERS ARE INADEQUATE,

Browne (Richard) Associates, Wayne, NJ.
N. K. Stegmann.
Public Works, Vol 112, No 11, p 74-75, November, 1981.

Descriptors: *Construction, *Sewers, *Municipal wastes, Planning, *Sewer systems, Management planning, *Wastewater facilities, Wastewater disposal, Wastewater treatment, Interceptor sewers, Main sewers, Flow, Sewer infiltration, Case studies, Wayne Township, *New Jersey.

Municipal problems related to an imposed sewer ban are discussed. The tax structure can be adversely affected if property cannot be developed. A domino effect can occur when shutdown of commercial or industrial development results in loss of potential jobs. Wayne Township in New Jersey has an imposed sewer ban. Developers are allowed to hook up to the Township sewer system if they agree to rehabilitate a portion of the sewer system, reducing infiltration. This program allows development to proceed and reduces the flow to the treatment plant without imposing additional tax burdens on the residents at large or waiting for federal funds. (Titus-FRC)
W82-03592

INLAND CONTAINER SAVES MONEY WITH ANAEROBIC-AEROBIC TREATMENT PLANT,

Inland Container Corp., Newport Mill, IN.
C. J. Priest.
Tappi, Vol 64, No 11, p 56-60, 1981. 7 Tab.

Descriptors: *Pulp and paper industry, *Wastewater treatment, *Aerobic treatment, Costs, *Anaerobic digestion, Industrial wastes, Water conservation, Indianapolis, Indiana.

A new 350 tons/day waste paper recycling mill was begun in 1973 at Indianapolis, Indiana. The mill was designed for low water usage. It utilizes one million gallons per day, or about 2,000 gals per ton. It is obtained from on-site wells and steam condensate. All of the water is used several times before it becomes effluent. There are a number of pieces of equipment designed into the mill for cleaning and recycling process water. The original plant was built using pilot studies and projections from older mills. The initial effluent system consisted of a one million gal/day Dorr-Oliver clarifier, a one million gal emergency sludge pond, two 5.5 million gal aeration basins, and two 3.3 million gal polishing (settling) basins. The two aeration basins each had two 60 hp stationary aerators. A Parshall flume was used to measure daily discharge to the river. The effluent system was begun using the aeration basins in parallel without nutrient addition. After a few months operation was improved by running the aeration basins in series. Shortly after start-up the BOD load began to exceed 9,000 lb/day and has continued to increase to the present levels of 15,000 to 24,000 lb/day. One solution to the effluent problem was an activated sludge plant. Another was a direct anaerobic treatment. A pilot study of anaerobic treatment was performed, with the result that Inland was allowed to pursue conversion to an anaerobic/aerobic system. Five items of critical importance to control of the system include volatile acids, alkalinity, pH, temperature, and organic and hydraulic loading. (Baker-FRC)
W82-03593

BIOLOGICAL KINETIC DESIGN FOR NITRIFICATION IN HIGH-STRENGTH INDUSTRIAL WASTEWATERS,

Weston (Roy E.), Inc., West Chester, PA.
M. Ramanathan, and E. L. Stover.
AIChe Symposium Series, Vol 77, No 209, p 295-303, 1981. 3 Fig, 5 Tab.

Descriptors: *Nitrification, *Industrial wastewater, *Ammonia, Chemical wastewater, Activated sludge process, Oxidation, Design criteria, Sludge, *Wastewater treatment, Biological treatment, Organic compounds, Nitrogen compounds.

A high-strength wastewater was used to obtain design data in a two-stage continuous flow, biological activated sludge system. The influent contained 15,000-25,000 mg per liter COD, 1,000-2,000 mg per liter total Kjeldahl nitrogen (TKN), and 100-300 mg per liter ammonia-nitrogen. Typical treated effluent contained 2,000-4,000 mg per liter COD, 500-1,500 mg per liter TKN, and 500-1,000 mg per liter ammonia after the first (carbonaceous) digestion stage and 2,000-4,000 mg per liter COD, 100-300 mg per liter TKN, < 5 mg per liter ammonia-N, and 500-1000 mg per liter nitrate-N. Design parameters for a 1 mgd facility are given. Wastewater containing up to 1,500 mg per liter TKN and 100 mg per liter ammonia-N can be successfully treated. The reaction kinetics for nitrification can be related to a concentration loading ratio based on TKN, and the ratio, in turn, to the ammonia oxidation rate coefficient. The organic nitrogen compound oxidation appeared to be the controlling reaction rather than biological nitrification. (Cassar-FRC)
W82-03597

PRODUCTION OF AMMONIA IN A PACKED-BED ANAEROBIC UPFLOW (ANFLOW) BIOREACTOR,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.
D. C. M. Hines, D. W. Wester, and R. K. Genung.
AIChE Symposium Series, Vol 77, No 209, p 286-294, 1981. 10 Fig, 5 Tab, 17 Ref.

Descriptors: *Ammonia, *Anaerobic digestion, *Organic loading, *Hydraulic loading, *Wastewater treatment, Nitrification, Methane, Packed beds, Volatile acids.

Effluent ammonia concentrations from anaerobic, upflow (ANFLOW) biological wastewater treatment systems were studied under organic loading rates of 0.43 to 3.50 kg per cu m per day, hydraulic loading rates of 0.0068 and 0.0136 liters per sq m per sec, and soluble COD concentrations of 750, 1500, and 3000 mg per liter. COD removals (87.5-94%) were linearly correlated with organic loading rates at a given hydraulic loading rate. The profiles of soluble COD and volatile acids levels showed distinct regions of complex organic breakdown, ammonia formation, and wastes stabilization. The zones shifted with changes in operating conditions. Methane production, about 0.4 cu m per kg of soluble COD removed, was insensitive to organic loading rates and hydraulic loading rates. Effluent ammonia concentrations (65-217 mg per liter) were correlated with influent soluble COD concentrations and organic loading rates for a given hydraulic loading rate. Ammonia production rates (1.1-5.2 g per day) were related to organic loading rates and were independent of hydraulic loading rates over the range studied. Residual effluent ammonia was effectively removed by an aerobic unit sized at about 5% of the volume of the ANFLOW reactor. (Cassar-FRC)
W82-03598

TREATABILITY AND PATHWAYS OF PRIORITY POLLUTANTS IN THE BIOLOGICAL WASTEWATER TREATMENT,

Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 5B.
W82-03599

CONTINUOUS ION EXCHANGE: DESIGN CALCULATIONS,

For primary bibliographic entry see Field 8C.
W82-03623

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOLUME I; GENERAL.

Environmental Protection Agency, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03624

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL II: COKE MAKING SUBCATEGORY, SINTERING SUBCATEGORY, IRON MAKING SUBCATEGORY,

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03625

DEVELOPMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY VOL III: STEEL MAKING SUBCATEGORY, VACUUM DEGASSING SUBCATEGORY, CONTINUOUS CASTING SUBCATEGORY CONTINUOUS CASTING SUBCATEGORY,

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Environmental Protection Agency Report EPA-440/1-80/024-b, December, 1980. 513 p, 90 Fig, 183 Tab.

Descriptors: *Steel industry, *Industrial wastes, *Water pollution sources, *Wastewater treatment, Effluents, Pollutants, Flow control, Toxicity, Metals, Fluorides, Oil, Grease, *Water pollution control, Costs, Heavy metals, Suspended solids, Standards.

This volume contains effluent limitation giuidelines for BPT, BCT and BAT as well as pretreatment standards for new and existing sources (PSNS and PSES) and new source performance standards for the steelmaking, vacuum degassing, and continuous casting subcategories of the steel industry. For the steelmaking category BPT and BAT effluent discharge limitations are proposed for flow, total suspended solids, toxic metals, and fluoride, and the estimated costs are given. The proposed NSPS are equivalent to the BPT limitations for the semi-wet segments and to the BAT limitations for the set segments, with the exception of the open hearth furnace subdivision; no more are expected to be built. The PSNS abd PSES standards are generelly equivalent to the proposed BAT limitations and NSPS. For the vacuum degassing subcategory, BPT and BAT limitations are proposed for flow, total suspended solids, and toxic metals, and cost estimates are given. The proposed NSPS are equivalent to the proposed BAT effluent limitations. The standards for PSNS and PSES are based upon the filtration of a treatment and recycle system effluent. For the continuous casting subcategory, BPT and BAT limitations are proposed for flow, total suspended solids, oil and grease, and toxic metals, and the estimated costs are given.

BAT, NSPS, PSES, and PSNS limitations and standards are being proposed for zinc, chromium, and lead. The proposed NSPS are equal to the proposed BCT limitations for conventional pollutants. The proposed PSNS and PSES limits are identical to the BAT limits for toxic metals. (Brambley-SRC)
W82-03626

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL IV: HOT FORMING SUBCATEGORY.

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03627

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENTS LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL V: SCALE REMOVAL SUBCATEGORY, ACID PICKLING SUBCATEGORY.

Environmental Protection Agency, Washinton, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5B.
W82-03628

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL VI: COLD FORMING SUBCATEGORY, HOT COATING SUBCATEGORY,

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Environmental Protection Agency Report EPA-440/1-80/024-b, December, 1980. 606 p, 87 Fig, 177 Tab.

Descriptors: *Steel industry, *Wastewater treatment, *Industrial wastes, *Water pollution sources, Pollutants, Effluents, Flow control, Suspended solids, Oil, Grease, Heavy metals, Chlorinated hydrocarbons, Organic compounds, Costs, Water pollution control, Standards.

This volume contains the BPT, BCT and BAT effluent limitations, pretreatment standards for new and existing sources (PSNS and PSES), and new source performance standards (NSPS) for the cold rolling and cold worked pipe and tube subdivisions of the cold forming subcategory, and the alkaline cleaning and hot coating subcategories of the steel industry. In the cold rolling subdivision limits are proposed for flow, total suspended solids, oil and grease, total chromium, lead, total zinc, trichloroethane, nitrophenol, anthracene, tetrachloroethylene, and pH. The cold worked pipe and tube subdivision operations may use water or soluble oil solutions. For both operations zero discharges are proposed for all limitations and standards except PSES and PSNS for operations using water. BPT effluent loadings are proposed for flow, total suspended solids, oil and grease, dissolved iron, toxic metals and toxic organics in alkaline cleaning subcategory. In the hot coating subcategory effluent limitations are proposed for flow, total suspended solids, oil and grease, cadmium, total chromium lead, zinc and pH. For each category the estimated cost of implementing the control strategies are estimated. (Brambley-SRC)
W82-03629

PALM OIL WASTE TREATMENT STUDY IN MALAYSIA,

Asian Inst. of Tech., Bangkok (Thailand).
K. S. Hum, N. C. Thanh, and T. L. Lee.
Effluent and Water Treatment Journal, Vol 21, No 10, p 452-455, October, 1981. 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Industrial wastes, *Wastewater treatment, Activated sludge, Digestion, Aerobic digestion, Anaerobic digestion, Anaerobic lagoons, Aerated lagoons, Lagoons, Food-processing wastes, *Palm oil wastewater, *Malaysia.

A palm oil wastewater treatment study was initiated in 1977 by the Asian Institute of Technology and the Division of Environment, Ministry of Science, Technology, and Environment, Malaysia. The combined wastewater from a palm oil mill is mainly composed of two kinds of wastes, the sterilizer condensate and the oil clarifier discharge. The waste is biologically degradable. Anaerobic ponds will generally be the simplest and cheapest anaerobic form of treatment for this wastewater. However, anaerobic ponds will not achieve an effluent quality suitable for discharge to a receiving water and a final aerobic stage of treatment be needed. At detention times between 15 and 20 days, 95% or more BOD5 and COD were removed by the anaerobic pond treatment. Various aerobic biological unit processes were then attempted for further treatment. Generally, aerobic processes were successful in removing 86-94% of BOD5 but only 60-68% of COD. Treatment methods employed included extended aeration with activated sludge process, aerated lagoons, biodrum, trickling filter, oxidation ditch and oxidation ponds. In cases where land prices are not high, anaerobic ponds followed by aerated lagoons would be an attractive combination for the treatment of palm oil wastewater in the tropical environment. However, high land costs could justify other treatment systems such as high rate digestion tank and/or activated sludge systems. (Baker-FRC)
W82-03632

WASTEWATER EFFECTS ON A WATERHYACINTH MARSH AND ADJACENT IMPOUNDMENT,

Universidad Nacional de Nicaragua, Managua.
A. Velga, and K. C. Ewel.
Environmental Management, Vol 5, No 6, p 537-541, November, 1981. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater disposal, *Water hyacinth, Water quality management, *Wastewater treatment, Phosphorus, Nutrients, Lakes, Ponds, Marshes, Florida, *Nutrient removal.

A study was conducted to determine the capability of a water hyacinth-dominated marsh to absorb nutrients from secondary sewage effluent, and thereby prevent eutrophication in an adjacent impoundment without additional management. Lake Alice, a shallow impoundment located on the campus of the University of Florida at Gainesville, was studied. The lake has received wastewater from the campus sewage treatment facilities since early 1960's. The lake has two components: a 21-ha shallow marsh to the east, dominated by waterhyacinths, and a deeper open water area to the west. The sewage treatment plant effluent and a stream that drains a small sinkhole are now the two major water inputs to the lake. The facility discharges about 7500 cubic meters/da. Retention time for the lake in the mid 1970's was about 4 days, but has doubled due to the diversion of effluent from a cooling system in 1976. Water flows from the marsh area into the area that is maintained free of waterhyacinths, and is discharged through wells at the far end of the impoundment. A water budget for the basin was estimated; phosphorus concentrations were monitored monthly at three stations in the marsh and at the discharge wells in the lake. Productivity levels were measured monthly where the marsh joined the lake and at the discharge wells. Only 16% of the phosphorus that enters the basin is stored. Gross primary productivity levels in the open water areas are very high, but high respiration rates appear to keep the lake in steady state. (Baker-FRC)
W82-03634

SOME METHODS AVAILABLE FOR TREATMENT OF WASTE WATER IN THE DAIRY INDUSTRY,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
M. A. Bull, R. M. Sterritt, and J. N. Lester.
Journal of Chemical Technology and Biotechnology, Vol 31, No 10, p 579-583, October, 1981. 33 Ref.

Descriptors: Wastewater, Effluent limitations, *Wastewater treatment, *Dairy industry, *Animal wastes, Recycling, Waste recovery, Filtration, Activated sludge, Ion exchange, Electrical equipment, Flocculation, Chemical coagulation, Farm wastes.

Methods of treating dairy waste water are reviewed. Typical ranges of effluent characteristics are presented, conventional methods of treatment are discussed and their disadvantages highlighted. Emphasis is placed on less common techniques of treatment including processed involving by-product recovery. Those processes concerned with protein recovery from whey have the greatest potential for future use within the industry and should be considered at the design stage of a new plant. Alternating double filtration is an effective treatment method which requires high land usage. Fixed film biological treatment methods are also possible, but their usefulness is limited by problems which frequently result in failure of the anaerobic processes. (Titus-FRC)
W82-03650

SLUDGE HANDLING AND DISPOSAL AT THE CENTRAL PROCESSING FACILITY, MONROE COUNTY, NEW YORK,

Monroe County Water Authority, Rochester, NY.
C. M. Frenz.
Journal of the New England Water Works Association, Vol 95, No 3, p 206-216, 1981.

Descriptors: *Sludge disposal, *Wastewater treatment, Water treatment facilities, Sludge drying, Dewatering, Sludge filters, Sludge thickening, *Monroe County, New York.

A joint venture study was conducted in 1971 to determine the most economically feasible plan to solve an existing pollution problem resulting from sludge contamination in Monroe County, New York, where sludge was entering the waters of Lake Ontario. At that time there were three water treatment plants. In this case the three water treatment plants were operated by distinct entities, one a municipality, one a private industry, and the third a public benefit corporation, the Authorit. The system as devised calls for equalized flow of wastewater of about one percent or less solids content being pumped to the processing facility, where each party's flow and solids are measured. Chemical inventory at each water treatment plant is a back-up to the solids meters. Wastewater enters two sludge thickener tanks. The thickened sludge is pumped to the reaction mixer and conditioned by the addition of lime, then further concentrated in the sludge decant tank, where the solids content reaches a maximum of about 9%. Supernatant from the thickener flows directly to the ship channel, where it is discharged without further treatment. Conditioned sludge from the decant tank is held in a retention tank, where polymer is added until sufficient inventory is available for a filter run. Filtrate removed is neutralized and discharged into the ship channel. The dewatered sludge cake drops into a storage bunker. While the facility is working well, further study is needed to test and improve operational procedures to produce the desired dewatered sludge at the optimum cost. (Baker-FRC)
W82-03664

PROCEDURES FOR ESTIMATING DRY WEATHER POLLUTANT DEPOSITION IN SEWER SYSTEMS,

Environmental Design and Planning, Inc., Boston, MA.
W. C. Pisano, C. Queiroz, G. L. Aronson, F. C. Blanc, and J. C. Shaughnessy.
Journal Water Pollution Control Federation, Vol 53, No 11, p 1627-1636, November, 1981. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Sewer systems, *Mathematical models, *Deposition, Sewers, Flushing, Solids, Sewage districts.

A predictive tool was developed, capable of defining on a preliminary basis the total amounts of solids and other pollutants that deposit in a sewer system. The model was a single-term power function relating total daily wastewater deposition over a collection system to simple sewer-shed characteristics such as service area, manhole-to-manhole length, etc. The physical characteristics of 75 collection subsystems from three major sewer systems in Massachusetts were analyzed. Data from field flushing experiments were used to estimate daily deposition loadings for some pollutants. The model was applied to a combined sewer collection system, and the estimated values given by three possible regression equations were reasonably close to the value derived from a detailed collection system model. (Small-FRC)
W82-03679

ANAEROBIC ACTIVATED CARBON FILTER FOR THE TREATMENT OF PHENOL-BEARING WASTE WATER,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
K. A. Khan, M. T. Suidan, and W. H. Cross.
Journal Water Pollution Control Federation, Vol 53, No 10, p 1519-1532, October, 1981. 14 Fig, 4 Tab, 25 Ref.

Descriptors: *Phenols, *Glucose, *Carbon filters, *Methane, *Anaerobic digestion, Organic carbon, Total organic carbon, Organic wastes, Activated carbon, Biodegradation, Anaerobic conditions, *Wastewater treatment, Biological wastewater treatment, Chemical oxygen demand, Filters.

Two granular activated carbon-packed anaerobic bioreactors were constructed to test the treatment of phenolic waste water. One reactor system was fed a 2,000 milligram/liter glucose bearing substrate, while the other was fed a synthetic substrate bearing 200, 400, or 1,000 milligrams/liter of phenol. The first reactor was later fed an additional 200 or 400 milligrams/liter of phenol to assess the preacclimation and co-degradation patterns of glucose and phenol. The glucose-fed reactor effectively reduced the organic content of the feed substrate in 9.30 hours while producing an 87% methane-rich gas at 2,071 milliliters/day at STP. When the 200-milligram/liter phenol-bearing substrate was fed to another set of anaerobic activated carbon-packed filter columns, little methane was produced during the initial 135 days of continuous operation. After day 240, steady state operating conditions were achieved. At this steady-state, the first anaerobic column was responsible for reductions in COD, TOC, and phenol of 91, 86, and 99.85% respectively, overall. Methane gas production increased when the feed phenol content was increased to 400 and 1,000 milligrams/liter. When the 2,000-milligram/liter glucose-fed anaerobic system was fed an additional organic carbon source of phenol, methane production immediately increased. The biodegradation of glucose and phenol could occur simultaneously with no apperent antagonistic effects. (Geiger-FRC)
W82-03680

THE SUCCESSFUL TREATMENT OF TANKER BALLAST WATER AT A MEDITERRANEAN SITE,

H. W. Marson.
Progress in Water Technology, Vol 12, No 1, p 67-78, 1980. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Oily water, *Ballast, *Oil tankers, *Wastewater treatment, Oil pollution, Bilge, Ships, Water pollution prevention, *Mediterranean Sea.

A plant for the treatment of discharged tanker ballast water built at Sidi Kerir, Egypt, and its principles of operation are described. The 12,000 cu m/hr plant was started up in 1978 and has achieved an average oil content value of below 2 mg/liter. Oil is removed by surface skimming in storage tanks, followed by unassisted gravity separation in P-V tilted plate separators. The last traces of oil are removed by air bubble flotation and skimming in the holding basin. Plant effluent is finally released into the sea. An API sampler is located about 4 m from the final discharge weir. A reduction of the oil content of the polluted ballast water to below 10 mg/liter satisfies all official specifications and is the best that can be expected from gravity separation without the additional expense and control problems of aeration with or without flocculants and polyelectrolytes. The conditions at Sidi Kerir are particularly suitable for the methods used, which explains the facility's excellent results. (Small-FRC)
W82-03703

OIL-WATER SEPARATION BY INDUCED AIR FLOTATION,

Tulsa Univ., OK.
J. J. Byeseda.
PhD Thesis, 1980. 222 p, 25 Fig, 23 Tab, 37 Ref, 10 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-09640.

Descriptors: *Wastewater treatment, *Separation techniques, *Oily water, *Flotation, Bubbles, Oil wastes, Oil-water separation, Air flotation.

Brine solutions containing kerosine stabilized with oil-soluble petroleum sulfonates were treated by induced-air flotation in a continuous-flow pilot unit. The effects of inlet oil concentration, vessel residence time, air flowrate, bubble diameter, oil drop diameter, temperature, NaCl concentration, and cationic polyelectrolyte concentration were investigated. Oil drop and air bubble diameters, liquid residence time, and concentration of cationic polyelectrolyte were the most significant variables affecting overall flotation performance. Only drops larger than 2 micro m showed significant removal, while smaller drops were generated by the air-inducing rotor. The cationic polyelectrolyte improved flotation performance by increasing the number of large oil drops. The removal rate for each oil drop size was first order with respect to oil drop concentration and an experimental procedure permitting determination of the first-order rate constants for removal due only to bubble-drop interactions was developed. The oil drop and air bubble diameters were the only variables which affected these rate constants. Increasing oil drop diameter and decreasing bubble diameter increased the rate constants. Comparison of experimental and theoretically predicted rate constants showed that the mechanism of oil droplet removal by bubbles from 0.2 to 0.7 mm is one of hydrodynamic attachment in the wake behind the rising bubbles. (Sinha-OEIS)
W82-03719

RETROSPECTIVE ANALYSIS OF WATER SUPPLY AND WASTEWATER POLICIES IN PITTSBURGH, 1800-1959,

Carnegie-Mellon Univ., Pittsburgh, PA. Coll. of Humanities and Social Sciences.
T. F. Yosie.
PhD Thesis, May, 1981. 460 p, 9 Tab, 54 Ref, Numerous Footnotes. University Microfilms International, Ann Arbor, MI; Order No GAX81-18450.

Descriptors: *History, *Wastewater management, *Water quality management, *Water supply, Water policy, Public policy, Capital, Public health, Legal aspects, Social values, Sanitation, Technology, Sewerage, Pittsburgh, Pennsylvania.

This study is a retrospective technology assessment of wastewater and water quality decisions made by the city of Pittsburgh in the period from 1800 to 1959. The study focuses upon the areas of technology development and implementation, impacts in the health, environmental, governmental, economic, and values areas, and the development of policies to deal with both implementation and regulation of water quality impacts. The major conclusions to emerge from the study are as follows: (1) sewerage technology transferred the locus of pollution from the immediate locale to downstream or adjacent cities and illustrates the difficulty in changing a capital-intensive technology implemented for beneficial reasons when the negative impacts of the technology are felt by second parties; (2) the existence of an in-place capital-intensive technology and the policy of dealing with its negative impacts by retrofit discouraged attempts to deal with the original problem by other means; and (3) general societal values were integral to the acceptance of the technology as well as the values of specific groups who wished to promote social change through its implementation; in addition, the positive and negative impacts of the technology had unexpected effects upon the values of society. (Sinha-OEIS)
W82-03721

PREDICTING SUSPENDED SOLIDS REMOVAL IN PILOT SCALE SEDIMENT PONDS UTILIZING CHEMICAL FLOCCULATION,

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
J. S. Tapp, Jr.
PhD Thesis, 1981. 506 p, 150 Fig, 28 Tab, 148 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-18534.

Descriptors: *Suspended solids, *Flocculation, *Coagulation, *Runoff, Mining engineering, Model studies, Rainfall, Chemical coagulation, Forecasting, *Settleable solids, Sediment ponds.

The research described in this report was conducted to gain insight into the coagulation-flocculation process as it applies to runoff and eroded material from large precipitation events typical of those found in steep sloped watersheds. Laboratory and pilot scale tests were conducted to evaluate the effectiveness of induced coagulation/flocculation on total suspended solids removal in mine sediment ponds and to evaluate commonly used procedures for designing sediment ponds. The laboratory and pilot scale tests showed that chemical coagulation/flocculation produced suspended solids removal to a concentration of approximately one order of magnitude less than when no chemical was added. Based on the data collected during the laboratory and pilot scale phase of the research, various models for use in designing sediment ponds utilizing chemical flocculation agents were developed. Also, new routines were developed to make existing sediment pond models more descriptive of the settling and transport process occurring in a sediment pond. Although the soil and overburden used in the research were typical of that from surface mine sites, the models and procedures developed can also be used when treating sediment in runoff from other land uses such as urban, agriculture, silviculture and construction. (Sinha-OEIS)
W82-03725

CHARACTERISTICS OF AN AERATED LAGOON FOR MUNICIPAL WASTEWATER TREATMENT,

Kansas Univ., Lawrence. Dept. of Civil Engineering.
M. Norouzian.
PhD Thesis, April, 1980. 246 p, 25 Fig, 68 Tab, 114 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-26725.

Descriptors: *Wastewater treatment, *Aerated lagoons, *Algal growth, Algae, Suspended solids, Municipal wastewater, Nitrification, Nutrients, Water quality standards, Pilot plants.

The objective of this research was to conduct a pilot plant study of a multicell aerated lagoon system treating domestic wastewaters with emphasis on changes in nutrients which affect algal growth in receiving waters. Two 3 cell aerated lagoons were constructed and operated for one year. The aerated lagoon had a 24 hour completely mixed cell followed by a 4 day partially mixed cell and a 9 day cell for solids separation. Data indicated that the 14 day aerated lagoon could produce a high quality effluent as far as BOD sub 5 and suspended solids reductions of the initial wastewaters were concerned. Approximately 40% of the nitrification reaction occurred in the 24 hour cell during summer operations with nitrification being completed in the second cell. When the ammonia nitrogen concentration was increased, nitrification destroyed the bicarbonate alkalinity and lowered the pH to 5.5. The effluent from the aerated lagoon under these conditions did not support algal growth over a period of one month. The wood media surfaces improved effluent quality by

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retaining microbial solids. For the most part effluent quality from an aerated lagoon treating municipal wastewaters is dependent upon the growth of algae and the removal of suspended solids. The three cell aerated lagoon is a simple treatment system which can be easily designed, constructed and operated to provide good wastewaters treatment for small communities and for developing nations with limited resources. (Sinha-OEIS)
W82-03727

EPA'S I/A PROGRAM SPEEDS USE OF NEW WASTEWATER TREATMENT METHODS,

G. Dallaire.
Civil Engineering (New York), Vol 51, No 11, p 62-64, November, 1981.

Descriptors: *Grants, *Technology, *Wastewater treatment, Financing, Disinfection, Ultraviolet radiation, Aquaculture, Algae, Fish, Alternative technology, Innovative technology, Land treatment, Municipal wastewater, Research priorities, Fluidized beds, Ponds, Nutrient removal, Water hyacinth, Sludge digestion, Composting, Economic aspects, Costs.

The federal construction grants program was modified in 1977 to pay for 85% instead of 75% of design and construction costs if a community used an innovative/alternative technology for wastewater treatment. Alternative methods have been proven (land treatment, anaerobic digestion, earth mounds, sludge incineration, etc.) Innovative technologies have not yet been proven (ultraviolet disinfection, fluidized bed processes, deep shaft aeration, etc.). The goal of the projects now in progress is to produce savings in costs and energy, better quality effluents, and more environmentally suitable treatment systems. Several programs are cited as illustrations. Nassau County, New York, is planning a 10 mgd fluidized bed wastewater treatment facility to expand its activated sludge treatment plant. Water hyacinth ponds remove solids and nutrients in Austin, Texas (activated sludge digester supernatant) and in Shreveport, Louisiana (140,000 gpd raw sewage). Smithsburg, Maryland, has decided on ultraviolet disinfection of wastewater rather than a dechlorination plant as a means of protecting trout in the receiving stream. A three-lagoon aquaculture system is being tried in New Castle, Virginia, in place of an expensive high rate trickling filter system packed with plastic media. Worms are digesting raw sludge, undigested and underwatered, into a solid compost at Lufkin, Texas. Many of these communities would not have attempted innovative technologies without financial aid and the assurance that funds were available for corrective action in case the experimental projects failed. (Cassar-FRC)
W82-03737

5E. Ultimate Disposal Of Wastes

FOUR OPTIONS FOR HAZARDOUS WASTE DISPOSAL,

Municipal Environment Research Lab., Cincinnati, OH.
R. D. Hill, N. B. Shomaker, R. E. Landreth, and C. C. Wiles.
Civil Engineering, (New York), Vol 51, No 9, p 82-85, September, 1981. 2 Fig, 2 Tab.

Descriptors: *Hazardous materials, *Waste storage, Storage requirements, Disposal wells, Wells, Injection wells, Underground waste disposal, Storage, Landfills, Waste dumps, Land disposal, Groundwater pollution, *Waste disposal.

Four options for hazardous waste disposal are considered: landfills with the option of fixation before landfilling, land treatment, mine storage, and deep well injection. A hazardous waste landfill is a facility that has received a permit from the US EPA or a state agency to dispose hazardous waste by the landfill method. The landfills must be carefully engineered to provide long-term protection of groundwater, surface water, air and human health. All surface water discharges must be in compliance with the National Pollutant Discharge Elimination System requirements. Rainfall patterns in the area need to be considered to determine runoff controls and diversions. Waste stabilization/solidification is a pretreatment process that has been proposed to insure safe disposal of wastes containing harmful constituents. Solidification improves the handling and physical characteristics of the waste. Use of land treatment can provide an efficient and cost effective treatment and disposal alternative when properly used. The technique is a dynamic process involving the interaction of waste, site, soil, climate, and biological activity, usually aerobic, to degrade, immobilize, or deactivate the waste constituents. Contaminants are reduced to acceptable limits, usually through biological degradation. Mine storage involves packing solidified wastes in drums, transporting them down mine shafts, and placing them in prepared rooms. The areas are segregated to contain wastes that are compatible with one another. The atmosphere is very dry, and the drums have an indefinite life unless corroded from the inside. Deep well disposal involves injection of liquid waste into subsurface geologic formations by means of wells.
W82-03416

HEAVY METALS IN SEWAGE SLUDGE–A MAJOR TOPIC OF JOINT EUROPEAN RESEARCH,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-.Boden-, und Lufthygiene.
R. Leschber.
Water Science and Technology, Vol 13, No 4/5, p 1087-1088, 1981.

Descriptors: *Heavy metals, *Research priorities, *Sludge utilization, International commissions, Europe, Sludge disposal, Environmental effects.

The problem of heavy metals in sewage sludge has been the subject of research conducted by the Second Research Program on Sewage Sludge, COST 68bis, of the CEC, since 1975. Working Party 2 has been active studying analytical methods for sludge digestion samples and the determination of heavy metals in digested samples. These results were reported at a Vienna symposium in October 1980. Working Party 5 is using the United Kingdom as a pilot country for studying the effects of heavy metals on soil and plants. (Cassar-FRC)
W82-03435

U. N. LAUNCHES INTERNATIONAL WATER DECADE; U. S. ROLE UNCERTAIN,

For primary bibliographic entry see Field 5G.
W82-03449

ROCKY MOUNTAIN ARSENAL: LANDMARK CASE OF GROUNDWATER POLLUTED BY ORGANIC CHEMICALS, AND BEING CLEANED UP.

For primary bibliographic entry see Field 5B.
W82-03458

ENERGY CRISIS REDIRECTS SLUDGE DISPOSAL PERSPECTIVES: PART II,

N. W. Schmidtke.
Water and Pollution Control, Vol 118, No 5, p 26, 28-29, May, 1980.

Descriptors: *Sludge disposal, *Sludge utilization, Digested sludge, *Land disposal, Municipal wastewater, Metals, Land reclamation, Agriculture, Composting.

The perception of sewage sludge as a disposal problem must change to recognition of sludge as a resource if cost effective and environmentally acceptable sludge management strategies are to be developed. Sludge disposal options currently available include sanitary landfills, incineration, ocean disposal, and underground disposal. Each of these options poses particular problems, and only incineration offers the possibility of resource recovery through the incorporation of heat recovery or power generation facilities. Several sludge utilization options are currently being investigated, including direct constituent recovery, land reclamation, application to agricultural land, and sludge composting. Many municipal sludges contain high concentrations of metals, phosphorus, precipitants such as iron and lime, and even precious metals, including gold and silver. Metal recovery is contemplated in some areas. Sludge has been successfully used for land reclamation purposes in several areas. Digested sludge has been used to generate topsoil for parks and golf courses, to stabilize and reclaim acid mine tailing areas and dredged river sand deposits, and to restore land to agricultural productivity. Sludge has been applied to agricultural lands for centuries to restore nutrients and organic materials. Sludge composting and the sale of sludge as a soil amendment are also being practiced in some areas. (Carroll-FRC)
W82-03482

DESIGN MANUAL; ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEMS,

Rural Systems Engineering, Madison, WI.
For primary bibliographic entry see Field 5D.
W82-03538

THE ADSORPTION CHARACTERISTICS OF SOILS AND REMOVAL OF CADMIUM AND NICKEL FROM WASTEWATERS,

College of Petroleum and Minerals, Dhahran (Saudi Arabia).
M. Sadiq, and T. H. Zaidi.
Water, Air, and Soil Pollution, Vol 16, No 3, p 293-299, October, 1981. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Heavy metals, *Adsorption, *Wastewater disposal, Sludge disposal, *Land application, Fate of pollutants, Cadmium, Nickel, Metals, Precipitation, Soil properties, Cation exchange.

Adsorption of cadmium and nickel from municipal wastewaters spiked to 100 ppm of each metal was tested by shaking soil-wastewater mixtures for 50 days. Precipitation, not adsorption, appeared to be the major mechanism of removal in all 27 experimental soils. In the Cd experiments the following soil characteristics were correlated with Cd sorption: after 1 day of shaking-surface area, total Fe, total Al, total Ca, free CaCO3, saturated paste pH, and suspension pH. After 50 days only saturated paste pH and suspension pH were significantly correlated with Cd removal from wastewater. Clay content, organic matter, and cation exchange capacity were not correlated with Cd removal at any time during the experiment. In the Ni experiment the surface area, clay content, total Fe, total Al, total Ca, saturated paste pH, and suspension pH were correlated with Ni removal from wastewater after 1 day of shaking. At 50 days, surface area, total Fe and Al, and both pH parameters were still significant. Organic matter, cation exchange capacity, and free CaCO3 were not significant in Ni adsorption at any time. Present guidelines for applying sewage sludge to soil rely on cation exchange capacity of the particular soil. This study suggests that precipitation, not adsorption or cation exchange capacity, should be the basis of any predictive model for estimating Cd and Ni removal in soils. (Cassar-FRC)
W82-03553

A CLOSER LOOK AT DEEP WELL DISPOSAL OF WASTES,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. G. Kazmann.
Ground Water, Vol 19, No 3, p 258-261, May/June, 1981.

Descriptors: *Waste disposal, *Aquifers, *Deep wells, *Saline water, *Geologic formations, Wells, Faults, Injection wells, Clays, Permeability, Oil wells.

The potential movement of wastes from deep injection wells to potable aquifers is examined in the Gulf Coast area. It was found that brine pressure in the deep well is approximately equal to sub-sea pressures, and that target aquifers are sandwiched between clay layers. The faults found in the Gulf Coast area serve primarily as obstacles to the flow of fluids. Abandoned test holes will not serve as conduits for the movement of wastes into overly-

ing formations of extremely low permeability. Deep well injection is considered the preferred method of toxic waste disposal under the conditions which exist in the Gulf Coast area, because it is unlikely that contamination would occur in the present era of geologic history. (Titus-FRC)
W82-03646

SLUDGE HANDLING AND DISPOSAL AT THE CENTRAL PROCESSING FACILITY, MONROE COUNTY, NEW YORK,

Monroe County Water Authority, Rochester, NY.
For primary bibliographic entry see Field 5D.
W82-03664

REGULATION OF UTILITY WASTE DISPOSAL PRACTICES,

K. D. Yard.
Power Engineering, Vol 85, No 11, p 83-85, November, 1981. 2 Fig, 2 Tab.

Descriptors: *Regulations, *Utilities, *Waste disposal, Industrial wastes, Hazardous materials, Groundwater, Water pollution sources, Water pollution control, Solid waste disposal, Wastewater disposal, Land disposal.

This article attempts to clarify the current regulatory picture as it relates to the utility industry and provide insight into possible future regulations. The legislative stimulus for new solid waste regulatory programs originated with the Resource Conservation and Recovery Act (RCRA) of 1976, which completely replaced the provisions of the Solid Waste Disposal Act of 1965 and expanded the role of the Environmental Protection Agency in solid waste management. The Act was designed to promote resource conservation and safe disposal of waste materials, and to direct the EPA to promulgate regulations to protect human health and the environment from the improper disposal and management of hazardous wastes. EPA regulations require the identification of waste materials as hazardous if they are included in a comprehensive list of waste sources and waste streams, or if they exhibit hazardous characteristics, such as toxicity, corrosivity, reactivity and ignitability. The criterion requiring groundwater protection has the greatest potential impact on utility waste disposal practices. It stipulated that a solid waste disposal facility must not contaminate an underground drinking water source beyond the solid waste boundary or an alternative boundary established by the state. The surface water management criterion refers to the Clean Water Act for control of point source discharges. Achieving regulatory compliance at already existing sites may not be straightforward. Strict compliance at some sites may not be possible. Coal burning wastes for the present are classified as non-hazardous while a study is being conducted. (Baker-FRC)
W82-03691

5F. Water Treatment and Quality Alteration

TRIHALOMETHANES IN DRINKING WATER,

Montgomery (James M.), Inc., Pasadena, CA.
M. D. Umphres, A. R. Trussell, C. H. Tate, and H. R. Trussell.
Water/Engineering and Management, Vol REF, No HB p R65-R66, R68-R70, R72-R74, R76, 1981. 8 Fig, 4 Tab, 43 Ref.

Descriptors: *Water quality, *Disinfection, *Trihalomethanes, Humus, Chlorination, Chlorine, Wastewater treatment, Activated carbon, Adsorption, Adsorbents, Ozonation, Potable water, Water treatment facilities, Methane, Organic compounds.

The presence of trihalomethanes (THM) in drinking water has caused concern over the past several years. In 1974 significant levels of THM were identified at the Rotterdam water utility in water which had just been chlorinated as part of the disinfection process. THMs are the products of the reaction of chlorine with humus. Due to the complexity of the organic precursors and the variety of possible reaction pathways, the chemistry of the THM reaction is not completely understood. Several analytical methods are available for measuring THMs in the low microgram/liter range. Many treatment alternatives have been considered for controlling THMs. Those with the greatest application involve minor adjustments in operation of existing unit processes such as reducing the chlorine dosage or changing the point of chlorination. These modifications include removing the THM precursor prior to chlorination, using an alternative disinfectant which does not form THMs, or removing the THMs after they are formed. Removal of the precursor can be achieved with granular activated carbon or ozonation. Alternative disinfectants include chlorine dioxide, ozone, chloramines, or combinations of disinfectants. Removal of THM can occur through adsorption techniques, packed-tower aeration, or the use of activated carbon. Treatment costs must be considered in any investigation of alternative methods and process changes. However, it is essential that all aspects of water quality and treatability be carefully examined and evaluated before a cost comparison is undertaken for a given treatment facility. (Baker-FRC)
W82-03447

OZONE WATER TREATMENT SYSTEMS,

PCI Ozone Corp., West Caldwell, NJ.
C. Nebel.
Water/Engineering and Management, Vol REF, No HB, p R77-R80, 1981. 8 Fig, 1 Tab.

Descriptors: *Ozonation, Solubility, Dissolved solids, *Water treatment, *Potable water, Disinfection.

When ozone is used to treat potable water, it must be transferred from the air in which it was generated to the liquid phase. This is called mass transfer. Several variables affect mass transfer, including dissolved organic materials which react chemically with ozone. The amount required in a treatment plant is largely dependent on the amount of dissolved organic materials in the water. Water temperature plays an important role. Decreasing water temperature increases the solubility of ozone. Mixing increases the rate of ozone mass transfer by thinning the liquid interfacial film. Mixing also increases the rate at which residual ozone is destroyed, which in turn decreases the rate of microorganism inactivation. Bubble size affects ozone transfer, which is increased by having the maximum area available between the water and the ozonated air. Slowing the ascent speed of bubbles will also increase transfer efficiency, water depth in an ozone contactor can serve as a means to increase the contact time between the bubbles and the water. Contact time is significant to disinfection. The speed of disinfection by ozone has been observed to be significantly faster than disinfection by chlorine. Higher pH values catalytically destroyed ozone residuals in water by interaction with the hydroxyl ion. Since most ozone contacting systems do not transfer all the ozone from its carrier gas to the water, the off-gases from the contactor contain small amounts of ozone. There are many methods of off-gas treatment including dilution, decomposition of ozone by granular activated carbon, catalytic destruction, thermal destruction, and off-gas reinjection. (Baker-FRC)
W82-03448

CARBON TREATMENT OF DRINKING WATER: N.J. PLANT TRYING TO GET OUT THE BUGS,

G. Dallaire.
Civil Engineering (New York), Vol 50, No 1, p 64-67, January, 1980. 3 Fig.

Descriptors: *Activated carbon, *Organic compounds, *Regeneration, Water treatment, Trace levels, *Passaic, *New Jersey, Filtration, Adsorption, Pilot plants.

The Passaic Valley, New Jersey, water treatment plant has been experimenting with activated carbon for removing the numerous synthetic organic chemicals in its raw water source. Trace synthetic organics removal is not to be equated with removal of odor, taste, and turbidity by activated carbon filters, an effective process in common use. Water filters through a 33 inch deep bed of granular activated carbon in 8 ft x 28 ft tanks. After two years of work, the percentage of organics removed and the best type of activated carbon has not yet been determined. Problems and unknowns include the desorption of chemicals into the effluent, frequency of regeneration, strict standards on regeneration, corrosion of equipment, and moving the carbon to the regeneration furnace. In experiments at the Jefferson Parish Water Department, New Orleans, it was established that a 20 min contact time is necessary for organics removal. Large molecules such as pesticides are moved more effectively than small molecules such as trihalomethanes. Problems with activated carbon treatment can be engineered out by constructing 2 to 4 full-scale demonstration carbon treatment plants so that each water works will not have to 'reinvent the wheel.' However, some communities have immediate problems with organics and cannot wait for information from demonstration projects, which is at least five years away. (Cassar-FRC)
W82-03461

MIXED BED TECHNOLOGY FOR POLISHING MAKE-UP WATER AND CONDENSATE RETURN, PART ONE,

R. A. F. Scott.
Effluent and Water Treatment Journal, Vol 21, No 3, p 113-115, 117-120, March, 1981. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Iron exchange, *Resins, *Boiler water, *Condensates, *Water treatment, Water purification, Regeneration, Fouling, Filtration, Anion exchange, Cation exchange.

This paper presents the current state of technology of the mixed bed process for polishing condensate return or water substantially deionized by preceding processes. The regeneration sequence for the mixed anion-cation resin involves backwash, settling, caustic regeneration and rinse, acid regeneration and rinse, air mixing, and final rinse. Technologies available to ease organic fouling problems are the total organic carbon analyzer for monitoring low levels of organic matter and improved acrylic base resins. Silica leakage may be minimized by removing silica by a working anion unit prior to the mixed bed polisher, by the countercurrent technique, or using the Hipol process. Recommendations for the minimum regeneration level are 64 g NaOH per liter anionic resin and 48 g H2SO4 per liter of cation resin. Service flow rates as high as 50 meters per hour are conventional. Specifications for polished condensate are given, with 1 ppb maximum levels for NaCl and Fe in the U.S. Sources of contamination in the condensate are boiler feed makeup water, chemical additives, corrosion and erosion products, air ingress, condenser leakage, and reserve feed water. Although the first mixed bed polishing units had filtration units installed ahead of the ion exchange section, more recent technology uses the polisher itself as a highly efficient filter. Other methods of improving filtrate efficiency are precation units to protect against iron and powdered resins for precoat filtration. Using the mixed bed unit as a filter can cause physical and/or chemical fouling. Techniques for solving these problems are backwashing, air sparging, air bump-rinse out, external resins regeneration, ultrasonic resin cleaning, sub-surface washes, and split bed polishers. (Cassar-FRC)
W82-03471

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM METCALF AND EDDY, INC., BOSTON, MA,

J. E. Moore.
Water/Engineering and Management, Vol 128, No 3, p 90, March, 1981.

Descriptors: *Wastewater treatment, *Water treatment, *Equipment, Drinking water, Projections, Sludge utilization, Energy conservation, Energy production, *Water treatment facilities.

Metcalf and Eddy, Inc., presents its predictions with respect to water and wastewater treatment

developments. The water treatment industry may expect an increase in the need for waterworks treatment equipment and systems as a result of implementation of the Safe Drinking Water Act. This is particularly true in areas where systems will be required to switch from simple chlorination to full treatment for the removal of turbidity. The wastewater treatment industry can expect continuation of the present major interest in energy saving equipment. Increased interest in the reuse of wastewater for agricultural purposes or aquifer recharge and in sludge recycling for agricultural use or as an energy source can also be anticipated. Manufacturer equipment sales are decreasing. In addition, the quality of equipment has generally decreased with increased competition, as has the willingness of manufacturers and suppliers to provide maintenance assistance and general service. (Carroll-FRC)
W82-03473

CHLORINATION OF DRINKING WATER AND PREGNANCY OUTCOMES IN NEW YORK VILLAGES, 1968-1977,

Columbia Univ., New York.
For primary bibliographic entry see Field 5C.
W82-03506

A NOVEL CHLORAMINE COMPOUND FOR WATER DISINFECTION,

Auburn Univ., AL. Dept. of Chemistry.
H. D. Burkett, J. H. Faison, H. H. Kohl, W. B. Wheatley, and S. D. Worley.
Water Resources Bulletin, Vol 17, No 5, p 874-879, October, 1981. 4 Tab, 33 Ref.

Descriptors: *Disinfection, *Chloramines, Chlorination, *Water treatment, Toxicity, Solubility, Bactericides, 3-chloro-4,4-dimethyl-2-oxazolidinone, Water purification.

3-chloro-4,4-dimethyl-2-oxazolidinone (Agent I) was an effective disinfectant in a laboratory scale water treatment plant. Bacterial counts in raw water treated with Agent I were reduced from about 10 million per cc to about 1,000 per cc using a nutrient-agar (total colony count) detection technique. In all, 10 runs were made, using aluminum sulfate, lime, sodium silica fluroide (SIC), and Agent I alone and in combination. Best results were obtained (500-600 bacteria per cc) with lime, aluminum sulfate, Agent I, with or without added solution for at least 6 weeks in darkness or light and to 1 hour exposures of ultraviolet light. Solubility in water is 0.8 g per 100 cc at 2 c and 1.2 g per 100 cc at 28C. It has an apparent anticorrosive effect on metals. No toxicity was observed in 4 laboratory rats fed 10 to 200 ppm Agent I for 6 months. The slow release of chlorine provides prolonged bactericidal action. It is less likely to produce chlorinated hydrocarbons in the treated water. This compound shows potential for treating small water supplies such as wells and military field units. (Cassar-FRC)
W82-03551

REPLACING LARGE WATER METERS: WHY AND HOW,

Rockwell International, Atlanta, GA.
F. L. Russell.
Water/Engineering and Management, Vol 128, No 10, p 66, 68, 73, 1981. 3 Fig.

Descriptors: *Water metering, *Maintenance, Cost analysis, *Economic aspects, Water supply systems, Water meters, Water delivery, Pipelines.

During a recent in-the-field large meter test program, a significant number of units were found to be losing tens of thousands of dollars of revenue each year due to inaccuracy and obsolescence. These amounts of losses were far in excess of the cost of replacement of the malfunctioning units. In cases where there is a pressing need to maintain service during repairs, a temporary or permanent bypass must be installed around the meter if none exists. A temporary bypass made with service saddles, tapping valves and either fire hose or hard pipe can be used if the volume of water that can be supplied will be adequate. The primary problems to be anticipated in replacing a large water meter that has been in service for a lengthy period include difficulty in removing the old meter, as it has become bound into the pipeline as a result of lateral pressure; the possibility that the line will expand laterally into the gap when the old meter is removed and make it difficult to install a new meter of the same laying length; and a need for spool pieces and/or reducers to make up differences in size between the old meter and the new one. After the new meter has been installed with all connections secure, the valves must be slowly and partially opened in reverse order of the shutdown to allow the lines to fill slowly and reestablish pressure. (Baker-FRC)
W82-03560

DOWN TO EARTH LEAK DETECTION,

Water Treatment Plant, Traverse City, MI.
R. Bowen.
Water/Engineering and Management, Vol 128, No 10, p 62, 65, 1981.

Descriptors: *Leakage, Water conservation, Water loss, *Water supply systems, Valves, Hydrants, Measuring instruments, Maintenance, *Traverse City, *Michigan, Case studies, Pipelines.

In Traverse City, Michigan, a project was undertaken to determine where leaks in the water supply system were located and what was going on under the streets of the city. Practical experience indicates that any loss above 10% is worth some effort to control and that if losses are 20% or more a loss control program which includes leak detection is certainly called for. In Traverse City the loss was 35-40%, with increasing electrical costs. Assumptions were made that losses were due to official hydrant use, unknown unmetered use of water, and underground water leakage. A log was started to record the official use of hydrant water. Unmetered usage is hard to control. Underground leakage was investigated by use of an instrument designed for this purpose. After an examination during a quiet time for water usage, about 15% of the hydrants in the city were identified as noisy, indicating water leakage. Areas with two noisy hydrants in succession were examined first, as they indicated possible larger areas of concern. A check of the storm sewers was then made. If a flow was found it was sampled for chlorine and fluoride, the two chemicals added to city water and not found in groundwater. Suspected leaks were then pinpointed. Various factors which affect leak detection should be considered during operator training. Leak noise can vary according to conditions associated with the leak. Some general guidelines are offered. (Baker-FRC)
W82-03561

URBAN WATER SYSTEMS: PROBLEMS AND ALTERNATIVE APPROACHES TO SOLUTIONS,

Army Corps of Engineers, Belvoir, VA.
K. E. Schilling.
Journal of the New England Water Works Association, Vol 95, No 3, p 178-186, September, 1981.

Descriptors: Water supply, *Government supports, Urban areas, Water resources development, Financial aspects, Planning, Decision making, Administrative decisions, Federal jurisdiction, Political aspects, *Municipal water, *Water supply systems, Costs.

The Subcommittee on Urban Water Supply of the President's Intergovernmental Water Policy Task Force has commissioned an inventory of existing Federal programs with potential for assisting urban water system rehabilitation or construction; identified and evaluated institutional and money problems connected with supply and distribution of municipal water; and identified and assessed policy and program changes at the Federal, state and local level. Urban water system capital expenditures needed over the next 20 years are estimated to total $75-$110 billion. As many as two out of every ten urban water systems might experience capital investment shortfalls over the next 20 years. The shortfall thus created could range between $5-$26 billion. About one half of the total estimated national shortfall is attributed to distribution system needs and one-third to new source development needs. Municipally owned and operated water systems are four times as likely to experience shortfalls as privately owned systems. Federal categorical programs which supply assistance specifically for water supply purposes have limited applicability to urban water supply problems. Some Federal assistance programs do provide substantial sources of funding assistance which could be directed to water supply. The subcommittee suggests that the selection and implementation of any one or combination of policy approaches should occur in conjunction with a more detailed study of urban water resource problems to reduce uncertainties as implementation proceeds. (Baker-FRC)
W82-03580

KINETICS OF TRIHALOMETHANE FORMATION IN LYOPHILIZED POTOMAC WATER,

Howard Univ., Washington, DC. Dept. of Chemical Engineering.
M. M. Varma, R. C. Chawla, A. Balram, and H. M. Katz.
AIChe Symposium Series, Vol 77, No 209, p 220-226, 1981. 9 Fig, 6 Ref.

Descriptors: *Chlorination, *Trihalomethanes, *Kinetics, *Water treatment, Model studies, *Potomac River, Chlorinated hydrocarbons, Chloroform, Organic compounds, Fate of pollutants.

The solid residue from 20 gallons of lyophilized Potomac River water was resuspended in water and chlorinated to study trihalomethane formation. At a Cl dose of 2 mg per liter and solids concentration of 115 mg per liter, about 18 micrograms per liter trihalomethanes (mostly chloroform) formed within 6 hours. The trihalomethane concentration increased with increasing Cl dose, but not linearly. Chloroform formation also increased with increasing solids concentrations from 15 to 150 mg per liter. At the higher solids concentrations chloroform formation also increased with time up to 100 hours. A simple semiempirical model is given to use for this water. It should be applied with caution to other water sources or for the same water under drastically different conditions. (Cassar-FRC)
W82-03596

INTRAPARTICLE DIFFUSIVITY OF METHYLENE BLUE INTO POROUS ACTIVATED CARBON,

Tokushima Univ. (Japan). Faculty of Pharmaceutical Sciences.
K. Boke, S. Tanada, T. Matsui, T. Kuwahara, and A. Kotani.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 5, p 610-615, November, 1981. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Activated carbon, *Adsorption, *Diffusivity, Water treatment, *Methylene blue, Pore size, *Water pollution treatment.

The variation of the intraparticle diffusivities with the adsorption ratio up to 0.2 and the relationship between intraparticle diffusivity and pore size distribution of activated carbon were investigated. This information is essential for transferring from a batch adsorption system to a column adsorption system in water pollution treatment. Methylene blue was the adsorbate. A figure shows Freundlich plots (constants 19.12 to 176.60) of the adsorption isotherms of methylene blue on five activated carbons ranging in particle diameter from 4.08 to 4.65 mm and surface area from 378.0 to 1384.5 sq meters per g. The results of another figure imply that intraparticle diffusivities change with adsorption ratio. Methylene blue was mainly adsorbed in the micropores of activated carbon (pore diffusivity predominating over surface diffusivity) in the early stages of adsorption. The relationship between the intraparticle diffusivity and pore size distribution is illustrated by curves. (Cassar-FRC)
W82-03601

OPTIMIZING COAGULATION WITH PILOT FILTERS AND ZETA POTENTIAL,

American Water Works Service Co., Inc., Haddonfield, NJ.
W. E. Neuman.
Journal of the American Water Works Association, Vol 73, No 9, p 472-475, September, 1981.

Descriptors: *Coagulation, *Zeta potential, *Pilot plants, *Control systems, Filters, Chemical coagulation, Alum, Jar tests, *Water treatment, Turbidity, Monitoring, Quality control.

Zeta potential and pilot filters are practical testing techniques for coagulation control in water treatment plants. Zeta potential measures the strength of the negative change on the colloidal particles (turbidity) in raw water by adding a cationic coagulant to determine if cationic additions result in adequate neutralization of the negative charge. The velocity of migrating particles is measured by applying a direct current voltage across a sample cell. Examples of successful applications of zeta potential are given: latex spills into a river water supply, high turbidity values at winter temperatures, sludge blanket breakthroughs, and a daily afternoon peak in alum dosage. In all four cases zeta potential indicated much lower coagulant dosages than did other methods. In-line pilot filters provide instant alerts of change and keep a record of performance. Use of either of these two monitoring methods leads to more accurate chemical dosages, better understanding of filter processes, and a more uniform water quality. (Cassar-FRC)
W82-03653

UPGRADING TO INCREASE TREATMENT CAPACITY,

Environmental Science and Engineering, Inc., Gainesville, FL.
T. P. Brodeur.
Journal of the American Water Works Association, Vol 73, No 9, p 464-471, September, 1931. 15 Fig, 2 Tab.

Descriptors: *Flocculation, *Filtration, *Water treatment facilities, Upgrading, *Cost-benefit analysis, Manatee County, *Florida, Coagulation, Alum, Color removal, Sludge lagoons, Sludge thickening, Pilot plants, Costs, Water supply.

The Manatee County, Florida, water treatment plant was upgraded, enabling a 46% expansion to 54 mgd at capital cost savings of $2 million and energy savings of $10,000 per year. New filters were added. Two mechanical rapid mixers and twelve 40 hp mixers were eliminated. Flocculator units were divided into 8 compartments each. Perforated baffles were added to the settling basins for better distribution of flocculated water. Alum dosage was reduced from 70 to 50 mg per liter. Raw water colors were high, 151-200 pcu. Finished water colors before plant modification were 18-23 pcu, and after modification, 10 pcu or less. The effectiveness of the sludge lagoons was increased by allowing sludge to thicken to 2-3% in settling basins prior to discharge into the lagoons. (Cassar-FRC)
W82-03654

UPGRADING WATER TREATMENT PLANTS IN SAN DIEGO,

San Diego Water Utilities Dept., CA.
R. W. King, and E. I. Crossley.
Journal of the American Water Works Association, Vol 73, No 9, p 476-477, September, 1981. 1 Fig.

Descriptors: *Water treatment facilities, *Flocculation, Filter media, Filtration, Upgrading, Mixing, *San Diego, California, Water supply.

The City of San Diego, California, modified two of its three water treatment plants to increase capacity by 30% without changing the physical size of the plants or the water quality. The filter media was changed from sand to anthracite-sand, filter controllers were modified, and high energy mixers replaced rapid mixers and some flocculators. These modifications also handled a concurrent change in raw water quality. Previous supplies from the Colorado River needed only chlorination. The new supply was half Colorado River water and half from northern California, which required full treatment. (Cassar-FRC)
W82-03655

DECLINING-RATE FILTRATION,

Iowa State Univ., Ames. Dept. of Civil Engineering.
J. L. Cleasby.
Journal of the American Water Works Association, Vol 73, No 9, p 484-489, September, 1981. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Filtration, *Water level fluctuations, *Head loss, *Water treatment, Declining rate filtration, Turbidity, Pilot plants, Design criteria.

The use of declining-rate filtration is increasing in new water treatment plants. In this operation the filtration rate is allowed to decline from a maximum value in the beginning of the run when the filter media is clean to a minimum value when backwashing is done. Two pilot plant runs, one declining-rate filtration (DRF) and the other constant rate filtration (CRF), were operated at 3.39 mm per sec. The DRF produced better water, showed no terminal turbidity breakthrough, and had about 1/3 longer filter run than the CRF method. Differences in water quality were greater when the CRF was allowed to run to a breakthrough of 1 turbidity unit than when the two plants were operated by the same terminal head loss in the media. To convert an existing constant-rate or constant-head plant to declining-rate filtration the total head loss and variations in water level must be determined, preferably by pilot tests. Alternatives for plant conversion are: (1) installing a vented loop in the effluent pipe to limit the total head loss across the filter and fix the maximum water level at the desired position, (2) installing a vented overflow weir box in the effluent pipe, (3) installing a weir or an upturned pipe in the clear well, (4) installing an orifice or fixed position valve in the effluent pipe, and (5) converting the effluent valve to a two-position valve. Methods are given for estimating the changes in water level during backwashing operations in a multiple filter unit. The rise in water level decreases with increasing number of filters and increases with longer backwashing periods. (Cassar-FRC)
W82-03656

REMOVING COLOR AND CHLOROFORM PRECURSORS FROM LOW TURBIDITY WATERS BY DIRECT FILTRATION,

Stearns and Wheler, Cazenovia, NY.
L. E. Scheuch, and J. K. Edzwald.
Journal of the American Water Works Association, Vol 73, No 9, p 497-502, September, 1981. 13 Fig, 4 Tab, 27 Ref.

Descriptors: *Filtration, *Color removal, *Organic matter, *Water treatment, Direct filtration, Humic acids, Chlorinated hydrocarbons, Chloroform, Flocculation, Polyelectrolytes, *Raquette River, *New York.

Direct filtration of colored raw waters was evaluated using bench-scale pilot tests. Synthetic waters with colors of 55 pcu (5 mg per liter humic acid) and 110 pcu (10 mg per liter humic acid) and Raquette River, New York, water of 40 to 70 pcu color and low turbidity were treated with a cationic polyelectrolyte. Dosages of polymer were determined by jar test and varied from 3.5 to 8 mg per liter. Color reductions were as follows: 55 pcy water, 90%; 110 pcu water, 95%; Raquette River water, 75-85%. Chloroform precursors were reduced 50-60% for the synthetic waters and 40% for the river water. (Cassar-FRC)
W82-03657

COMPARATIVE PERFORMANCE OF DUAL- AND MIXED-MEDIA FILTERS,

Minneapolis Water Works, MN.
N. Qureshi.
Journal of the American Water Works Association, Vol 73, No 9, p 490-496, September, 1981. 7 Fig, 4 Tab. 10 Ref.

Descriptors: *Filters, *Performance evaluation, *Water treatment, Mixed media filters, Dual media filters, Sand filters, Filtration, Filter media, Comparison studies, Costs.

There was very little difference in performance between dual media (coal and sand) and mixed media (anthracite, sand, and high density sand) filters in pilot and plant scale tests conducted in the Minneapolis Water Works. In the initial stages of filter operation, the mixed media produced a slightly less turbid water than the dual media. A break-even point was reached at 24 hours, after which the dual media increased gradually in performance. The dual media had slightly lower head loss and equal or larger filter runs than the mixed media. Results of these findings and of previous work at other locations do not substantiate the belief that mixed media is superior to dual media, which costs $3.25 less to install than mixed media. These results should not be applied to other situations without considering variations in water quality and equipment. (Cassar-FRC)
W82-03659

METHODS FOR EVALUATING PERFORMANCE OF FILTER MEDIA,

Metcalf and Eddy, Inc., Boston, MA.
S. L. Bishop.
Journal of the New England Water Works Association, Vol 95, No 3, p 193-207, 1981. 10 Fig, 3 Tab, 4 Ref.

Descriptors: *Filter media, *Evaluation, *Water treatment, Water treatment facilities, Reverse osmosis, Turbidity, Head loss, Microscopic analysis.

Techniques used in evaluating the performance of filter media are discussed. These techniques involve evaluating either the quality or quantity of filtered water to determine optimal operating conditions. Quality considerations include turbidity, conditions. Quality considerations include turbidity, microscopic count, suspended solids, or the silt density index, while quantity considerations include the net unit production of water. The evaluation of the internal distribution of head loss is of interest in adjusting filter design during piloting of water processes. Measuring turbidity as an evaluation of the performance of granular media filters has limitations, as it is not an accurate indicator of the amount of suspended material in the water. Filtered water also contains quantities of amorphous material and plankton which are not detected in turbidity measurements. For these reasons microscopic analysis of filtered water has been used in many cases as a supplement to the standard use of turbidity in determining the performance of water treatment processes. Microscopic analysis has an inherent statistical problem involving the theory of random sampling and a human problem involving procedural errors or variations in the laboratory. These problems must be considered in each case. Studies have indicated that the multi-media filter is more efficient than the dual media filter in removing microscopic material and turbidity, even at twice the normal filtration rate. No relation could be found between the microscopic cound and the duration of filter run to a set terminal head loss. Suspended solids are not useful as an indicator of filter media performance because of procedural limitations involved in measuring their low values in filtered water. (Baker-FRC)
W82-03661

VINYL LINED ASBESTOS CEMENT PIPE PROBLEMS-HEALTH ASPECTS,

Dept. Environmental Quality Engineering, MA.
P. T. Anderson.
Journal of the New England Water Works Association, Vol 95, No 3, p 217-219, 1981.

Descriptors: *Pipes, *Water pollution sources, Chemical compounds, *Asbestos, Cement, Vinyl, Linings, Coatings, Organic compounds, *Water treatment, Drinking water.

The finding of tetrachloroethylene (TCE) in drinking water from public water supplies using vinyl lined asbestos-cement pipe was first noted in Massachusetts in late January of 1980. Additional investigation suggested a problem in the low flow

situations in vinyl lined AC mains with TCE levels significantly over the 40 ppb recommended safety level. In the state of Massachusetts there were about 94 public water supplies involved, with about 644 miles of vinyl lined AC pipe. Various steps have been tried thus far to solve the problem. Faucet aeration proved ineffective. Dilution was effective but impractical. Impractical also was steam cleaning and sand blasting. Addition of a cement lining resulted in a 97-99% reduction but the long term effect is not known and the cost is $10-$15 per foot. Flushing was effective, but also wasteful and difficult to monitor. Bleeding was generally effective. Carbon filtration was effective under 800 ppb but cartridge life was a problem. Five minutes of vigorous boiling at 2 inches deep removes 99%, but many concentrate other chemicals. Adjustment of pH, polyphosphate addition and super chlorination were not effective. Pipe replacement was effective but very expensive. (Baker-FRC)
W82-03663

CENTRAL CITY DEMANDS IN THE 80'S WOONSOCKET, RHODE ISLAND,

H. V. Patterson.
Journal of the New England Water Works Association, Vol 95, No 3, p 224-228, 1981.

Descriptors: *Water conveyance, *Financial aspects, *Water supply, Water rates, Economic aspects, Planning, Water management, Water distribution, Water delivery, Pipelines, Water mains, Conveyance structures, Water demand, *Woonsocket, *Rhode Island.

The existing water supply system in Woonsocket, Rhode Island is reviewed, and needs for the future are described. Before 1885 a reservoir (number 1) was constructed with an available water capacity of 30 MG, a pumping station was built, and the first water mains installed. The water company as such became municipally owned in 1885 at a cost of $280,000. It has never become self-sustaining. The Crook Fall Brook has remained the major source of supply, and is of very high quality. A second reservoir was built, but washed out in the early 1890's; a third one was built later. Chlorination was the only chemical treatment employed prior to building the new plant in 1962. Woonsocket's Central Area comprises 3 square miles. Sixteen of the 44 miles of pipe laid before 1900 are nominal 4 and 6 inches in size, unlined cast iron, which should be replaced. A bond issue was floated seven years ago to repaint and refurbish the water tanks and begin other repairs. However, the first tank examined was in such bad shape that most of the money went for it. Efforts are also underway for fire hydrant renewal. The greatest handicap in all the problems is the dependency on the general fund of the city. (Baker-FRC)
W82-03665

UNCERTAINTIES IN WATER DISTRIBUTION SYSTEMS,

For primary bibliographic entry see Field 8A.
W82-03668

HYGIENIC EVALUATION OF THE POLYAMIDE MEMBRANE PHEYLONE-2S AND PHENOL FORMALDEHYDE RESIN VIAM-B FOR USE IN REVERSE OSMOSIS TREATMENT OF WATER. (GIGIENICHESKAYA OTSENKA POLIAMIDNYKH MEMBRAN FENILON-2S I FENOLFORMAL'DEGIDNOI SMOLY VIAM B, PRIMENENYAEMYKH PRI OBRATNOOSMOTICHESKOM OPRECHNENII VODY),

Institute of General and Municipal Hygiene, Moscow (USSR).
For primary bibliographic entry see Field 3A.
W82-03698

BAYANIHAN, THE SPIRIT BEHIND THE PHILIPPINE WATER SUPPLY DEPARTMENT SCENE,

Aqua, No 6, p 7-9, 1981.

Descriptors: *Water resources development, *Water supply, *Water demand, Resources development, *Philippines, Urban areas, Rural areas, Drinking water, Potable water, Water management, Metropolitan water management.

The spirit of self-help lies behind the attempts being made in the Philippines to promote the drinking water supply development program. At the start of the 1970's a study indicated that the water works systems which were installed by the National Waterworks and Sewerage Authority (NAWASA) were not maintained properly and were breaking down at a much faster rate than rehabilitation and repairs could manage. Through a presidential mandate in 1973 the control of Philippine water supplies was placed under three separate agencies. The Metro Manila area and some six adjacent municipalities of the provinces of Cavite and Rizal fall under the responsibility of the Metropolitan Waterworks and Sewerage Systems (MWSS), with the rest of the country divided between the Local Water Utilities Administration and the Rural Waterworks Development Corporation. The RWDC undertakes development of water supplies in areas with less than 20,000 population. The LWUA handles water needs of cities and municipalities outside Metro Manila with more than 20,000 population. The water district is owned, operated, managed and controlled by the people themselves once it is operational and has settled obligations with the LWUA. Thus its development depends on the people in the locality it serves. Because of the popularity of the self reliance concept in the Philippines, this concept of water supply development is making great strides. (Baker-FRC)
W82-03741

DEVELOPMENT OF WATER SUPPLY TO METRO-MANILA,

Aqua, No 6, p 10-13, 1981. 5 Fig, 1 Tab.

Descriptors: *Water resources development, *Water supply, Dams, Reservoirs, Resources development, Water demand, Urban areas, *Manila, Philippines, *Metropolitan water management.

In August of 1975 the Manila Water Supply Project II began for the purpose of developing fully the present major source at Angat River, carrying out rehabilitation and extension of the water distribution system, and transforming the Metropolitan Waterworks and Sewerage System (MWSS) into an efficient public utility. The first effects of the project were recently felt with the completion of modifications to the Balara Waer Treatment Plant, the partial operation of a new aquaduct, and the installation of additional distribution mains. The total Project cost is about US $416.0 million, of which $185.3 million is the estimated foreign exchange. Construction and commissioning the new La Mesa Water Treatment Plant is an integral and critical part of the Project program. Total completion and operation is scheduled for February 1982. Water to be treated at the La Mesa Plant will come from the Angat-Ipo supply system. This consists of the Angat multi-purpose dam, which discharges through power turbines to the Angat River and thence to the Ipo Diversion Dam, and then through tunnels and closed aqueducts to the Novaliches Reservoir. Prior to entering the Reservoir, the water will be diverted into an open channel to the La Mesa Treatment Plant. The new Ipo Dam is located on the Angat River near its confluence with the Ipo River in the Province of Bulacan. The dam will double the present water supply capacity to Manila. The project consists of building both the dam and the necessary flood and self-regulating radial gates and other material. (Baker-FRC)
W82-03742

A CENTURY OF EFFORT QUENCHES HONG KONG'S THIRST,

For primary bibliographic entry see Field 3B.
W82-03743

WATER SOFTENING BY CRYSTALLIZATION,

Amsterdam Waterworks (Netherlands).
I. A. Graveland.
Aqua, No 2, p 3-4, 1980. 3 Fig.

Descriptors: *Water softening, *Hardness, *Crystallization, Calcium carbonate, *Water treatment.

A water softening process uses sodium hydroxide to increase pH and cause calcium carbonate to crystallize on marble grains in a fluidized bed. Once every day or two the larger two mm grains are removed from the bottom, and new seeding sand is added. These marble grains may be used in industrial applications. Hardness is reduced from five to three meq per liter at pH 8.5. Heavy metals are almost completely removed, but organic compounds are not. Additional costs for central water softening per family in Holland are estimated at two pounds a year, with a ten pounds per year savings in washing powder and equipment maintenance. (Cassar-FRC)
W82-03750

5G. Water Quality Control

A CONTROL MODEL FOR PHOSPHORUS LOADING REDUCTION UNDER UNCERTAINTY,

Mining Development Inst., Budapest (Hungary).
I. Bogardi, L. Duckstein, and F. Szidarovszky.
Ecological Modelling, Vol 12, No 1, p 83-103, March, 1981. 6 Fig, 8 Tab, 38 Ref.

Descriptors: *Eutrophication, *Phosphorus, *Model studies, *Water quality control, Nutrients, Water quality management, Lakes, Snowmelt, Fertilizers, Erosion control, Sediment yield, Land use, *Nutrient loading control, Lake Balaton, Hungary.

An investigation into the control of nutrient loading to prevent eutrophication was made using a system model of Lake Balaton, Hungary. The model was composed of the state vector consisting of dissolved P and sediment-fixed P and the probability density (pdf) of these values. Six pure strategies concentrating on the control of point source pollution, fertilizer, erosion, land use, runoff, and sediment yield are used to define eight mixed alternatives. The measure of effectiveness of control has been taken as the relative frequency (uj) with which alternative j results in the highest loading reduction, in order to account for the stochastic character of loading. Under the data and conditions for the sub-watershed of Lake Balaton, the most effective treatment for the control of nutrient loading appears to be tertiary wastewater treatment. Stochastic models of snowmelt which may increase P-loading under no-till agricultural systems may also be used within the event-based framework of the present model. (Geiger-FRC)
W82-03421

U. N. LAUNCHES INTERNATIONAL WATER DECADE; U. S. ROLE UNCERTAIN,

G. Dallaire.
Civil Engineering (New York), Vol 51, No 3 p 59-62, March, 1981.

Descriptors: International Hydrolic Decade, Rural areas, *Public health, Sanitary engineer, Sewage treatment, *Potable water, *Waste disposal, Foreign countries, Governments, Engineering, Diseases, Water pollution, United Nations, *Water quality control, Drinking water.

Constraints to achieving the goals of the United Nations' International Water Decade are governmental commitment and motivation, managerial ability, manpower and training on all levels (from professional to laborer and handyman), appropriate technology, and money. Many developing countries consider industrial, agricultural, transportation, and power development much more important than water and sanitation. In some cases advanced technology is used to construct expensive, complicated treatment plants which cannot be maintained, whereas simple latrines or the double vault method can greatly improve sanitation. When engineering students from developing countries returned to their homelands, many took desk jobs and failed to spread their knowledge to the villages and rural areas. Although rural areas have severe problems from improper waste disposal and polluted drinking water, the problems in rapidly

growing third world cities are worse. As yet, United States consultants have not been involved significantly in these developing countries. Many have not had experience in simple, low cost technologies. The United States would benefit from involvement in the Water Decade because some diseases common to the third world are finding their way to the Western world. In addition, the developing countries supply some necessary raw materials as well as consuming American products and services. (Cassar-FRC)
W82-03449

RAPID SEWER ANALYSIS SAVES TOURIST SEASON,

M. Garbrecht.
Consulting Engineering (St. Joseph), Vol 54, No 4, p 148, 150, 152, April, 1980.

Descriptors: *Sewer infiltration, *Rehabilitation, *Cape May, New Jersey, *Water pollution control, Inspection, *Sewer systems, Maintenance.

Cape May, New Jersey, a seaside resort town with sewer service to 150,000, completed sewer inspections and repairs before the tourist season, worth more than $100 million, opened. The beaches had been closed by the state because of the high level of fecal coliforms entering the ocean and Delaware Bay from the defective system. Initial investigations covered the total collection system, 150,000 feet of mains and six pumping stations. Infiltration/inflow measurements eliminated two subsystems from study, and work concentrated on the 83,000 feet most likely to produce the remaining infiltration/inflow. Subsequent investigations concerned location of pollution from the storm drains and location of sources which caused surges and sewage treatment plant by-passing. About 35% of the infiltration/inflow sources were repairable and 42% of the manholes needed water-tight covers. All work from specifications development to major corrective work was done within six months, at a total cost less than the estimated $1.635 million. (Cassar-FRC)
W82-03494

THE EFFECT OF ARTIFICIAL DESTRATIFICATION ON PHYSICO-CHEMICAL PARAMETERS AND PHYTOPLANKTON IN HAM'S LAKE, OKLAHOMA,

Oklahoma State Univ., Stillwater.
H. N. Chau.
PhD Thesis, December, 1980. 135 p, 18 Fig, 19 Tab, 116 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13298.

Descriptors: *Water quality, *Lakes, *Mixing, *Destratification, *Environmental effects, Nutrients, Phytoplankton, Standing crops, Physicochemical parameters, *Ham's Lake, *Oklahoma.

Physico-chemical parameters of water quality and the standing crop of phytoplankton were observed during three comparable periods in 1976, 1977, and 1978 in Ham's Lake, Oklahoma. The objective was to determine the ecological effect of artificial mixing on the lake, which was artificially mixed during 1976 and 1978, but not in 1977. The major findings were as follows. Artificial mixing created isothermal conditions by raising the temperature between the bottom and 4 m. The larger axial flow pump of 1.6 m destratified the lake better than the smaller one of 1.1 m (diameter). Artificial mixing reduced the transparency of the Secchi disc. Anoxic conditions in the hypolimnion were eliminated by artificial mixing. Artificial mixing reduced free carbon dioxide at the bottom of the lake causing an increase in pH. Free carbon dioxide at the surface did not increase, probably due to higher rates of photosynthesis. Total alkalinity was isochemical with respect to depth during mixing. The concentration of nitrate was slightly higher during experimental years. The concentration of ammonia was lower in 1978 than in 1976. The concentration of sulfide decreased during artificial mixing. Phosphate was detected more often during the experimental years. Concentrations of chlorophyll a were higher during the experimental years. Artificial mixing encouraged the growth of the diatoms, Cyclotella, Melosira, and Navicula but discouraged the blue-green algae, Microcystis and Anabaena. Horizontal variability in water quality parameters and chlorophyll a was observed at Ham's Lake. (Sinha-OEIS)
W82-03510

IRRIGATED AGRICULTURE AND NITRATE POLLUTION OF RURAL WATER SUPPLIES: ECONOMICS FOR POLICY IN CENTRAL WISCONSIN,

Wisconsin Univ.-Madison. Dept. of Agricultural Economics.
R. C. Griffin.
PhD Thesis, 1980. 333 p, 9 Fig, 10 Tab, 234 Ref. University Microfilms International, Ann Arbor, MI; Order NO GAX81-02202.

Descriptors: *Groundwater pollution, *Water pollution control, *Agriculture, *Economic aspects, Water policy, Irrigation, Nonpoint pollution sources, Agricultural watersheds, Agricultural wastes, *Nitrates.

The economic structure which characterizes the nitrate pollution of groundwater by irrigated agriculture in the Wisconsin Central Sands Region is examined. The major emphasis is the development of a theoretical and methodological framework for evaluating problems involving agricultural pollution. The primary feature characterizing agricultural instances of pollution is their 'nonpoint' nature. 'Nonpoint production functions' are used to identify the technical relationships between nonpoint pollution generation and agricultural activities. This concept leads to several alternative policy proposals as well as specific policy parameters for use in non-point situations. Two additional concerns which are related to agricultural pollution involve the spatial nature of groundwater contamination and the 'policy transaction costs' to be encountered during policy implementation and maintenance. Policy transaction costs refer to the administrative and information costs which accompany the implementation of any pollution-control policy. These costs can be substantial in nonpoint situations, and the efficiency and effectiveness of alternative policy programs is shown to be related to these costs. Current economic procedures for analyzing policies and current nonpoint policy are critiqued and found to be deficient in several regards. Needed improvements in these procedures and institutions are suggested. (Sinha-OEIS)
W82-03512

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 6B.
W82-03518

GROUNDWATER MONITORING STRATEGIES TO SUPPORT COMMUNITY MANAGEMENT OF ON-SITE HOME SEWAGE DISPOSAL SYSTEMS,

Colorado State Univ., Fort Collins. Dept. of Agriculture and Chemical Engineering.
J. D. Nelson.
PhD Thesis, 1980. 147 p, 15 Fig, 8 Tab, 76 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22416.

Descriptors: *Water pollution prevention, *Water pollution sources, Groundwater, *Groundwater pollution, Monitoring, Domestic wastes, Septic wastewater, Mathematical models, Sampling, *Wastewater management, Septic tanks.

Organizations which provide centralized management of on-site sewage disposal systems are currently evolving in many areas of the United States. At present, there is no routine feedback for management agencies regarding their efforts in preventing ground water contamination. Ground water monitoring is necessary to provide these agencies with the information they need to maintain ground water quality. This research is directed toward supplying monitoring strategies for that purpose. Ground water monitoring strategies presented here were developed by combining deterministic and probabilistic approaches. Two types of monitoring are defined which need to be incorporated into an overall management plan. Inspection monitoring strategies are developed in terms of the sampling frequencies necessary to obtain a specific probability of detecting system failure. A mathematical model describing the flow of pollutants through the leach field is developed for the purpose of evaluating sampling plans and a sensitivity analysis is performed to determine the effect of varying the parameters of the system and the input to the leach field. The discussion of trend monitoring strategies is based primarily on existing statistical theory. Sampling frequency is discussed in terms of the number of samples required to obtain an estimate of the mean of a water quality variable within specified confidence limits. The effect of spatial and serial correlation is also considered. Finally, a discussion of various sampling techniques applicable to ground water monitoring is presented. (Sinha-OEIS)
W82-03527

ANALYSIS OF WASTE LOAD ALLOCATION PROCEDURES,

Villanova Univ., PA. Dept. of Civil Engineering.
R. A. Chadderton, A. C. Miller, and A. J. McDonnell.
Water Resources Bulletin, Vol 17, No 5, p 760-766, October, 1981. 5 Tab, 3 Ref.

Descriptors: *Waste load, *Water pollution prevention, Planning, Model studies, *Literature review, Water quality control, Regulations, *Streams, *Assimilative capacity, *Design flow.

A survey of the literature and of water resources research institutes produced 20 potential methods for calculating waste load allocations. Five of these were compared, using 25 sets of waste load allocation data. The most promising method in terms of insensitivity to basic water quality data errors was No. 1, equal percent removal or equal percent treatment. Method No. 4, effluent concentration inversely proportional to pollutant mass inflow to treatment facility, was nearly as insensitive. There were disadvantages associated with all 5 models studied in detail. No. 1 forces small volume dischargers and dilute sources to treat wastes to a higher and more expensive degree. No. 4 requires large dischargers to treat to a higher level. Waste load allocations were sensitive to variations in reaeration and deoxygenation rate constants and to pollutant source strengths and locations. (Cassar-FRC)
W82-03550

HYPOLIMNETIC AERATOR FIGHTS EUTROPHICATION,

Water and Pollution Control, Vol 119, No 10, p 24, October, 1981. 1 Fig.

Descriptors: *Lake restoration, *Eutrophication, *Aeration, Water pollution effects, Water pollution control, *Hypolimnion, Nutrients, Water pollution prevention, Water quality control, Lakes, Tertiary wastewater treatment, Population exposure, Population dynamics, *Ontario.

Free floating portable hypolimnetic aerators have been designed by a group of scientists at York University for combating eutrophication in Ontario lakes. The aerator features a riser tube of flexible polyvinyl coated nylon to resist breakage and rubber hoses to receive compressed air from the shore. One aerator can aerate the hypolimnion of a whole lake if operated long enoough. Initial testing of the apparatus has been conducted on Tory Lake and Lake St. George. By 1984, weekly followup testing including tests on the dynamics of lake aquatic species will amount to the largest study of lake aeration to date The aerator is seen as a short-term solution to lake eutrophication due to nutrient addition from urban and agricultural runoff. The construction of tertiary sewage treatment plants and the use of modified agricultural practices are recommended to solve the problems of lake deterioration in Ontario over the long run. (Geiger-FRC)
W82-03563

REMOVAL OF HEXAVALENT CHROMIUM FROM ESTUARINE WATERS BY MODEL SUBSTRATES AND NATURAL SEDIMENTS,
Maine Univ. at Orono.
L. M. Mayer, and L. L. Schick.
Environmental Science and Technology, Vol 15, No 12, p 1482-1484, December, 1981. 5 Fig, 14 Ref.

Descriptors: *Chromium, *Sediments, *Adsorption, *Salinity, Fate of pollutants, *Estuaries, Chromates, Metals, Estuarine environment, Phosphates, Silicates, Suspended sediments, Water pollution control.

Chromate was not effectively removed by suspended sediments at concentrations typical of estuarine systems (< 1 g per liter). Removal of hexavalent Cr was studied using two model substrates, alumina and kaolinite, and natural estuarine sediments at salinities of 0 to 32 o/oo and 1 microM Cr per liter as KxCrO4. Chromate removal from seawater varied from 0.1 to 0.4 microM per liter at sediment concentrations near 0 mg per liter to about 0.5 micro M per liter at 200 mg per liter. Natural estuarine sediments were more efficient in immobilizing Cr than the model substrates. Cr removal decreased with increasing salinity in alumina and kaolinite experiments over the range 0 to 32 o/oo. Cr removal in natural sediments increased to the 0.1-1.0 o/oo salinity range and decreased with increasing salinity thereafter. The peak is similar to that seen when Cr(6+) is reduced to Cr(3+) by gallic acid at increasing salinity. This suggests a two-step sequence of reduction followed by adsorption (reductive adsorption). Naturally occurring levels of phosphate and silicate had negligible effect on chromate removal. (Cassar-FRC)
W82-03637

BIODEGRADATION OF LINEAR ALCOHOL ETHOXYLATES IN NATURAL WATERS,
Procter and Gamble Co., Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W82-03638

GROUNDWATER QUALITY IMPROVEMENT THROUGH NONLINEAR DIFFUSION,
Center for Water Resources Development and Management, Trinandrum (India).
P. Basak, and V. V. N. Murty.
Journal of Hydrology, Vol 53, No 1-2, 151-159, September, 1981. 3 Fig, 10 Ref.

Descriptors: *Mathematical equations, *Water quality management, *Groundwater pollution, *Diffusion coefficient, Mathematical studies, Mathematical models, Water pollution control, Water quality control, Permeability, *Groundwater.

At the present, no formal analytical solution has been offered for the problem of gradual improvement of groundwater quality by diffusing the contaminant to the adjoining less contaminated source. An effort was made to develop an analytical solution to this problem with constant and concentration-dependent diffusivities. When the diffusion coefficient (D) is assumed to be constant, the governing differential equation is linear. When D is assumed to be concentration-dependent, the governing equation becomes nonlinear. Since the difference between the exact solution of the concentration-dependent diffusion and the linearized solution for diffusion is negligible, the use of the simplified linearized solution is recommended for all practical purposes. The nonlinearized solution to the problem of gradual improvement of groundwater quality by diffusing the contaminant should be used when greater accuracy is required. (Geiger-FRC)
W82-03652

VINYL LINED ASBESTOS CEMENT PIPE PROBLEMS-HEALTH ASPECTS,
Dept. Environmental Quality Engineering, MA.
For primary bibliographic entry see Field 5F.
W82-03663

SIMULATING COAL PILE RUNOFF AS A DESIGN TOOL,
For primary bibliographic entry see Field 5B.
W82-03692

EFFECTS OF A BARRAGE ON FLUSHING AND WATER QUALITY IN THE FITZROY RIVER ESTUARY, QUEENSLAND,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 4A.
W82-03705

RETROSPECTIVE ANALYSIS OF WATER SUPPLY AND WASTEWATER POLICIES IN PITTSBURGH, 1800-1959,
Carnegie-Mellon Univ., Pittsburgh, PA. Coll. of Humanities and Social Sciences.
For primary bibliographic entry see Field 5D.
W82-03721

AN ECONOMIC APPROACH TO GROUND WATER QUALITY MANAGEMENT,
California Univ., Davis. Dept. of Agricultural Economics.
R. E. Howitt, and P. Mean.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September, 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 103-113. 2 Fig, 3 Tab, 4 Ref.

Descriptors: Degradation, *Saline soils, *Crop yield, Aquifers, Percolation, *Economic aspects, Soil types, Salt balance, Leachates, Social costs, Water costs, Perched groundwater, Recharge, Agricultural hydrology, Hydrologic models, Agriculture, *Groundwater management, *Water quality control, Aquifer management.

Groundwater quality degradation, particularly salinity increases, seriously affect costs to agricultural, municipal and industrial users. This paper discusses the economic aspects in the agricultural sector and centers on two themes: (1) that farmers can take actions to offset much of the cost of expected salinity increases over the next 20 years: and (2) that the reactions of farmers to physical and economic changes must be considered when planning salinity reduction projects. Salinity mitigation actions include crop rotation, blending water sources, and using varied irrigation methods. Several factors that will affect farmers' reactions to increased salinity are the long run vs. short run costs and the timing of any remedial action. Salinity buildup is inevitable without remedial action; therefore, optimal economic management of an aquifer requires that both long and short run costs of salinity buildup be equated to remedial costs at any given time. An economic hydrologic model was built at one of two Kern County study sites and the most pertinent result showed that the cost of groundwater salinity degradation increases over time keeping other factors constant. Lag time, or memory, of salts percolating into the aquifer was omitted from the model, but is is generally believed that the time lags of salinity are very long and that the timing of remedies is crucial. The major long run cost of increased salinity is soil permeability rather than the intermediate cost of soil depression. Groundwater salinity is a common pool problem and all users must contribute to the solution. (Atkins-Omniplan)
W82-03732

COMMENTS ON A NATIONAL GROUNDWATER PROTECTION STRATEGY,
For primary bibliographic entry see Field 6F.
W82-03740

FLOW-AUGMENTATION AND WATER QUALITY IN PARAIBA DO SUL RIVER BASIN-BRAZIL,
C. Celso do Amaral e Silva.
Water Science and Technology, Vol 13, No 3, p 43-48, 1981. 2 Fig, 2 Ref.

Descriptors: *Water quality control, *Energy loss, *Minimum flow, *Flow augmentation, *River basins, Paraiba River, *Brazil, Model studies, Rivers, Multireservoir networks, Water pollution control, Reservoirs, Mathematical models, Computer models.

The DOSAGM model and the Multi-Reservoir model were applied to the South Paraiba River basin to study pollution control. Minimum flow was maximized at various points in the system. Optimum operation is based on comparisons between the cost necessary for waste treatment and the costs resulting from increases in minimum flow. A graph depicts the system energy loss in percent as a function of the minimum flow (cu meters per sec) at any point. Zero energy loss occurs at a flow of 45 cu meters per sec and 60% at 75 cu meters per sec. (Cassar-FRC)
W82-03744

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER SUPPLY RELIABILITY THEORY,
Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
U. Shamir, and C. D. D. Howard.
Journal of the American Water Works Association, Vol 73, No 7, p 379-384, July, 1981. 15 Fig, 2 Tab, 2 Ref.

Descriptors: *Reliability, *Mathematical analysis, *Water supply, Statistical methods, Maintenance, Water demand, Economic aspects, Water storage, Pumping.

Mathematical functions are used to describe water supply reliability and to develop a framework for its economic assessment. The analysis is based on demand being fixed and known, while future work will have to deal with the random nature of both demand and supply. A comprehensive statistical description of reliability can be developed by defining a reliability factor that is a function of the relative shortfall during a failure or over some period of time. The required data is usually readily available in the maintenance records of water supply companies, as interfailure times and repair durations are the only data needed. Also, a procedure can be developed to determine which expansion alternative provides the desired reliability. This procedure is demonstrated for the alternatives of additional storage versus standby pumping capacity. Reliability can be increased by adding facilities, storage, pumping capacity, and pipelines, and this procedure can be used to identify the least cost combination of facilities. (Small-FRC)
W82-03432

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM MALCOLM PIRNIE, INC., WHITE PLAINS, NY,
R. F. Bonner.
Water/Engineering and Management, Vol 128, No 3, p 63-64, March, 1981. 1 Fig.

Descriptors: *Wastewater treatment, *Projections, *Energy conservation, Wastewater facilities, Performance evaluation, Equipment, Sludge thickening, Sludge drying, Sludge digestion, Sludge conditioning, Aeration.

As a result of the change in the relationship of the relative costs of labor, chemicals, and energy, in addition to the possible unavailability of energy, energy reduction and savings will be the designer's focal point in choosing and specifying processes, systems, and equipment for wastewater treatment plant construction, whether new, retrofitted, or expanded. This is particularly true in metropolitan areas with large plants. As a result, the sludge handling and disposal processes and the aeration facilities, both of which are major consumers of energy, will be investigated intensively for ways to reduce energy usage. Various processes for thickening, digesting, conditioning, dewatering, and incinerating sludge which provide energy savings are currently under investigation. The addition of

waste heat recovery systems is also being explored. Aeration is the prime power user for the liquid portion of the wastewater treatment system, regardless of the technique selected. Choice of the particular method should be carefully investigated with respect to the type of waste to be treated. (Carroll-FRC)
W82-03474

OUTLOOK FOR WATER AND WASTEWATER SYSTEMS, PROCESSES, AND EQUIPMENT: COMMENTS FROM GILBERT/COMMONWEALTH, READING, PA,

J. E. Germaine.
Water/Engineering and Management, Vol 128, No 3, p 62, 63, 69, March, 1981.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Projections, Management planning, Water treatment, Sludge drying, Energy conservation, Energy, Conservation.

A variety of projections with respect to water and wastewater systems, processes, and equipment are presented. A continued slow demand for wastewater and water treatment equipment and facilities is expected in the near future, followed by a slight increase and leveling off as more wastewater projects move from current planning phases to construction and as increased water demands necessitate expansion of water supplies. Energy conservation considerations can be expected to continue to have a significant impact on capital investment decisions. The Environmental Protection Agency's emphasis on innovative and alternative systems and on consideration of on-lot wastewater disposal as an alternative to wastewater plants will affect equipment and facility selections and decisions in the wastewater treatment field. The use of the rotating biological contactor in the liquid process train of wastewater treatment facilities and of the belt filter press in the sludge train can be expected to increase. Rehabilitation of old water treatment systems will become increasingly urgent in the coming years. Pursuance of the goals of the United Nation's Water Decade should result in a large international market for basic equipment and services, particularly in rural areas. If water and wastewater facilities are to meet future needs, manufacturers will have to reestablish high standards for equipment quality and manufacturer service. (Carroll-FRC)
W82-03475

NUMERICAL SIMULATION OF RESERVOIRS,

Brown Univ., Providence, RI. Div. of Applied Mathematics.
M. C. Michaud.
PhD Thesis, June, 1980. 124 p, Numerous Illust, 10 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-11146.

Descriptors: *Mathematical models, *Mathematical studies, Algorithms, *Fluid mechanics, *Reservoirs, Flow.

The numerical methods presented have been developed for use in problems of fluid mechanics with flows that display shocks, shear layers or steep fronts. An area of particular interest is multiphase flow of oil, water and often other phases in an oil or natural gas reservoir. These reservoirs are discussed including their properties and some of the particulars of water flooding. Numerical methods for reliable simulation of the fluid motion of oil and water in waterflooding of a reservoir are explained and discussed. A simplified saturation equation is used as a model of two-phase flow in a porous medium. The techniques presented are applicable to the kinds of multiphase flows that are important in other secondary and tertiary recovery methods. The basic algorithm used is the biased difference algorithm. It has been modified to take into account the shape of the fractional flow rate equation. With this simple modification, the midpoint method, the results obtained were good for reasonable ranges of diffusion constants. The midpoint method is a first approximation in an iterative scheme which could be further improved for more precise results. The savings in computation and storage gained by using selective grid refinement versus recomputing the problem on a fine grid will be more pronounced in the three-dimensional case. Selective grid refinement is expected to be applicable in a wide variety of problems with shear layers or steep shocks. (Sinha-OEIS)
W82-03504

INVESTMENT ALTERNATIVES IN CASES OF EXTENDED WATER SUPPLY SHORTAGES IN CITIES OF DEVELOPING COUNTRIES,

Cornell Univ., Ithaca, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6D.
W82-03507

GENERALIZED STORAGE-YIELD RELATIONSHIPS FOR SURFACE WATER RESERVOIRS ON NORTHEASTERN UNITED STATES' WATERSHEDS,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
T. Haktanir.
PhD Thesis, May, 1980. 484 p, 31 Fig, 21 Tab, 66 Ref, 14 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-24450.

Descriptors: *Water supply, *Reservoirs, *Storage reservoirs, *Economic aspects, Model studies, Water Shortage, Watersheds, Urban areas, Economic yield, Water yield, Comparison studies, *Northeastern United States.

Utilizing 500-year-long synthetic data generated from 37-year-long historical data, yield versus storage capacity relationships were determined by a hydrologic model within 95% confidence limits on all the arbitrarily chosen 50 natural streams of various sizes in the study area. This model simulated the operations of an urban water supply reservoir, accounting for streamflows, lake evaporation loss, lake precipitation gain, and loss of storage by sedimentation. Although the statistical model did not account for lake evaporation and precipitation and sedimentation, the results obtained by the statistical formula utilizing the actual 37 years of historical data were observed to be in plausible agreement with those of the hydrologic model at 97.5% probabilities. An economic model, utilizing the empirically derived cost functions for reservoir costs and water shortage costs from the available data in the study area, searched for optimum urban water supply reservoirs by weighing the trade-offs between reservoir costs versus water shortage costs from smaller reservoirs and revealed the quasi-yield versus optimum storage capacity relationships. On the basis of the total costs from the optimum reservoirs at yields between 10 and 100 percent of the average streamflow, a marginal costs analysis showed economically feasible yield levels, which in the study area were found to be between 50 and 70 percent of the average streamflow. (Sinha-OEIS)
W82-03523

MATHEMATICAL MODELING OF EARTH DAM BREACHES,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W82-03532

INVESTIGATING WHETHER A LARGE HYDRO DEVELOPMENT CAN BE ENVIRONMENTALLY COMPATIBLE: THE SLAVE RIVER HYDRO FEASIBILITY STUDY,

Walker (R. L.) and Partners Ltd., Ottawa (Ontario).
B. Grover, and C. Primus.
Canadian Water Resources Journal, Vol 6, No 3, p 47-62, 1981. 2 Fig, 3 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, *Feasibility studies, *Slave River, *Alberta, Electric powerplants, Economic aspects, Dam construction, Project planning, Planning, Reservoirs, Lamprey, Mercury, Water resources development.

This paper discusses the principles used in studying the environmental effects of a possible 2000 megawatts development on the Slave River, Alberta. These principles are: (1) environmental considerations should be included from the beginning of project planning and evaluation, (2) environmental consequences can be positive as well as negative, (3) power projects should be evaluated in a systems context, i.e., alternative sites must be included in the planning process, (4) the scale of a project is no indication of its efficiency or environmental impact, and (5) preconceived constraints should not enter into planning at the initial stages. The provisional findings of a feasibility study indicate that the Slave River development is technically feasible and economically attractive. A single stage development is more economical than two smaller developments. Four possible environmental concerns are leakage of the reservoir through karstic formations, spread of the Arctic lamprey upstream, increases in the naturally high mercury levels of Lake Athabasca, and the most environmentally acceptable location for a transmission system. (Cassar-FRC)
W82-03615

HIGHLIGHTS OF THE ST. MARY'S REDEVELOPMENT PROJECT,

For primary bibliographic entry see Field 8A.
W82-03617

SWMM MODEL AND LEVEL OF DISCRETIZATION,

College of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
N. A. Zaghloul.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1535-1545, 1981. 8 Fig, 8 Ref.

Descriptors: *Runoff, *Hydrographs, Simulation, *Model studies, Design criteria, Planning, Catchments, Computers, Flow, Rainfall, Rainfall-runoff relationships, Storms, *Urban areas, *Flow profiles.

The accepted level of discretization used for flow simulation over an urban area was investigated, and the effect of reducing the number of subcatchments on the accuracy of runoff simulation was studied. Methodology is defined to achieve a representative equivalent catchment from theoretical considerations. Verification of the procedures involved a series of applications on both hypothetical and real areas. The simulation results of the simplified (coarse) discretization are compared with those of the detailed (fine) discretization of the same rainfall storms. The accuracy of the simulation is maintained by careful aggregation of the subcatchment parameters and proper selection of the aggregated hydraulic width. It was concluded that surface runoff hydrographs generated from both the detailed subcatchments and the aggregated equivalent catchment will be similar. The weighted average properties of the detailed sewer system will provide an aggregated equivalent transport system. In the proposed simplified simulation using a single catchment and the Runoff Block, the hydraulic width of the single catchment should be reduced to account for the loss in conduit storage by increasing surface storage. The accuracy of the simulation using the Runoff and Transport Blocks and the simplified procedure using only the Runoff Block is maintained by careful aggregation of the subcatchment parameters and proper selection of aggregated hydraulic width. Conduit routing for small areas proved insignificant. The SWMM simulation using coarse discretization will result in reducing setting up and computer costs. (Baker-FRC)
W82-03673

MODELING THE ECONOMICS OF GROUND WATER MANAGEMENT,

Auslam and Associates, Inc., Sacramento, CA.
For primary bibliographic entry see Field 4B.
W82-03733

6B. Evaluation Process

DESIGNING AN ENERGY-EFFICIENT WASTEWATER TREATMENT PLANT.

For primary bibliographic entry see Field 5D.
W82-03477

OPTIMIZING SALINITY CONTROL STRATEGIES FOR THE UPPER COLORADO RIVER BASIN,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. G. Evans.
PhD Thesis, 1981. 314 p, 37 Fig, 14 Tab, 139 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19700.

Descriptors: *Water quality control, *Cost benefit analysis, Economic aspects, Salinity, Desalination, Agricultural runoff, Nonpoint pollution sources, Resources development, *Colorado River Basin.

Salinity is the most serious water quality problem in the Clorado River Basin. To offset salinity caused by the development of the vast energy supplies and to allow the seven Colorado River Basin states to fully utilize their allocation of Colorado River water, it is necessary to implement cost-effective salinity control programs in the basin. A simple multi-level nonlinear optimization procedure was utilized to formulate the most cost-effective array of salinity control strategies for the Upper Colorado River Basin. The incremental cost-effectiveness methodology qualitatively indicates the location and general type of alternatives to be implemented in a least cost basin-wide salinity control program. The results also qualitatively indicated the anticipated salt load reduction and expected annual coats of each salinity reduction increase for any preselected level of control. Cost-effectiveness functions were developed for each of the major canals and laterals, the aggregate laterals under each canal, and an array of on-farm improvements for each agricultural project area. Similar functions were also developed for point sources such as Paradox Valley, Glenwood-Dotsero Springs and Crystal Geyser. Collection and desalination of agricultural return flows were also considered. Optimal salinity control programs are presented for the individual alternatives, for individual areas or projects, for the states of Colorado and Utah and the Upper Colorado River Basin. (Sinha-OEIS)
W82-03518

THE DIFFUSION OF TECHNOLOGY IN THE NINETEENTH CENTURY AMERICAN CITY: MUNICIPAL WATER SUPPLY INVESTMENTS,

Northwestern Univ., Evanston, IL.
L. D. Anderson.
PhD Thesis, June, 1980. 241 p, 2 Fig, 28 Tab, 237 Ref, 418 Footnotes. University Microfilms International, Ann Arbor, MI; Order No GAX80-26758.

Descriptors: *Municipal water, *Water supply, *Economic aspects, Investment, History, Social aspects, Benefits, Evaluation, Technology, Nineteenth Century, United States, New England.

The degree of economic rationality with which water supply decisions were made, particularly after 1870, are investigated. The technology of water works construction is examined and improvements in technology which reduced the risk of system failure are described. Changes in cities' perceptions of the potential benefits of water works construction are examined. Better health and less fire damage are the major ones, but the attraction of industry, hopes of future prominence, and municipal pride also motivated water works investments. The role of public health organizations in fostering water works construction is described, as is the effect of increasing medical knowledge about disease. The process by which many small towns obtained water works after 1870 can be described as the diffusion of technology. The general characteristics of diffusion models are discussed, and a limited model is treated with data on the diffusion of water works in New England. Finally, the economic rationality of decisions to construct water works is examined. Social benefits are estimated using fire insurance rate differentials as a measure of expected savings from fire damage. Using these benefits and reported cost of construction, the internal rate of return to water works investments is computed. It is demonstrated that the internal rate of return was substantially higher than the cost of capital, and that the long run advantage of water works over wells is quite large. (Sinha-OEIS)
W82-03537

POTENTIAL IMPACT OF IRRIGATION ON WATER RESOURCES IN THE LITTLE WABASH BASIN OF ILLINOIS,

Illinois Univ. at Urbana-Champaign.
For primary bibliographic entry see Field 6D.
W82-03547

REPLACING LARGE WATER METERS: WHY AND HOW,

Rockwell International, Atlanta, GA.
For primary bibliographic entry see Field 5F.
W82-03560

WATER METERING AND CONSERVATION,

Council of Economic Advisors, Washington, DC.
For primary bibliographic entry see Field 3D.
W82-03562

TREATING INFILTRATION AT ITS SOURCE REDUCES CAPITAL COSTS.

For primary bibliographic entry see Field 5D.
W82-03564

CURRENT ASSESSMENT OF PROSPECTS FOR FURTHER HYDRO DEVELOPMENT IN CANADA,

Walker (R. L.) and Partners Ltd., Ottawa (Ontario).
J. H. Diddens.
Canadian Water Resources Journal, Vol 6, No 3, p 63-83, 1981.

Descriptors: *Hydroelectric power, *Environmental effects, *Energy sources, Powerplants, *Cost analysis, Electric powerplants, Electric power costs, Costs, *Canada, Water resources development, Nuclear powerplants, Coal, Economic aspects, Planning, Fuel.

Sites for small hydroelectric plants (1 to 10 MW) in Canada are economically attractive only if certain conditions exist, for example, in an isolated location where fuel costs are high. The cost of investment and transmission is currently $10,000 per KW and varies widely according to site cost of alternative fuels, load factors, operating costs, variability of load, and supply requirements. Since the cost of electricity from large system is $1,000 to $3,000 per KW, new small hydroplants cannot generally compete. However, rehabilitation of old systems and pumped storage arrangements may make hydro projects more attractive. Constraining factors include the reluctance of a large power organization to deal with management of a string of small plants, problems with control and technical questions about price, and high engineering and environmental assessment costs. This paper compares the economic aspects and environmental effects of several types of power generation: oil, coal, gas, nuclear, hydroelectric, and innovative technologies. Major factors in the use of alternative power generation methods are the escalating costs, especially of oil; land destruction and acid emissions connected with coal; large reserves and easy transmission of gas; and public concern over long-term effects of nuclear plants. Hydropower, on the scale of thousands of MW, will continue to be the main focus in the Canadian power industry. As the large sites are developed, attention will turn to low head sites with capacities of hundreds of MW. (Cassar-FRC)
W82-03620

DICKSON DAM, ALBERTA - THE 20 MW POWER FACILITY,

For primary bibliographic entry see Field 8A.
W82-03621

WATER QUALITY: WHAT SHOULD BE DONE TODAY,

National Resources Defense Council, Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W82-03631

UPGRADING TO INCREASE TREATMENT CAPACITY,

Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5F.
W82-03654

ASSESSMENT OF CURRENT AND PROSPECTIVE FOUNDATIONS OF WATER RESOURCES PLANNING,

Nebraska Univ.-Lincoln.
A. H. Chan.
PhD Thesis, May, 1981. 362 p, 26 Fig, 7 Tab, 230 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-24508.

Descriptors: *Water resources development, *Planning, *Economic aspects, Project planning, Cost-benefit analysis, Water supply development, Social aspects, Methodology.

This effort focuses on the philosophic, ideological, and theoretic foundations of water planning. Its intent is to assess the current planning methodology in terms of goal fulfillment. Examination of the current approach uncovers a number of problem areas. First, traditional water planning has been limited to development projects. The process of planning for a project involves locating a suitable site, designing the structure, and evaluating the economic feasibility. The aggregate of these projects constitutes the existing U.S. water resources policy. This approach of planning-by-project suffers from a lack of comprehensiveness, coherence, coordination, and consistency. Secondly, embodied in this approach is a planning methodology which has been benefit-cost analysis as the center piece. Thirdly, benefit-cost analysis focuses exclusively on economic (monetary) values established through the market when evaluating project feasibility. This study demonstrates the inadequacy of the current approach for proper goal achievement. Any competing approach hoping to replace the one presently in use needs to possess certain attributes. They include the ability to generate a definitive statement of social aspirations, to evaluate existing conditions in accordance with established goals, and to accurately account for the system and the process. This study outlines the foundations of a prospective methodology which takes a broad view of planning, incorporating knowledge from a variety of disciplines while taking into consideration various aspects of the society and its culture; it indicates the appropriate stages of an alternative planning process; and provides a framework in an orderly and comprehensible form. (Sinha-OEIS)
W82-03713

THE AGRICULTURAL BENEFITS OF SALINITY CONTROL ON THE RED RIVER OF TEXAS AND OKLAHOMA,

Texas A and M Univ., College Station.
D. H. Laughlin.
PhD Thesis, December, 1980. 292 p, 14 Fig, 38 Tab, 71 Ref, 8 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-08023.

Descriptors: Economic aspects, Cost-benefit analysis, *Economic feasibility, *Agriculture, Irrigation, *Saline water, Chlorides, Computer programs, *Saline water control, Crop production, Texas, Oklahoma, *Red River.

Salinity of the waters from the Red River and its major tributaries has virtually eliminated its use for irrigation of agricultural crops in Texas and Oklahoma. A chloride control project has been proposed whereby the source salt waters will be cap-

tured and diverted to storage facilities. The purpose of this study was to estimate the net direct benefits to agricultural producers attributable to the proposed salinity control project. Further, estimates of project costs, municipal and industrial benefits and benefits from improving the water in Lake Kemp were obtained to complete a benefit-cost analysis. The procedure used to estimate agricultural benefits was to use a FORTRAN program to develop initial tableaus of a recursive linear programming model representing agricultural production in the study area. Alternative scenarios involving profit maximizing behavior on the part of producers, current cropping patterns, and with and without SAR crop yield effects were developed to provide a range of benefit estimates. Benefit-cost analysis indicated that the proposed project was economically feasible under assumptions of all scenarios considered except where current cropping patterns were followed for the entire analysis period. (Sinha-OEIS)
W82-03729

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

METERING PROBLEMS AND METER MANAGEMENT IN TUNISIA (LES PROBLEMES DU COMPTAGE ET LA GESTION DES COMPTEURS EN TUNISIE),

Societe Nationale d'Eploitation et de Distribution des Eaux (Tunisia).
A. Frih, and M. Benaicha.
Aqua, No 3, p 267-270, 1981. 5 Tab, 6 Ref.

Descriptors: *Water metering, *Utilities, *Water rates, Water distribution, Public utility districts, *Tunisia, Monitoring.

Two types of watermeters are in use in Tunisia: the volumetric and the rate of flow. The SONDEDE (Societe Nationale d'Exploitation et de Distribution des Eaux) supplies 385,000 metered customers with a total of 120 million cu meters yearly. Meter management includes checking on all subscribers to acquire statistics and to ensure correct metering and billing, and reducing waste by means of a progressive price structure. Subscribers are notified if unusually high consumption is registered. All those with meters $>$ 30 mm in diameter and who use $>$ 500 cu meters per quarter are monitored for meter overloads or unusually low readings. The 23 heavy users, accounting for 9.2% of consumption, are subjected to more thorough checks with monthly meter reading and state of the meter inspection. Time intervals for maintenance of 5 year minimum and 10 year maximum were determined by sampling in three large towns. (Cassar-FRC)
W82-03456

6D. Water Demand

WATER SUPPLY RELIABILITY THEORY,

Technion - Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03432

INVESTMENT ALTERNATIVES IN CASES OF EXTENDED WATER SUPPLY SHORTAGES IN CITIES OF DEVELOPING COUNTRIES,

Cornell Univ., Ithaca, NY. Dept. of Civil and Environmental Engineering.
B. U. Anyata.
PhD Thesis, August, 1980. 275 p, 49 Fig, 23 Tab, 79 Ref, 3 Append. University Microfilm International, Ann Arbor, MI; Order No GAX81-02898.

Descriptors: *Water supply, *Water supply systems, *Water shortage, *Mathematical models, Water distribution, Cost-benefit analysis, Developing countries, Rationing, Water use limitation.

In developing countries, cities commonly experience severe water shortages as a result of demands created by a rapidly growing population. The growth of the population of urban areas is caused by massive migrations from rural to urban areas and high birth rates. Population increases due to migration alone tend to overwhelm the available water supply resulting in water supply systems that are required to operate under 'deficit' conditions. Rather than operating on an intermittent basis, alternative operating strategies and design procedures to mitigate the adverse effects of water deficits associated with different types of distribution systems are examined and evaluated. Mathematical programming techniques were used to evaluate various design alternatives with pumping costs used as a surrogate for the operating costs of water distribution systems. The rate at which water is supplied to the users is the principal determinant of the cost of the system and the least costly systems are those which have the lowest flow rates. Among the various measures of controlling flow, valving systems appear to be the most cost-effective. (Sinha-OEIS)
W82-03507

THE NILE - ONE RIVER AND NINE COUNTRIES,

High Aswan Dam Authority, Cairo (Egypt).
For primary bibliographic entry see Field 4A.
W82-03545

POTENTIAL IMPACT OF IRRIGATION ON WATER RESOURCES IN THE LITTLE WABASH BASIN OF ILLINOIS,

Illinois Univ. at Urbana-Champaign.
J. W. Eheart, and A. E. Libby.
Water Resources Bulletin, Vol 17, No 5, p 851-856, October, 1981. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Water demand, *Irrigation effects, Economic aspects, Water supply, *Cost-benefit analysis, Water shortage, Water policy, Prices, Corn, *Little Wabash Basin, *Illinois.

An economic analysis of irrigation demands vs. prices of corn (Zea mays L.) in the Little Wabash basin, Illinois, showed that rising corn prices would make irrigation more profitable to the extent that water shortages would occur. At $3.50 per bushel, no irrigation is predicted. Between $3.50 and $6.50 irrigation is likely for a small region supplied with good quality groundwater. Above $6.50-$7.50 irrigation is profitable in the entire basin using impounded water. Possible shortfalls, where potential water demand exceeds supply, are 2-20% for a price of $3.50-$6.50 and about one-third at prices above $7.50. Although there has been little crop irrigation in the basin to date, it would probably follow the general trend of increasing irrigated acreage in Illinois. These findings suggest that the State of Illinois should begin developing policies for controlling withdrawals of natural waters before large capital investments in irrigation equipment are made. (Cassar-FRC)
W82-03547

GROUNDWATER QUALITY IN VISAKHAPATNAM BASIN, INDIA,

Andhra Univ., Waltair (India). Dept. of Geophysics.
V. V. J. Sarma, and A. N. Swamy.
Water, Air, and Soil Pollution, Vol 16, No 3, p 317-329, October, 1981. 6 Fig, 3 Tab, 16 Ref.

Descriptors: *Water quality, *Water use, *Visakhapatnam Basin, *India, Groundwater potential, Domestic water, Drinking water, Industrial water, Irrigation water, Saline water, Water hardness, Chemical composition, Developing countries.

The chemical nature of groundwater in the 148 sq km Visakhapatnam Basin, India, was investigated to determine its suitability for domestic, irrigation, and industrial purposes in this rapidly developing region. Almost half the wells produced water which exceeded the World Health Organization recommended upper limits for chloride, sulfate, fluoride, Mg, Ca, and/or total hardness. In some cases pollution from industrial wastes and sewage caused the high mineral levels; in others, saltbearing formations. Most of the well samples ranged from medium to very high salinity and low to very high Na content. Water quality varied considerably from the good water along the foothills to unsuitable water in the plains. As measured by the residual carbonate factor, 51% of the samples were considered safe for irrigation ($>$ 1.25 meq per liter), 12% were marginal, and 37% were unsuitable ($<$ 2.5 meq per liter). Industrial water quality requirements vary considerably, but most of the water is too hard for use as boiler feed water. (Cassar-FRC)
W82-03552

POLISH WATER MANAGEMENT–STRUCTURE, PROBLEMS AND RESEARCH,

M. Metler.
Effluent and Water Treatment Journal, Vol 21, No 10, p 456-459, October, 1981. 1 Fig, 1 Tab.

Descriptors: *Water management, *Planning, *Poland, Resources management, Water quality, Water treatment, Water requirements, Water use.

While Poland would appear to have adequate water resources, the usable, available resources are considerably less than would be estimated at first glance. Also problematic is the fact that the water is not distributed uniformly, either geographically or seasonally. The non-returnable water consumption for the year 2000 is estimated at 10 billion cubic meters, and it follows that without a significant increase in reservoir capacity, the existing maximum for non-returnable water consumption of 7 billion cubic meters will be exceeded by a substantial margin. The volume of municipal sewage and industrial effluent discharged into Polish rivers continues to increase rapidly, and the present state of treatment is unsatisfactory. Regulations currently in force in Poland divide water quality into three categories according to the intended use. The water quality surveillance system has determined constant deterioration in the quality of water resources during the past 20 years, and it is now considered to have reached an unsatisfactory level. At present the day to day coordination and supervision of water management and environmental protection matters is in the hands of 49 Provincial Presidents and the local authorities for each separate administrative area. This makes the control spread out into too many different hands and leads to confusion and little forward motion. A research program has been undertaken to improve the situation. Specific areas of concern include studies on the influences of pollution on water quality, technological methods of effluent treatment and sludge processing, and criteria and technological solutions leading to the prevention of water pollution. (Baker-FRC)
W82-03633

BAYANIHAN, THE SPIRIT BEHIND THE PHILIPPINE WATER SUPPLY DEPARTMENT SCENE.

For primary bibliographic entry see Field 5F.
W82-03741

DEVELOPMENT OF WATER SUPPLY TO METRO-MANILA.

For primary bibliographic entry see Field 5F.
W82-03742

GLOBAL FUTURE: TIME TO ACT. REPORT TO THE PRESIDENT ON GLOBAL RESOURCES, ENVIRONMENT AND POPULATION.

Council on Environmental Quality, Washington, DC.
For primary bibliographic entry see Field 6E.
W82-03747

6E. Water Law and Institutions

WILL EPA'S NATIONWIDE URBAN RUNOFF STUDY ACHIEVE USEFUL RESULTS,

Colorado State Univ., Fort Collins, Dept. of Civil Engineering.
G. F. Lee, and R. A. Jones.
Civil Engineering (New York), Vol 51, No 9, p 86-87, September, 1981.

Descriptors: *Urban runoff, *Water quality, Runoff, Urban drainage, Storm runoff, Water pollution sources, *Regulations.

About 30 different studies are being conducted in cities across the US in a Nationwide Urban Runoff Program, under the guidance of the EPA. The studies are attempting to determine whether large amounts of money spent in domestic and industrial wastewater treatment will bring about any improvement in receiving water quality due to the high contaminant loads concentrations arising from urban stormwater drainage. The most significant deficiency seen in the current program is the failure of those responsible for developing these studies to properly consider how chemical contaminants cause impairment of beneficial uses of water. Since many chemical contaminants exist in aquatic systems in forms which are not available to affect water quality, the total concentration of a chemical in a water cannot be used as a basis for developing cost-effective, technically valid, environmentally protective programs for its control. The amounts of available forms of chemical contaminants in a water sample cannot in general be determined by direct chemical analysis, but must use bioassay techniques. The fact that bioassays are not required in the National Urban Runoff Program studies is viewed as a serious shortcoming. The water quality standards used for urban stormwater drainage must be directed toward the concentrations of available forms of contaminants rather than the total concentrations, and must allow consideration of the length of time that concentrations of available forms exceed the critical concentrations for any duration of exposure at each site of concern, as well as the impact of those couplings on beneficial uses of the waters in question. Management programs should focus on the control of the sources contributing concentrations of contaminants most likely to directly affect the useable characteristics of the receiving waters. (Baker-FRC)
W82-03424

HOME RULE WETLANDS PROTECTION IN MASSACHUSETTS: LOVEQUIST V. CONSERVATION COMMISSION OF THE TOWN OF DENNIS,

K. W. Brown.
Boston College Environmental Affairs Law Review, Vol 9, No 1, p 103-131, 1980/1981. 150 Ref.

Descriptors: *Wetlands, Home rule, *Legislation, *Water law, Permits, *Judicial decisions, Zoning, *Massachusetts, Lovequist vs. Dennis, Road construction, Legal aspects, Construction, Local governments, Jurisdiction, State governments, Governments.

Although several federal statutes concern wetlands protection, responsibility for such regulation is mainly in the state domain. The Massachusetts Wetlands Protection Act of 1972 (WPA), the Zoning Act, and the state earth removal statute give substantial statutory authority over local wetlands to municipalities. All these laws have drawbacks, and municipalities have turned to enacting wetlands regulations under home rule. The Massachusetts Supreme Judicial Court Decision Lovequist v. Conservation Commission of the Town of Dennis said that state laws did not preempt wetlands regulation from home rule enactments. In this case the plaintiffs wanted to build an access road over a marsh to an adjacent upland. The Town of Dennis denied the permit and was challenged in court. There are several differences between the Dennis by-law and the state statutes. The Dennis by-law required a local permit for wetlands alteration in addition to the one required by the Wetlands Protection Act. If the development would affect erosion, wildlife, recreation, or esthetics (not covered in the WPA), the permit could be denied or conditions imposed on the work. The Lovequist decision illustrates a liberal approach to home rule environmental protection which does not jeopardized a state's authority of legislation. (Cassar-FRC)
W82-03450

WATER QUALITY AND THE EEC,

A. K. Galloway.
Water Services, Vol 84, No 1008, p 108-110, February, 1980. 1 Fig.

Descriptors: *Water quality, *International agreements, Planning, Organizations, Administrative agencies, Water resources institutes, Water management, Water quality management, Water quality standards, Water quality criteria, Water pollution prevention.

Ten EEC directives or decisions relating to water quality have been issued, covering discharge of dangerous substances, surface water intended for abstraction for drinking, bathing water, titanium dioxide wastes, freshwater fisheries, methods of sampling and analysis, and underground water. A proposal for an EEC directive must come from the Commission, but a directive may only be adopted by the Council of Ministers. In order to ensure final unanimity at the Council level a good deal of negotiating and discussing on the form and content of the directive is necessary. At this stage national authorities will consult the interests affected by the proposals and each member state will formulate the line which it will take in the discussions. The method used to identify the waters to which a given directive will apply is not always the same for each directive. In some cases the choice of waters affected by the directive is up to the individual member states. If a directive requires that certain conditions be met, for example in the quality of bathing water along the beaches, and the particular countries involved cannot meet the deadline established, there are provisions for obtaining extensions. (Baker-FRC)
W82-03472

THE EVOLUTION OF WATER QUALITY MANAGEMENT,

R. D. Hennigan.
Clearwaters, Vol 10, No 1, p 11-12, March, 1980. 4 Ref.

Descriptors: Planning, *Water quality management, Water quality, *Water pollution control, Decision making, Administration, *Regulations.

In 1977 changes were made in the Federal Water Pollution Control Act. The pollutant classification system was changed, with different deadlines and treatment requirements for each class. Construction grants for alternative and innovative technology for municipal waste treatment were increased. Increased control was imposed on sludge disposal. The states were given power to administer the construction grants and permit programs. The needs of rural counties were reemphasized. Farming and forestry activities were exempted from pollutant discharge control. Monies for institution of best management practices (BMP) on farmland were approved. Grant moves for sewer systems were limited. While considerable improvements have been noted in water quality in various areas, some areas lag behind in percentage compliance with the old deadlines of the 1972 Act. Toxic wastes were a major issue, including heavy metals, pesticides, PCBs, and other organic compounds. Advanced wastewater treatment came under fire as unduly expensive and unnecessary. Programming for the long haul is becoming more and more accepted as quick solutions to the water problem continue to fail and unreasonable expectations are ended. An all encompassing statute covering all environmental control will be proposed at some point in an attempt to bring a holistic perspective and integrated program administration to environmental affairs. (Baker-FRC)
W82-03476

COSTEL V. PACIFIC LEGAL FOUNDATION, 100 S. CT. 1095 (1980),

N. Hungerford.
Environmental Law, Vol 11, No 2, p 449-459, Winter, 1981. 67 Ref.

Descriptors: *Permits, *Legal aspects, Industrial wastes, Effluents, Decision making, *Water quality control, Water pollution sources, Legal aspects, Environmental control.

This case provided a look at the Supreme Court's view of the administrative processes by which environmental decisions are made. The narrow issue addressed in the case was whether the Environmental Protection Agency must hold a public hearing prior to extension of a permit issued pursuant to the National Pollutant Discharge Elimination System (NPDES) if it received no requests for such a hearing. The Supreme Court held that no public hearing was necessary. The implication from this decision, that the Court will narrowly construe statutory and regulatory language regarding public participation in administrative decision making including environmental decisions, is unmistakable and far reaching. The uneasy balance between public participation and agency ability to exclude the public is thus illuminated. When the Pacific Legal Foundation was begun, EPA's regulation implementing the FWPCA provided for public notice of a proposed issuance, denial, or modification of a permit. Those regulations then directed the EPA administrator to hold a public hearing on a proposed action if he found a significant degree of public interest. The regulations also allowed any interested person to request an adjudicatory hearing after EPA's decision had been made regarding a proposed action. A hearing request would be granted if it raised material issues of fact relevant to the questions of whether a permit should be issued, denied, or modified. In 1977 the expiration date of the permit issued for pollutants discharged from the giant Hyperion Wastewater Treatment Plant was extended without a hearing. A postdetermination request for an adjudicatory hearing was denied. Two petitions were filed challenging the EPA Administrator's action extending the section of the permit. The court of appeals upheld the petitions, but the decision was reversed in the Supreme Court. (Baker-FRC)
W82-03495

ECONOMICAL USE OF WATER RESOURCES.

Civil Engineer in South Africa, Vol 23, No 2, p 31, February, 1981.

Descriptors: *Water management, *Political constraints, *International agreements, South Africa, Water resources development, Utilities.

An international approach to water resources development and distribution is necessary for efficient management of water among the South African nations. Although interbasin transfers and other cooperative efforts are in practice in this region, these will become more difficult under proposed reorganization into a constellation of states unless an international nonpolitical water utility is established. The existing Rand Water Board is regional and severely constrained. (Cassar-FRC)
W82-03496

GROUNDWATER ALLOCATION MECHANISMS: THE CASE OF WESTERN KANSAS,

Kansas Univ., Kansas City. Dept. of Economics.
For primary bibliographic entry see Field 4B.
W82-03503

URBAN WATER SYSTEMS: PROBLEMS AND ALTERNATIVE APPROACHES TO SOLUTIONS,

Army Corps of Engineers, Belvoir, VA.
For primary bibliographic entry see Field 5F.
W82-03580

HOW DO YOU BUILD WHEN SEWERS ARE INADEQUATE,

Browne (Richard) Associates, Wayne, NJ.
For primary bibliographic entry see Field 5D.
W82-03592

ENVIRONMENTAL REGULATION AND CONSTRAINTS UPON SMALL HYDRO DEVELOPMENT IN CALIFORNIA, U.S.A.,

Tudor Engineering Co., San Francisco, CA.
D. S. Graham.
Canadian Water Resources Journal, Vol 6, No 3, p 295-302, 1981. 1 Ref.

Descriptors: *Environmental effects, *Regulations, *Hydroelectric plants, *California, Water rights, Water policy, Water resources development, Stratification, Reservoir, Fish, Dams.

Small hydroelectric development in California is described, with emphasis on environmental concerns and regulations. Such development is encouraged by the government, which has reduced red tape, provided loans, and screened potential sites. However, the problem of water rights is a constraint, especially in the West. In California a developer must follow both federal and state procedures with respect to environmental impact statements. These overlap considerably, so the same information can often be used for both requirements. Particular concerns in California are raptors, archeological sites, and recreation areas. Some other examples of environmental effects of small hydro development are: withdrawal of anoxic hypolimetric water through the turbine and downstream, reservoir stratification and temperature rise, disturbance to aquatic life, fish mortality in turbines, prevention of upstream migration, change of conditions in estuarine nurseries, water level fluctuations, and sediment problems, such as scouring and erosion. (Cassar-FRC)
W82-03614

HYDROELECTRIC POWER DEVELOPMENT CONFLICTS AND APPROVALS: THE ONTARIO SCENE,

Ontario Ministry of Natural Resources, Toronto.
For primary bibliographic entry see Field 6G.
W82-03616

DEVELOPMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY VOL III: STEEL MAKING SUBCATEGORY, VACUUM DEGASSING SUBCATEGORY, CONTINUOUS CASTING SUBCATEGORY CONTINUOUS CASTING SUBCATEGORY,

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5D.
W82-03626

DEVELOPMENT DOCUMENT FOR PROPOSED EFFLUENT LIMITATIONS GUIDELINES, NEW SOURCE PERFORMANCE STANDARDS, AND PRETREATMENT STANDARDS FOR THE IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY, VOL VI: COLD FORMING SUBCATEGORY, HOT COATING SUBCATEGORY,

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5D.
W82-03629

WATER QUALITY: WHAT SHOULD BE DONE TODAY,

National Resources Defense Council, Inc., Washington, DC.
J. T. Banks, F. Dubrowski, and J. M. Warren.
February 12, 1981. 90 p, 5 Tab.

Descriptors: *Legislation, *Groundwater pollution, *Non-point pollution sources, *Toxins, Hazardous materials, Federal jurisdiction, Public policy, Public participation, Political aspects, Cost-benefit analysis, Pollution load, Groundwater management.

The National Resources Defense Council (NRDC) sees some water quality cocerns as not only critical but near-term because they arise in the context of existing legislation and agency programs, and are on the agenda for the next year or two. The major issues stressed by the NRDS, in terms of the effectiveness of existing legislation and enforcement programs, are toxic industrial discharges, non-point sources, and groundwater protection. Those who seek ways to improve the Clean Water Act during the process of Congressional reauthorization in 1981 need a high level of sophistication to address complex questions of cost-effectiveness vs. cost-benefit, rule-setting policies of the U.S. Environmental Protection Agency, federal-state jurisdictional questions and related issues of shifting economic and administrative burdens on various levels of government, and the technology-based controls needed for second-generation toxics control. Non-point source discharges have received scant attention from Congress, and legislation is needed that incorporates an adequate data base, a public constituency, and sound policy analysis. EPA's proposed groundwater protection strategy raises several major issues, such as whether the principle of non-degradation of existing groundwater quality should be adopted, at least with respect to currently pristine and drinking water quality aquifers. Another issue is the lack of available information regarding the characteristics of groundwater and the relationships between aquifers, which is necessary before any classifications can be made. Meanwhile, a coordinated program of interim measures to reduce further contamination is urgently needed. (Garrison-Omniplan)
W82-03631

CLEAN WATER ACT.

Natural Resources Lawyer, Vol 14, No 2, p 261-303, 1981. 320 Ref.

Descriptors: *Water quality, *Legal aspects, *Federal jurisdiction, Reviews, Legislation, Standards, Jurisdiction, Permits, Regulations, Clean Water Act.

Developments in the field of water quality control are reviewed for the period of 1980. The review is divided into three parts: judicial and administrative developments under the Clean Water Act (CWA), judicial administrative and legislative developments under the Safe Drinking Water Act, and judicial developments in the area of private rights of action and the federal common law of nuisance. Under the CWA, judicial activity was highlighted by four unanimous Supreme Court reversals of lower court decisions which had disagreed with the EPA's interpretation of the act. A direct challenge to industrial effluent limitations guidelines was made for the seafood processing industry. The EPA's fundamentally different factors variance clause for best practicable technology (BPT) has proven to be a source of litigation. The dissolved oxygen concentration level needed to support the fishable-swimmable use classification in Mississippi waters was also problematic. Additional activity revolved around the antidegradation policy as part of the states' water quality standards and management plans, new source performance standards, discharges of oil and hazardous substances, the hearing requirements of the NPDES permit program, the dredge and fill permit program, definition of point source, Ohio water quality standards, water quality criteria, toxic pollutant listings, enforcement, and ocean discharge criteria. (Baker-FRC)
W82-03687

CLEAN WATER ACT.

Natural Resources Lawyer, Vol 13, No 1, p 231-286, 1980. 397 Ref.

Descriptors: *Legal aspects, *Water quality standards, *Regulations, Permits, Legislation, Water pollution control, Clean Water Act, Safe Drinking Water Act, Water law, Water policy.

A review of legal aspects of water quality focuses on judicial and administrative developments concerned with the Clean Water Act, the Safe Drinking Water Act, and judicial developments in two areas: definition of navigable waters and availability of relief under the federal common law of nuisance. No substantive changes to major federal statutes took place during 1979. Circuit court decisions regarding the Clean Water Act's effluent guidelines and standards showed deference to EPA technical judgements in areas of scientific uncertainity, but contained disagreements with EPA over the need to consider economic benefits and limitations. In 1979 two cases in Oregon illustrated that EPA is making efforts to enforce the Safe Drinking Water Act against small private suppliers of drinking water. Litigation aimed at defining the term 'navigable waters' as used in the Clean Water Act is generally decreasing. The courts continue to use the broadest possible definitions. (Cassar-FRC)
W82-03688

NEW LEGISLATION IN CALIFORNIA AND ITS EFFECTS,

A. Littleworth.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 46-52.

Descriptors: *Legislation, *Water law, *Groundwater management, Judicial decisions, State jurisdiction, Adjudication procedure, Groundwater availability, Groundwater depletion, Groundwater storage, Permits, Prescriptive rights, Overlying proprietor, Appropriation, Pumpage, *California.

Californians are pumping groundwater faster that it can be replenished by natural or artificial recharge. In some areas the overdraft is nearly 20 percent of the total groundwater supply. Currently, California has no statutory provisions to prevent or correct overdrafts. In 1977, the Commission to Review California Water Rights Law was formed and made recommendations in three general areas of groundwater law: establishment of groundwater authority; simplified judicial procedures for basin adjudications; and groundwater authority; simplified judicial procedures for basin adjudications; and groundwater storage management. The recommendations for underground storage were generally accepted; however, the other two recommendations were seen as rationing proposals and were opposed. Various bills were introduced to codify the Commission's proposals but, with few exceptions, all of them failed. SB 95, introduced in 1981, illustrates what happened to a relatively modest proposal with essentially non-controversial reforms. It was opposed by local farming groups who feared state and judicial interference with unnecessary limitations and adjudications. The final version only provided for hazardous waste facilities after all groundwater provisions were amended out. As a result, groundwater law continues to be essentially controlled by the courts or regulated by agreements among contracting parties. The fate of SB 200 will also affect California's future. If it fails, there will be much higher energy costs for increased pump lifts and the competition for insufficient water supply will be greatly intensified. If it passes, groundwater storage will be an integral part of any development program, and could form the nucleus for more comprehensive water management. (Atkins-Omniplan)
W82-03731

SB 1391--TOWARDS A PERMIT SYSTEM FOR GROUND WATER. TOWARDS A NEW DEFINITION OF OWNERSHIP OF GROUND WATER,

G. G. Fry.
In: Proceedings of the Thirteenth Biennial Conference on Ground Water, Irvine, September 14-15, 1981. California Water Resources Center, University of California, Davis, Report No 53, November, 1981. p 12-32. 1 Append.

Descriptors: *Groundwater management, Groundwater, Water districts, *Pumpage, *Water permits, Water supply, *Water law, Legislation, Equitable apportionment, Groundwater basins, Groundwater availability, Overdraft, Aquifers, *California.

The Sierra Valley Groundwater Basin Act--SB 1391--came into being as a result of local fears that both the Sierra and Long Valleys in the Sierra Nevada mountains were being overdrafted. Excluding SB 1391, there are three broad groups to control overdraft: replenishment programs, where water is spread over the ground to artificially recharge the aquifers; in lieu programs, which pay pumpers to use an alternate to groundwater; and pump taxes, which discourage pumping. However, no authority exists that permits a district to require

pumpers to pump less. SB 1391 is unique in that it grants the management districts the authority to limit pumping and the authority to ban export under limited circumstances. During an overdraft or a time of severe water quality problems, the district can implement a permit system for groundwater management. The permit can only be instituted during a time of threatened or actual overdraft and can only be exercised by a board of directors comprised of area residents. This act also attempts to clarify the definition of overlying rights. To provide some predictability to the rights of an overlying user, the extent of ownership was redefined. It is now based primarily on the number of acres overlying the basin that a user owns, in proportion to the total number of acres overlying the basin; a figure that can be adjusted for several factors. A plan such as this has never been set forth in California before and one benefit may be to make it easier to sell groundwater between private parties. This bill is innovative and it will be some time before a discernable track record is established. The appendix contains the text of the bill. (Atkins-Omniplan)
W82-03736

THE FIFTH AMENDMENT PRIVILEGE AGAINST SELF-INCRIMINATION AND COMPULSORY SELF-DISCLOSURE UNDER THE CLEAN AIR AND CLEAN WATER ACTS,
O. A. Caginalp.
Boston College Environmental Affairs Law Review, Vol 9, No 2, p 359-395, 1981. 244 Ref.

Descriptors: *Legal aspects, *Water pollution control, Legislation, Regulations, Self-incrimination, Federal juridiction.

Portions of the Clean Water and Clear Air Acts require that much information regarding the pollution come as a result of self-disclosure by those doing the pollution. In both of these Acts there are statements that the information gained through self-disclosure may then be used against the alleged polluter by the government in order to identify violators and exact penalties. Questions are thus raised with respect to the applicability of the Fifth Amendment provisions concerning self-incrimination. This article describes the section of the Clean Water Act dealing with oil and hazardous substance discharges; discusses the specific case of United States v. Ward, emphasizing the factors examined by the Supreme Court in its determination of the character of the penalty provision of section 311(b); and offers a comparison of the Clean Water Act effluent limitation sections. Since the Fifth Amendment protects any one who offers evidence against prosecution only on criminal charges and not on civil charges, great significance is attached to determining whether a penalty for polluting is judged to be criminal or civil in nature. In US v. Ward, the Court first acted to determine whether Congress indicated an intention to establish a civil or a criminal penalty, and second, where Congress has indicated a civil penalty, whether the sanction was so puritive as to negate that intention. It is felt that the Ward reasoning should not be limited solely to environmental legislation, but will probably be adopted in other areas as well. (Baker-FRC)
W82-03746

GLOBAL FUTURE: TIME TO ACT. REPORT TO THE PRESIDENT ON GLOBAL RESOURCES, ENVIRONMENT AND POPULATION,
Council on Environmental Quality, Washington, DC.
Boston College Environmental Affairs Law Review, Vol 9, No 2, p 261-283, 1981.

Descriptors: *Water supply, *Resources management, *International agreements, International commissions, Organization, Administrative decisions, Administrative agencies, Policy making, Decision making, Legislation.

Demands on the world's water supply will increase steadily over the next twenty years. Especially in the Third World, severe water shortages and drought are already being felt, along with waterborne diseases. Reliable water supplies will be increasingly disrupted due to damage to watersheds, and contamination will probably increase. US development assistance efforts will be undercut, and the need for drought relief will increase. With 148 of the world's major river basins shared by two or more countries, increased conflict over water rights and usage should be expected. One major US goal is to heighten awareness of water management issues. This goal requires the development of an adequate worldwide data base, not currently available, and subsequently a coherent strategy on world water needs by region. The US contribution to solving world water problems should make use of its strengths in data collection and monitoring, pollution control, environmental assessment of water resource development projects, nonstructural alternatives to such projects, and water conservation. Bilateral technical assistance in water resource management by the US should be increased, including financial support of the United Nations for training in water management. Research efforts, international agreements, and conflict resolution arrangements should be forthcoming if the problems in water supply and demand are to be resolved. (Baker-FRC)
W82-03747

6F. Nonstructural Alternatives

BEHAVIOURAL AND POLITICAL ASPECTS OF WATER DEVELOPMENT AND IRRIGATION PROJECTS,
International Fund for Agricultural Development, Rome (Italy).
A. A. El-Sherbini.
Water Supply and Management, Vol 5, No 4/5, p 307-316, 1981. 15 Ref.

Descriptors: *Water resources development, *Planning, Social impact, Social aspects, *Political aspects, Social values, Decision making, Design criteria, Behavior, Attitudes, *Irrigation programs, Motivation.

Investment in water development and irrigation projects commands a key role in the plans of most developing countries. In many cases the emphasis has largely centered on the engineering and economic aspects of such projects. Serious neglect has occurred in the areas of behavioral and political outcomes. The continuous failure to take notice of the numerous and very real links between the socio-political structures and project behavior is an indication of a grave omission in an area crucial to project performance and success. Technical change in many cases can come about only if it is accompanied by socio-cultural transformations. Planners and policy makers frequently commit themselves to technical innovations without giving enough thought to the extent to which this commitment entrains additional changes in behavior. Behavioral and political scientists should be involved in the various phases of water projects from the identification of the problem to the implementation of the solution. The monitoring and evaluation of water development and irrigation projects should also pay special attention to these behavioral and political aspects so that problems of these natures can be rapidly detected and timely solutions found. (Baker-FRC)
W82-03579

FLOOD AREA MODELLING FROM AN ELEMENTARY DATA BASE,
Leeds Univ. (England). School of Geography.
For primary bibliographic entry see Field 2E.
W82-03581

SWMM MODEL AND LEVEL OF DISCRETIZATION,
College of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-03673

COMMENTS ON A NATIONAL GROUNDWATER PROTECTION STRATEGY,
D. H. Howells.
Ground Water, Vol 19, No 5, p 466-468, September/October, 1981.

Descriptors: *Groundwater management, *Federal jurisdiction, Governmental interrelations, Political aspects, Water management, Legal aspects, Regulations, Standards, Resources, *Water quality control.

Exception is taken to the proposed EPA groundwater protection strategy, especially the goals of the program and the adoption of classification as the principal means of implementing a groundwater protection strategy. Planning is essential, but there is no adequate way to predict the needs of the distant future. Plans must therefore be flexible and adaptable, and their consequences must not be irreversible. Decisions affecting groundwater quality are not so readily reversible as those for surface waters. Classification of water for a specific use does not assure the specified water quality. While classification of surface waters for multiple uses is conceptually sound, it becomes less so with the adoption of such goals as fishing and swimming for all the waters in the nation. The time required for upgrading groundwater sources is too long to be considered achievable. Groundwater systems are vastly more complex than surface water systems. A reasonable strategy should include delineation of important recharge areas and the prohibition of any hazardous waste activities that might threaten the quality of related aquifers. There are also institutional aspects of implementing a national groundwater protection strategy which may prove difficult. (Baker-FRC)
W82-03740

6G. Ecologic Impact Of Water Development

STRANGLEHOLD ON THE SKAGIT,
J. W. Miller.
National Parks, Vol 54, No 4, p 16-19, April, 1980. 2 Fig.

Descriptors: *Electric power industry, *Environmental effects, Dams, *Skagit River, Forecasting, Wildlife habitats, Recreation, Rivers, National parks, *Seattle, Washington, Water policy, Legal aspects.

Proposed power development by the City of Seattle on the Skagit River and its tributaries in Washington and British Columbia threaten wildlife habitats and recreation in this scenic glacial river valley, which lies between two sections of the North Cascades National Park. Several dams were built in the valley, starting early in the century when the public was not concerned with conservation. Present plans include raising the height of the Ross Dam an additional 122.5 feet, the Thunder Creek diversion project, and a dam at Copper Creek. These projects would flood miles of river valley, destroy whitewater streams used for commercial raft trips, divert Thunder Creek into a tunnel, eliminate scenic trails, and adversely affect a variety of flora and fauna, particularly the harlequin duck, bald eagle, salmon, steelhead, river otter, a grove of giant western red cedar trees, a disjunct population of the red rhododendron, and the most northwestern stand of giant ponderosa pine on the continent. A legal decision was expected in mid-1980. (Cassar-FRC)
W82-03490

ENVIRONMENTAL REGULATION AND CONSTRAINTS UPON SMALL HYDRO DEVELOPMENT IN CALIFORNIA, U.S.A.,
Tudor Engineering Co., San Francisco, CA.
For primary bibliographic entry see Field 6E.
W82-03614

INVESTIGATING WHETHER A LARGE HYDRO DEVELOPMENT CAN BE ENVIRONMENTALLY COMPATIBLE: THE SLAVE RIVER HYDRO FEASIBILITY STUDY,
Walker (K. L.) and Partners Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 6A.
W82-03615

HYDROELECTRIC POWER DEVELOPMENT CONFLICTS AND APPROVALS: THE ONTARIO SCENE,
Ontario Ministry of Natural Resources, Toronto.
L. H. Eckel.
Canadian Water Resources Journal, Vol 6, No 3, p 303-308, 1981.

Descriptors: *Environmental effects, *Institutional constraints, *Hydroelectric power, Electric power production, Dams, Energy sources, Ontario Environmental Assessment Act, Water resources development, Legal aspects, Water policy, Water law, Parks, Permits, *Ontario.

The Ontario Environmental Assessment Act will play a major role in resolving conflicts between increased demand for hydroelectric power production and the environment. The provincial government has called for an additional 2,000 megawatts of hydropower by 1995. Sixteen plants are under consideration, some new and some retrofitted. Ontario Hydro, municipalities, and private projects as included by Order of Cabinet must obtain a water power lease. Environmental impacts will be considered with technology and money by a three-member assessment board. A proper balance between unchecked development and turning every river into a provincial park will be reached. (Cassar-FRC)
W82-03616

PEACE RIVER SITE C PROJECT: ENVIRONMENTAL STUDIES; DEVELOPMENT OF A MITIGATION AND COMPENSATION PROGRAM; AND PROJECT LICENSING,
J. Waite, and H. Gruber.
Canadian Water Resources Journal, Vol 6, No 3, p 20-37, 1981. 4 Tab, 6 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, *Social impact, *Peace River, *British Columbia, Cost-benefit analysis, Compensation, Recreation, Agriculture, Planning, Wildlife, Forests, Economic impact, Water resources development, Licensing, Canada.

Possible environmental and socioeconomic effects of the proposed Peace River Site C hydroelectric project in British Columbia are: removal of 12% of agricultural land, loss of residences or outbuildings by over 60 families, change from river-based recreation to reservoir-based activity, significant losses of wildlife on the local scale, increase in most fish populations (except rainbow trout), disturbance of many of the 310 known historical sites, insignificant losses of saleable timber, and increase in social problems at Fort St. John. Principles for mitigation of and compensation for project impacts are presented. These are: (1) payments must bear a reasonable relationship to the value of the resources affected, (2) mitigation expenditures will be made if benefits exceed the costs, (3) compensation payments would be made only if local regions would suffer disproportionately to the rest of the province, (4) funding will be made to the agencies directly responsible for the resources affected, (5) funds for community service impact will be based on social costs imposed by development. An Energy Project Review Process has been established to coordinate a review of environmental and technical aspects. (Cassar-FRC)
W82-03618

THREE CASE STUDIES OF SMALL SCALE HYDRO IN NEWFOUNDLAND AND LABRADOR,
Newfoundland and Labrador Hydro, St. John's.
B. W. Bursey.
Canadian Water Resources Journal, Vol 6, No 3, p 163-177, 1981. 1 Fig 3 Tab, 9 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, Water resources development, *Newfoundland, *Labrador, Canada, Environmental Assessment Act, Fisheries, Recreation, Forests, Salmon, Wildlife, Water resources development, Case studies.

Case studies of three small scale hydroelectric plants in Newfoundland and Labrador are presented, with emphasis on environmental concerns. These plants are designed to replace oil-based generators in areas remote from accessible fuel supplies. The Roddickton Project in Newfoundland incorporated water quality sampling, a survey to determine possible effects on Atlantic salmon upstream migration, use of untreated wood to protect a downstream municipal water supply, and stream flow regulation to protect fish habitats. At the Pinware River plant in Labrador $800,000 was spent over three years to study possible impacts on fisheries, wildlife, archeological sites, forests, a provincial recreational park, and socioeconomic aspects. The probable costs of mitigating these impacts caused indefinite postponement of this project. The Dry Pond Brook project was expected to have major impacts on fisheries and wildlife and minor impacts on recreation, historic resources, aggregate resources, and socioeconomics. Three conclusions were drawn, based on the experiences gained from these studies. Small-scale hydro projects have all the elements of larger scale projects with respect to environmental concerns. Impacts are site specific. Costs of environmental surveys are proportionately larger than in large scale projects. (Cassar-FRC)
W82-03619

CURRENT ASSESSMENT OF PROSPECTS FOR FURTHER HYDRO DEVELOPMENT IN CANADA,
Walker (R. L.) and Partners Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 6B.
W82-03620

7. RESOURCES DATA

7A. Network Design

RAINFALL INTERSTATION CORRELATION FUNCTIONS. II. APPLICATION TO THREE STORM MODELS WITH THE PERCENTAGE OF DRY DAYS AS A NEW PARAMETER,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
For primary bibliographic entry see Field 2B.
W82-03422

ON HYDROLOGICAL DATA NEEDS IN CANADA,
British Columbia Univ., Vancouver.
M. Church, and M. Kellerhals.
Canadian Water Resources Journal, Vol 6, No 2, p 109-132, 1980. 4 Fig, 1 Tab, 31 Ref.

Descriptors: *Hydrological data collections, *Water management, Decision making, Planning, *Canada.

Concern is expressed that the data available for making decisions regarding management of Canadian water resources is not sufficient for the need. The range of information readily available in the national hydrological data base should be developed considerably. Conventional records of levels, flows, and water quality should be extended both geographically and temporally. How this is to be achieved offers considerable thought. Three substantial innovations are offered. First, analyses of hydrological data should be considerably extended and convenient means should be developed for presenting the results. Second, field procedures should be substantially modified to permit more efficient collection of data of several types, and to take advantage of technical advances in measurement. Third, the types of data collected should be expanded to include information on ice regime, river morphology and biophysical processes. Two direct benefits would accrue from these changes. First, a range of hydrobiological analyses would become available in standard form. Second, the assembly of data on river morphology and history and on biophysical processes would permit better decisions to be made about complex aspects of river management that are not eaily reducible to terms involving only actual or desirable flow magnitudes. (Baker-FRC)
W32-03443

7B. Data Acquisition

SEASONAL VARIATION IN HETEROTROPHIC ACTIVITY AND POPULATION DENSITY OF PLANKTONIC BACTERIA IN A CLEAN RIVER,
Hull Univ. (England). Dept. of Plant Pathology.
R. Goulder.
Journal of Ecology, Vol 68, No 2, p 349-363, July, 1980. 7 Fig, 2 Tab, 36 Ref.

Descriptors: *Bacteria, *Seasonal variation, *Population density, Rivers, *Hull River, *England, *Heterotrophic bacteria, Allochtonous bacteria, Plankton.

Heterotrophic activity (as indicated by glucose mineralization), density of total bacteria, mean activity of individual bacteria, and density of viable bacteria were measured in the unpolluted River Hull, England, at 2-week intervals from January 1975 to December 1976. Heterotrophic activity was highest in summer. This can be explained by the high density of total bacteria and by high activity of individual bacteria. Low heterotrophic activity in winter was a result of low density and low activity of individual bacteria. Densities of total bacteria, obtained by direct counting, were 0.34-2.91 million per ml at Wansfor Bridge (fast-flowing water) and 0.32-4.38 million per ml at Bethell's Bridge (slowly-flowing water) and were roughly coincident with the heterotrophic activity values. A combination of high temperature and low river discharge produced the high densities of total bacteria found in summer, and high temperatures produced the high summer activity of individual bacteria. Since density of total bacteria and discharge or rainfall were not positively correlated, allochthonous bacteria were not important. The density of viable bacteria was very variable and showed no seasonal pattern. (Cassar-FRC)
W82-03405

INADEQUACIES IN THE TECHNIQUE OF RESISTIVITY METHOD FOR LOCATION OF WATERWELL SITES IN HARD ROCK AREAS,
Center for Water Resources, Madras (India).
P. N. Ballukraya, R. Sakthivadivel, and R. Baratan.

Descriptors: *Resistivity, *Exploration, *Groundwater availability, *India, Electrical studies, Water yield, Well yield, Wells, Rock testing, Water resources development, Drilling, Geohydrology, Granite, Gneiss.

The electrical resistivity method for locating groundwater has been inadequate in the hard rock region of south India. Water in this granite and gneiss bedrock is in two types of zones: decomposed rock and joints and fractures. Vertical sounding curves obtained at 17 sites near Bangalore, India, were matched against theoretical model curves and analyzed by the inverse slope method. The results did not agree well with actual driller's logs. There were no satisfactory correlations between the resistivity values and water yield. Thickness of overburden was usually underestimated by the resistivity measurements. (Cassar-FRC)
W82-03412

ENVIRONMENTAL ISOTOPES AS A TOOL IN HYDROGEOLOGICAL RESEARCH IN AN ARID BASIN,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). In for Desert Research.
For primary bibliographic entry see Field 2F.
W82-03415

A PORTABLE APPARATUS FOR THE MEASUREMENT OF RATE OF FLOW BY THE LITHIUM-TRACER METHOD,
Yorkshire Water Authority (England).
T. T. Rimmer.
Water Pollution Control, Vol 80, No 3, p 411-412, 1981. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Measuring instruments, *Flow measurement, *Tracers, Flow, Flow rates, Lithium, Rivers, Water treatment facilities.

An apparatus is described that was designed to contain and supply a predetermined, constant flow of lithium chloride solution. This apparatus is completely portable, needing no outside power source. The lithium chloride solution is contained within a 25 liter plastic aspirator which is pressurized by a foot-operated air pump. The outlet at the base is connected to an automated flow-control device which gives a constant pressure at the outlet. The discharge of solution is controlled and monitored by means of a rotameter. The Flostat is designed to work at low pressures of 50-150 mm Hg, but the discharge is difficult to monitor if the pressure exceeds this level. The scale on the gapmeter is calibrated from 50 to 800 ml/min of water at 20 degrees C. The flow rate must be measured accurately on site on each occasion to ensure that errors due to solution viscosity/temperature are not introduced. A practical example is given of this apparatus, used to check the flow recorded at a sewage treatment plant. (Baker-FRC)
W82-03428

AN EVALUATION OF THE SEDIGRAPH AS A STANDARD METHOD OF SEDIMENT PARTICLE SIZE ANALYSIS,

Hydrological Research Inst. Pretoria (South Africa).
A. V. B. Weaver, and D. C. Grobler.
Water SA, Vol 7, No 2, p 79-87, April, 1981. 7 Fig, 5 Tab, 19 Ref.

Descriptors: *Particle size, *Sediments, *Measuring instruments, Sedimentology, Performance evaluation, Reproducibility, Hydrology.

Various tests were performed to evaluate the applicability of the sedigraph as a standard instrument for particle size distribution analysis. The effects of varying concentrations, and the effects of cell size, reproducibility and accuracy were investigated. Using the sedigraph reduced measurement time considerably, and it gave results with good repetition. Also, it produced results in close agreement with standard samples. There were discrepancies in the results obtained with the sedigraph, pipette, hydrometer, and sedimentation balance methods, but microscopic analysis of the samples tended to support the results obtained with the sedigraph. The sedigraph is suggested as the standard tool for the measurement of sediment particle size distribution. Sediment particle size is an extremely important measurement in many areas of hydrological research. (Small-FRC)
W82-03437

PARTICLE COUNTER FOR SEDIMENT TRANSPORT STUDIES,

Washington Univ., Seattle. Dept. of Oceanography.
J. P. Downing, Jr.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1455-1465, November, 1981. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Measuring instruments, *Sediment transport, Bottom sediments, Sand, Acoustics, Electrochemistry, Particle size, Particle shape, Particle counters, *Bed load.

This paper reports the development of an acoustic instrument that measures bed load transport by responding to the direct impacts of sand-sized sediment particles entrained in the bed load layer. The instrument consists of an electromechanical transducer for the detection of particle impacts and an electronic circuit that shapes the transient signals produced by impacts into digital pulses and counts them. The transducer is rugged and physically small, and preliminary field evaluations indicate that the instrument is potentially useful for measuring bed load transport rates in natural flows. By virtue of the principle of particle detection, spurious response of the sensor to silt, clay, biological material, and air bubbles is negligible. The instrument may have application to the problem of local bed load measurement in natural transport systems. Due to the difficulties resulting from the dependence of the instrument output on grain momentum, the best results will be obtained in natural systems with well sorted bed material in the size range from .00975 to .078 inches, with grain velocities exceeding 0.60 meters/second and high transport rates. Other applications include laboratory studies of sediment transport in pipes and flumes and investigations of wind blown sand. The output of the instrument can be transmitted in digital form with only minor modifications to the electronics. In this way, the count-rate values would be recorded directly and more efficient processing of laboratory and field data would be possible. (Baker-FRC)
W82-03666

USE OF VISIBLE AND THERMAL SATELLITE DATA TO MONITOR AN INTERMITTENTLY FLOODING MARSHLAND,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research.
G. F. Byrne, K. Dabrowska-Zielinska, and G. N. Goddrick.
Remote Sensing of Environment, Vol 11, No 5, p 393-399, November, 1981. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Marshes, *Remote sensing, Monitoring, *Satellite technology, *Australia, Flood control, Water level, Flood profiles, Soil water, Soil-water-plant relationships.

Selected thermal and visible data from the Heat Capacity Mapping Mission satellite for the Macquarie Marshes of Eastern Central Australia were examined in the light of a substantial volume of data from other sources, including Landsat, with a view to evaluating meteorological satellite data as ecological monitors for this landform. It is apparent that at least four dominant components of the marshland scene can be mapped using HCMM imagery. These include free water - high thermal admittance, poor coupling for heat transfer to the atmosphere; woodland - low thermal admittance, good coupling to the atmosphere; soil or grass covered soil - lower thermal admittance, poor coupling to the atmosphere; and scald - low thermal admittance, poor coupling, and low soil water content, because of infiltration rate. The ecological status of such scenes is intimately linked with their water status, and a consideration of visible and thermal imagery with appropriate spatial resolution appears to be an economical and effective means of monitoring such systems. Such imagery would, in the long term, provide insight into changes occurring from week to week, insight which could be acquired by ground parties only with great difficulty. The work of a single ground party would be considerably more effective if carried out with a background knowledge of the current status of various components of the system. (Baker-FRC)
W82-03682

COMPARISON OF RESULTS OBTAINED WITH THE VIDIAZ SPECTROPLUVIOMETER AND THE JOSS-WALDVOGEL RAINFALL DISDROMETER IN A 'RAIN OF A THUNDERY TYPE',

Institut et Observatoire de Physique, Clermont-Ferrand (France).
For primary bibliographic entry see Field 2B.
W82-03707

DEVELOPMENT OF A SOIL MOISTURE MODEL FOR USE WITH PASSIVE MICROWAVE REMOTE SENSORS,

Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W82-03715

8. ENGINEERING WORKS

8A. Structures

THE NEW ENERGY BOOM: SMALL-SCALE HYDROPOWER,

A. Seitz-Petrash.
Civil Engineering (New York), Vol 50, No 4, p 66-71, April, 1980. 2 Fig.

Descriptors: *Hydroelectric power, *Electric power production, *Dams, Regulations, Construction, Financing, Utilities.

Retrofitting older, small dams to produce hydropower is feasible in about 10% of the nation's 50,000 dams. Although there are drawbacks (small size, typically 5 MW, drop in production in low flow and ice conditions, and high cost of custom made equipment), there also are advantages. Hydropower is renewable and clean, has well-understood technology, has a short time from inception to production (1-5 years), operates with few personnel, and has little environmental impact. In Phase 1 of a Department of Energy program, 7 pilot studies and 22 construction projects were begun in 1978. Phase 2 involves funding to encourage municipalities and private developers to become involved in small-scale hydropower. Several New England manufacturers have redeveloped existing low capacity hydropower on their sites for internal use. Some utilities such as Niagara Mohawk, New York, have begun developing hydropower. Hydropower redevelopment will most likely continue to grow. However, it will probably only contribute between 5 and 17% of the nation's total electrical needs. In certain areas it can be a significant power source, especially for manufacturers. Present hydropower costs per installed kW capacity are $300-$2000. (Cassar-FRC)
W82-03462

PUMPED-STORAGE FOR SWISS RAILWAYS, PART ONE,

Swiss Federal Railways, Bern.
P. Rochat, and J-L. Mottier.
International Water Power and Dam Construction, Vol 32, No 2, p 54-59, February, 1980. 5 Fig, 2 Tab.

Descriptors: *Pumped storage, *Railroads, *Water supply, Storage, Dam construction, Reservoirs, *Switzerland.

A pumped-storage system was added to the independent hydroelectrical supply system for the Swiss railroads. At the Chatelard-Barberine plant, a compensating basin with an active storage volume of about 200,000 cu m was constructed. The new station consists of two vertical-axis units with Pelton turbines and generator motors with an overall rating of 80 MVA. There is room for two storage pumps, but only one, with a discharge of 4 cu m/sec and a capacity of 31 MW, was installed. Construction of the Chatelard-Village compensating basin added an artificial reservoir with active storage capacity of 203,000 cu m and a total volume of about 250,000 cu m. The dams which form the basin have a maximum height of 35 m above the foundation level and consist of granitic and gneissic rock. Construction of the dam included several geotechnical tests, and compaction during construction was checked by determining the in-place density using the sand-cone and nuclear methods. The settlement of the foundation under the main dam was recorded using a Telemac settlement gauge with a vibrating wire and an instrument of the communicating-tube type. Eight benchmarks were surveyed to study deformations in the dam after filling of the basin. (Small-FRC)
W82-03468

GROUND WATER MONITORING: PART II,

T. Gass.
Water Well Journal, Vol 35, No 5, p 38-40, May, 1981. 5 Fig, 2 Ref.

Descriptors: *Monitoring, *Groundwater, Water supply development, Water resources development, Groundwater management, Groundwater pollution, Wells, *Well design criteria.

Critical design components of a monitoring well are examined, especially as it relates to well design and methods of extracting a sample. The characteristics of a given aquifer have a part to play in the design of the monitoring well system. The spacing, depth and even the drilling and installation methods used for the wells are to some extent determined by the characteristics of the aquifer. Types of monitoring wells include wells with intakes through a single vertical interval, piezometers and observation wells, well clusters, and single well-mulitple sample points. Wells screened over a single vertical interval of an aquifer are one of the most commonly designed and constructed wells for obtaining water samples from unconsolidated or semiconsolidated formations. The major drawback in using individual wells or piezometers screened over a single vertical interval of an aquifer is that they provide no information pertaining to the vertical distribution of the contaminant and only rudimentary information on its areal distribution. Use of well clusters to define the vertical distribution of a contaminant is one alternative. Use of single wells with multiple sampling points will also yield excellent information on the vertical distribution of a contaminant, but only when the sampling zones are carefully sealed from one another within the well and the annular space. (Baker-FRC)
W82-03484

EASTERN SCHELDT DESIGN HAS CHANGED.

Civil Engineering (London), p 47, October, 1981.

Descriptors: *Storm surges, *Barriers, *Environmental effects, *Fisheries, Storm tides, Eastern Scheldt, *Netherlands.

In order to protect the environment and fisheries in the area, the design of the storm surge barrier on Holland's Eastern Scheldt was changed. The original design called for closing the area off from the sea. The present design includes sliding gates in three tidal inlets which will be closed only during bad weather. The project is a large one consisting of 66 concrete piers 35 to 45 m high, each weighing about 17,500 tons. Problems experienced during the project included the necessity of compacting the seabed so it can support the pier footings and establishing pier footings. Pier footings will be embedded in dumped rock to resist the strong currents in the area. Six Dutch construction firms are working on the project, which began construction in 1979. (Small-FRC)
W82-03493

USE OF COMBINED CYCLIC-CONTINUOUS TECHNOLOGY IN EARTH-DAM CONSTRUCTION,

A. I. Churakov.
Hydrotechnical Construction, No 1 p 12-18, January, 1980. 6 Fig, 5 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 8-12, January, 1980.

Descriptors: *Conveyance structures, *Dam construction, *Rock excavation, Excavation, *Earth dams, Rockfill dams, Quarries.

The most common transport system for constructing earth dams combines trucks with conveyor belts in a 3-phase set-up. Motor vehicles transport quarry material to a storage hopper, a conveyor belt moves it to a hopper located at the dam, and trucks carry the fill to the dump site. Greatest efficiency is reached at a freight turnover of 3000-6000 tons per hour and a haul distance of 4.5-5.0 km. If large rocks exceed 3% of the total mass, conveyor output changes. Supplementary craching is carried out when 20-25% of the material is too large for transport (400 mm). An example of rock transport for a mining enrichment plant is given. When the conveyor system approaches design capacity, considerable savings are realized. (Cassar-FRC)
W82-03498

HYDRODYNAMIC EFFECTS IN DYNAMIC RESPONSE OF ARCH DAMS,

California Univ., Berkeley.
C. S. Porter.
PhD Thesis, December, 1980. 331 p, 43 Fig, 2 Tab, 27 Ref, 9 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13167.

Descriptors: *Hydrodynamics, *Arch dams, *Mathematical models, Structural behavior, Earthquakes, Concrete dams, Water resources development, Design criteria, Dynamic response, Ground motions, Impounded water.

The objective of this work was to study the dynamic structural behavior and response of arch dams to ground motion, with special emphasis on identifying hydrodynamic effects in the response behavior. The substructure method has been adapted and generalized for response analysis of arch dams subjected to upstream-downstream, cross-stream and vertical components of ground motion. The arch dam and impounded water are treated as two substructures of the total system and displacements of the dam are represented as a linear combination of the first few natural modes of vibration of the dam alone. Responses to arbitrary ground motion can be obtained by Fourier synthesis procedures applied to the complex frequency response functions determined by the analysis procedures presented. The analysis procedure permits the effects of structure-fluid interaction to be included rationally in dynamic response of arch dams. Dam-water interaction, considering water compressibility, affects the radial acceleration response of dams to upstream-downstream and cross-stream ground motions to a similar degree. However, the response to vertical ground motion is greatly increased by these effects. Just as in the case of gravity dams, vertical ground motion causes significant hydrodynamic pressures. These pressures act in the horizontal plane on a cylindrical dam face, thus causing significant additional response. The additional hydrodynamic forces causes by bank motions in the upstream-downstream or cross-stream directions may significantly affect the dynamic response of arch dams at some excitation frequencies. (Sinha-OEIS)
W82-03509

PROJECT REPORT, PLANNING AND DESIGN DEVELOPMENT KAW POINT WASTEWATER TREATMENT PLANT, KANSAS CITY, KANSAS,

S Kansas Univ., Lawrence. School of Engineering and Architecture.
For primary bibliographic entry see Field 5D.
W82-03525

MATHEMATICAL MODELING OF EARTH DAM BREACHES,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
W. C. Lou.
PhD Thesis, 1981. 238 p, 66 Fig, 11 Tab, 128 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-19715.

Descriptors: *Model studies, *Mathematical models, *Earth dams, *Dam failure, Sediment transport, Bank erosion, Slope degradation, Hydrographs, Flood discharge, *Teton Dam, *Mantaro Dam.

A mathematical model has been developed in order to predict the outflow hydrograph of earth dam breaches. The model is based on the water continuity and motion equations, the sediment continuity equation, a sediment transport equation and a breach form equation. In addition, another simple model was developed considering the Corps of Engineers - Schoklitsch discharge formula and Cristofano's approach for embankment erosion. The sediment transport discharge is considered according to two different approaches. The mechanism responsible for the breach formation is studied considering a section of greatest efficiency from the erosional stand-point, in which the geometric characteristics are functions of a new parameter: the embankment angle of repose. The second-order quasilinear hyperbolic system that includes continuity and motion equations, is implicitly solved by a four-point scheme in the space-time plane, considering the reservoir and a rating curve as boundary conditions upstream and downstream respectively. The spatial and temporal variations of the breach are combined with the unsteady water model yielding discharge and area along the embankment in each time step. The total sediment transport is explicitly calculated resulting in a new embankment profile, taking into consideration the updated boundary conditions. The validity of the mathematical models was checked by applying them to two actual earth dam failures: the Teton Dam and the Mantaro Dam. Good agreement was obtained between the model and the observed data. (Sinha-OEIS)
W82-03532

HIGHLIGHTS OF THE ST. MARY'S REDEVELOPMENT PROJECT,

L. H. Anderson, and K. Overbeeke.
Canadian Water Resources Journal, Vol 6, No 3, p 197-242, 1981. 16 Fig, 3 Tab.

Descriptors: *Environmental effects, *Hydroelectric plants, *Construction, St. Mary's River, Saulte Ste. Marie, *Ontario, Bulb turbines, Alternative planning, Planning, Water quality.

The St. Mary's Redevelopment project at Sault Ste. Marie, Ontario, is an example of redeveloping existing hydroelectric facilities installed between existing station, ice sluiceway, dikes, seepage cutoff trench, concrete gravity retaining wall, and deeper approach channel. Three horizontal bulb unit generators are scheduled to go on line starting August 1982. Advantages and disadvantages of seven alternatives for supplying the required power were evaluated. The environmental concerns were the waterfront, nature and recreational parks, archeological findings on Whitefish Island, a potential shipping canal, preservation of St. Mary's River rapids, fish remedial works, water quality, aquatic life, shoreline erosion, navigation, and restoration of borrow areas for construction materials. (Cassar-FRC)
W82-03617

DICKSON DAM, ALBERTA - THE 20 MW POWER FACILITY,

R. J. Simpson, and J. P. Sengupta.
Canadian Water Resources Journal, Vol 6, No 3, p 178-196, 1981. 4 Fig, 5 Tab.

Descriptors: *Hydroelectric plants, *Dam design, *Dickson Dam, Red Deer River, *Alberta, Diversion structures, Economic aspects, Benefits, *Cost-benefit analysis, Hydraulic structures, Design criteria, Reservoirs, Powerplants, Environmental effects.

An $18 million, 20 MW 2-unit power facility was added to the plans for construction of the $112 million Dickson Dam on the Red Deer River, Alberta. The dam and its flow regulating structures were originally designed to provide a minimal seasonal regulated flow of 16 cu m per sec and to improve water quality. The design intakes for the 530 m twin diversion tunnels were enlarged slightly and the gate system modified for use as power tunnels. The break-down point for net benefits vs. capital construction occurs at a mill rate of 20.8 per kwh. The environmental benefits produced by the original plans are not expected to change due to the addition of the powerplant. The structures are expected to be in service in 1983. (Cassar-FRC)
W82-03621

UNCERTAINTIES IN WATER DISTRIBUTION SYSTEMS,

D. A. Clarke, E. A. McBean, and S. A. Al-Nassri.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1263-1267, October, 1981. 1 Fig, 10 Ref.

Descriptors: *Water distribution, *Pressure distribution, *Pipes, *Design criteria, Water mains, Pipelines, Mathematical studies, *Water supply systems.

As a means of examining the uncertainties in the design of a water distribution system, the sensitivity of the pressure difference is examined using the First Order Analysis method. The sensitivity of the pressure differential was examined across a pipe due to uncertainties in a mathematical model, discharge, hydraulic slope exponent, and Hazen-William's coefficient. These results were used to obtain a required accuracy of measurement devices for providing meaningful results in field measurement of pressure differentials along sections of distributed mains. Uncertainties in the input data of water distribution networks were substantial and could lead to meaningless results. (Small-FRC)
W82-03668

EFFICIENT COOLING PONDS: DESIGN,
Cornell Univ., Ithaca. School of Civil and Environmental Engineering.
G. H. Jirka, C. F. Cerco, and D. R. F. Harleman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1547-1563, 1981. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Cooling ponds, *Design criteria, Thermal water, *Powerplants, Thermal pollution, Heated water, Ponds, Cooling ponds, Circulation, Hydrodynamics.

The design of cooling ponds for the dissipation of waste heat from steam-electric power plants is considered, keeping in mind steady-state performance and transient performance. Particular emphasis is put on the design of shallow ponds, as defined by classification criteria proposed earlier, which lack a predominant vertical stratification and are dominated by the through flow hydrodynamics. Such ponds are frequently built by kiking or excavating an offstream land area. A schematic laboratory study was performed to test the effect on pond performance of various design measures, notably internal baffle arrangements, discharge structures and a deep intake reservoir. An optimal pond design is suggested with moderate baffling to prevent recirculation zones, a radial discharge structure to minimize entrance mixing, and deep intake reservoir with a residence time of at least one half day to insure damping of diurnal intake temperature fluctuations. A moderate length/width ratio of 5-10 will require some amount of internal baffle to prevent recirculation zones. Given a common rectangular shape of available land, a U-shaped pond is frequently most attractive and a good tradeoff against the increased costs of a more dense baffle arrangement. (Baker-FRC)
W82-03672

SEDIMENTATION CONTROL IN INDIAN RESERVOIRS,
Edinburgh Univ. (Scotland).
E. J. McKeogh.
International Water Power and Dam Construction, Vol 33, No 10, p 41-43, October, 1981. 3 Fig, 6 Ref.

Descriptors: *Reservoirs, *Sedimentation, *Sediment control, *India, Dams, Soil erosion, Sediment transport.

The scale and complexity of the sedimentation problem in Indian reservoirs is discussed using data collected from as far back as 1870. Two basic approaches exist for sedimentation control: controlling soil erosion and handling sediment where it creates the problem. The first approach is preventive in nature, involving agronomic practices and management of vegetation. The second approach involves engineering measures. Sediment can be removed by various means, determined largely by the degree of sediment removal required. Conventional devices such as ejectors and vortex tubes have been used to remove sediment from canals, but only with partial success. The sediment removal system in use at the Baira Siul hydroelectric project in Himachal Pradesh is detailed. Large boulders are trapped in a recirculating zone and subsequently removed through the gates. Medium sediment is removed through a tunnel which emanates from the base of the channel. The remaining silt-laden flow is directed to a desilting basin. The average efficiency of the basin was found to be 94.5%. A description is also offered of the Trisuli power channel at the hydroelectric project in Nepal. Several devices for sediment exclusion from the canal were considered, from which a settling tank with flushing arrangement was selected for testing. (Baker-FRC)
W82-03693

OPTIMAL RISK-BASED DESIGN OF HYDRAULIC STRUCTURES,
Texas Univ. at Austin.
Y-K. Tung.
PhD Thesis, August, 1980. 420 p, 59 Fig, 41 Tab, 70 Ref, 9 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-00978.

Descriptors: *Hydraulic structures, *Model studies, Hydrologic aspects, Hydraulic models, Risks, Safety, Economic aspects, Statistical methods, Cost-benefit analysis, *Design criteria, Optimization, *Risk-based design.

A general framework for evaluating the risk and reliability of water resource engineering projects is developed which takes into account the uncertain features involved in both hydrologic and hydraulic aspects and parameter uncertainties. In most water resource engineering projects the evaluation of risk is limited to the consideration of the inherent hydrologic uncertainty while the hydrologic model and parameter uncertainties and the hydraulic uncertainties are ignored. This report illustrates that ignoring these additional uncertainties can lead to serious underestimates of the associated risks and consequently, underestimate the associated economic losses and safety hazard. First-order analysis is used to estimate the uncertainty of deterministic hydraulic models which have uncertain parameters. A new methodology for treating (minimizing) the hydrologic parameter uncertainty is developed that uses generalized parameter (mean, standard deviation, and skewness) values from a weighting between sample and regional hydrologic information. The methodology uses either of two nonparametric statistical techniques, the jackknife or the bootstrap, to determine variances of the sample parameters, and regression analysis is used to determine variances of the sample parameters. The hydrologic model uncertainty is treated using a weighting procedure by assigning a weight to various probability models considered. The generalized parameter estimates and the observations of sample data are both used. By doing so a composite probability model can be developed to define risk and reliability which reduces the uncertainty of adopting the probability model. (Sinha-OEIS)
W82-03710

8B. Hydraulics

PARAMETRIC STUDY OF FLOOD WAVE PROPAGATION,
Indian Inst. of Science, Bangalore (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-03425

NUMERICAL SIMULATION OF RESERVOIRS,
Brown Univ., Providence, RI. Div. of Applied Mathematics.
For primary bibliographic entry see Field 6A.
W82-03504

MODEL-PROTOTYPE COMPARISON OF FREE SURFACE VORTICES,
Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
G. E. Hecker.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1243-1259, October, 1981. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Vortices, *Model studies, *Prototype tests, Hydraulic models, Flow, *Intakes, Eddies.

Past research on vortices and scale effects is reviewed and a new summary of model versus prototype observations is provided regarding vortex intensity. The data summary indicates that sufficient operating problems due to vortices have occurred to warrant reasonable efforts to minimize vortices at intakes. When hydraulic models operated at Froude-scaled flows are used to predict vortex intensity some scale effects occur, while some increase in model flows above Froude-scale values may eliminate these. Large increases, however, are not justified and may result in model distortion. In models with Froude-scaled flows which predicted only swirls and surface dimples, negligible scale effects were found. In this case, no air vortices would occur in the prototype. (Small-FRC)
W82-03667

BUOYANT SURFACE JETS,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
G. H. Jirka, E. E. Adams, and K. D. Stolzenbach.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY11, p 1467-1487, 1981. 11 Fig, 1 Tab, 45 Ref.

Descriptors: *Dimensional analysis, *Jets, Hydraulics, Buoyancy, Plumes, Model studies, Thermal pollution, Heated water, Discharge measurement, *Fluid mechanics.

The fluid mechanical properties of buoyant surface jets entering various types of receiving waters are discussed. Then jet properties, such as mixing capacity and geometric scale, are defined using dimensional analysis, and these are then quantified through combined used of integral jet model predictions and field or laboratory observations. Not only are such relationships useful as initial estimates to define discharge behavior, mixing efficiency, regions of influence, and parametric sensitivity of different discharge design alternatives, but the results define limits of applicability of buoyant surface jet models. One application may be the establishment of criteria on transition distance and on bottom and shoreline attachment which can thus be used in the selection of appropriate predictive models. The study indicated that for deep stagnant receiving water, the buoyant jet has a certain transition length which is used to define the near field zone, a maximum penetration depth, and a limited dilution capacity which is predominantly met through bottom entrainment. These parameters are found to scale with a densimetric Froude number based on kinematic momentum and buoyancy fluxes and characteristic source length. A definition for shallow receiving water conditions is given on the basis of observation of reduced entrainment. Increasing shallowness decreases the jet mixing capacity and increases the length of bottom contact. A criterion is presented to distinguish free shoreline attached buoyant surface jets in crossflowing receiving water. A simple trajectory relation appears to describe the deflection of surface buoyant jets in crossflowing deep receiving water. (Baker-FRC)
W82-03670

UNIFORM FLOW CALCULATIONS FOR PIPES,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
D. I. H. Barr.
Civil Engineering (London), p 15, 17, 21, 30, June, 1981. 3 Fig, 17 Ref.

Descriptors: *Pipe flow, *Mathematical studies, *Graphical analysis, Uniform flow, Turbulent flow, Laminar flow, Channel flow.

Non-dimensional auxiliary scales are presented for direct solutions for each of the basic pipe flow problems. This method has inherent accuracy in terms of solution of the Colebrook-White function and involves only one diagram. It covers a wider range of flow circumstances than the Akers method and places the solution within the context of the familiar resistance diagram. These procedures are not bounded by the limitation of applying only to rough turbulent conditions, as past

methods have been. These cover transition turbulent and smooth turbulent flow as well as laminar and laminar-turbulent transition flows. The diameter of equivalent pipe concept is used rather than the hydraulic mean depth as adopted by Akers, because the equivalent diameter integrates better with the mainstream of resistance diagram and numerical solution practice. This method is an alternative for both pipe and open channel problems which provides valuable elements of direct representation and visualization of the flow circumstances involved. (Small-FRC)
W82-03748

8C. Hydraulic Machinery

CONTINUOUS ION EXCHANGE: DESIGN CALCULATIONS,

M. J. Slater.
Effluent and Water Treatment Journal, Vol 21, No 10, p 461, 464-466, October, 1981. 3 Fig, 14 Ref.

Descriptors: *Ion exchange, *Design criteria, Resins, Fluidized bed process, Wastewater treatment, Water treatment, Fluidized beds, Packed beds, Filters.

Assessment is made of the design principles for packed and fluidized bed ion exchange plants, both fixed bed and continuous flow systems. Use and validity of laboratory experiments in the generation of data for large plants are discussed. The relationship between packed and fluidized types of operation is demonstrated by analytical design equations. Axial mixing of liquid fluidized beds is considered, and its impact on scale-up is demonstrated. It is concluded that binary systems are amenable to mathematical interpretation with some simplification, and multi-component systems can be simulated by computer if all the relevant equilibrium and kinetic data are determined. Fluidized bed systems suffer mixing of liquid and resin, which can be characterized sufficiently well to demonstrate the importance of changing flow patterns on scaling-up and the need to justify use by treating dirty liquids. (Baker-FRC)
W82-03623

8D. Soil Mechanics

DETERMINING OF SEISMIC EARTH PRESSURE ON A RIGID RETAINING WALL,

B. M. Bakhtin, and V. K. Nguen.
Hydrotechnical Construction, No 1, p 70-77, January, 1980. 4 Fig, 1 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 1, p 41-45, January, 1980.

Descriptors: *Seismic properties, *Dam stability, *Retaining walls, Soil mechanics, Dam failure, Hydraulic structures, Earthquakes, Soil pressure.

A method for calculating the seismic earth pressure on a retaining wall, such as a dam, is proposed. If a rigid wall prevents movement of the earth, the energy of a seismic wave will be manifested as a dynamic earth pressure on the wall. It is expected that the pressure on a rigid retaining wall would be maximum near the top and decrease approaching the base. The results of calculations using the Construction Norms and Regulations method and the Rukhadze method (1965) were considerably different from those obtained using the method developed in this paper. Investigations on a plaster model of a retaining wall 10 cm high, 5 cm at the crest, 20 cm at the base, and 100 cm long showed that the diagram of the intensity of the seismic earth pressure had the form of an inverted triangle with the vertex at the base of the wall. The seismic pressure of cohesionless soil on a rigid wall was more dependent on the elastic characteristics of the soil medium and less on the angle of internal friction. The standard methods of determining loads from seismic earth pressure underestimated the design volume of the wall by 5-7%. According to calculations, the most likely type of failure for walls during earthquakes is overturning. This is consistent with reported cases of wall failure. (Cassar-FRC)
W82-03497

8E. Rock Mechanics and Geology

MODEL STUDIES OF AN OVERTOPPED ROCKFILL DAM,

M. Gerodetti.
International Water Power and Dam Construction, Vol 33, No 9, p 25-31, September, 1981. 6 Fig, 11 Ref.

Descriptors: *Dam stability, *Cofferdams, *Gabions, Rockfill dams, *Model studies, El Cajon, *Honduras, Hydraulic structures, Anchors, Overflow.

Results of tests and design concepts for the rockfill cofferdam at the El Cajon hydroelectric project in Honduras are described. Specifications stated that the 40 m high cofferdam, with steel sheetpile center wall, must withstand overtopping. Gabions are used to protect the downstream surface and part of the upstream side. In scale model tests unanchored gabions allowed severe disruption of the embankment at low flows. Inserting anchors protected the dam from high flows and from seepage water, which is significant. It is important that the grain size of stones in the gabion be filled with material coarser than the mesh. (Cassar-FRC)
W82-03694

8G. Materials

FILTER CRITERIA FOR SUB-SURFACE DRAINAGE,

B. Harrison.
Civil Engineering (London), p 22, 24, 26, April, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Drainage systems, *Subsurface filters, Design criteria, *Filters, Filtration, Drainage, Drainage engineering, Subsurface drainage.

The use of lightweight, easily placed and cost effective filter membranes of geotextiles replaced the need for costly graded aggregate filters for several purposes. In the United States their original use was as an alternative to graded natural filters beneath rip-rap on coastal protection schemes. Use has spread to pipe and aggregate wraps for subsurface drains, separators for temporary or permanent roads, filters for piezometer tips and well screens, drainage blankets to sports fields, components of reinforced earth construction and others. It is noted that too conservative an approach, depicted as using small mesh or pore opening sizes, may be unacceptable for long-term filtration performance. The only geotextile filter criterion released to date that allows for the controlled passage is the Trammel filter criterion, based on the Elmer curve. Allowing maximum mesh opening size while maintaining adequate retention and providing sufficient open areas minimizes the risk of clogging. (Baker-FRC)
W82-03660

CAVITATION-RESISTANT GUNITE COATINGS FOR HYDRAULIC STRUCTURES,

L. N. Gomolko, I. S. Novikova, S. V. Sharkunov, and G. N. Tsedrov.
Hydrotechnical Construction, No 6, p 587-589, June, 1980. 2 Fig, 1 Tab, 2 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 6, p 28-29, June, 1980.

Descriptors: *Gunite, *Cavitation, *Hydroelectric plants, *Hydraulic structures, *Materials engineering, *USSR, Water conveyance, Conduits, Concrete technology, Tunnel linings, Linings, Coatings.

Gunite showed increased cavitation resistance as compared with conventional concrete in laboratory tests. The composition of gunite mixtures and the cavitation erosion in grams per hour were as follows: gunite-sand (1:2), cement grade 300, 0.75; 1:3 mixture, cement grade 300, 2.53; 1:4 mixture, cement grade 300, 2.90; 1:2 mixture, cement grade 400, 0.38; and cement grade 400 without gunite, 0.76. Cavitation was produced by a rod 20 mm in diameter at stream velocities of 27 m per sec. This corresponds to the velocity of water near the wall in a water conduit, where the average flow is about 40 m per sec. (Cassar-FRC)
W82-03677

8H. Rapid Excavation

USE OF COMBINED CYCLIC-CONTINUOUS TECHNOLOGY IN EARTH-DAM CONSTRUCTION,

For primary bibliographic entry see Field 8A.
W82-03498

8I. Fisheries Engineering

EASTERN SCHELDT DESIGN HAS CHANGED,

For primary bibliographic entry see Field 8A.
W82-03493

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

PROFESSIONAL DEVELOPMENT FOR WATER QUALITY CONTROL PERSONNEL,

Ohio State Univ., Columbus.
C. L. Shepard.
PhD Thesis, 1980. 149 p, 13 Fig, 28 Tab, 127 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22345.

Descriptors: *Education, *Professional personnel, *Water quality control, Wastewater treatment, *Continuing education, Questionaires, Personnel requirements.

Generalizations based on the findings of this study must take into account the particular samples of respondents, the nature of the survey instrument, and the procedures used to analyze the data. However, in view of the information yielded, certain conclusions seem warranted. There is a significant lack of educational opportunities for the professional development of water quality control personnel. The response regarding available education opportunities is not consistent with the amount of participation indicated by personnel. There are differences among the states in their approach to water quality control and requirements for operations personnel. Employee classification, education level, and municipal size as variables are related to participation in, familiarity with, and importance attached to continuing education-professional development opportunities. There are areas of common agreement on the education opportunities relevant for water quality control personnel across employment classifications. There are differences between supervisors and technicians in the overall rankings for educational opportunities. The respective rankings of each group coincide directly with job responsibilities. The survey methodology provides a usable technique to collect information from water quality control personnel regarding relevant educational opportunities. Wastewater treatment plant personnel can be surveyed for the purpose of obtaining data on relevant educational opportunities for water quality control personnel. (Sinha-OEIS)
W82-03531

9B. Education (In-House)

TRAINING PROGRAMMES FOR BETTER WATER MANAGEMENT IN SURFACE IRRIGATION PROJECTS IN INDIA,

Mahi-Kadana Irrigation Project, Ahmedabad (India).
T. K. Jayaraman.
Water Supply and Management, Vol 5, No 3, p 261-272, 1981. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Irrigation projects, *Management, Planning, Training, Water resources development, Water supply, Water supply development, *India.

A serious problem which has adversely affected the performance of irrigation projects in India has been a lack of professionalization in water management tasks. One of the two suggested solutions to this problem calls for providing training programs for the project personnel serving in the spheres of operation and maintenance and irrigated agriculture extension and production. The programs visualized are for both in-service personnel and those entering the projects as fresh recruits. A training institution is to be located in a representative command area. Once these programs are initiated and run, the other solution of setting up a separate water management cadre becomes obvious and easier to implement as a logical sequel to the training programs. (Baker-FRC)
W82-03434

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

STORAGE AND RETRIEVAL OF GROUND-WATER DATA AT THE U.S. GEOLOGICAL SURVEY,

Geological Survey, Reston, VA. Water Resources Div.
M. W. Mercer, and C. O. Morgan.
Ground Water, Vol 19, No 5, p 543-551, September/October, 1981. 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Information systems, *Data collections, *Groundwater, Information retrieval, Data storage and retrieval, Computers, Wells, Springs, U.S. Geological Survey, National Water Data Exchange.

A computerized groundwater site inventory (GWSI) file, maintained by the U.S. Geological Survey, contains information on wells and springs at 770,000 sites (as of February 1981) throughout the U.S. This hierarchically structured data base is part of the central water resources data file known as National Water Data Storage and Retrieval System (WATSTORE). Data input is reviewed for accuracy before being entered into the file. Indexed information is stored randomly on a disk file. Among the many types of information in the file are location, construction, geology, water quality, and production. Data is retrieved by a natural language system or by a backup system in a higher program language. Users may request information by computer or by writing the U.S. Geological Survey at Reston, Virginia, or at any of 58 assistance centers listed in a table. (Cassar-FRC)
W82-03649

SUBJECT INDEX

ACCUMULATION
Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

ACID RAIN
Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 5B

'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

ACIDIC WATER
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

ACTIVATED CARBON
Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 5F

Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

ACTIVATED SLUDGE
Control of the Activated Sludge Process,
W82-03499 5D

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 5D

ACTIVATED SLUDGE PROCESS
Microorganism Inventory in Activated Sludge Control,
W82-03483 5D

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

Wastewater Treatment Plant Features New Technology,
W82-03591 5D

ADSORPTION
The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 5E

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 5B

Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

ADVANCED WASTEWATER TREATMENT
Tampa's Hookers Point Awt Plant Working Well,
W82-03455 5D

AERATED LAGOONS
Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 5D

AERATION
Control of the Activated Sludge Process,
W82-03499 5D

Hypolimnetic Aerator Fights Eutrophication,
W82-03563 5G

Wastewater Treatment Plant Features New Technology,
W82-03591 5D

AEROBIC BACTERIA
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

AEROBIC TREATMENT
Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 5D

AFRICA
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 2H

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 2H

AGRICULTURAL HYDROLOGY
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 5A

AGRICULTURAL RUNOFF
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

AGRICULTURAL WATERSHEDS
Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 2A

AGRICULTURE
Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 5G

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 3C

The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 6B

AIR STRIPPING
Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 5B

ALABAMA
Water Chemistry of Alabama Ponds,
W82-03534 2K

ALASKA
Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 2K

Deep Water Renewal in Subarctic Fjord,
W82-03675 2L

ALBERTA
Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 4C

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 2K

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 8A

ALGAE
On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 2L

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 5B

Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

ALGAL GROWTH
Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 2H

The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 2L

Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 5D

ALPINE REGIONS
Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 2K

ALUMINUM
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

AMAZON RIVER
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

AMINOCARB
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 5A

AMMONIA
Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 5D

Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 5B

AMMONIUM
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

ANAEROBIC BACTERIA
Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 5D

ANAEROBIC DIGESTION
Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 5D

Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

ANALYTICAL TECHNIQUES
Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 5A

ANIMAL WASTES
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 5D

ANTECEDENT PRECIPITATION INDEX
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 2A

AQUATIC ENVIRONMENT
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

AQUATIC FUNGI
Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 2L

AQUATIC HABITATS
Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H

AQUATIC LIFE
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 5B

AQUATIC PLANTS
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 2H

Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 2H

AQUIFER CHARACTERISTICS
Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 2F

AQUIFERS
Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 4B

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 5E

ARCH DAMS
Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 8A

ARIZONA
Hydrology and Mining in the Tucson Areas,
W82-03697 2F

ARSENIC
Arsenic in Lake Lansing, Michigan,
W82-03522 5B

Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 5C

ARTIFICIAL RECHARGE
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

Artificial Basin Recharge,
W82-03745 4B

ASBESTOS
Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 5F

ASSAY
Enumerating Bacteria in River Water and Sewage Effluent,
W82-03446 5A

ASSIMILATIVE CAPACITY
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

AUSTRALIA
Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 2L

Water Metering and Conservation,
W82-03562 3D

Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 2H

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

BACTERIA
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 2L

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 5C

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 2H

BACTERIAL ANALYSIS
Microbiological Quality of Selected Recreational Waters,
W82-03636 5A

BALLAST
The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 5D

BANGIA
On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 2L

BARLEY
Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 3C

BARNACLES
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 5A

BARRIERS
Eastern Scheldt Design Has Changed.
W82-03493 8A

BASELINE STUDIES
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 5A

BED LOAD
Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 2J

Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

Particle Counter for Sediment Transport Studies,
W82-03666 7B

BIOACCUMULATION
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 5B

BIOASSAY
  Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
  W82-03433 5C
  A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
  W82-03604 5C
BIOCHEMISTRY
  Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
  W82-03505 5A
BIODEGRADATION
  Degradation of Pentachlorophenol in Simulated Lentic Environment,
  W82-03489 5B
  Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
  W82-03557 1B
  Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
  W82-03599 5B
  Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
  W82-03638 5B
BIOINDICATORS
  Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
  W82-03417 5B
  Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
  W82-03605 5A
  Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
  W82-03608 5A
  Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
  W82-03730 5A
BIOLOGICAL TREATMENT
  A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
  W82-03568 5D
BLUEGILLS
  Temperature Effects on Hydrazine Toxicity to Bluegills,
  W82-03603 5C
BLUFF EROSION
  Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
  W82-03720 2J
BOILER WATER
  Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
  W82-03471 5F
BOTTOM SEDIMENTS
  Size Distribution of Amazon River Bed Sediment,
  W82-03488 2J
BRAZIL
  Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
  W82-03744 5G
BRINE
  Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
  W82-03586 2F
BRINES
  The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
  W82-03540 2F
  Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
  W82-03582 2F
  Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
  W82-03584 2F
BRITISH COLUMBIA
  Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
  W82-03618 6G
CADMIUM
  An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
  W82-03612 5C
  Movement of Cadmium and Water in Split-Root Wheat Plants,
  W82-03662 5B
  Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
  W82-03678 5C
  Cadmium in an Aquatic Ecosystem,
  W82-03724 5A
CALCIUM
  Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
  W82-03699 5C
CALIFORNIA
  Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
  W82-03614 6E
  The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
  W82-03714 4B
  New Legislation in California and Its Effects,
  W82-03731 6E
  SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
  W82-03736 6E
CANADA
  On Hydrological Data Needs in Canada,
  W82-03443 7A
  Current Assessment of Prospects for Further Hydro Development in Canada,
  W82-03620 6B
CAPE MAY
  Rapid Sewer Analysis Saves Tourist Season,
  W82-03494 5G
CAPILLARY WATER
  Movement of Cadmium and Water in Split-Root Wheat Plants
  W82-03662 5B
CAPITAL COSTS
  Treating Infiltration at Its Source Reduces Capital Costs.
  W82-03564 5D
CARBARYL
  High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
  W82-03444 5A
CARBON CYCLE
  Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
  W82-03403 2H
CARBON FILTERS
  Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
  W82-03680 5D
CARBON RADIOISOTOPES
  Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
  W82-03505 5A
CARBONATE AQUIFERS
  The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
  W82-03644 2K
CARCINOGENS
  Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
  W82-03433 5C
CARPATHIAN MOUNTAINS
  Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
  W82-03574 4C
CATCHMENT BASINS
  'Nadis', The Vital Water Resources of the Indian Arid Zone,
  W82-03413 3B
CATFISH
  Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
  W82-03590 5B
  Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
  W82-03607 5C
CAVITATION
  Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
  W82-03677 8G
CHALK FORMATION
  Identification of Connate Water in Interstitial Solution of Chalk Sediment,
  W82-03642 2K
CHANNEL FLOW
  Parametric Study of Flood Wave Propagation,
  W82-03425 2E
CHEMICAL ANALYSIS
  The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
  W82-03529 5A
  Water Chemistry of Alabama Ponds,
  W82-03534 2K
  Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
  W82-03584 2F
CHEMICAL COMPOSITION
  Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
  W82-03402 2K
CHEMICAL INTERFERENCES
  Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some

Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 5A

CHEMICAL OXYGEN DEMAND
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1A

CHEMICAL PROPERTIES
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

CHEMICAL STRATIFICATION
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

CHEMICAL WASTES
Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 5B

Dutch Dumps,
W82-03738 5B

CHILE
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

CHLORAMINES
A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

CHLORIDES
Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 2H

CHLORINATED HYDROCARBONS
An Organics Detection System for the Ohio River,
W82-03436 5A

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 5C

CHLORINATION
Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 5C

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

CHROMATOGRAPHY
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

CHROMIUM
Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

CLEANING
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

CLEAR-CUTTING
Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 4C

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 4C

COAGULATION
Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 5F

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 5D

COAL PILE RUNOFF
Simulating Coal Pile Runoff as a Design Tool,
W82-03692 5B

COASTAL AQUIFERS
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

COASTAL WATERS
Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 5B

COBALT
Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 2H

COFFERDAMS
Model Studies of an Overtopped Rockfill Dam,
W82-03694 8E

COLOR REMOVAL
Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 5F

COLORADO
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 5A

COLORADO RIVER BASIN
Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 6B

COMBINED SEWER OVERFLOW
A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 5B

COMPACTION
The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 4B

COMPUTER PROGRAMS
Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 2F

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 2G

COMPUTERS
Improving Treatment Works Efficiency.
W82-03500 5D

CONDENSATES
Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 5F

CONNATE WATER
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 2K

CONSTRUCTION
How Do You Build When Sewers Are Inadequate,
W82-03592 5D

Highlights of the St. Mary's Redevelopment Project,
W82-03617 8A

CONSTRUCTION METHODS
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 3B

CONTINUING EDUCATION
Professional Development for Water Quality Control Personnel,
W82-03531 9A

CONTROL SYSTEMS
Improving Treatment Works Efficiency.
W82-03500 5D

Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 5F

CONVEYANCE STRUCTURES
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 8A

COOLING PONDS
Efficient Cooling Ponds: Design,
W82-03672 8A

CORRELATION FUNCTIONS
Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 2B

COST ANALYSIS
Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 6B

COST BENEFIT ANALYSIS
Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 6B

Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

Water Metering and Conservation,
W82-03562 3D

Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 8A

Upgrading to Increase Treatment Capacity,
W82-03654 5F

CRESOLS
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I–Cresols,
W82-03470 5C

CROP PRODUCTION
Modeling the Economics of Ground Water Management,
W82-03733 4B

CROP YIELD
Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 3C

An Economic Approach to Ground Water Quality Management,
W82-03732 5G

CRYSTALLIZATION
Water Softening by Crystallization,
W82-03750 5F

CYCLING NUTRIENTS
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 2H

DAIRY INDUSTRY
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 5D

DAM CONSTRUCTION
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 8A

DAM DESIGN
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 8A

DAM FAILURE
Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

DAM STABILITY
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 8D

Model Studies of an Overtopped Rockfill Dam,
W82-03694 8E

DAMS
The New Energy Boom: Small-Scale Hydropower,
W82-03462 8A

DATA COLLECTIONSS
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 10B

DATING
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

DEAD SEA
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

DEEP WELLS
A Closer Look at Deep Well Disposal of Wastes,
W82-03646 5E

DEFORMATION
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 2F

DEGRADATION
Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 5B

DELTAS
Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

DEPOSITION
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

DESALINATION
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 3A

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 3A

DESALINATION PLANTS
From Screening to Filtration: Treating the Water Supply,
W82-03739 3A

DESIGN CONSIDERATIONS
Tampa's Hookers Point Awt Plant Working Well.
W82-03455 5D

DESIGN CRITERIA
Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 5D

Designing an Energy-Efficient Wastewater Treatment Plant.
W82-03477 5D

Designing for Coarse Sand Filtration Systems,
W82-03478 5D

Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 5D

Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

Continuous Ion Exchange: Design Calculations,
W82-03623 8C

Uncertainties in Water Distribution Systems,
W82-03668 8A

Efficient Cooling Ponds: Design,
W82-03672 8A

Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 8A

DESIGN FLOW
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

DESTRATIFICATION
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

DETECTION LIMITS
Trace Analyses for Wastewaters,
W82-03639 5A

DICKSON DAM
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 8A

DIELDRIN
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 5B

DIFFUSION COEFFICIENT
Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 5G

DIFFUSION COEFFICIENTS
The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1B

DIFFUSIVITY
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

DIMENSIONAL ANALYSIS
Buoyant Surface Jets,
W82-03670 8B

DISINFECTION
Trihalomethanes in Drinking Water,
W82-03447 5F

A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

Ozone for Municipal Wastewater Disinfection,
W82-03559 5D

DISTRIBUTION PATTERNS
Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 2B

DIVERSION
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 4A

DIVERSION DAMS
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 4A

DOMESTIC WASTES
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

DRAINAGE AREAS
Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 2E

DRAINAGE EFFECTS
Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 2H

DRAINAGE SYSTEMS
Filter Criteria for Sub-Surface Drainage,
W82-03660 8G

DRINKING WATER
Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 5B

Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
W82-03433 5C

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 5C

Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

DROUGHT RESISTANCE
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 2I

EARTH DAMS
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 8A

Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

ECONOMIC ASPECTS
Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 4B

The Economics of Urban Stormwater Management,
W82-03508 4A

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 5G

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 6A

The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 6B

Replacing Large Water Meters: Why and How,
W82-03560 5F

Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 6B

An Economic Approach to Ground Water Quality Management,
W82-03732 5G

Modeling the Economics of Ground Water Management,
W82-03733 4B

ECONOMIC FEASIBILITY
The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 6B

ECOSYSTEMS
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 2H

Cadmium in an Aquatic Ecosystem,
W82-03724 5A

EDUCATION
Professional Development for Water Quality Control Personnel,
W82-03531 9A

ELECTRIC POWER INDUSTRY
Stranglehold on the Skagit,
W82-03490 6G

ELECTRIC POWER PRODUCTION
The New Energy Boom: Small-Scale Hydropower,
W82-03462 8A

ELECTRICAL PROPERTIES
Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 2C

ELECTROLYTES
The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1B

ELECTROPLATING
Electroplating Wastes: History and Current Status,
W82-03588 5D

ENERGY CONSERVATION
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 6A

ENERGY LOSS
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 5G

ENERGY SOURCES
Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 6B

ENGINEERING
Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 5D

ENGLAND
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H

ENVIRONMENTAL EFFECTS
Will the World Face Up to Its Ever-Worsening Environmental Problems,
W82-03459 4C

Stranglehold on the Skagit,
W82-03490 6G

Eastern Scheldt Design Has Changed,
W82-03493 8A

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 3C

Water Chemistry of Alabama Ponds,
W82-03534 2K

Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 6E

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 6G

Highlights of the St. Mary's Redevelopment Project,
W82-03617 8A

Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 6G

Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 6G

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 6B

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H

EPIDEMIOLOGY
Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 5A

EQUIPMENT
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 5F

EROSION RATES
Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 2J

ERROR ANALYSIS
Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 2H

ESTUARIES
The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 2L

Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 2L

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B

Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 2L

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 2L

Heated Discharge in an Estuary: Case Study,
W82-03674 2L

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 2L

EUTROPHIC LAKES

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 2H

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 2H

EUTROPHICATION

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 5B

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

Hypolimnetic Aerator Fights Eutrophication,
W82-03563 5G

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 2H

EVALUATION

Methods for Evaluating Performance of Filter Media,
W82-03661 5F

EVAPORATION CONTROL

A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 3B

EVAPOTRANSPIRATION

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 2A

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 2G

EXPLORATION

Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

FARMING

City Sewage and the American Farmer,
W82-03600 3C

FATE OF POLLUTANTS

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 2H

Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1B

Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 5B

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 5B

Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 5B

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 5B

Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 5B

The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5B

FAUNA

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 2H

FEASIBILITY STUDIES

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

FEDERAL JURISDICTION

Clean Water Act.
W82-03687 6E

Comments on a National Ground-Water Protection Strategy,
W82-03740 6F

FEEDLOT RUNOFF

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 3C

FERTILIZERS

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

FILTER MEDIA

Methods for Evaluating Performance of Filter Media,
W82-03661 5F

FILTERS

Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 5F

Filter Criteria for Sub-Surface Drainage,
W82-03660 8G

FILTRATION

Designing for Coarse Sand Filtration Systems,
W82-03478 5D

Upgrading to Increase Treatment Capacity,
W82-03654 5F

Declining-Rate Filtration,
W82-03656 5F

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 5F

FINANCIAL ASPECTS

Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 5F

FISH

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 5C

Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 5C

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 5C

FISH POPULATIONS

Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 2L

FISHERIES

The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

Eastern Scheldt Design Has Changed.
W82-03493 8A

FISHKILL

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

FITZROY RIVER

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

FJORDS

Deep Water Renewal in Subarctic Fjord,
W82-03675 2L

FLOCCULATION

Upgrading to Increase Treatment Capacity,
W82-03654 5F

Upgrading Water Treatment Plants in San Diego,
W82-03655 5F

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 5D

FLOOD DAMAGE

Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

FLOOD DISCHARGE

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 4C

FLOOD HYDROGRAPHS
Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

FLOOD IRRIGATION
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

FLOOD PLAIN MANAGEMENT
Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

FLOOD WAVES
Parametric Study of Flood Wave Propagation,
W82-03425 2E

FLORIDA
The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 2L

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 2H

Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 5A

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

Microbiological Quality of Selected Recreational Waters,
W82-03636 5A

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

Upgrading to Increase Treatment Capacity,
W82-03654 5F

FLOTATION
Oil-Water Separation by Induced Air Flotation,
W82-03719 5D

FLOW AUGMENTATION
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 5G

FLOW MEASUREMENT
A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 7B

FLOW PROFILES
Hydraulic Exponents,
W82-03669 2E

SWMM Model and Level of Discretization,
W82-03673 6A

FLUID MECHANICS
Surface Viscosity of Water,
W82-03501 1A

Numerical Simulation of Reservoirs,
W82-03504 6A

Buoyant Surface Jets,
W82-03670 8B

FLYNN CREEK
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

FOOD CHAINS
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B

FOREST MANAGEMENT
Will the World Face Up to Its Ever-Worsening Environmental Problems.
W82-03459 4C

FOREST SOILS
Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 4C

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 5B

FORESTRY
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuze),
W82-03460 5A

FOUNDRY COVE
Cadmium in an Aquatic Ecosystem,
W82-03724 5A

FRANCE
Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

GABIONS
Model Studies of an Overtopped Rockfill Dam,
W82-03694 8E

GAGING STATIONS
Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 2B

GAMMA RADIATION
Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 2G

GASES
Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 5D

GEOCHEMISTRY
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 2K

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 2K

GEODETIC LEVELLING
Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 2H

GEOHYDROLOGY
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 4C

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 2F

Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 2F

GEOLOGIC FORMATIONS
A Closer Look at Deep Well Disposal of Wastes,
W82-03646 5E

GEORGIA COAST
Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

GERMINATION
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 2I

GLACIERS
Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 2C

GLUCOSE
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

GOCHEMISTRY
Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 2K

GOVERNMENT SUPPORTS
Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 5F

GRANTS
EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 5D

GRAPHICAL ANALYSIS
Uniform Flow Calculations for Pipes,
W82-03748 8B

GREAT LAKES
Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 5B

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 5D

Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 2J

GROUNDWATER
Ground Water Monitoring: Part II,
W82-03484 8A

Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 2F

Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 2F

Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 10B

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 5G

GROUNDWATER AVAILABILITY
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

GROUNDWATER BASINS
Hydrology and Mining in the Tucson Areas,
W82-03697 2F

GROUNDWATER DATING
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 2K

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

GROUNDWATER DEPLETION
The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 4B

GROUNDWATER LEVEL
Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading.
W82-03544 4C

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 2K

GROUNDWATER MANAGEMENT
Subsidence--A Geological Problem with a Political Solution.
W82-03452 4B

Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 4B

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 4B

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 4B

New Legislation in California and Its Effects,
W82-03731 6E

An Economic Approach to Ground Water Quality Management,
W82-03732 5G

Modeling the Economics of Ground Water Management,
W82-03733 4B

Managing Wells for Energy Efficiency,
W82-03734 4B

SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-05736 6E

Comments on a National Ground-Water Protection Strategy,
W82-03740 6F

Artificial Basin Recharge,
W82-03745 4B

GROUNDWATER MOVEMENT
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 2F

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 2F

Seepage Flow in Extremely Thin Aquifers,
W82-03594 2F

GROUNDWATER POLLUTION
If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 5B

Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 5B

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 5G

Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 5G

Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 5B

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

Water Quality: What Should Be Done Today,
W82-03631 6E

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 5B

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 5G

GROUNDWATER RECHARGE
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 2F

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 4C

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 2A

GUNITE
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

HAM'S LAKE
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

HARDNESS
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

Water Softening by Crystallization,
W82-03750 5F

HAZARDOUS MATERIALS
Four Options for Hazardous Waste Disposal,
W82-03416 5E

HEAD LOSS
Declining-Rate Filtration,
W82-03656 5F

HEAVY METALS
Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 5E

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 5E

Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 5A

HETEROTROPHIC BACTERIA
Seasonal Variction in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

HIGHWAY EFFECTS
Interstate Highways Versus Watershed Protection in New England,
W82-03431 5B

HISTORY
Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 5D

HOLLAND
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 2L

HONDURAS
Model Studies of an Overtopped Rockfill Dam,
W82-03694 8E

HONG KONG
Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 5B

A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 3B

HUDSON RIVER
Heated Discharge in an Estuary: Case Study,
W82-03674 2L

HULL RIVER
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

HUMAN DISEASES
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 5C

Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 5B

HUMAN PHYSIOLOGY
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

HYDRATION
Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 5D

HYDRAULIC CONDUCTIVITY
Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 2G

HYDRAULIC FRACTURING
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 2F

HYDRAULIC LOADING
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

HYDRAULIC STRUCTURES
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 8A

HYDRAULICS
Hydraulic Exponents,
W82-03669 2E

HYDRAZINE
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

HYDRODYNAMICS
Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 8A

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 4B

HYDROELECTRIC PLANTS
Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 6E

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

Highlights of the St. Mary's Redevelopment Project,
W82-03617 8A

Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 6G

Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 6G

Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 8A

Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

HYDROELECTRIC POWER
The New Energy Boom: Small-Scale Hydropower,
W82-03462 8A

Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 6G

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 6B

HYDROELECTRIC POWER PRODUCTION
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 4A

HYDROGRAPHS
SWMM Model and Level of Discretization,
W82-03673 6A

HYDROLOGIC BUDGET
The Nile - One River and Nine Countries,
W82-03545 4A

HYDROLOGIC MODELS
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 2A

HYDROLOGICAL DATA COLLECTIONS
On Hydrological Data Needs in Canada,
W82-03443 7A

HYPOLIMNION
Hypolimnetic Aerator Fights Eutrophication,
W82-03563 5G

ICE
Proton Mobility in Ice,
W82-03701 2C

ILLINOIS
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

INDIA
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 3B

Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 9B

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 6D

Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 2F

Sedimentation Control in Indian Reservoirs,
W82-03693 8A

INDIAN POINT NUCLEAR POWERPLANT
Heated Discharge in an Estuary: Case Study,
W82-03674 2L

INDIAN RIVER
Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 2K

INDUSTRIAL WASTE
Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 5B

INDUSTRIAL WASTES
Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 5D

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source

Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 5D

Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

INDUSTRIAL WASTEWATER
Republic Steel Recycling 80% of Steel-Mill Wastewater.
W82-03454 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

Electroplating Wastes: History and Current Status,
W82-03588 5D

Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 5D

Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

INFECTION
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 5C

INFILTRATION
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 2A

INFORMATION SYSTEMS
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 10B

INJECTION WELLS
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

INSECTICIDES
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 5B

INSTITUTIONAL CONSTRAINTS
Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 6G

INTAKES
Model-Prototype Comparison of Free Surface Vortices,
W82-03667 8B

INTERFACES
Surface Viscosity of Water,
W82-03501 1A

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

INTERNATIONAL AGREEMENTS
Water Quality and the EEC,
W82-03472 6E

Economical Use of Water Resources.
W82-03496 6E

Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 6E

INVERTEBRATES
Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 2H

ION EXCHANGE
Continuous Ion Exchange: Design Calculations,
W82-03623 8C

Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 3A

IONS
The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1B

IOWA
Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 2A

IRISH SEA
Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

IRON EXCHANGE
Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 5F

IRON INDUSTRY
Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 5B

IRON OXIDES
Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

IRRADIATION
Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 2H

IRRIGATION
Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 3C

Modeling the Economics of Ground Water Management,
W82-03733 4B

IRRIGATION DESIGN
Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 3F

IRRIGATION EFFECTS
Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 2G

Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

IRRIGATION EFFICIENCY
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 3F

IRRIGATION PRACTICES
Application of Soil Water Flow Theory in Field Simulation,
W82-03589 2G

IRRIGATION PROGRAMS
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 3F

Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 6F

IRRIGATION PROJECTS
Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 9B

IRRIGATION REQUIREMENTS
Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 3F

ISOPOTIC TRACERS
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 2F

ISOTOPE STUDIES
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 2F

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

ISOTOPIC TRACERS
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

ISRAEL
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 2F

IVANKOVO RESERVOIR
Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

JETS
Buoyant Surface Jets,
W82-03670 8B

JUDICIAL DECISIONS
Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 6E

KANSAS
Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 4B

KANSAS CITY
Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 5D

KENYA
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

KINEMATIC WAVE THEORY
Diverging Overland Flow,
W82-03676 2A

KINETICS
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 5B

Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 5B

KRAFT MILL WASTES
Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 5D

LABRADOR
Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 6G

LAGOONS
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Buhiret El Biban,
W82-03684 2K

LAKE CRETEIL
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

LAKE KEYSTONE
Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 5A

LAKE LANSING
Arsenic in Lake Lansing, Michigan,
W82-03522 5B

LAKE MICHIGAN
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 2H

Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 5B

LAKE NAIVASHA
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 2H

LAKE ONTARIO
Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 2H

LAKE RESTORATION
Hypolimnetic Aerator Fights Eutrophication,
W82-03563 5G

LAKE SEDIMENTS
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

Sulfur Constituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 5B

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 5B

LAKE TAHOE
Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 2H

LAKE TANGANYIKA
The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 2H

LAKE WASHINGTON
Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 5A

LAKES
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 2H

Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 2H

The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 2H

Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 2H

Arsenic in Lake Lansing, Michigan,
W82-03522 5B

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 2H

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 2H

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 2H

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 2H

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H

LAND APPLICATION
The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 5E

LAND DISPOSAL
Managing Vegetation in Wastewater Application,
W82-03401 5D

Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 5E

City Sewage and the American Farmer,
W82-03600 3C

LEACHATES
Migration Through Soil of Organic Solutes in An Oil-Seale Process Water,
W82-03640 5B

LEACHING
Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 3C

LEAD
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of

Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

LEAKAGE
Down to Earth Leak Detection,
W82-03561 5F

LEGAL ASPECTS
Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 6E

Clean Water Act.
W82-03687 6E

Clean Water Act.
W82-03688 6E

The Fifth Amendment Privilege Against Self-Incrimination and Compulsory Self-Disclosure Under the Clean Air and Clean Water Acts,
W82-03746 6E

LEGISLATION
Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 6E

Water Quality: What Should Be Done Today,
W82-03631 6E

New Legislation in California and Its Effects,
W82-03731 6E

LIGHT INTENSITY
Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H

LIME
Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 5D

LITERATURE REVIEW
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

LITTLE WABASH BASIN
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

LOGGING
Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 4C

LONG ISLAND
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

LOUISIANA
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 2F

LOW FLOW
Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 2E

MACROINVERTEBRATES
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 5A

MAGNESIUM
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

MAINE
Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 2L

MAINTENANCE
Replacing Large Water Meters: Why and How,
W82-03560 5F

Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

MALAYSIA
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

MANAGEMENT
Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 9B

MANAGEMENT PLANNING
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 5D

MANGROVE SWAMPS
The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 5B

MANILA
Development of Water Supply to Metro-Manila.
W82-03742 5F

MANTARO DAM
Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

MARSHES
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

MASS TRANSFER
Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 2G

MASSACHUSETTS
Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 6E

MATERIALS ENGINEERING
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

MATHEMATICAL ANALYSIS
Water Supply Reliability Theory,
W82-03432 6A

MATHEMATICAL EQUATIONS
Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 5G

MATHEMATICAL MODELS
Control of the Activated Sludge Process,
W82-03499 5D

Numerical Simulation of Reservoirs,
W82-03504 6A

Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 6D

Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 8A

Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 2H

Diverging Overland Flow,
W82-03676 2A

Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 2H

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 2G

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 2A

MATHEMATICAL STUDIES
Numerical Simulation of Reservoirs,
W82-03504 6A

Hydraulic Exponents,
W82-03669 2E

Uniform Flow Calculations for Pipes,
W82-03748 8B

MEASURING INSTRUMENTS
A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 7B

An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 7B

Particle Counter for Sediment Transport Studies,
W82-03666 7B

MEAT PROCESSING INDUSTRY
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

MEDITERRANEAN SEA
The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 5D

MEMBRANES
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 3A

MERCURY
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 5B

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

MEROMICTIC LAKES
Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 2H

METAL-FINISHING WASTES
Electroplating Wastes: History and Current Status,
W82-03588 5D

METALS
Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 5D

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 5B

METHANE
Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 5D

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

METHANOGENESIS
Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

METHANOL
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

METHYLENE BLUE
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

METROPOLITAN WATER MANAGEMENT
Development of Water Supply to Metro-Manila,
W82-03742 5F

MICHIGAN
Arsenic in Lake Lansing, Michigan,
W82-03522 5B

Down to Earth Leak Detection,
W82-03561 5F

Wastewater Treatment Plant Features New Technology,
W82-03591 5D

MICROBIAL DEGRADATION
Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 5B

MICROBIOLOGICAL STUDIES
Microbiological Quality of Selected Recreational Waters,
W82-03636 5A

MICROORGANISMS
Microorganism Inventory in Activated Sludge Control,
W82-03483 5D

Control of the Activated Sludge Process,
W82-03499 5D

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 2H

MINE DRAINAGE
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 2F

MINERAL WATER
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

MINERALS
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

MINIMUM FLOW
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 5G

MINING WASTES
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 5A

MISSISSIPPI RIVER
Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

MISSOURI RIVER BASIN
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 2A

MIXING
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

MIXING *WATER EXCHANGE
Deep Water Renewal in Subarctic Fjord,
W82-03675 2L

MODEL STUDIES
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 5B

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 2A

Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 2F

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 2H

Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 2G

Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 2G

Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 2F

Model-Prototype Comparison of Free Surface Vortices,
W82-03667 8B

Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 2L

SWMM Model and Level of Discretization,
W82-03673 6A

Heated Discharge in an Estuary: Case Study,
W82-03674 2L

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 2A

Nonlinear Sorption of Water in Soil,
W82-03686 2G

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 5B

Model Studies of an Overtopped Rockfill Dam,
W82-03694 8E

Sediment Transport by Rainsplash,
W82-03709 2J

Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 8A

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 2G

Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 2G

Modeling the Economics of Ground Water Management,
W82-03733 4B

MONITORING
An Organics Detection System for the Ohio River,
W82-03436 5A

Microorganism Inventory in Activated Sludge Control,
W82-03483 5D

Ground Water Monitoring: Part II,
W82-03484 8A

Improving Treatment Works Efficiency,
W82-03500 5D

Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 5A

The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5B

MONROE COUNTY
Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 5D

MUNICIPAL WASTES
How Do You Build When Sewers Are Inadequate,
W82-03592 5D

MUNICIPAL WATER
The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 6B

Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 5F

MUSSELS
Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 5A

NATURAL WATERS
Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1A

NETHERLANDS
Eastern Scheldt Design Has Changed.
W82-03493 8A

Dutch Dumps,
W82-03738 5B

NEUSIEDLERSEE
Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 2H

NEW ENGLAND
Interstate Highways Versus Watershed Protection in New England,
W82-03431 5B

NEW HAMPSHIRE
Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

NEW JERSEY
If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 5B

Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 5F

How Do You Build When Sewers Are Inadequate,
W82-03592 5D

NEW YORK
If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 5B

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 5B

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 5F

Cadmium in an Aquatic Ecosystem,
W82-03724 5A

NEW ZEALAND
Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 2J

Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

NEWFOUNDLAND
Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 6G

NEWPORT RIVER ESTUARY
Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 2L

NILE RIVER
The Nile - One River and Nine Countries,
W82-03545 4A

NITRATES
Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 5G

Seepage Flow in Extremely Thin Aquifers,
W82-03594 2F

NITRIFICATION
Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 5D

Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 5D

NITROGEN
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

NITROGEN REMOVAL
Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 5B

NON-POINT POLLUTION SOURCES
Water Quality: What Should Be Done Today,
W82-03631 6E

NONSTRUCTURAL ALTERNATIVES
Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

NORTH CAROLINA
Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 2L

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

NORTHEASTERN UNITED STATES
Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 6A

NORWAY
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

NUCLEAR POWERPLANTS
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 5B

Heated Discharge in an Estuary: Case Study,
W82-03674 2L

NUTRIENT LOADING CONTROL
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

NUTRIENT REMOVAL
Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 5D

NUTRIENTS
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 2H

Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 2H

Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 5B

Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 2H

OHIO
Microorganism Inventory in Activated Sludge Control,
W82-03483 5D

OHIO RIVER
An Organics Detection System for the Ohio River,
W82-03436 5A

OIL POLLUTION
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 5C

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 5C

OIL SHALE
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 5A

Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 5B

OIL TANKERS
The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 5D

OILY WATER
The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 5D

Oil-Water Separation by Induced Air Flotation,
W82-03719 5D

OKA VALLEY
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

OKLAHOMA
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

ONTARIO
Hypolimnetic Aerator Fights Eutrophication,
W82-03563 5G

Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 5D

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 6G

Highlights of the St. Mary's Redevelopment Project,
W82-03617 8A

OPEN-CHANNEL FLOW
Hydraulic Exponents,
W82-03669 2E

OPTIMAL YIELD
Managing Wells for Energy Efficiency,
W82-03734 4B

OREGON
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

ORGANIC COMPOUNDS
Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 5B

Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 5F

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 5A

Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1B

Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 5A

ORGANIC LOADING
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

ORGANIC MATTER
Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 2L

Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1A

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 5F

ORGANIC SOLVENTS
If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 5B

ORTHOPHOSPHATES
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

OSMOTIC PRESSURE
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 2I

OVERDRAFT
Subsidence--A Geological Problem with a Political Solution.
W82-03452 4B

OVERFLOW
Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 5D

OVERLAND FLOW
Diverging Overland Flow,
W82-03676 2A

OXIDATION
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1A

OXIDATION PONDS
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

OXYGEN
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

OXYGEN DEMAND
Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 5A

Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 5A

OZONATION
Ozone Water Treatment Systems,
W82-03448 5F

Ozone for Municipal Wastewater Disinfection,
W82-03559 5D

PALM OIL WASTEWATER
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

PARTICLE SIZE
An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 7B

Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

PARTICULATE MATTER
Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

PASSAIC
Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 5F

PATH OF POLLUTANTS
Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

PEACE RIVER
Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing.
W82-03618 6G

PERCOLATION
Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 2A

PERFORMANCE EVALUATION
Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 5F

PERMIAN BASIN
Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 2F

PERMITS
Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 6E

PERTH
Water Metering and Conservation,
W82-03562 3D

PESTICIDE RESIDUES
High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 5A

PESTICIDES
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 5A

PHENOL
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol–III. Treatment System Design,
W82-03568 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol–II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

PHENOLS
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 2L

PHILIPPINES
Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 5F

PHOSPHATES
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

PHOSPHORUS
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

PHOSPHORUS REMOVAL
Phosphorus Reduction Studies,
W82-03426 5D

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 5D

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 5B

PHOTOSYNTHETIC BACTERIA
Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 2H

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H

PHYSICAL PROPERTIES
Surface Viscosity of Water,
W82-03501 1A

PHYSIOLOGY
Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 5C

PHYTOPLANKTON
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I–Cresols,
W82-03470 5C

PILOT PLANTS
Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 5F

PIPE FLOW
Uniform Flow Calculations for Pipes,
W82-03748 8B

PIPELINES
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

PIPES
Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 5F

Uncertainties in Water Distribution Systems,
W82-03668 8A

PLANKTON
An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

PLANNING
Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 6F

Polish Water Management–Structure, Problems and Research,
W82-03633 6D

Assessment of Current and Prospective Foundations of Water Resources Planning.
W82-03713 6B

Artificial Basin Recharge,
W82-03745 4B

PLUMES
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 5B

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 5B

POLAND
Polish Water Management–Structure, Problems and Research,
W82-03633 6D

POLITICAL ASPECTS
Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 6F

POLITICAL CONSTRAINTS
Economical Use of Water Resources.
W82-03496 6E

POLLUTANT IDENTIFICATION
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 5A

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 5A

Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 5A

Trace Analyses for Wastewaters,
W82-03639 5A

POLYCHLORINATED BIPHENYLS
Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 5B

PONDS
Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 2H

Water Chemistry of Alabama Ponds,
W82-03534 2K

POPULATION DENSITY
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

PORE PRESSURE
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 2F

POROUS MEDIA
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

PORT VALDEZ
Deep Water Renewal in Subarctic Fjord,
W82-03675 2L

POTABLE WATER
Ozone Water Treatment Systems,
W82-03448 5F

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 5G

POTAMOGETON
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 2H

POTOMAC RIVER
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

POWERPLANTS
Efficient Cooling Ponds: Design,
W82-03672 8A

PRECIPITATION
Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 2J

PREDICTION
Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

PRESSURE DISTRIBUTION
Uncertainties in Water Distribution Systems,
W82-03668 8A

PRIMARY PRODUCTIVITY
Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 2H

Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 2H

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H

PROCESS CONTROL
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

PROFESSIONAL PERSONNEL
Professional Development for Water Quality Control Personnel,
W82-03531 9A

PROJECTIONS
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 6A

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Gilbert/Commonwealth, Reading, PA,
W82-03475 6A

PROTONS
Proton Mobility in Ice,
W82-03701 2C

PROTOTYPE TESTS
Model-Prototype Comparison of Free Surface Vortices,
W82-03667 8B

PUBLIC HEALTH
U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 5G

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 5C

Microbiological Quality of Selected Recreational Waters,
W82-03636 5A

Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 5A

PUBLICATIONS
Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 5D

PUGET SOUND
Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 5A

PULP AND PAPER INDUSTRY
Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 5D

Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 5D

Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

PULP WASTES
Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 5D

PUMP WELLS
Managing Wells for Energy Efficiency,
W82-03734 4B

PUMPAGE
SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 6E

PUMPED STORAGE
Pumped-Storage for Swiss Railways, Part One,
W82-03468 8A

PUMPS
Designing an Energy-Efficient Wastewater Treatment Plant.
W82-03477 5D

RADAR
Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 2B

RADIOACTIVE TRACERS
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

RAILROADS
Pumped-Storage for Swiss Railways, Part One,
W82-03468 8A

RAIN
Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 2B

RAINFALL
Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 2B

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

RAINFALL IMPACT
Sediment Transport by Rainsplash,
W82-03709 2J

RAINFALL-RUNOFF RELATIONSHIPS
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 2A

Diverging Overland Flow,
W82-03676 2A

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 2A

RAQUETTE RIVER
Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 5F

RECHARGE BASINS
Artificial Basin Recharge,
W82-03745 4B

RECLAIMED WATER
Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

RED DRUM
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

RED RIVER
The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 6B

REGENERATION
Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 5F

REGULATIONS
Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 6E

The Evolution of Water Quality Management,
W82-03476 6E

Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 6E

Clean Water Act.
W82-03688 6E

Regulation of Utility Waste Disposal Practices,
W82-03691 5E

REHABILITATION
Rapid Sewer Analysis Saves Tourist Season,
W82-03494 5G

RELIABILITY
Water Supply Reliability Theory,
W82-03432 6A

REMOTE SENSING
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 2G

Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 2B

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 2G

RESEARCH PRIORITIES
Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 5E

RESERVOIR CAPACITY
Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 2E

RESERVOIRS
Numerical Simulation of Reservoirs,
W82-03504 6A

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 6A

Sedimentation Control in Indian Reservoirs,
W82-03693 8A

RESINS
Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 5F

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 3A

RESISTIVITY
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 2C

RESOURCES MANAGEMENT
Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 6E

RETAINING WALLS
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 8D

REVERSE OSMOSIS
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 3A

From Screening to Filtration: Treating the Water Supply,
W82-03739 3A

RHODE ISLAND
Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 5F

RIPARIAN RIGHTS
The Nile - One River and Nine Countries,
W82-03545 4A

RISK-BASED DESIGN
Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 8A

RIVER BASINS
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 5G

RIVER BEDS
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

RIVERS
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 2H

ROAD CONSTRUCTION
Interstate Highways Versus Watershed Protection in New England,
W82-03431 5B

ROCK EXCAVATION
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 8A

ROCKY MOUNTAIN ARSENAL
Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 5B

ROSTHERNE MERE
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H

ROTTERDAMSE WATERWEG ESTUARY
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 2L

RUNOFF
Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 2A

SWMM Model and Level of Discretization,
W82-03673 6A

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 5B

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 5D

RUNOFF COEFFICIENT
Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 4C

SAFETY
Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 5D

SAGINAW BAY MODEL
Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 2H

SALINE LAKES
Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 2H

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 2H

Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

SALINE SOILS
Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 2G

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

An Economic Approach to Ground Water Quality Management,
W82-03732 5G

SALINE WATER
Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 2G

Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 3C

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 2F

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 5E

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Bîban,
W82-03684 2K

The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 6B

SALINE WATER BARRIERS
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

SALINE WATER CONTROL
The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 6B

SALINE WATER INTRUSION
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

SALINITY
The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 2L

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

SALT MARSHES
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 5B

SALT TOLERANCE
On the Conspecificity of Marine and Freshwater Bangia in Britain,
W87-03408 2L

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 2H

SAMPLING
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5B

SAN DIEGO
Upgrading Water Treatment Plants in San Diego,
W82-03655 5F

SAND FILTERS
Designing for Coarse Sand Filtration Systems,
W82-03478 5D

SANITARY ENGINEERING
Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 5D

SATELLITE TECHNOLOGY
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

SATURATION
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

SEA URCHINS
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

SEASONAL VARIATION
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 2L

Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 2K

SEATTLE
Stranglehold on the Skagit,
W82-03490 6G

SEAWATER
From Screening to Filtration: Treating the Water Supply,
W82-03739 3A

SECONDARY WASTEWATER TREATMENT
Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

SEDIMENT CONTROL
Sedimentation Control in Indian Reservoirs,
W82-03693 8A

SEDIMENT DISTRIBUTION
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

SEDIMENT SAMPLER
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

SEDIMENT TRANSPORT
Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 2J

Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

Particle Counter for Sediment Transport Studies,
W82-03666 7B

Sediment Transport by Rainsplash,.
W82-03709 2J

SEDIMENT YIELD
Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 2J

SEDIMENTARY BASINS
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 2F

SEDIMENTARY PETROLOGY
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 2F

SEDIMENTATION
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H

Primary Sedimentation of Sewage,
W82-03429 5D

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

Sedimentation Control in Indian Reservoirs,
W82-03693 8A

SEDIMENTOLOGY
The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 2K

SEDIMENTS
An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 7B

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 2H

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 5B

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 5B

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 2H

Cadmium in an Aquatic Ecosystem,
W82-03724 5A

SEEPAGE
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 2H

SEISMIC PROPERTIES
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 8D

SEPARATION TECHNIQUES
Oil-Water Separation by Induced Air Flotation,
W82-03719 5D

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 3A

SETTLEABLE SOLIDS
Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 5D

SETTLING TANKS
Primary Sedimentation of Sewage,
W82-03429 5D

SEWAGE BACTERIA
Enumerating Bacteria in River Water and Sewage Effluent,
W82-03446 5A

SEWER INFILTRATION
Rapid Sewer Analysis Saves Tourist Season,
W82-03494 5G

Treating Infiltration at its Source Reduces Capital Costs.
W82-03564 5D

SEWER SYSTEMS
Rapid Sewer Analysis Saves Tourist Season,
W82-03494 5G

How Do You Build When Sewers Are Inadequate,
W82-03592 5D

Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

SEWERS
How Do You Build When Sewers Are Inadequate,
W82-03592 5D

SHORES
Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 2J

SKAGIT RIVER
Stranglehold on the Skagit,
W82-03490 6G

SLAVE RIVER
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

SLIME
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

SLUDGE
Wastewater Treatment Plant Features New Technology,
W82-03591 5D

SLUDGE DISPOSAL
Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 5E

Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 5D

SLUDGE UTILIZATION
Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research.
W82-03435 5E

Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 5E

SMALL WATERSHEDS
Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

SOCIAL IMPACT
Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 6G

SODIUM CHLORIDE
Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 2F

SOIL ADSORPTION CAPACITY
Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 5B

SOIL AERATION
Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 2G

SOIL CHEMISTRY
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

SOIL EROSION
Will the World Face Up to Its Ever-Worsening Environmental Problems.
W82-03459 4C

SOIL MOISTURE
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 2A

SOIL POROSITY
Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 4C

SOIL WATER
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 2A

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 2G

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 2A

Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 2G

Nonlinear Sorption of Water in Soil,
W82-03686 2G

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 5B

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 2G

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 2G

SOIL-WATER-PLANT RELATIONSHIPS
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 2G

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 2A

SOIL WATER TABLE
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5B

SOLUBILITY
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

SOLUTE TRANSPORT
Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 5B

Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 2G

Seepage Flow in Extremely Thin Aquifers,
W82-03594 2F

Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 5B

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 5B

SORGHUM
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 2I

SOUTH AFRICA
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 2H

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 3F

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

SOYBEANS
Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 3C

SPECIATION
Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

SPECIES DIVERSITY
Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 2L

SPRAY IRRIGATION
Managing Vegetatidn in Wastewater Application,
W82-03401 5D

SPRING WATER
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

SPRINKLER IRRIGATION
Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 3C

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 3C

STEEL INDUSTRY
Republic Steel Recycling 80% of Steel-Mill Wastewater.
W82-03454 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 5D

STORAGE RESERVOIRS
Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 6A

Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 3F

STORM-OVERFLOW SEWERS
A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 5B

STORM RUNOFF
The Economics of Urban Stormwater Management,
W82-03508 4A

STORM SEEPAGE
Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 5D

STORM SURGES
Eastern Scheldt Design Has Changed.
W82-03493 8A

STRATIFICATION
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

STREAM DISCHARGE
Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 2J

STREAMFLOW
Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 2E

STREAMFLOW FORECASTING
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 2A

Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 2E

STREAMS
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

SUBSIDENCE
Subsidence--A Geological Problem with a Political Solution.
W82-03452 4B

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 4B

SUBSURFACE FILTERS
Filter Criteria for Sub-Surface Drainage,
W82-03660 8G

SULFATE REDUCTION
Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 2H

SULFATES
Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 2H

SULFIDES
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

SULFUR
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

SULFUR COMPOUNDS
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 5A

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 5B

SULFUR EMISSIONS
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

SURFACE-GROUNDWATER RELATIONS
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 2A

SURFACE RUNOFF
Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 2H

SURFACE TENSION
Surface Viscosity of Water,
W82-03501 1A

SURFACE WATER
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 5C

The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 5A

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 2L

SURFACTANTS
Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 5B

SUSPENDED SEDIMENTS
Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 2J

SUSPENDED SOLIDS
Primary Sedimentation of Sewage,
W82-03429 5D

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 5D

SWITZERLAND
Pumped-Storage for Swiss Railways, Part One,
W82-03468 8A

TAMPA
Tampa's Hookers Point Awt Plant Working Well.
W82-03455 5D

TAMPA BAY
Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 2L

TECHNOLOGY
EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 5D

TEMPERATURE GRADIENT
A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 2H

TERTIARY WASTEWATER TREATMENT
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

TETON DAM
Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

TETRAETHYL LEAD (TET)
Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

TEXAS
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

THAILAND
Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 4B

THEIS EQUATION
Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 2F

THERMAL POLLUTION
Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

Heated Discharge in an Estuary: Case Study,
W82-03674 2L

THERMAL WATER
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 5B

THERMOCLINE
Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 2H

A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 2H

TIDAL EFFECTS
Deep Water Renewal in Subarctic Fjord,
W82-03675 2L

TIDAL FLATS
The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 2K

TIDAL RIVERS
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

TOXICITY
Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 5D

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 5C

Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 5C

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 5C

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 5C

Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678 5C

Dutch Dumps,
W82-03738 5B

TOXINS
Water Quality: What Should Be Done Today,
W82-03631 6E

TRACE ELEMENTS
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 5B

TRACE LEVELS
Trace Analyses for Wastewaters,
W82-03639 5A

TRACE METALS
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B

TRACERS
A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 7B

TRAVERSE CITY
Down to Earth Leak Detection,
W82-03561 5F

TRIHALOMETHANE (THM)
Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

TRIHALOMETHANES
Trihalomethanes in Drinking Water,
W82-03447 5F

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

TROPIC ZONE
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

TROUT
Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 5C

TUCSON AREA
Hydrology and Mining in the Tucson Areas,
W82-03697 2F

TUNISIA
Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 6C

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 2K

UNITED KINGDOM
On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 2L

Improving Treatment Works Efficiency.
W82-03500 5D

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

UNSATURATED FLOW
Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 2G

UPTAKE
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

URBAN AREAS
SWMM Model and Level of Discretization,
W82-03673 6A

URBAN RUNOFF
Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 6E

The Economics of Urban Stormwater Management,
W82-03508 4A

USSR
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 4A

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 2H

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 4C

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

UTILITIES
Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 6C

Regulation of Utility Waste Disposal Practices,
W82-03691 5E

VADOSE WATER
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5E

VISAKHAPATNAM BASIN
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 6D

VISCOSITY
Surface Viscosity of Water,
W82-03501 1A

VORTICES
Model-Prototype Comparison of Free Surface Vortices,
W82-03667 8B

WASTE DISPOSAL
Four Options for Hazardous Waste Disposal,
W82-03416 5E

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 5G

Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 5B

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

City Sewage and the American Farmer,
W82-03600 3C

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 5E

Regulation of Utility Waste Disposal Practices,
W82-03691 5E

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 2G

WASTE DUMPS
Dutch Dumps,
W82-03738 5B

WASTE LOAD
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

WASTE STORAGE
Four Options for Hazardous Waste Disposal,
W82-03416 5E

WASTEWATER ANALYSIS
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 5A

Trace Analyses for Wastewaters,
W82-03639 5A

WASTEWATER DISPOSAL
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 5E

Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 5D

WASTEWATER FACILITIES
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Gilbert/Commonwealth, Reading, PA,
W82-03475 6A

Improving Treatment Works Efficiency.
W82-03500 5D

Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 5D

How Do You Build When Sewers Are Inadequate,
W82-03592 5D

WASTEWATER FARMING
City Sewage and the American Farmer,
W82-03600 3C

WASTEWATER IRRIGATION
Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 3C

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 3C

WASTEWATER MANAGEMENT
Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 5G

Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 5D

WASTEWATER RENOVATION
Managing Vegetation in Wastewater Application,
W82-03401 5D

WASTEWATER TREATMENT
Managing Vegetation in Wastewater Application,
W82-03401 5D

Phosphorus Reduction Studies,
W82-03426 5D

Primary Sedimentation of Sewage,
W82-03429 5D

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 5D

Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 5D

Republic Steel Recycling 80% of Steel-Mill Wastewater.
W82-03454 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 5D

Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 5F

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 6A

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Gilbert/Commonwealth, Reading, PA,
W82-03475 6A

Designing for Coarse Sand Filtration Systems,
W82-03478 5D

Control of the Activated Sludge Process,
W82-03499 5D

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 5D

Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 5D

Ozone for Municipal Wastewater Disinfection,
W82-03559 5D

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

Electroplating Wastes: History and Current Status,
W82-03588 5D

Wastewater Treatment Plant Features New Technology,
W82-03591 5D

Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 5D

Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 5D

Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory.
W82-03629 5D

Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 5D

Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 5D

Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 5D

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03600 5D

The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 5D

Oil-Water Separation by Induced Air Flotation,
W82-03719 5D

Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 5D

EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 5D

WASTEWATER TREATMENT FACILITIES
Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 5D

WATER ALLOCATION
Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 4B

WATER ANALYSIS
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 2H

High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 5A

Water Chemistry of Alabama Ponds,
W82-03534 2K

Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5B

WATER CIRCULATION
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

WATER CONVEYANCE
Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 5F

WATER DEMAND
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 5F

WATER DISTRIBUTION
Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 5B

Uncertainties in Water Distribution Systems,
W82-03668 8A

WATER HYACINTH
Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 5D

WATER LAW
Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 6E

New Legislation in California and Its Effects,
W82-03731 6E

SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 6E

WATER LEVEL
Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 2H

WATER LEVEL FLUCTUATIONS
Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 4C

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 2H

Declining-Rate Filtration,
W82-03656 5F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 2A

WATER LOGGING
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 3F

WATER MANAGEMENT
On Hydrological Data Needs in Canada,
W82-03443 7A

Economical Use of Water Resources.
W82-03496 6E

Polish Water Management--Structure, Problems and Research,
W82-03633 6D

Hydrology and Mining in the Tucson Areas,
W82-03697 2F

WATER METERING
Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 6C

Replacing Large Water Meters: Why and How,
W82-03560 5F

Water Metering and Conservation,
W82-03562 3D

WATER PERMITS
SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 6E

WATER POLLUTION
Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 5A

Arsenic in Lake Lansing, Michigan,
W82-03522 5B

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

WATER POLLUTION CONTROL
The Evolution of Water Quality Management,
W82-03476 6E

Rapid Sewer Analysis Saves Tourist Season,
W82-03494 5G

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 5G

Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 5B

The Fifth Amendment Privilege Against Self-Incrimination and Compulsory Self-Disclosure Under the Clean Air and Clean Water Acts,
W82-03746 6E

WATER POLLUTION EFFECTS
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 5C

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 5C

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 5B

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 5C

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

Cadmium in an Aquatic Ecosystem,
W82-03724 5A

WATER POLLUTION PREVENTION

Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 5G

Analysis of Waste Load Allocation Procedures,
W82-03550 5G

WATER POLLUTION SOURCES

Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 5G

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General,
W82-03624 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 5D

Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 5F

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 5B

WATER POLLUTION TREATMENT

Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 3F

WATER QUALITY

Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 2K

Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 6E

Trihalomethanes in Drinking Water,
W82-03447 5F

Water Quality and the EEC,
W82-03472 6E

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 5C

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 3C

Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 6D

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 2K

Microbiological Quality of Selected Recreational Waters,
W82-03636 5A

Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 5A

Clean Water Act.
W82-03667 6E

WATER QUALITY CONTROL

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

An Organics Detection System for the Ohio River,
W82-03436 5A

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 5G

Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 6E

Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 6B

Professional Development for Water Quality Control Personnel,
W82-03531 9A

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

An Economic Approach to Ground Water Quality Management,
W82-03732 5G

Comments on a National Ground-Water Protection Strategy,
W82-03740 6F

Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 5G

WATER QUALITY MANAGEMENT

The Evolution of Water Quality Management,
W82-03476 6E

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03632 5G

Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 5D

WATER QUALITY STANDARDS

Clean Water Act.
W82-03688 6E

Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 5A

WATER RATES

Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 6C

WATER RESOURCES DEVELOPMENT

The Nile - One River and Nine Countries,
W82-03545 4A

Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 6F

Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 6B

Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 5F

Development of Water Supply to Metro-Manila.
W82-03742 5F

A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 3B

WATER REUSE

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 5D

WATER SHORTAGE

Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 6D

WATER SOFTENING

Water Softening by Crystallization,
W82-03750 5F

WATER STORAGE
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 3B

A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 3B

Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 3F

WATER SUPPLY
Water Supply Reliability Theory,
W82-03432 6A

Pumped-Storage for Swiss Railways, Part One,
W82-03468 8A

Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 6D

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 6A

The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 6B

Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 5F

Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 5D

Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 5F

Development of Water Supply to Metro-Manila.
W82-03742 5F

A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 3B

Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 6E

WATER SUPPLY DEVELOPMENT
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 3B

The Nile - One River and Nine Countries,
W82-03545 4A

WATER SUPPLY SYSTEMS
Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 6D

Down to Earth Leak Detection,
W82-03561 5F

Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 5F

Uncertainties in Water Distribution Systems,
W82-03668 8A

WATER TABLE
Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 2G

WATER TEMPERATURE
A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 3B

Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 2H

WATER TREATMENT
Ozone Water Treatment Systems,
W82-03448 5F

Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 5F

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 5F

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 5C

A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 5F

Declining-Rate Filtration,
W82-03656 5F

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 5F

Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 5F

Methods for Evaluating Performance of Filter Media,
W82-03661 5F

Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 5F

Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 3A

Water Softening by Crystallization,
W82-03750 5F

WATER TREATMENT FACILITIES
Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 5F

Designing an Energy-Efficient Wastewater Treatment Plant.
W82-03477 5D

Upgrading to Increase Treatment Capacity,
W82-03654 5F

Upgrading Water Treatment Plants in San Diego,
W82-03655 5F

WATER USE
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 6D

WATERLOGGING
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

WATERSHED MANAGEMENT
Interstate Highways Versus Watershed Protection in New England,
W82-03431 5B

The Economics of Urban Stormwater Management,
W82-03508 4A

WATERSHEDS
Diverging Overland Flow,
W82-03676 2A

WAVE PROPAGATION
Parametric Study of Flood Wave Propagation,
W82-03425 2E

WEATHERING
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

WELL DESIGN CRITERIA
Ground Water Monitoring: Part II,
W82-03484 8A

WELL HYDRAULICS
Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 2F

WELL YIELD
Managing Wells for Energy Efficiency,
W82-03734 4B

WELLS
Managing Wells for Energy Efficiency,
W82-03734 4B

WEST AFRICA
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

WEST GERMANY
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

Seepage Flow in Extremely Thin Aquifers,
W82-03594 2F

WETLANDS
Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 6E

WHEAT
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 5B

WISCONSIN
Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 2J

WOONSOCKET
Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 5F

ZETA POTENTIAL
Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 5F

ZINC
Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. I. The Effect of Water Hardness,
W82-03678 5C

ZOOPLANKTON
The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

AUTHOR INDEX

ADAMS, E. E.
Buoyant Surface Jets,
W82-03670 8B

ADAMS, W. R. JR.
Interstate Highways Versus Watershed Protection in New England,
W82-03431 5B

ADDISON, R. F.
Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 5C

AGIRALIOGLU, N.
Diverging Overland Flow,
W82-03676 2A

AHMADI, M. Z.
Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 2G

AL-MASRI, N.
Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 3C

AL-NASSRI, S. A.
Uncertainties in Water Distribution Systems,
W82-03668 8A

ALEXANDER, M. L.
Wastewater Treatment Plant Features New Technology,
W82-03591 5D

ALVAREZ, R. J.
Microbiological Quality of Selected Recreational Waters,
W82-03636 5A

AMIARD, J-C.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B
Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

AMIARD-TRIQUET, C.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B
Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

ANDERSON, J. A.
Primary Sedimentation of Sewage,
W82-03429 5D

ANDERSON, L. D.
The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 6B

ANDERSON, L. H.
Highlights of the St. Mary's Redevelopment Project,
W82-03617 8A

ANDERSON, M. L.
Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 5B

ANDERSON, P. T.
Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 5F

ANDERSON, S. J.
Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1B

ANYATA, B. U.
Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 6D

APPLEBY, P.
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

ARBAB, M.
Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 2A

ARCE, R. G.
Water Chemistry of Alabama Ponds,
W82-03534 2K

ARFA, H.
Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 2A

ARMSTRONG, N. E.
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D
Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 5D

ARONSON, D. A.
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

ARONSON, G. L.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

ASPINWALL, D. M. V.
A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 5B

ASTON, S. R.
Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

BABUTSIDZE, M. G.
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 4A

BACK, W.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

BAKHTIN, B. M.
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 8D

BALLUKRAYA, P. N.
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

BALRAM, A.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

BANKS, J. T.
Water Quality: What Should Be Done Today,
W82-03631 6E

BARATAN, R.
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

BARBER, S.
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 5A

BARCELONA, M. J.
Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 5B

BARNER, U.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

BARR, D. I. H.
Uniform Flow Calculations for Pipes,
W82-03748 8B

BASAK, P.
Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 5G

BASHKIN, V. N.
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

BATH, A. H.
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 2K

BATTARBEE, R. W.
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

BATTERSON, T. R.
Arsenic in Lake Lansing, Michigan,
W82-03522 5B

BAUER, N. J.
A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 5C

BAUSCH, W. C.
Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 2G

BELANGER, T. V.
Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 2H

BENAICHA, M.
Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 6C

BERGAMIN, F. H.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

BESCHTA, R. L.
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

BEYTH, M.
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

BHIMASANKARAM, V. L. S.
Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 2F

BIANCHI, W. C.
Artificial Basin Recharge,
W82-03745 4B

BIKBULATOV, E. S.
Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1A

BISHOP, S. L.
Methods for Evaluating Performance of Filter Media,
W82-03661 5F

BLANC, F. C.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

BOES, R.
An Organics Detection System for the Ohio River,
W82-03436 5A

BOGARDI, I.
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

BOKE, K.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

BONNER, R. F.
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 6A

BOSIO, N. J.
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

BOUDOU, A.
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 5B

BOWEN, R.
Down to Earth Leak Detection,
W82-03561 5F

BOYLE, T. P.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

BOYLE, W. C.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

BREEN, C. M.
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 2H

BRETELER, R. J.
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 5B

BREUSERS, H. N. C.
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 2L

BRITO, R. A. L.
Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 3C

BRIZ-KISHORE, B. H.
Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 2F

BROCK, T. D.
Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 2H

BRODEUR, T. P.
Upgrading to Increase Treatment Capacity,
W82-03654 5F

BRODOWSKI, D. F.
Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 5B

BROOKMAN, G. T.
Simulating Coal Pile Runoff as a Design Tool,
W82-03692 5B

BROOKS, K. N.
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03349 2A

BROUGHTON, R. S.
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 2A

BROWN, D. J. A.
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

BROWN, K. W.
Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 6E

BRUBAKER, J. M.
Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 2H

BRUCE, R. R.
Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 2A

BUDDE, W. L.
Trace Analyses for Wastewaters,
W82-03639 5A

BULKLEY, R. V.
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 5B

BULL, M. A.
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 5D

BURKETT, H. D.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

BURNS, D. A.
Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

BURSEY, B. W.
Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 6G

BUSHWAY, R. J.
High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 5A

BYCROFT, B. M.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

BYESEDA, J. J.
Oil-Water Separation by Induced Air Flotation,
W82-03719 5D

BYRNE, G. F.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

CAGINALP, O. A.
The Fifth Amendment Privilege Against Self-Incrimination and Compulsory Self-Disclosure Under the Clean Air and Clean Water Acts,
W82-03746 6E

CAPDEVILLE, B.
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 5A

Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 5A

CARBONNEL, J. P.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

CARDEILHAC, P. T.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

CARLSON, D. J.
Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 2L

CARPENTER, T. J.
Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 5D

CARR, W. E.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

CARROLL, T. R.
Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 2G

CARTER, R. P.
Control of the Activated Sludge Process,
W82-03499 5D

CELSO DO AMARAL E SILVA, C.
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 5G

CERCO, C. F.
Efficient Cooling Ponds: Design,
W82-03672 8A

CHADDERTON, R. A.
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

CHAN, A. H.
Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 6B

CHAPMAN, G.
Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678 5C

CHAU, H. N.
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 5G

CHAWLA, R. C.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

CHENG, A. H-D.
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

CHEREMISINOFF, P. N.
From Screening to Filtration: Treating the Water Supply,
W82-03739 3A

CHESTERIKOFF, A.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

CHOW, V. T.
Hydraulic Exponents,
W82-03669 2E

CHUBATYI, O. V.
Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 4C

CHURAKOV, A. I.
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 8A

CHURCH, M.
On Hydrological Data Needs in Canada,
W82-03443 7A

CLARKE, D. A.
Uncertainties in Water Distribution Systems,
W82-03668 8A

CLEASBY, J. L.
Declining-Rate Filtration,
W82-03636 5F

CLEMENTS, E. V.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

COLLINS, D. R.
Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 4B

COLONELL, J. M.
Deep Water Renewal in Subarctic Fjord,
W82-03675 2L

CONNELL, D. W.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

CONNOR, J. N.
Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 2H

COOKE, D.
Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

COOPER, W. J.
Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 5A

CORDONNIER, M. J.
Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 3C

CRAUN, G. F.
Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 5B

CROSS, W. H.
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

CROSSLEY, E. I.
Upgrading Water Treatment Plants in San Diego,
W82-03655 5F

CUNDAY, T. W.
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 2A

CURTIS, W. F.
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

D'AURIA, J. M.
Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 5A

D'ITRI, F. M.
Managing Vegetation in Wastewater Application,
W82-03401 5D

DABROWSKA-ZIELINSKA, K.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

DALLAIRE, G.
Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 5F

EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 5D

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 5G

DANIEL, D. E. JR.
Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 2G

DAS GUPTA, A.
Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 4B

DAVENPORT, R. J.
Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 5A

DAVEY, T.
Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 5D

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 5D

DAWES, C. J.
The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 2L

DAZY, J.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

DE CAPRARIIS, P.
A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 2H

DE LA NOUE, J.
Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

DIDDENS, J. H.
Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 6B

DIGERFELDT, G.
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

DONNADIEU, G.
Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 2B

DOWNING, J. P. JR.
Particle Counter for Sediment Transport Studies,
W82-03666 7B

DRISCOLL, C. T.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

DUBROWSKI, F.
Water Quality: What Should Be Done Today,
W82-03631 6E

DUCKSTEIN, L.
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

DUNLOP, S.
Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678 5C

EARNSHAW, J. C.
Surface Viscosity of Water,
W82-03501 1A

EATON, J. S.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

ECKEL, L. H.
Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 6G

EDMUNDS, W. M.
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 2K

EDZWALD, J. K.
Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 5F

EHEART, J. W.
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

EL-SHERBINI, A. A.
Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 6F

ELLIOTT, L. P.
Enumerating Bacteria in River Water and Sewage Effluent,
W82-03446 5A

ERMAN, D. C.
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 5A

ERSHOVA, K. P.
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 3A

EVANS, R. G.
Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 6B

EWEL, K. C.
Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 5D

FAISON, J. H.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

FEE, E. J.
Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03430 2H

FERRE, R.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

FILBERT, J. W.
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 5D

FISHER, J. W.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

FLEIGE, H.
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

FLOTRE, D. M.
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 2I

FOERST, D. L.
Trace Analyses for Wastewaters,
W82-03639 5A

FOROUD, N.
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 2A

FRENZ, C. M.
Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 5D

FRIH, A.
Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 6C

FRITZ, P.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

FROLOV, A. V.
Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 2H

FRY, G. G.
SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 6E

GALLOWAY, A. K.
Water Quality and the EEC,
W82-03472 6E

GALLOWAY, J. N.
Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

GAMES, L. M.
Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 5B

GANZEL, L. A.
Electroplating Wastes: History and Current Status,
W82-03588 5D

GARBRECHT, M.
Rapid Sewer Analysis Saves Tourist Season,
W82-03494 5G

GASS, T.
Ground Water Monitoring: Part II,
W82-03484 8A

GAT, J.
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 2F

GAUDET, J. J.
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 2H

GENUNG, R. K.
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

GERMAINE, J. E.
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comment from Gilbert/Commonwealth, Reading, PA,
W82-03475 6A

GERODETTI, M.
Model Studies of an Overtopped Rockfill Dam,
W82-03694 8E

GLASER, J. A.
Trace Analyses for Wastewaters,
W82-03639 5A

GODDRICK, G. N.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

GODFREY, K. A. JR.
Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 5D

GOMOLKO, L. N.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

GOULDER, R.
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

GRAHAM, D. S.
Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 6E

GRAVELAND, I. A.
Water Softening by Crystallization,
W82-03750 5F

GRAY, A. V.
Phosphorus Reduction Studies,
W82-03426 5D

GREBENEVICH, E. V.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

GREEN, T.
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 5B

GRIFFIN, R. C.
Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 5G

GRIFFITHS, G. A.
Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 2J

GRIMESTAD, G.
Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 2F

GRIMME, H.
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

GROBLER, D. C.
An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 7B

GROVER, B.
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

GRUBER, H.
Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 6G

GURNHAM, C. F.
Electroplating Wastes: History and Current Status,
W82-03588 5D

GYUNTER, L. I.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

HACKBARTH, D. A.
Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 2K

HAKTANIR, T.
Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 6A

HALSE, S. A.
Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 2H

HAMMAN, H.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

HANKE, S. H.
Water Metering and Conservation,
W82-03562 3D

HANSHAW, B. B.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

HARBISON, P.
The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 5B

HARGIS, D. R.
Hydrology and Mining in the Tucson Area,
W82-03697 2F

HARLEMAN, D. R. F.
Efficient Cooling Ponds: Design,
W82-03672 8A

HARRISON, B.
Filter Criteria for Sub-Surface Drainage,
W82-03660 8G

HARSHBARGER, J. W.
Hydrology and Mining in the Tucson Area,
W82-03697 2F

HARVEY, R. W. S.
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 5C

HASHIZUME, T.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

HAZEN, R. E.
Cadmium in an Aquatic Ecosystem,
W82-03724 5A

HECKER, G. E.
Heated Discharge in an Estuary: Case Study,
W82-03674 2L

Model-Prototype Comparison of Free Surface Vortices,
W82-03667 8B

HECKY, R. E.
The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 2H

HELWEG, O.
Managing Wells for Energy Efficiency,
W82-03734 4B

HENDERSON-SELLERS, B.
A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 3B

HENDREY, G. R.
Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

HENNIGAN, R. D.
The Evolution of Water Quality Management,
W82-03476 6E

HILL, R. D.
Four Options for Hazardous Waste Disposal,
W82-03416 5E

HIMEBAUGH, R. R.
Microorganism Inventory in Activated Sludge Control,
W82-03483 5D

HINES, D. C. M.
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

HIRATSUKA, Y.
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

HO, Y. B.
Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 5B

HOEKS, J.
Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 5B

HOLT, S. M.
Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 2F

HOOK, L. A.
Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

HOUSTON, W. N.
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 2F

HOWARD, C. D. D.
Water Supply Reliability Theory,
W82-03432 6A

HOWELLS, D. H.
Comments on a National Ground-Water Protection Strategy,
W82-03740 6F

HOWITT, R. E.
An Economic Approach to Ground Water Quality Management,
W82-03732 5G

HSU, T-B.
Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 3A

HUM, K. S.
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

HUMENICK, M. J.
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

HUNDAL, H. S.
From Screening to Filtration: Treating the Water Supply,
W82-03739 3A

HUNGERFORD, N.
Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 6E

HUNT, T. P.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

HWANG, S. T.
Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 5B

ISSAR, A.
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 2F

JACINTHO, A. O.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

JAYARAMAN, T. K.
Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 9B

JENSEN, K. H.
Application of Soil Water Flow Theory in Field Simulation,
W82-03589 2G

JIRKA, G. H.
Buoyant Surface Jets,
W82-03670 8B

Efficient Cooling Ponds: Design,
W82-03672 8A

JOHNSON, K. S.
The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1B

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 2F

JOHNSON, N. M.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

JONES, R. A.
Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 6E

JOSHI, D. C.
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 3B

KASHEF, A-A. I.
The Nile - One River and Nine Countries,
W82-03545 4A

KATZ, A.
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

KATZ, H. M.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

KATZ, P. B.
Simulating Coal Pile Runoff as a Design Tool,
W82-03692 5B

KAVANAGH, B. V.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

KAZMANN, R. G.
A Closer Look at Deep Well Disposal of Wastes,
W82-03646 5E

KELLERHALS, M.
On Hydrological Data Needs in Canada,
W82-03443 7A

KHAN, K. A.
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

KHANJANI, M. J.
Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 3F

KIHANA, H.
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

KIM, J. W.
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 5D

KIMURA, I.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

KINAE, N.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

KING, R. W.
Upgrading Water Treatment Plants in San Diego,
W82-03655 5F

KIRKHAM, M. B.
Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 5B

KIROUAC, C.
Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

KLING, H. J.
The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

KNITTEL, M. D.
A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 5C

KOHL, H. H.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

KOTANI, A.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

KOUSSIS, A. D.
Nonlinear Sorption of Water in Soil,
W82-03686 2G

KRAYBILL, H. F.
Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
W82-03433 5C

KRISHNA, J. H.
Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

KUDEYAROV, V. N.
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

KUDEYAROVA, A. Y.
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

KUMAR, M. B.
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 2F

KUMAR, M. S. M.
Parametric Study of Flood Wave Propagation,
W82-03425 2E

KUNST, M.
Proton Mobility in Ice,
W82-03701 2C

KUWAHARA, T.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

LAFFONT, C.
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 5A

Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 5A

LAND, L. S.
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 2F

LANDERS, D. H.
Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 5B

LANDIM, P. M. B.
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

LANDRETH, R. E.
Four Options for Hazardous Waste Disposal,
W82-03416 5E

LARSON, R. J.
Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 5B

LASTOCHKINA, K. O.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

LATHER, P.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

LAUGHLIN, D. H.
The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 6B

LAW, F. C. P.
Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 5C

LAWRENCE, S. G.
An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

LECOLLE, P.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

LEDGER, D.
Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

LEE, G. F.
Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 6E

LEE, J. H.
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

LEE, T. L.
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

LEENHEER, J. A.
Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 5B

LELONG, F.
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

LESCHBER, R.
Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 5E

LESTER, J. N.
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 5D

LETOLLE, R.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 2H

LEUNG, S.-Y. T.
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 5B

LEVIN, A. I.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

LIBBY, A. E.
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

LIGGETT, J. A.
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

LIKENS, G. E.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

LINGEMAN, R.
Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 2H

LITTLEWORTH, A.
New Legislation in California and Its Effects,
W82-03731 6E

LIU, P. L-F.
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

LIVINGSTON, J. M.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

LIVINGSTONE, D.
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H

LOFFLER, H.
Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 2H

LOU, W. C.
Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

MACINTYRE, S.
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

MACKIN, J. E.
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 2H

MAHER, M. D.
The Economics of Urban Stormwater Management,
W82-03508 4A

MAKITA, T.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

MAMARBACHI, G.
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 5A

MANHEIM, F. T.
Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

MARCHAND, J.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B

MARSHALL, J. S.
An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

MARSON, H. W.
The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 5D

MARTINEZ, J. D.
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 2F

MARTYNOVA, M. V.
Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 5B

MATSUI, E.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

MATSUI, T.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

MAYER, L. M.
Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 2L

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

MCBEAN, E. A.
Uncertainties in Water Distribution Systems,
W82-03668 8A

MCCARTHY, C. J.
Sediment Transport by Rainsplash,
W82-03709 2J

MCCOLL, J. G.
Trace Elements in the Hydrologic Cycle of a Forest Ecosystem,
W82-03690 5B

MCDONALD, A.
Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

MCDONNELL, A. J.
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

MCDOWELL, W. H.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

MCINTOSH, R. P.
The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 2L

MCKEE, G. D.
Trace Analyses for Wastewaters,
W82-03639 5A

MCKEE, G. L.
Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 5A

MCKEOGH, E. J.
Sedimentation Control in Indian Reservoirs,
W82-03693 8A

MEADE, R. H.
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

MEAN, P.
An Economic Approach to Ground Water Quality Management,
W82-03732 5G

MEANS, J. L.
Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1B

MEDHIOUB, K.
The Influence of Peripheral Sebkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 2K

MELLINGER, D. L.
An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

MERCER, M. W.
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 10B

MERKUR'EVA, R. V.
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 3A

METAYER, C.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 5B

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 2L

METLER, M.
Polish Water Management--Structure, Problems and Research,
W82-03633 6D

MEYERS, P. A.
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 2H

MICHAUD, M. C.
Numerical Simulation of Reservoirs,
W82-03504 6A

MILLER, A. C.
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

MILLER, G. J.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

MILLER, J. W.
Stranglehold on the Skagit,
W82-03490 6G

MITCHELL, M. J.
Sulfur Constituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 5B

MOLENAAR, H. W.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

MOODIE, S. P.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

MOORE, G.
An Organics Detection System for the Ohio River,
W82-03436 5A

MOORE, J. E.
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 5F

MORGAN, C. O.
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 10B

MORRISON, A.
If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 5B

MOTTIER, J-L.
Pumped-Storage for Swiss Railways, Part One,
W82-03468 8A

MOY, H. C.
Heated Discharge in an Estuary: Case Study,
W82-03674 2L

MULDER, J. H.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

MURTY, V. V. N.
Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 5G

MUTHURI, F. M.
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 2H

NARASIMHAN, T. N.
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 2F

NAYMIK, T. G.
Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 5B

NEBEL, C.
Ozone Water Treatment Systems,
W82-03448 5F

NEL, C. C.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

NELSON, J. D.
Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 5G

NEUMAN, W. E.
Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 5F

NGUEN, V. K.
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 8D

NIGHTINGALE, H. L.
Artificial Basin Recharge,
W82-03745 4B

NOAROV, YU. A.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

NOEL, J. E.
Modeling the Economics of Ground Water Management,
W82-03733 4B

NORDIN, C. F. JR.
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J

NOROUZIAN, M.
Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 5D

NOVIKOV, YU
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

NOVIKOVA, I. S.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

NUR, A. M.
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 2F

NYSTROM, J. B.
Heated Discharge in an Estuary: Case Study,
W82-03674 2L

O'LEARY, S. J.
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

ODAJIMA, K.
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

OLDFIELD, F.
Palaeoecological Studies of the Recent Development of Lake Vaxjoejon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 5B

OTIS, R. J.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

OUSEY, J. R. JR.
Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 2E

OVERBEEKE, K.
Highlights of the St. Mary's Redevelopment Project,
W82-03617 8A

OWEN, R. M.
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 2H

PALUMBO, A. V.
Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 2L

PAREN, J. G.
Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 2C

PARKER, J. L.
An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

PARKIN, T. B.
Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H
Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 2H

PATTERSON, H. V.
Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 5F

PAULL, C. K.
Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

PAYNE, G.
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

PEARSON, F. J.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

PERTHUISOT, J. P.
The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 2K

PETTY, J. D.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

PICARD, G. A.
Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

PICKMERE, S.
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

PICKS, F. R.
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

PIETTE, J. P.
Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

PISANO, W. C.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

PLITMAN, S. I.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 5C

POLAND, J. F.
The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 4B

POPHAM, J. D.
Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 5A

PORTER, C. S.
Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 8A

PREZBINDOWSKI, D. R.
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 2F

PRICE, T. H.
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 5C

PRIEST, C. J.
Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 5D

PRIMUS, C.
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

PUTNAM, M. E.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

QUAVE, S. A.
Trace Analyses for Wastewaters,
W82-03639 5A

QUEIROZ, C.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

QUIMBY, B. D.
The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 5A

QUINN, N. J.
Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 2L

QURESHI, N.
Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 5F

RAE, J. E.
Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

RAKHMANIN, YU
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 3A

RAMANATHAN, M.
Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 5D

RAUSCH, L. L.
Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 5C

REED, R. H.
On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 2L

REIS, B. F.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

REYNOLDS, C. S.
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H

REYNOLDS, J. M.
Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 2C

RHODES, I. A-L.
Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

RIBEYRE, F.
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 5B

RICHARD, J. J.
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 5B

RICHARD, M. G.
Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

RIGHTMIRE, C. T.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

RIMMER, T. T.
A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 7B

ROBINSON-WILSON, E. F.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

ROCHAT, J.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

ROCHAT, P.
Pumped-Storage for Swiss Railways, Part One,
W82-03468 8A

ROFFLER, S.
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 5B

ROGERS, K. H.
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 2H

ROOSE, E. J.
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 2K

ROQUES, H.
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 5A
Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 5A

ROSSI, S. S.
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 5C

ROTH, J. C.
Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 5D

RUSHTON, K. R.
Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 2F

RUSSEL, L. C.
Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 5C

RUSSELL, F. L.
Replacing Large Water Meters: Why and How,
W82-03560 5F

RYCKBORST, H.
Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 4C

RYE, R. O.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

SADIQ, M.
The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 5E

SADLER, K.
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

SAKTHIVADIVEL, R.
Inadequecies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

SALATI, E.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

SARMA, V. V. J.
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 6D

SARROT-REYNAULD, J.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

SCAVIA, D.
Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 2H

SCHEUCH, L. E.
Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03687 5F

SCHICK, L. L.
Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

SCHILLING, K. E.
Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 5F

SCHMID, G.
Seepage Flow in Extremely Thin Aquifers,
W82-03594 2F

SCHMIDT, C. J.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 5D

SCHMIDTKE, N. W.
Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 5E

SCHUURING, C.
Dutch Dumps,
W82-03738 5B

SCHWARTZ, F. W.
Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 2G

SCOTT, R. A. F.
Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 5F

SEIBERT, D. L. R.
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 5C

SEIDLER, R. J.
A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 5C

SELTZ-PETRASH, A.
The New Energy Boom: Small-Scale Hydropower,
W82-03462 8A

SENGUPTA, J. P.
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 8A

SHAMIR, U.
Water Supply Reliability Theory,
W82-03432 6A

SHARKUNOV, S. V.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

SHARMA, K. D.
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 3B

SHARMA, Y. L. V.
A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 3B

SHAUGHNESSY, J. C.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

SHEPARD, C. L.
Professional Development for Water Quality Control Personnel,
W82-03531 9A

SHOMAKER, N. B.
Four Options for Hazardous Waste Disposal,
W82-03416 5E

SHVELIDZE, T. V.
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 4A

SIDDIQUE, M.
Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 4B

SILVA, C.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

SIMPSON, C. F.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

SIMPSON, G. M.
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 2I

SIMPSON, R. J.
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 8A

SINGH, V. P.
Diverging Overland Flow,
W82-03676 2A

SLATER, M. J.
Continuous Ion Exchange: Design Calculations,
W82-03623 8C

SMITH, L.
Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 2G

SMITH, M. G.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

SMITH, N. K. R.
Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 5C

SMITH, R.
Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 5D

SMITH, R. L.
Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 2H

SNYDER, W. M.
Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 2A

SOLOKHINA, T. A.
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde

Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Opreshnenii Vody),
W82-03698 3A

SORENSEN, E.M. B.
Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 5C

SRIDHARAN, K.
Parametric Study of Flood Wave Propagation,
W82-03425 2E

STARINSKY, A.
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

STEDNICK, J. D.
Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 2K

STEGMANN, N. E.
How Do You Build When Sewers Are Inadequate,
W82-03592 5D

STERRETT, R. J.
Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 2J

STERRITT, R. M.
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 5D

STOL, P. T.
Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 2B

Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 2B

STOLBUNOV, A. K.
Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

STOLZENBACH, K. D.
Buoyant Surface Jets,
W82-03670 8B

STOUGHTON, H. W.
Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 2H

STOUT, D. G.
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 2I

STOVER, E. L.
Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 5D

Ozone for Municipal Wastewater Disinfection,
W82-03559 5D

STREBEL, O.
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

STREUTKER, A.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 3F

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

STUBER, H. A.
Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 5B

SUAREZ, D. L.
Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 2G

SUIDAN, M. T.
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

SUZUKI, O.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

SWAMY, A. N.
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 6D

SWANSON, J. R.
Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 5A

SZIDAROVSZKY, F.
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

SZIKSZAY, M.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

TAITEL-GOLDMAN, N.
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

TANADA, S.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 5F

TAPP, J. S. JR.
Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 5D

TARR, J. A.
City Sewage and the American Farmer,
W82-03600 3C

TATE, C. H.
Trihalomethanes in Drinking Water,
W82-03447 5F

TEAL, J. M.
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 5B

TEISSEDRE, J-M.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 2F

THANH, N. C.
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

THOMAS, A. W.
Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 2A

THOMAS, W. H.
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 5C

THOMPSON, N.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

TIPPING, E.
Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

TOMITA, I.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 5C

TRATTNER, R. B.
From Screening to Filtration: Treating the Water Supply,
W82-03739 3A

TREFRY, J. H.
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 5A

TRUSSELL, A. R.
Trihalomethanes in Drinking Water,
W82-03447 5F

TRUSSELL, H. R.
Trihalomethanes in Drinking Water,
W82-03447 5F

TSEDROV, G. N.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 8G

TUCKER, S. S.
Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 2H

TUNG, Y-K.
Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 8A

TUTARASHVILI, B. A.
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 4A

UMPHRES, M. D.
Trihalomethanes in Drinking Water,
W82-03447 5F

VALIELA, I.
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 5B

VAN OS, A. G.
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 2L

VARMA, M. M.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

VASIL'EV, V. B.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

VAVILIN, V. A.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

VELGA, A.
Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 5D

WAGNER-MERNER, D. TES.
Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 2L

WAITE, J.
Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 6G

WALTERS, J. G.
Designing for Coarse Sand Filtration Systems,
W82-03478 5D

WARMAN, J. M.
Proton Mobility in Ice,
W82-03701 2C

WARREN, J. M.
Water Quality: What Should Be Done Today,
W82-03631 6E

WEAVER, A. V. B.
An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 7B

WEAVER, L.
An Organics Detection System for the Ohio River,
W82-03436 5A

WEBER, W.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

WEETER, D. W.
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 5D

WHEATLEY, W. B.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

WHITE, E.
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

WHITE, F. H.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

WIECHERS, S. G.
Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 5D

WILES, C. C.
Four Options for Hazardous Waste Disposal,
W82-03416 5E

WILSON, L. G.
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5B

WOOF, C.
Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

WORLEY, S. D.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

WYNVEEN, R. A.
Continuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 5A

YARD, K. D.
Regulation of Utility Waste Disposal Practices,
W82-03691 5E

YOSIE, T. F.
Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 5D

ZAGATTO, E. A. G.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

ZAGHLOUL, N. A.
SWMM Model and Level of Discretization,
W82-03673 6A

ZAHAVI, A.
Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 2J

ZAIDI, T. H.
The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 5E

ORGANIZATIONAL INDEX

ACADEMY OF MUNICIPAL ECONOMY, MOSCOW (USSR).
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 5D

ADELAIDE UNIV. (AUSTRALIA). CENTRE FOR ENVIRONMENTAL STUDIES.
The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 5B

AIR FORCE AEROSPACE MEDICAL RESEARCH LAB., WRIGHT-PATTERSON AFB, OH.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 5C

AKADEMIYA NAUK SSSR, BOROK. INST. BIOLOGII VNUTRENNYKH VOD.
Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 5B

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. AGROKHIMII I POCHVOVEDENIYA.
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 5B

AKADEMIYA NAUK SSSR, MOSCOW. INST. BIOLOGII VNUTRENNYKH VOD.
Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1A

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 5C

AMERICAN WATER WORKS SERVICE CO., INC., HADDONFIELD, NJ.
Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 5F

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF AQUATIC ECOLOGY.
Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 2H

AMSTERDAM WATERWORKS (NETHERLANDS).
Water Softening by Crystallization,
W82-03750 5F

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF GEOPHYSICS.
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 6D

ARGONNE NATIONAL LAB., IL.
An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 5C

ARIZONA WATER RESOURCES RESEARCH CENTER, TUSCON.
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 5B

ARMY CORPS OF ENGINEERS, BELVOIR, VA.
Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 5F

ASIAN INST. OF TECH., BANGKOK (THAILAND).
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 5D

ASIAN INST. OF TECH. BANGKOK (THAILAND). DIV. OF WATER RESOURCES ENGINEERING.
Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 4B

AUBURN UNIV., AL.
Water Chemistry of Alabama Ponds,
W82-03534 2K

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 5F

AUSLAM AND ASSOCIATES, INC., SACRAMENTO, CA.
Modeling the Economics of Ground Water Management,
W82-03733 4B

BATTELLE COLUMBUS DIV., OH.
Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1B

BEN-GURION UNIV. OF THE NEGEV, SDE BOKER (ISRAEL). IN FOR DESERT RESEARCH.
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 2F

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 2F

BOCHUM UNIV. (GERMANY, F.R.). INST. FUER KONSTRUKTIVEN INGENIEURBAU.
Seepage Flow in Extremely Thin Aquifers,
W82-03594 2F

BORDEAUX-1 UNIV., TALENCE (FRANCE). LAB. D'ECOLOGIE ANIMALE.
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 5B

BRITISH ANTARCTIC SURVEY, CAMBRIDGE (ENGLAND).
Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 2C

BRITISH COLUMBIA UNIV., VANCOUVER.
On Hydrological Data Needs in Canada,
W82-03443 7A

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF GEOLOGICAL SCIENCES.
Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 2G

BROWN UNIV., PROVIDENCE, RI. DIV. OF APPLIED MATHEMATICS.
Numerical Simulation of Reservoirs,
W82-03504 6A

BROWNE (RICHARD) ASSOCIATES, WAYNE, NJ.
How Do You Build When Sewers Are Inadequate,
W82-03592 5D

BUNDESANSTALT FUER GEOWISSENSCHAFTEN UND ROHSTOFFE, HANOVER (GERMANY, F.R.).
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 2I

BUNDESGESUNDHEITSAMT, BERLIN (GERMANY, F.R.). INST. FUER WASSER-.BODEN-, UND LUFTHYGIENE.
Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 5E

CALIFORNIA UNIV., BERKELEY.
Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 8A

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 5D

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND RESOURCES MANAGEMENT.
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 5A

CALIFORNIA UNIV., BERKELEY. DEPT. OF PLANT AND SOIL BIOLOGY.
Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 5B

CALIFORNIA UNIV., DAVIS. DEPT. OF AGRICULTURAL ECONOMICS.
An Economic Approach to Ground Water Quality Management,
W82-03732 5G

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Managing Wells for Energy Efficiency,
W82-03734 4B

CALIFORNIA UNIV., SANTA BARBARA. MARINE SCIENCE INST.
The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1B

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
City Sewage and the American Farmer,
W82-03600 3C

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. COLL. OF HUMANITIES AND SOCIAL SCIENCES.
Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 5D

CENTER FOR WATER RESOURCES DEVELOPMENT AND MANAGEMENT, TRINANDRUM (INDIA).
Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 5G

CENTER FOR WATER RESOURCES, MADRAS (INDIA).
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 7B

CENTRAL ARID ZONE RESEARCH INST., JODHPUR (INDIA).
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 3B

CENTRAL ELECTRICITY GENERATING BOARD, LEATHERHEAD (ENGLAND). CENTRAL ELECTRICITY RESEARCH LABS.
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 5C

CENTRO DE ENERGIA NUCLEAR NA AGRICULTURA, SAO PAULO (BRAZIL).
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 5A

CLARK UNIV., WORCESTER, MA. DEPT. OF GEOGRAPHY.
Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 2J

COLLEGE OF PETROLEUM AND MINERALS, DHAHRAN (SAUDI ARABIA).
The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 5E

COLLEGE OF PETROLEUM AND MINERALS, DHAHRAN (SAUDI ARABIA). DEPT. OF CIVIL ENGINEERING.
SWMM Model and Level of Discretization,
W82-03673 6A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 6B

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURE AND CHEMICAL ENGINEERING.
Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 5G

COLORADO STATE UNIV., FORT COLLINS, DEPT. OF CIVIL ENGINEERING.
Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 6E

Mathematical Modeling of Earth Dam Breaches,
W82-03532 8A

COLUMBIA UNIV., NEW YORK.
Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 5C

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF LAND RESEARCH.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 7B

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, SYDNEY (AUSTRALIA). ANIMAL RESEARCH LABS.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 5D

CORNELL UNIV., ITHACA, NY. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 6D

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 2F

Buoyant Surface Jets,
W82-03670 8B

CORNELL UNIV., ITHACA. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Efficient Cooling Ponds: Design,
W82-03672 8A

COUNCIL OF ECONOMIC ADVISORS, WASHINGTON, DC.
Water Metering and Conservation,
W82-03562 3D

COUNCIL ON ENVIRONMENTAL QUALITY, WASHINGTON, DC.
Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 6E

DALHOUSIE UNIV., HALIFAX (NOVA SCOTIA). COLL. OF PHARMACY.
Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 5C

DARTMOUTH COLL., HANOVER, NH. DEPT. OF EARTH SCIENCES.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 5B

DELAWARE UNIV., NEWARK. DEPT. OF CHEMICAL ENGINEERING.
Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 3A

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 2H

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). FRESHWATER SECTION.
Orthophosphate and Its Flux in Lake Waters,
W82-03613 2H

DEPT. ENVIRONMENTAL QUALITY ENGINEERING, MA.
Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 5F

DUKE UNIV., DURHAM, NC. DEPT. OF ZOOLOGY.
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 2H

EDINBURGH UNIV. (SCOTLAND).
Sedimentation Control in Indian Reservoirs,
W82-03693 8A

ENVIRONMENTAL DESIGN AND PLANNING, INC., BOSTON, MA.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 5D

ENVIRONMENTAL MONITORING AND SUPPORT LAB., CINCINNATI, OH.
Trace Analyses for Wastewaters,
W82-03639 5A

ENVIRONMENTAL PROTECTION AGENCY, DC. EFFLUENT GUIDELINES DIV.
Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 5B

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 5B

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. EFFLUENT GUIDELINES DIV.
Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 5D

ENVIRONMENTAL PROTECTION AGENCY, WASHINTON, DC. EFFLUENT GUIDELINES DIV.
Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 5B

ENVIRONMENTAL PROTECTION SERVICE, BURLINGTON (ONTARIO). WASTEWATER TECHNOLOGY CENTER.
Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 5D

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., GAINESVILLE, FL.
Upgrading to Increase Treatment Capacity,
W82-03654 5F

FISH AND WILDLIFE SERVICE, COLUMBIA, MO.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 5B

FLORIDA INST. OF TECH., MELBOURNE.
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 5A

FLORIDA UNIV., GAINESVILLE. COLL. OF VETERINARY MEDICINE.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 5C

FLORIDA UNIV., GAINESVILLE. DEPT. OF FOOD SCIENCE AND HUMAN NUTRITION.
Microbiological Quality of Selected Recreational Waters,
W82-03636 5A

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 2H
Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 2H

GEOLOGICAL SURVEY, DENVER, CO.
Size Distribution of Amazon River Bed Sediment,
W82-03488 2J
Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 5B

GEOLOGICAL SURVEY, LAKEWOOD, CO.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 2K

GEOLOGICAL SURVEY, NORMAN, OK.
Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 2F

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 10B

GEOLOGICAL SURVEY, SYOSSET, NY. WATER RESOURCES DIV.
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 4B

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 5D

GEORGIA PACIFIC CORP., FORT BRAGG, CA.
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 2J

GRENOBLE UNIV. (FRANCE). UNITE DE GEOLOGIE ET DE PHARMACIE.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 2F

GRIFFITH UNIV., NATHAN (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 4A

HARSHBARGER AND ASSOCIATES, TUCSON, AZ.
Hydrology and Mining in the Tucson Areas,
W82-03697 2F

HEALTH EFFECTS RESEARCH LAB., CINCINNATI, OH.
Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 5B

HEBREW UNIV., JERUSALEM (ISRAEL). DEPT. OF GEOLOGY.
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 2K

HIGH ASWAN DAM AUTHORITY, CAIRO (EGYPT).
The Nile - One River and Nine Countries,
W82-03545 4A

HITACHI LTD., YOKOHAMA (JAPAN). PRODUCTION ENGINEERING RESEARCH LAB.
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 5D

HONG KONG UNIV., DEPT. OF BOTANY.
Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 5B

HOWARD UNIV., WASHINGTON, DC. DEPT. OF CHEMICAL ENGINEERING.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 5F

HULL UNIV. (ENGLAND). DEPT. OF PLANT PATHOLOGY.
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 7B

HYDROLOGICAL RESEARCH INST. PRETORIA (SOUTH AFRICA).
An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 7B

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ENGINEERING.
Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 3F

ILLINOIS STATE WATER SURVEY, CHAMPAIGN.
Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 5B

ILLINOIS UNIV. AT URBANA-CHAMPAIGN.
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 6D

ILLINOISS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL AND HYDROSYSTEMS ENGINEERING.
Hydraulic Exponents,
W82-03669 2E

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). PUBLIC HEALTH ENGINEERING LAB.
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 5D

INDIAN INST. OF SCIENCE, BANGALORE (INDIA). DEPT. OF CIVIL ENGINEERING.
Parametric Study of Flood Wave Propagation,
W82-03425 2E

INDIANA UNIV.-PURDUE UNIV. AT INDIANAPOLIS. DEPT. OF GEOLOGY.
A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 2H

INLAND CONTAINER CORP., NEWPORT MILL, IN.
Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 5D

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W82-03491 2L

INSTITUT ET OBSERVATOIRE DE PHYSIQUE, CLERMONT-FERRAND (FRANCE).
Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 2B

INSTITUT NATIONAL DES SCIENCES APPLIQUEES, TOULOUSE (FRANCE). LAB. DE CHIMIE ET GENIE DE L'ENVIRONNEMENT.
Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 5A
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 5A

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W82-03698 3A

INSTITUTE OF GEOLOGICAL SCIENCES, WALLINGFORD (ENGLAND).
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 2K

INSTITUUT VOOR CULTUURTECHNIEK EN WATERHUISHOUDING, WAGENINGEN (NETHERLANDS).

Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 5B

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Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 2B

INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT, ROME (ITALY).

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W82-03579 6F

INTERUNIVERSITAIR REACTOR INST., DELFT (NETHERLANDS).

Proton Mobility in Ice,
W82-03701 2C

IOWA STATE UNIV., AMES. DEPT. OF CIVIL ENGINEERING.

Declining-Rate Filtration,
W82-03656 5F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 2A

JORDAN (PERKINS), INC., READING, MA.

Interstate Highways Versus Watershed Protection in New England,
W82-03431 5B

KANSAS UNIV., KANSAS CITY. DEPT. OF ECONOMICS.

Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 4B

KANSAS UNIV., LAWRENCE. DEPT. OF CIVIL ENGINEERING.

Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 5D

KENTUCKY UNIV., LEXINGTON. DEPT. OF AGRICULTURAL ENGINEERING.

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 5D

KOREA INST. OF SCIENCE AND TECHNOLOGY, SEOUL.

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 5D

LANCASTER UNIV., BAILRIGG (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 5B

LANCHESTER POLYTECHNIC, COVENTRY (ENGLAND). DEPT. OF CIVIL ENGINEERING.

Primary Sedimentation of Sewage,
W82-03429 5D

LAVAL UNIV., QUEBEC. CENTER FOR NUTRITION STUDIES.

Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 5D

LEEDS UNIV. (ENGLAND). SCHOOL OF GEOGRAPHY.

Flood Area Modelling from an Elementary Data Base,
W82-03581 2E

LIFE SYSTEMS, INC., CLEVELAND, OH.

Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 5A

LIVERPOOL UNIV. (ENGLAND). HARTLEY BOTANICAL LABS.

On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 2L

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CHEMISTRY.

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 5A

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CIVIL ENGINEERING.

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 5E

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF MICROBIOLOGY.

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 5B

LOUISIANA STATE UNIV., BATON ROUGE. INST. OF ENVIRONMENTAL STUDIES.

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 2F

MACDONALD COLL., STE. ANNE DE BELLEVUE (QUEBEC). DEPT. OF AGRICULTURAL ENGINEERING.

Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 2A

MAHI-KADANA IRRIGATION PROJECT, AHMEDABAD (INDIA).

Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 9B

MAINE UNIV. AT ORONO.

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 5G

MAINE UNIV., AT ORONO. DEPT. OF FOOD SCIENCE.

High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 5A

MAINE UNIV. AT ORONO. DEPT. OF OCEANOGRAPHY.

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 2L

MASSACHUSETTS UNIV., AMHURST. DEPT. OF CHEMISTRY.

The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 5A

METCALF AND EDDY, INC., BOSTON, MA.

Methods for Evaluating Performance of Filter Media,
W82-03661 5F

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCE.

Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 2H

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 3C

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF FISHERIES AND WILDLIFE.

Arsenic in Lake Lansing, Michigan,
W82-03522 5B

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF MICROBIOLOGY.

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 2H

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W82-03401 5D

MICHIGAN UNIV., ANN ARBOR.

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 2H

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ATMOSPHERIC AND OCEANIC SCIENCE.

A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 2H

MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.

Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 2H

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND WATER RESOURCES ENGINEERING.

Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 5B

MINING DEVELOPMENT INST., BUDAPEST (HUNGARY).

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 5G

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Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 2J

MINNEAPOLIS WATER WORKS, MN.
Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 5F

MINNESOTA POLLUTION CONTROL AGENCY, ROSEVILLE.
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W82-03590 5B

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Diverging Overland Flow,
W82-03676 2A

MONROE COUNTY WATER AUTHORITY, ROCHESTER, NY.
Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 5D

MONTGOMERY COUNTY SANITARY DEPT., DAYTON, OH.
Microorganism Inventory in Activated Sludge Control,
W82-03483 5D

MONTGOMERY (JAMES M.), INC., PASADENA, CA.
Trihalomethanes in Drinking Water,
W82-03447 5F

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Four Options for Hazardous Waste Disposal,
W82-03416 5E

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W82-03404 2H

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W82-03492 5B

NATAL UNIV., PIETERMARITZBURG (SOUTH AFRICA). DEPT. OF BOTANY.
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W82-03406 2H

NATIONAL CANCER INST., BETHESDA, MD. DIV. OF CANCER CAUSE AND PREVENTION.
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W82-03433 5C

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W82-03439 5D

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W82-03631 6E

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W82-03685 2G

NAUCHNO-ISSLEDOVATELSKII INST. GIGIENY, MOSCOW (USSR).
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W82-03699 5C

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W82-03438 3F

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 4B

NEBRASKA UNIV., LINCOLN.
Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 2A

Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 6B

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Control of the Activated Sludge Process,
W82-03499 5D

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W82-03546 2H

NEW JERSEY INST. OF TECH., NEWARK.
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W82-03739 3A

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W82-03724 5A

NEWFOUNDLAND AND LABRADOR HYDRO, ST. JOHN'S.
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W82-03619 6G

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W82-03520 2L

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W82-03537 6B

OHIO RIVER VALLEY WATER SANITATION COMMISSION, CINCINNATI.
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W82-03436 5A

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W82-03531 9A

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W82-03510 5G

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W82-03662 5B

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W82-03559 5D

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W82-03535 5D

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W82-03730 5A

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W82-03616 6G

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W82-03519 2H

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W82-03604 5C

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W82-03543 2K

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W82-03648 2F

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W82-03583 2H

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W82-03448 5F

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W82-03716 2E

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W82-03523 6A

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W82-03638 5B

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W82-03678 5C

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W82-03501 1A

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W82-03407 2L

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W82-03508 4A

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W82-03500 5F

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W82-03524 2H

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W82-03525 5D

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W82-03440 3B

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W82-03655 5F

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W82-03542 2F

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W82-03479 2I

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W82-03445 2G

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W82-03470 5C

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 2F

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W82-03460 5A

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W82-03610 5C

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W82-03608 5A

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W82-03456 6C

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W82-03681 2A

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W82-03714 4B

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W82-03611 2K

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W82-03558 5B

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W82-03657 5F

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W82-03468 8A

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W82-03589 2G

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W82-03432 6A

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W82-03528 3C

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W82-03598 5D

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W82-03729 6B

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W82-03715 2G

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W82-03710 8A

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 2G

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W82-03540 2F

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W82-03607 5C

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W82-03601 5F

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W82-03402 2K

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W82-03614 6E

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W82-03511 5C

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W82-03719 5D

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W82-03409 5C

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W82-03423 2L

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W82-03469 2L

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W82-03748 8B

UTAH STATE UNIV., LOGAN.
Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 2G

UTAH STATE UNIV., LOGAN. COLL. OF NATURAL RESOURCES.
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 2A

UTAH STATE UNIV., LOGAN. DEPT. OF ENGINEERING.
Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 2A

Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 3C

VANDERBILT UNIV., NASHVILLE, TN.
Nonlinear Sorption of Water in Soil,
W82-03686 2G

VIENNA UNIV. (AUSTRIA). ZOOLOGISCHES INST.
Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 2H

VILLANOVA UNIV., PA. DEPT. OF CIVIL ENGINEERING.
Analysis of Waste Load Allocation Procedures,
W82-03550 5G

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 5B

WADE, TRIM AND ASSOCIATES, TAYLOR, MI.
Wastewater Treatment Plant Features New Technology,
W82-03591 5D

WALKER (R. L.) AND PARTNERS LTD., OTTAWA (ONTARIO).
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 6A

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 6B

WASHINGTON UNIV., SEATTLE.
Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 5A

Sediment Transport by Rainsplash,
W82-03709 2J

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
Particle Counter for Sediment Transport Studies,
W82-03666 7B

WATER MANAGEMENT RESEARCH LABORATORY, FRESNO, CALIFORNIA.
Artificial Basin Recharge,
W82-03745 4B

WATER TREATMENT PLANT, TRAVERSE CITY, MI.
Down to Earth Leak Detection,
W82-03561 5F

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 2F

WATERLOOPKUNDIG LAB., DELFT (NETHERLANDS). BASIC RESEARCH DIV.
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 2L

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF SURGERY.
Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 2H

WESTERN KENTUCKY UNIV., BOWLING GREEN. DEPT. OF BIOLOGY.
Enumerating Bacteria in River Water and Sewage Effluent,
W82-03446 5A

WESTON (ROY F.), INC., WEST CHESTER, PA.
Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 5D

WISCONSIN UNIV.-MADISON.
Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 2H

Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 2J

WISCONSIN UNIV.-MADISON. DEPT. OF AGRICULTURAL ECONOMICS.
Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 5G

WISCONSIN UNIV.-MADISON. MARINE STUDIES CENTER.
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 5B

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 5B

WOODWARD-CLYDE CONSULTANTS, ANCHORAGE, AL.
Deep Water Renewal in Subarctic Fjord,
W82-03675 2L

WORCESTER POLYTECHNIC INST., HOLDEN, MA. ALDEN RESEARCH LABS.
Model-Prototype Comparison of Free Surface Vortices,
W82-03667 8B

Heated Discharge in an Estuary: Case Study,
W82-03674 2L

YORKSHIRE WATER AUTHORITY (ENGLAND).
A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 7B

YORKSHIRE WATER AUTHORITY, SHEFFIELDS (ENGLAND). SOUTHERN DIV.
A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 5B

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UNIVERSIDAD NACIONAL DE NICARAGUA, MANAGUA.

[illegible]

UNIVERSITY COLL., LONDON (ENGLAND).

[illegible]

WASHINGTON UNIV., SEATTLE.

[illegible]

ACCESSION NUMBER INDEX

W82-03401 5D
W82-03402 2K
W82-03403 2H
W82-03404 2H
W82-03405 7B
W82-03406 2H
W82-03407 2L
W82-03408 2L
W82-03409 5C
W82-03410 2I
W82-03411 2J
W82-03412 7B
W82-03413 3B
W82-03414 2H
W82-03415 2F
W82-03416 5E
W82-03417 5B
W82-03418 5C
W82-03419 2H
W82-03420 2H
W82-03421 5G
W82-03422 2B
W82-03423 2L
W82-03424 6E
W82-03425 2E
W82-03426 5D
W82-03427 5B
W82-03428 7B
W82-03429 5D
W82-03430 5B
W82-03431 5B
W82-03432 6A
W82-03433 5C
W82-03434 9B
W82-03435 5E
W82-03436 5A
W82-03437 7B
W82-03438 3F
W82-03439 5D
W82-03440 3B
W82-03441 2A
W82-03442 2H
W82-03443 7A
W82-03444 5A
W82-03445 2G
W82-03446 5A
W82-03447 5F
W82-03448 5F
W82-03449 5G
W82-03450 6E
W82-03451 5B
W82-03452 4B
W82-03453 5D
W82-03454 5D
W82-03455 5D
W82-03456 6C
W82-03457 4A
W82-03458 5B
W82-03459 4C
W82-03460 5A
W82-03461 5F
W82-03462 8A
W82-03463 5D
W82-03464 5D
W82-03465 2H
W82-03466 4B
W82-03467 2B
W82-03468 8A
W82-03469 2L
W82-03470 5C
W82-03471 5F
W82-03472 6E
W82-03473 5F
W82-03474 6A
W82-03475 6A
W82-03476 6E
W82-03477 5D
W82-03478 5D
W82-03479 2I
W82-03480 5B
W82-03481 2F
W82-03482 5E
W82-03483 5D
W82-03484 8A
W82-03485 5A
W82-03486 5A
W82-03487 1B
W82-03488 2J
W82-03489 5B
W82-03490 6G
W82-03491 2L
W82-03492 5B
W82-03493 8A
W82-03494 5G
W82-03495 6E
W82-03496 6E
W82-03497 8D
W82-03498 8A
W82-03499 5D
W82-03500 5D
W82-03501 1A
W82-03502 2A
W82-03503 4B
W82-03504 6A
W82-03505 5A
W82-03506 5C
W82-03507 6D
W82-03508 4A
W82-03509 8A
W82-03510 5G
W82-03511 5C
W82-03512 5G
W82-03513 2A
W82-03514 2H
W82-03515 2H
W82-03516 2J
W82-03517 5D
W82-03518 6B
W82-03519 2H
W82-03520 2L
W82-03521 3C
W82-03522 5B
W82-03523 6A
W82-03524 2H
W82-03525 5D
W82-03526 5A
W82-03527 5G
W82-03528 3C
W82-03529 5A
W82-03530 3F
W82-03531 9A
W82-03532 8A
W82-03533 5B
W82-03534 2K
W82-03535 5D
W82-03536 5B
W82-03537 6B
W82-03538 5D
W82-03539 5D
W82-03540 2F
W82-03541 2F
W82-03542 2F
W82-03543 2K
W82-03544 4C
W82-03545 4A
W82-03546 2H
W82-03547 6D
W82-03548 2J
W82-03549 2A
W82-03550 5G
W82-03551 5F
W82-03552 6D
W82-03553 5E
W82-03554 5B
W82-03555 5B
W82-03556 5B
W82-03557 1B
W82-03558 5B
W82-03559 5D
W82-03560 3F
W82-03561 5F
W82-03562 3D
W82-03563 5G
W82-03564 5D
W82-03565 5D
W82-03566 5D
W82-03567 5D
W82-03568 5D
W82-03569 5D
W82-03570 5D
W82-03571 5B
W82-03572 2H
W82-03573 1A
W82-03574 4C
W82-03575 5C
W82-03576 4B
W82-03577 2F
W82-03578 2G
W82-03579 6F
W82-03580 5F
W82-03581 2E
W82-03582 2F
W82-03583 2H
W82-03584 2F
W82-03585 5D
W82-03586 2F
W82-03587 5D
W82-03588 5D
W82-03589 2G
W82-03590 5B
W82-03591 5D
W82-03592 5D
W82-03593 5D
W82-03594 2F
W82-03595 5B
W82-03596 5F
W82-03597 5D
W82-03598 5D
W82-03599 5B
W82-03600 3C
W82-03601 5F
W82-03602 5B
W82-03603 5C
W82-03604 5C
W82-03605 5A
W82-03606 5C
W82-03607 5C
W82-03608 5A
W82-03609 5C
W82-03610 5C
W82-03611 2K
W82-03612 5C
W82-03613 2H
W82-03614 6E
W82-03615 6A
W82-03616 6G
W82-03617 8A
W82-03618 6G
W82-03619 6G
W82-03620 6B
W82-03621 8A
W82-03622 2H
W82-03623 8C
W82-03624 5B
W82-03625 5B
W82-03626 5D
W82-03627 5B
W82-03628 5B
W82-03629 5D
W82-03630 4B
W82-03631 6E
W82-03632 5D
W82-03633 6D
W82-03634 5D
W82-03635 5A
W82-03636 5A
W82-03637 5G
W82-03638 5B
W82-03639 5A
W82-03640 5B
W82-03641 5B
W82-03642 2K
W82-03643 2H
W82-03644 2K
W82-03645 5B
W82-03646 5E
W82-03647 2F
W82-03648 2F
W82-03649 10B
W82-03650 5D
W82-03651 2F
W82-03652 5G
W82-03653 5F
W82-03654 5F
W82-03655 5F
W82-03656 5F
W82-03657 5F
W82-03658 5A
W82-03659 5F
W82-03660 8G
W82-03661 5F
W82-03662 5B
W82-03663 5F
W82-03664 5D
W82-03665 5F
W82-03666 7B
W82-03667 8B
W82-03668 8A
W82-03669 2E
W82-03670 8B
W82-03671 2L
W82-03672 8A
W82-03673 6A
W82-03674 2L
W82-03675 2L
W82-03676 2A
W82-03677 8G
W82-03678 5C
W82-03679 5D
W82-03680 5D
W82-03681 2A
W82-03682 7B
W82-03683 5B
W82-03684 2K
W82-03685 2G
W82-03686 2G
W82-03687 6E
W82-03688 6E
W82-03689 2H
W82-03690 5B
W82-03691 5E
W82-03692 5B
W82-03693 8A
W82-03694 8E
W82-03695 5B
W82-03696 5B
W82-03697 2F
W82-03698 3A
W82-03699 5C
W82-03700 5A
W82-03701 2C
W82-03702 2C
W82-03703 5D
W82-03704 2H
W82-03705 4A
W82-03706 2F
W82-03707 2B
W82-03708 2K
W82-03709 2J
W82-03710 8A
W82-03711 2H
W82-03712 2H
W82-03713 6B
W82-03714 4B
W82-03715 2G
W82-03716 2E
W82-03717 2G
W82-03718 2A
W82-03719 5D
W82-03720 2J
W82-03721 5D
W82-03722 2H
W82-03723 3C
W82-03724 5A
W82-03725 5D
W82-03726 3A
W82-03727 5D
W82-03728 2G
W82-03729 6B
W82-03730 5A
W82-03731 6E
W82-03732 5G
W82-03733 4B
W82-03734 4B
W82-03735 5B
W82-03736 6E

W82-03737	5D
W82-03738	5B
W82-03739	3A
W82-03740	6F
W82-03741	5F
W82-03742	5F
W82-03743	3B
W82-03744	5G
W82-03745	4B
W82-03746	6E
W82-03747	6E
W82-03748	8B
W82-03749	2L
W82-03750	5F

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Subject Fields

- NATURE OF WATER
- WATER CYCLE
- WATER SUPPLY AUGMENTATION AND CONSERVATION
- WATER QUANTITY MANAGEMENT AND CONTROL
- WATER QUALITY MANAGEMENT AND PROTECTION
- WATER RESOURCES PLANNING
- RESOURCES DATA
- ENGINEERING WORKS
- MANPOWER, GRANTS, AND FACILITIES
- SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSSION NUMBER INDEX

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SELECTED WATER RESOURCES ABSTRACTS

U. S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

VOLUME 15, NUMBER 10
OCTOBER 1, 1982

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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

VOLUME 15, NUMBER 10
OCTOBER 1, 1982

W82-04251 -- W82-04750

MARCH 3, 1849

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

THE GEOTHERMAL HYDROLOGY OF WARNER VALLEY, OREGON: A RECONNAISSANCE STUDY,
Geological Survey, Menlo Park, CA. Water Resources Div.
E. A. Sammel, and R. W. Craig.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.00. Geological Survey Professional Paper 1044-I, 1981. 47 p, 21 Fig, 1 Plate, 9 Tab, 71 Ref.

Descriptors: *Geothermal studies, *Groundwater, *Thermal water, *Thermal properties, Aquifer characteristics, Geohydrology, Geochemistry, Warm springs, Heat flow, Thermocline, Geophysics, *Oregon, *Warner Valley.

Warner Valley, a high-desert valley situated in the Basin and Range province of south-central Oregon, contains thermal waters that are currently discharged from at least 30 springs and wells. The waters originate as local meteoric water which circulates to depths of 13,000 feet or more in faults and fault intersections in Tertiary basaltic flow rocks and tuffaceous sediments. The thermal waters are of two chemical types: sodium chloride and sodium bicarbonate waters. Temperatures in the hotter sodium chloride waters are known to be as high as 127 C; the cooler sodium bicarbonate waters are highly mixed with recharge water and have temperatures in the range 20 C to 40 C. Geothermometers and mixing models indicate that temperatures of equilibration are at least 170 C for the thermal components of the hotter waters. Conductive heat flow through the valley-fill deposits is estimated to be 75 milliwatts per square meter and the normal thermal gradient in the valley may be about 40 C per kilometer, both slightly low for the Basin and Range province. The size and location of the geothermal reservoirs are unknown. If a single reservoir underlies the two principal areas of thermal discharge, total heat stored in the reservoir above a base temperature of 10 C may be about 1.6 x 10 to the 19th power joules. If, however, the thermal fluids at depth are restricted to the major boundary faults, the stored heat at high temperatures may be about 5 x 10 to the 16th power joules. Recoverable heat at lower temperatures from depths less than 1,000 feet in the valley-fill deposits may also be about 5 x 10 to the 16th power joules. (USGS)
W82-04496

INTERPRETATION OF CHEMICAL ANALYSES OF WATER COLLECTED FROM TWO GEOTHERMAL WELLS AT COSO, CALIFORNIA,
Geological Survey, Menlo Park, CA.
R. O. Fournier, J. M. Thompson, and C. F. Austin.
Journal of Geophysical Research, Vol 85, No B5, p 2405-2410, May 10, 1980. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Geothermal studies, *Chemical analysis, *Water analysis, *Hot springs, Water temperature, Wells, Chlorides, Groundwater reservoirs, Coso, *California.

Wellhead and downhole water samples from two wells drilled for geothermal energy exploration were sampled and analyzed in an effort to predict reservoir temperatures and fluid characteristics in still unexplored parts of the system. The first well, Coso No. 1 located at Coso hot springs in California, had been drilled to a depth of 114.3 eters. The second well, CGEH No. 1 located 3.2 kilometers to the west, had been drilled to a depth of 1477 meters. The same chloride concentration is present in hot waters entering each of the wells (about 2350 milligrams per kilogram), indicating that a body of uniformly chloride-rich hot water is present at depth in the Coso geothermal system. The maximum measured temperatures were 142 C in the Coso No. 1 well and 195 C in the CGEH No. 1 well. Cation and sulfate isotope geothermometers indicate that the reservoir feeding water to the Coso hot spring has a temperature of about 240 C to 250 C, and that the reservoir feeding the CGEH well has a temperature of about 205 C. The fumarole, acid-sulfate pool, and shallow steam well expressions of hydrothermal activity in the area give a false indication of an extensive vapor-dominated system since the upward convecting, boiling, alkaline-chloride waters do not reach the surface. The presence of a chloride-rich hot water system rather than a vapor-dominated system should be considered when interpreting geophysical data and calculating the economics of exploiting the geothermal energy resource. (Carroll-FRC)
W82-04743

A MODEL OF HYDROTHERMAL CONVECTION IN AN AQUIFER,
Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY.
K. E. Torrance, V. W. C. Chan, and D. L. Turcotte.
Journal of Geophysical Research, Vol 85, No B5, p 2554-2558, May 10, 1980. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Hydrothermal studies, *Aquifers, Thermal conductivity, Turbulent flow, *Geothermal studies, Laminar flow, Transition flow, Velocity, Mathematical models, Numerical analysis.

Numerical calculations were conducted to determine the temperature distribution resulting from the steady state hydrothermal flow of water through a smoothly curved cylindrical aquifer. The outflow water temperature was found to be closest to the ambient temperature at the base of the aquifer at intermediate flow rates. Low flow velocities resulted in the cooling of the water by conduction to the wall rock before it reached the surface, while high flow velocity did not allow the water time to be heated by conduction from the wall rock. The transition from laminar to turbulent flow was found to reduce the flow through the aquifer and the temperature of the outflow water. Outflow temperatures were generally found to be too low to explain continental hot springs. Shallow laminar hydrothermal flows were shown to be more effective in transporting heat to the surface than deeper turbulent flows. These results suggest that very shallow (less than 100 meter) hydrothermal flows of seawater in the oceanic crust may be responsible for the reduction and variability of the measured near-surface geothermal gradient. (Carroll-FRC)
W82-04744

1B. Aqueous Solutions and Suspensions

THE CHEMISTRY OF SALINE WATER CHLORINATION,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 3C.
W82-04729

2. WATER CYCLE

2A. General

RELATION BETWEEN CURVE NUMBER AND RUNOFF COEFFICIENT,
Maryland Univ., College Park. Coll. of Engineering.
R. H. McCuen, and T. R. Bondelid.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 395-400 December, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Watersheds, *Graphical methods, *Land use, *Computer models, Model studies, Graphical analysis, Mathematical studies, Mathematical models, *Runoff, Peak discharge, Hydrologic models.

Two peak discharge methods, the rational formula and the TR-55 graphic method, are based on similar input data and give similar peak discharge estimates when land use is similar. Peak discharge estimates by the rational formula are more sensitive to runoff coefficient (C) values than are TR-55 estimates to the runoff curve number (CN). The graphical method is based on the conceptual framework of the RUNOFF subroutine of the Soil conservation Service (SCS) TR-20 computer program, which should form peak discharges similar to those obtained with the rational formula. Disparities in land use values create C values that are higher than normally acceptable. This bias should be taken into account when design projects are controlled by different policies. For residential and open space land use categories, the graphical method generally provides higher peak discharge estimates than the rational method. The SCS methods, including the TR-55 graphical method, ae based on a 24 hr storm distribution and do not necessarily have to include a bias in estimating the peak discharge. (Geiger-FRC)
W82-04266

YOUNG'S INEQUALITY FOR THREE-DIMENSIONAL FLOWS,
Public Power Corp., Athens (Greece). Computing Center.
A. T. Marinos.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 388-394, December, 1981. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Mathematical equations, *Drainage, *Precipitation intensity, *Flow profiles, Mathematical models, Darcys law, Youngs modulus, Water table, *Porosity.

Young's inequality for steady drainage through a porous strip contained between two parallel ditches is useful for relating the height of the water table at its center, the precipitation intensity, the ditch spacing, and the level of permanent water horizon. An extension of Young's inequality to three-dimensional flow is presented which may be applied to calculate the limits on precipitation intensity for steady flows so that the maximum height of the water will not exceed a prescribed value. The equations for calculating these bounds take on closed type formulas when the steady drainage takes place through regular (rectangular) cross sections and the precipitation intensity is such that a formal solution of the partial differential equation is possible. (Geiger-FRC)
W82-04267

PROBLEMS OF MODELLING A HIGH MOUNTAINOUS DRAINAGE BASIN WITH PREDOMINANT SNOW YIELDS,
Grenoble-1 Univ. (France). Inst. de Mecanique.
R. Charbonneau, J.-P. Lardeau, and C. Obled.
Hydrological Sciences Bulletin, Vol 26, No 4, p 345-361, December, 1981. 11 Fig, 4 Tab, 14 Ref.

Descriptors: *Hydrologic models, *Snowmelt, *Hydrologic cycle, *Catchment areas, Model studies, Evapotranspiration, Evaporation, Energy, Air temperature, Physiographic balance, Drainage area, Precipitation, Snow, Mountains, *Durance River basin, *French Alps.

Three snowmelt and evapotranspiration models for a high mountain drainage basin of the Durance River in the French Alps were developed and compared. The Durance model was specifically designed for the basin and used a refined description of the physiographic features and snowmelt routine based on energy budgets at 12 hr intervals. The HSP general purpose hydrological model was partially standardized and showed the best four-year adjustment due to its large number of degrees of freedom. An intermediate model kept all the parameter values of the HSP model, but did not benefit from a heat budget component. This modified HSP model receives air temperature values from a main program which has been shown to systematically underestimate the maximum temperature which influences snowmelt. The ready-made models took almost as long to set up and adjust as the Durance model. Major errors in calculations did not occur in the modelling of the hydrological cycle but rather in peripheral parameters dealing with data estimation or extrapolation.

It was suggested that standardized procedures for the estimation of missing model data be avoided and replaced by objective analyses of precipitation, snow cover and temperature fields of the drainage basin. (Geiger-(FRC)
W82-04303

RELATIVE RUNOFF BY CURVE NUMBER NOMOGRAPH,

New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 385-388, December, 1981. 1 Fig, 10 Ref.

Descriptors: *Graphical methods, *Watersheds, *Mathematical models, *Storm runoff, *Discharge measurement, Graphical analysis, Runoff, Model studies, Runoff, Precipitation, Mathematical equations, Mathematical studies, *Channel morphology.

The graphical solution for relative discharge allows rapid estimation of runoff changes due to watershed modifications and visual evaluation of the sensitivity of runoff change to the Soil Conservation Service curve number (CN) modifications and storm precipitation. An equation for relative runoff may be used for a more accurate calculation; however, an analysis based on curve numbers should be regarded as only an approximate solution. The relative runoff equation may be solved by graphical methods. Vertical and horizontal nomographs are used to intersect two specific sections of the rectangular chart, and the curve corresponding to the Cartesian coordinate defined by these two intersections represents the relative runoff. Graphical analysis of relative change provides a pragmatic basis for anticipating runoff modification for problems where actual discharge can be measured or estimated by alternative methods. (Geiger-FRC)
W82-04307

DIMENSIONLESS STREAM ADVANCE IN SLOPING BORDERS,

Science and Education Administration, Phoenix, AZ. Conservation Lab.
For primary bibliographic entry see Field 3F.
W82-04308

THE GENERAL HYDROLOGIC SYSTEM MODEL,

Mississippi State Univ., Mississippi State. Dept. of Mathematics.
R. C. McCann, and V. P. Singh.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, 1581-1592, December, 1981. 3 Fig, 14 Ref.

Descriptors: *Hydrographs, *Storm runoff, *Hydrologic models, General Hydrologic System model, Model studies, Runoff, Rainfall-runoff relationships, Excess rainfall, Chow and Kulandaiswamy model.

Improvements and simplifications are suggested for Chow and Kulandaiswamy's General Hydrologic System model. The problem of negative instantaneous unit hydrographs, arising from the inconsistencies in the derivations and initial conditions, was solved by assuming an instant unit hydrograph of zero at zero time. This caused coefficients associated with derivatives of excess rainfall to vanish. (Cassar-FRC)
W82-04314

TWO-DIMENSIONAL SOIL MOISTURE FLOW IN A SLOPING RECTANGULAR REGION: EXPERIMENTAL AND NUMERICAL STUDIES,

Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
J. L. Nieber, and M. F. Walter.
Water Resources Research, Vol 17, No 6, p 1722-1730, December, 1981. 12 Fig, 23 Ref.

Descriptors: *Soil water, *Slopes, *Infiltration, Numerical analysis, Hydrographs, Flumes, Rainfall infiltration, Capillarity.

The two-dimensional flow of soil moisture under the conditions of rainfall infiltration was studied in a hillslope soil moisture flow laboratory model composed of a flume (3.66 x 0.58 x 0.108 m) filled with sand. Experimental results, expressed as hydraulic head fields and runoff hydrographs, agreed well with results from a numerical solution after the effects of capillary hysteresis were incorporated into the numerical solution. Without considering the capillary hysteresis the numerically simulated hydrograph lagged behind the experimental hydrograph to a significant degree. the numerical technique was derived from a finite element-finite difference solution of the Richards equation. (Cassar-FRC)
W82-04333

STORM RUNOFF ANALYSES ON THREE SEMI-ARID CATCHMENTS,

Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
D. L. Murray, and A. H. M. Gorgens.
Water SA, Vol 7, No 4, p 223-233, October, 1981. 6 Fig, 6 Tab, 16 Ref.

Descriptors: *Storm runoff, *Rainstorms, *Hydrographs, *Semiarid lands, Rainfall-runoff relationships, Statistical analysis, Ecca River, Grahamstown, *South Africa, Runoff, Rainfall intensity, Evaporation, Streamflow, Antecedent moisture, Peak flow.

A statistical analysis of storm rainfall and streamflow data (1975-1979) from 3 semiarid catchments in the Ecca River region, South Africa, produced preliminary equations for predicting storm hydrograph characteristics. The best index of catchment wetness at the beginning of a storm was generally the seven-day antecedent rainfall. Storm flow volume was predicted using seven-day antecedent rainfall and storm rainfall. Storm flow peak and storm flow duration were obtained from predicted storm flow volume. Independent variables considered in this study were storm rainfall, rainfall duration, maximum intensity of rainfall, antecedent flow, and antecedent rainfall and moisture indices calculated by accumulating rainfall and potential evaporation over varying periods prior to storms. (Cassar-FRC)
W82-04339

HYDROGEOLOGIC EVALUATION OF WETLAND BASINS FOR LAND USE PLANNING,

Lowell Univ., MA. Dept. of Earth Sciences.
A. L. O'Brien, and W. S. Motts.
Water Resources Bulletin, Vol 16, No 5, p 785-789, October, 1980. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Wetlands, *Classification, *Land use, *Groundwater potential, Geohydrology, Geology, Topography, Geomorphology, Water quality, Aquifers, Hydrology.

Since wetlands vary according to geologic, hydrologic and topographic settings, a wetland classification based on these factors which modify hydrologic response is proposed to provide a good framework for evaluation of wetland research in relation to land use planning. Wetlands affect the potential for groundwater development in wetland dominated basin, modify the character of runoff from a basin and influence the discharge/recharge relationship with the underlying aquifer. Some geologic and hydrologic factors which might allow distinction between wetlands include the character and thinkness of surficial materials, bedrock type, hydrologic position, permeability of the organic layer, transmissivity, water quality, aquifer structure, groundwater outflows and depth of standing water. Some distinguishing topographic features of wetlands are position in the drainage basin, relative size, and absolute size of wetlands. Application of the proposed classification scheme to wetlands in the northeastern United States produced two realistic geologic types that could be expected to be encountered. Matrices of these two types produced 25 categories of wetlands, 13 of which are common types. These types should be further tested to define their hydrologic function in this classification scheme. (Geiger-FRC)
W82-04439

ANALYSIS OF DETENTION BASIN SYSTEMS,

Monash Univ., Clayton (Australia).
R. G. Mein.
Water Resources Bulletin, Vol 16, No 5, p 824-829, October, 1980. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Mathematical models, *Detention reservoirs, *Design criteria, *Flood peak, *Flood-control storage, Hydrologic models, Model studies, Catchment basins, Flood hydrographs, Storm runoff, Flood routing, Simulation analysis, Mathematical studies.

Simple procedures of designing detention basins to reduce peak flows on rivers and streams are often limited in scope. A more complicated routing model is described, and its application to an urban basin system at Gardiner's Creek, Australia is examined. The model computes design inflow hydrographs and routes flow downstream to the next point of interest. The catchment is divided into subcatchments along watershed lines, excess rainfall is calculated from the temporal pattern of the nearest recording rain gauge, and the depth is obtained from the isohyetal map of the storm event. Catchment storage effects are simulated by routing flows between subcatchments through simple nonlinear storage elements. The present model was found suitable for examining basins in series or in parallel. Although it seems unlikely that the addition of a basin would increase flood peaks downstream to any significant extent, it still may be possible for a particular combination of basins to have this effect. It is therefore suggested that multibasin systems be fully investigated under various storm events to assess the individual contribution of each basin to flood mitigation. (Geiger-FRC)
W82-04444

COMPARISON OF MODELS FOR FORECASTING SNOWMELT RUNOFF VOLUMES,

Maryland Univ., College Park. Dept. of Civil Engineering.
M. E. Hawley, R. H. McCuen, and A. Rango.
Water Resources Bulletin, Vol 16, No 5, p 914-920, October, 1980. 4 Tab, 8 Ref.

Descriptors: *Snowmelt, *Runoff-forecasting, *Model studies, Mathematical studies, Water supply, Remote sensing, Hydrologic models, Comparison studies.

Available snowmelt models were tested for accuracy on a single watershed using the same data base. Specific analyses were made for determining the value of Landsat derived snow covered area (SCA) data in the various runoff prediction models; to investigate the value of subdividing the watershed into smaller, more homogeneous areas; to determine the effect of delays in data collection such as that which might occur in the compilation and analysis of Landsat data; to evaluate the accuracy of forecasts based solely on SCA measurements; and to determine the length of record required for model calibration. Models tested include the Regression model, the Water Balance model, and the Martinec model. Accuracy of the Tangborn model and the regression models was greater if the test data fell within the range of calibration data rather than outside. Regression models were significantly more accurate for forecasts of 60 days or more than for shorter periods. The Tangborn model was more accurate for forecasts of 90 days or more. The Martinec model was more accurate for forecasts of 1, 2, 3, 5, 10, or 15 days. Accuracy of long term models was independent of forecast data. The short term models were least accurate for forecast periods in late May and early June. The Martinec model was the best of those tested for one and two day forecasts. Regression models were roughly equal in accuracy. Spatial separation of the watershed by elevation zones did not improve the accuracy of the Martinec model in the Kings River basin. Delays in data collection of more than one day may sig-

nificantly lessen the accuracy of the Martinec model. (Baker-FRC)
W82-04452

PREDICTION OF WATER INFLOW TO LAKE MEMPHREMAGOG (PREVISION DES APPORTS HYDRIQUES AU LAC MEMPHREMAGOG),

Ministere de l'Environnement, Sainte-Foy (Quebec). Service des Eaux de Surface.
V. D. Hoang, and B. Robert.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 433-441, 1981. 4 Fig, 3 Tab, 5 Ref. English summary.

Descriptors: *Hydrologic models, *Lakes, *Forecasting, Prediction, Water levels, *Lake Memphremagog, *Quebec, Flood control, Snowmelt, Runoff, Watersheds, *Inflow forecasting.

Water inflow forecasts are being designed for some Quebec watersheds for the purposes of environmental protection and to fulfill international agreements. Accurate assessment of runoff during the spring thaw and periods of heavy rain was necessary for Lake Memphremagog near Magog, Quebec, in view of the low discharge capacity at the outlet of the lake and the obligation to regulate water levels. A hydrometeorologic model of the deterministic type, the SSARR (streamflow synthesis and reservoir regulation) model, was selected. This model makes it possible to calculate the snowmelt based on daily temperature and precipitation values, whereas the other possibility, the Ohio-Stanford model, requires a knowledge of numerous physical parameters requiring complex measurements. The SSARR model incorporates sub-models of the watershed, the river drainage, and the lake reservoir, plus a forecasting model. The resulting model was calibrated using data from the Black River for 1971-1973, then verified with data from 1974 and 1975. The error in the observed flow compared to the calculated flow was estimated using the criterion of volume, the point criterion, and the final criterion. Predictive application of this model in 1979 gave highly encouraging results, with an error of about 16%. Further improvements are desired to reduce the error to 10%, but the information already available will permit adequate flood warning for downstream residents plus systematic operation of the outlet dam. (Carroll-FRC)
W82-04459

REGIONAL HYDROLOGIC MODELS FOR CLIMATOLOGY: AN APPLICATION TO THREE WISCONSIN WATERSHEDS,

Wisconsin Univ.-Madison.
D. R. Clark.
PhD Thesis, May, 1981. 106 p, 19 Fig, 17 Tab, 35 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-17508.

Descriptors: *Watersheds, *Hydrologic models, *Seasonal variation, *Evapotranspiration, Runoff, Drainage, Recharge, Soil moisture retention, *Climatology, *Wisconsin.

Two hydrologic models are applied to three watersheds in south central Wisconsin over a thirty year period. Although in the same climatic region, the three watersheds have different hydrologic responses due to their different basin characteristics. The two models are designed for the study of seasonal interactions between external climatic factors and regional hydrologic responses. Input data consists of monthly rainfall, snowmelt, absorbed solar radiation, frost depth and an empirical vegetation seasonality index. Evapotranspiration is parameterized in terms of absorbed solar radiation, a vegetation seasonality index, and moisture storage. Parameterization of runoff and drainage between storages includes the effect of soil freeze and moisture storage. Model parameter values were obtained by calibration of model runoff to observed streamflow. Model storage levels were compared to water table observations in one watershed. Sensitivity of the calibrations was tested by a series of Monte-Carlo experiments using randomly perturbed input data, and by parameter sensitivity tests. The two storage model is found to simulate streamflow just as well as the three-storage model. Normal spring ground water recharge is reduced or absent when preceding fall precipitation fails to replenish summer soil moisture losses, or scant snowcover permits deep winter soil freeze. Major recharge episodes result from consecutive months of excessive precipitation or snowmelt, but not from an isolated high-input month. (Sinha-OEIS)
W82-04483

DIGITAL-MODEL SIMULATION OF THE TOPPENISH ALLUVIAL AQUIFER, YAKIMA INDIAN RESERVATION, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
E. L. Bolke, and J. A. Skrivan.
Geological Survey Open-File Report 81-425 (WRI), 1981. 34 p, 14 Fig, 2 Tab, 8 Ref.

Descriptors: *Computer models, *Aquifers, *Surface-groundwater relations, *Water use, Simulation analysis, Model studies, Water demand, Hydrologic budget, Irrigation, Streamflow, Wells, Water levels fluctuations, Groundwater movement, Hydraulic conductivity, *Washington, *Yakima Indian Reservation, Yakima River.

Increasing demands for irrigating additional lands and proposals to divert water from the Yakima River by water users downstream from the Yakima Indian Reservation have made an accounting of water availability important for present-day water management in the Toppenish Creek basin. A digital model was constructed and calibrated for the Toppenish alluvial aquifer to help fulfill this need. The average difference between observed and model-calculated aquifer heads was about 4 feet. Results of model analysis show that the net gain from the Yakima River to the aquifer is 90 cubic feet per second, and the net loss from the aquifer to Toppenish Creek is 137 cubic feet per second. Water-level declines of about 5 feet were calculated for an area near Toppenish in response to a hypothetical tenfold increase in 1974 pumping rates. (USGS)
W82-04514

EVALUATION OF METHODS FOR DETERMINING URBAN RUNOFF CURVE NUMBERS,

Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 4C.
W82-04535

A KINETIC MODEL FOR SURFACE MINE SEDIMENT YIELD,

Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 2J.
W82-04552

SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,

Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-04646

A DIMENSIONLESS UNIT HYDROGRAPH FOR URBANIZING CATCHMENT AREAS,

Sir William Halcrow and Partners, London (England).
M. J. Hall.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 37-50, March, 1981. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Urbanization, *Hydrographs, *Streamflow forecasting, Land use, Rainfall-runoff relationships, Paving, Runoff, *Urban runoff, Excess rainfall, England.

A method for quantifying changes in flow regimes caused by urbanization was developed. Unit hydrographs corresponding to a common duration for catchments in different stages of urban growth were correlated with catchment characteristics such as degree of urban development. This procedure was used with data from several areas in England to derive a dimensionless one-hour unit hydrograph. The scaling parameter for the hydrograph was expressed as a function of the basin ratio and the percentage of impervious area. (Cassar-FRC)
W82-04683

FORECASTING CHANGES OF WATER RESOURCES IN LARGE RIVERS FOLLOWING LAND DRAINAGE,

Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
S. M. Novkov, and J. S. Goncharova.
Hydrological Sciences Bulletin, Vol 26, No 4, p 393-398, December, 1981. 10 Ref.

Descriptors: *Hydrologic budgets, Evaporation, Swamps, *River basins, *Drainage effects, *Hydrologic models, *Land management, Groundwater depletion, Predictions, Marshes, Wetlands, Catchment areas, Runoff, Model studies, Simulation analysis, Mathematical studies, Drainage.

Methods for predicting the annual water balance of a large river basin after drainage are considered. The precipitation of the model situations was assumed to be constant and unaffected by drainage. Drainage in the improved basins caused the annual runoff to decrease groundwater and swamp water resources, leading to changes in evaporation patterns. Reductions in groundwater resources were calculated for each percent of the basin drained, based on experimental data on the hydrophysical properties of mineral soils and subsoils and peats. Using this method, reductions in groundwater were taken into account, while changes in runoff were predicted. Evaporation changes were calculated from the difference between the potential evaporation (maximum possible evaporation) from cultivated sections and that from undisturbed swamps. (Geiger-FRC)
W82-04721

2B. Precipitation

A PRELIMINARY STUDY OF COMPARATIVE MEASUREMENTS OF RAINFALL RATE USING THE DIFFERENTIAL REFLECTIVITY RADAR TECHNIQUE AND A RAINGAGE NETWORK,

Ohio State Univ. Columbus. Dept. of Electrical Engineering.
T. A. Seliga, V. N. Bringi, and H. H. Al-Khatib.
Journal of Applied Meteorology, Volume 20, No 11, p 1362-1368, November, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Remote sensing, *Radar, *Rainfall, Raingages, Rainfall distribution, *Rainfall rate, Mathematical studies, Rainstorms, Chicago, Illinois, Measuring instruments, Calibrations, Spatial distribution.

Areal measurements of rainfall rate obtained by the differential reflectivity Z-DR technique were compared with raingage measurements and conventional radar measurements for two 550 sq km areas in the Chicago region over time intervals of about 1 hr. Z-DR is defined as ten times the logarithm of the quotient of the reflectivity at horizontal polarization divided by the reflectivity at vertical polarization. A relativecalibration between horizontally and vertically polarized reflectivities was done by pointing the radar vertically and comparing reflectivity factors at orthogonal polarizations. On the test day rainfall occurred over a wide area and lasted for several hours. Excellent agreement between radar Z-DR and raingage measurements was found; the Z-DR results were considerably better than those from two Z-R (reflectivity-rainfall rate) relationships, one of which was calibrated with 20 minutes of gage measurements. The University of Chicago-Illinois State Water Survey radar used had slow polarization switching, and significant improvements in the differential reflectivity measurements would be obtained by pulse-to-pulse switching of polarization. Over one of the 550 sq km areas the Z-DR method measured 86%

of the rainfall recorded on 26 raingages during an observation period of 80 min, and over the other, 117% of the rainfall recorded on 27 raingages was obtained during a 40 min period. (Carroll-FRC)
W82-04263

DIFFERENCES BETWEEN SOME RADAR RAINFALL ESTIMATION PROCEDURES IN A HIGH RAIN RATE GRADIENT STORM,

Bureau of Reclamation, Denver, CO.
G. E. Klazura.
Journal of Applied Metorology, Vol 20, No 11, p 1376-1380, November, 1981. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Remote sensing, *Rainfall, *Rain gages, *Radar, Rainfall distribution, Rainfall intensity, Mathematical studies, Convective precipitation, Rainstorms, Montana, Calibrations, Spatial distributions.

Attempts have been made to achieve optimal estimates of precipitation by combining radar and raingage data, essentially using raingages to calibrate the radar measurements. One method of calibration is that of computing an adjusted radar-rainfall field by means of the G/R ratio (gage amount divided by the sum of radar-derived rainfall throughout a rainfall event). A study was conducted to examine how much the G/R ratios would vary in an actual high rainfall-rate gradient situation considering the location and size of the radar contributing area, computation of radar-estimated rainfall using maximum, average or integrated values, and radar reflectivity factor threshold for average and integrated values. Data examined were collected on a convective shower day, June 6, 1976 at Miles city, Montana. Differences exceeded a factor of 6 and 3 were observed for individual gages and for the mean of 17 gages, respectively. Conclusions were incompleted because of the limited data set analyzed and the absence of positive truth, i.e., knowledge of the location of the most representative radar bin. Withouth a comparative analysis it was impossible to know whether improvements in G/R values will produce better rainfall estimates. If wind information is available at each gage location it may be possible to make a reverse trajectory analysis to identify the most representative radar bin for each averaging time period. If isolation of the representative radar bin is not possible, it is probably best to use either the averaging or integrating method with a reflectivity factor threshold, allowing for precipitation drift and evaporation. (Carroll-FRC)
W82-04265

HYDROCLIMATOLOGICAL CHARACTERISTICS OF ISOLATED SEVERE RAINSTORMS,

Illinois State Water Survey, Urbana.
S. A. Changnon Jr., and J. L. Vogel.
Water Resources Research, Vol 17, No 6, p 1694-1700, December, 1981. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Rainfall intensity, *Weather forecasting, *Storms, Precipitation intensity, Flood forecasting, Flash floods, Local precipitation, *Illinois, Rainstorms, Rainfall distribution, Rain gages, Climatology.

Intense, very localized severe rainstorms were studied in Illinois, where four dense rain gage networks produced data from 32 storms in the warm season, May-September, 1955-1978. These storms, responsible for flash floods with resulting erosion and water pollution, generally last 3-12 hours, affect less than 1000 sq km, and have 1 to 4 hour rainfall totals in excess of 7.5 cm. About 40 such storms occur over Illinois (145,000 sq km) each warm season. The storm of July 30-31, 1979, over central Illinois is described in detail. The storm began at 1445 CDT and ended by 2100. Over 17.8 cm of rain fell, with the greatest intensity within 4 hours, at a station near Urbana. The core of this storm was extremely small. Only 8 sq km received a depth of 18 cm or more, and 960 sq km received 5 cm or more. The storm occurred in a maritime tropical air mass and was not associated with frontal activity. Prior to the start of the storm the surface dewpoint temperature was greater than normal (23-26 C), the atmosphere was unstable, precipitable water from the surface to 400 mb was greater than average (3.97 cm), and wind speeds increased with height from 7.7 mps at 850 mb to 12.9 mps at 500 mb. Three distinct precipitation systems with a total of nine rain cells moved over the region. Radar and satellite photos can be used to detect the development of localized intense rainstorms. Characteristics of this type of storms--stationary multicelled in nature with strong preference for afternoon development--are keys for detection and local flood warnings. (Cassar-FRC)
W82-04336

SECULAR CHANGES IN ANNUAL AND SEASONAL GREAT LAKES PRECIPITATION, 1854-1979, AND THEIR IMPLICATIONS FOR GREAT LAKES WATER RESOURCE STUDIES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab. MI.
F. H. Quinn.
Water Resources Research, Vol 17, No 6, p 1619-1624, December, 1981. 5 Fig, 5 Tab, 12 Ref.

Descriptors: *Water level fluctuations, *Seasonal variation, *Water management, *Great Lakes, *Precipitation, Climatic data, Lakes, Lake shores, Erosion, Statistical analysis.

Two distinct precipitation regimes were identified by statistical analysis of annual precipitation data in the Great Lakes basin from 1854-1979. Since the late 1930's the precipitation regime has been relatively wet, with an increase in average annual precipitation of 50 mm per year, due primarily to greater amounts of spring and summer precipitation. A dry period existed from the mid- 1880's to about 1940. Prior to 1880 the sketchy records indicate that precipitation was similar to the present. Recorded levels of Michigan-Huron-Erie corresponded with the precipitation through the years of interest. In addition, annual flows of the Niagara River from 1860 to the present show above average flows before 1890 and after 1940, with below average flows in the interim years. This may mean that the present relatively wet conditions are the normal climate for the basin. If this persists, water managers must deal with problems such as poor performance of the current Great Lakes regulation plans, continuing erosion due to high lake levels, and revisions in water supply forecasting techniques to account for higher precipitation. (Cassar-FRC)
W82-04431

COMPARISON OF MODELS FOR FORECASTING SNOWMELT RUNOFF VOLUMES,

Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-04452

THUNDERSTORM IN AGRICULTURE AND IN FOREST MANAGEMENT,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
D. G. DeCoursey, W. L. Chameides, J. McQuigg, M. H. Frere, and A. D. Nicks.
In: Thunderstorms: A Social, Scientific, and Technological Documentary, Vol I, The Thunderstorm in Human Affairs, NOAA, September, 1981, p 85-112, 21 Fig, 1 Tab, 54 Ref.

Descriptors: *Thunerstorms, *Forest management, *Agriculture, Precipitation, *Water pollution, Nitrogen fixation, Lightning, Flooding, Soil erosion, Water pollution, Sediments, Hail, Nutrients, Pesticides, Channel erosion, Gully erosion, *Storm runoff, Sediment transport, Overland flow.

Precipitation can be divided into two general types: that associated with weak ascending air currents on a scale of about 1,000 km, and that associated with rapid overturning of a local air mass with large variability of air motion and precipitation on a scale of tens of kilometers. The showers and thunderstorms identified with the second type can be beneficial or harmful to agriculture. Beneficial effects of thunderstorms include: moisture for crop production; farm and ranch water supply; irrigation water supply; and nitrogen fixation by lightning. Harmful effects of thunderstorms can be grouped into four major areas: damage directly to rangeland and crops by hail, flooding, or wetting an air-dried product; erosion of cropland caused by excessive runoff rates; leaching of plant nutrients from the soil profile; polluting surface waters; flooding of cropland along major streams. Heavy rain, usually associated with thunder, produces large volumes of surface runoff, with resulting loss of soil and associated pollutants, including sediment, nutrients, and pesticides. Overbank flooding on a typical stream is estimated to occur once in 1 to 4 years. Quite often, flooded areas include the most productive soils planted with high-yield crops. Erosion of stream channels and gullies indirectly resulting from heavy rains is a major problem. (Moore-SRC)
W82-04617

REMOTE SENSING OF ATMOSPHERIC WATER CONTENT FROM SATELLITE MICROWAVE RADIOMETER (SAMIR) ON BHASKARA,

Indian Space Research Organization, Ahmedabad. Space Applications Centre.
For primary bibliographic entry see Field 7B.
W82-04647

CHEMICAL COMPOSITION OF MONSOON RAINWATER OVER BHOPAL, MADHYA PRADESH (INDIA) DURING 1977 AND 1978,

Indo-British Betwa Groundwater Project, Bhopal (India).
D. K. Das, G. K. Burman, and A. L. Kidwai.
Mausam, Vol 37, No 3, p 221-228, July, 1981. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Rain, *Chemical composition, *Monsoons, *India, Bicarbonates, Calcium, Salinity.

Monsoon rainwater samples collected at Bhopal, India, during June-August 1977 and April-September 1978 contained variable levels of chemical constituents. Bicarbonate and calcium were the predominant anion and cation, with concentration ranges of 2.4-32.0 (average 10.0) mg per liter and 0.6-12.0 (average 3.0) mg per liter, respectively. pH ranged from 6.0 to 7.2, average 6.2. EC varied from 15 to 80 micromhos per cm at 25 C. Concentration ranges of other constituents were as follows (in mg per liter): chloride, 0.9-9.4 (average 3.4); sulfete, 1.2-5.8 (average 3.2); nitrate, 0.12-0.88 (average 0.5); Mg, 0.16-4.3 (average 0.81); Na, 0.08-4.3 (average, 0.80); K, 0.01-1.2 (average 0.16); boron, 0.002-0.068; fluoride, 0.1; Fe, 0.01-0.08; and silica, 0.4-2.8. Ranges of trace metals were as follows (in ppb): Sr, 1-30; Zn, 10-76; Mn, 1-5; Cu, 1-8. No Li or Ni was detected. It is believed that most of the chemical constituents in the monsoon rainwater were from non-marine sources. (Cassar-FRC)
W82-04666

USEFULNESS OF MONTHLY RAINFALL NORMALS IN AGROCLIMATIC MAPPING,

Meteorological Office, Poona (India).
R. R. Kelkar.
Mausam, Vol 32, No 2, p 181-188, April, 1981. 7 Fig, 16 Ref.

Descriptors: *Rainfall distribution, *Mapping, *Planting management, Agriculture, *India, Crops, Planning, Seasonal variation, Meteorological data collection.

Several attempts to obtain rainfall data more appropriate than monthly rainfall data for agricultural planning in India are described. Most data and maps apply to the state of Maharashtra. The sowing rains concept is based on the dates of commencement of sowing rains (CSR), which are defined as a spell of at least 25 mm of rain in 7 days with 1 mm or more on any 5 of these 7 days. Raman applied this method to maps showing CSR dates for Maharashtra. Also indicated are standard deviation of CSR, average interval between CSR and next wet spell, and median CSR distribution. This information shows areas where likelihood of short growing seasons and necessity of second

sowings are high. Probability analysis indicates the probability of rainfall being adequate in a given week. India's total annual rainfall does not vary widely in spite of droughts and floods. Therefore the coefficient of variation has been used to indicate monthly rainfall patterns in stations throughout India. A simple method, an extension of the National Commission on Agriculture's mapping technique, involves only monthly normals of rainfall and number of rainy days. This accounts for large amounts of rainfall on isolated occasions when much water is lost as runoff. Maps prepared using this technique indicate optimum time of sowings, good locations for surface runoff ponds, places for early-maturing varieties, and sites for no karif planting but early rabi planting. (Cassar-FRC)
W82-04668

A PHYSICAL REASON FOR HIGHER PH OF TROPICAL RAINWATER,
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 2K.
W82-04669

STATISTICAL FORECASTING OF HEAVY RAIN AND FLOODS IN THE RIVER TEESTA,
Flood Meteorological Office (India).
A. Lahiri.
Mausam, Vol 32, No 1, p 41-44, January, 1981. 2 Fig, 7 Tab, 8 Ref.

Descriptors: *Rainfall distribution, *Synoptic analysis, *Flood forecasting, Weather forecasting, Forecasting, *Teesta River, *India, Monsoons, Rainfall-runoff relationships, Mountains, Precipitation.

Heavy rain producing synoptic systems were associated with intervals of average precipitation to produce quantitative precipitation forecasting in the 80% mountainous Teesta River catchment, India. The region is affected by six categories of heavy rain producing synoptic systems, classified according to the position of the low pressure areas or monsoons. The frequency distributions of floods occurring from precipitation amounts of 11-25, 26-50, and > 51 mm in the six categories range from 2 to 19, with a total of 46. Frequency distributions of heavy average areal precipitation for the same groups of precipitation amounts in the 5 months of the flood season are as follows: June, 113, July, 122, August, 105, September, 70, and October, 13. June, July, and August are the most flood prone months, partly because heavy rains are not evenly distributed. In September and October heavy rains are more evenly distributed. (Cassar-FRC)
W82-04670

EVIDENCE OF URBAN AND LAKE INFLUENCES ON PRECIPITATION IN THE CHICAGO AREA,
State Water Survey Div., Champaign.
S. A. Changnon, Jr.
Journal of Applied Meteorology, Vol 19, No 10, p 1137-1159, October, 1980. 17 Fig, 11 Tab, 20 Ref.

Descriptors: *Precipitation, *Urban areas, *Lakes, *Rainfall, Areal precipitation, *Environmental effects, Convective precipitation, Rainfall distribution, Storms, Illinois, *Chicago, St Louis, Missouri.

A study of summer precipitation conditions in the Chicago, Illinois, area sought to discern evidence of urban influences on precipitation processes and on rainfall magnitude by investigating the time and space characteristics of clouds, radar echoes, surface rainfall, and thunderstorms. Historical data for the period 1931 through 1977 anddata from new and special instruments operated during the period 1975 through 1978 were investigated to identify local and regional influences as suggested by precipitation time trends, the areal distribution of heavier rainstorms, thunderstorm frequencies, cloud distributions, radar echo characteristics, raincells, rainfall in discrete rain periods, and total rainfall. An area of 15 percent greater rainfall, which was considered largely a result of urban influences, was identified in central Chicago. Although the degree of change is less than that found in studies at St. Louis, possibly as a result of the inhibiting effects of the lake at Chicago, there was general agreement between these two studies with respect to the placement of the rain change, the synoptic weather conditions when rain changes occur, and the tendency for rain changes to exist in heavier rainfall conditions. Limited causative studies suggest an urban enhancement of convective clouds over Chicago and southern Lake Michigan during the later afternoon. Case studies of radar echo behavior showed that maximum echo intensification repeatedly occurred over the city and at higher elevations than in non-urban cells. (Carroll-FRC)
W82-04741

2C. Snow, Ice, and Frost

PROBLEMS OF MODELLING A HIGH MOUNTAINOUS DRAINAGE BASIN WITH PREDOMINANT SNOW YIELDS,
Grenoble-1 Univ. (France). Inst. de Mecanique.
For primary bibliographic entry see Field 2A.
W82-04303

ELEVATION: A MAJOR INFLUENCE ON THE HYDROLOGY OF NEW HAMPSHIRE AND VERMONT, USA,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
For primary bibliographic entry see Field 2E.
W82-04304

A NEW METHOD FOR SAMPLING SNOW MELT AND RAINFALL IN FORESTS,
Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
For primary bibliographic entry see Field 7B.
W82-04435

TESTS OF FRAZIL COLLECTOR LINES TO ASSIST ICE COVER FORMATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
R. E. Perham.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 442-448, December, 1981. 10 Fig, 1 Tab, 1 Ref.

Descriptors: *Frazil ice, *Ice cover, *Ice formation, Rivers, Water flow, Flow velocity, Line sets, Experimental data.

Laboratory and field tests were performed on frazil ice collector lines to discover methods of promoting solid ice cover formation in fast flowing, shallow river sections. Line sets were composed of nylon parachute cord, nylon twisted rope, nylon braided line, and a combination of nylon, steel, brass, and aluminum, with 1 to 40 lines and different line lengths and spacings. Laboratory tests using a refrigerated flume were conducted with flume depths of 2-22 cm and average flow velocities of 0.08-0.84 m per sec. The tests in small mountain rivers 33-50 cm deep had average flow velocities of 0.6-0.8 m per sec. In the flumes at -23 to -26 C, frazil ice collected rapidly on the test lines, typically reaching a diameter of 3.2 cm in 15 min. Density of the drained ice was 470 kg per cu m, and porosity was 49%. The best river test results were obtained from a set of 20 lines, 3.2 mm diameter, 4.9 m long at a spacing of 38 mm and placed parallel to the streamflow. An ice cover 0.9 m wide and 5 m long formed overnight at about -20 C in swift water, 0.7 m per sec. Ice covers formed either from frazil ice collecting on submerged line sets and then floating to the surface or on lines initially floating. Possible applications for frazil collectors are fringed ice booms, a reinforced ice cover for a power canal or shallow stream, and ice sheet anchors to stabilize large ice sheets. (Cassar-FRC)
W82-04460

CONVECTION PATTERNS IN A POND,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
K. B. Katsaros.
Bulletin of the American Meteorological Society, Vol 62, No 10, p 1446-1453, October, 1981. 5 Fig, 18 Ref.

Descriptors: *Convection, Stratification, *Thermal stratification, *Ponds, *Ice, Ice cover, Snow, Flow pattern, *Slush.

Unusual convection patterns were noted in snow-slush on a pond in Seattle, Washington, during January of 1980 and again during February of 1981. The patterns resemble a spoke-type convection discovered experimentally by Busse and Whitehead in 1974. The first reference to large-cell patterns on a pond was made in Surrey, England, in 1946. Similar findings were reported in 1958 concerning a pond in Darmstadt, Germany, with one or two open spots in the centers. The pond in current question is a shallow and seasonal one, drying up in the summer and filling from rains in the fall. No discernible inflow or outflow exists. Temperatures at the bottom of the pond were 1.5 to 2 degrees C, while the slush layer on top was at zero degrees C and 0.08 meter in thickness. Air temperature above the pond was about 0.5 degrees C. At the time the pictures were taken, the pond was stably stratified. (Baker-FRC)
W82-04461

ACID SNOW IN THE CANADIAN HIGH ARCTIC,
Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
R. M. Koerner, and D. Fisher.
Nature (London), Vol 295, No 5845, p 137-140, January 14, 1982. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Snow, *Chemical analysis, Precipitation, Snow sampling, Arctic regions, *Air pollution effects, Environmental effects, *Acidity, Canada, *Ice, Arctic, Ellesmere Island.

Acid concentrations in ice from part of a 337 meter surface to bedrock core taken on northern Ellesmore Island are presented. The sample represents the past 5000 years and was compared with the significantly higher acid concentrations occurring in snow deposited over the past 25 years at the same location, showing seasonal variations in the concentrations which together constitute a significant trend of increasing acid levels over the past 25 years. The most highly acid snow is located at the snow surface when melt begins in May or June in the high Arctic. Unless this melt refreezes at the base of the snowpack, the first runoff in spring will be the most acid. Acid levels in high Arctic snow and their effects should be monitored, especially in areas where the lake fish form a source of Inuit income. Concentrations of sodium, calcium, potassium, and magnesium along with insoluble particulates were also maximum in the spring. (Baker-FRC)
W82-04542

SEVERE SNOWMELT RUNOFF IN NORTHEAST ENGLAND AND ITS IMPLICATIONS,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 2E.
W82-04648

2D. Evaporation and Transpiration

SPACING AND TRANSPIRATION OF VARIOUS SIZED CLUMPS OF A DESERT GRASS, HILARIA RIGIDA,
California Univ., Los Angeles, Dept. of Biology.
P. S. Nobel.
Journal of Ecology, Vol 69, No 3, p 735-742, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Transpiration, *Plant tissues, Desert grass, Grasses, Carbon dioxide, *Roots, Groundwater, *Desert plants, Soil-water-plant relationships.

Within-species competition between clumps of the grass Hilaria rigida was investigated using conventional plotless techniques and also by root excava-

tions. Root distribution was determined and leaf water vapor conductance measured. Larger clumps were found further from a random point as well as separated from their nearest neighboring plants by greater distances than smaller clumps. Larger clumps had more ground area available for their roots. The larger space occupied by the larger clumps presumably reflected their preemption of ground water. On the smaller clumps of less than 10 culms, leaves had a three fold higher rate of transpiration per unit leaf area than had leaves on larger clumps, of over 200 culms. However, the larger clumps had nearly three times as much leaf area per unit ground area. Therefore the depth of water transpired daily did not depend on the size of the clump. Since the amount of carbon dioxide fixed per unit ground area also did not change with clump size, the pattern of small and large clumps may be quite persistent over time. (Baker-FRC)
W82-04295

BLANEY-CRIDDLE COEFFICIENTS FOR WESTERN TURF GRASSES,

Wyoming Univ., Laramie.
J. Borrelli, L. O. Pochop, W. R. Kneebone, I. L. Pepper, and R. E. Danielson.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 333-341, December, 1981. 6 Tab, 15 Ref.

Descriptors: *Consumptive use, *Evapotranspiration, *Turf grasses, *Semiarid lands, *Water supply development, Evaporation, Transpiration, Grasses, Semiarid climates, Urban areas, Water requirements, Water supply, Vegetation effects, Mathematical studies.

Very little data exists on calculating the consumptive use of water by turf grass. Some data on turf grass evapotranspiration recorded from lysimeter studies over extended periods at various locations were used to calibrate a Soil Conservation Service (SCS) modification of the Blaney-Criddle technique of calculating evapotranspiration. Results obtained from the revised method should be useful in yielding fairly accurate estimates of city wide water requirements for turfed areas typical of the western United States for use in long range water supply evaluations. Data from these SCS calculations showed that warm season turf grasses should be used in warm regions because they consume considerably less water than other types. In transition areas with summer temperatures over 25 degrees, cool season grasses may undergo heat stress and suffer a decrease in evapotranspiration rates. (Geiger-FRC)
W82-04310

USE OF MODIFIED BLANEY AND CRIDDLE FORMULA FOR ESTIMATING WATER REQUIREMENTS,

Meteorological Office, Poona (India).
K. Subba Rao, and G. Yazdani.
Mausam, Vol 32, No 2, p 195-200, April, 1981. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Evapotranspiration, *Water requirements, Evaporation, *Irrigation requirements, *India, *Rice, *Sugarcane, Blaney and Criddle method, Crop growth stage coefficient.

Experimental values of the crop growth stage coefficient (Kc) were determined for paddy and sugarcane from lysimeter data recorded at four locations in India. Kc gradually increased with advancement of the crop season, reached a peak at about 65% of the growing season, and then declined. This seasonal variation was similar to potential evaporation. Kc values for sugarcane were 0.6-1.1 and for paddy, 0.5-11, 0.6-1.4, and 0.7-0.9 at 3 locations. Ratios of potential evapotranspiration to pan evaporation were 0.9-1.7 for paddy and 0.5-2.0 for sugarcane. The modified Blaney and Criddle method was used to compute evapotranspiration using Kc derived in this work. Differences from measured values for paddy ranged from -6.4 to 16.8 mm. Previous work, which probably used Kc unsuitable for these locations, obtained values differing from the observed values by -40.6 to +29.0. (Cassar-FRC)
W82-04667

MODELLING EVAPORATION FROM RESERVOIRS,

Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Hydrological Sciences Bulletin, Vol 26, No 4, p 363-367, December, 1981. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Mathematical models, *Reservoirs, *Water temperature, *Numerical analysis, *Reservoir evaporation, Lakes, Water management, Thermal stratification, Evaporation, Seasonal variation, Energy loss, Evaporation rate, Lake evaporation.

The greater thermal capacity of large reservoirs often delays the response of water temperature to changes in insolation and air temperature, offsetting the usual patterns of increased evaporation in the summer. A finite differences numerical model for predicting water temperature in the vertical dimension in freshwater reservoirs is described that is based on the annual variation of evaporation. The model is applicable to both small and large lakes, and the seasonal change in peak evaporation from summer (in small lakes) to winter (in large lakes) is satisfactorily simulated. Some differences in actual and model conditions may be observed, especially in March and August, due to the large spatial averaging inherent in both observations and calculations. In areas where water supplies are short, accurate calculations of evaporation rates may be vital to the planning of water management strategies. (Geiger-FRC)
W82-04722

2E. Streamflow and Runoff

RELATION BETWEEN CURVE NUMBER AND RUNOFF COEFFICIENT,

Maryland Univ., College Park. Coll. of Engineering.
For primary bibliographic entry see Field 2A.
W82-04266

ELEVATION: A MAJOR INFLUENCE ON THE HYDROLOGY OF NEW HAMPSHIRE AND VERMONT, USA,

New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
S. L. Dingman.
Hydrological Sciences Bulletin, Vol 26, No 4, p 399-413, December, 1981. 8 Fig, 13 Ref.

Descriptors: *Streamflow, *Snowmelt, *Elevation, *Prediction, *Drainage area, *Alpine regions, Overland flow, Air temperature, Evapotranspiration, Altitude, Flood peak, Precipitation, Catchment areas, Runoff, Hydrologic data, Data collections, Orography, Vermont, New Hampshire.

Elevations in Vermont and New Hampshire are generally very high, with many mountain peaks exceeding 1200 m in height. As elevation increases, so does the mean annual and mean monthly precipitation, snow depth, and snow water equivalents, while mean monthly temperatures decreases. Temperature from National Weather Service networks may be used in conjunction with other data to illustrate how potential evapotranspiration fluctuares with elevation. These combined parameters exert strong elevational increases in mean annual streamflow and cause both short term and annual streamflow variability to decrease with the mean elevation of the drainage basin. As mean basin elevation increases above 340 m, low flows for a given exceedance probability show marked increases. For a given return period, flood peaks are also enhanced with increases in mean basin elevation. Although slope and aspect influence the timing of snowmelt runoff, these values exert little effect on hydrology. Usually elevation can be used as the single independent variable for predicting streamflow parameters. (Geiger-FRC)
W82-04304

CONFORMAL MAPPING FOR CHANNEL JUNCTION FLOW,

Malviya Regional Engineering Coll. Jaipur (India). Dept. of Civil Engineering.
P. N. Modi, P. D. Ariel, and M. M. Dandekar.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1713-1733, December, 1981. 7 Fig, 4 Tab, 2 Ref.

Descriptors: *Channel flow, *Flow characteristics, Streamflow, Hydraulics, Conformal mapping, Mapping, Open-channel flow, Stagnant water, Free-streamline theory, Mapping, *Channel junction flow.

Analysis of flow behavior at channel junctions where two streams combine to form a third is extended to cases with any junction angle and different bed widths. The solution was obtained with the aid of conformal mapping. For small values of the discharge ratio (discharge in channel 2 less than in channel 1) the stagnation point is along the channel 2 boundary closest to channel 1. In the opposite case, greater discharge in channel 1, the stagnation point coincides with the upstream corner at the junction point of the 2 channels. Relationships are developed for the location of the stagnation point with respect to junction angle and the ratio of bed widths of the two channels. For different locations of the stagnation points in the channel junctions, the solutions of the equation for the free-streamline are presented in dimensionless form. The location of the zone of stagnant fluid between the free-streamline and the channel boundary changes with changes in junction angle and as the stagnation point shifts from one channel to the other. (Cassar-FRC)
W82-04306

RELATIVE RUNOFF BY CURVE NUMBER NOMOGRAPH,

New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-04307

FLOOD PROBABILITY ESTIMATION,

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W82-04318

HYSTERESIS IN RELATIONSHIPS BETWEEN DISCHARGE AND WATER CHEMISTRY IN THE FRASER RIVER BASIN, BRITISH COLUMBIA,

Department of the Environment, Vancouver (British Columbia).
For primary bibliographic entry see Field 2K.
W82-04326

DETENTION BASINS–AN URBAN EXPERIENCE,

Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 4A.
W82-04332

ESTIMATION OF EXTREME LOW FLOWS FOR PUMPED STORAGE RESERVOIR DESIGN,

Newcastle upon Tyne Univ., (England). Dept. of Engineering Mathematics.
A. V. Metcalfe, and J. A. Mawdsley.
Water Resources Research, Vol 17, No 6, p 1715-1721, December, 1981. 7 Fig, 5 Tab, 11 Ref.

Descriptors: *Reservoir design, *Drought, *Low flow, River flow, *Flow augmentation, Poaka Beck reservoir, Crake River, *United Kingdom, Reservoir storage, Pumped storage, Minimum flow, Water transfer.

A model was developed for estimating extreme low flows with a certain probability of nonexceedance for reservoirs where natural inflow from a river is supplemented by pumping from an adjacent river. The method is based on the joint probability distribution of an extreme value distribution and a truncated extreme value distribution. The

estimates of the probabilities of given low flows are made using integrals which are evaluated numerically for a range of low flows and maximum daily pumping rates. Results obtained by applying the derived density function to 25 years of data from the Poaka Beck reservoir and the River Crake in northwest United Kingdom are given for a 3-month drought. This detailed model has several advantages: effects of varying parameters can be studied, flow sequence simulation is not necessary if a suitable distribution for pumped flows can be hypothesized, and the distributional models suggested for the low flows of the two streams are easier to justify than any other particular choice of distribution. (Cassar-FRC)
W82-04334

STORM RUNOFF ANALYSES ON THREE SEMI-ARID CATCHMENTS,

Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W82-04339

RECONSTRUCTED STREAM FLOW FOR THE SALT AND VERDE RIVERS FROM TREE-RING DATA,

Arizona Univ., Tucson. Lab. of Tree-Ring Research.
L. P. Smith, and C. W. Stockton.
Water Resources Bulletin, Vol 17, No 6, p 939-947, December, 1981. 6 Fig, 5 Tab, 20 Ref.

Descriptors: Floods, Droughts, *Dating, *Streamflow, *Salt River, *Verde River, *Arizona, Trees, History, Flood peak, Precipitation, Planning, Water supply, Tree rings technique.

Tree ring data were used to extend streamflow records of the Salt and Verde Rivers, Arizona, back to 1580 A.D. The reconstruction of streamflows indicates that the available gaged records dating back to 1889 contain an above average number of high seasonal and annual flows when compared with the 400 year period. Peak flows may be similarly biased, making designs based on historical records of peak flow conservative. The average frequency of occurrence of annual and seasonal discharges associated with the peak flows has remained constant over the 400 year mean. Therefore, water supplies estimated using the historical means may be overestimated. Several long periods of low annual discharge, more severe than in the 1890 to present period, occurred on the average of every 22 years during the reconstructed period. In the Salt River Basin 1905-1920 was the wettest period in the 400 year period. A severe 5 year drought ended in 1670. Another low flow period was 1728-1739, during which average annual discharge was only 43% of the 400 year mean. The Verde River basin had high flows in the early 1900's and low flows at the turn of the century. The most severe drought was in the mid-1770's to mid-1780's. A possible low flow period, based on only 1 tree ring series, was 1580-1620. In general low and high flows in the Verde River coincided with those in the Salt River. (Cassar-FRC)
W82-04340

COMPARISON OF TWO AUTOREGRESSIVE MODELS FOR MONTHLY STREAM FLOW GENERATION,

Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and M. A. Khan.
Water Resources Bulletin, Vol 17, No 6, p 1035-1041, December, 1981. 8 Tab, 28 Ref.

Descriptors: *Streamflow, *Stochastic hydrology, Model studies, Reservoir storage, Thomas-Fiering model, Spolia-Chandler model, *Comparison studies, Laos, Thailand, Cambodia.

Two closely-related autoregression models for monthly streamflow generation were compared by theoretical consideration and practical applications to flow data from stations in Laos, Thailand, and Cambodia. The Thomas-Fiering model (1962) was superior to the Spolia-Chandler model (1974). The latter model is a reduced parameter modification of the Thomas-Fiering model. Errors in the reproduction of the correlation coefficient and skewness coefficient by the Thomas-Fiering model occurred during months when parameters are nearly zero. This is considered a remediable situation. The gamma random generator produced better results than the lognormal random generator in most cases. (Cassar-FRC)
W82-04351

SEARCH: A GAGED WATERSHED INVENTORY,

State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
For primary bibliographic entry see Field 10B.
W82-04433

ANALYSIS AND PREDICTION OF WATER MOVEMENTS AND WATER QUALITY IN A SHALLOW RIVER IMPOUNDMENT. APPLICATION TO MISSISSIPPI RIVER POOL NO 2,

For primary bibliographic entry see Field 7B.
W82-04482

FLOOD AND RELATED DEBRIS FLOW HAZARDS MAP, LAS VEGAS SE QUADRANGLE,

Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04490

WATER RESOURCES INVENTORY OF CONNECTICUT, PART 7, UPPER CONNECTICUT RIVER BASIN,

Geological Survey, Hartford, CT. Water Resources Div.
R. B. Ryder, M. P. Thomas, and L. A. Weiss.
Connecticut Water Resources Bulletin No 24, 1981. 78 p, 41 Fig, 23 Tab, 76 Ref.

Descriptors: *Groundwater, *Surface water, *Water quality, *Hydrologic data, Hydrologic cycle, Aquifers, Aquifer characteristics, Wells, Water supply, Streamflow, Sediment transport, Precipitation, Runoff, Chemical analysis, Maps, *Connecticut, *Upper Connecticut River basin.

The 508 square-mile upper Connecticut River basin during the 1931-60 period received an average of 44 inches of precipitation per year; evapotranspiration averaged 22.2 inches per year while inflow from streams was approximately 4,060 billion gallons per year. Flow out of the basin in the Connecticut River at Portland, Conn., averaged 4,230 billion gallons per year. In 1968, freshwater use was estimated at 108,547 million gallons, a small fraction of the total available. Ground-water sources in the basin yield from several million gallons per day at large well fields to 1 gallon per minute from single wells. Stratified-drift aquifers are the most productive and individual well yields of 100 gallons per minute or more are common. Bedrock aquifers that underlie the basin generally yield a few gallons a minute and are adequate sources for domestic supply. Surface-water samples collected at 25 sites in the area had median dissolved-solids concentrations of 113 milligrams per liter at high flow and 148 milligrams per liter at low flow. Ground-water samples from 164 wells had dissolved-solids concentrations that ranged from 52 to 2,060 milligrams per liter. High concentrations of iron, manganese, sulfate, sodium, and hardness cause ground-water quality problems in parts of the area. (USGS)
W82-04505

MEAN ANNUAL STREAMFLOW OF SELECTED DRAINAGE BASINS IN THE COAL AREA OF SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-04506

SELECTED HYDROLOGIC RELATIONSHIPS FOR SOLDIER CREEK, NORTHEASTERN KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
W. J. Carswell, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-138751, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-8, 1981. 68 p, 36 Fig, 7 Tab, 21 Ref.

Descriptors: *Streamflow, *Water quality, *Precipitation, *Flow characteristics, Low flow, Flow duration, Fluvial sediments, Sediment discharge, *Kansas, Soldier Creek basin, Flood frequency, Comparison studies.

Hydrologic data from Soldier Creek basin, northeastern Kansas, were compared with relations from statewide data. The quantity and quality of streamflow were affected mostly by soils, slopes, and land use. Average annual precipitation during the study (1964-76) was 35.12 inches, or 2.3 percent greater than the long-term (1929-76) average. The average streamflow in Soldier Creek at Topeka was 23 percent greater than the long-term average. In general, frequency curves of annual peak discharges compared poorly with curves from statewide relations due to the absence of extremely low peaks during the short period. A comparison of low-flow frequency for drainage areas of more than 100 square miles suggests that reasonable results may be obtained by extrapolating the statewide relations to small basins. Comparisons of flow-duration curves confirms the extrapolation for basins of less than 100 square miles, although the percentage duration of mean flow is variable. Water surveys showed that calcium, bicarbonate, and sulfate were the predominant ions and dissolved solids were derived mostly from limestones and shales. Suspended sediment at gaged sites ranged from 9.84 to 848 tons per days; yield per unit area increased significantly between two sites due to changes in slopes and land use. (USGS)
W82-04519

DISASTER BY FLOOD,

National Oceanic and Atmospheric Administration, Boulder. Environmental Research Labs.
L. R. Hoxit, H. S. Lieb, C. F. Chappell, and H. M. Mogil.
In: Thunderstorms: A Social, Scientific, and Technological Documentary, Vol I, The Thunderstorm in Human Affairs, NOAA, September, 1981. p 23-45, 15 Fig, 27 Ref.

Descriptors: *Thunderstorms, *Flash floods, Precipitation, Flood forecasting, *Flood damage, Disasters, Flooding, Rainfall distribution, Warning systems, Canyons, *United States.

During the 1970's flash floods were the leading cause of death and destruction from weather-related causes; they have devastated parts of nearly every state. More than 15,000 communities and recreational areas have been identified as vulnerable to flash floods. Increased use of mountainous areas for recreation and canyons for home building has greatly increased the potential for disaster. The Big Thompson Canyon flash flood of 1976 is an example of the meteorological processes, the problems of warning and preparedness, and the human response to floods. Intense thunderstorms produced up to 12 inches of localized rainfall within a few hours over the rugged Big Thompson River drainage in north-central Colorado. The normally placid river received great quantities of water from several tributaries. Near Drake, the flow on the river just before the rain began was 137 cfs; the peak flow was 31,200 cfs. Only a few hours separated the onset of heavy rain from the flood crest passing the canyon mouth. The phenomenal local episode was appreciated only after it was under way, and many people either disregarded warnings or received no warning. The flash flood that swept through the canyon and onto the plains resulted in 139 casualties and property damage estimated at $35 million. The toll taken by flash floods in the future will be determined by the nature and density of settlements, the quality of flood control measures, the systems used for acquiring and interpreting meteorological observations, forecast and

warning communications, and responses to warnings. (Moore-SRC)
W82-04618

THE DISASTROUS SOUTHERN CALIFORNIA AND CENTRAL ARIZONA FLOODS, FLASH FLOODS, AND MUDSLIDES OF FEBRUARY 1980.

National Weather Service, Silver Spring, MD.
Natural Disaster Survey Report NWS-81-1, March, 1981. 128 p, 28 Fig, 3 Tab, 7 Append.

Descriptors: *Floods, *Flash floods, Flood forecasting, *Mudflows, Rainfall distribution, Weather forecasting, Warning systems, *Flood damage, *California, *Arizona.

For 9 days during mid-February 1980, the southwestern U.S. was battered by a series of heavy rainstorms. Over the period, 5 inches or more of rain fell over most of Southern California's coastal valleys, and some mountain areas received over 25 inches. Rainfall amounts in Central Arizona ranged from 1 to over 16 inches. The large rainfall amounts produced floods and flash floods in many areas, and mudslides were a major problem in Southern California. Overall, the NOAA warning systems worked well in both California and Arizona. The Los Angeles Weather Service Forecast Office (WSFO) issued watches, warnings, and statements well in advance of flooding, flash flooding, and mudslides. The Phoenix WSFO also issued timely flood/flash flood watches, warnings and statements. All indications are that the NOAA services contributed significantly to reducing property losses and probably deaths. Nevertheless, 21 people died as a direct result of flooding, flash flooding, and mudslides; and total property damage in the two states topped $400 million. Part of these losses might have been prevented if, in some cases, more effective action had been taken on the part of the public. One factor that apparently contributed to citizen inaction during this disaster was the inability to give a more precise description of the rainfall distribution in the warning statements. (Moore-SRC)
W82-04632

THE DEVELOPMENT OF A VIABLE METHOD OF STREAM FLOW MEASUREMENT USING THE INTEGRATING FLOAT TECHNIQUE,

Lancaster Univ., Bailrigg (England).
For primary bibliographic entry see Field 7B.
W82-04643

SEASONALITY OF FLOODING AND THE ASSESSMENT OF SEASONAL FLOOD RISK,

Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 4, p 1023-1035, December, 1981. 7 Fig, 2 Tab, 3 Ref.

Descriptors: *Flood forecasting, Risks, *Seasonal variation, *Flood frequency, *England, Rainfall-runoff relationships, Soil water, Storm water, Streamflow forecasting.

A method for seasonal flood analysis is presented. It is based on the percentage of the annual number of floods above a given return period occurring in each month. Variations in seasonal regime are identified for stations in northeast England. These are related to controlling factors of storm rainfall and catchment wetness. A graph depicts the relationship between construction period/design life, return period, and the risk of flood occurrence. A table gives the percentage of annual number of flood events above a given return period occurring each month in three regions. This method can determine the seasonal flood risks to crops grown on a flood plain or to construction projects such as bridges, outfalls, and piers. (Cassar-FRC)
W82-04646

SEVERE SNOWMELT RUNOFF IN NORTHEAST ENGLAND AND ITS IMPLICATIONS,

Northumbrian Water Authority, Gosforth (England).
D. R. Archer.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 4, p 1049-1060, December, 1981. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Flood forecasting, *Snowmelt, *Runoff rates, Forecasting, Snow density, Snow depth, Melting, Streamflow forecasting, *England.

Measured snowmelt runoff rates in northeast Britain were considerably higher than those obtained from meteorological data. Analysis of snowmelt rates in 1978-97 confirmed earlier observations of runoff rates. The differences in rates were attributed to limitations in data on which the meteorological conclusions were based. No deep snowpacks were included in the estimates of water equivalent depletion. Rates of depth depletion do not directly indicate melt or yield. Densities of snowpacks in the uplands were also much higher than in the lowlands because of higher windspeeds, greater compaction due to deeper snow, and lower temperatures. These discrepancies can cause underestimates of probable maximum floods. (Cassar-FRC)
W82-04648

WATER QUALITY MONITORING - IDENTIFICATION OF RESIDENCE/TRAVELLING TIMES FROM HYDROLOGICAL AND WATER QUALITY INFORMATION,

Karlsruhe Univ. (Germany, F.R.).
G. Troubounis, H. H. Hahn, and B. Eppler.
Water Science and Technology, Vol 13, No 11/12, p 677-682, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality, *Monitoring, Water pollution control, Hydrologic data, Rivers, Data collections, Data acquisition, Detection times, Detention time, Streamflow.

The corresponding residence or travelling time between monitored river cross sections is a necessary piece of information in conceiving a river quality monitoring program. This traveling or transit time is a function of the discharge rate of the river itself. The problems encountered in residence/traveling time determinations are discussed. Two methods are described which are more compatible with water quality considerations than the well known hydraulic computations: the use of isoconcentration graphs based on data for concentration changes of conservative water constituents, and time series analysis methods. Comparing the computed flow and traveling times between predetermined cross-sections, one finds significant differences between hydraulically computed data and those determined on the basis of water quality measurements. It is concluded that if automatic sampling or quasi- continuous analyses exist, then such data will form a sufficient basis for the determination of residence and traveling times in free flowing as well as impounded rivers. If periodic variations or oscillations in the quality of a river exist, then such quasi-continuous or continuous measurements on concentration changes of conservative substances can be used for a detention time determination on the basis of iso-concentration diagrams. If no periodic fluctuation in the concentration of conservative water constituents can be observed, but non-conservative substances are available, then the method using the cross-correlation function should be employed. (Baker-FRC)
W82-04663

STATISTICAL FORECASTING OF HEAVY RAIN AND FLOODS IN THE RIVER TEESTA,

Flood Meteorological Office (India).
For primary bibliographic entry see Field 2B.
W82-04670

THE FUTURE OF FLOOD ESTIMATION AND THE FLOOD STUDIES REPORT,

Northumbrian Water Authority, Gosforth (England).
P. Johnson.
Proceedings of the Institution of Civil Engineers. Part I. Design and Construction, Vol 70, No 3, p 833-843, 1981. 1 Tab.

Descriptors: *Flood flow, *Flood plain management, *Spillway capacity, *Rainfall, *Snowmelt, Floof forecasting, Flood-control storage, Floods, Data collections, Urban areas, Catchment areas, Runoff, Reservoirs, *United Kingdom.

The proceedings of the 1975 conference, The Flood Studies Report (FSR) held by the Hydraulics and Public Health Engineering Board of the Institution of Civil Engineers, are summarized in the committee chairman's report. Priority tasks to improve upon and extend the FSR are mainly ones of better mapping of flood boundaries, finding the adequacy of urban catchment, and estimating more accurately the trends and cycles of floods. Several priority tasks for updating the FSR will require more sophisticated and broader data base analyses. The REGIME concept for relating discharge to river channel cross-sectional areas and other features should be studied for application to the FSR. The URBAN program was adopted to aid in estimating flood discharges in or as a result of urban areas. Radar is suggested for more accurate data collections on rainfall. Information on snowmelt also needs more development. Plans were made to survey all major spillways in the British Isles and to examine wind velocities and directions of storms causing flood inflow. Recommendations to expand data on reservoirs in an engineering guide were also made. Extrapolation of FSR methods for use overseas and training in the proper understanding of the report are considered. (Geiger-FRC)
W82-04687

RESISTANCE EQUATION FOR LARGE-SCALE ROUGHNESS,

Institute of Hydrology, Wallingford (England).
J. C. Bathurst, R. M. Li, and D. B. Simons.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1593-1613, December, 1981. 11 Fig, 8 Tab, 21 Ref.

Descriptors: *Channel flow, *Flow resistance, *Hydraulic roughness, Flumes, Reynolds number, Rocks, Roughness coefficient, Froude number, Channel morphology, Resistance, *River beds, Bed material, Particle size, Mountain streams.

Flow in channels with large-scale roughness, such as boulder-bed channels increasingly being used in developing mountainous areas, was investigated in a steep stream flume. Bed material was of five different sizes, from 0.5 to 2.5 inches. A flow resistance equation was developed for this situation, in which the ratio of flow depth to mean element height was less than 4. The flow resistance in large-scale roughness depended on the form drag of the elements and their deposition in the channel. The relevant processes of flow were described as functions of Reynolds number, Froude number, roughness geometry, and channel geometry. Values predicted by this equation and by other workers for the Upper River Tees, United Kingdom, were compared with observed values. Agreement was generally good, but further refinement is necessary to account for variations in channel width and element shape. (Cassar-FRC)
W82-04696

2F. Groundwater

A GROUND WATER RESOURCES STUDY OF A PACIFIC OCEAN ATOLL--TARAWA, GILBERT ISLANDS,

Birmingham Univ. (England). Dept. of Geological Sciences.
J. W. Lloyd, J. C. Miles, G. R. Chessman, and S. F. Bugg.
Water Resources Bulletin, Vol 16, No 4, p 646-653, August, 1980. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Groundwater potential, *Resistivity, *Atolls, Groundwater availability, Groundwater management, *Tarawa, *Gilbert Islands, Water supply, Drought, Aquifers, Lenses, Islands.

Groundwater resources were investigated in Tarawa, Gilbert Islands, typical of thousands of small atolls in the Pacific Ocean. Surface resistivity

measurements were combined with an electrical conductivity survey of well waters to establish the size and shape of fresh water lenses. Most wells in this atoll intercept only the top edge of the lens. Although precipitation is the controlling factor for groundwater recharge input, there is a 15% interception loss. Steady state conditions were not appropriate for modeling water resources in this atoll because long periods occur during which there is no recharge. Therefore nonsteady digital modeling methods were used to analyze the groundwater resources in the largest 4 of the 8 atolls in the Tara group. Results of the study showed that the 4 main lenses can supply water adequately for a 2% drought of 2-year duration. To prevent saline water intrusion, water should not be abstracted during the second year of a drought. Once a lens has been overabstracted, it may not recover. Increasing populations in these islands, the susceptibility of lens resources to drought, and the expense and difficulty of obtaining alternate intermittent water supplies are problems common to many Pacific atolls. (Cassar-FRC)
W82-04254

DELAYED DRAINAGE IN A STREAM-AQUIFER SYSTEM,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 407-410, December, 1981. 1 Fig, 7 Ref.

Descriptors: *Groundwater movement, *Subsurface drainage, *Mathematical models, *Drainage wells, *Unconfined aquifers, Aquifers, Drainage, Model studies, Hydrologic models, Mathematical studies, Water table, Mathematical equations, Flow patterns, Fully penetrating wells, Streams.

An explanation of Higgins' results for nonsteady flow from an unconfined aquifer into a fully penetrating stream in which the water level fluctuates in a prescribed pattern was developed which does not account for unsaturated flow. The proposed theory is similar to that of Higgins, except that the aquifer material is assumed to be uniformly elastic and the water compressible, and the aquifer itself is assumed to be anisotropic. The new theory is based on the concept of delayed drainage as applied to the problem of unconfined flow to a well. At small values of time, the water table drawdowns observed experimentally by Higgins exceeded those predicted by his theory, while at large values of time, some of the water table drawdowns observed by Higgins were less than those predicted by his theory. A simple explanation of how this situation occurs and equations to remedy this problem are presented. (Geiger-FRC)
W82-04268

THE SEEPAGE FLOW THROUGH A FREE BOUNDARY AQUIFER INTO A RIVER,

Reading Univ. (England). Dept. of Mathematics.
J. O'Shea, and M. J. Baines.
Hydrological Sciences Bulletin, Vol 26, No 4, p 415-411, December, 1981. 3 Fig, 2 Tab, 5 Ref.

Descriptors: *Groundwater movement, *Mathematical models, *Numerical analysis, Model studies, Hydrologic models, Aquifers, Mathematical studies, Mathematical equations, Rivers, *Influent streams.

A model of groundwater flow from an aquifer beneath a river into the river channel is presented in order to determine the discharge q into the river for different values of the boundary data, namely at the river boundary and at the outer edge of the aquifer. Information from this model may be applied for calculating the total water content in a river or the inflow conditions when modeling water systems. The solution procedure for solving Laplace's equation utilizes a variational inequality, which yields a numerical approximation solution using finite differences. The discharge parameter q is determined from Neumann boundary conditions and iterations on q using a compatibility condition obtained by the discretizing of discharge equations. (Geiger-FRC)
W82-04305

SOIL PERCOLATION RATES FROM NEUTRON PROBE MEASUREMENTS,

Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 4B.
W82-04309

HYDROLOGIC EFFECTS FROM CHANGES IN GROUND WATER PUMPAGE,

International Engineering Co., Incorp., San Francisco, CA.
M. V. Damm.
Water Resources Bulletin, Vol 16, No 5, p 907-913, October, 1980. 11 Fig, 2 Tab, 8 Ref.

Descriptors: *Groundwater, *Pumpage, Aquifers, Recharge, River basins, Simulation, *Groundwater recharge, Model studies, *Hydrologic budget, Nebraska.

The purpose of this paper is to explore the hydrologic effects of implementing an allocation scheme in an area where groundwater pumpage provides a substantial portion of the applied water. In general a reduction of pumped groundwater applied at the surface will result in less recharge to the groundwater body. Recharge will decrease in an amount approximately equal to the decrease in pumpage, as long as the water pumped is in excess of actual water needs. Simulation of a stream-aquifer system in Nebraska was undertaken to determine estimates of the effects of controls on groundwater withdrawals. Due to uncertainties in the calibration processes and projections of various types of data and to simplifications employed in the models, the results of the simulation most likely include some error. The relatively small savings from reductions in pumpage result primarily from recirculation effects. Differences between groundwater contributions to stream flow were small for all simulations examined. These contributions decreased with time and increased pumpage amounts. base flow rates at the end of the simulation were about 25% of those at the beginning. (Baker-FRC)
W82-04428

THE USE OF LANDSAT IMAGERY IN GROUND WATER EXPLORATION,

Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
For primary bibliographic entry see Field 7B.
W82-04436

A LUMPED APPROACH TO THE INVERSE PROBLEM IN GROUND WATER HYDROLOGY,

Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W82-04451

A NUMERICAL LINKED MODEL FOR THE PREDICTION OF THE DECLINE OF GROUNDWATER MOUNDS DEVELOPED UNDER RECHARGE,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. A. Kashkuli.
PhD Thesis, July, 1981. 159 p, 21 Fig, 7 Tab, 59 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-26436.

Descriptors: *Model studies, *Mathematical models, *Groundwater recharge, Groundwater movement, Saturated flow, Water table, *Groundwater mounds.

A model is developed to couple the approximate solution of one-dimensional vertical partially saturated flow to the two-dimensional saturated horizontal flow. The linked model is used to predict the decline of a groundwater mound developed under recharge areas. It consists of linking beneath the recharge area one-dimensional vertical unsaturated columns to a two-dimensional areal saturated flow model. Besides the Dupuit-Forchheimer assumptions in the saturated flow, it is further assumed that the partially saturated flow is vertical. The solution of the equation governing the partially saturated flow above the water table determined the recharge and storage information needed for the solution of the saturated flow equation. The model simulates the lateral unsaturated flow by an equivalent permeable height and uses an equivalent saturated height to account for a changing specific yield. The model was verified by comparing the results for a certain problem to those predicted by a rigorous model. A field size problem of strip recharge was simulated and solved. It was found that for this particular problem the water table decline rate is considerably faster if the traditional approach of excluding the unsaturated flow region is employed. In this model both Su-Brooks and Brooks-Corey methods for determining soil parameters can be used. (Sinha-OEIS)
W82-04481

GROUND-WATER CONDITIONS IN THE UPPER VIRGIN RIVER AND KANAB CREEK BASINS AREA, UTAH, WITH EMPHASIS ON THE NAVAJO SANDSTONE,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 6D.
W82-04486

DIGITAL MODELS OF GROUND-WATER FLOW IN THE CAPE COD AQUIFER SYSTEM, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
J. H. Guswa, and D. R. LeBlanc.
Geological Survey Open-File Report 80-67 (WRI), 1981. 128 p, 60 Fig, 12 Tab, 19 Ref.

Descriptors: *Groundwater, *Computer models, *Coastal aquifers, *Unconfined aquifers, Groundwater movement, Saline-freshwater interfaces, Regional development, Prediction, Hydrologic data, Finite difference methods, *Massachusetts, *Cape Cod.

The Cape Cod aquifer system was simulated with three-dimensional finite-difference ground-water-flow models. Five areas were modeled to provide tools which can be used to help predict the hydrologic impacts of regional water development and disposal schemes. Model boundaries were selected to represent the natural hydrologic boundaries of the aquifer. The boundary between fresh and saline ground water is treated as an interface of no dispersion, and the saline-water zone is treated as being non-flowing. Comparisons of calculated and observed head values, position of the freshwater and saline-water boundary, and ground-water-discharge rates at locations where data are available indicate that the simulated ground-water reservoirs generally agree with the field conditions and the models can be used for predictive studies. (USGS)
W82-04487

MAPS SHOWING GROUND-WATER CONDITIONS IN THE BILL WILLIAMS AREA, MOHAVE, YAVAPAI, AND YUMA COUNTIES, ARIZONA--1980,

Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04488

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1981,

Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04489

TWO-DIMENSIONAL GROUND-WATER FLOW MODEL OF THE CRETACEOUS AQUIFER SYSTEM OF LEE COUNTY AND VICINITY, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
J. M. Kernodle.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142852, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-70, 1981. 53 p, 28 Fig, 26 Ref.

Descriptors: *Computer models, *Groundwater, *Aquifer systems, *Water management, Geohydrology, *Groundwater movement, Observation wells, Water level, Hydraulic conductivity, Available water, *Mississippi, *Lee County, Eutaw-McShan aquifer, Gordo aquifer.

A two-dimensional ground-water flow model of the Eutaw-McShan and Gordo aquifers in the area of Lee County, Miss., was successfully calibrated and verified using data from six long-term observation wells and two intensive studies of areal water levels. The water levels computed by the model were found to be most sensitive to changes in simulated aquifer hydraulic conductivity and to changes in head in the overlying Coffee Sand aquifer. The two-dimensional model performed reasonably well in simulating the aquifer system except possibly in southern Lee County and southward where a clay bed at the top of the Gordo Formation partially isolated the Gordo from the overlying Eutaw-McShan aquifer. The verified model was used to determine theoretical aquifer response to increased ground-water withdrawal to the year 2000. Two estimated rates of increase and five possible well field locations were examined. (USGS)
W82-04492

BOREHOLE DATA-COLLECTION METHODS APPLICABLE FOR THE REGIONAL OBSERVATION AND MONITOR WELL PROGRAM, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04493

EFFECT OF IRRIGATION PUMPING ON THE GROUND-WATER SYSTEM IN NEWTON AND JASPER COUNTIES, INDIANA,

Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04497

GEOHYDROLOGIC RECONNAISSANCE OF THE CROFTON UNIT, NORTHEASTERN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-04498

WATER RESOURCES INVENTORY OF CONNECTICUT, PART 7, UPPER CONNECTICUT RIVER BASIN,

Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04505

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1981,

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04507

PROBABLE HIGH GROUND-WATER LEVELS ON CAPE COD, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04511

PRELIMINARY DATA FROM ARBUCKLE TEST WELLS, MIAMI, DOUGLAS, SALINE, AND LABETTE COUNTIES, KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04512

CARBONATE GEOCHEMISTRY OF VADOSE WATER RECHARGING LIMESTONE AQUIFERS,

Kentucky Univ., Lexington. Dept. of Geology.
J. Thrailkill, and T. L. Robl.
Journal of Hydrology, Vol 54, No 1-3, p 195-208, December, 1981. 4 Fig, 3 Tab, 20 Ref. OWRT-A-009-KY.

Descriptors: *Geochemistry, *Vadose water, *Groundwater recharge, Carbonates, Aquifers, Flow, Seepage, Caves, *Limestone aquifers.

An investigation of the carbonate equilibrium of water which is transiting the vadose zone in Kentucky caves included repeated sampling at the same sites to examine possible seasonal variations. Also, measurements were made of discharge at the sources, and the pH was determined as soon as possible after the water entered the cave environment. Furthermore, the carbonate chemistry of the soil waters overlying at least some of the sites was investigated. An apparent chemical distinction could be made between vadose flows and vadose seepage, with the vadose flows being originally more undersaturated with respect to calcite. Calcite is actively dissolved as water passes through the vadose zone. Two types of vadose seepage were identified: low-Ca vadose seepage and high-Ca vadose seepage. High-Ca vadose seepage is probably the most abundant source of recharge to limestone aquifers which are not overlain by other lithologies. (Small-FRC)
W82-04526

THEORY FOR AQUIFER TEST ANALYSIS IN FRACTURED ROCK UNDER LINEAR (NONRADIAL) FLOW CONDITIONS,

Water Futures, Albuquerque, NM.
D. N. Jenkins, and J. K. Prentice.
Ground Water, Vol 20, No 1, p 12-21, 1982. 11 Fig, 13 Ref.

Descriptors: *Mathematical studies, *Aquifers, *Groundwater movement, *Pump wells, Mathematical equations, *Geologic fractures, Drawdown, Permeability, Fracture permeability, Flow pattern, Graphical methods.

If a well penetrates a geologic fracture with a permeability much greater than that of the surrounding aquifer, then the flow of groundwater in a fractured rock aquifer may be linear toward a natural production surface rather than radial toward a pumping well. Such linear flow has been discovered in fractured rock aquifers in three distinct areas of New Mexico. Similar aquifers were identified from aquifer test data in Mendocino and Placer Counties in California. Conventional methods of aquifer analysis were deemed inadequate due to curvilinear test data on semi-log plots and straight line data on log-log plots. Mathematical methods of fitting straight lines to arithmetic plots of pumped well and observation well data showed that the flow in the vicinity of the test well was linear. Flow lines in a linear system are parallel, and drawdown is a function of the perpendicular distance from the extended well. (Geiger-FRC)
W82-04676

DETERMINATION OF EFFECTIVE WELL BLOCK RADII FOR NUMERICAL RESERVOIR SIMULATIONS,

Systems, Science and Software, LaJolla, CA.
For primary bibliographic entry see Field 6A.
W82-04732

ISOTOPE GEOCHEMISTRY OF WATER IN GULF COAST SALT DOMES,

Arizona State Univ., Tempe. Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-04742

INTERPRETATION OF CHEMICAL ANALYSES OF WATER COLLECTED FROM TWO GEOTHERMAL WELLS AT COSO, CALIFORNIA,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 1A.
W82-04743

A MODEL OF HYDROTHERMAL CONVECTION IN AN AQUIFER,

Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY.
For primary bibliographic entry see Field 1A.
W82-04744

GROUND WATER MONITORING OF UNDERGROUND COAL MINES,

Moody and Associates Inc., Meadville, PA.
For primary bibliographic entry see Field 5B.
W82-04750

2G. Water In Soils

A PROBE METHOD FOR SOIL WATER SAMPLING AND SUBSURFACE MEASUREMENTS,

Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 7B.
W82-04325

TWO-DIMENSIONAL SOIL MOISTURE FLOW IN A SLOPING RECTANGULAR REGION: EXPERIMENTAL AND NUMERICAL STUDIES,

Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W82-04333

IRRIGATION, CROP YIELD AND DRAINAGE AT THE VAALHARTS IRRIGATION SCHEME: 3. THE INFLUENCE OF SALINIZATION ABOVE A SHALLOW GROUND WATER TABLE ON THE YIELD OF WHEAT AND OTHER CROPS (IN AFRIKAANS),

Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
A. Streutker, N. Van Vliet, and H. W. Molenaar.
Water SA, Vol 7, No 4, p 255-264, October, 1981. 6 Fig, 7 Tab, 13 Ref.

Descriptors: *Water table rise, *Irrigation effects, *Saline soils, Crop yield, Drainage, Conductivity, Water pollution effects, Soil water, *Vaalharts Irrigation Project, *South Africa, Soil compaction, Soil density, *Saline water intrusion.

Overirrigation and leakage from soil dams produced a shallow groundwater table of 0.9-1.5 m at the Vaalharts Irrigation Scheme, South Africa. The water table rose further to 0.3-0.6 m from the surface during above average rainfall on occasions during 1974-1976, allowing salt accumulation and reducing yields of wheat, cotton, maize, and groundnuts to nearly zero. There was a correlation between electrical conductivity of the topsoil and wheat yield. Factors having a detrimental influence on seed germination and seedling growth were sodium absorption ratio less than 4, high bulk density, and high soil moisture content. The soil characteristics were a result of mechanical cultivation of the fine sandy soil and the shallow ground water table. Irrigation practices should be improved and drains installed if necessary. (Cassar-FRC)
W82-04359

EFFECT OF SURFACE SEALING ON INFILTRATION,

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. D. Moore.
Transactions of the ASAE, Vol 24, No 6, p 1546-1552, 1561, November/December, 1981. 6 Fig, 8 Tab, 40 Ref.

Descriptors: *Infiltration, *Surface sealing, *Soil water, Surface permeability, Soil types, *Model studies, Richards equation, Ponding, *Soil properties.

Numerical solutions of Richards' equation showed the effects of surface sealing of soils on infiltration. The three conditions examined in the model were: (1) no seal, (2) developing seal, gradual surface sealing under rainfall activity, and (3) constant seal, a well-established surface seal. Rainfall application rate was 5.3 cm per hour. Measurements on nine A-horizon soils from different counties in Minnesota and Wisconsin were used as model inputs. Results indicated that surface sealing, virtually ignored in infiltration modeling in the past, reduced predicted infiltration rates and volumes by up to 80%. This may account for some of the differences in infiltration behavior observed by different researchers using the same soil type. (Cassar-FRC)
W82-04362

DEEP TILLAGE OF IRRIGATED PULLMAN CLAY LOAM--A LONG-TERM EVALUATION,

Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
J. T. Musick, D. A. Dusek, and A. D. Schneider.
Transactions of the ASAE, Vol 24, No 6, p 1515-1519, November/December, 1981. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Irrigation efficiency, *Cultivation, *Infiltration, Drainage, Furrow irrigation, Corn, Wheat, *Crop yield, Sorghum, Grain crops, Soil compaction, Soil density, Agriculture, *Water stress, Bushland, Texas, Soil-water-plant relationships.

One-time deep moldboard plowing in 1966 to depths of 0.4, 0.6, and 0.8 meters in slowly permeable Pullman clay loam at Bushland, Texas, increased water intake and crop yield (wheat, sorghum, and corn) during subsequent years. This study reports the results of evaluations in the 1973-79 interval. Soil was disturbed by the deep plowing, which mixed some of the topsoil with lower layers so that the soil had a crumb-type structure, compared with the previous blocky peds. Compared with 0.2 m conventional tillage, the one-time deep tillage increased irrigation water uptake from 120 to 240 mm in 1975 and from 170 to 280 mm in 1978. This effect did not diminish with time. As soil compacted during the growing season from wheel traffic and irrigation water, the water permeability decreased. This was restored by conventional moldboard plowing to 0.2 m. The deep tillage treatment increased sorghum grain yields (in kg per ha) from 6040 to 7290 in 1975 and 9080 to 9960 in 1979. Similarly, corn yields (in kg per ha) were increased from 10,020 to 11,300 in 1977. The increased water intake and the deeper profile wetting of the deeply plowed fields delayed the beginning and reduced the severity of plant water stress. The deep-tillage method is most effective in the normally drier, lower parts of graded furrow irrigated fields, where tailwater runoff can be reduced. It is not recommended for upper sections of the field, where drainage losses may result. (Cassar-FRC)
W82-04372

INFILTRATION INTO TWO-LAYERED SOIL PROFILES,

Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
I. D. Moore, and J. D. Eigel.
Transactions of the ASAE, Vol 24, No 6, p 1496-1503, November/December, 1981. 7 Fig, 5 Tab, 34 Ref.

Descriptors: *Infiltration, *Soil profiles, *Ponding, *Soil water, Model studies, Soil porosity, Green-Ampt Mein-Larson model, Richards equation, Numerical analysis, Loam, Stratification.

Results from the Modified Green-Ampt, Mein-Larson infiltration equations (GAML) for two-layered soil profiles were compared with observed data and results from the numerical solution of Richards' equation. Examples of two-layered soil profiles are plowed soil over undisturbed soil and topsoil over mine spoil. The two-layers of soil used were a Lewiston fine sandy loam (coarse) and a Millville silt loam (fine). Both coarse-over-fine and fine-over-coarse were examined. In the two-layered soil profiles the GAML and numerical models produced similar results (time to surface ponding, infiltration volume, and infiltration rate). Layering sequence was a significant factor in infiltration behavior. Infiltration rates and volumes were lower for fine-over-coarse than for coarse-over-fine stratifications. For the coarse-over-fine profiles there was a general increase in time to ponding as the application rate decreased and surface layer thickness increased. For the fine-over-coarse, layering times to surface ponding predicted by the Modified GAML model were independent of the thickness of the surface layer. However, the time to ponding increased with increasing thickness for the numerical model. Agreement between predicted and observed data ranged from excellent to fair. Best agreement was for the smaller surface layer thicknesses. Both models underpredicted infiltration rates for coarse-over-fine stratifications. (Cassar-FRC)
W82-04536

NOTE ON PUDDLING EFFECTS ON WATER FLOW THROUGH SOILS,

Punjab Agricultural Univ., Ludhiana (India).
B. K. Sinha, S. R. Singh, and R. G. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 6, p 460-461, June, 1981. 1 Fig, 3 Ref.

Descriptors: *Irrigation practices, *Puddling, Percolation, Crop yield, *Rice, Irrigation requirements, Water loss, *Soil water.

The effect of puddling intensity on the nature of water flow and irrigation requirements of rice crop were investigated in laboratory and field studies. The response to puddling in different soils varied according to the soil texture. The resistance to water flow, as evidence by specific discharge, was increased in all the soils following puddling. The reduction in specific discharge after the first puddling ranged from 6 to 10 fold at different hydraulic gradients in sand. In sandy loam it was small, especially at lower gradients. In silty clay loam soil the reduction was marginal. Apparently puddling could reduce percolation losses only in coarse-textured soils. The second puddling was less effective than the first in reducing the specific discharge, except in sandy loam soil, where the second puddling might have resulted in a more uniform sealing of pores. Thus structure destruction due to puddling may not be of much importance in reducing water flux through the soil. Puddling altered the nature of water flow, particularly in silty clay loam. Increased puddling intensity in fine textured soils did not effect any significant saving in irrigation water. Evidently fine textured soils need not be puddled if the sole aim is to reduce percolation losses. (Baker-FRC)
W82-04671

WATER MOVEMENT IN UNIFORM SOILS DURING CONSTANT-FLUX INFILTRATION,

Commonwealth Scientific and Industrial Research Organization, Canberra City (Australia). Div. of Environmental Mechanics.
K. M. Perroux, D. E. Smiles, and I. White.
Soil Science Society of America Journal, Vol 45, No 2, p 237-240, March/April, 1981. 5 Fig, 11 Ref.

Descriptors: *Infiltration, *Soil water, Mathematical models, Mathematical equations, Fluctuations, Absorption, Gravity studies, Ponding, *Soil water movement.

Several studies have addressed the problem of predicting water movement and distribution in soils during nonponding rainfall or sprinkler irrigation. While a variety of numerical methods have been successfully applied to flux boundary conditions for a variety of initial conditions, the search for general analytical solutions to the flow equation for the constant-flux boundary condition initially met with less success. This paper presents an analysis for constant-flux infiltration of water in soil based on the flux-concentration relation. The results of laboratory experiments on constant-flux infiltration into columns of fine sand and silty loam are compared with behavior predicted both with and without a gravitational component. The effect of gravity was shown to be small for the early stage. During the early stage it is possible to make sufficiently accurate predictions of moisture profile development using the simpler absorption analysis of White, et al. (1979). (Carroll-FRC)
W82-04691

2H. Lakes

ESTIMATION OF PRIMARY PRODUCTIVITY IN AQUATIC SYSTEMS USING FREE OXYGEN MEASUREMENTS,

Amsterdam Univ. (Netherlands). Dept. of Aquatic Ecology.
R. Lingeman, and S. Vermij.
Water Resources Bulletin, Vol 16, No 4, p 745-748, August, 1980. 2 Fig, 13 Ref.

Descriptors: *Primary productivity, *Oxygen, *Temperature, Lakes, Productivity, Water temperature, *Model studies, Stratification, Heat transfer, Eddy diffusion, Barlosche Kolk, Netherlands.

One-dimensional models for heat or oxygen transport in aquatic systems have been used by several authors to estimate primary productivity. These methods use free oxygen and temperature measurements at discrete time and depth intervals and assume that the eddy diffusion coefficients of heat and oxygen are interchangeable. This method was applied to data from the Barlosche Kolk, a 3.5 ha lake with maximum depth of 6 m. Steep oxygen gradients and moderate temperature stratification are present in summer, but there is no distinct hypolimnion. Temperature and oxygen were measured hourly at 0.5 m intervals of depth. Primary productivity calculated from these data and the model did not agree with simultaneous measurements of primary productivity by the light and dark bottle method. It was concluded that the one-dimensional model is inadequate for this application because the discrete measurements of temperature and oxygen do not provide sufficient data. A more adequate model should include horizontal transports induced by internal waves along the sheets of steep temperature gradients. Continuous recording of temperature and oxygen may provide necessary data. (Cassar-FRC)
W82-04256

WATER BUDGET COMPUTATIONS FOR A SHALLOW--LAKE OKEECHOBEE, FLORIDA,

Florida Univ., Belle Glade. Agricultural Research and Education Center.
S. F. Shih.
Water Resources Bulletin, Vol 16, No 4, p 724-728, August, 1980. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Hydrologic budget, *Storage capacity, *Evapotranspiration, Lakes, *Lake Okeechobee, *Florida, Shallow lakes, Marsh plants, Model studies, Evaporation.

The water budget for Lake Okeechobee, Florida, was computed using a model which included marsh plant evapotranspiration. This model was labeled WET and the conventional methods, without the evapotranspiration factor, WOET. Three periods were used to compare the differences in the sum of storage deviation between the two methods. These periods differed in length: testing (1969-74), planning (1963-74), and recorded period (1952-77). The WOET method gave the following sums of stage deviations: 87.42 cm, 231.80 cm, and 284.5 cm for the three periods respectively. These were equivalent to 29, 76, and 93% of the lake volume. The WOET method overestimated storage, as compared with recorded data, for 21 out of 26 years. The WET method reduced the sum of storage deviation by 42, 31, and 49%, respectively, for the three periods. The sums of stage deviations were 50.72 cm, 160. 08 cm, and 144.81 cm, respectively. Storage deviations were overestimated in 15 out of 26 years. (Cassar-FRC)
W82-04258

PHOSPHORUS AVAILABILITY IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,

McGill Univ., Montreal (Quebec). Dept. of Biology.
R. H. Peters.
Limnology and Oceanography, Vol 26, No 6, p 1150-1161, 1981. 4 Fig, 3 Tab, 40 Ref.

Descriptors: *Lakes, *Phosphorous, Nutrients, Biomass, *Lake Memphremagog, Canada, Rivers, Limnology, Water analysis

Water samples were taken from Lake Memphremagog and five of its tributaries. The percentage of total phosphorus in the samples which was biologically available was measured on three dates. The criteria used to measure the percentage of biologically available phosphorus were the distribution of radioactive phosphorus among exchanging fractions and the enzymatic release of soluble phosphorus from particulate phosphorus when stored with chloroform. The available phosphorous in the lake water formed 83% of the total phosphorus. The available phosphorous in rivers was only 18-57% of the total, much less than in the lakes. The most refractory fraction was usually high molecular weight phosphorus, and was separated by gel filtration. Substantial amounts of unavailable phosphorus were also associated with particles and with low molecular weights. Intermediate molecular weight soluble phosphorus was too small a fraction for determining its availability. Variations in the percentage of available phosphorus in natural waters could substantially change the biological effect of a given phosphorus load. (Baker-FRC)
W82-04324

COMPARISONS OF SOLUBLE REACTIVE PHOSPHORUS AND ORTHOPHOSPHORUS CONCENTRATIONS AT AN OFFSHORE STATION IN SOUTHERN LAKE MICHIGAN,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, and C. Rubitschun.
Journal of Great Lakes Research, Vol 7, No 3, p 290-298, 1981. 2 Fig, 3 Tab, 32 Ref.

Descriptors: *Phosphorus, *Lake Michigan, Lakes, Phosphates, Bioassay, Chemical analysis, *Fate of pollutants, Pollutant identification, Lake sediments, Phytoplankton.

Soluble reactive phosphorus in the epilimnion of southeast Lake Michigan, measured at a station 15 km from shore in May-October 1976, was higher and more variable than previously published measurements. The overall means were 4.9 micrograms P per liter (range 2.0-10.3 micrograms P per liter) using Harvey's method and 3.4 micrograms P per iter (range 1.2-7.7 micrograms P per liter) using the Chamberlain-Shapiro extraction technique. At times there were significant vertical variations in the water column and near the sediment, but the hypolimnion did not accumulate P. Both methods overestimated maximum possible phosphate-P concentrations up to two orders of magnitude. Maximum possible phosphate-P concentrations as measured by Rigler's radiobioassay method were an average of 22.5% of those measured by Harvey's method and 25.6% of those measured by the extraction technique. Several factors which could cause too-high P measurements were investigated. It was concluded that the values were, in fact, higher because high concentrations of particulates were carried out to distances 10-15 km from shore in this region during the extremely wet year 1976. Data suggest that true phosphate concentrations may be lower in the epilimnion of eutrophic lakes than in mesotrophic lakes because of high biological utilization rates and less efficient recycling mechanisms. (Cassar-FRC)
W82-04377

TEMPERATURES AND CURRENTS IN A STRATIFIED LAKE: A TWO-DIMENSIONAL ANALYSIS,

Arizona Univ., Tucson.
J. Henrich, W. Lick, and J. Paul.
Journal of Great Lakes Research, Vol 7, No 3, p 264-275, 1981. 13 Fig, 36 Ref.

Descriptors: *Water temperature, *Water currents, *Stratification, Lakes, Water circulation, Lake circulation, Temperature, Currents, Wind-driven currents, Thermal stratification, *Lake Erie, *Model studies, Thermocline, Turbulent flow, Heat transfer.

A two-dimensional (vertical and horizontal) time-dependent model was used to predict temperatures and currents in a stratified lake comparable to the central basin of Lake Erie. Stratified flow during the time of formation, maintenance, and decay of the thermocline were investigated. Increasing heat flux to the water causes earlier, shallower, and stronger formation of a thermocline. Increasing turbulence causes later, deeper, and weaker thermocline formation. Heat transfer to the sediment in a shallow lake can decrease hypolimnion temperatures by 1 C. Effects of a sinusoidal 24-hour period heat flux and the temperature distribution of thermal radiation are limited to the near surface region and do not change thermocline formation. Wind stress perpendicular to the cross-section results in a stronger, narrower return flow just above the thermocline than does wind parallel to the cross-section. Wind reversal shifts the orientation of the thermocline so that the hypolimnion waters are shifted in the upwind direction and the thermocline becomes deeper in the downwind direction. If wind has not reversed by 50 days, a second thermocline can form above the first thermocline. In general, calculated results agreed with observations. (Cassar-FRC)
W82-04378

WINTER TEMPERATURE STRUCTURE IN LAKE HURON,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. S. Miller, and J. H. Saylor.
Journal of Great Lakes Research, Vol 7, No 3, p 201-206, 1981. 8 Fig, 1 Tab, 13 Ref.

Descriptors: *Water temperature, Stratification, *Mixing, Lakes, *Lake Huron, Temperature, Water depth, *Thermal stratification, Water circulation, Seasonal variation.

Water temperatures were continuously recorded at 17 sites in Lake Huron during the winter of 1974-75 at depths of 15,25, and 50 m below the surface and 2 m from the bottom. In the beginning of fall overturn in November several warm pulses were observed at depths below 100 m. The shallower southern basin was already isothermal at 7 C. Monthly isotherms followed the bathymetry of the lake. The shore regions rapidly cooled to near freezing by early February. The deep northern basin did not reach a minimum of 1.5 C until mid-April. Differences between mean monthly temperatures at the 15 and 25 m depths were < 0.3 C during December-April. In the deep basins a weak winter thermocline, temperature difference 1.5 C, developed in March and nearly disappeared by April. (Cassar-FRC)
W82-04381

FACTORS REGULATING THE SPATIAL DISTRIBUTION OF THE FILAMENTOUS ALGA PITHOPHORA OEDOGONIA (CHLOROPHYCEAE) IN AN INDIANA LAKE,

Purdue Univ., Lafayette, IN. Dept. of Botany and Plant Pathology.
D. F. Spencer, and C. A. Lembi.
Journal of Phycology, Vol 17, No 2, p 168-173, 1981. 8 Fig, 4 Tab, 26 Ref.

Descriptors: *Algal growth, *Lakes, Littoral environment, Littoral zone, Algae, Eutrophication, Nitrogen, Phosphorus, *Nutrients, Limiting factors, Limiting nutrients.

A combined field and laboratory study was designed to determine the factors regulating the spatial distribution of Pithophora oedogonia in Surrey Lake, Indiana. Surrey Lake is small and shallow, man-made, with a water flow from south to north. The inflowing stream drains a watershed of about 1128 ha, 62% of which is agricultural land and pastures, 21% woodland, and 16% residential properties. Water samples and algal biomass samples were collected from May 1978 to December 1979. The biomass was greater in the littoral than in the pelagial region. Although mean soluble reactive phosphorus concentrations did not differ significantly in the open vs cove water, nitrate concentrations were almost six times higher in the latter. Nitrogen limiting conditions were prevalent in the open water section of the lake. Alkaline phosphatase and dark ammonia uptake analyses on field collected filaments from the shallow and deep water sections confirmed the hypothesis that nitrate is the major factor limiting growth of Pithophora in Surrey Lake. (Baker-FRC)
W82-04382

ULTRAPLANKTON BIOMASS, PRODUCTIVITY AND EFFICIENCY IN LAC MATAMEC, A PRECAMBRIAN SHIELD LAKE,

Waterloo Univ., (Ontario). Dept. of Biology.
P. E. Ross, and H. C. Duthie.
Journal of Phycology, Vol 17, No 2, p 181-186, 1981. 5 Fig, 3 Tab, 44 Ref.

Descriptors: *Lakes, *Plankton, Aquatic life, Phytoplankton, Biomass, Photosynthesis, *Canada, Eutrophication, *Lake Matamec, Aquatic productivity, Oligotrophic lakes, *Quebec.

Extremely low phosphorus concentrations were found in Lac Matamec, suggesting that it must be extremely oligotrophic. The summer range of chlorophyll concentrations places the lake among the least productive in the world. Since blue light is attenuated most quickly with depth and red light the least, a characteristic typical of water rich in dissolved humic substances, the lake may also be dystrophic. Further evidence for a dystrophic condition lies in the relationship between chlorophyll a and light extinction. In Lac Matamec there is virtually no correlation between the two parameters of chlorophyll and transparency. The ultraplankton accounted for an average of 47% of the biomass of the lake, but yet was responsible for 71% of the carbon fixation. The ultraplankton had the highest photosynthetic efficiencies of the three classes, ultraplankton, nanoplankton, and plankton. The importance of the ultraplankton in the ecology of Lac Matamec is enhanced by the marked scarcity of littoral habitat. High surface:volume ratios may explain the high efficiency of the ultraplankton. (Baker-FRC)
W82-04383

SUNLIGHT INDUCED MOVEMENT OF PLANKTONIC ORGANISMS AND THEIR RELATIONSHIPS TO WATER MOVEMENTS,

Kentucky Water Resources Research Inst., Lexington.
J. Calkins, E. Wallingford, and C. Hulsey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211509, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 132, 1982. 59 p, 12 Fig, 1 Tab, 32 Ref. OWRT A-082-KY(1). 14-340001-0119(FY80), 14-34-0001-1119(FY81).

Descriptors: Ecosystems, *Ultraviolet radiation, Ozone, Microorganisms, Thermocline, *Solar radiation, *Plankton, Plankton-sunlight-water movement relationships, Radiation regime, UV-B.

Previous studies have shown the planktonic organisms of various natural water bodies to be quite sensitive to the levels of solar ultraviolet radiation incident at the water surface in summer. It has been assumed that the majority of the phytoplankton are simply carried about in the mass of the water which they inhabit with little controlof their position or sunlight exposure. Photosynthetic microorganisms must strike a delicate balance with regard to solar radiation; they must obtain enough visible light for adequate photosynthesis while avoiding an excessive exposure to the injurious solar UV-B radiation. It is proposed that the circulation in natural waters is such that organisms can 'ride' the current to obtain radiation exposures approximating the average radiation level of the euphotic zone. If exposure tends to become excessive, the plankton 'drop out' of the circulation into the relatively immobile thermocline region until conditions are favorable for a return to the highly illuminated surface waters. Observations with two

species of aquatic plants generally cofirm the proposed model. A radiation regime where the entire population receives essentially the same exposure to sunlight could be substantially more efficient in using the available light for photosynthesis than the 'static' model where it is assumed that part of the population is overly exposed and another segment continuosly dwells deep in the water in very dim light.
W82-04417

SECULAR CHANGES IN ANNUAL AND SEASONAL GREAT LAKES PRECIPITATION, 1854-1979, AND THEIR IMPLICATIONS FOR GREAT LAKES WATER RESOURCE STUDIES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab. MI.
For primary bibliographic entry see Field 2B.
W82-04431

RIDGE REGRESSION TECHNIQUES APPLIED TO LANDSAT INVESTIGATION OF WATER QUALITY IN LAKE OKEECHOBEE,

Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
S. F. Shih, and J. C. Gervin.
Water Resources Bulletin, Vol 16, No 5, p 790-796, October, 1980. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Eutrophic lakes, *Water quality, Light penetration, Regression analysis, Lakes, Mathematical studies, *Turbidity, Water analysis, Opacity, Eutrophication, *Chlorophyll a, *Suspended sediments, Remote sensing, *Landsat, *Lake Okeechobee, Florida.

Studies were made on the eutrophic Lake Okeechobee in Florida to derive a relationship between the chlorophyll a, turbidity and suspended sediment water quality parameters and Landsat radiance values applicable over several days and to compare the regression results for two different levels of accuracy in measuring Landsat radiance values. The general concepts of ridge regression techniques were applied to satellite data analysis. Landsat radiance values processed at a double level of precision gave a better solution when applied to the estimation of water quality parameters. Ridge regression analysis for double level accuracy eliminated problems of multicollinearity and reduced the total mean square error by 13 to 20% and the confidence interval by 6 to 28% when compared to ordinary least square analysis. The stabilized regression equations and individual parameter estimates are more readily interpretable from the standpoint of lake water quality analysis. (Geiger-FRC)
W82-04440

EFFECT OF TEMPERATURE ON HETEROTROPHIC GLUCOSE UPTAKE, MINERALIZATION, AND TURNOVER RATES IN LAKE SEDIMENTS,

Orange Free State Univ., Bloemfontein (South Africa). Inst. for Environmental Sciences.
D. F. Toerien, and B. Cavari.
Applied and Environmental Microbiology, Vol 43, No 1, p 1-5, 1982. 6 Tab, 18 Ref.

Descriptors: *Glucose, *Bottom sediments, *Lakes, Sedimentation, Chemical analysis, Absorption, Metabolism, Mineralization, *Lake Kinneret, *Israel, *Temperature effects, Microbial degradation.

Using sediments from Lake Kinneret, Israel, an evaluation was made of the effect of temperature on the maximum uptake rate, in situ substrate concentration and turnover rate for glucose uptake and mineralization. The major features of Lake Kinneret sediments are a high percentage of fine grain material, an abundance of calcium carbonate, and a dominance of montmorillonite in the clay fraction. The maximum uptake rate was similar when aerobic and anaerobic conditions were used in the assay procedure. The maximum uptake rate values for carbon dioxide evolution (glucose mineralization) ranged from 2.75 to 4.77 micrograms of CO2/g/hr. No consistent pattern was observed in glucose mineralization for the aerobic or anaerobic sediments when assayed aerobically or anaerobically. All temperature experiments were run under aerobic conditions. It was concluded that the maximum uptake rate and the turnover rates of glucose uptake and mineralization were temperature dependent. The glucose respiration/uptake ratio was not greatly influenced by the presence or absence of oxygen or by different assay temperatures. (Baker-FRC)
W82-04466

CONTRIBUTION OF PARTICLE-BOUND BACTERIA TO TOTAL MICROHETEROTROPHIC ACTIVITY IN FIVE PONDS AND TWO MARSHES,

Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
D. Kirchman, and R. Mitchell.
Applied and Environmental Microbiology, Vol 43, No 1, p 200-209, 1982. 2 Fig, 5 Tab, 46 Ref.

Descriptors: *Ponds, *Bacteria, *Marshes, Ecosystems, Biomass, Particulate matter, Microbiological studies, Coastal mareshes, Salinity, Filtration, Metabolism, Organic compounds, *Coastal waters.

This report compares the number and heterotrophic activity of epibacteria and unattached bacteria in five coastal ponds and two marshes. It is suggested that, although the numbers of epibacteria are low, they may contribute significantly to the turnover of dissolved organic matter in selected aquatic ecosystems. The data presented support the hypothesis that bacteria associated with particulate matter are metabolically more active per cell than unattached bacteria. The particle-bound bacteria incorporated a large proportion of glucose and glutamate in selected aquatic systems. The uptake per cell was significantly higher for epibacteria than for unattached bacteria in all systems. Particle-bound bacteria were more important than total bacteria in those waters with a high particle concentration and not flushed regularly by tides in contrast to waters with a low particle concentration and being flushed regularly. The study indicates that the importance of epibacteria may be greatly underestimated due to their small numbers. (Baker-FRC)
W82-04467

HORIZONTAL DISTRIBUTION AND FLUX OF PHOSPHORUS IN FISH LAKE, WISCONSIN,

Wisconsin Univ.-Madison.
R. J. Erickson.
PhD Thesis, August, 1980. 189 p, 13 Fig, 19 Tab, 110 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28177.

Descriptors: *Lakes, *Littoral environment, *Phosphorus, Sediments, Mass transfer, *Fish Lake, *Distribution patterns, *Wisconsin, Pelagial sources.

Effects of the littoral zone on epilimnetic phosphorus were investigated in Fish Lake, Wisconsin, a mesoeutrophic, calcareous, seepage lake with an area of 88 ha, maximum depth of 19 m, and mean depth of 6.3 m. The littoral comprises 55% of the lake's area and is diverse with respect to sediment texture, angiosperm development, and hydraulic turnover time with the pelagial. Phosphorus concentrations were positively correlated with areas with (a) fine sediment and significant angiosperm development, (b) limited exchange of water with the pelagial, and (c) substantial runoff contributions to sediments. During turnover, pelagial phosphorus concentrations equalled or exceeded littoral concentrations because the hypolimnetic phosphorus pool became a significant phosphorus source to surface waters. Littoral phorphorus concentrations were not correlated with groundwater seepage and showed only a minor response to surface runoff events. This suggests that internal loading from littoral sediments was the major cause of these gradients rather than temporary storage of external loadings. The existence of internal loading was confirmed by observations of phosphorus accretion in littoral enclosures. Littoral-to-pelagial transport was the major phosphorus source to the pelagial during summer stratification, corresponding to 300-1500% of the pelagial phosphorus pool. Net transport of phosphorus from the littoral requires a source of phosphorus to replenish littoral sediments. Measurements in this investigation suggested that external loading was a major immediate source of this phosphorus, but that return of phosphorus from midlake to the littoral during turnover could also be important. (Sinha-OEIS)
W82-04484

HEAVY METAL CONTENT IN SEDIMENTS OF LAKES IN SOUTHERN BAVARIA AS A SIGN OF LONG-TERM ENVIRONMENTAL IMPACT (SCHWERMETALLGEHALTE IN SEDIMENTEN SUDBAYERISCHER SEEN ALS INDIKATOREN LANGFRISTIGER UMWELTBELASTUNG),

Munich Univ. (Germany, F.R.). Geographisches Inst.
For primary bibliographic entry see Field 5B.
W82-04550

SIMULATION AND VERIFICATION OF LAKE ONTARIO'S MEAN STATE,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. C. K. Huang, and P. W. Sloss.
Journal of Physical Oceanography, Vol 11, No 11, p 1548-1566, November, 1981. 11 Fig, 2 Tab, 35 Ref.

Descriptors: *Model studies, *Lakes, Thermal stratification, Stratification, *Lake Ontario, Great Lakes, Flow pattern, Wind, Mathematical studies, *Limnology.

A numerical dynamic model was developed for Lake Ontario based on primitive equations. All major current generating mechanisms were taken into account. The model is used for hindcasting the mean state in Lake Ontario during the International Field Year for the Great Lakes (IFYGL). Two simulations were carried out in July and December as representations of summer and winter. One simulation was done under the respective monthly mean steady frocing and the other under the respective hourly, time dependent atmospheric forcing. The constant forcing simulation resulted in a typical two gyre circulation pattern when the wind blew approximately parallel to the major axis of the lake. In the time dependent variable forcing simulation, the high frequency atmosheric fluctuations have not only excited strong inertial motions, but also generated mesoscale eddied near the downwind end boundary. Large scale low frequency topographic waves, propagating cyclonically at a phase speed of 60 cm/second, are also shown in the simulations. the generation, evolution, and dissipation of topographic waves, as well as mesoscale eddies can be expalined satisfactorily by the principle of conservation of potential vorticity. In the July case the lake dynamics are more complicated owing to the presence of thermal stratifications in addition to the mechanical forcing. (Baker-FRC)
W82-04570

STRUCTURE OF THE FLOW WITHIN THE COASTAL BOUNDARY LAYER OF THE GREAT LAKES,

Canada Centre for Inland Waters, Burlington (Ontario).
C. R. Murthy, and D. S. Dunbar.
Journal of Physical Oceanography, Vol 11, No 11, p 1567-1577, November, 1981. 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Boundary layers, *Lakes, Lake Huron, Boundaries, *Great Lakes, Lake coasts, Flow patterns, Flow, Coastal waters, Nearshore processes, Water currents.

Detailed observations on properties of the nearshore flow were noted at Douglas Point, Lake Huron. A network of current meters deployed in a coastal chain perpendicular to the local shoreline was used to obtain time series flow data. Data from these points was analyzed to resolve the mean flow

properties, horizontal turbulence characteristics and the kinetic energy within the coastal boundary layer. The variability of these parameters as a function of the distance from shore for an episode during which persistent short-parallel currents prevailed for several days has revealed two distinct boundary layers, an inner boundary layer dominated by bottom and shore friction and an outer boundary layer as a consequence of the adjustments of inertial oscillations to the lateral boundary. If the width of the frictional boundary layer is taken as the distance to the point where the kinetic energy of currents peak, it is about 2 km at Douglas Point. As the width of the inertial boundary layer, the distance to the point where inertial oscillations begin to dominate short parallel flow may be taken. This width at Douglas Point is about 8 to 10 km. (Baker-FRC)
W82-04572

WIND MIXING AND RESTRATIFICATION IN A LAKE NEAR THE TEMPERATURE OF MAXIMUM DENSITY,

Department of the Environment, Victoria (British Columbia). Inst. of Ocean Sciences.
D. M. Farmer, and E. Carmack.
Journal of Physical Oceanography, Vol 11, No 11, p 1516-1533, November, 1981. 13 fig, 2 Tab, 34 Ref.

Descriptors: *Thermal stratification, *Wind, Mixing, Density, *Destratification, *Lakes, Temperature effects, Seasonal variation, Convection, Babine Lake, *British Columbia, Canada.

Wind mixing and restratification were studied under conditions of a density maximum during the cooling of a freshwater lake. A mixed layer model was used to explore the concepts. The model incorporated both nonlinearity and pressure dependence in the equation of state. The results offer a basis for interpreting temperature structure in Babine Lake and for making some more general observations on mixing and restratification. After summer stratification is destroyed by wind mixing and convection in autumn, the lake is essentially isothermal as it cools through 4 degrees C. The coefficient of expansion becomes so small near this temperature that pressure effects which play little part in the dynamics at higher temperatures can dominate the stability. The transition between forced and free convection is marked at the depth where the local temperature equals the temperature of maximum density at constant pressure. Above this transition depth the wind must work against buoyance forces during cooling. Below this temperature the water is gravitionally unstable. Conditional instabilities occur which allow for a downward movement of initially stable water, leading to gravitational instability. As the lake cools the stability becomes less sensitive to pressure, and a given heat flux produces a progressively greater buoyancy flux, leading to the process of restratification. (Baker-FRC)
W82-04573

DETERMINATION OF CHARACTERISTIC VALUES FOR PHYSICAL AND CHEMICAL LAKE SEDIMENT PARAMETERS,

National Swedish Environment Protection Board, Uppsala (Sweden).
L. Hakanson.
Water Resources Research, Vol 17, No 6, p 1625-1640, December, 1981. 20 Fig, 13 Tab, 31 Ref.

Descriptors: *Sediments, *Lake sediments, *Physical properties, *Path of pollutants, Lakes, Mercury, Organic matter, Nitrogen, Phosphorus, Zinc, Heavy metals, Metals, Nutrients, Model studies, Characteristic values, Statistical analysis, *Sweden.

Characteristic values are determined for physical and chemical sediment parameters in lakes. The various physical sediment parameters (water content, bulk density, organic content, grain siize, degree of compaction, and sediment depth) are related to each other and to the sediment water conoent, a key parameter. The areal distribution of these physical parameters is described by a general formula, which is used with data for 5 Swedish lakes (Hjalmaren, Vanern, northern Vattern, western Malaren, and Ekoln). This relationship provides a way to determine the physically relevant characteristic values, not just traditional statistical values. Results show that (1) the distribution of the physical sediment parameters depends on the water depth, (2) the standard deviation around the mean is large in shallow waters where erosion, transportation, and fine sediments occur, (3) the spread decreases with increasing water depth, and (4) the spread is relatively small at water depths within the zone of accumulation. A formula is given for estimating the critical water content separating areas of accumulation from zones of transportation. Characteristic values may also be determined for chemical parameters showing high correlation with water content (the noncontaminating parameters). This procedure cannot be used on pollutants, which are usually distributed as distinct tongues with concentrations decreasing with increasing distance from the pollution source. Characteristic values for contaminating substances such as mercury may be determined from a map showing the areal distribution pattern as the areal median value. (Cassar-FRC)
W82-04586

BIOGENIC CALCITE STRUCTURES FORMING IN LAKE FRYXELL, ANTARCTICA,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. A. Wharton, Jr., B. C. Parker, G. M. Simmons, Jr., K. G. Seaburg, and F. G. Love.
Nature (London), Vol 295, No 5848, p 403-405, February 4, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Polar regions, *Lakes, Calcite, *Lake Fryxell, *Antarctic, Precambrian era, Microorganisms, Sedimentation, Algal growth, Inflow, Meltwater.

Observations in Lake Fryxell, Antarctica, revealed biogenic calcite structures not observed in other studies of Antarctic lakes. These structures were laminated, indurate, unbranched, and had either a vertical or a horizontal orientation. It was inferred that these calcite structures are biogenic in origin, due to the presence of an actively metabolizing algal mat on their surface and an internal composition of filamentous blue-green algal cell wall fragments, diatom frustules and calcite crystals. Lake Fryxell is located at the eastern end of Taylor Valley in southern Victoria Land. The lake lacks outgoing streams, and receives sediment, salts and nutrients from glacial meltstreams during the austral summer. The vertical calcite structures in the lake apparently resulted from the growth of the algal mat in dimly-lit shallow, non-turbulent water. Further study may offer insight into the palaeoecology of Precambrian stromatolites. (Baker-FRC)
W82-04638

PREDICTION OF THE CIRCULATION IN RESERVOIRS,

Liverpool Univ. (England). Dept. of Civil Engineering.
K. H. M. Ali, and D. Pateman.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 427-461, June, 1981. 27 Fig, 20 Ref.

Descriptors: *Reservoirs, *Water circulation, *Wind-driven currents, Lake circulation, *Model studies, Water currents, Coriolis force, Shallow lakes.

Circulation in shallow, open reservoirs was analyzed analytically and experimentally. The theoretical work considered inflows and outflows and geostrophic and wind effects. Experimental work was done on three circular reservoirs with radii of 0.73 to 3.68 m, using dye and illuminated surface floats. In a circular reservoir tangential or radial jets caused circulation patterns dependent on the Reynolds number of the jet and the aspect ratio of the reservoir. Outlet dimensions had little influence on circulation patterns. Circulation was predicted for prototype reservoirs using the equations developed in this paper. Water circulation caused by wind and the earth's rotation were highly dependent on reservoir water depth, wind shear stress at the water surface, and eddy viscosity. Predicted circulation was not applicable to the peripheral areas of the reservoirs. Diagrams for circulation in the experimental reservoirs are given for different combinations of wind stress, eddy viscosity, Coriolis factor, jet velocity, and water depth. (Circulation patterns for two irregularly-shaped reservoirs at Liverpool are also given. (Cassar-FRC)
W82-04682

LIMNOLOGICAL CHARACTERISTICS OF EUTROPHIC LAKE ISTOKPOGA, FLORIDA,

Bucknell Univ., Lewisburg, PA. Dept. of Biology.
W. F. McDiffett.
Florida Scientist, Vol 44, No 3, p 172-181, 1981. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Eutrophication, *Limnology, Lakes, Nutrients, Phosphorus, Algal growth, *Lake Istokpoga, *Florida, Field studies, Path of pollutants, Primary productivity, Agricultural runoff, Watersheds.

The results of a comprehensive limnological investigation of Lake Istokpoga are described. This lake represents a significant component of the Lake Okeechobee drainage basin. Nutrient enrichment bioassay experiments are also discussed. The study area is located in Highlands County, south-central Florida, just east of the Lake Wales sand ridge. The surface area is about 112 square kilometers, with a drainage basin of about 1700 square kilometers. The physico-chemical data indicate a well mixed body of water. The large surface area in conjunction with a shallow depth facilitates wind-generated mixing. The influent streams are significant contributors of nutrients to the lake; high primary productivity levels are the result. Irrigation projects contribute significant amounts of nutrients in runoff during dry periods. Nutrient enrichment experiments indicated that primary productivity in the lake was chiefly limited by phosphorus. Seasonal differences in response to ambient algal populations may have been responsible. Taken as a whole, the data suggest that Lake Istokpoga is a eutrophic system. (Baker-FRC)
W82-04719

THE BIOGEOCHEMISTRY OF SULFUR IN TWO SMALL LAKES,

R. B. Cook.
PhD Thesis, 1981. 267 p, 46 Fig, 45 Tab, 97 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13497.

Descriptors: *Biochemistry, *Lakes, *Sulfur, Bacteria, Sediments, Alkalinity, Chemical reactions, Chemical reduction, Chemical model.

The sulfur cycle in natural systems is greatly influenced by the presence of anoxic zones in which sulfate may be bacterially reduced to form labile H2S. The two lakes examined in this study, Lake 227 and Lake 223 at the Experimental Lakes Area, northwestern Ontario, have seasonally anoxic hypolimnia that exhibit bacterial sulfate reduction. Sulfate reduction rates were estimated from the decrease in hypolimnion sulfate concentrations during thermal and winter stagnation for both lakes and from a water column numerical model in L227. The anoxic breakdown of organic matter, as indicated by NH3 production, liberates S from amino acids and proteins at a rate 1/3 that of sulfate reduction in L227 and 4% of sulfate reduction in L223. Comparison of predicted amounts of FeS precipitated with actually measured FeS shows that there is approximately 3 years accumulation in L223 and greater than 10 years in L227. In L223, all of the FeS that formed during the acidification experiment is present in the sediment. The residence times for sulfate in both lakes are similar to the water residence times (2-6 years). A chemical model has been derived which predicts the increase in alkalinity from ammonia production, sulfate reduction, Fe 2+ production and FeS precipitation and compares this to the observed increase in alkalinity. This model shows that alkalinity gained by Fe 2+ production and FeS precipitation and compares this to the observed increase in alkalinity. This model shows that alkalinity gained by Fe 2+ is lost from the lake system during the invasion of oxygen at fall overturn

when Fe 2+ precipitates as an iron(III) hydroxide. (Sinha-OEIS)
W82-04726

ADDITION OF RADIOCARBON TO THE MIXED-LAYERS OF TWO SMALL LAKES: PRIMARY PRODUCTION, GAS EXCHANGE, SEDIMENTATION AND CARBON BUDGET,

P. M. Bower.
PhD Thesis, 1981. 263 p, 49 Fig, 53 Tab, 104 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25254.

Descriptors: *Lakes, *Primary productivity, *Phytoplankton, *Sedimentation, *Carbon cycle, Photosynthesis, Carbon radioisotopes, Mixed layers, Dimictic lakes, Gas exchange.

Addition of radiocarbon to the mixed-layers of two small dimictic lakes had made it possible to assess the validity of enclosing natural phytoplankton populations in bottles for the purpose of estimating primary production. Productivity results for the incubator-model averaged from 0.77 to 0.93 of the whole-lake values depending upon the choice of variables as input to the model. During a period of very high productivity, the 16 hour in situ incubations underestimated the whole-lake results by an average 60%, but the performance of the incubator-model was not affected during this time. Strong surface inhibition of photosynthesis was observed in the vertical profiles of production for the 4 and 16 hour in situ incubations but it was never quantitatively significant for the incubator-model. It is argued that this strong surface depression of photosynthesis is an artifact of the stationary position of the bottles and the unnaturally long exposure to supraoptimal light. A correction for daytime respiration of C14 incorporated on previous days suggests that whole-lake productivity is significantly enhanced over that measured in bottles. The fate of C14 was also monitored in the dissolved inorganic, dissolved and particulate organic, and sediment organic fractions. (Sinha-OEIS)
W82-04730

DISTRIBUTION OF CLAY MINERALS AND THEIR DIAGENESIS IN THE SEDIMENTS OF LAKE EDKU,

Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 2J.
W82-04748

2I. Water In Plants

SUNFLOWER YIELD VS. WATER DEFICITS IN MAJOR GROWTH PERIODS,

North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
E. C. Stegman, and G. W. Lemert.
Transactions of the ASAE, Vol 24, No 6, p 1533-1538, 1545, November/December, 1981. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Water stress, *Evapotranspiration, *Irrigation requirements, *Sunflower, Seeds, Crop yield, Water requirements, Water use, *Growth stages, North Dakota, Root zone, Plant growth, Soil water.

Water stress was applied to several growth stages of sunflower (hybrid 894): planting to bud, bud to last anther, and last anther to physiologic maturity. Stress level, based on degree of soil water depletion and an allowable level of leaf xylem pressure depression in mid-afternoon, was generally limited to one of the three growth stages. Seed yields vs. seasonal evapotranspiration showed a linear relationship for the upper bound function near 84.3 kg per ha per cm. Maximum yields at two North Dakota sites were 2900 kg per ha (seasonal evapotranspiration, 47 cm) and 3400 kg per ha (seasonal evapotranspiration, 51 cm). On a relative scale the upper bound slope indicated a potential yield loss of 1.3% per 1.0% decline in seasonal evapotranspiration. In this climate near potential yield was attained when available root zone storage capacity was not less than 50-60% in the planting to bud period, 30-40% in the bud to last anther period, and 50-60% in the seed filling period. Reductions of 20% in water requirements are possible with appropriate irrigation regimes. (Cassar-FRC)
W82-04361

EFFECTS OF DECREASED WATERING ON CROP YIELDS,

New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. Sammis, and J. Guitar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211442, Price codes: A03 in paper copy, A01 in microfiche. WRRI Report No 36, August, 1981. 29 p, 3 Fig, 9 Tab, 23 Ref. OWRT-A-063-NMEX(1).

Descriptors: *Alfalfa, *Cotton, *Crop response, Sprinkler irrigation, Lysimeters, Consumptive use, Irrigation deficit, *New Mexico, *Soil-water-plant relationships, Water production function.

Cotton and alfalfa were irrigated for three years at Las Cruces, with a range of water levels using a sprinkler-line source to determine yield and evapotranspiration under deficit irrigation. Alfalfa was grown at five locations and cotton was grown at two locations in New Mexico using flood irrigated nonweighing lysimeters to measure the yield and evapotranspiration under nonlimiting soil-moisture conditions. A linear water-production function was observed for alfalfa. This function appeared to be transferable to any location in New Mexico, based on the data from five locations within the state. The New Mexico relationship was statistically the same as alfalfa water-production functions for Nebraska and North Dakota. A linear water-production function was also observed for cotton, but was applicable only for the two areas in southern New Mexico where the study was conducted. This study indicated that biomass production may require the same amount of evapotranspiration regardless of site and management differences, as in the case of alfalfa, but that lint or seed production per unit of water will vary from place to place and from year to year.
W82-04411

EFFECTS OF SOIL MOISTURE, PLANTING DATE, AND WEEDS ON CEREAL YIELDS (EFFETS DE L'HUMIDITE DU SOL, DES DATES DE SEMIS ET DES MAUVAISES HERBES SUR LE RENDEMENT DES CEREALES),

Department of Agriculture, Sainte-Foy (Quebec).
J. M. Deschenes, and J. P. Dubuc.
Canadian Journal of Plant Science, Vol 61, No 4, p 851-857, December, 1981. 4 Tab, 17 Ref. English summary.

Descriptors: *Irrigation effects, *Soil-water-plant relationships, *Planting management, *Crop yield, Grain crops, *Cereal crops, Wheat, Oats, Barley, Weeds, Plant growth, Soil temperature, *Quebec.

An observed increase in grain yield from early sowing was investigated using two seeding dates (early and late May), two soil moisture levels (natural precipitation and natural plus irrigation with 25 mm of water per week), and three crops (oats, barley, and wheat). Studies were conducted in the field and under greenhouse conditions in Quebec's St. Andre sandy loam during 1976, 1977, and 1979. In the field early seeding plus irrigation increased yields, but the difference in planting time was more significant than the difference in soil moisture levels. Irrigated, late-planted cereals produced 80% of the yield of unirrigated, early-planted cereals. More than 50% of the yield variation was explained by the soil thermal units between sowing and emergence and the total amount of water between emergence and heading. Greenhouse results were similar to field results except that the effect of soil moisture was more evident. Weeds did not play an important role. Best cereal yields in this climate and soil are obtained by cool soil temperatures at seeding and high soil moisture between emergence and heading. Early May sowing fulfills these conditions. (Cassar-FRC)
W82-04470

SORGHUM AND BARLEY IN SOUTHERN ALBERTA: GRAIN YIELD RESPONSE TO IRRIGATION AND FERTILIZER,

Department of Agriculture, Lethbridge (Alberta).
E. H. Hobbs, and K. K. Krogman.
Canadian Journal of Plant Science, Vol 61, No 4, p 837-842, 1981. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Water use efficiency, *Soil-water-plant relationships, *Irrigation requirements, Grain crops, *Sorghum, *Barley, *Alberta, Crop yield, Fertilizers, Plant growth.

Grain sorghum and barley were compared with the respect to seasonal water requirements, interaction between water use and applied N fertilizer, and water use efficiency. Sorghum's seasonal water use was 500 mm, 20% greater than for barley because sorghum's growing season is 2 months longer. Peak daily water uses were 6 mm for sorghum and 5 mm for barley. With adequate irrigation both crops showed a linear yield response to applied N up to 80 kg per ha. However, under dryland conditions fertilizer had little effect on sorghum yield. Water use efficiency decreased with increasing water availability for both crops. Maximum yields were achieved under irrigation. In 1979, a growing season favorable for sorghum (warm fall), water use efficiency was close to 1.25 kg grain per cu m of water for complete season irrigation and early season irrigation regimes for both sorghum and barley. Sorghum grain yield was 6900 kg per ha. In 1978, an unfavorable year for sorghum, water use efficiency (in kg grain per cu m of water) was between 0.5 and 1.0 with or without irrigation; 1.25 for irrigated barley and 2.1 for nonirrigated barley. (Cassar-FRC)
W82-04471

COMPARISON OF PRESSURE CHAMBER AND PSYCHROMETER ESTIMATES OF LEAF WATER POTENTIAL IN RICE,

International Rice Research Inst., Los Banos, Laguna (Philippines).
J. C. O'Toole, and T. B. Moya.
Plant and Soil, Vol 62, No 2, p 313-317, 1981. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water potentials, *Leaves, Experimental design, *Rice, Dewpoint, Hydrometers, Hydrometry, Water analysis, Plant water potential, Measuring instruments.

Two rice cultivars, IR 2035-117-3, a modern semidwarf breeding line from the International Rice Research Institute, and Dular, a tall traditional cultivar from northeast India, were grown in 25 cm deep containers in a well fertilized clay-loam soil. Rice leaves were sampled for water potential between 8 and 9 A.M. on each sample date. Measurements of leaf water potential were made on the two cultivars by two measurement methods, from stress and control treatments and from protected and unprotected leaf handling prior to pressure chamber measurement. Sampling was accomplished over a 26 day period. Protection of leaf samples against water loss during excision, transport and handling was found to be more important at higher leaf water potentials. The two cultivars used appeared to differ in their response to protection of the leaf sample. These results serve to further caution pressure chamber users on extrapolating comparisons between the two measurement methods and between tissue handling techniques even with a single crop species. (Baker-FRC)
W82-04541

ANALYSIS OF THE COMPONENTS OF AREA GROWTH OF BEAN ROOT SYSTEMS,

Science and Education Administration, Fort Collins, CO.
E. L. Fiscus.
Crop Science, Vol 21, No 6, p 909-913, November-December, 1981. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Roots, *Water transport, *Plant water potential, Condutance, *Plant growth, *Beans, Hydraulic properties.

Root and shoot growth data are presented for Phaseolous plants grown under two conditions of

light intensity, and discussion is offered on how the distribution of various sizes of roots and their maturation might be related to the mean water transport coefficients and the growth rates for the whole root system. Plants were grown in aerated nutrient solution for 41 days in a greenhouse, under two light intensities, 425 and 300 microE/square meter/second. Determinations were made of leaf area, root area ratios, distribution of root sizes, and the fraction of the total root surface area of each root class. For plants with leaf and root areas greater than 1000 square centimeters, all of these parameters remained stable. They were not changed by light intensity or by growth rate. The mean root system hydraulic conductance appeared to be related to plant size rather than to plant age. In small plants the conductance was very low. Conductance increased about sixfold and peaked when the root systems reached about 1000 square centimeters in surface area. When the root size distribution stabilized in plants larger than 1000 square centimeters conductance gradually declined, probably because of suberization or some other growth related factor. The same pattern of relationships between root system size, root size distribution and hydraulic conductance was noted in plants grown at lower light intensity, except that the overall hydraulic conductance was consistently lower for plants of similar sizes. (Baker-FRC)
W82-04715

2J. Erosion and Sedimentation

TRANSVERSE BED SLOPE IN ALLUVIAL CHANNEL BENDS,
Iowa Univ., Iowa City. Inst. of Hydrological Research.
A. J. Odgaard.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1677-1694, December, 1981. 7 Fig, 2 Tab, 22 Ref.

Descriptors: *Sediment transport, *Slope degradation, *River beds, *Model studies, *Channel erosion, Channel morphology, Channel flow, Banks, Stream erosion, Streambeds, Sacramento River, Shear stress, Particle size, Alluvial channels, Bed load.

Existing models for the prediction of the steady-state transverse bed slope in channel bends and an alternative model developed in this paper were compared using laboratory and field data from the Sacramento River. Flows in alluvial channel bends are difficult to describe because of the helical flow pattern in the bend and its interactionwith the topography of the channel bed. Strong secondary currents combined with a transverse slope of the bed, deeper toward the outer bank, undermine and erode the outer bank. Existing models are based on equations of motion for the sediment particles in the bed load, whereas the writer's model is based on the assumption that the bed topography is determined by the critical conditions for sediment entrainment. All models gave reasonable agreement between measured and predicted slopes at smaller transverse slopes. At larger slopes the writer's model and one other were the only ones giving acceptable agreement. Grain size is a key parameter in all models, but there is no technique which can simulate the spatial variation of the grain size. (Cassar-FRC)
W82-04366

INCIPIENT MOTION OF SAND PARTICLES ON SIDE SLOPES,
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 8D.
W82-04368

SEDIMENTATION RATES AND DEPOSITIONAL PROCESSES IN LAKE SUPERIOR FROM PB210 GEOCHRONOLOGY,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
J. E. Evans, T. C. Johnson, E. C. Alexander, Jr., R. S. Lively, and S. J. Eisenreich.
Journal of Great Lakes Research, Vol 7, No 3, p 299-310, 1981. 4 Fig, 4 Tab, 47 Ref.

Descriptors: *Sedimentation rates, *Lake sediments, Lakes, *Lake Superior, Lake basins, *Trace metals, Shores, Storms, Erosion, Sediment cores, *Cores, Sediment sampler.

Sedimentation rates in Lake Superior ranged from 0.01 to 0.32 cm per year as determined by Pb210 geochronology of 17 sediment box cores taken in representative locations. The western arm of the lake had moderate to high sedimentation rates (0.05-0.11 cm per year), caused by shoreline erosion and resuspension of nearshore sediments. Marginal bays adjacent to the lake had the highest rates (>0.15 cm per year). Open lake regions adjacent to marginal bays had slightly lower rates (0.07-0.19 cm per year). Lowest sedimentation rates (0.01-0.03 cm per year) were in the central basins, which are isolated from sediment sources. Anomalies in Pb210 profiles in the southern and southeastern lake correspondended with severe storms in 1905, 1916-1918, and 1940, the severest storm of the century. These sediment disturbances were produced by resuspension of nearshore and shoal top sediments. Pb210 flux rates range from 0.2-10.0 dpm per sq cm per year, higher than those reported for other lakes. Possible reasons for this are: (1) higher atmospheric deposition rates from uranium bearing rocks or (2) samples collected in shore regions in this study. (Cassar-FRC)
W82-04380

THE EFFECTS OF SEDIMENTATION ON AQUATIC LIFE OF THE KANKAKEE RIVER, PHASE II: QUANTITATIVE STUDIES AND THREATENED, ENDANGERED, AND RARE SPECIES,
Illinois Natural History Survey, Chicago.
For primary bibliographic entry see Field 5C.
W82-04389

NUTRIENT AND HEAVY METAL TRANSPORT CAPABILITIES OF SEDIMENT IN THE SOUTHWESTERN UNITED STATES,
New Mexico Univ., Albuquerque. Dept. of Biology.
J. R. Gosz, C. S. White, and P. F. Ffolliott.
Water Resources Bulletin, Vol 16, No 5, p 927-933, October, 1980. 4 Fig, 4 Tab, 13 Ref.

Descriptors: *Sediment transport, *Chemical analysis, *Phosphorus, Trace metals, *Heavy metals, *Nutrients, Watersheds, Geology, Pine trees, New Mexico, Arizona, Solute transport, Soil types, Vegetation, Comparison studies.

This paper reports on a preliminary test of the hypothesis that sediment of a given size classification derived from small watersheds of uniform bedrock and a single vegetation type would have a uniform nutrient and heavy metal transport capacity. A comparison was made of samples from ponderosa pine communities growing on basalt, sandstone, limestone, and granite bedrock, and a comparison was made between a ponderosa pine community and a mixed conifer community on basalt bedrock. Analyses of acid-digestable and extractable nutrients showed differences for sediments derived from ponderosa pine forests in the Southwest on different geologies. These differences were similar for soil, stream bank, and stream channel material from a given site. Suspended sediment collections had nutrient concentrations similar to those of stream channel collections. Different vegetation on a given geology affected primarily the organic matter content, cation exchange capacity, total phosphorus, and levels of extractable nutrients in sediment. With additional work on other vegetation associations and a larger number of examples for a given bedrock, this approach may allow reasonable estimates of element loss from watersheds, knowing only bedrock composition, vegetation association, and sediment output. (Baker-FRC)
W82-04437

SOIL CONSERVATION SERVICE RUNOFF CURVE NUMBER ESTIMATES FROM LANDSAT DATA,
Science and Education Administration, Athens, GA.
For primary bibliographic entry see Field 7B.
W82-04438

RESERVOIR SEDIMENTATION WITH RANDOM DEPOSITS,
Asian Inst. of Tech., Bangkok. (Thailand).
H. N. Phien, A. Arbhabhirama, and P. Chenyapanich.
Water Resources Bulletin, Vol 16, No 5, 2 Tab, 13 Ref.

Descriptors: *Sedimentation, *Mathematical models, *Sediment discharge, *Reservoirs, Mathematical studies, Model studies, Statistical models, Statistical methods, Markov process, Sediment load, Sediment distribution, Sediment yield.

The volume of sediment accumulated in a reservoir over a period of years was considered as the sum of the annual sediment volumes for those years, which are obtained using the correlation between sediment discharge and river discharge and are treated as random variables in a statistical analysis. If longer records of stream flows are available, the relationship between sediment load and river discharge may function as a transformation of variables by which the distribution of sediment discharge (S) is transferred from the distribution of river discharge (Q). The relationship between these variables may also serve as a data generating system which provides a sediment S-sequence of the same length as the river discharge Q-sequence. Assuming the S- and Q-sequences follow a log-normal distribution, the mean and variance of the sediment volume accumulated in the design was applied to case studies at Kang Khoi on the Pasak River and at Nawarat Bridge on the Ping River, good agreement between values of the S- and Q-sequences were found. (Geiger-FRC)
W82-04443

RESERVOIR SEDIMENTATION AND ITS CAUSES IN ILLINOIS,
Illinois State Water Survey, Urbana.
J. B. Stall, and M. T. Lee.
Water Resources Bulletin, Vol 16, No 5, p 874-880, October, 1980. 6 Fig, 6 Tab, 10 Ref.

Descriptors: *Reservoirs, *Sedimentation, Sedimentation rates, Reservoir silting, Watersheds, Soil erosion, Lakes, *Illinois, Model studies, Computers.

The objectives of this paper were to provide for the state of Illinois a summary of the rates of destruction of impounding reservoirs by sediment deposition; to illustrate the use of the Universal Soil Loss Equation (USLE) to calculate soil losses from every farmer's field, from subwatersheds, and from an entire drainage area; to illustrate a sediment source map for an entire watershed; and to show how this sediment source map can be used to identify areas of the watershed where soil losses are excessive. Detailed surveys were made on 107 lakes. A generalized graph allows annual reservoir capacity loss in percent to be estimated based on size of watershed, lake capacity and watershed ratio. For the 258 square miles of land on the watershed of Lake Springfield, complete soil maps were measured using a graphic digitizer. A computer readable map was produced. The USLE was solved to provide upland soil losses for each area of the watershed. Average watershed soil loss was 3.96 tons per acre per year, and 24% of this was delivered to the lake, meaning that a representative lake in Illinois would have a normal life of 161 years. (Baker-FRC)
W82-04450

BANK FAILURE AND EROSION ON THE OHIO RIVER,
Louisville Univ., KY. Dept. of Civil Engineering.
D. J. Hagerty, M. F. Spoor, and C. R. Ullrich.
Engineering Geology, Vol 17, No 3, p 141-158, 1981. 9 Fig, 3 Tab, 6 Ref.

Descriptors: *Bank erosion, *Mechanical failure, *Erosion, River flow, *Ohio River, Navigation, Locks, Water level, Boats, Washouts, Infiltration, Land use, Alluvial deposits, Drainage.

Large numbers of riparian landowners along the Ohio River have complained that bank failures and erosion have been caused and/or accelerated by the existence of navigation-aid structures as well as prop turbulence and wave-related erosion by river traffic. Therefore studies were conducted on failure and erosion as well as on river regulation mechanisms. Paintings, photographs and reports revealed a history of significant bank erosion on the Ohio River for more than 150 years, primarily related to storms and high water periods. Construction of larger dams and locks raised retained water levels in some areas. No correlation was found between the ages of given pools and the apparent severity of erosion. During low to moderate flows water levels in the upstream reaches of navigation pools fluctuate somewhat more frequently than water levels immediately upstream from the dams, but fluctuations are smaller than those which occurred prior to dam construction. Based on reconnaissance surveys, bank failure and erosion were found to be a function of bank materials, topography, land use, river morphology and weather cycles. The phenomena are episodic and complex. The principal erosion mechanism appears to be bank material removal by current tractive forces during flood events and internal erosion of bank materials by bank discharge following floods. Landslides at several sites were triggered by periods of greater than average precipitation. Changes in drainage and land use which increase infiltration behind river banks could accelerate this internal erosion mechanism. No significant correlation was found between boat traffic level and bank erosion, but significant site-specific effects are possible. (Carroll-FRC)
W82-04473

EROSION AND SEDIMENTATION IN THE KENAI RIVER, ALASKA,

Geological Survey, Laguna Niguel, CA. Water Resources Div.
K. M. Scott.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.25. Geological Survey Professional Paper 1235, 1982. 35 p, 19 Fig, 5 Tab, 53 Ref.

Descriptors: *Streams, *Channel erosion, *Bank erosion, *Sedimentation, Watersheds, Flow characteristics, Snowmelt, Floods, Bed load, Gravel, Vegetation effects, Fisheries, Salmon, Hydrographs, Aerial photography, *Alaska, *Kenai River.

The Kenai River is the most important freshwater fishery in Alaska. The flow regime is characterized by high summer flow of glacial meltwater and periodic flooding caused by sudden releases of glacier-dammed lakes in the headwaters. Every part of the stream is a known or potential salmon-spawning site. The stream channel is underfit, attributed to regional glacial recession and drainage changes, and locally is entrenched in response to geologically recent changes in base level. Throughout the central section of the river the channel is armored, a condition with implications for the ability of this section of channel to support the spawning and rearing of salmon. The entrenched section of the channel has been stable since 1951. Bank erosion is active both upstream and downstream from the entrenched channel, however. Although erosion rates have been generally constant since 1951, evidence suggests a possible recent decrease in bank stability that may be related to changes in river use. As population and recreation use increases, development can pose a hazard to the productivity of the stream through increased suspended-sediment concentration resulting directly from construction and, with greater potential for long-term impact, indirectly from bank erosion. A short-term hazard to both stream and developments is the cutoff of meander loops, the risk of which is increased by canals and boat slips cut in the surface layer of cohesive, erosion-resistant sediment on the flood plain within nonentrenched meander loops. A long-term hazard is an increase in bank erosion rates resulting from loss of vegetation on the high (up to 70 feet) cutbacks of entrenched and partially entrenched section. (USGS)
W82-04495

ANASTOMOSED RIVER DEPOSITS: MODERN AND ANCIENT EXAMPLES IN ALBERTA, CANADA,

Calgary Univ. (Alberta). Dept. of Geography.
D. G. Smith, and P. E. Putnam.
Canadian Journal of Earth Sciences, Vol 17, No 10, p 1396-1406, October, 1980. 7 Fig, 1 Tab, 41 Ref.

Descriptors: *River beds, *Sediments, *Sedimentation, River basins, Wetlands, Channel flow, Aggrading rivers, Anastomosed deposits, *Canada, Alexandra River, Alluvial deposits, *Braided streams, Alberta, British Columbia.

Anastomosis is suggested as an alternative fluvial system to those of deltaic, braided, and meandering for the deposition of some thick fluvial deposits located in Alberta and British Columbia. An anastomosed fluvial system is a low energy complex of several interconnected channels of variable sinuosity crossing a wetland and forming many elongate vegetated islands. The causal mechanism is either a rising local base level control downriver, or a subsidence of the depocentre relative to a downriver reach. Modern and ancient examples of anastomosis are described to provide a basic depositional framework. One modern example is the lower reach of the Alexandra River in Banff Park. Ancient examples occur in east central Alberta and southwest Saskatchewan. Anastomosed systems have only recently been recognized as a unique fluvial style related to specific causal conditions. Much more field work on modern examples is necessary. (Small-FRC)
W82-04531

HOW RAIN INTENSITY AFFECTS INTERRILL EROSION,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. D. Meyer.
Transactions of the ASAE, Vol 24, No 6, p 1472-1475, November/December, 1981. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Rain intensity, *Erosion, *Sediment transport, Clays, Soil types, *Rill erosion, Soil erosion, Interrill erosion, Runoff, Cropland, Sediment yield, Cultivation, Vegetation effects.

Artificial rainfall was applied to crop row side slopes in fields to determine the effects of rain intensity on interrill erosion. Study sites were farm fields in Mississippi and Iowa. Different soils and cropping conditions were used in the investigation. An equation, E = aI to the b power, where E = erosion rate, a = coefficient of best fit, I = rain intensity, and b = exponent of best fit, was suitable for a wide range of soils and cropping conditions. The exponent b decreased from 2.0 for soils of low clay content to 1.6 for soils with 50% clay. This showed that the influence of rain intensity on erosion was greater for low-clay soils than for high-clay soils, possibly because of greater soil cohesiveness in the higher-clay soils. The equation E = cI squared, where c = ratio of coefficients, fit the data for high clay soils. The relative interrill erodibilities of the different soils or the relative erosion from different cropping conditions are quantitatively indicated by c. (Cassar-FRC)
W82-04537

A KINETIC MODEL FOR SURFACE MINE SEDIMENT YIELD,

Science and Education Administration, Fort Collins, CO.
R. E. Smith.
Transactions of the ASAE, Vol 24, No 6, p 1508-1514, November/December, 1981. 11 Fig, 20 Ref.

Descriptors: *Sediment transport, *Surface runoff, *Strip mines, Sediment yield, *Model studies, *Colorado, *Watershed management, Erosion, Sedimentation ponds, Ponds, Hydrologic models, Runoff, Snowmelt, Land treatment, Vegetation effects, Simulation.

A general watershed runoff and sediment transport model, KINEROS, is given for managing watersheds. Although the model can be applied to a wide range of situations from small urban regions to agricultural watersheds, this paper features its application to a watershed disturbed by surface mining. The major components are infiltration, surface water flow, channel flow, sediment transport, and pond storage. The model is applied to a steep 22-ha watershed established in a strip mine region in western Colorado. Measured and simulated runoff from two summer storms in August 1979 agreed well. Simulation of the April 19, 1979, snowmelt did not produce results comparable to the observed sediment concentrations. Modeling of a sedimentation pond, not yet in operation, indicated the effects of different treatments of surrounding land, such as terraces and vegetative cover. More suitable transport equations are needed for predicting sediment transport on steep watersheds with fine sediments. (Cassar-FRC)
W82-04552

THUNDERSTORM IN AGRICULTURE AND IN FOREST MANAGEMENT,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2B.
W82-04617

THE VORTEX SCOUR MECHANISM AT BRIDGE PIERS,

Zakir Husain Coll. of Engineering and Technology, Aligarh (India).
For primary bibliographic entry see Field 8B.
W82-04642

MATHEMATICAL SIMULATION OF SEDIMENT MOVEMENT IN STREAMS,

Hydraulics Research Station, Wallingford (England).
R. Bettess, and W. R. White.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 879-892, September, 1981. 4 Fig, 14 Ref.

Descriptors: *Sediment transport, *River beds, Sediment sorting, *Model studies, Bed load, Milburn Dam, *Nebraska, *Middle Loup River.

A model for sediment movement in streams was developed and used to predict changes in bed loads and changes in the composition of the bed materials over periods of several years. The model is one-dimensional and time-dependent, and all river properties such as discharge, stage, and bed level, depend only on two variables: the distance along the river and the time. Satisfactory results were obtained when the model was applied to two problems: a laboratory flume test and a field test of a 5200 m reach of the Middle Loup River downstream of Milburn Dam, Nebraska. The observed and calculated bed levels directly downstream of the dam in 1964 were about 1 m less than the original 1961 bed level. (Cassar-FRC)
W82-04650

GROUND-WATER FLOW SYSTEMS AND STABILITY OF A SLOPE,

Woodward-Clyde Consultants, San Francisco, CA.
R. J. Sterrett, and T. B. Edil.
Ground Water, Vol 20, No 1, p 5-11, 1982. 12 Fig, 10 Ref.

Descriptors: *Beach erosion, *Great Lakes, *Artesian pressure, *Groundwater movement, *Slope stability, Erosion, Bank erosion, Slope degradation, Artesian flow, Confined aquifers, Shore protection, Piezometers, Pore pressure, Geologic fractures, Canada, United States.

Receding shorelines along the Great Lakes have resulted in millions of dollars worth of property damage in the United States and Canada. Various projects that have investigated this erosion problem have shown that wave action at the base of the bluff is the main cause of bluff-top retreat. A study of the physical processes which cause bluff erosion

was undertaken with special focus on the role of groundwater in bluff stability. In one section of the Lake Michigan shoreline, an annual bluff-top recession of 9 to 10 m was recorded that was not related to toe erosion. Heads were measured in 25 piezometers at the site and a complex groundwater flow system was found. A glacial sand unit under artesian pressure was detected 5 m above the toe bluff while another 'perched' system existed in a fractured till unit at the top of the bluff. Fluctuations of up to 13 m/year which were recorded in the lower sand unit significantly affected bluff stability. Field data of pore pressures and calculations of the effective strength values of soil units were utilized in slope stability determinations to estimate safety factors. (Geiger-FRC)
W82-04677

DISTRIBUTION OF CLAY MINERALS AND THEIR DIAGENESIS IN THE SEDIMENTS OF LAKE EDKU,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. El Sabrouti, and A. A. Sokkary.
Marine Geology, Vol 45, No 1/2, p M15-M21, 1982. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Diagenesis, *Clays, *Sediments, Shallow lakes, *Lake sediments, Bottom sediments, Organic acids, Organic matter, Montmorillonite, Kaolinite, Illite, Nile Delta, *Lake Edku, Lagoons, Egypt.

Analyses of seven core samples from bottom sediments in Lake Edku, west of the Nile Delta, indicated that these sediments were derived from the Nile River, not from wind-transported sediments. This coastal lagoon varies in depth from 10 to 140 cm and receives inflow from the Mediterranean during dry periods. The major contituent of the sediments was montmorillonite, 47-80%. Illite and kaolinite were present at 7-37% and 6-29%. The proportion of montmorillonite increased and the proportion of illite decreased with increasing sediment depth. Kaolinite also decreased with depth, but to a smaller degree, 4-12%. It is believed that some of the illite was diagenetically changed to montmorillonite through the action of organic acids formed through decomposition of organic matter in the bottom sediments. (Cassar-FRC)
W82-04748

2K. Chemical Processes

HYSTERESIS IN RELATIONSHIPS BETWEEN DISCHARGE AND WATER CHEMISTRY IN THE FRASER RIVER BASIN, BRITISH COLUMBIA,
Department of the Environment, Vancouver (British Columbia).
P. H. Whitfield, and H. Schreier.
Limnology and Oceanography, Vol 26, No 6, p 1179-1182, 1981. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Water chemistry, *Hysteresis, *Fraser River, Rivers, Sampling, Sample preparation, Water sampling, Monitoring, Water quality, Discharge measurement, Load distribution, *British Columbia, *Streamflow-water quality relations.

Analysis of water samples taken from the Fraser River showed a general hysteresis in the discharge-concentration relationship recurring from year to year, with an overall pattern which was remarkably consistent over a 4 year period. The shape of the hysteresis changed more dramatically from one sampling station to another than from year to year. If the hysteresis were symmetrical the overall regression equation would balance the seasonal over- and under-predictions. However, most of the loops are asymmetrical, and yearly predictions thus become more complex and less accurate. Many properties showed hysteresis development when plotted against discharge. Differences were noted not only in the shape of the hysteresis but also in the direction. At some stations the loop developed in a clockwise direction, while in others it was counterclockwise, and in some it crossed over. Several different processes influence the development and shape of the hysteresis, and thus it is not possible to develop a universal model for predicting loadings in the entire river basin. Different rates of nutrient cycling, biological uptake, storage-discharge relationships, and factors relating to climatic and cyclic events are in part responsible for creating a hysteresis. To avoid statistical problems related to serial correlations and hysteresis a complex sampling design is needed, where samples are collected at equal spaces in time and at equal increases in discharge volume. Samples need to be taken often enough to include individual events of high discharge. (Baker-FRC)
W82-04326

WATER CHEMISTRY OF THE ILLINOIS WATERWAY,
Illinois State Water Survey Div., Champaign.
V. Kothandaraman, R. A. Sinclair, and R. L. Evans.
Circular 147, 1981. 23 p, 6 Fig, 15 Tab, 12 Ref.

Descriptors: *Chemical analysis, Physical analysis Water sampling, Streams, *Waterways, Water quality, Data collections, Alkalinity, Dissolved oxygen, Chlorides, Suspended solids, Water temperature, Orthophosphates, Ammonium compounds, Nitrogen compounds, Nitrates, Fluctuations, *Baseline studies, *Lake Michigan, *Water diversion, *Illinois waterway.

A two-year field sampling effort was undertaken by the Illinois State Water Survey to develop baseline water chemistry data prior to increased diversions of Lake Michigan waters into the Illinois Waterway, and to assess the probable impact of the diverted waters on the water chemistry of the waterway. Physical and chemical water quality characteristics are summarized from data obtained at 28 sampling locations established at 10-mile intervals and covering about 270 miles of the waterway. Observations and samples were used to determine temperature, dissolved oxygen (DO), turbidity, pH alkalinity, hardness, chlorides, total solids, suspended solids, orthophosphate-phosphorus, total phosphate-phosphorus, ammonium-nitrogen, and nitrate nitrogen. The waterway was divided into seven reaches and data within each were combined. The Illinois Waterway is high in alkalinity, total solids, and hardness. The pH samples varied from 7.6 to 9.3---within established limits of the Illinois Pollution Control Board. Alkalinity and hardness increased as the river flowed downstream. Ammonia concentrations were higher in the upper reaches of the river as were DO levels. Long-term average mineral and nutrient transports at three USGS gaging stations were made by the flow duration curve method. Nitrate flux at the stations varied from 8.88 to 13.83 lbs/ac/yr and are in the mid-range of values reported for other Illinois streams. Phosphorus loads varied from 1.20 to 2.96 lbs/ac/yr which are several times higher than the values reported for other Illinois streams. (Atkins-Omniplan)
W82-04390

SELECTED HYDROLOGIC RELATIONSHIPS FOR SOLDIER CREEK, NORTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04519

CHEMICAL COMPOSITION OF MONSOON RAINWATER OVER BHOPAL, MADHYA PRADESH (INDIA) DURING 1977 AND 1978,
Indo-British Betwa Groundwater Project, Bhopal (India).
For primary bibliographic entry see Field 2B.
W82-04666

A PHYSICAL REASON FOR HIGHER PH OF TROPICAL RAINWATER,
Meteorological Office, Poona (India).
A. K. Mukherjee, and K. Nand.
Mausam, Vol 32, No 3, p 231-236, July, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Rain, *Carbon dioxide, *Hydrogen ion concentration, *India, Tropical regions, Monsoons, Solubility, Temperature, Air temperature.

Differences in pH of rainwater between northern European countries and tropical countries are explained with respect to the solubility of carbon dioxide at different temperatures. The theoretically calculated pH at 20 C is 5.65, based on the assumption that dissolved carbon dioxide is in equilibrium with atmospheric CO2. The pH of rainwater in India is close to neutral, 7.0. In colder European countries the solubility of CO2 in water is about 1.5 times that in the tropics. In addition, the dissolution rate of CO2 in rainwater is about 1.5 times higher in the colder countries. In the tropics the higher atmospheric temperature, lower solubility and dissolution rate of CO2, and the rapid cloud formation and precipitation result in a higher pH. (Cassar-FRC)
W82-04669

GEOCHEMISTRY OF THERMAL AND MINERAL WATERS IN THE CASCADE MOUNTAINS OF WESTERN NORTH AMERICA,
Oregon Water Resources Dept., Salem.
L. S. Forcella.
Ground Water, Vol 20, No 1, p 39-47, 1982. 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Thermal springs, *Thermal properties, *Chemical properties, *Mineral springs, Hydrogen ion concentration, Ions, Water properties, Geohydrologic units, Geohydrology, Geothermal studies, Geothermal resources, Mineral water, Geophysics, *Cascade Mountains, Washington, Oregon.

The chemistry of thermal and mineral waters in the Cascade Mountains was examined as a basis for future comparisons with other hydrothermal systems and for future development of geothermal resources. The thermal and mineral waters from the Cascades may be classified into three chemically distinct groups. Group 1 exhibits a neutral pH, an average total dissolved solids (TDS) value of 2650 ppm, and dominant Na and Cl ions. Group 1 waters issue from the geothermally attractive Central Cascades and were probably in prolonged contact with Eocene marine sediments during the Mesozoic era. Group 2 waters are fumarolic acid-sulfate waters from the vents of Mt. Lassen, Newberry Crater and Mt. Hood. Basic brines discharge from the base of Mt. Lassen and Mt. Hood. The Group 3 waters are characterized by chemical inhomogeneity between different points of discharge. Dominant ions are Cl, Na, HCO3, and SO4 and the pH ranges from 6.2 to 9.7. The thermal waters of the Cascade Province have been subject to various degrees of mixing and proximity to heat which might account for the chemical differences. (Geiger-FRC)
W82-04673

INFLUENCE OF AN AMERICIUM SOLID PHASE ON AMERICIUM CONCENTRATIONS IN SOLUTIONS,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W82-04720

THE BIOGEOCHEMISTRY OF SULFUR IN TWO SMALL LAKES,
For primary bibliographic entry see Field 2H.
W82-04726

ISOTOPE GEOCHEMISTRY OF WATER IN GULF COAST SALT DOMES,
Arizona State Univ., Tempe. Dept. of Geology.
L. P. Knauth, M. B. Kumar, and J. D. Martinez.
Journal of Geophysical Research, Vol 85, No B9, p 4863-4871, September 10, 1980. 2 Fig, 1 Tab, 32 Ref.

Descriptors: *Geochemistry, *Isotope studies, *Salt domes, Meteoric water, Chemical composition, Oxygen, Hydrogen, Salt mines, Saline water, Groundwater, Louisiana, *Gulf of Mexico, Weeks Island, Jefferson Island, Belle Isle.

Water has occasionally been found to enter newly excavated chambers in salt domes along the northern coast of the Gulf of Mexico from ceiling drips,

wall seeps, and exploratory boreholes. An understanding of the origin of this water is extremely important in evaluating the suitability of salt domes as isolation sites for nuclear waste proucts. Possible origins include connate waters that have been in the salt since deposition and waters external to the dome which have somehow penetrated or become incorporated into the salt. The hydrogen and oxygen isotopic composition of water samples collected from salt mines on Weeks Island, Jefferson Island, and Belle Isle in southern Louisiana were analyzed in an effort to determine the origin of the water. Two samples were found to be isotopically similar to local surface waters and clearly of meteoric origin. All of the other samples were too enriched in oxygen-18 to be meteoric waters. Water derived from active leaks in three mines on Weeks Island was too enriched in oxygen-18 and too depleted in D to be connate ocean water or evaporite connate water trapped in the salt. It is unlikely that the water originated from the dehydration of gypsum or that isotopic exchange with anhydrite is responsible for the oxygen-18 enrichments. It is concluded that the nonmeteoric waters are saline formation waters which have become incorporated in the salt. The observed oxygen-18 enrichments suggests that the formation waters were incorporated during diapiric rise of salt at a depth of 3 to 4 kilometers and have been trapped within the salt for between 10 and 13 million years. The presence of limited amounts of such trapped formation water in the salt within salt domes will have to be considered when planning radioactive waste storage in salt domes. (Carroll-FRC)
W82-04742

2L. Estuaries

SURVIVAL AND HETEROTROPHIC ACTIVITIES OF FRASER RIVER AND STRAIT OF GEORGIA BACTERIOPLANKTON WITHIN THE FRASER RIVER PLUME,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
M. Valdes, and L. J. Albright.
Marine Biology (Berlin), Vol 64, No 3, p 231-234, 1981. 9 Fig, 3 Tab, 40 Ref.

Descriptors: *Nutrients, *Plumes, Rivers, Carbon, Nitrates, Phosphorus, *Bacteria, *Estuaries, Plankton, Fraser River, Strait of Georgia, *British Columbia, Canada.

Subsurface samples of water were taken from various locations in the Fraser River, its plume and the Strait of Georgia and use for experimental purposes within 1 hr of collection. The majority of the autochthonous heterotrophic bacterioplankton of the lower Fraser River appeared to be killed when placed in marine water taken from the Strait of Georgia. However, their marine counterparts with Strait of corgia surface water remained viable when treated with Fraser River water. Within the plume water a stimulation of glucose heterotrophic activity occurred within the salinity range of about 3-18 0/00. The plume water itself arises naturally when the freshwater of the Fraser River mixes with the marine water of the Strait of Georgia. This increase in bacterioplankton activity may be a result of a better nutrient environment within plume water as compared to either parent water. It is noted that there is a well distributed and relatively high inorganic carbon, nitrate and phosphorus content in the plume water, which makes it more nutritionally complete for acteria than either of the other waters. (Baker-FRC)
W82-04291

ELECTROMAGNETIC MEASUREMENTS OF TIDAL TRANSPORTS IN ESTUARIES,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 7B.
W82-04296

ICHTHYOPLANKTON SAMPLERS FOR SIMULTANEOUS REPLICATE SAMPLES AT SURFACE AND BOTTOM,

North Carolina State Univ. at Raleign. Dept. of Zoology.
For primary bibliographic entry see Field 7B.
W82-04297

THE EFFECT OF DRIED AND CRACKED SEDIMENT ON THE AVAILABILITY OF PHOSPHORUS IN A COASTAL LAGOON,

Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Biologia.
V. Arenas, and G. De La Lanza.
Estuaries, Vol 4, No 3, p 206-212, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Lagoons, *Phosphorus, Nutrients, Estuaries, Estuarine environment, Cycling nutrients, *Mexico, Coastal waters, Water level, Aquatic plants, Sediments, *Caimanero Lagoon, Dry sediment.

The effect of dried and cracked sediments on the availability of nutrients such as phosphorus in coastal ecosystems was investigated. The study area was the Caimanero Lagoon, which is subject to alternate periods of low water and flooding. In times of low water, more than 70% of the lagoon area is dry, cracked and colonized by halophytes to variable proportions. Mineralization of organic matter occurs during these dry times and reavailability of phosphorus takes place to a great extent. The amount of soluble organic matter also increased during the dry seasons. It was established that the sedimentary drying and cracking process contributed significantly to estuarine productivity, probably due to the ability of algae to utilize the phosphorus from organic sources. (Baker-FRC)
W82-04299

OREGON COASTAL SALT MARSH UPPER LIMITS AND TIDAL DATUMS,

Oregon State Univ., Corvallis.
R. E. Frenkel, H. P. Eilers, and C. A. Jefferson.
Estuaries, Vol 4, No 3, p 198-205, 1981. 4 Fig, 3 Tab, 18 Ref.

Descriptors: *Salt marshes, Coastal zone management, Wetlands, *Tidal marshes, Marshes, *Oregon, *Coastal marshes, *Saline-freshwater interfaces, Saline water intrusion.

Independent surveys were made of three coastal salt marshes to determine the upper limit of marsh. The areas of study included South Beach marsh of the Yaquina River estuary, Drift Creek marsh of the Alsea River estuary, and Bandon marsh of the Coquille River estuary. Primary tidal data are relatively infrequent for the Oregon Coast. Of the marshes studied, only South Beach had dependable data. The relation of tidal datum planes to National Geodetic Vertical Datum (NGVD) was not readily available and was determined from vertical control data for bench marks. A transition zone between marsh and upland was identified by strong dominance of Potentilla pacifica and the presence of Achillea millefolium, Angelica lucida, Aster subspicatus, Oenanthe sarmentosa, Trifolium wormskjoldii, and Vicia gigantea. The mean elevation of the lower boundary of the transition zone was 1.38 meters above NGVD and the upper boundary of the transition zone was 1.54 meters above NGVD. The relation of the upper limit of marsh to tidal datums varied with marsh. The mean elevation of the upper and lower limit of the transition zone was 0.58 meters above MHW and 0.36 meters above MHW, respectively. Two teams of biologists using the same biological criteria for defining the upper limit of marsh independently agreed on the elevational position of the upper limit of marsh. Additional research on defining the upper limit of coastal marsh is needed.
W82-04312

NUTRIENT MASS BALANCES FOR THE WATERSHED, HEADWATERS INTERTIDAL ZONE, AND BASIN OF THE RHODE RIVER ESTUARY,

Chesapeake Bay Center for Environmental Studies, Edgewater, MD.
D. L. Correll.
Limnology and Oceanography, Vol 26, No 6, p 1142-1149, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Estuaries, *Nutrients, Nutrient removal, *Rhode River Estuary, Maryland, Rivers, Cycling nutrients, Organic matter, Nitrogen, Phosphorus, Seasonal variation, Path of pollutants.

Measurements were made of the dynamics of nitrogen, phosphorus, and organic matter content in the basin, headwaters, intertidal zone and watershed of the Rhode River Estuary. Inputs from precipitation and both surface and groundwater runoff were measured continuously, as well as the tidal flux between the intetidal zone and the main estuarine, open water basin, for a 13-month period. The watershed is dominated by agriculture and secondary successional vegetation, 38 ha of todal marshes and mudflats, and an estuarine open water basin. Less organic matter moved out to the estuary than was discharged into the intertidal zone from the watersheds and deposited in precipitation. Only 1.9 tons of the 2.7 tons of phosphorus discharged from the uplands into the intertidal zone moved into the estuary. In most instances a high discharge of phosphorus from the watersheds was followed in a week or two by a high discharge into the estuary from the intertidal zone. A significantly lower fraction of the total phosphorus moving into the estuary was made up of orthophosphate than had been anticipated based on the amount of orthophosphate moving from the watershed. Of the 10 tons of nitrogen discharged from the watershed into the intertidal zone, only 7.4 tons moved into the estuary. Thus overall removal and storage of nutrients from land runoff by the intertidal zone is apparent. Only when runoff was high due to storms were some of the stored nutrients flushed from the intertidal zone. (Baker-FRC)
W82-04330

VERTICAL MIXING AND PHOTOSYNTHETIC CAPACITY OF ESTUARINE PHYTOPLANKTON (MELANGE VERTICAL ET CAPACITE PHOTOSYNTHETIQUE DU PHYTOPLANCTON ESTUARIEN (ESTUAIRE DU SAINT-LAURENT)),

Laval Univ., Quebec. Dept. de Biologie.
S. Demers, and L. Legendre.
Marine Biology (Berlin), Vol 64, No 3, p 243-250, 1981. 5 Fig, 45 Ref. English summary.

Descriptors: *Estuaries, *Phytoplankton, Vertical distribution, *St. Lawrence Estuary, Vertical distribution, Chlorophyll, Photosynthesis.

Water samples were collected hourly for 167 hours in August of 1975 at an anchor station in the Middle Estuary of the St. Lawrence River, Canada. These samples served as a time series for measuring chlorophyll a, photosynthetic capacity and many physical parameters. Sampling was conducted during the transition from neap to spring tides. Variations in chlorophyll a, both long and short-term, are coupled with the advection of water masses, which in turn depends on the tidal currents. The chlorophyll a concentration of the cells is also influenced by the vertical mixing, as it modifies the physiological state of the phytoplankton. Periodicities were also noted in the photosynthetic capacity, suggesting that the phytoplankton of this area have a homogeneous light history due to strong vertical mixing. The photosynthetic capacity is adapted to the mean light intensity in the mixed layer under these conditions. Semi-monthly variations of the mean light intensity in the mixed layer depend on the semi-monthly variations in the vertical mixing, whereas in the short-term, the variations in mean light intensity in the mixed layer are circadian. (Baker-FRC)
W82-04331

SUNLIGHT INDUCED MOVEMENT OF PLANKTONIC ORGANISMS AND THEIR RELATIONSHIPS TO WATER MOVEMENTS,

Kentucky Water Resources Research Inst., Lexington.
For primary bibliographic entry see Field 2H.
W82-04417

EVIDENCE FOR COEXISTENCE OF TWO DISTINCT FUNCTIONAL GROUPS OF SULFATE-REDUCING BACTERIA IN SALT MARSH SEDIMENT,

Essex Univ., Colchester (England). Dept. of Biology.
I. M. Banat, E. B. Lindstrom, D. B. Nedwell, and M. T. Balba.
Applied and Environmental Microbiology, Vol 42, No 6, p 985-992, December, 1981. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Bacteria, *Sulfates, *Sediments, *Salt marshes, Sulfides, Sulfur bacteria, Molybdates, Fluoroacetates, Oxidation, Marine sediments, Marshes, Estuarine environment, Wetlands, Lake sediments, *England, Ray Creek, Colne Point Marsh, United Kingdom.

Two types of sulfate-reducing bacteria, one oxidizing acetate and one probably oxidizing hydrogen, were found in the salt marsh sediments of Ray Creek, Colne Point Marsh, United Kingdom. Acetate oxidation was partially inhibited by addition of fluoroacetate, a known inhibitor of acetate metabolism. Molybdate completely inhibited acetate oxidation. It apparently acts by suppressing adenosine triphosphate sulfurylase, common to both groups of bacteria. Acetate metabolism in freshwater pond sediments in the absence of sulfate was not affected by molybdate but was inhibited by fluoroacetate. Acetate was oxidized to carbon dioxide, not to methane. (Cassar-FRC)
W82-04464

DEPTH, SILT AND CURRENT: FACTORS IN THE TRANSVERSE MICRODISTRIBUTION OF THE BENTHOS IN THE FRESHWATER ESTUARY OF THE ST. LAWRENCE (PROFONDEUR, VASE ET COURANT, FACTEURS DE MICROREPARTITION TRANSVERSALE DU BENTHOS DANS L'ESTUAIRE D'EAU DOUCE DU SAINT-LAURENT (QUEBEC),

Quebec Univ., Trois-Rivieres. Dept. of Chemistry-Biologie.
B. Vincent.
Canadian Journal of Zoology, Vol 59, No 12, December, 1981. 3 Fig, 3 Tab, 29 Ref. English summary.

Descriptors: *Estuarine environment, *Species composition, *Benthic fauna, Silt, Flow velocity, *St Lawrence River, Water currents, Water depth, Rivers, Species diversity, *Spatial distribution.

To study the spatial variability of the faunal characteristics and numbers and relate them to the abiotic factors prevailing at various locations, benthic samples were collected with a Ponar bucket at 33 locations on a transect of the upper St. Lawrence estuary. Data were simultaneously obtained on the physicochemical characteristics of the water, water depth, silt content of the surface sediments, and current speed. The principal taxonomic groups represented were oligochaetes (34.4%), hirudinea (4.9%), gastropoda (38.1%), sphaeriidae (19.6%) and chironomids. The physico-chemical characteristics of the water were fairly stable. The most abundant species followed a definite zonation, but no species was truly typical of any one habitat. Depth, percentage of silt, and current velocity, in decreasing order, affected the structure of the benthic associations. The diversity was independent of these factors, but the organism density, number of taxa, and equitability were all significantly correlated with the percentage of silt. (Carroll-FRC)
W82-04472

EFFECT OF RIVER DISCHARGE ON THE DISTRIBUTION PATTERN OF DISSOLVED CONSTITUENTS IN THE GAMO ESTUARY, MIYAGI PREFECTURE,

Tohoku Univ., Sendai (Japan). Biological Inst.
E. Kikuchi, and Y. Kurihara.
Japanese Journal of Limnology, Vol 42, No 2, p 100-107, 1981. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater pollution, *Dissolved solids, *Phytoplankton, *Estuaries, *Gamo Estuary, Nanakita River, *Japan, Rivers, Nutrients, Nitrates, Chlorides, Phosphates, Ammonium, Dissolved oxygen, Oxygen, Eutrophication, Diatoms, Cytocella, Ciliates, Mesodinium, Salt wedge estuaries, Saline-freshwater interfaces, Sendai Bay.

Chlorinity, dissolved inorganic nitrogen, phosphate, and dissolved oxygen were measured at 7 sites in the Gamo estuary, Japan, a salt wedge estuary highly polluted with domestic sewage. A weir is located about 4.2 km upstream from the mouth. Sampling sites were located from the mouth to 4 km upstream and at different depths from the surface to the bottom, which ranged from 1 m deep at the mouth to 5 m deep in a trough. Ammonium and phosphate concentrations increased with distance upstream, and dissolved oxygen decreased with distance upstream. Levels of ammonium and phosphate increased with depth. Dissolved oxygen concentrations decreased with depth, reaching zero at the bottom of a trough. These results indicate that the deeper water was trapped in basins by shallow sills for long periods. Nitrate concentrations were higher in the fresh surface water than in the saline bottom water. The effect of the tide on the dissolved constituents was almost negligible in the estuary except near the mouth. In the brackish surface water dissolved oxygen levels were high, and ammonium, nitrate, and phosphate levels were very low. A phytoplankton bloom at low flow in summer was dominated by diatoms (Cytocella) in the fresh surface water and ciliates (Mesodinium) in the saline water. (Cassar-FRC)
W82-04543

SALINITY INTRUSION IN ESTUARIES,

Institute of Oceanographic Sciences, Merseyside (England).
D. Prandle.
Journal of Physical Oceanography, Vol 11, No 10, p 1311-1324, October, 1981. 7 Fig, 2 Tab, 30 Ref.

Descriptors: *Saline water intrusion, *Tidal effects, *Mixing, *Estuaries, Rivers, Model studies, Salinity, Fate of pollution, Dispersion coefficient.

One-dimensional solutions were examined for thd degree of saline water intrusion into estuaries of different shapes. These solutions emphasize the importance of the rate of change of cross-sectional area in determining salinity distribution. The salinity distribution was shown to be highly dependent on the dimensionless parameter V1, which equals U1 x X1 divided by D, where U1 = velocity of freshwater flow at position X1, the point where the salinity of the estuary equals the oceanic value, and D = longitudinal dispersion coefficient. The predicted and observed salinity distributions were compared for 8 estuaries. The values of D were within the range of 50-500 sq m per sec for 6 estuaries (Hudson, Potomac, Delaware, Bristol Channel, Thames, and St. Lawrence). Since salinity distribution is highly sensitive to the specified value of D, the one-dimensional, time-averaged approach may be limited. Attempts to derive a more rational dimensionless form for the longitudinal dispersion coefficient in terms of gross estuarine parameters were not successful. (Cassar-FRC)
W82-04574

REQUIREMENTS FOR CONTINUOUS AUTOMATIC WATER QUALITY MONITORING IN THE THAMES ESTUARY,

Thames Water Authority, London (England).
A. G. Cockburn, and R. J. Furley.
Water Science and Technology, Vol 13, No 11/12, p 693-698, 1981. 3 Fig, 5 Ref.

Descriptors: *Estuaries, *Water quality, Monitoring, Estuarine environment, Water management, Measuring instruments, *Thames River, Rivers, Water pollution control, Water management, England.

The paper discusses the reason for automatic continuous monitoring on tidal rivers and the requirements of such a system in the Thames Estuary. The Tidal Thames is a well mixed estuary stretching some 140 kilometers from Teddington, through the heart of London, th the North Sea. Prior to 1960 the Tideway was anaerobic and devoid of all fish life for much of its length, but improvements in effluent quality have resulted in minimum average dissolved oxygen concentrations of 30% in recent years and the consequent return of large fish populations. Automatic continuous water quality monitoring should prove an efficient and cost effective management tool in the continuing improvement of the Tidal Thames. Running costs including servicing requirements will be less than those currently incurred by manual sampling and analysis using launches, and the information obtained will be much more complete. Significant storm sewage discharges occur in the uppermost 30 kilometers of the estuary, where dilution is small; these can cause sudden severe depletion in dissolved oxygen and consequent fish mortality. It is possible to alleviate the situation by direct injection of pure oxygen into the river by barges towed to the appropriate locations. For this method to be viable, continuous monitoring, together with appropriate telemetry, is essential to give early warning of deteriorating water quality and proper operational control. Site selection for water quality monitoring programs is absolutely critical. (Baker-FRC)
W82-04591

A SUSPENDED SEDIMENT FRONT IN THE SEVERN ESTUARY,

Institute of Oceanographic Sciences, Taunton (England).
R. Kirby, and W. R. Parker.
Nature (London), Vol 295, No 5848, February, 1982. 5 Fig, 12 Ref.

Descriptors: *Estuaries, *Suspended sediments, Sediments, Salinity, Sedimentation, Estuarine environment, Topography, Coriolis force, Tidal effects, *Severn Estuary, *England.

The structure of the suspended solids field was observed in the Severn Estuary using a free-fall array consisting of two narrow-gap optical turbidity meters, a pressure depth sensor, and occasionally a continuously recording conductivity meter, allowing continuous and rapid vertical profiles to be made from drifting or anchored vessels. The regional spring surface and spring bed distributions show the sediment front as a zone of marked gradient approximately along the axis of the estuary between The Shoots and the Holm Islands, and extending across the inner Bristol Channel to the English coast in the region of Watchet, in Bridgewater Bay. The more turbid water mass lies on the English side of the estuary. On neap tides the regional distribution was similar, although the contrast between surface and bed concentration values is greater. Data plots showed that the sediment front was more prominent on spring than on neap tides and on ebb rather than flood tides. Steeply inclined concentration contours were noted across the gradient zone in the region between The Bridge and a line joining Barry and Burnham. The front may be due to an interaction between the regional and local topography. Coriolis effects and lateral phase differences in tidal elevation across the estuary, which set up secondary water circulation cells in the plane of the cross-section, leading to convergence along the main channel axis. It is concluded that the Severn estuary, while well mixed with regard to salt, shows marked lateral partitioning of suspended sediment, with a stably positioned front forming the junction between the two water masses. (Baker-FRC)
W82-04639

DISPERSION COEFFICIENTS IN ESTUARIES,

Birmingham Univ. (England).
For primary bibliographic entry see Field 5B.
W82-04684

SHEET FLOW IN A SALT-MARSH BASIN, NORTH INLET, SOUTH CAROLINA,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
J. L. Miller, and L. R. Gardner.
Estuaries, Vol 4, No 3, p 234-237, 1981. 4 Fig, 13 Ref.

Descriptors: *Laminar flow, *Salt marshes, Stratification, Tidal prism, Water storage, Estuaries, Estuarine environment, Tidal marshes, *South Carolina, North Inlet area, Saline-freshwater interfaces.

This paper evaluates the magnitude of sheet flow in a small marsh basin near North Inlet, South

Carolina by comparing basin storage curves determined by current measurements with a basin storage curve based on direct measurements of marsh topography and hypsometry. The basin is well outlined by terrestrial vegetation. The study indicated that on spring tides, more than 50% of the tidal prism that enters Oyster Landing basin enters as sheet flow over the grassy flats of the marsh. The discharge data also suggest that the storage curve for the basin may be a hysteresis loop with separate flood and ebb segments. (Baker-FRC)
W82-04716

SEASONAL CHANGES IN THE DEPTH DISTRIBUTIONS OF INTERSTITIAL SALINITIES IN THE FRASER RIVER ESTUARY, BRITISH COLUMBIA,
Victoria Univ. (British Columbia). Dept. of Biology.
P. M. Chapman.
Estuaries, Vol 4, No 3, p 226-228, 1981. 2 Fig, 11 Ref.

Descriptors: *Sediments, *Interstitial water, *Salinity, *Fraser River estuary, Estuaries, *British Columbia, Estuarine environments, *Seasonal variation, Stratification.

Results of a study of vertical and temporal variations in the interstitial salinities of subtidal estuarine sediments are presented. The study was carried out at six stations in the Fraser River estuary spaced to encompass the whole spectrum from freshwater to salt water regions. Stations were sampled monthly in replicate at four sediment depths, and horizontal and vertical changes in interstitial salinity were recorded. The main pattern of flow in the Fraser River is a constant one of low discharge in winter, medium discharge in autumn, and highest discharge between May and June. Maximal salinities occur over winter and minimal salinities during freshet. The seasonal pattern of interstitial salinities at all stations reflected this trend. Interstitial salinities were conservative and reflected seasonal changes in the salinity of the overlying water. These seasonal changes in interstitial salinity are probably due to diffusion. Definite salinity gradients were present in the sediments, particularly in the mesohaline zone of the estuary, and the magnitude of these gradients changed seasonally. It is suggested that interstitial salinity gradients may be a common feature of estuaries. (Baker-FRC)
W82-04717

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

JEDDAH IV SEAWATER DESALINATION AND POWER PLANT IN OPERATION IN SAUDI ARABIA (MEERWASSERENTSALZUNGS UND KRAFTANLAGE JEDDAH IV IN SAUDI - ARABIEN IN BETRIEB),
G. Marotz.
Wasserwirtschaft, Vol 71, No 12, p 377-378, 1981. 1 Fig, 1 Ref. (No English summary).

Descriptors: *Desalination, *Distillation, *Powerplants, Jeddah, *Saudi Arabia, *Red Sea, Seawater, Boilers, Turbines, Water supply, Water treatment.

The Jeddah IV seawater desalination and power plant was put into operation in Saudi Arabia on October 24, 1981. This is currently the largest such plant in the world, and upon full operation will supply about 220,000 cu m of drinking water per day. It is located on the Red Sea, about 8 km north of the city of Jeddah. It covers an area of 20 hectares and supplies electrical energy as well as water. Five oil-fired boilers produce 605 t/hr of steam which is used to run the turbines and as the desalination starting product. The basic process for desalination is multi-stage flash distillation. Ten desalination sections can be operated independently, at a brine temperature of 112 C. Sulfuric acid is added to prevent the deposition of magnesium hydroxide and calcium carbonate in the evaporator-condenser chambers. The boiler supply and cooling water (43 cu m/sec at full capacity) is collected at 16 m below the sea surface, and prepurified with rakes and band filters. Oil is delivered by tank ship, with sufficient storage capacity on site for 32 days of operation. (Carroll-FRC)
W82-04581

DESIGN, FABRICATION AND START-UP OF A 25,000 GALLONS PER DAY ABSORPTION FREEZING VAPOR COMPRESSION DESALINATION PILOT PLANT.
Concentration Specialists, Inc., Andover, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220526, Price codes: A04 in paper copy, A01 in microfiche. Report, May, 1981. 63 p, 8 Fig, 1 Tab, 1 Append. 14-34-0001-8502.

Descriptors: *Desalination plant, *Freezing, *Vacuum, *Absorption, Pilot plant, Ice-brine systems, Refrigeration, Electric power demand, Specifications, *Wrightsville Beach, North Carolina, Test facility.

Concentration Specialists, Inc. designed, built, initiated start-up and began operational testing of a 25,000 gallons per day adsorption freezing vapor compression (AFVC) sea water desalination plant at the Office of Water Research and Technology's Test Facility at Wrightsville Beach, North Carolina. The AFVC process is a novel freezing process based upon an absorption cycle powered by a heat pump. The energy savings and lack of corrosion of freezing compared to evaporative processes is a significant feature of this process. The pilot plant was designed to produce 25,000 gallons per day of fresh water while consuming 49 kWh of energy per 1000 gallons of product water. Upon design and fabrication, start-up and operational testing of the pilot plant has shown the need for considerable process and component modification as would be expected with a developmental process. By the end of the contract period, June 1980, the pilot plant produced 8000 gallons per day of product water under non-steady state operating conditions. Equipment modification continues toward increasing plant capacity and achieving steady state production.
W82-04724

3B. Water Yield Improvement

WILL NEW ORLEANS MISS THE MISSISSIPPI,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-04274

3C. Use Of Water Of Impaired Quality

REUSE OF BIOLOGICALLY TREATED WASTEWATER AS COOLING TOWER MAKEUP,
R. J. Franco, J. C. Wykowski, and J. Delaunay.
Industrial Water Engineering, Vol 18, No 5, p 14-19, September-October, 1981. 3 Fig, 8 Tab, 1 Ref.

Descriptors: *Water reuse, *Cooling water, *Industrial wastewater, Impaired water use, Water treatment, Wastewater treatment, Water softening, *Fos Refinery, *France, Heat transfer, Corrosion control, Filtration, Ammonia, Pilot plants, Biological treatment, Chromates, *Oil refineries, Biocides, Bacteria, Scaling.

Pilot plant studies at the France, demonstrated that ammonia-containing refinery wastewater effluents could be successfully used in cooling towers with addition of chromate corrosion inhibitors and appropirate water treatment. The effluent contained 20-30 mg per liter ammonia, which encouraged biological fouling. This was controlled by shock chlorination, supplementary biocides, and the chromate inhibitor (zinc chromate phosphate). Isothiazolin was effective in depressing bacterial counts, but the other antibacterials tested (methylene bisthiocyanate, sulfone, and acrolein) permitted rapid regrowth of bacteria. Scaling was minimized by softening the water to reduce total hardness from 340 to 87 mg per liter as CaCO3. Suspended solids should be less than 10 mg per liter. Filtration and an alternate water supply must be available in case of wastewater treatment upsets. Non-chromate inhibitors (two polyphosphate-phosphonates and zinc polyolester) did not adequately protect the system against corrosion and loss of heat transfer. They allowed growth of sulfate-reducing bacteria. Use of the effluent in cooling towers will result in significant reductions of water use, water discharge, and contaminant discharge. (Cassar-FRC)
W82-04317

REFUSE OF POWER PLANT COOLING WATER FOR IRRIGATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, H. J. Vaux Jr., and L. H. Stolzy.
Water Resources Bulletin, Vol 16, No 5, 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Powerplants, *Groundwater management, *Water reuse, *Cooling water, *Irrigation practices, California, Water policy, Saline water, Water quality management, Hydroelectric plants, Environmental protection, Evaporation, Impaired water use.

California water policy at present requires saline blowdown waters from powerplants to be disposed of in sealed evaporation ponds to prevent deterioration of groundwater. This policy attempts to strike a balance between demand for energy and environmental protection goals. Saline blowdown waters may be used in the irrigation of certain salt tolerant crops. When the irrigation is managed carefully, residual salts may be stored in the soil profile with litter potential for harming groundwater. Studies of blowdown irrigation water discharge below a successful irrigation project indicated a downward movement of salts below the root zone, but no farther than with conventional blowdown water disposal techniques. The reuse of blowdown waters for irrigation proved less costly than storage in evaporation ponds. These analyses showed that irrigation reuse of blowdown water is a viable means of saline water disposal within the existing standards of groundwater quality protection. (Geiger-FRC)
W82-04445

WATER RECYCLING/REUSE IN THE FOOD PROCESSING INDUSTRY,
Montgomery (James), Inc., Walnut Creek, CA.
For primary bibliographic entry see Field 5D.
W82-04566

APPLICATION OF THE WASTEWATER EFFLUENT OF A RURAL COMMUNITY TO A MOUNTAIN MEADOW,
Colorado E Agricultural Experiment Station, Fort Collins.
For primary bibliographic entry see Field 5E.
W82-04705

THE CHEMISTRY OF SALINE WATER CHLORINATION,
Tennessee Univ., Knoxville.
W. R. Haag.
PhD Thesis, June, 1981. 165 p, 24 Fig, 5 Tab, 119 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-23155.

Descriptors: *Model studies, *Chlorination, *Saline water, *Chemical reactions, Industrial water, Cooling water, Powerplants, Environmental effects, Bromine.

A review of the present state of knowledge of natural water chlorination chemistry was performed, with particular reference to saline waters.

Experimental work demonstrated that bromochloramines can readily form under conditions of power plant cooling water chlorination, if saline water is used. Further experimental work explained the results of previous workers by showing that chlorine losses at very high doses in seawater are simply the result of chlorate and bromate formation which is negligible at normal doses. The most important chlorine-produced oxidants, along with the relevant chemical reactions, were chosen as a basis for a kinetic model of saline water chlorination chemistry. Kinetic data were compiled in a computer program which simultaneously solves 24 differential equations, one for each species modelled. Estimates were made for the unknown rate constants, with the hope that measured values would be determined by future researchers. A purely predictive model was not possible due to the great variability in the organic demand; however, the model is applicable under a broad variety of conditions (except sunlight), and its provides a reasonably good description of a halamine chemistry under environmental conditions. (Sinha-OEIS)
W82-04729

3D. Conservation In Domestic and Municipal Use

CONSERVING WATER THROUGH PRICING,
State Univ. of New York at Albany.
E. F. Renshaw.
Journal of the American Water Works Association, Vol 74, No 1, p 2-5, January, 1982. 4 Fig, 11 Ref.

Descriptors: *Water conservation, *Water shortage, *Pricing, Water demand, Water use, Economic aspects, Social aspects, Domestic water.

The success of water conservation efforts and availability of new technologies for reducing water consumption in households and industries suggest that conservation opportunities should be explored before projects to augment water supply are initiated. Classical economic theory illustrates the benefits of pricing water at the long-run marginal cost rather than the long-run average cost. The regressive nature of such a pricing policy could be combated by giving lump sum credits to deserving households or businesses, independent of actual water use. Lifeline rates and progressive rate structures have considerable appeal, but are neither an efficient way to ration water nor an equitable way to redistribute income. To maximize social benefits from water it is necessary to minimize social costs, which consist of cost to the utility of supplying water and the loss of consumer surplus that is likely to result from a water shortage. While nonprice rationing has achieved a high degree of social acceptance in communities that have experienced a water shortage, it will usually result in a larger economic loss than would be the case if wate were rationed by means of a higher price. A temporary system of penalty rates for excessive use and conservation credits would encourage more rational allocation of available water during shortages. Such systems appear to be acceptable by the public. (Carroll-FRC)
W82-04272

THE ADOPTION OF MUNICIPAL WATER CONSERVATION: AN UNLIKELY EVENT,
Oklahoma State Univ. Stillwater. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W82-04343

LEAK DETECTION--HISTORIES,
Alvord, Burdick and Howson, Chicago, IL.
J. E. Pilzer.
Journal of the American Water Works Association, Vol 73, No 11, p 565-567, November, 1981.

Descriptors: *Leakage, *Water distribution, Water conservation, *Water loss, *Water supply systems, Municipal water.

Several case histories of leak detection in water systems are reported from a survey of water companies and consultants by the American Water Works Association leak detection committee. In most cases discovery of leaks, some very large and some multiple small leaks, saved considerable water and money. A practical leak detection program can start with a modest overall study to determine where pinpoint leak detection would be most productive. Review of records can identify areas for closer scrutiny. The leak survey may be performed by water company personnel or an outside consultant. It is important to use the proper detection equipment, which filters some of the background noise that makes detection difficult. As energy and chemical costs escalate, leak detection should be considered even in systems with relatively low losses. (Cassar-FRC)
W82-04363

LEAK DETECTION PROGRAMS RECOVER REVENUES,
Community Consultants, Inc., Provo, UT.
S. E. Sowby.
Journal of the American Water Works Association, Vol 73, No 11, p 562-564, November, 1981. 2 Fig.

Descriptors: *Leakage, *Water metering, *Water distribution, Water conservation, *Operating costs, Water loss, Municipal water, Benefits, Case histories.

Seven case histories of leak detection in towns located in the semiarid western U.S. are given. In the first case, an average daily use of 1500 gal per person indicated that losses were occurring. Investigations showed that 33% of the raw water supply was leaking into a stream, and another 17% was being lost from the distribution system. In case 2, an old lead joint pipe had 21 leaks, which lost 50% of a town's water supply during a drought. In the third case, metering located a crushed pipeline leaking 4 mgd or 20% of a Utah city's supply into a river. Repair of 23 large meters in the fourth example increased an Idaho city's water revenue by $100,000 per year at a cost of $5000 in repairs. In a Colorado city, the fifth example, 55% of meters were broken or inaccurate, not accounting for 18-43% of the water metered into the system. In case 6, metering an entire city reduced waste by 30%, and leak detection located 32 leaks. In the last case, malfunctions and leaky valves were causing losses. (Cassar-FRC)
W82-04375

BENEFITS FROM WATER CONSERVATION DEPEND ON COMPREHENSIVE PLANNING,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
W. J. Maier, J. DeZellar, and R. M. Miller.
Water Resources Bulletin, Vol 17 No 4, p 672-677, 1981. 2 Fig, 8 Tab, 12 Ref. OWRT B-139-MINN. 14-34-0001-8092.

Descriptors: *Water use, *Water conservation, Wastewater treatment, *Water treatment facilities, Water demand, Drought, Pollution load, Costs.

Experiences during the 1976-77 drought in California indicated that substantial savings in water consumption can be achieved under emergency conditions, resulting in some problems in wastewater treatment plants. In contrast, planned water conservation can be engineered to provide maximum monetary benefits when conservation programs coincide with increased populations to be saved. Fortunately, the self-cleaning hydraulic characteristics of circular channels, such as sewers, are relatively insensitive to flow over a wide range, reducing the problems caused by increased residence time. A computerized model study of effects of effluent flow reduction in a conventional municipal wastewater treatment plant indicated that the total BOD load discharged to receiving waters to reduced in direct proportion tothe flow reduction. The higher influent concentrations were compensated by increased residence time in the plant. The effects on suspended solids are similar. Treatment plant operating costs are relatively insensitive to hydraulic loading, resulting in an increase per unit volume of sewage treated. The net effect, however, is a decrease in per capita customer charges. (Baker-FRC)
W82-04557

REDUCING THE FLUSH,
Building Research Establishment, Watford (England).
C. J. D. Webster, and P. J. Davidson.
Water, No 42, p 12-16, 1981. 5 Fig, 3 Ref.

Descriptors: *Flushing, *Water conservation, Domestic water, Domestic wastes, *Toilets, Wastewater, Design criteria, Great Britain.

Efforts are underway to reduce the amount of water used in dwellings and elsewhere for domestic purposes. The flushing of water closets (WCs) is estimated to account for up to 20% of the total public water supply although complexities may be involved in obtaining optimum savings from this area. Current pans used in the United Kingdom are designed to operate on a 9 liter flush, as there has been little incentive until now to design for a lower volume. In the absence of immediately available WCs using reduced flush volumes, the use of dual flush systems is an immediate strategy which both follows the normal replacement approach and depends on the user's mode of operation for its saving. The dual flush principle has been available for a long time, giving the user the option of about 4-5 liters or the full 9 liters. All trials have reported substantial water savings. Controlled flush cisterns are arranged so that flushing terminates as soon as the handle is released. In dwellings where there is a metered water supply there is some financial incentive to the householders to install a new system. It is thought to be possible to design a suite that will perform acceptably at three liters or a little more, and that such suites can be used in most drainage installations, subject to certain restrictions. Changes in urinal structure are also discussed. (Baker-FRC)
W82-04654

THE TRADITIONAL APPROACH TO WATER LOSS,
Thames Water Authority (England).
J. S. Pocock.
Water, No 42, p 43-44, 1982.

Descriptors: *Water loss, *Water supply development, Water demand, Water management, *Pipelines, Leakage, *Water conservation, Design standards.

At intervals of about every 30 years an apparent interest in water losses has surfaced. The need for better materials and better standards of design was recognized at a very early stage. Detailed regulations regarding the customers' fittings and pipework were introduced in 1871. Recently the institution of consumer protection policies has done away with the threat of retribution wherein water supplies could be shut off in cases of uncontrolled water waste in London. One of the earliest means of assessing the effectiveness of a system of waste control was that of comparing the total consumption in different towns on a per capita basis. A remarkable correlation was found between the demand growth rates of four British towns, and it was concluded that at any time within that period an effective waste control policy would have had a significant impact on the capital program of the organization. The financial return derived from an increase of effort in waste control can vary widely from place to place in an authority's area, perhaps by a factor of as much as 20. (Baker-FRC)
W82-04656

A MULTIVARIATE ANALYSIS OF MUNICIPAL WATER USE IN UTAH,
Utah State Univ., Logan.
R. D. Hansen.
PhD Thesis, 1981. 102 p, 14 Fig, 18 Tab, 32 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-20713.

Descriptors: *Water use, *Multivariate analysis, *Municipal water, *Model studies, Water supply, Drought, Groundwater, Surface water, *Utah.

This work formulates two multivariate models for the study of municipal water systems: (1) a monthly time series model for use in analyzing water use and (2) an additive logit model for analyzing water system response to drought. Both models are applied to Utah data. The time series regression model is used to study water demands in the Salt Lake City Water Department (SLCWD), Ogden City, and Granger-Hunter Improvement District service areas. The research shows that real price, as well as three weather/climate variables--average temperature, total precipitation, and daylight hours (percent)--has a significant impact on water usage in Utah. The usefulness of a monthly time series model for examining water management options is demonstrated. A hypothetical peak-season pricing scheme is examined. The characteristics of municipal systems which restricted water usage during the 1976-77 drought are studied using a logit model. This model specifies that the natural logarithm of the odds in favor of a municipal system having restrictions is a function of the size of the system, the percentage of individual connections served by separate outdoor systems, and the variability of the water supply. It is found that systems which rely heavily on surface water supplies were more vulnerable to drought conditions that those using groundwater or a combination of sources. The larger systems had a higher propensity for using restriction during the drought, as did those systems without separate pressure irrigation. (Sinha-OEIS)
W82-04728

3E. Conservation In Industry

STATUS AND PROBLEMS OF PROCESS WATER SUPPLY IN THE FRUIT AND VEGETABLE PROCESSING INDUSTRY (SITUATION UND AUFGABEN DER BETRIEBSWASSERWIRTSCHAFT IN DER OBST- UND GEMUSEVERARBEITENDEN INDUSTRIE),

M. Henkel, and M. Richter.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 358-359, 1981. 3 Fig, 2 Tab. (No English summary).

Descriptors: *Industrial water, *Food processing industry, *Water management, Water reuse, Fruit crops, Vegetable crops, Process water, Water conservation, Effluents, Wastewater discharge, Economic aspects, Social aspects, Water use.

A survey of 56 representative fruit and vegetable processing plants in the German Democratic Republic revealed that the status of water management in these industries is generally unsatisfactory. Considerable differences in quantities of water consumed per unit finished product were found even within the individual branches (product groups) of fruit juice, canned products, frozen products, fresh products, jams and jellies, and baby foods. Water supply becomes especially problematic for these firms when dry periods coincide with the start of the busy season. Only about half of the plants queried had information on their wastewater discharges, and most of these determined only degradable/filterable substances and pH. Of the approximately 50% of the plants surveyed which discharged their wastewaters directly into receiving streams, only 46% had even mechanical treatment plants, and 39% had to pay discharge fees. The responsibility of plant managers for water management is clearly outlined in East German law. Suggestions for improving the currently unsatisfactory situation included metering, increasing the consciousness of employees regarding water conservation, inclusion of water specialists in plant planning, and increasing research programs for specific industries. A few instances of successful water conservation projects are listed, including addition of condensate from fruit juice concentration to the transport water, recycling water from autoclaves and pasteurizers, recycling raw fruit wash water, and other in-plant reuse. (Carroll-FRC)
W82-04584

3F. Conservation In Agriculture

A CONCEPTUAL FRAMEWORK FOR EVALUATING AGRICULTURAL WATER CONSERVATION POTENTIALS,

California Univ. Davis. Dept. of Land, Air, and Water Resources.
D. C. Davenport, and R. M. Hagan.
Water Resources Bulletin, Vol 16, No 4, p 717-723, August, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Water losses, *Agricultural, *Evapotranspiration, *Water conservation, Methodology, Irrigation efficiency, Runoff, Subsurface runoff, Evaporation, Water reuse, Water quality, Water management, Water use efficiency, Seepage control.

Types of water losses in agriculture are defined and potential conservation measures outlined. Recoverable water remains on or below the land surface and includes seepage, leakage, spills, surface runoff and percolation below the root zone. Water is irrecoverably lost by evaporation from soil or water bodies and by transpiration from plants. The largest potential for water conservation is in reducing irrecoverable losses. Possible methods include reducing the ratio of open water surface to total volume in ponds and reservoirs, using groundwater storage via recharge ponds, applying evaporation supressants to surfaces of water bodies, irrigating at night, using drip irrigation and mulches, growing shorter season crops or varieties, reducing the cropped area and the acrerge of phreatophytes, using deficit irrigation, withholding water at nonsensitive growth stages, applying foliar antitranspirants, adjusting planting dates to avoid high evapotranspiration periods, changing row direction and plant spacing to alter solar and advected energy, and controlling weeds. Recoverable water losses may be managed by recovery and reuse of water, reducing further losses, and intercepting water before it reaches the sea and becomes unusable. Advantages and disadvantages of reducing recoverable and irrecoverable losses by these methods are discussed. (Cassar-FRC)
W82-04251

IRRIGATION PRACTICES FOR RECLAIMED ALKALI SOILS,

Central Soil Salinity Research Inst., Karnal (India). Div. of Engineering.
V. V. D. Narayana, and N. K. Tyagi.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 400-406, December, 1981. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Irrigation efficiency, *Border irrigation, *Crop production, *Alkaline soils, Irrigation practices, Contour irrigation, Crop yield, Rice, Wheat, Mathematical studies, Slopes, Grading, *India.

Field experiments were carried out in India to compare irrigation efficiency on graded and level borders, determine the stream cutoff point, and determine the optimum border dimensions and see how sloping borders could be adopted for rice or wheat cultivation on alkali soils. With the prevailing gentle land slope of 0.1-0.2% as the border grade, wheat and rice can be grown in a layout of graded and closed borders in rotation. Light and frequent irrigations may be applied by cutting off irrigation once it has advanced to 70% of the border length. Irrigation efficiencies in small fields which are common in the Indo-Gangetic alluvial plains may be enhanced by using graded borders with lengths ranging from 50 to 70 m and widths from 6 to 8 m. These graded borders may also be used for growing rice during the rainy season by dividing them into two or three compartments connected by asbestos pipes. The rice yield estimates for a sloping border layout in two or three compartments are 65.4 and 67.7 quintals/ha, respectively. (Geiger-FRC)
W82-04269

EVALUATING DIRECT BENEFIT ESTIMATION PROCEDURES FOR IRRIGATION PROJECTS: A SIMPLIFIED APPROACH,

Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W82-04287

DIMENSIONLESS STREAM ADVANCE IN SLOPING BORDERS,

Science and Education Administration, Phoenix, AZ. Conservation Lab.
T. Strelkoff, and A. J. Clemmens.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 361-382, December, 1981. 18 Fig, 6 Ref.

Descriptors: *Mathematical studies, *Infiltration, *Mathematical models, *Border irrigation, Irrigation, Stream banks, Graphical methods, Streambeds, Rrunoff, Model studies, Recession curve.

A simple case of general stream border advance contains a plane border of great length and a constant inflowing discharge prior to cutoff. The advance curve is controlled by border slope, roughness, infiltration, and inflow discharge and cutoff time. If the advanced function is viewed in dimensionless terms, the number of controlling parameters is significantly reduced. If only advance prior to inflow cutoff is of interest, then two dimensionless parameters govern the dimensionless advance curves. Methods of applying kinematic-wave theory to the computation of border-irrigation flow proved simpler than the zero-inertia analysis employed for the general case. Using a dimensionless boundary value as a pertinent controlling variable increased the number of dimensionless governing parameters to three. Difficulty in representing a three-parameter family of advance curves was overcome by using normal depth as the characteristic depth and equating the dimensionless parameter for bed slope to one. Curves were given representing all practical cases of advance of an irrigation stream over a plane border with inflow that is constant prior to cutoff. (Geiger-FRC)
W82-04308

SUBSURFACE TRICKLE IRRIGATION MANAGEMENT WITH MULTIPLE CROPPING,

Department of Agriculture, Phoenix, Arizona, Water Conservation Laboratory.
D. A. Bucks, L. J. Erie, O. F. French, F. S. Nakayama, and W. D. Pew.
Transactions of the ASAE, Vol 24, No 6, p 1482-1489, November/December, 1981. 6 Fig, 5 Tab, 17 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Evapotranspiration, *Trickle irrigation, Subsurface irrigation, Surface irrigation, Cultivation, Cantaloupes, Onions, Carrots, Productivity, Planting management, Soil-water-plant relationships.

Subsurface trickle irrigation with multiple cropping and minimum cultivation had many advantages over surface trickle irrigation: minimal interference with field operations, continuous production of two or more row crops without replacement of trickle lines, and extension of the useful life of a trickle system over a larger production base. Spring and Fall cantaloupes were grown on a clay loam soil with moderately saline water in 1977, 1978; dry onion and carrots in spring 1979; and fall cantaloupe in 1979. Cantaloupe yield was higher with weekly than with daily trickle irrigation; onion yield was higher with daily irrigation. Carrot yields were not affected by irrigation frequency. Production was highest at water application rates equal to or slightly higher than the seasonal evapotranspiration values for furrow irrigation. Maximum cantaloupe production was obtained with an average evapotranspiration of 51 cm for the spring crop and 39 for the fall crop. Seasonal evapotranspiration values for trickle irrigated onions and carrots were 56 cm and 41 cm, respectively. Roots of these plants did not clog the subsurface irrigation lines. (Cassar-FRC)
W82-04356

ENERGY, WATER, AND COST TRADE-OFFS IN IRRIGATION SYSTEM SELECTION AND MANAGEMENT,
California Univ., Davis.
R. M. Hagan, and E. B. Roberts.
Transactions of the ASAE, Vol 24, No 6, p 1539-1545, November/December, 1981. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Energy, *Cost analysis, *Irrigation efficiency, Water requirements, Irrigation design, Management, Surface irrigation, Sprinkler irrigation, Furrow irrigation, Electric power, Pumping, Peak demand, Water costs.

Energy, water, and cost tradeoffs were examined in detail for 28 variations of irrigation system design and operation. These included sprinkler irrigation (hand-move, wheel-line, four types of center-pivot, and two types of lateral-move) and furrow irrigation (four types of graded and two types of level). The assumed crop was cotton growing in the San Joaquin Valley on very fine sandy loam soil. Both inexpensive, low energy water and expensive, high energy water were considered. Changes made to conserve water either increased or decreased annual energy requirements and annual costs. No single system provided the lowest energy requirements, water requirements, and costs. A guide is given to determine the feasibility of shifting irrigation pumping away from peak electrical use hours. It considers the water supply capacity, irrigation system capacity, and other factors such as labor and capital costs. Suggestions are given for modifying systems if changes are feasible. (Cassar-FRC)
W82-04360

SUNFLOWER YIELD VS. WATER DEFICITS IN MAJOR GROWTH PERIODS,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2I.
W82-04361

DEEP TILLAGE OF IRRIGATED FULLMAN CLAY LOAM--A LONG-TERM EVALUATION,
Science and Education Administration, Bushland, TX. Conservation and Production Research Lab.
For primary bibliographic entry see Field 2G.
W82-04372

SOIL AND WATER REGIMES FOR OPTIMUM AND FOR MAXIMUM YIELDS,
South Dakota State Univ., Brookings. Water Resources Inst.
L. O. Fine, and J. D. McLeod.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211483, Price codes: A03 in paper copy, A01 in microfiche. Completion Report December, 1981. 32 p, 17 Fig, 6 Tab, 4 Ref. OWRT A-068-SDAK. 14-4-0001-8044.

Descriptors: *Water use efficiency, Soybeans, *Irrigation efficiency, *Crop production, *Soil-water-plant relationships, *Cost-benefit analysis, Corn, Sorghum, *Great Plains.

Rapidly increasing demands on usable water resources, and escalating energy costs, with virtually stable or falling farm commodity prices have resulted in production pressures and cost-price squeeze situations for agriculture, particularly irrigated agriculture, in the corn-soybean-sorghum areas of the Great Plains. Actual out-of-pocket pumping costs have doubled or tripled in 4-6 years in most areas, and are projected to double again in the next 8-10 years. These circumstances are especially important to the irrigator with high lifts or in an area of especially high energy costs. The situation described makes it essential that the irrigator know, for each crop, the time of most critical water need by that crop, the amount to supply, and the nature of the water supply-yield response curve, so that he can manage his water supply to the best advantage. If two or more crops need water simultaneously and his water supply or funds available are limited, he needs to make a decision as to which crop to water and suffer the least economic loss. For more than three decades, information has been available on the consumptive use: total, seasonal distribution of need and critical periods of need of water by corn. The results of most investigations in the northern Great Plains point to a peak period of maximum daily use corresponding with the grand period of growth through tasseling-silking. Some studies agree on the critical nature of the tassel-silk brown stage for maximum yield impact. Because of the above quite well established information for corn, it was felt that a more productive study area would be the water regimes most profitable and productive for soybeans.
W82-04415

WATER MOVEMENT FACTORS IMPORTANT TO THE DESIGN AND OPERATION OF SUBIRRIGATION SYSTEMS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs.
Transactions of the ASAE, Vol 24, No 6, p 1553-1561, November/December, 1981. 11 Fig, 1 Tab, 23 Ref.

Descriptors: *Irrigation design, *Drain spacing, *Subsurface irrigation, *Soil water movement, Design criteria, *Drainage systems, Soil properties, Water table fluctuations, Model studies.

Design of subirrigation and drainage systems depends on soil properties, crop, and climate. Movement in these systems is lateral from a drain or open ditch (saturated flow) and vertical in the zone above the water table (unsaturated flow). Three operational modes are considered in design of a subirrigation system. (1) Steady state--the drains should be spaced to maintain the desired water table depth range during long periods of high evapotranspiration. (2) Transient state--the system should be designed to manipulate the water table as desired in case of operator error, equipment failure, or low levels at the beginning of the growing season. (3) Subirrigation under changing weather conditions--the operation of the system in both deficient and excessive rainfall periods should be considered. Methods are given for calculating the position and shape of the water table during steady state and transient subirrigation. Use of the water management model, DRAINMOD, for operation of a subirrigation system under changing weather conditions is discussed. A drainage system is developed for a 110 acre field of sandy loam underlain by sandy clay loam near Farmville, North Carolina. Optimum drainage spacing is 18 m for subirrigation-drainage and 25 m for conventional drainage alone. (Cassar-FRC)
W82-04538

WATER USE EFFICIENCY AND ROTATIONAL WATER SUPPLY AT THE FARM LEVEL: CERTAIN RESULTS FROM AN EXPERIMENTAL PILOT PROJECT IN GUJARAT STATE, INDIA,
Mahi-Kadana Irrigation Project, Ahmedabad (India).
T. K. Jayaraman.
Water Supply and Management, Vol 5, No 6, p 391-399, 1981. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Irrigation efficiency, *Water use efficiency, Rotational irrigation, Irrigation practices, *India, Agriculture, Water management, Social aspects, Economic aspects, Vegetable crops.

Pilot studies (1976-1980) in the 557 ha Mahi-Kadana project, India, showed that rotational irrigation in the rabi season increased water use efficiency to 69% the season the method was introduced and 72% after the system was stabilized. Water use efficiency in the 2 years before rotational irrigation were 41% and 59%. The total number of irrigated acres increased 9% after rotational irrigation. Cropping intensity also increased from 57-78% during the control years to 85% under rotational irrigation. The total water drawn from November to March averaged 532.70 and 369.76 cusecs in the control years and 530.76 and 509.19 cusecs in the rotational irrigation years. A survey of farmers after the project was completed showed that owners of both large- and small-size holdings supported the program. Quarreling over water supplies and worry about receiving water on time had been eliminated. (Cassar-FRC)
W82-04608

NOTE ON PUDDLING EFFECTS ON WATER FLOW THROUGH SOILS,
Punjab Agricultural Univ., Ludhiana (India).
For primary bibliographic entry see Field 2G.
W82-04671

ENERGY AND WATER CONSERVATION STRATEGIES IN IRRIGATED AGRICULTURE,
California Univ., Berkeley. Lawrence Berkeley Lab.
R. L. Ritschard, and K. Tsao.
Water Resources Bulletin, Bulletin, Vol 16, No 2, p 340-347, April, 1980. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Water conservation, *Drought, *California, *Irrigation practices, Irrigation, Farming, Water supply, Water management, Energy, Energy conservation.

Conservation strategies applicable to California are considered in the light of the drought of 1976 and 1977. These strategies include increased use of ground water, increased irrigation efficiencies, and shifts in cropping patterns. These modifications lessened the losses due to the drought. However, some of these changes may have caused problems for future water supply, for example the extensive pumping of ground water supplies and ground subsidence. Changes in irrigation practices may have affected the salt balance for future years. Maintaining and augmenting surface water supply, increasing power use efficiencies, and improving irrigation efficiencies are viewed as potential conservation strategies for that region. Electricity savings associated with water conservation have been estimated to be as much as 25%. Specific near term actions suggested for facilitating conservation include an expanded irrigation management system, efficient water deliveries, and a continued effort on the part of individual growers to use resources during periods of normal rainfall as they were used under drought conditions. (Baker-FRC)
W82-04736

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

YOUNG'S INEQUALITY FOR THREE-DIMENSIONAL FLOWS,
Public Power Corp., Athens (Greece). Computing Center.
For primary bibliographic entry see Field 2A.
W82-04267

SIMPLE EQUATIONS FOR HOOGHOUDT EQUIVALENT DEPTH,
Democritos Univ. of Thraki, Xanthi (Greece). School of Engineering.
J. G. Sakkas, and V. Z. Antonopoulos.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 411-414, December, 1981. 1 Tab, 4 Ref.

Descriptors: *Hydrologic models, *Design criteria, *Tile drainage, *Mathematical equations, Mathematical studies, Drainage, Drain spacing, Drainage practices, Drainage engineering, Drains, Mathematical models.

The Hooghoudt equation for drainage design problems has been reworked and simplified by other researchers to include dimensionless variables. Unique nomographic solutions for the equivalent depth and drain spacing formulas may be used in conjunction with elaborate computer programs to solve transient flow problems. For faster estima-

tions of the equivalent depth which avoid storage of a table in the computer memory, approximate fomulas have been developed which may be reworked into simple algebraic expressions. A series of values for the drain spacing function was used to fit three curves to the data by the least squares method. The relative error using these solutions was dependent upon the radius of the tile drains. The simplified formulas show no appreciable loss of accuracy and may be used to compute the equivalent depth for steady or unsteady state drainage problems with a desk calculator or digital computer. (Geiger-FRC)
W82-04271

WILL NEW ORLEANS MISS THE MISSISSIPPI,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. G. Kazmann.
Journal of the American Water Works Association, Vol 73, No 11, p 18, 20, November, 1981. 1 Fig.

Descriptors: *Saline water intrusion, *Disasters, *Water supply development, *New Orleans, Louisiana, *Mississippi River, *Atchafalaya River, Municipal water, Rivers, Flood damage, Flood control, Old River Control Complex, Conjunctive use, Water resources development, Water management, Injection wells, Alternative planning, Potential water supply, Water control.

Cities with water supplies vulnerable to natural disasters should plan alternate means of obtaining water. New Orleans faces the possibility of losing Mississippi River flow to an alternate distributary, the Atchafalaya River. Throughout the early 20th century an increasing proportion of river flow entered the Atchafalaya, reaching greater than 30% by 1954. The Old River Control Complex was built at the point where the Atchafalaya and the main stem are closest, near Simmesport. This structure consists of a spillway and an overland structure to assist during floods. The Atchafalaya channel continued to deepen and build a higher flood plain in the lower basin. The 1973 flood greatly weakened the control structure. If this is destroyed by a future flood, 70% of the river flow would be diverted through the Atchafalaya. Although navigation in the New Orleans area would not be affected, the Mississippi River water could become saline, unusable for drinking or industrial purposes. A proposed scheme to provide water to the city under these circumstances is conjunctive use of groundwater and water from the Pearl River. A treatment plant would inject filtered surplus river water into a well field, prventing land subsidence from excess groundwater withdrawals. Although the Corps of Engineers claims that the Mississippi River can be kept in its present course indefinitely, the author suggests that an alternate supply must be established for New Orleans before a catastrophe occurs. (Cassar-FRC)
W82-04274

DETENTION BASINS--AN URBAN EXPERIENCE,

Georgia Inst. of Tech., Atlanta.
T. N. Debo, and H. Ruby.
Public Works, Vol 113, No 1, p 42-43, 93-94, January, 1982.

Descriptors: *Flood control, *Detention reservoirs, *Urban drainage, Maintenance, Safety, Retention basins, Basins, *Atlanta, Georgia, Runoff, Evaluation.

Detention basins, encouraged for runoff control in the Atlanta, Georgia, metropolitan area, also produce problems. These include maintenance problems and health and safety problems. Detention basins do not effectively control flooding in all situations. Sometimes all the drainage is concentrated in one drainage channel. The combined effects of several detention basins may change the timing of flood discharges so that higher peak flows will occur than would have occurred under natural conditions. The many swimming pool-sized detention basins have little effect on downstream flooding. Erosion may also be increased. Detention basins designed for a 100-year flood have little flood control effect on a 5- or 10-year storm. Costs assessments of detention basins should consider loss of valuable land for building, esthetics, and loss of tax revenue. A survey of residents living near 15 small detention basins showed that 68% said no water accumulated in the basins, 12% felt the basins decreased flooding problems, and 5% felt drainage problems were aggravated. Over 70% did not realize that adjacent property owners were responsible for maintenance. A survey of engineers indicated that many basins were not functioning as planned and that only basins in developments of 20 acres or more had a major positive flood control effect. (Cassar-FRC)
W82-04332

ESTIMATION OF EXTREME LOW FLOWS FOR PUMPED STORAGE RESERVOIR DESIGN,

Newcastle upon Tyne Univ., (England). Dept. of Engineering Mathematics.
For primary bibliographic entry see Field 2E.
W82-04334

PUMPED OUTLETS FOR DRAINAGE SYSTEMS,

For primary bibliographic entry see Field 8A.
W82-04364

ANALYSIS OF DETENTION BASIN SYSTEMS,

Monash Univ., Clayton (Australia).
For primary bibliographic entry see Field 2A.
W82-04444

PREDICTION OF WATER INFLOW TO LAKE MEMPHREMAGOG (PREVISION DES APPORTS HYDRIQUES AU LAC MEMPHREMAGOG),

Ministere de l'Environnement, Sainte-Foy (Quebec). Service des Eaux de Surface.
For primary bibliographic entry see Field 2A.
W82-04459

DETERMINATION AND REPRESENTATION OF THE STORAGE EFFECT (ZUR ERMITTLUNG UND DARSTELLUNG DER SPEICHERWIRKUNG),

Technische Univ., Dresden (German D.R.).
S. Dyck.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 331-335, 1981. 9 Fig, 10 Ref. (No English Summary).

Descriptors: *Reservoirs, *Water storage, *Planning, Design criteria, Management planning, *Reservoir operation, Flow control, Reservoir releases, Water demand.

Storage reservoirs, as important components of water management systems, must be carefully designed and operated. The general flow equalization goal of storage reservoirs, either in terms of constant release throughout the year or of demand-based release, must be achieved with the smallest possible storage volume. The most important factors influencing the selection of storage volume are the distribution function of the inflow (coefficient of variation and skewness), the determination interval, the long-term and short-term persistence characteristics of the inflow series, the demand or release function, the operation or balancing time, the initial level of the reservoir, and the simulation model of the experimental method. The simple autoregression model or Markov model is generally superior to the fractional noise model. For annual determination intervals, series of at least 1000 data runs are required in order to assure 99% reliability of coverage of the demand with the selected storage volume. Optimal reservoir operating plans, in terms of maximal compensation of the flow variations, were developed using the 'rule of clamped thread', i.e., a process for calculating the shortest path through a corridor of irregular shape. the inherent unpredictability of future inflows emphasizes the great significance of large data series, especially in the case of smaller reservoirs. (Carroll-FRC)
W82-04576

MONEY DOWN THE DRAIN,

Hydraulics Research Station, Wallingford (England).
P. Colyer.
Water, No 42, p 6-9, 1982. 2 Fig.

Descriptors: *Urban drainage, *Economic aspects, Computers, Automation, *Design criteria, Management, Construction, Water management, Drainage, Storm drains, *Urban runoff.

Due to the great expense involved in urban drainage networks, it is imperative that the system be efficient, well founded and accurate regarding design, construction and management. The Wallingford Procedure is a set of computer programs and accompanying reports which embody the latest recommendations on urban storm drainage. It is based on research started in 1974 at the Hydraulics Research Station, the Institute of Hydrology and the Meteorological Office. The Procedure presented four alternative methods. One is appropriate for design work only, one for analysis only and two for both design and analysis. The Modified Rational method is based on the long-established principles of the Rational method, calculating peak runoff discharge only. The Optimising method determines flows from the Modified Rational method but a minimum cost design is produced. The Hydrograph method includes the full modelling procedure for surface runoff and free surface pipe or channel flow. The simulation method includes all the main features of the Hydrograph method and also extends to surcharge analysis and surface flooding. Flapped outfalls can also be represented. The computer package is available from the Hydraulics Research Station. (Baker-FRC)
W82-04653

FORECASTING CHANGES OF WATER RESOURCES IN LARGE RIVERS FOLLOWING LAND DRAINAGE,

Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
For primary bibliographic entry see Field 2A.
W82-04721

SIMULATED INTERACTIONS BETWEEN THE PROPOSED NARROWS RESERVOIR AND THE WATER-TABLE AQUIFER ALONG THE SOUTH PLATTE RIVER, MORGAN COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-04725

DEMAND SIGNALS FOR URBAN DRAINAGE AND FLOOD CONTROL PROJECTS,

North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 6A.
W82-04737

4B. Groundwater Management

SOIL PERCOLATION RATES FROM NEUTRON PROBE MEASUREMENTS,

Oregon State Univ., Corvallis.
T. S. Vinson, and L. Mahar.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR4, p 343-359, December, 1981. 14 Fig, 3 Tab, 31 Ref.

Descriptors: *Groundwater movement, *Groundwater management, *Moisture probe, Spray irrigation, Percolation, Moisture meters, Moisture profiles, Soil columns, Moisture content, Irrigation water.

Studies were conducted to assess the feasibility of using subsurface neutron moisture probes to estimate soil percolation rates as part of a long-term research project to determine hydrologic conditions at a spray irrigation facility. The new technique utilizes the soil moisture content in relation

to time obtained at two levels in a soil column or profile in which one-dimensional percolation is taking place. The procedure was validated in laboratory percolation tests using 10 columns filled with well graded sand. The calculated quantities of water during these trials agreed well with the actual amounts of water collected from each column. The procedure is simpler than traditional percolation rate tests, but its validity for layered soil profiles or shallow groundwater table conditions has yet to be ascertained. When performing in situ measurements using the neutron moisture probes, consideration should be given to the method of installation of the access tube, the time intervals at which moisture contents will be recorded at each site, the distance between levels where moisture content values are taken, and the depth from the ground surface to the level where moisture content readings are recorded. (Geiger-FRC)
W82-04309

THE RESPONSE OF GROUNDWATER TO ARTIFICIAL RECHARGE SCHEMES,

Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopoulos.
Water Resources Research, Vol 17, No 6, p 1712-1714, December, 1981. 3 Fig, 3 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Aquifers, Mathematical studies, Groundwater movement, Recharge, *Groundwater management, Unconfined aquifers, Groundwater storage, Transmissivity, Seasonal variation.

Analytical solutions for the groundwater flow in an unconfined aquifer showed that uniform recharge rates over the whole period of recharge are not the optimal solution. A greater net gain (up to 24%) in aquifer storage and outflow can be obtained by distributing the recharge volume over several periods of variable duration. Artificial recharge can be scheduled, knowing the effects of seasonal variations in infiltration. (Cassar-FRC)
W82-04337

HYDROLOGIC EFFECTS FROM CHANGES IN GROUND WATER PUMPAGE,

International Engineering Co., Incorp., San Francisco, CA.
For primary bibliographic entry see Field 2F.
W82-04428

A LUMPED APPROACH TO THE INVERSE PROBLEM IN GROUND WATER HYDROLOGY,

Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 16, No 5, p 866-873, October, 1980. 5 Fig, 23 Ref.

Descriptors: *Groundwater, *Geohydrology, Groundwater hydrology, *Model studies, *Groundwater movement, Computers, Hydrologic models, Simulation, Water resources development, Water supply development.

A solution for the inverse problem in groundwater has been proposed, based on the lumped approach. For the purpose of illustrating the solution procedure, a hypothetical aquifer having impermeable boundaries was considered. Of primary concern was the demonstration of the validity of the approach and the observance of the convergence characteristics of the search algorithm. The aquifer is unconfined, having uniform depth of 100 ft, overlying a horizontal impermeable bed. It is 8000 feet wide and 12,000 feet long and has five pumping wells of various capacities. The inverse model uses a simulation model and approximate boundary conditions to generate values for surrogate permeabilities such that the model output agrees reasonably with the observed data. The emphasis is on the determination not of the conventional aquifer permeability, but of a surrogate permeability, so that the model can eventually be used for the management studies. The surrogate permeability should not be interpreted as a property of the porous media. It is simply a transformation constant in the management model. The advantage of such an approach is that the system complexities that are hard to determine essentially become incorporated into the surrogate parameters. The proposed method also allows the same ground water flow equations and the same solution procedure with the same initial and boundary conditions to be employed both in the identification process and in the subsequent management studies. This tends to minimize errors inherent in a simulation process. (Baker-FRC)
W82-04451

TWO-DIMENSIONAL GROUND-WATER FLOW MODEL OF THE CRETACEOUS AQUIFER SYSTEM OF LEE COUNTY AND VICINITY, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04492

BOREHOLE DATA-COLLECTION METHODS APPLICABLE FOR THE REGIONAL OBSERVATION AND MONITOR WELL PROGRAM, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT,

Geological Survey, Tallahassee, FL. Water Resources Div.
J. J. Hickey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-133448, Price codes: A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-57, 1981. 10 p, 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Borehole geophysics, *Groundwater, *Water management, *Data collections, Aquifers, Observation wells, Monitoring, Geohydrology, Carbonate rates, Water quality, Water level, *Florida, *Floridan aquifer.

Management of ground-water resources within the Southwest Florida Water Management District requires that hydrogeologic characteristics of water-bearing rocks and quality characteristics of water be described. Wells for the District's Regional Observation and Monitor Well Program are drilled specifically to collect data to describe the ground-water resource. Suggested borehole data-collection methods for these wells include drilling in stages; running geophysical logs at the completion of each stage; collection of water-level and specific-conductance data before, during, and after a day's drilling; specific-capacity determinations after a day's drilling; and placing a packer in the gypsiferous and anhydritic limestone and dolomite for water-level and water-quality data. (USGS)
W82-04493

EFFECT OF IRRIGATION PUMPING ON THE GROUND-WATER SYSTEM IN NEWTON AND JASPER COUNTIES, INDIANA,

Geological Survey, Indianapolis, IN. Water Resources Div.
M. P. Bergeron.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-137688, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-38, August, 1981. 73 p, 33 Fig, 7 Tab, 25 Ref.

Descriptors: *Groundwater, *Irrigation, *Pumping, *Surface-groundwater relations, Groundwater movement, Model studies, Simulation analysis, Aquifers, Aquifer characteristics, Bedrock, Water level fluctuation, Drawdown, Glacial drift, *Groundwater mining, Groundwater recharge, *Indiana, Newton County, Jasper County, Hydraulic conductivity.

Flow in the ground-water system in Newton and Jasper Counties, Indiana, was simulated in a quasi-three-dimensional model in a study of irrigation use of ground water in the two counties. The ground-water system consists of three aquifers: (1) a surficial coarse sand aquifer known as the Kankakee aquifer, (2) a limestone and dolomite bedrock aquifer, and (3) a sand and gravel bedrock valley aquifer. Irrigation pumping, derived primarily from the bedrock, was estimated to be 34.8 million gallons per day during peak irrigation in 1977. Acreage irrigated with ground water is estimated to be 6,200 acres. A series of model experiments was used to estimate the effects of irrigation pumping on ground-water levels and streamflow. Model analysis indicates that a major factor controlling drawdown due to pumping in the bedrock aquifer are the variations in thickness and in vertical hydraulic conductivity in a semiconfining unit overlying the bedrock. Streamflow was not significantly reduced by hypothetical withdrawals of 12.6 million gallons per day from the bedrock aquifer and 10.3 million gallons per day in the Kankakee aquifer. Simulation of water-level recovery after irrigation pumping indicated that a 5-year period of alternating between increasing pumping and recovery will not cause serious problems of residual drawdown or ground-water mining. (USGS)
W82-04497

GEOHYDROLOGIC RECONNAISSANCE OF THE CROFTON UNIT, NORTHEASTERN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
S J. Kent, R. A Engberg, and M. J. Ellis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-129115, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-58, 1981. 34 p, 14 Fig, 5 Tab, 15 Ref.

Descriptors: *Groundwater, *Water quality, *Geohydrology, *Groundwater availability, Water table, Irrigation wells, Water yield, Sampling, Water analysis, *Nebraska, *Crofton unit.

This report describes sources, locations, quantity, and quality of ground water in a 350-square-mile area whose potential for irrigation development is being evaluated by the U.S. Bureau of Reclamation. The entire area is underlain by Precambrian Sioux Quartzite, which throughout most of the area is overlain by undifferentiated Paleozoic rocks. The Sioux and, where present, Paleozoic rocks are overlain unconformably by Cretaceous formations, including the Dakota and Niobrara Formations. Surface strata are Pleistocene and Holocene deposits of sand and gravel and Pleistocene glacial till. The Dakota and Niobrara Formations are each capable of yielding water sufficient for irrigation wells in parts of the area. Pleistocene and Holocene deposits yield adequate water for irrigation in the southern part of the area and along the flood plain of the Missouri River. Water from the Dakota Formation is so saline as to necessitate burdensome salinity-control measures for successful long-term irrigation use. That from the Niobrara Formation is suitable for irrigation of most crops. Water from Pleistocene and Holocene deposits is highly variable, but is suitable for irrigation in the southern part of the area and along the Missouri River. (USGS)
W82-04498

ROADS IN WATER-PROCURING REGIONS - WATER POLLUTION CONTROL AND SAFEGUARDING OF WATER SUPPLY, EXEMPLIFIED BY THE STUTTGART-SINGEN AUTOBAHN (STRASSEN IN WASSERGEWINNUNGSGEBIETEN-GEWASSERSCHUTZ UND SICHERSTELLUNG DER WASSERVERSORGUNG AM BEISPIEL DER AUTOBAHN A 81 STUTTGART-SINGEN),

Tubingen Regierungspresidium (Germany, F.R.).
H. Bartel.
Wasserwirtschaft, Vol 71, No 11, p 313-318, November, 1981. 4 Fig, 3 Ref. English summary.

Descriptors: *Road construction, *Watershed protection, *Karst hydrology, Aquifers, *Groundwater protection, *Germany, Runoff, Construction materials, Costs, Turbidity, Oil spills, Water treatment, Impervious boundaries, Imported water, Water pollution control, Erosion control, Geology.

Water supply is a major government objective in the State of Baden-Wurttemberg, since available

groundwater reserves are concentrated in limited areas, while the remainder of the territory has inadequate local supplies. A major international highway, Autobahn A81, is under construction in this State. The vulnerability of the groundwater in the karstic formations is intensified by highway construction and anticipated petroleum pollution. In highway planning, important water-bearing formations were circumvented insofar as possible, but collecting regions are traversed over a distance of 24 km. Water protection plans were developed cooperatively by highway engineers, water supply planners and geologists. Where the clay marl layer generally overlying the karst was lacking, a special impermeable layer was applied in preparation of the roadbed. Piping was installed to divert highway runoff to suitable infiltration areas with oil protection. Fissures and cavities exposed during construction were also sealed with impermeable materials such as clay or cement. Protection costs were estimated at 9.6 million German Marks. Water supply security was simultaneously improved by installing additional filtration and biological equipment in affected water supply plants. Where the protection offered by these measures was judged inadequate, provisions were made for permanent or emergency water important. (Carroll-FRC)
W82-04551

LOCAL IRRIGATION AGENCIES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Revesz, and D. H. Marks.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 329-338, October, 1981. 1 Tab, 10 Ref. OWRT 14-34-0001-9430.

Descriptors: *Irrigation districts, *Conjunctive use, *Water management, Model studies, Water policy, Water law, Local governments, Water distribution, Water management, Public policy, Water districts, Groundwater management, Institutions, Legal aspects, Planning.

The history and nature of irrigation institutions in the U.S. are described. Mathematical models of irrigation supplies assume that comprehensive irrigation management exists. In reality, the three major types of irrigation agencies (public irrigation disricts, mutual water companies, and commerical water companies) have limited power. With few exceptions, they have no direct control over groundwater depletion. Public irrigation districts are most powerful, followed by mutual companies, then by commerical water companies (which have virtually disappeared). Conjunctive use modelers should rely only on those decision variables controlled by the particular agency under study. (Cassar-FRC)
W82-04560

GROUNDWATER CONTROL,
King's Coll., London (England). Dept. of Civil Engineering.
J. K. White.
Civil Engineering (London), p 27, 29-31, December, 1981. 10 Fig.

Descriptors: *Construction methods, *Groundwater management, Unconfined aquifers, Confined aquifers, Dewatering, Groundwater level, *Excavation, Urbanization, Industrial development, *Coastal areas, Estuaries, *Water table.

Urban and industrial development occurring near rivers, coastal areas and estuaries where the water table is closest to the ground surface frequently calls for control of groundwater to be undertaken. Two types of control are considered. The first occurs when a foundation excavation goes below the water table in a saturated permeable material, such as gravel or sand, which lies above a substantial impermeable base. The second type of situation occurs when the excavation is in a relatively dry impermeable strata, which is near the surface but which overlies a saturated permeable material in which the water pressure would cause the water level in a stand pipe located in it to rise above the formation level of the foundation. Under these circumstances there is the risk that removal of the excavating material will cause sufficient imbalance between overburden and water pressure for the water to break through and flood the excavation. The method of control adopted will vary and depends on the circumstances. While experience plays a large and essential part in the specification of a dewatering system, there has been a growing demand in recent years for analytical justification for design. Models have been devised which are used to give more reliable estimates of well point performance when used in conjunction with sheet pile cut-offs in those cases where both the system and the cut-off partially penetrate an unconfined aquifer. (Baker-FRC)
W82-04714

4C. Effects On Water Of Man's Non-Water Activities

EVALUATION OF METHODS FOR DETERMINING URBAN RUNOFF CURVE NUMBERS,
Science and Education Administration, Beltsville, MD.
W. J. Rawls, A. Shalaby, and R. H. McCuen.
Transactions of the ASAE, Vol 24, No 6, p 1562-1566, November/December, 1981. 3 Fig, 5 Tab, 11 Ref.

Descriptors: *Urban runoff, *Hydrologic models, *Land use, Urban hydrology, Soil types, Rainfall-runoff relationships, Antecedent moisture, Soil water, Runoff curve number.

The runoff curve number, an important input parameter to the Soil Conservation Service's hydrologic models, integrates land cover, soil type, and antecedent soil moisture conditions. Data from 175 urban watersheds were used to determine runoff curve number by three methods: the contingency table approach (measuring the fractions of land use and soils separately and integrating them with a weighted average scheme), use of the U.S. Geological Survey land use maps, and the conventional approach (use of the overlay method with low altitude aerial photos, land use maps, and onsite investigations). Results indicated that estimates of runoff curve numbers were sensitive to the land use classification system and relatively insensitive to the method of integrating soils and land cover data. The detailed, time-consuming conventional approach was not necessary for watersheds of greater than 26 sq km. A set of runoff curve numbers was calculated for the three hydrologic soil groups for Level II U.S. Geological Survey land use categories. Although these were not in total agreement with those estimated by the conventional approach, the level of imprecision was considered satisfactory for most hydrologic studies. (Cassar-FRC)
W82-04535

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME I, STATE-OF-THE-ART REPORT,
Envirex Inc., Milwaukee. WI.
M. K. Gupta, R. W. Agnew, and N. P. Kobriger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241895, Price codes: A06 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/042, February, 1981. 121 p, 16 Fig, 37 Tab, 169 Ref. DOT-FH-11-8600.

Descriptors: *Highways, *Roads, *Water pollution sources, *Storm runoff, *Urban runoff, Drainage effects, Particulate matter, Deicers, *Highway effects, Environmental effects, Heavy metals, Pesticides, Oxygen demand, Salt.

The factors which most affect quantity and quality of highway runoff are traffic volume, rainfall intensity and pattern, highway drainage characteristics, operation and maintenance characteristics and degree of imperviousness of the drainage area. Maintenance of adequate drainage is one of the most important aspects of highway design. Highway runoff characteristics are similar to those of urban runoff and may exert significant shock pollutional loads on receiving waters. The weighted average of total solids accumulations between successive street cleanings, a period of 2 to 12 days, for eight cities was found to be 1400 lb/curb mile. A high percentage of street surface pollutants are associated with very fine dust and dirt particles. Substantial quantities of toxic materials, such as heavy metals and pesticides, are present in street surface contaminants with the amounts varying considerably from site to site. Because of the consistent presence of heavy metals in amounts large enough to interfere with BOD5 measurements, COD is considered to be a better parameter for measuring the oxygen demand potential of highway runoff. Highway salting rates usually range from 400 to 1200 lbs per two-lane mile. Over the winter season, a typical multiple lane highway may use 100 tons or more of salt per mile. Significant amounts of vehicle released airborne matter are settled out and washed off the road surface during rainstorms. (Moore-SRC)
W82-04627

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME II, PROCEDURAL MANUAL FOR MONITORING OF HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5A.
W82-04628

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME III, PREDICTIVE PROCEDURE FOR DETERMINING POLLUTION CHARACTERISTICS IN HIGHWAY RUNOFF,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04629

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME V, HIGHWAY RUNOFF DATA STORAGE PROGRAM AND COMPUTER USER'S MANUAL,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04630

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME IV, CHARACTERISTICS OF HIGHWAY RUNOFF FROM OPERATING HIGHWAYS. RESEARCH REPORT,
Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5B.
W82-04637

A DIMENSIONLESS UNIT HYDROGRAPH FOR URBANIZING CATCHMENT AREAS,
Sir William Halcrow and Partners, London (England).
For primary bibliographic entry see Field 2A.
W82-04683

PRESCRIBED FIRE: EFFECTS ON WATER QUALITY AND FOREST NUTRIENT CYCLE,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
D. D. Richter, C. W. Ralston, and W. R. Harms.
Science, Vol 215, No 4533, p 661-663, February 5, 1982. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Forest management, *Water quality, Cycling nutrients, Phosphorus, Sodium, Nitrogen, Carbon, Calcium, Magnesium, Water pollution sources, Groundwater, Forest soils, Hydrology, Nutrients, *Forest fires, Environmental effects, Runoff.

This report examines both off-site and on-site effects of a series of prescribed fires on experimental watersheds in the Lower Coastal Plain of South Carolina. Studies of off-site effects were concerned with fire-caused exports of materials from a pine forest ecosystem to drainage waters and the atmosphere, while on-site effects focused on the magnitude and extent of hydrologic fluxes of nutrients from burned litter to mineral soils and ground waters. Hydrologic nutrient fluxes from burned

forest floors were evaluated from the nutrient contents of litter samples collected immediately after the fire and again after postburn rainfall of about 15 cm. The contents of total nitrogen, phosphorus and sulfur in burned forest floors were not significantly changed by the initial rainfall. Analysis of mineral soil collections before fire and after fire and rain indicated minor effects of fires on mineral soil chemical properties, despite variations in fire intensities and in postburn leaching conditions. The changes in total mineral soil carbon, nitrogen and phosphorus were small. No fire effects were observed on specific conductance, pH, or dissolved concentrations of ammonium, nitrates, phosphates, sulfates, chlorides, calcium, magnesium, potassium or sodium in ground waters collected from surface soil and subsoil horizons. No changes were noted in the chemical constituents of streams which could be attributed to the fire treatment. (Baker-FRC)
W82-04690

GROUNDWATER CONTROL,
King's Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W82-04714

4D. Watershed Protection

PONDING SURFACE DRAINAGE WATER FOR SEDIMENT AND PHOSPHORUS REMOVAL,
Snake River Conservation Research Center, Kimberly, ID.
M. J. Brown, J. A. Bondurant, and C. E. Brockway.
Transactions of the ASAE, Vol 24, No 6, p 1478-1481, November/December, 1981. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Sedimentation basins, *Phosphorus removal, *Agricultural runoff, Irrigation, Drainage water, Surface drainage, Ponds, Sediment control, Suspended sediment, Water pollution control, Erosion control. Runoff, Idaho, Sediment removal.

A 3400 cu m sediment retention pond receiving surface water runoff from 4050 ha of irrigated land in Idaho removed sediment and phosphorus at greater than design efficiency (50% of total sediment input) for the 5-year observation period, 1972-1976. Removal efficiencies were 65-76% for sediment and 25-33% for total P. Phosphorus passing through this pond was either soluble or attached to soil particles too small to settle without flocculation. Average daily flow through the pond during the irrigation runoff period, April-November, was 347 liters per sec, and average retention time was 2.7 hours. Removal efficiency generally increased with increasing flow rate. A stream flow of 340-453 liters per sec removed sediment most efficiently. Very high flow rates did not allow even silt particles to settle. Optimum sediment concentration was 20-750 mg per liter. (Cassar-FRC)
W82-04358

TOPSOIL MANAGEMENT OF MINED SOILS,
Science and Education Administration, Cheyenne, WY.
G. E. Schuman, and J. F. Power.
Journal of Soil and Water Conservation, Vol 36, No 2, March/April p 77-78, 1981. 23 Ref.

Descriptors: *Land reclamation, *Topsoil, *Resources management, *Strip mine wastes, *Strip mines, Soil management, Soil properties, Crop yield, Runoff, Infiltration, Watershed protection.

Federal and state laws require that strip mined land be reclaimed to a level of productivity equal to or greater than that which existed before the mining. Topsoil must be removed before the mining operation and redistributed over the graded overburden after the coal has been removed. Studies on necessary topsoil depth found maximum grass yields with a subsoil depth of 28 inches and a topsoil depth of 8 inches. Another study found topsoil depths of 8 and 16 inches to give good yields. Topsoil plays a major role in water infiltration; infiltration increases with topsoil depth. Some studies have found that the major portion of a root system is limited to the topsoil. Forage grown on reclaimed mine areas is generally of lower quality than that grown on adjacent land. This may be a result of topsoil stockpiling which causes shifts in soil fungal dominants and the loss of other microorganisms. In general, topsoil provides a good rooting medium, improves infiltration, reduces runoff, and encourages faster establishment of nutrient cycles. It also usually increases the species diversity of vegetational cover. (Small-FRC)
W82-04571

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EVALUATING MEDIUMS AND PLATING TECHNIQUES FOR ENUMERATING BACTERIA IN WATER DISTRIBUTION SYSTEMS,
Southern California Metropolitan Water District, LaVerne.
E. G. Means, L. Hanami, H. F. Ridgway, and B. H. Olson.
Journal of the American Water Works Association, Vol 73, No 11, p 585-590, November, 1981. 1 Fig, 7 Tab, 13 Ref.

Descriptors: *Bacterial analysis, *Culture media, Microbiological studies, Chlorination, *Drinking water, Water distribution, Membrane filtration, *Pollutant identification, Water analysis, Agar, Unchlorinated water, Comparison studies.

Media and plating techniques for bacterial enumeration were evaluated using 2 drinking waters, one chlorinated surface water and the other unchlorinated groundwater. Samples were collected bimonthly from June 1978 to September 1979. Media were plate count agar, R-2A low nutrient agar, and m-standard plate count agar. Incubation temperatures were either 20 or 35 C. The techniques were spread plate, pour plate, and membrane filtration. The m-standard plate count medium with membrane filtration recovered bacterial from the water systems most efficiently. The spread plate technique was better than the pour plate technique for counting the total and pigmented bacteria in both waters. The different media tended to select for particular subpopulations. There were also discrepancies in bacteria recovery efficiencies between the chlorinated and unchlorinated waters. In view of this evidence the pour plate method should be replaced with alternative methods for enumerating bacteria in water distribution systems. (Cassar-FRC)
W82-04277

EVALUATING STREAM STANDARD VIOLATIONS USING A WATER QUALITY DATA BASE,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, and R. C. Ward.
Water Resources Bulletin, Vol 17, No 6, p 1071-1078, December, 1981. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Standards, *Water quality, *Variability, Effluent standards, Monitoring, Sampling, Model studies, Regulations, *Pollutant identification, Seasonal variation, Streams, *Sangamon River, *Illinois, Dissolved oxygen, Specific conductivity.

Two models (normal and nonparametric) for the behavior of a water quality random variable are reviewed. These models gave similar results when used with a water quality data base to describe the past behavior of a water quality variable relative to a stream standard and to evaluate apparent changes in the frequency of standard violations. They help to determine whether violations of standards are a result of natural variability or quality degradation. Cumulative density functions for water quality random variables were estimated using data from a routine grab sampling program, then were used to estimate the probability that a single grab sample will violate a given stream standard and to determine the anticipated number of violations in a given number of samples. Confidence limits about a point on the cumulative density function may be used to reflect the accuracy with which the sample estimate represents the true cumulative density function. The procedure, intended for use by state regulatory agencies, was illustrated using specific conductance and dissolved oxygen in the Sangamon River, Illinois. (Cassar-FRC)
W82-04286

PHOSPHORUS AVAILABILITY IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-04324

RESPONSES OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. II. PURE CULTURE VS. MIXED CULTURE RESPONSE,
Texas Univ. at Austin. School of Public Health.
For primary bibliographic entry see Field 5C.
W82-04341

RESPONSE OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. I. RESPONSE OF BACTERIAL INDICATORS VS. RESPONSE OF PATHOGENIC BACTERIAL SPECIES,
Ife Univ. (Nigeria). Dept. of Environmental Health.
For primary bibliographic entry see Field 5C.
W82-04342

ANALYTICAL QUALITY CONTROL,
For primary bibliographic entry see Field 5G.
W82-04345

HEALTH ASPECTS OF WATERS AT PUBLIC HEALTH RESORTS,
National Inst. for Water Research, Pretoria (South Africa).
E. M. Nupen, and J. S. Burger.
Water SA, Vol 7, No 4, p 216-222, October, 1981. 4 Tab, 23 Ref.

Descriptors: *Swimming pools, *Microbiological studies, *Disinfection, Pollutant identification, Water treatment, Recreation facilities, Water quality, Public health, Bacteria, Coliforms, *South Africa, Chlorination, Drinking water, Mineral water.

Drinking waters, mineral waters, rheumatic treatment bath waters, and recreational hot and cold swimming pool waters in seven South African resorts were examined microbiologically. No viruses were isolated from recreational or drinking waters. Candida albicans was found in only 1 sample. Bacterial counts of most waters did not exceed accepted limits. Chlorine was effective as a disinfectant. It is suggested that drinking waters at resorts be monitored constantly and that children's swimming pools should have their own filtration-disinfection system. (Cassar-FRC)
W82-04348

DETERMINATION OF VOLATILE ORGANICS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,
California Analytical Lab., Sacramento.
J. L. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-119090, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-071, December, 1981. 7 p, 5 Tab. 68-03-2033.

Descriptors: *Wastewater analysis, *Volatile organic compounds, *Gas chromatography, Electron capture gas chomatography, Industrial wastewater, Municipal wastewater, Sample preservation, Halogenated hydrocarbon, *Organic compounds, Volatility.

Methodologies for the analysis of volatile organic compounds in industrial and municipal wastewater were developed and evaluated, using gas chromatography (GC) with flame ionization, electron capture, and Coulson detectors. Although no single GC column was found that gives complete chromatographic separation of all 36 of the test compounds, several packing materials were identified that provide good separation of all but a few compounds. All the test compounds were detected by one or more of the analytical approaches studied at levels of 1 ppb or less. The nonhalogenated compounds were not detected by Coulson or electron capture. Many of the compounds are detectable at levels of 0.1 ppb or lower. The addition of preservatives to reduce residual chlorine in aqueous samples was found to help maintain the chemical stability of the samples. The major limitation of all the analytical approaches investigated was the lack of specificity of detection. The flame ionization detector was the only detector that was able to detect the nonhalogenated compounds. However, it was the least specific of the detectors studied. For relatively clean wastewaters, a combination of the analytical methods was found to usually be both specific and sensitive. For grossly polluted wastewaters, interferences became such a severe problem that qualitative identification was not feasible. (Moore-SRC)
V 32-04396

DETERMINATION OF HALOETHERS IN INDUSTRIAL AND MUNICIPAL WASTEWATERS,

Monsanto Research Corp., Dayton, OH.
P. L. Sherman, J. M. Kyne, R. C. Gable, J. V. Pustinger, and C. R. McMillin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-123290, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-062, December, 1981. 5 p, 1 Fig, 4 Tab. 68-03-2033

Descriptors: *Haloethers, *Wastewater analysis, *Gas chromatography, *Chlorinated hydrocarbons, Municipal wastewater, Industrial wastewater, Ethers, Chemical analysis, Water analysis, Sample preservation.

The following haloethers were originally included in this study: 2-chloroethyl vinyl ether, bis(2-chloroisopropyl) ether, bis(2-chloroethyl) ether, bis(2-chloroethoxy) methane, 4-chlorophenyl phenyl ether, and bis(chloromethyl) ether. The 2-chloroethyl vinyl ether and bis(chloromethyl) ether were later deleted from the project because of extreme volatility and hydrolytic instability, respectively. A literature search was conducted to acquire published information on the hydrolytic stability of the haloethers, methods for the detection of haloethers in water, and methods for the isolation, concentration and analysis of haloethers. The workable method developed in this program for the analysis of haloethers in wastewater consisted of a liquid/liquid evaporators, a column chromatographic clean-up procedure using Florisil, another K-D evaporation of the fraction from the Florisil column, and subsequent analysis by gas chromatography using an electrolytic conductivity detector. Sample preservation was studied at various pH and residual chlorine levels and different temperatures. The stability of haloethers stored in acetone and in methanol was observed. (Moore-SRC)
W82-04398

SEWAGE SLUDGE PATHOGEN TRANSPORT MODEL PROJECT,

BDM Corp., Albuquerque, NM.
J. F. Dawson, K. E. Hain, B. McClure, R. E. Sheridan, and J. G. Yeager.
Environmental Protection Agency Project Summary EPA-600/S1-81-049, October, 1981. 5 p, 1 Fig.

Descriptors: *Computer models, *Pathogens, *Parasites, *Bacteria, *Viruses, *Sludge disposal, Wastewater treatment, Enteroviruses, Salmonella, Poliovirus, Ascaris, Mathematical models, Public health, Simulation, Fate of pollutants.

A computer model was developed to predict the numbers of specific pathogens that would be found in sewage sludge at various points during sludge treatment and application, along 13 defined pathways. These pathways describe the use of dried or liquid, raw or anaerobically digested sludge as a cropland fertilizer, dried raw sludge as an animal feed supplement, and composted sludge as a residential soil amendment. Three organisms were selected to represent the enteric pathogens most commonly found in sludge: Salmonella species were used to represent the bacteria; Ascaris species were used to represent parasites; and polioviruses were used to represent all enteric viruses. The model uses a compartment-vector approach in which a mathematical state represents a discrete point in a treatment or application pathway where pathogen populations are computed as a function of time. Within these compartments, methematical process functions describe population changes due to environmental factors. Pathogen exchanges between compartments are described by transfer functions. The model permits user specification of various parameters in both process and transfer functions, for simulation of a unique set of environmental conditions. The model has the additional capability of performing exposure risk calculations for environmental compartments specified by the model user at the time of model variable initialization. (Moore-SRC)
W82-04403

EVALUATION OF ELECTROMAGNETIC TERRAIN CONDUCTIVITY MEASUREMENTS FOR DETECTION AND MAPPING OF SALTWATER INTERFACES IN COASTAL AQUIFERS.

University of South Florida, Tampa. Dept. of Geology.
T. Stewart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211459, Price codes: A04 in paper copy, A01 in microfiche. Publication No 60, September, 1981. 57 p, 27 Fig, 2 Tab, 28 Ref. OWRT A-043-FLA(1). 14-34-0001-1110.

Descriptors: *Remote sensing, *Geophysical surveys, Saltwater interfaces, Coastal aquifers, *Saline-freshwater interfaces, Electromagnetic waves, Conductivity, Measuring instruments.

In coastal areas salt-water intrusion represents a significant threat to water quality in coastal aquifer systems. The electromagnetic method evaluated in this study proved to be rapid, very inexpensive, and it yields results which agree well with geologic and geochemical surveys using direct sampling. The instrument reads directly in conductivity units, and the depth of investigation is constant for a particular spacing and orientation of the receiver and transmitter coils. Data can be obtained and interpreted by personnel with little technical training. Data interpretation normally involves contouring terrain conductivity maps, but quantitative solutions can be obtained where the geoelectric section can be reasonable approximated by a two-layer section. Some problems were experienced with interference. However interference sources usually were very localized and could be avoided. This study in two areas of Florida demonstrates that the EM conductivity method is very useful for rapid, inexpensive ground water surveys where the objective is to locate zones of conductive pore fluids at depths less than 30-40 meters. Although interpretation is indirect and qualitative, neither data aquisition nor interpretation require special training. This characteristic of the EM method makes it very suitable for use by agencies where highly-trained technical personnel are not available.
W82-04412

THE IDENTIFICATION AND TREATMENT OF BROMIDES AND TRIHALOMETHANES IN POTABLE WATER FROM THE PEARL RIVER AT JACKSON, MS: EVALUATION OF TOXICITY ON SPECIES DIVERSITY,

Mississippi State Univ., Mississippi State. Water Resources Research Inst.
G. D. Barnes, B. S. Dhillon, and A. S. Hume.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211467, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, December, 1981. 70 p, 20 Fig, 18 Tab, 48 Ref. OWRT B-028-MS(1). 14-34-0001-1239.

Descriptors: *Water pollution, *Trihalomethanes, Silver bromide, Silver bromate, *Bromides, Potassium bromide, Species diversity, Mean numbers of organisms, Community composition, Zooplankton, Decay rates of trihalomethanes, *Phytoplankton, Toxicity, Water treatment, Potable water, *Pearl River, *Jackson, Mississippi, Daphnia, Cyclops.

Significant differences in a completely randomized block design were found in species diversity (d) and mean numbers of phytoplankton in microcosms by the following treatments when compared to a control: total trihalomethane levels (1, 10, 1000 and 100,000 ppb); potassium bromide levels (1, 10 and 1000 ppb); silver bromide levels (1, 10, 1000, 10,000 and 100,000 ppb) and silver bromate (1, 10 and 1000 ppb). Toxic threshold levels for algae were between the two highest levels in THM and silver bromide respectively. Daphnia sp. and Cyclops sp. mortality increased with increasing levels of treatments: total trihalomethanes (1, 10, 100 and 1000 ppb); silver bromides (1, 10, 1000 and 10,000); silver bromates (1, 10, 1000 and 10,000). The high level of silver bromate was extremely toxic in both experiments to Daphnia and Cyclops. Percent decay rates for chloroform, bromodichloromethane, chlorodibromomethane and bromoform were similar at all time intervals throughout the study. By 11.3 hrs., approximately fifty percent of all the trihalomethanes were depleted from the microcosms. From computer projected decay rates, chloroform and bromoform were depleted from the microcosms by 80 hrs.
W82-04413

DEVELOPMENT OF THE FECAL STREPTOCOCCUS GROUP AND ITS INDIVIDUAL SPECIES AS WATER QUALITY INDICATORS,

Northern Arizona Univ., Flagstaff. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W82-04416

MEMBRANE FILTER METHOD FOR ENUMERATION OF ACINETOBACTER CALCOACETICUS FROM ENVIRONMENTAL WATERS,

Rhode Island Univ., Kinston. Dept. of Microbiology.
S. J. LaCroix, and V. J. Cabelli.
Applied and Environmental Microbiology, Vol 43, No 1, p 90-96, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Membrane processes, *Bacteria, Ponds, Filtration, *Bacterial analysis, Separation techniques, Lakes, Nutrients, Microbiological studies, Acinetobacter calcoaceticus, Pathogenic bacteria, Pollutant identification.

The aim of this study was to develop a selective-differential procedure for the quantification of Acinetobacter calcoaceticus as the first step in better defining the ecology of the organism. The procedure developed uses a mineral medium, with sodium acetate and potassium nitrate as the carbon and nitrogen sources, respectively. The recovery of A. calcoaceticus was enhanced through the introduction of formic acid, which also inhibited background growth. After incubation at 30 degrees C for 46 hr, fermentation and cytochrome oxidase tests were performed on the colonies as they appeared on the membrane. Background microbial growth decreased on the average by 1.77 orders of magnitude. An essentially quantitative recovery relative to that on nutrient agar spread plates was obtained from freshly prepared suspensions of eight A. calcoaceticus strains in filter sterilized pond water at 15 and 22 degrees C. With the three remaining strains markedly reduced relative recoveries were obtained. However, these three strains, in contrast to the first five, not only did not grow,

but also decreased in number in the eutrophic, filter sterilized pond water. The confirmation rate of presumptive A. calcoaceticus colonies was 95%, whereas 8% of the presumptively negative colonies were A. calcoaceticus. Densities of A. calcoaceticus in freshwaters ranged from less than 1 to 79,000 organisms per 100 ml water and were about 1,000,000 organisms per 100 ml in raw sewage. (Baker-FRC)
W82-04453

A SIMPLE MICRODETERMINATION OF POLYMER FLOCCULANTS (POLYACRYLAMIDES AND GUAR) IN MINE WATER,

Anglo American Research Lab., Johannesburg (South Africa).
E. Jungreis.
Analytical Letters, Vol 14, No A14, p 1177-1183, 1981. 3 Tab, 8 Ref.

Descriptors: *Mine drainage, *Chemical analysis, Filtration, Membrane filters, Filters, Membrane processes, *Polymers, Guar, Polyacrylamides, Flocculation, *Wastewater analysis.

A method is presented for the microdetermination of polymer flocculants in mine water by measuring the laminar flow rate through a membrane filter under vacuum. The procedure calls for filtering the mine water sample through an 8.0 micrometer millipore filter, measuring the pH, and filtering 50 ml of this pretreated sample through a 0.22 micrometer, 25 mm diameter millipore filter under vacuum. The filtration time is measured. A calibration graph is prepared at the same temperature, same pH, same vacuum conditions and the same filtering system, with freshly prepared polymer flocculant solution of the same kind. The concentration of the unknown is determined from the time-concentration plot. The precision of the method is acceptable. (Baker-FRC)
W82-04457

DETERMINATION OF TRACE INORGANIC POLLUTANTS (CU, PB, CD, ZN) IN WATERS BY DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY AT A ROTATING MERCURY FILM ELECTRODE (DOSAGE DE MICROPOLLUANTS MINERAUX DES EAUX (CU, PB, CD, ZN) PAR VOLTAMPEROMETRIE DE REDISSOLUTION ANODIQUE IMPULSIONNELLE SUR ELECTRODE TOURNANTE A FILM DE MERCURE),

Parisien Lab. Regional de l'Est, Le Bourget (France).
M. Bouzanne.
Analysis, Vol 9, No 10, p 461-467, December, 1981. 5 Fig, 11 Ref. English summary.

Descriptors: *Chemical analysis, *Water quality, *Heavy metals, Metals, Electrodes, Electrochemistry, Chemical interference, Dissolved oxygen, Natural waters, Copper, Lead, Cadmium, Zinc.

Various anodic stripping techniques seem promising for rapid, simple determination of trace inorganic pollutants, especially heavy metals, in natural waters. Differential pulse anodic stripping voltammetry using a preconcentrated phase is inherently more sensitive than direct electrochemical methods such as pulse polarography. A rapid deoxygenation apparatus was developed for use with this method, which was then applied for heavy metal determination in 500 samples of various natural waters. Operating conditions such as pulse duration, electrolysis potential, and final potential depend to some extent on the nature and concentration of the supporting electrolyte. The duration of electrolysis, electrode rotation speed, and measurement scale were adjusted after a preliminary tracing was obtained. Use of an internal standard is recommended rather than a calibration curve because of possible variations between samples due to the presence of traces of surfactants or dissolved oxygen and alterations in the mercury distribution. Interference due to the formation of intermetallic compounds in simultaneous determinations can be eliminated by addition of suitable reagents such as gallium and germanium salts. Prior oxidation with potassium persulfate or UV photolysis can eliminate interference by traces of dissolved organic compounds. At the microgram per liter level, the coefficient of variation for eight successive determinations of lead, cadmium and copper was 1-1.5%, depending on the element examined. For a reasonable electrolysis time of 15 min, detection limits of 10 ng/l were achieved for lead and 5 ng/l for copper and cadmium. (Carroll-FRC)
W82-04458

ENTEROTOXIGENIC BACTERIA IN FOOD AND WATER FROM AN ETHIOPIAN COMMUNITY,

Sveriges Lantbruksuniversitet, Uppsala. Dept. of Bacteriology and Epizootology.
S. F. H. Jiwa, K. Krovacek, and T. Wadstrom.
Applied and Environmental Microbiology, Vol 41, No 4, p 1010-1019, April, 1981. 1 Fig, 5 Tab, 57 Ref.

Descriptors: *Pollutant identification, *Pathogenic bacteria, *Bacterial analysis, Water pollution, Developing countries, Enteric bacteria, E. coli, Isolation, Separation techniques, Human diseases, Coliforms, Foods, Public health, *Ethiopia.

Forty of 213 bacterial isolates from Ethiopian food and natural water samples were capable of producing heat-labile enterotoxin (LT). Among the LT-producers Escherichia coli, Enterobacter, Klebsiella, Serratia, and Proteus were present. Enterotoxigenic isolates from food included oxidase positive strains of Aeromonas, Pseudomonas, Achromobacter, Flavobacterium, and Vibrio. LT-enterotoxigenic species from food and water samples included Enterobacter, Acinetobacter, Klebsiella, Proteus, Providencia, and Serratia. Several isolates gave positive reactions in Chinese hamster ovary cell tests and induced fluid accumulation in rabbit ileal loops. After storage in trypticase soy broth with glycerol at -70 degrees C for 9 months, only about 33% of the oxidase-positive strains were still LT enterotoxigenic. None of the E. coli isolates possessed K88, K99 or colonization factor antigen. Although this study showed that food and water contained enterotoxigens of the same species as those isolated from infantile diarrhea cases, no correlations were made between these pathogens and the incidence of infantile diarrhea in developing countries. (Geiger-FRC)
W82-04463

INFLUENCE OF DILUENTS, MEDIA, AND MEMBRANE FILTERS ON DETECTION OF INJURED WATERBORNE COLIFORM BACTERIA,

Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, S. C. Cameron, and M. W. LeChevallier.
Applied and Environmental Microbiology, Vol 43, No 1, p 97-103, 1982. 3 Fig, 2 Tab, 44 Ref.

Descriptors: *Bacteria, *Drinking water, Water analysis, Filtration, Membrane processes, Membranes, *Coliforms, Waterborne bacteria.

The recovery of coliforms both before and after substantial cellular injury in drinking water is examined with respect to the composition, exposure time, and temperature of the diluents; the composition of various media commonly used in water quality testing; and the surface pore morphology of membrane filters at 35 degrees C. Pure cultures of Escherichia coli, Klebsiella pneumoniae, Enterobacter aerogenes, and Citrobacter freundii were injured in water from a dead end section of the Bozeman, Montana, distribution system. The addition of peptone or milk solids to diluents and low temperatures of 4 degrees C maximized the recovery of injured cells but did not significantly affect undamaged cells. High efficiencies of recovery of control cells were noted on most media tested, but recoveries of injured cells ranged from 0 to nearly 100%. Less than 30% of the injured cells were recovered by most of the media commonly used in water analysis. This was done in part to the sensitivity of injured bacteria to deoxycholate concentrations greater than 0.01%, whereas control cells were unaffected by 0.1%. A negligible effect of membrane filter surface pore morphology on total coliform recoveries was noted at 35 degrees C. These findings support the development of new methodologies, allowing a more complete enumeration of injured coliforms in potable water and providing more accurate and dependable water quality information. (Baker-FRC)
W82-04469

OCCURRENCE AND FATE OF CERTAIN TRIPHENYLMETHANE BLUE DYESTUFFS IN THE AQUATIC ENVIRONMENT,

Thames Water Authority, London (England).
For primary bibliographic entry see Field 5B.
W82-04478

DETERMINATION OF TRACE ELEMENTS IN SEAWATER BY NEUTRON ACTIVATION ANALYSIS AND ELECTROCHEMICAL SEPARATION,

Oslo Univ. (Norway).
K. Jorstad, and B. Salbu.
Analytical Chemistry, Vol 52, No 4, p 672-676, April, 1980. 4 Fig, 4 Tab, 9 Ref.

Descriptors: *Trace elements, *Water analysis, *Neutron activation analysis, Electrochemistry, Chemical reactions, Heavy metals, *Seawater, Electrolysis, Separation techniques, *Pollutant identification, Water pollution, Radioactive tracers, Radioisotopes.

In order to reduce the respective disadvantages of the individual methods, neutron activation analysis has been combined with electrodeposition on a mercury electrode to concentrate traces of reducible metals, leaving interfering elements in solution. This combination provides a useful multielement method for the determination of 28 elements in seawater. Samples which have been freeze-dried and irradiated are dissolved in dilute nitric acid and electrolyzed for 1 hour. Silver, arsenic, gold, cadmium, cobalt, chromium, iron, mercury, gallium, lanthanum, molybdenum, antimony, selenium, and zinc can be determined from the radioactive species deposited on the mercury cathode. After a radioactive decay time of 2 weeks, the following 14 elements can be determined by measuring the activities in the residual solution: barium, bromine, calcium, cerium, cesium, europium, sodium, rubidium, scandium, samarium, strontium, thorium, uranium, and ytterbium. Since only radioactive species deposited on the cathode or left in the solution are being measured, technical grade reagents can be used. In order to obtain a reproducible electrolysis, radioactive tracers have been used to study the decrease of element concentrations in solution as a function of time of electrolysis, the influence of the initial element concentration on the rate constant K, the effect of cathode material, and the effect of the pH in solution. The technique may be used for multielement analysis of other samples having a high content of interfering elements which are not deposited on the electrode, such as samples of biological or geologic origin. (Carroll-FRC)
W82-04530

AUTOMATIC MEASURING STATION FOR CONTINUOUS MONITORING OF RIVERS,

Passavant-Werke Michelbacher Huette, Aarbergen (Germany, F.R.).
H. B. Kloppel.
Water Science and Technology, Vol 13, No 11/12, p 683-686, 1981. 1 Fig.

Descriptors: *Monitoring, *Water quality, *Automation, Computers, Water management, Rivers, Data acquisition, Data collections, Turbidity, Hydrogen ion concentration, Dissolved oxygen, Conductivity, Wastewater treatment, *Effluents.

A measuring station is described which was developed for the constant monitoring of rivers or water with similar characteristics. It is equipped for automatic cleaning and calibration and can be monitored remotely by means of an integrated computer via MODEM and telephone connection. The parameters for water temperature, pH, dissolved oxygen, conductivity and turbidity are measured. The computer collects the test data. It carries out preliminary data processing and stores the data

until it is called up by telephone. In addition the computer accepts the commands for controlling the station via to a telephone connection. It transfers the commands to the control unit of the station, and reports back the operating condition of the station via telephone. The station can also be operated as an independent functional unit without a computer, and as such can be used for monitoring the final effluent of a sewage treatment plant without much maintenance. The measured values are then transmitted separately via cable to the control center of the treatment plant itself. The measuring station is provided with very effectively operating equipment for the automatic cleaning and calibration of the sensors so that the station can operate without supervision for 4 weeks. (Baker-FRC)
W82-04569

WATER QUALITY MONITORING SYSTEM IN NIEDERSACHSEN - APPLICATION OF AUTOMATIC STATIONS FOR CONTROL AND MONITORING OF WATER QUALITY,

Niedersachsisches Wasseruntersuchungsamt, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 7B.
W82-04575

CONTINUOUS MEASUREMENT OF ORGANIC SOLVENTS IN AIR AND WATER (KONTINUIERLICHE MESSUNG ORGANISCHER LOSEMITTEL IN LUFT UND WASSER),

Siegrist G.m.b.H., Hamburg (Germany, F.R.).
H. Fuhrmann.
Wasser, Luft und Betrieb, Vol 25, No 12, p 25-28. 1981. 8 Fig, 4 Ref. (No English Summary).

Descriptors: *Chemical analysis, *Solvents, *Measuring insruments, Industrial water, Indusrial wastewater, Organic compounds, Chemical industry, Separation techniques, Trace levels.

A flexible second generation measurement system was developed which can be applied to the measurement of organic solvents in air and water. The measurement principle is based on changes in the elecrical conductivity of heated gas semiconductors due to the presence of adsorbed reducing materials. Systems applicable to water include membrane-sensor systems immersed directly in the liquid to be measured and connected to the evaluation apparatus by cable; membrane systems immersed in the liquid to be measured, with continuous measurement provided by diffusion rate dilution with clean air, and continuously operating phase exchange systems with evaluation by gas sensors. The latter system avoids problems due to water contaminants in that only the volatile solvents are transferred into the gas phase. Range selection and calibration curves can be used to measure individual and total components. These instruments are particularly suitable for industrial applications. (Carroll-FRC)
W82-04579

CHLORIDE DETERMINATION IN AUTOMATED WATER COMPOSITION MONITORING (CHLORIDBESTIMMUNG IN DER AUTOMATISIERTEN WASSERBESCHAFFENHEITSKONTROLLE),

Institute fuer Wasserwirtschaft, Berlin (German D.R.).
H. Heitmann.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 341-342, 1981. 6 Ref. (No English Summary).

Descriptors: *Chlorides, *Chemical analysis, *Titration, Automation, Salinity, *Monitoring, Drinking water, Industrial water, River water, Saale River, *Elbe River, Potentiometry, Saline water intrusion, Germany.

Chloride levels in drinking water should not exceed 250 mg/l, since higher concentrations give a brackish taste. Chloride in industrial water corrodes iron, and chloride monitoring is also necessary as an indicator of saltwater intrusion. Possible methods of automated chloride monitoring include continuous potentiometric measurement of chloride ion activity with an ion-sensitive electrode and automated potentiometric titration of chloride ions with silver nitrate solutions. The former method is easier, but the latter method is more accurate, and therefore each of these methods is most suitable for specific applications. Use of continuous potentiometric chloride measurement is advantageous only where great accuracy is not required, for example for saltwater intrusion monitoring, so that an alarm can be sounded if a specific chloride level is exceeded. It is less useful for effluent monitoring because of possible interference by sulfide, bromide, iodide, cyanide and thiosulfate ions, as well as changes in the total salt content and temperature of the water. Automated electrode cleaning and calibration could improve accuracy beyont the presentplus or minus 15%. automated titration equipment is available which has a sample collection timing device. Mixing effects can introduce errors, especially in turbid samples, but can be controlled by slowing the rate of titration. Automated titration for determining the chloride input from the Saale into the Elbe iver over a number of years gave accuracy comparable to that of laboratory titration, (Carroll-FRC)
W82-04580

CONTINUOUS MONITORING OF THE EFFLUENT QUALITY OF AN ACTIVATED SLUDGE PLANT BY TURBIDITY MEASUREMENT (KONTINUIERLICHE KONTROLLE DER ABLAUFGUTE EINER BELEBTSCHLAMMANLAGE MITTELS TRUBUNGSMESSUNG),

Forschungszentrum Wassertechnik (German, D.R.).
K. Hanel, P. Liedke, W. Gutendort, and C. Anton.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 337-340, 1981. 5 Fig, 9 Ref. (No English summary).

Descriptors: *Activated sludge process, *Turbidity, *Process control, Sludge solids, Wastewater treatment facilities, Effluents, Sludge excess, *Monitoring, Automation, Measuring instruments.

The characteristics most frequently used for evaluating wastewater treatment effluent quality, such as BOD and filterable materials, are not suitable for rapid measurement, within a time period suitable for process control utilization. Other possible characteristics, such as chemical oxygen demand and total organic carbon, are not directly linked with the functioning of the activated sludge plant. Turbidity measurement has not been widely used for rapid estimation of effluent quality because of the difficulty of establishing a definite relationship between turbidity and other quality criteria in different waters. Sludge discharge was a frequent problem at the Wahren wastewater treatment plant. An attempt was made to monitor the occurrence of this phenomenon using a continuous light scattering turbidimeter, Nephelon II. Relatively close correlations were found between turbidity values, activated sludge content and BOD. Correlations were poor when large numbers of hydrophobic particulates were present following heavy rain and when incomplete biological purification was occurring, but errors were on the conservative side in these cases. If hydraulic conditions are favorable, measurements may be employed to control the operation of excess sludge pumps as long as safeguards against over-running are added. (Carroll-FRC)
W82-04583

UTILIZATION OF DATA FROM AUTOMATIC WATER QUALITY MONITORING STATIONS IN FINLAND,

National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 7B.
W82-04585

THE UNTERWESER AUTOMATIC WATER QUALITY MEASUREMENT SYSTEM,

H. Kunz.
Water Science and Technology, Vol 13, No 11/12, p 657-662, 1981. 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Water quality, *Monitoring, *Weser River, Germany, Data acquisition, Automation, Water management, Oxygen, Acidity, Powerplants, *Wastewater, Mixing, Tidal rivers, Heated water, *Nuclear powerplants, *Tidal effects.

This paper describes the requirements placed on the Unterweser nuclear power plant (KKU) measurement system, the technical configuration, experience and results. The nuclear power plant operator must control his plant so as to remain within specified limits. The water authority responsible requires proof of this and carries out checks on the plant. In addition to thee temperature, the oxygen content, the conductivity and to a limited extent the pH value are also calculated. The measuring stations in the Unterweser have been placed as far out into the deep navigation channel as shipping permits because this offers the best point for presenting the applicable water quality conditions. The measurement station only records the values and transmits them to a central station when polled by radio. The stationary KKU water quality measurement system has available a fast measurement vessel as well as two meteorological measuring stations. These systems can both collect and record data themselves as well as be integrated in the data flow controlled from the central station. In contrast to tidal-free waters, the water level as well as the flow rates periodically vary with the tide, and sea water flows in. One and the same body of water passes a discharge point several times and is thus charged with waste water many times. Waste water discharged into the river may be carried by the tidal flow far beyond the discharge point. This complicated transporting and mixing process demands sophisticated measuring equipment to obtain data needed for control, monitoring and securing evidence of falling quality. (Baker-FRC)
W82-04588

CONTINUOUS WATER QUALITY MONITORING SYSTEM USING TELEMETRY IN THE CITY OF OSAKA,

Japan Sewage Works Bureau, Osaka.
K. Nanbo, and R. Kunogi.
Water Science and Technology, Vol 13, No 11/12, p 639-644, 1981. 3 Fig, 1 Tab.

Descriptors: *Water quality, *Monitoring, *Automation, Telemetry, Computers, Data acquisition, *Osaka, *Japan, Networks, Performance evaluation, *Wastewater facilities.

This paper summarizes the monitoring system used for water quality control in the city of Osaka, Japan, and lists items of importance for ensuring that the system operates at maximum efficiency and provides exact data. The central monitoring system is connected with the river monitoring stations, the sewage treatment plant monitoring stations and the factory monitoring stations by telemetry and collects data from them. Nine river, three sewage, and six factory monitoring stations have already been installed, and plans exist for 1, 10, and 4 additional stations, respectively. The central monitoring station is connected with each river and sewage treatment plant monitoring station through an allotted communication circuit and with factory monitoring stations through the public communication circuit. Data are collected every 5 minutes from river stations, every hour from sewage treatment plant stations and every day from factory stations, by a polling system. Various kinds of instruments are installed for telemetry, data logger and input-output of data in the central monitoring station. Proper maintenance is indispensable to get the most efficient operation from the equipment. It is hoped that the information being gained will aid the establishment of automatic water quality monitoring systems. (Baker-FRC)
W82-04590

THE AUTOMATIC MEASURING OF SEWAGE IN THE ARTOIS-PICARDIE AREA,

Artois-Picardie Agence de l'Eau, Douai (France).
J. -M. Journet.
Water Science and Technology, Vol 13, No 11/12, p 619-624, 1981. 2 Fig.

Descriptors: *Water quality, *Monitoring, Wastewater treatment, Automation, Data acquisition, Water management, Effluents, *Water pollution sources, Watershed protection, Chemical analysis, Dissolved oxygen, Turbidity, *Waterways, *France.

In 1971 automatic monitoring of waterways was introduced into the Artois-Picardie area in northern France. This monitoring was found to be insufficient after a few years, and automatic monitoring of sewage was introduced. From 1975 on, two mobile stations were used to observe the natural conditions in the waterways of the catchment area and those affected by sewage pollution. The results showed the influence of nocturnal discharges from a cheese dairy upstream of the recording station on the quality of a small waterway. From 8 PM to 6 AM a significant increase of organic matter was noted, and a marked decrease in dissolved oxygen content. Subsequently an automatic Philips total oxygen demand meter and turbidimeters were tested on site with treated sewage and sewage containing industrial effluents. These were then included in the overall monitoring system in 1978 and 1979, with the building of four sewage monitoring stations. The results obtained by the end of 1980 concern 25 different types of discharge: paper mill, chemical, breweries, canning factories, iron and steel, domestic sewage and others. Plans for the future are briefly discussed. (Baker-FRC)
W82-04602

EVALUATION OF WATER QUALITY DATA RECEIVED BY AUTOMATIC CONTROL STATIONS AT THE TELTOW-CANAL IN BERLIN (WEST),

Technische Univ., Berlin (Germany, F.R.). Inst. fuer Chemieingenieurtechnik.
J. Schafer, H. Schumann, W. Niemitz, and U. Wiesmann.
Water Science and Technology, Vol 13, No 11/12, p 663-670, 1981. 7 Fig.

Descriptors: *Data collections, *Water quality, Automation, Monitoring, Canals, *Germany, *Teltow Canal, Berlin, *Effluents, Powerplants, Computers, Municipal sewage, Wastewater facilities.

The Teltow Canal is now one of the most heavily loaded waterways in Germany and contributes greatly to eutrophication of the lower Havel and the Havel lakes. This paper presents a first evaluation of water quality data from six automatic control stations along the canal. Mean values are given for each half year from 1972 through 1979 for concentrations of dissolved oxygen, temperature, conductivity and acidity. Changes in the distribution functions are given for diurnal mean values of oxygen concentration. A continuous degeneration of water quality over this time period was easily demonstrated. A special computer program was adapted to show the local and temporal changes in the data collected. Some of the results are presented as isolines for oxygen concentration and temperature. The increase in loading of the canal over the years was dramatic after the introduction of effluents from a new sewage treatment plant and another large power station. (Baker-FRC)
W82-04607

DETECTION AND MAPPING OF INSOLUBLE SINKING POLLUTANTS,

Rockwell International, Newbury Park, CA.
R. A. Meyer, M. Kirsch, and L. F. Marx.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105586, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-198, October, 1981. p, 5 Fig, 1 Tab. 68-03-2648.

Descriptors: *Water pollution, *Conductivity, *Acoustics, *Mapping, *Monitoring, *Hazardous materials, Carbon tetrachloride, Immiscibility, Solubility, Computers, Cleanup operations, Spills, *Pollutant identification.

Some of the hazardous materials spilled into rivers, streams, or lakes are immiscible, slightly soluble, and denser than water. These sinking pollutants must be detected at once, and their locations must be mapped to initiate cleanup operations and minimize impacts. An electrical conductivity monitoring system was developed to detect the arrival of sinking pollutants at the bottom of a watercourse. The submersible monitor uses a cyclically purged electrical conductivity probe capable of long-term deployment even when partially buried in sand or silt. The submersible unit, which is battery powered, will transmit the conductivity data to the shore-base receiver by means of ultrasonics. The unattended design life of the monitor is 1 year. A commercial 200-kHz depth-finder system has been extensively modified and tested for use in an underwater acoustic mapping system to locate pools when a spill of a sinking pollutant is known to have occurred. Laboratory tests indicate that the system is capable of resolving the echoes from the surface of a 1-cm deep layer of carbon tetrachloride from those returning from a hard, sandy, or muddy bottom. Field testing revealed few precursor echoes that might mask or interfere with the detection of an echo from a pollutant pool. Return echoes were evaluated by 16-mm motion picture photography, and a computer-based comparator-counter technique has been developed for data management. (Moore-SRC)
W82-04619

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME II, PROCEDURAL MANUAL FOR MONITORING OF HIGHWAY RUNOFF,

Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, and T. L. Meinholz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241903, Price codes: A07 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/043, February, 1981. 121 p, 36 Fig, 9 Tab, 34 Ref, 3 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Water pollution sources, *Monitoring, *Runoff, *Water sampling, Flow measurement, Precipitation, Storm runoff, Land use, Site selection, *Highway effects, Environmental effects.

This manual has been prepared for use by highway department personnel to evaluate highway runoff. It contains detailed procedures for establishing and conducting a monitoring program and evaluating the collected data. There are a number of factors affecting the quality of the runoff that must be actively monitored for any site. Primary among these are traffic characteristics, highway operation and maintenance practices, precipitation characteristics, and the accumulation of pollutants on the highway. Other factors which must be noted because of their relevance to the quality of runoff include: adjacent land usage, right-of-way characteristics, roadway alinement, vertical plane, alinement of the highway, and pavement conditions. The steps required in establishing a successful monitoring program include: selection of a suitable site; planning a monitoring program; installing the monitoring equipment; maintenance and monitoring procedures; and evaluation and application of the results. A simple program may involve monitoring a single runoff event using manual sampling and flow monitoring techniques. A more complex program might involve monitoring events for an entire year or longer automated equipment. (Moore-SRC)
W82-04628

THE EFFECT OF STORAGE BY FREEZING ON DISSOLVED INORGANIC PHOSPHATE, NITRATE AND REACTIVE SILICATE FOR SAMPLES FROM COASTAL AND ESTUARINE WATERS,

Department of the Environment, Sidney (British Columbia). Inst. of Ocean Sciences.
R. W. Macdonald, and F. A. McLaughlin.
Water Research, Vol 16, No 1, p 95-104, January, 1982. 11 Fig, 4 Tab, 15 Ref.

Descriptors: *Sample preservation, *Nutrients, *Storage, Freezing, Silicates, Estuaries, Nitrates, Phosphates, Water sampling, Filtration, Thawing, Water analysis.

The effect of storage methods on stability of nutrients in coastal and estuarine waters was investigated. Parameters compared were freezing, quick freezing, filtering, and storage time. For phosphate, quick freezing produced better accuracy and precision in analysis. Filtration was necessary for turbid samples. Thaw time was not significant; storage time was significant for two of four samples, but examination of the data showed no clear trends. For nitrates, freezing was satisfactory; filtration was not necessary. Quick freezing slightly reduced the number of maverick samples. Freezing slightly decreased nitrate (1.6% for saline samples and zero for low salinity samples) and increased variance. Thaw time had no effects. In silicate determination, freezing was satisfactory for storage of saline water samples but not for low salinity estuarine samples, in which 5-15% of silicate was lost even after 24 hours that time. Quick freezing was better than regular freezing for the saline samples; filtering was not required. Samples should be analyzed for all three nutrients within two months after collection to limit variance caused by storage. (Cassar-FRC)
W82-04660

WATER QUALITY MONITORING - IDENTIFICATION OF RESIDENCE/TRAVELLING TIMES FROM HYDROLOGICAL AND WATER QUALITY INFORMATION,

Karlsruhe Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2E.
W82-04663

SURROGATE PARAMETER ANALYSIS FOR ORGANIC PRIORITY POLLUTANTS,

Virginia Univ., Charlottesville. Dept. of Civil Engineering.
C. E. Parker.
Journal Water Pollution Control Federation, Vol 54, No 1, p 77-86, January, 1982. 10 Fig, 33 Ref.

Descriptors: *Environmental effects, *Hazardous materials, *Toxins, Organic compounds, Wastewater, Water pollution sources, Bacteria, Cultures, Oxygen uptake, Adenosine triphosphatase, Pollutant identification, Water quality control.

In this paper the concept of using two microbial activities, adenosine triphosphate (ATP) and oxygen uptake, to quantify the strength of toxics in wastewater through a surrogate parameter is explored. Integrating short-term activity-time curves for various toxin concentrations and then correlating the activity-area curves with toxin concentration seem to be conceptually sound and offer one possible methodology for establishing a surrogate measurement of toxicity. The response of an ATP pool for a bacterial population to a toxic substance differs significantly from oxygen utilization. Because changes in the ATP pool are rapid and depend on the physiological state of the organism, standardization of the growth phase and of environmental conditions are essential. To eliminate the effect of the physiological state and to minimize fluctuations in the ATP pool, the ATP response to toxins is best measured during engogenous respiration and without substrate additions. The ATP activity response versus time for the endogenous culture could then reflect inhibition by the toxin. Toxins with the same activity-time response patterns may be quantified on the basis that equivalent areas represent short-term equivalent toxic effects. It has been shown that for several toxins the areas from activity-time plots for a bacterial culture can be related to toxin concentration. The ATP response is the more sensitive of the two activity measurements. Development of a bacterial bioassary procedure for surrogate toxin measurements will require the use of a pure culture. (Baker-FRC)
W82-04704

5B. Sources Of Pollution

WATER QUALITY PATTERNS DURING A STORM ON A MALL PARKING LOT,

State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
P. E. Black.

Water Resources Bulletin, Vol 16, No 4, p 615-620, August, 1980. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Urban runoff, *Nonpoint pollution sources, *Runoff, Fate of pollutants, Parking lots, Water pollution sources, Paving, Water quality, Rainfall-runoff relationships, Ammonium, Metals, Subsurface runoff, Streams, Conductivity, Water temperature, Surburban malls, New York.

Rainfall, surface runoff, and subsurface drainage plus streamflow upstream and downstream of a suburban New York mall parking lot were intensively sampled during and after a thunderstorm on June 18, 1978. Prior to the 11.4 mm which fell within less than 1.5 hours, no rain had fallen for 4 days. Ammonia-N concentrations were high (up to 2.5 mg per liter) in parking lot runoff, a result of precipitation which contained up to 2.0 mg per liter ammonia-N. Surface runoff had a peak in conductivity during the rainfall and returned to prestorm levels by the end of the study period. Initial runoff appeared gray and nearly opaque. Nine constituents (K, Mn, Fe, P, Pb, Zn, Mg, Ca, and Na) showed a peak in surface runoff between 45 and 60 min after the rain started, declined to a low at 75 min, and returned to prestorm values by 105 min. Drainage from subsurface drains was brown in color and had a strong odor. In the receiving stream, water temperature increased and conductivity decreased during the beginning of the storm and returned to prestorm levels after 5 hours. (Cassar-FRC)
W82-04252

OCCURRENCE AND DISTRIBUTION OF CHEMICAL POLLUTANTS IN LAKE MARIUT, EGYPT. II. HEAVY METALS,

Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, A. A. Ezzat, O. A. El-Rayis, and H. Hafez.
Water, Air and Soil Pollution, Vol 16, No 4, p 401-407, 1981. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Heavy metals, *Lakes, Zinc, Copper, Manganese, Iron, Cadmium, *Distribution patterns, Water pollution sources, *Lake Mariut, *Egypt, Industrial wastes, Fish.

This study deals with the occurrence and seasonal distribution of heavy metals in the water and Tilapia fish of Lake Mariut. Six stations were chosen to represent different regions in Lake Mariut. Two additional stations were selected at the connections of Umum Drain and Qala Drain with the lake. The mean concentrations of zinc, copper, iron, manganese, and calcium in the lake water were 10.9, 4.2, 19.1, 26.2, and 0.62 micrograms/liter, respectively. The monthly average values of zinc varied from a minimum of 3.4 micrograms/liter in October 1978 to a maximum of 20.5 micrograms/ liter in May 1979. The metal concentrations in the fish gave higher values for the liver than the stomach concerning zinc, copper, iron, and cadmium. The mean concentrations of zinc, copper, iron, and manganese found in the stomach were markedly higher than those present in the edible flesh of the flank region and the caudal peduncle. (Baker-FRC)
W82-04290

BIOGENIC AND ABIOGENIC POLYNUCLEAR AROMATIC HYDROCARBONS IN SEDIMENTS FROM TWO REMOTE ADIRONDACK LAKES,

Department of Energy, New York. Environmental Measurements Lab.
Y. L. Tan, and M. Heit.
Geochimica et Cosmochimica Acta, Vol 45, No 11, 9 Fig, 7 Tab, 39 Ref.

Descriptors: *Aromatic compounds, *Lakes, *Sediments, Polynuclear aromatic hydrocarbons, Hydrocarbons, *Sagamore Lake, *Woods Lake, *New York, Perylene, Lake sediments, Organic matter, Abietic acid, Retene, Terpenes, Organic compounds, Water pollution sources, Fate of pollutants.

Polynuclear aromatic hydrocarbons (PAH) were determined in sediment cores from Sagamore Lake and Woods Lake, New York, remote from industrial activities. The composition and distribution of the parental PAH in the sediment indicate that the source of PAH in the surface is anthropogenic combustion of fossil fuels. Forest fires were ruled out as a source because sediment cores revealed no trace of the only known fire, which occurred about 80 years ago. All parental PAH, with the exception of perylene, decreased in concentration with depth in the cores. Perylene levels increased dramatically with depth to a maximum at 35 cm and decreased at greater depths. It has been suggested that perylene is transformed from natural precursors in the reducing environment, but the identity of these precursors was not investigated in this study. Concentrations of nonparental PAH were relatively uniform throughout the sediment cores. Some of the products identified were retene and other intermediates in the conversion of abietic acid to retene and hydrochrysenes and hydropicenes derived from pentacyclic triterpenes. Abietic acid is a major component of pine resins, and the pentacyclic triterpenes are widely distributed in higher plants. Concentrations of all parental PAH, except perylene, were higher in Woods than in Sagamore. The sediment densities and sedimentation rates are higher in Sagamore. (Cassar-FRC)
W82-04293

ACIDIC PRECIPITATION: CONSIDERATIONS FOR AN AIR QUALITY STANDARD,

Brookhaven National Lab., Upton, NY.
L. S. Evans, G. R. Hendrey, G. J. Stensland, D. W. Johnson, and A. J. Francis.
Water, Air, and Soil Pollution, Vol 16, No 4, p 469-509, 1981. 3 Fig, 3 Tab, 83 Ref.

Descriptors: *Water quality, *Acid rain, Rainfall, Air pollution, Acidic water, Hydrogen, Fish, Water pollution sources, *Water pollution effects, Ecological effects.

This paper discusses the relationship between precipitation acidity and receptor effects. First, the existence of acidic precipitation is documented, including temporal and spatial variability. A review of receptor characteristics is presented, along with responses to acidic precipitation, describing links between acidic precipitation and enviornmental effects where wuch links are known. Information gaps are highlighted. Finally the possibility of establishing a critical threshold for precipitation acidity is evaluated, which can serve as a meaningful standard to protect to protect terrestrial and/or aquatic biota. The chief anions accounting for the acidity in rainfall are nitrate and sulfate. Greater nutritional benefits are derived from acid rain by agricultural rather than forest systems, when considering soils alone. Acid deposition has caused acidification of fresh waters of southern Scandinavia, southwestern Scotland, southeastern Canada, and northeastern United States. Biological effects of acidification of fresh waters are detectable below a pH of 6.0. As lake and stream pH levels decreased below pH 6.0, many species of plants, invertebrates, and vertebrates were progressively eliminated. Current research inducates that establishing a maximum permissible value for the volume weighted annual hydrogen ion concentration of precipitation at 25 microeq/liter may protect the most sensitive areas from permanent lake acidification. (Baker-FRC)
W82-04302

A PRELIMINARY POLLUTION SURVEY OF THE PAPENKUILS RIVER, PORT ELIZABETH,

Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and W. D. Emmerson.
Water SA, Vol 7, No 4, p 211-215, October, 1981. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Heavy metals, *Water quality, *Water pollution sources, Path of pollutants, Coliforms, Metals, Sediments, Rivers, *Papenkuils River, Port Elizabeth, *South Africa, Nutrients.

Water samples from 20 sites along the course of the Papenkuils River, Port Elizabeth, South Africa, were analyzed for nutrients (ammonia, nitrite, nitrate, phosphate, and total phosphorus), Escherichia coli, and heavy metals. One identified pollution source was the Fishwater Flats sewage works. Many other unknown industries contributed wastes along the entire length of the river (formerly known as Smelly Creek), causing high metal concentrations in water and sediments and an absence of invertebrate fauna. Fecal coliforms were high near the sewage plant discharge and near a stormwater drain. Highest metal levels in water samples were (in micrograms per liter): Cu, 67, Pb, 326, Zn, 3600, Mn, 650; Ni, 106; Cd, 0.88; Cr, 83; and Hg, 1.047. Highest metal levels in sediments were (in micrograms per g): Cu, 740; Pb, 2400; Zn, 22,400; 465; Co, 6.0; Ni, 96; Cd, 15; Cr, 40,000; and Hg, 2. (Cassar-FRC)
W82-04346

ENGINEERING IN CATFISH PRODUCTION,

For primary bibliographic entry see Field 8I.
W82-04367

COMPARISONS OF SOLUBLE REACTIVE PHOSPHORUS AND ORTHOPHOSPHORUS CONCENTRATIONS AT AN OFFSHORE STATION IN SOUTHERN LAKE MICHIGAN,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-04377

AREAWIDE STORMWATER POLLUTION ANALYSIS WITH THE MACROSCOPIC PLANNING (ABMAC) MODEL,

RAMLIT Associates, Berkeley, CA.
Y. J. Litwin, J. A. Lager, and W. G. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107947, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-223, October 1981. 3 p, 1 Fig. R-806357.

Descriptors: *Storm runoff, *Computer models, *Storm water, *Water pollution, Simulation, Planning, Land use, Water quality, Rainfall-runoff relationships, Nonpoint pollution sources, Wastewater treatment.

A simplified, continuous, stormwater management model (ABMAC) and user's manual were developed to provide an inexpensive, flexible tool for preliminary assessment of stormwater management strategy over large developed and undeveloped areas. The model, intended for use by local engineers and planners, is adaptable for mini-computer applications. The model is designed to simulate runoff, water quality, storage, and treatment while incorporating time and probability into the analysis. It allows for substantial flexibility in terms of input data requirements and output formats. All simulated quantities vary on a daily basis. The model can simulate nonpoint source pollution from a maximum of six land use categories. Six quality constituents are simulated including one user specified constituent. The application and testing of the model in the San Francisco Bay area, from 1976 to 1978, and 1978 to 1980, indicated satisfactory agreement between recorded and simulated records (within 40%). The model can be used effectively in conjunction with more sophisticated models of stromwater runoff and receiving waters. In such applications, ABMAC looks at broad areas and long periods, whereas the more sophisticated models can be best applied to selected, relatively small watersheds. (Moore-SRC)
W82-04393

SEWAGE SLUDGE PATHOGEN TRANSPORT MODEL PROJECT,

BDM Corp., Albuquerque, NM.
For primary bibliographic entry see Field 5A.
W82-04403

PARASITES IN SOUTHERN SLUDGES AND DISINFECTION BY STANDARD SLUDGE TREATMENT,

Tulane Univ., New Orleans, LA. School of Public Health and Tropical Medicine.
R. S. Reimers, M. D. Little, A. J. Englande, D. B. Leftwich, and D. D. Bowman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102344, Price codes: A10 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-166, October, 1981. 7 p, 2 Fig, 7 Tab. 805107

Descriptors: *Parasites, *Disinfection, *Sludge, *Protozoa, *Wastewater treatment, Heat, Eggs, Helminths, Lime, Ultrasonics, Seasonal variation, Pathogens, Temperature effects.

Sludge samples collected during each of the four seasons from 27 municipal wastewater plants located in Alabama, Florida, Mississippi, Louisiana, and Texas were examined for thee presence and densities of resistant stages of human and animal parasites. Viable eggs of Ascaris and Toxocara were recovered at least once from every plant and viable eggs of Trichuris vulpis and Trichuris trichiura were recovered at least once from 26 and 15 plants, respectively. Viable eggs of at least 10 other helminths and cysts of a few protozoa were also found in fewer numbers and less frequently. Depending upon the parasite, the inactivation of parasites during sewage treatment fluctuated from season to season, but, in general, most were inactivated in the summer. Laboratory studies verified that destruction of resistant parasite eggs is primarily due to temperature (heat) and not to a specific digestion process. Very large lime doses were required for the inactivation of viable Ascaris in sludges and results were not always consistent. Laboratory experiments also showed that at certain combinations of ultrasonic frequency intensity and exposure time, Toxocara eggs could be destroyed, but that the same ultrasonic conditions did not affect Ascaris eggs. An important finding of this study is the poor suitability of Ascaris eggs taken from the uteri of gravid female worms as indicators of the characteristics of Ascaris eggs discharged in the feces of the host. (Moore-SRC)
W82-04408

DEVELOPMENT OF THE FECAL STREPTOCOCCUS GROUP AND ITS INDIVIDUAL SPECIES AS WATER QUALITY INDICATORS,

Northern Arizona Univ., Flagstaff. Dept. of Microbiology.
H. K. Speidel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211425, Price codes: A02 in paper copy, A01 in microfiche. Report, June, 1981. 13 p. OWRT A-096-ARIZ(1). 14-34-0001-0103.

Descriptors: *Water pollution, *Coliforms, *Bacteria, *Pollutant identification, *Fecal streptococcus, Indicator bacteria, Speciation techniques, Bacterial survival.

Procedures proposed by the U.S. Environmental Protection Agency for the verification and speciation of fecal streptococci were evaluated using 9 standard cultures of streptococci obtained from the American Type Culture Collection (ATCC). The verification portion of the procedure was found to be very useful for the standard cultures as well as environmental isolates. The speciation method was not able to successfully speciate 67% of the standard cultures. The major problems which arose in the use of the speciation scheme included: carbohydrate fermentation reactions, hemolytic reactions, telurite reduction and excessive time and media requirements. A new scheme was developed to speciate the fecal streptococci. Thisnew procedure was based upon differences in the fermentation of six carbohydrates. The new procedure utilizes carbohydrate discs placed on Phenol Red Agar and takes only 24 hours after the verification of the fecal streptococcus isolate. Fecal streptococcal cultures were obtained from a variety of warm-blooded animals from the Northern Arizona Region. The cultures were speciated using the new procedure as well as the EPA procedure. The survival of fecal streptococci in an aquatic system was examined by placing the standard cultures into lake water held at 15 C. Samples were taken at 48 hour intervals and viable counts were made. The survival curves obtained classified the organisms into short term, medium term and long term survivors. The data also indicate that the currently used fecal coliform to fecal streptococcus ratio may not be valid especially after 12 hours from the time the organisms enter the water.
W82-04416

RESPONSES OF NORTHERN NEW ENGLAND LAKES TO ATMOSPHERIC INPUTS OF ACIDS AND HEAVY METALS,

Maine Univ. at Orono. Land and Water Resources Center.
S. A. Norton, R. B. Davis, D. F. Brakke, D. W. Hanson, and K. H. Kenlan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211434, Price codes: A06 in paper copy, A01 in microfiche. Report, July, 1981. 90 p, 50 Fig, 6 Tab, 50 Ref, 2 Append. OWRT A-048-ME(1).

Descriptors: *Acid rain, Acidic water, Diatoms, Plankton, *Heavy metals, *Water pollution sources, Cations, Lake sediments, *Lakes, *New England, *Ecological effects.

Ninety-four low-humic lakes in northern New England (82 in Maine) located in largely noncalcareous terrain were studied to detect possible changes in pH and associated effects. Modern colorimetric and electrode pH measurements yield equivalent results plus or minus 0.1 pH unit, permitting comparison of modern electrode pH measurements with older colorimetric measurements. Eight-five percent of the lakes are more acidic now. Studies of present water chemistry indicate that Fe, Mn, Pb, Zn, and Al concentrations tend to be higher with decreasing pH for the set of lakes; Na, K, Ca, Mg, and alkalinity tend to be higher with increasing pH for the set of lakes. Surface sediment chemistry indicates that (at the 95% significance level) the concentrations of Na2O, K2O, MgO, and organics are highest at higher lake pH values; Cu increases with decreasing pH. CaO, FeO, MnO, A12O3, TiO2, Pb, and Zn concentrations do not relate to pH. The relative abundances of taxa of diatom remains in profundal surface sediments from a sub-set of 25 lakes are related to surface water pH's in the range of 4.4 to 7.0. In a cluster analysis, the diatom assemblages from lakes with pH less than 5.7 separate from those with pH greater than 5.8. Greatest taxonomic diversity occurs at pH 5.8. Some unknown factor associated with lake altitude (52 - 1009 m) accounts for scatter in the pH-diatom relationship. In studies of cladoceran associations in profundal surface sediments from 13 of the lakes with a pH range of 4.4 to 6.9, it was not possible to uncouple the effects of pH and altitude (78 - 1123 m). Cladoceran stratigraphy in sediment cores from three high-altitude lakes indicates community changes concurrent with changes in diatom assemblages postulated to be caused by lake acidification.
W82-04420

ESTIMATION OF ACCUMULATION PARAMETERS FOR URBAN RUNOFF QUALITY MODELING,

Geological Survey, Reston, VA.
W. M. Alley, and P. E. Smith.
Water Resources Research, Vol 17, No 6, p 1657-1664, December, 1981. 5 fig, 2 tab, 13 Ref.

Descriptors: *Urban runoff, *Accumulation, *Water quality, *Model studies, Pollutant load, Water pollution sources, Washoff, Fate of pollutants, Runoff, Sensitivity analysis, Paving.

Watershed models use accumulation and washoff equations to simulate the quality of runoff from urban impervious areas. This paper explores methods of estimating accumulation parameters and analyzes the sensitivity of model output to changes in these parameter values. Parameters evaluated are the maximum amount of constituent on effective impervious areas (in kg); the rate constant for constituent removal (per day); and the washoff coefficient (per mm). An equation is given which accounts for observations that the rate of pollutant accumulation is largest for a few days after a rainfall or street cleaning and eventually approaches zero because constituents are resuspended by wind or vehicular traffic. This curve is more general than the linear accumulation curves used in most models. An exponential equation for constituent washoff developed in a previous paper is presented. Results of applying these techniques and sensitivity analysis show that the shape and magnitude of the constituent accumulation curves should be better defined. The amount of residual material remaining on the streets after storms and cleaning must also be considered. (Cassar-FRC)
W82-04432

A FINITE ELEMENT MODEL FOR THE MIGRATION OF LEACHATE FROM A SANITARY LANDFILL IN LONG ISLAND, NEW YORK - PART I: THEORY,

Argonne National Lab., IL.
A. B. Gureghian, D. S. Ward, and R. W. Cleary.
Water Resources Bulletin, Vol 16, No 5, p 900-906, October, 1980. 3 fig, 1 Tab, 31 Ref.

Descriptors: *Leachates, *Model studies, Simulation, Computers, Infiltration, Percolation, Leaching, Soil solution, *Landfills, Sanitary landfills, Waste dumps, Mathematical studies, *Long Island, New York.

This work illustrates the development and accuracy of a two dimensional finite element mathematical model for the migration of ground water contamination. For obtaining a solution to the mass transport equation by means of quadrilateral elements with linear sides, the Upstream (Upwind) FEM seems to be a better choice than the Galerkin FEM to avoid overshoot and oscillations in applying the model to field problems. Due to the fact that the weighting functions are dependent on the cell Courant number, the computational cost will increase slightly if the value of this parameter is other than constant in the progress of the solution. The optimal weighting parameters in the transient simulation need to be precisely defined for grid networks with variable mesh spacing. A field application of the model to the leachate migration from the Babylon sanitary landfill in Long Island, New York, has been carried out. (Baker-FRC)
W82-04434

NUTRIENT AND HEAVY METAL TRANSPORT CAPABILITIES OF SEDIMENT IN THE SOUTHWESTERN UNITED STATES,

New Mexico Univ., Albuquerque. Dept. of Biology.
For primary bibliographic entry see Field 2J.
W82-04437

PROPORTIONS OF SEVERAL ELEMENTS FOUND IN SEWAGE EFFLUENT AND SLUDGE FROM SEVERAL MUNICIPALITIES IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Div. of Animal and Veterinary Sciences.
D. J. Horvath, and R. A. Koshut.
Journal of Environmental Quality, Vol 10, No 4, p 491-497, October/December, 1981. 7 Tab, 30 Ref. A-025-WVA(2).

Descriptors: *Sludge, *Effluents, *Heavy metals, *Wastewater treatment, Metals, Land disposal, Water pollution sources, Cadmium, Zinc, Lead, Nickel, Manganese, Iron, Chromium, Potassium, Magnesium, Phosphorus, Nitrogen, Calcium, Copper, *Municipal wastewater, *West Virginia.

The distribution of 13 elements between sludges and effluents from 11 West Virginia municipal sewage treatment plants was determined from analytical results and the discharge rates. It was obvious that municipalities vary appreciably in their ability to remove elements from wastewater and that the elements vary in behavior. The % of element in effluent followed by % in sludge were Ca, Mg, and K, 82-99, 1-18; Cd, 35-98, 2-65; Cr, 12-86, 9-88; Cu, 15-99, 1-85; Fe, 9-88, 12-91; Mn, 18-81, 19-82; Ni, 30-97, 3-70; Pb, 42-85, 15-58; Zn, 33-84, 16-67; P, 56-96, 4-44; and N, 57-98, 2-43. Ratios of Zn:Cd were 97:1 in influents, 150:1 in sludges, and 30:1 in effluents. Zn:Cu ratios remained about

6:1 through the entire process. This points out cadmium's greater mobility (and the greater environmental threat to water and soil). (Cassar-FRC)
W82-04465

POSSIBLE WATERBORNE TRANSMISSION AND MAINTENANCE OF INFLUENZA VIRUSES IN DOMESTIC DUCKS,

Hong Kong Univ. Dept. of Microbiology.
D. D. Markwell, and K. R. Shortridge.
Applied and Environmental Microbiology, Vol 43, No 1, p 101-116, 1982. 1 Fig, 5 Tab, 25 Ref.

Descriptors: *Water supply, *Diseases, *Contamination, *Ducks, Ponds, Potable water, Public health, *Viruses, Infection, *Influenza, Path of pollutants, Epidemics, Epizootiology, Hong Kong.

The ecology of avian influenza viruses was examined on two duck farms in the Hong Kong area. Monthly examinations were made for a period of 1 year. In one community the predominant virus was H3N2, which is antigenically related to the pandemic Hong Kong strain. The virus was isolated each month from either the feces or the pond water, or both, which suggests a pathway of waterborne transmission. The viruses demonstrated persistence in the community in that 1 and 2 years after the last sampling date viruses of the same antigenic combination were isolated. Infection was asymptomatic. The virus appeared to be dependent on the continual introduction of ducklings susceptible to infection onto virus contaminated water. Ducks 70 to 80 days old were generally free of detectable virus in spite of exposure to virus in pond water. The normal practice of raising ducks of different ages on the same farm and having them share a common water supply seems significant in the large reservoir of influenza viruses in the duck population of southern China. It is conceivable that virus transmission could occur in this manner to other susceptible animals, including humans. (Baker-FRC)
W82-04468

THE FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS,

Henkel KGaA, Dusseldorf (Germany, F.C.). Dept. of Ecology.
For primary bibliographic entry see Field 5D.
W82-04477

OCCURRENCE AND FATE OF CERTAIN TRIPHENYLMETHANE BLUE DYESTUFFS IN THE AQUATIC ENVIRONMENT,

Thames Water Authority, London (England).
M. L. Richardson, and A. Waggott.
Ecotoxicology and Environmental Safety, Vol 5, No 4, p 424-436, 1981. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Dyes, *Degradation, Fate of pollutants, *Pollutant identification, Acid Blue 1, Water analysis, Wastewater analysis, Chlorination, Adsorption, Spectrophotometry, Chromatography.

The presence of the triphenylmethane dye, Acid Blue 1 (Chemical Abstracts Services Registry Number 129-17-9) was determined in the aquatic environment by adsorption of XAD-2 ion exchange resin, elution, and spectrophotometric measurement as well as by high performance liquid chromatography. Concentrations of the dye (in micrograms per liter) were 0.6-1.7 in river and reservoir water, 9.2-12.3 in sewage effluent, and less than 0.4 in finished water. Distilled water and tap water containing 2 to 10 micrograms per liter Acid Blue 1 were chlorinated with water containing 2 to 10 micrograms per liter Acid Blue 1 were chlorinated with 1 mg per liter chlorine for 10, 15 or 30 minutes. Dye was destroyed in all but one case; tap water with a 10 microgram per liter concentration of dye exposed for 10 minutes contained 0.6 micrograms per liter residual dye. Exposure of 4 mg per liter dye in distilled water to 15 hours of continuous simulated sunlight did not measurably reduce the dye concentration. (Cassar-FRC)
W82-04478

ACCUMULATION AND DEPURATION OF METALS BY DUCKWEED (LEMNA PERPUSILLA),

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. R. Clark, J. H. VanHassel, R. B. Nicholson, D. S. Cherry, and J. Cairns, Jr.
Ecotoxicology and Environmental Safety, Vol 5, No 1, p 87-96, 1981. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Heavy metals, *Aquatic plants, *Bioaccumulation, Fate of pollutants, Metals, Cadmium, Copper, Iron, Manganese, Zinc, Chromium, Lead, Nickel, *Duckweed, Macrophytes, Detention reservoirs, Ash, Powerplants.

Duckweed (Lemna perpusilla) accumulated metals (Cd, Cu, Fe, Mn, Zn, Cr, Pb, and Ni) both in a heavy coal ash secondary retaining basin and under controlled laborntory conditions simulating metal concentrations 0.5, 1, 10, 25, and 100 times the levels of metals found in the retaining basin water. Duckweed in the outdoor basin accumulated Cr, Pb, and Ni to a slightly higher extent and Cd, Cu, Fe, Mn, and Zn to a much greater extent than found in sediments. Levels of metals in the basin water were lower than duckweed and sediment concentrations. During a 14-day depuration period concentrations of Pb, Cr, and Ni declined to sediment levels, Cu and Cd levels approached sediment levels, and Zn, Mn, and Fe levels remained considerably higher. During the 10-day laboratory exposures Pb and Cr bioaccumulation was significantly greater than control at levels of 10 times or greater, and Ni accumulation was significant at the 1 x level and above. Duckweed populations showed high mortality at concentrations 10 x and higher. After 8 days depuration the metal concentrations in duckweed were reduced to control levels. Cu and Cd showed high increases in bioconcentration at the 0.5 and 1 x concentrations and were not eliminated during the depuration period. Duckweed accumulated Zn and Mn at the 1 x exposure and above but did not show depuration. Duckweed's capacity to concentrate metals may result in minimal concentrations of these metals in water during the growing season and sudden releases upon natural die-off in the fall, causing unusually high levels of metals at that time. (Cassar-FRC)
W82-04479

A HYDROLOGIC SIMULATION FOR PREDICTING NONPOINT SOURCE POLLUTION,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
K. G. Eggert.
PhD Thesis, 1980. 431 p, 41 Fig, 21 Tab, 117 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-10802.

Descriptors: *Hydrologic models, *Water pollution sources, *Watershed management, *Nonpoint pollution sources, Prediction, Mathematical models, Flow channels.

A hydrologic model for use in predicting nonpoint source pollution is developed. The model is a mathematical representation of watershed hydrology and hydraulics. It is formulated to investigate watershed response to management activity. The model simulates water balance on a daily basis by incorporating the processes of evapotranspiration and soil water redistribution resulting from meteorological variations. Surface water runoff is calculated using the kinematic wave approximation for overland and channel flows. The multiple watershed routing component allows large drainage basins to be addressed. Analytic techniques are used for overland flow routing and primary channels, while a numerical solution is used in the main channel segments. Sediment is routed by size fraction using the Meyer-Peter, Muller equation for bedload, and suspended sediment is calculated. Application for validation of individual components is presented. Examples of management alternative impact on water and sediment yields from a hypothetical watershed are also presented. The alternatives examines include clearcut timber harvest by various techniques and the impact of wildland grazing methods. The model's strength are shown to be a flexible computation structure, a minimum of regionally specific code and a representation based on hydrologic and hydraulic processes. The physically based mode allows management alternative changes to be reflected in physically predictable parameters. The model is formulated in such a manner that it may be used to drive other nonpoint source models as required by a specific problem. (Sinha-OEIS)
W82-04485

HYDROLOGIC RECONNAISSANCE OF THE BELUGA, PETERS CREEK, AND HEALY COAL AREAS, ALASKA,

Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04504

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, TRENTON TO PENNSVILLE, NEW JERSEY, 1980,

Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04515

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-4A, H-4B, AND H-4C AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
J. W. Mercer, P. Davis, K. F. Dennehy, and C. L. Goetz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-153610, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-36, May, 1981. 92 p, 20 Fig, 5 Tab, 5 Ref.

Descriptors: *Radioactive waste disposal, *Geohydrology, *Test wells, *Hydrologic data, Groundwater movement, Transmissivity, Storage coefficient, Testing procedures, Water sampling, Water analysis, *New Mexico, Eddy County, Waste Isolation Pilot Plant.

Data were collected during hydrologic testing at wells H-4A, H-4B, and H-4C in the southern part of the proposed Waste Isolation Pilot Plant site in southeastern New Mexico. The three water-bearing zones tested, the Magenta and Culebra Dolomite Members of the Rustler Formation and the Rustler Formation-Salado Formation contact, yield water to wells at rates less than 0.9 gallon per minute. Throughout the testing, water-pressure response in the tested zone was monitored by a pressure transducer system. Shut-in and slug tests were conducted to acquire the data from which the following values were derived. Calculated transmissivities for the Magenta, Culebra and the Rustler-Salado contact at wells H-4A, H-4B, and H-4C were 0.06, 0.9, and 0.0006 foot squared per day respectively. Water samples from the Magenta and Culebra had dissolved-solids concentrations of 22,300 and 18,100 milligrams per liter, respectively. The major chemical constituents of ground-water samples from these two zones were sodium, chloride, and sulfate. Water samples from the Rustler-Salado contact had a dissolved-solids concentration of 322,000 milligrams per liter and magnesium, sodium, and chloride were the major constituents. Radium-226, a naturally occurring radioactive element, was present in samples from all three zones. (USGS)
W82-04517

SURVEY OF SELECTED ORGANIC COMPOUNDS IN AQUIFERS OF NEW YORK STATE EXCLUDING LONG ISLAND,

Geological Survey, Albany, NY. Water Resources Div.
R. A. Schroeder, and D. S. Snavely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-139957, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-47, 1981. 60 p, 1 Fig, 8 Tables, 41 Ref.

Descriptors: *Organic compounds, *Groundwater, *Aquifers, *Water pollution sources, Organic wastes, Contamination, Wells, Sampling, Water analysis, *New York.

Samples from 56 wells at 49 sites in New York State, excluding Long Island, were analyzed by gas chromatography/mass spectrometry for the presence of organic compounds designated 'priority pollutants' by the U.S. Environmental Protection Agency. Most samples were taken from public-supply wells tapping shallow, permeable aquifers, the most susceptible to contamination. Analytical sensitivity reported by the laboratory for most compounds was less than 1 microgram per liter, but contamination during collection, shipping, or laboratory processing required that concentrations be about 10 micrograms per liter before the presence of a compound could be confirmed. Only a small percentage of wells sampled in this study was found to be contaminated. Where contamination is present, it probably results from point sources such as landfills or dumps rather than from general sources such as atmospheric deposition or proximity to urban centers. Two sites, Brewster in Putnam County and Olean in Cattaraugus County, showed clear evidence of contamination. Two other sites, Corning in Steuben County and Fulton in Oswego County, showed evidence of possible contamination. (USGS)
W82-04520

A CORRELATION STUDY OF BIODEGRADABILITY DETERMINATIONS WITH VARIOUS CHEMICALS IN VARIOUS TESTS II. ADDITIONAL RESULTS AND CONCLUSIONS,

Henkel KGaA, Dusseldorf (Germany, F.R.)
P. Gerike, and W. K. Fischer.
Ecotoxicology and Environmental Safety, Vol 5, No 1, p 45-55, 1981. 3 Tab, 20 Ref.

Descriptors: *Biodegradation, *Organic compounds, *Toxicity, Activated sludge process, Biological treatment, Wastewater treatment, Degradation, *Fate of pollutants, Water pollution effects.

This paper reports work previously started on biodegradability of 44 compounds by 7 tests (the modification of the OECD Confirmatory Test for the application of the carbon analysis, the Zahn-Wellens, the Japanese MITI, the French AFNOR T 90-302, the Sturm, the Modified OECD Screening, and the Closed Bottle Test according to Fischer). This work added two more tests, the U.S. EPA Activated Sludge Test and a model trickling filter. The following conclusions were based on previous and present work. The AFNOR T 90-302 42-day test is a powerful test for noninhibitory compounds and may exaggerate degradation in some cases, e.g., sulfanilic acid. It is overly sensitive toward inhibitory or toxic materials. The EPA activated sludge test strongly exaggerated the predictive value of biodegradability results for the general environment. Environmentally relevant positive results were obtained from the Closed Bottle Tests, the Modified OECD Screening Test, and the MITI Test. The authors feel that special preacclimation procedures should be excluded in the first step of biodegradability testing and that the test duration be limited to 4 weeks. A group of tests was designated appropriate for fail-safe tests of ready biodegradability with the limits 60% dissolved organic carbon removal or 50% BODT or CO2 production. These were the Japanese MITI test, the French AFNOR T 90-302 Test restricted to 4 weeks, the Sturm Test without the preacclimatization step, the Modified OECD Screening Test extended to 4 weeks, and the Closed Bottle Test according to Fischer. (Cassar-FRC)
W82-04534

ROLE OF NATURAL COLLOIDS IN THE TRANSPORT OF HYDROPHOBIC POLLUTANTS,

Maryland Univ., College Park. Center for Environmental and Estuarine Studies.
J. C. Means, and R. Wijayaratne.
Science, Vol 215, No 4535, p 968-970, February 19, 1982. 2 Fig, 1 Tab, 12 Footnotes.

Descriptors: *Herbicides, *Adsorption, *Colloids, *Fate of pollutants, Atrazine, Linuron, Estuarine environment, Sorption, Organic matter, Salinity, Hydrogen ion concentration, Chesapeake Bay, *Choptank River, *Patuxent River.

Linear Freundlich adsorption coefficients for the herbicides atrazine and linuron were 1850 and 6750, respectively, in a study of waters containing natural estuarine colloids. Water samples collected from the Choptank and Patuxent Rivers near Chesapeake Bay were filtered to enrich the colloidal fraction. Salinities ranged from 1 to 19 o/oo, and carbon contents of the enriched colloidal fractions from 33.5 to 108.5 mg per liter. The herbicide-colloid-water mixtures were equilibrated in a shaker for 18 hours at 20 C. The sorption constants of atrazine decreased from 2200 to 1800 with a salinity increase from 8 to 16 o/oo. Linuron and atrazine showed sorption peaks at pH 8.0. Significant decreases in sorption were observed as pH decreased to 5.0 or increased to 9.0. The high adsorption coefficients suggest that natural colloids may be important in transporting hydrophobic pollutants in the aquatic environment. (Cassar-FRC)
W82-04539

ACID SNOW IN THE CANADIAN HIGH ARCTIC,

Department of Energy, Mines and Resources, Ottawa (Ontario). Polar Continental Shelf Project.
For primary bibliographic entry see Field 2C.
W82-04542

HEAVY METAL CONTENT IN SEDIMENTS OF LAKES IN SOUTHERN BAVARIA AS A SIGN OF LONG-TERM ENVIRONMENTAL IMPACT (SCHWERMETALLGEHALTE IN SEDIMENTEN SUDBAYERISCHER SEEN ALS INDIKATOREN LANGFRISTIGER UMWELTBELASTUNG),

Munich Univ. (Germany, F.R.). Geographisches Inst.
G. Michler, C. Steinberg, and P. Schramel.
Wasserwirtschaft, Vol 71, No 11, p 323-330, 1981. 4 Fig, 3 Tab, 27 Ref. English Summary.

Descriptors: *Heavy metals, *Lakes, *Sediments, *Bavaria, Germany, Cores, Dating, Limnology, Path of pollutants, History, Isar River, Diversion, Catchment areas, Municipal wastes.

Typical examples of results obtained to date in a study of the heavy metal contents in sediment cores from 18 South Bavarian lakes are presented. The Ammersee core was studied for vertical distribution of heavy metals. The heavy metal contents in the lower layer were taken as the geological background. The heavy metal contents generally increased at an accelerating rate, over time, with some irregularities which could be correlated with historical events and with a decrease in the last 10-20 years corresponding to decreased coal burning. According to the geoaccumulation index, the Ammersee is classified as moderately to heavily loaded with cadmium, heavily loaded with zinc, and scarcely loaded with copper, lead and chromium. The Walchensee illustrates the effects of water use projects on heavy metal levels. Part of the upper Isar and Rissbach flows were diverted into the Walchensee in 1924 and 1949 to provide increased flows for a hydroelectric plant, increasing the catchment area of the Walchensee from 74 sq km to 770 sq km. The metal components could be divided into two groups: those which are deposited at practically constant rates in the absence of increased sedimentation due to water projects, and those whose levels increased continuously even after the construction erosion ended. Copper accumulation is showing a continuous increase accompanying introduction of treated wastewaters into the Isar. The Speichersee is an artificial lake, receiving large volumes of wastewater, from Munich. Even considering its function as a 'heavy metal trap' the concentrations found were alarming. Lead concentrations exceeding 2000 ppm and cadmium concentrations exceeding 100 ppm were found. (Carroll-FRC)
W82-04550

DEVELOPMENT OF IMPROVED STORMWATER QUALITY MODELS,

Union Coll., Schenectady, NY. Dept. of Civil Engineering.
T. K. Jewell, and D. D. Adrian.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No 5, p 957-974, October, 1981. 6 Tab, 16 Ref. OWRT A-095-MASS, B-059-MASS.

Descriptors: *Urban hydrology, *Storm water, *Water quality, Rainfall-runoff relationships, Model studies, Water pollution sources, *Fate of pollutants, Runoff, *Urban runoff.

A method for developing urban storm water pollutant washoff models has been outlined for the purpose of improving reliability of results. The procedure consists of testing several linear and linear transform multiple regression models for estimating pollutant washoff loadings as a function of storm and basin characteristics using measured data. Then the best model can be chosen for each pollutant using the coefficient of determination and othe criteria. Although estimates of buildup and washoff are eliminated, it is still necessary to gather storm event data for each basin to be modeled. The method is illustrated using data from Seattle, Washington, to predict storm event total loadings for long-term simulation purposes. Calculated results were as follows: suspended solids and COD, within the range of reported values; ammonia, slightly less than reported values. (Cassar-FRC)
W82-04559

NEARFIELD PERFORMANCE OF RIVER DIFFUSERS,

Kansas Univ., Lawrence. Dept. of Civil Engineering.
A. D. Parr, and J. G. Melville.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE5, p 995-1008, October, 1981. 9 Fig, 1 Tab, 10 Ref. OWRT A-077-ALA.

Descriptors: *Diffusers, *Thermal pollution, *Mixing, Rivers, Model studies, Mathematical models, Mississippi River, Powerplants, Heated water, Thermal water, Fate of pollutants, Temperature, Water temperature, Flow characteristics.

A model was developed to describe the flow field induced by a submerged multiport diffuser discharging in a rectangular channel. Nearfield dilution was determined as a function of effluent and ambient flow parameters. A family of curves is given for a range of conditions characteristic of prototype river diffusers (centered and shore-attached). Comparisons of model predictions with data observed in the Mississippi River downstream from the Quad Cities Nuclear Power Station diffuser were generally in agreement. However, the depth-averaged minimum dilution was underpredicted by about 7%, probably as a result of neglecting lateral entrainment. (Cassar-FRC)
W82-04561

ORGANIC CARBON FLOW IN A SWAMP-STREAM ECOSYSTEM,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. J. Mulholland.
Ecological Monographs, Vol 51, No 3, p 307-322, September, 1981. 9 Fig, 6 Tab, 72 Ref. OWRT B-084-NC, B-110-NC.

Descriptors: *Organic carbon, *Litter, *Streams, *Swamps, *Organic loading, *North Carolina, Total organic carbon, Carbon, Decomposing organic matter, Organic matter, Respiration, Detritus, Dissolved solids, Ecosystems, Oxidation, Watersheds, Wetlands, Productivity.

An annual organic carbon budget for a section of Creeping Swamp, North Carolina is presented. Most of the input was allochthonous, with high autochthonous organic carbon input from filamentous algae during February and March. The output of organic carbon by fluvial processes was 36% of total annual inputs, indicating that the swamp section studied was 64% efficient at retaining organic

carbon. Most organic carbon was retained by respiration. Indices of organic matter processing and a loading potential index were used to compare organic carbon dynamics in the Creeping Swamp segment to that of upland stream segments. The organic carbon loading potential of the swamp was greater then that of the comparison streams, due to its great width and complete canopy. The dense vegetation and low gradient of the swamp increase organic carbon retention by maintaining low water velocities with little erosive force, tortuous flow paths and debris dams. Retention and oxidation of organic carbon in the flooded Creeping Swamp ecosystem occurs in the floodplain. A net annual export of organic carbon in the dissolved form is attributed to the extensive drainage network of the swamp stream system. (Geiger-FRC)
W82-04564

SOME EFFECTS OF LAND USE ON BACTERIOLOGICAL WATER QUALITY IN A RECREATIONAL LAKE,

Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, and A. Troth.
Water Research, Vol 16, No 1, p 105-112, January, 1982. 9 Tab, 26 Ref.

Descriptors: *Bacterial analysis, *Land use, *Lake shores, *Water pollution sources, Fate of pollutants, Water quality, Coliforms, Lakes, *Mississippi Lake, *Ontario, Heterotrophic bacteria, Swimming, Eutrophic lakes, Recreation, Chlorophyll a, Diseases, Water pollution effects, Public health.

A bacterial analysis of water samples from Mississippi Lake, a shallow eutrophic lake in Ontario, indicated that the main sources of fecal coliforms were cattle watering sites, farms, public beaches, flooded and substandard septic tanks, and a bird sanctuary. Sampling was done May 28-June 6 and July 20-29, 1976, at 75 shoreline locations, 5 mid-lake stations and 5 lake bottom locations. Water quality impairment was localized near the suspected pollution sources. After a rain, levels of fecal coliforms and fecal streptococci increased 10-fold in the lake surface water. Bacterial counts returned to previous levels after 2-3 days. Aerobic heterotrophic bacterial counts at mid lake surface sites were 1600 per 100 ml in June and 8270 per ml in July. Average chlorophyll a concentrations were 2.0 micrograms per liter. A survey of cottage residents on the lake indicated that 57 of 67 reported infections were ear infections, which were experienced by3.28% of bathers. Ear infections were more common in the bathers who spent more time in the water. Young people had higher ear infection rates than adults. Suggestions to improve the water quality of this lake are: eliminate cattle watering sites from the lake shore, correct substandard septic tanks, and open more public beaches. (Cassar-FRC)
W82-04567

DETERMINATION OF CHARACTERISTIC VALUES FOR PHYSICAL AND CHEMICAL LAKE SEDIMENT PARAMETERS,

National Swedish Environment Protection Board, Uppsala (Sweden).
For primary bibliographic entry see Field 2H.
W82-04586

THE UNTERWESER AUTOMATIC WATER QUALITY MEASUREMENT SYSTEM,

For primary bibliographic entry see Field 5A.
W82-04588

ATTENUATION OF POLYBROMINATED BIPHENYLS AND HEXACHLOROBENZENE BY EARTH MATERIALS,

Municipal Environmental Research Lab., Cincinnati, OH.
N. M. Lewis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107558, Price codes: A04 in paper copy, A01 in microfiche. EPA-600/S2-81-191, December, 1981. 7 p, 2 Fig, 6 Tab. R-804684-01.

Descriptors: *Polybrominated biphenyls, *Hexachlorobenzene, *Leaching, *Solubility, *Land disposal, Waste disposal, Leachates, Microbial degradation, Pollutants, Adsorption, Soil contamination, Landfills, Water pollution sources.

This laboratory study of the aqueous solubility, adsorption, mobility, and microbial degradation of polybrominated biphenyls (PBB's) and hexachlorobenzene (HCB) was undertaken to provide information on their behavior in the environment, particularly on the potential for their movement through soil at land disposal facilities for hazardous wastes. PBB's were more than 200 times, and HCB more than 2.5 times more soluble in landfill leachate than in distilled water. Also the solubilities of PBB's and HCB were higher in creekwater and landfill leachates than in purified waters; this was correlated with the level of dissolved organics in the waters. HCB showed a greater tendency for adsorption on soils than did PBB's. There was a high direct correlation between the total organic carbon content of the soils and the amount adsorbed. PBB's and HCB were strongly adsorbed by carbonaceous Ambersorb XE-348 from organic solvents. PBB's and HCB remained immobile in earth materials when leached with water and DuPage leachate, but were highly mobile when leached with organic solvents. PBB's and HCB were found to be resistant to microbial degradation. It is recommended that disposal of PBB or HCB wastes dissolved in organic solvents, or co-disposal of PBB or HCB materials with organic solvents be avoided at land disposal sites unless a carbonaceous liner material is used. (Moore-SRC)
W82-04620

TREATMENT EFFECTIVENESS: OIL TANKER BALLAST WATER FACILITY,

Rockwell International, Newbury Park, CA.
For primary bibliographic entry see Field 5D.
W82-04625

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME I, STATE-OF-THE-ART REPORT,

Envirex Inc., Milwaukee, WI.
For primary bibliographic entry see Field 4C.
W82-04627

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME III, PREDICTIVE PROCEDURE FOR DETERMINING POLLUTION CHARACTERISTICS IN HIGHWAY RUNOFF,

Envirex Inc., Milwaukee, WI.
N. P. Kobriger, T. L. Meinholz, M. K. Gupta, and R. W. Agnew.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-124911, Price codes: A10 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/044, February, 1981. 205 p, 25Fig, 36 Tab, 16 Ref, 8 Append. DOT-FH-11-8600.

Descriptors: *Mathematical models, *Computer models, Highways, *Runoff, *Water pollution sources, Storm runoff, *Highway effects, Environmental effects, Urban runoff, Rainfall-runoff relationships.

The purpose of the predictive procedure is to provide highway designers with a simplified tool to estimate the quantity and quality of storm generated highway runoff. The predictive procedure is comprised of a series of equations which can be computerized to form a mathematical model. The procedure is made up of four components corresponding to the following functions: rainfall runoff; pollutant buildup; pollutant wash-off; and constituent loadings. The predictive procedure can be used for Environmental Impact Statements or to determine the loadings for analysis of the pollutant discharge effect of various design storms at a particular site. The procedure can also be used to evaluate existing highway systems. Equations were developed relating runoff volume to rainfall volume for three highway site types: urban elevated bridge decks with 100% paved areas; urban paved and nonpaved drainage areas; and rural flush shouldered highways. Total solids showed the highest correlation with other monitored parameters and is therefore used as the carrier pollutant in the predictive procedure to estimate 16 other parameters. The wash-off coefficients developed for the three highway site types used in this study are: 5.0 for urban elevated bridge decks; 6.5 for urban paved and nonpaved drainage areas; and 12.0 for rural flush shouldered highways. (Moore-SRC)
W82-04629

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME V, HIGHWAY RUNOFF DATA STORAGE PROGRAM AND COMPUTER USER'S MANUAL,

Envirex Inc., Milwaukee, WI.
N. P. Kobriger, and T. M. Krischan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241937, Price codes: A07 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-81/046, February, 1981. 125 p, 18 Fig, 18 Tab, 2 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Runoff, *Water pollution sources, *Computer programs, Snowmelt, Storm runoff, *Water quality, Hyetographs, Hydrographs, Rainfall-runoff relationships, Path of pollutants.

The Data Storage Program (DSP) was developed as part of a project to determine the characteristics of highway runoff. Due to the nature of the study, an extensive data collection and chemical analysis program was required and more than 14,000 pieces of data were generated. DSP was developed to: retain a large quantity of field generated data in an organized and easily accessible format; permit conversion of standard units to metric; and provide a mechanism by which the data can be recalled for optional plotting or statistical analysis. The data base developed during the project is perhaps the most extensive highway runoff quantity/quality data in existence. This data is available on magnetic tape with access provided by DSP. Highway runoff is highly variable in that it results primarily from precipitation or snowmelts and as such its description contains a rainfall hyetograph, a runoff hydrograph, water quality parameters, dustfall data, and various site characteristics. The program provides a readily available and convenient means for storage and analysis of environmental and operational data collected during future highway runoff studies. (Moore-SRC)
W82-04630

CONSTITUENTS OF HIGHWAY RUNOFF; VOLUME IV, CHARACTERISTICS OF HIGHWAY RUNOFF FROM OPERATING HIGHWAYS. RESEARCH REPORT,

Envirex Inc., Milwaukee, WI.
M. K. Gupta, R. W. Agnew, D. Gruber, and W. Kreutzberger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-241929, Price codes: A08 in paper copy, A01 in microfiche. Federal Highway Administration Report FHWA/RD-81/045, February, 1981. 171 p, 43 Fig, 41 Tab, 27 Ref, 2 Append. DOT-FH-11-8600.

Descriptors: *Highways, *Runoff, *Water pollution sources, *Storm runoff, *Highway effects, Environmental effects, Rainfall-runoff relationships, Nutrients, Heavy metals, Particulate matter, Oxygen demand, Coliforms, Oil pollution, Fate of pollutants.

From the Spring of 1976 to September 1977, a total of 159 storm events were monitored at six sites: three sites in Milwaukee, Wisconsin; one in Harrisburg, Pennsylvania; one in Nashville, Tennessee; and one in Denver, Colorado. The data were evaluated for: rainfall/runoff relationships; highway runoff pollutant loadings and variations with time; differences in pollutant characteristics from paved and non-paved areas; and correlation of pollutants among measured parameters as well as with highway operation related factors. The average runoff volume to rainfall volume coefficients for non-winter storm events were found to vary between 0.20 to 0.92. Most heavy metals were associated with the particulate matter in highway runoff. The average BOD5 values in highway runoff were found to be comparable with effluent from a well

operated secondary municipal treatment plant. The nutrient loadings were generally comparable to urban stormwater runoff. Sizable concentrations of total coliforms, fecal coliforms, and fecal streptococci were found at all sites. The average oil and grease concentrations in monitored storm events ranged between 1 mg/l at the all-grassy site to 20 mg/l at the all-paved site. Generally, the all-paved site showed the highest loadings for various constituents. (Moore-SRC)
W82-04637

SYNTHESIS AND DEGRADATION OF CARBOHYDRATES IN THE MARINE PLANKTONIC COMMUNITY OF EUTROPHIC WATERS (SYNTHESE ET DEGRADATION DES COMPOSES GLUCIDIQUES AU SEIN DE LA COMMAUNAUTE PLANCTONIQUE EN ZONE MARINE EUTROPHE),

Arago Lab., Banyuls-sur-Mer (France).
G. Cahet, P. Crassous, J. Neveux, and F. Rassoulzadegan.
Internale Revue der Gesamten Hydrobiologie, Vol 66, No 2, p 223-248, 1981. 12 Fig. 4 Tab, 38 Ref. English summary.

Descriptors: *Plankton, *Eutrophication, *Marine bacteria, Marine algal, Nutrients, Euphotic zone, Dissolved organic matter, Metabolism, *Carbohydrates, Phytoplankton.

Relationships between heterotrophic activity and phytoplankton excretion were studied in naturally and artificially eutrophicated systems. Excretion appears to have a greater significance in zones of low phytoplankton content than of high content. It increases in the presence of light and ammonium ion. Ion exchange resin analysis of the excreta indicated that the acid fraction generally dominates, while the neutral (glycid) fraction is more significant under dim light conditions. Two enrichment studies on eutrophic and oligotrophic marine waters. In the first case heterotrophy increases with algal biomass; in the second case a first heterotrophic optimum precedes the exponential growth phase of the algae and a second optimum follows. The findings aid in explaining the observed variations in degradation of organic matter depending on the phytoplankton composition. The metabolic adaptability of the bacterioplankton appears responsible for their ability to thrive in nutrient-poor water. In upwelling zones the bacterioplankton activity determines the chemical composition of the water. It also contributes to the maintenance of low dissolved organic carbon contents across large gradients of primary productivity in the photic zone. (Carroll-FRC)
W82-04672

DISPERSION COEFFICIENTS IN ESTUARIES,

Birmingham Univ. (England).
J. R. West, and T. W. Broyd.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 721-737, September, 1981. 7 Fig, 3 Tab, 27 Ref.

Descriptors: *Saline water intrusion, *Solute transport, *Mixing, *Dispersion coefficients, Tidal hydraulics, Fate of pollutants, *Estuaries, Tidal effects.

Published methods of predicting longitudinal dispersion coefficients for estuaries were compared using field data from five British estuaries, Mersey, Conwy, Tay, Usk, and Thames. Values of dispersion coefficients predicted by theoretically based expressions gave values within a factor of three of the gross field data values for mean tidal range and low river flow in all five estuaries. In the narrow, shallow estuaries the transverse oscillating shear mechanisms were dominant. Transverse gravitational shear mechanisms dominated in the wide estuaries. An empirical expression predicted tidal mixing within a factor of five of the field data values. The theoretical and empirical expressions can provide useful estimates of dispersion coefficients if carefully used. (Cassar-FRC)
W82-04684

PRESCRIBED FIRE: EFFECTS ON WATER QUALITY AND FOREST NUTRIENT CYCLE,

Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 4C.
W82-04690

SELECTED TRACE METALS IN THE UPPER ST. JOHNS RIVER AND THEIR LAND USE RELATIONSHIPS,

General Battery Corp., Reading, PA.
J. A. Leed, and T. V. Belanger.
Florida Scientist, Vol 44, No 3, p 136-150, 1981. 8 Fig, 5 Tab, 14 Ref.

Descriptors: *Rivers, *Trace metals, *St Johns River, Florida, Land use, Path of pollutants, Water pollution sources, Copper, Zinc, Iron, Environmental effects, Water analysis, Fish, Sediments.

In this study iron, copper and zinc were monitored in four species of fish, in the water and in sediments of the upper St. Johns River in order to evaluate land use-water quality relationships. The role of natural interacting processes was also investigated in regulating surface water trace metal concentrations, the accumulation of trace metals in bottom sediments and fish tissues, the relationships between fish weight or total length and trace metal levels in the muscle, gills, and liver, and the relationship between volatile solids (organic matter) and trace metal concentrations in the sediments. Total copper and zinc were present at low concentrations in the surface waters of the upper St. Johns River, but total iron frequently occurred at concentrations exceeding the state standard of 300 micrograms/liter. Levels of total iron appear to be regulated by resuspension of bottom sediments caused by increased discharge and resulting turbulence. Groundwater inputs may influence trace metal content, particularly of iron. The average surface water total iron was highest in the headwaters region of the river above Lake Helen Blazes, decreasing in a northward direction to Lake Washington, and increasing to Lake Poinsett. Higher levels of iron, copper and zinc were found in sediments containing higher percentages of organic matter. Analysis of these metals in the tissues of fish indicates that they are concentrated in the liver, with lower amounts in the gill and muscle tissue. Total copper and total zinc were highly correlated to land use associated with urban activities. (Baker-FRC)
W82-04718

INFLUENCE OF AN AMERICIUM SOLID PHASE ON AMERICIUM CONCENTRATIONS IN SOLUTIONS,

Battelle Pacific Northwest Labs., Richland, WA.
D. Rai, R. G. Strickert, D. A. Moore, and R. J. Serne.
Geochimica et Cosmochimica Acta, Vol 45, No 11, p 2257-2265, November, 1981. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Americium, *Solubility, *Radioactive waste disposal, Waste disposal, Fate of pollutants, Equilibrium, Hydrogen ion concentration, Minerals, Sorption, Chemical precipitation, Solute transport, *Groundwater pollution.

Solubility mechanisms of americium, a long-lived waste product of nuclear energy production, were studied to predict Am concentrations in groundwaters. Suspensions of sediments contaminated with acidic (pH 2.5) liquid radioactive wastes were equilibrated in 0.0015 M CaCl2 solutions adjusted with NaOH to pH of 4.35, 5.3, 6.8, and 7.72 for 100 days. The solubility-limited Am concentrations decreased 10-fold with one unit increase in pH. An equation is presented for predicting Am concentrations in solutions containing contaminated sediments from old waste disposal sites. It is not applicable to high carbonate groundwaters. Lithospheric materials such as granite, basalt, tuff, and salt generally contain alkaline groundwater, and therefore Am is not expected to be very mobile in this environment. The chemical form of Am in aqueous solution is probably Am(OH)2+; the form in soil was not determined, but is probably not Am(OH)3. Published data on sorption coefficients of Am by different rocks, soils, and minerals were evaluated. Final Am solution concentrations calculated from sorption coefficients of earth materials with solutions agreed well with concentrations predicted from the solubility of solid Am in soil. This indicates that sorption coefficient data are controlled by Am precipitation. (Cassar-FRC)
W82-04720

GROUND WATER MONITORING OF UNDERGROUND COAL MINES,

Moody and Associates Inc., Meadville, PA.
B. A. Waite.
Mining Engineering, Vol 34, No 2, p 170-171, February, 1982.

Descriptors: *Monitoring, *Groundwater movement, *Coal mining, Mining engineering, *Regulations, Dewatering, Drainage effects, Observation wells, Wells.

The coal mining industry has been concerned about the new regulations requiring groundwater monitoring of underground mines. A study of 30 monitoring plans for existing mines in Pennsylvania, West Virginia, and Ohio indicates that for deep mines ranging from 20-81 sq km, 5 to 20 monitoring wells will be required. Variables to consider in electing monitoring locations are aerial coverage of the mine, topographic and structural settings, position of the aquifer in relation to coal seams, population densities, and mining status of various sections of the mine. Possible problems caused by installing monitoring wells include cave-ins, undesirable dewatering, and disruption of mining plans. Methods for minimizing adverse effects on groundwater are sealing mining openings on completion of mining, providing additional roof supports in wet areas, and avoiding excessively fractured zones. Mine operators face difficulties in collecting data and in being responsible for groundwater supply and quality. For example, considerable money and time may be expended trying to substantiate or refute lost water claims. Future development in a dewatered area may force the coal company to provide a water supply for home owners and industry. It may be difficult or impossible to obtain permission to enter private property and adjacent coal mines to obtain data as required for regulatory compliance. (Cassar-FRC)
W82-04750

5C. Effects Of Pollution

METABOLIC RESPONSES OF AQUATIC BACTERIAL POPULATIONS TO SELECTED INSECTICIDES,

Texas Univ. Health Science Center at Houston. School of Public Health.
H. E. Murray, and R. K. Guthrie.
Water Resources Bulletin, Vol 16, No 4, p 749-751, August, 1980. 3 Fig, 9 Ref.

Descriptors: *Bacteria, *Insecticides, *Oxygen uptake, Water pollution effects, Biodegradation, Metabolism, Malathion, Sevin, 1-Naphthol, Aquatic bacteria, Warburg respirometry, Lake Houston samples, Laboratory tests, Aquariums.

Bacterial populations from Lake Houston were exposed in laboratory aquariums to 5 mg per liter concentrations of sevin or malathion at temperatures of 23, 28, and 33 C. Predominant genera were Pseudomonas, Alcaligenes, Flavobacterium, Bacillus, and Enterobacter. Increased uptake of oxygen as measured by Warburg manometry indicated degradation of sevin by the bacteria. Addition of 1-naphthol, the principal degradation product of sevin, produced the same stimulation of bacterial growth. Plate counts were higher for 3-5 days following sevin or 1-naphthol addition and returned to normal after 10-14 days. Addition of malathion or malathion monocarboxylic acid did not affect metabolic rates at any temperature. However, at 33 C a slight inhibition in bacterial growth was noted. Bacterial counts rose when malathion was reapplied to the aquariums after 2 weeks, possibly indicating a selection of genera able to metabolize the chemical. (Cassar-FRC)
W82-04257

EFFECTS OF PHENOL ON OXYGEN CONSUMPTION IN THE WHELK, BULLIA DIGITALIS (DILLWYN),

Cape Town Univ., Rondebosch (South Africa). Dept. of Zoology.
T. Golombick, and A. C. Brown.
South African Journal of Science, Vol 76, No 8, p 375, August, 1980. 16 Ref.

Descriptors: *Phenols, *Shellfish, *Toxicity, Oxygen demand, *Sea water, Control waters, Effluents, Industrial wastes, *South Africa, Water pollution effect.

High concentrations of pheolic compounds were found from an industrial effluent discharging into the sea on the west coast of south Africa near Cape Twon. To assess potential effect of the discharge, oxygen consumption in large female whelks (Bullia digitalis) was measured after exposure to phenol in natural sea water at 15 deg C. Animals exposed to 0.1% phenol for five minutes died after returning to sea water. Those exposed to 0.005% phenol all recovered although stress symptoms were noted. At 0.1% phenol, oxygen uptake showed an immediate sharp decrease and fell to about 1/5 the control level. At 0.005% phenol, oxygen uptake increased to double the control value. thus, high concentrations caused a decrease and low concentrations caused an increase. These results are consistent with results found by other researchers with other invertebrates. (Small-FRC)
W82-04262

APPLICATION OF THE OECD EUTROPHICATION MODELING APPROACH TO LAKE RAY HUBBARD, TEXAS,

Brown and Caldwell, Sacramento, CA.
E. M. Archibald, and G. F. Lee.
Journal of the American Water Works Association, Vol 73, No 11, p 590-599, November, 1981. 13 Fig, 2 Tab, 14 Ref.

Descriptors: *Lakes, *Eutrophication, *Phosphorus, *Lake Ray Hubbard, *Texas, Dallas, Water quality, Reservoirs, Water pollution effects, Dissolved oxygen, Oxygen, Taste, Odor, Model studies, Algae, Nutrients, Chlorophyll a, *Water pollution control.

Lake Ray Hubbard, Texas, used for drinking water and recreation by the Dallas Water Utilities, was the site of algal-related taste and odor problems during the mid-1970's. The lake, of area 550 million cu m and average depth 6.3 m, is divided into four areas, the Main Body and three arms. Extensive water quality sampling and application of the Organization for Economic Cooperation and Development eutrophication models showed that low flows from the Lake Lavon arm into the Main Body increased the average chlorophyll a levels from 6.5 to 11.5 micrograms per liter for 1976-77 data. The models predicted that an 85% reduction in phosphorus in domestic wastewater discharged into the lake would significantly improve water quality. However, it is unlikely that the P load can be sufficiently reduced to maintain oxygen in the hypolimnion during the thermal stratification period unless period unless both point and nonpoint pollution sources are strickly controlled. Increased population in the watershed will aggravate the problems of disagreeable tastes and odors, shortened filter runs, and trihalomethane formation. (Cassar-FRC)
W82-04278

DIEL VARIATION IN THE ABUNDANCE, VERTICAL DISTRIBUTION, AND SPECIES COMPOSITION OF PHYTOPLANKTON IN A EUTROPHIC ENGLISH LAKE,

Freshwater Biological Association, Ambleside (England).
E. Frempong.
Journal of Ecology, Vol 69, No 3, p 919-939, 1981. 7 Fig, 2 Tab, 58 Ref.

Descriptors: *Eutrophication, *Phytoplankton, *Lakes, *England, Vertical distribution, Seasonal variation, Stratification, Thermal stratification.

The diel distribution of chlorophyll and component species throughout the water column in a productive English lake over a range of seasonal phases is discussed. Esthwaite Water is the lake, with an area of about 1 square kilometer, a mean depth of 6.4 meters, and a maximum depth of about 15.5 meters. The lake is composed of three basins. About 83% of the total lake volume is within the 8 meter depth isobath. Eight sampling periods were arranged between June 1977 and September 1978. The seasonal variation of environmental factors, such as thermal and density stratification, largely controlled the size of the diel variations in biomass concentrations. Under strongly stratified conditions and with little turbulence the amplitude of the diel variations increased, and the influence of many factors was restricted to the upper water layers. High daytime light flux influenced the distribution of the dominant motile algae. Sub-surface population maxima under high surface light flux were also noted for two buoyant species, Anabaena flos-aquae and A. solitaria. Loss or accumulation of phytoplankton at the sampling site by lateral transport was associated with wind-induced water movements. Two flagellates, Ceratium hirundinella and Cryptomonas ovata, showed diel vertical migration. Pseudo-diel variations were recognized and linked to weather events with some degree of regularity. (Baker-FRC)
W82-04294

ACIDIC PRECIPITATION: CONSIDERATIONS FOR AN AIR QUALITY STANDARD,

Brookhaven National Lab., Upton, NY.
For primary bibliographic entry see Field 5B.
W82-04302

RESPONSES OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. II. PURE CULTURE VS. MIXED CULTURE RESPONSE,

Texas Univ. at Austin. School of Public Health.
R. K. Guthrie, U. A. Anugwelem, and E. M. Davis.
Water Resources Bulletin, Vol 17, No 6, p 1005-1007, December, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Bacterial analysis, *Indicators, *Carbaryl, *Pollutant identification, Pathogens, Bioindicators, Microbiological studies, Insecticides, Coliforms, Escherichia coli, Streptococcus faecalis, Salmonella typhimurium, Staphylococcus aureus, Water pollution effects.

The effects of 1 or 5 mg per liter carbaryl in water on bacteria were studied on pure and mixed cultures. Bacteria were the indicators, Escherichia coli, and Streptococcus faecalis, and the pathogens, Salmonella typhimurium and Staphylococcus aureus. Oxygen uptake was inhibited by 5 mg per liter carbaryl in all pure cultures. E. coli and . typhimurium pure cultures showed increased oxygen uptake in 1 mg per liter carbaryl. Mixtures of all 4 bacteria showed no increase in oxygen uptake. Carbaryl at 1 and 5 mg per liter significantly inhibited oxygen uptake for mixtures of E. coli-S. faecalis and E. coli-S. aureus, significantly increased oxygen uptake for E. coli-S. typhimurium, and insignificantly increased oxygen uptake for S. typhimurium-S. aureus. Carbaryl had no effect on S. typhimurium-S. faecalis mixtures. Survival times in 5 mg per liter carbaryl were > 8 days for pure and mixed cultures of E. coli, pure cultures of S. faecalis, and mixed cultures of S. typhimurium; < 8 days for pure and mixed cultures of S. aureus, mixed cultures of S. faecalis, and pure S. typhimurium. In mixed cultures in the presence of carbaryl the one pathogen (S. typhimurium) had increased survival time and one indicator (S. faecalis) had reduced survival time. This wouid make S. faecalis unsuitable as an indicator of fecal pollution under these conditions. (Cassar-FRC)
W82-04341

RESPONSE OF BACTERIA TO THE PRESENCE OF CARBARYL IN WATER. I. RESPONSE OF BACTERIAL INDICATORS VS. RESPONSE OF PATHOGENIC BACTERIAL SPECIES,

Ife Univ. (Nigeria). Dept. of Environmental Health.
U. A. Anugwelem, R. K. Guthrie, and E. M. Davis.
Water Resources Bulletin, Vol 17, No 6, p 1000-1004, December, 1981. 3 Fig, 9 Ref.

Descriptors: *Bacterial analysis, *Indicators, *Carbaryl, *Pollutant identification, Pathogens, Bioindicators, Microbiological studies, Insecticides, Coliforms, Escherichia coli, Streptococcus faecalis, Salmonella typhimurium, Staphylococcus aureus, Water pollution effects.

The effects of 1 or 5 mg per liter carbaryl in water on fecal pollution indicators (Escherichia coli and Streptococcus faecalis) and the pathogens (Salmonella typhimurium and Staphylococcus aureus) were determined by plate counts and Warburg respirometry. Growth of gram negative bateria, E. coli and S. typhimurium, were initially stimulated by carbaryl, whereas gram positive bacteria, S. faecalis and S. aureus, were inhibited. Over the 8 day study all bacteria died off more rapidly in the presence of carbaryl. Small concentrations of carbaryl can lead to incorrect conclusions in bacterial analysis of water. In some cases indicators died off before pathogens, contrary to the requirements for an indicator bacteria. The ratio of fecal coli to fecal streptococci would lead to false impressions during the period of initial growth stimulation. (Cassar-FRC)
W82-04342

WHEN A WATER SUPPLY WENT BAD,

American City and County, Vol 96, No 12, p 33, 35-36, December, 1981.

Descriptors: *Municipal water, *Chemical wastes, *Activated carbon, *Water pollution effects, *Water treatment, Adsorption, Trichloroethylene, Water supply, Rockaway, *New Jersey, Organic compounds, Political aspects.

Two New Jersey communities, Rockaway Borough and Rockaway Township, handled toxic organic chemical pollution of their water supplies by installing activated carbon water treatment systems. Testing of municipal well water showed trichloroethylene levels as high as 554 ppb in borough water and 180 ppb in township water. The township water was also contaminated with diisopropyl ether and methylene chloride. gasoline additives leaking from a gas station storage tank. Potable water was supplied to residents from water trucks until the activated carbon treatment systems were placed in operation, 21 days for the township and about 6 weeks for the borough. Although sources of chemicals were identified and corrective measures taken, high levels of organic chemicals remained in the well water. However, the carbon adsorption systems removed the contaminants to below the 1 ppb detection limit. (Cassar-FRC)
W82-04357

IRRIGATION, CROP YIELD AND DRAINAGE AT THE VAALHARTS IRRIGATION SCHEME: 3. THE INFLUENCE OF SALINIZATION ABOVE A SHALLOW GROUND WATER TABLE ON THE YIELD OF WHEAT AND OTHER CROPS (IN AFRIKAANS),

Navorsingsinstituut vir Grond en Besproeiing, Pretoria (South Africa).
For primary bibliographic entry see Field 2G.
W82-04359

COMBINED EFFECTS OF CADMIUM AND ZINC ON A LAKE MICHIGAN ZOOPLANKTON COMMUNITY,

Argonne National Lab., IL.
J. S. Marshall, D. L. Mellinger, and J. I. Parker.
Journal of Great Lakes Research, Vol 7, No 3, p 215-223, 1981. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Cadmium. *Zinc, *Toxicity, *Zooplankton, Metals, Heavy metals, Crustaceans, Lakes, *Lake Michigan, *Green Bay, *Water pollution effects, Population density, Dissolved oxygen, Species diversity, Species composition.

The effects of cadmium and zinc alone and in combination on the zooplankton community of Green Bay, Lake Michigan, were studied in situ during duplicate 3-week experiments conducted in

8 liter plastic carboys suspended in the epilimnion. Metal treatments (all in micrograms per liter) were: (1) Cd, 2; (2) Zn, 100; (3) Cd, 2, plus Zn, 100, and (4) Cd, 1 plus Zn, 50. Cd109 and Zn 65 were used as tracers to determine the sorption of Cd, and Zn by the different particle size fractions. All four treatments significantly reduced total crustacean density, species diversity, community similarity indexes, and final dissolved oxygen concentrations during the August 1-22, 1978, run. Average crustacean densities for the treatments were: control, 68 plus or minus 11.9, (1) 46.1 plus or minus 15.4, (2) 21.9 plus or minus 6.0, (3) 17.3 plus or minus 1.4, and (4) 30.8 plus or minus 6.4. The effects of treatment (3) were similar to those of 100 micrograms Zn per liter alone since Cd uptake by zooplankton was reduced by the Zn. Results suggest that less than a ten-fold increase in Zn levels in the lake (from the present 5 micrograms per liter) would have pronounced effects on the plankton community. (Cassar-FRC)
W82-04379

ULTRAPLANKTON BIOMASS, PRODUCTIVITY AND EFFICIENCY IN LAC MATAMEC, A PRECAMBRIAN SHIELD LAKE,

Waterloo Univ., (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-04383

THE EFFECTS OF SEDIMENTATION ON AQUATIC LIFE OF THE KANKAKEE RIVER, PHASE II: QUANTITATIVE STUDIES AND THREATENED, ENDANGERED, AND RARE SPECIES,

Illinois Natural History Survey, Chicago.
A. R. Brigham, L. B. Suloway, and L. M. Page.
Document No. 81/37 November 1981. Illinois Department of Energy and Natural Resources, Chicago. 16 p, 5 Fig, 8 Tab, 24 Ref.

Descriptors: *Sedimentation, *Substrates, Sediments, Sand, Silt, *River flow, Biological samples, Biomass, Benthic flora, Benthic fauna, Macroinvertebrates, Rivers, Mussels, Fish, Fish populations, *Ecological effects, *Aquatic life, *Kankakee River, Illinois.

Increased sediment transport is considered the most serious water pollution problem in Illinois. Of concern is that when sediments washed into the Kankakee in Indian reach the slower-moving Illinois portion of the river, diversity and abundance of aquatic life are reduced. The objectives of this study were to assess the impact in Illinois of upstream activities that might increase sediment transport, especially upstream of Kankakee, by quantitatively estimating principal macroinvertebrate populations associated with known substrate types, and to combine this sampling with other sampling to assess the status of endangered or threatened species. In 1979, 44 species of fish were collected. Sites where sand or silt-sand substrates predominated supported fewer species, fewer individuals, and lower biomass than sites with coarser substrates. The transition area had about the same number of species and biomass but fewer individuals as sites where coarser substrates predominated. Thirteen species of mussels were collected. Predominantly sand substrates support few, if any, mussels. Density and number of species were varied at sites with substrates other than predominantly sand. Sedimentation of the non-sand areas would destroy part of the mussel fauna. Also in 1979, 143 taxa of benthic macroinvertebrates were collected. Sites with progressively more complex substrates supported more taxa. Sites where sand or sand-silt substrates predominated supported fewer taxa than sites with substrates composed of silt, sand, gravel, cobble and/or bedrock. (Atkins-Omniplan)
W82-04389

A STRESS FUNCTION FOR EVALUATING STRATEGIES FOR WATER QUALITY MANAGEMENT,

Illinois Natural History Survey, Urbana.
W. U. Brigham, and D. L. Hey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109828, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-217, October, 1981. 4 p, 1 Tab. R-805614-01-0

Descriptors: *Water quality management, *Computer models, *Toxicity, *Water pollution effects, *Bluegills, *Stress, Carp, Aquatic environment, Ammonia, Seasonal variation, Combined sewer overflows, Oxygen demand, Effluents, Residual chlorine, Fish.

This investigation explores the relationship between biological communities and the physical and chemical conditions in the aquatic environment. Seasonal patterns and the duration and probability of the occurrence of chemical conditions and physicial events are established by means of computer modelling. An instantaneous measure of stress is calculated by summing the decimal fractions of the 96-hr lethal concentrations (for bluegills) of each of 21 toxicants. These data are summarized as a quasicontinuous stress function calculated over 1-hr intervals. The stress function is related to five distinct biological communities ranging from the most to the least tolerant of pollution. Data from a test watershed in northeastern Illinois yielded stress functions as follows: 0.120 to 783.7 (mean 23.02) from a site with no fish, 0.155 to 98.47 (mean 1.038) from a site with a carp population, and 0.005 to 0.279 (mean 0.116) from a site with a bass population. A hypothetical management plan to reduce the ammonia component at the no-fish site was incorporated into the stress function. This plan limited effluent ammonia concentrations to 1.5 mg/liter during summer months and 4.0 mg/liter during the winter, eliminated combined sewer overflows, reduced sediment oxygen demand levels substantially, and increased dissolved oxygen levels moderately in treatment plant effluents. Mean stress was reduced from 23.02 to 2.12- more than an order of magnitude. This level was still significantly higher than that of the carp site, primarily because of residual chlorine in the effluents from wastewater treatment plants. These results suggest that if species other than carp are desired in the fishery, further control strategies might need to be implemented. (Author's abstract)
W82-04407

RELATIVE EFFECTS ON STREAM BIOTA OF CHLORINE AND AMMONIA OCCURRING IN SECONDARY SEWAGE,

Southern Illinois Univ. at Carbondale.
W. M. Lewis, R. C. Heidinger, M. H. Paller, and L. J. Wawronowicz.
Document No 81/35, November, 1981. Illinois Department of Energy and Natural Resources. 253 p, 19 Fig, 12 Ref, 14 Append.

Descriptors: *Chlorine, *Ammonia, *Residual chlorine, *Effluents, *Secondary wastewater treatment, Fish toxins, Dissolved oxygen, Turbidity, Fish populations, Algal control, Invertebrates, Stream biota, Water pollution, Streamflow, Toxicity, Pollutants, *Illinois, Water quality standards.

According to Illinois pollution standards, sewage treatment plants cannot legally dischange an effluent which elevates stream total ammonia levels above 1.5 mg/l. Prior studies suggest that chlorine added to secondary sewage effluent as a disinfectant is the principal environmental toxicant, not ammonia, as was previously thought. This study examined the relative effects of the two pollutants. Three streams receiving chlorinated secondary sewage were monitored for significant biotic and abiotic variables. After a year, chlorination was stopped to observe any changes that might occur when only ammonia was present. It was found that eliminating residual chlorine from god quality secondary sewage effluents will result in quantiative and qualitative restoration of fish communities. Further conclusions were that eliminating residual chlorine from poor quality sewage effluents will not necessarily revive fish communities; that high ammonia-nitrogen concentrations did not affect the distribution of fishes in these three streams (but might in high quality streams with much pollution-sensitive taxa); that effluent turbidity can limit fish distribution; that cessation of chlorination did not result in excessive algal growth and significant decreases in dissolved oxygen if effluent quality is good and flow rates are moderately high; that invertebrate communities may show favorable quantitative but not qualitative responses to chlorination cessation in good quality secondary sewage effluent; and that the effects of highly toxic sewage may be more severe in winter than in summer. In most cases, cessation of chlorination will be environmentally more beneficial than tertiary ammonia removal. (Atkins-Omniplant)
W82-04409

THE ECOLOGICAL SIGNIFICANCE OF A STUNTED WHITE PERCH POPULATION IN AN EUTROPHIC MAINE POND,

Maine Univ. at Orono. Land and Water Resources Center.
R. Hines.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211517, Price codes: A04 in paper copy, A01 in microfiche. MS Thesis, May, 1981. 45 p, 8 Fig, 10 Tab, 61 Ref, 1 Append. OWRT B-018-ME(1).

Descriptors: Fish food organisms, Fish management, *Fish populations, *Eutrophic lakes, Food chains, *Perch, Trophic level, *Growth rates, White perch, Hermon Pond, *Maine, Ecological effects.

A study was conducted to evaluate the ecological role of an abundant white perch (Morone americana Gmelin) population in an eutrophic pond, Hermon Pond, Maine. Data on growth and feeding habits for this population were combined with published literature to construct food web models for the pond community. The responses of these model systms to the manipulation of fish stocks were predicted using loop analysis with special attention being paid to those changes that would affect fishing and water quality. The diet composition of yearling-plus white perch varied markedly with season and size. In August and September, 1979, and in July, 1980, perch less than 220 mm fed largely on the aquatic larvae and pupae of Diptera. In May, 1980, the diet was a mixture of immature insects and cladocerans. By June, these perch were feeding mainly on daphnids. White perch larger than 220 mm were largely piscivorous. Growth and age determinations indicated that the white perch population was characteristically stunted. The growth rate of white perch in the study population was slow when compared with growth rates reported for populations in other waters; however overabundant and stunted populations are common in many other areas. Several studies indicate that predation pressure may counteract the species' tendency to overpopulate and stunt. Loop analysis of the seasonal food web models suggests that management efforts for white perch should be directed at reducing the number of young-of-the-year. The introduction of an openwater piscivore may be a way to implement this strategy in eutrophic Maine waters.
W82-04418

RESPONSES OF NORTHERN NEW ENGLAND LAKES TO ATMOSPHERIC INPUTS OF ACIDS AND HEAVY METALS,

Maine Univ. at Orono. Land and Water Resources Center.
For primary bibliographic entry see Field 5B.
W82-04420

HEALTH EFFECTS OF ALTERNATE DISINFECTANTS AND THEIR REACTION PRODUCTS,

Environmental Protection Agency, Cincinnati, OH.
R. J. Bull.
Journal of the American Water Works Association, Vol 72, No 5, p 299-303, May, 1980. 10 Tab, 19 Ref.

Descriptors: *Disinfection, *Water treatment, *Chlorinated hydrocarbons, *Toxicity, Water pollution effects, Chlorination, Chlorine dioxide, Ozone, Chlorine, Chloramine, Drinking water, Organic compounds, Carcinogens, Public health, Chlorites, Trihalomethanes, Reviews.

The health effects of the water disinfectants, chlorine dioxide, chloramines, and ozone, are reviewed. Many studies concentrated on chlorine dioxide and its inorganic byproducts, chlorite and chlorate. Chlorite produces methemoglobinemia in humans and laboratory animals. Unlike nitrite, chlorite is hemolytic. Similar changes are produced by chlorate, but the observed changes disappear with continued exposure after 2 months. No significant effects of 5 mg per liter chlorite in drinking water were observed in the population of a small town. However, red cell glutathione and 2,3-diphosphoglyceric acid were not determined. One individual with glucose-6-phosphate dehydrogenase deficiency showed 15% decreases in hemoglobin and hematocrit during the period when chlorite was used for disinfection. Rats exposed to monochloramine in drinking water at concentrations up to 100 mg per liter for 45 days showed no overt adverse effects. However, patients undergoing kidney dialysis with chloramine-treated water suffered acute hemolytic anemia. The organic reaction products of disinfectants include trihalomethanes, known carcinogens. One study investigated the susceptability of mice to tumors produced by painting the skin with tumor promotors and disinfected Ohio River water concentrated by a factor of 102-186 by reverse osmosis, which does not concentrate trihalomethanes, but higher molecular weight compounds. No tumors were produced by nondisinfected water or water treated with chlorine dioxide plus tumor promotor. Tumors were produced by disinfection reaction products plus tumor promotors as follows: chlorine, 4 of 25 animals; chloramine, 5 of 25 animals; and ozone, 7 of 25 animals. (Cassar-FRC)
W82-04422

EFFECTS OF PETROLEUM HYDROCARBONS ON PLANT LITTER MICROBIOTA IN AN ARCTIC LAKE,

Cincinnati Univ., OH. Dept. of Biological Sciences.
V. L. McKinley, T. W. Federle, and J. R. Vestal.
Applied and Environmental Microbiology, Vol 43, No 1, p 129-135, 1982. 4 Fig, 32 Ref.

Descriptors: *Lakes, *Hydrocarbons, Biomass, Arctic, Polar regions, *Environmental effects, Arctic zone, Microbiological studies, Leaves, Microorganisms, Plant litter, Oil, *Toolik Lake, *Alaska.

The short term effects of Prudhoe Bay crude oil, diesel fuel, and toluene on microbial adenosine triphosphate (ATP) levels and the rate of acetate incorporation into microbial lipids on colonized Carex sedge leaf litter were examined. Study was also made of the effects of Prudhoe Bay crude oil, motor oil, diesel fuel, gasoline, hexane, and toluene on Carex lignocellulose mineralization by Toolik Lake sediments. Microbial metabolic activity, measured as the rate of acetate incorporation into lipid, did not vary significantly from controls over a 12 hr period after exposure of colonized Carex litter to 3.0 ml of Prudhoe Bay crude oil, diesel fuel, or toluene per liter. ATP levels were elevated within 2 hr after exposure to diesel fuel or toluene, but returned to control levels after 4 to 8 hr. Mineralization of specifically labeled lignocellulose by Toolik Lake sediments was inhibited 58, 67, 67, and 86% by exposure to diesel fuel, motor oil, gasoline, and toluene, respectively. Hexane-treated samples displayed an increase in the rate of lignocellulose mineralization of 33%. Mineralization of the labeled lignin component of lignocellulose appeared to be more sensitive to hydrocarbon perturbations than was the labeled cellulose component. (Baker-FRC)
W82-04455

EFFECT OF WATER POLLUTANTS AND OTHER CHEMICALS UPON THE ACTIVITY OF LIPASE IN VITRO,

Environmental Research Lab.-Duluth, MN.
G. M. Christensen, and B. Riedel.
Archives of Environmental Contamination and Toxicology, Vol 10, No 3, p 357-363, 1981. 2 Tab, 9 Ref.

Descriptors: *Pollutants, *Water pollution effects, *Enzymes, Mercury, *Heavy metals, Chemical reactions, *Lipids, Organic compounds, Inorganic compounds, Pesticides.

Lipase is an important lipid enzyme which may be particularly vulnerable to some highly lipid-soluble environmental chemicals which bioaccumulate in lipid-rich tissue when their rates of degradation or elimination are relatively slow. This study investigated the effects of 100 organic and inorganic chemicals representative of some of the major types of chemical water pollutants on lipase activity. The chemicals tested included thiomides, thiocarbamates, organothiophosphates, urea derivatives, antibiotics and other biocides, aromatic halogenated hydrocarbons, aliphatic halogenated hydrocarbons, phenols and halophenoxy acids, solvents and other industrial chemicals, inorganic salts (both active cations and active anions), organo-metals, carcinogens, and several miscellaneous chemicals. The mercuric ion was found to have the strongest inhibitory effect, followed by other heavy metals, pentachlorophenol, and dicofol. The enzyme was generally found to be relatively highly sensitive to many of the heavy metal cations that are toxic to aquatic animals. Chlorinated phenols and chlorobenzene pesticides were the most inhibiting of the organic chemicals tested, followed by warfarin and malathion. Organometals, phenyl mercuric chloride, and methyl mercuric chloride had intermediate inhibitory effects. Some anions usually considered fairly toxic were found to have only a slight or negligible effect. The four organic carcinogens tested were relatively uninhibiting. The inhibitory effect of a mixture of 10 inorganic salts on lipase was shown to develop through an accumulation of the effects of the components. None of the chemicals studied caused a measurable activation of the enzyme. (Carroll-FRC)
W82-04462

THE RESTORATION OF VEGETATION IN LAKES IN THE PODA LOCALITY NEAR BURGAS AFTER DISCHARGING OF BIOLOGICALLY PURIFIED WASTE WATERS (VUZSTANOVIAVANE NA RADTITELNATA POKRIVKA V SUBIRATELNITE EZERA V MESTNOSSTTA PODA KRAI BURGAS SLED PUSKANETO NA BIOLOGICHNO PRECHISTENI OTPADUCHNI VODI V TIAKH),

Bulgarian Academy of Sciences, Sofia. Inst. of Botany.
I. A. Bondev, and S. Ya. Simeonov.
Ekologiia, Vol 9, p 28-36, September, 1981. 2 Fig, 3 Ref. English Summary.

Descriptors: *Lakes, *Lake restoration, *Macrophytes, Aquatic plants, *Water pollution effects, *Industrial wastes, Petroleum industry, Mapping, Comparative productivity, Bulgaria.

Higher macrophyte vegetation was completely destroyed by dredging operations and oil pollution in the collecting ponds at Poda, which received wastes from a petroleum plant in 1963-1971. Following the construction of a biological treatment plant in 1972, the water purity improved, and gradual restoration of the macrophytes began. The restoration process was followed by mapping, and began in 1973 with the appearance of single Phragmites communis L. at the edges of the lake. In 1974 Typha angustifolia and Bolboschoemus maritimus L. also appeared. By 1978 the vegetation covered 16.2% of the fourth lake. The greatest annual vegetation increase, 8.36%, was seen in 1975. Phragmites communis L. showed the most rapid recovery, accounting for 98.37% of the surface currently covered by vegetation. The stem height and diameter as well as the biological productivity of Phragmites communis were lower than in control lakes. The other two species recovered more slowly.
W82-04476

CYTOGENETIC EFFECTS ON THE EASTERN MUDMINNOW, UMBRA PYGMAEA, EXPOSED TO ETHYL METHANESULFONATE, BENZO(A)PYRENE, AND RIVER WATER,

Nijverheidsorganisatie TNO, Delft (Netherlands).
R. N. Hooftman, and G. J. Vink.
Ecotoxicology and Environmental Safety, Vol 5, No 3, p 261-269, 1981. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Fish, *Mudminnow, *Mutagens, *Water pollution effects, *Ethyl methanesulfonate, Benzopyrene, Rivers, *Rhine River, Bioindicators, Aromatic compounds, Organic compounds.

The eastern mudminnow, Umbra pygmaea, was a suitable bioindicator for detecting cytogenetic effects of chemical pollutants in the aquatic environment. Groups of fish were exposed to two known genotoxic agents, ethyl methanesulfonate and benzo(a)pyrene, and to polluted Rhine River water sampled near Lobith, the Netherlands. Best results were obtained with gill tissue after 2 injections with bromodeoxyuridine. Chromosome damage was found in fin and gill tissue. Chromatid aberrations were most common, but chromosome breaks were also found. A 2-day exposure to ethyl methanesulfonate at concentrations of 0, 18, 40, and 200 mg per liter produced 0.3, 1.1, 6.8, and 19.6% metaphases with chromosome aberrations, respectively. Benzopyrene at concentrations of 0.00001 mg per liter produced no metaphase aberrations. At the 0.0001 mg per liter level, exposures of 2, 4, and 6 days gave aberrations of 0.3, 1.5, and 1.8%, respectively. Rhine River water caused 0.7, 2.5, and 4.1% metaphases with chromosome aberrations at 8 days exposure to water diluted by high flow, and 8 and 14 days exposure to less diluted low flow water, respectively. Sister chromatid exchange induction analysis after 8 days exposure to Rhine River water produced fin and gill metaphase aberrations of 7.0-8.4% and 5.0-5.2%, respectively, compared with the control, 2.2-2.7%. (Cassar-FRC)
W82-04480

EFFECTS OF LAND USE ON SURFACE-WATER QUALITY IN THE EAST EVERGLADES, DADE COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-176520, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-59, 1982. 37 p, 2 Fig, 22 Tab, 7 Ref.

Descriptors: *Land use, *Surface water, *Water quality, *Environmental effects, Agricultural chemicals, Runoff, Wetlands, Nutrients, Data collections, Water pollution effects, Pesticides, Bacteria, *Florida, *Dade County, Everglades.

Water-quality characteristics were determined at five developed areas in the East Everglades, Dade County, Florida, during the 1978 wet season (June through October). These areas are designated as: Coopertown; Chekika Hammock State Park; residential area; rock-plowed tomato field; and Cracker Jack Slough agricultural area. Data from the developed areas were compared with data from four baseline sites in undeveloped areas to determine the effects of land use on the surface-water quality. The rock-plowed tomato field was the only area where surface-water quality was affected. Water quality at this field is affected by agricultural activities and chemical applications as indicated by increased concentrations of orthophosphate, organic nitrogen, organic carbon, copper, manganese, mercury, and potassium. The remaining four areas of land use had water-quality characteristics typical of baseline sites in nearby Northeast Shark River Slough or Taylor Slough. Chemical analyses of soil indicated chlorinated-hydrocarbon insecticide residues at Coopertown and the two agricultural areas, Cracker Jack Slough and the rock-plowed tomato field. Trace elements in concentrations greater than base level occurred at both agricultural areas (manganese), Chekika Hammock State Park (manganese), and at Coopertown (lead and zinc). (USGS)
W82-04491

BIOTA AND BIOLOGICAL PRINCIPLES OF THE AQUATIC ENVIRONMENT.

Geological Survey, Reston, VA. Water Resources Div.
Available from Dist. Branch, USGS 604 South Pickett St. Alexandria, VA 22304. Geological Survey Circular 848-A, 1982. 49 p, 29 Fig, 1 Tab. (Greeson, P.E., editor).

Descriptors: *Biota, *Water quality, *Biological communities, *Aquatic environment, *Water pollution, Environmental effects, Ecosystems, Algae, Streams, Phytoplankton, Invertebrates, Microorganisms, Midges, Water temperature, Channeling, Fauna.

This is the first of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, non-technical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected biota and biological principles of the aquatic environment. Briefing papers are included on 'Why biology in water-quality studies', 'Stream biology', 'Phytoplankton', 'Periphyton', 'Drift organisms in streams', 'Family Chironomidae (Diptera)', 'Influences of water temperature on aquatic biota', and 'Stream channelization: Effects on stream fauna'. (USGS)
W82-04499

MEAN ANNUAL STREAMFLOW OF SELECTED DRAINAGE BASINS IN THE COAL AREA OF SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
R. F. Ferrieria.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-137696, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-61, October, 1981. 21 p, 5 Fig, 5 Tab, 13 Ref.

Descriptors: *Streamflow, *Coal mines, *Irrigation effects, Evaluation, Forecasting, Flow characteristics, Surface runoff, Land use, Data collections, *Montana, *Fort Union coal region.

Streamflow characteristics of drainage basins within the Forst Union coal region of southeastern Montana were estimated to provide premining data for evaluating the future effects of mining on the environment. Estimated annual mean streamflow at 22 data-collection stations for water years 1975-77 ranged from 0 to 887 cubic feet per second. These estimates are based on miscellaneous-streamflow records at each station and continuous-streamflow records from other stations in the study area. Estimated mean annual streamflow for a 10-year period (water years 1968-77) ranged from 0 to 372 cubic feet per second. These long-term estimates were based on data from stations in the surrounding area having continuous-streamflow records. Estimates mean annual runoff in inches for selected drainage basins within the study area showed no discernible pattern. Many of the drainage basins had a mean annual runoff of less than 0.60 inch; the maximum observed mean annual runoff was 4.45 inches. (USGS)
W82-04506

AN ANNOTATED KEY TO THE IDENTIFICATION OF COMMONLY OCCURRING AND DOMINANT GENERA OF ALGAE OBSERVED IN THE PHYTOPLANKTON OF THE UNITED STATES,

Geological Survey, Reston, VA. Water Resources Div.
P. E. Greeson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $4.75. Geological Survey Water-Supply Paper 2079, 1982. 138 p, 58 Fig, 4 Tab, 123 Ref.

Descriptors: *Algal, *Phytoplankton, *Taxonomy, *Water quality, Hydrologic data, United States, Genera, *Genera identification.

In early 1979, a retrieval was made for all phytoplankton data contained in the computerized data file of the U.S. Geological Survey. The retrieval revealed the analytical results of 17,959 samples collected and processed between October 1973 and October 1978. Of the approximately 500 genera of fresh-water algae reported in the United States, the U.S. Geological Survey observed 321 genera in the phytoplankton. Fifty-two genera were considered to be commonly occurring and 42 genera were considered to be community dominants. The report lists, describes, and provides a detailed taxonomic key for the identification of 58 genera of algae considered either commonly occurring or dominant. Also included is a summary of environmental conditions under which each algal genus was observed, as well as a glossary and an extensive list of selected references. (USGS)
W82-04524

TOXICITY OF NITRITE TO LARVAE OF THE SALAMANDER AMBYSTOMA TEXANUM,

North Texas State Univ., Denton. Dept. of Biological Sciences.
D. W. Huey, and T. L. Beitinger.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 6, p 909-912, 1980. 1 Tab, 16 Ref.

Descriptors: *Nitrites, *Salamanders, *Toxicity, Water pollution effects, Nitrogen compounds, Mortality, Aquatic animals, Texas, Ponds.

Larvae of the salamander, Ambystoma texanum, from a Texas pond were highly sensitive to nitrite in low chloride (5.0 mg per liter) water. The 96 hour LC50 was 1.09 mg per liter nitrite. Nearly 100% mortality was seen at concentrations of 2.5 mg per liter nitrite and above. In water containing 300 mg per liter chloride and 10 mg per liter nitrite, no mortality was observed in 96 hours, probably as a result of lower nitrite uptake rates. (Cassar-FRC)
W82-04529

A METHOD FOR DETERMINING STRESS IN WETLAND PLANT COMMUNITIES FOLLOWING AN OIL SPILL,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. J. Smith, R. D. DeLaune, and W. H. Patrick, Jr.
Environmental Pollution, Series A: Ecological and Biological, Vol 26, No 4, p 297-304, December, 1981. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Marsh plants, *Stress, *Sublethal effects, *Carbon dioxide, Photosynthesis, Toxicity, Marshes, Spartina, Ecosystems, Plant pathology, Wetlands, *Oil spills, Gas chromatography, Water pollution effects, *Ecological effects.

A portable gaseous exchange chamber was developed to measure sublethal stress, such as the effects of oil spills, in wetland plant communities. The system, which requires no on-site electricity, was tested in Louisiana salt marsh on Spartina alterniflora by measuring carbon dioxide fixation rates. Stresses studied were manmade (two concentrations of crude oil) and natural (streamside and inland location). The procedure involved placing light and dark chambers adjacent to each other on marsh plants for about 20 min. Air samples were taken every 5 min and analyzed for carbon dioxide by a gas chromatograph equipped with a flame ionization detector and a catalytic conversion unit to quantitatively reduce CO2 to CH4. The samples were analyzed within 24 hours after collection in an off-site laboratory. After 7 and 14 days exposure the oil-treated plants had fixation rates 19-37% of those in the control plants. In the plants suffering natural water stress, the shorter inland plants had carbon fixations equal to 27-34% of that of the taller streamside plants. (Cassar-FRC)
W82-04548

NITRIFYING POPULATION DENSITIES AND INHIBITION OF AMMONIUM OXIDATION IN NATURAL AND SEWAGE-ENRICHED CYPRESS SWAMPS,

Florida Univ., Gainesville, Dept. of Environmental Engineering.
F. E. Dierberg, and P. L. Brezonik.
Water Research, Vol 16, No 1, p 123-126, January, 1982. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Nitrification, *Wastewater disposal, *Bacteria, Cypress, Water pollution effects, Organic matter, Ammonium, Oxidation, Nitrates, Swamps, Peat, *Florida.

The densities of autotrophic nitrifiers in peat from the floors of cyress domes near Gainesville, Florida, were investigated. One dome received groundwater from a deep artesian aquifer, two were amended with secondary treated sewage effluent, and a fourth was left in the natural state. Nitrifying bacterial densities as determined by the most probable number method (in cells per ml) were as follows: groundwater dome, 78-7900; sewage domes, 350->160,000; and natural dome, 0-56. mmonium concentrations (in mg per liter) were as high as 24.5 in the sewage domes, 3.8 or less in the groundwater dome, and 0.55 or less in the natural dome. Water from the natural dome was used for nitrification rate studies. It was determined that the low pH (4-5) and not dissolved humic materials was responsible for nitrification inhibition. The pH value of the sewage domes was 6-7, more favorable for nitrification. Nitrification inhibition, as seen in natural cypress domes, prevents N losses in these ecosystems because ammonium ion, the dominant inorganic N species, does not leach from the root zone as readily as nitrate. (Cassar-FRC)
W82-04556

SOME EFFECTS OF LAND USE ON BACTERIOLOGICAL WATER QUALITY IN A RECREATIONAL LAKE,

Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5B.
W82-04567

SYNTHESIS AND DEGRADATION OF CARBOHYDRATES IN THE MARINE PLANKTONIC COMMUNITY OF EUTROPHIC WATERS (SYNTHESE ET DEGRADATION DES COMPOSES GLUCIDIQUES AU SEIN DE LA COMMAUNAUTE PLANCTONIQUE EN ZONE MARINE EUTROPHE),

Arago Lab., Banyuls-sur-Mer (France).
For primary bibliographic entry see Field 5B.
W82-04672

SEASONAL VARIATIONS IN PRIMARY PRODUCTION IN SURFACE WATERS OF THE SAGUENAY RIVER (VARIATIONS SAISONNIERES DE LA PRODUCTION PRIMAIRE DANS LES EAUX DE SURFACE DE LA RIVIERE DU SAGUENAY),

Quebec Univ., Chicoutimi. Dept. des Sciences Pures.
R. Cote.
Hydrobiologia, Vol 83, No 1, p 1-10, 1981. 2 Fig, 3 Tab, 19 Ref. English Summary.

Descriptors: *Water pollution effects, *Primary production, *Seasonal effects, Population dynamics, *Chlorophyll, Rivers, Saguenay River, *Heavy metals, Industrial wastewater, Phytoplankton, Tides, River flow.

Seasonal variability of chlorophyll a and primary production rates were investigated at a station on the Saguenay River near Chicoutimi, May-December, 1978. The annual mean flow in the Saguenay may reach 1300 cu m per sec, and surface tides in the range of 4-6 m are present. At this station, with a maximum water depth of 20 m, the photic zone showed a maximum depth of 2 m. Phosphate levels were very low, with a seasonal mean of 0.02 + or - 0.02 microatom-gram per liter, and nitrates relatively high (mean of 5.6 + or - 0.75 microatom-gram per liter). Seasonal dynamics of the river are characterized by absence of a definite spring bloom, a late growth season, and persistently poor phytoplankton biomasses (chlorophyll a maximum of 3.7 mg per cu m). The maximum production rate was 3.5 mg C per cu m per hr, and the correlation between production rate and biomass was poor. This river flows through an industrialized region and receives effluents from metallurgical plants and paper mills, as well as urban runoff. The presence of trace metals (mercury, copper, lead and iron) may account to some degree for the inhibition of phytoplankton growth. (Carroll-FRC)
W82-04678

MICROBIAL ECOLOGY OF RIVER DEPOSITS IN THE RIVERS KENNET AND THAMES AT READING, ENGLAND,

Lyne and Martin Public Analysts, Reading (England).
R. M. Webster.
Process Biochemistry, Vol 16, No 6, p 12-15, 19, October/November, 1981. 3 Fig, 6 Tab, 24 Ref.

Descriptors: *Detritus, *Microbiological studies, *Aquatic plants, Rivers, *Kennet River, *Thames River, Epiphytes, Actinomycetes, Heterotrophic bacteria, Nutrients, Heavy metals, Algal growth, Aeromonas hydrophila, Toxicity, Indicators, Eutrophication, Water pollution effects, *England.

Surveys were conducted on the microbiology of detritus and sediments of the rivers Kennet and Thames. The first survey, in 1974, estimated populations of algae, fungi, yeasts, blue-green algae and bacteria in different detritus and sediment samples. The second survey, in 1979, estimated the populations of heterotrophic bacteria and actinomycetes on the epiphytic detritus accumulated on the leaves of Nuphar lutea, the yellow water lily, and on the benthic detritus of reed beds, indicated in the first studies as sites of high microbial activity. A simplified succession pattern indicates that peaks of yeasts, blue-green algae, Chromobacterium and total bacteria (by microscopic count) are associated with algal peaks in the summer. Peaks of heterotrophic bacteria and micromonosporas which followed the algal peaks were probably stimulated by decay of the algae. During a bloom the greatest increase in numbers was due to Aeromonas hydrophila. The presence of heavy metals inhibited microbial growth in some of the samples. In addition to relatively high levels in May when the sediments were stirred up, heavy metal levels increased to a peak at the end of October, at which time the number of yellow colonies did not increase with the peak of total heterotrophic bacteria. Although interactions appear to exist between nutritional and metabolic stresses, it seems potentially interesting to use A. hydrophila as a bacterial indicator of organic and heavy metal pollution. The ATP assay could also be used as an indicator of toxicity. (Carroll-FRC)
W82-04688

AN INTEGRATED WATER-QUALITY INDEX FOR IRRIGATION USE,

Central Groundwater Board, Lucknow (India).
B. K. Handa.
Indian Journal of Agricultural Sciences, Vol 51, No 6, p 422-426, June, 1981. 2 Tab, 12 Ref.

Descriptors: *Water quality, *Irrigation water, Monitoring, Salinity, *Soil contamination, *Plant toxins, *Hazardous materials, Water pollution effects, Mathematical studies.

A water quality index has been developed which takes into consideration the effect of various constituents present in water on its use for irrigation. These constituents were divided into two categories: those that are highly toxic to plants and humans, and those that adversely affect soil characteristics and plant growth and are also a health hazard to humans consuming those plants. The latter properties were further subdivided into several subgroups depending on their relative importance, and a ranking factor was assigned to each subgroup in order of importance. For all waters that presented high salinity and other hazards the index was negative. When positive values of the index were obtained, it was taken to indicate that the water so rated could be used for irrigation purposes. The index proved to be quite useful in comparing the overall quality of irrigation water from various sources. The index itself is very flexible and can be modified for various soils, crops, and irrigation techniques. (Baker-FRC)
W82-04723

PESTICIDES IN THE AQUATIC ENVIRONMENT,

Illinois Univ. at Urbana-Champaign.
D. A. Belluck.
PhD Thesis, 1981. 153 p, 15 Fig, 32 Tab, 159 Ref, 7 Illust. University Microfilms International, Ann Arbor, MI; Order No GAX81-14387.

Descriptors: *Aquatic environment, *Pesticides, *Water pollution effects, Aquatic life, Toxicity, Bioassay, Surface water, *Caddisflies, *Eggs, Organochlorine pesticides, Triaenodes tardus, *Illinois, Xenobiotics.

Organochlorine pesticide data of samples obtained from Clear Creek (Southern Illinois) and Lodge Pond (Central Illinois) are presented. Organochlorine pesticide residue levels in organisms from both aquatic communities suggest that residue concentrations may be primarily determined by the habitat and detoxification capabilities (or biological properties) of an organism rather than by its trophic level position. A new bioassay, the caddisfly egg toxicity bioassay, has been developed to measure the effects of zenobiotics on caddisfly embryogenesis. Results from this bioassay indicate that certain insecticides and herbicides are embryotic and/or teratogenic to eggs of the caddisfly, Triaenodes tardus. Bioconcentration of pesticides by T. tardus egg masses is correlated with the physiocochemical properties of the pesticide. A strong correlation exists between water solubility and bioconcentration factor. Passive biological system such as caddisfly eggs can accumulate significant quantities of pesticiede from water. Within 24 hours of exposure to radiolabelled pesticides, egg mass pesticide concentrations were at least equal to that in the surrounding water. The caddisfly egg toxicity bioassay provides a quick (three weeks or less), sensitive and inexpensive technique for use by researchers to determine the effects of xenobiotics on aquatic organisms. This new bioassay enables a biologist to test the unique genetic endowment of a local insect population for resistance or susceptibility to a given compound. (Sinha-OEIS)
W82-04727

5D. Waste Treatment Processes

SPECIFIC AND CHELATE EXCHANGERS: NEW FUNCTIONAL POLYMERS FOR WATER AND WASTEWATER TREATMENT,

Water Purification Associates, Cambridge, MA.
For primary bibliographic entry see Field 5F.
W82-04275

EXPERIENCES WITH A PILOT SCALE RESEARCH PLANT FOR PHOSPHATE REMOVAL FROM WASTEWATER WITH ACTIVATED ALUMINA (ERFAHRUNGEN MIT EINER HALBTECHNISCHEN VERSUCHSANLAGE ZUR ABTRENNUNG VON PHOSPHAT AUS ABWASSER MIT AKTIVTONERDE),

Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
D. Donnert, S. H. Eberle, P. Gruber, H. Metzger, and H. P. Sapandowski.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 188-193, 1981. 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Phosphate removal, *Adsorbents, Activated alumina, Pilot plants, Process control, Chemical recovery, Regeneration, Aluminum compounds, Advanced wastewater treatment, Germany.

Prior experiments had revealed the potential usefulness of activated alumina for removing phosphate from wastewaters in a form suitable for recovery. A pilot plant was constructed on the experimental field of the Federal Health Bureau in Berlin to test this process on secondary effluent. The plant comprised four stirring reactors with a volume of 0.44 cu m each, of which three were in use for phosphate adsorption while the fourth was being switched to regeneration of activated alumina. Each reactor is filled with 50 kg of activated alumina.. An automatically operating Phosphatometer measures the phosphorus content in the effluent from each reactor, and when the concentration exceeds 1 mg/liter, a process computer switches the reactor over for regeneration with NaOH solution. The intake line is equipped with a turbidimeter to detect sludge influx during heavy rains. A pressure monitor detects obstructions in the process line, and a pH meter regulates carbon dioxide addition for pH adjustment. An effluent turbidimeter indicates alumina carryover. In trials conducted from November 1980 to April 1981, uniform effluent quality was achieved despite influent phosphorus fluctuations. Approximately 40% reductions in COD and 20% reductions in DOC were also achieved in the alumina step. Regeneration efficiencies were only 60% instead of the anticipated 80%; however, this did not greatly increase operating costs. Alumina losses during regeneration were about 4%. Mean effluent concentrations in the range of 0.6-0.7 mg/liter P were obtained over the trial period. (Carroll-FRC)
W82-04280

USE OF STORMWATER DETENTION BASINS FOR NEUTRALIZATION AND SPECIAL TREATMENT OF TOXICANTS (EINSATZ VON REGENKLARBECKEN ZUM AUSGLEICH UND ZUR SONDERBEHANDLUNG TOXISCHER ABWASSERSTOSSE),

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Ingenieurbiologie und Biotechnologie des Abwassers.
F. Kast, K. A. Wippler, and L. Hartmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 218-223, 1981. 8 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Toxicity, *Retention basins, *Heavy metals, Sulfides, Chemical precipitation, Iron compounds, Automation, Process control, *Industrial wastewater, Copper, Zinc, Chromium, Cyanide, Biological wastewater treatment, Diversion, Germany.

Studies were conducted from May 1978 to June 1980 at the Geislingen/Steige wastewater treatment plant regarding the possibility of protecting the biological treatment stage from toxicants with the aid of stormwater dention basins. Recurrent reductions in protozoan populations and impariment of activated sludge settling indicated the influx of toxicants into this plant. In many cases, the heavy metal contents of the filter cake and the activated sludge exceeded the permissible levels for agricultural land disposal. A toxicant warning system was installed, consisting of pH, conductivity and temperature sensors, turbidimeter, Toximeter, and photometers for measuring chromium (VI), copper, zinc, cyanide, oils and grasses. If limiting values for any of these indices are exceeded, a slide valve preceding the treatment plant diverts the wastewater into the stormwater detention basin. A procedure for treating the diverted water at reasonable expense was also developed. Sulfide precipitation was the only practical method found for removing copper and zinc, in the presence of complexants, while 97-99% elimination of chromium(VI) was achieved by sequential addition of iron(II) and iron(III) compounds. The diversion technique was judged reasonably effective; however, the high cost of chemical treatment means that this treatment should not be considered a 'normal' part of the wastewater treatment process. Instead, the industrial dischargers must improve effluent quality so that special treatment will only be required in emergencies. (Carroll-FRC)
W82-04282

WASTEWATER TREATMENT WITH ACTIVATED CARBON ADDITION AT THE AERATION STAGE AND SPENT CARBON REGENERATION. (ABWASSERREINIGUNG UNTER ZUGABE VON AKTIVKOHLE IN DIE BELEBUNGSSTUFE UND REGENERIERUNG DER AKTIVKOHLE),

Uhde (Friedrich) G.m.b.H., Dortmund (Germany, F.R.).
K. Eisenacher, U. Neumann, and J. Kelin.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 168-173, 1981. 11 Fig, 2 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Activated carbon, Biological treatment, *Activated sludge process, Organic compounds, Effluents, Recycling, Regeneration, Pilot plants, Germany.

A wastewater discharging concern, a chemical plant construction company, and a research institution performed a cooperative study aimed at demonstrating the advantages of continuous addition of powdered activated carbon in the biological purification of wastewaters containing refractory organic materials. A pilot plant was constructed, treating

wastewater from the Griesheim plant of the Hoechst Co., previously subjected to neutralization and sedimentation. Two activated sludge treatment units were used, one with and one without powdered activated carbon. The wastewater contained aliphatic and aromatic, chlorinated and nitrated organic compounds in amounts varying with production demand. Effluent TOC values of 175-355 mg/liter were attained following activated sludge treatment without active carbon, compared to values of 50-128 mg/liter for fresh active carbon addition at 100 mg/liter of wastewater. A visible improvement in effluent clarity was achieved. During some experimental periods, normal operation of the biological treatment plant without carbon addition was impossible. To reduce the cost of treatment, an experimental carbon regeneration plant was constructed. The mixture of excess sludge, spent carbon and wastewater was collected, mechanically dewatered, and the carbon regenerated. Adequate reactivation was accomplished for several cycles by desorption with stream at 150-200 degrees C, but then a more rigorous treatment was required, comprising desorption at higher temperatures and reactivation in an inert gas (fluidized sand bed) at temperatures above 800 degrees C. (Carroll-FRC)
W82-04283

COMBINATION OF MACROPOROUS RESINS AND ACTIVATED CARBON IN ADVANCED WASTEWATER TREATMENT. (KOMBINATION VON MAKROPOROSEN ADSORBERHARZEN MIT AKTIVKOHLE ZUR WEITERGEHENDEN ABWASSERREINIGUNG),

Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. Ruffer, and T. Slomka.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 176-180, 1981. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Resins, Municipal wastewaters, Organic compounds, Recycling, Regeneration, Filtration, Total organic carbon, *Macroporous resins.

Combining weakly basic ion exchange resins and active carbon for treatment of municipal wastewaters would reduce costs by prolonging carbon life and increasing adsorber performance. A test system was constructed comprising multilayer (gravel/sand/anthracite) filtration, macroporous resin adsorption, and activated carbon adsorption, with the possibility of removing samples for analysis after each treatment stage. A high-quality regenerable carbon produced more complete removal of organic materials than an inexpensive, disposable carbon. Using a biologically pretreated feed water, the initial TOC 26.4 mg/l decreased to 20.6 g/liter following filtration, 11.8 mg/liter following resin adsorption, and 6.14 mg/l after treatment with the regenerable carbon. Effluent quality remained constant up to the breakthrough point of the column, which was reached after 6000 bed volumes had passed through. Subsequent chlorination gave water of excellent quality for industrial use. The problem of disposal and cost of the regenerant solution had previously interfered with practical use of resin adsorption. The regeneration eluate should not be discarded, as it can be reused up to 8 times. Eluate volume for disposal was reduced to about 1 cu m/10,000 cu m of wastewater treated by allowing a diffusion interval, i.e., allowing the regenerant to remain in contact with the resin for a few hours early in the regeneration process. The most heavily contaminated regenerant fractions were discharged to the biological water treatment plant, and the remainder reused. (Carroll-FRC)
W82-04294

CHRYSLER UPGRADES OILY WASTES TREATMENT IN KOKOMO,

Chrysler Corp., Kokomo, IN.
B. D. Harlow, and T. M. Doran.
Industrial Wastes, Vol 27, No 6, p 24-27, November/December 1981. 2 Fig, 2 Tab.

Descriptors: *Industrial wastewater, *Oily water, *Wastewater treatment, Freon, *Separation techniques, *Metal-finishing wastes, Chrysler Corporation.

The Chrysler Corporation plant in Kokomo, Indiana, has upgraded its waste treatment plant to reduce the concentration of freon extractable compounds to less than 50 mg per liter prior to discharge into the city sewer system. The facility makes and assembles cast aluminum transmission parts. These processes require large quantities of oil. Problems with the original treatment facilities were inadequate batch tank capacity, inefficient chemical feed system, only a single flotation unit, necessity for a separate low grade oil processing system, and a large volume of water. Modifications included use of an emulsion breaker, addition of a batch treatment tank, oil/water separator tank, oil pre-heat tanks, and filtered oil tank; pH adjustment; and elimination of a flotation unit and oil cookers. Reclaimed oil is sent elsewhere for additional refining or storage on-site. current effluent freon extractables are 21 mg per liter compared with 80 mg per liter in 1976. The volume of liquid treated has been reduced from 10.8 million gal per month to 7.6 gal per month, alum dose from 602 to 58 mg per liter, polymer dose from 9.7 to 1 mg per liter, chemical costs from $11,573 to $2,437 per month, and cost per 1000 gal from $1.07 to 33 cents. No waste oils are generated by the modified process, whereas 10,000 gal per week were formerly produced for disposal at 10 cents per gal. (Cassar-FRC)
W82-04285

IMPACT OF PHOSPHORUS REMOVAL AT THE DANBURY, CONNECTICUT SEWAGE TREATMENT PLANT ON WATER QUALITY IN LAKE LILLINONAH,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Water, Air, and Soil Pollution, Vol 16, No 4, p 511-531, 1981. 12 Fig, 5 Tab, 14 Ref.

Descriptors: *Water quality, *Phosphorus removal, *Water treatment facilities, Eutrophication, Lakes, Rivers, *Lake Lillinonah, Housatonic River, Filtration, *Danbury, Connecticut, *Wastewater treatment, Lake restoration.

This paper presents an independent assessment of the results of the FMC Corporation's limnological surveys made of Lake Lillinonah and Lake Zoar, an impoundment just downstream from Lake Lillinonah, and their major tributaries during the summers of 1976 and 1977. The surveys provide data which should help evaluate the effect of phosphorus removal at the Danbury wastewater treatment plant on water quality in the two lakes. The data revealed an apparent improvement in Lake Lillinonah water quality between the two years which might be related to phosphorus removal at the Danbury treatment plant. Phosphorus load was reduced from 13600 to 6700 kg/year in 1976 and 1977, respectively. The flows of the Housatonic River in 1976 and 1977 were also dissimilar: in 1977 about twice as much water entered Lake Lillinonah as in the former year. The eutrophication study results were used to estimate the impact of flow and altered phosphorus loads on Lake Lillinonah's eutrophication-related water quality. The average planktonic algal chlorophyll concentration would have been reduced from 35 to 30 micrograms/liter if the flows of the Housatonic River were to have been the same during the two years of the study. (Baker-FRC)
W82-04298

DESIGN MODELS FOR ADSOPRTION SYSTEMS IN WASTEWATER TREATMENT,

Queen's Univ., Belfast (Northern Ireland). Dept. of Industrial Chemistry.
G. McKay.
Journal of Chemical Technology and Biotechnology, Vol 13, No 2, p 717-731, 1981. 12 Fig, 69 Ref.

Descriptors: *Design criteria, *Water treatment facilities, Wastewater treatment, Mathematical models, Model studies, Simulation, Adsorption, Industrial wastes, Effluents.

Various methods of solid-liquid contacting in adsorption systems have been considered. High mass-transfer rates are obtained in fluidized bed systems, and small adsorbent particles may be used, giving a large external surface area for adsoprtion. The control of such systems is more difficult than of a fixed-bed column, and there is a lack of flexibility in operation. Fixed-bed adsorbers are most widely used, and the effluent continuously comes into contact with fresh adsorbent. Therefore the driving force to each equilibrium is high. In batch processes a relatively long contact time is needed to reach equilibrium and a further solid-liquid separation stage is needed at the end of the process. The selection of the correct adsorbent, the method of contacting and the regeneration system determine the economics of adsorption systems. Various methods of designing adsorption systems for wastewater treatment have been considered. The design of the reactivation unit is considered, and the technique of minimizing the cost of adsorption plants is discussed. It is usually wise in the design of wastewater treatment plants to allow some overdesign to account for certain factors, including flow rate surges, changes in feed concentration, increases in throughput requirements or increased levels of effluent quality, and for decreased adsorbent performance due to numerous reactivations. (Baker-FRC)
W82-04300

WATER TREATMENT AT HOMESTAKE'S BULLDOG MOUNTAIN OPERATION,

Homestake Mining Co., Creede, CO.
J. L. Young, and R. A. Bohling.
Mining Engineering, Vol 33, No 12, p 1689-1691, December, 1981. 4 Fig.

Descriptors: *Wastewater treatment, *Mine drainage, *Heavy metals, *Water quality standards, Hydrogen ion concentration, Mine wastes, Silver, Lead, Metals, Wastewater facilities, Aeration, Clarification, Filtration, Sand filters, *Colorado.

In 1977, a mine water treatment plant was constructed for Homestake's Bulldog Mountain silver and lead mines to keep discharge waters in line with National Pollutant Discharge Elimination System regulations. In 1980, construction began on a wastewater treatment plant. During treatment, mine discharge is first metered and then passed to the aeration stage. Metals are precipitated in a clarifier as hydroxides at pH 9.5-10.0 regulated by lime solution. The clarified effluent is sent to a splitter, where part of the stream may be treated by sand filtration. Sulfuric acid is used to make final pH adjustments to 6.0-9.0. Initial plant start-up problems were encountered with maintaining clarifier and final pH, effective lime pumping, and sludge removal. Most control problems were solved by a programmable Taylor 1380R adaptable gain controller. Daily assays from the plant show good compliance of discharge with permit parameters. High copper levels are occassionally encountered and are treated with hydrogen perioxide. Tests are in progress to study the feasibility of using O2 in place of sulfuric acid for effluent pH adjustment. (Geiger-FRC)
W82-04311

ZERO-DISCHARGE IN PRACTICE AT RAY D. NIXON POWER PLANT,

Ray D. Nixon Power Plant Water Supply, Colorado Springs, CO.
W. D. Givens, F. K. Marotte, and C. T. Zeien.
Industrial Water Engineering, Vol 18, No 5 p 20-25, September/October, 1981. 8 Fig.

Descriptors: *Cooling water, *Powerplants, *Water reuse, Water treatment, *Wastewater treatment, Water management, Water softening, Industrial wastewater, Algicides, Reverse osmosis, Evaporation, Ash, Solid waste disposal, Waste disposal, Water conservation, *Coal, Fuel, Water pollution prevention, Zero discharge, Colorado.

The Ray D. Nixon coal-fired power plant near Colorado Springs, Colorado, has successfully practiced zero-discharge water management since its opening in April 1980. The water comes from eight wells above a small brackish aquifer, which is

recharged from a nearby creek. Water softening by sodium-base ion exchange reduces the hardness. The treated water is stored in a 5.2 million gal steel reservoir until needed. Wastewater streams are equalized in a 10 million gal clay lined basin with 2 week detention time. Algae are controlled with simazine. The automated filtration system consists of three package units with capacities of 300 gpm each. Ferric chloride and a cationic polymer are used as flocculators. A 120,000 gal clear well provides filter backwash water and cushions flow changes. The remainder of the water treatment system consists of reverse osmosis, evaporators, decant basins, and evaporation ponds. (Cassar-FRC)
W82-04320

RECYCLING ALLOWS ZERO POWERPLANT WASTEWATER DISCHARGE,

B. B. Hall, and L. Stierwalt.
Industrial Water Engineering, Vol 18, No 5, p 26-30, September/October, 1981. 1 Fig, 5 Tab.

Descriptors: *Cooling water, *Powerplants, *Water reuse, *Wastewater treatment, Industrial wastewater, Water management, Ash, Solid waste disposal, *Waste disposal, Water conservation, Water pollution prevention, Clarifiers, Martin Drake Power Station, *Colorado Springs, Colorado, Zero discharge.

A zero discharge plant was designed for the coal-fired Martin Drake Power Station, Colorado Springs, Colorado, to comply with environmental regulations. A dual treatment system with limited interconnections was selected, one system to process ash transport water and the other to process cooling water blowdown. Fly ash and bottom ash are sent via the existing hydraulic transport system to new clarifiers for gravity settling. The ash transport water is reused for transporting more ash. Settled ash is trucked to a landfill. Cooling tower blowdown is treated with a cold lime-soda ash softening process to control Ca, Mg, and silica followed by clarification, filtration through dual sand-anthracite media, and pH adjustment. Sludge is added to the ash treatment process, and water is returned to the cooling system. (Cassar-FRC)
W82-04323

SHAKING DOWN A SOLIDS HANDLING SYSTEM,

Greater Lawrence Sanitary District, North Andover, MA.
E. Teittinen.
Water/Engineering and Management, Vol 129, No 1, p 45-46, January, 1982. 2 Fig.

Descriptors: *Wastewater facilities *Sludge solids, Treatment plants, *Water treatment facilities, Filters, Pumps, Clogging, Springs, Fibers, Industrial wastes, Textile mill wastes, Waste disposal, Solid wastes.

Problems which occurred during the start-up of a solids handling system in North Andover, Massachusetts are reviewed. Early problems were noted in the development of the vacuum filter operation; these were overcome. At the start, running the vacuum filters with only a primary sludge feed was trouble-free. This ended when activated sludge was generated and mixed with primary. The system's ability to keep pace with the solids being produced became severely limited, and an intensive diagnostic program was begun. Problems were identified in the spring gap and sprays, following which steps had to be taken to ensure that coil integrity would be maintained after they were refurbished. A final refinement in the vacuum filter operation was achieved when ferric chloride and lime were replaced with polymers as dewatering aids. Material handling had been simplified by converting an unused sodium hypochlorite storage tank to bulk polymer storage. In addition to labor savings, significant reductions were realized in processing chemical costs. While there was no reduction in cake solids content due to the conversion, there was a significant increase in volatile solids (65-75%) and a reduction in ash volume for disposal. (Baker-FRC)
W82-04338

DISSOLVED OXYGEN CONTENT MONITORING USING GAS PHASE OXYGEN ANALYSIS IN A HIGH PURITY OXYGEN ACTIVATED SLUDGE PLANT,

Yokohama Sewerage Bureau, Kawasaki (Japan).
Y. Kurokawa, Y. Nameda, Y. Itoh, T. Katoh, and R. Tanuma.
Water Science and Technology, Vol 13, No 9, p 293-298, 1981. 3 Fig, 3 Ref.

Descriptors: *Activated sludge process, *Oxygenation, *Monitoring, Dissolved oxygen, Wastewater treatment, Oxygen transfer, Aeration, *Kawasaki, *Japan.

Dissolved oxygen control in a high purity oxygen activated sludge plant was achieved by monitoring the partial oxygen pressure in the vapor phase and the water temperature. Values calculated from this procedure compared well with measured dissolved oxygen concentrations from April 17 to December 30 at the 1500 cu m per day Ikuta sewage treatment plant, Kawasaki, Japan. A dissolved oxygen rate of 20 mg per liter was found suitable for this plant. Further increases in dissolved oxygen levels did not consistently improve treated water quality. (Cassar-FRC)
W82-04344

A TREATMENT SYSTEM FOR AN ORGANIC CHEMICALS PLANT,

Allied Chemical Company, Danville, IL.
N. L. Lanter, and D. L. Hatfield.
Industrial Wastes, Vol 27, No 6, p 22-23, November/December, 1981. 1 Fig, 1 Tab.

Descriptors: *Chemical wastewater, *Organic compounds, *Chlorinated hydrocarbons, *Wastewater treatment, *Industrial wastewater, Carbon tetrachloride, Acidic water, Sodium hypochlorite, Sedimentation, Chemical wastewater.

The Allied Chemical Company plant at Danville, Illinois, treats six wastewater streams individually before combining them for suspended solids removal and discharge into the city sewer system. The basic process involves reaction of carbon tetrachloride with hydrofluoric acid, using the additional raw materials sulfuric acid, hydrochloric acid, hydrocarbons, finishing agents, sodium hydroxide, and heavy metals. The six wastewater streams are as follows: (1) weak sodium hypochlorite solution, (2) chlorocarbons and chlorofluorocarbons, (3) acidic water containing fluorocarbons, (4) colling tower and boiler blowdown, and (5) and (6) acidic water with up to 50% total suspended solids. Sanitary waste and stream (4) are discharged directly into the sewer. Noncontaminated storm water is transported off-site. Stream (1) treatment catalytically decomposes sodium hypochlorite into oxygen and chloride. Stream (2) treatment involves settling chlorocarbons and separation in a tank; Stream (3) is sent directly to the combined final treatment. The high solids (5) and (6) wastewaters are subjected to sedimentation in the containment vessels. Terminal combined treatment consists of two sedimentation steps and filtration followed by discharge into the sewer. (Cassar-FRC)
W82-04353

AMERICAN HOECHST UPGRADES A TREATMENT SYSTEM THROUGH AUTOMATION,

American Hoechst Corp., Leominister, MA.
V. M. DiTaranto, Jr.
Industrial Wastes, Vol 27, No 6, p 28, 31-33, November/December, 1981. 2 Fig, 2 Tab.

Descriptors: *Heavy metals, *Metal-finishing wastes, *Automation, *Sludge drying, *Wastewater treatment, Nickel, Copper, Zinc, American Hoechst Corporation, Industrial wastewater, Chemical wastewater, Electroplating.

Pretreatment of electroplating wastewater removes 96% total suspended solids, 97% nickel, and 98% zinc at the American Hoechst plastics manufacturing facility at Leominster, Massachusetts. The effluent is then combined with wastewater from the styrene polymerization process for further treatment. The system uses lime neutralization, ferric sulfate coagulation, flocculation, sedimentation, sludge dewatering, and effluent polishing. Influent and effluent metal levels (in mg per liter) average: Cu, 17.2 and 0.9; Ni, 19.2 and 2.4; and Zn, 56.4 and 1.3. Much of the system is automatically controlled, including start-up and shutdown, level control, pH control, sludge centrifugation, and monitoring. (Cassar-FRC)
W82-04354

OPERATIONAL PERFORMANCE OF AN RBC UNIT IN CONJUNCTION WITH A SEPTIC TANK,

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
J. W. Atwater, and G. Bradshaw.
Canadian Journal of Civil Engineering, Vol 8, No 4, p 477-483, December, 1981. 7 Fig, 11 Ref.

Descriptors: *Septic tanks, *Solids contact processes, *Primary wastewater treatment, Wastewater treatment, Rotating biological contactors, Biological treatment, Performance evaluation, Denitrification, Oxidation, Nitrogen removal, *British Columbia.

Data collected from the wastewater system operation at a 60-man prison camp near Agassiz, British Columbia, was analyzed. The system consisted of a rotating biological contactor in series with a septic tank for primary solids removal and sludge storage. A secondary clarifier sent sludge back to the septic tank for recycling. Chlorination and three days of lagooning were followed by discharge of effluent into a stream. An initial odor problem was solved by recycling effluent from the last stage of the contactor back to the septic tank. This system produced an effluent acceptable by federal guidelines, 20 mg per liter for BOD and 25 mg per liter for suspended solids. Effluent quality degenerated if solids were not removed from the septic tank within 12 months. Data suggest that the required surface area for rotating biological contactors operating with primary treatment by septic tanks is three times that using conventional primary treatment. Denitrification occurred concurrently with carbonaceous oxidation. (Cassar-FRC)
W82-04355

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATER--IV. CONCLUSIONS, DESIGN AND OPERATIONAL CONSIDERATIONS FOR ARTIFICIAL FOOD CHAINS,

California Univ., Davis. Dept. of Biology.
M. S. Gordon, D. J. Chapman, L. Y. Kawasaki, E. Tarifeno-Silva, and D. P. Yu.
Water Research, Vol 16, No 1, p 67-71, January, 1982. 10 Ref.

Descriptors: *Aquaculture, *Tertiary wastewater treatment, Wastewater treatment, *Recycling, *Nutrients, Design criteria, Heavy metals, Metals, *Food chains, Fate of pollutants, Effluents, Bioaccumulation, Accumulation, Nutrient removal, Cultures, Algal growth, Algae, Scenedesmus, Cladocerans, Crustaceans, Fish, Daphnia, Chlorophyta, Shinrs, Fathead minnows, Carp.

This paper summarizes the results of three previous papers on growing food chains in secondary wastewater for the purposes of tertiary wastewater treatment in effluent which has been chlorinated, then dechlorinated. The food chains consisted of unicellular green algae, herbivorous cladocerans or fish, and carnivorous fish, followed in som cases by filamentous green algae. Aspects studied in the first three papers were nutrient uptake, biological productivity, and heavy metal accumulation. Some general conclusions are drawn in this paper. This process is feasible for reducing effluent nutrient loading and for growing usable crops of organisms in sunny, temperate regions. Batch cultures are reliable, but continuous cultures are not likely to be usable without pH control. A near-neutral pH will produce high densities of suspended algal cells, while absence of pH control will produce clumped cells for easy harvesting. These aquaculture operations are best suited to rural and suburban areas,

where competition for land use is not too great. (Cassar-FRC)
W82-04369

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS–III. UPTAKE OF DISSOLVED HEAVY METALS BY ARTIFICIAL FOOD CHAINS,

California Univ., Davis. Dept. of Biology.
E. Tarifeno-Silva, L. Y. Kawasaki, D. P. Yu, M. S. Gordon, and D. J. Chapman.
Water Research, Vol 16, No 1, p 59-65, January, 1982. 9 Tab, 23 Ref.

Descriptors: *Aquaculture, *Tertiary wastewater treatment, *Heavy metals, *Accumulation, *Nutrients, Fate of pollutants, *Food chains, Cultures, Wastewater treatment, Metals, *Recycling, Effluents, Bioaccumulation, Algae, Chlorophyta, Scenedesmus, Cladocerans, Daphnia, Fish, Notemigonus, Pimephales, Shiners, Fathead minnows.

Concentrations of 15 heavy metals (Ba, Cd, Co, Cr, Cu, Fe, Mn,Mo,Ni, Pb, Sn, Sr, Ti, V, Zn) accumulating in an algae algae-cladoceran-fish food chain growing in secondary wastewater effluent were reported. The food chain consisted of Scenedesmus (algae); Daphnia magna and Daphnia pulex (cladocerans); and Notemigonus crysoleucas and Pimephales promelas (fish). Concentration factors were higher in algae (500-30,000) than in Daphnia (30-6000) and fish (4-1600). The concentrations of metals found in algal cells depended on buffering and presence of ferrous sulfate. Relative abundances of metals in algae were substantially different from the abundances in effluent. Concentrations of metals in cladocerans were 2 to 50% of those in algal cells. Relative abundance differed between algae and Daphnia and between Daphnia magna and Daphnia pulex. Most elements were either equal in both species or higher in Daphnia magna than in Daphnia pulex. For 7 of 9 metals fish showed lower metal concentrations in muscles than the Daphnia they ate. Relative abundances of the metals differed between the two fish species. (Cassar-FRC)
W82-04370

AQUACULTURAL APPROACHES TO RECYCLING OF DISSOLVED NUTRIENTS IN SECONDARILY TREATED DOMESTIC WASTEWATERS–I. NUTRIENT UPTAKE AND RELEASE BY ARTIFICIAL FOOD CHAINS,

California Univ., Davis. Dept. of Biology.
L. Y. Kawasaki, W. Tarifeno-Silva, D. P. Yu, M. S. Gordon, and D. J. Chapman.
Water Research, Vol 16, No 1, p 37-49, January, 1982. 2 Fig, 8 Tab, 55 Ref.

Descriptors: *Tertiary wastewater treatment, *Nutrient removal, *Recycling, *Aquaculture, Wastewater treatment, Algal growth, Algal harvesting, Fish, Cladocerans, Algae, Chlorophyta, *Food chains, Nitrates, Phosphates, Effluents, Nitrogen removal, Phosphorus removal, Cultures, Scenedesmus, Cladophora, Ulothrix, Daphnia, Notemigonus crysoleucas, Pimephales promelas, Notropis lutrensis, Carp, Shiners, Fathead minnows, *Water reuse.

The nutrient (nitrate and phosphate) dynamics of each stage in artificial food chains was investigated in a secondary wastewater effluent for the purpose of producing a tertiary-treated effluent. Suitable organisms were Scenedesmus, a unicellular green alga; Cladophora and Ulothrix, filamentous green algae; Daphnia magna and Daphnia pulex, cladocerans; and Notemigonus crysoleucas, Pimephales promelas, and Notropis lutrensis, fish. Addition of 1 ppm ferrous iron and 5% carbon dioxide were required to provide good algal growth for the cladocerans' food supply. Nitrate and phosphate removals in buffered algal cultures were 78% and 55%, respectively; in unbuffered algal cultures, 30% and 98%, respectively. The high removal of phosphate in the unbuffered cultures was probably a result of precipitation of phosphate at the high pH levels. The cladocerans and fish returned ammonia and phosphate to the effluent. These were removed in the final stage by filamentous green algae. Continuous light conditions were more conducive to nutrient removal than a 12 hour light-12 hour dark cycle. Daily harvesting rates of 25-75% of culture volumes did not significantly affect nitrate removals in buffered algal cultures, but phosphate removals were inversely proportional to harvesting rates. (Cassar-FRC)
W82-04371

DESTABILIZATION OF BIOLOGICAL SOLIDS WITH FERRIC CHLORIDE,

North Carolina State Univ. at Raleigh. Dept. of Civil Engineering.
A. C. Chao, and T. M. Keinath.
Water Research, Vol 16, No 1, p 23-30, January, 1982. 10 Fig, 1 Tab, 20 Ref.

Descriptors: *Activated sludge process, *Coagulation, *Ferric chloride, Wastewater treatment, Flocculation, Suspended solids, Organic matter, Hydrogen ion concentration, Microorganisms.

A two-step pH control method is given for coagulating suspended biological solids produced during upsets in the activated sludge process. This situation is characterized by high levels of sludge pinpoint flocs and dispersed cells. In ferric chloride coagulation the flocs are readily removed at low dose levels, but the cells, only a small percentage of the total suspended solids, require a much higher dose of coagulant for complete removal. In the two-step method, ferric chloride is added quickly so that solution pH drops to 3-4. During this low pH period the ferric chloride is in soluble form, effectively sorbed by biological particles. After 20 sec mixing, the pH is adjusted to 5.0. Then the soluble ferric chloride species polymerizes, forming insoluble bridges more evenly sorbed by solids than those produced by the constant pH method. This method removed 13 mg per liter biological solids with 1 mg per liter ferric chloride, a 25% savings in chemical over the constant pH method. (Cassar-FRC)
W82-04373

ON THE MARGINAL COST OF WASTEWATER SERVICES,

President's Council of Economic Advisers, Washington, DC.
For primary bibliographic entry see Field 6C.
W82-04376

WASTEWATER DECHLORINATION STATE-OF-THE-ART FIELD SURVEY AND PILOT STUDIES,

Los Angeles County Sanitation Districts, Whittier, CA.
C. Chen, and H. B. Gan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102336, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-169, October 1981. 5 p, 6 Fig. 14-12-150, 68-03-2745.

Descriptors: *Wastewater treatment, *Dechlorination, *Activated carbon, *Sulfur dioxide, *Holding tanks, *Cost analysis, Residual chlorine, Coliforms, Effluents, Aeration, Bacteria, chemical treatment, Disinfection, Los Angeles county, California.

A study of dechlorination was conducted in the County Sanitation Districts of Los Angeles County to determine the utility and efficiency of the sulfur dioxide method and to provide a cost-effective comparison of sulfur dioxide and two other methods of dechlorination, namely, activated carbon and holding tank processes. Pilot-scale testing indicated that no degradation of physical and chemical water quality occurred in the dechlorinated effluents from any of the three dechlorination processes investigated. However, a one to two order of magnitude increase in total coliform density in the 10-minute samples following dechlorination was commonly observed among the three dechlorination processes. The increase seemed to originate from contamination by the existing microorganism communities in the dechlorinated effluent rather than from the reactivation of injured bacterial cells. A field survey involved the canvassing of 55 operating plants in California by mail, telephone, and site visits to selected facilities. The feed forward method of sulfur dioxide dosage control with signals received from both a flow and residual chlorine controller appeared to be the most commonly employed method. Although overdosing of sulfur dioxide was frequently necessary to meet the residual chlorine discharge standards, most installations found pH adjustment and reaeration of the dechlorinated effluent unnecessary. Process cost estimates based on the field survey and pilot-plant study have been prepared for all three dechlorination processes. The sulfur dioxide process seems to be the most cost-effective method for dechlorination. (Moore-SRC)
W82-04392

PERFORMANCE OF ACTIVATED SLUDGE PROCESSES: RELIABILITY, STABILITY AND VARIABILITY,

Brown and Caldwell, Pasadena, CA.
S. Niku, E. D. Schroeder, G. Tchobanoglous, and F. J. Samaniego.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109604, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-227, December, 1981.11 p, 3 Fig, 6 Tab. R805097-01.

Descriptors: *Wastewater treatment, *Activated sludge process, *Effluents, *Statistical analysis, Standards, Variability, Reliability, Mathematical models, Biochemical oxygen demand, Suspended solids, Effluent variables.

Variations in the daily effluent quality of 43 activated sludge processes were examined. From an analysis of the data, it was found that the effluent variables are not distributed symmetrically, and generally their distributions are skewed further to the right than to the left of the most frequent value. The log-normal distribution was fond to fit the observed effluent biochemical oxygen demand (BOD) and suspended solids (SS) data most consistently. Using the lognormal distribution and a coefficient of reliability (COR), a probabilistic model and design tables and graphs have been developed for predicting achievable effluent BOD and SS concentrations. Mean constituent values are correlated to selected standards with the COR. The proposed model can be used in the design of a treatment process expected to perform at a certain reliability and/or to estimate the reliability of an operating treatment plant. Validity of the reliability model in prediction of effluent quality performance has been verified. The standard deviation was found to be the most appropriate indicator of stability. A standard deviation of 10 g/cu m was selected as stability cut-off point on the basis of a qualitative examination of the data. Plants with effluent values below 10 g/cu m are considered stable; plants with values greater than 10 g/cu m are considered unstable. No single variable or group of variables was found that could be used to characterize the variability of effluent quality for all plants in general. The appropriateness of effluent standards as they are currently stated was discussed, and the use of the geometric mean as a measure of central tendency of daily effluent quality data was recommended for setting discharge standards. (Moore-SRC)
W82-04394

SURVEY AND EVALUATION OF FINE BUBBLE DOME DIFFUSER AERATION EQUIPMENT,

Association of Metroplitan Sewerage Agencies, Washington, DC.
D. H. Houck, and A. G. Boon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105578, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-222, October, 1981. 8 p, 5 Tab. R806990.

Descriptors: *Aerators, *Wastewater treatment, *Oxygen transfer, *Activated sludge process, Maintenance, Cost analysis, Energy, Design criteria.

Aeration equipment employed in activated sludge service is usually the single largest energy consumer in a wastewater treatment plant. Because fine bubble aeration equipment has the potential for markedly higher oxygen transfer efficiencies than coarse bubble designs, its use is rapidly expanding in new or retrofitted treatment plants. In order to assess the long-term oxygen transfer performance, and operation and maintenance history of fine bubble dome diffuser aerators, 19 treatment plants were studied. Thirteen of the plants were in the United Kingdom, two in the Netherlands, and four in the U. S. As nearly as possible, data on influent and effluent wastewater characteristics, power demand, air supply, and process parameters were compiled for a 5-yr period. Maintenance personnel were interviewed to develop a summary of long-term operation and maintenance experience. Specific designs and plant equipment for aeration, air clearing, and diffuser maintenance were studied. Although this survey clearly shows the need for optimized design and operating control strategies to realize the full energy saving potential of this type of equipment, dome diffuser fine bubble aeration systems were providing relatively efficient, low-maintenance service in the plants visited. (Moore-SRC)
W82-04395

DEMONSTRATION PHYSICAL CHEMICAL SEWAGE TREATMENT PLANT UTILIZING BIOLOGICAL NITRIFICATION,

Municipal Environmental Research Lab., Cincinnati, OH.
J. F. Kreissl, and R. F. Lewis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101643, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-173, October, 1981. 7 p, 2 Fig. 2 Tab.

Descriptors: *Physicochemical treatment, *Biological wastewater treatment, *Nitrification, *Wastewater treatment, Domestic wastes, Phosphorus removal, Nitrogen removal, Effluent, Oxygen demand.

This demonstration project was conducted to show that wastewater could be treated in a physical-chemical wastewater treatment plant employing a biological intermediate stage for oxidation of nitrogenous material to produce a high quality effluent and provide different treatment levels to meet a variety of effluent requirements. The physical-chemical plant chosen was of a modular design employing high-rate processes which normally facilitate a relatively speedy installation, a minimum amount of lag time to produce the desired effluent quality, and ease of transport for relocation to other critical areas when needed. The plant was located in the drainage area of a planned residential development known as Beechgrove Village in Kentucky. The wastewater was domestic in nature with no commercial or industrial sources. The removals of BOD5, COD, total organic carbon and suspended solids were excellent. Phosphorus removal was also excellent but the nitrogen removal was rather low. Nitrification never properly developed during the course of the study, even though the nitrogen removals averaged 32%. Although the system produced a consistent, high quality effluent, its utility as a transportable system was only partially demonstrated and its viability as a treatment sequence could not be confirmed due to several design and operational problems. (Moore-SRC)
W82-04397

DESIGN OPTIMIZATION OF THE CHLORINATION PROCESS: VOLUME 1. COMPARISON OF OPTIMIZED PILOT SYSTEM WITH EXISTING FULL-SCALE SYSTEMS,

California Dept. of Health Services, Berkeley.
E. Sepp, and P. Bao.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-100835, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-167, October, 1981. 5 p, 2 Fig. 2 Tab. S-803459.

Descriptors: *Chlorination, *Wastewater treatment, *Disinfection, *Effluents, *Residual chlorine, Coliforms, Toxicity, Pilot plants, Contact time, Mixing, Plug flow, Bacteria, Water pollution control.

Parallel wastewater effluent chlorination studies were done on a mobile optimized chlorination pilot system and the full-scale system at eight different treatment plants. Disinfection efficiency was measured by total coliform enumeration and chlorine residual tests. Parallel flow-through fish bioassays were also conducted at each location. The objectives of the study were as follows: achievement of adequate disinfection with minimum use of chlorine; reduction of chlorine-induced toxicity; and writing of a design manual. At 7 of the 8 plants studied the optimized pilot plant achieved an equivalent level of disinfection with significantly lower chlorine dosage, in some cases more than 50% lower, than the full-scale plants. The pilot plant chlorine residuals were also lower by the same proportions. The reasons for the better pilot plant results were rapid initial mixing, improved chlorine control, and plug flow contact. In most cases the bacterial survival ratio could be expressed as a function of the product of chlorine residual and contact time. There appeared to be, however, a limiting contact time to which this relationship applied. The degree of coliform reduction obtained during initial mixing appeared to be a function of chlorine residual. (Author's abstract)
W82-04399

HOURLY DIURNAL FLOW VARIATIONS IN PUBLICLY-OWNED WASTEWATER TREATMENT FACILITIES,

Weston (Roy F.), Inc., West Chester, PA.
W. H. Chesner, and M. Pai.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-107954, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-218, October, 1981. 4 p, 2 Tab. 68-03-2775.

Descriptors: *Flow rate, *Wastewater, *Sewer systems, *Wastewater facilities, *Sewer infiltration, Pumps, Seasonal distribution, Industrial wastewater, *Diurnal distribution, Groundwater level, Design criteria, *Hydraulic design.

Flow variations are rarely addressed in the design of wastewater treatment plants. A survey of 39 sanitary sewer collection systems was undertaken to determine the magnitude of hourly peak flows and to identify the collection system parameters that were most influential in affecting the observed peaks. Significant collection system parameters identified included industrial contribution, average age of the collection system, depth to groundwater, and low-lift, pre-plant pumping stations. Collection systems with industrial or institutional flow contributions greater than 40% were found consistently to have higher daily peak flows than those below 40%. Industrial flows can also be seasonal, with flows during the industrial season resulting in higher peaking factors. Peak flow hours of the day tend to occur at earlier hours in industry-dominated systems. Nonindustrial collection systems with an average age greater than 25 years and high groundwater tables are more susceptible to infiltration, and exhibit higher peaking factors during the spring or infiltration season. The mean average hourly peak flow for nonindustrial systems, excluding inflow, was found to be 1.23 times the annual average daily flow. As collection system flow rate increases, variations around the mean value decrease. Instantaneous maximum peaking factors for low-lit, pump-dominated systems ranged from 1.3 to 4.7, and the minimum instantaneous flow factors varied from 0 to 0.8. (Moore-SRC)
W82-04402

EVALUATION OF ON-SITE WASTEWATER TREATMENT AND DISPOSAL OPTIONS,

Municipal Environmental Research Lab., Cincinnati, OH.
J. A. Heidman, and R. P. G. Bowker.
Available from National Technical Information Service, Springfield, VA 22161 as PB82-101635, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-178, October, 1981. 5 p, 1 Tab. 68-03-2627.

Descriptors: *Wastewater treatment, *Wastewater disposal, *Domestic wastes, *On-site systems, *Wastewater management, Literature review, Disinfection, Land disposal, Biological treatment, Physicochemical treatment, Cost analysis, Environmental effects, Soil properties.

A literature review of published and unpublished data was conducted to identify conceivable on-site systems, including wastewater manipulation, treatment, and disposal options. Wastewater manipulation options included flow reduction, wasteload reduction, and waste segregation. Treatment options included disinfection and biological and physical/chemical methods. Disposal options included air, soil, and surface water methods and practical combinations. Both tested and untested systems were identified, and combinations of the various components were developed. An equipment inventory was then performed to determine the availability of hardware for the systems, and system components were identified. Data on engineering, economic, and environmental acceptability characteristics were collected. These systems were evaluated on the basis of performance, operation and maintenance, environmental acceptability, and total annual cost for 15 specific site conditions. Site conditions were defined by soil percolation rate, soil depth, slope, available land area, direct discharge effluent requirements, and net evaporation. Where site conditions are appropriate (conventional septic tank-soil absorption systems) were found to be the least-cost and top-ranked method of on-site wastewater treatment and disposal. Under other conditions, systems incorporating other methods of disposal, such as soil disposal with modified distribution, mounds, evapotranspiration, irrigation, evaporation, or direct discharge, are appropriate. A septic tank normally provides adequate pretreatment for most of these disposal methods. Where irrigation or surface discharge disposal is used, additional treatment, such as that provided by an intermittent sand filter and iodine disinfection, may be required. Use of low pressure membrane filtration where high quality effluent is required also appears promising, based on very limited operating experience.
W82-04404

PRODUCTION ENGINEERING AND MARKETING ANALYSIS OF THE ROTATING DISK EVAPORATOR,

Municipal Environmental Research Lab., Cincinnati, OH.
J. A. Heidman, and R. P. G. Bowker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101676, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-179, October, 1981. 4 p, 1 Fig, 5 Tab. 68-03-2738.

Descriptors: *Wastewater treatment, *On-site systems, *Rotating disk evaporators, *Cost analysis, *Domestic wastes, *Marketing, Climates, Evaporators, Economic aspects, Wastewater disposal.

Recent research into the on-site, mechanical evaporation of wastewater from single family homes revealed that a rotating disk evaporator (RDE) could function in an non-discharging mode. Such a device has potential use where site limitations preclude conventional methods for on-site disposal. A marketing analysis of the RDE defined the market potential, developed a practical design, estimated production and installation costs, and refined market estimates based on cost comparisons. A small unit suitable for only the most favorable climates would have an FOB factory selling price of about $10,000 if fabricated with aluminum disks. Distribution costs and freight will amount to about $3,300. An additional $8,000 is required for installation (including a storage tank), resulting in a total capital cost of about $22,000. Including amortized capital costs, and operating and maintenance costs, an RDE system would treat household wastewater for about 3.4 cents/gallon. Because of these high

costs, the potential RDE market is quite small. It is limited to very expensive homes, second homes with no winter occupancy, and high cash-flow, low sewage-flow commercial establishments. Furthermore, unfavorable climatic conditions eliminate much of the nation from consideration. It is unlikely that manufacturers of RDE systems would collectively generate national sales of 100 units/year. (Moore-SRC)
W82-04405

TREATABILITY STUDIES OF PESTICIDE MANUFACTURING WASTEWATERS,

Research Triangle Inst., Research Triangle Park, NC.
R. Zweidinger, E. Monnig, L. Little, R. Batten, and D. Liverman.
Environmental Protection Agency Project Summary EPA-600/S2-80-077, December, 1981. 4 p, 1 Fig, 3 Ref.

Descriptors: *Pesticides, *Industrial wastes, *Wastewater treatment, *Biological wastewater treatment, Activated sludge process, Fungicides, Herbicides, Insecticides, Carbamate pesticides, Biodegradation, Nitrification.

Laboratory and pilot studies of the treatability of pesticide manufacturing wastewaters were conducted in a project designed to investigate the suitability of individual pesticide manufacturing wastewaters for discharge to biological treatment systems, whether publicly owned treatment works or on-site systems. The pesticides studied were carbaryl, dinoseb, atrazine, dazomet, glyphosate, and an ethylenebisdithiocarbamate fungicide. The approach taken with each pesticide manufacturing wastewater was prioritized; that is, less costly, more available methods of treatment were investigated. The preferred method of treatment was assumed to be biological. Both carbaryl manufacturing wastewater, when mixed 1 part in 9 with municipal wastewater, and carbaryl itself, spiked at 10 mg/l in municipal wastewater, appear suitable for biological treatment by acclimated systems if additional provision is made for removing ammonia in the effluents from the treatment system. The effluent from the manufacture of dinoseb and atrazine proved suitable for a treatment system involving preliminary activated carbon filtration to remove the herbicide, followed by biological treatment to reduce oxygen demand exerted by solvents and other organic compounds. It is recommended that dazomet wastewater be diluted to at least 1:1000 in municipal wastewater to minimize the negative effects on the nitrification of during the activated sludge treatment process. Biological treatment significantly reduced the toxicity of hlyphosate effluents, but hlyphosate itself showed only partial reduction with treatment (38 to 45%). The presence of ethylenebisdithiocarbamate fungicide manufacturing wastewater strongly inhibits nitrification in activated sludge units. Biological treatment decreased, but failed to eliminate, the amount of ethylenethiourea in the wastewaters. (Moore-SRC)
W82-04406

TREATMENT OF SULFITE EVAPORATION CONDENSATE WITH AN ANAEROBIC REACTOR,

Washington Univ., Seattle. Dept. of Civil Engineering.
M. M. Benjamin, J. F. Ferguson, and M. E. Buggins.
In: Proceedings TAPPI Environmental Conference, 1981, TAPPI Press, Atlanta, Georgia, p 307-316. 6 Fig, 7 Tab, 7 Ref.

Descriptors: *Anaerobic treatment, Methane fermentation, Sulfite evaporator condensate, *Wastewater treatment, *Organic wastes, Sulfur compounds, Toxicity.

A study has been underway since 1979 evaluating the use of submerged anaerobic reactors to treat sulfite evaporator condensate (SEC). Both SEC from a calcium bisulfite mill and a synthetic SEC have been treated at an organic loading of 16 kg COD/m3.d and a detention time of seven hours, achieving 79% to 90% reduction in COD. A yield coefficient of 0.09 gr cells/gr COD removed has been calculated, and the balance of the removed COD is stoichiometrically converted to CH4. Toxicity from sulfur compounds, furfural or trace organics have not been a problem. Partial neutralization of the feed is necessary, as are additions of nitrogen, phosphorus and some trace nutrients. The process produces methane with a significant energy value. In addition, when used as pretreatment, it reduces the energy needed for aerobic treatment.
W82-04419

DEVELOPING AN EFFECTIVE MAINTENANCE PROGRAM PART A: EVALUATION,

Morris Forman Wastewater Treatment Plant, Louisville, KY.
G. R. Freiberg, and W. B. Thompson.
Water/Engineering and Management, Vol 129, No 1, p 30-33, January, 1980. 4 Fig.

Descriptors: *Maintenance, *Wastewater treatment facilities, Maintenance costs, Water treatment facilities, Planning, Management, *Louisville, Kentucky.

Many wastewater treatment facilities have a common problem of spending too much time keeping things running, and not enough time searching for ways to improve operational efficiency. The wastewater treatment plant in Louisville, Kentucky was used to develop an evaluation and implementation procedure for the establishment or upgrading of maintenance systems. The focus of the study was primarily on preventive maintenance, but water and wastewater managers and engineers should find the approach applicable to most maintenance activities. The strengths and weaknesses of each functional area were examined. One major problem which was exposed by this procedure was a substantial spread between estimated and actual costs. Reasons for this appeared to be that either the work was improperly estimated, or workers took too much time and used too much material to complete the task. A review of the existing work order procedure led to a new, more clearly defined set of instructions. Corrective and major maintenance scheduling and planning procedures proved to be ineffective. District-wide accounting and spare parts inventory procedures were included in the study because of their indirect, but critical, effect on the entire maintenance program. The purpose of any maintenance management system is to obtain reliable, efficient, cost-effective service from the equipment. Preventive maintenance is seen as just one element of any comprehensive program. (Baker-FRC)
W82-04447

TERMINAL REACTIONS IN THE ANAEROBIC DIGESTION OF ANIMAL WASTE,

Research Council of Alberta, Edmonton.
D. R. Boone.
Applied and Environmental Microbiology, Vol 43, No 1, p 57-64, 1982. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Anaerobic digestion, *Animal wastes, Organic matter, Biological treatment, *Wastewater treatment, Digestion, Biodegradation.

The terminal reactions of anaerobic digestion were examined to determine whether they are rate limiting. Acetate degradation was measured in digestors which were fed animal waste and in digestors fed animal waste with ultimate methanogenic substrates added continuously to the fermentation. The continuous pumping of acetic acid into the digestor caused an increase in acetate concentration in the effluent which was proportional to the increase in total acetate production, biological production plus amount pumped in. Propionate concentration also increased, perhaps due to product inhibition of propionate-degrading bacteria by the higher levels of acetic acid or due to increased propionate production by fermentative bacteria. When H2/CO2 was the added substrate, there were occasional instabilities in the fermentation immediately after increases in addition rate. The data allow the hypothesis that abrupt changes in digestor influent substrates, which cause a rapid increase in hydrogen production by hydrogen-producing microflora, could create instabilities, causing digestor failure. Digestors with added acetate or H2/CO2 converted at least 95% of the added substrates stoichiometrically to methane, assuming gas production from the animal waste was the same as in controls with no added substrates. Also, volatile solids destruction was similar in the presence and absence of added substrates, suggesting that fermentation of animal waste was not significantly affected by the added load on the methanogenic bacteria. Acetate levels in the digestor with added H2/CO2 were higher, apparently due to both increased acetate production and inhibition of acetate dissimilation. Increases in H2 addition caused temporary instabilities in the fermentation, whereas increases in acetate addition did not. (Baker-FRC)
W82-04454

BIODEGRADATION OF GLYCIDOL AND GLYCIDYL NITRATE,

Army Natick Research and Development Labs., MA.
D. L. Kaplan, J. H. Cornell, and A. M. Kaplan.
Applied and Environmental Microbiology, Vol 43, No 1, p 144-150, 1982. 7 Fig, 13 Ref.

Descriptors: *Nitrates, *Biodegradation, *Organic compounds, *Wastewater treatment, Chemical reactions, Industrial wastes, Biological treatment, Biological wastewater treatment, Nitroglycerine, Mutagens, *Glycidol.

The fate of glycidol and glycidyl nitrate was examined under exposure to microbial activity in order to indicate the feasibility of a biological approach to the decomposition of glycerol trinitrate chemical reaction products. The desensitization of glycerol trinitrate containing waste streams with calcium hydroxide produces the expoxides, glycidol and glycidyl nitrate. Epoxide rings of both compounds are unstable to heat in aqueous solutions. They open to form glycerol 1-mononitrate and presumably glycerol. Microbial activity accelerates these transformations. Glycerol 1-mononitrate was slowly denitrated to form glycerol. Glycidol and glycidyl nitrate caused base pair substitutions in the Ames test for mutagenicity, whereas glycerol 1-mononitrate tests were negative. Biological treatment causes a loss of the mutagenic activity. (Baker-FRC)
W82-04456

PROPORTIONS OF SEVERAL ELEMENTS FOUND IN SEWAGE EFFLUENT AND SLUDGE FROM SEVERAL MUNICIPALITIES IN WEST VIRGINIA,

West Virginia Univ., Morgantown. Div. of Animal and Veterinary Sciences.
For primary bibliographic entry see Field 5B.
W82-04465

THE FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS,

Henkel KGaA, Dusseldorf (Germany, F.C.). Dept. of Ecology.
P. Wierich, and P. Gerike.
Ecotoxicology and Environmental Safety, Vol 5, No 2, p 161-170, 1981. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Wastewater treatment, *Adsorption, *Activated sludge process, *Fate of pollutants, Organic compounds, Degradation, Biodegradation, Model studies, Retention time.

A mathematical model was developed to describe the fate of a compound in the activated sludge stage of sewage treatment plants. The compounds under consideration were soluble, nonbiodegradable, and strongly adsorbing. It was concluded that high adsorption in a batch test did not guarantee efficient elimination in a continuous flow activatd sludge process. The effluent concentration reached a limiting value dependent on adsorption constant of the sludge and the surplus sludge wasteage rate. The retention time of the adsorbate exceeded the mean retention time of the sewage and increased with increasing adsorption constant. The maximum

load of the adsorbent on the sludge was lower than the maximum capacity indicated by static batch tests, but it was higher than the influent concentration. The model described in this paper permitted calculation of a base value above which elimination in activated sludge tests was due to biodegradation and not just adsorption. (Cassar-FRC)
W82-04477

MUNICIPAL SEWAGE TREATMENT - SOME RECENT DEVELOPMENTS,

J. M. Sidwick.
Effluent and Water Treatment Journal, Vol 21, No 11, p 501, 503, 505-507, November, 1981. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, Reviews, Sedimentation, Filtration, Activated sludge process, Nitrification, Dissolved oxygen, Anaerobic conditions, Aeronic conditions, Anaerobic digestion, Computers, Automation, *Wastewater management.

Recent developments in the municipal sewage treatment field are discused. The two most significant trends in primary sedimentation are the increasing use of chemical precipitation and a move toward reducing retention time. Chemical precipitation is being used primarily to remove phosphorus from sewage. Biological filtration has recently been connected with serious odor complications. Part of the problem seems to be the inability of a high rate filter to supply sufficient oxygen to maintain an adequately aerobic biomass, with the consequent development of anaerobic degradation products which escape from the filter aerially or with the wasted sludge. In the conventional activated sludge system the most important new developments relate to the use of this process for nitrogen removal. The chief attraction of biological denitrification is that the nitrogen is completely removed from the system as nitrogen gas without causing atmospheric pollution or a liquor concentrate. Two of the most important recent developments from conventional activated sludge treatment are the use of oxygen-enriched air and the deep shaft process. Biological fluidized beds have only very recently been considered for wastewater treatment. The principle of the fluidized beds is that mixed microbial cultures associated with wastewater have excellent adhesion characteristics. The value of anaerobic treatment has been appreciated for many years, but its application has largely been restricted to sludges and a few particularly strong biodegradable organic industrial effluents. The long retention periods needed for this process have tended to make it costly, and effluents have not been of high quality. Recent advances in the area of instrumentation for automation and control are briefly mentioned. (Baker-FRC)
W82-04528

LABORATORY EXPERIMENTS ON THE PHYSICO-CHEMICAL TREATMENT OF MEAT PROCESSING EFFLUENTS,

Research Inst. for Water Resources Development, Budapest (Hungary).
I. Tookos.
Effluent and Water Treatment Journal, Vol 21, No 11, p 493-500, November, 1981. 6 Fig, 3 Tab, 29 Ref.

Descriptors: *Meat processing industry, *Wastewater treatment, Effluents, Industrial wastes, Chemical coagulation, Separation techniques, Particle size, Coiloids, Dissolved organic matter, Chemical engineering, Reviews, Bentonite, *Chemical treatment.

Effluents produced in the course of meat processing operations are highly detrimental, rich in coarse, floating, suspended and dissolved organic pollutants, and have high oxygen demands and unpleasant odors. Intensive mechanical primary treatment processes are effective in removing only coarse pollutants larger than 1-2 mm diameter, but the effluent is still very highly polluted. The physico-chemical treatment of wastewaters produced during the slaughtering and processing of poultry and meat is reviewed. The amount of pollutants removed was found to increase in a linear proportion with the strength of the wastewater treated. A relatively constant treatment efficiency can be expected. Evidently, the same close correlation exists between the raw wastewater and the treated effluent as well. In the case of wastewaters containing particulate matter not larger than 1-2 mm in size, laboratory studies demonstrated that the amount of colloidal substance precipitated did not depend on whether the pollutant was present in suspended form, or in a state which may be regarded as dissolved from the viewpoint of treatment technology. The optimal range of chemical feed rate determined by the laboratory provided no more than preliminary guidance. Higher feed rates may be needed in the interests of precipitate separation if the stability of the resulting sludge is poor. Bentonites alone were ineffective in precipitating colloidal proteins. Results obtained with sulfonic acid were poorer than had been expected. This was due to the carbohydrate content of the coagulant used in the study. The precipitate formed was highly unstable and impossible to remove by sedimentation. (Baker-FRC)
W82-04532

MICROBIOLOGY OF ANAEROBIC DIGESTORS FOR WASTEWATER PURIFICATION. (MICROBIOLOGIE DES DIGESTEURS ANAEROBIES DE L'EPURATION DES EAUX RESIDUAIRES),

Institut National de la Recherche Agronomique, Villeneuve-d' Ascq (France). Station de Technologie Alimentaire.
J. P. Touzel, E. Samain, G. Albagnac, and J. N. Morfaux.
Industries Alimentaires et Agricoles, Vol 98, No 10, p 845-847, 1981. 8 Fig, 3 Tab, 28 Ref. English Summary.

Descriptors: *Bacterial analysis, *Wastewater treatment, *Anaerobic digestion, Microbiological studies, Metabolism, Methane, *Food processing industry, Industrial wastewaters, Organic compounds, Hydrogen.

Detailed information concerning the biochemical characteristics of microbial populations employed in anaerobic digestion aid in optimization of the processes. Studies were performed on laboratory methane digesters treating food processing wastewaters, using recently developed techniques for isolating and growing strictly anaerobic bacteria. The pilot-scale digester was originally inoculated with municipal digester sludge. Media used for enumeration of the total flora and the lactate, propionate and acetate utilizing flora included an all-synthetic reference medium, a rumen fluid medium, a medium based on digester fluid, a medium based on the fluid from the digester from which the flora was taken, and fluid from a municipal digester. The anaerobic precautions employed were adequate to protect the oxygen-sensitive organisms. The predominant bacteria in the total flora were slow growing. The all-synthetic medium seemed to be the medium of choice for total flora enumeration. Presumptive identification was made of the lactate-utilizing strains, the presence of which indicates that the digestion of sugars proceeds through a lactate phase. Acetate enrichment cultures were set up to ascertain the importance of acetate as an intermediate in sugar digestion under the test conditions. After six transfers, bacteria of two principal morphological types were demonstrated: an elongated filament and a sarcina, which were tentatively identified with recently described strains. In propionate enrichment cultures, after four transfers, consumption of propionate and formation of methane were noted. Microscopic observation at this stage revealed the presence of a filamentous bacterium analogous to that obtained on acetate enrichment. Previous studies have shown that degradation of acetate and propionate does not take place in the presence of hydrogen. Hydrogen is therefore being efficiently eliminated from this medium by the methanogenic bacteria. (Carroll-FRC)
W82-04544

INCREASING WASTEWATER TREATMENT EFFICIENCY (UBER DIE ERHOHUNG DES WIRKUNGSGRADES DER ABWASSERREINIGUNG),

P. Benedek.
GWF-Wasser/Abwasser, Vol 122, No 12, p 573-581, 1981. 6 Fig, 10 Tab, 37 Ref. English Summary.

Descriptors: *Wastewater treatment, *Activated sludge process, *Cost effectiveness, Activated carbon, Lake Balaton, *Hungary, Chemical coagulation, Aluminum sulfate, Phosphorus removal, Heavy metals, Organic compounds, Sand filtration, Technology.

In recent years VITUKI, the central research institute of the Hungarian water agency, performed laboratory, pilot and full-scale studies on improvements in wastewater treatment technology. Operating data, cost analyses, and the possibility of process combinations are reported. Heavy metal removal following filtration was found to be poorer in biologically treated wastewater than in the raw wastewater, apparently due to complexation by degradation products. Therefore maximal heavy metal removal prior to biological treatment is important. Providing a mixing pond, prior to the preclarifier, in which the wastewater remains for a few minutes in contact with raw sludge recycled from the preclarifier at the rate of 10-20% would allow precipitation of metals by the sulfides present in the raw sludge. Addition of powdered activated carbon during the activated sludge process was shown to enhance refractory organics removal. Phosphorus elimination, especially important in the case of the Lake Balaton water supply, was accomplished by addition of iron or aluminum sulfate, or with a combination of activated bentonite, aluminum sulfate and polyelectrolytes. Sand filtration guidelines are currently being optimized. Cost comparisons for different combinations of treatment processes showed that the activated sludge process with activated carbon provides greatest cost effectiveness for small and medium sized wastewater treatment plants and can easily be combined with phosphate precipitation by aluminum sulfate. (Carroll-FRC)
W82-04545

THE IMPORTANCE OF THE SOLIDS CONTENT OF THE SLUDGE IN ANAEROBIC ALKALINE DIGESTION (DIE BEDEUTUNG DES FESTSTOFFGEHALTS BEI DER SCHLAMMFAULUNG),

Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergueteund Abfallwirtschaft.
H. Kapp.
Wasserwirtschaft, Vol 71, No 11, p 319-322, 1981. 3 Fig, 6 Ref. English Summary.

Descriptors: *Mathematical studies, *Anaerobic digestion, *Wastewater treatment, Organic compounds, Sewage gas, Energy conservation, Sludge solids.

Anaerobic digestion has the advantages over aerobic digestion for sewage treatment of lower energy costs (the air supply accounts for 80% of the total energy requirement in an aerobic sewage treatment plant) and production of an off gas usable for heating. Disadvantages include the lability of the process and greater construction costs. A simple equation was developed for assessing the degree of degradation of the organic matter and thus the degree of anaerobic stabilization. Degradation rates of about 50% based on the organic matter supplied are considered normal for municipal sludges. The degree of sludge degradation was plotted against the loss on ignition of the original sludge, using the loss on ignition in the digester sludge as the parameter. This equation and graph should be used for evaluating the digestion results only over long periods (e.g., months), although this is also customary for other methods as well (solids balances). The method is applicable for operation with or without water withdrawal. A pseudo-three-dimensional plot was also developed, relating the initial solids contents, digested sludge solids content, and organic solids fraction in the sludge at different degrees of degradation. (Carroll-FRC)
W82-04549

VARIATION OF SLUDGE VOLUME INDEX WITH ACTIVATED SLUDGE CHARACTERISTICS,

Georgia Inst. of Tech. Atlanta. School of Civil Engineering.
M. Sezgin.
Water Research, Vol 16, No 1, p 83-88, January, 1982. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Sludge volume index, *Microorganisms, *Settling velocity, Suspended solids, *Activated sludge, Flocculation, Wastewater treatment, *Wastewater facilities.

Activated sludge samples from two laboratory sources and 12 sewage plants were used to investigate the variation of sludge volume index (SVI) with the quantity of filamentous microorganisms and floc size at different suspended solids concentrations. For a suspended solids concentration range of 700-4800 mg per liter, the SVI increased sharply with filament length concentrations of over 10,000,000 microns per mg suspended solids. At filament length concentrations less than 10,000,000 microns per mg suspended solids, SVI was unaffected by filament length but increased with increasing mean floc size. A well-defined relationship between SVI and zone settling velocity (cm per min) was found at all suspended solids concentrations examined. Maximum attainable SVI varied from 1429 to 208 mg per liter over the suspended solids concentration range, 700-4800 mg per liter. The zone settling velocities corresponding to the maximum attainable SVI were 2 to 0 cm per sec. This relationship was independent of the source and type of sludge, domestic or industrial. (Caesar-FRC)
W82-04555

BENEFITS FROM WATER CONSERVATION DEPEND ON COMPREHENSIVE PLANNING,

Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3D.
W82-04557

MULTIPERIOD DESIGN OF REGIONAL WASTEWATER SYSTEMS: GENERATING AND EVALUATING ALTERNATIVE PLANTS,

Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
M. Nakamura, E. D. Brill, Jr., and J. C. Liebman.
Water Resources Research, Vol 17, No 5, p 1339-1348, October, 1981. 8 Fig, 3 Tab, 11 Ref. OWRT A-082-ILL.

Descriptors: *Wastewater treatment, Planning, *Design criteria, Decision making, *Model studies, flow, Network design, *Wastewater facilities.

An extension was prepared of previous works dealing with the generation of single-period alternative solutions and the comparison of alternative regional plans using an impunted value analysis method. The primary purpose of the method is generation of multiperiod locations and facility expansion timings. The method is based on several simplifying assumptions. The solution procedure involves a branch and bound algorithm specifically developed for integrating a set of solutions obtained using the initial design flow with a set of solutions obtained using the terminal design flow. A method for comparing the generated multiperiod alternatives is also presented. The usefulness of the method is demonstrated with an example of a hypothetical regional wastewater system. A Fortran program was written to implement the method. Based on the simplifying assumptions, construction and operating and maintenance costs were reduced to functions of the initial and terminal design year flows, creating two decomposed problems. The two decomposed problems can be tied together using coupling constraints, and a coupled branch and bound process can be used to obtain solutions. The method can generate many alternative plans besides the approximate least cost solution, and the imputed value incidence matrix can be provided. This approach represents a significant departure from conventional multiperiod public facility location analysis, and may be very useful for analyzing other water resources problems that include concave cost functions. (Baker-FRC)
W82-04562

WATER REUSE PLANNING MODELS: EXTENSIONS AND APPLICATIONS,

Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-04565

WATER RECYCLING/REUSE IN THE FOOD PROCESSING INDUSTRY,

Montgomery (James), Inc., Walnut Creek, CA.
L. L. Russell, C. Creson, and K. Conarroe.
Industrial Wastes, Vol 27, No 5, p 25-28, September/October, 1981. 3 Fig, 1 Tab. OWRT C-9416.

Descriptors: *Water reuse, *Food processing industry, *Industrial water, Water conservation, Dairy industry, Meat processing industry, Poultry, Sugar refining, Wastewater reclamation, *Wastewater renovation, Wastewater treatment.

An evaluation of 10,000 U.S. food processing plants revealed the potential for water reuse/recycling in this industry. Reuse is defined as treated wastewater recycled within the facility; recycle is defined as multiple use of wastewater within the facility. Time and economic constraints limit a practical implementation to water conservation and recycling for the present. By the year 2000 increased costs and decreased water supplies may necessitate water reuse in some segments of the industry. Health and safety must be carefully considered in water recycling. Fruit and vegetable processing with terminal heat processing are intrinsically safer than meat and poultry packing, where the product is served to the consumer without heat treatment. Small plants will find it less practical to recycle water than large facilities. Water reuse presents further concerns: trihalomethanes production, concentration of pesticides, and pathogenic organisms. Major water-using food industries are sugar refining, canning and preserving fruits and vegetables, grain milling, meat packing, poultry dressing, dairy product manufacture, and beverages. Water reuse facilities at the Snokist Growers fruit processing plant in Yakima, Washington, and the Sterling Poultry Processing Corp., Maryland, are described. (Caesar-FRC)
W82-04566

THE EFFECTS OF PH AND SUSPENDED SOLIDS IN THE REMOVAL OF ORGANICS FROM WATER AND WASTEWATERS BY THE ACTIVATED CARBON ADSORPTION PROCESS,

Birmingham Univ. (England). Dept. of Civil Engineering.
R. J. Martin, and K. O. Iwugo.
Water Research, Vol 16, No 1, p 73-82, January, 1982. 13 Fig, 4 Tab, 32 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Hydrogen ion concentration, *Suspended solids, *Wastewater treatment, Adsorption, Organic matter, Kaolin, Chlorophenol, Cresol, Bromocresol green, Inorganic compounds, Biological treatment, Effluents, Municipal wastewater.

The effects of pH and inorganic and organic suspended solids concentrations on activated carbon adsorption of organic compounds in municipal wastewater and effluents were studied in the laboratory using actual effluents and model solutions. The adsorption capacity and adsorption rate of carbon for o-chlorophenol and o-cresol (molecular weights, 100-130) and bromocresol green (molecular weight, 700) were not affected by the presence of inorganic suspended solids up to 200 mg per liter kaolin. At the 500 mg per liter level adsorption of only the largest molecule was slightly depressed. The organic suspended solids (mixed liquor volatile suspended solids) at 0-200 mg per liter slightly decreased adsorption rates for the three compounds. At the 200-500 mg per liter concentration of organic suspended solids, adsorption rates for the three molecules were significantly reduced. Adsorption capacity was reduced for the two smaller molecules but not for bromocresol green. In both model solutions and sewage effluents adsorption was strongest in the acidic and basic pH regions (3-5 and 10-11), which favored the highest proportion of undissociated molecules. Although pH adjustment of municipal effluents to aid activated carbon adsorption is not justified, it may have an application in industrial wastewater treatment. (Caesar-FRC)
W82-04568

EVALUATION OF INSTRUMENTS FOR CONTINUOUS ACTIVATED SLUDGE MONITORING,

Environmental Protection Service, Burlington (Ontario). Wastewater Technology Centre.
J. P. Stephenson, E. G. Luxon, B. A. Monaghan, and R. G. Gillespie.
Water Science and Technology, Vol 13, No 11/12, p 721-728, 1981. 10 Fig, 4 Tab, 8 Ref.

Descriptors: *Measuring instruments, *Wastewater treatment, *Monitoring, Acidity, Dissolved oxygen, Suspended solids, Temperature, Flow rates, Organic carbon, *Activated sludge process.

The performance of selected commercial monitoring instruments including those for the measurement of dissolved oxygen, pH, suspended solids, temperature, flow and organic carbon has been evaluated. The pilot plant facilities used consist of two identical parallel activated sludge units with a common primary clarifier, and secondary clarifier surface areas. Degritted raw sewage is fed to the primary clarifier at a constant flow rate with uncontrolled variations in constituent concentrations. Primary effluent and return activated sludge are fed to each biological reactor with a maximum flow of 21.6 cubic meters/day. Diffused air is introduced through perforated PVC piping. Three identical dissolved oxygen instruments were monitored and compared to an air-calibrated reference YSI model 54 oxygen meter. Each instrument performed adequately for 141, 125, and 114 days before attention was needed. Two on-line mixed liquor suspended solids instruments and two RASS instruments were assessed by comparison to reference gravimetric analysis. One on-line self cleaning ISS analyzer and two flow-through ESS analyzers were evaluated by comparison to gravimetric results. The study concluded that suitable instruments exist for continuously monitoring the activated sludge process. The accuracies and instrument standard deviations measured indicate that instruments are sufficiently reliable for continuous monitoring and control functions associated with their use. Adequate maintenance and calibration are required if results are to be acceptable. (Baker-FRC)
W82-04594

DYNAMIC STEP FEED CONTROL FOR ORGANIC CARBON REMOVAL IN A SUSPENDED GROWTH SYSTEM,

Environmental Protection Service, Burlington (Ontario). Wastewater Technology Centre.
L. J. Yust, J. P. Stephenson, and K. L. Murphy.
Water Science and Technology, Vol 13, No 11/12, p 729-736, 1981. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Organic carbon, *Wastewater treatment, Wastewater facilities, Activated sludge process, Oxygen uptake, Process control, Effluent, Effluent variability reduction.

The objective of the present study was to reduce effluent variability from wastewater treatment operations. The study investigated the usefulness of SCOUR control (Specific Oxygen Utilization Rate), which is a dynamic indicator of sludge activity, the nature of pollutants, and the substrate reactor concentration. SCOUR is dependent on both the biological oxygen uptake rate and the concentration of activated sludge in the reactor. SCOUR control was achieved by using the step feed process when compared to a single tank completely-mixed process. Filterable organic carbon effluent data suggest that a reduced effluent variability can be obtained from a SCOUR control strategy during high loading periods. At low loading where SCOUR control was inadequate no improvement of SCOUR or effluent total organic

carbon variability was obtained in comparison with the system consisting of a single compartment completely mixed reactor with recycle. A further modification to the SCOUR controller constraints is required to obtain a unique optimal influent flow distribution if the SCOUR value of a three or more compartment system is to be controlled. The problem of increased effluent suspended solids concentrations must be addressed before SCOUR control can be fully evaluated. The maximum computing time for any one optimization did not exceed 10 minutes, making the iterative control presented acceptable for hydraulic time constants characteristic of the step feed activated sludge process. (Baker-FRC)
W82-04595

CONTROL AND AUTOMATION IN WASTEWATER TREATMENT - ADVANCES, UNSOLVED PROBLEMS AND CHALLENGES,

G. Olsson.
Water Science and Technology, Vol 13, No 11/12, p 826-831, 1981. 15 Ref.

Descriptors: *Wastewater treatment, *Automation, Computers, Reviews, *Activated sludge process, Process control, *Costs, *Operating costs.

A workshop was conducted on improving operation and reducing operating costs at wastewater treatment plants through obtaining a better understanding of the dynamics of the plant and the application of instrumentation and control. The activated sludge process is used as a model for the study, as it forms the heart of most wastewater treatment plants and usually requires the highest expenditure of energy. A common objective for plant operation is to minimize the variability of the effluent quality. Effluent quality measurements are often crude. More study is also needed in the area of the linkage between sludge retention time and energy demand, settleability, clarifying properties and activity. The sludge blanket level is cricial for the settler and clarifier operation, but varies widely in practice. Many plants are operated so as to keep the mixed liquor suspended solids concentration constant, but there is seldom any apparent reason for doing so. Dissolved oxygen control has been recognized as a rewarding and meaningful control means, from both an economical and biological viewpoint. The availability of good sensors for wastewater treatment is not satisfactory, sometimes due to a lack of knowledge or proper attitude on the part of the user rather than the manufacturer. Extensive research has been performed during the last decade to develop dynamic models for wastewater treatment systems. (Baker-FRC)
W82-04597

AUTOMATIC OPERATION OF A FREEZE-THAWING AND DEWATERING PLANT FOR SEWAGE SLUDGES,

Mitsubishi Electric Corp., Hyogo (Japan).
T. Honda, S. Hiro, and K. Yamanishi.
Water Science and Technology, Vol 13, No 11/12, p 599-604, 1981. 5 Fig, 3 Ref.

Descriptors: *Automation, *Sludge drying, *Sludge thickening, *Freeze drying, Control systems, Process control, Sludge conditioning, Sludge solids, *Wastewater treatment, Hydrogen ion concentration, Pilot plants, Cost savings.

An automatic control system for a freeze-thawing method of sludge dewatering is described. In the freeze-thawing method, agglomeration of solid sludge occurs during freezing, and the specific filtration resistance is decreased from 10,000 m/kg to 10 to the 12th power m/kg. This allows reductions in sludge moisture content of up to 65 wt% with simple dehydrators, resulting in great decreases in the amount of sludge. Since no coagulant is required during the process, additional water pollution problems are avoided. A density sensor is installed in the thickener to signal when the slurry should be drawn out by a pump to a storage tank. pH monitors are used during pH conditioning, and freez-thawing is controlled by brine temperature and a timer. A pilot plant has used the process with little trouble for over two years. The method is economically competitive with other dewatering techniques and reduces the mass of the dewatered cake to 1/2.5 of that of conventional methods. (Geiger-FRC)
W82-04599

APPLICATION EXAMPLES OF AND OPERATING EXPERIENCES WITH THE USE OF PROCESS COMPUTERS IN SEWAGE TREATMENT PLANTS,

Siemens A.G., Karlsruhe (Germany, F.R.).
E. F. Michel.
Water Science and Technology, Vol 13, No 10, p 483-488, 1981. 4 Fig, 5 Ref.

Descriptors: *Process control, *Computers, *Wastewater treatment, *Automation, Monitoring, Data processing, Wastewater facilities, Control systems, Operating costs, Electronic equipment, Maintenance costs, Netherlands, Sweden, Germany, Comparison studies.

The operating experiences of three sewage treatment plants, the Deventer facility (The Netherlands), the Malmo-Sjolunda plant (Sweden), and the Regenberg plant (Germany) are reviewed. The Deventer plant, which serves a population of roughly 120,000, is equipped with a SAMSY automated process control system. This system has been operating favorably since 1967 and has saved on energy costs, material, and personnel. The Swedish plant serves approximately 530,000 and features two central control stations. The entire process at the Malmo-Sjolunda plant is controlled and monitored by the SIMAT C/SAMSY automation system with the SIMATIC electronic control system as a backup for manual and remote controls. The Regensberg facility was designed to handle a population of 300,000 but plans to handle 400,000. This plant also uses the SIMAT C/SAMSY system along with free programmable electronic controls. These automated systems have improved process control, decreased power costs and reduced maintenance in the aforementioned plants. A new automation system concentrating on decentralized intelligence, the TELEPERM M, is also described. (Geiger-FRC)
W82-04600

EXPERIENCE WITH COMPUTER CONTROL OF WASTEWATER TREATMENT PROCESSES AT LOS ANGELES AND OTHER COMMUNITIES,

Los Angeles Bureau of Sanitation, CA.
W. F. Garber, and J. J. Anderson.
Water Science and Technology, Vol 13, No 11/12, p 759-770, 1981. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Computers, *Automation, Design criteria, Reviews, *Los Angeles, California, Municipal wastewater, Process control, Case studies.

Case study reviews were made of computer controlled wastewater treatment centers at the Hyperion treatment plant at Los Angeles, the Terminal Island treatment plant in Los Angeles, and the Glendale Water Reclamation Plant in Los Angeles, as well as treatment plants in Cleveland, Ohio; Bridgeport, Connecticut; Philadelphia, Pennsylvania; and Moorhead, Minnesota. The studies suggest that it is very difficult to provide isolated environmentally controlled spaces for computers in a wastewater treatment plant. Voltage or current variations lasting for microseconds could drastically affect the computer control systems when such systems were not isolated electrically from the power system supply lines. An analog control loop or other means of control should be provided for selected critical steps or processes, and these should be interfaced with the central processing computer. Computer control systems should not be designed as hybrid systems to handle process control and data processing. Conditions other than maximum should be considered during the design stage. The complexity of the computer control system and the frequency of measurement needs to be carefully studied prior to design. A prime manufacturer/installer should be selected who has the ability and desire to make an installed system work as designed. Cities and operating authorities must provide in advance the necessary trained and dedicated personnel. A number of large central process control computers are not meeting the reliability requirements needed for their acceptance as a useful tool for wastewater control. (Baker-FRC)
W82-04609

AUTOMATIC CONTROL OF SOLIDS RETENTION TIME AND DISSOLVED OXYGEN IN THE ACTIVATED SLUDGE PROCESS,

Environmental Protection Services, Burlington (Ontario). Wastewater Technology Centre.
J. P. Stephenson, B. A. Monaghan, and P. J. Laughton.
Water Science and Technology, Vol 13, No 11/12, p 751-758, 1981. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Wastewater treatment, *Automation, Computers, *Activated sludge process, *Dissolved oxygen, Monitoring, Solids, retention time.

This paper summarizes the dissolved oxygen (DO), solids retention time (SRT), and oxygen uptake rate (OUR) control approaches investigated at pilot scale. The pilot plant consisted of two identical parallel activated sludge units. The results indicate that a computer controlled facility can provide control of the instantaneous SRT equivalent to a well operated manually controlled plant. Energy savings and improved process operating conditions are achieveable through automatic dissolved oxygen control in activated sludge systems. The use of on-line process analyzers for flow and suspended solids, interfaced to a process computer, can provide effective solids inventory control in activated sludge systems. Automatic SRT control can provide solids inventory control equivalent to that achieved in a well controlled manually operated plant. No significant difference can be expected in the effluent quality based on effluent suspended solids. The use of OUR for control of plant solids inventory can be automated readily and merits further development and evaluation. (Baker-FRC)
W82-04610

WASTE WATER TREATMENT PLANT RELIABILITY - ENGINEERING DESIGN FOR FAILURE AND ECONOMIC GAIN,

UKAEA Systems Reliability Service, Warrington (England).
K. C. Hignett, and B. Sayers.
Water Science and Technology, Vol 13, No 11/12, p 743-750, 1981. 5 Fig.

Descriptors: *Mathematical models, *Wastewater treatment, Water treatment facilities, *Wastewater facilities, *Design criteria, Economic aspects, Engineering, Systems engineering, Case studies.

Quantified assessments of systems' availability may be derived on the basis of fault tree logic and mathematical modelling. The techniques described require a knowledge of representative failure data and downtimes. A data collection and availability modeling procedure were developed. A case study on sixteen wastewater plants was performed over a three year period, beginning in mid 1978. The study related to primary sedimentation systems, but the techniques are applicable to any system where basic failure data can be obtained. The analyses enabled weak areas in the systems to be identified and recommendations made for improving reliability. The results often confirmed the intuitive feelings of plant managers and made it possible to quantify the effects of different proposed improvements. The increased application of reliability technology can provide an important contribution to the realization of more efficient and lower cost waste water processing systems. (Baker-FRC)
W82-04611

ESTIMATION AND CONTROL PROBLEMS IN ACTIVATED SLUDGE PROCESSES,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
S. Cook, and S. Marsili-Libelli.
Water Science and Technology, Vol 13, No 11/12, p 737-742, 1981. 2 Fig, 7 Ref.

Descriptors: *Activated sludge process, *Control systems, *Model studies, Mathematical studies, Wastewater treatment, Water quality, Monitoring.

This paper assesses the feasibility of some estimation and control schemes applied to the time varying operation of the Activated Sludge Treatment Process (ASTP). Real-time control of ASTP is becoming a significant issue in the context of water quality management. Preliminary results concerning the estimation of process variables are presented, and some new control concepts which imply the notions of optimality and energy conservation are introduced. Estimation and control algorithms developed are based on a reduced order model, thus making them easily implementable on microprocessors. Numerical simulation results are presented and discussed to assess the relative merits of the various algorithms. While far from exhaustive, this partitioned approach as demonstrated has shown the viability of Extended Kalman Filtering (EKF) state/parameter estimation and of optimal feedback control. Simulations have shown that improved performance and energy conservation can be achieved by using biochemical oxygen demand as a direct control variable. A foreseeable extension of the EKF properties concerns the inclusion in the performance index of some measure of upstream quality. In this way, the treatment cost can be made dependent of the present condition of the receiving water body. This, in addition to providing very sensible set points for diurnal operation, may help reduce treatment costs in many cases of medium or high flow conditions. (Baker-FRC)
W82-04612

PULSED-BED TECHNIQUE CAN CUT TREATMENT STAGES,

J. Irwin.
World Water, Vol 4, No 12, p 42-43, December, 1981. 1 Fig, 5 Tab.

Descriptors: *Percolating filters, *Backwash, Effluent, *Wastewater treatment, *Filtration, Sand filters, Filters, Separation techniques, Costs, Filter media, Clarification, Sludge treatment.

Pulsed-bed filtration is being used increasingly for primary effluent filtration (PEF) to reduce secondary treatment costs in municipal sewage plants as part of plant upgradings or expansions. Pulsed-bed units have a much shallower filter cell than conventional filters and can operate at heads of 0.6-1.5 m. They can accommodate high loading rates and cost less to backwash due to a special air diffuser device over the media surface. A pulse mix system helps fold the majority of particles into the media, while a screen media-retaining system permits filter media to be placed directly on top of the underdrain system for improved backwashing. A chemical detergent is used during backwashing, and a backwash control system recycles backwash water to a separate clarifier. The Hydro Clear Corporation has experimented with placing a pulsed-bed filter after the primary clarifier at several pilot plants. These efforts showed that primary clarification, PEF, and trickling filtered produced secondary quality effluent without final clarifiers at great cost reductions. Sludge treatment was also easier with PEF. Hydro Clear is developing a fine-sand pulsed-bed filtration technique for algae removal which may also be useful in potable water development and wastewater reuse. (Geiger-FRC)
W82-04613

DETOXIFICATION OF WASTE WATER CONTAINING CYANIDES FROM THE WET-SCRUBBING SYSTEMS OF STEEL MILLS (ENTGIFTUNG CYANIDHALTIGEN GICHTGASWASCHWASSER VON HOCHOFEN),

Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
B. Fischer, H. Ruffer, W. Duppers, G. Nagels, and H. Knorre.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 210-217, 1981. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Cyanide, *Steel industry, Effluents, Wastewater oxidation, Hydrogen peroxide, Formaldehyde, Catalysts, Weser River, Standards, *Germany.

Blast-furnace stack gas in steel mills is wet-scrubbed prior to utilization of its heat content. At the Bremen plant of the Klockner-Werke AG, process water is withdrawn from the Weser River; prior to return it must be treated to meet effluent standards, including a cyanide ceiling of 0.1 mg/liter. Various treatments for oxidative cyanide detoxification in scrubber water were considered: hypochlorite, ozone, catalytic oxidation with active carbon, peroxydisulfates, potassium permanganate, hydrogen peroxide, hydrogen peroxide/formaldehyde, and peroxymonosulfuric acid. Following laboratory trials, pilot tests were set up using the last four methods. The hydrogen peroxide-formaldehyde process was selected for full-scale trails. The initial settling basin was selected as the site for chemical introduction, since the turbulence of the inflowing stack gases provided adequate mixing. Sodium hydroxide was added to raise the pH of this water to 9-10. Chemical addition was metered via a sample stream. The goal of purifying the average flow of 1400 cu m per hour of wastewater at a maximum cyanide ion content of 50 mg/liter to register less than 0.1 mg/liter was attained during 93.5% of the measurement intervals in 6 months of operation. The standard for effluent from the settling basin, 1 mg/liter, was exceeded in 2.5% of the intervals, mostly for brief periods, due to operational problems. Chemical costs were about 2700 German Marks per day; the relatively high labor costs were primarily attributable to analytical requirements. The plant operated reliably even under the intensified demands caused by blast furnace shutdown. (Carroll-FRC)
W82-04616

DEMONSTRATION OF ZINC CYANIDE RECOVERY USING REVERSE OSMOSIS AND EVAPORATION,

Abcor, Inc., Wilmington, MA.
K. J. McNulty, and J. W. Kubarewicz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-231243, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency EPA-600/S2-81-132, September, 1981. 6 p, 3 Fig, 6 Ref. R805300.

Descriptors: *Metal-finishing wastes, *Reverse osmosis, *Evaporation, *Wastewater treatment, *Water reuse, Industrial wastewater, Zinc, Cyanide, Cost analysis, *Zinc cyanide recovery.

A field test was conducted to demonstrate closed-loop recovery of zinc cyanide rinse-water at a job shop plating facility. Since the zinc cyanide bath operates at room temperature with very little evaporation from the bath, reverse osmosis (RO) treatment of the rinsewater must be supplemented by evaporation in order to achieve the volume reduction necessary for return of a concentrate to the plating bath. The permeate from the RO unit was recycled to the first rinse after plating, while the distillate from the evaporator was recycled to the second rinse after plating. Spiral-wound PA-300 membrane modules were used in the RO unit. A gradual loss in membrane performance is attributable to fouling of the membrane by particulates in the rinsewater. Such fouling can be reduced by better prefiltration and reversed by periodic cleaning. The economics of the combined RO evaporation system were assessed for a system designed to provide rinsing equivalent to the present two-stage counter-current rinse at the demonstration site. The total operating cost was somewhat less for the combined RO evaporation system than for evaporation alone. However, credits for rinsewater recovery were insufficient to completely off-set the total operating cost of the recovery system. (Moore-SRC)
W82-04622

EVALUATION OF A TREATMENT LAGOON FOR COMBINED SEWER OVERFLOW,

Environmental Design and Planning, Inc., Boston, MA.
D. J. Connick, W. C. Pisano, and GL. Aronson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105214, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-196, December, 1981. 7 p, 6 Tab, 1 Ref. 11023FAV.

Descriptors: *Wastewater lagoons, *Combined sewer overflows, Disinfection, Stabilization lagoons, *Wastewater treatment, Industrial wastewater, Chlorination, Chlorine dioxide, Aerators, Oxygenation, *East Chicago, *Indiana.

The East Chicago Sanitary District operates a wastewater treatment plant that handles about 19 mgd of dry weather municipal wastewater from the city of East Chicago, Indiana. The sewerage system has combined sewers with overflows containing direct industrial discharges and runoff from industrial areas. The world's largest facultative lagoon was constructed tere to polish the secondary effluent from the wastewater treatment plant and to provide preliminary treatment with disinfection to the combined sewer overflows. Volume of the lagoon is estimated to be 142.2 million gal. Results of a two-year evaluation of the East Chicago lagoon indicate that relatively good treatment can be provided by a deep stabilization pond. During dry weather flow periods, the lagoon provided removal capabilities of 30 to 70% for the secondary effluent, depending on the parameter. The reoxygenation function of the aerators was found to be necessary. Under most circumstances, four aerators were adequate, but at times of high organic loading, the use of all eight appeared to be more advantageous. Disinfection results indicated that chlorination should be used until more reliable chlorine dioxide equipment is provided. The chlorine dioxide system should be reconstructed to provide extensive mixing upon initial disinfection, and it should provide a 15 to 30 second delay time between doses. (Moore-SRC)
W82-04623

PARALLEL EVALUATION OF AIR- AND OXYGEN-ACTIVATED SLUDGE,

Los Angeles County Sanitation Districts, Whittier, CA.
S. Austin, and D. Wuerdeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-246712, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-155, September, 1981. 6 p, 5 Tab. 14-12-150.

Descriptors: *Activated sludge, *Wastewater treatment, *Secondary wastewater treatment, *Pilot plants, Aeration, Nitrification, Denitrification, Clarification, Trace metals, Organic compounds, Solids, Comparison studies, Carson, California.

To provide data on the relative merits of air and of oxygen in the activated sludge process, two 1,900 cu m/day activated sludge pilot plants were operated side-by-side at the Joint Water Pollution Control Plant, Carson, California. One incorporated the UNOX high-purity oxygen process, and one used an air-sparged mechanical aerator. Although both pilot plants met the applicable discharge limitations for everything but three trace metals, the oxygen system provided a more stable operation. The two systems obtained good removals of soluble organics, and factors affecting solids separation in the final clarifier are most significant in terms of their effects on effluent quality. The most notable detrimental factors encountered in the study were excessive input of aerator power, which sheared the flocs in both systems and nitrification-denitrification, which caused the settled sludge from the air system to resuspend. The oxygen system did not nitrify. Claims have been made that oxygen-activated sludge processes produce less sludge than air-activated sludge processes. In this study, the total plant solids were compared and the difference was found to be insignificant at the 90% confidence level. The results of power consumption estimates indicate that the oxygen systems use substantially less energy. (Moore-SRC)
W82-04624

TREATMENT EFFECTIVENESS: OIL TANKER BALLAST WATER FACILITY,

Rockwell International, Newbury Park, CA.
I. Lysyj.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-101361, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency, EPA-600/S2-81-192, October, 1981. 6 p, 3 Fig, 2 Tab. 68-03-2648.

Descriptors: *Ballast, *Oily water, *Oil tankers, *Wastewater treatment, Fjords, Trap zone, Stratification, Alaska, Hydrocarbons, Effluent, Organic compounds, Organic loading, Water pollution sources, Valdez, Alaska.

The large, modern ballast water treatment plant at the Valdez, Alaska, marine terminal was studied using specially developed chemical analytical methods to determine the effectiveness of each unit process and to characterize compositional changes in the process stream. The studies disclosed that the state-of-the-art processes are generally effective in reducing the free oil content of the oily wastewater discharged from arriving tankers. A reduction of more than 99.8% in the organic load of the process stream is realized with ballast water treatment by gravity separation, dissolved air flotation, and retention in polishing ponds. Less effectively removed, however, are the water soluble fractions of the oily wastewater, which often include five priority pollutsats: benzene, toluene, ethylbenzene, phenol, and naphthalene. Such priority pollutants make up more than 50% of the total organic load in the effluent from the ballast treatment plant, and they are discharged in significant quantities into the receiving waters of Port Valdez. The plant discharges approximately half a metric ton of organic carbon each day. Included in this daily dischargew are 102 L of benzene, 91 L of toluene, 45 L of ethylbenzene/xylenes, 27 kg of phenol, and 2.8 kg of naphthalene. Because benzene, toluene, and ethylbenzene/xylenes constitute a significant fraction of the total organic discharge, their distribution in the receiving waters was studied. During the summer months, when the waters of the fjord are stratified, the effluent does not mix uniformly with the receiving waters, but forms a submerged field of diluted effluent. The aromatic hydrocarbons are contained at a depth of 50 to 70 m in a thin trap zone that spreads horizontally as far as 2 to 3 km from the plant outfall. The top of the trap zone moves progressively farther below the surface as the summer heating season progresses, from 50 m in June to 65 m in September. No aromatic hydrocarbons were found in the fjord outside the confines of the trap zone.
W82-04625

THE DEVELOPMENT OF DESIGN EQUATIONS FOR FACULTATIVE WASTE STABILIZATION PONDS IN SEMIARID AREAS,

J. P. Arthur.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 197-213, March, 1981. 13 Fig, 10 Tab, 14 Ref.

Descriptors: *Waste treatment, *Stabilization ponds, *Wastewater treatment, Temperature, Organic loading, Detention time, Bacteria, Sewage bacteria, Biological oxygen demand, *Nigeria, Semiarid lands, Ponds, Performance evaluation, Design criteria.

A comprehensive pilot scale study of waste stabilization ponds was conducted in semiarid northern Nigeria for a year. Two small ponds and 44-gal oil drums were arranged in various parallel and series combinations to investigate the effects of climatic factors and changes in organic loadings and detention times. The experimental systems provided excellent BOD and fecal bacteria removal. Anaerobic conditions occasionally developed as a result of overloading, but facultative operation became reestablished when favorable conditions returned. Temperature had a more significant effect on BOD and fecal bacteria removal than solar insolation. Equations were developed to aid in design of waste stabilization pond systems. Series ponds were more effective than single units. Other factors which promoted treatment efficiency were complete mixing, increased detention time, and optimum organic loading. (Cassar-FRC)
W82-04641

PILOT STUDIES OF THE NITRIFICATION PROCESS IN FIXED FILM REACTORS (PILOTVERSUCHE ZUR NITRIFIKATION IN FESTBETTREAKTOREN),

Hamburg Univ. (Germany, F.R.).
I. Sekoulov, and D. Heinrich.
Wasserwirtschaft, Vol 71, No 11, p 331-333, 1981. 4 Fig, 2 Tab, 3 Ref. English summary.

Descriptors: *Aerobic digestion, *Wastewater treatment, *Nitrification, Pilot plants, Fixed film reactors, *Germany.

The ability of nitrifying bacteria to grow attached to solid surfaces can be optimally utilized in fixed film reactors in order to concentrate them in a system. After the growth phase of the nitrifiers is complete, the hydraulic loading (residence time) is of practical importance for the nitrification behavior of the fixed bed reactor. Nitrifiers show ability to adapt to low oxygen concentrations and pH values, especially when they have been grown under these conditions. The nitrifiers produce very thin biological films which in themselves do not cause clogging of the reactors. However, when used in wastewater treatment the fixed bed reactors encounter suspended solids. In such cases it is necessary to provide the possibility for back-washing. The filler materials must permit uniform circulation. Expanded clay beads have proven to be acceptable filler materials. The proper size of a fixed-bed reactor can be selected with the aid of the Michaelis-Menten equation. Pilot-scale studies were conducted with two conventional fixed bed reactors, connected in parallel, and a completely immersed, rotating fixed bed reactor. In the case of non-limiting ammonium concentrations and short residence times, e.g., 0.5 hr, a maximal nitrification speed relative to the surface area of the filler material of 58.7 mg ammonium nitrogen per sq m per hr was achieved. If the nitrification rate is calculated relative to the reactor volume, the result is about 10 times higher than previously available values for activated sludge plants. (Carroll-FRC)
W82-04652

COMPARATIVE DISINFECTION OF POLIOVIRUS BY BROMINE CHLORIDE AND CHLORINE IN A MODEL CONTACT CHAMBER,

Hawaii Univ., Honolulu. Dept. of Tropical Medicine.
B. H. Keswick, R. S. Fujioka, N. C. Burbank, and P. C. Loh.
Water Research, Vol 16, No 1, p 89-94, January, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Disinfection, *Viruses, *Halogens, *Wastewater treatment, *Bromine chloride, *Chlorine, Chlorination, Poliovirus, Ammonium.

Bromine chloride proved superior to chlorine in inactivating poliovirus in 0.00009 M ammonium chloride solution and water containing 10% sewage effluent. In clear tap water both BrCl and Cl at doses of 0.5 and 2.0 mg per liter were effective disinfectants for poliovirus. The apparatus used for the studies was a 4 gal per min model contact chamber built to simulate conditions in a wastewater treatment plant. Concentrations of poliovirus in the initial mixture were 100,000 PFU per ml. The 2.0 mg per liter dose of BrCl was effective under all conditions. The 2.0 mg per liter dose of Cl failed to inactivate sufficient poliovirus when sewage effluent was present. (Cassar-FRC)
W82-04661

TEMPERATURE DEPENDENCY OF BIOLOGICAL DENITRIFICATION WITH ORGANIC MATERIALS ADDITION,

Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.
Z. Lewandowski.
Water Research, Vol 16, No 1, p 19-22, January 1982. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Temperature, *Kinetics, *Denitrification, *Organic compounds, Biological treatment, *Wastewater treatment, Activated sludge process, Nitrogen removal, Methanol, Acetone, Acetic acid.

The rate of denitrification in a wastewater treatment process depends on temperature and on the compound used as the electron donor. Fresh activated sludge was incubated in laboratory plastic containers at eight temperatures from 2.5 to 35 C. Nitrate was added, followed by the organic compound, methanol, acetone, or acetic acid. Kinetic constants for the reactions are presented. Acetic acid was most effective in increasing the denitrification rate, acetone showed no improvement, and methanol was intermediate. The Arrhenius activation energy was similar in all cases. 10.9-12.3 kcal per mol. (Cassar-FRC)
W82-04662

TREATMENT OF NONCYANIDE ELECTROPLATING CADMIUM WASTEWATER BY REVERSE OSMOSIS,

Shanghai Inst. of Mechanical and Electrical Engineering (China).
F. Menwei, B. Tingyong, L. You, and Z. Aili.
Water Science and Technology, Vol 13, No 11-12, p 517-522, 1981. 3 Fig, 1 Tab.

Descriptors: *Cadmium, *Separation techniques, *Reverse osmosis, *Electroplating, *Wastewater treatment, Industrial wastes, Heavy metals, Membrane processes, Osmosis, Water pollution prevention, Chelating agents, Industrial wastewater.

Since cadmium (Cd) is hazardous to the environment and human health, the removal of Cd from the wastewaters of industries using Cd electroplating is an area of constant consideration. Reverse osmosis, a membrane separation technology, has been applied to noncyanide electroplating Cd rinse water. Closed-loop rinse systems using cellulose acetate membranes were tried in laboratory and pilot plant tests. The reverse osmosis units were of an out-press tubular structure and gave an average flux of 17 liters/sq m-h. At an operating pressure of 30 kilograms/sq cm Cd rejections of 95-98% were obtained. The reverse osmosis installation and its attachments require only 10 sq m of space and can restore 99% of the amount of Cd previously discharged. The present system when aided by some simple controllers was found to be suited for small-scale wastewater treatment operations. (Geiger-FRC)
W82-04664

ON LINE CONTROL OF PHARMACEUTICAL INFLUENT LOADS TO A BIOLOGICAL WASTEWATER TREATMENT PLANT,

OTV, Coubevoie (France).
A. Minier, H. Moreaud, G. Castelnau, and M. Mevolhon.
Water Science and Technology, Vol 13, No 11-12, p 523-529, 1981. 5 Fig.

Descriptors: *Biological wastewater treatment, *Flow regulators, *Activated sludge, *Respiration, *Wastewater treatment, Process control, Biodegradability, Fluctuations, Industrial wastes, Biological treatment, Pollution load, Control systems, *Pharmaceutical wastes.

A special pollution flux-regulator for the biological treatment of effluents in cases where the composition and flow rate are subject to considerable variation is described. The system is an industrial application of the metabolization technique in which wastewater is batch injected into a reactor containing activated sludge. A rapid respirometric test shows the affinity between the influent and the sludge bacteria and from this the biological reaction parameters are deduced. These parameters are then used to calculate the maximum load and hydraulic properties of the facility. This system has been successfully operated since July of 1980 for the treatment of wastes from the SAPCHIM pharmaceutical factory at Sisteron, France. An on-line biodegradability analyzer helps to regulate the flow between the storage tank and the contact tank of a biological treatment line by a contact-stabilization process. (Geiger-FRC)
W82-04665

OPTIMIZATION OF AREAWIDE WASTEWATER MANAGEMENT,

State Univ. of New York at Stony Brook. Inst. for Energy Research.
K. J. Phillips, E. J. Beltrami, T. O. Carroll, and S. R. Kellogg.
Journal Water Pollution Control Federation, Vol 54, No 1, p 87-93, January, 1982. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Wastewater management, *Planning, Design criteria, *Wastewater facilities, Wastewater treatment, Water treatment facilities, Computers, *Model studies, *Nassau County, New York.

This paper examines the application of a mixed integer programming screening model to determine a regional wastewater management plan of Nassau County, New York, in compliance with the federal '208' mandate. The model described in this paper was used to establish cost-optimal tradeoffs between the economies of scale from building larger treatment plants and the costs of piping to divert wastewater flows from the older systems. The model also defines in quantitative terms the price to be paid for increasing levels of treatment and improved water quality in Nassau County bays. The results suggest that mixed integer programming is a useful and flexible tool which enables the engineer to investigate a multitude of diversion, plant expansion, upgrading, and location alternatives and to develop an optimal plan for wastewater management within a region. The mixed integer program does not consume large amounts of computer time in its solution, as the preliminary engineering feasibility work reduced the number of options that had to be considered in the screening model. (Baker-FRC)
W82-04703

PHOSPHORUS REMOVAL PROCESSES FROM OVERLAND FLOW TREATMENT OF SIMULATED WASTEWATER,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. A. Khalid, W. H. Patrick, Jr., and M. N. Mixon.
Journal Water Pollution Control Federation, Vol 54, No 1, p 61-69, January, 1982. 5 Fig, 5 Tab, 32 Ref.

Descriptors: *Municipal wastewater, *Land disposal, Phosphorus, *Phosphorus removal, Wastewater treatment, Leaching, Isotherms, Sorption, Overland flow, Soil properties.

The effects of prereduced soil conditions and pH amendment with calcium carbonate on the efficiency of the soil/plant system for phosphorus removal in an overland flow model were determined. A relationship between phosphorus removal efficiency in an overland flow system and phosphorus sorption-desorption characteristics of the soil determined in the laboratory using phosphorus sorption isotherms was established. The overland flow experiments were conducted on a Crowley silt loam/ryegrass system established on a 1.2% slope and demonstrated that the efficiency of phosphorus removal from municipal wastewater would be greatly enhanced by the addition of lime to the soil. The phosphorus sorption isotherms indicated that the efficiency of phosphorus removal in the overland flow experiment was related to the phosphorus sorption capacity of various treatments. A slightly higher desorption of phosphorus sorbed by the soil mass in the limed treatments in the overland flow as well as in the laboratory studies was due to the lower phosphorus loading energy in this treatment. Phosphorus sorbed under alkaline conditions was more available to growing plants than the unamended treatments. The study also suggests that phosphorus sorption is a kinetic process and that the leaching losses of phosphorus retained by the soil mass during overland flow application would be smaller than the desorption potential determined under laboratory conditions because of longer contact time. (Baker-FRC)
W82-04706

INFLUENCE OF DISSOLVED OXYGEN ON SUBSTRATE UTILIZATION KINETICS OF ACTIVATED SLUDGE,

Kramer, Chin, and Mayo, Portland, OR.
M. K. Knudson, K. J. Williamson, and P. O. Nelson.
Journal Water Pollution Control Federation, Vol 54, No 1, p 52-60, January, 1982. 8 Fig, 1 Tab, 28 Ref.

Descriptors: *Activated sludge process, *Kinetics, *Wastewater treatment, Dissolved oxygen, Sludge, Bacteria.

The effect of mixed liquor dissolved oxygen (DO) concentrations on the maximum substrate utilization rate was evaluated and attempts were made to determine whether such effects correspond to changes in specific viability as well as to evaluate the influence of floc size on specific viability. Phenol was selected as the substrate due to its ease of measurement and low detection limit. It was concluded that the maximum substrate utilization rates of activated sludge based on total volume of suspended solids may increase with increasing DO concentrations over the range of 1.5 to 15 mg/l if flocs of greater than about 300 micrometers diameter are present. This effect can allow the operation of oxygen systems at higher specific utilization rates than air systems to obtain equal removals. Sludge production and effluent substrate concentrations may decrease with an increase in DO concentrations if flocs of greater than about 400 micrometers diameter are present. Maximum substrate utilization rates of activated sludge based on viable cells are constant with increasing DO concentrations over the range of 1.5 to 15 mg/liter. The maximum substrate utilization rates are directly related to the specific viabilities as measured by adenosine triphosphate content. A significant portion of activated sludge flocs may be DO limited at typical DO concentrations in some activated sludge plants. (Baker-FRC)
W82-04707

MUNICIPAL WASTEWATER RECLAMATION BY REVERSE OSMOSIS - A 3-YEAR CASE STUDY,

California Univ., Los Angeles.
M. K. Stenstrom, J. R. Davis, J. G. Lopez, and J. W. McCutchan.
Journal Water Pollution Control Federation, Vol 54, No 1, p 43-51, January, 1982. 4 Fig, 7 Tab, 21 Ref.

Descriptors: *Reverse osmosis, *Wastewater renovation, Membrane processes, *Wastewater treatment, Water demand, Water reuse, Municipal wastewater, *California.

An experimental and economic analysis of a 10 gallon/minute reverse osmosis (RO) pilot plant is presented. The study showed that flushes of citric acid, followed by enzyme detergent and spongeball cleaning, are effective in maintaining essentially the initial membrane-flux levels. Citric acid is the major cleaning agent. Enzyme detergent and spongeball cleaning without citric acid are relatively ineffective. The automatic spongeball cleaning technique appears to have promise for maintaining membrane flux between chemical cleanings. The major factor in determining membrane life for this type of membrane construction is corrosion, resulting in an average membrane life of 420 days or 10,000 hours. For the feed water investigated in this study, ferric chloride coagulation with clarification and filtration provided the highest quality feed water with the least fouling tendency. For the optimal conditions investigated, reclaimed water containing about 500 mg/l total dissolved solids can be produced for about 40 cents/cubic meter. The cost estimates are considered tentative. For all the conditions tested, the greatest level of pretreatment provided the most economical operation. The optimal energy requirements are about 2.6 K Wh/cubic meter. The relatively simple pretreatment used is stressed as a high point of this investigation. (Baker-FRC)
W82-04708

USE OF MICROSCREENS TO POLISH LAGOON EFFLUENTS,

Barber (B. P.) and Associates, Inc., Columbia, SC.
M. E. Harrelson, and J. B. Cravens.
Journal Water Pollution Control Federation, Vol 54, No 1, p 36-42, 1982. 7 Fig, 3 Tab, 8 Ref.

Descriptors: *Oxidation lagoons, *Algal control, Algae, *Lagoons, Oxidation, Wastewater treatment, Eutrophication, Algal growth, Screens, Filters, *Camden, South Carolina, *Water treatment facilities, Design criteria.

Pilot tests and design criteria employed in the construction of the Camden Wastewater Treatment Facility, South Carolina, are described. One of the main engineering concerns during the process selection procedure was the presence of blue-algae, which not only appear as suspended solids, but also exert an oxygen demand on the receiving stream from wastewater treatment plants. Bench tests were designed for microscreens at six lagoons in South Carolina. Tests indicated that the effluent values could be kept below 30/30 BOD5/SS. Algae counts and species identification were then performed in full-scale microscreen testing. To obtain design information needed, these pilot tests were performed at various drum speeds, backwash pressures, and head losses. Based on the test results, the preliminary cost analysis, and consultations, the decision was made to use the microscreens with ultrafine media for upgrading the oxidation ponds at the Camden site. The microscreens were made with 1 micron polyester media for low hydraulic loading. Standby equipment is provided for all major components. A high degree of operational flexibility was built into the design, and a fully automatic control and supervisory system is included to reduce the need for operator attention. During the past three years the process has been shown to be both a viable and an economical process. With efficient separation and recovery, the algae biomass could be used for energy production as well as for producing animal feed supplements or fertilizers. (Baker-FRC)
W82-04709

VACUUM FILTRATION OF SEPTAGE,

Lowell Univ., MA. Dept. of Civil Engineering.
C. R. Ott, and B. A. Segall.
Journal Water Pollution Control Federation, Vol 54, No 1, p 27-35, 1982. 2 Fig, 8 Tab, 7 Ref.

Descriptors: *Vacuum filtration, *Septic wastewater, Septic tanks, *Wastewater treatment, Filtration, Sludge, *Activated sludge process, Sludge thickening, Dewatering, Sludge drying, *Medfield, Massachusetts.

The feasibility of dewatering chemically treated septage by itself and in combination with thickened waste-activated sludge (TWAS) was explored at a municipal wastewater treatment plant in Medfield, Massachusetts. Chemicals used as septage conditioners were aluminum sulfate, ferric chloride, and sulfuric acid, each used separately. Conditioned sludges were dewatered on conventional coil-spring vacuum filters. In the majority of tests polymer was also used (Nalco 7120). The plant is a 0.066 cu m/sec conventional activated sludge process. During the septage dewatering study period the plant flow rate was 0.013 cu sec (0.3 mgd), and the primary clarifiers were not in use. The vacuum filter at Medfield is normally operated at about 55 kPa (8 psi) and at a rotational speed of 6.5 minutes per cycle. The cake yield during field test 1 averaged 12.1 kg/sq m/hr. The study showed that septage conditioned with either coagulant or acid could not be filtered unless combined with thickened waste-activated sludge. Reduction in cake yields observed during the course of 'septage only' runs was due to filter coil clogging with septage particles. Septage treated with sulfuric acid, ferric chloride or aluminum sulfate, combined in equal proportions with TWAS, vacuum-filtered well on a coil spring medium. Conditioned septage in combination with TWAS produced better yields than are normally experienced with TWAS alone. The best yields were obtained with aluminum sulfate conditioning and a 55% septage/45% TWAS mixture. Fe(III) and acid conditioning also produced excellent yields. (Baker-FRC)
W82-04710

AIR DRYING LIQUID ANAEROBICALLY DIGESTED SLUDGE IN EARTHEN DRYING BASINS,

Metropolitan Denver Sewage Disposal, District No. 1, CO.
J. C. Baxter, and W. J. Martin.
Journal Water Pollution Control Federation, Vol 54, No 1, p 16-26, January, 1982. 8 Fig, 7 Tab, 7 Ref.

Descriptors: *Sludge drying, *Wastewater treatment, Dewatering, Drying, Sludge, Sludge digestion, Groundwater, Water pollution sources, *Sludge utilization, Fertilizers.

The studies described were intended to examine the most efficient depths of sludge application that would enhance drying rates of sludge to the point where sludge could be handled as a solid (about 40% moisture) and then stockpiled for eventual use as a fertilizer. In conjunction with investigations of drying rates, the potential for groundwater degradation because of the leaching of nitrates from the sludge and possible methods for mitigating the amounts of potentially harmful pollutants were also investigated. Results of the study indicated that 25 cm applications of liquid sludge to earthen drying basins could lead to significant quantities of polluted water moving toward the groundwater. Data from 1977 studies indicate that any basin will leach significant quantities of polluted water if the sludge/soil interface is allowed to dry. Applications of 60 to 100 cm of liquid sludge led to a rapid sealing effect that produced an impermeable layer which prevented contaminants from moving toward the groundwater. Any operational scheme that removes sludge before the sludge/soil interface dries would preserve groundwater quality and at the same time provide a cost effective means of dewatering sludge. (Baker-FRC)
W82-04711

TREATMENT OF HIGH-STRENGTH FATTY AMINES WASTEWATER - A CASE HISTORY,
Huff and Huff, Inc., LaGrange, IL.
J. E. Huff, and C. B. Muchmore.
Journal Water Pollution Control Federation, Vol 54, No 1, p 94-102, January, 1982. 7 Fig, 8 Tab.

Descriptors: *Wastewater management, *Design criteria, Planning, Wastewater facilities, *Wastewater treatment, Biochemical oxygen demand, Aerated lagoons, Land disposal, Drainage, Tile drainage, *Fatty amines.

The waste treatment system originally designed for a new chemical complex which produces fatty amines is described. The system allowed for the collection of wastewater in containment basins, one located in each process area. In the event of heavy rainstorms, the basins overflow to a contaminated stormwater collection system. Each containment basin is pumped out to a separator and then to an equalization tank. The basic design concept was to minimize the formation of emulsions, which occur when the wastes from the various areas are mixed together. Wastewater from the equalization tank is pumped to an aerated lagoon. Wastewater from the second lagoon was originally designed to be pumped onto a 6.5 ha spray field, year around. A drain tile system was installed under the field due to poor drainage characteristics. The drain tile discharged into Aux Sable Creek via a man-made ditch. The major problem was the inability to achieve the Illinois effluent standard of 10 mg/liter for the 5-day biochemical oxygen demand (BOD). Based on treatability studies which were then made a land application system was selected for the expanded wastewater treatment facilities. Supplemental bacteria addition to the first stage lagoon was also evaluated, and has become an integral part of the overall system. The land application has demonstrated successful nitrification and denitrification. (Baker-FRC)
W82-04712

ANAEROBIC FERMENTATION - FILTRATION OF POTATO PROCESSING WASTEWATER,
AID Ltd., Fredericton (New Brunswick).
R. C. Landine, T. Viraraghavan, A. A. Cocci, G. J. Brown, and K-C. Lin.
Journal Water Pollution Control Federation, Vol 54, No 1, p 103-110, January, 1982. 8 Fig, 5 Tab, 9 Ref.

Descriptors: *Filtration, *Food-processing wastes, Industrial wastes, *Wastewater treatment, Food processing industry, Industrial plants, Fermentation, Anaerobic conditions, *Potatoes.

Experiments were conducted on a potato processing wastewater treatment system using a unified anaerobic fermenter-filter system. The mean chemical oxygen demand (COD) removal efficiency of the anaerobic fermenter on a clarifier waste with a high proportion of dissolved COD ranged from 73.3 to 86.8% when the loading rate was approximately 1 kg COD/cubic meter/day. The mean suspended solids (SS) removal efficiency through the anaerobic fermenter was inconsistent, as it was greatly influenced by SS concentration in the presettled feed. The effluent quality with respect to SS concentration was relatively consistent. The mean COD removal efficiency through the fermenter increased with loading rate, which implies that a higher optimum loading rate is possible. Mean COD and biochemical oxygen demand removal efficiencies through the fermenter did not change significantly when hydraulic detention time was lowered to 5 days from 10 with the loading rate maintained in the range of 1 kg COD/cubic meter/day, but both dropped about 10% between 5 and 4 days' detention. The mean COD removal efficiency through the anaerobic filter was 45.3 to 67.7% when the filter was loaded in the range of 0.82 to 1.20 kg COD/cubic meter/day and the hydraulic retention time was 8.2 to 19.2 hr. The COD removal in the filter decreased at the lower hydraulic detention times. The mean COD removal efficiency through the anaerobic fermenter-filter system was 85-95% when the fermenter was loaded at the rate of 1 kg COD/cubic meter/day. (Baker-FRC)
W82-04713

5E. Ultimate Disposal Of Wastes

LIME SOFTENING SLUDGE TREATMENT AND DISPOSAL,
Journal of the American Water Works Association, Vol 73, No 11, p 600-608, November, 1981. 6 Fig, 11 Tab, 32 Ref.

Descriptors: *Water softening, *Dewatering, *Lime, Reviews, *Sludge disposal, Calcium carbonate, Sludge volume index, Land application, Sludge lagoons, Lagoons, Sludge utilization, *Waste treatment, Drying, Centrifugation, Filtration, Research priorities, Water treatment, Recalcination, Pelletization.

Recent advances in sludge handling and disposal are reviewed. Residues from lime softening are predominantly calcium carbonate and magnesium hydroxide, with small amounts of unreacted lime and residues from iron or aluminum coagulation. Sludge production can be minimized by removal of water, reduction of solids, or a combination of the two. Solids production can be reduced by using larger quantities of NaOH in place of some or all of the lime or soda ash, split treatment, optimization of chemical feed systems, sludge recirculation, reducing the degree of softening, recycling filter backwash, and controlling sludge withdrawals from the settling basin. Sludge treatment and disposal may use one or a combination of the following: gravity thickening, nonmechanical dewatering (lagoons and sand drying beds), mechanical dewatering (centrifugation, vacuum filtration, pressure filtration, and belt filtration), pelletization, recalcination, codisposal with other wastes, and land application. Results of survey replies from water softening plants are presented for subjects such as water source, chemicals used, calculated and reported sludge quantities, and dewatering methods. Lagooning is practiced at 56% of the plants; 13% discharge sludges into a river. Research needs include methods to increase solids contact to improve calcium carbonate precipitation, the role of calcium carbonate particle size, improvements in the pelletizing process, the fundamental process in mechanical dewatering, and long term effects of land application. (Cassar-FRC)
W82-04276

RECYCLING ALLOWS ZERO POWERPLANT WASTEWATER DISCHARGE,
For primary bibliographic entry see Field 5D.
W82-04323

SLUDGE DISPOSAL BY COMBUSTION OFFERS POTENTIAL ENERGY SOURCE,
Dorr-Oliver Inc., Stamford, CT.
J. H. Kleinau.
Pulp and Paper, Vol 55, No 13, p 141-143, December, 1981. 1 Fig, 6 Tab, 2 Ref.

Descriptors: *Sludge disposal, *Dewatering, *Incineration, Coal, Pulp and paper industry, Wastewater treatment, Energy sources, Filtration, Steam, Sludge cake, Fluidized beds.

Sludges high in organic materials, such as those from pulp and paper mills, can be economically dewatered, using pulverized coal as a filter aid and burning the resulting filter cake in a fluidized bed steam generator. Limestone added to the steam generator scavenges sulfur from the coal. A typical system uses 0.2 lb of coal along with each pound of sludge solids to produce a cake of 24% dry solids, suitable for incineration. Money saved by reduced sludge disposal and the value of steam generated (total $1.3 million) amounts to almost twice the annual operating costs ($765,000) in a 22,000 lb per hour plant. (Cassar-FRC)
W82-04329

SHAKING DOWN A SOLIDS HANDLING SYSTEM,
Greater Lawrence Sanitary District, North Andover, MA.
For primary bibliographic entry see Field 5D.
W82-04338

ANAEROBIC DIGESTION OF FARM WASTES: A REVIEW - PART 2,
Birmingham Univ. (England). Dept. of Chemical Engineering.
I. D. Cowley, and D. A. J. Wase.
Process Biochemistry, Vol 16, No 6, p 16-19, October/November, 1981. 2 Fig, 3 Tab, 35 Ref.

Descriptors: *Farm wastes, *Anaerobic digestion, *Methane, Wastewater treatment, *Waste disposal, Animal wastes, Reviews, Economic aspects, Safety, Manure, Digestion, Energy.

Processes for anaerobic digestion of farm wastes are reviewed. Typical instrumentation for a digester is described. Safety procedures involve isolation of motors in flameproof housings, prohibition of open flames on the site, use of a flare stack to burn off excess gas, and provision for proper relief valves. Digesters may be started up in two ways: (1) filling the digester with seed sludge, then slowly adding raw slurry, or (2) filling the digester 80% full of water and adding raw slurry and seed at the designed loading rate. Possible uses for the biogas are cooking, domestic heating, and electric power generation. Operating parameters are given for different types of digester systems and wastes. Heating and insulation are necessary to maintain the usual 30-35 C operating temperatures. Although biogas is not expected to make a major contribution to distribute gas supplies, it is economically sound to produce energy from material otherwise wasted. (Cassar-FRC)
W82-04347

WET DISPOSAL OF FOSSIL PLANT WASTE: CASE HISTORY,
Ebasco Services Inc., Norcross, GA.
K. A. Kessler.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 199-208, December, 1981. 10 Fig.

Descriptors: *Ponds, *Seepage control, Embankments, *Waste disposal, Powerplants, Ash, Clays, Landfills, Slope stability, Soil properties, Soil mechanics, *Minnesota, Water pollution control, *Solid waste disposal, Dikes, *Clay Boswell Generating Station.

The planning, construction, and operation of a solid waste disposal pond for the Clay Boswell Generating Station, Minnesota, are described. This fossil fuel-burning plant is expected to produce 12.3 million cu m of solid waste (fly ash, bottom ash, and SO2 scrubber sludge) over its 35-year life. Wet ponding was chosen over two alternatives, chemical stabilization for landfill disposal and disposal in open pit iron mines. Boring tests located a suitable pond site with a continuous subsurface clay layer. The soils were further studied in the laboratory. The final design for the pond was an embankment built of random soil with a clay lining constructed on the upstream embankment slope. The entire pond was clay lined and soil-bentonite slurry cut-off trenches were installed down to the natural clay layer. Seepage calculations predicted a total long-term steady state seepage rate of 450 gal per acre per day. The pond, constructed during 1978 and 1979, consists of three compartments divided by earth dikes. Ash is kept covered with 2 ft of water. Piezometers, settlement mounnments, and visual inspections are used for monitoring pond performance, which had met design expectations. A seepage problem in one compartment was the result of a frozen dividing dike. A reverse filter drainage system was constructed in the problem area to relieve the excessive piezometric head. (Caesar-FRC)
W82-04385

DENSITY LEVELS OF PATHOGENIC ORGANISMS IN MUNICIPAL WASTEWATER SLUDGE - A LITERATURE REVIEW,

Camp, Dresser, and McKee, Inc., Boston, MA.
D. C. Pederson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102286, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-170, October, 1981. 5 p, 2 Tab. 68-03-2803.

Descriptors: *Sludge drying, *Pathogens, *Disinfection, Parasites, *Viruses, *Bacteria, *Wastewater treatment, Literature review, Public health, Indicators, Lime, Anaerobic digestion, Composting, Aerobic digestion, Pathogenic fungi, Eggs, Sludge disposal.

Sludges originating from municipal wastewater treatment plants harbor a multitude of microorganisms, many of which present a potential health hazard. A literature review of available domestic and foreign data from 1940 to 1980 was undertaken concerning bacteria, viruses and parasites densities in raw municipal wastewater sludges, on the effectiveness of the 'Processes to Significantly Reduce Pathogens' (40 CFR Part 257), and on conventional sludge dewatering techniques to reduce levels of these organisms. Anaerobic digestion and lime stabilization consistently produce reductions of about 1 to 2 logs in densities of indicator and pathogenic bacteria, and in the case of anaerobic digestion, in densities of viruses as well. Conditions of mesophilic composting may inactivate common indicator and pathogenic bacteria and viruses, provided that specified temperatures are attained uniformly throughout the compost mass. The pathogenic fungus Aspergillus fumigatus thrives under conditions of mesophilic composting. Density reductions of bacteria by aerobic digestion are variable and of relatively small magnitudes. Sludge lagoons can achieve 1-log reductions in densities of bacteria and viable parasite ova, but storage of one month to more than three years may be required. Mechanical dewatering of sludge, with or without the use of chemical conditioners, has little reliable effect on densities of pathogens. (Moore-SRC)
W82-04400

DEEP WELL DISPOSAL OF SECONDARY EFFLUENT IN DADE COUNTY FLORIDA,

CH2M/Hill Inc., Gainesville, FL.
U. P. Singh, J. I. Garcia-Bengochea, and C. R. Sproul.
Water Resources Bulletin, Vol 16, No 6, p 812-817, October, 1980. 4 Fig, 3 Tab, 5 Ref.

Descriptors: *Wastewater disposal, *Deep wells, *Transmissivity, Groundwater movement, *Injection wells, Underground waste disposal, Environmental effects, Groundwater management, Geophysics, Wastewater management, Subsurface drainage, Aquifer management, Aquifers, *Florida, Saline water intrusion, Dade County.

Drilling and testing were carried out on a test injection well site for deep underground injection of wastewater effluent from the proposed 50 mgd South District Regional Wastewater Treatment Plant of the Miami-Dade Water and Sewer Authority. The total depth of the well is 3,200 ft. The Boulder Zone, a highly cavernous and transmissive aquifer with water much like seawater, begins at 2,790 ft in depth. This zone is separated from the Floridan aquifer above it by about 1,100 ft of confining limestone layers. Packer testing proved these limestone layers very effective in separating the Boulder Zone, the proposed injection area, from the aquifer above. The transmissivity of the Boulder Zone was estimated at 14 million gallons/day/ft from pump-out test data. An 8,000 gallon/minute injection test was performed to evaluate well performance under operating conditions. A detailed monitoring program consisting of subsurface wells in various strata will be provided to monitor injection rate, injection pressure and effluent quality. A possible remedial action for salt water migration into the Floridan aquifer would be the construction of relief wells in the lower part of the aquifer. It was concluded that underground injection of secondary wastes from the proposed treatment facility is a feasible and cost-effective plan, both hydraulically and environmentally. (Geiger-FRC)
W82-04442

U.S. GEOLOGICAL SURVEY RESEARCH IN RADIOACTIVE WASTE DISPOSAL--FISCAL YEAR 1979,

Geological Survey, Reston, VA. Water Resources Div.
R. Schneider, E. H. Roseboom, Jr., J. B. Robertson, and P. R. Stevens.
Available from Br. of Distr., USGS 604 South Pickett St. Alexandria, VA 22304. Geological Survey Circular 847, 1982. 74 p, 15 Fig, 79 Ref.

Descriptors: *Radioactive waste disposal, *Geological surveys, *Waste storage, *Water pollution sources, Environmental effects, Waste management, Geology, Hydrology, Geochemistry.

The report summarizes progress on geologic and hydrologic research related to the disposal of radioactive wastes. The research is described according to whether it is related most directly to: (1) high-level and transuranic wastes; (2) low-level wastes, or (3) uranium mill tailings. Included is research applicable to the identification and geohydrologic characterization of waste-disposal sites, investigations of specific sites where wastes have been stored, and studies of regions or environments where waste-disposal sites might be located. A significant part of the activity is concerned with techniques and methods for characterizing disposal sites and studies of geologic and hydrologic processes related to the transport and(or) retention of waste radionuclides. (USGS)
W82-04500

AUTOMATIC CONTROL OF THE SEWAGE SLUDGE PYROLYSIS PROCESS IN MULTIPLE HEARTH FURNACE,

NGK Insulators, Ltd, Nagoya (Japan).
T. Kasakura, T. Majima, and N. Izumi.
Water Science and Technology, Vol 13, No 11-12, p 605-610, 1981. 3 Fig, 1 Tab.

Descriptors: *Incineration, *Sludge disposal, *Cost analysis, *Solid waste disposal, Automation, Control systems, Waste disposal, Sludge, Monitoring, Process control, Solid wastes.

An automatic control system for a 60 T/day sewage sludge pyrolysis plant with multiple hearth furnace has been developed as an energy-saving alternative to conventional incineration. The new control system maintains the required furnace temperature through control of the partial combustion ratio of the furnace by adjusting the amount of air supplied to the furnace. It also features stable automatic gas analysis and monitoring under severe conditions. A feed forward method is used to control the furnace and combustion chamber pressure, and the steam line of the waste heat boiler is designed so that some steam may be recycled other uses. These features result in a fuel comsumption one third that of conventional incineration methods. (Geiger-FRC)
W82-04587

AUTOMATIC CONTROL OF SLUDGE CONDITIONING AND VACUUM FILTRATION,

EMA, Inc., St. Paul, MN.
D. I. Knudsen, and G. A. Mathes.
Water Science and Technology, Vol 13, No 11/12, p 611-617, 1981. 6 Fig, 1 Tab.

Descriptors: *Sludge conditioning, *Vacuum filtration, Costs, Automation, Computers, *Activated sludge process, Sludge, Filtration, *Sludge disposal, Incineration, Process control.

This paper reports progressive development of control strategies and the resultant benefits derived from the Seneca Treatment Plant in Eagen, Minnesota. The plant is a 24 mgd activated sludge plant with two paralles 12 mgd trains. Two identical sludge processing trains consist of flotation thickeners, sludge holding tanks, chemical conditioning with ferric chloride and calcium hydroxide, vacuum filters, multiple hearth incinerator, and ash disposal by one common pipeline to a remote ash pond. The developmental nature of the project required a flexible control system. A microcomputer-based remote terminal unit communicates with a minicomputer over a four-wire asynchronous 1200 baud link. The minicomputer with its operations console is located in a buliding remote from the sludge disposal building. Various types of sludge conditioning and vacuum filter automatic process control resulted in economic benefits. The highest savings are achieved with a multivariable model based control strategy. Instrumentation requirements are met with proven equipment that does no require excessive maintenance. Properly applied sludge conditioning control strategies reduced ferric and lime usage, stabilized performance, increased production capacity, improved incinerator performance and decreased fuel usage. Operator and laborer requirements can be reduced because the control system can maintain continuity of stable operation with various sludge and chemical qualities. (Baker-FRC)
W82-04589

DENSIFICATION OF PAPER MILL SLUDGE MATERIALS,

Michigan State Univ., East Lansing. Dept. of Civil Engineering.
O. B. Andersland, A. W. N. Al-Khafaji, and R. K. Loew.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 1-15, January, 1982. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Dewatering, *Pulp and paper industry, *Compressibility, Sludge thickening, *Sludge disposal, Organic matter, Decomposition, Landfills, Void ratio, Waste disposal.

Densification of model paper mill sludges made from kaolinite and pulp fibers was studied to predict settlement of decomposing sludges. Densification involves removal of additional water from dewatered sludge, usually by placing surcharge loads in a landfill. Ignition tests were used to determine the organic content, and compression tests to follow the course of decomposition. The relationship between void ratio and organic fraction for a constant stress level was shown to be linear for the model sludges. A method was developed to calculate the void ratios as a function of pressure and organic content. These values agreed well with field data. Predictions of settlement of

decomposing sludges were formulated from the initial and final void ratios and the degree of decomposition. (Cassar-FRC)
W82-04694

APPLICATION OF THE WASTEWATER EFFLUENT OF A RURAL COMMUNITY TO A MOUNTAIN MEADOW,

Colorado E Agricultural Experiment Station, Fort Collins.
K. A. Barbarick, B. R. Sabey, and N. A. Evans.
Journal Water Pollution Control Federation, Vol 54, No 1, p 70-76, January, 1982. 7 Tab, 29 Ref.

Descriptors: *Land disposal, *Wastewater treatment, *Meadows, Effluents, Wastewater, Phosphorus, Sodium, Chlorides, Potassium, *Wastewater irrigation, Irrigation, Crop yield, Hay, Grasslands, *Impaired water use, Colorado, Hayden area.

Changes in the water, soil, and plant properties of a mountain meadow caused by sprinkler application of wastewater effluent or ditch water and the presence of subsurface drainage tiles or natural drainage were investigated. The study was conducted near Hayden, Colorado, at an elevation of 1977 meters, a latitude of about 41 degrees C, and a population of about 1,000. Ranching, farming and coal mining are the main industries of the area. A mountain meadow situated west of the Hayden wastewater treatment lagoons was used for the field study. The soil profile consists of layers ranging from a dark brown, silty clay loam to a mottled gray-brown clay. A gravel lens is encountered at depth of 1.5 to 2.0 meters. The meadow has been used for hay production for at least 10 years and has been flood irrigated continuously during this period. Application of effluent to the meadow produced only a few significant changes in area characteristics. Effluent caused significant increases in the chloride and sodium ion concentrations and uptake of sodium by plants in 1977. Hay yields, protein production and sodium and phosphorus uptake by plants were increased in 1978, and the concentrations of phosphate-phosphorus and exchangeable sodium and potassium in surface soil samples were also increased. Drainage tiles effectively lowered the water table for most of the 1977 irrigation season. The groundwater was below the drainage tiles in most of the 1978 season. Application of the effluent to the meadow for 2 years indicated that no environmental or health hazards resulted. (Baker-FRC)
W82-04705

5F. Water Treatment and Quality Alteration

THE SIDERITE MODEL OF THE FORMATION OF CORROSION-RESISTANT SCALES,

Karlsruhe University (Federal Republic of Germany), Water Chemistry Dept.
H. Sontheimer, W. Kolle, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 73, No 11, p 572-579, November, 1981. 11 Fig, 1 Tab, 36 Ref.

Descriptors: Corrosion inhibition, *Scaling, *Iron, Water distribution, Water mains, *Corrosion control, Water quality, Siderite, Ferrous carbonate, Calcium carbonate, *Pipes, Water supply systems, Protection, Chemical precipitation.

The concept that siderite (FeCO3) is important in the formation of a protective, corrosion-inhibiting layer in water distribution pipes has led to a siderite model. The model is based on the following reactions: primary--formation of ferrous ion and 2 electrons from elemental iron, formation of hydroxyl ions from water, and formation of carbonates from bicarbonate; secondary--formation of calcium carbonate, ferrous carbonate, and goethite (FeOOH); tertiary--fromation of goethite pseudomorph and magnetite (Fe304) from ferrous carbonate. Laboratory studies were performed by measuring corrosion rates in steel pipe and by analyzing the chemical composition of the scale. Water from the Karlsruhe, Federal Republic of Germany, distribution system was used. Scales formed from highly buffered water contained 85-90% ferrous iron and 10-15% ferric iron. In slightly buffered water the ferrous portion was 40%. The more ferrous iron in the scale, the better the corrosion protection. The presence of humic acids, calcium ion, and lower oxygen concentrations all increased corrosion protection. although this simplified model cannot explain all observations, it may predict general trends. (Cassar-FRC)
W82-04270

SPECIFIC AND CHELATE EXCHANGERS: NEW FUNCTIONAL POLYMERS FOR WATER AND WASTEWATER TREATMENT,

Water Purification Associates, Cambridge, MA.
C. Calmon.
Journal of the American Water Works Association, Vol 73, No 12, p 652-656, December, 1981. 2 Fig, 7 Tab, 42 Ref.

Descriptors: *Ion exchange, *Chelation, *Metals, *Water treatment, *Wastewater treatment, *Polymers, Resins, Heavy metals, Anion exchange, Cation exchange, Bactericides.

The 1935 discovery of ion exchange resins has led to development of selective and specific ion exchange materials for water and wastewater treatments. This review presents the characteristics of 21 of these resins. The standard ion exchangers using sulfonic, carboxylic, or amine groups are not selective. All ions are packed up rather than the ones of concern, such as toxic metals. Regenerant costs are high, and selective recovery of ions from effluents is very difficult. Recently developed resins can remove specific metals, such as Hg or Cu, or groups of metals, such as the rare earths. A chelate resin, an insoluble polymer to which is attached a complexing group, involves both ion exchange and chemical reactions. Chelate resins have some limitations. Reaction rates are slower, special operating conditions during elution are required, and high concentrations of elutants may be needed. Recently bactericidal resins have been developed. These rely on (1) the affinity of amino and carboxylic groups in the organisms' tissues for the ion exchange resins, or (2) the presence of a bactericidal agent in the resin. (Cassar-FRC)
W82-04275

THE SEARCH FOR A CORROSION INDEX,

Environmental Science and Engineering, Inc., Gainesville, FL.
J. E. Singley.
Journal of the American Water Works Association, Vol 73, No 11, p 579-582, November, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Corrosion index, *Calcium carbonate, *Water quality, Alkalinity, Water distribution, Solubility, *Water mains, Hydrogen ion concentration, *Water supply systems.

A review of corrosion indexes revealed that no general corrosion index is available. It is not likely that a single index can apply to all metals. Some indexes have been applied in inappropriate circumstances. Use of any corrosion index should first be correlated with field test results to determine if it is applicable to a given water. Among the corrosion indexes described are: Langelier (1936), based on the effect of pH on the solubility of calcium carbonate, and a modification by Larson and Buswell (1942); Ryznar's (1944) stability index, with higher numbers indicating a more saturated water; Dye's (1958) momentary excess concept, the casil index, and the aggressive index which accounts for alkalinity. All these methods based on carbonate solubility equations are a measure of solubility of calcium carbonate, not corrosivity. Other methods are based on the ability of water to attack metal pipes and include additional factors. Parameters that must be considered in developing a corrosion index are hardness, alkalinity, carbonate, carbon dioxide, pH, chloride, sulfate, ionic strength, conductivity, total dissolved solids, color, hydrogen sulfide, buffer capacity, phosphate, silica, dissolved oxygen, chlorine, and temperature. (Cassar-FRC)
W82-04279

THE SCIENTIFIC BASIS FOR CONTROL OF LEAD IN DRINKING WATER BY WATER TREATMENT,

Wiggins Teape Research and Development, Ltd. (England).
I. Sheiham, and P. J. Jackson.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 6, p 491-515, December, 1981. 8 Fig, 8 Tab, 10 Ref.

Descriptors: *Drinking water, *Lead, Potable water, Heavy metals, *Water treatment, Alkalinity, Acidity, Carbonates, Water supply systems, Water quality.

Work is described which was carried out to identify the factors of water quality which determine lead concentration, to provide the ability to predict the types of water which give rise to excessive lead concentrations, and to define the methods and quality targets for water treatment to minimize lead levels in water. To achieve these objectives, the composition of deposits on the interior walls of lead pipes has been examined, the solubility of lead in water in equilibirum with these deposits has been calculated, and experimental tests have demonstrated the effects of a range of possible methods of water treatment to reduce lead concentrations. The study concludes that lead concentrations in water from lead pipes are limited to a high degree by the solubility of lead in water, and that water treatment can reduce lead levels effectively by ensuring that this solubility is as low as possible. In low alkalinity water, low pH is the predominant cause of high lead concentrations, and pH elevation to about pH 8.5 is required but not generally necessary to increase alkalinity. Addition of orthophosphate is a secondary approach to the treatment of this type of water. For water of high alkalinity addition of orthophosphate is the favored method of treatment, as simple pH adjustment is unlikely to produce a significant decrease in lead concentration. The large increase in pH required to produce substantial reductions in lead levels would have to be preceded by softening or removal of alkalinity, which are subjected to considerable disadvantages. (Baker-FRC)
W82-04301

REUSE OF BIOLOGICALLY TREATED WASTEWATER AS COOLING TOWER MAKEUP,

For primary bibliographic entry see Field 3C.
W82-04317

OBTAINING LAYOUT OF WATER DISTRIBUTION SYSTEMS,

Department of the Air Force, Washington, DC.
For primary bibliographic entry see Field 8A.
W82-04319

ZERO-DISCHARGE IN PRACTICE AT RAY D. NIXON POWER PLANT,

Ray D. Nixon Power Plant Water Supply, Colorado Springs, CO.
For primary bibliographic entry see Field 5D.
W82-04320

REGULATING CORROSIVE WATER,

Environmental Protection Agency, Warhington, DC.
For primary bibliographic entry see Field 6B.
W82-04335

HEALTH ASPECTS OF WATERS AT PUBLIC HEALTH RESORTS,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-04348

EXPERIMENTS IN IMPROVING RURAL WATER SUPPLIES,

Vermont Univ., Burlington. Dept. of Agricultural and Resource Economics.
F. O. Sargent, J. H. Mann, and T. N. Neiman.
Water Resources Bulletin, Vol 17, No 6, p 1008-1011, December, 1981. 1 Tab, 9 Ref.

Descriptors: *Information exchange, *Rural areas, *Water quality control, Public relations, Public participation, Public health, Attitudes, Surveys, Publications, Drinking water, *Water supply, Eutrophication, *Vermont, Local governments, Water treatment.

Two experiments in improving the information gap between rural Vermont water consumers and state agencies are described. Mann (1974) used an information display board, a survey of health officers, a health officers' conference, and a 3-month newspaper information compaign. Results indicated that people would take action to assure that their water supply passes minimum standards if they had proper information. A model news release was successful in reporting water quality problems to the public; it required only filling in blanks with the appropriate data. Meetings and training sessions for town health officers significantly reduced errors and problems in sampling water supplies. Neiman prepared two publications to help inform rural water users of water quality problems and solutions. 'A Handbook for Rural Water Users' explains the nature of drinking water standards, reasons for those standards, dangers and results of not meeting the standards, and cost effective alternatives for improving water quality. 'A Layman's Guide to Eutrophication' provides information on one of the subjects least understood by town officials. Obstacles to improvement of rural water supplies were lack of information exchange between local officials and consumers, fragmentation of agencies into diverse departments, and public apathy. (Cassar-FRC)
W82-04350

WHEN A WATER SUPPLY WENT BAD,

For primary bibliographic entry see Field 5C.
W82-04357

CONSIDERATIONS ON ORGANIC MATTER IN DRINKING WATER TREATMENT,

Municipal Water Works of Rotterdam (Netherlands).
J. J. Rook, A. Graveland, and L. J. Schultink.
Water Research, Vol 16, No 1. p 113-122, January, 1982, 6 Fig, 5 Tab, 3 Ref.

Descriptors: *Organic matter, *Chlorinated hydrocarbons, *Activated carbon, *Water treatment, Drinking water, Design criteria, Surface water, *Netherlands, Performance evaluation, Organic carbon, Water quality, Ozonation, Chlorination, Adsorption, Water treatment facilities.

The efficiency of organic matter removal was evaluated in four water treatment systems in the Netherlands. All systems used stored surface water as the raw water source. Performance varied according to the parameters chosen. Most groups of parameters gave incomplete information. The classic parameters, COD, permanganate, ultraviolet extinction, and color, may give false impressions of removal efficiencies when oxidative treatments are involved. The instrumental total organic carbon (TOC) method is the most reliable in this group. The parameters, taste, color, and odor, also give limited information on water quality. A method for determining biodegradable organic matter (AOC) introduced by van der Kooy (1978) is the best parameter to judge efficiencies of water treatment chains from the bacteriological aspect. Toxic material parameters include chlorinated organic compounds and organically bound chlorinated compounds adsorbable on activated carbon (AOCl). In designing drinking water treatment trains, water should have minimum: (1) taste and odor, determined by organoleptic means, (2) toxic substances, determined by halogenated organic compounds (AOCl), and (3) bacterial count, determined by the AOC test and 22 C bacterial counts. This procedure helps avoid overtreatment. Parameters (bacterial counts, AOC, trihalomethanes, and AOCl) are given for the four treatment systems: (1) prechlorination plus granular activated carbon, Rhine River and polder water, (2) prechlorination and powdered activated carbon, Meuse River, (3) ozonation and biological filtration, highly colored water, and (4) ozonation and granular activated carbon, Meuse River. (Cassar-FRC)
W82-04374

LEAK DETECTION PROGRAMS RECOVER REVENUES,

Community Consultants, Inc., Provo, UT.
For primary bibliographic entry see Field 3D.
W82-04375

GRANULAR ACTIVATED CARBON INSTALLATIONS,

Culp/Wesner/Culp, Cameron Park, CA.
R. L. Culp, and R. M. Clark.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102492, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-177, October, 1981. 9 p, 1 Fig, 1 Tab.

Descriptors: *Activated carbon, *Water treatment, *Cost analysis, *Drinking water, *Adsorbents, Wastewater treatment, Reactivation, Odor control, Color removal, Organic compounds.

On January 9, 1978, EPA proposed the use of granular activated carbon (GAC) as a means of treating drinking water. Questions have been raised regarding EPA's cost estimates for GAC use. As part of studies designed to establish water supply unit process costs, GAC treatment design criteria, performance, and cost data were compiled from 22 operating municipal and industrial GAC installations that treat water and wastewater, and that process food and beverage products. Results indicate that a substantial number of GAC installations have been operating successfully for many years. Although long-term use of GAC and powdered activated carbon by municipal waterworks and industries has been widespread, no adverse health effects have been reported. GAC treatment of public water supplies to remove trace organics is fairly new, but GAC treatment of public water supplies for taste and color control or for color removal is practiced in about 46 cities in the US. Pilot plant testing of GAC adsorptive and reactivation characteristics in municipal water treatment plants can be combined properly with the known costs of GAC systems in wastewater treatment to yield a design basis and preliminary cost estimates that are satisfactory for developing water treatment projects. (Moore-SRC)
W82-04391

EFFECT OF HALOGENS ON GIARDIA CYST VIABILITY,

Oregon Univ. Health Sciences Center, Portland.
E. A. Meyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102294, Price codes: A02 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-174, October, 1981. 3 p, 2 Ref. R-806032.

Descriptors: *Giardia, *Disinfection, *Drinking water, *Water treatment, *Chlorination, *Iodine, Water temperature, Hydrogen ion concentration, Protozoa, Parasites, Halogens.

The vehicle for spreading epidemic giardiasis is drinking water. The development of a method to induce the excystation of Giardia cysts has made possible, for the first time, a reliable method of determining Giardia cyst viability, and thus, the ability to determine whether a given procedure kills these cysts. Using this method, the effects of halogens on thee cysts of G. lamblia were tested. In one set of experiments, chlorine was tested under a variety of conditions including chlorine concentrations, temperature, pH, and chlorine-cyst contact time. Within the range of variables studied, the ability of cysts to excyst after treatment was affected by each of these variables. Percent excystation decreased with: increasing chlorine concentration; increasing temperature; decreasing pH; and increasing contact time. In a second set of experiments, six small-quantity water disinfection methods were tested. Two methods (Halazone and bleach) employed a form of chlorine, and four methods (Globaline, EDWGT, and elemental iodine in tincture and in saturated form) involved some form of iodine. Halazone and EDWGT inactivated all of the cysts under all test conditions. Bleach, Globaline, and tincture of iodine only failed to inactivate all cysts under one set of conditions: in clear water at 3 C. Saturated iodine failed to inactivate all of the cysts in either clear or cloudy water at 3 C, but inactivated all cysts at 20 C. (Moore-SRC)
W82-04401

THE IDENTIFICATION AND TREATMENT OF BROMIDES AND TRIHALOMETHANES IN POTABLE WATER FROM THE PEARL RIVER AT JACKSON, MS: EVALUATION OF TOXICITY ON SPECIES DIVERSITY,

Mississippi State Univ., Mississippi State. Water Resources Research Inst.
For primary bibliographic entry see Field 5A.
W82-04413

COAGULATION MECHANISMS: AN ELECTRON MICROSCOPIC STUDY USING ALUMINUM SULFATE,

Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
T. Ishibashi.
Journal of the American Water Works Association, Vol 72, No 9, p 514-518, 1980. 8 Fig, 9 Ref.

Descriptors: *Turbidity, *Water treatment, Drinking water, Potable water, *Coagulation, Clays, *Aluminum sulfate, Zeta potential.

A transmission electron microscopic study was performed to obtain visual data on the mechanism of coagulation. The findings call into question the validity of the double-layer theory of coagulation on clay colloid. Shokozan clay, classified mineralogically as dickite clay, was selected for the study. After the clay solution settled for 24hr, microscopic inspection revealed particles several micrometers in diameter among the particles remaining in suspension. Further treatment of the suspension was rendered. The primary stage of coagulation of the clay colloid was reached by adsorption of soluble aluminum hydrolysis ions and by the chemical reactions producing aluminum hydroxide on the surface of the clay particles. The coagulation could be carried out at a zeta potential of -26.6 mV, much lower than the typical values reported in the literature, suggesting that coagulation was not directly related to the zeta potential value. At this low dosage of alum the coagulated particles and the uncoagulated particles coexisted in the suspension. Adsorption and chemical reactions between soluble aluminum hydrolysis ions and the surface of clay particles seem to be completed instantaneously after the alum dosing. Whether aluminum hydroxide is formed in films on the colloids or on independent particles may have a significant effect on the floc growth. The double-layer theory holds that the zeta potential and the colloid stability are correlated, and that a sufficient reduction of zeta potential is needed to achieve coagulation. In this study coagulation was carried out even with high zeta potential, indicating that adsorption of potential determining ions and bridging explain the observed phenomena better than the double-layer theory. (Baker-FRC)
W82-04423

COAGULATION: EXPERIENCES IN ORGANICS REMOVAL,

Minnesota Univ., Minneaplis. Dept. of Civil and Mineral Engineering.
M. J. Semmens, and T. K. Field.
Journal of the American Water Works Association, Vol 72, No 8, p 476-483, August, 1980. 17 Fig, 1 Tab, 10 Ref.

Descriptors: *Water treatment, *Coagulation, Organic compounds, Trihalomethanes, Sludge, Alum, Acidity, Temperature effects, Flocculation, Sampling, *Mississippi River, *Minneapolis, Minnesota.

Coagulation tests were run of water samples taken from the Mississippi River close to the point of extraction for the Minneapolis water treatment plant. The water is high in organic content, with dissolved organic carbon concentrations ranging between 10 and 16 mg/liter during the course of the study. Turbidity ranged between 2 and 25

NTU. The coagulation process with alum as the sole coagulant was found to be capable of achieving significant organics removal from the Mississippi River water. The removals were found to be strongly pH and dose dependent. Organics absorbing ultraviolet light are removed more effectively by coagulation. Tests conducted on unconcentrated and reconstituted Mississippi River water at various times indicate that the organics removal was very reproducible. The only significant variation was noted when low alum doses were used in high turbidity waters. The influence of varying flocculation times on turbidity and organics removal was examined for three river water samples. Tests were also conducted to determine whether the organics removal performance could be improved by altering the way in which the coagulant was added to the river water. The results essentially indicated that there was no benefit to a two-stage coagulation process. Similar results were obtained with the three- and four-stage studies. The recycling of sludge to supplement an alum dose did not improve organics removal compared to controls receiving no recycled alum sludge. It was concluded that the most important variables influencing organics removal by alum coagulation are alum dose and pH. (Baker-FRC)
W82-04424

CONTROL OF TRIHALOMETHANES IN DRINKING WATER,

Louisville Water Co., KY.
D. T. Duke, J. W. Siria, B. D. Burton, and D. W. Amundsen.
Journal of the American Water Works Association, Vol 72, No 8, p 470-476, August, 1980. 5 Fig, 5 Tab.

Descriptors: *Drinking water, *Organic compounds, Water quality, *Water treatment, Potable water, *Trihalomethanes, Activated carbon, Hydrogen peroxide, Chlorination, Ammonification, Ammonium.

The implementation of effective methods for the control of trihalomethanes (THM) is neither impossible nor overly difficult. Methods such as ammoniation for hindering THM increases after chlorination have been explored and the technology is available, as is the technology for other methods of disinfecting water supplies without forming significant amounts of THMs. While these do pose an inevitable cost problem, they also present solutions to the major problem. Each plant must survey its individual needs for THM control and select the most appropriate technology for the job. One test that has been widely used to study the effect of chlorination on source waters is the trihalomethane formation potential test (THMFP). Temperature, pH, chlorine dosage and chlorine contact time are the critical factors in this test. Since chlorine contact time is critical in THM formation, a system that reduces this contact time may feasibly reduce THM formation. The THMFP of the source water increases as the temperature of the water increases, peaking during the summer months. Use of ammoniation in place of chlorination offers an effective means of reducing THM growth. The use of chloramines, ozone, and hydrogen peroxide as disinfectants that do not form THMs should also be considered. Hydrogen peroxide, a dechlorinating agent, when used in conjunction with chlorine might provide the right combination to achieve complete disinfection and prevent THM formation simultaneously. The cost of chemicals for this treatment would be significantly higher than for ammoniation, but the results are much more successful. Suggested use of granular activated carbon pertains to a wider scale removal of organic compounds than just THMs. (Baker-FRC)
W82-04425

THE MONOCHLORAMINE-GAC REACTION IN ADSORPTION SYSTEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Environmental Engineering.
B. R. Kim, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 72, No 8, p 488-490, August, 1980. 3 Fig, 11 Ref.

Descriptors: *Adsorption, *Activated carbon, Granular activated carbon, Simulation, Model studies, Water treatment, Drinking water, Potable water, *Chlorination, Organic compounds, *Monochloramine, Chemical reactions.

This paper deals with the reaction kinetics of monochloramine, a critical component of chlorine residual, with granular activated carbon. The results show the effect of influent concentration, flow rate, contact time, and carbon particle size on the GAC-ammonium chloride reaction. Monochloramine reacted slowly with GAC by comparison to the rates at which free chlorine and dichloramine react. After an acclimation period, the effluent ammonium chloride concentration from a GAC contactor reaches a steady state value if such influent conditions as ammonium chloride concentration, flow rate and other factors do not change. The reaction rate at steady state is slower than the initial rate. At steady state the reaction rate for ammonium chloride is very slow if the solution concentration is below about 1 mg/liter as chlorine. Very long contact times are therefore required if the concentration is to be reduced below detectable levels. (Baker-FRC)
W82-04426

EVALUATION AND TREATMENT OF SYNTHETIC ORGANICS IN DRINKING WATER SUPPLIES,

Montgomery (James M.), Pasadena, CA.
R. R. Trussell, and A. R. Trussell.
Journal of the American Water Works Association, Vol 72, No 8, p 458-470, August, 1980. 21 Fig, 5 Tab, 51 Ref.

Descriptors: *Water supply, *Organic compounds, Pollutant identification, *Drinking water, Potable water, *Water treatment, Reulations, Evaluation, Reviews, *Synthetic organics.

An approach is outlined which a water utility might employ to evaluate the purity of its water source, review the effectiveness of its current treatment, assess the exposure of the consumer to risks, study the feasibility of various courses of action, and implement a final plan. The task of dealing with synthetic organics can be divided into six parts: source evaluation, risk assessment, feasibility analysis, scheduled periodic surveillance, cost-benefit analysis, and implementation. Tasks required to evaluate the integrity of the quality of a water source are the source survey and the source analysis. Once source evaluation is complete, an assessment must be made of the health risk imposed on the population consuming the water. Potential synergistic and antagonistic effects must be considered between different compounds. If the results of the source evaluation and risk assessment are not satisfactory, a feasibility study must be conducted to determine the most effective means of providing a safe water supply. Five basic alternatives may be considered if the water supply is not adequately protected: find a protected source; eliminate the contaminants; use a combination of off-line storage with river supplies so that water can be drawn off during periods of good quality; treat the water supply to remove the materials of concern; and install dual distribution systems and use water from a protected source for domestic supply and water from the unprotected source for less exacting uses. Treatment may include aeration, coagulation, oxidation, biological processes and adsorption. (Baker-FRC)
W82-04427

REMOVAL OF TOTAL ORGANIC HALOGEN BY GRANULAR ACTIVATED CARBON ADSORBERS,

Illinois Univ. at Urbana. Champaign. Dept. of Civil Engineering.
J. E. Quinn, and V. L. Snoeyink.
Journal of the American Water Works Association, Vol 72, No 8, p 483-488, August, 1980. 14 Fig, 3 Tab, 6 Ref.

Descriptors: Water quality, *Organic carbon, Adsorption, *Activated carbon, *Halogens, Hazardous materials, *Water treatment, *Monitoring, Drinking water, Potable water, Water supplies.

This study was undertaken to show the potential for using total organic halogen (TOX) measurements to determine the degree of saturation of activated carbon adsorbers. Humic substances, a major constituent of natural waters, were chlorinated and applied to laboratory columns for this purpose. Samples taken at several times from experimental adsorbers at Jefferson Parish, Louisiana, were also evaluated. The results of the study showed that for these adsorbates TOX buildup on the carbon was gradual and consistent, and that measurement of the TOX profile in the adsorber at different times can be used to determine when the adsorption capacity has been depleted and replacement or regeneration is needed. Determination of the TOX profiles at Jefferson Parish showed a gradual saturation of adsorption capacity at all depths with time. Thus it appears that measuring the group parameter total organic halogen may be an acceptable alternative to analyzing specific compounds in order to monitor water quality and the efficiency of water treatment processes for removing potentially hazardous organics. (Baker-FRC)
W82-04429

EFFECTS OF CHLORINE CONCENTRATION ON THE STRUCTURE OF POLIOVIRUS,

New Mexico State Univ., Las Cruces. Dept. of Biology.
M. E. Alvarez, and R. T. O'Brien.
Applied and Environmental Microbiology, Vol 43, No 1, p 237-239, 1982. 1 Fig, 4 Ref. OWRT-A-066-NM.

Descriptors: *Viruses, *Chlorination, Wastewater treatment, *Water treatment, Chemical reactions, Poliovirus.

Relationships are explored between chlorine concentration, loss of viral infectivity and viral composition in aqueous medium changes. Poliovirus type 1 (Mahoney) was used in the study. At chlorine concentrations up to 0.4 mg/liter, there were no major changes in the poliovirus sedimentation coefficients, although virus inactivation was 38%. At chlorine concentrations of 0.8 mg/liter or higher, there was a shift of the virus sedimentation coefficients from the 156S value associated with intact particles to 80S, which was shown to represent structures lacking RNA. The percentage of counts associated with empty capsid peaks did not correlate with percent inactivation values. These results indicate that changes in virus composition and structure are dependent on the initial chlorine concentration and that these changes are not the primary cause of virus inactivation. Chlorine concentrations in excess of 0.8 mg/liter apparently lead to reactions within the virus particles which can result in separation of the viral components. (Baker-FRC)
W82-04525

WATER IN PHARMACEUTICALS AND COSMETICS INDUSTRIES,

Chiltern Water Treatment Co. (England).
R. W. Hill.
Effluent and Water Treatment Journal, Vol 21, No 11, p 515-517, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Water quality, *Industrial water, *Water treatment, Reverse osmosis, Filtration, Membrane processes, Standards, Bacteria, Water use, *Pharmaceutical industry, *Cosmetic industry.

The treatment of water which appears in the products of the cosmetics or pharmaceuticals industries is discussed. In the British Pharmacopoeia two categories are specified for water used by the pharmaceutical industry, purified water and water for injections. The major difference between these two categories is that purified water refers to chemical impurities, while water for injection must also be free of biological contaminants. With the exception of injection and infusion solutions, other products will be exposed at some time to the atmosphere and thus to possible biological contamination. It is usually necessary to use purified water even for apparently non-critical cosmetics because contaminants may interfere with the manufacturing process or cause deterioration in the

appearance of the product. Ion exchange is fast becoming the most common method of preparing purified water on the commercial scale. Reverse osmosis is able to remove non-ionized contaminants and is becoming increasingly popular. However, this method alone will not usually effect sufficient removal to meet purified water requirements, and it is usual to employ a mixed bed ion exchange polishing unit downstream. Reverse osmosis can be used for producing sterile water, but there is some recent evidence that certain small bacteria, viruses and pyrogens can pass through the semipermeable membranes. Storage of high purity water is difficult, as this substance is an exceptionally good solvent. Care must be taken in selecting construction materials for purified water systems. Polishing filters should be employed at the points of use whenever possible. (Baker-FRC)
W82-04533

THE NECKAR AS A SOURCE OF PROCESS AND RESERVE WATER (DER NECKAR ALS LIFEFERANT VON BETRIEBS- UND RESERVEWASSER),

Technisch Werke der Stadt Stuttgart (Germany, F.R.).
K. E. Oehler.
GWF-Wasser/Abwasser, Vol 122, No 12, p 566-571, 1981. 2 Fig, 5 Tab. English Summary.

Descriptors: *Water supply, *River water, *Municipal water, Water quality, Neckar River, *Stuttgart, Germany, Impaired water use, Ammonium, Process water, Industrial water, Water distribution, *Water treatment, Potable water, Drinking water, Chlorination.

Following completion of the Lake Constance drinking water supply for the city of Stuttgart, the Berg water treatment plant on the Neckar River was kept in operation to supply industrial process water, to serve as an emergency supply for the city if needed, and to reduce the demand on the piped supply. Berg water is used in a power plant, the gas plant, the city laundry, the railway, the parks and fountains of the city, and municipal air conditioning facilities. The quality of Neckar water is still monitored regularly. The principal problem pollutants in the Neckar at present are high ammonium concentrations and trihalomethanes. Detailed analyses of chemical composition for 1980 revealed significant changes only during extremely high and low flow. During high flow sludge transport was noted, and enrichment of wastewater constituents occurred during low flow. Nevertheless most water quality parameters still fell within the highest quality class, except for phosphate and ammonium concentrations. The water treatment of the Neckar supply comprises sub-breakpoint chlorination, aluminum sulfate flocculation, settling and rapid filtration. Powdered activated carbon, slow sand filtration and charcoal filtration are used only in the case of drinking water. Low-level chlorination is the final step. This simplified treatment and the short distribution pathways make it possible to supply the process water at half the cost of normal drinking water. (Carroll-FRC)
W82-04546

TREATING TASTE AND ODOUR PROBLEMS USING OZONE AND ACTIVATED CARBON,

Degremont Infilco Ltd., Rueil-Malmaison (France).
R. Cyr, and Y. Richard.
Water and Pollution Control, Vol 119, No 12, p 15-17, December, 1981.

Descriptors: *Ozone, *Activated carbon, *Taste, *Odor control, Water treatment, Adsorption, Filtration, Clarification, Organic matter, Monsang-sur-Seine, France. *Paris.

The 13.9 mgd Monsang-sur-Seine plant suplying water to Paris suburbs has incorporated granular or powdered activated carbon and ozone into the treatment process. The ozone treatment step takes place between the clarification-sand filtration step and the activated carbon treatment. This sequence eliminates taste and odor in the water prolongs the useful life of the carbon. This procedure produces good quality water in spite of the variable quality of the raw river water, which is occasionally polluted, especially during low flow in summer. (Cassar-FRC)
W82-04553

PURIFICATION OF SURFACE WATERS (REINIGUNG VON OBERFLACHENWASSER),

Bohiden-Knapsack G.m.b.H., Hurth-Knapsack (Germany, F.R.).
G. K. Kohler.
Wasser, Luft und Betrieb, Vol 25, No 11, p 10-12, 1981. (No English Summary).

Descriptors: *Water treatment, *Drinking water, *Filtration, Flocculation, Chemical coagulants, Flotation, Separation techniques, Magnetic separation, Phosphate removal, Surface water, Tegeler Sea, *Berlin, Germany.

Increasing demands for water necessitate the use of increasing amounts of surface water for drinking water preparation. Numerous studies have been conducted on improved methods for surface water treatment, including especially flocculation. Phosphorus removal is a major goal of flocculation and of combined chemical precipitation and filtration. The use of a two-filter system with a second flocculation step between the filters greatly improves phosphate removals. Including a container flocculation step before the filter increases filter life and phosphate retention without excessive chemical addition. This system was applied to cleanup of water obtained from the heavily contaminated Tegeler Sea near Berlin. Sludge retention was a substantial problem during the trial runs. Tube flocculation could markedly increase floc removal efficiency. Magnetic flocculation is another possibility for increasing flocculation efficiency. Flotation may be preferable to flocculation in special circumstances. Nevertheless available systems are not yet perfect in efficiency. (Carroll-FRC)
W82-04577

SELECTIVE REMOVAL OF FLUORIDE, ARSENATE AND PHOSPHATE IONS FROM WATER (SELEKTIVE ENTFERNUNG VON FLUORID-, ARSENAT- UND PHOSPHAT-IONEN AUS WASSER),

Institut Fresenius, Chemische und Biologische Laboratorien GmbH, Taunusstein-Neuhof (Germany, F.R.).
W. Fresenius, and W. Schneider.
Wasser Luft und Betrieb, Vol 25, No 11, p 14-15, 1981. 12 Ref. (No English Summary).

Descriptors: *Water treatment, *Fluoride, *Adsorption, Aluminum oxide, Arsenic compounds, *Phosphate removal, Drinking water, Hydrogen ion concentration, Aluminum compounds.

Available waters in some localities exceed the maximum permissible levels for fluoride, phosphate and arsenate, and therefore require treatment prior to consumption as drinking water. Special grades of aluminum oxide were developed as fluoride adsorbents and tested in a pilot scale installation. Residual fluoride contents below 1 mg/1 were obtained using initial waters with fluoride contents of 3 mg/1 and 10 mg/1 and pH values of 6.3-6.5. Filter lifetimes were about 30 days. About 10 liters of 2 N sodium hydroxide per kg aluminum oxide were required for regeneration. Accumulation of fluoride by the adsorbent from the rinse water can be prevented by using rinse water with pH values in excess of about 7.5. Fluoride ion removal is not selective, but hydrogen arsenate and hydrogen phosphate are also removed to a high degree. Changes in other mineral constituents were not observed. The increase in alumicum content in the filtered water samples amounted to about 0.1 mg/l. (Carroll-FRC)
W82-04578

SLOW-SAND TEST-BEDS HELP REFINE DESIGN,

A. Raman, G. Singh, and J. L. Nagpal.
World Water, Vol 4, No 12, p 44-45, December, 1981. 2 Fig.

Descriptors: *Water treatment, *Rural areas, *Pilot plants, *Sand filters, Filtration, Water supply, Raw water, Filters, Separation techniques, Control systems, Chlorination, Design criteria, Abub Shahar, *India.

In designing the Abub Shahar water treatment demonstration plant in India, the lack of skilled staff and possibility of discontinuous terminal chlorination were taken into account. The filters function mainly for polishing and bacterial purification. Raw water in a storage tank is filtered 24 hr per day by four circular filters with one as a standby. The filtered water is chlorinated and held in two clearwater tanks until distribution to the rural villages. The Abub Shahar village demonstration plant has experienced vagaries of electric power supply since it began operation in June of 1979. Although backup diesel generators can be used, extra capacity capabilities could be supplied to the plant's different units to satisfy about 66% of design demand during these adverse periods. The backup filter is being operated constantly, and the high-level tank lacks a float valve on the outlet. A partially above ground filter would have been more appropriate to facilitate scouring of supernatant water. A master sluice valve to control raw water pumping and overflows in all the filters are suggested to improve flow regulation. A separate supernatant scour-out box combined with filter overflow and a modified outlet arrangement incorporating rate-limiting and measuring orifices in the backfilling pipe are also proposed. (Geiger-FRC)
W82-04614

FLOCCULATION IN PIPES FOR WATER POLLUTION CONTROL AND PHOSPHORUS REMOVAL PURPOSES (UBER DIE ANWENDUNG DER FLOCKENBILDUNG IN ROHREN ZUR WASSERREINHALTUNG UND PHOSPHATELIMINATION),

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
A. Grohmann.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 194-209, 1981. 15 Fig, 3 Tab, 16 Ref.

Descriptors: *Water treatment, *Flocculation, *Design criteria, Wastewater treatment, Water treatment facilities, Laboratory studies, Separation techniques, Chemical coagulation, Pilot plants, *Phosphate removal, Industrial wastewater, *Water pollution control.

The possibility of performing flocculation in pipes offers a means of significantly accelerating the flocculation process, since the velocity gradients in pipes enhance agglomeration of microflocs. A pipe length of 40 m will allow an adequate safety margin for maintenance of flocculation, since a steady state of floc growth versus breakup is reached in approximately 20 m. Adequate colloid and precipitation products destabilization is required. In addition to rising velocity gradients, addition of anionic polyacrylamides will also increase floc size. The design selected must provide sufficient turbulence to bring microflocs into contact with one another, but not to destroy flocs already formed. Design and operation data are presented for a trailer-mounted water treatment pilot plant and an industrial water treatment plant. Data are also tabulated for pipe flocculation systems ranging from laboratory tests with model colloids to full-scale water and wastewater treatment plants. Pipe sizes ranged from 8 to 600 mm diameter. Typical values obtained were flocs of 2-3 mm with a settling rate of 10 m/hr and a residual turbidity (after 10 min standing) of 1.5 formazin units, at an anionic polyacrylamide addition rate of 0.5 g/cu m and a mean flow velocity gradient of 70/sec. (Carroll-FRC)
W82-04615

TANZANIA'S MASTER WATER PLAN WILL MISS DECADE GOAL,

R. Laishey.
Water, No 42, p 26-27, 1982.

Descriptors: *Developing countries, *Water supply development, Potable water, Drinking water, Water supply, *Tanzania, Shallow wells, Wells.

In 1977, 90% of the rural population of Tanzania was living in village settlements, and the government was attempting to supply them with safe potable water. The country had announced an ambitious water plan in 1977, with a target date of 1991 as the year by which all the rural population would be within 400 meters of safe potable water. In 1973 the first phase of the scheme began, with the drawing up of a master plan for each of the 20 regions of the country. By the beginning of the 1980s, 12 regions were equipped with paster plans, another five were under preparation and for three no plans had yet gotten underway. A Master Plan Coordination Unit was established to oversee the project and gather the needed funding. Officially some six to seven million people or just under 40% of the rural population are now within 400 meters of potable water. In reality the figure may be closer to three to four million. Part of the problem is cost. Experiments are being conducted with cheaper technologies and self-help schemes. It is believed that the shallow well scheme can reach some 50% of the population in rural areas, but shallow wells have serious drawbacks. One well can probably only efficiently serve a village of 1,500 people. Many villages have 2,000 or more people. (Baker-FRC)
W82-04657

COLLOIDAL ORGANICS,

Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 113, No 2, p 65-67, 1982. 2 Fig, 8 Ref.

Descriptors: *Colloids, *Organic matter, Decomposing organic matter, Litter, Taste, *Water treatment, *Water quality, Odor control, Odor-producing algae, Odors, Coagulation.

Relatively high concentrations of organic colloids in a water supply are troublesome and should be removed for the following health and esthetic reasons: taste and odor problems are largely due to colloidal organics, byproducts of algae, diatoms, and actinomycetes, which produce objectional tastes and odors; humic and fulvic acids are precursors of chloroform; colloidal organics produce undesirable colors in water; colloidal organics cause fouling of anion exchangers and interfere with the demineralization of water; metal complexes of organic colloids strongly influence metal distribution between the dissolved and particulate state; the presence of colloidal organics can shield waterborne pathogens from disinfection treatment and can create problems associated with biological quality of treated water; and colloidal organics interfere with oxidation and removal of iron and manganese from water. Most organic substances produced by plants and animals in lakes and rivers and those brought there from the outside, such as leaf litter, are eventually decomposed through the metabolism of various aquatic organisms such as bacteria and fungi. Since the electrically charged surfaces of colloidal particles cause them to repel one another and maintain the stability of a colloidal dispersion, neutralization of the charged surfaces would permit the colloidal particles to come together and be removed from a water supply. The removal of colloids in this manner can be accomplished by coagulation. Various hypothetical models have been proposed to explain the destabilization and initial aggregation of colloidal matter by the addition of coagulants. (Baker-FRC)
W82-04689

YEAR-ROUND DISTRIBUTION SYSTEM MAINTENANCE,

Connecticut Water Co., Clinton.
J. E. Lebert, Jr.
Journal of the New England Water Works Association, Vol 95, No 4, p 267-270, December, 1981.

Descriptors: *Water conveyance, *Maintenance, Water distribution, *Water mains, Water supply systems, Management planning, Materials, Iron, Corrosion, Saline water, *Guilford-Chester Division, Connecticut Water Company, *Connecticut.

A review is presented of the last 15 years of year round distribution system maintenance carried out by the Connecticut Water Company, Guilford-Chester Division. During this time over 37,000 feet of 2, 4 and 6 inch cast iron and galvanized iron main was replaced with 8 inch or larger ductile iron mains. All new water mains in the salt water areas have been transilwrapped for protection. Larger mains have provided greater fire protection and a better quality of water, as they are all cement lined. Many dead ends were also tied in to improve fire protection and quality. Every service on the replacement mains was also replaced with copper tubing or plastic tubing. Crew size has been kept low, primarily due to the replacement vs repair program. Work is very seldom interrupted to make an emergency repair. A winter and spring maintenance program has been devised to make the best use of the time available. A program of replacing or repairing bridge crossing, culvert crossings, and river crossings has also been started. The policy aims at repairing or replacing before a problem occurs. (Baker-FRC)
W82-04699

REACTION OF OZONE WITH TRANS,TRANS-MUCONIC ACID IN AQUEOUS SOLUTION,

Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
E. Gilbert.
Water Research, Vol 14, No 11, p 1637-1643, November, 1980. 8 Fig, 3 Tab, 13 Ref.

Descriptors: *Ozone, *Organic compounds, *Oxidation, *Water treatment, Aromatic compounds, Muconic acid, Peroxides, Chemical degradation, Degradation products, *Ozonation, Drinking water, Chemical reactions, Phenols, Kinetics.

Ozonation of trans,trans-muconic acid in aqueous solution at pH 3 leads to the formation of fumaric acid aldehyde, glyoxal, glyoxylic acid and formic acid. As the reaction progresses, these are oxidized to the stable end products oxalic acid, mesoxalic acid and carbon dioxide. Hydrogen peroxide has been observed, in addition to unstable organic peroxides. Organic peroxides are not observed in the case of ozonation at pH 7-8, and the amounts of organic peroxides formed in this case are smaller than at pH 3. Up to the point of complete elimination of muconic acid the specific ozone consumption was 3.2 mmol ozone per mmol acid. Quantitative analysis of the oxidation products indicated that the ring opening products initially formed are further oxidized during ozonation, resulting in very low steady state concentrations in the course of ozonation at high ozone doses and low initial concentrations of aromatics to be oxidized. (Carroll-FRC)
W82-04731

5G. Water Quality Control

WATER MANAGEMENT IN ONTARIO,

Ontario Ministry of the Environment, Toronto.
For primary bibliographic entry see Field 6E.
W82-04259

STRATEGIES TO CONTROL NONPOINT SOURCE WATER POLLUTION,

Duke Univ., Durham, NC. Dept. of Civil Engineering.
J. J. Peirce.
Water Resources Bulletin, Vol 16, No 2, p 220-225, April, 1980. 1 Tab.

Descriptors: *Water pollution control, *Nonpoint pollution sources, Regulations, Environmental management, *Regional planning, Planning, Water quality control, Management, Water policy, Research priorities, Monitoring, New York, Virginia, Wisconsin, Urban runoff.

Strategies for nonpoint source water pollution control are discussed for three representative states, Virginia, New York, and Wisconsin. The most significant nonpoint pollution source in these states is urban storm water runoff, including combined sewer overflows. Others are silviculture activities, construction, mining activities, on-site wastewater treatment facilities, disposal of municipal and idustrial sludge and refuse, and agricultural runoff. A complete range of control strategies is illustrated, from voluntary compliance to strict regulations. Virginia favors voluntary action, Wisconsin plans to implement strict regulations if voluntary compliance is ineffective, and New York favors voluntary compliance combined with some regulations. A study of the programs and agencies in these states indicates: (1) nonpoint sources of pollution are a major component of overall water pollution, (2) technology exists to control these problems, (3) present control programs are not always technologically sound or cost effective, and (4) existing control programs will work only if meaningful actions take place in the future (voluntary compliance and effective implementation of regulations). (Cassar-FRC)
W82-04261

APPLICATION OF THE OECD EUTROPHICATION MODELING APPROACH TO LAKE RAY HUBBARD, TEXAS,

Brown and Caldwell, Sacramento, CA.
For primary bibliographic entry see Field 5C.
W82-04278

USE OF ACTIVE ALUMINA FILTRATION FOR REMOVING PHOSPHATES FROM SMALL INFLUENTS INTO AN IMPOUNDING RESERVOIR (ANWENDUNG DER AKTIVTONERDEFILTRATION ZUR ELIMINERUNG VON PHOSPHATEN AUS KLEINEN TALSPERRENZULAUFEN),

Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt, S. Fberle, D. Donnert, H. Struwe, and A. Wilhelms.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 180-187, 1981. 9 Fig, 4 Tab, 7 Ref.

Descriptors: *Watershed protection, *Reservoirs, *Phosphate removal, *Fish ponds, Adsorbents, Activated alumina, Filtration, Impoundments, Nonpoint pollution sources, Aluminum compounds, Nitrification, Ammonium, Receiving waters, Germany.

Fish ponds can represent significant sources of pollutants, especially phosphorus compounds and ammonia, in receiving waters. In 1987-1980 a hatchery located on the Derenbach introduced 55-65 kg of total phosphorus per year into an impounding reservoir located on the Wahnbach, contributing significantly to algal growth in the reservoir. Gravity filtration units were designed and inserted in the fish pond effluent line. The filters had a total surface area of 24 sq m and contained 19.8 metric tons of activated alumina. Filtration speed was conrolled to achieve satisfactory phosphate elimination and ammonium removal by nitrification. Filters were back-washed every 4 weeks with pond water; the back-wash water and sludge were returned to the main pond. Over the 10-month operation period, average orthophosphate removals of 83% were achieved, and average total phosphate removals of 77%. The effluent orthophosphate concentration was approximately equal to the desired value of 50 microg/liter. About 40% of the total organic carbon was also removed. Unexpectedly high ammonium ion removals were also attained, ranging up to 90%. No increase in aluminum level was recorded in the effluent. lgal clogging of the filter can be reduced by excluding light. Operating costs were estimated at 0.05 German Marks per cu m of filtered water. The filtration unit is still operating satisfactorily after one year. (Carroll-FRC)
W82-04281

ANALYTICAL QUALITY CONTROL,

D. Hunt.
Water, Vol 41, p 17-19, November, 1981. 3 Fig.

Descriptors: *Quality control, *Water analysis, Pollutant identification, Precision, Accuracy, Standard deviation, Laboratories, *Water quality control.

Analytical quality control in the water industry is necessary because there are many sources of ana-

lytical error--the analyst, the method, instruments, and contamination. The Water Research Council recommends a method for achieving comparability of analytical results from several laboratories. A working group defines the analytical objectives, chooses the most suitable method or develops a new one, ensures that instructions for methods are complete and clear, estimates standard deviation, compares standard solutions used by all laboratories, sets up control charts for systematic analysis of known solutions, and estimates the bias of each laboratory. A group of laboratories using quality control was far superior in analyzing a known lead solution when compared with a group not applying a quality control scheme. (Caesar-FRC)
W82-04345

PONDING SURFACE DRAINAGE WATER FOR SEDIMENT AND PHOSPHORUS REMOVAL,

Snake River Conservation Research Center, Kimberly, ID.
For primary bibliographic entry see Field 4D.
W82-04358

WATER-QUALITY PROBLEMS AND MANAGEMENT OF AN URBAN WATERFOWL SANCTUARY,

Wisconsin Univ. Green Bay. Coll. of Environmental Science.
H. J. Harris, Jr., J. A. Ladowski, and D. J. Worden.
Journal of Wildlife Management, Vol 45, No 2, p 501-507, 1981. 8 Fig, 22 Ref.

Descriptors: *Ponds, *Eutrophication, Nutrients, Birds, Water birds, *Waterfowl, *Water pollution sources, Wildlife habitats, Wildlife, Wildlife conservation, *Beach Wildlife Sanctuary, Green Bay, Wisconsin, *Water quality control.

The effects of waterfowl on water quality of an urban waterfowl sanctuary and the effectiveness of dredging as a renovation technique were investigated. The study was conducted at the Bay Beach Wildlife Sanctuary, Green Bay, Wisconsin. The sanctuary is a complex of interconnected manmade ponds surrounded by urban open space, including wetlands. Sources of water for all ponds are rain, runoff, and groundwater, with no connection between the ponds and Green Bay. Waterfowl use was estimated by direct counts several times a month over a 4 year period, usually taken at the time of water sampling. There were large differences in intensity of waterfowl use between the two ponds selected for study, one of which (N) was dredged, while the other (L) served as control. The estimated average annual use of N over a 4 yr period was 180,000 waterfowl days, whereas the use of L was 31 waterfowl days. Calculated annual loading from waterfowl in N amounted to 378 kg of total phosphate, 378 kg total nitrogen, and 7,830 kg of total solids. For L, comparable fiures were 0.065 kg phosphate, 0.065 kg total nitrogen, and 1.35 kg total solids. A sharp decrease in total phosphate and nitrate-nitrogen was noted in N the year following dredging. A marked decline in chlorophyll a was also noted in N after dredging and was correlated with decrease in the number of phytoplankton units/liter of water in the year following dredging. Diversity of phytoplankton, however, increased. While it may be assumed that waterfowl act as a nutrient source and bring small ponds to eutrophication, the key finding of this study was that eutrophication can and does occur rapidly under certain conditions. This is critical in the design and operation of waterfowl urban sanctuaries. (Baker-FRC)
W82-04384

AERATION CHARACTERISTICS OF FLOW RELEASE CONTROLS ON ILLINOIS WATERWAY DAMS,

Illinois State Water Survey, Urbana.
T. A. Butts, and R. L. Evans.
Circular 145, 1980. 69 p, 7 Fig, 24 Tab, 18 Ref, 7 Append.

Descriptors: *Dams, *Flow control, *Reservoir releases, *Dissolved oxygen, *Aeration, *Spillway gates, Discharge coefficient, Water quality, Weirs, Locks, Flow measurement, Spillways, Diversion, On-site data collections, *Water quality control, *Illinois waterway dams.

One of the most obvious and direct effects dams have on water quality is the creation of abrupt changes in dissolved oxygen (DO) concentrations. This study's main objectives were to gather physical and chemical data for use in a dam aeration calibration procedure based on a weir formula developed in Great Britain, and to evaluate the effects of increased Lake Michigan diversion water on the dam aeration characteristics. On-site DO and temperature measurements were taken above and below flow release structures and in calibrated weir boxes at seven dams. Water flowing over weirs or through head-loss control structures, such as Tainter and sluice gates, can be aerated or deaerated depending upon the ambient upstream DO concentration. Smaller gate openings consistently had greater reaeration capacities (approximately twice the oxygen transfer efficiency) than larger openings, i.e., the aeration efficiency is inversely related to opening size. This means more efficient aeration could be achieved by using the smallest opening possible while maintaining a desired downstream flow. For example, if 8 feet of opening is required at Starved Rock, 8 gates opened at one foot would be better than two gates at 4 feet, or two at 3 feet and one at 2 feet. However, dam aeration coefficients derived varied significantly within a dam, depending on the mode of operation, and varied greatly between dams. It was determined that under current operating modes the aeration capabilities of the flow release structures at the dams above the LaGrange and Alton pools will be significantly lowered by increasing diversion to 10,000 cfs. (Atkins-Omniplan)
W82-04388

DESIGN OPTIMIZATION OF THE CHLORINATION PROCESS: VOLUME 1. COMPARISON OF OPTIMIZED PILOT SYSTEM WITH EXISTING FULL-SCALE SYSTEMS,

California Dept. of Health Services, Berkeley.
For primary bibliographic entry see Field 5D.
W82-04399

A STRESS FUNCTION FOR EVALUATING STRATEGIES FOR WATER QUALITY MANAGEMENT,

Illinois Natural History Survey, Urbana.
For primary bibliographic entry see Field 5C.
W82-04407

COVERING BOTTOM SEDIMENTS AS A LAKE RESTORATION TECHNIQUE,

Kent State Univ., OH. Dept. of Biological Sciences.
G. D. Cooke.
Water resources Bulletin, Vol 16, No 5, p 921-926, October, 1980. 3 Tab, 28 Ref.

Descriptors: *Eutrophication, *Water pollution prevention, *Lakes, *Linings, Nutrients, *Sediment covers, *Sediments, Bottom sediments, Water resources development, Recreation facilities, Plastics, Macrophytes, Nutrients.

Sediment covering has been suggested for controlling macrophytes and sediment nutrient release in order to effect lake restoration. The application of fly ash to control sediment phosphorus release apparently introduces more problems than it solves and should not be used. The possible adverse effects of fly ash application include high pH, dissolved oxygen depletion, biological reduction of sulfate to sulfide, heavy metal accumulation and toxicity, and physical clogging and crushing of organisms. Plastic sheeting has been suggested as a potentially effective technique to control macrophytes and nutrient release. Sand covered sheeting may also be useful in construction of swimming beaches. The largest scale reported experience with sheeting was the Marion Millpond, Wisconsin, where a black polyethylene sheet was used over ten hectares to control or retard macrophyte regrowth. In March of 1978 a finely porous compound, spun bonded DuPont Typar 3201 and 3202 black polypropylene, was applied to exposed sediments of Country Lake in Ohio. Further evaluation of this project is needed. Polyvinyl chloride has also been used. The use of plastic sheeting for control of macrophytes and sediment nutrient release has received insufficient evaluation to make conclusions about effectiveness, duration, application, and cost problems. Very little published information exists about the use of clays or sand to retard nutrient release or macrophyte growth. Heavier materials such as sand are apparently ineffective, as they sink into flocculent sediments. (Baker-FRC)
W82-04421

EVALUATION AND TREATMENT OF SYNTHETIC ORGANICS IN DRINKING WATER SUPPLIES,

Montgomery (James M.), Pasadena, CA.
For primary bibliographic entry see Field 5F.
W82-04427

MODELED IMPACTS OF SURFACE COAL MINING ON DISSOLVED SOLIDS IN THE TONGUE RIVER, SOUTHEASTERN MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
P. F. Woods.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-117771, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-64, October, 1981. 73 p, 3 Fig, 33 Tab, 39 Ref.

Descriptors: *Computer models, *Coal mines, *Strip mines, *Dissolved solids, Leaching, Salinity, Irrigation effects, Streamflow, Irrigation water, Selective withdrawal, Return flow, Reservoirs, *Montana, Tongue River, *Water quality control.

A computer model has been developed for spatial and temporal simulation of streamflow and dissolved solids in the Tongue River from the Tongue River Dam to Miles City, Montana. User-defined plans of surface coal mining and agricultural development permit evaluation of potential changes in dissolved solids resulting from leaching of overburden material used to backfill mine pits and from withdrawal and return flow of irrigation water. Provision is made for simulation runs using increased streamflow from a proposed larger reservoir intended to replace the present Tongue River Reservoir. Simulations at mean streamflow indicated that mining 119,600 acres of federally leased coal tracts may increase by 4.8 percent the present annual dissolved-solids concentration in the Tongue River at Miles City. Simulations using the proposed Tongue River reservoir show substantial reductions in dissolved-solids concentration when paired with similar simulations using the present Tongue River Reservoir. When compared on a per-acre basis for the study area, the dewatering caused by irrigation increases dissolved-solids concentration more than the input of leachates from surface coal-mining operations. (USGS)
W82-04494

QUALITY OF SURFACE WATER IN THE COAL-MINING AREAS OF WESTERN MARYLAND AND ADJACENT AREAS OF PENNSYLVANIA AND WEST VIRGINIA FROM APRIL 1979 TO JUNE 1980,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04516

ROADS IN WATER-PROCURING REGIONS - WATER POLLUTION CONTROL AND SAFEGUARDING OF WATER SUPPLY, EXEMPLIFIED BY THE STUTTGART-SINGEN AUTOBAHN (STRASSEN IN WASSERGEWINNUNGSGEBIETEN-GEWASSERSCHUTZ UND SICHERSTELLUNG DER WASSERVERSORGUNG AM BEISPIEL DER AUTOBAHN A 81 STUTTGART-SINGEN),

Tubingen Regierungspraesidium (Germany, F.R.).
For primary bibliographic entry see Field 4B.
W82-04551

WHO WINS IN THE FIGHT FOR POLLUTION CONTROL,

For primary bibliographic entry see Field 6B.
W82-04554

TELEMETRIC WATER CONTROL SYSTEM OF THE ARTIFICIALLY AERATED MOSEL RIVER,

Landesamt fuer Gewasserkunde, Mainz (Germany, F.R.).
H. Kalweit.
Water Science and Technology, Vol 13, No 11/12, p 645-650, 1981. 4 Fig.

Descriptors: *Telemetry, *Water management, Oxygen, *Aeration, Remote sensing, Computers, Automation, *Water pollution control, Rivers, *Mosel River, Weirs, Spillways, Water pollution sources, Wastewater, Navigation, Plankton, *Germany.

A temporary but substantial deterioration of the oxygen balance has been noted in the Mosel River due to weir steps which were constructed to aid in the use of the river for navigational and hydroelectric purposes. The river is loaded by sewage effluent and self polluted by plankton. Overspill has been provided at the barrages to alow artificial aeration to be carried out, thus increasing the oxygen content of the river water. The overspilling is to the debit of hydropower and should thus be as small as possible but sufficient for river protection. An accurate adaptation to the aeration demand has to be figured temporally and locally. Such aeration is needed mainly during the nighttime hours. In individual impounding sections very different oxygen contents can occur at the same time. Therefore it is necessary to gain information at several points. The staff at the hydropower stations needs information on the amount of aeration water, on the weirs and the hours of overspill 12 to 24 hr in advance. The data is gained through a telemetric system. Automatic data transmission was begun in August 1978. The system works nearly without loss of data. The transmission has been interrupted several times by lightning. (Baker-FRC)
W82-04598

FLOCCULATION IN PIPES FOR WATER POLLUTION CONTROL AND PHOSPHORUS REMOVAL PURPOSES (UBER DIE ANWENDUNG DER FLOCKENBILDUNG IN ROHREN ZUR WASSERREINHALTUNG UND PHOSPHATELIMINATION),

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5F.
W82-04615

PERFORMANCE TESTING OF THE SOVIET OIL/DEBRIS SKIMMER,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
H. W. Lichte.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-244790, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency EPA-600/S2-81-154, September, 1981. 4 p, 2 Fig. 68-03-2642.

Descriptors: *Oil skimmers, *Oil spills, *Cleanup operations, Oil recovery, Oil pollution, Viscosity, Harbors, Water pollution control, *USSR.

The oil skimming capability of a specially modified Soviet oil/debris skimmer was investigated at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) in 1979. The self-propelled vessel is 17.7 m long and weighs 39 metric tons. The 111-kw diesel engine drives a ducted propeller, water jet propulsion system. The vessel is capable of 5 knots forward speed and skims effectively at speeds of 0 to 1.0 m/s. The unique combination of various weir designs into one system, vessel mobility, the efficient use of energy, a series-type of oil/water gravity separator, and the propulsion techniques all suggest that this model is an effective harbor skimmer. The oil recover rate of 12.4 cu m/hr was confirmed using high-viscosity test oil in calm water conditions. Recovery efficiency was 85% at 0.77 m/s forward speed, and throughout efficiency was 90% at 0.51 m/s forward speed. Performance dropped when low-viscosity oils were skimmed at faster speeds and higher wave conditions. The skimmer collected 64% of the 81.3 cu m oil volume encountered during the test program. (Moore-SRC)
W82-04621

APPLICATION OF THE AREA OF REVIEW CONCEPT,

Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 6E.
W82-04674

EXPERIENCES WITH FLOATING RESERVOIR COVERS AT THE MANCHESTER WATER WORKS,

Manchester Water Works, NH.
D. Kittredge.
Journal of the New England Water Works Association, Vol 95, No 4, p 258-263, December, 1981. 1 Tab.

Descriptors: *Reservoirs, *Water pollution sources, Reservoir operation, Surface water, Drinking water, Water quality, *Manchester, New Hampshire.

Pollution of open reservoirs by airborne matter, birds and animals and often by man himself has been a problem at the Manchester Water Works for a number of years. A decision was reached in 1969 to install a system of synthetic rubber floating covers over the three open reservoirs as the first phase of a general improvement plan to upgrade and protect water quality. The second phase of the plan involved construction of a complete and modern water filtration system. The Manchester Water System consists of more than 355 miles of mains ranging in diameter from 2 to 36 inches and three principal water distribution reservoirs with a combined storage capacity of 41 MG. The first winter of floating cover operation was a severe test, with a prolonged cold spell of sub-zero weather lasting most of the month of February, resulting in a massive ice buildup along reservoir walls. Several large tears were noted in the cover membrane the following spring. Extensive ice and vandalism caused one of the covers to be removed in 1979. The condition of the remaining two covers is questionable, but the utility estimates a total life expectancy of 10-12 years. During the first year of floating cover operation, bacterial quality of treated water improved substantially, chlorination dosages were lowered, and as a result chemical costs were reduced by about 44%. (Baker-FRC)
W82-04697

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION: STATE OF THE ART,

New Hampshire Water Supply and Pollution Control Commission, Concord.
For primary bibliographic entry see Field 6E.
W82-04700

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION, DESIGN ASPECTS AND ALTERNATIVES,

Whitman and Howard, Inc., Wellesley, MA.
J. Murphy.
Journal of the New England Water Works Association, Vol 95, No 4, p 248-252, December, 1981.

Descriptors: *Reservoirs, Water supply development, Water quality, Water pollution sources, *Water pollution control, *Water supply systems, *Reservoir covers, *New England, Design criteria.

Some of the concepts and problems which must be considered during the design of various covering systems for reservoirs are discussed. One of the earliest steps in the process is to evaluate the problems that the cover is supposed to correct. These may include airborne contaminants, surface runoff, ground-water, vandalism, birds, animals, and aquatic organisms. Open reservoirs which can be evaluated in terms of cost effectiveness of covering are usually among the following: steel reservoirs, concrete reservoirs, and earthen reservoirs. An evaluation of the type of roof system to employ for an open water distribution reservoir must consider such factors as foundation soils, access to the area, location of the facility both from the standpoint of vandalism and topography, climate of the area, dead and live load requirements, the life of various construction materials, the aesthetics of the completed facility, the down-time required for construction, and finally, the relative costs of the various systems. (Baker-FRC)
W82-04701

THE ROOFLOAT (FLOATING) COVER SYSTEM FOR LIQUID STORAGE,

Globe Linings Inc., Long Beach, CA.
W. B. Kays.
Journal of the New England Water Works Association, Vol 95, No 4, p 253-257, December, 1981.

Descriptors: *Reservoirs, Water supply development, Water quality, Water pollution sources, Water resources development, Water storage, *Water pollution control, Reservoir covers, *Design criteria, Economic aspects, Water supply.

An attempt was made to develop alternatives to the conventional roof structure for reservoirs. In examining the possibilities of an inflated membrane, the largest drawback appeared to be the high-rise feature. Reservoir owners demanded a flat or nearly-flat profile to ease public relations problems. A compromise was worked out to a 10% rise which owners had to accept if they wished to benefit from the lower costs and other advantages associated with the inflatable roof. The coated fabric that gave the best combination of availability, low cost and high strength was the popular 22/24 oz per sq yd construction, using a 5.5 oz nylon with a 60/40 unbalanced white PVC coating. Disadvantages of this material outweighed the advantages, and a new flexible floating cover system, ROOFLOAT, was designed. The ROOFLOAT cover is essentially a stress-free system. As further developments are made, the following qualifications for a cover should be met: a high degree of outdoor weatherability, with a 50 yr minimum life expectancy in all climates; a relatively simple and effective field and factory seaming procedure that will yield joints that cannot fail; possible field installation at all temperatures above freezing; no delamination of reinforcement fibers or membrane plies; easy repair of the membrane at any age; and physical properties which would allow the aforementioned conditions to be met. (Baker-FRC)
W82-04702

SURROGATE PARAMETER ANALYSIS FOR ORGANIC PRIORITY POLLUTANTS,

Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-04704

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

AREAWIDE STORMWATER POLLUTION ANALYSIS WITH THE MACROSCOPIC PLANNING (ABMAC) MODEL,

RAMLIT Associates, Berkeley, CA.
For primary bibliographic entry see Field 5B.
W82-04393

STOCHASTIC STATE VARIABLE DYNAMIC PROGRAMMING FOR RESERVOIR SYSTEMS ANALYSIS,

Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, and V. T. Chow.
Water Resources Research, Vol 17, No 6, p 1578-1584, December, 1981. 5 fig, 1 Tab, 21 Ref.

Descriptors: *Reservoir management, *Operating policies, *Reservoir releases, Reservoir operation, Reservoir storage, *Dynamic programming, Watasheamu Dam, Nevada, Model studies, Stochastic analysis, Markov process, Hydroelectric plants, Electric power production, Systems analysis, Optimization, *Multipurpose reservoirs.

The concept of the state of a system was used to link together state space modeling, dynamic programming, and Markov chain analysis for optimization of reservoir systems in monthly stages over a year. The mathematical description of the inflows to the reservoir system and the response of the system to inflow and releases were formulated as the state space model. This was incorporated within an explicit dynamic programming procedure as the state transition equation. Transition probabilities of the state variables were found for each decision and tested in dynamic programming. Those for the optimal decisions were used in a Markov chain analysis to determine the statistical characteristics of the state and decision variables if the reservoir is operated for a long period with the optimized policy. This method was used to determine the operating policies for the proposed Watasheamu Dam, Nevada, designed for irrigation water supply, hydroelectric power, and flood control. Operating policies developed by two techniques, independently distributed or serially correlated monthly flows, were similar over the mid-range of flows but different for very high and low inflows. chance constraints were used to avoid the probability that storage would be outside the desired range. These constraints may be varied to obtain tradeoffs between economic efficiency benefits and the risk of violating storage limits. (Cassar-FRC)
W82-04430

THE REPRESENTATION OF VARIABLE HYDRO POTENTIAL IN LONG-RANGE ELECTRICITY PLANNING MODELS,

Victoria Univ., Wellington (New Zealand). Dept. of Information Science.
B. R. Smith.
Energy, Vol 6, No 4, p 323-331, 1981. 3 Fig, 8 Ref.

Descriptors: *Hydroelectric power, *Model studies, *Drought, Long-term planning, Planning, Energy, Electric power production, Linear programming, *Capital costs, Operating costs, Costs, Fuel, *New Zealand.

A linear programming model for long-range planning of electricity generation in areas with a high proportion of hydro power is presented. It considers the effects of both low and high water inflows. Increases in model size are kept to a minimum. This is important in large time-staged models and in multi-fuel supply models. The least cost choice for reserve capacity must account for capital costs of the generating capacity, but also the fuel and operating costs incurred when water intake is low. The model described herein has been implemented in a multi-fuel model of the New Zealand energy system. (Cassar-FRC)
W82-04474

MULTIPERIOD DESIGN OF REGIONAL WASTEWATER SYSTEMS: GENERATING AND EVALUATING ALTERNATIVE PLANTS,

Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
For primary bibliographic entry see Field 5D.
W82-04562

A MULTIOBJECTIVE BRANCH AND BOUND METHOD FOR NETWORK-STRUCTURED WATER RESOURCES PLANNING PROBLEMS,

Louisville Univ., KY. Dept. of Chemical and Environmental Engineering.
M. Nakamura, and J. M. Riley.
Water Resources Research, Vol 17, No 5, p 1349-1359, October, 1981. 4 Fig, 5 Tab, 11 Ref. OWRT A083-KY.

Descriptors: Planning, *Water resources development, Resources development, *Multiobjective planning, Water supply development, Model studies, Computers, Flow, *Network design.

A multiobjective branch and bound method is proposed for analyzing problems involving a network flow structure which are commonly found in the water resources planning field. The method appears to be computationally efficient due to the special problem structure associated with the nonlinear network flow formulation. The method was successfully applied to a realistic regional wastewater planning problem of a moderate size. Also proposed is a multiobjective imputed value analysis which makes use of the branch and bound tree structure and allows comparison of the importance of facilities in the network as represented by individual arcs or sets of arcs. The mathematical formulation and the analysis procedure of the method are described, and the potential usefulness is demonstrated. A Fortran program for implementing the algorithm is available and was used to analyze the example problem consisting of about 650 executable statements. It is an interactive program which provides information on the growth of multiobjective branch and bound trees and the generation of noninferior alternatives in the process of computation. (Baker-FRC)
W82-04563

WATER REUSE PLANNING MODELS: EXTENSIONS AND APPLICATIONS,

Texas Univ. at Austin. Dept. of Civil Engineering.
G. Ocanas, and L. W. Mays.
Water Resources Research, Vol 17 No 5, p 1311-1327, October, 1981. 7 fig, 8 Tab, 14 Ref. OWRT 14-34-0001-9483.

Descriptors: *Model studies, *Water reuse, Decision making, Planning, Wastewater treatment, Water treatment facilities, Sinks.

This paper presents a real world application of both the single period and the multiperiod planning models to a region that includes the City of San Antonio, Texas. The use of the single period model is shown through a set of different planning scenarios for the years 1980, 2000, and 2030. The multiperiod model was applied to a planning horizon consisting of three planning periods beginning in the years 1980, 2000, and 2030. The optimal capacity expansion of treatment facilities was determined, considering the capacities already available at the beginning of the planning horizon. The system consists of many elements: water sources, water treatment plants, wastewater treatment plants, and water sinks. The following conclusions were drawn from the study. Optimal water allocation planning should incorporate both water and wastewater systems conjunctively to better assess the impact of water reuse. Economies of scale have a significant effect on the cost and consequently the configuration of the water systems. The solution of a sequence of independent single period problems does not provide an accurate representation of the growing nature of the system. Therefore single-period planning is best suited to assess the impacts of different planning scenarios under current conditions. The performance of the solution algorithm was apparently influenced by the selection of the initial point. The final solution can be dependent upon the specified initial solution, indicating the importance of selecting a good initial point. The model, however, does not provide the ultimate answer to the problem of water allocation and capacity expansion within a region. The model is deterministic; no stochastic or seasonal variations are included. Finally, the model does not guarantee global optimality due to the nonconvex structure of the constraint set and the concavity of the objective function when economies of scale are incorporated. (Baker-FRC)
W82-04565

TRANSGLOBAL VARIATIONS IN THE PLANNING OBJECTIVES AND CRITIQUES,

Ministry of Water and Power, Islamabad (Pakistan).
S. M. H. Bokhari.
Water Supply and Management, Vol 5, No 6, p 377-389, 1981. 22 Ref.

Descriptors: *Water management, *Water policy, *Planning, *Pakistan, Agriculture, Water resources development, Indus Basin, Environmental quality, Economic development, Social aspects, Political aspects, Technology, Water law, Comparison studies, United States.

The history and present state of planning and management of water resources is contrasted for Pakistan and the U.S., two countries with greatly differing economic and social conditions. In the early U.S. planning was almost nonexistent on a federal scale. Water resources were regarded as exploitable for economic development. The battle between conservationists and developers began early in the 20th century and reached a climax during the 1960's. During the 1930's regional and multi-purpose development projects were popular. In 1973 the Water Resource Council adopted two planning objectives, national economic development and environmental quality. Pakistan's history of water resources planning objectives includes the British colonial period 1856-1947, during which the few water projects were greatly underdesigned, wasteful, nonscientific, and without regard to future problems such as waterlogging and salinity of the soil. Investments were minimized. A Development Board was created a year after Independence to prepare a 5-year plan. These plans have been prepared regularly since 1955. Objectives for water resources development included conservation, development of new surface and groundwater resources, increasing irrigated areas, reclamation of waterlogged and saline soils, flood and erosion control, and a research program. Project evaluation in Pakistan is based on benefit-cost analysis. The many differences in background and policy between the two countries make it impossible to effectively apply planning objectives from the U.S. in the developing countries. (Cassar-FRC)
W82-04605

SIMULATED INTERACTIONS BETWEEN THE PROPOSED NARROWS RESERVOIR AND THE WATER-TABLE AQUIFER ALONG THE SOUTH PLATTE RIVER, MORGAN COUNTY, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
A. W. Burns.
Geological Survey Water-Resources Investigations 80-119, 1981. 61 p, 24 Fig, 11 Tab, 9 Ref.

Descriptors: *Model studies, *Preimpoundment, *Water table, *Surface-groundwater relations, Simulation analysis, Forecasting, Reservoirs, Dams, *Colorado, Morgan County, Narrows Reservoir, *South Platte River, Groundwater movement.

A computer model, including a ground-water-flow component and a mass balance reservoir-operations component, was developed to simulate the proposed Narrows Reservoir and the adjacent alluvial aquifer of the South Platte River, Morgan County, Colo. This model, using a weekly time step, simulated the transient interactions of these two systems for an initial-fill condition and general-operational condition. A sensitivity analysis was made to test the effects of possible errors in the description of aquifer characteristics on the model results. The initial-fill simulation indicated that to fill the reservoir when hydraulic connection between the surface-water system and the aquifer is simulated would take 2 additional years than if no connection was assumed. Simulated ground-water return flow to the river downstream of the proposed dam was about 85 percent of the estimated maximum values, computed under steady-state conditions in an earlier study. The general operation simulation indicated that during the period of lowest reservoir contents the aquifer provided about 80,000 acre-feet of recoverable storage to the reservoir's capacity. Average return flow was only about 70 percent of the estimated maximum values computed in the earlier, steady-state analysis. Monthly ground-water outflow from the reservoir to the aquifer ranged from 55,200 to -10,400 acre-feet. Parameters tested for sensitivity, in order of decreasing sensitivity, were: Hydraulic conductivity, specific yield, hydraulic connection between

reservoir and aquifer, local recharge, boundary conditions, and dam permeability. The probable error in the parameters tested would not seem to warrant significant new data collection. (USGS)
W82-04725

DETERMINATION OF EFFECTIVE WELL BLOCK RADII FOR NUMERICAL RESERVOIR SIMULATIONS,

Systems, Science and Software, LaJolla, CA.
J. W. Pritchett, and S. K. Garg.
Water Resources Research, Vol 16, No 4, p 665-674, August, 1980. 7 Fig, 6 Tab, 6 Ref.

Descriptors: *Wells, *Reservoirs, *Simulation, *Numerical analysis, Mathematical equations, Model studies, Underground reservoirs, *Groundwater movement.

When using a numerical simulator to model underground reservoir behavior, it is often necessary to use well blocks, which are grid blocks containing a well, with dimensions much larger than the well diameter. Practical procedures have been developed for making reasonable estimates of well bore sandface conditions from the well block conditions calculated by numerical reservoir simulations. Assuming that pressures will equilibrate much more rapidly on a subgrid scale than in the reservoir as a whole, the subgrid flow may be treated as steady flow. The conditions at the sandface may then be deduced from mean well block conditions by assuming that the latter obtain at a definite distance, defined as the 'effective well block radius', from the well. However, the value of this effective well block radius must be established in terms of the size of the well block and other relevant parameters. Examination of the grid pressures obtained in the numerical solution of liquid flow into a single well located in both radial and rectangular grid blocks showed that the effective well block radius depends on the shape of the grid block (radial or rectangular), the type of mesh (uniform or otherwise), and the character of the spatial discretization scheme, among others. (Carroll-FRC)
W82-04732

INPUT-OUTPUT AND BENEFIT-COST ANALYSIS FOR WATER RESOURCE DEVELOPMENT PROJECTS,

Science and Education Administration, Lincoln, NE.
R. T. Clark.
Water Resources Bulletin, Vol 16, No 1, p 36-40, February, 1980. 9 Ref.

Descriptors: *Water resources development, *Cost-benefit analysis, Regional development, Resources development, Urban planning, Planning, *Input-output analysis.

The purpose of this research was to aid the use of input-output (I-O) in conjunction with benefit-cost (B-C) analysis for water resource development type projects. Terminological differences and differences due to benefit measuring methods are discussed. Proper use of the I-O model for estimating the secondary methods are discussed. Proper use of the I-O model for estimating the secondary effects depends in part on how the project benefits were valued, whether project outputs were sold to final or intermediate demand, and whether project output is represented by an endogenous sector. The analyst must look to the total effects on household income to determine secondary effects for B-C. Consequently, I-O models closed to households are more helpful than those that are open. Access to only final demand multipliers will limit the usefulness of I-O for estimating secondary benefits and costs, since final demand multipliers measure gross output changes instead of household income changes. Even income multipliers are not as helpful as the entire I-O model. There are many issues related to proper use of the I-O model that depend on the analyst's knowledge of I-O techniques and knowledge of how a specific model was developed. A result is that even though I-O can be helpful it can also be rather easily misused and can, therefore, provide misleading information. (Baker-FRC)
W82-04733

DEMAND SIGNALS FOR URBAN DRAINAGE AND FLOOD CONTROL PROJECTS,

North Carolina Water Resources Research Inst., Raleigh.
N. S. Grigg, and H. A. Vance.
Water Resources Bulletin, Vol 16, No 1, p 69-71, February, 1980. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Urban drainage, *Planning, *Economic aspects, *Flood control, Public opinion.

A new method is presented for determining the demand for urban drainage and flood control projects and to show how it can be used as part of an integrated planning procedure for setting priorities and allocating funds to competing projects. The method was devised by the Los Angeles County Flood Control District. The basic objective of the plan is to develop a logical rational planning procedure that will consider public demand for projects and allow planning to take place in the open. This ensures that opposition will be identified and dealt with early in the planning process and that surprises will be minimized. Results should yield a better utilization of the public funds both for planning and for implementation. The BENEVAL equation as developed represents a major step, as it is a surrogate measure of the public perception of the value of projects. It allows both screening for projects whose further development should be considered based on economic justification and prioritizing to allow greatest attention to those projects which are most urgent. (Baker-FRC)
W82-04737

6B. Evaluation Process

AUBURN DAM: A CASE STUDY OF WATER POLICY AND ECONOMICS,

Montana Univ., Missoula. Dept. of Economics.
J. W. Duffield.
Water Resources Bulletin, Vol 16, No 2, p 226-234, April, 1980. 4 Tab, 39 Ref.

Descriptors: *Cost-benefit analysis, *Water policy, *Economic analysis, Benefits, *Dams, *Auburn Dam, American River, *Sacramento, California, Water resources development, Earthquakes, Recreation, Irrigation, Dam failure.

This paper critically analyzes the economic justification of the Auburn Dam, part of the $1.5 billion Auburn-Folsom south unit of the Bureau of Reclamation's Central Valley Project in California. Construction on this dam has been stopped because the high thin arch structure, located on a major geological fault, is being redesigned for greater earthquake resistance. Errors in previous benefit-cost estimates were large. Irrigation benefits were overestimated and recreational losses underestimated. Revised benefit-cost ratios are 0.61 at 3 and 1/8% discount rate and 0.18 at 6 and 5/8% discount rate. Original estimates were 1.72 and 0.79 at the respective discount rates and failed to consider the cost of the permanent inundation of 48 miles of the American River Canyon or a probability-weighted estimate of catastrophic earthquake loss (much of metropolitan Sacramento would be inundated). This paper recommends that the project should not be continued. Suggestions for improving benefit estimation are: (1) use several approaches, (2) give priority to direct evidence of willingness to pay, as in market prices, (3) perform a site-specific analysis if results are sensitive to changes in average national numbers parameters, and (4) do not ignore destruction of natural environments such as wild rivers. (Cassar-FRC)
W82-04260

EVALUATING DIRECT BENEFIT ESTIMATION PROCEDURES FOR IRRIGATION PROJECTS: A SIMPLIFIED APPROACH,

Arizona Univ., Tucson. Dept. of Agricultural Economics.
D. C. Cory, and J. Daubert.
Water Resources Bulletin, Vol 17, No 6, p 1066-1070, December, 1981. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Benefits, *Cost-benefit analysis, *Irrigation programs, Agriculture, Corn, *Nebraska, Economic analysis, Error analysis, Irrigation efficiency.

Commonly used methods for estimating direct benefits from irrigation are compared with a new method which estimates the sum of the changes in producers' and consumers' surplus. Errors inherent in the traditional methods are computed. Traditional methods measure impacts on the commodity markets by assuming the supply is inelastic. They either assume no change in commodity prices and calculate net returns to project farmers or allow commodity prices to fall in accordance with a given elasticity of demand and subtract commodity production costs from the associated area under the commodity demand curve. The new approach is used to evaluate 3 similar irrigation projects in Nebraska. Errors in benefits were 2% for the smallest project (10,000 acres of corn), and 8% and 15% for the larger projects (44,000 and 77,000 acres), respectively. (Cassar-FRC)
W82-04287

ENVIRONMENTAL THRESHOLD FUNCTIONS FOR USER ORIENTED RESOURCE PLANNING AND MANAGEMENT,

Illinois Univ. at Chicago Circle. School of Urban Sciences.
J. S. DeBettencourt, and G. L. Peterson.
Water Resources Bulletin, Vol 17, No 6, p 1050-1055, December, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Management planning, *Recreation, *Evaluation, Planning, Rivers, Surveys, Model studies, *Recreation facilities, *Site selection.

A method for assessing and measuring recreational site quality, called environmental threshold modeling, is described. It is based on the idea that persons using the recreation facilities have specific identifiable criteria which can be expressed as a mathematical function of site characteristics. The function separates acceptable recreational settings from unacceptable settings, hence the term, threshold function. The individual specific threshold functions can be combined to produce a population specific threshold function that gives the proportion of the population that finds a particular setting acceptable for a specific activity. Canoeists using the Pine River in Michigan's Manistee National Forest were asked to state whether or not each of 15 randomly generated combinations of characteristics would be acceptable for recreational canoeing. The characteristics were four levels each of water condition (pure to undesirable), degree of development (wilderness to urban), crowding/use (no other users to large number of users), trash/litter (none to heavy), and skill level required for canoeing (expert to beginner). The equation predicted that 80% of those surveyed would find characteristics of the Pine River site acceptable for use. If littering and crowding were reduced, the proportion of the population finding the conditions acceptable would rise to 93%. (Cassar-FRC)
W82-04289

FLOOD PROBABILITY ESTIMATION,

British Columbia Univ., Vancouver. Dept. of Civil Engineering.
S. O. Russel.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 63-73, January, 1982. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Flood forecasting, *Design floods, *Estimating, Hydrologic data, Flood data, Flood frequency, Susquehanna River, Carpenter Creek, British Columbia, Streamflow, Flood peak, Numerical analysis, Computer programs.

A procedure is presented for estimating design floods from the many types of hydrologic information available, even though there is not sufficient data for conventional frequency analysis. A compound distribution is used, and parameters of the underlying distribution are updated using Bayes' theorem. This permits subjective information to be combined with recorded data. The subjective information, not generally usable for traditional frequency analysis, may include a few recorded

floods, memory of bridges not being overtopped, evidence of a very large flood, envelope curves for the area, and river cross-sections. Numerical methods are used because analytical procedures are too limited. A computer program is used for calculations. Examples are given for a hypothetical case and for Carpenter Creek, British Columbia, and the Susquehanna River. The sparser and more uncertain the available data, the more conservative the results. (Caesar-FRC)
W82-04318

SMALL HYDRO SCHEMES FOR PRIVATE DEVELOPERS,

Hydro Watts Inc., Washington Grove, MD.
For primary bibliographic entry see Field 8A.
W82-04327

REGULATING CORROSIVE WATER,

Environmental Protection Agency, Washington, DC.
R. Anderson, and D. Berry.
Water Resources Research, Vol 17, No 6, p 1571-1577, December, 1981. 5 Tab, 22 Ref.

Descriptors: *Cost-benefit analysis, *Corrosion control, *Public health, *Water treatment, Benefits, Drinking water, Regulations, Lead, Toxicity, Cadmium, Asbestos, Water softening, Diseases, Lime, Economic analysis.

The benefit-cost relationships of an EPA proposal to regulate the corrosvity of drinking water are examined. Corrosivity may result from low pH, low buffering capacity, presence of dissolved oxygen, high total dissolved solids, high halogen and sulfate/alkalinity ratio, and high temperature. The major health effects of corrosive water are lead toxicity, increased incidence of hypertension and cardiovascular disease produced by cadmium, and the possibility of cancer from ingestion of asbestos fibers. Possible benefits of reducing corrosivity are less health risk, fewer operations and maintenance problems, and improved esthetics (reduction of discolored water and stained fixtures). Negative effects of increasing the water hardness to reduce corrosivity are negligible. Evidence indicates that water treatment to reduce corrosivity is warranted, especially for larger systems. Costs per life saved vary from $1720 (145 lives saved per year) in a 100 mgd plant serving 1 million people to $114,000 (0.0036 lives saved per year) in a 2500 gpd plant serving 2500 people. Annual per capita costs for lime treatment of soft water range from 25 cents for the 100 mgd plant to $16.40 for the 2500 gpd plant. This study illustrates the uncertainties involved in placing an economic value on benefits from reduction in incidence of diseases. (Caesar-FRC)
W82-04335

ENERGY, WATER, AND COST TRADE-OFFS IN IRRIGATION SYSTEM SELECTION AND MANAGEMENT,

California Univ., Davis.
For primary bibliographic entry see Field 3F.
W82-04360

GRANULAR ACTIVATED CARBON INSTALLATIONS,

Culp/Wesner/Culp, Cameron Park, CA.
For primary bibliographic entry see Field 5F.
W82-04391

THE REPRESENTATION OF VARIABLE HYDRO POTENTIAL IN LONG-RANGE ELECTRICITY PLANNING MODELS,

Victoria Univ., Wellington (New Zealand). Dept. of Information Science.
For primary bibliographic entry see Field 6A.
W82-04474

DEVELOPMENT OF HYDRO-POWER IN NIGERIA,

Benin Univ. (Nigeria). Dept. of Physics.
V. C. Sharma, and A. Sharma.
Energy, Vol 6, No 6, p 475-478, 1981. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Hydroelectric power, Prediction, *Nigeria, *Developing countries, *Costs, Water demand, Water use, Interest rates, Project benefits, Energy conservation.

Nigeria has a hydropower potential of 9500 MW, including 1300 MW from 21 minor sites. Only 8% of this or 800 MW has been developed. Early development of hydropower will not only reduce the burden on Nigeria's crude oil supply, but will also have an impact on agriculture, fish industry, fresh water supply, navigation and employment. The rate of hydropower development is heavily dependent on international loans from industrialized nations. Total hydropower generating capacities in 1985 and 1995 are expected to be 3245 and 4895 MW, respectively, reaching 8185 MW by 2000. (Caesar-FRC)
W82-04475

REVERSING WATER POLLUTION STANDARDS IN AN UNCERTAIN WORLD,

Geological Survey, Reston, VA.
W. D. Watson, and R. G. Ridker.
Land Economics, Vol 57, No 4, p 485-506, November, 1981. 4 Fig, 6 Tab, 14 Ref.

Descriptors: *Decision making, *Water pollution control, *Water quality standards, Planning, Nonpoint pollution sources, Water pollution sources, Regulations, Legal aspects, *Cost-benefit analysis, Benefits.

The overall results of a decision analysis of EPA's water pollution control policies indicate that lower costs for implementing these controls would be incurred if significant amounts of additional information were gathered and decisions changed accordingly. Little concrete information is available concerning the contribution of nonpoint pollution sources to water quality degradation. There is a possibility that more pollution control at lesser cost could be attained by reducing nonpoint source pollution than by upgrading point source treatment systems. Two cases were assumed: (1) EPA is attempting to minimize expected costs and (2) EPA is establishing controls to achieve fishable and swimmable water quality. The expected cost savings provided by additional information are $400 million per year at present, rising to $2 billion per year in Case (1) and $1 billion per year in Case (2) by 2010. These estimates are considered conservative. (Caesar-FRC)
W82-04540

WHO WINS IN THE FIGHT FOR POLLUTION CONTROL,

J. Donnan.
Water and Pollution Control, Vol 119, No 11, p 9-10, 12, 1981.

Descriptors: *Benefits, *Environmental quality, *Industrial wastes, Economic aspects, *Water pollution control, Water pollution prevention, Cost-benefit analysis, Social aspects, Regulations, Environmental policy, Public health, *Canada, Waste treatment.

Pollution control efforts must be directed toward the opportunities and benefits that can be attained. Economic studies have indicated that pollution control expenditures by industry are small relative to other expenditure categories and investments. The adverse effects on inflation and economic growth are insignificant. It has been more effective to apply pollution control technologies and waste prevention early in an industrial process than to treat waste products at the end. The 3M company has saved $17.4 million in this way over 3 years. For example, in one installation ppainting equipment designed to avoid overspraying cost $45,000 and saved the plant $120,000 per year in resin and paint costs. Tightening flanges at a Union Carbide plant saved $2,000 per day in raw material costs. Other possibilities for combined pollution and cost reduction are avoiding spills, reclaiming materials (such as wood fibers in paper mills), running a clean and tidy operation, using low sulfur fuels, changing a process to a less polluting one (producing chlorine for pulp bleaching by a mercury free process), producing saleable products from waste materials (suluric acid from SO2), and early environmental assessments in the planning or new plant construction. The public benefits of pollution control include reductions in pollution damage and increased enjoyment of a cleaner environment. Pollution costs are borne by a small, easily identifiable segment of society; benefits are spread over a large, less easily identifiable group. (Caesar-FRC)
W82-04554

CONTROL AND AUTOMATION IN WASTEWATER TREATMENT - ADVANCES, UNSOLVED PROBLEMS AND CHALLENGES,

For primary bibliographic entry see Field 5D.
W82-04597

CLEAN WATER FOR THE THIRD WORLD,

Biswas and Associates, Oxford (England).
For primary bibliographic entry see Field 6D.
W82-04604

THE RELATIONSHIP OF ACCESSIBLE SAFE WATER AND ADEQUATE SANITATION TO MATERNAL AND CHILD HEALTH–LOOKING FORWARD TO THE DRINKING WATER AND SANITATION DECADE,

Water and Sanitation for Health Project, Washington, DC.
For primary bibliographic entry see Field 6D.
W82-04606

THE FINANCING OF PRIVATE SMALL SCALE HYDROELECTRIC PROJECTS.

Franklin Pierce Law Inst. Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/CE/04934-44, Price codes: A06 in paper copy, A01 in microfiche. Department of Energy DOE/CE/04934-44, March, 1981. 106 p, 17 Tab, 1 Append. AS02-78RA04934.

Descriptors: *Hydroelectric plants, *Financing, *Economic feasibility, *Loans, Government finance, Costs, Marketing, Economic aspects, Regulations.

As a result of legislative and regulatory improvements, small scale hydroelectric (SSH) development is viewed as a potentially profitable enterprise. However, the lack of recent models for the development of SSH projects causes problems in the financing of these projects. A lack of developer information and a lack of lender information can combine to make it difficult to obtain funds necessary for the development of projects characterized by relatively large fixed costs, and whose only underlying security is the value of the power output. This manual is a description of the financing process associated with the private development of SSH projects, and is intended to provide the developer with some assistance in meeting the challenge of deciding how to proceed with the critical task of arranging the financing of his project. In any business venture, the business plan is a crucial guide for both internal and external financing decisions. The financing of SSH projects differs from most small business loans in that a SSH project usually requires an exceptionally large ratio of debt to equity, has an unusual marketing structure and is exposed to a pervasive regulatory scheme. A business plan should address the variables affecting the size, structure and cash flow and show how they would affect the project. The three business forms considered are corporations, Subchapter S corporations, and partnerships. Sources of funds which should be considered: commercial banks and savings and loan associations; manufacturers of hydroelectric equipment; investment bankers; state and municipal industrial development authorities; and federal financing assistance. (Moore-SRC)
W82-04633

A MANUAL FOR DEVELOPMENT OF SMALL SCALE HYDROELECTRIC PROJECTS BY PUBLIC ENTITIES.

Energy Law Institute, Franklin Pierce Law Inst. Center, Concord, NH.

For primary bibliographic entry see Field 6E.
W82-04634

ENERGY TECHNOLOGY SCENARIOS FOR USE IN WATER RESOURCES ASSESSMENTS UNDER SECTION 13A OF THE FEDERAL NONNUCLEAR ENERGY RESEARCH AND DEVELOPMENT ACT.

Department of Energy, Washington, DC. Office of Environmental Assessments.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0090, Price codes: A09 in paper copy, A01 in microfiche. DOE/EV-0090, October, 1980. 185 p, 6 Fig, 7 Tab, 17 Ref, 6 Append.

Descriptors: *Energy, *Fuel, *Water resources development, *Prices, *Hydroelectric power, *Geothermal power, Economic aspects, Forecasting, Future planning, Economic aspects, Pumped storage, Resources development, River basin development, Technology.

Two estimates of future growth of emerging energy technology in the years 1985, 1990, and 2000 were developed to be used as a basis for conducting Water Resources Council assessments. The two scenarios are called the high world oil price (HWOP) and low world oil price (LWOP) cases. The scenarios were generally derived from assumptions of he Second National Energy Plan (NEP II), including estimates of high and low world oil price cases growth rate of GNP, and related economic parameters. The overall national energy growth inherent in these assumptions was expressed as a detailed projection of various energy fuel cycles through use of the Fossil-2 model and regionalized through use of the strategic Environmental Assessment System (SEAS). These scenarios are for the use of regional analysis in examining the availability of water for and the potential impacts of future growth of emerging energy technology in selected river basins. The energy scenarios provide projections for the following categories of emerging energy technology: coal gasification; coal liquefaction; oil shale; geothermal; enhanced oil recovery; solar and biomass; small scale, low head, and pumped storage hydroelectric; and advanced coal combustion. (Moore-SRC)
W82-04635

DETERMINING FEASIBILITY OF SMALL-SCALE HYDROPOWER,

Tudor Engineering Co., San Francisco, CA.
D. C. Willer.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 209-217, December, 1981. 4 Fig, 4 Tab, 3 Ref.

Descriptors: *Hydroelectric plants, *Cost-benefit analysis, *Feasibility studies, Hydraulic structures, Benefits, Dams, Powerplants, Energy, Economic analysis, Capital costs, Rate of return, Discount rates, Small-scale hydropower.

Techniques for evaluating the economic feasibility of small hydropower projects are presented and illustrated with examples. The simplest is the benefit-cost analysis, which compares annualized capital, operating, maintenance, and administration costs with the value of power produced. Another method is that using the internal rate of return, the discount rate where the benefit-cost ratio equals 1.0. It is computed by plotting several benefit-cost ratios vs. discount rates. A third technique is the discount cash flow analysis, which uses different escalation and discount rates to provide a variety of benefit-cost streams. The present worths of the benefit-cost streams are then assumed and a ratio computed. A further consideration is the primary energy factor, the energy required to manufacture and construct a hydro project. (Cassar-FRC)
W82-04693

INPUT-OUTPUT AND BENEFIT-COST ANALYSIS FOR WATER RESOURCE DEVELOPMENT PROJECTS,

Science and Education Administration, Lincoln, NE.
For primary bibliographic entry see Field 6A.
W82-04733

A MUNICIPAL WATER SUPPLY INVESTMENT PROBLEM IN RHODE-ISLAND,

Western Washington Univ., Bellingham. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W82-04740

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER QUALITY ALLOCATED COST FOR MULTIPURPOSE RESERVOIRS,

New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Water Resources Bulletin, Vol 16, No 1, p 127-132, February, 1980. 7 Tab, 5 Ref.

Descriptors: *Water quality, *Cost allocation, Reservoirs, Cost sharing, Economic aspects, Cost analysis, Low flow, Water management, Wastewater treatment, Flow augmentation, *Multipurpose reservoirs, *Model studies, *Willamette River, Oregon.

Apportionment of reservoir costs may be appropriate to downstream waste water dischargers who by virtue of reservoir drawdown may be saved the expense of advanced secondary of tertiary waste treatment. Low flow augmentation from multipurpose reservoirs may yield significant water quality benefits. By using cost allocation, a portion of reservoir expense is assigned to water quality consumers, waste water dischargers who benefit from the increased receiving flow. Federal projects do not authorize such allocation. However, the procedure is increasingly appropriate for efficient multiobjective management. A model was constructed for waste water treatment costs, multipurpose reservoir costs, and water quality for Oregon's Willamette River. Water quality is expressed as a function of treatment and augmentation levels. Treatment cost needed to achieve a given quality of water without augmentation less treatment cost with augmentation gives an alternative cost of maintaining water quality. This alternative cost is used to determine water quality's share of reservoir cost via a cost allocation procedure. Water quality beneficiaries could be charged, under current conditions, about 7% of annualized reservoir expense. This charge is one-fourth of the expense of additional treatment facilities required if augmentation were not provided. (Baker-FRC)
W82-04255

CONSERVING WATER THROUGH PRICING,

State Univ. of New York at Albany.
For primary bibliographic entry see Field 3D.
W82-04272

MARGINAL COST AND SEASONAL PRICING OF WATER SERVICE,

West Virginia Univ., Morgantown. Regional Research Inst.
P. C. Mann, and D. L. Schlenger.
Journal of the American Water Works Association, Vol 74, No 1, p 6-11, January, 1981. 7 Ref.

Descriptors: *Water rates, *Marginal costs, *Seasonal variation, Pricing, Costs, Water demand.

Seasonal pricing is not synonymous with marginal cost pricing, although it is a logical consequence of the latter. Effective seasonal pricing requires that several criteria be fulfilled. There must be substantial variations in demand between peak and off-peak periods. Installed capacity requirement must be determined primarily by the peak demands of the specific system. The water utility must have peak demands which consistently occur during the same periods of the year, and the water utility must be able to estimate the difference in cost between meeting peak and off-peak demands. Several application problems can impede the use of seasonal pricing: cost calculation problems, prediction problems, excess revenue problems, income distribution and efficiency problems, needle peaking, shifting peaks, public acceptance, and metering difficulties. Systematic consideration of these problems is necessary for successful implementation of innovative pricing plans. They should not be regarded as barriers to reform in rate structures. (Carroll-FRC)
W82-04273

ON THE MARGINAL COST OF WASTEWATER SERVICES,

President's Council of Economic Advisers, Washington, DC.
S. H. Hanke, and R. W. Wentworth.
Land Economics, Vol 57, No 4, p 558-567, November, 1981. 3 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Pricing, *Marginal costs, Economic aspects, *Operating costs, Capital costs, Cost analysis, Economies of scale, Opportunity costs, Tariff.

The marginal cost of municipal wastewater services is analyzed for the purposes of designing a tariff for these services. In this paper marginal cost of wastwater services is defined so that the opportunity cost may be measured. The marginal cost is estimated for a hypothetical wastewater system, capacity 570,000 cu m per day, using the activated sludge process to serve a community of 300,000. In 1979 the total marginal cost for this system was 57 cents per cu m per year (54 cents major capital costs and 3 cents running costs). A two-part tariff is the most efficient and sound. Part 1 is the price per composite unit of use (57 cents in the above example) and part 2, the annual standing charge per customer (equal to the total cost of system overheads not directly related to use, but necessary to guarantee system maintenance over time). The overheads may include costs of meters, billing expenses, and connection costs. (Cassar-FRC)
W82-04376

COSTING DAR-ES-SALAAM'S SANITATION PLAN,

Peat, Marwick and Co., London (England).
M. Hoyle, and R. Eadie.
World Water, Vol 4, No 12, p 30-31, December, 1981.

Descriptors: *Waste disposal, *Domestic wastes, *Urban areas, *Costs, Sewer systems, Sanitation, Public health, Housing, *Tanzania, Urban hydrology, Land disposal, *Developing countries.

Since two-thirds of the householders of Dar-esSalaam, Tanzania have low incomes and are unable to pay for high-priced sanitation systems, a new master-plan for low cost sewage disposal was drawn up from data on water consumption, plumbing facilities and income levels to accomodate the new housing developments with sanitary sewage disposal systems. The first stage of the plan, which will take from 1981-85 to complete, calls for the installation of improved pit latrines in most housing units, the implementation of a community health education program, and a rehabilitation and expansion of the pit emptying service. Funds for this stage will come from City Council, the World Bank, and other government aid agencies. Direct educational assistance will be given to households needing to install new latrines, while the cost of constructing and emptying the pit latrine will be borne directly by the owner of the house. The total cost for construction and maintenance of the pit latrine should account for no more than about 1.5% of total family income. The extension of the pit installation service should be funded out of general taxation because the annual user per capita costs are small and the direct beneficiaries of such a service are not identifiable. An Urban House Tax based upon the type of latrine present would be charged as a simple flat rate to each household. At present, pit emptying is carried out by the City Council and a number of independent operators who receive full payment when services are rendered or collect payments over the course of set periods by a more easily payable installment plan. (Geiger-FRC)
W82-04603

FINANCING FEDERAL WATER DEVELOPMENT PROJECTS AND SHARING THE COSTS,

Water Resources Council, Washington, DC.
R. M. Wheeler, L. M. Eisel, and G. D. Seinwill.
Water Resources Bulletin, Vol 16, No 2, p 326-335, April, 1980. 5 Fig, 20 Ref.

Descriptors: *Financing, *Water supply development, *Cost sharing, Water management, Planning, Administration, Political aspects, *Federal jurisdiction, Economic aspects.

A brief survey is presented of past and present Federal involvement in water resources development, along with a closer look at the nature of cost sharing and an assessment of the varied assortment of existing Federal and non-Federal cost sharing provisions. Samplings of some relevant emerging issues are presented, with the focus on policy questions that are currently arising due to competing interests for water and water project funding. Several proposed strategies for dealing with cost sharing policy reform are discussed, with detailed emphasis on two current proposals under consideration. The joint venture approach results in an effective composite cost share which changes significantly but not drastically, from 19 to 35% non-Federal share for a hypothetical project. The block grant approach would alter the regional distribution of Federal water development funding from the South and West to the Northwest and North Central States. To be successful any strategy not only must be theoretically sound, but must be politically sound as well. Practical solutions must be sought through the existing political structure, as any realistic solution generally requires the transfer of a subsidy from one interest to another. (Baker-FRC)
W82-04739

THIRD-DEGREE PRICE DISCRIMINATION AND REGULATION IN THE MUNICIPAL WATER INDUSTRY,

Lafayette Coll., Easton, PA.
T. H. Bruggink.
Land Economics, Vol 58, No 1, p 86-95, February, 1982. 5 Tab, 17 Ref.

Descriptors: *Pricing, *Water rates, Regulations, Economic aspects, Water demand, Water supply, *Price discrimination.

This paper discusses the practice of third-degree price discrimination and the role of state regulation in governing rate structures as they concern the structuring of rates for municipally owned water utilities. The conclusions suggest that third-degree price discrimination is practiced by municipally owned water utilities. The average pice-marginal cost ratios for the residential, commercial, and industrial customer classes are 3.45, 2.32, and 1.52, respectively in the unregulated utilities, and 3.12, 1.81, and 1.04 in the regulated utilities. The differences are excessively large, with the industrial customers clearly identified as the benefited group. There is no evidence of internal subsidization across the customer classes. However, the excessive price discrimination is undesirable under the criteria suggested by Hollas and Friedland. Also noted are sharp reductions in the price-cost ratios for all customer classes in utilities regulated at the state level. The reductions are uneven, however, with the industrial and commercial customer classes receiving larger absolute and percentage reductions than the residential class. In regulated, municipally owned electric utilities the industrial customers had the lowest price-cost ratios. (Baker-FRC)
W82-04747

6D. Water Demand

DETERMINISTIC MODELS FOR PREDICTING RESIDENTIAL WATER CONSUMPTION,

Department of Transport and Works, Darwin (Australia).
N. A. Power, R. E. Volker, and K. P. Stark.
Water Resources Bulletin, Vol 17, No 6, p 1042-1049, December, 1981. 5 Fig, 4 Tab, 8 Ref.

Descriptors: *Water consumption, *Lawns, *Domestic water, *Model studies, Water demand, *Residential water, *Water use, Irrigation, Townsville, Australia.

Two deterministic models for forecasting residential water demand are presented. Lawn water requirements and in-house use are considered separately, then combined for a total predicted consumption. The in-house model requires the residence population, appliance ownership per residence, and water consumption of an appliance per use. It can simulate effects of changes in appliance ownership patterns, population distribution, appliance unit water use, and frequency of use. The lawn water model is a daily water balance model with a single soil moisture store. It operates in two phases, a drying phase through evaporation and transpiration and a wetting phase through rainfall and irrigation. Residential water consumption in Townsville, Australia, was modeled after a survey of a random sample of residences. In-house model results were 197 liters per capita per day; 205 liters per capita per day was obtained by measuring sewage flows. Simulations showed that increases of 100% in dishwasher ownership and garbage disposal ownership would increase average in-house consumption by 5.2% and 3.4%, respectively. Lawn water consumption was measured at five metered homes for 12 months. Simulated and actual water applied agreed within about 6 mm in the range of 669-885 mm seasonal irrigation water depths. (Cassar-FRC)
W82-04352

WATER RIGHTS, ALLOCATION, AND CONFLICTS IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,

Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
For primary bibliographic entry see Field 6E.
W82-04441

AN ECONOMIST'S VIEW OF DEMAND PROJECTIONS CONSIDERING CONSERVATION,

California Univ., Santa Barbara. Dept. of Economics.
W. D. Morgan.
Water Resources Bulletin, Vol 16, No 5, p 941-943, October, 1980. 2 Fig, 6 Ref.

Descriptors: *Water demand, *Water conservation, *Water use, *Economic aspects, Prices, Water management, Water supply, Mathematical studies, Elasticity of demand.

An approach was developed to clarify and elaborate on procedures for measuring water use undder alternative conservation specifications. An attempt was made to place the analyses in terms of traditional economic analysis. Using this analysis, the effects of conservation can be divided into two classes, pure conservation effects and pure demand management. The use of demand management to reduce quantity demanded operates through an increase in the price of water, which means individuals move up their demand curve and choose a smaller quantity. Conservation policies incorporate other factors that affect water usage, while holding the price constant. An increase in the conservation percentage reduces the quantity of water demanded. Providing information on techniques or technology is very important to enable users to choose the proper amount of water needed to meet their specified goals. Some instruments to meet these goals are under the control of the water agency, while others are not. However, the variable price is always under the control of the water purveyors. (Baker-FRC)
W82-04448

GROUND-WATER CONDITIONS IN THE UPPER VIRGIN RIVER AND KANAB CREEK BASINS AREA, UTAH, WITH EMPHASIS ON THE NAVAJO SANDSTONE,

Geological Survey, Salt Lake City, UT. Water Resources Div.
R. M. Cordova.
Available from Utah Dept. of Natural Res. Div. of Water Rights 231 East 400 South Salt Lake City, Utah 84111. Utah Department of Natural Resources Technical Publication No 70, 1981. 87 p, 18 Fig, 3 Plates, 23 Tab, 30 Ref.

Descriptors: *Groundwater, *Aquifer characteristics, *Water quality, *Well yield, Well data, Pumping, Drawdown, Groundwater recharge, Water level fluctuations, Surface-groundwater relations, Groundwater availability, Water supply, Water demand, Chemical analysis, Maps, *Utah, Virgin River basin, Kanab River basin, Navajo Sandstone.

The upper Virgin River and Kanab Creek basins area in south-central Utah includes about 1,300 square miles in the upper Virgin River basin and about 650 square miles in the upper Kanab Creek basin. The sparsely populated area contains large coal reserves. Water occurs in both the unconsolidated and consolidated rocks. Principal aquifers in the unconsolidated rocks include older stream-channel deposits, lower parts of alluvial fans, and stream-valley alluvium. The most important consolidated-rock aquifer is the Navajo Sandstone of Triassic and Jurassic age. Other consolidated-rock aquifers of note include the Shinarump Member of the Chinle Formation of Triassic age, sandstone strata of Cretaceous age, and the Wasatch Formation of Tertiary age. Groundwater recharge is derived chiefly from precipitation on the area and is estimated to average about 80,000 acre-feet per year. Discharge occurs chiefly as seepage to lower stream reaches and evapotranspiration; natural discharge is estimated to total at least 62,700 acre-feet per year. In addition, about 5,000 acre-feet per year discharges as underflow into Arizona; and in 1977, at least 3,300 acre-feet was withdrawn by wells. Chemical quality of ground water varies considerably with geologic source. Water in the Navajo Sandstone and Wasatch Formation is generally fresh, containing less than 500 mg/L of dissolved solids in most places. Water in the Chinle and Moenkopi Formations of Triassic age and the Carmel Formation of Jurassic age is generally saline, containing 1,000 to 3,000 mg/L of dissolved solids in most places. (USGS)
W82-04486

WATER-QUALITY DATA FOR SELECTED STATIONS IN THE EAST EVERGLADES, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04513

DIGITAL-MODEL SIMULATION OF THE TOPPENISH ALLUVIAL AQUIFER, YAKIMA INDIAN RESERVATION, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2A.
W82-04514

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978,

Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04518

CLEAN WATER FOR THE THIRD WORLD,

Biswas and Associates, Oxford (England).
A. K. Biswas.
Water Supply and Management, Vol 5, No 6, p 401-415, 1981. 12 Ref.

Descriptors: *Drinking water, *Public health, *Developing countries, United Nations, *Costs, International Drinking Water Supply and Sanitation Decade, Water resources development, Sanitation, World Health Organization, Education, Water supply, Water quality standards, Investment, Institutional constraints, Political constraints, Reviews.

Current information on the availability and use of potable water in developing countries is critically

reviewed. Weaknesses in the World Health surveys of 1962, 1970, and 1975 are incomplete information (China and several other countries were not included), countries overestimating or underestimating the status of clean water supplies either to improve their images or to call attention to their difficulties, the intermittent nature of water service in may locations, and differences in enumeration method among countries. Provision of clean water without concurrent improvements in sanitation and health education is very ineffective. Western world water quality standards cannot be imposed on developing countries because significant percentages of existing water suplies would be automatically condemned and cost of equipment and personnel to maintain these high standards would be impractically high. The goal should be a variable standard to suit the locale, people, infection risks, and finances. Many cost estimates for the Decade have been calculated and revised. The currently accepted cost is $300 billion, considered by many to be a serious underestimate. There is small chance that the Decade will meet its goals. Constraints that must be overcome to ensure success are the lack of funds in the developing countries, the priorities of the individual countries, the lack of institutional infrastructure in many areas, lack of trained manpower, and lack of understanding of local conditions. (Cassar-FRC)
W82-04604

TRANSGLOBAL VARIATIONS IN THE PLANNING OBJECTIVES AND CRITIQUES,

Ministry of Water and Power, Islamabad (Pakistan).
For primary bibliographic entry see Field 6A.
W82-04605

THE RELATIONSHIP OF ACCESSIBLE SAFE WATER AND ADEQUATE SANITATION TO MATERNAL AND CHILD HEALTH--LOOKING FORWARD TO THE DRINKING WATER AND SANITATION DECADE,

Water and Sanitation for Health Project, Washington, DC.
R. B. Isely.
Water Supply and Management, Vol 5, No 6, p 417-424, 1981. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Drinking water, *Public health, *Social aspects, Sanitation, International Drinking Water and Sanitation Decade, Benefits, *Developing countries, United Nations, Diseases, Women, Children.

The chief beneficiaries of planned improvements in developing countries' water supplies and sanitation will be women and children. The average East African woman uses 9% of her daily caloric intake to obtain water for the household, up to 27% in hilly country. Diarrhea and its effects account for 30% of deaths in Third World children 0 to 4 years old. Waterborne diseases are responsible for undernutrition and many other ailments. Benefits from safe water supplies and improved sanitation are three fold: a better quality of life for women, reduced mortality and morbidity in young children, and the advantages that mother and child experience as a single bio-social unit (increased birthweight of infants, prolonged breastfeeding period, more time for child care, and a reduction in birth rate). (Cassar-FRC)
W82-04606

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: SEVIER LAKE BASIN, UTAH.

Federal Energy Regulatory Commission, San Francisco, CA. San Francisco Regional Office.
Appraisal Report, September, 1980. 61 p, 20 Fig, 10 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Water demand, *River basin development, Irrigation, Flood control, Precipitation, Runoff, *Sevier Lake basin, *Utah.

The Sevier Lake basin is a major land-locked drainage basin covering all or portions of 11 counties in southwest Utah and a small portion of one county in Nevada. Average annual precipitation ranges from about 8 inches in the western desert to over 30 inches in the mountains. In spite of groundwater tables, which tend to recharge the Sevier River, losses to evapotranspiration aided by irrigation deplete flows in the river to the extent that runoff reaches Sevier Lake only during rare high flows. Approximately 400,000 acres (less than 5% of the total basin area) are irrigated. Fourteen small operating hydroelectric powerplants in the basin have a combined installed capacity of 6,260 kw, of which 77% is under license. The basin's hydroelectric plants produce about 34 gigawatt-hours annually which is about 5% of the forecasted 1978 energy requirement. There are two flood control projects in the basin. About 38% of the basin's installed hydroelectric capacity is developed in the 2,400 kw Upper Beaver plant. The Upper Beaver plant is in good condition and capable of being operated efficiently for a number of years in the future. It is not considered to be economically justified for the company to make repairs for resumed power production at the Lower Beaver plant. Water resource projects which have been considered for development include: a land rehabilitation program; a water diversion project; two pumped storage projects, and two low-head hydroelectric powerplants. (Moore-SRC)
W82-04636

THE WELSH APPROACH TO WATER RECREATION,

S. Le Lievre.
Water, No 42, p 29-31, 1982. 3 Fig.

Descriptors: *Water use, *Recreation, *Water demand, Boating, Fishing, Lakes, Reservoirs, *Wales, Regulations.

The Welsh Water Authority Strategic Plan for Waterspace Recreation and Amenity was recently released. Representative bodies of users and individuals with interests in countryside conservation and wildlife protection have given unequivocal approval and support to the authority's proposals, which took six years to complete. Uppermost in the minds of the authority is the conservation of the countryside in which the visible assets of water space are located. Much of the time taken in preparing the master plan was occupied in consultations with all types of users, in order to search for practical solutions to possible areas of conflict or clashes of interest. (Baker-FRC)
W82-04658

THE SEVEN-TRENT STUDIES OF INDUSTRIAL WATER USE,

Severn-Trent Water Authority, Birmingham (England).
J. E. Thackray, and G. G. Archibald.
Proceedings of the Institution of Civil Engineers, Part 1: Design and Construction, Vol 70, No 2, p 403-434, August, 1981. 9 Fig, 22 Tab, 16 Ref.

Descriptors: *Water use, *Industrial water, Water consumption, *Water demand, *Municipal water, Water reuse, Wastewater disposal, Economic aspects, *Severn-Trent Water Authority, Water prices, *England.

An extensive investigation of industrial and commercial water use in the Severn-Trent Water Authority region involved a detailed survey of water use practices and policies of 3000 metered consumers. The proportions of piped water and directly abstracted water used by different industries are reported. Average annual metered consumption in the region rose from 550 million/liters per day in 1965 to 625 million liters per day in 1970, declined sharply to 525 million liters per day in 1977, and increased slightly to 575 million liters per day in the late 1970's. A table of water use classified by 18 different processes (cooling, product rinsing, gas scrubbing, etc.) in 16 industry categories (mining, food, chemicals, etc.) is presented. Water use per employees in manufacturing industries averaged 2065 liters per day, with wide variations. Domestic type water use by persons at work in industry averaged 96 liters per person per day, slightly less than the average household per capita consumption, 115-120 liters per day. Other tables and figures concern water use per unit of manufacturing output, water charges as a percentage of total costs, water saving schemes used in industry, elasticity of demand with respect to output, water recycling, average water use in service industries, and disposal of used water. This information base is usable by those involved in economic appraisals and in forecasting and design of facilities for water suppliers and consumers. (Cassar-FRC)
W82-04686

MASSACHUSETTS WATER SUPPLY PRIORITIES,

Massachusetts Dept. of Environmental Quality Engineering, Boston.
T. F. McLoughlin.
Journal of the New England Water Works Association, Vol 95, No 4, p 271-279, December, 1981. 2 Ref.

Descriptors: *Water supply, *Water resources development, *Massachusetts, *Water demand, Conservation, *Water quality, Industrial wastes, Aquifers, Financial aspects.

Water supply priorities are discussed, including impacts of hazardous waste on water supply, protection of existing and future aquifers, water conservation, regionalization, and budgetary constraints. Drinking water supplies in at least one-third of the communities in Massachusetts have been affected by organic chemical contamination to some degree, resulting in the closure of wells in 22 communities, with capacity losses averaging 40% and ranging as high as 100%. Increasing demands on groundwater supplies must be met with safeguards to protect the aquifers from further contamination. Fluctuations in groundwater levels are caused by a number of factors, including seasonal variations, changes in river and stream stages, various forms of withdrawal, and recharge. Tremendous efforts are underway to explore traditional and non-traditional sources of water supply. However, the need for conservation is clear. Water conservation programs can benefit water quality and quantity in various ways, including financial savings for the municipality as well as the individual homeowner. Regionalization is another name for sharing resources. This type of approach has great potential in solving supply and demand issues in the state of Massachusetts. Various factors to be considered include adequacy and reliability, quality, cost, legality and politics. (Baker-FRC)
W82-04698

A MULTIVARIATE ANALYSIS OF MUNICIPAL WATER USE IN UTAH,

Utah State Univ., Logan.
For primary bibliographic entry see Field 3D.
W82-04728

A METHOD FOR ESTIMATING PEAK WATER DEMAND OF MULTIFAMILY RESIDENCES,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
B. Bobee, P. Boucher, and H. Demard.
Water Resources Bulletin, Vol 16, No 4, p 729-737, August, 1980. 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Peak demand, *Domestic water, Apartments, *Water demand, *Statistical analysis, Water pressure.

Peak water demand for apartment residences of three or more units was estimated from the square root of the number of apartment units in the building and the cube root of water pressure. This relationship was obtained from statistical analysis of data from 17 apartment buildings, 3 to 41 apartments each, in Sainte-Foy, Quebec, using the Ridge-regression technique. The formula may be applied to the eastern U.S., where appliances, pressure conditions, and mean water demands are similar to those used in the study. Oversizing of meters and service lines increases maintenance costs, underregisters low demand, and requires a large initial investment. Undersizing the equipment leads to increases in friction loss, possible damage to the meter, and undercapacity. (Cassar-FRC)
W82-04734

A MUNICIPAL WATER SUPPLY INVESTMENT PROBLEM IN RHODE-ISLAND,

Western Washington Univ., Bellingham. Dept. of Economics.
R. Frye, and J. W. McFarland.
Water Resources Bulletin, Vol 16, No 1, p 31-35, February, 1980. 10 Ref.

Descriptors: *Water demand, *Water conservation, *Economic aspects, Computers, Water resources development, Resources development, *Rhode Island, Water supply, Water supply development, Water requirements, Model studies, Pricing.

Two approaches are considered to a residential water supply problem being experienced in Rhode Island. The first approach is a benefit maximization model incorporating price sensitive water demand as the basis for measuring system benefits. This is contrasted with a 'requirements' approach, which is a cost minimization model constrained b the requirement to provide a minimum quantity per household. To reconcile the differences between the results of the two approaches, a modification is made in the benefit-maximization approach to include peak demand considerations. The study focuses on Newport, Middletown, and Portsmouth, Rhode Island, located on Aquidneck Island in Narragansett Bay. Results indicate that a requirements approach can lead to findings similar to a benefit maximization model incorporating price sensitive demand. Incorporating price sensitive demand also leads to ambiguous results due to not knowing which demand function to use as a measure of benefits or how to construct such a function. The findings do confirm that dynamic programming is a useful way of formulating the intertemporal investment-production problem in different sources of supply and/or capital components exhibiting differing economies of scale. The method allows explicit consideration of the tradeoffs between the costs of periods of excess capacity and economies of scale for a number of components. The choice of an objective function requires flexibility; benefit maximization and cost minimization can lead to similar or dissimilar results, depending on the flexibility of the analyst and the model. (Baker-FRC)
W82-04740

6E. Water Law and Institutions

WATER MANAGEMENT IN ONTARIO,

Ontario Ministry of the Environment, Toronto.
S. E. Salbach, and R. P. Dennis.
Water Resources Bulletin, Vol 16, No 4, p 621-262, August, 1980.

Descriptors: *Water management, *Regulations, *Water policy, *Water quality standards, Management, *Ontario, Groundwater, Surface water, Effluent standards, Water allocation, Water pollution control.

The Ontario Ministry of the Environment revised its 1970 guidelines for water quality management in 1976 as a response to changes in the social and economic background, advances in technology, and philosophical attitudes toward water management. Goals, objectives, and policies to implement the goals are given for management of surface water quality and quantity and groundwater quality and quantity. For example, the goal for surface water quality is to ensure that the surface waters of the province are of a qality which is satisfactory for aquatic life and recreation. The policies for implementation concern areas with water quality better than the objectives, areas with water quality not meeting the objectives, effluent requirements, hazardous subsurfaces, and mixing zones. The revised approach involves imposition of legally enforceable effluent requirements on a case-by-case basis rather than having province-wide effluent standards. Five working groups are developing the necessary detailed implementation procedures. (Cassar-FRC)
W82-04259

OBJECTIVES AND CONSTRAINTS IN FEDERAL WATER RESOURCES PLANNING,

Policy Sciences Associates, Boulder, CO.
W. B. Lord.
Water Resources Bulletin, Vol 17, No 6, p 1060-1065, December, 1981. 6 Ref.

Descriptors: *Planning, *Decision making, *Political constraints, Water Resources Council, Water resources development, Economic development, Environmental quality, *Water policy, Public participation.

The Water Research Council's 1973 'Principles and Standards' states that plans should be formulated to reflect national, regional, state, and local needs or problems consistent with the objectives of improvements in national economic development and environmental quality. There is no specified approach to reconciling national objectives with local needs and problems. Increasingly, the approach has been to plan with national objectives as the first consideration. This is not the most practical or desirable method, partly because the national objectives are general and abstract. Many conflicts between the federal government and local groups have arisen over water resources development projects. A more satisfactory planning method is to formulate plans for solving a specific local problem and then consider the restraints imposed by the national objectives. Public participation on the local level is recommended. (Cassar-FRC)
W82-04288

THE ADOPTION OF MUNICIPAL WATER CONSERVATION: AN UNLIKELY EVENT,

Oklahoma State Univ. Stillwater. Dept. of Economics.
R. L. Moomaw, and L. Warner.
Water Resources Bulletin, Vol 17, No 6, p 1029-1034, December, 1981. 1 Tab, 11 Ref.

Descriptors: *Water conservation, *Institutional constraints, *Pricing, *Municipal water, Water rates, Planning, Nonstructural alternatives, Water policy, Profit, Political aspects.

Municipal water utilities are unlikely to voluntarily adopt water conservation practices which reduce net revenues, even if they are beneficial in the long term. Institutional changes are suggested. Decisions involving decreases of revenues (pure conservation measures such as new plumbing codes, education, and retrofitting) should be removed from the water enterprises jurisdiction. Subsidies to the water company for improved management practices such as meter repair and leak control may increase chances for adoption of these conservation measures, even though they decrease revenues. Conservation pricing (overall rate increase, summer surcharges, and flat rates) increase water company revenues but may create illegal or unpopular profits. Laws can be changed to allow use of such profits for property tax relief or other acceptable programs. A study of five Texas and Louisiana cities illustrates some of these alternatives. All these cities have had recent water increases of 10% to 35%, and all but one had sewer increases from 35% to 140%. There is also a trend toward conservation by better management and maintenance. Only one city adopted measures that cost the utilities money and decreased short-term revenues. (Cassar-FRC)
W82-04343

THREE IMPORTANT COURT DECISIONS,

Cook Coll., New Brunswick, NJ.
W. Goldfarb.
Water Resources Bulletin, Vol 17, No 6, p 1097-1098, December, 1981.

Descriptors: *Judicial decisions, *Landfills, *Effluent standards, Water law, *Water management, Chemical wastes, Waste disposal, Cost-benefit analysis, Permits, *Illinois.

Three court decisions of concern in water management are reported. In the Village of Wilsonville v. SCA Services, Inc., the Illinois Supreme Court affirmed a lower court decision to close a hazardous waste landfill located in a coal mine subsidence zone because it threatened groundwater quality. The argument that the landfill site and all disposals had state EPA approval were rejected because permits were allegedly based on inaccurate data. In Isaac Walton League v. Marsh a federal court of appeals refused to review the cost-benefit analysis for the Army Corps of Engineers Locks and Dam 26 Project on the Mississippi River near Alton, Illinois, thus allowing the project to preceed as authorized. The American Paper Institute v. EPA case invalidated the Environmental Protection Agency regulations for industrial effluent discharges based on best conventional pollutant control technology (BCT). It is likely that little progress beyond Phase I, best practicable technology (BPT), will be seen in the near future. (Cassar-FRC)
W82-04349

THE WINTERS DECISION AND INDIAN WATER RIGHTS–A MYSTERY REEXAMINED,

California Univ., Los Angeles. Dept. of History.
N. Hundley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211525, Price codes: A03 in paper copy, A01 in microfiche. March, 1982. 31 p, 77 Fig. OWRT A-059-CAL(3).

Descriptors: *Legal aspects, *Water rights, *Judicial decisions, *History, *Indian reservations, Western United States, Semiarid lands.

Water is the natural resource of greatest concern in western American, an area of few rivers, sparse rainfall, and monumental struggles over the precious commodity. Joining increasingly in the struggles have been Native Americans, most of whose reservations and reservation population are found in the driest portions of the region. No less concerned are non-Indians whose cities, industries, and farms are already using most of the West's water. At the heart of these controversies, both past and in-th-making, are differences over a 1908 decision rendered by the United States Supreme Court in Winters v. United States. That decision announced for the first time the existence of an Indian water right, but the meaning of the court's action has become clouded in debate which has exacerbated conflicts between Indians and non-Indians and created a crisis of national significance. For more than half a century, attorneys, legal scholars, and historians have quarreled over the meaning to the Winters decision with three issues in particular dominating their differences: the quantum or volume of the Indian right, the legitimate uses to which the water guaranteed by the right can be put, and the priority of the right in relation to the rights of non-Indians desirous of the same water sources. Careful examination of published documents and heretofore overlooked manuscript materials helps to clarify the intentions of the Winters court and to shed light on the ongoing disputes over the Indian water right. (Snyder-California)
W82-04413

WATER RIGHTS, ALLOCATION, AND CONFLICTS IN THE TONGUE RIVER BASIN, SOUTHEASTERN MONTANA,

Ohio Wesleyan Univ., Delaware. Dept. of Geography and Geology.
D. H. Kickox.
Water Resources Bulletin, Vol 16, No 5, p 797-803, October, 1980. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Water law, *Montana, *Water resources development, *Water rights, Water requirements, Legal aspects, Water use, Water policy, State jurisdiction, *Water demand, Water supply, Riparian rights, Reservoir storage, Irrigation requirements, Future planning, Coal, *Tongue River basin.

The extensive development of coal deposits in Southeastern Montana's Tongue River basin has created a great demand on the area's water resources. In some areas not enough water is available to meet demands, while in other cases, even though water is in abundance, it may not be legally available due to a new Montana water allocation system, Indian lawsuits, or state policy toward water resource development. Some energy proj-

ects threaten to dewater the river, degrade water quality and endanger aquatic ecosystems. The Montana Water Use Act was enacted in 1973 to end the uncertainties existing in Montana water law by requiring final allocation and adjudication of the state's waters. In 1974, the Water Moratorium Act was passed to allow the state time to plan for future water use. In 1978, plans were made for the Tongue River Reservoir, which will soon be replaced by a larger dam and reservoir. Irrigation districts will be allotted all the water they have requested. The Fish and Game Department has requested enough water to maintain instream flows. Processing of industrial applications for water began in 1979. The Montana Water Storage Company and the Water Reserve Company have both requested large diversions that cannot be met by the available water in the Tongue River. Industrial allotments will probably continue to take a second place to preferred agricultural water uses in Montana. (Geiger-FRC)
W82-04441

DEVELOPMENT OF FEDERAL RESERVE RIGHTS,
Nevada Univ. System, Reno. Dept. of Civil Engineering.
J. W. Bird.
Water Resources Bulletin, Vol 16, No 5, p 837-842, October, 1980.

Descriptors: *Federal jurisdiction, *Water rights, *Water law, *Arid zone hydrology, *Reservation doctrine, Flood control, Water management, Legal aspects, Riparian rights, Water policy, Water supply, Water use, Navigable waters, Arid lands.

States in arid regions are concerned over the federal reserved rights termed 'Indian Rights to Water', which include such concepts as navigation improvement and flood control plans. Recently a large number of lawsuits concerning water based on the Winters' Doctrine been filed in arid states. The protection of federal reserved water rights can be seen in such landmark cases as the U.S. vs. Rio Grande Dam and Irrigation Company (1899), Winters vs. U.S. (1908), Federal Power Commission vs. Oregon (1955), Arizona vs. California (1963), and U.S. vs. District Court for Eagle County (1971). The existing lawsuits on surface water sources such as the one now on appeal involving reserved federal rights on the Truckee River have promulgated two standards for deciding on the use of reserved waters. Those uses needed to fulfill the purposes contemplated when the reservation was created will be considered under one plan, while all possible uses, including those which appear in the future, without reference to the purposes for which the reservation was created, will form a second plan for reserved water use. The first plan allows a rapid quantification of the reserved water rights to identify and protect a certain amount of water from others. In the second case, the Indians' rights would remain uncertain, and the courts may be able to force the Indians to accept compensation for their claim if no water is available. (Geiger-FRC)
W82-04446

NEW FEDERAL WASTEWATER DISCHARGE STANDARDS IN GERMANY,
Ministry of the Interior, Berlin (Germany, F.R.).
H. Hornef, and S. Kanowski.
Effluent and Water Treatment Journal, Vol 21, No 11, p 510, 511, 513, 514, November, 1981. 2 Tab, 2 Ref.

Descriptors: *Wastewater disposal, *Regulations, Standards, *Federal jurisdiction, *Industrial wastes, Water quality, *Water pollution control, *West Germany.

The federal government in Germany has enacted two general laws which emphasize the principle of precaution and the need for those who do the polluting to pay for the cost of cleanup. The Wastewater Charges Act rules that a fee has to be paid for discharging wastewater into receiving waters. This charge may be reduced by 50% if the minimum quality requirements are met. The minimum requirements are compulsory everywhere in the Federal Republic of Germany and are independent of the state of the receiving waters. These requirements are generally emission standards in the form of concentrations and/or load of pollutants specific for products. In 1977 the federal government established 50 task forces to develop proposals for minimum requirements on an industry-by-industry basis. The most important pollutants/parameters for which minimum requirements are to be fixed are those for which a wastewater charge has to be paid, including settleable solids, chemical oxygen demand, cadmium, mercury, and toxicity for fish. In specific branches requirements will be set for biochemical oxygen demand, hydrocarbons, phenols, cyanide, heavy metals, halogenated hydrocarbons, sulfide, ammonia, fluoride, phosphorus, and total suspended solids. State authorities will set requirements for pH and temperature parameters. (Baker-FRC)
W82-04527

EXPERIENCES WITH EEC GUIDELINE 75/440 ON THE QUALITY OF SURFACE WATERS FOR DRINKING WATER PRODUCTION IN THE MEMBER STATES (ERFAHRUNGEN MIT DER EG RICHTLINIE 75/440 UBER DIE QUALITAT VON OBERFLACHENWASSER FUR DIE TRINKWASSERGEWINNUNG IN DEN MITGLIEDSTAATEN).
GWF-Wasser/Abwasser, Vol 122, No 12, p 555-560, 1981. 5 Fig. English Summary.

Descriptors: *Legal aspects, *Water quality standards, *European Economic Community, International law, Drinking water, Potable water, Surface water, Water quality, Lead.

The European Economic Community (EEC) Council of Ministers' guidelines on surface water quality for drinking water, published in 1975, is critically reviewed. This guideline had a dual goal of preventing water pollution and protecting public health. Some European water managers have expressed the opinion that this guideline offers more hindrance than help. Implementation in many countries has placed the burden of assuring acceptable source quality on the water supply enterprise and has failed sufficiently to emphasize pollution prevention. Some water obtainment treatment techniques widely used in Europe are not covered by the guideline. No encouragement is provided for improving water quality beyond minimum standards. Not all of the recommended methods and standards are adequately defined. Since this guideline is in the process of being adopted in legislation of the EEC member countries, it is advisable that these problems be resolved as soon as possible. (Carroll-FRC)
W82-04547

THE FINANCING OF PRIVATE SMALL SCALE HYDROELECTRIC PROJECTS.
Franklin Pierce Law Inst. Center, Concord, NH.
For primary bibliographic entry see Field 6B.
W82-04633

A MANUAL FOR DEVELOPMENT OF SMALL SCALE HYDROELECTRIC PROJECTS BY PUBLIC ENTITIES.
Energy Law Institute, Franklin Pierce Law Inst. Center, Concord, NH.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/CE/04934-45, Price codes: A03 in paper copy, A01 in microfiche. DOE/CE/04934-45, March, 1981. 39 p, 1 Tab.

Descriptors: *Hydroelectric plants, *Legal aspects, *Economic aspects, *Local givernments, Financing, Permits, Licensing, Dams, Construction, Feasibility studies, Legislation.

This manual is designed to provide guidance to towns, cities, counties and other political subdivisions which are interested in undertaking or participating in small scale hydroelectric (SSH) development within or close to their territorial boundaries. A SSH project is of 25 to 30 MW or less and utilizes an existing dam or structure or utilizes the site characteristics of partially breached dams or structures. Since 1978 new federal legislation has removed some of the obstacles to SSH projects and has created substantial incentives for development. The hydroelectric development process can be braken down into the following sequential steps: reconnaissance study; feasibility study; permits, licensing, and exemptions study; engineering design; power purchase negotiations; construction; and operation. Every political subdivision must examine its charter or enabling legislation in order to determine whether it is authorized to proceesed with development of a SSH project. Assuming the requisite authorization exists, the political subdivision may choose to be the sole owner, developer and operator, in which case the financing and other arrangements are straight-forward. Assuming state or local law permits, the political subdivision may consider joint development with a private development firm, the local investor owned utility or another political subdivision. Disposition of a site owned by a political subdivision can take a variety of forms: outright sale at auction, sale of an option to purchase, a lease resulting from a bidding system, or a management and development contract resulting from a competitive proposal system. Since at least 80% of the annual cost of a hydroelectric project consists of interest payments and capital amortization expenses, it is important to select a financing strategy that minimizes the cost of financing the project. (Moore-SRC)
W82-04634

APPLICATION OF THE AREA OF REVIEW CONCEPT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. T. Thornhill, T. E. Short, and L. Silka.
Ground Water, Vol 20, No 1, p 32-38, 1982. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Injection wells, *Water quality control, *Mathematical studies, *Computer models, *Oil wells, *Hydrostatic pressure, Groundwater management, Water quality management, Model studies, Digital computers, Aquifers, Groundwater movement, Drinking water, Injection wells, Regulations.

Underground Injection Control regulations require that the issuers of permits determine, within an 'area of review', whether a proposed injection operation has a potential for contaminating underlying or overlying aquifers through faults, wells, or other conduits that permeate the injection zone. The 'area of review' is defined as that area the radius of which is the lateral distance from an injection well or injection well pattern in which the pressure change due to injection operations may cause the migration of the injection and/or formation fluid into an underground drinking water supply. It is thus the area around an injection well where, during injection, the hydrostatic head of the formation fluid in the injection zone is equal to or greater than the hydrostatic head of underground sources of drinking water. A Theirs equation may be used to determine the zone of endangering influence to define the area of review. The concept was applied to Texas oil fields in Anderson County, Andrews County and Refugio County, where active injection wells already existed and sufficient data was available to determine the area of review. The Warner analytical method for determining pressure buildup and a programmable desk calculator and digital computer were used in this exercise. In studying areas that have numerous injection wells discharging into the same zone, it was suggested that the effect of all the wells on the pressure buildup be considered. (Geiger-FRC)
W82-04674

RECENT DEVELOPMENTS IN COLORADO GROUNDWATER LAW,
Davis, Graham and Stubbs, Denver, CO.
F. Hannay.
Denver Law Journal, Vol 58, No 4, p 801-823, 1981. 194 Ref.

Descriptors: *Water law, *Wells, *Water rights, *Colorado, *Groundwater management, *State jurisdiction, *Appropriation, Legal aspects, Riparian rights, Water use, Tributaries, Surface water, Water allocation, Resources development, Water management, Equitable apportionment, Permits.

The developments in Colorado water law with respect to both tributary and nontributary groundwater are reviewed. Tributary groundwater is defined as any surface and underground water of the state that would affect the rate of flow of the natural stream into which it flows over a period of forty years or less. A case in which the use of groundwater for two wells would have affected the rate and flow of the Cache La Poudre River helped establish the definition of tributary groundwater. If a well's operation would not affect the flow in a stream until one hundred years or more after the commencement of pumping, such a water supply would be defined as nontributary groundwater. In 1965, House Bill 1066 gave the state engineer the authority to control existing and new wells in Colorado. The 1969 Water Rights Determination and Administration Act served to implement and refine the doctrine of maximum water utilization while preserving vested rights. Recent court cases which sought to clarify the 1969 Act were unsuccessful at this task. The Colorado Supreme Court must still decide if nontributary groundwater can be appropriated, and, if so, how and by whom. (Geiger-FRC)
W82-04679

BUBB V. CHRISTENSEN: THE RIGHTS OF THE PRIVATE LANDOWNER YIELD TO THE RIGHTS OF THE WATER APPROPRIATOR UNDER THE COLORADO DOCTRINE,
E. A. Rada.
Denver Law Journal, Vol 58, No 4, p 825-836, 1981. 88 Ref.

Descriptors: *Water rights, *Colorado, *Appropriation, *State jurisdiction, *Land tenure, Water law, Riparian rights, Legal aspects, Water use, Water allocation, Water management, Land rights.

The Colorado Doctrine, which was developed to permit maximum utilization of water, implies that a water right may be acquired separate from the land. This negates the importance of trespass in the determination of a valid water right as seen in the case of Bubb vs. Christensen. The private landowner's right to be protected against trespass is subordinate if the trespasser can clearly demonstrate his intent to appropriate water on or adjacent to another's property. The landowner's recovery will be limited only to damages rather than to denial of the appropriator's right to use the diverted water. If it can be demonstrated that the appropriator did not put the water to good use and wrongfully took the owner's land, then the landowner may obtain relief in a court of general jurisdiction in an action for trespass. The court decision handed down in Bubb vs. Christensen suggests that a private landowner's property may be taken by one holding a conditional water right without first making compensation to the owner. (Geiger-FRC)
W82-04680

NOTE, WATER FOR OIL SHALE: FRAMEWORK FOR THE LEGAL ISSUES,
C. Robinson, and M. E. Walta.
Denver Law Journal, Vol 58, No 4, p 703-714, 1981. 95 Refs.

Descriptors: *Oil industry, *Legal aspects, *Water quality, Water supply, Shales, Energy, *Oil shale, Water pollution sources, Industrial water, Process water, *Colorado.

The proposed oil shale industry in Colorado will have a significant impact on the limited water resources of the state in two vital respects - depletion of water quantity and degradation of water quality. Oil shale companies will compete with agriculture, municipalities, other industries and recreation for the state's limited water supplies and will face environmental concern over water systems already polluted by existing users and by nature. General information of a technical nature is presented about oil shale geology and technology in order to form a framework for the legal issues related to water for oil shale development. The paper considers water availability, geology of oil shale formation, technologies for shale development, water requirements of the industry, and anticipated water quality impacts. This background will facilitate understanding of the legal problems inherent in the acquisition and use of Colorado water. A multitude of legal problems will surface as the oil shale industry continues to seek adequate and dependable water supplies. These problems will be further compounded by the labyrinth of federal regulations and by Colorado's specialized water law system. Ultimate resolution of these legal questions by the courts will significantly influence Colorado's role in helping the United States achieve energy independence. (Baker-FRC)
W82-04681

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION: STATE OF THE ART,
New Hampshire Water Supply and Pollution Control Commission, Concord.
S. W Leavenworth.
Journal of the New England Water Works Association, Vol 95, No 4, p 245-247, December, 1981.

Descriptors: *Reservoirs, *Water pollution prevention, Water supply development, Surface water, Water pollution sources, *Legal aspects, Public health, *Concord, *New Hampshire.

Problems encountered during efforts to secure a covering for a storage reservoir in the City of Concord, New Hampshire, are reviewed. In the summer of 1969 high levels of coliform bacteria were noted in water samples collected from the high service portion of the distribution system, while samples from other parts of the system were of a much better quality. The high service portion was served by a ground level uncovered storage reservoir with a capacity of about two million gallons. Application to install a cover was granted, but when funding finally became available, the priority of other projects was put above the reservoir cover and the project did not begin as planned. After a hearing before the Commission, the City was ordered to install a cover. The objections which the city had presented stemmed mainly from an epidemiologist's report that there had been no statistical evidence linking waterborne disease outbreaks to uncovered reservoirs. However, this approach to reasoning disregards the entire concept of prevention. There is also ample evidence that the various improvements in water treatment and in knowledge of water supply and distribution have reduced the incidence of waterborne disease outbreaks dramatically. Eventually in the City of Concord, the technical aspects took second place to the legal approach, as the order of the Commission was eventually appealed by the City to the State Supreme Court. In the final judgment, the Commission won, but more on legal grounds than on health and safety evidence. (Baker-FRC)
W82-04700

AUCTIONS AND ALTERNATIVE PROCEDURES FOR ALLOCATING POLLUTION RIGHTS,
Texas Univ. at Austin. Dept. of Economics.
R. M. Lyon.
Land Economics, Vol 58, No 1, p 16-32, February, 1982. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Water pollution control, *Legal aspects, *Water rights, Industrial wastes, *Regulations, Effluent charges, Effluent limitations.

This paper considers both potential strategic behavior of dischargers bidding for rights and price-taking behavior. Particular attention is given to examining the types of auction procedures that could be used to implement rights sales by the government, if the approach of government sales is adopted. A special type of auction, a type of roves mechanism, that discourages strategic bidding by dischargers is contrasted with auctions that use a single clearing price as a method for government sales. Regulatory procedures are considered, as they represent a standard against which programs involving transferable rights can be compared. Under the single-price auction rights would be sold to the highest bidders for a price that could represent either the lowest accepted bid or the highest rejected bid. A discriminating auction is designed specifically to eliminate dischargers' incentives for strategic bidding. Based on both theoretical and practical considerations, it is concluded that there is a fundamental trade-off between reducing the financial burden of rights purchases and eliminating the incentives for strategic behavior. Very few dischargers in either of the two case studies presented would have lowered expenses under government sales of rights rather than under uniform treatment regardless of whether sales are by a single-price or incentive-compatible auction. The simulations also suggest that there may be opportunities for strategic behavior under nonincentive-compatible procedures because of small numers of dischargers. The rights allocation approach of free distribution followed by exchange may present the most desirable package of features. (Baker-FRC)
W82-04746

6F. Nonstructural Alternatives

EXPERIMENTS IN IMPROVING RURAL WATER SUPPLIES,
Vermont Univ., Burlington. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 5F.
W82-04350

MASSACHUSETTS WATER SUPPLY PRIORITIES,
Massachusetts Dept. of Environmental Quality Engineering, Boston.
For primary bibliographic entry see Field 6D.
W82-04698

FLOOD HAZARD IDENTIFICATION AND FLOOD PLAIN MANAGEMENT ON ALLUVIAL FANS,
Army Engineer Div. North Pacific, Portland, OR.
L. M. Hagura, and D. E. Wood.
Water Resources Bulletin, Vol 16, No 1, p 56-62, February, 1980. 8 Fig, 6 Ref.

Descriptors: *Flood control, *Alluvial fans, Alluvial plains, Sedimentary structures, Floods, United States, Land management, *Flood plains, Flood plain management, California.

This paper focuses on a special study procedure that the Federal Insurance Administration (FIA) has developed and is requiring its flood insurance study contractors to utilize for identifying alluvial fan (AF) zones. The need for an appropriate AF hazard identification procedure was dramatically emphasized by the passage of Tropical Storm Kathleen over the desert areas of Southern California in September of 1976. The pattern of flood damage was more typical of midwestern tornado damage, with certain localities extremely hard hit and other adjacent communities experiencing little or no structural damage. The basic cause of the substantial flood damage was a failure on the part of the local planning and building officials and developers to recognize the true degree of flood hazard that exists on alluvial fans. The procedure is understandably crude compared to other flood hazard identification techniques applied to more conventional flood problems. (Baker-FRC)
W82-04738

6G. Ecologic Impact Of Water Development

HYDROGEOLOGIC EVALUATION OF WETLAND BASINS FOR LAND USE PLANNING,
Lowell Univ., MA. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2A.
W82-04439

MODELING THE ENVIRONMENTAL EFFECTS OF A NAVIGATION CHANNEL IN A TIDAL BAY,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient, R. W. Hall, and C. J. Newell.
Water Resources Bulletin, Vol 16, No 5, p 881-886, October, 1980. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Navigation canals, *Environmental effects, *Model studies, Mathematical models, Salinity, Simulation, Channels, Tidal basins, Hydrologic models, *Tidal waters, Bays, Louisiana, Vermilion Bay, New Iberia.

This paper documents the use of a mathematical bay model to predict the environmental impacts of a proposed navigation channel from the Port of New Iberia, Louisiana, to the Gulf of Mexico through Vermilion Bay. Although these large bays cover an area of 293,895 acres, they are rather shallow, with depths averaging 5 to 7 feet. Models wer used to predict the changes in flow and salinity in the bay system under a variety of flow, wind, and channel conditions. The major assumptions in the model were that the bay is vertically well mixed, significant variations in depth from cell to cell do not occur at more than a few places in the bay, Atchafalaya inflows do not appreciably alter the tidal variation input to West Cote Blanche Bay, salinities are based on tidally averaged flows and do not represent actual peaks and lows within a tide cycle, and source salinities and source tides are assumed to correspond, although actual data were not simultaneously available for both. The model predicted that average salinity in the Vermilion Bay system would decrease with both high south winds and high fresh water inflows when compared to standard conditions. With a navigation channel incorporated in the model, average bay salinities were predicted to be lower for all three simulation cases. This project also pointed out the crucial role of complete input data in the effective appraisal of major projects such as the Vermilion Bay channel. Environmental impacts of major projects do not always follow the course of similar projects, as seen by the Vermilion Bay model results when compared to other channels constructed on the Gulf Coast. (Baker-FRC)
W82-04449

SIMULATED HYDROLOGIC EFFECTS OF POSSIBLE GROUND-WATER AND SURFACE-WATER MANAGEMENT ALTERNATIVES IN AND NEAR THE PLATTE RIVER, SOUTH-CENTRAL NEBRASKA,

Geological Survey, Denver, CO. Water Resources Div.
A. W. Burns.
Geological Survey Open-File Report 81-1116, 1981. 41 p, 21 Fig, 5 Tab, 10 Ref, Append.

Descriptors: *Surface-groundwater relations, *Wildlife habitats, *Water management, Wetlands, Aquifers, Groundwater recharge, Streamflow, Irrigation, *Nebraska, *Platte River.

Digital computer models were developed and used to simulate the hydrologic effects of hypothetical water-management alternatives on the wetland habitat area near Grand Island, Nebr. Areally distributed recharge to and discharge from the aquifer system adjacent to the Platte River between Overton and Grand Island were computed for four hypothetical water-management alternatives. Using stream-aquifer response functions, the stream depletions resulting from the different alternatives ranged from 53,000 acre-feet per year for increased surface-water irrigation to 177,000 acre-feet per year for increased ground-water pumpage. Current conditions would result in stream depletions of 125,000 acre-feet per year. Using the relationship between discharge and river stage, frequency curves of the stage in the river near the wildlife habitat area were computed using a 50-year sequence of historical streamflow at Overton, minus the stream depletions resulting from various management practices. For the management alternatives previously discussed, differences in the stage-frequency curves were minimal. For comparative purposes, three additional water-management alternatives whose application would change the incoming streamflow at Overton were simulated. Although in these alternatives the amounts of water that were diverted or imported were similar to the amounts in the previous alternatives, their effects on the stage-frequency curves were much more dramatic. (USGS)
W82-04509

INERTIA AND RECOVERY: AN APPROACH TO STREAM CLASSIFICATION AND STRESS EVALUATION,

Maryland Univ., Frostburg. Appalachian Environmental Lab.
J. R. Stauffer, Jr., and C. H. Hocutt.
Water Resources Bulletin, Vol 16, No 1, p 72-78, February, 1980. 2 Fig, 3 Tab, 36 Ref.

Descriptors: *Stream classification, *Stress, *Fish, Classification, Elastic properties, *Ecosystems, Biological communities, Water management, Streams, Inertia.

The feasibility of using a system based on inertia and elasticity was examined, and these concepts were applied to fish data collected by Hocutt and Stauffer on Conowingo Creek. For the purposes of the study, Conowingo Creek was divided into four sections based on stream order and gradient. The concept of inertia and elasticity was able to be used to formulate a stream classification system, which can predict the amount of stress a particular system can assimilate and the potential of a system to recover if and when the assimilative capacity is exceeded. In this example a stress at any of the upstream locations would probably affect downstream areas, and therefore both inertia and elasticity indices would be more realistic if calculated for separate tributaries of a major drainage basin. These types of analyses must be applied to various ecosystems using different phyletic groups before this system can be fully evaluated. In this study fish were used because they occupy the top of the food chain in most stream systems, and thus their presence implies the presence of many other phyletic groups. Fish also pass through most, if not all trophic levels above the primary producer stage as their development proceeds from larvae through adults. Inertia appeared to be a more useful concept than elasticity for predicting the effects of potential stress. The relationship between structural and functional redundancy and their influences on the inertia index are discussed. (Baker-FRC)
W82-04735

MAN-MADE STORAGE OF WATER RESOURCES-A LIABILITY TO THE OCEAN ENVIRONMENT. PART I,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
H. J. A. Neu.
Marine Pollution Bulletin, Vol 13, No 1, p 7-12, January, 1982. 11 Fig, 11 Ref.

Descriptors: *Ecological effects, *Water storage, *Runoff cycle, *Cycling nutrients, *Electric power production, Runoff, Seasonal variation, Estuaries, Salinity currents, Saline-freshwater interfaces, Tidal marshes, Continental shelf, Density currents.

The storage of spring and summer runoff to generate electric power may pose a serious threat to the freshwater supply required by estuaries, embayments, marshes, and continental shelves for the mixing and entrainment of nutrient-rich deep water into the surface layer. Along the northeastern United States and the eastern coast of Canada, the typical winter runoff of freshwater is small, but the spring and summer freshwater runoff into the estuaries is much larger. Reducing the flow of freshwater during spring and summer and increasing it during winter alters the seasonal composition of the water in the surface layer and the seasonal strength of the density current. Studies of salinity in the south side of Cabot Strait before regulation commenced, and in the 1970's after runoff regulation showed that drastic increases in salinity occurred after regulation and much of the cyclic variation in salinity had disappeared. If the trend continues, the cyclic variation will be reversed, summer and winter temperatures will probably increase and the strength of the density current may decline to the point of disappearance. Reductions in the transport of salt water will be accompanied by a decrease in the influx of nutrients during the active season of the year. (Geiger-FRC)
W82-04749

7. RESOURCES DATA

7A. Network Design

REQUIREMENTS FOR CONTINUOUS AUTOMATIC WATER QUALITY MONITORING IN THE THAMES ESTUARY,

Thames Water Authority, London (England).
For primary bibliographic entry see Field 2L.
W82-04591

A DATA ACQUISITION SYSTEM FOR RECORDING AND PROCESSING RIVER QUALITY MONITORING DATA,

Severn Trent Water Authority, Coventry (England).
J. Cope.
Water Science and Technology, Vol 13, No 11/12, p 699-706, 1981. 13 Ref.

Descriptors: *Rivers, *Water quality, *Monitoring, Automation, Data acquisition, Water management, Equipment, Data processing, *Severn-Trent Water Authority, England.

In the Severn-Trent Water Authority a selection of commercial monitors is used together with specialist in-house developed monitors to help give a comprehensive water quality picture. Monitoring statins are expected to fulfill the two roles of sounding an alarm in the event of a polution problem and gathering historical quality data at that site. The procedure used to minimize false call-outs is briefly reviewed. The automatic data acquisition system is described, including data logger operations, and data recovery. Sensor technology has not as yet developed sufficiently to enable an automatic monitoring system to measure determinands which are most desirable, or if this is possible, costs are frequently prohibitive, particularly if a number of stations are required. At present, monitoring stations frequently measure determinands which may hint at undesirable contaminatino, but do not allow this to be quantified or identified unequivocally. Current sensors and sampling systems have a significant failure rate; consequently a limited proportion of erroneous results should be expected and dealt with accordingly. (Baker-FRC)
W82-04592

AUTOMATIC COLLECTION AND TRANSMISSION OF DATA FOR THE FEDERAL WATERWAY AUTHORITY,

Bundesanstalt fuer Gewasserkunde, Coblenz (Germany, F.R.).
F. Gunneberg.
Water Science and Technology, Vol 13, No 11/12, p 657-662, 1981. 1 Fig, 1 Tab.

Descriptors: *Automation, *Data transmission, *Data acquisition, Water quality data, On-site data collections, Hydrologic data, Flood data, Water level, Rivers, Germany, Remote control, Computers.

The West German Federal Waterway Authority is installing remote control equipment at its gauging and water quality monitoring stations in order to save labor costs and provide instantaneous access to water level data for flood prediction and pollution monitoring. Transmission is via the authority's own telephone lines. On-site storage of data for several days is provided in case of service interruption. Check channels are provided. Analog data from temperature, conductivity, acidity, and other sensors are transformed by an analog-digital converter, whereas water level data are obtained in digital form by coupling an optical encoder to the standard gauging facility. A quartz clock controlled microprocessor calls up gauging data every full minute, averages the data every 15 minutes, and stores the value in solid state memory. This procedure smooths the ripple caused by passing ships. Up to 22 sensors can be connected to one field station. The microprocessor is restarted every

day at midnight in order to protect against program execution breakdown due to power failures and the like. Maintenance personnel visiting the field station can plug in a liquid crystal display to read out the last values registered and the clock setting. Additional facilities are provided on regulated rivers. (Carroll-FRC)
W82-04596

DATA ACQUISITION FOR RIVER MANAGEMENT,

Thames Water Authority, Berkshire (England).
C. A. Hanson.
Water Science and Technology, Vol 13, No 11/12, p 687-692, 1981. 2 Ref.

Descriptors: *Water management, *Data acquisition, Computers, Monitoring, Automation, Rivers, *Thames River, River Lea, Catchment areas, *River systems, River management.

The requirements for data and information to manage and control a river system go beyond those for single process control. These requirements are discussed along with the philosophy of operation for the Thames Water data acquisition and control system for river management. This system has been operational since 1979. The system covers the catchments of the freshwater Thames above Teddington Lock and the River Lea, a major catchment which discharges directly to the tidal Thames and whose lower reaches pass through the outer conurbation of north east London. Both rivers have a navigational function. One of the additional requirements in river management beyond water supply and sewage treatment functions is for continuous time-series data as a prerequisite of system understanding before any meaningful control objectives can be established. Catchment data is also required to make projections for planning purposes. In river management data acquisition must be commenced in anticipation of problems to be met years ahead, and the quality of the data should assume decreasing margins of error and improving modelling techniques able to take advantage of the data quality. The first stage of the Thames Water data acquisition system consisted of a radio communications network, a computer control system and 67 field stations. Most of the difficulties encountered in commissioning the system revolved around the computer. At present attempts are underway to integrate the system of data from a precipitation radar station into the overall scheme. (Baker-FRC)
W82-04601

7B. Data Acquisition

A PRELIMINARY STUDY OF COMPARATIVE MEASUREMENTS OF RAINFALL RATE USING THE DIFFERENTIAL REFLECTIVITY RADAR TECHNIQUE AND A RAINGAGE NETWORK,

Ohio State Univ. Columbus. Dept. of Electrical Engineering.
For primary bibliographic entry see Field 2B.
W82-04263

DIFFERENCES BETWEEN SOME RADAR RAINFALL ESTIMATION PROCEDURES IN A HIGH RAIN RATE GRADIENT STORM,

Bureau of Reclamation, Denver, CO.
For primary bibliographic entry see Field 2B.
W82-04265

ELECTROMAGNETIC MEASUREMENTS OF TIDAL TRANSPORTS IN ESTUARIES,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
E. M. Swenson.
Estuaries, Vol 4, No 3, p 161-166, 1981. 7 Fig, 17 Ref.

Descriptors: *Estuarine environment, *Tidal rivers, Electromagnetic waves, *Tidal range, *Measuring instruments, Monitoring, Flow, Flow measurement, Tidal flow.

An electromagnetic method for monitoring tidal flow, inexpensive and relatively maintenance free after deployment, is presented. This provides a possible alternative transport measurement system for understanding tidal transports. Comparison of the electric potential signal to transports determined from current meter records is used to calibrate the system. The method depends on the measurement of the electric potential produced across a tidal channel by tidal currents. The induced potential is proportional to the vector cross product of the magnetic field of the earth and the water velocity. A volume flow of 100 cubic meters per second will induce a potential near 1 mV. Examples are given of measurements taken at Great Bay, New Hampshire and Lake Pontchartrain, Louisiana. These examples illustrate the observation that the method is capable of yielding volume flow measurements with an uncertainty of about 15%. The method does have some limitations due to salinity and temperature changes, calibration drift, and lack of definition of the spatial characteristics of the flow. (Baker-FRC)
W82-04296

ICHTHYOPLANKTON SAMPLERS FOR SIMULTANEOUS REPLICATE SAMPLES AT SURFACE AND BOTTOM,

North Carolina State Univ. at Raleign. Dept. of Zoology.
R. G. Hodson, C. R. Bennett, and R. J. Monroe.
Estuaries, Vol 4, No 3, p 176-184, 1981. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Sampling, *Estuarine environment, *Plankton, Fish, Biomass, *Measuring instruments, Bottom sampling, Sampling devices.

The construction and use of some new and modified ichthyoplankton sampling devices are described. These devices can be operated from small, relatively fast boats in shallow estuarine waters using nets up to 1 meter in diameter. The gear uses one meter diameter nets on square and rectangular frames and provides simultaneous surface and bottom samples. The equipment provides quantitative and qualitative ichthyoplankton samples from shallow estuarine waters 1 to 12 meters deep. Filtration performance in relation to clogging of 505 micron mesh nets averaged 97% and 103% for the surface and bottom nets respectively. These high filtration rates were attributed to the design of the net frames, which apparently act as mouth reducing cones. Catch data for several species from the side-by-side and separated rigs were analyzed with a nested model of analysis of variance. No systematic error was noted to be inherent in the design of the two samplers, which precluded direct comparison of surface and bottom samples taken with them. (Baker-FRC)
W82-04297

MEASUREMENT OF AIR IN FLOWING WATER,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
A. F. Babb, and H. C. Aus.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY12, p 1615-1630, December, 1981. 16 Fig, 6 Ref.

Descriptors: *Bubbles, *Air entrainment, *Flow characteristics, Anemometers, Hydraulics, Water flow, Spillways, Flow velocity, Hot-film anemometer, Duration factor, Hydraulic engineering.

Air void fraction and bubble size were measured by the hot-film anemometer method, modified by a gamma-ray attenuation technique for calibrating the duration factor for the hot-film procedure. The duration factor, a function of velocity, varied from 1.5 msec for a velocity of 0.5 m per sec to 0.5 msec for 3.5 m per sec. Errors produced by computer identification of a nonexistent bubble and failure to detect the end of the bubbles were minimized by concurrent display of the anemometer signal and a computer signal indicating whether air or water was being detected. Minimum detectable bubble size was a function of the duration factor, and in turn, of velocity. Void ratio and bubble size were studied in a stable hydraulic jump maintained at a Froude number of 6. Larger bubbles, about 10 mm, were located near the upstream end of the jump. Larger bubbles were easily broken by turbulence, shear, and buoyancy. (Cassar-FRC)
W82-04322

A PROBE METHOD FOR SOIL WATER SAMPLING AND SUBSURFACE MEASUREMENTS,

Alaska Univ., Fairbanks. Geophysical Inst.
W. D. Harrison, and T. E. Osterkamp.
Water Resources Research, Vol 17, No 6, p 1731-1736, December, 1981. 5 Fig, 16 Ref.

Descriptors: *Soil water, *Sampling, *Sediment sampler, Interstitial water, Permafrost, Sea ice, *Beaufort Sea Shelf, Alaska, Hydraulic conductivity, Water pressure, Temperature, Measurements, Water sampling.

An apparatus for obtaining interstitial soil water samples was applied in a study of sediments under the sea ice of the Beaufort Sea Shelf, Alaska. The portable, inexpensive sampler consists of a probe, metal shield, porous metal filter, and a check valve connected to the surface by plastic tubing inside a drill rod. It is designed for use in the saturated zone and works best in coarse-grained sediments difficult to sample by other methods. The water sample is removed with a bailer inside the tubing. It is not necessary to remove the probe between samples at different depths in the same hole. The apparatus may also be used to measure hydraulic conductivity, temperature, and water pressure. Special problems encountered in working with the permafrost sediments were: the interstitial soil water was partly frozen and only the liquid phase was collected, freezing in the tubing occurred occasionally, and bailers and sometimes tubing had to be warmed electrically before using. (Cassar-FRC)
W82-04325

SEDIMENTATION RATES AND DEPOSITIONAL PROCESSES IN LAKE SUPERIOR FROM PB210 GEOCHRONOLOGY,

Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W82-04380

EVALUATION OF ELECTROMAGNETIC TERRAIN CONDUCTIVITY MEASUREMENTS FOR DETECTION AND MAPPING OF SALT-WATER INTERFACES IN COASTAL AQUIFERS,

University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5A.
W82-04412

A NEW METHOD FOR SAMPLING SNOW MELT AND RAINFALL IN FORESTS,

Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, and W. B. Fowler.
Water Resources Bulletin, Vol 16, No 5, p 938-940, October, 1980. 2 Fig, 7 Ref.

Descriptors: *Snowmelt, *Measuring instruments, Lysimeter, Rainfall, Precipitation, Snow, Forest soils, Forest watersheds, Remote sensing, *Automation.

A technique is described for automatically recording the rate of snow melt at remote sites. The method can also be used for estimating liquid precipitation at the soil surface. The advantages of the method include the fact that water input to the forest floor is sampled directly and corrections for interception are not required; that windeffects on moisture deposition are completely avoided; that the system operates unattended for long periods of time; that the system is versatile in that the number and size of catch pans can be changed according to expected point to point variability in melt rates, and the size of the buckets can be changed; and the system can be adapted to a telemetering system for data transfer. (Baker-FRC)
W82-04435

THE USE OF LANDSAT IMAGERY IN GROUND WATER EXPLORATION,

Arizona Univ., Tucson. Dept. of Mining and Geological Engineering.
K. E. Foster, R. A. Schowengerdt, and C. E. Glass.
Water Resources Bulleting, Vol 16, No 5, p 934-937, October, 1980. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Groundwater, *Remote sensing, *Landsat, Satellite technology, Water resources development, Water supply development, Water supply, *Arizona, Mapping, *Geohydrology.

A study was undertaken in 1978 to develop methods of exploring for water supplies based upon faulting detectable in satellite imagery. Northeastern Arizona was the site of the study. Control sites near Flagstaff and St. Johns were selected for more detailed investigation. The study was conducted in three phases. During Phase I lineaments ithin the entire study area were mapped using standard Landsat 1:250,000 scale, false color composites. Phase II, conducted simultaneously with Phase I, consisted of an inventory within the two study sites of well location, depth, land-surface altitude, yield, drawdown, specific capacity, and transmissivity. Four hydrologic parameters were chosen to correlate with lineament data: specific capacity, transmissivity, water temperature, and specific conductance. During Phase III a methodology was developed to correlate mapped lineaments with the hydrologic data. A well centered grid model was used in which the cumulative length of lineaments within a specified radial distance from each well was correlated with the four hydrologic parameters by use of linear regression. The correlations developed between lineament density and water data for the Flagstaff and Springerville well fields support the hypothesis that a relationship exists between regional geologic structure and well production. The study indicates that if there is a relationship between Landsat mapped lineaments and smaller fracturing in a given area, this two stage procedure can provide an efficient approach to groundwater exploration over large areas. (Baker-FRC)
W82-04436

SOIL CONSERVATION SERVICE RUNOFF CURVE NUMBER ESTIMATES FROM LANDSAT DATA,

Science and Education Administration, Athens, GA.
R. B. Slack, and R. Welch.
Water Resources Bulletin, Vol 16, No 5, p 887-893, October, 1980. 7 Fig, 5 Tab, 12 Ref.

Descriptors: *Remote sensing, *Runoff forecasting, Hydrology, *Watersheds, *Mapping, Topographic mapping, *Landsat, Computers, Erosion, Soil conservation.

The possibility of deriving Soil Conservation Service (SCS) curve numbers for large watersheds from Landsat digital data is discussed. A curve number is a quantitative descriptor of the land cover/soil complex and is commonly assigned based on information gained from field surveys and interpretations of aerial photographs. The current study took place over the Little River watershed near Tifton, Georgia, an area of about 125 square miles. Landsat data was used to generate a classification map of this area with four hydrologically important classes: agricultural vegetation, forest, wetland, and bare ground. Missing soil data was interpolated from the vegetation patterns of the classification map. About half of the needed data was available from the Landsat experiment. A modification of the SCS curve table number was developed and used to assign each pixel to a category. The average curve number for each of six subwatersheds and for the entire watershed was then computed and compared with SCS values for the same areas. Agreement was to within two curve number units. The multitemporal aspect of Landsat permits the selection of image data at periods of the year when land cover and runoff considerations are critical to hydrologic studies. The digital format of Landsat data is compatible with the input requirements of hydrologic models. It appears feasible to combine in a data base the CN's for pixel or grid cell sized units with information on soils, precipitation, slope, aspect, vegetation, and land use. Such an approach would permit refinement of hydrologic models. (Baker-FRC)
W82-04438

RIDGE REGRESSION TECHNIQUES APPLIED TO LANDSAT INVESTIGATION OF WATER QUALITY IN LAKE OKEECHOBEE,

Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2H.
W82-04440

TESTS OF FRAZIL COLLECTOR LINES TO ASSIST ICE COVER FORMATION,

Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W82-04460

ANALYSIS AND PREDICTION OF WATER MOVEMENTS AND WATER QUALITY IN A SHALLOW RIVER IMPOUNDMENT. APPLICATION TO MISSISSIPPI RIVER POOL NO 2,

A. C. Demetracopoulos.
PhD Thesis, June, 1981. 280 p, 70 Fig, 7 Tab, 190 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-25950.

Descriptors: *Water quality, *Flow system, *Hydrologic aspects, *Model studies, Dissolved oxygen, Water circulation, Ponds, Mass transfer, *Impoundments, River systems, *Mississippi River, Water movement, Temporal variation, Spatial variation, Flow analysis.

The physical processes governing water circulation and hydrologic mass transport, as well as some of the biochemical processes determining the oxygen characteristics of shallow river impoundments are studied. Flow analysis is performed for an interconnected system of channels and for quasi-steady state conditions. The bulk flow is examined and interest is focused on the dynamic behavior of the flow. The response time of the aquatic system to changing wind conditions is examined in a simplified unsteady flow analysis. The study is extended to the water quality of shallow run-of-the-river impoundments. The main quality parameters are dissolved oxygen and algal biomass. The formulation and incorporation of the source and sink terms are addressed in the study. The validity of the combined hydrodynamic/transport/water quality model is checked against field measurements obtained in Pool 2 of the Mississippi River. The results are reasonable and show the significance of several interacting processes on dissolved materials and in particular dissolved oxygen very clearly. The model predicts concentrations of a dissolved conservative tracer or material, of dissolved oxygen, chlorophyll-a and water temperature. It is particularly suitable for low flow summer conditions when wind effects become significant or dominant and water quality exhibits strong temporal and spatial variations. (Sinha-OEIS)
W82-04482

WATER QUALITY MONITORING SYSTEM IN NIEDERSACHSEN - APPLICATION OF AUTOMATIC STATIONS FOR CONTROL AND MONITORING OF WATER QUALITY,

Niedersachsisches Wasseruntersuchungsamt, Hildesheim (Germany, F.R.).
V. Plate.
Water Science and Technology, Vol 13, No 11/12, p 671-676, 1981. 1 Fig, 1 Ref.

Descriptors: *Water quality, *Monitoring, Flood protection, *Automation, *Data transmission, Data acquisition, *Germany, Lower Saxony, Networks, Costs, Water level, Water resources management.

A network of 36 automatic monitoring stations is being developed in Lower Saxony in accordance with the reorganization of the water quality surveillance system now being undertaken. This network will be connected with a surveillance center in Hildesheim. The monitoring system will offer continuous observation of the water quality, allow for early recognition and announcement of deterioration or dangerous situations, and provide basic documentation for the purposes of studying water resources policies and management. The system will be completed by 1985. Principles, tasks and aims of the surveillance system as well as technical equipment of the monitoring stations, methods of data acquisition and transmission and the organization of the surveillance center in Hildesheim are described. Some timing and cost information is presented. About 30 of the most important water level gauge stations will be equipped with instrumentation appropriate for digital acquisition of water level measurement values and remote data transmission, especially for the purpose of flood protection. (Baker-FRC)
W82-04575

MANUAL GROUNDWATER SAMPLING DEVICE (VORRICHTUNG ZUR MANUELLEN WASSERPROBENENTNAHME AUS GRUNDWASSERMESSSTELLEN),

Forschungszentrum Wassertechnik (German,D.R.).
V. Peukert.
Wasserwirtschaft-Wassertechnik, Vol 31, No 10, p 336, 1981, 1 Fig. (No English summary).

Descriptors: *Groundwater, *Sampling, *Equipment, Automation, *Water quality, Water sampling, Dissolved oxygen, Germany.

The standard technique for groundwater quality analysis in the German Deocratic Republic requires that the collecting tube be flushed before the sample is collected, a procedure which was difficult to accomplish with existing sampling devices. A new device was developed which permits a representative groundwater sample to be collected, based on a vacuum principle. This principle requires a difference of less than 9 m in height between the groundwater level and the sampler. A converted automatic air pump creates a vacuum, maintained by means of a check valve, in the sampling line. Water is drawn up through the collecting tube. Once the collection vessel is filled, ambient pressure is restored by opening a three-way stopcock, and the water collected is either placed in the sampling bottle or discarded. A water volume at least equal to the volume of tubing between the water level and the filter area is pumped out and discarded. Then the sample is drawn off from just above the filter. Introduction of oxygen to the sample is prevented by keeping the system closed and filling the reservoir completely during sampling. The desired sample water volume is carefully pipetted from the reservoir into a sample bottle. (Carroll-FRC)
W82-04582

UTILIZATION OF DATA FROM AUTOMATIC WATER QUALITY MONITORING STATIONS IN FINLAND,

National Board of Waters, Helsinki (Finland). Water Research Inst.
T. Kohonen.
Water Science and Technology, Vol 13, No 11/12, p 631-637, 1981. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Water quality, *Monitoring, *Automation, Computers, Data acquisition, Water management, *Finland, Networks, Turbidity, Dissolved oxygen, Rivers, Hydrogen ion concentration, Chloride, Kymyoki River, Kokemaenjokia, *Data transmission.

The Kymijoki River and Kokemaenjoki River monitoring network comprises five land-based river stations and a central commputing unit consisting of a PDP 11/35 computer located at the Helsinki office of the National Board of Waters. The system began service in September of 1977. Data transfer from the station occurs twice daily via leased public telephone lines and is initiated by the computer. Data can also be requested manually from a control terminal if the need arises. Every monitoring station measures temperature, pH, conductivity, dissolved oxygen, turbidity, and chloride level at five stations and redox potential at two of the stations. In seven stations the measuring cham-

ber also houses the built-in ultrasonic transducers for cleaning the sensors hourly, together with the drive motors needed for daily calibration and cleaning cycles. The quantity of the data gathered allows the use of statistical procedures for estimating the optimal sampling frequencies. (Baker-FRC)
W82-04585

RECENT DEVELOPMENTS IN AND APPLICATION OF AUTOMATION AND MONITORING IN WATER MANGEMENT,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden-, und Lufthygiene.
R. Leschber.
Water Science and Technology, Vol 13, No 11/12, p 715-719, 1981.

Descriptors: *Water management, *Reviews, *Monitoring, Automation, Water supply, *Water quality, Water quality control.

This communication briefly reviews the main subjects presented at the Congress and Exhibition 'Wasser Berlin '81' and the essential new ideas and results of research. The range of subjects covered at the conference included general reports on the present and future role of automation and related fields in water management as well as papers which dealt with telemetry and micro-processors. Monitoring of surface waters and other drinking water sources made up another group of subjects. The bulk of papers pertained to the subjects of water treatment and supply. The two most advanced systems operating in Switzerland were described, one of which operates without any technical staff and the other where staff can rely on the most conemporary aids of data processing. Data flow, data storage, and data retrieval in the form of periodic reports were described. In the fields of water treatment the major subjects were dosage of chemicals and monitoring of the success of the individual stages of treatment. Automation of sequences of procedures or complex methods of treatment was considered. The great advantage of using a computer with reserve capacity for specific raw water treatment was considered. Water supply was covered in papers dealing with general problems of the operation of municipal networks and a number of specific subjects. The various applications of servosystems for the operation of pumps and valves were described. (Baker-FRC)
W82-04593

STORM SEWER FLOW COMPUTATIONS,

Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
K. Sivaloganathan.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 513-522, June, 1981. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Sewer systems, Lateral sewers, *Pipe flow, *Storm sewers, Hydraulics, *Flow characteristics, Hydrographs.

A new technique for dealing with storm sewer flows involving concentrated lateral inflows at junctions is described. Using St. Venant equations, each concentrated lateral inflow is replaced by a triangularly distributed lateral inflow over the adjoining few distance steps. The diffusing and the Lax- Wendroff methods were most suitable for solving the St. Venant equations with this technique. The implicit method of Strelkoff may be used if the equivalent triangular distribution of each concentrated lateral inflow is not done over too small a distance. Methods unsuitable for this technique were the rectangular grid broken characteristic scheme and the leap frog method. Depth hydrographs prepared from experimental and computed data were in good agreement. (Cassar-FRC)
W82-04640

THE DEVELOPMENT OF A VIABLE METHOD OF STREAM FLOW MEASUREMENT USING THE INTEGRATING FLOAT TECHNIQUE,

Lancaster Univ., Bailrigg (England).
D. M. Sargent.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 1-15, March, 1981. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Flow measurement, *Streamflow, *Bubbles, Integrating float method, Photography.

The integrating float method for measuring streamflow was modified by using air bubbles as rising floats. This method, first suggested a century ago, has never been practical because the buoyant floats in the stream were difficult to locate. A length of pipe was installed in a straight line across the river bottom. Air was forced through nozzles placed at intervals along the pipe to produce a line of rising air bubbles. Photographic equipment was set up on the bank to record the position of the air bubble line. Streamflow values obtained using the integrating float method in a medium-sized river were within -6 to +10% (average 1.3%) of streamflows measured by a weir. Errors were greatest at low and high flow. (Cassar-FRC)
W82-04643

REMOTE SENSING OF ATMOSPHERIC WATER CONTENT FROM SATELLITE MICROWAVE RADIOMETER (SAMIR) ON BHASKARA,

Indian Space Research Organization, Ahmedabad. Space Applications Centre.
P. C. Pandley, B. S. Gohil, and A. K. Sharma.
Mausam, Vol 32, No 1, p 17-22, January, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Meteorological data collection, Water vapor, Microwaves, Radiosondes, *India, Bay of Bengal, Arabian Sea, Satellite technology, Radiometry, *Bhaskara satellite.

Integrated abundances of water vapor and liquid water over oceans were determined from data obtained from the Indian satellite Bhaskara during its June 27, 28, and 29, 1979, orbits. Aboard the satellite is a microwave radiometer (SAMIR) with 19.35 GHz and 22.235 GHz channels. Values of water vapor and liquid water content, respectively, were: June 27 over the Arabian Sea, 4.0 g per sq cm and 0.5-0.7 kg per sq m; June 28 over the Bay of Bengal, 4.4-6.0 g per sq cm and 0.8-2.1 kg per sq m; and June 29, a tropical depression over the Bay of Bengal, 3.6-4.7 g per sq cm and 1.7-1.9 kg per sq m. Although no accurate data were available for comparison, the findings were in general agreement with mean monthly precipitable water radiosonde data from coastal stations and from APT pictures. (Cassar-FRC)
W82-04647

COLLAPSIBLE-BAG SUSPENDED-SEDIMENT SAMPLER,

Geological Survey, Lakewood, CO.
H. H. Stevens, Jr., G. A. Lutz, and D. W. Hubbell.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY4, p 608-611, April, 1980. 2 Fig, 5 Ref.

Descriptors: Water sampling, *Suspended sediments, Rivers, Estuaries, Measuring instruments, *Sediment sampler.

The U. S. Federal Interagency Sedimentation Committee has developed special sampling techniques and equipment to help ensure the collection of meaningful samples of the suspended-sediment load in rivers and estuaries. This paper describes a collapsible-bag sampler that is based on somewhat different operating principles than conventional U.S.-series samplers, but which has similar sampling characteristics and is used in the same manner as those samplers. This collapsible bag sampler facilitates the collection of samples from large rivers and estuaries because it permits the continuous collection of representative depth-integrated samples of water-sediment mixture in all water depths and velocity distributions and the convenient and quick collection of large volume samples. In addition, the maximum depth capacity of the sampler can be readily changed by altering the internal diameter of the nozzle or the volume of the sample bag. The nozzle of the container can easily be fitted with an off-on valve to permit the sampler to be used as a point-integrating sampler. The sampler is easy to use and to maintain, even in salt water. Various potential improvements in the sampler are also identified. (Carroll-FRC)
W82-04745

7C. Evaluation, Processing and Publication

WATERSHEDS AS THE BASIC ECOSYSTEMS: THIS CONCEPTUAL FRAMEWORK PROVIDES A BASIS FOR A NATURAL CLASSIFICATION SYSTEM,

Corvallis Environmental Research Lab., OR.
F. B. Lotspeich.
Water Resources Bulletin, Vol 16, No 4, p 581-586, August, 1980. 1 Fig, 27 Ref.

Descriptors: *Watersheds, *Ecosystems, *Stream classification, Classification, Climate, Geology, Soil, Vegetation.

A classification scheme for watersheds, based on the ecosystem concept, is outlined. Climate and geology are selected as the state factors. These two factors interact to produce a land form and in turn an ecosystem. Climate is considered the master factor, having overwhelming influence on all ecosystem features. Possible classes of climate can be based on size, the concept of equivalent latitude, or the isophane concept (lines of equal biological activity as a function of temperature, which is in turn a function of latitude and elevation). Geology classifications may consider bedrock. Transactional factors are soil and vegetation, which interact with climatic and geologic factors to form a variety of tesseras. The stream, at the bottom of the scale, is passive and does not interact with the higher factors in the ecosystem. The stream is a result of interactions of all the forces on the two higher levels. (Cassar-FRC)
W82-04253

DECISIONS UNDER VIOLATION OF REGRESSION NORMALITY,

Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
E. Castano, L. Duckstein, and J. Weber.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR2, p 549-561, October, 1981. 1 Tab, 5 Fig, 35 Ref.

Descriptors: *Mathematical models, *Statistical analysis, *Management planning, Decision making, *Regression analysis, *Hydrology, Prediction, Engineering, Monte Carlo methods, Simulation, Distribution.

The accuracy of hydrologic predictions based on regression analysis under the incorrect assumption of normality is investigated. Monte carlo simulation is used to investigate the small sample behavior of the estimated regression coefficients, estimated variances, and predicted values of the dependent variable when the errors are not normally distributed. The distributions simulated are lognormal, Pearson, and LogPearson with varying degrees of skew. The estimated values of the regression coefficients are not appreciably affected by skew of the error distribution. Decisions based on both the mean and variance are less robust to nonnormality than decisions based only on the mean. For example, whenever hydrologic decisions are based on a percentile, as in T-year floods, or on a confidence interval statement in regression analysis, as in flood plain zoning, standard deviations are involved, so that results may be sensitive to violation of the normality assumption. (Titus-FRC)
W82-04264

VERTICAL ROUND BUOYANT JET IN SHALLOW WATER,

Delaware Univ., Newark. Dept. of Civil Engineering.
J. H. W. Lee, and G. H. Jirka.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107,

No HY12, p 1651-1675, December, 1981. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Cooling water, *Mixing, *Thermal pollution, Dilution, Powerplants, Tracers, Dyes, Shallow water, Jets, Water pollution control, Buoyancy, Fate of pollutants, Hydraulics, Flow characteristics, Turbulent flow.

The stability and mixing characteristics of a round turbulent buoyant jet discharging vertically into a stagnant water body of large horizontal extent were investigated analytically and experimentally to determine the aquatic impact of thermal effluents. In the case of a stable discharge configuration, four flow regimes can be distinguishd: (1) initial buoyant jet region, where the discharge mixes with the ambient fluid by turbulent entrainment, (2) surface impingement region, where the buoyant mixed flow is turned into a radially outward moving supercritical flow, (3) radial internal hydraulic jump region, transferring the flow into a subcritical region downstream with loss of energy, and (4) stratified counterflow region, with negligible entrainment across the surface. These 4 regions are analyzed separately and the solutions combined to predict the stability criteria. A laboratory half jet and dye were used to observe flows under different conditions. Jet diameters varied from 1.0 to 0.25 inches; discharge velocities, 0.82 to 30.0 ft per sec; discharge excess temperatures, 21.4 to 34.8 F; initial ambient temperatures, 70.2 to 79.1 F; discharge flows, 0.31 to 3.20 gal per min; Froude numbers, 8.0 to 583.4; and Reynolds numbers, 6800 to 62,500. Stability or nonstability and near field dilution were noted. This study indicates that shallow site conditions limit the dilution possible with single port discharges. Alternative designs include moving the outfall to greater depths or using a multiport diffuser. (Caesar-FRC)
W82-04365

MAPS SHOWING GROUND-WATER CONDITIONS IN THE BILL WILLIAMS AREA, MOHAVE, YAVAPAI, AND YUMA COUNTIES, ARIZONA--1980,

Geological Survey, Tucson, AZ. Water Resources Div.
H. W. Sanger, and G. R. Littin.
Geological Survey Open-File Report 82-87 (WRI), November, 1981. 2 Sheets, 16 Ref.

Descriptors: *Maps, *Groundwater, *Aquifer characteristics, *Water quality, Water level, Wells, Springs, Specific conductivity, Fluoride, *Arizona, Mohave County, Yavapai County, Yuma County, Bill Williams River.

The Bill Williams area includes about 3,200 square miles in west-central Arizona. Most water used is from ground water, although a small amount of surface water also may be diverted. About 18,000 acre-feet of ground water was withdrawn in 1979. The main water-bearing unit is the basin-fill deposits, which consist of boulder to pebble conglomerate and interbedded coarse- to fine-grained sandstone, siltstone, mudstone, and in places rhyolitic and basaltic tuff. Depth to water, altitude of the water level, well depth, and specific conductance and fluoride concentration are shown on the 1:125,000-scale map of the area. (USGS)
W82-04488

GROUND-WATER LEVELS IN ARKANSAS, SPRING 1981,

Geological Survey, Little Rock, AR. Water Resources Div.
J. Edds.
Geological Survey Open-File Report 81-1114, September, 1981. 52 p, 5 Fig, 16 Tab, 18 Ref.

Descriptors: *Groundwater, *Groundwater level, *Hydrologic data, *Aquifers, Potentiometric level, Observation wells, Well hydrographs, Water measurement, Groundwater availability, *Arkansas, Sparta Sand.

This report contains about 600 ground-water level measurements made in observation wells in Arkansas in the spring of 1981. In addition, the report contains potentiometric surface maps and well hydrographs relating to the alluvial aquifer and the Sparta Sand, the most important aquifers with respect to groundwater availability and use in Arkansas. (USGS)
W82-04489

FLOOD AND RELATED DEBRIS FLOW HAZARDS MAP, LAS VEGAS SE QUADRANGLE,

Geological Survey, Carson City, NV. Water Resources Div.
T. Katzer.
Available from Nevada Bureau of Mines and Geology, Univ. of Nevada, Reno, Nevada 89557, Price: $2.50. Nevada Bureau of Mines and Geology Map 3A1, 1981. 1 Sheet.

Descriptors: *Maps, *Floods, *Detritus, *Hazards, Flood peak, Flood plains, Flood flow, Erosion, Deposition, *Nevada, *Las Vegas SE quadrangle.

This map shows flood and debris hazards on the Las Vegas SE quadrangle, Nevada. Estimates of the 100-year flood peak were made and the corresponding flood plains were outlined on the map for the principal drainages in the area. Degrees of hazard were assigned to the entire quadrangle on the basis of floodflows and potential debris movement. (USGS)
W82-04490

THICKNESS, PERCENT SAND, AND CONFIGURATION OF SHALLOW HYDROGEOLOGIC UNITS IN THE POWDER RIVER BASIN, MONTANA AND WYOMING,

Geological Survey, Billings, MT. Water Resources Div.
B. D. Lewis, and W. R. Hotchkiss.
Available from Western Distr. Branch USGS, Box 25286 Denver, CO 80225, Price: $12.50. Geological Survey Miscellaneous Investigations Map I-1317, 1981. 6 Sheets, 23 Ref.

Descriptors: *Maps, *Geohydrology, *Geohydrologic units, *Aquifer characteristics, Hydrologic data, Geology, Geological surveys, *Montana, *Wyoming, Powder River basin.

The shallow hydrogeologic system is composed of five distinct units, bounded at its base by the regionally widespread and relatively impermeable Bearpaw Shale. The units, which were in age from Late Cretaceous to Holocene, are in ascending order the Fox Hills-lower Hell Creek aquifer, upper Hell Creek confining layer, Tullock aquifer, Lebo confining layer, and Tongue River-Wasatch aquifer. Shallow hydrogeologic units mapped in the Powder River basin of Montana and Wyoming are of marine and continental origin. The Fox Hills Sandstone is a marine deposit with all overlying units representing continental conditions. Thick and extensive coal deposits are present in the Tongue River Member of the Fort Union Formation and the Wasatch Formation. Geologic and hydrogeologic data were used to separate the various units into a system of alternating aquifers anf confining layers. Physical characteristics used to describe the units were thickness, percent sand, and configuration of the base of each hydrogeologic unit. (USGS)
W82-04501

DISSOLVED-SOLIDS CONCENTRATIONS OF GROUND WATER IN THE SACRAMENTO VALLEY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman.
Available from Western Distr. Branch USGS, Box 25286 Denver, CO 80225, Price: $3.00. Geological Survey Hydrologic Investigations Atlas HA-645, 1982. 1 Sheet, 1 Tab, 14 Ref.

Descriptors: *Maps, *Dissolved solids, *Groundwater, *Water quality, Wells, Irrigation, Domestic water, Water analyses, Chemical analysis, Geohydrology, *California, *Sacramento Valley.

The general quality of the ground water in the Sacramento Valley, Calif., in terms of dissolved-solids concentration is considered good for irrigation, domestic, and most other uses. This map shows the distribution of dissolved-solids concentrations and is based on about 1,330 chemical analyses collected from about 900 wells between 1974 and 1978. On the west side of the valley some of the smaller streams contribute water of higher dissolved-solids concentrations to the ground water. The sources of these waters are thought to be the upper Cretaceous Chico Formation or marine deposits of Early Cretaceous age that are exposed in the Coast Ranges. (USGS)
W82-04502

WATER RESOURCES DATA FOR ARKANSAS, WATER YEAR 1980.

Geological Survey, Little Rock, AR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190380, Price codes: A25 in paper copy, A01 in microfiche. Geological Survey Water-Data Report AR-80-1, 1981. 585 p, 5 Fig, 3 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Arkansas.

Water resources data for the 1980 water year for Arkansas consist of records of stage, discharge, and water quality of streams; and stage, contents, and water quality of lakes and reservoirs. This report contains discharge records for 60 gaging stations; stage and contents for four lakes and reservoirs; water quality for 152 stations, 69 partial-record flow stations, and eight lakes; and water levels for 79 observation wells. Also included are 116 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Arkansas. (USGS)
W82-04503

HYDROLOGIC RECONNAISSANCE OF THE BELUGA, PETERS CREEK, AND HEALY COAL AREAS, ALASKA,

Geological Survey, Anchorage, AK. Water Resources Div.
D. R. Scully, A. P. Krumhardt, and D. R. Kernodle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-168402, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-56, 1981. 71 p, 37 Fig, 17 Tab, 31 Ref.

Descriptors: *Surface water, *Water quality, *Hydrologic data, *Coal mines, Streams, Flow characteristics, *Alaska, Beluga coal area, Peters Creek coal area, Healy coal area.

The Beluga, Peters Creek, and Healy coal areas in Alaska were studied during 1975-1978, with major emphasis on surface-water hydrology and water quality. In the Beluga coal area, mean annual discharge is estimated to range from 2.2 to 3.4 cubic feet per second per square mile of drainage area. The 7-day low flow with a 10-year recurrence interval is estimated to be 0.3 to 0.6 cubic feet per second per square mile. The surface waters are calcium bicarbonate type; have low concentrations of nutrients; and, at times, may contain dissolved iron and manganese in concentrations in excess of U.S. Environmental Protection Agency recommended limits. The pooled diversity index of the benthic invertebrate community ranges from 2.93 to 4.06. No ground-water wells have been drilled in the potential mining areas. Water quality of streams in the Peters Creek coal area is similar to that of the streams in the Beluga coal area. No attempt is made to define streamflow characteristics in the Peters Creek coal area due to poor correlations with nearby gaging stations. In the Healy coal area, streamflow characteristics are dissimilar between the two major basins studied. Lig-

nite Creek is estimated to have less yield than Healy Creek. Studied tributaries of Healy and Lignite Creeks contain waters with a dissolved solids range of 111 to 636 milligrams per liter and have calcium and bicarbonate or magnesium and bicarbonate as principal ions. Iron and manganese concentrations are high at some times of the year. The concentrations of sodium and chloride increase significantly in the lower reaches of Lignite Creek. (USGS)
W82-04504

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1981,

Geological Survey, Orlando, FL. Water Resources Div.
A. S. Navoy.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $2.50, Microfiche $0.50. Geological Survey Open-File Report 81-1198, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Pumping, Geohydrology, *Florida, Sumter County.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Fla., for May 1981. The Floridan aquifer is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the low water-level period. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 90 feet in the southeast part of the county to less than 35 feet northwest of Lake Panasoffkee in the west central area. (USGS)
W82-04507

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN KANSAS–FISCAL YEAR 1979 AND 1980,

Geological Survey, Lawrence, KS. Water Resources Div.
H. E. McGovern, and L. J. Combs.
Geological Survey Open-File Report 81-348 (WRI), March, 1981. 107 p, 9 Fig, 5 Tab.

Descriptors: *Available water, *Water quality, *Groundwater, *Surface water, Water resources development, Water management, Aquifers, Selective withdrawal, Irrigation, Water use, *Water supply, Streamflow, Runoff, Sediment transport, Flood frequency, Urbanization, Data collections, Publications, *Kansas, *Projects.

Activities of the U.S. Geological Survey in Kansas include the systematic collection and analysis of data to describe the framework of hydrologic systems, assess the water resources, define existing or potential problems in the quantity or quality of water, and provide information for optimum development and management of resources. Streamflow studies are made to determine availability of supplies and relations to rainfall runoff, urbanization, flood frequencies, and sediment-transport. Groundwater studies are made to determine the quantity of supplies available in aquifer systems, the effects of natural or artificial contamination, and the effects of withdrawals by irrigation, industrial, and municipal supplies. Water-quality studies are made to define physical, chemical, and biological characteristics in streams and principal aquifers, and to evaluate the chemical changes due to urbanization and surface mining. (USGS)
W82-04510

PROBABLE HIGH GROUND-WATER LEVELS ON CAPE COD, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
M. H. Frimpter.
Geological Survey Open-File Report 80-1008 (WRI), 1980. 20 p, 5 Fig, 4 Plates, 10 Tab, 7 Ref.

Descriptors: *Groundwater, *Water table, *Observation wells, *Water level fluctuations, Sites, Maps, Estimating, Massachusetts, *Cape Cod.

Water-level records from 146 short-term (1 year) observation wells and 13 long-term (16-28 years) observation wells were used to estimate the probable high ground-water level that could occur at any site on Cape Cod. The estimation was based on correlation of a single water-level measurement from a test site with water-level records of the nine index wells. Maps showing areas of Cape Cod represented by the nine index wells and showing five ranges of water-level fluctuation are used in conjunction with tables of water-level adjustments to make the estimates. (USGS)
W82-04511

PRELIMINARY DATA FROM ARBUCKLE TEST WELLS, MIAMI, DOUGLAS, SALINE, AND LABETTE COUNTIES, KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
T. Gogel.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $20.00, Microfiche $3.50. Geological Survey Open-File Report 81-1112, 1981. 155 p, 54 Fig, 16 Tab, 3 Ref, 2 Append.

Descriptors: *Hydrologic data, *Aquifer characteristics, *Structural geology, *Cores, Test wells, Hydraulics, Water quality, Water analysis, Hydraulic conductivity, Logging(Recording), Geochemistry, *Kansas, Arbuckle Group, Miami County, Douglas County, Saline County, Labette County.

Preliminary data are presented for test wells in Kansas that were completed in Cambrian and Ordovician rocks of the Arbuckle Group in late 1979 and early 1980. Included in the report are hole history, electrical logs, geology (sample descriptions and cores), hydrologic testing, and geochemistry. These wells were drilled to determine the regional hydrology of the Arbuckle Group and to investigate the hydraulic characteristics of the formation at site-specific areas. The test wells were drilled in Miami, Douglas, Saline, and Labette Counties, Kansas. Depths of the wells ranged from 1,816 feet in Labette County to 3,665 feet in Saline County. Results of core analyses from rocks in the Arbuckle Group are presented for vertical and horizontal permeability to air, porosity, fluid saturation, acoustic velocity, resistivity indices, and formation factor. Formation data from drill-stem tests are presented for use in calculating transmissivity, hydraulic conductivity, and hydraulic head. Analyses of water samples from the test wells are presented to indicate water quality in the aquifers. (USGS)
W82-04512

WATER-QUALITY DATA FOR SELECTED STATIONS IN THE EAST EVERGLADES, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $10.75, Microfiche $3.50. Geological Survey Open-File Report 81-821, 1981. 77 p, 6 Fig, 37 Tab, 1 Ref.

Descriptors: *Water quality, *Data collections, *Surface water, *Groundwater, Canals, Marshes, Bottom sampling, Water analysis, Nutrients, Trace elements, Algae, *Florida, Dade County, *Everglades.

The results of water-quality samples collected from April 1978 through April 1980 from three canal stations, four marsh stations, and two ground-water stations within the East Everglades, Dade County, Florida, are tabulated in 37 tables. The major categories of parameters analyzed are field measurements, physical characteristics, macronutrients (carbon, nitrogen, and phosphorus), major ions, trace elements, and algae. Chemical data for bulk-precipitation stations within and adjacent to the East Everglades are also given. The parameters analyzed include macronutrients, major ions, and trace elements. The period of record for these stations is October 1977 through April 1980. Bottom material at the canal and marsh stations was collected twice during the investigation. These data include analyses for macronutrients, trace elements, and chlorinated-hydrocarbon insecticides. (USGS)
W82-04513

WATER-QUALITY DATA FOR THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM, TRENTON TO PENNSVILLE, NEW JERSEY, 1980,

Geological Survey, Trenton, NJ. Water Resources Div.
T. V. Fusillo, and L. M. Voronin.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $9.00, Microfiche $4.50. Geological Survey Open-File Report 81-814, May, 1981. 38 p, 1 Fig, 2 Plates, 6 Tab, 19 Ref.

Descriptors: *Water quality, *Groundwater, *Data collections, Unconsolidated aquifers, Aquifer characteristics, Sampling, Chemical analysis, Wells, Well data, Inorganic compounds, Organic compounds, *Water analysis, Coastal plains, *New Jersey, Potomac-Raritan-Magothy aquifer system, Pennsylvania.

Samples for chemical analysis were collected from June to December 1980 from 262 wells tapping the Potomac-Raritan-Magothy aquifer system. The samples were analyzed for common ions, dissolved metals, nutrients, dissolved organic carbon, volatile organic compounds, pH, temperature, and specific conductance. This report contains the results of the analyses, well construction data for the wells sampled, and simple statistical summaries for each parameter. Most parameters showed wide variations in concentration. Concentrations of dissolved organic carbon ranged from 0 to 106 mg/L (milligrams per liter), with a median of 1.7 mg/L. Chloride concentration ranged from 0.8 to 810 mg/L, with a median of 15 mg/L. Iron concentration ranged from 3 micrograms per liter to 79,000 micrograms per liter, with a median of 1,400 micrograms per liter. Detectable concentrations of volatile organic compounds were found in 46 wells, approximately 19 percent of the 246 wells sampled for such compounds. Trichloroethylene and benzene, the most common compounds, were detected in 24 and 18 wells, respectively. The maximum concentrations of several compounds detected include: benzene, 1,960 micrograms per liter; 1,1-dichloroethylene, 670 micrograms per liter; trichloroethylene, 472 micrograms per liter; and tetrachloroethylene, 335 micrograms per liter. (USGS)
W82-04515

QUALITY OF SURFACE WATER IN THE COAL-MINING AREAS OF WESTERN MARYLAND AND ADJACENT AREAS OF PENNSYLVANIA AND WEST VIRGINIA FROM APRIL 1979 TO JUNE 1980,

Geological Survey, Towson, MD. Water Resources Div.
W. W. Staubitz.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $13.75, Microfiche $3.50. Geological Survey Open-File Report 81-812, August, 1981. 103 p, 1 Fig, 6 Tab, 7 Ref.

Descriptors: *Water quality, *Strip mines, *Streamflow, *Data collections, Monitoring, Networks, Surface water, Sediment discharge, Coal mining, Water analysis, Benthic fauna, Base flow, *Eastern Coal Province, Area 5, Area 6, North Branch Potomac River, Youghiogheny River, Casselman River, Maryland, Pennsylvania, West Virginia.

The U.S. Geological Survey is monitoring the water quality of streams within the Eastern Coal Province. This report contains streamflow, water-quality, and biological data collected in the North Branch Potomac River basin and in the Maryland portion of the Youghiogheny and Casselman River basins. Data collected from 64 streams from April 1979 to June 1980 are presented in tables. Other sources of hydrologic information within the study area are also described in the report. (USGS)
W82-04516

RESULTS OF HYDROLOGIC TESTS AND WATER-CHEMISTRY ANALYSES, WELLS H-4A, H-4B, AND H-4C AT THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-04517

WATER TYPE AND SUITABILITY OF OKLAHOMA SURFACE WATERS FOR PUBLIC SUPPLY AND IRRIGATION. PART 1: ARKANSAS RIVER MAINSTEM AND VERDIGRIS, NEOSHO, AND ILLINOIS RIVER BASINS THROUGH 1978,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. D. Stoner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-142902, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-33, May, 1981. 297 p, 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Water supply, *Irrigation, *Surface water, *Data collections, *Water quality, Water analysis, Trace elements, Hardness, Water use, *Oklahoma, Arkansas River, Verdigris River basin, Neosho River basin, Illinois River basin.

Water-quality data in the Arkansas River mainstem and the Verdigris, Neosho, and Illinois River basins within Oklahoma were examined for water type and suitability for public water supply and irrigation use. The classification of water type was based on the relation of the major ions: calcium, magnesium, sodium, bicarbonate/carbonate, sulfate, and chloride to each other within the range of measured specific conductance. The judgement of suitability for public supply use was based on the concentration levels and distributions of selected constituents. The Wilcox irrigation classification scheme was used to relate sodium concentrations and the salinity distribution to the use of the water for irrigation. The possibility of phytotoxic effects from boron was discussed where data were available. (USGS)
W82-04518

WATER RESOURCES DATA FOR PENNSYLVANIA, WATER YEAR 1980--VOLUME 1. DELAWARE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190372, Price codes: A16 in paper copy, A01 in microfiche. Geological Survey Water-Data Report PA-80-1, 1981. 341 p, 8 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Pennsylvania, *Delaware River basin.

Water resources data for the 1980 water year for Pennsylvania consist of records of discharge and water quality of streams, elevation and contents of lakes and reservoirs, and water levels of groundwater wells. This volume contains records for water discharge at 73 gaging stations, elevation and contents at 11 lakes and reservoirs, water quality at 39 gaging stations, and water levels at 16 observation wells. Also included are data for 43 crest-stage 28 low-flow, and 43 water-quality partial-record stations. Locations of these sites are shown on figures 4 through 7. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volumes 2 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania. (USGS)
W82-04521

WATER RESOURCES DATA FOR WEST VIRGINIA, WATER YEAR 1980. APPENDIX - COAL AREAS.
Geological Survey, Charleston, WV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-159674, Price codes: A11 in paper copy, A01 in microfiche. Geological Survey Water-Data Report WV-80-A, October, 1981. 228 p, 9 Fig, 8 Tab.

Descriptors: *Coal, *Hydrologic data, *Surface water, *Water quality, Streamflow, Flow rates, Sediments, Water analysis, Water temperature, Chemical analysis, Coal mines, Data collection, Sites, *West Virginia, Coal areas.

Water resources data for the 1980 water year for coal regions of West Virginia consist of discharge and water-quality records collected during two sampling periods at 369 sites. Also included are sediment data from 26 sites. Data were collected as a part of the statewide Coal Hydrology project. (USGS)
W82-04522

WATER RESOURCES DATA FOR LOUISIANA, WATER YEAR 1981--VOLUME 3. COASTAL LOUISIANA.
Geological Survey, Baton Rouge, LA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-129305, Price codes: A14 in paper copy, A01 in microfiche. Geological Survey Water-Data Report LA-81-3, 1981. 218 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Louisiana, *Coastal Louisiana.

Water resources data for the 1981 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 81 gaging stations (including stage for 76 of these stations); stage only for 37 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 142 surface-water stations (including 35 gaging stations), 27 miscellaneous sites, 10 lakes, and 286 wells; and water levels for 679 observation wells. Also included are data for 250 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W82-04523

8. ENGINEERING WORKS

8A. Structures

RIDING MILL PUMPING STATION,
D. J. Banks, D. F. H. Pain, and W. Banks.
Journal of the Institution of Water Engineers and Scientists, Vol 35, No 6, p 463-482, 1981. 7 Fig, 6 Ref.

Descriptors: *Water conveyance, *Construction, Design criteria, Maintenance, Pumps, *Water supply systems, Kielder Water Scheme, Pumping plants, River Tyne, River Wear, River Trees, *England, Water transfer, Pipelines, Water demand.

The large pumping capacity, intermittent usage, and large size of the Riding Mill pumping station have demanded reconsideration of usual water supply practices. The operating concepts, design development, and plant selection are described for this plant, which is part of the Kielder Water Scheme and is designed for bulk transfer of water from the River Tyne to the Rivers Wear and Trees. Tyne water is relatively unpolluted, with virtually no suspended solids. Therefore it was possible to use single-stage pumping and thus avoid the major costs of low-lift pumps and large settling tanks. Debris and sediment intake problems was reduced by arranging the draw-off to avoid obstruction to river flow and keeping the draw-off sill above river bed level and the intake velocity as low as possible. Fine mesh band screens were placed in a chamber back from the river frontage to protect the pumps and exclude smolts. Trash bars were selected rather than penstock openings. The pumping station was designed for unattended automatic operation. A special pipeline filling pump was installed. (Baker-FRC)
W82-04292

APPROXIMATE SIZING OF RESERVOIRS FOR DETENTION TIME,
Commonwealth Tech, Inc., Lexington, KY.
J. S. Tapp, A. D. Ward, and B. J. Barfield.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 17-23, January, 1982. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Detention times, *Reservoir design, *Sedimentation basins, Design criteria, *Sediment control, Spillways, Hydrographs, Storms, Rainfall, Reservoir storage.

Design of sediment control reservoirs has been facilitated by a new procedure using triangular hydroraphs to give a first approximation of the peak outflow and storage volume necessary to give a desired detention time. Only 1 or 2 trials are necessary. The size of the spillway system and the sediment pond design may be hand calculated for a given detention time. The triangles approximate the inflow-outflow hydrographs. This method was compared with the detailed computer model DEPOSITS. After modifications in the equations, the standard error was an acceptable 0.028 watershed in. The procedure is applicable to reservoirs with principal spillway crests located at the top of the sediment storage pool. (Cassar-FRC)
W82-04315

MICRO HYDROPOWER IN THE USA,
EG and G Idaho, Inc., Idaho Falls.
R. O. Haroldsen, and F. B. Simpson.
International Water Power and Dam Construction, Vol 33, No 11, p 48-50, November, 1981. 1 Fig.

Descriptors: *Hydroelectric plants, *Powerplants, *Economic evaluation, Water resources development, Rural areas, Diesel units, Case studies.

Micro hydropower is not expected to make a major contribution to the nation's energy production. However, developers may gain a measure of independence and security, especially in isolated areas where small diesel units are used. Two plants are described. The 50 kW plant at Bliss, Idaho, produces $1000 per month of power from a $40,000 capital investment. A low head installation (effective head 2 m) at Aumsville, Oregon, produces a maximum 23 kW out of a design 40 kW. Many other problems make this site a poor investment, producing only $100-200 of power monthly. There is a need for reasonable standards to cover connections with the utility power grid and for better information on site assessment, equipment, institutional requirements, and available technology. (Cassar-FRC)
W82-04316

OBTAINING LAYOUT OF WATER DISTRIBUTION SYSTEMS,
Department of the Air Force, Washington, DC.
W. F. Rowell, and J. W. Barnes.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 137-148, January, 1982. 4 Fig, 17 Ref.

Descriptors: *Network design, Pipes, *Water distribution, Water quality control, *Model studies, Water demand, Water conveyance, Water mains, Design criteria, *Water supply systems.

A procedure to help with selecting a water distribution network layout involves two steps. The first step uses a nonlinear programming model to select an economical tree layout for the larger diameter pipe links to provide service under normal demand. The second step uses an integer programming model to choose loop-forming redundant links and corresponding link diameters to provide adequate capacity in case the large diameter primary link system fails. The second level system reduces water stagnation, retards sediment accumulation, facilitates pipe cleaning, and provides alternate paths. The procedure is illustrated using a two-source water distribution system. (Cassar-FRC)
W82-04319

SMALL HYDRO SCHEMES FOR PRIVATE DEVELOPERS,

Hydro Watts Inc., Washington Grove, MD.
S. L. Bierman, and R. A. Klempner.
International Water Power and Dam Construction, Vol 33, No 11, p 35-36, November, 1981. 1 Tab.

Descriptors: *Hydroelectric plants, *Powerplants, *Dams, Hydraulic structures, *Cost analysis, Feasibility studies, Costs.

Incentives for private developers to invest small (less than 5 MW) hydropower schemes include rising fuel prices, governmental financial assistance, and the obligation of utilities to offer to buy output. There are 700 existing U.S. dams which are feasible to develop. Average head is 15 m; average flow, 10 cu m per sec; and average reservoir surface area, 2.4 million sq m. Development costs, which range up to $2000 per kW of installed capacity, are quipment, 33% of total costs; civil works. 40-50%; engineering and interest during construction, 10-15%; and contingency, 10%. Operating costs are variable and may be as high as 6 cents per kWh. (Cassar-FRC)
W82-04327

RURAL POWER SCHEMES IN PAKISTAN,

Peshawar Univ. (Pakistan). Dept. of Electrical Engineering.
M. Abdullah, and A. R. Inversin.
International Water Power and Dam Construction, Vol 33, No 11, p 23-25, November, 1981. 2 Fig.

Descriptors: *Rural areas, *Hydroelectric plants, *Pakistan, *Developing countries, Design criteria, Powerplants, Hydraulic structures, Dams.

In the mountainous remote regions of northern Pakistan there are 22 5-15 kW microhydropower schemes in operation. Costs per installed kilowatt are $250-400. These projects are built by villagers from local materials. No engineering drawings are provided. Technical assistance is given by the Appropriate Technology Development Organization, a government agency. A typical installation has an intake consisting of a low stone weir and unlined headrace. Penstocks, usually 5-15 m long, are made of steel pipe or oil drums. The cross-flow turbine is made locally from strips of steel or pieces of pipe. Generators, presently made in China, will be manufactured locally in the near future, saving about 25% in costs. The electricity is generally used for lighting and to run machines in cottage industries. (Cassar-FRC)
W82-04328

PUMPED OUTLETS FOR DRAINAGE SYSTEMS,

A. T. Corey.
Transactions of the ASAE, Vol 24, No 6, p 1504-1507, November/December, 1981. 1 Fig, 3 Ref.

Descriptors: *Drainage systems, *Sumps, *Storage capacity, Design criteria, *Pumps, *Tile drainage, Subsurface drainage, Conduits.

The size and cost of storage capacity of sumps for pumped outlets of subsurface drainage systems can be reduced by using the disposal tile as part of the storage system. This is feasible where the tiles can be below the grade of the collector tiles so that submergence of the main drain does not block discharge from the laterals. The maximum discharge capacity of the disposal tile should be nearly that of the pump, or else the pump motor will cycle excessively when the tile is flowing nearly full. Equations and a method for designing necessary sump storage are given. (Cassar-FRC)
W82-04364

OPTIMAL DESIGN OF URBAN STORM WATER DRAINAGE SYSTEMS,

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. K. Robinson, and J. W. Labadie.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-211491, Price codes: A02 in paper copy, A01 in microfiche. In: Proceedings 1981 International Symposium on Urban Hydrology, Hydraulics, and Sdiment Control, July 27-30, 1981. University of Kentucky, Lexington. 12 p, 4 Fig, 6 Tab, 12 Ref. OWRT C-90037-U(0507)(1). 14-34-0001-0507.

Descriptors: *Urban drainage, *Storm sewers, Minimum cost, Storm sewer design, Dynamic programming, *Design criteria, *Costs, Systems analysis, Comparison studies.

Several researchers have developed screening models for minimizing the cost of sizing and vertical alignment of storm sewer systems. One of the disadvantages of these models is that they are designed with specific physical/economic assumptions in mind, as well as specific types of cost functions. These assumptions are effectively hardwird into the program, which militates against modifying the program to suit situations not covered in the original assumptions. A generalized dynamic programming computer code has been developed at Colorado State University called CSUDP. A library of subroutines is being prepared as an adjunct to the basic code for solving a wide range of civil engineering problems. One of the packages includes a set of subroutines for storm sewer design. The coding includes data management routines for convenience to the user not familiar with dynamic programming. The code can consider complex branching networks with up to three pipes entering a given manhole. Default options are available for excavation, pipe, and manhole cost functions. If the costs for a particular case have a significantly different structure, the user can supply his own subroutine. There are several other default options which make this program extremely convenient for normal design conditions, as well as usable for unique problems. Extensive comparisons have been made between available published results of other dynamic programming screening models and the CSUDP package. Results are extremely close. The one comparison resulting in a large deviation was due to slightly differing hydraulic and cost assumptions, which caused larger commercial pipe sizes to be chosen by CSUDP, even though actual pipe requirements deviated little.
W82-04414

JET INJECTIONS FOR OPTIMUM MIXING IN PIPE FLOW,

Turner, Collie and Braden, Inc., Houston, TX.
S. D. Fitzgerald, and E. R. Holley.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY10, p 1179-1195, October, 1981. 5 Fig, 11 Ref. OWRT A-091-ILL.

Descriptors: *Pipe flow, *Jets, *Mixing, Optimization, Pipes, Uniform flow, Water currents, Pipelines.

The use of jet injections was evaluated to provide initial mixing and thereby hasten the mixing process between a miscible substance and water flowing in a piepline. The study experimentally investigated several jet injection systems to determine their mixing characteristics, identified those systems providing the most rapid mixing, determined optimum operating conditions, and investigated the effects which secondary currents had on the mixing. For uniform pipe flow with a given number and orientation of jets, the ratio of jet momentum flux to the pipe-flow momentum flux was the parameter indicative of the mixing induced by the jets. Under many circumstances, it may be practical to consider only a 90 deg angle of injection. Experiments also investigated two diametrically opposed 90 deg jets in uniform flow. Optimum mixing was obtained when the momentum ratio for each jet was on the order of one-half of the optimum momentum ratio for a single jet injection. Also, experiments on a pipe flow with an induced secondary current indicated that the use of two or more jets would provide a factor of safety against the effects of unknown secondary currents. (Small-FRC)
W82-04558

DETERMINATION AND REPRESENTATION OF THE STORAGE EFFECT (ZUR ERMITTLUNG UND DARSTELLUNG DER SPEICHERWIRKUNG),

Technische Univ., Dresden (German D.R.).
For primary bibliographic entry see Field 4A.
W82-04576

METHODS FOR ASSESSMENT OF STREAM-RELATED HAZARDS TO HIGHWAYS AND BRIDGES,

Colorado State Univ., Fort Collins. Engineering Research Center.
H. W. Shen, S. A. Schumm, J. D. Nelson, D. O. Doehring, and M. M. Skimmer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-219750, Price codes: A12 in paper copy, A01 in microfiche. Federal Highway Administration Report No FHWA/RD-80/160, March, 1981. 252 p, 32 Fig, 3 Tab, 51 Ref, 4 Append. DOT-FH-11-9396.

Descriptors: *Bridge design, *Highways, *Hydraulic design, *Stream erosion, *Bank erosion, Sedimentation, Deposition, Bridge failure, Land use, Remote sensing, Slope stability, Stream banks, Avulsion, Aggradation, Meanders, Morphology, Scour, Waves, Flotsam.

River behavior at a highway crossing depends not only on the stability of that particular river reach, but also on the behavior of the entire fluvial system. A complete evaluation of hydraulic hazards cannot be solely based on on-site hydrologic, hydraulic and geomorphic factors; but must also include insight into historic trends, synoptic considerations of basin characteristics, and anticipation of future changes. Because determination of stream-related hazards is a complex task, it is beneficial to generalize relative stability based on stream type. Streams can be divided into five types based on channel pattern and mode of sediment deposition. Each stream type exhibits its own characteristic stability. After evaluating stream variables, a list of potential stream hazards can be developed. Stream-related hazards include: degradation and scour; nickpoint migration; bank erosion; aggradation and fill; downfilling and backfilling; berming; meander growth and shift; channel bars and islands; cutoffs; avulsion; river-metamorphosis; floating objects; waves and surges. Each potential hazard can be evaluated on an individual basis and properly considered in either the design of a new crossing or maintenance of an existing one. Numerous evaluation methods are available to hydraulic engineers that have not been fully utilized. Methods such as remote sensing, land use evaluation and slope stability analysis should not be overlooked. (Moore-SRC)
W82-04626

THE DESIGN OF ENCROACHMENTS ON FLOOD PLAINS USING RISK ANALYSIS,

Federal Highway Administration, Washington, DC. Office of Engineering.
M. L. Corry, J. S. Jones, and P. L. Thompson.
Hydraulic Engineering Circular No 17, October, 1980. 134 p, 15 Fig, 14 Tab, 23 Ref, 3 Append.

Descriptors: *Flood plains, *Bridge design, *Risks, *Highways, *Flood damage, *Cost analysis, Culverts, Scour, Channel erosion, Economic aspects, Design criteria, Embankments, Dikes, Earthworks, Alternative planning.

The design of all flood plain encroachments should include an evaluation of the inherent flood related risks to the highway facility and to the surrounding property. When this evaluation indicates that the risk warrants additional study, a detailed analysis of alternative designs is necessary in order to determine that design with the least total expected cost (LTEC) to the public. An essential ingredient in the LTEC design concept is risk analysis. All quantifiable losses are included in the risk analysis. These may involve damage to structures, embankments, surrounding property, traffic related losses and scour or stream channel damage. The product of the risk analysis is the annual economic risk associated with each design strategy. The sum of the annual economic risk and the annual capital costs results in the total expected cost (TEC) for each design strategy. Comparison of the TEC's for all design strategies allows the designer to select the LTEC or optimum design. Although the emphasis in this manual is on bridge crossings, the LTEC decisionmaking process concept is applicable to other drainage features. For example, it may be utilized in the design evaluation of culverts, longitudinal encroachments, countermeasures and foundation elevations. (Moore-SRC)
W82-04631

APPLICATION OF THE SOUTHWELL PLOT METHOD TO THE INSPECTION AND TESTING OF BURIED FLEXIBLE PIPES,

Cambridge Univ. (England).
A. J. Valsangkar, A. M. Britto, and M. J. Gunn.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 63-82, March, 1981. 14 Fig, 5 Tab.

Descriptors: *Pipes, *Buckling, *Deformation, Nondestructive tests, Southwell plot, *Stress, Flexibility, Inspection, Safety, Soil mechanics, Soil strength, Pipelines, *Design criteria.

A nondestructive method for estimating the buckling load of buried flexible pipes uses the Southwell plot. It allows estimation of a generalized out-of-roundness and predicts a buckling load. The difference between predicted and actual buckling loads is greater at larger initial out-of-roundness values for the buried pipe. A method is presented for estimating the safe failure load from the Southwell plot buckling load and the generalized out-of-roundness. Experimental data produced by other investigators on the stability of buried pipes were used to test the validity of this method. Very flexible pipes (effective stiffness < 0.5 kN per sq m) in dense sand produce small deflections before failure and cannot be reliably analyzed by the Southwell plot method. Pipes with effective stiffness of 3.62-157.1 kN per sq m may be loaded to about two thirds of their buckling load, at which stage the Southwell plot is linear. (Cassar-FRC)
W82-04649

ADOPTING SEWERS,

Southern Water Authority (England).
J. Budleigh.
Water, No 42, p 20-21, 1982. 2 Ref.

Descriptors: *Sewer systems, *Design criteria, Management, *Construction, *Housing, Land development.

Traditionally sewers are constructed by the developers of housing projects and offered to the water authority for adoption when finished in much the same way as estate roads. The ground rules for adoption are laid down in Section 17 and 18 of the Public Health Act of 1936. Two alternative arrangements are offered to the developer. In Section 17 he may design and construct the sewers as he sees fit and then offer them for adoption. Section 18 provides for a clear cut agreement prior to construction between the developer and the sewerage authority. A considerable step forward would be provided for by a national agreement on the standards and conditions which must be met by the water and housebuilding industries. Such an agreement has been reached. As far as the design and layout of sewers is concerned, the standards required are generally in line with the present British Standard Code of Practice for sewerage, CP2005. One long standing problem has been the supervision allowed by Section 18 on the part of the sewerage authority. The building company generally does not object to the fact that supervisors from the sewerage authority are present, but does object to having to pay for this. Another problem concerns the provision of a guarantee to the authority that the builder would actually carry on and finish the sewers as agreed. The third problem has to do with sewage pumping stations. These problems are dealt with in the housing developer's guide. (Baker-FRC)
W82-04655

JAMES BAY SPILLWAYS AND CONTROL STRUCTURES,

La Societe d'Energie de la Baie James, Montreal (Quebec).
K. R. Ludwig, and R. T. Olive.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY2, p 183-198, December, 1981. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Spillways, *Flow control, *Hydraulic gates, James Bay, *La Grande Complex, *Quebec, Hydraulic structures, *Reservoirs, Water resources development, Gates, Hydraulic design, Flow velocity, Design criteria, Concrete, Maintenance, Cold weather construction, Bridges, Ice, Dam construction, Hydroelectric plants.

The structural conception of the major spillways and control structures of Quebec's six-reservoir La Grande Complex is summarized. All spillways and control structures contain a gate structure and a downstream discharge facility. Concrete has been used only where necessary to control flow, since the resistance of rock in this region is superior to concrete. The standardized gate opening is 40 ft, and all gates are of the flat, wheeled, vertical-lift type. The number of gates varies with the discharge capacities. Flow velocities have been limited to 60 ft per sec at the sill and 100 ft per sec at the downstream end for structures in intermittent operation. Control structures in use for prolonged periods are limited to a maximum velocity of 60 ft per sec for no more than 10% of the time. Drainage systems are located in areas protected against freezing, and gates are equipped with electric deicers. The dam bridge, aligned with the crest to either side of the spillway, is upstream of the stoplogs. Discharge from the gate structures is handled in a variety of ways, depending on the location. These include stilling basins, rock cut channels to the lake or river, chutes, flip buckets, intervening lakes, plunge pools, and combinations of these. (Cassar-FRC)
W82-04692

DETERMINING FEASIBILITY OF SMALL-SCALE HYDROPOWER,

Tudor Engineering Co., San Francisco, CA.
For primary bibliographic entry see Field 6B.
W82-04693

TAPERED INLET DESIGN USING SPECIFIC ENERGY CURVES,

Iowa State Univ., Ames. Dept. of Civil Engineering.
R. L. Rossmiller, and M. D. Dougal.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 127-135, January, 1982. 4 Fig, 5 Ref.

Descriptors: *Design criteria, *Culverts, *Inlets, Hydraulic structures, Water conveyance, Conduits, Pipes, Highways, Iowa, Specific energy curves, Economic aspects.

Design charts for the hydraulic design of tapered inlet highway culverts are given for both rectangular (box) and circular (pipe) sections. Errors, design time, and construction costs are greatly reduced by use of these charts. In Iowa savings from the use of tapered culverts at individual sites range from $1000 to over $100,000, for a total of millions of dollars over the past five years. The raised inlet culverts can form ponds for recreation or stock watering and help stabilize the upstream channel slope. For box culverts the chart plots depth in feet against specific energy head in feet for different ratios of design discharge to width of culvert. For pipe culverts, depth to pipe diameter ratio is plotted against specific energy to diameter ratio for different values of Q squared divided by D to the 5th power, where Q = design discharge and D = diameter of pipe. (Cassar-FRC)
W82-04695

YEAR-ROUND DISTRIBUTION SYSTEM MAINTENANCE,

Connecticut Water Co., Clinton.
For primary bibliographic entry see Field 5F.
W82-04699

COVERING DISTRIBUTION STORAGE, PANEL DISCUSSION, DESIGN ASPECTS AND ALTERNATIVES,

Whitman and Howard, Inc., Wellesley, MA.
For primary bibliographic entry see Field 5G.
W82-04701

THE ROOFLOAT (FLOATING) COVER SYSTEM FOR LIQUID STORAGE,

Globe Linings Inc., Long Beach, CA.
For primary bibliographic entry see Field 5G.
W82-04702

8B. Hydraulics

ASYMPTOTIC SOLUTION FOR DAM-BREAK PROBLEM,

Cantebury Univ., Christchurch (New Zealand).
B. Hunt.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 115-126, January, 1982. 6 Fig, 9 Ref.

Descriptors: *Dam failure, *Kinematic wave theory, *Flood waves, Wave propagation, Hydraulics, Reservoir releases, Water flow.

The kinematic wave approximation is used to obtain a simple, closed-form solution for the catastrophic failure of a dam upon a dry, sloping channel. The solution validity is investigated by computing orders of magnitude for neglected terms in the equations of motion and by comparing the solution with the results of previously calculated numerical solutions and with experimentap results. These calculations and comparisons suggest that the kinematic wave solution becomes asymptotically valid after the flood wave has advanced about four reservoirlengths downstream. (Author abstract)
W82-04313

MEASUREMENT OF AIR IN FLOWING WATER,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7B.
W82-04322

USE OF TWIN WELLS AND WATER-SOURCE HEAT PUMPS FOR ENERGY CONSERVATION IN LOUISIANA,

Louisiana Water Resources Research Inst., Baton Rouge.
R. Kazmann.
Technical Report No 9, December 181. 68 p, 27 Fig, 22 Tab, 16 Ref, 2 Append.

Descriptors: *Wells, *Pump wells, *Injection wells, Recharge wells, Site selection, Water cooling, Well water, Heated water, Thermal pollution, Aquifers, Cooling, Air temperature, Water table decline, Conservation, *Louisiana, *Energy conservation, Heat pumps.

Acceptance of water-source heat pumps has been slow because of potential environmental impacts

(water-level declines, subsidence, injecting substances into aquifers), cost, and lack of design data. The purpose of this work was to determine proper well spacing for single sets of twin wells, and for multiple sets; to examine the feasibility of their use in two Louisiana parishes; and to determine the potential use, economics, and environmental impact of water-source heat pumps. The use of twin wells–one to pump water, one to recharge the aquifer–precludes groundwater declines and, if properly spaced, avoids altering the groundwater temperature. The well used for production in summer is used for injection in winter, and vice-versa. A table is given to approximate the needed spacing between the wells. Even using an annual interest rate of 14%, a water-source heat pump and single well combination is often the most effective system for heating/cooling. In many areas of the two parishes studied, this system will be economical, especially in areas underlain by groundwater at shallow depth. Also, if properly designed and built, twin well systems will have no environmental impact on the biosphere and only minimal thermal impact on the source aquifers. It is recommended that no legislation be adopted that would prevent use of the system for those wanting to conserve energy; that research be encouraged to achieve higher coefficients of performance by use of a new working fluid, an increase in the throughput of water, or by reducing head loss in a unit; and that a streamline-tracking program be prepared to compute the consequences of operating large numbers of well pairs. (Atkins-Omniplan)
W82-04387

JET INJECTIONS FOR OPTIMUM MIXING IN PIPE FLOW,
Turner, Collie and Braden, Inc., Houston, TX.
For primary bibliographic entry see Field 8A.
W82-04558

STORM SEWER FLOW COMPUTATIONS,
Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W82-04640

THE VORTEX SCOUR MECHANISM AT BRIDGE PIERS,
Zakir Husain Coll. of Engineering and Technology, Aligarh (India).
A. Qadar.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 739-757, September, 1981. 13 Fig, 8 Tab, 10 Ref.

Descriptors: *Scour, *Vortices, *Erosion, Sediment transport, *Piers, Rivers, Hydraulics, Riprap, Bridges, Flow around objects, Flow characteristics, *Bridge piers.

A tilting non-recirculating flume (0.3 m wide x 0.45 m deep x 5 m long) was used to study the vortex scour mechanism at bridge piers. First, experiments were performed on a rigid bed to study the behavior of the scouring vortex. Second, a sand bed was installed to measure the depth of scour holes. Results of field tests at several bridges in India and Canada were also reported. Several conclusions were developed from the observations. The basic mechanism of localized scours was identified as a secondary circulation caused by an upstream flow separation ahead of the pier. The maximum depth of the scour is a function of the strength of the vortex which develops ahead of the pier and is described in an equation containing the following terms: initial strength of vortex, an experimentally determined exponent to sediments up to 0.5 mm in diameter. For larger-sized sediments, roughness elements cause a reduction in scour. Although the depth of the approach flow has little measurable effect on maximum scour depth, there is a minimum depth of flow necessary for full development of vortex action. Scouring may be prevented or reduced by installing large-size riprap around piers or by weakening the basic mechanisms. (Cassar-FRC)
W82-04642

FLOW RESONANCE IN RIGID PIPES WITH REGULAR LONGITUDINAL CORRUGATIONS,
Thessaloniki Univ., Salonika (Greece). Dept. of Hydraulics.
P. Latinopoulos, and D. K. Tolikas.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 263-267, March, 1981. 3 Ref.

Descriptors: *Pipe flow, *Resonance, *Flow characteristics, Wave propagation, Hydraulics, Water hammer.

The method of multiple scales was used to derive a uniform first order expansion for the condition of resonance in a corrugated pipe. Weak waves caused by small undulations on the pipe wall can be generated. Under certain conditions a resonance occurs that is independent of water hammer or resonance due to reflections at the boundaries of the system. Resonance can be expected when the wave number of the wall undulations matches the difference of the wave number of any two propagating nodes which are strongly coupled and travel unattenuated along the pipe. (Cassar-FRC)
W82-04644

ANALYSIS OF THE HYDRAULIC JUMP WITHIN A DIVERGING RECTANGULAR CHANNEL,
University of Wales Inst. of Science and Technology, Cardiff.
P. W. France.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 369-378, June, 1981. 6 Fig, 8 Ref.

Descriptors: *Hydraulic jump, *Spillways, Dam design, *Channel flow, Flow characteristics, Froude number, Model studies.

Properties of hydraulic jumps with parallel-sided channels and gradually diverging rectangular channels were compared theoretically and in laboratory flume studies. An equation was developed to predict the sequent depth in a diverging channel. The relative energy loss in a diverging channel was 12% higher than in a parallel-sided channel for the same Froude number. Although the energy loss was independent of the angle of divergence, it was a function of the sequent radius ratio. The lengths of diverging jumps were about 40% less than the straight-sided jumps for the same Froude number. The sensitivity of the jump became more stable as the angle of divergence increased. (Cassar-FRC)
W82-04645

SIMULATION OF SURGES AFTER REMOVAL OF A SEPARATING BARRIER BETWEEN SHALLOWER AND DEEPER BODIES OF WATER,
University of Strathclyde, Glasgow (Scotland).
D. I. H. Barr, and M. M. Das.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 3, p 911-919, September, 1981. 9 Fig, 7 Ref.

Descriptors: *Surges, *Barriers, *Flow characteristics, Hydraulics, Water level, Channel flow, Roughness, Water depth, Simulation analysis.

Surges produced after removal of a barrier separating water bodies with surfaces at different levels were numerically simulated. The equations were based on the St. Venant equations as applied to the dry bed dam burst case. Laboratory measurements were taken in rectangular channels with both smooth and artificially roughened surfaces. Laboratory data were compared with numerical simulations on three bases: surface profiles, depth hydrographs, and front trajectories. Agreement between observed and calculated values was good. Increased rates of damping and lagging of the surge front were seen both in the smaller-scale experiments and in roughened channels. (Cassar-FRC)
W82-04685

RESISTANCE EQUATION FOR LARGE-SCALE ROUGHNESS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2E.
W82-04696

8C. Hydraulic Machinery

RIDING MILL PUMPING STATION,
For primary bibliographic entry see Field 8A.
W82-04292

VERTICAL ROUND BUOYANT JET IN SHALLOW WATER,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-04365

AERATION CHARACTERISTICS OF FLOW RELEASE CONTROLS ON ILLINOIS WATERWAY DAMS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 5G.
W82-04388

JAMES BAY SPILLWAYS AND CONTROL STRUCTURES,
La Societe d'Energie de la Baie James, Montreal (Quebec).
For primary bibliographic entry see Field 8A.
W82-04692

8D. Soil Mechanics

DESIGN OF FILTERS FOR CLAY CORES OF DAMS,
Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 8G.
W82-04321

INCIPIENT MOTION OF SAND PARTICLES ON SIDE SLOPES,
Saitama Univ., Urawa (Japan). Dept. of Foundation Engineering.
S. Ikeda.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY1, p 95-114, January, 1982. 15 Fig, 2 Tab, 22 Ref.

Descriptors: *Slope stability, *Tractive forces, *Sediment transport, Channel erosion, *Stream banks, Sand, Erosion, Sedimentation, Flow velocity, Critical velocity, Turbulent flow, Drag, Soil mechanics, Hydraulics, Channel scour.

Although several criteria have been theoretically proposed for the critical shear stress of noncohesive sediment on side slopes of river and channel banks, no laboratory work on this problem has been reported. This paper presents a theoretical study on the incipient motion of sediment particles on side slopes, accounting for the effects o the viscous sublayer, turbulence, and lift force. A laterally tilting wind tunnel was used to measure critical shear stress on side slopes from 0 to 40 degrees. Wind velocity varied from 0 to 30 m per sec. Two grades of noncohesive sand with median diameters of 1.3 and 0.42 mm were used in the experiment. Results of the wind tunnel tests confirmed the theory presented in this paper. On level beds the incipient motion of sand particles was essentially stochastic for the 1.3 mm sand, with a few particles first set in motion in isolated spots. The 0.42 mm sand particles moved intermittently as a unit. Although the lift force can be neglected when using the most probable values of critical tractive forces, it should be included for safety. The present equation does not account for disturbances such as sand waves, channel irregularities, and bends. (Cassar-FRC)
W82-04368

WET DISPOSAL OF FOSSIL PLANT WASTE: CASE HISTORY,

Ebasco Services Inc., Norcross, GA.
For primary bibliographic entry see Field 5E.
W82-04385

WATER MOVEMENT FACTORS IMPORTANT TO THE DESIGN AND OPERATION OF SUBIRRIGATION SYSTEMS,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W82-04538

EVALUATION OF A CHIMNEY DRAIN DESIGN IN AN EARTHFILL DAM,
Geological Survey, Doraville, GA.
M. L. Maslia, and M. M. Aral.
Ground Water, Vol 20, No 1, p 22-31, 1982. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Mathematical models, *Earth dams, *Drainage systems, *Performance evaluation, Soil physical properties, Clays, Sand filters, Silt, Model studies, Mathematical studies, Numerical analysis, Pressure head, Seepage, *Wallace Dam, Georgia.

The finite element Galerkin method was used to formulate a numerical model to study the performance of a vertical drainage filter in a clay fill zone of the Wallace Dam on the Oconee River, Georgia. The resulting model was applied to determine the steady-state saturated-unsaturated seepage characteristics at Station 58 + 00 on the west dike of the earthfill dam. Numerical results for the four cases (clay fill, sand filter, silty sand, and weathered) analyzed define the location of the zero pressure isobar and total hydraulic head values ranging from 130 m to 11 m. Using a saturated horizontal hydraulic conductivity of 8.64 cm/day, a maximum seepage velocity of 0.80 m/day was calculated, resulting in a maximum seepage rate of .752 cu cm/sec. An average pressure head reduction of 16 m from the upstream to the downstream side of the dam was determined from hydrostatic uplift forces along the base of the dam. When local seepage velocities were compared to critical seepage velocities inside of an upstream of the filter, safety factors against piping ranging from 0.3 to 3.7 were found. (Geiger-FRC)
W82-04675

8G. Materials

THE SIDERITE MODEL OF THE FORMATION OF CORROSION-RESISTANT SCALES,
Karlsruhe University (Federal Republic of Germany), Water Chemistry Dept.
For primary bibliographic entry see Field 5F.
W82-04270

DESIGN OF FILTERS FOR CLAY CORES OF DAMS,
Imperial Coll. of Science and Technology, London (England).
P. R. Vaughn, and H. F. Soares.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT1, p 17-31, January, 1982. 8 Fig, 18 Ref.

Descriptors: *Filters, *Dam design, *Cores, Sand filters, Soil filters, Clays, Dam failure, Soil mechanics, Grading, Permeability, Sediment sorting, Erosion, Cracks, *Balderhead Dam, *England.

The failure of a filter drain in the clay core of Balderhead Dam, Northern England, prompted a study of filter effectiveness and design. Although the grading of the crushed limestone filter material conformed to accepted designs, the possibility of cracks in the clay core had not been considered. In the Balderhead Dam erosion damage developed above a crack in the clay core. The damage zone contained lenses and other signs of segregation by water action. In some sections of the crack coarse particles accumulated, allowing small soil particles to be lost and enlarging the crack. A 'perfect' filter was designed for the Cow Green Dam and the Empingham Dam to retain the smallest particles (in this case clay flocs) that can arise during erosion. Laboratory tests helped determine that natural, unwashed sand was suitable as the fine filter. An experimental relationship was found between the size of the particle retained by the filter and its permeability. In the laboratory uniformly-sized filter materials produced fail-no results. Graded filters showed a range during which slow clogging occurred. Permeability appears to be a better method of describing the retention characteristics of a filter than grading. (Caesar-FRC)
W82-04321

COVERING BOTTOM SEDIMENTS AS A LAKE RESTORATION TECHNIQUE,
Kent State Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W82-04421

8I. Fisheries Engineering

ENGINEERING IN CATFISH PRODUCTION,
P. Forsythe.
Agricultural Engineering, Vol 61, No 6, p 18-21, June, 1980.

Descriptors: *Fisheries, *Catfish, *Catfish farming, Catfish ponds, Fish harvest, Water pollution sources, Fish farming, Food processing wastes.

Scientifically managed catfish pond systems are used to produce an average yield of 3000 lb/acre. Optimum pond efficiency results from a layout of 8 ponds per 160 acre area each 660 ft by 1320 ft. The ponds are confined by levees having a 14 ft top width and 3:1 side slopes providing 2 ft of freeboard. The water area is about 17 acres. Th drainage of ponds at harvest creates significant shock loads to streams. The unused catfish feed plus wastes provides an enriched discharge. When fish are processed, processing wastes are treated usually in oxidation lagoons and discharged into city treatment systems. The handling and disposal of processing wastes needs the most attention from agricultural engineers. There is a tremendous opportunity to utilize these thousands of tons of fish protein. The effects on water quality of pond draining also need further investigation. (Small-FRC)
W82-04367

STATUS REPORT ON STRIPED BASS ANALYSES,
California State Dept. of Fish and Game, Sacramento.
Staff report prepared for the State Water Resources Control Board, Sacramento, California, January 20, 1982. 47 p 21 Fig, 10 Tab.

Descriptors: *Fish populations, *Bass, *Fish food organisms, *Fish diets, Fish eggs, Regression analysis, Correlation analysis, Diversion, Fish foods, Food chains, Phytoplankton, Zooplankton, Distribution patterns, Powerplants, Striped bass, *California.

In 1976, the California Department of Fish and Game (DFG) submitted evidence to the State Water Resources Control board indicating that the abundance of young striped bass was largely controlled by the magnitude of Delat outflow and losses in water diversions by the Central Valley Project and the State Water Project. When the abundance of bass was lower than DFG's expectations, the evidence was reexamined. Four hypotheses were advanced--increased competition, diversion, food abundance, and outflow. Most testing used correlation or multiple regression analyses, but a limiting factor of these approaches was that they only determined whether variables vary in a similar manner. None of the hypotheses described the actual mechanisms controlling striped bass abundance since 1959. Other hypotheses are being tested. However, a common theme was the variations in Delta outflow in spring/early summer have a major effect on abundance. High flows spread striped bass over a larger area and expansion of habitat reduces intraspecific competition and, thus, survival. High flows also probably increase food supply for young bass. Several regression analyses indicate that stock size, not food supply, may have caused the unusually low abundance of striped bass since 1976, but that hypothesis, too, has been questioned because bass are so prolific and because of evidence of stock size limitation elsewhere. A basic problem is that striped bass populations have been increasing recently, so any variable with a declining trend is correlated with young bass abundance whether a cause and effect relationship exists or not. (Atkins-Omniplan)
W82-04386

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

SEARCH: A GAGED WATERSHED INVENTORY,
State Univ. of New York at Syracuse. Coll. of Environmental Science and Forestry.
P. E. Black.
Water Resources Bulletin, Vol 16, No 5, p 894-899, October, 1980. 4 Fig.

Descriptors: *Information retrieval, *Watersheds, Computers, Surveys, Information systems, Hydrologic data collections, Data collections, Data storage and retrieval, *New York, *Streamflow, *Gaging stations.

The purpose of this paper is to provide the potential user of SEARCH with the information needed to implement its use. The purpose of the program is to provide a ready inventory and search of all gaged streams in New York along with a compilation of major parameters upon which a decision to use records from such a gage might be based. The method is adaptable to any other state or region. The method as described is adapted to an APL interactive terminal, allowing the operator to thoroughly search a large set of gaged watersheds to find sources of comparable hydrologic data for detailed analysis. Bases of the search include drainage basin size and elevation and geographical and temporal parameters. (Baker-FRC)
W82-04433

TNRIS: A SOURCE FOR WATER-RELATED DATA IN TEXAS,
Southwest and Texas Water Works Journal, Vol 63, No 4, p 10-11, July, 1981. 1 Fig, 2 Tab.

Descriptors: *Data storage and retrieval, Information systems, Weather, Water quality, Water supply, Wells, Precipitation, *Texas, TNRIS.

The Texas Natural Resources Information System (TNRIS) stores, processes, and disseminates data and information on Texas' water and other natural resources to State agencies, other governmental agencies, universities, and the public. The system provides access to hydrological, meteorological, geological, biological, socioeconomic, and base data located in more than 300 automated files and over 150 manual files. Base data includes maps and remotely sensed data. TNRIS data files cover such areas as daily and monthly precipitation, daily pan evaporation, daily surface water conductance, surface water quality, daily suspended sediment, and water well measurements. Data for these files are supplied by the National Weather Service, the U.S. Geological Survey, the International Boundary and Water Commission, and Texas State agencies. In addition, TNRIS interfaces with data bases maintained by the U.S. Geological Survey, the Environmental Protection Agency, the Department of Commerce, the Department of Agriculture, and the Department of Energy. TNRIS is capable of providing computer-printed reports, graphic outputs, interface with remote terminals, statistical packages, computer-generated microform, geocoding, analysis of remotely sensed data, catalogs and indices, information on availability of specialized data, and ordering services. The System also conducts a variety of remote sensing and cartographic activities. TNRIS can be assessed

by letter, telephone, terminal, or personal visit. (Carroll-FRC)
W82-04651

AN INTERACTIVE DATA MANAGEMENT SYSTEM FOR RIVER WATER QUALITY DATA,
Michigan Univ., Ann Arbor. School of Public Health.
R. A Deininger.
Water Research, Vol 16, No 1, p 31-36, January, 1982. 2 Fig, 13 Tab, 3 Ref.

Descriptors: *Water quality, *Data storage and retrieval, *Information systems, Computers, Rivers, Statistical analysis, *Ohio River basin.

A water quality data bank for interactive use is described. Unlike the STORET, NAQUADAT, and EIS systems in the U.S., Canada, and Scandinavia, respectively, this system allows the user to search, update, rstrieve, and analyze data from a computer terminal without the help of specially trained personnel. This system, located at the University of Michigan, can be accessed by lcoal telephone numbers in 100 U.S. and Canadian cities and by the TELENET system from European cities. The system is illustrated by a sample problem using a small water quality data base with values for 9 selected parameters from 35 monitoring stations in the Ohio River Basin. Statistical analysis can be performed using the MIDAS software system. Graphs may be displayed on a television screen. (Cassar-FRC)
W82-04659

10C. Secondary Publication And Distribution

ANNOTATED SELECTED REFERENCES ON NATURAL RESOURCES INVESTIGATIONS, COLLIER COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. J. Swayze.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $6.00, Microfiche $3.50. Geological Survey Open-File Report 81-1184, 1981. 45 p.

Descriptors: *Bibliographics, *Publications, *Natural resources, Hydrology, Geology, Ecology, Geochemistry, *Florida, *Collier County, Biology.

A data base for future natural resources investigations in Collier County, Fla., was initiated by compiling a selected annotated bibliography. This report provides references and annotations for selected reports released between 1950 and 1978. The references are presented by subject material as follows: biologic, ecologic, geologic, geochemical, and hydrologic. (USGS)
W82-04508

SUBJECT INDEX

ABSORPTION
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 3A

ACCUMULATION
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 5B

ACID RAIN
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

ACIDITY
Acid Snow in the Canadian High Arctic,
W82-04542 2C

ACOUSTICS
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

ACTIVATED CARBON
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 5D

When a Water Supply Went Bad.
W82-04357 5C

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

Granular Activated Carbon Installations,
W82-04391 5F

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 5F

Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 5D

ACTIVATED SLUDGE
Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 5D

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 5D

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

ACTIVATED SLUDGE PROCESS
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

Destabilization of Biological Solids with Ferric Chloride,
W82-04373 5D

Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 5D

Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 5D

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 5D

Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 5D

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 5E

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 5D

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

Estimation and Control Problems in Activated Sludge Processes,
W82-04612 5D

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 5D

Vacuum Filtration of Septage,
W82-04710 5D

ADSORBENTS
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

Granular Activated Carbon Installations,
W82-04391 5F

ADSORPTION
The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 5F

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 5D

Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 5F

AERATION
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

AERATORS
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 5D

AEROBIC DIGESTION
Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 5D

AGRICULTURAL
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 3F

AGRICULTURAL RUNOFF
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 4D

AGRICULTURE
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

AIR ENTRAINMENT
Measurement of Air in Flowing Water,
W82-04322 7B

AIR POLLUTION EFFECTS
Acid Snow in the Canadian High Arctic,
W82-04542 2C

ALASKA
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

ALBERTA
Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

ALFALFA
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

ALGAL
An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 5C

ALGAL CONTROL
Use of Microscreens to Polish Lagoon Effluents,
W82-04709 5D

ALGAL GROWTH
Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04302 2H

ALKALINE SOILS
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

ALLUVIAL FANS
Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 6F

ALPINE REGIONS
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 2E

ALUMINUM SULFATE
Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 5F

AMERICIUM
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 5B

AMMONIA
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

ANAEROBIC DIGESTION
Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 5E

Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 5D

Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 5D

ANAEROBIC TREATMENT
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 5D

ANIMAL WASTES
Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 5D

ANTARCTIC
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

APPROPRIATION
Recent Developments in Colorado Groundwater Law,
W82-04679 6E

Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 6E

AQUACULTURE
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

AQUATIC ENVIRONMENT
Biota and Biological Principles of the Aquatic Environment.
W82-04499 5C

Pesticides in the Aquatic Environment,
W82-04727 5C

AQUATIC LIFE
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

AQUATIC PLANTS
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

AQUIFER CHARACTERISTICS
Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 6D

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 7C

AQUIFER SYSTEMS
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

AQUIFERS
The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 4B

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 7C

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1A

ARID ZONE HYDROLOGY
Development of Federal Reserve Rights,
W82-04446 6E

ARIZONA
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 2E

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 2E

ARKANSAS
Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 7C

AROMATIC COMPOUNDS
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

ARTESIAN PRESSURE
Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

ARTIFICIAL RECHARGE
The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 4B

ATCHAFALAYA RIVER
Will New Orleans Miss The Mississippi,
W82-04274 4A

ATLANTA
Detention Basins--An Urban Experience,
W82-04332 4A

ATMOSPHERIC WATER
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

ATOLLS
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

AUBURN DAM
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 6B

AUTOMATION

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 5D

A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 7B

Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 5A

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 7B

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 7B

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

Automatic Collection and Transmission of Data for the Federal Waterway Authority.
W82-04596 7A

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 5D

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 5D

Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 5D

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

AVAILABLE WATER

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

BACKWASH

Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 5D

BACTERIA

Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 5C

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 2L

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 5B

Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 5A

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 2H

Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 5A

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 5C

BACTERIAL ANALYSIS

Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 5A

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response.
W82-04341 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 5A

Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

BALDERHEAD DAM

Design of Filters for Clay Cores of Dams,
W82-04321 8G

BALLAST

Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 5D

BANK EROSION

Bank Failure and Erosion on the Ohio River,
W82-04473 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

BARLEY

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

BARRIERS

Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 8B

BASELINE STUDIES

Water Chemistry of the Illinois Waterway,
W82-04390 2K

BASS

Status Report on Striped Bass Analyses,
W82-04386 8I

BAVARIA

Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

BEACH EROSION

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

BEACH WILDLIFE SANCTUARY

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

BEANS

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 2I

BEAUFORT SEA SHELF

A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 7B

BENEFITS

Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 6B

Who Wins in the Fight for Pollution Control,
W82-04554 6B

BENTHIC FAUNA

Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 2L

BERLIN

Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 5F

BHASKARA SATELLITE

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

BIBLIOGRAPHICS

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 10C

BIOACCUMULATION

Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

BIOCHEMISTRY

The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 2H

BIODEGRADATION

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 5D

BIOLOGICAL COMMUNITIES

Biota and Biological Principles of the Aquatic Environment.
W82-04499 5C

BIOLOGICAL WASTEWATER TREATMENT

Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 5D

Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

BIOTA

Biota and Biological Principles of the Aquatic Environment.
W82-04499 5C

BLUEGILLS

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C

BORDER IRRIGATION

Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

Dimensionless Stream Advance in Sloping Borders,
W82-04308 3F

BOREHOLE GEOPHYSICS

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

BOTTOM SEDIMENTS

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

BOUNDARY LAYERS

Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 2H

BRAIDED STREAMS

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

BRIDGE DESIGN

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

BRIDGE PIERS

The Vortex Scour Mechanism at Bridge Piers,
W82-04642 8B

BRITISH COLUMBIA

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 2L

Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 5D

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

BROMIDES

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

BROMINE CHLORIDE

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

BUBBLES

Measurement of Air in Flowing Water,
W82-04322 7B

The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 7B

BUCKLING

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

CADDISFLIES

Pesticides in the Aquatic Environment,
W82-04727 5C

CADMIUM

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

CAIMANERO LAGOON

The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 2L

CALCIUM CARBONATE

The Search for a Corrosion Index,
W82-04279 5F

CALIFORNIA

Status Report on Striped Bass Analyses,
W82-04386 8I

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 2E

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 3F

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

CAMDEN

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 5D

CANADA

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 2H

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

Who Wins in the Fight for Pollution Control,
W82-04554 6B

CAPE COD

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 7C

CAPITAL COSTS

The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 6A

CARBARYL

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

CARBOHYDRATES

Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

CARBON CYCLE

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 2H

CARBON DIOXIDE

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 2K

CASCADE MOUNTAINS

Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 2K

CATCHMENT AREAS

Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

CATFISH

Engineering in Catfish Production,
W82-04367 8I

CATFISH FARMING

Engineering in Catfish Production,
W82-04367 8I

CEREAL CROPS
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

CHANNEL EROSION
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

CHANNEL FLOW
Conformal Mapping for Channel Junction Flow,
W82-04306 2E

Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 8B

Resistance Equation for Large-Scale Roughness,
W82-04696 2E

CHANNEL JUNCTION FLOW
Conformal Mapping for Channel Junction Flow,
W82-04306 2E

CHANNEL MORPHOLOGY
Relative Runoff by Curve Number Nomograph,
W82-04307 2A

CHELATION
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

CHEMICAL ANALYSIS
Water Chemistry of the Illinois Waterway,
W82-04390 2K

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 5A

Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 5A

Acid Snow in the Canadian High Arctic,
W82-04542 2C

Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Losemittel in Luft und Wasser),
W82-04579 5A

Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 5A

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

CHEMICAL COMPOSITION
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B

CHEMICAL PROPERTIES
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 2K

CHEMICAL REACTIONS
The Chemistry of Saline Water Chlorination,
W82-04729 3C

CHEMICAL TREATMENT
Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 5D

CHEMICAL WASTES
When a Water Supply Went Bad.
W82-04357 5C

CHEMICAL WASTEWATER
A Treatment System for an Organic Chemicals Plant,
W82-04353 5D

CHICAGO
Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

CHLORIDES
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 5A

CHLORINATED HYDROCARBONS
A Treatment System for an Organic Chemicals Plant,
W82-04353 5D

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 5C

CHLORINATION
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 5D

Effect of Halogens on Giardia Cyst Viability,
W82-04401 5F

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 5F

Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 5F

The Chemistry of Saline Water Chlorination,
W82-04729 3C

CHLORINE
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

CHLOROPHYLL
Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 5C

CHLOROPHYLL A
Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

CHOPTANK RIVER
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

CLASSIFICATION
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 2A

CLAY BOSWELL GENERATING STATION
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 5E

CLAYS
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 2J

CLEANUP OPERATIONS
Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 5G

CLIMATOLOGY
Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

COAGULATION
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 5D

Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 5F

Coagulation: Experiences in Organics Removal,
W82-04424 5F

COAL
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 7C

COAL MINES
Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 3C

COAL MINING
Ground Water Monitoring of Underground Coal Mines,
W82-04750 5B

COASTAL AQUIFERS
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

COASTAL AREAS
Groundwater Control,
W82-04714 4B

COASTAL LOUISIANA
Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 7C

COASTAL MARSHES
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

COASTAL WATERS
Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 2H

COLIFORMS
Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 5B
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 5A

COLLIER COUNTY
Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 10C

COLLOIDS
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B
Colloidal Organics,
W82-04689 5F

COLORADO
Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D
A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J
Recent Developments in Colorado Groundwater Law,
W82-04679 6E
Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 6E
Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 6E
Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 6A

COLORADO SPRINGS
Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D

COMBINED SEWER OVERFLOWS
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

COMPARISON STUDIES
Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 2E

COMPRESSIBILITY
Densification of Paper Mill Sludge Materials,
W82-04694 5E

COMPUTER MODELS
Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 5B
Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F
Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A
Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B
Application of the Area of Review Concept,
W82-04674 6E

COMPUTER PROGRAMS
Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

COMPUTERS
Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 5D
Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 5D

CONCORD
Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 6E

CONDUCTIVITY
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

CONJUNCTIVE USE
Local Irrigation Agencies,
W82-04560 4B

CONNECTICUT
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E
Year-Round Distribution System Maintenance,
W82-04699 5F

CONSTRUCTION
Riding Mill Pumping Station,
W82-04292 8A
Adopting Sewers,
W82-04655 8A

CONSTRUCTION METHODS
Groundwater Control,
W82-04714 4B

CONSUMPTIVE USE
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

CONTAMINATION
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

CONTROL SYSTEMS
Estimation and Control Problems in Activated Sludge Processes,
W82-04612 5D

CONVECTION
Convection Patterns in a Pond,
W82-04461 2C

COOLING WATER
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D
Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 7C
Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

CORES
Design of Filters for Clay Cores of Dams,
W82-04321 8G
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J
Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 7C

CORROSION CONTROL
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F
Regulating Corrosive Water,
W82-04335 6B

CORROSION INDEX
The Search for a Corrosion Index,
W82-04279 5F

COSMETIC INDUSTRY
Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 5F

COST ALLOCATION
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 6C

COST ANALYSIS
Small Hydro Schemes for Private Developers,
W82-04327 8A
Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 3F
Granular Activated Carbon Installations,
W82-04391 5F

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 5E

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

COST-BENEFIT ANALYSIS
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 6B

Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 6B

Regulating Corrosive Water,
W82-04335 6B

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 6B

Determining Feasibility of Small-Scale Hydropower,
W82-04693 6B

Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 6A

COST EFFECTIVENESS
Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 5D

COST SHARING
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

COSTS
Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 8A

Development of Hydro-Power in Nigeria,
W82-04475 6B

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 5D

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

Clean Water for the Third World,
W82-04604 6D

COTTON
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

CROFTON UNIT
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

CROP PRODUCTION
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

CROP RESPONSE
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

CROP YIELD
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 2G

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

CULTIVATION
Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 2G

CULTURE MEDIA
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 5A

CULVERTS
Tapered Inlet Design Using Specific Energy Curves,
W82-04695 8A

CYANIDE
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

CYCLING NUTRIENTS
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 6G

DADE COUNTY
Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

DAM DESIGN
Design of Filters for Clay Cores of Dams,
W82-04321 8G

DAM FAILURE
Asymptotic Solution for Dam-Break Problem,
W82-04313 8B

DAMS
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 6B

Small Hydro Schemes for Private Developers,
W82-04327 8A

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

DANBURY
Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

DATA ACQUISITION
Automatic Collection and Transmission of Data for the Federal Waterway Authority,
W82-04596 7A

Data Acquisition for River Management,
W82-04601 7A

DATA COLLECTIONS
Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 7C

Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

DATA STORAGE AND RETRIEVAL
TNRIS: A Source for Water-Related Data in Texas.
W82-04651 10B

An Interactive Data Management System for River Water Quality Data,
W82-04659 10B

DATA TRANSMISSION
Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 7B

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 7B

Automatic Collection and Transmission of Data for the Federal Waterway Authority,
W82-04596 7A

DATING
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 2E

DECHLORINATION
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

DECISION MAKING
Objectives and Constraints in Federal Water Resources Planning,
W82-04288 6E

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 6B

DEEP WELLS
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

DEFORMATION
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

DEGRADATION
Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 5B

DELAWARE RIVER BASIN
Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 7C

DENITRIFICATION
Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 5D

DESALINATION
Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 3A

DESALINATION PLANT
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 3A

DESERT PLANTS
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 2D

DESIGN CRITERIA
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 4A

Design Models for Adsoprtion Systems in Wastewater Treatment,
W82-04300 5D

Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 8A

Analysis of Detention Basin Systems,
W82-04444 2A

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 5D

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 5F

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

Money Down the Drain,
W82-04653 4A

Adopting Sewers,
W82-04655 8A

Tapered Inlet Design Using Specific Energy Curves,
W82-04695 8A

The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 5G

Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 5D

DESIGN FLOODS
Flood Probability Estimation,
W82-04318 6B

DESTRATIFICATION
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

DETENTION RESERVOIRS
Detention Basins--An Urban Experience,
W82-04332 4A

Analysis of Detention Basin Systems,
W82-04444 2A

DETENTION TIMES
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

DETRITUS
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

DEVELOPING COUNTRIES
Rural Power Schemes in Pakistan,
W82-04328 8A

Development of Hydro-Power in Nigeria,
W82-04475 6B

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

Clean Water for the Third World,
W82-04604 6D

The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 6D

Tanzania's Master Water Plan Will Miss Decade Goal,
W82-04657 5F

DEWATERING
Lime Softening Sludge Treatment and Disposal.
W82-04276 5E

Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 5E

Densification of Paper Mill Sludge Materials,
W82-04694 5E

DIAGENESIS
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 2J

DIFFUSERS
Nearfield Performance of River Diffusers,
W82-04561 5B

DISASTERS
Will New Orleans Miss The Mississippi,
W82-04274 4A

DISCHARGE MEASUREMENT
Relative Runoff by Curve Number Nomograph,
W82-04307 2A

DISEASES
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

DISINFECTION
Health Aspects of Waters at Public Health Resorts,
W82-04348 5A

Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 5D

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

Effect of Halogens on Giardia Cyst Viability,
W82-04401 5F

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 5C

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

DISPERSION COEFFICIENTS
Dispersion Coefficients in Estuaries,
W82-04684 5B

DISSOLVED OXYGEN
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

DISSOLVED SOLIDS
Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

DISTILLATION
Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 3A

DISTRIBUTION PATTERNS
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

DIURNAL DISTRIBUTION
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

DOMESTIC WASTES
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

DOMESTIC WATER
Deterministic Models for Predicting Residential Water Consumption, W82-04352 6D
A Method for Estimating Peak Water Demand of Multifamily Residences, W82-04734 6D

DRAIN SPACING
Water Movement Factors Important to the Design and Operation of Subirrigation Systems, W82-04538 3F

DRAINAGE
Young's Inequality for Three-Dimensional Flows, W82-04267 2A

DRAINAGE AREA
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA, W82-04304 2E

DRAINAGE EFFECTS
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage, W82-04721 2A

DRAINAGE SYSTEMS
Pumped Outlets for Drainage Systems, W82-04364 8A
Water Movement Factors Important to the Design and Operation of Subirrigation Systems, W82-04538 3F
Evaluation of a Chimney Drain Design in an Earthfill Dam, W82-04675 8D

DRAINAGE WELLS
Delayed Drainage in a Stream-Aquifer System, W82-04268 2F

DRINKING WATER
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems, W82-04277 5A
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment, W82-04301 5F
Granular Activated Carbon Installations, W82-04391 5F
Effect of Halogens on Giardia Cyst Viability, W82-04401 5F
Control of Trihalomethanes in Drinking Water, W82-04425 5F
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies, W82-04427 5F
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria, W82-04469 5A
Purification of Surface Waters (Reinigung von Oberflachenwasser), W82-04577 5F
Clean Water for the Third World, W82-04604 6D
The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade, W82-0460[illegible] 6D

DROUGHT
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design, W82-04334 2E
The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models, W82-04474 6A
Energy and Water Conservation Strategies in Irrigated Agriculture, W82-04736 3F

DUCKS
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks, W82-04468 5B

DUCKWEED
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla), W82-04479 5B

DURANCE RIVER BASIN
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields, W82-04303 2A

DYES
Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment, W82-04478 5B

DYNAMIC PROGRAMMING
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis, W82-04430 6A

EARTH DAMS
Evaluation of a Chimney Drain Design in an Earthfill Dam, W82-04675 8D

EAST CHICAGO
Evaluation of a Treatment Lagoon for Combined Sewer Overflow, W82-04623 5D

EASTERN COAL PROVINCE
Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980, W82-04516 7C

ECOLOGICAL EFFECTS
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species, W82-04389 5C
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals, W82-04420 5B
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill, W82-04548 5C
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I, W82-04749 6G

ECONOMIC ANALYSIS
Auburn Dam: A Case Study of Water Policy and Economics, W82-04260 6B

ECONOMIC ASPECTS
An Economist's View of Demand Projections Considering Conservation, W82-04448 6D
A Manual for Development of Small Scale Hydroelectric Projects by Public Entities, W82-04634 6E
Money Down the Drain, W82-04653 4A
Demand Signals for Urban Drainage and Flood Control Projects, W82-04737 6A
A Municipal Water Supply Investment Problem in Rhode-Island, W82-04740 6D

ECONOMIC EVALUATION
Micro Hydropower in the USA, W82-04316 8A

ECONOMIC FEASIBILITY
The Financing of Private Small Scale Hydroelectric Projects, W82-04633 6B

ECOSYSTEMS
Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System, W82-04253 7C
Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation, W82-04735 6G

EFFLUENT STANDARDS
Three Important Court Decisions, W82-04349 6E

EFFLUENTS
Performance of Activated Sludge Processes: Reliability, Stability and Variability, W82-04394 5D
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems, W82-04399 5D
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage, W82-04409 5C
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia, W82-04465 5B
Automatic Measuring Station for Continuous Monitoring of Rivers, W82-04569 5A
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West), W82-04607 5A

EGGS
Pesticides in the Aquatic Environment, W82-04727 5C

EGYPT
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals, W82-04290 5B

ELBE RIVER
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle), W82-04580 5A

ELECTRIC POWER PRODUCTION
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I, W82-04749 6G

ELECTROPLATING
Treatment of Noncyanide Electroplating Cadmium Westewater by Reverse Osmosis, W82-04664 5D

ELEVATION
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 2E

ENERGY
Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 3F

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act,
W82-04635 6B

ENERGY CONSERVATION
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 8B

ENGLAND
Riding Mill Pumping Station,
W82-04292 8A

Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 5C

Design of Filters for Clay Cores of Dams,
W82-04321 8G

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

A Suspended Sediment Front in the Severn Estuary,
W82-04639 2L

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 2E

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 2E

The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

ENVIRONMENTAL EFFECTS
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 5A

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

ENVIRONMENTAL QUALITY
Who Wins in the Fight for Pollution Control,
W82-04554 6B

ENZYMES
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

EQUIPMENT
Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermessstellen),
W82-04582 7B

EROSION
Bank Failure and Erosion on the Ohio River,
W82-04473 2J

How Rain Intensity Affects Interrill Erosion,
W82-04537 2J

The Vortex Scour Mechanism at Bridge Piers,
W82-04642 8B

ESTIMATING
Flood Probability Estimation,
W82-04318 6B

ESTUARIES
Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 2L

Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 2L

Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 2L

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

Salinity Intrusion in Estuaries,
W82-04574 2L

Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 2L

A Suspended Sediment Front in the Severn Estuary,
W82-04639 2L

Dispersion Coefficients in Estuaries,
W82-04684 5B

ESTUARINE ENVIRONMENT
Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 7B

Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 2L

ETHIOPIA
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

ETHYL METHANESULFONATE
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

EUROPEAN ECONOMIC COMMUNITY
Experiences with EEC Guideline 75/440 on the Quality of Surface Waters for Drinking Water Production in the Member States (Erfahrungen mit der EG Richtlinie 75/440 Uber die Qualitat von Oberflachenwasser fur die Trinkwassergewinnung in den Mitgliedstaaten),
W82-04547 6E

EUTROPHIC LAKES
The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 5C

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

EUTROPHICATION
Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C

Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 5C

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 2H

EVALUATION
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

EVAPORATION
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

EVAPOTRANSPIRATION
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 3F

Water Budget Computations for a Shallow-Lake Okeechobee, Florida,
W82-04258 2H

Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

EVERGLADES
Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

EXCAVATION
Groundwater Control,
W82-04714 4B

FARM WASTES
Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 5E

FATE OF POLLUTANTS
Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 2H

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 5D

A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 5B

Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

Development of Improved Stormwater Quality Models,
W82-04559 5B

FATTY AMINES
Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 5D

FEASIBILITY STUDIES
Determining Feasibility of Small-Scale Hydropower,
W82-04693 6B

FECAL STREPTOCOCCUS
Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 5B

FEDERAL JURISDICTION
Development of Federal Reserve Rights,
W82-04446 6E

New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

FERRIC CHLORIDE
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 5D

FILTERS
Design of Filters for Clay Cores of Dams,
W82-04321 8G

FILTRATION
Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 5F

Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 5D

Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

FINANCING
The Financing of Private Small Scale Hydroelectric Projects,
W82-04633 6B

Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

FINLAND
Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 7B

FISH
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 6G

FISH DIETS
Status Report on Striped Bass Analyses,
W82-04386 8I

FISH FOOD ORGANISMS
Status Report on Striped Bass Analyses,
W82-04386 8I

FISH LAKE
Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

FISH PONDS
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

FISH POPULATIONS
Status Report on Striped Bass Analyses,
W82-04386 8I

The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 5C

FISHERIES
Engineering in Catfish Production,
W82-04367 8I

FLASH FLOODS
Disaster by Flood,
W82-04618 2E

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 2E

FLOCCULATION
Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 5F

FLOOD CONTROL
Detention Basins--An Urban Experience,
W82-04332 4A

Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 6A

Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 6F

FLOOD-CONTROL STORAGE
Analysis of Detention Basin Systems,
W82-04444 2A

FLOOD DAMAGE
Disaster by Flood,
W82-04618 2E

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 2E

FLOOD FLOW
The Future of Flood Estimation and the Flood Studies Report,
W82-04687 2E

FLOOD FORECASTING
Flood Probability Estimation,
W82-04318 6B

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 2E

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 2E

Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 2B

FLOOD FREQUENCY
Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 2E

FLOOD PEAK
Analysis of Detention Basin Systems,
W82-04444 2A

FLOOD PLAIN MANAGEMENT
The Future of Flood Estimation and the Flood Studies Report,
W82-04687 2E

FLOOD PLAINS
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 6F

FLOOD WAVES
Asymptotic Solution for Dam-Break Problem,
W82-04313 8B

FLOODS
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 2E

FLORIDA
Water Budget Computations for a Shallow-Lake Okeechobee, Florida,
W82-04258 2H

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 7C

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 10C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 5C

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 2H

FLORIDAN AQUIFER
Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

FLOW AUGMENTATION
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 2E

FLOW CHARACTERISTICS
Conformal Mapping for Channel Junction Flow,
W82-04306 2E

Measurement of Air in Flowing Water,
W82-04322 7B

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 2E

Storm Sewer Flow Computations,
W82-04640 7B

Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 8B

Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 8B

FLOW CONTROL
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

James Bay Spillways and Control Structures,
W82-04692 8A

FLOW MEASUREMENT
The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 7B

FLOW PROFILES
Young's Inequality for Three-Dimensional Flows,
W82-04267 2A

FLOW RATE
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

FLOW REGULATORS
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

FLOW RESISTANCE
Resistance Equation for Large-Scale Roughness,
W82-04696 2E

FLOW SYSTEM
Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 7B

FLUORIDE
Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 5F

FLUSHING
Reducing the Flush,
W82-04654 3D

FOOD CHAINS
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

FOOD PROCESSING INDUSTRY
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 3E

FOOD-PROCESSING WASTES
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

FORECASTING
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

FOREST FIRES
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 4C

FOREST MANAGEMENT
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 4C

FORT UNION COAL REGION
Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 5C

FOS REFINERY
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

FRANCE
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 5A

FRASER RIVER
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

FRASER RIVER ESTUARY
Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

FRAZIL ICE
Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 2C

FREEZE DRYING
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

FREEZING
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 3A

FRENCH ALPS
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

FUEL
Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 6B

GAGING STATIONS
Search: A Gaged Watershed Inventory,
W82-04433 10B

GAMO ESTUARY
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

GAS CHROMATOGRAPHY
Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 5A

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

GENERA IDENTIFICATION
An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 5C

GEOCHEMISTRY
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 2F

Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 2K

GEOHYDROLOGIC UNITS

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

GEOHYDROLOGY

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 4B

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

GEOLOGIC FRACTURES

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

GEOLOGICAL SURVEYS

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

GEOPHYSICAL SURVEYS

Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers,
W82-04412 5A

GEOTHERMAL POWER

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act,
W82-04635 6B

GEOTHERMAL STUDIES

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1A

GERMANY

Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 4B

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 7B

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 5D

GIARDIA

Effect of Halogens on Giardia Cyst Viability,
W82-04401 5F

GILBERT ISLANDS

A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

GLUCOSE

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

GLYCIDOL

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

GRAPHICAL METHODS

Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A

Relative Runoff by Curve Number Nomograph,
W82-04307 2A

GREAT LAKES

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 2B

Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 2H

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

GREAT PLAINS

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

GREEN BAY

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

GROUNDWATER

Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 2F

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 4B

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 6D

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 7C

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 7C

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 7C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 7C

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 7C

Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermesstellen),
W82-04582 7B

GROUNDWATER AVAILABILITY

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

GROUNDWATER LEVEL
Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 7C

GROUNDWATER MANAGEMENT
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 4B

The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 4B

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

Recent Developments in Colorado Groundwater Law,
W82-04679 6E

Groundwater Control,
W82-04714 4B

GROUNDWATER MINING
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

GROUNDWATER MOUNDS
A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 2F

GROUNDWATER MOVEMENT
Delayed Drainage in a Stream-Aquifer System,
W82-04268 2F

The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 2F

Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 4B

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 4B

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

Ground Water Monitoring of Underground Coal Mines,
W82-04750 5B

GROUNDWATER POLLUTION
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 5B

GROUNDWATER POTENTIAL
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 2A

GROUNDWATER PROTECTION
Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 4B

GROUNDWATER RECHARGE
The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 4B

Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 2F

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 2F

Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 2F

GROWTH RATES
The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 5C

GROWTH STAGES
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

GUILFORD-CHESTER DIVISION
Year-Round Distribution System Maintenance,
W82-04699 5F

GULF OF MEXICO
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 2K

HALOETHERS
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

HALOGENS
Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 5F

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

HAZARDOUS MATERIALS
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 5A

An Integrated Water-Quality Index for Irrigation Use,
W82-04723 5C

HAZARDS
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

HEAVY METALS
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 5D

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D

A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 5B

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 5A

Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 5C

HERBICIDES
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

HEXACHLOROBENZENE
Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 5B

HIGHWAY EFFECTS
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

HIGHWAYS
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

HISTORY
The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 6E

HOLDING TANKS
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

HOT SPRINGS
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

HOUSING
Adopting Sewers,
W82-04655 8A

HUNGARY
Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 5D

HYDRAULIC DESIGN
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

HYDRAULIC GATES
James Bay Spillways and Control Structures,
W82-04692 8A

HYDRAULIC JUMP
Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 8B

HYDRAULIC ROUGHNESS
Resistance Equation for Large-Scale Roughness,
W82-04696 2E

HYDROCARBONS
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

HYDROELECTRIC PLANTS
Micro Hydropower in the USA,
W82-04316 8A

Small Hydro Schemes for Private Developers,
W82-04327 8A

Rural Power Schemes in Pakistan,
W82-04328 8A

The Financing of Private Small Scale Hydroelectric Projects,
W82-04633 6B

A Manual for Development of Small Scale Hydroelectric Projects by Public Entities,
W82-04634 6E

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah,
W82-04636 6D

Determining Feasibility of Small-Scale Hydropower,
W82-04693 6B

HYDROELECTRIC POWER
The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 6A

Development of Hydro-Power in Nigeria,
W82-04475 6B

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act,
W82-04635 6B

HYDROGEN ION CONCENTRATION
The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 5D

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 2K

HYDROGRAPHS
The General Hydrologic System Model,
W82-04314 2A

Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 2A

A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 2A

HYDROLOGIC ASPECTS
Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 7B

HYDROLOGIC BUDGET
Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 2H

Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 2F

HYDROLOGIC BUDGETS
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 2A

HYDROLOGIC CYCLE
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

HYDROLOGIC DATA
Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 7C

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 7C

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 7C

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 7C

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 7C

HYDROLOGIC MODELS
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 4A

Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

The General Hydrologic System Model,
W82-04314 2A

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 5B

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 4C

Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 2A

HYDROLOGY
Decisions Under Violation of Regression Normality,
W82-04264 7C

HYDROSTATIC PRESSURE
Application of the Area of Review Concept,
W82-04674 6E

HYDROTHERMAL STUDIES
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1A

HYSTERESIS
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

ICE
Convection Patterns in a Pond,
W82-04461 2C

Acid Snow in the Canadian High Arctic,
W82-04542 2C

ICE COVER
Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 2C

ICE FORMATION
Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 2C

ILLINOIS
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 2B

Three Important Court Decisions,
W82-04349 6E

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 2J

Pesticides in the Aquatic Environment,
W82-04727 5C

ILLINOIS WATERWAY
Water Chemistry of the Illinois Waterway,
W82-04390 2K

ILLINOIS WATERWAY DAMS
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

IMPAIRED WATER USE
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

IMPOUNDMENTS
Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 7B

INCINERATION
Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 5E

Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 5E

INDIA
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 3F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 2B

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 2K

Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 2B

INDIAN RESERVATIONS
The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 6E

INDIANA
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

INDICATORS
Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

INDUSTRIAL WASTES
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnoestta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 5C

New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

Who Wins in the Fight for Pollution Control,
W82-04554 6B

INDUSTRIAL WASTEWATER
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04[illegible]82 5D

Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

A Treatment System for an Organic Chemicals Plant,
W82-04353 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

INDUSTRIAL WATER
Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 5F

Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 3E

The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

INFILTRATION
Dimensionless Stream Advance in Sloping Borders,
W82-04308 3F

Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 2A

Effect of Surface Sealing on Infiltration,
W82-04362 2G

Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 2G

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 2G

INFLOW FORECASTING
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

INFLUENT STREAMS
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 2F

INFLUENZA
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

INFORMATION EXCHANGE
Experiments in Improving Rural Water Supplies,
W82-04350 5F

INFORMATION RETRIEVAL
Search: A Gaged Watershed Inventory,
W82-04433 10B

INFORMATION SYSTEMS
An Interactive Data Management System for River Water Quality Data,
W82-04659 10B

INJECTION WELLS
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 8B

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

Application of the Area of Review Concept,
W82-04674 6E

INLETS
Tapered Inlet Design Using Specific Energy Curves,
W82-04695 8A

INPUT-OUTPUT ANALYSIS
Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 6A

INSECTICIDES
Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 5C

INSTITUTIONAL CONSTRAINTS
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 6E

INTERSTITIAL WATER
Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

IODINE
Effect of Halogens on Giardia Cyst Viability,
W82-04401 5F

ION EXCHANGE
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

IRON
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F

IRRIGATION
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 7C

IRRIGATION DESIGN
Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 3F

IRRIGATION DISTRICTS
Local Irrigation Agencies,
W82-04560 4B

IRRIGATION EFFECTS
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 5C

IRRIGATION EFFICIENCY
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 3F

Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 2G

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 3F

IRRIGATION PRACTICES
Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 3F

IRRIGATION PROGRAMS
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 6B

IRRIGATION REQUIREMENTS
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

IRRIGATION WATER
An Integrated Water-Quality Index for Irrigation Use,
W82-04723 5C

ISOTOPE STUDIES
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 2K

ISRAEL
Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

JACKSON
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

JAPAN
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

JETS
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 8A

JUDICIAL DECISIONS
Three Important Court Decisions,
W82-04349 6E

The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 6E

KANKAKEE RIVER
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

KANSAS
Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 2E

KARST HYDROLOGY
Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 4B

KAWASAKI
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

KENAI RIVER
Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

KENNET RIVER
Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

KINEMATIC WAVE THEORY

Asymptotic Solution for Dam-Break Problem,
W82-04313 8B

KINETICS

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 5D

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 5D

LA GRANDE COMPLEX

James Bay Spillways and Control Structures,
W82-04692 8A

LAGOONS

The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 2L

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 5D

LAKE EDKU

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 2J

LAKE ERIE

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 2H

LAKE FRYXELL

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

LAKE HURON

Winter Temperature Structure in Lake Huron,
W82-04381 2H

LAKE ISTOKPOGA

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 2H

LAKE KINNERET

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

LAKE LILLINONAH

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

LAKE MARIUT

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

LAKE MATAMEC

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 2H

LAKE MEMPHREMAGOG

Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 2H

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

LAKE MICHIGAN

Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 2H

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

Water Chemistry of the Illinois Waterway,
W82-04390 2K

LAKE OKEECHOBEE

Water Budget Computations for a Shallow-Lake Okeechobee, Florida,
W82-04258 2H

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

LAKE ONTARIO

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 2H

LAKE RAY HUBBARD

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C

LAKE RESTORATION

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 5C

LAKE SEDIMENTS

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 2H

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 2J

LAKE SHORES

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

LAKE SUPERIOR

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

LAKES

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 5C

Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 2H

Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 2H

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 2H

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 5C

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 2H

Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 2H

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 2H

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 2H

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

LAMINAR FLOW

Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 2L

LAND DISPOSAL

Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 5B

Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 5D

LAND MANAGEMENT
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 2A

LAND RECLAMATION
Topsoil Management of Mined Soils,
W82-04571 4D

LAND TENURE
Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 6E

LAND USE
Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A

Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 2A

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 4C

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

LANDFILLS
Three Important Court Decisions,
W82-04349 6E

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 5B

LANDSAT
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

LAS VEGAS SE QUADRANGLE
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

LAWNS
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

LEACHATES
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 5B

LEACHING
Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 5B

LEAD
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 5F

LEAKAGE
Leak Detection--Histories,
W82-04363 3D

Leak Detection Programs Recover Revenues,
W82-04375 3D

LEAVES
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 2I

LEE COUNTY
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

LEGAL ASPECTS
The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 6E

Experiences with EEC Guideline 75/440 on the Quality of Surface Waters for Drinking Water Production in the Member States (Erfahrungen mit der EG Richtlinie 75/440 Uber die Qualitat von Oberflachenwasser fur die Trinkwassergewinnung in den Mitgliedstaaten).
W82-04547 6E

A Manual for Development of Small Scale Hydroelectric Projects by Public Entities.
W82-04634 6E

Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 6E

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 6E

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 6E

LIME
Lime Softening Sludge Treatment and Disposal.
W82-04276 5E

LIMESTONE AQUIFERS
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 2F

LIMNOLOGY
Simulation and Verification of Lake Ontario's Mean State,
W82-04570 2H

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 2H

LININGS
Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

LIPIDS
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

LITTER
Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

LITTORAL ENVIRONMENT
Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

LOANS
The Financing of Private Small Scale Hydroelectric Projects.
W82-04633 6B

LOCAL GIVERNMENTS
A Manual for Development of Small Scale Hydroelectric Projects by Public Entities.
W82-04634 6E

LONG ISLAND
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 5B

LOS ANGELES
Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 5D

LOUISIANA
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 8B

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 7C

LOUISVILLE
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 5D

LOW FLOW
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 2E

MACROPHYTES
The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnoastta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 5C

MACROPOROUS RESINS
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 5D

MAINE
The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 5C

MAINTENANCE
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 5D

Year-Round Distribution System Maintenance,
W82-04699 5F

MANAGEMENT PLANNING
Decisions Under Violation of Regression Normality,
W82-04264 7C

Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

MANCHESTER
Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 5G

MAPPING
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 2B

MAPS
Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 7C

MARGINAL COSTS
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 6C

On the Marginal Cost of Wastewater Services,
W82-04376 6C

MARINE BACTERIA
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

MARKETING
Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

MARSH PLANTS
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04348 5C

MARSHES
Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 2H

MASSACHUSETTS
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

Massachusetts Water Supply Priorities,
W82-04698 6D

MATHEMATICAL EQUATIONS
Young's Inequality for Three-Dimensional Flows,
W82-04267 2A

Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 4A

MATHEMATICAL MODELS
Decisions Under Violation of Regression Normality,
W82-04264 7C

Delayed Drainage in a Stream-Aquifer System,
W82-04268 2F

The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 2F

Relative Runoff by Curve Number Nomograph,
W82-04307 2A

Dimensionless Stream Advance in Sloping Borders,
W82-04308 3F

Reservoir Sedimentation with Random Deposits,
W82-04443 2J

Analysis of Detention Basin Systems,
W82-04444 2A

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 2F

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 5D

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 8D

Modelling Evaporation from Reservoirs,
W82-04722 2D

MATHEMATICAL STUDIES
Dimensionless Stream Advance in Sloping Borders,
W82-04308 3F

The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 5D

Application of the Area of Review Concept,
W82-04674 6E

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

MEADOWS
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

MEASURING INSRUMENTS
Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Losemittel in Luft und Wasser),
W82-04579 5A

MEASURING INSTRUMENTS
Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 7B

Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 7B

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

MEAT PROCESSING INDUSTRY
Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 5D

MECHANICAL FAILURE
Bank Failure and Erosion on the Ohio River,
W82-04473 2J

MEDFIELD
Vacuum Filtration of Septage,
W82-04710 5D

MEMBRANE PROCESSES
Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 5A

METAL-FINISHING WASTES
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 5D

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

METALS
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

METEOROLOGICAL DATA COLLECTION
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

METHANE
Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 5E

MEXICO
The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 2L

MICROBIOLOGICAL STUDIES
Health Aspects of Waters at Public Health Resorts,
W82-04348 5A

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

MICROORGANSIMS
Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 5D

MIDDLE LOUP RIVER
Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

MINE DRAINAGE
Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D

A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 5A

MINERAL SPRINGS
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 2K

MINNEAPOLIS
Coagulation: Experiences in Organics Removal,
W82-04424 5F

MINNESOTA
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 5E

MISSISSIPPI
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

MISSISSIPPI LAKE
Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

MISSISSIPPI RIVER
Will New Orleans Miss The Mississippi,
W82-04274 4A

Coagulation: Experiences in Organics Removal,
W82-04424 5F

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 7B

MIXING
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 7C

Winter Temperature Structure in Lake Huron,
W82-04381 2H

Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 8A

Nearfield Performance of River Diffusers,
W82-04561 5B

Salinity Intrusion in Estuaries,
W82-04574 2L

Dispersion Coefficients in Estuaries,
W82-04684 5B

MODEL STUDIES
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 6C

Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 2H

Obtaining Layout of Water Distribution Systems,
W82-04319 8A

Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

Effect of Surface Sealing on Infiltration,
W82-04362 2G

Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 2J

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 2H

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 5B

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 5B

Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 4B

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 2A

The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 6A

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 2F

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 7B

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

Water Reuse Planning Models: Extensions and Applications,
W82-04565 6A

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 2H

Estimation and Control Problems in Activated Sludge Processes,
W82-04612 5D

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

Prediction of the Circulation in Reservoirs,
W82-04682 2H

Optimization of Areawide Wastewater Management,
W82-04703 5D

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 6A

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 3D

The Chemistry of Saline Water Chlorination,
W82-04729 3C

MOISTURE PROBE
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 4B

MONITORING
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 5F

Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 5A

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 7B

Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 5A

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 7B

The Unterweser Automatic Water Quality Measurement System,
W82-04585 5A

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 7A

Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 7B

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 5A

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 2E

Ground Water Monitoring of Underground Coal Mines,
W82-04750 5B

MONOCHLORAMINE
The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 5F

MONSOONS
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B

MONTANA
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6E

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 5C

MOSEL RIVER
Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

MUDFLOWS
The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 2E

MUDMINNOW
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

MULTIOBJECTIVE PLANNING
A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 6A

MULTIPURPOSE RESERVOIRS
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 6C

Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 6A

MULTIVARIATE ANALYSIS
A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 3D

MUNICIPAL WASTEWATER
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

Municipal Sewage Treatment - Some Recent Developments,
W82-04528 5D

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 5D

MUNICIPAL WATER
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 6E

When a Water Supply Went Bad.
W82-04357 5C

The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 5F

The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 3D

MUTAGENS
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

NASSAU COUNTY
Optimization of Areawide Wastewater Management,
W82-04703 5D

NATURAL RESOURCES
Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 10C

NAVIGATION CANALS
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

NEBRASKA
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 6B

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 6G

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

NETHERLANDS
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

NETWORK DESIGN
Obtaining Layout of Water Distribution Systems,
W82-04319 8A

A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 6A

NEUTRON ACTIVATION ANALYSIS
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

NEVADA
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

NEW ENGLAND
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 5G

NEW HAMPSHIRE
Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 6E

NEW JERSEY
When a Water Supply Went Bad.
W82-04357 5C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

NEW MEXICO
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

NEW ORLEANS
Will New Orleans Miss The Mississippi,
W82-04274 4A

NEW YORK
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

Search: A Gaged Watershed Inventory,
W82-04433 10B

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

NEW ZEALAND
The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 6A

NIGERIA
Development of Hydro-Power in Nigeria.
W82-04475 6B

The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 5D

NITRATES
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

NITRIFICATION
Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 5D

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 5C

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 5D

NITRITES
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 5C

NONPOINT POLLUTION SOURCES
Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 5B

Strategies to Control Nonpoint Source Water Pollution,
W82-04261 5G

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 5B

NORTH CAROLINA
Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

NUCLEAR POWERPLANTS
The Unterweser Automatic Water Quality Measurement System,
W82-04588 5A

NUMERICAL ANALYSIS
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 2F

Modelling Evaporation from Reservoirs,
W82-04722 2D

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

NUTRIENT REMOVAL
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

NUTRIENTS
Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 2L

Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 2L

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 2H

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 5A

OBSERVATION WELLS
Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 7C

ODOR CONTROL
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

OHIO RIVER
Bank Failure and Erosion on the Ohio River,
W82-04473 2J

OHIO RIVER BASIN
An Interactive Data Management System for River Water Quality Data,
W82-04659 10B

OIL INDUSTRY
Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 6E

OIL REFINERIES
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

OIL SHALE
Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 6E

OIL SKIMMERS
Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 5G

OIL SPILLS
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 5G

OIL TANKERS
Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 5D

OIL WELLS
Application of the Area of Review Concept,
W82-04674 6E

OILY WATER
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 5D

OKLAHOMA
Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 7C

ON-SITE SYSTEMS
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

ONTARIO
Water Management in Ontario,
W82-04259 6E

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

OPERATING COSTS
Leak Detection Programs Recover Revenues,
W82-04375 3D

On the Marginal Cost of Wastewater Services,
W82-04376 6C

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 5D

OPERATING POLICIES
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 6A

OREGON
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A

ORGANIC CARBON
Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 5F

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 5D

ORGANIC COMPOUNDS
A Treatment System for an Organic Chemicals Plant,
W82-04353 5D

Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 5A

Control of Trihalomethanes in Drinking Water,
W82-04425 5F

Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 5F

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 5B

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 5D

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 5D

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 5F

ORGANIC LOADING
Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

ORGANIC MATTER
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

Colloidal Organics,
W82-04689 5F

ORGANIC WASTES
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 5D

OSAKA
Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

OXIDATION
Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 5F

OXIDATION LAGOONS
Use of Microscreens to Polish Lagoon Effluents,
W82-04709 5D

OXYGEN
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 2H

OXYGEN TRANSFER
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 5D

OXYGEN UPTAKE
Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 5C

OXYGENATION
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

OZONATION
Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 5F

OZONE
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 5F

PAKISTAN
Rural Power Schemes in Pakistan,
W82-04328 8A

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 6A

PAPENKUILS RIVER
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 5B

PARASITES
Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

PARIS
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

PATH OF POLLUTANTS
Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 2H

PATHOGENIC BACTERIA
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

PATHOGENS
Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

PATUXENT RIVER
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

PEAK DEMAND
A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 6D

PEARL RIVER
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

PENNSYLVANIA
Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 7C

PERCH
The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 5C

PERCOLATING FILTERS
Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 5D

PERFORMANCE EVALUATION
Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 8D

PESTICIDES
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

Pesticides in the Aquatic Environment,
W82-04727 5C

PHARMACEUTICAL INDUSTRY
Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 5F

PHARMACEUTICAL WASTES
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

PHENOLS
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 5C

PHOSPHATE REMOVAL
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 5F

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 5F

PHOSPHOROUS
Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 2H

PHOSPHORUS
Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C

The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 2L

Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 2H

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

PHOSPHORUS REMOVAL
Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 4D

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 5D

PHYSICAL PROPERTIES
Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 2H

PHYSICOCHEMICAL TREATMENT
Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 5D

PHYTOPLANKTON
Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 5C

Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 2L

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 5C

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 2H

PIERS
The Vortex Scour Mechanism at Bridge Piers,
W82-04642 8B

PILOT PLANTS
Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 5D

PIPE FLOW
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 8A

Storm Sewer Flow Computations,
W82-04640 7B

Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 8B

PIPELINES
The Traditional Approach to Water Loss,
W82-04656 3D

PIPES
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

PLANKTON
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 2H

Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 2H

Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

PLANNING
Objectives and Constraints in Federal Water Resources Planning,
W82-04288 6E

Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 4A

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 6A

Optimization of Areawide Wastewater Management,
W82-04703 5D

Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 6A

PLANT GROWTH
Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 2I

PLANT TISSUES
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 2D

PLANT TOXINS
An Integrated Water-Quality Index for Irrigation Use,
W82-04723 5C

PLANT WATER POTENTIAL
Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 2I

PLANTING MANAGEMENT
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 2B

PLATTE RIVER
Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 6G

PLUMES
Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 2L

POLAR REGIONS
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

POLITICAL CONSTRAINTS
Objectives and Constraints in Federal Water Resources Planning,
W82-04288 6E

POLLUTANT IDENTIFICATION
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 5A

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 5B

Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 5B

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

POLLUTANTS
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

POLYBROMINATED BIPHENYLS
Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 5B

POLYMERS
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 5A

PONDING
Infiltration into Two-Layered Soil Profiles,
W82-04536 2G

PONDS
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 5E

Convection Patterns in a Pond,
W82-04461 2C

Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 2H

POROSITY
Young's Inequality for Three-Dimensional Flows,
W82-04267 2A

POTATOES
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

POTENTIOMETRIC LEVEL
Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 7C

POWERPLANTS
Micro Hydropower in the USA,
W82-04316 8A

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D

Small Hydro Schemes for Private Developers,
W82-04327 8A

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 3A

PRECIPITATION
Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 2B
Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 2E
Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

PRECIPITATION INTENSITY
Young's Inequality for Three-Dimensional Flows,
W82-04267 2A

PREDICTION
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 2E

PREIMPOUNDMENT
Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 6A

PRICE DISCRIMINATION
Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 6C

PRICES
Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 6B

PRICING
Conserving Water Through Pricing,
W82-04272 3D
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 6E
On the Marginal Cost of Wastewater Services,
W82-04376 6C
Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 6C

PRIMARY PRODUCTION
Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 5C

PRIMARY PRODUCTIVITY
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 2H
Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 2H

PRIMARY WASTEWATER TREATMENT
Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 5D

PROCESS CONTROL
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A
Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 5D

PROJECTS
Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

PROTOZOA
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

PUBLIC HEALTH
Regulating Corrosive Water,
W82-04335 6B
Clean Water for the Third World,
W82-04604 6D
The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 6D

PUBLICATIONS
Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 10C

PUDDLING
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

PULP AND PAPER INDUSTRY
Densification of Paper Mill Sludge Materials,
W82-04694 5E

PUMP WELLS
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 8B
Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

PUMPAGE
Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 2F

PUMPING
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

PUMPS
Pumped Outlets for Drainage Systems,
W82-04364 8A

QUALITY CONTROL
Analytical Quality Control,
W82-04345 5G

QUEBEC
Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 2H
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I
James Bay Spillways and Control Structures,
W82-04692 8A

RADAR
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B
Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 2B

RADIOACTIVE WASTE DISPOSAL
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 5B

RAIN
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B
A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 2K

RAIN GAGES
Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 2B

RAIN INTENSITY
How Rain Intensity Affects Interrill Erosion,
W82-04537 2J

RAINFALL
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B
Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 2B
The Future of Flood Estimation and the Flood Studies Report,
W82-04687 2E
Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

RAINFALL DISTRIBUTION
Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 2B
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 2B

RAINFALL INTENSITY
Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 2B

RAINFALL RATE
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential

Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B

RAINSTORMS
Storm Runoff Analyses on Three Semi-Arid Catchments.
W82-04339 2A

RECREATION
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

The Welsh Approach to Water Recreation,
W82-04658 6D

RECREATION FACILITIES
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

RECYCLING
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

RED SEA
Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 3A

REGIONAL PLANNING
Strategies to Control Nonpoint Source Water Pollution,
W82-04261 5G

REGRESSION ANALYSIS
Decisions Under Violation of Regression Normality,
W82-04264 7C

REGULATIONS
Water Management in Ontario,
W82-04259 6E

New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 6E

Ground Water Monitoring of Underground Coal Mines,
W82-04750 5B

REMOTE SENSING
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B

Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 2B

Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 5A

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

RESERVATION DOCTRINE
Development of Federal Reserve Rights,
W82-04446 6E

RESERVOIR COVERS
Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 5G

RESERVOIR DESIGN
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 2E

RESERVOIR EVAPORATION
Modelling Evaporation from Reservoirs,
W82-04722 2D

RESERVOIR MANAGEMENT
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 6A

RESERVOIR OPERATION
Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 4A

RESERVOIR RELEASES
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 6A

RESERVOIRS
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

Reservoir Sedimentation with Random Deposits,
W82-04443 2J

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 2J

Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 4A

Prediction of the Circulation in Reservoirs,
W82-04682 2H

James Bay Spillways and Control Structures,
W82-04692 8A

Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 5G

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 6E

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 5G

The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 5G

Modelling Evaporation from Reservoirs,
W82-04722 2D

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

RESIDENTIAL WATER
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

RESIDUAL CHLORINE
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 5D

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

RESINS
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 5D

RESISTIVITY
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

RESONANCE
Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 8B

RESOURCES MANAGEMENT
Topsoil Management of Mined Soils,
W82-04571 4D

RESPIRATION
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

RETENTION BASINS
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 5D

REVERSE OSMOSIS
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

REVIEWS
Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 7B

RHINE RIVER
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

RHODE ISLAND
A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 6D

RHODE RIVER ESTUARY
Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 2L

RICE
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 2I

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

RILL EROSION
How Rain Intensity Affects Interrill Erosion,
W82-04537 2J

RISKS
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

RIVER BASIN DEVELOPMENT
Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 6D

RIVER BASINS
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 2A

RIVER BEDS
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 2J

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

Resistance Equation for Large-Scale Roughness,
W82-04696 2E

RIVER FLOW
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

RIVER SYSTEMS
Data Acquisition for River Management,
W82-04601 7A

RIVER WATER
The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 5F

RIVERS
A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 7A

Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 5B

ROAD CONSTRUCTION
Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 4B

ROADS
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

ROOTS
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 2D

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 2I

ROTATING DISK EVAPORATORS
Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

RUNOFF
Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 5B

Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

RUNOFF CYCLE
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 6G

RUNOFF FORECASTING
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 2A

RUNOFF RATES
Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 2E

RURAL AREAS
Rural Power Schemes in Pakistan,
W82-04328 8A

Experiments in Improving Rural Water Supplies,
W82-04350 5F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

SACRAMENTO
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 6B

SACRAMENTO VALLEY
Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

SAGAMORE LAKE
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

SALAMANDERS
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 5C

SALINE-FRESHWATER INTERFACES
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 5A

SALINE SOILS
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

SALINE WATER
The Chemistry of Saline Water Chlorination,
W82-04729 3C

SALINE WATER INTRUSION
Will New Orleans Miss The Mississippi,
W82-04274 4A

Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

Salinity Intrusion in Estuaries,
W82-04574 2L

Dispersion Coefficients in Estuaries,
W82-04684 5B

SALINITY
Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

SALT DOMES
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 2K

SALT MARSHES
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 2L

SALT RIVER
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 2E

SAMPLE PRESERVATION
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 5A

SAMPLING
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 7B

Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermessstellen),
W82-04582 7B

SAND FILTERS
Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

SANGAMON RIVER
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

SAUDI ARABIA
Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 3A

SCALING
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F

SCOUR
The Vortex Scour Mechanism at Bridge Piers,
W82-04642 8B

SEA WATER
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 5C

SEASONAL EFFECTS
Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 5C

SEASONAL VARIATION
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 6C

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 2B

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 2E

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

SEAWATER
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

SECONDARY WASTEWATER TREATMENT
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 5D

SEDIMENT CONTROL
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

SEDIMENT COVERS
Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

SEDIMENT DISCHARGE
Reservoir Sedimentation with Random Deposits,
W82-04443 2J

SEDIMENT SAMPLER
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W87-04325 7B

Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 7B

SEDIMENT TRANSPORT
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 2J

Incipient Motion of Sand Particles on Side Slopes,
W82-04368 8D

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

How Rain Intensity Affects Interrill Erosion,
W82-04537 2J

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

SEDIMENTATION
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

Reservoir Sedimentation with Random Deposits,
W82-04443 2J

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 2H

SEDIMENTATION BASINS
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 4D

SEDIMENTATION RATES
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

SEDIMENTS
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 2H

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 2J

SEEPAGE CONTROL
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 5E

SEMIARID LANDS
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 2A

SEPARATION TECHNIQUES
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

SEPTIC TANKS
Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 5D

SEPTIC WASTEWATER
Vacuum Filtration of Septage,
W82-04710 5D

SETTLING VELOCITY
Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 5D

SEVERN ESTUARY
A Suspended Sediment Front in the Severn Estuary,
W82-04639 2L

SEVERN-TRENT WATER AUTHORITY
A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 7A

The Seven-Trent Studies of Industrial Water Use,
W82-04636 6D

SEVIER LAKE BASIN
Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 6D

SEWER INFILTRATION
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

SEWER SYSTEMS
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

Storm Sewer Flow Computations,
W82-04640 7B

Adopting Sewers,
W82-04655 8A

SHELLFISH
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 5C

SIMULATION
Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

SITE SELECTION
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

SLOPE DEGRADATION
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 2J

SLOPE STABILITY
Incipient Motion of Sand Particles on Side Slopes,
W82-04368 8D

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

SLOPES
Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 2A

SLUDGE
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

SLUDGE CONDITIONING
Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 5E

SLUDGE DISPOSAL
Lime Softening Sludge Treatment and Disposal.
W82-04276 5E

Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 5E

Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 5E

Densification of Paper Mill Sludge Materials,
W82-04694 5E

SLUDGE DRYING
American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 5D

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 5D

SLUDGE THICKENING
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

SLUDGE UTILIZATION
Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 5D

SLUDGE VOLUME INDEX
Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 5D

SLUSH
Convection Patterns in a Pond,
W82-04461 2C

SNOW
Acid Snow in the Canadian High Arctic,
W82-04542 2C

SNOWMELT
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 2E

A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 7B

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 2A

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 2E

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 2E

SOCIAL ASPECTS
The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 6D

SOIL CONTAMINATION
An Integrated Water-Quality Index for Irrigation Use,
W82-04723 5C

SOIL PROFILES
Infiltration into Two-Layered Soil Profiles,
W82-04536 2G

SOIL PROPERTIES
Effect of Surface Sealing on Infiltration,
W82-04362 2G

SOIL WATER
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 7B

Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 2A

Effect of Surface Sealing on Infiltration,
W82-04362 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 2G

Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 2G

SOIL WATER MOVEMENT
Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 3F

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 2G

SOIL-WATER-PLANT RELATIONSHIPS
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

SOLAR RADIATION
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 2H

SOLID WASTE DISPOSAL
Wet Disposal of Fossil Plant Waste: Case History, W82-04385 5E
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace, W82-04587 5E

SOLIDS CONTACT PROCESSES
Operational Performance of an RBC Unit in Conjunction with a Septic Tank, W82-04355 5D

SOLUBILITY
Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials, W82-04620 5B
Influence of an Americium Solid Phase on Americium Concentrations in Solutions, W82-04720 5B

SOLUTE TRANSPORT
Dispersion Coefficients in Estuaries, W82-04684 5B

SOLVENTS
Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Losemittel in Luft und Wasser), W82-04579 5A

SORGHUM
Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer, W82-04471 2I

SOUTH AFRICA
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn), W82-04262 5C
Storm Runoff Analyses on Three Semi-Arid Catchments, W82-04339 2A
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth, W82-04346 5B
Health Aspects of Waters at Public Health Resorts, W82-04348 5A
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans), W82-04359 2G

SOUTH CAROLINA
Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina, W82-04716 2L

SOUTH PLATTE RIVER
Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado, W82-04725 6A

SPATIAL DISTRIBUTION
Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec), W82-04472 2L

SPECIES COMPOSITION
Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec), W82-04472 2L

SPILLWAY CAPACITY
The Future of Flood Estimation and the Flood Studies Report, W82-04687 2E

SPILLWAY GATES
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams, W82-04388 5G

SPILLWAYS
Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel, W82-04645 8B
James Bay Spillways and Control Structures, W82-04692 8A

ST JOHNS RIVER
Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships, W82-04718 5B

ST. LAWRENCE ESTUARY
Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)), W82-04331 2L

ST LAWRENCE RIVER
Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec), W82-04472 2L

STABILIZATION PONDS
The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas, W82-04641 5D

STANDARDS
Evaluating Stream Standard Violations Using a Water Quality Data Base, W82-04286 5A

STATE JURISDICTION
Recent Developments in Colorado Groundwater Law, W82-04679 6E
Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine, W82-04680 6E

STATISTICAL ANALYSIS
Decisions Under Violation of Regression Normality, W82-04264 7C
Performance of Activated Sludge Processes: Reliability, Stability and Variability, W82-04394 5D
A Method for Estimating Peak Water Demand of Multifamily Residences, W82-04734 6D

STEEL INDUSTRY
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen), W82-04616 5D

STOCHASTIC HYDROLOGY
Comparison of Two Autoregressive Models for Monthly Stream Flow Generation, W82-04351 2E

STORAGE
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters, W82-04660 5A

STORAGE CAPACITY
Water Budget Computations for a Shallow--Lake Okeechobee, Florida, W82-04258 2H
Pumped Outlets for Drainage Systems, W82-04364 8A

STORM RUNOFF
Relative Runoff by Curve Number Nomograph, W82-04307 2A
The General Hydrologic System Model, W82-04314 2A
Storm Runoff Analyses on Three Semi-Arid Catchments, W82-04339 2A
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model, W82-04393 5B
Thunderstorm in Agriculture and in Forest Management, W82-04617 2B
Constituents of Highway Runoff; Volume I, State-of-the-Art Report, W82-04627 4C
Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report, W82-04637 5B

STORM SEWERS
Optimal Design of Urban Storm Water Drainage Systems, W82-04414 8A
Storm Sewer Flow Computations, W82-04640 7B

STORM WATER
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model, W82-04393 5B
Development of Improved Stormwater Quality Models, W82-04559 5B

STORMS
Hydroclimatological Characteristics of Isolated Severe Rainstorms, W82-04336 2B

STRATIFICATION
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis, W82-04378 2H

STREAM BANKS
Incipient Motion of Sand Particles on Side Slopes, W82-04368 8D

STREAM CLASSIFICATION
Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System, W82-04253 7C
Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation, W82-04735 6G

STREAM EROSION
Methods for Assessment of Stream-Related Hazards to Highways and Bridges, W82-04626 8A

STREAMFLOW
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 2E

Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 2E

Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 2E

Search: A Gaged Watershed Inventory,
W82-04433 10B

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 5C

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 2E

The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 7B

STREAMFLOW FORECASTING
A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 2A

STREAMFLOW-WATER QUALITY RELATIONS
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

STREAMS
Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

STRESS
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 6G

STRIP MINE WASTES
Topsoil Management of Mined Soils,
W82-04571 4D

STRIP MINES
Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 7C

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J

Topsoil Management of Mined Soils,
W82-04571 4D

STRUCTURAL GEOLOGY
Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 7C

STUTTGART
The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 5F

SUBLETHAL EFFECTS
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

SUBSTRATES
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

SUBSURFACE DRAINAGE
Delayed Drainage in a Stream-Aquifer System,
W82-04268 2F

SUBSURFACE IRRIGATION
Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 3F

SUGARCANE
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

SULFATES
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

SULFUR
The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 2H

SULFUR DIOXIDE
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

SUMPS
Pumped Outlets for Drainage Systems,
W82-04364 8A

SUNFLOWER
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

SURFACE-GROUNDWATER RELATIONS
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 6G

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 6A

SURFACE RUNOFF
A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J

SURFACE SEALING
Effect of Surface Sealing on Infiltration,
W82-04362 2G

SURFACE WATER
Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 7C

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 7C

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 7C

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 7C

SURGES
Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 8B

SUSPENDED SEDIMENTS
Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

A Suspended Sediment Front in the Severn Estuary,
W82-04639 2L

Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 7B

SUSPENDED SOLIDS
The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 5D

SWAMPS
Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

SWEDEN
Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 2H

SWIMMING POOLS
Health Aspects of Waters at Public Health Resorts,
W82-04348 5A

SYNOPTIC ANALYSIS
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 2B

SYNTHETIC ORGANICS
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 5F

TANZANIA
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C
Tanzania's Master Water Plan Will Miss Decade Goal,
W82-04657 5F

TARAWA
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

TASTE
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

TAXONOMY
An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 5C

TEESTA RIVER
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 2B

TELEMETRY
Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

TELTOW CANAL
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

TEMPERATURE
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 2H
Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 5D

TEMPERATURE EFFECTS
Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

TERTIARY WASTEWATER TREATMENT
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

TEST WELLS
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

TEXAS
Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C
TNRIS: A Source for Water-Related Data in Texas.
W82-04651 10B

THAMES RIVER
Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 2L
Data Acquisition for River Management,
W82-04601 7A
Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

THERMAL POLLUTION
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 7C
Nearfield Performance of River Diffusers,
W82-04561 5B

THERMAL PROPERTIES
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 2K

THERMAL SPRINGS
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 2K

THERMAL STRATIFICATION
Winter Temperature Structure in Lake Huron,
W82-04381 2H
Convection Patterns in a Pond,
W82-04461 2C
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

THERMAL WATER
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A

THUNDERSTORMS
Disaster by Flood,
W82-04618 2E

THUNERSTORMS
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

TIDAL EFFECTS
Salinity Intrusion in Estuaries,
W82-04574 2L
The Unterweser Automatic Water Quality Measurement System,
W82-04588 5A

TIDAL MARSHES
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

TIDAL RANGE
Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 7B

TIDAL RIVERS
Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 7B

TIDAL WATERS
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

TILE DRAINAGE
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 4A
Pumped Outlets for Drainage Systems,
W82-04364 8A

TITRATION
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 5A

TOILETS
Reducing the Flush,
W82-04654 3D

TONGUE RIVER BASIN
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6E

TOO...K LAKE
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

TOPSOIL
Topsoil Management of Mined Soils,
W82-04571 4D

TOXICITY
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 5C
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstoffe),
W82-04282 5D
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C
Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 5C
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 5C
A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 5B

TOXINS
Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 5A

TRACE ELEMENTS
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

TRACE METALS
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 5B

TRACTIVE FORCES
Incipient Motion of Sand Particles on Side Slopes,
W82-04368 8D

TRANSMISSIVITY
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

TRANSPIRATION
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 2D

TRICKLE IRRIGATION
Subsurface Trickle Irrigation Mangement with Multiple Cropping.
W82-04356 3F

TRIHALOMETHANES
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

Control of Trihalomethanes in Drinking Water,
W82-04425 5F

TURBIDITY
Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 5F

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechober,
W82-04440 2H

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

TURF GRASSES
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

ULTRAVIOLET RADIATION
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 2H

UNCONFINED AQUIFERS
Delayed Drainage in a Stream-Aquifer System,
W82-04268 2F

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

UNITED KINGDOM
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 2E

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 2E

UNITED STATES
Disaster by Flood,
W82-04618 2E

UPPER CONNECTICUT RIVER BASIN
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

URBAN AREAS
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

URBAN DRAINAGE
Detention Basins--An Urban Experience,
W82-04332 4A

Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 8A

Money Down the Drain,
W82-04653 4A

Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 6A

URBAN HYDROLOGY
Development of Improved Stormwater Quality Models,
W82-04559 5B

URBAN RUNOFF
Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 5B

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 5B

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 4C

Development of Improved Stormwater Quality Models,
W82-04559 5B

Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

Money Down the Drain,
W82-04653 4A

A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 2A

URBANIZATION
A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 2A

USSR
Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 5G

UTAH
Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 6D

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 6D

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 3D

VAALHARTS IRRIGATION PROJECT
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

VACUUM
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 3A

VACUUM FILTRATION
Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 5E

Vacuum Filtration of Septage,
W82-04710 5D

VADOSE WATER
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 2F

VARIABILITY
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

VERDE RIVER
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-King Data,
W82-04340 2E

VERMONT
Experiments in Improving Rural Water Supplies,
W82-04350 5F

VIRUSES
Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 5F

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

VOLATILE ORGANIC COMPOUNDS
Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 5A

VORTICES
The Vortex Scour Mechanism at Bridge Piers,
W82-04642 8B

WALES
The Welsh Approach to Water Recreation,
W82-04658 6D

WALLACE DAM
Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 8D

WARNER VALLEY
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A

WASHINGTON
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

WASTE DISPOSAL
Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D

Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 5E

Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 5E

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

WASTE STORAGE
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

WASTE TREATMENT
Lime Softening Sludge Treatment and Disposal.
W82-04276 5E

The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 5D

WASTEWATER
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

The Unterweser Automatic Water Quality Measurement System,
W82-04588 5A

WASTEWATER ANALYSIS
Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 5A

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 5A

WASTEWATER DISPOSAL
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 5C

WASTEWATER FACILITIES
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 5D

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 5D

Optimization of Areawide Wastewater Management,
W82-04703 5D

WASTEWATER FACILITIES *SLUDGE SOLIDS
Shaking Down a Solids Handling System,
W82-04338 5D

WASTEWATER IRRIGATION
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

WASTEWATER LAGOONS
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

WASTEWATER MANAGEMENT
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D

Municipal Sewage Treatment - Some Recent Developments,
W82-04528 5D

Optimization of Areawide Wastewater Management,
W82-04703 5D

Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 5D

WASTEWATER POLLUTION
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

WASTEWATER RENOVATION
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

WASTEWATER TREATMENT
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 5D

Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 5D

Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D

A Treatment System for an Organic Chemicals Plant,
W82-04353 5D

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 5D

On the Marginal Cost of Wastewater Services,
W82-04376 6C

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 5D

Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 5D

Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 5D

Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 5D

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

WASTEWATER TREATMENT

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 5D

Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 5D

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 5D

Municipal Sewage Treatment - Some Recent Developments,
W82-04528 5D

Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 5D

Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 5D

The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 5D

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 5D

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 5D

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 5D

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 5D

Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 5D

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 5D

Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 5D

Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 5D

The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 5D

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 5D

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 5D

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

Vacuum Filtration of Septage,
W82-04710 5D

Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 5D

Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 5D

Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

WASTEWATER TREATMENT FACILITIES

Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 5D

WATER ANALYSIS

Analytical Quality Control,
W82-04345 5G

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

WATER CHEMISTRY

Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

WATER CIRCULATION

Prediction of the Circulation in Reservoirs,
W82-04682 2H

WATER CONSERVATION

A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 3F

Conserving Water Through Pricing,
W82-04272 3D

The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 6E

An Economist's View of Demand Projections Considering Conservation,
W82-04448 6D

Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 3D

Reducing the Flush,
W82-04654 3D

The Traditional Approach to Water Loss,
W82-04656 3D

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 3F

A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 6D

WATER CONSUMPTION

Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

WATER CONVEYANCE

Riding Mill Pumping Station,
W82-04292 8A

Year-Round Distribution System Maintenance,
W82-04699 5F

WATER CURRENTS

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 2H

WATER DEMAND

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6B

An Economist's View of Demand Projections Considering Conservation,
W82-04448 6D

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 6D

The Welsh Approach to Water Recreation,
W82-04658 6D

The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

Massachusetts Water Supply Priorities,
W82-04698 6D

A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 6D

A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 6D

WATER DISTRIBUTION

Obtaining Layout of Water Distribution Systems,
W82-04319 8A

Leak Detection–Histories,
W82-04363 3D

Leak Detection Programs Recover Revenues,
W82-04375 3D

WATER DIVERSION

Water Chemistry of the Illinois Waterway,
W82-04390 2K

WATER LAW

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6E

Development of Federal Reserve Rights,
W82-04446 6E

Recent Developments in Colorado Groundwater Law,
W82-04679 6E

WATER LEVEL FLUCTUATIONS

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 2B

Probable High Ground-Water Levels on Cape Cod, Massachusetts
W82-04511 7C

WATER LOSS

Leak Detection–Histories,
W82-04363 3D

The Traditional Approach to Water Loss,
W82-04656 3D

WATER LOSSES

A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 3F

WATER MAINS

The Search for a Corrosion Index,
W82-04279 5F

Year-Round Distribution System Maintenance,
W82-04699 5F

WATER MANAGEMENT

Water Management in Ontario,
W82-04259 6E

Three Important Court Decisions,
W82-04349 6E

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 2B

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 6G

Local Irrigation Agencies.
W82-04560 4B

Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 3E

Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 7B

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

Data Acquisition for River Management,
W82-04601 7A

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 6A

WATER METERING

Leak Detection Programs Recover Revenues,
W82-04375 3D

WATER POLICY

Water Management in Ontario,
W82-04259 6E

Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 6B

Objectives and Constraints in Federal Water Resources Planning,
W82-04288 6E

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 6A

WATER POLLUTION

Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 5B

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 5B

Biota and Biological Principles of the Aquetic Environment.
W82-04499 5C

Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

WATER POLLUTION CONTROL

Strategies to Control Nonpoint Source Water Pollution,
W82-04261 5G

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C

New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 6B

Who Wins in the Fight for Pollution Control,
W82-04554 6B

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 5F

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 5G

The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 5G

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 6E

WATER POLLUTION EFFECTS

Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

When a Water Supply Went Bad.
W82-04357 5C

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C

Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 5C

Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire

dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 5C

Pesticides in the Aquatic Environment,
W82-04727 5C

WATER POLLUTION PREVENTION
Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 6E

WATER POLLUTION SOURCES
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 5B

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 5B

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 5A

Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 5G

WATER POTENTIALS
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 2I

WATER QUALITY
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 6C

The Search for a Corrosion Index,
W82-04279 5F

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 5B

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 5B

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 5A

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 7B

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 6D

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

Biota and Biological Principles of the Aquatic Environment.
W82-04499 5C

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 7C

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 2E

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 7C

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 7C

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 7C

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 5C

Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 5F

Development of Improved Stormwater Quality Models,
W82-04559 5B

Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 5A

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 7B

Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermessstellen),
W82-04582 7B

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 7B

The Unterweser Automatic Water Quality Measurement System,
W82-04588 5A

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 2L

A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 7A

Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 7B

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 5A

Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

Constituents of Highway Runoff, Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

An Interactive Data Management System for River Water Quality Data,
W82-04659 10B

Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 2E

Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 6E

Colloidal Organics,
W82-04689 5F

Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 4C

Massachusetts Water Supply Priorities,
W82-04698 6D

An Integrated Water-Quality Index for Irrigation Use,
W82-04723 5C

WATER QUALITY CONTROL
Analytical Quality Control,
W82-04345 5G

Experiments in Improving Rural Water Supplies,
W82-04350 5F

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G

Application of the Area of Review Concept,
W82-04674 6E

WATER QUALITY MANAGEMENT
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C

WATER QUALITY STANDARDS
Water Management in Ontario,
W82-04259 6E

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 6B

Experiences with EEC Guideline 75/440 on the Quality of Surface Waters for Drinking Water Production in the Member States (Erfahrungen mit der EG Richtlinie 75/440 Uber die Qualitat von Oberflachenwasser fur die Trinkwassergewinnung in den Mitgliedstaaten).
W82-04547 6E

WATER RATES
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 6C

Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 6C

WATER REQUIREMENTS
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

WATER RESOURCES DEVELOPMENT
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6E

A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 6A

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 6B

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 6D

Massachusetts Water Supply Priorities,
W82-04698 6D

Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 6A

WATER REUSE
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

Water Reuse Planning Models: Extensions and Applications,
W82-04565 6A

Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

WATER RIGHTS
The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 6E

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6E

Development of Federal Reserve Rights,
W82-04446 6E

Recent Developments in Colorado Groundwater Law,
W82-04679 6E

Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 6E

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 6E

WATER SAMPLING
Constituents of Highway Runoff, Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

WATER SHORTAGE
Conserving Water Through Pricing,
W82-04272 3D

WATER SOFTENING
Lime Softening Sludge Treatment and Disposal.
W82-04276 5E

WATER STORAGE
Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 4A

Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 6G

WATER STRESS
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

WATER SUPPLY
Experiments in Improving Rural Water Supplies,
W82-04350 5F

Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 5F

Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1975,
W82-04518 7C

The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 5F

Massachusetts Water Supply Priorities,
W82-04698 6D

WATER SUPPLY DEVELOPMENT
Will New Orleans Miss The Mississippi,
W82-04274 4A

Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

The Traditional Approach to Water Loss,
W82-04656 3D

Tanzania's Master Water Plan Will Miss Decade Goal,
W82-04657 5F

Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

WATER SUPPLY SYSTEMS
The Search for a Corrosion Index,
W82-04279 5F

Riding Mill Pumping Station,
W82-04292 8A

Obtaining Layout of Water Distribution Systems,
W82-04319 8A

Leak Detection–Histories,
W82-04363 3D

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 5G

WATER TABLE
Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 7C

Groundwater Control,
W82-04714 4B

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 6A

WATER TABLE RISE
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

WATER TEMPERATURE
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 2H

Winter Temperature Structure in Lake Huron,
W82-04381 2H

Modelling Evaporation from Reservoirs,
W82-04722 2D

WATER TRANSPORT
Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 2I

WATER TREATMENT
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 5F

Regulating Corrosive Water,
W82-04335 6B

When a Water Supply Went Bad.
W82-04357 5C

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

Granular Activated Carbon Installations,
W82-04391 5F

Effect of Halogens on Giardia Cyst Viability,
W82-04401 5F

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 5C

Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 5F

Coagulation: Experiences in Organics Removal,
W82-04424 5F

Control of Trihalomethanes in Drinking Water,
W82-04425 5F

Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 5F

Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 5F

Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 5F

The Neckar as a Source of Process and Reserve Water (Der Neckar als Lieferant von Betriebs- und Reservewasser),
W82-04546 5F

Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 5F

Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 5F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 5F

Colloidal Organics,
W82-04689 5F

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 5F

WATER TREATMENT FACILITIES
Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

Design Models for Adsoprtion Systems in Wastewater Treatment,
W82-04300 5D

Shaking Down a Solids Handling System,
W82-04338 5D

Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 3D

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 5D

WATER USE
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

An Economist's View of Demand Projections Considering Conservation,
W82-04448 6D

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 3D

The Welsh Approach to Water Recreation,
W82-04658 6D

The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 3D

WATER USE EFFICIENCY
Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 3F

WATERFOWL
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

WATERSHED MANAGEMENT
A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 5B

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J

WATERSHED PROTECTION
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 4B

WATERSHEDS
Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 7C

Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A

Relative Runoff by Curve Number Nomograph,
W82-04307 2A

Search: A Gaged Watershed Inventory,
W82-04433 10B

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

WATERWAYS
Water Chemistry of the Illinois Waterway,
W82-04390 2K

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 5A

WEATHER FORECASTING
Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 2B

WELL YIELD
Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 6D

WELLS
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 8B

Recent Developments in Colorado Ground-water Law,
W82-04679 6E

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

WESER RIVER
The Unterweser Automatic Water Quality Measurement System,
W82-04588 5A

WEST GERMANY
New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

WEST VIRGINIA
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 7C

WETLANDS
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 2A

WILDLIFE HABITATS
Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 6G

WILLAMETTE RIVER
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 6C

WIND
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

WIND-DRIVEN CURRENTS
Prediction of the Circulation in Reservoirs,
W82-04682 2H

WISCONSIN
Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

WOODS LAKE
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

WRIGHTSVILLE BEACH
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 3A

WYOMING
Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

YAKIMA INDIAN RESERVATION
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

ZINC
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

ZINC CYANIDE RECOVERY
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

ZOOPANKTON
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

WATER SUPPLY SYSTEMS
The Search for a Cyclonics Index,
[illegible]

[illegible]

AUTHOR INDEX

ABDULLAH, M.
Rural Power Schemes in Pakistan,
W82-04328 8A

ADRIAN, D. D.
Development of Improved Stormwater Quality Models,
W82-04559 5B

AGNEW, R. W.
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

AILI, Z.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

AL-KHAFAJI, A. W. N.
Densification of Paper Mill Sludge Materials,
W82-04694 5E

AL-KHATIB, H. H.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B

ALBAGNAC, G.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

ALBRIGHT, L. J.
Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 2L

ALEXANDER, E. C. JR.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

ALI, K. H. M.
Prediction of the Circulation in Reservoirs,
W82-04682 2H

ALLEY, W. M.
Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 5B

ALVAREZ, M. E.
Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 5F

AMUNDSEN, D. W.
Control of Trihalomethanes in Drinking Water,
W82-04425 5F

ANDERSLAND, O. B.
Densification of Paper Mill Sludge Materials,
W82-04694 5E

ANDERSON, J. J.
Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 5D

ANDERSON, R.
Regulating Corrosive Water,
W82-04335 6B

ANTON, C.
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

ANTONOPOULOS, V. Z.
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 4A

ANUGWELEM, U. A.
Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 5C

ARAL, M. M.
Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 8D

ARBHABHIRAMA, A.
Reservoir Sedimentation with Random Deposits,
W82-04443 2J

ARCHER, D. R.
Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 2E

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 2E

ARCHIBALD, E. M.
Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C

ARCHIBALD, G. G.
The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

ARENAS, V.
The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 2L

ARIEL, P. D.
Conformal Mapping for Channel Junction Flow,
W82-04306 2E

ARONSON, GL.
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

ARTHUR, J. P.
The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 5D

ATWATER, J. W.
Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 5D

AUS, H. C.
Measurement of Air in Flowing Water,
W82-04322 7B

AUSTIN, C. F.
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

AUSTIN, S.
Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04524 5D

BABB, A. F.
Measurement of Air in Flowing Water,
W82-04322 7B

BAINES, M. J.
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 2F

BALBA, M. T.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

BANAT, I. M.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

BANKS, D. J.
Riding Mill Pumping Station,
W82-04292 8A

BANKS, W.
Riding Mill Pumping Station,
W82-04292 8A

BAO, P.
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 5D

BARBARICK, K. A.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

BARFIELD, B. J.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

BARNES, G. D.
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

BARNES, J. W.
Obtaining Layout of Water Distribution Systems,
W82-04319 8A

BARR, D. I. H.
Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 8B

BARTEL, H.
Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 4B

BATHURST, J. C.
Resistance Equation for Large-Scale Roughness,
W82-04696 2E

BATTEN, R.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

BAXTER, J. C.
Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 5D

BEDIENT, P. B.
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

BEITINGER, T. L.
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 5C

BELANGER, T. V.
Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 5B

BELLUCK, D. A.
Pesticides in the Aquatic Environment,
W82-04727 5C

BELTRAMI, E. J.
Optimization of Areawide Wastewater Management,
W82-04703 5D

BENEDEK, P.
Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 5D

BENJAMIN, M. M.
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 5D

BENNETT, C. R.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

BERGERON, M. P.
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

BERNHARDT, H.
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

BERRY, D.
Regulating Corrosive Water,
W82-04335 6B

BETTESS, R.
Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

BIERMAN, S. L.
Small Hydro Schemes for Private Developers,
W82-04327 8A

BIRD, J. W.
Development of Federal Reserve Rights,
W82-04446 6E

BISWAS, A. K.
Clean Water for the Third World,
W82-04604 6D

BLACK, P. E.
Search: A Gaged Watershed Inventory,
W82-04433 10B

Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 5B

BOBEE, B.
A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 6D

BOHLING, R. A.
Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D

BOKHARI, S. M. H.
Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 6A

BOLKE, E. L.
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

BONDELID, T. R.
Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A

BONDEV, I. A.
The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 5C

BONDURANT, J. A.
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 4D

BOON, A. G.
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 5D

BOONE, D. R.
Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 5D

BORRELLI, J.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

BOUCHER, P.
A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 6D

BOUZANNE, M.
Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 5A

BOWER, P. M.
Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 2H

BOWKER, R. P. G.
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

BOWMAN, D. D.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

BRADSHAW, G.
Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 5D

BRAKKE, D. F.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

BREZONIK, P. L.
Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 5C

BRIGHAM, A. R.
The Effect of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

BRIGHAM, W. U.
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C

BRILL, E. D. JR.
Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

BRINGI, V. N.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B

BRITTO, A. M.
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

BROCKWAY, C. E.
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 4D

BROWN, A. C.
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 5C

BROWN, G. J.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

BROWN, M. J.
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 4D

BROYD, T. W.
Dispersion Coefficients in Estuaries,
W82-04684 5B

BRUGGINK, T. H.
Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 6C

BUCKS, D. A.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

BUDLEIGH, J.
Adopting Sewers,
W82-04655 8A

BUGG, S. F.
A Ground Water Resources Study Of A Pacific Ocean Atoll–Tarawa, Gilbert Islands,
W82-04254 2F

BUGGINS, M. E.
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 5D

BULL, R. J.
Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 5C

BURBANK, N. C.
Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

BURGER, J. S.
Health Aspects of Waters at Public Health Resorts,
W82-04348 5A

BURMAN, G. K.
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B

BURNS, A. W.
Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 6G
Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 6A

BURTON, B. D.
Control of Trihalomethanes in Drinking Water,
W82-04425 5F

BUTTS, T. A.
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

CABELLI, V. J.
Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 5A

CAHET, G.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

CAIRNS, J. JR.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

CALKINS, J.
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 2H

CALMON, C.
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

CAMERON, S. C.
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 5A

CARMACK, E.
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

CARROLL, T. O.
Optimization of Areawide Wastewater Management,
W82-04703 5D

CARSWELL, W. J. JR.
Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 2E

CASTANO, E.
Decisions Under Violation of Regression Normality,
W82-04264 7C

CASTELNAU, G.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

CAVARI, B.
Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

CHAMEIDES, W. L.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

CHAN, V. W. C.
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1A

CHANGNON JR, S. A.
Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 2B

CHANGNON, S. A. JR.
Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

CHAO, A. C.
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 5D

CHAPMAN, D. J.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

CHAPMAN, P. M.
Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

CHAPPELL, C. F.
Disaster by Flood,
W82-04618 2E

CHARBONNEAU, R.
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

CHEN, C.
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

CHENYAPANICH, P.
Reservoir Sedimentation with Random Deposits,
W82-04443 2J

CHERRY, D. S.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

CHESNER, W. H.
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

CHESSMAN, G. R.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

CHOW, V. T.
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 6A

CHRISTENSEN, G. M.
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

CLARK, D. R.
Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

CLARK, J. R.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

CLARK, R. M.
Granular Activated Carbon Installations,
W82-04391 5F

CLARK, R. T.
Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 6A

CLEARY, R. W.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 5B

CLEMMENS, A. J.
Dimensionless Stream Advance in Sloping Borders,
W82-04308 3F

COCCI, A. A.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

COCKBURN, A. G.
Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 2L

COLYER, P.
Money Down the Drain,
W82-04653 4A

COMBS, L. J.
Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

CONARROE, K.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

CONNICK, D. J.
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

COOK, R. B.
The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 2H

COOK, S.
Estimation and Control Problems in Activated Sludge Processes,
W82-04612 5D

COOKE, G. D.
Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

COPE, J.
A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 7A

CORDOVA, R. M.
Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 6D

COREY, A. T.
Pumped Outlets for Drainage Systems,
W82-04364 8A

CORNELL, J. H.
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

CORRELL, D. L.
Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 2L

CORRY, M. L.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

CORY, D. C.
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 6B

COTE, R.
Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 5C

COWLEY, I. D.
Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 5E

CRAIG, R. W.
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A

CRASSOUS, P.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

CRAVENS, J. B.
Use of Microscreens to Polish Lagoon Effluents,
W82-04709 5D

CRESON, C.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

CULP, R. L.
Granular Activated Carbon Installations,
W82-04391 5F

CYR, R.
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

DAMM, M. V.
Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 2F

DANDEKAR, M. M.
Conformal Mapping for Channel Junction Flow,
W82-04306 2E

DANIELSON, R. E.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

DAS, D. K.
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B

DAS, M. M.
Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 8B

DAUBERT, J.
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 6B

DAVENPORT, D. C.
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 3F

DAVIDSON, P. J.
Reducing the Flush,
W82-04654 3D

DAVIS, E. M.
Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 5C

DAVIS, J. R.
Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

DAVIS, P.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

DAVIS, R. B.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

DAWSON, J. F.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

DE LA LANZA, G.
The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 2L

DEBETTENCOURT, J. S.
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

DEBO, T. N.
Detention Basins--An Urban Experience,
W82-04332 4A

DECOURSEY, D. G.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

DEININGER, R. A
An Interactive Data Management System for River Water Quality Data,
W82-04659 10B

DELAUNAY, J.
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

DELAUNE, R. D.
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

DEMARD, H.
A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 6D

DEMERS, S.
Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 2L

DEMETRACOPOULOS, A. C.
Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 7B

DENNEHY, K. F.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

DENNIS, R. P.
Water Management in Ontario,
W82-04259 6E

DESCHENES, J. M.
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

DEZELLAR, J.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 3D

DHILLON, B. S.
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

DIERBERG, F. E.
Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 5C

DINGMAN, S. L.
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 2E

DITARANTO, V. M. JR.
American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 5D

DOEHRING, D. O.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

DONNAN, J.
Who Wins in the Fight for Pollution Control,
W82-04554 6B

DONNERT, D.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

DORAN, T. M.
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

DOUGAL, M. D.
Tapered Inlet Design Using Specific Energy Curves,
W82-04695 8A

DUBUC, J. P.
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

DUCKSTEIN, L.
Decisions Under Violation of Regression Normality,
W82-04264 7C

DUFFIELD, J. W.
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 6B

DUKE, D. T.
Control of Trihalomethanes in Drinking Water,
W82-04425 5F

DUNBAR, D. S.
Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 2H

DUPPERS, W.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

DUSEK, D. A.
Deep Tillage of Irrigated Pullman Clay Loam–A Long-Term Evaluation,
W82-04372 2G

DUTHIE, H. C.
Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 2H

DYCK, S.
Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 4A

EADIE, R.
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

EBERLE, S. H.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

EDDS, J.
Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 7C

EDIL, T. B.
Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

EGGERT, K. G.
A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 5B

EIGEL, J. D.
Infiltration into Two-Layered Soil Profiles,
W82-04536 2G

EILERS, H. P.
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

EISEL, L. M.
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

EISENACHER, K.
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

EISENREICH, S. J.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

EL-RAYIS, O. A.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

EL SABROUTI, M. A.
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 2J

ELLIS, M. J.
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

EMMERSON, W. D.
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 5B

ENGBERG, R. A
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

ENGLANDE, A. J.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

EPPLER, B.
Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 2E

ERICKSON, R. J.
Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

ERIE, L. J.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

EVANS, J. E.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

EVANS, L. S.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

EVANS, N. A.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

EVANS, R. L.
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

Water Chemistry of the Illinois Waterway,
W82-04390 2K

EZZAT, A. A.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

FARMER, D. M.
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

FBERLE, S.
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

FEDERLE, T. W.
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

FERGUSON, J. F.
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 5D

FERRIERIA, R. F.
Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 5C

FFOLLIOTT, P. F.
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

FIELD, T. K.
Coagulation: Experiences in Organics Removal,
W82-04424 5F

FINE, L. O.
Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

FISCHER, B.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

FISCHER, W. K.
A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 5B

FISCUS, E. L.
Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 2I

FISHER, D.
Acid Snow in the Canadian High Arctic,
W82-04542 2C

FITZGERALD, S. D.
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 5A

FOGELMAN, R. P.
Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

FORCELLA, L. S.
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 2K

FORSYTHE, P.
Engineering in Catfish Production,
W82-04367 8I

FOSTER, K. E.
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

FOURNIER, R. O.
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

FOWLER, W. B.
A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 7B

FRANCE, P. W.
Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 8B

FRANCIS, A. J.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

FRANCO, R. J.
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

FREIBERG, G. R.
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 5D

FREMPONG, E.
Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 5C

FRENCH, O. F.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

FRENKEL, R. E.
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

FRERE, M. H.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

FRESENIUS, W.
Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 5F

FRIMPTER, M. H.
Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 7C

FRYE, R.
A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 6D

FUHRMANN, H.
Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Losemittel in Luft und Wasser),
W82-04579 5A

FUJIOKA, R. S.
Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

FURLEY, R. J.
Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 2L

FUSILLO, T. V.
Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

GABLE, R. C.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

GAN, H. B.
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

GARBER, W. F.
Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 5D

GARCIA-BENGOCHEA, J. I.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

GARDNER, L. R.
Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 2L

GARG, S. K.
Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

GERARDI, M. H.
Colloidal Organics,
W82-04689 5F

GERIKE, P.
A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 5B

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 5D

GERVIN, J. C.
Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

GILBERT, E.
Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 5F

GILLESPIE, R. G.
Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

GIVENS, W. D.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

GLASS, C. E.
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

GOETZ, C. L.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

GOGEL, T.
Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 7C

GOHIL, B. S.
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

GOLDFARB, W.
Three Important Court Decisions,
W82-04349 6E

GOLOMBICK, T.
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 5C

GONCHAROVA, J. S.
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 2A

GORDON, M. S.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

GORGENS, A. H. M.
Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 2A

GOSZ, J. R.
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

GRAVELAND, A.
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

GREESON, P. E.
An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 5C

GRIGG, N. S.
Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 6A

GROHMANN, A.
Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 5F

GRUBER, D.
Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

GRUBER, P.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

GUITAR, J.
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

GUNN, M. J.
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

GUNNEBERG, F.
Automatic Collection and Transmission of Data for the Federal Waterway Authority.
W82-04596 7A

GUPTA, M. K.
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

GUREGHIAN, A. B.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 5B

GUSWA, J. H.
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

GUTENDORT, W.
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

GUTHRIE, R. K.
Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 5C

HAAG, W. R.
The Chemistry of Saline Water Chlorination,
W82-04729 3C

HAFEZ, H.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

HAGAN, R. M.
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 3F

Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 3F

HAGERTY, D. J.
Bank Failure and Erosion on the Ohio River,
W82-04473 2J

HAGURA, L. M.
Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 6F

HAHN, H. H.
Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 2E

HAIN, K. E.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

HAKANSON, L.
Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 2H

HALL, B. B.
Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D

HALL, M. J.
A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 2A

HALL, R. W.
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

HANAMI, L.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 5A

HANDA, B. K.
An Integrated Water-Quality Index for Irrigation Use,
W82-04723 5C

HANEL, K.
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

HANKE, S. H.
On the Marginal Cost of Wastewater Services,
W82-04376 6C

HANNAY, F.
Recent Developments in Colorado Groundwater Law,
W82-04679 6E

HANSEN, R. D.
A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 3D

HANSON, C. A.
Data Acquisition for River Management,
W82-04601 7A

HANSON, D. W.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

HARLOW, B. D.
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

HARMS, W. R.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 4C

HAROLDSEN, R. O.
Micro Hydropower in the USA,
W82-04316 8A

HARRELSON, M. E.
Use of Microscreens to Polish Lagoon Effluents,
W82-04709 5D

HARRIS, H. J. JR.
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

HARRISON, W. D.
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 7B

HARTMANN, L.
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 5D

HATFIELD, D. L.
A Treatment System for an Organic Chemicals Plant,
W82-04353 5D

HAWLEY, M. E.
Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 2A

HEGGEN, R. J.
Relative Runoff by Curve Number Nomograph,
W82-04307 2A

Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 6C

HEIDINGER, R. C.
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

HEIDMAN, J. A.
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

HEINRICH, D.
Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 5D

HEIT, M.
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

HEITMANN, H.
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 5A

HELVEY, J. D.
A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 7B

HENDERSON-SELLERS, B.
Modelling Evaporation from Reservoirs,
W82-04722 2D

HENDREY, G. R.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

HENDRY, G. S.
Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

HENKEL, M.
Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 3E

HENRICH, J.
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 2H

HEY, D. L.
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C

HICKEY, J. J.
Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

HIGNETT, K. C.
Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 5D

HILL, R. W.
Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 5F

HINES, R.
The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 5C

HIRO, S.
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

HOANG, V. D.
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

HOBBS, E. H.
Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

HOCUTT, C. H.
Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 6G

HODSON, R. G.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

HOLLEY, E. R.
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 8A

HONDA, T.
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

HOOFTMAN, R. N.
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

HORNEF, H.
New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

HORVATH, D. J.
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

HOTCHKISS, W. R.
Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

HOUCK, D. H.
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 5D

HOXIT, L. R.
Disaster by Flood,
W82-04618 2E

HOYLE, M.
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

HUANG, J. C. K.
Simulation and Verification of Lake Ontario's Mean State,
W82-04570 2H

HUBBELL, D. W.
Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 7B

HUEY, D. W.
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 5C

HUFF, J. E.
Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 5D

HULSEY, C.
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 2H

HUME, A. S.
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

HUNDLEY, N.
The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 6E

HUNT, B.
Asymptotic Solution for Dam-Break Problem,
W82-04313 8B

HUNT, D.
Analytical Quality Control,
W82-04345 5G

IKEDA, S.
Incipient Motion of Sand Particles on Side Slopes,
W82-04368 8D

INVERSIN, A. R.
Rural Power Schemes in Pakistan,
W82-04328 8A

IRWIN, J.
Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 5D

ISELY, R. B.
The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 6D

ISHIBASHI, T.
Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 5F

ITOH, Y.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

IWUGO, K. O.
The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 5D

IZUMI, N.
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 5E

JACKSON, P. J.
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 5F

JAYARAMAN, T. K.
Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 3F

JEFFERSON, C. A.
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

JENKINS, D. N.
Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

JEWELL, T. K.
Development of Improved Stormwater Quality Models,
W82-04559 5D

JIRKA, G. H.
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 7C

JIWA, S. F. H.
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

JOHNSON, D. W.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

JOHNSON, P.
The Future of Flood Estimation and the Flood Studies Report,
W82-04687 2E

JOHNSON, T. C.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

JONES, J. S.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

JONES, R. A.
Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

JORSTAD, E.
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

JOURNET, J. -M.
The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 5A

JUNGREIS, E.
A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 5A

JURY, W. A.
Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

KALWEIT, H.
Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

KANOWSKI, S.
New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

KAPLAN, A. M.
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

KAPLAN, D. L.
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 5D

KAPP, H.
The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 5D

KASAKURA, T.
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 5E

KASHKULI, H. A.
A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 2F

KAST, F.
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstoffe),
W82-04282 5D

KATOH, T.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

KATSAROS, K. B.
Convection Patterns in a Pond,
W82-04461 2C

KATZER, T.
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

KAWASAKI, L. Y.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

KAYS, W. B.
The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 5G

KAZMANN, R.
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 8B

KAZMANN, R. G.
Will New Orleans Miss The Mississippi,
W82-04274 4A

KEINATH, T. M.
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 5D

KELIN, J.
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

KELKAR, R. R.
Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 2B

KELLOGG, S. R.
Optimization of Areawide Wastewater Management,
W82-04703 5D

KENLAN, K. H.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

KENT, S. J.
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

KERNODLE, D. R.
Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

KERNODLE, J. M.
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

KESSLER, K. A.
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 5E

KESWICK, B. H.
Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

KHALID, R. A.
Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 5D

KHAN, I. A.
A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 4B

KHAN, M. A.
Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 2E

KICKOX, D. H.
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6E

KIDWAI, A. L.
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B

KIKUCHI, E.
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

KIM, B. R.
The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 5F

KIRBY, R.
A Suspended Sediment Front in the Severn Estuary,
W82-04639 2L

KIRCHMAN, D.
Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 2H

KIRSCH, M.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

KITTREDGE, D.
Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 5G

KLAZURA, G. E.
Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 2B

KLEINAU, J. H.
Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 5E

KLEMPNER, R. A.
Small Hydro Schemes for Private Developers,
W82-04327 8A

KLOPPEL, H. B.
Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 5A

KNAUTH, L. P.
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 2K

KNEEBONE, W. R.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

KNORRE, H.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

KNUDSEN, D. L.
Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 5E

KNUDSON, M. K.
Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 5D

KOBRIGER, N. P.
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 4C

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

KOERNER, R. M.
Acid Snow in the Canadian High Arctic,
W82-04542 2C

KOHLER, G. K.
Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 5F

KOHONEN, T.
Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 7B

KOLLE, W.
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F

KOSHUT, R. A.
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

KOTHANDARAMAN, V.
Water Chemistry of the Illinois Waterway,
W82-04390 2K

KREISSL, J. F.
Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 5D

KREUTZBERGER, W.
Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

KRISCHAN, T. M.
Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

KROGMAN, K. K.
Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

KROVACEK, K.
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

KRUMHARDT, A. P.
Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

KUBAREWICZ, J. W.
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

KUMAR, M. B.
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 2K

KUNOGI, R.
Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

KUNZ, H.
The Unterweser Automatic Water Quality Measurement System,
W82-04588 5A

KURIHARA, Y.
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

KUROKAWA, Y.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

KYNE, J. M.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

LABADIE, J. W.
Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 8A

LACROIX, S. J.
Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 5A

LADOWSKI, J. A.
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

LAGER, J. A.
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 5B

LAHIRI, A.
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 2B

LAISHEY, R.
Tanzania's Master Water Plan Will Miss Decade Goal,
W82-04657 5F

LANDINE, R. C.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

LANTER, N. L.
A Treatment System for an Organic Chemicals Plant,
W82-04353 5D

LARDEAU, J.-P.
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

LATINOPOULOS, P.
Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 8B

The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 4B

LAUGHTON, P. J.
Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

LE LIEVRE, S.
The Welsh Approach to Water Recreation,
W82-04658 6D

LEAVENWORTH, S. W
Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 6E

LEBERT, J. E. JR.
Year-Round Distribution System Maintenance,
W82-04699 5F

LEBLANC, D. R.
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

LECHEVALLIER, M. W.
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 5A

LEE, G. F.
Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 5C

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

LEE, J. H. W.
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 7C

LEE, M. T.
Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 2J

LEED, J. A.
Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 5B

LEFTWICH, D. B.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

LEGENDRE, L.
Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 2L

LEMBI, C. A.
Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 2H

LEMERT, G. W.
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

LESCHBER, R.
Recent Developments in and Application of Automation and Monitoring in Water Management,
W82-04593 7B

LEWANDOWSKI, Z.
Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 5D

LEWIS, B. D.
Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

LEWIS, N. M.
Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 5B

LEWIS, R. F.
Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 5D

LEWIS, W. M.
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

LI, R. M.
Resistance Equation for Large-Scale Roughness,
W82-04696 2E

LICHTE, H. W.
Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 5G

LICK, W.
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 2H

LIEB, H. S.
Disaster by Flood,
W82-04618 2E

LIEBMAN, J. C.
Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

LIEDKE, P.
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

LIN, K-C.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

LINDSTROM, E. B.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

LINGEMAN, R.
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 2H

LITTIN, G. R.
Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

LITTLE, L.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

LITTLE, M. D.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

LITWIN, Y. J.
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 5B

LIVELY, R. S.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

LIVERMAN, D.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

LLOYD, J. W.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

LOEW, R. K.
Densification of Paper Mill Sludge Materials,
W82-04694 5E

LOFTIS, J. C.
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

LOH, P. C.
Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

LOPEZ, J. G.
Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

LORD, W. B.
Objectives and Constraints in Federal Water Resources Planning,
W82-04288 6E

LOTSPEICH, F. B.
Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 7C

LOVE, F. G.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

LUDWIG, K. R.
James Bay Spillways and Control Structures,
W82-04692 8A

LUTZ, G. A.
Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 7B

LUXON, E. G.
Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

LYON, R. M.
Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 6E

LYSYJ, I.
Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 5D

MACDONALD, R. W.
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 5A

MAHAR, L.
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 4B

MAIDMENT, D. R.
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 6A

MAIER, W. J.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 3D

MAJIMA, T.
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 5E

MANN, J. H.
Experiments in Improving Rural Water Supplies,
W82-04350 5F

MANN, P. C.
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 6C

MARINOS, A. T.
Young's Inequality for Three-Dimensional Flows,
W82-04267 2A

MARKS, D. H.
Local Irrigation Agencies,
W82-04560 4B

MARKWELL, D. D.
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

MAROTTE, F. K.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

MAROTZ, G.
Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 3A

MARSHALL, J. S.
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

MARSILI-LIBELLI, S.
Estimation and Control Problems in Activated Sludge Processes,
W82-04612 5D

MARTIN, R. J.
The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 5D

MARTIN, W. J.
Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 5D

MARTINEZ, J. D.
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 2K

MARX, L. F.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

MASLIA, M. L.
Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 8D

MATHES, G. A.
Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 5E

MAWDSLEY, J. A.
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 2E

MAYS, L. W.
Water Reuse Planning Models: Extensions and Applications,
W82-04565 6A

MCCANN, R. C.
The General Hydrologic System Model,
W82-04314 2A

MCCLURE, B.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

MCCUEN, R. H.
Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 2A

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 4C

Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A

MCCUTCHAN, J. W.
Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

MCDIFFETT, W. F.
Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 2H

MCFARLAND, J. W.
A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 6D

MCFETERS, G. A.
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 5A

MCGOVERN, H. E.
Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

MCKAY, G.
Design Models for Adsoprtion Systems in Wastewater Treatment,
W82-04300 5D

MCKINLEY, V. L.
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

MCLAUGHLIN, F. A.
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 5A

MCLEOD, J. D.
Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 3F

MCLOUGHLIN, T. F.
Massachusetts Water Supply Priorities,
W82-04698 6D

MCMILLIN, C. R.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

MCNULTY, K. J.
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 5D

MCQUIGG, J.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

MEANS, E. G.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 5A

MEANS, J. C.
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

MEIN, R. G.
Analysis of Detention Basin Systems,
W82-04444 2A

MEINHOLZ, T. L.
Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

MELLINGER, D. L.
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

MELVILLE, J. G.
Nearfield Performance of River Diffusers,
W82-04561 5B

MENWEI, F.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

MERCER, J. W.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

METCALFE, A. V.
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 2E

METZGER, H.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

MEVOLHON, M.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

MEYER, E. A.
Effect of Halogens on Giardia Cyst Viability,
W82-04401 5F

MEYER, L. D.
How Rain Intensity Affects Interrill Erosion,
W82-04537 2J

MEYER, R. A.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

MICHEL, E. F.
Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 5D

MICHLER, G.
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

MILES, J. C.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 2F

MILLER, G. S.
Winter Temperature Structure in Lake Huron,
W82-04381 2H

MILLER, J. L.
Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 2L

MILLER, R. M.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 3D

MINIER, A.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

MITCHELL, R.
Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 2H

MIXON, M. N.
Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 5D

MODI, P. N.
Conformal Mapping for Channel Junction Flow,
W82-04306 2E

MOGIL, H. M.
Disaster by Flood,
W82-04618 2E

MOLENAAR, H. W.
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

MONAGHAN, B. A.
Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

MONNIG, E.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

MONROE, R. J.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

MOOMAW, R. L.
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 6E

MOORE, D. A.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 5B

MOORE, I. D.
Effect of Surface Sealing on Infiltration,
W82-04362 2G
Infiltration into Two-Layered Soil Profiles,
W82-04536 2G

MOREAUD, H.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 5D

MORFAUX, J. N.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

MORGAN, W. D.
An Economist's View of Demand Projections Considering Conservation,
W82-04448 6D

MOTTS, W. S.
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 2A

MOYA, T. B.
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 2I

MUCHMORE, C. B.
Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 5D

MUKHERJEE, A. K.
A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 2K

MULHOLLAND, P. J.
Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

MURPHY, J.
Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 5G

MURPHY, K. L.
Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 5D

MURRAY, D. L.
Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 2A

MURRAY, H. E.
Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 5C

MURTHY, C. R.
Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 2H

MUSICK, J. T.
Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 2G

NAGELS, G.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

NAGPAL, J. L.
Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

NAKAMURA, M.
A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 6A
Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

NAKAYAMA, F. S.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

NAMEDA, Y.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

NANBO, K.
Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

NAND, K.
A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 2K

NARAYANA, V. V. D.
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

NAVOY, A. S.
Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 7C

NEDWELL, D. B.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

NEIMAN, T. N.
Experiments in Improving Rural Water Supplies,
W82-04350 5F

NELSON, J. D.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

NELSON, P. O.
Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 5D

NEU, H. J. A.
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 6G

NEUMAN, S. P.
Delayed Drainage in a Stream-Aquifer System,
W82-04268 2F

NEUMANN, U.
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

NEVEUX, J.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

NEWELL, C. J.
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

NICHOLSON, R. B.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

NICKS, A. D.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

NIEBER, J. L.
Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 2A

NIEMITZ, W.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

NIKU, S.
Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 5D

NOBEL, P. S.
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 2D

NORTON, S. A.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

NOVKOV, S. M.
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 2A

NUPEN, E. M.
Health Aspects of Waters at Public Health Resorts,
W82-04348 5A

O'BRIEN, A. L.
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 2A

O'BRIEN, R. T.
Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 5F

O'SHEA, J.
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 2F

O'TOOLE, J. C.
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 2I

OBLED, C.
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

OCANAS, G.
Water Reuse Planning Models: Extensions and Applications,
W82-04565 6A

ODGAARD, A. J.
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 2J

OEHLER, K. E.
The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 5F

OLIVE, R. T.
James Bay Spillways and Control Structures,
W82-04692 8A

OLSON, B. H.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 5A

OLSSON, G.
Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 5D

OSTERKAMP, T. E.
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 7B

OTT, C. R.
Vacuum Filtration of Septage,
W82-04710 5D

PAGE, L. M.
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

PAI, M.
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

PAIN, D. F. H.
Riding Mill Pumping Station,
W82-04292 8A

PALLER, M. H.
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

PANDLEY, P. C.
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

PARKER, B. C.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

PARKER, C. E.
Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 5A

PARKER, J. I.
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 5C

PARKER, W. R.
A Suspended Sediment Front in the Severn Estuary,
W82-04639 2L

PARR, A. D.
Nearfield Performance of River Diffusers,
W82-04561 5B

PATEMAN, D.
Prediction of the Circulation in Reservoirs,
W82-04682 2H

PATRICK, W. H. JR.
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 5D

PAUL, J.
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 2H

PEDERSON, D. C.
Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

PEIRCE, J. J.
Strategies to Control Nonpoint Source Water Pollution,
W82-04261 5G

PEPPER, I. L.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

PERHAM, R. E.
Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 2C

PERROUX, K. M.
Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 2G

PETERS, R. H.
Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 2H

PETERSON, G. L.
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

PEUKERT, V.
Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermesstellen),
W82-04582 7B

PEW, W. D.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

PHIEN, H. N.
Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 2E

Reservoir Sedimentation with Random Deposits,
W82-04443 2J

PHILLIPS, K. J.
Optimization of Areawide Wastewater Management,
W82-04703 5D

PILZER, J. E.
Leak Detection--Histories,
W82-04363 3D

PISANO, W. C.
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

PLATE, V.
Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 7B

POCHOP, L. O.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

POCOCK, J. S.
The Traditional Approach to Water Loss,
W82-04656 3D

POWER, J. F.
Topsoil Management of Mined Soils,
W82-04571 4D

POWER, N. A.
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

PRANDLE, D.
Salinity Intrusion in Estuaries,
W82-04574 2L

PRENTICE, J. K.
Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

PRITCHETT, J. W.
Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

PUSTINGER, J. V.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

PUTNAM, P. E.
Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

QADAR, A.
The Vortex Scour Mechanism at Bridge Piers,
W82-04642 8B

QUINN, F. H.
Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 2B

QUINN, J. E.
Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 5F

RADA, E. A.
Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 6E

RAI, D.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 5B

RALSTON, C. W.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 4C

RAMAN, A.
Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

RANGO, A.
Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 2A

RASSOULZADEGAN, F.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Commaunaute Planctonique en Zone Marine Eutrophe),
W82-04672 5B

RAWLS, W. J.
Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 4C

REIMERS, R. S.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

RENSHAW, E. F.
Conserving Water Through Pricing,
W82-04272 3D

REVESZ, R. L.
Local Irrigation Agencies,
W82-04560 4B

RICHARD, Y.
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

RICHARDSON, M. L.
Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 5B

RICHTER, D. D.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 4C

RICHTER, M.
Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 3E

RIDGWAY, H. F.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 5A

RIDKER, R. G.
Reversing Water Pollution Standards in an Uncertain World,
W82-04540 6B

RIEDEL, B.
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

RILEY, J. M.
A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 6A

RITSCHARD, R. L.
Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 3F

ROBERT, B.
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

ROBERTS, E. B.
Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 3F

ROBERTSON, J. B.
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

ROBINSON, C.
Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 6E

ROBINSON, D. K.
Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 8A

ROBL, T. L.
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 2F

ROOK, J. J.
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

ROSEBOOM, E. H. JR.
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

ROSS, P. E.
Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 2H

ROSSMILLER, R. L.
Tapered Inlet Design Using Specific Energy Curves,
W82-04695 8A

ROWELL, W. F.
Obtaining Layout of Water Distribution Systems,
W82-04319 8A

RUBITSCHUN, C.
Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 2H

RUBY, H.
Detention Basins--An Urban Experience,
W82-04332 4A

RUFFER, H.
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

RUSSEL, S. O.
Flood Probability Estimation,
W82-04318 6B

RUSSELL, L. L.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

RYDER, R. B.
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

SAAD, M. A. H.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 5B

SABEY, B. R.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

SAKKAS, J. G.
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 4A

SALBACH, S. E.
Water Management in Ontario,
W82-04259 6E

SALBU, B.
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

SAMAIN, E.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

SAMANIEGO, F. J.
Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 5D

SAMMEL, E. A.
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1A

SAMMIS, T.
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

SANGER, H. W.
Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

SAPANDOWSKI, H. P.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

SARGENT, D. M.
The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 7B

SARGENT, F. O.
Experiments in Improving Rural Water Supplies,
W82-04350 5F

SAYERS, B.
Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 5D

SAYLOR, J. H.
Winter Temperature Structure in Lake Huron,
W82-04381 2H

SCHAFER, J.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

SCHLENGER, D. L.
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 6C

SCHNEIDER, A. D.
Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 2G

SCHNEIDER, R.
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

SCHNEIDER, W.
Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 5F

SCHOWENGERDT, R. A.
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 7B

SCHRAMEL, P.
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

SCHREIER, H.
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

SCHROEDER, E. D.
Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 5D

SCHROEDER, R. A.
Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

SCHULTINK, L. J.
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

SCHUMAN, G. E.
Topsoil Management of Mined Soils,
W82-04571 4D

SCHUMANN, H.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

SCHUMM, S. A.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

SCOTT, K. M.
Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

SCULLY, D. R.
Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

SEABURG, K. G.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

SEGALL, B. A.
Vacuum Filtration of Septage,
W82-04710 5D

SEINWILL, G. D.
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

SEKOULOV, I.
Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 5D

SELIGA, T. A.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B

SEMMENS, M. J.
Coagulation: Experiences in Organics Removal,
W82-04424 5F

SEPP, E.
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 5D

SERNE, R. J.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 5B

SEZGIN, M.
Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 5D

SHALABY, A.
Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 4C

SHARMA, A.
Development of Hydro-Power in Nigeria,
W82-04475 6B

SHARMA, A. K.
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

SHARMA, R. G.
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

SHARMA, V. C.
Development of Hydro-Power in Nigeria,
W82-04475 6B

SHEIHAM, I.
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 5F

SHEN, H. W.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

SHERIDAN, R. E.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

SHERMAN, P. L.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

SHIH, S. F.
Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

Water Budget Computations for a Shallow–Lake Okeechobee, Florida,
W82-04258 2H

SHORT, T. E.
Application of the Area of Review Concept,
W82-04674 6E

SHORTRIDGE, K. R.
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

SIDWICK, J. M.
Municipal Sewage Treatment - Some Recent Developments,
W82-04528 5D

SILKA, L.
Application of the Area of Review Concept,
W82-04674 6E

SIMEONOV, S. YA.
The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnoestta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpeduchni Vodi v Tiakh),
W82-04476 5C

SIMMONS, G. M. JR.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

SIMONS, D. B.
Resistance Equation for Large-Scale Roughness,
W82-04696 2E

SIMPSON, F. B.
Micro Hydropower in the USA,
W82-04316 8A

SINCLAIR, R. A.
Water Chemistry of the Illinois Waterway,
W82-04390 2K

SINGH, G.
Slow-Sand Test-Beds Help Refine Design,
W82-04614 5F

SINGH, S. R.
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

SINGH, U. P.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

SINGH, V. P.
The General Hydrologic System Model,
W82-04314 2A

SINGLEY, J. E.
The Search for a Corrosion Index,
W82-04279 5F

SINHA, B. K.
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

SIRIA, J. W.
Control of Trihalomethanes in Drinking Water,
W82-04425 5F

SIVALOGANATHAN, K.
Storm Sewer Flow Computations,
W82-04640 7B

SKAGGS, R. W.
Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 3F

SKIMMER, M. M.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

SKRIVAN, J. A.
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

SLACK, R. B.
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

SLOMKA, T.
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 5D

SLOSS, P. W.
Simulation and Verification of Lake Ontario's Mean State,
W82-04570 2H

SMILES, D. E.
Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 2G

SMITH, B. R.
The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 6A

SMITH, C. J.
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

SMITH, D. G.
Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

SMITH, L. P.
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 2E

SMITH, P. E.
Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 5B

SMITH, R. E.
A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J

SMITH, W. G.
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 5B

SNAVELY, D. S.
Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

SNOEYINK, V. L.
The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 5F

The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F

SOARES, H. F.
Design of Filters for Clay Cores of Dams,
W82-04321 8G

SOKKARY, A. A.
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 2J

SONTHEIMER, H.
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F

SOWBY, S. E.
Leak Detection Programs Recover Revenues,
W82-04375 3D

SPEIDEL, H. K.
Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 5B

SPENCER, D. F.
Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 2H

SPOOR, M. F.
Bank Failure and Erosion on the Ohio River,
W82-04473 2J

SPROUL, C. R.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

STALL, J. B.
Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 2J

STARK, K. P.
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

STAUBITZ, W. W.
Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 7C

STAUFFER, J. R. JR.
Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 6G

STEGMAN, E. C.
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

STEINBERG, C.
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

STENSLAND, G. J.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 5B

STENSTROM, M. K.
Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

STEPHENSON, J. P.
Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 5D

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

STERRETT, R. J.
Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

STEVENS, H. H. JR.
Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 7B

STEVENS, P. R.
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

STEWART, T.
Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 5A

STIERWALT, L.
Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 5D

STOCKTON, C. W.
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 2E

STOLZY, L. H.
Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

STONER, J. D.
Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 7C

STRELKOFF, T.
Dimensionless Stream Advance in Sloping Borders,
W82-04308 3F

STREUTKER, A.
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

STRICKERT, R. G.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 5B

STRUWE, H.
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

SUBBA RAO, K.
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

SULOWAY, L. B.
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

SWAYZE, L. J.
Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 10C

SWENSON, E. M.
Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 7B

TAN, Y. L.
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

TANUMA, R.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

TAPP, J. S.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

TARAPCHAK, S. J.
Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 2H

TARIFENO-SILVA, E.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

TARIFENO-SILVA, W.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

TCHOBANOGLOUS, G.
Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 5D

TEITTINEN, E.
Shaking Down a Solids Handling System,
W82-04338 5D

THACKRAY, J. E.
The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

THOMAS, M. P.
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

THOMPSON, J. M.
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

THOMPSON, P. L.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

THOMPSON, W. B.
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 5D

THORNHILL, J. T.
Application of the Area of Review Concept,
W82-04674 6E

THRAILKILL, J.
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 2F

TINGYONG, B.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

TOERIEN, D. F.
Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

TOLIKAS, D. K.
Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 8B

TOOKOS, I.
Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 5D

TORRANCE, K. E.
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1A

TOUZEL, J. P.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 5D

TROTH, A.
Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

TROUBOUNIS, G.
Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 2E

TRUSSELL, A. R.
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 5F

TRUSSELL, R. R.
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 5F

TSAO, K.
Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 3F

TURCOTTE, D. L.
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1A

TYAGI, N. K.
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

ULLRICH, C. R.
Bank Failure and Erosion on the Ohio River,
W82-04473 2J

VALDES, M.
Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 2L

VALSANGKAR, A. J.
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

VAN VLIET, N.
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

VANCE, H. A.
Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 6A

VANHASSEL, J. H.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

VAUGHN, P. R.
Design of Filters for Clay Cores of Dams,
W82-04321 8G

VAUX JR, H. J.
Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 3C

VERMIJ, S.
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 2H

VESTAL, J. R.
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

VINCENT, B.
Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 2L

VINK, G. J.
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 5C

VINSON, T. S.
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 4B

VIRARAGHAVAN, T.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 5D

VOGEL, J. L.
Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 2B

VOLKER, R. E.
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

VORONIN, L. M.
Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

WADSTROM, T.
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

WAGGOTT, A.
Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 5B

WAITE, B. A.
Ground Water Monitoring of Underground Coal Mines,
W82-04750 5B

WALLER, B. G.
Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

WALLINGFORD, E.
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 2H

WALTA, M. R.
Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 6E

WALTER, M. F.
Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 2A

WARD, A. D.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

WARD, D. S.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 5B

WARD, R. C.
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

WARNER, L.
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 6E

WASE, D. A. J.
Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 5E

WATLING, R. J.
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 5B

WATSON, W. D.
Reversing Water Pollution Standards in an Uncertain World,
W82-04540 6B

WAWRONOWICZ, L. J.
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 5C

WEBER, J.
Decisions Under Violation of Regression Normality,
W82-04264 7C

WEBSTER, C. J. D.
Reducing the Flush,
W82-04654 3D

WEBSTER, R. M.
Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

WEISS, L. A.
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

WELCH, R.
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

WENTWORTH, R. W.
On the Marginal Cost of Wastewater Services,
W82-04376 6C

WEST, J. R.
Dispersion Coefficients in Estuaries,
W82-04684 5B

WHARTON, R. A. JR.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

WHEELER, R. M.
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

WHITE, C. S.
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

WHITE, I.
Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 2G

WHITE, J. K.
Groundwater Control,
W82-04714 4B

WHITE, W. R.
Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

WHITFIELD, P. H.
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

WIERICH, P.
The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 5D

WIESMANN, U.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

WIJAYARATNE, R.
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

WILHELMS, A.
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

WILLER, D. C.
Determining Feasibility of Small-Scale Hydropower,
W82-04693 6B

WILLIAMSON, K. J.
Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 5D

WILSON, J. L.
Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 5A

WIPPLER, K. A.
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 5D

WOOD, D. E.
Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 6F

WOODS, P. F.
Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G

WORDEN, D. J.
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

WUERDEMAN, D.
Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 5D

WYKOWSKI, J. C.
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 3C

YAMANISHI, K.
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

YAZDANI, G.
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D

YEAGER, J. G.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 5A

YOU, L.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 5D

YOUNG, J. L.
Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D

YU, D. P.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

YUST, L. J.
Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 5D

ZEIEN, C. T.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

ZWEIDINGER, R.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

YADAV, G.
[illegible] Wells [illegible]
[illegible]

YEAGER, J. G.
[illegible]

[illegible]
[illegible] Wastewater [illegible]
[illegible]

YEAGER, J. L.
[illegible]
[illegible]

YU, D. P.
[illegible]
[illegible]

YUAN, Y.
[illegible]
[illegible]

ZIMMERMANN, E.
[illegible]
[illegible]

WHITE, J. E.
[illegible] Groundwater [illegible]
[illegible]

WHITE, R. W.
[illegible]

WHITEHEAD, P. G.
[illegible]

WHITMAN, E.
[illegible]

WHITTEMORE, J.
[illegible]

WIESNER, M. R.
[illegible]

WILKINSON, P. A.
[illegible]

WILLIAMS, K. E.
[illegible]

WISNER, R. A.
[illegible] Stormwater [illegible]
[illegible]

WOLFF, D. S.
[illegible]

WONG, F. J.
[illegible] Montana.
[illegible]

WOOLLEY, D. L.
[illegible]

WUERSCHER, D.
[illegible]

WYSOWSKI, L. C.
[illegible]

YAMANISHI, S.
[illegible]

WARD, O. H.
[illegible]
W73-04456

WARREN, R. C.
[illegible]

WATKINS, S.
[illegible]

WATSON, J. C.
[illegible]

WATTENBERG, H.
[illegible]

WEAVER, W. E.
[illegible]

WEBER, W. J.
[illegible]

WEBB, J.
[illegible]

WEBSTER, C. H.
[illegible]

WEBSTER, R. G.
[illegible]

WEISS, J. A.
[illegible]

WELCH, E.
[illegible] Number [illegible]

WESTERHOFF, G. P.
[illegible]

WHEELER, R. H.
[illegible]

WHITE, C. W.
[illegible]

WHITE, C. S.
[illegible]

WHITE, D. M.
[illegible]

WHITE, J.
[illegible]

ORGANIZATIONAL INDEX

ABCOR, INC., WILMINGTON, MA.
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation, 5D
W82-04622

AID LTD., FREDERICTON (NEW BRUNSWICK).
Anaerobic Fermentation - Filtration of Potato Processing Wastewater, 5D
W82-04713

ALASKA UNIV., FAIRBANKS. GEOPHYSICAL INST.
A Probe Method for Soil Water Sampling and Subsurface Measurements, 7B
W82-04325

ALEXANDRIA UNIV. (EGYPT). DEPT. OF OCEANOGRAPHY.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals, 5B
W82-04290

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku, 2J
W82-04748

ALLIED CHEMICAL COMPANY, DANVILLE, IL.
A Treatment System for an Organic Chemicals Plant, 5D
W82-04353

ALVORD, BURDICK AND HOWSON, CHICAGO, IL.
Leak Detection--Histories, 3D
W82-04363

AMERICAN HOECHST CORP., LEOMINISTER, MA.
American Hoechst Upgrades a Treatment System Through Automation, 5D
W82-04354

AMSTERDAM UNIV. (NETHERLANDS). DEPT. OF AQUATIC ECOLOGY.
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements, 2H
W82-04256

ANGLO AMERICAN RESEARCH LAB., JOHANNESBURG (SOUTH AFRICA).
A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water, 5A
W82-04457

ARAGO LAB., BANYULS-SUR-MER (FRANCE).
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese c: Degradation des Composes Glucidiques au sein de la Commaunaute Planctonique en Zone Marine Eutrophe), 5B
W82-04672

ARGONNE NATIONAL LAB., IL.
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community, 5C
W82-04379

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory, 5B
W82-04434

ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOLOGY.
Isotope Geochemistry of Water in Gulf Coast Salt Domes, 2K
W82-04742

ARIZONA UNIV., TUCSON.
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis, 2H
W82-04378

ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL ECONOMICS.
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach, 6B
W82-04287

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Delayed Drainage in a Stream-Aquifer System, 2F
W82-04268

ARIZONA UNIV., TUCSON. DEPT. OF MINING AND GEOLOGICAL ENGINEERING.
The Use of Landsat Imagery in Ground Water Exploration, 7B
W82-04436

ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS AND INDUSTRIAL ENGINEERING.
Decisions Under Violation of Regression Normality, 7C
W82-04264

ARIZONA UNIV., TUCSON. LAB. OF TREE-RING RESEARCH.
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data, 2E
W82-04340

ARMY ENGINEER DIV. NORTH PACIFIC, PORTLAND, OR.
Flood Hazard Identification and Flood Plain Management on Alluvial Fans, 6F
W82-04738

ARMY NATICK RESEARCH AND DEVELOPMENT LABS., MA.
Biodegradation of Glycidol and Glycidyl Nitrate, 5D
W82-04456

ARTOIS-PICARDIE AGENCE DE l'EAU, DOUAI (FRANCE).
The Automatic Measuring of Sewage in the Artois-Picardie Area, 5A
W82-04602

ASIAN INST. OF TECH., BANGKOK (THAILAND).
Comparison of Two Autoregressive Models for Monthly Stream Flow Generation, 2E
W82-04351

Reservoir Sedimentation with Random Deposits, 2J
W82-04443

ASSOCIATION OF METROPLITAN SEWERAGE AGENCIES, WASHINGTON, DC.
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment, 5D
W82-04395

BARBER (B. P.) AND ASSOCIATES, INC., COLUMBIA, SC.
Use of Microscreens to Polish Lagoon Effluents, 5D
W82-04709

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions, 5B
W82-04720

BDM CORP., ALBUQUERQUE, NM.
Sewage Sludge Pathogen Transport Model Project, 5A
W82-04403

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA).
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I, 6G
W82-04749

BENIN UNIV. (NIGERIA). DEPT. OF PHYSICS.
Development of Hydro-Power in Nigeria, 6B
W82-04475

BIRMINGHAM UNIV. (ENGLAND).
Dispersion Coefficients in Estuaries, 5B
W82-04684

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CHEMICAL ENGINEERING.
Anaerobic Digestion of Farm Wastes: A Review - Part 2, 5E
W82-04347

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process, 5D
W82-04568

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF GEOLOGICAL SCIENCES.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands, 2F
W82-04254

BISWAS AND ASSOCIATES, OXFORD (ENGLAND).
Clean Water for the Third World, 6D
W82-04604

BOLIDEN-KNAPSACK G.M.B.H., HURTH-KNAPSACK (GERMANY, F.R.).
Purification of Surface Waters (Reinigung von Oberflachenwasser), 5F
W82-04577

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF CIVIL ENGINEERING.
Flood Probability Estimation, 6B
W82-04318

Operational Performance of an RBC Unit in Conjunction with a Septic Tank, 5D
W82-04355

BROOKHAVEN NATIONAL LAB., UPTON, NY.
Acidic Precipitation: Considerations for an Air Quality Standard, 5B
W82-04302

BROWN AND CALDWELL, PASADENA, CA.
Performance of Activated Sludge Processes: Reliability, Stability and Variability, 5D
W82-04394

BROWN AND CALDWELL, SACRAMENTO, CA.
Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas, 5C
W82-04278

BUCKNELL UNIV., LEWISBURG, PA. DEPT. OF BIOLOGY.
Limnological Characteristics of Eutrophic Lake Istokpoga, Florida, 2H
W82-04719

BUILDING RESEARCH ESTABLISHMENT, WATFORD (ENGLAND).
Reducing the Flush, 3D
W82-04654

BULGARIAN ACADEMY OF SCIENCES, SOFIA. INST. OF BOTANY.
The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Raditelnata Pokrivka v Subiratelnite Ezera v Mestnostta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh), 5C
W82-04476

BUNDESANSTALT FUER GEWASSERKUNDE, COBLENZ (GERMANY, F.R.).
Automatic Collection and Transmission of Data for the Federal Waterway Authority.
W82-04596 7A

BUNDESGESUNDHEITSAMT, BERLIN (GERMANY, F.R.). INST. FUER WASSER-, BODEN-, UND LUFTHYGIENE.
Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 7B

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 5F

BUREAU OF RECLAMATION, DENVER, CO.
Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 2B

CALGARY UNIV. (ALBERTA). DEPT. OF GEOGRAPHY.
Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 2J

CALIFORNIA ANALYTICAL LAB., SACRAMENTO.
Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 5A

CALIFORNIA DEPT. OF HEALTH SERVICES, BERKELEY.
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 5D

CALIFORNIA STATE DEPT. OF FISH AND GAME, SACRAMENTO.
Status Report on Striped Bass Analyses,
W82-04386 8I

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 3F

CALIFORNIA UNIV., DAVIS.
Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 3F

CALIFORNIA UNIV., DAVIS. DEPT. OF BIOLOGY.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 5D

CALIFORNIA UNIV. DAVIS. DEPT. OF LAND, AIR, AND WATER RESOURCES.
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 3F

CALIFORNIA UNIV., LOS ANGELES.
Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 5D

CALIFORNIA UNIV., LOS ANGELES, DEPT. OF BIOLOGY.
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 2D

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF HISTORY.
The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 6E

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Refuse of Power Plant Cooling Water for Irrigation,
W82-04443 3C

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF ECONOMICS.
An Economist's View of Demand Projections Considering Conservation,
W82-04448 6D

CAMBRIDGE UNIV. (ENGLAND).
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 8A

CAMP, DRESSER, AND MCKEE, INC., BOSTON, MA.
Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 5E

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 2H

CANTEBURY UNIV., CHRISTCHURCH (NEW ZEALAND).
Asymptotic Solution for Dam-Break Problem,
W82-04313 8B

CAPE TOWN UNIV., RONDEBOSCH (SOUTH AFRICA). DEPT. OF ZOOLOGY.
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 5C

CENTRAL GROUNDWATER BOARD, LUCKNOW (INDIA).
An Integrated Water-Quality Index for Irrigation Use,
W82-04723 5C

CENTRAL SOIL SALINITY RESEARCH INST., KARNAL (INDIA). DIV. OF ENGINEERING.
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 3F

CH2M/HILL INC., GAINESVILLE, FL.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 5E

CHESAPEAKE BAY CENTER FOR ENVIRONMENTAL STUDIES, EDGEWATER, MD.
Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 2L

CHILTERN WATER TREATMENT CO. (ENGLAND).
Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 3F

CHRYSLER CORP., KOKOMO, IN.
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 5D

CINCINNATI UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 5C

COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 2C

COLORADO E AGRICULTURAL EXPERIMENT STATION, FORT COLLINS.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 5E

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 5A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 5D

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 2F

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 5B

COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 8A

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA CITY (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 2G

COMMONWEALTH TECH, INC., LEXINGTON, KY.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 8A

COMMUNITY CONSULTANTS, INC., PROVO, UT.
Leak Detection Programs Recover Revenues,
W82-04375 3D

CONCENTRATION SPECIALISTS, INC., ANDOVER, MA.
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 3A

CONNECTICUT WATER CO., CLINTON.
Year-Round Distribution System Maintenance,
W82-04699 5F

COOK COLL., NEW BRUNSWICK, NJ.
Three Important Court Decisions,
W82-04349 6E

CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 7C

CULP/WESNER/CULP, CAMERON PARK, CA.
Granular Activated Carbon Installations,
W82-04391 5F

DAVIS, GRAHAM AND STUBBS, DENVER, CO.
Recent Developments in Colorado Groundwater Law,
W82-04679 6E

DEGREMONT INFILCO LTD., RUEIL-MALMAISON (FRANCE).
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 5F

DELAWARE UNIV., NEWARK. DEPT. OF CIVIL ENGINEERING.
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 7C

DEMOCRITOS UNIV. OF THRAKI, XANTHI (GREECE). SCHOOL OF ENGINEERING.
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 4A

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA).
Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 2I

DEPARTMENT OF AGRICULTURE, PHOENIX, ARIZONA, WATER CONSERVATION LABORATORY.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 3F

DEPARTMENT OF AGRICULTURE, SAINTE-FOY (QUEBEC).
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 2I

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO). POLAR CONTINENTAL SHELF PROJECT.
Acid Snow in the Canadian High Arctic,
W82-04342 2C

DEPARTMENT OF ENERGY, NEW YORK. ENVIRONMENTAL MEASUREMENTS LAB.
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 5B

DEPARTMENT OF ENERGY, WASHINGTON, DC. OFFICE OF ENVIRONMENTAL ASSESSMENTS.
Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 6B

DEPARTMENT OF THE AIR FORCE, WASHINGTON, DC.
Obtaining Layout of Water Distribution Systems,
W82-04319 8A

DEPARTMENT OF THE ENVIRONMENT, SIDNEY (BRITISH COLUMBIA). INST. OF OCEAN SCIENCES.
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 5A

DEPARTMENT OF THE ENVIRONMENT, VANCOUVER (BRITISH COLUMBIA).
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 2K

DEPARTMENT OF THE ENVIRONMENT, VICTORIA (BRITISH COLUMBIA). INST. OF OCEAN SCIENCES.
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 2H

DEPARTMENT OF TRANSPORT AND WORKS, DARWIN (AUSTRALIA).
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 6D

DORR-OLIVER INC., STAMFORD, CT.
Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 5E

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL ENGINEERING.
Strategies to Control Nonpoint Source Water Pollution,
W82-04261 5G

DUKE UNIV., DURHAM, NC. SCHOOL OF FORESTRY AND ENVIRONMENTAL STUDIES.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 4C

EBASCO SERVICES INC., NORCROSS, GA.
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 5E

EG AND G IDAHO, INC., IDAHO FALLS.
Micro Hydropower in the USA,
W82-04316 8A

EMA, INC., ST. PAUL, MN.
Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 5E

ENERGY LAW INSTITUTE, FRANKLIN PIERCE LAW INST. CENTER, CONCORD, NH.
A Manual for Development of Small Scale Hydroelectric Projects by Public Entities.
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ENVIREX INC., MILWAUKEE, WI.
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
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Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
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Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 5B

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 5B

ENVIRONMENTAL DESIGN AND PLANNING, INC., BOSTON, MA.
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 5D

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 5C

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
Regulating Corrosive Water,
W82-04335 6B

ENVIRONMENTAL PROTECTION SERVICE, BURLINGTON (ONTARIO). WASTEWATER TECHNOLOGY CENTRE.
Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 5D

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 5D

ENVIRONMENTAL PROTECTION SERVICES, BURLINGTON (ONTARIO). WASTEWATER TECHNOLOGY CENTRE.
Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 5D

ENVIRONMENTAL RESEARCH LAB.-DULUTH, MN.
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 5C

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC., GAINESVILLE, FL.
The Search for a Corrosion Index,
W82-04279 5F

ESSEX UNIV., COLCHESTER (ENGLAND). DEPT. OF BIOLOGY.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 2L

FEDERAL ENERGY REGULATORY COMMISSION, SAN FRANCISCO, CA. SAN FRANCISCO REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 6D

FEDERAL HIGHWAY ADMINISTRATION, WASHINGTON, DC. OFFICE OF ENGINEERING.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 8A

FLOOD METEOROLOGICAL OFFICE (INDIA).
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 2B

FLORIDA UNIV., BELLE GLADE. AGRICULTURAL RESEARCH AND EDUCATION CENTER.
Water Budget Computations for a Shallow-Lake Okeechobee, Florida,
W82-04258 2H

FLORIDA UNIV., BELLE GLADE. DEPT. OF AGRICULTURAL ENGINEERING.
Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 2H

FLORIDA UNIV., GAINESVILLE, DEPT. OF ENVIRONMENTAL ENGINEERING.
Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 5C

FORSCHUNGSZENTRUM WASSERTECHNIK (GERMAN,D.R.).
Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermesstellen),
W82-04582 7B

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 5A

FRANKLIN PIERCE LAW INST. CENTER, CONCORD, NH.
The Financing of Private Small Scale Hydroelectric Projects.
W82-04633 6B

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 5C

GENERAL BATTERY CORP., READING, PA.
Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 5B

GEOLOGICAL SURVEY, ALBANY, NY. WATER RESOURCES DIV.
Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 5B

GEOLOGICAL SURVEY, ALBUQUERQUE, NM. WATER RESOURCES DIV.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 5B

GEOLOGICAL SURVEY, ANCHORAGE, AK. WATER RESOURCES DIV.
Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 7C

GEOLOGICAL SURVEY, BATON ROUGE, LA. WATER RESOURCES DIV.
Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 7C

GEOLOGICAL SURVEY, BILLINGS, MT. WATER RESOURCES DIV.
Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 7C

GEOLOGICAL SURVEY, BOSTON, MA. WATER RESOURCES DIV.
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 2F

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 7C

GEOLOGICAL SURVEY, CARSON CITY, NV. WATER RESOURCES DIV.
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 7C

GEOLOGICAL SURVEY, CHARLESTON, WV. WATER RESOURCES DIV.
Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 7C

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.
Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 6G

GEOLOGICAL SURVEY, DORAVILLE, GA.
Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 8D

GEOLOGICAL SURVEY, HARRISBURG, PA. WATER RESOURCES DIV.
Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 7C

GEOLOGICAL SURVEY, HARTFORD, CT. WATER RESOURCES DIV.
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 2E

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.
Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 5G

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 5C

GEOLOGICAL SURVEY, INDIANAPOLIS, IN. WATER RESOURCES DIV.
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 4B

GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 2F

GEOLOGICAL SURVEY, LAGUNA NIGUEL, CA. WATER RESOURCES DIV.
Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 2J

GEOLOGICAL SURVEY, LAKEWOOD, CO.
Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 7B

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 6A

GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.
Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 7C

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 2E

GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 4B

GEOLOGICAL SURVEY, LITTLE ROCK, AR. WATER RESOURCES DIV.
Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 7C

GEOLOGICAL SURVEY, MENLO PARK, CA.
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1A

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
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GEOLOGICAL SURVEY, OKLAHOMA CITY, OK. WATER RESOURCES DIV.
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W82-04518 7C

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Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 7C

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Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 5B

Reversing Water Pollution Standards in an Uncertain World,
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W82-04499 5C

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 5E

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 5C

GEOLOGICAL SURVEY, SACRAMENTO, CA. WATER RESOURCES DIV.
Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 7C

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 6D

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 2A

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 5C

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 4B

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 10C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 7C

GEOLOGICAL SURVEY, TOWSON, MD. WATER RESOURCES DIV.
Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 7C

GEOLOGICAL SURVEY, TRENTON, NJ. WATER RESOURCES DIV.
Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 7C

GEOLOGICAL SURVEY, TUCSON, AZ. WATER RESOURCES DIV.
Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 7C

GEORGIA INST. OF TECH., ATLANTA.
Detention Basins--An Urban Experience,
W82-04332 4A

GEORGIA INST. OF TECH. ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 5D

GLOBE LININGS INC., LONG BEACH, CA.
The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 5G

GOSUDARSTVENNYI GIDROLOGICHESKII INST., LENINGRAD (USSR).
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 2A

GREATER LAWRENCE SANITARY DISTRICT, NORTH ANDOVER, MA.
Shaking Down a Solids Handling System,
W82-04338 5D

GRENOBLE-1 UNIV. (FRANCE). INST. DE MECANIQUE.
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 2A

HAMBURG UNIV. (GERMANY, F.R.).
Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 5D

HANOVER UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERWIRTSCHAFT.
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 5D

HARVARD UNIV., CAMBRIDGE, MA. DIV. OF APPLIED SCIENCES.
Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 2H

HAWAII UNIV., HONOLULU. DEPT. OF TROPICAL MEDICINE.
Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 5D

HENKEL KGAA, DUSSELDORF (GERMANY, F.C.). DEPT. OF ECOLOGY.
The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 5D

HENKEL KGAA, DUSSELDORF (GERMANY, F.R.).
A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 5B

HOMESTAKE MINING CO., CREEDE, CO.
Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 5D

HONG KONG UNIV. DEPT. OF MICROBIOLOGY.
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 5B

HUFF AND HUFF, INC., LAGRANGE, IL.
Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 5D

HYDRAULICS RESEARCH STATION, WALLINGFORD (ENGLAND).
Mathematical Simulation of Sediment Movement in Streams,
W82-04650 2J

Money Down the Drain,
W82-04653 4A

HYDRO WATTS INC., WASHINGTON GROVE, MD.
Small Hydro Schemes for Private Developers,
W82-04327 8A

IFE UNIV. (NIGERIA). DEPT. OF ENVIRONMENTAL HEALTH.
Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 5C

ILLINOIS NATURAL HISTORY SURVEY, CHICAGO.
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 5C

ILLINOIS NATURAL HISTORY SURVEY, URBANA.
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 5C

ILLINOIS STATE WATER SURVEY DIV., CHAMPAIGN.
Water Chemistry of the Illinois Waterway,
W82-04390 2K

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Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 2B

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 5G

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 2J

ILLINOIS UNIV. AT CHICAGO CIRCLE. SCHOOL OF URBAN SCIENCES.
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 6B

ILLINOIS UNIV. AT URBANA-CHAMPAIGN.
Pesticides in the Aquatic Environment,
W82-04727 5C

ILLINOIS UNIV. AT URBANA. CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
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W82-04429 5F

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF ENVIRONMENTAL ENGINEERING.
The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 5F

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).
Design of Filters for Clay Cores of Dams,
W82-04321 8G

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W82-04612 5D

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Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 7B

INDO-BRITISH BETWA GROUNDWATER PROJECT, BHOPAL (INDIA).
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 2B

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Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 5F

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W82-04544 5D

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W82-04734 6D

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Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 5A

INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).
Resistance Equation for Large-Scale Roughness,
W82-04696 2E

INSTITUTE OF OCEANOGRAPHIC SCIENCES, MERSEYSIDE (ENGLAND).
Salinity Intrusion in Estuaries,
W82-04574 2L

INSTITUTE OF OCEANOGRAPHIC SCIENCES, TAUNTON (ENGLAND).
A Suspended Sediment Front in the Severn Estuary,
W82-04639 2L

INTERNATIONAL ENGINEERING CO., INCORP., SAN FRANCISCO, CA.
Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 2F

INTERNATIONAL RICE RESEARCH INST., LOS BANOS, LAGUNA (PHILIPPINES).
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 2I

IOWA STATE UNIV., AMES. DEPT. OF CIVIL ENGINEERING.
Tapered Inlet Design Using Specific Energy Curves,
W82-04695 8A

IOWA UNIV., IOWA CITY. INST. OF HYDROLOGICAL RESEARCH.
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 2J

JAPAN SEWAGE WORKS BUREAU, OSAKA.
Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 5A

KANSAS UNIV., LAWRENCE. DEPT. OF CIVIL ENGINEERING.
Nearfield Performance of River Diffusers,
W82-04561 5B

KARLSRUHE UNIV. (GERMANY, F.R.).
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W82-04663 2E

KARLSRUHE UNIV. (GERMANY, F.R.). INST. FUER INGENIEURBIOLOGIE UND BIOTECHNOLOGIE DES ABWASSERS.
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstoffe),
W82-04282 5D

KARLSRUHE UNIVERSITY (FEDERAL REPUBLIC OF GERMANY), WATER CHEMISTRY DEPT.
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 5F

KENT STATE UNIV., OH. DEPT. OF BIOLOGICAL SCIENCES.
Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 5G

KENTUCKY UNIV., LEXINGTON. DEPT. OF AGRICULTURAL ENGINEERING.
Effect of Surface Sealing on Infiltration,
W82-04362 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 2G

KENTUCKY UNIV., LEXINGTON. DEPT. OF GEOLOGY.
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 2F

KENTUCKY WATER RESOURCES RESEARCH INST., LEXINGTON.
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 2H

KERNFORSCHUNGSZENTRUM KARLSRUHE G.M.B.H. (GERMANY, F.R.). INST. FUER RADIOCHEMIE.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 5D

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 5F

KING'S COLL., LONDON (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Groundwater Control,
W82-04714 4B

KRAMER, CHIN, AND MAYO, PORTLAND, OR.
Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 5D

LA SOCIETE D'ENERGIE DE LA BAIE JAMES, MONTREAL (QUEBEC).
James Bay Spillways and Control Structures,
W82-04692 8A

LAFAYETTE COLL., EASTON, PA.
Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 6C

LANCASTER UNIV., BAILRIGG (ENGLAND).
The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 7B

LANCHESTER POLYTECHNIC, COVENTRY (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Storm Sewer Flow Computations,
W82-04640 7B

LANDESAMT FUER GEWASSERKUNDE, MAINZ (GERMANY, F.R.).
Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 5G

LAVAL UNIV., QUEBEC. DEPT. DE BIOLOGIE.
Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 2L

LIVERPOOL UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Prediction of the Circulation in Reservoirs,
W82-04682 2H

LOS ANGELES BUREAU OF SANITATION, CA.
Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 5D

LOS ANGELES COUNTY SANITATION DISTRICTS, WHITTIER, CA.
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 5D

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 5D

LOUISIANA STATE UNIV., BATON ROUGE. CENTER FOR WETLAND RESOURCES.
Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 7B

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 5C

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 5D

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CIVIL ENGINEERING.
Will New Orleans Miss The Mississippi,
W82-04274 4A

LOUISIANA WATER RESOURCES RESEARCH INST., BATON ROUGE.
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 8B

LOUISVILLE UNIV., KY. DEPT. OF CHEMICAL AND ENVIRONMENTAL ENGINEERING.
Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 5D

A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 6A

LOUISVILLE UNIV., KY. DEPT. OF CIVIL ENGINEERING.
Bank Failure and Erosion on the Ohio River,
W82-04473 2J

LOUISVILLE WATER CO., KY.
Control of Trihalomethanes in Drinking Water,
W82-04425 5F

LOWELL UNIV., MA. DEPT. OF CIVIL ENGINEERING.
Vacuum Filtration of Septage,
W82-04710 5D

LOWELL UNIV., MA. DEPT. OF EARTH SCIENCES.
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 2A

LYNE AND MARTIN PUBLIC ANALYSTS, READING (ENGLAND).
Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 5C

MAHI-KADANA IRRIGATION PROJECT, AHMEDABAD (INDIA).
Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 3F

MAINE UNIV. AT ORONO. LAND AND WATER RESOURCES CENTER.
The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 5C
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 5B

MALVIYA REGIONAL ENGINEERING COLL. JAIPUR (INDIA). DEPT. OF CIVIL ENGINEERING.
Conformal Mapping for Channel Junction Flow,
W82-04306 2E

MANCHESTER WATER WORKS, NH.
Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 5G

MARYLAND UNIV., COLLEGE PARK. CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES.
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 5B

MARYLAND UNIV., COLLEGE PARK. COLL. OF ENGINEERING.
Relation Between Curve Number and Runoff Coefficient,
W82-04266 2A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CIVIL ENGINEERING.
Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 2A

MARYLAND UNIV., FROSTBURG. APPALACHIAN ENVIRONMENTAL LAB.
Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 6G

MASON AND HANGER-SILAS MASON CO., INC., LEONARDO, NJ.
Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 5G

MASSACHUSETTS DEPT. OF ENVIRONMENTAL QUALITY ENGINEERING, BOSTON.
Massachusetts Water Supply Priorities,
W82-04698 6D

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Local Irrigation Agencies,
W82-04560 4B

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 2H

METEOROLOGICAL OFFICE, POONA (INDIA).
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 2D
Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 2B
A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 2K

METROPOLITAN DENVER SEWAGE DISPOSAL, DISTRICT NO. 1, CO.
Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 5D

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CIVIL ENGINEERING.
Densification of Paper Mill Sludge Materials,
W82-04694 5E

MICHIGAN UNIV., ANN ARBOR. SCHOOL OF PUBLIC HEALTH.
An Interactive Data Management System for River Water Quality Data,
W82-04659 10B

MINISTERE DE L'ENVIRONNEMENT, SAINTE-FOY (QUEBEC). SERVICE DES EAUX DE SURFACE.
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 2A

MINISTRY OF THE INTERIOR, BERLIN (GERMANY, F.R.).
New Federal Wastewater Discharge Standards in Germany,
W82-04527 6E

MINISTRY OF WATER AND POWER, ISLAMABAD (PAKISTAN).
Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 6A

MINNESOTA UNIV., MINNEAPLIS. DEPT. OF CIVIL AND MINERAL ENGINEERING.
Coagulation: Experiences in Organics Removal,
W82-04424 5F

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL ENGINEERING.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 3D

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF GEOLOGY AND GEOPHYSICS.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 2J

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF MATHEMATICS.
The General Hydrologic System Model,
W82-04314 2A

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. WATER RESOURCES RESEARCH INST.
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 5A

MITSUBISHI ELECTRIC CORP., HYOGO (JAPAN).
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 5D

MONASH UNIV., CLAYTON (AUSTRALIA).
Analysis of Detention Basin Systems,
W82-04444 2A

MONSANTO RESEARCH CORP., DAYTON, OH.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 5A

MONTANA STATE UNIV., BOZEMAN. DEPT. OF MICROBIOLOGY.
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 5A

MONTANA UNIV., MISSOULA. DEPT. OF ECONOMICS.
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 6B

MONTGOMERY (JAMES), INC., WALNUT CREEK, CA.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 5D

MONTGOMERY (JAMES M.), PASADENA, CA.
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 5F

MOODY AND ASSOCIATES INC., MEADVILLE, PA.
Ground Water Monitoring of Underground Coal Mines,
W82-04750 5B

MORRIS FORMAN WASTEWATER TREATMENT PLANT, LOUISVILLE, KY.
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 5D

MUNICH UNIV. (GERMANY, F.R.). GEOGRAPHISCHES INST.
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 5B

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 5D
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 5D
Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 5D

Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 5B

MUNICIPAL WATER WORKS OF ROTTERDAM (NETHERLANDS).
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 5F

NATIONAL BOARD OF WATERS, HELSINKI (FINLAND). WATER RESEARCH INST.
Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 7B

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
Health Aspects of Waters at Public Health Resorts,
W82-04348 5A

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 2H
Winter Temperature Structure in Lake Huron,
W82-04381 2H
Simulation and Verification of Lake Ontario's Mean State,
W82-04570 2H

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB. MI.
Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 2B

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER. ENVIRONMENTAL RESEARCH LABS.
Disaster by Flood,
W82-04618 2E

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, UPPSALA (SWEDEN).
Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 2H

NATIONAL WEATHER SERVICE, SILVER SPRING, MD.
The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 2E

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Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 2G

NEVADA UNIV. SYSTEM, RENO. DEPT. OF CIVIL ENGINEERING.
Development of Federal Reserve Rights,
W82-04446 6E

NEW HAMPSHIRE UNIV., DURHAM. INST. OF NATURAL AND ENVIRONMENTAL RESOURCES.
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 2E

NEW HAMPSHIRE WATER SUPPLY AND POLLUTION CONTROL COMMISSION, CONCORD.
Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 6E

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF AGRICULTURAL ENGINEERING.
Effects of Decreased Watering on Crop Yields,
W82-04411 2I

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF BIOLOGY.
Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 5F

NEW MEXICO UNIV., ALBUQUERQUE. DEPT. OF BIOLOGY.
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 2J

NEW MEXICO UNIV., ALBUQUERQUE. DEPT. OF CIVIL ENGINEERING.
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 6C
Relative Runoff by Curve Number Nomograph,
W82-04307 2A

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). SCHOOL OF CIVIL ENGINEERING.
Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 8A

NEWCASTLE UPON TYNE UNIV., (ENGLAND). DEPT. OF ENGINEERING MATHEMATICS.
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 2E

NGK INSULATORS, LTD, NAGOYA (JAPAN).
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 5E

NIEDERSACHSISCHES WASSERUNTERSUCHUNGSAMT, HILDESHEIM (GERMANY, F.R.).
Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 7B

NIJVERHEIDSORGANISATIE TNO, DELFT (NETHERLANDS).
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W82-04480 5C

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 3F

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF CIVIL ENGINEERING.
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 5D

NORTH CAROLINA STATE UNIV. AT RALEIGN. DEPT. OF ZOOLOGY.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 7B

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 5B

NORTH CAROLINA WATER RESOURCES RESEARCH INST., RALEIGH.
Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 6A

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF AGRICULTURAL ENGINEERING.
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 2I

NORTH TEXAS STATE UNIV., DENTON. DEPT. OF BIOLOGICAL SCIENCES.
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 5C

NORTHEASTERN FOREST EXPERIMENT STATION, PARSONS, WV. TIMBER AND WATERSHED LAB.
A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 7B

NORTHERN ARIZONA UNIV., FLAGSTAFF. DEPT. OF MICROBIOLOGY.
Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 5B

NORTHUMBRIAN WATER AUTHORITY, GOSFORTH (ENGLAND).
Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 2E
Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 2E
The Future of Flood Estimation and the Flood Studies Report,
W82-04687 2E

OHIO STATE UNIV. COLUMBUS. DEPT. OF ELECTRICAL ENGINEERING.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 2B

OHIO WESLEYAN UNIV., DELAWARE. DEPT. OF GEOGRAPHY AND GEOLOGY.
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 6E

OKLAHOMA STATE UNIV. STILLWATER. DEPT. OF ECONOMICS.
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 6E

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE.
Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 5B

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Water Management in Ontario,
W82-04259 6E

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). INST. FOR ENVIRONMENTAL SCIENCES.
Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 2H

OREGON STATE UNIV., CORVALLIS.
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 4B

Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 2L

OREGON UNIV. HEALTH SCIENCES CENTER, PORTLAND.
Effect of Halogens on Giardia Cyst Viability,
W82-04401 5F

OREGON WATER RESOURCES DEPT., SALEM.
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 2K

OSLO UNIV. (NORWAY).
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 5A

OTV, COUBEVOIE (FRANCE).
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W82-04665 5D

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W82-04458 5A

PASSAVANT-WERKE MICHELBACHER HUETTE, AARBERGEN (GERMANY, F.R.).
Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 5A

PEAT, MARWICK AND CO., LONDON (ENGLAND).
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 6C

PESHAWAR UNIV. (PAKISTAN). DEPT. OF ELECTRICAL ENGINEERING.
Rural Power Schemes in Pakistan,
W82-04328 8A

POLICY SCIENCES ASSOCIATES, BOULDER, CO.
Objectives and Constraints in Federal Water Resources Planning,
W82-04288 6E

POLISH ACADEMY OF SCIENCES, ZABRZE. INST. OF ENVIRONMENTAL ENGINEERING.
Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 5D

PORT ELIZABETH UNIV. (SOUTH AFRICA). DEPT. OF ZOOLOGY.
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 5B

PRESIDENT'S COUNCIL OF ECONOMIC ADVISERS, WASHINGTON, DC.
On the Marginal Cost of Wastewater Services,
W82-04376 6C

PUBLIC POWER CORP., ATHENS (GREECE). COMPUTING CENTER.
Young's Inequality for Three-Dimensional Flows,
W82-04267 2A

PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA).
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 2G

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF BOTANY AND PLANT PATHOLOGY.
Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 2H

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Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 5C

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W82-04472 2L

QUEEN'S UNIV., BELFAST (NORTHERN IRELAND). DEPT. OF INDUSTRIAL CHEMISTRY.
Design Models for Adsoprtion Systems in Wastewater Treatment,
W82-04300 5D

RAMLIT ASSOCIATES, BERKELEY, CA.
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 5B

RAY D. NIXON POWER PLANT WATER SUPPLY, COLORADO SPRINGS, CO.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 5D

READING UNIV. (ENGLAND). DEPT. OF MATHEMATICS.
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 2F

RESEARCH COUNCIL OF ALBERTA, EDMONTON.
Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 5D

RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAPEST (HUNGARY).
Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 5D

RESEARCH TRIANGLE INST., RESEARCH TRIANGLE PARK, NC.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 5D

RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY.
Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 2L

RHODE ISLAND UNIV., KINSTON. DEPT. OF MICROBIOLOGY.
Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 5A

RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). DEPT. OF GEOGRAPHY.
Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 2A

RICE UNIV., HOUSTON, TX. DEPT. OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 6G

ROBERT S. KERR ENVIRONMENTAL RESEARCH LAB., ADA, OK.
Application of the Area of Review Concept,
W82-04674 6E

ROCKWELL INTERNATIONAL, NEWBURY PARK, CA.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 5A

Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 5D

SAITAMA UNIV., URAWA (JAPAN). DEPT. OF FOUNDATION ENGINEERING.
Incipient Motion of Sand Particles on Side Slopes,
W82-04368 8D

SALFORD UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Modelling Evaporation from Reservoirs,
W82-04722 2D

SCIENCE AND EDUCATION ADMINISTRATION, ATHENS, GA.
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 7B

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 4C

SCIENCE AND EDUCATION ADMINISTRATION, BUSHLAND, TX. CONSERVATION AND PRODUCTION RESEARCH LAB.
Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 2G

SCIENCE AND EDUCATION ADMINISTRATION, CHEYENNE, WY.
Topsoil Management of Mined Soils,
W82-04571 4D

SCIENCE AND EDUCATION ADMINISTRATION, FORT COLLINS, CO.
A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 2J

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 2I

SCIENCE AND EDUCATION ADMINISTRATION, LINCOLN, NE.
Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 6A

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
How Rain Intensity Affects Interrill Erosion,
W82-04537 2J

Thunderstorm in Agriculture and in Forest Management,
W82-04617 2B

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. CONSERVATION LAB.
Dimensionless Stream Advance in Sloping Borders,
W82-04308 3F

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
The Seven-Trent Studies of Industrial Water Use,
W82-04686 6D

SEVERN TRENT WATER AUTHORITY, COVENTRY (ENGLAND).
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W82-04592 7A

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W82-04664 5D

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W82-04744 1A

SIEGRIST G.M.B.H., HAMBURG (GERMANY, F.R.).
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W82-04579 5A

SIEMENS A.G., KARLSRUHE (GERMANY, F.R.).
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W82-04600 5D

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W82-04291 2L

SIR WILLIAM HALCROW AND PARTNERS, LONDON (ENGLAND).
A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 2A

SNAKE RIVER CONSERVATION RESEARCH CENTER, KIMBERLY, ID.
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04338 4D

SOUTH DAKOTA STATE UNIV., BROOKINGS. WATER RESOURCES INST.
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W82-04415 3F

SOUTHERN CALIFORNIA METROPOLITAN WATER DISTRICT, LAVERNE.
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W82-04277 5A

SOUTHERN ILLINOIS UNIV. AT CARBONDALE.
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W82-04409 5C

SOUTHERN WATER AUTHORITY (ENGLAND).
Adopting Sewers,
W82-04655 8A

STATE UNIV. OF NEW YORK AT ALBANY.
Conserving Water Through Pricing,
W82-04272 3D

STATE UNIV. OF NEW YORK AT STONY BROOK. INST. FOR ENERGY RESEARCH.
Optimization of Areawide Wastewater Management,
W82-04703 5D

STATE UNIV. OF NEW YORK AT SYRACUSE. COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY.
Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 5B

Search: A Gaged Watershed Inventory,
W82-04433 10B

STATE WATER SURVEY DIV., CHAMPAIGN.
Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 2B

STUTTGART UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERBAU, WASSERGUETEUND ABFALLWIRTSCHAFT.
The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 5D

SVERIGES LANTBRUKSUNIVERSITET, UPPSALA. DEPT. OF BACTERIOLOGY AND EPIZOOTOLOGY.
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 5A

SYSTEMS, SCIENCE AND SOFTWARE, LAJOLLA, CA.
Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 6A

TECHNISCH WERKE DER STADT STUTTGART (GERMANY, F.R.).
The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebe- und Reservewasser),
W82-04546 5F

TECHNISCHE UNIV., BERLIN (GERMANY, F.R.). INST. FUER CHEMIEINGENIEURTECHNIK.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 5A

TECHNISCHE UNIV., DRESDEN (GERMAN D.R.).
Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 4A

TENNESSEE UNIV., KNOXVILLE.
The Chemistry of Saline Water Chlorination,
W82-04729 3C

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF AGRICULTURAL ENGINEERING.
Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 2A

TEXAS UNIV. AT AUSTIN. DEPT. OF CIVIL ENGINEERING.
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 6A

Water Reuse Planning Models: Extensions and Applications,
W82-04565 6A

TEXAS UNIV. AT AUSTIN. DEPT. OF ECONOMICS.
Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 6E

TEXAS UNIV. AT AUSTIN, SCHOOL OF PUBLIC HEALTH.
Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 5C

TEXAS UNIV. HEALTH SCIENCE CENTER AT HOUSTON. SCHOOL OF PUBLIC HEALTH.
Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 5C

THAMES WATER AUTHORITY, BERKSHIRE (ENGLAND).
Data Acquisition for River Management,
W82-04601 7A

THAMES WATER AUTHORITY (ENGLAND).
The Traditional Approach to Water Loss,
W82-04656 3D

THAMES WATER AUTHORITY, LONDON (ENGLAND).
Occurrence and Fate of Certain Triphenyimethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 5B

Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 2L

THESSALONIKI UNIV., SALONIKA (GREECE). DEPT. OF HYDRAULICS.
Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 8B

THESSALONIKI UNIV., SALONIKA (GREECE). SCHOOL OF TECHNOLOGY.
The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 4B

TOHOKU UNIV., SENDAI (JAPAN). BIOLOGICAL INST.
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 2L

TUBINGEN REGIERUNGSPRESIDIUM (GERMANY, F.R.).
Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 4B

TUDOR ENGINEERING CO., SAN FRANCISCO, CA.
Determining Feasibility of Small-Scale Hydropower,
W82-04693 6B

TULANE UNIV., NEW ORLEANS, LA. SCHOOL OF PUBLIC HEALTH AND TROPICAL MEDICINE.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 5B

TURNER, COLLIE AND BRADEN, INC., HOUSTON, TX.
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 8A

UHDE (FRIEDRICH) G.M.B.H., DORTMUND (GERMANY, F.R.).
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 5D

UKAEA SYSTEMS RELIABILITY SERVICE, WARRINGTON (ENGLAND).
Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 5D

UNION COLL., SCHENECTADY, NY. DEPT. OF CIVIL ENGINEERING.
Development of Improved Stormwater Quality Models,
W82-04559 5B

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO CITY. INST. DE BIOLOGIA.
The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 2L

UNIVERSITY OF SOUTH FLORIDA, TAMPA. DEPT. OF GEOLOGY.
Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 5A

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND).
Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 8B

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF.
Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 8B

UTAH STATE UNIV., LOGAN.
A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 3D

VERMONT UNIV., BURLINGTON. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMICS.
Experiments in Improving Rural Water Supplies,
W82-04350 5F

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOLOGY.
Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 2L

VICTORIA UNIV., WELLINGTON (NEW ZEALAND). DEPT. OF INFORMATION SCIENCE.
The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 6A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 5B

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 2H

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF CIVIL ENGINEERING.
Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 5A

WAHNBACHTALSPERRENVERBAND, SIEGBURG (GERMANY, F.R.).
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 5G

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Measurement of Air in Flowing Water,
W82-04322 7B

WASHINGTON UNIV., SEATTLE. DEPT. OF ATMOSPHERIC SCIENCES.
Convection Patterns in a Pond,
W82-04461 2C

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 5D

WATER AND SANITATION FOR HEALTH PROJECT, WASHINGTON, DC.
The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 6D

WATER FUTURES, ALBUQUERQUE, NM.
Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 2F

WATER PURIFICATION ASSOCIATES, CAMBRIDGE, MA.
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 5F

WATER RESOURCES COUNCIL, WASHINGTON, DC.
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 6C

WATERLOO UNIV., (ONTARIO). DEPT. OF BIOLOGY.
Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04393 2H

WEST VIRGINIA UNIV., MORGANTOWN. DIV. OF ANIMAL AND VETERINARY SCIENCES.
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 5B

WEST VIRGINIA UNIV., MORGANTOWN. REGIONAL RESEARCH INST.
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 6C

WESTERN WASHINGTON UNIV., BELLINGHAM. DEPT. OF ECONOMICS.
A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 6D

WESTON (ROY F.), INC., WEST CHESTER, PA.
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 5D

WHITMAN AND HOWARD, INC., WELLESLEY, MA.
Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 5G

WIGGINS TEAPE RESEARCH AND DEVELOPMENT, LTD. (ENGLAND).
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 5F

WILLIAMSPORT SANITARY AUTHORITY, PA.
Colloidal Organics,
W82-04689 5F

WISCONSIN UNIV. GREEN BAY. COLL. OF ENVIRONMENTAL SCIENCE.
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 5G

WISCONSIN UNIV.-MADISON.
Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 2A

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 2H

WOODWARD-CLYDE CONSULTANTS, SAN FRANCISCO, CA.
Ground-Water Flow Systems and Stability of a Slope,
W82-04677 2J

WYOMING UNIV., LARAMIE.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 2D

YAMANASHI UNIV., KOFU (JAPAN). DEPT. OF ENVIRONMENTAL ENGINEERING.
Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 5F

YOKOHAMA SEWERAGE BUREAU, KAWASAKI (JAPAN).
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 5D

YOUNGSTOWN STATE UNIV., OH. DEPT. OF CIVIL ENGINEERING.
A Lumped Approach to the Inverse Problem in Ground Water Hydrology.
W82-04451 4B

ZAKIR HUSAIN COLL. OF ENGINEERING AND TECHNOLOGY, ALIGARH (INDIA).
The Vortex Scour Mechanism at Bridge Piers,
W82-04642 8B

ACCESSION NUMBER INDEX

W82-04251	3F
W82-04252	5B
W82-04253	7C
W82-04254	2F
W82-04255	6C
W82-04256	2H
W82-04257	5C
W82-04258	2H
W82-04259	6E
W82-04260	6B
W82-04261	5G
W82-04262	5C
W82-04263	2B
W82-04264	7C
W82-04265	2B
W82-04266	2A
W82-04267	2A
W82-04268	2F
W82-04269	3F
W82-04270	5F
W82-04271	4A
W82-04272	3D
W82-04273	6C
W82-04274	4A
W82-04275	5F
W82-04276	5E
W82-04277	5A
W82-04278	5C
W82-04279	5F
W82-04280	5D
W82-04281	5G
W82-04282	5D
W82-04283	5D
W82-04284	5D
W82-04285	5D
W82-04286	5A
W82-04287	6B
W82-04288	6E
W82-04289	6B
W82-04290	5B
W82-04291	2L
W82-04292	8A
W82-04293	5B
W82-04294	5C
W82-04295	2D
W82-04296	7B
W82-04297	7B
W82-04298	5D
W82-04299	2L
W82-04300	5D
W82-04301	5F
W82-04302	5B
W82-04303	2A
W82-04304	2E
W82-04305	2F
W82-04306	2E
W82-04307	2A
W82-04308	3F
W82-04309	4B
W82-04310	2D
W82-04311	5D
W82-04312	2L
W82-04313	8B
W82-04314	2A
W82-04315	8A
W82-04316	8A
W82-04317	3C
W82-04318	6B
W82-04319	8A
W82-04320	5D
W82-04321	8G
W82-04322	7B
W82-04323	5D
W82-04324	2H
W82-04325	7B
W82-04326	2K
W82-04327	8A
W82-04328	8A
W82-04329	5E
W82-04330	2L
W82-04331	2L
W82-04332	4A
W82-04333	2A
W82-04334	2E
W82-04335	6B
W82-04336	2B
W82-04337	4B
W82-04338	5D
W82-04339	2A
W82-04340	2E
W82-04341	5C
W82-04342	5C
W82-04343	6E
W82-04344	5D
W82-04345	5G
W82-04346	5B
W82-04347	5E
W82-04348	5A
W82-04349	6E
W82-04350	5F
W82-04351	2E
W82-04352	6D
W82-04353	5D
W82-04354	5D
W82-04355	5D
W82-04356	3F
W82-04357	5C
W82-04358	4D
W82-04359	2G
W82-04360	3F
W82-04361	2I
W82-04362	2G
W82-04363	3D
W82-04364	8A
W82-04365	7C
W82-04366	2J
W82-04367	8I
W82-04368	8D
W82-04369	5D
W82-04370	5D
W82-04371	5D
W82-04372	2G
W82-04373	5D
W82-04374	5F
W82-04375	3D
W82-04376	6C
W82-04377	2H
W82-04378	2H
W82-04379	5C
W82-04380	2J
W82-04381	2H
W82-04382	2H
W82-04383	2H
W82-04384	5G
W82-04385	5E
W82-04386	8I
W82-04387	8B
W82-04388	5G
W82-04389	5C
W82-04390	2K
W82-04391	5F
W82-04392	5D
W82-04393	5B
W82-04394	5D
W82-04395	5D
W82-04396	5A
W82-04397	5D
W82-04398	5A
W82-04399	5D
W82-04400	5E
W82-04401	5F
W82-04402	5D
W82-04403	5A
W82-04404	5D
W82-04405	5D
W82-04406	5D
W82-04407	5C
W82-04408	5B
W82-04409	5C
W82-04410	6E
W82-04411	2I
W82-04412	5A
W82-04413	5A
W82-04414	8A
W82-04415	3F
W82-04416	5B
W82-04417	2H
W82-04418	5C
W82-04419	5D
W82-04420	5B
W82-04421	5G
W82-04422	5C
W82-04423	5F
W82-04424	5F
W82-04425	5F
W82-04426	5F
W82-04427	5F
W82-04428	2F
W82-04429	5F
W82-04430	6A
W82-04431	2B
W82-04432	5B
W82-04433	10B
W82-04434	5B
W82-04435	7B
W82-04436	7B
W82-04437	2J
W82-04438	7B
W82-04439	2A
W82-04440	2H
W82-04441	6E
W82-04442	5E
W82-04443	2J
W82-04444	2A
W82-04445	3C
W82-04446	6E
W82-04447	5D
W82-04448	6D
W82-04449	6G
W82-04450	2J
W82-04451	4B
W82-04452	2A
W82-04453	5A
W82-04454	5D
W82-04455	5C
W82-04456	5D
W82-04457	5A
W82-04458	5A
W82-04459	2A
W82-04460	2C
W82-04461	2C
W82-04462	5C
W82-04463	5A
W82-04464	2L
W82-04465	5B
W82-04466	2H
W82-04467	2H
W82-04468	5B
W82-04469	5A
W82-04470	2I
W82-04471	2I
W82-04472	2L
W82-04473	2J
W82-04474	6A
W82-04475	6B
W82-04476	5C
W82-04477	5D
W82-04478	5B
W82-04479	5B
W82-04480	5C
W82-04481	2F
W82-04482	7B
W82-04483	2A
W82-04484	2H
W82-04485	5B
W82-04486	6D
W82-04487	2F
W82-04488	7C
W82-04489	7C
W82-04490	7C
W82-04491	5C
W82-04492	2F
W82-04493	4B
W82-04494	5G
W82-04495	2J
W82-04496	1A
W82-04497	4B
W82-04498	4B
W82-04499	5C
W82-04500	5E
W82-04501	7C
W82-04502	7C
W82-04503	7C
W82-04504	7C
W82-04505	2B
W82-04506	5C
W82-04507	7C
W82-04508	10C
W82-04509	6G
W82-04510	7C
W82-04511	7C
W82-04512	7C
W82-04513	7C
W82-04514	2A
W82-04515	7C
W82-04516	7C
W82-04517	5B
W82-04518	7C
W82-04519	2E
W82-04520	5B
W82-04521	7C
W82-04522	7C
W82-04523	7C
W82-04524	5C
W82-04525	5F
W82-04526	2F
W82-04527	6E
W82-04528	5D
W82-04529	5C
W82-04530	5A
W82-04531	2J
W82-04532	5D
W82-04533	5F
W82-04534	5B
W82-04535	4C
W82-04536	2G
W82-04537	2J
W82-04538	3F
W82-04539	5B
W82-04540	6B
W82-04541	2I
W82-04542	2C
W82-04543	2L
W82-04544	5D
W82-04545	5D
W82-04546	5F
W82-04547	6E
W82-04548	5C
W82-04549	5D
W82-04550	5B
W82-04551	4B
W82-04552	2J
W82-04553	5F
W82-04554	6B
W82-04555	5D
W82-04556	5C
W82-04557	3D
W82-04558	8A
W82-04559	5B
W82-04560	4B
W82-04561	5B
W82-04562	5D
W82-04563	6A
W82-04564	5B
W82-04565	6A
W82-04566	5D
W82-04567	5B
W82-04568	5D
W82-04569	5A
W82-04570	2H
W82-04571	4D
W82-04572	2H
W82-04573	2H
W82-04574	2L
W82-04575	7B
W82-04576	4A
W82-04577	5F
W82-04578	5F
W82-04579	5A
W82-04580	5A
W82-04581	3A
W82-04582	7B
W82-04583	5A
W82-04584	3E
W82-04585	7B
W82-04586	2H

ACCESSION NUMBER INDEX

W82-04587	5B
W82-04588	5A
W82-04589	5B
W82-04590	5A
W82-04591	2L
W82-04592	7A
W82-04593	7B
W82-04594	5D
W82-04595	5D
W82-04596	7A
W82-04597	5D
W82-04598	5G
W82-04599	5D
W82-04600	5D
W82-04601	7A
W82-04602	5A
W82-04603	6C
W82-04604	6D
W82-04605	6A
W82-04606	6D
W82-04607	5A
W82-04608	3F
W82-04609	5D
W82-04610	5D
W82-04611	5D
W82-04612	5D
W82-04613	5D
W82-04614	5F
W82-04615	5F
W82-04616	5D
W82-04617	2B
W82-04618	2E
W82-04619	5A
W82-04620	5B
W82-04621	5G
W82-04622	5D
W82-04623	5D
W82-04624	5D
W82-04625	5D
W82-04626	8A
W82-04627	4C
W82-04628	5A
W82-04629	5B
W82-04630	5B
W82-04631	8A
W82-04632	2E
W82-04633	6B
W82-04634	6E
W82-04635	6B
W82-04636	6D
W82-04637	5B
W82-04638	2H
W82-04639	2L
W82-04640	7B
W82-04641	5D
W82-04642	8B
W82-04643	7B
W82-04644	8B
W82-04645	8B
W82-04646	2E
W82-04647	7B
W82-04648	2E
W82-04649	8A
W82-04650	2J
W82-04651	10B
W82-04652	5D
W82-04653	4A
W82-04654	3D
W82-04655	8A
W82-04656	3D
W82-04657	5F
W82-04658	6D
W82-04659	10B
W82-04660	5A
W82-04661	5D
W82-04662	5D
W82-04663	2E
W82-04664	5D
W82-04665	5D
W82-04666	2B
W82-04667	2D
W82-04668	2B
W82-04669	2K
W82-04670	2B
W82-04671	2G
W82-04672	5B
W82-04673	2K
W82-04674	6E
W82-04675	8D
W82-04676	2F
W82-04677	2J
W82-04678	5C
W82-04679	6E
W82-04680	6E
W82-04681	6E
W82-04682	2H
W82-04683	2A
W82-04684	5B
W82-04685	8B
W82-04686	6D
W82-04687	2E
W82-04688	5C
W82-04689	5F
W82-04690	4C
W82-04691	2G
W82-04692	8A
W82-04693	6B
W82-04694	5E
W82-04695	8A
W82-04696	2E
W82-04697	5G
W82-04698	6D
W82-04699	5F
W82-04700	6E
W82-04701	5G
W82-04702	5G
W82-04703	5D
W82-04704	5A
W82-04705	5E
W82-04706	5D
W82-04707	5D
W82-04708	5D
W82-04709	5D
W82-04710	5D
W82-04711	5D
W82-04712	5D
W82-04713	5D
W82-04714	4B
W82-04715	2I
W82-04716	2L
W82-04717	2L
W82-04718	5B
W82-04719	2H
W82-04720	5B
W82-04721	2A
W82-04722	2D
W82-04723	5C
W82-04724	3A
W82-04725	6A
W82-04726	2H
W82-04727	5C
W82-04728	3D
W82-04729	3C
W82-04730	2H
W82-04731	5F
W82-04732	6A
W82-04733	6A
W82-04734	6D
W82-04735	6G
W82-04736	3F
W82-04737	6A
W82-04738	6F
W82-04739	6C
W82-04740	6D
W82-04741	2B
W82-04742	2K
W82-04743	1A
W82-04744	1A
W82-04745	7B
W82-04746	6E
W82-04747	6C
W82-04748	2J
W82-04749	6G
W82-04750	5B

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SELECTED WATER RESOURCES ABSTRACTS · VOL. 16, NO. 11 · NOVEMBER 1, 1983

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 15, NUMBER 11
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OFFICE OF WATER RESEARCH AND TECHNOLOGY

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SELECTED
WATER RESOURCES
ABSTRACTS

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VOLUME 15, NUMBER 11
NOVEMBER 1, 1982

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

SEASONAL STREAM TEMPERATURE CHANGES FOLLOWING FOREST HARVESTING,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 4C.
W82-04870

SURVEY OF PRESENT KNOWLEDGE ON CAVITATION IN LIQUIDS OTHER THAN COLD WATER (THERMODYNAMIC EFFECT),
International Association of Hydrological Sciences, Paris (France).
For primary bibliographic entry see Field 8D.
W82-05280

HETEROTROPHIC ASSIMULATION OF PHYTOPLANKTON AS AN INTEGRAL PART OF THE SELF PURIFICATION OF NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
M. I. Kuz'menko, and V. G. Klenus.
Hydrobiological Journal, Vol 16, No 5, p 103-104, 1980.

Descriptors: *Bacteria, *Algae, *Oxygen uptake, *Phytoplankton, Heterotrophic bacteria, *Self purification, Organic matter, Assimilative capacity.

Oxidative heterotrophic assimilation by phytoplankton and bacterioplankton was demonstrated by differences in oxygen uptake in natural water (18.75-21.80 mg 0 per g dry matter for algae and 65.09-101.42 for bacteria) and in water with added organic matter such as amino acids and sugars (19.75-65.20 mg 0 per g dry matter per hour of exposure for algae and 71.93-818 for bacteria). Oxidative heterotrophic assimilation of algae was 1.59-5.67 times greater than that of bacteria for the stated level of biomass when calculated per unit volume. (Cassar-FRC)
W82-05326

STUDIES ON OXYGEN TRANSFER MODELS,
Tokyo Univ. (Japan). Dept. of Urban Engineering.
T. Matsuo, and K. Hirayama.
Water Science and Technology, Vol 14, No 1/2, p 321-329, 1982. 7 Fig, 4 Tab, 12 Ref.

Descriptors: *Self-purification, *Turbulent flow, *Oxygen transfer, Model studies, Liquid film coefficient, Air-water interfaces, Energy dissipation, Temperature effects, Flow velocity, Eddies, Hydraulic properties.

The liquid film coefficient, a measure of the rate of oxygen transfer at air-water interfaces, depends on hydraulic parameters such as velocity, depth, and particularly turbulence characteristics of the flow. Two kinds of turbulence parameters were evaluated: the turbulence energy dissipation, corresponding to smaller-scale movements designated by Kolmogoroff's micro-scale, and the root mean square velocity fluctuation, corresponding to larger scale movements such as eddies. Results of laboratory experiments measuring the turbulence parameters and investigations on the effects of water temperature imply that for the mass transfer mechanism at the air-water surfaces, larger scale turbulent motion is dominant over smaller scale motion. (Cassar-FRC)
W82-05349

CHARACTERIZATION OF PROPERTIES OF WATER,
Rochester Univ., NY. Distillation Research Lab.
K. Hickman, W. V. Kayser, D. K. Thakur, I. White, and H. J. Palmer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236555, Price codes: A04 in paper copy, A01 in microfiche. Report, July, 1981. 27 p, 16 Fig, 1 Tab, 17 Ref. OWRT(No 3236)(1), 14-30-3236).

Descriptors: *Water properties, *Water vapor, *Surface tension, *Surfactants, *Water surface profiles, Physical properties, Vapor pressure, Air-water interfaces, Ice-water interfaces, Capillarity, Supercooling, Ice formation, Water, Reservoir storage, Water temperature, Water stress, Water cooling, Distilled water.

Research summaries are provided, covering studies on various aspects of the properties of water: vapor recoil; surface tension; the isothermal water-vapor interface. In studies of vapor recoil from non-aqueous liquids (triethanolamine) during steady-state evaporation under vacuum, addition of 20-microliter solutions of relatively involatile surfactants (erucic acid, Igepal CO-210 and CO-970, vitamin E acid succinate) produced rapid torpidity, with the degree of imparted surface stability due to both the surface-activity and interfacial concentration of the surfactant. In another study using a slower induction of evaporation from water supercooled below -12 degrees, instead of the surface dividing as the temperature fell, instantaneous formation of an icy layer pitted by conical depressions was observed; this was explained in terms of vapor recoil. Other studies included: superheating and surface tensions of water at temperatures lower then the ambient boiling point; calculations of surface tension and the evaporation coefficient at the isothermal interface; increases in surface temperatures accompanying known heat input to the surface; and mathematical and experimental reservoir storage study of mixing of hot water layers over denser colder water. (Zielinski-MAXIMA)
W82-05540

EFFECT OF WATER TURBULENCE ON ILLUMINATION AT DEPTH,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. I. Bykovskiy.
Hydrobiological Journal, Vol 16, No 6, p 46-49, 1980. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Light penetration, *Turbulent flow, Algae, Productivity, Physical properties, Wave refraction, Flow, Wavelengths.

Light penetration into water of varying turbulence was studied in an aquarium equipped with a pump which produced turbulence without air entrapment. Illumination was measured at a depth of 0.27 m. The light attenuation factor correlated with turbulence and varied from 2.9-4.5 per meter for stagnant water to 4.8-6.4 per meter for highly turbulent flow (Reynolds number 200,000). Light of different spectral wavelengthes was unequally attenuated by the moving flow. The blue-violet range of the spectrum was attenuated 1.1-1.5 times more strongly than the red at flows of R = 20,000-30,000, but at R = 200,000 the difference disappeared. The yellow-green range of the spectrum correlated with turbulence and did not show any anomalies. Turbulent flow can be harmful to algal growth in two ways: by decreasing total illumination (decreases productivity) and by producing wave lenses or small areas of great light intensity (destroys cell pigments). (Cassar-FRC)
W82-05594

1B. Aqueous Solutions and Suspensions

CONTROLLED NUCLEATION AND QUASI-ORDERED GROWTH OF ICE CRYSTALS FROM LOW TEMPERATURE ELECTROLYTE SOLUTIONS,
Lyon-1 Univ., Villeurbanne (France). Lab. de Physique des Materiaux.
For primary bibliographic entry see Field 2C.
W82-05123

THE EFFECT OF PRESSURE ON THE SOLUBILITY OF MINERALS IN WATER AND SEAWATER,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
F. J. Millero.
Geochimica et Cosmochimica Acta, Vol 46, No 1, p 11-22, January, 1982. 9 Fig, 15 Tab, 48 Ref.

Descriptors: *Solubility, *Minerals, *Atmospheric pressure, *Seawater, Compressibility, *Surface water, Mathematical studies, Volumetric analysis.

Recently, several attempts have been made to use molal volume and compressibility data to estimate the effect of pressure on ionic equiliria such as the ionization of acids, the formation of ion pairs, and the solubility of minerals in water and seawater. Equations are presented for estimating the effect of pressure on the solubility of minerals in water and seawater and for determining the volume and compressibility changes at one atmoshere of pressure. The values of the partial molal volume and compressibility in water and seawater are tabulated for several ions at temperatures ranging from 0 to 50 C. The large compressibility change found for the sulubility of most minerals accounts for the large differences which have been observed between values of partial molal volume obtained from linear plots of compressibility versus atmospheric pressure and molal volume data. Calculated values for the solubility of several compounds in water were found to be in good agreement with direct measurements. Similar calculations for the solubility of minerals in seawater were also found to be in good agreement with direct measurements, providing that the surface of the solid phase is not appreciably altered. The reported tabulated data can be used to make reasonable estimates of the effect of pressure on the solubility of minerals and other ionic equilibria in water and seawater. (Carroll-FRC)
W82-05135

2. WATER CYCLE

2A. General

EFFECTS OF USE PATTERN, COVER, SOIL DRAINAGE CLASS, AND OVERWINTER CHANGES ON RAIN INFILTRATION ON CAMPSITES,
Ohio Agricultural Research and Development Center, Wooster.
For primary bibliographic entry see Field 2G.
W82-04858

BACTERIOLOGICAL QUALITY OF SURFACE AND SUBSURFACE RUNOFF FROM MANURED SANDY CLAY LOAM SOIL,
Department of Agriculture, Ottawa (Ontario).
J. L. B. Culley, and P. A. Phillips.
Journal of Environmental Quality, Vol 11, No 1, p 155-158, January-March, 1982. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Agricultural runoff, *Bacteria, Fecal coliforms, Water quality, Coliforms, Water pollution sources, *Manure, *Farm wastes, Runoff, Seasonal variation.

The objectives of this study were to investigate the bacteriological quality of snowmelt surface and subsurface discharge from corn cropland receiving different rates of liquid dairy manure at different application times and to measure survival rates of indicator organisms in winter-spread manure. A gently sloping field of imperfactly drained Manotick sandy clay loam was divided into 14 plots which had been cropped in silage corn since 1973. After an intial year when no manure was applied, liquid dairy manure treatments at three rates and four different application periods were randomized and assigned to each plot for a period of 6 years. Liquid manure application rates averaged 105, 264, and 420 cubic meters per ha per year. The bacteriological quality of runoff from manured, corn-cropped sandy clay loam indicated that both spring snowmelt surface and subsurface discharge from winter applied treatments contained higher numbers of indicator organisms than did similar runoff from plots manured either the previous spring or fall. There was also some evidence that June storm surface runoff from spring treatments contained higher bacterial densities than did plots that received manure the previous winter or fall. Survival of fecal streptococcus organisms in surface applied frozen manure was noted, while both total coliform and fecal coliform densities declined to low

levels within 40 days after application. Results indicate that land should be manured and plowed in the fall, prior to freeze-up, in order to minimize microbial densities in runoff during the following spring. (Baker-FRC)
W82-04880

CYCLIC FLUCTUATIONS IN THE FLOOD AREA AND RELATIONSHIP WITH THE DOUBLE (HALE) SUNSPOT CYCLE,

Indian Inst. of Tropical Meteorology, Poona.
H. N. Bhalme, and D. A. Mooley.
Journal of Applied Meteorology, Vol 20, No 9, p 1041-1048, 1981. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Flood forecasting, *Weather patterns, Forecasting, *Sunspots, Weather, Distribution patterns, Mathematical studies, *India, Western United States.

In this paper the possible relationship between the double sunspot cycle and the variation of the Flood Area Index over India is investigated. Harmonic analysis is used, and power spectrum and cross-spectrum analysis to relate the Flood Area Index series to the series of sunspot numbers of the double sunspot cycle. The power spectrum analysis reveals a highly significant approximately 22 year cycle in the Flood Area Indices over India. Harmonic analysis of the same record also shows a well marked 22-year Flood Area Index cycle in phase with the souble sunspot cycle. The Drought Area Index series shows a weak quasi-periodicity of 2.7-3.0 years. Cross spectrum analysis presents strong evidence that the 22 year FAI cycle over India is related to the double sunspot cycle. Further, the 22 year FAI cycle is nearly in phase with the double sunspot cycle. Harmonic dial analysis shows that all of the large scale flood events over India occurred consistently in the major sunspot cycle and none occurred in the minor sunspot cycle. Large scale drought events have no preference to the phase of the sunspot cycle. The strong evidence for a relationship between the areal extent of the floods over India and the double sunspot cycle reported shares in the kind of sun climate relationship reported for the western United States, but for flood rather than drought. (Baker-FRC)
W82-04896

NUMERICAL MODELING STUDY OF LAKE PONTCHARTRAIN,

NOAA Data Buoy Office, NSTL Station, MS.
G. D. Hamilton, C. W. Soileau, and A. D. Stroud.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW1, p 49-64, February, 1982. 13 Fig, 1 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Lakes, *Wind tides, *Water level fluctuations, Mixing, Particulate matter, Numerical analysis, *Water circulation, Model studies, Tidal effects, Monte Carlo method, Mathematical models, Mathematical studies, Wind-driven currents, Friction, Advection, Surface velocity, *Lake Pontchartrain, Louisiana.

Actual wind circulation, water levels, and particulate matter dispersion in Lake Pontchartrain were simulated by a Hansen-type hydrodynamic numerical model utilizing an explicit numerical difference scheme. The model utilizes a leap-frog integration through time of the two-dimensional Eulerian form of the hydrodynamic equations to achieve a dynamical boundary-value solution of tidal order. Differential equations are derived by integrating x and y velocity components through a layer of assumed uniform density to yield vertically averaged mean components. The model also includes terms to account for the rotation of the earth, dissipative friction, and wind and tidal forcing. A Monte Carlo stochastic process helps to define diffusion and advection. The present paradigm was successfully applied to the estimation of lake surface movement by tides and wind and to the modeling of injunction and plume dispersion of particulate matter in lakes. (Geiger-FRC)
W82-05006

APPLICATION OF A TWO-DIMENSIONAL MODEL OF FORMATION OF STORM RUNOFF TO CALCULATION OF THE RAIN-WATER COLLECTOR-DRAIN DISCHARGE FROM AN URBANIZED TERRITORY,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. N. Demidov, and N. P. Lobanskaya.
Water Resources, Vol 8, No 2, p 126-132, March-April, 1981. 2 Fig, 3 Ref. Translated from Vodnye Resursy, No 2, p 63-71, March-April, 1981.

Descriptors: *Urban areas, *Drainage engineering, *Storm runoff, Runoff, Urban runoff, *Model studies, *Industrial development, Rainfall-runoff relationships, *Nizhnekamsk, USSR.

A two-dimensional model of runoff formation was used to calculate the collector drain discharge at a 0.365 sq km industrial complex under construction at Nizhnekamsk. It was possible to account for the characteristics of the relief of an urbanized area, the characteristics of its underlying surface, and the parameters of the rainwater collecting system. Comparing the results of the two-dimensional model with those of the isochrone method showed that the isochrone method overestimated values of maximum water discharges by as much as 38%. The two-dimensional method can also be used for designing a collection system. (Cassar-FRC)
W82-05027

ATMOSPHERIC MOISTURE TRANSPORT AND THE WATER BALANCE OF THE MEDITERRANEAN SEA,

Lisbon Univ. (Portugal).
J. P. Peixoto, M. de Almeida, R. D. Rosen, and D. A. Salstein.
Water Resources Research, Vol 18, No 1, p 83-90, February, 1982. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Atmospheric water, *Evaporation, *Hydrologic budget, Wind, Precipitable water, *Mediterranean Sea, Water vapor, Climatology, Weather patterns, Hydrologic cycle, Salinity, Air circulation, Precipitation rate, *Water balance.

The water balance of the Mediterranean Sea was obtained from the net difference between evaporation and precipitation rates by evaluating the divergence of the atmospheric flux of water vapor over the region. Upper air data from 1968-1973 were used to compute this value. The net difference between evaporation and precipitation from this study was 55,000 cu m per sec, compared with 59,000-67 cu m per sec obtained by other authors using more classical methods. Maps are printed showing the two-dimensional fields of precipitable water, the vertically integrated water vapor flux vector, and the divergence of water vapor over the region. The Mediterranean is not a closed system. Moisture enters from distant sources including the Atlantic, and a larger amount of water vapor is exported from the area to the Middle East and northeast Africa. Precipitable water averages 22.4 kg per sq m and totals 56 billion cu m over the whole sea. Three main centers of high water vapor content (over 24 kg per sq m) are found over the western Mediterranean, the Aegean, and the Levantine basin. Minima are found over desert areas, regions of high terrain, and over islands. Although the moisture transport pattern over the Mediterranean is generally west-to-east, there are nonuniformities. The Alps block the dominant westerlies and lead to dry air in the northern Adriatic. Drier air over Turkey is related to topographic effects. Southward transport dominates in central and eastern Mediterranean and northern transport over the Alboran Sea and Italy. The net meridional flow is 20 kg per m southward. Areas of strong divergence are found in the Levantine Basin and from south of Italy to the Libyan coast. Convergence zones, less widespread, are found over the Aegean, the Adriatic, the south of France, and the west African coast towards Morocco. (Cassar-FRC)
W82-05050

BEDROCK AQUIFERS IN THE LOWER DIRTY DEVIL RIVER BASIN AREA, UTAH, WITH SPECIAL EMPHASIS ON THE NAVAJO SANDSTONE,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05220

PEAK RUNOFF MODEL COMPARISON ON CENTRAL ILLINOIS WATERSHEDS,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. Mostaghimi, and J. K. Mitchell.
Water Resources Bulletin, Vol 18, No 1, p 9-13, February, 1982. 4 Tab, 12 Ref.

Descriptors: *Watersheds, *Runoff rates, *Flood peaks, Mathematical models, Model studies, Performance evaluation, Statistical analysis, Areal hydrology, Illinois.

Although estimates of peak flows are needed for the design of the thousands of hydraulic conveyances and structures built each year, it is physically and economically impossible to measure runoff from each watershed for which such and estimate is required. As a result, it is necessary to extend the results of peak runoff measurements made in a small number of watersheds to ungaged areas. Four models for predicting peak runoff rates in watersheds of mild topography were selected and compared to determine the model most applicable to the small agricultural watersheds of east-central Illinois. The 15 watersheds used for this study are representative of slopes, soils, and land-use patterns found throughout much of the area. Rainfall and runoff measurements were available continuously since 1949 for four watersheds at Allerton Park, while data were available for the other watersheds for various lengths of time between 1955 and 1970. The Cypress Creek, Rational, Chow, and Soil Conservation Service (SCS) peak runoff models were found to be appropriate for the available data and physical conditions of these watersheds. Evaluations of the performances of these models showed that: (1) the Cypress Creek model underpredicted peak flow for most of the watersheds; (2) the Rational model overestimated the peak flow rates for most of the watersheds; (3) the Chow model generally resulted in better estimates of peak runoff for the Allerton watersheds than for the other watersheds; and (4) the SCS model was considered to be best for predicting peak runoff rates from these mild topography, agricultural watersheds. Error-mean-square tests confirmed that the SCS model predicted peak runoff rates better than the other three models for all but two watersheds. (Carroll-FRC)
W82-05489

ON THE RELATIONSHIP BETWEEN THE RELIABILITY OF PARAMETER ESTIMATES AND HYDROLOGIC TIME SERIES DATA USED IN CALIBRATION,

Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
G. Kuczera.
Water Resources Research, Vol 1, No 1, p 146-154, February, 1982. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Streamflow, *Time series analysis, Parametric hydrology, Model studies, Precipitation, Stochastic process, Ocala, Florida, Watersheds, Rainfall-runoff relationships, Groundwater, Runoff, Estimating, Calibrations, Soil water.

Parameters of conceptual hydrologic models are calibrated using limited information, input-output time series data, such as precipitation and streamflow. The sources of stochasticity in these models are identified. Conditions under which parameter estimates are consistent are: (1) the structure of the model represents without bias the internal hydrologic transfers, (2) the hydrologic transfers are deterministic in the sense that state-dependent fluxes can be predicted with negligible error, and (3) measurement errors on observable driving fluxes are negligible. Improving the stability of parameter estimates is considered. On the first information level the first two moments of measurement errors are used to make large sample bias corrections. The second level uses time series data corresponding to storage volumes such as groundwater and

soil moisture to remove the source of inconsistency due to erroneous influence of estimated storage volume and to improve the stability of parameter estimates. Proper exploitation requires that the estimation procedure exploits the interdependence of model equations arising from coupled model structure and correlated disturbances. The generalized least squares procedure offers a promising approach for exploiting all available time series information in model calibration. An example features hydrological data from a watershed near Ocala, Florida. (Casar-FRC)
W82-05490

RIVER-BASIN SIMULATION IN SYSTEMS WITH LARGE RESPONSE TIME,

Massachusetts Inst. of Tech., Cambridge, Dept. of Civil Engineering.
V. P. Nogueira, J. L. Wilson, and K. Strzepek.
Journal of Hydrology, Vol 51, No 1-4, p 159-168, May, 1981. 6 Ref.

Descriptors: *Simulation analysis, *River basins, Performance evaluation, Optimization, Cost analysis, Systems analysis, Mathematical equations, Mathematical studies, Markov process.

Two common problems encountered in the static simulation of a river basin are the determination of the simulation length and the balancing of the effect of the initial conditions on the system measures of performance. Since it is impossible to formulate general solutions to these problems, some general guidelines are developed and applied to the specific case of a simple system in which a synthetic sequence was used as input and an output sequence was obtained and assumed Markovian. The results show that Conway's rules, which suggest that data from some initial period be excluded from consideration and that starting conditions be chosen which make the necessary excluded interval as short as possible, can be implemented even though they seem to be rather general and loose. Care must be taken for each particular case, and a general idea about the output to be obtained must be developed before any rational action can be taken or any simplifying assumptions made. The costs of estimation must be balanced against the costs provoked by errors of estimation in order to determine the run length. Such analysis should be made even when computer costs are fixed or constant, so that compensation may be made for errors of estimation. Whenever possible, costs should be weighted before deciding between a long run and a series of replicated runs. Generally, replication results in increased bias due to the effect of initial conditions but decreased variance. It is suggested that this methodology can be used for practically every case if appropriate modifications are made. (Carroll-FRC)
W82-05496

ESTIMATION OF FLOOD PEAKS WITH LIMITED HYDROLOGIC DATA,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
E. J. Schiller, and J. O. Ngana.
Journal of Hydrology, Vol 51, No 1-4, p 151-157, May, 1981. 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Flood peak, *Hydrologic data, *Prediction, Flood flow, Mathematical models, Mathematical equations, Developing countries, Tanzania, Africa.

In developing countries, designers of water projects are often confronted with the need to develop projects making the best use of very scanty hydrologic data and limited available capital. Flood data for instance, are often required on rivers having little or no recorded hydrologic data. In Tanzania, the government plans to proceed with hydropower and rural development in the Rukwa region, for which hydrologic data is very scarce. However, the drainage basins of the nearby Mbeya region are quite well monitored. Statistical analyses of the discharge data from selected catchments in the Mbeya region were compared with the TRRL (United Kingdom Transport and Road Research Laboratory) flood model results for the region. The high level of agreement between the results indicated that the TRRL model is applicable to Mbeya catchments. A regional flood-frequency study for the Mbeya catchments resulted in the development of a regional frequency curve of discharge ratios and of a curve of mean annual flood versus drainage areas of the basins. The TRRL flood model results and the regional frequency curve for the Mbeya region were then utilized in the Rukwa catchments. The results obtained from these two methods agreed well with each other, suggesting that both the TRRL flood model technique and the derived regional frequency curve can be used fairly well on ungauged catchments in the Mbeya and Rukwa regions where hydrologic similarity exists. Although more data would increase the accuracy of the results of the two methods, each method produced results of useful accuracy based on the limited data available. (Carroll/FRC)
W82-05521

KINEMATIC WAVE THEORY OF CATCHMENT RESPONSE WITH STORAGE,

Newcastle Univ. (Australia). Dept. of Civil Engineering and Surveying.
For primary bibliographic entry see Field 4A.
W82-05714

GROUND-WATER RECONNAISSANCE OF PART OF THE LOWER KENAI PENINSULA, ALASKA,

Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-05837

QUANTITATIVE GEOMORPHOLOGY OF DRAINAGE BASINS IN SUMTER NATIONAL FOREST, SOUTH CAROLINA,

Geological Survey, Columbia, SC. Water Resources Div.
G. G. Patterson.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $7.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-417, 1981. 55 p, 1 Fig, 4 Ref, Append.

Descriptors: *Computer programs, *Geomorphology, *Small watersheds, *Drainage systems, Hypsometric analysis, Drainage density, *South Carolina, Sumter National Forest.

This report describes a computer program, written in Basic, that facilitates quantitative analysis of drainage basins and channel networks. The program was used to inventory 2,000 small watersheds in Sumter National Forest, South Carolina during 1980 and 1981. Drainage basins and stream segments were delineated in color on mylar overlays over U.S. Geological Survey 1:24,000-scale maps. Drainage basin characteristics were quantified and stored on eight-inch diskettes. The program can produce printouts and plots that summarize geomorphic data for each watershed. The program is adaptable to other locations. (USGS)
W82-05839

STATISTICAL ANALYSIS TO DERIVE IMPROVED STORMWATER QUALITY MODELS,

Union Coll., Schenectady, NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-05857

COASTAL FRESH WATER DISCHARGE IN THE NORTHEAST PACIFIC,

Alaska Univ., Fairbanks. Inst. of Marine Science.
T. C. Royer.
Journal of Geophysical Research, Vol 87, No C3, p 2017-2021, March 20, 1982. 7 Fig, 17 Ref.

Descriptors: *Precipitation, *Water currents, Fresh water, Storms, Streams, Stream flow, Orography, Mountains, Pacific Ocean, Alaska, Coastal waters, Coastal streams, Advection.

In this paper the sources of runoff and advection for the northeast Pacific are discussed. Seasonal changes of the runoff and their effects on the coastal circulation are considered. The high precipitation rates produce large fresh water discharges which enter the ocean by way of numerous small rivers and streams. Therefore they act as a line source rather than a point source. This coastal discharge contributes at least 40% of the fresh water that enters the northeast Pacific from the atmosphere. The discharge is comparable to the mean annual discharge of the Mississippi River system. The fresh water creates a cross-shelf density gradient that drives an alongshore baroclinic jet. The width of this jet is less than 25 km, with speeds in excess of 100 cm/second. It extends along the coast from southeast Alaska at least to Kodiak Island. The flow is apparently maintained as a narrow current adjacent to the coast by wind stress that causes downwelling conditions here throughout most of the year. The coastal mountain ranges bordering the Gulf of Alaska act as a barrier to the storms that move easterly across the North Pacific. Adiabatic elevation of these moist air masses causes very high rates of precipitation. (Baker-FRC)
W82-05870

THE RESIDENCE TIME OF THE FRESHWATER COMPONENT IN THE ARTIC OCEAN,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
H. G. Ostlund.
Journal of Geophysical Research, Vol 87, No C3, p 2035-2043, March 20, 1982. 10 Fig, 3 Tab, 22 Ref.

Descriptors: *Ocean circulation, *Natural waters, Upwelling, Water currents, Dating, Snowmelt, Ocean ice, Arctic, Rivers, Runoff, Arctic Ocean, Polar regions, Arctic zone.

The time function of bomb tritium concentrations in river runoff to the Arctic Ocean was reconstructed from published data on tritium in precipitation, 1959-1975. The relationship between tritium and salinity indicated that sea ice melt and freezing affect the upper 10-60 meters of water in the Nansen Basin, increasing toward the Canada Basin to about 150 meters. The average age of the freshwater component is about 11 years from its first appearance at the shelf to its emergence from these basin as a constituent of the modified Atlantic water in the East Greenland Current. In the Canada Basin the modified Atlantic water itself has the same residence time, since mixing may occur in several steps. The freshwater residence times could be revised downward by 1 or possibly 2 years if there is an unexpectedly large effect of air-to-sea molecular transport during initial formation of the halocline water. There are clear isotopic indications of snowmelt water penetrating the ice and freezing on its underside. In 1979 waters west of the Lomonosov Ridge down to 1200 meters and east of the ridge even at 2500 meters contained tritium at concentrations higher than one would expect in 1957 Norwegian Sea water, and most likely these waters entered the basin after 1965. This means that at these places and depths the Atlantic source waters are probably younger than 16 years and definitely younger than 20 years. (Baker-FRC)
W82-05872

AN ANALYSIS OF MEDIUM AND LONG DURATION EXTREME RAINFALLS IN THE SOUTHERN CAPE COASTAL LAKES REGION FOR THE PURPOSES OF FLOOD HYDROGRAPH GENERATION,

Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
A. H. M. Gorgens, and D. A. Hughes.
Water S. A., Vol 8, No 1, p 16-22, January, 1982. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Rainfall, *Flood hydrographs, Hydrographs, Lakes, Flood control, Precipitation, South Africa, Graphical analysis, Mathematical studies, Graphical methods, Simulation.

In order to develop an efficient and careful system of management of the movement of water within

the scenic Wilderness Lakes in the south eastern Cape area of South Africa, a collaborative program was launched which has as one of its aims the development of a mathematical model of the dynamics of the Lake system. A major application of the lake system model is the simulation of lake level responses to the inter-lake exchanges during various combinations of flood events in the major influent streams and sand bar obstructions across the Touw River mouth. Different ameliorative measures can then be superimposed on the system model and their effects on the system simulated and evaluated. The extreme value analysis of 39 years of daily rainfall records revealed clear relationships between extreme rainfalls, return periods, durations equal to or greater than one day, and area. Graphs are presented which allow the user to determine an areal correction factor for a specific duration, return period and area. When multiplied by the relevant extreme rainfall for the whole area, the correction factor produces an extreme rainfall for the sub-area in question. Comparisons with other methods available in South Africa for estimating areally averaged design rainfalls suggest that lower return period rainfalls were usually below the ones determined in this study. The results warrant their use as input in the generation of improved flood hydrographs for the Wilderness Lakes study. (Baker-FRC)
W82-05899

2B. Precipitation

RAINFALL INTERSTATION CORRELATION FUNCTIONS: III. APPROXIMATIONS TO THE ANALYTICALLY DERIVED EQUATION OF THE CORRELATION FUNCTION FOR AN EXPONENTIAL STORM MODEL COMPARED TO THOSE FOR A RECTANGULAR AND A TRIANGULAR STORM,

Institute for Land and Water Management Research, Wageningen (Netherlands).
P. T. Stol.
Journal of Hydrology, Vol 52, No 3/4, p 269-289, July, 1981. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Rainstorms, *Correlation analysis, *Mathematical models, Numerical analysis, Mathematical equations, Rainfall, Precipitation.

The rainfall interstation correlation function can be analytically derived on the basis of a storm model. The interstation correlation function for the exponential storm model has a complicated structure and contains an arbitrary storm parameter (b) which must be established before the interstation correlation function for the model can be numerically evaluated. Choices for this parameter include (b) based on the shape of the storm profile, (b) based on minimum rainfall amounts that still can be observed, or (b) based on the storm volume of a triangular storm which has the same storm width. When the last choice is selected, it is possible to simplify the complicated structure of the correlation function for the exponential storm mode by means of sequential best approximations. The structure and properties of the correlation function for the rectangular, the triangular, and the exponential storm models can be compared using this simplified approximating form, providing insight into the behavior of the three storm models and their impacts on interstation correlation functions. In sampling rainfall data for correlation analysis, the effects of storm maximum, storm width, fraction of dry days, and area size should receive particular consideration. (Carroll-FRC)
W82-04864

A SELF-EVALUATING DISDROMETER FOR THE MEASUREMENT OF RAINDROP SIZE AND CHARGE AT THE GROUND,

Auckland Univ., (New Zealand). Dept. of Physics.
C. D. Stow, and K. Jones.
Journal of Applied Meteorology, Vol 20, No 10, p 1160-1176, 1981. 18 Fig, 2 Tab, 20 Ref.

Descriptors: *Rain, *Measuring instruments, Disdrometer, Rainfall, *Raindrop size.

This article considers the concept of instrument design to minimize effects of overlap and splashing in the measurement of raindrop size and describes an experiment which was conducted to provide direct evidence of inadmissible or unreliable data on drop size and charge, which should enable more useful spectra to be obtained than previously was possible. Fundamental errors include drop overlap which occurs at times of simultaneous occupation of the sampling volume by more than one drop, splashing, and the influence of the wind. The disdrometer described can determine the sizes of individual drops in the range of 0.1-2.5 mm radius and charges within the limits of magnitude 0.1-10 pC. Drop velocity and the detection of drop overlap within the charge sensitive volume can be accomplished by the use of two size detectors. Non-ideal data arising from natural conditions, measuring sites, and from fundamental or unavoidable deficiencies in disdrometer design could be tested and monitored automatically using a central processor under software control. The performance of the instrument was tested using individual drops generated in the laboratory and through exposure to natural rain falling through an aperture into a chamber shielded from wind and associated turbulence. Some improvements in the design of the current disdrometer are suggested. (Baker-FRC)
W82-04897

MOISTURE ANALYSES FROM RADIOSONDE AND MICROWAVE SPECTROMETER DATA,

Florida State Univ., Tallahassee. Dept. of Meteorology.
K. J. Haydu, and T. N. Krishnamurti.
Journal of Applied Meteorology, Vol 20, No 10, p 1177-1191, 1981. 11 Fig, 27 Ref.

Descriptors: *Moisture profiles, *Spectrometers, Microwaves, *Remote sensing, Potential rainfall, Measuring instruments, Satellite technology, Moisture availability, Precipitation, Rainfall, *Atmospheric water.

This study exploited the objective of providing a detailed analysis technique for moisture over several vertical levels in the atmosphere. Two major problems were encountered: the need to formulate some type of a correction scheme to calibrate the satellite-derived total precipitable water and the development of an objective technique to obtain the vertical distribution of moisture. The method of analysis uses satellite, upper air and surface data. A brief overview of the microwave sensors on board Nimbus 5 and 6 is also included. The technique provided uses the radiosonde data sets to calibrate the satellite field of total precipitable water. The calibrated satellite-derived field is then used along with ship and coastal reports of moisture and thus provides a mapping of specific humidity at several levels in the troposphere. Using these procedures, analyses for several case studies were performed. The resultant maps showed detailed distributions of specific humidity along with interesting climatological features. A reasonable acceptance of the available aerological data sets by the analysis scheme is also demonstrated. (Baker-FRC)
W82-04900

DETERMINATION OF THE TOTAL PRECIPITABLE WATER BY VARYING THE INTERCEPT IN REITAN'S RELATIONSHIP,

Consiglio Nazionale delle Ricerche, Bologna (Italy).
C. Tomasi.
Journal of Applied Meteorology, Vol 20, No 9, p 1058-1069, September, 1981. 10 Fig, 17 Ref.

Descriptors: *Probable maximum precipitation, *Weather forecasting, Mathematical studies, Rainfall, Forecasting, Rain, *Precipitation, Dewpoint, Temperature.

Reitan in 1963 proposed a relationship between the total precipitable water and the dewpoint temperature at ground level in which the intercept was found to be a function of the scale height of the atmospheric water vapor and of the ground temperature. The scale height was closely related to the features of the vertical moisture profile in the low troposphere. The ground temperature is responsible for diurnal and seasonal variations of the intercept which are of little importance. The slope coefficient has a constant value. Using this as a base, a method is proposed which determines the nocturnal time pattern of the intercept by linear interpolation in time between the daytime estimates obtained from spectral hygrometer measurements. The nocturnal time pattern of the total precipitable water can be calculated from Reitan's relationship using these interpolated values of the intercept together with the nocturnal measurements of the dew point temperature at ground level. This method was satisfactorily applied to spectral hygrometer measurements made on several days. Estimates of the total precipitable water at two stations of the Po Valley were obtained from Reitan's relationship by using local measurements of the dew point temperature at ground level and suitable values of the intercept. (Baker-FRC)
W82-04901

FORESEEABLE EFFECTS OF CO2-INDUCED CLIMATIC CHANGE: FRESHWATER CONCERNS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
C. C. Coutant.
Environmental Conservation, Vol 8, No 4, p 285-297, Winter, 1981. 3 Fig, 33 Ref.

Descriptors: *Carbon dioxide, *Climatology, *Research priorities, Air pollution, Temperature effects, Precipitation, Ecological effects, Water supply, Productivity, Species distribution, Sinks, Reservoirs, Water resources development, Arid climates, Streamflow, Water allocation, Aquatic life, Irrigation, Water pollution, Weather patterns, Cold regions, Algae, Eutrophication, Organic carbon, Estuaries.

The possible effects of increases in atmospheric carbon dioxide are a 2-3 C increase in global mean annual surface temperatures (least near the equator and most at 80 degrees north latitute, with anomalies in many locations) and precipitation changes (increased rainfall in some zones and increased aridity in others). These potential climatic changes many profoundly affect water resources availability and net productivity relationships and species distribution in aquatic ecosystems. High ranking research priorities include determination of the quality and quantity of organic materials transported by rivers into the ocean under present CO2 atmospheric conditions, determining whether estuarine or marine environments are a significant sink for river carbon, determination of the effects of CO2 enrichment of the air and concurrent temperature and precipitation changes on aquatic productivity and eutrophication of lakes, determination of changes in geographic ranges of commercially important and exotic aquatic species due to increased temperature, and development of plans for constructing water storage reservoirs in areas of increasing aridity. Medium-rank research priorities concern organic carbon deposits in sediments as a carbon sink, changes in water pollutant loads, effects on northern aquatic ecosystems from the elimination of permafrost, and the role of carbon in the organic load of rivers entering the sea. Several low-ranking priorities are also listed. (Cassar-FRC)
W82-05574

RECORDING RAINGAGE MODIFICATIONS,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 7B.
W82-05665

IDENTIFICATION OF INDEPENDENT RAINSTORMS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. J. Restrepo-Posada, and P. S. Eagleson.
Journal of Hydrology, Vol 55, No 1/4, p 303-319, 1982. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Atmospheric precipitation, *Rainstorms, *Statistical analysis, Arid climates, Saudi Arabia, Storms, Seasonal variation, Coefficient of variation, Forecasting.

Separation of point precipitation records into statistically independent storms is done according to the criterion of exponentiality of the time between storms. If the coefficient of variation for time between storms is unity, the storms are considered independent. An algorithm is given for obtaining the above coefficient from a given storm sequence for successively larger minimum storm separation. Estimates of the time between independent storms obtained in this manner produce Poisson distributions of annual precipitation which agree well with observed distributions at 3 arid climate sites in Saudi Arabia. Values of time between independent storms from 17 stations with annual rainfalls varying from 24 to 5107 mm correlate with the rainy season monthly precipitation, providing a means of estimating time between independent storms from mean annual rainfall and mean length of rainy season. (Caesar-FRC)
W82-05708

REVISED RAINFALL FREQUENCY ANALYSIS FOR HOUSTON,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
T. C. Bouvette, J. L. Lambert, and P. B. Bedient.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 515-528, April, 1982, 7 Fig, 6 Tab, 24 Ref.

Descriptors: *Rainfall, *Frequency analysis, Mathematical studies, Regional analysis, Precipitation, Frequency distribution, Houston, Urban areas.

A study was designed to determine whether significant rainfall pattern and intensity changes have occurred in the Houston area since 1960. Such changes are associated with contemporary urban development and could help to explain the severe flooding problems encountered in recent years. Data was analyzed by four Houston area stations. The data indicated that the downtown station is receiving less rainfall and the areas around Houston are receiving more rainfall, as the Double Mass analysis illustrated. The 100 yr design storms indicated an increase in rainfall intensity occurring around the Houston area, while the downtown 100 yr design stroms indicate a decrease in rainfall intensity since the 1960 United States Weather Bureau effort. The number of recorded extreme events occurring downtwon has also diminished since 1960. The change in rainfall intensity could have come about through a shading effect caused by the increased density of tall buildings downtown, which could cause inaccurate gaging. However, this does not explain the observed increase in rainfall outside the downtown area. The increased extreme event intensities outside of the downtown area indicate a potential problem in designing drainage and sewer systems. Reevaluation of design storm parameters should be done periodically, no less than once every five years in growing urban centers. (Baker-FRC)
W82-05863

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES. I. SWARTKOPS RIVER,

National Physical Research Lab., Pretoria (South Africa).
R. J. Watling, and H. R. Watling.
Water S. A., Vol 8, No 1, p 26-35, January, 1982. 4 Fig, 10 Tab, 9 Ref.

Descriptors: *Trace metals, *Estuaries, Estuarine environment, Water pollution sources, Rivers, South Africa, Copper, Lead, Zinc, Nickel, Oysters, Monitoring, Brickworks, Outfalls, Municipal sewage.

The results of a detailed trace metal survey of the Swartkops River, South Africa, are reported. Oysters growing at the mouth of the river contained considerably more zinc, copper and lead than had been determined for the same species growing at other locations on the South African coast. Surface water samples were collected in 2.5 foot high density polyethylene bottles. Surface sediment and sediment core samples were also collected up to 15 km from the mouth of the Swartkops River and analyzed for up to 16 elements. Four main areas of contamination were thus found: at Redhouse, Swartkops, a brickworks, and Amsterdam Hoek. Large accumulations of zinc, copper lead and nickel by the oysters at the mouth confirm the presence of greater than normal metal concentrations in the river. The Swartkops area may obtain a contribution from the power station effluent, and Uitenage and Despatch municipal effluents probably contribute to the contamination of the Redhouse area. The Fishwater Flats sewer outfall appears to be a further source of contaminants but may not be significant in terms of metal buildup, as tidal sweep disperses the effluent relatively quickly. At the present time the concentration of metals in the area is not viewed as cause for alarm. Monitoring should be made at specific sites of input of these contaminants to establish long term trends. (Baker-FRC)
W82-05898

VARIATIONS IN MOISTURE DEFICITS OVER THE MAIZE-GROWING REGION OF SOUTH AFRICA II: TEMPORAL ASPECTS,

Missouri Univ., Columbia. Dept. of Atmospheric Science.
J. F. Gillooly, and T. G. J. Dyer.
Water S. A., Vol 8, No 1, p 9-15, January, 1982. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Rainfall, *Temporal distribution, Precipitation, South Africa, Distribution, Semiarid climates, Seasonal variations, Moisture availability, Moisture, Plants, Maize.

A description of temporal variations in moisture deficits over the period of 1945 to 1974 in the maize-growing region of South Africa is offered. Temporal changes in moisture deficits were considered on two scales: first on a seasonal basis and then on a monthly time scale. Within each time scale temporal variation was examined on a regional basis and then for the maize growing area as a whole. These time series were then analyzed using Jenikinson's modified version of harmonic analysis, which removes the constraint placed on resolution in straightforward harmonic analysis and avoids the need to guess a maximum lag for use in the conventional spectral approach to analyses over the frequency domain. Moisture deficits were shown to be more severe and more variable in the dry western parts of the maize growing region of South Africa. The greater variability of moisture deficits in the west is of relevance to agricultural planning, as this is the area where maize is commonly grown under marginal dryland conditions. It has been possible to isolate months, or groups of months, during the growing season when deficits exhibit marked variability. Finally, the isolation of periods of above- and below-normal moisture deficits between 1945 and 1975 suggests that the moisture deficit term provides a potentially useful index for assessing the impact of climatic variability on food production in South Africa. (Baker-FRC)
W82-05900

2C. Snow, Ice, and Frost

GLACIERS AND THEIR FLUCTUATIONS,

Swiss Federal Inst. of Tech., Zurich.
F. Muller.
Nature and Resources, Vol 16, No 2, p 5-11, April/June, 1980. 5 Fig, 1 Tab.

Descriptors: *Glaciers, *Climatic, *Climatology, Glacial drift, Glacier mass balance, Monitoring, International commissions.

Two international bodies, the Permanent Service on Fluctuations of Glaciers (PSFG) and the Temporary Technical Secretariat (TTS) for the World Glacier Inventory, both located at the Swiss Federal Institute of Technology, have been created to advance snow and ice research in the contexts of hydrology, technology, and climatic change. This TTS is charged with coordinating and assisting national glacier inventory efforts, collecting and standardizing data, making the data computer compatible in one system, eventually producing a global summary, and initiating and supporting analysis based on these data. The objective of the PSFG is to produce a global set of data on the fluctuations of glaciers which will provide a general view of the changes, encourage more extensive measurements, facilitate consultation, and serve as a data base for monitoring climatic change. Twenty-seven countries participate and regularly submit data on glaciers within their national boundaries or collected by their scientists elsewhere. Although it is generally accepted that glacier-tongue fluctuations are caused by changes in climatic conditions, data collected on over 800 glaciers show that there are great differences in the reactions of individual glaciers. However, the statistically averaged behavior of a sufficiently large number of glaciers within a certain region reflects changes in climate very reliably. It appears that mean annual temperature variations of less than 1 C can have a profound effect on glaciers, and that in some areas the summer temperatures have more influence than annual mean values. However, the complex chain of causal dependence within the climate-glacier relationship is not fully understood. Long-term measurements of both mass balance and climatic parameters on local and regional levels are needed in order to construct reliable quantitative models for prediction. (Carroll-FRC)
W82-04777

ICEBERGS: TECHNOLOGY FOR THE FUTURE,

Cambridge Univ. (England).
H. E. Huppert.
Nature (London), Vol 285, No 5760, p 67-68, May 8, 1980.

Descriptors: *Icebergs, *Water transport, *Water supply, Ice-water interfaces.

Presentations to a conference on The Use of Icebergs organized by the International Glaciological Society are summarized These presentations focused on the physical characteristics of icebergs, including the way they break up and roll over; their melt-rate; and the feasibility of capturing and towing icebergs to locales where they could be used as freshwater supplies. Studies of the break-up of icebergs indicate that only very large ice sheets will remain intact as they drift far from their sources. Scaled towing tests conducted by Iceberg Transport International indicate that the most efficient means of propulsion is by hauling the iceberg on lines attached to a very large parachute drogue ahead of the iceberg. Reasonable efficiency may be achieved by using two drogues. Although it may be possible to process icebergs for water supply supplements using existing technology, little is known about the environmental effects of moving icebergs in shipping lanes could result in accidents. (Carroll-FRC)
W82-04778

A MECHANISM FOR THE FORMATION OF LARGE ICEBERGS,

National Hydrology Research Inst., Ottawa (Ontario).
G. Holdsworth, and J. E. Glynn.
Journal of Geophysical Research, Vol 86, No C4, p 3210-3222, April 20, 1981. 8 Fig, 1 Tab, 32 Ref.

Descriptors: *Icebergs, *Ice breakup, *Floating ice, *Vibrations, Glaciers, Ocean waves, Tensile stress, Stress, *Antarctica.

The Antarctic ice sheet is connected to significant peripheral areas of floating ice, which calve to form icebergs, resulting in substantial losses in terms of ice mass budget. The largest type of iceberg is formed by the disintegration of massive, unconfined, seaward extending ice shelves or glacier tongues. A number of ice tongues are known to exhibit a quasi-cyclic pattern of calving and subsequent regrowth. One mechanism that would appear to explain this type of calving behavior is based on the vibrational characteristics of the system of a buoyant ice plate floating in shallow water. The glacier intercepts the ocean wave energy responsible for the motion either directly from open ocean or after transmission through, and subsequent filtering by, sea ice. The glacier also acts as a wave filter, with filtering characteristics depending on the thickness of the ice. When a

dominant frequency occurring in the incident wave spectrum coincides with one of the natural frequencies of the glacier, then a resonant motion will occur. For relatively high modes of oscillation, low level but sustained cyclic bending stresses may lead to crack propagation and subsequent fatigue failure in the ice. The contributions of other mechanisms which induce tensile stresses in the ice are considered to be very important in an overall view of the calving problem, and some of these mechanisms are discussed in relation to the vibration mechanism. It is possible to view the proposed vibration mechanism as a trigger which raises the resultant stresses in the ice to the point where fracture will occur. (Carroll-FRC)
W82-04798

FRESH-WATER TRANSPORT BY SEA,

Oufresne and Henry Engineers, Inc., North Springfield, VT.
For primary bibliographic entry see Field 6D.
W82-04861

RESISTANCE OF BEAUHARNOIS CANAL IN WINTER,

National Water Research Inst., Burlington, (Ontario).
O. Tsang.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY2, p 167-186, February, 1982. 11 Fig, 1 Tab, 11 Ref.

Descriptors: *Canals, *Chezy equation, *Ice formation, *Flow resistance, *Electric power production, *Mannings equation, *Open-channel flow, Water management, Open channels, Roughness coefficient, Resistance, Frazil ice, Hydroelectric power, Streamflow, Ice cover.

Under natural conditions the Beauharnois Canal connecting Lake Saint-Louis and Lake Saint Francis would remain open until quite late in the winter, despite ice cover on Lake St. Francis. An open water surface invites frazil ice production, causing increased operational problems on the canal. The formation of ice cover on the canal is accelerated by placing ice booms across the canal to detain ice drift and initiate ice covers in front of them. As ice cover progresses, the resistance of the open canal to the flow changes and water resource utilization may be maximized. The flow in this canal was examined using the open-water Chezy equation while ignoring the presence of ice by using a corrective coefficient for Chezy's roughness coefficient. This corrective coefficient followed a well-defined trend during the frazil ice period which, when present in small amounts, could reduce the flow by as much as 50%. The present approach offers an advantage over using the Manning equation because it can handle situations where a river is only partially ice covered or is affected by frazil ice while avoiding a choice of formula for evaluating the composite Manning's roughness coefficient. A corrective coefficient curve was generated in the present study which may lead to an alternative ice management scheme and better electric power production on the Beauharnois Canal. (Geiger-FRC)
W82-04998

A LABORATORY AND THEORETICAL STUDY OF THE BOUNDARY LAYER ADJACENT TO A VERTICAL MELTING ICE WALL IN SALT WATER,

Washington Univ., Seattle. Dept. of Oceanography.
E. G. Josberger, and S. Martin.
Journal of Fluid Mechanics, Vol 111, p 439-473, 1981. 18 Fig, 5 Tab, 23 Ref.

Descriptors: *Fluid mechanics, *Ice, Ice-water interfaces, Interfaces, Temperature effects, Salinity, Model studies, Flow, Laminar flow, *Boundry Layers, Flow characteristics.

The convection generated in the polar oceans when a freshwater ice wall melts in salt water of uniform far field temperature and salinity has been modeled in this experimental and theoretical study. The results show that there are three different flow regimes which depend on the temperature and salinity., First, when temperature and salinity lie between the maximum density curve and the freezing curve, the flow is only upward. Second, for the oceanic case where salinity lies between 30 and 35% and temperature is less than 20 degrees C, the flow consists of a laminar bidirectional flow at the bottom of the ice and a turbulent upward flow along the remainder of the ice wall. The laminar flow consists of an upward flowing layer about 2 mm thick inside of a downward flowing outer layer about 10 mm thick. Third, for the same salinity but for temperatures above 20 degrees C, the flow reverses. A laminar bidirectional flow occurs at the top of the ice above a downward turbulent flow. The governing equations were solved in similarity form with a spatially varying eddy diffusivity to model the turbulent upward flow theoretically. The spatially varying eddy diffusivity depends on the density difference between the ice/water interface and the far field. Data then allows the evaluation of the dependence of eddy diffusivity on temperature and salinity. The magnitude of the eddy diffusivity is of the same order as the molecular viscosity, and both mass injection at the interface and opposed buoyancy forces must be included in a realistic flow model. An intergral approach was used to predict the far field conditions that yield the high temperature flow reversal and obtain a result consistent with the observations. (Baker-FRC)
W82-05084

DISCHARGE CAPACITY OF LARGE STREAMS UNDER AN ICE COVER,

For primary bibliographic entry see Field 2E.
W82-05106

CONTROLLED NUCLEATION AND QUASI-ORDERED GROWTH OF ICE CRYSTALS FROM LOW TEMPERATURE ELECTROLYTE SOLUTIONS,

Lyon-1 Univ., Villeurbanne (France). Lab. de Physique des Materiaux.
J. Dupuy, J. F. Jal, C. Ferradou, P. Chieux, and A. F. Wright.
Nature (London), Vol 296, No 5853, p138-140, March 11, 1982.

Descriptors: *Ice formation, *Nucleation, Chemistry of precipitation, Precipitation, Chemical reactions, Ice, Ice crystals, Electrolytes, *Temperature effects, Controlled nucleation.

The crystallization of water was carried out in conditions where the growth is extremely slow and the nucleation events can be controlled. Slow nucleation conditions were obtained by choosing a concentration of water in an electrolyte solution such that the homogeneous nucleation temperature lay very close to the glass transition temperature. Solutions of 10.5 mol% lithium chloride in deuterium oxide were prepared in controlled conditions to avoid the ingress of any light water. Samples of the solution were introduced into a 3-mm space between sapphire windows in a cell whose temperature could be manipulated by a controlled temperature block in which the cell was mounted. The block with cell was then suspended in a liquid helium cooled cryostat which provided the low temperature ambient for the temperature control system. Considering the mean separated crystallite size of 700 Angstroms, it was noted that the nucleation density at 139 degrees K must be a least 2,500 centers per cube micron, so high that the homogeneous nature of the nucleation phenomenon under study could not be doubted. A Guinier plot of the high Q side of the peak yields an average crystallite size for the small particles, after initial development at 140.4 K, of about 100 Angstroms. A maximum particle radium was determined of 220 Angostroms. An average radium of 100 Angostroms seems reasonable. The scattering cross section per mole of solution decreases rapidly with increasing concentration of LiC1. If the scattering power of ice initially formed from the supersaturated solution is weaker than that of the initial solution then, as the ice precipitates and residual solution concentrates, the contrast must pass through zero, giving a scattered intensity minimum. (Baker-FRC)
W82-05123

EVALUATION OF SNOWMELT FORECASTING METHODS,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05552

SPECTRAL REFLECTANCES OF FRESH-WATER ICE AND SNOW FROM 340 THROUGH 1100 NM,

S. J. Bolsenga.
PhD Thesis, 1981. 163 p, 59 Fig, 38 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX81-25073.

Descriptors: *Ice, *Ice cover, *Snow, Snow surveys, *Remote sensing, Computer programs, Prediction, *Spectral reflectance, Spectroradiometers, Great Lakes, Instrumentation.

A scanning, dual spectroradiometer system which simultaneously records incident and reflected flux in the 280-1100 nm range was developed for this study. In addition, two programs were written for data acquisition and storage that are compatible with a desk-top calculator. The assemblage represents a state-of-the-art system which can be used in the laboratory, where varying incident illumination or natural light might occur, as well as in the natural environment, where changes in incident flux cannot be controlled. Several devices were fabricated to protect the instruments in the natural environment. One of the most productive uses of the scans is in ice formation, growth and decay prediction using energy budget techniques. Knowledge of the spectral reflectances of each ice type should enable the energy budget modeler to calculate the overall spectral reflectances of an ice field by first determining the ice types and amounts present in the field and then by assigning the appropriate spectral reflectances to each ice type in proportion to its areal extent. The scans for snow have provided definite spectral signature information. It appears likely that a remote sensing plan, using an aircraft under overcast skies, could be developed to distinguish between snow and clear ice on the bases of detector output alone. Since the resolution of such a system would be high, shapes of the ice types could likely be observed. By combining shape with spectral reflectances, it is possible that groups of secondary ice types could be mapped. (Sinha - OEIS)
W82-05556

VELOCITY DISTRIBUTIONS UNDER FLOATING COVERS,

Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 2E.
W82-05562

CONFIGURATION OF ICE IN FROZEN MEDIA,

Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Colbeck.
Soil Science, Vol 133, No 2, p 116-123, February, 1982. 11 Fig, 9 Ref.

Descriptors: *Ice formation, *Crystal growth, *Frozen ground, Soil porosity, Ice-air interfaces, Pore water, Ground ice, Interstitial ice, Freezing.

Many different ice shapes and crystal distributions were detected by microscopic examination of 0.8 and 3 mm glass beads and silica sand, simulating different soils. Initial water content was 5%. Samples were examined soon after freezing and 10 months later. The air-ice interfaces were convex, and some pores were filled while others were not. Generally, small pores filled first. The variety in growth rates, nucleation sites, and local paths of heat and mass flow produced single and multicrystalline structures. Multi-crystals were common with the 3 mm glass beads, and single crystals were

more common in 0.5 mm glass beads. A variety of crystals were seen within a single sample. (Casser-FRC)
W82-05615

DIRECT SNOW-WATER EQUIVALENT MEASUREMENTS BY AIR-BORNE GAMMA-RAY SPECTROMETRY,

Geological Survey of Canada, Ottawa (Ontario).
R. L. Grasty.
Journal of Hydrology, Vol 55, No 1/4, p 213-235, 1982. 10 Fig, 4 Tab, 23 Ref.

Descriptors: *Snow water equivalent, *Radioactivity techniques, Aircraft, Soil moisture, *Gamma radiation, Spectrometry, Potassium radioisotopes, *Remote sensing, Canada, *Ontario.

Snow water equivalent was measured by a technique that uses the buildup of scattered gamma-radiation from K40 with increasing snow water equivalent. This direct, single-flight airborne technique eliminates the problems associated with the standard two-flight technique, which requires soil moisture measurements, a pre-snow flight, and the same path for both flights. Variations in the gamma ray spectral shapes of K, U, and Th were determined on large concrete pads with known concentrations of the three radioelements using plywood sheets to simulate snow water equivalent layers. The airborne system was calibrated by flying over the Breckenridge and Lake Mead test areas, where radioactivity is well-documented, and converting the aircraft altitudes to an equivalent layer of water. Nine test flights over an area of unknown radioactivity 40 km southeast of Ottawa at altitudes of 90 to 210 meters gave results (141.9 + or - 13,9 mm) consistent with ground measurements of snow water equivalent (142 + or - 11 mm) and results from the two-flight method (139 + or - 1.4 mm). (Casser-FRC)
W82-05643

EROSION FROM MOUNTAIN SNOWPACK MELT,

Utah State Univ., Logan. Watershed Science Unit.
For primary bibliographic entry see Field 2J.
W82-05664

WINTER HEAT BUDGET AND FRAZIL ICE PRODUCTION IN THE UPPER ST. LAWRENCE RIVER,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
H. T. Shen, and R. W. Ruggles.
Water Resources Bulletin, Vol 18, No 2, p 251-257, April, 1982. 7 Fig, 10 Ref.

Descriptors: *Frazil ice, *Heat budget, *Ice formation, *St. Lawrence River, Rivers, Ice cover, Temperature effects, Heat transfer.

Winter heat budget and frazil ice production in the St. Lawrence River between the Ogdensburg-Prescott Boom and the Moses-Saunders Power Dam were analyzed. Heat budgets and spatial distribution of heat exchange rates were calculated for three winters. The most dominant factor in the heat budget was thermal energy contained in the flowing river water. In 1974-75, a warm winter, the ice-covered period was short, large open water areas existed, and water temperature was relatively warm. Surface heat loss was relatively large. Bed heat influx and frictional heating accounted for 18% and 2% of the total heat budget respectively. Frazil ice production was not extensive. In the average winter of 1977-78 ice cover was extensive. Although the total net heat exchange was small, frazil ice production in open water areas was large. During the cold winter of 1978-79 open water areas were greater than in 1977-78 and air temperatures were lower. Frazil ice production was extensive and formed a large hanging dam at Cardinal. Predictions that there should be less frazil ice production downstream of the Iroquois dam in 1978-79 than in 1977-78 were confirmed by field studies. (Casser-FRC)
W82-05736

EFFECT OF ASHFALL ON SNOWMELT RATE AT PARADISE, MOUNT RAINIER, WASHINGTON,

University of Puget, Tacoma, WA. Dept. of Physics.
B. E. Brown.
Journal of Geophysical Research, Vol 87, No C2, p 1347-1350, February 20, 1982. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Snowmelt, *Volcanoes, Temperature effects, Thaw, Paradise, Mount Rainier, Washington, Geophysics.

Paradise, Mount Rainier, was the location of the only regularly reporting weather station receiving an ashfall from Mt. St. Helens which still had significant winter snowpack on the ground, making it possible to assess the effect of a layer of volcanic ash on a mountain snowpack. Paradise is located 74km north-northeast of Mt. St. Helens, at a bearing of 27 degrees east of north from the latter peak. Paradise received an ashfall of 0.0032 to 0.0064 meters on May 18, 1980. The ashfall was very effective in accelerating the melting of the spring snow cover. Similar effects on adjacent glaciers should have produced increased runoffs during the summer of 1980. The dark ash layer increased snowmelt by about 40% over the rate which would have been expected based on ambient temperatures. (Baker-FRC)
W82-05871

2D. Evaporation and Transpiration

A FLOODPLAIN STORAGE MODEL USED TO DETERMINE EVAPORATION LOSSES IN THE UPPER YOBE RIVER, NORTHERN NIGERIA,

CBA Engineering Ltd., Vancouver (British Columbia).
C. D. Sellars.
Journal of Hydrology, Vol 52, No 3/4, p 257-268, July, 1981. 5 Fig, 6 Ref.

Descriptors: *Flood plains, *Evaporation rate, *Water storage, Water loss, Mathematical models, Simulation analysis, Rivers, *Nigeria, *Upper Yobe River.

The Upper Yobe River system comprises the Hadejia and Jamaare Rivers, which rise in the Jos Plateau of northern Nigeria and combine in the lowlands upstream of the town of Gashua to form the Yobe River, which flows into Lake Chad. The catchments of these three rivers were studied to determine the most effective way of developing the water resources of the basin with emphasis on larger-scale water storage and irrigation development. The flow losses in the lowland area upstream of Gashua generally amount to about 70 percent of the total annual runoff from the upland area, while losses at lake Chad approach 90 percent. The annual flow regime is seasonal, with widespread flooding in the lowland areas where the rivers are multichannel and deltaic in nature. The storage effect resulting from the formation of large open water areas and swamps in the wet season causes flooding to continue into the dry season, when potential evaporation is at a maximum. The open-water and swamp evaporation losses could not be calculated directly due to the scarcity of data on the area flooded, which varies monthly and seasonally. A flood plain storage model was developed to simulate the changes in the flooded area with time on a monthly basis for 11 years of record. The open-water and swamp evaporation losses were found to comprise about 65 percent of the total annual losses, or about 45 percent of the total runoff. Other losses included an estimated 25 percent by evapotranspiration from the shallow groundwater table in the flood plain and about 10 percent by regional groundwater flow away from the flood plain. (Carroll-FRC)
W82-04863

EVAPORATION AT A HIGH ARCTIC SITE,

McMaster Univ., Hamilton, (Ontario). Dept. of Geography.
P. Marsh, W. R. Rouse, and M.-K. Woo.
Journal of Applied Meteorology, Vol 20, No 6, p 713-716, 1981. 3 Fig, 10 Ref.

Descriptors: *Arctic, *Evaporation rate, Polar regions, *Model studies, Soil water, Moisture, *Lysimeters, *Comparison studies.

This note attempts to define an empirical relationship between the alpha' parameter in Priestley and Taylor's version of the combination model and the surface soil moisture for a typical high arctic site. A comparison with the results obtained in other similar studies is also presented. The study was carried out about 5 km northeast of Resolute Airport, Northwest Territories. The dominant surface materials range from gravels to sandy loam. The climate is typical of the central Canadian High Arctic. The active layer deepens very rapidly as soon as the ground becomes bare of snow. To allow the direct measurement of evaporation small lysimeters were used which measured 13.8 cm in depth and 9.8 cm in diameter. The measured evaporation rates varied depending on the site of the lysimeter. For soil moisture volumes greater than 30% evaporation is large and proceeds near the potential rate. Between 30 and 20% there is a very rapid decrease in evaporation and below 20% it is very small. It was apparent from the study that there is no unique relationship between surface soil moisture and evaporation rates. The unvegetated high arctic soils are distinctive because it is the surace layer that must provide the water for evaporation, a major flux from deeper layers being unlikely due to the cold permfrost zone. As a result the evaporation rate falls rapidly as the soil surface dries. Most sites are distinctive, and under drying conditions the evaporation rate will be a response to the particular site characteristics. A generalized model is unlikely to be achieved. (Baker-FRC)
W82-04899

EVALUATION OF THE EFFECT OF LINEARIZATION OF THE MAGNUS EQUATION ON THE ACCURACY OF CALCULATING EVAPORATION FROM THE SURFACE OF MOIST SOIL AND TRANSPIRATION,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
E. A. Loziaskaya.
Water Resources, Vol 8, No 2, p 114-119, March-April, 1981. 3 Fig, 6 Ref. Translated from Vodnye Resursy, No 2, p 50-55, March-April, 1981.

Descriptors: *Soil-water-plant relationships, *Specific humidity, *Evapotranspiration, Magnus equation, Linear equation, Mathematical equations, Evaporation, Soil water, Transpiration, Humidity, Air temperature, Temperature, Vegetation effects.

The Magnus equation, one of four in a system used to calculate evaporation from the surface of moist soil, relates the saturated specific humidity of air to its temperature. Linearization of this equation produces less accurate results but clearly shows the relation between evaporation and various parameters of the problem. It is also more graphic and convenient for practical use. Errors introduced into the evaporation determination by linearization did not exceed 3% in typical cases and 8% in extreme cases. (Casser-FRC)
W82-05031

EXECUTIVE SUMMARY FOR POWER PLANT COOLING SYSTEM WATER CONSUMPTION AND NONWATER IMPACT REPORTS,

United Engineers and Constructors, Inc., Philadelphia, PA.
M. C. Hu, G. F. Pavlenco, and G. A. Englesson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-123474, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-112, September 1981. 19 p, 4 Fig, 9 Tab.

Descriptors: *Consumptive use, *Cooling water, *Cooling tower, *Powerplants, *Model studies, Cooling ponds, Water use, Industrial water, Evaporation, Saline water, Acid rain, Environmental effects, Air pollution.

Group 2D—Evaporation and Transpiration

Three studies were performed by United Engineers and Constructors Inc... (UE and C) and Versar, Inc. to aid EPA in assessing water consumption and other nonwater quality environmental impacts of cooling systems used by the steam-electric generating industry. The two reports on water consumption agree that the Leung-Moore model satisfactorily predicts evaporation rates of evaporative cooling towers. Versar found that this model predicted evaporation rates of base-load plants within + or - 15 percent of material balance values based on plant data. UE and C addressed the Harbeck and Brady models for predicting evaporation rates from cooling ponds and (using available data) could not reach a definite conclusion on which model predicted evaporation more closely. Comparing predictions from five models, including the Harbeck and Brady models, Versar concluded that the Harbeck-Hughes and Meyer models predicted evaporation rates for five of six cooling ponds studied within + or - 15 percent of material balance values and appear suited to preliminary studies. UE and C conclude that limited data precluded general conclusions on drift effects from saltwater cooling towers, but that cooling tower drift and deposition apparently do not increase ambient salt loading to an extent that a significant impact has been observed or is expected. Similarly, the effect of wet cooling tower and stack plume interactions on acid rain formation and deposition could not be established from available information. (Moore-SRC)
W82-05067

INFLUENCE OF SEASONAL EVAPORATIVE DEMAND ON EVAPOTRANSPIRATION AND YIELD OF IRRIGATED WHEAT,

Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
I. K. Jaggi, and S. B. Sinha.
Indian Journal of Agricultural Sciences, Vol 51, No 12, p 891-895, December, 1981. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Irrigation, *Evapotranspiration, *Water use efficiency, Soil-water-plant relationships, *Wheat, Crop yield, Grain crops, *India.

Irrigated wheat (Triticum aestivum Linn. emend. Theil.) was grown in India during 2 successive winter seasons to determine the seasonal variations in extractable soil water in a meter profile, evapotranspiration, and evaporative losses from an open pan. Extractable soil water remained between 13 and 18 cm for the first 90 days in both seasons, indicating that the evapotranspiration needs of the wheat were largely met by irrigation or rainfall. By day 120 extractable soil water had reached less than 4 cm. The second season had less rainfall, slightly lower amounts of extractable soil water, and a greater open pan evaporation rate. Evapotranspiration was 35.9 cm in both seasons, of which 1/3 was contributed by profile-stored water. Open pan evaporation rates were 1 to 5 mm per day the first season and 2 to 8 mm per day the second season. Grain yields were 44.1 q per ha the first season and 40.2 q per ha the second, drier season. Water use efficiency (in q per ha per cm) was 1.23 the first season and 1.11 the second. On this vertisol the optimum yield of irrigated wheat may be predicted for a season with evapotranspiration/open pan loss ratios from 0.7 to 1.1. Serious yield reductions are likely at ratios below 0.6. (Cassar-FRC)
W82-05121

STABILITY EFFECTS ON GREAT LAKES EVAPORATION,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
J. A. Derecki.
Journal of Great Lakes Research, Vol 7, No 4, p 357-362, 1981. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Lakes, *Evaporation, *Lake evaporation, Water loss, Great Lakes, Atmosphere, Atmospheric physics, Atmospheric pressure, Stability analysis, Mathematical studies, *Lake Erie, *Lake Superior, *Lake St Clair.

This paper summarizes air stability effects on evaporation for the highest and lowest Great Lakes in terms of evaporation, Lakes Superior and Erie, and also for a much smaller water body within the chain of Great Lakes, Lake St. Clair. Stability effects for the other, intermediate Great Lakes should fall between these extremes. The mass transfer method for computing evaporation is based on the removal of water vapor from the lake surface by turbulent diffusion. It is a function of the overlake wind speed and the vapor pressure difference between the saturated air at the lake surface and the ambient air at some predetermined level. The results indicated that atmospheric stability has to be considered for reliable mass transfer evaporation estimates from the Great Lakes. Seasonal variation in the mass transfer coefficient was seen to be of similar magnitude to that of the input data (wind, vapor pressure difference) or evaporation, and the use of constant coefficients cannot be justified. Winter ice-cover reduction of evaporation was seen to be perhaps as important as the stability effects on the input data or mass transfer coefficient and should be included for lakes with extensive ice cover. It was also noted that inclusion of the air stability-dependent mass transfer coefficient, land to lake data adjustment, and ice-cover effects during winter permits determination of realistic mass transfer operational evaporation estimates from readily available perimeter data. (Baker-FRC)
W82-05634

ESTIMATION OF ISOTOPIC EXCHANGE PARAMETERS, USING CONSTANT-FEED PANS,

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison, and F. W. Leaney.
Journal of Hydrology, Vol 55, No 1/4, p 151-161, 1982. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Evaporation pans, *Isotope studies, Water vapor, Humidity, Lakes, Measuring instruments, Isotope fractionation, Air-water interface, Evaporation.

Constant volume evaporation pans were used to estimate the isotopic composition of water evaporating from an open water body. There was close agreement between directly measured values and the values estimated from the pans for the isotopic composition of water vapor in the atmosphere and the relative humidity of the air normalized to the water surface temperature. To obtain annual data, separate experiments should be run for each 2-3 month period to avoid large climatic changes within the time scale of each experiment. This information is expected to be useful in water balance studies of open water bodies. (Cassar-FRC)
W82-05648

NEW EVAPOTRANSPIRATION CROP COEFFICIENTS,

Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W82-05692

A PREDICTION EQUATION FOR DAY NIGHT WIND RATIO CORRECTION ON REFERENCE CROP EVAPOTRANSPIRATION,

Marathwada Agricultural Univ., Parbhani (India).
G. R. Rao, S. L. Tate, and S. B. Varade.
Annals of Arid Zone, Vol 20, No 3, p 199-201, 1981. 2 Fig, 2 Ref.

Descriptors: *Evapotranspiration, *Semiarid lands, *Water requirements, Wind, *India, Penman equation, Monsoons.

Reference crop evapotranspiration (ET) values predicted by the modified Penman equation are corrected for day/night wind ratio under Indian conditions by the following equation: $ETo = 0.969 + 0.812ETo^{*}$, where ETo and ETo* are the adjusted and unadjusted reference crop ET in mm per day, respectively. Unadjusted values (ETo*) are near to adjusted ET values after establishment of the southwest monsoon (late summer-fall), close or underpredicted in winter, and overpredicted in the premonsoon season (spring and early summer). The day/night wind ratio (range 1.1 to 3.8) is highest after establishment of the monsoon and lowest in the premonsoon season. (Cassar-FRC)
W82-05722

MEASUREMENT AND MODELLING OF PRIMARY PRODUCTION AND WATER USE IN A SOUTH TUNISIAN STEPPE,

Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
C. Floret, R. Pontanier, and S. Rambal.
Journal of Arid Environments, Vol 5, No 1, p 77-90, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Water use, *Steppes, Grasslands, Evaporation, Tunisia, Natural use, Model studies, Water resources development, Water supply development, Plant populations.

The effect of rainfall on above ground plant production was studied between 1971 and 1977 on a site consisting of steppeland on sandy soil, dominated by the perennial dwarf shrub Rhantherium suaveolens, with associated annual species. The average precipitation in this region was 180 mm, which produced about 1000 kg of dry matter/ha. A model was developed, ARFEJ, using the most pertinent characteristics of the system so that production could be predicted under the assumption that water is the limiting factor. Seven model coefficients were calculated with data from 1971-1975. The results of this study indicate that the effect of rainfall distribution on evaporation from bare soil is extensive. The mean of this evaporation was 55% of total evapotranspiration. During the short annual period of fast growth, the ratio of dry matter to water transpired would be about 1.26 g dry matter/kg water for annuals and 1.39 g dry matter/kg water for perennial species. Over the whole year, the average efficiency of water use was 0.45 g dry matter/kg water for all species. Above 250 mm of precipitation, the availability of nitrogen and/or phosphorus became the limiting factor for plant production, and efficiency of water use decreased. The accuracy of growth trends in general indicated that the model had considerable predictive value. It is therefore possible to calculate not only the dynamics of the phytomass of annual and perennial species, but also variations in soil water content. The model could help in range management by forecasting carrying capacity consistent with plant production, the quantity of fodder reserves needed and the time when they must be available. (Baker-FRC)
W82-05876

2E. Streamflow and Runoff

DOWNSTREAM REDUCTION OF RURAL CHANNEL SIZE WITH CONTRASTING URBAN EFFECTS IN SMALL COASTAL STREAMS OF SOUTHEASTERN AUSTRALIA,

Wollongong Univ. (Australia). Dept. of Geography.
G. C. Nanson, and R. W. Young.
Journal of Hydrology, Vol 52, No 3/4, p 239-255, July, 1981. 32 Ref.

Descriptors: *Channel flow, *Coastal streams, Flood plains, Urban planning, Land use, Flood discharge, Alluvial channels, *Australia, *New South Wales, *Urban effects, Coastal streams, *Channel morphology.

Although the size of a river channel normally relates to the volume of water the channel must carry, streams flowing off the Illawarra escarpment in New South Wales, Australia, show a marked reduction of channel size accompanied by a downstream increase in flood frequency in their lower reaches. Bed and bank sediments are relatively coarse and uncohesive in the confined and steeply sloping valleys of the escarpment foothills, and channels increase in size in relation to increasing discharge downstream. However, there is a dramatic reduction in channel size as these streams emerge into the more open rural valleys at lower

slopes which are accompanied by extensive floodplains formed of fine cohesive sediment. The sudden decline in channel slope and associated stream power, the cohesive nature of the downstream alluvium, retention of the sediment on the channel banks by a dense cover of pasture grasses, and the availability of the extensive flood plain all contribute to the decrease in channel size. Floodwaters from these streams very frequently spill out over the floodplain, resulting in the reduction of the downstream channel flow to a relatively minor component of the total peak discharge. Stream channels formed in the fine alluvium rapidly entrench and increase in cross-sectional area by two to three times when urban development results in increased peak runoff and decreased effective floodplain area. This enlargement may be triggered by minor human-induced channel alteration and maintenance. (Carroll-FRC)
W82-04862

STABLE-CHANNEL DESIGN IN GRAVEL-BED RIVERS,

Ministry of Works and Development, Christchurch (New Zealand).
G. A. Griffiths.
Journal of Hydrology, Vol 52, No 3/4, p 291-305, July, 1981. 2 Fig, 4 Tab, 27 Ref.

Descriptors: *River beds, *Gravel, *Stable channels, Mathematical equations, Particle size, Sdiments, Sediment load, Mathematical models.

Regime relations are derived for more or less straight, stable, symmetrical, wide reaches of coarse gravel-bed rivers having low rates of bedload transport and at bankfull flow conditions. The relations are combined to express channel width as a function of median size of bed pavement, energy slope, and bankfull water discharge for sediment of constant specific gravity. This stable-channel design equation, together with three others of similar form in current usage, is tested for accuracy of channel with prediction with 60 field data sets from appropriate gravel-bed reaches. The minimum mean deviation of predicted width from the actual width prescribed in each data set was 160 percent, with a standard deviation of 430 percent. A dimensionless stability index, defined in terms of the above parameters, is deduced and shown to be remarkably constant in value at stable reach sections on particular gravel-bed rivers and for rivers within a single watershed. Employment of this index will result in a substantial improvement in the accuracy of stable-channel design. The range of application of the stability index method is increased by combination with an empirical equation that predicts median bed-pavement size from given flow conditions over gravel-bed material having a known initial sediment size distribution. An example of the suggested design procedure following from this combination is given for an existing unstable river-diversion channel. Some recommendations are made concerning the identification of stable river reaches and the determination of the requisite sediment parameters for design. (Author's abstract-FRC)
W82-04865

THE RELATIONSHIP BETWEEN FLOW-SHEAR STRESS AND STREAM PATTERN,

Geological Survey of Israel, Jerusalem.
Z. B. Begin.
Journal of Hydrology, Vol 52, No 3/4, p 307-319, July, 1981. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Shear stress, *Streams, *Stream profiles, Stream discharge, Braided streams, Data interpretation, Mathematical equations, *Hydrological regime, Geologic environment.

River channel patterns, whether straight, meandering, or braided, represent an equilibrium between hydrologic regime and geologic environment. Previous studies have shown that channel pattern is related to stream power, and therefore to hydraulic parameters which describe the flow in a more meaningful way than the mere specification of a certain combination of slope and discharge. The purpose of this study is to present a physical interpretation of the relationships depicted on a discharge-slope diagram which can be used to rationally differentiate between braided, straight, and meandering streams. Simple hydraulic reasoning is used to assign a 'relative shear-stress' value to each stream on the basis of a discharge-slope diagram for streams. A sample of 359 streams, ranging in mean annual discharge from 900,000 to 0.05 cubic feet per second and varying in pattern from highly sinuous to straight and braided, is sorted according to relative shear-stress values. Straight streams are produced by low-energy flow. Increases in energy, which are also increases in shear stress, result in bank erosion and meandering due to internal instability of the flow, which produces secondary currents. When an additional increase in flow energy results in such a high momentum that a different equilibrium is maintained between flow and bank sediments, the streams tend to have a greater radius of curvature of bends and to be less sinuous. A further increase in shear stress will result in such a high rate of bank erosion and sediment transport that braided channels form. The passage from one pattern to another within natural stream populations is gradual, since the geomorphic thresholds, defined by relative shear stress, tend to be fuzzy. (Carroll-FRC)
W82-04866

CYCLIC FLUCTUATIONS IN THE FLOOD AREA AND RELATIONSHIP WITH THE DOUBLE (HALE) SUNSPOT CYCLE,

Indian Inst. of Tropical Meteorology, Poona.
For primary bibliographic entry see Field 2A.
W82-04896

A STUDY OF LOW-FLOW OPERATION OF MILFORD AND ELK CITY LAKES IN KANSAS,

Kansas Water Resources Research Inst., L Manhattan.
Y-S. Yu, E. C. Pogge, V. Knapp, and S. Esmaeil-Beik.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224536, Price codes: A13 in paper copy, A01 in microfiche. Contribution No 217, October, 1980. 280 p, 75 Fig, 61 Tab, 62 Ref. OWRT B-053-KAN(1). 14-34-0001-8087.

Descriptors: *Streamflow, *Time series analysis, Lake evaporation, Mass-transfer method, Mathematical models, Reservoir operation, *Dynamic programming, Stochastic processer, Kansas, Elk River, Milford Lake, Low flow, Synthetic hydrology, Simulation analysis.

PART I -- The streamflow records at Elk City, Kansas, on the Elk River and at Clay Center, Kansas, on the Republican River have been analyzed to determine the seasonal means, standard deviations, correlation coefficients and skew coefficients. A first-order Markovian model has been developed for generating the synthetic streamflows. This model generates weekly and monthly streamflows, respectively, for the Elk River and the Republican River. The results indicate that taking the square root of the observed series prior to the application of the model produces the best overall agreement between the stochastic parameters of the synthetic streamflows and those of the observed streamflow series. PART II -- Weekly evaporations from the Milford and Elk City Lakes, respectively, were computed based on available climatological data, measured water temperature and the mass-transfer equation. The mean annual evaporations obtained from the weekly values for the Milford and Elk City Lakes are about 3% and 9%, respectively, greater than the values presented in the U. S. Weather Bureau Technical Report No. 37 (1959). The monthly pan coefficients obtained from this study are generally 5% higher than the pan coefficients used by the Kansas Water Resources Board (1974). Mathematical models for weekly evaporation were developed by the combined use of the Fourier approximations and an autoregressive model. The generated time series of the weekly evaporation closely matches the statistics of the weekly evaporation computed by the mass-transfer method. A sensitivity analysis was also made to determine the effect of variation of the model parameters on estimated evaporation and the change of evaporation per unit change of each input component of the mass-transfer equation. The results show that the mass-transfer model is most sensitive to changes in the water temperature. Part III -- A stochastic dynamic programming model has been developed and applied to determine the steady-state optimal policies for operating the conservation storages of Elk City and Milford Lakes, respectively. The model for the smaller Elk City Lake is based on Weekly net inflows calculated from the historical data while the model for the larger Milford Lake is based on monthly net inflows. The derived optimal policies are applied to operate the respective reservoir over a period of 10 years from 1967 through 1977. The results show that the developed algorithm is efficient in terms of both computer storage and time, attributable to the adaptation of a termination criterion based on the method of successive approximations. The results also show that adopting the optimal policies in operating the reservoir results in substantially less deviations from target storage than those shown in historical record.
W82-04964

DERIVATION OF HOMOGENEOUS STREAMFLOW RECORDS FOR THE GREEN RIVER BASIN, KENTUCKY,

Geological Survey, Doraville, GA. Water Resources Div.
T. W. Hale.
Geological Survey Open-File Report 79-1066 (WRI), 1979. 61 p, 39 Fig, 4 Tab, 5 Ref.

Descriptors: *Streamflow forecasting, Rivers, *Reservoirs, *Computer models, Simulation analysis, Hydrologic data, Low flow, Natural flow, Regulated flow, Routing, Reservoir operation, *Kentucky, *Green River basin.

Four flood-control reservoirs, Green River Lake, Nolin River Lake, Barren River Lake, and Rough River Lake, were completed in the Green River basin of Kentucky between 1959 and 1969. A digital computer model of these reservoirs and the stream reaches from the reservoirs downstream to the Green River at Calhoun, Ky., was developed to simulate mean daily streamflows. Simulations of 1941 through 1971 water year streamflows were made for both the pre-reservoir and post-reservoir basin conditions, thus supplying homogeneous data sets for low-flow analyses of eight stream sites. The 7-day, 10-year recurrence interval, minimum discharges of the simulated regulated flows exceed those of the simulated natural flows by about 30 cubic feet per second for the Barren River at Bowling Green, Ky., and about 260 cubic feet per second for the Green River at Calhoun, Ky. Analyses of the pre-reservoir simulations show that, for seven of the stream sites, the model yields streamflow which have annual minimum 7-day average discharges that are not significantly different, at the 95 percent significance level, from those of the observed flows. Results of the post-reservoir simulations show that actual reservoir operation was not closely matched by the model. Therefore, the low-flow characteristics of the simulated regulated streamflows are merely estimates of those that could be expected if the basin were regulated according to the modeled reservoir operating criteria. (USGS)
W82-04979

BASE FLOW OF STREAMS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-79,

Geological Survey, Syosset, NY. Water Resources Div.
H. F. H. Ku, and D. L. Simmons.
Geological Survey Open-File Report 81-420 (WRI), 1981. 32 p, 1 Fig, 1 Plate, 3 Tab, 8 Ref.

Descriptors: *Streamflow, *Stream discharge, Data collections, Low flow, *Base flow, Flow characteristics, Flow measurement, Surface-groundwater relations, Aquifers, Seepage, Runoff, *New York, *Long Island, Nassau County.

South-shore streams on Long Island, N.Y., are small, widely spaced and have few or no tributaries. Their gradients are gentle, averaging 10 feet

per mile. All streams in the area studied have a mean annual discharge of less than 20 cubic feet per second, and most are from 3 to 10 miles long. Under natural conditions, about 95 percent of total streamflow originates as ground-water seepage from the upper glacial aquifer; the remaining 5 percent consists of direct runoff. Thus, the streams of Long Island function as ground-water drains, the flow of which in dry weather is controlled directly by ground-water levels adjacent to the stream channels. Monthly low-flow discharge measurements of 18 south-shore streams in Nassau County from 1978-79 are tabulated in this report. Measurement sites were established at 1,000-foot intervals between the southern tide-affected reach and the northern headwaters of each stream. The measurements provide a data base for the 'Flow Augmentation Needs Study,' supported by the U.S. Environmental Protection Agency, which will evaluate the need to replace streamflow lost through lowering of the water table as a result of sewage in Nassau County Sewer Districts 2 and 3. (USGS)
W82-04980

NATURE OF WAVE ATTENUATION IN OPEN CHANNEL FLOW,

San Diego State Univ., CA.
V. M. Ponce.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 2, p 257-262, February, 1982. 5 Ref.

Descriptors: *Mathematical studies, *Open-channel flow, *Kinematic waves, *Waves, Wave action, Mathematical equations, Channel flow, Kinematic wave theory, Unsteady flow, Flow friction, Flow velocity, Channels, Wave velocity.

The mechanisms responsible for wave attenuation in open channel flow were studied in order to identify the term or group of terms which will cause a free-surface flow wave to dissipate. Linear stability theory was used to clarify the nature of wave attenuation in prismatic channels. Wave attenuation is shown to result from the interaction of the kinematic term (friction and bottom slope) with the local acceleration term. When local acceleration is neglected, wave attenuation may be attributed to the interaction of the kinematic term with the pressure gradient or convective acceleration terms or both. These findings may prove useful in the study of unsteady open channel flow. (Geiger-FRC)
W82-05003

NEW METHODS OF DESIGNING FLOOD CONTROL MEASURES,

A. V. Kozar, and Z. D. Romanyutina.
Water Resources, Vol 8, No 2, p 119-126, March-April, 1981. 2 Fig, 15 Ref. Translated from Vodnye Resursy, No 2, p 56-64, March-April, 1981.

Descriptors: *Flood control, *Reservoir releases, *Streamflow forecasting, Automation, Reservoir operation, Weather forecasting, Flood forecasting, *Stryi River, *USSR, Water storage, Control systems, Information systems, Water level recorders, Cloudbursts, Forecasting, Water management, Systems analysis, Precipitation, Rainfall-runoff relationships.

The flood control complex for the Stryi River, USSR, incorporates an automatic information measurement system for forecasting floods and controlling the hydrostation. High annual precipitation, 321 to 1301 mm, and summer cloudbursts cause catastrophic floods in this region. When heavy rainfall has been forecast, water is released from the reservoir at a rate which does not damage the downstream land. The automatic information measurement system consists of five subsystems: Short-range forecasting of rainfall floods, operative control of the hydrostation, analysis and monitoring of the control of the hydrostation, planning for multipurpose use of the water, and forecasting of water quality. Further refinements to the automated system are planned. A denser network of automatic observation posts will be installed, evaluated, and expanded if desirable. Forecasting is done by radar measurement of precipitation within a 100 km radius. This information is processed by the system to indicate the amount of moisture that fell on the drainage basin. Automated ground precipitation gages are used to double check the amount of precipitation. Water levels in the reservoir and at stream gaging stations are automatically measured. These measures are expected to reduce flood damages in this basin by 70%. (Cassar-FRC)
W82-05030

CONSEQUENCES AND RESPONSIBILITIES IN DROUGHT FORECASTING: THE CASE OF YAKIMA, 1977,

National Center for Atmospheric Research, Boulder, CO.
M. H. Glantz.
Water Resources Research, Vol 18, No 1, p 3-13, February, 1982. 5 Fig, 3 Tab, 51 Ref.

Descriptors: *Water allocation, *Forecasting, *Drought, *Yakima Valley, *Washington, Water supply, *Legal aspects, Political aspects, Social impact, Economic impact, Irrigation, Prediction, Water rights, Bureau of Reclamation, Streamflow forecasting, Weather modification, Columbia River basin.

In February 1977 the Bureau of Reclamation issued an erroneous forecast that during the coming irrigation season Yakima, Washington, irrigators would have an available water supply less than half of the average long-term supply. Those with senior water rights were to receive 98% of their normal water allocation; those with junior rights, 6% of their normal allocation. The forecast and allocations caused irrigation districts, farmers, and government agencies to undertake drought-inspired actions. These responses included buying and selling water rights at greatly inflated prices, constructing new wells at costs up to $250,000 each for a total of $9 million, proposing large-scale diversion projects, transplanting of mint and other perennials to the Columbia River Basin at personal expense, cloudseeding at a cost of $400,000 and complaints from states which felt their rainwater was being stolen, and implementing water conservation practices in farming. As the spring progressed it was evident that the forecast was not correct. Angry farmers started legal suits to recover some of the millions of dollars unnecessarily spent for drought protection. The primary forecasting error, since admitted by the Bureau, was a balancing out of return flow against some relatively minor diversions to other smaller irrigation projects. This should be done for flood control but not for water allocation. As a result of the fiasco the Bureau lost its credibility, built up since 1945. This raises the question of whether farmers will implement drought measures if the Bureau forecasts water shortages in the future. (Cassar-FRC)
W82-05082

BEND THEORY OF RIVER MEANDERS. PART 1. LINEAR DEVELOPMENT,

Saitama Univ. Urawa (Japan). Dept. of Foundation Engineering.
S. Ikeda, G. Parker, and K. Sawai.
Journal of Fluid Mechanics, Vol 112, p 363-377, 1981.

Descriptors: *Meanders, *Mathematical equations, Fluid mechanics, Rivers, Hydraulics, *Bank erosion, *Alluvial channels, Comparison studies.

In this analysis the heuristic model of Ikeda is used to develop a formal stability theory of channels with sinuous banks. Bank erosion is described, and the stability criterion is presented in terms of the growth rate of lateral bend amplitude. This aspect suggests the parlance of 'bend' theory, as opposed to the previously quoted 'bar' theories. The bend theory is applied to both the alluvial and incised cases. The linear theory herein yields a relation for initial characteristic bend wavelength that differs from that of Ikeda and shows much better agreement with data. A comparison with the predictions of one of the 'bar' theories indicates that, for alluvial streams, bar and bend instabilities operate at similar wavelengths when sinuosity is not too large. (Baker-FRC)
W82-05085

SEVERAL PLUME FLOWS IN PURE AND SALINE WATER AT ITS DENSITY EXTREMUM,

State Univ. of New York at Buffalo, Amherst. Dept. of Mechanical and Engineering Aerospace.
J. C. Mollendorf, R. S. Johnson, and B. Gebhart.
Journal of Fluid Mechanics, Vol 113, p 269-282, 1981. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Fluid mechanics, *Plumes, Flow, *Temperature effects, Salinity, Mathematical equations, Laminar flow, Physical properties, *Density, Density stratification, Saline-freshwater interfacts.

This study is a similarity analysis of three constant-buoyancy plume flows in pure or saline water at its extremum temperature. Although the effect of saline diffusion is neglected, the influence of salinity level is retained. The analysis considers the only conditions for which a similarity solution is known for constant-buoyancy plume flows in cold unstratified water. The calculated results cover a wide range of Prandtl numbers and salinity and pressure levels. The three flow situations considered here are two above a horizontal line heat source and one above a point heat source. The first flow is a freely rising plane plume and the second is a wall plume (flow over a vertical, adiabatic surface with a horizontal line source imbedded in it). The third flow is the freely rising axisymmetric plume. These are the models in laminar theory of many processes which arise in cold water. The main purpose of the study was to calculate the effect of using a nonlinear density relation for water, which is much more accurate at low temperatures than the conventional linear one used in classical analyses. The downstream variations of the temperature and velocity fields were found to be very different from those for flows where the effect of a density extremum is not included. (Baker-FRC)
W82-05088

A NOTE ON THE STRUCTURE OF THE HEAD OF AN INTRUSIVE GRAVITY CURRENT,

Cambridge Univ. (England). Dept. of Engineering.
R. E. Britter, and J. E. Simpson.
Journal of Fluid Mechanics, Vol 112,p 459-466, 1981. 7 Fig, 17 Ref.

Descriptors: *Gravity studies, *Fluid mechanics, *Density currents, Water Currents, Plumes, Density, Interfaces, *Saline-freshwater interfaces.

In this note experiments are described in which the ratio of interface thickness to current depth and the ratio of current depth to the overall depth of fluid are systematically varied. The head of an intrusive flow advancing along the interface between two fluids is studied. The dependence of the flow on the interface thickness and the depth of the intrusion is determined. The tank used in the experimentation was 360 cm long by 20 cm wide and could be filled to a depth of 45 cm. It was filled to half the required depth with salt water and then tap water was carefully added to an equal depth above it. A partition was inserted 50 cm from one end, and the two fluids behind it were completely mixed. Removal of the partition released a current whose head was viewed throughout its journey by shadowgraph. The experiments show, at the smallest interfaces, clear Kelvin-Helmholtz billows, whose two-dimensional form is not broken up by any lobe and cleft structure as in boundary currents. When the interface thickness was less than 1/5 of the depth of the current, the behavior of the intrusive head approached that of a reflected inviscid current. This supports the conjecture that the results of Britter and SSimpson would be directly applicable to flows under a free surface. As the ratio of interface thickness to current depth increases, the Kelvin-Helmholtz billows were reduced in magnitude until mixing between the two fluids at the head ceases. When the interface thickness is comparable to the current depth the speed of second mode internal waves may be close to, or greater than, that of the intrusion and an interaction between the internal wave and the intrusive flow is noted. (Baker-FRC)
W82-05089

DISCHARGE CAPACITY OF LARGE STREAMS UNDER AN ICE COVER,

V. S. Altunin, E. G. Gladkov, and V. L. Ryabov.
Hydrotechnical Construction, Vol 15, No 6, p 329-335, June, 1981. 3 Fig, 3 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 14-18, June, 1981.

Descriptors: *Ice cover, *Canal design, *Discharge capacity, Ice formation, *Flow velocity, Roughness coefficient, Rivers, Hydraulic structures, Hydraulic roughness, Design criteria, *USSR.

The effects of ice formation on the discharge capacity of large unlined canals (discharges of 500-1000 cu m per sec) were observed in several rivers in Russia during 1977-80. Equations were developed to describe the observations. Roughness coefficients do not remain constant during the ice period even in the absence of visible deformations of the canal bottom and in the presence of very small roughness projections on the lower ice surface. Mean velocity of flow has the greatest effect on the value of roughness coefficient. Rapid formation of an ice cover is desirable to minimize ice problems. Usually flow velocity is limited and average filling is maintained to encourage the formation of crystalline ice. Ice jams can be prevented by reducing releases and maintaining average filling. (Casaar-FRC)
W82-05106

DISEQUILIBRIUM PROFILE OF THE POTOMAC RIVER NEAR WASHINGTON, D.C. - A RESULT OF LOWERED BASE LEVEL OR QUATERNARY TECTONICS ALONG THE FALL LINE,

Geological Survey, Denver, CO.
J. C. Reed, Jr.
Geology, Vol 9, No 10, p 445-450, October, 1981. 4 Fig, 28 Ref.

Descriptors: *Tectonics, *Coastal plains, *Flow, *Stream profiles, Water level fluctuation, *Geologic formations, Profiles, *Sea level, Geologic time, Faults, Fall velocity, Rivers, Geological terraces, Stream beds, Tributaries, Bedrock, *Potomac River, Tributaries, Maryland, Virginia.

The long profiles of several major rivers in Maryland and Virginia are studied, and explanations for discontinuities near the Fall Line are sought. It is postulated that changes in base level during sea-level fluctuations in the Pleistocene were important contributors to discontinuities. Quarternary downcutting in response to a lowered base level may exlain the process. Strong circumstantial evidence suggests that the discontinuities in river profiles may be due to differential uplife of the Piedmont as well. However, terrace remnants at higher elevations are so dissected that correlations between remnants is impossible. Also, no fossils or radiometrically datable materials have been recovered from terraces above the Fall Line, and attempts to apply paleomagnetic techniques have yielded equivocal results. (Titus-FRC)
W82-05134

STOCHASTIC ANALYSES AND TRANSFER FUNCTIONS FOR FLOWS OF THE UPPER DELAWARE RIVER,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
R. C. Ahlert, and B. M. Mehta.
Ecological Modelling, Vol 14, No 1, p 59-78, 1981. 5 Fig, 13 Tab, 10 Ref.

Descriptors: *Stochastic process, *Model studies, *Flow discharge, Water supply systems, Mathematical models, *Delaware River, Streamflow.

The use of stochastic modeling for description of regulated and unregulated flows and coupled flow networks is described, and application of this methodology to surface flows for the upper Delaware River and its tributary, the Lehigh River, is demonstrated. This type of modeling is possible only when data are available for extensive time periods and at relatively uniform intervals. Autoregressive integrated moving average (ARIMA) models have been synthesized to describe the random components of discharge time series. The effects of reservoir control on predictive flow models are examined in the context of combined deterministic-probabilistic models. Transfer functions have been developed to model the interaction between input and output data without a deterministic structure. Cross-correlation analysis has been used to describe the propagation of chance events throughout the system. (Carroll-FRC)
W82-05186

PLANKTON METABOLISM AND CARBON PROCESSES IN THE AMAZON RIVER, ITS TRIBUTARIES, AND FLOODPLAIN WATERS, PERU-BRAZIL, MAY-JUNE 1977,

Washington Univ., Seattle. Coll. of Fisheries.
For primary bibliographic entry see Field 2K.
W82-05197

HYDROLOGIC ANALYSIS OF PEARL RIVER FLOODS, APRIL 1979 AND APRIL 1980, IN LOUISIANA AND MISSISSIPPI,

Geological Survey, Baton Rouge, LA. Water Resources Div.
F. N. Lee, and G. J. Arcement.
Louisiana Department of Transportation and Development Research Study No 81-1-SS, 1981. 37 p, 40 Fig, 4 Tab, 19 Ref.

Descriptors: *Floods, *Flood peak, Precipitation, Streamflow, Runoff, Excess rainfall, Frequency analysis, *Flood data, Flood damage, Urbanization, *Louisiana, *Mississippi, *Pearl River.

Double-mass and trend curves of precipitation and streamflow data indicate that flooding in the Pearl River basin follows a natural, random pattern. The April 1979 flood was caused by excessive rainfall in the upper part of the basin where as much as 19.6 inches of rain fell in one storm. This caused the largest flood since 1901 in the Jackson, Miss. area, and the largest since 1938 in the Bogalusa, La. area. The Ross Barnett Reservoir, although generally not having a measurable effect on flood peaks in the Bogalusa area, may have dampened the peak discharge of the April 1979 flood in the Jackson, Miss., area by as much as 20%. The April 1980 flood was caused by excessive rainfall over the entire Pearl River basin, where precipitation amounts ranged from 8.6 to 15.0 inches. The coincidental timing of peak discharges of the Pearl River and the Bogue Chitto at their confluence caused a larger flood peak to occur near Slidell, La. than would be expected, based on the peak discharge recorded at Bogalusa, La. Land-use statistics indicate that about 4.8% of the basin is urbanized. Damage to urban property during the April 1980 flood amounted to about 12.75 million dollars in the Slidell area alone. (USGS)
W82-05216

FLOOD AND DEBRIS FLOOD HAZARDS MAP, CARSON CITY QUADRANGLE,

Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05217

STREAMFLOW CHARACTERISTICS OF THE UPPER COLUMBIA RIVER BASIN, MONTANA, THROUGH 1979,

Geological Survey, Helena, MT. Water Resources Div.
S. D. Waltemeyer, and R. R. Shields.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-185760, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-82, March 1982. 74 p, 1 Fig, 5 Ref.

Descriptors: *Streamflow, *Stream discharge, *Discharge frequency, *Data collections, Flow characteristics, Gaging stations, regulated flow, Low flow, Flow duration, Flood frequency, *Montana, *Upper Columbia River basin.

Statistical summaries of streamflow data for selected stream-gaging sites presented in this report aid in appraising the hydrology of the upper Columbia River basin in Montana. Streamflow records are provided for 54 gaging stations for the period of record. Streamflow records for five gaging stations were compiled into separate periods related to changes in regulation after data collection commenced. The entire period of record, the period before regulation, and the period after regulation are presented for comparison. For each gaging station selected for this report, a brief description is given for station location, drainage area, period of record, revisions of previously published records, type and history of gages, regulation and diversions, and extremes of discharge. These data are followed by tables of monthly and annual flow statistics, flood-frequency data, low-flow and high-flow frequency data, and flow-duration information. (USGS)
W82-05225

FLOODS OF SEPTEMBER 16, 1975 IN TALLABOA VALLEY, PUERTO RICO,

Geological Survey, San Juan, PR. Water Resources Div.
For primary bibliographic entry see Field 6F.
W82-05230

FLOOD OF JULY 1-5, 1978 ON THE KICKAPOO RIVER, SOUTHWESTERN WISCONSIN,

Geological Survey, Madison, WI. Water Resources Div.
P. E. Hughes, J. S. Hannukesla, and W. J. Danchuk.
Available from the Br. of Distr. 1200 S. Eads St. Arlington, VA 22202, Price: $14.00. Geological Survey Hydrologic Investigations Atlas HA-653, 1981. 7 Sheets, 7 Ref.

Descriptors: *Floods, *Flood damage, Precipitation, Storm runoff, *Flood discharge, Flash floods, Flood plains, Flood recurrence interval, Flood profiles, Aerial photographs, *Wisconsin, *Kickapoo River, Flood-plain delineation.

The Kickapoo River valley in southwestern Wisconsin had a devastating flood ($10 million estimated damages) during July 1-5, 1978. The flash flooding was caused by intense storms on June 30 through July 2. Total rainfall accumulation ranged from 3.8 inches near Ontario to 9.5 inches at La Farge. The resulting flood equaled or exceeded the largest ones recorded since the 1850's and equaled or exceeded the 100-year flood frequency at the U.S. Geological Survey's streamflow gages at La Farge and Steuben. Elevation and delineation of the flood are shown on photo mosaics developed from black and white aerial photographs. The 100-mile reach from Wauzeka to Wilton is shown. A summary of the storm conditions causing the flood and an analysis of the rainfall totals, as prepared by the Wisconsin Geological and Natural History Survey, are also included. (USGS)
W82-05236

STREAM-AQUIFER INFLUENCE COEFFICIENTS AS TOOLS FOR SIMULATION AND MANAGEMENT,

Colorado State Univ., Fort Collins. Engineering Research Center.
For primary bibliographic entry see Field 2F.
W82-05346

ON MEASURING TIME-AVERAGED VELOCITIES IN OPEN CHANNEL FLOW,

Copenhagen Univ. (Denmark). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-05462

FLOOD PEAK REGIONALIZATION USING MIXED-MODE ESTIMATION OF THE PARAMETERS OF THE LOG-NORMAL DISTRIBUTION,

Maryland Univ., College Park. Dept. of Civil Engineering.
M. L. Shrader, W. J. Rawls, W. M. Snyder, and R. H. McCuen.
Journal of Hydrology, Vol 52, No 3/4, p 229-237, July, 1981. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Flood peak, *Estimating equations, Prediction, Mathematical equations, Regional analysis.

Most hydrologic design problems occur at sites for which stream-gage data are not available. Either an uncalibrated estimation method or an empirical equation based on a regionalization of peak discharge estimates from gaged data must be used for the ungaged locations. Traditionally, empirical equations have been calibrated by regressing estimated peak discharges, which have been obtained from a log-Pearson Type-III analysis of gaged data, on watershed and precipitation characteristics. Although this method is sensitive to both extreme events and small sample sizes, problems, a particular form of the three-parameter log-normal distribution has been developed by utilizing a variate transform of the annual peak-flow series for fitting to a histogram. This mixed-mode fitting uses nonlinear least squares to optimize on the class errors between the observed and computed histograms of the data. A fixed probability range is used to control the sample variability. The mixed-mode estimator technique and the traditional technique were each used to derive parameters for 132 gauge sites in Pennsylvania. Peak discharges of five different exceedance probabilities were then computed for each station and regionalized for use at ungaged sites. Regression techniques were used to relate the peak discharges to watershed and precipitation characteristics; drainage area was the only predictor variable that was necessary for accurate estimates. The average error for the mixed-mode log-normal method did not differ significantly from the log-Pearson Type-III regionalization equation error, although the range of the correlation coefficients was slightly smaller for the mixed-mode method. (Carroll-FRC)
W82-05495

THE PROPERTIES OF THE KERNELS OF THE VOLTERRA SERIES DESCRIBING FLOW DEVIATIONS FROM A STEADY STATE IN AN OPEN CHANNEL,

Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
J. J. Napiorkowski, and W. G. Strupczewski.
Journal of Hydrology, Vol 52, No 3/4, p 185-198, July, 1981. 5 Fig, 10 Ref.

Descriptors: *Flow characteristics, *Mathematical models, *Open channels, Channel flow, Mathematical equations, Unsteady flow.

The modeling of the deviations of the flow from the steady state in an open channel by the Volterra series is discussed. A non-linear state equation is used to derive analytically the kernels of the Volterra series. The results of the modeling presented in this paper demonstrate the effect of the type of input signal on the accuracy of approximmation of the nonlinear state equation that describes the flow deviations from a steady state by means of the integral Volterra series. The simulation of the inflow deviations from a steady state was carried out for a channel with the length five times longer than the characteristic reach. The Runge-Kutta method was used to solve the complete nonlinear set of differential equations numerically. The standard IBM procedure, in which the step of integration is chosen automatically for an imposed computational accuracy was used. Inflows of the form of rectangular pulses with different duration andd amplitude were taken as input signals. The linear and quadratic approximation for the analyzed inflows were determined. It is suggested that determination of the structure of the kernels in such a way that the convergence can be examined may be a decisive factor in further application of the Volterra series to modelling and identification of hydrological systems. (Carroll-FRC)
W82-05525

VELOCITY DISTRIBUTIONS UNDER FLOATING COVERS,

Canada Center for Inland Waters, Burlington (Ontario).
Y. L. Lau.
Canadian Journal of Civil Engineering, Vol 9, No 1, p 76-83, 1982. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Velocity distribution, *Floating ice, *Streamflow, Velocity, Ice, Mathematical equations, Stream gages, Ice cover, Model studies, Turbulence.

The turbulence model was used to calculate the velocity distributions for a large number of stream flows under a variety of conditions. The results are used to review the stream gaging procedure and to examine some of the flow properties that are important in the development of many of the equations for ice-covered flow. The computed velocity distributions show that the velocity profiles are logarithmic only for about 60% of the layer thickness. For the 40% of the flow near the location of maximum velocity, the velocities are less than those given by the logarithmic distribution. The velocities at 0.2 and 0.8 of the depth may deviate significantly from the overall average velocity. However, the differences seem to compensate for each other, and the average of these two velocities is only about 2% higher than the actual mean velocity for most of the flows considered. When the depth is small and the velocity has to be measured at mid-depth, the correction needed to obtain the mean velocity can be 5% larger or smaller than the value of 0.88 generally used. The distance to the point of maximum velocity or the thickness of the rougher layer increases as the difference in the roughness of the boundaries increases. For fully rough flow, this thickness is almost independent of the relative roughness. However, when one boundary is smooth or when the flow near the boundary is not fully rough, both the Reynolds number and relative roughness can have an appreciable effect. (Baker-FRC)
W82-05562

INVESTIGATIONS OF CATASTROPHIC MAXIMUM DISCHARGES OF THE ARAKS RIVER,

G. T. Trembovel'skii.
Hydrotechnical Construction, Vol 15, No 7, p 423-427, 1981. 2 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 30-32, July, 1981.

Descriptors: *Flood frequency, *Peak discharge, *Historic floods, Araks River, Euphrates River, USSR, Flood discharge, Streamflow, Rivers, Discharge frequency, Statistical analysis, Flood recurrence interval.

Historical discharge data for the Araks River, USSR, were analyzed. During 1912-1968 maximum discharges at the Karadonly basin outlet were 240-1700 cu m per sec. The May 7, 1969, flood discharge was 2700 cu m per sec., classed as catastrophic and of quite rare frequency. Data indicated that the 1969 discharge was not exceeded at least since 1888. Prior to that date floods occurred in 1868, 1850, and 1828, for which only descriptions are available. However, it is believed that these floods also did not exceed the 1969 event. Considering the synchronism of the Araks with the Euphrates, it may be assumed that a high flood occurred on the Araks in 1174. The Khudaferin bridge on the Araks, constructed in the 12-13th centuries, has a discharge capacity of 3140 cu m per sec. Distribution curves of maximum discharge were prepared by several different statistical methods and for four reference stations on the river. The best estimates of distribution parameters were obtained by the maximum likelihood method. Maximum discharges calculated by the method of moments with the 91-year series, and by Monte Carlo, Humbel, and graphico-analytical methods using the 53 and 60 year series were underestimated. (Cassar-FRC)
W82-05591

EFFECT OF THE SPRING FLOOD REGIME ON THE DEVELOPMENT OF NORTH CASPIAN ZOOBENTHOS,

Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
V. F. Osadchykh.
Hydrobiological Journal, Vol 16, No 6, p 17-24, 1980. 10 Fig, 5 Tab, 18 Ref.

Descriptors: *Benthic fauna, *Floodwater, *Biomass, Rivers, Streamflow, Aquatic animals, Volga River, Caspian Sea, Fish food organisms, Rising stage, Invertebrates, Productivity, Water management, Flow duration, Lakes.

The effects of the Volga River spring flood on living organisms in the North Caspian Sea were studied from 1956 to 1973. Benthic biomass was significantly correlated with flood characteristics such as volume of discharge for the flood period, date in April of the beginning of the flood, duration of rise of flood waters, duration of flooding, and rate of rise of the flood. The highest benthic biomasses (>80 g per sq m) occurred with spring floods of 120-140 cu km beginning in early April, with 75-80 days of flood water rise at a rate of 2-3 cm per day or less and a total flood duration of 100-110 days. Low benthic biomasses (30 g per sq m) were found with low flood volumes (66 cu km) beginning in May, with a rapid rise (9-10 cm per day) of short duration (30-35 days). It is important that these relationships be used as a whole, and not selectively, in optimizing water releases into the lower Volga River. (Cassar-FRC)
W82-05596

PRELIMINARY MODEL OF AN URBAN FLOODPLAIN UNDER CHANGING LAND USE,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 4C.
W82-05642

A PARAMETRIC MODEL TO ESTIMATE RUNOFF FROM SMALL AGRICULTURAL WATERSHEDS IN THE SEMI-ARID TROPICS,

International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
J. H. Krishna.
Journal of Hydrology, Vol 55, No 1/4, p 43-51, 1982. 2 Fig, 3 Tab, 8 Ref.

Descriptors: *Agricultural watersheds, *Surface runoff, *Land management, Rainfall-runoff relations, Parametric hydrology, Runoff, Model studies, Cropland, Semiarid lands, Vertisols, Hydrologic budget, Soil water, Evapotranspiration, Texas, India(Hyderabad).

A parametric water balance model (RUNMOD) was developed from hydrologic data collected from small semiarid tropical agricultural watersheds with Vertisols. Watersheds were located in Hyderabad, India, and in Texas. Individual storm runoff volumes were satisfactorily predicted, especially when good data were used for the high intensity, short duration storms. The model was also used to predict evapotranspiration and soil moisture. The model operates with limited input and helps in evaluation of the effects of different land management practices on rainfall utilization for crop production. (Cassar-FRC)
W82-05646

BEND THEORY OF RIVER MEANDERS. PART 2, NONLINEAR DEFORMATION OF FINITE-AMPLITUDE BENDS,

Minnesota Univ., Minneapolis, St. Anthony Falls Hydraulic Lab.
G. Parker, K. Sawai, and S. Ikeda.
Journal of Fluid Mechanics, Vl 115, p 303-314, 1982. 6 Fig, 5 Ref.

Descriptors: *Meanders, *Rivers, Mathematical studies, *Mathematical equations, *River mechanics, Statistical analysis, Alluvial channels, River beds, Channel accretion, Channel erosion, Equations.

In this paper a generalized nonlinear equation of bend migration is treated, based on a analysis in an earlier paper. An expansion technique reminiscent of the Stokes expansion for water waves is developed to perform a nonlinear stability analysis. This analysis provides an explanation of skewing and fattening, and also indicates that lateral and downstream migration rates should increase as bend amplitude develops. The analysis predicts the following nonlinear effects on bend development: reduction in lateral and downstream migration rates

below the values predicted by the linear theory; the development of positive fattening and skewing; and an increase in characteristic meander wavelength for the case of alluvial meanders. (Baker-FRC)
W82-05651

STORM RUNOFF FROM SMALL LOWLAND CATCHMENTS IN SOUTHWEST ENGLAND,

Imperial College of Science and Technology, London (England).
For primary bibliographic entry see Field 4C.
W82-05653

THREE-STATE MARKOV MODEL FOR DIFFERENTIAL PERSISTENCE,

Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
M. Bayazit.
Journal of Hydrology, Vol 55, No 1/4, p 339-346, 1982. 2 Fig, 7 Ref.

Descriptors: *Streamflow forecasting, *Markov processes, Rivers, Low flow, High flow, Model studies, Mathematical models.

Annual flows of some rivers exhibit differential persistence in that low flows are more persistent than high flows. A mathematical model for such flows is described, which is a three-state Markov model. States of the Markov process are defined as low, normal and high flows with respect to a lower and an upper truncation level. In the simulation of annual streamflows using this model a sequence of flow states is generated to start with, and then actual flow values are produced by means of a Markov model. This model preserves mean, variance, covariance, positive and negative run-lengths of observed flows. Charts are given to determine the values of the autocorrelation coefficient of the model. The proposed model is applied to the simulation of annual flows of a river exhibiting differential persistence, and it is found that it can satisfactorily represent the process. (Author's abstract)
W82-05654

TIME AND FREQUENCY DOMAIN ANALYSES OF HYDROLOGICAL SYSTEMS,

Federal Inst. of Hydrology, Coblenz (Germany F.R.).
G. Huthmann, and K. Wilke.
Journal of Hydrology, Vol 55, No 1/4, p 347-369, 1982. 10 Fig, 2 Tab, 20 Ref.

Descriptors: *Input-output analysis, *Streamflow forecasting, *Hydrologic models, *Discharge hydrographs, Rivers, *Rhine River, Nahe River, Tributaries, Forecasting, Simulation analysis, Model studies, Mathematical models, Multichannel filtering method, *Multiple frequency response analysis.

Two recently developed multiple input-single output (MISO) models were compared in an analysis of high flows of a 47.9 km Rhine River reach where discharge behavior is affected by a tributary, the Nahe River. The Wiener multichannel filtering method, used in the time domain, and multiple frequency response analysis, used in the frequency domain, were analyzed mathematically in detail. Discharge records of high flow events from 1957 to 1966 on the Rhine were used as input. Forecasting was done for the period February 4-25, 1966, and compared with observed data. There were no statistically significant differences between results from both methods. There was good agreement with recorded observations. (Caesar-FRC)
W82-05655

MULTI-DECISION ANALYSIS FOR LARGE-SCALE RIVER-BASIN RESERVOIR SYSTEMS,

Little (Arthur D.), Inc., Cambridge, MA.
M. Bonazountas, and J. M. Camboulives.
Journal of Hydrology, Vl 51, No 1-4, p 139-149, May, 1981. 5 Fig, 11 Ref.

Descriptors: *River basin development, *Reservoir design, Mathematical studies, *Optimization, *Optimum development plans, Reservoir operation, Flood control, Water quality control.

In order to achieve the potential benefits of river basin management, it is necessary to construct a variety of reservoirs or other secondary facilities, which must be planned and operated according to several optimization rules, and to specify a variety of objectives. Although there have been many studies of flood control, there are no examples of research on flood and water quality control for large-scale reservoir systems where the adaptive predictor for the reservoir releases is strongly influenced by that of the subsystems. A method is proposed for optimizing problems of conjunctive operation of large-scale multipurpose reservoir systems. The problem specifies three different objectives for the immediate operation of the entire system. As a result, the analysis must include formulation of an on-line optimization problem for as long as the flood lasts, of a long-term optimization problem, and of a flood-water quality problem and a search for the overall optimal policy for the entire system. Discrete dynamic programming and linear and mixed integer programming are used in the model. The overall hierarchical optimization is formulated by using the goal-coordinating method and a numerical iterative solution with two levels. Application of this method to the specified problem demonstrates the feasibility of using decomposition techniques in the search for overall optima regarding flood and water quality river control for large-scale reservoir systems. However, the solvability of the problem will depend largely on the solvability of the decomposed models and on the capability to identify saddle point conditions for the decomposed optimization. (Carroll-FRC)
W82-05659

DISPERSION IN TUMBLING FLOW,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 8B.
W82-05796

FLOW RESISTANCE IN WIDE RECTANGULAR CHANNELS,

New Univ. of Ulster, Coleraine (Northern Ireland). School of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-05798

FLOOD OF APRIL 12-13, 1979 IN TUSCALOOSA AND NORTHPORT, ALABAMA,

Geological Survey, Tuscaloosa, AL. Water Resources Div.
J. R. Harkins.
Geological Survey Open-File Report 81-1037 (WRI), 1980. 1 Sheet, 15 Fig, 2 Tab, 3 Ref.

Descriptors: *Floods, *Storms, *Runoff, *Flood damage, Rainfall intensity, Streams, Flood peak, High water mark, Flood frequency, Flood recurrence interval, Historic flood, Flood plains, Flood hydrographs, *Alabama, Tuscaloosa, Northport, Black Warrior River.

The April 12-13, 1979, storm produced record flooding on the Black Warrior River at Tuscaloosa and Northport, Ala. The peak discharge exceeded the 100-year flood at the U.S. Geological Survey gaging station at Northport. Small streams in the urban areas had floods of approximately 10-year recurrence intervals. Rainfall of 9.0 inches for 24 hours ending 8:00 a.m. April 13 was equivalent to the 100-year rainfall-frequency intensity for Tuscaloosa. Flood peak elevations caused by the April 12-13, 1979, storm were determined from high water marks along streams in Tuscaloosa and Northport. These peaks are compared to historic peaks at gaging stations. The flood peak discharge on the Black Warrior River at Northport exceeded the maximum known flood of April 1900. However, the flood peak of the April 13, 1979, flow was of a lower elevation because of changes in the flood plain. (USGS)
W82-05824

RIVER PLUME STUDIES IN DISTORTED FROUDE MODELS,

Norwegian Hydrodynamic Labs., Trondheim. River and Harbour Lab. Div.
T. A. McClimans, and S. Sægrov.
Journal of Hydraulic Research, Vol 20, No 1, p 15-27, 1982. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *River flow, *Plumes, Mathematical studies, Mixing, Destratification, Salinity, Mathematical models, Model studies, Froude number, Fjords, Orkla River, Surface tension, Simulation, Laboratory studies, Hydraulic models.

A laboratory study was performed of a river discharge to a stratified receiving basin to control a conjecture that mixing occurs predominantly in a frontal region in the absence of wind and tidal currents. Buoyant surface discharges with a densimetric Froude number of about 1 and various aspect ratios were studies in a simulated fjord basin with a seaward narrows. The results demonstrated that river plume entrainment can be simulated accurately in distorted Froude models so long as the aspect ratio of width to depth is greater than 10 in the laboratory, provided that the depth was greater than 1 centimeter for salinity stratification and greater than 4 centimeters for thermal stratification. These present results fill in some of the details regarding Haggstrom's work and extend the physics to a stratified receiving body. The hypothesis of frontal mixing was supported by the findings. (Baker-FRC)
W82-05864

FLOOD DAMAGE ASSESSMENT AND FLOOD CONTROL PLANNING AS PART AND PARCEL OF THE ECONOMICS OF WATER UTILIZATION (VLOEDSKADEBEPALING EN VLOEDSKADEBEHEER AS ONDERDELE VAN DIE EKONOMIE VAN WATERBENUTTING),

Orange Free State Univ., Bloemfontein (South Africa).
For primary bibliographic entry see Field 6A.
W82-05896

2F. Groundwater

A DERIVATION OF THE EQUATIONS FOR TRANSPORT OF LIQUID AND HEAT IN THREE DIMENSIONS IN A FRACTURED POROUS MEDIUM,

Cold Regions Research and Engineering Lab., Hanover, NH.
K. O'Neill, and G. F. Pinder.
Advances in Water Resources, Vol 4, No 4, p 150-164, December, 1981. 2 Fig, 65 Ref.

Descriptors: *Geothermal studies, *Porous media, *Heat transfer, Mass transfer, Heat flow, Equations, Model studies, Fracture permeability, *Groundwater movement, Groundwater flow, Pore water.

Equations are derived for the transient, three-dimensional transport of heat and mass in compressible, liquid saturated, fractured porous media. Single component thermochemical transport equations are applied to each point in the microscopic medium and are transformed to produce analogous equations in terms of variables which pertain to the scale of observation. Chemical reactions and species transport are ignored. The equations are reduced to a set of coupled, non-linear partial differential equations, which can be solved by numerical methods. The primary purpose of this study was to develop a model for simulating naturally fractured geothermal reservoirs, particularly hydrothermal reservoirs under exploitation. The equations may also be applied to underground heat storage problems, process analysis, species transport, and waste disposal problems. (Caesar-FRC)
W82-04888

LINEBORO QUADRANGLE: HYDROGEOLOGY,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04969

HYDROLOGIC DATA OF THE SHAWSHEEN RIVER BASIN, MASSACHUSETTS,

Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04970

GROUNDWATER RESOURCES OF THE WILLIAMSPORT REGION, LYCOMING COUNTY, PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
O. B. Lloyd, Jr., and L. D. Carswell.
Available from State Book Store P.O. Box 1365, Harrisburg, PA 17125. Pennsylvania Geological Survey, Fourth Series, Water Resource Report 51, 1981. 69 p, 5 Fig, 2 Plates, 14 Tab, 13 Ref.

Descriptors: *Groundwater, Aquifers, *Aquifer characteristics, *Wells, Well data, Water yield, Groundwater movement, Water properties, Geohydrology, Water quality, Chemical analysis, Groundwater availability, Maps, *Pennsylvania, *Lycoming County, Williamsport region.

The aquifers that form the groundwater reservoir in the Williamsport region are composed of consolidated fractured rocks and overlying unconsolidated deposits. The fractured rocks consist of carbonate rocks, shale, siltstone, and sandstone that range in age from Ordovician to Pennsylvania. The unconsolidated deposits are Quarternary in age. The average yield of wells located and constructed for high yield is about 300 gallons per minute from unconsolidated deposits, 200 gallons per minute from carbonate rocks, 150 gallons per minute from sandstone, 100 gallons per minute from shale, and 75 gallons per minute from siltstone. The maximum yields that have been obtained range from 2.5 to 10 times these amounts. Typically, water from the carbonate rocks has a pH of 7.0, is very hard (200 milligrams per liter), and has about 450 milligrams per liter dissolved solids. Water from the noncarbonate rocks generally has a pH of 6.9, is moderately hard (85 milligrams per liter), and has about 150 milligrams per liter dissolved solids. Concentrations in excess of the Environmental Protection Agency standards for iron, manganese, sulfate, chloride, dissolved solids, hydrogen sulfide, barium, cadmium, lead, nitrate, and zinc are found locally. (USGS)
W82-04971

GROUNDWATER AND GEOLOGY OF THE CUMBERLAND VALLEY, CUMBERLAND COUNTY, PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div., and Esso Prospeccao Limitada, Rio de Janeiro, Brazil.
A. E. Becher, and S. I. Root.
Available from State Book Store, P. O. Box 1365, Harrisburg, PA 17125. Pennsylvania Geological Survey, Fourth Series, Water Resource Report 50, 1981. 94 p, 14 Fig, 3 Plates, 14 Tab, 51 Ref, Append.

Descriptors: *Groundwater, Aquifers, *Aquifer characteristics, Wells, Well data, Geohydrology, Water use, Water demand, Specific yield, Transmissivity, Hydrologic budget, Water quality, Chemical analysis, Water analysis, Trace elements, Contamination, *Pennsylvania, *Cumberland County, Cumberland Valley.

Demands on water resources of the northern part of the cumberland valley have increased 70 percent in the 15 years since 1960. Total use in 1975 was about 25 million gallons per day. Data from 650 wells, 30 springs, 106 chemical and 50 coliform-bacteria analyses indicate the intensely deformed rocks can provide abundant good quality water. The median, sustained yields in gallons per minute, calculated from specific capacity data of the carbonate rocks are Tomstown, 1000; Waynesboro, 170; Elbrook, 220; Zullinger, 82; Shadygrove, 26; Stonehenge, 57; Rockdale Run, 400; St. Paul, 82; Chambersburg, 11; and in shale of the Martinsburg formation, 28. In preferred locations such as valleys or on fracture trace, wells in the carbonate aquifer may produce 2000 gallons per minute, Colluvium on the flank of South Mountain provides extra storage for the carbonate aquifer, reduces ground-water level fluctuations, lowers flood peaks, and increases flow in the Yellow Breeches Creek during drought. Joints, faults, solution enlarged openings and variations in lithology control the occurrence and movement of water. A north-south diabase dike acts as a subsurface dam. Losses from the Yellow Breeches to the Conodoguinet basin average 9000 gallons per minute. The water is hard. Moderate levels of nitrate occur in the carbonate aquifer. Iron and hydrogen sulfide are common in the Martinsburg. Flooding of subsurface structures and increasing chemical and bacterial contamination are the major problems. (USGS)
W82-04972

GROUNDWATER RESOURCES OF THE GETTYSBURG AND HAMMER CREEK FORMATIONS, SOUTHEASTERN PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
C. R. Wood.
Available from State Book Store, P. O. Box 1365, Harrisburg, PA 17125. Pennsylvania Geological Survey, Fourth Series, Water Resources Report 49, 1980. 87 p, 4 fig, 2 Plates, 17 tab, 62 Ref.

Descriptors: *Groundwater, Aquifers, *Aquifer characteristics, *Wells, Well data, Springs, Water level, Water yield, Groundwater availability, Water use, Groundwater recharge, Pumping, Drawdown, Groundwater movement, Geohydrology, Water quality, Water pollution, Water analysis, Maps, *Pennsylvania, *Gettysburg Formation, *Hammer Creek formation.

The area of investigation is in southeastern Pennsylvania and is underlain by sandstone, shale, and conglomerate of the Gettysburg and Hammer Creek formations and by diabase dikes and sills. In 1976, about 6 million gallons per day of water was obtained from wells and springs for all uses except domestic and stock, but possibly as much as 144 million gallons per day could be pumped from the entire area. Ground water in the study area is chiefly of the calcium bicarbonate type, and its chemical quality is generally good. Most ground water occurs in and moves through very narrow bedding planes and joints. These openings, which close with depth, are developed only in a few thin beds. Median yields of nondomestic wells are 110, 85, and 6 gallons per minute in the Hammer Creek Formation, Gettysburg Formation, and diabase, respectively. Median specific capacities of nondomestic wells are 1.2, 1.0, and 0.07 gallons per minute per foot of drawdown for these same units. Nondomestic wells show little uniform relationship between specific capacity and topographic position, suggesting that water-yielding zones are no more abundant or permeable beneath valleys than beneath other topographic settings. (USGS)
W82-04973

HYDROGEOLOGIC DATA COLLECTED FROM THE KISSIMMEE PLANNING AREA, SOUTH FLORIDA WATER MANAGEMENT DISTRICT,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04974

SINKHOLE DEVELOPMENT RESULTING FROM GROUND-WATER WITHDRAWAL IN THE TAMPA AREA, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Sinclair.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-185141, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-50, 1982. 19 p, 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Sinks, *Karst, Aquifer characteristics, *Wells, Pumping, Groundwater level, Carbonate rocks, Limestone, Subsidence, *Florida, *Tampa, Floridan aquifer, Sinkholes, *Drawdown.

The area of municipal well fields on the Gulf Coastal Plain north of tampa, Fla., is densely pitted with natural sinkholes and sinkhole lakes that have resulted from collapse of surficial sand and clay into solution cavities in the underlying carbonate rocks of the Floridan aquifer. Although solution of the underlying rocks is the ultimate cause of sinkholes, some have been induced by abrupt changes in ground-water levels caused by pumping. Declines in water levels cause loss of support to the bedrock roofs over cavities and to surficial material overlying openings in the top of bedrock. The volume of calcium, magnesium, and carbonate (the constituents of limestone and dolomite) in solution in the water withdrawn from four well fields near Tampa totaled about 240,000 cubic feet in 1978. Most induced solution takes place at the limestone surface however, and the area of induced recharge is so extensive that the effect of induced limestone solution on sinkhole development is negligible. Alinement of established sinkholes along joint patterns in the bedrock suggests that a well along these lineations might have direct hydraulic connection with a zone of incipient sinkholes. Therefore, pumping of large-capacity wells along such lineations would increase the probability of sinkhole development. Although sinkholes generally form abruptly in the study area, local changes such as vegetative stress, ponding of rainfall, misalinement of structures, and turbidity in well water are all indications that percollapse subsidence may be taking place. (USGS)
W82-04982

LITTLETOWN QUADRANGLE: HYDROGEOLOGY,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04984

GROUND-WATER HYDROLOGY OF JEFFERSON COUNTY, WEST VIRGINIA,

Geological Survey, Morgantown, WV. Water Resources Div.
W. A. Hobbs, Jr.
West Virginia Geological and Economic Survey Environmental Geology Bulletin EGB-16, 1981. 21 p 11 Ref.

Descriptors: *Groundwater, *Water quality, Planning, *Water use, Data collections, Urbanization, Water supply, Aquifer characteristics, Pollution abatement, Groundwater availability, Wells, Springs, Sampling, Water level fluctuations, *West Virginia, *Jefferson County.

Jefferson County is an area of 211 square miles in the Valley and Ridge Physiographic Province in the eastern panhandle of West Virginia. In 1970 the population was 21,280, up 14 percent from 1960; the population for the entire State of West Virginia for the same period decreased by 6.2 percent. Many of the new housing developments are not within municipalities; therefore, individual water supplies have been developed and septic-tank systems installed. Because much of the county is underlain by fractured and cavernous limestone aquifers that are susceptible to contamination, sewage-disposal and water-supply systems are designed for minimum contamination potential. This report contains information about the occurrence, quality, and quantity of ground water in the county, and the direction of its movement. Water levels were measured at 196 well sites, and samples were collected at 188 well and spring sites. All but a few measurements and samples were collected during September 16-27, 1974. Fifteen wells and three springs were sampled for bacteria and nitrate; several of these were resampled in March and May 1975. To trace the movement of ground water, dye was injected into two sinkholes, and possible discharge points were monitored using activated charcoal to trap the dye. However, no dye was recovered, even though discharge points were monitored for as long as 8 weeks after injection. Fracture traces and faults were mapped from aerial photographs, satellite imagery, and available geologic maps. (USGS)
W82-04986

COMPILATION OF HYDROLOGIC DATA FOR THE EDWARDS AQUIFER, SAN ANTONIO AREA, TEXAS, 1934-79,

Geological Survey, San Antonio, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04987

POSSIBILITY OF SUBSTANTIATING THE GROUNDWATER FLOW EQUATION ON THE BASIS OF THERMODYNAMICS OF IRREVERSIVBLE PROCESSES,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
N. A. Ogil'vi.
Water Resources, Vol 8, No 2, p 136-147, March-April, 1981. 1 Tab, 13 Ref. Translated from Vodnye Resursy, No 2, p 77-89, March-April, 1981.

Descriptors: *Geothermal studies, *Gravity flow, Thermodynamics, *Groundwater movement, Mathematical equations.

A refined groundwater flow equation is derived. The interrelated processes of transport of mass, energy and heat in rocks are very complex, and therefore certain simplifications are used in modeling. When using the phenomenological description of groundwater flow processes it was assumed that rocks not containing gas or oil are completely saturated with water, that the attached (pellicular and hygroscopic) water cannot form flows, and that the relative content of attached water is very small. Lorentz and Coriolis forces and flows of elastic energy related to seismic phenomena are ignored. Under these conditions the transport phenomena are governed by the mass fluxes and heat flux for the soil skeleton, pure water, and substances dissolved in water. For groundwater with a constant composition the flow equation is analogous to the empirical Darcy equation. The refined equation allows estimating the effect of the earth's gravity field and the effect of the geothermal field on groundwater flow. (Cassar-FRC)
W82-05032

ASSESSMENT OF A REGIONAL AQUIFER IN CENTRAL ILLINOIS,

Illinois State Water Survey Div., Champaign; and Illinois State Geological Survey Div., Champaign.
C. B. Burris, W. J. Morse, and T. G. Naymik.
Cooperative Groundwater Report 6, 1981. 79 p 28 Fig, 5 Tab, 32 Ref, 3 Append.

Descriptors: *Aquifers, Sand aquifers, Surface water, *Pumpage, Water table decline, Reservoirs, Groundwater storage, Water level, Water supply development, *Water table fluctuations, *Groundwater recharge, Hydrologic models, Selective withdrawal, Well screens, Water table wells, *Aquifer characteristics, *Central Illinois, Groundwater availability.

This study of a major Central Illinois aquifer was initiated to determine its adequacy for both present and future needs. The objectives were to identify the geologic and hydrologic characteristics of the aquifer, and to develop a numerical model that would predict the aquifer's response to future pumpage. The aquifer's northern and southern segments are considered two separate hydrologic entities and serve nine municipalities and one industry. From 1888 to the present, withdrawals have been increasing, particularly in the north near Taylorville. In the mid-50s, and in 1976, there were serious water shortages, but conservation, completion of Lake Taylorville and development of other supplies helped restore water levels. Though supplies have increased, total water withdrawn has not risen proportionately. The average daily pumpage outside Taylorville is about 1/3 the total water withdrawn from the aquifer's northern half. As of 1980, there has been no discernable water level decline due to pumpage outside of Taylorville. The model results indicate that the aquifer can meet present and future needs of the user communities, with the exception of Taylorville, which will be at critical levels by the year 2000. Updating and expanding the surface water treatment plant at Taylorville may be a solution. Data for the south part of the aquifer show no depletion due to pumpage. By 2000, pumpage should increase from the present 270,000 gpd to 278,000, and if recharge remains the same no declines are predicted. The most critical elements of water supply development in the aquifer's south half are well design and maintenance. Well performance monitoring can detect deterioration and allow remedial actions to be taken (Atkins-Omniplan)
W82-05052

STRUCTURE AND PERMEABILITY: GEOLOGIC CONTROLS ON INDUCED SEISMICITY AT NUREK RESERVOIR, TADJIKISTAN, USSR,

Columbia Univ., New York. Dept of Geological Sciences.
W. Leith, D. W. Simpson, and Z. W. Alvarez.
Geology, Vol 9, No 10, p 440-444, October, 1981. 6 Fig, 20 Ref.

Descriptors: *Seismology, *Geophysics, *Permeability, *Geologic formations, *Geohydrology, Boreholes, *Reservoirs, Interstitial water, Pore pressure, Anisotropy. Stress, Stress analysis, Geography, Borehole geophysics, Geologic faults, *Nurek Reservoir, *USSR.

Seismicity in the vicinity of the Nurek reservoir in the Soviet Union has been studied. The spatial distribution of seismicity was evaluated using borehole data and data from a high-resolution seismograph network installed at Nurek in 1975. Results indicate that seismicity is not homogeneously distributed. Two distinct areas were identified. In the aseismic area vertical fluid flow is blocked by a syncline that cups the base of the reservoir. Because the strata are essentially impermeable in this area, diffusion of water to depth is restricted, and effective stress ceases to be significant. In the seismic area, a plunging anticline that crops out beneath the reservoir allows water to flow to depth along bedding planes. This structure may serve as a means of predicting the local distribution of seismicity. (titus-FRC)
W82-05133

GROUND-WATER HYDROLOGY AROUND SALT DOMES IN THE EAST TEXAS BASIN: A PRACTICAL APPROACH TO THE CONTAMINANT TRANSPORT PROBLEM,

Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 5B.
W82-05202

TEST-HOLE DATA FOR THE EDWARDS AQUIFER IN THE SAN ANTONIO AREA, TEXAS,

Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05218

QUALITY OF GROUND WATER IN ROUTT COUNTY, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
K. J. Covay, and R. L. Tobin.
Geological Survey Water Resources Investigations Open-File Report 20-956, 1981. 38 p, 8 Fig, 1 Plate, 6 Tab, 17 Ref.

Descriptors: *Groundwater, *Water quality, *Aquifers, *Geohydrology, Aquifer characteristics, Water yield, Wells, Springs, Water use, Water demand, Water analysis, Chemical analysis, Bacteria, Water quality standards, Maps, *Colorado, *Routt County, Yampa River basin.

Chemical and bacteriological data were collected to describe the quality of water from selected geologic units in Routt County, Colo. Calcium bicarbonate was the dominant water-chemistry type; magnesium, sodium, and sulfate frequently occurred as codominant ions. Specific conductance values ranged from 50 to 6,000 micromhos. Mean values of specific conductance, dissolved solids, and hardness from the sampled aquifers were generally greatest in waters from the older sedimentary rocks of the Lance Formation, Lewis Shale, Mesaverde Group, and Mancos Shale, and least in the ground waters from the alluvial deposits, Browns Park Formation, and the basement complex. Correlations of specific conductance with dissolved solids and specific conductance with hardness were found within specified concentration ranges. On the basis of water-quality analyses, water from the alluvial desposits, Browns Park Formation, and the basement complex generally is the most suitable for domestic uses. Chemical constituents in water from wells or springs exceeded State and Federal standards for public-water supplies or State criteria for agricultural uses were pH, arsenic, boron, chloride, iron, fluoride, manganese, nitrite plus nitrate, selenium, sulfate, or dissolved solids. Total-coliform bacteria were detected in water from 29 sites and fecal-coliform bacteria were detected in water from 6 of the 29 sites. (USGS)
W82-05227

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SAN SIMON WASH AREA, PAPAGO INDIAN RESERVATION, ARIZONA--1979,

Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05231

MAPS SHOWING GROUND-WATER CONDITIONS IN THE AGUA FRIA AREA, YAVAPAI AND MARICOPA COUNTIES, ARIZONA-1979,

Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05232

STREAM-AQUIFER INFLUENCE COEFFICIENTS AS TOOLS FOR SIMULATION AND MANAGEMENT,

Colorado State Univ., Fort Collins. Engineering Research Center.
T. Illangasekare, and H. J. Morel-Seytoux.
Water Resources Research, Vol 18, No 1, p 168-176, February, 1982. 6 Fig, 42 Ref.

Descriptors: *Aquifers, *Streamflow forecasting, *Water management, Streams, Pumping, Model studies, Water table, Drawdown, Wells, *Surface-groundwater relations.

The discrete kernel approach for an isolated aquifer is combined with the discrete kernel approach for an isolated stream to derive influence coefficients for a combined stream-aquifer system. The influence coefficients establish explicit relationships between the controllable decision variables and known initial conditions and the resulting states of the combined system. The aquifer and stream systems are coupled using a linear relation for the aquifer-stream interaction. A hypothetical system is used as an example. The effects of pumping from one or two wells in an aquifer adjoining a river are determined on the aquifer level, the direction of flow between river and aquifer, and the river level in three river reaches. (Cassar-FRC)
W82-05346

AN EVALUATION OF THE EFFECTIVENESS OF COMBINING ECONOMIC AND PHYSICAL GROUND-WATER MODELS,

Arizona Univ., Tucson.
T. Maddock, III.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236597, Price codes: A03 in paper copy, A01 in microfiche. Report, 1981. 30 p, 1 Fig, 3 Tab, 27 Ref. OWRT A-095-ARIZ(1), 14-34-0001-0103.

Descriptors: *Groundwater movement, *Geohydrology, *Hydrologic models, *Economic prediction, *Model studies, Groundwater runoff, Groundwater management, Base flow, Groundwater budget, Mathematical studies, Linear programing, Systems analysis, Economic aspects, Economic evaluation, Flow system, Costs, Evaluation.

Techniques for combining or coupling regional groundwater flow models are evaluated. The two principal techniques described are linking and embedding. In the use of linking, the economic model and the hydrologic model are run at different stages: the economic model is run with known hydrologic factors (e.g., drawdown); the hydrologic model is then run with the output of the economic model as demands and the cycle are repeated. In the case of bedding, two approaches are used: difference equations and response functions. Using difference equations, the groundwater hydrogeology is molded by a set of linear equations derived from the partial differential equations of flow through porous media, and this set of equations is embedded directly into the economic model as a constraint set. Using response functions, a linear relationship between drawdown and stress (e.g., pumping) can be determined. It was found that the linking technique is preferrable for highly non-linear hydrologic systems, and that the response function approach is preferred for linear flow systems (and non-linear flow systems where good linear approximations exist or where a transformation can inface a linear system). (Zielinski-MAXIMA)
W82-05545

THE APPLICABILITY OF LARGE-DIAMETER, SHALLOW WELLS TO A COASTAL PLAIN HYDROGEOLOGIC ENVIRONMENT, GEORGIA,

Georgia Southwestern Coll., Americus. Dept. of Geology and Physics.
For primary bibliographic entry see Field 3B.
W82-05548

NUMERICAL SIMULATION OF A THICK FRESHWATER LENS: PEARL HARBOR GROUNDWATER MODEL,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
C. K. Clark, L. S. Lau, and J. F. Mink.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243296, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 139, December, 1981. 71 p, 14 Fig, 2 Tab, 31 Ref, 2 Append. OWRT A-090-HI(1), 14-34-0001-1113.

Descriptors: *Aquifer characteristics, *Computer models, *Groundwater movement, *Hydrologic models, Hydrogeology, Mathematical models, Numberical analysis, Darcy's law, *Hawaii, Simulation analysis, dispersion, Ghyben-Herzberg lens, Pearl Harbor aquifer.

The freshwater aquifer in the Pearl Harbor area on Oahu, Hawaii is the most important water resource of the island and constitutes a large proportion of its freshwater supply. The aquifer has a freshwater lens up to 304.8 m (1000 ft) thick floating on top of a saline water zone. Mechanisms of groundwater movement are extremely complex because the upper boundery is confined near the coast and phreatic inland, while the lower boundary is nowhere confined. In this study, regional groundwater movement due to various pumping schemes is mathematically simulated by a set of partial differential equations. These equations are then solved numerically with a finite difference approximation. The location of the freshwater and saltwater interface, which constitutes the lower boundary of the system model was estimated by Hubbert's formula. Consideration was also given to features concerning geohydrologic boundaries of the Pearl Harbor aquifer. It was concluded that a mathematical model can be used as a tool in the management of groundwater development in a thick Bhyben-Hergzerg aquifer. Improvement of system simulation may be achieved by adding a mass transport element to study hydrodynamic dispersion within a transition zone where fluid density changes gradually. (Author abstract)
W82-05621

TRACING INTERAQUIFER CONNECTIONS IN THE KEFAR URIYYA-AGUR REGION (ISRAEL), USING NATURAL URANIUM ISOTOPES,

TAHAL—Water Planning for Israel, Ltd., Tel Aviv (Israel).
J. Guttman, and J. Kronfeld.
Journal of Hydrology, Vol 55, No 1/4, p 143-150, 1982. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Uranium radioisotopes, *Aquifers, *Saline water, *Isotope studies, Radioisotopes, Senonian aquifer, Cenomanian aquifer, Groundwater movement, Kefar Uriyya-Agur, *Israel, Tracers.

The natural uranium isotopic technique was used to detect a hydrologic connection between two strata in the Kefar Uriyya-Agur region west of Jerusalem, Israel. The Senonian aquifer, which overlies the Cenomanian aquifer, contains low-grade uranium phosphates. The natural U content of water samples from the aquifers were: Senonian, 60 micrograms per liter; Cenomanian under Senonian, 1-50 micrograms per liter; and Cenomanian not overlain by Senonian, 1-2 micrograms per liter. A relationship between the thickness of the overlying Senonian and the excess U234 activity was also demonstrated. This evidence shows that the Senonian aquifer is connected to, and contributes to, the water of the Cenomanian aquifer. This may account for the transfer of salinity, indigenous in the very poor quality Senonian aquifer, to the important Cenomanian aquifer. (Cassar-FRC)
W82-05644

EVIDENCE FOR A SHALLOW HIGHLY-PERMEABLE ZONE IN THE CHALK OF HAMPSHIRE, U.K.,

Southern Water Authority (England).
H. G. Headworth, T. Keating, and M. J. Packman.
Journal of Hydrology, Vol 55, No 1/4, p 93-112, 1982. 12 Fig, 3 Tab, 24 Ref.

Descriptors: *Aquifers, *Geologic fissures, *Permeability, Streamflow, Groundwater, *Chalk aquifer, Candover River, Transmissivity, Storativity, Water level fluctuations, Pumping tests, Carbonate aquifers, Flow augmentation, Rivers, United Kingdom, *England(Hampshire).

The Chalk Aquifer in England is most productive 20-50 m below the water table. Yield from this very fine grained limestone formation decreases with depth. Most of the active storage and permeability is confined to fissures making up 1-2% of the total volume. However, river abstraction studies in the Candover catchment in Hampshire revealed the existence of an unusually well-fissured 6 m thick zone. In the Candover catchment annual groundwater fluctuations are only 3-5 m (one-third of those in other areas), the water table is unusually flat (1 in 500 gradient), and storativity is 5-7% (compared with 1-3% elsewhere). Studies of streamflows during and after long-term pumping tests suggested that the fissured zone acted as an important conduit to streamflows. Streamflows entering the river in its upper and lower reaches are similar, suggesting that the river is fed by different levels of the aquifer having similar response times (transmissivity/storativity ratios). The upper and lower aquifer zones appear to be hydraulically connected and controlled by the same head. Extensive pumping from the aquifer into the river produced a concentration of depression which decreased streamflows for several months after pumping had stopped. (Cassar-FRC)
W82-05645

AN ENRICHED FINITE ELEMENT FOR SIMULATION OF GROUNDWATER FLOW TO A WELL OR DRAIN,

Wright State Univ., Dayton, OH. Dept. of Geology.
T. M. Tharp.
Journal of Hydrology, Vol 55, No 1/4, p 237-245, 1982. 5 Fig, 11 Ref.

Descriptors: *Finite element method, *Wells, *Drains, Fluid flow, Simulation analysis, Groundwater movement, Porous media, Model studies.

A quadrilateral finite element was developed to simulate a well or drain in two-dimensional fluid flow through porous media. The enriched four-node element models the logarithmic head distribution about a well located at its center. The enriched element is compatible at its boundaries with unenriched elements and can represent head boundary conditions at the well. The element is most accurate with a large ratio of element diameter/well diameter and for coarse meshes, as are used in regional groundwater studies. Accuracy is less for dense arrays with very large ratios of well diameter/element diameter. (Cassar-FRC)
W82-05652

THE LIKELIHOOD OF ACTIVE GROUNDWATER RECHARGE IN THE BOTSWANA KALAHARI,

Institute of Geological Sciences, Wallingford (England). (United Kingdom).
For primary bibliographic entry see Field 4B.
W82-05657

DETERMINATION OF AQUIFER PARAMETERS USING REGRESSION ANALYSIS,

Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 18, No 2, p 325-330, April, 1982. 2 Fig, 6 Tab, 13 Ref.

Descriptors: *Aquifer characteristics, *Regression analysis, *Transmissivity, Graphical analysis, Storativity, Pumping tets, Drawdown, Wells, Artesian aquifers, Confined aquifers, Leaky aquifers, Water table aquifers.

A method for determining aquifer transmissivity and storativity, which avoids the errors inherent in graphical analysis, is described. Regression analysis of the nonsteady time drawdown field data is performed by hand held calculator. Examples are given for four situations: a well penetrating a confined aquifer, a production well fully penetrating a nonleaky artesian aquifer, a leaky artesian aquifer, and a water table aquifer. Comparison of results showed that this method is a viable alternative to Theis or Jacob graphical solutions for nonleaky artesian aquifers. However, it did not perform well for leaky artesian aquifers at small values of time or for water table aquifers. (Cassar-FRC)
W82-05734

WATER-LEVEL FLUCTUATIONS DUE TO EARTH TIDES AT FORT MACKAY, ALBERTA,

Northern Illinois Univ., DeKalb. Dept. of Geology.
For primary bibliographic entry see Field 4B.
W82-05780

THE HYDROGEOLOGICAL BASIS FOR A WATER SUPPLY TO KABWE, ZAMBIA,

Aspinwall Hydrotechnical Services Ltd. (England), (United Kingdom).
For primary bibliographic entry see Field 4B.
W82-05804

CAPE COD AQUIFER, CAPE COD, MASSACHUSETTS,

Geological Survey, Providence, RI.
B. J. Ryan.
Journal of the New England Water Works Association, Vol 96, No 1, p 25-54, 1982. 8 Fig, 5 Tab, 49 Ref.

Descriptors: *Aquifers, *Water supply, *Geohydrology, Cape Cod, *Massachusetts, Groundwater, Water quality, Hydrologic properties, Recharge, Groundwater recharge, Groundwater pollution, Saline water intrusion, Wells, Municipal water, Saline-freshwater interface, Water pollution sources, Wastewater disposal, Salt, Deicers, Recreation.

Existing information on the Cape Cod Aquifer, Massachusetts, was compiled. As of 1978 over 100 municipal wells and 15,000 private wells were withdrawing water from the aquifer, which is composed of unconsolidated deposits of sand, gravel, silt, and clay. Bedrock ranges from 80 to 900 ft below sea level. The aquifer is unconfined except

along the north shore between Bourne and Brewster, along the south shore, and at Chatham and Orleans. There is a saline-freshwater mixing zone where chloride concentrations range from 25 to 18,000 mg per liter. Natural recharge (average 18 inches per year) is from precipitation infiltrating into the sandy soils. Discharge is from wells, evapotranspiration, evaporation from the water table and seepage to rivers, marshes, and ocean. Water quality is generally good low in dissolved solids, soft, and mildly acidic. Dominant ions are Na and Cl. In some locations water is naturally high in Fe, Mn, hydrogen sulfide, and salt. Contamination has resulted from land-deposited wastewaters, solid waste disposal dumps, deicing salt storage areas, spills of chemicals and fuels, urban runoff, and saline-water intrusion. In 1978 6.4 billion gallons were pumped by public water systems for supplying 80% of the population, which in 1975 ranged from 127,000 in winter to 382,000 in summer. Alternative drinking water sources are desalination of saline water, transport from the mainland, and rainwater cisterns. (Cassar-FRC)
W82-05807

MAP SHOWING GROUND-WATER CONDITIONS IN THE SACRAMENTO VALLEY AREA, MOHAVE COUNTY, ARIZONA--1979,

Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05827

HYDROGEOLOGIC RECONNAISSANCE OF THE REPUBLICAN RIVER BASIN IN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05828

CHLORIDE AND TOTAL HARDNESS CONCENTRATIONS OF WATER FROM THE UPPER PART OF THE FLORIDAN AQUIFER IN ST. JOHNS COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05829

HYDROGEOLOGIC SECTIONS THROUGH LEE COUNTY AND ADJACENT AREAS OF HENDRY AND COLLIER COUNTIES, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05830

GROUND-WATER RECONNAISSANCE OF PART OF THE LOWER KENAI PENINSULA, ALASKA,

Geological Survey, Anchorage, AK. Water Resources Div.
G. L. Nelson, and P. R. Johnson.
Geological Survey Open-File Report 81-905 (WRI), 1981. 32 p, 16 Fig, 10 Ref.

Descriptors: *Groundwater, *Glacial aquifers, *Aquifer characteristics, *Geohydrology, Wells, Natural recharge, Water yield, Well logs, Surface-groundwater relations, Glacial drift, Glacial sediments, Groundwater potential, *Alaska, Kenai Peninsula Borough, Ninilchik, Anchor Point.

Most residential and industrial development of the Lower Kenai Peninsula, Alaska, is along the coast of Cook Inlet. Most of the information about subsurface conditions is obtained from wells along the coast. Ground water is recharged by local precipitation, and slow drainage of ground water to the streams maintains streamflow during winters and periods of no precipitation. Sedimentary bedrock of the Tertiary Kenai Group is the principal source of water to wells, but subsurface data are too sparse to differentiate individual aquifers within the bedrock. Most bedrock wells are completed in poorly consolidated sandstone. Glacial till overlies bedrock in much of the study area, but few wells obtain water from the poorly permeable till. Glacial outwash and abandoned-channel deposits in major drainageways of alluvial plains provide water to wells but are little utilized and have not been explored by drilling. Intermorainal valleys and areas of low relief are poorly drained, and bog deposits overlie surficial materials in parts of the area. Bog deposits contain highly colored, iron-rich water that is undesirable to most consumers. Lacustrine clays overlie and are interbedded with fluvial materials and contain little extractable water. Streams have incised older glacial sediments and deposited alluvium along the present flood plains. Where the alluvium is thick enough, it has good potential for providing ground water to high-capacity wells. However, production of ground water from alluvium or other deposits hydraulically connected to streams will reduce streamflow. Surficial deposits with the best potential for developing significant ground-water supplies in the study area are the deltaic complex near the mouth of Kasilof River, the alluvium of Crooked Creek, and abandoned-channel deposits in the alluvial plain near Ninilchik and in an ancestral drainageway of Tustumena Glacier south of Crooked Creek. (USGS)
W82-05837

COMPUTER SIMULATION OF THE STEADY-STATE FLOW SYSTEM OF THE TERTIARY LIMESTONE (FLORIDAN) AQUIFER SYSTEM IN EAST-CENTRAL FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
C. H. Tibbals.
Geological Survey Open-File Report 81-681 (WRI), 1981. 31 p, 10 Fig, 4 Tab, 20 Ref.

Descriptors: *Groundwater, *Simulation analysis, *Confined aquifers, *Groundwater movement, Limestone, Recharge, Springs, Transmissivity, Computer models, *Florida, East-central Florida, Floridan aquifer.

The predevelopment steady-state ground-water flow system for 13,700 square miles of the Tertiary limestone aquifer system (known as the Florida aquifer in Florida) in east-central Florida is simulated by means of a digital computer model. The model results indicate that about 1,900 cubic feet per second recharges the aquifer as downward leakage from the surficial aquifer. The average recharge rate where recharge actually occurs (approximately 6,550 square miles) is about 4 inches per year. The maximum recharge rate is about 14 inches per year. An additional 21 cubic feet per second is recharged to the modeled area of the aquifer by means of lateral boundary inflow along the northeast boundary. The Floridan aquifer system, as simulated, discharges 1,300 cubic feet per second as springflow, 540 cubic feet per second as diffuse upward leakage to the surficial aquifer in an area of approximately 7,150 square miles and 81 cubic feet per second as lateral boundary outflow to the southwest and to the east. The average transmissivity of the upper unit of the aquifer, as simulated, is about 120,000 square feet per day while that for the lower unit is about 60,000 square feet per day. (USGS)
W82-05844

HYDROLOGY AND THE EFFECTS OF INDUSTRIAL PUMPING IN THE NIKISKI AREA, ALASKA,

Geological Survey, Anchorage, AK. Water Resources Div.
G. L. Nelson.
Geological Survey Open-File Report 81-685 (WRI), 1981. 22 p, 11 Fig, 5 Ref.

Descriptors: *Groundwater, *Water use, *Industrial water, *Pumping, *Drawdown, Recharge, Aquifer systems, Water level fluctuations, Lakes, Water quality, Saline water intrusion, Groundwater potential, *Alaska, Nikiski.

Industries in the Nikiski area pumped about 4.2 million gallons of water per day from three aquifers in 1979. The upper confined aquifer, from which most of the water is pumped, is recharged by leakage from the overlying unconfined aquifer. The unconfined aquifer is hydraulically connected to lakes and streams. The lower confined aquifer, the deepest of the three aquifers, is hydraulically poorly connected to the other two aquifers. Drawdown caused by pumping appears to have stabilized in all three aquifers, but water levels continue to fluctuate in response to annual changes in precipitation. In the lower two aquifers, the potentiometric surfaces near some production wells are below sea level; however, no salt water had intruded the aquifers as far as the pumped wells. If additional water supplies are needed, another potential site for ground-water development is the Beaver Creek basin, 7-10 miles east of the industrial area. (USGS)
W82-05846

2G. Water In Soils

EFFECTS OF USE PATTERN, COVER, SOIL DRAINAGE CLASS, AND OVERWINTER CHANGES ON RAIN INFILTRATION ON CAMPSITES,

Ohio Agricultural Research and Development Center, Wooster.
J. P. Vimmerstedt, F. O. Scoles, J. H. Brown, and M. C. Schmittgen.
Journal of Environmental Quality, Vol 11, No 1, p 25-28, January-March, 1982. 5 Tab, 22 Ref.

Descriptors: *Rainfall, *Infiltration, Rainfall infiltration, Soil types, Infiltration rate, Sedimentation, Erosion, Rainfall-runoff relationships, Sediment yield, Simulation, Storms, Land use, Recreation, *Campsites, Vegetation effects, *Seasonal variation, *Drainage patterns.

Objectives of this study were to determine the effect of soil drainage class, vegetative cover, and intensity of use within a campsite on rainfall infiltration, sediment yield, and soil bulk density. The changes occurring in various parameters over the winter season were also determined. Campsite conditions at 15 Ohio Public campgrounds were used as the study sites. Infiltration and sediment yield were measured during 60 minute applications of 11 cm of simulated rain on campsite use zones, using a spray infiltrometer. Initial percentages of infiltration were 82 and 89 in fall and spring with sod cover, and 68 and 79 in fall and spring with hardwood cover. Initial infiltration also varied with use zone and season: heavy use showed 32% in the fall, 65% in the spring; moderate use showed 79% in the fall, and 87% in the spring; and light use showed 95% in fall and 99% in spring. Fall infiltration during the last 10 min of simulated streams on poorly drained soils was 4% with sod cover vs 12% with hardwood cover. On well drained soils, the cover effect was reversed. Final infiltration rate and total infiltration changed but little from one use zone to another on poorly drained campsites, but on well- or excessively drained soils there was a marked and progressive reduction in infiltration from light to moderate and heavy use zones. Sediment concentration in runoff and soil bulk density increased with use intensity. (Baker-FRC)
W82-04858

THE EFFECT OF RAINDROP IMPACT ON THE DYNAMICS OF SOIL SURFACE CRUSTING AND WATER MOVEMENT IN THE PROFILE,

Israel Soil Conservation and Drainage Div., Emek Hefer. Soil Erosion Research Station.
J. Morin, Y. Benyamini, and A. Michaeli.
Journal of Hydrology, Vol 52, No 3/4, p 321-335, July, 1981. 10 Fig, 3 Tab, 13 Ref.

Descriptors: *Rainfall infiltration, *Infiltration rate, *Surface sealing, Soil profiles, Loess, Sand, Permeability coefficient, Clays, Mathematical studies, *Soil types, Mathematical models.

The infiltration of rainfall into bare soil was studied in field and laboratory experiments on two types of soil in Israel: hamra, a soil composed of 85 percent sand and 13 percent clay, and loess. The formation of a crust with an hydraulic conductivity several orders of magnitude lower than that of the soil profile was the primary process governing

the infiltration rate. The decrease in hydraulic conductivity is attributed to the organization of a very thin layer on the soil surface. The sealing efficiency of this crust is achieved by suction forces which arrange soil particles, probably clay, into a continuous, dense layer. Conditions of unsaturated flow in the soil profile below the crust result from the decrease in flux through the crust. An analytical model was used to analyze the dynamics of the changes in the different soil parameters from the beginning of the rainfall until the soil crust was completely formed. (Carroll-FRC)
W82-04868

EFFECTS OF SULFURIC ACID RAIN ON MAJOR CATION AND SULFATE CONCENTRATIONS OF WATER PERCOLATING THROUGH TWO MODEL HARDWOOD FORESTS,

Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 5C.
W82-04872

USE OF SPECTRAL DATA TO ESTIMATE THE RELATIONSHIP BETWEEN SOIL MOISTURE TENSIONS AND THEIR CORRESPONDING REFLECTANCES,

Purdue Univ. Lafayette, IN. Water Resources Research Center.
J. B. Peterson, and M. F. Baumgardner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224528, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 143, 1981, 36 p, 22 Fig, 19 Ref, 4 Append. OWRT A-061-IND(2).

Descriptors: *Soil water, *Soil moisture, *Remote sensing, *Reflectance, Moisture tension, Optical properties, Soil properties, Soil types.

Fifty-seven soils covering a wide range were studied for the relationship between their loss in reflectance when wet versus their oven dry reflectance. Regression analysis revealed R2 values of .196 and .963 for the water absorption bands and of .845 for one of the visible bands, 0.52 to 0.58 um. Twelve of the soils were brought to equilibrium with 1/3 and 1/10 bar moisture levels and compared with oven dry. This study revealed that soils of high cation exchange capacity generally exhibited very low reflectance when moist whereas a stairstepped relationship existed for the sandier soils. To further appraise the effect of different moisture levels to reflectance, 11 soils were equilibrated at 10 and 15 bar moisture tension and the spectral data compared with those for oven dry, 1/3 and 1/10 bar. Reflectance data for oven dry, 15, 10, 1/3 and 1/10 on these samples revealed three general patterns of spectral response for these soils. The fine textured soils showed low reflectance for the wetter levels with little differentiation; the sandy soils showed much higher, brighter responses for the drier samples than for the wetter moisture levels. A more even gradient of reflectance existed for the silt loams. However, there were enough exceptions to these groupings to indicate the presence of other causative factors than color and/or texture not yet evaluated.
W82-04963

ESTIMATION OF MOISTURE EXCHANGE OF GROUNDWATER WITH ROCKS OF THE ZONE OF AERATION IN THE WINTER AND SPRING,

A. A. Konoplyantsev, V. K. Sedova, and I. V. Obukhova.
Water Resources, Vol 8, No 2, p 148-154, March-April, 1981. 5 Fig, 2 Tab, 9 Ref. Translated from Vodyne Resursy, No 2, p 90-97, March-April, 1981.

Descriptors: *Groundwater level, *Aeration zone, *Freezing, Thawing, Soil water, Infiltration, Frozen ground, Precipitation, Seasonal variation, Water storage.

Observations of the moisture content and temperature of the rocks of the zone of aeration, the level and temperature of the groundwater, and meteorological factors were studied under natural conditions from 1968 to 1979 in an experimental area near Moscow. The confined aquifer occurred in unequigranular fluvioglacial sands of permeability 0.5 to 30 m per day. Groundwater level was 3.5-4.5 m. In winter and spring moisture was discharged from the groundwater level to the zone of aeration. The amount of moisture discharged varied from 2.5 to 55.4 mm. The quantity of moisture drawn from the groundwater level during freezing depended on the moisture storage in the rocks of the zone of aeration at the start of freezing. The smaller the zone of aeration, the larger were the quantities of moisture drawn from the groundwater level. When the moisture content of the rocks in the zone of aeration was less than 12%, the rock moisture content was directly related to the rate of freezing of the ground and little or no moisture was withdrawn from the groundwater level in winter. In spring the groundwater level rose, starting in March or early April. This rise was caused by the inflow of moisture stored in the zone of aeration, not from infiltration of precipitation. Only after complete thawing of rocks in the zone of aeration did infiltration of precipitation begin. Thawing of rocks began at lower depths and proceeded toward the surface. As thawing progressed, the moisture content of the rocks increased, and the groundwater level began to rise long before thawing was completed. (Cassar-FRC)
W82-05043

AN APPROXIMATE METHOD OF ESTIMATING SOIL WATER DIFFUSIVITY FOR DIFFERENT SOIL BULK DENSITIES,

Centro de Energia Nuclear na Agricultura, Sao Paulo (Brazil).
P. L. Libardi, K. Reichardt, C. Jose, and M. Bazza.
Water Resources Research, Vol 18, No 1, p 177-181, February, 1982. 5 Fig, 2 Tab, 15 Ref.

Descriptors: *Diffusivity, *Soil density, *Infiltration, Density, *Soil water, Bulk density, *Estimating equation.

Reichardt and Libardi's method (1973) for determining the effect of soil bulk density on soil water diffusivity and infiltration was extended to 13 soils varying in density from 0.900 to 1.7 g per cu cm. Dry soils were placed in 50 cm long plastic cylinders and tapped to produce several bulk density values for each soil. A generalized equation was presented to express the soil water diffusivity for any soil as a function of the soil water content and soil bulk density, knowing the rate at which the wetting from advances for one value of bulk density. (Cassar-FRC)
W82-05073

OPTIMIZATION PRINCIPLE FOR AIR AND WATER MOVEMENT,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J-Y. Parlange, R. D. Braddock, R. W. Simpson, and D. E. Hill.
Soil Science, Vol 133, No 1, p 4-9, January, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Earth-water interfaces, *Mathematical equations, Optimization, *Soil water, Leaching, Sediment transport, Solute transport, Air-water interfaces, Groundwater movement, Subsurface water.

The aim of this paper is to describe the structure of the water profile and accurately predict water intake using an optimization principle. The principle can be used first of all to accurately predict water intake into a soil when air movement is not negligible. The principle is also useful for solving the transport equation numerically, avoiding numerous iterations. Finally, analytical approximations can be greatly improved when the principle is taken into account. These three applications of the optimization principle are illustrated by comparisons with an exact solution of the water movement equation obtained using Brutsaert's technique. (Baker-FRC)
W82-05172

SIMPLIFYING NEUTRON MOISTURE METER CALIBRATION,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 7B.
W82-05173

REDUCED RUNOFF AND NONPOINT SOURCE POLLUTION THROUGH INCREASED INFILTRATION,

Pennsylvania State Univ., University Park.
A. R. Jarrett, and J. R. Hoover.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224759, Price codes: A07 in paper copy, A01 in microfiche. Report, November 1981. 114 p, 34 Fig, 9 Tab, 58 Ref. OWRT A-055-PA(1), 14-34-0001-1140.

Descriptors: *Surface runoff, *Nonpoint pollution sources, *Rainfall infiltration, *Infiltration capacity, *Soil water, Runoff, Rainfall-runoff relationships, Infiltration, Infiltration rate, Free water, Air entrainment, Sand, Intestitial water, Soil porosity, Pervious soils, Soil tests, Soil saturation, Agricultural runoff, Agricultural hydrology, Technology.

Three studies were carried out to assess the effects of increased soil infiltration on the reduction of runoff and nonpoint source pollution. The first study examined surface venting of entrapped soil air for increasing infiltration in sand. Simulated rainfall was applied to a large 75 cm thick sand sample having 13 different surface variations or venting mechanisms, with soil-air pressure measured at seven piezometer locations and runoff recorded. Air entrapment reduced water infiltration, while the installation of air wells, holes, and vertical mulch columns significantly increased infiltration rates. The second study estimated the kinetic energy of escaped soil air and its effect on the detachment of soil particles in dry and saturated soil conditions. Also examined was the combined effects of overland flow, escaped soil air, and its transport by overland flow. In the third study, a preliminary field study showed that shallow drainage systems reduced air entrapment, peak runoff, total runoff, sediment concentration and sediment load on tilled land. Where air entrapment is a problem, farmers can install subsurface drain tiles to enhance infiltration and soil water storage capacity. (Zielinski-MAXIMA)
W82-05300

CONFIGURATION OF ICE IN FROZEN MEDIA,

Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2C.
W82-05615

ON DETERMINING VOLUMETRIC SOIL MOISTURE VARIATIONS IN PEAT BY THE GRAVIMETRIC METHOD,

Toronto Univ. (Ontario). Dept. of Geography.
D. S. Munro.
Soil Science, Vol 133, No 2, p 103-110, February, 1982. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Soil water, *Porosity, *Saturated soils, Peat, Beverly Swamp, Hamilton, Ontario, Volumetric analysis, Organic matter, Soil porosity, Soil density, Density.

The most suitable method for determining soil moisture during a three-summer weekly sampling program of periodically flooded peat was the volume ration method. This method determined the ratio of water in the sample to total sample volume. It was sensitive only to error in sampling the water fraction of the soil. The effect of the error was small in porosity estimates made from unsaturated peat samples and would probably be even less important in estimating the soil moisture fraction of unsaturated soil. Volume ratio estimates of soil porosity in Beverly Swamp, near Hamilton, Ontario, were: samples above the water table, 0.821 in the surface layer, decreasing to 0.642 at 50-60 cm depth; and samples below the water table, 0.863 in the surface layer, decreasing to 0.750 at 60-70 cm depth. The more common method of measuring soil moisture by multiplying in situ bulk density by sample weight ratio of water to solid

produced unreasonable results, 0.82-0.86 throughout the soil profile. Standard errors in the volume method (0.003-0.039) were less than standard errors in the weight method (0.03-0.05). (Cassar-FRC)
W82-05616

SOIL WATER AVAILABILITY,

Science and Education Administration, Temple, TX. Grassland, Soil and Water Research.
J. T. Ritchie.
Plant and Soil, Vol 58, No 1-3, p 327-338, 1981. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Available water, *Soil water, *Evapotranspiration, *Root zone, *Soil-water-plant relationships, *Model studies, Transpiration, Soil water potential, Mathematical studies, Drainage, Subsurface drainage, Evaporation, Hydrologic budget.

The upper and lower limits of soil water availability are often difficult to define because of water flow into and out of the root zone and because of incomplete extraction by sparse roots at the lower boundaries of the root zone. For accurate soil water balance modelling, it is important to obtain accurate measurements of these upper and lower limits in the field. A simple field-measured drainage function is described for determining the time when water is available above the upper limit while soils are draining. The extractable water may then be estimated using only soil water content measurements taken preferably by a neutron meter. Once the range of extractable soil water is established, some general relationships to reduce transpiration can be established. Above 70% of the range of extractable soil water, transpiration is affected little by soil water deficit. In dry regions where evapotranspiration is the critical factor in soil water balance modelling, accurate calculations of transpiration are vital. (Geiger-FRC)
W82-05623

A FIELD METHOD FOR MEASURING SHORT-CIRCUITING IN CLAY SOILS,

Soil Survey Inst., Wageningen (Netherlands). Dept. of Soil Physics.
J. Bouma, L. W. Dekker, and C. J. Muilwijk.
Journal of Hydrology, Vol 52, No 3/4, p 347-354, July, 1981. 4 Fig, 7 Ref.

Descriptors: *Clays, *Soil moisture retentiion, Soil physics, *Soil types, Vertical flow, Flow characteristics, *Soil water, Flow measurement, *Unsaturated flow, Field tests.

Vertical flow of free water along the walls of macropores in unsaturated soils, a process called short-circuiting, has been observed in clay soils in the field during natural rainfall and during sprinkling irrigation. A method for measurement of short-circuiting in the field is described. A cylinder with a diameter and height of 20 centimeters is filled with undisturbed surface soil and is placed on a perforated disk in a funnel. The funnel is supported to allow periodic measurement of the volume of outflow from the soil. This assembly, together with a similar assembly with no surface soil, is placed along the track of a spray gun used for sprinkling irrigation. At least four samples can be measured during one run, while the assembly without soil measures the total water applied to the soil. The measured short-circuiting in a heavy clay soil, in a light clay soil with two different types of structure in and adjacent to potato ridges, and in a heavy clay soil with two types of surface microrelief is reported. Results of these measurements show that the tortuosity of the macropores and their size distribution significantly affect the degree and duration of short-circuiting. Increasing the microrelief of heavy clay soil was found to significantly retard sort-circuiting. Reduction of short-circuiting is advisable, since this phenomenon results in the rapid movement of irrigation water to the subsoil without benefit to the roots of plants and without wetting and leaching the soil between macropores. In addition, short-circuiting may result in rapid movement of surface-applied fertilizers to deeper layers. (Carroll-FRC)
W82-05526

SUBSURFACE FLOW VELOCITIES THROUGH SELECTED FOREST SOILS, SOUTH ISLAND, NEW ZEALAND,

Forest Research Inst. Christchurch (New Zealand).
For primary bibliographic entry see Field 4C.
W82-05712

THE RELATIONSHIP BETWEEN 018 AND DEUTERIUM IN WATER IN SAND COLUMNS UNDERGOING EVAPORATION,

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison.
Journal of Hydrology, Vol 55, No 1/4, p 163-169, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Isotope studies, *Evaporation, *Deuterium, *Oxygen isotopes, Recharge, Groundwater recharge, Arid lands, Water vapor, Stable isotopes, Groundwater.

Slopes produced by plotting deuterium against 018 (% relative to standard mean ocean water) were as follows: soil water in unsaturated sand subjected to evaporation in columns for 3.8 to 15.8 days, 2.4 to 4.6; water evaporating from an open pan, 5. The lower slope values corresponded with the longer evaporation times in the columns. This effect is produced by the increasing thickness of sand through which the water must travel. In the beginning of the evaporation period water movement to the surface is predominantly by liquid flow, and the slopes are similar to the saturated case. As evaporation proceeds and the water must travel further to reach the surface, the vapor phase movement predominates and the 018-D relationship changes. The suggests that in very arid areas groundwaters replenished by local recharge are characterized by lower 018-D slopes. (Cassar-FRC)
W82-05759

LEACHING FRACTIONS AND SALT STATUS OF TWO IRRIGATED GYPSUM-RICH SOILS IN SOUTHERN ALBERTA,

Department of Agriculture, Lethbridge (Alberta). Research Station.
C. Chang, S. Dubetz, T. G. Sommerfeldt, and D. C. MacKay.
Canadian Journal of Soil Science, Vol 62, No 1, p 97-103, February, 1982. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Soil chemistry, *Irrigation, Leaching, Soil water, Salinity, Salts, Calcium, Mathematical studies, *Alberta, *Canada.

The objectives of this study were to determine the changes in soil salinity at two field sites and to develop a new method for calculating the leaching fractions in typical irrigated soils near Tilley, Alberta, after more than 60 years of flood irrigation. This information is useful in assessing the adequacy of existing irrigation practices. Two sites with long term salinity status records were selected. The salt content in the surface 60 cm of soil was initially lower than that below, and remained fairly low throughout the years of irrigation. The rate of leaching of salts below 60 cm was very fast in the beginningd decreased to 1.6% of the initial rate at Tilley 1. The salt content in the soil apparently reached a pseudosteady state after 43 yr of irrigation. About 7 years were required for one pore volume of water to leach through the 180 cm profile. After 7 years of irrigation about half of the leachable salt was leached out of the soil profile. Since the average calcium content of the soil profile decreased linearly with time, the crop uptake of calcium was small compared to the total annual losses of calcium. The main loss of calcium was attributed to leaching. Drainage volume was obtained from the use of calcium concentration in the saturated extracts of soil rich in gypsum and the net leaching loss of soluble calcium. The results of this study indicate that the new method developed by determining drainage volume is reliable. The water balance method is simple, but it requires accurate data on the annual rate of irrigation and precipitation, and on crop consumptive use. (Baker-FRC)
W82-05762

2H. Lakes

ABIOGENIC ELIMINATION OF NUTRIENTS IN A NEWLY BUILT RESERVOIR (TWISTETALSPERRE, NORDHESSEN) (ABIOGENE NAHRSTOFFELIMINIERUNG IN EINER NEUENTSTANDENEN TALSPERRE (TWISTETALSPHERRE, NORDHESSEN),

Kassel Univ. (Germany, F. R.). Zoologisches Inst.
K. Schocke.
Archiv fur Hydrobiologie, Vol 80, No 4, p 483-508, August, 1980. 10 Fig, 6 Tab, 49 Ref.

Descriptors: *Reservoirs, *Nutrients, *Adsorption, *Phytoplankton, Reservoir stages, Phosphates, Nitrates, Ammonium, Silica, Diatoms, Algal growth, Bottom sediments, Clay.

The development of phytoplankton and some chemical aspects of the water composition were studied over a two-year period following the filling of a new reservoir. The bottom of the reservoir is lined with clay material of high ion exchange capacity. The total adsorptive capacity of this material, including the clays with chemically bound aluminum and iron, decreased the nutrient content of the reservoir water by adsorption of cations and anions. Dissolved silica in particular was adsorbed. As a result, silica became a limiting factor for diatom growth during the first year of observation. Samples of the bottom material were collected from various sites in the reservoir and their adsorption capacity tested by incubating with seawater samples for 24 hr in the laboratory. These studies showed that 28 mg Si/sq m were fixed in 24 hr. Some of the orthophosphate and ammonia in the water was also adsorbed in laboratory experiments; in field studies, no clear distinction between abiogenic and biogenic factors could be made with respect to phosphate and ammonia removal. During the first year of the investigation sufficient phosphate and ammonia were still present to permit phytoplankton growth. Biological removal of phosphate predominated. Nitrates were not adsorbed. Calcium. Magnesium and chlorides also decreased due to the effects of the reservoir bottom: nevertheless this decrease was insignificant. (Carroll-FRC)
W82-04768

ALGAL BIOASSAY OF THE PORTAGE LAKES, SUMMIT COUNTY, OHIO,

Akron Univ., OH. Dept. of Biology.
J. H. Olive, and G. Higgins.
Environmental Pollution, Series A, Vol 26, No 1, p 59-67, 1981. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Algal, *Bioassay, *Lakes, Nutrients, Phosphates, Nitrates, Lentic environment, Lotic environment, *Ohio, Summit Ccounty, *Portage Lakes.

The Portage Lakes are a series of natural lakes and man-made reservoirs in the upper Tuscarawas River of northeastern Ohio. Algal bioassays were used to determine the effects of phosphate and nitrate enrichment on the algal growth potential in the lakes and to predict the effects of diverting algal nutrients from one part of the lake ystem to another area within the system. The temporal patterns of water fertility appeared to be different for standing waters than for those with more of the characteristics of running waters, probably as a result of differences in nutrient availability. In lentic environments, algal growth rates ranged from about 0.6 doublings per day in early summer to less than 0.2 doublings per day in late summer. Algal growth rates in more lotic environments increased from between 0.2 and 0.3 doublings per day in June to between 0.3 and 0.5 doublings in July, followed by a decline to less than 0.3 doublings per day in August. Nutrient enrichments with PO4-P and NO3-N suggested that phosphorus was usually the major limiting nutrient in both groups of lakes, although NO3-N additions sometimes stimulated algal growth in the lotic environments. (Carroll-FRC)
W82-04813

TOWARDS DIGITAL TECHNOLOGY IN THE MEASUREMENT AND CONTROL OF WATER LEVELS,

Churchill Controls Ltd., Reading (England).
For primary bibliographic entry see Field 7B.
W82-04847

PRIMARY PRODUCTION IN SALINE LAKES,

Saskatchewan Univ., Saskatoon. Dept. of Biology.
U. T. Hammer.
Hydrobiologia, Vol 81, p 47-57, 1981. 3 Fig, 2 Tab, 28 Ref.

Descriptors: *Saline lakes, *Primary productivity , Lakes, *Phytoplankton, Plankton, Reviews, Variability.

The paper compares the results of several studies made on the variability of primary production in saline waters and related parameters. Phytoplankton primary production is discussed in terms of hourly volumetric rates, daily volumetric rates, areal rates, annual rates of primary production, chlorophyll a and a photosynthetic capacity, and efficiency of integral photosynthesis. Also presented are factors which influence algal biomass and rates of primary production. Photosynthetic bacterial primary production, macrophyte primary production, and Aufwuchs primary production are also reviewed. While extensive work has been done in establishing upper limits of photosynthesis in saline lakes, major problems still exist regarding the usefulness of light and dark bottles for accurately measuring the rates in highly productive lakes. Also, the factors which limit production in saline lakes should be examined more closely along with further studies into aquatic macrophytes and Aufwuchs production. (Baker-FRC)
W82-04926

A COMPARISON OF VASCULAR VEGETATION AND PROTOZOAN COMMUNITIES IN SOME FRESHWATER WETLAND OF NORTHERN LOWER MICHIGAN,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
M. S. Henebry, J. Cairns, C. R. Schwintzer, and W. H. Yongue.
Hydrobiologia, Vol 83, No 3, p 353-375, 1981. 2 Fig, 13 Tab, 80 Ref.

Descriptors: *Wetlands, *Protozoa, Marshes, Bogs, Fens, Swamps, Eutrophication, Chemical properties, Aquatic animals, *Ecosystems, Lakes, Vegetation, *Michigan.

This study was designed to examine vegetation, water levels, water chemistry and Protozoa in the major wetland types to determine similarities and differences among wetland types and extent of covariation between vegetation, Protozoa, and water characteristics. The wetlands included in the study were located in Emmet and Cheboygan counties in northern lower Michigan. The bedrock consists of dolomites and limestone, but outcrops are rare and most of the surface is covered by glacial deposits. Seven wetlands were sampled in the summer of 1977. Two were bog sites and were vegetated by tree, tall-shrub, and ground layers. The vegetation in the remaining sites consisted entirely of a ground layer. Two marshes studied did not have a dominant species. In the Hebron Swamp, duckweed was the leading dominant with leatherleaf and cattail condominant. Early to midsummer water levels were well below the surface in the bogs, slightly below the surface at the fens where water was observed at the soil surface at some sample points, and well above the surface in the two marshes and Hebron swamp. The wetlands examined formed three distinct groups with respect to vascular vegetation and midsummer water levels. They formed two distinct groups with respect to chemistry of the standing waters. The similarities and differences between wetland sites were not as great for Protozoa as for vascular vegetation, but the patterns were similar. The open waters at the fed and bog sites and at the Cheboygan marsh may have been highly eutrophic. It was concluded that the structure and dynamics of protozoan communities of wetlands seem to be broadly different from that of other freshwaters, and somewhat unique to particular wetland types. (Baker-FRC)
W82-04927

LIMNOLOGY OF A LARGE, DEEP, NORTH AMERICAN TERMINAL LAKE, PYRAMID LAKE, NEVADA, U.S.A.,

Colorado Cooperative Fishery Research Unit, Fort Collins.
D. L. Galat, E. L. Lider, S. Vigg, and S. R. Robertson.
Hydrobiologia, Vol 82, p 281-317, 1981. 39 Fig, 7 Tab, 156 Ref.

Descriptors: *Saline lakes, *Limnology, *Pyramid Lake, Lakes, *Nevada, Lake stages, Lake morphology.

This paper seeks to update earlier reports on Pyramid Lake and to compare this lake with other athalassic saline lakes and synthesize past studies into a more holistic treatment. Pyramid Lake occupies a large, north-south oriented graben wholly within the boundaries of the Pyramid Lake Paiute Indian Reservation in northwestern Nevada. The eastern shore is abruptly determined by the Lake Range's fault scarp, while the western shore is bounded by the Virginia Range. The headwaters of the Truckee River, the only permanent water source, arise in the Sierra Nevada mountains of eastern California and western Nevada. Although classified as saline, this lake does not fill all the characteristics of that classification. About the only characteristic that the Pyramid Lake shares with all athalassic saline lakes is its lack of outflow. The allochthonous contributions from the Truckee River figure significantly in Pyramid's dynamics. Certainly the reproductive success of the anadromous fishes depends on this river. The composition of the benthic substrate is quite homogeneous, but the shoreline development is high, unlike many other saline waters. The vertical water column provides substantial spatial heterogeneity, not noted in shallower, polymictic saline waters. The lake does not contain a well-developed macrophyte community. It is concluded that the lake does not fix large amounts of energy, providing an exception to the generalization that saline lakes are highly productive. The rich biological community of the lake is a dramatic departure from the low species diversity classically associated with inland saline waters. (Baker-FRC)
W82-04928

ON THE CHEMISTRY OF SOME SALT LAKES AND PONDS IN YUGOSLAVIA,

Bioloski Inst., Belgrade (Yugoslavia).
G. Petrovic.
Hydrobiologia, Vol 81, p 195-200, 1981. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Saline lakes, *Chemical properties, *Yugoslavia, Lakes, Ponds, Magnesium, Calcium, Acidity, Sulfates, Chlorides, Carbonates, *Pannonian plain.

This paper is concerned with some salt lakes and ponds occurring on the Pannonian plain in Yugoslavia. Chemical features are reported of about 75 shallow alkaline lakes and ponds in this region. Geologically the plain represents the evolution of a desiccated basin in which the role of surface and underground water has been significant. Color of the water varied from green to brown. Salinity varied from 0.376 to 13.5%. pH values were seldom below 8.0, being usually between 8.5 and 9.5. All three types of major saline water occurred: carbonate, sulfate and chloride. Sodium bicarbonate and sodium/magnesium bicarbonate waters predominate, and calcium bicarbonate waters were rare. Such chemical diversity reflected the geological nature of the region, the arid climate, the variety in the chemical nature of the soils, the small distance of saline underground water from the surface, and the occurrence of flooding by the Rivers Danube and Tisa. The data reveal that waters on the Pannonian plain outside Yugoslavia have similar ionic compositions to those inside and display a similar range of salinity. It is noted that saline waters of similar chemical composition to those recorded in Yugoslavia occur in many parts of the world. (Baker-FRC)
W82-04929

ALGAL BIOASSAY OF THE WATER FROM TWO LINKED BUT CONTRASTING WELSH LAKES,

University Coll. of North Wales, Bangor. School of Plant Biology.
C. M. Happey-Wood, and A. Pentecost.
Freshwater Biology, Vol 11, No 5, p 473-491, 1981. 8 Fig, 4 Tab, 49 Ref.

Descriptors: *Algal growth, *Lakes, Eutrophication, Nitrogen, Phosphorus, Nutrients, *Bioassay, *Diatoms, Seasonal variations, Thermal stratification, Wastewater, *Wales, Llyn Padarn, Llyn Peris.

Bioassay experiments were conducted for a year using the diatom to assess differences in fertility of water samples from Llyn Padarn and Llyn Peris by growth of Asterionella formosa in filtered water samples and to investigate nutrient limitation by enrichment of these filtered water samples. A rapid bioassay procedure employing C-14 labeled A. formosa was developed as a more sensitive means of assessing the differences in nutrient status of the waters of the two lakes. Water samples were collected every 2 weeks, from a depth of 3 meters. In unenriched water, growth was more rapid in Padarn water during autumn-winter-spring, but there was no significant difference between growth in water from the two lakes during the period of thermal stratification. Mean growth rates in treatments with additions of nitrogen and chelated iron were not significantly different from unenriched water samples, both between treatments and in lakes during thermal stratification. Phosphate additions increased growth in water from both lakes. The potential fertility of water samples from the two lakes differs more during mixed water conditions than in the period of thermal stratification. The addition of diluted sewage effluent which enters the drainage system between the two lakes resulted in similar rates of growth of A. formosa in water from both lakes. (Baker-FRC)
W82-04934

ON THE CHEMISTRY AND BIOTA OF SOME SALINE LAKES IN WESTERN AUSTRALIA,

Adelaide Univ. (Australia). Dept. of Zoology.
M. C. Geddes, P. De Decker, W. D. Williams, D. W. Morton, and M. Topping.
Hydrobiologia, Vol 82, p 201-222, 1982. 6 Fig, 5 Tab, 37 Ref.

Descriptors: *Saline lakes, *Ecosystems, Biota, Salinity, *Australia, *Chemical properties, *Limnology, Lakes, Sodium, Chlorides, Ions.

The limnology of salt lakes in Western Australia was investigated. Water bodies studied were those accessible from the highway between Kalgoorlie, Wiluna, Meekathara, Northam, Lake Grace, Esperance and Norseman, an area of some 800 by 500 km. The study was undertaken in 1978 with about 100 water bodies being sampled. Fifty-four had salinities of 3% or more, and only these are considered in this paper. Crustaceans were by far the dominant group and were represented by twenty-one species of ostracods, ten of anostracans, ten of copepods, three of cladocerans, and one of the Conchostraca and Am phipoda. The halobiont gastropod, Coxiella, was collected from 10 localities. Nematodes were noted in one. No relationship was noted between basin size and fauna. The major factors affecting distribution appeared to be salinity and geographic position. The pattern of major ion dominance was almost always sodium, magnesium, calcium, potassium, and chlorides, sulfate, and bicarbonate in order of decreasing concentrations, with sodium and chloride the dominant cation and anion respectively on all occasions. While this study presents the occurrences of similarities between the fauna of salt lakes in the southwest and southeast of Australia, it also highlights the differences. The most significant result of the studies is the addition of further evidence of greater diversity in the salt lake fauna in the west. (Baker-FRC)
W82-04940

THE LIMNOLOGY OF SALINE LAKES IN WESTERN VICTORIA, A REVIEW OF SOME RECENT STUDIES,

Adelaide Univ. (Australia). Dept. of Zoology.
W. D. Williams.
Hydrobiologia, Vol 82, p 233-259, 1981. 7 Fig. 5 Tab, 108 Ref.

Descriptors: *Saline lakes, *Limnology, Reviews, *Australia, Seasonal variations, Chemical properties, Acidity, Salinity, Dissolved oxygen, Sedimentation, Lake sediments.

This review considers studies of the major physical, chemical and faunistic features of saline lakes in Western Victoria, but does not consider botanical studies, estimates of primary and secondary production or palaeolimnological findings. The lakes in question lie about 150 km west-southwest of Melbourne in a region known as the Western District of Victoria. Most lakes lie at altitudes of greater than 150 miles above sea level. All are the termini of inland drainage basins, and the area is almost entirely endorheically drained. The climate is temperate, with warm dry summers and cool wet winters. The region is now almost totally used for agricultural purposes. Physical limnology (morphology, temperature, and light), chemical limnology (concentration of dissolved solids, ionic composition, sources of dissolved salts, pH, dissolved oxygen, and sediment composition), and faunal studies (relationship between salinity and occurrence, composition, evolution, adaptations, and seasonal changes) are included in the review. (Baker-FRC)
W82-04942

THERMAL REGIMES OF FLORIDA LAKES, A COMPARISON WITH BIOTIC AND CLIMATIC TRANSITIONS,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. R. Beaver, T. L. Crisman, and J. S. Bays.
Hydrobiologia, Vol 83, No 2, p 267-273, 1981. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Lake classification, *Lakes, *Thermal properties, Hydrothermal studies, *Florida, Seasonal variation, Cycling nutrients, Climatic zones, Limnology, Mixing, Water circulation, Lake morphometry, Thermal regimes.

The extent of latitudinal variation in the thermal structure and mixing regime of warm monomictic lakes in Florida is quantified and related to major biotic and climatic zones within the state. Temperature profiles were determined monthly during 1979 for 24 lakes and bimonthly for 5 lakes in peninsular Florida. Zonal thermal differences were nearly eliminated during summer, as evidenced by the fact that August was the only month for which no significant temperature differences existed between any geographic zone, suggesting that differences in the regional thermal regimes of lakes in Florida are related principally to the extent and duration of winter temperature minima. Of 36 statistical comparisons made, only 7 cases displayed a significant temperature difference between shallow and deep lakes for a given month, and no clear trend could be discerned for any lake group. Thus, due to the generally shallow nature of Florida lakes and the less pronounced seasonal temperature fluctuations, basin morphometry does not appear to play as important a role in determining the thermal regimes of Florida lakes as seen for northern lakes. These findings support the contention that the American system for classifying lakes according to their mixing regimes is more concise than the European system but does not provide for transitional lake types. While it is not proposed that the term warm monomictic be revised to formally account for transitional lakes, it is suggested that annual patterns of nutrient cycling and algal productivity in climatically transitional areas such as peninsular Florida may be strongly influenced by intraregional differences in lakes' circulation patterns. (Baker-FRC)
W82-04943

THE DECLINE OF SALVINIA MOLESTA ON LAKE KARIBA,

Lake Kariba Fisheries Research Inst., (Zimbabwe).
B. E. Marshall, and F. J. R. Junor.
Hydrobiologia, Vol 83, No 3, p 477-484, 1981. 3 Fig, 2 Tab, 47 Ref.

Descriptors: *Lakes, *Ecosystems, Eutrophication, *Zimbabwe, *Lake Kariba, Aquatic plants, Salvinia molesta, *Nutrients, Limnology, Reservoir stages, Ferns.

Ecological aspects of Lake Kariba and their possible effects on the decline of Salvinia in Kariba are discussed. During the early post-impoundment years, Lake Kariba was eutrophic as a result of nutrients leached from flooded land, but it rapidly became less eutrophic as these nutrients were lost through the outflow. During this time an explosive growth was noted among several aquatic organisms, of which Salvinia was perhaps the most striking example. The lake reached its full supply level in July 1963, by which time many sheltered areas suitable for Salvinia disappeared and the effects of wave action on the exposed mats became more pronounced. Extensive mats are still found on the lake, but are restricted to the larger estuaries, notably those of the Gachegache, Bumi and Sibilobilo River Basins. No obvious link could be noted between the decline of Salvinia and physico-chemical conditions of the lake. Several factors acting synergistically were probably responsible, including direct attack by Paulinia as well as the indirect effects of competition for nutrients with other ecosystgem components of the developing lake. The ecological effects of the decline of Salvinia on Lake Kariba are not clear. The mats provided a substrate for fish food organisms as well as a cover for various species. Submerged macrophytes will probably fill both of these roles now. The effects on shoreline vegetation will perhaps be more significant. Nutrient retention in the lake, once carried out by the Salvinia, is now carried out more efectively by other ecosystem components. (Baker-FRC)
W82-04945

AN ECOLOGICAL STUDY OF AN ANTARCTIC FRESHWATER POOL WITH PARTICULAR REFERENCE TO TARDIGRADA AND ROTIFERA,

Department of Science, Melbourne (Australia).
D. A. Everitt.
Hydrobiologia, Vol 83, No 2, p 225-237, 1981. 6 Fig, 7 Tab, 54 Ref.

Descriptors: *Lakes, *Polar regions, Antarctic, Benthos, Benthic Environment, Aquatic Life, Biomass, *Rotifers, *Ecology.

This paper records the seasonal population changes of two metazoan groups, rotifers and tardigrades, in a freshwater tarn in Antarctica. Deep Lake Tarn is a small, permanent body of freshwater in the Vestfold Hills, Princess Elizabeth Land, Antarctica. The surface area is 6,200 square meters and maximum depth is 0.45 meters. It is frozen solid for 8 months of the year and is partially or completely melted during the remaining four. Most of the tarn's bottom is a soft, black, anoxic mud overlain with a luxuriant algal carpet. Water was sampled seven times for nutrient analysis from up to seven stations. The benthic algal mat was comprised of cyanophytes, chlorophytes, chrysophytes, a pyrrophyte, rotifers, tardigrades, nematodes, protozoans and bacteria. A sharp rise was noted in all animals when the tarn melted. The ability to cryptobiose or form resistant eggs and the reproductive behavior of tardigrades and rotifers may account for their particular success in the Antarctic environment. A new species of tardigrade (Isohypsibius) is reported. Light intensity ranged from zero in winter to a maximum of 0.22 Langleys/minute during December. Water temperatures ranged from zero to 12.5 degrees C. Nutrient levels were generally similar to those of the sea and other lakes in the area. Nutrients are believed to be of marine origin and transported to the tarn via the meltstream. (Baker-FRC)
W82-04950

A STUDY OF LOW-FLOW OPERATION OF MILFORD AND ELK CITY LAKES IN KANSAS,

Kansas Water Resources Research Inst., L Manhattan.
For primary bibliographic entry see Field 2E.
W82-04964

HYDROLOGIC DESCRIPTION OF LAKE JACKSON, SEBRING, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04975

HORIZONTAL DISTRIBUTION OF CHLOROPHYLL IN THE BIELERSEE (DIE HORIZONTALE VERTEILUNG VON CHLOROPHYLL IM BIELERSEE),

Bern Univ. (Switzerland). Zoologisches Inst.
J. V. Orelli.
Schweizerische Zeitschrift fur Hydrologie, Vol 43, No 1, p 168-175, 1981. 4 Fig, 2 Tab, 6 Ref. English Summary.

Descriptors: *Chlorophyll, *Primary productivity, *Lakes, Algae, Eutrophication, Population dynamics, Limnology, Mathematical studies, Sampling, Variation coefficient, *Bielersee.

One goal of current studies in the Bielersee is that of reliably estimating primary production. The morphology of the lake and the effects of the principal influents imply that samples taken at one point may not be representative. Therefore samples were collected at 0.10 m depth at 15 different points throughout the lake body and analyzed for chlorophyll content. The time-averaged chlorophyll content for the different sites varied from a value of 10.8 mg/cu m with a coefficient of variation of about 50%. No explanation was apparent for the two extremal time averages of 13.2 and 8.8 mg/cu m at two sampling sites. The variation coefficient for the mean chlorophyll contents at all the sampling sites on 14 different dates between April and October 1977 averaged 32%. A clear explanation for the time variation was apparent in the phytoplankton growth stages, which did not occur synchronously throughout the lake. However, the variation between the values at individual sampling sites on individual dates was considerable, and therefore a single value can scarcely be considered representative for the entire lake. The correlations between the 14 measurements at a given site and the values at other sites were analyzed to see whether on site could be selected as optimally representative. In general, the sites near the lake center were most representative. For a reliable representation of algal biomass and primary prductivity throughout the year, it is more suitable to perform frequent measurements at a single site than less frequent measurements at various sites. (Carroll-FRC)
W82-05007

A BUDGET MODEL ACCOUNTING FOR THE POSITIONAL AVAILABILITY OF PHOSPHORUS IN LAKES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W82-05018

SESTON OF THE KREMENCHUG RESERVOIR AND QUANTITATIVE PROPORTIONS OF ITS COMPONENTS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. D. Priimachenko, L. E. Mikhailenko, S. L. Gusynskaya, Y. L. Fuksman, and L. I. Pshenichnaya.
Water Resources, Vol 8, No 2, p 186-195, March-April, 1981. 1 Fig, 5 Tab, 14 Ref. Translated from Vodnye Resursy, No 2, p 134-143, March-April, 1981.

Descriptors: *Seston, *Trophic level, *Algae, Eutrophication, Lakes, Detritus, Invertebrates, Zooplankton, Phytoplankton, Cyanophyta, *Kremenchug Reservoir, *Russia, Seasonal variation, Organic matter, Bacteria.

Seston in Kremenchug Reservoir varied from 2 to 5000 g per cu m dry weight during 1970-72. Seasonal variations in the water column in 1972, a year of lower eutrophication, were 2.2-14.0 g per cu m in spring, 2.4-76.0 g per cu m in summer, and 1.7-13.2 g per cu m in fall. The average seston content (in g per sq m) for the entire reservoir was 52 in May, 133.5 in July, and 35.3 in October of 1972. In July 1971 the average seston concentration in a blue-green algae bloom was 550 g per sq m. In 1972 the relative amount of organic matter in the seston varied from 18 to 52% in May, from 24 to 82% in July, and from 20 to 78% in October. Values were generally higher in the lower and deeper zones than in the upper and shallower zones, as well as in areas where blue-green algae were predominant. During the 1972 vegetative period algae comprised 1.7-82.0% of the organic part of the seston; bacteria, 0.9-74.6%; and invertebrates, 0.001-8.7%. In stretches where young algae predominated, proportions of bacteria in the organic part of the seston were 1-2%. As the algae aged, the bacteria increased to 20-40%. Comparisons with data from other lakes showed that highly eutrophic lakes had 0.04-3.6% zooplankton in the seston, and mesotrophic lakes 7-9.8%. Kremenchug Reservoir had 0.04% zooplankton in a bloom zone in 1970 (whole lake area). There was a correlation between individual components of the organic matter of the seston and between the latter as a whole and its components. (Cassar-FRC)
W82-05029

THE PH HISTORY OF LAKES IN SOUTHWESTERN SWEDEN AS CALCULATED FROM THE SUBSOIL DIATOM FLORA OF THE SEDIMENTS,

Umea Univ. (Sweden). Dept. of Ecological Botany.
I. Renberg, and T. Hellberg.
Ambio, Vol 11, No 1, p 30-33, 1982. 6 Fig, 30 Ref.

Descriptors: *Lakes, *Diatoms, Monitoring, Water quality, Acidity, Acid precipitation, *Sweden, *Sediments, Lake sediments, Sedimentation, *Hydrogen ion concentration, History.

The method of Hustedt's pH-system has been improved and applied in elucidating the pH history of some acidified lakes in southwest Sweden. The lakes studied included Gardajon, Harsvatten, and Lysevatten, all situated about 10 km east and sooutheast of Stenungsund in Bohuslan. The soil in the region is thin, with frequent outcrops of bedrock. The drainage basins of the lakes are forested. Lake shores shelve rather steeply in many places, and the marginal belt of macrophytic vegetation is generally sparse. The composition of the diatom spectrum in a sediment sample depends on the pH of the lake water at the time the sediment was laid down. Diatom samples from the lowermost part of the long sediment core from Gardajon, representing the transitional zone between the mineral sediments of glacial origin and the true lake sediment, were dominated by a periphytic and relatively acidophilous flora, with many valves of Nitzschia and Fragilaria species. No marine species were found. Six to seven centimeters below the sediment surfaces there was the start of a drastic change in the diatom flora. These lakes came into existence after the deglaciation of the region about 12,500 years ago. The minerogenic sediment in the lowest samples of the long core from Gardsjon was deposited during the final stage of that period. The diatoms in these sediment samples are peryphytic species, many of which are classified as acidophilous, and which are derived both from the lake basin and from the streams and various shallow water bodies. After its formation the lake was more eutrophic than it was later on, and its pH was just below 7. Lakes in Sweden then became more and more oligotrophic and acidic. A sudden fall in pH from 6 to 4.5 during the last few decades, probably due to precipitation falling on the region, has changed the diatom flora dramatically. (Baker-FRC)
W82-05034

SURFACE HEAT FLUXES FROM LAKE ONTARIO: FURTHER VERIFICATION OF LAKE THERMAL MODEL,

Little (Arthur D.), Inc., Cambridge, MA.
W. A. Tucker.
Water Resources Research, Vol 18, No 1, p 77-82, February, 1982. 5 Fig, 2 Tab, 16 Ref.

Descriptors: *Heat transfer, *Evaporation, Lakes, *Lake Ontario, *Model studies, Cloud cover, Heat flow, Stratified lakes, Thermal properties.

A one-dimensional heat transfer/thermal structure model was used to estimate the components of heat flux at the surface of Lake Ontario during July-October 1972. Model inputs were lake geometry, water optical properties, and surface weather observations. Comparisons of the heat flux components with estimates obtained from observations showed that the next flux was accurately predicted by the model, but the radiative input to the lake was significantly overestimated. This error was a result of a deficiency in the expression accounting for the effect of cloud cover on insolation. Errors in sensible and latent heat fluxes were compensating, producing an accurate value for net heat flux. Evaportation rates predicted by the model were 50% higher than an average of estimates obtained using seven other methods. (Cassar-FRC)
W82-05048

METABOLIC ACTIVITY OF HERBIVOROUS ZOOPLANKTON IN LAKE KINNERET (ISRAEL) DURING 1972-1977,

Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen.
Journal of Plankton Research, Vol 3, No 1, p 15-24, 1981. 5 Fig, 5 Tab, 19 Ref.

Descriptors: *Zooplankton, *Lakes, *Biomass, *Metabolism, *Food chains, Grazing, Water temperature, Aquatic productivity, Aquatic populations, Respiration, Aquatic animals, *Lake Kinneret, *Israel.

The metabolic activities of the herbivorous grazer zooplankton community in Lake Kinneret, Israel were studied from 1972 to 1977. For most years, two peaks for metabolic activity were found: the first in May-June and the second in October-November. Two distinct metabolic periods were found during the entire study period, namely from January 1972 to June 1974 and from June 1974 to December 1976. In 1974-1975, there was a significant increase in the sardine (Mirogrex terraesanctae-terraesanctae) population. The herbivore communities were reduced by Mirogrex during June 1974-1976. The high summer temperatures of the epilimnic water caused increased respiration rates from July through November. The late summer-early fall peak of zooplankton biomass is probably due to a slowing of Mirogrex feeding or an increase in water temperature. Seasonal cumulative food consumption, respiration, productivity, and defecation values for 1975-1977 were lower than 1972-1974 values. The highest defecation activity occurred during April-June when a high level of inedible material was present in the lake. No significant increases in relative and absolute densities of larval stages were found in 1975-1977 compared to 1972-1974. It was likely that the grazed food increased in nutritional value between 1974 and 1975. (Geiger-FRC)
W82-05074

NUTRIENT DISTRIBUTION IN NORTH GERMAN LAKE SEDIMENTS AND REMARKS ON SEDIMENT-PELAGIC EXCHANGE (DIE NAHRSTOFFVERTEILUNG IN SEDIMENTEN NORDDEUTSCHER SEEN UND HINWEISE AUF DEN AUSTAUSCH SEDIMENT-PELAGIAL),

Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geookologie.
G. Mothes.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 35-46, 1980. 6 Fig, 1 Tab, 10 Ref. (No English summary).

Descriptors: *Lake sediments, *Cycling nutrients, *Lakes, Limnology, *Germany, Phosphorus, Eutrophication, Productivity, Nutrients, Sediments, Chemical composition, Stagnant water.

As part of a large-scale research program on material dynamics in lakes and wetlands of North Germany (centered on Stechlin Lake), investigations were conducted on nutrient distribution and transfer in lake sediments. Sediments are closely involved in the questions of nutrient resupply for primary production, persistence of sedimented seston, and stability of water bodies relative to environmental events. Sediment samples were collected at maximum depths from lakes Stechlin, Nehmitz (north and south basins), Grosse Fuchskuhle, Dagow, Jabel (central and northern basins) and Globsow. These lakes represented oligotrophic and eutrophic, low and high productivity, and overfertilized types. Fractions of dry matter, ash mass, calcium carbonate, carbon, nitrogen, phosphorus and silica in the sediments were analyzed. The phosphorus distribution in the sediment was found to represent the most useful indicator of lake status. In addition to total phosphorus, the ratio of phosphorus in interstitial water to particulate fraction and the ratio of orthophosphate to total phosphate in the interstitial water play an essential role. An increase in C:P ratio in an eutrophicated water body occurs during restoration, with carbon oxidation in the sediment. Because of the stabilizing effect of lake sediments, lake restoratin by cleanup of inputs or supplemental aeration takes decades to become significant, while eutrophication can occur in a few years. Specific sediment conditions for the individual lakes are discussed. (Carroll-FRC)
W82-05091

DECOMPOSITION OF UREA BY SIZE-FRACTIONATED PLANKTONIC COMMUNITY IN A EUTROPHIC RESERVOIR IN JAPAN,

Yamagata Univ. (Japan). Dept. of Chemistry.
Y. Satoh.
Hydrobiologia, Vol 83, No 1, p 153-160, 1981. 3 Fig. 3 Tab, 34 Ref.

Descriptors: *Reservoirs, *Plankton, Phytoplankton, Lakes, Bacteria, Seasonal variations, *Urea, *Biodegradation, Microbial degradation, Kinetics.

Phytoplankton is usually considered responsible for most of the urea decomposition occurring in natural waters. Free bacteria had been found to be inactive for urea decomposition in previous studies. In the present study, free bacterial populations were separated from an intact planktonic community in water of a eutrophic reservoir in Japan by filtration through Whatman GF/C glass fiber filters (mean porosity .2 micron). Urea decomposition by the free bacterial populations and the intact planktonic community was determined in six different months. The count of free heterotrophic bacteria increased during the urea decomposition experiments, but the urea concentration did not decrease. Thus, the separated free bacteria apparently did not take part in urea decomposition. On the other hand, urea was decomposed by the intact planktonic community in five out of six cases. The phytoplankton in the sixth case was hypothesized to have been in a sensecent state. Thus it appears that phytoplankton were responsible for most of the urea decomposition. Rate constants were calculated at 0.00-0.63/day with a mean value of 0.21/day, assuming that urea decomposition obeyed first-order kinetics. (Baker-FRC)
W82-05095

THE MICROFAUNA OF ALGAL MATS AND ARTIFICIAL SUBSTRATES IN SOUTHERN VICTORIA LAND LAKES OF ANTARCTICA,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
D. D. Cathey, B. C. Parker, G. M. Simmons, Jr., W. H. Yongue, Jr., and M. R. Van Brunt.
Hydrobiologia, Vol 85, No 1, p 3-15, 1981. 2 Fig, 9 Tab, 28 Ref.

Descriptors: *Cold regions, *Aquatic fauna, *Species composition, *Lakes, Iced lakes, Glacial lakes, *Antarctica, *Algal mats, Benthic fauna, Southern Victoria Land, Protozoa, Rotifers, Tardigrades, Invertebrates.

This paper reports results of the first study of the microfaunal community inhabitating the littoral and benthic zones of eight Antarctic dry valley

lakes. General taxonomic compositions were given for six lakes and detailed community composition analyses for two lakes. Four major faunal groups were identified on algal mat samples and artificial polyurethane foam substrates: protozoa, rotifers, tardigrades (Hypsibus antarcticus), and nematoes (rare and not further identified). The lakes differed in limnological properties and in distribution ofmicrofauna. Protozoans were the most diverse, with 88 taxa belonging to 40 genera identified in Lakes Fryxell and Hoare in 1978-79. The most productive lake, Fryxell, had the greatest number of protozoan taxa (55). The shallow Lake Chad also had an abundant microfaunal community in comparison with the other lakes. For the first time, dinoflagellates (Gymnodinium andd Glenodinium) were identified in this region. Since all lakes had similar temperature and light regimes, the differences in faunal composition in these remote Antarctic lakes were probably caused by the variations in physical and chemical properties of the lakes. The distribution of the fauna followed patterns similar to those seen in temperature lakes. (Cassar-FRC)
W82-05096

DIEL VARIATIONS OF CERTAIN PHYSICO-CHEMICAL PARAMETERS OF WATER IN SELECTED AQUATIC SYSTEMS,

Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy.
Hydrobiologia, Vol 85, No 3, p 201-207, 1981. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Aquatic plants, *Diel variatins, *Physicochemical properties, *Seasonal variation, Water hyacinth, Ponds, Ammonium, Nitrates, Phosphates, Bicarbonates, Carbonates, Hydrogen ion concentration, Dissolved oxygen, Eutrophic lakes, Elodea, Cattails, *Lake Apopka, *Florida, Lakes, Macrophytes, Algae, Vegetation effects, Nutrients, Water quality.

Diel variations in physical and chemical parameters were determined in waters from a drainage canal containing water hyacinth (floating plant), a water hyacinth pond, an elodea (submerged plant) pond, a cattail (emersed plant) pond, a pond without aquatic macrophytes (control), and eutrophic Lake Apopka, Florida. Parameters measured in the October, January, May, and July (1979-80) samplings were dissolved oxygen, pH, dissolved carbon dioxide, bicarbonate and carbonate alkalinity, ammonium-N, nitrate-N, phosphate-P and conductivity. Water in hyacinth ponds showed little or no diel or seasonal variation in dissolved oxygen, pH, dissolved carbon dioxide and bicarbonate alkalinity. In aquatic systems with no floating vegetation (elodea, cattail, control, and Lake Apoka) dissolved oxygen increased to a high of 5-20 micrograms per ml at midday and decreased to 2-8 micrograms per ml at night. The pH of the waters ranged from 8-9.5 during midday to 7-8 at night. In systems with no floating vegetation bicarbonate levels decreased during daylight and carbonate levels increased. An inverse relationship between carbonate and bicarbonate alkalinity was seen at night. No carbonates were detected in the water hyacinth ponds. No diel variations in N (ammonium and nitrate) or P (phosphate) were observed in any systems. (Cassar-FRC)
W82-05097

MINERAL COMPOSITION OF PHRAGMITES AUSTRALIS IN SCOTTISH LOCHS AS RELATED TO EUTROPHICATION. I. SEASONAL CHANGES IN ORGANS,

Dundee Univ. (Scotland). Dept. of Biological Sciences.
Y. B. Ho.
Hydrobiologia, Vol 85, No 3, p 227-237, 1981. 3 Fig, 7 Tab, 48 Ref.

Descriptors: *Seasonal variation, *Nutrients, *Eutrophication, *Lakes, Aquatic plants, Eutrophied lakes, Trophic level, Plant physiology, Reeds, *Scotland, Phragmitess australis, Forfr Loch, Balgavies Loch, Lowes Loch.

Levels of N, P, K, Na, Ca, Mg, and Fe in root, rhizome, stem, leaf, and panicle of the common reed (Phragmites australis) were determined monthly from March to November 1975 in 3 Scottish lakes: Forfar (very eutrophic), Balgavies (eutrophic), and Lowes (mesotrophic). Mineral levels in root, rhizone, and panicle showed no consistent seasonal changes. Aboveground organs, the leaf in particular, had higher levels of ash, N, K, Ca, and Mg than the belowground parts; the reverse was true for Na and Fe. The concentrations of N, P, K, Ca, and Mg in stem and leaf rose to a peak before they declined for the remainder of the growth period. Peaks were in April, May, June, September, or October depending on the part of the plant and the particular mineral. Plants in Forfar, the most eutrophied lake, contained significantly higher levels of tissue N, P, K, and Ca than plants from less eutrophied lakes (Cassar-FRC)
W82-05099

CHEMISTRY, PHYSICS AND EVOLUTION OF ANTARCTIC SALINE LAKES,

H. R. Burton.
Hydrobiologia, Vol 82, p 339-362, 1981. 4 Fig, 2 Tab, 206 Ref.

Descriptors: *Lakes, *Polar regions, Reviews, Nutrients, Seasonal variations, *Saline lakes, *Chemical properties, Hydrology, Evolution, Antarctic.

This review deals with Antarctic saline lakes, discussing specifically the history and evolution of coastal lakes, South Victoria land lakes, the source of water, major ions and dissolved gases present in the water, minor ions present, nutrients and organic matter, light, temperature, stability, water circulation, hydrology, and future work needed in this area. Many of the well developed characteristics of Antarctic saline lakes are related to the extreme seasonal range in solar radiation levels. These characteristics include thick and sometimes permanent ice cover which can ensure long-lasting meromixis, low water temperatures in hypersaline lakes, and usually, oligotrophy. (Baker-FRC)
W82-05100

PHOTOSYNTHETIC ACTIVITY OF PHYTOPLANKTON IN TROPICAL AFRICAN SODA LAKES,

California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack.
Hydrobiologia, Vol 81, p 72-85, 1981. 8 Fig, 9 Tab, 39 Ref.

Descriptors: *Lakes, *Plankton, *Phytoplankton, *Photosynthesis, Africa, Tropical regions, Soda lakes, *Kenya, Limnology, Diurnal variations, Chlorophyll.

A comparative analysis is presented of the variability of photosynthetic activity during an 18-month period in four Kenyan soda lakes. Three aspects of the photosynthetic activity of phytoplankton are presented: the diurnal and month-to-month changes in photosynthetic activity in two contrasting lakes; the photosynthetic rates and phytoplankton abundances in these two lakes and in additional tropical African soda lakes; and the relations among photosynthetic activity, insolation and efficiency of light utilization for tropical soda lakes. These four lakes encompass most conditions present in the soda lakes of Africa. Lakes Elmenteita and Bogoria are broad, shallow lakes lying in tectonic basins associated with fault scarps. Lakes Simbi and Sonachi occupy small, moderately deep volcanic explosion craters. All four lie in semi-arid basins of internal drainage and their levels fluctuate considerably. The biota includes few species and phytoplankton are usually the major primary producer. To appreciate fully the amplitude and patterns of variability in photosynthetic activity and to determine how ecological factors influence photosynthesis required measurements on time scales from minutes to years. Even in time intervals of only hours, days and months, significant variability was noted. Chlorophyll a concentrations measured in the study varied over 200-fold. While Lake Sonachi had a low rate of photosynthesis, Lake Simbi had exceptionally high rates. A possible explanation is the lower chlorolphyll a concentration in Lake Sonachi, which may be due to a lower rate of supply of nutrients. In general a direct correlation was noted between photosynthetic efficiency of light utilization and photosynthetic rates. (Baker-FRC)
W82-05101

LIMNOLOGICAL STUDY OF A FRESHWATER RESERVOIR, JAMWA RAMGARH (JAIPUR).

Rajasthan Univ. Jaipur (India). Dept. of Botany.
B. Gopal, P. K. Goel, K. P. Sharma, and R. K. Trivedy.
Hydrobiologia, Vol 83, No 2, p 283-294, 1981. 8 Fig, 6 Tab, 20 Ref.

Descriptors: *Limnology, *Reservoirs, Monitoring, Lakes, Water supply, Water quality, Jamwa Ramgarh, Jaipur, *India, Eutrophication, *Semiarid lands.

This paper documents some data on the human activities in the catchment area of, and limnology of a reservoir in the semiarid region of India, along with observations on the recent influences of human activities on the water quality. Jamwa reservoir was constructed by damming the river Banganga, which originates in the midst of the Aravalli ranges in district Jaipur at about 16 km northwest of Manoharpura. The reservoir has a total catchment area of 769 square kilometers which is bounded on all sides by hills of the Aravalli ranges, up to several hundred meters in height. The reservoir is triangular in shape, with maximum length of 7 km and maximum breadth of about 3.5 km. Surface area at the full level is 12.69 square kilometers. Maximum and mean depth are 18 and 4.6 meters, respectively. The reservoir harbors a rich phytoplankton flora; however, it is not rich in fauna. The reservoir is the main source of drinking water supply for the city of Jaipur, supplying about 8 million gallons per day or about 40% of the total water requirement. Forest cover is present in 19.5% of the catchment area, while 25.7% is under irrigated cultivation and the rest is either fallow land or cultivable waste land or not available for agriculture. Accelerated denudation of the vegetation around the reservoir has resulted due to increased numbers of people living there. After remaining oligotrophic during 75 years of its existence, the reservoir is now showing signs of eutrophication. The data collected will help in monitoring the future changes in water quality, an urgent need. (Baker-FRC)
W82-05102

EPILIMNETIC AND HYPOLIMNETIC SYMPTOMS OF EUTROPHICATION IN GREAT MAZURIAN LAKES, POLAND,

Warsaw Univ. (Poland). Chair of Hydrobiology.
Z. M. Gliwicz, and A. Kowalczewski.
Freshwater Biology, Vol 11, No 5, p 425-433, 1981. 5 Fig 1 Tab, 12 Ref.

Descriptors: *Lakes, *Eutrophication, *Poland, *Limnology, Lake morphology, Lake stages, *Great Mazurian Lakes, Epilimnion, Thermal stratification, Oxygen requirements.

An analysis of the long term changes in epilimnetic and hypolimnetic symptoms of eutrophication was performed on data for the Great Mazurian Lakes, a complex of connected lakes with a total area of 310 square kilometers and water flow of low intensity, directed both north and south away from the channel connecting Lake Niegocin with the northern part of the complex. An increase in the rate of eutrophication occurred, beginning in the 1950s with an intensification of agriculture, recreational development and the general expansion of towns. The values of the absolute oxygen deficit, during the analyzed period of time, ranged from 0.037 to 0.132 and from 1950 to 1077 they ranged from 0.049 to 0.132 mg oxygen/square centimeter/day, indicating the sutrophic character of all the lakes studied. For Mamry Polnocne, which is a mesotrophic lake according to SDI data, the value of the absolute oxygen deficit was 0.078-0.125, suggesting it is eutrophic in character. The Seochi disc readings converted to values of SDI show that there was a relatively rapid increase in the trophic state of the lakes studied after 1950, which is comparable with the SDI change in Lake Washington in

the same period. In spite of morphometric similarity, which is important for the intensity of internal loading, smaller lakes advanced their trophic state quicker than larger ones, as each unit of their surface was exposed to more allochthonous input from the neighboring area of their direct drainage basins and from their proportionally larger total drainage basins. Their flushing rates, higher than larger lakes, did not tend to weaken the symptoms of eutrophication. The different thermoclines in smaller vs larger lakes may also be an important factor in determining the rate of hypolimnetic eutrophication. (Baker-FRC)
W82-05103

BIOMASS AND ANNUAL PRODUCTION OF THE FRESHWATER MUSSEL ELLIPTIO COMPLANATA IN AN OLIGOTROPHIC SOFTWATER LAKE,

Cornell Univ., Ithaca, NY.
D. L. Strayer, J. J. Cole, G. E. Likens, and D. C. Busc
Freshwater Biology, Vol 11, No 5 p 435-440, 1981. 4 Fig. 1 Tab, 22 Ref.

Descriptors: *Lakes, *Ecosystems, *Biomass, Mussels, Aquatic life, Oligotrophic lakes, Trophic cycle, Oligotrophy, *Mirrow Lake, *New Hampshire.

Data on the distribution and abundance of a fresh water mussel in Mirror Lake, New Hampshire, are presented with particular reference to the importance of this mussel in the ecosystem of the lake. Mirror Lake is a small oligotrophic lake in the White Mountains. Its water is clear and soft. From July to September of 1978 and 1979 divers with SCUBA swam transects at 80 meter intervals around the entire lake, and at 40 meter intervals in regions of high clam population density. E. complanata was not abundant in Mirrow lake. It reached maximum density between 2 and 3 meter depths and was most common in gently sloping sandy areas. Only 3% of the biomass and 116% of the annual production are in the younger age-classes. It appears that E. complanata may live to be 16-18 years old in the waters. Therefore, while E. complanata population forms a considerable part of the benthic biomass between 1 and 4 meters depth, it appears to play a trivial role in the functioning of the ecosystem, with its annual production being only about 0.1% of the total macrobenthic production. (Baker-FRC)
W82-05104

DOWNCORE VARIATION IN SEDIMENT ORGANIC NITROGEN,

Case Western Reserve Univ., Cleveland, OH, Dept. of Geological Sciences
J. B. Fisher, G. Matisoff, and W. J. Lick.
Nature, Vol 296, No 5855, p 345-347, March 25, 1982. 2 Fig, 15 Ref.

Descriptors: *Nitrogen, *Sediments, *Deposition, *Lake Erie, Lakes, Sedimentology, Lake sediments, Organic compounds, Particulates, Fate of pollutants, *Core sampling, *Temporal distribution.

A procedure for calculating historical depositional flux (loading record) is given for a substance which undergoes post-depositional chemical reaction in a compacting sediment column. Lake Erie sediments were analyzed for organic nitrogen, whose vertical distribution depends solely on the depositional flux of particulate organic nitrogen and the post-depositional rate of microbial decomposition. Net ammonium production was used as a measure of the destruction of particulate organic N. As a result, the rates are minimal, not including possible conversion to other N species. Results indicate that the loading of organic N to the sediments at this locality increased since 1950. The flux of particulate organic N was 0.165 mol per sq m per year in 1820-60 and 0.285 mol per sq m per year in 1974-77, giving a ratio of anthropogenic to natural loading of 0.73. Inclusion of the decomposition factor in calculations of N loading produces lower ratios of apparent anthropogenic contributions of N than obtained in previous work. This method may also be applied to reactive materials such as P and C. (Cassar-FRC)
W82-05124

INITIAL MICROBIOLOGICAL RESPONSE IN LAKES TO THE MT ST HELENS ERUPTION,

Oregon State Univ., Corvallis. School of Oceanography.
J. A. Baross, C. N. Dahm, A. K. Ward, M. D. Lilley, and J. R. Sedell.
Nature (London), Vol 296, No 5852, p 49-52, March, 1982. 2 Fig, 2 Tab, 32 Ref.

Descriptors: *Lakes, *Succession, *Volcanoes, *Water pollution effects, Photosynthesis, Bacteria, Population dynamics, Denitrification. Eutrophication, Oligotrophic lakes, Anaerobic conditions, Hydrobiology, *Microbiological studies, *Mt St Helens.

Little information exists on the early stages in the establishment and succession of aquatic microbial communities and other related chemical and geochemical transformations shortly after a volcanic eruption. The chemical, microbial and hydrothermal responses of lakes affected by the May 18, 1980 eruption of Mount Saint Helens were examined 3 to 4 months after the eruption. The impacted lakes were ultraeutrophic, anaerobic and contained extensive bacterial populations, some not common to the area. By August of 1980, the extent of chemosynthetic , photosynthetic, and heterotrophic activity on the lakes was regulated by both the assimilative and dissimilative nitrogen cycles. Oxygen production by photosynthesis, denitrification and anaerobic oxidation of reduced metals, gases, and organic compounds will aid in restoring the lakes to their normal oligotrophic state.(Geiger-FRC)
W82-05125

KINETICS OF NUTRIENT AND METAL RELEASE FROM DECOMPOSING LAKE SEDIMENTS,

Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
G. Matisoff, J. B. Fisher, and P. L. McCall.
Geochimica et Cosmochimica Acta, Vol 45, No 12, p 2333-2347, December, 1981. 7 Fig, 6 Tab, 64 Ref.

Descriptors: *Lake sediments, *Decomposing organic matter, *Nutrients, *Metals, Bottom sediments, Temperature effects, Kinetics, Decomposition, Stochastic process, Model studies, Anaerobic conditions, *Lake Erie, Great Lakes.

Incubation tests with sealed sediment sections from Lake Erie were conducted to determine the rates of anaerobic decomposition for seven depth intervals at three temperatures. The interstitial waters were serially sampled over a period of about 200 days. Concentration increases of bicarbonate, phosphate, ammonium, calcium, magnesium, iron, and manganese in pore water within any given depth interval followed zero order kinetics over the sampling period and exhabited Arrhenius temperature dependency. The rates of release to the pore waters were proportional to the concentrations in the solid phases, indicating first order kinetics overall. The observed release rates decreased exponentially with depth in the sediment due to a corresponding decrease in the amount of metabolizable organic matter and acid hydrolyzable mineral phases. A model was constructed to predict the stoichiometry of the decomposing organic matter and the nature of the hydrogen buffer. The modelling indicates that 60% of the observed bicarbonate release is the direct result of organic decomposition, with the remainder due equally to the dissolution of calcium carbonate mineral phases and to the dissolution of manganese, iron, and magnesium carbonate mineral phases. Kinetic modelling of the observed production rates accurately predicted the vertical profiles of calcium, magnesium, iron, and manganese, but did not quantitatively account for all the concentration differences of carbon, nitrogen, and phosphorus, suggesting that increased depositional flux may partly account for the significant changes in concentrations of these nutrient elements in the near surface sediments. (Carroll-FRC)
W82-05139

CYANOBACTERIAL BLOOMS: CARBON AND NITROGEN LIMITATION HAVE OPPOSITE EFFECTS ON THE BUOYANCE OF OSCILLATORI,

State Univ. of New York Coll. at Purchase.
For primary bibliographic entry see Field 5C.
W82-05175

INCORPORATION OF CHEMICAL EQUILIBRIUM, PHYSICO-CHEMICAL REACTIONS AND THE SIMULATION OF INORGANIC QUALITIES IN A RESERVOIR ECOLOGIC MODEL,

Texas Univ. at Austin. Dept. of Civil Engineering.
L. W. K. Lum, N. E. Armstrong, and E. G. Fruh.
Ecological Modelling, Vol 14, No 1, p 95-123, 1981. 22 Fig, 7 Tab, 13 Ref.

Descriptors: *Simulation analysis, *Mathematical studies, *Reservoirs, *Ecology, Chemical reactions, Physicochemical properties, Water quality.

An existing ecological model, LAKECO, was modified and expanded to include physico-chemical reactions including chemical equilibrium between inorganic species and the addition of six inorganic variables that may be of significance in water supply and ecological cycles. LAKECO is a water quality reservoir model consisting of 18 variables which undergo predominantly biochemical-biological reactions. The chemical equilibrium program which was added distributes total concentrations of inorganic variables into free, complexed, and precipitate forms. The six inorganic variables added to the original 18 are calcium, magnesium, iron, silicate, sulfate, and fluorine. The physicochemical reactions incorporated into the model include precipitation and resolubilization, diffusion of ions from sediments or weathering, complexation, and adsorption of phosphorus onto calcium and iron precipitates and bottom sediments. Two original variables in LAKECO, total dissolved solids and alkalinity, were converted to nonconservative substance. Data from Lake Lyndon B. Johnson, in Texas, were used to calibrate and validate the new, expanded model. The calibration results indicated that chemical equilibrium was a proper assumption on some occasions, such as the simulation of surface phosphorus, but not in others, such as pH. Consideration of the zero-order diffusion of ions from sediments was found to be appropriate in simulating phosphate-phosphorus, ammonia nitrogen, silicate, calcium, magnesium, and iron. The new model allows good simulation of algae. (Carroll-FRC)
W82-05187

EFFECTS OF INCREASED ATMOSPHERIC C02 ON GREAT LAKES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
B. J. Eadie.
In: Workshop on Environmental and Societal Consequences of a Possible C02-Induced Climate Change, Annapolis, Maryland, April 2-6, 1979. Department of Energy Report CONF-7904143, October 1980, p 237-249. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Carbon dioxide, *Great Lakes, *Calcium carbonate, *Hydrogen ion concentration, *Water temperature, Mathematical models, Model studies, Alkalinity, Productivity, Light penetration, Nutrients, Environmental effects, Ecological effects.

Regular occurrences of green or milky water in several of the Great Lakes has been termed whiting. Seasonal whiting in Lakes Michigan, Ontario and Erie is the result of autogenic precipitation of calcite, caused by the seasonal patterns in temperature and pH. Increasing levels of atmospheric carbon dioxide will lead to laterizations in the aquatic inorganic carbon cycle. An inorganic carbon model based on known PC02 concentrations, constant alkalinity, and constant calcium was

analyzed for the effects of increasing PC02. The model was run at 5 degrees C temperature increments from 0-25 degrees C and at PC02 concentrations of 290 (representing pre-industrial concentrations), 330 (approximate current concentration), 660, 990, and 1980 parts per million. Hydrogen ion concentration will increase with increased carbon dioxide, driving the pH down by approximately 0.3 units by the time the current atmospheric carbon dioxide concentration doubles and by approximately 0.5 at three times the present concentration. At twice the present level, the ratio of the ion activity product of calcium and carbonate divided by the solubility product of calcite will have dropped to 50% of its current value, and at three atmospheres of carbon dioxide the ratio will have dropped below the critical saturation level in Erie and Ontario and be barely supersaturated in Michigan. The overall indication is that the increase in atmospheric carbon dioxide will inhibit the formation of the lakewide whiting of calcium carbonate. The ecological consequences are postulated to be increased productivity due to removal of light backscatter by calcite particles and removal of the mechanism of micronutrient absorption. (Moore-SRC)
W82-05209

THE ECOLOGY OF SOUTHERN CALIFORNIA COASTAL SALT MARSHES: A COMMUNITY PROFILE,

San Diego State Univ., CA. Dept. of Biology.
J. B. Zedler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-205717, Price codes: A06 in paper copy, A01 in microfiche. Fish and Wildlife Service Report FWS/OBS-81/54, March 1982. 119 p, 49 Fig, 19 Tab, 180 Ref.

Descriptors: *Coastal marshes, *Wetlands, *Ecology, *Marsh management, *Salt marshes, Tidal marshes, Salinity, Flooding, Productivity, Halophytes, Algae, Vegetation, Fauna, Hydrology, Tidal effects, Rainfall, Lagoons, *California.

Southern California coastal marshes are confined to narrow stream outlets along a coastline of rugged topography and continuing geological activity. Tidal sea water is the major source of moisture throughout all but the brief winter wet season. Extreme variations in intertidal soil salinities occur between years of flooding and drought. Lagoon closures cause additional variability in salinity. Freshwater input stimulates germination of most halophytes and flooding events appear to be important for establishment and expansion of species distribution. The net annual productivity of the marsh vascular plants tends to be under 1 kg/sq m/yr. The low-growing, open canopies of vascular plants allow light penetration to the soil surface and subsequent development of lush algal mats. Halophytes probably decompose before being consumed by marsh animals, therby funneling much of their carbon to microbes, while algae are grazed directly by snails, crabs, and topsmelt. Marsh vegetation provides a refuge and food for the native invertebrates, birds and small mammals. Much of the region's wetlands acreage has been destroyed. Management problems include continuing development, reduced tidal circulation, depauperate species lists, and the need to create marsh communities on newly exposed substrates. (Moore-SRC)
W82-05215

MICROBIAL ECOLOGY OF PECTIN DECOMPOSITION IN ANOXIC LAKE SEDIMENTS,

Wisconsin Univ.-Madison. Dept. of Bacteriology.
B. Schink, and J. G. Zeikus.
Journal of General Microbiology, Vol 128, Part 2, p 393-404, 1982. 5 Fig, 2 Tab, 44 Ref.

Descriptors: *Organic matter, *Decomposition, Sedimentation, Sediments, Lakes, *Lake sediments, *Eutrophication, Methanol, Acetate, Pectin, Anaerobic digestion, Bacteria, Lake Mendota, Knaack Lake, *Wisconsin.

The study was performed to characterize the decomposition of pectin and anaerobic pectinolytic population in two freshwater lake sediments and to document the metabolic interactions between prevalent pectinolytic bacteria and other sediment bacteria that account for complete anaerobic mineralization of the polymer. Lake Mendota is a moderately eutrophic, hard water lake, of glacial origin. Knaack Lake is a eutrophic, meromictic lake. The turnover times for pectin biodegradation to methane in sediments incubated at in situ temperatures were much than that observed for glucose or previously reported for acetate. The numbers of pectinolytic anaerobes varied seasonally in both sediments and were highest during the fall after sedimentation of algal blooms and/or leaf detritus. Clostridium butyricum was identified as a prevalent pectinolytic anaerobe in both lakes. In monoculture pectin fermentations, C. butyricum produced methanol, acetate, ethanol and butyrate. Growth stopped in the presence of excess energy source when the pH fell to 4.3. In co-culture pectin fermentations of C. butyricum/Methanosarcina barkeri, methanol and acetate were detected as intermediary metabolites and pectin was completely degraded to methane and carbon dioxide, the pH remaining neutral. During co-culture growth on pectin the concentration of methanogenic substrates is limited by the rate of pectin conversion and the rate of intermediary metabolite consumption. (Baker-FRC)
W82-05275

DO MODEL FOR DISCHARGES FROM DEEP IMPOUNDMENTS,

Tennessee Valley Authority, Chattanooga.
J. M. Higgins, and B. R. Kim.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 107-122, February, 1982. 6 Fig, 3 Tab, 34 Ref.

Descriptors: *Model studies, *Dissolved oxygen, *Impoundments, Reservoirs, Oxygen, Mathematical models, Turbines, Biochemical oxygen demand, Temperature effects, Thermal stratification, Seasonal variations, Deep water.

This paper presents a simple model for the annual dissolved oxygen (DO) cycle of releases from the hypolimnion of deep impoundments. This model includes mathematical formulations and rate constant for the processes of biochemical oxygen demand (BOD) decay, atmospheric reaeration, and thermal stratification. The model was used to characterize the DO cycle of releases from 17 Tennessee Valley Authority reservoirs, using three years of weekly DO and temperature data. Rate constants were estimated using the quasilinearization technique for estimating unknown parameters in a system of ordinary differential equations. The results of the study indicate that the model can reasonably simulate annual DO variations of turbine discharges from hypolimnetic waters. Since the model is a simple formulation of complex reservoir processes, it is best suited for preliminary analyses. Future applications of the model would be improved by better data on: inflow BOD and DO concentrations, in-lake BOD variations with time, internally generated BOD, and surface water temperature. The use of weekly flow rates and reservoir volumes and annual rate constant values should also improve the simulation of DO variations from year to year. (Baker-FRC)
W82-05316

HETEROTROPHIC ASSIMULATION OF PHYTOPLANKTON AS AN INTEGRAL PART OF THE SELF PURIFICATION OF NATURAL WATERS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 1A.
W82-05326

HYPANIA INVALIDA IN THE VOLGA RESEVOIRS AND HYDROBIOLOGICAL MONITORING,

N. A. Dzuban, and N. B. Slobodchikov.
Hydrobiological Journal, Vol 16, No 5, p 49-52, 1980. 1 Tab, 22 Ref.

Descriptors: *Hypania, *Reservoirs, *Fish food organisms, Benthic fauna, Invertebrates, *Volga River, *USSR, Self-purification.

Hypania invalida, a polychaete, was introduced as fish fodder into Kuybyshev Reservoir on the Volga River in 1959-67. It was first found near the Kuybyshev Dam in 1977 at a depth of 25 m on silted bottom material at 1000 specimens per sq m. In 1978 it was found at concentrations of 20 specimens per sq on sandy bottom material and 1280 specimens per sq m on silted bottom material. Many specimens were slightly larger (14 mm) than the 12 mm noted in the identification key for the region. Hypania has also been found in the Saratov River and other places in the Volga River system. The organism colonized in a downstream direction from Kuybyushev Reservoir, rather than upstream from the Volga delta, where it is indigenous. In addition to serving as a food resource for fisheries, Hypania and the related Monodacna may help to stabilize the food resources of benthophages. Studies are underway regarding the relation of Hypania to the saprobicity indices and to reservoiir self-purification processes. (Cassar-FRC)
W82-05331

SOME DATA ON THE FAUNA AND ECOLOGY OF METOPIDAE (INFUSORIA) IN KIEV RESERVOIR,

A. A. Koval'chuk.
Hydrobiological Journal, Vol 16, No 5, p 38-44, 1980. 2 Fig, 1 Tab, 34 Ref.

Descriptors: *Species composition, *Lake sediments, *Benthic fauna, Sediments, Reservoirs, Infusoria, Metopids, Invertebrates, *Kiev Reservoir, *USSR.

The composition of the metopid population in Kiev Reservoir indicated that the reservoir is in a satisfactory sanitary state. Altogether 28 species of metopids, 11 of them new to the USSR, were found in 1977-79. The abundance of M. spinosus was greatest in July-September, when water was warmest. A new species, M. tortus pulcher var. tortus, was noted. A new variant was M. setifer var. ovata, and two new forms were M. liminarius f. minima (small and lacking elongated cilia at the posterior) and Brachonella undulans f. tetracilliata (small, truncated posterior and few caudal cilia). The numbers and diversity of these species depend on water quality factors, especially food and temperature factors, but also trace element levels. The metopids are tolerant of hydrogen sulfide. The fact that metopids were not dominant in any instance investigated in associations of Infusoria confirms the satisfactory water quality conditions in this reservoir. (Cassar-FRC)
W82-05332

STATE-OF-THE-ART OF MODELING SURFACE WATER IMPOUNDMENTS,

Nevada Univ. System, Reno. Water Resources Center.
P. A. Krenkel, and R. H. French.
Water Science and Technology, Vol 14, No 1/2, p 241-261, 1982. 8 Fig, 5 Tab, 43 Ref.

Descriptors: *Model studies, *Water quality, *Reservoirs, Lakes, Mathematical models, Hydrodynamics, Water circulation, Aquatic life, Phosphorus, Algae, Dissolved oxygen, Nitrates, Phytoplankton, Ammonia, Zooplankton, Mixing.

Modeling of surface water impoundments, which began in 1920, received impetus in the 1960's from the development of large computers and from the growing awareness of the environment. Since then, reservoir modeling has reached a sophisticated level. One-, two-, and three-dimensional models with many water quality parameters are available. Although the hydrodynamic aspects of the models are reasonably satisfactory, the water quality parameters need further development. In general, models which have been formulated by biologists tend to ignore or simplify the importance of water circulation and mixing, whereas models developed by engineers slight the biological subtleties. The best water quality model lies between the two extremes. When only a few parameters are of interest, simple models may be used in place of complicated, general models. Although most models apply to the pelagic zone, the public is generally interested in the littoral zone, which has

not been subjected to modeling. At this stage in model development the knowledge of physical and biological systems lags behind computer capability. (Cassar-FRC)
W82-05351

THE STRUCTURE OF CRUSTACEAN ZOOPLANKTON COMMUNITIES IN GLACIATED EASTERN NORTH AMERICA,

Guelph Univ., (Ontario). Dept. of Zoology.
J. C. Roff, W. G. Sprules, J. C. H. Carter, and M. J. Dadswell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1428-1437, November, 1981. 2 Fig, 7 Tab, 38 Ref.

Descriptors: *Glacial lakes, *Zooplankton, *Population dyasmics, Lake classification, *Crustaceans, *Species composition, Species diversity, Geology, Regional analysis, North America, Eastern North America.

Since recent studies of the relationship between the structure of freshwater zooplankton communities and physicochemical features of lakes in North America have been made in restricted geographical areas of rather homogeneous character, it has not been possible to determine whether or not species associations tend to vary among regions. Data from 522 lakes of glaciated eastern North America were examined to determine what species coexist and in what combinations and to study possible reasons for the observed patterns of existence. Glacial influence was found to be the primary determinant of zooplankton community structure in these lakes. Use of this criterion resulted in successful discrimination of 82% of the lakes between glacial lakes, to which Diaptomus sicilis, Limnocalanus macrurus, Mysis relicta, and Senecella calanoides were restricted, and nonglacial lakes, of which Cyclops scutifer, Eubosmina longispina, Daphnia pulex, D. catawba, and other species were characteristic. A third large group of common species was distributed throughout the study area with no particular relation to glacial lake influence. There were no clear patterns in community structure with respect to size of zooplankters. Most of the species distributions or abundances were not consistent with the well-known predatory and competitive interactions among zooplankters typical of small lakes and ponds. It is suggested that this resulted partly from the use of large and heterogeneous study area and partly because the biological interactions observed in small lakes and ponds may be less intense in the more physically complex environment of large lakes. (Carroll-FRC)
W82-05379

THE CHEMISTRY OF SUSPENDED MATTER IN ESTHWAITE WATER, A BIOLOGICALLY PRODUCTION LAKE WITH SEASONALLY ANOXIC HYPOLIMNION,

Edinburgh Univ. (Scotland). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W82-05416

THE ROLE OF AGRICULTURAL SEDIMENTS AND CHEMICALS IN EUTROPHICATION,

Iowa State Univ., Ames. Dept. of Animal Ecology.
R. W. Bachmann.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2425-2431, 2600, October, 1980. 2 Tab, 28 Ref.

Descriptors: *Eutrophication, *Lakes, Rivers, Nutrients, Model studies, Reviews, Environmental effects, Limnology, Lake stages, Lakes, *Chemical composition, *Agricultural runoff, *Sediments.

Basin concepts are reviewed concerning the trophic state of lakes, the eutrophication process, and the role of point and nonpoint sources of nutrients and sediments. The need for specific research on the effectiveness of nonpoint pollution controls is presented. Oligotrophic is the classification applied to those lakes with the smallest concentrations of plant nutrients and the least biological productivity. Eutrophic lakes such as Lake Mendota in Wisconsin have high levels of plant nutrients and high levels of biological productivity. The term mesotrophic is sometimes applied to lakes intermediate between oligotrophic and eutrophic, while ultraoligotrophic and hypereutrophic are sometimes used for lake on the extreme ends of the scale. While many lakes were originally oligotrophic, they have become eutrophic over the years. Lakes influenced by human activity have undergone eutrophication in the period of a few decades, much quicker than lakes out of the reach of man's influence. The high levels of algae in eutrophic lakes make the cost of treatment to obtain desired water quality from the lake much higher. Phosphorus is extremely important in lake restoration programs, not only because it is important as a limiting nutrient, but also because of its chemical nature. Point sources have been responsible for the most publicized cases of cultural eutrophication such as Lake Zurich, Lake Erie and Lake Washington. There are additional problems with lakes that have been heavily loaded for periods of time. Flowing water systems are much more difficult to deal with than lakes. There is little accumulation of nutrients over time as the water is continually moving through the system. Different types of models are used for lakes and rivers. (Baker-FRC)
W82-05447

INTERRELATIONSHIPS IN THE DEVELOPMENT OF THE THREE STRUCTURAL COMPONENTS OF THE PLANKTON IN THE OFF-BOTTOM ZONE OF LAKES,

Belorussian State Univ., Minsk (USSR).
V. A. Babitskiy, T. M. Mikheyeva, and G. A. Inkina.
Hydrobiological Journal, Vol 17, No 1, p 8-14, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Lakes, *Phytoplankton, *Zooplankton, *Bacterioplankton, Biomass, Nutrients, Temperature effects, Plankton, Lake beds, *Trophic level, Population dynamics, Limiting factors, Bottom water, Mesotrophic lakes, Eutrophic lakes, Comparison studies, *USSR.

A study was made of zooplankton, phytoplankton and bacterioplankton in a thin zone close to the bottom of the mesotrophic Lake Naroch, the eutrophic Lake Myastro and the highly eutrophic Lake Batorin. Research was conducted in the lakes from May 1970 to May 1971. The mean abundance of all groups of the plankton increased in a regular manner from the mesotrophic Lake Naroch to the highly eutrophic Lake Batorin. Research was conducted in the lakes from May 1970 to May 1971. The mean abundance of all groups of the plankton increased in a regular manner from the mesotrophic Lake Naroch to the highly eutrophic Lake Batorin. The same species were dominant in the zooplankton of all the lakes. Blue-green algae were less abundant in the zone near the bottom of Lakes Naroch and Myastro than in the pelagic zone. In Lake Batorin the bulk of the phytoplankton biomass in the zone near the bottom was largely Ceratium and blue-green algae, but in the pelagic zone exclusively blue-green algae. Throughout the study the biomass of fodder phytoplankton in Lakes Naroch and Myastro altered only slightly, invariably remaining at a fairly low level. The biomass of the filter feeders was higher over the vegetation season than that of fodder phytoplankton, and in Lake Myastro was also higher than that of bacterioplankton. The low biomass values of fodder phytoplankton and their slight fluctuations in Lakes Naroch and Myastro confirm the previous suggestion that interrelationships between the zooplankton and its food are evidently strained in the zone near the bottom of the lakes. Detritus must play an appreciable role in the consumption of the zooplankton of these areas. The temperature factor has appreciably influenced the development of first-order and second order consumers of fodder phytoplankton, and of bacterioplankton in Lake Myastro. Food may not be a limiting factor in the development of planktonic filter feeders in highly eutrophic lakes. (Baker-FRC)
W82-05451

AN ELECTRON MICROSCOPIC STUDY OF THE FORMS OF BACTERIA IN THE SURFACE FILM OF THE WATER,

Akademiya Nauk SSSR, Moscow. Inst. Biologii Vnutrennykh Vod.
Ye. A. Lepilova, and V. A. Gavrilova.
Hydrobiological Journal, Vol 17, No 1, p 27-30, 1981. 2 Fig, 7 Ref.

Descriptors: *Reservoirs, *Bacteria, *Surface water, Lakes, Water quality, Seasonal variations, *Microbiological studies, Air-water interfaces, *USSR.

A method is presented for producing bacterial preparations for electron microscopy studies by placing electron microscope grids in the surface film of the water to pick up fouling. This method was used to study the microflora of the surface film. Research was carried out at the Rybinsk Reservoir in May, August and September of 1978. Water samples were taken at six stations in the open part of the reservoir and in the inshore zone. The studies showed that the bulk of the bacteria in the surface film of the water, both in the inshore zone and in the open part of the reservoir, and rod-shaped bacteria and cocci, members of the genus Caulobacter. Rod-shaped forms constitute the overwhelming majority in the surface film in all experiments. Most often they are in clusters, sometimes joined into chains, but solitary forms are also encountered. Rare species were more frequently found in the inshore zone than in the central part of the reservoir. Only filamentous forms were found in the open part of the reservoir. Smaller rod-shaped bacteria were sometimes parasitic on filamentous forms. The most varied microflora in the surface film of the water in the inshore zone was recorded in August, which is also the time of maximum production of organic matter through the photosynthesis of algae. (Baker-FRC)
W82-05452

THE FORMATION OF WATER QUALITY IN THE SHALLOWS OF A SOUTHERN RESERVOIR (DNIEPER-KRIVOI ROG CANAL) UNDER THE INFLUENCE OF BEDS OF HIGHER AQUATIC VEGETATION,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. B. Korsak, and V. K. Myakushko.
Hydrobiological Journal, Vol 17, No 1, p 37-42, 1981. 2 Tab, 17 Ref.

Descriptors: *Water quality, *Reservoirs, Lakes, Aquatic plants, Biomass, Seasonal variation, *Yuzhnoye Reservoir, USSR.

Changes in water quality were investigated in the Dnieper-Krivoi Rog Canal reservoir, called the Yuzhnoye. The reservoir has a water area of 11.03 square kilometers, a volume of 57.3 million cubic meters, and a mean depth of 5.2 meters, with a maximum depth of 26 meters. Aerial-aquatic plants play the major role both in overgrowth and in the formation of primary production. The effect of higher water plants on water quality was investigated. The water quality in the shallows of Yuzhonoye Reservoir extensively involved higher water plants and was dependent on the composition of the communities, their productivity, the stage of phenological development of the plants and the extent of the flow through the overgrown areas. The most favorable hydrochemical conditions during the period of study were noted in the highly productive beds of aerial-aquatic vegetation, through which there was no flow. When macrophyte production was moderate and flow through the shallows was adequate, water quality in the communities of aerial-aquatic vegetation did not alter appreciably, and in the summer was often better than in the open areas. The effect of the submerged vegetation on the hydrochemical regime of the shallows during the vegetation period was generally positive, with the oxygen saturation of the water in the weed beds reaching 135%, the content of dissolved biogenic matter being lower than in the plant-free areas as a result of its active consumption by plants, the concentration of organic compounds not exceeding the standards for maximum permissible concentrations, and partial decalcination of the water in a number of instances in the absence of carbon dioxide and high pH values. (Baker-FRC)
W82-05453

PLANKTONIC INFUSORIA AS INDICATORS OF THE EXTENT OF ORGANIC POLLUTION IN AZERBAIDZHANIAN RESERVOIRS,

Akademiya Nauk Azerbaidzhansjoi SSR, Baku. Inst. Zoologii.
I. K. Alekperov.
Hydrobiological Journal, Vol 17, No 1, p 57-42, 1981. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Reservoirs, *Water quality, Oxygen, Oxidation, Aquatic plants, *Plankton, Azerbaidzhanian Reservoirs, Indicators, *Organic pollution, Pollutant identification, *USSR.

An account is given of the extent of organic pollution in three Azerbaidzhanian reservoirs - the Mingechaur, Varvara and Dzheyranbatan. Date was collected seasonally from 1972 through 1974. Sixty species of Infusoria were recorded as indicators of different degrees of saprobicity in the plankton of all the reservoirs investigated. Each reservoir belonged to the beta-meso and alpha-mesosaprobic zones as regards the degree of organic pollution, as the indicators of these zones accounted for between 64 and 76% in each of them. The main reason for the heavier pollution in the upper part of the reservoir is the water of the rivers supplying it. The pollution of the Khanabad part was due to rotting organic matter accumulating in it. The upper part of the Varvara Reservoir was the cleanest part of the reservoirs examined. The inshore zone of the Varvara Reservoir was the most polluted, being used by the inhabitants for watering cattle. The number of indicator species of the alpha-meso-polysaprobic zone found here was 8%. The middle part of the Dzheyranbatan Reservoir was the cleanest part of this reservoir. Of the total of indicator Infusoria recorded in it, 78% belong to the oligo-beta-mesosaprobic zones. Indicators of the alpha-meso-polysaprobic zone were also recorded in the inshore area of these parts, in the upper part accounting for 4% of the total, in the lower part for 6%. Consequently, ecological analysis of the Infusoria of Mingechaur, Varvara and Dzheyranbatan reservoirs shows that their water belongs in the main to the mesosaprobic zone, that is, there is adequate oxygen in the water, and mineralization takes place by the total oxidation of organic matter. (Baker-FRC)
W82-05454

SALT AND TRACE ELEMENT COMPOSITION OF THE WATER OF LAKE MALINOVOYE (ALTAI TERRITORY); AS A HABITAT OF ARTEMIA SALINA,

Lvov Univ., (USSR).
N. S. Yalynskaya, and I. V. Strubitskiy.
Hydrobiological Journal, Vol 17, No 1, p 73-77, 1981. 2 Tab, 23 Ref.

Descriptors: *Chemical composition, *Lakes, Aquatic life, Crustaceans, *Salinity, Sodium chloride, Magnesium, Sediment, *Lake Malinovoye, *Trace elements, Aquatic environment, Water quality, Water analysis, Biological samples, Sediment samples, *USSR.

Samples of water, bottom material and specimens of Artemia salina were collected from Lake Malinovoye during July of 1978 and 1979. The water was quite highly saline, with the principal salt being sodium chloride. The water was shown to contain 20 components, the bottom material 26. Artemia was represented by four physiological groups in the samples from the lake. Females molting with undiscarded exuviae, females between the period of molts and oviferous, sexually mature females in the period between molts without eggs, and mature molted females with soft integuments made up the four groups. The morphological structures responsible for maintaining the water and salt balance are manifested in response to the distinctive ionic-salt composition of the habitat of the halobiont Artemia salina. Under the conditions of Lake Malinovoye, the development and growth of Artemia salina took place with a small quantity of calcium cation and in the absence of the salt, calcium carbonate. As in other water bodies, A. salina in Lake Malinovoye needed sodium chloride as its principal salt. Magnesium was apparently a vitally important ion for Artemia salina. (Baker-FRC)
W82-05455

MUTUAL FLOCCULATION OF ALGAE AND CLAY: EVIDENCE AND IMPLICATIONS,

Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
Y. Avnimelech, B. W. Troeger, and L. W. Reed.
Science, Vol 216, No 4541, p 63-65, April 2, 1982. 2 Fig, 14 Footnotes.

Descriptors: *Flocculation, *Algae, *Clays, Aggregates, Turbidity, Anabaena, Chlorella, Chlamydomonas, Sedimentation, Clarification, Lakes, Water quality management.

Algae-clay aggregates were formed in the presence of a critical concentration of electrolyte, 0.005 M for CaC12 and 0.02 M for NaCl. Algae were not flocculated in the absence of clay under the conditions studied. Flocculation patterns of the algae were biphasic. In the first phase (at the lower clay concentrations) increasing the clay concentrations sharply increased the degree of flocculation. Further increases in clay concentration after a certain point produced little additional flocculation. The maximum ratios of clay to algae in the particles were 1.7, 0.2, and 0.03 (wet weight) for Anabaena, Chlamydomonas, and Chlorella, respectively. Eglena gracilis had little tendency to flocculate. The variability in flocculating potential among the different algae is probably affected by composition and properties of the cell wall, extent and type of secretions, physiological conditions, and age. Algal-clay flocculation may be useful in water quality management. For example, turbid water could be clarified by promoting algal growth, or algal-rich water could be clarified by addition of clay to the water. Sedimentation of algae leads to a downward displacement of nutrients. Filter feeders such as silver carp can only use particles larger than 20-50 microns; therefore, algae too small to be trapped may be used if aggregated with clay. (Cassar-FRC)
W82-05460

BIOASSAYS AND THE ALGAL POPULATIONS OF HASTINGS LAKE, ALBERTA, CANADA,

Zurich Univ. (Switzerland). Hydrobiology-Limnology Station.
F. Schanz.
Water Research, Vol 16, No 4, p 441-447, April, 1982. 4 Fig, 2 Tab, 42 Ref.

Descriptors: *Bioassay, *Biomass, *Algal growth, *Anabaena, *Eutrophic lakes, *Limiting nutrients, Eutrophication, Cyanophyta, Lakes, Iron, Phosphorus, Nutrients, Temperature, Weather, Aquatic populations, Species composition.

A set of experiments was carried out to investigate the success of introducing Anaebaena clones into untreated waters of Hastings Lake, Alberta, Canada to establish this species as the dominant indigenous plankton population. Experiments were carried out in the summer of 1978 on the biomass development of the eutrophic lake, and bioassays were performed on untreated water, water inoculated with Anabaena flos-aquae, and filtered or autoclaved water. Bioassays on untreated Hastings Lake water showed good correlations with the biomass developments in the lake. Nutrient levels were assessed by bioassays with unialgal cultures in filtered or autoclaved water samples. During the summer months, iron and/or phosphorus seemed to be important limiting nutrients for algal growth in Hastings Lake. Results of competition experiments failed to render conclusive information upon which to base predictions about the future development of Anabaena on the lake. Some effects of weather on algal production are discussed. (Geiger-FRC)
W82-05484

INDOLES IN THE DECOMPOSITION PRODUCTS OF CERTAIN BLUE-GREEN ALGAE,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. V. Arendarchuk.
Hydrobiological Journal, Vol 17, No 1, p 50-53, 1981. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Algae, *Decomposition, Eutrophication, Degradation, Indoles, Lakes, Dissolved solids, Seston.

An attempt was made to elucidate the dynamics of the concentration of indole compounds and to identify such compounds in the decomposition products of seston collected in a water body during the mass bloom of blue-green algae. The research was conducted on seston consisting as to 80-90% of Microcystis aeruginosa and Aphanizomenon flos-aquae. The content of indoles in the water increased following the decomposition of the organic matter of dying cells of blue-green algae to a certain level, after which it declined as a result of mineralization. Temperature had an appreciable effect on the decomposition of the algal mass and the formation of indole-containing compounds. Chromatographic separation of the decomposition products of the algal mass showed that various substances entered the water in appreciable amounts. Among the decomposition products of the algal mass were found two indole compounds and one phenol compound. One of the indole compounds found on the chromatograms was verified, it was established that zones corresponding to indole compounds stimulated the growth of wheat coleoptiles. The maximum stimulation was given by the indole-acetic acid zone. The zone corresponding to the phenol compound inhibited growth. Consequently, phenol and indole compounds entered the water on the death and post mortem decomposition of the organic matter of the blue-green algae that cause the algal bloom. These compounds have a growth-stimulating activity. (Baker-FRC)
W82-05505

THE IMPORTANCE OF LACUSTRINE ZOOPLANKTON TO THE FEEDING CAPACITY OF THE LIZHMA LAKE-RIVER SYSTEM (BASIN OF LAKE ONEGA).

Akademiya Nauk USSR, Petrozavodsk. Inst. of Biology.
A. N. Kruglova.
Hydrobiological Journal, Vol 17, No 1, p 15-20, 1981. 4 Fig, 2 Tab, 24 Ref.

Descriptors: *Lakes, *Zooplankton, Rivers, Lake Kedra, Kedra River, Lake Tarasm, Fish food, Plankton, Biomass, Aquatic fauna.

The object of this study was to establish the part played by zooplankton carried out of lakes in providing food resources for the spawning and growing reaches of salmon rivers. Research was carried out in the lower reach of the Lizhma, covering 4.3 km from its outflow from Lake Kedra to the mouth, location of the main spawning grounds of valuable food fishes such as salmon, whitefish, and trout. Observations and data were collected during the open water period of May through October in the years 1972 and 1973 and every 10 days at 6 permanent stations during 1976 and 1977. A total of 78 species of plankton organisms were found in the investigated part of the Lizhma River. There were more crustaceans and Rotatoria, members of the weekbedbank complex, in the plankton of the river reaches than in the lake reached. These species are particularly plentiful in calm reaches of the river with developed aquatic vegetation. The potamoplankton in the Lizhma River mostly originate from the lakes. The main sources for the development of the plankton are Lake Kedra and Lake Tarasm. The plankton fauna of the river rapids consist mainly of Rotatoria, the smaller Copepods, and some species of Cladocera. The species and quantitative indices of the zooplankton vary with distance from the outflow from the lakes. The parts of lake-river system below the lakes are the most productive. An appreciable amount of plankton is carried out of Lake Kedra and lake Tarasm. The plankton flow is greatest in the main in the summer months. Zooplankton carried out of the lakes is utilized by juvenile fishes and benthic invertebrates, and helps to increase the density of the drift, the main food for juvenile salmon. (Baker-FRC)
W82-05508

Group 2H—Lakes

TRANSPORT PROCESSES OF COPPER AND ZINC IN A HIGHLY EUTROPHIC AND MEROMICTIC LAKE,

Eidgenoessische Anstalt fuer Wasservorgung, Abwasserreinigung und Gewaesserschutz, Kastienbaum (Switzerland). Lake Research Lab.
For primary bibliographic entry see Field 5B.
W82-05518

EVALUATION OF FOURTEEN TROPHIC STATE INDICES FOR PHYTOPLANKTON OF INDIANA LAKES AND RESERVOIRS,

Notre Dame Univ., IN. Dept. of Biology.
P. F. Sullivan, and S. R. Carpenter.
Environmental Pollution, Series A, Vol 27, No 2, p 143-153, February, 1982. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Lakes, *Phytoplankton, *Reservoirs, *Trophic level, Water quality, Water analysis, Lake classification, Algal growth, Eutrophication, Plankton, Indiana, Statistical analysis, Diversity indices, Species diversity.

Principal components analysis (PCA) was used to examine the relationships of fourteen phytoplankton trophic state indices to forty-two samples from Indiona lakes and reservoirs. The goals of the study were to determine which groups of indices were redundant and which indices were most diagnostic of the various classes of sample that emerged from the PCA. Twenty-seven Indiana lakes and reservoirs, each downstream of a sewage treatment plant outfall, were sampled in the spring, summer and autumn of 1973. The results indicated that diversity indices were not useful of trophic classification, as they are not monotonically related to degree of eutrophication and require more data for their calculation than other indices. Nygaard's indices were often undefined, and therefore unusable, because the denominator was zero. Palmer's genus index was more sensitive to differences among samples than Palmer's species index. Of the indices examined, two were relatively useful - Palmer's genus index, which reflects the abundance of eutrophic indicator genera, and the concentration of the most abundant taxon, which is sensitive to bloom samples. (Baker-FRC)
W82-05579

EFFECT OF THE SPRING FLOOD REGIME ON THE DEVELOPMENT OF NORTH CASPIAN ZOOBENTHOS,

Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
For primary bibliographic entry see Field 2E.
W32-05596

MICROSCALE PATCHINESS OF NUTRIENTS IN PLANKTON COMMUNITIES,

Michigan Univ., Ann Arbor.
J. T. Lehman, and D. Acavia.
Science, Vol 216, No 4547, p 729-730, May 14, 1982. 1 Tab, 15 Footnotes.

Descriptors: *Nutrients, *Algae, *Population dynamics, Phosphorus, Plankton, Phytoplankton, Zooplankton, Daphnia, Chlamydomonas, Lakes, Species composition.

Unstirred cultures containing zooplankton (Daphnia) labeled with P33 and algae (Chlamydomonas) were compared with stirred cultures by autoradiographic techniques. In the unstirred vessels, which simulated the natural microscale (mm or less) patchiness of nutrient distribution, algae augmented their cell quota of P33 as much as 12% per encounter. Apparently the nutrient patches produced by excretion of P by the zooplankton exist long enough for algae passing through to absorb more nutrients than do algae outside the patches. These conditions favor development and survival of algal types which can quickly acquire nutrients from the short-lived nutrient patches existing in otherwise nutrient-poor waters. (Cassar-FRC)
W82-05613

PRELIMINARY INVESTIGATION OF THE ALGAL FLORA IN THE SEDIMENTS OF LAKE ERIE,

State Univ., of New York Coll. at Buffalo. Great Lakes Lab.
For primary bibliographic entry see Field 5C.
W82-05633

STABILITY EFFECTS ON GREAT LAKES EVAPORATION,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2D.
W82-05634

WATER QUALITY MODELING OF LAKE MICHIGAN AND CONSIDERATION OF THE ANOMALOUS ICE COVER OF 1976-1977,

Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5B.
W82-05638

WETLANDS AND DEEPWATER HABITATS: A NEW CLASSIFICATION,

Fish and Wildlife Service, Jamestown, ND. Northern Prairie Wildlife Research Center.
For primary bibliographic entry see Field 2L.
W82-05716

SELECTING A METHOD FOR ESTIMATING SUBSTANCE LOADINGS,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 5B.
W82-05746

EFFECTS OF WATERHYACINTH ON THE PHYSICOCHEMISTRY OF A SOUTH GEORGIA POND,

Clemson Univ., SC. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-05809

AGE, SPACING AND GROWTH RATE OF TAMARIX AS AN INDICATION OF LAKE BOUNDARY FLUCTUATIONS AT SEBKHET KELBIA, TUNISIA,

University Coll., London (England). Dept. of Botany and Microbiology.
F. B. Goldsmith, and N. Smart.
Journal of Arid Environments, Vol 5, No 1, p 43-51, 1982. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Lakes, *Tamarisk, Phreatophytes, Tunisia, Saline lakes, Population densities, Floods, Boundaries, Water boundary, Sebkhet Kelbia, Wildlife habitats, Evapotranspiration.

Measurements were made of the population structure, growth rates and spacing of tamarisk in the northeast corner of Sebkhet Kelbia, a shallow evaporative lake in central Tunisia. The area chosen for intensive study is a considerable fringing zone of tamarisk; the zonation was clear. This was also near the point where outflow occurs during the large flood events. The tamarisk varied considerably in density, intensity of grazing and height, so a stratified method of sampling was employed to investigate the range of variation. The oldest bushes in the sample examined were only 8 years old. The distribution of stems between age classes approximated a normal curve with a mean aroung 1974/75 and a range of 6 years. This type of distribution would only be expected if the tamarisk were being harvested or had been destroyed in a catastrphic event such as the 1969 and 1973 floods. Since the colonization and age structure of the population postdates the 1969 and 1973 floods, it can be assumed that the areas were last inundated during these events. The annual growth rates since that time indicate a period of relative inactivity from the hydrological viewpoint, with continued shrinkage of the lake and encroachment of the fringing lake vegetation. Areas of dead Typha which mark former lake levels were being colonized by tamarisk as evidence of this encroachment. Tamarisk in the future is likely to increase in extent, and its ecological effects upon the area deserve further attention. (Baker-FRC)
W82-05877

2I. Water In Plants

WATER MANAGEMENT OF WHEAT IN HEAVY CLAY SOILS OF MADHYA PRADESH,

Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
S. S. Tomar, R. K. Gupta, and A. S. Tomar.
Indian Journal of Agricultural Sciences, Vol 51, No 7, p 493-497, July, 1981. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Water use efficiency, *Irrigation, *Crop yield, *Wheat, Clays, Irrigation efficiency, *India, Grain crops, Water management, Soil-water-plant relationships.

Wheat (Triticum aestivum-Linn. emend. Thell.) grown on heavy clay soil of central Madhya Pradesh, India, was irrigated 1 to 4 times during the growing season during a study in 1974-77. Treatments were: T1 irrigation at preemergence; T2, T1 plus 1 irrigation at crown root initiation; T3, T2 plus 1 irrigation at tillering; and T4, T3 plus 1 irrigation at flowering. The crop receiving 4 irrigations (t4) produced the highest yield of grain, 43.45 q per ha. Lowest yield was produced by treatment T1,26.70 q per ha. Water use efficiency was highest with treatment T1 (105-123 kg per ha per cm) and decreased with increasing mumber of irrigations to 97-105 kg per ha per cm for T4. This was a result of the higher residual moisture left unused in the profile and deep percolation losses. Moisture regimes of less than 40 cm in a 150 cm profile adversely affected water used by the crop. (Cassar-FRC)
W82-05119

EFFECT OF MOISTURE LEVELS IN VEGETATIVE AND REPRODUCTIVE PHASES OF WINTER-SOWN MAIZE ON GRAIN YIELD, IRRIGATION REQUIREMENT AND WATER-USE EFFICIENCY,

Rajendra Agricultural Univ., Samastipur (India).
D. P. Singh, S. D. Prasad, U. K. Prasad, and N. N. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 12, p 861-864, December, 1981. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Irrigation requirements, *Water use efficiency, *Corn, Irrigation efficiency, Soil-water-plant relationships, *India, Grain crops, Crop yield.

Maize (Zea mays Linn.) was planted in the winters of 1976-77 to 1978-79 at Dholi, India, to determine the irrigation requirements. Irrigations were scheduled when the available soil moisture (ASM) in the top 0-30 cm soil layer reached 70,50, and 30% in the vegetative and reproductive phases separately. Maximum yield of 57.3-68.8 q per ha was produced by irrigation at 70% ASM in the vegetative phase and 50 or 70% ASM in the reproductive phase. Water use efficiency increased with the drier regimes. These results suggest that the optimum irrigation regime for winter-sown maize in this region would be 5 or 6 irrigations (intervals of 30-34 days) to produce 70% ASM in the vegetative phase and 50-70% ASM in the reproductive phase. This recommendation applies for the seasonal rainfall range of 66-173 mm. (Cassar-FRC)
W82-05120

INFLUENCE OF SEASONAL EVAPORATIVE DEMAND ON EVAPOTRANSPIRATION AND YIELD OF IRRIGATED WHEAT,

Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
For primary bibliographic entry see Field 2D.
W82-05121

EFFECT OF PLANT POPULATION AND NITROGEN ON WATER-USE EFFICIENCY OF

PEARLMILLET IN THE ARID ZONE OF WESTERN RAJASTAN,
Central Arid Zone Research Inst., Jodhpur (India).
A. Krishnan, S. D. Singh, and A. S. R. A. S. Sastri.
Indian Journal of Agricultural Sciences, Vol 51, No 12, p 865-870, December, 1981. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Irrigation, *Water use efficiency, *Fertilizers, Millet, *India, Crop yield, Grain crops, Water management, Nitrogen, Arid lands, Evapotranspiration, Consumptive use, Soil-water-plant relationships.

Seasonal consumptive use by rainfed pearl miller (Pennisetum typhoides Burm. f.) was studied at 10 and 20 cm plant spacing and nitrogen additions of 0 to 120 kg per ha. The experiment was conducted during 1974, 1975, and 1977 when annual rainfall amounts in this arid region of India were 67%, 178%, and 95% of normal (366.9 mm). Seasonal consumptive uses at 10 cm spacing were 223, 253, and 247 mm at N additions of 0, 60, and 120 kg per ha, respectively. Seasonal consumptive uses at 20 cm spacing were 213, 210, and 289 mm at the same N addition regimes, respectively. Water use efficiency (in kg grain per mm evapotranspiration) was highest with 60 kg N per ha (5.38) followed by 4.83 for 120 kg per ha N, and 3.54 at no added N. Water use efficiencies for the two plant spacings were almost the same. Results of predictions of the soil moisture storage with consideration of initial soil moisture storage by the climatic water budget method (Thornthwaite and Mather, 1955) agreed well with observed values, but the conventional prediction method underestimated soil moisture storage. (Cassar-FRC)
W82-05122

DEEP DRAINAGE AND WATER USE OF FORESTS AND PASTURES GROWN ON DEEP SANDS IN A MEDITERRANEAN ENVIRONMENT,
Alcoa of Australia, Pinjarra.
For primary bibliographic entry see Field 4B.
W82-05629

MEASUREMENT AND MODELLING OF PRIMARY PRODUCTION AND WATER USE IN A SOUTH TUNISIAN STEPPE,
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.
For primary bibliographic entry see Field 2D.
W82-05876

2J. Erosion and Sedimentation

SEDIMENT TRANSPORT AND SHOALING IN ESTUARINE AND OTHER SHALLOW-WATER AREAS,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W82-04753

MODELING: HOW AND WHEN TO USE,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W82-04754

MOVEMENT OF DIFFUSE SOURCE POLLUTANTS IN SMALL AGRICULTURAL WATERSHEDS OF THE GREAT LAKES BASIN,
Michigan Agricultural Experiment Station, East Lansing.
For primary bibliographic entry see Field 5B.
W82-04856

STABLE-CHANNEL DESIGN IN GRAVEL-BED RIVERS,
Ministry of Works and Development, Christchurch (New Zealand).
For primary bibliographic entry see Field 2E.
W82-04865

STORM SEDIMENT CONCENTRATIONS AS AFFECTED BY LAND USE, HYDROLOGY, AND WEATHER,
West Virginia Univ., Morgantown. Dept. of Chemical Engineering.
F. H. Verhoff, and S. M. Yaksich.
Journal of Environmental Quality, Vol 11, No 1, p 72-78, January-March, 1982. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Sediment transport, *Storms, *Suspended sediment, Temperature effects, Seasonal variations, Erosion, Rainfall-runoff relationships, Lakes, *Lake Erie, Water pollution sources.

A study is reported of suspended sediment transport to Lake Erie. Two types of analyses are reported: time variations and hydrologic variations. The principal variable used is an average suspended sediment concenration, computed by summing the suspended sediment transported during a given time period, divided by the water discharge during the same time period. From the total phosphorus data on the Sandusky River, it is concluded that 3 or 4 years of data are not sufficient to determine the effect of point source abatement in an agricultural watershed. Hydrology and weather are the major factors affecting the storm average suspended sediment concentration in the Maumee River at Waterville. Important variables are maximum discharge during the storm, storm duration, water temperature and high wind average for the days since the previous storm. Raindrop impact and rain energy do not explain the variation in the suspended sediment concentration at Waterville on the Maumee River. Maximum dischage has a positive influence on storm average suspended sediment concentration because higher velocities are able to carry greater concentrations of sediment. Storm duration is significant in a negative way on concentration because longer storms tend to have declining stages during which the suspended sediment concentration is lower. Water temperature's positive influence may be due to microbial activity in the river bottoms. The dependency of the average storm suspended sediment concentration on the maximum discharge is nearly the same for all seasons of the year. (Baker-FRC)
W82-04878

THE INFLUENCE OF WATER SALINITY ON PALUDAL EROSION PROCESSES,
New Orleans Univ., LA. Dept. of Geography.
N. L. Froomer.
Journal of Geology, Vol 90, No 2, p 179-185, March, 1982. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Salinity, *Soil erosion, Water quality, River banks, *Mississippi River Delta, Geology, Marshes, Aquatic plants, *Environmental effects, *Salt marshes.

This paper investigates the influence of water salinity on marsh erosion processes. Laboratory experiments were constructed to determine the influence of water salinity on the erodibility of three different coastal marsh soils from the Lake Pontchartrain-Lake Borgne area of southeastern Louisiana. Site 1 was located in a brackish environment where vegetation is dominated by the grass Spartina alterniflora, producing a coarse but interconnected underground matrix of large diameter roots and rhizomes. Site 2 was in a slightly brackish environment near the mouth of Bayou Lacombe with Spartina patens dominating the vegetation, producing a tightly interwoven underground matrix of thin, fibrous rhizomes. The third site was in a slightly brackish to fresh environment with spartina cynosuerdes vegetation, which does not produce an underground framework of interconnected rhizomes. Although the influence of salinity varied in different soils, erodibility generally decreased as the water salinity was increased from 0 to 10%. The field evidence from the Mississippi River delta indicates that most rapid erosion occurred where and when water salinity was lowest, given the same wave energy. Salinity is believed to influence marsh erodibility due to the influence of salt concentration of electrical field interactions among soil colloids. (Baker-FRC)
W82-04995

BED LOAD FLUCTUATION: APPLICATIONS,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
H. Qiwei, and H. Mingmin.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY2, p 199-210, February, 1982. 2 Tab, 4 Ref.

Descriptors: *Sediment transport, *Mathematical studies, *Bed load, *Fluctuations, *Sediment erosion, Sediment load, Sedimentation, Model studies, Mathematical equations, Streambeds, Stream profiles, Stream erosion, Sediments, Erosion, *Particle size, Sampling.

Research on the mechanism of bed load movement is important in interpreting hydrological measurements. The sampling duration under various conditions should be recorded so that the measured transport rate may be obtained with sufficient accuracy. Derivations are examined for the variance and coefficient of variation of transport rate for uniform and nonuniform sand with determinate and random size distributions over a pebble bed. Due to frequent deposition and erosion, along with apparent sorting, the particles become more uniform at certain locations. The relationship between the coefficient of variation of transport rate for the whole cross section of the stream bed and that of local points was derived. This information will aid in estimating the accuracy available from the sampling duration used. (Geiger-FRC)
W82-05000

EROSION BY SUBMERGED CIRCULAR JETS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No 2, p 262-267, February, 1982. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Erosion, *Jets, *Mathematical studies, *Froude number, Scour, *Nozzles, Mathematical equations, Sand, Flow velocity, Plane flow.

Recent work on the erosion of sand beds by plane submerged air and water jets in the impinging as well as wall jet modes shows that, for the air-sand and water-sand systems, even though the functional dependence of the ratios of maximum depth of erosion to impingement height and the diameter of the jet at the nozzle of the densimetric Froude number might be of the same kind, there are considerable differences in the magnitude of these relationships. A series of experiments was performed on the erosion of sand beds by submerged circular impinging water jets to see if this kind of difference exists for circular jets. Similarities were found in the air-sand and the water-sand system, but significant differences concerning the depth, as well as the radial extent of the scour hole were also noted. A relationship involving the densimetric Froude number, the impingement height, and the diameter of the jet at the nozzle influenced the erosion of sand beds by impinging submerged circular water jets, as well as the maximum depth of erosion, the radial extent of the scour hole, and the height of the ridge that forms around the scour hole. For some values of this relationship, the depth of scour in the water-sand system would be smaller while the radial extent of erosion would be much smaller. (Geiger-FRC)
W82-05002

BEND THEORY OF RIVER MEANDERS. PART 1. LINEAR DEVELOPMENT,
Saitama Univ. Urawa (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 2E.
W82-05085

HYDRAULIC CALCULATIONS OF STABLE UNLINED CANALS BY THE VERTICAL VELOCITY DISTRIBUTION METHOD,
For primary bibliographic entry see Field 8A.
W82-05108

CALCULATION OF LARGE UNLINED CANALS,

For primary bibliographic entry see Field 8B.
W82-05131

DISTRIBUTION OF SUSPENDED SEDIMENT IN THE PATUXENT RIVER, MARYLAND DURING DREDGING OPERATIONS FOR CONSTRUCTION OF A PIPELINE,

Columbia Gas System Service Corp., Wilmington, DE.
E. Onuschak, Jr.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 25-34, 1982. 8 Fig, 6 Ref.

Descriptors: *Dredging, *Sediment transport, *Spoil disposal, Suspended sediment, Turbidity, Patuxent River, Maryland, *Pipelines, Trenches, Erosion, Sediment erosion, Tidal rivers, Estuaries, Environmental effects, *Patuxent River, Maryland.

Dredging in the Patuxent River, Maryland, offered an opportunity to study the environmental impact of temporary, underwater storage of spoil during trench construction in a tidal river. An 8 ft deep trench was dredged with a clam shell-type dredge mounted on a barge. Spoil was deposited in piles underwater within range of the dredge boom. Backfilling from the spoil pile was done after the pipeline had been installed. Suspended solids were measured on the surface, at mid-depth, and at the bottom at 4 sites in the deepest part of the channel before, during, and after dredge operations. During dredging the average turbidity of the water increased a maximum of 2 times (50-70 mg per liter) over the baseline level (30-50 mg/per liter). After dredging was completed, turbidity returned to baseline levels within 3 weeks. Monitoring downstream of the spoil piles indicated that the sediment from the piles was not being significantly eroded. (Cassar-FRC)
W82-05198

ERODIBILITY OF SELECTED SOILS AND ESTIMATES OF SEDIMENT YIELDS IN THE SAN JUAN BASIN, NEW MEXICO,

Geological Survey, Denver, CO. Water Resources Div.
R. M. Summer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-195744, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-44, 1981. 33 p, 10 Fig, 9 Tab, 31 Ref.

Descriptors: *Soil erosion, *Small watersheds, Simulated rainfall, *Land reclamation, *Sediment yield, Soil management, Coal mining, *New Mexico, *San Juan basin, Sediment transport.

Onsite rainfall-simulation experiments were conducted to derive field-erodibility indexes for rangeland soils and soils disturbed by mining in coal fields of northwestern New Mexico. Mean indexes on rangeland soils range from 0 grams (of detached soil) on dune soil to 121 grams on wash-transport zones. Mean field-erodibility-index values of soils disturbed by mining range from 16 to 32 grams; they can be extrapolted to nearby coal fields where future mining is expected. Because field-erodibility-index data allow differentiation of erodibilities across a variable landscape, these indexes were used to adjust values of K, the erodibility factor of the Universal Soil Loss Equation. Estimates of soil loss and sediment yield were then calculated for a small basin following mining. (USGS)
W82-05223

SAWMILL BROOK: AN EXAMPLE OF RAPID GEOMORPHIC CHANGE RELATED TO URBANIZATION,

Wesleyan Univ., Middletown, CT. Dept. of Earth and Environmental Sciences.
For primary bibliographic entry see Field 4C.
W82-05276

A STOCHASTIC MODEL OF SOIL EROSION,

Ohio State Univ., Columbus. Dept. of Civil Engineering.
T. H. Wu, K. W. Bedford, M. E. Mossaad, K. L. McCurdy, and E. M. Ali.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224734, Price codes: A08 in paper copy, A01 in microfiche. Report No. 711523. 145 p, 55 Fig, 6 Tab, 42 Ref, 4 Append. OWRT A-056-OHIO(1).

Descriptors: *Soil erosion, *Model studies, *Terrain analysis, Surface flow, *Stochastic process, Soil surfaces, Flow, Surface runoff, Surface water, Surface drainage, Mathematical studies, Stochastic hydrology, Probabilistic process, Model testing, Topography, Prediction, Rills, Channels, Rill erosion, Gully erosion, Rainfall intensity, Slope degradation, Runoff, *Erosion rates.

Research was carried out to develop a mathematical model of the progress of erosion on sloping ground that would be able to account for the irregular topography of the ground surface, the overland flow pattern compatible with the topography, and the erosion and topographic change due to flow. The model computes the erosion and flow pattern, and the rill-interrill characteristics as a function of time and space. It also includes simplified mechanisms to simulate ponding, deposition, and failure of side slopes of rills. Sensitivity analysis of the model revealed that the use of shorter time intervals gives better erosion rate estimates. Surface elevation randomness has a significant effect on erosion rate reduction; surfaces with greater random variations evidence smaller erosion rates, while rill pattern randomness appeared to have a smaller effect. The effects of slope gradient, slope length, and rainfall intensity were also examined. The results are in general agreement with experience. (Zielinski-MAXIMA)
W82-05298

A FIELD TECHNIQUE TO DIRECTLY MEASURE RIVER BANK EROSION,

Alberta Research Council, Edmonton.
For primary bibliographic entry see Field 7B.
W82-05410

ON MEASURING TIME-AVERAGED VELOCITIES IN OPEN CHANNEL FLOW,

Copenhagen Univ. (Denmark). Dept. of Geography.
J. Bartholdy.
Sedimentology, Vol 29, No 1, p 91-94, February, 1982. 2 Fig, 7 Ref.

Descriptors: *Open channels, *Flow measurement, Velocity, Channels, Canals, Mathematical studies, Sediment transport, Sedimentation.

The problem of determining the necessary length of time over which velocities must be measured in open channel flows in order to secure accurate time-averaged velocities is addressed. The method presented was tested against the data from velocities measured at 60 second intervals at 10 points in a vertical on the Columbia River below Priest Rapids Dam. The measurements were carried out simultaneously and were continued for 66 minutes. Depth at the measuring station was 6.4 meters, the 66 minute mean velocity was 1.0 meters/second, and the Nikuradse roughness and friction velocities calculated from the velocity profile were 0.31 meters and 0.07 meters/second, respectively. The experiments and theory applied to determine the necessary equations were based on a steady and uniform two-dimensional flow. The results are therefore limited to cases in which these conditions are fulfilled or can be approximated. Where inhomogeneities in the water column play an important role, such as in stratified estuaries, or where discontinuities in the cross-profile cause large eddies to appear, the measuring time must necessarily be much longer than predicted herein. In spite of these limitations, the method as described can find use in many natural channels and offers the possibility of making a qualified choice of the optimal measuring time when working in the field. (Baker-FRC)
W82-05462

SOURCES OF SEDIMENT-INDUCED REDUCTIONS IN WATER QUALITY APPRAISED FROM CATCHMENT ATTRIBUTES AND LAND USE,

H. W. Anderson.
Journal of Hydrology, Vol 51, No 1-4, p 347-358, May, 1981. 7 Tab, 9 Ref.

Descriptors: *Suspended sediments, *Sediment load, Catchment areas, Land use, Water quality, Sediment discharge, Factor analysis, Mathematical studies, Streamflow, Landslides, Geology.

In order to develop estimates of sediment discharge from catchments or of the expected contribution of parts of catchments to sediment discharge or to sediment-induced reductions in water quality, it is first necessary to evaluate the sources and causes of suspended sediments. Suspended sediment measurements from 61 catchments in California were used to relate suspended sediment discharge to the following ten catchment attributes: steep grasslands, landslide potential, watershed steepness, rain-snow frequency, streamflow volume, poor logging, watershed shape, unconsolidated sediment, geology (including faults), and forest fires. Suspended sediment was normalized by using long-term streamflow estimates for each catchment. Factor analysis showed no confounding among the ten variables. The ten variable regressions had an explained variance of 73%. The contribution of watershed factors to this explained variance in suspended sediment discharge was as follows: landslide potential, 31%; steep grasslands, 11%; streamflow and rain-snow frequency, 12%; poor logging, 9% and other, 10%. Catchment shape was the least important variable, while differences in landslide classes produced the greatest differences in sediment discharge. A separate analysis was used to develop a basis for calculating landslide classes from catchment attributes. The results of these analyses were applied to the Redwood Creek Basin in California to separate natural from accellrated sediment discharge and sediment concentration in the basin. It was concluded that thee relationships found in this study have direct application to thee evaluation of sedimentation problems and control in northern California and control in northern California and may give some first approximation to evaluations in other areas. (Carroll-FRC)
W82-05494

SEDIMENTARY RECORD OF RAINFALL VARIATIONS ON A SUB-HUMIC LAKE,

New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey.
Nature (London), Vol 296, No 5856, p 434-436, April 1, 1982. 4 Fig, 26 Ref.

Descriptors: *Lake sediments, *Sedimentology, *Climatology, Dayat Afougach, Morocco, Precipitation, Prediction, Rainfall, Sedimentation rate.

A 1.3 m sediment core was obtained from the deepest part of a lake, Dayat Afougach, Morocco, on September 25, 1979. Fourier analysis was performed on the dry weights of 1 or 2 cm sections and the annual rainfall totals from 1958-79 for Ifrane, 23 km from the lake. At a wave length of about 12 cm (range 8-18 cm) an annual sedimentation cycle was evident. This was consistent with previous evidence that in this Mediterranean-type climate sediment particle size is largest (highest dry weight) in the wet season immediately following the dry season. The relationships of organic matter, Na, Mg, and Fe to dry weight show that particle size is responible for the variations in dry weight. The 12 cm annual sedimentation rate is also consistent with data from other lakes in similar environmental settings. Lower sediment dry weights were found at core depths corresponding to 1971-74, low rainfall years. Study of lake sediment dry weights may give information on precipitation patterns in areas where climatological records are not available. (Cassar-FRC)
W82-05516

HINDERED BEDLOAD SETTLING AS A MODEL OF SAND BED PLANATION BY WATER WAVES,

Coastal Engineering Research Center, Fort Belvoir, VA.
R. J. Hallermeier.
Nature, Vol 297, No 5861, p 53-55, May 6, 1982. 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Sediment transport, *Bed load, *Wave action, Planation, Sand, Fluid flow, Flow velocity, Oscillatory waves, Settling velocity, River beds.

Sand bed planation is converted to a threshold effect in hindered settling with increasing concentration of noncohesive sediment moving near the bed. The equation derived was consistent with laboratory results using 15 sediments with buoyance indexes of 19 to 137,000, corresponding to quartz sand in water. The viewpoint in this paper is different from that of Bagnold's criterion for planar bed occurrence for unidirectional and oscillatory flows. (Cassar-FRC)
W82-05607

DETERMINATION OF RECENT DESPOSITION RATES IN LAKE CONSTANCE WITH RADIOISOTOPIC METHODS,

Heidelberg Univ. (Germany, F. R.). Lab. for Sedimentology.
For primary bibliographic entry see Field 5B.
W82-05625

EROSION FROM MOUNTAIN SNOWPACK MELT,

Utah State Univ., Logan. Watershed Science Unit.
G. E. Hart, and S. A. Loomis.
Journal of Soil and Water Conservation, Vol 37, No 1, p 55-57, January/February, 1982. 1 Tab, 3 Ref.

Descriptors: *Snowmelt, *Erosion, *Surface runoff, Snowpack, Mountains, Soil erosion, *Utah, Slopes, Runoff, Infiltration.

Soil loss from clear-weather snowmelt was minimal on four test plots located on a bare mountain slope in Utah. Erosion was 2.8-10.6 pounds per acre on the plots with 11% slope and 7.8-23.6 pounds per acre on the plots with 32% slope. Maximum snowpack in 1978 was 12 inches water equivalent; in 1979, 16 inches; and in 1980, not measured. Soil loss was twice as great in 1979 as in 1978, although the snowmelt runoff volume in 1979 was three times greater. Most of the snowmelt infiltrated into the soil. Only a small percentage of the water equivalent in the snowpack appeared as surface runoff, up to 1.3% on the gentle slope and 1.0-3.5% on the steep slope. The small soil losses do not warrant inclusion of the snowmelt factor in the universal soil loss equation in mountain terrain with a moderately deep snowpack which persists throughout the winter. (Cassar-FRC)
W82-05664

BEDLOAD AND SIZE DISTRIBUTION IN PAVED GRAVEL-BED STREAMS,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
G. Parker, P. C. Klingeman, and D. G. McLean.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 544-571, April, 1982. 14 Fig, 5 Tab, 20 Ref.

Descriptors: *Bed load, *Gravel, Streams, Sediment transport, Sediment load, Mathematical equations, Model studies, *Oregon, Oak Creek.

An attempt has been made to describe, based solely on field data, bedload relations for natural, paved gravel-bed streams. Data gathered from Oak Creek, Oregon were used to study the size distribution of bedload in paved gravel-bed streams. Similarity analysis suggests that once the pavement is broken, essentially all sizes are rendered of roughly equal mobility. This implies that for poorly-graded gravels only one grain size is required to characterize total bedload as a function of Shields stress, and that not much extra accuracy can be gained by calculating the bedload for each size range separately and summing. It also suggests that the bedload size distribution should approximate that of the pavement. The first implication was used to develop a simple means of predicting total bedload in gravel bed streams in conjunction with data from Oak Creek, the Elbow River, and other streams. The method approximates accuracy for streams with moderate to steep slopes that are not dominated by sand throughput load. The second implication would appear to apply in terms of annual sediment yield form gravel-bed streams that are not dominated by throughput load. A reanalysis of the Oak Creek data reveals that higher flows favor coarser bedload material. As concerns the relation of Meyer-Peter and Muller, its performance regarding the field data presented in this study is poor. There also appears to be no way to adjust the relation in terms of an effective grain size to bring it into accord with the data. Thus, it is not recommended. (Baker-FRC)
W82-05795

TRAP EFFICIENCY STUDY, HIGHLAND CREEK FLOOD RETARDING RESERVOIR NEAR KELSEYVILLE, CALIFORNIA, WATER YEARS 1966-77,

Geological Survey, Menlo Park, CA. Water Resources Div.
L. F. Trujillo.
Geological Survey Water-Supply Paper 2182, 1982. 15 p, 7 Fig, 8 Tab, 12 Ref.

Descriptors: *Trap efficiency, *Detention reservoirs, *Sediments, *California, Water storage, Sediment transport, Particle size, Chemical analysis, *California, Lake County, Kelseyville, Highland Creek Reservoir.

This investigation is part of a nationwide study of trap efficiency of detention reservioirs. In this report, trap efficiency was computed from reservoir inflow and outflow sediment data and from reservoir survey and outflow data. Highland Creek Reservoir is a flood retarding reservoir located in Lake County, near Kelseyville, California. This reservoir has a maximum storage capacity of 3,199 acre-feet and permanent pool storage of 921 acre-feet. Mean annual rainfall for the 14.1-square-mile drainage area above Highland Creek Dam was 29 inches during the December 1965 to September 1977 study period. Resultant mean annual runoff was 17,100 acre-feet. Total reservoir inflow for the 11.8-year study period was 202,000 acre-feet, transporting an estimated 126,000 tons (10,700 tons per year) of suspended sediment. Total reservoir outflow for the same period was 188,700 acre-feet, including 15,230 tons (1,290 tons per year) of sediment. Estimated trap efficiency for the study period was 88 percent, based on estimated sediment inflow and measured sediment outflow. Reservoir surveys made in December 1965 and April 1972 revealed a storage capacity loss of 35.8 acre-feet during the 6.3-year period. Ccomputed by using an estimated specific weight, this loss represents 54,600 tons of deposited sediment. Sediment outflow during the same period was 8,890 tons. Trap efficiency for the survey period was 86 percent. (USGS)
W82-05852

POTENTIAL SEDIMENT PRODUCTION WITHIN VEGETATIVE COMMUNITIES IN OREGON'S BLUE MOUNTAINS,

Oregon State Univ., Corvallis. Dept. of Rangeland Resources.
J. C. Buckhouse, and R. E. Gaither.
Journal of Soil and Water Conservation, Vol 37, No 2, p 120-122, March/April, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Sediment yield, *Erosion rates, *Vegetation effects, *Forest hydrology, Sagebrush, Grasslands, Meadows, Alpine regions, Pine trees, Fir trees, Juniper trees, Spruce trees, Trees, Larch trees, Blue Mountains, Oregon, Infiltrometers, Soil erosion.

Potential sediment losses were determined in 10 natural ecosystems in Oregon's Blue Mountains using a Rocky Mountain infiltrometer simulating rainstorms of 10 cm per hour. Potential sediment production levels (kg per ha) in various ecosystems were: juniper, 1572; sagebrush, 1284; grassland, 431; spruce-fir, 217; ponderosa pine, 183; alpine, 140; Douglas fir, 109; lodgepole pine, 36; meadow, 22; and larch, 15. As ecological condition class and/or vegetative productivity class changed within an ecosystem significant changes in potential sediment production occurred. Condition class refers to tree size in forested units and to condition (poor to fair) in other ecosystems. Productivity refers to pounds per acre of forage or cu ft per acre per year of wood produced, Class I being most productive and Class IV, least productive. In general, sediment losses increased as the condition class changed from good toward poor and decreased with improvement in productivity. (Cassar-FRC)
W82-05867

SEDIMENT MIXING AND ACCUMULATION RATE EFFECTS ON RADIONUCLIDE DEPTH PROFILES IN HUDSON ESTUARY SEDIMENTS,

Lamont-Doherty Geological Observatory, Palisades, NY.
C. R. Olsen, H. J. Simpson, T.-H. Peng, R. F. Bopp, and R. M. Trier.
Journal of Geophysical Research, Vol 86, No C11, p 11020-11028, November 20, 1981. 10 Fig, 31 Ref.

Descriptors: *Sediment distribution, *Estuarine environment, Estuaries, Sediments, Sedimentation, Hudson River, Rivers, Radioactivity.

A comparison was made of the measured anthropogenic radionuclide profiles in sediment cores from the Hudson River estuary by using known input histories of radionuclides to the estuary and mixing coefficients which decreased exponentially with depth in the sediment. The effective mechanical mixing rates of the upper layers of sediments appeared to be of the order of 0.25 to 1 square centimeter per year or less. These rates do not appear to alter substantially the depth of subsurface activity peaks owing to reactor releases in areas with accumulation rates of 1 cm per year or greater. Thus the subsurface peak radionuclide activities in Hudson sediments appear to be useful as first order time stratigraphic reference levels for estimating rates and patterns of sediment accumulation. Variations in the observed sediment radionuclide depth profiles from trends that would be expected from the history of fallout delivery and reactor releases can be used as indicators of the various processes regulating particle transport and accumulation along the axis of the Hudson estuary. (Baker-FRC)
W82-05868

2K. Chemical Processes

CHEMICAL FRACTIONATION OF HEAVY METALS IN WASTEWATER-AFFECTED SOILS,

Chile Univ., Santiago. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-04781

THE BEHAVIOR OF ASBESTOS-CEMENT PIPE UNDER VARIOUS WATER QUALITY CONDITIONS: PART 2, THEORETICAL CONSIDERATIONS,

Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 8G.
W82-04791

APPLICATION OF AN APPROXIMATE ANALYTIC METHOD OF COMPUTING SOLUTE PROFILES WITH DISPERSION IN SOILS,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-04876

A CONTRIBUTION TO SIMPLIFIED MODELS OF FIELD SOLUTE TRANSPORT,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W82-04877

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: I. SUNLIGHT INDUCED REACTIONS OF AQUATIC POLLUTANTS PHOTOSENSITIZED,

Environmental Research Lab., Athens, GA.
R. G. Zepp, G. L. Baughman, and P. F. Schlotzhauer.
Chemosphere, Vol 10, No 1, p 109-117, January, 1981. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Humic acids, *Organic compounds, *Chemical reactions, *Photochemical reactions, Fulvic acids, Organic matter, Disulfoton, Aniline, Pentadiene, Dimethylfuran, Kinetics, Fate of pollutants, Solar radiation, Oxygenation, Comparison studies.

Organic chemicals which do not undergo photochemical reactions in distilled water degraded when exposed to sunlight in water containing natural or commercial humic substances. Chemicals tested were disulfoton, aniline, 2,5-dimethylfuran, and cis-1,3-pentadiene. Photoproducts were generally the same for each chemical regardless of the source of humic material. Kinetic data indicated that rate constants were within a factor of 2 in solutions of humic substances of different origin. Disulfoton and 2,5-dimethylfuran underwent photosensitized oxygenation to disulfoton sulfoxide and diacetylethylene, respectively. The half life of disulfoton ranged from 4 hours during summer to 10 hours during winter. The major photoproduct of aniline was azobenzene; the half life of aniline in May was 4-8 hours. Cis-1,3-pentadiene isomerized to trans-1,3-pentadiene. (Cassar-FRC)
W82-04914

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: II. PHOTOSENSITIZED OXYGENATIONS,

Environmental Research Lab., Athens, GA.
R. G. Zepp, G. L. Baughman, and P. F. Schlotzhauer.
Chemosphere, Vol 10, No 1, p 119-126, January, 1981. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Humic acids, *Chemical reactions, *Organic compounds, Fate of pollutants, Dimethylfuran, Organic matter, *Photochemical reactions, Kinetics, Solar radiation, Oxygenation, Comparison studies.

The photochemical oxygenation of 2,5-dimethylfuran (DMF) in water was investigated using humic substances from natural sources and commercial sources as photosensitizers. At low DMF concentrations the reactions were first order with respect to DMF. Reaction rate constants were directly proportional to the average light intensity and to the concentration of humic substances. Rate constants were independent of hydrogen ion activity from pH 5 to 10. Above pH 10 the rate constants decreased with increasing pH. Ultraviolet and blue radiation were most influential in the photosensitization. Rate constants for this reaction calculated from computer-simulated sunlight intensities agreed well with the observed values. Since the ratios of sunlight rate constants to total visible solar irradiance (400-700 nm) were nearly constant, it may be possible to calibrate the rate constants in terms of units such as foot candles. (Cassar-FRC)
W82-04915

THE OCCURRENCE AND ORIGIN OF METHANE IN SOME GROUNDWATER FLOW SYSTEMS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. F. Barker, and P. Fritz.
Canadian Journal of Earth Sciences, Vol 18, No 12, p 1802-1816, December, 1981. 5 Fig, 4 Tab, 62 Ref.

Descriptors: *Methane, *Carbon isotopes, *Geochemistry, *Groundwater, Organic matter, Landfills, Sanitary landfills, Chemical reactions, Biodegradation.

Groundwaters from 10 areas in Canada and the U.S. contained methane at levels from below the detection limit of 10 to the minus 7th power mol per liter to 0.0063 mol per liter. The origin of the methane was determined from carbon isotope ratios. Of 28 samples whose stable carbon isotope ratios were measured, 5 samples with delta C13 values greater than -45 o/oo were of thermocatalytic origin (nonbiological, chemical production). The common biogenic methanes had delta C13 values less than -60 o/oo. Biogenic methanes from sanitary landfill sites had intermediate values of -38 to 56 o/oo and were easily distinguished from normal biogenic methanes. The biogenic methanes in this study appeared to derive from organic matter. The carbon isotope ratios of dissolved methane and total inorganic carbon were not controlled by equilibrium fractionation processes but by kinetic isotope effects. (Cassar-FRC)
W82-04925

NITROGEN AND PHOSPHORUS DYNAMICS IN HOT DESERT STREAMS OF SOUTHWESTERN U.S.A.,

Arizona State Univ., Tempe. Dept. of Zoology.
N. G. Grimm, S. G. Fisher, and W. L. Minckley.
Hydrobiologia, Vol 83, No 2, p 303-312, 1981. 5 Fig, 2 Tab, 46 Ref.

Descriptors: *Streams, *Deserts, Arid lands, *Nitrogen, *Phosphorus, Chemical properties, Nutrients, *Arizona, Nitrates, Phosphates, *Gila River basin.

The potentials for nutrient limitation in streams in hot, arid and semi-arid regions of Arizona were examined by determining the dynamics of nitrogen and phosphorus in 38 different systems of the Gila River drainage. Thirty-eight low elevation streams and stream segments were sampled in Southern Arizona, primarily in summer 1979. Most sites were in the Sonoran Desert, with some in a transition zone between the Sonoran and Chihuahuan Deserts and others in Interior Chaparral. Perennial flowing waters in the Sonoran Desert region usually exist because they originate in highlands outside arid zones. Typical Arizona surface waters are carbonate dominated. Highest nitrogen concentrations were associated with stream sources and flood waters which enter stream channels at elevated nitrogen levels after recent contact with nitrate rich terrestrial soils. Soluble reactive phosphate was not significantly higher in sources and floods than in free-flowing streams, and in the latter, concentrations were usually greater than 0.5 microM. Nitrogen is a likely candidate for nutrient limitation in free flowing streams of this region. Nitrate, but not soluble reactive phosphate, was correlated with periphyton abundance and net production in reaches originating at enriched sources. Rapid uptake by periphyton lowered nitrate concentrations to potentially limiting levels; however, soluble reactive phosphate was seldom depleted and was apparently controlled by other factors. Thus, in spite of the presence of nitrate enriched sources in desert streams, nitrogen may be reduced to limiting levels before phosphorus. (Baker-FRC)
W82-04930

THE EFFECT OF PRESSURE ON THE SOLUBILITY OF MINERALS IN WATER AND SEAWATER,

Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 1B.
W82-05135

METAL ION COMPLEX FORMATION CONSTANTS OF SOME SEDIMENTARY HUMIC ACIDS WITH ZN(II), CU(II) AND CD(II),

Lehigh Univ., Bethlehem, PA. Dept. of Chemistry.
M. L. Sohn, and M. C. Hughes.
Geochimica et Cosmochimica Acta, Vol 45, No 12, p 2393-2399, December, 1981. 1 Fig, 3 Tab, 52 Ref.

Descriptors: *Humic acids, *Bottom sediments, *Metal complexes, Zinc, Copper, Cadmium, *Lake sediments, *Marine sediments, Chemical analysis.

Humic acids form one of the most important source/sink systems for metal ions in the soils and bottom sediments in both fresh and saline waters. A substantial portion of the metal ions presented in soils and sediments is bound in labile form to humic acids. A size exclusion chromatography technique as used to determine metal ion complex formation constants for several sedimentary humic acids derived from a fresh water lake and several coastal marine environments. Zinc(II), copper(II), and cadmium(II) were selected are representative of pollutant metals in coastal areas. Only one type of binding site was observed in all cases. Elemental composition of the sedimentary humic acids, except that the nitrogen content was sifnificantly higher in the sedimentary humic acids. Other chemical properties of the sedimentary humic acids were consistent with previously reported findings. Spectroscopic measurements indicated that the sedimentary humic acids may have contained significant amounts of polysaccharide compunds which were not removed by conventional separation and purification processes, but analysis showed only very low levels of polysaccharides present in the humic acids. (Carroll-FRC)
W82-05136

THE EFFECTS OF ADSORBED HUMIC SUBSTANCES ON THE SURFACE CHARGE OF GOETHITE (ALPHA-FE00H) IN FRESHWATERS,

Freshwater Biological Association, Cumbria (England).
E. Tipping, and D. Cooke.
Geochimica et Cosmochimica Acta, Vol 46, No 1, p 75-80, January, 1982. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Organic matter, *Electrical properties, *Iron oxides, Surface water, Ions, Cations, Calcium, Magnesium, *Electrophoresis, Adsorption, Shear, *Chemical reactions.

Electrophoresis has been used to demonstrate that a negative charge is conferred on a variety of types of particles in freshwaters by the adsorption of organic matter. A previous study of a single lake showed that the magnitude of the negative charge conferred on the surface by adsorbed humic substances was determined not only bu the amount of humics adsorbed, but also by coadsorbed bivalent calcium (Ca) and magnesium (Mg) ions. This study attempted to generalize these earlier results by measuring electrophoretic mobilities of a model iron oxide, goethite, added to solutions in which humic and cation concentrations were varied systematically over wide ranges, to surface water samples from three more British lakes having varied chemical properties, and to artificial lakewaters with compositions based on those of the natural samples. These electrophoretic measurements showed that goethite particles added to lake surface water samples become negatively charged because of the adsorption of humic substances. The magnitude of the negative charge was found to decrease with increasing concentrations of the bivalent cations Ca(2 plus) and Mg(2 plus). It is suggested that the large molecular size of the humics causes the plane of electrokinetic shear to be some distance from the oxide surface, with the shear potential attributable to ionized humic functional groups not involved in adsorptive interactions with the oxide surface. This model accounts qualitatively for (a) the effects of Ca(2 plus) and Mg(2 plus) in terms of interactions with the humic functional groups in the shear plane; (b) the pH-dependence of the electrophoretic mobilities; and (c) the lack of effect of inorganic phosphate and silicate on the mobilities, despite the shared ability of these solutes to compete with humics for adsorption at natural concentrations. (Carroll-FRC)
W82-05140

HUMIC SUBSTANCES,

For primary bibliographic entry see Field 5B.
W82-05148

PLANKTON METABOLISM AND CARBON PROCESSES IN THE AMAZON RIVER, ITS TRIBUTARIES, AND FLOODPLAIN WATERS, PERU-BRAZIL, MAY-JUNE 1977,

Washington Univ., Seattle. Coll. of Fisheries.
R. C. Wissmar, J. E. Richey, R. F. Stallard, and J. M. Edmond.
Ecology, Vol 62, No 6, p 1622-1633, December, 1981. 6 Fig, 1 Tab, 77 Ref.

Descriptors: *Plankton, *Carbon cycle, Ecosystems, Aquatic environment, *Nutrients, Cycling nutrients, Flooding, Phytoplankton, Suspended solids, Bacteria, South America, Brazil, Peru, *Amazon River.

The biological and chemical characteristics of the various plankton environments of the Amazon River system were examined in an effort evaluate the influence of exogenous carbon and nutrients on plankton metabolism and the importance of respiration and phytoplankton production to the carbon dioxide equilibria in the riverine and floodplain waters. The study results indicated that large-scale events such as flooding can have a major impact upon the cycling of carbon and nutrients in these aquatic ecosystems. The major factors influencing primary production during high water appeared to be nutrient concentrations in the mouthbays and varzea (floodplain) lakes and high levels of suspended matter in the Amazon mainstream. Bacterial densities, carbon-14-acetate uptake rate constants, and plankton carbon: ATP ratios implied that heterotrophic microbiota were important components of the plankton communities in riverine waters. High particulate carbon: nitrogen ratios (20:1) indicated that terrestrial organics were important to metabolic activity in all Amazon surface waters. The observed supersaturation of Amazon waters by carbon dioxide was similar to observations for other rivers of the world. The primary source of the carbon dioxide is most likely decomposing organic matter in planktonic and benthic environments of the rivers, lakes, and flooded terrestrial lowlands. These findings support the hypothesis that respiratory input of carbon dioxide balanced by evasion is sufficient to explain high carbon dioxide vapor pressures in the Amazon, but further examination is recommended. (Carroll-FRC)
W82-05197

QUALITY OF GROUND WATER IN ROUTT COUNTY, NORTHWESTERN COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-05227

CHEMICAL CHARACTER OF WATER IN THE RED RIVER ALLUVIAL AQUIFER, LOUISIANA,

Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05228

THEORETICAL ANALYSIS OF IONIC EQUILIBRIA IN NATURAL WATER,

Moscow State Univ. (USSR).
V. S. Savenko.
Water Resources, Vol 8, No 2, p 173-185, March-April, 1981. 9 Tab, 59 Ref. Translated from Vodnye Resursy, No 2, p 120-133, March-April, 1981.

Descriptors: *Ions, *Activity coefficient, *Equilibrium, *Chemical reactions, Seawater, Geochemistry, Thermodynamics, *Saline water, Sodium, Potassium, Calcium, Magnesium, Sulfates, Fluorides, Chlorides, Bromides, Iodides, Bicarbonates, Carbonates, Sulfides, Theoretical analysis.

Experimental data on activity coefficients of ions and salts in seawater were compared with theoretical predictions obtained from several methods. Differences between experimental and theoretical activity coefficients of ions and salts did not exceed 0.03-0.05 (3-10% relative) and were within the limits of accuracy in determining the instability of ion pairs. The greatest differences were seen for strongly associated salts. Therefore, chemical reactions should be calculated with respect to the least associated salts. (Cassar-FRC)
W82-05239

SULFATE BUDGET AND MODEL FOR SULFATE CONCENTRATIONS IN STREAM WATER AT BIRKENES, A SMALL FORESTED CATCHMENT IN SOUTHERNMOST NORWAY,

Central Insitute for Industrial Research, Oslo (Norway).
N. Christophersen, and R. F. Wright.
Water Resources Research, Vol 17, No 2, p 377-389, April, 1981. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Sulfates, *Streams, *Forest watersheds, Watersheds, Forest soils, Soil types, Catchment areas, Catchment basins, River basins, Chemical composition, Solute transport, Birkenes catchment, *Norway.

The flux of sulfate into and out of the Birkenes catchment is calculated from data collected over a 6 yr period. Ground vegetation is 58% blueberry-bracken community, 28% pine community, and 7% fen and bog forest. Soils consist of 79% podzols, 17% peaty soils and 4% bare rock. Bedrock is biotite-granite. The annual sulfate flux is about 5-10 times higher than would be expected. The result is an acidification of stream water and an increased leaching of base cations from the soil. The concentration of sulfate in stream water at Birkenes shows a characteristic pattern of high levels in the first stormflow following a dry summer period and low levels in baseflow. Sulfate is assumed to accumulate in the uppermost soil layers due to dry deposition and evapotranspiration of rainwater. Mineralization of other sulfur compounds is included indirectly. In the lower mineral soil layers, adsorption/desorption of sulfate is assumed to occur. The ability of this simple model to simulate sulfate concentrations in stream water suggests that the model quantitatively accounts for these processes. (Baker-FRC)
W82-05288

ION HYDRATION AND ION INTERACTION,

Maryland Univ., College Park. Dept. of Chemistry.
G. Atkinson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224841, Price codes: A02 in paper copy, A01 in microfiche. Report, October 1981. 21 p, 2 Tab, 11 Ref. OWRT (No 1656)(1), 14-01-0001-1656(1).

Descriptors: *Ion transport, *Thermodynamics, *Salts, *Equilibrium, *Chemical reactions, *Hydration, Ionic interference, Anions, Cations, Ions, Salinity, Seawater, Ultrasonics, Baseline studies, Chemical analysis, Water properties, Research needs.

A summary is provided on research which was undertaken to define the nature and properties of aqueous ionic species and to understand the relationship between individual ion hydration and classical thermodynamic properties. The research, experimentally, relied heavily on relaxation methods (particularly, ultrasonic absorption (UA) to bridge the gap between dynamic processes and equilibrium considerations. Studies with UA were made on aqueous solutions of tetraalkylammonium halide salts as a function of concentration and temperature. Combining the UA results with dielectric relaxation and equilibrium thermodynamics made it possible to quantitatively describe such systems in terms of the coupled equilibrium processes. Partial molal volumes and compressibilities at infinite dilution are directly related to the structural effects of the salts in water. Measurements of sound velocity in salt solutions down to 0.0001 molal were made for developing ionic compressibility data. In addition, several aqueous salt equilibria were studied and a lanthanide nitrate complexation model was quantitatively treated. Application in this case was directed towards the interaction between multivalent cations and various anions which lead to many important association equilibria in sea water. (Zielinski-MAXIMA)
W82-05310

EXCHANGE OF MARINE SODIUM FOR CALCIUM DURING CHEMICAL WEATHERING IN THE ISLE AUX MORTS RIVER BASIN, NEWFOUNDLAND,

Canada Center for Inland Waters, Burlington (Ontario).
M. E. Thompson.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 361-365, March, 1982. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Weathering, *Salts, *Ion exchange, Precipitation, Sea salt, Sodium, Calcium, *Isle aux Morts, *Newfoundland, Rivers, Chlorides, Sodium chloride, Chemical composition, Cation exchange.

Sea salt corrections must be applied in coastal river water chemistry studies prior to calculating weathering rates and evaluating the impact of acid precipitation. Sea salt corrections applied to data on contents of major seawater ions (Ca, Mg, Na, K, chloride, sulfate and bicarbonate) in the Isle aux Morts River, Newfoundland, using Cl(-) as the indicator species produced several negative values of Na(+). These were most numerous in winter when sea salt concentrations were high. Periods of negative Na(+) corresponded with periods of higher than usual Ca(2+) concentrations, suggesting that the higher sea salt levels may promote an exchange reaction in the soils: calcium silicate + 2Na(+) = sodium silicate + Ca(2+). Analysis of atmospheric precipitation in this region showed that sea salt levels were highest in winter and early spring. (Cassar-FRC)
W82-05414

SULFUR SPECIATION AND ASSOCIATED TRACE METALS (FE, CU) IN THE PORE WATERS OF GREAT MARSH, DELAWARE,

Paris Univ. (France). Lab. of the Geochemistry of Water.
J. Boulegue, C. J. Lord, III, and T. M. Church.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 453-464, March, 1982. 5 Fig, 3 Tab, 63 Ref.

Descriptors: *Sulfur compounds, *Metals, *Chemical reduction, Sediments, Tidal marshes, *Salt marshes, Marshes, *Great Marsh, *Delaware, Estuarine environment, Trace elements, Copper, Iron, Oxidation-reduction potential, Pore water, Sulfides, Hydrogen sulfide, Polysulfides, Thiosulfates, Sulfates, Sulfites, Organic matter, Decomposition.

Sulfur species and trace metals were determined in pore waters of sediments from a salt marsh near Lewes, Delaware. Three cores were collected during the summer of 1978, one to study the analytical methods, one a day before the monthly inundation and one at the end of the inundation period. The most important of the many inorganic and organic sulfur compounds detected at significant levels were hydrogen sulfide, polysulfides, and thiosulfates. Equilibria between hydrogen sulfide, thiols, and the polysulfides depend on the redox conditions. Bacterial sulfate reduction is dominant in the pore waters except at the surface during dry conditions, where oxidation of hydrogen sulfide produces thiosulfate and sulfide. Inorganic polysulfides are formed from the reaction of hydrogen sulfide with elemental sulfur. Organic polysulfides are the result of the reaction of thiols with elemental S and/or organic polysulfides. Thiols are produced by reactions of organic matter with hydrogen sulfide and/or elemental S. Thiosulfates are yielded by hydrogen sulfide oxidation and the hydrolysis of polysulfides and pyrite. It is suggested that the redox couple sulfide/polysulfide is a good indicator in this situation. Concentrations of Cu and Fe in the pore waters are controlled by formation of metal sulfides. Cu is probably complexed by organic matter, possibly a thiol. (Cassar-FRC)
W82-05415

THE CHEMISTRY OF SUSPENDED MATTER IN ESTHWAITE WATER, A BIOLOGICALLY

PRODUCTION LAKE WITH SEASONALLY ANOXIC HYPOLIMNION,

Edinburgh Univ. (Scotland). Dept. of Geology.
E. R. Sholkovitz, and D. Copland.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 393-410, March, 1982. 23 Fig, 6 Tab, 49 Ref.

Descriptors: *Particulate matter, *Seasonal variation, *Chemical precipitation, Sampling, *Esthwaite Water, *United Kingdom, Suspended solids, Anaerobic conditions, *Lakes, Organic carbon, Iron, Manganese, Phosphorus, Sulfur, Magnesium, Potassium, Barium, Calcium, Phytoplankton, Hypolimnion, Oxidation-reduction potential, Chemical reduction, Geochemistry, Adsorption, Iron oxide.

A study of ten water column profiles in Esthwaite Water (England's Lake District) between April and November 1979 revealed that particle chemistry in this highly productive lake is controlled by three biogeochemical cycles. A large excess of particulate P, S, Mg, Ca, Ba, and K is generated in situ in the epilimnion by growth of phytoplankton in spring and summer. Concentration variations follow that of particulate organic carbon. This particulate buildup is a result of oxidative precipitation of ferric oxide, which causes adsorption and/or coprecipitation with the Mg, Ca, and other elements. The formation of ferric oxide is, in turn, a result of the dissolved ferrous iron released as the hypolimnion becomes anoxic. The onset of anoxic conditions in the hypolimnion also induces an increase in bacterial populations in the bottom water. As reducing conditions become more intense after July, the iron oxide particles with the associated particulate Mg, Ca, etc., solubilize. Just before the lake overturns, large populations of bacteria and the formation of FeS particles control the concentration of excess particulate carbon, S, P, Mg, K, and Ca. The results of this study point out the importance of understanding the biogeochemical cycles in designing sampling schedules for monitoring a lake's natural or man-modified chemistry. (Cassar-FRC)
W82-05416

FLUORAPATITE AND FLUORITE SOLUBILITY CONTROLS ON GEOTHERMAL WATERS IN YELLOWSTONE NATIONAL PARK,

Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Geochimica et Cosmochimica Acta, Vol 46, No 3, p 465-474, March, 1982. 4 Tab, 42 Ref.

Descriptors: *Phosphates, *Solubility, *Geothermal studies, Fluorapatite, *Chemical composition, *Yellowstone National Park, Wyoming, Equilibrium, Hot springs, Chlorides, Fluorite, Calcium fluoride, Geochemistry, Saturation, Geysers.

Stauffer and Thompson's (1978) data on the phosphate contents of six differing classes of Yellowstone National Park geothermal waters were analyzed by a computer program, WATEQF. The near-boiling high-chloride waters (Class I) were at or near saturation with respect to fluorapatite. The 16 springs in this category had fluorapatite saturation indexes ranging from -3.2 to +4.9 (average +0.9). The strongly positive indexes were associated with the high alkaline conditions resulting from adiabatic cooling near the surface. Spring waters diluted with meteoric water (Class II) had lower chloride content, lower pH, and were undersaturated with fluorapatite in spite of high phosphate and Ca concentration. The travertine-depositing mixed water springs (Class VI) were super-saturated with fluorapatite at the surface and at or near saturation with hydroxylapatite. The supersaturation may be a result of kinetic inhibition of apatite crystallization by the high concentrations of Mg(++) and bicarbonate as well as the lower water temperatures. With respect to fluorapatite, Class III waters (hot, near neutral condensed vapor springs) were also weakly supersaturated, Class IV waters (acid Norris mixed water springs) were strongly undersaturated, and Class V waters (bicarbonate buffered mixed water springs) were weakly undersaturated. The hottest spring waters (90-100 C at the surface) were undersaturated with calcium fluoride at the surface, probably as a result of fluorite equilibration at the higher temperatures (> 200 C) in deeper reservuirs. (Cassar-FRC)
W82-05449

RADIUM CONTENT AND THE 226RA/228RA ACTIVITY RATIO IN GROUNDWATER FROM BEDROCK,

Institute of Radiation Protection, Helsinki (Finland).
M. Asikainen.
Geochimica et Cosmochimica Acta, Vol 45, No 8, p 1375-1381, August, 1981. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Radioactivity, *Groundwater, *Bedrock, *Aquifers, *Radium, Geologic formations, Chemical composition, Radium radioisotopes, Isotope fractionation, *Finland, Wells, Leaching, Groundwater dating.

The concentrations of Ra228 and the Ra226/Ra228 ratio in water from drilled wells situated in different parts of Finland were investigated. Areas with unusually highly radioactive water were emphasized in this study, and Ra228 was analyzed mainly in samples with an elevated Ra226 content. These measurements were supplemented by additional analyses of Ra226 and Ra228 carried out on water from some drilled wells situated in areas with no known radioactivity anomalies in groundwater. The concentration of Ra228 was independent of the amount of Ra226 present in the samples. The concentrations of Ra228 were nearly the same over the whole range of Ra226 concentrations, and the average Ra226/Ra228 ratio increased sharply as the Ra226 content of water increased. The Ra226/Ra228 ratio in the drilled wells varied from 0.3 to 26. Abnormally high Ra226/Ra228 ratios were found in areas with known uranium deposits as well as in several drilled wells at other locations. The abnormally high Ra226/Ra228 ratios present in groundwater suggest that the radioactivity anomaly is caused by uranium deposits and not by common rocks. In samples with a low radioactivity level, the average Ra226/Ra228 ratio was slightly below unity, corresponding to the typical U/Th ratio of granite, the most common kind of rock in the study area. The samples from the rapakivi area proved to be exceptional in that they had a low Ra226/Ra228 ratio, independent of the concentration of Ra226. (Baker-FRC)
W82-05450

FORMS OF THE MIGRATION OF METALLIC IONS IN FRESH WATER,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik, and B. I. Nabivanets.
Hydrobiological Journal, Vol 17, No 1, p 91-92, 1981.

Descriptors: *Ion transport, *Rivers, Manganese, *Dnieper River, Hydrobiology, *Heavy metals, Kinetics, Aquatic life, Chemical composition, Path of pollutants, Pollutant identification, *USSR.

An outline for step by step analysis of surface waters for the content of individual forms of metals has been developed. This outline may be used to determine the following, most general characteristics of the state of metallic ions in fresh water: the distribution of the metal between suspended, colloidal and truly dissolved forms; the concentration of free metallic ions and ions in complexes; the sign of the charge of the metallic ions; the molecular mass of complex or polynuclear compounds; and the degree of oxidation of the metal. The scope of the outline devised has been verifed in a study of the forms of the migration of manganese in the water of the Dnieper River. It has been established that manganese is in a dissolved state in the water of this river as free ions and complex compounds of different molecular mass. Macromolecular manganese complexes are represented mainly by anionic compounds, which are about 85-90% of the total content. Cationic manganese complexes are found in fractions with a molecular mass of about 0.5 to 1.5 thousand. The combining of manganese into complex compounds by the complex-forming substances in the water of the Dnieper is typified by a fairly slow rate. (Baker-FRC)
W82-05456

GEOCHEMICAL ENVIRONMENTS AND THE GEOGRAPHICAL DISTRIBUTION OF SOME DISEASES IN SRI LANKA,

Sri Lanka Univ., Peradeniya. Dept. of Geology.
For primary bibliographic entry see Field 5C.
W82-05463

THE EFFECT OF SULFATE ON ALUMINUM CONCENTRATIONS IN NATURAL WATERS: SOME STABILITY RELATIONS IN THE SYSTEM AL2O3-SO3-H2O AT 298 K,

Geological Survey, Menlo Park, CA.
D. K. Nordstrom.
Geochimica et Cosmochimica Acta, Vol 46, No 4, p 681-692, 1982. 7 Fig, 2 Tab, 93 Ref.

Descriptors: *Aluminum compounds, *Solubility, *Sulfates, Chemical reactions, Chemical precipitation, Gibbsite, Kaolinite, Hydrogen ion concentration, Minerals, Acid rain, Alunogen, Alunite, Jurbanite, Basaluminite, Acid mine drainage, Adsorption, Soil chemistry, Sediments, Clays, Water pollution effects.

In natural waters aluminum concentrations are generally regulated by gibbsite and kaolinite solubilities. However, addition of sulfate by acid precipitation or acid mine drainage can shift solubility control to less soluble minerals. These minerals include alunogen, $Al2(SO4)3 \times 17H2O$; alunite, $KAl2(SO4)2(OH)5$; jurbanite, $Al(SO4)(OH) \times 5H2O$; and basaluminite, $Al4(SO4)(OH)10 \times 5H2O$. Values for the log of the solubility product constant obtained from the literature or estimated in this work are: alunite, -85.4; basaluminite, -117.7; alunogen, -7.0; and jurbanite, -17.8. The solubility and stability relations among these four minerals were plotted as a function of pH and sulfate activity at 298 K. Within the range of most natural waters (pH 0 to 13 and log of sulfate activity, -6 to 1) alunogen is unstable, jurbanite is stable from pH o to 5, alunite is stable from pH 3 to 7, and gibbsite, from pH 3 to 8. Basaluminite is metastable for all values of pH and sulfate activity. These equilibrium calculations predict that sulfate and aluminum can be immoblized in acid waters by precipitation of aluminum hydroxy sulfates, which rather than adsorption may be the cause of sulfate retention in soils and sediments. (Cassar-FRC)
W82-05581

FLOODWATER NUTRIENT PROCESSING IN A LOUISIANA SWAMP FOREST RECEIVING AGRICULTURAL RUNOFF,

Louisiana State Univ., Baton Rouge. Center for Wetlands Resources.
For primary bibliographic entry see Field 5C.
W82-05622

IONIC COMPOSITION OF GROUND WATERS AND THEIR DISTRIBUTION IN KARNAL DISTRICT (HARYANA).

Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 5A.
W82-05721

INDICATIONS OF GROUND WATER INFLUENCES ON NUTRIENT TRANSPORT THROUGH SCHWATKA LAKE, YUKON TERRITORY,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 5B.
W82-05741

THE ORIGIN OF HIGH IRON CONCENTRATIONS IN GROUNDWATER FROM THE TRIASSIC AQUIFER IN EAST DEVON,

Institute of Geological Sciences, London (England).
N. R. G. Walton.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 63-77, 1982. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Iron, *Geochemistry, *Water quality, Chemical composition, Sherwood Sandstone, Otter Sandstone, Budleigh Salterton Pebble Beds, Aquifers, Groundwater, Wells, Acid water.

Exploratory drilling for groundwater resources in the Sherwood Sandstone aquifer in eastern Devon, England, revealed water of anomalously high iron concentration. Total Fe concentrations were 9800, 3900, and 1400 mg per liter in the three highest-level samples and 4-230 mg per liter in the remaining 17 samples. Ferrous iron levels were 0.01-3.90 mg per liter. This was a result of interdependence between two formations. The upper formation, Otter Sandstone, acts as a confining stratum for the Budleigh Salterton Pebble Beds, promoting reducing conditions in the Pebble Beds and mobilizing iron in the ferrous form. The tendency toward natural upward flow from the Pebble Beds to the Otter formation and the acid nature of the Pebble Beds water (pH 5.0) cause the high iron levels in the mixed groundwater. To minimize Fe content in wells drilled in this region the lower Pebble Beds formation should not be penetrated or approached closely in drilling a well, except in the region within 1.5 km of the outcrop. Conditions such as faults, permeable strata, and connections between the two formations will promote leakage of Pebble Beds water into Otter Sandstone wells. Proper positioning of the well screen and careful managing of pumping regime can also help avoid excessive Fe concentrations in abstracted water. (Cassar-FRC)
W82-05801

AN EVALUATION OF THE EFFECTS OF ACID RAIN ON LOW CONDUCTIVITY HEADWATER STREAMS IN PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05843

INFLUENCE OF DISSOLVED ORGANIC MATERIALS ON TURBID WATER OPTICAL PROPERTIES AND REMOTE-SENSING REFLECTANCE,

National Aerounautics and Space Administration, Hampton, VA. Langley Research Center.
W. G. Witte, C. H. Whitlock, R. C. Harriss, J. W. Usry, and L. R. Poole.
Jounral of Geophysical Research, Vol 87, No c1, p 441-446, January 10, 1982. 11 Fig, 2 Tab, 18 Ref.

Descriptors: *Dissolved solids, *Remote sensing, Turbidity, Measuring instruments, Water quality, Physical properties, Rivers, Georgia, Humic acids.

The purpose of this study was to assess quantitatively the influence of dissolved organic matter on turbid water optical properties and remote sensing reflectance over a range of concentrations typical of inland and coastal waters. Both field measurements and laboratory results were studied. Field measurements were taken of upwelled water volume reflectance on five of the major rivers of Georgia. Results implied that dissolved organic matter has the effect of reducing the inherent reflectance of turbid water mixtures, but a firm conclusion to that effect could not be made because of possible variations in uncontrolled variables such as solar elevation angle, atmospheric haze, chlorophyll, sediment mineralogy, iron content, and particulate organic carbon. Controlled lab tests were conducted in an attempt to isolate the optical effects of dissolved humic acids. The laboratory measurements showed nonlinear degradation in reflectance signals with changing dissolved organic carbon at visible and some near-infrared wavelengths, with degradation gradients greatest for dissolved organic carbon concentrations less than 3 mg/liter. Theoretical analysis, using a model relating upwelled reflectance to backscattering and absorption parameters, confirmed the nonlinear nature of the experimental results. (Baker-FRC)
W82-05869

EVALUATION OF THE RATE OF UPTAKE OF NITROGEN DIOXIDE BY ATMOSPHERIC AND SURFACE LIQUID WATER,

Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
Y.-N. Lee, and S. E. Schwartz.
Journal of Geophysical Research, Vol 86, No C12, p11971-11983, December 20, 1981. 2 Fig, 2 Tab, 78 Ref.

Descriptors: *Nitrogen dioxide, *Surface water, Chemical reactions, Absorption, Sulfur, Water pollution sources, Solubility, Chemistry of precipitation, Acid rain, Catalysts, Clouds.

The rate of uptake of nitrogen dioxide by liquid water was shown to be unaffected by oxygen at 0.2 atm pressure. Therefore, the rate constant and Henry's law solubility constant of nitrogen dioxide previously obtained may be used to evaluate the rates of aqueous phase reactions of nitrogen dioxide in the ambient atmosphere. Reactions are quite slow at representative atmospheric partial pressures and cloud liquid water content. The characteristic times range upward from 1000 to 10000 hours at 0.1 microatm, increasing with decreasing partial pressures of the gases. Direct acidification of cloud liquid water is also unimportant. Catalytic enhancement is potentially important for catalyst concentrations of the order of 0.1 microatm, assuming sufficiently fast rate constants. Iron-catalyzed reaction in particular was unimportant. Reaction of nitrogen dioxide with dissolved sulfur is potentially important, based on an assumed upper limit rate constant of 0.25 micromolar per sec. Deposition of nitrogen dioxide to surfaces of oceans or lakes is shown to be controlled by aqueous phase mass transport and/or reaction and is much slower than heretofore assumed. (Baker-FRC)
W82-05873

2L. Estuaries

SEDIMENT WATER EXCHANGES OF NUTRIENTS AND OXYGEN ON TIDAL FLATS IN THE EMS-DOLLART ESTUARY,

Nederlands Inst. voor Onderzoek der Zee, Texel. Biological Research Ems-Dollart Estuary.
M. M. Rutgers Van Der Loeff, F. B. Van Es, W. Helder, and R. T. P. De Vries.
Netherlands Journal of Sea Research, Vol 15, No 1, p 113-129, October, 1981. 9 Fig, 2 Tab, 50 Ref.

Descriptors: *Estuaries, *Tidal flats, *Nutrients, *Oxygen uptake, *Light penetration, *Marine sediments, Tidal marshes, Cycling nutrients, Oxygen balance, Silica, Nitrogen, Oxygen, Phosphates, Nitrate, Ammonia, Interstitial water, *Netherlands, Ems-Dollart Estuary.

The relationship between oxygen exchange and nutrient exchange on the tidal flats of the Ems-Dollart Estuary of the Netherlands was examined by bell jar experiments in an attempt to qualitatively evaluate the effect of these exchanges on the nutrient budgets of the estuary. At two sampling stations, the exchange of ammonia and silica was correlated with oxygen exchange and light conditions. Throughout the entire year, the Heringsplaat in the Dollart River was a sink for nitrate, ammonia, and silica in both light and dark periods even during periods of net oxygen consumption. The other two sampling sites showed different patterns due to a longer emersion period at the Heringsplaat and a greater supply of nutrients. In general, phosphate exchange was low, except at the Heringsplaat in June, where a release of 1 mmol/sq m/day was recorded. In the Dollard, a net release of silica in late summer was attributed to the dissolution of suspended material in the water phase. Inorganic nitrogen supplies may become depleted at the sediment surface during emersion, thereby restricting the growth of diatoms. (Geiger-FRC)
W82-04751

COMPOSITION AND DISTRIBUTION OF DISSOLVED FLUORESCENT SUBSTANCES IN THE EMS-DOLLART ESTUARY,

Nederlands Inst. voor Onderzoek der Zee, Texel. Biological Research Ems-Dollart Estuary.
R. W. P. M. Laane.
Netherlands Journal of Sea Research, Vol 15, No 1, p 86-99, October, 1981. 3 Fig, 2 Tab, 35 Ref.

Descriptors: *Estuaries, *Decomposing organic matter, *Fluorescence, Water analysis, Mixing, Salinity, Tracers, Environmental tracers, Organic matter, Distribution, Decomposition, Temperature, Hydrogen ion concentration, Phytoplankton, *Netherlands, Ems-Dollart Estuary.

From October 1978 to October 1980, the fluorescence was measured in the Ems-Dollart Estuary to characterize the mixing patterns of the waters and identify the types of matter connected with the fluorescence. It was concluded that the fluorescence originates from fluvial sources and behaves conservatively from the linearity of the inverse relation between fluorescence and salinity. At high salinity, there was an increase in fluorescence during the summer months in the outer portions of the estuary. These increases could be due to accumulated fluorescent matter due to slower decomposition at high salinities, in situ formation of fluorescent substances from the degradation of phytoplankton changes in water temperature or pH causing a disturbance in the equilibrium between dissolved particulate and dissolved fluorescent substances, or a combination of these. Ultrafiltration was performed during five surveys between February and August of 1980 to determine the polymeric character of the fluorescent matter. A fraction with molecular weight < 500 showed a high contribution to the total fluorescence for all dates. It was deemed possible for the measure of aggregation of fluorescent matter to fluctuate during transport through the estuary. (Geiger-FRC)
W82-04752

SEDIMENT TRANSPORT AND SHOALING IN ESTUARINE AND OTHER SHALLOW-WATER AREAS,

Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
J. C. Ludwick, and C. E. Grosch.
Ocean Science and Engineering, Vol 6, No 2, p 163-194, 1981. 88 Ref.

Descriptors: *Sediment transport, *Estuaries, *Shoals, Shallow water, Sedimentation, *Sediment distribution, Estuarine environment, Environment, Bed load, Sediment load.

This paper discusses four sediment transport formulations, with the aim of emphasizing the need to understand mechanics of the problem in spite of the present incompleteness of the solutions. Knowledge of sediment transport mechanics, particularly the sediment transport continuity equation, can increase insight into erosion and deposition. Specific discussion is offered on the Shields Bed Load transport equation, which pertains to a sediment bed on which the surface grains are in strong motion and hence no longer form a flat surface, but instead are shaped into scales or bars of low height to length ratio. Also discussed are the Einstein and Einstein-Brown equations for bed load transport, the 1950 Einstein bed load transport function, and the Bagnold 1973 formulation for bed load transport rate. (Baker-FRC)
W82-04753

MODELING: HOW AND WHEN TO USE,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. H. McAnally, Jr.
Ocean Science and Engineering, Vol 6, No 2, p 149-162, 1981. 12 Ref.

Descriptors: *Model studies, *Estuarine environment, *Sedimentation, *Sediment transport, Cost analysis, Economic aspects.

In order to determine if modeling is an appropriate approach to specific problems, the physical processes contributing to a sedimentation problem must be understood. Potential sources of estuarine sediments include: upland drainage basins; the estuary itself through erosion of banks, bottoms and marshes; the ocean; municipal and industrial wastes; windborne sediment; and organic materials. Different sediments will predominate in different parts of an estuary. Estuarine sedimentation is dependent upon the supply of depositable sediment and flow conditions near the bed. Four primary

methods are used for studying estuarine sedimentation - field methods, analytical methods, physical modeling and numerical modeling. Numerical modeling is relatively new and employs special computational methods such as iteration and approximation to solve mathematical expersions that do not have closed form solutions. Numerical modeling provides much more detailed results than analytical methods and may be more accurate, but is also more expensive and time consuming. Modeling should be employed when the cost or importance of the problem justifies the time and cost of modeling and the dominant processes involved are susceptible to modeling. Most estuarine construction projects are either very expensive or possess the potential for expensive side effects. (Baker-FRC)
W82-04754

INVESTIGATIONS ON THE SEDIMENTATION IN THE DARST-ZINGST BODDEN CHAIN - A CONTRIBUTION TO ESTABLISHMENT OF AN ENERGY AND MATTER BALANCE IN THE ECOSYSTEM. PART 2: RESEARCH ON THE SEDIMENTATION OF PLANKTON. (UNTERSUCHUNGEN ZUR SEDIMENTATION IN DER DARSS-ZINGSTER BODDENKETTE EIN BEITRAG ZUR AUFSTELLUNG EINER ENERGIE-UND-STOFFBILANZ IM OKOSYSTEM. TIEL 2: UNTERSUCHUNGEN ZUR SEDIMENTATION DES PLANKTONS),

Rostock Univ. (German, D.R.).
M. Nausch-Stengel.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 71-82, 1980. 5 Fig, 8 Tab, 16 Ref. (No English summary).

Descriptors: *Sedimentation, *Zooplankton, *Phytoplankton, *Estuarine environment, Boddens, Bays, Salinity, Productivity, Detritus, *Baltic Sea, Coastal waters, Lagoons.

Complex studies on the hydrographic and biological regime have been underway in the area of the shallow bays (bodden) to the south of the Darss and Zingst peninsulas since 1969. The relationships between the water body and the sediment are especially close in shallow water areas such as those studied. In the current investigation, quantitative and qualitative studies were performed on the sedimentation of the phytoplankton and zooplankton in the western portion of the Bodstedter Bodden. The phytoplankton sedimentation rate varies with the species, but in general the groups most numerous in the water are also most common in the sediment. The two peaks observed in the phytoplankton growth in the water were reflected without time lag in the detritus (August 6 and 14, 1975). The Bacillariophyceae had the highest sedimentation rate. The sedimentation rate of the Chlorophyceae was greater than that of the Cyanophyceae, but the absolute numbers of the former were smaller. Very high zooplankton abundances were found, averaging 27,000 individuals/liter. Rotatoria represented the most common species. The organisms found were freshwater species. Interpretation due to the sporadic occurrences of some species. The small numbers of sedimenting zooplankton were balanced by their greater biomass, and relative to their occurrence in the water, larger numbers of zooplankters sedimented each day. A total mean plankton sedimentation rate accounting for 16% of the deposition volume was found. (Carroll-FRC)
W82-04761

INVESTIGATIONS ON THE SEDIMENTATION IN THE DARSS-ZINGST BODDEN WATERS - A CONTRIBUTION TO THE ESTABLISHMENT OF AN ENERGY AND MATTER BALANCE IN THE ECOSYSTEM. PART 1: THE DETERMINATION OF THE RATE OF SEDIMENTATION AND PRODUCTIVITY FACTORS OF SEDIMENTED MATERIAL (UNTERSUCHUNGEN ZUR SEDIMENTATION IN DEN DARSS-ZINGSTER BODDENGEWASSERN - EIN BEITRAG ZUR AUFSTELLUNG EINER ENERGIE- UND STOFFBILANZ IM OKOSYSTEM. TEIL 1: DIE BESTIMMUNG DER SEDIMENTATIONSRATE UND DIE ERFASSUNG PRODUKTIONSBIOLOGISCH WICHTIGER PARAMETER DES SEDIMENTIERTEN MATERIALS).

Rostock Univ. (German, D.R.).
M. Nausch-Stengl, G. Schlungbaum, and J. A. von Oertzen.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 58-69, 1980. 3 Fig, 1 Tab, 31 Ref. (No English summay).

Descriptors: *Sedimentation, *Estuarine environment, *Productivity, Chemical oxygen demand, Organic matter, Boddens, *Baltic Sea, Bays, Coastal waters, Lagoons, Shallow water, *Energy balance, Phosphorus, Iron.

The boddens to the south of the Darss and Zingst peninsulas are a system of communicating water bodies connected with the Baltic Sea and presenting estuarine conditions, with salinities decreasing with distance from the Baltic. The water is very shallow (average depth 1.7 m, maximum 12 m); wind-induced turbulence can constantly rearrange large areas of sediment surface, making sedimentation studies very difficult. Studies were conducted at a relatively sheltered site when the salinity was relatively high (0.5%) and the water was warm (average for August 1975, 18-19 C). Two types of sediment traps were used: plastic funnels and settling tubes; best results were achieved with the funnels. An average sedimentation rate of 1316 ml/sq m was measured for July/August 1975, with a dry matter content of 16.4 g/sq m. The organic matter content (loss on ignition) was 64.4% on August 1, and the COD was 786 mg 02/mg dry matter. The iron/phosphorus ratio averaged around 2.5 in freshly sedimented material. An estimation of the energy content of the sediment suggested that about 1% of the solar irradiation is initially stored in the sediment. The information obtained will be used for formulating a mathematical model of the ecosystem. (Carroll-FRC)
W82-04762

DETERMINATION OF TRACE METALS IN ESTUARINE SEDIMENTS BY GRAPHITE-FURNACE ATOMIC ABSORPTION SPECTROMETRY,

National Research Council of Canada, Ottawa (Ontario). Div of Chemistry.
For primary bibliographic entry see Field 5A.
W82-04893

DISTRIBUTION OF METHANOGENIC AND SULFATE-REDUCING BACTERIA IN NEAR-SHORE MARINE SEDIMENTS,

Connecticut Univ., Noank.
M. E. Hines, and J. D. Buck.
Applied and Environmental Microbiology, Vol 43, No 2, p 447-453, February, 1982. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Bacteria, *Marine sediments, Sedimentation, Sediments, Estuarine environment, Sulfates, Population dynamics, Methanosarcina, *Long Island Sound.

Populations of both methanogenic and sulfate-reducing bacteria were investigated in various sediments of eastern Long Island Sound and contiguous waters to determine whether their distribution agreed with previous hypotheses. The findings suggested that the distribution of abundant methanogenic and sulfate-reducing bacteria were mutally exclusive in these marine sediments. Three distributional patterns were noted. Four sites exhibited methanogenic and sulfate-reducing populations which were restricted to the upper 10 to 20 cm, with a predominance of sulfate reducers. Three sites in western Long Island Sound exhibited a methanogenic population most abundant in sediments deeper than those occupied by sulfate reducers. At one site which was influenced by fresh groundwater, methanogens and sulfate reducers were numerous within the same depths, however, the number of sulfate reducers varied vertically and temporally with sulfate concentrations, Methanogenic enrichments yielded all genera of methanogens except Methanosarcina, with the methanobacteria predominating. (Baker-FRC)
W82-04894

SEASONAL DISTRIBUTION OF BDELLOVIBRIOS AT THE MOUTH OF THE PATUXENT RIVER IN THE CHESAPEAKE BAY,

Maryland Univ., Baltimore. Dept. of Microbiology.
H. N. Williams, W. A. Falkler, Jr., and D. E. Shay.
Canadian Journal of Microbiology, Vol 28, No 1, p 111-116, 1982. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Bdellovibrios, *Bacteria, *Seasonal variation, Vibrios, Rivers, *Patuxent River, *Chesapeake Bay, Marine bacteria, Predators, Estuaries.

Marine bdellovibrios, bacterial predators of susceptible gram-negative bacilli, were cultured from samples taken monthly from June 1979 to June 1980 at the end, middle, and shoreline of a pier at Solomon's Island, Maryland in the mouth of the Patuxent River, Chesapeake Bay. The number of bdellovibrios was highest in April-June and decreased to a low in January-March. With one exception the shoreline site had higher counts than the middle and end of the pier. The number of bdellovibrios was also significantly correlated with water temperature. In July-September, the mean water temperature was 26 C, slightly above the 23-25 C temperature for optimum growth. Bdellovibrios (in plaque-forming units per 10 ml) recovered at the shoreline site were: 178.8 + or - 205.5 in April-June, 158.7 + or - 145.8 in July-September, 91.8 + or - 16.0 in October-December, and 7.2 + or - 6.7 in January-March. (Cassar-FRC)
W82-04924

A NEW METHOD OF CUBATURE USING SPLINE FUNCTIONS,

Louvain Univ. (Belgium). Applied Mathematics Div.
P. Dierckx, E. Smets, R. Piessens, and M. Temmerman.
Deutsche Hydrographische Zeitschrift, Vol 34, No 2, p 61-69, 1981. 7 fig, 4 Tab, 13 Ref.

Descriptors: *Tidal basins, *Discharge measurements, *Water level fluctuations, Tidal rivers, Cubature calculations, Spline approximations, *Schelde Basin, Estuaries, River basins, Stream discharge, Flood discharge, Ebb discharge, Netherlands, Belgium.

This paper presents a new method for cubature calculations to obatin a value for river discharge which is more accurate than those obtained by measurement of current velocities. The method uses measurements of water level variations in a limited number of cross sections along with a knowledge of the geometry and upstream discharge. Spline approximations are constructed for the discharge variations in several rivers in a given tidal basin. This smooths out the effects of measuring errors. The approximations may be evaluated for any location or time in the total region. Ebb and flood volumes can be easily evaluated. The Schelde tidal basin, the Netherlands and Belgium, is used to illustrate the calcualtion procedure. (Cassar-FRC)
W82-04939

THE ECOLOGY OF PLANKTON FAUNA IN SALINE RIVER POOLS,

Western Australia Inst. of Tech., Perth. Dept. of Biology.
R. J. Rippingale.
Hydrobiologia, Vol 82, p 223-232, 1981. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Saline water, *Plankton, *Estuaries, Fauna, Benthic fauna, Rivers, Ponds, River pools, Salinity, *Swan-Avon River system, *Australia.

The occurrence of a planktonic copepod typical of estuaries in pools of the Swan-Avon river system is investigated. Plankton samples were taken from a number of pools during 1972 and 1979. Any discussion of the mechanism for the initial recruitment of an estuarine fauna into saline river pools during this century can only be speculative. Upstream penetration could not have occurred due to rapids and periods at which the river bed is dry. One transport mechanism which is possible would in-

volve the use of waterfowl. However, recriutment must be a continual event, as the Sulcanus conflictus could not survive winter floods in this area. The fact that dense populations of adult S. conflictus frequently dominate the saline pools is explained by their omnivorous feeding habit. S. conflictus exploits phytoplankton in the estuaries and saline river. Thus with the ability to survive both as a filter feeder and a predator, and with significant tolerance to low environmental salinities, S. conflictus was able to extend its range into the saline pools of the Avon River when this habitat became available during historical times through increase in groundwater salinities. (Baker-FRC)
W82-04941

A SYSTEM FOR MEASURING METHANE FLUXES FROM INLAND AND COASTAL WETLAND ENVIRONMENTS,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
D. I. Sebacher, and R. C. Harriss.
Journal of Environmental Quality, Vol 11, No 1, p 34-37, January-March, 1982. 3 Fig, 30 Ref.

Descriptors: *Wetland, *Methane, Measuring instruments, *Air-water interfaces, Interfaces, Fluctuations, Monitoring, Bayous, Bogs, Fens, Marshes, Muskeg, Swamps, *Tide lands, Estuaries.

A simple monitoring system for measuring methane fluxes at the water-air interface in wetland environments has been developed and field tested. The system permits precise detection of methane emission rates as low as .0001 g methane per square meter per day in 5 minutes or less. Systematic studies on the importance of methane in the carbon budget of flooded agricultural soils, wetland waste management sites, salt marshes and inland wetlands may be possible. The method employs a partitioned chamber placed over the water surface where the air velocity along the surface can be controlled. Emission rates of gas across an air-water interface are controlled by shear stress of winds in the overlying gas. Therefore the objective of the present studies was to develop a relatively simple field system with the capability of quantitatively controlling air velocity over water surface within the chamber sampling area. The technique has the important advantage of including a continuous monitoring system so that data can be observed on site. Measurements obtained in a coastal wetland creek demonstrated that the methane flux passing through a water-atmosphere interface can be quantified as a function of air velocity over the water surface. (Baker-FRC)
W82-04989

SEVERAL PLUME FLOWS IN PURE AND SALINE WATER AT ITS DENSITY EXTREMUM,

State Univ. of New York at Buffalo, Amherst. Dept. of Mechanical and Engineering Aerospace.
For primary bibliographic entry see Field 2E.
W82-05088

A NOTE ON THE STRUCTURE OF THE HEAD OF AN INTRUSIVE GRAVITY CURRENT,

Cambridge Univ. (England). Dept. of Engineering.
For primary bibliographic entry see Field 2E.
W82-05089

COMPOSITION OF ESTUARINE COLLOIDAL MATERIAL: MAJOR AND TRACE ELEMENTS,

Maryland Univ., College Park. Dept. of Chemistry.
A. C. Sigleo, and G. R. Helz.
Geochemical et Cosmochimica Acta, Vol 45, No 12, p 2501-2509, December, 1981. 6 Fig, 4 Tab, 38 Ref.

Descriptors: *Chemical composition, *Colloidals, *Estuaries, Trace levels, Seasonal variation, Aluminum carbon, *Patuxent River, *Maryland.

Instrumental neutron activation analysis was used to analyze colloidal sized material from the Patuxent River estuary, in Maryland, for more than 30 elements, Data on samples taken from five stations, ranging in salinity from 0.04 grams per kiogram (g/kg) to 12 g/kg, in February and June indicate that the winter colloidal material is dominated upstream by poorly crystallized clay minerals and iron oxide, but that it consists primarily of carbonaceous material at salinities over 10 g/kg. During the winter, colloidal material decreases non-conservatively seaward from 29 to 0.6 milligram per liter. The summer colloidal material was found to be carbon-rich throughout the estuary and the amount of colloidal material in the upper water column did not change significantly with increasing salinity. Trace elements which covary with aluminum, including cesium, hafnium, rubidium, scandium, thorium, vanadium, and the REE, are probably associated with the clay component of the colloidal material. Other elements, including selenium, arsenic, barium, uranium, and zinc, were considerably enriched relative to aluminum and may covary with the organic component. These findings suggest that while the freshwater summer colloidal material is derived primary from estuarine biological processes, the winter colloidal system is a product of continental weathering processes. (Carroll-FRC)
W82-05137

EXPERIMENTAL STUDIES TO DETERMINE THE FATE OF PETROLEUM HYDROCARBONS FROM REFINERY EFFLUENT ON AN ESTUARINE SYSTEM,

Bermuda Biological Station, St. Georges West.
For primary bibliographic entry see Field 5B.
W82-05144

THE TRANSPORT TO AND DEPOSITION OF AMERICIUM IN INTERTIDAL SEDIMENTS OF THE RAVENGLASS ESTUARY AND ITS RELATIONSHIP TO PLUTONIUM,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-05178

MODELLING AND CONTROL OF DISSOLVED OXYGEN IN AN ESTUARY,

Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Electrical Engineering.
For primary bibliographic entry see Field 6A.
W82-05188

A NEW METHOD OF CUBATURE USING SPLINE FUNCTIONS,

Louvain Univ. (Belgium). Applied Mathematics Div.
P. Dierckx, E. Smets, R. Piessens, and M. Temmerman.
Deutsche Hydrographische Zeitschrfit, Vol 34, No 2, pp 61-79, August, 1981. 4 Tab, 7 Fig, 13 Ref.

Descriptors: *Discharge, *Floods, *Tides, *Mathematical studies, *Cross-sections, Tidal floods, Time series analysis, Basins, Flood basins, Equations, Simulation analysis, Seasonal variation, Hydrographs, Velocity, Flow discharge, Flood data, *Cubature, Water level fluctuations.

A new method for cubature calculations is presented. The cubature requires measured water-level variations in a limited number of cross-sections and knowledge of the geometry and of the upstream discharge as a boundary condition. By numerical integration of the continuity equation, spline approximations are constructed for the discharge variations in the different rivers of a given tidal basin. In that way measuring faults and their efects are smoothed out. Once the approximations are obtained, they can be evaluated in a quick and accurate way for any location in the tidal region and at any time. Derived quantities as ebb- and flood-volumes can be evaluated likewise, in a very simple procedure. A computer program based on this method is described. Some results from the basin of the Schelde estuary in the Netherlands and Belgium are presented; they confirm the validity of the method. (Titus-FRC)
W82-05189

THE TIDAL STREAM IN THE GERMAN BIGHT,

Deutsches Hydrographisches Inst., Hamburg (Germany, F.R.).
C. Brockmann, W. Lange, E. Mittelstaedt, and K. C. Soetje.
Deutsche Hydrographische Zeitschrift, Vol 34, No 2, pp 56-60, August, 1981. 1 Tab, 4 Ref.

Descriptors: *Bights, *Bays, *Estuaries, *Currents, *Time series analysis, Sounds, Estuaries, Hydrologic data, Water depth, Mathematical models, *German Bight, Tidal effects, Tidal currents.

A numerical model of the German Bight is presented and current measurements are compared with the model results. The model is three-dimensional with four layers in the German Bight, and two-dimensional in the coupled North Sea. Tidal stream vectors resulting from the model are compared with data obtained over a twenty year period for hourly intervals in spring high water conditions. Spring conditions were chosen for simulation because during this time the diurnal inequalities of the tides are minimum. The model currents compare well with the observed tidal streams in areas with water depths greater than 10 meters. In shallower regions local topographic differences influence currents. (Titus-FRC)
W82-05190

INITIAL COLONIZATION OF ARTIFICIAL SUBSTRATE: COMMUNITY DEVELOPMENT AND STRUCTURE STUDIED BY SCANNING ELECTRON MICROSCOPY,

Laval Univ., Quebec. Dept. de Biologie.
C. Hudon, and E. Bourget.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1371-1384, November, 1981. 7 Fig, 7 Tab, 49 Ref.

Descriptors: *Substrates, *Population dynamics, *Estuaries, Bacteria, Diatoms, Electron microscopy, Intertidal areas, Canada, *St. Lawrence Estuary.

A 90 kilometer section of the south shore of the lower St. Lawrence Estuary, which is influenced by strong semidiurnal tides, was used for a quantitive study of the community development and biological interactions occurring in a slow-growing, low-density periphytic assemblage. The initial phases of the subtidal and intertidal community development were observed using scanning electron microscopy on samples from plastic panels immersed monthly in the estuary between May and November 1978. The community structure was significantly influenced by the pattern of immersion and/or periodical emersion. Subtidal panels were rapidly colonized by bacteria, while diatoms settled 2 to 7 weeks later, depending on the season. All dominant species formed well-defined, generally monospecific clumps until mid-September. Clump overlap and increased species interactions occurred with higher cell densities. In the intertidal zone, bacteria settled after 8 to 12 weeks, while the only diatom species able to resist semidiurnal emersion, Achnanthes brevipes, appeared after 20 weeks. Panels emersed only at spring tides (monthly) were rapidly colonized by bacteria, with heavy diatom settlement occurring within 4 weeks. These diatom populations were eliminated or strongly reduced by successive monthly emersions and were replaced by filamentous algae. The various types of communities are compared and the strategic advantages of vertical growth discussed with reference to population density, light availability, and detrital cover. (Carroll-FRC)
W82-05193

DISTRIBUTION OF SUSPENDED SEDIMENT IN THE PATUXENT RIVER, MARYLAND DURING DREDGING OPERATIONS FOR CONSTRUCTION OF A PIPELINE,

Columbia Gas System Service Corp., Wilmington, DE.
For primary bibliographic entry see Field 2J.
W82-05198

THE ECOLOGY OF SOUTHERN CALIFORNIA COASTAL SALT MARSHES: A COMMUNITY PROFILE,

San Diego State Univ., CA. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W82-05215

DYNAMIC ESTUARY MODEL PERFORMANCE,

Environmental Research Lab., Athens, GA.
R. B. Ambrose, Jr., and S. E. Roesch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 51-71, February, 1982. 5 Fig, 7 Tab, 17 Ref.

Descriptors: *Estuaries, *Model studies, Mathematical models, Estuarine environment, *Delaware Estuary, *Potomac Estuary, Water quality, Sediment transport, Hydrodynamics, Mass transfer, *Tidal effects, Inflow, Rainfall impart, *Stream discharge.

This report evaluates how well the dynamic estuary model (DEM) simulates historical hydrodynamic, mass transport, and water quality data in the Delaware and Potomac Estuaries. The Delaware and Potomac Estuaries are drowned river valleys. Well-defined heads-of-tide are located at the fall line between the piedmont and coastal plain. Freshwater inflow controls the net seaward advection. Wind stress adds a significant stochastic variation. Dredging is required to maintain navigational channels. The Delaware Estuary application of the DEM yielded coefficients of variation between 2% and 10% for the most important hydrodynamic variables, between 13 and 45% for the important transport variables, and between 15 and 41% for the water quality variables. The Potomac Estuary application gave coefficients of variation from 5 to 7% for the hydrodynamics, 5 to 44% for the transport, and 11 to 267% for water quality. The Potomac water quality response falls between 11 and 90%. Correlation coefficients showed the same trends. These statistics reveal the DEM to be basically reliable when operated within the range of conditions for which it is calibrated and tested. Certain limitations should be remembered. The model cannot reliably predict transient or steep concentration gradients with precision exceeding 5 kilometers or three hours. Above these limits the model is limited by the precision of the input data and the nature of the water quality structure implemented. The model should be able to predict relative changes in water quality expected from incremental wastewater management alternatives. (Baker-FRC)
W82-05319

CONTAMINANT DISPERSION IN OSCILLATORY FLOWS,

Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 5B.
W82-05631

WETLANDS AND DEEPWATER HABITATS: A NEW CLASSIFICATION,

Fish and Wildlife Service, Jamestown, ND. Northern Prairie Wildlife Research Center.
L. M. Cowardin.
Journal of Soil and Water Conservation, Vol 37, No 2, p 83-85, March/April, 1982. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Wetlands, *Classification, *Habitats, Marshes, Swamps, Vegetation, Hydrophytes, Soil types, Water chemistry, Lakes, Rivers, Estuaries, Marine environment, Aquatic habitats, Deep-water habitats.

A new classification system for wetlands and deep water habitats was developed by the Fish and Wildlife Service starting in 1974 with a national wetlands inventory. The system is hierarchical (system, subsystem, class, subclass). The first level (system) includes marine, estuarine, riverine, lacustrine, and palustrine. These are further divided into subsystems: subtidal and intertidal for marine and estuarine; tidal, lower and upper perennial, and intermittent for riverine; and limnetic and littoral for lacustrine. Classes include some of the following, depending on the subsystem: rock bottom, unconsolidated bottom, aquatic bed, reef, rocky-shore, unconsolidated shore, streambed, emergent wetland, scrub-shrub wetland, forested wetland, and moss-lichen wetland. Classes are defined by form of vegetation or substrate composition. Modifying terms are used with the classes--water regime, water chemistry, soils, and dominance type. Classes are divided into subclasses on the basis of the same attributes used to form classes. An example of the classification of a specific Massachusetts salt marsh is as follows: System: Estuarine; Subsystem: Intertidal; Class: Emergent wetland; Subclass: Intertidal; Subclass: Persistent; Water regime: Regularly flooded: Water chemistry: Mixohaline; Soil: Organic (Sulfihemist); and Dominance type: Spartina alterniflora. (Cassar-FRC)
W82-05716

PHYSICOCHEMISTRY OF WATER IN THE ST. LAWRENCE GULF AND ESTUARY (PHYSICO-CHIMIE DES EAUX DU GOLFE ET DE L' ESTUAIRE SAINT-LAURENT),

Quebec Univ., Rimouski. Inst. National de la Recherche Scientifique.
For primary bibliographic entry see Field 5B.
W82-05763

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES, II. KNYSNA RIVER,

National Physical Research Lab., Pretoria (South Africa).
For primary bibliographic entry see Field 5B.
W82-05897

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

VTE/VC FOR SEA WATER,

Envirogenics Systems Co., El Monte, CA.
C. H. Hughes, and D. K. Emmermann.
Chemical Engineering Progress, Vol 77, No 7, p 72-73, July, 1981. 2 Fig.

Descriptors: *Desalination plants, *Evaporation, *Distillation, *Seawater, Vertical tube evaporation, Vapor compression, Energy, Reverse osmosis, Multistage flash distillation, Heat transfer.

A combined vertical tube evaporation and vapor compression process has been applied to sea water desalination. Since the performance ratio of this process increases almost linearly with the number of effects in the unit, the process has an advantage over multistage flash distillation when energy is at a premium. For a 24-effect process the practical performance ratio of 21 is raised to 42 by passing the boiler steam through a turbine to drive the vapor compressor of the topping effect. The compressor elevates the saturation temperature of the stream so it can be used as heating steam in the same effect. The vapor condensed in the topping effect increases total distillate production by 100% with no increase in heat. This process has been incorporated in a barge-mounted plant capable of producing 5000 cu m of water per day. It also uses partial softening of seawater feed by ion exchange pretreatment. (Cassar-FRC)
W82-04909

RECONNAISSANCE SAMPLINGS AND CHARACTERIZATION OF AQUATIC HUMIC SUBSTANCES AT THE YUMA DESALTING TEST FACILITY, ARIZONA,

Geological Survey, Denver, CO. Water Resources Div.
R. L. Malcolm, R. L. Wershaw, E. M. Thurman, G. R. Aiken, and D. J. Pinckney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-177965, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-42, 1981. 79 p, 9 Fig, 31 Tab, 21 Ref.

Descriptors: Fulvic acids, *Reverse osmosis, *Mmbrane processes, Chromatography, Chlorination, Clay minerals, *Desalination, Fouling, Water quality, Chemical analysis, *Arizona, *Yuma Desalting Test Facility.

Smectite clay minerals were found to be the principal compound on the surface of the cellulose-acetate, reverse-osmosis membranes at the Yuma Desalting Test Facility. These clay minerals were not present in the pumped ground water, but were blown into the conveyance canal from adjacent soils. Humic substances from the water and suspended sediments were associated with the clay films on the membrane, but no definitive results concerning their role in fouling were achieved. Microbial fouling is believed to be only a minor aspect of membrane fouling. Chemical and physical changes in humic substances were extensively studied at four points in the water-treatment process. Humic substances accounted for the largest component (over 25 percent) of organic constituents. Humic substances in the canal source water were similar to other aquatic humic substances present in natural waters. During the treatment process, these substances are brominated and decolorized. The effect of these halogenated humic substances on membrane fouling is unclear, but their presence in the reverse-osmosis product water and reverse-osmosis reject brine, along with volatile trihalomethanes, has led to environmental concerns. (USGS)
W82-04983

LOW TEMPERATURE EVAPORATION PLANTS,

Isreal Desalination Engineering Ltd., Tel-Aviv.
D. Hoffman.
Chemical Engineering Progress, Vol 77, No 10, p 59-62, October, 1981. 6 Fig.

Descriptors: *Desalination, *Distillation, *Evaporation, Seawater, Saline water, Temperature, Vapor compression distillation, Scaling, Low temperature operation, Energy, Heat transfer, Wastewater treatment, Corrosion.

Low-temperature plants for seawater distillation have significant advantages over conventional distillation plants. These low-temperature plants commonly operate at 30-55 C with a maximum of 75 C. At these temperatures scale formation from non-acid soluble scalants (magnesium hydroxide and calcium sulfate) and soft acid-soluble calcium carbonate scales is minimized, allowing operation up to 2.5 years without cleaning. In addition, low cost PVC and other plastics may be used. A relatively inexpensive aluminum alloy, superior in heat transfer and corrosion resistance, may be used in place of copper-nickel alloys or steel. Low-temperature vapor compression plants require small feed heat exchangers, little or no insulation, no make-up heat, and permit quick start-up. The same features are applied to multi-effect distillation plants. A 2000 cu m per day plant operates on heat rejected from a 20-MW diesel generator station. The only other energy requirements are 1.5 kW per hour per cu m for process pumping. Concentrators operating at low temperatures can concentrate brackish water by a factor of 300 to 1 (99.5% product recovery) and seawater by a factor of 7 to 1 (85% product recovery). These concentrators produce a distillate of < 5 ppm total dissolved solids and are readily incorporated in zero discharge disposal systems for cooling tower blowdown and other effluents. (Cassar-FRC)
W82-05118

FOAM FRACTIONATION-FLOTATION AS PARTIAL PRETREATMENT FOR REVERSE OSMOSIS,

H. H. Sephton, and D. P. Antonoff.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224676, Price codes: A03 in paper copy, A01 in microfiche. Report, July 1981. 25 p, 6 Fig, 5 Tab, 19 Ref. OWRT S-0075(No 7539(1), 14-34-0001-7539.

Descriptors: *Reverse osmosis, *Foam separation, *Flotation, *Pretreatment of water, *Desalintion, Water quality, Water treatment, Membranes, Turbidity, Coastal waters, Baseline studies, Membrane processes, Seawater, Clarification, Filtration, Saline water, Surface tension, Conductivity, Technology, San Francisco Bay water.

Foam flotation equipment designed, constructed, and tested to assess its utility as a partial pretreatment method on San Francisco Bay water prior to its desalination by reverse osmosis (RO). Test data obtained from a dual-flow facility revealed that foam flotation is effective in reducing feed turbidity, usually by a factor of five (ranging from 3-fold to 10-fold) in terms of national turbidity units. However, due to the poorly-matched single pair of RO units employed, the results could not detect whether feed clarity improvement significantly affected the flux decline or quality of the desalted water produced by RO. The dual-flow facility was comprised of two pretreatment and RO trains and was used for simultaneous comparative testing of conventional cartridge filtration and for the further foam flotation clarification, followed by RO applied to both pretreated feed streams. Surface tension, membrane plugging, and water conductivity were also monitored. The results of this study indicate that further evaluation using well-matched pairs of RO ion-exchange membranes is justified. (Zielinski-MAXIMA)
W82-05290

RESEARCH ON PIEZODIALYSIS - SIXTH REPORT,

Ionics, Inc., Watertown, MA.
R. B. Hodgdon, S. S. Alexander, and C. M. Swenson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224692, Price codes: A04 in paper copy, A01 in microfiche. Report, December 1975. 49 p, 9 Fig, 6 Tab, 4 Ref. OWRT (No 3248)(1), 14-30-3248.

Descriptors: *Desalination apparatus, *Polyelectrolytes, *Membranes, *Ion exchange, *Baseline studies, Desalination, Anions, Cations, Saline water, Seawater, Enrichment, Ion transport, Anion exchange, Cation exchange, Membrane filters, Water treatment, Water quality, Water quality control.

Two new types of double polyelectrolyte membranes were developed and tested for their application in the desalinization of water by piezodialysis. Membrane I was a fixed (crosslinked) anionic ion-exchanger membrane filled with soluble (linear) cationic polyelectrolyte; membrane II was a fixed cationic ion-exchanger membrane filled with fixed anionic ion-exchanger sites or islands, representing a true mosaic membrane. Both membrane types had their polyelectrolyte island at/near 0.1 micron diameter. Both types showed capability for salt enrichment under applied pressure, while mosaics having polyelectrolyte islands of only 0.003 microns failed to give salt enrichments. Pressure, anion-cation capacity ratios, crosslink density, pore volumes, and salt concentrations were the most important variables affecting salt enrichment. While salt enrichments of these new membranes were less than for latex-polyelectrolyte membranes studied earlier, the new membranes can be easily and reproducibly prepared without mosaic polyelectrolyte loss. Membranes having desalting capacities of 6000-500 ppm NaCl at a production rate of 1 gallon/sq ft/day should be feasible. (Zielinski-MAXIMA)
W82-05294

PARAMETRIC ANALYSIS OF DIRECT-CONTACT (PISTONLESS) WORK EXCHANGER FOR REVERSE OSMOSIS APPLICATIONS,

Hittman Associates, Inc., Columbia, MD.
H. M. Curran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224825, Price codes: A08 in paper copy, A01 in microfiche. Final Report, HIT-580, August, 1974. Hittman Associates, Inc., Columbia, MD. 69 p, 24 Fig, 13 Tab, 10 Ref, 1 Append. OWRT C-(No 3264)(1), 14-30-3264(1).

Descriptors: *Economic evaluation, *Cost-benefit analysis, *Mechnical engineering, *Desalination, *Reverse osmosis, *Energy transfer, Parametric hydrology, Flow system, Flow discharges, Economic feasibility, Economic justification, Economic efficiency, Economic prediction, Energy loss, Energy dissipation, Cost analysis, Electric power costs, Estimated costs, Operating costs, Flow discharge, Flow rates, Brine disposal, Saline water.

A direct-contact (pistonless) work exchanger concept was analyzed parametrically to determine its economic potential as an alternative to the hydraulic turbine for recovery of flow work from high pressure brine streams discharged by reverse osmosis (RO) plants. The results showed that, for the use of work exchangers to recover energy from RO brine discharges, the break-even unit cost of electric energy increases as the brine volumetric flow rate decreases. Hence, the most cost-effective applications are those with high brine flow rates. The break-even cost at which the exchanger starts to provide a net unit water cost reduction ranges from about $0.004/Kw-hr (for a 1.3 million gallons/day (MGD) RO seawater plant with 1500 psig module inlet pressure, concentration ratio of 2, and brine flow rate of 1000 gallons/minute (gpm), to about $0.058/Kw-hr (for a 0.05 MGD RO brackish water plant with 500 psig inlet pressure, concentration ratio of 5, and brine flow rate of 10 gpm). The results indicate that these exchangers apply best in large seawater RO plants operating at high pressure and low concentration ratio. Energy recovery in cost-effectiveness for such exchangers, however, is only equivalent to hydraulic turbines for flows below 100 gpm, and is less cost-effective above 100 gpm. (Zielinski-MAXIMA)
W82-05309

FABRICATION AND CHARACTERIZATION OF METAL MEMBRANES HAVING PORE CHARGE CONTROL FOR DESALINATION,

Allied Chemical Corp., Idaho. Idaho Chemical Programs-Operations Office.
G. L. Booman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224890, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1977. 12 p, 1 Tab. 14-01-0001-1291.

Descriptors: *Desalination apparatus, *Desalination, *Membranes, *Pore size, *Water treatment, Saline water, Membrane processes, Membrane filters, Filters, Pores, Water quality, Water quality control, Thin films, Brines, Seawater, Electrodialysis, Electro-osmosis, Electrical potential, Metallurgy.

Research studies assessed the soundness of the basic principle of using charged metal membrane separation for water desalination, and compared the effectiveness of the metal membranes with currently-available membranes. Desalination by charge control of metal membranes was experimentally verified as a sound concept. While only dilute KC1 solutions illustrated the desired salt rejection of greater than 99%, extension of this new technique to seawater compositions should be feasible with refinement of the membrane fabrication technique for 100 A (or similar) pore diameters in the electrically-controlled metal layer of the membrane. Fabrication of suitable metal membrane structures made use of microelectronics industry technology, with radio frequency sputter deposition as the primary method for thin film formation. Plasma etching, high temperature diffusion, fission fragment damage track etching, and various chemical etching procedures were used to fabricate appropriate structures. The use of microporous metal membrane structures for desalination would have unique advantages with respect to chemical resistance, cleaning ease, absence of compaction, thermal stability, biological inactivity, dry storage, and direct control of pore geometry for optimizing to specific applications. A U.S. patent (3,794,174; 'Porous Metal Insulator Sandwich Membrane') covering the charged metal membrane desalination concept evolved from this work. (Zielinski-MAXIMA)
W82-05314

OPERATING EXPERIENCES ON A REVERSE OSMOSIS PLANT WHICH CONVERTS SEA WATER INTO BOILER FEED WATER,

I. Vera.
Industrial Water Engineering, Vol 18, No 6, p 22-29, November/December, 1981. 4 Fig, 4 Tab, 2 Ref.

Descriptors: *Desalination, *Reverse osmosis, Membranes, Electric powerplants, Boiler water, Water treatment, Operating costs, Seawater, Venezuela.

The National Electric Company of Venezuela (CADAFE) operates a surface sea water reverse osmosis desalting plant, producing 1.7 mgd as of the end of 1981. The treated water, wiith less than 100 mg per liter total dissolved solids, is used as boiler feed water and potable water. The installation is expensive to operate, $7.63 per 1000 gal vs. $2.30 per 1000 gal for surface water (if it were available). Costs could be reduced further by prolonging the membrane performance and life. This may be attained by optimizing the pretreatment process, both equipment and chemical dosage. Problems encountered in maintaining a low turbidity feed to the membranes have been: large variation in raw water turbidity, accumulation of sediments at the seawater intake, occasional plugging of chemical feed lines, use of polyelectrolyte which had exceeded its shelf life, and improper frequency of filter backwash. Poor membrane performance was evident during early 1980. It was determined that iron corrosion products in the pumping system were fouling the membranes. Replacement of booster pump barrels with stainless steel eliminated fouling and improved membrane performance. (Cassar-FRC)
W82-05509

WATER AND SALT TRANSPORT IN MEMBRANES,

Michigan Technological Univ., Houghton. Dept. of Chemistry and Chemical Engineering.
K. S. Spiegler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232026, Price codes: A04 in paper copy, A01 in microfiche. Report, July 1981. 65 p, 20 Fig, 6 Tab, 48 Ref. C-80319-S(8539)(1). 14-34-0001-8539.

Descriptors: *Membrane processes, *Membranes, *Ion transport, *Theoretical analysis, *Desalination, Ion exchange, Ions, Salt rejection, Saline water, Saline-freshwater interfaces, Permeability, Permeability coefficient, Hydraulic conductivity, Electrolytes, Conductivity, Electrical properties, Hydraulic permeability, Experimental design, Waste transport, Experimental data.

Detailed theoretical aspects and experimental studies in membrane transport of water and salt are discussed. Accurate measurements were made of the isothermal transport of ions and water across a synthetic ion-exchange membrane. Conductivity probe-activated automatic feedback mechanism was employed in which electrolyte transport was determined from the amounts of electrolyte and water that needed to be added to and/or withdrawn from the half-cells separated by the membrane in order to keep the solution concentraton constant. Four types of experiments (electric conductivity; hydraulic permeability and streaming potential; electromigration and electroosmosis; and osmosis, dialysis, and membrane potential) were conducted, leading to the determination of eight independent transport coefficients using the developed apparatus. Membrane systems separated by two dilute NaC1 solutions in which Ag-AgC1 electrodes were immersed, permitted the checking of two reciprocity relations. These two reciprocities were found to hold for a cation-exchange membrane (CEM) studied, with the highest NaC1 concentration being 0.5N. Comparing the conductance coefficients obtained with this CEM to those of another membrane indicated that the CEM had higher permeability characteristics. (Zielinski-MAXIMA)
W82-05537

Group 3A—Saline Water Conversion

THE ROLE OF DESALTING TCHNOLOGY IN WATER SUPPLY, WASTEWATER REUSE AND INDUSTRIAL APPLICATIONS,

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236571, Price codes: A13 in paper copy, A01 in microfiche. Compilation of papers presented at four Technology Transfer Workshops, coordinated by the National Water Supply Improvement Association, November, 1981. 272 p, 72 Fig, 39 Tab.. C-80360-T(No 5709)(1),14-34-0001-8709.

Descriptors: *Desalination, *Conferences, *Water supply, *Industrial water, *Technology transfer, *Water supply development, Demineralization, Wastewater renovation, Water reuse, Water use, Technology, Water resources development, Water conveyance, Water requirements, Water conservation, Water demand, Civil engineering.

A compilation of papers presented at four 1978-79 technology transfer workshops on 'The Role of Desalting Technology in Water Supply, Wastewater Reuse and Industrial Applications' is presented. The material covered is focused towards the enhancement of water resources through technological applications of water demineralization. The papers are segregated into three major categories: overview; case histories; Federal and State programs. Participants of the workshops represent a cross-section of the water desalting industry, including engineering consultants, Federal, State, and local water engineers and managers, and representatives of water treatment equipment. As availability of usable water resources decreases and water demand increases, planners must consider greater use of advanced technologies for desalination and wastewater reclamation. Demineralization of brackish ground and domestic wastewater and seawater conversion are existing activity areas that need technological and practical growth. Topics considered include: desalting processes and pretreatment; wastewater reuse and groundwater recharge; reverse osmosis operations; industrial wastewater recovery through vapor compression evaporation; current and future desalting technology; desalination programs of the U.S. Department of Interior's Office of Water Research and Technology; and desalting operations in various localities (Virginia, Arizona, Texas, Colorado, California). (Zielinski-MAXIMA)
W82-05543

FIELD TEST EVALUATION RESEARCH AND DEVELOPMENT AND OPERATION AND MAINTENANCE OF REVERSE OSMOSIS SYSTEMS AND ELECTRODIALYSIS PILOT PLANTS AT ROSWELL TEST FACILITY.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236696, Price codes: A11 in paper copy, A01 in microfiche. First Annual Report, October, 1980. 212 p, 8 Fig, 92 Tab, 1 Append. OWRT C-(No 8515)(1), 14-34-0001-8515.

Descriptors: *Field tests, *Reverse osmosis, *Electrodialysis, *Pilot plants, *Feedwater treatment, Membrane processes, Test facilities, Pretreatment of water, Water tratment, On-site tests, Sites, Clarified water, Chlorination, Wastewater treatment, Water purification, Wastewater facilities, Microbiological studies, Desalination, Saline water, Brines, Management planning.

The primary objective of this work is to provide field evaluation testing of the reverse osmosis (RO) and electrodialysis (ED) pilot plants at the Roswell test facility (RTF). This report describes the blend systems, pretreatment systems, and pilot plants, and provides detailed information and test data on the performance of the pretreatment systems and pilot plants. Results of on-going research and development work on microbiological determination and control and details of the mechanical maintenance program are included. Four separate pretreatment and blend systems (a chlorinated and a nonchlorinated feedwater blend system, and two simulated feedwaters) were assessed at the RTF during the past year. In addition, activities were conducted in the operation and maintenance of 14 specific tests concerning RO systems, subsystems, test loops, and the ED reversal pilot plant. These tests included: long-term high-recovery performance evaluation with the RO stage using softened RO brine feedwater and use of concentrated brines for softener regeneration; independent evaluation of membrane performance using a simulated feedwater; evaluation of feedwater containing about 3000 ppm total dissolved solids with/without iodine; tests with/without chlorine; and tests on bacteriological effects. Detailed chemical and physical analysis results on the feedwaters and products are provided. (Zielinski-MAXIMA)
W82-05555

FURTHER RESULTS ON THE PERFORMACE OF PRESENT-DAY OSMOTIC MEMBRANES IN VARIOUS OSMOTIC REGIONS,

InterTechnology/Solar Corp., Warrenton, VA.
G. D. Mehta.
Journal of Membrane Sciences, Vol 10, No 1, p 3-19, 1982. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Osmosis, *Membranes, Wastewater treatment, *Reverse osmosis, *Membrane processes, Pressure retarded osmosis, Brines, Electric power generation, Saline water.

The performaces of osmotic membranes from several manufacturers were evaluated in osmosis, reverse osmosis (RO), and pressure retarded osmosis (PRO). Flat sheet, spiral-wound minimodules and hollow fiber minipermeators were tested for the purpose of concentrating brine in a salinity power system. Fourteen flat sheet membranes had a 1.2 to 3.0 times lower water permeation coefficient in osmosis than in RO. At higher osmotic pressures and with osmotic pressure on the porous substructure side, the water permeation coefficient in osmosis decreased. There was no permanent damage to the membrane. The UOP 4-port spiral-wound RO minimodule made of cellulose acetate was usable in PRO. However, performance was one order of magnitude less than required for economical power generation in a salinity gradient system. Water permeation coefficients (in cu m per sq m per day per atmosphere) were 0.015 for RO and 0.002 for PRO at lower pressures and 0 to 0.001 for PRO at higher pressures. The DuPont Permasep B-9 RO hollow fibers using potassium alum as the solute at 50-60 C in PRO had water permeation coefficients of 0.003, only 18% of that in RO with NaC1 at the same temperatures. Since most osmotic membranes are manufactured for RO, it will be necessary to improve the performance of membranes for use in PRO. (Cassar-FRC)
W82-05660

SEAWATER RO HEADS JAPAN'S WATER REUSE RESEARCH.

World Water, Vol 5, No 3, p 29, 31-32, March, 1982. 4 Fig, 2 Tab.

Descriptors: *Water reuse, *Reverse osmosis, *Desalination, Water conservation, Wastewater treatment, Seawater, Industrial water, Wastewater renovation, *Japan, Membranes, Advanced wastewater treatment, Sludge treatment, Reclaimed water.

The Water Reuse Promotion Center (WRPC) was established in Japan in 1973 to promote desalination technology in that country and abroad. As of January 1981 reverse osmosis accounted for 56.4% of installations, electrodialysis for 23.9%, and distillation for 19.7%. Reverse osmosis research and full-scale operations are active in Japan. In addition, several companies and cities remove salts from municipal sewage effluents to allow their reuse as industrial water. In Mitsubishi's 60-story building, a maximum of 1700 cu m per day of building wastewater is automatically treated for use in toilet flushing. The WRPC is also active in research involving wastewater treatment and sludge treatment and in data collection. (Cassar-FRC)
W82-05736

3B. Water Yield Improvement

FROGMEN'S SUBTERRANEAN SWIM SITES SOURCE,

For primary bibliographic entry see Field 8A.
W82-05501

RICE REIGNS SUPREME AS INDONESIA BUILDS UP THE SAWAHS,

World Water, Vol 5, No 2, p 22-23, February 1982. 2 Fig.

Descriptors: *Irrigation, *Water demand, Farming, Rice, Water supply, Water resources development, Indonesia, Java.

Improved and increased irrigation which has directed water onto every available strip of fertile land, particularly in Java, may make Indonesia self-sufficient in rice supply by the early 1980s. The Kali Progo project in the special province of Jogjakarta is typical of the large scale irrigation schemes being implemented. Population in the project area is 1,200/square km, and there is an urgent need to increase cropping capacity to enable farmers to live. To obtain optimum water flow the system required complete rehabilitation of canals, Construction of volcanic debris check dams and flood diversion channels, remodeling of major intakes, and reconstruction of a number of tributary weirs. The project stretches across a 30 km wide swathe of land containing a sawah area of 103,000 ha, fed by two main canals, the Kalibawang and the Mataram. (Baker-FRC)
W82-05502

CAN HARD-ROCK WELLS SOLVE AFRICA'S IRRIGATION PROBLEM,

D. Gear.
World Water, Vol 5, No 2, p 33-35, 37, February, 1982. 2 Fig.

Descriptors: *Water resources development, *Wells, Water supply, Drinking water, Africa, Irrigation, Water demand.

In African countries, hard rocks cannot usually be exploited economically for crop irrigation by tubewells due to the fact that their yield is too low to help solve water problems. Surface water irrigation is restricted to infrequent local combinations of favorable circumstances. Groundwater, however, can be economically exploited by the use of the most appropriate package of techniques. Crop irrigation using hard rock groundwaters would ideally be performed in separate family operated units, each averaging about one hectare. The shape, dimensions and orientation of the traditional Indian storage well, under the right conditions, enable it to draw upon a much larger volume of slowly permeable rock than does a tubewell, and allows a greater chance of intersecting a number of the more permeable collecting zones within the rock. Another advantage of the Indian storage well is that beyond a certain number of people served, it will usually provide drinking water at a lower cost than tubewells. A variation of the Persian wheel powered by draught animals, might be the most suitable water drawing device. Basin irrigation would probably be used, it is still a good method for unsophisticated conditions, but not the only one. Associated catchment, farm, land-use and water conservation practices are needed for a variety of reasons, including the extension of the period of water availability during adverse climatic conditions and the reduction of soil and timber fuel losses. (Baker-FRC)
W82-05503

THE APPLICABILITY OF LARGE-DIAMETER, SHALLOW WELLS TO A COASTAL PLAIN HYDROGEOLOGIC ENVIRONMENT, GEORGIA,

Georgia Southwestern Coll., Americus. Dept. of Geology and Physics.
B. F. Beck.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236621, Price codes: A03 in paper copy, A01 in microfiche. Report ERC 03-81, November, 1981. 37 p, 13 Fig, 4 Tab, 20 Ref. OWRT A-085-GA(1).

Descriptors: *Shallow wells, *Irrigation wells, *Coastal plains, *Stratigraphy, *Hydrologic aspects, Well water, Drilling, Water supply development, Sediments, Coastal aquifers, Hydraulic permeability, Theoretical analysis, field tests, On-site tests, Groundwater, Water quality, Economic aspects, Hydrologic system.

Research was conducted to determine the success of large-diameter shallow wells based on field evaluation of currently-used irrigation pits and a detailed examination of the area stratigraphy. Such wells may prove economically advantageous over deeper wells in the Georgia coastal plains. It was found that shallow Pleistocene coastal plain sediments form a series of alternating bands of lagoonal and barrier island facies deposits laid down by a prograding shoreline, and that the two facies have distinctly different hydrologic characteristics and cannot be treated as a single shallow aquifer. The Clayey lagoonal sediments are impermeable for practical use; the sandy barrier island sediments are highly permeable. Narrow bands of the island sediments are good aquifers. Field tests of two irrigation pits and theoretical predictions indicate that large-diameter shallow wells (irrigation pits) should provide sustained yields of at least 4 up to 20 gallons/minute in older Miocene sediments at the surface inland of the Pleistocene shoreline complex, while island sediments should yield over 100,000 gallons/day. Water quality of the shallow sediments is good to excellent, with shallow wells having total dissolved solids of 100 ppm or less and undetectable bacterial contamination. Further, these wells may cost only 15% that of deeper sand wells or deep wells. (Zielinski-MAXIMA)
W82-05548

WATER YIELD ESTIMATION IN WESTERN UNITED STATES,

Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4D.
W82-05689

SOLUBLE MINERAL CONTENT IN SURFICIAL ALLUVIUM AND ASSOCIATED MANCOS SHALE,

Ben-Gurion Univ. of the Negev, Beer-Sheba (Israel). Dept. of Geography.
J. B. Laronne, and S. A. Schumm.
Water Resources Bulletin, Vol 18, No 1, p 27-35, February, 1982. 8 Fig. 3 Tab, 22 Ref. OWRT B-121-COLO.

Descriptors: Solute, *Alluvium, *Shales, *Minerals, *Salts, River basins, Sedimentation, *Salinity, *Upper Colorado River, Water pollution sources.

Most arid and semiarid regions experience problems resulting from high salt content in soils and from high solute concentrations in runoff. The rate of salt pickup under varying hydrologic conditions depends on net dissolution and sediment removal rates and on soluble mineral content and its spatial and temporal variations. The Mancos Shale terrain is a source of considerable solute contribution to the Colorado River. The spatial variability of soluble mineral content in weathered Mancos Shale and its associated alluvium was studied in an effort to understand the mechanism of salt production and to determine the source of salinity. Soluble mineral content was found to be highly variable in the alluvium and in associated surficial Mancos Shale. However, it was possible to identify lithomorphological units based on the soluble mineral content. Study results show that crusts are leached in deep alluvial fills, and that they have somewhat lower soluble mineral contents than underlying Mancos Shale on hillslopes. The crusts were found to be saline, sometimes efflorescent, in shale bedrock channels or where channels abut against the shale. Soluble mineral content increases in alluvium with decrease in depth of alluvial fill, does not vary significantly with depth in deep alluvial fills, and increases with depth in shallow fills. Soluble mineral content trends identified by this study can be used in the development of mathematical models and land management programs in areas of the Colorado River basin experiencing salinity problems. (Carroll-FRC)
W82-05751

HOW PROPER PROSPECTING IMPROVES THE ODDS,

International Reference Center for the Community Water Supply, the Hague (Netherlands).
E. Hofkes, and L. Terwey.
World Water, Vol 5, No 3, p 41-43, March, 1982. 3 Fig.

Descriptors: *Groundwater mining, *Measuring instruments, *Resistivity, Electrical well logging, Groundwater availability, Groundwater movement, Groundwater potential, Well logs, Seismic refraction, Remote sensing, Tracers, Radioactive tracers.

Proper groundwater prospecting is important in providing water supplies in developing regions. After the objective is defined (local or regional supply), a systematic approach is used. First, all available hydrogeological data are studied. Then the study area should be surveyed, preferably toward the end of the dry season. Among the surface geophysical methods electrical resistivity and seismic refraction are suitable for prospecting in shallow formation. Equipment is readily available. Geophysical well logging provides data on the physical properties and characteristics of the formations, water quality, and proper well construction. Well logging may involve measurements of electric resistivity, spontaneous potential, and natural gamma radiation. Aerial methods are photography, multispectral and thermal infrared scanning, and side-looking radar. Radioisotopes (deuterium, 018, tritium, and C14) are used as tracers to study groundwater movement, residence time, recharging, and location. (Cassar-FRC)
W82-05757

FOREST MANAGEMENT FOR INCREASED WATER YIELD--HOW USEFUL IN SOUTHERN ALBERTA,

C. R. Neill.
Canadian Water Resources Journal, Vol 5, No 1, p 56-75, 1980. 4 Fig, 1 Tab, 16 Ref.

Descriptors: *Forest management, *Vegetation effects, *Water yield improvement, Small watersheds, Clearcutting, Alberta, Oldman River, Forest watersheds, Snowmelt, Chinook, Colorado, Land management, Flow augmentation, Watershed management, River basins, Seasonal variation.

Reducing forest cover to increase water yield in the Oldman River Basin, Alberta, would produce questionable benefits and possibly adverse effects on flow regulation and water quality. Data from international research on small basins indicate that clearcutting increases water yield from 5 to 50%, highest in warm humid regions. Thinning or selective cutting produces negligible effects. Yield gradually decreases with vegetation reestablishment and reforestation. In some regions such as Colorado the increased yield occurs almost entirely in the snowmelt period. It is unreliable to extrapolate results from one region to an untested region. Results from large basins and from Russia are less conclusive and sometimes contradictory. Although clearcutting in Colorado increased water yield by 18-31%, results from Alberta experiences in clearcutting were inconclusive. Estimates of water yield increases by manipulating 1300 sq km of forest at Lethbridge are 2% of natural average flow averaged over the life of the timber cycle and nonexistent during dry year sequences. (Cassar-FRC)
W82-05760

3C. Use Of Water Of Impaired Quality

WATER REUSE PLANNING BY MEANS OF AN INPUT-OUTPUT TABLE,

Swiss Reinsurance Co., Zurich.
For primary bibliographic entry see Field 6A.
W82-04794

COMPARISON OF COLIPHAGE AAD BACTERIAL AEROSOLS AT A WASTEWATER SPRAY IRRIGATION SITE,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
H. T. Bausum, S. A. Schaub, K. F. Kenyon, and M. J. Small.
Applied and Environmental Microbiology, Vol 43, No 1, p 28-38, 1982. 2 Fig, 9 Tab, 25 Ref.

Descriptors: *Wastewater irrigation, *Bacteria, *Aerosols, Irrigation, *Land application, Wastewater, Wastewater disposal, Coliforms, Viruses, Coliphage, Public health, Impaired water use.

Land application by spray irrigation has been suggested as an alternative to advance wastewater treatment. However, this procedure entails potential human health hazards due to pathogen-containing aerosols. Data were gathered at a golf course irrigated with secondary domestic wastewater effluent. Bacterial aerosols reached 500 bacteria per cubic meter at 152 meters downwind and 10,500 bacteria per cubic meter at 46 meters. Seeded coliphage f2 averaged 400,000 plaque-forming units per ml in the effluent and were detected 563 meters downwind. Downwind microbial aerosol levels were somewhat enhanced by night time conditions. The median aerodynamic particle size of the microbial aerosols was about 5.0 micrometers. Chlorination reduced wastewater bacterial levels 99.97% and reduced aerosol concentrations to near background levels. Coliphage f2 was reduced only 95.4% in the chlorinated effluent and was readily measured 137 meters downwind. Microbiological source strength and meteorological data were used in conjunction with a dispersion model to generate mathematical predictions of aerosol strength at various sampler locations. The mean calculated survival of aerosolized bacteria in the range 46 to 76 meters downwind was 5.2%, and that of coliphage f2 was 4.3%. (Baker-FRC)
W82-04830

ALFALFA HAY GROWN WITH MUNICIPAL WASTE WATER AND PUMP WATER,

Arizona Agricultural Experiment Station, Tucson.
A. D. Day, R. S. Swingle, T. C. Tucker, and C. B. Cluff.
Journal of Environmental Quality, Vol 11, No 1, p 23-24, 1982. 2 Tab, 11 Ref.

Descriptors: *Wastewater irrigation, *Municipal wastewater, Water reuse, Water conservation, Agriculture, *Alfalfa, Irrigation, Irrigation programs.

The objectives of this research were to compare the quality of a wastewater and pump water mixture with the quality of pump water alone as a source of irrigation water for alfalfa hay production and to compare the yield and quality of alfalfa hay irrigated with a mixture of wastewater and pump water with the yield and quality of alfalfa hay irrigated with pump water alone. The average water penetration into the soil was higher for the wastewater and pump water mixture than for pump water alone. Pump water contained more total soluble salts and nitrate-nitrogen but less total nitrogen and phosphorus than the wastewater and pump water mixture. The general quality of irrigation water was influenced by salt concentrations. High salt concentrations in irrigation water were detrimental to plant growth, as excessive salt levels inhibited germination, limited water uptake and caused specific toxic effects on plants due to ions present in the salts. The wastewater-pump water mixture was a higher quality irrigation source than pump water alone, and was superior for use in growing plants. More phosphorus was deposited on fields irrigated with the wastewater-pump water mixture than was added to fields irrigated with only pump water. This may explain the high levels of extractable phosphorus present in soils irrigated with the wastewater-pump water mixture than were found in soils that received pump water alone. Plants grown with the wastewater-pump water mixture were taller and produced more dry matter in both 1974 and 1975 than did plants irrigated with only pump water. (Baker-FRC)
W82-04873

CASEIN WHEY WASTEWATER EFFECTS ON SOIL PERMEABILITY,

Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
K. W. McAuliffe, D. R. Scotter, A. N. Macgregor, and K. D. Earl.
Journal of Environmental Quality, Vol 11, No 1, p 31-34, January-March, 1982. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Wastewater disposal, *Land disposal, *Wastewater irrigation, Irrigation, *Dairy industry, Irrigation programs, Permeability coefficient, Permeability, Soils, Soil properties, Saturation, Pores.

Experiments are reported to show the changes in soil permeability induced by dairy plant effluent application and to elucidate the mechanisms responsible for the observed changes. Soil cores were collected from a Tokomaru silt loam, a Kopua silt loam and a Manawatu silt loam. A single application of simulated effluent reduced hydraulic conductivity by an average of 46% in the soils. In comparison, cores treated with only water exhibited negligible reduction in hydraulic conductivity. The incorporation of sodium azide (a microbial inhibitor) with the effluent minimized the decline in hydraulic conductivity. Cores that received repetitive effluent applications exhibited an average hydraulic conductivity decline of 99%, whereas cores that received repeated doses of effluent plus inhibitor showed a smaller reduction of 55%. Respirometry studies indicated that the sodium azide did not completely inhibit soil biological activity throughout the entire undisturbed core. It is suggested that the reduction in hydraulic conductivity may reflect a combination of physical and biological processes. Several practical implications were noted. To avoid reduction in saturated hydraulic conductivity an aerobic soil environment should be maintained; thus a land disposal site should never be overloaded so that ponding occurs. An interval between applications is needed to allow hydraulic conductivity recovery. Pore blockage would be lessened, but not eliminated, if suspended solids were removed from the effluent prior to irrigation. (Baker-FRC)
W82-04874

THE OCCURRENCE OF FLOW CHANNELS IN SOILS,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
T. W. Simpson, and R. L. Cunningham.
Journal of Environmental Quality, Vol 11, No 1, p 29-30, January-March, 1982. 1 Fig, 6 Ref.

Descriptors: *Groundwater pollution, *Wastewater irrigation, Channels, Topography, *Water reuse, Saturated flow, Saturation, Water pollution, Soil types, Wastewater disposal.

Investigations were conducted at the Pennsylvania State University Wastewater Irrigation Site which identified soil water flow features described as channels. The site under study has been used as a wastewater disposal area over a 14 year period. Plots received 0, 2.5, or 5 cm of irrigation per week. Some areas only received irrigation water during the growing season. Soil morphology changes were studied and related to changes in time and amounts of wastewater applied. Soil sample cores were also collected from selected horizons of some pits to determine saturated hydraulic conductivity associated with the observed channels. The channels were vertically oriented, variable in size from 50 to 2 cm in diameter, had inverted cone-shaped bodies that had a low bulk density, and were much less firm than the surrounding soil. Many large apparently continuous pores exist in soil material recognized as a channel. Channels usually start in the upper subsoil and extend into lower horizons. Channels range in depth from less than one centimeter to 60 cm. The presence of channels in non-irrigated control areas suggests that their existence may be a natural phenomenon. Channel formation is most likely related to internal erosion of the soil material along structural faces that are coincident with solution channels in the bedrock. Hydraulic conductivity results suggest that the conventional core method may reduce the measured conductivity of the channels. It is evident that the channels are important in water movement at the wastewater irrigation site. If they allow wastewater to leave the biologically active portion of the soil without adequate renovation, groundwater contamination is likely. (Baker-FRC)
W82-04875

DISTRIBUTION OF PHOSPHORUS IN SOILS IRRIGATED WITH MUNICIPAL WASTEWATER EFFLUENT: A 5-YEAR STUDY,

Minnesota Agricultural Experiment Station, St. Paul.
J. J. Latterell, R. H. Dowdy, C. E. Clapp, W. E. Larson, and D. R. Linden.
Journal of Environmental Quality, Vol 11, No 1, p 124-128, January-March, 1982. 1 Fig, 4 Tab, 23 Ref.

Descriptors: *Wastewater irrigation, *Phosphorus, Soil water, Groundwater, Water pollution sources, *Municipal wastewater, Land disposal, Phosphates, Phosphorus removal, *Water reuse.

The objectives of this study were to determine the distribution of various phorphous forms in soil irrigated for 5 years with municipal wastewater and to measure the phorphous-adsorption power of the soil after 5 years of phosphorous loading. The experiment site was adjacent to the Apple Valley, Minnesota wastewater treatment plant, an activated sludge plant with effluent polishing filters. The soil was Waukegan silt loam with a water table at about the 140 to 150 cm depth. Plots receiving comparable quantities of phosphates via wastewater and mineral fertilizer behaved in a similar manner. Plots receiving about two times the above phosphate loading lost some phosphate through leaching to the 60 cm depth. Phosphorus adsorption studies, using the Langmuir equation, showed that the adsorption power of soil in the high rate treatment had been reduced. This was substantiated by the higher phosphorus concentrations noted in soil water at the 60 cm depth in the high treatment areas. (Baker-FRC)
W82-04881

WATER TO THE SOUTH-WESTERN CAPE KEEPING UP WITH THE DEMAND.

Civil Engineering in South Africa, Vol 23, No 11, p 521, November, 1981.

Descriptors: *Water supply development, *Water demand, Water resources development, Water reuse, Rivers, Water desalination, Desalination, *Cape Town, *South Africa.

The demand for water in Cape Town and the South-Western Cape area has forced water planners to consider unconventional water sources, such as recycling or desalination of sea water. The current supply should be adequate until 1988. Only about six conventional sources of water of the South Western Cape remain to be tapped, most of them too small to make a difference. The development of the Cape Flats' groundwater potential is one of the more promising schemes although its potential is limited, with a yield of about 10 million cubic meters per annum. Diverting untapped water out of the Eerste and Kuils Rivers to supplement the groundwater supply would add about 20 million cubic meters per annum. The Diep River could yield 11 million cubic meters per annum, but the water is brackish and unreliable. Rietvlei, which is fed by the Diep River, could also create an ecological problem if the river were to be dammed. Surplus water in the Berg River could still be tapped, yielding 10 million additional cubic meters per annum. The Lourens River source will yield 10 million cubic meters per annum, but will only be economically viable if done in conjunction with the Ralmiet River Project which would yield 33 million cubic meters per annum. If these sources are tapped and coupled with recycled water usage, the supply could be enlarged to sufficient proportions to meet demand into the end of this century. (Baker-FRC)
W82-04887

REVEGETATING STRIP-MINED LAND WITH MUNICIPAL SEWAGE SLUDGE,

Pennsylvania State Univ., Harrisburg. Dept. of Environmental Resources.
For primary bibliographic entry see Field 5E.
W82-05065

IRRIGATION OF CALIFORNIAGRASS WITH DOMESTIC SEWAGE EFFLUENT: WATER AND NITROGEN BUDGETS AND CROP PRODUCTIVITY,

Hawaii Univ., Honolulu. Water Resources Research Center.
L. L. Handley, and P. C. Ekern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224585, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 141, December 1981. 29 p, 1 Fig, 8 Tab, 67 Ref, 1 Append. A-075-HI(1), 14-34-0001-9013, -0113.

Descriptors: *Effluent reuse, *Nitrogen cycle, Water budget, Biomass, Pastures, Hawaii, *Impaired water use, *Irrigation practices, *Crop production, Wastewater disposal, *Californiagrass, Nitrogen budget, Tropical grass cultivation, Paragrass, Mililani, Oahu.

Californiagrass (paragrass) irrigated with effluent from secondarily treated domestic sewage showed excellent response as a means for disposal of large amounts of water, effective removal of nitrogen, and high production of excellent fodder. This grass, already well established in Hawaii, is used for pasture and fodder, endures flooding, and because of its allelopathic habit forms dense, easily maintained monostands. The water, nitrogen, and biomass budgets of the grass over a 17-mo period, from April 1979 through August 1980, were measured in eight large percolate-style lysimeters filled with the Lahaina series soil (Tropeptic Haplustox). The experiment was conducted on the grounds of the Mililani Wastewater Treatment Plant in central Oahu, Hawaii. Under irrigation rates which reached as great as 98 mm/day 5 days a week, consumptive use of water by the grass averaged 4 mm/day and was linearly correlated with biomass production. The monthly effluent nitrogen content ranged from 17 to 59 mg/l. With effluent nitrogen application rates which ranged from 475 to 2 600 kg/ha/yr, an average 69% was harvested in the grass, 3% percolated, nearly 28% was denitrofied, while the soil nitrogen status remained unchanged or decreased slightly. Even with the highest effluent irrigation rates, nitrate nitrogen levels in the percolate remained less than the 10 mg/l recommended maximum for potable water. Crop productivity was linear with applied nitrogen. Dry weight averaged 150 tons/ha/yr, with a maximum short-term productivity equivalent to 193 tons/ha/yr. The calculated crude protein content with the highest nitrogen application rates was 13%, while the caloric value was 4 000 kcal/kg, and no nitrate nitrogen levels in the forage exceeded 0.1%.
W82-05153

ABANDONED COAL MINES IN WEST VIRGINIA AS SOURCES OF WATER SUPPLIES,

West Virginia Geological and Economic Survey, Morgantown.
P. Lessing, and W. A. Hobba, Jr.
West Virginia Geological Survey, Circular C-24, 1981. 18 p, 3 Fig, 1 Tab, 1 Append.

Descriptors: *Water supply, *Water use, *Coal mines, Mine drainage, Available water, *Water storage, Precipitation, Infiltration, Selective withdrawal, Wells, Water quality, Water treatment, *West Virginia, Appalachian Plateaus, *Abandoned coal mines.

West Virginia is underlain by numerous beds of coal, many of which have been mined out in places. These underground mines have subsequently been abandoned and are now flooded and/or drain continuously. At present, 72 public water systems supply 8 to 12 million gallons of water per day from abandoned or active mines to 81,600 people and various industrial and commercial establishments. Most of these systems are in southern West Virginia, where the coal contains few sulfur minerals to dissolve and create problems of acid, iron, and sulfate in water. From 5 to 6 inches of precipitation is potentially available annually to seep into underground mine reservoirs. The

amount of water stored in the mine, the rate of infiltration, and the rate of withdrawal determine how much water is available for use. If the water is pumped from a mine by a well, then care must be taken to locate the well in lower parts of the mine, where water tends to accumulate as the water level is lowered by pumping. Some communities using mine water only chlorinate the water, but generally more extensive treatment is required to increase the pH or remove excessive concentrations of hardness, iron, and sulfate. (USGS)
W82-05219

FORAGE PRODUCTION UTILIZING CHEESE PLANT EFFLUENT UNDER HIGH-ALTITUDE CONDITIONS,

Wyoming Univ., Laramie.
M. C. Greene, R. H. Delaney, J. L. Moyer, and J. Borrelli.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2855-2864, December, 1980. 4 Fig, 6 Tab, 23 Ref.

Descriptors: *Dairy industry, *Wastewater irrigation, *Nutrients, Effluents, Land application, *Forages, Grasses, Pasture management, Feeds, Irrigation, Nitrogen, Phosphorus, *Impaired water use, Plant growth, Livestock, Water pollution effects, Cold regions, Thayne, Wyoming, Fertilizers.

Effluent from the manufacture of Swiss and mozzarella cheeses was applied to forage plants in laboratory pots and under field conditions. Garrison creeping foxtail, smooth bromegrass, reed canarygrass, tall fescue, meadow bromegrass, alfalfa, and sainfoin were grown in pots under conditions similar to that of the cheese plant irrigation site at Thayne, Wyoming, where there is a 30-day frost free period. No growth inhibitors were present in the cheese plant effluent or a soluttion with the same N, P, and K concentrations (0.1, 0.3, and 61.0 mg per liter, respectively). Highest dry matter production was obtained with a control fertilizer solution with nutrient concentrations suitable for grasses (10.0 mg per liter N, 6.5 mg per liter P, 33.3 mg per liter K, and 45.0 mg per liter S). Most of the grass species watered with effluent contained less protein than the control. Legumes did not show this N deficiency. P content was higher in the effluent-watered plants. Digestibility was not affected by effluent. In general plants grown at 20/10C contained less dry matter, less protein, and less P than plants grown at 23/18C. In the field tests only four of 20 species survived the winter ice pack-- creeping foxtail, reed canarygrass, smooth bromegrass, and western wheatgrass. Creeping foxtail was superior to the others in digestibility and ash content and was well suited to the harsh growing conditions of the irrigation site. Nitrate levels in several species of grass approached levels potentially toxic to cattle, 0.32%. Soil N appeared to become stabilized at the site, but soil P levels increased, especially in the upper soil profile. (Cassar-FRC)
W82-05265

RAPID-INFILTRATION RESEARCH AT FLUSHING MEADOWS PROJECT, ARIZONA,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 5D.
W82-05334

MANAGING SALINITY IN IRRIGATED AGRICULTURE,

Youngstown State Univ., OH. Dept. of Civil Engineering.
I. A. Khan.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 43-56, March, 1982. 6 Fig, 29 Ref.

Descriptors: *Irrigation efficiency, *Model studies, *Salinity, *Salt balance, Irrigation design, Irrigation practices, Irrigation-return flow, Hydrologic models, Simulation analysis, Optimization, Systems analysis, Groundwater management.

Salt balance is an important factor of any irrigated system. Structural measures to control salt levels in irrigation waters are effective but costly. Excessive accumulation of salts in groundwater and soils is often a problem in irrigated semiarid and subhumid agricultural areas. A non-structural management model is described which may aid in maintaining a permanent irrigated agricultural system at reasonable costs. An optimization model is used to distribute land and water resources, encourage conjunctive use of surface and groundwater, maintain salt movement out of the system, and keep the proper hydrologic balance. Simulation models are employed to assess the impact of agricultural activities on the saturated and unsaturated zones. The whole model operates on the concept that an irrigated system is made up of a number of components, each of which is vital to the smooth operation of the whole system. A simplified version of the model was applied to problems of salinity control in the Pauma, Pala, and Bonsall sub-basins of the San Luis Rey River Basin of Southern California. Model results suggest possible reductions in the normal rate of groundwater depletion by about 80%. (Geiger-FRC)
W82-05691

SEQUENTIAL WATER REUSE EFFECT ON STREAM SALINITY,

Colorado State Univ., Fort Collins. Engineering Research Center.
D. W. Hendricks, C. D. Turner, and D. Klooz.
Water Resources Bulletin, Vol 18, No 2, p 317-324, April, 1982. 6 Fig, 1 Tab, 3 Ref. OWRT A-051-COLO.

Descriptors: *Water reuse, *Salinity, *Irrigation, Water quality, South Platte River, *Colorado, Agriculture, Arid lands, Semiarid lands, Diversion, *Streamflow depletion, Flow regulation, Water storage.

A salinity model based on the water balance principle was developed to estimate the effects of sequential reuse of stream water on residual streamflow and salinity. The salinity increases and streamflow decreases caused by sequential water reuse in arid and semiarid western U.S. areas were shown in an application of the model to the South Platte River Basin, Colorado. The upper limit of total diversions based on minimum streamflow alone was 6,846,900 acre feet per year, which corresponded with an intolerable 5,000 to 10,000 mg per liter dissolved solids. Considering a tolerable salinity of 2600 mg per liter, the upper limit of total diversions was only 5,430,300 acre feet per year. If it was possible to capture an additional 300,00 acre feet per year of excess flow for reuse, 896,100 acre feet more water would be available. (Cassar-FRC)
W82-05731

LEACHING FRACTIONS AND SALT STATUS OF TWO IRRIGATED GYPSUM-RICH SOILS IN SOUTHERN ALBERTA,

Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 2G.
W82-05762

STRATEGIES FOR REUSE AND CONSERVATION,

Dames and Moore, Houston, TX.
B. P. Popkin.
Water/Engineering and Management, Vol 129, No 3, p 36 40-41, March, 1982. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Water conservation, *Water reuse, Conservation, Water supply, Nonstructural alternatives, Water demand, Economic aspects, Wastewater renovation, Pricing.

Technological and managerial strategies for municipal water conservation and reuse have been developed. Municipal water conservation and reuse strategies can reduce total and peak water consumptive use and redistribute water use demands. Such strategies can effect water, energy and waste utilities. Water conserving users may find that they incur a net cost burden by conserving and reusing, as service fees increase to offset inflation, expanded services and declining per capita water use. Water management plans and decisions are not based solely on economic analysis, but include many aspects such as multiple objectives, political considerations and historic imperatives. Structural water conservation and reuse strategies are those which consist primarily of the use of hardware and systems. Nonstructural water conservation and reuse strategies are those which consist primarily of software, policies and operations. Examples of devices used in structural water conservation strategies include lawn irrigation timers, swimming pool covers, low-flow shower heads, faucet aerators, toilet and pressure restrictors, and other specialty appliances. Examples of structural water reuse strategies include municipal wastewater and domestic grey-water reuse systems for yard irrigation, municipal wastewater recycling systems for all yard uses, and land application of municipal wastewater for irrigation of recreational facilities. Nonstructural water conservation strategies can incorporate water supply rationing, low minimum water use charges with increasing unit price rates for increasing total water use, seasonal water fees, and high charges and fines for excessive or selected water uses. Numerous economic approaches are useful in any review of water conservation and reuse strategies. (Baker-FRC)
W82-05790

THE WELLTON-MOHWAK DILEMMA,

Science and Education Administration, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 3F.
W82-05883

IMPACT OF ENERGY DEVELOPMENT UPON WATER AND SALINITY IN THE UPPER COLORADO RIVER BASIN,

M. Flug, W. R. Walker, and G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 199-220, 1982. 8 Fig, 6 Tab, 25 Ref.

Descriptors: *Water resources development, *Mathematical models, *Energy sources, *Salinity, *Colorado River, *Water supply development, *Environmental effects, Water management, Resources management, Model studies, River basins, Policy making, Water policy, Cost analysis, Environmental policy, Available water.

The development and utilization of coal, oil, shale, uranium and energy in the upper Colorado River Basin will create large demands on the available water supply of the region and threaten the quantity and quality of downstream flow. A mathematical model based on a sub-basin analysis of available mineral and water resources was used to simulate the salt and water exchange phase of potential fuel conversion in the river basin. Potential energy developments are examined with respect to the resulting impacts upon both the salinity and quantity of the waters of Colorado River. A multilevel minimum cost of developing predetermined levels of energy output was used to generate model solutions. Results showed that water availability is the most critical factor affecting energy development in the Colorado River. Use of high salinity waters in development policies and interstate water transfers on the Upper Colorado River will allow a net reduction in salinity in waters at Lee Ferry, Arizona, of up to 20 milligrams/liter. (Geiger-FRC)
W82-05886

3D. Conservation In Domestic and Municipal Use

WATER SUPPLY IN THE USSR.

For primary bibliographic entry see Field 6D.
W82-04849

CONSERVATION ETHICS FOR THE 1980'S,

Black and Veatch, Dallas, TX.
H. J. Graeser.
Southwest and Texas Water Works Journal, Vol 63, No 10, p 8-10, 44, January, 1982.

Descriptors: *Water conservation, Legal aspects, Riparian rights, Water quality, *Irrigation, Water use, Consumptive use, Conservation, Water supply, *Municipal water, *Texas High Plains.

Recent studies by the High Plains Study Commission in Texas indicate that a 50% reduction in water use, from 1.38 acre feet per acre to 0.65 acre feet in 2020, would still necessitate a reduction in irrigated acreage in the Texas High Plains, from 6.1 million to 4.9 million acres. A shift to higher value, more water efficient crops would be necessary. In some states where water is abundant, problems occur over ownership of water rights. Facing the problem of interstate transfer of water rights and diminishing groundwater as well as international and interstate compacts affecting the quantity of surface water available from the Rio Grande River, the city of El Paso has attacked the problem of conservation. Homeowners have been encouraged to plant indigenous plants as opposed to high water consuming plants in their yards. Additional measures must be taken in the area of crops and farming to conserve needed water. Consideration is also given to the pricing of water on the basis of how it is used and how much is used. Public opinion must be brought into play to help in cutting down the wasteful application of water. Legal and financial procedures which will allow orderly reordering of water allocations with minimum economic and social penalties are needed. Above all a course of conservation must be taken which avoids consumptive use to the maximum extent and encourages augmentation of existing sources through re-use. (Baker-FRC)
W82-05009

DOMESTIC WATER CONSERVATION RESEARCH PLAN,

For primary bibliographic entry see Field 6B.
W82-05547

DROUGHT MANAGEMENT: EXPECTING THE UNEXPECTED,

Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning.
V. Woo.
Journal of the American Water Works Association, Vol 74, No 3, p 126-131, March, 1982. 2 Fig, 19 Ref.

Descriptors: *Drought, Water management(applied), *Water supply, *Boston, Massachusetts, *San Francisco, California, Planning, Water shortage, Water conservation, Water demand, Water use, Urban areas, Risks.

Implementation of drought management plans in the San Francisco Bay area and in Boston, Massachusetts, produced large and long-lasting reductions in water consumption. In the 1976-77 San Francisco drought, both supply augmentation and demand reduction were used. Water (400,000 acre-feet) was reallocated from southern California to Marin County. The most dramatic reductions in demand occurred in Marin County. At the end of the drought in December 1977 consumers had reduced use there by 60% overall and by 75% among homeowners. Although the commercial and industrial sectors successfully met the requirements of mandatory conservation, they failed to accomplish goals under voluntary programs. A very successful method of promoting conservation was to establish a household water allotment but not dictate the particular use of the ration. As of 1980 water consumption in Marin County was still 22.5% below predought use, and in the East Bay Municipal Utility District, 86-100% of predrought use, without adjusting the figures for an 8.6% increase in connections. These changes in consumption have resulted in the adoption of risk management or incremental planning by some of the California water districts. Boston's 1962-66 drought caused minor economic losses, produced some new installations of long-term benefit, and pointed out idle capacity and inefficiencies. Although demand management appeared to be most suitable for water conservation planning, it was not the city's post-drought response. Instead, physical supply augmentation and incremental adjustments were chosen to supply water for future growth and drought emergencies during the next 10-20 years, considered a transitional period. (Cassar-FRC)
W82-05649

DROUGHT-RELATED WATER CONSERVATION EFFORTS IN MISSOURI,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.
G. D. Reed.
Journal of the American Water Works Association, Vol 74, No 3, p 121-125, March, 1982. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Water conservation, *Drought, *Water shortage, Water supply, *Missouri, Water consumption, Water demand, Water use, Water management(Applied), Public relations.

During the drought of 1980 water suppliers to Missouri had to implement various water conservation policies with little time for planning. A review of literature on water conservation indicated that voluntary conservation schemes were successful only if accompanied by continous intensive public education and information programs. Pricing schemes, which produced greater use reductions than voluntary schemes, were effective only when the surcharge cost was significant and well-enforced. Answers to a questionnaire to which 31 of 52 Missouri water suppliers responded indicated that 24 suppliers had supply problems and attempted conservation measures. The most common reasons for initating conservation were limitations on treatment and storage facilities (42%) and inadequate raw water (29%). Voluntary conservation was used by 63% and mandatory bans on nonessental uses by 29% of respondents. Most of the failures occured in the voluntary programs. The methods of informing customers of the conservation measures were not as important as the enforcement procedures. None used a water bill surcharge. Seven supliers threatened to disconnect service in case of violation, and none experienced failures in their programs. Eighteen (75%) of suppliers reported successful conservation programs. Most difficulties were experienced by the public water supply districts. The keyto successful conservation programs appeared to be strict enforcement. (Cassar-FRC)
W82-05672

EFFECTS OF POTENTIAL WATER CONSERVATION EFFORTS IN EAST TENNESSEE,

East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
C. S. Bishop, G. T. Broach, W. H. Hester, and V. A. Sikora.
Water Resources Bulletin, Vol 18, No 2, p 189-196, April, 1982. 5 Tab, 15 Ref.

Descriptors: *Water conservation, *Water policy, *Water management, Water use, French-Broad River Basin, Tennessee, Regulations, National Water Policy, Social impact, Economic impact, Institutional constraints, Water supply, Water rates, Wastewater treatment.

The National Water Policy, established during the Carter administration, stressed water conservation on a national scale. The possible positive and negative effects of 10% voluntary reduction and 30% regulated reduction of water usage in the water-rich French-Broad River basin, Tennessee, are described. The two-county basin has abundant rainfall, small-scale agriculture, towns, and industry. With no water conservation in the basin there would probably be no significant environmental, socioeconomic, or institutional changes in the near future. A 10% voluntary reduction would be practical and achievable without producing significant impact on regional economic stability, water rates, or per capita consumption. Possible benefits are improved efficiency and delayed expansion for municipal wastewater treatment plants and improvements in efficiency and life of individual sewage disposal systems. A compulsory 30% water use reduction would be deleterious to social, economic, and political environments. Small marginal industries would close, cutting income of the residents and producing hostility to the plan. Water prices would rise dramatically to compensate for reduced municipal revenues. The local residents are opposed to housing and building codes and other regulations. Before a national conservation policy is implemented further studies must determine regional differences in cultural, social, economic, and institutional factors. (Cassar-FRC)
W82-05745

MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,

Policy Sciences Associates, Boulder, CO.
W. B. Lord.
Water Resources Bulletin, Vol 18, No 2, p 271-277, April, 1982. 3 Tab, 19 Ref.

Descriptors: *Water conservation, *Elasticity of demand, Water use, Water policy, Municipal water, Industrial development, Economic development, Water rates, Domestic water, Arid lands.

The results of this study cast doubt on the widely believed assumption that municipal water supply restrictions and/or conservation policies affect urban growth, at least in western states. A water reduction of 25% would have little effect and would not likely inhibit growth because both household and industrial water demands are quite flexible. Present water use practices are generally wasteful. Water costs in industry are usually a small fraction (on the order of 1%) of total production costs. Neither water quantities nor water prices are likely to deter industries from locating in Western cities. However, cutting water use by 50% or more might discourage persons from moving to Western locations. Hence, there is little reason to oppose moderate water restrictions in fear of inhibiting urban growth or to favor such restrictions in hope of constraining growth. (Cassar-FRC)
W82-05748

WATER MANAGEMENT IN THE METROPOLITAN TORONTO REGION,

Metropolitan Toronto and Region Conservation Authority, Downsview (Ontario). Water Resource Division.
For primary bibliographic entry see Field 6B.
W82-05775

CURRENT TRENDS IN COST OF SERVICE STUDIES,

Coffin and Richardson, Boston, MA.
For primary bibliographic entry see Field 6C.
W82-05806

3E. Conservation In Industry

INDUSTRY HELPS CONSERVE MUNICIPAL WATER,

Anderson-Nichols and Co., Inc., Providence, RI.
P. R. Levine.
Journal of the American Water Works Association, Vol 74, No 3, p 132-135, March, 1982. 6 Fig.

Descriptors: *Water conservation, *Industrial water, *Water supply, New England, Attleboro, Massachusetts, Fracture permeability, *Groundwater availability, Municipal water, Wells, Groundwater mining, Groundwater sources.

Recent droughts caused the Attleboro, Massachusetts, reservoir to drop far below capacity. An industrial user, which consumed 25% of the city's supply, initiated water conservation measures and searched for alternate supplies. Two measures, employee education and recycling of process and cooling water, reduced use from 2 mgd to 0.85 mgd. No sand or gravel aquifers were found on the site. However, additional groundwater sources were located in fractured regions of bedrock by a new technique, fracture-trace mapping. Aerial photography located these places, which occur throughout New England in lengths of a few hundred feet to several miles. Four wells safely yielded 1 mgd of water if 8 hours rest period was allowed every 4 days. Currently, the manufacturer draws on the municipal water supply only for its potable water needs. (Cassar-FRC)
W82-05674

3F. Conservation In Agriculture

ALFALFA HAY GROWN WITH MUNICIPAL WASTE WATER AND PUMP WATER,

Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 3C.
W82-04873

THE 1977 DROUGHT IN IDAHO: ECONOMIC IMPACTS AND THE RESPONSES OF IRRIGATORS AND WATER DELIVERY ORGANIZATIONS,

Idaho water and Energy Resources Research Inst., Moscow.
J. R. Hamilton, D. J. Walker, and D. L. Grant.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220658, Price codes: A11 in paper copy, A01 in microfiche. Research Technical Completion Report, May 1981, 238 p, 4 Fig, 64 Tab, 115 Ref. OWRT B-246-IDA(1).

Descriptors: *Drought, *Cropping patterns, *Irrigation practices, Water management, *Crop production, *Idaho, Institutional constraints, Water shortage, Water law, Economic impact.

Survey methods were used in Idaho to document changes in cropping patterns, irrigation systems, and water management strategies caused by the 1977 drought; to document the way management strategies caused by the 1977 drought; to document the way insitutuions such as water delivery organizations and goverment agencies respond to drought; to measure the economic consequences of drought in southern Idaho; to draw implications regarding probable farmer response in future droughts; and to make suggestions for drought management strategies. While some farmers changed crops and varieties or idled land in anticipation of water shortage, the majority proceeded with normal cropping patterns. When water shortage occurred, the result was reduced yield, or in some cases complete loss of the crop. These yield declines and lost crops comprised the largest part of the economic impact of the drought.
W82-04959

RESTRUCTURATION OF THE WATER TARIFF SYSTEM FOR IRRIGATION DISTRICTS IN MEXICO,

Secretaria de Agricultura y Recurosos Hidraulicos, Mexico City.
For primary bibliographic entry see Field 6C.
W82-04962

CONSERVATION ETHICS FOR THE 1980'S,

Black and Veatch, Dallas, TX.
For primary bibliographic entry see Field 3D.
W82-05009

LATERAL MOVE IRRIGATION OFFERS ADVANTAGES FOR RECTANGULAR FIELDS,

World Farming, Vol 24, No 1, p 8, 26, 34-35, January/February, 1982.

Descriptors: *Irrigation engineering, *Automation, Linear irrigation, Canals, Farm equipment, Irrigation canals, Mechanical equipment, *Irrigation efficiency, Waker conservation.

The lateral move irrigation system offers many advantages not available in other irrigation systems, especially for large rectangular fields. Uniformity of water distribution increases crop yield by eliminating overwatered and underwatered areas. Fertilizer can be applied through the irrigation system. The linear system irrigates a field twice as fast as surface irrigation and uses 10-60% less water. Heavy, tight soils can be efficiently irrigated by this method bwcause of the low application rates, small droplet size, and low water pressure. The 3 types of linear irrigation systems are based on different types of water pickup. The canal or ditch method, most suitable for level fields, draws water from a canal located at either end or the center of a field. The hose system, useful on sloping fields, uses a high pressure hose, dragged along as the apparatus moves. An underground mainline pipe supplies water through evenly spaced hydrants, to which the system automatically couples and uncouples. Many variations in design are available to suit individual conditions. In addition to the different types of water pickup, there are a variety of nozzles and guidance systems, engines from 45 to 225 horsepower, and pumps from 1600 to 13,300 liters per minute. (Caesar-FRC)
W82-05080

CUTTING IRRIGATION COSTS,

J. E. Bowen, and B. A. Kratky.
World Farming, Vol 24, No 1, p 14-15, 18-19, 28-29, January/February, 1982. 1 Tab.

Descriptors: *Irrigation efficiency, *Costs, *Pumps, Energy, Surge irrigation, Surface irrigation, Return flow, Water reuse, Maintenance, *Water conservation.

Increasing energy and water costs have forced reevaluation of irrigation practices. Suggestions for saving irrigation costs include: avoid over-irrigation, optimize timing of water application, substitute low-pressure nozzles for high-pressure ones, modify tillage and management practices to reduce runoff, use gravity flow where possible, improve pump efficiency through preventive maintenance, use a return flow system, convert from sprinklers to a surface system, and try the surge flow technique. Windpower can be an alternate energy source for operating hydraulic rams. (Caesar-FRC)
W82-05081

WATER MANAGEMENT OF WHEAT IN HEAVY CLAY SOILS OF MADHYA PRADESH,

Jawaharlal Nehru Agricultural Univ., Jabalpur (India). Dept. of Soil Science and Agricultural Chemistry.
For primary bibliographic entry see Field 2I.
W82-05119

EFFECT OF MOISTURE LEVELS IN VEGETATIVE AND REPRODUCTIVE PHASES OF WINTER-SOWN MAIZE ON GRAIN YIELD, IRRIGATION REQUIREMENT AND WATER-USE EFFICIENCY,

Rajendra Agricultural Univ., Samastipur (India).
For primary bibliographic entry see Field 2I.
W82-05120

FLEXCROP: A DRYLAND CROPPING SYSTEMS MODEL,

Science and Education Administration, Sidney, MT.
A. D. Halvorson, and P. O. Kresge.
Production Research Report Number 180, April 1982. 49 p, 9 Fig, 10 Tab, 51 Ref, 4 Append.

Descriptors: *Crop production, *Computer models, *Fallowing, *Grain crops, *Soil water, Saline seep, Deep percolation, Soil erosion, *Water use efficiency, Available water, Irrigation practices, *Northern Great Plains.

Wind and water erosion problems along with the development of saline seep areas in the northern Great Plains have made the crop-fallow system of farming undesirable as a farm management practice. Production of small grain or oilseed crops more often than every other year on soils affected by saline seep would reduce the loss of water during fallow by deep percolation, reduce saline seepage, and increase water-use efficiency. A flexible cropping system should consider the amount of plant-available soil water at seeding time; estimated average growing season precipitation; and grower management factors. Summer fallowing should be done only when water is so deficient that the probability of producing a profitable crop is low. A dryland cropping system computer model, 'FLEXCROP', was developed to help farm managers evaluate the effects of their crop and soil management decisions on potential crop yield and to help them decide whether to recrop or summer fallow a given field. Winter wheat, spring wheat, barley, oats, and safflower are the crops covered in the current model. (Moore-SRC)
W82-05208

REFLECTIONS OF THE CHOICE OF SOME PRIORITY AXES OF HYDRAULIC RESEARCH IN THE FIELD OF LAND AND WATER MANAGEMENT,

Rural Department for Waters and Forestry, Paris (France).
For primary bibliographic entry see Field 4B.
W82-05278

IMPROVED WATER AND NUTRIENT MANAGEMENT THROUGH HIGH-FREQUENCY IRRIGATION, VOL 2: RESPONSE OF PEANUTS TO IRRIGATION MANAGEMENT AT DIFFERENT CROP GROWTH STAGES,

Texas A and M Univ., College Station. Water Resources Inst.
T. A. Howell, M. J. McFarland, D. L. Reddell, K. W. Brown, and R. J. Newton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224874, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 113, Vol 2, December 1980. 94 p, 29 Fig, 20 Tab, 25 Ref, 2 Append. OWRT B-219-TEX(2), 14-34-001-8121.

Descriptors: *Peanuts, *Irrigation practices, *Crop yield, *Evapotranspiration potential, *Growth stages, Irrigation, Plant growth, Irrigation efficiency, Irrigation effects, Irrigation operation, Water requirements, Evapotranspiration, Irrigation requirements, Agricultural hydrology, Assessments, Irrigation water, Transpiration.

A study was conducted to determine the optimum irrigation schedule for peanuts at different crop growth stages, using two peanut varieties (Spanish and Florunner) evaluated under seven different irrigation treatments. The treatments included a no-stress check treatment and a dryland treatment. Each treatment had a different schedule of either irrigating or stressing the peanut plant during one or more of three crop growth stages. For the Spanish variety: providing irrigation only during the pegging stage produced 394 kg/ha higher yield than irrigating during the early maturation stage; pegging stage irrigation treatments had an evapotranspiration amount at least 25 mm greater than treatments with no irrigation at this stage. For the Florunner variety: treatments which had an irrigation during the late maturation stage produced near maximum yield even though some treatments had a drought period; treatments having an irrigation during this stage had a steady evapotranspiration rate. The effects of other treatment schedules at other growth stages are also discussed. Recommendations for futher studies are provided. (Zielinski-MAXIMA)
W82-05293

A REPORT ON: RESEARCH NEEDS....WATER CONSERVATION IN AGRICULTURE,

E. A. Hiler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224833, Price codes: A03 in paper copy, A01 in microfiche. Report, July 1978. 29 p, 10 Ref. (No 8542)(1).

Descriptors: *Water conservation, *Water supply development, *Irrigation efficiency, *Research priorities, *Systems analysis, Assessments, *Agriculture, Water requirements, Irrigation requirements, Water storage, Water conveyance, Water management, Irrigation programs, Irrigation practices, Water control, Farms, Groundwater recharge, Optimization.

Current situations in various areas of two major categories related to water conservation in agricultural operations are assessed, with generally 3-6 critical themes identified in each area where research is most needed. The first major category (water source augmentations and improvements in off-farm delivery systems) addresses six water conservation areas (storage and conveyance; groundwater replenishment; improved water control and measurement structures; soil water; increasing and

regulating streamflow; sediment reduction; improving economic and institutional arrangements). The second major category (improved on-farm water management related to irrigation scheduling and efficient systems) addresses three water conservation areas (irrigation water use efficiency; salinity control/management efficiency; optimizing crop water use). It is pointed out that isolated problem-solving can effect a slight change that may cause undue stress elsewhere in the entire system. Systems analysis is proposed as a means for viewing the entire water management problem. Specific research needs in systems analysis and a generalized approach for its use are also included. (Zielinski-MAXIMA)
W82-05308

IMPROVED WATER AND NUTRIENT MANAGEMENT THROUGH HIGH-FREQUENCY IRRIGATION, VOL. 3: DETERMINING THE TRANSPIRATION RATE OF PEACH TREES UNDER TWO TRICKLE IRRIGATION REGIMES,

Texas A and M Univ., College Station.
T. A. Howell, M. J. McFarland, D. L. Reddell, K. W. Brown, and R. J. Newton.
Available from the National Technical Information Service, Springfield, VA 22161 as Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 113, Vol 3, December, 1980. 56 p, 8 Fig, 7 Tab, 19 Ref, 1 Append. OWRT B-219-TEX, 14-34-001-8121.

Descriptors: *Transpiration, *Evapotranspiration potential, *Trickle irrigation, *Peaches, *Irrigation efficiency, Evapotranspiration, Soil moisture retention, Rainfall rate, Irrigation effects, Irrigation operation, Irrigation practices, Irrigation requirements, Nutrient requirements, Water requirements, Crop yield, Plant growth, Trees, Water conveyance, Agricultural hydrology, Hydrologic aspects, *Texas.

Research was carried out to quantitatively determine the transpiration rate of two trickle irrigation treatments in a northcentral Texas peach orchard. A soil water balance method was used to determine evapotranspiration (ET). One treatment (II) irrigated at a calculated rate (the measured pan evaporation, times the surface area inside the tree drip line, multiplied by a replenishment factor of 0.6) through two emitters; the other treatment (I) received half the calculated rate, distributed through one emitter. Treatment II may have had a more extensive root distribution than I, as indicated by observed moisture extraction patterns. The tree in each treatment could obtain moisture stored in the root zone. Both treatments had an ET rate considerably greater than their irrigation rates. However, the ET rates of both treatments were below the potential ET. Estimates of the transpiration rates of treatments I and II were 1.6 and 3.5 mm/day, respectively. Determinations of ET were based upon determinations of the change in soil moisture, and the levels of rainfall and irrigation. Recommendations of future research and design criteria areas based on the results of these studies are delineated. (Zielinski-MAXIMA)
W82-05312

IMPROVED WATER AND NUTRIENT MANAGEMENT THROUGH HIGH FREQUENCY IRRIGATION,

Texas A and M Univ., College Station.
T. A. Howell, K. W. Brown, R. J. Newton, D. L. Reddell, and M. J. McFarland.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224866, Price codes: A02 in paper copy, A01 in microfiche. Summary Report for Technical Report No 113, March 1981. 12 p, 1 Fig, 3 Tab, 2 Ref. OWRT B-219-TEX, 14-34-0001-8121.

Descriptors: *Irrigation efficiency, *Irrigation practices, *Nutrient requirements, *Crop yield, *Plant growth, Irrigation effects, Irrigation operation, Irrigation requirements, Sprinkler irrigation, Trickle irrigation, Peanuts, Peaches, Trees, Water requirements, Water conveyance, Water supply, Soil moisture retention, Agricultural hydrology, Hydrologic aspects, Nitrates, Water allocation, Water conservation, Sorghum, *Texas.

Research was directed toward defing the best management practices for irrigation timing and fertilizer applications under high frequency irrigation. Following a comparison of methods for determining soil hydraulic properties (Vol. I), research was conducted on a comparison of peanut water use efficiencies under differing sprinkler irrigation regimes (Vol. II), on an evaluation of water requirements by peach trees under trickle irrigation (Vol. III), and on a determination of nutrient and water requirements relative to grain sorghum response (Vol. IV). Irrigation water was pumped from the Brazos River into a lined pond, filtered, and pumped by turbines for the trickle system and for sprinkler, micro-basin, and furrow plots. An automatic weather station monitored climatic conditions, and soil samples were routinely analyzed for nitrogen content. The research results demonstrated high frequency irrigation to be a proven management system with several advantages. It has the potential for significantly increasing crop yield by application of a relatively small percentage of the total water requirement. The rainfall regime must, however, be favorable for the value of high frequency irrigation studies to be quantifiable. (Zielinski-MAXIMA)
W82-05313

SOIL WATER INTAKE RATES AND SURFACE IRRIGATION SYSTEM CHARACTERISTICS BY SOIL SERIES IN SOUTHEASTERN IDAHO,

Idaho Univ., Moscow. Coll. of Engineering.
K. H. Yoo, and J. R. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236548, Price codes: A05 in paper copy, A01 in microfiche. Report, March, 1981. 84 p, 4 Fig, 7 Tab, 12 Ref, 4 Append. OWRT B-041-IDA(3).

Descriptors: *Soil water, *Soil types, *Intakes, *Surface irrigation, *Irrigation practices soil water potential, Loam, Soil texture, Hygroscopic water, Agricultural runoff, Experimental design, Agricultural hydrology, Soil conservation, Crop yield, Field capacity, Testing procedures, Field tests.

Seven major soil series of irrigated agricultural land in southeastern Idaho, ranging from silt loam to gravelly loam in texture, were evaluated to obtain soil water intake rates. Three crops (hay, grain, and poatoes) were selected for the study, and soil survey maps from the local Soil Conservation Service were used to locate each area soil series. Since it was difficult to select representative sampling sites in a given field, it was necessary to test several different sites to obtain average results. Irrigation practices evaluated on two furrow fields from data obtained in the study revealed that improved water management practices are needed on both fields to obtain higher application efficiencies. One field had excess irrigation with high runoff loss; the other had a lack of irrigation with high runoff loss. Application efficiency could be increased by using a cut-back stream and/or a return flow recovery system. To assess border irrigated fields the infiltrometer ring test (RT) was used; for furrow fields, the inflow-outflow (IO) method was used. Potato fields generally had lower intake rates than other crops by the RT method. Intake rates for furrow-irrigated potato fields differed between those obtained by the RT and those obtained by the IO method. While the IO method has been known as the most dependable for obtaining intake rates, under some conditions the RT is a simpler and easier method. (Zielinski-MAXIMA)
W82-05539

OPTIMIZING THE USE OF WATER AND NITROGEN THROUGH BREEDING OF CROPS,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
R. A. Fischer.
Plant and Soil, Vol 58, No 1-3, p 249-278, 1981. 9 Fig, 3 Tab, 55 Ref.

Descriptors: *Crop production, *Water use efficiency, *Crop yield, *Water stress, *Nitrogen, Transpiration, Wheat, Barley, Arid zones, Soil-water-plant relationships, Water uptake, Plant growth, Drought resistance.

Breeding of special wheat and barley cultivars has increased crop yield in certain Mediterranean type environments over the past 20 years. The black box approach to drought resistance examines the yield differences of crops in terms of underlying process differences. Dwarfing of wheats has significantly increased their yield in arid regions. The ideotype approach to drought resistance and trait formulation, based on field measurements, is described. Encompassed in this approach are the effects of water limitation, crop transpiration, and the maximization of the harvest index. Optimal flowering date strategies, preanthesis water stress, and hot spell damage are also discussed. Ideotype testing is often limited by lack of rapid screening methods. The impoved nitrogen utilization efficiency of higher yielding cultivars is related to more grain per unit of nitrogen taken up by the crop rather than to more nitrogen uptake. Genotype selection may help overcome water stress injury due to high plant nitrogen content. (Geiger-FRC)
W82-05608

OPTIMIZING THE USE OF WATER AND NITROGEN THROUGH SOIL AND CROP MANAGEMENT,

Oregon State Univ., Corvallis. Dept. of Crop Science.
F. E. Bolton.
Plant and Soil, Vol 58, No 1-3, p 231-247, 1981. 4 Fig, 3 Tab, 34 Ref.

Descriptors: *Crop production, *Water use efficiency, *Soil management, *Nitrogen, Soil water, Arid zones, Fertilizers, Water use, Weed control, Water storage, Transpiration, Soil-water-plant relationships, Planting management.

Under rainfed production of crops, water must be used efficiently to optimize water and nitrogen supplies. To accomplish this, maximum amounts of water can be stored in the soil profile by improved tillage and moisture conservation practices while maximum use is made of stored water through improved crop management practices. In semi-arid, rainfed regions, fertilizer applications should be based on current moisture supplies rather than long-term averages. The 'package of practices' approach involves utilizing the best combinations of tillage, selection of adapted varieties and optimum planting and fertilizer application times, and weed control and harvesting techniques. The proper package of practices must be determined in extensive field studies conducted over a long period of time. Each element in the production package must be performed in the proper sequence or to the advantage of the other elements. Since many resources such as fertilizers and herbicides are not presently available in the developing countries, implementation of the complete production package in these nations is not yet feasible. Use of some elements of the production package which fit into the traditional system may offer substantial increases in yield until other elements of the production package are applied at a later date. (Geiger-FRC)
W82-05609

PLANT IMPROVEMENT FOR SEMI-ARID RANGELANDS: POSSIBILITIES FOR DROUGHT RESISTANCE AND NITROGEN FIXATION,

Utah State Univ., Logan. Crops Research Lab.
D. A. Johnson, M. D. Rumbaugh, and K. H. Asay.
Plant and Soil, Vol 58, No 1-3, p 279-303, 1981. 3 Fig, 98 Ref.

Descriptors: *Range management, *Semiarid lands, *Grazing, *Drought resistance, *Vegetation regrowth, Range grasses, Water stress, Water deficit, Drought, Nitrogen, Legumes.

As world population increases, so should the importance of semi-arid rangeland for off-season livestock grazing in rotation with croplands. Improved plant materials and better grazing management practices are needed to rectify problems caused by underproduction due to overgrazing. The development of drought-resistant range plants is being studied through drought characterization, defini-

tion of selection criteria, assemblage of a broad genetic base, and the development and application of screening methods. Since plant productivity on many arid rangelands is limited by nitrogen, legumes should be evaluated to assess their potential for contributing nitrogen to the rangeland environment. Interdisciplinary programs should be tested to bring about plant improvement under drought stress to develop cultivars suitable for the re-vegetation of semi-arid rangelands. (Geiger-FRC)
W82-05610

CABLEGATION: I. CABLE CONTROLLED PLUGS IN PERFORATED SUPPLY PIPES FOR AUTOMATIC FURROW IRRIGATION,

Science and Education Administration, Kimberly, ID.
For primary bibliographic entry see Field 8A.
W82-05617

EROSION CONTROL POTENTIAL WITH CONSERVATION TILLAGE IN THE LAKE ERIE BASIN: ESTIMATES USING THE UNIVERSAL SOIL LOSS EQUATION AND THE LAND RESOURCE INFORMATION SYSTEM (LRIS),

Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 4D.
W82-05661

POTENTIAL FOR GROUNDWATER RECHARGE SEEPAGE FROM FLOOD-RETARDING RESERVOIRS IN SOUTH CENTRAL NEBRASKA,

Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W82-05663

ADVANCE AND RUNOFF-SURGE FLOW FURROW IRRIGATION,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
P. S. Coolidge, W. R. Walker, and A. A. Bishop.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 35-42, March, 1982. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Furrow drainage, *Irrigation efficiency, *Irrigation design, *Irrigation requirements, Furrow irrigation, Furrows, Surges, Irrigation ditches, Irrigation return flow, Irrigation practices, Irrigation engineering, Irrigation water, Water conservation.

Furrow advance and runoff studies were conducted on a field of silt loam soil using pulsed water applications. The surge flow irrigation method, defined as the intermittent application of water to furrows or borders creating a series of on and off modes of constant or variable time spans, was applied in two experiments each covering 100 m furrow sections. The first experiment tested 13 combinations of on-and off-times, each replicated 5 times. The second investigation consisted of 10 combinations of cycle period and cycle ratio with two replications. Results showed that the application of surge flow irrigation significantly accelerated furrow advance per unit of water used while reducing the temporal and spatial variability among furrows in the field. It was suggested that furrow drainage between surges accelerated the formation of thin surface seals, thereby reducing intake rates. (Geiger-FRC)
W82-05690

MANAGING SALINITY IN IRRIGATED AGRICULTURE,

Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3C.
W82-05691

NEW EVAPOTRANSPIRATION CROP COEFFICIENTS,

Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
J. L. Wright.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 57-74, March, 1982. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Mathematical studies, *Evapotranspiration, *Irrigation requirements, *Irrigation efficiency, *Model studies, Evaporation, Evapotranspiration potential, Irrigation programs, Irrigation water, Mathematical models, Crop production, Transpiration.

New crop coefficients for the Pacific Northwest irrigated crops of alfalfa, potatoes, snap beans, sugar beets, sweet and field corn, garden peas, winter and spring wheat, and spring barley were developed for use in the relationship describing evapotranspiration (ET). Reference ET was based on the ET rate for well watered, actively growing alfalfa in arid, irrigated regions. The improved ET coefficients represent basal or minimal coefficients reflecting conditions of minimal soil evaporation, but adequate root zone moisture. They can be used with the United Stated Department of Agriculture Computerized Irrigation Scheduling Program for estimating daily crop ET. When combined with improved estimates of evaporation from wet soils, the new coefficients should permit more accurate estimates of daily crop ET, and irrigation water requirements and thus more accurate irrigation scheduling. New crop models are needed to permit partitioning soil evaporation and plant transpiration, and to provide a basis for directly relating the crop coefficient to crop development. (Geiger-FRC)
W82-05692

OPTIMUM DEPTH AND SPACING OF SUBSURFACE DRAINS,

Marathwada Agricultural Univ., Parbhani (India).
For primary bibliographic entry see Field 8B.
W82-05693

A PREDICTION EQUATION FOR DAY NIGHT WIND RATIO CORRECTION ON REFERENCE CROP EVAPOTRANSPIRATION,

Marathwada Agricultural Univ., Parbhani (India).
For primary bibliographic entry see Field 2D.
W82-05722

IRRIGATION EFFICIENCY IN ORCHARDS,

Department of Agriculture, Summerland (British Columbia). Research Station.
D. S. Stevenson.
Canadian Water Resources Journal, Vol 5, No 3, p 102-110, 1980. 4 Tab, 1 Ref.

Descriptors: *Irrigation efficiency, *Orchards, *Fertilizers, Apples, Water use, Summerland, *British Columbia, Fruit crops, Water conservation, Irrigation techniques, Lysimeters, *Canada.

The term irrigation efficiency encompasses four interrelated factors: efficiency of water use, efficiency of labor, efficiency of dollars, and efficiency of land. Orchardists in British Columbia's arid Okanagan Valley traditionally overirrigate, wasting 50% of the water applied, losing fertilizer, and changing soil chemistry. Possible solutions to this are increased capacity of the irrigation system so that irrigation can be done quickly and less frequently and conversion from sprinklers to trickle irrigation. In the Summerland District 12 lysimeters planted with McIntosh apple trees were used to study irrigation efficiency and fertilizer application. Application rates were equivalent to 3.6 mm per day (37% of usual irrigation allotment) in 1974-77; 4.6 mm per day in 1978-79. In these 6 years very little drainage was obtained from silt soils. Drainage from sandy loam soils was 13-38% of total applied water on bare ground and 1-31% of total applied water on grass covered lysimeters. Amounts of nitrogen fertilizer reaching the groundwater were about 50% for cultivated soil and 5-15% for grass covered soil. (Cassar-FRC)
W82-05768

THE WELLTON-MOHWAK DILEMMA,

Science and Education Administration, Riverside, CA. Salinity Lab.
J. Van Schilfgaarde.
Water Supply and Management, Vol 6, No 1-2, p 115-127, 1982.. 2 Fig, 5 Tab, 9 Ref.

Descriptors: *Irrigation effects, *Salinity, *Irrigation efficiency, *Desalination plants, *Economic aspect, *Colorado River, Desalination, Water management, Irrigation programs, Irrigation practices, Irrigation water, Irrigation-return flows, Rate of return, Water pollution sources.

The Wellton-Mohawk irrigation project near Yuma, Arizona involves the conveyance of Colorado River waters to lands in and above the Gila River Valley. To alleviate waterlogging and salinity problems caused by the project, numerous pump drains were installed, which resulted in significant increases in the salinity levels of downstream waters in the Mexicale Valley. The United States has planned an expensive desalting plant to upgrade water salinity levels to be in accordance with the 1973 Water Treaty with Mexico. Improving irrigation management practices in the area of the Wellton-Mohawk project was considered a more cost-effective approach, but one that was difficult to implement based on economic return. If irrigation efficiency is increased and return flows decreased, the size of the proposed desalting plant may be reduced. (Geiger-FRC)
W82-05883

FUTURE WATER DEVELOPMENT POLICIES,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W82-05884

OPTIMAL SALINITY CONTROL PROGRAM FOR THE UPPER COLORADO RIVER BASIN,

Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
For primary bibliographic entry see Field 5G.
W82-05893

SALINITY CONTROL MEASURES FOR GRAND VALLEY,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe, W. R. Walker, and R. G. Evans.
Water Supply and Management, Vol 6, No 1-2 p 129-167, 1982. 14 Fig, 7 Tab, 28 Ref.

Descriptors: *Desalination, *Irrigation effects, *Colorado river, *Salinity, *Irrigation efficiency, *Irrigation-returnflow, *Canal linings, Water quality control, Groundwater management, Irrigation engineering, Irigation canals, Irrigation practices, Saline water, Irrigation water, River basins, River basin development.

Irrigation return flows which contact the marine deposited Mancos shale enter aquifers of the Grand Valley in west central Colorado and cause excessively saline waters to reach the Upper Colorado River Basin. Various measures are studied for reducing the salt load from this area. On-farm improvements to reduce irrigation return flows include irrigation scheduling, head ditch linings, and sprinkler and trickle irrigation. Other approaches are conveyance channel linings, field relief drainage, taxation and land retirement, modified legal constraints, and collection and desalting of return flows. A restructuring of the local irrigation system lying below the turnouts from the major canal systems would be the best procedure for salinity control in the waters of the Grand Valley. At higher levels of valley-wide salinity control, emphasis should be placed on canal linings for other irrigation canals in addition to the Government Highline Canal. Only after major irrigation system improvements are implemented would desalination become a cost-effective means of salinity control. (Geiger-FRC)
W82-05894

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ON-SITE STORMWATER DETENTION: AN OVERVIEW,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
J. M. Mason, Jr.
Public Works, Vol 113, No 2, p 62-64, February, 1982. 2 Fig, 3 Ref.

Descriptors: *Storm water, *Runoff, Flood control, Storm runoff, Detention reservoirs, *Urban runoff, Surface runoff, Dry wells, Trenches, Ditches, Economic aspects, Ponds, Cisterns, *Sewer systems, *Water pollution control.

Street runoff is composed of many pollutants also found in sanitary sewage, along with considerable amounts of metals. Various measures may be taken to collect contaminants before they enter the sewer system. The objective of detention facilities in general is simply to regulate the runoff from a storm by distributing it over a longer time period. Methods include surface storage using dry ponds, wet ponds, parking lots, shallow surface catchments, and subsidiary fill impoundments; rooftop storage; underground storage with trench, pipe and cistern storage and tunnel-reservoir systems; and infiltration storage such as dry wells and infiltration trenches. To control the discharge from small on-site detention basins, a number of outlet structures are needed: pipe/culvent, perforated riser pipe, weir, or a special outlet control box. An emergency spillway must be provided in the event of a critical storm that exceeds the basins's design frequency. The preferred location of an emergency spillway is on undisturbed ground rather than over a prepared embankment. The emergency spillway must be sufficiently protected to eliminate any potential erosion. Efforts should be made to direct the spillway away from high value property and toward the natural drainage pattern. Economic justification for constructing the facilities for control of stormwater runoff has been that they enhanced the value of the areas affected. Other benefits would be the creation of recreation areas and the replenishment of the ground water supply. Identifying the beneficiaries of flood and pollution control projects is an important consideration in allocating the costs of such improvements. (Baker-FRC)
W82-04758

RESISTANCE OF BEAUHARNOIS CANAL IN WINTER,
National Water Research Inst., Burlington, (Ontario).
For primary bibliographic entry see Field 2C.
W82-04998

PREDICTION OF WATER LEVEL IN TIDAL INLET,
Kanazawa Inst. of Technology (Japan). Dept. of Civil Engineering.
K. Mizumura.
Journal of the Waterway Port Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW1, p97-106, February, 1982. 13 Fig, 10 Ref.

Descriptors: *Model studies, *Intake gates, *Water level fluctuations, *Tides, *Lakes, *Regression analysis, Mathematical models, Hydraulic models, Irrigation water, Filtration, Mathematical studies, Inlets, Theoretical analysis, Markov process, Prediction, Tidal lakes, Lake Kahokugata, *Japan.

In order to control the water quality and quantity of tidal lakes, the operation of gates at the inlets must be undertaken with extreme care. Water flow through the inlet must be sufficient for crop irrigation without being high enough to cause flooding. In order to optimize gate control, water levels downstream are predicted by a combined model which uses regression theory and control theory. In the first part of this two part model, a regression equation is used along with sea levels to predict the water levels downstream of the gate. In the second part, a Kalman filtering algorithm is utilized to identify parameters used in constructing the state equation. The model was applied to problems of estimating water levels on the downstream side of the gate at the Lake Kahokugata inlet in Ishikawa, Japan. It was possible to determine changes in water levels under the arbitrary gate operations one or two hours before the actual water fluctuation events. Use of Kalman filtering made possible the realtime prediction of water levels when the second order Markov model was employed. (Geiger-FRC)
W82-05005

NEW METHODS OF DESIGNING FLOOD CONTROL MEASURES,
For primary bibliographic entry see Field 2E.
W82-05030

MAN-MADE STORAGE OF WATER RESOURCES--A LIABILITY TO THE OCEAN ENVIRONMENT. PART II,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
H. J. A. Neu.
Marine Pollution Bulletin, Vol 13, No 2, p 44-47, February, 1982. 2 Fig, 6 Ref.

Descriptors: *Water storage, *Environmental effects, *Seasonal variation, Balance of nature, Hydroelectric power, Salinity, Canada, Reservoirs, Water resources development, Estuaries, Fisheries, Marine fisheries, Runoff, Marine biology, Powerplants, *Regulated flow, *Ecological effects, Ocean circulation.

Regulating natural seasonal runoff for power production may product serious damage to marine life. Biological activities in large ocean currents such as the Gulf Stream depend on a seasonal nutrient supply, which in turn is regulated by the seasonal fresh water runoff. Modifications of these patterns, which have evolved over thousands of years, may be responsible for declines in fish catches, as seen in the late sixties and early seventies off the North Atlantic Coast. Other areas where marine life has been disturbed by water resources development are the Nile Delta, the Black and Azov Seas, and the Grand Banks of Newfoundland. Over 300 water storage projects have been built in Canada during the last 25 years. This has changed the balance of water storage in this region from the natural ratio of 4:1 (summer:winter) to 3:2. Possibilities for achieving more natural seasonal flows are power production without storage (run of the river stations), closed-circuit twin lake systems in which water is pumped into the upper lake during periods of low power demand and excess available energy, and determining the minimum spring flow necessary to maintain primary production in estuaries. (Cassar-FRC)
W82-05126

PREDICTIVE MODELS OF BENTHIC MACROINVERTEBRATE DENSITY FOR USE IN INSTREAM FLOW STUDIES AND REGULATED FLOW MANAGEMENT,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 8I.
W82-05194

DEVELOPMENT OF NATURAL SUBIRRIGATION OF LANDS AND ITS PREDICTION NEAR LARGE RESERVOIRS,
Northern Scientific Research Inst. of Hydraulic Engineering and Reclamation, Kazan (USSR).
G. N. Petrov.
Water Resources, Vol 8, No 2, p 155-164, March-April, 1981. 4 Tab, 9 Ref. Translated from Vodnye Resursy, No 2, p 98-108, March-April, 1981.

Descriptors: *Waterlogging, *Reservoirs, *Subirrigation, Soil water, Environmental effects, *Dam effects, Drainage, Hydrophytes, Swamps, Wetlands, Water level fluctuations, Capillary water, Saline soils, Demineralization, Vegetation, Soil saturation, *USSR.

Natural subirrigation, an adverse result of building reservoirs on flatland rivers, may affect areas of 0.5 to 3000 ha, according to investigations of several large reservoirs in Russia. A consequence of subirrigation is waterlogging of the soil, leading to the development of swamps, increase of soil acidity, salinity, gleization, and transformation into meadows. A succession of vegetation from mesophilic to hydrophilic occurs over a number of years. Several conditions which promote the development of subirrigation are: increase in humidity on the low windward shores, wind-induced denivellation phenomena accompanied by tilting of the water surface and flooding, raising the reservoir level above normal, daily and weekly variations up to 1 m of the water level, closed small depressions, rapid spread and slow decomposition of hygrophytes with tubers and rhizomes, disturbance of soil by grazing cattle, enclosing subirrigated lands (which encourages deposition of debris), existence of low spots many km from the reservoir, and fine-textured soil. Studies on prediction of subirrigation are described. (Cassar-FRC)
W82-05238

THE UTILIZATION OF GRASS CARP, CTENOPHARYNGODON IDELLA VAL., FOR HYDRILLA CONTROL IN LAKE BALDWIN, FLORIDA,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
J. V. Shireman, and M. J. Maceina.
Journal of Fish Biology, Vol 19, No 6, p 629-636, December, 1981. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Vegetation, *Fish, *Aquatic weed control, Aquatic plants, *Water pollution control, Eutrophication, *Florida, Lakes, Lake Baldwin, Carp, Hydrilla, Plant growth.

The effectiveness of grass carp in control of hydrilla was investigated by stocking Lake Baldwin, Florida with this control agent during 1978 at a rate of 24 fish per ha. At two years after stocking, hydrilla was nearly eradicated from the lake. Control was effective with 130 kg grass carp/ha of hydrilla, and control was definite when biomass exceeded 185 kg/ha of hydrilla. During the first two years the growth of grass carp was rapid,as the fish reached 9.17 kg by June of 1980. Grass carp greater than 6 kg in weight consumed 25-28% of their body weight of hydrilla per day. The use of grass carp for vegetation management is discussed. It is proposed that three methods can be used to manage vegetation with grass carp; method selection depends on the management goal. First, stock sufficient grass carp to completely remove vegetation. Second, stock grass carp in low numbers to remove vegetation at a slow rate which achieves desired vegetation levels after three to four years and adjust grass carp numbers as needed. Or, third, use chemical or mechanical methods to achieve control within the first year and stock only enough grass carp to maintain this level. The third option appears to offer the best possibilities. Grass carp should be stocked (0.5 kg) during the first winter at 5-6 fish/ha of hydrilla. This should be sufficient to consume regrowth. (Baker-FRC)
W82-05274

SEASONAL RISK-BASED RESERVOIR OPERATING RULES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
T. P. Ballestero.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224742, Price codes: A10 in paper copy, A01 in microfiche. PhD. Thesis, Spring 1981. 189 p, 108 Fig, 9 Tab, 61 Ref, 4 Append. OWRT B-195-COLO(4).

Descriptors: *Reservoir operation, *Operating policies, *Probabilistic process, *Risks, *Seasonal variation, Economic aspects, Reservoir storage, Water storage, Reservoirs, Management planning,

Planning, Estimating, Priorities, Prediction, Forecasting, Projections, Policy making, Water supply systems, Water supply, Water scarcity, Water loss, Water management, *Hazardous materials, Spills.

Research was carried out to develop a capability to predict short-term (seasonal) effects of various reservoir operation policy on future failure (spill or deficit) probabilities, based on application of the concept of the Anticipated Decision Influence Period (ADIP). The ADIP is defined as the time from the present to the end of the current failure (spill or deficit) period. Three methods of identifying the ADIP and two types of risk-based rule schedules were tested. Two reservoirs were analyzed: one with almost insignificant overyear storage; one with considerable overyear storage. It was concluded that the risk-based rules yield improvement over standard normal conditions for the small reservoir, with improvements being magnified for the large reservoir. Three steps were used to formulate reservoir policy based on the future failure volume distribution and implementation of the policy if future failure probability criteria were violated. This was followed by the mapping out of the results of various levels of action to decrease future failure risk. Thus, future failure risk may be decreased and the magnitude of the decrease may be controlled. (Zielinski-MAXIMA)
W82-05299

INTEGRATED MANAGEMENT OF WATER DEFICITS AND FLOODS IN A RESERVOIR SYSTEM,

Centro Teoria dei Sistemi, Milan (Italy). Ist. di Elettrotecnica ed Elettronica.
P. Bolzern, G. Fronza, F. Garofalo, and G. Ambrosino.
Journal of Environmental Management, Vol 13, No 1, 1981. p 1-12. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Reservoirs, *Flood control, Mathematical studies, *Statistical methods, Stochastic processes, Management planning, Multipurpose reservoirs, Reservoir storage, Reservoir yield, Simulation analysis, *Optimization, Systems analysis, Flood data, *Reservoir operation.

A reservoir management approach is described. The approach assumes that inflow forecast is one of the driving variables of reservoir operation and avoids fixing a minimum advisable freeboard. The design also takes into account both short- and long-term objectives, specifically, mitigation of downstream water deficiencies and mitigation of flooding adjacent to the reservoir. The first goal is addressed in an optimization model which prescribes a schedule of releases on the basis of current storage and forecast inflows. The second goal is addressed in daily yield decisions based on flood control requirements. (Titus-FRC)
W82-05325

FLOOD CONTROL AND FLOW REGULATION PROBLEMS ON THE ASSINIBOINE RIVER,

Manitoba Dept. of Natural Resources, Winnipeg.
N. Mudry, G. H. MacKay, and V. M. Austford.
Canadian Water Resources Journal, Vol 6, No 4, p 157-173, 1981. 1 Fig, 4 Ref.

Descriptors: *Flood control, *Water management, *Enviromental effects, Diversion structures, Flood protection, Flow regulation, *Assiniboine River, *Manitoba, Floodways, Flood channels, Reservoirs, Shellmouth Dam, Brandon, Winnipeg, Portage-la-Prairie, Land acquisition, Water conveyance, Water quality, Drainage, Water supply, Intakes, Flood plains, River basins, Water resources development, Canada.

Several unanticipated problems have resulted from the flood control and flow regulation projects on the Assiniboine River in the Winnipeg, Manitoba, region. The control structures include a floodway to divert Red River water around Winnipeg, a diversion channel to convey floodwaters from the Assiniboine River to Lake Manitoba, the 35-mile long Shellmouth Reservoir on the upper reaches of the river, and a dike system within Winnipeg and in agricultural regions between Portage-la-Prairie and Winnipeg. Criteria for land acquisition at the head of the reservoir were relaxed to allow private ownership of 160-200 ha of 607 ha of marginally affected land below the 431.3 m level. This was a mistake, because the drainage time on this land was substantially increased after reservoir construction. Flooding and impeded drainage have also increased in cultivated land directly downstream from the dam. Adjustment of flow rates to solve this problem would greatly increase flooding further downstream. The major algae blooms on the reservoir have affected municipal water supplies as far downstream as Brandon, especially at flows of 8.5 cu m per sec or less. A winter water supply intake for the Portage-la-Prairie municipal supply does not perform as designed because flow fluctuations and high silt levels cause damage and operational problems in the pumping system. In addition, heating of equipment and a larger staff are necessary. There is also a danger of ice damage to the conduit gate. The diversion channel to Lake Manitoba has caused silt damage and poor drainage in adjacent farmlands. Since the government did not buy all the land for the Assiniboine River dike system prior to construction, there have been problems with farmers removing dikes, with dike maintenance, and with subsequent land acquistion. (Cassar-FRC)
W82-05389

CALIFORNIA'S PERIPHERAL CANAL: SKIRTING THE DELTA - AND THE ISSUES,

T. Pfaff.
Environment, Vol 24, No 3, p 25-35, April, 1982. 6 Fig, 22 Ref.

Descriptors: *Water resources development, *Canals, *California, Peripheral canal, *Sacramento River, Construction, Financial aspects, Public opinion, Ecological effects, Planning, Diversion structures.

The proposed peripheral canal to be built in California is described. The canal would be the largest public works project in world history. The issue is complex and needs to be viewed from many perspectives. An overview of the state's geography and hydrology is an important factor. At its proposed size the canal would have an annual capacity of 16.3 MAF of water. At peak operating levels it could divert as much as 70% of the Sacramento River's average flow. From the start environmentalists have expressed concern about the effects such a diversion would have on water quality in the Sacramento-San Joaquin Rivers and San Francisco Bay. Even without the canal Delta conditions are deteriorating. Some officials claim that the canal would solve the problem of reverse flow, but others caution against this view. Both recreational and commercial fishermen have long opposed the water projects that pose so great a menace to the important fish populations of the area. While much has been said about the long term effects of the canal, relatively little has been thought about the immediate effects. If conservation and wastewater reclamation would obviate the need for some facilities, it would seem difficult to justify the phenomenal expense of building the various facilities. The peripheral canal alone would cost about $1.3 billion by the time it would be completed. The costs of construction are only a beginning. It would take a tremendous and continual supply of electricity to transport water within California. (Baker-FRC)
W82-05411

PROBLEMS OF THE MULTIPURPOSE USE OF WATER RESOURCES OF THE VOLGA-AKHTUBA FLOODPLAIN AND VOLGA DELTA,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
G. V. Voropaev, and T. N. Ivanova.
Water Resources, Vol 8, No 2, p 107-114, March-April, 1981. 2 Tab, 6 Ref. Translated from Vodnye Resursy, No 2, p 12-21, March-April, 1981.

Descriptors: *Multipurpose projects, *Reservoirs, *Water management, Volga River, USSR, Caspian Sea, Water resources development, Agriculture, Irrigation, Fisheries, Interbasin transfer, Diversion, Hydro-electric plants, Reservoir releases, Regulated flow, Water transport, Streamflow forecasting, Water distribution, Rivers, Water transfer, Deltas, Flood plains.

Problems exist in management of water in the Volga River Basin, a heavily populated agricultural and industrial region of Russia. Large water losses occur in non-wet years (85-90% of the time) because water management below Volgograd has not been changed to meet the conditions produced by the controlled management above Volgograd. Conflicts in consumer demand are especially apparent in spring and in dry years. The hydropower, water transport, and irrigation interests favor storage of water in spring, with subsequent release during the year. The fishery and agricultural consumers in the lower reaches prefer a more unregulated flow. The planned water management programs designed to operate under conditions of controlled spring flood have been tried in the lower Volga reaches since 1959. Since it is difficult to forecast the optimal release, desired results are rarely achieved. The level of the Caspian Sea has been dropping and the water quality deteriorating. The spring releases also cause electric power production losses at the lower river hydrostations during the second quarter. These problems will become more serious and complex as water consumption in the region increases and the planned diversions to the Don and Ural Rivers are accomplished. Measures to alleviate the problems and reduce waste include development of intensive irrigated agriculture and controlled fisheries, improvement in techniques for forecasting river flow and economic effects, creation of better models to determine procedures for automatic control of reservoirs, and construction of a water distributor at the apex of the delta to sustain the flow in the Volga tributary (Buzan) at an acceptable level and lengthen the flood period for fish reproduction. (Cassar-FRC)
W82-05487

DISCRETIZATION IN STOCHASTIC RESERVOIR THEORY WITH MARKOVIAN INFLOWS,

Monash Univ., Clayton (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 6A.
W82-05524

MULTIPLE OBJECTIVE PLANNING OF LAND/WATER INTERFACE IN MEDIUM SIZE CITIES: APPLICATION TO WEST LAFAYETTE, INDIANA,

Purdue Univ., Lafayette, Ind. Water Resources Research Center.
G. V. Loganathan, and J. W. Delleur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236647, Price codes: A07 in paper copy, A01 in microfiche. Technical Report No 144, March, 1982. 119 p, 16 Fig, 16 Tab, 48 Ref, 1 Append. OWRT-A-057-IND(4), 14-34-0001-1116.

Descriptors: *Land use, *Urban runoff, *Water quality, *Planning, *Simulation analysis, Urban planning, Multivariate analysis, Decision making, Overflow, Pollution load, Urban drainage, Water storage, Storm water, Storm runoff, Storn-overflow sewers, Mathematical studies, Detention reservoirs.

Research was focused on the conflicting goals of land use expansion and the control of urban runoff effluent quality. A probablity distribution approach was used to obtain the distribution of the overflows and of pollutant concentration levels in the receiving stream. At the planning level, this approach is simpler than the simulation approach developed in previous research. This study also extends the theory of milti-criteria decision-making (MCDM); the application of which to West Lafayette shows it to be a viable tool which deserves further study. The nearly-developed probability distributions provide a simple but powerful methodology for solving urban stormwater problems in estimating the size of the required detention storage, the reliability of the treatment system, and the size of the treatment plant for a given reliability level. The general MCDM prob-

lem theory was extended by development of a new cutting plane algorithm. The probability distribution for the receiving stream pollutant concentration requires further research. Study of the potential for developing joint distributions for different hydrologic variables is also recommended. (Zielinski-MAXIMA)
W82-05550

EVALUATION OF SNOWMELT FORECASTING METHODS,

Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier, K. A. Erickson, and D. B. Parkinson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236662, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 68, December, 1980. 70 p. 11 Fig, 12 Tab, 20 Ref. OWRT A-104-WASH(1), 14-34-001-0151.

Descriptors: *Snowmelt, *Runoff forecasting, *Model studies, *Model testing, Thaw, Runoff volume, Runoff rates, Flood forecasting, Prediction, Projections, Water storage, Watershed models, Converter models, Hydrologic models, Statistical models, Evaluation analysis, Mathematical studies, Watersheds, Weather forecasting.

Snowmelt runoff forecast accuracy has significant economic implications for water resources management (especially for hydroenergy production and agricultural irrigation). Assessment of snowmelt forecasting methods was conducted as part of an on-going study of streamflow forecasting methods. Retrospective forecasts were made for two western Washington rivers using the National Weather Service snowmelt and soil moisture as state-of-the-art conceptual models (CMs), and the Tangborn hydrometeorological model as representative of the more sophisticated of the storage index (SI) models. Analysis of about 20 years of forecast data for both river basins indicated the CMs performed no better than the SI model, despite greatly increased logistical requirements. Analysis of four years of extreme low runoff data also showed no conclusive differences in forecast accuracy between the CMs and the SI model. Calculations made to determine the limiting forecast accuracy for the CM (conditions on the statistics of monthly simulation errors) showed that simulation error (largely dependent on data network density) probably limits forecast accuracy, especially for late runoff season forecasting; this implies that significant forecast accuracy improvements for CMs may not be possible, given current data limitations for many mountainous watersheds. Two situations are identified in which CMs are preferred over the SI model. (Zielinski-MAXIMA)
W82-05552

MODIFICATIONS TO STEAM CHANNELS IN THE BRISBANE METROPOLITAN AREA, AUSTRALIA,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
W. C. Boughton, and R. J. Neller.
Environmental Conservation, Vol 8, No 4, p 299-306, Winter, 1981. 5 Fig, 4 Tab, 23 Ref.

Descriptors: *Water management, *Environmental effects, *Urban runoff, Streamflow, Channel improvement, Channel morphology, Brisbane, Australia, Urban watersheds, Flood control, Urban drainage, Dams, Water supply, Runoff, Highways, Dredging.

The environmental impacts of human activities (urban development, water resources development, and dredging) in Brisbane, Australia, at the mouth of the Brisbane River are documented. One steam, the Big Creek, formerly used as the city's principal water supply, now flows through pipes under the central city; no traces of its course are visible on the surface. Several dams in the Brisbane watershed have affected the geomorphological characteristics of the streams by trapping sediment and reducing flows. Flood control works such as channel dredging and straightening now aid in carring stormwater runoff. Freeway construction has resulted in eliminating some creeks and digging new channels. Flood storage capacity in the Norman Creek valley has been reduced. Culverts and man made channels in the Freeway area have completely changed the characteristics of the stream channel. Enlargement of Brisbane Airport will cover Serpentine Creek, requiring construction of a new floodway. Sand, gravel, and other building materials have been dredged from streams for many years forming, in some cases, man made lakes. Sediment is trapped in these lake areas, causing degradation downstream. In other places sediment concentrations in water are greatly increased by excavation of clay and sand. Suburban development has affected characterisics of the streams by increased runoff from impervious areas and by increased flow velocity in artificial channels. (Cassar-FRC)
W82-05572

ISSUES IN SIMULATION MODEL DESIGN–A CASE STUDY,

Waterloo Univ., (Ontario). Dept. of Civil Engineering.
E. A. McBean.
Journal of Hydrology, Vol 51, No 1-4, p 205-218, May, 1981. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Simulation analysis, *Model studies, Mathematical models, Water resources development, Planning, Reservoirs, Irrigation, Hydroelectric power, Water transfer, Computers, *Argentina, Rio Colorado(Argentina).

Computer simulation of potential river basin development, until recently merely an interesting academic exercise, is now a practical enginering procedure of increasing utility in water management. As a result of the limitations on accuracy and fidelity inherent in all-encompassing models, many modeling studies tend toward the use of a number of relatively limited mathematical models, each of which is restricted in the scope of questions which it addresses, while still useful for providing particular insights into the planning problem. The simulation model described in this paper was one of four models developed as part of a large basin-planning study of the reservoir capacities, irrigation areas, diversions and hydroelectric installations for the Rio Colorado, Argentina. A governing criterion in designing this simulation model was the ability to accept from and provide information to the other models used in the study. The computational and data efficiency of the model, the output characteristics of the model, and the maintenance of a general structure which would enhance the ease of use on other basin planning problems were also major concerns in designing the model. The model utilizes the following types of required input data: system definition, economic data, structural data, and hydrologic data. Efforts have been made in designing the model to minimize the disturbance of the data deck required for the investigation of minor changes to the system components. The model was successfully applied as input to a large planning study of the Rio Colorado basin. It is capable of solving problems of about 100 event points for a 50-year simulation, three seasons per year, for about $10.00. (Carroll-FRC)
W82-05627

A REVIEW OF CATCHMENT EXPERIMENTS TO DETERMINE THE EFFECT OF VEGETATION CHANGES ON WATER YIELD AND EVAPOTRANSPIRATION,

Jonkershoek Forestry Research Station, Stellenbosch (South Africa).
For primary bibliographic entry see Field 4C.
W82-05647

THREE-STATE MARKOV MODEL FOR DIFFERENTIAL PERSISTENCE,

Technical Univ. of Istanbul (Turkey). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05654

TIME AND FREQUENCY DOMAIN ANALYSES OF HYDROLOGICAL SYSTEMS,

Federal Inst. of Hydrology, Coblenz (Germany F.R.).
For primary bibliographic entry see Field 2E.
W82-05655

MODIFIED STANDARD OPERATION RULES FOR RESERVOIRS,

Technische Hochschule, Aachen (Germany, F.R.). Hydropower Div.
F. G. Rohde, and K. Naparaxawong.
Journal of Hydrology, Vol 51, No 1-4, p 169-177, May, 981. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Operating policies, *Reservoir operatin, Standards, *Optimization, Planning, Mathematical studies, *Simulation analysis, *Reservoir releases, Reservoir storage.

The problem of optimal reservoir operation occurs both in the planning phase, when operational costs and benefits related to different system designs must be assessed, and in the production phase, for the development of real-time management policies for existing systems. In the planning phase, two principal rules are widely applied: the standard operation rule and linear decision rules, derived either by implicit or explicit stochastic optimization techniques. The modified standard operation rule, which controls not only the reservoir release, but also the reservoir storage, provides a further alternative. Rules of this type are most widely applied in real-time reservoir operation. A procedure for the derivation of modified standard rules which uses time-dependent upper and lower storage bounds determined by a two-stage optimization process is presented. The application of this technique to an existing two-reservoir system in Thailand, which produces hydroelectric power, irrigation water, and low-flow augmentation for salinity control, is discussed. Long term simulations were used to compare the derived rule with the rules presently used in real-time operation. These simulations showed that, although the difference in system output in absolute terms was small, the operation with the new rule resulted in the increase of firm energy, non-firm energy and dependable capacity and in the decrease of frequency and volume of reservoir spills. (Carroll/FRC)
W82-05658

MULTI-DECISION ANALYSIS FOR LARGE-SCALE RIVER-BASIN RESERVOIR SYSTEMS,

Little (Arthur D.), Inc., Cambridge, MA.
For primary bibliographic entry see Field 2E.
W82-05659

A CONSISTENT METHODOLOGY FOR WASTELOAD ALLOCATIONS,

Hays and Lindsey, Inc., Austin, TX.
For primary bibliographic entry see Field 5G.
W82-05702

IDENTIFICATION OF INDEPENDENT RAINSTORMS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W82-05708

SOME CHARACTERISTICS AND IMPLICATIONS OF DRAINAGE BASIN LINEARITY AND NON-LINEARITY,

Nebraska Univ., Omaha. Dept. of Civil Engineering.
W. F. Rogers.
Journal of Hydrology, Vol 55, No 1/4, p 247-265, 1982. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Drainage engineering, *Runoff volume, *Linearity, Hydrologic models, *Rainfall-runoff relationships, Peak discharge, River basins, Precipitation, Design criteria, Unit hydrographs, Hydrographs.

In linear drainage basins runoff volume is directly proportional to precipitation volume, whereas in nonlinear drainage basins it is not. When the slope of the mathematical linear equation describing the

second-order standardized peak discharge distribution (SSPDD) is about -1.00, the drainage basins are linear. If the slope is less than -1.00, the drainage basin is nonlinear. The degree of nonlinearity is indicated by the magnitude of the negative slope of the SSPDD. The small- and medium-sized basins (up to 450 sq mi) studied had slopes from -1.02 to -2.83, mean -1.38. Using linear design procedures such as the unit hydrograph in nonlinear basins can result in serious overdesign. Peak discharge from Codorous Creek, Pennsylvania, drainage area 73.4 sq mi with a nonlinear slope of -1.39, was overestimated by 72% using linear equations. (Cassar-FRC)
W82-05710

LINEAR AND NONLINEAR RUNOFF FROM LARGE DRAINAGE BASINS,

Nebraska Univ. at Omaha. Dept. of Civil Engineering.
W. F. Rogers, and H. A. Zia.
Journal of Hydrology, Vol 55, No 1/4, p 267-278, 1982. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Drainage engineering, *Runoff volume, *Linearity, Snowmelt, Hydrologic models, Rainfall-runoff relationships, Peak discharge, Precipitation, Design criteria, Hydrographs, Unit hydrographs, River basins.

The second-order standardized peak discharge distribution (SSPDD) procedure described in a previous paper was applied to large drainage basins, 450 to 8190 sq mi. These basins showed linearity and nonlinearity with slopes of -1.01 to -1.43 derived from the equations. Even very small runoff volumes (0.001 inch expressed as depth distribution over the drainage basin) fit the distribution well. Twenty-two snowmelt hydrographs from several basins in Nebraska also fit the distribution. (Cassar-FRC)
W82-05711

KINEMATIC WAVE THEORY OF CATCHMENT RESPONSE WITH STORAGE,

Newcastle Univ. (Australia). Dept. of Civil Engineering and Surveying.
W. G. Field.
Journal of Hydrology, Vol 55, No 1/4, p 279-301, 1982. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Runoff, *Storage, *Kinematic wave theory, Rainfall-runoff relationships, Catchments, Excess rainfall, Open-channel flow, Hydrographs, Channel storage, Hydrologic models, Model studies, Urban runoff.

The catchment response model proposed in this paper consists of a continuous distribution of storage elements feeding into a branched channel system. It is assumed that rainfall excess enters the off-channel storage elements (linear or nonlinear) before being transformed to channel elements (linear or nonlinear) for transport to the catchment outlet. The discharge hydrograph is produced from solving the kinematic wave equation using the method of characteristics. Illustrations are given using a rectangular catchment and a linear catchment. It is shown that the model is a generalization of several other well-known models. For a linear catchment the runoff hydrograph is described by a double convolution integral in which the rainfall excess function and catchment time-area function can be interchanged to produce the solution for an equivalent catchment and hyetograph shape. Typical values for runoff coefficients are given for small rural catchments of different soil types and vegetation. For design purposes urban areas may be divided into impervious and pervious subareas. (Cassar-FRC)
W82-05714

FLOODPLAIN ANALYSIS, SIMPLIFIED VS. COMPLEX METHODS: A CASE STUDY,

Enviroscience, Inc., Minneapolis, MN.
I. Yomtovian, and D. Ford.
Water Resources Bulletin, Vol 18, No 2, p 259-263, April, 1982. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Flood plain management, *Flood insurance, *Flood profiles, Nonstructural alternatives, Flood damage, Flood discharge, Hydrologic models, Model studies, Maps.

Simple and complex methods of determining flood plain information were compared using data from three North Dakota creeks: Apple, Burnt, and Hay. A simplified manual technique (Soil Conservation Service) and a complex computer technique (HEC-2) produced similar flood plain boundaries. Differences of 1-3 ft in 100-year surface profiles were found in use of the 2 methods. Major differences were in locations near bridges. Simplified methods are recommended for rapid determination of flood hazard, flood information studies, and preparation of inundation maps for flood emergency plans. The complex mathematical models are recommended for determining the 10- and 100-year flood elevations. (Cassar-FRC)
W82-05732

ECONOMIC EVALUATION OF WATERSHED PROJECTS--AN OVERVIEW METHODOLOGY AND APPLICATION,

Minnesota Univ., St. Paul. Coll. of Forestry.
For primary bibliographic entry see Field 6B.
W82-05735

WINTER HEAT BUDGET AND FRAZIL ICE PRODUCTION IN THE UPPER ST. LAWRENCE RIVER,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2C.
W82-05736

MODELING OF WATER SUPPLY/DEMAND IN THE SOUTH PLATTE RIVER BASIN, 1970-2020,

Colorado State Univ., Fort Collins. Engineering Research Center.
For primary bibliographic entry see Field 6D.
W82-05738

LOCAL ATTITUDES TOWARD ALTERNATIVE USES OF A RESERVOIR PROJECT,

Ohio State Univ., Columbus. Dept. of Development Sociology.
For primary bibliographic entry see Field 6B.
W82-05743

NORMALITY OF HYDROLOGICAL DATA,

Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 7B.
W82-05752

FOREST MANAGEMENT FOR INCREASED WATER YIELD--HOW USEFUL IN SOUTHERN ALBERTA,

For primary bibliographic entry see Field 3B.
W82-05760

RESOLVING THE FISH VS FLOOD CONTROL CONTROVERSY ON THE VEDDER RIVER,

E. Bonham.
Canadian Water Resources Journal, Vol 5, No 1, p 38-53, 1980. 1 Fig, 3 Ref.

Descriptors: *Flood control, *Fisheries, *Channel improvement, Vedder River, British Columbia, Flood plain management, Dikes, Dredging, Bank protection, Sedimentation, Gravel, River beds, Water management.

A destructive flood of the Vedder River, British Columbia, in December 1975 prompted immediate remedial work--repair of the existing bank protection, scalping of major bars, burning of wood debris (completed March 1976), and removal of 750,000 cu yards of gravel from the main channel in July-August 1976. A management plan was devised as a long-term solution to accommodate both flood protection against a 200-year event and the salmon and trout fisheries. Strategies include increasing the floodway width and construction of 10 ft high gravel setback dikes, provision of ten 8' x 8' culverts in the railway embankment near the B. C. Hydro bridge constriction, and floodboxes within the setback dikes to enhance fish spawning. Cost estimates for the project, expected to be finished in 1982, are $1.8 million. The Vedder River Management Committee was formed in April 1980 with representatives in flood control, fisheries, wildlife, recreation, and agriculture. Major activities of the Committee will be to accommodate the conflicting interests, devise a long-term river sedimentation and gravel removal program, administer leasing of flood plain land for grazing and haying, and establish a riverside campsite. (Cassar-FRC)
W82-05765

TELEMETRY AND REAL TIME ENVIRONMENTAL DATA ACQUISITION (LA TELEMETRIE ET L'ACQUISITION EN TEMPS REEL DES DONNEES SUR L'ENVIRONNEMENT),

For primary bibliographic entry see Field 7B.
W82-05770

WATER MANAGEMENT IN THE MARITIMES,

New Brunswick Dept. of Fisheries and Environment, Frederiction.
For primary bibliographic entry see Field 6B.
W82-05776

THE MACKENZIE RIVER BASIN STUDY,

Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
H. Foerstel.
Canadian Water Resources Journal, Vol 5, No 2, p 13-27, 1980. 4 Fig, 4 Ref.

Descriptors: *Canada, *Water management, *Data collections, *Mackenzie River, History, Network design, River basins, Slave River, Deltas, Floods, Planning, Water policy.

The 3-year Mackenzie River Basin study, scheduled for completion in August 1981, covers a vast area (one-fifth of Canada) for which little data has been compiled. The study's main objective is to plug the many gaps in information. Because of the remoteness and enormous size, severe weather, and torrential flows in spring, information was scarce on precipitation in the mountains, the weather, water quality, the Slave River Delta, the Liard River spring ice breakup, the interrelations in the alluvial ecosystem, and the Athabasca Sand Dunes. All these fields have been under study. Some of the difficulties encountered in this basin study are the vast size (which required consideration of scales varying from very local to almost continental), the enormous but still inadequate amount of data, the verbosity of reports, long distance effects, and multiple interests. (Cassar-FRC)
W82-05778

THE OKANAGAN BASIN AGREEMENTS--AN EXAMPLE OF INTEGRATED WATER RESOURCE PLANNING IN BRITISH COLUMBIA,

For primary bibliographic entry see Field 6E.
W82-05779

WATER FLUCTUATION AND THE AQUATIC FLORA OF LAKE MICCOSUKEE,

Florida Dept. of Natural Resources, Tallahassee Bureau of Aquatic Plant Research and Control.
D. P. Tarver.
Journal of Aquatic Plant Management, Vol 18, 19-23, 1980. 1 Fig, 3 Tab, 12 Ref.

Descriptors: *Water level fluctuations, *Aquatic plants, *Weed control, Lakes, Lake Miccosukee, Florida, Aquatic weeds, Drawdown, Vegetation, Sediments, Lake sediments, Organic matter, Plant populations, Aquatic weed control.

In an attempt to control aquatic plant growth Lake Miccosukee, Florida, a shallow 2954 ha lake, was drawn down 1.7 m, so that by September 1977 90% of the lake bottom was exposed to drying conditions. Water level returned to normal by April 1978. Total water surface coverage in summer was 81% before drawdown (June 1976)

and 75.6% after drawdown and refilling (June 1978); in winter 62% before drawdown (February 1977) and 26% after drawdown and refilling (February 1979). Some plant species were considerably reduced as a result of drawdown: water shield, cabomba, variable leaf milfoil, water willow and related plants, and bladderwort. Several other plant types increased in abundance or remained at constant levels: azolla, duckweed, bog mat, frog's bit, yellow cow lily, fragrant water lily, and terrestrial annuals. Drying and plant desiccation produced compaction and stabilization of sediments. The peat zone decreased 70% in depth (from 6-40 cm to 3-12 cm) and the muck zone, 17% (from 3-40 cm to 3-39 cm). (Cassar-FRC)
W82-05808

HYDROLOGIC RECONNAISSANCE OF THE NOATAK RIVER BASIN, ALASKA, 1978,

Geological Survey, Anchorage, AK. Water Resources Div.
J. M. Childers, and D. R. Kernodle.
Geological Survey Open-File Report 81-1005 (WRI), 1981. 38 p, 18 Fig, 8 Tab, 10 Ref.

Descriptors: *Hydrologic data, *Surface water, *Springs, *Streamflow, Flow rates, Discharge measurement, Floods, Flood peak, Runoff, High water mark, Ice, Bank erosion, Aquatic life, Invertebrates, *Alaska, Noatak River basin, Arctic.

Hydrologic data were collected in 1978 described water resources of the Noatak River basin, Alaska. Streamflow varies seasonally. No flow was observed from the upper part of the basin in late winter (April). In the lower part of the basin springs support perennial flow in the Kugururok River and downstream along the Noatak. The discharge of the Noatak was 150 cubic feet per second in April 1978. During the summer, rainstorms are common, and runoff produces high flow. During August 1978, flow was normal in the basin; unit runoff averaged about 1 cubic foot per second per square mile. The Noatak is a gravel-bed stream of moderate slope. It drops about 1,800 feet in elevation from a point near the head waters to the mouth, a distance of 400 miles. Streambed material in most places is gravel, cobbles, and boulders, maximum riffle depths and pool widths increase in a downstream direction. Stream velocity in August 1978 increased from about 1 foot per second in the upper basin to about 4 feet per second in the lower reaches. High-water marks of the maximum evident flood were found at elevations from bankfull to 5 feet above bankfull. Maximum evident flood unit runoff rates were estimated to be less than 50 cubic feet per second per square mile. Scars produced by ice jams were seldom seen above bankfull. Bank erosion appears to be most active in the lowlands. Water in the Noatak River basin is virtually unaffected by man's activity. Water quality varies with location, weather, season, and source; the water is normally clear, cool, and hard. During late winter sea water intrudes into the Lower Noatak Canyon. Benthic invertebrate community composition and variability suggest the river's undiminished natural quality. (USGS)
W82-05848

COLORADO RIVER DEVELOPMENT,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, and Management, Vol 6, No 1-2, p 29-61, 1982. 10 Fig, 1 Ref.

Descriptors: *Water resources development, *Colorado River, *Resources development, *Reclaimed water, *Project planning, Water supply development, River basins, Water use, Water management, Irrigation water, Water supply.

Since the enactment of the Reclamation Act of 1902, many attempts have been made to develop the water resources of the Colorado River Basin. Some early reclamation projects which played a major role in the development of the western United States are reviewed. Many newer projects including the Central Utah Project and the Central Arizona Project are currently under construction. The Central Utah Project will develop water from Utah Lake, the Provo River, and water tributary to the Colorado River for use in the Uinta Basin and the eastern part of the Bonneville Basin. The Central Arizona Project will provide supplemental Colorado River water to nearly 1 million acres of agricultural land in several Arizona and New Mexico counties and municipal and industrial water for the Phoenix and Tucson metropolitan areas. Additional projects have been authorized but are not yet under construction. The present storage capacity of the Colorado River Basin exceeds 65 million acre-feet, which is more than four times greater than the rivers' mean annual flow. Billions of dollars have already been spend for developing this river basin. (Geiger-FRC)
W82-05887

4B. Groundwater Management

ADVANCED WASTEWATER TREATMENT FOR GROUNDWATER RECHARGE–BERLIN RECHARGE PROJECT (RECYCLAGE ET TRAITEMENT D'EAUX USEES POUR RECHARGER UNE NAPPE SOUTERRAINE: L'INSTALLATION PILOTE DE BERLIN),

For primary bibliographic entry see Field 5D.
W82-04831

BARRIERS TO EFFECTIVE GROUND-WATER MANAGEMENT: THE CALIFORNIA CASE,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
K. Knapp, and H. J. Vaux, Jr.
Ground Water, Vol 20, No 1, p 61-66, 1982. 3 Tab, 11 Ref.

Descriptors: *California, *Groundwater management, *Model studies, *Cost analysis, *Groundwater mining, Groundwater depletion, Water demand, Water supply, Water supply development, Water management, Water law, Water policy, Pumping, Available water.

In California, 40% of the annual water needs are met by groundwater which is essentially unmanaged. As surface supplies become scarcer, groundwater depletion becomes more of a concern. A dynamic optimization model was used to show that substantial benefits may be gained from groundwater management in the southern San Joaquin area. The magnitude of these benefits is influenced by energy costs, interest rates, water demand and the availability of substitute surface supplies. The regulatory strategy chosen for management will affect the distribution of benefits. If additional surface water supplies are provided, groundwater mining is permitted even where quality is threatened. Individual fears of economic loss suffered for the collective and uncertain gain to a larger group are a real barrier to the implementation of groundwater management programs. In order to be effective, future groundwater management policies in California will have to be uncomplicated, equitable, flexible, and inexpensive to administer. (Geiger-FRC)
W82-04917

THE POTENTIAL FOR GROUND-WATER MANAGEMENT IN THE WEST: A SYMPOSIUM,

Oklahoma State Univ., Stillwater.
J. W. Westphal.
Ground Water, Vol 20, No 1, p 59-60, 1982. 3 Ref.

Descriptors: *Groundwater management, *Symposium, *Water supply development, *Water policy, *Water table decline, Environmental policy, Groundwater mining, Water resources development, Water rights, Water law, Irrigation water, Aquifers, *Western United States.

Many states in the West have no clear policy on groundwater use. Since a user's rights involve a combination of physical, economic, and social factors, competition among these interests should be expected. About 80% of the total irrigation in the United States takes place in 17 western states. Groundwater in the West constitutes 46% of its domestic use and 44% of its industrial use. This heavy use has resulted in decreasing water tables, especially in the Ogallala aquifer. The depletion of groundwater has caused a decline in streamflow. There seems to be room for careful development and management of groundwater resources in the West without totally exhausting the supply. California and Texas have virtually no groundwater rights law and only New Mexico had water quality standards for groundwater. Oklahoma is the only Western state with an existing comprehensive groundwater law. Five groundwater management studies are presented in a symposium to identify some management issues and see how they relate to economic and social considerations. They cover such topics as groundwater management in California, Arizona and the High Plains area, the Ogallala aquifer, surface water-groundwater interrelationships, and the storage and transmission characteristics of the basalts of the Pacific Northwest. (Geiger-FRC)
W82-04918

GROUND-WATER NETWORK DESIGN FOR NORTHWEST KANSAS, USING THE THEORY OF REGIONALIZED VARIABLES,

Kansas State Geological Survey, Lawrence.
M. Sophocleous, J. E. Paschetto, and R. A. Olea.
Ground Water, Vol 20, No 1, p 48-58, 1982. 14 Fig, 7 Ref.

Descriptors: *Groundwater management, *Networks, *Observation wells, *Water table decline, *Kansas, *Statistical methods, Network design, Water table wells, Monitoring, Test wells, Water table fluctuations, Water surface profiles, Groundwater depletion, Aquifers, Error analysis.

A study of the existing groundwater observation well network in northwest Kansas was designed to formulate the most effective arrangement for evaluating water table levels and monitoring groundwater resources. The theory of rationalized variables was used to estimate the amount of spatial variability of the water table surface. Structural analysis, a statistical procedure that investigates the behavior of a mapped variables with changes in distance, was employed. Semivariograms were used to assess the degree of spatial continuity of the water table. The method was applied to Groundwater Management District No. 4, which holds groundwaters mainly of the Ogallala Formation. The error analysis produced by universal kriging showed that fewer wells would be required for the same level of accuracy if a regular 5.4-km network was used. Reducing the estimation error in the water-table surface uniformly throughout the region proved impractical due to the higher costs of well monitoring. (Geiger-FRC)
W82-04921

ECONOMICS OF DECLINING WATER SUPPLIES IN THE OGALLALA AQUIFER,

Oklahoma State Univ., Stillwater. Dept. of Agricultural Economics.
J. Warren, H. Mapp, D. Ray, D. Kletke, and C. Wang.
Ground Water, Vol 20, No 1, p 73-79, 1982. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater management, *Oklahoma, *Model studies, *Groundwater depletion, *Economic aspects, *Irrigation requirements, *Computer models, Aquifers, Crop production, Agriculture, Cultivated lands, Irrigation effects, Irrigation water, Irrigation wells, Water demand, Water supply, Water supply development, *Ogallala aquifer.

Discovery and exploitation of the Ogallala Formation generated dramatic economic growth, primarily based on irrigated agriculture, in the High Plains region of the United States beginning early in the twentieth century. The problem of declining water levels in the Ogallala Aquifer began to attract public attention in the early 1970s. An integrated six-state study was initiated, in which Oklahoma researchers developed a computer model of the agricultural sector of northwestern Oklahoma and estimated irrigated and dryland cropping patterns, farm output and farm income over a 40-year

planning horizon. Sensitivities of the outputs to alternative assumptions on energy costs, commodity prices and technological development were also analyzed. The model was run for a baeline case and two water management alternatives. Preliminary results suggest a favorable outlook for irrigated agriculture in the area through the near to mid term. (Geiger-FRC)
W82-04922

GROUND-WATER MANAGEMENT IN BASALTS,

California Univ., Davis. Dept. of Geography.
M. L. Shelton.
Ground Water, Vol 20, No 1, p 86-93, 1982. 4 Fig, 18 Ref.

Descriptors: *Groundwater management, *Model studies, *Groundwater storage, *Basalts, *Water management, *Groundwater basins, Aquifers, Groundwater recharge, Groundwater mining, Groundwater depletion, Water resources development, Decision making, Hydrologic models, *Columbia River basalts.

The mining of groundwater in the Columbia River basalts of the Pacific Northwest is complicated by the spatial variability of the hydrologic properties of the deep stratified lava flows. This area is experiencing greater demands for groundwater resources due to new irrigation projects and municipal and industrial requirements. Individual basin studies aid in decision making on water management issues and also increase the data on regional groundwater systems. The Deschutes River Basin system in Oregon is described by a distributed-system multiple storage model which gives the magnitude of spatial variations in groundwater recharge, storage, and discharge for this watershed. The functional properties of the basin groundwater system and the presence and magnitude of its inter-basin linkages are revealed by input-output analysis. Model simulations of storage and transmission characteristics suggest that basin or regional perspectives are required to fully utilize the groundwater stored in basalts. (Geiger-FRC)
W82-04931

GROUND-WATER DEVELOPMENT IN WESTERN RIVER BASINS: LARGE ECONOMIC GAINS WITH UNSEEN COSTS,

Arizona Univ., Tucson. Dept. of Agricultural Economics.
J. T. Daubert, and R. A. Young.
Ground Water, Vol 20, No 1, p 80-85, 1982. 2 Tab, 14 Ref.

Descriptors: *Groundwater management, *Colorado, Surface water availabilty, *Economic aspects, *Water rights, *Computer models, *Water supply development, Model studies, Groundwater depletion, Water shortage, Water law, Simulation analysis, Digital computers, Irrigation water, Aquifers, Water demand, Water management, Groundwater availability.

In river basins where aquifers are in close hydrologic contact with streams, groundwater development projects can lower water tables and decrease the amount of surface water available for irrigation of cropland. A digital computer simulation model was formulated to study the economic impact of water management policies in the lower South Platte River basin of Colorado. Colorado water law gives priority on appropriation of water to senior water rights holders with the earliest application dates. Those with subsequent dates hold junior rights. Evaluations of an independent water allocation approach showed that surface water owners cannot protect their historical water rights and must cope with costs associated with declining surface diversions. An approach which allocated both surface and groundwater according to prior appropriation protects senior surface water rights, forcing groundwater users to cease pumping or pay full damages. An open access management policy yielded high income benefits but imposed greater costs on the users of surface water when water supply shortages occurred. Regulation of groundwater usage under the appropriation system reduced the losses of surface water users, but greatly reduced the profits of groundwater users. (Geiger-FRC)
W82-04932

REGIONAL MANAGEMENT OF GROUNDWATER RECHARGE AND POLLUTION IN A RAPIDLY URBANIZING AREA: LONG ISLAND, N.Y.,

Cornell Univ., Ithaca, NY., Dept. of Environmental Engineering.
C. A. Shoemaker, and J. P. Leighton.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220625, Price codes: A04 in paper copy, A01 in microfiche. Report, March 1982. 53 p, 6 Fig, 16 Ref, 2 Append. B-091-NY(1). 14-34-0001-9087.

Descriptors: Sewerage network, Optimization, Groundwater, 201 regions, Urbanization, *Model studies, *Sewer systems, *Wastewater facilities, Groundwater recharge, Water pollution control, *Groundwater management, *Suffolk County, Long Island, *New York.

Augmentation of a network of sewer lines and wastewater treatment plants is anlayzed using optimization methods. The optimization model uses integer programming to determine the most economical location of wastewater treatment plants and sewer pipe routes. Because of the extraordinarily large number of integer variables, a special procedure was developed to solve the integer programming problem. The optimization model was applied to western Suffolk County in Long Island, N.Y. The patterns of wastewater treatment and collection which the optimization program found to be least expensive were also those which had relatively little recharge of treatment plant effluent to groundwater. Because of concerns that such major changes in recharge patterns would result in decreased streamflows, the optimization model was modified to encourage more recharge to groundwater. Similarly, preferences for preserving 201 boundaries in wastewater treatment and collection were addressed by computing the solution to the optimization model with restrictions which prevented shipment of wastewater from 201 region to another. The results indicated that the cost for wastewater treatment could be as much as $100 M (18%) more expensive if western Suffolk County is forced to consider only local treatment within existing 201 areas instead of more efficient regional alternatives.
W82-04956

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 1 - ENVIRONMENT, HEALTH AND SOCIO-ECONOMICS,

California Univ., Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 6G.
W82-05214

REFLECTIONS OF THE CHOICE OF SOME PRIORITY AXES OF HYDRAULIC RESEARCH IN THE FIELD OF LAND AND WATER MANAGEMENT,

Rural Department for Waters and Forestry, Paris (France).
R. Darves-Bornoz.
Journal of Hydraulic Research, Vol 19, No 4, p 307-315, 1981.

Descriptors: *Hydraulics, *Agriculture, Agricultural engineering, Irrigation, Water reuse, Water use efficiency, *Water management, *Land management, Drainage, Irrigation efficiency, Priorities.

Priorities for hydraulic research in the area of land and water management are discussed. Agricultural hydraulics plays a major role in how problems relating to global food production and water management are addressed. The saving of water in irrigation and the increased efficiency of its use for crop production are at the core of major world problems. Reuse of wastewaters for agricultural purposes is another area requiring further investigation. International objectives relating to agricultural and rural development in developing countries are partly linked to water control in agriculture. A better knowledge of the terrestrial cycle of water is needed. Water retention in soil for rainfed agriculture, reduction of irrigation water losses, drainage of excess water, and control of recharge to underground waters are the modifying actions of terrestrial cycle of water at the quantity level which need to be addressed by hydraulic research. Means for avoiding salinization of soils and water and pollution of underground water resources and rivers need to be developed to help improve or maintain the quality of water in this cycle. There is a need for a generalized physico-mathematical model of the terrestrial cycle which will permit consideration of the impact of all human actions on the quality and quantity of water. The relationship between irrigation and power resources also needs to be investigated. (Carroll-FRC)
W82-05278

HEAT LOSS FROM RAPID INFILTRATION BASIN IN WINTER,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 5D.
W82-05317

GROUNDWATER RESOURCES OF KWAJALEIN ISLAND, MARSHALL ISLANDS,

Hawaii Univ., Honolulu. Water Resources Research Center.
F. L. Peterson, and C. D. Hunt, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236605, Price codes: A03 in paper copy, A01 in microfiche. Technical Memorandum Report No 63, March, 1981. 38 p, 2 Fig, 4 Tab, 1 Ref, 1 Append. OWRT A-082-HI(1), 14-34-0001-0113.

Descriptors: *Groundwater availability, *Aquifers, *Pump wells, *Water level fluctuations, *Water resources development, Groundwater depletion, Groundwater management, Groundwater recharge, Groundwater storage, Electrical conductivity, Salinity, Water use, Water management, Available water, Water supply.

A detailed 2.5 year study was carried out to assess the magnitude and fluctuation of fresh groundwater resources of Kwajalein Island. Twenty-three observation wells were constructed and monitored with respect to the thickness, areal-extent, and quality of the groundwater lens. Recharge to the fresh groundwater lens averaged 1,140,000 cu m/year (300 million gallons/year (MG/Y)) over the study period, ranging from 893,000-1,450,000 cu m/year (236-383 MG/Y). The average fresh groundwater lens storage was over 1,060,000 cu m (280 million gallons), but fluctuated widely from about 908,000-1,210,000 cu m/year (50 MG/Y) for safe extraction, provided that an additional lens well is constructed. It is recommended that a proposed new pumping code be instituted on a trial basis to better utilize catchment during the wet season, and storm recharge to the groundwater lens during the dry season. In addition, the present salinity monitoring program (electrical conductivity observations) should be continued to permit assessment of any lens changes which might occur from groundwater development from the proposed new lens well. (Zielinski-MAXIMA)
W82-05546

NUMERICAL SIMULATION OF A THICK FRESHWATER LENS: PEARL HARBOR GROUNDWATER MODEL,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 2F.
W82-05621

EFFICIENT WATER USE IN CALIFORNIA: CONJUNCTIVE MANAGEMENT OF GROUND AND SURFACE RESERVOIRS,

Rand Corp., Santa Monica, CA.
D. J. Jaquette.
Journal of Hydrology, Vol 51, No. 1-4, p 187-204, May, 1981. 4 Fig, 9 Tab, 16 Ref.

Descriptors: *Groundwater management, *Water use efficiency, *Water supply development, Groundwater reservoirs, Reservoir operation, Water policy, Water management(Applied), Surface water, *California, *Conjunctive use.

This paper presents a summary of the findings of the Rand Corporation's study of water use efficiency in California. The study, which produced a wide variety of policy recommendations designed to improve the efficiency of water use in the State, found that an integrated water management plan could result in the development of significant quantities of new water at costs considerably less than the costs of new water from major facilities proposed for the State. The report recommended an aggressive plan for the conjunctive management of surface and groundwater reservoirs. This conjunctive use plan calls for releases in excess of customer needs to be made from the surface reservoirs and delivered to water contractors for groundwater recharge through the flooding of spreading grounds or through surface deliveries to current pumpers. Water shortages would be met by repumping water from the ground. Analysis of the feasibility of this plan showed that conjunctive management is most profitable in areas with high groundwater tables and in river systems with high ratios of average inflow to reservoir storage capacity; that more aggressive conjunctive management can result in the development of significant amounts of new water, perhaps delaying the need for new facilities; that conjunctive management plans benefit significantly from even modest advances in the reliability of long-range weather forecasting; and that conjunctive use is economically viable and physically feasible. It is suggested that the benefits of conjunctive use are attractive enough that the State should direct attention to overcoming the political and institutional barriers to such a management plan. (Carroll-FRC)
W82-05628

DEEP DRAINAGE AND WATER USE OF FORESTS AND PASTURES GROWN ON DEEP SANDS IN A MEDITERRANEAN ENVIRONMENT,

Alcoa of Australia, Pinjarra.
B. A. Carbon, F. J. Roberts, P. Farrington, and J. D. Beresford.
Journal of Hydrology, Vol 55, No 1/4, p 53-63, 1982. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Soil-water-plant relationships, *Recharge, Groundwater recharge, Evapotranspiration, Pastures, Sands, Forests, *Australia, *Neutron activation analysis.

Soil water content was determined beneath three different types of vegetation growing in deep sands of southwestern Western Australia for the purpose of studying deep drainage and aquifer recharge. The climate in this region is Mediterranean (cool, rainy winters and hot, dry summers). The neutron scattering method was used for field measurements in native hardwood forests, softwood plantations, perennial pastures, and winter annual pastures. Results indicated that deep drainage was greatest under winter annual pastures and least under Pinus pinaster (Ait.) plantations. Perennial pastures and native forests were similar in water use patterns, soil water depletion and deep drainage, contributing about 34% of the annual water balance to deep drainage. Thus replacing natural forest with pine plantations would decrease groundwater recharge, while replacing with annual pasture would increase recharge. (Cassar-FRC)
W82-05629

TRACING INTERAQUIFER CONNECTIONS IN THE KEFAR URIYYA-AGUR REGION (ISRAEL), USING NATURAL URANIUM ISOTOPES,

TAHAL--Water Planning for Israel, Ltd., Tel Aviv (Israel).
For primary bibliographic entry see Field 2F.
W82-05644

EVIDENCE FOR A SHALLOW HIGHLY-PERMEABLE ZONE IN THE CHALK OF HAMPSHIRE, U.K.,

Southern Water Authority (England).
For primary bibliographic entry see Field 2F.
W82-05645

CHEMICAL CONSTRAINTS OF GROUNDWATER MANAGEMENT IN THE YUCATAN PENINSULA, MEXICO,

Geological Survey, Reston, VA.
W. Back, and J. M. Lesser.
Journal of Hydrology, Vol 51, No 1-4, p 119-130, May, 1981. 25 Ref.

Descriptors: *Water management(applied), *Groundwater management, Chemical properties, History, Geologic formations, Geohydrology, Groundwater pollution, *Geochemistry, Limestone, Solubility, Karst, Salinity, *Mexico(Yucatan Peninsula), Aquifer management.

Throughout its history, the cultural and economic development of the Yucatan Peninsula in Mexico has been significantly affected by the management of water resources. At present, the two critical objectives for groundwater management in the Yucatan are the development of regional groundwater supplies to meet the increasing demands of the expanding populations and the growing tourist industry in the area and the control of groundwater pollution in this chemically sensitive system made critically vulnerable by climate and geologic conditions. The chemical character of the groundwater of the Yucatan is largely controlled by the mixing of rain water with the sub-surface salt water, the solution of limestone and gypsum, and contamination by organic material and sewage. Although the peninsula is a coastal plain underlain by permeable limestone and has an annual rainfall of over 1,000 millimeters, which should provide abundant supplies of water, factors of climate and hydrogeology have combined to form a hydrologic system in which fresh water is scarce and whose chemical environment further decreases that restricted supply. Many wells have recently had to be abandoned due to serious pollution problems resulting from the use of sewage disposal wells adjacent to supply wells. The Secretaria de Recursos Hidraulicos has been charged with responsibility for scientific investigations and development programs for water supply and sewage disposal systems for the region since 1959. Several studies have been undertaken, water supply problems have been resolved so that cities and towns generally have safe water supplies, and sewage treatment and disposal programs are being developed. (Carroll-FRC)
W82-05650

AN ENRICHED FINITE ELEMENT FOR SIMULATION OF GROUNDWATER FLOW TO A WELL OR DRAIN,

Wright State Univ., Dayton, OH. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-05652

THE LIKELIHOOD OF ACTIVE GROUNDWATER RECHARGE IN THE BOTSWANA KALAHARI,

Institute of Geological Sciences, Wallingford (England). (United Kingdom).
S. S. D. Foster, A. H. Bath, J. L. Farr, and W. J. Lewis.
Journal of Hydrology, Vol 55, No 1/4, p 113-136, 1982. 10 Fig, 2 Tab, 28 Ref.

Descriptors: *Groundwater recharge, *Infiltration, *Excess rainfall, Recharge, Kalahari Desert, Africa, *Botswana, Kweneng, *Sands, Groundwater mining, Geohydrology, Pore water, Rainfall, Evaporation, Dating, Groundwater, Semiarid lands.

Groundwater resources were investigated in the Kalahari, covering over 2.5 million sq km of southern Africa with surface sands up to 9 m deep. This region is virtually devoid of surface water. Samples of soil and rock were collected by drilling to determine the geological and physical properties and the chemical and isotopic character of the interstitial water. Evidence indicates that in the study region, the Kweneng, which has a mean annual rainfall of 450 mm, diffused groundwater recharge is unlikely where sand cover is more than 4 m deep. Any short term excess rainfall is stored in the sands and used by vegetation or evaporated. Tritium and radiocarbon analysis of the groundwater being used in this area indicated ages of 2000-4500 years for some samples and over 10,000 years for others. These correspond with the two most recent pluvial eposides in the Kalahari, 750-2500 and 13,000-18,000 years ago. Therefore, it must be assumed that groundwater wells in this area are tapping unreplenishable supplies, unless the presence of deep aquifers and sand-free tracts can be confirmed. (Cassar-FRC)
W82-05657

POTENTIAL FOR GROUNDWATER RECHARGE SEEPAGE FROM FLOOD-RETARDING RESERVOIRS IN SOUTH CENTRAL NEBRASKA,

Nebraska Univ.-Lincoln. Dept. of Agricultural Engineering.
D. E. Eisenhauer, D. M. Manbeck, and T. H. Stork.
Journal of Soil and Water Conservation, Vol 37, No 1, p 57-60, January/February, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Groundwater recharge, *Reservoirs, *Seepage, Recharge, *Nebraska, Big Blue River Basin, Runoff, Irrigation, Hydrologic budget, Aquifers, Water conservation.

Seepage rates at two flood control reservoirs in Nebraska's Upper Blue River Basin were monitored April through November 1975-77 to determine their contribution to groundwater recharge. Average seepage rates for the 1000 acre reservoirs were 0.50 inch per day and 0.59 inch per day at the Clay County site and the York County site, respectively. Average annual seepage volumes were 53 acre-feet at the Clay site and 92 acre-feet at the York site. Although the sum of the volume of outflow and seepage was nearly equal for both sites, about 130 acre-feet per year, the York County reservoir was more conducive to seepage because its surface area at high water levels was greater. It is possible to use reservoirs for groundwater recharge in the Great Plains, but the method is less feasible west of the study area. In the more arid regions there is less surface water and evaporation rates are higher, requiring more efficient recharge systems. (Cassar-FRC)
W82-05663

INDUSTRY HELPS CONSERVE MUNICIPAL WATER,

Anderson-Nichols and Co., Inc., Providence, RI.
For primary bibliographic entry see Field 3E.
W82-05674

DETERMINATION OF AQUIFER PARAMETERS USING REGRESSION ANALYSIS,

Youngstown State Univ., OH. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-05734

PHYTOPLANKTON RESPONSES TO GROUND WATER ADDITION IN CENTRAL FLORIDA LAKES,

Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 5C.
W82-05747

HOW PROPER PROSPECTING IMPROVES THE ODDS,

International Reference Center for the Community Water Supply, the Hague (Netherlands).
For primary bibliographic entry see Field 3B.
W82-05757

THE RELATIONSHIP BETWEEN 018 AND DEUTERIUM IN WATER IN SAND COLUMNS UNDERGOING EVAPORATION,

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 2G.
W82-05759

WATER-LEVEL FLUCTUATIONS DUE TO EARTH TIDES AT FORT MACKAY, ALBERTA,

Northern Illinois Univ., DeKalb. Dept. of Geology.
D. A. Hackbarth.
Canadian Water Resources Journal, Vol 5, No 1, p 87-99, 1980. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Tidal effects, *Water level fluctuations, *Well hydraulics, Groundwater movement, Fort MacKay, Alberta, Confined aquifers, Aquifers, Gravity waves, Statistical analysis, Tides, Hydraulics, Geohydrology.

Diurnal water level fluctuations were observed in a 315 m deep well, stratigraphically the lowest in a network of 90 wells in the Athabasca Oil Sands area. The well is completed fractured Devonian rocks. Overlying and underlying the water source are rocks of low permeability. The pressure head is well above the top of the aquifer. Statistical analysis indicated that barometric pressure was not a factor. However, autocorrelation of tidal-gravity corrections and water level fluctuations showed periods of 24.2 and 24.7 hours, respectively. Cross-correlation of residual water level and total gravity showed a period of 24.2 hours. Ratios of the wave amplitudes of tidal-gravity corrections and residual water levels were essentially constant. A semidiurnal wave did not appear to be present. In this well a 6-hour time lag was observed. This was caused by the slow response of the water to pressure changes in the aquifer and by the high total dissolved solids levels, 240,000 mg ep per liter. All evidence confirmed that the water level fluctuations were a result of earth tides. (Cassar-FRC)
W82-05780

AQUIFER MANAGEMENT IN DADE COUNTY,

Dade County Dept. of Environmental Resources Management, Miami, FL. Environmental Planning Div.
For primary bibliographic entry see Field 5G.
W82-05784

GROUND-WATER CONTAMINATION DUE TO VANISHING AND FINITE-SIZE CONTINUOUS SOURCES,

Dames and Moore, Golden, CO.
For primary bibliographic entry see Field 5B.
W82-05799

THE ORIGIN OF HIGH IRON CONCENTRATIONS IN GROUNDWATER FROM THE TRIASSIC AQUIFER IN EAST DEVON,

Institute of Geological Sciences, London (England).
For primary bibliographic entry see Field 2K.
W82-05801

THE HYDROGEOLOGICAL BASIS FOR A WATER SUPPLY TO KABWE, ZAMBIA,

Aspinwall Hydrotechnical Services Ltd. (England), (United Kingdom).
J. F. T. Houston, and M. J. Morrey.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 27-42, 1982. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Hydrogeology, *Aquifer characteristics, *Groundwater mining, Water quality, Well yield, Water supply, Kabwe, *Zambia, Drilling, Groundwater recharge, Recharge, Groundwater availability, Groundwater budget, Groundwater management.

Results of a feasibility study for groundwater exploitation of the Dolomite Aquifer near Kabwe, Zambia, are reported. The investigation involved exploration, drilling, pump testing, and ancillary studies. The exploration phase used aerial photographs and resistivity depth soundings. In the drilling phase three types of boreholes were used: two NX-sized cored boreholes of 150 m depth to quantify fissure frequency and to locate the aquifer base and 21 150 mm percussive rotary boreholes to define the aquifer's extent and to find sites for the seven 300 mm rotary test production boreholes. Pumping tests were undertaken on the 150 mm boreholes, and the test production boreholes were tested with a turbine pump. Other tests included electric and gamma logs, fluid conductivity and temperature logs, and groundwater analysis. The aquifer base is about 80 m deep, and the dolomite formation 150 m. Transmissivity values are 200-500 sq m per day in the northeast, more than 1000 sq m per day over most of the aquifer, and up to 3500 sq m per day in areas of localized fissure development. Specific yield is 0.14 on the average. Waters are dominated by Ca-Mg-carbonate-bicarbonate ions and have 500 mg per liter total dissolved solids. The upper 20 m section of the dolomite has lower conductivity than the deeper layer. Annual precipitation recharge during 1965-80 was 26-771 mm in short vegetation areas and 0-534 mm in open forest. Subsurface recharge from the surrounding schist varies between 500 and 1200 cu m per day per km of boundary. Current demands on the Dolomite Aquifer are 55 Ml per day, total annual recharge 50-70 Ml per day. Recommendations for best development of the well field include new boreholes to spread abstraction over a wider area and to reduce the present pumping from the Kalulu well field. (Cassar-FRC)
W82-05804

CAPE COD AQUIFER, CAPE COD, MASSACHUSETTS,

Geological Survey, Providence, RI.
For primary bibliographic entry see Field 2F.
W82-05807

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1979 TO SPRING 1980.

Geological Survey, Tucson, AZ. Water Resources Div.
Geological Survey Open-File Report 81-906 (WRI), July 1981. 2 Plates, 25 Ref.

Descriptors: *Maps, *Groundwater, *Water level, *Pumpage, *Drawdown, Water level fluctuations, Irrigation, Water yield, Groundwater availability, Water supply, *Arizona.

Withdrawal of ground water, about 4.0 million acre-feet in Arizona in 1979, is about 200,000 acre-feet less than the amount withdrawn in 1978. The withdrawals in 1978 and 1979 are the smallest since the mid-1950's except in 1966. Nearly all the decrease was in the amount of ground water used for irrigation in the Basin and Range lowlands province. The large amount of water in storage in the surface-water reservoirs, release of water from the reservoirs, floods, and conservation practices contributed to the decrease in ground-water use and caused water-level rises in the Salt River Valley, Gila Bend basin, and Gila River drainage from Painted Rock Dam to Texas Hill. Two small-scale maps show ground-water pumpage by areas and the status of the ground-water inventory in the State. The main map, which is at a scale of 1:500,000, shows potential well production, depth to water in selected wells in spring 1980, and change in water level in selected wells from 1975 to 1980. A brief text summarizes the current ground-water conditions in the State. (USGS)
W82-05826

4C. Effects On Water Of Man's Non-Water Activities

SEASONAL STREAM TEMPERATURE CHANGES FOLLOWING FOREST HARVESTING,

Pennsylvania State Univ., University Park. School of Forest Resources.
G. B. Rishel, J. A. Lynch, and E. S. Corbett.
Journal of Environmental Quality, Vol 11, No 1, p 112-116, January-March, 1982. 2 Fig, 5 Tab, 12 Ref.

Descriptors: *Forest management, *Water temperature, Streams, *Clear-cutting, Cutting management, Forest watersheds, Herbicides, *Seasonal variations, Diurnal distribution.

Changes in water temperature of small, headwater streams were documented following a clearcut-herbicide treatment and a commercial clearcut harvest. The study site was the Leading Ridge Watershed Research Unit about 24 km southwest of State Collete, Pennsylvania. The unit is comprised of three adjacent watersheds that are representative of about 4.0 million ha of Pennsylvania forest. The clearcut herbicide treatment exposed the entire stream channel to direct solar radiation. The average maximum monthly stream temperature increase was 4.4 degrees C. Stream temperatures above 21 degrees C occurred nearly every day during the summer. Temperatures above 25 C were recorded as early as May. Highest stream temperature recorded was 32 degrees C, while on a control watershed stream water temperatures rarely exceeded 20 degrees C. Minimum stream temperatures were as much as 3.9 degrees C lower during the fall and winter months. Diurnal fluctuations also increased, being as high as 17 degrees C, compared to only 4 degrees C on non-treated watersheds. On an adjacent commercially clearcut watershed a buffer zone was left along the perennial stream channels, and only slight changes in stream temperature were noted. (Baker-FRC)
W82-04870

AN EVALUATION OF THE URBAN DESIGN STORM CONCEPT,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-04960

FAMILY LIFE CYCLE DISRUPTION IN RURAL COMMUNITIES: THE CASE OF THE LAKE SHELBYVILLE RESERVOIR,

Illinois Univ. at Urbana-Champaign. Inst. for Environmental Studies.
R. E. Roper, and R. J. Burdge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224551, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 166, 102 p, 6 Fig, 4 Tab, 288 Ref. OWRT B-131-ILL(1). 14-34-0001-0218.

Descriptors: *Social impact, *Assessments, *Land acquisition, *Commercial farming, Ethnography, Personal and family life-cycles, Developmental cycles, Career contingencies, *Reservoirs, Construction, Anthropology, *Illinois, Lake Shelbyville, *Rural areas.

This project, assessed on an ex post facto basis, selected impacts upon families and individuals due to the land acquisition program associated with the construction of the Shelbyville Reservoir in east-central Illinois begun in 1962. Research focused on Okaw Township, which borders Lake Shelbyville to the west in Shelby County. The in-depth, individual and family case studies indicated that farm family businesses are not the products of a single generation, or a single family. They are intimately tied to the intergenerational land transfer process which occurs among interconnected families living in close proximity. Thus, the time perspective in examining changes brought about by land acquisition and relocation must be extended on the generational level if the full range of impacts on the local cultural ecology is to be represented. Areawide changes in the impacts on the local cultural ecology is to be represented. Areawide changes in the availability and price of land made the difficult task of reestablishing a family farm even harder for selected families. The Corps' land acquisition policies in 1962 did not consider the generations involved in the establishment of family farms. Furthermore, local residents were critical of the Corps' policies and personnel during the land acquisition process. That historical complaint summarized by the quote, 'the Corps is not a good

neighbor,' has even today hindered the Corps' ability to manage its relations with area residents and local government units. An understanding of the personal and family life-cycle perspectives on local cultural ecology, coupled with an appreciation of the degree to which rural social processes are bound in time, can strengthen State of Illinois comprehensive planning, decision-making, and review procedures for water and related resource development.
W82-04966

SAWMILL BROOK: AN EXAMPLE OF RAPID GEOMORPHIC CHANGE RELATED TO URBANIZATION,

Wesleyan Univ., Middletown, CT. Dept. of Earth and Environmental Sciences.
C. L. Arnold, P. J. Boison, and P. C. Patton.
Journal of Geology, Vol 90, No 2, p 155-166, March, 1982. 11 Fig, 1 Tab, 24 Ref.

Descriptors: *Urbanization, *Geomorphology, Brooks, Channels, Watersheds, Runoff, Erosion, *Sediment transport, Sedimentation, *Environmental effects, Sawmill Brook, *Connecticut.

The effects that urbanization can have on stream pattern morphology are documented. Such observations can lead to a deeper understanding of the complex-response that can occur in the sediment transport regime as basin-wide sediment yields decline and stream runoff increases. The study area was Sawmill Brook, a tributary of the Mattabesset River, which drains a small watershed in central Connecticut on the northwest fringe of Middletown. Changes in land use were documented by comparison of sequential topographic maps and aerial photographs and from direct field observations. The southern headwater region of the basin has remained forested for the past 45 years. Within the study area reapportionment of agricultural and urban land use took place during 1934 to 1975. Urban development has included a large industrial park, several residential subdivisions, and the construction of an interstate highway through the basin. Associated with this development has been the major alteration of the drainage system in the lower portion of the basin. Runoff from the interstate highway and a portion of the industrial park has been funneled into Fall Brook, which has also been channelized to its confluence with Sawmill Brook. An increased frequency of flooding may be considered the result of short term climatic fluctuations, producing a change in precipitation. The increased frequency of moderate floods, the channel widening, and the change in the sediment transport regime is causing a change from a meandering to a braided channel pattern. With continued urbanization of the basin the present disequilibrium of the channel will be enhanced, resulting in an unstable channel pattern for Sawmill Brook. (Baker-FRC)
W82-05276

THE EFFECTS OF LAND-CLEARING ON A SMALL WATERSHED IN SOUTHERN GUAM,

Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5C.
W82-05303

LIFE HISTORY AND HABITAT UTILIZATION OF CUTTHROAT TROUT (SALMO CLARKI) IN A HEADWATER STREAM ON THE OLYMPIC PENINSULA, WASHINGTON,

For primary bibliographic entry see Field 5C.
W82-05306

MODIFICATIONS TO STEAM CHANNELS IN THE BRISBANE METROPOLITAN AREA, AUSTRALIA,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 4A.
W82-05572

RUN-OFF AND INFILTRATION LOSSES RELATED TO SHIFTING AGRICULTURE (JHUM) IN NORTHEASTERN INDIA,

Northeastern Hill Univ., Shillong (India). Dept. of Botany.
O. P. Toky, and P. S. Ramakrishnan.
Environmental Conservation, Vol 8, No 4, p 313-321, Winter, 1981. 10 Fig, 6 Tab, 21 Ref.

Descriptors: *Agricultural hydrology, *Runoff, *Nutrients, Infiltration, India, Percolation, Clearcutting, Vegetation effects, Minerals, Hydrologic cycles, Geochemistry, Fallowing, Monsoons, Jhum agriculture.

In northeast India shifting cultivation (Jhum) involves clearcutting the forest, during the dried biomass, and mixed cropping for 1 or 2 years, followed by a fallow period. In recent times the desirable 20-30 year cycle has been shortened to 4-5 years. Similar freshly-burned fields under 30, 10, and 5 year Jhum cycles and forested fallows of 5 and 10 years regrowth were studied. Nutrients were lost through ash and runoff in all cycles. More ash was liberated and more ash blew away in the 30-year cycle field than in the 5-year cycle field. Calcium losses were high in the 30-year cycle field (broad-leaved trees) and potassium losses were high in the 10-year cycle field (bamboo). Burning also released nutrients (C, N, and S) through volatilization. Runoffs (in cm) during the monsoon period (total 142 cm precipitation) in 1978 were: 5-year, 26.6; 10-year, 33.9; 30-year, 29.4; 5-year fallow, 26.9; and 10-year fallow, 18.5. Sediment losses were 22.5-30.0 tons per ha per year, increasing with shortening of the Jhum cycles, and about 1 ton per ha per year in the 5 and 10-year fallow fields. Percolated water losses were 14-18 cm for the 10 and 30-year Jhum cycles and the 10-yea fallow, and 21-23 cm for the 5-year fallow and 5-year Jhum cycle. Nutrient losses were 5-60 time higher, depending on the mineral, under the three Jhum cycle regimes than in the 10-year fallow. Shortening the Jhum cycle to 4-5 years has adversely affected the vegetation cover and the biological, geochemical, and hydrologic cycles. (Cassar-FRC)
W82-05573

PRELIMINARY MODEL OF AN URBAN FLOODPLAIN UNDER CHANGING LAND USE,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
D. P. Smith, and P. B. Bedient.
Journal of Hydrology, Vol 51, No 1-4, p 179-185, May, 1981. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Flood plains, *Urban areas, *Land use, Mathematical models, *Urban watersheds, Urbanization, Flood hydrographs, Detention reservoirs, Design criteria, Flood control, Storm runoff, Brays Bayou, Houston, *Texas.

The hydrologic response of Brays Bayou, a rapidly developing watershed in southwest Houston, was simulated by a computer model using the U.S. Corps of Engineers HEC-1 flood hydrograph package. Existing drainage specification and topographic maps were used to delineate six subwatersheds, while aerial photography was used to reveal current land-use patterns. The modeling effort was designed to predict the effect of urbanization on the runoff pattern of the basin and to test various storm water management alternatives. Unit responses of the six individual subcatchments were generated as functions of various basin parameters and of the extent of urbanization. Several historical storm events at four separate gauges within the Brays watershed were used to calibrate the hydrologic model. The detention storage capacities in the less developed subwatersheds were simulated by placing a reservoir at the outlet of each subwatershed. Detention storage was defined as the additional storage necessary to reduce the peak discharge downstream to a level below the capacity of the channel. A variety of rainfall patterns of different durations and intensities were used to determine the design detention storage for each subwatershed. Land uses were simulated for present conditions and for various development possibilities. Application of the model showed that full-scale development of the Upper Brays Bayou can be expected to overload a flood control system designed to handle the 100-year storm. The current drainage network has been found to be inadequate. Temporary on-site detention of runoff in the upper basin is recommended. (Carroll-FRC)
W82-05642

A REVIEW OF CATCHMENT EXPERIMENTS TO DETERMINE THE EFFECT OF VEGETATION CHANGES ON WATER YIELD AND EVAPOTRANSPIRATION,

Jonkershoek Forestry Research Station, Stellenbosch (South Africa).
J. M. Bosch, and J. D. Hewlett.
Journal of Hydrology, Vol 55, No 1/4, p 3-23, 1982. 3 Fig, 2 Tab, 75 Ref.

Descriptors: *Forest hydrology, *Water yield, *Vegetation effects, *Reviews, Land use, *Catchments, *Evapotranspiration, Forest watersheds, Forest management, Clearcutting, Afforestation.

A summary and review of 94 catchment experiments throughout the world revealed several general conclusions on the effects of vegetation changes on water yield. Paired, nested, or grouped catchment experiments produced stronger evidence than less-controlled studies. Results of Hibbert's 1967 review of 39 catchment studies were little changed by the addition of results from 55 more recent investigations. The additional evidence strongly supported his first two generalizations-- (1) reduction of forest cover increases water yield, and (2) establishment of forest cover on sparsely vegetated land decreases water yield. However, the third generalization-response to treatment is highly variable, and for the most part, unpredictable-was not well supported. The present review indicates that vegetation has an influence on water yield as follows: coniferous forest > deciduous hardwood > brush and grass. Changing cover type by 10% produces the following changes in water yield: coniferous and eucalyptus, 40 mm; deciduous hardwoods, 25 mm; and brush and grasslands, 10 mm. Yield changes are greatest in high-rainfall areas, and the effect of clearcutting is shorter-lived than in low-rainfall areas. The annual changes due to treatment in high-rainfall areas are independent of rainfall variation from year to year, but dependent in low-rainfall areas. In low-rainfall areas recovery of water yields is slow because vegetation cover is slow to reestablish. The highest water change in any study was 660 mm per year (relative to bare ground) reported in the Coweeta catchment, North Carolina, where a mixed hardwood forest was 100% clearcut in 1941, regrowth was cut annually, and the area was 100% planted with pine in 1956. (Cassar-FRC)
W82-05647

STORM RUNOFF FROM SMALL LOWLAND CATCHMENTS IN SOUTHWEST ENGLAND,

Imperial College of Science and Technology, London (England).
H. S. Wheater, T. L. Shaw, and J. C. Rutherford.
Journal of Hydrology, Vol 55, No 1/4, p 321-337, 1982. 12 Fig, 2 Tab, 8 Ref.

Descriptors: *Storm runoff, *Urbanization, *Flood peak, Rainfall-runoff relationships, Gloucester, *England, Hydrographs, Soil water, Catchments, Streamflow, Antecedent moisture.

Fifty-five storm runoff events (1970-74) in eight small lowland catchments with clay soils in southwest England were analyzed. Unit hydrograph shape was related to antecedent soil moisture, stream slope, and degree of urbanization. The storm runoff volume was related to soil moisture deficit and to storm rainfall. Dry catchments responded more rapidly to rainfall than wet catchments, with higher peak flow, shorter unit hydrographs, and increased time to peak. The proportion of urbanization was postively correlated with unit hydrograph flow peak and negatively correlated with time-to-peak, with little effect seen for wet catchments and very noticeable effects for dry catchments. Unit hydrograph peak flow increased with channel slope and was negatively correlated with total rainfall volume. Unit hydrograph lag was positively correlated with catchment length and negatively correlated with slope and degree or ubanization. Rainfall loss was independent of

catchment morphology and depended on total rainfall volume and antecedent soil moisture deficit. (Cassar-FRC)
W82-05653

SUBSURFACE FLOW VELOCITIES THROUGH SELECTED FOREST SOILS, SOUTH ISLAND, NEW ZEALAND,
Forest Research Inst. Christchurch (New Zealand).
M. P. Mosley.
Journal of Hydrology, Vol 55, No 1/4, p 65-92, 1982. 7 Fig, 6 Tab, 26 Ref.

Descriptors: *Subsurface flow, *Flow velocity, Forest hydrology, Forest soils, *New Zealand, Tawhai Forest, Big Bush Forest, Craigieburn Forest, Streamflow, Soil water, Antecedent moisture, Hydrology, Soil saturation, Soil porosity, Soil structure, Porosity, Permeability, Bedrock, Root zone, Rainstorms.

Subsurface flow through soils at a total of 51 locations in three New Zealand state forests was investigated by applying water upslope from a pit and determining mean and maximum flow velocities. Mean flow velocity and maximum flow velocity (both in cm per sec), respectively were: Tawhia Forest, undisturbed, 0.1-0.45 and 0.037- 0.67, logged/unburned, 0.020-0.79 and 0.049-2.08, and logged/burned/planted, 0.015-0.64 and 0.072-0.83; Big Bush Forest, 0.-0.93 and 0.055-1.67; and craigieburn Forest, beech forest, 0-0.98 and 0.072-1.67, tussock sites, 0-0.22 and 0.074-0.48. Coefficients of variation were large. There was no significant difference in results from the three different land treatments in Tawhia Forest. Factors affecting subsurface flow were antecedent moisture conditions, soil properties, macropore network, and parent material at the base of the soil. The macropore network was less important in determining hydrological behavior in open-structured soil with a permeable parent material than in less open-structured soil over impermeable bedrock. In Tawhia Forest saturation of the lower soil layers regularly occurs, so that rapid flow through macropores is common and many reach 40% in a small 3-hour storm and 100% in moderate to large rain events. At Big Bush, with less soil moisture and longer slopes, rapid subsurface flow is likely to reach the stream only during larger and longer storms. Craigieburn's drier, deeper soils and permeable underlayer allow less subsurface flow to reach streams during the storm period. (Cassar-FRC)
W82-05712

SLASH BURNING EFFECTS ON SOIL AND WATER CHEMISTRY IN SOUTHEASTERN ALASKA,
Colorado State Univ., Fort Collins. Dept. of Earth Resources.
J. D. Stednick, L. N. Tripp, and R. J. McDonald.
Journal of Soil and Water Conservation, Vol 37, No 2, p 126-128. March/April, 1982. 1 Fig, 3 Tab, 24 Ref.

Descriptors: *Water quality, *Forest fires, *Soil chemistry, *Alaska, Forest management, Forest soils, Nutrients, Water pollution sources, Erosion.

Timber harvest followed by slash burning in the coastal hemlock-spruce forests of Chicagof Island in southeastern Alaska did not produce significant long-term effects on soil or water resources. A 13 ha site, logged in 1977 and burned in June 1978, was monitored by collecting daily stream water samples from above and below the burn during the snow-free months of 1978 and 1979. Soil samples were also analyzed. Suspended sediment levels were higher in the water below the burn (116.8 mg per liter) than above the burn (35.4 mg per liter). Fourteen of the 16 water quality parameters were not significantly different when above-burn and below-burn sample results were compared. However, total P and K levels were higher in below-burn stream water. In soil samples slash burning produced no significant differences in litter depth, pH, N, P, and Ca levels. However, K and Mg concentrations in the burned soil were about half of the control concentrations. (Cassar-FRC)
W82-05715

NORTHWESTERN ONTARIO RIVER DIMENSIONS,
Simon Fraser Univ., Burnaby (British Columbia).
For primary bibliographic entry see Field 6G.
W82-05742

TOTAL SUSPENDED SOLIDS IN HIGHWAY RUNOFF IN WASHINGTON STATE,
RH2 Engineering, Seattle, WA.
For primary bibliographic entry see Field 5B.
W82-05820

4D. Watershed Protection

EROSION BY PLANE TURBULENT JETS,
Alberta Univ., Edmonton.
For primary bibliographic entry see Field 8B.
W82-05277

A PARAMETRIC MODEL TO ESTIMATE RUNOFF FROM SMALL AGRICULTURAL WATERSHEDS IN THE SEMI-ARID TROPICS,
International Crops Research Inst. for the Semi-Arid Tropics, Patacheru (India).
For primary bibliographic entry see Field 2E.
W82-05646

DRYLAND SALINITY IN A CLOSED DRAINAGE BASIN IN NOBLEFORD, ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
T. G. Sommerfeldt, and D. C. MacKay.
Journal of Hydrology, Vol 55, No 1/4, p 25-41, 1982. 7 Fig, 3 Tab, 16

Descriptors: *Drainage, *Closed basins, *Saline soils, Nobleford, *Alberta, Canada, Soil water, Ecological effects, Water management, Land use, Vegetation effects, Fallowing, Range grasses, Cropland.

Factors causing dryland salinity near Nobleford, Alberta, were defined during a 1972-77 study on a site forming a 650 ha dome, which contained a closed basin. Although salinity in the basin was not evident in 1938, two small seeps had appeared by 1954. More than 50 ha of land was salinized by 1973. Studies of well data, precipitation records, rock and soil profiles, snow drifting, and water analysis results indicated that the salinity problems in this basin were a result of disturbances of the natural ecosystem. Native range had been replaced by cereal cropping and summer fallow. Natural drainage patterns had been changed by snow and water retainers and drainage of runoff into the basin. Also contributing to the salinity condition were natural conditions--shallow bedrock in the recharge area, fine soil in the lowland, depressions in bedrock under certain areas, and lack of surface drainage from the basin. Corrective measures are based on discouraging water access in the basin, discontinuing summer fallow, continuous cropping, growing perennial forage crops, removing snow and water retainers, and removing accumulated water from the basin for use in irrigation. (Cassar-FRC)
W82-05656

EROSION CONTROL POTENTIAL WITH CONSERVATION TILLAGE IN THE LAKE ERIE BASIN: ESTIMATES USING THE UNIVERSAL SOIL LOSS EQUATION AND THE LAND RESOURCE INFORMATION SYSTEM (LRIS),
Ohio State Univ., Columbus. Dept. of Agronomy.
T. J. Logan, D. R. Urban, J. R. Adams, and S. M. Yaksich.
Journal of Soil and Water Conservation, Vol 37, No 1, p 50-55, January/February, 1982. 1 Fig, 8 Tab, 12 Ref.

Descriptors: *Erosion control, *Phosphorus, *Water pollution control, *Lake Erie Basin, *Soil erosion, Cropland, Soil conservation, Cultivation, Soil management, Watershed management, *Cultivation.

Soil loss in the U.S. Lake Erie drainage basin was estimated using the Universal Soil Loss Equation and the U.S. Army Corps of Engineers Land Resources Information System (LRIS). Average annual soil loss was 2.2 tons per acre, with a range of 0.4 to 4.4 tons per acre for individual watersheds. Highest soil losses were in the western and central basins. Basins with the greatest soil losses were the Raisin (Michigan); Maumee, Sandusky, Huron, and Vermilion (Ohio); and Cattaraugus (New York). These watersheds have fine-medium glacial-till derived soils and are highly cultivated, except for the Cattaraugus watershed, which has steep slopes. Reducing soil loss to the tolerance level in all cases would reduce soil loss in the basin as a whole by 40%. The conservation tillage method and the maximum conservation tillage method would reduce soil loss by 46% and 69%, respectively. Methods which made little difference in soil loss were spring plow only and winter cover. Fall plow only actually increased soil loss by 7%. Since a 75% reduction in mean soil loss is necessary to reduce diffuse source phosphorus loads by 50%, none of these methods alone can accomplish this goal. (Cassar-FRC)
W82-05661

WATER YIELD ESTIMATION IN WESTERN UNITED STATES,
Maryland Univ., College Park. Dept. of Civil Engineering.
M. E. Hawley, and R. H. McCuen.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 25-34, March, 1982. 1 Fig, 6 Tab, 8 Ref.

Descriptors: *Project planning, *Watershed management, *Water yield, Hydrologic models, *Statistical analysis, Mathematical studies, Precipitation(Atmospheric), Vegetation effects, Precipitation intensity, Model studies, Mathematical models, Statistical methods, Prediction, *Western US.

The mean annual water yield of a watershed is used in planning, managing and designing some watershed projects, especially irrigation projects. A statistical study of water yield data from 605 watersheds of noncoastal areas of the western United States was used to develop five equations to estimate the annual water yield of five distinct hydrologic regions. Empirical estimation coupled with regionalization was deemed the most practical method for estimating mean annual water yield. Separation of the study area into five regions significantly improved the accuracy of the estimation. Cluster analysis was used to define the five regions, and a linear mathematical model was developed which explained 57.95% of the variation of the mean annual water yield. The most important predictor of water yield in all regions was the mean annual precipitation, while other variables such as vegetation cover density and precipitation intensity explained smaller amounts of the total variation. (Geiger-FRC)
W82-05689

EROSIVITY VALUES FOR INDIVIDUAL DESIGN STORMS,
Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 85-87, March, 1982. 1 Tab.

Descriptors: *Mathematical studies, *Error analysis, *Erosion control, *Storm runoff, *Soil conservation, Errors, Erosion, Soil erosion, Storms, Model studies, Mathematical models.

To address the questions raised about the magnitude of errors involved in calculating erosivity values for individual design storms, the value of EI/100 for storm volumes of 2 and 12 inches for durations from 0.5 to 24 hr and for each of four Soil Conservation Service (SCS) storm distributions was determined. The use of various figures in the original paper is explained. Normalizations in

the original work provided better comparisons than did actual storm data of any duration, as compared to the 24-hr SCS distributions suggested by previous investigators. By using long periods of actual storm data, the frequency of storm types likely to occur at a site may be determined. The knowledge of frequency of occurrence of a given storm type may be used in designing soil conservation measures. (Geiger-FRC)
W82-05694

STREAM IMPROVEMENT: THE CHICOD CREEK EPISODE,

Soil Conservation Service, Greenville, NC.
A. Coffey.
Journal of Soil and Water Conservation, Vol 37, No 2, p 80-82, March/April, 1982. 6 Ref.

Descriptors: *Channel improvement, *Watershed management, *Legal aspects, Chicod Creek, North Carolina, Flood control, Sediment control, Environmental effects, Excavation, Monitoring, Fish, Wildlife, Water quality, Water law, Judicial decisions, Flood plain management.

Planned improvements to the clogged and flood prone Chicod Creek, North Carolina, were challenged in a lawsuit November 30, 1971, by a group of five local and national organizations. As a result the project was modified to minimize environmental impacts. Work started in November 1978. Major changes in plans were: wooded swamps were not excavated, only fallen trees and debris were removed; construction was shut down from February 1 to June 30 to avoid interference with herring spawning runs; sediment traps were constructed at critical points; 15 ft wide grass strips were established on banks in non-forested land; channels were excavated from one side only; spoil banks were placed 15 ft from the channel bank in critical areas and were seeded with stabilizing vegetation; clumps of trees were preserved at 200-300 ft intervals; and channel banks were sloped 1:1 except for some experimental areas with 2:1 and 3:1 slopes. Monitoring of fish and wildlife, water quality, and groundwater condition was started before construction and will continue until about 1986. As a result of this landmark suit, watershed planning has become more comprehensive and considerate of environmental values. (Cassar-FRC)
W82-05717

MODELING SEDIMENT YIELDS FROM AGRICULTURAL WATERSHEDS,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley, L. F. Huggins, and E. J. Monke.
Journal of Soil and Water Conservation, Vol 37, No 2, p 113-117, March/April, 1982. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Agricultural watersheds, *Watershed management, *Sediment yield, Cultivation, Model studies, ANSWERS model, Indiana, Black Creek, Erosion control, Nonpoint source pollution, Soil conservation.

Distributed parameter models are potentially more accurate than lumped parameter models in estimating sediment yields. A distributed parameter model, ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) was applied to a 714-ha agricultural watershed in the Black Creek Basin, Indiana. Rainfall amount and total sediment yield were predicted within 13% of observed amounts. Simulation of sediment yield under different tillage practices showed that chisel plowing produced one-third less sediment than the prevailing practice, fall moldboard plowing. Closer examination of two small high-erosion sections, combined area 32 ha, showed that changing to chisel plowing only in these small sections would account for 40% of the sediment yield reduction that would be achieved if the entire watershed were chisel plowed. (Cassar-FRC)
W82-05718

UNIFIED RIVER BASIN MANAGEMENT,

Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6B.
W82-05769

BEDLOAD AND SIZE DISTRIBUTION IN PAVED GRAVEL-BED STREAMS,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 2J.
W82-05795

USING THE ANSWERS MODEL TO ESTIMATE SEDIMENT YIELDS ON CONSTRUCTION SITES,

Guam Univ., Agana. Water and Energy Research Inst.
T. A. Dillaha, III, D. B. Beasley, and L. F. Huggins.
Journal of Soil and Water Conservation, vol 37, No 2, p 117-120, March/April, 1982. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Sediment yield, *Construction, *Watershed management, ANSWERS model, Model studies, Erosion control, Runoff, Alternative planning, Land management, Soil conservation.

ANSWERS (Areal Nonpoint source Watershed Environment Rresponse Simulation), a distributed parameter model designed for use in agricultural watersheds, was used to evaluate solutions to runoff and erosion from construction activities. A residential development was being built in a 53-ha watershed with slopes of 0-17% in which 95% of the land had been used for row crops (corn), 15% trees, and 2% swampy lowlands. The design storm, 5.28 cm of rainfall within 1.5 hours, produced from 5,100 (chisel plowing) to 16,300 (fallow) kg per ha of sediment under the 12 tested alternatives. The agricultural conditions before development (corn) yielded 13,500 kg per ha. Construction by scalped topsoil with bare roadways, gravel roadways, or paved roadways yielded 16,000, 14,500, and 15,400 kg per ha, respectively. Scaled, but seeded and mulched areas with bare roadways or gravel roadways produced 12,700 and 9,800 kg per ha sediment, respectively. Land left as crop residues and weeds with bare roadways or gravel roadways reduced sediment losses to 11,500 and 6,900 kg per ha, respectively. The practice of scaled topsoil with bare roadways and sediment basins or diversion structures allowed 13,800 and 15,500 kg per ha losses, respectively. Model results were consistent with the few available field observations at the construction site. (Cassar-FRC)
W82-05865

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

COMPARISON OF VARIOUS BACTERIAL INDICATORS OF FECAL CONTAMINATION OF THE SEINE IN THE PARIS REGION (COMPARISON DE DIFFERENTS INDICATEURS BACTERIENS DE CONTAMINATION FECALE SUR LA SEINE EN REGION PARISIENNE),

Societe Lyonnaise des Eaux et de l'Eclairage (France).
M. Rizet.
Aqua, No 7, p 150-152, July, 1980. 1 Fig, 2 Tab. (English summary).

Descriptors: *Bacterial analysis, *Water quality, *Indicators, *Seine River, Paris, Feces, Coliforms, *Bioindicators, Variation coefficient, Mathematical studies, Water pollution, *Pollutant identification.

Water samples were collected approximately weekly at four potable water plant intakes in the Paris area and subjected to comparative bacterial counts. Fecal coliforms were counted on Chapman TTC medium, sulfite reducing clostridium (Clostridium perfringens) on Bacto SPS agar medium, and fecal streptococci on Stranetz and Bartley medium, in each case following concentration by membrane filtration. The maximum amplitudes of variation in bacterial counts between the two treatment plants farthest apart, based on the annual means, were 26 for fecal coliforms, 18 for fecal streptococci and 8 for clostridium. Thus the fecal coliform count seems to be the most sensitive of the three indicators investigated. Variations from the mean at a single point were 76% for fecal coliforms, 107% for fecal streptococci and 120% for clostridium. The bacterial as well as physical and chemical analyses of the Seine water demonstrated increasing deterioration of water quality from upstream to downstream of Paris. (Carroll-FRC)
W82-04763

BORON STATUS OF BERLIN WATERS (BOR-STATUS BERLINER GEWASSER),

Technische Univ., Berlin (Germany, F.R.). Inst. fuer Okologie.
H. P. Blume, R. Bornkamm, T. Kempf, S. Muljadi, and F. Raghi-Atri.
Archiv fur Hydrobiologie, Vol 89, No 4, p 426-439, August, 1980. 4 Fig, 10 Tab, 17 Ref.

Descriptors: *Boron, *Lakes, *Chemical analysis, *Nutrients, Drinking water, *Berlin, Germany, Water pollution sources, Phosphorus removal, Chemical precipitation, Lime.

Boron is a micronutrient of widespread occurrence, which may be toxic to crops at higher concentrations. Substantial increases in boron contents of some German waterbodies have occurrent in recent years due to increased use of boron-containing fertilizers, pharmaceuticals, laundry bleaches, and other chemicals. The boron levels were investigated in the Tegeler See, Oberhavel, Heiligensee, and Pechsee, four lakes in the Berlin watershed. The Tegeler See receives wastewater effluents and is considered polluted. In 1975-76 the Tegeler See had a mean boron content of 0.2 mg/l; the Nordgraben, its principal feed stream, contained 0.6 mg/l. Boron contents in the Heiligensee and Pechsee were below 0.1 mg/l. Seasonal variations in the Tegeler See were small, while the large variations in the Heiligensee were attributed to occational occurrence of backup from the Havel as well as to biological binding and precipitation. Boron accumulations were also determined in the biocenosis and the sediment of the lakes. The present boron levels and rates of increase (ca. 5%/yr) appear to present no threat to drinking water quality if water is obtained from wells into which lake water infiltrates. Combined use of lime and iron chloride for phosphate removal from lake influents would have the side effect of removing most of the boron and heavy metals. (Carroll-FRC)
W82-04767

MYTILUS CALIFORNIANUS AS A BIOINDICATOR OF TRACE METAL POLLUTION: VARIABILITY AND STATISTICAL CONSIDERATIONS,

Moss Landing Marine Lab., CA.
M. Gordon, G. A. Knauer, and J. H. Martin.
Marine Pollution Bulletin, Vol 11, No 7, p 195-198, July, 1980. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Bioindicators, *Trace metals, Mytilus, Mussels, Water pollution, Pollutants, Indicators, Aluminum, Cadmium, Lead, Chromium, Iron, Nickel, Copper, Zinc, Aquatic populations, *Pollutant identification.

Mytilus californianus is a commonly used trace metal bioindicator species. This study investigated the natural variability of this mussell by analyzing specimens collected from two sites in the Southern California Bight for their aluminum, cadmium, chromium, copper, iron, nickel, lead, and zinc contents. Factors which can contribute to the observed population variability include water temperature, salinity, and with in-site variation. This variance should be minimized in order to maximize the ability to resolve differences in mean trace metal levels between populations in relation to a given independent variable. When M. californianus is used as the bioindicator, increases or decreases in metal concentrations on the order of 15 to 40 percent must occur if significant differences are to be detected by analyzing 30 individuals from each site. In general, analysis of between 10 and 30 individuals was required to yield maximum resolution in terms of trace metal concentration between population means while maintaining cost effectiveness. The number of samples required to detect a

given difference may vary from year to year or from site to site, necessitating the determination of population variance estimates for each collection site. The technique of pooling many individual organisms into a single sample may be used to increase resolution and reduce analytical load. However, a variability study using individual samples should still be used as the first step in any baseline or monitoring program. (Carroll-FRC)
W82-04776

APPARATUS NEEDS AND COSTS FOR MONITORING PRIORITY POLLUTANTS,

Ohio River Valley Water Sanitation Commission, Cincinnati.
A. H. Vicory, Jr., and J. F. Malina, Jr.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 125-128, February, 1981. 1 Fig, 5 Ref.

Descriptors: *Laboratory equipment, *Monitoring, *Water analysis, *Pollutant identification, Wastewater analysis, Priority pollutants, Organic compounds, Metals, Pesticides, Chromatoraphy, Costs.

This report, prepared by the Water Pollution Control Federation Toxic Substances Committee, described the equipment and resources needed for monitoring toxic materials in wastewater effluent and natural waters. Analysis of the 127 compounds on the priority pollutant list requires a gas chromatograph-mass spectrometer for organic and miscellaneous compounds (minimum $75,000), a purge and trap attachment for the chromatograph ($5500) for purgeable organics, equipment for base/neutral extractables ($2500), flame ionization detector or electron capture devices for the chromatograph to isolate acid-extractable organics ($4000), pesticide analysis equipment ($2500), and atomic absorption spectrophotometer and associated equipment (up to $20,000) and colorimetric apparatus (up to $6000) for metals and cyanides. A recently built 2600 sq ft facility for wastewater effluent analysis cost $250,000, excluding costs of land, utilities, and instruments. Operating costs including salaries for an analytical facility are a minimum of $100,000 per year. Analytical costs per sample range from $10 to $2000. Monitoring priority pollutants in natural waters requires a minimum investment of $30,000 for equipment and $10,000 annual operating costs based on 1 sample per day, 5 days per week. (Cassar-FRC)
W82-04779

RELIABILITY OF ANALYTICAL METHODS FOR ANAEROBIC MUNICIPAL SOLID WASTE SAMPLES,

Miami Univ., FL. Dept. of Mechanical Engineering.
E. L. Daly, Jr., and S. Farooq.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 187-192, February, 1982. 5 Fig, 4 Tab, 5 Ref.

Descriptors: *Chemical analysis, *Precision, *Solid wastes, *Pollutant identification, Heavy metals, Metals, Nitrogen compounds, Ammonia, Nitrates, Nitrites, Phosphorus, Chloride, Chemical oxygen demand, Sulfides, Anaerobic digestion, Municipal wastes.

Samples of anaerobically digested municipal refuse were spiked with 1 to 2.5 times the normal level of the constituent of interest to test the reliability of standard analtyical methods as described in 'Standard Methods' and EPA's Level One Assessment. Samples were spiked with a single chemical or a mixture of substances. Statistical analysis of the data showed that relative recoveries of singly-spiked substances were: total organic nitrogen, 93%; ammonia N, 84.1%; nitrite N, 119%; nitrate N, 44%; total phosphorus, 157%; chloride, 104%; COD, 70%; total organic carbon, 65%; sulfide, 80%; zinc, 86.1% calcium, 174%; iron, 86%; manganese, 75.1%; nickel, 88.5%; cobalt, 154%, cadmium, 56.7%; copper, 111%; and chromium, 101%. Recoveries for nearly two thirds of the 18 parameters were within the range 80-120%. Analytical precision was about 10% for most of the parameters analyzed. In the composite spike samples self-interferences produced recoveries from -0.11% to 502% in a distilled water matrix and -33.3% to 805% in an effluent filtrate matrix. These results emphasize the importance of conducting spiking experiments individually or with an appropriate control. (Cassar-FRC)
W82-04789

GAS-CHROMATOGRAPHIC SPECIATION OF METHYLSTANNANES IN THE CHESAPEAKE BAY USING PURGE TRAP SAMPLING WITH A TIN-SELECTIVE DECTOR,

National Bureau of Standards, Washington, DC.
J. A. A. Jackson, W. R. Blair, F. E. Brinckman,
and W. P. Iverson.
Environmental Science and Technology, Vol 16, No 2, p 110-119, February, 1982. 8 Ffig, 3 Tab, 31 Ref.

Descriptors: *Chemical analysis, *Bays, Chromatography, Organotin compounds, Metabolism, Organometallic compounds, Photometry, Flame photometry, Tin, Heavy metals, *Chesapeake Bay, *Pollution identification.

A method is presented which permits detection and speciation of both volatile and nonvolatile organotin compounds in aqueous media. The method makes use of a commercial gas chromatograph with a flame photometric detector optimized for tin-selective detection. The purge volatiles and species volatilized by hydridization with NaBH4 were concentrated by a commercial automatic purge and trap sampler employing a Tteaax-GC filled trap. Varying amounts of methyltin compounds were detected by the method, including tetramethyltin and methyltin hydrides, in polluted sites in Baltimore Harbor. Gas chromatography-mass spectrometry was used to confirm earlier reports of microbial methylation of inorganic tin by a strain of Pseudomonas isolated from the Chesapeake Bay. Biogenic origins are thus suspected for the methylstannanes found in the Bay area. (Baker-FRC)
W82-04808

GROUNDWATER MONITORING,

For primary bibliographic entry see Field 6E.
W82-04809

ANODIC STRIPPING VOLTAMMETRY AS AN ANALYTICAL TOOL,

New Mexico State Univ., Las Cruces. Dept. of Chemistry.
J. Wang.
Environmental Science and Technology, Vol 16, No 2, p 104A-109A, 1982. 2 Fig, 1 Tab, 50 Ref.

Descriptors: *Heavy metals, *Water analysis, Measuring instruments, *Anodic stripping voltammetry, Pollution load, Monitoring, Water quality, Water pollution control.

Anodic stripping voltammetry has been used extensively to analyze natural water samples. Beginning in the 1970s ASV has been widely used for analyzing about 20 trace metals in different types of natural waters such as oceans, lakes, rivers, and sewage and industrial effluents, along with tap water. The more sensitive version of ASV, involving the sensitive differential pulse excitation ramp during the stripping step, is usually employed for measuring ultratrace concentration levels of some toxic metals such as thallium, lead, and cadmium in seawater and inland waters. The advantages of using ASV for measuring trace metals in natural water are the direct analysis capability, elimination of concentration steps, and minimum use of reagents. ASV is subject to many potential interferences due to the myriad of variances, such as surfactants, metals, and ligands present in natural waters. An important feature of ASV is its capability to differentiate various chemical forms of a given trace metal in solution, in contrast to atomic absorption or neutron activation, which measure the total metal content. (Baker-FRC)
W82-04811

ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN WATER, WASTE WATER AND AN INDUSTRIAL EFFLUENT,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
P. Leinster, A. E. McIntyre, J. N. Lester, and R. Perry.
Chemosphere, Vol 10, No 3, p 291-301, March, 1981. 9 Fig, 1 Tab, 13 Ref.

Descriptors: *Organic compounds, *Volatile compounds, *Industrial wastewater, Chlorinated hydrocarbons, Chloroalkanes, *Pollutant identification, Water analysis, Wastewater analysis, Extraction, Solvent extraction, Gas purging, Adsorption.

Three methods for removing volatile organic compounds from water samples prior to gas-liquid chromatographic analysis were evaluated. These methods were solvent extraction, gas sparging, and closed-loop stripping. Water samples spiked with a mixture of n-chloroalkanes (C8-C18) were used as standards. Using dichloromethane as an extraction solvent, chloroalkane recoveries were 42-66%, increasing with increasing alkly chain length. Hexane, cyclohexane, and diethyl ether recovered 20-45% of the chloroalkanes. In the gas sparging technique, recovery of organics increased with increasing helium volumes from 2 to 12 liters. Recovery decreased with increasing chloroalkane chain length from 65%-100% at C8 to < 20% at C18. A 55 C sparging temperature gave better recovery than 30 C and 21 C from C8 to C14. Recovery at all three temperatures decreased to about 10% at C18. Closed-loop stripping for 40 hours completely recovered C8 to C12 chloroalkanes but only 10-70% of the higher alkanes. Recoveries of all compounds increased with temperature, especially the higher molecular weight materials. Analysis of a trade effluent containing high levels of volatile organic compounds, sewage, sewage effluents, river water, and air samples after using each of the three extraction methods produced very different results. Each method removed a different porportion of the constituents. Solvent extraction with dichloromethane removed the widest range of compounds. It is likely that more than one extraction method must be used to obtain extensive information about the organic constituents of a water sample. (Cassar-FRC)
W82-04815

GAS CHROMATOGRAPHIC DETERMINATION OF PHENOLIC COMPOUNDS IN WATER, AS THEIR PENTAFLUOROBENZOYL DERIVATIVES,

Stockholm Univ. (Sweden).
L. Renberg.
Chemosphere, Vol 110, No 7, p 767-773, July, 1981. 2 Fig, 1 Tab, 23 Ref.

Descriptors: *Phenols, *Wastewater analysis, *Pollutant identification, *Gas chromatography, Water analysis, Organic compounds, Fluorobenzoylation.

Phenolic compounds in water and wastewater were determined by gas chromatography-mass spectrometry after conversion to the pentafluorobenzoyl derivatives and extraction into an organic solvent. No isolation step was necessary before the derivatization procedure. Test substances were phenol, 2,4-dimethyiphenol, 4-chloro-2-cresol, 4-hloroe-e-cresol, 2-chlorophenol, 2,4-dichlorophenol, and 2-hydroxy-5-chlorodiphenylmethane. Precision of the method was 3.1-6.6% relative standard deviation. The method was linear within the 0.001 to 10 mg per liter range. Comparisons with the pentafluorobenzylation method showed that the pentafluorobenzoylation method was faster and had less background on the chromatogram. (Cassar-FRC)
W82-04816

PIXE TRACE ELEMENT ANALYSIS OF AN AQUATIC PLANT AS INDICATOR OF HEAVY METAL POLLUTION,

Tokyo Univ. (Japan).
A. Jahnke, T. Shimmen, H. Koyama-Ito, and T. Yamazaki.
Chemosphere, Vol 10, No 3, p 303-312, March, 1981. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Bioindicators, *Heavy metals, *Algae, *Indicators, Metals, Trace metals, Water analysis, Chara corallina, Accumulation, Bioaccumulation, X-ray emission analysis, Aquatic plants, Pollutant identification, *Fate of pollutants.

Trace metals in water were determined by charged particle induced X-ray emission (PIXE) analysis of Chara corallina, a fresh water alga with large (1 cm x 1 mm), easily-located internodal cells. This alga accumulates metals in its cell walls. After 1 day incubation in water supplemented with 0.01 mM heavy metal ions, the algal cell walls concentrated metals by a factor as large as 1000. Cu, Zn, and Hg were preferentially accumulated. Other metals used in the study were Fe, Sr, Ba, Pb, Ag, and Cd. cu accumulation rates were greater in 0.1 mM solutions than in the lower concentrations tested. This alga is a useful indicator plant for heavy metals. (Cassar-FRC)
W82-04818

RECENT TRENDS OF BIOCIDES IN PIKES OF THE LAKE PAIJANNY,

Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
J. Paasivirta, J. Sarkka, M. Aho, K. Surma-Aho, and J. Tarhanen.
Chemosphere, Vol 10, No 4, p 405-416, April, 1981. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Fish, *Mercury, *Chlorinated hydrocarbons, *Lake Paijanne, *Finland, *Pike, Methylmecury, Organic compounds, Insecticides, Pulp and paper industry, Phenols, Fate of pollutants, Pollutant identification.

Pike (Esox lucius) were sampled in May 1980 in three areas of Lake Paijanne, Finland, and analyzed for several pollutants. Average mercury levels were as follows: total Hg, 642 + or - 204 ng per g; and methylmercury, 83.21 + or - 11.11%. Other contaminants monitored were HCB, DDE, polychlorinated biphenyls, 2,4,6-trichlorophenol, 2,3,4,6-tetrachlorophenol, tetrachloroguaiacol, pentachlorophenol, and tetrachlorocatechol. Levels of these chemicals were variable. Although pentachlorophenol concentrations were 10-70 ppb (fresh weight) in all three locations of the lake, the other chemicals associated with pulp and paper manufacture were found in abundance only at Tiirinselka. Regression analysis of the current findings and previous results showed a decreasing trend in Hg levels in fish tissue from 1970 to the present. Curves were developed to predict Hg levels to 1984, based on the fact that Hg pollution of the lake stopped in 1968. (Cassar-FRC)
W82-04819

OCCURRENCE AND DETERMINATION OF ORGANIC OXIDANTS IN RIVERS AND WASTEWATERS,

Illinois Univ at Urbana-Champaign. Inst. for Environmental Studies.
R. A. Larson, K. Smykowski, and L. L. Hunt.
Chemosphere, Vol 10, No 11/12, p 1335-1338, November/December 1981. 1 Tab, 12 Ref.

Descriptors: *Organic compounds, *Oxidation, *Pollutant identification, *Wastewater analysis, *Raw water, Water analysis, Rivers, Iodometric methods, Disinfection, Chemical analysis.

A spectrophotometric iodometric method, using two concentration procedures, was used to detect organic oxidants in river water and wastewater. Examples of oxidants under consideration are chloramines, quinones, and hydroxyhydroperoxides. Recovery of two known peroxides indicated that the concentration method using ion exchange was 80-85% efficient, and dichloromethane extraction, 70-82% efficient. Organic oxidants were detected in water samples as follows: Henry, Illinois, municipal wastewater, 2.5 times 10 to the minus 5th power M; Delaware River, Chester, Pennsylvania, 8.6 times 10 to the minus 6th power M; Brandywine Creek Wilmington, Delaware, 5.8 times 10 to the minus 6th power M; Delaware River, New Castle, Delaware, 2.7 times 10 to the minus 6th power M; Christiana River at Wilmington, 1.6 times 10 to the minus 7th power M; Boneyard Creek, Urbana, Illinois, 1.4 times 10 to the minus 7th power M; and Crystal Lake, Urbana, Illinois, 1.3 times 10 to the minus 7th power. Other samples of municipal water, Wastewater, and river water gave values in the range of 10 to the minus 8th power, the lowest detectable limit. (Cassar-FRC)
W82-04821

UNUSUAL POLYHALOGENATED CHEMICAL RESIDUES IDENTIFIED IN FISH TISSUE FROM THE ENVIRONMENT,

Environmental Research Lab.-Duluth, MN.
D. W. Kuehl.
Chemosphere, Vol 10, No 3, p 231-242, March, 1981. 86 Ref.

Descriptors: *Chlorinated hydrocarbons, *Fish, *Pesticides, *Pollutant identification, Bioassay, Organic compounds, Chemical wastes, Brominated compounds, Water pollution sources, Reviews.

Unusual polyhalogenated compounds identified in fish are the subject of a review of the 1970-80 literature. Not included are papers on routine monitoring or papers describing laboratory bioassays. Some of the compounds were pesticides, their metabolites, or their manufacturing intermediates: methylthiopentachlorobenzene and di-(methylthio)tetrachlorobenzene, dimethyltetrachloroterephthalate, chloronorbornadiene and chloronorborene compounds, polychlorinated dibenzo-p-dioxins, trifluralin, 1,3,5-trichloro-2-(4-nitrophenoxy)benzene, polychloro-2-(chloromethylsulfonamide) diphenyl ethers and metabolic products, pentachlorophenol, dichlorobenzophenone, hexachlorobenzene, mirex, kepone, chlordene epoxide, 1-hydrolychlordene, and toxaphene. Industrial chemicals and their intermediates are chlorofluorotoluene mixture, hexachloro-1,3-butadiene, 2,4,6-trichlorophenol, isomers of chloroguaiacol, polychlorinated dibenzofurans, polychlorinated terpehnyls, polychlorinated styrene, and 2-chloroaniline, Many brominated compounds were found in fish living in waters receiving effluents disinfected with bromine chloride. Other compounds include chloramines, trichlorophenol, pentachloroanisole, and polychlorinated napthalenes. (Cassar-FRC)
W82-04822

ANALYSIS OF MARINE SEDIMENT, WATER AND BIOTA FOR SELECTED ORGANIC POLLUTANTS,

Texas A and M Univ., College Station. Dept. of Chemistry.
H. E. Murray, L. E. Ray, and C. S. Giam.
Chemosphere, Vol 10, No 11/12, p 1327-1334, November/December, 1981. 1 Fig, 2 Tab, 30 Ref.

Descriptors: *Sediments, *Marine animals, *Aromatic compounds, *Pollutant identification, Organic compounds, Pesticides, Benzo(a)pyrene, Hexachlorobenzene, Pentachlorophenol, Chlorinated hydrocarbons, Phenols, *San Luis Pass, *Texas, Marine sediments, Water analysis, Polycyclic aromatic hydrocarbons, Fish, Phthalates, Crabs, Squid, Shrimp.

Water, sediments, and biota collected from San Luis Pass, West Galveston Bay, Texas, in February-June 1980 were analyzed for organic pollutants. Water samples had no detectable hexachlorobenzene (HCB) or benzo(a)pyrene (BaP); pentachlorophenol (PCP) concentrations were 4.3-11 ng per liter. Average pollutantconcentrations in sediments were (ng per g dry weight); HCB, 0.49; BaP, 2.2; PCP, 0.18; dibutyl phthalate, 60; di(2-ethylhexyl) phthalate, 94; diethyl phthalate, 5; and polychlorinated biphenyls, 0.52, DDE, DDT, chlordane and dieldrin were all below the detection limits of 0103 ng per g. BaP levels in biota were all below the detection limit of 0101 ng per g wet weight. Average HCB concentrations in biota (ng per g wet weight) were: flounder, 049; longnose killifish, 0.65; brown shrimp, 0.88; blue crab, 9.6; and dwarf squid, 0.71. Average PCP levels in biota were (ng per g wet weight): flounder, 2.6; longnose killifish, 5.3; brown shrimp, 7.5; blue crab, 2.8; and dwarf squid, 1.9. The order of concentrations in biota (except blue crab) was PCP > HCB > BaP; in sedimentsat the site where the biota were collected, BaP > NCB > PCP. This indicates that the concentrations of pollutants in sediments may not accurately indicate the exposure of animals which do not ingest large quantities of sediments. (Cassar-FRC)
W82-04823

CONTENTS OF CHLORDANE-, PCB- AND DDT-COMPOUNDS AND THE BIOTRANSFORMATION CAPACITY OF FISHES IN THE LAKE AREA OF EASTERN FINLAND,

Finland Technical Research Center, Espoo.
H. Pyysalo, K. Wickstrom, R. Litmanen, P. Lindstrom-Seppa, and U. Koivusarri.
Chemosphere, Vol 10, No 8, p 865-876, August, 1981. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Fish, *Biotransformation, *Insecticides, Perch, Roach, Vendace, Trout, *Finland, Chlordane, DDT, Polychlorinated biphenyls, *Lakes, Organic compounds, Chlorinated hydrocarbons, Pesticides, *Pollutant identification, Fate of pollutants.

Chlordane compounds were detected in fish (perch, roach, vendace, and rainbow trout) in lakes of eastern Finland. Since chlordane has not been used in this region, there is a possibility that it was transported by air. Concentrations of three chlordane isomers, DDT, and polychlorinated biphenyls were reported for muscles and liver of the fish. Pollutant levels appeared to be negatively correlated with the biotransformation capacity of the fish species. Highest concentrations of pollutants were found in vendace, which had the poorest monooxygenase and conjugating activity. Rainbow trout, with the greatest biotransformation ability of the group, had the lowest pesticide levels. Perch and roach were intermediate in pesticides levels and biotransformation capacity. (Cassar-FRC)
W82-04827

ORGANOCHLORINE POLLUTANT ANALYSIS OF CONTAMINATED AND UNCONTAMINATED LAKE SEDIMENTS BY HIGH RESOLUTION GAS CHROMATOGRAPHY,

Ulm Univ. (Germany, F. R.).
H. Buchert, S. Bihler, P. Schott, H. P. Roper, and H. J. Pachur.
Chemosphere, Vol 10, No 8, p 945-956, August, 1981. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Chlorinated hydrocarbons, *Lake sediments, *Pesticides, Lakes, Sediments, *Organochlorine, *Pollutant identification, Accumulation, Polychlorinated biphenyls, Polychlorinated terphenyls, DDT, DDE, DDD, Organic compounds, Gas chromatography, Hexachlorocyclohexane.

Samples of sediments from several German lakes in industrial areas contained a variety of organochlorine pollutants, including chlorobenzenes (tri-, tetra-, penta-, and hexa-), isomers of HCH, isomers of DDT, polychlorinated biphenyls, and polychlorinated terphenyls. Maximum concentrations of several pollutants were (in micrograms per kg dry weight): HCB, 15; alpha-hexachlorocyclohexane (HCH), 316; gamma HCH, 156; 4,4'-DDE, 499; 4,4'-DDD, 747; 4,4'-DDT, 188; polychlorinated biphenyls (PCB) (60% Cl), 1200; and polychlorinated terphenyls (PCT) (54% Cl), 1200. Even at a depth of 6 m, traces of organochlorine compounds were detected in one lake. Surface sediments of a salt lake in Libya had traces of HCB, PCB, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT. Sediments from a rural German lake showed traces of PCB, 4,4'-DDE, and 4,4'-DDD at depth levels corresponding to the year 1920. (Cassar-FRC)
W82-04828

PERSISTENT ORGANIC CHEMICALS IN SEWAGE EFFLUENTS: I. IDENTIFICATIONS OF NONYLPHENOLS AND NONYLPHENOLETHOXYLATES BY GLASS CAPILLARY GAS CHROMATOGRAPHY/MASS SPECTROMETRY,

Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
W. Giger, E. Stephanou, and C. Schaffner.

Chemosphere, Vol 10, No 11/12, p 1253-1261, November/December, 1981. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Phenols, *Surfactants, *Pollutant identification, Organic compounds, Nonylphenols, Effluents, Rivers, *Zurich, Switzerland, *Glatt River, Gas chromatography, Mass spectrometry.

Nonylphenols and nonylphenolethoxylates containing 1 to 3 oxyethylene groups were detected in effluents from activated sludge sewage treatment plants in Zurich, Switzerland. Concentrations were estimated at 100-300 micrograms per liter. In addition, several samples contained an octylphenoldiethoxylate. These compounds are persistent metabolites of nonionic detergents. Chromatograms and mass spectra of these compounds are presented. Water samples from the River Glatt, flowing through a densely populated area east of Zurich, contained nonylphenol and mono- and diethoxylated nonylphenol. (Cassar-FRC)
W82-04834

AUTOMATIC MONITORING OF COPPER IN WASTE WATER FROM PLATING SHOPS,

Siemens Naamloze Vennootschap, Oostkamp (Belgium).
J. B. Vanhumbeeck.
Water Science and Technology, Vol 13, No 11-12, p 539-544, 1981. 1 Fig.

Descriptors: *Copper, *Monitoring, *Computers, *Process control, *Colorimetry, Electroplating, Wastewater treatment, *Industrial wastes, Heavy metals, Automation, Control systems, Water analysis, Pollutant identification, Water quality control.

Wastewater from plating shops can be monitored for copper before entering the treatment regime, during the process for operation control or when leaving the plant site for emission control. A continuous monitoring process for copper levels in the discharge waters is usually required due to unreliable removal processes for this toxic heavy metal. An automatic monitoring system was developed based on the German standard colorimetric method using bathocuproin sulphonic acid. The analytical procedure was optimized, and the mechanical system was made simple, durable and easy to maintain. A simple microcomputer and data treatment system was added to control the automated monitoring process, rendering a reliable but practical copper control program for use under normal process conditions. (Geiger-FRC)
W82-04845

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF NITRITE IN ENVIRONMENTAL SAMPLES BY THE USE OF HYDRALAZINE,

University of Occupational and Environmental Health, Kitakyushu (Japan). School of Medicine.
H. Noda, M. Minemoto, and T. Asahara.
Journal of Chromatography, Vol 235, No 1, p 187-195, 1982. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Nitrites, *Water analysis, Chemical analysis, Environmental protection, *Chromatography, Pollutant identification.

The usefulness of the high-pressure liquid chromatographic method is described for the determination of nitrite ion in environmental samples, particularly in biological fluids, foods and ambient waters. The procedure makes use of UV and fluorometric detectors. Hydralazine reacts with nitrite ion under acidic conditions at 37 degrees C to form tetrazolo (5,1-alpha)phthalazine (Tetra-P) almost quantitatively. The determination of Tetra-P by reversed-phase high-pressure liquid chromatography was simple, specific, sensitive and reliable over the range of 0.001-0.10 ppm of nitrite nitrogen. The hydralazine procedure is one of the most useful methods for routine analysis of nitrites in environmental samples. (Baker-FRC)
W82-04855

POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS AND ASSOCIATED BENTHOS IN LAKE ERIE,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
B. J. Eadie, W. Faust, W. S. Gardiner, and T. Nalepa.
Chemosphere, Vol 11, No 2, p 185-191, 1982. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Lake sediments, *Aromatic compounds, *Benthic fauna, *Polyaromatic hydrocarbons, *Lake Erie, Sediments, Powerplants, Worms, Midges, Invertebrates, Aquatic fauna, Water pollution sources, Fate of pollutants, Water pollution effects.

Polyaromatic hydrocarbons (PAH) in lake surface sediments near a large coal fired powerplant on the Michigan shore of Lake Erie ranged from 0.54 to 3.75 ppm total PAH. Stations south of the plant had much lower concentrations than stations north of the plant. There was a significant correlation between percent organic matter and PAH content of the sediment. Worms and midges were scarce at the northern stations because PAH concentrations were near or above the 96 hour LC50. Oligochaete worms did not bioaccumulate PAH, but some biodegradation was noted. Midges within 1 km of the shore had the highest PAH levels. These decreased with increasing distance offshore. Midges bioaccumulated phenanthrene, fluoranthene, pyrene, chrysene, and benzo(a)pyrene. The River Raisin appeared to be a source of PAH. No point source at the powerplant was evident. Combustion products were well dispersed, and coal leachate was small in quantity. Concentrations of PAH were similar to those measured in other industrial areas. (Cassar-FRC)
W82-04882

DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FRESH WATER FISH,

Health Effects Research Lab., Research Triangle Park, NC.
R. L. Harless, E. O. Oswald, R. G. Lewis, A. E. Dupuy, Jr., and D. D. McDaniel.
Chemosphere, Vol 11, No 2, p 193-198, 1982. 2 Fig, 2 Tab, 21 Ref.

Descriptors: *Fish, *Chlorinated compounds, *Dioxins, Organic compounds, *Pollutant identification, Polychlorinated biphenyls, Tetrachlorodibenzo-p-dioxin, *Michigan.

Four to 695 ppt of 2,3,7,8-tetrachlorodibenzo-p-dioxin were found in the edible flesh of fresh water fish taken from several bodies of water in Michigan (Tittabawassee, Grand, and Saginaw Rivers, Lake Michigan, and Saginaw Bay). Twenty-six of 36 samples contained detectable quantities of this compound. Ten of the 36 samples contained levels higher than 40 ppt. Bottom feeders (catfish and carp) had higher concentrations than bass, perch, and suckers. Analysis was done by high resolution gas chromatography-high resolution mass spectrometry. Other compounds qualitatively identified in fish tissue were: chlorinated diphenyl ethers, trichlorohydroxybenzylphenyl ether, tetrachlorodibenzofurans, trichloroterphenyl, polychlorinated biphenyls, and tri- and penta-chlorodibenzo-p-dioxins. The source of this contamination was not known. (Cassar-FRC)
W82-04883

DETERMINATION OF SULFATE IN RIVER WATER BY FLOW INJECTION ANALYSIS,

Okayama Univ. (Japan). Dept. of Chemistry.
O. Kondo, H. Miyata, and S. Toei.
Analytica Chimica Acta, Vol 134, p 353-358, 1982. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Sulfates, *Water analysis, Chemical analysis, Measuring instruments, *Pollutant identification, Rivers, Water quality, Monitoring.

The determination of sulfate ion by flow injection analysis (f.i.a.) using the barium chelate of sulfonazo-III or dimethylsulfonazo-III is reported. The method can be used for 1-30 ppm sulfate ion in river water, which range covers almost all river waters in Japan. Thirty samples can be determined per hour within 1% relative error. The flow rates of the reagent solution and barium sulfate solutions are optimally 2 ml/minute each. Sample solutions are filtered through a Millipore filter and passed through an Amberlite IR120-B column before being injected. From the sample loop, 80 microliters of treated sample solution is injected into the carrier stream. Peak heights are measured at 645 nm for the sulfonazo-III method and at 662 nm for the DMSA-III method. The concentration of sulfate ion is measured from a calibration graph prepared with potassium sulfate standards. The absorption spectra of sulfonazo-III and its barium chelate show maxima at 575 nm and 643 nm, respectively. Absorbance is measured at 645 nm for greatest sensitivity. The effects of co-existing ions were investigated. Calcium ions in ordinary river water interfere with the determination. To prevent this, samples are first passed through a column of cation-exchange resin. The procedure was applied to the determination of sulfate in waters from the Asahi, the Yoshii and the Takahashi Rivers in Okayama Prefecture. Recovery tests indicate that the method was not affected by the various matters dissolved in these river waters. (Baker-FRC)
W82-04891

COMPARISON OF ATOMIC ABSORPTION SPECTROMETRIC, SPECTROPHOTOMETRIC, AND FLUORIMETRIC METHODS FOR DETERMINATION OF ALUMINUM IN WATER,

McMaster Univ., Hamilton (Ontario). Dept. of Geology.
R. Playle, J. Gleed, R. Jonasson, and J. R. Kramer.
Analytica Chimica Acta, Vol 134, p 369-373, 1982. 20 Ref.

Descriptors: *Aluminum, *Pollutant identification, Water quality, Water pollution control, Atomic absorption spectrometry, Spectrophotometry, Measuring instruments, Water analysis, Trace metals, *Comparison studies.

The ferron colorimetric method, the lumogallion fluorimetric method, and the electrothermal atomic absorption spectrometry (a.a.s.) method are compared for determining the aluminum content in water. Interferences for each method are described. It was found that in the three methods, standard additions generally gave more reliable results than calibrations against a standard curve. The ferron method gave unreliable results below about 50 micrograms/liter, while the lumogallion and a.a.s. methods yield similar results. When a large difference between these latter two methods occurred, it may have been due to the fact that a.a.s. measures total aluminum, while the lumogallion method does not measure unreactive aluminum. Natural kaolinite was selected as a representative refractory material to test the assumption that electrothermal a.a.s. quantified total aluminum in an aqueous sample. The electrothermal a.a.s. method is assumed free of interferences and has an applicable range of 10 to above 1000 micrograms aluminum/liter. The colorimetric ferron method has multiple interferences and is useful in the 50-1500 microgram aluminum/liter range. The fluorimetric method has few important interferences and is useful to below 1 microgram aluminum/liter. (Baker-FRC)
W82-04892

DETERMINATION OF TRACE METALS IN ESTUARINE SEDIMENTS BY GRAPHITE-FURNACE ATOMIC ABSORPTION SPECTROMETRY,

National Research Council of Canada, Ottawa (Ontario). Div of Chemistry.
R. E. Sturgeon, J. A. H. Desauliniers, S. S. Berman, and D. S. Russell.
Analytica Chemica Acta, Vol, 134, p 283-291, 1982. 7 Tab, 24 Ref.

Descriptors: *Sediments, *Trace metals, Estuarine environments, *Estuaries, Sedimentation, Atomic absorption spectrometry, *Pollutant identification, Copper, Cobalt, Chromium, Lead, Nickel, Beryllium.

This report details a description of procedures which permitted the accurate determination of cadium, lead, cobalt, copper, chromium nickel and beryllium in estuarine sediments by graphite furnace atomic absorption spectrometry in combination with the L'vov Platform. The technique is interference free and permits calibration with simple aqueous solutions of metal standards. Results for lead and copper appear to be biased on the low side of acceptability. Quantitative dissolution and recovery of chromium in both sediment samples examined was evident, indicating that complete dissolution of chromium-bearing minerals was achieved and that no significant loss of volatile CrOC12 species occurred. (Baker-FRC)
W82-04893

THE USE OF XAD-RESINS FOR THE DETECTION OF MUTAGENIC ACTIVITY IN WATER. II. STUDIES WITH DRINKING WATER,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
H. J. Kool, C. F. van Kreijl, and H. J. van Kranen.
Chemosphere, Vol 10, No 1, p 99-108, January, 1981. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Ion exchange, *Mutagens, *Water analysis, Pollutant identification, Drinking water, Organic matter, *Netherlands, *Water supply, Rhine River, Meuse River.

The ion exhange method for concentrating mutagens in water, described in Part I of the work, was successfully applid to the anlaysis of drinking water from 6 Netherlands cities which derive their water from the Rhine and Meuse Rivers. Water from 4 of the cities showed dose-related responses. The type of mutagen mutations induced (TA98 or TA100) was different among the different cities. Water from 2 cities did not produce any mutagenic activity in the test. It is likely that the treatment processes used in these cities effectively remove organic mutagens present in the raw water supply. (Cassar-FRC)
W82-04912

USE OF XAD-RESINS FOR THE DETECTION OF MUTAGENIC ACTIVITY IN WATER. I. STUDIES WITH SURFACE WATER,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
H. J. Kool, C. F. van Kreijl, H. J. van Kranen, and E. de Greef.
Chemosphere, Vol 10, No 1, p 85-98, January, 1981. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Ion exchange, *Mutagens, *Water analysis, Rivers, Organic matter, *Pollutant identification, Surface water, *Netherlands.

An equal mixture of XAD-4 and -8 resins and dimethyl sulfoxide as an elutant were most suitable for concentration of mutagens in surface waters. Optimal flow rates were 2-4 bed volumes per minute. Most mutagenic substances were adsorbed at a neutral pH, except for a minor fraction which was adsorbed at pH 3. The mutagenic activity of the concentrate produced by XAD resin adsorption and of a concentrate prepared by freeze drying were similar. The method was tested on water from several rivers (Rhine, Meuse, and Biesbosch), wastewater plant effluent, and seawater from nearshore North Sea. (Cassar-FRC)
W82-04913

ANALYSIS OF PCBS IN SEDIMENT BY GLASS CAPILLARY GAS CHROMATOGRAPHY,
Rijksinstituut voor Visserijonderzoek,Ijmuiden (Netherlands).
M. A. T. Kerkhoff, A. de Vries, R. C. C. Wegman, and A. W. M. Hofstee.
Chemosphere, Vol 11, No 2, p 165-174, 1982. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Polychlorinated biphenyls, Sediments, *Gas chromatography, *Pollutant identification, Chlorinated hydrocarbons, Rivers, *Rhine River, Aroclors, Organic compounds, Aromatic compounds.

Sediment samples from the Rhine River and its tributaries were analyzed for polychlorinated biphenyls (PCB) by glass capillary gas chromatography. Sediment samples from 6 rivers contained from 1.0 to 3.9 mg per kg total PCB as determined by the capillary method. The perchlorination method, which converts all PCB's to the decachlorobiphenyl, produced results 1.1 to 3.7 times higher than those obtained by the capillary gas chromatograph. Mean recovery of 13 individual components of Aroclor 1242 was over 85% in spiked samples. Seventeen individual components were identified. The glass capillary gas chromatographic method, which provides information on individual PCB components, may be useful in identifying sources of contamination. (Cassar-FRC)
W82-04916

COPROSTANOL AND BACTERIAL INDICATORS OF FAECAL POLLUTION IN THE SCHELDT ESTUARY,
Institut d'Hygiene et d'Epidemiologie, Brussels (Belgium).
M. Yde, E. De Wulf, S. De Maeyer-Cleempoel, and D. Quaghebeur.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 2, p 129-134, February, 1982. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Coprostanol, *Indicators, *Bacteria, Pollutant identification, Bioindicators, *Coliforms, *Scheldt Estuary, Streptococcus, Clostridium, Sewage bacteria, Feces, Netherlands, Belgium.

Coprostanol (5-beta-cholestan-3-beta-ol), a steroid present in animal and human feces, was tested as an indicator of fecal pollution in waters of the Scheldt estuary (The Netherlands-Belgium). Analysis was performed by conversion to the trimethylsilyl derivative, followed by gas chromatography using a flame ionization detector and glass capillary column. For comparison, total coliforms, fecal coliforms, fecal streptococci, and sulfite-reducing clostridia were determined. Coprostanol levels were not as reliable as the bacterial indicators in determining fecal pollution. In some samples bacteria were detected but coprostanol was below the detection limit. However, coprostanol analysis may be useful in determining fecal pollution in waters where bacteria have been destroyed by thermal pollution or toxic substances, by low temperatures, or by a delay between sampling and analysis. (Cassar-FRC)
W82-04923

AUTOMATED TURBIDIMETRIC DETERMINATION OF SULPHATE IN SURFACE, GROUND AND DOMESTIC WATER BY FLOW-INJECTION ANALYSIS,
Pretoria Univ., (South Africa). Dept. of Chemistry.
J. F. Van Staden.
Fresenius Zeitschrift fur Analytische Chemie, Vol 310, No 3/4, p 239-242, 1982. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Water analysis, *Sulfates, Chemical analyis, *Pollutant identification, Flow injection analysis, *Turbidity, Surface waters, Groundwater, Drinking water.

A flow-injection procedure is reported in which one sampling loop of a two-position sampling valve is used to sample an alkaline buffer-EDTA solution alternating with water samples picked up on the other loop, obviating acidification of water samples and reducing baseline drift. The procedure as described is suitable for carrying out sulfate analysis at a rate of about 60 water samples per hour. The alkaline buffer-EDTA solution dissolves any residual precipitate coating the walls of the flow cell and keeps the system clean. The coefficient of variation is better than 0.95%. The reproducibility of the method was tested on standard sulfate solutions and water samples. (Baker-FRC)
W82-04935

DATA ACQUISITION AND EVALUATION IN BIOLOGICAL MONITORING SYSTEMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
D. Gruber, and J. Cairns.
Hydrobiologia, Vol 83, No 3, p 387-393, 1981. 2 Fig, 25 Ref.

Descriptors: *Water quality, *Monitoring, *Bioindicators, Pollutant identification, Indicators, Behavior, Respiration, Water pollution control, Wastewater, Computers, Automation, *Fish, Data acquisition, Data interpretation.

The ventilatory rates of fish may be used in biological monitoring for continuous and automated pollutant detection. Over the past 15 years many studies have used the ventilatory behavior of fish to assess wastewater quality. A variety of ventilatory parameters have been measured, including ventilatory frequency, ventilatory amplitude, and gill purges or coughs. Methods developed for receiving the ventilatory signals have incorporated manometric techniques, attached electrodes, unattached electrodes, and visual observation. The most suitable method for industrial use incorporated noncontact submerged electrodes. Strip chart recorders have typically been utilized for fish ventilatory signal acquisition, as they are relatively inexpensive, are easily interfaced to electrodes, and provide a hard copy of the data. Some systems allow the ventilatory rates of 12 fish to be accumulated continuously with the aid of an online minicomputer. It is important that differences among fish be considered when analyzing ventilatory behavior. The static baseline approach to data handling is discussed, along with a time series approximation. Widespread application of on-line biomonitoring systems will almost certainly require computer technology. The incorporation of computer based biomonitoring apparatus facilitates collections of data from many fish almost continuously. The computer can be programmed to trigger a water sampler whenever the fish are behaving abnormally. (Baker-FRC)
W82-04944

THE USE OF THE THREE-RIDGE CLAM (AMBLEMA PERPLICATA) TO MONITOR TRACE METAL CONTAMINATION,
Purdue Univ., Lafayette, IN. School of Pharmacy and Pharmacal Sciences.
T. G. Adams, G. J. Atchison, and R. J. Vetter.
Hydrobiologia, Vol 83, No 1, p 67-72, 1981. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Bioindicators, *Rivers, Industrial wastes, Indicators, Pollutant identification, Clams, Water pollution, *Zinc, *Cadmium, *Electroplating, *India.

The use of the three-ridge clam as a monitor of zinc and cadmium contamination in two freshwater streams was evaluated. The streams, Williamson Ditch and Trimble Creek, are located in northcentral India. An electroplating plant discharges wastes that contain zinc and cadmium into Williamson Ditch about 3 km from Palestine Lake. Clams were collected from a relatively uncontaminated area in one river and transported to four study sites in the two contaminated streams. The clams were placed into polyethylene cages and left in these streams for one week. Control clams were treated in a similar manner and left in the uncontaminated river. The highest mean concentration of zinc was 956 micrograms/gram dry weight and was found in the gill tissue of clams from the most contaminated site. The highest mean cadmium concentration, 18.6 micrograms/gram dry weight, was found in the digestive glands, also from the most contaminated site. Mean concentrations at contaminated sites were significantly higher than background and control levels. These findings suggest that these particular organs of clams may be useful in monitoring levels of zinc and cadmium in other freshwater systems. (Baker-FRC)
W82-04948

THE EFFECTS OF DISSOLVED HEAVY METALS ON ATTACHED DIATOMS IN THE UINTAH BASIN OF UTAH, U.S.A.,
Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
S. R. Rushforth, J. D. Brotherson, N. Fungladda, and W. E. Evenson.
Hydrobiologia, Vol 83, No 2 p 313-323, 1981. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Heavy metals, *Diatoms, Basins, *Utah, Streams, River basins, Chemical properties, Water analysis, Bioindicators, *Ecological effects.

A study was performed to examine how diatoms differ in their response to heavy metal concentrations in natural systems. Initial data was also collected on the response to heavy metals of important diatom species in order to suggest further autecological studies. Samples of diatom populations were collected from 22 sites along selected streams in the Uintah Basin of Utah during 1977-1978. Seasonal changes in the concentrations of heavy metals were noted. The trends noted were largely due to runoff patterns and characteristics of the river drainage basins. The study demonstrated that under field conditions several diatom species showed different patterns of abundance with varying concentrations of heavy metals. Such responses were shown to be probably related to seasonal differences. This is due to the fact that environmental factors do not operate separately from one another, but rather in some sort of interaction, be it complementary or antagonistic. Thus the effects of heavy metals on diatom species would be expected to be mitigated by other environmental parameters, such as day length, temperature, nutrients of water hardness. Achnanthes minutissima, Cylotella meneghiniana, Cymbella minuta, Gomphonema parvulum, Navicula secreta var. apiculata, Nitzschia frustulum, Nitzschia frustulum var. perminuta, Nitzschia pale, and Synedra ulna appear to be indicator species of high or low heavy metal concentrations. Other species also demonstrated meaningful relationships to high or low heavy metal concentrations. (Baker-FRC)
W82-04951

PRELIMINARY SCREENING OF BACTERIAL COMPONENTS AS ORGANIC PRECURSORS TO THE FORMATION OF TRIHALOMETHANES,

Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 5F.
W82-04957

INFLUENCE OF CHLORINATION AND THE DISTRIBUTION SYSTEM ON MUTAGENS IN A POTABLE WATER SUPPLY,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
J. B. Johnston, and R. R. Clark.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220674, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 168, March 1982, 137 p, 33 Tab, 26 Fig, 53 Ref, 2 Append. OWRT B-125-ILL(1). USDI 14-01-0001-9148.

Descriptors: Ames assay, *Chlorination, Distribution system, *Mutagens, Polynuclear aromatic hydrocarbons, *Potable water, *Water supply systems.

A growing number of studies have detected mutagens in public water supplies. This study examined a central Illinois public water supply and found the presence of mutagens dependent on mammalian metabolism (promutagens) in addition to chlorination-related, direct-acting mutagens. Both kinds of mutagens were recovered by adsorption on polyurethane foam and quantitated by the Ames Salmonella/microsome reversion assay. It was found that the pro-mutagens first appeared in the distribution system (following treatment) and that the direct-acting activity increased somewhat within the system. It was found that chloramine disinfection produced water with more promutagenic activity than direct-acting mutagenicity and that chlorination beyond break-point reversed this order. Detailed study of the time of appearance of mutagens and chlorine residuals showed patterns consistent with the formation of direct-acting mutagens by reaction of the free chlorine residual with substances in the water - possibly materials contributed by the distribution system. Particulate matter collected from hydrant flush water at dead ends in the distribution system were found to harbor high amounts of two known carcinogens and other unidentified mutagenic substances. These high levels of mutagens were not found in tap water, nor could the carcinogens be identified in the tap water.
W82-04961

QUANTIFICATION OF OCTACHLOROSTYRENE AND RELATED COMPOUNDS IN GREAT LAKES FISH BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY,

Environmental Research Lab.-Duluth, MN.
D. W. Kuehl, K. L. Johnson, B. C. Butterworth, E. N. Leonard, and G. D. Veith.
Journal of Great Lakes Research, Vol 7, No 3, p 330-335, 1981. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Fish, *Chemical analysis, *Chlorinated compounds, *Great Lakes, Gas chromatography, Mass spectrometry, Octachlorostyrene, *Pollutant identification.

Studies have been underway since 1974 on gas chromatographic-mass spectrometric (GC-MS) exploration of organic chemical residues in composite samples of fishes from major watersheds in the United States. A large bank of fish tissue samples was established. These samples were utilized to estimate the levels of octachlorostyrene and related polychlorinated hydrocarbons in Great Lakes fish. Whole fish were composited, ground, dried with anhydrous sodium sulfate, and extracted with hexane. The extract was concentrated, cleaned up on a Florisil column, and analyzed by multiple ion detection of two ions for each compound on a computerized system with peak-finding and quantification software. The results indicate that octachlorostyrene residues in fish from the two uppoer lakes, Superior and Michigan, were below the detection limit of 5 ng/g (wet weight), while residues in fish from Lakes Huron, Ontario and Erie reached as high as 400 ng/g. Fish from the Ashtabula River/Field Brook area contained extremely large quantities of octachlorostyrene and other chlorinated compounds, suggesting specific industries as the source of these pollutants. (Carroll-FRC)
W82-04993

ON THE USE OF FILTERS FOR DISTINGUISHING BETWEEN DISSOLVED AND PARTICULATE FRACTIONS IN NATURAL WATERS,

Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
L. G. Danielsson.
Water Research, Vol 16, No 2, p 179-182, February, 1982. 2 Fig, 16 Ref.

Descriptors: *Filtration, *Natural waters, Water, Colloids, Water quality, Iron, Heavy metals, Pore size, Particulate matter, Lakes, Bogs, Estuaries, Marshes, Swamps, *Lake Alenashalan, Sweden.

The effects of filtration on colloidal matter present in natural waters were investigated. Samples were taken from Lake Alenashalan in southwestern Sweden. The lake is surrounded by peat bogs and is high in concentration of iron and humic substances. Even though these substances are present in high concentrations here, the compounds responsible for them are present in most natural waters. The nature of these compounds is probably a co-colloid of iron hydroxide and organic compounds. The two types of membrane filters used in the study have widely different construction. Millipore filters are made of a copolymer of cellulose nitrate and cellulose acetate, forming a three dimensional net. The specified pore size is actually a mean value. Nucleopore filters have a somewhat better defined pore size, as these filters are made by perforating a sheet of polycarbonate in a well defined way. The filtration characteristics are, however, rather similar for the two filters. The use of filters of normal pore sized (0.4 to 0.7 micrometers) is inadequate for the separation of particulate and truly dissolved fractions of metals in natural waters, especially for colloid-laden samples such as bog waters, woodland streams and lakes, and estuarine waters. Use of membrane filters for the removal of large particles from a water sample can introduce large errors due to the changing effective pore size caused by clogging. For large volume filtrations, frequent filter change and/or large area filters should be used. Filter holders supplied with stirrers like those used for ultrafiltration might also be beneficial in helping to avoid clogging. (Baker-FRC)
W82-05012

BIOLOGICAL MONITORING, PART IIA - RECEIVING SYSTEM FUNCTIONAL METHODS, RELATIONSHIPS AND INDICES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
R. A. Matthews, A. L. Buikema, Jr., J. Cairns,Jr., and J. H. Rodgers, Jr.
Water Research, Vol 16, No 2, p 129-139, February, 1982. 1 Tab, 113 Ref.

Descriptors: *Monitoring, *Reviews, Ecosystems, Stress, Water quality, Water resources development, Stress analysis, *Biological properties, *Environmental effects.

Biological monitoring is defined as the systematic use of biological responses to evaluate changes in the environment with the intent to use this information in a quality control program. Biological monitoring is reviewed primarily from the functional aspect, integrating structure and function into a more complete picture of exosystem response to stress. Ecosystem structure considers the composition of the biological community, including species, numbers, biomass, life history and spatial distribution of populations, the quantity and distribution of the abiotic materials, and the range or conditions of existence. Function is concerned with the rate of biological energy flow through the ecosystem, the rate of material or nutrient cycling, biological or ecological regulation, and regulation of the environment by the organisms. Functional responses to stress in aquatic systems can be studied by photosynthesis and respiration measurements taken at the population level or higher. Physicochemical measurements, behavioral changes, and changes in physiological functions such as nitrogen fixation and electron transport can also be used as measurements. Effective biomonitoring should emphasize a combined structure/function testing strategy. A holistic evaluation should include the measurements of both biotic and abiotic structural and functional parameters, should include community and higher level biomonitoring tests in testing strategies, and should include comparison studies between microcosms and field systems. A high correlation between microcosm and field responses would allow effluent hazard evaluations to be made with the least amount of risk. (Baker-FRC)
W82-05013

VIRAL POLLUTION DETERMINATION OF SUPERFICIAL WATERS (RIVER WATER AND SEA-WATER) FROM THE URBAN AREA OF BARCELONA (SPAIN),

Barcelona Univ. (Spain). Dept. de Microbiologia.
F. Lucena, C. Finance, J. Jofre, J. Sancho, and L. Schwartzbrod.
Water Research, Vol 16, No 2, p 173-177, February, 1982. 3 Tab, 21 Ref.

Descriptors: *Water quality, *Measuring instruments, Rivers, Marine environment, Bacteria, *Viruses, Public health, Human diseases, *Spain, Municipal wastes, *Surface water.

A survey of virus occurrence was performed using the method of adsorption onto glass powder for concentrating the virus in a variety of aquatic systems located in the metropolitan area of Barcelona, Spain, including two rivers and three beaches. Samples were always collected from a depth of 30 cm. Viruses were recovered from all samples. Values were high and ranged from 18.4 to 55 most probable number of cytopathogenic units (MPNCU)/liter in the samples corresponding to the Besos River and from 0.44 to 44 MPNCU/liter from the Llobregat River. Levels of viruses in the Besos were about 10 times higher than the values from the Llobregat River. corresponding to other parameters of pollution. Viruses were also recovered in all samples from the three marine locations

near the beaches. The viruses spread far from the shore, since the number of viruses recovered from samples taken 2, 5, 20, and 1,000 meters from the outfall did not differ significantly. The percentage of positive assays decreased in June. These findings confirm that current methods for determining the microbial quality of coastal sea-waters used for recreational purposes such as bathing and sailing are inapplicable to viruses. The findings also indicate that the survival time of viruses in sea water is longer than the survival time of bacteria. (Baker-FRC)
W82-05014

GC/MS ANALYSIS OF XAD-2 EXTRACTS OF SUPERCHLORINATED SEPTAGE,

North Texas State Univ., Denton. Dept. of Chemistry.
J. E. Henderson, and W. H. Glaze.
Water Research, Vol 16, No 2, p 211-218, February, 1982. 7 Fig, 2 Tab, 21 Ref.

Descriptors: *Chlorination,*Wastewater treatment, Municipal wastewater, Public health, Chlorinated hydrocarbons, *Organic compounds, *Mass spectrometry.

A new mass spectral search system is presented for the detection of chlorinated and brominated organic compounds formed by the superchlorination of a septage. Samples of raw and superchlorinated septage were used. Many of the halocarbons found in this study are structurally similar and in may cases identical to compounds formed from the chlorination of humic material and surface water organics. Compounds detected through a purge and trap analysis included methylene chloride, acetone, diethylether, acetic acid, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, alpha,alpha,beta-trichloropropionitrile, toluene, chlorobenzene, chlorotoluene, and dichlorobenzene. Compounds determined through microcoulometric analysis of XAD-resin/ether extracts included chloroform, dichlorobenzene, tetrachloroacetone, dichlorobenzene, chlorobutendione-3, dichlorotoluene, and trichlorotoluene. It is suggested that neutral chloro-aromatics result from the decarboxylation of the corresponding aromatic acids that are formed during oxidative cleavage of the humic polymer. Whether chlorination occurs before or after oxidative cleavage of the polymer or both is not clear. Nor is it clear that a radical chlorine intermediate is responsible for the decarboxylation process. It is concluded that the major chlorinated compounds from the chlorination of municipal wastewaters appear to result from chlorination and degradation of humic substances present in the water and bear striking resemblance to products obtained from natural humics and model compounds thought to be constituents of humic and fulvic acid. (Baker-FRC)
W82-05016

MEASUREMENT OF EFFECTS OF CARBARYL IN SURFACE WATER ON FECAL POLLUTION INDICATOR BACTERIA BY USE OF PLATE COUNTS AND RESPIROMETRY,

Texas Univ., Houston. School of Public Health.
U. A. Anugwelem, and R. K. Guthrie.
Water Research, Vol 16, No 2, p 219-221, February, 1982, 2 Fig, 16 Ref.

Descriptors: *Water quality, *Monitoring, Public health, *Carbaryl, Pesticides, Insecticides, Bioindicators, Indicators, *Escherichia coli, Streptococcus faecalis, *Bacteria.

The objectives of the present study were to determine the responses of Escherichia coli and Streptococcus faecalis to the presence of low concentrations of carbaryl, as measured by plate counts; to assess changes in numbers of viable organisms; and by Warburg respirometry, to assess changes in metabolic rates. The results of the study indicate that the presence of carbaryl in surface water would cause a more rapid die-off of these indicator organisms, with S. faecalis dying off more rapidly than E. coli. If this occurred in a polluted water source it could result in false or misleading conclusions, as Geldreich has suggested that the presence of certain fecal streptococci indicates recent fecal pollution of water and other investigators have reported that these organisms survive longer in water than do coliforms. To provide a different measure of the effects of carbaryl on these fecal pollution indicators, oxygen uptake as measured by Warburg respirometry was determined. Oxygen uptake by pure cultures of E. coli in the presence of 1 mg/liter carbaryl was significantly increased as compared to uptake by E. coli controls. Oxygen consumption by pure cultures of S. faecalis was decreased significantly in the presence of both 1 and 5 mg/liter carbaryl. The data indicate the desirability of using more than one method when seeking to determine the effect of chemicals on microorganisms, as the fecal results obtained by the two methods here appeared to be contradictory until the early data from plate counts were considered and the different results in early and late time frames were noted. (Baker FRC)
W82-05019

A SIMPLE AND RAPID METHOD FOR THE DETERMINATION OF LEAD AND CADMIUM IN SEDIMENT BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY,

Central Research Inst. of Electric Power Industry, Tokyo (Japan).
M. Sakata, and O. Shimoda.
Water Research, Vol 16, No 2, p 231-235, February, 1982. 1 Fig, 6 Tab, 10 Ref.

Descriptors: *Sediments, *Pollutant identification, *Cadmium, *Lead, Spectroscopy, *Atomic absorption spectroscopy, Chemical analysis, Sedimentation.

A simple and rapid method is presented for the routine determination of lead and cadmium in sediment using graphite furnace atomic absorption spectrometry. Sample solutions are injected into the graphite furnace by means of an automatic sampling device for the rapid and simple analyses. The automated analysis procedure has better precision than the manually per formed method. Dry sediment is digested for 1 hr at 140 C with a mixture of hydrogen fluoride, nitric acid, and hydrochloric acid in the Teflon-lined bomb. Severe interference was offered by several major elements, including sodium and potassium. However, such disturbances can be overcome by adding to the sample a 1% solution of ammonium phosphate in the same volume as the sample solution for lead and 1% ammonium sulfate for cadmium as matrix modifiers. In thirty-six sediments taken from 13 reservoirs in remoter areas of Japan, the average contents of lead and cadmium were 35 and 0.40 ppm for cadmium on the basis of dry sediment. The proposed method is applicable to the routine determination of a large number of sediments with minimal effort. (Baker-FRC)
W82-05020

BIOLOGICAL MONITORING, PART III.- RECEIVING SYSTEM METHODOLOGY BASED ON COMMUNITY STRUCTURE,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. E. Herricks, and J. Cairns, Jr.
Water Research, Vol 16, No 2, p 141-153, 1982. 2 Fig, 1 Tab, 104 Ref.

Descriptors: *Monitoring, *Reviews, Water quality, *Ecosystems, Aquatic life, Aquatic habitats, Data collections, Data acquisition, Aquatic life, Biological samples, *Pollutant identification.

The use and limitations of data that describe the structure of aquatic communities are discussed, first in terms of data resources and the range of analysis techniques available, then in terms of interpretative methodologies for input to management and protection decisions, including limits that should be placed on data. The analysis of aquatic ecosystem structure requires identification and enumeration of community elements. Procedures which facilitate extraction off information follow classical investigative approaches that require formulation of a hypothesis followed by data collection and analysis to support or nullify the hypothesis. The procedures that employ structural analysis methodologies are based on the theory of species abundance relationships as well as community identification based on indicator, target, or keystone species. Monitoring programs can be categorized as descriptive or analytical. Descriptive approaches include biomonitoring designs which establish baselines, identify trends, and only allow inference of cause-effect relationships. Both descriptive and analytical biomonitoring are dependent on data analysis procedures. Specific sample analysis procedures are dependent on the quality and thoroughness of both the collection procedures and processing and identification of samples . Multiply sample analysis allows comparisons to be made between samples. The capacity to discriminate between samples and the importance of identifying why sample differences occur is the goal of aquatic community biomonitoring. The goal of biomonitoring efforts should be the development of information resources that will allow decision making based on certainty of cause-effect relationships. This can be achieved through a conjunction of descriptive and analytical approaches to community structure biomonitoring. (Baker-FRC)
W82-05023

DETERMINATION OF CADMIUM IN LAKE MICHIGAN BY MASS SPECTROMETRIC ISOTOPE DILUTION ANALYSIS OR ATOMIC ABSORPTION SPECTROMETRY FOLLOWING ELECTRODEPOSITION,

Argonne National Lab., IL.
J. Muhlbaier, C. Stevens, D. Graczyk, and T. Tisue.
Analytical Chemistry, Vol 54, No 3, p 496-499, March, 1982. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Cadmium, *Water analysis, Lakes, *Lake Michigan, Chemical analysis, *Mass spectrometry, Atomic absorption spectrometry, Electrodeposition, Mass spectrometric isotope dilution.

Mass spectrometric isotope dilution analysis was used to assess the efficiency of the electrodeposition and stripping procedure described and to study control of contamination in sampling and handling operations in attempts to determine cadmium concentration levels in Lake Michigan. One of the goals of the study was therefore to evaluate the suitability of electrodeposition for routine use as a means of preconcentrating cadmium prior to atomic absorption analysis. When specific precautions were taken, the electrodeposition-MSID combination proved suitable, yielding a concentrate that is free of significant interferences and giving steady ion currents from samples and blanks containing 25-100 ng total cadmium. In practice, the lower working limit was determined by the blank value rather than by the inherent sensitivity. It is the variability introduced by contamination that appears to control the overall precision. The most persistent and troublesome source of this contamination was cadmium-laden particulate matter in the laboratory and shipboard atmospheres. Use of closed containers and clean air work stations was effective in dealing with these problems. When using MSID, the calculated instrumental limit of detection was less than 0.1 ng, well below the limits imposed by the observed precision and blank values. The overall procedure had a precision of 14% relative standard deviation. Electrothermal atomic absorption spectrometric detection gave a relative precision of 19%. The main cadmium concentration in Lake Michigan water samples collected in 1978 ranged from 31 to 41 ng/liter. (Baker-FRC)
W82-05040

EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF CADMIUM BASED ON THE FORMATION OF A TERNARY COMPLEX WITH CADION AND 1,10-PHENANTHROLINE,

China Univ. of Science and Technology, Hefei. Dept. of Chemistry.
S. Nai-kui, W. Fu-sheng, and Q. Qi-ping.
Analytical Letters, Vol 14, No 19, p 1565-1577, 1981. 5 Fig, 2 Tab, 14 Ref.

Descriptors: *Water analysis, *Cadmium, *Spectrophotometry, Chemical analysis, Measuring instruments, Pollutant identification, *Industrial wastewater, Electroplating.

A method is reported for the determination of cadmium in electroplating wastewater. An aliquot of the cadmium sample (less than 5 micrograms of cadmium) was pipetted into a 60-ml separating funnel, adding 2 ml of 0.2% 1, 10-phenanthroline, and 7 ml of 2N sodium hydroxide, and diluted nearly to 28 ml with distilled water to give approximately a 0.5 N basicity in sodium hydroxide. Then add 0.5 ml of 0.025% ethanolic solution of Cadion and exactly 5 ml of chloroform and shake vigorously for 2 minutes. Allow the phases to separate and then drain off the chloroform layer into a dry small test tube, and measure the absorbance in a 1-cm cell at 490 nm against reagent blank. (Baker-FRC)
W82-05041

PROBLEMS OF THE DETECTION OF ORGANIC TRACE SUBSTANCES IN WATER (ZU PROBLEMEN DES NACHWEISES ORGANISCHER SPURENSTOFFE IM WASSER),

R. Koch.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 3-17, 1980. 1 Fig, 6 Tab, 73 Ref. (No English Summary).

Descriptors: *Chemical analysis, *Water quality, *Organic compounds, Gas chromatography, Thin layer chromatography, Sample preparation, Data acquistion, Experimental design, Screening, *Toxins, Trace levels.

The possible methods for detection of individual toxicologically relevant water contaminants are reviewed. Prerequisites for performance of analytical screening are outlined. Methods of test substance enrichment, separation of mixtures, and detection and identification of individual compounds are discussed, along with questions of the systematization and standardization of test methods and data acquisition. The importance of the sampling procedure employed should not be underestimated. The principal enrichment techniques performed today are adsorption and liquid/liquid extraction. Gas chromatography (GLC) and thin-layer chromatography (TIC) are the most common methods for separation and identification of individual substances. Results obtained by TLC are often confirmed by IR, UV or fluorescence spectrometry, and GLC results by mass spectrometry. A great variety of solvent systems are available for TLC separation of various groups of substances, and group regents serve for detection of specific substance groups. Screening of water samples for unknown contaminants, followed by specific confirmatory techniques, is now possible. Analysis of all compounds present is not necessary for water quality or public health purposes; a selection must be made based on the toxicologic significance, ecological fate, productin quantities, and application areas of the compounds. (Carroll-FRC)
W82-05093

DETERMINATION OF ARSENIC AND ANTIMONY IN WATER AND SOIL BY HYDRIDE GENERATION AND ATOMIC ABSORPTION SPECTROSCOPY,

Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
J. A. Haring, W. Van Delft, and C. M. Bom.
Fresenius' Zeitschrift fuer Analytische Chemie, Vol 310, No 3/4, p 217-223, 1982. 6 Fig, 6 Tab, 9 Ref.

Descriptors: *Metals, *Water analysis, Atomic absorption spectroscopy, *Arsenic, *Antimony, Water quality, Soils, *Pollutant identification, Colorimetry.

This report describes the optimization of analytical parameters such as temperature of the quartz cell, pH of the sample and the effect of the valence of the elements in the sample on the rate of metal-hydride formation, as related to the determination of arsenic and antimony in water and soil. Descriptions are also offered of the graphite furnace technique and a colorimetric method. During the intercomparison experiments, the importance of adding potassium iodide before the addition of sodium borohydride reagent to the sample was clearly demonstrated. Compared with the colorimetric technique, the atomic absorption hydride technique with the heated quartz cell was found to suffer from interferences by other hydride forming elements. Slow addition of NaBH4 (over 5 minutes in case of the colorimetric method) resulted in a longer reaction time, giving a complete transformation of the hydride forming elements. The optimization of various analytical parameters with respect to the hydride technique is discussed. (Baker-FRC)
W82-05141

FINGERPRINTING INORGANIC ARSENIC AND ORGANOARSENIC COMPOUNDS IN THE SITU OIL SHALE RETORT AND PROCESS WATERS USING A LIQUID CHROMATOGRAPH COUPLED WITH AN ATOMIC ABSORPTION SPECTROMETER AS A DETECTOR,

California Univ., Berkeley. Lawrence Berkeley Lab.
R. H. Fish, F. E. Brinckman, and K. L. Jewett.
Environmental Science and Technology, Vol 16, No 3, p 174-179, March, 1982. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Oil shale, *Arsenic, *Industrial wastes, Chemical analysis, Public health, Environmental effects, Hazardous wastes, Toxicity, Path of pollutants, *Toxins, *Pollutant identification.

Inorganic arsenic and organoarsenic compounds were speciated in seven oil shale retort and process waters, including samples from simulated, true, and modified in situ processes, by using a high performance liquid chromatograph automatically coupled to a graphite furnace atomic absorption detector. Molecular forms of arsenic were identified in these waters for the first time at ppm levels and shown to include arsenate, methylarsonic acid, and phenylarsonic acid. The significant environmental finding is that these potentially toxic inorganic arsenic and organo-arsenic compounds in varied mixtures at appreciable concentrations are either released or synthesized during oil shale retorting processes representing present day technology. The possibility of their bioaccumulation in soils, water and edible biota at appreciable distances from the retorting site via disposal of retort leachate waters containing bioactive forms may represent potential health hazards for humans as well as a threat to aquatic species. (Baker-FRC)
W82-05151

BIOLOGICAL MONITORING OF HAZARDOUS WASTES IN AQUATIC SYSTEMS,

Environmental Monitoring Systems Lab. Las Vegas, NV.
V. W. Lambou, and L. R. Williams.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 11-18.

Descriptors: *Bioassay, *Monitoring, *Aquatic environment, Aquatic life, Water pollution, Pollutants, Environmental effects, Bioaccumulation, *Hazardous materials, Population density, Species composition, Wastes, Biological samples.

Biological monitoring has had a relatively weak supportive role in monitoring programs of the past; however, it is rapidly attaining the recognition it warrants in a systems approach to monitoring. Physical and chemical testing cannot predict the cumulative impacts and/or the interactions of mixed pollution sources on environmental health. Biological monitoring is well-suited for this as the biota in aquatic systems responds to the sum of the interactions of environmental factors and integrates their effects over time. Approaches to biomonitoring include in-situ bioassays, bioaccumulation, use of indicator organisms, community and population changes, and species health. For selection of appropriate biomonitoring techniques, the monitoring requirements of a specific program should be clearly determined; the selection criteria provided should be reviewed and prioritized relative to those monitoring requirements identified; and the selection criteria should be rigorously applied in determining those tests or measurements needed to meet program objectives. Biological monitoring methods which are sensitive, simple to apply, reproducible, and economical in their application, and which provide answers to vital environmental questions in realistic time frames, are already in use and will have increasing application in the future. (Brambley-SRC)
W82-05154

ENZYMES AND OTHER BIOCHEMICAL INDICATORS OF TOXICANT EFFECTS IN FISHES,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
For primary bibliographic entry see Field 5C.
W82-05155

OVERVIEW AND ASSESSMENT OF BIOLOGICAL SENSING,

Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5C.
W82-05156

NEW IN-SITU TECHNIQUES IN BIOMONITORING,

BioControl Co., Inc., Port Sanilac, MI.
H. E. Schlichting, Jr.
In: 2nd Interagency Workshop on In-Situ Water Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 55-58, 1 Tab, 7 Ref.

Descriptors: *Biomonitoring, *Bioindicators, *Water quality, *Aquatic life, Chemical properties, Physical properties, Water pollution, Algal growth, Biomass, Species diversity, Morphology, Prediction.

Continuous in-situ biological monitoring systems continually assess the responses of selected indicator organisms to the changes occurring in the water chemistry and physical parameters. Successful prediction of water quality changes depends upon the selection of indicator organisms, membrane filter selectivity, and the measurement of pertinent physical and chemical data at the test sites. Measurements of biomass increase, organism health, species diversity, and morphological and physiological changes can be used to estimate the degree of eutrophication or the presence of toxic pollutants. Algal growth potential when determined for a period of a year, can be used in predicting future water quality changes. The importance of recording the physical and chemical parameters, including light, is noted. Biomonitors can be used in other studies including measurement of radionuclide bioconcentration, degree of toxicity of sewage effluent, heavy metals, pesticides, growth regulators and fertilizers in selected organisms in strip mine ponds, lakes, and rivers. (Brambley-SRC)
W82-05157

COMPUTER INTERFACED SYSTEMS FOR BIOLOGICAL MONITORING OF WATER QUALITY,

Virginia Polytecnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, Jr.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 81-101, 15 Fig, 19 Ref.

Descriptors: *Monitoring, *Bioindicators, *Automation, *Water analysis, *Water pollution, Computers, Chemical properties, Physical properties, Fish behavior, Water quality control, Effluents, Cost analysis, Aquatic life.

It is necessary to couple biological with chemical and physical data for effective environmental protection and quality control. Continuous biological monitoring is not routine because of the cost and time required for examination of the biological material. Progress in automation of biological mon-

itoring has led to an early warning system, automated identification, automation of behavior analysis, and simulation of variable effluent discharges. The automated early warning system monitors fish movement and breathing during continual exposure to a diluted waste stream. A distress response is used to trigger an alert so that remedial action can be taken. The automated identification unit is a pattern recognition system using species such as diatoms. Sample counts are made, and on the basis of species diversity and numbers an evaluation of pollution level may be made. Automated behavior analysis has been used to obtain preliminary estimates of preference, avoidance, and induction of aberrant behavior in fish exposed to pollutants. A unit has been designed to monitor fish ventilation in response to variable effluent discharges such as are likely to occur in streams. More work is required before it can be used as a routine monitor. Automated monitoring can be cost effective and provides improved data analysis, storage and retrieval capabilities. (Brambley-SRC)
W82-05158

METABOLIC RESPONSE OF FISH TO STRESS,

Texas Univ. at Austin, Port Aransas. Marine Science Inst.
For primary bibliographic entry see Field 5C.
W82-05159

ENZYMES AND ANTIBODIES AS SENSORS OF TOXIC SUBSTANCES,

Midwest Research Inst., Kansas City, MO.
D. R. Sellers.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 143-160, 6 Fig, 2 Tab.

Descriptors: *Enzymes, *Water pollution, *Pesticides, *Biodetection, *Antibodies, Electronic equipment, Monitoring, Bioindicators, Air pollution, Effluents, Industrial wastewater, Soil contamination, Phenols, Metals, Phthalates, *Toxins.

Biodetection is the name given to the use of a combination of electronics and material from living tissue for the estimation of compounds in nature. The biological part, either an enzyme or an antibody, provides rapid sensitivity and specificity while the electronics portion magnifies the signal into readout formats. Most work has been done using cholinesterase, in part because it is sensitive to organophosphate and carbamate pesticides. The enzyme can be immobilized for detection of pesticides in water or impregnated in a base for detecting pesticide vapors. Both applications are in commercial use, monitoring wastewater effluent from a pesticide plant, and monitoring the air within the plant, respectively. A soil analysis technique has also been developed. Fifty-two enzymes have been identified which are inhibited by one or more compound on the EPA's priority pollutant list in the groups pesticides, phenols, metals, and phthalates, so that there are good prospects of incorporating them in biodectection equipment for continuous monitoring. An antibody-based biodetection system has been developed to detect 2,4-dinitrophenol. It uses a coupled enzyme system to amplify the signal and provide a display related to the amount of antigen present. (Brambley-SRC)
W82-05160

BIOPROBES FOR THE MONITORING OF TOXIC COMPOUNDS AND HAZARDOUS MATERIALS IN WATER,

New Orleans Univ., LA. Dept. of Chemistry.
S. S. Kuan, and G. G. Guilbault.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 161-165, 12 Ref.

Descriptors: *Monitoring, *Bioindicators, *Enzymes, *Water pollution, *Hazardous materials, Electronic equipment, Nitrate, Nitrite, Cyanide, Carbamate pesticides, Electrodes, Decontamination.

Bioprobes and analytical systems for fast, simple accurate, selective, and sensitive assay have been developed for a number of compounds, including the water pollutants nitrate and nitrite, cyanide, and carbamate pesticides. The nitrate/nitrite bioprobe depends on the successive reduction of nitrate to nitrite by nitrate reductase, and nitrite to ammonia by nitrite reductase, and the measurement of ammonia by an ammonium ion selective electrode. The ammonium ion electrodes used include nonactin membrane electrodes, air gap electrodes, or gas selective membrane electrodes. The systems may use either soluble or immobilized enzymes. Biological detection and decontamination systems have been developed for cyanide using the enzymes rhodanese and beta-cyanoalanine synthase, and cyanide and sulfide electrodes. Both soluble and immobilized enzymes have been used in either batch or flow systems. An aryl acylamidase enzyme extracted from Pseudomonas striata has been found to be able to hydrolyze phenyl or methyl carbamate pesticides, with methylamine detection by an air gap electrode. (Brambley-SRC)
W82-05161

UTILITY OF THE MICROTOX LUMINESCENT BACTERIAL ASSAY FOR THE RAPID ASSESSMENT OF AQUATIC POLLUTION,

Beckman Instruments, Inc., Carlsbad, CA.
A. A. Bulich.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 173-184, 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Bioassay, *Bacterial physiology, *Luminescence, *Water pollution, *Testing procedures, Toxicity, Pollutants, Effluents, Monitoring, Metals, Phenols, Alcohols, Pesticides, Aromatic compounds.

The Microtox Toxicity Analyzer is a bioassay system using luminescent bacteria which has potential as a rapid, reliable, and inexpensive method for assessing the toxicity of water samples. The system is used to determine the concentration of chemical which produces a 50% reduction in light emission for 5 min (EC50). EC50's were obtained for 20 substances, including metals, phenols, alchols, pesticides, and aromatic hydrocarbons, and these figures were compared with 24-96 h fish toxicity bioassays. A good correlation was observed between fish toxicity and luminescence reduction. Similar correlations were observed when complex effluents were used rather than pure compounds. An improved testing procedure allows a determination of EC50 to be completed in 30 min. The Microtox system appears to be a convenient reliable approach for the rapid determination of acute toxicity of water samples. (Brambley-SRC)
W82-05162

THE USE OF ALGAE AS BIOLOGICAL ACCUMULATORS FOR MONITORING AQUATIC POLLUTANTS,

Academy of Natural Sciences of Philadelphia, PA. Div. of Limnology and Ecology.
S. L. Friant, and J. W. Sherman.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 185-206, 8 Fig, 3 Tab, 52 Ref.

Descriptors: *Algae, *Bioaccumulation, *Monitoring, *Water pollution, *Bioindicators, Metals, Water chemistry, Organic compounds, Water pollution source, Nonpoint pollution sources, Diatoms.

An overview is presented of possible biomonitoring uses of algae as aquatic pollutant bioaccumulators. While metals and other pollutants found in animal tissues may originate in the water column, this is the only source of the substances for algae. The uptake of metals by algae is, however, affected by pH, ligands, competition of metals, and the natural background matrix. These influences must be investigated before algae can be used for long-term monitoring. Algae (primarily diatoms) colonizing artificial substrates have been analyzed for metal uptake over long periods, in some cases up to 20 years. The colonizing period has been two weeks, after which the algae are removed from the slide and subjected to extraction procedures followed by chromatographic analysis. This method has been used to survey rivers for trace metals and trace organics. The results show that the method may be used to assess point source discharges of biologically available pollutants, and the effects of dilution and to identify chemical sinks in flowing systems, and to characterize pollutants resulting from both point and non-point sources present over wide areas. (Brambley-SRC)
W82-05163

DIRECT ANALYTICAL METHOD FOR AROMATIC COMPOUNDS IN WATER BY STEAM CARRIER GAS CHROMATOGRAPHY,

Yokohama National Univ. (Japan). Dept. of Safety and Environmental Engineering.
K. Urano, H. Maeda, K. Ogura, and H. Wada.
Water Research, Vol 16, No 3, p 323-327, March, 1982. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Water quality, *Water analysis, Chromatography, Measuring instruments, *Gas chromatogrphy, *Aromatic compounds, Hydrocarbons, Chemical analysis, Wastewater treatment, Industrial wastewater.

Steam carrier gas chromatography was used to determine the presence of various aromatic compounds in water. A hydrogen flame ionization detector was used with acid washed Chromosorb P modified with 3.5 wt% phosphoric acid as a stationary solid-in-glass column. The aqueous solutions of typical aromatic compounds including mono- and di-substituted, benzenes, naphthalene and naphthol, and wastewater from an oil refinery and its treated water were used as samples in this study. The results indicated that various aliphatic and aromatic compounds in water could be directly analyzed by the SCGC method. Water samples from the oil refinery were analyzed after only filtration with 0.45 micrometer membrane. There were six or more compounds in the raw wastewater, and several compounds remained in the water after treatment. The compounds in the wastewater included methyl alcohol, ethyl alcohol, phenol, o-, m-, and p-cresols, and one unknown, which was characterized as a polar low molecular weight aliphatic compound. The wastewater treatment system being used at the refinery was effective only in removing the phenol and cresols. Thus SCGC is a useful technique for evaluating water quality and water treatment processes. (Baker-FRC)
W82-05164

EVALUATION OF METHODS FOR THE ASSAY OF RADIUM-228 IN WATER,

National Bureau of Standards, Washington, DC. National Measurement Lab.
J. R. Noyce.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-178162, Price codes: A02 in paper copy, A01 in microfiche. NBS Technical Note 1137, February 1981. 18 p, 1 Tab, 38 Ref.

Descriptors: *Radium radioisotopes, *Water analysis, *Drinking water, *Radiochemical analysis, Chemical analysis, Assay, Water quality, Water pollution.

Radium-228 is ingested primarily by the drinking of water, and it is hazardous to human health. It has been found to occur in higher concentrations than radium-226 in water in contact with some geological formations. Radium-228 is difficult to assay accurately, especially at low concentrations, because it emits only very low-energy conversion electrons and low-energy beta particles. The technical literature from 1967 to May 1980 was searched for methods for assaying radium-228 in water, and these methods were evaluated for suitability as potential EPA reference methods for drinking water assays. Most of the assay methods were eliminated from consideration by applying

the following criteria: adequate sensitivity, yield determination without radioactive tracers, and a waiting time for ingrowth or decay of radionuclides in the sample of no more than 30 days. It is suggested that the EPA retain the present reference method (Krieger, 1976) but improve its decontamination factor for Y-90 and correct its chemical yield calculation. The McCurdy and Mellor (1979) method should be added as a second reference method. The two procedures complement each other. (Moore-SRC)
W82-05212

DYNAMICS OF THE NUMBER OF BACTERIA AND CONVERSION OF READILY OXIDIZABLE SUBSTANCES IN SMALL RIVERS,

Tallin Polytechnic Inst. (USSR).
A. E. Saava.
Water Resources, Vol 8, No 2, p 195-201, March-April, 1981. 3 Fig, 2 Tab, 12 Ref. Translated from Vodnye Resursy, No 2, p 144-150, March-April, 1981.

Descriptors: *Bacteria, *Indicators, *Self-purification, *Wastewater pollution, *Estonia, Streams, Biological oxygen demand, Bioindicators, Coliforms, Enteric bacteria, Temperature effects, Water temperature, Saprophytic bacteria, Water quality, Fate of pollutants.

Bacterial indicators in wastewater pollution (saprophytes, coliforms, and enterococci) were determined upstream and downstream of wastewater outfalls in small (discharge < 30 cu m per sec) unpolluted Estonian streams. Samples were also collected in winter and summer to study temperature dependence. Relationships between saprophytes, coliforms, and enterococci were found at upstream sites. In winter saprophyte numbers were positively correlated with BOD and with ammonia and nitrite concentrations. Coli index and enterococci numbers were negatively correlated with water temperature, indicating longer survival of bacteria at lower temperatures. In summer the bacterial indicators did not correlate among themselves or with chemical water quality parameters. At downstream sites in winter there were more saprophytes and enterococci than in summer. This was caused by slow dieoff of bacteria at low temperatures. There was a positive correlation between the three bacterial indicators, BOD, and chloride levels. In summer downstream samples, bacterial indicators were postively correlated with the ammonia levels and negatively correlated with dissolved oxygen. A study of bacterial population dynamics in the self-purification process showed that enterococci and E. coli 015 did not multiply in river water at temperatures of 0 to 20 C. Other E. coli strains grew rapidly at higher water temperatures, 10 to 50 C. In summer more than 95% of bacteria died within the first 12-15 hours, and microbial self-purification was completed in about 24 hours. In winter only 70% of bacterial died within the first 12 hours and 95% by the end of the second day. Equations are given, relating the coefficient of death rate of bacteria to temperature or current velocity. (Cassar-FRC)
W82-05237

CHARACTERIZATION OF INDUSTRIAL WASTES BY EVALUATING BOD, COD, AND TOC,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
D. R. Hill, and S. J. Spiegel.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2704-2708, November, 1980. 1 Fig, 4 Tab, 5 Ref.

Descriptors: *Industrial wastes, *Oxygen demand, Mathematical studies, Biochemical oxygen demand, Chemical oxygen demand, Water analysis, Oxygen, Wastewater treatment, Wastewater, Evaluation, *Onondaga, *New York.

Substantial cost and manpower could be saved if any of the three parameters BOD, TOC and COD could be accurately estimated by calculation from the analytical value of one of the others. An examination was undertaken to discern any consistent relationships between these parameters as part of an intensive industrial waste survey in Onondaga County, New York. Data for the study were generated from samples collected from 1973 through mid-1977. About 95% of the samples collected were composites over the production periods of each industry. Relationships were sought between BOD, COD, and TOC using a measurably larger data file, in some industrial waste categories, than had been reported in earlier literature. In these high-data Standard Industrial Classification (SIC) categories, the correlations were sometimes found to be within the 99% significance level, thus permitting extrapolations from only one observed value and reducing the need for and cost of continued testing. (Baker-FRC)
W82-05255

SAMPLING AND ANALYZING WATER,

J. Lehr, T. Gass, W. Pettyjohn, and J. DeMarre.
Water Well Journal, Vol 36, No 2, p 46-51, February, 1982. 1 Tab, 3 Ref.

Descriptors: *Water analysis, *Sampling, Sample preparation, Water quality, Chemical analysis, Public health, Bacteria, *Water supply, Drinking water, *Domestic water.

The process of sampling and analysis of domestic water supplies not only evaluates the cause of a particular problem but also determines the kind of treatment and the size of the equipment needed to provide clear, safe, palatable water in desired quantities. Sampling and analysis of water may also become in some localities a prerequisite for meeting local laws concerning water. A sanitary survey locates potential sources of water quality degradation in and around the point of water withdrawal and determines whether special chemical or biological tests are needed to identify potential sources of pollution. To many homeowners, the most important consideration about any water supply is its freedom from disease-producing organisms. Water must be sampled periodically and be analyzed for bacterial contamination. Various chemical elements and compounds may also be present in groundwater. The sources of these chemicals are associated with either natural processes or human activities. To obtain an adequate sample of water for either biological or mineral analysis, the objectives of the sampling must first be established. Once the purpose is established, the sample taken must accurately represent the quality of the water source. Methods for collecting, preserving, packaging, identifying, and shipping sample bottles and containers for bacteriological analysis are highlighted. (Baker-FRC)
W82-05263

SAMPLING FREQUENCY OPTIMIZATION USING A WATER QUALITY INDEX,

Oregon State Dept. of Environmental Quality, Salem.
D. A. Dunnette.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2807-2811, November, 1980. 5 Tab, 7 Ref.

Descriptors: *Water quality, *Evaluation, *Monitoring, Sampling, Mathematical equations, Water pollution control, Water analysis.

This work describes a water quality index and how it can be used in a very simple way to evaluate and upgrade present monitoring programs. While a complete and thorough theoretical statistical evaluation of an ambient water quality monitoring network is often beyond the resource capability of a state water quality control agency, use of two assumptions can simplify the statistical processes greatly. These two assumptions are: that future water quality statistical data will correlate fairly well with present data, and that data obtained in the water quality monitoring program are normally distributed, i.e., the data describes the classical bell curve. A study was made of the distribution of Oregon Water Quality Index values over a 6 year period, 1972-1977. The simplification suggested in this paper was justified, particularly when the sampling frequency evaluation is considered an interim step prior to a more rigorous evaluation. The simplified approaches to sampling frequency determination indicate a range of between 25 samples per year for a lower water quality station and 6 per year for a higher water quality station, assuming 95% confidence and 5% allowable error. It is emphasized that these sampling frequences are based on observed variability in the OWQI and indicate the number of samples required to meet the confidence and error limits imposed. (Baker-FRC)
W82-05268

METAL CONCENTRATIONS IN GUAM URBAN RUNOFF,

Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5B.
W82-05302

WATER QUALITY ASSESSMENT FOR AGANA SPRINGS,

Guam Univ., Agana. Water and Energy Research Inst.
T. L. Smalley, and W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224791, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 22, April 1981. 34p, 12 Fig, 4 Tab, 19 Ref, 3 Append. OWRT A-015-GUAM, 14-34-001-0112.

Descriptors: *Water quality, *Municipal wastes, *Water analysis, *Water resources development, *Guam, Water quality standards, Bacterial analysis, Chemical analysis, Wells, Groundwater availability, Groundwater contamination, Resources development, Water supply development, Evaluation, Drinking water, Potable water, Water distribution, Environmental protection, Environmental quality, Environmental policy.

This water quality study assessed the potential of Agana Springs for possible development as a municipal water source. The results indicated that water quality was sufficiently high to merit development of Agana Springs as a freshwater resource. The chemical and physical quality of the water within the impoundment was found to be high relative to the Guam EPA standards for drinking water and standing waters used for drinking water. The observed quality was also higher than many wells and surface water sources currently used by the Guam water distribution system. The observed light-to-moderate bacterial contamination (thought to be due to surface runoff and animal activities and not to contaminated groundwater) could be controlled by chlorination. The results of thirteen chemical and bacterial parameters analyzed over a five-month study are reported and discussed. It is recommended that Guam's government should attempt to obtain the Agana Springs resource for development if the Navy does not plan to develop it for its own needs. Tapping this resource would augment the northern well field with a volume equal to or greater than 4-6 high-production groundwater wells. (Zielinski-MAXIMA)
W82-05304

AUTOMATED BIOMONITORING APPLICATIONS IN REMOTE WATER QUALITY SURVEILLANCE AND TIME RATED TOXICOLOGICAL ASSAY,

Tennessee Technological Univ., Cookeville. Dept. of Biology.
For primary bibliographic entry see Field 7B.
W82-05305

BIOLOGICAL MONITORING, PART IV - TOXICITY TESTING,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-05339

BIOLOGICAL MONITORING, PART V - PREFERENCE AND AVOIDANCE STUDIES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-05340

FLUORESCENCE CELL DESIGN AND USE TO DETERMINE CRUDE OIL IN WATER,

Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Chemistry.
P. John, E. R. McQuat, and I. Soutar.
Analyst, Vol 107, No 1271, p 221-223, February, 1982. 2 Fig, 2 Ref.

Descriptors: *Fluorescence, *Oil, Crude oil, Water analysis, *Pollutant identification, Technology.

A commercial fluorescene cell was modified for use in measuring fluorescence emission from water-dispersed crude oil. A 1 cm path length quartz fluorescence cell was altered to accommodate two concentric inlet tubes and a co-linear exit tube. Maximum flow rates for this cell were 160 cu cm per sec for the sample flow and 504 cu cm per sec for the outer concentric flow. The upper flow guides were adjustable in the vertical direction, allowing establishment of laminar flow after the flow guide was lowered until coincident with the fixed exit tube. They prevented contamination of the optical surfaces. In sufficiently dilute solutions, fluorescence emission intensity for oils of differing characteristics was linearly related to the concentration in non-quenching organic solvents. This relationship was also valid for three crude oils in water, tested at concentrations up to 10 microliters per liter. (Cassar-FRC)
W82-05358

DETERMINATION OF ULTRATRACE LEVELS OF FLUORINE IN WATER AND URINE SAMPLES BY A GAS CHROMATOGRAPHIC/ATMOSPHERIC PRESSURE HELIUM MICROWAVE INDUCED PLASMA EMISSION SPECTROMETRIC SYSTEM,

Tokyo Univ. (Japan). Dept. of Chemistry.
K. Chiba, K. Yoshida, K. Tanabe, M. Ozaki, and H. Haraguchi.
Analytical Chemistry, Vol 54, No 4, p 761-764, April, 1982. 3 Fig, 4 Tab, 27 Ref.

Descriptors: *Fluorides, *Pollutant identification, Trace levels, Seawater, *Gas chromatography, Fluorine, Water analysis.

Fluoride was determined in seawater, tap water, and pond water at concentrations as low as 0.2 micrograms per ml. After extraction with trimethylchlorosilane and conversion to trimethylfluorosilane, the sample was injected into a gas chromatograph and detected by atmospheric pressure helium microwave induced plasma (MIP) emission spectrometry. The emission line of fluorine at 685.6 nm was used for detection. Results from the fluoride ion selective electrode method were comparable with those from the MIP method. Interferences of other ions were studied in samples containing 1 microgram F per ml. Aluminum at 100 micrograms per ml interfered, but the major and minor species found in seawater did not interfere at levels normally present in seawater. (Cassar-FRC)
W82-05359

SAMPLE DIGESTION PROCEDURES FOR SIMULTANEOUS DETERMINATION OF ARSENIC, ANTIMONY, AND SELENIUM BY INDUCTIVELY COUPLED ARGON PLASMA EMISSION SPECTROMETRY WITH HYDRIDE GENERATION,

National Enforcement Investigations Center, Denver, CO.
D. D. Nygaard, and J. H. Lowry.
Analytical Chemistry, Vol 54, No 4, p 803-807, April, 1982. 2 Fig, 8 Tab, 11 Ref.

Descriptors: Metals, *Wastewater analysis, Sample preparation, *Pollutant identification, *Arsenic, *Antimony, *Selenium, Spectrometry.

Persulfate digestion in acid solution followed by heating at 95C in 6M HC1 was the best of five sample digestion techniques to prepare water samples for simultaneous determination of arsenic, antimony, and selenium at the microgram per liter level by hydride generation and plasma emission detection. Other, less effective, digestion procedures were nitric acid/sulfuric acid, hydrogen peroxide/sulfuric acid, hydrogen peroxide/nitric acid, and nitric acid. Test samples contained dissolved inorganic, dissolved organic, and suspended particulates. Modifications to the hydride generation apparatus allowed simultaneous generation and detection of the hydrides. Spiked and unspiked wastewater effluent samples from a variety of industrial sources and a sewage plant were analyzed for As, Sb, and Se by the method described in this paper and by the graphite furnace atomic absorption. Results from the two methods were comparable. (Cassar-FRC)
W82-05360

DETERMINATION OF METALS IN GROUNDWATERS BY TRACE ENRICHMENT AND LIQUID CHROMATOGRAPHY,

Atomic Energy of Canada Ltd., Chalk River (Ontario).
R. M. Cassidy, S. Elchuk, and J. O. McHugh.
Analytical Chemistry, Vol 54, No 4, p 727-731, April, 1982. 1 Fig, 5 Tab, 14 Ref.

Descriptors: Trace metals, *Metals, Heavy metals, *Pollutant identification, *Path of pollutants, Chromatography, *Groundwater pollution, Water analysis, *Landfills, Cobalt, Leachates.

Trace enrichment and liquid chromatography were used to detect metal ions in groundwater at the ng or pg per ml levels. Samples of groundwater collected in and near a waste management site were enriched using an in-line cartridge containing a strong acid cation exchanger. The enriched solution was then placed in a conventional high performance liquid chromatograph gradient pumping system with variable wave-length detector. Several sample treatments were evaluated. Fuming with nitric acid and ashing were not reliable methods of releasing bound metal ions. Citrate and nitric acid equilibrations did not give quantitative recovery for total metal ion determination. Sample treatment with Co60 irradiation was the best sample treatment in this study; relative standard deviation values for the metals (Co, Ni, Cu, Zn, Pb, Mg) tested with this treatment were 2-10%. (Cassar-FRC)
W82-05361

TRACE ENRICHMENT OF DIFENZOQUAT IN WATER AND ITS DETERMINATION BY REVERSED PHASE HIGH PERFORMANCE LIQUID CHROMATOGRAPHY,

Alberta Environmental Center, Vegreville.
I. Ahmad.
Analytical Letters, Vol 15, No 1, p 27-37, 1982. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Herbicides, *Chromatography, *Pollutant identification, Difenzoquat, Water analysis.

A simple, reliable, and quick method for the determination of the herbicide difenzoquat (1,2-dimethyl-3,5-diphenyl-1H-pyrazolium methyl sulfate) in water samples used the reverse phase ion pair chromatographic technique. Enrichment was accomplished with a C18 SEP-PAK reverse phase cartridge, using potassium dihydrogen orthophosphate dissolved in acrylonitrile/water (50:50 by volume) as an eluant reagent. Samples were injected into the high performance liquid chromatograph with no further treatment. Ultraviolet detection was performed at 255 nm. Recoveries of the spiked samples were 88-98%. The practical lower detection limit is 2 ppb. (Cassar-FRC)
W82-05362

GAS-LIQUID CHROMATOGRAPHIC DETERMINATION OF SOME CHLORO- AND NITROPHENOLS BY DIRECT ACETYLATION IN AQUEOUS SOLUTION,

Clemson Univ., SC.
J. Mathew, and A. W. Elzerman.
Analytical Letters, Vol 14, No 16, p 1351-1361, 1981. 2 Fig, 3 Tab, 19 Ref.

Descriptors: *Nitrophenols, *Chlorophenols, *Phenols, *Pollutant identification, Water analysis, Gas liquid chromatography, Acetylation.

Trace levels of chloro- and nitrophenols in water were determined by gas liquid chromatography after direct acetylation. The derivatives were formed by adding 10 g NaHC03 to 250 ml of aqueous solution of phenol compound followed by addition of 1 ml acetic anhydride. After 2 min the derivatives were extracted twice with 10 ml methylene chloride. The extract was concentrated by a nitrogen stream for injection into the gas chromatograph. Recoveries of phenol acetates at a level of 0.8 to 40 ppb ranged from 90 to 120%. Compounds used in the study were 2,4-dichlorophenol, 2,4,6-trichlorophenol, 2-nitrophenol, 4-nitrophenol, pentachlorophenol, and 2-sec-butyl-4,6-dinitrophenol. (Cassar-FRC)
W82-05363

OVERESTIMATION OF ORTHOPHOSPHORUS CONCENTRATIONS IN SURFACE WATERS OF SOUTHERN LAKE MICHIGAN: EFFECTS OF ACID AND AMMONIUM MOLYBDATE,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, S. M. Bigelow, and C. Rubitschun.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 2, p 296-304, February, 1982. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Phosphorus, Lakes, *Fate of pollutants, *Separation techniques, Phosphates, Phosphorus compounds, Water pollution sources, Molybdenum, Pollutant identification, Nutrients, *Filtration, Organic matter, Inorganic compounds, Water analysis, *Lake Michigan.

Molybdenum blue methods are thought to overestimate orthophosphorus (P04-P) levels in filtered lake water because P04-P is released from bound sources by hydrolysis. Water samples from southern Lake Michigan were analyzed to assess the accuracy of the molybdenum blue technique and to evaluate the potential effects of ammonium molybdate on soluble reactive phosphorus (SRP) determinations. Time-course hydrolysis tests showed that sizeable quantities of P04-P were released from bound sources into solution immediately after the addition of acid molybdate. Molybdate-reactive P04-P could be retained by filters or released from particulate matter into filtrates during filtration. Using the recommended exposure time of 30 sec, P04-P levels were overestimated minimally by up to 86% and ammonium molybdate increased P04-P release in filtered samples. Other tests employing up to a fourfold range in ammonium molybdate concentrations indicated that Harvey's method and the extraction procedure gave SRP values that varied two- to three-fold or more, with most of the P04-P release originating from particles in filtrates. While the chemical composition of the SRP pool in lake water is not well known, potential sources of particulate P04-P in Lake Michigan filtrates could include large organic molecules or their fragments, colloidal inorganic-organic complexes, or capsular or fibrillar material produced by microorganisms. (Geiger-FRC)
W82-05382

VARIATION IN FECAL POLLUTION INDICATORS THROUGH TIDAL CYCLES IN THE FRASER RIVER ESTUARY,

Department of the Environment, Vancouver (British Columbia). Inland Water Directorate (Pacific Region).
L. M. Churchland, G. Kan, and A. Ages.
Canadian Journal of Microbiology, Vol 28, No 2, p 239-247, February, 1982. 7 Fig, 15 Ref.

Descriptors: *Tidal rivers, *Variability, *Indicators, Fate of pollutants, *Fraser River, Estuaries, Sampling, Feces, *Coliforms, Bacteria, Shellfish farming, Coprostanol, Sterols, *British Columbia, Canada.

Four sites in the Fraser River estuary were sampled over a 24 hour period and the water analyzed for fecal pollution indicators. Maximum concentrations of fecal sterols and coliforms occurred after high tide at the station upstream of major sewage

outfalls and on the ebb or low tide at stations downstream of the sewage outfalls. Fecal coliform counts were highly correlated with coprostanol and cholesterol levels at sites near sewage plants. In summer fecal coliform counts, but not sterol concentrations, were reduced by chlorination of sewage plant effluent. Fecal sterols may serve as useful indicators of sewage pollution, especially in shellfish harvesting waters and where bacterial determinations require concentration of large volumes of water. Monitoring of fecal pollution in these waters should be done randomly and frequently enough so that the tidal variations are included. (Cassar-FRC)
W82-05384

THE DETERMINATION OF HEAVY METALS (AL, MN, FE, NI, CU, ZN, CD, AND PB) IN URBAN SNOW USING AN ATOMIC ABSORPTION GRAPHITE FURNACE,

Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
S. Landsberger, R. E. Jervis, S. Aufreiter, and J. C. Van Loon.
Chemosphere, Vol 11, No 3, p 237-247, 1982. 1 Fig, 2 Tab, 31 Ref.

Descriptors: *Metals, *Snow, *Urban areas, *Pollution identification, Heavy metals, *Montreal, Quebec, Water pollution sources, Air pollution, Canada.

Snow from the island of Montreal, Quebec, contained the following average quantities of trace metals (in nanograms per g): Al, 69; Mn, 11; Fe, 40; Ni, 43; Cu, 28; Zn, 94; Cd, 6; and Pb, 8. An atomic absorption graphite furnace was used for the determinations. Analysis of enrichment factors suggested that Al, Mn, and Fe are normal components, while Ni, Cu, Zn, Pb, and especially Cd were anthropogenically derived. Total annual trace metal deposits by rain and snow in metric tons per year were at Al, 31, Mn, 5; Fe, 18; Ni, 19; Cu, 13; Zn, 42; Cd, 3; and Pb, 4. (Cassar-FRC)
W82-05397

DETERMINATION OF MUTAGENIC POTENTIAL AND ORGANIC CONTAMINANTS OF GREAT LAKES DRINKING WATER,

Department of National Health and Welfare, Ottawa (Ontario).
D. T. Williams, E. R. Nestmann, G. L. LaBel, F. M. Benoit, and R. Otson.
Chemosphere, Vol 11, No 3, p 263-276, 1982. 3 Fig, 8 Tab, 19 Ref.

Descriptors: *Mutagens, *Organic compounds, Drinking water, *Pollutant identification, Water analysis, Pesticides, Chlorinated hydrocarbons, Seasonal variation, *Great Lakes, Polyaromatic hydrocarbons, Alkylaryl phosphates, Aromatic compounds, *Canada.

Ion exchange resin extracts of municipal drinking water from 12 Great Lakes communities were tested for mutagenic potential using the Salmonella/mammalian microsome assay. The samples were also analyzed for organochlorine pesticides, organopophate pesticides, polyaromatic hydrocarbons, trialkylaryl phosphates, and volatile organic compounds. Dose-related increases in mutagenicity were found in extracts from 11 of the 12 water supplies. Summer samples were more mutagenic than winter samples. No relationships between mutagenic activity and the presence of individual or groups of chemicals could be deduced. Polyaromatic hydrocarbon levels were higher in winter than in summer and were higher in river water than in lake water. Of the organochlorine compounds only alpha- and beta-BHC were detected. Levels were 20 and 8 ng per liter, respectively, or less. No organophosphate pesticides were detected in samples. Trialkylaryl phosphate concentrations were similar in winter and summer samples and increased through the system from Lake Superior to Lake Ontario. Volatile organics concentrations were on the order of those found in previous studies. (Cassar-FRC)
W82-05398

EFFLUENT ANALYSIS OF WASTEWATER GENERATED IN THE MANUFACTURE OF 2,4,6-TRINITROTOLUENE, 2. DETERMINATION OF A REPRESENTATIVE DISCHARGE OF ETHER-EXTRACTABLE COMPONENTS,

SRI International, Menlo Park, CA.
R. J. Spanggord, and B. E. Suta.
Environmental Science and Technology, Vol 16, No 4, p 233-236, April, 1982. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Chemical wastewater, *Trinitrotoluene, *Wastewater analysis, Cluster analysis, *Pollutant identification, Statistical analysis, Phenols, Industrial wastewater, Organic compounds, Phenols, Nitrotoluenes, Nitrobenzenes, *Explosives, Aromatic compounds.

The distribution of components in a TNT manufacturing wastewater was characterized by cluster analysis and by the 90th percentile approach. Both methods gave comparable results. The major components were 2,4-dinitrotoluene (43-49%), 2,6-dinitrotoluene (21%), and 1,3-dinitrobenzene (12-41%). Constituents comprising between 1 and 5% by either method were toluene, 2,3-dinitrotoluene, 2,5-dinitrotoluene, 3,4-dinitrotoluene, 3,5-dinitrotoluene, 1,5-dimethyl-2,4-dinitrobenzene, 3-amino-2,4-nitrotoluene, 3-amine-2,6-nitrotoluene, 4-amino-2,6-nitrotoluene, 5-amino-2,4-nitrotoluene, and 2,4,6-trinitrotoluene. Sixteen other compounds were present at less than 1%. (Cassar-FRC)
W82-05412

EFFLUENT ANALYSIS OF WASTEWATER GENERATED IN THE MANUFACTURE OF 2,4,6-TRINITROTOLUENE. 1. CHARACTERIZATION STUDY,

SRI International, Menlo Park, CA.
R. J. Spanggord, B. W. Gibson, R. G. Keck, D. W. Thomas, and J. J. Barkley, Jr.
Environmental Science and Technology, Vol 16, No 4, p 229-232, April, 1982. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Chemical wastewater, *Trinitrotoluene, *Wastewater analysis, *Pollutant identification, Industrial wastewater, Organic compounds, Phenols, Nitrotoluenes, Nitrobenzenes, *Explosives, Aromatic compounds.

Ether extracts of pretreated wastewater from the continuous trinitrotoluene (TNT) manufacturing process were analyzed by glass capillary gas chromatography to characterize the constituents. Samples were collected weekly for 1 year. A total of 32 compounds were identified. The major components, accounting for 75% by weight of the total component distribution, were 2,4-dinitrotoluene, 2,6-dinitrotoluene, and 1,3-denitrobenzene. Also present were N-nitrosomorpholine; N-morpholinoacetonitrile; mono-, di-, and trinitrotoluenes; 1,5-dimethyl-2,4-dinitrobenzene; methyl nitrophenols; amino mono- and dinitrotoluenes; toluene; 1,3,5-trinitrobenzene; 2,4-dinitro-5-methylphenol; 3,5-dinitroaniline; and nitrobenzo-nitriles. Sources of the compounds were suggested. These analyses will aid in toxicologic investigations of this wastewater. (Cassar-FRC)
W82-05413

PORTABLE WATER-WASTES LABORATORY HIGHLIGHTS BENEFITS OF NITROGEN ANALYZING SYSTEMS.

Journal of the American Water Works Association, Vol 74, No 2, p 34, 36, February, 1982.

Descriptors: *Nitrogen, *Laboratory equipment, *Kjeldahl procedure, Pollutant identification, Water analysis, *Wastewater analysis, Automation, On-site tests.

Reduced-size apparatus for measuring nitrogen has enabled the U.S. Army to equip a portable laboratory for on-site analysis of water and wastes. The new Kjeldahl systems fit on a table top, need no hood, and are well insulated. Fully automated operation allows faster processing of samples. The apparatus handles liquid and solid samples from 1 to 250 ml and 0.1 to 10 g, at N levels as low as 0.1 mg per liter. (Cassar-FRC)
W82-05437

PROCEDURES FOR ANALYZING CONTAMINANTS IN DRINKING WATER,

Environmental Protection Agency, Cincinnati, OH.
H. J. Brass.
Journal of the American Water Works Association, Vol 74, No 2, p 107-112, February, 1982. 8 Fig, 7 Tab, 34 Ref.

Descriptors: *Organic compounds, *Water analysis, *Chromatography, Reviews, *Pollutant identification, Drinking water, Laboratory equipment, Chlorinated hydrocarbons.

Many analytical methods are available for determining organic chemicals in drinking water. Sources of contaminants may be natural (humic and fulvic acids), the treatment process (trihalomethanes), point sources (priority pollutants), and nonpoint sources (pesticides). In most cases it is necessary to quantify compounds at the ppb or ppt range. Basic steps in analysis are extraction, concentration, separation, detection and quantitation. Gas chromatography-mass spectrometry and gas chromatography with conventional detectors are useful for low to medium molecular weight compounds. Cost per sample is $100-1500 and $30-500, respectively. High performance liquid chromatography can be used to determine compositions of low to high molecular weight compounds at a cost of $50-500 per sample. Systems for measuring total organic carbon and total organic halogens are available for $9000-15,000 and $9000, respectively. The importance of a quality assurance program is emphasized. The bibliography lists many books, trade publications, and government documents which provide detailed information. (Cassar-FRC)
W82-05438

PROCEDURE FOR CALCULATING THE COMPLEX RANK INDEX OF WATER QUALITY,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Gavrishova.
Hydrobiological Journal, Vol 17, No 1, p 87-90, 1981. 2 Tab, 2 Ref.

Descriptors: *Water quality, *Classification, Bacterial analysis, *Water analysis, Chemical analysis, Chemical composition, Water properties, Biological properties, *Technology, *USSR.

A method has been proposed for the rank assessment of the set of hydrochemical, bacteriological, hydrobiological and saprobiological indices embodied in the classification of surface waters. The approach of the rank processing of the data enables a quantitiative evaluation to be made of the whole set of hydrochemical hydrobiological and bacteriological indices when analyzing water quality in a water body or parts of it. For the complex assessment of the water quality of a given sample typified by the set of indices proposed in the system, the gradations of its scale are estimated in terms of rank numbers from 1 to 9 in a sequence from the most highly pure water to the most highly polluted. A rank assessment is made of each index investigated in accordance with its magnitude and position in the system. The sample is then assessed by the set of ranks. For this purpose the sum of the ranks is computed, the arithmetic mean found, and its value employed in evaluation of the sample in conformity with the gradation of the system. Since, in practice, the composition and properties of the water may come under different gradations in terms of the individual indices of the system, and may be different worth as criteria, complex evaluation using the method of rank indices enables the level of saprobicity to be established with greater certainty than on the basis of individually selected hydrochemical, hydrobiological and bacteriological indices or on the basis of their overall consideration but without the proposed method of rank processing. (Baker-FRC)
W82-05457

THE RESPONSE OF SPECIFIC CONDUCTANCE TO ENVIRONMENTAL CONDITIONS IN THE EVERGLADES NATIONAL PARK, FLORIDA,

National Park Service, Homestead, FL.
M. D. Flora, and P. C. Rosendahl.

Water, Air and Soil Pollution, Vol 17, No 1, p 51-59, 1982. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Environment, *Monitoring, Everglades, Florida, Specific conductivity, Conductivity, Evapotranspiration, Seasonal variation, Water quality.

A study was conducted to document present day isoconductivity patterns found throughout Shark Slough under both wet season and dry season conditions, relate these patterns to quantitative change in the delivery of canal water to the slough and geograhic proximity to the S-12 delivery site, and assess the short-term response at a single site to short term environmental changes such as extreme storm events. From October 1978 through September 1979, hourly stage and specific conductance were recorded at a station in central Shark Slough, about 17 km south of the S-12 water delivery structures. A comparative analysis of rainfall input and S-12 water delivery indicates that the study period can be subdivided into 8 hydrologic periods of differing water input character. Factors emerging as important in determining isoconductivity patterns in Shark Slough included the quality and quantity of surface water delivered to the slough, the quantitiative realtionship between the amount of surface water delivery and the amount of direct precipitation, and the effects of interrupted sheet flow within the slough during seasonal drawdown periods. The temporal trend from year to year is primarily dependent on the quality of the surface water delivered to the Slough and can be expected to continue to increase should the specific conductance and cation concentration of the delivery water continue to increase. Minimum and maximum extremes in specific conductance are likely to vary annually, depending on regional rainfall and hydrologic conditions. In a system as complex as the Everglades, it is important to maintain a continuing monitoring program both to detect any change in water quality and to differentiate between changes occurring in response to natural conditions and those produced by human actions. (Baker-FRC)
W82-05464

MUTAGENS, CARCINOGENS AND THE WATER CYCLE,

Severn-Trent Water Authority (England).
R. J. Tye, and W. M. Waite.
Water Pollution Control, Vol 80, No 5, p 600-613, 1981. 4 Fig, 17 Ref.

Descriptors: *Pollutants, *Carcinogens, *Mutagens, Water pollution, Public health, Measurement techniques, Pollutant identification.

Epidemiological studies on the incidence of various types of cancer in genetically similar populations in different environments have indicated that over 80% of cancers have some environmental links. The recent development of simple laboratory tests for mutagenesis provides a powerful tool for the tentative identification of potential carcinogens. Mutagenesis is the induction of inheritable changes in the genetic material of a cell. Since studies have shown that over 90% of carcinogens are mutagens, identifiable mutagens should be investigated further to determine whether or not they are also carcinogenic. Epidemiological techniques and laboratory studies have been used to investigate the possible mutagenic and carcinogenic effects of water sources and the pollutants associated with them. The Severn-Trent Water Authority Mutagenicity Unit has investigated modified bacterial test systems which permit the testing of large sample volumes, increasing the sensitivity of any preliminary screening test. The Unit has identified about 200 organic chemicals in water samples. The haloforms and the polycyclic aromatic hydrocarbons are of greatest interest. Mutagenic responses of these organic chemicals can be induced by a wide range of both raw and treated waters using a tube-fluctuation test procedure without prior concentration. However, before work on the fractionation and identification of active organics can begin, it is desirable to concentrate the organic fraction in the waters. Some concentration techniques are discussed. Mutagenesis testing can be applied either to natural water samples or to material shown to be present in waters by analytical techniques and subsequently tested as pure substances. Possible future applications of mutagenesis testing are described. (Carroll-FRC)
W82-05468

A METHOD FOR THE DETERMINATION OF SULPHIDES IN WATER, SEWAGE AND EFFLUENTS,

Southern Water Authority (England).
D. Ballinger, and A. Lloyd.
Water Pollution Control, Vol 80, No 5, p 648-654, 1981. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Sulfides, *Pollutants, *Measurement techniques, Water pollution, Effluents, Wastewater, Calibrations.

A previous review of existing methods for the measurement of sulfides concluded that none of the available methods was entirely satisfactory. Major complaints included the failure of the methods to determine sulfides selectively and the need to utilize time-consuming procedures. A sulfide analysis procedure for use on sewage, water, and effluents is proposed which attempts to overcome these problems. The method is designed to identify dissolved inorganic sulfides, including undissociated hydrogen sulfide, hydrosulfide, and sulfide ions, as well as total sulfides, including dissolved inorganic sulfides and other compounds liberating hydrogen sulfide from a cold solution containing 0.5 M hydrochloric acid. The procedure involves bringing the sample to solution vapor equilibrium in a closed flask under controlled conditions, determining the concentration of hydrogen sulfide vapor by means of Draeger tubes, and using a calibration graph to relate the concentration of hydrogen sulfide vapor to the concentration in solution. This procedure allows rapid analysis of sulfide in a wide range of sample types. No physical pretreatment is required to distinguish dissolved sulfide from total sulfide, since such a separation cannot be achieved without significant loss of hydrogen sulfide from solution. The technique was developed for use as a field analysis procedure, and the published data for precision and accuracy may be acceptable for routine environmental analyses. (Carroll-FRC)
W82-05477

ORGANIC GROUPS AND MOLECULAR WEIGHT DISTRIBUTION IN TERTIARY EFFLUENTS AND RENOVATED WATERS,

Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5D.
W82-05480

A NEW SENSITIVE AND SIMPLE SPOT TEST FOR THE DETECTION OF TERTIARY AMINE POLLUTANTS IN WATER,

Z. H. Coll. of Engineering and Technology, Aligarh (India).
M. Qureshi, H. S. Rathore, and A. M. Sulaiman.
Water Research, Vol 16, No 4, p 435-440, April, 1982. 1 Fig, 4 Tab, 27 Ref.

Descriptors: *Pollutant identification, *Organic compounds, *Organic pesticides, *Toxins, Pesticides, Aminotriazole, Saline water, Industrial wastes, Separation techniques, Organic solvents, Solvents, Detection limits, Water analysis.

A simple, inexpensive and specific spot test for the detection of tertiary amines by citric acid in acetic anhydride has been reported. These compounds frequently occur as water pollutants from the use of pesticides or in industrial wastes. An attempt was made to modify this procedure for the detection of organic pollutants in water. The test solution was prepared in acidic, basic, or saline waters, and citric acid impregnated filter paper was used as the reagent. The detection limits for the pesticides amitrol, azobenzene, bavistin and calixin were 0.04, 40, 2, and 3.2 micrograms/drop, respectively. For the toxins 2,4-lutidine, 2,6-lutidine, nicotinic acid, beta-picoline, and quinoline, the detection limits were 4, 100, 0.04, 0.4 and 100 micrograms/drop, respectively. The spot test coupled with solvent extraction can be used to detect the presence of calixin and azobenzene in water, and is simple enough for field use. (Geiger-FRC)
W82-05483

HIGH RESOLUTION ALPHA SPECTROSCOPY BY LIQUID SCINTILLATION TECHNIQUES,

Maine Univ. at Orono. Dept. of Physics and Astronomy.
E. G. Coombs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236563, Price codes: A03 in paper copy, A01 in microfiche. M. S. Thesis, August, 1980. 39 p, 15 Fig, 2 Tab, 1 Ref. OWRT B-017-ME(4).

Descriptors: *Radioactivity techniques, *Spectroscopy, *Radium radioisotopes, *Pollutant identification, *Water analysis, Uranium radioisotopes, Radioisotopes, Radiochemical analysis, Radioactivity, Radioactive wastes, Pollutants, Pollution load, Environmental protection, Population exposure, Water pollution control, Groundwater pollution, Water quality, Environmental effects.

The use of high-resolution liquid scintillation spectroscopy is described as an inexpensive and rapid method for the determination of radium-226 (an identified health hazard) and other alpha-emitting radionuclides in environmental water samples. Procedures are reported for measuring radium-226, uranium-238, and uranium-234, affording positive identification, high sensitivity due to pulse shape discrimination, and rapid sample preparation. No environmental water samples examined were found to have measurable levels of radium-226. Nonetheless, radium-226 can be detected, measured, and positively identified down to a level of 4 pCi/liter, with a recovery efficiency of 47%. The method was optimized for environmental radiation measurements by: optimizing the energy resolution; reducing the background by use of pulse shape discrimination; and optimizing the scintillation fluor. Since the extractant used will extract any actinide series element, the instrumentation and techniques developed can be applied to other areas (e.g., mesurement of plutonium and uranium in environmental effects studies of the nuclear fuel cycle). Measurements of the polonium 218, 214, and 210 isotopes, and radon-222, were also made. With the present energy resolution, an alpha energy identification to within 0.4 MeV is possible. (Zielinski-MAXIMA)
W82-05541

CLASSIFICATION AND MANAGEMENT OF WETLANDS IN THE WESTERN KENTUCKY COAL FIELD,

Kentucky University, Lexington Water Resources Research Inst., KY.
For primary bibliographic entry see Field 5C.
W82-05549

A PRAGMATIC APPROACH TO WATER QUALITY MICROBIOLOGY IN A CLEAN RIVER AREA,

North West Water Authority (England), Rivers Div.
G. Dussart.
Environmental Pollution, Series A, Vol 27, No 2, p 97-118, February, 1982. 6 Fig, 4 Tab, 38 Ref.

Descriptors: *Water quality, *Monitoring, Rivers, England, Statistical analysis, Data acquisition, Mathematical studies, Microorganisms, Bioindicators, Ecosystems, Aquatic organisms.

A description is offered of how the microbiota may be used for pollution assessment and results are presented of a typical comparative investigation. The utility of canoical correlation analysis was evaluated. Three river systems in northwest England were evaluated using this technique. In the Ehen, nitrite, phosphate and flow appear to relate to the distribution of diatoms, nonmotile green algae and filamentous algae. While a landfill leachate problem exists causing high iron concentrations, the correlation does not identify iron as a significant variable. For the Derwent, phosphate

and biochemical oxygen demand are related to the distribution of most groups except for the blue-green algae. For the nutrient-poor Irt, physical, rather than chemical, variables are important. At a more sophisticated level, canonical correlation may be a robust and useful method of examining the factors which affect the distribution of groups of microorganisms in river ecosystems. (Baker-FRC)
W82-05575

TRACE DETERMINATION OF AS(III) AND AS(V) IN NATURAL WATERS BY DIFFERENTIAL PULSE ANODIC STRIPPING VOLTAMMETRY,

Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
F. G. Bodewig, P. Valenta, and H. W. Nurnberg.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 311, No 3, p 187-191, March, 1982. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Arsenic, Pollutant identification, Water analysis, Organic matter, Trace metals, Anodes.

Arsenic was determined at trace levels in estuarine water and seawater samples. The method involved depositing arsenic onto a rotating gold electrode at a potential of -0.3V vs. a normal calomel electrode, followed by anodic stripping. For a deposition time of 4 min the detection limit was 0.2 micrograms per liter. As(5+), which is electroinactive, was first reduced to As(3+) by gaseous SO2. Other metals at levels usually found in polluted waters did not interfere. Destroying organic matter with hydrogen peroxide-ultraviolet radiation was not necessary in most samples, but did improve accuracy. At As levels of 2-5 micrograms per liter the relative standard deviation was 6-10%. Complete analysis of a sample required 30 min without the As(5+) reduction step and 75 min with the reduction step. (Cassar-FRC)
W82-05580

PROCEDURE FOR INVESTIGATING METALLIC ION COMPLEXING IN NATURAL WATERS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik.
Hydrobiological Journal, Vol 16, No 6, p 50-51, 1980.

Descriptors: *Chelation, *Metals, Pollutant identification, Organic matter, Chemical analysis, Natural waters, Fate of pollutants, Chemical composition.

A method for determining mean composition and stability of metal complexes in natural waters is described. It does not give qualitative and quantitative composition. Instead, it measures the concentration of ions not incorporated in complexes (using methods such as ionometric measurements, voltamperometric measurements) and hetotal concentration of complex-forming substances, expressed in terms of the concentration of the metal under investigation. (Cassar-FRC)
W82-05595

OCCURRENCE AND DISTRIBUTION OF CHEMICAL POLLUTANTS IN LAKE MARIUT, EGYPT, I. RESIDUES OF ORGANOCHLORINE PESTICIDES,

Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W82-05620

ORGANOCHLORINE RESIDUES IN SUSPENDED SOLIDS COLLECTED FROM THE MOUTHS OF CANADIAN STREAMS FLOWING INTO THE GREAT LAKES 1974-1977,

Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
For primary bibliographic entry see Field 5B.
W82-05635

ORGANIC CONTAMINANTS IN THE SUSPENDED SEDIMENTS OF THE NIAGARA RIVER,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-05636

GEOCHEMICAL PATHWAY STUDIES OF HEAVY METALS IN LAKE SEDIMENTS FROM THE SUDBURY-TEMAGAMI AREA, ONTARIO,

McMaster Univ., Hamilton (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W82-05640

A LAND RESOURCE INFORMATION SYSTEM (LRIS) FOR WATER QUALITY MANAGEMENT IN THE LAKE ERIE BASIN,

Corps of Engineers, Buffalo, NY.
For primary bibliographic entry see Field 7B.
W82-05662

INVESTIGATING POTENTIAL WATER CONTAMINATION BY PETROLEUM-ASPHALT COATINGS IN DUCTILE-IRON PIPE,

Southern Research Inst. Birmingham, AL. Analytical and Physical Chemistry Div.
H. C. Miller, W. J. Barrett, and R. H. James.
Journal of the American Water Works Association, Vol 74, No 3, p 151-156, March, 1982. 2 Fig, 11 Tab, 7 Ref.

Descriptors: *Asphalt, *Pipes, *Polyaromatic hydrocarbons, Pollutant identification, Coatings, Aromatic compounds, Fate of pollutants, Paint, Water pollution sources.

Petroleum asphalt seal coatings inside ductile iron water pipes contributed no significant polyaromatic hydrocarbons (PAH) to the water supply under worst-case conditions in a laboratory test. The experimental apparatus circulated clean water through 10.3 m of 150 mm production line pipe in a closed system. The interior of the pipe was coated with asphalt paint according to ANSI specification A21.4. Flange faces were also coated. The pipe was aged for 1 month after coating. Linear velocity of the water was 0.9 m per sec. Water samples were taken at intervals up to 232 hours and analyzed for benzo(a)pyrene and five other common PAH included in the WHO drinking water standards. The analytical method used was high pressure liquid chromatography with fluorescence detection and gas chromatography-mass spectrometry. The sum of the concentrations of the six specified PAH did not exceed 10 ng in any of the water samples. This was only 5% of the WHO recommended maximum of 200 ng per liter. (Cassar-FRC)
W82-05676

IONIC COMPOSITION OF GROUND WATERS AND THEIR DISTRIBUTION IN KARNAL DISTRICT (HARYANA).

Central Soil Salinity Research Inst., Karnal (India).
R. C. Sharma.
Annals of Arid Zone, Vol 20, No 3, p 209-214, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Water quality, *Saline water, *Irrigation water, Water analysis, Karnal District, *India, Conductivity, Sodium, Chemical composition, Pollutant identification, Arid lands.

Water quality in the Karnal district, India, area 8007 sq km, was evaluated by collecting 222 groundwater samples from 107 villages. Analyses included electrical conductivity (EC), cations (Ca, Mg, Na, K) and anions (carbonate, bicarbonate, chloride, sulfate). Five classes of water quality were designated: Class I, EC < 2000 micromhos per cm, residual sodium carbonate (RSC) < 5 me per liter, considered safe for irrigation; Class II, EC < 2000 micromhos per cm, RSC > 5 me per liter, usable as irrigation water if soluble Ca salts are added periodically; Class III, EC 2000-4000 micromhos per cm, RSC < 5 me per liter, usable as irrigation water on light soils or with salt-tolerant crops; Class IV, EC 2000-4000 micromhos per cm, RSC > 5 me per liter, usable as irrigation water by mixing with better quality water and application of gypsum; Class V, EC > 4000 micromhos per cm, usable as in Class IV. About 84% of the waters were classified low sodium and 16% high sodium. (Cassar-FRC)
W82-05721

A SIMPLE SPECTROPHOTOMETRIC TECHNIQUE FOR THE DETERMINATION OF PENTACHLOROPHENOL IN WATER,

Battelle New England Marine Research Lab., Duxbury, MA.
R. S. Carr, P. Thomas, and J. M. Neff.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 477-479, 1982. 1 Tab, 9 Ref.

Descriptors: *Phenols, *Pentachlorophenol, *Water analysis, Organic compounds, *Pollutant identification, Spectrophotometry.

A simple, relatively sensitive, reliable spectrophotometric method for quantifying pentachlorophenol (PCP) in water is described. After HCl treatment to release PCP from salts, the sample is extracted with 10 ml chloroform. Then 2 ml of 200 mM NaOH is added to the chloroform extract and the sample vortexed for 30 sec. Absorbance of the resulting aqueous fraction is measured at 320 nm with a Pye Unicam SP 1800 double beam ultraviolet spectrophotometer. Detection limit varies from 5 to 50 ppb for samples of 1000 ml and 100 ml, respectively. There is a linear relationship between PCP concentrations from the detection limit up to 5 ppm, near the saturation limit of PCP in seawater. Extraction efficiencies are 92-102%. (Cassar-FRC)
W82-05725

USE OF ALGAL FLUORESCENCE FOR AN AUTOMATED BIOLOGICAL MONITORING SYSTEM,

Institute for Water Research Ltd., Dortmund (Germany, F. R.).
G. Benecke, W. Falke, and C. Schmidt.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 385-395, 1982. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Fluorescence, *Algae, *Bioassay, *Pollutant identification, Herbicides, Photosynthesis, Monitoring, Automation.

A bioassay procedure uses algal fluorescence in stream quality monitoring. Test organisms are Scenedesmus or Chlorella. Conditions and pollutants which retard photosynthesis produce variations in the fluorescence curve of plant materials. A normal fluorescence curve shows an increase in height with time, followed by a slight depression, then a second increase. Photosynthetic inhibitors such as herbicides change fluorescence intensity and produce curve leveling and changes in the first phases of the curve. In the fluorescence measurement cell agal cultures mixed into the filtered water sample under investigation are kept dark for a specified period, then exposed to light. In this work an exposure time of 0.5 sec, 150 watt light source, and dark phase of 10 min are used. The light passes through a blue filter, through the cell, and through a red filter with a transmission maximum at 660 nm. A photomultiplier amplifies the signal and a curve is recorded on the oscillograph. For a permanent record, the curve can be photographed. (Cassar-FRC)
W82-05728

SNOW CONTAMINATION BY HEAVY METALS AND SULPHUR IN CRACOW AGGLOMERATION (SOUTHERN POLAND),

Academy of Mining and Metallurgy, Kracow (Poland). Inst. of Environmental Protection.
For primary bibliographic entry see Field 5B.
W82-05783

INDICATOR BACTERIA SURVIVAL UNDER LABORATORY CONDITIONS,

Marquette Univ., Milwakee, WI. Dept. of Civil Engineering.
A. E. Zanoni, and J. T. Fleissner.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 500-503, May, 1982. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Indicators, *Bacteria, *Survival, Pollutant identification, Fate of pollutants, Coliforms, Die-off coefficients, Sampling, Incubation, Wastewater, Population dynamics, Mixing.

Jug tests (in vitro) of indicator bacteria survival were performed using three natural waters, Lake Michigan harbor and beach and Milwaukee River, seeded with settled sewage supernatant wastewater. The 3 incubation methods were: quiescent (no disturbance of jug contents), prior mix (vigorously mixed just prior to sampling), and constant mix. Jugs containing 15 liters of water were incubated at 20 C in a dark closet. No matter how the treatment of samples was varied, the population of bacteria peaked at 1 day after seeding. Significant differences in bacterial survival over a 9-10 day period were seen with the three incubation methods, with the three natural waters, with reseeding every 7 days, and with seed concentrations of 0.17-1%. These results suggest that jug tests should not be used to establish die-off coefficients for indicator bacteria. (Cassar-FRC)
W82-05853

VOLATILE CONSTITUENTS OF THE PRODUCED WATER EFFLUENT FROM THE BUCCANEER GAS AND OIL FIELD,
Houston Univ., TX. Dept. of Biochemical and Biophysical Sciences.
B. S. Middleditch.
Journal of Chromatography, Vol 239, p 159-171, 1982. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Hydrocarbons, Gas chromatography, Industrial wastes, Alkanes, Volatility, Mass spectrometry.

A procedure is presented for the examination of some 200 volatile liquid hydrocarbons in effluents. The examination is performed on Tenax gas chromatography using an automated purge and trap device and the volatile constituents are then examined by combined gas chromatography-mass spectrometry. Using a bonded-phase fused-silica column, these 200 compounds are resolved and then characterized with the aid of several data manipulation techniques. While the n-alkanes are the individual compounds found in highest concentration, the alkylaromatic hydrocarbons comprise a significant proportion of the total hydrocarbons. (Baker-FRC)
W82-05874

5B. Sources Of Pollution

BORON STATUS OF BERLIN WATERS (BORSTATUS BERLINER GEWASSER),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Okologie.
For primary bibliographic entry see Field 5A.
W82-04767

ACID PRECIPITATION. 1. CAUSES AND CONSEQUENCES,
Environmental Law Inst., Washington, DC.
For primary bibliographic entry see Field 5C.
W82-04771

CHEMICAL FRACTIONATION OF HEAVY METALS IN WASTEWATER-AFFECTED SOILS,
Chile Univ., Santiago. Dept. of Chemistry.
E. B. Schalscha, M. Morales, I. Vergara, and A. C. Chang.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 175-180, February, 1982. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Wastewater irrigation, *Heavy metals, *Fate of pollutants, Metals, Copper, Zinc, lead, Chromium, Nickel, Manganese, *Santiago, *Chile Irrigation, Accumulation, Soil chemistry.

Agricultural soils irrigated for 50 years with wastewaters from Santiago, Chile, contained higher levels of extractable heavy metals than soils irrigated with river water. Three extraction methods were used. Each obtained different proportions of soluble, exchangeable, organically bonded, precipitated, adsorbed, occluded, and primary and secondary minerals. Total concentrations of metals (micrograms per g) in contaminated soils were: Cu, 127-183; Zn, 157-315; Pb, 59-64; Cr, 13-74, and Ni 23.5-24.2. In uncontaminated soils metal levels (micrograms per g) were Cu, 61-175; Zn, 94-140; Pb, 21-46; Cr, 4.5-11; and Ni, 18-25. Natural levels of Mn were high in both contaminated and uncontaminated soils. Extractable fractions varied from 48 to 169% in contaminated soils and 21-60% in uncontaminated soils. Although the metals in nonliable form (organic for Cu and inorganic precipitates for Zn) reduce the leaching potential, a shift in chemical equilibrium can mobilize the metal into plant-available forms. (Cassar-FRC)
W82-04781

ACID PRECIPITATION IN HISTORICAL PERSPECTIVE,
North Carolina State Univ. at Raleigh.
E. B. Cowling.
Environmental Science and Technology, Vol 16, No 2, p 110A-123A, February, 1982. 1 Fig, 3 Tab, 142 Ref.

Descriptors: *Acid rain, *Reviews, Rainfall, Air pollution, Fallout, Precipitation, Sulfur dioxide, Sulfuric acid, *Water pollution sources, History.

This article reviews several steps in the transformation of the concepts of acid precipitation from the domain of scientific curiosity to the domain of public concern and debate. An historical resume is presented in tabular form of the progress that has been made toward understanding the phenomena connected with man's influence on the chemical climate of the earth and their biological consequences. Contributions are presented in the chronological order of their occurrence, whether or not the work was recognized or accepted at the time. The names of the major scientists, the country in which the research was conducted, and the principal contribution to science or public affairs are presented, with appropriate references when possible. Many features of the acid rain phenomenon were first discovered in the mid-1800s in and around the city of Manchester, England. Contemporary concepts about acid precipitation and its environmental effects originated in three seemingly unrelated fields of science: limnology, agriculture and atmospheric chemistry. Concern about acid precipitation and its ecological effects in North America developed first in Canada and later in the United States, initially centering on the effects of sulfur dioxide exposure and associated acid precipitation and heavy metal deposition in the vicinity of metal smelting and sintering operations, especially near Sudbury, Ontario. (Baker-FRC)
W82-04807

VOLATILIZATION RATES OF INTERMEDIATE AND LOW VOLATILITY CHEMICALS FROM WATER,
SRI International, Menlo Park, CA.
J. H. Smith, D. C. Bomberger, Jr., and D. L. Haynes.
Chemosphere, Vol 10, No 3, p 281-289, March, 1981. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Organic compounds, *Volatility, *Mass transfer, *Fate of pollutants, Phenols, Aromatic compounds, Evaporation, Model studies.

A laboratory procedure for measuring the gas and liquid phase mass transfer coefficients and volatilization rate constants was developed. This method applies to compounds of intermediate and low volatility. The basic procedure for measuring volatilization rates was to prepare a saturated or 10 ppm solution of the chemical, whichever was lower. The oxygen reaeration rate characterized the liquid phase turbulence, and the evaporation rate of water characterized the gas phase turbulence. Data for naphthalene, anthracene, 2,4-dinitrophenol, and 1,3-dinitrobenzene were listed. This model was also used to predict the volatilization rate of the 144 organic chemicals on the EPA priority pollutant list in a natural water body. (Cassar-FRC)
W82-04817

PIXE TRACE ELEMENT ANALYSIS OF AN AQUATIC PLANT AS INDICATOR OF HEAVY METAL POLLUTION,
Tokyo Univ. (Japan).
For primary bibliographic entry see Field 5A.
W82-04818

RECENT TRENDS OF BIOCIDES IN PIKES OF THE LAKE PAIJANNE,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-04819

USE OF THE PARTITION COEFFICIENT AS AN INDICATOR OF BIOACCUMULATION TENDENCY OF DYESTUFFS IN FISH,
Ecological and toxicological Association, Basel (Switzerland).
R. Anliker, E. A. Clarke, and P. Moser.
Chemosphere, Vol 10, No 3, p 263-274, March, 1981. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Dyes, *Fish, *Bioaccumulation, *Partition coefficients, Solubility, Fate of pollutants, Accumulation, Organic compounds, *Chemical wastewater.

The partition coefficient in n-octanol/water is a useful indicator of the bioaccumulation tendency of synthetic organic dyestuffs in fish. Fish bioaccumulation, data, obtained according to experimental procedures specified by the Japanese auhtorities under the 1974 Chemical substances Control Law, was produced by member companies of the Ecological and toxicological Association of the Dyestuffs Manufacturing Industry. Partition coefficients were determined experimentally by the shake flask method and were calculated by one of three methods, depending on the chemical sructure of the dyestuff. Tables list the fish bioaccumulation factors and the experimental and calculated partition coefficients for 74 dyes. Substances with experimental partition coefficients of < 1000 have bioaccumulation factors < 100 and need not be subjected to expensive fish accumulation tests. Since the partition coefficients cannot be determined experimentally for highly lipophilic or hydrophilic dyestuffs, the calculated partition coefficient provides a satisfactory alternative approach. (Cassar-FRC)
W82-04820

UNUSUAL POLYHALOGENATED CHEMICAL RESIDUES IDENTIFIED IN FISH TISSUE FROM THE ENVIRONMENT,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W82-04822

ANALYSIS OF MARINE SEDIMENT, WATER AND BIOTA FOR SELECTED ORGANIC POLLUTANTS,
Texas A and M Univ., College Station. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-04823

BIOTRANSFORMATION OF N-PHENYL-BETA-NAPHTHYLAMINE TO BETA-NAPHTHYLAMINE IN A LABORATORY SLUDGE SYSTEM,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
Y. Ku, and G. Alvarez.
Chemosphere, Vol 11, No 1, p 41-46, 1982. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water pollution sources, *Wastewater treatment, Npahthylamine, Biodegradation, Sludge, *Activated sludge process, *Carcinogens, Microorganisms, Laboratory tests.

The purpose of this study was to determine whether beta-naphthylamine (BNA) is produced from N-phenyl-beta-naphthylamine (PBNA) by sludge microorganisms under laboratory conditions. The activated sludge was obtained from a local sewage treatment plant in Lorton, Virginia, and used within 1 hr of receipt. High concentrations of PBNA apparently inhibited the growth of the microorganisms or their degradative abilities. Large amounts of BNA were found in the aqueous phase, suggesting that further biodegradation of BNA is limited. A steady rate of conversion of PBNA to BNA was maintained throughout a 36 hr period of study. It was concluded that, due to the biotransformation of PBNA to BNA, a potent cacinogen in humans, BNA may well be released to the aquatic environment if PBNA enters sewage treatment plants. (Baker-FRC)
W82-04824

CONTENTS OF CHLORDANE-, PCB- AND DDT-COMPOUNDS AND THE BIOTRANSFORMATION CAPACITY OF FISHES IN THE LAKE AREA OF EASTERN FINLAND,

Finland Technical Research Center, Espoo.
For primary bibliographic entry see Field 5A.
W82-04827

BIODEGRADATION OF 14C-TRIS(2,3-DIBROMOPROPYL) PHOSPHATE IN A LABORATORY ACTIVATED SLUDGE SYSTEM,

Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
For primary bibliographic entry see Field 5D.
W82-04833

PHOTOLYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS IN WATER,

SRI International, Menlo Park, CA.
R. Mill, W. R. Mabey, B. Y. Lan, and A. Baraze.
Chemosphere, Vol 10, No 11/12, p 1281-1290, November/December, 1981. 1 Fig, 5 Tab, 13 Ref.

Descriptors: *Degradation, *Aromatic hydrocarbons, *Solar radiation, *Fate of pollutants, Photolysis, Polycyclic aromatic hydrocarbons, Organic compounds, Humic acids, Kinetics.

Photolysis of 8 polycyclic aromatic compounds and heteroatom analogs was studied in a merry-go-round reactor at wavelengths of 313 and 366 nm as well as in broad spectrum light at > 300 nm and sunlight. Quantum yields (all much less than 1), rate constants, and half lives (from a few minutes to several days) were calculated as a fuction of time of year at 40 degrees north latitude. Ratios of summer to winter rate constants were 25 for benzo(b)thiophene, 7.2 for quinoline, and 2-5 for the other compounds, benz(a)anthracene, benzo(a)pyrene, benzo(f)quinoline, 9H-carbazole, 7H-dibenzo(c,g)carbazole, and dibenzothiophene. Photolysis rates were variably affected by addition of dissolved humus and/or oxygen. No obvious relationships between structure and quantum yield were noticeable. (Cassar-FRC)
W82-04835

AUTOMATIC CONTROL OF THE DISCHARGE OF RADIOACTIVE SUBSUBSTANCES FROM LIGHT WATER NUCLEAR POWER PLANTS OF THE PRESSURIZED WATER REACTOR TYPE INTO FLOWING STREAMS WITH SPECIAL REFERENCE TO THE UNTERWESER NUCLEAR POWER PLANT,

Wasserwirtschaftsamt Brake (Germany, F. R.).
For primary bibliographic entry see Field 5E.
W82-04839

MOVEMENT OF DIFFUSE SOURCE POLLUTANTS IN SMALL AGRICULTURAL WATERSHEDS OF THE GREAT LAKES BASIN,

Michigan Agricultural Experiment Station, East Lansing.
R. K. Hubbard, A. E. Erickson, B. G. Ellis, and A. R. Wolcott.
Journal of Environmental Quality, Vol 11, No 1, p 117-123, January-March, 1982. 2 Fig, 4 Tab, 30 Ref.

Descriptors: *Runoff, *Agricultural watersheds, Watersheds, *Fertilizers, Agricultural chemicals, Water pollution sources, Water quality, Rainfall-runoff relationships, Erosion, Nitrogen, Phosphorus, *Soil erosion, Canopy, Throughfall, *Agricultural runoff.

Total losses of sediment, nitrogen and phosphorus and the nitrogen and phosphorus distribution in runoff waters and sediments were investigated over a two year period on a small agricultural watershed in the Great Lakes Basin region. High rates of fertilizer application had been made to the area, which was planted to corn or soybeans. During the study period, two events equaled or exceeded the 20 year expectancy in rainfall intensity, amount, and potential for erosion. Of the sediment lost, 99% was removed during 11 months, and 64-86% was lost during a single April Storm. Total sediment, nitrogen, and phosphorus losses during the period were, respectively, 19.213, 64.9, and 31.5 kg/ha for one watershed and 36.821, 72.8, and 41.2 kg/ha for the other. Evaluation of nitrogen and phosphorus distributions in the sediment and water phases respectively showed that 70-95% and 90-98% of these were carried in sediments, except during winter months. The water phase carried 80% of the nitrogen and 33% of the phosphorus during the winter. The study showed the sediments were enriched in total nitrogen but not in extractable phosphorus relative to soils. Microrelief imposed planted ridges and plant stalks or stubble retarded cross row runoff. Greater runoff was observed on the longer and steeper east-west slope of one watershed. Textural discontinuities in the upper parts of the watersheds promoted lateral seepage, resulting in emergent interflow on intermediate slopes, particularly during winter and early spring thaws. (Baker-FRC)
W82-04856

STREAM TRANSPORT OF NUTRIENTS THROUGH A WETLAND,

Cornell Univ., Ithaca, NY. Dept. of Agronomy.
J. H. Peverly.
Journal of Environmental Quality, Vol 11, No 1, p 38-43, January-March, 1982. 4 Fig, 3 Tab, 12 Ref.

Descriptors: *Wetlands, *Nutrient removal, Nitrogen, Phosphorus, Streams, Potassium, Calcium, Carbon, Seasonal variations, Water quality, Runoff, Nonpoint pollution sources, Pollution load, Water pollution sources, *Nutrients, Sedimentation, Organic soils.

A study was conducted to measure the transport of nutrients downstream from cultivated organic soil inputs and to determine the effect of managed wetlands on the creek load downstream. Oak Orchard Creek, just north of the city of Batavia in Genesee County, New York, was the study site. The Creek flows to the northeast a few kilometers through cultivated upland before entering the 3,000 ha Elba Muckland. Water samples were taken from the middle of the stream, about 15 cm below the surface and upstream of the road bridges. Samples were taken biweekly except during times of ice cover. The Oak Orchard Creek system is close to equilibrium for nitrogen and phosphorus movements, with net differences between years in gains and losses depending on quantity and timing of water movement. This wetland did not, therefore, remove significant amounts of nitrogen or phosphorus from water flowing through it, and actually increased the quantities of potassium, calcium, and carbon in the water over the 2 year study period. Highest loading was associated with highest flows, which occur in the winter and spring. Inorganic nitrogen levels in the outflow from the wetlands may fall below phosphorus levels during July and August as a result of plant utilization and denitrification losses. Biological processes downstream may be nitrogen-limited during the late summer. (Baker-FRC)
W82-04857

EFFECT OF SOIL SLOPE AND RAINFALL CHARACTERISTICS ON PHOSPHORUS IN RUNOFF,

Science and Education Administration, Durant, OK. Southern Plains Watershed and Water Quality Lab.
L. R. Ahuja, A. N. Sharpley, and O. R. Lehman.
Journal of Environmental Quality, Vol 11, No 1, p 9-13, January-March, 1982. 5 Fig, 7 Ref.

Descriptors: *Rainfall-runoff relationships, *Phosphorus, *Chemical composition, *Topography, Soil types, Soils, Soil structure, Runoff, Kinetics, Slopes, Storm runoff, *Phosphorus runoff.

Objectives of this study were to investigate, under controlled laboratory conditions, the effect of slope length, percent slope, soil cover and storm size on average solution phosphorus concentrations of runoff and to relate these effects to the kinetic mechanism of phosphorus release as expressed in a given equation. The results demonstrated that the concentration of solution phosphorus in runoff water is appreciably influenced by slope length, degree of slope, soil cover, and storm size. The degree of slope and soil cover primarily influence the effective soil mass that interacts with rainfall and runoff waters, while the slope length influences both the soil mass and water/soil ratio by determining the overland flow depths and velocities along the slope. The effect of storm size on average phosphorus concentration is a result of the kinetics of phosphorus desorption. The experimental data obtained so far on the influence of the above factors on soil phosphorus release in runoff seem to fit in to the conceptual framework of the equation. However, further work is needed on longer slopes and under field conditions to develop a working model. (Baker-FRC)
W82-04859

WATER QUALITY IN A STREAM RECEIVING DAIRY FEEDLOT EFFLUENT,

Science and Education Administration, Lewis, TN. Dairy Experimental Station.
B. F. Hollon, J. R. Owen, and J. I. Sewell.
Journal of Environmental Quality, Vol 11, No 1, p 5-9, January-March, 1982. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Animal wastes, *Water pollution sources, Runoff, *Dairy industry, *Feedlot runoff, Feedlots, Farm wastes, Water quality, Flow rates, Surface runoff, *Path of pollutants.

A study was begun in 1975 to determine water quality in a stream both above and below the point of direct discharge of surface runoff and waste water from a 200 cow dairy feedlot operation and to evaluate changes in pollution level at selected distances downstream from the point of discharge. The dairy experiment station consists of 172 ha, with a rolling to steep topography. Soils are primarily clay and silt loams over a limestone substrate. Grab samples were collected at 2 week intervals from stations located 400 meters and 3 km upstream, and 100, 500 and 1200 meters downstream from the point source of discharge. Mean coliform concentrations exceeded the EPA permissible level of 2,000/100 ml at 100 and 500 meters below the point source of discharge, but not at 1200 meters. All other parameters were below the permissible levels, Mean concentrations increased for all parameters except BOC and pH when dowstream stations were compared with upstream stations. Concentrations of fecal coliforms, fecal streptococci, BOD and orthophosphate declined significantly at 1200 meters, while other parameters were unchanged or declined slightly. Discharge of effluent into the stream did not appear to have a great effect on water quality, and the value of controlling the discharge would be questionable in terms of improving water quality in the receiving stream. (Baker-FRC)
W82-04860

THE OCCURRENCE OF FLOW CHANNELS IN SOILS,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 3C.
W82-04875

Group 5B—Sources Of Pollution

APPLICATION OF AN APPROXIMATE ANALYTIC METHOD OF COMPUTING SOLUTE PROFILES WITH DISPERSION IN SOILS,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, F. W. Chichester, J. R. Williams, and J. T. Ritchie.
Journal of Environmental Quality, Vol 11, No 1, p 151-155, January-March, 1982. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Solute transport, *Model studies, *Leaching, *Fertilizers, Nitrates, Nitrogen, Mathematical studies, Lagrangian coordinates.

This paper presents an approximate analytic method of computing the effects of dispersion, assuming that the mean solute penetration depth alpha is separately determined so that alpha provides a Lagrangian coordinate system for the dispersion calculations. The method is based on theories suggested by DeSmedt and Wierenga and assumes that irregular field boundary conditions can be replaced by a defined equivalent constant-flux boundary condition. The adequacy of this assumption was tested using data on the leaching of nitrogen-15 labeled fertilizer nitrate. The use of the analytic model described gave useful interpretation of the field monolith lysimeter data on the movement of the fertilizer. The study data was collected over 5 years from four undisturbed field lysimeters, each enclosed in an 8 square meter block whose topsoil was Keene silt loam. The approximate analytic equation was developed as follows: the solution of the convection/dispersion equation for a step change in concentration under constant flux boundary conditions was assumed to apply approximately under non-steady conditions using an equivalent constant flux. Then an equation describing convection/dispersion of an initially rectangular concentration pulse was constructed by superposition. (Baker-FRC)
W82-04876

A CONTRIBUTION TO SIMPLIFIED MODELS OF FIELD SOLUTE TRANSPORT,

Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
C. W. Rose, F. W. Chichester, J. R. Williams, and J. T. Ritchie.
Journal of Environmental Quality, Vol 11, No 1, p 146-150, January-March, 1982. 1 Tab, 19 Ref.

Descriptors: *Solute transport, *Model studies, Nitrates, Nitrogen, *Agricultural chemicals, Fertilizers, Leaching, Irrigation, Irrigation programs.

This paper develops and tests the utility of a simple deterministic model for predicting the movement of the mean depth of solute penetration resulting from application of a non-sorbed and non-transformed solute, such as chloride ions. In situations where a peak is discernible in the solute concentration profile, peak position may be substituted for mean solute penetration depth. Despite transformation of the forms of nitrogen, the model is also tested against field observations on the movement of the leachable or mobile form, nitrite ions. The model appears to give results sufficiently accurate for management of mobile solutes in the field, provided tow major assumptions are satisified: that the end result if infiltration into soil is adequately described by a water budgeting approach using knowledge of the soil's field capacity, and that the solute undergoes no processes other than convection (or mass transport) together with dispersion and diffusion. Such other processes could be chemical transformation or sorption, preferential movement down fissures or voids, or instability effects. In contrast to the leaching of anions such as NO3 and C1, cations are much more strongly sorbed in general, but then their loss by leaching is less severe. The calculations presented are based on physical theory and are of a simplicity compatible with practical irrigation management. (Baker-FRC)
W82-04877

DECOMPOSITION OF CHELATES LEACHED FROM WASTE DISPOSAL SITES,

Technion-Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Y. Avnimelech, and A. Raveh.
Journal of Environmental Quality, Vol 11, No 1, p 69-72, January-March, 1982. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Chelating agents, Chelation, Heavy metals, *Landfills, *Leachates, Sludge, Water pollution sources, Solid waste, Water quality, Drainage, Adsorption.

A simple and reliable method was developed to determine the chelating capacity of leachates and soil solution in a study of the degradation of chelating agents in soil. The method is based on the measurement of the effect of chelating agents on the solubility of calcium carbonate. The decomposition of chelating agents in soil as affected by soil composition and aeration was studied with this procedure. Leachates from most waste disposal sites are rich in organic matter and have the capacity to chelate heavy metals and carry them to different water bodies. Leachates from sanitary landfills have been found to contain up to 900 ppm of iron. Leachate coming out of a sanitary landfill model is shown to be stable under anaerobic conditions. However, if exposed to aerobic conditions the chelation capacity is reduced to 0.1-1% of its initial value within about 10 weeks. Physical adsorption of the chelating agent on clay or calcium carbonate particles does not seem significant. The clear-cut effect of aeration on the decomposition of chelating agents manifests the importance of proper and prolonged aeration of the leachate along its pathway from the waste disposal site to the receiving water body. Direct drainage, under anaerobic conditions, from a waste disposal site into a water body should be avoided. (Baker-FRC)
W82-04879

BACTERIOLOGICAL QUALITY OF SURFACE AND SUBSURFACE RUNOFF FROM MANURED SANDY CLAY LOAM SOIL,

Department of Agriculture, Ottawa (Ontario).
For primary bibliographic entry see Field 2A.
W82-04880

POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENTS AND ASSOCIATED BENTHOS IN LAKE ERIE,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5A.
W82-04882

BIOSORPTION OF HYDROPHOBIC ORGANIC POLLUTANTS BY MIXED MICROBIAL POPULATIONS,

Environmental Research Lab., Athens, GA.
W. C. Steen, and S. W. Karickhoff.
Chemosphere, Vol 10, No 1, p 27-32, 1981. 3 Tab, 12 Ref.

Descriptors: *Bioaccumulation, *Bacteria, *Aromatic compounds, *Fate of pollutants, Organic compounds, Polyaromatic hydrocarbons, Phenanthrene, Pyrene, Accumulation, Solubility, Partition coefficients.

Microbial biosorption or bioaccumulation of aquatic pollutants has received increased attention because of its impact on the environmental fate and effects of hazardous organics in aquatic systems. Biosorption partition coefficients for pyrene and phenanthrene were determined on mixed microbial populations generated from 14 sediments and soils collected in several states. Sorption isotherms were determined by equilibrating aliquots of the stock bacterial suspensions with variable concentrations of aqueous solutions of pyrene or phenanthrene at 25 C. The coefficients, 24600 + 6000 for pyrene and 6340 + 1000 for phenanthrene, were nearly constant for all the microbial populations, regardless of source. Semi-empirical equations were developed to relate biosorption partition coefficients to octanol/water partition coefficients and to water solubility and melting point. It is expected that the equations obtained can be extended to other families of hydrophobic compounds besides the condensed ring aromatics with little or no coefficient adjustment. (Cassar-FRC)
W82-04885

SULFATE WASHOUT RATIOS IN WINTER STORMS,

Battelle Pacific Northwest Labs., Richland, WA.
B. C. Scott.
Journal of Applied Meteorology, Vol 20, No 6, p 619-625, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Sulfates, *Storm runoff, Precipitation, Rainfall, Water pollution sources, *Path of pollutants, Winter storms.

This paper examines washout ratio variability for sulfate deposition during the winter season. The variability of the data is clearly evident and is plotted so as to illustrate the vast range of washout ratios observed. However, specific trends do emerge, such as an apparent relationship between the washout ratio and the precipitation rate. The microphysical processes of precipitation growth exerted a definite influence on the washout ratio. Indeed, by stratifying the data according to dominant mode of precipitation growth, some insight was gained into the complexities of nucleation scavenging and transformation processes. Evidence based on the total number of observations in 15 storms suggested that the number of events which contain rimed snow are about equal to the events which contain unrimed snow. Since the nature of precipitation growth can influence sulfate deposition rated by a factor of 50 or more, it is significant to distinguish between these two dominant growth modes, riming versus vapor deposition. More important is the implication that in spite of a rather detailed theoretical explanation of wet removal, washout ratios for sulfate cannot be reliably predicted to within a fator of 2. Thus, much work clearly remains in identifying and parameterizing sulfate removal mechanisms and rates during storm periods. (Baker-FRC)
W82-04898

BIODEGRADATION OF HAZARDOUS ORGANIC POLLUTANTS,

Illinois Inst. of Tech., Chicago.
J. W. Patterson, and P. S. Kodukala.
Chemical Engineering Progress, Vol 77, No 4, p 48-55, April, 1981. 5 Tab, 15 Ref.

Descriptors: *Biodegradation, *Organic compounds, *Industrial wastewater, Priority pollutants, *Wastewater treatment, Biological treatment, Degradation, *Fate of pollutants, Ozonation, Activated carbon, Adsorption, Bioaccumulation, Accumulation.

Less than half of the 114 known organic priority pollutants occur in industrial effluents with sufficient frequency to warrant broad-scale controls. Those with the highest frequency are phthalates, chloroform, methylene chloride, benzene, toluene, phenol, ethylbenzene, naphthalene, phenanthrene/anthracene, tetrachloroethylene, trichloroethylene, and trichloroethane. Several treatment systems for hazardous organics are available. Air and steam stripping, dependent on the principles of Henry's Law, produce air pollution and contaminated condensates, respectively. Ozone oxidation, activated carbon adsorption, and biological degradation are each effective in destroying some of the compounds on the list. In some cases more toxic compounds are formed in the process. A table lists the degree of removal of many toxic organic compounds by biological treatment systems. Several compounds concentrate in sludge by factors of 5 to 100. These are acenaphthene, 1,2- and 1,3-dichlorobenzene, fluoranthene, naphthalene, N-nitrosodi-n-propylamine, bis(2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl and di-n-octyl phthalates, dimethyl phthalate, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, acenaphthylene, fluorene, phenanthrene, pyrene, tetrachloroethylene, and toluene. (Cassar-FRC)
W82-04910

GEOTHERMAL POWER: ACCIDENTAL FLUID RELEASES AND WASTE DISPOSAL,

California Univ., Livermore. Lawrence Livermore Lab.
D. W. Layton, and W. F. Morris.
Chemical Engineering Progress, Vol 77, No 4, p 62-67, April, 1981. 4 Fig, 28 Ref.

Descriptors: *Geothermal power, *Cooling water, *Waste disposal, Water pollution control, *Water pollution sources, *Underground waste disposal, Saline water, Hydrogen sulfide, Boron, Ammonia, Powerplants, Injection wells, Wastewater treatment.

Geothermal power plants are a potential source of environmental contamination through accidental releases of saline geothermal fluids and the disposal of liquid and solid wastes. The composition of geothermal fluids varies according to site, up to 250,000 mg per liter total dissolved solids at Salton Sea, California, and may contain boron, arsenic, lead, hydrogen sulfide, and other toxic substances. A spill of 1300 cu m could contaminate soil water and surface waters. Berms can protect against such accidental releases. The most feasible disposal technique for spent geothermal fluids, the most abundant waste, is injection into underground wells. The solid wastes require disposal in carefully constructed and monitored landfills. The ammonium sulfate recovered from the hydrogen sulfide removal process may be marketed as fertilizer if it is boron-free. Cooling waters for geothermal facilities are obtained from irrigation water, waste agricultural water, and steam condensate from flashed-steam power plants. Treatment to remove the substantial suspended solids and dissolved solids of these cooling waters produces significant quantities of solids. An alternate to evaporation ponds is subsurface injection into an aquifer isolated from potable water supplies. Cooling tower drift is a source of boron which can damage agricultural crops and enter the soil. Boron emissions at a 106 MW facility are estimated at 2273 kg per year. Design of geothermal power facilities must provide for accidental releases of fluid, treatment of spent fluids, proper disposal of toxic wastes and blowdown, and containment of drift. (Cassar-FRC)
W82-04911

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: I. SUNLIGHT INDUCED REACTIONS OF AQUATIC POLLUTANTS PHOTOSENSITIZED,

Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 2K.
W82-04914

COMPARISON OF PHOTOCHEMICAL BEHAVIOR OF VARIOUS HUMIC SUBSTANCES IN WATER: II. PHOTOSENSITIZED OXYGENATIONS,

Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 2K.
W82-04915

THE OCCURRENCE AND ORIGIN OF METHANE IN SOME GROUNDWATER FLOW SYSTEMS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2K.
W82-04925

UPTAKE OF ARSENIC, CADMIUM, LEAD AND MERCURY FROM POLLUTED WATERS BY THE WATER HYACINTH EICHORNIA CRASSIPES,

Jackson State Univ., MS. Dept. of Chemistry.
F. E. Chigbo, R. W. Smith, and F. L. Shore.
Environmental Pollution, Series A, Vol 27, No 1, p 31-36, January, 1982.. 2 Tab, 18 Ref.

Descriptors: *Monitoring, *Water quality, Cadmium, Lead, Mercury, Arsenic, *Heavy metals, Water pollution control, Plants, *Water hyacinth, *Adsorption.

The ability of the water hyacinth to simultaneously accumulate arsenic, cadmium, lead, and mercury at a relatively high level of exposure was investigated. After cultivation of the plants for 2 days in tanks containing 10 ppm of each of the metals in aqueous solution, the plants were harvested and rinsed with tap water. The leaves and stems were separated and analyzed for each of the metals. The ratio of the concentrations of arsenic and mercury in the leaves to the concentrations in the stems was about 2:1. Cadmium and lead showed a concentration ratio in leaves to stems of about 1:1. Leaf concentration of arsenic was the lowest of the metals at 0.3428 mg/g of dried plant material while the leaf concentration of cadmium was highest at 0.5740 mg/g of dried plant material. Analyses were also made of control plants grown in unpolluted water and of plants grown in Bay St. Louis, Mississippi sewage lagoon. The mercury concentrations of plants grown in the sewage lagoon were significantly different from the control sample, which had a concentration of 0.0700 mg/g of dried plant material. These findings suggest that the water hyacinth can absorb relatively high concentrations of arsenic, cadmium, mercury and lead over a relatively short period of time. Periodic analysis of wild plants should result in a pollution monitor of the water to which the plants are exposed. (Baker-FRC)
W82-04936

THE NEW POLLUTION–GROUNDWATER CONTAMINATION,

For primary bibliographic entry see Field 5C.
W82-04938

ORGANIC MATTER TRANSPORT IN AN APPALACHIAN MOUNTAIN RIVER IN VIRGINIA, U.S.A.,

Virginia Polytechnic Inst., and State Univ., Blacksburg. Dept. of Biology.
L. A. Newbern, J. R. Webster, E. F. Benfield, and J. H. Kennedy.
Hydrobiologia, Vol 83, No 1, p 73-83, 1981. 5 Fig, 3 Tab, 42 Ref.

Descriptors: *Rivers, *Organic matter, Decomposing organic matter, Detritus, Litter, Municipal wastes, Industrial wastes, *New River, Virginia, *Path of pollutants.

Results are presented of an investigation of organic matter transport in an Appalachian Mountain river. The New River is a sixth order stream flowing partly in the ancient Teas River channel in the Appalachian Mountains and is considered to be the second oldest river in the world. Collections for study were made at two points:near Fries, Virginia, and near Glen Lyn, Virginia. Between these two points were several cities and industries which release effluent into the river. Dissolved organic matter was the most abundant form of organic matter transported at both sites throughout most of the year. For the most part, dissolved organic matter concentrations were similar to values reported or other medium to large rivers. Highest dissolved organic matter values were recorded during low flows, but there was no statistically significant correlation between the concentration and discharge. Fine particulate organic matter concentrations were in general lowest in the winter, somewhat higher in summer, and exhibited sharp peaks in spring and fall. No statistically significant correlations between fine particulate organic matter and river discharge over the year or seasonally were detected. However, fine particulate organic matter concentrations increased 15-fold during a storm. Coarse particulate organic matter concentration was highest during autumnal leaf fall and constituted about 13% of the total particulate organic matter samples. However, coarse particulate organic matter was generally less than 1% of the total particulate organic matter throughout most of the year. It appeared that municipal and industrial treatment facilities between the two study sites supplemented the concentration of dissolved organic matter in the river. (Baker-FRC)
W82-04949

BEHAVIOR OF ORGANIC PRIORITY POLLUTANTS IN THE TERRESTRIAL SYSTEM: DI-N-BUTYL PHTHALATE ESTER, TOLUENE, AND 2,4 DINITROPHENOL,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
M. R. Overcash, J. B. Weber, and M. L. Miles.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224544, Price codes: A06 in paper copy, A01 in microfiche. Report No 171, January, 1982. 94 p, 22 Fig, 24 Tab, 173 Ref. OWRT B-122-NC(6). 14-34-0001-9088.

Descriptors: *Path of pollutants, Pollution effects, Plant growth, Plant toxicity, *Organic compounds, Phytotoxicity, Fate of pollutants, Plant growth, *Water pollution effects, Organic priority pollutants, Di-n-butyl phthalate (DnBP) ester, Toluene, 2-4 Dinitrophenol.

Detailed literature reviews were performed for three of the organic priority pollutants. These reviews were strictly oriented toward the terrestrial system response, including soil adsorption, microbial decomposition, abiotic losses, plant phytotoxicity and uptake by vegetative species. Data and conclusions from these evaluations can be used directly in land treatment design, in-situ spill cleanup design, and multi-media effects studies on terrestrial systems. Specific soil decomposition experiments were conducted for di-n-butyl phthalate (DnBP) and 2,4 dinitrophenol (DNP). The half life of DnBP when applied at 1,000 - 10,000 ppm (dry soil basis) was in excess of 26 weeks while at 200 ppm t 1/2 is about 12 weeks (the latter is closer to actual land treatment loading rates). For DNP the half life was less than 4 weeks for soil loadings of 5-50 ppm (dry soil basis). Volatilization and abiotic loss rates for DnBP and DNP were also determined. DnBP had less than 5% loss by these mechanisms while DNP losses were greater than 90%. Phytotoxicity studies were conducted on corn, soybean and fescue seeds freshly planted in the chemical-soil mixture. For toluene a significant germination effect was determined at 2000 ppm for corn and soybeans. DNBP affected soybean germination at 200 ppm but not corn (even at 20,000 pm). DNP was the most phytotoxic with germination effects appearing at 80 ppm for corn and 40 ppm for soybean.
W82-04965

ALGAL-AVAILABLE PHOSPHORUS IN SUSPENDED SEDIMENTS FROM LOWER GREAT LAKES TRIBUTARIES,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto, T. C. Young, and S. C. Martin.
Journal of Great Lakes Research, Vol 7, No 3, p 311-325, 1981. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Phosphorus, *Sediments, *Algae, Lakes, Rivers, *Great Lakes tributaries, Suspended sediments, Phytoplankton, Selenastrum, Particulate matter, Model studies, Fate of pollutants, Maumee River, Sandusky River, Cuyahoga River, Ohio, Cattaraugus River, Genesee River, New York.

Phosphorus available for algal growth was measured in suspended sediment from 5 tributaries to the lower Great Lakes during March-June 1980. The rivers were Maumee, Sandusky, and Cuyahoga in Ohio and Cattaraugus and Genesee in New York. Both chemical analyses and bioassays under aerobic conditions were performed. An average of 21.8% of total particulate P was ultimately available to Selenastrum capricornutum. Total sediment P (in micrograms P per mg dry weight) and ultimately bioavailable P were higher in the Ohio rivers, mean 1.06-1.25 and 6.1-19.5% of total, respectively. Non-apatite fractions of inorganic P (base- and reductant-extractable) correlated well with levels of available P in the suspended sediment samples. The rate of available P release from the sediments was generally independent of the observed sediment characteristics. Accuracy of model studies on P dynamics may be improved by considering available P to be released from an ultimately available fraction of the total particulate P in the water column rather than the short-term available P. (Cassar-FRC)
W82-04994

CIRCULAR WALL JETS IN COFLOWING STREAMS,

Alberta Univ., Edmonton.
N. Rajaratnam, and M. J. Stalker.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY2, p 187-198, February, 1982. 10 Fig, 1 Tab, 11 Ref.

Descriptors: *Path off pollutants, *Open channels, *Jets, *Flow velocity, *Mixing, *Mathematical studies, *Flow profiles, Fate of pollutants, Flow discharge, Channel flow, Nozzles, Instream flow, Industrial wastewater.

The diffusion of circular turbulent wall jets for the discharge of industrial or municipal wastewaters into a coflowing stream was studied, with the depth of flow in the range of 20-30 times the nozzle diameter and the jet velocity varying from about 2 to 30 times the mean velocity of the channel flow. Similar distributions were found between the jet longitudinal velocity and the stream velocity in the free mixing region in the channel centerplane. The velocity profiles might be described by a power law that varies the exponent within a band in the boundary layer portion. The jet velocity with respect to the free stream was found to be similar in the transverse direction in the horizontal plane of the maximum velocity. The length scales in the vertical direction and in the transverse direction were correlated using the excess momentum thickness. The velocity and shear velocity scales have also been correlated using the excess momentum thickness. When the ratios of the longitudinal distance from the nozzle to the excess momentum thickness is near 5, the present results give good agreement with the corresponding predictions for circular free jets in coflowing streams. For larger values of this ratio, the results are influenced by the presence of the boundary (bed). The freestream gives significant restrictions of the transverse spreading of the jet compared with circular wall jets in stagnant ambients. (Geiger-FRC)
W82-04999

THERMAL FRONT FORMATION FROM BUOYANT SURFACE JETS,

Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 5C.
W82-05004

MIGRATION OF RUTHENIUM-106 IN A NEVADA TEST SITE AQUIFER: DISCREPANCY BETWEEN FIELD AND LABORATORY RESULTS,

Lawrence Livermore National Lab., CA.
D. G. Coles, and L. D. Ramspott.
Science, Vol 215, No 4537, p 1235-1237, March, 1982. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Radioactive wastes, *Groundwater, Wells, Migration, Aquifers, Groundwater movement, Water pollution sources, Nuclear explosions, Ruthenium-106, *Nevada Test Site.

As part of a program to study the interaction of nuclear explosion debris and ground water, events in a flooded nuclear waste repository were also considered. The migration rate of ruthenium-106 in the field was investigated. Water was sampled from a well which intersected the explosion cavity created by detonating a nuclear device at a depth of 294 meters in tuffaceous alluvium. Tritium and strontium-90 were the only radionuclides whose concentrations were above the maximum permitted for unrestricted public use of drinking water, even though the water had been in direct contact with nuclear debris for 10 years. A satellite well was drilled 91 meters south of the explosion point to study migration rates of the radionuclides in the cavity water. Pumping from the satellite well induced a gradient between the explosion point and the well. Ruthenium-106 migrated in ground water at about the same velocity as tritium from the underground explosion site to the pumped satellite. This finding contradicts the predictions of laboratory studies based on batch sorption measurements that ruthenium-106 should migrate at a much lower rate than tritium. To predict migration of radionuclides in groundwater, more relevant laboratory measurements are needed. (Baker-FRC)
W82-05008

GC/MS ANALYSES OF XAD-2 EXTRACTS OF SUPERCHLORINATED SEPTAGE,

North Texas State Univ., Denton. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-05016

UPWARD TREND IN NITRATE CONCENTRATIONS IN RIVER DISCHARGING INTO LOUGH NEAGH FOR THE PERIOD 1969-1979,

Ministry of Agriculture, Belfast (Northern Ireland). Agricultural and Food Chemistry Div.
R. V. Smith, R. J. Stevens, R. H. Foy, and C. E. Gibson.
Water Research, Vol 16, No 2, p 183-188, February, 1982. 5 Fig, 5 Tab, 15 Ref.

Descriptors: *Nitrates, *Rivers, Water quality, Public health, Drinking water, Phytoplankton, Municipal wastewater, Land use, Farming, *Water pollution sources, *Lough Neagh, *Northern Ireland.

Results are reported of a discrete sampling program of the nitrate concentrations in the major rivers discharging into Lough Neagh for the period 1969-1979. An attempt was made to assess causal factors for the increase in nitrate concentration observed by examining the trends in land usage, drainage, agricultural practices and human population over the study period. The Lough Neagh catchment has a total size of 4453.4 square kilometers, with average rainfall of 1028 mm. Six inflow rivers drain 88% of the catchment. Soil material is mostly basaltic glacial till, and the principal soil associations are climatic peat and acid brown earths and gleys on the lowland. The mean nitrate N concentration in the major rivers discharging into Lough Neagh for the years 1969 and 1970 was 1.41 mg nitrogen/liter. For the years 1978-1979 this mean had risen to 2.41 mg nitrogen/liter. One important concern regarding this increased nitrate concentration was the possible increased risk of methemoglobinemia if these waters were consumed directly by infants. However, all present values are well below the permissible nitrate concentration of 11.3 mg nitrogen/liter. A notable feature regarding changes in land use in Northern Ireland during the study period is the reduction in arable farming, which is a continuation of a trend established since World War II. Another factor is the human population changes during the study period. A redistribution occurred between the rural and sewered population. Rural populations declived from 144,000 to 128,000, while the sewered population increased by 25%. Still it seems unlikely that the increase in human sewered population observed could have contributed more than 3.7% increase to the rise in nitrate concentration noted in the present study. (Baker-FRC)
W82-05017

A BUDGET MODEL ACCOUNTING FOR THE POSITIONAL AVAILABILITY OF PHOSPHORUS IN LAKES,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. C. Chapra.
Water Research, Vol 16, No 2, p 205-209, February, 1982. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Lakes, *Phosphorus, Eutrophication, *Model studies, Sediments, Lake Erie, Phosphorus loading, Lake sediments, Suspended sediments.

A budget model for phosphorus loading relationships in lakes is presented. The model takes into consideration the fact that phosphorus may be reintroduced into the water column by wind-induced sediment resuspension in shallow lakes. The model is calibrated with Schaffner and Oglesby's data from lake loading/response relationship studies and is used to simulate in-lake phosphorus levels for the three basins of Lake Erie. The major objective of the model development was to provide a more mechanistic framework for assessing the effect of positional availability on lake eutrophication. An ancillary result was the reintroduction of mean depth as an explicit variable in trophic state assessment. The model as presented accounts for both the rapid settling of allochthonous particles and the slow settling of autochthonous particles that remove phosphorus from the water column. The effect of resuspension of bottom sediments is modeled by making the apparent settling velocity a function of lake depth. The resuspension effect is important for lakes less than 10 meters in depth. (Baker-FRC)
W82-05018

DETECTION OF DIETHYLNITROSAMINE IN NITRITE-RICH WATER FOLLOWING TREATMENT WITH RHODAMINE FLOW TRACERS,

National Fishery Research Lab., La Crosse, WI.
S. L. Abidi.
Water Research, Vol 16, No 2, p 199-204, February, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Dyes, *Nitrites, Nitrosamines, Carcinogens, *Tracers, Dye releases, Public health, Environmental effects, Rhodamine B, Rhodamine WT, Diethylnitrosamine, *Path of pollutants.

The results of an investigation of the reaction of nitrite with two commonly used water tracing dyes are reported. The effects of reaction variables on yields of diethylnitrosamine (DENA), including inhibition by ascorbic acid, are described. The optimum pH for quantitative formation of DENA is 5. On either side of 5 the yields decreased. The more favorable nitrosation occurred at a higher level of nitrite relative to the starting amine, at a more elevated temperature, and at a longer duration of reaction. A yield as high as 75% was realized when the reaction was run with a large excess of nitrite in pH 5 buffer at 80 degrees C for 12 hr. Under identical conditions, the DENA yield from Rhodamine WT was at least twice that obtained from Rhodamine B. It is suggested that the additional carboxy group in the former accelerated its conversion into the nitrosamine. Ascorbic acid effectively inhibited nitrosation. Experiments were also made on environmental samples. Samples were collected and pH's and nitrite-nitrate contents measured. Samples were taken and treated with Rhodamine flow tracer at levels of 1, 10 and 20 micrograms/liter. Mixtures were stirred gently with and without added nitrite. The dichloromethane extracts of each of the nitrosated mixtures were then purified and analyzed for DENA. The levels of nitrite present in local stream water were thus monitored weekly by sampling top and bottom river water . Photodegradation of DENA formed in river water samples containing the Rhodamine dye and nitrite proceeded somewhat sluggishly. The finding that red fluorescent water tracing dyes can react with nitrite in natural water to form the carcinogenic DENA is cause for concern. (Baker-FRC)
W82-05022

INDIA: EVERY RIVER POLLUTED, AND FEW EFFECTIVE CONTROLS,

D. J. Davidar.
Ambio, Vol 11, No 1, p 63-64, 1982.

Descriptors: *Water pollution control, *Legal aspects, *Water pollution sources, *India, Water pollution, Drinking water, Municipal wastes, Industrial wastes.

Every major river system in India is polluted. Although the major part of the pollution is caused by biodegradable domestic wastes, heavy metals such as mercury, cadmium, nickel, manganese, lead, chromium, copper and antimony have been found in rivers in Gujarat, Rajasthan, Bihar, Maharashtra, Kerala and Andhra Pradesh. All the rivers have industrial pollutants discharged into them by industries. Toxic wastes are indiscriminately dumped on land as well. What aggravates the problem of land and water pollution is the seasonal monsoon rains. When the rains fall the stockpiled wastes are leached into thee groundwater reservoirs which are used for drinking pur-

poses. Any wastes dumped into the smaller rivers become highly concentrated when the rivers dry up. Sanitary conditions in the entire country are minimal. Only 8 of the more than 3000 cities in India have complete sewage facilities, leading to enormous problems. Nuclear and radioactive wastes must also be disposed of in this country. National and state legislation to regulate all the various types of pollution does exist. Under provisions of the Water Pollution Act most State Boards have functions including laying down safe pollution levels for industry, monitoring air and water quality, and prosecuting violators of pollution controls. But the State Pollution Control Boards have not been very effective. When prosecuted, private companies sometimes threaten to close down the factory rather than install pollution control measures. Lack of funds and trained personnel make the job harder. (Baker-FRC)
W82-05033

WEAK CONTROLS FROM SEA TO SHINING SEA,

University of Western Ontario, London. Dept. of Zoology.
D. M. Ogilvie.
Ambio, Vol 11, No 1, p 51-53, 1982. 2 Fig, 7 Ref.

Descriptors: *Hazardous materials, *Waste disposal, Water pollution sources, Groundwater pollution, *Canada, *Legal aspects, *Regulations, Leaching.

A rather low standard of care has been maintained in Canada concerning hazardous wastes, and the results are clearly evident in many parts of the country where improper waste disposal practices have been carried on. The discharge of benzene-containing solvents and mercury-contaminated acids into the sewer system, the presence of mercaptan pesticide in an insecure landfill, the dumping of wastes contaminated with heavy metals and cyanide in municipal dumps, and the contamination of groundwater by leaky dumpsites have been reported. Industry spokesmen claim it is difficult and expensive for many companies to do anything with their wastes except dump them into the sewer system. In the wheat producing province of Saskatchewan an aquifer that supplies drinking water for the capital city of Regina is reported in danger of contamination from a 1976 PCB spill and from chemicals leaching from a landfill site. One proposal to alleviate the situation calls for management of hazardous wastes in western and northern Canada to be done on a regional, rather than strictly provincial, basis. The system would consist of one incineration plant to serve the entire region, with physical-chemical treatment plants in each of the four western provinces and a network of collection stations across the region. Federal control can be applied to environmental hazards which are associated with activities such as fishing and with certain aspects of manufacturing and shipping. Provincial governments have broad legal jurisdiction. However, it is mainly with provincial authority that waste disposal can be controlled. The Canadian legal system has few absolute constraints on government actions to effectively control and regulate hazardous substances. The key question is whether governments will adopt appropriate regulatory policy. (Baker-FRC)
W82-05035

INFILTRATION INFLOW ANALYSIS: FINDING THE SOURCE,

CH2M/Hill, Seattle, WA.
K. T. Holmes, E. Black, and D. E. Brown.
American City and County, Vol 97, No 2, p 23-26, February, 1982.

Descriptors: *Sewer systems, *Infiltration, *Sewer infiltration, *Testing procedures, Stormwater, Runoff, Wastewater collection, *Springfield, *Oregon.

As a first step in the sewer system evaluation survey for Springfield, Oregon, flows in the wastewater collection system were monitored at 54 manhole sites during low and high groundwater conditions. This monitoring revealed that groundwater entered the 165 mile collection system when the water table was above the pipeline invert. It also showed that rainfall caused an immediate and sharp increase in flows. To complete the study, the wastewater collection system was smoke tested to locate sources of storm induced infiltration and direct stormwater runoff entry. From the outset it was recognized that smoke testing is only a detecting technique and cannot be used to quantify the I/I flow rate. It was also noted that smoke testing would not reveal what needed to be repaired in a sewer section without additional field work. Testing also would not reveal the location of a defect between manholes. Also, if smoke is not observed escaping, it does not necessarily mean the manhole-to-manhole segment tested does not have any defects. Dyed water testing was conducted at each of the 79 indicated cross connection locations to determine the exact location of any connection. Use of the dyed water testing with closed-circuit internal television inspection revealed that most of the noted sites were not directly connected. (Baker-FRC)
W82-05038

MOVEMENT AND IDENTIFICATION OF A CREOSOTE-DERIVED PAH COMPLEX BELOW A RIVER POLLUTION POINT SOURCE,

Roswell Park Memorial Inst., Buffalo, NY.
J. J. Black.
Archives of Environmental Contamination and Toxicology, Vol 11, No 2, p 161-166, 1982. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Creosote, *Sediments, *Rivers, Water pollution sources, Fate of pollutants, Path of pollutants, Polyaromatic hydrocarbons, Aromatic compounds, *Hersey River, *Michigan, Muskegon River, Organic compounds, Hydrocarbons, Wood treatment wastes.

A wood treatment operation abandoned in 1949 was identified as the source of creosote contamination of the Hersey River, Michigan. Creosote from two major spills of 15,000 and 18,000 gal as well as small leaks and drips had permeated the sandy surface soils to an impervious clay layer, then entered the river via springs. Sampling of river sediments at 9 sites and analysis by high pressure liquid chromatography showed a pattern of pollution concentration that decreased in a double exponential curve with distance. The greatest concentrations of polyaromatic hydrocarbons and of the individual compounds monitored (1,2-benzanthracene and 3,4-benzo(a)pyrene) were found directly downstream from the source. Levels were 231,000, 61,669, and 15,817 ng per g (wet basis), respectively. These levels decreased to 352, 1023, and 396 ng per g wet basis, respectively, at 400 decameters from the source. The curve obtained by plotting distance from the source against concentration of contaminants was asymptotic, implying that the river's sediments were polluted over a considerable distance. (Cassar-FRC)
W82-05042

PROCEDURES FOR THE COLLECTION OF REPRESENTATIVE WATER QUALITY DATA FROM MONITORING WELLS,

Illinois State Water Survey Div., Campaign; and Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 7B.
W82-05051

PILOT FIELD STUDIES OF FGD WASTE DISPOSAL AT LOUISVILLE GAS AND ELECTRIC,

Louisville Gas and Electric Co., KY.
For primary bibliographic entry see Field 5E.
W82-05066

EXECUTIVE SUMMARY FOR POWER PLANT COOLING SYSTEM WATER CONSUMPTION AND NONWATER IMPACT REPORTS.

United Engineers and Constructors, Inc., Philadelphia, PA.
For primary bibliographic entry see Field 2D.
W82-05067

MODELING OF LEACHATE ORGANIC MIGRATION AND ATTENUATION IN GROUNDWATERS BELOW SANITARY LANDFILLS,

Waterloo Univ., Ontario.
J. F. Sykes, S. Soyupak, and G. J. Farquhar.
Water Resources Research, Vol 18, No 1, p 135-145, February, 1982. 11 Fig, 3 Tab, 33 Ref.

Descriptors: *Leachates, *Landfills, *Organic matter, *Model studies, Sanitary landfills, Chemical oxygen demand, Path of pollutants, Fate of pollutants, Biodegradation, Degradation, Microbial degradation, Garbage dumps, Groundwater pollution.

A model for transport of organic matter, measured as COD, in soils near sanitary landfills is developed. The model treats organic transport in 3 phases. The first models degradation with simultaneous Michaelis-Menten substrate utilization and microbial mass production equations with convection and dispersion included for the former. In the biologically-active zone, suggested by these equations, substantial organic degradation occurs within small distances, often less than 5 meters, even under widely varying conditions. The second phase involves first-order decay. The third phase consists of a nonbiodegradable organic residue which migrates by connection and dispersion. Field studies were conducted at the Canadian Forces Base Borden sanitary landfill, closed in 1976, to provide data for comparison with model predictions. This showed that COD was reduced to about 100 mg per liter after traveling 1 or 2 meters, by biodegradation, not adsorption. A nonbiodegradable component of 50-100 mg per liter concentration was also detected. (Cassar-FRC)
W82-05075

NUMERICAL SIMULATION OF THE TRANSPORT AND SPECIATION OF NONCONSERVATIVE CHEMICAL REACTANTS IN RIVERS,

Commonwealth Scientific and Industrial Research Organization, Ryde (Australia). Inst. of Earth Resources.
B. M. Chapman.
Water Resources Research, Vol 18, No 1, p 155-167, February, 1982. 11 Fig, 5 Tab, 37 Ref.

Descriptors: *Solute transport, *Chemical reactions, *Rivers, *Fate of pollutants, *Model studies, Sedimentation, Chemical precipitation, Suspended solids, Absorption, Ion transport, Speciation, Mine wastes.

A model using the program MINEQL was used to simulate the transport of nonconservative chemical pollutants in flowing water. The processes of precipitation, sedimentation, and adsorption were added to a model of conservative chemical transport. The physical transport submodel used a convolution integral procedure with an approximation form of the impulse function to solve a one-dimensional convective-diffusion equation. Although the model assumed chemical equilibrium, a pseudokinetic treatment was necessary to deal with redissolution of precipitates and dissociation of surface species. Hypothetical examples were given for calcium chloride entering a stream. The model was tested by injecting NaOH into Daylight Creek, New South Wales, Australia, draining an abandoned lead-zinc mine. Concentrations of the metals Zn, Al, Cu, Fe, and Na in the stream water were expressed as total metals and as suspended solids. These were followed as a function of time and distance downstream. Significant sedimentation of the precipitate was noted. Substantial quantities of protons and/or metal ions were absorbed on the stream bed. The model results agreed reasonably with observations. Better results would have been obtained if sedimentation time constants for the five metal precipitates had been individually considered. (Cassar-FRC)
W82-05079

MERCURY CIRCULATION IN AQUATIC ENVIRONMENT. PART 3. MERCURY TRANSFORMATIONS IN SEDIMENTS,

J. Stary, B. Havlik, K. Kratzer, J. Prasilova, and J. Hanusova.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 29-33, 1980. 1 Tab, 10 Ref.

Descriptors: *Mercury, *Methylmercury, *Sediments, Fate of pollutants, Heavy metals, Metals, Aquatic environment, Chemical reactions, *Czechoslovakia, Reslava Creek, Botic Creek.

Sediment from the Reslava Creek, Czechoslovakia, highly polluted with pulp and chemical wastes, contained an average of 0.19 + or - 0.02 ppm methylmercury (1.05% of total mercury). Sediment from the Botic Creek, polluted with urban sewage, had lower levels of methylmercury, 0.029 0.003 ppm (6.3% of total mercury). Transformation of inorganic Hg, methylmercury, and phenylmercury were studied in the laboratory using Hg203 compounds and sediments incubated by three procedures: (A) in open glass vessels for 28 days, (B) under a nitrogen atmosphere for 28 days, and (C) in test tubes standing in darkness for 42 days. Method (C), most like natural conditions, formed methylmercury at the fastest rates. The equilibrium concentration of methylmercury was dependent on the rates of the two reactions: methylation of inorganic Hg and transformation of organomercury compounds into inorganic Hg. The lower the rate of demethylation, the higher the concentration of methylmercury. During the 14-28 days necessary to reach equilibrium conditions inorganic Hg formed 1.0 to 3.9% organic Hg, methylmercury was reduced to 42-86% of the original content, and phenylmercury was reduced to 35-43% of the original content. (Cassar-FRC)
W82-05094

DOWNCORE VARIATION IN SEDIMENT ORGANIC NITROGEN,

Case Western Reserve Univ., Cleveland, OH, Dept. of Geological Sciences
For primary bibliographic entry see Field 2H.
W82-05124

FLUXES OF POLYCYCLIC AROMATIC HYDROCARBONS TO MARINE AND LACUSTRINE SEDIMENTS IN THE NORTHEASTERN UNITED STATES,

Indiana Univ., Bloomington. School of Public and Environmental Affairs.
P. M. Gschwend, and R. A. Hites.
Geochimica et Cosmochimica Acta, Vol 45, No 12, p 2359-2367, 1981. 2 Fig, 3 Tab, 50 Ref.

Descriptors: *Hydrocarbons, *Bottom sediments, Marine sediments, Lake sediments, Precipitation, Fluctuations, Aromatic compounds, *Path of pollutants, Cores.

In an effort to quantify the deposition rates for polycyclic aromatic hydrocarbons (PAH) in both remote and urban locales, the PAH abundances in several dated sediment cores from the northeastern United States were determined and the corresponding PAH fluxes to these sites were calculated. Fluxes of 10 of these hydrocarbons were measured for each of six sites for the periods roughly corresponding to the present, 1950, and 1900. Present-day deliveries of individual PAH were consistently close to 1 nanogram per square centimeter per year at remote sites, probably reflecting the atmospheric fallout of these combustion-derived pollutants. The current inputs of individual PAH at sites located nearer to urban centers averaged about 35 nanograms per square centimeter per year, presumably as a result of greater fallout of PAH-laden particles nearer their origins and of runoff delivery of PAH-contaminated sediments. The differences in the relative abundances of individual PAH support assumptions of different delivery mechanisms at urban and at remote locations. Deposition data indicate that current PAH fluxes are 5 to 10 times greater than those of 80 years ago, but that these inputs have diminished by a factor of 2 during the last two decades. (Carroll-FRC)
W82-05138

EXTRACTABLE ORGANIC MATTER IN MUNICIPAL WASTEWATERS. I. PETROLEUM HYDROCARBONS: TEMPORAL VARIATIONS AND MASS EMISSION RATES TO THE OCEAN,

California Univ., Los Angeles. Dept. of Earth and Space Sciences.
R. P. Eganhouse, and I. R. Kaplan.
Environmental Science and Technology, Vol 16, No 3, p 180-186, March, 1982. 3 Fig, 5 Tab, 33 Ref.

Descriptors: *Municipal wastewater, *Ocean dumping, *Hydrocarbons, Chemical analysis, Petroleum, Organic compounds, Organic matter, *California Bight, Fate of pollutants.

The research presented here is part of a large study aimed at characterizing the terrestrial sources of organic matter to the southern California Bight and constructing a reasonable budget for this coastal system. The majority of southern California's municipal wastewaters receive only primary treatment and are introduced directly to the ocean via submarine outfall systems at a water depth of about 60 meters. During 1979 a series of flow proportioned 24 hr composite samples were collected by personnel at each of four treatment plants. Samples were analyzed for total, aliphatic, and aromatic hydrocarbons. Mean total hydrocarbon contents of those effluents having received mainly primary treatment ranged from 6.1 to 16.3 mg/L, whereas sludge concentrations were about 340 mg/L. The vast majority of these hydrocarbons are associated with particulate matter. However, their composition was virtually identical for all effluents. The temporal variations of wastewater total hydrocarbon concentrations appeared to be independent of sampling frequency. From this data Southern California's treatment plants were estimated to discharge more than 17400 metric tons of hydrocarbons per year or 4.9 grams per capita day to coastal waters. This is about double the input rate due to surface runoff in this same region. It also represents nearly 6% of the worldwide input of wastewater borne petroleum to the ocean. Problems associated with global input assessments are considered, and a correlative means of estimating wastewater hydrocarbon concentrations is presented. (Baker-FRC)
W82-05142

EMPIRICAL TEST OF THE ASSOCIATION BETWEEN GROSS CONTAMINATION OF WELLS WITH TOXIC SUBSTANCES AND SURROUNDING LAND USE,

Rutgers-The State Univ., New Brunswick, NJ.
M. Greenberg, R. Anderson, J. Keene, A. Kennedy, and G. W. Page.
Environmentel Science and Technology, Vol 16, No 1, p 14-19, January, 1982. 7 Tab, 11 Ref.

Descriptors: *Well water, *Groundwater pollution, *Land use, *Pesticides, Chlorinated hydrocarbons, *Heavy metals, Water pollution sources, *New Jersey.

In order to get a broad perspective on the spatial distribution of hazardous substances in the environment, it is necessary to explore the relationship between land use and gross contamination by hazardous materials. Data on toxic substances present in water from a sample of 408 wells located throughout the state of New Jersey were used to select the following: the 10 wells most contaminated with light chlorinated hydrocarbons, the 10 wells with the highest levels of pesticides, the 10 wells with the highest levels of heavy metals, and a control group of 10 wells with nondetectable or trace amounts of the 45 toxic pollutants investigated. New Jersey's Land Oriented Reference Data System (LORDS), which provides 21 categories of land use based on aerial photography, was used to identify land uses within a 1 mile radius and within a 10 mile radius of each of the 40 wells selected. Factor analysis showed that the 45 chemicals investigated strongly associated by type and that each of the wells tended to associate with only one of the categories. The Mann-Whitney test and discriminant analysis were used to determine whether any of the four groundwater well groups had significantly different percentages of any of the 21 land uses. Distinctive land-use patterns were found for the 1-mile radius areas surrounding the pesticide and light chlorinated hydrocarbons wells, while the heavy metal and clean well land use profiles were similar to each other. The pesticide wells showed a relative excess of mixed and evergreen forests and agricultural land uses within 1 mile of the well sites, while residential, industrial, utility, commercial, and other urban land uses were dominant in the areas within a 1 mile radius of wells highly contaminated with light chlorinated hydrocarbons. (Carroll-FRC)
W82-05143

EXPERIMENTAL STUDIES TO DETERMINE THE FATE OF PETROLEUM HYDROCARBONS FROM REFINERY EFFLUENT ON AN ESTUARINE SYSTEM,

Bermuda Biological Station, St. Georges West.
A. H. Knap, and P. J. LeB. Williams.
Environmental Science and Technology, Vol 16, No 1, p 1-4, January, 1982. 5 Tab, 24 Ref.

Descriptors: *Industrial wastes, *Fate of pollutants, *Estuaries, Hydrocarbons, *Oil industry, Estuarine environment, *Great Britain.

Southampton Water, which is a major estuary in Great Britain, receives a variety of industrial discharges, the largest of which is from a petroleum refinery at Fawley. The seawater waste derived from cooling and processing and discharged to the estuary contains some dissolved, dispersed, and particulate adsorbed heavy and floating oils. Laboratory experiments were conducted to investigate the various biological, chemical, and physical processes which would act on these effluents close to the point of discharge. The effects of such processes as biodegradation, evaporation and bubble ejection, and adsorption of hydrocarbons by estuarine sediments on refinery effluent incubated in glass containers were investigated. The adsorption of petroleum hydrocarbons by estuarine sediments appears to be the most important removal mechanism within the time scale of the estuarine system. In the laboratory studies, 70% of the hydrocarbons originally in the water column were found in the sediments after 1 hour. The initial concentration of the hydrocarbons in the effluent appears to be the rate-determining factor for the adsorption. Compounds of high water solubility were found to be adsorbed to a lesser extent than the less soluble compounds. This rapid near-source sedimentation can be expected to create a deposit of petroleum hydrocarbons which are available for release to the aqueous environment over an extended period. (Carroll-FRC)
W82-05144

ANTHROPOGENICALLY DERIVED CHANGES IN THE SEDIMENTARY FLUX OF MG, NI, CU, ZN, HG, PB, AND P IN LOUGH NEAGH, NORTHERN IRELAND,

University of New Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey, R. J. Murphy, and S. W. Kyle.
Environmental Science and Technology, Vol 16, No 1, p 23-30, January, 1982. 5 Fig, 6 Tab, 74 Ref.

Descriptors: *Trace metals, *Bottom sediments, *Phosphorus, *History, Water pollution sources, Copper, Zinc, Lead, Mercury, Magnesium, Chromium, Nickel, *Northern Ireland, Lugh Neagh.

Several studies have reported increases in the flux of certain trace metals to the sediments of aquatic systems in industrial, rural, and remote mountain areas. The concentration-depth behaviors of magnesium, chromium, nickel, copper, zinc, mercury, lead, and phosphorus in three sediment cores from a central site in Lough Neagh, Northern Ireland, were examined for changes in the sedimentary flux of these elements. Lough Neagh is a large, relatively shallow lake with a mainly rural catchment which has become eutrophic due to increases of phosphorus loading. Two main periods of change were found. Widespread and comprehensive woodland clearance in the 17th century resulted in a change in the catchment erosion-leaching regime which produced increased sedimentary magnesium, copper, and lead concentrations. A second and more significant change occurred after about 1880 A.D. The concentrations of chromium, copper, zinc, mercury, lead, phosphorus and, to a lesser degree, nickel were found to increase toward the sediment surface. Differing phosphorus and trace metal profiles, a comparison of the estimated anthropogenic sedimentary flux with background atmospheric conditions, and a general comparison with other situations all suggest that background

atmospheric sources make a substantial contribution to more recent contamination of the sediment with copper, zinc, mercury, and lead. These results indicate that the anthropogenic component of the sedimentary flux of chromium, nickel, copper, zinc, mercury, lead, and phosphorus is important in this rural environmental setting and that the trace-metal contamination of Lough Neagh is part of a global pattern. (Carroll-FRC)
W82-05145

HUMIC SUBSTANCES,

J. Josephson.
Environmental Science and Technology, Vol 16, No 1, p 20A, 24A, January, 1982. 1 Fig.

Descriptors: *Decomposing organic matter, Water pollution, *CHemical reaction, *Biochemistry, Humic acids, *Fate of pollutants, Chemical analysis, Model studies.

Increasing attention is being focussed on the chemistry and biochemistry of humic substances as a result of their known and perceived threats to safe water. Humic substances, which are formed when living matter dies and decays, react with metals, anions, organics, and chlorine, forming compounds which present health and environmental hazards. The Symposium on Terrestrial and Aquatic Humic Materials, held at Chapel Hill, North Carolina in November, 1981, was convened to exchange ideas and information on the structure, composition, identification, quantification, and control of humic substances and their reaction products. Humic substances absorb and increase the environmental distribution of inorganic and organic micropollutants. Since humic substances are composed of the reaction products of a large number of other compounds, their molecular structures are generaly hard to identify. Examination of their breakdown prducts may provide some clues to their structures. Comparison of the properties of natural humic material with those model synthetic polymers made from likely precursors might also provide insights into their structures. Studies using calcium as a model for reactions were used to examine the removal of humic subtances from solution in natural waters and the treatment of water supplies. Very little information is currently available on the effects of the binding which occurs between humic substances and free metal ions, anions, and/or other radical and molecular groups with which humic substances could react or on the effects of the breakdown of these compounds, although research in this area is beginning. (Carroll-FRC)
W82-05148

EFFECTS OF ACID PRECIPITATION,

Environmental Protection Agency, Corvallis, OR.
For primary bibliographic entry see Field 5C.
W82-05149

FINGERPRINTING INORGANIC ARSENIC AND ORGANOARSENIC COMPOUNDS IN THE SITU OIL SHALE RETORT AND PROCESS WATERS USING A LIQUID CHROMATOGRAPH COUPLED WITH AN ATOMIC ABSORPTION SPECTROMETER AS A DETECTOR,

California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W82-05151

THE USE OF ALGAE AS BIOLOGICAL ACCUMULATORS FOR MONITORING AQUATIC POLLUTANTS,

Academy of Natural Sciences of Philadelphia, PA. Div. of Limnology and Ecology.
For primary bibliographic entry see Field 5A.
W82-05163

THE TRANSPORT TO AND DEPOSITION OF AMERICIUM IN INTERTIDAL SEDIMENTS OF THE RAVENGLASS ESTUARY AND ITS RELATIONSHIP TO PLUTONIUM,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Environmental Pollution, Series B, Vol 3, No 1, p 1-9, 1982. 3 Fig, 3 Tab, 10 Ref.

Descriptors: *Sediment transport, *Nuclear wastes, Americium-241, Marine sediments, Plutonium, Water pollution sources, *Radioactive wastes, *Ravenglass Estuary, *Great Britain.

The Ravenglass estuary is of radioecological interest, as it is a site of sediment accumulation close to the Windscale nuclear fuel reprocessing facility. Results are presented of analyses of americium-241 in four cores collected from the Newbiggin area at Ravenglass. Surface segments ranged in Am-241 activity from 48.8 to 60.0 pCi/g. In all four cores, greater Am-241 activities were found at depth and in the buried sediments. Greatest activities were found at a few centimeters depth in the sediments. The occurrence of Am-241 peak activities at lesser depths than predicted in the sediments has been interpreted as resulting from a finite lag-time of transport from Windscale to the estuary. The best estimate of this lag time is about 2.5 years.
W82-05178

SULPHUR IN THE ENVIRONMENT: A REVIEW,

Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
K. A. Brown.
Environmental Pollution, Series B, Vol 3, No 1, p 47-80, 1982. 1 Fig, 5 Tab, 124 Ref.

Descriptors: *Sulfur, *Environmental effects, Sulfates, Sedimentation, Nutrients, Cycling nutrients, Marine sediments, Reviews, Sulfur cycle, Soil chemistry, Sulfides, Lakes, Lake sediments, Geochemistry, *Path of pollutants.

The path of sulfur compounds released into the atmosphere by man and by natural processes is reviewed, along with their transformation in the atmosphere and deposition to the earth's surface. The size and nature of the sources and sinks of sulfur in soils are discussed in relation to bio- and geochemical processes which govern the soil sulfur cycle, in particular organic matter transformations and mechanisms of sulfur oxidation and reduction. Environmental effects of sulfur pollution in soils and freshwater systems are considered, and the sulfur budget for a freshwater lake is discussed. Sulfur turnover in a freshwater system is compared with that of the marine environment. In fresh waters, most problems arising through sulfur pollution are caused by sulfate reduction to highly toxic sulfide, or by cations associated with sulfate, the direct toxicity of the sulfate anion being extremely low. Eutrophication does not occur as a result of sulfur pollution because sulfate is probably never growth limiting in natural waters. Sulfate can change the path of carbon mineralization in anaerobic sediments by inhibiting methanogenesis, although the significance in nature of this observation is not known. Sulfate reduction in marine sediments may be a major pathway of carbon mineralization. Most of the iron sulfides present in reduced marine sediments have arisen through bacterial sulfate reduction, rather than from degradation of organic matter. (Baker-FRC)
W82-05179

MICROCOMPUTER WATER QUALITY SIMULATION MODEL,

Camp, Dresser and McKee, Inc., Waltham, MA.
For primary bibliographic entry see Field 7B.
W82-05191

ELIMINATION OF HEXACHLOROBENZENE (HCB) BY RAINBOW TROUT (SALMO GAIRDNERI), AND AN EXAMINATION OF ITS KINETICS IN LAKE ONTARIO SALMONIDS,

Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and C. Y. Cho.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1350-1356, November, 1981. 4 Fig, 1 Tab, 36 Ref.

Descriptors: *Benzenes, *Chlorine, *Trout, *Lakes, Pollutants, Water pollution, Fish, Kinetics, Mathematical equations, *Industrial wastes, Lake Ontario, *Hexachlorobenzene, Pesticides.

The extensive use and worldwide distribution of hexachlorobenzene (HCB), which is an industrial chemical frequently found in wastewaters, have led to increased concern about its becoming an important environmental contaminant. The rate of elimination of HCB by rainbow trout was established and then related to earlier studies that examined HCB uptake from food and HCB levels surveyed in salmonids from Lake Ontario. Subadult rainbow trout (Salmo gairdneri) were fed diets containing HCB to establish mean body burdens of 225 and 440 micrograms HCB per fish. The rate of elimination was then estimated by sampling conducted after 0, 24, 55, and 110 days. Results of these tests showed that the biological half-life of HCB for these trout was at least 7 months, and perhaps as long as several years. The implications of increasing body weight for kinetics measurements are discussed, and an equation is presented which can be used to adjust for changes in body weight where estimates of half-lives are calculated using tissue concentrations. Use of this information in examining the kinetics of HCB in salmonids collected from Lake Ontario resulted in good agreement between the expected level and that monitored in field samples of rainbow trout, but only fair agreement for lake trout and coho salmon. Differences in the HCB kinetics of these species may be attributed to body weight, age, and perhaps feeding habits. Field sampling programs have resulted in reports of HCB concentrations ranging from 1 to 100 micrograms per kilogram in fish. These levels are probably due primarily to the limited availability of HCB in the Lake Ontario environment. (Carroll-FRC)
W82-05195

GROUND-WATER HYDROLOGY AROUND SALT DOMES IN THE EAST TEXAS BASIN: A PRACTICAL APPROACH TO THE CONTAMINANT TRANSPORT PROBLEM,

Texas Univ. at Austin. Bureau of Economic Geology.
G. E. Fogg, and C. W. Kreitler.
Bulletin of the Association of Engineering Geologists, Vol 18, No 4, p 387-411, 1981. 15 Fig, 1 Tab, 44 Ref.

Descriptors: *Groundwater pollution, *Geohydrology, *Salt domes, Aquifer systems, Waste disposal, Aquitards, Groundwater recharge, Groundwater movement, Radioactive waste disposal, *Texas.

Salt domes in the East Texas Basin are being studied as potential sites for deep burial of nuclear waste. This paper presents a report on progress being made in a program designed to characterize the capability of each of two domes, Oakwood and Keechi, and surrounding media to isolate radioactive wastes. The program includes study of factors which control vulnerability of a dome repository to failure, such as dome growth, cap rock development, and salt dissolution, and of factors which determine how radionuclides would be transported away from a dome should a failure occur. Waste escaping from either dome would, at worst, move into either the Wilcox-Carrizo, a thick, semiconfined, fresh-to-brackish groundwater system, or into the Woodbine Formation, a deeper, saline aquifer. The potential for upward discharge from the Woodbine to the Wilcox-Carrizo appears to be nonexistent at present. Potential impacts of a nuclide escape from the domes into the Wilcox-Carrizo would depend in large part on how deeply recharge over each dome would move contaminants downward and on whether the contaminants would then migrate toward discharge areas in the basin due to topographic effects. Orientation of a moderately brackish-water plume extending away from the Oakwood dome implies topographic control on flow and suggests that contaminants escaping from the dome would become significantly diluted within 5 or 6 miles along the pathway. Groundwater chemistry indicates a trend toward greater capacity for attenuation of radionuclides as fluids move from recharge areas into more alkaline, reducing environments in the artesian sections of the Wilcox-Carrizo. (Carroll-FRC)
W82-05202

AN ENVIRONMENTAL HEALTH SURVEY OF DRINKING WATER CONTAMINATION BY LEACHATE FROM A PESTICIDE WASTE DUMP IN HARDEMAN COUNTY, TENNESSEE,

Cincinnati Univ. Medical Center, OH. Dept. of
Environmental Health.
C. S. Clark, C. R. Meyer, P. S. Gartside, V. A.
Majeti, and B. Specker.
Archives of Environmental Health, Vol 37, No 1,
p 9-18, January-February, 1982. 2 Fig. 10 Tab, 24
Ref.

Descriptors: *Carbon tetrachloride, *Drinking water, Industrial wastes, Aquifers, Groundwater contamination, Well water, Wells, Path of pollutants, Potable water, Public health, Leaching, *Leachates, Hazardous wastes, *Waste dumps, Human disease, Liver, Hardenman County, *Tennessee.

By late 1978 officials of the Environmental Protection Agency had detected more than 12 chlorinated organic compounds in wells serving individuals living near the Hardeman County, Tennessee, toxic waste dump. The most abundant toxic substance detected was carbon tetrachloride. Sixty-one individuals in 16 households used water from wells containing carbon tetrachloride in concentrations exceeding 150 micrograms/liter. Two health evaluations were made. Fifty-nine of the 61 individuals participated in at least one of the two studies; 31 participated in both. Others examined included individuals with less contaminated wells and individuals who had been occupationally exposed to pesticides, including those who had worked at the dump site. The study conducted included a health questionnaire, a clinical examination, and a biochemical screening, with analysis of serum for liver and kidney function parameters, determination of hepatitis A and B serology, and bile acid determinations on fasting and postprandial serum and urine specimens. Initial hepatic profile testing revealed elevated concentrations of the serum enzymes, alkaline phosphatase and serum glutamic oxaloacetic transaminase in residents using contaminated water. During follow up examinations two months later, these values had dropped significantly, as had postprandial serum concentrations of the bile acids of cholyglycine. The findings suggest a transitory liver injury probably related to exposure to the contaminated drinking water. (Baker-FRC)
W82-05203

INFLUENCE OF WATER MOVEMENTS AND OTHER FACTORS ON DISTRIBUTION AND TRANSPORT OF HEAVY METALS IN A SHALLOW BAY (CANADA),

Alberta Environmental Centre, Vegreville.
J. W. Moore.
Archives of Environmental Contamination and
Toxicology, Vol 10, No 6, p 715-724, December,
1981. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Heavy metals, *Bays, Water pollution, Bottom sediments, Cyanide, Arsenic, *Mine wastes, Lead, Copper, Zinc, Mercury, Iron, *Canada, *Path of pollutants, Great Slave Lake, *Yellowknife Bay.

Yellowknife Bay, which is situated on the north slope of Great Slave Lake in northern Canada, receives a continuous discharge of liquid mine wastes, including heavy metals, salts, and cyanide, from an operating gold mine. The concentrations of heavy metals in the water and sediments of the bay were measured and correlated with water movement, water depth, distance from the waste source, and the organic content of the sediments. Arsenic reached a maximum concentration of 3100 milligrams per kilogram in sediments near the waste source, decreasing to less than 12 milligrams per kilogram in the extreme reaches of the bay. The corresponding ranges for other heavy metals were 13 to 800 milligrams of lead per kilogram, 45 to 785 milligrams of copper per kilogram, 23 to 935 milligrams of zinc per kilogram, 35 to 505 micrograms of mercury per kilogram, and 1.9% to 6.3% iron. Although most pollutants were recorded at low levels in the water, arsenic and copper rose to 0.75 and 0.29 milligrams per liter, respectively, coincident with maximum discharge from the mine. The most important factor governing the distribution of metals in the bay was found to be water movement, generated by inflowing rivers and wind. While surrounding islands also restricted the movement of pollutants through the bay, water depth, slope of the bottom and organic content of the substrate did not appear to have a significant impact on the concentrations of heavy metals in the sediments. (Carroll-FRC)
W82-05205

AN EVALUATION SYSTEM TO RATE FEEDLOT POLLUTION POTENTIAL,

Science and Education Administration, Morris,
MN. North Central Soil Conservation Research
Lab.
R. A. Young, M. A. Otterby, and A. Roos.
Agricultural Reviews and Manuals ARM-NC-17,
April 1982. 82 p, 3 Fig, 3 Tab, 48 Ref, 6 Append.

Descriptors: *Feedlot runoff, *Animal wastes, *Water pollution sources, *Computer models, Feedlot wastes, Water pollution control, Groundwater pollution, Minnesota, Chemical oxygen demand, Phosphorus, Forecasting, Pollution potential.

An evaluation system was developed through the cooperation of several State and Federal agencies to provide a uniform and objective method of evaluating and rating the pollution potential of the approximately 90,000 animal feedlot operations in Minnesota. The first part of the evaluation consists of five simple questions which can be answered by the feedlot operator, allowing the person making the evaluation to disregard the feedlot immediately if it is definitely not a pollution hazard. If the screening procedure indicates a potential hazard, then a more detailed evaluation form must be completed. The first step is to study the animal lot and the area around it to determine the local watershed, and then sketch the watershed. The next step is to determine the design rainfall for which the feedlot is to be determined. For this model, chemical oxygen demand and phosphorus were selected to represent the potential pollution hazard. The soil cover complex method is used to estimate runoff from rainfall for each area included in the local watershed. Equivalent animal units (EAU) are determined from tables and used as a unit of measure to compare differences in the production of waste constituents by different animal species. Other factors considered in this model include: animal unit density; concentration of runoff at feedlot edge; contact time; pollutant reduction from filtration; and concentration reduction from dilution. Once the final concentration of the runoff at the discharge point is estimated, the pollution hazard can be developed. (Moore-SRC)
W82-05207

RESULTS OF DEEP-WELL INJECTION TESTING AT MULBERRY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
J. J. Hickey, and W. E. Wilson.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB82-193004,
Price codes: A02 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations
81-75, 1982. 15 p, 7 Fig, 5 Ref.

Descriptors: *Injection wells, *Industrial wastes, *Transmissivity, *Aquifer characteristics, Geohydrology, *Liquid wastes, Carbonate rocks, Aquitards, Leakage, Groundwater barriers, *Florida, Mulberry, Waste disposal.

At the Kaiser Aluminum and Chemical Corporation plant, Mulberry, Fla., high-chloride, acidic liquid wastes are injected into a dolomite section at depths below about 4,000 feet below land surface. In 1975, a satellite monitor well was drilled 2,291 feet from the injection well and a series of three injection tests were performed. Duration of the tests ranged from 240 to 10,020 minutes and injection rates ranged from 110 to 230 gallons per minute. Based on an evaluation of factors that affect hydraulic response, water-level data suitable for interpretation of hydraulic characteristics of the injection zone were identified to occur from 200 to 1,000 minutes during the 10,020-minute test. Transmissivity of the injection zone was computed to be within the range from 700 to 1,000 feet squared per day and storage coefficient of the injection zone was computed to be within the range from .00001 to .00005. The confining bed accepting most of the leakage appears to be the underlying bed. Also, it appears that the overlying beds are probably relatively impermeable and significantly retard the vertical movement of neutralized waste effluent. (USGS)
W82-05224

A PRELIMINARY APPRAISAL OF THE EFFECTS OF AGRICULTURE ON STREAM QUALITY IN SOUTHWEST GEORGIA,

Geological Survey, Doraville, CA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-05229

A WIND-POWERED, GROUND WATER MONITORING INSTALLATION AT A RADIOACTIVE WASTE MANAGEMENT SITE IN IDAHO,

Geological Survey, Idaho Falls, ID. Water Resources Div.
J. C. Bagby, G. E. Ghering, R. G. Jensen, and J.
T. Barraclough.
Geological Survey Water Resources Investigations
Open-File Report 81-493, April 1981. 28 p, 14 Fig,
1 Tab, 2 Ref.

Descriptors: *Radioactive waste disposal, *Groundwater, *Monitoring, *Water quality, Path of pollutants, Geohydrology, Waste storage, Water pollution sources, Aquifers, Wells, Contamination, Pumping, Water level, Water sampling, Data collections, *Idaho, Snake River Plain, *Idaho National Engineering Laboratory.

In 1971, four wells were drilled just outside a radioactive solid waste storage and disposal facility located on the Idaho National Engineering Laboratory in southeastern Idaho. This facility, the Radioactive Waste Management Complex (RWMC), has been in use since 1952. These wells serve several purposes: to study the geology and hydrology at the RWMC, to determine the potential for radioactive waste migration, and to obtain water samples to determine if waste products are migrating downward into the Snake River Plain aquifer. Special efforts are made to insure that surface contamination does not enter the wells by either water, wind, or contaminated equipment. A submersible pump and a continuous water-level measuring device were installed in each well. Permanent installation of this equipment allowed the well heads to be sealed while providing for collection of data from these wells. The water-level measuring device is a small diameter, differential-pressure, transducer probe. The transducer produces a variable-reluctance signal which is converted to an analog signal and recorded as the depth to water on a strip chart recorder. Windmill-charged storage batteries provide power for the water-level measuring system. This system is reliable, sensitive, and relatively maintenance free. (USGS)
W82-05233

ASSESSMENT OF WATER QUALITY IN STREAMS DRAINING COAL-PRODUCING AREAS IN OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
C. L. Pfaff, D. R. Helsel, D. P. Johnson, and C. G.
Angelo.
Geological Survey Water Resources Investigations
Open-File Report 81-409, October 1981. 98 p, 17
Fig, 7 Tab, 43 Ref, Append.

Descriptors: *Water quality, *Streams, *Acid mine drainage, *Water pollution sources, *Data collections, Mine wastes, Strip mines, Geohydrology, Statistical analysis, Sampling, Chemical analysis, *Ohio, Coal mines.

Water quality in the coal-producing areas of eastern Ohio was studied in a two-phase investigation between May 1975 and August 1976. Results of

phase one, a reconnaissance of water quality at 150 sites, indicated that acid mine drainage generally occurred where abandoned drift or strip mines were located, whereas areas characterized by reclaimed or active strip mines showed few instances of acid drainage. Phase two was a detailed study of four small basins: One contained abandoned drift mines; the second, abandoned strip mines; the third, reclaimed strip mines; the last, active strip mines. Results of phase two were similar to those of phase one. (USGS)
W82-05234

DYNAMICS OF THE NUMBER OF BACTERIA AND CONVERSION OF READILY OXIDIZABLE SUBSTANCES IN SMALL RIVERS,

Tallin Polytechnic Inst. (USSR).
For primary bibliographic entry see Field 5A.
W82-05237

CONTAINMENT AND TREATMENT OF THE LOVE CANAL LANDFILL LEACHATE,

Niagara Falls Wastewater Treatment Plant, New York.
For primary bibliographic entry see Field 5D.
W82-05250

SULFUR BACTERIAL PROBLEMS REVISTED,

S. Smith.
Water Well Journal, Vol 36, No 2, p 45-46, 1982. 7 Ref.

Descriptors: *Bacteria, *Sulfur, *Corrosion, *Hydrogen sulfide, Water quality, Water analysis, Chemical analysis, Well water, Wells, *Water pollution sources.

There are two very distinct forms of bacteria which interact with sulfur compounds to cause water problems. First there are sulfur or sulfide oxidizers, which are aerobic and require oxygen for growth. The second group are the sulfate-reducers (SRB), which generate hydrogen sulfide and are implicated in the corrosion of iron and steel as well as concrete and other materials subject to attack by hydrogen sulfide. Sulfur bacteria live and act as part of a very complex system of interacting soil chemistry and bacteria. They are the primary agents responsible for the cycling of sulfur compounds through the biosphere, although inorganic processes do remove the bulk of the mineral sulfur through simpler cycles involving sulfide minerals. Sulfur bacteria are found in almost every imaginable environmental condition. Detection and treatment of sulfur bacteria infestations are considered. The simplest and most reliable means of detection is microscopic examination, providing that enough material is present. Treatment for sulfate reducing bacteria is fairly routine. All sulfur bacteria are killed by chlorination. SRBs are also controlled by aeration, since oxygen is poisonous to them. Use of chlorinated drilling water and the avoidance of introducing soil into the borehole are helpful. During routine bacterial tests for coliform types, laboratory tests should also be run to determine iron and sulfur bacteria. (Baker-FRC)
W82-05264

THE DISSIPATION OF NONYLPHENOL IN STREAM AND POND WATER UNDER SIMULATED FIELD CONDITIONS,

Forest Pest Management Inst., Sault Ste. Marie (Ontario).
K. M. S. Sundaram, and S. Szeto.
Journal of Environmental Science and Health, Part B, Vol 16, No 6, p 746-776, 1981. 4 Fig, 10 Ref.

Descriptors: *Microbial degradation, *Organic compounds, Streams, Ponds, Biodegradation, Sediments, Sedimentation, Nonylphenol, *Fate of pollutants, Aquatic environment, Northland Creek, Hargraft Lake, *Ontario, Canada.

The behavior of nonlyphenol was investigated in a static aquatic environment. Natural waters and pond sediment were taken from Northland Creek and Hargraft Lake, northeast of Sault Ste. Marie, Ontario, Canada. Nonylphenol was rapidly dissipated from both stream and pond water when incubated in open flasks at 16 degrees C under simulated field conditions in the environmental chamber. The concentrations decreased exponentially. Nonylphenol persisted much longer in both stream and pond water when incubated in flasks closed with polyethylene snap caps under identical environmental conditions. A transformed product was detected in both stream and pond water when incubated in closed flasks for more than 3 days. The transformed product is probably more polar than the parent, since its retention time was shorter than that nonylphenol in reverse-phase solvent elution, Its formation may be due to photooxidation or microbial hydroxylation of nonylphenol in the aquatic system. The presence of sediment greatly reduced the loss of nonylphenol from pond water through surface volatilization and codistillation. Most of the nonlyphenol adsorbed onto the particulate matter in suspension and then gradually settled in the sediment. Less than 5% of the added nonlyphenol was still present in water incubation for 4 days, and nonlyphenol was no longer detected in water after 10 days. Nonylphenol persisted in autoclaved sediment, but disappeared rapidly in ono-autoclaved sediment. These findings suggest that nonlyphenol was rapidly lost in natural sediment due to microbial degradation. (Baker-FRC)
W82-05273

RETENTION OF URBAN DERIVED PHOSPHORUS BY AN ALLUVIAL SWAMP OF THE COASTAL PLAIN OF GEORGIA,

Georgia Southwestern Coll., Americus. Dept. of Biology.
W. L. Tietjen, and J. C. Carter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224635, Price codes: A05 in paper copy, A01 in microfiche. Report ERC 05-81, July 1981. 68 p, 2 Fig, 17 Tab, 21 Ref. 2 Append. OWRT A-084-GA(1).

Descriptors: *Phosphorus, *Alluvial deposits, *Swamps, *Retention time, Retention capacity, Urban runoff, Urban drainage, Wastewater, Phosphorus removal, Alluvial rivers, Streams, Detention time, Settling basins, *Nutrient removal, Wastewater facilities, Wastewater treatment, Effluent streams, Effluents, Enrichment, Muckalee Creek, *Georgia, Coastal plains, Urban sewage effluent.

The alluvial swamp system of Muckalee Creek near Americus, Georgia was studied for the entire year of 1979 to determine its capability for retaining phosphorus (P) derived from sewage treatment plant effluent and other urban sources. Retention was determined by comparing the swamp P influx (enrichment) from the urban sources, with P outflux five kilometers further downstream. The annual P aqueous concentration in water above the enrichment point was 0.05 mg P/liter, while that below this point was 0.17 mg P/liter. The annual mean estimates for P movement rates were 0.52, 0.84, 0.45, 1.44, and 0.37 g P/second for input sewage, unknown urban sources, upstream contribution, stream transport out of the swamp, and total retention within the swamp, respectively. Only about 20% of the incoming P was retained by the swamp, with an estimated 6.11 g P/ sq m/year. The P accumulation rate in soil sediments is unknown, but it appears that the swamp soil is the major sink for swamp P retention. The data suggest that the contention that the swamp is important in retaining urban-derived P is sound. (Zielinski-MAXIMA)
W82-05286

ACID PRECIPITATION IN THE WASHINGTON CASCADES,

Central Washington Univ., Ellensburg. Dept. of Chemistry.
L. C. Duncan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224643, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1981. 20 p, 5 Fig, 5 Tab, 22 Ref. OWRT A-110-WASH(1), 14-34-0001-1151.

Descriptors: *Acid rain, *Hydrogen ion concentration, *Water analysis, *Sulfuric acid, *Air pollution effects, Rainfall, Air pollution, Fallout, Acidic water, Acidity, Sulfates, Seasonal variation, Watersheds, Catchment areas, Rainfall impact, Local precipitation, Water quality, Pollutants, Ecological effects, Environmental effects, *Washington Cascades, Water pollution sources.

Five sites maintained across the Washington Cascades from January-June 1981 sampled precipitation for determinations of its potential acidity. The precipitation collected at each site was acidic in that the average pH values were substantially below pH 5.6, a level expected for waters containing only equilibrium concentrations of dissolved carbon dioxide. The pH values varied somewhat with lcoation. Sulfate was the dominant negative ion at all sites, even after correction for sea-salt input. The mean strong acid composition over the sites ranged 50-57 weight-% H2S04. Precipitation falling on the Cascades east and windward of the urban Puget Sound area was notably acidic, with a volume average pH of 4.71 at the Cascade Crest (Snoqualmie Pass). Strong acid content in precipitation increased in the summer months. In addition, 29 watershed source lakes lying along the Cascade Crest 3-20 miles north of the site collectors were sampled in the summer of 1981; all lakes were found to be highly sensitive (but not acidified), with alkalinities ranging from 4-190 microequivalents/liter (mean value of 50.4). The lakes were nonetheless, considered to be highly susceptible to acid input, being in a region of thin top soil and resistant strata. (Zielinski-MAXIMA)
W82-05287

NONPOINT SOURCE POLLUTION FROM AGRICULTURAL WATERSHEDS ON COASTAL PLAIN SOILS,

Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224650, Price codes: A03 in paper copy, A01 in microfiche. Report, April 1981. 31 p, 4 Fig, 17 Tab, 12 Ref. OWRT A-046-DEL(1), 14-34-0001-9008.

Descriptors: *Nonpoint pollution sources, *Agricultural watersheds, *Nitrogen, *Phosphorus, Water analysis, Pollution load, Watersheds, Chemical oxygen demand, Waste load, Organic loading, Nitrogen compounds, Nitrates, Ammonia, Water quality, Model studies, Watershed models, Rainfall, Base flow, Storm runoff, *Delaware, *Coastal plains.

A study was conducted on two rural agricultural watersheds in southern Delaware to obtain information on nitrogen (N) and phosphorus (P) loading rates, and to develop data for future water quality modeling efforts. The amount of rainfall N and P was found to be greater than the nonpoint source N and P loading rates. Over 50% of the N, P, and chemical oxygen demand (COD) loads occurred in baseflow. A larger relative percentage of total P, COD, and organic N was transported during storm runoff than nitrate-N. However, there was no observed relationship between N and P concentrations and flowrate for either watershed. Installing best management practices would not greatly affect the reduction of N and P loads. The two watersheds were monitored for a two-year period, with storm runoff, baseflow samples, and rainfall analyzed for nitrate-N, ammonia, organic N, orthophosphorus, total P, COD, and pH. In 1979, the total N and P loading rates were 24.7 and 1.3 kg/ha for one watershed, and 20.8 and 1.4 kg/ha for the other. (Zielinski-MAXIMA)
W82-05291

STUDIES OF NITRIFICATION IN A COKE-WASTE ACTIVATED SLUDGE PROCESS,

Alabama Univ., Birmingham. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W82-05295

REDUCED RUNOFF AND NONPOINT SOURCE POLLUTION THROUGH INCREASED INFILTRATION,

Pennsylvania State Univ., University Park.

For primary bibliographic entry see Field 2G.
W82-05300

METAL CONCENTRATIONS IN GUAM URBAN RUNOFF,

Guam Univ., Agana. Water and Energy Research Inst.
W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224775, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 25, June 1981. 27 p, 5 Fig, 8 Tab, 19 Ref, 2 Append. OWRT A-011-GUAM, 14-34-0001-9012.

Descriptors: *Urban runoff, *Heavy metals, *Water analysis, *Water pollution sources, *Water quality standards, *Guam, Runoff, Urban drainage, Urban areas, Mercury, Lead, Cadmium, Hydrogen ion concentration, Hardness, Contamination, Water pollution, Water quality, Recharge basins, Watersheds, Watershed management, Groundwater basins.

Northern Guam serves as a recharge watershed for the groundwater aquifer that supplies most of Guam's drinking water. Samples from five sites in northern Guam which best characterize runoff from commercial and residential areas were analyzed for heavy metals to assess the potential for aquifer contamination. The 13 metals investigated were arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc. Analyses revealed low levels (in the microgram/liter range) of these metals. Mercury, lead, and cadmium approached/exceeded drinking water standards as dissolved metals in urban runoff. Chromium, copper, iron, manganese, nickel, and zinc were below drinking water standards, but approached/exceeded surface water standards. Other metals analyzed were very low. Suspended metal concentrations were generally higher than dissolved metal concentrations. Metal concentrations in commercial runoffs far exceeded those in residential runoffs. However, commercial runoff waters are discharged in a manner that does not pose a threat to groundwaters used for drinking water. It was concluded that the metal levels found were generally lower than observed in other U.S. communities. Other data (such as pH, total solids, hardness) indicate that urban runoff quality has not changed in the past four years. Further study is needed to determine the distribution of metals in Guam's environment. (Zielinski-MAXIMA)
W82-05302

SEPTIC LEACHATE SURVEYS FOR LAKESIDE SEWER NEEDS EVALUATION,

K-V Associates, Inc., Falmouth, MA.
W. B. Kerfoot, and S. M. Skinner, Jr.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1717-1725, December 1981. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Septic wastewater, *Water pollution sources, *Leachates, Septic tanks, Lakes, Sewer systems, *Lake shores, Groundwater, *Crystal Lake, *Michigan.

A review of wastewater facilities planning for rural lake communities showed that facility plan proposals often viewed the existence of shoreline septic facilities as a priori evidence of water quality problems, that only casual efforts were made to determine whether any cause-and-effect relationships existed between individual septic systems and perceived water quality problems, and that public health officials were generally unprepared to provide comprehensive information on actual water quality and the effect on public health from shoreline septic systems. A specially designed survey was conducted along the shoreline of Crystal Lake in northern Michigan to demonstrate a method for increasing the effectiveness of evaluation of septic systems. The performance of shoreline on-lot treatment systems was analyzed through the use of a newly developed septic leachate detector, a groundwater flow meter, a surface and groundwater sampling program, and mathematical techniques for evaluating the condition of groundwater plumes. Three different types of discharges from malfunctioning shoreline systems were identified by the survey: erupting groundwater plumes, dormant (seasonal) groundwater plumes, and surface-water plumes. The position and density of plumes were related to the observed flow of shoreline groundwater. The survey showed that more than 90 groundwater plumes of wastewater origin were entering the shoreline from the 1090 seasonal and year-round residences. The greatest frequency of erupting plumes was found along the unsewered shoreline. A high correlation was found between the location of emergence of plumes and attached plant growth, particularly Cladophora. There did not appear to be any significant change in surface water nutrient contents as a result of plume emergence. The location and characteristics of emergent plumes were directly related to the prevailing groundwater flow. (Carroll-FRC)
W82-05322

RANDOM DIFFERENTIAL EQUATIONS IN RIVER WATER QUALITY MODELING,

Humboldt State Univ., Arcata, Dept. of Engineering.
For primary bibliographic entry see Field 6A.
W82-05343

HYDRODYNAMIC DISPERSION DURING ABSORPTION IN A FINE SAND 1. THE CONSTANT CONCENTRATION CASE,

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and M. J. Jones.
Water Resources Research, Vol 18, No 1, p 91-100, February, 1982. 8 Fig, 14 Ref.

Descriptors: *Solute transport, *Absorption, *Dispersion coefficient, Numerical analysis, Sand, Hydrodynamics, Unsaturated flow, Soil water, Path of pollutants.

This peper reports results of the investigation of the velocity dependence of the hydrodynamic dispersion coefficient for a fine sand during horizontal adsorption of a solute under constant concentration conditions. Experimental data obtained with Bungendore fine sand was compared with quasianalytical solutions using constant-valued dispersion coefficients and with numerical solutions. Agreement was good when a constant dispersion coefficient of 10 to the minus 8th power sq m per sec was used. Results from computer-based numerical analysis agreed well with the integral solution. Concentration profiles obtained from numerical analysis in the case of a velocity-dependent dispersion coefficient had less scatter than experimental data. Therefore, the velocity-dependent effect cannot be described solely on the basis of experimental data. The fact that the Peclet numbers appropriate to the system were greater than unity suggests that the dispersion coefficient is velocity dependent and that the parameters used in the numerical analysis to express this dependence are satisfactory for Bungendore fine sand under constant concentration adsorption. (Cassar-FRC)
W82-05347

SURFACE CHEMICAL THEORY AS AN AID TO PREDICT THE DISTRIBUTION AND THE FATE OF TRACE CONSTITUENTS AND POLLUTANTS IN THE AQUATIC ENVIRONMENT,

Eidgenoessische Technische Hochschule, Zurich (Switzerland).
W. Stumm.
Water Science and Technology, Vol 14, No 1/2, p 481-491, 1982. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Adsorption, *Particulate matter, *Sedimentation, *Fate of pollutants, Surface chemistry, Mass transfer, Model studies.

Surface chemical theory provides some of the information (constants and coefficients related to adsorption and mass transfer) needed to describe the reactions occurring at the water-particulate interface and to predict the fate of pollutants in the aquatic environment. The emphasis of the discussion is adsorption of dissolved species onto aquatic particles and the role of scavenging by settling particles. Models for predicting adsorption and settling are reviewed. (Cassar-FRC)
W82-05353

IMPACT OF DISCHARGES AS A BASIS FOR CONTROL MEASURES,

Union Carbide Corp., South Charleston, WV.
R. A. Conway.
Water Science and Technology, Vol 14, No 1/2, p 95-109, 1982. 4 Fig, 4 Tab, 25 Ref.

Descriptors: *Risks, *Water quality standards, *Environmental effects, Fate of pollutants, Solute transport, Chemical reactions, Biotransformation, Ecological effects, Water pollution effects, Decision making, Model studies, Effluent standards, Data collections, Chemical wastes, Wastewater pollution, *Water pollution control.

Methods of environmental risk analysis are described as a basis for tailoring water pollution control measures to individual effluents and receiving waters. There are 4 basic approaches to environmental risk analysis. The stochastic-statistical approach establishes correlations between input of a material and results. The model ecosystem, or microcosm, tests the results of a pollutant on a physical model of an environmental situation, for example, an aquarium. The deterministic approach uses mathematical models to describe the fate and transport of pollutants in the environment. The baseline approach constructs full-scale characterizations of transport, persistence, and effects of chemicals and compares results of later pollutant additions with the original data. Tiered testing protocols start with simple screening tests to guide decision making for materials of small impact and use tests of increasing complexity as decisions having large impact are needed. Tables list some candidate tests for screening the ecological impact of new products and effluents, mechanisms affecting environmental fate of chemicals, and environmental process and properties (physical, chemical, and biological transformations and transports). Mathematical models for estimating concentrations of chemicals after transport and transformation are reviewed. (Cassar-FRC)
W82-05354

DETERMINATION OF METALS IN GROUNDWATERS BY TRACE ENRICHMENT AND LIQUID CHROMATOGRAPHY,

Atomic Energy of Canada Ltd., Chalk River (Ontario).
For primary bibliographic entry see Field 5A.
W82-05361

A SURVEY OF AZINPHOS METHYL AND AZINPHOS METHYL OXON IN WATER AND BLUEBERRY SAMPLES FROM HANCOCK AND WASHINGTON COUNTIES OF MAINE,

Maine Univ. at Orono. Dept. of Food Science.
R. J. Bushway, W. Litten, K. Porter, and J. Wertam.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 341-347, March, 1982. 1 Fig, 3 Tab, 6 Ref.

Descriptors: *Insecticides, *Fate of pollutants, *Pesticides, Azinphos methyl, Guthion, *Maine, *Blueberries, Well water, Water pollution, Streams.

Water samples at seven sites in Washington and Hancock Counties, Maine, were analyzed for the insecticide azinphos methyl (guthion) and its metabolite, azinphos methyl oxon. The pesticide is sprayed extensively on low bush blueberry acreage. Azinphos methyl was detected in two locations: household well water in a sprayed field, 1900-24,000 ng per liter; and process water from a blueberry processing plant, 12,700 ng per liter. No azinphos methyl oxon was detected in any sample (detection limit, 230 ng per liter). The other five sites with nondetectable levels of azinphos methyl were two streams, a pond outlet, a clam flat area, and a tidal flat. The well water sample was analyzed several times during the summer, during which the pesticide was applied twice. The high concentration of 24,000 ng per liter was found on

July 23. The August 11 sampling showed no detectable pesticide. Most likely this reduction was caused by groundwater dilution rather than degradation. (Cassar-FRC)
W82-05376

RADIOTRACER EXPERIMENTS ON PHOSPHORUS UPTAKE AND RELEASE BY LIMNETIC MICROZOOPLANKTON,

Canada Centre for Inland Waters, Burlington (Ontario).
W. D. Taylor, and D. R. S. Lean.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1316-1321, November, 1981. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Phosphorus, *Lakes, *Microorganisms, Zooplankton, Phosphorus radioisotopes, Nutrients, Phosphate, Isotopic tracers, Metabolism, Path of pollutants, *Phosphorus uptake and release, Strombidium virde, *Ontario, Canada.

Previous studies have suggested that very small zooplankton, particularly ciliated protozoa, might be particularly important in mineralization of limnetic phosphorus. This study investigated phosphorus uptake and release by Strombidium viride, a ciliate species abundant in lake plankton. Addition of carrier-free 32P04 to lakewater resulted in gradual labeling of S. viride over at least 30 hours. The label entered the protozoa primarily by the ingestion of labeled particles 0.2 to 1.0 microns in size; direct uptake of phosphate or uptake of particles 5 microns or larger was relatively slight or absent. S. viride transferred to unlabeled lake water lost 32P by a discontinuous process, presumed to be defecation, and by a relatively slow continuous process. The latter process was presumed to be the equivalent of what is usually termed excretion for crustacean zooplankton and is equivalent to a turnover time for the animal's phosphorus content of many hours. Release experiments with the rotifer Keratella cochlearis resulted in similar total losses of 32P, although defecation provided a much larger portion of the total. The turnover times for excretion were similar for the two organisms. Analysis by gel filtration showed that the soluble phosphorus released by both species was primarily phosphate. The results of these experiments do not support the conventional view that microzooplankton regenerate dissolved phosphorus much more rapidly for their biomass than do larger crustacean zooplankton. (Carroll-FRC)
W82-05381

VARIATION IN FECAL POLLUTION INDICATORS THROUGH TIDAL CYCLES IN THE FRASER RIVER ESTUARY,

Department of the Environment, Vancouver (British Columbia). Inland Water Directorate (Pacific Region).
For primary bibliographic entry see Field 5A.
W82-05384

GROUNDWATER STRATEGY: PROTECTING A VITAL RESOURCE,

C. W. Warren.
Clearwaters, Vol 11, No 1, p 6-7, March, 1981.

Descriptors: *Groundwater, *Water resources development, *Aquifers, Contamination, Water pollution sources, *Legislation, Legal aspects, Regulations, Standards, *Water pollution control, United States.

Groundwater is seriously contaminated in many areas throughout the nation. This contamination includes a variety of materials such as toxic organic and inorganic chemicals. No federal health standards exist for most of the organic chemicals found in drinking water. There are two major sources of groundwater contamination: hazardous waste dump sites and wastewater surface impoundments. Over 600 cases of groundwater contamination due to impoundments have been reported in the nation. Even this number is probably a very low estimate of actual cases. Recent national monitoring efforts have confirmed that groundwater contamination is widespread. Frequently contaminants are found at high concentrations, due to the fact that aquifers do not provide the natural dilution which occurs in surface waters. A contaminant that penetrates groundwater tends to form a plume of highly contaminated water which moves very slowly. Clean-up of contaminated aquifers is an extremely expensive and difficult process. The most important laws which deal with groundwater contamination are the Federal Water Pollution Control Act, the Safe Drinking Water Act, the Toxic Substances Control Act, the Resource Conservation and Recovery Act, and the recently passed 'Superfund' legislation. The EPA is now proposing a National Groundwater Protection Strategy which should help focus on the goal of protecting the groundwater resources. (Baker-FRC)
W82-05403

EFFECT OF TURBULENT DISPERSION ON THE RATE OF AMMONIA NITROGEN IN RIVERS,

Technical Univ. of Istanbul (Turkey). Environmental Sciences Div.
D. Orhon, and E. Goneng.
Water Science and Technology, Vol 14, No 1/2, p 345-366, 1982. 20 Fig, 2 Tab, 9 Ref.

Descriptors: *Ammonia, *Turbulent flow, *Nitrification, *Fate of pollutants, Rivers, Chemical reactions, Oxidation, Biochemical oxygen demand, Shock loads, Plug flow, Industrial wastes, Fertilizers, Model studies, *Turkey, Porsuk River.

A model for predicting the fate of ammonia in rivers subject to unsteady discharges includes biochemical oxidation and longitudinal dispersion components. Theoretical analysis and field tests on the Porsuk River determined that the concept of turbulent diffusion should be included in the model to prevent the misleading conclusions obtained when rivers are idealized as plug flow reactors. This river receives periodic loads of ammonia from a fertilizer factory. The effect of turbulent diffusion is less important at high rates of biochemical conversion. (Cassar-FRC)
W82-05418

ENVIRONMENTAL IMPACT OF THE MICROBIAL AEROSOL EMISSIONS FROM WASTEWATER TREATMENT PLANTS,

Metropolitan Sanitary District of Greater Chicago, IL.
C. Lue-Hing, D. R. Zenz, and S. J. Sedita.
Water Science and Technology, Vol 14, No 1/2, p 289-309, 1982. 9 Fig, 5 Tab, 20 Ref.

Descriptors: *Wastewater treatment, *Risks, *Public health, *Microorganisms, *Chicago, Illinois, Viruses, Bacteria, Aerosols, Coliforms, Aeration, Air pollution, Water pollution effects, Fate of pollutants, *Environmental effects.

Microbial aerosol emissions from wastewater treatment plants are not a significant health risk to the population living in the vicinity of a treatment plant. This is the conclusion of a literature survey and analysis of data collected at a plant operated by the Metropolitan Sanitary District of Greater Chicago in 1979-80. Aerosol sampling in vertical profiles above the aeration tanks and 5, 25, and 50 m downwind of the aeration tanks showed that standard plate count levels of bacteria declined exponentially with distance above the tanks and linearly with distance downwind of tanks. At a distance of 50 m downwind, the fecal coliforms and total coliforms approached background levels. Net bacterial emissions (background subtracted) measured 0.3 m above 2 tanks were 0-1136 colony forming units per cu m, with geometric means of 386 and 208 cfu per cu m above each tank. No detectable animal viruses were collected 3 m downwind of the aeration tanks. (Cassar-FRC)
W82-05428

NEW TRENDS IN WATER QUALITY MANAGEMENT,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary). Inst. for Water Pollution Control.
For primary bibliographic entry see Field 5G.
W82-05429

FATE OF SUSPENDED BIOLOGICAL SOLIDS DISCHARGED TO RECEIVING WATERS,

National Council for Air and Stream Improvement, Inc., Medford, MA.
H. S. Costa, J. J. McKeown, and D. L. Borton.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2432-2441, October, 1980. 4 Fig, 8 Tab, 19 Ref.

Descriptors: *Suspended solids, *Effluents, Sedimentation, *Sediments, Water pollution sources, Wastewater treatment, Biological treatment, Biological wastewater treatment, *Path of pollutants, *Radioactive traces, Tracking techniques.

This study was undertaken to identify and quantify the major pathways through which effluent total suspended solids are assimilated naturally in receiving waters. Effluent suspended solids were traced in a receiving stream by using a radioisotope tag. The findings suggest that the major sink for total suspended solids discharged from biological treatment systems is oxidation, while the solids remain in suspension. Effluent biosolids also were ingested and incorporated into the cellular materials of aquatic food-chain organisms in a logical food-chain pattern. The C-14 tagged biosolids discharged to the receiving water traced the effluent solids at a diluted TSS concentration of 2 mg/l. Sediment traps placed in pools behind dams captured less than 5% of the discharged solids. Over 95% of the discharged solids remained suspended or were oxidized in the stream, even though stream velocities were conducive to settling. All measureable C-14 contained in the effluent from a 1-day aerated stabilization basin was incorporated in solids that were suspended. A 31% reduction in C-14 tagged biosolids occurred during 2.5 days of plug-flow travel through an unaerated polishing pond following aerated stabilization basin (ASB) treatment. Of the amount removed in the polishing pond, 36% settled, and it was postulated that the remaining 64% exited as methane or carbon dioxide. Additional treatment consisting of aeration and quiescent detention for 0.25 day resulted in a 6% reduction in TSS. Of that amount, 48% was traced to sediment and 52% to having escaped as methane or carbon dioxide. (Baker-FRC)
W82-05448

PLANKTONIC INFUSORIA AS INDICATORS OF THE EXTENT OF ORGANIC POLLUTION IN AZERBAIDZHANIAN RESERVOIRS,

Akademiya Nauk Azerbaidzhansjoi SSR, Baku. Inst. Zoologii.
For primary bibliographic entry see Field 2H.
W82-05454

FORMS OF THE MIGRATION OF METALLIC IONS IN FRESH WATER,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2K.
W82-05456

MANGANESE, ZINC AND COPPER IN HYDROBIONTS IN THE DANUBE AND THE NORTHWESTERN BLACK SEA,

Institute of Biology of the Southern Seas.
L. I. Rozhanskaya, and O. B. Spirandi.
Hydrobiological Journal, Vol 17, No 1, p 78-83, 1981. 1 Tab, 19 Ref.

Descriptors: *Heavy metals, *Aquatic life, *Path of pollutants, Manganese, Zinc, Copper, *Black Sea, *Danube River, Rivers, Fish, Algae, Mollusks, Metabolism, Aquatic plants.

The concentration of heavy metals by hydrobionts in the Danube and the adjacent Northwestern Black Sea was investigated. Phyllophora collected in July 1977 in the Northwestern Black Sea had a very high manganese content of 740 mg/kg wet mass. The amount of manganese in Phyllophora obtained in the same area in August was 151 mg/kg. The amount of manganese in Cystoseira was 14.0 mg/kg. The concentration of manganese in Cystoseira barbata collected in the Black Sea was considerably lower, between 1.7 and 2.4 mg/kg wet mass. Zinc content in Phyllophora was higher

than in the other algal species, but one order lower than manganese. The amount of zinc in Phyllophora was 70.3 mg/kg in July and 26.3 mg/kg in August. The amount of zinc in Enteromorpha collected in the Black Sea along the Rumanian coast was 107 mg/kg. High zinc content was noted in the viscera of fish, especially bream, in which the content was 2920 mg/kg ash, or 70.2 mg/kg wet mass. The highest copper content was recorded in the July Phyllophora samples at 29.4 mg/kg. The high content of all trace elements in the July Phyllophora was probably connected with its growth. Almost all the young segments developing in the spring reach maturity in July. The concentration factors determined here in hydrobionts from the Danube and the Northwestern Black Sea may be used when setting standards for the pollution of water by heavy metals. (Baker-FRC)
W82-05458

CHEMICAL CHANGES OF LAKES WITHIN THE MOUNT ST. HELENS BLAST ZONE,

Washington Univ., Seattle. Fisheries Research Inst.
R. C. Wissmar, A. H. Devol, A. E. Nevissi, and J. R. Sedell.
Science, Vol 216, No 4542, p 175-178, April 9, 1982. 2 Fig, 1 Tab, 19 Footnotes.

Descriptors: *Lakes, *Volcanoes, *Water quality, Dissolved solids, Mount St. Helens, Washington, Air pollution, Fate of pollutants, Chemical composition.

Water in 12 lakes devastated by the Mount St. Helens May 18, 1980, eruption and in 4 lakes outside the blast zone were sampled on June 30, 1980. Changes in dissolved constituents depended on the lake's location relative to the lateral blast trajectory of the eruption and to the location of mineral deposits. In general Spirit Lake showed the greatest changes. Total alkalinity increased 22-fold; Mn, 815-fold; Fe, 193-fold; phosphate, 248-fold; sulfate, 157-fold; and chloride, 85-fold. K, Na, Ca, Mg, P, silicate, ammonia, Al, and Cu were enriched to a lesser degree, 13 to 40-fold. Zn, Pb, and Sb were increased from 2 to 4-fold. Enrichments of dissolved chemicals in other lakes also reflect the influences of dissolution of magmatic and lithic deposits. pH changes were minor because of buffering by carbonic acid, neutralization by mineral particles, the limited acid sulfate alteration of minerals, and dissociation of dissolved humic substances. (Cassar-FRC)
W82-05459

RADIONUCLIDES IN MONO LAKE, CALIFORNIA,

Lamont-Doherty Geological Observatory, Palisades, NY.
H. J. Simpson, R. M. Trier, J. R. Toggweiler, G. Mathieu, and B. L. Deck.
Science, Vol 216, No 4545, p 512-514, April 30, 1982. 2 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Radioisotopes, *Lake sediments, *Water pollution sources, Radioactive wastes, Adsorption, Uranium radioisotopes, Isotope studies, Radium radioisotopes, Plutonium, Thorium, Carbonates.

In the water column of Mono Lake, a natural alkaline, saline lake of California, unusually high levels of uranium (U), thorium (Th) and plutonium (Pu) have been recorded. Information on the behavior of radionuclides in natural waters may aid in assessment procedures for the isolation and storage of nuclear wastes. The enhanced solubility of actinide elements with oxidation states IV to VI was attributed to complexing with carbonate ions. After inorganic carbon was experimentally removed from lake water by acification, and the pH was adjusted to 10, over 90% of the Th and Pu moved from the aqueous to the sediment phase, while the particle concentration of U increased. Fallout strontium-90 has been largely removed from the water, most probably as a result of coprecipitation with calcium carbonate. Daughter/parent activity ratios of Th, radium, and U isotopes indicate that Th is removed from the water column on time scales much longer than a month and that the desorption of Th from sediments to the water column takes place in less than a few years. (Geiger-FRC)
W82-05461

THE IMPACT OF FISH FARMING ON WATER QUALITY,

Solway River Purification Board (Scotland).
D. J. Tervet.
Water Pollution Control, Vol 80, No 5, p 571-581, 1981. 7 Fig, 6 Tab, 16 Ref.

Descriptors: *Fish farming, *Water quality, Water use, Water pollution control, Diseases, Public health, Fish diseases, Wastewater, Fish food, Pollutants, Water pollution sources.

The dramatic increase in the fish farming industry has caused river authorities to become concerned about the pollution potential of this industry. Water quality problems resulting from fish farming include abstraction problems, pollution control problems, and disease control problems. Pollution control, which is particularly important when high densities of fish are being maintained with water of restricted availability, is caused primarily by wasted food and fecal material. In order to investigate the pollution control problems related to fish farming, a brief survey of general conditions at fish farms within the Solway River Purification Board's area in Scotland was conducted, and one particular rainbow trout rearing farm was studied in detail in order to quantify the pollution problems. These studies showed that a considerable reduction of water quality occurred on many occasions at fish farms and that these occasions were especially serious where the farms abstracted most of the water flow from a watercourse. The extent of the reduction in water quality was found to correlate closely with the weight of fish carried and the flow through a farm. It was concluded that pollution was liable to result downstream from fish farms unless annual production rates were maintained at levels well below 200 tons for each 1 cubic meter per second of available flow. This constraint is less important as the residual flow in the watercourse increases, but is significantly affected by the quality of water available. It may be necessary to install effluent treatment processes at fish farms in order to maintain current production rates. (Carroll-FRC)
W82-05471

GROUNDWATER POLLUTION INVESTIGATIONS IN THE GREAT OUSE BASIN,

Anglian Water Authority (England).
D. J. Tester, and R. J. Harker.
Water Pollution Control, Vol 80, No 5, p 614-631, 1981. 4 Fig, 6 Tab, 25 Ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Waste pollution prevention, *Water quality control, Aquifers, Leachates, Solid waste disposal, Oil spills, Great Ouse Basin, England.

The principal aquifer of the Great Ouse basin is the Chalk, which supplies over 50% of the water needs of East Anglia. Waste disposal, effluent discharges, and accidental spillage were investigated at several sites in the basin where the groundwater in the underlying aquifer was thought to be contaminated by chemical spillage, waste disposal activities, and agricultural practices. The investigations were designed to establish the extent of contamination of the aquifer in the vicinity of the site, to assess the pollution risk to abstractors and/or surface watercourses resulting from the spread of pollutants from the site and to determine any necessary remedial actions, and to provide more information on the movement and attenuation of pollutants in groudwater. The results of two case studies which provided useful information on the movement and attenuation of pollutants in the Chalk aquifer are presented. Chloride was found to be an effective tracer of sewage effluent contamination. Organic matter was found to rapidly attenuate within short distances of sewage disposal sites. The potential use of the Chalk aquifer for sewage treatment is discussed. Biological activity affects groundwater quality by depleting dissolved oxygen levels and using oxygen chemically bound to nitrate and/or sulfate. Traces of certain soluble complex organic compounds present in oil spills can persist in the aquifer and can seriously affect the quality of the groundwater. (Carroll-FRC)
W82-05475

THE OCCURRENCE OF SEWAGE-BORNE PATHOGENS IN THE UK,

Liverpool School of Tropical Medicine (England). Dept. of Parasitology.
W. Crewe, and R. R. Owen.
Water Pollution Control, Vol 80, No 5, p 632, 637, 1981. 4 Fig, 1 Tab.

Descriptors: *Pathogens, *Municipal wastewater, *Parasites, Public health, Protozoa, Trematodes, Nematodes, Cestodes, Great Britain, Water pollution sources.

A considerable number of protozoan and helminth parasites could theoretically be transmitted through sewage in the United Kingdom. The transmission of fecal-borne human parasites of humans usually depends upon human ingestion of the state of the parasite which is found in sewage following contamination of food or drink. Parasites transmitted in this way include the intestinal protozoa Entamoeba histolytica, the cause of amoebic dysentery, and Giardia intestinalis, which often causes severe diarrhea. The only trematode parasite of humans found in the United Kingdom is the sheep liver fluke, which could only be transmitted if sewage containing the eggs of the parasite were spread on pasture on which the right species of snail was breeding. Although the eggs and larvae of some common intestinal nematodes are found in considerable numbers in sewage sludges in Great Britain, they cannot be transmitted because suitable conditions for their development in soil are not common there. The nematodes Ascaris and Trichuris are transmitted, at least in small numbers, through sewage sludges used as garden fertilizers. The beef tapeworm is the only parasite of humans indigenous to the United Kingdom which is cause for concern. This parasite, which is of veterinary and economic importance, is found in sewage in the stage infective to cattle. Further information is needed before any conclusions can be drawn concerning the importance of sewage sludge in the spread of pathogens generally, and parasites specifically. (Carroll-FRC)
W82-05476

THE FATE OF ORGANIC POLLUTANTS IN FROZEN WATERS: SUNLIGHT PHOTODECOMPOSITION OF URACIL HERBICIDES IN FROZEN AQUEOUS SOLUTIONS,

Utah Water Research Lab., Logan.
A. J. Acher.
Water Research, Vol 16, No 4, p 405-410, April, 1982. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Decomposition, *Fate of pollutants, *Herbicides, *Pesticide kinetics, *Ice cover, Degradation, Hydrogen ion concentration, Pesticides, Oxidation, Irradiation, Organic pesticides, Organic compounds.

The photooxidative stability of two uracil herbicide derivatives in frozen sensitized solutions under simulated winter conditions was examined. Solutions of bromacil and terbacil were exposed directly to sunlight or covered by different thicknesses of ice. At all three pH levels tested (6.8, 8.2, and 9.1), both herbicides were rapidly decomposed by sunlight in the presence of a sensitizer, methylene blue, rose bengal or riboflavin. In the first two hours of irradiation, the maximum decomposition of bromacil and terbacil occurred in the alkaline pH range when the sensitizers were used. At pH 6.8, a practical rate of photodecomposition was found only for terbacil. When the frozen samples were covered by 11 cm of ice, the photodecomposition rates remained high enough to be of practical value. Extract residues of irradiated solutions of bromacil and terbacil contained no herbicides upon TLC and GC-MS analysis. Only small amounts of one decomposition product were found in a residue concentrate of the bromacil solution, while minute quantities of four decomposition products

were found in a residue concentrate of the terbacil solution. (Geiger-FRC)
W82-05479

INVESTIGATIONS INTO THE PROTECTIVE EFFECT OF ESTUARINE SEDIMENT ON VIRUS SURVIVAL,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5C.
W82-05485

BIODEGRADATION OF SYNTHETIC CRUDE OIL IN TWO RIVERS OF NORTHERN ALBERTA, CANADA,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. A. Lock, R. R. Wallace, and D. W. S. Westlake.
Water Research, Vol 16, No 4, p 497-500, April, 1982. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Oil, *Aquatic bacteria, Microbial degradation, Water temperature, Rivers, Oil pollution, Hydrocarbons, Water pollution sources.

The potential capacity of the Muskeg and Steepbank, two brown-water rivers in Northern Alberta, to biodegrade synthetic crude oil was examined in laboratory tests. The Steepbank River flows through the Athabasca oil sand deposits characteristic of this area. Samples of water and rocks were taken from various stations in December 1977 and were exposed for various periods of time to previously frozen and sterilized water samples from either river. Gas chromatographs from these incubates were compared with incubates containing known oil-degrading bacteria cultures. All samples of water and epilithon from both rivers were able to biodegrade the saturate fraction of synthetic crude oil resulting from the up-grading of oil sand suggesting that the oil degradative capability of river microorganisms was ubiquitous in this area. At 4 degrees, degradation was quite rapid, although even higher degradation rates were observed at 20 degrees. The Muskeg and Steepbank water temperatures are close to 0 degrees for about six months of the year. (Geiger-FRC)
W82-05486

FILTERING OF DISSOLVED OXYGEN DATA IN STREAM WATER QUALITY ANALYSIS,

Hawaii Univ., Honolulu. Dept. of Civil Engineering.
C. C. K. Liu.
Water Resources Bulletin, Vol 18, No 1, p 15-20, February, 1982. 5 Fig, 1 Tab, 11 Ref.

Descriptors: *Dissolved oxygen, *Water quality, *Streams, Simulation analysis, Data interpretation, Decomposing organic matter, Mathematical models.

Most of the stream biological oxygen demand/dissolved oxygen water quality models currently used for the purpose of waste assimilative capacity analysis and waste load allocation in natural receiving waters are steady state models, largely due to their simplicity. In a bioligically active stream, observed dissolved oxygen content is the result of several dynamic processes, including photosynthesis and respiration actions which cause diurnal fluctuations of oxygen levels. A set of equations has been developed which can be used to separate the time varying effects of these biological activities from observed dissolved oxygen data based only on readiily available field data. The resultant steady state dissolved oxygen profile allows a reasonable stream simulation based on a model and data which do not contain dissolved oxygen due to biological activities. By excluding the highly variable processes of biological dissolved oxygen production and consumption, this method significantly simplifies stream dissolved oxygen modelling. Unless changes in stream ecology are a major concern, it is desirable to formulate the stream water quality model without this time-varying term. (Carroll-FRC)
W82-05488

NITRATE REDUCTION BY PSEUDOMONAS SPP.: ANTAGONISM BY FERMENTATIVE BACTERIA,

Freshwater Biological Association, Ambleside (England).
R. W. Horsley, J. V. Roscoe, and I. B. Talling.
Journal of Applied Bacteriology, Vol 52, No 1, p 57-66, 1982. 3 Fig, 4 Tab, 32 Ref.

Descriptors: *Bacteria, *Nitrates, *Denitrification, Fate of pollutants, Nitrites, Heterotrophic bacteria, Rivers, Escherichia coli, Aeromonas hydrophila, Enterobacter aerogenes, Chemical reduction, Oxidation-reduction potential.

Pseudomonas denitrificans was incubated aerobically or anaerobically with fermentative heterotrophs (Aeromonas hydrophila, Escherichia coli, and Enterobacter aerogenes) at ratios of 100:1 to 0:100 in culture media comprised of glycerol, yeast extract, and 140 or 700 mg per liter nitrate-N. Under aerobic and anaerobic condition and with a 140 mg per liter nitrate-N concentration, 97-99% of nitrate was reduced at all ratios of A. hydrophila and E. coli with P. denitrificans. Nitrite accumulated only in the presence of pure heterotroph cultures. At the 700 mg per liter concentration of nitrate-N, 12-100% of the nitrate was reduced to nitrite in mixed cultures of P. denitrificans:heterotroph at ratios of 10:1 or less. P. denitrificans and A. hydrophila mixtures produced less nitrite than did coliforms. Inhibition of nitrate reduction was evident when 100-150 mg per liter nitrite-N had accumulated in the media. As nitrite accumulated in the 700 mg per liter nitrate-N culture, P. denitrificans decreased in number and heterotrophs slightly increased. When P. denitrificans, E. coli, and 50:50 mixtures of the two bacteria were added to autoclaved river water containing 3.5-10.0 mg per liter nitrate-N and 0.23-0.81 mg per liter nitrite-N, nitrite concentrations after incubation for 7 days at 20 C were (in mg per liter) E. coli, 1.48-5.03; P. denitrificans, 0.05-0.48; and 50:50 mixture, 0.06-1.12. (Cassar-FRC)
W82-05499

TRANSPORT PROCESSES OF COPPER AND ZINC IN A HIGHLY EUTROPHIC AND MEROMICTIC LAKE,

Eidgenoessische Anstalt fuer Wasservorgung, Abwasserreinigung und Gewaesserschutz, Kastienbaum (Switzerland). Lake Research Lab.
P. Baccini, and T. Joller.
Schweizerische Zeitschrift fur Hydrologie, Vol 43, No 1, p 176-199, 1981. 18 Fig, 3 Tab, 19 Ref.

Descriptors: *Copper, *Zinc, *Lakes, Sedimentation, Eutrophic lakes, Meromictic lakes, Sedimentation rates, Heavy metals, Iron, Anaerobic conditions, Diffusion coefficient, Mathematical models.

Previous studies of the effects of heavy metal inputs on the ecology of aquatic systems have indicated that copper and zinc are the two elements whose tolerance limits should be lowered to prevent toxic effects on plankton communities in Swiss running waters. The residence time of copper and zinc in holomictic systems under aerobic conditions can be predicted if the production of biomass, the sedimentation rate, and the hydraulic properties of the lake are known. Lake Baldegg, a meromictic lake in central Switzerland, was selected for study of the effects of a permanent anaerobic hypolimnion on the transport of copper and zinc within the lake. An analysis of the seasonal variations of the dissolved and particulate concentrations of the two metals indicated that a significant quantity of particulate copper is formed in the hypolimnion. Zinc did not show a similar pattern. Analysis of the sedimentation rates at the lake bottom indicated that there is a distinct difference between copper and zinc in a period of high organic production and stagnation. While zinc correlates well with organic carbon, copper does not. Zinc was found to be more strongly assimilated into planktonic particles than was copper, with most of the particulate zinc reaching the sediment being of autochthonous origin. Copper, but not zinc, was also sorbed on iron particles formed in the upper hypolimnion at the Fe(3+)/Fe(2+) interface, leading to additional copper elimination by sedimentation. A flux scheme for the hypolimnic transport of copper, which was quantified in a one-dimensional diffusion model, was used to explain the observed variations of concentration profiles. (Carroll-FRC)
W82-05518

ELEVATED CONCENTRATIONS OF ACTINIDES IN MONO LAKE,

Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
R. F. Anderson, M. P. Bacon, and P. G. Brewer.
Science, Vol 216, No 4545, p 514-516, April 30, 1982. 2 Tab, 25 Ref.

Descriptors: *Radioisotopes, *Fate of pollutants, *Radioactive wastes, *Saline lakes, Thorium, Uranium radioisotopes, Plutonium, Protactinium, Lakes, Water pollution sources, Carbonates.

Tetravalent thorium (Th), pentavalent protactinium (Pa), hexavalent uranium (U), and plutonium (Pu) are present at higher concentrations in Mono Lake water than in seawater. Low ratios of actinium to Pa and americium to Pu suggested that the levels of trivalent actinides in the water column are not similarly enchanced. High levels of the ordinarily insoluble actinides are kept in solution by natural ligands such as carbonate ions or alkaline brines. This effect inhibits their chemical removal from the water column and has important implications for the management of radioactive wastes and their transport in groundwater. (Geiger-FRC)
W82-05520

A COMPUTER MODEL FOR HEAVY METAL TRANSPORT WITHIN THE PENOBSCOT RIVER,

Maine Univ. at Orono. Dept. of Civil Engineering.
J. H. Fitch, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236589, Price codes: A05 in paper copy, A01 in microfiche. M.S. Thesis, May, 1979. 79 p, 1 Fig, 3 Tab, 23 Ref, 5 Append. OWRT A-037-ME(2).

Descriptors: *Heavy metals, *Mathematical models, *River flow, *Pollution lo[illegible] Water pollution, Pollutant identification, Computer models, Model studies, Computers, Mathematical studies, Mixing, Zones, Reach, River mechanics, Flow, Streamflow, River wash, Adsorption.

A three-component integrated mathematical model was developed and computerized for use in predicting heavy metal concentrations (dissolved and fixed) at locations downstream from a waste discharge to a river. The model was formulated using a step-wise approach which first simulates the mixing of a waste steam with a river flow, then simulates adsorption-desorption reactions, and finally simulates particulate transport. Mixing and adsorption-desorption reactions are assumed to occur in a mixing zone at the beginning of each river reach. The mixing zone output is considered to be stable with respect to metal speciation throughout the reach, and is used as input data to the particulate transport model to determine metal locations at any reach point. Use of the modified Einstein procedure afforded a description of particulate motion in the river. It was concluded that: river sediment motion is important for describing river heavy metal movement; interactions of ions, particulates, and other natural substances must be described to simulate heavy metal transfer within natural waters. In addition to predicting heavy metal concentrations at any given point, location of contamination areas may also be feasible. (Zielinski-MAXIMA)
W82-05544

ROLE OF SEDIMENT IN NON-POINT SOURCE SALT LOADING WITHIN THE UPPER COLORADO RIVER BASIN,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. W. Shen, J. B. Laronne, E. D. Enck, G. Sunday, and K. K. Tanji.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236654, Price codes: A11 in paper copy, A01 in microfiche.

Report No 107, August, 1981. 213 p, 81 Fig, 35
Tab, 39 Ref, 7 Append. OWRT B-137-COLO(1),
OWRT B-170-COLO(5).

Descriptors: *Nonpoint pollution sources, *Sediment transport, *Simulation analysis, *Solute transport, *River basins, Pollution load, Sediments, Suspended load, Suspended solids, Sediment discharge, Tractive forces, Sediment-carrying capacity, Channel flow, Channeling, Slope degradation, Rills, Computer models, Model studies, Saltation, Catchment areas.

The role of sediment in diffuse-source salt loading in the upper Colorado River basin was investigated. The results proved that entrainment and transport of sediment by overland and channelized flow are crucial factors affecting the salinity of runoff from diffuse source areas. Increased concentration of transported sediment increases the availability of soluble minerals; further transported sediment may continue dissolving due to kinetic disequilibrium and/or when mixed with Colorado River water. Sediment yield increases during rilling with a contemporaneous increase in solute yield. Rills form faster and are undercut to a greater extent by direct runoff than by rainfall-induced runoff. The importance of rill flow to erosion and solute yield is so overwhelming that a computer simulation of rill pattern and its variation with hillslope inclinetion was developed. The most practical conclusion arising from the rilling effect is the indirect dependence of solute yield on hillslope inclination. Regression of solute yield on hillslope inclination. Regression of solute yield versus slope may be used as a reliable procedure to estimate solute yield under varying climatic conditions from diffuse source areas that are comparable in terms of their soluble mineral concentration and erodibility. Ionic derivatives of more soluble minerals are more common as sediment load increases. Recommendations for decreasing solute yields are provided. (Zielinski-MAXIMA)
W82-05551

THE SOCIO-ENVIRONMENTAL IMPACTS OF ENERGY DEVELOPMENT ON LOCAL USER GROUPS AND WATER RESOURCE PLANNING,

Washington State Univ., Pullman.
R. L. Wisniewski, and W. R. Freudenburg.
Available from the National Technical Information
Service, Springfield, VA 22161 as PB82-236670,
Price codes: A07 in paper copy, A01 in microfiche.
Report, October, 1981. 114 p, 7 Fig, 38 Tab, 60
Ref, 1 Append. OWRT A-106-WASH(1), 14-34-0001-1151.

Descriptors: *Nuclear powerplants, *Public opinion, *Public utility districts, *Surveys, *Electric power production, Fuel reprocessing, Powerplants, Nuclear reactors, Radioactive wastes, Attitudes, Public participation, Social participation, Construction, Nuclear energy, Environmental effects, Environmental protection, Regional development, Regional analysis, Urban planning.

Assessment was made of the soci-environmental impacts created by the Grays Harbor County twin nuclear power generating plants being constructed by the Washington Public Power Supply System (WPPSS), using a combination of methods. The methods included over 300 interviews concluded in the immediate vicinity of the plants, and another 300 in a comparison area of eastern Pacific County. Five major conclusions were reached: both Counties showed strong opposition to the power plants, and to nuclear power, in general; water quality issues appeared to be a major reason behind the opposition; Grays Harbor County residents appeared significantly more concerned about most sources of pollution than Pacific County residents; residents of the region may have a moderate tendency to underestimate their own contributions to existing water quality problems; and, residents in both counties evidenced relatively little awareness of water conservation possibilities. The results of this study implied that an energy facility builder's action can have significant consequences for local and regional public opinion, which, in turn, can have significant implications for the builder. Public opinion appears to have been strongly affected by a perceived lack of competence on the part of WPPSS and by the perception that WPPSS has failed to devote adequate consideration to local preferences. Public attitudes were not predictable on the basis of economic factors alone. (Aielinski-MAXIMA)
W82-05553

OIL AND GREASE IN STORMWATER RUNOFF,

California Univ., Los Angeles. Dept. of Engineering Systems.
For primary bibliographic entry see Field 5C.
W82-05557

AGRICULTURAL RUNOFF AND WATER POLLUTION,

Department of the Environment, Victoria (British Columbia). Assessment and Planning Div.
J. H. Weins.
Canadian Water Resources Journal, Vol 5, No 3, p
78-89, 1980. 13 Ref.

Descriptors: *Agricultural runoff, *Nonpoint pollution sources, *Animal wastes, British Columbia, Water pollution sources, Agricultural wastes, Legislation, Regulations, Water pollution control, Farm management, Farm wastes, Nutrients, Sediments, Pesticides, Fertilizers, Feedlot runoff.

Livestock activities (dairy farms, beef feedlots, cattle overwintering areas, waste storage areas, and watering locations) are the most serious sources of agricultural runoff pollution to surface and groundwater in British Columbia. These activities raise levels of BOD, fecal coliforms, nitrogen, and phosphorus in watercourses and downstream lakes, especially during spring melt and rainfall events. Other nonpoint source pollutants--sediment, pesticides, and fertilizers--are less of a problem in this region. Several legislative acts regulate pollution from agricultural activities. The Agricultural Environmental Control program, organized in 1975, handles pollution complaints and promotes improvements in farm management practices. Essentially it is a combined regulatory and voluntary system. Some perceive this program as inadequate. Some measures to reduce pollution from agricultural sources include: education and extension programs, monitoring both on a regular basis and during special events (snowmelt, high and low flow), pilot improvement projects to investigate and demonstrate runoff control technologies, and review of present voluntary and regulatory measures. (Cassar-FRC)
W82-05569

HUMIC SUBSTANCES IN SEWAG[illegible]LUDGES,

Catania Univ. (Italy). Inst. of Agric[illegible]l Chemistry.
For primary bibliographic entry see Field 5E.
W82-05576

A CASE STUDY OF NUTRIENTS IN THE RIVER HOLEM, WEST YORKSHIRE, ENGLAND,

Victoria Univ. of Manchester (England). Pollution Research Unit.
L. Brown, E. G. Bellinger, and J. P. Day.
Environmental Pollution, Series B, Vol 3, No 2, p
81-100, February, 1982. 4 Fig, 4 Tab, 44 Ref.

Descriptors: *Rivers, *Nutrients, Cycling nutrients, Orthophosphates, Phosphates, Nitrates, Ammonium, Nitrite, Seasonal variations, Water pollution effects.

This paper discusses the use of river concentration and mass flow data to suggest the possible nature of equilibrium processes which affect river nutrient concentrations. The concurrent analysis of biologically more stable ions was used to obtain some form of internal standardization for the nutrient assessment. The concentrations of orthophosphate, nitrate, ammonium, and nitrite were determined and found to demonstrate significant natural fluctuations dependent upon effects related to season and/or river flow. A mass flow balance suggests appreciable losses of both orthophosphate and ammonium following pollutant inputs. No comparable losses, other than that accountable for by tributary dilution, occurred for nitrate, nitrite or the various biologically stable ions studied concurrently to act as internal standards. (Baker-FRC)
W82-05577

COPPER POLLUTION STUDIES IN LAKES GEORGE AND EDWARD, UGANDA: THE DISTRIBUTION OF CU, CD AND FE IN THE WATER AND SEDIMENTS,

East African Freshwater Fisheries Research Organization, Jinja (Uganda).
F. W. B. Bugenyi.
Environmental Pollution, Series B, Vol 3, No 2, p
129-138, February, 1982. 2 Fig, 6 Tab, 10 Ref.

Descriptors: *Water pollution sources, *Lakes, Lake George, Lake Edward, Uganda, Copper, Cadmium, Iron, Sediments, Water quality, Path of pollutants, Lake sediments.

A program was initiated in East African lakes to obtain baseline information on the distribution of copper in the water body, the sediments and the biota and also on its toxic effects on the aquatic biota, particularly the Tilapia fish species, which form a major commercial fishery and food resource for the area. Nine sampling sites were established on the water system: River Nyamwambа-Lake George-Kazinga channel-Lake Edward. The distribution of copper, cadmium, and iron in the entire water system showed no major differences in the concentrations in the surface, mid-depth, and bottom waters. However, a gradual drop was noted in the concentrations in the sediments from Lake George to Lake Edward. The sediments act as natural sinks for a large fraction of the metal ions. The chemical oxygen demand, the ionic conductivity, and the volatile organic carbon results indicate that Lake George has higher COD and lower ionic conductivity values, whereas Lake Edward has higher COD and conductivity values. The indirect effect of this fact on the distribution of the heavy metals was noted. The higher concentrations of phosphates in Lake George ensure an abundance of algal blooms and thus higher turbidity. This leads to lower transparency values. The reverse is true for Lake Edward. Concentrations of copper, iron and cadmium appear likely to cause little environmental damage at the present time. (Baker-FRC)
W82-05578

QUANTITATIVE ASSESSMENT OF FILAMENTOUS ALGAE AS A SOURCE OF DETERIORATING WATER QUALITY IN CANALS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. P. Oksiyuk, F. V. Stol'berg, and V. N.
Sotnikov.
Hydrobiological Journal, Vol 16, No 6, p 69-73,
1980. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Algae, *Biological oxygen demand, *Canals, Water pollution sources, Filamentous algae, Canal linings, N. Donets-Donbass Canal, Water quality, Organic matter, Cladophora, Spirogyra.

Data (962-76) on water discharge, flow rate, filamentous algal biomass, and BOD in the N. Donets-Donbass Canal, USSR, were analyzed to derive a quantitative picture of the role of filamentous algae in water pollution. In lined canals these algae increased BOD by hyperproduction of organic matter. In 1968 algae produced BOD equivalent to 46,000 g oxygen per 100 km of canal length, corresponding to the effluents of a city with 200,000 to 300,000 population. An equation is given to calculate the input of organic matter and increase of BOD in the canal water from cross sectional area, canal length, flow velocity, and canal discharge. Mean annual indices should be used to counteract the variations caused by temperature and life cycles of the algae. (Cassar-FRC)
W82-05593

EFFECT OF SEWAGE EFFLUENT ON THE SEDIMENTS OF NORDASVATNET (A LANDLOCKED FJORD), NORWAY,

Alexandria Univ. (Egypt). Dept. of Oceanography.
M. K. El-Sayed.
Marine Pollution Bulletin, Vol 13, No 3, p 85-88, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Wastewater disposal, *Sediments, *Metals, Fate of pollutants, Water pollution sources, Fjords, Heavy metals, Organic matter, Anaerobic conditions, Iron, Manganese, Copper, Zinc, Bottom sediments, Carbonates.

Sediments from the anoxic Nordasvatnet fjord, Norway, which receives 8000 cu meters per day of untreated domestic sewage, were analyzed. Concentrations of metals and other constituents were: total iron, 2.53-5.75%, average 4.2%; manganese, 300-1400 ppm, average 565 ppm; copper, 20-125 ppm, average 41.2 ppm; zinc, 72-427 ppm, average 209.5 ppm; carbonate, 1.2-12.2%, average 7.6%; and organic carbon, 2.5-12.5%, average 9.97%. Concentrations of heavy metals were highest in the upper layers of the core samples; carbonate levels increased from the srface to the deeper levels. (Cassar-FRC)
W82-05605

AN APPROXIMATE PETROLEUM HYDROCARBON BUDGET FOR THE HUDSON RARITAN ESTUARY–NEW YORK,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. W. Connell.
Marine Pollution Bulletin, Vol 13, No 3, p 89-93, 1982. 1 Fig, 2 Tab, 29 Ref.

Descriptors: *Oil pollution, *Sediments, *Industrial wastes, Oil spills, Path of pollutants, Fate of pollutants, Water pollution sources, Hudson River, Raritan River, Estuaries, New York Bight, New York, Polyaromatic hydrocarbons, Runoff, Wastewater pollution, Dredging, Evaporation, Organic compounds.

A petroleum budget for the Hudson Raritan Estuary, New York, estimated from published literature, accounted for an input of 92 tons per day and losses of 70 tons per day. Inputs (in tons per day) were: sewage discharges, 35; oil refinery discharges, 1.3; non-oil refinery industrial discharges, 17; oil spills, 1.5; atmospheric deposition, 0.002; urban and rural runoff, 37. Losses (in tons per day) were: permanent deposition in sediments, 11; dredging, 5.8; advection, 6.5; bed sedimentary transport, 0.007; decomposition in water and sediments, 42; evaporation, 0.4; movement of surface slicks, 0.4. (Cassar-FRC)
W82-05606

FECAL COLIFORM DENSITIES IN A WESTERN WATERSHED,

Black and Veatch, Denver, CO.
P. J. Psaris, and D. W. Hendricks.
Water, Air, and Soil Pollution, Vol 17, No 3, p 253-262, 1982. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Coliforms, *Bacteria, *Irrigation water, Path of pollutants, South Platte River, Colorado, Water quality standards, Wastewater disposal.

Fecal coliforms concentration data (EPA STORET records, 1980) from 99 sampling stations throughout the South Platte River system, Colorado, were analyzed. Coliform densities were 0-99 organisms per 100 ml in mountain streams and 10,000-100,000 organisms per 100 ml or higher in plains streams. The source of coliforms is wastewater discharged by municipalities into the river system or into land disposal areas. Colorado Departmet of Health standards (200 fecal coliforms per 100 ml for Recreation Class I, 1000 for irrigation water, and 2000 for Recreation Class 2 and Drinking Water Supply Class 2) were exceeded by 33-53% of stations overall, depending on use, by 3-12% of mountain stations, and by 50-75% of plains stations. Water from this river system is widely spread during irrigation. The current policies encouraging land treatment and reuse of wastewater should be reviewd with respect to compliance with proposed fecal coliform standards. (Cassar-FRC)
W82-05618

OCCURRENCE AND DISTRIBUTION OF CHEMICAL POLLUTANTS IN LAKE MARIUT, EGYPT, I. RESIDUES OF ORGANOCHLORINE PESTICIDES,

Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, M. M. A. Elamayem, A. H. El-Sebae, and I. F. Sharaf.
Water, Air, and Soil Pollution, Vol 17, No 3, p 245-252, 1981. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Fish, *Water analysis, *Pesticides, Fate of pollutants, Saline lakes, Accumulation, Lake Mariut, Egypt, Insecticides, Lakes, DDT, Lindane, Chlorinated hydrocarbons, Pollutant identification.

Water and fish from the brackish coastal Lake Mariut, Egypt, were analyzed for organochlorine pesticides at monthly intervals from August 1978 to July 1979. The lake has been severly polluted by human, industrial, and agricultural wastes. Mean concentrations of several pesticides (in ppb) were: lindane, 2.09; p,p'-DDE, 4.49; o,p'-DDT, 0.01; p,p'-DDT, 0.13; and total DDT, 5.1. DDT levels were highest (about 10 ppb) in January-March with a secondary peak (8 ppb) in October. Lindane levels were highest in October (8 ppb) and lowest in November-February. In Tilapia fish the mean concentrations (in ppb) of pesticides were: lindane, 35.0; p,p'-DDE, 39.0; p,p'-DDT, 17.4; and total DDT, 60.8. Higher pesticide concentrations in the southern part of the lake reflected input of drainage waters. (Cassar-FRC)
W82-05620

DETERMINATION OF RECENT DESPOSITION RATES IN LAKE CONSTANCE WITH RADIOISOTOPIC METHODS,

Heidelberg Univ. (Germany, F. R.). Lab. for Sedimentology.
J. Dominik, A. Mangini, and G. Muller.
Sedimentology, Vol 28, No 5, p 653-677, October, 1981. 10 Fig, 11 Tab, 54 Ref.

Descriptors: *Sedimentation rates, *Radioisotopes, *Lead radioisotopes, *Deposition(Sediments), Lead, Zinc, *Lake Constance, Radioactive dating, Dating, Cesium radioisotopes, Heavy metals, Metals, Fate of pollutants, Lakes, Nutrients, Sedimentology, *Lake sediments.

Sedimentation rates were determined with the Pb-210 method in eight sediment cores from Lake Constance. The rate of deposition in the main basin (Obersee) varies from about O.06 g/sq cm/y in the central part to 0.13 g/sq cm/y in the eastern part of the lake and then increases rapidly towards the Rhine delta. In the central lake area the rate of deposition has been approximately constant since 1900, and dating with the Pb-210 method is in good agreement with sedimentological observations. In the Konstanzer Trichter area, the deposition rate has been increasing since about 1955 as a result of eutrophication and subsequent high carbonate production. Dating with Cs-137 is fairly accurate for sediments deposited at a high rate, but is questionable for slowly accumulating ones. A positive correlation of Pb-210 fluxes and sedimentation rates indicates that Pb-210 flux into sediments follows the distribution pattern of solids. Pb-210 profiles in four sediment cores interpreted in terms of a constant flux model display synchronous fluctuation of the sedimentation rate; however, their relation to long-range particulate input variations remains to be proved. Sedimentation rates determined with the Pb-210 method were used to calculate recent nutrient and heavy metal fluxes. Anthropogenic fluxes of Zn and Pb are in the same range of magnitude as in other polluted areas in Europe and America. (Author abstract)
W82-05625

CONTAMINANT DISPERSION IN OSCILLATORY FLOWS,

Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol 114, p 379-398, 1982. 7 Fig, 19 Ref.

Descriptors: *Contamination, *Flow profile, Oscillatory waves, Waves, Mathematical equations, Model studies, *Estuaries, Estuarine environment, *Path of pollutants.

A substantial time span can occur in which a cloud of a contaminant is contracting after each flow reversal in an oscillatory system if the time scale for cross-sectional mixing is comparable with or larger than the flow period. Thus the apparent longitudinal diffusion coefficient in such systems, including many major tidal waterways, is negative. The contaminant dispersion therefore cannot be modeled by a diffusion equation, since negative diffusivities imply the spontaneous development of infinite concentrations. The manner in which this periodic contracting and expanding can be modeled by a delay diffusion equation is demonstrated, using the bulk velocity, a coordinate displacement and the diffision coefficient at a specific time after discharge. The recent memory is always positive and diffusive in character, so singularities cannot arise. However, when the time after discharge is large, this memory function can be negative due to reversed flow at earlier times. Particular attention is given to estuarine flows, and results are derived for the dependence of the diffusion coefficient on the water depth and on the width of the estuary. (Baker-FRC)
W82-05631

ORGANOCHLORINE RESIDUES IN SUSPENDED SOLIDS COLLECTED FROM THE MOUTHS OF CANADIAN STREAMS FLOWING INTO THE GREAT LAKES 1974-1977,

Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank, R. L. Thomas, H. Holdrinet, R. K. McMillan, and H. E. Braun.
Journal of Great Lakes Research, Vol 7, No 4, p 363-381, 1981. 2 Fig, 13 Tab, 13 Ref.

Descriptors: *Suspended solids, *Pollutant identification, Sedimentation, *Organophosphorus pesticides, *Great Lakes, Organic compounds, Pesticides, *Canada, Water pollution sources, Land drainage, Path of pollutants.

A study was conducted to determine whether and how the boundary waters of the Great Lakes are being polluted by land drainage. Between 1974 and 1977, 186 samples of suspended solids were collected from 105 stream mouths out of 176 streams draining the Canadian shoreline of the Great Lakes basin. The widespread use of DDT between 1947 and 1971 was reflected in the presence of DDT and its metabolites in suspended solids of all 105 streams sampled. HEOD was detected in 15 of the 43 suspended solid samples collected, with the highest mean residues occurring in streams draining into Lake Ontario along the southwest shoreline. Endosulfan was present in five of the eleven streams draining into Lake Ontario along the southwestern shoreline. Endrin was noted in 30 Mile Creek at 4 micrograms/kg. No residues of chlordane and HE were detected in 1974 samples. During the study period, about 70% of the total insecticides used by Ontario agriculture were applied in the Lake Erie watershed, 14% each in the Lake Ontario and St. Clair watersheds and 2% in the Lake Huron watershed. No aldrin, endrin mirex, heptachlor or organophosphorus insecticides were detected. (Baker-FRC)
W82-05635

ORGANIC CONTAMINANTS IN THE SUSPENDED SEDIMENTS OF THE NIAGARA RIVER,

Canada Centre for Inland Waters, Burlington (Ontario).
N. D. Warry, and C. H. Chan.
Journal of Great Lakes Research, Vol 7, No 4, p 394-403, 1981. 5 Fig, 4 Tab, 7 Ref.

Descriptors: *Suspended sediments, *Organic chemicals, Pesticides, Great Lakes, *Lake Ontario, *Niagara River, Rivers, Sediment transport, Water pollution sources, DDT, Dieldrin, Lindane, Heptachlor epoxide, Chemical analysis, Organic wastes, *Pollutant identification.

A suspended sediment sampling program was initiated in the lower Niagara River during 1978 to

determine quantitatively the presence of organic contaminant residues in the suspended sediments of the Niagara River. This report covers results obtained from April 26, 1979, through April 22, 1980. The suspended sediments provided a continuing source of PCBs and other pesticide residues to Lake Ontario. The loadings are ranked in decreasing order of concentration as PCB, DDT, mirex, chlordane, methoxychlor and endosulfan. The concentrations of all these residues are quite variable with time, with concentration changes up to a factor of 3 not being unusual within a month. The available evidence suggests that active sources of some contaminants are located along the Niagara River downstream from Grand Island. The 1979 loading of total PCBs to Lake Ontario from the Niagara River is 2.7 times the total PCB loading to the whole lake as calculated for 1968, while DDT and mirex loading from the Niagara River in 1979 are less than the 1968 loadings. The most surprising result is that the loading of mirex to Lake Ontario is continuing in spite of the fact that the primary source, Hooker Chemical, no longer produces the pesticide. Other pesticides sought included lindane, dieldrin, endrin, heptachlor, heptachlor epoxide, and aldrin. Of these, only lindane, dieldrin, and heptachlor epoxide were ever detected. (Baker-FRC)
W82-05636

WATER QUALITY MODELING OF LAKE MICHIGAN AND CONSIDERATION OF THE ANOMALOUS ICE COVER OF 1976-1977,

Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
P. Rodgers, and D. Salisbury.
Journal of Great Lakes Research, Vol 7, No 4, p 467-480, 1981. 10 Fig, 3 Tab, 43 Ref.

Descriptors: Water quality, *Model studies, Lakes, *Lake Michigan, Great Lakes, *Ice cover, *Phosphorus, Phytoplankton, *Load distribution, *Path of pollutants.

The concurrent effects of a phosphorus load reduction in 1977 and a climatically induced ice cover are examined via a phytoplankton simulation model for their relative importance in affecting an observed phosphorus depletion. The application of ecological models to the Lake Michigan basin was the central focus of this research. A modified version of a deterministic phytoplankton mode, Lake 1 by Thomann, was first calibrated to the 1976 Lake Michigan field data. A dynamic phytoplankton simulation model (MICHI) was developed to investigate the observed field data and to use in forecasting lake responses to various phosphorus loading scenarios. The 1977 data indicated that the southern basin of Lake Michigan lost up to 3 micrograms of phosphorus per liter compared to concentrations observed in 1976. In an attempt to simulate this rapid depletion of phosphorus, MICHI required an implicit representation of suspected effects of an extensive ice cover observed during the winter of 1976-77. This included increasing the net apparent settling rate eight fold during ice cover. A total phosphorus model was used in conjunction with MICHI for forecasting. These forecasts indicate a steady-state total phosphorus concentration of 7 micrograms phosphorus per liter, given the target load recommended by the 1978 Water Quality Agreement. The projected time to obtain 95% of steady-state response to a load change was 7-14 years. (Baker-FRC)
W82-05638

GEOCHEMICAL PATHWAY STUDIES OF HEAVY METALS IN LAKE SEDIMENTS FROM THE SUDBURY-TEMAGAMI AREA, ONTARIO,

McMaster Univ., Hamilton (Ontario). Dept. of Geology.
J. H. Crocket, and A. Kabir.
Journal of Great Lakes Research, Vol 7, No 4, p 455-466, 1981, 4 Fig, 7 Tab, 14 Ref.

Descriptors: *Heavy metals, Water pollution sources, Lakes, Industrial production, Fallout, Lead, Nickel, Palladiu., Gold, Selenium, Copper, Iridium, Neutron activation analysis, *Lake sediments, *Path of pollutants, atomic absorption, x-ray fluorescence, Canada (Ontario).

Radiochemical neutron activation, atomic absorption, and x-ray fluorescence were used to determine the concentrations of some heavy metals in lake sediments from the Sudbury-Temagami area. Dredge samples were taken from 23 lakes, usually from the deepest part. The study area contains a major world source of nickel and an important producer of copper and other heavy metal byproducts, including the noble metal group. Major nickel and copper minerals of the Sudbury area are pentlandite, pyrrhotite, and chalcopyrite. Concentration gradients for lead, arsenic, and selenium tend to center about the Sudbury industrial complex and increase toward it. Metal concentration profiles over the top 20 cm of sediment core samples from five lakes show pronounced increases in lead, iridium, gold, arsenic, selenium, copper, nickel, and palladium in the top 5 cm. These data suggest that one of the principal routes for heavy metal loading of lake sediments in the area is atmospheric fallout of particulate material. (Baker-FRC).
W82-05640

PESTICIDES AND PCB IN THE GRAND AND SAUGEEN RIVER BASINS,

Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.
R. Frank.
Journal of Great Lakes Research, Vol 7, No 4, p 440-454, 1981. 1 Fig, 12 Tab, 34 Ref.

Descriptors: *Polychlorinated biphenyls, *Pesticides, River basins, Catchment areas, Land use, Rivers, Basins, Suspended solids, Great Lakes, *Non-Point sources, Dieldrin, Chlordane, Atrazine, Simazine, *Agricultural chemicals, DDT, Water pollution sources, Agricultural runoff.

This paper forms part of an overall study into pollutant losses from diffuse sources due to land use activities, adding information on pesticides and PCBs to the information base being established. Attempts were made to integrate crop distribution and pesticide use information in order to develop a better understanding of the dispersal of pesticides in two major river systems. The Grand and Saugeen rivers drain two major basins in the Ontario Province of Canada, and discharges into Lake Erie and Lake Huron respectively pesticides were classified as persistent or non-persistent. Members of both categories appeared in upstream waters; however, only the former appeared at the river mouths. Non-persistent pesticides found in the system occurred at the time of spraying or shortly thereafter in storm runoff waters but not at other times. Persistent pesticides found in the system included those that had been discontinued and those in use throughout the study period. Dieldrin, DDT, chlordane, atrazine, and simazine were identified in water or on suspended solids throughout the year. Atrazine was the most widely used pesticide in the basins, and loadings at the mouth appeared to be 0.6% of that applied. Loadings of chlordane and heptachlor epoxide at the mouth suggest that greater inputs were coming from urban uses. PCB was ubiquitous in the two basins, and losses as measured at the river mouths were on the order of 30-40- and 7-10 kg/year for the Grand River and Saugeen River watersheds, respectively. No residues of mirex were detected in either system. (Baker-FRC)
W82-05641

TRANSPORT OF NITRATE AND GASEOUS DENITRIFICATION IN SOIL COLUMNS DURING LEACHING,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. S. Kanwar, H. P. Johnson, and D. Kirkham.
Journal of Hydrology, Vol 55, No 1/4, p 171-184, 1982. 7 Fig, 2 Tab, 25 Ref.

Descriptors: *Nitrates, *Solute transport, Fate of pollutants, Nitrogen compounds, Denitrification, Fertilizers, Leaching, Soil columns.

Nitrate leaching (considered a first-order reaction) in a soil column of finite length was theoretically analyzed. Transport equations and boundary conditions describing nitrate movement and denitrification in soil were solved for continuous application of nitrate at the soil surface. The relative concentration profiles of nitrate movement were obtained for any time and for known values of the diffusion coefficient and average solute velocity. Laboratory experimental data reported in the literature supported the validity of the model. In field conditions an aquifer with moving water would act as a sink. This model is useful in determining the optimum application of fertilizers to agricultural land in order to avoid nitrogen accumulation in the soil or water contamination. (Cassar-FRC)
W82-05709

EFFECTS OF SELECTED ORGANIC COMPOUNDS ON RADIONUCLIDE ADSORPTION TO SEDIMENTS IN FRESHWATER SYSTEMS,

Washington Univ., Seattle. Coll. of Ocean and Fisheries Sciences.
For primary bibliographic entry see Field 5C.
W82-05724

METHOXYCHLOR RESIDUES IN TREATED IRRIGATION CANAL WATER IN SOUTHCENTRAL IDAHO,

Idaho Univ., Moscow. Twin Falls Cooperative Extension Service.
R. L. Stoltz, and G. A. Pollock.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 473-476, 1982. 2 Fig, 6 Ref.

Descriptors: *Insecticides, *Canals, *Methoxychlor, Pesticides, Twin Falls, Idaho, Fate of pollutants, Snake River.

Methoxychlor, an insecticide used to control black fly larvae in water bodies, reached peak levels of 1.4 ppb, 0.4% of initial concentration (0.3 ppm), during application to a canal system. The water was treated 12 times during the summer of 1980 at Murtaugh Lake on the Twin Falls canal system, Idaho. Samples for residue analysis were taken 42-45 hours after four of the applications at a distance 75 miles downstream before the canal enters the Snake River. Low levels of methoxychlor (0.14 ppb) were present 70 hours after the August applications. All measured methoxychlor levels were far below the 52 ppb LC50 for rainbow trout. (Cassar-FRC)
W82-05726

INDICATIONS OF GROUND WATER INFLUENCES ON NUTRIENT TRANSPORT THROUGH SCHWATKA LAKE, YUKON TERRITORY,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
P. H. Whitfield, B. McNaughton, and W. G. Whitley.
Water Resources Bulletin, Vol 18, No 2, p 197-202, April, 1982. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Nutrients, *Solute transport, *Infiltration water, Groundwater movement, *Canada, Schwatka Lake, Yukon Territory, Phosphorus, Nitrates, Lakes, Nitrites, Nitrogen, Silicates, Carbon, Inorganic carbon, Organic carbon.

Nutrient budgets were estimated for Schwatka Lake, Yukon Territory, formed by the Whitehorse Rapids Dam, by analyzing water samples collected upstream and downstream of the lake. Exports of nutrients, expressed as % of input, were: total P, 17.0; nitrate and nitrite, 19.8; total N, 5.0; silicate, 1.2; inorganic C, 0.1; and organic C, 10.3. The most likely reason for these differences is groundwater contribtions to the lake. A probable source is the wastewater from the White Horse Copper Mines, and a probable route is via the large deposit of unconsolidated material underlying the reservoir. Other processes not considered influential in this particular case are evaporation from the impoundment, land surface drainage, bank erosion, and channel scouring. (Cassar-FRC)
W82-05741

SELECTING A METHOD FOR ESTIMATING SUBSTANCE LOADINGS,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
P. H. Whitfield.
Water Resources Bulletin, Vol 18, No 2, p 203-210, April, 1982. 5 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Solute transport, *Nutrients, *Statistical analysis, Schwatka Lake, *Canada, Yukon Territory, Phosphorus, Nitrates, Nitrites, Nitrogen, Silicates, Inorganic carbon, Organic carbon, Carbon, Lakes.

Four methods for estimating mass transport are evaluated using data on nutrient concentrations of waters flowing into and out of Schwatka Lake, Yukon Territory. The four methods are permutations of arithmetic vs. logarithmic normal distributions and independence vs. dependence on discharge. Method A is based on the assumption that concentration data has a unimodal normal distribution and that concentration is independent of discharge. Method B assumes that the logarithmic transfer of the concentration data is unimodal normal and that concentration is independent of discharge. Method C assumes that concentration is unimodal normal and dependent on discharge. Method D assumes that the logarithm of concentration is normally distributed and dependent on the logarithm of discharge. The most precise mass transport estimates were obtained using Method B. Method A overestimated the loadings. Methods C and D were within plus or minus 5% of Method B results in some cases but were inconsistent. (Cassar-FRC)
W82-05746

SOLUBLE MINERAL CONTENT IN SURFICIAL ALLUVIUM AND ASSOCIATED MANCOS SHALE,

Ben-Gurion Univ. of the Negev, Beer-Sheba (Israel). Dept. of Geography.
For primary bibliographic entry see Field 3B.
W82-05751

PHYSICOCHEMISTRY OF WATER IN THE ST. LAWRENCE GULF AND ESTUARY (PHYSICO-CHIMIE DES EAUX DU GOLFE ET DE L'ESTUAIRE SAINT-LAURENT),

Quebec Univ., Rimouski. Inst. National de la Recherche Scientifique.
D. Couillard.
Canadian Water Resources Journal, Vol 5, No 4, p 55-81, 1980. 9 Fig, 9 Tab, 31 Ref.

Descriptors: *Physicochemical properties, *Water quality, Reviews, *St. Lawrence Estuary, *Canada, Quebec, Dissolved oxygen, Water circulation, Salinity, Metals, Estuaries, Mercury, Fish, Suspended sediments, Water pollution sources.

The physicochemical properties of water in the St. Lawrence Gulf (east of Pointe-des-Monts) and Estuary (Quebec City to Pointe-des-Monts) is reviewed. General water circulation, salinity, bathymetry, and river discharges are depicted. Dissolved oxygen in the gulf varies from 1.8 ml per liter in the deep strata to 8 ml per liter in the surface water layer. The minimum oxygen concentrations are found in a 300-370 m deep area located between the Isle d'Anticosti and Newfoundland. pH of water is 8.0 at the surface and 7.6 in deeper water. Sediment pH is 6.9-8.1. Suspended sediments rarely exceed 1 mg per liter. Metals concentrations are generally low. Concentrations determined in one study were (in micrograms per liter): Zn, 10.2; Ni, 4.6; Cu, 4.5; Mn, 2.5; Pb, 2.3; and Cd, V, Mo, and Co all less than 0.4. Mercury levels in fish varied from 0.76 to 1.85 ppm. (Cassar-FRC)
W82-05763

SNOW CONTAMINATION BY HEAVY METALS AND SULPHUR IN CRACOW AGGLOMERATION (SOUTHERN POLAND),

Academy of Mining and Metallurgy, Kracow (Poland). Inst. of Environmental Protection.
P. K. Zajac, and K. Grodzinska.
Water, Air, and Soil Pollution, Vol 17, No 3, p 269-280, 1982. 5 Fig, 9 Tab, 23 Ref.

Descriptors: *Snow, *Steel industry, *Air pollution, Precipitation, Path of pollutants, Sulfates, Heavy metals, Metals, Acid rain, Sulfur compounds, Cracow, *Poland, Water pollution sources.

Samples of snow were collected on 3 dates in 1977 and 1978 at 27 sites in open and forest stands east of the large steel mill at Cracow, Poland. Concentrations of heavy metals, light metals, and sulfate decreased with increasing distance from the source, but snow acidity increased. There was considerable variation in pollutant concentrations in snow between sites, sample sets, type of forest, and open vs. cleared areas. Average metal concentrations (in mg per liter) were: Cd, 0.29; Pb, 3.1; Zn, 8.7; Fe, 923; Mg, 78; and Ca, 325. The mean sulfate ion concentration was 17.25 mg per liter. Snow pH varied from 10 at the source to 5 at a distance of 25 km. (Cassar-FRC)
W82-05783

GROUND-WATER CONTAMINATION DUE TO VANISHING AND FINITE-SIZE CONTINUOUS SOURCES,

Dames and Moore, Golden, CO.
A. Prakash.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 572-590, April, 1982. 10 Fig, 1 Tab, 27 Ref.

Descriptors: *Groundwater, *Water pollution sources, Contamination, Aquifers, Model studies, Mathematical equations, Leaching.

This paper presents simple analytical models to predict the spatial distribution of steady-state concentrations caused by continuous release of contaminants from a point, line, rectangular, or parallelepiped source in a groundwater environment with one- or two-dimensional uniform flow. This formulation includes the contributions of radioactive decay and soil adsorption, and the solutions can be used to approximate transports through stream-aquifer systems and through confined or unconfined aquifers. The results of the analytical model are compared with those of a finite-element study. The analytical model is simple, requires smaller computer time, and is free from convergence and stability problems associated with some numerical models. It is expected that the methods as presented would provide reasonably accurate results for many field situations. Examples are included to illustrate the effect of source configuration, for example point, line or plane, and the presence or absence of a fully penetrating perennial stream in the flowfield. To validate the model, concentration isopleths are developed for the release of effluents from an ashpond in a two-dimensional stream aquifer system. (Baker-FRC)
W82-05799

OCCURRENCE OF ENDOTOXINS IN GROUNDWATER DURING THE LAND APPLICATION OF WASTEWATER,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
S. M. Goyal, and C. P. Gerba.
Journal of Environmental Science and Health, Part A, Vol 17, No 2, p 187-196, 1982. 2 Tab, 10 Ref.

Descriptors: *Groundwater pollution, *Toxins, *Land application, Wastewater disposal, Endotoxins, Bacteria, Algae, Fate of pollutants.

Algal or bacterial endotoxin concentrations were 0.3 to 480 ng per ml in groundwater from wells 3 to 37 m beneath five sewage land application sites in Texas, Michigan, Arizona, and Massachusetts. Concentrations in wastewater samples were 300-6000 ng per ml. The groundwaters with the highest endotoxin levels were found at the sites with the highest endotoxin levels in the applied sewage effluents. Although endotoxin removal in the soil was 90-99.9%, levels were still higher than in most drinking waters (1.25-12.5 ng per ml). Most groundwaters have low or nondetectable levels of endotoxins. The possibility of using endotoxins as indicators of sewage water infiltration was suggested. (Cassar-FRC)
W82-05810

DILUTION OF MUNICIPAL LANDFILL LEACHATE, FRANKLIN COUNTY, INDIANA,

Ball State Univ., Muncie, IN. Dept. of Natural Resources.
P. J. Sullivan, and W. L. Morgan.
Journal of Environmental Health, Vol 44, No 5, p 253-257, March-April, 1982. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Leachates, *Landfills, Groundwater, Groundwater pollution, Leaching, *Indiana, Sanitary landfills, Waste dumps, Water quality, Rivers, Surface water.

This study was initiated to identify the possible source for contamination of local water resources in Franklin County, Indiana. In this county the sanitary landfill is located in an abandoned gravel pit and has been placed on a mandated phase-out schedule by the Land Pollution Control Division due to its poor geologic location and the absence of adequate leachate control. Soil textures of the daily cover at the landfill range from a sandy loam to a loam. This results in the rapid infiltration of rainfall. Groundwater monitoring wells were installed at several sites, and soil cores were taken. The Whitewater River was sampled upstream and downstream of the landfill as well. The soil coring data clearly demonstrated the lack of an impervious liner to the landfill. Areas south and east of the landfill will allow the movement of the leachate. The clay materials to the west will also force most groundwater flows away from the landfill to the south and southeast. No apparent change was noted in water quality within the Whitewater River. Only low concentrations of trace metals were found in the surface and groundwaters, perhaps due to the formation of insoluble metal complexes as a consequence of alkaline surface and groundwater. The fact that all the non-metal leachate parameters usually fall well below US EPA criteria may indicate that dilution of leachate is occurring. Iron concentrations slightly exceeded these same criteria. Existing groundwater conditions suggest a high volume and rapid movement of water within the aquifer. (Baker-FRC)
W82-05811

MODELS OF LANDFILL LEACHING: ORGANIC STRENGTH,

Wright-Pierce Architects/Engineers, Portsmouth, NH.
W. A. Straub, and D. R. Lynch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 251-268, April, 1982. 12 Fig, 2 Tab, 26 Ref.

Descriptors: *Landfills, *Leachates, Model studies, Mathematical equations, Infiltration, Percolation, Wastewater disposal, Sanitary landfill, Groundwater pollution, Waste disposal, Waste dumps.

To estimate groundwater pollution potential, mathematical models of moisture movement and inorganic leachate strength which had been applied using analysis of compacted solid waste as an unsaturated porous medium were extended to describe leachate organic strength, microbial activity and gas production. The roles of aerobic and anaerobic bacteria were simulated using conventional kinetic formulations. Computer simulations were obtained for landfill experiments reported by others, and good agreement with observed behavior was demonstrated. The models proved useful in describing organic leachate strength and landfill stabilization. Specific conclusions indicated that convective removal and anaerobic microbial activity dominate leachate organic strength and landfill stabilization. Convective effects may be dominant in some cases. Aerobic activity is relatively unimportant in determining the long-term quality of leachate when external air is not supplied to the landfill. Anaerobic activity was noted to occur in the landfill at a rate inhibited from ideal rates. The Monod kinetic model is useful in preliminary descriptions of anaerobic activity and indicates inhibition within the landfill. A microbial kinetic model may be useful in estimating landfill gas production. Finally, the retention of cells within the landfill system during recirculation of leachate may be a primary contributor to the accelerated

organic stabilization typical of such systems. (Baker-FRC)
W82-05817

MODELS OF LANDFILL LEACHING: MOISTURE FLOW AND INORGANIC STRENGTH,

Wright-Pierce Architects/Engineers, Portsmouth, NH.
W. A. Straub, and D. R. Lynch.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 231-250, April, 1982. 14 Fig, 33 Ref.

Descriptors: *Leachates, *Model studies, Landfills, Waste disposal, Mathematical studies, Infiltration, Percolation, Waste dumps, Sanitary landfills, Wastewater disposal, Groundwater pollution.

The literature concerning both empirical investigations and modeling of leachate production are reviewed, and models are developed which simulate landfill moisture movement and the inorganic contaminant strength of leachate. The models are used to simulate leachate behavior from experimental landfills documented by other investigators in order to illustrate their analytical potential. The study demonstrated the feasibility of analyzing compacted solid waste as an unsaturated porous medium. The advantage of this analytical approach lies in its process orientation - leachate quantity and quality result from the interaction of fundamental transport phenomena within specific physical and environmental settings. At present, leachate models are appropriate primarily for research purposes, insofar as they provide organized analytical structures for the design and interpretation of experiments. Simulations obtained with preliminary, aggregate representations of major hydraulic and contaminant transport processes are in overall agreement with leachate data documented in separate studies. Additional experimental work is needed identify and refine the description of basic processes occurring in the landfill environment. Ultimately, porous medium-based landfill models could be applied to field scale problems, although it must be noted that such applications would require extensive empirical support. (Baker-FRC)
W82-05818

TOTAL SUSPENDED SOLIDS IN HIGHWAY RUNOFF IN WASHINGTON STATE,

RH2 Engineering, Seattle, WA.
R. Asplund, B. W. Mar, and J. F. Ferguson.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 391-404, April, 1982. 3 Fig, 6 Tab, 37 Ref.

Descriptors: *Suspended solids, *Runoff, Highways, Roads, Rainfall, Rainfall-runoff relationships, Water pollution sources, *Washington.

A characterization of total suspended solids (TSS) found in highway storm water runoff was based on the first year of continuous statewide monitoring at nine sites in the state of Washington. The major topics explored included a comparison of the data collected from this project with previously published data, a determination of trends in the data which may support the development of a model, and a determination of the major sources of storm water runoff TSS and parameters which may influence TSS deposition and removal from the highway. During this year a total of 241 storms were sampled with a composite sampling system. Vehicle traffic during the storm was found to be the principal factor influencing the mass of suspended solids in the runoff. During winter ice conditions a major fraction of solids loadings in runoff could be traced to sand use. A predictive model for total suspended solids loadings was derived as a function of cumulative traffic during the storms. Traffic during the dry periods appeared to remove pollutants from the highway and is not significant in predicting pollutant loadings in the state of Washington. (Baker-FRC)
W82-05820

HYDROLOGY OF AREA 3, EASTERN COAL PROVINCE, PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05831

HYDROLOGY OF AREA 28, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05832

HYDROLOGY OF AREA 4, EASTERN COAL PROVINCE, PENNSYLVANIA, OHIO, AND WEST VIRGINIA,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05833

HYDROLOGY OF AREA 5, EASTERN COAL PROVINCE, PENNSYLVANIA, MARYLAND, AND WEST VIRGINIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-05834

QUALITY OF WATER IN JAMES CREEK, MONROE COUNTY, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
G. A. Bednar.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1181, 1981. 28 p, 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Water quality, *Surface water, *Streamflow, *Path of pollutants, Low flow, Hydrologic data, Water temperature, Heavy metals, Pesticides, Water analysis, *Mississippi, Monroe County, James Creek.

A short-term quality-of-water study of James Creek near Aberdeen, Mississippi was conducted on November 14-16, 1978, during a period of low streamflow. During the study, the water in the 2.6-mile stream reach was undesireable for many uses. Wastewater inflow immediately upstream of the study area contributed to the dissolved-solids load in James Creek. The specific conductance of the water ranged from 775 to 890 micromhos at the head of the study reach and from 650 to 750 micromhos at the end of the study reach. A substantial biochemical oxygen-demand was evident in James Creek. Five-day biochemical oxygen demand values downstream of a sewage disposal pond outfall ranged from 8.3 to 11 milligrams per liter and dissolved-oxygen concentrations ranged from 0.4 to 4.5 milligrams per liter. Nitrogen and phosphorus compounds and fecal bacteria densities were highest downstream. Total ammonia nitrogen and phosphorus concentrations in the water leaving the study area ranged from 0.29 to 1.4 milligrams per liter and from 0.65 to 1.7 milligrams per liter, respectively. Fecal coliform densities exceeding 50,000 colonies per 100 milliliters of sample were observed in the study area. The median fecal coliform density of the water leaving the study area was 2,800 colonies per 100 milliliters. (USGS)
W82-05842

AN EVALUATION OF THE EFFECTS OF ACID RAIN ON LOW CONDUCTIVITY HEADWATER STREAMS IN PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
J. R. Ritter, and A. E. Brown.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $7.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1025, September 1981. 53 p, 10 Fig, 5 Tab, 7 Ref.

Descriptors: *Acid rain, *Water quality, *Comparison studies, *Streams, Low flow, Data collections, Water analysis, Chemical reactions, Alkalinity, Hydrogen ion concentration, Conductivity, Sulfates, *Pennsylvania, Delaware River basin, Susquehanna River basin, Ohio River basin.

Analyses of water collected at 32 sites on headwater streams in Pennsylvania during low-flow conditions in 1979-80 were compared to pre-1971 data to evaluate whether acid rain had changed the chemistry of the streams in the previous decade. Most pH, alkalinity, and sulfate values of the samples collected in 1979-80 fell within the ranges of values for samples collected before 1971. The limited data indicate, however, that pH may have increased and alkalinity and sulfate may have decreased with time. (USGS)
W82-05843

QUALITY OF WATER AND TIME OF TRAVEL IN GOODWATER AND OKATOMA CREEKS NEAR MAGEE, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $5.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1012, 1981. 34 p, 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Water quality, *Surface water, *Streamflow, *Path of pollutants, Low flow, Hydrologic data, Water temperature, Heavy metals, Pesticides, Water analysis, Dye releases, *Mississippi, Goodwater Creek, Okatoma Creek, Time of travel.

An intensive quality-of-water study was conducted during a period of generally low streamflow in Goodwater and Okatoma Creeks near Magee, Miss. During the August 12-14, 1980, study, the mean specific conductance of the water at all sites was less than 59 micromhos per centimeter; the dissolved-oxygen concentrations were greater than 5.0 milligrams per liter: pH values ranged from 6.0 to 6.8, and the mean water temperature ranged from 23.0 to 27.0 Celsius. The biochemical oxygen demand and nutrient concentrations at the downstream sampling sites were higher in Goodwater Creek than in Okatoma Creek. The maximum 5-day biochemical oxygen demand was 2.7 milligrams per liter in Goodwater Creek and 1.5 milligrams per liter in Okatoma Creek. The mean concentration of total nitrogen was 1.0 and 0.71 milligrams per liter and the mean total phosphorus concentration was 0.26 and 0.10 milligrams per liter at the downstream sites on Goodwater and Okatoma Creeks, respectively. Fecal coliform densities generally were high at all sites, exceeding 4,000 colonies per 100 milliliters in both Goodwater and Okatoma Creeks. Objectionable concentrations of total cadmium, mercury, iron, and phenol were present in a sample of water. Dieldrin, chlordane, DDD, DDE, and DDT were present in a sample of bottom material collected at the downstream site of Okstoma Creek. The peak concentration of dye injected into Goodwater Creek traveled through a 1.7-mile reach at a rate of 0.3 mile per hour. (USGS)
W82-05845

QUALITY OF WATER AND TIME OF TRAVEL IN LITTLE COPIAH CREEK NEAR CRYSTAL SPRINGS, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-1069, 1981. 31 p, 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Water quality, *Surface water, *Streamflow, *Path of pollutants, Low flow, Hydrologic data, Water temperature, Heavy metals, Pesticides, Water analysis, Dye releases, *Mississippi, Little Copiah Creek, Time of travel.

An intensive quality of water study was conducted on Little Copiah Creek in the vicinity of Crystal

Springs, Miss., from August 19 to August 21, 1980. The quality of water in Little Copiah Creek improved 7 miles downstream of a source of wastewater inflow. The mean total nitrogen concentration decreased from 17 to 1.1 milligrams per liter and the mean total phosphorus concentrations decreased from 5.8 to 0.39 milligrams per liter. The maximum five-day biochemical oxygen demand decreased from 14 to 1.4 milligrams per liter while the dissolved-oxygen concentration increased from 2.0 to 6.9 milligrams per liter. The maximum fecal coliform and fecal streptococcus densities at the upstream sampling site were 2,200 and 6,700 colonies per 100 milliliter, respectively, and were observed to decrease downstream to 160 and 1,500 colonies per 100 milliliters. The mean stream temperatures decreased downstream only slightly from 26.5 to 25.0 Celsius and the pH of the water ranged from 7.2 to 7.4 units upstream and 6.5 to 7.0 units at the downstream site. The average rate of dye travel through the upstream 2.3 mile reach was 0.08 miles per hour during the study. (USGS)
W82-05847

INDICATOR BACTERIA SURVIVAL UNDER LABORATORY CONDITIONS,

Marquette Univ., Milwakee, WI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-05853

STATISTICAL ANALYSES TO DERIVE IMPROVED STORMWATER QUALITY MODELS,

Union Coll., Schenectady, NY. Dept. of Civil Engineering.
T. K. Jewell, and D. D. Adrian.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 489-499, May, 1982. 3 Fig, 11 Tab, 5 Ref.

Descriptors: *Rainfall-runoff relationships, *Storm water, *Water quality, Model studies, Urban runoff, Runoff, Hydrologic models, Statistical analysis, Fate of pollutants, Pollution load, Rainfall intensity.

Statistical analysis of storm water quality models revealed that no one model was consistently better than others in predicting storm water pollutant washoff. Even when the same model fit well for several basins, the estimated parameter values varied significantly among the basins. Therefore, calibration of an existing model is not advisable for predicting storm water quality. A better procedure would be to gather data from each basin under study and develop models from this data. The primary independent variables were total volume of runoff for storm total analyses and runoff intensity for instantaneous flux analyses. Also used as independent variables in selected models were storm duration, time since start of storm, particulate fallout, population density, and percentage impervious area. Fourteen models for storm event total loadings and 15 models for instantaneous flux were analyzed. (Casser-FRC)
W82-05857

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES. II. KNYSNA RIVER,

National Physical Research Lab., Pretoria (South Africa).
R. J. Watling, and H. R. Watling.
Water S. A., Vol 8, No 1, p 36-44, January, 1982. 5 Fig, 6 Tab, 11 Ref.

Descriptors: *Estuaries, *Trace metals, Oysters, Estuarine environment, Knysna River, South Africa, Zinc, Copper, Cadmium, Cobalt, Thesen's Island, Lead, Sediments, Monitoring, Rivers, Water pollution sources.

A survey was conducted to determine metal levels in the Knysna estuary and the rivers leading to it. Surface and bottom water samples were taken from up to 25 sites at low tide during May 1977. Metal levels in surface waters were generally higher in the river, gradually decreasing towards the national road bridge, after which concentrations remained relatively constant in the rest of the estuary. Cobalt and mercury levels did not follow this pattern. Surface sediments in the estuary demonstrated that the estuary is relatively unpolluted with respect to tract metals. Metal levels in the drain sediments were considerably higher than those in the normal estuarine sediments, as expected. Twelve sediment cores were also collected. Four sites of metal accumulation of a relatively long-lived nature were identified, including Thesen's Island point, close to the Leisure Isle resort, with high cadmium levels; and Thesen's Island jetty, where there are elevated levels of cadmium, chromium, zinc, cobalt, and nickel. It is suggested that there was once a localized source of these metals which now no longer exists. As yet the Knysna Lagoon is considered relatively unpolluted. Metal concentrations in Crassostrea gigas and Ostrea edulis from the Knysna estuary are much lower than many of the reported values for these species. (Baker-FRC)
W82-05897

5C. Effects Of Pollution

ACID PRECIPITATION. 1. CAUSES AND CONSEQUENCES,

Environmental Law Inst., Washington, DC.
H. Babich, D. L. Davis, and G. Stotzky.
Environment, Vol 22, No 4, p 6-13, 40-41, May, 1980. 4 Fig, 1 Tab, 74 Ref.

Descriptors: *Acid rain, Air pollution, Rainfall, Air pollution effects, *Environmental effects, Aquatic environment, Ecosystems, *Hydrogen ion concentration, *Ecological effects.

The causes of acid precipitation are detailed and its consequences for the abiotic and biotic components of the terrestrial and aquatic ecosystems and for natural and man-made materials are described. Acid precipitation is defined as rain or snow with pH values of less than 5.6. The incidence and severity of acid precipitation falling over the United States, Canada, and most of western Europe had increased significantly within the last 20 to 25 years. Acid precipitation is associated with industrial and automotive emissions of sulfur oxides, nitrogen oxides, and gaseous hydrogen chloride resulting from the combustion of fossil fuels. These pollutants may remain in the atmosphere for several days, during which they may be transported large distances, sometimes exceeding 500 miles, before being deposited on water or land surfaces. Acid precipitation may have a toxic effect on indigenous plants and animals by altering the chemical composition of the land or aquatic environments on which it is deposited. Soil type is a factor in determining the susceptibility of terrestrial environments to acid precipitation. The pH of some soils may be lowered, or the leaching of calcium, magnesium, or heavy metals from the soil may be accelerated. In addition, acid rain may adversely affect the reproductive success of some terrestrial animals and cause a variety of plant growth and foilage damage problems. The pH of lakes or streams may be lowered, resulting in the release of toxic heavy metals, the disappearance of fish populations, a reduction in the microbial decomposition processes, and a general lowering of the fertility of the aquatic ecocystem. Acid precipitation has also been shown to promote the corrosion of metals, particularly iron and iron-containing alloys, and the deterioration of stone and marble structures. (Carroll-FRC)
W82-04771

KINETIC MODELING OF THE OZONATION OF PHENOL IN WATER,

Vanderbilt Univ., Nashville, TN. Dept. of Chemical Engineering.
J. A. Roth, W. L. Moench, Jr., and K. A. Debalak.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 135-139, February, 1981. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Kinetics, *Phenol, *Ozonation, Model studies, *Wastewater treatment, *Industrial wastewater, Mass transfer, Chemical reactions.

A model for predicting the extent of the gas-liquid reaction between ozone and phenol was developed from bench-scale studies. This is relevant to ozonation of phenols in industrial wastewater streams. Experimental data showed first-order dependence with respect to phenol. The model was fit to data obtained from semibatch and continuous stirred tank reactor studies. Analysis of data by other investigators produced model parameters which compared well with results of this study. Gram-moles of phenol removed vs, gram-moles of ozone consumed were plotted on a graph, not distinguishing between ozone reacting with phenol and intermediates and ozone which self-decomposes. For complete removal of phenol, 4-6 moles of ozone were required. (Casser-FRC)
W82-04780

ALTERNATIVE APPROACH TO ASSESSING WATER QUALITY IMPACT OF WASTEWATER EFFLUENTS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-04788

COSTS FOR SMALL SYSTEMS TO MEET THE NATIONAL INTERIM DRINKING WATER REGULATIONS,

North Carolina Utilities Commission, Raleigh.
R. G. Stevie, and R. M. Clark.
Journal of the American Water Works Association, Vol 74, No 1, p 13-17, January, 1982. 5 Fig, 8 Tab, 13 Ref.

Descriptors: *Costs, *Water treatment, *Economies of scale, Water quality standards, *Small water systems, Water quality control, Financing, Regulations, Water supply.

More than 95% of the water suppliers in the United States are small systems, serving fewer than 10,000 people. The increased water quality demands of the National Interim Drinking Water Regulations (NIPDWR) have a special financial impact on small systems because of their characteristics cost patterns and financing possibilities. The existence of positive economies of scale is a pervasive characteristic of water supply technology. The increasing financial burden imposed by NIPDWR will increase pressure in the direction of regionalization or joining small water companies to edjacent large ones. An analysis was undertaken of the costs of required new technolgy in 23 small water utilities from EPA regions 3,5 and 6. Seven of the utilities were determined to suffer from potential NIPDWR violations. cost impacts were calculated for proposed treatments to solve these violations. Cost increases ranted from 1.3 cents/1000 gal for chemical oxidation to remove excessive manganese to $4.18/1000 gal for lime softening to remove excessive barium. (Carroll-FRC)
W82-04793

FACTORS AFFECTING THE RECOVERY OF ISH POPULATIONS IN AN INDUSTRIAL RIVER,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
A. W. H. Turnpenny, and R. Williams.
Environmental Pollution, Series A, Vol 26, No 1, p 39-58, 1981. 6 Fig, 6 Tab, 31 Ref.

Descriptors: *Fish populations, *Water pollution control, Water quality, Fish, Stream improvement, Toxicity, Hydrogen ion concentration, Dissolved oxygen, Industrial wastewater, *Wales, Great Britain, Ebbw Fawr.

The Ebbw Fawr is a river located in southeast Wales which was rendered virtually devoid of fish by industrial pollution over 100 years ago. Progressive improvements in water quality have been achieved since the early 1960s with the introduction of various pollution control measures. Significant water quality improvements have resulted from the installation of pollution control measures at coal washeries and a steelworks on the river in the early 1970s. These pollution control measures have been successful in reducing the levels of toxic materials in the river and in restoring dissolved oxygen levels and pH values acceptable to fish.

The brown trout was the first freshwater fish species to become reestablished in parts of the river between 1974 and 1977. The trout was followed by eel, stoneloach, stickleback, and bullhead species. Calculated toxicities and the results of fish caging tests indicated that water quality was satisfactory for fish populations throughout the river, with the possible exception of a short reach immediately below the steelworks. The limited numbers of fish available for recolonization and the restrictions on their movements resulted in the failure of the fish to recolonize some upstream reaches having good water quality. Although good growth and condition factors among the recolonizing brown trout stock suggest that a sport fishery could be developed on the river, stocking with hatchery-reared fish will be necessary for some time due to residual silt pollution which inhibits spawning. (Carroll-FRC)
W82-04812

TOXICITIES OF PARAQUAT AND METRIBUZIN (SENCOR) HERBICIDES TO THE FRESHWATER COPEPODS, EUCYCLOPS AGILIS AND DIAPTOMUS MISSISSIPPIENSIS,

Southern Univ., Baton Rouge, LA. Dept. of Biological Sciences.
S. M. Naqvi, T. S. Leung, and N. Z. Naqvi.
Environmental Pollution, Series A: Ecological and Biological, Vol 26, No 4, p275-280, December, 1981. 3 Tab, 13 Ref.

Descriptors: *Herbicides, *Toxicity, *Copepods, *Water pollution effects, Aquatic animals, Crustaceans, Paraquat, Metribuzin, Bioassay, Mortality.

The acute toxicities of the herbicides, paraquat and metribuzin, on freshwater copepods were determined by 24- and 48-hour static bioassay tests. Zooplanktonic organisms were collected from Lake Kernan and acclimatized for 96 hr in 90-liter aquaria containing lake water. Copepods were separated by passing through a plankton net into a vial, where they accumulated at the top of the vial. The copepod population was comprised of 91% calanoids (Diaptomus mississippiensis March) and 9% cyclopoids (Eucyclops agilis Koch). The 24-hour LC50 values for paraquat and metribuzin were 10 and 205 ppm; the 48-hour LC50 values, 5 and 150 ppm, respectively. Mortality rates off the copepods due to herbicide exposure were dosage dependent and directly proportional to exposure time. A 1:1 mixture of the two herbicides was less toxic than paraquat and more toxic than metribuzin. LC50 values for the mixture were 29.1 ppm for 24 hours and 17.1 for 48 hours. (Cassar-FRC)
W82-04814

THE ASSESSMENT OF THE POSSIBLE INHIBITORY EFFECT OF DYESTUFFS ON AEROBIC WASTE-WATER BACTERIA, EXPERIENCE WITH A SCREENINT TEST,

Imperial Chemical Industries Ltd., Brixham (England).
D. Brown, H. R. Hitz, and L. Schaefer.
Chemosphere, Vol 10, No 3, p 245-261, 1981. 5 Fig, 8 Tab, 14 Ref.

Descriptors: *Dyes, *Activated sludge process, *Bacteria, *Water pollution effects, Wastewater treatment, Sewage bacteria, Inhibition, Respiration Oxygen uptake, *Aerobic bacteria, Industrial wastewater, Chemical wastewater.

A rapid screening test for assessing the possible inhibitory effects of dyestuffs on aerobic wastewater bacteria was developed and tested. Respiration rates of bacteria in activated sludge with and without the chemical under test were compared. Chemicals may be screened in a series at the 100 mg per liter level, or one chemical may be tested at several concentrations over the range < 1 to > 100 mg per liter. An activated sludge concentration of 1600 mg per liter, about half that in many sewage plants, was used to confine the oxygen uptake rates to a convenient range. Recommended contact time was 32 hours, and recommended pH range, 7-8. One year of testing 202 dyes showed that 19, all in the Basic Dye Group, had IC50 (50% inhibition concentrations) less than 100 mg per liter. Other groups of dyes tested were Acid, Direct, disperse, Reactive, ad Miscellaneous. The chemical 3,5-dichlorophenol was found suitable as a procedural check. (Cassar-FRC)
W82-04825

EFFECT OF MIXED LIQUOR SUSPENDED SOLIDS CONCENTRATION ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS,

Imperial Coll. of Science and Technology London (England). Public Health Engineering Lab.
L. A. Obeng, J. N. Lester, and R. Perry.
Chemosphere, Vol 10, No 9, p 1005-1009, September, 1981. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Nitrilotriacetic acid, *Mixed liquor solids, *Biodegradation, Degradation, Wastewater treatment, *Activated sludge process, Detergents, *Heavy metals, Metals, Water pollution effects, Fate of pollutants, Chelation.

Biodegradation of nitrilotriacetic acid (NTA) and heavy metal removal were studied in a laboratory-scale activated sludge system at two concentrations of mixed liquor suspended solids (MLSS), 2000 and 4000 mg per liter. Heavy metals in the influent sewage ranged from 0.1 to 0.5 mg per liter (Cd, Cr, Cu, Ni, Pb, and Zn). A 10 mg per liter dose of NTA added to the activated sludge system produced effluent concentrations of 0 to 1 mg per liter NTA for the 4000 mg per liter MLSS and 0 to 3 mg per liter for the 2000 mg per liter MLSS. Metal levels in the effluent were lower than in the influent. Doubling the NTA levels to simulate a wash day increased effluent NTA levels to 10 mg per liter in the 2000 mg per liter MLSS and to 5 mg per liter in the 4000 mg per liter MLSS. Doubling the NTA concentration did not have any adverse effects on suspended solids or COD removal. (Cassar-FRC)
W82-04829

A ONE YEAR STUDY OF THE SEASONAL VARIATIONS OF SDDT AND PCB LEVELS IN FISH FROM HEATED AND UNHEATED AREAS NEAR A NUCLEAR POWER PLANT.

National Swedish Environment Protection Board, Stockholm.
M. Edgren, M. Olsson, and L. Reutergardh.
Chemosphere, Vol 10, No 5, p 447-452, May, 1981. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Fish, *Thermal pollution, *Chlorinated hydrocarbons, *Water pollution effects, Perch, Roach, Cooling water, Insecticides, Pesticides, DDT, Polychlorinated biphenyls, *Nuclear powerplants, Seasonal variation, Simpevarp, *Sweden.

Perch living in the heated water discharges of a nuclear power plant at Simpevarp, Sweden, had higher levels of DDT and polychlorinated biphenyls than perch in the intake areas. The difference in temperature between the two sites was 4 to 10C. No significant differences in organochlorine levels were found in roach from the two locations. Levels of DDT and polychlorinated biphenyls were highest in spring and early summer and lower in autumn. (Cassar-FRC)
W82-04836

EFFECTS OF SULFURIC ACID RAIN ON MAJOR CATION AND SULFATE CONCENTRATIONS OF WATER PERCOLATING THROUGH TWO MODEL HARDWOOD FORESTS,

Corvallis Environmental Research Lab., OR.
J. J. Lee, and D. E. Weber.
Journal of Environmental Quality, Vol 11, No 1, p 57-64, January-March, 1982. 5 Fig, 2 Tab, 40 Ref.

Descriptors: *Acid rain, *Forest watersheds, *Ecosystems, Percolation, Soil types, Forest soils, Forest management, Sulfuric acid, Nitric acid, Acidity, Leaching, Cycling nutrients, Water pollution sources, Groundwater, Ecological effects.

Changes are reported in pH, calcium, magnesium, potassium and sulfate ions in acid rain as it percolates through experimental forest ecosystems. The findings indicate that interaction with a well developed hardwood canopy and litter layer can significantly raise the pH and increase concentrations of basic cations in rainwater along with increasing concentrations of sulfate ions. Increased anion concentrations in soil solutions will cause increased concentrations in soil solutions, will cause increased concentrations of cations, which would immediately lead to increased leaching of basic cations from the soil and to decreases in the pH of the soil solution. Sulfuric acid rain, however, may not cause significantly higher sulfate concentrations in soil solutions until the ability of the soil to adsorb sulfate is exhausted. For a strong sulfate adsorber, this might occur after a year or two for rain at pH 4.0. The response of soil solutions to nitric acid rain could be more rapid, but lower in magnitude. The various layers of the model ecosystems responded differently to the sulfuric acid rain, emphasizing that the effects of acid precipitation on forest soils can only be adequately studied in an ecosystem context. (Baker-FRC)
W82-04872

EFFECT OF LONG TERM EXPOSURE TO PETROLEUM ON MIXED FUNCTION OXYGENASES IN FISH: FURTHER SUPPORT FOR USE OF THE ENZYME SYSTEM IN BIOLOGICAL MONITORING,

Dept. of Fisheries and Oceans, St. John's (Newfoundland).
J. F. Payne, and L. L. Fancey.
Chemosphere, Vol 11, No 2, p 207-213, 1982. 1 Tab, 30 Ref.

Descriptors: *Fish, *Oil spills, *Enzymes, *Water pollution effects, Fate of pollutants, Codfish, Flounder, Sculpin, Toxicity, Mixed function oxygenases, Oil pollution, Monitoring, Hydrocarbons.

Fish were exposed at ambient temperatures in laboratory aquariums to low levels of petroleum hydrocarbons in sediments for several months to determine mixed function oxygenase (oxidase) (MFO) response. Three species at three different stages of the sexual cycle were studied: spawning codfish (Gadus morhua), post-spawned sculpins (Myoxocephalus octodecemspinosus), and gonadally maturing flounder (Pseudopleuronectes americanus). MFO activity was elevated 4-fold in the liver and 3-fold in the gills of codfish exposed for 4 months to concentrations of 0.30-0.60 ppm petroleum at temperatures of -1 to +1 C. Liver enzyme activity remained elevated 3-fold in sculpins exposed to 0.15 to 0.20 ppm of petroleum for 3 months at 4-12 C. Using an oil-contaminated sediment weathered for 1 year induced a 7-fold level of MFO activity in flounder. Several factors that might detract from use of the MFO system in biological monitoring did not interfere. These were sex, state of sexual maturity, small number of animals, and the codfish's large fatty liver, which could possibly negate induction. (Cassar-FRC)
W82-04884

PETROLEUM REFINERY WASTEWATER INDUCTION OF THE HEPATIC MIXED-FUNCTION OXIDASE SYSTEM IN PACIFIC STAGHORN SCULPIN,

Northrop Services, Inc., Corvallis, OR.
J. W. Ridlington, D. E. Chapman, B. L. Boese, and V. G. Johnson.
Archives of Environmental Contamination and Toxicology, Vol 11, No 1, p 123-127, 1982. 4 Tab, 16 Ref.

Descriptors: *Industrial wastes, *Estuarine environment, Aquatic life, Pollution effects, Water quality, Enzymes, *Yaquina Bay, *Oregon, *Oil industry.

The purpose of this study was to establish the presence of cytochrome P-450 and mixed function oxidase (MFO) in the ubiquitous estuarine sculpin, Leptocottus armatus, and to determine whether induction of these enzymes occurs as a result of exposure to petroleum refinery wastewater. Immature Pacific staghorn sculpin were collected from tidal channels in Yaquina Bay, Oregon, by 15 meters beach seine. Wastewater was collected from two Class B refineries and stored at 1 to 4

degrees C. The microsomal cytochrome P-450 linked mixed function oxidase system was found to be present in staghorn sculpin. The increase in cytochrome P450 in response to beta-naphtholflavone injection indicated that at least part of this system is inducible by an aromatic hydrocarbon known to induce MFO activity in other fish. Different wastewaters were able to induce sculpin MFOs to different degrees, probably due to differences in aromatic hydrocarbon content. (Baker-FRC)
W82-04895

THE NEW POLLUTION–GROUNDWATER CONTAMINATION,

D. E. Burmaster.
Environment, Vol 24, No 2, p 6-13, 33-36, March, 1982. 2 Fig, 7 Tab, 35 Ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Public health, Fate of pollutants, Water pollution sources, Regulations, Chlorinated hydrocarbons, Wells, Water supply, Drinking water, Carcinogens, Risks, Water quality standards, Water pollution effects.

Groundwater, considered in the past to be a pristine resource, is vulnerable to contamination from human activities: surface impoundments, landfills, agriculture, leaks and spills, land disposal of wastewater, septic tanks, mining, petroleum and gas production, and injection wells. Once contaminated with nonbiodegradable organic chemicals, groundwater may remain so for hundreds or thousands of years. The degree of threat to groundwater depends on local geology and hydrological conditions. If plumes of pollution move very slowly, it may take decades for contamination to reach a water supply. Monitoring this movement is very expensive. Toxic organic chemicals have been found in many municiplal and private wells throughout the U.S. Areas with major problems are states east of the Mississippi River and several sparsely populated western states. Crude estimates of cancer risks from using water from chemically-contaminated wells were possible in a few cases. In Nassau County, Long Island, where groundwater contains high levels of chlorinated hydrocarbons and other organic chemicals, it is estimated that a additional 750 people out of a million population will contract cancer in their lifetimes as a result of exposure to these chemicals in drinking water. The EPA has adopted maximum contaminant levels for pollutants in drinking water for a few substances, including trihalomethanes, but for most of the synthetic organic compounds found in groundwater supplies there are no proposed standards to date. (Cassar-FRC)
W82-04938

THE DECLINE OF SALVINIA MOLESTA ON LAKE KARIBA,

Lake Kariba Fisheries Research Inst., (Zimbabwe).
For primary bibliographic entry see Field 2H.
W82-04945

BENTHOS AND ZOOPLANKTON OF COAL STRIP MINE PONDS IN THE MOUNTAINS OF NORTHWESTERN COLORADO, U.S.A.,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
S. P. Canton, and J. V. Ward.
Hydrobiologia, Vol 85, No 1, p 23-31, 1981. 3 Fig, 4 Tab, 29 Ref.

Descriptors: Invertebrates, Mine drainage, Water quality, *Strip mine wastes, *Benthos, Benthic fauna, *Zooplankton, *Colorado, Physicochemical properties, *Ponds, Water pollution effects, Species diversity, Spoil banks, Aquatic fauna, Coal mines, Ecological effects.

Zooplankton, benthic fauna, and physicochemical parameters were studied in four ponds in a coal strip mine region of northwest Colorado from July 1977 to May 1978. Pond 1, age 10 years, received mine drainage. Pond 2, age over 30 years, received mine drainage. Pond 3 received partial mine drainage. Pond 4, control, received no mine drainage. The spoils ponds received no acid mine drainage (pH of all ponds, 7.4-7.6) but were higher in total dissolved solids, nitrate, and sulfate than the control pond. The younger spoils pond was lowest in zooplankton density and diversity, but benthic invertebrates were highest in Pond 1, decreasing in order through Pond 4. Pond 1 contained few or no Cladocera, Trichoptera, Amphipoda, Hydracarina, and Sphaeriidae. It is believed that the younger spoils pond had lower density and diversity because colonizers did not yet have the opportunity to become established because of either distance or time. In addition, nitrate, sulfate, and total dissolved solids levels in Pond 1, although higher than in the other ponds, were not outside tolerable limits for the aquatic species. (Cassar-FRC)
W82-04946

ECOLOGICAL EFFECTS OF URBAN STORMWATER RUNOFF ON BENTHIC MACROINVERTEBRATES IHIBITING THE GREEN RIVER, MASSACHUSETTS,

Massachusetts Univ., Amherst, Dept. of Environmental Sciences.
J. M. Pratt, R. A. Coler, and P. J. Godfrey.
Hydrobiologia, Vol 83, No 1, p 29-42, 1981. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Storm runoff, Rivers, *Massachusetts, Benthos, Runoff, Storm water, *Urban runoff, Aquatic life, Population dynamics, Aquatic populations, Water pollution, *Green River, *Ecological effects.

The purpose of this study was to investigate the long term effects of urban runoff on the benthic community in the Green River, Massachusetts. The Green River originates in south-central Vermont and flows in a southerly direction, 32 km before joining the Deerfield River near Greenfield, Massachusetts. The water quality is typically good upstream but deteriorates immediately after passing through an urban reach. Four analytical procedures were used: species diversity (the Brillouin index), hierarchical diversity, major taxa composition, and collection dissimilarity at the species level. The overall results from these four analytical studies strongly indicated that the macrobenthic community became progressively disrupted downstream in the urban reach. The high degree of correspondence between the known sources of urban runoff and the observed effects on the benthic community are forceful arguments that urban runoff is the casual agent of disruption. The impact is not confined to periods following heavy rains. The stress was heaviest in the summer low flow and was probably localized in or near the stream bed. Monitoring of physical, chemical, and biological parameters should be undertaken to understand the stream bed microzone. Urban runoff pollutant loading standards must take into account the apparent long term residence of pollutants in the substrate and the associated stress of summer low flows. (Baker-FRC)
W82-04947

THE EFFECTS OF DISSOLVED HEAVY METALS ON ATTACHED DIATOMS IN THE UINTAH BASIN OF UTAH, U.S.A.,

Brigham Young Univ., Provo, UT. Dept. of Botany and Range Science.
For primary bibliographic entry see Field 5A.
W82-04951

BEHAVIOR OF ORGANIC PRIORITY POLLUTANTS IN THE TERRESTRIAL SYSTEM: DI-N-BUTYL PHTHALATE ESTER, TOLUENE, AND 2,4 DINITROPHENOL,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-04965

RARE AND ENDANGERED SPECIES: FRESHWATER GASTROPODS OF SOUTHERN NEW ENGLAND,

Connecticut Univ., Storrs.
E. H. Jokinen, and J. Pondick.
Bulletin of the American Malacological Union, 1981, p 52-53, 1 Tab, 6 Ref.

Descriptors: Snails, *Endangered species, Connecticut, *Gastropods, Cincinnatia cincinnatiensis, Amnicola walkeri, Pomatiopsis lapidaria, Goniobasis virginica, *Acid rain, Air pollution fallout, *New England, *Ecological effects, Endangered species.

The rare and endangered species of freshwater gastropods of southern New England are reported on based upon data collected over the past four years. Field sampling was concentrated in Connecticut but included parts of southern Massachusetts east to Cape Cod (69 55 W to 73 45'W, 40 00'N). Water chemistry data were collected along with the snails. Collection methods and water analysis techniques have been described elsewhere by Jokinen (The Nautilus 92:156-160, 1978). Voucher specimens have been placed in the Museum of Comparative Zoology, Harvard University, the Florida State Museum, and the Museum of Zoology, the University of Michigan. Acid rain poses a threat to poorly buffered habitats.
W82-04968

TOXICITY OF ANAKEESTA FORMATION LEACHATES TO SHOVEL-NOSED SALAMANDER, GREAT SMOKY MOUNTAINS NATIONAL PARK,

Tennessee Technological Univ., Cookeville.
R. C. Matthews, Jr., and E. L. Morgan.
Journal of Environmental Quality, Vol 11, No 1, p 102-106, January-March, 1982. 2 Fig, 2 Tab, 31 Ref.

Descriptors: *Leachates, *Toxicity, Highways, *Highway effects, Infiltration, Percolation, Water pollution sources, *Salamanders, *Great Smoky Mountains National Park.

In 1963 following relocation of U.S. Highway 441 near Newfound Gap in the Great Smoky Mountains National Park, aquatic life in a headwater stream, Beech Flats Prong, was severely disrupted. Attempts to restock the stream with brook trout at various times after highway completion failed. Toxic substances were not identified until almost a decade later in leachate from roadfill materials consisting of pyrite-containing Anakeesta rock. Toxic metals, especially A1 and lesser quantities of Cu and Zn, are dissolved and transported by acidic leachates generated by redox actions of metal sulfides. The toxicity of leachates produced in the laboratory from Anakeesta rock and stream reference water was investigated in 96-hr bioassays with the shovel-nosed salamander, Leurognathus mamoratus, abundant in the park. After 48 hr of exposure at leachate concentrations of about 50%, mortality of about half of the salamanders present occurred. The mortality rate was a function of exposure time and concentration. The exact mechanism of death is unknown. Similar problems may be anticipated in other areas where this type of rock formation occurs. (Baker-FRC)
W82-04988

THERMAL FRONT FORMATION FROM BUOYANT SURFACE JETS,

Alaska Univ., Fairbanks. Geophysical Inst.
J. P. Gosink.
Journal of the hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No Hy2, p 252-257, February, 1982. 2 Fig, 17 Ref.

Descriptors: *Thermal water, *Powerplants, *Froude number, *Mathematical studies, *Thermal pollution, *Jets, Electric powerplants, Nuclear powerplants, Water pollution effects, Thermal powerplants, Heated water, Waste heat, Temperature effects, Temperature gradient.

Electric generating plants powered by nuclear or fossil fuels produce waste heat that is usually released into a stream or water basin as a horizontal buoyant jet causing great elevations in temperature in the receiving waters. Concentric thermal waves also radiate from such outfalls. An attempt was made to explain the formation of thermal fronts for outfall Froude numbers in the range of F less than or equal to 3.3. Using experimental and theoretical data, it was demonstrated that the homogeneous round jet has a characteristic natural frequency in

the range 0.3 > Strouhal number < 0.5 which is damped out beyond the ration of some distance x/ D (the jet diameter) greater than or equal to 5. Instabilities in the form of thermal fronts may increase and spread radially from the outfall if the brunt-Vaisala frequency of the ambient basin near the outfall is greater than or equal to the characteristic jet frequency. These findings may be useful in designing warm water diffusers. To minimize the occurrence to steep thermal gradients associated with thermal fronts, outfall Froude numbers < 3.3 should be avoided. More research into the behavior of thermal fronts is needed to protect aquatic organisms from the steep gradients of temperature that may occur with the passage of a thermal front and may be linked to a given range of outfall froude number. (Geiger-FRC)
W82-05004

DETECTION OF DIETHYLNITROSAMINE IN NITRITE-RICH WATER FOLLOWING TREATMENT WITH RHODAMINE FLOW TRACERS,

National Fishery Research Lab., La Crosse, WI.
For primary bibliographic entry see Field 5B.
W82-05022

LIMNOLOGICAL STUDY OF A FRESHWATER RESERVOIR, JAMWA RAMGARH (JAIPUR).

Rajasthan Univ. Jaipur (India). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W82-05102

INITIAL MICROBIOLOGICAL RESPONSE IN LAKES TO THE MT ST HELENS ERUPTION,

Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 2H.
W82-05125

PESTICIDE EFFECTS ON AQUATIC HABITATS,

Hamburg Univ. Inst. fuer Hydrobiologie und Fischereiwissenschaft (Germany, F.R.).
C. W. Heckman.
Environmental Science and Technology, Vol 16, No 1, p 48A-57A, January, 1982. 3 Tab, 42 Ref.

Descriptors: *Pesticides, *Aquatic habitats, Ecosystems, Aquatic environment, Agricultural chemicals, *Ecological effects.

Only a small percentage of the studies of the effects of pesticides have addressed the effects of pesticides on aquatic habitats. Water bodies may be affected by contamination from persistent agricultural chemicals which find their way into nearby water bodies, from direct application to rice fields or marshes, from wastewater released to water bodies, or from localized direct applications to make a water body more suitable for a selected purpose. Application of pesticides to orchards or other agricultural land may drastically reduce both the number of species and the numbers of individuals within each species remaining in adjacent drainage ditches or other water bodies. Pesticides which find their way into water bodies frequently eliminate food organisms for the fish, such as insects, small crustaceans, or rotifers, leading to subsequent reductions in fish populations. Many agricultural pesticides which are subject to severe use restrictions in industrial countries continue to be used in developing countries, where there are few persons trained to evaluate the ecological stresses on biota or their effectiveness in meeting agricultural objectives. Some of the problems caused by extensive pesticide application programs in these countries could be avoided if the international development aid organizations which finance these efforts would provide adequate monitoring programs and planning support. (Carroll-FRC)
W82-05146

EFFECTS OF ACID PRECIPITATION,

Environmental Protection Agency, Corvallis, OR.
N. R. Glass, D. E. Arnold, J. N. Galloway, G. R. Hendrey, and J. J. Lee.
Environmental Science and Technology, Vol 16, No 3, p 162A-169A, March, 1982. 4 Fig, 4 Tab, 23 Ref.

Descriptors: *Acid rain, *Environmental effects, Sulfuric acid, Pollution effects, Water pollution sources, Reviews, Public health, Appalachian Mountains, Coal, Fuel, Lakes, Ecological effects.

Acid precipitation has become a widespread problem due to the ubiquitous nature of the pollution sources contributing to acid precipitation and the ease with which the emissions causing it are carried by moving air masses. Serious symptoms of acidification have been documented in lakes of New York's Adirondack Mountains, far removed from any industrial activity. While precipitation is most acidic in the northeast US, the geographic extent of the problem encompasses the southeast and portions of the midwest and far west. A growing body of evidence suggests that acid precipitation adversely affects public welfare through loss of fish and other aquatic life, increased leaching of nutrient cations from the soil, possible reductions in crop and forest productivity, and the release of heavy metals or nutrients from rocks, soils and lake and stream bottom sediments. Research on aspects of acid rain is reviewed. The sensitivity of surface water bodies to acid precipitation was evaluated, and historical changes in surface waters were documented. (Baker-FRC)
W82-05149

ENZYMES AND OTHER BIOCHEMICAL INDICATORS OF TOXICANT EFFECTS IN FISHES,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. R. M. Passino.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 19-43, 3 Fig, 2 Tab, 14 Ref. 3 Append.

Descriptors: *Bioassay, *Bioindicators, *Enzymes, *Fish, *Water pollution, Pollutants, Pesticides, Lead, Mortality, Chlorinated hydrocarbons, Growth, Population dynamics, Polychlorinated biphenyls, DDE, Dieldrin, Chlordane, *Pollutant identification.

Enzymes and reproductive hormones may be used as biochemical indicators of toxicant effects in aquatic organisms. Lake trout in the Great Lakes have suffered a serious population decline caused by excessive fishing and predation, but also possibly by the effects of pollutants, since natural reproduction of planted fish is almost non-existent. Two fish enzymes have been identified as indicators of specific contaminants or classes of contaminants. Acetylcholinesterase is inhibited by organophosphate insecticides, while lead inhibits delta-amino levulinic acid dehydratase. Detoxifying enzymes, which are induced when an organism is exposed to toxic substances, have been recognized in fish. Lake trout fry mortality was 40.7% when they were exposed to simulated Lake Michigan levels of PCB and DDE, 10 ng/l and 1.0 ng/l, respectively. A slight increase in growth was observed in the exposed fish. A similar increase in growth was observed in lake trout eggs and fry exposed to simulated Lake Michigan levels of organochlorines, 1 ng/l PCB, 0.2 ng/l DDE, 1 ng/l dieldrin, and 0.9 ng/l technical grade chlordane. The exposed fish had a higher RNA/DNA ratio than the controls, supporting the trend towards increased growth. Reproductive and steroid hormones have been shown to be affected by contaminants. The baseline levels for such chemicals are not known, nor are the effects of season, spawning and migration, so these biochemical indicators can not be used with any certainty yet. (Brambley-SRC)
W82-05155

OVERVIEW AND ASSESSMENT OF BIOLOGICAL SENSING,

Environmental Protection Agency, Washington, DC. Office of Research and Development.
J. D. Koutsandreas.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 45-54.

Descriptors: *Biomonitoring, *Ecosystems, *Aquatic life, *Bioassay, Bioaccumulation, Hazardous materials, Environmental effects, Bioindicators, Water pollution, Air pollution, Soil contamination, Evaluation.

The Environmental Protection Agency is evaluating six approaches to biomonitoring: in-situ bioassays; bioaccumulation; indicator organisms; community and population changes; species health; and integration of biological methods to determine release of toxic substances from hazardous waste operations for air, water, and land. Biological monitoring is defined as the use of a living organism to measure, for a specific time and location, the presence or amount of a substance in the environment or in man, or the effect of a substance on the environment or man. The organism may be a naturally present or introduced species in the environment, or in the laboratory, or in a simulated environment or microcosm. Biological monitoring offers great promise for detecting specific chemicals and has the advantages of greater biological relevance, greater sensitivity, and ability to indicate actual or potential exposures. Most of the emphasis has been on monitoring of aquatic systems, but biological monitoring can be applied to air and terrestrial systems. (Brambley-SRC)
W82-05156

NEW IN-SITU TECHNIQUES IN BIOMONITORING,

BioControl Co., Inc., Port Sanilac, MI.
For primary bibliographic entry see Field 5A.
W82-05157

COMPUTER INTERFACED SYSTEMS FOR BIOLOGICAL MONITORING OF WATER QUALITY,

Virginia Polytecnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-05158

METABOLIC RESPONSE OF FISH TO STRESS,

Texas Univ. at Austin, Port Aransas. Marine Science Inst.
D. E. Wohlsching.
In: 2nd Interagency Workshop on In-Situ Water-Quality Sensing: Biological Sensors, April 28-30, 1980, Pensacola Beach, Florida. National Oceanic and Atmospheric Administration Report, 1981. p 119-141, 11 Fig, 35 Ref.

Descriptors: *Fish, *Fish behavior, *Metabolism, *Monitoring, *Sublethal effects, *Environmental effects, Water pollution effects, Pollutants, Toxicity, Industrial wastes, Salinity, Water temperature.

Fish may be used to monitor consistency of water quality; establish optimal natural environmental conditions; assess and monitor normal, or sublethal departures from normal, conditions with respect to optimal natural environments; assess and monitor deleterious sublethal stress effects of toxic materials; and predict the long-term outcome of natural or anthropogenic stresses at sublethal levels. Before being used in monitoring tests the standard, routine, and active metabolic rates must be determined on acclimatized fish. Using spotted sea trout, red snapper, and striped mullet, experiments have shown the effects of temperature, salinity, red tide exposure, chronic pollution, and ocean dumped petrochemical waste and pharmaceutical waste on metabolic rates and swimming performance. The metabolic rates declined in proportion to the stress. It may be possible to utilize more or less continuous operations to measure swimming rates and general swimming performances in clean and polluted waters. In appropriate equipment other behavior may be observed and the information added to the knowledge of general bioenergetics of fish populations. (Brambley-SRC)
W82-05159

UTILITY OF THE MICROTOX LUMINESCENT BACTERIAL ASSAY FOR THE RAPID ASSESSMENT OF AQUATIC POLLUTION,

Beckman Instruments, Inc., Carlsbad, CA.
For primary bibliographic entry see Field 5A.
W82-05162

CYANOBACTERIAL BLOOMS: CARBON AND NITROGEN LIMITATION HAVE OPPOSITE EFFECTS ON THE BUOYANCE OF OSCILLATORI,

State Univ. of New York Coll. at Purchase.
A. R. Klemer, J. Feuillade, and M. Feuillade.
Science, Vol 215, No 4540, p 1629-1631, March 26, 1982. 2 Fig, 27 Ref.

Descriptors: *Eutrophication, *Limiting factors, *Algae, Nitrogen, Carbon, Oscillatoria, Nutrients, Lakes, *Cyanophyta, Buoyancy.

Relative gas vacuolation (RGV) and buoyancy in blue-green algae depend on an interaction of light and limiting nutrients that affects relative rates of photosynthesis, growth, and gas-vesicle synthesis. To study dynamics of surface bloom developments, RGV was measured nephelometrically with a modified version of Walsby's technique. After a reduction in the dilution rate of a N-limiting cyclostat, RGV in Oscillatoria rubescens declined along with cell N content, and then stabilized as N content continued to decline. A companion culture was supplied by the same peristaltic pump, but deprived of carbon dioxide by a trap installed in the air line after the reduction in dilution rate. With the removal of carbon dioxide, RGV remained stable at first and then increased as the culture became increasingly limited by inorganic carbon. The effect of carbon dioxide deprivation was also noted in two intially N-limiting cyclostats with constant dilution rates. It was concluded that the relative gas vacuole content of the cell of 0. rubescens decreased with increased N limitation and increased with transitions to inorganic limitation. It is suggested that N limitation has a role in the formation of subsurface population maxima by certain species and that inorganic carbon limitation can contribute to the formation or maintenance of surface blooms. N limitation could promote increased turgor pressure and gas-vesicle collapse by contributing to the accumulation of osmotically active photosynthate, whereas the relief of N limitation would increase the assimilation of photosynthate and would reduce turgor pressure. (Baker-FRC)
W82-05175

ENTRAINMENT MORTALITY OF ICHTHYOPLANKON: DETECTABILITY AND PRECISION OF ESTIMATES,

Oak Ridge National Lab., TN.
D. S. Vaughan, and K. D. Kumar.
Environmental Management, Vol 6, No 2, p 155-162, 1982. 3 Fig, 18 Ref.

Descriptors: *Entrainment, *Powerplants, *Fish, Mathematical studies, Environmental effects, Mortality, Monitoring, Sampling, *Intakes.

The purpose of this paper is to show how a biologist may get the maximum information from entrainment sampling by controlling those aspects of sampling over which he has some control. To aid in the design of a more useful sampling program, a method is presented which examines the interrelationships among the following six variables: sample size at the intake and discharge sampling stations, fractions alive in the intake sample, population mean of entrainment mortality fraction, minimum detectable entrainment mortality, width of the confidence interval, and power of the statistical test. Only the first two are under the control of the biologist. The value of the method presented is that it interrelates controllable aspects of the sampling procedures in a manner that permits achievement of a specified level of detectable entrainment mortality, a specified width of a confidence interval, or a specified level of statistical power. Increasing sample size and/or decreasing sampling mortality will decrease the minimum detectable entrainment mortality, confidence interval width, and type II error for a given level of type I error. (Baker-FRC)
W82-05181

PLACER MINING AND SALMON SPAWNING IN AMERICAN RIVER BASIN, CALIFORNIA,

Bureau of Reclamation, Sacramento, CA.
For primary bibliographic entry see Field 8I.
W82-05200

AN ENVIRONMENTAL HEALTH SURVEY OF DRINKING WATER CONTAMINATION BY LEACHATE FROM A PESTICIDE WASTE DUMP IN HARDEMAN COUNTY, TENNESSEE,

Cincinnati Univ. Medical Center, OH. Dept. of Environmental Health.
For primary bibliographic entry see Field 5B.
W82-05203

SEASONAL TEMPERATURE AND POWER PLANT CHLORINATION EFFECTS ON ESTUARINE INVERTEBRATES,

Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
S. L. Margrey, D. T. Burton, and L. W. Hall, Jr.
Archives of Environmental Contamination and Toxicology, Vol 10, No 6, p 691-703, December, 1981. 6 Fig, 3 Tab, 29 Ref.

Descriptors: *Chlorination, *Thermal stress, *Estuaries, *Invertebrates, Estuarine environment, Temperature effects, Seasonal variation, Powerplants, Coastal streams, Eastern United States.

This study investigated the effect of seasonal variations in temperature on the responses of two estuarine invertebrates to interacting chlorine, changes in temperature, and exposure duration conditions simulating powerplant condenser entrainment and effluent discharge conditions. The species selected, opossum shrimp and amphipods, are major food sources for higher organisms along the East Coast of the United States. The situations studied included seasonal temperatures ranging from 15 to 22C; total residual chlorine values of 0.00, 0.15, and 0.30 milligrams per liter; changes in temperature of 2, 6 and 10C; and exposure durations of 0.08, 2.0, and 4.0 hours. The two crustaceans showed a range of sensitivity when tested at various seasonal temperatures. Opossum shrimp were found to be sensitive to powerplant chlorination conditions at both acclimation temperatures, while amphipods were fairly tolerant under the same conditions. Seasonal temperature was an important factor influencing the toxicity of simulated powerplant effluents to these species, with greater mortality occurring at higher seasonal temperatures than at lower temperatures. Seasonal temperature was only a marginal factor in the mortality rates for amphipods. It is suggested that powerplants consider regulating conditions to minimize changes in temperature and total residual chlorine during the summer months in order to minimize the effects on estuarine aquatic invertebrates. (Carroll-FRC)
W82-05204

IMPACT OF HEXAZINONE ON INVERTEBRATES AFTER APPLICATION TO FORESTED WATERSHEDS,

Georgia Univ., Athens. Dept. of Poultry Science.
D. T. Mayack, P. B. Bush, D. G. Neary, and J. E. Douglass.
Archives of Environmental Contamination and Toxicology, Vol 11, No 2, p 209-217, 1982. 5 Fig, 4 Tab, 24 Ref.

Descriptors: *Invertebrates, *Forest watersheds, *Herbicides, Water pollution effects, Hexazinone, Aquatic animals, Species composition, Species diversity, Fate of pollutants, *Chattahoochee National Forest, *Georgia, Macroinvertebrates, Pesticide residues, Accumulation, Bioaccumulation, Forest soils, Aquatic plants, Macrophytes, Ecological effects.

The effect of the herbicide hexazinone (useful in reforestation) on aqautic macrophytes and aquatic and terrestrial invertebrates was assessed in the Chattahoochee National Forest, Georgia. Pelletized hexazinone was applied at the rates of 16.8 kg per ha to four small watersheds in the forest on April 23, 1979. One untreated watershed served as a control. During the 8-month monitoring period hexazinone levels in samples of stream water were generally below the 1 ppb detection limit except for three peaks of 10 to 40 ppb in July-August and three very minor peaks at other times. The peaks did not appear to be correlated with storms. Traces of hexazinone or metabolites were found in aquatic macrophytes on a few occasions. The forest floor litter contained residues of hexazinone and metabolites for about 90 days after application. The highest level was 0.18 + or - 0.19 ppm hexazinone (dry weight basis) and 0.10 + or - 0.17 ppm metabolite 5 days after the first rainfall. No major changes in species composition or diversity were detected in aquatic or terrestrial invertebrates. Most samples of aquatic and terrestrial invertebrates contained no detectable herbicide residues. On a few occasions there were detectable hexazinone and/or metabolites at average levels of less than 2 ppm (wet weight basis). (Cassar-FRC)
W82-05206

ALGAL CONDITIONS IN THE CALOOSAHATCHEE RIVER (1975-79) LAKE OKEECHOBEE TO FRANKLIN LOCK, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
B. F. McPherson, and H. R. La Rose.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-192345, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-81, 1982. 28 p, 7 Fig, 7 Tab, 10 Ref.

Descriptors: *Algae, *Cyanophyta, *Water quality, *Streams, Algal growth, Eutrophication, Nutrients, Phytoplankton, Flow, Seasonal variation, *Florida, *Caloosahatchee River.

Maximum numbers of suspended algae occurred in late spring and early summer, in each of the years 1975-79, in the Caloosahatchee River. Numbers exceeded 100,000 cells per milliliter at all stations sometime during the study. Concentrations decreased during late summer and autumn and were low during winter, except in January 1979 when numbers at most sites exceeded 100,000 cells per milliliter. The January 1979 bloom coincided with large discharges from Lake Okeechobee. During previous winters, discharges and algal numbers were lower. During other seasons, algal blooms occurred most frequently under low-flow or stagnant conditions. The upstream site at Moore Haven, which had the least discharge and was most stagnant, had consistently higher algal concentrations than downstream sites. Blue-green algae were dominant in the river during the summer at the upstream site throughout the year. The percentage of blue-green algae decreased downstream. Concentrations of nitrite plus nitrate nitrogen were inversely correlated with concentrations of algae and decreased to near zero during algal blooms. The low concentrations of these forms of inorganic nitrogen relative to other major nutrients probably favor blue-green algae and limit growth of other algae. Contributions by the basin tributaries to the nutritive condition of the river were small because concentrations of nutrients, algal growth potential, and algae in the tributaries were generally less than those in the river. (USGS)
W82-05222

A PRELIMINARY APPRAISAL OF THE EFFECTS OF AGRICULTURE ON STREAM QUALITY IN SOUTHWEST GEORGIA,

Geological Survey, Doraville, CA. Water Resources Div.
D. B. Radtke, J. B. McConnell, and W. P. Carey.
Geological Survey Water Resources Investigation Open-File Report 80-771, August 1980. 40 p, 15 Fig, 6 Tab, 18 Ref.

Descriptors: *Agricultural chemicals, *Water quality, *Water pollution effects, *Data collections, Sampling, Streams, Surface runoff, Agricultural watersheds, Water quality standards, Water analysis, Pesticides, Organic compounds, Inorganic compounds, Sediment yield, *Georgia, *Agricultural runoff.

Water-quality and suspended-sediment samples were collected in two basins in southwest Georgia

to identify current or potential water-quality problems resulting from agricultural practices. Samples were collected monthly and during periods of storm runoff from December 1976 through July 1978. Concentrations of chemical constituents relevant to agricultural practices were found to be low, even during periods of storm runoff. Concentrations of total nitrogen and total phosphorus ranged from 0.30 to 1.60 and 0.01 to 0.42 milligrams per liter, respectively. Copper, arsenic, lead-mercury, and zinc concentrations were low and did not exceed Georgia or U.S. Environmental Protection Agency (1977) standards for safe drinking water. Concentrations of suspended sediment and total nitrogen were found to remain relatively constant over a wide range of water discharge. Concentrations of total phosphorus showed a better relation to water discharge at Little River near Lenox than at Spring Creek near Iron City. Dissolved-solids concentrations in both streams generally decreased with an increase in water discharge. Average annual yields of selected constituents were low. Total nitrogen and total phosphorus yields were 0.60 to 0.63 and 0.04 to 0.06 tons per year per square mile in Little River and Spring Creek basins. Atrazine, butylante, and ethroprop pesticides were detected at concentrations up to 0.91 micrograms per liter in storm-runoff samples collected during the active farming season. (USGS)
W82-05229

THE RIVER TAME–A SHORT HISTORY OF WATER POLLUTION AND CONTROL WITHIN AN INDUSTRIAL RIVER BASIN,

Severn-Trent Water Authority, Birmingham (England).
N. Harkness.
Water Science and Technology, Vol 14, No 1/2, p 153-165, 1982. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *History, *Water pollution control, *Water quality control, Wastewater treatment, Water pollution effects, Birmingham, *England, *Tame River, Urban areas, Rivers, Industrial wastes, River Tame.

Severe pollution of the River Tame, near Birmingham, England, was evident by 1872, when the river water was judged no longer safe for drinking. Legal action was taken about 1870 to prevent sewage disposal in the river and to prevent odors arising from existing wastewater treatment processes. Coal gas works, iron manufacturing, domestic sewage, and paper mills were the main sources of pollution. Many fish kills were recorded during the latter part of the 19th century. The Birmingham Tame and Rea District Drainage Board was established in 1877 to cover pollution control for the region, with its population of 476,000. Nevertheless, pollution, complaints, and legal actions continued, so that by 1918 the river was an open sewer, supporting no fish life. Industrial and domestic wastes continued to pour into the river after World War II. Since then several pollution control measures have imported water quality. Gas manufacturing ceased in 1960, sewage treatment plants were built and improved, sewer overflows were reduced, and purification lakes were built. These measures have been reflected in an increase in the number of species and abudance of fish. (Cassar-FRC)
W82-05242

THE AQUATIC TOXICITY OF ORGANIC COMPOUNDS TO EMBRYO-LARVAL STAGES OF FISH AND AMPHIBIANS,

Kentucky Water Resources Research Inst., Lexington.
J. A. Black, W. J. Birge, W. E. McDonnell, A. G. Westerman, and B. A. Ramey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224601, Price codes: A04 in paper copy, A01 in microfiche. Research Report No 133, 1982. 68 p, 3 Fig, 15 Tab, 43 Ref. OWRT B-071-KY(1), 14-34-0001-0223.

Descriptors: Embryos, Larvea, *Organic compounds, Water quality, *Toxicity, *Larvae, Benzene, Phenol, Toluene, *Fish, *Embryo-larval tests, Predictive toxicology, Aquatic toxicity tests, Amphibians.

Aquatic toxicity tests were conducted on 11 organic compounds considered hazardous to water resources. The toxicity of each compound was evaluated using embryo-larval stages of up to eight fish and amphibian species. Exposure was initiated at fertilization and maintained through 4 days posthatching. The animal test species exhibited varying degrees of sensitivity to the selected toxicants. Combined frequencies for mortality and teratogenesis at 4 days posthatching gave LC-50 ranges of 3.66 to 8.25 mg/L for benzene, 1.16 to 22.42 mg/L for carbon tetrachloride, 0.11 to 1.20 mg/L for chlorogenzene, 2.03 to 68 mg/L for chlorogrorm, 3.01 to 5.56 mg/L for 1,2 dichlorobenzene, 2.54 to 34 mg/L for 1,2 dichloroethane, 13.16 to 48 mg/L for methylene chloride, 0.002 to 0.64 mg/L for nitrobenzene, 0.04 to 32 mg/L for phenol, 0.02 to 0.85 mg/L for toluene, and 3.53 to 3.77 mg/L for m-xylene. The species which exhibited the greatest susceptibility to organic compounds were the rainbow trout, Rana pipiens, and Rana temporaria. The more sensitive amphibian species generally were those which normally are restricted to aquatic or moist terrestrial habitats, whereas the more tolerant amphibians included those semi-aquatic and terrestrial species which appear to be more broadly adapted ecologically. Of the 11 test compounds, nitrobenzene, toluene, chlorobenzene, and phenol were the most toxic. The least toxic organics included dicloroethane and methylene chloride. For three chlorinated alkanes, including methylene chloride, chloroform, and carbin tetrachloride toxicity was found to increase with the degree of chlorination.
W82-05283

ACID PRECIPITATION IN THE WASHINGTON CASCADES,

Central Washington Univ., Ellensburg. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-05287

THE EFFECTS OF LAND-CLEARING ON A SMALL WATERSHED IN SOUTHERN GUAM,

Guam Univ., Agana. Water and Energy Research Inst.
C. P. Neubauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224783, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 24, August 1981. 56 p, 13 Fig, 3 Tab, 87 Ref. OWRT A-018-GUAM(1), 14-34-0001-0112.

Descriptors: *Land clearing, *Guam, *Small watersheds, *Limnology, *Ecological effects, Watersheds, Aquatic environment, Environmental effects, Water quality, Clear-cutting, Soil temperature, Air temperature, Water temperature, Conductivity, Hardness, Hydrogen ion concentration, Phosphorus, Orthophosphates, Runoff.

A study of the limnology and aquatic ecology of a small watershed in southern Guam showed that land-clearing had pronounced effects when compared to that of an upstream control area. While no significant differences were observed in nitrate concentrations and turbidity between stations, significant mean differences were observed in the watershed in soil temperatures (0.7 degrees greater), maximum air and water temperatures (1.4 degrees less), minimum water temperature (2.0 degrees higher), conductivity (11.0 micro-mhos/sq cm less), hardness (9.0 mg/l less), pH (0.22 pH units greater), and in total phosphorus and orthophosphate concentrations (8.15 and 1.64 micrograms/l less, respectively). Savanna vegetation repopulated the perturbed ravine forest watershed, and thus appeared to be an earlier stage of succession than the ravine forest. Fire or continued clear-cutting would set back succession and maintain savanna vegetation in the watershed. Clear-cutting increases water loss and may accentuate droughts and flooding. In addition, increased temperatures and nutrient losses from the land may cause algal blooms in the downstream areas, and nutrient losses may be long-term problems. (Zielinski-MAXIMA)
W82-05303

LIFE HISTORY AND HABITAT UTILIZATION OF CUTTHROAT TROUT (SALMO CLARKI) IN A HEADWATER STREAM ON THE OLYMPIC PENINSULA, WASHINGTON,

J. A. June.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224817, Price codes: A07 in paper copy, A01 in microfiche. M.S. Thesis, June, 1981. 116 p, 22 Fig, 31 Tab, 95 Ref, 1 Append. OWRT A-101-WASH(1).

Descriptors: *Trout, *Life history studies, Aquatic habitats, Coastal streams, *Land clearing, *Probabilistic process, Fish migration, Growth, Fish populations, Life cycles, Headwaters, Streams, Coastal waters, Canopy, Environmental effects, Probability distribution, Mathematical studies, Model studies, Computer models, *Bear Creek, *Washington, Baseline studies.

A study of the life history and habitat utilization of cutthroat trout in Bear Creek, Washington, provided baseline information for a timber removal study. Trout life history information included upstream adult spawning migration, spawning, incubation and emergence, population dynamics, and movement. Trout habitat utilization study included quantifying the Bear Creek habitat, calculating probability-of-use curves by trout life stage for certain habitat parameters, and combining the two in a habitat utilization model that calculated quality of habitat indexes. The indexes were correlated with biological measurements taken in the same sections. Significant positive correlations were found between the mean length and weight of adult trout and the quality of the indexes. Depth, velocity, and instream cover proved to be the most important of six parameters measured in relation to trout biomass and density. While there were differences in timing of spawning of resident and sea-run cutthroat trout, life history characteristics of both sea-run and resident cutthroat trout in Bear Creek were similar to those reported for other Pacific Northwest streams. The effects of timber canopy removal on density and growth of Bear Creek trout would have to be considerable to be distinguished from the effects caused by variable trout recruitment. (Zielinski-MAXIMA)
W82-05306

SOME FEATURES OF THE TOXIC ACTION OF THE NON-IONIC SURFACTANT LAUROX-9 ON DAPHNIA MAGNA,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
E. P. Shcherban.
Hydrobiological Journal, Vol 16, No 5, p 83-86, 1980. 1 Fig, 1 Tab.

Descriptors: *Surfactants, *Daphnia, *Toxicity, Water pollution effects, Crustaceans, *Laurox-9, Nonionic surfactants, Detergents, Organic compounds, Invertebrates, Eggs, Mortality, Laboratory studies.

The chronic effects of 1, 10, and 25 mg per liter of Laurox-9, a nonionic surfactant, on Daphnia magna were determined for successive generation. The surfactant was toxic to the crustacea at all levels. At the highest level a large proportion of eggs were aborted or the embryos born dead. Many of the live young had morphological defects. The second generation was of low viability, and the third generation failed to reproduce. The 1 mg per liter concentration of Laurox-9 caused a one week reduction in the minimum life span with each successive generation–from 30 days for the first generation to 17 days for the third. Egg abortion in the second and third generations was 5-6 times greater than in the first generation. The second and third generations produced more, but smaller-sized, eggs than the first generation. In the fourth and subsequent generations frequent egg abortion and slow embryo development were evident. Daphnia exposed to the 10 mg per liter concentration of Laurox-9 also had egg abortions, similar in number for the first 3 generations, and nearly doubled for the fourth and fifth generations. A secondary egg batch was often produced. If the interval between batches was 1-1.5 days these secondary eggs developed faster than the first batch. If the interval was 2 days or longer, all undevel-

oped eggs and hatched young were ejected from the brood chamber. Dwarf individuals were often observed. These eventually reached normal size. (Cassar-FRC)
W82-05328

CHANGES IN THE FATNESS OF ROACH (RUTILUS RUTILUS) UNDER THE INFLUENCE OF WARM WASTE WATER FROM A DISTRICT POWER STATION,

Gosudarstvennyi Nauchno-Issledovatelskii Inst. Ozernogo i Rechnogo Rybnogo Khozyaistva, Leningrad (USSR).
V. V. Baranova.
Hydrobiological Journal, Vol 16, No 5, p 61-66, 1980. 1 Tab, 21 Ref.

Descriptors: *Fish, *Thermal pollution, *Lipids, *Roach, Heated water, *Water pollution effects, Seasonal variation, Powerplants, *Ivan'kovo Reservoir, *USSR.

Lipid contents of roach tissues (dorsal muscles, liver, gut, and gonads) were determined in populations exposed to thermal effluent from a power station in Ivan'kovo Reservoir during 1973-75. Water temperature was higher in the thermal discharge region by 11.2C in winter, 7.8C in summer, and 8.8C in autumn. Lipid contents of the tissues followed similar seasonal patterns in both warm water and control groups. The two groups of fish showed no differences in lipid content of muscles (range 2.78-6.55%). However, during summer and autumn the livers, gut, and gonads from the warm water fish were higher in lipid content than organs from the control fish. (Cassar-FRC)
W82-05330

ENZYME ACTIVITY AND KINETICS IN SUBSTRATE-AMENDED RIVER SEDIMENTS,

Sheffield University (England) Dept. of Microbiology.
J. E. Duddridge, and M. Wainwright.
Water Research, Vol 16, No 3, p 329-334, March, 1982. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Enzymes, *Sediments, Rivers, Sedimention, Mathematical equations, Michaelis-Menten equation, Amylase, Cellulase, Urease, Kinetics, *Heavy metals, *Enviromental effects, *Microbiological studies, England.

This paper reports studies to develop assays to measure amylase, cellulase and urease activity in substrate-amended river sediments, and to determine whether activity follows Michaelis-Menten kinetics. Sediments were sampled from four English rivers. The pH optimum for amylase activity was between 5.9 and 6.2 Linear relationships between amylase activity, length of incubation up to to 8 hr and sediment concentration up to 10 ml were demonstrated. The temperature optimum for amylase activity in all sediments was between 45 and 55 degrees C. Optimum pH for cellulase activity in the sediments ranged from 5.6 to 6.8. In all sediments cellulase activity showed a linear increase time and sediment concentration up to 10 ml. Optimum temperature for activity was between 37 and 44 degrees C, and the enzyme was denatured above 55 degrees C. Optimum pH for urease activity in all four sediments was in the range 7.1-7.4. Linear relationships between urease activity and incubation time up to 8 hr and sediment concentration up to 10 ml were established. Enzyme activity was inherently low in the sediments studied, but increased markedly on the addition of substrate, approximating the situation where starch, cellulase and urea enter the sediments as pollutants or from natural sources. Sediment enzyme activity generally obeyed Michaelis-Menten kinetics, but of the three enzymes, urease gave least significant correlation coefficients when the data for substrate concentration versus activity was applied to the Eadie-Hofstee transformation of the Michaelis-Menten equation. (Baker-FRC)
W82-05336

BIOLOGICAL MONITORING, PART IV - TOXICITY TESTING,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
A. L. Buikema, Jr., B. R. Niederlehner, and J. K. Cairns, Jr.
Water Research, Vol 16, No 3, p 239-262, March, 1982. 8 Fig, 2 Tab, 146 Ref.

Descriptors: *Toxicity, *Testing procedures, Monitoring, *Bioindicators, Fish, Reviews, Water quality, Water pollution control, Pollution effects, Aquatic life.

The review describes the most common toxicity tests as they are currently carried out for the purpose of managing pollution in the environment. The type of information provided by each type of test is described, along with various attempts made to apply this information in environmental management schemes. Most toxicity tests have evaluated the short-term lethality of wastes to adult fish. Fish have been the most popular test organism, as they are presumed to be the best understood organism in the aquatic environment and perceived as most valuable by the majority of laymen. Acute toxicity tests are described from the viewpoint of the format of a test, specific considerations in test design, and the use of controls. Data collected from these tests are considered in relation to the response curve, the calculation of the median lethal dose and fiducial limits, comparisons of acute toxicity, and test standardization. Consideration is also given to the sublethal chronic test, deriving safe concentrations, and the application of toxicity test data in environmental management. In spite of increased sophistication in toxicity test methods, increased awareness of the variety of processes operating in a natural system, and the integration of information from a system of tests in various hazard evaluation protocols, the ultimate question of what is an acceptable concentration of a chemical ascertained with a known degree of accuracy is still unanswered. Research is needed on the development and validation of prediction strategies rather than the development of new toxicity tests. (Baker-FRC)
W82-05339

BIOLOGICAL MONITORING. PART V - PREFERENCE AND AVOIDANCE STUDIES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
D. S. Cherry, and J. Cairns, Jr.
Water Research, Vol 16, No 3, p 263-301, March, 1982. 4 Fig, 7 Tab, 303 Ref.

Descriptors: *Reviews, *Bioindicators, Monitoring, *Temperature effects, Heated water, Plumes, Water quality, Chlorine, Environmental effects.

Preference and avoidance studies can be used to determine if fish or other aquatic organisms that are mobile will avoid plumes of toxic materials, whether a thermal plume or other water discharge causing no adverse biological effects will nevertheless alter the distribution of aquatic life, and whether prior conditions to which organisms have been accustomed tend to alter the preference-avoidance response, and can compare preference and avoidance data of fish to the lethal thresholds of elevated temperature and chemical effluents. Various methodologies are reviewed, including temperature preference studies, chemical avoidance studies, and temperature and chlorine avoidance tests. A ranking of final temperature preferenda by fish families is tabulated, and the relationships, between preference, avoidance, and lethal temperatures are considered. Consideration is also given to the correspondence between behavioral responses in laboratory and field thermal chlorinated effluents. (Baker-FRC)
W82-05340

THE CONTINUING STRUGGLE OF WATERBORNE ILLNESS,

E. W. Taylor.
Aqua, No 1, p 12-14,15, 1982.

Descriptors: *Public health, *Water quality, *Pathogens, Water treatment, *History, *Waterborne diseases, Drinking water, Diseases, Water pollution effects, Bacteria.

A pioneer in the fight against waterborne diseases was a London medical practitioner, Dr. John Snow, who established a connection between cholera epidemics and water supplies in the 1850's, more than 20 years before the discovery of bacteria. Other important investigators in this field were Robert Koch, who identified the causative agent of cholera in 1882, and Percy Franklin, who demonstrated the concept of fecal bacteria as indicators of sewage pollution. Waterborne diseases are still problems in subtropical and tropical areas and among visitors returning from these areas. Cholera, typhoid fever, Salmonellosis, infectious hepatitis, guinea worm, and bilharzia occur to varying degrees in both undeveloped and developed countries. Many types of water treatment are available to combat these diseases. Direct abstraction of river water with chlorination, coagulation, rapid filtration, etc. is less reliable than slower, self-purification methods. Sometimes only a few hours elapse between abstraction and consumption, allowing little time to correct quality problems. Additional disadvantages of abstracting water from rivers are the presence of small aquatic animals and ova in the distribution system and the formation of trihalomethanes from organic matter. The modern view is that water must be safe and attractive to drink (free from visible suspended matter, color, tastes, smells, undesirable bacteria, and all substances hazardous to health) and not corrosive to metals. (Cassar-FRC)
W82-05366

CHRONIC EFFECTS OF AMMONIA-STRIPPED OIL SHALE RETORT WATER ON FISHES, BIRDS, AND MAMMALS,

Colorado State Univ., Fort Collins. Dept. of Fishery and Wildlife Biology.
R. R. Nystrom, and G. Post.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 271-276, March, 1982. 2 Tab, 9 Ref.

Descriptors: *Fish, *Wildlife, *Oil shale, *Water pollution effects, Birds, Hamsters, Trout, Fathead minnows, Quail, Ammonia, Industrial wastewater, Mine wastes, Toxicity, Environmental effects, Ecological effects, *Oil shale mining.

The effects of chronic low-level exposure of fish and wildlife to ammonia-stripped oil shale retort water (SRW) were investigated using rainbow trout (Salmo gairdneri Richardson), fathead minnows (Pimephales promelas Rafinesque), coturnix quail (Coturnix coturnix Temminck and Schlegel), and golden hamsters (Mesocricetus auratus Water). Some parameters of SRW were: total Kjeldahl nitrogen, 1180 mg per liter; phenols, 47 mg per liter; conductivity, 13,000 micromhos per cm; and ammonia, 1320 mg per liter. Normal activity, behavior, and appearance continued among all the animals exposed for 10 months to SRW at the following concentrations: trout and fathead minnows, 50 or 100 ppm in water and 10% v/w SRW in food; hamsters and quail, 25% v/v SRW in drinking water and 10% v/w SRW in food. Trout showed mortalities of 85% at the 250 ppm level and 100% at 125 ppm. Examination of liver, kidney, spleen, pancreas, intestine, and other tissues revealed no pathological changes attributed to exposure to SRW. (Cassar-FRC)
W82-05375

KRAFT PULP MILL EFFLUENT COMPONENTS CAUSE LIVER DYSFUNCTION IN TROUT,

Helsinki Univ. (Finland). Dept. of Zoology.
A. O. J. Oikari, and T. Nakari.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 266-270, March, 1982. 1 Tab, 22 Ref.

Descriptors: *Fish, *Toxicity, *Pulp and paper industry, Bioassay, Water pollution effects, *Trout, Industrial wastewater, Liver, Kraft mills, Sublethal effects.

Studies are underway to devise improved methods of ascertaining sublethal effects of pulp and paper industry discharges on aquatic life. Juvenile rainbow trout, exposed to sublethal concentrations of a

sulfate resin soap, a substance typical of kraft mill effluents, showed evidence of liver function impairment, particularly liver glycogen depletion and UDP-glucuronyltransferase activity. Exposures were 0.3 of the 96 hour LC50 (0.53 mg) for 3 days and 0.15 of the 96 hour LC50 for 11 days. Liver glycogen was 0.67 + or - 0.31% in the 3 day test and 0.58 + or - 0.34% in the 11 day test, compared with 2.06 + or - 0.54% in the unexposed control fish. Liver UPD-glucuronyltransferase values (in micrograms per g protein) were: control, 223 + or - 18; 3-day test, 160 + or - 19; and 11-day test, 134 + or - 13. There were also significant increases in % of liver somatic index, plasma ammonia, and plasma total bilirubin and a decrease in plasma glucose in fish exposed for 11 days. (Caesar-FRC)
W82-05377

BENTHOS INVESTIGATIONS: SEDIMENT BOXES OR NATURAL BOTTOM,

Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint, T. W. Duke, and R. D. Kalke.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 3, p 257-265, March, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Benthic fauna, *Species composition, *Sediments, Invertebrates, Aquatic animals, Bottom sediments, *Estuarine environment, Experimental design.

The differences in benthic community structure between the natural marine bottom and sediment boxes colonized with fauna under both field and laboratory conditions were studied from December 5, 1979, to February 4, 1980. Cluster analysis of species list for the 3 types of samples suggested that laboratory-colonized sediments had a patchier distribution of species than field-colonized sediments or natural estuarine bottom sediments. According to inverse cluster analysis the dominant fauna were similar in all 3 groups. However, the species assemblage of the laboratory-colonized group was otherwise very different from the other 2 groups. Total biomass and density of the dominant organisms, Abra aequalis, per 0.18 sq m sediment box were 25.4 grams and 42,900 individuals (average weight 0.6 mg) in the field-colonized sediments, 2.3 grams and 1461 individuals (average weight 1.6 mg) in the natural bottom sediments, and 3.5 grams and about 1250 individuals in the laboratory colonized sediments. Natural bottom samples had larger individuals than the colonized communities. The large numbers of small Abra aequalis in the field boxes were probably artifacts of the phase of colonization and reproductive cycle. The field-colonized communities would probably stabilize and approach the size and composition of the natural community after a longer period. The field-colonized sediment boxes were a better alternative than laboratory-colonized boxes for studying natural benthic communities. (Caesar-FRC)
W82-05378

THE EFFECT OF PHOSPHORUS LIMITATION ON ALGAL GROWTH RATES: EVIDENCE FROM ALKALINE PHOSPHATASE,

McGill Univ., Montreal (Quebec). Dept. of Biology.
R. E. H. Smith, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1421-1427, November, 1981. 7 Fig, 1 Tab, 31 Ref.

Descriptors: *Phosphorus, *Algae, *Growth rates, Nutrients, Phosphates, Enzymes, Lake Memphremagog, Eutrophication, Metabolism, *Limiting nutrients, Effects, Indicators, Canada.

Alkaline phosphatase (APA) is an enzyme induced by phosphorus limitation in many phytoplankton species and is quantitatively related to phosphorus-limited growth in some species. Previous studies have shown the APA correlates with other signs of phosphorus shortage in several lakes and have defined APA values characteristic of severe, mild, and no limitation. The development of APA in continuous flow cultures of natural freshwater phytoplankton communities was studied to further quantify phosphorus limitation of phytoplankton growth in situ. Natural phytoplankton communities from oligothrophic-eutrophic Lake Memphremagog were grown at phosphorus-limited rates of 0.06 to 0.03 per day. APA was found to vary inversely with phosphorus-limited growth rate and to be generally uninfluenced by the community composition changes that occurred in culture. The average in situ APA in Lake Memphremagog during the ice-free season was lower than that of cultures and suggested that phosphorus-limited growth rates were greater than 0.6 per day in even the most oligotrophic sections of the lake. Algal abundance varies with total phosphorus in most north-temperate zone lakes, including Lake Memphremagog. However, data from these tests show that average community growth rates are normally high and change relatively little over a fourfold range of total phosphorus concentration. (Carroll-FRC)
W82-05380

FISH ABUNDANCE AND DISTRIBUTION NEAR THREE HEATED EFFLUENTS TO LAKE MICHIGAN,

Argonne National Lab., IL.
S. A. Spigarelli, R. M. Goldstein, W. Prepejchal, and M. M. Thommes.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 2, p 305-315, February, 1982. 4 Fig, 4 Tab, 14 Ref.

Descriptors: *Thermal pollution, *Nuclear powerplants, *Fish populations, *Ecological effects, Plumes, Lakes, Water pollution effects, Heated water, Powerplants, Electric powerplants, Environmental effects, Seasonal variation, Thermal water, Water temperature, Effluents, *Lake Michigan.

The abundance and distribution of fish with depth and temperature in locally heated and unheated sections of Lake Michigan were examined by a combined echo location-temperature mapping procedure. Measurements were taken between April and October at two adjacent powerplants in the southern basin and at one plant in the northern basin. Seasonal variations in fish densities were found in both plume and reference areas. The greatest plume densities were recorded in late spring, when alewife were spawning inshore. High fish densities were consistently noted downstream of the interfaces between ambient shore-parallel currents and discharge flows. At canal discharges, fish tended to congregate inshore, while at the offshore discharge, they congregated in deeper zones. In plume areas, fish tended to occupy shallower depth strata, which were 1-3 degrees higher than the maximum ambient temperatures. A positive correlation between fish density and increasing temperature was generally observed at both plume and reference stations during all three seasons studied. (Geiger-FRC)
W82-05383

EFFECTS OF TREATED MUNICIPAL WASTEWATER ON THE HEPATIC, XENOBIOTIC, AND STEROID METABOLISM IN TROUT,

Goeteborg Univ. (Sweden). Dept. of Zoophysiology.
L. Forlin, and T. Hansson.
Ecotoxicology and Environmental Safety, Vol 6, No 1, p 41-48, 1982. 3 Tab, 37 Ref.

Descriptors: *Fish, *Wastewater, *Metabolism, Water pollution effects, *Trout, Enzymes, Liver, Steroids, Polyaromatic hydrocarbons, Oil pollution, Organic compounds, Mixed function oxidase, *Bioassay, Laboratory studies, *Treated municipal wastewater.

The effects of treated municipal wastewater on liver microsomal in vitro metabolism of 4-androstene-3,17-dione, benzo(a) pyrene, ethylmorphine, and p-nitroanisole were studied in rainbow trout (Salmo gairdneri). Fish were exposed for 2 weeks to two effluent: tap water ratios, 1:5 (Group B) and 1:1 (Group C). Group B fish showed significant increases in NADPH cytochrome c reductase on a liver weight basis. Group C showed significant increases in cytochrome P-450, NADPH cytochrome c reductase, and microsomal protein on a liver weight basis, but not on a protein weight basis, and an increase in liver somatic index. In vitro incubation of liver tissue from effluent-exposed fish with benzo(a)pyrene, ethylmorphine, and p-nitro-anisole produced increases in p-nitroanisole o-demethylase and benzopyrene hydroxylase activities and decreases in ethylmorphine N-demethylase activity. Fish exposed to effluent showed altered liver microsomal metabolism of androstenedione; 6-beta-hydroxylase activity was decreased, 17-hydroxysteriod oxidoreductase activity was increased, and 5-alpha reductase activity was not changed. Although the in vivo effects cannot be predicted, it is possible that production of mutagens and carcinogens may be increased and distrubances in the endocrine system may occur. (Caesar-FRC)
W82-05406

THE ROLE OF AGRICULTURAL SEDIMENTS AND CHEMICALS IN EUTROPHICATION,

Iowa State Univ., Ames. Dept. of Animal Ecology.
For primary bibliographic entry see Field 2H.
W82-05447

GEOCHEMICAL ENVIRONMENTS AND THE GEOGRAPHICAL DISTRIBUTION OF SOME DISEASES IN SRI LANKA,

Sri Lanka Univ., Peradeniya. Dept. of Geology.
C. B. Dissanayake, and A. Senaratne.
Water, Air, and Soil Pollution, Vol 17, No 1, p 17-28, 1982. 8 Fig, 3 Tab, 29 Ref.

Descriptors: *Fluorides, *Human diseases, *Water quality, Cancer, Chemical composition, Environmental effects, Sri Lanka, Geography, Well water, Geochemistry.

The incidence of dental disease and the distribution of fluoride in drinking water wells in Sri Lanka was investigated. Dental fluorosis and caries and the total incidence of cancer were studied. Fluoride ions were measured with the Orion ion specific electrode. The central hill country and the southwest coastal regions were relatively free of fluoride. The lowland dry zone contained a higher amount of fluoride in the water, with areas around Eppawala in the North Central Province, Maha Oya in the Eastern Province and Uda Walawe in the Southern Province showing anomalously high fluoride concentrations. Areas of high fluoride content showed a higher dental fluorosis, whereas individuals living in low fluoride regions suffered from dental caries. The intensity of rainfall is a major factor in the geographical distribution of fluoride in well water, but the natural geological factors are also significant. A proportional increase of fluoride with water hardness was noted, reflecting the geochemical status of ions in the rocks and minerals of the area. In studying the variation of the total cancer rates with the total dissolved solids in the water and the hardness of the water in the nine provinces of Sri Lanka, it became apparent that even though the curves for total solids and hardness against cancer incidence appear to be complementary, the relationship is not a simple one and there is an optimum level of hardness and total solids that corresponds to a minimum incidence of cancer. The complementary association of environmental factors such as rainfall, dissolved ions and water hardness with the incidence of cancer points to the use of goechemical correlative factors as a guide in the delineation of disease areas. (Baker-FRC)
W82-05463

INVESTIGATIONS INTO THE PROTECTIVE EFFECT OF ESTUARINE SEDIMENT ON VIRUS SURVIVAL,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
R. LaBelle, and C. P. Gerba.
Water Research, Vol 16, No 4, p 469-478, April, 1982. 7 Fig, 3 Tab, 38 Ref.

Descriptors: *Coastal waters, *Enteroviruses, *Adsorption, *Marine sediments, *Fate of pollutants, *Water pollution sources, Bacteria, Bacteriophage, Bioindicators, Estuaries, Biological magnification, Viruses, Sediments, Pathogens.

Contamination of coastal waters with human pathogens can lead to the elimination of these resources from human use. Viruses can be bioaccumulated in filter-feeding shellfish and cause epidemics of hepatitis and gastrointestinal diseases. The adsorption of enteric viruses to estuarine sediments helps to prolong their survival in marine waters. Studies were carried out to ascertain whether sediment protects viruses from any one specific inactivating factor. The properties of sediment responsible for such protection were also investigated. Laboratory tests showed that sediment protected poliovirus l (strain LSc) from inactivation by microorganisms, salts, and heat. Anaerobic conditions did not affect virus survival. Bacteria nutrients increased virus survival, probably by enhancing the number of bacteria available for virus adsorption. The presence of natural organic matter did not enhance virus survival in sea-water. (Geiger-FRC)
W82-05485

INDOLES IN THE DECOMPOSITION PRODUCTS OF CERTAIN BLUE-GREEN ALGAE,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W82-05505

RELATIONSHIP BETWEEN THE DISTRIBUTION OF PHOSPHORUS COMPOUNDS IN THE TISSUES OF THE BIVALVE ANODONTA CYGNEA AND ENVIRONMENTAL PHOSPHORUS LEVEL,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. D. Solomatina.
Hydrobiological Journal, Vol 17, No 1, p 54-59, 1981. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Phosphorus, *Aquatic environment, Chemical reactions, Environment, Mollusks, Water pollution effects, Metabolism.

The effect of an increased level of inorganic phosphorus in water on some of the indices of phosphorus metabolism in bivalve tissues was investigated. Experiments were conducted in aquaria on tissues of the bivalve Anodonta cygnea. Phosphorus content in the control aquarium was 0.06 mg/liter. An increased phosphorus concentration in the experimental aquaria was created by adding suitable amounts of disodium phosphate. The experiments showed that an increase in the lovel of phosphorus in the water appreciably influenced its entry into the organism of the mollusks and its distribution therein. A typical tissue reaction of their glandular organs to an increase of phosphates in the water was established. Total phosphorus in the mantle of the mollusks was appreciably increased from the third day of the research, when there was 0.3 mg/liter of phosphorus in the medium. The rate of total phosphorus acculul ation in the mantle increased with the time spent by the mollusks in such a medium. When phosphate content in the water was increased to 0.6 mg/liter, the amount of total phosphorus in the mantle began to increase on the very first day under these conditions. An increase of organic phosphorus content in the water to an amount 5-10 times its content in natural water has an appreciable effect on the trend of bioenergetic processes in the tissues of the mollusks. This effect was most marked in the mantle. Under the influence of increased phosphorus content in the environment of the fresh water mollusks appreciable changes were noted in the enzyme activity, the nature of which was dependent on the phosphorus level in the water. (Baker-FRC)
W82-05506

CHOLINESTERASE ACTIVITY IN ESTUARINE FISHES IN THE CUMULATION OF DDT,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii
O. V. Maslova.
Hydrobiological Journal, Vol 17, No 1, p 69-72, 1981. 1 Fig, 5 Ref.

Descriptors: *Fish populations, *Water pollution effects, Pesticide toxicity, Toxicity, Rivers, Cholinesterase, Enzymes, Accumulation, Bioaccumulation.

The level of concentration of DDT and its metabolites DDD and DDE was investigated in the organs and tissues of fishes from the Danube and the Dnieper, and the functional shifts occurring during chronic intoxication by sublethal DDT concentrations were analyzed. Fish were caught during the summer months of 1978 and 1979. The indices of cholinesterase activity in the liver and brain tissues of the fishes from the Dnieper-Bug estuary were generally higher than those in fishes from the Danube delta containing large residual amounts of DDT. Cholinesterase activity of liver tissues of pike-perch yearlings from the Danube delta was significantly lower (by 36%) than activity in pike-perch yearlings from the Dnieper-Bug estuary. As regards cholinesterase activity in the blood of the fishes studied, the results indicate that this characteristic either fails to react to the presence of DDT in the fish organism, or is increased in relation to the increase in the concentration of the toxicant. Species differences in cholinesterase activity were noted. Significant age-related differences were also found in the cholinesterase activity of the organs of the fish, and also in DDT concentrations. In all the species investigated it was the brain that had the greatest cholinesterase activity, that of the liver was less, and that of the blood least. When this characteristic was compared in fishes of different trophic levels, it was noted that the cholinesterase activity of the organs and the blood of nonpredatory fishes form the two water bodies differed less than in predatory fishes. The accumulation of residual amounts of DDT and the associated reduction of cholinesterase activity are indications of possible functional disturbances to the nervous system and to metabolic processes, and overall of a reduction in the resistance of the organism to the effect of adverse environmental factors. (Baker-FRC)
W82-05507

BIOLOGICAL RESPONSES ON LAKES IN THE MOUNT ST. HELENS BLAST ZONE,

Washington Univ., Seattle. Fisheries Research Inst.
R. C. Wissmar, A. H. Devol, J. T. Staley, and J. R. Sedell.
Science, Vol 216, No 4542, p 178-181, April 9, 1982. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Lakes, *Volcanoes, *Aquatic life, Mount St. Helens, Organic matter, Air pollution, Water pollution effects, Ecological effects, Phytoplankton, Algae, Adenosine triphosphate, Bacteria, Chlorophyll a, Nutrients, Light penetration.

The biological effects in lakes impacted by the May 18, 1980, eruption of Mount St. Helens, Washington, were investigated on June 30, 1980. In Spirit Lake suspended particulate matter increased 33-fold; light extinction coefficient, 36-fold; dissolved organic matter, 48-fold; and adenosine triphosphate, 17-fold. Other lakes within the blast zone showed increases in these parameters to a varying degree. Total bacterial counts were above 1 million per ml compared with 0.1 to 0.8 million per ml in unaffected lakes. Viable bacteria were 0.02-3% of total bacteria. Total and fecal coliforms were as high as 10,000 per 100 ml in some lakes. The high levels of dissolved organic carbon, product of pyrolyzed and steam-leached vegetation and soils, provided a food source for the bacterial population. Algal concentrations were very low, most likely as a result of light limitation rather than toxicity or competition for nutrients. The biological life of the lakes may not recover until significant mineral alterations, organic degradation, and vegetation regrowth occur. (Cassar-FRC)
W82-05519

THE IMPACT OF ACIDIC PRECIPITATION AND HEAVY METALS ON SOILS IN RELATION TO FOREST ECOSYSTEMS,

Maine Univ. at Orono. Dept. of Geological Sciences.
S. A. Norton, D. W. Hanson, and R. J. Campana.
In: Proceedings of Symposium on Effects of air Pollutants on Mediterranean and Temperate Forest Ecosystems, June, 1980, Riverside, California. Report PSW-43, Forest Service, USDA, Berkeley, California. p 152-157, 3 Fig, 1 Tab, 23 Ref. OWRT A-026-ME(9), 14-31-001-4240.

Descriptors: *Acid rain, *Fallout, *Air pollution effects, *Heavy metals, *Water pollution effects, Rainfall, Air pollution, Acidic water, Accidity, Environmental effects, Water pollution effects, Pollution load, Lead, Leading, Hydrogen ion concentration, Sulfuric acid, Vegetation effects.

Acid precipitation, experimentally and empirically, accelerates podsolization and depletes nutrient pools in forest litter and shallow inorganic soils. Further, normal terrestrial cycling of metals in eastern North America and the Pacific coast States has been altered by increasing precipitation acidity. Some heavy metals (e.g., lead) accumulate to concentrations which may impede biological soil processes and inherit phosphorus (P). Other metals are being leached from soils and inherit phosphorus (P). Other metals are being leached from soils (Al, Ca, K, Mg, and Mn). It was observed that the mobilities of Fe, Zn, and P vary with site characteristics. Biological recycling of nutrients by decomposition and uptake is impeded by a lowered pH and elevated levels of toxic metals in soils. Increased nutrient leaching caused by increased hydrogen ion input, decreases the percent base saturation. Deeper rooted plants are subjected to elvated (potentially toxic) concentrations of dissolved metals (e.g., A1 and Mn). The results of this work indicates that nutrient pools are decreasing in the northeast U.S., suggesting that decreases in forest productivity will occur. (Zielinski-MAXIMA)
W82-05534

THE IMPACT OF MANAGED STREAMSIDE TIMBER REMOVAL ON CUTTHROAT TROUT AND THE STREAM ECOSYSTEM,

Washington Univ., Seattle. Fisheries Research Inst.
D. J. Martin, E. O. Salo, S. T. White, J. A. June, and W. J. Foris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236530, Price codes: A05 in paper copy, A01 in microfiche. Report FRI-UW-8107, March, 1981. 65 p, 16 Fig, 4 Tab, 34 Ref. 1 Append. OWRT A-101-WASH(2), 14-34-001-0151.

Descriptors: *Trout, *Aquatic habitants, *Land clearing, *Canopy, *Coastal zone menagement, Fish migration, Growth, Fish populations, Streams, Environmental effects, Probability distribution, Mathematical studies, Model studies, Water temperature, Biomass, Stream banks, Stream degradation.

A summary of the streamside timber removal study conducted at Bear Creek is presented. In this study, the components of the stream ecosystem influenced by removal of riparian vegetation were isolated from physical disturbances (road building and log yarding) by postponing removal of fallen timber in a streamside management zone (SMZ), and by delaying watershed logging. Physical and biological parameters linked with cutthroat trout production were examined for two years (1977-78) in designated treatment and control zones. Commercially-valued timber was then carefully removed from the tratment zone in a way that assured maintenance of under-story vegetation and streambank integrity. Keg environmental parameters in the post-treatment (1979-80) and pre-treatment (1977-78) phase were intercompared. It was deduced that canopy density reduction causes quantity and quality changes for fixed energy inputs entering the stream, and stimulates can increase in the density and biomass of the fish food supply. Sclimonid biomass can be controlled by fish food availability; hence canopy density is functionally related to fish production through a food supply control mechanism. Further, riparian management is functionally related to fish population density and age structure. Proper implementation of the SMZ concept affords a useful management practice. (Zielinski-MAXIMA)
W82-05538

CLASSIFICATION AND MANAGEMENT OF WETLANDS IN THE WESTERN KENTUCKY COAL FIELD,

Kentucky University, Lexington Water Resources Research Inst., KY.
W. J. Mitsch, and R. W. Bosserman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236639, Price codes: A05 in paper copy, A01 in microfiche. Report 131, March, 1982. 78 p, 25 Fig, 15 Tab, 66 Ref. OWRT A-086-KY(1), 14-34-0001-1119.

Descriptors: *Wetlands, *Coal mining, *Management planning, *Field tests, *Model studies, Coal mines, Strip mines, Assessments, On-site tests, Sites, Water quality, Ecological distribution, Computer models, Watersheds, Ecosystems, Mine drainage, Classification.

This initial research report of a three-year study on wetland identification and management criteria in the western Kentucky coal field focuses on four specific activities: establishment of three intensive study sites in major wetlands for identification and management impact assessment; sampling the study site to measure water quality and ecologic structure; application of a developed classification to the study sites; and development of conceptual models of the region, watersheds, and specific ecosystems, and preliminary simulations of a wetland model. The study sites are affected by mine drainage, channelization, higher water levels, oil wells, and agriculture clearing. Preliminary analysis of field surveys demonstrated that coal mining and oil extraction may affect wetlands health; drainage, logging, channelization, and impoundments have also caused significant alterations. Field measurements and conceptual models facilitated classification scheme development for the wetlands, which considers ecologic structure system hydrology, and major man-made effects. A number of water quality (e.g., pH, temperature, conductance, sulfates, turbidity) and ecologic (e.g., vegetation growth, biomass) parameters will be considered for impact assessment relative to standard values. (Zielinski-MAXIMA)
W82-05549

OIL AND GREASE IN STORMWATER RUNOFF,

California Univ., Los Angeles. Dept. of Engineering Systems.
M. K. Stenstrom, G. Silverman, T. A.
Bursztynsky, A. L. Zarzana, and S. E. Salarz.
Report, February 1982. Association of Bay Area Governments, Berkeley, California. 241 p, 41 Fig, 44 Tab, 158 Ref, 3 Append.

Descriptors: Storm water, *Storm runoff, *Urban runoff, *Oily water, *Grease, Sampling, Land use, Hydrocarbons, Chromatography, Wastewater, Oil pollution, Runoff rates, Adsorption, Rainfall-runoff relationships, Environmental effects, Path of pollutants, *San Francisco Bay, Ecological effects.

The objective of this project was to determine the environmental effects of oil and grease in urban stormwater on marine environments in San Francisco Bay and to recommend suitable control measures. Studies show that there are significant effects of low level oil/grease pollution and that continuous pollution from urban stormwater can change the ecology of a marine environment. Five field sampling stations were selected in a stormwater basis in Richmond, CA to determine oil/grease pollution by land-use type. Samples were taken from the mouth of the watershed, a parking lot, a commercial street, a residential area, and from a light industrial facility. Land-use strongly affects oil/grease in stormwater. The major contributing factor is motor vehicles. Areas with the most auto traffic had the highest concentration of oil/grease in stormwater and the highest hydrocarbon load factor. Mean oil/grease concentration in runoff flow ranged from 4.13 mg/1 in an upstream residential area to 15.25 mg/1 in a parking lot. A strong correlation exists between total rainfall and total mass of oil/grease pollution—contamination is higher at the beginning of a storm than at the end. Nine control techniques showed promise. Three non-structural techniques were to recycle used crankcase oil, reduce auto emissions through better inspections, and improve standards. Six structural techniques were to improve street/parking lot cleaning, sorption systems for manhole and gutter intakes, porous pavement, greenbelts around parking lots, dispersion devices, and wetlands or marshes to trap pollutants. These are site-specific techniques but it was recommended they be developed further. (Atkins-Omniplan)
W82-05557

THE LONG LAKE DIVERSION: AN ENVIRONMENTAL EVALUATION,

Ontario Ministry of Natural Resources, Thunder Bay.
For primary bibliographic entry see Field 6G.
W82-05568

STRUCTURAL DAMAGE TO LEAF CHLOROPLASTS OF ELODEA DENSA CAUSED BY METHYLMERCURY ACCUMULATED FROM WATER,

National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
D. C. Mortimer, and M. Czuba.
Ecotoxicology and Environmental Safety, Vol 6, No 2, p 193-195, 1982. 3 Fig, 4 Ref.

Descriptors: *Plant pathology, *Laboratory studies, *Organic compounds, Methylmercury, Pesticides, Water pollution effects, Industrial wastes, Environmental effects, Rivers, Ottawa, Canada, Elodea densa, Aquatic plants.

One of the effects resulting from the adbsorption of methylmercury by Elodea densa leaves is damage to chloroplast integrity. Elodea densa plants were placed in aquaria with Ottawa municipal water flowing through. Methylmercury solutions of varying strengths were added. The first stage of damage shows swollen chloroplasts with evidence of outer membrane rupture and a suggestion of internal thykaloid disturbance. The micochondria and other organelles appear intact. Second stage revealed exploded or peeled chloroplasts with the outer membrane completely gone. While the mechanism of methylmercury toxicity in the leaves is not yet understood, it is clear that individual cells have different sensitivities to methyl-mercury and that the chloroplast membrane is much more senitive than other membranes within the cell, such as mitochondrial membranes. The tissue level of methylmercury at this stage of damage was about 5 ng/g fresh weight, obtained by absorption from water containing 150 ng/liter over 25 days. With such low concentrations within the plant tissue as a whole, it has not been decided whether the chloroplast membrane is damaged by methylmercury effects acting from within the chloroplast or from the cytoplasmic side of the membrane. (Baker-FRC)
W82-05570

EFFECT OF PHENOL ON IN VIVO ACTIVITY OF TISSUE TRANSAMINASES IN THE FISH NOTOPTERUS NOTOPTERUS,

D. A. V. Coll., Muzaffarnagar (India). Dept. of Zoology.
S. R. Verma, S. Rani, and R. C. Dalela.
Ecotoxicology and Environmental Safety, Vol 6, No 2, p 171-176, 1982. 2 Tab, 25 Ref.

Descriptors: *Fish populations, *Phenols, Organic compounds, Water pollution effects, Population exposure, Enzymes, Amino acids.

This study was undertaken to investigate in vivo the chronic effects of the water-pollutant phenol on glutamic oxalacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) activity in tissues of N. notopterus. Active and healthy fish specimens were collected from freshwater resources. Groups of fish were exposed to concentrations of phenol in tap water equivalent to 1/2, 1/5, and 1/10 of the 96 hr median lethal dose. Fish were examined after 10, 20 and 30 days of exposure. Alterations were produced in activity of the transamaminases in different tissues, and the difference between control and treated fish was significant. In general, the maximum stimulation of GOT was noted in the liver. For GPT maximum stimulation occurred in the heart, reaching the highest concentration after 30 days of exposure. Minimum stimulation for both GOT and GPT was in the kidney, with the lowest concentration occurring after 10 days of exposure. The stimulation pattern was similar in most cases and was found to be dose and duration dependent. The marked stimulation of GOT and GPT activity by phenol suggests a potential for phenol to interfere with processes related to amino acid metabolism inside the fish body. (Baker-FRC)
W82-05571

FLOODWATER NUTRIENT PROCESSING IN A LOUISIANA SWAMP FOREST RECEIVING AGRICULTURAL RUNOFF,

Louisiana State Univ., Baton Rouge. Center for Wetlands Resources.
G. P. Kemp, and J. W. Day, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243304, Price codes: A05 in paper copy, A01 in microfiche. Final Report, December, 1981. 72 p, 18 Fig, 9 Tab, 85 Ref. OWRT A-043-LA(2).

Descriptors: *Louisiana, *Swamp forest, *Agricultural runoff, Overland flow, *Nutrient dynamics, Eutrophication, Nitrogen, Phosphorus, Hydrologic budget, Decomposing organic matter, Dissolved oxygen, Swamps.

From September 1978 through June 1979, experiments were carried out to: (1) measure N and P dynamics in a Louisiana swamp which receives agricultural runoff, (2) Calculate N and P budgets to determine if there was a net uptake or release, (3) Conduct laboratory experiments to determine the influence of leaf litter decomposition and dissolved oxygen nutrient retention by the swamp. A water budget was calculated as follows: input was 23% precipitation and 77% pumpage, outflows were 11% evapotranspiration and 89% drain. This water budget along with measured nutrient concenrations were used to calculate N and P budgets. Most of the input to the swamp study site (70% N, 74% P) was pumped into the ponds as particulates. Of the total inputs only 3% N and 1% P was introduced with precipitation, however, rain accounted for 30% of the input of total inorganic N. Outflows from the swamp were 56% and 60% of total N and P inputs, respectively. Thus the swamp retained 44% N and 40% P. Most of this was in the form of particulates. The swamp removed inorganic N and exports PO4 and organic N. This is reflected in the characteristically low N:P ratio of the swamp waters. The microcosm studies indicate that dissolved oxygen concentrations are most important factor regulating swamp water chemistry. The results indicate that the swamp can serve as long-term sink for significant quantities of N and P and that burial in sediments and dentrification are mechanisms for permanent losses. (Author abstract)
W82-05622

HISTOPATHOLOGICAL CHANGES IN THE LIVER AND BRAIN OF FISH EXPOSED TO ENDOSULFAN INSECTICIDE DURING TSETSE FLY CONTROL OPERATIONS IN BOTSWANA,

Centre for Overseas Pest Research, London (England).
P. Matthiessen, and R. J. Roberts.
Journal of Fish Diseases, Vol 5, No 2, p 153-159, 1982. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Fish populations, *Insecticides *Endosulfan, *Botswana, Fish toxins, Pesticides, Sprays, Spraying, Water pollution sources, Tsetse fly control.

This study was made to determine whether the tsetse control campaign in the Okavango Delta produced significant histopathological changes in exposed fish, and if so, how quickly they recovered after spraying. Studies were confined to liver and brain. Several herbivorous and carnivorous species were investigated, but detailed discussion was limited to Clarias gariepinus and Tilapia rendalli. The histopathological changes were placed in the context of simultaneous observations that were

being made of fish activity and reproductive behavior. Samples were gathered throughout the 1978 spraying season and during the ensuing 7 months. All sampled fish were apparently healthy, and none were taken from locations where fish kills were noted. All species studied contained histological lesions during the spraying season which were distinguishable from the normal background disease pattern and indicative of pesticide induced damage. Lesions in the piscivore Hepsetus odoe were relatively mild, whereas those in the omnivorous Clarias gariepinus and herbivorous Tilapia rendalli were more serious. There is little doubt that the pathological changes were caused by endosulfan. Liver damage in C. gariepinus was severe, especially in the peribiliary tissue. Accumulations of large amounts of lipid were noted in poisoned tissue, and a disappearance of melanomacrophage centers from C. gariepinus liver was observed Pathological changes in T. rendalli brain clearly show that endosulfan has neurotoxic effects. (Baker-FRC)
W82-05630

PRELIMINARY INVESTIGATION OF THE ALGAL FLORA IN THE SEDIMENTS OF LAKE ERIE,

State Univ., of New York Coll. at Buffalo. Great Lakes Lab.
V. R. Frederick.
Journal of Great Lakes Research, Vol 7, No 4, p 404-408, 1981. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Sediments, *Algal growth, Eutrophication, *Lake Erie, Great Lakes, *Diatoms, *Lake sediments.

A preliminary examination was performed regarding the extent of the diatom floras in the sediments of Lake Erie and their applicability in providing a better understanding of the process of natural and cultural eutrophication in the Great Lakes. The non-diatom algal flora in the sediments was also investigated. A 45-cm long core was obtained from a site in the eastern basin of Lake Erie. Asterionella formosa, Melosira islandica, M. italica, Stephanodiscus niagarae, and Tabellaria fenestrata were the most abundant diatoms encountered in the core sample. Thirteen non-diatom algal taxa were identified in the 13 sediment samples. Forty diatom taxa were identified in the sediments of this study. Centric and araphidinate diatoms dominated the flora at all sediment levels. Quantitative diatom profiles and relative abundance profiles each provide a contrasting history of post settlement Lake Erie. In view of the known history of the lake, the relative frequency profiles appear to be most applicable. The C/P index of trophic status and the diatom diversity support those profile. (BAker-FRC)
W82-05633

WATER TEMPERATURES IN NANTICOKE-LONG POINT BAY REGION OF LAKE ERIE,

Ontario Hydro, Toronto. Hydraulic Studies and Development Dept.
R. S. Arden, and R. Farooqui.
Journal of Great Lakes Research, Vol 7, No 4, p 337-344, 1981. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Water temperature, *Electric power industry, *Lake Erie, Lakes, *Thermal pollution, Heated water, Thermal powerplants, Thermal power.

A summary of continuous temperature data and an analysis of results obtained from temperature measurements taken near the Nanticoke Thermal Generating Station during May to November of 1970-1979 are presented. Although temperatures varied from year to year, generally similar temperatures were recorded at all shore-based stations, with slightly higher temperatures being recorded at Peacock Point during both pre-operational and post-operational years of the power plant. The monthly mean water temperatures at 2 meter depths were generally in step with the air temperature. During the spring, water temperature did not keep pace with changes in air temperature, sometimes varying by as much as 8-10 degrees C. Maximum monthly and daily mean temperatures recorded a the tower location in the Outfall Bay were about 1 degree higher than the nearshore locations during the summer months of 1975 and 1976. This may be attributed in part to the influence of the thermal effluent from Nanticoke GS, as the average plant output for July to September was highest during those years. During the summer and fall large water temperature changes occurred in the Nanticoke-Long Point Bay Region in both pre-operational and post-operational phases of the Nanticoke Generating Station. With the exception of the Outfall Bay location, which had slightly elevated temperatures during 1975 and 1976, the operation of the Nanticoke Generating Station had essentially no effect on the temperature regime of this area. (Baker-FRC)
W82-05637

MODELING OF PHYTOPLANKTON-NUTRIENT DYNAMICS IN SAGINAW BAY, LAKE HURON,

Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
V. J. Bierman, and D. M. Dolan.
Journal of Great Lakes Research, Vol 7, No 4, p 409-439, 1981. 15 Fig, 6 Tab, 48 Ref.

Descriptors: *Phytoplankton, Nutrients, *Lake Huron, *Saginaw Bay, Lakes, *Nutrient dynamics, Great Lakes, Model studies, Phosphorus, Silicon, Plankton, Nitrogen.

A study was conducted to gain insight into the physical, chemical, and biological processes affecting phytoplankton growth and to use the model as a tool for comparing future effects of various waste water management strategies. The multi-class phytoplankton simulation model was set to field data acquired on Saginaw Bay, Lake Huron, during 1974. The concept of a single limiting factor for phytoplankton growth was found to be overly simplistic. Results indicated that temperature and light were relatively more growth rate limiting than nutrients on an annual average basis. However, as a consequence of nutrient depletion, nutrients became relatively more important at the times of peak phytoplankton crops. Nitrogen was more growth rate limiting than phosphorus to the total phytoplankton crop, although important differences occurred among the individual functional groups. While nitrogen and silicon were important in phytoplankton-nutrient dynamics, the supply of phosphorus would ultimately determine the size of the blue-green component of the total crop because nitrogen fixing blue-greens did not have absolute requirements for dissolved available nitrogen or silicon. Phosphorus requirements for summer crops were satisfied by recycle processes within the water column. Phytoplankton production was extremely sensitive to variation in the light extinction coefficient in the water column and relatively insensitive to variations in incident solar radiation. (Baker-FRC)
W82-05639

ESTIMATION OF ORGANIC COMPOUND EMISSIONS FROM WASTE LAGOONS,

New York State Dept. of Environmental Conservation, Albany.
T. T. Shen.
Journal of the Air Pollution Control Association, Vol 32, No 1, p 79-82, January, 1982. 1 Tab, 14 Ref.

Descriptors: *Waste disposal, *Air pollution, Organic compounds, Hazardous wastes, Environmental effects, Air pollution effects, Volatility, Lagoons, Wastewater lagoons, Ponds.

A method is described for the estimation of organic compound emissions from waste lagoons. The method is based on the best information currently available and offers a simple technique for estimating the volatilization rate of volatile organics from these lagoons. The volatilization rates depend on meteorological conditions occurring at the gas-liquid interface, which may vary appreciably with time. Thus only short-term emission rates can be used for estimation. The rates are also greatly influenced by the presence of surface materials such as floating solids and/or liquids. Based on the illustrative examples given and other calculations, it appears logical to conclude that for most air contaminants of environmental concern, the liquid phase mass transfer coefficient controls the rate of volatile organic compound emissions from waste lagoons, and the gas phase mass transfer coefficient has insignificant effects on the calculation of the overall mass transfer coefficient. The gas phase mass transfer coefficient can be influenced greatly by turbulence and surface films; these effects are not included in the equations. The method as presented becomes fairly simple and straightforward, but it should be used with care and discretion and with a good knowledge of the waste composition and the prevailing physical situation of the waste lagoon. (Baker-FRC).
W82-05679

ELECTRICAL INTERACTION BETWEEN POLARIZED WATER MASSES AND ZOOPLANKTON IN WATER BODIES,

Akademiya Nauk SSSR Leningrad. Inst. Ozerovedeniya.
For primary bibliographic entry see Field 5G.
W82-05707

EFFECTS OF SELECTED ORGANIC COMPOUNDS ON RADIONUCLIDE ADSORPTION TO SEDIMENTS IN FRESHWATER SYSTEMS,

Washington Univ., Seattle. Coll. of Ocean and Fisheries Sciences.
J. R. Clayton, Jr., T. H. Sibley, and W. R. Schell.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 409-415, 1982. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Radioisotopes, *Adsorption, *Sediments, *Organic compounds, Fate of pollutants, Cobalt radioisotopes, Americium radioisotopes, Rubidium radioisotopes, Cesium radioisotopes, Salicylic acid, Acetic acid, Ethylenediamine tetraacetic acid, Phenanthroline, Nitrosonaphthol.

The effects of organic compounds on radionuclide adsorption to sediments were determined using autoclaved sediments and water from Lake Washington, Washington, and Cattaraugus Creek, New York. Organic compounds, selected for the variety of functional groups available for reaction with radionuclides and sediment particles, were 1,10-phenanthroline, acetic acid, salicylic acid, and ethylenediamine-tetraacetic acid (EDTA) all at concentrations of 0.0001 M, and 1-nitroso-2-naphthol at a concentration of 0.00001M. The radionuclides were Co57, Ru106, Cs137, and Am241. Distribution coefficients (kd) were constant with increasing concentrations of EDTA for Ru106 or Cs137. However, for Am241 marked decreases in distribution coefficients occurred at EDTA concentrations of 0.0001 to 0.000001M, a result of the formation of soluble EDTA-Am241 complexes. Statistically significant differences were obtained for Kd values and Am241, Co57, and Ru106 but not for Cs137. Co57 and Am241 Kd were much higher with acetic acid, and lower for EDTA. For Ru106, 1-nitroso-2-naphthol,1,10-phenanthroline, acetic acid, and EDTA all produced higher Kd values than controls, Salicylic acid did not significantly change Kd values for any of the radionuclides tested. The complex variety of interacting factors shows the necessity of characterizing water and sediment chemical parameters in adsorption studies. (Cassar-FRC)
W82-05724

MUTAGENIC POTENTIAL OF WATER CONCENTRATES FROM THE EFFLUENT OF A WASTE OIL STORAGE POND,

Texas A and M Univ., College Station. Dept. of Soil and Crop Science.
K. W. Brown, and K. C. Donnelly.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 424-429, 1982. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Mutagens, *Oil wastes, *Chlorinated hydrocarbons, Water pollution effects, Carcinogens, Pesticides, Polychlorinated biphenyls, Hexachlorobenzene, Indicators, Bioindicators, Bioassay.

Water samples collected before and after dredging a waste oil storage pond were analyzed by two systems capable of detecting mutagens and carcinogens: the Ames Salmonella/microsome assay and the Bacillus subtilis DNA repair assay. In the Salmonella test bactericidal effects on all strains were observed at doses equivalent to 140 ml of unconcentrated effluent. Although the post-dredging sample produced slight increases in the mutation frequency of strain TA98 at lower dose levels, there was no dose response effect. The pre-dredging sample results were inconclusive. The DNA repair assay showed the presence of DNA damaging agents at a dose equivalent to 400 ml per plate in pre-dredging samples. In the post-dredging sample there was a substantial reduction in capacity to produce repairable DNA damage. Chemical analyses of the oil waste water determined that hexachlorobenzene and polychlorinated biphenyls were present at trace levels in the pre-dredging samples but were undetectable in the post-dredging sample. (Cassar-FRC)
W82-05727

A SENSITIVITY AND ERROR ANALYSIS FRAMEWORK FOR LAKE EUTROPHICATION MODELING,

W. W. Walker.

Water Resources Bulletin, Vol 18, No 1, p 53-60, February, 1982. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Eutrophication, *Lakes, *Mathematical models, Water quality, *Error analysis, *Sensitivity analysis, *Simulation analysis, Watersheds, Phosphorus, Chlorophyll A, Watershed protection, Water quality management, Lake Morey, *Vermont, Monte Carlo method.

Agencies responsible for managing lake water quality at regional levels are frequently confronted with a scarcity of information. Data limitations result in uncertainties with respect to assessment of problem conditions and priorities for further study and/or restoration. A modeling framework which permits quantitative assessment of this uncertainty in a useful and flexible manner is described and demonstrated. The Lake Eutrophication Analysis Procedure consists of a series of linked models which predict lake water quality conditions as a function of watershed land use, hydrologic variables, and morphometric variables. Sensitivity and error analysis techniques are presented which provide the user of the model or of a given model linkage with the following statistics for each predicted variable: mean, variance, confidence limits, and ranking of input variables with respect to sensitivity and contribution to prediction variance. Predicted distributions were found to compare favorably with those estimated using Mone Carlo simulation. Application of the framework to data from Lake Morey, Vermont, showed that prediction variances, attributed largely to model error, were comparable to the observed year-to-year variance in water quality, as measured by spring phosphorus concentration, hypolimnetic oxygen depletion rate, summer chlorophyll-a, and summer transparency for this lake. Use of the framework provides perspective on key assumptions and controlling factors and identifies the major sources of uncertainty in a given model application. As a result, it is possible to design effective additional monitoring and/or modelling efforts, and the probability that a significant management decision will be made with excessive confidence in the predicted outcome is reduced. (Carroll-FRC)
W82-05739

PHYTOPLANKTON RESPONSES TO GROUND WATER ADDITION IN CENTRAL FLORIDA LAKES,

Southwest Florida Water Management District, Brooksville.

P. M. Dooris, G. M. Dooris, and D. F. Martin.

Water Resources Bulletin, Vol 18, No 2, p 335-337, April, 1982. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Phytoplankton, *Bicarbonates, *Species diversity, Lakes, Water quality, Florida, Inorganic carbon, Carbon, Floridan aquifer, Pumping, Groundwater.

Phytoplankton diversity indexes were higher (especially in the wet season) in small Florida lakes augmented by groundwater pumping than in unaugmented lakes. The diversity indexes were directly correlated with inorganic carbon levels of the groundwater. As much as 549 kg of inorganic C can be added as bicarbonate to a lake, assuming 7 days pumping at 2.18 million liters per day and an inorganic C concentration of 36 mg per liter in the groundwater. (Cassar-FRC)
W82-05747

DUAL OBJECTIVE CONTROL OF NUTRIENT LOADING INTO A LAKE,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

For primary bibliographic entry see Field 5G.
W82-05750

WATER QUALITY MANAGEMENT IN BRITISH COLUMBIA,

Pollution Control Board (British Columbia).

C. J. G. Mackenzie.

Canadian Water Resources Journal, Vol 5, No 3, p 69-77, 1980. 5 Ref.

Descriptors: *Canada, Water management, *Water policy, *Water quality management, *British Columbia, Water resources development, Fraser River, Okanagan River, Water pollution effects, Environmental effects, Wildlife, Fish, Recreation, Hydroelectric plants, Dams.

Water use policy in British Columbia has not been precisely enunciated. Two federal agencies with opposing interests are in charge of the Fraser River. Enhancement of the salmon fishery is not compatible with the efforts to improve navigation and port facilities on the lower river (dredging and filling of wetlands). Water quality in the Fraser and Okanagan systems is still good, but both basins are candidates for destruction as population and economic growth continues. In the Okanagan 100 years of disregard for an integrated land and water use policy have produced visible deterioration--silt in beach areas and proliferation of algae and littoral plants in lakes. Heavy metals and other pollution have been occurring with increasing frequency in the Fraser Estuary. Future water resources management will likely be in response to short-term commercial needs, with little regard for long-term implications. Even when wildlife, fish, and recreation are considered in master plans, results are often ineffective and expensive. For example, salmon ladders at the large Colorado river dams allowed adult fish to move upstream but blocked young fish from returning to the sea. It is expected that all major wild rivers in British Columbia will be tame within a generation. (Cassar-FRC)
W82-05767

VOLATILIZATION OF KETONES FROM WATER,

Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.

R. E. Rathbun, and D. Y. Tai.

Water, Air, and Soil Pollution, Vol 17, No 3, p 281-293, 1982. 2 Fig, 6 Tab, 35 Ref.

Descriptors: *Organic compounds, *Volatility, *Mass transfer, *Ketones, Fate of pollutants, Oxygen absorption coefficient, Liquid-film coefficient, Gas-film coefficient, Kinetics, Thermodynamics, Mathematical equations, Air-water interfaces.

Mass transfer coefficients for volatilization from water were measured in a laboratory water bath simultaneously with the oxygen adsorption coefficient for several ketones: acetone, 2-butanone, 2-pentanone, 3-pentanone, 4-methyl-2-pentanone, 2-heptanone, and 2-octanone. The liquid-film and gas-film coefficients of the 2-film model were determined for the ketones from the mass transfer coefficients. The % resistance of the liquid-film ranged from 37.6% for acetone to 74.7% for 2-octanone at low mixing conditions and from 10.8% for acetone to 37.1% for 2-octanone at high mixing conditions. The liquid-film coefficients for the ketones varied with the 0.719 power of the molecular diffusion coefficient, consistent with values reported in the literature. However, the liquid-film coefficients were variably dependent on molecular weight (-0.263 power for acetone to -0.378 power for 2-octanone). This disagreed with the constant -0.500 power assumed in the literature. Gas-film coefficients were independent of molecular weight, in disagreement with the -0.500 power assumed in the literature. The reason for these discrepancies may be that the organic materials used in the present work are very soluble in water whereas previous work dealt with slightly soluble organics. (Cassar-FRC)
W82-05782

EFFECTS OF WATERHYACINTH ON THE PHYSICOCHEMISTRY OF A SOUTH GEORGIA POND,

Clemson Univ., SC. Dept. of Zoology.

S. P. Schreiner.

Journal of Aquatic Plant Management, Vol 18, p 9-12, 1980. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Herbicides, *Water hyacinth, *Water quality, Aquatic weeds, Weed control, Aquatic plants, Dissolved oxygen, Nutrients, Grassy Pond, *Georgia, Water pollution effects, Detritus, Biomass.

Water quality and water hyacinth biomass and floating detritus were determined in three areas of Grassy Pond, Georgia, 97 ha in area and 2 m deep, in the summer of 1977. The three sampling sites were: old untreated, undisturbed mat; the edge of an undisturbed mat; and in a herbicide-treated area following 6 weeks of macrophyte regrowth. Water hyacinth and floating detritus (in kg per sq m dry weight), respectively, for the three sites were: old mat, 0.99 and 1.14; mat edge, 0.83 and 0.11; and herbicide-treated mat, 0.39 and 0.03. Water below untreated plants had lower oxygen, pH, and Eh and increased C02. In herbicide-treated areas water quality was similar to that of open water except for temporary decreases in 0 and increases in C02 and nutrients produced by plant decomposition. (Cassar-FRC)
W82-05809

INHIBITION OF NITRIFICATION BY ARSENIC, CHROMIUM, AND FLUORIDE,

College of Petroleum and Mineral, Dhahran (Saudi Arabia).

S. A. Beg, R. H. Siddiqi, and S. Ilias.

Journal of the Water Pollution Control Federation, Vol 54, No 5, p 482-488, May, 1982. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Inhibition, *Nitrification, Kinetics, Water pollution effects, Toxicity, Ammonia, Oxidation, Arsenic, Fluorides, Chomium, Fewrtilizers, Industrial wastewater, Shock loads, Wastewater treatment.

The inhibitory effects of arsenic, chromium, and fluoride on the nitrification process were investigated in a packed bed fixed film biological reactor. The nitrification reaction (ammonia oxidation) was independent of residual substrate concentrations, a zero-order reaction, for the conditions of the experiment, 60 and 120 mg per liter initial concentrations of ammonia. Nitrification was inhibited by Cr, As, and F under shock load conditions. The inhibited reaction was also zero-order. The inhibitor coefficients (the concentration of inhibitor that would inhibit the reaction rate by 50%) were 50 mg per liter for Cr (most toxic), 292 mg per liter for As, and 1218 mg per liter for F. Fertilizer plant wastewater contains 0-10 mg per liter Cr, 0-20 mg per liter As, and 0-200 mg per liter F. Therefore, at the upper limits of these concentrations, the inhibitory effect would be 17%, 7%, and 14% for Cr, As, anf F, respectively. (Cassar-FRC)
W82-05855

THE PHOSPHORUS CYCLE IN GERMISTON LAKE. II. THE IN VITRO AND IN SITU ABSORPTION OF 32-P BY POTAMOGETON PECTINATUS L,

Rand Afrikaans Univ., Johannesburg (South Africa). Research Group for Freshwater biology.
J. F. Vermaak, J. H. Swanepoel, and H. J. Schoonbee.
Water S. A., Vol 8, No 1, p 52-57, January, 1982. 3 Tab, 50 Ref.

Descriptors: *Phosphorus, *Macrophytes, Absorption, Nutrients, Germinston Lake, Potamogeton pectinatus, Translocation, Lakes, Cycling nutrients.

The effect of the soluble reactive phosphorus concentration on the adborption of phosphorus by the different organs of Potaogeton pectinatus L. was investigated. The effect of a higher soluble reactive phosphorus concentration in the root compartment on the absorption, translocation, and release of phosphorus by this species was also studied. The roots of P. pectinatus absorbed P32 in situ. both the roots and foliage of this species absorbed P32 from their respective environments, and both the roots and the foliage released a small fraction of the absorbed P32 after translocation. On the basis of this study, it was decided to use the compartmentalized container method to study the uptake and release of P32 by P. pectinatus in Germinston Lake on a seasonal basis. The results of this experiment, which showed the existence of a seasonal variance in phosphorus uptake, translocation, and release, will be presented later. (Baker-FRC)
W82-05895

5D. Waste Treatment Processes

POLLUTION: CLEANING UP WITH THE WATER HYACINTH,

J. F. Schlais.
Environment, Vol 22, No 5, p 5, 43, June, 1980.

Descriptors: *Wastewater treatment, *Water hyacinth, Biological oxygen demand, Suspended solids, Nitrogen, Phosphorus, *Wastewater lagoons, *Biological wastewater treatment, Chemical recovery.

In 1976, the National Aeronautics and Space Administration's National Space Technology Laboratory in Mississippi began using water hyacinths to treat the wastewater in its sewage lagoon. This action was taken on the advice of the head of the Laboratory's Vascular Aquatic Plant Program, who had been investigating the possibility of using the plant in waste reuse and water recycling systems on manned space flights. In 3 months, the water hyacinths cut the 5-day biological oxygen demand by 95 percent to 5 milligrams per liter and the total suspended solids by 90 percent to 10 milligrams per liter. In addition, the water hyacinths reduced ammonia and organically bound nitrogen by 73 percent and phosphorus by 57 percent. Water hyacinths used to treat a second lagoon, which received wastewater from the Laboratory's large general, photographic, and pesticide laboratory complex, were found to readily absorb and concentrate in their roots such pollutants as lead, mercury, cadmium, and organic compounds suspected of being carcinogenic. Although these plants must be disposed of in a manner designed to prevent the heavy metals from leaching out, it may be possible to recover valuable metals after several years. The water hyacinth can survive temperate winters, and an enclosed greenhouse system is being developed to facilitate use of this wastewater treatment method where freezing temperatures would kill the plant. Harvested plants can be sold as cattle food supplements, for use in producing methane, or as a fertilizer for sandy soils. Although evapotranspiration rates are high, use of greenhouse covers with special drainage pipes can result in the recovery of as much as 40 percent of the daily wastewater as pure freshwater. (Carroll-FRC)
W82-04770

DISINFECTION EFFICIENCIES OF CHLORINE DIOXIDE IN A GRAVITY FLOW CONTRACTOR,

Strauss and Roberts, Porterville, CA.
K. E. Longley, B. E. Moore, and C. A. Sorber.
Journal of the Water Pollution Control Federation, vol 54, No 2, p 140-145, February, 1982. 7 Fig, 4 Tab, 11 Ref.

Descriptors: *Disinfection, *Chlorine dioxide, *Bacteria, Viruses, *Coliforms, Mixing, *Wastewater treatment, Chlorine, Chlorination, Gravity flow contractors.

Chlorine dioxide and chlorine were evaluated as disinfectants for reduction of wastewater fecal coliforms and coliphages in a gravity flow contractor. Both disinfectants produced biphasic inactivation curves with most of the inactivation occurring within the first 3 minutes. Fecal coliforms were reduced by log 1.7 and log 5.1 by initial chlorine dioxide doses of 1.0 and 10.,0 mg per liter, respectively, at 30 minutes contact time. Coliphage inactivations were log 1.4 and log 3.7 for chlorine dioxide doses of 1.0 and 10,0 mg per liter, respectively, at 30 minutes contact time. A dose of 5 mg per liter chlorine reduced fecal coliforms by log 5.1 and coliphages by log 1.7. Chlorine dioxide was superior to chlorine as a disinfectant when both concentrations were expressed in terms of chlorine. Chlorine dioxide also produced very low disinfectant residuals. (Casear-FRC)
W82-04782

COMPUTER-BASED IMPLEMENTATION OF COMBINED SEWER CONTROL,

EMA, Inc., St. Paul, MN.
T. M. Brueck, D. F. Peterson, and J. A. Nye.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 198-205, February, 1982. 12 Fig, 2 Ref.

Descriptors: *Combined sewers, *Sewer systems, *Control systems, Computers, Automation, Storm water, *Lima, *Ohio, Gates, Overflow, Storage, *Wastewater management, Wastewater collection.

A computer-controlled combined sewer system, operating the Lima, Ohio, since the spring of 1980, has provided accurate and responsive automatic control of storage and overflows during storm events, operational ease and flexibility, and a reduction in sewer system maintenance. The original computerized system, serving an area of about 1500 ha, included eight regulator/overflow stations and an interceptor lift station. Analysis of the existing computer system by simulation and field testing resulted in a new computer control system. This allows control of sewer gates for storage equalization, measurement of river overflow, and control of river gates to protect against in-system flooding. A CRT tube displays information about the sewer system in either overview or detailed form. Three modes of control (Downstream Storage, Equal Storage, and Dewatering) are used to achieve the objectives: to minimize upstream in-system flooding, to maximize rainfall in-system storage, to equalize diurnal flow variations to the treatment plant, to minimize gate operations, and to measure overflow to the river. (Casear-FRC)
W82-04783

RELIABILITY AND STABILITY OF TRICKLING FILTER PROCESSES,

S. Niju, E. D. Schroeder, and R. S. Haugh.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 129-134, February, 1982. 3 Fig, 6 Tab, 7 Ref.

Descriptors: *Trickling filters, *Design criteria, *Reliability, *Stability analysis, Activated sludge process, *Wastewater treatment, Model studies, Statistical analysis, Biological oxygen demand, Suspended solids.

Concentrations of BOD and suspended solids in effluents from 11 trickling filter plants were statistically analyzed. Lognormal distribution functions fit these data. Since reliability and stability models developed for the activated sludge process fit the trickling filter data well, these models may be used to design a trickling filter plant of chosen reliability or to assess the reliability and stability of an existing plant. Plants with a standard deviation of 10 g per cu m or less BOD or suspended solids generally have maximum daily concentrations of these parameters which are less then 70 g per cu m. (Casear-FRC)
W82-04784

TREATMENT OF CYANIDE WASTE BY THE EXTENDED AERATION PROCESS,

Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy, Jr., E. T. Gaudy, Y. J. Feng, and G. Brueggemann.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 153-164, February, 1982. 11 Fig, 1 Tab, 31 Ref.

Descriptors: *Cyanide, *Industrial wastewater, *Extended aeration, Aeration, Chemical wastewater, *Wastewater treatment, Biological treatment, Aeration, Sludge, Toxicity, Sewage bacteria, Hydrolytic assist.

Cyanide at levels of 10, 15, and 20 mg per liter was efficiently metabolized in a laboratory extended aeration process using a periodic hydrolytic assist to the autodigestive process. The hydrolytic assist controls the mixed liquor suspended solids level without wasting sludge. Steady feeding and prolonged acclimatization were necessary to achieve good efficiency and nitrification. Under these conditions cyanide was not detached in sludge or effluent. Sudden 5 mg per liter increases in cyanide concentrations produced severe upsets which required 2 to 4 weeks for recovery. The predominant organisms, Bacillus and Klebsiella, did not metabolize cyanide but survived up to concentrations of 90 mg per liter. Other cyanide-degrading organisms were present in the biomass. Experiments indicated that up to 60% of cyanide in the system was removed by stripping. This study showed that low concentrations of cyanide may be sewered to a public treatment works using the hydrolytically assisted extended aeration process without adverse effects. (Casear-FRC)
W82-04787

EFFECT OF MIXED LIQUOR SUSPENDED SOLIDS CONCENTRATION ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS,

Imperial Coll. of Science and Technology London (England). Public Health Engineering Lab.
For primary bibliographic entry see Field 5C.
W82-04829

ADVANCED WASTEWATER TREATMENT FOR GROUNDWATER RECHARGE--BERLIN RECHARGE PROJECT (RECYCLAGE ET TRAITEMENT D'EAUX USEES POUR RECHARGER UNE NAPPE SOUTERRAINE: L'INSTALLATION PILOTE DE BERLIN),

F. Sarfert.
Aqua, No 1, p 17-18, 1981. (No English summary).

Descriptors: *Wastewater treatment, *Advanced wastewater treatment, *Groundwater recharge, *Berlin, Germany, Filtration, Biological wastewater treatment, Infiltration, Aeration, *Groundwater management.

Infiltration fields have long been used for groundwater rechange in Berlin. Research is currently underway on optimal methods of treating wastewater prior to artificial recharge in order to produce groundwater of quality equaling that of natural groundwater. Following biological treatment, the wastewater passes through a flocculation tube, a settling basin, a dual media filter, and a pressure aeration tube. The water is infiltrated into the soil via two shafts 200 m deep. The infiltration field comprises a slightly sloping 10 m sand layer over an impermeable marl layer. Water sampling tubes are provided 100 m from the infiltration point. Significant reductions were achieved by the subterranean migration in suspended solids, BOD, DOC, COD, UV extinction, phosphate and E. coli titer. An ozonization stage is under construction. (Carroll-FRC)
W82-04831

MICROBIAL DEGRADATION OF 14C-DIPHENYLAMINE IN A LABORATORY MODEL SEWAGE SLUDGE SYSTEM,

Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
A. M. Gardner, H. G. Alvarez, and Y. Ku.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 1, p 91-96, January, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Activated sludge process, *Aromatic compounds, *Biodegradation, Organic compounds, Amines, Sludge, Model studies, *Wastewater treatment, Industrial effluents, Toxicity.

This report describes the biodegradation of diphenylamine in a laboratory model sewage sludge system. DPA is an aromatic amine, used as a stabilizer in propellants and as an antioxidant in polymers and rubber. The results of degradation experiments using three different 1.5 liter batches of sludge were virtually identical. The average recovery of added radioactivity was 82%. Sludge microorganisms produced some DPA metabolites which were more acutely toxic than the parent material. The metabolites identified suggest that DPA undergoes progressive oxidative metabolism in the sewage treatment process. DPA is probably first oxidized to 4-hydroxy-DPA and an isomeric compound. The oxidized ring is then cleaved, forming water soluble acids which are degraded further to aniline and carbon dioxide. After 6 hr incubation under the experimental conditions, the microbial degradation of DPA was incomplete, with more than 35% of the compound undegraded. Although the identified metabolites are more toxic than DPA, they are not persistent in the sludge mixed liquor after they are formed. (Baker-FRC)
W82-04832

BIODEGRADATION OF 14C-TRIS(2,3-DIBROMOPROPYL) PHOSPHATE IN A LABORATORY ACTIVATED SLUDGE SYSTEM,

Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
G. H. Alvarez, S. W. Page, and Y. Ku.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 1, p 85-90, January, 1982. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Phosphates, *Activated sludge process, Environmental effects, Biodegradation, *Toxicity, Organic compounds, TRIS, *Industrial wastewater, Path of pollutants, Radioactivity effects.

The fate of tris(2,3-dibromopropyl) phosphate (Tris) in a laboratory activated sludge system was investigated. The distribution of radioactivity from various fractions of biodegradation studies was determined. The total recovery of the added radioactivity was 91%. Thin layer chromatography of petroleum ether extracts showed a single radioactive spot with the same Rf value as authentic Tris. The recovery of undergraded Tris was 55% after 24 hr. The mineralization of Tris by the sludge system was indicated by the C-14 labeled carbon dioxide in the trap, 6% of the added radioactivity. The half-life of Tris was estimated at 19.7 hr by least squares regression analysis. Ethyl ether extracts of both the solids and the aqueous phase contained 21% of the added radioactivity, and the majority of this radioactivity was present in the aqueous phase (18%). TLC of this fraction identified a single spot with Rf 0.64, identical to that of bis(2,3-dibromopropyl) phosphate. The radioactive compound in this fraction was isolated by TLC, methylated, and analyzed by GC/MS, and had a mass spectrum identical to the methyl ester of bis(2,3-dibromopropyl) phosphate. It was concluded that about 50% of the Tris was degraded in 24 hr, with the major metabolite being bis(2,3-dibromopropyl) phosphate. The toxicity and environmental consequences of this metabolite are not known. (Baker-FRC)
W82-04833

CONTROL OF ALUM ADDITION IN WASTEWATER TREATMENT,

Norsk Inst. for Vannforskning, Oslo.
T. Damhaug, J. F. Ferguson, H. Buset, and R. Braaletto.
Water Science and Technology, Vol 13, No 11-12, p 531-537, 1981. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Hydrogen ion concentration, *Phosphorus removal, Process control, *Chemical treatment, *Alum, *Wastewater treatment, Alkalinity, Phosphorus, Phosphate, Control systems, Carbon dioxide, Automation, Pilot plants.

Phosphate removal from wastewaters is achieved through the use of alum additions to control eutrophication of surface waters. Results of a national project on 'Instrumentation and Control of Chemical Treatment Plants' are discussed to consider various control strategies for process control which maintain the final pH within an optimum range. Full scale studies showed that in some cases a constant alum feed or time clocked program or flow proportional dosage is sufficient to provide an effective level of control. Numerous deficiencies in design and use were uncovered in a survey of plants using pH feedback control. The main dynamic problem was found to be the rapid deterioration of pH electrode time response. A method which avoids most of the problems of oscillations between the sensor and the chemical dosage with the resulting oscillations in effluent quality is an alkalinity feedforward process. An alkalinity measuring device based on the measurement of CO2 gas by a gas sensing electrode after the conversion of bicarbonate to CO2 was successfully tested in pilot plant studies. (Geiger-FRC)
W82-04837

STRATEGIES FOR THE CONTROL OF ACTIVATED SLUDGE PLANTS TREATING INDUSTRIAL WASTEWATERS,

Aware, Inc., Nashville, TN.
M. L. Duke, W. W. Eckenfelder, and M. E. Templeton.
Water Science and Technology, Vol 13, No 11-12, p 553-559, 1981. 5 Fig.

Descriptors: *Activated sludge, *Performance evaluation, *Biological oxygen demand, *Mathematical models, Process control, Sludge conditioning, Wastewater treatment, Industrial wastewater, Water quality standards, Oxygen uptake, Mathematical studies, Graphical methods, *Activated sludge process.

Mathematical models are presented which provide a rapid assessment of activated sludge plant performance and a guide for operational strategies. Oxygen uptake has been shown to be a useful parameter in the control of the activated sludge process. The effluent quality of a steady-state system may be viewed as a function of sludge age and the degradation properties of the wastewater. The specific oxygen uptake rate (SOUR) is also associated with sludge age and is therefore related to the effluent quality for any wastewater with defined degradation characteristics. For a given activated sludge plant, kinetic coefficients may be calculated from plant operating records and supplemental laboratory investigations. By plugging the coefficients into the mathematical model, graphical relationships of sludge, SOUR, and effluent quality may be obtained. (Geiger-FRC)
W82-04838

NEW FLOCCULATION UNITS WITH HIGH EFFICIENCY,

Bundesgesundheitsamt, Berlin (Germany, F. R.). Inst. fuer Wasser, Boden, und Lufthygiene.
A. Grohmann, M. Reiter, and U. Wiesmann.
Water Science and Technology, Vol 13, No 11-12, p 567-573, 1981. 9 Fig, 5 Ref.

Descriptors: *Flocculation, *Precipitation, *Colloids, *Phosphorous removal, *Design criteria, *Wastewater treatment, Phosphate, Turbidity, Municipal wastes, Separation techniques, Sedimentation, Coagulation, Mixing.

To design flocculation reactors with a more suitable flow pattern, the precipitation and flocculation of phosphate and turbidity caused by the model colloid, skim milk and from effluents of a municipal wastewater treatment plant were investigated. Preliminary studies demonstrated the profitability of performing mixing, precipitation and/or coagulation as well as flocculation in three different units. Flocculation was examined in two new reactors, a cylinder stirrer and a tubular reactor within a turbulent flow region. The mean residence time, concentration of chemicals, input of energy and the dimensions of the reactors were varied. In only 30 seconds, the turbidity and total concentration of phosphate could be reduced to 5% of their original levels. A lower specific energy input was required by the present system than with conventional flocculation units. (Geiger-FRC)
W82-04840

ADVANCED SUPERVISORY CONTROL SYSTEM FOR SLUDGE TREATMENT,

Meidensha Electric Mfg., Co., Tokyo, (Japan).
T. Imamura.
Water Science and Technology, Vol 13, No 11-12, p 575-580, 1981. 3 Fig, 3 Tab.

Descriptors: *Process control, *Digital computers, *Control systems, *Sludge digestion, Wastewater treatment, Automation, Sludge drying, Dewatering, Computers, Data transmission, *Sludge treatment.

A hard-wired logic for a micro-computer-applied distributed control system was designed to control sludge treatment (raw sludge system plus digestion sludge system) in a large-scale wastewater treatment facility. The system is composed mainly of graphic panels, an operation console, industrial instruments, auxiliary relays and other equipment for the supervision of process conditions, the operation of various devices, and automatic controls. The system may be expanded in accordance with the size of the treatment facility, with accompanying problems such as the expansion of installation space and an increase in required man-hours for operators. In the case of expansion or modification of the facility, the system proved less flexible, so that extreme modification or the complete replacement of the supervisory control system was required. (Geiger-FRC)
W82-04841

ULTRASONIC SENSORS FOR MONITORING FLOWS AND SLUDGE SOLIDS CONCENTRATIONS IN WATER AND WASTE-WATER TREATMENT,

Southampton Univ. (England).
W. Balachandran, and R. Briggs.
Water Science and Technology, Vol 13, No 11-12, p 581-588, 1981. 5 Fig, 7 Ref.

Descriptors: *Process control, *Automation, *Sensors, *Suspended solids, *Flow velocity, *Wastewater treatment, Sludge thickening, Dewatering, Sludge drying, Cost analysis, Monitoring, Control systems, Water treatment.

The monitoring of sludge solids concentration, mass and volumetric flows, and other parameters of sludge dewatering is important to water, wastewater, and sludge treatment processes. A technique based on the measurement of auto- and cross-correlation of turbulence-induced electrical noise using ultrasonic sensing equipment has been designed to optimize the monitoring process. Using two pairs of identical sensors, the suspended solids concentration and flow velocities of slurries and sludges have been successfully monitored. Since the system requires an engineered pipe section and various sensor housings for pipes of different diameters, it is a fairly expensive technology. If a reasonable market is established for this technology, significant price reductions should result. (Geiger-FRC)
W82-04842

APPLICATION OF ELECTRO-OSMOSIS TO DEWATERING SLUDGES,

Wroclaw Technical Univ. (Poland). Inst. of Environmental Protection Engineering.
E. S. Kempa, and J. Dobosz.
Water Science and Technology, Vol 13, No 11-12, p 589-592, 1981. 3 Fig.

Descriptors: *Dewatering, *Automation, *Industrial wastes, Sludge thickening, Process control, Separation techniques, Control systems, Wastewater treatment, Electrochemistry, Sludge conditioning, *Sludge drying, *Electro-osmosis.

An electroosmosis technique was modified to allow automation of sludge dewatering sludge characterized by high specific resistance. The electroosmosis installation was altered by covering the anode with a thin layer of sludge to press it down and ensure humidity near the anode. A vertical flow of liquid ensures process continuity. The optimal potential gradient was 1 V/cm, and the water content of a sludge cake from a crystal-glass works using the technique was 45-50%. Other sludge systems achieved water contents of 60-70% of the total mass. Electroosmosis provided a removal of 80% of the heavy metals via the liquor with a total energy consumption of 80-200 kWh/cu m of sludge. The process has also been successfully applied to sludges from the industrial wastewaters of manufacturers of paints, varnishes, lacquers and synthetic fibers. (Geiger-FRC)
W82-04843

A DYNAMIC MODEL IDENTIFICATION OF THE SLUDGE DEWATERING PROCESS,

Kinki Univ. Osaka (Japan). Dept. of Electrical Engineering.
E. Bamba, S. Yamawaki, M. Yamamura, H. Kitagishi, and T. Yamashita.
Water Science and Technology, Vol 13, No 11-12, p 593-598, 1981. 2 Fig, 3 Tab.

Descriptors: *Mathematical models, *Dewatering, *Mathematical equations, *Process control, Wastewater treatment, Sludge, Mathematical studies, Sludge thickening, Model studies, Control systems.

An identification algorithm called the Revised GMDH (Group Method for Data Handling) algorithm is proposed which gives static and/or dynamic mathematical models. The dynamic mathematical models are used to prepare generalized control equations which are employed as part of a feedforward control that is sensitive to disturbances in the sludge dewatering process. The linearized control equations obtained allow complete control of the dewatering process. The results of this research will be used to design an optimal control system for the dewatering process by taking the appropriate performance index into account. (Geiger-FRC)
W82-04844

AUTOMATIC MONITORING OF COPPER IN WASTE WATER FROM PLATING SHOPS,

Siemens Naamloze Vennootschap, Oostkamp (Belgium).
For primary bibliographic entry see Field 5A.
W82-04845

MANAGEMENT SYSTEM FOR CONTROL OF PROCESS LOSSES AND SPILLS IN THE KRAFT PULPING INDUSTRY,

Tufts Univ., Medford, MA.
G. W. Gove, and J. J. McKeown.
Water Science and Technology, Vol 13, No 11-12, p 545-551, 1981. 3 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Water pollution prevention, *Pulp wastes, *Digital computers, *Simulation analysis, Water pollution control, Industrial wastes, Computer models, Model studies, Analog computers, Mathematical studies, Mathematical models, Kraft mills.

A four-year project was carried out to evaluate analog and direct digital control systems designed to intercept and recover intermittent losses discharged from a kraft pulp mill. A design approach for evaluating spill tank capacity and routing systems through dynamic simulation modeling (DYNAMO) is also presented. Results showed that conductivity and flow could be successfully utilized as inputs to the control system along with values for pumping rate and tank level. Over a two-year trial period, sensors were maintained to yield a 90% reliability, while computer availability was nearly 100%. The intercepted material was returned to recovery rather than to the wastewater treatment facility. The spill control tank was generally kept at less than 20% full. (Geiger-FRC)
W82-04846

AN EXERCISE IN SLUDGE CONSOLIDATION,

W. Campbell, and D. D. McCallum.
Water Services, Vol 85, No 1029, p 551-552, 555, 1981. 2 Tab, 2 Ref.

Descriptors: *Design criteria, *Sludge thickening, *Wastewater facilities, *Separation techniques, Wastewater treatment, Costs, Sludge disposal, Sludge conditioning, Industrial wastes, Cost analysis, Activated sludge, Flocculation, Sludge filters.

The objectives, site investigation and design work carried out prior to the installation of a sludge consolidation plant at the Dextran pharmaceutical manufacturing plant in Holmes Chapel are presented. Sludge generated at the site is derived largely from a Flocor E biofilter system. Main considerations in the design of the sludge handling plant were cost savings (through reduced sludge transport costs), simplicity of operation, ability to handle future increases in sludge production, energy efficiency, odor-free operation, and minimal space requirements. Dewplant (ET) Ltd. was selected to conduct a laboratory investigation of process options and design and to cost out a suitable consolidation scheme based on their results. Laboratory studies showed that gravity separation without expensive flocculants would allow consolidation of raw sludge to 30-50% of its original volume. Duplicate mild steel tanks were used to perform the consolidation on the fill and draw principle. A new thickened sludge holding tank was supplied that provided advantageous disposal rates while meeting space requirements. Duplicate pumps could transfer both consolidated sludge and decanted liquors. Operating results proved satisfactory and have validated design figures. The reduction in volume of transported sludge in 1980 amounted to 575 cu m/month. The final cost savings of the method will depend on the available method of ultimate disposal. (Geiger-FRC)
W82-04848

PACKAGE ANAEROBIC SLUDGE DIGESTION.

Water Services, Vol 85, No 1029, p 556, 559, November, 1981.

Descriptors: *Anaerobic digestion, *Automation, *Wastewater treatment, *Sludge digestion, *Automation, *Farm wastes, Wastewater facilities, Solid wastes, Process control, Mixing, Sludge conditioning, Sludge utilization.

Anaerobic sludge digestion (ASD) reduces pathogens and odors while offering recovery of energy through methane production. ASD is usually feasible only for large wastewater treatment facilities. The retention time for ASD can be reduced to 15 days or less with careful attention to the loading design and heating and mixing systems. The use of steel digesters has cut capital costs and considerably reduced the construction requirements. The Farm Gas ASD plant features automated loading, mixing and heating systems that may be used as unmanned treatment works. Loading is performed by duty and standby positive displacement pumps. Raw sludge is loaded into the top of the digester through an overflow port and is then rapidly dispersed by an unconfined gas mixing system. The sludge is maintained at 35 degrees by means of heated water circulated through an array of tube heat exchangers. The water is heated from a boiler which burns digester gas, and backup heating is provided by electric immersion heaters. The excess gas is used for heating the facility or for payback power generation. An agreement was made in January of 1981 in which Degremont Laing, a subsidiary of Degremont SA of Paris, was licensed to exclusively market the Farm Gas range of ASD systems in the United Kingdom and Ireland. Contracts have already been awarded by Severn Trent Water Authority and the Department of the Environment for Northern Ireland for package ASD plants. (Geiger-FRC)
W82-04850

ISOLATION AND CHARACTERIZATION OF CELLULOLYTIC BACTERIA FROM ACTIVATED SLUDGE,

Louvain Univ. (Belgium). Lab. of Industrial Microbiology and Biochemistry.
K. Ramasamy, M. Meyers, J. Bevers, and H. Verachtert.
Journal of Applied Bacteriology, Vol 51, No 3 p 475-481, December, 1981. 4 Tab, 27 Ref.

Descriptors: *Activated sludge process, *Bacteria, Sewage bacteria, *Culture media, Cellulolytic bacteria, Aerobic bacteria, Cellulomonas, Pseudomonas, Wastewater treatment, Microbiological studies.

An attempt was made to characterize five strains of cellulolytic bacteria isolated from activated sludge using the solid media of Berg et al. and Pochon and Tardieu overlayered with Whatman No. 1 filter paper circles. Colonies appearing in 3-4 days of incubation in the dark at 28 C were transferred to slants of mineral salts medium overlayered with rectangular pieces of filter paper. Inocula from the slants were transferred to tubes of Dubos mineral solution containing a strip of filter paper. After disintegration of the filter paper occurred (3 days), the contents of the test tubes were homogenized, and dilutions were plated onto solid media containing cellulose powder, starch or silica gel overlayered with filter paper. Colonies which appeared pure were transferred to slants of mineral agar covered with filter paper strips. Isolates derived from filter paper overlayered media were mostly cellulolytic and tended to spread, so that incubation time was critical. Incorporation of other substances into the media decreased the percentage of cellulolytic colonies. The five strains studied in detail were rods with a single polar flagellum; strain DK showed a helical structure of the flagellum. The strains were Gram negative (or variable) and non-sporulating; they formed pigments of different colors on starch agar. Strain DK was probably a Cellulomonas and the other strains alcaligenes-like Pseudomonas, though they did not correspond completely to descriptions of known strains. (Carroll-FRC)
W82-04854

TREATMENT OF SECONDARY SEWAGE EFFLUENT WITH A PEAT-SAND FILTER BED,

Forestry Sciences Lab., Grand Rapids, MN.
D. S. Nichols, and D. H. Boelter.
Journal of Environmental Quality, Vol 11, No 1, p 86-92, January-March, 1982. 2 Fig, 6 Tab, 33 Ref.

Descriptors: *Filtration, *Wastewater treatment, *Phosphorus removal, Coliforms, Feces, Nitrogen, Phosphorus, Water quality, Plants, Tertiary wastewater treatment, Advanced wastewater treatment, Peat soils, Separation techniques, Microbial degradation, *Wastewater treatment.

To provide additional treatment of the secondary sewage effluent from a campground on the shore of North Star Lake a peat-sand filter bed was constructed. The lake is within the Chippewa National Forest in north-central Minnesota. The effluent contained an average of 30.9 mg/liter total nitrogen, 8.63 mg/liter total phosphorus, and 122,000 fecal coliforms/100 ml. From late May through early October an average of 6.8 cm/week was applied for an 8 year period. Almost complete removal of fecal coliform bacteria and phosphorus was achieved by the peat-sand filter bed. During the 2nd and 3rd years of operation about 90% of the wastewater nitrogen was removed. By the 5th year this level had declined to about 50% due to the oxidation of the peat and the release of nitrogen. The high iron, aluminum, and ash content of the peat contributed to the highly efficient removal of phosphorus by the filter. During the first 2 or 3 years of wastewater appplication the microbial immobilization in the peat contributed to nitrogen and phosphorus removal. In overall nitrogen and phosphorus removal, rough stalked bluegrass increased each year and accounted for 45% of the phosphorus and virtually all of the nitrogen removal from the wastewater in the fifth year of the study. (Baker-FRC)
W82-04871

PURIFICATION OF DYE WORKS EFFLUENTS WITH ACTIVE CARBON (REINIGUNG VON FARBEREIABWASSERN MIT AKTIVKOHLE),
Laboratorium fuer Adsorptionstechnik, G.m.b.H., Frankfurt am Main (Germany, F.R.).
J. Wirth.
Zeitschrift fur Wasser und Abwasser Forschung, Vol 14, No 5/6, p 173-175, 1981. 5 Fig. English summary.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Activated carbon, Adsorbents, Water reuse, *Dye industry wastes, Costs, Regeneration, Pilot plants.

Previous attempts to improve the quality of dyeworks effluents by treatment with ozone or flocculants have proven inadequate or expensive. In-plant reuse of treated water, desirable for cost savings and environmental protection, imposes high demands on treatment quality, resulting in residual dye levels below 0.1-0.2 mg/liter. To test the applicability of active carbon on a variety of dyes, adsorption isotherms were prepared, and filtration studies were performed on a laboratory apparatus. The column was able to be operated for 370 hr without dye breakthrough, regardless of the dye type and concentration tested. A small pilot filtration plant using a commercial active carbon was then installed in a dye works. A flow-through photometer was used for continuous measurement of the extinction after treatment. The purified water was almost completely colorless; however, inorganic salts were not removed by the column, nor was the slight turbidity due to textile auxiliaries. About 2 cu m of wastewater could be treated with 1 kg active carbon operated up to full loading. The active carbon was thermally reactivated and reused, allowing for reactivation losses of 5-10%. Only slight differences in coloration were apparent between lots of fabric treated with fresh water and reused water. Treatment costs were estimated at about 2.50 German Marks per cu m, approximately equal to the cost of fresh water. Additional savings would be realized by elimination of discharge fees. Therefore this process seems worthy of further investigation. (Carroll-FRC)
W82-04903

SELECTING ENERGY-EFFICIENT WASTEWATER TREATMENT SYSTEMS,
Resources Conservation Co., Seattle, WA.
T. M. Fosberg, D. Mukhopadhyay, T. M. O'Neail, and R. C. Whalen.
Chemical Engineering Progress, Vol 77, No 10, p 63-67, October, 1981. 5 Fig, 3 Tab.

Descriptors: *Industrial wastewater, *Energy, *Reverse osmosis, *Vapor compression distillation, Zero discharge, *Wastewater treatment, Distillation, Evaporation, Ponds, Waste disposal, Economic aspects, Brine disposal.

Reverse osmosis and vapor compression evaporation are energy-efficient methods of treating wastewaters from industries such as electric power generation, coal gasification/liquefaction, oil shale processing, and metal ore processing. These systems can be combined with evaporation ponds or mechanical drying equipment to achieve zero liquid discharge. The energy requirements (in kWh per 1000 gal wastewater) for these systems are as follows: reverse osmosis, 10; vapor compression evaporation brine concentration, 87; and combined reverse osmosis and vapor compression evaporation, 27. The preferred system for each application must also consider life cycle cost (vapor compression evaporation brine concentration is generally cheaper at lower energy costs of 3-5 cents per kWh) and the choice of pond evaporation vs. mechanical dryers (ponds are preferred for the Southwest and some parts of the West, whereas mechanical dryers are more suitable for the remainder of the country). (Cassar-FRC)
W82-04904

SHALE OIL WASTEWATER TREATMENT BY EVAPORATION,
Battelle Pacific Northwest Labs., Richland, WA.
W. Wakamiya.
Chemical Engineering Progress, Vol 77, No 5, p 54-60, May, 1981. 10 Fig, 3 Tab, 7 Ref.

Descriptors: *Oil shale, *Industrial wastewater, *Evaporation, *Wastewater treatment, *Oil industry, Ammonia, Organic carbon, Sludge disposal, Petroleum industry.

Oil shale retort water, high in organic carbon and ammonia, was effectively treated by evaporation. A 95 liter per day laboratory evaporator removed over 90% of inorganic carbon, conductivity, alkalinity, total solids, and suspended solids. Removal of organic carbon was 70% and of ammonia, 86%. The quality of water produced from the process was high enough for use as irrigation water or boiler feed water. This distillate may also be injected into an aquifer, although the ammonia levels are 9 times higher than in groundwater. The sump concentrate is not suitable for incineration and may be classified as hazardous waste if arsenic and selenium levels exceed regulatory limits. Costs for the evaporation process, including ammonia stripping pretreatment, were estimated at $1.79 to $2.25 per cu m compared with $2.84-$6.51 per cu m for biological and physical treatment methods. (Cassar-FRC)
W82-04905

DESIGNING WASTEWATER TREATMENT SYSTEMS TO SAVE ENERGY,
Edeco, Inc., Tulsa, OK.
B. V. Prather, and W. J. Gossom.
Chemical Engineering Progress, Vol 77, No 10, p 68-77, October, 1981. 12 Fig, 4 Ref.

Descriptors: *Industrial wastewater, *Oil refineries, *Energy, Wastewater treatment, Design criteria, Filtration, Flotation, Gravity flow, Pumping, Operating costs, Oil wastes, Activated sludge process, Separation techniques, Mixing, Aeration, *Sludge disposal, Sludge thickening, Dissolved air flotation.

A procedure for designing petroleum refinery wastewater treatment systems applies rigorous sensitivity analysis to each component of the system to derive the most cost-effective system. The real effects of energy costs and costs of operator attention are balanced against treatment efficiency. Some of the most cost-effective processes are described. Maximum use of gravity flow and minimum differences in elevation for pumping wastewater can reduce pumping energy costs. In the primary treatment step oil/water gravity separators are desirable. Energy saving modifications of the process include part-time operation of skimmers and bottom rakes, proper choice of separator volume, and minimum mixing in equalization basins. Baffles may provide sufficient non-energy-consuming mixing in equalization vessels. In the intermediate step the dissolved air flotation process, which consumes more energy than sedimentation, may be more energy-efficient because it removes more pollutants. Suggestions for optimum design in the dissolved air flotation process include the eductor/emulsifier for producing fine air bubbles and optimum recycle pump design and operation. Secondary treatment by the activated sludge process may be optimized by a high sludge age, vertical upflow tanks, and good mixing. Other treatments for which energy requirements may be determined before choosing a final design are aeration/mixing, clarifiers, and sludge recycle pumps. Advanced treatment options include filters (gravity types are the most energy-efficient) and activated carbon. Land farming requires less energy than other sludge disposal methods. However, a sludge with sufficient oil content (16-18%) may be incinerated without additional fuel. (Cassar-FRC)
W82-04906

ANAEROBIC TREATMENT OF HIGH-STRENGTH WASTES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
A. W. Obayaski, H. D. Stensel, and E. Kominek.
Chemical Engineering Progress, Vol 77, No 4, p 68-73, April, 1981. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Anaerobic digestion, *Industrial wastewater, *Wastewater treatment, Aerobic treatment, Methane, Fluidized bed process, Biological treatment, Sludge blanket process, Design criteria, Retention time, *Cost analysis, Nutrient requirements.

Anaerobic system for treatment of high strength industrial wastewaters from food processing, pharmaceutical manufacturing, and distilleries can have annual costs 50% less for pretreatment and 18% less for complete treatment. Mary improvements in the anaerobic process have been made within the last 15 years. In the contact process adequate solids retention time is maintained in spite of a reduction in hydraulic retention time. The upflow anaerobic sludge blanket process is the most significant advance in treatment of high-strength wastewaters. A full-scale system has been built to handle sugar beet waste. Other recent developments are the fluidized bed upflow reactor and the Clarigester, a clarifier over a digestion tank. Design of full-scale anaerobic system should begin with an evaluation of wastewater temperature, pH, potential toxic substances, the need for equalization, and nutrient requirements. Advantages of the anaerobic process are low sludge production, low nutrient requirements, no aeration required, 90% conversion of biodegradable organic matter to methane, seasonal operation possible, and high degree of waste stabilization at high loadings. Disadvantages are the lack of practical experience in full-scale operations, the long startup period, poor quality effluent, and sensitivity to variable loads and toxic substances. (Cassar-FRC)
W82-04907

TREATMENT OF COOLING TOWER BLOWDOWN,
Bechtel National, Inc., San Francisco, CA.
A. N. Rogers, M. C. Weekes, S. C. May, and E. H. Houle.
Chemical Engineering Progress, Vol 77, No 7, p 31-38, July, 1981. 3 Fig, 6 Tab, 9 Ref.

Descriptors: *Cooling towers, *Distillation, Reverse osmosis, *Wastewater treatment, Vapor compression distillation, Evaporation, Saline water, Vertical tube foaming evaporation, Scale, Heat transfer, Ponds, Energy, Costs, Operating costs, *Comparison studies.

Three treatments for cooling tower blowdown are compared: reverse osmosis, vapor compression, and vertical tube evaporation. No single process is definitely superior to the others in all aspects. Reverse osmosis requires the least plant investment. Vertical tube evaporation and reverse osmosis are lower than vapor compression in total annual costs. Reverse osmosis and vertical tube evaporation use about one-tenth the electricity that vapor compression does. Reverse osmosis has the largest ponding requirements, minimal long-term operating experience with blowdown, can be constructed in modular units, is very sensitive to upsets in pretreatment, and produces a fair quality product (salinity 475 ppm). Vertical tube foaming evaporation has moderate ponding requirements, no long-term operating experience with blowdown, is not practical to construct in modular units, is not too sensitive to upsets in pretreatment, and produces a high quality product (salinity 10 ppm). Vapor compression has moderate ponding requirements, a successful long-term history of operating with blowdown, is not practical to construct in modular units, is not too sensitive to upsets in pretreatment, and produces a high quality product (salinity 10 ppm). (Cassar-FRC)
W82-04908

BIODEGRADATION OF HAZARDOUS ORGANIC POLLUTANTS,
Illinois Inst. of Tech., Chicago.
For primary bibliographic entry see Field 5B.
W82-04910

SPECIATION OF COPPER AND MANGANESE IN EFFLUENTS FROM THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
R. M. Sterritt, and J. N. Lester.
Environmental Pollution, Series A: Vol 27, No 1, p 37-44, January, 1982. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Activated sludge process, *Heavy metals, *Wastewater treatment, Copper Manganese, Effluents, Industrial wastes, Sludge.

The solubility and soluble speciation of heavy metals in effluent samples from an activated sludge simulation were investigated. An attempt was made to relate these phenomena to the capacity of the activated sludge process to remove them. A continuous flow laboratory scale activated sludge simulation system was employed. Ten heavy metals, silver, cadmium, cobalt, chromium, copper, manganese, molybdenum, nickel, lead, and zinc were added continuously to the aerator at nominal influent concentrations in the range of 0.01-0.50 mg/liter. The system was operated at sludge ages of 6, 9, 12, 15, and 18 days, maintained by wasting an appropriate quantity of mixed liquor. Samples of effluent were taken after the system had reached stability at each sludge age. Soluble metal was taken to be that which passed a 0.22 micrometer pore size. The proportions of total copper and manganese in solution were greater than 50% for sludge ages of 6-15 days, but fell to 13% and 7%, respectively at a sludge age of 18 days. This appeared to coincide with an increase in the effluent suspended solids concentration from 25 mg/liter to 50 mg/liter, possibly indicating that the solids had adsorbed significant quantities of both metals. No effect of chemical oxygen demand on metal solubility could be observed, as this parameter did not change appreciably with sludge age. Gel filtration indicated that both copper and manganese were maintained in solution by organic metal-binding fractions, although each metal was associated with different fractions. Copper speciation in the effluent changed with increasing sludge age, whereas forms of manganese were little changed. The data obtained indicate that the association of copper and manganese with different metal binding components may be related to differences in their observed removal efficiencies. (Baker-FRC)
W82-04937

REGIONAL MANAGEMENT OF GROUNDWATER RECHARGE AND POLLUTION IN A RAPIDLY URBANIZING AREA: LONG ISLAND, N.Y.,

Cornell Univ., Ithaca, NY., Dept. of Environmental Engineering.
For primary bibliographic entry see Field 4B.
W82-04956

ACCLIMATION OF SLUDGE FOR EFFICIENT REMOVAL OF NITROGEN FROM FERMENTATION WASTEWATER,

Kogyo Co. Lt., Bofu (Japan).
M. Nagashima, S. Noguchi, and T. Suzuki.
Journal of Fermentation Technology (Osaka), Vol 59, No 1, p 49-53, 1981. 5 Fig, 3 Tab, 5 Ref.

Descriptors: *Activated sludge process, *Denitrification, *Nitrogen removal, *Wastewater treatment, Nitrates, Nitrites, Nitrification, Nitrous oxide, Fermentation.

Activated sludge acclimated to nitrates and to nitrites differed in their ability to remove nitrogen from fermentation wastewaters. At a given BOD the nitrite sludge reduced nitrite at 2 or 3 times the rate at which nitrate sludge reduced nitrate. Nitrous oxide was formed with the nitrate sludge under high loads of nitrate and BOD but was minimized by rapid recycling and mixing. The nitrate sludge was converted to nitrite sludge by maintaining alkaline pH and high influent loads. (Cassar-FRC)
W82-04990

STUDIES ON BIOLOGICAL NUTRIENTS REMOVAL FROM FERMENTATION WASTEWATER (III). OPERATIONAL CONDITIONS ELIMIATING THE EVOLUTION OF NITROUS OXIDE IN A DENITRIFICATION PROCESS,

Kyowa Hakko Kogyo Co. Ltd., Bofu (Japan).
M. Nagashima, S. Noguchi, and T. Suzuki.
Journal of Fermentation Technology, Vol 59, No 1, p 55-58, 1981. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Activated sludge process, *Denitrification, *Nitrous oxide, Fermentation, *Wastewater treatment, Nitrates, Nitrites, Hydrogen ion concentration.

Nitrous oxide formation from two types of activated sludge was studied in laboratory batch operations. Sludge acclimated to nitrate readily reduced nitrate to nitrite. However, nitrite accumulated and nitrous oxide was evolved under these conditions, especially at acidic and alkaline pH. Sludge acclimated to nitrite reduced both nitrite and nitrate to gaseous nitrogen without evolution of nitrous oxide at any pH tested. The results help explain the previous finding that a rapid circulation of liquid between nitrification and denitrification basins eliminated the evolution of nitrous oxide, which is desirable in order to prevent secondary pollution. (Cassar-FRC)
W82-04991

EFFECT OF ROTATION SPEED ON REACTION RATE ON A ROTATING BIOLOGICAL CONTACTOR,

Tokyo Inst. of Tech., Yokohama. Research Lab. of Resources Utilization.
S. Odai, K. Fujie, and H. Kubota.
Journal of Fermentation Technology, Vol 59, No 3, p 227-234, June, 1981. 9 Fig, 2 Tab, 5 Ref.

Descriptors: *Biological treatment, *Rotation speed, *Wastewater treatment, Glucose, Model studies, Rotating biological contactors.

The effect of the rotation speed of the discs of a rotating biological contactor on the biochemical reaction rate in the microbial film was simulated by a mathematical model. This effect was expressed as a rotation factor, which describes the relation between the time-average reaction rate and the rotation speed of the biodisc. The empirical equation, tested in a glucose oxidation experiment, produced results in agreement with the experimental results. The rotation factor is useful in predicting the power economy of the system, which depends on the disc rotation speed. (Cassar-FRC)
W82-04992

CALORIFIC VALUE OF WASTEWATER PLANT SLUDGES,

Marquette Univ., Milwaukee, WI.
For primary bibliographic entry see Field 5E.
W82-04997

KINETIC CONSIDERATIONS ON THE PERFORMANCE OF ACTIVATED SLUDGE REACTORS AND ROTATING BIOLOGICAL CONTACTORS,

Rome Univ. (Italy). Ist. di Chimica Applicata ed Industriale.
A. E. Paolini, and G. Variali.
Water Research, Vol 16, No 2, p 155-160, February, 1982. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Activated sludge process, *Kinetics, *Wastewater treatment, Sludge, Activated sludge, Biological oxygen demand, Films, Thin films, *Industrial wastes, Hydraulics, Mathematical studies, Effluents, Performance evaluation, Comparison studies.

A study was designed to compare the performance characteristics of laboratory scale activated sludge and rotating biological contactor (RBC) plants treating the effluent from an urban solid waste processing industry, to verify a simplified design equation for RBC systems and evaluate the possibility of using the kinetic constants of suspended growths for fixed microbial films, and to develop an estimation procedure for the effective surface area of biofilms. A steady-state kinetic model for completely mixed activated sludge reactors with solids recycle and soluble substrate has been used in this study for correlating the experimental results and evaluating the kinetic constants of the suspended growth. Within the range of hydraulic detention time examined, 0.3 to 1.7 days, the activated sludge and RBC units showed very similar biological oxygen demand-5 removal kinetics when the activated sludge concenration and the geometric area of the discs per unit volume of aeration reactor are 2000 mg VSS/liter and 1340 square centimeters/liter, respectively. For disc rotational speeds not limiting microbial growth, a simplified kinetic equation is employed successfully to predict the steady-state performance of RBC systems under conditions of both varying organic loading and varying influent substrate concentration. Also, the kinetic constants of suspended microbial growth may be effectively included in this equation. This equation proves quite useful in evaluating the effective surface area of the biofilm. (Baker-FRC)
W82-05011

SURFACTANT ADSORPTION ON THE WOOL CARBONIZING WASTE (ADSORPTION DE SURFACTANTS SUR LE DECHET LAINIER DE CARBONISAGE),

Ecole Nationale Superieure de Chimie, Toulouse (France), Laboratoire de Chimie Organique et d'Agrochimie.
F. Perineau, J. Molinier, and A. Gaset.
Water Research, Vol 16, No 2, p 189-197, February, 1982. 7 Fig, 5 Tab, 21 Ref. English summary.

Descriptors: *Surfactants, *Wastewater treatment, *Absorption, Wool, Industrial wastes, Acidity, Temperature effects.

Wool carbonizing waste is composed mostly of chemically modified short sized wool fibers and of plant material particles considered as sulfuric lignins. Wool carbonizing waste was considered likely to be a suitable material for the absorption of ionic organic solutes from industrial waste water due to its physical structure as well as to the polar and apolar characteristics of its macromolecules. The absorption isotherms of anionic, cationic, and nonionic surfactants were drawn from various pH and temperature conditions to determine the absorption mechanisms involved as well as the absorption capacity of the carbonizing waste and the optimal absorption conditions. Temperature induced changes in absorption structure enhanced the absorption characteristics. Therefore wool carbonizing waste was proposed for the purification of hot effluents. The processing of anionic surfactant solutions requires acidic media, whereas alkaline media are more suitable for effluents containing cationic surfactants. In both cases ionic bonding is involved. The absorption isotherms have an L-shape, which corroborates the successive involvement of ionic and hydrophobic interactions in the case of ionic surfactants. Langmuir and Freundlich models were used for modeling of water processing units. The processing of industrial effluents in a stirred reactor corroborated the outstanding ability of wool carbonizing waste to absorb cationic surfactants. The tests also showed that the removal of non-ionic surfactants is improved when they are mixed with anionic surfactants. (Baker-FRC)
W82-05021

GEOCHEMICAL ANALYSIS OF THE STATE DRINKING WATER STANDARD GOST 2874-73 AND WAYS TO IMPROVE IT,

All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology.
S. R. Krainov, I. Y. Sokolov, and M. S. Galitsyn.
Water Resources, Vol 8, No 2, p 164-173, March-April, 1981. 2 Fig, 2 Tab, 16 Ref. Translated from Vodnye Resursy, No 2, p 109-119, March-April, 1981.

Descriptors: *Water quality standards, *Drinking water, *Geochemistry, Standards, Groundwater, Water analysis, Mineral water, Public health, Chelation, Metals, Organic compounds, Chemical composition, *USSR.

Creation of optimal state (USSR) drinking water standards and methods of analysis is only possible with close cooperation between hygienists and specialists in geochemistry. As a result of natural processes, groundwater may contain elements in concentrations higher than the maximum allowable concentrations (MAC). Water containing toxic elements or organic compounds derived from wastewater are covered by the standards, but those

with high mineral contents from natural processes are not. An additional problem is the standardization of certain elements in forms which do not exist in all waters. For example, molybdenum is standardized as Mo(2+) and Mo(6+), but in natural water molybdic anions are predominant. Similarly Se, standardized as SE(4+) and Se(6+), is found in groundwater as HSe03(-), Se03(2-), and HSe(-). The same situation occurs with Be, Pb, Cu, Zn, Fe, and Mn. Many standardized analytical methods do not detect the true concentrations of the elements in question, for example, complexed metals (Fe). The effects of elements vary according to the chemical form. Flourine is most hazardous in sodium bicarbonate waters and much less in BF(-) compounds. The authors state that the drinking water standards should not have MACs lower that the global background concentrations of these elements in natural groundwater. Background levels of Zn, Cu, Mg, Pb, and U are always less than the MAC except in acid or sulfide waters; background levels of Sr, F, Fe, Mn, As, Se, and Be are often near MAC levels. Natural waters high in one or morre of the elements under discussion are identified. (Caesar-FRC)
W82-05025

PROSPECTS OF USING RADIATION WATER TREATMENT METHODS,

P. I. Dolin, and S. A. Bruesntseva.
Water Resources, Vol 8, No 2, p 201-205, March-April, 1981. 14 Ref. Translated from Vodnye Resursy, No 2, p 151-155, March-April, 1981.

Descriptors: *Radioactivity, *Disinfection, Reviews, *Wastewater treatment, Industrial wastewater, Detergents, Flotation, Oxidation, Polymers, Animal wastes, Activated carbon, Color removal, *Water treatment, Humic acids.

Radiation disinfection of wastewaters is presently the most promising method of using radiation in water treatment, according to a review of recent developments in this field. It is not clear whether microorganisms are killed by a direct hit of radiation energy or by radiolysis products of water (OH, N, or hydrated electrons). Accelerated electrons (energy 9 MeV, dose 0.2 Mrad) have been used with bubbling air to disinfect wastewater from livestock complexes, producing 100% disinfection of salmonellas, E. coli, and helminth embryos. Radiation plus the action of atmospheric oxygen produces decolorization, removal of tastes and odors, and disinfection of natural waters containing humic substances. Radiation-induced polymerization has been used to treat black liquor from the sulfite papermaking processing with 80-85% removal of lignin. It is also suitable for removing urea and certain dyes. The radiation flotation method in foam has been applied to treatment of wastewater containing nonbiodegradable synthetic detergents (alkyl aryl sulfonates) to reduce foam formation, increase surface tension, and decompose the detergent at the rate of 50 molecule per 100 eV. Organic pollutants extracted into a foam layer may be readily oxidized by this process. Co60 radiation treatment of activated carbon during livestock wastewater treatment prolongs the life of the carbon and produces a highly effluent. (Caesar-FRC)
W82-05026

TRY CHEMICAL TESTS IF INDUSTRIAL WASTES ARE STRONG,

K. A. Bradstreet.
American City and County, Vol 97, No 2, p 26-27, February, 1982. 2 Fig.

Descriptors: *Sewer infiltration, *Flow measurement, *Wastewater treatment, Industrial wastes, Rainfall, Lithium chloride, Wastewater facilities, Secondary wastewater treatment, *Derby, *Connecticut.

Engineers in Connecticut turned to a chemical dilution flow measurement method to determine how greatly infiltration and inflow were adding to a treatment plant's load. The sewage treatment plant in Derby was upgraded in 1973 to include secondary treatment. However, at times when the regulating chambers malfunctioned, excessive flows overloaded the treatment plant, interrupting plant operation. Traditional flow measuring techniques could not be used because large portions of the system were consistently surcharged during high groundwater and storm periods. Some sort of dilution procedure was needed, and lithium chloride was selected as the dilution agent. This compound is ideally suited for this use, as it is rare in most sewer systems, relatively nontoxic and easily measured using an atomic absorption spectrophotometer equipped with a lamp for lithium analysis. It is not affected by chemical reactions which may occur when it is fed into the sewer system. Once samples have been analyzed and flow rates determined, estimates of infiltration and inflow were made. Estimated inflow rates were adjusted based on the ratio of intensity of the rainfall during the gauging compared to expected rainfall intensity during a 10 year storm. (Baker-FRC)
W82-05037

LITERATURE STUDY OF THE BIODEGRADABILITY OF CHEMICALS IN WATER: VOLUMES 1 AND 2,

Franklin Research Center, Philadelphia, PA.
J. Geating.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-100843, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-175/176, October, 1981. 4 p, 1 Fig, 1 Tab, 1 Ref. R806699-01.

Descriptors: *Biodegradation, *Wastewater treatment, *Inhibition, *Mathematical models, *Molecular structure, Model studies, Chemical interference, Bibliographies, Microbial degradation, Microorganisms, *Chemical degradation.

This project was initiated to compile and review post-1974 literature references on aqueous biodegradability of chemicals, to update a previous report. Additionally, literature back to 1913 was searched for inhibitory effects of specific chemicals on wastewater treatment processes. Results are presented as an in-depth hierarchical index and bibliography of 600 items. The index is searchable at three levels: chemical name or chemical class; name of microorganism or type of microbial population affecting or being affected by the chemical; and wastewater treatment process. A structure-activity model was developed to distinguish between biodegradable and nonbiodegradable chemicals. Two parameters were used in the biodegradability model: molecular weight and Wiswesser Line Notation (WLN) based substructural keys. The WLN-based keys are based on major modification of the CROSSBOW program. In a test of the structure-activity model, 270 of 292 degradable compounds, or 92.5% were correctly classified whereas 39 of 57 (68.4%) nondegradable compounds were correctly classified. A total of 25 compounds could not be classified by the model. (Moore-SRC)
W82-05055

DATA BASE FOR INFLUENT HEAVY METALS IN PUBLICLY OWNED TREATMENT WORKS,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.
R. A. Minear, R. O. Ball, and R. L. Church.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108168, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-220, October, 1981. 5 p, 2 Fig, 1 Tab, 1 Ref. R805606-01.

Descriptors: *Heavy metals, *Wastewater composition, *Wastewater facilities, *Influent water, Industrial wastewater, Wastewater analysis, Seasonal variation, Waste load, *Wastewater treatment.

The heavy metals loading to publicly owned treatment works (POTW's) is of interest because of: the possible inhibitory effect it has on the biological treatment process; the effluent levels that can be achieved as a function of influent concentration; and the practice of land disposal of waste sludge. Data on influent heavy metals were obtained from 239 wastewater treatment plants. Wastewater treatment plant laboratories were evaluated during the study and generally found to be satisfactory within the framework of the evaluation method. Of the 80,000 individual items of data from the 239 plants, a substantial data base was generated for cadmium, chromium, copper, nickel, lead, and zinc. Extensive data were obtained for silver, arsenic, and mercury. Limited data were obtained for beryllium, cobalt, antimony, and selenium. Aluminum, iron, and manganese data were obtained as well. Overall, the individual plant mean and median metal concentration data tend to fit a log normal distribution. Though no association could be determined between the percent of industrial effluent and metal concentrations in POTW influents, sufficient data were available to determine that cities with less than 4% industrial contribution had significantly lower levels of cadmium, chromium, copper, mercury, nickel, and zinc. Only lead concentrations were not significantly different for the two populations. There were seasonal variations in metal concentration, from 5% to 20% greater in the fall than in the spring. (Moore-SRC)
W82-05056

HEAVY METAL SOURCES AND FLOWS IN A MUNICIPAL SEWAGE SYSTEM: LITERATURE SURVEY AND FIELD INVESTIGATION OF THE KOKOMO, INDIANA, SEWAGE SYSTEM,

Purdue Univ., Lafayette. IN.
K. J. Yost, R. F. Wukasch, T. G. Adams, and B. Michalczyk.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108366, Price codes: A13 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-224, October 1981. 3 p, 4 Tab. R805361-01.

Descriptors: *Heavy metals, *Cyanide, *Wastewater, *Sludge disposal, *Sampling, Copper, Chromium, Cadmium, Zinc, Nickel, Lead, Pollution load, *Wastewater treatment, Domestic wastes, Land disposal, Pollutant sources, Kokomo, Indiana.

The mass flows of heavy metals (Cu, Cr, Cd, Zn, Ni, Pb) and cyanide in the Kokomo, Indiana, collection system and wastewater treatment plant were analyzed. The primary objectives were to determine the relatve contributions of domestic and nondomestic sources to the total pollutant load in the system, and to assess the levels of discharge control required for the disposal of municipal sludge by landfill or agricultural land spreading. Sampling was conducted at point source locations, in major sewer trunklines and feeder lines, and at the treatment plant. Production and waste treatment data were presented for point sources sampled to characterize metal and cyanide discharges as a function of these parameters. A heavy metals mass balance was attempted for the treatment plant. Metal removal factors were presented for various plant operations. With the exception of lead, metals were found to be largely from nondomestic sources. With the exception of nickel, the Kokomo treatment plant removed 80% to 90% of the influent metals. Required reductions in nondomestic sources of metals to meet EPA landspreading guidelines for sludge were 98% for cadmium, 84% for zinc, and 42% for copper.. A simple statistical approach was presented for the design of a cost-effective sampling program for correlating point source and trunkline pollutant sampling. The purpose was to minimize the amount of sampling required to account for pollutants seen in truklines and treatment plant streams in terms of discharges from specific sources. (Author's abstract)
W82-05061

ENGINEERING AND ECONOMIC ASSESSMENT OF AUTOHEATED THERMOPHILIC AEROBIC DIGESTION WITH AIR AERATION,

Camp, Dresser, and McKee, Inc., Boston, MA.
P. W. Keohan, P. J. Cornelly, and A. B. Prince.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102310, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Sum-

mary EPA-600/S2-81-171, October 1981. 4 p, 2 Fig, 1 Tab.

Descriptors: *Aerobic digestion, *Sludge digestion, *Cost analysis, *Aeration, Economic aspects, Sludge drying, Disinfection, Pathogens, Biodegradation, Thermophilic bacteria, Heavy metals.

A major disadvantage of aerobic digestion is that its efficiency is greatly reduced during periods of cold weather. If heat losses are controlled, it becomes possible for the digester system to maintain its operating temperatures within the thermophilic range despite severe winter conditions. Engineering and economic analyses were made of test results obtained in experiments on a modified sludge stabilization process termed autoheated thermophilic digestion (ATAD) with air aeration. Test results were analyzed for system kinetics, heat balance, aerator transfer efficiency, pathogen destruction, dewaterability, and heavy metal interactions. Additionally, economic viability of ATAD was examined using very conservative criteria in application to facilities of 1, 10, and 100 mgd capacity. ATAD with air eration is found to be feasibile on a thickened municipal sludge. The favorable economics at plants of 1 mgd capacity merits serious consideration in planning for design of sludge processing facilities. In general, the characteristics of sludge processed by ATAD to a 40% reduction in volatile solids should be similar to those of sludge processed by ambient aerobic digestion or mesophilic anaerobic digestion. (Moore-SRC)
W82-05071

CARBOHYDRATES AND PROTEINS REMOVALS IN ACTIVATED-SLUDGE PROCEDURE,

Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
K. Barteszewski.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 89-96, 1980. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Carbohydrates, *Proteins, *Activated sludge process, Biological treatment, Glucose, Albumin, *Wastewater treatment, Organic loading.

Six synthetic wastewaters, differing in protein concentrations (0 to 198 g albumin per cu m) and carbohydrate concentrations (10 to 647 g glucose per cu m) were subjected to laboratory-scale activated sludge digestion by biomass adapted to high-protein wastewaters. Suitable analytical methods were the pheno method for carbohydrates and the Lowry method for proteins. Removal of the carbohydrates and proteins proceeded in several stages. First, sorption occurred on the surface of flocs, slightly decreasing the concentration of organic matter. Second, protein levels increased temporarily, then gradually decreased. In wastewaters with high carbohydrate levels, carbohydrate concentrations decreased with simultaneous hydrolysis of proteins. When protein hydrolysis was complete, decomposition of both carbohydrate and proteins proceeded simultaneously. A wastewater containing high levels of carbohydrate and no protein degraded only after adaptation; decomposition was linear, not exponential, as in the mixed wastewater. Wastewater containing no protein at the beginning of degradation showed a slight rise in protein levels as the digestion proceeded due to the death of some of the microorganisms. (Cassar-FRC)
W82-05090

TREATING PHENOL RESIN PLANT WASTES,

S. R. Gelman, G. A. Mooney, and H. Craven.
Industrial Wastes, Vol 28, No 1, p 32-35, January-February, 1982. 4 Fig.

Descriptors: *Industrial wastes, *Wastewater treatment, *Phenols, Aerated lagoons, *Resins, Plastics, Biological wastewater treatment.

A two-phase program was instituted at a Georgia phenolic resin plant in efforts to rehabilitate the existing effluent ponds to meet discharge standards and to develop the long-range procedures and facilities needed in order for the plant to meet discharge standards year round under the existing and projected wastewater loadings. Wastewater treatment at the plant consists of two aerated lagoons which may be operated either in series or in parallel. The system provides pretreatment prior to discharge to a municipal sewer. A treatability study was conducted, and the data from that study were used in setting guidelines for treatment system operation. These guidelines have enabled operators to control waste flow into the treatment ponds in a manner that ensures discharge limit compliance. Mass limits were set for biochemical oxygen demand and chemical oxygen demand above which the system would fail. Raw waste is analyzed daily. Allowable flow is then computed from the limits. Prior to the study the operators would pump into the pond the amount of waste generated the previous day. They now pump the maximum volume that will maintain the prescribed phenol or chemical oxygen demand mass limit. Implementation of the results of this study along with increased operator monitoring and attention has considerably improved phonol removal performance and provided highly consistent treatment operations. (Baker-FRC)
W82-05128

BIOLOGICAL NITRIFICATION OF INDUSTRIAL WASTEWATER,

M. Olthof, and J. A. Oleszkiewicz.
Industrial Wastes, Vol 28, No 1, p 29-30, January-February, 1982. 5 Fig.

Descriptors: *Wastewater treatment. *Nitrification, *Activated sludge process, Industrial wastes, Biological wastewater treatment, Nitrogen, Nitrates, Ammonia, Chemical reactions.

Data are presented from two studies on ammonia removal from industrial wastes - one on coke oven effluents and one on a waste acid handling facility. The information was collected to define some of the factors affecting the ammonia removal in a one stage activated sludge system, with particular emphasis on optimization of the biological system with reference to sludge separation, removal rate and temperature effects, and without regard to denitrification facilities that would have to follow. The general trend appears to be a decrease in effluent ammonia concentration with decreased loading. Good sludge separation and control over the final solids carryover is essential to proper management of the bio-systems, since the active nitrifying organisms account for only 3 to 9% of the microorganism biomass of activated sludge, and are the lightest and thus most easily lost from the system. A decrease in chemical oxygen demand to nitrogen ratio was achieved by increasing the nitrogen concentration from 125 to 1,000 mg/1, which yielded substantial increases in the rate of removal in spite of ammonia concentrations in the reactor exceeding 250 mg/l at higher loadings. The temperature exerted a profound effect on all biological systems. The significant effect of temperature on nitrification accounts for the seasonal variation in effluent quality from the existing full scale plants. The successful operation of the biological ammonia nitrogen removal system is dependent on adequate supply of phosphorus and oxygen to oxidize ammonia to NO2 and NO3. (Baker-FRC)
W82-05129

RAILROAD'S SHOPS CORRECT AN OILY WASTES PROBLEM,

Nalco Chemical Co., Oak Brook, IL.
R. Cardile, and R. Fronczak.
Industrial Wastes, Vol 28, No 1, p 20-40, January-February, 1982. 1 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Sludge, *Industrial wastes, Oil, Oil wastes, Wastes, Railroad industry, Oil recovery, *Railroads, Sewers, *Milwaukee, *Railroad yards.

Design and construction changes were made by the Chicago, Milwaukee, St. Paul and Pacific Railroad in an effort to bring the existing treatment facilities at the Milwaukee Shops into compliance with their NPDES permit and local sewer ordinances. In the storm water treatment system, sludge generated from the IAF unit was originally designed to flow into the sludge holding tank and be dewatered on the belt press. The IAF units were designed to perated at a constant flow level through a range of influent flow conditions controlled by a pneumatically operated butterfly valve on the discharge line from the unit. However, this valve was unable to maintain the desired constant level condition. Due to the length and number of weirs in the IAF units, the level in the tank fluctuated so that either too little sludge was removed, resulting in lower quality effluent, or too much sludge was conveyed to the holding tank, causing it to overflow. After various changes had been made, the plant plant operated satisfactorily and allowed the Milwaukee Road shops and Yards to meet requirements. The belt press has proven to be an effective sludge dewatering technique for oily type sludges of railroad treatment facilities. The plant has recovered free oil as a valuable byproduct of the operation of the railroad's shops. Additional methods of sludge treatment are being considered by the firm to further increase oil recovery by releasing oil bound in sludge solids. (Baker-FRC)
W82-05130

SELECTIVE PASSAGE OF HYDROPHILIC NITROGENOUS ORGANIC MATERIALS THROUGH MACRORETICULAR RESINS,

Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
N. M. Ram, and J. C. Morris.
Environmental Science and Technology, Vol 16, No 3, p 170-174, March, 1982. 3 Tab, 2 Fig, 26 Ref.

Descriptors: *Resins, *Filtration, *Organic compounds, Nitrogen, Humic acids, Water treatment, Adsorption, Carbonates.

Filtration of water samples through a combination of macroreticular resins XAD-8 and Tenax GC was examined as a method of selectively removing hydrophobic carbonaceous materials, such as humic acid, from aqueous solution. Such a method as this might be used as a pretreatment step in the analysis of N-organic hydrophilic substances by first selectively adsorbing potentially interfering hydrophobic materials from solution. The inability of N-organic substances to be absorbed onto the macroreticular resin combination was examined. Prefiltration of the natural water samples selectively removed hydrophobic carbonaceous organic materials without significantly affecting hydrophilic nitrogenous organic substances. Hydrophobic carbonaceous adsorbates competitively decreased adsorption of hydrophilic materials. This phenomenon permits high recoveries of organic nitrogen while simultaneously removing humic material. (Baker-FRC)
W82-05150

SLUDGE MANAGEMENT IN THE ROCKY MOUNTAIN STATE,

Black and Veatch, Denver, CO.
For primary bibliographic entry see Field 5E.
W82-05165

HOW SCREEN MOUNTING AFFECTS MICROSCREENING HYDRAULICS,

Envirex Inc., Waukesha, WI.
J. W. Wittmann.
Water/Engineering and Management, Vol 129, No 2, p 44, 46, 47, February, 1982. 3 Fig, 6 Ref.

Descriptors: *Wastewater treatment, *Screens, Filters, Filtration, *Suspended solids, Design criteria, Hydraulics, *Separation techniques.

Microscreening is a physical straining process used for separation of solids from a liquid suspension by means of the liquid's passage through a porous membrane, defined as the screening or filtering medium. Separation occurs through the retention of solids, either directly by the screen or indirectly by capture of the biomat formed on the screening medium. The microscreen consists of a screening medium attached to the periphery of a rotating horizontal drum. While several studies have been made to establish those criteria which affect the hydraulic design of a microscreen, several significant principles are frequently omitted, foremost among which has been the net effective screening

area and headloss capability associated with various screening medium mounting concepts. For conventional microscreen applications including the polishing of a secondary effluent, microscreen design has been based on hydraulic loading criteria, defined in terms of gpm/sq ft of nominal submerged surface area. Field research for the development of process technology in the newest microscreening application, algae removal from lagoons, ponds and stabilization basins, led to the establishment of hydraulic loading results in terms of gpm/ft of net effective submerged surface area. The traditional screening media mounting concept employs a fine screening medium backed up by a coarse, typically 10 or 20 mesh screen. The screening grid is an innovative mounting concept consisting of a single screen integrally cast into an 18 by 24 in polypropylene grid with the medium supported on 1 in centers by grid rib framework. Suspended solids, removal efficiencies of 70-90% are achievable when operating at a headloss up to 15 in. (Baker-FRC)
W82-05168

A LOW-COST SECONDARY TREATMENT ALTERNATIVE,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water/Engineering and Management, Vol 129, No 2, p 27-28, February, 1982. 4 Fig, 2 Tab.

Descriptors: *Secondary wastewater treatment, *Aerated lagoons, Lagoons, Wastewater treatment, *Wastewater facilities, Activated sludge processes, Sludge, *Economic aspects.

A low-cost alternative to high-maintenance, mechanically complex secondary wastewater treatment systems is provided by dual-power level, multicellular aerated lagoon systems. These systems will discharge effluents low in both suspended solids and biochemical oxygen demand. Such systems consist of a first cell in which sufficient aerator power is applied to maintain all organic solids in suspension. It is followed by a series of cells, each of which is aerated at power levels that permit the settleable fraction of the suspended solids in the effluent from the first cell to settle. The concept of the dual-power level, multicellular system has been followed in the upgrading of existing faculative lagoon systems. One such system is located in a subdivision of Columbia, South Carolina. Preliminary performance data indicate that after the upgrading had been completed, only one BOD5 reading and no total suspended solids readings exceeded 30 mg/l. Most of the values were less than 20 mg/l. A typical activated sludge system where land disposal is practiced provides for conversion of wastewater components to biomass, solids separation, solids stabilization and solids storage. This last step is needed to accommodate the seasonal nature of land disposal. A dual-power level multicellular aerated lagoon system, the solids from which are also disposed of on land, is descriped. This simpler lagoon facility provides for all the steps listed above for the activated sludge system. The advantages held by the dual power level multicellular aerated lagoon systems are primarily economic. The greatest disadvantage is the lack of control over system operation. (Baker-FRC)
W82-05169

VIRGINIANS OPTIMIZE SLUDGE HANDLING,

Lynchburg Regional Wastewater Treatment Plant, VA.
M. H. Thomas.
Water/Engineering and Management, Vol 128, No 12, p 36, December, 1981. 1 Fig.

Descriptors: *Sludge, *Wastewater treatment, *Cost-benefit analysis, *Suspended solids, *Sludge cake, Economic aspects, Rainfall, Land disposal, Effluents, Sludge drying, Sludge thickening, Operating policies, Operating costs, Dewatering, *Lynchburg, Virginia.

The Lynchburg regional wastewater treatment plant in Virginia is described. It serves approximately 70,000 people. It incorporates a thermal conditioning section for the treatment and dewatering of sludge, and it also treats wastes of a paper board mill. By manning and running the thermal conditioning unit on a 24 hour schedule Monday through Friday, several economies have been achieved. Among these are savings on gas, electricity, maintenance, and personnel. In addition, transport costs are saved by eliminating week-end truck services. (Titus-FRC)
W82-05171

REMOVAL OF REFRACTORY ORGANICS FROM WATER BY AERATION. I. METHYL CHLOROFORM,

Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
T. Lionel, D. J. Wilson, and D. E. Pearson.
Separation Science and Technology, Vol 16, No 8, p 908-935, September, 1981. 22 Fig, 4 Tab, 38 Ref.

Descriptors: *Water treatment, *Aeration, Wastewater treatment, Model studies, Mathematical models, *Methyl chloroform, Chloroform, *Organic compounds, Industrial wastes.

A straightforward mathematical model is presented of an aerator apparatus used for removing volatile organics with a supernatant nonvolatile organic liquid layer. The dependence of the model's output on the physical parameters describing the system being modeled is investigated. Data on the removal of 1,1,1-trichloroethane are reported and used as a test of the mathematical model. The agreement between the observed results and the calculated curves is fairly good. The major discrepancies appear to be associated with uncertainties in the gas chromatographic analysis and with the decrease in temperature during the initial stages of the runs. These data are believed to support the mathematical model. It is noted that the only parameter in the model which is adjustable is the mass transfer rate coefficient. The experimental results are encouraging in terms of the application of the technique for wastewater and drinking water treatment. As an example, it was estimated that 3.39 volumes of air per volume of water removes about 91% of the trichloroethane when the air flow rate is 120 mL/min. At an air flow rate of 60 mL/min, 3.39 volumes of air per volume of water removes about 92% of the trichloroethane. The situation is not so favorable in the case of chloroform, since about 6.0 volumes of air are needed to remove 90% of the chloroform from water with this apparatus. The findings demonstrate the importance of having fairly small bubbles and long columns, which provide large bubble surface-to-volume ratios and long bubble-water contact times, both of which favor increased mass transfer. Solvent sublation is also able to remove nonvolatile materials from water, provided that they are surface-active. (Baker-FRC)
W82-05174

MICROBIAL REMOVAL OF HAZARDOUS ORGANIC COMPOUNDS,

Sohio Research Center, Cleveland, OH.
H. Kobayashi, and B. E. Rittmann.
Environmental Science and Technology, Vol 16, No 3, p 170A-138A, March, 1982. 6 Fig, 3 Tab, 151 Ref.

Descriptors: *Hazardous materials, *Biodegradation, Bacteria, Anaerobic bacteria, *Organic compounds, Degradation, *Wastewater treatment, Fungi, Actinomycetes.

Many microorganisms not previously considered useful for biological waste treatment could be applied to the removal of anthropogenic substances within certain broad limitations. Biological treatment can in numerous cases eliminate hazardous compounds by biotransforming them into innocuous forms, degrading them by mineralization to carbon dioxide and water, or anaerobically decomposing them to carbon dioxide and methane. In contrast to naturally occurring compounds, man-made compounds are relatively refractory to biodegradation. Many environmentally important man-made compounds are halogenated, and halogenation is often implicated as a reason for persistence. Examples of biological reductive dehalogenation are well documented. Specific groups of organisms that may be useful for treating specific types of man-made compounds are briefly discussed, including actinomycetes, fungi, bacteria, phototrophic microorganisms, anaerobic bacteria, and oligotrophic bacteria. The major issues which must be considered in attempts to improve biological treatment by use of selective types of organisms are population selection, development and retention. (Baker-FRC)
W82-05177

INFLUENCE OF TEMPERATURE ON THE ANAEROBIC ACIDIFICATION OF GLUCOSE IN A MIXED CULTURE FORMING PART OF A TWO-STAGE DIGESTION PROCESS,

Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
R. J. Zoetemeyer, P. Arnoldy, A. Cohen, and C. Boelhouwer.
Water Research, Vol 16, No 3, p 313-321, March, 1982. 11 Fig, 4 Tab, 35 Ref.

Descriptors: *Sludge digestion, *Temperature effects, Activated sludge process, Anaerobic conditions, *Anaerobic digestion, Biodegradation, Digestion, Anaerobic bacteria, Bacteria, Glucose.

The anaerobic acidification of a 1% glucose monohydrate containing medium was studied with respect to maximum dilution rate and product distribution over the temperature range of 20 to 60 degrees C. A Continuous Flow Stirred Tank Reactor inoculated with activated sludge was used for the study, allowing carbon limited growth of microorganisms. A mesophilic and a thermophilic region could be distinguished, with optimum temperatures of 37 degrees C at a dilution rate maximum of 0.51/hour and 52 degrees C with a maximum dilution rate of 0.71/hr. Optimal sludge loadings were 77 and 112 kg chemical oxygen demand/day. The gas phase consisted of carbon dioxide and hydrogen, and yield values ranged between 13.5 and 18.0% as the temperature was varied from 25 to 55 degrees C. Deviations were obtained at lower and higher temperatures. In the liquid phase, mainly acetate, propionate, butyrate, lactate and ethanol were found. Product distribution at the maximum loading rates was fairly constant in the mesophilic range, but was markely variable in the thermophilic range. Product distribution also was highly dependent on sludge loading except at high loadings. Separate acidification should be designed at mesophilic temperature below optimal temperature and at high, almost maximal sludge loadings. (Baker-FRC)
W82-05240

EXPERIENCES WITH PURIFICATION LAKES AND POLISHING LAGOONS,

Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Water Science and Technology, Vol 14, No 1/2, p 189-204, 1982. 16 Fig, 3 Tab, 11 Ref.

Descriptors: *Lakes, *Lagoons, *Tertiary wastewater treatment, Self-purification, Wastewater treatment, Ruhr River, *Germany, Wastewater lagoons, Sediment, Lake sediment, Effluents, Lake Kemnade, Lake Hengstey, Lake Kettwig, Lake Baldeney, Lake Harkort, Recreation, Algal growth, *Ruhr Valley.

Purification lakes and polishing lagoons have been successful in tertiary treatment of wastewater in the Ruhr Valley, Federal Republic of Germany. A series of 5 lakes, built along the river starting in 1929, provide low-cost primary and secondary effluent polishing as well as stormwater treatment. After 40-50 years of operation the lakes have accumulated millions of cu m of sludge, containing high concentrations of phosphate and heavy metals. In 1982 this sediment will be dredged from the river bed and placed in lagoons for dewatering and drying. Polishing lagoons have also been built to further treat effluents from older trickling filter and activated sludge plants. Generally the required 20 mg per liter BOD and 100 mg per liter COD are attained with 1-2 days retention time. An average of 55% of BOD and 31% COD are removed in

this manner. Suggestions for design and operating of lagoons are: 2 days retention time, 1-2 meters depth, ponds in series with gravel beds serving as overflows into the next pond, no lining to allow percolation, and removal of sludge as necessary. The lakes and ponds are desirable for recreation and wildlife observation. (Cassar-FRC)
W82-05241

THE RIVER TAME–A SHORT HISTORY OF WATER POLLUTION AND CONTROL WITHIN AN INDUSTRIAL RIVER BASIN,

Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5C.
W82-05242

NITROGEN CONTROL FOR THE PARTLY SEWERED BASIN OF YODO RIVER-LAKE BIWA SYSTEM,

Kyoto Univ. (Japan).
S. Iwai.
Water Science and Technology, Vol 14, No 1/2, p 215-225, 1982. 7 Fig, 7 Ref.

Descriptors: *Nitrogen removal, *Eutrophication, *Aeration, Wastewater treatment, *Yodo River, Lake Biwa, *Japan, Phosphorus removal, Model studies, Water pollution sources, Phytoplankton, Nitrification, Denitrification, Faculative denitro-aeration process, Water quality, Water pollution effects.

Water quality in the downstream reaches of the Yodo River and in Lake Biwa, Japan, has deteriorated so that their use as water supplies for 13 million inhabitants is threatened. Sources of pollution in this watershed are nightsoil, lack of sewage treatment, industries, livestock rising, and farming. A simulation process is developed for eutrophication of lake water and applied to Lake Biwa, with good agreement between calculated and observed data. Faculative Denitro-Aeration (FDA) is described for treatment of nightsoil. This consists of simultaneous BOD removal, nitrification, and denitrification with mixed liquor recycle; sedimentation with sludge recycle; nitrification followed by denitrification using methanol as a carbon source; flush aeration; and sedimentation. Recycling distances are very short. The FDA process consumes little power for pumping and can tolerate mixed liquor suspended solids up to 12,000 mg per liter. Removal rates reach 95% BOD5, 90% COD, and 95% total N. This method, with modifications, was used at the Hikone nightsoil plant to produce potable water with no coliforms, 0.4 mg per liter BOD5, 3.7 mg per liter COD, less than 1 mg per liter suspended solids, 3.46 mg per liter total N, 0.41 mg per liter total P, and 180 mg per liter chloride. (Cassar-FRC)
W82-05244

SINGLE SLUDGE NITROGEN REMOVAL FROM INDUSTRIAL WASTEWATER,

AWARE Corp., Nashville, TN.
Y. Argaman.
Water Science and Technology, Vol 14, No 1/2, p 7-20, 1982. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Industrial wastewater, *Nitrogen removal, *Activated sludge process, Wastewater treatment, Nitrification, Denitrification, Biological treatment, Ammonium, Nitrates, Kinetics, Single sludge process.

The single sludge nitrification-denitrification process is described and compared with the two-sludge system. The single sludge process does not require an external carbon source, needs less oxygen and neutralizing chemicals, but may use more pumping energy, depending on the wastewater composition. The design procedure developed in this paper uses zero order kinetics for nitrogenous substrates removal and first order kinetics for carbonaceous organics removal. Trial and error calculations yield a solution. In industrial wastewater applications acid-base equilibria are significant. Inhibition of nitrification and denitrification takes place at both high and low pH levels. Free ammonia is inhibiting at high pH and free nitrous acid at low pH. Nitrification destroys alkalinity, and denitrification forms alkalinity. A bench-scale continuous flow run of an amino acid industrial wastewater containing 6360 mg per liter BOD and 1625 mg per liter total Kjeldahl nitrogen (TKN) produced an effluent with 24 mg per liter BOD and 265 mg per liter TKN. Full-scale operations of a ditch-type system using a combined pharmaceutical-pesticides-herbicides wastewater (influent BOD 800-1100 mg per liter, ammonia-N 32-126 mg per liter) produced a good quality effluent (8-13 mg per liter BOD, 0-18 mg per liter ammonia-N, and 2-7.2 mg per liter nitrate). (Cassar-FRC)
W82-05245

A RELIABLE DISSOLVED OXYGEN PROBE FOR WASTE WATER TREATMENT PLANTS,

For primary bibliographic entry see Field 7B.
W82-05248

HOW THE TYNE WAS SAVED. DUKE OF EDINBURGH OPENS 120 MILLION POUND STERLING SCHEME.

Water and Waste Treatment, Vol 24, No 12, p 22-24, December, 1981. 5 Fig.

Descriptors: *Wastewater treatment facilities, *Design considerations, Wastewater treatment, Construction, *Tyne River, Rivers, England, Hydrogen sulfide, Sludge, Activated sludge process, Primary wastewater treatment, *Odor control.

An innovative manner of dealing with hydrogen sulfide emissions at the Tyneside Sewage Treatment Scheme involves the measured introduction of oxygen. The plan has attracted considerable international interest, as have the remote monitoring arrangements for the sewers and the treatment works of this scheme. Twenty-five miles of interceptor sewers have been built, out of the eventual total of 45 miles, and now most of the main sewers on both banks of the east of the Tyne Bridge section are completed. The total length of sewers in the completed scheme will be about 75 km, varying in internal diameter between 0.45 and 3 meters. The system is designed so that most of the sewage flows by gravity, but in some places pumping stations have had to be built to lift the sewage from low lying areas. Primary treatment is expected to be sufficient to maintain the Tyne estuary in a healthy state, but if the sewage load should increase or a higher standard of river water quality is needed in the future, enough land is available on the site for further treatment. (Baker-FRC)
W82-05249

CONTAINMENT AND TREATMENT OF THE LOVE CANAL LANDFILL LEACHATE,

Niagara Falls Wastewater Treatment Plant, New York.
W. J. McDougall, R. A. Fusco, and R. P. O'Brien.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2914-2924, December, 1980. 7 Fig, 7 Tab, 4 Ref.

Descriptors: *Landfills, *Leachates, *Organic compounds, *Activated carbon, Priority pollutants, Wastewater treatment, Adsorption, *Love Canal, *New York, Path of pollutants, Chemical wastes, Chlorinated hydrocarbons.

The leachate containment and collection system built at the Love Canal chemical landfill site near Niagara Falls, New York are described. At this site, rainwater entered the top layer of permeable soil, carrying contaminants laterally. In the southern sector of the dump area an impervious clay cap was constructed to minimize surface water entrance. A perimeter drain tile collection system of 8 inch perforated pipe, 10-15 ft deep, carried the leachate to pumping stations, where the contaminated water was fed to an activated carbon treatment system. The temporary 2-stage adsorption system installed held a full truckload of 20,000 pounds of granular carbon in each vessel and processed 175 gal per min of wastewater. Spent carbon was transferred to an empty truck for reactivation at another site, and the empty vessel was refilled with a fresh truckload of carbon. All carbon transfers were handled in a closed system to prevent workers' exposure to the spent carbon. Assessment of the treatment showed a removal rate of nearly 100% for some of the 80 organic compounds identified in the leachate. Only 67% of the methylene chloride was removed. A permanent carbon system was started up in December 1979. This has continued to operate satisfactorily according to specifications. (Cassar-FRC)
W82-05250

PERFORMANCE OF A LARGE ADVANCED WASTE TREATMENT PLANT,

Alvord, Burdick and Howson, Chicago, IL.
D. E. Eckmann, and H. S. Zimmerman.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2717-2725, November, 1980. 7 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Evaluation, Advanced wastewater treatment, *Wastewater facilities, Reservoirs, Eutrophication, Water pollution sources, *Water pollution prevention, Roanoke; *Virginia, *Smith Mountain Lake.

A dam was built on the Roanoke River to create Smith Mountain Lake in southwest Virginia in the 1960s. This lake is one of the finest recreational reservoirs in southwest Virginia. The state determined that the Roanoke Sewage Treatment Plant, which is located upstream from the dam, had to be upgraded to control eutrophication of the lake. A 132 Ml/d advanced wastewater treatment plant was built for about $28 million, and has been in operation for more than one year. It has at times treated flows of over 227 Ml/d (60 mgd) and on an annual average has produced the following quality effluent: biochemical oxygen demand 1.8 mg/l, suspended solids 0.8 mg/l, phosphorus 0.1 mg/l, total Kjeldahl nitrogen 0.2 mg/l, and fecal coliforms 2.8/100 ml. The plant consists of the activated sludge process followed by nitrification, flocculation, coagulation, filtration, and disinfection facilities. The quality of the effluent under average and maximum conditions, the effect of each process upon the overall treatment, amount of sludge generated, chemicals used, and other major parameters of each process are presented with special emphasis on filtration as well as construction and operating costs. (Baker-FRC)
W82-05251

MICROBIAL ECOSYSTEMS RESPONSIBLE FOR ANAEROBIC DIGESTION AND COMPOSTING,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5E.
W82-05252

SHOCK LOAD OF CHROMIUM (VI),

Mankato State Univ., MN.
R. C. Henney, M. C. Fralish, and W. V. Lacina.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2755-2760, November, 1980. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Chromium, *Activated sludge process, Sludge, *Wastewater treatment, Industrial wastewater, Biological wastewater treatment, Microorganisms, Bacteria, Chemical spills, Electroplating.

A spill of about 227 kg of chromium(VI) from a slowly overflowing electroplating tank into the collection system of the Mankato, Minnesota 38,000 cubic meter/day (10 mgd) activated sludge plant occurring on October 23-24, 1977, precipitated this study. Automatic samplers at the wastewater treatment plant sampled the influent and effluent before, during, and after the spill along with additional grab samples from various plant units. The greatest effect of the chromium(VI) on the activated sludge process was seen in the aeration tanks, where the activity of the organisms was severely, but only temporarily, depressed. The greater part of the shock load of chromium(VI) passed through the plant with the wastewater. Chromium(VI) was removed by wastewater treatment processes only to the extent that it was reduced to chromium(III), a process

that depended on the concentration of dichromate as well as the acidity and the concentration of reducing substances. Chromium(III), being insoluble at the normal acidity range of the wastewater, remained largely in the plant adsorbed onto the sludge particles, but in moderate amounts was apparently not harmful either to the processes in the aeration tank or to those in the digesters. Since the chromium(III) ended up in the finished sludge, the disposal of the sludge must be monitored. (Baker-FRC)
W82-05253

NITRIFICATION IN THE SEQUENCING BATCH BIOLOGICAL REACTOR,

Maryland Univ., College Park. Dept. of Civil Engineering.
J. E. Alleman, and R. L. Irvine.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2747-2754, November, 1980. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Nitrification, *Biological wastewater treatment, *Wastewater treatment, *Sludge, Bacteria, Nitrates, Oxidation, Acidity.

Studies were conducted to demonstrate the potential of the sequencing batch reactor to maintain combined organic carbon oxidation and nitrification. Using a synthetic, high-strength waste input, a bench-scale sequencing batch reactor (SBR) consistently discharged a good quality effluent, with 98+% oxidation of both the organic carbon and nitrogen components. A high quality discharge was maintained over a 2 month period. Sludge settleability was extremely good, producing a clear effluent with suspended solids averaging 6 mg/l. Sludge Volume Index measurements remained steady at 85 to 95. There was no indication of the pin floc and/or transient settling abnormalities that have been known to plague the low loading PCSTR-nitrification systems. Sequential exposure to periods of reduced oxygen tension had no apparent effect on the activity of the nitrifying bacteria. A depression in alkalinity did occur during the nitrification period, although the extent of the reduction was markedly less than the stoichiometric rate based on proton release through ammonium oxidation. Overall, the sequencing batch reactor unequivocally demonstrated a capacity for combined oxidation of organic carbon and nitrogen. The SBR design also provided a unique opportunity to follow the metabolism of the substrate species during the React phase. (Baker-FRC)
W82-05254

A SURVEY OF PHOSPHORUS REMOVAL IN LOWER GREAT LAKES MUNICIPAL TREATMENT PLANTS,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
M. S. Switzenbaum, J. V. DePinto, T. C. Young, and J. K. Edzwald.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2628-2633, November, 1980. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Effluent limitations, *Phosphorus removal, *Great Lakes, *Municipal wastewater, *Chemical coagulation, Phosphorus, Water quality standards, Lakes, Wastewater treatment, Surveys, Water quality control, Chemical treatment, Lake Erie basin, Lake Ontario basin.

A questionnaire was sent to 229 municipal wastewater treatment plants in the Lake Erie and Lake Ontario basins with effluent flows greater than 3,785 cu m/day. Results of the survey showed that the approach most commonly used to comply with the 1978 Great Lakes Water Quality Agreement for phosphorus was the addition of iron or aluminum salts to the wastewater during secondary treatment. Currently 52% of the treatment facilities surveyed have effluent total P levels of less than or equal to 1.0 mg/l. Total P loadings to the two lakes were determined. It was estimated that a 0.5-mg/l P effluent standard alone would not be sufficient to achieve the International Joint Commission target loads of 11,000 and 7,000 metric tons/year for Lake Erie and Lake Ontario, respectively. (Geiger-FRC)
W82-05256

RELATIVE HEALTH RISKS OF ACTIVATED SLUDGE TREATMENT AND SLOW-RATE LAND TREATMENT,

Metcalf and Eddy, Inc., Palo Alto, CA.
A. Uiga, and R. W. Crites.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2865-2874, December, 1980. 12 Tab, 24 Ref.

Descriptors: *Risks, *Land application, *Activated sludge process, Public health, Wastewater treatment, Wastewater irrigation, *Wastewater disposal, Lagoons, Aerosols, Viruses, Bacteria, Pathogens, Metals, Organic compounds, Sludge treatment, Sludge disposal.

The potential health effects of two wastewater treatment systems--activated sludge with effluent discharge to surface water and slow-rate land application-- are compared. Evaluation considers contact intensity (physical, aerosol inhalation, accidental ingestion, and potable ingestion) and contact duration. Both systems, if properly maintained, minimize health risks. Slow-rate land treatment offers greater protection against parasites and viruses, trace metals, nitrates, and trace organics and is less susceptible to process upsets. Workers at treatment facilities may be exposed to infectious agents via aerosol inhalation and incidental contact, but the health risks are no greater than for the general public. Wastewater irrigation of non-food crops is safer than irrigation of food crops. Health hazards from trace metals and trace organics are difficult to evaluate. Some of the differences in health risks are a result of the high concentration of the sludge versus the more dilute and more widely dispersed wastewater applied to land. (Cassar-FRC)
W82-05258

ION-PRECIPITATE FLOTATION OF IRON-CYANIDE COMPLEXES,

International Nickel Inc., Sterling Forest, NY.
R. O. Bucsh, D. J. Spottiswood, and G. W. Lower.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2925-2930, December, 1980. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Cyanide, *Metal-finishing wastes, *Flotation, Surfactants, *Wastewater treatment, Iron compounds, Ferrocyanide, Ferricyanide, *Separation techniques.

Removal of cyanide, ferrocyanide, and ferricyanide ions from wastewaters was accomplished by an ion-precipitate flotation process. Tricaprylmethyl ammonium chloride, a surfactant, combined with cyanide ions to form a waxy material. This substance rose to the surface during air flotation. Average recoveries of the three ions were: cyanide, 28%; ferrocyanide, 73%; and ferricyanide, 71%. Process variables were studied, using ferricyanide for most experiments. Recovery of ferricyanide increased with surfactant dosage to 1.25 times the stochiometric amount of surfactant. Chloride ion decreased the critical micelle concentration; up to 1.5 stochiometric multiples of surfactant, more ferricyanide was removed without chloride than in the presence of chloride. Removal decreased with feed flow rate increases up to about 500 ml per min, and became constant at higher flow rates. An air flow rate above 3 liters per min caused a sharp drop in removal of ferricyanide. Ferricyanide at concentrations < 15 ppm was poorly removed because wax moelcules were too few to agglomerate and float. The concentration-recovery curve leveled off at about 30 ppm. Although pH slightly decreased removal at pH 7-10, recovery was acceptable over the range 4-10 pH. (Cassar-FRC)
W82-05259

CONTROL OF SLUDGE BULKING IN THE BREWING INDUSTRY,

Sverdrup and Parcel and Associates, Inc., St. Louis, MO.
H. G. Schwartz, Jr., T. Popowchak, and K. Becker.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2977-2993, December, 1980. 11 Fig, 6 Tab, 16 Ref.

Descriptors: *Fermentation, *Sludge bulking, *Process control, Wastewater treatment, Industrial wastewater, *Activated sludge process, Carbohydrates, Shock loads, Organic loading, Dissolved oxygen, Oxygen, Nutrients, Chlorination, Hydrogen peroxide, Oxidation, *Brewing industry.

The Miller Brewing Company wastewater treatment plant at Fulton, New York, suffered two extended periods of filamentous sludge bulking and solids loss during the first two years of operation. These incidents (September 1976 to February 1977 and November 1977 to April 1978) presented opportunities for evaluating control methods. The single most cirtical factor in maintaining a healthy mixed microbial population was adequate dissolved oxygen, no less than 2 mg per liter, throughout the aeration basin. In addition, nitrogen, phosphorus, and possibly iron were essential nutrients. The activated sludge system, operating with variable strength, high carbohydrate wastes, required careful monitoring and control to equalize waste loads. On one occasion a shock load of caustic cleaning solution and disinfectants destroyed the microbial population. A plant information program was prepared to educate plant personnel about the harmful effects of shock loads and toxic substances. When settleability dropped and sludge blankets rose, immediate treatment with 10-20 mg per liter cationic polymers allowed restabilization. Chlorination and hydrogen peroxide additions were ineffective in reducing sludge bulking at this plant. Since conditions that lead to sludge bulking take several weeks to develop, corrective measures usually requie several weeks to be effective. Since the latest recovery period, effluents from the treatment plant have met discharge permit standards. (Cassar-FRC)
W82-05260

ULTRA-HIGH-RATE FILTRATION OF RAW AND COMBINED SEWER OVERFLOWS,

Environmental Protection Agency, New York.
H. Innerfeld, and D. Ruggiero.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2931-2945, December, 1980. 2 Fig, 12 Tab, 1 Ref.

Descriptors: *Combined sewer overflows, *Filtration, *Wastewater treatment, High rate filtration, Suspended solids, Biological oxygen demand, Chemical oxygen demand, Alum, Polyelectrolytes, Settleable solids, Backwash, *Newton Creek Water Pollution Control Plant, *New York City.

Combined sewer overflows (CSO) and raw dry weather wastewater flows (RDWWW) were treated by ultrahigh-rate filtration at a pilot plant located in New York City's Newtown Creek Water Pollution Control Plant. The 760 mm diameter filter column contained 1.5 m of No 3 anthracite above 760 mm of No 612 sand on a 460 mm gravel base. CSO treatment at 11 liters per sq m per sec removed suspended solids at an average of 62% across the filter and 66% across the system. BOD removals were 32% and COD removals 40%. Polymer and alum additions improved removals to 38% for BOD and 50% for COD. Treatment of RDWWW at 5.4 liters per sq m per sec produced suspended solids removals of 67% across the filter and 70% across the system, BOD removals of 33%, and COD removals of 32% across the filter. Addition of polymers improved performance to 39% for BOD and 34% for COD at flow of 8.1 liters per sq m per sec. Use of polymers plus alum did not improve filtration further. Since % removals of suspended solids are dependent on the strength of influent flows, the filtration system should be rated on the basis of total solids captured per unit filter area. This should be at least 15.1 kg per sq m for RDWWW and 22.0 kg per sq m for CSO. Settleable solids were removed to an extent of 95% or greater, but dissolved materials were not removed. (Cassar-FRC)
W82-05266

MATHEMATICAL MODEL OF SEQUENTIAL LOADING IN FIXED-BED ADSORBERS,

Michigan Technological Univ., Houghton.
J. C. Crittenden, B. W. C. Wong, W. E. Thacker, and R. L. Hinrichs.

Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2780-2795, November, 1980. 5 Fig, 1 Tab, 43 Ref.

Descriptors: *Model studies, *Adsorption, *Wastewater treatment, Mathematical models, Water treatment, Water quality, Organic compounds, Adsorbents.

This work is part of a continuing effort to develop a model that accurately predicts the organic removal efficiency of fixed-bed adsorption systems. The model will be useful to the design engineer in the designing of adsorbent systems which minimize the possibility of chromatographic desorption of weakly adsorbed toxics, in the selection of adsorber design likely to yield the best quality effluent at the least cost, and in the selection of adsorbents based on relatively simple and quick batch tests. The focus of the study was on the development of a model able to predict displacement or chromatographic effects. The model described predicts the concentration history profiles of binary mixtures with time-variant influent feed conditions. Mass balance relationships within the column in the axial direction and within the adsorbent particles in the radial direction that incorporate Fick's Law for the intraparticle surface diffusion flux and film transfer for the liquid-phase diffusion flux were the conceptual basis of the model. Orthogonal collocation was used to solve the model equations. Model predictions were compared to column data for these two time-variant influent conditions: the non-key component was fed until the adsorber was exhausted and then both adsorbates were fed until the adsorber was exhausted with respect to the key component; and the reverse loading order. These comparisons represented a verification of the model for sequential influent loadings and for single solute adsorption because good agreement between model predictions and data was found and because parameters used in the model were obtained from independent tests. (Baker-FRC)
W82-05269

PHOSPHORUS AND NITROGEN REMOVAL AT CADILLAC, MICHIGAN,

Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI.
A. K. Singhal.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2761-2770, November, 1980. 7 Fig, 8 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Water pollution control, Phosphorus, *Phosphorus removal, *Nitrogen removal, Suspended solids, Alkalinity, Acidity, Advanced wastewater treatment, *Cadillac, Michigan.

The advanced wastewater treatment at the Cadillac, Michigan treatment facility all but eliminates pollution to the receiving stream, the Clam River, thus allowing recreational use of the waters without endangering public health. The plant is able to meet stringent state and federal treatment requirements with overall removals of greater than 97% biochemical oxygen demand (BOD), 96% suspended solids (SS), 92.5% ammonia nitrogen, and 80% phosphorus. Experience at the plant indicates that an aeration system can be effectively used for phosphorus removal provided the air quantity after addition of ferric chloride or alum is properly adjusted to provide velocity gradients of around 50/sec. Equations are presented which can be used to estimate the air requirements for any given plant. The design of an aeration system piping should make provisions for monitoring the air input into the portion of the system being used for phosphorus removal by using air-flow metering devices. Attached biological growth systems using rotating biological contactors (RBC) can be successfully used for ammonia nitrogen removal from secondary effluent. Consistent BOD and SS removal are obtained by using rapid sand filters at the end of the RBC units. There does not appear to be a need for a clarifier between the RBC and tertiary sand filters in a system treating secondary effluent. Design of a nitrification system should take into account the impact of various parameters such as alkalinity of the influent wastewater and impact of ammonia nitrogen loading and provide for potential accumulation of heavy metals in the attached growth systems. (Baker-FRC)
W82-05270

COMPREHENSIVE ANALYSIS OF NITRIFICATION OF CHEMICAL PROCESSING WASTEWATERS,

Engineering-Science Inc., Austin, TX.
D. L. Ford, R. L. Churchwell, and J. W. Kachtick.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2726-2746, November, 1980. 16 Fig, 4 Tab, 33 Ref.

Descriptors: *Industrial wastewater, *Nitrification, Chemical analysis, Ammonia, *Wastewater treatment, *Biological processes, Microorganisms, *Huston, Texas.

To determine the feasibility of enchancing biological nitrification of the wastewater discharged from the Tenneco Chemicals plant in Houston, Texas, a series of comprehensive bench-scale treatability studies was undertaken. Throughout the program an extensive effort was made to isolate and quantify Nitrobacher and Nitrosomonas. The fraction of viable bacteria that these autotrophs represented in the mixed liquor was then correlated with specific system variables such as ammonia-nitrogen loading, resultant-fee ammonia and free nitrous acid concentrations and specific ammonia removal. The study was divided into two parts. In the first part a control reactor with an aeration and side-stream reaeration system evaluation was used. The second study concerned a control reactor with a two-stage aeration system evaluation. Biological nitrification did not change organic removal capacity of the biological reactors. Data showed that free ammonia concentrations of 30 mg/l or higher may be inhibitory to Nitrosomonas. Free nitrous acid concentrations from 0.28 to 1.0 mg/l tended to inhibit Nitrobacher, resulting in nitrite accumulation. (Baker-FRC)
W82-05271

USE OF BENCH-SCALE DIGESTERS TO EVALUATE FULL-SCALE DIGESTER PERFORMANCE,

C. M. Engineering Associates, Vista, CA.
J. S. Murk, J. L. Frieling, L. D. Tortorici, and C. C. Dietrich.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2709-2716, November, 1980. 8 Fig, 2 Tab.

Descriptors: *Digestion, *Evaluation, *Wastewater treatment, Wastewater facilities, *Anaerobic digestion, Laboratory studies, Performance evaluation, Monitoring, *Encina Water Pollution Control Facility, California.

A large municipal wastewater treatment plant in Southern California was used to demonstrate the reliability and accuracy of laboratory scale pilot digesters to duplicate and predict the performance of full scale anaerobic digester. Three 28 liter bench scale digesters were fabricated and operated at the Encina Water Pollution Control Facility, a 52,040 cubic meter/day regional wastewater treatment plant in North San Diego County, to help overcome a chronic operational problem with foaming digesters. These bench scale anaerobic digestion studies have afforded an economical, reliable, and simple approach to determining the causes for digester foaming. By this inexpensive technique, design and operational changes have been implemented, providing improved digester performance and unhampered operation. Properly designed laboratory scale digesters can greatly assist in controlling and maintaining anaerobic digester performance and determining at little cost the reasons for process inefficiencies. (Baker-FRC)
W82-05272

DEVELOPMENT OF EVALUATION OF ION-EXCHANGE RESINS FOR REMOVAL OF SPECIFIC METALS IN WATER TREATMENT,

West Virginia Univ. Morgantown. Water Research Inst.
For primary bibliographic entry see Field 5F.
W82-05282

LOW PRESSURE MEMBRANE SEPARATION PROCESS TO REMOVE HEAVY METAL COMPLEXES,

Kentucky Water Resources Research Inst., Lexington.
D. Bhattacharyya, and C-S. Cheng.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224619, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 129, September 1981. 142 p, 42 Fig, 16 Tab, 35 Ref. OWRT B-059-KY(1), 14-34-0001-9073.

Descriptors: *Heavy metals, *Membrane processes, *Wastewater treatment, Chelation, *Chelating agents, *Ultrafiltration, Charged membrane ultrafiltration, Donnan Exlusion, Rejection model, Complex species, EDTA, Oxalates, Cyanide, Zinc, Copper, Cadmium, *Separation techniques.

The rejection behavior of heavy metals was established in the presence of complexing agents, utilizing negatively charged ultrafiltration membranes. An extensive experimental investigation was conducted with Zn, Cd, and Cu, in the presence of cyanide, ethylenediamine tetraacetic acid, and oxalates, under insignificant concentration polarization condition. The rejection dependence of the heavy metals was found to be a function of feed metal concentration, metal types, complexing agent to metal feed molar ratio, pH and ionic strength. The dependence of rejection behavior of heavy metals and complexing agents on pH concentration is explained in terms of metal complex species distribution and Donnan Exclusion model. For EDTA and oxalate systems, the rejections of metal are independent of initial metal concentration; whereas for the cyanide system the rejections of both metal and cyanide decrease with concentration. At transmembrane pressure of 5.6 x 10 to the fifth power N/sq m, metal rejections range between 77% and 96%. For all cases, the rejection of metal is highly dependent on the size and charge of the complex metal species.
W82-05284

FILTRATION PERFORMANCE IN WATER AND WASTEWATER TREATMENT: THEORY AND MEASUREMENT,

Wright-Pierce Architects/Engineers, Portsmouth, NH.
J. E. Tobiason, and C. R. O'Melia.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224627, Price codes: A07 in paper copy, A01 microfiche. Report No 172, March 1982, 110 p, 28 Fig, 5 Tab, 60 Ref. 2 Append. OWRT A-104-NC(2), 14-34-0001-9035.

Descriptors: Sand filters, Soil filters, Mathematical models, *Filter performance, *Flocculation, *Filtration, Filter media, Filter rate, *Wastewater treatment, *Particle size, Granular filter, Filter theory, Filter ripening.

An earlier model for filter ripening, designed to predict changes in effluent quality and head loss with time as filtration proceeds, was extended and applied. Reasonable agreement was found between observed and predicted filtrate quality. Head loss predictions are quantitatively similar to observations but are generally lower. Suspensions containing small particles produce more head loss than suspensions of larger particles when the comparison is based on equivalent masses of solids removed by the filters. Particles smaller than a few microns in size are particularly troublesome in this regard. This indicates that flocculation prior to filtration is important when direct filtration is considered, particularly when submicron sized particles are to be treated. Additional important effects have been noted for the concentration of solids applied to a filter and, as noted by others, for the chemistry of the pretreatment processes. High concentrations of suspended solids are observed to produce more head loss than lower concentrations.
W82-05285

RETENTION OF URBAN DERIVED PHOSPHORUS BY AN ALLUVIAL SWAMP OF THE COASTAL PLAIN OF GEORGIA,

Georgia Southwestern Coll., Americus. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-05286

CHARACTERIZATION, RENOVATION, AND UTILIZATION OF WATER FROM SLURRY TRANSPORT SYSTEMS,

Missouri Water Resources Research Center, Columbia.
S. E. Manahan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224668, Price codes: A02 in paper copy, A01 in microfiche. Report, February 1982. 22 p, 10 Fig. OWRT B-145-MO(2), 14-34-0001-0228.

Descriptors: *Slurries, *Chromium, *Coal, Water exchange, *Sorption, Heavy metals, Baseline studies, Water use, Water conveyance, Water carrying capacity, Water transport, Energy sources, Resources management, Water management, Industrial water, Industrial development, Chemical properties, Corrosion control, *Wastewater renovation.

An understanding of water-solid interactions under slurry conditions is needed in order to characterize, renovate, and utilize water from slurry transport systems. To address this need, study emphasis was placed on two major considerations: water interchange between the suspending medium and the coal and coal-derived solids; and the interaction of coal and coal-derived solids with chromium (VI), or chromate, an anticorrosive agent that may be used in coal slurries. Materials used in these investigations were prepared in laboratory-scale operations from ground and sieved Wyoming subbituminous coal. Water interchange was studied in experiments using radiolabelled tritiated water. Sorptin of chromium (VI) by solids was studied in slurries containing 10 g of damp solid and 10 ml of chromate solution as a function of pH. The study results indicated that coal and coal-derived solids have a strong affinity for certain solutes in water, such as chromate, with (generally) a rapid instantaneous sorption of a fraction of the solute occurring. Water interchange study indicated that part of this rapid sorption may be due to exchange of exchangeable water in initially moist solids. The methodology employed here and the concept of exchangeable water and its dilution effect should be useful in future studies of coal-water interactions. (Zielinski-MAXIMA)
W82-05289

STUDIES OF NITRIFICATION IN A COKE-WASTE ACTIVATED SLUDGE PROCESS,

Alabama Univ., Birmingham. Dept. of Biology.
D. D. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224700, Price codes: A04 in paper copy, A01 in microfiche. Report, September 1981. 27 p, 8 Fig, 10 Tab, 22 Ref. OWRT A-075-ALA(2), 14-34-0001-0101.

Descriptors: *Nitrification, *Bacteria, *Activated sludge process, *Coal, *Industrial wastewater, Activated sludge, Fluorescence, Microbial degradation, Industrial wastes, Refinery wastes, Ammonia, Biodegradation, Sludge digestion, Bioassay, Biological wastewater treatment, Baseline studies.

Studies were carried out to assess the effects of environmental conditions on the activity of nitrifying bacteria in a coke-waste activated sludge process using samples of mixed liquor obtained from bench-scale reactors handling wastewater from a commercial Alabama coke plant. Using a fluorescent-antibody technique which could provide reliable estimates of the number of nitrifiers within a few hours, it was found that coke-plant mixed liquor contains about four orders of magnitude more Nitrosomonas (N) cells than shown by MPN (most probable number) estimates. It was also determined that N comprises about 2% of the total cells in the liquor at 25 day solids retention tines (SRT) or greater, and about 1% at 4.2 days SRT. Correlations between effluent ammonia and N population dynamics indicated that the ammonia removal rate in the liquor is affected by both the number of nitrifiers and the activity/cell. Experimentation using an in vitro measure of the nitrifying ability of the liquor defined the tolerance limits of nitrifiers to a variety of physical and nutritional conditions. (Zielinski-MAXIMA)
W82-05295

HEAT LOSS FROM RAPID INFILTRATION BASIN IN WINTER,

Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
H. G. Stefan.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 141-158, February, 1982. 7 Fig, 11 Ref.

Descriptors: *Infiltration, *Heat flow, Model studies, Basins, Groundwater, *Leaching, Percolation, Mathematical studies, Seasonal variations, Temperature effects, Economic aspects, Wastewater treatment, *Wastewater facilites.

A heat budget analysis is presented for a rapid wastewater infiltration/percolation basin to be operated at air temperatures below zero degrees C. In a rapid infiltration basin, the unchlorinated secondary effluent from a wastewater treatment plant is discharged onto the ground by flooding. Rapid infiltration basins return water to the groundwater table and provide a form of tertiary treatment. For small communities in cold climates, the year-round operation of infiltration basins without major storage requirement is economicaly attractive. The heat exchange processes associated with such a winter operation are analyzed herein with a view toward design applications. The analysis is theoretical and considers two modes of operation, one with a permanent ice cover on the basin and one without. The loading of the infiltration basin is intermittent. The analysis provides a complete heat budget. The equations are expressed in a form which permits estimation of frequency of loading of a basin as a function of loading depth. Heat losses to the atmosphere, formation of an ice cover, and cyclic freezing and thawing of the soil are included in the analysis. (Baker-FRC)
W82-05317

INTERNATIONAL NUTRIENT CONTROL TECHNOLOGY FOR MUNICIPAL EFFLUENTS,

Municipal Environmental Research Lab., Cincinnati, OH.
E. F. Barth, and H. D. Stensel.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1691-1701, December, 1981. 4 Fig, 8 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Phosphorus removal, *Nitrification, *Nitrogen removal, Nutrients, *Municipal wastewater, Cost analysis, Wastewater facilities.

The U.S. Environmental Protection Agency sponsored an 'International Seminar on Control of Nutrients in Municipal Wastewater Effluents' in September, 1980. This seminar reviewed nutrient control technology and needs for Canada, Japan, Sweden, Austria, Australia, Switzerland, and the United States. Design aspects, performance, operating characteristics, and costs associated with various full-scale systems for phosphorus removal, nitrification, and nitrogen removal were discussed. Chemical treatment is the most commonly used method for removing phosphorus from municipal wastewater, although biochemical and biological treatment systems are also in use. In some areas, laws requiring the use of low-phosphorus detergents reduce the costs of phosphorus removal. Full-scale nitrification systems discussed included single-stage and two-stage activated sludge nitrification systems and fixed-film processes such as plastic media trickling filters and rotating biological contactors. Full-scale nitrogen removal systems examined included oxidation ditch systems, and alternating aerobic and anoxic single-stage system, the Bardenpho system, a tertiary denitrication filter with methanol addition, a continuous-flow sequentially aerated activated sludge system, an overland flow system, and a clinoptilolite selective ion-exchange system. The capital cost and operating and maintenance costs for the facilities for removing phosphorus and nitrogen from wastewater varied over a wide range due to differences in design and operation and in effluent requirements. (Carroll-FRC)
W82-05321

INHIBITION OF NITROGENOUS BOD AND TREATMENT PLANT PERFORMANCE EVALUATION,

Iowa Univ., Iowa City. Coll. of Engineering.
R. E. Dague.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1738-1741, December, 1981. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Biochemical oxygen demand, *Wastewater facilities, *Nitrification, Wastewater treatment, *Performance evaluation, Secondary wastewater treatment, Effluent standards.

The importance of considering carbonaceous and nitrogenous oxygen demands separately in evaluating the performance of wastewater treatment plants is discussed. In several cases, state regulatory agencies and/or the U.S. Environmental Protection Agency have refused to accept the inhibited (carbonaceous) 5-day biochemical oxygen demand (BOD) test as the basis for interpreting plant performance. In these cases it is difficult, if not impossible, for treatment facilities achieving partial nitrification to meet the 5-day BOD performance criteria for secondary treatment (average 5-day BOD of 30 milligrams per liter). Treatment plants which are partially nitrifying will have nitrifying bacteria associated with the volatile suspended solids in the effluent. As a result, the effluent BOD will be increased due to nitrification occurring during the standard 5-day test. Although these treatment plants would actually be removing more total BOD, they would display a higher effluent 5-day BOD than plants treating an identical wastewater but not achieving partial nitrification. It is suggested that errors resulting from the use of the standard uninhibited BOD test may result in the selection of inferior treatment processes and systems or in the penalization of treatment facilities providing superior treatment through partial nitrification. (Carroll-FRC)
W82-05323

ECONOMICAL AND EFFICIENT PHOSPHORUS CONTROL AT A DOMESTIC-INDUSTRIAL WASTEWATER PLANT,

D. Van Dam.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1732-1737, December, 1981. 2 Fig, 5 Tab.

Descriptors: *Wastewater treatment, *Phosphorus removal, Wastewater facilities, *Municipal wastewater, Industrial wastewater, Activated sludge process, Operating costs, Grand Haven, Spring Lake, *Michigan.

The towns of Grand Haven and Spring Lake, Michigan, formed a combined sewer authority and began planning a new central wastewater treatment facility in 1968. The treatment plant was designed to process both domestic wastes and a substantial volume of wastewater from a chrome and vegetable tannery. The treatment plant employs grit removal, phosphorus removal, primary clarification, and activated sludge and chlorine contact and conditions solids thermally prior to vacuum filtration. The tannery contributes about 18% of the total flow, but 80% of the suspended solids and biological oxygen demand. Suspended solids and biological oxygen demand removals have consistently been above 90%. The final effluent phosphorus concentration has been under 1.0 milligrams per liter, representing removal rates over 80%. This successful control of phosphorus in the effluent has been achieved by adding waste pickle liquor to the primary settling tank. This waste pickle liquor is obtained from steel mills in Gary, Indiana. No flocculating aids are necessary. It is necessary to add much larger amounts of this

iron solution when the tannery wastes are limited or not present than when they are present in considerable amounts. As a result, analyses are made on daily composite wastewater samples, and the iron feed is adjusted based on the previous day's operating results. (Carroll-FRC)
W82-05324

THE USE OF CONTAINER-REARED CULTURES OF CLADOCERA IN POLISHING FISH FARM EFFLUENTS,

Vsesoyuznyi Nauchno-Issledovatelskii Inst. Prudovogo Rybnogo Khozialstva Rybnoe (USSR).
I. B. Bogatova, and Z. I. Yerofeyeva.
Hydrobiological Journal, Vol 16, No 5, p 56-61, 1980. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Zooplankton, *Biofilters, *Fish farming, Daphnia, Cladocerans, Wastewater treatment, Invertebrates, Biological treatment, Organic matter, Settling tanks.

Mesh containers of cladocerans were immersed in fish farm waste settling tanks to remove excess organic matter before discharging the effluent into receiving waters. Daphnia magna, Moina macrocopa, Ceriodaphnia reticulata, and D. magna plus C. reticulata were used in 5 to 11 containers per pond, arranged in checkerboard fashion or longitudinally. Best results were obtained with Daphnia magna in 10 containers arranged in checkerboard order. Settling tanks with zooplankton had lower levels (19.1-24.5%) of organic matter in the sediment than the control (27.5%). Total nitrogen content and total phosphorus content were lower in tanks with cladocerans. Ammonia-N was increased. Adding the cladocerans to the tanks without enclosing them in containers was unsuccessful because fish escaped from the farm ponds into the settling tanks and ate large quantities of cladocerans. (Cassar-FRC)
W82-05327

BACTERICIDAL AGENTS IN WASTEWATER LAGOONS AND LAGOON DESIGN,

Idaho Div. of Environment, Pocatello.
J. R. Moeller, and J. Calkins.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2442-2451, October, 1980. 5 Fig, 4 Tab, 27 Ref.

Descriptors: *Coliforms, *Ultraviolet radiation, *Design criteria, Bacteria, *Wastewater lagoons, Wastewater treatment, Lagoons, Chlorination, Disinfection, Irradiation, Hydrogen ion concentration, Activated sludge process, West Hickman Creek Wastewater Treatment Facility, *Kentucky.

A study was conducted at the West Hickman Creek Wastewater Treatment Facility, located on the Jessamine County-Fayette County line in Kentucky on West Hickman Creek. Treatment at this plant includes the Kraus modification of the activated sludge process, secondary treatment, four tertiary lagoons, and disinfection by chlorination just prior to discharge. The study was designed to determine more clearly the role of solar ultraviolet radiation in the destruction of coliform bacteria. Coliform concentrations were measured in each of the four lagoons. A close correlation between pH and coliform reduction was noted in earlier studies, but since the pH in the West Hickman lagoon system rarely exceeded 8.5, it is doubtful that this was a factor in coliform survival at this facility. Nutrient loading in terms of ortho-phosphorus, total phosphorus, and total Kjeldahl nitrogen remained essentially constant for the duration of the study, although total Kjeldahl nitrogen concentrations became erratic and increased by about 50% during the last 2 months of the study. Coliform densities were generally higher during winter than in summer. Declining doses of ultraviolet light in autumn may have partially contributed to the increase. It is also likely that the increase resulted from cessation of lagoon chlorination prior to initiation of the study. The data do, however, suggest the importance of ultraviolet light lethality to coliforms. A large and highly significant portion of the survival variance was correlated with ultraviolet dosage. Samples taken from low temperature waters exhibited greater destruction than can be reasonably explained by UV-B effects alone. (Baker-FRC)
W82-05333

RAPID-INFILTRATION RESEARCH AT FLUSHING MEADOWS PROJECT, ARIZONA,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
H. Bouwer, R. C. Rice, J. C. Lance, and R. G. Gilbert.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2457-2470, October, 1980. 4 Fig, 3 Tab, 23 Ref.

Descriptors: *Infiltration, *Wastewater treatment, Secondary wastewater treatment, Effluents, Water quality, Basins, *Flushing Meadows Project, *Arizona, Water reuse, Conservation, Water conservation, Nitrogen, Phosphorus, Phosphates, Nutrients, Acidity, Groundwater recharge.

During the first five years of the Flushing Meadows Project, the main objective was to maximize hydraulic loading and to determine the associated quality improvement of the effluent as it seeped down to the groundwater and moved laterally through the aquifer. During the second five years the research comprised studying maximization of nitrogen removal, which required a reduction in hydraulic loading. The Project consisted of six parallel, horizontal basins. Secondary wastewater effluent from an activated sludge process with no chlorination was pumped into the basins at one end. The 5-day BOD generally was in the 10 to 20 mg/l range for secondary effluent going into the infiltration basins, and less than 1 mg/liter for the renovated water from the East Center Well. Chemical oxygen demand of the secondary effluent was 30-60 mg/l, and that of the renovated water, 10-20 mg/l. Total nitrogen content of the secondary effluent normally ranged between 20 and 40 mg/l, with the low values occurring in the summer. Phosphorus in the secondary effluent was mostly in the orthophosphate form. Concentrations of phosphate-phosphorus showed a slightly decreasing trend in the 10 years of the research, from an average of about 11 mg/l in 1969 to about 8 mg/l in 1977. This decrease can probably be attributed to an increase in household use of low phosphate detergents. The fluoride concentration of the secondary effluent decreased during 1973-77 and averaged 20.8 mg/l in 1977. Boron concentrations averaged 0.45 mg/l in 1968 and increased to 0.85 mg/l in 1971, decreasing to 0.59 mg/l in 1977. The secondary effluent contained 21 PFU's/l; viruses could not be detected in renovated water sampled below the basins. (Baker-FRC)
W82-05334

VELOCITY DEPENDENCE OF PHOSPHORUS TRANSPORT IN A PACKED-BED REACTOR,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, B. R. McMahon, and R.-L. Chu.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2371-2376, October, 1980. 9 Fig, 4 Ref.

Descriptors: *Model studies, *Phosphorus, *Packed beds, Wastewater treatment, *Velocity, Phosphorus transport, Mathematical equations, Mathematical studies, *Packed-bed reactor, Phosphorus kinetics.

A model is presented that provides a quantitative correlation between phosphorus kinetics and velocity in a packed-bed reactor. The model includes the processes of dispersion, convection, adsorption, transformation, decomposition, and reaction. Dispersion was found to be negligible compared with other processes. Decomposition and reaction were both shown to be velocity dependent, and accounted for the shift of the midpoint with velocity and the dependence of the overall reaction, respectively. The net rate of formation of fixed phosphate showed a strong dependence on velocity, which established the strong coupling between the hydrodynamic and chemical processes. (Baker-FRC)
W82-05335

WASTEWATER FROM A SUGAR REFINING INDUSTRY,

Mosul Univ. (Iraq).
S. Ahmad, and T. A. Mahmood.
Water Research, Vol 16, No 3, p 345-355, March, 1982. 11 Fig, 4 Tab, 21 Ref.

Descriptors: *Wastewater treatment, *Sugar crops, Beets, Sugarcane, Chemical oxygen demand, *Iraq, Chemical analysis, Water analysis, Water quality.

Wastewater was collected from a sugar factory in Mosul which refines raw sugar for most of the year, except for a maximum of 40 days when it processes beet sugar, depending on the availability. The factory has a production capacity of 2000 t/day of beet sugar, 600 t/day of white sugar and 300 t/year of bakery yeast. It also produces 24,000 tons of lime. The quantity of wastewater produced per ton of sugar refined is relatively high, perhaps due to the fact that the quantity of water available and its cost are not yet limiting factors. There was considerable variation in the characteristics of the wastewater. The possible variations should be considered when designing any treatment facility. The kinetic coefficients determined by inexpensive batch reactor studies could be helpful in obtaining estimates of design data. The mathematical model suggested by Eckenfelder is applicable to sugar refinery wastewater. The Tucek model is applicable to data based on chemical oxygen demand values. The performance relationship as suggested by Tucek can be used to predict the efficiency of chemical oxygen demand for a given set of conditions. (Baker-FRC)
W82-05337

ORGANIC POLLUTANTS ADSORPTION FROM MULTICOMPONENT SYSTEMS MODELED BY FREUNDLICH TYPE ISOTHERM,

Technion-Israel Inst. of Tech., Haifa. Div. of Environmental and Water Resources Engineering.
C. Sheindorf, M. Rebhun, and M. Sheintuch.
Water Research, Vol 16, No 3, p 357-362, March, 1982. 10 Fig, 1 Tab, 3 Ref.

Descriptors: *Isotherms, *Mathematical equations, Temperature gradient, Thermocline, Langmuir isotherm, Freundlich isotherm, *Adsorption, Uptake, *Wastewater treatment.

A novel Freundlich-type multicomponent adsorption isotherm has been used to describe adsorption data in multicomponent systems. This isotherm is suitable for multicomponent systems that consist of components which obey a Langmuir isotherm when present as a single component. The isotherm was used to describe the adsorption of parabromophenol, phenol and benzenesulfonate on activated carbon from the respective bicomponent and three-component aqueous solutions. This method demonstrated superiority over the commonly employed miltisection Langmuir isotherm. (Baker-FRC)
W82-05338

PH INFLUENCE ON ACIDOGENIC DISSIMILATION OF GLUCOSE IN AN ANAEROBIC DIGESTOR,

Amsterdam Univ. (Netherlands). Lab. of Chemical Technology.
R. J. Zoetemeyer, J. C. Van Den Heuvel, and A. Cohen.
Water Research, Vol 16, No 3, p 303-311, March, 1982. 7 Fig, 9 Tab, 18 Ref.

Descriptors: *Anaerobic digestion, *Acidity, *Wastewater treatment, Biodegradation, Bacteria, Anaerobic bacteria, Digestion, Activated sludge process, *Hydrogen ion concentration, Glucose.

The influence of the pH value on acidogenesis was investigated with reference to maximum specific growth rates and product distributions at various delution rates in order to optimize product distribution with respect to the more sensitive methanogenic stage. Glucose was used as the carbon limiting substrate, since its acidogenesis was rate limiting in the continuous flow stirred tank reactor (CFSTR). The gas phase consisted of carbon dioxide and hydrogen. Recovery of dissolved products,

mainly short-chain fatty acids, gas and biomass, calculated as total carbon, amounted to 85-95%. Yield values ranged from 12 to 14%. An optimal growth rate of 0.33/hr was achieved at a pH of 6.0. Product distrubution at 90% of the maximum growth rate was fairly constant up to the pH value of 6.0, after which dramatic changes in the main product were found to occur, from butyric acid to lactic acid and subsequently to acetic acid, formic acid and ethanol. (Baker-FRC)
W82-05341

INDUSTRIAL WASTEWATER TREATMENT TECHNOLOGY–RECENT DEVELOPMENTS,

Vanderbilt Univ., Nashville, TN.
W. W. Eckenfelder, Jr.
Water Science and Technology, Vol 14, No 1/2, p 111-119, 1982. 5 Fig, 2 Tab, 3 Ref.

Descriptors: *Industrial wastewater, *Organic compounds, *Activated carbon, *Wastewater treatment, Technology, Activated sludge process, *Heavy metals, Adsorption, PACT process, Oxidation, Nitrification, Dentrification, Economic aspects, Costs.

Conventional treatment of industrial wastewaters is concerned with removal of BOD, suspended solids and certin specified pollutants: nitrogen, phosphorus, heavy metals, cyanide, and phenol. Recent legislation will require control of toxic organics and color in addition to the above pollutants. Emphasis is presently directed toward in-plant control technology or modifications of conventional technology. Some examples of source control are: precipitation of heavy metals followed by filtration or ion exchange if necessary, organics removal by oxidation using ozone or hydrogen peroxide with or without ultraviolet light or catalysts, adsorption on granular activated carbon or macroreticular resins, and air or steam stripping of volatile pollutants. In DuPont's PACT process powdered activated carbon is added to the activated sludge process. This results in improved removal of non-biodegradable organics and priority pollutants, especially under shock loads, dampening of effluent variability, improved hydraulic capacity, and enhanced nitrification. The performance characteristics of the PACT process are listed for several types of municipal and industrial wastewaters. PACT dosages ranged from 125-310 mg per liter. Economics of several treatment systems are compared for plants of 1, 10, and 50 mgd capacity. Lowest costs were activated sludge with solids handling and rotating biological contactors with solids handling; intermediate were activated sludge with 2-stage nitrification and solids handling and PACT with and without nitrification plus solids handling, regeneration, and carbon makeup; highest was physical chemical treatment with granular activated carbon. (Cassar-FRC)
W82-05348

WASTEWATER TECHNOLOGIES IN SOUTH AFRICA: RESEARCH AND APPLICATION,

Water Research Commission, Pretoria (South Africa).
G. J. Stander, G. G. Cillie, E. J. Hall, and M. R. Henzen.
Water Science and Technology, Vol 14, No 1/2, p 465-480, 1982. 8 Fig, 1 Tab, 27 Ref.

Descriptors: *Research priorities, *Water reclamation, *Advanced wastewater treatment, Technology, Wastewater treatment, Industrial wastewater, Water reuse, Reverse osmosis, *South Africa, Public health, Water quality, Nutrient removal, Textile mill wastes, Pulp and paper industry, Ponds, Algae, Ultrafiltration, Ion exchange, Color removal, Dyes, Bardenpho process, Phosphorus removal, Phoredox process, Sludge treatment, Monitoring, Pollutant identification, Viruses, Carcinogens, Potable water.

Highlights of recent research and applications in South Africa cover water and wastewater management and water reuse. Potable water is produced at Windhoek, Namibia, by treating maturation pond effluent with high lime clarification, foam fractionation, clarification, breakpoint chlorination, activated carbon adsorption, and free residual chlorination. Quality control includes monitoring of volatile halogenated hydrocarbons and epidemiological studies. Municipal water reclamation plants are operated at Pretoria and Cape Town. Water reuse plants at two paper mills produce good guality effluents. Reverse osmosis, effective in removing accumulated inorganic salts, is currently under investigation. The Bardenpho process was a result of studies to remove nutrients without chemical addition. It consists of four stages--primary anoxic, primary aerated, secondary anoxic, and secondary aerated--followed by clarification. Organic matter in the wastewater is the sole carbon source. The Phoredox process is a refinement of the Bardenpho process. About 30 plants using these processes are presently operating in South Africa. Research on handling of the dilute sludge has tried dissolved air flotation, belt filters, centrifuges, polyelectrolytes, and land application. Nitrogen removal from an industrial effluent is being studied in a system of algae ponds with decreasng depth. (Cassar-FRC)
W82-05350

CRITERIA FOR NITRIFICATION IN FIXED FILM REACTORS,

Technical Univ. of Denmark, Copenhagen. Dept. of Sanitary Engineering.
P. Harremoes.
Water Science and Technology, Vol 14, No 1/2, p 167-187, 1982. 8 Fig, 3 Tab, 16 Ref.

Descriptors: *Nitrification, *Oxygen, *Ammonia, *Wastewater treatment, Biological treatment, Model studies, Organic matter, Dissolved oxygen, Trickling filters, Contact filters, Aerobic conditions.

A hypothesis concerning nitrification in fixed films, analytically modeled under simplified assumptions, agreed qualitatively with data from the literature. The postulation was that nitrification in fixed films can be achieved only when nitrifying bacteria embedded in a biofilm surface of mineralizing bacteria have sufficient exposure to aerobic conditions to multiply and reach concentrations high enough to convert ammonia. Several cases are considered: (1) the entire thickness of the biofilm is aerobic, (2) ammonia cannot fully penetrate the biofilm, (3) oxygen cannot fully penetrate the biofilm, (4) oxygen and ammonia fully penetrate the biofilm, and (5) the penetration of oxygen is greater than the penetration of ammonia. Oxygen penetrates deeper into the biofilm than soluble organic matter. In practice the soluble BOD should be limited to 20 mg per liter for 3 mg per liter dissolved oxygen. (Cassar-FRC)
W82-05352

HIGH-RATE ALGAE PONDS FOR WASTEWATER TREATMENT AND PROTEIN PRODUCTION,

Technion-Israel Inst. of Tech., Haifa. Dept. of Civil Engineering.
G. Shelef.
Water Science and Technology, Vol 14, No 1/2, p 439-452, 1982. 3 Fig, 2 Tab, 31 Ref.

Descriptors: *Algae harvesting, *Wastewater lagoons, *Feeds, *Wastewater treatment, Biomass, Algae growth, Photosynthesis, Nutrient removal, Bacteria, Proteins, Ponds, Lagoons, Productivity, *Israel.

Work on municipal wastewater treatment in high rate algae ponds (HRAP) began in Israel in 1968. This paper summarizes results of the 1975-80 period. Total biomass yields of 35-50 g per sq m per day or over 180 metric tons (dry) of mixed biomass per ha per year may be obtained with these systems. Bacterial productivity is fairly constant at about 20 g per sq m per day throughout the year. Algal productivity ranges from 10 g per sq m per day in winter to over 30 g per sq m per day in summer. The system is composed of a photosynthetic mixed meandering channel type pond 20-60 cm deep. Mixing is provided by paddle wheels or cage aerators to produce a longitudinal velocity of 5 10 cm per sec. The algal harvesting and processing units thicken, dewater, and dry the biomass for use as animal feed. Effluent is polished in an intermittent shallow coarse sand filter and chlorinator. Complete data are given for 12 months operation of a pilot pond using raw municipal wastewater from Haifa, Israel. This 120 sq m pond produced 1935 kg biomass (dry) in the 12 months starting September 1978. Effluent under favorable conditions averaged < 10 mg per liter total suspended solids, < 10 mg per liter total BOD, 50 mg per liter total COD, 24 mg per liter total N, < 0.5 mg per liter total P, and 100 per 100 ml total coliforms. Since no fertilizers, carbon source, pond liners, or axenic cultures are needed, production costs for the algal biomass are only $80 per ton sundried or $120 per ton drum dried after costs of secondary wastewater treatment have been deducted. (Cassar-FRC)
W82-05355

DESIGN AND OPERATION INTERACTION–AN EXAMPLE: MAIN TREATMENT PLANT VIENNA,

Technische Univ., Vienna (Austria).
W. von der Emde.
Water Science and Technology, Vol 14, No 1/2, p 493-506, 1982. 3 Fig, 9 Tab, 10 Ref.

Descriptors: *Activated sludge process, *Sludge disposal, *Municipal wastewater, *Wastewater treatment, Incineration, Pilot plants, Biological wastewater treatment, Design criteria, Aeration, *Vienna, Austria.

The Main Treatment plant in Vienna, Austria, uses the high-rate activated sludge process (1.2 days sludge age and 1.5 hour hydraulic detention time). To minimize construction and operating costs four large aeration tanks of 10,000 cu m capacity each were installed. A plug flow mixing regime was specified. Aeration motors are direct-current so that speed may be easily decreased during periods of low oxygen demand. Sludge is incinerated with spent oil and garbage after dewatering and drying. Average wastewater flow in March 1981 was 656,400 cu m per day; influent COD, 756 mg per liter; influent BOD5, 323 mg per liter; effluent COD, 90 mg per liter; and effluent BOD5, 31 mg per liter. Overall removal efficiencies were COD, 88%; and BOD5, 90%. Details are given of the 16-year design, pilot plant, and full-scale studies that preceded the plant startup in October 1980. (Cassar-FRC)
W82-05356

FLUID FLOW PATTERN IN UPFLOW REACTORS FOR ANAEROBIC TREATMENT OF BEET SUGAR FACTORY WASTEWATER,

Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.
P. M. Heertjes, L. J. Kuijvenhoven, and R. R. van der Meer.
Biotechnology and Bioengineering, Vol 24, No 2, p 443-459, February, 1982. 11 Fig, 3 Tab, 7 Ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Flow pattern, Anaerobic digestion, Food-processing wastes, Wastewater facilities, Design criteria, Pilot plants, Prototypes, Beets, *Beet sugar industry.

The fluid flow pattern of a 30 cubic meter upflow reactor used for the anaerobic treatment of wastewater from a beet sugar factory was studied. The prototype 200 cubic meter reactor was constructed based on the results of experiments with the pilot reactor. Residence time distribution experiments were conducted in the prototype reactor using continuous injection of a lithium chloride (LiCl) solution as a tracer in the influent of the reactor and measuring the response to this stimulus at several locations in the reactor and in the effluent. These measured data were used to develop models of the fluid flow pattern which consisted of regions of ideal mixing, plug flow, dead space, and short circuiting. Comparisons of the fluid flow patterns of the pilot plant and the prototype indicated that three-mixer models were appropriate for the pilot plant, while two-mixer models were found for the prototype. The studies found that, at the influent concentrations and liquid residence times applied, the gas produced by the anaerobic bacteria provided good mixing of the fluid inside

the reactor. However, the settler on top of the reactor must be effectively shielded from the region in the reactor where the anaerobic conversion takes place. Dead space regions may be created by high concentrations of mud in the blanket, which cause extra thickening of the suspended solids in the bed. Experiments with the prototype reactor showed that upflow reactors for anaerobic treatment of wastewater should contain enough sludge to provide a sludge bed height of between 1.5 and 2.5 meters. Most of the influent bypassed the sludge bed at bed heights of 0.4 meters. (Carroll-FRC)
W82-05372

CARBON LIMITATION OF BIOMASS PRODUCTION IN HIGH-RATE OXIDATION PONDS,

Technion-Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
Y. Azov, G. Shelef, and R. Moraine.
Biotechnology and Bioengineering, Vol 24, No 3, p 579-594, March, 1982. 7 Fig, 5 Tab, 16 Ref.

Descriptors: *Photosynthesis, *Algal growth, *Carbon dioxide, *Oxidation ponds, Ponds, Wastewater ponds, Growth rates, Organic loading, *Wastewater treatment, Biomass, High rate oxidation ponds, *Israel.

Carbon was the limiting factor in biomass production in high rate wastewater oxidation ponds. This conclusion was reached by theoretical considerations and by field experiments performed near Haifa, Israel. The main contributor to algal photosynthesis was the dissolved carbon dioxide provided by bacterial degradation of the organic compounds in the wastewater. Atmospheric carbon dioxide was a minor contributor under conditions of high organic loading but was significant at low organic loadings. Adding carbondioxide gas to a pond during a period of high organic matter concentrations did not increase photosynthesis. Shallower ponds became carbon limited more quickly than deeper ponds. Addition of bicarbonate did not increase algal growth as did carbon dioxide. (Cassar-FRC)
W82-05373

KINETICS OF BIOFILM NITRIFICATION,

Eidgenoessesche Technische Hochschule, Zurich (Switzerland). Technisch-Chemisches Lab.
H. Tanaka, and I. J. Dunn.
Biotechnology and Bioengineering, Vol 24, No 3, p 669-689, March, 1982. 17 Fig, 11 Tab, 14 Ref.

Descriptors: *Nitrification, *Kinetics, *Biofilms, *Wastewater treatment, Oxidation, Ammonium, Nitrites, Oxygen, Chemical reactions, Model studies, Nitrosomonas, Nitrobacter.

Reaction rates of the two-step nitrification reaction (ammonia oxidation followed by nitrite oxidation) were studied in a fluidized sand bed biofilm reactor. Under low NH4+ concentrations, when the oxygen/NH4+ ratio in the bulk liquid was less than the stoichiometric coefficient (3.4 mg per mg), oxygen was rate limiting. Under low oxygen conditions the nitrite oxidation rate was lower than the NH4+ oxidation rate, leading to an accumulation of nitrite. pH had little effect on biofilm nitrification kinetics. Organic carbon oxidation in the biofilm reduced NH4+ and nitrite oxidation rates. The influence of oxygen penetration effects on the relative values of NH4+ and nitrite oxidation rates was caused either by the Nitrobacter location in the inner biofilm regions or by a saturation effect for oxygen. A differential diffusion-reaction model was used to simulate the experimental results. (Cassar-FRC)
W82-05374

WESTCHESTER COUNTY'S PEEKSKILL WASTEWATER TREATMENT PLANT REPLACES FIVE PLANTS,

W. G. Borghard, and W. B. Sinnott.
Clearwaters, Vol 11, No 4, p 11-14, December, 1981. 1 Fig, 2 Tab.

Descriptors: *Wastewater facilities, *Complete wastewater treatment, Water treatment facilities, Wastewater treatment, Wastewater management, Computers, Aeration lagoons, Activated sludge process, Sludge, Advanced wastewater treatment, *Westchester County, *New York.

After the energy crisis of 1973, a re-study of a proposed sludge disposal method was undertaken by the Westchester County Department of Environmental Facilities for the Peekskill Sanitary Sewer District. The study indicated that thickening, anaerobic digestion, utilization of methane gas, dewatering by centrifugation, and disposal through composting and/or landfill were the most economical processes; the original design was revised accordingly. New secondary treatment facilities utilize the activated sludge process with diffused air. The plant is designed for 10 MGD with provision for expansion to 15 MGD. Pretreatment of incoming flow causes it to pass through mechanically cleaned bar screens and then to grit chambers. Four primary settling tanks begin the primary treatment, and effluent from these tanks flows into secondary treatment by pipeline into aeration tanks. Mixed liquor flows to any of four final settling tanks. Chlorine is applied to the final effluent through a diffuser located immediately ahead of the plant effluent conduit. The final effluent discharges through diffusers in the ship channel of the Hudson River after passing through an outfall. Raw sludge is pumped from two combined sludge gravity thickeners by pumps to the primary digester. Dewatering is accomplished through the use of centrifuges. A UCS 3000 computer receives, records, totalizes, and prints all the analog data as well as the alarm status of over 110 items. Start-up of the sludge digestion process by filling the primary tank with a mixture of raw sludge and wastewater was not successful. The process was successfuly restarted with seed sludge trucked in from another Westchester County plant. (Baker-FRC)
W82-05399

CONVERSION OF AERATOR TO CHLORINE CONTACT TANK AT THE OWLS HEAD WATER POLLUTION CONTROL PLANT,

New York City Environmental Protection Administration.
J. J. Donnellon, and D. Katz.
Clearwaters, Vol 11, No 1, p 14-19, March, 1981. 6 Fig, 4 Tab, 4 Ref.

Descriptors: *Wastewater facilities, *Chlorination, Aeration, Disinfection, Design criteria, Water pollution control, Chlorine, *Owls Head Treatment Plant, *New York, *Water treatment.

A chlorination problem at the Owls Head Water Pollution Control Plant was solved by converting an idle aerator, which was situated adjacent to the plant effluent channel, to a chlorine contact tank. While the merit of this solution was immediately obvious, once suggested, in 1975, it was not recognized during long study and experimentation sessions, which were conducted from 1969 on. The major problem with the old chlorination system was a lack of sufficient contact time; it was decided to chlorinate in the final sedimentation tanks which would provide a detention of 68 minutes, as opposed to the previous 10 minute contact. The system of final tank disinfection, however, had several serious disadvantages. Although it did afford a long detention, it did not provide adequate mixing, and the chlorine demand was excessive due to the suspended solids in the final tanks. Thus it was necessary to dose at the rate that ranged from 80 to 100 gallons per M.G. The system was also dependent on stable final tank operation, and several of these failed during 1973. The two essential components in an efficient chlorination are contact time and mixing. The conversion the idle aerator at Owls Head provides an excellent example of the potential for improvement that may reside in existing plant facilities. (Baker-FRC)
W82-05402

USE OF SYNTHETIC ADSORBENTS IN CHEMICAL PROCESSES,

Rohm and Haas Ltd., Croydon (England).
R. M. Carlyle.
Effluent and Water Treatment Journal, Vol 22, No 2, p 55-59, February, 1982. 7 Fig, 4 Tab.

Descriptors: *Polymers, *Adsorbents, *Absorption, *Advanced wastewater treatment, *Organic compounds, *Tertiary wastewater treatment, Separation techniques, Wastewater treatment, Activated carbon, Pesticides, Organic solvents, Organic pesticides, Industrial wastes, Water treatment.

Some applications and properties of synthetic polymeric adsorbents are reviewed with special focus on the use of Amberlite synthetic adsorbents for the removal of organic compounds during water and wastewater treatment. The Ambersorb adsorbents have properties similar to those of activated carbon. The concentration of adsorbate solution, solution pH, and regeneration during the adsorption process influence the efficiency of absorption. Chemical regeneration, polar solvents regeneration, and stream regeneration are described. Phenol can be recovered from the effluents of bisphenol-A production by a solvent regeneration process which yields a production effluent with < 10,000 ppm of phenol and non-polar solvents. Phenol may also be recovered from cumene by the cumene process and from phenol-formaldehyde resin using a Grignard reaction. Similar methods are used for the recovery of pesticides of the substituted phenol or phenoxy acid type from their production wastewaters. When using synthetic adsorbents for the removal of ethylene dichloride from the production effluents of vinyl chloride and the removal of benzene, toluene and xylene from refinery effluents, steam regeneration processes yield an effluent of high quality. (Geiger-FRC)
W82-05404

UPRATING SLUDGE DIGESTERS BY IMPROVING THE HEAT TRANSFER OF HEATAMIX UNITS,

Severn-Trent Water Authority (England).
J. Upton, and R. Schofield.
Effluent and Water Treatment Journal, Vol 21, No 12, p 538-540, December, 1981. 2 Fig.

Descriptors: *Sludge digestion, *Heat transfer, *Fouling, Heatamix units, *Leicester, *England, Anaerobic digestion, Digestion, Mixing, Sewage gas, Energy conservation, Performance evaluation, Flow pattern, Alteration of flow, Direct flow.

Poor performance in anaerobic sludge digestion tanks at the City of Leicester's Wanlip works was attributed to fouling of the heat exchange surfaces and inadequate design of the Heatamix units, which heat and mix the sludge. The units were operating with a heat transfer coefficient of 694 KJ per sq m per degree C per hour, 70% of the design figure. Since it was impractical in this case to change the gas flow rate, water flow rate, or water temperature, the Heatamix units were converted to a co-current flow arrangement. The pipe system was reversed so that the conventional water flow was reversed, hot inlet water was pumped to the bottom, and cooler water left from the top. Modification of the units increased the heat transfer coefficient to 1000 KJ per sq m per degree C per hour. (Cassar-FRC)
W82-05405

DOES CONVENTIONAL SEWAGE TREATMENT MEET THE DEMANDS OF THE 1980'S,

K. Stendahl.
Effluent and Water Treatment Journal, Vol 22, No 2, p 61-65, February, 1982. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Biological wastewater treatment, *Chemical precipitation, *Cost analysis, *Advanced wastewater treatment, *Phosphorus removal, Wastewater treatment, Chemical treatment, Phosphorus, Separation techniques, Physicochemical treatment, Filtration, Tertiary wastewater treatment, Evaluation, Standards.

The design and construction of sewage treatment facilities often follow conventional patterns based on increased demands and economic feasibility. Primary treatment mechanically removes coarse pollutants by screening and sedimentation. Secondary biological treatment breaks down organic pollutants. Phosphorus elimination is achieved by chemical precipitation during tertiary treatment. A fourth stage, filtration, may also be used for sensi-

tive receiving waters. Chemical precipitation is also useful in removing biochemical oxygen demand, heavy metals, and other contaminants in wastewater. Experience in Sweden shows that biological treatment is better than chemical precipitation for the removal of BOD. A cost breakdown for the four treatment stages for various plant sizes based on the 1979 cost level in Sweden is given. Costs can be reduced if the biological stage is replaced by chemical precipitation in a two stage process, and if mechanical and chemical precipitation are combined in a single process. An English study estimated the energy cost to be 1.3 dollars-person/yr for biological treatment or 0.1 dollars-person/yr for chemcial treatment. A two stage plant which combines mechanical and chemical treatment can reduce the energy costs in the biological stage by about 33%. In the 1970s many plants in Norway introduced chemical precipitation processes to reduce phosphorus discharge to Lake Mjosa. A new sewage treatment plant planned for Oslo will be based on primary precipitation. (Geiger-FRC)
W82-05407

PHOSPHORUS REDUCTION STUDIES,

A. V. Gray.
Effluent and Water Treatment Journal, Vol 22, No 2, p 68-71, 73, 74. February, 1982. 5 Fig, 20 Ref.

Descriptors: *Phosphorus removal, *Chemical precipitation, *Eutrophication, *Advanced wastewater treatment, Wastewater treatment, Phosphorus, Nutrients, Sulfates, Biological wastewater treatment, Lime, Tertiary wastewater treatment, Separation techniques, Activated sludge, *Lough Neagh, *Northern Ireland.

Phosphorus enrichment in Lough Neagh, Northern Ireland has been occurring since about 1900 with the advent of the water closet and use of artificial fertilizers. Various measures were tried to control eutrophication caused by massive blooms of Anabaena flos-aquae. Temporary measures to control algal growth included harvesting of weeds or introducing grazing organisms. More permanant measures of nutrient reduction include flow diversion or dilution and chemical precipitation which are often performed at discharge or manufacturing sources. Phosphorus entering sewage treatment works comes from household detergents, human excreta, and industrial sources. Influent sewage can contain phosphorus in many forms. Some phosphorus is removed during normal sewage treatment processes. The Bardenpho process can remove up to 85% of the phosphorus under strict operating conditions. Chemical precipitation of phosphorus combined with mechanical dosing provides efficient removal of phosphorus from wastewaters. Split-effluent lime processing is advocated for achieving phosphorus reduction by treatment of secondary effluent during biological filtration. Operation of a ferrous sulfate dosing plant should prove the economic value of this method of phosphorus reduction at activated sludge plants. Other wastewater treatment plants in the Lough Neagh catchment area are scheduled to be installed in the near future to reduce phosphorus loading to this lake. (Geiger-FRC)
W82-05408

RE-EXAMINING THE KINETICS OF THE BIOCHEMICAL OXIDATION OF SEWAGE,

T. Stones.
Effluent and Water Treatment Journal, Vol 22, No 2, p 75, February, 1982. 1 Tab, 7 Ref.

Descriptors: *Kinetics, *Oxidation, *Dissolved oxygen, *Biochemical oxygen demand, *Wastewater, Mathematical equations, Nitrification, Wastewater treatment, Biological wastewater treatment, Mathematical studies, Ammonia, Domestic wastes, Sewage.

The oxidation of sewage occurs spontaneously when it is diluted with clean aerated water. In this two stage process, the carbonaceous matter is first oxidized over a period of 15 to 20 days, and the second stage consists of the oxidation (nitrification) of original ammonia and that produced during the first stage. The kinetics of the carbonaceous stage follow a second order reaction whose rate depends on the biochemical oxygen demand (BOD) and the residual dissolved oxygen (DO) concentration. An equation was given for the kinetics of the first stage oxidation for a .01 dilution of settled domestic sewage at 20 degrees. By using a value of 6.00 milligrams/liter as the total BOD, the biochemical oxidation of sewage closely conforms to a second order reaction with a mean velocity coefficient of 0.039 for most of the first stage. These findings show that the decreasing rate of oxidation as the first stage proceeds is governed by the conjoint effect of consequential reductions in the residual dissolved oxygen level and the unsatisfied carbonaceous BOD. (Geiger-FRC)
W82-05409

OPERATION AND PERFORMANCE OF A NEW ACTIVATED SLUDGE PROCESS: THE CONTACT STABILIZATION EXTENDED AERATION HYBRID,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
B. H. Paepcke, and P. H. Jones.
Water Science and Technology, Vol 14, No 1/2, p 367-380, 1982. 10 Fig, 5 Tab, 8 Ref.

Descriptors: *Activated sludge process, *Contact stabilization, *Aeration, Biological wastewater treatment, Wastewater treatment, Municipal wastewater.

A hybrid activated sludge process combined the contact stabilization process and the conventional extended aeration process. Data obtained at a full-scale municpal wastewater treatment plant showed that the hybrid process had advantages of both components. Process stability was good because the sludge in the stabilization tank was not exposed to shock loads as in the conventional plant. The total aeration period was 6 hours vs. 24 hours for the conventional process. Large variations in hydraulic and organic loadings were handled without upset using a smaller, less expensive aeration tank volume. Effluent quality was consistently good. Only occasionally did BOD or suspended solids concentrations exceed 6 mg per liter. The food: microorganisms rations, 0.01-0.08 kg BOD per kg of volatile suspended solids per day, were in the low range characteristic of the extended aeration process. For a plant treating stronger wastewaters, longer detention times would be required. (Cassar-FRC)
W82-05417

LAND EXTENSIVE PROCESSES FOR WASTEWATER TREATMENT AND DISPOSAL--A PERSPECTIVE,

Water Science Lab., Melbourne (Australia).
C. D. Parker.
Water Science and Technology, Vol 14, No 1/2, p 393-406, 1982. 35 Ref.

Descriptors: *Wastewater irrigation, *Wastewater lagoons, *Land application, Irrigation, Lagoons, Ponds, Melbourne, Werribee, Australia, Wastewater composition, Water pollution effects, Soil properties, Agriculture, Water reuse, *Wastewater treatment, Pastures, Odor control, Heavy metals, Metals, Accumulation, Organic compounds, Pathogens, Public health, Groundwater pollution, Tertiary wastewater treatment, Fate of pollutants, *Wastewater disposal.

Land extensive wastewater treatment processes (ponds/lagoons and irrigation) have been used by the cities of Melbourne and Werribee, Australia, and in other countries. These experiences have led to conclusions helpful to planners of land extensive systems. Flat or slightly sloping ground is best for irrigation; ponds can tolerate up to 10-20% slope. Tight clay soil is best for pond sides and bottoms, although seepage always eventually stops due to sealing with sludge and algal matter. Very permeable soil spreads viable pathogens rapidly. Soils differ in ability to retain nutrients and heavy metals. There must be a compromise between the goals of maximum crop yield and maximum wastewater disposal. Irrigation methods must be adapted to the crop grown. The composition of the wastewater, whether domestic, industrial, or mixed, must be considered. Objectives of the land extensive systems may be complete treatment of raw waste, secondary or tertiary treatment, disposal of final effluent, or reuse of final effluent. Possible adverse effects of lagoon systems are unpleasant odor, groundwater contamination, and high concentrations of algae in the effluent. Irrigation schemes may cause accumulation of heavy metals and bioresistant organics in the soil, transmission of pathogens, sewage sickness on pasturelands, and groundwater pollution. Options are available to minimize the effects of the above problems. (Cassar-FRC)
W82-05419

AMMONIA AND TOTAL KJELDAHL NITROGEN REMOVAL IN AERATED LAGOONS,

Utah State Univ., Logan. College of Engineering.
A. Pano, and E. J. Middlebrooks.
Water Science and Technology, Vol 14, No 1/2, p 381-391, 1982. 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Nitrogen removal, *Wastewater lagoons, *Temperature effects, *Kjeldahl procedure, Detention times, Ammonia, Wastewater treatment, Aerated lagoons, Lagoons, Hydraulic loading, Aeration, Performance evaluation, Seasonal variation, Nitrification, Comparison studies, Oklahoma, Wisconsin, Mississippi, Illinois, Pennsylvania.

Five aerated lagoons located in Oklahoma, Wisconsin, Mississippi, Illinois, and Pennsylvania were monitored for ammonia-N and total Kjeldahl nitrogen (TKN) removal. The lagoons differed in climatic conditions and in wastewater compositions. Mean annual ammonia-N and TKN removals were 49-94% and 50-87%, respectively, except for the Pennsylvania system, which had zero ammonia-N and TKN removal. The percentage removals of ammonia-N and TKN increased with decreases in hydraulic loading rates and increases in detention time. Removals in summer months were 10-20% higher than in winter. Differences in performance were observed between surface-aerated lagoons and lagoons with diffused-air aeration systems. Temperature differences, rather than type of equipment, were the likely causes of these differences. Less than 45 days hydraulic retention time or more than 0.055 cu m per sq m per day resulted in no ammonia-N or TKN removal. There was no relationship between dissolved oxygen concentration and percentage TKN and ammonia-N removals. (Cassar-FRC)
W82-05420

ELECTROCHEMICAL PROCESSES FOR WASTEWATER TREATMENT,

Naples Univ. (Italy). Dept. of Sanitary Engineering.
L. Mendia.
Water Science and Technology, Vol 14, No 1/2, p 331-344, 1982. 2 Fig, 5 Tab, 11 Ref.

Descriptors: *Electrochemistry, *Phosphate removal, *Tertiary wastewater treatment, *Wastewater treatment, Electrolysis, Seawater, Chlorination, Disinfection, Flocculation, Clarification, Electrodes, Magnesium hydroxide.

An electrochemical treatment of wastewater-seawater mixtures, especially useful in coastal communities, is described. After bar screening and grit removal the sewage is mixed with seawater at ratios of 1:3 or 1:4. The mixture passes through an electrolysis cell at retention times of 5-20 sec. The effluent is sent to a clari-flocculator basin where sedimentation of suspended solids and disinfection occurs during a 60-90 min retention period. Sludge from the process can be recirculated because of its high chlorine content and need not be digested. Chemicals used in treatment are generated from the electrolysis process. Hydrogen, chlorine, and hydroxyl ions are produced at the electrode and further react with each other and seawater constituents to form flocculant (magnesium hydroxide) and disinfectants hypochlorite). Advantages of the electrochemical treatment are no chemical costs, small plant size, recovery of metals if desired, and good phosphate removal. In this study the electrolytic cell was made of 6 contiguous perforated silicon-iron blocks (anode) and six contiguous per-

forated sheet irons (cathode). Operating parameters were: current density, 200 A; anodic current density, 1.33 A per sq dm; potential difference, 4V; energy consumption, 0.53 kWh per cu m; and feed flow, 2000 liters per hour. Suspended solids removal was 97%; BOD removal, 57% and phosphates removal, 86%. (Cassar-FRC)
W82-05422

CONTROL OF BULKING SLUDGE--PRACTICAL EXPERIENCES IN AUSTRIA,

Technische Univ., Vienna (Austria).
N. F. Matsche.
Water Science and Technology, Vol 14, No 1/2, p 311-320, 1982. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Sludge bulking, *Activated sludge process, *Wastewater treatment, Sludge volume index, *Austria, Filamentous organisms, Bacteria, Chlorination, Oxidation, Technology, Anaerobic conditions, Formaldehyde, Nutrients, Settling velocity, Organic loading, Flow patterns, Plug flow, Food-processing wastes, Ferrous sulfate, Polyelectrolytes.

In Austria experience with bulking sludge control has been successful with several methods: increase in specific weight of the floc, damage to the filamentous organisms, removing conditions favoring growth of filamentous organisms, and producing conditions adverse to growth of filamentous organisms. The specific weight of the floc may be increased by omitting the primary sedimentation step, reducing the concentration of polyelectrolytes so that soil particles are later incorporated onto the floc, or adding ferrous sulfate. Chlorination successfully inhibits filamentous organism growth. Formalin at 100 mg per liter is detrimental to both filamentous bacteria and nitrifying organisms but not to sludge bacteria. Factors which favor growth of filamentous organisms are septic conditions and nutrient deficiencies. These may be minimized by adequate flow velocities, frequent sludge removal, lower organic loads, and nutrient additions. Processes can be modified to produce conditions adverse to filamentous organism growth: use of intermittent feeding, increase in denitrification, division of the aeration tank into small compartments to cause plug flow conditions, and installation of a contact tank ahead of the aeration tank. (Cassar-FRC)
W82-05423

EXPERIENCE FROM 10 YEARS ADVANCED WASTEWATER TREATMENT--TECHNOLOGY AND RESULTS,

Uppsala Univ. (Sweden). Dept. of Limnology.
C. Forsberg, B. Hawerman, and B. Hultman.
Water Science and Technoloy, Vol 14, No 1/2, p 121-133, 1982. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Advanced wastewater treatment, *Phosphorus removal, *Chemical precipitation, Wastewater treatment, *Sweden, Eutrophication, Lakes, Nitrogen removal, Lake restoration, Heavy metals, Alum, Iron compounds, Coagulation, Nitrification, Chemical treatment, Technology.

Sweden's Environmental Protection Act of 1969 precipitated intensive construction of municipal wastewater plants during the 1970's. About 74% of the urban population is served by wastewater treatment plants with a combined biochemical and chemical treatment. The effluent goals are 15 mg per liter BOD7 and 0.5 mg per liter phosphorus. In certain cases more stringent standards are imposed. About 70% of the plants meet the requirements. In 1977 post-precipitation was used at 554 plants, direct precipitation at 138, pre-precipitation at 17, and simultaneous precipitation at 35. Aluminum sulfate was used at 600 plants, iron salts at 92 plants, and lime or combinations at the remainder. In the post-precipitation method several procedures are used to improve P removal and lower costs of chemical additions: 2-stage precipitation, recirculation of post-precipitation sludge to the activated sludge aeration basins, or biological P removal. Most of the 22 lakes evaluated have responded to the advanced wastewater treatment with lowered concentrations of P and organic matter. Half of these had lower chlorophyll a values and 6, significant increases in transparency. Heavily polluted lakes will not show decreases in chlorophyll until P concentration is decreased to less than 0.1-0.2 g per cu m. Nitrogen increased in 10 lakes and decreased in 4 lakes. Improvement is easier to achieve in deep stratified waters than in shallow vegetated lakes. (Cassar-FRC)
W82-05424

WATER AND WASTEWATER TREATMENT IN LATIN AMERICA--APPLIED TECHNOLOGY,

Universidade Central de Venezuela, Caracas. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5F.
W82-05425

SOME PERSPECTIVES IN THE MODELLING OF BIOLOGICAL TREATMENT OF WASTEWATERS,

Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
A. James.
Water Science and Technology, Vol 14, No 1/2, p 227-240, 1982. 4 Fig, 44 Ref.

Descriptors: *Model studies, *Design criteria, *Research priorities, *Biological wastewater treatment, Computers, Activated sludge process, Trickling filters, Filters, Settleable solids, Sludge volume index, Optimization.

Modeling of biological wastewater treatment is reviewed, with emphasis on areas of dispute and needs for further research. Models of dispersed growth are extremely useful in understanding process fundamentals. However, more recent developments using a variable yield are improvements over the fixed yield models. Use of steady-state equations and evaluation of coefficients need to be improved. Fixed film reactor models have not reached the same stage of development as the dispersed growth models. Understanding of percolating filters lags behind high-rate filters. Processes involved are very complex and reactions are rate-limiting, except with very thin films. Settlement of flocculent suspensions does not lend itself to simple mathematical description. At present it is best to use models involving a sludge concentration factor which can be obtained from sludge volume index/sludge age relationship rather than a difficult-to-evaluate coefficient. Optimization models have reached a high degree of sophistication, and there is little point in further research in this field. Computers are often used in the process design stage which comprises 10-15% of the total required design time. There are many opportunities in extension of computer aid to structural design, preparation of bills of quantities, and preparation of design drawings. (Cassar-FRC)
W82-05430

THE EFFECTS OF TEMPERATURE ON THE BIOCHEMICAL REACTION RATES OF THE ACTIVATED SLUDGE PROCESS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. W. Randall, L. D. Benefield, and D. Buth.
Water Science and Technology, Vol 14, No 1/2, p 413-430, 1982. 11 Fig, 2 Tab, 17 Ref.

Descriptors: *Activated sludge process, *Temperature effects, *Kinetics, Nitrification, *Wastewater treatment, Oxygen requirements, Chemical reactions, Arrhenius equation, Aerobic digestion, Biological wastewater treatment, Microorganisms.

The effects of temperature change on biochemical reactions that occur in the activated sludge process were analyzed using experimental results and data from the literature. Results support the postulate that microbial population dynamics play an important role in temperature effects on biochemical reaction rates of mixed populations. Organic substrate stabilization follows the Arrhenius relationship over the temperature span 5-40C. Other biochemical reactions (production of cellular material, maintenance energy requirements, aerobic digestion, autooxidation of cellular material, and nitrification) generally follow the Arrhenius relationship from 5-10C. The Arrhenius relationship was valid for total oxygen consumption rates over the range 13-22C. The energy oxygenutilization coefficient was completely independent of temperature over the range 15-31.5C. Heterotrophs successfully metabolize substrate at lower temperatures than nitrifiers, and nitrite formers metabolize efficiently at lower temperatures than nitrate formers. (Cassar-FRC)
W82-05431

NITROGEN CONTROL AT THREE RELATED PLANTS,

Greeley and Hansen, Chicago, IL.
T. E. Wilson, E. D. Lukasik, and M. D. R. Riddell.
Water/Engineering and Management, Vol 128, No 12, p 43-44, 46, 50, 51. December, 1981. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Activated sludge, *Denitrification, *Nitrogen, *Sludge, Aeration, Biochemical oxygen demand, Settling basins, Retention capacity, Suspended solids, Effluent standards, *Chicago area.

Three large wastewater treatment plants near Chicago which incorporate full-scale nitrogen control processes are compared. Each has been operating in a nitrogen control mode for three years, with essentially the same liquid stream process flow. All three have excess flow retention basins. Plants at Waukegan and Gurnee are flexible in that they employ MID-Step nitrification, whereas the Clavey Road Plant has the advantage of greater aeration times and detention times. Studies of effluent quality show that performance of the Waukegan plant was less optimal than that of the Clavey Road or Gurnee plants. At the Waukegan plant design flow was exceeded during four months, and recycle streams caused excessively high loadings of biochemical oxygen demand and suspended solids. (Titus-FRC)
W82-05434

ENERGY CONSERVATION AND ALTERNATIVE ENERGY SOURCES IN WASTEWATER TREATMENT,

Anderson-Nichols and Co., Inc., Concord, NH.
E. L. Rushbrook, Jr., and D. A. Wilke.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2477-2483, October, 1980. 3 Fig, 5 Tab, 7 Ref.

Descriptors: *Biological wastewater treatment, *Anaerobic digestion, *Wastewater treatment, *Energy, *Cost analysis, Project planning, Maintenance costs, Biological filters, Construction costs, Aerobic digestion, Solar energy, Design criteria, Wastewater facilities, Operating costs, Hillsborough, *New Hampshire.

With the passage of the Federal Water Pollution Control Act Amendments of 1972, significant changes were made in the requirements for water pollution control. These amendments coupled with increased pressure for energy conservation spurred the municipality of Hillsborough to investigate alternative treatment processes and energy sources for its wastewater facility. As a result of energy use studies, the use of rotating biological contactors with anaerobic digestion was chosen for innovative funding in November 1978. The project capital cost for the collection system and construction of the treatment plant was estimated at over $5.3 million in cost-effect analyses. In 1979, the town of Hillsborough voted to appropriate funds for the project, and the EPA declared the proposed alternative an innovative technology which was eligible for 85% funding. The Hillsborough project was placed on the 1981 Construction Grants Project List. (Geiger-FRC)
W82-05440

RELATIONSHIP BETWEEN ORGANIC LOADING, DISSOLVED OXYGEN CONCENTRATION AND SLUDGE SETTLEABILITY IN THE COMPLETELY-MIXED ACTIVATED SLUDGE PROCESS,

California Univ., Berkeley.
J. C. Palm, D. Jenkins, and D. S. Parker.

Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2484-2506, October, 1980. 23 Fig, 3 Tab, 21 Ref.

Descriptors: *Organic loading, *Chemical oxygen demand, Process control, *Bulking sludge, *Dissolved oxygen, *Wastewater treatment, Activated sludge, Aeration, Biological wastewater treatment, Sludge conditioning, Microorganisms.

It is often difficult to draw well-defined relationships among aeration basin dissolved oxygen, chemical oxygen demand removal rate, and sludge bulking in wastewater treatment processes. To clarify this situation, experiments were carried out in continous flow, completely mixed activated sludge laboratory units operating at steady state on a settled domestic wastewater. A consistent relationship was found between the COD removal rate and the aeration basin DO level of the completely mixed activated sludge process. The data allows the establishment of COD removal rate/aeration basin DO level combinations that will prevent the development of large populations of filamentous organisms as well as the occurrence of bulking. An activated sludge that has bulked because of low aeration basin DO can be adjusted by raising the aeration basin DO to a value that prevents filamentous outgrowth from the floc. Scanning electron micrographs of activated sludge show the action of filamentous microorganisms in the bulking process. (Geiger-FRC)
W82-05441

SAFETY CONSIDERATIONS IN HANDLING ACTIVATED CARBON,

Environmental Services, Inc., Cleveland, OH.
G. E. Strudgeon, B. J. Lewis, W. W. Albury, and R. C. Clinger.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2516-2522, October, 1980. 4 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Safety, *Hazards, Accidents, Design criteria, Adsorbents, Dissolved oxygen, Wastewater facilities, Hydrogen sulfide.

Some of the hazards connected with the use of activated carbon for the treatment of wastewater are identified along with specific design and operational measures to minimize these hazards. Dust and dust explosions are a hazard in the carbon unloading area. Waste flows from activated carbon units that become low in dissolved oxygen may cuase hydrogen sulfide gases to be released by anaerobic organisms. Oxygen can also be adsorbed by wet carbon. Carbon may bridge and collapse, burying heavy objects or personnel. Activated carbon also tends to corrode equipment. Two case histories are presented in which low oxygen levels in the activated carbon solumns caused dangerous and even fatal accidents. A third case study showed that harmful off-gases could be released from a carbon regeneration furnace. It was suggested that the atmosphere inside of the vessel be checked, better ventilation installed, and probes be used to check carbon bridging to alleviate some of the hazards in an activated carbon facility. (Geiger-FRC)
W82-05442

INDUSTRIAL WASTE PRETREATMENT AND EPA CADMIUM LIMITATIONS,

Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5E.
W82-05443

START-UP PROBLEMS OF SLUDGE DEWATERING FACILITY,

Los Angeles County Sanitation Districts, CA.
B. E. Hansen, W. E. Garrison, and D. L. Smith.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2558-2570, October, 1980. 12 Fig, 3 Tab, 3 Ref.

Descriptors: *Design criteria, *Dewatering, *Scaling, *Foaming, *Wastewater facilities, Sludge conditioning, Sludge thickening, Wastewater treatment, Sludge digestion, Chemical treatment, *Sludge drying.

Problems in the start-up of the Joint Water Pollution Control Plant of the County of Los Angeles are described. Substantial changes in the digested sludge characteristics from 1970 to 1978 resulted in a finer, more dilute sludge. Scaling and foaming were also a problem. To control the scaling problem, work on a sulfuric acid addition project to control the pH of the feed sludge was undertaken. Foaming was partially corrected by feeding the digested sludge directly to the basket centrifuges. Since particles of the digested sludge solids played an important part in the sludge dilution, a return to a 3% sludge feed concentration and coarser particle size distribution resulted in adequate performance. The automation of polymer feed rate and the use of chemical dewatering aids also helped to stabilize plant performance. (Geiger-FRC)
W82-05444

MECHANISMS AND METHODS FOR POLYMER CONDITIONING OF ACTIVATED SLUDGE,

Missouri Univ.-Columbia.
J. T. Novak, and B.-E. Haugan.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2571-2580, October, 1980. 13 Fig, 10 Ref.

Descriptors: *Activated sludge, *Flocculation, *Mixing, *Dewatering, *Polymers, Wastewater treatment, Sludge thickening, Sludge conditioning, Model studies, Filtration, *Sludge drying.

Studies were conducted to uncover the mechanisms by which cationic polymers improve the dewatering of activated sludge of wastewater treatment plants. The effects of polymer dosing and mixing on sludge dewatering and floc stability were evaluated by a proposed floc surface model. The amount of polymer required was found to be dependent upon the mixing speed, mixing time, and sludge solids concentration. Tests with a pilot filter press confirmed the model predictions for filter performance. The optimal dose of polymer needed for filter press operation can be estimated by using the European recommended 'standard stirring device' which provides a mixing speed of 1,000 revolutions/min. Polymer additions to the sludge should be conducted at an energy input level similar to that in the standard stirrer. Undermixing could result in a sludge cake with lowered solids content while wasting expensive synthetic polymers. (Geiger-FRC)
W82-05445

COMPARATIVE DISINFECTION BY BROMINE CHLORIDE AND CHLORINE OF VIRUSES AND BACTERIA IN WASTEWATER,

Baylor Coll. of Medicine, Houston, TX.
B. H. Keswick, R. S. Fujioka, P. C. Loh, and N. C. Burbank.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2581-2588, October, 1980. 5 Tab, 21 Ref.

Descriptors: *Disinfection, *Bromine, *Chlorine, *Coliforms, *Enteroviruses, *Wastewater treatment, Halogens, Residual chlorine, Chlorides, Bacteria, Enteric bacteria, Viruses.

The efficiency and feasibility of using BrCl in place of Cl in the disinfection of human enteric viruses and indicator bacteria usually present in wastewater effluent was evaluated under field operating conditions. BrCl or Cl solutions were automatically and simultaneously injected into model contact chambers with activated sludge effluent flowing through them at a rate of 15.1 1/min with a contact time of 15 to 30 min. BrCl was found to be a more effective disinfectant than Cl for several human enteric viruses as well as for some naturally occurring coliform indicator bacteria. Whereas Cl was more effective in disinfecting human enteric viruses than coliform bacteria, BrCl was found to be equally effective against both types of pathogens. BrCl required a shorter contact time for efficacy than Cl, but the resulting residual BrCl was unstable compared with the stable residuals formed by Cl. These findings indicate that BrCl is a better disinfectant than Cl for use in the treatment of wastewater. (Geiger-FRC)
W82-05446

SULPHIDE CONTROL IN RISING MAINS,

Severn-Trent Water Authority (England).
I. W. Griffiths.
Water Pollution Control, Vol 80, No 5, p 644-647, 1981. 1 Tab.

Descriptors: *Sulfides, *Water mains, Water transport, Septic wastewater, Sewers, Rural areas, Sodium compounds, Nitrogen compounds, Iron compounds, Cost analysis.

Three separate rural sewerage systems in the Upper Severn Division of the Severn-Trent Water Authority, Great Britain, experienced severe difficulties as a result of sulfide produced from septic sewages. Several chemical treatments designed to prevent the production of sulfide were investigated in the laboratory and at operational levels. Treatments investigated included hydrogen peroxide, sodium nitrate, ferric nitrate, and a solution of ferric sulfate spiked with a little nitric acid. A solution of ferric sulfate and nitric acid, with a strength equivalent to 42,000 milligrams per liter nitrate nitrogen and 125,000 milligrams per liter ferric iron, was found to be the most cost effective of the treatments evaluated for overcoming the septicity problems in sewer mains. Although attempts to correlate chemical dosing levels with flow, retention period, and sulfide concentrations in the sewers were unsuccessful, a consistent relationship was found between total internal surface area of the main and the dose rate required per hour of pumping. Since the size of the dosing pump is critical to efficient treatment, it is necessary to calculate the dosage level requirements on a particular main prior to treatment. The costs of treatment vary with respect to the length and diameter of the rising main and with the frequency and duration of pumping. (Carroll-FRC)
W82-05465

CHEMICAL AND BIOCHEMICAL OXYGEN DEMAND AS INDICATORS OF BIODEGRADABLE SUBSTRATE CONCENTRATION,

Technion - Israel Inst. of Tech., Haifa. Environmental Engineering Labs.
M. Green, G. Shelef, and R. Moraine.
Water Pollution Control, Vol 80, No 5, p 655-658, 1981. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Biological wastewater treatment, *Oxygen demand, *Substrates, Biodegradation, Chemical oxygen demand, Biological oxygen demand, Wastewater treatment.

The use of biological oxygen demand (BOD) as a measurement of organic substrate concentration in biological wastewater treatment processes was compared with the use of chemical oxygen demand (COD) for this purpose. This study also investigated the questions of whether BOD may underestimate substrate concentration and whether COD values may be used with certain modifications in kinetic models relating biomass growth rate to total substrate concentration. The 5-day biochemical oxygen demand test and the ultimate BOD test were both found to underestimate the true concentration of biodegradable substrate in wastewater and the incremental amount which is removed by biological activity. The COD test can be readily used to describe changes in the substrate concentration and to compute substrate removal rates and biomass yields. In order to use the COD test for kinetic models which involve the total substrate concentration rather than the incremental one, it is first necessary to overcome the problem caused by the nonbiodegradable fraction of the COD. This can be accomplished by estimating the nonbiodegradable fraction, which is fairly constant for a given type of sewage and under the typical range of activated sludge operating condtions. Laboratory experiments can contrive conditions which will result in a constant ratio of effluent COD to nonbiodegradable COD by maintaining the product of biomass concentration and residence time at a constant value. (Carroll-FRC)
W82-05466

A COMPARISON OF THE CARBONACEOUS OXYGEN DEMANDS OF A DOMESTIC AND INDUSTRIAL SEWAGE,

T. Stones.

Water Pollution Control, Vol 80, No 5, p 659-662, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: *Oxygen demand, *Wastewater oxidation, Biochemical oxygen demand, Chemical oxygen demand, Wastewater treatment, Wastewater analysis.

Sewage is characterized on the basis of its demand for oxygen. Since this demand is determined by the amount of oxidizable matter in the sewage,oxygen demand is designated as the sewage's strength. Arbitrary criteria which have been adopted as parameters for assessing the strength of sewage include the 5-day biochemical oxygen demand (BOD) and the permanganate value. However, these measures will provide truly comparative results only if the oxidation always occurs at the same rate, so that the measures always give the same constant proportion of the total carbonaceous oxygen demand. Experiments with industrial and domestic sewages showed that the proportions of the total carbonaceous oxygen demand represented by the 5-day BOD and by the permanganate value were not constant, but varied with the nature of the sewage. In addition, the two measures may give conflicting results. A low 5-day BOD may not necessarily represent a weak sewage, but rather one that contains a relatively high proportion of carbonaceous matter which is inert to biochemical oxidation. Similarly, a high permanganate value may not represent a strong sewage, but rather result from one that is rapidly oxidized by acid permanganate, giving an unrealistically inflated value for its strength. However, the ratio of the 5-day BOD of a sewage to its COD does provide a rational indication of its amenability to treatment. (Carroll-FRC)
W82-05467

THE PERFORMANCE OF AN OFF-SEWER STORM-SEWAGE TANK,

Secretary of State for Scotland, Edinburgh. Scottish Development Dept.
R. J. A. Henderson, W. McBain, and F. Pettigrew.
Water Pollution Control, Vol 80, No 5, p 582-599, 1981. 10 Fig, 6 Tab, 4 Ref.

Descriptors: *Combined sewer overflows, *Storage tanks, *Storm sewers, *Storm wastewater, Wastewater disposal, Wastewater management, Water pollution control, Performance evaluation.

In many areas, municipal sewage and storm water are discharged to a combined sewer system. When heavy rain results in system overloads, the normal practice is to relieve the drainage system through controlled spillages into a watercourse. The use of storage tanks to collect initial storm overflows, with further flow discharged over the tank outlet weir to the watercourse, is increasing. The Bannockburn sewer catchment in Scotland, which is served by both separate and combined drainage systems, uses an off-sewer storm-sewage tank overflow system for storm water management. The storm-sewage arrangement consists of a circular, 20 meter diameter storage tank with a peripheral overflow weir discharging to the Bannockburn watercourse. This paper describes research designed to quantify some of the benefits ascribed to the use of storage tanks at storm-sewage overflows. The pattern over time of the biochemical oxygen demand (BOD) and suspended solids concentration of the overflow sewage showed a high pollution intensity at the start of an overflow event, followed by a steady decrease in strength. Investigations showed that by the time the storage tank was filled, the strength of the inflow was well below the strength of the original inflow and also weaker than the partially-settled sewage being overflowed to the river. In this case, diversion of sewer overflow directly to the river when the tank was full provided the best management alternative. When limits on the concentration of the discharge are to be enforced, plotting of time against BOD and suspended solids concentrations will provide information on the point at which the strength of the overflow falls below the required limit. The storage tank must be large enough to collect the volume of overflow before this point. Several methods for determining this volume are discussed. (Carroll-FRC)
W82-05469

THE COLESHILL ADVANCED WASTE-WATER TREATMENT PLANT,

Water Research Centre, Marlow (England).
N. B. Banks, and A. J. Butwell.
Water Pollution Control, Vol 80, No 5, p 559-570, 1981. 9 Fig, 4 Tab, 9 Ref.

Descriptors: *Wastewater facilities, *Wastewater treatment, Physicochemical treatment, Pilot plants, Advanced wastewater treatment, England, Research facilities, Coleshill Experimental Plant.

The Coleshill Experimental Plant, formerly the Coleshill Advanced Waste-Water Treatment Plant, was built as a pilot plant for the investigation of the applicability of physicochemical methods of treatment to British sewages and as a proving ground for sewage-treatment projects generally. The plant and its antecedents are described. Experimental work conducted at the plant since partial operation began in 1975 has included study of chemically-aided sedimentation, including lime treatment, ferric sulfate, aluminum sulfate, phosphate removal, cost of chemicals, sludge production, and total costs; treatment in granular activated carbon columns, including downflow experiments and carbon capacity; and comparison of physicochemical treatment and activated sludge treatment. The pilot plant is now managed by the Water Research Centre. Several modifications are envisioned as part of this new role. New areas of research which will be addressed in the future are identified. (Carroll-FRC)
W82-05470

A COMPUTER-BASED CENTRALIZED CONTROL AND SUPERVISORY SYSTEM FOR THE DAVYHULME SEWAGE TREATMENT WORKS,

Kennedy and Donkin (England).
M. R. Windle, and T. E. Chappell.
Water Pollution Control, Vol 80, No 5, p 663-673, 1981. 3 Fig.

Descriptors: *Wastewater facilities, *Computers, *Automation, Wastewater treatment, Design criteria, Monitoring, Process control, Remote control, Telemetry, Performance evaluation, Planning, Davyhulme.

The Davyhulme sewage treatment works in Great Britain treats the sewage and industrial effluent from the Greater Manchester metropolitan area. Since the original Davyhulme plant was completed in 1894, major extensions have been made periodically. The works now includes two activated sludge plants, with a third activated sludge plant planned for the future. The control and instrumentation equipment for the plants is generally mounted individually on the plant or grouped on control panels local to the plant and staffed by plant attendants on a permanent or roving basis. The interrelated operation of the existing plant with the new inlet facilities added during 1980 and the need for integrated operation of the old and new facilities, together with the considerable amount of control and instrumentation equipment associated with the new inlet works, focused attention on the need for centralized control and supervision of the plant. A review of the feasibility and cost-effectiveness of central control options indicated that the older activated sludge plant should be provided with centralized plant monitoring facilities, but that operation of the plant should be carried out by local plant operators under the control of the operator in the central control room, while the newer activated sludge plant should be provided with central remote control and supervision. An evaluation of three centralized control and supervisory systems concluded that a computer-based telemetry system was most appropriate in view of planned expansions. This system provides telemetry outstations for the transmission of control from and indication signals to a central master station and computer, direct digital control, software-based sequence control, centralized fire alarm annunciators and communications, and provisions for emergency operation. Specific design features and evaluation criteria are discussed. (Carroll-FRC)
W82-05472

PRODUCTION AND CONDITIONING OF SLUDGES FROM A HIGH-RATE BIOLOGICAL FILTER,

Commonwealth Scientific and Industrial Research Organization, Rockhampton (Australia). Meat Research Lab.
S. P. Moodie, and B. V. Kavanagh.
Water Pollution Control, Vol 80, No 5, p 674-681, 1981. 6 Fig, 3 Tab, 19 Ref.

Descriptors: *Biological filters, *Sludge conditioning, *Industrial wastewater, Food-processing wastes, Wastewater treatment, Clarification, Sedimentation, Chemical oxygen demand, Dewatering.

The treatment of meat processing wastewaters with pilot-scale biological filters has been the subject of several studies. However, most of these studies have investigated the effects of various operating variables on the removal of chemical oxygen demand (COD) from the wastewater. Little attention has been given to clarification of the effluent from these filters or to the disposal of the resulting sludges. This study of the use of pilot-scale high-rate biological filters for the treatment of meat processing wastewaters examined the settling characteristics of the effluent from the filter, the rate of sludge production, and the dewatering and chemical conditioning of the effluent from the filter. The emphasis of the study was on the development of information for design purposes. The study found that effluents from high-rate biological filters typically contain high levels of suspended solids and COD. As a result, clarification of these effluents is a significant factor in determining the overall degree of COD removal. Settling tests showed that meat processing wastewater requires a clarifier surface overflow rate of about 50 cubic meters per square meter per day to achieve removal of between 80 and 95% of settleable solids. The amount of sludge produced was found to be independent of the hydraulic rate and to have a mean value of about 0.35 kg dry solids per kilogram COD removed. Measurements of the specific resistance to filtration of the biological filter sludge indicated that chemical conditioning of the sludges would be necessary to facilitate dewatering by such devices as rotary vacuum filters or filter presses. Commercially available cationic polyelectrolytes and inorganic coagulants such as ferric chloride and alum were shown to be effective conditioning agents. (Carroll-FRC)
W82-05473

ORGANIC GROUPS AND MOLECULAR WEIGHT DISTRIBUTION IN TERTIARY EFFLUENTS AND RENOVATED WATERS,

Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
J. Manka, and M. Rebhun.
Water Research, Vol 16, No 4, p 399-403, April, 1982. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Pollutant identification, *Humic acids, *Tertiary wastewater treatment, *Advanced wastewater treatment, *Organic compounds, *Ultrafiltration, *Clarified wastewater, Separation techniques, Organic matter, Biological wastewater treatment, Chemical treatment, Clarification, Wastewater treatment, Lime, Chemical oxygen demand.

The molecular weight (MW) distribution and group composition of soluble organics in effluents from successive biological and chemical treatment stages were studied in efforts to follow their removal during advanced wastewater treatment processes. Molecular weight distributions were determined by ultrafiltration of effluent samples collected over a period of almost 2 years from the oxidation pond, lime clarifier, and after-lime polishing pond at the first-stage treatment plant of the Dan region Sewage Reclamation Plant at Tel-Aviv. The effluent contained relatively high COD and nitrogen levels. The effluents from the lime clarifier and after lime polishing pond were low in suspended solids and BOD and very low in phosphate. Humic substances were the most prevalent organic group in the oxidation pond samples, followed by proteins. The removal of 70% of the humic acid substances occurred in the lime clarifier. In the secondary effluents, about 61% of the

organics are included in the highest MW fraction. Maximum removals are obtained from the two highest MW fractions (72 and 65% respectively) in the advanced treatment. A correlation was noted between the emergence of an unidentifiable fraction after lime treatment and an increase in the lowest MW fraction in terms of absolute COD units. (Geiger-FRC)
W82-05480

SELECTED ORGANIC PESTICIDES, BEHAVIOR AND REMOVAL FROM DOMESTIC WASTEWATER BY CHEMICAL AND PHYSICAL PROCESSES,

North Texas State Univ., Denton. Inst. of Applied Sciences.
F. Y. Saleh, G. F. Lee, and H. W. Wolf.
Water Research, Vol 16, No 4, p 479-488, April, 1982. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Biological wastewater treatment, *Chemical coagulation, *Physicochemical treatment, *Organic pesticides, *Herbicides, *Halogenated pesticides, Domestic wastes, Wastewater treatment, Chemical treatment, Organic compounds, Separation techniques, Organic wastes, Pesticides, Activated carbon, Filtration.

The removal of selected chlorinated hydrocarbon pesticides and chlorophenoxy herbicides from a domestic wastewater by different regimes of biological, chemical, and physical treatment processes was examined qualitatively and quantitatively. Qualitative characteristic profiles showed a limited number of refractory organic residues on the chromatograms of extracts from each of the treatment units. In the biologically treated wastewater, 13 compounds including DDT and its metabolites, aldrin, dieldrin, and 2,4-D alkyl esters and salts were detected at the parts per trillion level. Chemical coagulation with alum-lime or lime-ferric chloride yielded slight reductions in the organic residues detected on the chromatograms. Mutimedia filtration had no noticeable effect on the organic residues remaining in wastewater after biological or chemical treatment. Activated carbon columns offered maximum removal of refractory organic residues when used for less than one year. The use of several sequences of treatment processes on domestic wastewater provided a high quality effluent virtually free of detectable organic residues. (Geiger-FRC)
W82-05481

INVESTIGATIONS OF NATURAL HUNGARIAN ZEOLITE FOR AMMONIA REMOVAL,

Veszpremi Vegyipari Egyetem (Hungary). Inst. for Analytical Chemistry.
J. Hlavay, G. Vigh, V. Olaszi, and J. Inczedy.
Water Research, Vol 16, No 4, p 417-420, April, 1982. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Separation techniques, *Ammonia, *Ion exchange, *Zeolites, *Nitrogen removal, Wastewater treatment, Municipal wastewater, Particle size, Cations, Synthetic hydrology, Nitrogen, Denitrification, Ammonium compounds.

Natural zeolites containing clinoptilolite have ion exchange properties showing a great affinity and selectivity for ammonium ions. The use of zeolite formed columns from Tokaj Mountain in Hungary for the removal of ammonia from synthetic and municipal wastewaters was studied under laboratory conditions. Particle size of the clinoptilolites played an important part in column performance. Na-from clinoptilolite in the particle size range of 0.5-1.0 mm gave optimal ion exchange at 5-7 BV/hr. Approximately 4.50 milligrams of ammonia-N/gram of clinoptilolite ammonia breakthrough capacity was achieved using synthetic wastewater in a column with inside diameter of 0.5 cm and 92 cm in length. Ten to twenty BV (bed volumes) of regenerant were required to remove 98-99% of the ammonia with flow rates of 5-7 BV/hr during regeneration of the ion exchange bed. (Geiger-FRC)
W82-05482

CONTROL OF ACTIVATED SLUDGE FILAMENTOUS BULKING--IV. EFFECT OF SLUDGE REGENERATION,

Prague Dept. of Water Technology and Environmental Engineering (Czechoslovakia).
J. Chudoba, M. Dohanyos, and P. Grau.
Water Science and Technology, Vol 14, No 1/2, p 73-93, 1982. 9 Fig, 1 Tab, 37 Ref.

Descriptors: *Sludge volume index, *Activated sludge process, *Regeneration, *Accumulation, Oxidation, Filamentous microorganisms, Microorganisms, Population dynamics, Wastewater treatment.

The accumulation-regeneration theory of microorganisms selection in activated sludge was verified in the laboratory. This theory is based on the observation that activated sludge organisms accululate and store soluble substrate prior to replication. This quantity of accumulated substrate is the accumulation capacity. It is assumed that the predominant microorganisms in a mixed culture are those with the highest accumulation capacity and rates. A sufficient regeneration period, which allows time for oxidation of the accumolated substrate, is necessary for optimum operation. An acculation-regeneration model is given. The two key parameters are the quantity of substrate removed which should be oxidized during the regeneration period and the average heterotrophic respiration rate in the whole system. The regeneration period is defined as the total period of activated sludge aeration in one acculation-regeneration cycle. Sludge volume index decreased with increases in the proportion of substrate oxidized and was < 200 ml per g only if more than 50% of the substrate was oxidized. Methods of reducing sludge bulking are illustrated in diagrams. (Cassar-FRC)
W82-05491

PROTEIN RECOVERY FROM DAIRY INDUSTRY WASTES WITH AEROBIC BIOFILTRATION,

Victoria Univ. of Manchester (England). Pollution Research Unit.
A. D. Wheatley, R. I. Mitra, and H. A. Hawkes.
Journal of Chemical Technology and Biotechnology, Vol 32, No 1, p 203-212, January, 1982. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Dairy industry, *Proteins, *Fungi, Wastewater treatment, Biofiltration, Filtration, Fusarium, Geotrichum, Aerobic conditions, Food-processing wastes.

The feasibility of recovering single cell protein on dairy industry wastes was studied. Field observations showed that wastes from five food or pharmaceutical plants (low pH and > 2.5 kg BOD loading per day) produced a predominantly fungal biomass. The most common species were Geotrichum and Fusarium. A detailed study of dairy wastes (butter, cream, milk bottling, cheese, yogurt, dried milk, and combinations of these) showed variations in species with type of waste and organic loading. In batch cultures Fusarium and Geotrichum grew within a pH range of 2-10, but the 5-8 range was optimal. Geotrichum grew between 7 and 35 C (optimum 28-31 C) and Fusarium grew between 12 and 36 C (optimum 28-30 C). Continuous cultures on horizontal fixed films produced 100 and 75 g per sq m of surface (dry weight) of Geotrichum and Fusarium, respectively. Biomass and growth rate were dependent on applied organic loading. A pilot plant for treating cheese, butter, and cream production wastes was run at pH 4-5 and 5-10 kg BOD per day per cu m. BOD removal was 30-50% and biomass production 0.1-0.5 kg per day (dry weight). The amino acid content was similar to that of other single cell proteins. The biomass was white and had a slight odor of stale milk. (Cassar-FRC)
W82-05497

INFLUENCE OF HIGH PARTIAL PRESSURE OF CARBON DIOXIDE AND/OR OXYGEN ON NITRIFICATION,

Water Research Center Stevenage (England).
G. L. Jones, and A. R. Paskins.
Journal of Chemical Technology and Biotechnology, Vol 32, No 1, p 213-223, January, 1982. 7 Fig, 3 Tab, 29 Ref.

Descriptors: *Nitrification, *Oxygen, *Carbon dioxide, *Bacteria, Wastewater treatment, Growth rates.

The high concentrations of carbon dioxide and oxygen in the mixed liquor of intensive wastewater treatment processes such as the oxygen activated sludge process. the Deep Shaft process, and the fluidized bed reactor inhibit nitrification. Mixed cultures of nitrifiers were exposed to different proportions of C02 and 0 while being maintained at constant pH (7.8) and temperature (20 C). The specific growth rate of the nitrifying bacteria was independent of C02 concentration to 20% produced acidic conditions. Addition of NaOH to maintain constant pH caused a buildup of Na ions to 26 g per cu dm after 10 days and a 50% reduction in dry weight of the culture. Nitrification was only 40-50% at pH 7.4 and nearly zero at pH 6.8 and below, compared with 100% at pH 7.8. Nitrifying bacteria were initially inhibited by high partial pressures of 0 but appeared to acclimatize and retain the ammonia-oxidizing ability even after exposure to lower partial pressures for several generations and subsequent reexposure to higher pressures. (Cassar-FRC)
W82-05498

THE INFLUENCE OF NITROGEN ON PHOSPHORUS REMOVAL IN ACTIVATED SLUDGE PLANTS,

Meiring (P. G. J.) and Partners (South Africa).
J. L. Barnard.
Water Science and Technology, Vol 14, No 1/2, p 31-45, 1982. 10 Fig, 2 Tab, 23 Ref.

Descriptors: *Activated sludge process, *Nitrogen removal, *Phoshorus removal, Wastewater treatment, Nitrates, Nitrification, Denitrification, Anaerobic conditions, Phoredox process, Dissolved oxygen, Oxygen, Organic carbon, Sedimentation, Sludge.

Nitrates can interfere with phosphorus removal in activated sludge plants under some conditions. Nitrates serve as alternate sources of oxygen, preventing anaerobic conditions. Nitrification should be avoided and nitrate concentrations kept low. When nitrification is required, the nitrates must be reduced to low levels by internal denitrification. Sufficient carbon (ratios of COD: TKN of 10:1 or greater) for nitrate removal and anaerobic conditions in a specific zone of the plant ensures good phosphate removal. Several practical meaures may be considered to achieve N and P removal at lower COD:TKN ratios: (1) partial bypass of the primary sedimentation process, (2) sludge return at times of low load, (3) avoidance of aeration or turbulence in the anaerobic zone, (4) prethickening of sludge to prevent return of liquid from the anaerobic phase, (5) adjustment of the zones' arrangement to suit the nature of the organic compounds in the sewage, (6) control of dissolved oxygen in the aeration basin to minimize return of dissolved oxygen to the anoxic basin, (7) prevention of aeration of phosphorus-containing wasted sludge, (8) a retention time of 2.5 hours in the anaerobic basin, and (9) supplementary chemical additions if cost-effective. (Cassar-FRC)
W82-05504

DEVELOPMENTS IN WASTEWATER HANDLING AT POWER PLANTS,

R. C. Rittenhouse.
Power Engineering, Vol 86, No 3, p 34-42, March, 1982. 2 Fig, 6 Tab.

Descriptors: *Powerplants, *Zero discharge, Wastewater treatment, Industrial wastewater, Waste treatment, Design criteria, Cooling towers, Evaporation, Water reuse, Thermal pollution, Monitoring.

Many options for wastewater handling systems at powerplants are available. The experiences at several zero discharge facilities, the efforts to reduce cooling tower blowdown, the problems of thermal

discharges, and recommendations for monitoring groundwater at powerplant disposal sites are presented. Retrofitting the operating Martin Drake Power Station, Colorado Springs, to produce zero discharge is described in detail. Designing a zero discharge system for a new plant is not limited by existing equipment capabilities. The wastewater system is so important that it should receive the same priority as the power block in the design stage. Zero discharge is not economically or environmentally feasible for every geographic area, and it must not be promoted as a cure-all or national goal for all powerplants. Other equipment can limit, rather than totally eliminate, waste discharges by side-stream softening, reuse of some streams as process water, and wet and dry scrubbers. Commercial methods available for reducing cooling tower blowdown are vapor-compression-evaporation, chemical softening in makeup and side-stream treatment modes, electrodialysis, and reverse osmosis. Some experimental methods are wet/dry cooling, indirect freeze concentration, foam-enhanced evaporation, and the magma cooling tower. There is much controversy in handling of thermal discharges, which in many cases have little or no adverse environmental effects, but must nevertheless be treated with expensive equipment. Proper handling of coal pile runoff, fly ash, bottom ash, and flue desulfurization wastes to prevent groundwater contamination are still being debated. (Cassar-FRC)
W82-05517

FACTORS TO BE CONSIDERED IN DISPOSING DOMESTIC WASTE ON PROBLEM SITES AND APPRAISAL OF WATER QUALITY IN A PIEDMONT SETTING,

North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Plant Science and Technology.
G. A. Gayle, G. B. Reddy, M. R. Reddy, S. M. Ross, and S. J. Dunn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232000, Price codes: A05 in paper copy, A01 in microfiche. Report No 160, June, 1981. 79 p, 20 Fig, 16 Tab, 28 Ref. OWRT A-105-NC(1), 14-34-0001-9035.

Descriptors: *Domestic wastes, *Water quality, *Waste disposal, *Impervious soils, *Septic tanks, Wastes, Wastewater treatment, Soils, Slopes, On-site tests, Flow rates, Flow characteristics, Water table rise, Septic wastewater, Wastewater absorption, Field capacity.

A method is proposed for sizing septic tank absorption fields by examining the effect of domestic waste on water quality and water table elevations. The necessity for thorough on-site evaluation of sloping impermeable soils such as those encountered in the study area is emphasized. On-site determinations were made on hydraulic conductivity, percolation, infiltration rates, and water quality. To characterize flow, it was necessary to ascertain the relation between design-flow rate and the water table rise in terms of soils and site parameters. A published method was used to determine the uniform flow depth on sloping soils which allowed the determination of the flow rate and on estimation of trench length to be made. This method showed good agreement with a standard method. Water quality studies suggested the principal ionic species in wells to be calcium, magnesium, sodium, and bicarbonate, and that most of the deep wells produce water from two different aquifers. In addition, most well water was found to be relatively hard, and nitrate and phosphorus were below EPA limits. However, the observed presence of fecal coliforms, apparently from adjacent septic systems, indicate a potential community health hazard. (Zielinski-MASIMA)
W82-05536

FIELD TEST EVALUATION RESEARCH AND DEVELOPMENT AND OPERATION AND MAINTENANCE OF REVERSE OSMOSIS SYSTEMS AND ELECTRODIALYSIS PILOT PLANTS AT ROSWELL TEST FACILITY.

For primary bibliographic entry see Field 3A.
W82-05555

FURTHER RESULTS ON THE PERFORMACE OF PRESENT-DAY OSMOTIC MEMBRANES IN VARIOUS OSMOTIC REGIONS,

InterTechnology/Solar Corp., Warrenton, VA.
For primary bibliographic entry see Field 3A.
W82-05660

EFFECTS OF SALTS ON ACTIVATED CARBON ADSORPTION OF FULVIC ACIDS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W82-05667

REMOVING TRIHALOMETHANE PRECURSORS BY PERMANGANATE OXIDATION AND MANGANESE DIOXIDE ADSORPTION,

Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5F.
W82-05668

EVALUATING REGENERATED ACTIVATED CARBON THROUGH LABORATORY AND PILOT-COLUMN STUDIES,

Philadelphia Water Dept., PA.
For primary bibliographic entry see Field 5F.
W82-05670

CONSIDERING SLUDGE PRODUCTION IN THE SELECTION OF COAGULANTS,

Montgomery (James M.), Inc., Reston, VA.
For primary bibliographic entry see Field 5F.
W82-05675

REACTIVITY OF HALOGENS WITH AQUEOUS MICROPOLLUTANTS: A MECHANISM FOR THE FORMATION OF TRIHALOMETHANES,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W82-05678

ANAEROBIC TREATMENT IN NOVEL CONTACT DIGESTER,

Duncan, Lagnese and Associates, Inc., Pittsburgh, PA.
J. A. Oleszkiwicz, and S. Koziarski.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 367-378, April, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Anaerobic conditions, *Wastewater treatment, Oxygen demand, Biochemical oxygen demand, Chemical oxygen demand, Industrial wastes, Animal wastes, Barn wastes.

Various methods of anaerobic digestion are compared as applied to the treatment of dilute piggery wastewaters from an industrial scale piggery. The work encompassed batch tests, studies in anaerobic flow-through digesters without sludge recycle, studies in contact digesters with continuous sludge recycle, and studies in upflow anaerobic biofilters. Specific attention is given to the results of the continuous sludge recycle reactors study, which was designed as a combined unit encompassing both vigorous jet mixing with digester gas and quiescent sludge blanket upflow biofiltration-clarification. The studies explored the lower limits of hydraulic retention time (HRT) and the upper limits of organic loadings to the reactor. Gas production and methane content were studied and compared with gas yields from the anaerobic flow-through digesters. Raw piggery waste substrate was used as feed with chemical oxygen demand contents of 13-14 g/liter. The studies demonstrated the feasibility of obtaining methanogenic conditions at HRT as low as 0.5 d and corresponging organic load of 38 kg COD/cubic meter/day. Satisfactory secondary treatment was attained at HRT of 3.5 day and a load of 4 kg COD/cubic meter/day, yielding steady state chemical oxygen demand removals in excess of 85% and filtered effluent COD and BOD of 1,200 and 500 mg oxygen/liter, respectively. The biogas production at that loading is 3.15 cubuc meters/day. 75% of which was methane, which corresponds to 0.17 cubic meters/kg COD removed. (Baker-FRC)
W82-05681

ALGORITHM FOR OPTIMAL ACTIVATED SLUDGE OPERATION,

Lewis and Clark Law School, Portland, OR.
P. W. Hughey, D. D. Meredith, and A. C. Middleton.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 349-366, April, 1982. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Activated sludge processes, *Optimization, Systems analysis, Planning, Wastewater treatment, Sludge, Algorithms, Mathematical studies.

The objective of the present paper is to present a concise, readily usable, and efficient method for performing cost optimization in the operation of the activated sludge system by using realistic models for the unit processes. A method has been presented for determining the minimum cost operation of an activated sludge wastewater treatment plant for several time periods. This method was applied to a plant in Erie County, New York. The method uses a search technique for discrete valued variables to optimize a nonlinear cost function for the operation of an activated sludge process. To present the method and computational procedures, an example activated sludge system is presented. The operation of the activated sludge process was formulated as an optimization problem with nonlinear cost functions and realistic models for the unit processes. A complex method of constrained optimization for discrete-valued variables is also presented, and an example problem is solved for an existing plant. The complex method proved to be an efficient procedure for determining the optimal operation of an activated sludge wastewater treatment system. The procedure allows the use of nonlinear objective function, nonlinear noncontinuous constraints, and noncontinuous variables. Therefore, realistic process models and actual physical constraints can be used. The optimal operation procedures are obtained directly from the algorithm. The algorithm is developed so that the operator can use it with the same input data and data format that he is generally accustomed to using. Inflows for each period of operation need to be included in the analysis. However, the analysis may now be done for several different inflow sequences to determine operation sensitivity to inflows. (Baker-FRC)
W82-05682

SEWERS AND CITIES: FRANCE AND THE UNITED STATES COMPARED,

National School of Bridges and Roads, Paris (France).
G. Dupuy, and J. A. Tarr.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 327-338, April, 1982. 13 Ref.

Descriptors: *Wastewater treatment, *Sewer systems, France, United States, Reviews, Public policy, Urban wastewater, Political aspects, Governmental interrelations, Public health, Federal jurisdiction, Wastewater disposal, Storm runoff, Public investment.

This article attempts to compare the development of technological systems for the removal and disposal of human wastes in France and the United States. The areas addressed include the motivations driving technological innovation in the waste removal and disposal area, factors affecting system choice, the development and impacts of systems, and the relative roles of government, professional groups, and the public in influencing decisions. It was concluded that innovations in the water and wastewater areas were often made without fully understanding either the operation of systems being replaced or the possible impacts of the innovation. The primary anticipatory failures concerned the impacts of urban water systems and the

disposal of the wastewater generated. Sewerage technology transferred the locus of pollution and hazards to public health from the immediate locale to downstream or down-lake cities. The resulting political and policy conflict over water quality illustrates the difficulty in changing a capital-intensive technology, implemented for beneficial reasons, when the negative impacts of the technology are felt by second parties. The existence of an in-place capital intensive technology and the policy of dealing with its negative impacts by retrofit discouraged attempts to deal with the original problem by alternative means. Due to the transport of pollutants over political boundaries, wastewater technology resulted in an upward shift of governmental regulatory power from local to the state and federal levels. General societal values such as a belief in progese and technological optimism were integral to the acceptance of the technology. (Baker-FRC)
W82-05684

ROTATING BIODISKS RECARBONATE ALKALINE WASTEWATER,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
C. I. Noss, R. D. Miller, and E. D. Smith.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 339-348, April, 1982. 5 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Nitrification, Alkalinity, Phosphorus, Lime, Rotating biological contactor, Microorganisms.

A study was performed on phosphorus removal by low-level lime (pH 9.5) precipitation in the primary clarifier, followed by biological recarbonation using the rotating biological contactor (RBC) process. The enhancement of nitrification by a chemically induced increase in pH was also demonstrated. The desired goal was to determine if the microbial populations attached to an RBC could function under the stress of elevated pH. Uniform flow rates were applied, thereby eliminating diurnal flow variations which could have affected recarbonation during full-scale treatments. The low level lime addition resulted in high alkalinity in the RBC at an optimum pH for nitrification. It also reduced the biochemical oxygen demand (BOD) loading to the RBC, which should increase the media surface area available for nitrifying organisms. Recarbonation and phosphorus removal were achieved at hydraulic loadings of 2.0,3.0, and 4.0 gal/day/square foot (0.08,0.12, and 0.16 cubic meters/square meter/day), but organic substrate removal was less efficient and nitrification was far less efficient at high loading. Splitting the wastewater influent among RBC stages did not significantly alter the performance of this system. (Baker-FRC)
W82-05685

PHARMACEUTICAL WASTE TREATMENT BY ANAEROBIC FILTER,

Camp, Dresser and McKee, Inc., New York.
E. F. Sachs, J. C. Jennett, and M. C. Rand.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 297-314, April, 1982. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Filter media, Pharmaceutical industry, Organic compounds, Industrial wastes, Anaerobic conditions, Adsorbents, Biochemical oxygen demand, Oxygen demand.

A study was designed to investigate the physical characteristics, chemical composition, and variations of wastewater from chemically synthesized pharmaceutical production, apply that waste to the anaerobic filter and determine its treatability. The anaerobic filter sucessfully treated the pharmaceutical waste at an influent chemical oxygen demand (COD) condentration of 2,000 mg/liter when operated at 35 degrees C utilizing a 36 hour hydraulic retention time, while producing constant COD removal efficiencies of 70-80% and biochemical oxygen demand (BOD) removals of 94%. The anaerobic filter exceeded the performance of the existing treatment scheme by 33% in terms of lb COD/1,000 cubic feet/day removed, and also greatly reduced the effluent color. The anaerobic filter could not withstand a threefold concentration increase as a shock loading as evidenced by 18% COD and 25% BOD reductions while feeding an influent COD concentration of 6000 mg/liter at a 36 hr hydraulic retention time. The anaerobic filter proved very useful as a pretreatment device for the treatment of chemically synthesized pharmaceutical waste. Low cellular synthesis rates and long solids retention times enable it to treat waste efficiently without the need for solids wasting. (Baker-FRC)
W82-05686

TREATABILITY OF TYPE A ZEOLITE IN WASTEWATER--PART I,

Procter and Gamble Co., Cincinnati, OH.
J. E. King, W. D. Hopping, and W. F. Holman.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2875-2886, December, 1980. 5 Fig, 5 Tab, 26 Ref.

Descriptors: *Zeolite, *Sewer systems, *Suspended solids, *Primary treatment, Detergents, Activated sludge process, Trickling filters, Wastewater treatment, Trace metals, Coagulation, Plumbing.

Type A Zeolite, a silica-alumina detergent builder with a particle size of 3-4 microns, did not accumulate in wastewater collection systems or adversely affect primary of secondary treatment processes. The sodium form of this agent is present in laundry formulations and the calcium form in wastewater. Testing was performed with concentrations of zeolite considerably higher than the 10 mg per liter expected under normal conditions. Examination of washing machine plumbing made of copper, iron, and polyvinyl chloride revealed only a very thin layer at some locations, apparently as a function of roughness, after a equivalent of 4-5 months of average home washing machine use. Sink traps contained no deposits ascribable to Zeolite Type A. Sewer lines in a village where 75 of 109 households used Zeolite Type A detergents had small amounts of the builder in the surface sediment layer. No long term accumulation or flow impairment was likely. In settling tests which modeled primary treatment, Type A Zeolite was removed with the other suspended solids. Model activated sludge and trickling filter processes removed 98% of the Zeolite; full-scale processes would probably be 80% effective. Both the smallest size fraction and the bulk material were removed to the extent of 97-98% by primary treatment and activated sludge-secondary clarification. Addition of ferric chloride, alum, or lime removed nearly 100% of the zeolite compared with 33-72% without chemical treatment. The activated sludge treatment of linear alkylbenzene sulfonate was not affected by addition of the Ca form zeolite up to 444 mg per liter. Effluent concentrations of trace metals were not adversely affected by the presence of the zeolite. (Cassar-FRC)
W82-05687

TREATABILITY OF TYPE A ZEOLITE IN WASTEWATER--PART II,

Procter and Gamble Co., Cincinnati, OH.
W. F. Holman, and W. D. Hopping.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2887-2905, December, 1980. 12 Fig, 11 Tab, 25 Ref.

Descriptors: *Zeolite, *Septic tanks, *Sludge conditioning, *Suspended solids, Settling velocity, Detergents, *Wastewater treatment, Percolation, Sludge thickening, Activated sludge, Anaerobic digestion, Dewatering.

The presence of the detergent builder, Type A Zeolite, in wastewater did not adversely affect sludge treatment processes or home wastewater treatment systems. The settling velocity of activated sludge was doubled at zeolite concentrations up to 20% of suspended solids (SS). The following processes were not adversely affected by zeolite: anaerobic digestion of sludge (up to 20% of SS); dewatering properties of unconditioned activated sludge (up to 53% of SS); dewatering properties of unconditioned anaerobic digester sludge (up to 20% of SS); and dewatering properties of chemically conditioned activated and anaerobic digester sludges (up to 20% of SS). The dosage of conditioning chemicals was not affected at zeolite concentrations up to 10% of SS. Laboratory septic tank units removed > 97% of the zeolite; field septic tanks, 81-88%. Process efficiencies, sludge volume, and soil percolation rate were not meaningfully affected. (Cassar-FRC)
W82-05688

EXAMINATION OF PROCESS PARAMETERS AFFECTING SLUDGE DEWATERING WITH A DIAPHRAGM FILTER PRESS,

K. A. Pietila, and P. J. Joubert.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1708-1716, December, 1981. 13 Fig, 5 Tab, 8 Ref.

Descriptors: *Sludge filters, *Dewatering, *Filtration, Sludge solids, Diaphragm filter press, *Wastewater treatment.

The diaphragm filter press for sludge dewatering is a two-step process--filtration and squeezing. It achieves the same % cake solids as the conventional presses but in only 15-25% of the time. Several process parameters were investigated in field tests at 11 treatment plants: cake solids, solids recovery, cake discharge characteristics, yield, feed solids, chemical dosage, filtration time, and squeeze time. As filtration time increased, cake solids decreased and sludge throughput increased. As squeeze time increased, cake solids increased and solids throughput decreased. As feed solids increased, cake solids and solids throughout increased with lower chemical requirements. As chemical dosage increased, cake solids and solids throughput increased. The diaphragm filter press has advantages over a conventional pres: wide range of process flexibility and substantial reduction in chemical dosage. Proper cloth selection and cake discharge are necessary for maximum solids throughput. (Cassar-FRC)
W82-05695

MATERIALS BALANCE IN AERATED STATIC PILE COMPOSTING,

Science and Education Administration, Beltsville, MD.
L. J. Sikora, G. B. Willson, D. Colacicco, and J. F. Parr.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1702-1707, December, 1981. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Sludge cake, *Composting, *Aerobic conditions, Aeration, Decomposition, Sludge disposal, *Wastewater treatment.

Composting of wastewater sludge by the aerated static pile method was studied for a year to determine the material balance for design purposes. The pile base was 20 cu yd of used wood chips. Wood chip bulking agent (72 cu yd) was mixed with 30 tons of 22% solids sludge and covered with 64 cu yd of unscreened compost as a blanket. The dimensions of the pile were 45 ft x 18 ft x 8 ft. Aeration was provided for the 21-day cycle to produce temperatures averaging 80 C. Thirty tons of wastewater sludge filter cake produced 11.5 wet tons (27 cu yd) of screened compost. At each cycle about a third of the wood chips had to be replaced. The dry weight loss was 4.7 tons (11% of the initial dry weight) and the wet weight loss was 21 tons, equivalent to 5000 gal of water. (Cassar-FRC)
W82-05696

CRITERIA FOR ACHIEVING PATHOGEN DESTRUCTION DURING COMPOSTING,

Science and Education Administration, Beltsville, MD.
W. D. Burge, D. Colacicco, and W. N. Cramer.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1683-1690, December, 1981. 3 Fig, 1 Tab, 34 Ref.

Descriptors: *Composting, *Pathogens, *Coliphages, Fate of pollutants, Sludge, Viruses, Bacteria, Parasites, Coliforms, Enteric bacteria, Enteroviruses, Monitoring, Graphical methods, Wastewater treatment.

The f2 coliphage was a suitable indicator organism for determining the state of pathogen destruction in wastewater sludge compost piles. A literature search showed that this coliphage was more resistant to heat inactivation than any other enteric pathogen, except for some atypical mycobacteria. A family of curves was constructed relating time and temperature with logs of f2 inactivation. Direct determination of pathogens was not necessary. The degree of pathogen destruction was determined by monitoring compost pile temperatures at the coolest part of the pile, the toe or lower edge. To account for the temperature uncertainty inherent in composting sludge, a reduction of 15 logs of f2 concentration was suggested for complete pathogen destruction. (Cassar-FRC)
W82-05697

BIOFILTRATION DESIGN BASED ON VOLUMETRIC LOADING,

Research Inst. for Environmental Development, Wroclaw (Poland).
J. A. Oleszkiewicz.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2906-2913, December, 1980. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Biofilters, *Organic loading, *Oxygen uptake, Activated sludge process, Trickling filters, Kinetics, Model studies, Mathematical models, *Wastewater treatment, Biological wastewater treatment, Industrial wastewater.

A model equating removal efficiency in biofilters to an exponential function of organic loading was shown to be applicable in cases where the Eckenfelder model gives insufficient correlation. The activated sludge and trickling filter models based on applied organic loading were shown to converge. The autooxidation coefficients were directly proportional to the biological activity of the slime and increased whenever slime showed increases in oxygen consumption. (Cassar-FRC)
W82-05698

SEPTAGE AND WASTEWATER TREATMENT IN THE ACTIVATED SLUDGE PROCESS,

Lowell Univ., MA.
B. A. Segall, and C. R. Ott.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2655-2665, November, 1980. 4 Fig, 8 Tab, 3 Ref.

Descriptors: *Municipal wastewater, *Design criteria, *Wastewater management, *Septic sludge, *Organic loading, Municipal wastes, Activated sludge, Clarifiers, Dissolved oxygen, Separation techniques, Wastewater treatment, Solid wastes.

Since septage is generally not accepted by municipal wastewater treatment plants in the Commonwealth of Massachusetts, this type of waste is discharged directly to land and surface waters. A septage monitoring program was carried out at the large Marlboro Easterly Wastewater Treatment Plant to determine feasible septage capacities for wastewater treatment facilities. Treatment cost and effluent quality were also examined. Results showed that a 2% addition of septage, on the average, doubles solids and organic loading on the treatment facility. Septage organic and solids content can be removed by a conventional activated sludge process. Septage did not markedly change oxygen utilization rates nor cause excessive short circuiting at feeding rates of 37% of the design flow rate and at wastewater flow within the design rate. Accumulation of anaerobic solids at the bottom can cause sludge upsets, especially during the summer months. In designing clarifiers for combined wastewater and septage solids removal, effluent quality, sludge removal, and surface skimming are critical. While septage seems to enhance settling and removal efficiency, particular attention should be paid to the skimming mechanism design. Fast removal of settled solids requires adequate pump and dewatering capacity. (Geiger-FRC)
W82-05699

LOAD FACTORS AND NON-DESTRUCTIVE TESTING OF CLAY PIPE,

National Clay Pipe Inst., Crystal Lake, IL.
For primary bibliographic entry see Field 8G.
W82-05700

EFFECTS OF CHEMICAL ADDITION ON THE PERFORMANCE OF SETTLING TANKS,

Toronto Univ. (Ontario). Dept. of Civil Engineering.
G. W. Heinke, A. J. Tay, and M. A. Qazi.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2946-2954, December, 1980. 5 Fig, 5 Tab, 17 Ref.

Descriptors: *Primary treatment, *Settling tanks, *Coagulation, *Wastewater treatment, Ferric chloride, Polymers, Design criteria, Suspended solids, Biological oxygen demand, Phosphorus removal.

Addition of ferric chloride and polymers to wastewater primary treatment tanks for the purpose of phosphorus removal produced secondary benefits. A 4-year study at three Ontario treatment plants revealed that chemical addition caused suspensions to settle more quickly. In design of new plants, smaller tanks may be used; for existing plants the settling tank capacity is substantially increased, avoiding or delaying expansion. BOD and suspended solids removal in the primary stage was enhanced. In some cases effluent was of high enough quality to discharge without further treatment. In others the load to the secondary system was greatly decreased. Costs for the chemicals were offset by decreases in capital costs for the primary and secondary treatment plants. However, more sludge was produced by the chemical addition. The following tentative design guidelines were proposed for primary horizontal-flow clarifiers treating domestic wastewater: design flow rate of 1.5 to 2.0 times the average daily flow, detention tiimes of 10-30 min with chemical addition and 20-45 min without, overflow rate of < 1.2 liters per sq m per sec under maximum flow conditions, velocity of < 8 ft per min under maximum flow conditions, and suspended solids removal efficiency of 70% with ferric chloride, 85% with ferric chloride plus polymer, and 40-50% with no chemical addition. (Cassar-FRC)
W82-05701

THE XIII OLYMPIC GAMES AND ENVIRONMENTAL QUALITY PERSPECTIVE,

D. A. Corliss, and K. Freiling.
Clearwaters, Vol 10, No 2, p 6-7, 9, June, 1980.

Descriptors: *Environmental effects, *Slope stabilization, *Wastewater treatment, Lake Placid, Olympic Games, New York, Soil stabilization, Sludge disposal, Erosion, Recreation wastes, *Waste disposal.

Waste disposal at Lake Placid, New York, during the Winter Olympic Games in 1980 had a minimal environmental impact. Sediment generated during construction caused stream load violations on numerous occasions. The problem was solved by using a properly designed and maintained sedimentation basin, and, on slopes, jute mesh, slope stabilization, and seeding. Portable toilet wastes were hauled to the Lake Placid treatment plant for treatment. Although a 10,000 gal holding tank was planned to control silver-containing photographic developing wastes from the Kodak film processing installation, it was not necessary because a silver recovery system was installed. Receiving streams were monitored continuously during the Olympic period. Flow in Lake Placid's treatment plant (2.5 mgd design capacity and 1.0 mgd normal winter flow) averaged 1.5-1.98 mgd during the peak period. Effluent COD did not exceed 120 mg per liter on any day. (Cassar-FRC)
W82-05703

LAND APPLICATION OF SECONDARY EFFLUENT AT LAKE GEORGE, NY,

D. B. Aulenbach, and N. L. Clesceri.
Clearwaters, Vol 10, No 2, p 16-21, June, 1980. 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Land application, *Tertiary wastewater treatment, *Sand filters, Lake George, New York, Wastewater treatment, Filtration, Trickling filters, Recreation wastes, Infiltration, Water quality, Nutrients, Nitrates, Phosphates, Environmental effects.

Since 1939 secondary effluent from the resort community of Lake George, New York has been successfully treated without chlorination by application to natural delta sand by intermittent dosing using the rapid infiltration technique. The system consists of sedimentation, sludge digestion, trickling filter treatment, secondary sedimentation, and land application. At present the maximum daily summer flows approach 1.3 mgd, near the treatment plant design capacity of 1.75 mgd. Occasionally all the sand beds are full and effluent is applied to beds in an adjacent field. If both force main pumps are running simultaneously, the flow reaches 2.5 mgd. This creates turbulent flow in the primary settling tanks and increases the suspended solids load to the trickling filters. In spite of temperatures s low as -30 F and occasional ice cover, the sand beds function satiffactorily. Infiltration rates vary between 0.3 and 1 ft per day. Immediately after cleaning (scraping, discing, and releveling) infiltration rates of 2.5 ft per day are observed. Average annual application is 63% of infiltration capacity for a slow bed and 82% for a fast bed. During the extreme conditions of August 1976 (heavy rainfall at a time of peak sewage flow) 100% of capacity was reached. Since the water ultimately returns to Lake George via seepage into streams, water quality is monitored for nutrients and bacteria. Biodegradable matter, coliforms, and fecal streptococci are removed in the top of the sand. Viruses were not determined. The seepage water, of drinking water quality, contains 5-6 mg per liter more nitrate and 2 micrograms per liter more otheophosphate than background levels of the local groundwater. (Cassar-FRC)
W82-05704

POISONS IN THE HUDSON,

For primary bibliographic entry see Field 5G.
W82-05705

DIE-AWAY KINETICS OF AEROSOLIZED BACTERIA FROM SPRINKLER APPLICATION OF WASTEWATER,

Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
B. Teltsch, H. I. Shuval, and J. Tadmor.
Applied and Environmental Microbiology, Vol 39, No 6, p 1191-1197, June, 1980. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Wastewater disposal, *Land disposal, *Bacteria, Mortality, Pathogens, Escherichia coli, Mathematical equations, Aeration, Aerosols, Public health, Wastewater treatment.

Increased emphasis on wastewater reuse and disposal by land treatment has emphasized the need for a means of predicting the concentration of aerosolized pathogenic microorganisms downwind from the wastewater spray or aeration site. Wastewater treatment processes involving aeration can lead to the formation of aerosols which contain concentrations of enteric microorganisms 100 times or more greater than that detected in the ambient liquid. This paper presents a methodology for estimating, under field conditions, the microbial die-away constant. This constant may be used in predicting the aerosolized pathogenic microorganism concentrations downwind from a spray or aeration site by means of modified atmospheric diffusion equations. Experiments conducted using Escherichia coli labeled with tritium demonstrated that there was a much slower rate of bacterial die-away in the morning than in the afternoon, when the meteorological conditions were more hostile to airborne bacteria. (Carroll-FRC)
W82-05706

SEWAGE PUMPING STATION SPLIT FOR MAINTENANCE,

Wilson and Co., Witchita, KS.
J. C. Dowell, and S. Wood.
Amerocan City and County, Vol 97, No 4, p 60-61, April, 1982. 1 Fig.

Descriptors: *Pumping plants, *Maintenance, Pumps, Wastewater treatment, Wichita, Kansas.

A dual-flow design permits half of the Wichita, Kansas, sewage pumping station to be shut down for maintenance and repairs while the other half continues to operate. The 160 mgd plant receives 35 mgd of bar-screened raw sewage during normal dry weather service. Each half of the pumping station contains a 17 ft wide, 22 ft long, 16 maximum depth wet well, four 24 inch sewage pumps (2 constant speed drive and 2 variable speed drive). The constant speed pumps are used only during wet weather flow. This arrangement is expected to handle growth in volume for the next 20 years. (Cassar-FRC)
W82-05719

'COMPUTERIZED' MEANS COST-EFFECTIVE FOR SEWAGE TREATMENT,

Thorn Creek Basin Sanitary District Water, Chicago Heights, IL.
R. A. Davis, and J. L. Daugherty.
American City and County, Vol 97, No 3, p 39-44, March, 1982.

Descriptors: *Computers, *Control systems, *Automation, *Wastewater treatment, Thorn Creek Basin Sanitary District, Chicago Heights, Illinois.

A computerized system was installed in the Thorn Creek Basin Sanitary District's advanced treatment plant in Chicago Heights, Illinois. The high speed digital processor is supported by printers, a remote station, and a color cathode ray tube display console. The computer logs all types of data as required and produces a 31-page monthly report. It supervises many operations including calculations, pumping, running blowers, chlorination, and flow control. A large variety of information is readily available for example, inputs and outputs, alarm occurrences, laboratory data, equipment status, and simulations. A computer system can save money through centalization of equipment, extended service life of equipment, manpower reduction, and energy conservation. (Cassar-FRC)
W82-05720

THE MECHANISM OF URANIUM BIOSORPTION BY RHIZOPUS ARRHIZUS,

McGill Univ., Montreal (Quebec). Dept. of Chemical Engineering.
M. Tsezos, and B. Volesky.
Biotechnology and Bioengineering, Vol 24, No 2, p 385-401, February, 1982. 10 Fig, 22 Ref.

Descriptors: *Uranium, *Biomass, Adsorption, Heavy metals, Wastewater treatment, Microorganisms, Industrial wastewater, Fungi, *Rhizopus.

This article presents an account of the work which led to the formation of a hypothesis on the mechanism of uranium biosorption by inactive Rhizopus arrhizus biomass. Experimental techniques used in the study included electron microscopy, x-ray energy dispersion analysis, and infrared spectroscopy, and supporting evidence was obtained for a biosorption mechanism consisting of at least three processes. Uranium coordination and adsorption in the cell wall chitin structure occurred simultaneously and rapidly, whereas precipitation of uranyl hydroxide within the chitin micro-crystalline cell wall structure took place at a lower rate. Interference of iron and zinc coions with uranium biosorption was indicated. Interference with any of these three processes can affect negatively the overall uranium biosorptive uptake. Such interference could involve the blocking of chitin amine nitrogen by other ions forming complexes or the increase in solubility of the adsorbate by changing the solution acidity. Uranium biosorption by inactive R. arrhizus is clearly a physicochemcial process with a considerable potential for technical applications, including industrial wastewater treatment. (Baker-FRC)
W82-05723

AN OVERVIEW OF POROUS PAVEMENT RESEARCH,

Municipal Environmental Research Lab., Edison, NJ. Storm and Combined Sewer Section.
R. Field, H. Masters, and M. Singer.
Water Resources Bulletin, Vol 18, No 2, p 265-270, April, 1982. 3 Fig, 8 Ref.

Descriptors: *Storm water, *Paving, *Urban runoff, *Porous media, Asphaltic concrete, Concretes, Water management, Runoff volume, Design criteria, Recharge, Groundwater recharge, Drainage.

Porous pavement is a storm water management technique usable on parking lots and low traffic roadways to reduce runoff volume and pollution while increasing groundwater recharge. Cost reductions can result from elimination of curbs, drains, and small storm sewers. Porous asphalt pavements are a thin layer (0.75-1 inch) of open graded asphalt concrete mix overlying a deep base of large crushed stones. The surface coat has a coarse texture and a high void space ratio. This structure allows water to quickly enter the crushed stone layer, where it gradually drains to the subbase or in a lateral direction. Other surfaces include concrete lattice blocks and porous concrete. Each design situation is unique. However, a few general design suggestions can be mentioned. Most soils, with proper drainage, will be suitable. The base aggregate must be hard, durable, and angular. The surface aggregate should be 2 inches of 0.5 inch crushed stone. The porous asphalt concrete surface layer has a void volume of 16%. The asphalt is 50 to 100 penetration grade, according to climate, and 5.5 to 6% of total pavement weight. Current research programs are described. One concerns the long-term structural integrity of pavements under severe environmental conditions, and the other compares different types of porous pavement construction. (Cassar-FRC)
W82-05744

SEAWATER RO HEADS JAPAN'S WATER REUSE RESEARCH.

For primary bibliographic entry see Field 3A.
W82-05756

TRACKING SEASONAL LOAD VARIATIONS,

Worcester County Sanitary District, MD.
N. Connell.
Water/Engineering and Management, Vol 129, No 3, p 52, 54, March, 1982. 3 Fig.

Descriptors: *Wastewater treatment, *Seasonal variations, Water treatment facilities, Design criteria, Ocean City, Maryland, Tourism.

A serious problem in municipal wastewater treatment plants in resort areas is seasonal load variation. A primary treatment plant was designed for Worcester County Sanitary District at Ocean City, Maryland, to deal with this problem. New clarifiers with sludge withdrawal circuits for continuously seeding upstream aeration tanks are key elements in the design modifications. Primary treatment begins when the raw influent from the community enters a large grit chamber which channels the flow to a wet well and pump station for distribution to two inverted-siphon clarifiers. Automatic skimmers traverse the periphery of the clarifiers every 4½ minutes, removing oil and scum to scum tanks. The underflow continues on to thickeners. In summer the thickener underflow is fed to a disintegrator. In winter the underflow is piped to two clarigesters - combination units promoting clarification and digestion. Off-season storage of sludge provides frequent breaks for inspection and maintenance of plant equipment. During the summer of 1976 the plant incinerated about 473,200 lb of dry solids. The oxygen waste-activated sludge process secondary treatment system was added to the Ocean City facility in March of 1981. System biomass is broken into three trains capable of handling a summer seasonal maximum of 12 mgd. In winter this drops to as low as 2 mgd. Thus process engineering efforts have successfully met the problem of seasonal waste load variation in Ocean City. A clean outfall is now discharged directly to the Atlantic Ocean and an inert biomass is trucked to a regional Maryland storage lagoon for injection to crop lands. (Baker-FRC)
W82-05787

RIGHT VELOCITY KEEPS THE SOLIDS UP,

Garland Wastewater Treatment Dept., TX.
B. Cook.
Water/Engineering and Management, Vol 129, No 3, p 49-50, March, 1982. 3 Fig.

Descriptors: *Wastewater treatment, *Water treatment facilities, Equalizing basins, Basins, Equalizing reservoirs, Balancing reservoirs, Construction, Design criteria.

The Duck Creek Wastewater Treatment Plant in Garland, Texas, features an oval equalization basin more than four times the length of a football field, surrounded by a sloping embankment resembling a stadium grandstand. The basin provides fully controlled flow of the wastewater to the plant, which incorporates both biological and chemical treatment. Flow control substantially reduces the quantities of chemicals used in the process and generates significant savings. About 25% of the wastewater is industrial. With a peak capacity of 30 mgd and a daily average flow of 15.5 mgd, the plant serves a population of about 100,000. Influent enters the equalization basin untreated. The basin acts as a surge facility to ensure controlled flow, as well as keeping the grit, sand and other solids suspended in the wastewater. It also introduces air to provide an adequate dissolved oxygen content. Wastewater flows from the basin through a grit chamber and bar screens, then into a pumping station where the flow is split into two streams. One stream is directed to a biological activated sludge treatment facility and the other through a chemical treatment plant incorporating four clarifiers with lime, ferric chloride and polymer injection for solids flocculation and settling. Wastewater is then piped to a recarbonation basin, where carbon dioxide lowers the high pH. It is then pumped through ultra-high rate mixed media filters and chlorinated for disinfection before discharge. Flow from the biological treatment facility joins the chemically treated stream before chlorination. (Baker-FRC)
W82-05788

SAVING WATER SCENICALLY,

Camp, Dresser, and McKee, Inc., Albuquerque, NM.
J. Burgh.
Water/Engineering and Management, Vol 129, No 3, p 46-47, March, 1982. 1 Fig.

Descriptors: *Water conservation, *Aesthetics, *Wastewater treatment, Design criteria, Construction, Wastewater facilities, Water treatment facilities, Wastewater renovation, Water reuse, Tourism.

An unusual wastewater reclamation system tailored to stringent site, recreational and aesthetic constraints was installed at the Bishop's Lodge resort in New Mexico. Designed to be an integral part of the resort, the system provides secondary treatment through a packaged extended-aeration plant. Effluent is either used for pasture irrigation or passed through pressure filtration and a pool and waterfall display which provides further aeration and exposure to sunlight. Water supply in this area of the country has always been limited, with an annual precipitation rate averaging only 13 inches. Tourists pass the treatment facility site, and therefore odors, noise and visual nuisances had to be strictly controlled. The potential for nitrate contamination of the valley's groundwater was an important consideration. An extremely short construction season had also to be considered. The arrangement as designed not only blends into the natural terrain, but also complements the riding and hiking trails. The secondary treatment unit is screened from view by means of earth mounds and plantings. Surrounding the pool system are foot

paths for strolling, and one of the principal pack trails crosses through a waterfall halfway up the hillside. Effluent is circulated through the pool system 8 to 12 times per day during the sunlight hours. Polished effluent is pumped to the lawn irrigation system. Similar systems were designed by the same architect for Disneyland, Disneyworld, and Busch Gardens. (Baker-FRC)
W82-05789

DEEP SHAFT,

J. Lock.
Water/Engineering and Management, Vol 129, No 3, p 57-58, 60, 62, March, 1982. 4 Fig.

Descriptors: *Wastewater treatment, *Design criteria, Water treatment facilities, London, England, Construction, Deep shaft process.

A Deep Shaft effluent treatment plant has been in operation since early 1978 at Marsh Farm Sewage Treatment Plant in Tilbury on the Thames, east of London, England. Four major benefits of deep shaft treatment are: primary settlement of the sewage is not needed, the sludge produced is able to be disposed without further treatment, real estate requirements are minimal, and environmental impact is easily controlled. One of the major requirements to make the process competitive with natural products was economy of scale; this was achieved by building a very large single stream plant. At its heart is the pressure cycle fermenter, designed for an annual output of 55,000 to 65,000 tons of dried product. Volume in the Deep Shaft process is dictated by the biodegradability of the wastewater to be treated rather than by oxygen transfer characteristics. The heart of the process is the deep shaft itself, with its head tank, from which nitrogen, oxygen and carbon dioxide bubbles rising from the shaft are released. Circulation of the liquid in the shaft is brought about by injecting air mainly or wholly into the downcomer. Since installation of the Shaft, the Anglian Water Authority has undertaken a series of studies to prove its ability to meet the design criteria and to determine the optimum process parameters for maximum and predictable performance. Start-up problems have included flow reversal, foaming, shaft ventilation, and blockages. (Baker-FRC)
W82-05793

RELIABILITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS IN FAIRFAX COUNTY, VIRGINIA,

Fairfax County Div. of Environmental Health, VA.
J. O. Bowman.
Journal of Environmental Health, Vol 44, No 5, p 249-252, March-April, 1982. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Wastewater disposal, *Septic tanks, Wastewater treatment, Septic wastewater, Environmental effects, *Virginia, Fairfax County.

In 1979 a study was made of on-site sewage disposal systems in the area of Fairfax County, Virginia, which had been installed between 1952 and 1978. The typical on-site system in this study consists of a septic tank, distribution box and soil absorption trenches. A typical system installed in 1955 served a three bedroom dwelling and consisted of 400 lineal feet of absorption trench. The typical system 20 years later served a four bedroom dwelling and consisted of a 1480 gallon septic tank with 480 lineal feet of absorption trenches. The increase in the size of the septic tank was due primarily to the popularity of garbage disposal devices and the requirement that all systems be designed for such devices. The study in 1979 showed that of the 1013 systems installed between 1952 and 1958, 96% were operational at the end of 20 years after installation and had not experienced any malfunctions. While the potential life of an on-site sewage disposal system is not known, the study revealed that of 62 systems installed in 1952, 97% have functioned satisfactorily for 27 years. Of the 110 systems which malfunctioned, the peak period for such occurrences was between the 11th and 18th year, with 47% occurring during this period. Seven systems were identified in which the malfunctions were attributed to soil clogging; the average period prior to this occurrence was 18.4 years. It was concluded that on-site sewage disposal systems for small wastewater flows offer a reliable method of disposal with minimal environmental impact. (Baker-FRC)
W82-05812

ROLE OF SURFACE ACTIVE MEDIA IN ANAEROBIC FILTERS,

Burk and Associates, Inc., New Orleans, LA.
K. A. Khan, M. T. Suidan, and W. H. Cross.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 269-285, April, 1982. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Anaerobic conditions, *Filter media, Activated carbon, Adsorbents, Coal, Wastewater treatment, Water treatment, Chemical oxygen demand, Oxygen demand.

The objectives of this study were to determine whether surface active granular activated carbon provides a better packing medium than nonporous anthracite coal for the anaerobic filter. The wastewaters used in the study included both synthetic wastewaters and a commercial aircraft paint-stripping wastewater. The organic content of the synthetic wastewaters included the readily degradable but poorly adsorbable glucose, the more biologically resistant, strongly adsorbable phenol, and combinations of the two organic nutrients. The glucose-bearing substrate was selected to minimize the adsorptive concentration polarization advantage of the activated carbon, while phenol was used to evaluate the role of substrate concentration polarization induced by the carbon surfaces. The response of the two filters under dynamic loading conditions of the phenol substrate was also evaluated. Throughout all phases of the study, the granular activated carbon packed filter out-performed the anthracite packed filter in terms of reduction of feed organic matter, methane production, and biomass retention. The granular activated carbon packed column resulted in a methane yield of 70.3% of the reduced dissolved chemical oxygen demand (DCOD), while only 38.5% of the reduced DCOD was converted to methane in the anthracite packed column. The DCOD and DOC conversion efficiencies obtained from the anthracite-packed column were 69 and 58%, respectively. An additional advantage of the carbon medium appears to be its biomass retention characteristics. (Baker-FRC)
W82-05816

HYDRAULIC REGIME AND ACTIVATED SLUDGE PERFORMANCE,

Ohio State Univ., Columbus. Dept. of Civil Engineering.
R. M. Sykes.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 286-296, April, 1982. 19 Ref.

Descriptors: *Activated sludge process, *Model studies, Biological oxygen demand, Chemical oxygen demand, Oxygen demand, Microorganisms, Sludge, Wastewater treatment.

An alternative to the standard bio-kinetic theory is presented to describe the activated sludge process. This new method identifies the effluent soluble organic matter (SOM) as a product synthesized and excreted by the microbes of the activated sludge. This model predicts that all aeration tanks treating a given wastewater will produce the same effluent SOM concentration if they contain the same total biomass and are operated at the same solids retention time (SRT). This alternative model also predicts that the effluent SOM concentration will be proportional to the influent organic matter concentration, that the apparent microbial decay rate will vary as different nutrients are considered, and that plots of the specific uptake rate versus the effluent SOM concentration will show a positive SOM intercept. All these predictions were supported by experiment. (Baker-FRC)
W82-05819

IMPROVEMENT OF SWIRL CONCENTRATOR,

Centre National de la Recherche Scientifique, Toulouse (France).
M. Alquier, D. Delmas, and M. Pellerej.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 379-390, April, 1982. 7 Fig, 6 Tab, 5 Ref.

Descriptors: *Combined sewer overflows, *Water treatment, Overflow, Sewer systems, Rainfall, Concentrator, Design criteria.

An analysis was made of a treatment device for pluvial water, as proposed by the American Public Works Association. The characterization of the convective-diffusive process is done by measuring the transit-time distribution of fluid and liquid particles. The study of similarity law done on two hydrualic models observes the critical velocity of solid particles as a similarity parameter. The device is called a swirl concentrator. The analysis showed that its efficiency greatly depends on a large eddy structure generated by an obstacle placed so as to obtain a usable hydraulic load-discharge characteristic. This large eddy structure is one of the most important phenomena in the efficiency obtained for the device. This has two effects on studies made on swirl concentrators. First the behavior is better characterized by the critical velocity of solid particles because of the resuspension of deposited solids. Second, it is possible to propose an obstacle configuration which increases the efficiency of the swirl concentrator. This configuration is on the basis of vertical bars put into the device. In swirl concentrators already built, the addition of such a pattern of bars improves the efficiency. (Baker-FRC)
W82-05821

INHIBITION OF NITRIFICATION BY ARSENIC, CHROMIUM, AND FLUORIDE,

College of Petroleum and Mineral, Dhahran (Saudi Arabia).
For primary bibliographic entry see Field 5C.
W82-05855

CHEMOMETRIC MODELING OF WASTEWATER TREATMENT PROCESSE,

Ford Motor Co., Dearborn, MI.
D. Schuetzle, J. R. Koskinen, and F. L. Horsfall, III.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 457-465, May, 1982. 5 Fig, 5 Tab, 33 Ref.

Descriptors: *Biological oxygen demand, *Statstical analysis, *Prediction, Wastewater treatment, Model studies, Chemometric methods, Nitrates, Phosphates, Suspended solids, Trace metals, Temperature effects.

Chemometric methods (pattern recognition) and multivariate analysis were used in modeling a complex lagoon system treating a wastewater containing petroleum oil, glycols, and esters. BOD was correlated with 19 other parameters, 6 describing input and 13 describing output. Data obtained from 166 days of operation were used to develop a model to predict BOD for the following 81 days. Accuracy of the prediction was an average of 87%. The most significant parameters that controlled prediction of BOD levels were minimum temperature, suspended solids, calcium, magnesium, nitrate, iron, and phosphate. Optimum values for some of these (in mg per liter) were phosphate, 12; Cs, 150; Mg, 3; and Fe, 0.3. There was no relationshp between influent pH and BOD reduction. (Cassar-FRC)
W82-05858

COMPARATIVE PERFORMANCE OF ROTATING BIOLOGICAL CONTRACTORS USING AIR AND PURE OXYGEN,

Missouri Univ., Rolla. Dept. of Civil Engineering.
J-C. Huang, and V. T. Bates.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2686-2703, November, 1980. 14 Fig, 1 Tab, 14 Ref.

Descriptors: *Biological wastewater treatment, *Peformance evaluation, Oxygenation, Aeration, Dairy industry wastes, Industrial wastewaters, Oxidation, Organic matter, Biomass dynamics, Kinetics, chemical oxygen demand, Sludge, Settling velocity.

The objective of this study was to investigate the relative performances of three parallel rotating biological contractors in treating a synthetic milk waste by using air and pure oxygen under atmospheric or pressurized conditions. Performance parameters examined include acidity, dissolved oxygen, mixed liquor suspended solids, chemical oxygen demand reductions, sludge settleability, microbial nature, effluent suspended solids, ammonium-nitrogen, and nitrate-nitrogen. The thicknesses of the biofilms developed on the disk surface were increased by pure oxygen under pressure. This in turn improves the chemical oxygen demand reduction, provided that the waste strength is high and the biofilms do not bridge over the disk clearance. Use of pure oxygen also greatly improves the sludge settleability and reduces the filamentous growth. However, laboratory data appear to indicate that an excessively high concentration of dissolved oxygen has an inhibitory effect on biological nitrification. (Baker-FRC)
W82-05859

FILTERABILITY OF ACTIVATED SLUDGE IN RESPONSE TO GROWTH CONDITIONS,

Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, E. D. Smith, and R. Novak.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 444-456, May, 1982. 20 fig, 2 Tab, 30 Ref.

Descriptors: *Activated sludge process, *Filtration, *Nitrogen, Wastewater treatment, Sludge conditioning, Dewatering, Microorganisms, Wastewater composition, Filamentous bacteria, Bacteria.

Growth of activated sludge under severe nitrogen limitation of the influent wastewater produced sludge with poor dewatering properties. The filtering properties were poor in the presence of long-length filamentous organisms, dispersed and pinpoint flocs, and extracellular biopolymers. However, short-length attached filaments were beneficial to floc formation and sludge filtration. Sludge with the best filtering properties in pilot plant tests was grown at a sludge age of 14.2 days and food/microorganism ratio of 0.35 for N-deficient sludge. N-rich sludges required higher chemical conditioner doses than N-deficient sludge. The presence of extracellular biopolymers, a natural thickening agent, also reduced the conditioner requirements. (Cassar-FRC)
W82-05860

MUNICIPAL POLLUTION ABATEMENT REPORT CARD: SIGNIFICANT PROGRESS,

Environmental Protection Agency, Washington, DC.
J. A. Chamblee.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 422-427, May, 1982. 2 Fig, 3 Tab.

Descriptors: *Municipal wastewater, *Capital costs, *Statistics, Wastewater treatment, Secondary wastewater treatment, Biological oxygen demand, Suspended solids, Grants, Clean Water Act, Economic aspects.

Municipal wastewater treatment statistics collected during a 1980 EPA survey show significant progress toward the nation's clean water goals. Compared with 1973, the total flow reaching treatment plants has increased 36% to 95,594 million cu m per day, BOD removal has increased 13% to 76.4%, solids removal has increased 11% to 79.6%, and dry sludge has increased 58% to 23,763 metric tons per day. The population served by treatment plants in 1980 was 156.7 million (70% of the total population), 8.5% more than in 1976. Those served by secondary treatment or better increased 25.3% since 1976 to 119.4 million (53% of population). Since 1976 the number of secondary plants has increased by 58.8% to 6852 and the number of plants that do not discharge, by 36.1%; to 1361. During 1973 to 1979 $20 billion in federal, state, and local funds and $6.3 billion in non-government funds were spent for capital improvements. By 1985 it is expected that flows reaching treatment plants will reach 28,000 mgd, an increase of 14%, and BOD removal and suspended solids removal efficiencies will have increased to 82.6% and 83.4%, respectively. (Cassar-FRC)
W82-05861

1980 NEEDS SURVEY: COMBINED SEWER SSITE STUDIES,

Water Resource Engineers, Gainesville, FL.
J. E. Scholl, and R. L. Wycoff.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2; p 315-326, April, 1982. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Planning, Surveys, Data acquisition, Sewer systems, Economic aspects, Water treatment facilities, Costs, Environmental Protection Agency.

The Environmental Protection Agency is mandated to prepare a biennial estimate of the cost to achieve the goals of the Federal Water Pollution Control Act. Such an estimate requires conducting a survey. Sites for the survey are generally selected to provide a wide range of sizes of combined sewer systems and a representative distribution across the United States. The 1980 Needs Survey investigated 10 sites to develop transferable criteria, principles and relationships which could be applied nationwide to estimate the cost to construct publicly owned wet-weather pollution control facilities. The site studies were performed using a receiving water simulation program called the Continuous Stormwater Pollution Simulation System (CSPSS) and an economic optimization program called the Computer Optimized Stormwater Treatment (COST) program. For these 10 study sites it was found that three types of receiving water/urban area conditions existed with respect to dissolved oxygen concentrations. These were sites where no DO problem existed, sites where the problem could be solved with removal of various inputs, and sites where a DO problem remained. A direct link between the CSPSS receiving water analysis and COST program economic analysis was obtained. It was then possible to establish the combination of wet-weather pollution abatement alternatives which achieved the desired removal for the least total annual cost. (Baker-FRC)
W82-05862

5E. Ultimate Disposal Of Wastes

LAND DISPOSAL OF SLUDGE,

J. W. Cormack, F. J. Winter, and M. D. R. Riddell.
Public Works, Vol 113, No 2, p 42-44, 90, February, 1982. 3 Fig, 3 Tab.

Descriptors: *Land disposal, *Sludge disposal. *Landfills, Sanitary landfills, Waste dumps, Sludge, Wastewater treatment, Sludge utilization, Cost analysis, *Lake County, *Illinois.

The North Shore Sanitary District in Lake County, Illinois is located about 20 miles north of Chicago, adjacent to Lake Michigan. Wastewater is treated at three major advanced treatment plants, each providing biological nitrification, chemical precipitation of phosphorus, and effluent filtration. Raw and digested sludge are transported to Waukegan for dewatering and ultimate disposal in a landfill. A portion of the digested sludge is hauled by truck for use as soil conditioner and fertilizer during the growing season. Before selecting the site for the landfill, field tests were conducted to demonstrate the stability of the soil, and consultations were held with various members of government agencies and district staff so as to present detailed development and operating plans. Site preparations included demolition of existing minor buildings, installation of ten 30-foot deep groundwater monitoring wells, construction of a sludge delivery road, a 10,000 gallon leachate tank, a new well, and an access road, rerouting existing farm drainage tiles traversing the area, and constructing sod waterways to convey surface drainage through the project area to adjoining downstream land at existing runoff locations. The application of sludge on agricultural land is limited by the type of crop grown and the chemical constituents of the sludge, particularly heavy metals and nitrogen. Data suggest that nitrogen rather than heavy metal content is the limiting factor. Landspreading of a small amount of liquid digested sludge is significantly less costly than dewatering and landfilling the same sludge. The amount that can be landspread is limited by space and spreading equipment availabilities. (Baker-FRC)
W82-04757

IMPROVED THERMAL SLUDGE CONDITIONING BY TREATMENT WITH ACIDS AND BASES,

Union Carbide Corp., South Charleston, WV. Research and Development Dept.
G. M. Alsop, and R. A. Conway.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 146-152, February, 1982. 7 Fig, 6 Tab, 14 Ref.

Descriptors: *Sludge conditioning, *Dewatering, *Heat treatment, Acids, Bases, Pathogens, Coliforms, Bacteria, Zinc, Cadmium, Metals, Heavy metals, Filtration.

Temperature and reaction times for heat conditioning of sludge for dewatering were reduced by a base-heat-acid treatment. The laboratory-scale study used sludges with different characteristics, two petrochemical wastewater sludges and a domestic wastewater sludge. Although optimum conditions differed with the sludge properties, a typical conditioning process was treatment at pH 10 and 70 C for 60 seconds followed by reaction at initial pH of 3.5 and 90 C for 60 seconds. The first step extracts polymers from the cells, and the second modifies the cell surface and causes flocculation using the extracted polymers. This treatment produced only 50-60 mg per liter soluble organic carbon. Subsequent dewatering of the base-heat-acid conditioned sludge on a belt pressures (3-5 psig) produced 20-30% cake solids. The process reduced fecal coliforms from 2.3 million per 100 ml to zero. Odor in stored samples was almost negligible. Zn and Cd contents of sludge were reduced by 49% and 73%, respectively. Shear tests on the conditioned sludge showed that it was resistant to shearing and subject to less floc breakup during subsequent processing. Comparison with other sludge conditioning processes (FeCl-lime-filter press and polymer conditioning-basket centrifuge) showed similar capital costs and lower operating costs, $12 a ton vs. $18 and $19 a ton, respectively. (Cassar-FRC)
W82-04785

COMPARISON OF COLIPHAGE AAD BACTERIAL AEROSOLS AT A WASTEWATER SPRAY IRRIGATION SITE,

Army Medical Bioengineering Research and Development Lab., Fort Detrick, MD.
For primary bibliographic entry see Field 3C.
W82-04830

AUTOMATIC CONTROL OF THE DISCHARGE OF RADIOACTIVE SUBSUBSTANCES FROM LIGHT WATER NUCLEAR POWER PLANTS OF THE PRESSURIZED WATER REACTOR TYPE INTO FLOWING STREAMS WITH SPECIAL REFERENCE TO THE UNTERWESER NUCLEAR POWER PLANT,

Wasserwirtschaftsamt Brake (Germany, F. R.).
H. Kunz.
Water Science and Technology, Vol 13, No 11-12, p 561-566, 1981. 3 Fig, 7 Ref,

Descriptors: *Monitoring, Data transmission, Remote sensing, *Water pollution prevention, *Radioactive wastes, Sensors, Data aquisition, *Nuclear powerplants, *Germany, Environmental protection, Water pollution control, Automation, Networks.

Nuclear power plants in the Federal Republic of Germany must apply for official permission to discharge radioactivity liquid wastes into receiving waters. In order to receive this permission the plant must be operated according to specific regulations. The Unterweser Nuclear Power Plant (KKU) is used as an example to demonstrate how the discharge of radioactive substances in a tidal river can be automatically monitored and controlled. The Nuclear Inspectorate is now making use of remote monitoring equipment to regulate the discharges of nuclear power stations and protect receiving waters of their surrounding environments. An automatic remote monitoring system is being installed in the KKU to check plant operation and levels of radioactive wastes in all possible receiving waters. The regulations laid down by the water authority extend from the receiving water to these measuring points. The KKU will be required to provide automatic data transmission to the water authority from all the designated measuring stations. (Geiger-FRC)
W82-04839

CASEIN WHEY WASTEWATER EFFECTS ON SOIL PERMEABILITY,

Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 3C.
W82-04874

DISTRIBUTION OF PHOSPHORUS IN SOILS IRRIGATED WITH MUNICIPAL WASTEWATER EFFLUENT: A 5-YEAR STUDY,

Minnesota Agricultural Experiment Station, St. Paul.
For primary bibliographic entry see Field 3C.
W82-04881

DESIGNING WASTEWATER TREATMENT SYSTEMS TO SAVE ENERGY,

Edeco, Inc., Tulsa, OK.
For primary bibliographic entry see Field 5D.
W82-04906

LEACHATE COLLECTION DESIGN FOR CONTAINMENT LANDFILLS,

Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, R. Poland, F. A. Rovers, and A. J. Crutcher.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 204-209, February, 1982. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Mathematical models, *Land disposal, *Landfills, *Leaching, *Waste management, Mathematical studies, Waste disposal, Water quality control, Model studies, Waste dumps, Leachates, Infiltration, Percolation, Groundwater movement, Subsurface drainage.

A simple methodology for use in designing leachate collection systems for the containment of wastes at disposal sites is presented. The methodology concentrates specifically on the engineering of drain spacing and groundwater mounding. A mathematical model is derived which describes leachate mounding over a sloping clay liner. The model, although implicit and nonlinear, converges rapidly. Parameter sensitivities can be readily manipulated for specific applications and to explore the need for new data input requirements into the model. The model was applied to the problem of designing a collection system for a landfill, where the concern is the impact on the groundwater mounding during leachate recycle, versus after the recycle is completed. The model will be useful in exploring the impacts of alternative designs for leachate collection systems. (Geiger-FRC)
W82-04996

CALORIFIC VALUE OF WASTEWATER PLANT SLUDGES,

Marquette Univ., Milwaukee, WI.
A. E. Zanoni, and D. L. Mueller.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 187-195, February, 1982. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Calorimetry, *Sludge utilization, *Chemical oxygen demand, *Volatile solids, Wastewater treatment, Mathematical studies, Sludge, Digested sludge, Primary sludge, Municipal wastewater, *Energy sources, Sludge disposal.

The energy usage of a wastewater treatment plant is an important consideration in its design and operation. The calorific values of various sludges generated during wastewater processing may be established by an oxygen bomb calorimeter. The use of this instrument in smaller plants is not a very common practice. To aid in calorific determinations, the calorific values of a variety of municipal waste water plant sludges are presented. A method for correlating the calorific value of a sludge sample to the COD value was developed. This procedure was sufficient for estimating the calorific value of most municipal wastewater plant sludges with a high degree of reliability. Calorific values of sludges were also correlated to the percent volatile solids value to compare the present results with those of other researchers. The COD correlation proved more accurate than the volatile residue technique. It was suggested that the COD determination is inherently a more sensitive measure of the material which accounts for the calorific content of the sludge. (Geiger-FRC)
W82-04997

WEAK CONTROLS FROM SEA TO SHINING SEA,

University of Western Ontario, London. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W82-05035

REVEGETATING STRIP-MINED LAND WITH MUNICIPAL SEWAGE SLUDGE,

Pennsylvania State Univ., Harrisburg. Dept. of Environmental Resources.
W. E. Sopper, and S. N. Kerr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-102484, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-182, October 1981. 7 p, 4 Fig, 7 Tab. S-804511.

Descriptors: *Revegetation, *Strip mines, *Sludge disposal, *Land disposal, *Water pollution control, Groundwater pollution, Soil water, Trace metals, Bacteria, Coal mines, Municipal wastewater, Erosion control, Percolating water, Mine wastes, Impaired water use.

The lack of vegetative cover on old strip mine sites contributes to pollution from both soil erosion and acid mine drainage. The use of municipal sludge to revegetate mined land in an environmentally acceptable manner was demonstrated on several 4-ha plots in the anthracite and bituminous coal mining regions of Pennsylvania. Three sites representative of abandoned, barren bituminous and anthracite mines were treated with various types of municipal sludge at high and low application rates, and broadcast seeded with a mixture of grasses and legumes. A monitoring system was installed at each demonstration site to determine the effects of the sludge application on the chemical and bacteriological quality of groundwater and soil percolate water, chemical properties of the soil, and quality and growth of vegetative cover. Data collected during the 3-year period indicate that the sludge applications ameliorated the harsh site conditions and resulted in a quick vegetative cover that completely stabilized the demonstration site. Each site's vegetative cover has persisted and improved each year since its establishment. Although sludge applications increased some trace metal concentrations in the vegetation, all concentrations were below plant tolerance levels. Sludge applications have had no significant adverse effect on the chemical or bacteriologically quality of soil percolate or groundwater. (Moore-SRC)
W82-05065

PILOT FIELD STUDIES OF FGD WASTE DISPOSAL AT LOUISVILLE GAS AND ELECTRIC,

Louisville Gas and Electric Co., KY.
R. VanNess, A. Plumley, N. Mohn, C. Ullrich, and D. Hagerty.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105479, Price codes: A14 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-155, October 1981. 14 p, 8 Fig, 6 Tab, 10 Ref.

Descriptors: *Landfills, *Waste disposal, *Trace elements, *Groundwater pollution, *Leachates, Sludge, Land disposal, Soil contamination, Water pollution sources, Runoff, Permeability.

The most extensive commercial experience in flue gas desulfurization (FGD) to date has been with lime/limestone wet scrubbers. A major challenge associated with the commercial development of these systems is the disposal of large amounts of by-product sludge within the constraints of land and water quality regulations. Properly prepared landfill from FGD sludge/fly ash mixtures can prevent trace element contamination of underlying groundwater. Analyses of leachates from the series of landfill impoundments in this study show that trace elements on the Resource Conservation and Recovery Act (RCRA) list of contaminants were found in concentrations below those proposed to characterize hazardous or toxic wastes. Decreasing concentrations, with time, of trace contaminants were observed in both leachate and runoff samples obtained from the stabilized sludge mixtures. Small, synthetically lined, above-ground impoundments provided higher concentrations of trace contaminants than the subsurface impoundments since no attenuation by local soil was provided and vegetation that might minimize runoff was not established on these sites. Water samples from beneath larger subsurface impoundments indicated that the filtering action of soil aids in decreasing the concentration of contaminants reaching the ground water supply. Certain mixtures have undergone a fixation reaction, reducing the permeability and minimizing the release of moisture and contaminants to the surrounding soil. (Moore-SRC)
W82-05066

DISPOSING OF SEWAGE SLUDGE AT SEA,

S. H. Jenkins.
Marine Pollution Bulletin, Vol 13, No 2, p 37-39, February, 1982. 1 Tab.

Descriptors: *Sewage sludge, *Sludge disposal, *Ocean dumping, Environmental effects, *Regulations, Water pollution control, North Sea, *Germany.

A review of recent papers on sewage sludge disposal at sea shown that this problem is being handled by different methods according to national attitudes. The Federal Republic of Germany is planning to terminate all sludge disposal in the North Sea. The U.S. EPA's decision to prohibit sludge dumping in coastal waters has been challenged in light of conflicting evidence on its environmental effects. The United Kingdom disposes of sewage sludge at 13 ocean sites under annual licences granted by the Military of Agriculture, Fisheries, and Food. The effects of sludge dumping and pollution from rivers are carefully monitored by chemical analysis and bioassays to limit the undesirable elements to levels which can be absorbed by the sea without producing ecological damage. (Cassar-FRC)
W82-05127

IRRIGATION OF CALIFORNIAGRASS WITH DOMESTIC SEWAGE EFFLUENT: WATER AND NITROGEN BUDGETS AND CROP PRODUCTIVITY,

Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 3C.
W82-05153

SLUDGE MANAGEMENT IN THE ROCKY MOUNTAIN STATE,

Black and Veatch, Denver, CO.
M. J. Maxwell.
Water/Engineering and Management, Vol 128, No 12, pp 28-31, 56, 57, December, 1981. 4 Tab, 2 Fig.

Descriptors: *Sludge, *Sludge reconditioning, *Wastewater management, *Hydraulic capacity, Sludge drying, Aeration, Lagoon systems, Filtration, Aerobic digestion, Reclamation, Sludge cake, *Sludge disposal, Inventory, *Colorado, Sludge management.

A complete inventory of all municipal treatment plants in Colorado was carried out in 1980, to assess the status of wastewater sludge management in that state. More than half of the 318 municipal facilities are lagoon systems which do not routinely process sludge. Mechanical systems predominate in the Mountain Resort and Front Range areas, where land costs are high and population is dense. Most plants have ample reserve capacity. The most common sludge disposal method is land application. Less than 20 plants use mechanical thickening equipment. Most plants employ anaerobic digestion. About 70% of the plants which dewater sludge use drying beds. Three sludge stabilization processes, anaerobic digestion, aerobic digestion, and composting, are used in Colorado. (Titus-FRC)
W82-05165

PREDICTING FULL-SCALE BATCH THICKENER PERFORMANCE USING THE FROZEN-IMAGE CENTRIFUGE,

Water Research Centre, Stevenage (England).
C. F. Lockyear.
Effluent and Water Treatment Journal, Vol 21, No 12, p 560-563, December, 1981. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Sludge thickening, *Performance evaluation, *Centrifugation, Dewatering, Sludge drying, Prediction, Mathematical equations, *Wastewater treatment, *Sludge disposal.

Gravity thickening is a process commonly used to reduce the costs for treating and disposing of sewage sludges. The extreme variations in the characteristics of the sludge necessitate the use of laboratory characterization tests in operating and designing sludge treatment processes. The frozen-image centrifuge test is one such laboratory test. This technique uses a low speed centrifuge and involves observation of the change in the interface height between the sludge and the supernatant liquor. The experimental results are then used to calculate the change in solids concentration of the sludge with time and to predict the ultimate concentration achievable for a given height of sludge in a thickener. However, the technique does not provide information on the time needed to achieve these results. A new empirical equation is presented which links directly the time in a gravity thickener to achieve a particular concentration with the time in the frozen-image centrifuge to achieve the same concentration. This method can be used either to monitor the performance of full-scale thickeners or to design new units. (Carroll-FRC)
W82-05185

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 2 - ENVIRONMENTAL CONTROL TECHNOLOGY,

California Univ., Livermore. Lawrence Livermore Lab.
G. Armantrout, N. Crow, P. Leitner, C. R. Molenkamp, and F. Stephens.
Department of Energy Report DOE/EV-0092, July 1980. 133 p, 24 Fig, 18 Tab, 93 Ref. Morris, W., and Hill, J., Eds. W-7405-ENG-48.

Descriptors: *Geothermal power, *Geothermal resources, *Environmental control, *Brine disposal, *Injection, Subsidence, Cooling towers, Water quality, Waste disposal, Scaling, Drilling, Water treatment, *Imparial Valley, California.

Based on energy production scenarios and predicted environmental impact levels, environmental controls applicable to abatement of hydrogen sulfide emissions, cooling tower drift, noise, liquid and solid wastes, and induced subsidence and seismicity were assessed. Several currently available and emerging hydrogen sulfide abatement technologies are applicable to power systems contemplated for the Imperial Valley. The environmental impact of cooling tower drift will be closely tied to the quality of cooling water supplies. Although significant technological progress has been achieved in reducing drift emissions, the efficiency of drift eliminators may be rapidly degraded if low quality water supplies are used. Noise emission is not expected to be an important environmental issue. Spent geothermal brine constitutes the largest volume of waste generated in geothermal power plant operations. Other liquid wastes include: cooling tower blow-down fluid, accidentally discharged brine, and accidentally spilled process chemicals. These liquid wastes, for the most part, are expected to be disposed of by subsurface injection. Solid waste sources include: well drilling and wellbore cleanout debris, separated solids from spent brine and cooling water treatment operations, solids from hydrogen sulfide abatement, geothermal scale, and a variety of wastes from evaporation ponds and treatment facilities. Subsurface injection of fluids is the primary control for managing induced subsidence. Careful maintenance of injection pressure is expected to control induced seismicity. (Moore-SRC)
W82-05213

RESULTS OF DEEP-WELL INJECTION TESTING AT MULBERRY, FLORIDA,

Geological Survey, Tallahassee. FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05224

MICROBIAL ECOSYSTEMS RESPONSIBLE FOR ANAEROBIC DIGESTION AND COMPOSTING,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
M. S. Finstein, J. Cirello, D. J. Suler, M. L. Morris, and P. F. Strom.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2675-2685, November, 1980. 3 Tab, 47 Ref.

Descriptors: *Anaerobic digestion, *Composting, *Wastewater treatment, Sludge, *Waste disposal, *Activated sludge process, Microbial degradation, Microbiological studies.

The most significant features of the anaerobic digestion and composting ecosystems are summarized and compared specifically in relation to contemporary needs in sludge management. The course of microbial events in sludge is determined by the water content and the presence or absence of porous structure. Consequently, for anaerobic digestion, the sludge is processed in aqueous form, whereas for composting it is processed as a solid material. Anaerobic digestion involves the formation and release of gases, but no inward movement of ambient air. It is a continuous process. Batch processing is not practicable for large-scale operation. Composting involves the formation and liberation of carbon dioxide and water vapor, and unlike anaerobic digestion, requires the movement of ambient air into the mass. In understanding the biological processes at work, three groups of microbial functions are recognizable in anaerobic digestion: solubilization, acid formation, and methane production. The stability of the process as a whole is discussed. While anaerobic digestion and composting are intended to achieve almost identical goals, the mechanisms involved and the extent to which the goals are met differ. Anaerobic digestion is advantageous primarily in requiring less labor for materials handling and in producing methane. Composting is advantageous with respect to pathogen kill, process stability, decomposition of industrial compounds, drying and residue acceptability as related to aesthetic quality and ultimate disposal. Composting would appear to be the superior process for crowded areas where final disposal is on land. (Baker-FRC)
W82-05252

RELATIVE HEALTH RISKS OF ACTIVATED SLUDGE TREATMENT AND SLOW-RATE LAND TREATMENT,

Metcalf and Eddy, Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5D.
W82-05258

DRAINABILITY OF AEROBICALLY DIGESTED BIOLOGICAL SLUDGE FROM TEXTILE WASTE,

Auburn Univ., AL. Dept. of Civil Engineering.
J. R. Judkins, Jr., and M. L. Hatcher.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2955-2963, December, 1980. 11 Fig, 4 Tab, 11 Ref.

Descriptors: *Sludge digestion, *Textile mill wastes, *Dewatering, Sludge conditioning, *Sludge disposal, Sludge drying, Sludge thickening, Aerobic digestion, Digestion, Polyelectrolytes, Wastewater treatment, Activated sludge process.

Sludge from a textile finishing mill was aerobically digested in the laboratory. Two-thirds of the total BOD reduction of 75% was attained within the first 7 days. Volatile suspended solids were reduced by 16-34% in 21 days. The non-volatile suspended solids increased during the early stages of digestion and decreased by 19-57% in 21 days for the first batch of sludge and 1-14% in 29 days for the second batch of sludge. Results of dewaterability studies suggested that optimum drainability was achieved at solids detention times of 3-5 days. Increasing the digestion time beyond 5 days decreased drainability. Applying raw, undigested sludge directly to sand drying beds was a feasible process. The drainability was improved by adding a cationic polyelectrolyte. Increasing the dosage of polyelectrolyte slightly decreased the volume of total drainable water. Therefore, an optimum polymer dose will maximize sludge drainage rate without decreasing total drainable water. (Cassar-FRC)
W82-05261

HOW MUCH SEWAGE NITROGEN ON FOREST SOILS. A CASE HISTORY,

Florida Univ., Gainesville. School of Forest Resources.
H. Riekerk.
BioCycle, Vol 23, No 1, p 53-56, January-February, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Forest soils, *Land application, *Sludge disposal, Wastewater disposal, Nitrates, Sulfates, Seattle, Washington, Soil types, Fertilizers, Trees, Plant growth, Waterlogging.

Application of sewage sludge or watewater effluents to forested lands offers several advantages over application to cleared areas. Decomposition is slower under the humid conditions and has a less dramatic environmental impact. Excess moisture is readily removed by transpiration of the trees. Forest soils are usually of low quality and are remote from the human food chain. Even on a 25% slope 0.4 cm dry sludge can be applied without contaminating surface runoff. Nitrates are the main problem for groundwater contamination. Studies on application of sewage to forest soils showed that this is feasible, but the volume must be carefully controlled to avoid surface runoff on slopes, formation of wetlands in level areas, clogging of soil pores with fine particulates, or escape of ammonia into the air. Sludge, 150 to 300 dry tons per ha, was applied to 2 coniferous forest soils near Seattle, Washington, in 1974-77. All treatments significantly increased nitrate and sulfate levels in C-horizon leachates, except in the gravelly soil. The various experimental variables did not significantly affect the nitrate-N or sulfate-S content of output drainage. (Cassar-FRC)
W82-05371

LAND EXTENSIVE PROCESSES FOR WASTEWATER TREATMENT AND DISPOSAL--A PERSPECTIVE,

Water Science Lab., Melbourne (Australia).
For primary bibliographic entry see Field 5D.
W82-05419

TRENDS IN SLUDGE MANAGEMENT,

A. Jacobs.
Water/Engineering and Management, Vol 128, No 12, p 10, December, 1981.

Descriptors: Mercury, Polychlorinated biphenyls, Heavy metals, Legal aspects.

A study of ocean dumping of sludge is reviewed. In their recent report the National Advisory Committee on the Oceans and the Atmosphere (NACOA) recommended that ocean dumping should continue to be permitted under appropriate management control in areas where no unreasonable degradation of the marine environment results. It is believed that ocean contamination is caused primarily by sources other than sludge dumping. Methods for evaluating the costs and hazards of land-based alternatives are needed. At present, land application of sludge is increasing, as is research dealing with application rates, crop selection, and health effects. The Environmental Protection Agency is in litigation over their position that all ocean disposal should be eliminated. (Titus-FRC)
W82-05435

PRESSURE DISTRIBUTION DESIGN FOR SEPTIC TANK SYSTEMS,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
R. J. Otis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 123-140, February, 1982. 11 Fig, 3 Tab, 16 Ref.

Descriptors: *Septic tanks, *Design criteria, *Pressure distribution, Septic wastewater, Wastewater, Compaction, High pressure, Load distribution, Clogging.

This paper reviews the principles of pressure distribution network design and presents a simplified design procedure for septic tank systems. The use of pressure distribution networks has been limited primarily to mound systems and large soil adsorption fields. Their use is greatest in Wisconsin, where the networks were first developed. Most are employed in individual home systems, but several of them are employed in community and commercial systems designed for daily flows up to 30,000 gal. The length of service of these systems ranges from 9 years for the individual mound systems to 4 years for the large networks. Limited monitoring of the networks has indicated that this method of distribution retards the development of a clogging mat on the soil's infiltrative surface. Excavation of several systems did not reveal signs of a clogging mat even after 2 years of continuous operation. Mechanical failures have been infrequent. Of more than 500 networks in use in Wisconsin, less than 10 have malfunctioned, with none employing siphons. Pump switch failure is the most common problem, resulting in pump burnout. High quality corrosion proof switches have corrected this problem. One such system serves a butcher shop in which the waste has a high grease content. The grease passed through the septic tank and into the distribution network where it plugged the laterals. More frequent septage removal has corrected this problem. Another system serves an office building. It is not expected that pressure distribution networks will replace conventional designs. However, they are recommended for use in very rapidly permeable soils and soils with shallow restrictive horizons as well as mounds and large absorption field. (Baker-FRC)
W82-05439

INDUSTRIAL WASTE PRETREATMENT AND EPA CADMIUM LIMITATIONS,

Metropolitan Sanitary District of Greater Chicago, IL.
C. Lue-Hing, D. R. Zenz, B. Sawyer, E. Guth, and S. Whitebloom.
Journal of the Water Pollution Control Federation, Vol 52, No 10, p 2538-2551, October, 1980. 4 Fig, 17 Tab, 9 Ref.

Descriptors: *Cadmium, *Effluent limitations, *Industrial wastewater, *Pretreatment of water, *Sludge, *Land disposal, Wastewater treatment, Hazardous materials, Industrial wastes, Waste disposal, Solid wastes, Regulations, Municipal wastewater, Water pollution sources, Pre-treatment standards, Domestic wastes.

The impact of the Solid Waste Disposal Act as it pertains to cadmium (Cd) levels on the treatment of municipal wastes is discussed. The feasibility of using industrial waste pretreatment regulations to reduce sludge Cd levels or allow reasonable sludge application quantities is explored. Implementation of the EPA regulations would severely limit the land application of Cd sludge in the Metropolitan Sanitary District of Greater Chicago under its current land application programs. A comprehensive industrial waste survey was conducted to determine the present industrial discharges of Cd in the district's service area. Only 37.8% of the Cd loading to the treatment plants was from industrial sources. The remaining 62.2% was from nonindustrial sources over which the district has no legal control. Reducing the industrial waste Cd standard from 2.0 mg/l to 0.5 mg/l would have only a minimal effect on the Cd loadings. There has already been a 57.7% reduction in influent Cd loadings since 1971 as a result of strict enforcement of the district's Industrial Waste Ordinance. (Geiger-FRC)
W82-05443

POTENTIAL USE OF EARTHWORMS AS A SOLUTION TO SLUDGE MANAGEMENT,

State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse.
R. Hartenstein.
Water Pollution Control, Vol 80, No 5, p 638-643, 1981. 1 Fig, 15 Ref.

Descriptors: *Activated sludge, *Sludge disposal, Sludge digestion, Composting, Earthworms.

Activated sludge, which ordinarily dries as a form with relatively small surface area, has a high potential for putrescence, pathogenicity, and toxicity. A procedure for using a microbivorous earthworm, Eisenia foetida, to convert activated sludge into castings, which have a relatively large surface area and low potential for putrescence, is described. This procedure requires two unit operations: the production of a stock of earthworms (vermiculture) and the use of the stock for conversion of sludge to castings (sludge vermicomposting). An initial supply of E. foetida may be obtained from biological filter beds in many sewage treatment facilities. Vermiculture then involves cultivation of these earthworms in horse manure uncontaminated by urine and harvesting with an inclined rotating drum on a monthly basis. Experimental studies have indicated that anaerobic sludges are not amenable to digestion by E. foetida. One volume of earthworms is placed into 20 volumes of activated sludge containing 12 to 15% or more solids in a layer not exceeding about 30 millimeters. The earthworms appear to convert all the sludge into castings within 10 days at 20 to 25 C. After the solids content is allowed to increase to about 20 or 25%, the worms can be harvested for reuse. Only small losses in earthworm numbers occur in the vermicomposting process. It is suggested that the application of vermiculture to sludge management may provide a reliable, economical, and environmentally beneficial resolution to sludge management problems. (Carroll-FRC)
W82-05478

WASTEWATER MANAGEMENT IN COASTAL NORTH CAROLINA,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences.
R. J. Nierstedt, D. A. Okun, C. R. O'Melia, J. K. Sherwani, and M. S. Heath.
Report No. 165, December, 1980. Water Resources Research Institute, North Carolina State University, Raleigh. 208 p, 13 Fig, 50 Tab, 14 Maps, 77 Ref.

Descriptors: *Wastewater treatment, *Wastewater outfall, *Wastewater management, *Coastal waters, *Ocean dumping, Inland waterways, Chlorination, Secodary wastewater, Shellfish, Ecological effects, Aquatic environment, Water circulation, Outfall sewers, Dare County, *North Carolina.

Rapid growth and development in North Carolina have done serious damage to the aquatic environment. The purpose of this study was to evaluate the options for water management in coastal North Carolina, and focused on Dare County in the north and Carteret County in the southern area. Three wastewater management options were examined, with treatment appropriate to the method of disposal; 1) discharge to inland coastal waters; 2) discharge to the ocean; and 3) disposal on land. Options 2 and 3 are the most feasible. Inland coastal waters have poor circulation and the shellfish growing areas are extremely vulnerable to pollution. Ocean disposal is the most environmentally acceptable; however, extensive sewerage is needed to collect the wastewater at a single point for disposal. Four options for ocean disposal are evaluated; primary treatment, with and without chlorination; and secondary treatment, with and without chlorination. The least cost option that provides adequate beach protection in both areas is primary treatment plus chlorination. Ocean outfalls are only economical if they serve large populations, so this study includes an assessment of institutional options available for implementing regional wastewater collection and disposal systems. Primary responsibility would be placed on county governments. The main legal issue to be resolved is authorized for ocean outfalls in North Carolina in the first place and federal constraints on ocean discharge with only primary treatment. (Atkins-Omniplan)
W82-05559

HUMIC SUBSTANCES IN SEWAGE SLUDGES,

Catania Univ. (Italy). Inst. of Agricultural Chemistry.
R. Riffaldi, F. Sartori, and R. Levi-Minzi.
Environmental Pollution, Series B, Vol 3, No 2, p 139-146, February, 1982. 1 Fig, 3 Tab, 25 Ref.

Descriptors: .

The purpose of this research was to make a detailed investigation of the humic compounds of municipal sewage sludges in the form in which they are usually applied to agricultural land. Sewage sludges were collected from ten plants located in Tuscany and receiving wastewater mainly from domestic districts. Two samples were anaerobically digested, while all the other sludges were subjected to aerobic digestion. The results indicate that the content and distribution of humic substances in sewage sludges vary widely, probably depending on the collateral industrial activities in the sewage collection area. No correlation has been sought between differences in the sludges and type of digestion owing to the limited number of plants considered, particularly of those characterized by anaerobic digestion. Sludge humic acids and fulvic acids appeared to be more aromatic and/or constituted by smaller size particles than soil humic acids and fulvic acids. They appear to be classed as a young form of humic substance. It was concluded that although humic carbon in the sludges represents only about 17% of total organic carbon, increasing amounts of these materials applied to agricultural land can effectively supply to the soil a considerable amount of the most chemically and physically active organic matter. (Baker-FRC)
W82-05576

CHANGES TO A SOIL ON IRRIGATION WITH A SANITARY LANDFILL LEACHATE,

State Pollution Control Commissions, Lidcombe (Australia).
K. Y. Chan.
Water, Air, and Soil Pollution, Vol 17, No 3, p 295-304, 1982. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Leachates, *Soil porosity, *Wastewater irrigation, Waste disposal, Waste characteristics, Landfills, Sanitary landfills, Water pollution effects, Irrigation, Ion exchange, Wastewater disposal, Calcium, Magnesium, Soil disposal fields.

Sanitary landfill leachate (pH 10.3 and COD, 1240 ppm) was applied to soil columns containing soil covering samples from a landfill site in Australia. In the month-long experiment 370 cm of the leachate was applied to the 40.6 cm long, 9.53 cm diameter soil columns. Soil pH changed from 5 to 10 during the irrigation. The Mg-dominated soil changed to an exchangeable Ca-dominated soil. Mg was displaced by ion exchange at acid pH, but at pH 10, 14.2 meq Mg per 100 g (3 times the cation exchange capacity of Mg) was adsorbed in non-exchangeable forms at the immediate surface of the soil column by specific adsorption reactions. Distilled water applied to leachate-treated soil columns in a simulation of rainfall reduced hydraulic conductivity by 64-fold. This was caused by clay dispersion and reduction in pore space. To avoid death of vegetation and reduction in adsorption efficiency of the soil receiving the leachate, the leachate and soil must first be fully characterized. Then the wastes must be modified by pretreatment, such as dilution, to minimize adverse effects. (Cassar-FRC)
W82-05619

EXAMINATION OF PROCESS PARAMETERS AFFECTING SLUDGE DEWATERING WITH A DIAPHRAGM FILTER PRESS,

For primary bibliographic entry see Field 5D.
W82-05695

MATERIALS BALANCE IN AERATED STATIC PILE COMPOSTING,

Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 5D.
W82-05696

THE XIII OLYMPIC GAMES AND ENVIRONMENTAL QUALITY PERSPECTIVE,

For primary bibliographic entry see Field 5D.
W82-05703

LAND APPLICATION OF SECONDARY EFFLUENT AT LAKE GEORGE, NY,

For primary bibliographic entry see Field 5D.
W82-05704

DIE-AWAY KINETICS OF AEROSOLIZED BACTERIA FROM SPRINKLER APPLICATION OF WASTEWATER,

Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
For primary bibliographic entry see Field 5D.
W82-05706

OPTIMAL LOCATION AND MANAGEMENT OF WASTE DISPOSAL FACILITIES AFFECTING GROUND WATER QUALITY,

Stanford Univ., CA. Dept. of Applied Earth Sciences.
For primary bibliographic entry see Field 5G.
W82-05740

OCCURRENCE OF ENDOTOXINS IN GROUNDWATER DURING THE LAND APPLICATION OF WASTEWATER,

Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
For primary bibliographic entry see Field 5B.
W82-05810

DILUTION OF MUNICIPAL LANDFILL LEACHATE, FRANKLIN COUNTY, INDIANA,

Ball State Univ., Muncie, IN. Dept. of Natural Resources.
For primary bibliographic entry see Field 5B.
W82-05811

RELIABILITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS IN FAIRFAX COUNTY, VIRGINIA,

Fairfax County Div. of Environmental Health, VA.
For primary bibliographic entry see Field 5D.
W82-05812

MODELS OF LANDFILL LEACHING: ORGANIC STRENGTH,

Wright-Pierce Architects/Engineers, Portsmouth, NH.
For primary bibliographic entry see Field 5B.
W82-05817

MODELS OF LANDFILL LEACHING: MOISTURE FLOW AND INORGANIC STRENGTH,

Wright-Pierce Architects/Engineers, Portsmouth, NH.
For primary bibliographic entry see Field 5B.
W82-05818

ORGANIC COMPOSITION OF AEROBIC, ANAEROBIC, AND COMPOST-STABILIZED SLUDGES,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biological and Agricultural Engineering.
A. J. Higgins, A. J. Kaplovsky, and J. V. Hunter.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 466-473, May, 1982. 4 Fig, 13 Tab, 22 Ref.

Descriptors: *Sludge digestion, *Composting, *Organic matter, Land application, Nitrogen compounds, Anaerobic digestion, Aerobic digestion, Digestion, Chemical oxygen demand, Grease, Organic acids, Volatile solids, Carbohydrates, Amino acids, Cellulose, Lignin, Fatty acids.

The organic matter was characterized in sludge treated by three processes: aerobic digestion, anaerobic digestion, and composting. Compost stabilization produced the most highly oxidized and most innocuous sludge. Anaerobic sludge was least oxidized and had the most potential for creating objectionable odors upon land disposal. Constituents of raw sludge, aerobic sludge, anaerobic sludge, and compost sludge, respectively, were: volatile solids, 75%, 56.5%, 59.9%, and 49.0%; COD (as mg 02 per 100 mg solids), 77.2, 39.6, 49.9, 34.6; carbon, 39.4%, 25.1%, 30.1%, 22.1%; total grease, 11.0%, 4.90%, 4.60%, 5.92%; total unsaponifiables, 2.9%: 3.32%, 3.97%, 3.35%; cellulose, 32.2%; 12.9% 15.7%, 7.2%; and lignin, 13.6%, 9.5%, 12.1%, 10.5%. Also listed are the composition of the free fatty acids fraction, the composition of the glyceride fatty acids, amino acids, tannins, and carbohydrates. (Cassar-FRC)
W82-05854

5F. Water Treatment and Quality Alteration

DYNAMIC PARAMETER TUNING FOR WATER DISTRIBUTION NETWORK MODELS IN AN EXTENDED PERIOD SIMULATION,

Sheffield Univ. (England). Dept. of Control Engineering.
C. M. Rahal, and M. J. H. Sterling.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 1, p 151-164, March, 1981. 2 Fig, 7 Tab, 10 Ref.

Descriptors: *Networks, *Water distribution, *Model studies, Simulation analysis, Water supply systems, *Yorkshire Water Authority, Reservoirs, Algorithms, England.

A dynamic parameter tuning algorithm was developed so that results of simulating water distribution systems agreed with actual network operating and calibration data. This algorithm extends the static parameter algorithm so that both may be used for network validation. The dynamic parameter tuning algorithm selects the loads that have the highest sensitivity coefficients for any particular discrepancy and only chooses loads that are applied to the load nodes for which measurements are available. The model handles variations in time and reservoir dynamics. The network model is solved at every time interval and information derived from the balanced model is used to detect the parameters which should be tuned in order to force agreement between simulated and observed data. (Cassar-FRC)
W82-04756

SUPPRESSION OF BREAK POINT PRECHLORINATION BY FAST BIOLOGICAL FILTRATION, COMPARATIVE STUDY OF CLARIFICATION EFFICIENCIES OBTAINED BY SINGLE OR MULTILAYERED BLANKETS (SUPPRESSION DE LA PRECHLORATION AU BREAK POINT PAR FILTRATION BIOLOGIQUE RAPIDE: ETUDE COMPAREE DE L'EFFICACITE DE DECANTEURS BIOLOGIQUES A LITS FLUIDISES SIMPLES OU SUPERPOSES),

Service de Controle des Eaux de la Ville de Paris (France).
R. Vilagines, A. Montiel, J. Ouvrard, and S. Rigal.
Aqua, No 4, p 86-89, April, 1980. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Water treatment, *Biological treatment, *Filtration, Fluidized beds, *Pretreatment of water, Chemical coagulation, Ammonium, Nitrogen compounds, Organic matter, Organic carbon, Halomethanes, Chlorination, Drinking water, Biological filters, Activated sludge treatment.

Improved purification of water prior to disinfection would reduce the need for disinfectant addition with resultant formation of undesirable compounds such as halomethanes. Biological filtration is a promising pretreatment method, but has suffered from the disadvantages of slow filtration speed and large filter areas. The use of fluidized bed techniques could alleviate these problems. Two pilot plants were set up, one with a single fluidized bed and another with a double oxygenated fluidized bed, for rapid biological filtration of Marne river water. After ten days of maturation the following percent reductions of raw water constituents were achieved: ammonium nitrogen: single bed 22%, double bed 57%; nitrite and nitrate nitrogen: single bed no change, double bed increase; oxidizability, basic: single bed 32%, double bed 19%; oxidizability, acidic: single bed 35%, double bed 28%, taste threshold: single bed 8%, double bed 9%; T.O.C.: single bed 32%, double bed 28%; and halomethane precursors: single bed 30%, double bed 39%. Further water quality improvements could be obtained by subsequent rapid filtration through a 120 cm sand layer at 6 cu m per sq m per hr (ammonium elimination was virtually complete), while slow filtration through adsorbent materials further reduced organic matter content. (Carroll-FRC)
W82-04765

CENTRALIZED CONTROL OF THE WATER SUPPLY COMPLEX FOR THE MARSEILLES URBAN AREA (CONTROLE CENTRALISE DU COMPLEXE D'ALIMENTATION EN EAU DE L'AGGLOMERATION DE MARSEILLE),

Societe des Eaux de Marseille (France). Dept. Adduction et Exploitation.
J. F. Garcin.
Aqua, No 5, p 8, May, 1980. (English summary).

Descriptors: *Water distribution, *Remote control, *Computers, Automation, Sluice gates, *Marseilles, *France, Water treatment, Water quality.

The Marseilles Water Company has introduced a remote control system for its production supply and distribution installations, including the Marseilles Canal, four water treatment stations, and a 2060 km distribution network. The system is based on question-response type transmission equipment using radio transmission, a main and a secondary control center, and 120 stations. The system performs remote signaling, measurement, alarm and instruction functions. It provides data on the positions of the sluice gates in the Canal, pump functioning, water level at different points in the canal, pressures or reservoir levels in the distribution network, and water quality parameters. Two operators are always on duty at the control center. The operators may make use of two system maps, a battery of recorders, and printer, a terminal screen for visualizing various stations, and a control keyboard. Routine and special data are provided, and

commands are initiated from the center. Service to subscribers has been improved by this system. (Carroll-FRC)
W82-04766

ELECTROPHORETIC MOBILITY MEASUREMENTS IN COAGULATION WITH ALUMINUM SALTS,

Syracuse Univ., NY. Dept. of Civil Engineering.
R. D. Letterman, S. G. Vanderbrook, and P. Sricharoenchaitkit.
Journal of the American Water Works Association, Vol 74, No 1, p 44-51, January, 1981. 11 Fig, 1 Tab, 22 Ref.

Descriptors: *Chemical coagulation, *Electrical properties, *Process control, *Aluminum compounds, Silica, Particulate matter, Kaolin, *Alum, Flocculation, Laboratory studies, Hydrogen ion concentration, Colloids, Suspended solids, Separation techniques, *Water treatment.

Studies were made to improve the usefulness of EM (electrophoretic mobility) as a control technique in alum coagulation. Effects of aluminum, salt and initial suspension concentrations and pH were assessed on flocculation efficiencies of particles in batch experiments then the results obtained were commpared with corresponding electrophoretic mobilities of the particles. At low sulfate concentrations, efficient flocculation was limited to a range of aluminum concentrations that bracket the concentration corresponding to EM = 0. At increasing sulfate concentrations, flocculation increased indefinitely as the aluminum concentration increased. The critical anion (nitrate or sulfate) concentration was negligible at pH values of 3.5-4.5 and above 7.5. At low sulfate concentrations the range of aluminum concentrations which corresponded to flocculent suspensions widened and shifted toward higher aluminum concentrations as the kaolin concentration increased from 50 to 500 mg/l. The aluminum concentration corresponding to zero electrophoretic mobility is essentially directly proportional to the kaolin concentrations. Some evidence was seen that the approximate critical EM value is independent of the type of anion and the particular destabilizing combination of pH and anion concentration. The range of EM values that corresponds to flocculent suspensions seems to depend to some extent on the type of article used in the suspension (silica or kaolin). Results of the study support the contention that hydrolyzed aluminum adsorbs on the particles and forms a coating of aluminum hydroxide precipitate. Addition of aluminum sulfate to a suspension with negligible concentrations of destablizing electrolytes and pH < 7.5 can lead to two regions of flocculation -- a low aluminum flocculation zone corresponding to the destabilization of the positive precipitate coated particles. (Carroll-FRC)
W82-04790

FACTORS AFFECTING COLIFORM BACTERIA GROWTH IN DISTRIBUTION SYSTEMS,

Victoria General Hospital, Halifax (Nova Scotia). Div. of Laboratories.
R. S. Martin, W. H. Gates, R. S. Tobin, D. Grantham, and R. Sumarah.
Journal of the American Water works Association, Vol 74, No 1, p 34-37, January, 1982. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Coliforms, *Water treatment, *Lime, Hydrogen ion concentration, Water distribution, *Halifac, *Nova Scotia, Corrosion, Water quality, Deterioration, chlorination, Pipes, Klebsiella, Bacterial analysis, Lake Pockwock.

A new surface water source, Lake Pockwock, and treatment plant were put into service in Halifax, Nova Scotia, in the summer of 1977. During the summer and fall months up to 30% of the distribution samples showed the presence of coliform bacteria, mainly Klebsiella and other enterobacteria. Postfiltration lime addition at the treatment plant appeared to alleviate the coliform problem. The effects of pH change and lime addition on Klebsiella pneumoniae isolated from the distribution system were investigated in the laboratory. Minimum survival times were found at pH 9.0 and maximum survival times at pH 7.3. Addition of more than 5 mg/liter of lime to raw water caused at least 99% reduction in K. pneumoniae levels. Tubercle material scraped from a pipe removed from the distribution system sustained bacterial growth and reduced a free chlorine residual of 2.5 mg/liter to low levels within 8-14 hr. The strong pH modification and lethal effect on bacteria resulting from lime addition were moderated by the addition of 10 g/liter tubercle material. Lime addition was more effective in controlling the growth of coliform bacteria than increasing the chlorine residual. (Carroll-FRC)
W82-04792

LABORATORY TESTING OF OZONATION SYSTEMS PRIOR TO PILOT-PLANT OPERATIONS,

Vassar Coll., Poughkeepsie, NY.
P. C. Chrostowski, A. M. Dietrich, and I. H. Suffet.
Journal of the American Water Works Association, Vol 74, No 1, p 38-43, 1982. 7 Fig, 5 Table, 34 Ref.

Descriptors: *Ozone, *Water treatment, *Drinking water, Experimental design, *Ozonation, Organic compounds, Oxidation, Biological treatment, Activated carbon, Chemical analysis.

An experimental protocol was designed for bench-scale testing of an ozonation system prior to pilot-plant or full-scale operation. The protocol, a rationalized approach to determination of the chief system parameters, was applied to the ozone pretreatment stage of a biological activated carbon (BAC) process. The need for treatment prior to ozonation was assessed; it was found that the goal of organics removal is best achieved by placing the ozone unit immediately after raw water intake. Comparison of several techniques for quantifying organics removal resulted in selection of an automated system for monitoring UV-absorbing substances at 254 nm. The rates of the ozone-organics and ozone decomposition reactions were determined and used to calculate contact time, contractor volume, optimum alkalinity, and other system parameters. Finally experiments aimed at optimizing the applied ozone dose were conducted. The protocol facilitates system design and is being improved to permit optimization of ozone systems as well as pediction of the effects of ozone in a given system on an individual water supply. (Carroll-FRC)
W82-04795

A SPATIAL COSTING SYSTEM FOR DRINKING WATER,

Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 6C.
W82-04796

COMPARISON OF TRIHALOMETHANE LEVELS AND OTHER WATER QUALITY PARAMETERS FOR THREE TREATMENT PLANTS ON THE OTTAWA RIVER,

Health and Welfare Canada, Ottawa (Ontario); and Environmental Health Directorate, Ottawa (Ontario).
R. Otson, D. T. Williams, P. D. Bothwell, and T. K. Quon.
Environmental Science and Technology, Vol 15, No 9, p 1075-1080, September, 1981. 1 Fig, 3 Tab, 24 Ref.

Descriptors: *Halogens, *Methane, *Water quality, Chlorinzation, Potable water, Water treatment, Seasonal variation, Canada, *Ottawa River, Water treatment facilities, Potable water.

A detailed, 13-month study of water quality in three potable water treatment systems obtaining raw water from the Ottawa River in Canada was conducted to complement earlier studies of water quality parameters and treatment practices and studies of factors controlling the production of trihalomethanes (THMs) in potable water treatment systems. Treated water from two plants, which are of similar design and applied conventional coagulation and sedimentation with rapid sand and anthracite filtration, was similar, but differed significantly from treated water from the third treatment plant, which had a different design and used different chlorination practices. Pearson correlation coefficients showed a complex relationship among several water quality parameters. Multiple regression analysis showed that chlorine dosages and demands were the dominant factors controlling chloroform levels, while other parameters displayed minor effects which varied from system to system and according to stage of treatment. Temperature, chlorine dosages and demands, THM levels, alkalinity measurements, and alum dosages all showed pronounced seasonal variation. THM levels varied significantly over a 24-hour period at any particular point in a system. (Carroll-FRC;
W82-04810

FACTORS INFLUENCING FORMATION OF TRIHALOMETHANES IN DRINKING WATER WITH SPECIAL REFERENCE TO SWEDISH CONDITIONS,

National Inst. of Environmental Medicine, Stockholm (Sweden).
H. Norin, L. Renberg, J. Hjort, and P. O. Lundblad.
Chemosphere, Vol 10, No 11/12, p 1265-1273, November/December, 1981. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Chlorinated hydrocarbons, *Disinfection, *Chlorine, *Trihalomethanes, Organic compounds, Drinking water, *Sweden, Chlorine dioxide, Ammonium sulfate, *Water treatment, Water quality control.

Trihalomethane (THM) formation during water treatment with chlorine and ammonium sulfate was studied in full-scale experiments at the Norsborg water works, Stockholm, Sweden. Under normal conditions (0.5 mg per liter Cl and 0.15 mg per liter ammonium sulfate) total THM concentrations increased from 1.8 to 4.1 micrograms per liter within 2 hours. This indicated that drinking water at the tap had a higher THM concentration than water leaving the treatment plant. THM levels decreased with increases in ammonium sulfate doses: 5.1 and 1.7 micrograms per liter THM at ammonium sulfate doses of 0 and 0.35 mg per liter, respectively. THM concentrations decreased with increases in ammonium sulfate/chlorine ratio: 5.1 to 0.9 micrograms per liter THM at ratios of 0 and 1.1, respectively. A high dose of Cl (2 mg per liter) without ammonium sulfate addition produced 70 microgams per liter THM after a 6 day laboratory experiment. Additional laboratory experiments using 2 mg per liter chlorine dioxide produced only 1.8 micrograms per liter THM after 6 days. Sampling of community water disinfected with chlorine dioxide showed only bromodichloromethane present at levels of 0.02 micrograms per liter and no chloroform, dibromochloromethane, or bromoform. Instantaneous THM levels found in water at 191 Swedish water works using some form of disinfection were 0.2 to 200 micrograms per liter. Most of the samples had THM levels of 25 micrograms per liter or below. (Cassar-FRC)
W82-04826

POTABLE WATER PRODUCTION IN HOLLAND,

Water Services, Vol 85, No 1030, p 618-619, December, 1981.

Descriptors: *Drinking water, *Water treatment, *Water supply, *Netherlands, Desalination, Distillation, Surface water, Maas River, Rhine River, *Groundwater, Ground contamination, Activated carbon, Filtration, Dune infiltration.

Annual water production in the Netherlands is approaching the two billion cubic meter mark, yet the provision of water with suitable quality is becoming increasingly difficult. Pollution is threatening Holland's groundwater, which supplies two thirds of the drinking water. Two national organizations are concerned with water recovery and production research. Much research is being conducted in hydrogeology to secure groundwater

supply. Activated carbon is being used for groundwater purification at some points where chemicals have penetrated through the subsoil into the groundwater. In coastal areas, natural groundwater is too salty for use, except in the case of the coastal dunes. Reservoirs have been constructed on the Maas river, which is less polluted than the Rhine, to equalize the annual flow. Reservoirs have been lined with nylon mats and bitumen, but algae control is still required. Plate clarifiers are widely used for initial purification, followed by sand filtration, carbon filtration if necessary (carbon is obtained from peat in some areas), and chlorination or ozonization for disinfection. Electrochemical and physical purification methods are under investigation. A seawater distillation plant has been constructed on the island of Texel; studies in the Netherlands Antilles have shown that solar distillation plants are feasible. (Carroll-FRC)
W82-04851

NEW TELEMETRY SYSTEM FOR THE CAMBRIDGE WATER COMPANY.

Water Services, Vol 85, No 1030, p 606-609, December, 1981.

Descriptors: *Water supply, *Automation, *Telemetry, *Cambridge Water Company, *England, Computers, Water management, Water quality management.

A complete telemetry control system was installed by the Cambridge Water Company in 1980. The hardware uses standard modules, with communication by UHF radio to 31 outstations and substations. At two minute intervals the system scans the network points, looking for changes of status or exceeding of preset values. In case of abnormal reports, the operator may institute a control function. Values are indicated in user selected units or by color changes. All aspects of system operation are assigned security levels. Only selected records are stored for historical use: data on flow rates in various areas of the network and patterns in daily water supplies. The flexibility of the system allows for expansion and modification. (Carroll-FRC)
W82-04852

THE HYGIENIC CONTROL OF SWIMMING BATHS.

Water Services, Vol 85, No 1030, p 595-597, December, 1981. 2 Fig, 1 Tab.

Descriptors: *Water treatment, *Swimming pools, *Disinfection, Chlorine, Chlorine dioxide, Ozone, Isocyanurates, Filtration, Flocculation, Water circulation, Hydrogen ion concentration.

Water treatment systems employed for maintaining the safety of swimming pool water include flocculation, disinfection, algal destruction and filtration operations. A balance between contaminants introduced and removed must be maintained by fresh water addition and uniform circulation of the water by pumping. The circulation system is generally aimed at circulating the pool contents every 8-10 hr; an average of 2 cu m of treated water should be available for each swimmer. At least 30 liters of fresh water per bather per day should be added to reduce salt accumulation. The addition may be made every 2-3 days when the filters are backwashed. Flocculants are generally aluminum or iron compounds, with the former being more sensitive to pH of the water. Filtration removes both the flocs produced by the flocculants and other small-particulate materials. Disinfection should destroy 99.9% of bacteria present in 30 sec, which can be accomplished by maintaining a redox potential of 700 mV. Sodium hypochlorite solution is the most commonly used disinfectant, but chlorine dioxide, ozone and isocyanurate have also been used. Ozone must be removed by activated carbon filtration after disinfection of the water. Isocyanurates are suitable as simple methods of treatment for small pools. (Carroll-FRC)
W82-04853

DESIGN, CONSTRUCTION AND OPERATION OF A NEW FILTER APPROACH FOR TREATMENT OF SURFACE WATERS IN SOUTHEAST ASIA,

SEATEC International, Bangkok (Thailand).
R. J. Frankel.
Journal of Hydrology, Vol 51, No 1-4, p 319-328, May, 1981. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Water treatment, *Filtration, *Surface water, Gravity filters, Carbon filters, Potable water, Wastewater treatment, Adsorption, Design criteria, *Southeast Asia, Philippines, Thailand.

The development of simple, inexpensive, and efficient water purification and wastewater treatment methods suitable for use in rural communities in Southeast Asia is reported. The filter utilizes local materials that are widely available, principally shredded coconut fiber and burnt rice hulks, in a two-stage filtering process designed as a gravity-fed system. Since the materials are inexpensive enough to discard after use, backwashing is eliminated. Raw water is first passed through shredded coconut fiber for an initial reduction in turbidity and suspended solids removal. This step provides a substitute for the coagulation and sedimenation phases of conventional water treatment plants. The treated water is then passed through the burnt rice husks, removing residual turbidity and bacteria in a manner similar to that accomplished by slow sand filtration in traditional systems, with the additional benefits of taste, color, and odor removal through the absorption properties of the activated carbon in the husks. This system generally does not require the addition of any chemicals. Use of the two filters in series generally produces a clear effluent which is free of odor and color and is of an agreeable and acceptable taste to the villagers. Bacterial removals average between 60 to 90 percent without the use of any disinfectant. Experiences with eight village size units ranging in capacity from 1.0 to 15.0 cubic meters per hour which were constructed in Lower Mekong River Basin countries and in the Philippines are described. (Carroll-FRC)
W82-04869

PRELIMINARY SCREENING OF BACTERIAL COMPONENTS AS ORGANIC PRECURSORS TO THE FORMATION OF TRIHALOMETHANES,

Missouri Water Resources Research Center, Columbia.
R. B. Jacquez, and F. Dolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220633, Price codes: A05 in paper copy, A01 in microfiche. Report, July 31, 1981, 76 p, 12 Fig, 8 Tab, 31 Ref. OWRT A-116-MO(1). 14-34-0001-0127.

Descriptors: *Trihalomethanes, Organic precursors, *Bacteria, *Drinking water, Chloroform, *Chlorination, Iron, *Water treatment, Water pollution sources.

The bacteria from a suspended growth system were studied as organic precursors to the formation of THM's. THM production was monitored as a function of initial chlorine dose and the concentration of bacterial mass as measured by turbidity. Tests were conducted on a batch basis. Ferric iron was also examined for its potential to act as a catalyst for THM production during the chlorination of bacterial cells. In a system saturated with chlorine, chloroform formation was found to increase linearly with the amount of cell mass used as an organic precursor. Chloroform production was also found to increase in relation to a greater exposure of cell surface area (e.g. dispersed cells vs. flocculated cells). Ferric iron appeared to catalyze chlorination reactions in water, causing increased chlorine consumption, but did not increase THM production.
W82-04957

INFLUENCE OF CHLORINATION AND THE DISTRIBUTION SYSTEM ON MUTAGENS IN A POTABLE WATER SUPPLY,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-04961

PROSPECTS OF USING RADIATION WATER TREATMENT METHODS,

For primary bibliographic entry see Field 5D.
W82-05026

STUDY OF CHLORINE DIOXIDE AND ITS METABOLITES IN MAN,

Ohio State Univ., Columbus. Dept. of Pharmacology.
J. R. Bianchine, J. R. Lubbers, S. Chauhan, and J. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109356, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S1-81-068, December 1981. 3 p.

Descriptors: *Chlorine dioxide, *Toxicity, *Water treatment, *Disinfection, Metabolites, Chlorination, chlorite, chlorate, Chloramine.

Chlorine dioxide has been identified as a potential water disinfectant alternative to chlorination. A three-phase human investigation was undertaken to assess the safety of chlorine dioxide and its metabolites. In phase I, normal healthy adult males were treated with successive increasing doses of chlorine dioxide, chlorite, chlorate, chloramine, chlorine or untreated water. Phase II considered the effect on normal subjects of daily ingestion of disinfectants at a concentrations of 5 mg/L over a 12 week period. In phase III, chlorite, at a concentration of 5 mg/L was administered daily to three glucose-6-phosphate dehydrogenase (G-6-PD) deficient subjects. Physiological impace was assessed by evaluation of a large battery of qualitative and quantitative tests. All three phases of this clinical evaluation were completed uneventfully. there were no obvious undesirable clinical sequellae noted by any of the participating subjects or the observing medical team. In several cases statistically significant trends in certain biochemical or physiological parameters were associated with treatment; however, none of these trends were judged to have physiological consequences. Within the limits of the study, the relative safety of oral ingestion of chlorine dioxide and its metabolites, chlorite and chlorate, was demonstrated. (Moore-SRC)
W82-05057

USE OF MATHEMATICAL MODELS TO GENERATE ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W82-05072

WATER SYSTEM DESIGN MEETS MODERN CHALLENGES,

Watson and Co., Tampa, FL.
J. L. Carter.
Water/Engineering and Management, Vol 128, No 12, p 33-34, December, 1981. 3 Fig.

Descriptors: *Water supply, *Water quantity, *Water treatment, *Wells, Recreation facilities, Recreation, Filtration, *Drinking water, Water storage, Groundwater recharge, Rainfall, *Tampa, Florida, Water supply systems, Design criteria.

The selection and design of a supplementary drinking water system in Tampa, Florida is described. Three issues were of prime consideration in this undertaking: (1) achieving a yield of 40 million gallons per day, (2) minimizing ecological impact, and (3) conserving energy. This task was further complicated by the fact that the water regime in this area of Florida is highly variable. A recharge area was chosen as the well field. Service road construction was designed to minimize the effect on the natural surroundings, and wells are scattered through the well field, equipped with dual purpose pump houses, which also serve as picnic shelters that blend into the surroundings. Energy conservation is achieved in that gravity is used to move water through the processing facility. (Titus-FRC)
W82-05170

THE USE OF ACTIVATED CARBON IN WATER TREATMENT,

Anglian Water Authority (England).

C. R. Hayes, and C. J. Whitford.

Effluent and Water Treatment Journal, Vol 22, No 1, p 9-16, January, 1982. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Drinking water, *Water treatment, Trihalomethanes, Filtration, Adsorption, Trace levels, Performance evaluation, Taste, Odor control, Economic aspects, Ozone, Oxidation.

Experience of the Anglian Water Authority in use of powdered activated carbon (PAC) and granular activated carbon (GAC) in water treatment is reviewed. Although GAC is more effective than PAC in removing tastes and odors, it is presently being used in only four water works in the United Kingdom, whereas PAC is used in 100 works. GAC removes organic contaminants, but the more volatile compounds are removed effectively only during early bed life. Organochlorine pesticides and other high molecular weight low polar compounds are more effectively adsorbed. If more than 60% of total organic carbon in the range of 4-7 mg per liter must be removed from surface water, GAC is relatively expensive. Ozone pretreatment improves GAC performance, but temperature and other oxidants have little effect. The most attractive option with respect to capital costs is using GAC to replace sand at the rapid gravity filtration stage. The use of GAC is expected to increase with the public concern about trace organic contaminants in drinking water. It is not likely that PAC use will increase. (Cassar-FRC)

W82-05182

SAVING ENERGY BY CATALYTIC REDUCTION OF OXYGEN IN FEEDWATER,

Bayer A.G., Leverkusen (Germany , F.R.).

B. Martinola, and P. Thomas.

Effluent and Water Treatment Journal, Vol 21, No 12, p 542-546, December, 1981. 10 Fig, 5 Tab, 6 Ref.

Descriptors: *Oxygen, *Feedwater treatment, *Catalysts, *Dissolved oxygen, Residual oxygen, *Industrial water, Water use, Water treatment, Energy conservation.

It is virtually always necessary to remove most of the dissolved oxygen from water for steam generating stations, industrial process waters, and heating water in order to avoid corrosion of equipment in which the water is circulating. The most common method used to reduce dissolved oxygen, thermal degassing under vacuum or at slightly increased pressure, is generally inefficient and energy-expensive. Chemical methods, including reduction with sulfite and hydrazine, result in unwanted by-products and are often expensive. The use of hydrogen gas introduced into the water to react with the dissolved oxygen to produce water is a simple process which is also energy-saving. However, the reaction must be accelerated catalytically at low temperatures in order to be completely terminated in a sufficiently short time. Tests were conducted to design a simple reaction unit, to identify a good catalyst, and to determine the optimum operating conditions. Pilot plant tests were conducted to examine design and operating options. Metallic palladium was selected as the catalyst. Ion exchange resins were doped with various amounts of palladium and placed in columns through which water was passed. The size of the individual beads ranged from 0.3 to 1.5 millimeters. An industrial-scale unit for the production of 450 cubic meters per hour of oxygen-free water was constructed. After stoichiometric addition of hydrogen, residual oxygen values of about 20 parts per billion were obtained with a residence time of 30 seconds. There were no signs of fatigue in the catalysis resin after treatment of over 450,000 bed volumes of water. The required apparatus is simple and requires almost no maintenance. The use of this system is recommended wherever the heat used for thermal degassing cannot be recovered. (Carroll-FRC)

W82-05183

BIOLOGICAL DENITRIFICATION FOR POTABLE WATER TREATMENT,

R. Gauntlett, and T. F. Zabel.

Water Services, Vol 86, No 1031, p 17-18, January, 1982. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Denitrification, *Sand filters, *Nitrates, *Water treatment, Fluidized beds, Biological treatment, Filters.

Seasonal high nitrate levels in British rivers and groundwaters used for drinking water supplies prompted investigations of methods of biological denitrification. A fluidized sand bed removed up to 10 mg per liter nitrates with a bed depth of 4-5 m, temperatures as low as 2 C, and an upflow rate of 20 m per hour. Methanol was an effective source of carbon for the denitrifying bacteria; acetic acid produced excessive slime and occasional high nitrate levels in treated water. Sand cleaning and aeratin were necessay parts of the fluidized bed process. The expanded sand bed, an alternative to the fluidized bed, removed 10 mg per liter N at an upflow rate of 14 m per hour, temperatures of 3-5 C, and bed depth of 1.5 m. Backwashing removed excess bacterial growth. Raw water turbidity of > 30 FTU adversely affected performance. The 10-14 day start-up period of the denitrigying process requires anticipation of the high seasonal nitrate levels. (Cassar-FRC)

W82-05247

EXTENDED DECHLORINATION STUDIES WITH GRANULAR ACTIVATED CARBON FILTERS,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

M. T. Suidan, W. H. Cross, and K. A. Chacey.

Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2634-2646, November, 1980. 14 Fig, 1 Tab, 15 Ref.

Descriptors: *Carbon filters, *Oxidation, *Mathematical models, *Activated carbon, *Residual chlorine, Chlorine, Halogens, *Separation techniques, Water treatment, Wastewater treatment, Disinfection.

When activated carbon which is used to control residual chlorine levels is oxidized by free chlorine, a dark brown color results that renders the product water useless for consumption. An operating procedure has been developed which allows for the removal of column segments that have reached predetermined oxidation levels while permitting a more efficient use of activated carbon. A mathematical model was developed which describes the decreasing bed-length dechlorinator and can simulate the stratified-carbon column in both upflow and downflow operating modes. The model was tested over a wide range of operating and environmental conditions. The extent of carbon utilization prior to elimination and the operating pH had a marked effect on the performance of the system. Bed length had a significant influence on the service life of a carbon dechlorination column. Increased detention of flow resulted in increased carbon utilization efficiency. Higher temperatures also improved performance and extended the service life of a column. Mode-of-flow studies showed that the upflow mode would result in an extended service life of the contactor while allowing for more uniform exhaustion of the carbon along the column. Efforts to use one representative carbon size throughout the column failed due to a redistribution of particle sizes in a stratified bed during carbon removal. (Geiger-FRC)

W82-05257

METHANE IN WATER WELLS,

Michigan Dept. of Public Health, Lansing.

D. K. Keech, and M. S. Gaber.

Water Well Journal, Vol 36, No 2, p 33-36, 1982. 5 Fig, 1 Tab.

Descriptors: *Methane, *Water quality, *Water treatment, Hydrocarbons, Wells, Potable water, Separation techniques, *Water wells, Gases, *Ventilation.

A treatment is described whereby methane and other dissolved gases in water wells can be effectively removed. Proper venting at the well head is essential to allow the methane to be removed from the well. The upward movement of water in the casing when the well is recovering after pumping will push the accumulated methane gas out the top of the well. If large amounts of combustible gases are present, the well vent should terminate above a person's head to avoid ignition by lawnmowers, barbeque grills or other items. The installation of a gas shroud on the submersible pump has been successful in several gaseous water wells. An additional method involves the use of a vented storage tank with a spray bar mechanism. The spray bar is a length of pipe with small holes drilled in it to disperse the water. Agricultural spray nozzles may be used for this purpose. Another method involves the use of an air release valve on a galvanized storage tank. An air-separator system was installed in a newly constructed high school in northern Michigan to solve the gas in water problem there. The air separator is a cylindrical device with an inlet near the top, outlet near the bottom and air vent on top. Water flowing through the unit creates a centrifugal force which causes heavier, gas-free water to move toward the outside. Lighter gas-entrained water moves toward the center due to a low velocity vortex being created within the air separator. Gas rises and exits through a vent line into the top of a vented tank. A vent from the tank terminates about a foot above the roof line of the building. (Baker-FRC)

W82-05262

DEVELOPMENT OF EVALUATION OF ION-EXCHANGE RESINS FOR REMOVAL OF SPECIFIC METALS IN WATER TREATMENT,

West Virginia Univ. Morgantown. Water Research Inst.

A. Winston, C. R. Jenkins, W. Lerdthusnee, and S. J. Masten.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224593, Price codes: A03 in paper copy, A01 in microfiche. Information Report 17, 1981. 22 p, 6 Fig, 2 Tab, 7 Ref. OWRT A-043-WVA(1), 14-34-0001-1152.

Descriptors: Acid mine water, Cation exchange, Chelation, *Demineralization, *Ion exchange, *Iron, *Polymers, *Water treatment, Groundwater, Heavy metals, Industrial wastes, Manganese, Mine water, Treatment, *Wastewater treatment, Water pollution, Water supply.

An ion-exchange resin specific for iron was developed and evaluated for its performance in removing iron from water supplies. The resin was synthesized by converting the carboxyl groups of Chelex 100 (Bio-Rad) to hydroxamic acids by reaction with ethylchloroformate followed by hydroxylamine. The resin was evaluated in bench scale equipment consisting of a column 5 cm in diameter by 1.0 m containing from 0.5 to 1 pound of resin. Iron (III) perchlorate solutions were passed through the column and the iron concentration of the effluent was monitored by atomic absorption spectroscopy. Breakthrough was considered to have occurred when the effluent iron concentration had reached 0.3 ppm. The effects of flow rate and iron concentration on column performance were determined. Increasing flow rate and increasing iron concentration caused decreases in operating exchange capacity of the resin. The exchange capacity varied between 2.9 and 5.8 eq iron per cubic foot of resin depending upon the flow rate and influent iron concentration. The resin can be regenerated by reduction of the iron (III) to iron (II) using sodium hydrosulfite followed by washing.

W82-05282

AUTOMATION OF THE SEINE WATER TREATMENT STATION AT MORSANG AND OF THE WATER SOFTENING STATION AT VILLENEUVE-LA-GARENNE (AUTOMATISATION DE LA STATION DE TRAITEMENT D'EAU DE SEINE A MORSANG ET DE LA STATION D'ADOUCISSEMENT DE VILLENEUVE-LA-GARENNE),

Societe Lyonnaise des Eaux et de l'Eclairage (France).

G. Facy, and P. Musquere.

Aqua, No 1, p 368-376, 1982. 8 Fig. 10 Ref. English summary.

Descriptors: *Water softening, *Automation, *Control systems, *Water treatment, Paris, France, Water supply, *Seine River, Municipal water.

Examples of automation in two water treatment plants in France are described. The Morsang-sur-Seine plant (150,000 cu m per day) treats water by clarification, sand filtration, ozonation, filtration through granular activated carbon, pH adjustment, and final chlorination. A central computer coordinates all aspects of the system, monitoring water quality parameters at all stages of treatment, operating pumping equipment, regulating flow, dosing chemicals, measuring residual disinfectant, adjusting pH, designating the time for backwash, etc. The Villeneuve-la-Garenne softening plant removes carbonate from 40,000 cu m per day of water. The treatment sequence in this plant is iron removal, nitrification, sand filtration, carbonate removal, dual-media filtration, ozonation, pH correction, and final chlorination. The plant is controlled by a programmable automatic system, regulating circuits according to results of automatic monitoring of water quality and residuals. (Cassar-FRC)
W82-05364

THE CONTINUING STRUGGLE OF WATER-BORNE ILLNESS,

For primary bibliographic entry see Field 5C.
W82-05366

DEVELOPMENT OF WATER TREATMENT IN FRANCE (EVOLUTION DANS LE TRAITEMENT DES EAUX EN FRANCE: QUELQUES EXEMPLES D'ACTUALITE),

M. Rapinat.
Aqua, No 1, p 4-9, 1982. 4 Fig, 4 Tab, 53 Ref. English summary.

Descriptors: *Disinfection, *Biological treatment, *Water treatment, *France, Chlorination, Activated carbon, Reviews, Water pollution prevention, Trihalomethanes, Ozonation, Chlorine dioxide.

The status of water treatment in France is reported. Biological processes, based on self-purification, preozonation, and activated carbon, have been developed. Chlorine dioxide and ozone have partially replaced chlorine as disinfectants; ozonation is also effective in removing organic compounds. The efficiency of sedimentation equipment has been improved. Methods to protect water supplies from accidental pollution include storage basins, rapid communications, and shutting down or emptying the treatment plant if necessary. Formation of trihalomethanes is minimized by using chlorine only at the end of the treatment process. Attention to energy conservation and decreasing chemical costs have produced rapidly responding pumping systems, systems for careful control of chemical dosages, and combination chemical-biological treatments. In the future research will center on reduction of A1 concentrations, protection of aquifers from nitrate pollution, and sludge treatment. (Cassar-FRC)
W82-05367

TREATMENT OF WATER FROM EUTROPHIED IMPOUNDMENTS,

National Inst. for Water Research, Pretoria (South Africa).
L. R. J. van Vuuren, F. J. de Wet, and G. G. Cillie.
Aqua, No 1, p 354-360, 1982. 7 Fig, 6 Tab, 7 Ref.

Descriptors: *Flotation, *Filtration, *Eutrophication, *Water treatment, Algae, *South Africa, Dissolved air flotation, Coagulation, Pilot tests, Costs, Capital costs, Taste, Odor, Drinking water, Wastewater treatment, Water reuse.

The combined dissolved air flotation-filtration process (DAFF) was successfully applied to treatment of eutrophied surface waters in South Africa. Problems with conventional treatment of these algae-rich waters include frothing of the water, floating flocs, requirement for excessive chemical doses, very short filter runs, caking of filter sand by slime, residual turbidity in finished water, formation of a white deposit on boiling or acidification, and objectionable tastes and odors. Six eutrophied waters treated in the pilot unit included water from several rivers, a secondary municipal wastewater effluent, and a gold mine sewage works effluent. Turbidity was reduced to 0-1.5 NTU, suspended solids to 0.6-6.5 mg per liter, and chlorophyll a to 0-19 micrograms per liter. The process consisted of dosing with alum and polyelectrolyte; air flotation; and filtration through activated carbon, anthracite, and sand. Capital cost estimates for conventional (sedimentation plus filtration), flotation plus filtration (DAF), and combined flotation-filtration (DAFF) treatment were 1,977,000 1,870,000, and 1,386,000 rands (1 rand = $1.27), respectively. Unit costs of the DAFF process were 7.5% lower than for the conventional process. (Cassar-FRC)
W82-05368

CHEMICALS IN WATER TREATMENT--EFFECTS ON WATER QUALITY,

Water Research Centre, Stevenage (England).
T. Burke.
Aqua, No 1, p 351-353, 1982. 1 Fig, 6 Ref.

Descriptors: *Water quality, *Water treatment, *Disinfection, Chlorination, Ozonation, Activated carbon, Adsorption, Trihalomethanes, Chlorinated hydrocarbons, Denitrification, Chemical treatment, Potable water, *Chemical reactions, Adverse effects.

Most chemicals used in water treatment have some side-effects on water quality. In the conventional treatment process coagulants (alum, ferric salts, and polyelectrolytes) may enter the distribution system, producing discolored water, subsequent coagulation, difficulty in maintaining a disinfectant residual, increased corrosion, and residual A1 or acrylamide monomer. Possible adverse effects of treating waters corrosive to lead pipes are calcium carbonate precipitation and breakup of deposits on the insides of pipes. Processes for removing excess nitrates include ion exchange and biological denitrification, each of which has drawbacks. The waste brine regenerant solution from the ion exchange process is costly to dispose of. In biological denitrification possible problems are sloughing of excess biological growth and residual methanol (the source of carbon). Chlorination of water produces trihalomethanes and other chlorinated compounds from the organic matter present in surface waters. Health risks of using alternative disinfectants, chlorine dioxide or ozone, have not been fully established. Activated carbon treatment, unless carefully monitored, can release harmful organics into water if the adsorbent is not regenerated before breakthrough occurs. (Cassar-FRC)
W82-05369

OZONE AND ACTIVATED CARBON,

C. Engels.
Aqua, No 1, p 361-367, 1982. 2 Fig, 3 Tab. English Summary.

Descriptors: *Ozonation, *Activated carbon, *Water treatment, *Dusseldorf, *Rhine River, Groundwater, Adsorption, Organic compounds, Taste, Odor control, Toxins.

The water treatment plant at Dusseldorf uses ozonation followed by activated carbon filtration to treat mixed groundwater, predominantly infiltrating through the Rhine River banks. Ozone at a concentration of about 2.5 g per cu m of water oxidizes inorganic compounds (Fe and Mn) and organic compounds (taste and odor producing substances and toxic chemicals). The oxidation products and other materials such as organic chlorine compounds are adsorbed by the activated carbon. In the final stage carbon dioxide is neutralized with NaOH. (Cassar-FRC)
W82-05370

WATER AND WASTEWATER TREATMENT IN LATIN AMERICA--APPLIED TECHNOLOGY,

Universidade Central de Venezuela, Caracas. Dept. of Sanitary Engineering.
G. R. Mijares.
Water Science and Technology, Vol 14, No 1/2, p 431-437, 1982. 17 Ref.

Descriptors: *Technology, *Developing countries, *Water treatment, *Wastewater treatment, *Latin America, Pathogens, Iron compounds, Filtration, Wastewater composition, Lagoons, Stabilization lagoons, Land application, Sludge drying, Disinfection.

During the last 6-7 years Latin America water and wastewater engineers have adapted sophisticated technology from industrial countries to local climates, sewage characteristics, and economic conditions. Some conditions commonly encountered in these countries are: high iron content of deep well water, a high proportion of carbohydrate to protein in wastewater, good tolerance of tropical fish to low dissolved oxygen concentrations, abundance of light energy and warm temperatures, and presence of resistant pathogens and parasites. Engineers have developed process modifications to handle these conditions. Ferrous compounds are oxidized with simple aeration towers, chlorination, or rapid turbulent mixing. High rate sedimentation apparatus made of parallel sheets of asbestos cement inclined at 45-60 degrees from the horizontal have been satisfactorily used in settling of suspended solids. Rapid filtration units operating at declining rates are smaller than conventional units. In these countries wastewater treatment and sludge digester detention times can be less because of higher ambient temperatures and less nitrogenous matter in the sewage. Settling velocity is also greater. Hydraulic and organic loads must be modified to handle specific wastewater compositions. Sewage stabilization lagoons, high-rate photosynthetic lagoons, and land applications show great promise, but the dangers posed by tropical disease organisms must be considered. Sludge drying bed area needs to be only 1/3 of beds in temperate zones. Iodine is being evaluated as a disinfection agent because schistosomiasis and amoebiasis organisms are rather resistant to destruction by chlorination. (Cassar-FRC)
W82-05425

EFFECTS OF SALTS ON ACTIVATED CARBON ADSORPTION OF FULVIC ACIDS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. J. Randtke, and C. P. Jepsen.
Journal of the American Water Works Association, Vol 74, No 2, p 84-93, February, 1982. 19 Fig, 4 Tab, 55 Ref.

Descriptors: *Fulvic acids, *Activated carbon, Adsorption, Calcium, Magnesium, Sodium, *Salts, Water treatment, Drinking water, Potable water.

A study was conducted to more fully characterize the effects of changing concentrations of various salts on activated carbon adsorption and to consider the implications of such effects with respect to the design and operation of treatment systems for organics removal. Fulvic acids were the primary source of organic matter used, as they are considered resonably representative of naturally occurring organic substances in most water supplies. A literature review was included, which concentrated on the effects of nonreactive inorganic salts on the rate and extent of adsorption of anionic and neutral organic adsorbates onto negatively charged adsorbents. Calcium, magnesium, and sodium salts enhanced the adsorption of fulvic acids onto activated carbon. Various inorganic anions had no observable influence on the adsorption of fulvic acid. Calcium significantly influenced the adsorption of fulvic acid by a small activated carbon column. The addition of calcium greatly improved adsorption. The enhancement of fulvic acid adsorption by calcium and magnesium was less pronounced at low pH. Adsorptive capacity was most sensitive to changes in salt concentration at low concentrations of salt, with little adsorption occurring in the absence of added salts. Sodium chloride and sodium sulfate had no effect on the adsorption of fulvic acid when calcium or magnesium was present at a concentration of 0.5 mM. Adsorption

of 2,4-dihydroxybenzoic acid was influenced by salt addition in a manner similar to fulvic acids. Salts do not affect the adsorption of all organic anions in the same manner, as evidenced by the various effects of salts on the adsorption of EDTA, citric acid, and aspartic acid. (Baker-FRC)
W82-05667

REMOVING TRIHALOMETHANE PRECURSORS BY PERMANGANATE OXIDATION AND MANGANESE DIOXIDE ADSORPTION,

Brown and Caldwell, Walnut Creek, CA.
J. M. Colthurst, and P. C. Singer.
Journal of the American Water Works Association, Vol 74, No 2, p 78-83, February, 1982. 15 Fig, 15 Ref.

Descriptors: *Water treatment, *Drinking water, Water quality, Trihalomethanes, Manganese dioxide, Adsorption, Permanganate, Oxidation, Chloroform, Humic acids, Fulvic acids.

The effects of permanganate oxidation and manganese dioxide adsorption on the formation of trihalomethanes from humic substances were investigated. Most of the experiments were conducted with a technical-grade humic acid. Selected experimental runs were duplicated using an aquatic fulvic acid extracted from Lake Drummond, Virginia. Various concentrations of humic material were adjusted to pH 7.0 and contacted with different amounts of permanganate for 2 hours. The study demonstrated that permanganate treatment at neutral pH using doses commonly employed in water treatment practices lowers the chloroform formation potential of humic substances to some degree. The largest decreases occurred in those samples subjected to the greatest permanganate: total organic carbon concentration ratios. Similar decreases in chloroform formation potential were noted for both the humic acid and fulvic acid studied. Manganese dioxide alone did not appreciably absorb humic substances at pH 7.0. Consequently, little reduction in chloroform formation potential can be expected as a result of the presence of manganese dioxide alone. Calcium facilitated the adsorption of humic substances on manganese dioxide. Significant reductions in chloroform formation potential, TOC, and chlorine demand were noted as a result of adsorption of the humic substances on manganese dioxide in the presence of calcium. Humic acid was more easily adsorbed than the aquatic fulvic extract. (Baker-FRC)
W82-05668

EVALUATING REGENERATED ACTIVATED CARBON THROUGH LABORATORY AND PILOT-COLUMN STUDIES,

Philadelphia Water Dept., PA.
P. R. Cairo, J. T. Coyle, J. J. Davis, H. M. Neukrug, and I. H. Suffet.
Journal of the America Water Works Association, Vol 74, No 2, p 94-102, February, 1982. 17 Fig, 6 Tab, 16 Ref.

Descriptors: *Activated carbon, *Regeneration, Organic compounds, Carbon, Adsorption, Water treatment, Drinking water. Temperature effects.

Results are presented from ongoing laboratory and pilot-column research comparing the effectiveness of regenerated and virgin carbon for use at water treatment plants. The carbon used in the study was regenerated for one cycle at several furnace temperatures. The laboratory study showed that 542 degrees C regeneration did not restore the fundamental kinetic characteristics of virgin carbon for the test substances methyl ethyl ketone and n-butanol. For these same compounds, the 850 degree C regeneration condition produced breakthrough curves that were virtually identical to the virgin carbon. The pilot column study evaluated 542, 850 and 962 degree C conditions for F400 GAC and two gasification phase regeneration temperatures; for F300 GAC. The most significant results were shown in the breakthrough curves of chloroform for F400 operating in a postcontractor mode. The 962 degree C regenerated carbon produced an effluent concentration twice as high as the virgin, 542 and 850 degree C regenerated carbons. The total organic carbon (TOC) breakthrough curves for all virgin and regenerated F400 GACs were virtually the same. Particularly significant was the fact that the leveling-off plateau of TOC occurred for all virgin and regenerated carbons. The analysis of specific nonpolar organics by GC profiling resulted in the identification of a number of alkyl benzene compounds in the influent that were fairly effectively removed by the virgin and regenerated carbons, even after 17 weeks of operation. It is suggested that the 962 degree C regeneration may be too harsh a condition for drinking water carbon, as it was initially developed for use on carbon heavily laden with organics from industrial and municipal wastewater applications. (Baker-FRC)
W82-05670

CONSIDERING SLUDGE PRODUCTION IN THE SELECTION OF COAGULANTS,

Montgomery (James M.), Inc., Reston, VA.
C. R. James, and C. R. O'Melia.
Journal of the American Water Works Association, Vol 74, No 3, p 148-151, March, 1982. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Coagulation, *Sludge excess, Water treatment, Cost analysis, Alum, Polymers, Orange County, North Carolina, Turbidity, Organic carbon.

Requirements of the 1977 Clean Water Act caused the Orange County, North Carolina, water authority, which discharged its sludge to a stream, to reduce the sludge volume from its water treatment plant by adjusting the coagulation regime. Total organic carbon and turbidity were most effectively removed and sludge production decreased by a combination of alum (30 mg per liter) and a high-molecular weight weakly-charged polymer (0.05 mg per liter). Best results were obtained when alum was added first, followed by polymer. Alum alone produced a difficult-to-dewater, voluminous sludge. Use of polymers alone removed less than optimum total organic carbon, and dosage requirements were high. Costs of the combined treatment for treating water with 27 NTU and 8 mg per liter total organic carbon at a flow rate of 0.24 cu m per sec were $80 per day, compared with $140 per day for alum alone. Costs were calculated using alum at 11 cents per kg and polymer at $6.56 per kg. (Cassar-FRC)
W82-05675

PERFORMANCE OF GRANULAR ACTIVATED CARBON FOR TOTAL ORGANIC CARBON REMOVAL,

Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, and R. S. Summers.
Journal of the American Water Works Association, Vol 74 No 2, p 113-118, February, 1982. 12 Fig, 3 Tab, 21 Ref.

Descriptors: *Activated carbon, *Adsorption, *Organic carbon, Water treatment, Drinking water, Reviews, Mathematical studies, Kinetics, Performance evaluation, Water reuse, Costs, Regeneration.

An overview of a conference concerning the state of the art of oxidation and adsorption techniques in drinking water treatment uses total organic carbon (TOC) as a parameter for measuring removal of collected organics. A total of 47 data sets from 13 investigations (6 from the U.S. and 7 from Europe) were evaluated. Order-of-magnitude agreement was obtained over an extremely broad range of conditions. Partial breakthrough of TOC occurred immediately after startup. This was caused by the influent compounds, which were not amenable to removal by this method. A steady-state condition was attained after about 14,000 bed volumes. At this point, effluent TOC was 25% less than influent TOC because of biodegradation or slow mass transfer into micropores. Adsorption capacity was estimated by subtracting the amount of TOC removed by biodegradation from the total quantity of TOC removed. The adsorption equilibrium capacity calculated from breakthrough data agreed in order or magnitude with equilibrium isotherms measured in laboratory batch studies. Regeneration intervals in multiple paralled-operated units can be significantly reduced by blending the effluents from adsorbers regenerated sequentially. This is especially beneficial in larger plants, 10-38 ML per day capacity. (Cassar-FRC)
W82-05677

REACTIVITY OF HALOGENS WITH AQUEOUS MICROPOLLUTANTS: A MECHANISM FOR THE FORMATION OF TRIHALOMETHANES,

Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
M. Ddore, N. Merlet, J. De Laat, and J. Goichon.
Journal of the American Water Works Association, Vol 74, No 2, p 103-107, February, 1982. 14 Fig, 1 Tab, 18 Ref.

Descriptors: *Trihalomethanes, *Chlorination, *Organic compounds, Chemical reactions, Disinfection, Water treatment, Chlorinated hydrocarbons, Chlorine, Bromine, Iodine.

The formation of trihalomethanes (THM) by chlorination of organic precursors during the water treatment process depends on many factors. Reactions carried out in stirred reactors showed that the yield of THM was proportional to the concentration of precursor (not necessarily identical to COD) and the quantity of chlorine available for reaction. Maximum yield of THM was obtained at near neutral pH for some precursors (acetylacetone and resorcine1) and at higher pH for other compounds. Some precursors reacted more rapidly with one halogen than another. For example, the methylketone reaction with iodine was much more rapid than the reaction with chlorine. The opposite was true for metapolyhydroxybenzene. Ammonia decreased the amount of THM formed from Cl and Br, but did not affect the reaction with iodine. The formation of total THM during chorination of natural water enriched with resorcinol and different doses of Br decreased with increasing Br concentrations. Under these conditions the chloroform concentrations decreased and bromoform and mixed organohalogen compounds increased. Conclusions reached from these experiments were as follows: (1) at the neutral pH values encountered in water chlorination some compounds such as methylketones present little danger of THM formation, but beta-diketones and metapolyhydroxybenzenes are reactive; (2) halogens react with ammonia in the order Cl > Br > I, and some chloroform is formed during chlorination of ammonia-containing waters; and (3) iodine can be used as a global test for determining THM precursors. (Cassar-FRC)
W82-05678

ADDENDUM TO: EVALUATING REGENERATED ACTIVATED CARBON THROUGH LABORATORY AND PILOT-COLUMN STUDIES,

I. H. Suffet, A. Wicklund, and B. Shultz.
Journal of the American Water Works Association, Vol 74, No 3, p 150, March, 1982. 1 Fig, 2 Ref.

Descriptors: *Activated carbon, *Regeneration, *Isotherms, Water treatment, Kinetics, Organic compounds, Methyl ethyl ketone, Adsorption, Trace levels.

An addendum to the original paper, Journal of the American Water Works Association, Vol 74, No 2, p 94, considers isotherm (capacity) and kinetic (column) factors in the evaluation of differing adsorbents. Freundlich isotherms were determined for each constituent of the 4-probe mix (methyl ethyl ketone, 1,4-dioxane, n-butanol, and nitromethane) on each sample of virgin and regenerated granular activated carbon. Four families of isotherms with roughly equal slopes but different vertical distribution were obtained. Nitromethane was not suitable as a probe for regeneration changes, because different regeneration techniques produced no apparent correlation with isotherms. However, methyl ethyl ketone isotherms were indicative of the regeneration methods. Results of the isotherm studies reiterated the general conclusious deduced from laboratory column studies in the original work. (Cassar-FRC)
W82-05680

MICROBIAL ACTIVITY IN ACTIVATED CARBON FILTERS,

Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
J. G. den Blanken.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE2, p 405-424, 1982. 11 Fig, 4 Tab, 23 Ref.

Descriptors: *Activated carbon, *Water treatment, Filtration, Purification, Drinking water, Bacteria, Adsorption, Oxidation, Filter media.

The oxygen consumption and the removal of organic carbon as well as their relation to one another were studied to obtain information on the adsorption, bacteriological oxidation and desorption processes in filters. The measured oxygen consumption and pH decrease were the result of the bacteriological activity in the filters. The activity of the slow sand filter was comparable with that of the activated carbon filter in respect to bacteriological activity. In the carbon filter the physical and bacteriological processes have to be combined as well as possible. The bacteriological activity in filters can be increased by choosing carbon types with high adsorption capacity for bacteria and for easily degradable substances. To determine the contribution of bacteria to the purification capacity, both the oxygen consumption and the organics removal as well as their ratio have to be studied. In filters without phenol dose the oxygen consumption increased at a water temperature of 20 degrees C during the running time. The purification capacity and the running time are considerably increased by the bacteriological activity in the filters. The Norit RBW carbon type showed more intensive and more constant carbon removal and greater bacteriological activity than the Norit PK carbon types. With the help of phenol as a model substance the kinetics of the biological carbon filtration process can be studied. Under the influence of the copper dose, the pH of the water decreased. Numerous bacteria of various kinds are present on the carbon particles and can oxidize various organic substances. No indication was found that the bacteria present in the filters are harmful with regard to the consumption of the water. (Baker-FRC)
W82-05683

TRIHALOMETHANES IN CHLORINATED COOLING WATERS OF NUCLEAR REACTORS,

Du Pont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
G. J. Hollod, and E. W. Wilde.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 404-408, 1982. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water treatment, *Chlorinated hydrocarbons, *Cooling water, Heated water, Water pollution sources, Fate of pollutants, Nuclear powerplants, Savannah River, Aiken, South Carolina, Organic compounds, Chlorination, Trihalomethanes.

Trihalomethanes (THM) were determined in cooling water before and after chlorination and in the river receiving effluent at the Savannah River nuclear plant, Aiken, South Carolina, in April and November 1980. THM levels (in micrograms per liter) were as follows: Savannah River upstream and downstream of the plant, < 1 to 2; unchlorinated cooling waters, < 1 to 2; chlorinated cooling waters, 12-38. No value exceeded the EPA drinking water guidelines of 100 micrograms per liter. Chloroform and dichlorobromomethane were most abundant, 86-92% and 7-13% of total THM, respectively. Laboratory chlorination experiments with cooling water samples showed that 65 C water produced higher THM concentrations than 25 and 45 C water. However, THM dissipated more rapidly at the higher temperatures than at the lower temperatures. (Cassar-FRC)
W82-05713

EGYPT TACKLES RURAL SUPPLY TASK,

G. Chernock.
World Water, Vol 5, No 3, p 37, 39, March, 1982.

Descriptors: *Water supply, *Rural areas, *Developing countries, *Egypt, Water treatment, Water distribution, Beheira Water Company, Rehabilitation.

Egypt is using the Beheira province as a pilot region for supplying water to poorly served areas. The semi-autonomous Beheira Water Company will control the daily operations of water supply and revenue collection. The projected work on this water system includes rehabilitation of 12 treatment plants and 106 boreholes, installation of 70,000 new water meters, addition of chlorination units to 70 boreholes, improvements in water treatment plant operation, addition of 250 km of distribution system to the present 1500 km, and leak repair. The goal is increasing the present 99,000 cu m per day to meet the needs of 3.5 million people by 1990, at which time 100% of urban households and 90% of rural households should have access to safe water. After water treatment and distribution problems have been solved, the company expects to tackle wastewater disposal. (Cassar-FRC)
W82-05754

RELATIONSHIPS BETWEEN RAW WATER QUALITY, TREATMENT, AND OCCURRENCE OF ORGANICS IN CANADIAN POTABLE WATER,

Health and Welfare Canada, Ottawa (Ontario). Environmental Health Directorate.
R. Otson, D. T. Williams, and D. C. Biggs.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 4, p 396-403, 1982. 6 Tab, 15 Ref.

Descriptors: *Organic compounds, *Water quality, *Chlorinated hydrocarbons, *Water treatment, Fate of pollutants, Seasonal variation, Chlorination, Trihalomethanes, Hydrocarbons, Aromatic compounds, Chloroform.

Raw and treated water samples from 30 Canadian water treatment plants were analyzed for total organic carbon and for volatile organics. Certain correlations with raw water quality and treatment methods were found. Generally, the highest organics levels were found in summer and in raw and treated river water. Lowest organic levels were in raw and treated groundwater. Treated water had lower or the same levels of total organics but higher levels of halogenated compounds than raw water. The organic materials most commonly found in treated water were chloroform and other halogenated compounds, benzene, toluene, and xylenes. Chlorine dosages ranged from 0.1 to 9.0 mg per liter. The higher dosages and demands usually resulted in high chloroform and bromodichloromethane levels in treated water. Relationships of several compounds with each other and with treatment methods and summer-winter were complex. For raw water there were no significant correlations of chlorine dosages and water quality with organics levels. (Cassar-FRC)
W82-05761

PROTECTING THE SOURCE,

Pirnie (Malcolm), Inc., White Plains, NY.
S. A. Roberts, and S. K. Krishnaswami.
Water/Engineering and Management, Vol 129, No 3, p 28-31, March, 1982. 2 Fig, 3 Tab.

Descriptors: *Water quality, *Management planning, Groundwater, Drinking water, Water resources development, Water demand, Water supply, Resources management.

The first step to be taken in assuring a safe and acceptable public water supply is protecting the quality of its source. Where existing sources are contaminated, properly engineered, built, operated and supervised treatment facilities are needed. Control of contamination must be accomplished by judicious management and oversight of land use and human activities within the watershed involved. Protection of the inland wetlands is vital, as these areas play an important role in natural ecological cycles in terms of water supply sources, plant and animal habitats, flood control, oxygenation of watercourses and entrapment of pollutants, as well as other human needs such as recreation. The Safe Drinking Water Act of 1974 recognizes the importance of source protection in maintaining and enhancing drinking water quality as well as in conserving and protecting groundwater supply. Proper forest management, the creation of vegetative buffer zones on the edges of reservoirs and water courses, and the control of the growth of urbanization consistent with these protective objectives are also essential in order for long term economic burdens to be minimized. Unauthorized disposal of sludge and solid, septic and hazardous wastes within the watershed must be closely tracked and controlled. Unathorized use of herbicides and pesticides must be stopped. Monitoring and inspection programs are vital. Such a program to control and guard the quality of the nation's water requires coordinated, well planned and carefully executed efforts on the part of many people. Such a program, however, would assure maximum protection and obviate the need for expensive water treatment facilities or alternative sources in the long term. (Baker-FRC)
W82-05785

PILOTING MAG-CARBONATE TREATMENT,

Dallas City Water Utilities Dept., TX.
T. E. Taylor, M. E. Bolding, and C. E. Stringer.
Water/Engineering and Management, Vol 129, No 4, p 50, 53-55, April, 1982. 1 Fig, 1 Tab.

Descriptors: *Water softening, *Magnesium carbonate, *Lime, Water treatment, Dallas, Texas, Sludge disposal, Calcium carbonate.

The magnesium carbonate water treatment process was tested in a pilot plant at the Dallas, Texas, Elm Fork plant. The process involves addition of lime and a soluble Mg salt to the raw untreated water. Calcium carbonate and magnesium hydroxide are precipitated. Mg is removed as the soluble Mg(HC03)3, and the CaC03 is recovered and recalcined. The process worked successfully at a feed rate of 60 ppm Mg as carbonate in normal waters and with addition of 15-20 ppm Mg as magnesium sulfate in waters of higher turbidity. Mg recovery was 90% or greater. Sludge production was 3100 lb dry solids per million gallons by the Mg process and 1407 lb per million gallons by the ferric sulfate process. Both processes had the same amount of final sludge disposal solids, but 55% of the Mg sludge was recoverable for reuse. Ultimate sludge disposal for the Mg process was 20-30% of the ferric sulfate process. Sludge recycle at 35-50% of formation rate produced a good particle size for filtration. Although the Mg process requires a larger staff and additional electric power, coagulant consumption and lagoon capacity are reduced. (Cassar-FRC)
W82-05794

CONVERSION OF RAPID GRAVITY FILTERS TO FULLY AUTOMATIC OPERATION USING A PROGRAMMABLE LOGIC CONTROLLER,

North Surrey Water Co. (England).
J. Bowyer-Lowe.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 56-62, 1982. 2 Fig.

Descriptors: *Automation, *Control systems, *Backwash, Filtration, Water treatment, Chertsey Works, Gravity filters, Water treatment facilities.

Operation of the 12 rapid gravity filters at Chertsey Works was automated by application of a programmable logic controller. Backwashing was based on monitoring of filter head loss and filtrate turbidity. The system may be manually controlled if necessary. In the 18 months of operation the logic controller has been 100% reliable in spite of a power failure. The program was not lost at this time. The system proved reliable, easy to program and modify, simple to commission, and reasonable in cost. (Cassar-FRC)
W82-05802

THE CHERTSEY AUTOMATION PROJECT AT NORTH SURREY,

K. Benjamin.

Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 43-56, 1982. 4 Fig.

Descriptors: *Automation, *Control systems, Water treatment, Water distribution, Computers, Chertsey Works, England, North Survey Water Company.

The North Surrey Water Company chose the Chertsey Works for installation of the first system using computers to control water treatment and distribution. This paper describes in detail all the preliminary feasibility and design studies which led to the installation of the system. The main components are: the master control center (microprocessor, storage, monitors, entry keyboard, printer, etc.), nine unit controllers exercising direct local control, and system development equipment for changing programs. The Motorola 6809 was the model chosen for the 14 microprocessors used in the system. The water system is automatically regulated according to predetermined operating levels and pressures. Close real-time servo control is only required for the high lift and gravel well pumps and for chlorine disinfection and residual control. The central controller provides commands to the unit controllers, which are in direct control of the processes. Unit controllers do not communicate with each other. All performance data is logged either automatically or by an operator, and a daily record is printed. (Cassar-FRC)
W82-05805

IMPROVEMENT OF SWIRL CONCENTRATOR,

Centre National de la Recherche Scientifique, Toulouse (France).
For primary bibliographic entry see Field 5D.
W82-05821

5G. Water Quality Control

ON-SITE STORMWATER DETENTION: AN OVERVIEW,

Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-04758

A PRELIMINARY ASSESSMENT OF MICHIGAN'S PHOSPHORUS DETERGENT BAN,

Michigan Dept. of Natural Resources, Lansing.
J. H. Hartig, and F. J. Horvath.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 193-197, February, 1982. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Phosphorus, *Detergents, *Water quality standards, *Michigan, Wastewater treatment facilities, *Great Lakes, Water quality control, Lakes, Water pollution control.

Michigan's October 1, 1977, ban on phosphorus-containing detergents has reduced total P loadings in the Great Lakes by 20%. Since the ban, total P levels in influents of 58 large wastewater plants in the state decreased 23%, from 6.5 to 4.8 mg per liter, and in effluents, 24%, from 21. to 1.7 mg per liter. P loadings from the Saginaw River to Saginaw Bay decreased 60% over 1976-1979 as a result of the detergent ban, upgraded wastewater treatment, and decreased in flow. P loading for the Detroit River to Lake Erie decreased 50% over the same period as a result of the ban and improved wastewater treatment.No changes in P levels have yet been documented in western Lake Erie. (Cassar-FRC)
W82-04786

ALTERNATIVE APPROACH TO ASSESSING WATER QUALITY IMPACT OF WASTEWATER EFFLUENTS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. F. Lee, R. A. Jones, and B. W. Newbry.
Journal of the Water Pollution Control Federation, Vol 54, No 2, p 165-174, February, 1982. 4 fig, 13 Ref.

Descriptors: *Water quality standards, *Decision making, *Risks, *Water pollution effects, Water quality control, Effluents, Ammonia, Chlorine, Wastewater, Hazard assessment, Toxicity, Environmental effects, Fate of pollutants, Water pollution control.

Water quality assessment should be based on the impacts of contaminants on the desired beneficial uses of the water by man, not on the total concentration of contaminants in a water sample. The hazard assessment approach provides a technically valid basis for evaluating the effects of a contaminant on water quality. It is a sequential, selective testing scheme used to develop information on the toxicology of a chemical and its fate in the environment so that a decision can be made concerning the environmental risks of discharging a chemical. A hazard assessment is conducted in tiers of increasing sophistication and detail with a decision point at the end of each tier. This greatly reduces unnecessary testing and the possibility of overlooking unacceptable risks to water quality. Decision choices at the end of each tier's testing are: not to discharge the substance, to restrict discharge, to allow unrestricted discharge, or to continue testing to gather more information. An exampple of this tiered hazard assessment scheme is given for discharge of toxic domestic wastewater effluent components (ammonia, nitrate, and residual chlorine) into a river. (Cassar-FRC)
W82-04788

MANAGEMENT SYSTEM FOR CONTROL OF PROCESS LOSSES AND SPILLS IN THE KRAFT PULPING INDUSTRY,

Tufts Univ., Medford, MA.
For primary bibliographic entry see Field 5D.
W82-04846

GEOTHERMAL POWER: ACCIDENTAL FLUID RELEASES AND WASTE DISPOSAL,

California Univ., Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 5B.
W82-04911

ENHANCED BIODEGRADATION OF PESTICIDES IN SOIL TO ALLEVIATE CONTAMINATED RUNOFF,

Cornell Univ., Ithaca, NY. School of Chemical Engineering.
R. U. Edgehill, and R. K. Finn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224569, Price codes: A03 in paper copy, A01 in microfiche. November 1981. 22 p 4 Fig, 15 Ref. OWRT A-090-NY(1).

Descriptors: *Soil contamination, *Microbial treatment, *Pentachlorophenol, Soil amendments, Spills, Treatment, *Pesticides, Soil water, Microbial degradation.

Soil inoculation may be a feasible method of rapidly removing some pesticides from contaminated soil in short-term situations, such as when a spill has occurred. Pentachlorophenol (PCP) was rapidly removed from laboratory and field soils by the use of a microbial inoculant. Direct inoculation of 1,000,000 PCP-degrading bacteria per gram of soil containing 120-150 ppm of the pesticide resulted in a PCP half-life of 15 hours under laboratory conditions, whereas the half-life was 14 days without inoculation. In a field test with approximately 100,000 PCP-degradating bacteria per gram of soil containing 100 ppm PCP, a half-life of 2 days was observed. Inoculation was also found to be effective in removing PCP from soil placed in an outdoor shelter. Even though this test was conducted during rather cool weather (8-16 degrees C) and the soil was shielded from the sun, a much more rapid rate of degradation was observed in test soil than in uninoculated control soil.
W82-04967

HYDROGEOLOGY FOR LAND-USE PLANNING: THE POTTER CREEK AREA, ANCHORAGE, ALASKA,

Geological Survey, Anchorage, AK. Water Resources Div.
R. P. Emanuel, and D. J. Cowing.
Geological Survey Water Resources Investigations 82-86 (open-file report), 1982. 4 Sheets, 14 Fig, 7 Tab, 15 Ref.

Descriptors: *Land use, *Water resources development, Planning, Groundwater, Water quality, Water pollution, Septic tanks, Wastewater disposal, Geohydrologic units, Surface drainage, Soil environment, Wetlands, Snowmelt, Erosion, Hydrologic budget, Urbanization, Land classification, Potential water supply, *Alaska, *Anchorage, *Potter Creek area, Chugach Mountains, *Geohydrology.

The U.S. Geological Survey and the Municipality of Anchorage, Alaska, jointly funded a study of the Potter Creek area to obtain hydrogeologic information for land-use planning. The study area comprises about 16 square miles, from Cook Inlet into the Chugach Mountains. Annual precipitation is about 30 inches, approximately twice that of the lower, main part of the Anchorage bowl. About 31 million gallons of water per day flow through the hydrologic system in the study area. Precipitation contributes 23 million gallons per day; outflow as streamflow is 17 million gallons per day. Surface and ground water were found to be of good quality. Domestic wells were the sole source of water supply in 1980 and most wells tapped bedrock. The average bedrock well is more than 200 feet deep and yields 4.5 gallons per minute; the average well tapping unconsolidated sediments is less than 100 feet deep and yields 7.5 gallons per minute. Wetlands and areas of shallow ground water occupy about 24 percent of the study area. Landslope exceeds 20 percent in more than half the study area. Bedrock is exposed in about a third of the study area. Where maps indicate wetlands or shallow ground water, moderate to steep slopes, shallow bedrock, or surficial materials of low permeability, site-specific investigations can determine suitability for development. (USGS)
W82-04981

HYPOLIMNION OXYGENATION STUDIES IN CLARK HILL LAKE,

Drexel Univ., Philadelphia, PA.
R. E. Speece, C. Givler, R. Aubert, J. Crate, and R. Caire.
Journal of the Hydraulics Division, Proceeding of the American Society of Civil Engineers, Vol 108, No HY2, p 225-244, February, 1982. 17 Fig, 12 Ref.

Descriptors: *Dam effects, *Oxygenation, *Dissolved oxygen, *Hypolimnion, *Water quality control, Dams, Environmental effects, *Fisheries, Thermal stratification, Water quality management, Reservoirs, Lakes.

Large impoundments used for generating hydroelectric power usually have intakes located low on the dam face. After summer stratification of the reservoirs, hypolimnion water is discharged through the turbines, providing a cold water fishery below the dam. Oxygen depletion within the hypolimnion results in low dissolved oxygen (DO) levels in the waters being discharged, which affects water quality as well as downstream fisheries. The economic feasibility of injecting commercial oxygen into the reservoirs was studied in pilot tests conducted at Clark Hill Lake at the Clark Hill Dam, Georgia. Oxygen was injected 130 ft below the surface of the lake at a rate of 100 tons/day (90,700 kg/day) through a diffuser system extending 2,000 ft across the lake 1 mile upstream from the dam. DO was tested in each of the seven turbine discharges to evaluate the efficacy of the system in achieving a 6 milligrams/liter DO standard for discharges below the dam. Hypolimnion oxygenation by on-site production of cryogenic oxygen was estimated to cost $30/ton. An added 6 milligrams/liter DO with 85% absorption efficiency was produced by pulsed oxygen at a rate of 100 tons/day one mile above the dam resulted in a 50% loss of injected oxygen. (Geiger-FRC)
W82-05001

UTILIZATION OF ORGANIC PHOSPHATES BY SELECTED BACTERIA AND ALGAE,

Wroclaw Technical Univ. (Poland). Inst. of Inorganic Chemistry and Metallurgy of Rare Elements.
I. Langowska.
Water Research, Vol 16, No 2, p 161-167, February, 1982. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Phosphates, *Biodegradation, Eutrophication, Water quality, Organic compounds, Reservoirs, *Bacteria, *Algae.

A study was designed to find out whether synthetic phosphates may act as a source of carbon for bacteria isolated from a water reservoir. Studies also were made to determine whether the organic phosphates used could be utilized directly by algae or whether bacteria capable of forming phosphatase enzymes must coparticipate in this process by means of metabiosis. Respiration rates were examined in four bacterial strains for which the only sources of carbon were the phosphorus compounds under study. Glucose was the control. The respiration activities of the four species were different, with the highest activity in glucose being found in Bacillus coagulans. The synthetic surface active agents were relatively readily oxidized by aquatic bacteria. Bacillus coagulans appeared to be the most active of the strains, used since the quantities of oxygen consumed during respiration were much higher than with other bacteria. The effect of phosphorus compounds on growth of algae in pure culture was compared with that on growth of algae in the presence of four bacterial strains. The results indicated that the algae were able to use directly all of the organic compounds studied as a source of phosphorus, except for poly(oxyethylene)dodecylphosphoric acid. The quantity of biomass produced expressed in terms of chlorophyll content varied for different compounds, which indicates that a given compound was more or less available as a source of phosphorus. Good growth of algae in nonbacterial cultures proves that algae possess suitable phosphatases which enable them to utilize a specific organic compound. Not only bacteria but also autotrophic algae may participate in the biodegradation process of organic phosphates, even those which exhibit unfavorable chemical properties for living organisms. (Baker-FRC)
W82-05024

PERFORMANCE TESTING OF THE DIPERNA SWEEPER,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
M. K. Breslin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109174, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protect Agency Project Summary EPA-600/S2-81-229, December 1981, 8 p, 4 Fig, 2 Tab. 68-03-2642.

Descriptors: *Oil skimmers, *Oil recovery, *Cleanup operations, Oil spills, Water pollution control, Wave action.

The DiPerna Sweeper, a partial-vacuum oil skimmer, was tested in a 2-week program conducted at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT). Forty-three oil recovery tests were run to establish a range of best performance for the skimmer under various environmental conditions in light and heavy oil. The DiPerna Swepper is a self-contained, floating oil skimmer that can operate in either a stationary or advancing mode. Its principle of operation is based upon drawing oil and water into a sealed container by creating a slight vacuum in the container. A floating weir serves as the inlet. The partial vacuum is crated by pumping fluid from the sealed container. The container serves as an oil/water separator. Separator pumps draw water from the bottom of the vessel while others draw oil from the top. The device was able to recover over 75% of the oil presented to it in calm water at low speeds up to 2 knots. The skimmer performed best in high viscosity oil in calm water, and has the capability of collecting oil with less than 5% water. A rdesign of the skimming head and inlet hose should be undertaken to improve the skimming head water ballasting system, to prevent wave splashover response and to prevent turbulence and headwave production while under tow. (Moore-SRC)
W82-05058

PERFORMANCE TESTING OF FOUR SKIMMING SYSTEMS,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
H. W. Lichte, M. K. Breslin, and G. F. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101353, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-189, October 1981. 8 p, 5 Fig, 4 Tab. 68-03.2642.

Descriptors: *Oil skimmers, *Oil recovery, *Cleanup operations, *Water pollution control, Oil spills, Wave action, Viscosity, Entrainment, Comparison studies.

A test program conducted during the 1979 season evaluated skimmer performance in collecting oil floating on water using several wave conditions, two speeds, and skimmer operating parameters. Tests were conducted at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) on four commercial oil spill cleanup devices. In tests with the Sapiens Sirene, the highest values of recovery efficiency (RE), throughput efficiency (TE), and oil recovery rate (ORR) were obtained during tow tests with waves. Medium viscosity oil was entrained and lost from the system more easily than high viscosity oil because of interfacial shear forces. No oil was lost because of wave splashover. Tests were conducted with the Oil Mop remote skimmer in order to generate design information for future construction of a larger version. The operating limits for this skimmer appeared to depend on two factors; oil mop contact time, and slippage of oil-soaked mops through the squeezing roller assembly. The Troil/Destroil skimmer system has the following operating limits; the maximum towing speed at which the boom can retain collected oil without significant loss is 1 knot; and the maximum pumping rate of the skimmer pump is approximately 37.4 cu m/hr. The versatile Environment Products Arctic Skimmer should be operated at speeds not greater than 2 knots for high efficiency, and to maintain high recovery efficiency a thick oil layer should be maintained at the collection belt. The oil recovery rate of the skimmer is limited by the maximum pumping rate of the skimmer pump. (Moore-SRC)
W82-05059

REMOVAL OF WATER SOLUBLE HAZARDOUS MATERIALS SPILLS FROM WATERWAYS BY ACTIVATED CARBON,

Rockwell International, Newbury Park, CA.
G. R. Schneider.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-103813, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-195, October 1981. 6 p, 5 Fig, 1 Tab. 68-03-2648.

Descriptors: *Hazardous materials, *Cleanup operations, *Activated carbon, *Organic compounds, *Phenol, Spills, Waterways, Mathematical models, Turbulence, Adsorption.

A model of the removal of water soluble organic materials from water by carbon-filled, buoyant packets and panels was developed. Based on this model, equations were derived for removing dissolved organic compounds from waterways by buoyant packets that are either cycled through a water column, or suspended in the waterway by natural turbulence and by panels mechanically suspended in waterways. Assuming that response is required within 1 to 8 hr to an 1,814-kg phenol spill into the Chicago Sanitary and Ship Canal (CSSC), packet cycling with 18,140 kg of activated granular carbon in 897,000 buoyant packets, would require 155 to 368 cycles to effect a 10% reduction in concentration. If it were possible to keep the buoyant packets suspended in the CSSC by turbulence, a response to a 1,814 kg spill in 1 to 8 hr would produce a situation requiring 25 to 60 hr to remove 10% of the spilled phenol, even if the dispersion process were to cease.. A continuing dispersion process will prevent the success of a carbon filled packet approach to cleanup. Carbon panels fixed in a watercourse the size of the CSSC will remove about 4% to a 1,814 kg phenol spill as the polluted fluid passes by the panels, according to the model, if the carbon to phenol ratio is 10. (Moore-SRC)
W82-05060

DEPLOYMENT CONFIGURATIONS FOR IMPROVED OIL CONTAINMENT WITH SELECTED SORBENT BOOMS,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
G. F. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-210650, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-168, October 1981. 3 p. 68-03-2642.

Descriptors: *Oil spills, *Cleanup operations, *Oil recovery, *Water pollution control, Containment booms, Harbors, Wave action, Sorbent booms.

Performance tests on three catenary oil containment configurations using sorbent boom sections alone and in conjunction with a conventional containment boom were conducted at the Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT). Other test varables included wave condition, tow speed, and oil quantity encountered. Maximum no-oil-loss containment tow speed was determined for each wave and oil quantity tested. Use of a sorbent raft inside the apex of a catenary, conventional oil containment boom failed to increase the maximum no-oil-loss tow speed; in fact, no-oil-loss tow speeds increased with the use of sorbent raft apex sections. Conventional boom sides coupled with a sorbent raft apex section increased the no-oil-loss tow speed in calm water and 100% oil capacity from 0.25 m/s for a single-layer totally sorbent boom to 0.29 m/s for a four-layer sorbent raft apex section. similar tests in the 0.3-m harbor chop (HC) wave exhibited a no-oil loss tow speed increase from 0 m/s to 0.22 m/s. Loss of oil occurred mainly at the attachment points of the sorbent raft to the conventional boom sides. Tests using an all sorbent boom with a five-layer sorbent raft apex caused increases in no-oil-loss tow speeds to 0.33 m/s in calm water and 0.17 m/s in the 0.3-m HC.. Attempts at boom regeneration were futile. (Moore-SRC)1c
W82-05062

USE OF SELECTED SORBENTS AND AN AQUEOUS FILM FOAM ON FLOATING HAZARDOUS MATERIALS,

Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
M. K. Breslin, and M. D. Royer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108895, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-211, October 1981. 6 p, 7 Fig. 68-03-0490.

Descriptors: *Hazardous materials, *Cleanup operations, *Spills, Water pollution control, Wave action, Adsorption, Naphtha, Octanol, Dioctyl phthalate, Vaporization, *Sorbent materials.

In order to enhance present techniques for handling spills of floating, immiscible hazardous materials, tests were conducted on the effects of sorbent materials and firefighting from on containment, recovery, and vapor suppression. Dioctyl phthalate (DOP), octanol, and naphtha served as the hazardous materials. The sorbent materials were polyurethane foam cubes, Sorbent C, and dow Imbiber beads. As aqueous film forming foam (AFFF), FC-206 was used. Results indicate that introducing sorbents or congealing agents into the hazardous material enables a stable boom to contain the material at a higher current velocity or

tow speed in calm water. The polyurethane foam cubes were most easily distributed and accounted for later. To optimize the effect of sorbents, time for mixing and adsorption of the hazardous material must be allowed. Because the splash-over failure, neither the sorbents nor the Imbiber beads enhanced containment in the presence of 0.3-m harbor chop. Cleanup effort was substantially increased as a result of the use of sorbents. Some tests results indicate that a higher critical tow speed is attainable using AFFF and sorbent rather than sorbent alone. (Moore-SRC)
W82-05063

OIL SLICK MECHANICS,

Rutgers - The State Univ., Brunswick, NJ.
C. A. Osamor, and R. C. Ahlert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-105560, Price codes: A11 in paper copy, A01 in microfiche. Environmental Protection Agency Summary EPA-600/S2-81-199, October 1981. 3 p. R805901.

Descriptors: *Oil slicks, *Oil spills, *Dispersants, *Solubility, *Oil-water interfaces, Cleanup operations, Mathematical models, Saline water, Hydrocarbons, Surface tension, Water pollution control.

Oily discharges to aquatic systems are usually marked by slick formation. The potential for damage by oil spills depends on the rates of the dispersal mechanisms and other factors. Spreading and dissolution of oils in the underlying water are important dispersal mechanisms. The rates of dissolution and spreading of 12 oils were investigated under laboratory conditions. Mathematical models were derived for oils spreading on calm water. The principle forces influencing the spread of oils on calm water are gravitational, viscous, inertial, and net surface tension. The dissolution rates of the oils were determined by measuring their solubilities in water during equilibration in open static tests. Experimental data show increases in oil concentrations initially and decreases later during the period of equilibration. Solubilities were lower in tests with salt water, and the oils attained maximum solubilities at slower rates. Data suggest that as oil slicks equilibrate with water, volatile hydrocarbon species evaporate into the atmosphere from the air/oil interface, and soluble species dissolve into the underlying column of water from the oil/water interface. These processes are not in equilibrium; hydrocarbons continue to evaporate from solution after the oil layer has been depleted of volatile hydrocarbons. The efficiencies of five commercial products for dispersing three oils were evaluated in a large-scale laboratory system. Efficience was found to increase with the volume of dispersant added. The dispersal of spilled oil by application of chemical dispersants appears to be a promising method for cleaning up oil spills. (Moore-SRC)
W82-05064

FEASIBILITY OF COMMERCIALIZED WATER TREATMENT TECHNIQUES FOR CONCENTRATED WASTE SPILLS,

TRW Environmental Engineering Div., Redondo Beach, CA.
M. Ghassemi, K. Yu, and S. Quinlivan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108440, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-213, October 1981. 6 p, 4 Tab, 68-03-2560.

Descriptors: *Wastewater treatment, *Hazardous materials, *Spills, *Cost analysis, *Feasibility studies, Reverse osmosis, Ultrafiltration, Ion exchange, Oxidation, Activated sludge processes, Coagulation, Mobile systems, On-site systems.

Data from the published literature and those obtained from process suppliers provided the data basis for an evaluation of commercial water treatment techniques for on-site treatment of waters containing high concentrations of contaminants that are encountered in hazardous materials spill situations and at uncontrolled waste disposal sites. The techniques include reverse osmosis, ultrafiltration, ion exchange, wet-air oxidation, high-purity oxygen-activated sludge process, ultraviolet-ozone oxidation, and coagulation/precipitation. When used alone, none of the processes considered would be economically applicable to on-site mobile unit treatment of the variety of concentrated wastes encountered, although reverse osmosis, ion exchange, and wet-air oxidation meet many of the application requirements and, hence, require less pretreatment, or post-treatment. The estimated capital costs for a unit suitable for trailer mounting vary from as low as $35,000 for a 227,000 L/day ultrafiltration unit to as high as $1.25 to $1.5 million for a 54,000 L/day two-trailer, wet-air oxidation unit. For short-term operation, the operating cost of the mobile unit is determined largely by nonprocess-specific costs such as transportation, labor, subsistence, analytical support, which vary from situation to situation. (Moore-SRC)
W82-05068

DISPERSANT APPLICATION SYSTEM FOR THE U.S. COAST GUARD 32-FOOT WPB,

Mason and Hanger-Silas Mason Co., Inc., Leonard, NJ.
M. Borst, and G. F. Smith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-101684, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-172, October 1981. 2 p 1 Fig. 68-03-2642.

Descriptors: *Dispersants, *Oil spills, *Cleanup operations, Water pollution control, Waterways, Oil pollution.

A lightweight, easily assembled system for dispensing chemical dispersants on oil spills was designed to be fitted onto the aft deck of the Coast Guard 32-foot waterways patrol boat (WPB), a vessel stationed in many areas where oils are commonly transferred or transported. It includes two spray booms supported by a rectangular framework. The spray booms are supplied water from the boat's fire fighting system, and chemical dispersant is fed into the water by an eductor. The system could readily be adapted for use on other vessels of opportunity. The only limiting conditions are the ability to provide sufficient height for the spray booms and structural integrity. The system needs an adequate supply of water from an onboard source. For example, the end sections of the support frames could be lashed to the side handrails of most vessels with fore and aft stays secured as convenient. (Moore-SRC)
W82-05069

A MOBILE STREAM DIVERSION SYSTEM FOR HAZARDOUS MATERIALS SPILLS ISOLATION,

Scientific Service, Inc., Redwood City, CA.
J. V. Zaccor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-109679, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-219, October 1981. 3 p, 1 Fig, 1 Tab. 68-03-2458.

Descriptors: *Cleanup operations, *Diversion, *Stream pollution, *Hazardous materials, Isolation, Decontamination, Pumps, Pipes, Conveyance structures, Mobile systems,.

Spill cleanup scenarios often involve contamination of small streams by insoluble, sinking hazardous materials. One cleanup approach is to dam the stream above the affected area and bypass the normal flow; this procedure allows the contaminated stream to dry and, thus, facilitates mechanical cleanup. Spill scenarios were analyzed to establish designcriteria for a completely self-contained, independent system that would maintain flow continuity around a region undergoing decontamination processing. The system was designed to use stock items available nationwide, to be easily maintained, and to be readily repairable. To provide flexibility and reliability, the system has been assembled as two totally independent units mounted on trailers. These trailers do not require permits for hauling over state or interstate highways and they can also be moved over unimproved roads to gain access to spill sites. Once onsite, the system can be assembled and placed in operation by a crew of five in a matter of hours. Unit operation and ability to deliver a flowrate of 0.35 cu m a distance of 0.3 km over unprepared ground were evaluated in a shakedown test. The major components of the system are: booster pumps; submersible pumps; generator; pipes, hose, and fittings; crane; transportation system; and lighting system. (Moore-SRC)
W82-05070

THE EFFECTS OF VARYING CULTURE NITROGEN AND PHOSPHORUS LEVELS OF NUTRIENT UPTAKE AND STORAGE BY THE WATERHYACINTH EICHHORNIA CRASSIPES (MART) SOLMS,

University of the Witwatersrand, Johannesburg (South Africa). Dept. of Botany and Microbiology.
J. Ower, C. F. Cresswell, and G. C. Bate.
Hydrobiologia, Vol 85, No 1, p 17-22, 1981. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Water hyacinth, *Nutrient removal, *Eutrophication, Aquatic plants, *Nitrogen, *Phosphorus, Fertilizers, Water pollution treatment, Water treatment.

Water hyacinths were cultured for one month in solutions with nutrient levels varying from zero phosphorus and nitrogen to 16.1 ppm P and 36 ppm N. Maximum uptake by the plants was in a culture solution containing 36 ppm N and 6.53 ppm P. Uptake of P was stimulated by elevating either N or P levels or both. N accumulation was inhibited at all levels of P addition. Both N and P levels were highest in leaves and d lowest in roots. The ability of the water hyacinth to accumulate nutrients from eutrohied bodies of water indicates a possible use of this plant for nutrient removal and harvesting as fertifilizer. (Cassar-FRC)
W82-05098

POSSIBILITIES OF OPTIMIZING PROCESSES FORMING THE QUALITY OF NATURAL WATER,

L. A. Sirenko.
Hydrotechnical Construction, Vol 15, No 6, p 319-323, June, 1981. 1 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 8-11, June, 1981.

Descriptors: *Alagal harvesting, *Eutrophication, *Lakes, Algal control, Water pollution control, *Water quality control, Reservoirs, Cyanophyta, Nutrient removal.

Suggestions for improving the quality of lake and reservoir water in the presence of blue-green algal blooms include reduction of nutrients in water and wastewater entering the reservoirs, construction of buffer zones of trees and grass around water bodies to filter out nutrients draining into the water bodies, use of improved slow-release and encapsulated fertilizers, improvement of fertilizer application techniques to minimize fertilizer losses, aeration of natural water, and large scale removal of excess plant material from eutrophic water bodies. As an example of the last technique, removal of 1 ton of dry seston eliminates 50-150 kg N, 10 kg, P, 50-60 kg of other minerals, and 200-400 kg of organic matter. Removal of 1 kg P leads to a 100 kg decrease in algal production. (Cassar-FRC)
W82-05115

SELECTIVE PASSAGE OF HYDROPHILIC NITROGENOUS ORGANIC MATERIALS THROUGH MACRORETICULAR RESINS,

Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
For primary bibliographic entry see Field 5D.
W82-05150

ACID POND DRAINAGE,

Science and Education Administration, Columbia, MO.
V. L. Finney.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 49-54, 1982. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Mine drainage, *Neutralization, *Acid mine drainage, Ponds, Settling ponds, Water treatment, *Calcium carbonate, Calcium hydroxide, *Coal mining, Strip mine lakes, Hydrogen ion concentration, Barton County, *Missouri.

It was necessary to neutralize an acid settling pond (pH 2.6) in Barton County, Missouri, before drainage for reconnaissance investigations. Instead of the recommended method of adding lime and calcium carbonate in situ, a two-stage neutralization was done. First 13 tons of calcium carbonate was spread over the water, raising the pH from 2.6 on September 15, 1980, to 4.3 on September 16. The water was then pumped 800 ft into an empty receiving pond in which 10 tons of calcium carbonate had been spread. The entering water flowed over the spread limestone. Turbulence accelerated the escape of carbon dioxide into the atmosphere, driving the neutralization reaction toward completion. The pH of the water was 5.6 by the afternoon of September 16. Costs were 80% less than estimated for the in situ method. After 3 weeks the receiving pond water had a pH of 5.3-6.8. (Cassar-FRC)
W82-05199

HANDBOOK FOR OIL SPILL PROTECTION AND CLEANUP PRIORITIES,

Versar, Inc., Springfield, VA.
J. D. Byroade, A. M. Twedell, and J. P. LeBoff.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-183394, Price codes: A07 in paper copy, A01 in microfiche. Environmental Protection Agency Report EPA-600/8-81-002, February 1981. 142 p, 12 Fig, 34 Tab, 44 Ref, 6 Append. 68-03-2648.

Descriptors: *Oil spills, *Cleanup operations, *Water pollution control, *Priorities, Decision making, Environmental effects, Natural resources, Oil pollution, Environmental protection.

Any oil discharge into marine or fresh water systems will inevitably affect both natural and man-made resources. Ideally, all potentially affected resources should be protected from damage, but usually some priorities must be set to adequately use the available manpower and equipment for resource protection. Responsibility for determining priorities for both protection and cleanup lies with the designated on-scene coordinators (OSC). This manual was developed for use by OSC to guide them in assessing priorities during all phases of an oil spill reponse. The guidelines enable the OSC to: determine pertinent facts about a particular oil discharge; identify the resources and installations that may be affected; and establish priorities for protecting and cleaning up these sensitive resources and installations. Special attention is given to response activities such as: determining spill contamination potential; rating area sensitivity to oil contamination; establishing priorities for containment, protection, and cleanup; deciding the best practical containment, protection, and cleanup methods, assessing response effectiveness; and deciding when to terminate cleanup efforts. (Moore-SRC)
W82-05210

THE REHABILITATION OF NORWAY'S LARGEST LAKE,

Norsk Inst. for Vannforskning, Oslo.
K. Baalsrud.
Water Science and Technology, Vol 14, No 1/2, p 21-30, 1982. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Eutrophic lakes, *Phosphorus removal, *Lake restoration, Water pollution effects, Lakes, *Lake Mjosa, *Norway, Eutrophication, Water quality management, Phosphates, Algae, Geosmin, Wastewater treatment.

Lake Mjosa, Norway's largest lake, is long and narrow, with a water volume of 56 cu km and maximum depth of 449 m. Eutrophication, first noticed in the 1960's, progressed to the point of severe algal blooms and formation of geosmin, which made the water undrinkable. Restoration started in 1977 with two objectives: develop wastewater treatment systems and remove phosphorus. Forty-six new treatment plants and 500 km of new sewer pipes were installed, so that 105,000 people of the 115,000 living in urban areas were included in the phosphorus control program as of 1980. Home wastewater treatment for the 85,000 person rural population of the area was financed through direct grants and low-interest loans. Pollution controls were implemented in agriculture and industry. Use of phosphate-free laundry detergents was encouraged. By 1980 the P load was reduced to about 225 tons per year (the goal is 175 tons per year). Signs of eutrophication have been much less apparent. Some blue-green algae are still present, but in small numbers, and lake transparency has improved. In 1980 algal biomass had dropped to 0.8 cu mm per liter from a high of 1.7 cu mm per liter in 1978. Under oligotrophic conditions in 1900 algal biomass was 0.2 cu mm per liter. (Cassar-FRC)
W82-05243

WATER-POLLUTION RESEARCH AND ITS APPLICATION IN DEVELOPING COUNTRIES,

Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
P. Isaac, and W. Pescod.
Water Science and Technology, Vol 14, No 1/2, p 205-213, 1982. 1 Ref.

Descriptors: *Research priorities, *Developing countries, *Water pollution control, Wastewater treatment, Sanitation, Water pollution sources, Political aspects, Economic aspects, Social aspects, Institutional constraints, Information exchange, Planning, Rural areas.

Water pollution research for developing countries must be directed toward practical applications, taking into consideration the social, political, religious, and financial factors in these poorer rural areas. Sources of pollution in these countries are poor sanitation and disposal of human wastes, industrial effluents, and organically-loaded effluents from food processing (sugar cane, palm oil, and tapioca). Water pollution control efforts by governments are inadequate and ineffective. Research for Third World countries should emphasize development of simple, low-cost systems rather than esoteric subjects such as reaction kinetics. The simple systems should be designed with upgrading in mind. Urban areas can use conventional systems without further research efforts. Demonstration projects are ideal for convincing government officials and local populations of a treatment system's potential. Ex-post-facto analysis of projects too elaborate, too expensive, or unacceptable for social reasons can prevent perpetuation of mistakes. Information transfer throughout the developing world must be facilitated through conferences, organization of published literature, and publishing of research papers by Third World authors. (Cassar-FRC)
W82-05246

AMMONIUM UPTAKE BY MICRONESIAN SPECIES OF GRACILARIA (RHODOPHYTA),

Guam Univ., Agana. Water and Energy Research Inst.
S. G. Nelson, and R. N. Tsutsui.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224858, Price codes: A02 in paper copy, A01 in microfiche. Final Report, Technical Report No 23, May, 1981. 13 p, 3 Fig, 2 Tab, 20 Ref. OWRT A-019-GUAM(1), 14-34-0001-0112.

Descriptors: *Absorption, *Ammonium, *Nitrogen removal, *Bacterial analysis, *Microorganisms, Regression analysis, Nitrogen compounds, Nitrogen fixing bacteria, Water analysis, Kinetics, Biological properties, Water quality, Bioassay, Correlation analysis, Correlation coefficient, Mathematical studies, Evaluation, Baseline studies, *Guam.

Research was carried out to examine the kinetics of ammonium uptake by thalli of several Gracilaria species from Micronesia to evaluate their relative potential for removing ammonium from mariculture systems. It was found that ammonium uptake was dependent upon substrate concentration, and that the uptake kinetics were consistent with a diffusive ammonium uptake process, as shown for ammonium depletion curves of ammonium concentration versus time for each species. Regressions of the log of substrate concentration with time were linear, with correlation coefficients ranging from 0.913-0.996. Uptake rates were independent of light, and were similar during both day and night. Uptake rates were also independent of the thalli nitrogen content. The observed rates of uptake were generally higher for Gracilaria edulis than for other Gracilaria species. The latter observation may be related to thallus morphology. The uptake rates (micrograms ammonium/gram dry thallus/hour) ranged from 0.810-2.184 for Gracilaria edulis, and 0.086-0.722 for other species. The thalli of the Gracilaria species were collected from various locations in Guam and Saipan in the Mariana Islands, and near Malakal Island, Palau. (Zielinski-MAXIMA)
W82-05311

URBAN IMPACTS OF WATER SUPPLY RESERVOIR,

Woodward-Clyde Consultants, Houston, TX.
E. Baca, P. B. Bedient, and R. Olsen.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE1, p 73-87, February, 1982. 6 Fig, 4 Tab, 20 Ref.

Descriptors: *Reservoirs, *Urban drainage, *Lake Houston, Phosphorus, Nitrates, Sedimentation, *Sediments, Drainage, Water quality, Water supply, Eutrophication, Turbidity, Watershed protection, Texas, *Nutrients, Environmental effects.

This study characterized the lake hydrology and developed nutrient and sediment budgets for Lake Houston, quantified algal productivity as it related to lake water quality characteristics, and suggested a set of management strategies for developing areas to improve the water quality in the lake. The lake was formed in 1954 by an earthfilled dam on the San Jacinto River. Storage capacity of the lake is about 146,800 acre-feet at spillway level and has a surface area of 12,765 acres. Maximum depth is close to 45 ft at the dam, with mean depth of only 12.5 ft. Total drainage area of the lake is 2,828 sq mi and can be divided into the two forks of the San Jacinto River. Most of the solids that come into the lake remain there, while most of the nitrates and half the total phosphorus are lost over the spillway. Sedimentation is controlled by bathymetry, energy and distribution of wind generated waves, location of relict sediments, proximity to sediment source, and man-made barriers. Lower water quality was observed in the West Fork, which represents a rapidly urbanizing area, as compared with the East Fork, which represents an undeveloped, mostly forested area. Storm flows are extremely important because of the washout effect they have on algae and the turbidity that is usually associated with them. Low flows are also important, as they represent critical periods when suspended solids start to settle and more light is allowed to penetrate the water column. Principal management strategies available involve sediment or nutrient load control. Sediment control may be attained by using a system of detention ponds. Nutrient loads can be reduced significantly by better operation of wastewater treatment plants. (Baker-FRC)
W82-05318

SETTLEABILITY OF URBAN RUNOFF POLLUTION,

Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
W. Whipple, Jr., and J. V. Hunter.
Journal of the Water Pollution Control Federation, Vol 53, No 12, p 1726-1731, December, 1981. 9 Fig, 14 Ref.

Descriptors: *Urban runoff, *Sedimentation rates, *Water pollution sources, Watershed protection, Settleable solids, *Detention reservoirs, Suspended solids, Storm runoff.

The possibility of using dual purpose detention basins for the removal of particulate pollution from

urban runoff is currently under investigation. Tests of urban runoff were conducted to measure the removal of different types of pollutants by sedimentation. Sampling was conducted in five intensively developed areas. Analyses were conducted to determine total phosphate, fecal coliform counts, suspended solids, 5 and 20 day biochemical oxygen demand, nitrates, heavy metals, hydrocarbons, and ammonia. These studies showed that detention of runoff in an undisturbed environment with a water depth of 6 feet for 32 hours resulted in removal of substantial quantities of the common pollutants associated with urban runoff. The settleability data for pollutants showed more scatter than data for total suspended solids. The data for suspended solids, hydrocarbons, and lead indicated that most of the sedimentation of these pollutants was accomplished in 16 hours, but results for other pollutants, particularly copper, were more irregular. Considerable variation was found in the settleability of runoff from different sites. The results of this study did not support the common assumption that pollutants will settle out in amounts proportionate to their respective particulate concentrations. (Carroll-FRC)
W82-05320

OPTIMAL DYNAMIC MANAGEMENT OF GROUNDWATER POLLUTANT SOURCES,

Geological Survey, Menlo Park, CA.
S. M. Gorelick, and I. Remson.
Water Resources Research, Vol 18, No 1, p 71-76, February, 1982. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Solute transport, *Water quality management, *Disposal wells, *Wastewater disposal, Fate of pollutants, Waste management, Wastewater management, Waste disposal, Model studies, Injection wells, Wells, *Groundwater pollution.

A linear programming-superposition method is presented for optimum management of several groundwater pollutant sources (for example, waste disposal) over time so that maximum disposal is accomplished without violating water quality standards. It uses any linear solute transport simulation model to generate a unit source-concentration response matrix to derive the management model. Special simulation model development is not required. The constraints take the form of a series of solute breakthrough curves at supply wells where water quality must be maintained. The matrix shows the concentrations that result at particular locations from solute injections at each of the disposal sites over time. The linear program operates on the matrix to obtain optimal disposal schedules. The method is applied to a sample problem in which three water supply wells must be protected from pollutants injected into three disposal sites over three continuous 200-day periods. (Cassar-FRC)
W82-05345

STATE-OF-THE-ART OF MODELING SURFACE WATER IMPOUNDMENTS,

Nevada Univ. System, Reno. Water Resources Center.
For primary bibliographic entry see Field 2H.
W82-05351

IMPACT OF DISCHARGES AS A BASIS FOR CONTROL MEASURES,

Union Carbide Corp., South Charleston, WV.
For primary bibliographic entry see Field 5B.
W82-05354

NEW TRENDS IN WATER QUALITY MANAGEMENT,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary). Inst. for Water Pollution Control.
P. Benedek.
Water Science and Technology, Vol 14, No 1/2, p 47-72, 1982. 10 Fig, 5 Tab, 79 Ref.

Descriptors: *Water quality management, *Sediment transport, *River beds, *Danube River, Model studies, Water supply, Filtration, Bank filtration, Suspended solids, Water pollution control, Fate of pollutants, Adsorption.

A water management system for the Danube River is proposed. This is not based on the classification of surface waters but on the morphological, hydrological, hdyraulic, and technological conditions of drinking water production. The role of micropollutants adsorbed to sediments, neglected in former management schemes, is considered in determining the quality of the bank filtered water supply. A transport model consists of several submodels, including water regime of the river, pollutant dispersion, settling and reentrainment, chemical interactions between wastewater and river water, biochemical processes in bottom sediments, and groundwater flow toward the bank filtering wells. (Cassar-FRC)
W82-05429

INSTITUTIONAL PROBLEMS OF WATER QUALITY PLANNING IN URBANIZING AREAS IN THE PACIFIC NORTHWEST,

Dornbusch (David M.) and Co., Inc., San Francisco, CA.
For primary bibliographic entry see Field 6B.
W82-05554

STORMWATER MANAGEMENT IN THE OTTAWA-CARLETON REGION,

Rideau River Stormwater Management Study, Ottawa (Ontario).
H. S. Loijens.
Canadian Water Resources Journal, Vol 5, No 2, p 54-67, 1980. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Storm wastewater, *Combined sewer overflows, Rideau River, Ottawa, Ontario, Bacteria, Planning, Recreation, Swimming, Water pollution control, Water pollution sources, Water quality control, Assimilative capacity, Storm-overflow sewers, Pollution load, Ponds.

Bacterial pollution of the Rideau River flowing through Ottawa, Ontario, forced closing of bathing beaches in 1970. The major pollution source was overflow from combined sewers during rainfall events. Abatement measures included separation of storm and sanitary sewers (scheduled for completion in 1990), installation of pumps to improve water circulation at the most upstream beach, closing of a small sanitary treament plant, and construction of ponds to reduce suspended solids and bacteria levels. A storm water management study of the Rideau River was initiated to study the magnitude and sources of pollutant loads and the hydraulic conditions of the river, to predict pollutant loads from future developments, to determine the assimilative capacity of the river, to determine the effectiveness of present storm water management, to assess the effectiveness and cost of control measures, and to clarify the recreational needs and most practical bathing areas. The 3-year, $1.4 million study began in June 1979. (Cassar-FRC)
W82-05563

STRATEGIES FOR MAINTAINING WATER QUALITY IN TWO BRITISH COLUMBIA LAKES,

Department of the Environment, Victoria (British Columbia).
R. N. Nordin.
Canadian Water Resources Journal, Vol 5, No 3, p 90-101, 1980. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Lake restoration, *Aeration, *Nutrients, Water quality control, British Columbia, Wood Lake, Kalamalka Lake, Water pollution sources, Algae, Eutrophication, Nonpoint pollution sources, Transparency, Phosphorus, Nitrates.

Kalamalka and Wood Lakes, in the Okanagan Valley of British Columbia, are subject to excess nutrient inputs from agriculture and residential development and are separated by only a narrow strip of land. However, they are very different in water quality and morphometry and require different strategies to manage water quality. Kalamalka Lake, 25.8 sq km in area, 142 m deep, is extraordinarily attractive with clear water and low productivity. Wood Lake, 9.3 sq km, 34 m deep, has already suffered significant deterioration in water quality. Water quality control options in Lake Kalamalka are limited to source control (sewers, improved agricultural practices, green belting, erosion control, and improved water quality in Wood Lake). Smaller Wood Lake has several options for improving water quality. Control of internal loading by phosphorus stripping using alum, mixing with other lake waters, and tertiary treatment are impractical and expensive. Aeration may be the most practical method in spite of the 6000-7000 kg per day oxygen demand over the summer stratification period. Other techniques being considered are use of nutrient-rich hypolimnetic water for irrigation and addition of nitrates to the hypolimnion to stimulate the denitrification process. Since lake restoration is still an art in many ways, treatments must be chosen and applied cautiously to avoid adverse effects. (Cassar-FRC)
W82-05567

AGRICULTURAL RUNOFF AND WATER POLLUTION,

Department of the Environment, Victoria (British Columbia). Assessment and Planning Div.
For primary bibliographic entry see Field 5B.
W82-05569

HISTOPATHOLOGICAL CHANGES IN THE LIVER AND BRAIN OF FISH EXPOSED TO ENDOSULFAN INSECTICIDE DURING TSETSE FLY CONTROL OPERATIONS IN BOTSWANA,

Centre for Overseas Pest Research, London (England).
For primary bibliographic entry see Field 5C
W82-05630

WHERE TO PUT A STEADY DISCHARGE IN A RIVER,

Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
R. Smith.
Journal of Fluid Mechanics, Vol 115, p 1-11, 1982. 6 Fig, 11 Ref.

Descriptors: *Wastewater outfall, *Design criteria, Effluents, Outfall, Outfall sewers, Rivers, Water pollution control, Mathematical studies, Hydraulics, Wastewater discharge.

In order to avoid high pollution levels along the banks of rivers and streams it is desirable to release effluents from industrial processes and sewage works somewhere near the center of the receiving water body. The position of a single discharge point, or the distribution of multiple discharges, determines the way in which the asymptotic state is approached. The most ambitious target would be to minimize the peak concentration anywhere in the flow. This can be achieved if the discharge rate at each point across the flow is exactly matched to the local volume flow rate, that is, if the constant-concentration asymptote is attained immediately. A more practicable target is to restrict attention to a single discharge point and to minimize the peak concentration at the shoreline. In a straight channel with a symmetric depth profile the shoreline concentration would exhibit such an overshoot unless the outlet were positioned at the center. The question then becomes that of ascertaining the center of a non-symmetric or meandering river. The precise location of the optimal discharge site is at the single zero crossing of the first advection-diffusion eigenmode. Simple examples are described which reveal that this position tends to be weighted toward the inside bank at the beginning of bends. (Baker-FRC)
W82-05632

WATER TEMPERATURES IN NANTICOKE-LONG POINT BAY REGION OF LAKE ERIE,

Ontario Hydro, Toronto. Hydraulic Studies and Development Dept.
For primary bibliographic entry see Field 5C.
W82-05637

MODELING OF PHYTOPLANKTON-NUTRIENT DYNAMICS IN SAGINAW BAY, LAKE HURON,

Environmental Protection Agency, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5C.
W82-05639

CHEMICAL CONSTRAINTS OF GROUND-WATER MANAGEMENT IN THE YUCATAN PENINSULA, MEXICO,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 4B.
W82-05650

DRYLAND SALINITY IN A CLOSED DRAINAGE BASIN IN NOBLEFORD, ALBERTA,

Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 4D.
W82-05656

THE COST AND EFFECTIVENESS OF PUBLIC NOTIFICATION OF MCL VIOLATIONS,

Pittsburgh Univ., PA. School of Education.
C. E. Stegman, and G. Schneider.
Journal of the American Water Works Association, Vol 74, No 2, p 59-65, February, 1982. 9 Tab, 2 Ref.

Descriptors: *Water quality standards, *Public relations, Public health, Public rights, Attitudes, Social participation, Water quality, Drinking water, Potable water, Turbidity, Economic aspects, *Cost analysis, Expenditures.

The National Interim Primary Drinking Water Regulations, effective as of June, 1977, require that whenever a community water system fails to comply with any maximum contaminant levels established under the regulations, the water supplier must promptly publish notice of such failure in a newspaper of general circulation in the area serviced by the system or post notices in local post offices. Copies of the notice must also be furnished to local radio and television stations. This study examined maximum contaminant level violations for 164 water systems in 14 states to determine how the water systems notified their customers and how much it cost to do so. Putting an enclosure in the bill and sending a separate mailing are more frequently used than any other direct notification methods. The average cost of public notification for small systems was $31.30 for bacteriologic violations and $30.92 for turbidity violations. The average total cost for large systems reporting turbidity violations was $1218.58. For indirect notification, radio announcements, newspaper articles, and legal notices were all frequently used by the systems. Television stations carried the information as part of their news programs, and thus the water companies did not have to buy air time in this medium. In most cases it was felt that public notification was not effective in either educating or informing the public. Although some felt that consumers are generally indifferent to water problems, others expressed that it was unreasonable to expect customer support, given the delay between the violation and the notification. Concern was also noted that customers might not understand the notices and could in some cases become overly alarmed. (Baker-FRC)
W82-05669

WATER SUPPLY FOR NEW YORK CITY IN THE 1980S,

Olympia and York Battery Park Co., New York.
For primary bibliographic entry see Field 6D.
W82-05671

INVESTIGATING POTENTIAL WATER CONTAMINATION BY PETROLEUM-ASPHALT COATINGS IN DUCTILE-IRON PIPE,

Southern Research Inst. Birmingham, AL. Analytical and Physical Chemistry Div.
For primary bibliographic entry see Field 5A.
W82-05676

CRITERIA FOR ACHIEVING PATHOGEN DESTRUCTION DURING COMPOSTING,

Science and Education Administration, Beltsville, MD.
For primary bibliographic entry see Field 5D.
W82-05697

A CONSISTENT METHODOLOGY FOR WASTELOAD ALLOCATIONS,

Hays and Lindsey, Inc., Austin, TX.
A. J. Hays, Jr.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2994-2997, December, 1980. 2 Fig.

Descriptors: *Assimilative capacity, *Waste load, *Water quality standards, Streamflow, Ouachita River, Louisiana, Model studies, Flow measurement, Low flow.

Steady-state models for estimating the assimilative capacities of stream segments can give overly conservative results under some circumstances. An example is a 161 km segment of the Ouachita River, Louisiana, in which the difference between the actual and predicted time-of-travel through the segment for the 7-day low flow was 86 days. Use of more complicated dynamic models can be avoided by using a graphical approach wherein low flow is determined intuitively by the intersection of two curves: the estimated travel time vs. Steady-state flow rate through the river segment and the frequency relationship between the 2 or 10 year low flow and the n-day flow averaging period u.v.d. In the Ouachita River segment the wasteload allocation computed by this method was 70% greater than by the previous method. (Cassar-FRC)
W82-05702

POISONS IN THE HUDSON,

C. S. Warren.
Clearwaters, Vol 10, No 2, p 12-13, June, 1980.

Descriptors: *Polychlorinated biphenyls, *Sediments, *Water pollution treatment, Hudson River, New York, Organic compounds, Chlorinated hydrocarbons, Rivers, Dredging, Legislation.

Although polychlorinated biphenyls (PCB) input to the Hudson River has been discontinued, river bed sediments remain highly contaminated. A plan to dredge 40 'hot spots' with average concentrations of 51-155 micrograms per g PCB has been developed. An estimated 1.8 million cu yards of material containing 277,600 pounds of PCB would be dredged and placed in a secure landfill built for this purpose. Total costs are estimated at $30 million for the 3-year project. Funds are not available at present to finance this cleanup. The EPA supports Superfund legislation as a means of implementing these plans. (Cassar-FRC)
W82-05705

ELECTRICAL INTERACTION BETWEEN POLARIZED WATER MASSES AND ZOOPLANKTON IN WATER BODIES,

Akademiya Nauk SSSR Leningrad. Inst. Ozerovedeniya.
V. V. Aleksandrov.
Hydrobiological Journal, Vol 16, No 5, p 11-17, 1980. 3 Fig, 30 Ref.

Descriptors: *Zooplankton, *Lakes, *Electric fields, Water pollution effects, Lake Ladoga, USSR, Rotifers, Infusoria, Pulp and paper industry, Polarization, Eutrophication, Plankton.

The electric field and the distribution of zooplankton were studied on June 23, 1974, at 16 stations in Lake Ladoga, USSR, part of which was polluted with paper mill effluents. The electric field values were more negative in areas where rotifers and infusoria were more abundant. In unpolluted water the electric field was 5-10 times 10 to the minus 5th power V per m and the number of hydrobionts, 200 specimens per liter. Concentrations of 748 total plankton specimens per liter were found in water with electric field values of -1 to -1.2 times 10 to the minus 4th power V per m. The boundary zones between polluted and unpolluted water were rich in plankton. Two possible explanations for the difference in electric field gradient and the abundance of microorganisms were given. Eutrophication leads to an abundance of saprophytic bacteria which attract large numbers of zooplankton. On the other hand, electrostatic forces may attract charged microorganisms in the boundary zone between polluted and unpolluted water and hold them there until the gradient disappears as a result of dilution. (Cassar-FRC)
W82-05707

TRANSPORT OF NITRATE AND GASEOUS DENITRIFICATION IN SOIL COLUMNS DURING LEACHING,

Iows State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W82-05709

TRIHALOMETHANES IN CHLORINATED COOLING WATERS OF NUCLEAR REACTORS,

Du Pont de Nemours (E. I.) and Co., Aiken, SC. Savannah River Lab.
For primary bibliographic entry see Field 5F.
W82-05713

SLASH BURNING EFFECTS ON SOIL AND WATER CHEMISTRY IN SOUTHEASTERN ALASKA,

Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 4C.
W82-05715

METHOXYCHLOR RESIDUES IN TREATED IRRIGATION CANAL WATER IN SOUTHCENTRAL IDAHO,

Idaho Univ., Moscow. Twin Falls Cooperative Extension Service.
For primary bibliographic entry see Field 5B.
W82-05726

MUTAGENIC POTENTIAL OF WATER CONCENTRATES FROM THE EFFLUENT OF A WASTE OIL STORAGE POND,

Texas A and M Univ., College Station. Dept. of Soil and Crop Science.
For primary bibliographic entry see Field 5C.
W82-05727

OXYGENATION OF THE AVON RIVER,

Ontario Ministry of the Environment, Toronto.
D. Huber, D. Veal, and J. Goldman.
Water and Pollution Control, Vol 120, No 2, p 38-39, March/April, 1982.

Descriptors: River water, *Oxygenation, Rivers, Water quality, Aquatic plants, Respiration, Oxygen, Avon River, *Canada, Water quality management, *Aeration, *Instream aeration, Dissolved oxygen.

Water quality in the Avon River is affected by agricultural drainage and by urban inputs from the City of Stratford, Ontario, Canada. One major problem is low dissolved oxygen levels during summer night-time periods, resulting from the respiration of heavy growths of aquatic plants. An assessment was made of in-stream oxygenation of the river water. Oxygen was injected into the pumped water at a constant rate of 5.00 cubic meters per hour. With the 0.028 cubic meter/second flow of river water through the pumping system, the injected oxygen was estimated to have increased by oxygen concentration in the diffuser by 75 mg/liter. The estimated velocity of the river was 0.37 km/hr. Hence, it would take the river 10.8 hours to travel from the point of injection to an area 4.0 km downstream where the last dissolved oxygen monitor was located. Only localized benefits were obtained from this procedure because as the river moved on downstream, night time plant respiration would gradually offset the improvements of the oxygenation. After several

hours of travel away from the oxygenator, equating to about 1-3 river km, day-time conditions would result in natural oxygen recovery from plant photosynthesis. In order to substantially improve the night time oxygen status of a lengthy river, a number of oxygenation units would be needed. (Baker-FRC)
W82-05730

A SENSITIVITY AND ERROR ANALYSIS FRAMEWORK FOR LAKE EUTROPHICATION MODELING,

For primary bibliographic entry see Field 5C.
W82-05739

OPTIMAL LOCATION AND MANAGEMENT OF WASTE DISPOSAL FACILITIES AFFECTING GROUND WATER QUALITY,

Stanford Univ., CA. Dept. of Applied Earth Sciences.
S. M. Gorelick, and I. Remson.
Water Resources Bulletin, Vol 18, No 1, p 43-51, February, 1982. 7 Fig, 1 Tab, 25 Ref.

Descriptors: *Optimization, *Waste disposal, *Groundwater pollution, Water quality control, Simulation analysis, Numerical analysis, Solutes, Linear programming, Water supply, Aquifers, Groundwater management, Water pollution prevention, Path of pollutants.

Groundwater systems which are used for both waste disposal and water supply must be properly managed to ensure long range water quality protection. Numerical simulation of groundwater solute transport can be used in combination with linear programming to optimize waste disposal. Two management problems are described. In the first problem, waste disposal at potential sites is maximized while maintaining water quality at supply wells and operating an existing disposal facility. An iterative procedure is used to deal with changes in the velocity field induced by wastewater injection, which causes a nonlinearity in the solute transport equation. The value of parametric programming in analyzing waste disposal tradeoffs among existing and potential facilities is demonstrated. The second problem addresses the evaluation of a groundwater system in order to identify all sites which are suitable for subsurface waste disposal. This management model is manipulated so that the optimal values of the dual variables provide information with respect to the utility of each potential disposal site. The joint simulation and optimization approach permits optimal evaluation, selection, and management of groundwater waste disposal facilities where the aquifer is also used for water supply. (Carroll-FRC)
W82-05740

DUAL OBJECTIVE CONTROL OF NUTRIENT LOADING INTO A LAKE,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
L. Duckstein, I. Bogardi, and L. David.
Water Resources Bulletin, Vol 18, No 1, p 21-26, February, 1982. 3 Fig, 6 Tab, 29 Ref.

Descriptors: *Nutrients, *Management planning, *Water pollution control, *Lakes, Eutrophication, Monte Carlo method, Multiobjective planning, Stochastic process, Phosphorus, Watershed management, Lake Balaton, Hungary, Model studies.

A framework is presented for multiobjective modelling of nutrient loading reduction from a watershed into a water body. Lake Balaton, Hungary, is used as a case study. The nutrient phosphorus was chosen for examination since it appears to be the limiting factor of eutrophication in this lake, which has experienced rapid development of tourism around the lake and of agriculture over the watershed. Although about 50% of the overall phosphorus loading originates from nonpoint sources, the mechanism is poorly understood and few observation data are available. While the objective of eutrophication control is to minimize phosphorus loading, the objective of watershed management is to maximize agricultural revenue. A discrete set of alternative methods for controlling nutrient loading is defined, which comprises a mix of control alternatives for the following elements: point sources, runoff, fertilizer type and application, cropping management, erosion, and sedimentation. A previously developed stochastic model is used to estimate the probability density function of dissolved and fixed phosphorus loading which reflects the control policy. A compromise solution can then be selected as a mix of the best-ranked policies. (Carroll-FRC)
W82-05750

STORMWATER MANAGEMENT - ONE DEVELOPER'S EXPERIENCE,

Major Holdings Ltd., Kitchener (Ontario).
For primary bibliographic entry see Field 6B.
W82-05777

A CITIZEN'S VIEW OF WATER MANAGEMENT IN THE OKANAGAN VALLEY,

For primary bibliographic entry see Field 6G.
W82-05781

AQUIFER MANAGEMENT IN DADE COUNTY,

Dade County Dept. of Environmental Resources Management, Miami, FL. Environmental Planning Div.
D. Yoder.
Water/Engineering and Management, Vol 129, No 4, p 34-38-40,42, April, 1982. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Aquifer management, *Land use. Dade County, *Florida, Biscayne Aquifer, Salt water intrusion, Organic compounds, Trihalomethanes, Chlorinated hydrocarbons, Pesticides, Wells, Groundwater pollution, Nitrates, Water management, Water quality control, Planning, Monitoring, Agriculture, Water supply, Nonstructural alternatives.

Early water management activities in Dade County, Florida, focused on drainage works. This lowered groundwater levels and allowed salt water intrusion into coastal aquifers. In 1975 the county Department of Environmental Resources Management (DERM) was designated the 208 areawide water quality planning agency. In 1979 the Biscayne Aquifer was named as a sole source aquifer as a result of studies undertaken by the DERM. The Department monitored nitrates in canals during and after storm events and in groundwater and found levels high, but not generally exceeding the 10 mg per liter standards. Sources of the nitrates were determined by monitoring at 26 selected sites for a year. The major contributor was, as expected, agriculture. A voluntary and educational control program is being developed to minimize the agricultural sources of nitrates. Volatile organics (trihalomethanes and industrial chemicals) are another concern. No pesticide contamination has been evident to date. Mean average volatile organics for all wells are 4.9 micrograms per liter in the wet season and 6.3 micrograms per liter in the dry season. An ordinance regulating land use around public water supply wells is being prepared. No new activities involving the use of hazardous materials would be permitted within the 210-day hydraulic travel time, which represents the highest recorded period without recharge from rainfall. Other agencies involved with water management in this region are the state Environmental Regulation Department, the South Florida Water Management District, and the U.S. EPA. Plans cited for development are new management practices for storm water disposal, improved septic tank regulations, a more active public information and education program, and expanded monitoring of water resources. (Caesar-FRC)
W82-05784

THE SAFE DRINKING WATER ACT ON REVIEW,

Johnson (C. C.) and Associates, Inc., Silver Spring, MD.
C. C. Johnson, Jr.
Water/Engineering and Management, Vol 129, No 3, p 14-15, March, 1982. 1 Ref.

Descriptors: *Drinking water, *Legal aspects, Legislation, Safe Drinking Water Act, Public health, Water treatment, Regulations, Standards.

The legislative history of the Safe Drinking Water Act is reviewed as an aid to understanding several of the suggested changes in the legislation, since the authorizing legislation for the act will expire in September 1982. The major concern of some advocates for change is the discretion given to the Environmental Protection Agency to regulate drinking water contaminants which in the judgment of the administration may have an adverse effect on human health. Another issue under debate pertains to the administrator's authority to require a specific treatment technology. A third major concern of the public and suppliers is the economic impact of the Act on small water supplies. Many other issues have been raised in the debate over the Act, including subjects associated with public notification, health advisories, risk analysis, benefit-cost analysis, operation and maintenance regulations, and a host of others. (Baker-FRC)
W82-05792

OUTFALL DIFFUSER BEHAVIOR IN STRATIFIED AMBIENT FLUID,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-05797

LAW FOR ENVIRONMENTALISTS,

V. Sikora.
Journal of Environmental Health, Vol 44, No 5, p 258-259, March-April, 1982.

Descriptors: *Waste disposal, *Environmental protection, Permits, Hazardous materials, Legal aspects, Regulations, Sewage disposal.

Various problems in on-site sewage disposal are discussed, and an unusual way in which a county tried to resist the siting of a hazardous waste disposal facility is presented. Developments in administrative inspections in states are also cited. The problems presented deal with the denial of an on-site sewage disposal permit to a developer for his lots if they are unsuitable, even though there is no other use which can be made of the lots; the prohibiting of holding tank sewage disposal systems in coastal areas; the authority of a state health department to establish regulations for subsurface sewage disposal; and the justification for requiring permits to be obtained from different two state environmental agencies for an on-lot disposal system. (Baker-FRC)
W82-05813

THE NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS, PART I - HISTORICAL DEVELOPMENT,

Northern Illinois Univ., DeKalb. School of Allied Health Professions.
W. A. Oleckno.
Journal of Environmental Health, Vol 44, No 5, p 236-239, March-April, 1982. 22 Ref.

Descriptors: *Drinking water, *Regulations, Potable water, Water quality, Standards, Legal aspects, Federal Jurisdiction, Public health, Water pollution.

This article is the first of a two part series dealing with the National Interim Primary Drinking Water Regulations as they apply to community water systems. The historical development of the Regulations is presented. They result from two nationally significant historical events: the promulgation and revision of the U.S. Public Health Service Drinking Water Standards of 1962 and the enactment of the Safe Drinking Water Act of 1974. These regulations were the first comprehensive set of drinking water standards applicable to all public water systems in the United States. It was the substandard condition of water supply systems in the United States as well as reports of suspected carcinogens in the New Orleans drinking water supply that underscored the need for the regulations and pro-

vided the motivation for their legislative mandates. In a February 1969 study, 41% of the water supply systems studied did not meet the limits established in the 1962 Drinking Water Standards; 56% were deficient in aspects of source protection, disinfection, clarification and/or pressure in the distribution system; 90% of the systems collected an insufficient number of bacteriological samples and/or collected samples showing poor bacteriological quality. While the Safe Drinking Water Act called for the eventual establishment of revised primary drinking water regulations after a detailed study of the health effects of contaminants in drinking water, no such standards have yet been proposed. (Baker-FRC)
W82-05814

THE NATIONAL INTERIM PRIMARY DRINKING WATER STANDARDS. PART II. IMPACT ON COMMUNITY WATER SYSTEMS. THE INDIANA EXPERIENCE,

Northern Illinois Univ., DeKalb. School of Allied Health Professions.
W. A. Oleckno.
Journal of Environmental Health, Vol 44, No 5, p 240-244, March-April, 1982. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Drinking water, *Standards, Water quality, Legal aspects, Legislation, *Indiana, Regulations, Federal Jurisdiction, National Interim Primary Drinking Water Regulations, Surveys.

The impact of the National Interim Primary Drinking Water Regulations (NIPDWR) on Community Water Systems (CWS) in Indiana was investigated. The current study was designed to determine to what degree the major provisions of the NIPDWR impacted on CWS in Indiana; how system size, source of water supply, and system ownership related to the reported impacts; and what steps had been taken or planned to reduce the major impacts. A total of 190 questionaires, representing 63.3% of those mailed, were returned. Of these, 4.7% were unusable. The final usable sample appeared to be reasonably representative of the population of Indiana CWS both geographically and in terms of relative percentages of CWS when stratified by system size, source of water supply, and system ownership, based on previous data. Based on the findings it would seem that the overwhelming majority of Indiana CWS experienced little or no impact from the NIPDWR. About 38% can be said to have experienced a moderate impact on system operations due to the passage of the NIPDWR. Classifying Indiana CWS by size, source of water supply, and ownership was of limited value in predicting the actual degree of impact of a singular provision of the regulations on a particular community water system. The classification schemes were useful in identifying important differences in system characteristics. (Baker-FRC)
W82-05815

PHOSPHORUS INACTIVATION BY ZIRCONIUM IN A EUTROPHIC POND,

Corvallis Environmental Research Lab., OR.
W. D. Sanville, C. F. Powers, G. S. Schuytema, F. S. Stay, and W. L. Lauer.
Journal of the Water Pollution Control Federation, Vol 54, No 5, p 434-443, May, 1982. 8 Fig, 7 Tab, 25 Ref.

Descriptors: *Phosphorus removal, *Zirconium, *Algae, Water treatment, Nutrients, Eutrophied lakes, Fish, Ponds, Phytoplankton, Sediments, Biomass.

Zirconium tetrachloride at initial levels of 5 mg Zr per liter controlled phytoplankton production in a ecthrophic farm pond without producing acute or long-term effects in plants and animals. The chemical was added to the experimental half of the pond on March, 26-27, 1974. The other half, separated by a vinyl curtain, was the control. During the first year after treatment the experimental side had lower total phosphorus and all measures of biomass than the control. By the end of July the control pond contained 200,000 cells per ml, and the experimental side, 30,000 cells per ml. There was no drastic changes in species diversity in the experimental pond after Zr treatment. Zr contents of pond plants and invertebrates were highly variable. Fish showed no bioaccumulation. Total Zr concentrations (in mg per liter) in pond water were 1.9 the day after application, 0.592 on April 25, 1974, and 0.010 or less thereafter. Leakage from the experimental side to the control side caused Zr levels in the control side to reach 0.2 mg per liter for the month after application. Concentrations of Zr (micrograms per g) in sediments on November 20, 1975, were 468, experimental; 193, control; and 65 in an adjacent pond and fields. (Cassar-FRC)
W82-05856

LIMING FISH PONDS,

Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
C. E. Boyd.
Journal of Soil and Water conservation, Vol 37, No 2, p 86-88, March/April, 1982. 2 Tab, 30 Ref.

Descriptors: *Ponds, *Lime, Acidic water, Water treatment, Fish ponds, Carbonates, Fish food organisms, Sediments, Water quality management, Acid soils, Alkalinity, Calcium carbonate, Aquaculture.

Fish production in ponds can often be improved by liming with agricultural limestone, calcium hydroxide, calcium oxide, basic slag, or liquid lime. Properly applied, these materials react with acidity to form bicarbonate which is then available as a carbon source to plants. In sediments liming increases the rates of organic matter decomposition and nutrients cycling. Other effects of liming on ponds are reduction of turbidity and increase in production of fish food organisms. A table of lime requirements for pond muds of different pH and texture is given. Mud of pH < 4.0 requires 12,800 pounds per acre of $CaCO3$ in heavy loams or clays, 6,400 pounds per acre in sandy loams, and 4,000 pounds per acre in sand. Lime requirements drop to 1600, 1600, and zero, respectively, at pH 6.1-6.5. Ponds above pH 6.5 need not be limed. Application methods include liming the bottom with conventional spreader before filling, spreading from a boat or raft or platform between boats, and pumping slurries or blowing dust from a truck on the shore. The boats, and pumping slurries or blowing dust from a truck on the shore. The effects of lime treatment last 2-4 years if the water exchange rate is low. Highly acid ponds (below 4.5) usually received drainage from acid sulfate soils. For liming to be effective the source of acid must be treated or removed. (Cassar-FRC)
W82-05866

FUTURE WATER DEVELOPMENT POLICIES,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe, and G. E. Radosevich.
Water Supply and Management, Vol 6, No 1-2, p 221-232, 1982. 11 Ref.

Descriptors: *Salinity, *Colorado River, *Irrigation efficiency, *Water resources development, *Water policy, *River basin development, Desalination, Irrigation canals, Canal linings, Resources development, Water law, Water demand, Water management, Irrigation practices, River basins, Irrigation-return flow.

Energy resources are being increasingly developed in the Upper Colorado River Basin, with the consequences of further deterioration of the waters reaching the Lower Colorado Basin, especially in the form of added salinity. The basin-wide, nondegradation salinity policy for the lower stem of the river mandates that each development offset salinity contributions by making on-site improvements or off-site alterations somewhere else in the river basin. One practical off-site modification involves providing irrigation canal linings and onfarm improvements in irrigation efficiency. Such projects decrease irrigation diversion requirements while increasing agricultural productivity. with changes in western water laws, economic incentives and administrative programs could be devised to allow the contract sale or rent of decreased diversion requirements to other water demands; resulting revenues could be used to improve irrigation systems to further reduce salt loading to the Colorado River. (Geiger-FRC)
W82-05884

THE COLORADO RIVER SALINITY PROBLEM,

Environmental Protection Agency, Ada, OK. Robert S. Kerr Environmental Research Lab.
J. P. Law, Jr., and A. G. Hornsby.
Water Supply and Management, Vol 6, No 1-2, p 87-104, 1982. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Water quality control, *Salinity, *Colorado River, *Environmental effects, *Resources development, *Irrigation practices, River basins, River basin development, Water resources development, Resources management, Water demand, Irrigation water, Water management.

In the Upper Basin of the Colorado River, 52% of the salt loading comes from irrigated agriculture, 9% from natural point sources, and only 2% from municipal and industrial uses. Damage from salt loading occurs mostly in the Lower Colorado River Basin. Remedies for salinity problems include collecting and treating or disposal of natural point sources. Cost-effective technologies for dealing with salt loadings due to irrigated agriculture include improved irrigation and on-farm management practices to reduce deep percoaltion loss and the building of canals and laterals to channel salt losses. Development of coal and oil shale resources in the Upper Colorado River Basin will necessitate use of river water, allowing even less downstream flow for salt dilution. Future water resource developments will require more stringent salinity control and management decisions based on scientific reasoning rathe than political motivations. (Geiger-FRC)
W82-05889

INTERNATIONAL PROBLEMS ON THE COLORADO RIVER,

Colorado River Board of California, Los Angeles.
M. B. Holburt.
Water Supply and Management, Vol 6, No 1-2, p 105-114, 1982. 1 Tab.

Descriptors: *Water quality control, *Salinity, *Colorado River, *International agreements, *Irrigation effects, River basins, Water policy, Water management, Groundwater availability, Water resources development, Desalination.

The Colorado River provides irrigation water to nearly 500,000 acres of land in the Republic of Mexico and serves over 500,000 people in that country. In 1961, the discharge of highly saline pumped drainage from the Wellton-Mohawk Irrigation and Drainage District surrounding Yuma, Arizona, significantly increased the salinity of the Colorado River waters reaching Mexico. In 1973, a Water Treaty was signed, establishing definite limits to the salinity levels that would be allowed in the Colorado River was delivered to Mexico upstream from the Morelos Dam in relation to the water at Imperiam Dam. Although this treaty was intended as a permanent solution to the salinity problem, new arguments could arise with Mexico if the operation of the Unuma Desalting Plant fails to reach the standards which were agreed upon. The pumping of groundwater by Mexico that induces groundwater flow from the United States to Mexico may also develop into a controversial issue. New water resources developments in the United States may require the implementation of additional salinity control measures in the near future. (Geiger-FRC)
W82-05892

OPTIMAL SALINITY CONTROL PROGRAM FOR THE UPPER COLORADO RIVER BASIN,

Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
R. G. Evans, W. R. Walker, and G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 169-197, 1982. 14 Fig, 7 Tab, 13 Ref.

Descriptors: *Model studies, *Optimum development plans, *Desalination, *Cost analysis, *Colorado River, Salinity, Optimization, Irrigation efficiency, Planning, Irrigation effects, River basin development, Water resources development, Irrigation-return flows.

A simple multi-level nonlinear optimization model was used to derive the most cost-effective strategies for salinity control in the waters of the Upper Colorado River Basin. The methodology gives qualitative data on the location and general types of alternatives that would be useful in a least cost basin-wide salinity control program and the expected salt load reduction and annual costs of each preselected level of control. Conditions from January 1980 were used to estimate the costs and salinity contributions associated with various control alternatives. Cost effectiveness functions were formulated for each major irrigation canal and laterals, aggregate laterals under each canal, and on-farm improvements for each agricultural project area. Similar functions were developed for such point sources as Paradox Valley, Glenwood-Dotsero Springs and Crystal Geyser. The desalination of agricultural return flows was also evaluated. The optimal salinity control program in the Upper Colorado river Basin would cost about $30 million annually for 1.2 million metric tons of salt removal. Sensitivity analysis of the optimization procedure showed that substantial error in costs and the respective salt load contributions of the individual alternatives would have to occur to alter the optimal order of implementation of a basin-wide salinity control program. (Geiger-FRC)
W82-05893

SALINITY CONTROL MEASURES FOR GRAND VALLEY,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 3F.
W82-05894

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER REUSE PLANNING BY MEANS OF AN INPUT-OUTPUT TABLE,

Swiss Reinsurance Co., Zurich.
D. Klooz, and D. W. Hendricks.
Journal of the American Water Works Association, Vol 74, No 1, p 51-56, 1982. 7 Fig, 3 Tab, 3 Ref.

Descriptors: Planning, *Water reuse, *Colorado, *Cache La Poudre River Basin, Data analysis, *Project planning, Agricultural water use, Industrial water, Water storage, *Input-output analysis, Water demand, Water use, Future planning, Used water.

An input-output table analysis suitable for application in water reuse planning was developed and applied to the Cache La Poudre River basin in Colorado. Analysis is facilitated by the ability of the input-output table to organize and collate large amounts of complex data both structurally and operationally. Aggregated input-output tables were developed for proposals for new projects construction and intensified reuse for the year 2020. The tables failitate comparison of the uses of virgin water and used water between the two solutions. Reused water is shown to represent a feasibile means for meeting projected demands. The reuse factor, defined as the total water use divided by the total amount of virgin water supply, increases from 1.34 to 1.46 upon implementation of intensified reuse. Used water is prominent in satisfying industrial and agricultural water demands under the intensified reuse solution. Unplanned reuse maintains its important place in both solutions. Basin outflow is reduced by intensified reuse. The amount of water saved by intensified reuse is only about 8%, but this could spare the need for expensive new storage projects. This clearly organized evaluation format aids in assessing proposed projects for their ability to satisfy new water demands and in examining their positive and negative interactions on the rest of the system. (Carroll-FRC)
W82-04794

AN EVALUATION OF THE URBAN DESIGN STORM CONCEPT,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
H. G. Wenzel, Jr., and M. L. Voorhees.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220666, Price codes: A08 in paper copy, A01 in microfiche. Research Report No 164, 147 p, 43 Fig, 19 Tab, 25 Ref, 8 Append. OWRT-A-095-IL L(2). 14-31-0001-6073.

Descriptors: *Design storms, *Simulation model, *Storm sewers, *Urban drainage, *Urban runoff, Design-hydraulics, Frequency analysis, Sewer systems, Simulation analyses, Storm drainage, Design flow.

This report describes an evaluation of the assumption commonly employed in drainage design that the return period of the rainfall used to design a system is the same as the peak flow produced by that rainfall. Specifically, the sensitivity of the frequency response of four catchments to design storm parameters is examined. Parameters include, hyetograph shape, antecedent soil moisture and rainfall duration. A continuous simulation model is used to compute simulated historical frequency responses for three different long term rainfall records.. Design storms also developed from depth-duration-frequency analyses of the rainfall data. Comparisons are made on frequency graphs. It is concluded that an appropriate choice of design storm parameters can produce a design which yields peak flows of the desired return period.
W82-04960

A SCREENING MODEL TO QUANTIFY RESILIENCE,

Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 27-32, February, 1982. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Performance evaluation, *Water resources development, *Risks, Planning, Resiliency, Costs, Economic evaluation, Systems analysis, Water supply, Optimization, *Project planning, Design criteria, Reservoirs, *Model studies.

The concept of resilience, used in statistics and biology, is applied to water resource systems. A resilient water supply system does not respond precipitously to a major surprise or perturbation during the course of its economic life. For example, a well-designed water system is relatively insensitive (or resilient) to an event such as the Northeast Drought of 1961-65. Neglecting this resilience factor in planning an optimum design may produce a system which is cost-effective but intolerant of perturbations. A screening model is presented for 8 reservoirs of different size operating in parallel. Results imply that large systems which are not markedly over- or understressed can adapt to a range of potential capital investments without seriously compromising performance characteristics. For understressed systems the most resilient design used 2 or 3 reservoirs; for overstressed systems, more than 6; and for the intermmediate cases, 4. Another measure of system resilience is based on adaptability of a single design to changes in target. A fully resilient system can deliver all intermediate targets at the same performance level. Mean resilience peaks at systems slightly smaller than maximal. Further increases in size produce small reductions in mean resilience and greatly reduce variance (resilience). A tradeoff between the mean and standard deviation of resilience can help attain the optimum system size. (Cassar-FRC)
W82-05044

ALTERNATIVE INDICES OF RESILIENCE,

Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 33-39, February, 1982. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Performance evaluation, *Water resources development, *Risks, Planning, *Resilience, Economic evaluation, *Systems analysis, *Project planning.

The concept of resilience, previously introduced into ecology literature, may be useful in the application of systems analysis to water resources planning. Various ideas regarding resilience deal with recovery of water resource systems and minimization of surprises. Several mathematical definitions for resilience of water resource systems are outlined, and the advantages and disadvantages of these definitions compared. No single definition is designated as the best. All are based on the time required to pass from one system state to another. The passage to or from a given state is defined as failure. Some of the definitions involve probability of recovery from failure to an acceptable state within a specified time interval. (Cassar-FRC)
W82-05045

ESTIMATES OF RESILIENCE INDICES BY SIMULATION,

Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 41-50, February, 1982. 5 Fig, 2 Tab, 3 Ref.

Descriptors: *Reservoirs, *Design criteria, Planning, *Water resources development, *Model studies, Mathematical studies, *Resilience, Alternative planning, Reservoirs.

A simulation study was performed to define and assess the basin property of resilience. Testing was carried out on a few speculative definitions developed for this property. The purpose of the analysis was to develop some insights into the resilience of the system in the vicinity of its global or local cost optima. Resilience indices were calculated according to some of the previously published formulas for several reservoir configurations which constitute a set of sample plans for a river basin. Basin characteristics are introduced to estimate proposed surrogates of system resilience without the necessity of performing long and expensive simulation studies. These simulations are necessary to develop resilience indices for the sample basins and to compare them to a few conventional ranking functions. The objective of this procedure was to determine if conventional indices replicate information contained in resilience indices and the extent to which either or both of these can be estimated from basin geometry. Consideration is given to combinatorial analysis, system operating policy, generalization to six reservoir storages, and an index for estimating system performance. The results, although imperfect, are encouraging and suggest areas for continuing work in the mapping of basin characteristics and configuration into performance indices. (Carroll-FRC)
W82-05046

ESTIMATING RESILIENCE BY CANONICAL ANALYSIS,

Harvard Univ., Cambridge, MA.
M. B. Fiering.
Water Resources Research, Vol 18, No 1, p 51-57, February, 1982. 3 Fig, 6 Tab, 4 Ref.

Descriptors: *Planning, *Reservoirs, *Mathematical studies, Design criteria, *Model studies, Operating criteria, *Water resources development, *Resilience, Alternative planning.

In a previous study, mutivariate or cluster analyses were proposed to define the basin properties and storage surrogates which, alone or in combination, could be used to form a tight estimator of system performance. Canonical correlation was suggested as especially suitable for predicting system resilience and some conventional performance indices without expensive simulation, and thus 'backing into' an operational definition of resilience. Canonical correlation analysis is used to formulate linear estimates of independent or orthogonal (incremental) information on the performance of water resource systems. Simple economic and resilience indicators are compared, and for the particular configurations selected the replicated and inde-

pendent information sets are explained in terms of the connectivity of the various reservoirs. The canonical correlations obtained are relatively high, suggesting that there is a significant replication of information. A taxonomy is developed which suggests the basin and structural characteristics which would show less replication and permit improved description of system performance. (Carroll-FRC)
W82-05047

USE OF MATHEMATICAL MODELS TO GENERATE ALTERNATIVE SOLUTIONS TO WATER RESOURCES PLANNING PROBLEMS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
S. Y. Chang, E. D. Brill, Jr., and L. D. Hopkins.
Water Resources Research, Vol 18, No 1, p 58-64, February, 1982. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Alternative planning, *Optimization, *Model studies, Mathematical models, Wastewater treatment, *Water resources development, *Wastewater facilities.

Alternatives for water resources planning problems were generated by three optimization models, the Hop. Skip, and Jump method (HSJ), a random method, and a branch and bound/screening method (BBS). The sample problem was to find the best arrangement for a wastewater treatment system with 15 wastewater sources, 12 possible plant sites, and 15 potential interceptor levels. The sets of alternatives generated by all 3 methods were different from each other. For each method the alternatives were different in different ways. The HSJ method generated alternatives differing in number of plants, i.e., degree of centralization. The random method produced alternatives with similar numbers of plants and interceptors but with facilities in different locations. The BBS method generated alternatives in which part of the wastewater system was constant but combined with other arrangements of the rest of the system. The wide range of alternatives offers possibilities for creative solutions and consideration of political, social, and environmental aspects by the evaluators. All methods were efficient, suggesting that in practice it might be desirable to use all 3 for formulating alternatives. (Cassar-FRC)
W82-05072

ROBUSTNESS OF WATER RESOURCES SYSTEMS,

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
T. Hashimoto, D. P. Loucks, and J. R. Stedinger.
Water Resources Research, Vol 18, No 1, p 21-26, February, 1982. 5 Fig, 4 Tab, 13 Ref.

Descriptors: *Performance evaluation, *Economic evaluation, *Water resources development, Design criteria, Robustness, Planning, Alternative planning, Costs, *Skane, *Sweden, Systems analysis, Water supply, Optimization, Risks, Project planning, *Cost analysis.

Robustness describes the overall economic performance of a water resource project. It measures the likelihood that the actual costs of a project will not exceed some fraction of the minimum possible cost of a system designed for the actual conditions that occur in the future. A water supply system planning problem in Skane, Sweden, was used as an illustration of the method. A large-scale interbasin transfer was proposed to meet uncertain future demands. Four design alternatives were evaluated for ability to meet demand in the year 2000. The value of robustness was calculated for each alternative. One of the four possibilities was clearly more robust than the other three, giving only a 2% probability of relatively very poor cost performance. (Cassar-FRC)
W82-05077

RELIABILITY, RESILIENCY, AND VULNERABILITY CRITERIA FOR WATER RESOURCE SYSTEM PERFORMANCE EVALUATION,

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
T. Hashimoto, J. R. Stedinger, and D. P. Loucks.
Water Resources Research, Vol 18, No 1, p 14-20, February, 1982. 9 Fig, 2 Tab, 26 Ref.

Descriptors: *Performance evaluation, *Water resources development, *Risks, Reliability, Resiliency, Vulnerability, Dam failure, *Reservoirs, Operating policies, Systems analysis, Reservoir releases, Water supply, Planning.

Three performance criteria for evaluating water resource systems are proposed as additions to the commonly used mean and variance of benefits, pollutant concentrations, and operating variables. These are reliability (how likely a system is to fail), resiliency (how quickly it recovers from failure), and vulnerability (how severe are the consequences of failure). The three criteria are expecially important during periods of drought, peak demand, or extreme weather. As an example, they are used to evaluate the performance of a water supply reservoir under a winter operating policy of a specified released with storage of the excess. Alternative summer policies are standard (meet as much demand as possible), hedging (providing a portion of the target release), and one in which the entire target is met if possible, but in case of unavoidable modest failure no water is released. In this system high reliability is accompanied by high vulnerability. Although the optimum situation is maximum reliability and minimum vulnerability, this is impossible in practice. Tradeoffs can produce a high reliability, modest resiliency, and low vulnerability. (Cassar-FRC)
W82-05078

MODELLING AND CONTROL OF DISSOLVED OXYGEN IN AN ESTUARY,

Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Electrical Engineering.
B. J. Olufeagba, and R. H. Flake.
Ecological Modelling, Vol 14, No 1, p 79-94, 1981. 9 Fig, 3 Tab, 13 Ref.

Descriptors: *Dissolved oxygen, *Estuarine environment, *Mathematical models, Nitrification, Water pollution control, Bays, Prediction, Biochemical oxygen demand, Algorithms, Water quality management, Management planning, *Jamaica Bay, *New York.

Jamaica Bay, New York, is a highly polluted estuary which suffers from reduced dissolved oxygen concentrations due to the biochemical oxygen demand (BOD) of organic materials discharged by waste sources. The two-dimensional spatial distribution of dissolved oxygen in Jamaica Bay is approximated by a vector multipoint boundary value problem. This problem, which includes interactions involving the carbonaceous BOD and the total unoxidized nitrogen, is solved by a multiple shooting technique. This shooting algorithm requires less computer storage than its finite difference counterpart, realizes higher order accuracy easily, and requires the solution of a relatively small matrix. These results are then used in a variational sensitivity model, which is used together with the Goldfarb method for constrained nonlinear programming to determine optimal management policies. The performance index in each case is the capital cost of nitrification treatment at each of the polluting sources discharging into the bay. The model is used to determine the optimal economic nitrification treatment levels required to achieve a minimum dissolved oxygen concentration level of 5 milligrams per liter throughout the bay. The use of this model for the evaluation and choice of management alternatives in water quality planning is demonstrated. (Carroll-FRC)
W82-05188

ENERGY SITING IN UTAH: A PROGRAMMING MODEL,

Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6B.
W82-05297

SEASONAL RISK-BASED RESERVOIR OPERATING RULES,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05299

RANDOM DIFFERENTIAL EQUATIONS IN RIVER WATER QUALITY MODELING,

Humboldt State Univ., Arcata, Dept. of Engineering.
B. A. Finney, D. S. Bowler, and M. P. Windham.
Water Resources Research, Vol 18, No 1, p 122-134, February, 1982. 11 Fig, 8 Tab, 31 Ref.

Descriptors: *Water quality, *Rivers, *Stochastic processes, *Model studies, Biological oxygen demand, Dissolved oxygen, Probablistic process, *Fate of pollutents.

A random differential equation model, a development from steady state probabilistic river water quality models, compensates for uncertainties such as natural variability and uncertainties in measurement--unrepresentativeness, errors, and incompleteness. The model is not limited by Monte Carlo, first-order analysis, or estimation theory techniques. Equations describing the water quality system are transformed from deterministic to random differential equations. Solution of these equations allows prediction of the joint probability density function of the water quality constituents at any location in the river system. Point loads and diversions may be handled. The model was applied to a sensitivity problem and to determination of BOD and dissolved oxygen in a hypothetical river system. Representing the randomness in water quality equations inputs and coefficients as a Gaussian white noise process is convenient. Randomness in water quality coefficient equations has greater influence on prediction concentrations than randomness in equation inputs. It is advantageous to approximate the marginal probability distribution function of BOD and dissolved oxygen with a normal distribution. This model may be useful in design of river water quality monitoring systems, implementation of reliability based on stream standards, and quantification of variability of constituent concentration for mangement, planning, and control purposes. (Cassar-FRC)
W82-05343

OPERATIONAL RESEARCH TECHNIQUES IN RIVER BASIN MANAGEMENT,

Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
K. W. Hipel.
Canadian Water Resources Journal, Vol 6, No 4, p 205-226, 1981. 1 Fig, 2 Tab, 51 Ref.

Descriptors: *Decision making, *Operations research, *Water management, *River basins, Conflict analysis, Fuzzy set theory, Model studies, Social aspects, Multipurpose projects, Poplar River, *Saskatchewan, Fort Peck, Montana, Stability analysis, Water resources development, Systems analysis, Canada.

Operations research methods for use in river basins management are described. The quantitative methods, divided into deterministic and probabilistic categories, have been widely applied to management problems. Nonquantitative methods, including the fuzzy set theory combined with multicriteria modelling, are especially valuable in evaluating intangible factors such as social and cultural effects of a water project. A conflict analysis methodology, the improved metagame analysis algorithm, is applied to the conflict in the Poplar River Basin (Saskatchewan-Montana). The three conflicting players are the Saskatchewan Power Company's thermal generating station, completed in 1979; Fort Peck Indians' irrigation water; and the International Joint Commissions's interests. Options are the possible activities of the players, such as power plant or irrigation projects of different sizes. Of the 4048 possible outcomes in this situation, only 22 are feasible. These are arranged in order of preference for each party. Each feasible outcome is then subjected to stability analysis by the improved metagame method, and equilibria (three in this study) established to indicate options most satisfactory to all parties. (Cassar-FRC)
W82-05387

A FEDERAL PERSPECTIVE ON RIVER BASIN MANAGEMENT,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 6E.
W82-05388

PROMISING STEPS TOWARD A NEW OTTAWA RIVER REGULATION,

For primary bibliographic entry see Field 6E.
W82-05394

NEW STRATEGIES FOR WATER RESOURCE PLANNING IN BRITISH COLUMBIA,

Department of the Environment, Victoria (British Columbia).
For primary bibliographic entry see Field 6E.
W82-05395

COLD LAKE-BEAVER RIVER REGIONAL WATER RESOURCES STUDY,

Department of the Environment (Edmonton).
For primary bibliographic entry see Field 6D.
W82-0539

COMPUTER-AIDED EVALUATION OF PERU'S HYDROPOWER,

S. Morariu.
International Water Power and Dam Construction, Vol 33, No 12, p 52-55, December, 1981. 2 Fig, 2 Tab.

Descriptors: *Computer programs, *Hydroelectric power, Predictions, Hydrologic data, Hydroelectric powerplants, Peru, Water resources development, Future planning.

A master plan has been prepared for the development of Peru's hydroelectric potential. As a first step in this process, data on the hydrological characteristics of Peru were collected from limited published sources, including Landsat data and radar photographs, and backed up by field surveys. A unified, computerized hydrological data bank for Peru is now in existence. A computerized model of 111 river basin models was used to calculate the mean discharge and theoretical hydro potential and to define 81,355 kilometers of hydrographic networks. The theoretical mean linear hydropower potential for Peru was found to be about 206,107 megawatts, most of which is concentrated on the eastern side of the Andes. About 25 to 50% of this quantity could be developed within existing technical and economic constraints. Potential projects were identified on the basis of available topographical, geological, and hydrological information and then inspected to evaluate technical feasibility. Basic designs were developed for all projects considered to be technically feasible. General cost curves were applied to each project and project variation for the estimation of capital expenditures attributable to each project element. Potential hydroelectric projects were then compared on the basis of calculated unit cost per kilowatt hour of energy produced. A preliminary screening process was conducted to identify optimal development chains on the basis of the minimum weighted cost of energy production. Potential projects were then ranked according to a number of technical/economic criteria and classified with respect to a range of installed capacities and availability of basic information. Visits to over 800 sites resulted in assessment of 560 projects in 2,300 different configurations. (Carroll-FRC)
W82-05515

APPLICATIONS OF SIMULATION TO SPECIFIC WATER PROJECTS,

Bochum Univ. (Germany, F.R.). Dept. of Water Sciences and Environmental Technology.
R. Harboe, and G. A. Schultz.
Journal of Hydrology, Vol 51, No 1-4, p 131-138, May, 1981. 6 Fig, 10 Ref.

Descriptors: *Simulation analysis, *Water supply development, *Water use, Water pollution, Irrigation, Environmental effects, Mathematical models, Water management, Computer programs.

Digital computer simulation involves the reproduction of the real system's static and dynamic characteristics through a mathematical model which is translated into a computer program. In only a few minutes this model can then reproduce the behavior of the system over long periods of time, allowing the decision-maker to analyze several alternatives rapidly. In water resources systems, computer simulations may be used to examine such alternatives as different sizes of reservoirs, power plants, and irrigation areas, several operation policy options; and hydrological records and various constraints due to water quality, navigation, recreation, and/or environmental protection. Four examples of applications of simulation analysis are discussed. These include simulations for a hydroelectric power system in Central Europe, for an irrigation system in South America, for a water supply reservoir system including environmental requirements in Germany. The examples include discussion of inputs used for each of the simulations, analysis goals, and performance of the simulation. The examples demonstrate the flexibility of the simulation technique. The technique is not too difficult to apply in practice and can be used to find optimum solutions for both design and operation of water resources systems. (Carroll-FRC)
W82-05522

THE ROLE OF UNCONDITIONED AND CONDITIONED CUMULATIVE DISTRIBUTION FUNCTIONS IN RESERVOIR RELIABILITY PROGRAMMING,

Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
S. P. Simonovic, and M. A. Marino.
Journal of Hydrology, Vol 52, No 3/4, p 219-228, July, 1981. 5 Tab, 14 Ref.

Descriptors: *Reservoir operation, *Mathematical studies, *Computer models, Reservoir releases, Reservoir design, Stochastic process, Mathematical models.

Mathematical models based on the relliability programming technique have been developed for solving stochastic problems of reservoir design and/or operation. The results obtained from the reliability program of a reservoir management problem based on the use of unconditioned cumulative distribution functions are compared with those obtained when conditioned cumulative distribution functions are used. The reliability program considers the reservoir releases and the reliabilities of the elements of the reservoir system as decision variables. Data from the Vardar River system in Yugoslavia are fitted with Pearson Type-III distributions for the case of unconditioned cumulative distribution functions and with bivariate gamma distributions for the case of conditioned cumulative distribution functions. Objective-function values and reliability tolerances obtained when conditioned cumulative distribution functions were used in the reliability program were greater than those obtained using unconditioned cumulative distribution functions. Although the study results cannot be generalized to other reservoir management problems, the use of conditioned cumulative distribution functions will give more realistic results than the use of unconditioned cumulative distribution functions in cases in which streamflow data are known to be stochastically dependent. It is concluded that the use of conditioned cumulative distribution functions represents a step forward in overcoming the conservative nature of stochastic models used for the design and/or operation of multipurpose multiple reservoir systems. (Carroll-FRC)
W82-05523

DISCRETIZATION IN STOCHASTIC RESERVOIR THEORY WITH MARKOVIAN INFLOWS,

Monash Univ., Clayton (Australia). Dept. of Mathematics.
R. M. Phatarfod, and R. Srikanthan.
Journal of Hydrology, Vol 52, No 3/4, p 199-218, July, 1981. 9 Tab, 8 Ref.

Descriptors: *Stochastic process, *Mathematical models, *Reservoirs, Mathematical equations, Markov process, Numerical analysis.

The twin problems of the nature of discretization and the size of the unit of discretization used in stochastic reservoir theory are examined. The feasibility of constructing a discretization sheme which allows the relese and the reservoir size to assume fractional values is demonstrated. The case where the inflows form a sequence of seasonal Markov dependent variables is then considered. A discretization scheme is suggested which gives better estimates of the probabilities of emptiness and fullness of the reservoir than those provided by the scheme developed by Dearlove and Harris. A numerical comparison of these probabilities with those obtained by simulation is made for the case where the inflows follow a Thomas-Fiering model. Finally, the effect of the size of the unit of water on these probabilities is disussed briefly. (Carroll-FRC)
W82-05524

MULTIPLE OBJECTIVE PLANNING OF LAND/WATER INTERFACE IN MEDIUM SIZE CITIES: APPLICATION TO WEST LAFAYETTE, INDIANA,

Purdue Univ., Lafayette, Ind. Water Resources Research Center.
For primary bibliographic entry see Field 4A.
W82-05550

OPTIMALITY, INFORMATION GENERATION STRATEGIES, AND WATER RESOURCES MANAGEMENT IN THE YUKON TERRITORY,

British Columbia Univ., Vancouver. Westwater Research Center.
I. K. Fox.
Canadian Water Resources Journal, Vol 5, No 3, p 56-68, 1980. 1 Fig, 3 Tab.

Descriptors: *Water management, *Project planning, *Research priorities, Planning, Yukon Territory, Public participation, Westwater Project, Electric power, River basins, Optimization.

The planning method used in the Westwater Research Center's Yukon Water Research Program (University of British Columbia) is described. Basic steps are as follows: (1) determine the range of preferences through interviews with persons representing many interest groups, (2) establish investigation priorities during a 3-day professional workshop divided into four groups (electric power, mining, fish and wildlife, and recreation-tourism), (3) undertake the high priority investigations, (4) assess the study results at a second workshop, and (5) prepare reports. Two suggestions are emphasized: (1) the public should be included in establishing investigation priorities, and (2) yearly review and reporting produces results more sensitive to changes in economic, social, and environmental conditions than final reports after several years' study. (Cassar-FRC)
W82-05564

EVOLUTION OF WATER MANAGEMENT TECHNIQUES,

British Columbia Univ., Vancouver. Dept. of Civil Engineerig.
S. O. Russell.
Canadian Water Resources Journal, Vol 5, No 3, p 49-55, 1980. 3 Ref.

Descriptors: *Decision making, *Water management, *Computers, Simulation analysis, Hydrologic data collections, Data collections.

Computers have aided the evolution of water management techniques during the last 20 years. Storage and manipulation of hydrologic data and simulation analysis of runoff and floods are widely and successfully used in decision making. However, human judgment has not been eliminated, only used at a different level and time. Examples of simulation analysis are forecasting levels in Lake Athabasca if the Peace River Project is built and optimizing design of water distribution networks. Although problems involvig uncertainty and multiple objectives are still difficult to handle, the trend is toward more objective and automatic techniques and less judgment and intuition. (Cassar-FRC)
W82-05565

MODIFIED STANDARD OPERATION RULES FOR RESERVOIRS,
Technische Hochschule, Aachen (Germany, F.R.). Hydropower Div.
For primary bibliographic entry see Field 4A.
W82-05658

AN APPLICATION OF MATHEMATICAL PROGRAMMING TO WATER RESOURCES PLANNING: AN ECONOMIC VIEW,
New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
B. E. Lindsay, and D. L. Dunn.
Water Resources Bulletin, Vol 18, No 2, p 289-296, April, 1982. 6 Tab, 4 Ref.

Descriptors: *Optimization, *Water resources development, Systems analysis, *Regional planning, Planning, Water use, Water demand, Water supply, Municipal water, Mathematical models, Model studies, Merrimack River, New Hampshire, Costs, Water distribution.

A mixed integer multiperiod programming model using hydrologic and economic data was used to identify the discounted least cost of water supply, distribution, and scheduling for three New Hampshire towns, Hudson, Merrimack, and Nashua. The model was applied on an individual town basis and on a regional basis. Costs of regionalized water resources development ($2.8-4.3 million) were about 5-10% less than costs of deregionalized schemes for the three towns ($3-4.5 million) for present water usage, 20% more water usage, and 10% less water usage. (Casear-FRC)
W82-05737

FLOOD DAMAGE ASSESSMENT AND FLOOD CONTROL PLANNING AS PART AND PARCEL OF THE ECONOMICS OF WATER UTILIZATION (VLOEDSKADEBEPALING EN VLOEDSKADEBEHEER AS ONDERDELE VAN DIE EKONOMIE VAN WATERBENUTTING),
Orange Free State Univ., Bloemfontein (South Africa).
M. F. Viljoen, and D. J. G. Smith.
Water S. A., Vol 8, No 1, p 45-51, January, 1982. 9 Fig, 12 Ref. English abstract.

Descriptors: *Economic aspects, *Flood control, Floods, Flood damage, Flood protection, Cost-benefit analysis, Cost analysis, Water use, Planning.

In the field of the economics of water utilization, flood damage assessment and flood control planning play integral parts. National welfare is increased by rational use of national resources, including water. Welfare economics supplies the theoretical framework for use in the planning of water utilization. The cost-benefit technique is generally accepted as the application of welfare economics, but it is necessary to consider that this technique only focuses on economic efficiency within a partial equilibrium framework. The traditional application of the technique does not supply the final answer for the maximization of welfare. For completeness, this method should be supplemented with the evaluation of other welfare objectives such as environmental quality, distribution of income and security. In planning for control of flood damage, the minimization of flood damage represents the greatest part of the benefits to be obtained, and thus it comprises one of the important components in cost benefit analysis. Other benefits embodied in welfare objectives are frequently hard to measure, and the best alternative seems to be an optimal understanding of these, quantitatively and qualitatively. When weighing the intangibles against the tangibles, value judgments will necessarily have a role to play. (Baker-FRC)
W82-05896

6B. Evaluation Process

APPARATUS NEEDS AND COSTS FOR MONITORING PRIORITY POLLUTANTS,
Ohio River Valley Water Sanitation Commission, Cincinnati.
For primary bibliographic entry see Field 5A.
W82-04779

COMPETITION FOR WATER RESOURCES: COAL AND AGRICULTURE IN THE YELLOWSTONE BASIN,
Indiana Univ. at Bloomington.
For primary bibliographic entry see Field 6D.
W82-04805

ANAEROBIC TREATMENT OF HIGH-STRENGTH WASTES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W82-04907

GROUND-WATER DEVELOPMENT IN WESTERN RIVER BASINS: LARGE ECONOMIC GAINS WITH UNSEEN COSTS,
Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4B.
W82-04932

COMPUTER-AIDED EVALUATION OF PERU'S HYDROPOWER,
S. Morariu.
International Water Power and Dam Construction, Vol 34, No 1 p 34-39, January, 1982.

Descriptors: *Hydroelectric plants, *Evaluation, Computers, Testing procedures, Hydrology, Geology, *Turbines, Flow profiles, Hydraulics, Water demand, *Peru.

The kind of data and the assessment of the data employed in a computer aided study of Peru's hydropower situation are presented. Both geologic and hydrologic parameters were included in the study. The overall objective of the hydrology studies was the analysis of all available data and the identification of regional patterns and trends. The hydrological parameter of overriding importance was the flow available for the turbines. Design floods were estimated through regional analysis. A regional drought analysis was also carried out, based on the need to determine the firm capacity of the independent projects and the guaranteed power and energy of the interconnected system. A very large number of hydropower projects was evaluated using a computer based method which allowed a systematic evaluation of the hydropower resources of the country to be made. With over 2300 hydropower project options, it was possible to analyze 1.6 x 10 to the 13th power river development chains. As a result of the optimization model used, 328 project variations emerged as being compatible, with a total installed capacity of over 58,000 MW. It is suggested that a proper and systematic evaluation of the world's hydropower be made using the same or similar computer aided methodologies to minimize the time and manpower requirements without sacrificing accuracy. (Baker-FRC)
W82-04954

INSTITUTIONAL OBSTACLES TO WATER REUSE IN THE WESTERN UNITED STATES,
Dornbusch (David M.) and Co., Inc., San Francisco, CA.
K. Wehbring.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-220641, Price codes: A09 in paper copy, A01 in microfiche. OWRT/RU-80/8, 1981, 195 p, 7 Fig, 3 Tab. OWRT C-80215-R(1). 14-34-0001-8819.

Descriptors: *Water reuse, *Institutional constraints, *Legal aspects, *Political aspects, Local governments, Water law, Water rights, Economic aspects, Financing, Public health, Wastewater treatment, Planning, City planning, *Western United States, California, Arizona, Nevada, Colorado, New Mexico.

The institutional barriers were examined to reusing wastewater in nine communities in the Western United States. Institutional barriers include legal, political, financial and organizational problems which hinder the development of water reuse projects. Case studies were prepared for the following communities: Santa Clara Valley Water District, Goleta County Water District, Los Angeles, Las Virgenes, and Solano County in California; Tucson, Arizona; Las Vegas, Nevada; Northglenn, Colorado; and Santa Fe, New Mexico. The study identifies obstacles and suggests ways of overcoming the obstacles. They are 1) Competing uses for water; 2) EPA grant requirements; 3) Health regulations; 4) Financing methods; 5) Neighborhood opposition to treatment facility site; 6) Urban growth issues; 7) Inter-agency conflict. The main approach recommended for overcoming these obstacles is to carry out institutional planning as a part of the overall planning for a water reuse project so that obstacles can be defined and alternative methods of overcoming them devised.
W82-04958

THE 1977 DROUGHT IN IDAHO: ECONOMIC IMPACTS AND THE RESPONSES OF IRRIGATORS AND WATER DELIVERY ORGANIZATIONS.
Idaho water and Energy Resources Research Inst., Moscow.
For primary bibliographic entry see Field 3F.
W82-04959

HYDROGEOLOGY FOR LAND-USE PLANNING: THE POTTER CREEK AREA, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 5G.
W82-04981

WATER AND WASTEWATER MANAGERS FACE THE FINANCIALLY TROUBLED 1980S,
Graham Associates, Inc., Dallas, TX.
F. G. Honeycutt, Jr., and W. B. London.
Water/Engineering and Management, Vol 129, No 2, p 24-26, February, 1982. 2 Tab.

Descriptors: *Economic aspects, *Water management, Planning, Wastewater treatment, Feasibility studies, Municipal wastewater, *Wastewater management, Future planning.

Many water managers believe that financing will be the major problem facing the water industry in the current decade. The water industry is striving to meet this problem through reassessments of its management and financial practices in an effort to become self-reliant in performing the needed capital improvements. In the preparation of budget controls and financing alternatives for capital improvement programs, some of the major economic factors include current and projected inflation as well as municipal bond and prime interest rates. Inflation is the primary economic factor that continually plagues budgets and long term financial plans. Water and wastewater managers are especially aware of the effect of inflation on municipal bond and prime interest rates. However, in spite of the current hardships facing water and wastewater managers, innovative and creative capital improvements strategies are either currently available or are in the formulation stages. Several methods of direct state participation are currently in use throughout various parts of the country. A concept also exists whereby states guarantee principal and interest through the life of the municipal bonds issued by qualifying municipalities. States may also provide matching funds for certain types of water and sewer projects to their local units of government, particularly for planning purposes. A relatively new factor in the bond market is municipal bond insurance, which has some limited success in lowering borrowing costs for certain municipalities. (Baker-FRC)
W82-05166

WATER RESOURCES OF THE WALKER RIVER INDIAN RESERVATION, WEST-CENTRAL NEVADA,

Geological Survey, Carson City, NV. Water Resources Div.
D. H. Schaefer.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $8.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 80-427, December 1980. 61 p, 18 Fig, 14 Tab, 25 Ref.

Descriptors: *Water resources development, *Available water, Groundwater, *Water use, Streamflow, Irrigation water, Wells, Groundwater recharge, Groundwater movement, Water level, Mathematical models, Potential water supply, Evaluation, Hydrologic data, *Nevada, *Walker River Indian Reservation, Surface water.

Increasing interest in expanding the livestock and agricultural operations on the Walker River Indian Reservation, Nev., has prompted the Walker River Paiute Tribe to have the present and available water resources of the reservation appraised and proposed sites for new wells evaluated. Flow of the Walker River into the reservation averages about 113,000 acre-feet a year. Of this amount, about 42,000 acre-feet is used on the reservation, recharging the gound-water system and supplying irrigation water for alfalfa and pasture crops. The water quality of the river water is well suited for these purposes, and the possibility of expanding surface-water use exists. A mathematical model of the ground-water system was constructed to test various assumptions about recharge and discharge rates. The model generated water-level contours that agreed reasonably well with measured water levels, median deviation was 12 feet. With additional data, the model could be used in the future to test the feasibility of evapotranspiration salvage at the seven proposed sites for new stock and irrigation wells. The primary users of ground water on the reservation are phreatophytes and playa surfaces. They allow ground water to be lost to evaporation. About 19,000 acre-feet per year is lost through this mechanism. Domestic and livestock uses account for only about 250 acre-feet per year. Total recharge to the ground-water system amounts to about 30,000 acre-feet per year, and the possibility of more extensive use of ground water on the reservation exists. Quality of the ground water in most areas is suitable for all intended purposes. (USGS)
W82-05235

WATER RESEARCH IN ACTION,

Texas A and M Univ., College Station. Water Resources Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224684, Price codes: A09 in paper copy, A01 in microfiche. Water Research in Action, Vols. 1-5, 1976-1981. Ruesink, L.E., ed. 172 p. OWRT C-80021-T(No 8703)(1).

Descriptors: *Research priorities, *Water resources institutes, *Literature review, *Research needs, *Water conservation, *Water quality control, Organizations, Water quality management, Reviews, Water quality, Water supply, Research facilities, Land use, Runoff, Water use, Water pollution, Water analysis, Technology, Water law, *Office of Water Research and Technology.

Five years (1976-81) of Water Research in Action bulletins are provided, covering Volumes 1-5. Each issue of the bulletin focuses on new knowledge and technology developed through the cooperative research program between the 54 state water resources research institutes and the Office of Water Research and Technology (OWRT), U.S. Department of the Interior. The bulletin is regularly distributed to over 22,000 individuals in all 50 states and a number of foreign countries. The early bulletin issues report on individual research projects from the institutes; the later issues present comprehensive overviews of specific water resources problems, and feature OWRT-funded institute-directed projects that have contributed to the solution of these problems. The numerous topic areas included address land use, flooding, runoff, wastewater, planning optimization, nonpoint source pollution, modeling, erosion, groundwater, water quality, irrigation, reservoirs, waste heat disposal, water sterilization, eutrophication, water conservation and reuse, water law, droughts, acid precipitation, economics, and management. (Zielinski-MAXIMA)
W82-05292

ENERGY SITING IN UTAH: A PROGRAMMING MODEL,

Utah Water Research Lab., Logan.
D. L. Snyder, J. E. Keith, T. F. Glover, and G. L. Wooldridge.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224726, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Planning Series UWRL/P-81/04, June 1981. 55 p, 6 Fig, 32 Tab, 78 Ref. 3 Append. OWRT A-047-UTAH(1), 14-34-0001-9047.

Descriptors: *Energy sources, *Regional development, *Model studies, *Linear programming, *Utah, Systems analysis, Mathematical models, Industrial development, Industrial plants, Electric power industry, Resources development, Industrial production, Resource allocation, Water allocation, Political constraints, Air pollution, Regulations, Legal aspects, Economic impact, Economic evaluation, Economic feasibility, Energy, Agriculture, Air pollution effects.

A study was conducted to examine the economically efficient allocation of resources between existing and proposed production entities, given resource and environmental constraints. The necessary conditions for an optimal input and output allocation were determined for a region constrained by resource availabilities and/or policy constraints, using a conceptual model of a multiple-product firm. A linear programming model was developed to determine optimal water allocation between agricultural and coal-fired power plants and the trade-offs which could occur if electrical generation were increased. Other potential trade-offs examined included coal source restrictions and air quality regulations. Also included were coal mining, transportation costs, and pollutant (S02, nitrogen oxides, particulates) emission rates on a coal and plant basis. Few trade-offs between power generation and agricultural irrigation were noted. However, substantial energy sector changes were discovered as coal capacities were decreased and air quality standards increased, causing a sharp decline in net revenues. Substantial changes in regional economic activity occurred due to these restrictions on development. (Zielinski-MAXIMA)
W82-05297

FIVE-YEAR PLAN FOR WATER RESEARCH OF THE OKLAHOMA WATER RESOURCES RESEARCH INSTITUTE.

Oklahoma Water Resources Research Inst., Stillwater.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224767, Price codes: A03 in paper copy, A01 in microfiche. Oklahoma Five-Year Water Resources Research Plan, submitted to the Office of Water Research and Technology, December 1980. 39 p, 6 Fig, 10 Ref.

Descriptors: *Oklahoma, *Research priorities, *Planning, *Water management, *Water resources development, Rainfall distribution, Land rights, Water supply, Available water, Water shortage, Reservoir construction, Flooding, Groundwater depletion, Streamflow depletion, Municipal water, Industrial wastes, Water pollution, Mineralization, Acid mine drainage, Pollutants, *Five-year plan.

This report outlines the water resource quantity and quality problems of Oklahoma and identifies areas for research emphasis. While water quality problems warrent concern and action, water quantity in certain areas is an overriding current concern. Annual precipitation varies from 56 inches in the humid southeast to 15 inches in the semiarid Panhandle. Furthermore, evapotranspiration and percolation consume about 80% of the annual rainfall, leaving only about 20% available for use. Another major problem has been the lack of a water resources plan. Such a plan, addressing water needs through the year 2040, has now been developed and is under review. A third problem area is an on-going mineral rights dispute with the Osage Indians, causing interruption of construction on four reservoirs. Other identified water quantity problems include flooding, groundwater depletion, low streamwater, inadequate municipal water systems, and urban growth demands. Eleven water quality problems (such as heavy water chloride content, excessive mineralization in groundwater supplies, low stream flows, industrial waste effluents, acid mine drainage) have also been identified. Eight specific research areas have been determined to address the identified priority Oklahoma water resources problems. (Zielinski-MAXIMA)
W82-05301

WATER QUALITY ASSESSMENT FOR AGANA SPRINGS,

Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5A.
W82-05304

AN EVALUATION OF TWIN WELLS FOR USE WITH WATER SOURCE HEAT PUMPS,

Louisana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-05307

A REPORT ON: RESEARCH NEEDS....WATER CONSERVATION IN AGRICULTURE,

For primary bibliographic entry see Field 3F.
W82-05308

PARAMETRIC ANALYSIS OF DIRECT-CONTACT (PISTONLESS) WORK EXCHANGER FOR REVERSE OSMOSIS APPLICATIONS,

Hittman Associates, Inc., Columbia, MD.
For primary bibliographic entry see Field 3A.
W82-05309

WATER QUALITY PLANNING IN THE NORTHEAST AND MIDWEST: THE SECTION 208 EXPERIENCE,

Atlantic Environmental Associates, Inc., Waltham, MA.
J. J. Goldrosen, and G. C. McMahon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224908, Price codes: A10 in paper copy, A01 in microfiche. Report, September 1981. 219 p, 57 Ref, 2 Append. OWRT C-90244-U(No 0525)(1), 14-34-0001-0525(1).

Descriptors: *Water quality, *Research priorities, *Planning, *Institutional constraints, *Political constraints, *Assessments, Economic aspects, Economic feasibility, Economic impact, Cost allocation, Water law, Legal aspects, State jurisdiction, Political aspects, Federal jurisdiction, Policy making, Administrative decisions.

Examination is made of institutional obstacles to water quality planning for urbanizing areas, based on the experiences of Section 208 planning programs conducted in fifteen States of the Northeast and Midwest U.S. The focus is on the institutional, rather than the technical, obstacles to plan implementation. These obstacles include inadequate recognition of water quality problems, difficulty in financing identified solutions, insufficient legal or regulatory authority, local resistance to water quality planning, lack of cooperation among local political units, and lack of cooperation among different government levels. Most of the information used was obtained through direct contact with individuals involved in preparing the Section 208 plans, with nine of the programs selected for on-site visits. An analysis was made of the factors which affected the ability of various agencies to overcome the identified obstacles and to implement solutions to water quality problems. The fifteen States studied were Connecticut, Delaware, Illinois, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and Wisconsin. The Section 208 agencies have fulfilled, to

some extent, all three of their requisite roles, as catalysts, planning consultants, and providers of technical assistance for areawide water quality management. (Zielinski-MAXIMA)
W82-05315

AN ANALYSIS OF THE APPROPRIATENESS OF WIND AND OTHER ENERGY SYSTEMS FOR IRRIGATION WATER PUMPING IN INDIA,

National Aeronautical Lab., Bangalore (India).
S. K. Towari.
Agricultural Water Management, Vol 4, No 4, p 445-455, December, 1981. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Wind, *Irrigasion, Pumps, Alternative planning, *Energy sources, *India, Water delivery.

Wind energy can be used in a variety of agricultural and industrial applications requiring shaft power, such as water pumping. The appropriateness of wind energy as a source of power for irrigation water pumping was investigated in India in terms of energy availability, cost factors, social priority for the use of particular energy resources for specified applications, organizational and maintenance problems, likelihood of social acceptance, creation of local employment opportunities, and the use of locally available resources. Analysis was carried out on these seven factors in two ways: quantification in respect to possible alternative choices of energy conversion systems, and via the relative importance of these factors, so that a single total value of appropriateness can be computed. Of the options considered, windmills scored the highest appropriateness, with the solar pump being the second best option, followed by photovoltaic conversion. When the qualitative attributes were considered as well, windmills were rated highest, followed by solar pumps, photovoltaic conversion, biogas, solar thermal devices, electrical pumps and diesel pumps. The total appropriateness score including cost factors ranked electrical pumps first, followed by diesel pumps, biogas engines, windmills, solar thermal devices, solar pumps, and photovoltaic devices. (Baker-FRC)
W82-05357

CAN THE GOALS OF THE UN DECADE ON WATER SUPPLY AND SANITATION BE ACHIEVED,

Amsterdam Water Works (Netherlands).
C. van der Veen.
Aqua, No 1, p 18-21, 1982. 1 Tab.

Descriptors: *Developing countries, *Water resources development, *Drinking water, Sanitation, Planning, Water supply, *United Nations, *International Drinking Water Supply and Sanitation Decade, Energy, Rural areas, Population dynamics, Political aspects, Economic aspects, Political constraints, *Evaluation.

It is unlikely that the goals of the United Nations International Drinking Water Supply and Sanitation Decade will be met by 1990. Particular problems are population growth, economic recession, large sums spent for armaments, and the increasing cost of energy. However, it is probable that substantial progress will be evident by the end of the decade and that the water goals can be met within two decades. Necessary conditions are: public awareness of needs, development of political priorities, government organization at all levels, adequate planning, community participation, private enterprise involvement, a high status image of water projects and persons working on the projects, good quality management, sound financial basis, and aid to rural areas. (Cassar-FRC)
W82-05365

THE SHUBENACADIE-STEWIACKE RIVER BASIN STUDY,

Department of the Environment, Halifax (Nova Scotia).
R. H. Bailey.
Canadian Water Resources Journal, Vol 6, No 4, p 187-204, 1981.

Descriptors: *Water management, *River basins, *Water quality management, Bank erosion, Water quality, *Shubenacadie-Stewiacke River, *Nova Scotia, Land use, Economic aspects, Institutional constraints, Regulations, Planning, Water policy, Public participation, Canada.

A study of the 1976-80 Shubenacadie-Stewiacke River Basin, the largest in Nova Scotia, revealed that most of the critical problems in the basin are in an embryonic stage. Water quality problems at present are related to streambank erosion and natural concentrations of undesirable ions in well waters. The major threat to water quality will probably arise from the cumulative effects of small resource use decisions, rather than from the large developments which require intensive environmental scrutiny. The study board concluded that the existing water management framework is not adequate to manage these cumulative developments. Recommendations included: a shift in emphasis from a reactive approach toward a planning approach, an increase in capability to handle long-term cumulative effects of economic activities, coordination among agencies at all levels of government, and an increase in public participation in development and implementation of these objectives. Instituting a Water Resources Management Center at a Nova Scotia university was also suggested. (Cassar-FRC)
W82-05385

DOES CONVENTIONAL SEWAGE TREATMENT MEET THE DEMANDS OF THE 1980'S,

For primary bibliographic entry see Field 5D.
W82-05407

FIVE-YEAR PLAN OF THE WATER RESOURCES RESEARCH CENTER,

College of the Virgin Islands, St. Thomas.
R. U. Champney.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231960, Price codes: A02 in paper copy, A01 in microfiche. Report, July, 1981. 8 p, 1 Tab.

Descriptors: *Virgin Islands, *Research priorities, *Planning, *Water management (Applied), *Water resource development, *Water shortage, Water supply, Water demand, Water use, Groundwater potential, Potable water, Desalination, Semiarid lands, Water importing, Brackish water, Wastewater treatment, Water quality.

Water research and development needs for the Virgin Islands for the five years starting with fiscal year 1982 are summarized. Water problems relate to the observation that water supply falls far short of water demand, and that the available water is largely of subpotable quality. This plan focuses on evaluating individual Virgin Island watersheds relative to water storage capacity, recharge rates, on permissable water withdrawal rates on one hand, and on investigating possible methods of achieving and maintaining high quality water in the public water distribution system, on the other. Average annual rainfall varies from 40-45 inches, but demand for rainfall by evapotranspiration exceeds the supply, and the Islands are classified as semi-arid. For all practical purposes, the Islands have no surface water, and groundwater resources are largely unknown and brackish. Water deficits have been addressed by water importation and desalination plant installation; the former is inefficient. Major problems include: inadequate potable water supply and public distribution system; polluted water in the distribution system; and inadequate wastewater treatment facilities. The highest research priority is a needed assessment of groundwater resources. The second highest priority will be studies of pollution in public water related to source identification and remedy. (Zielinski-MAXIMA)
W82-05526

A FIVE-YEAR PLAN OF WATER RESOURCES RESEARCH.

Auburn Univ. AL. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232042, Price codes: A03 in paper copy, A01 in microfiche. Report, 1981. 39 p, 2 Fig, 3 Tab, 33 Ref.

Descriptors: *Alabama, *Research priorities, *Planning, *Water management (Applied), *Water resources development, Water supply, Water resources institutes, Water demand, Groundwater availability, Irrigation water, Aricultural runoff, Groundwater pollution, Coal mining, Strip mine wastes, Surface water availability, Sediment load, Water quality, Water use, Legal aspects, Institutional constraints.

This plan includes a brief description of Alabama's water resources, physical geography, and geology. The use of Alabama's water resources, estimated at 52 billion gallons/day, is described, and water resources problems are identified. Data indicate that there is no general water shortage at the present time and that none is anticipated. Projections of water use are included to the year 2020. Six problem areas to be addressed were identified from a listing of 27 major water and related land resources problems facing Alabama. The six problems for research plan focus are: inadequate data and methods concerning water supply as related to groundwater quantity and quality; a projected competing increased demand on groundwater resources in southern Alabama for irrigation; groundwater contamination from agricultural and other practices/sources, including the need for improved monitoring; adverse effects of strip and subsurface mining on water supplies; and heavy sediment loads degrading water quality. The six problem areas fall under one or more of five generic research categories (e.g., atmospheric/hydrologic/hydraulic processes; water quality processes; water resources management; ecologic-environmental relationships; institutional, legal, and other constraints. (Zielinski-MAXIMA)
W82-05527

FIVE-YEAR WATER RESOURCES RESEARCH AND DEVELOPMENT GOALS AND OBJECTIVES FOR WYOMING.

Wyoming Univ., Laramie. Water Resources Research Inst.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231978, Price codes: A06 in paper copy, A01 in microfiche. Report, July, 1981. 96 p, 2 Fig, 12 Tab, 7 Ref, 1 Append.

Descriptors: *Wyoming, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Water supply, Water quality, Water use, Water conservation, Flurial sediments, Flooding, Water harvesting, Weather modification, Groundwater recharge, Water rights, Legal aspects, Institutional constraints, Economic aspects.

This report dicusses Wyoming's land/and water resources, water uses and problems, water and related land planning and development activities, and priority water issues that need attention. Wyoming contains seven river basins and the headwaters of four major river basins, with over 90% of the water flowing through Wyoming originating within its boundaries. Large groundwater stores are also present. Wyoming water use is constrained, however, by the appreciation system of water laws and by compacts with neighboring states. Further, water competition among Wyoming's three most prosperous economic sectors (minerals, recreation/tourism, and agriculture) will become increasingly serious as natural resources development continues. Issues needing attention in the water quantity area are: water availability, flurial morphology, flooding, water harvesting, weather modification, and groundwater recharge. Water quality issues are related to municipal, agricultural, and industrial concerns. Water use and conservation topics include: water use efficiency in food/fiber production and for municipal/industrial use, institutional incentives for conservation, coservation practice impacts on hydrologic systems, water reuse, and instream flow needs. Economic/institutional water concerns are also discussed. (Zielinski-MAXIMA)
W82-05528

VIRGINIA WATER RESOURCES RESEARCH CENTER FIVE-YEAR PLAN,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Virginia Water Resources Research Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231986, Price codes: A08 in paper copy, A01 in microfiche. Report, June, 1981. 143 p, 3 Fig, 7 Tab, 1 Append.

Descriptors: *Virginia, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Management planning, Information systems, Land management, Surface water availability, Groundwater pollution, Environmental protection, Water quality, Monitoring, Sludge disposal, Groundwater management, Water supply, Water use.

This report describes Virginia's water resources, the significant problems affecting them, and a five-year plan for dealing with these problems from fiscal year 1983-87. Priority problems were identified in each of eight areas: water supply, inventory and monitoring, resource management, nonpoint source pollution, flood damage abatement, outdoor recreation, waste treatment, and marine environment, with the first four identified as the highest priority problem areas. The most significant water resources problem can generally be characterized as problems of management, with the most pressing being the lack of a comprehensive water resources management plan. The five-year activity plan is based on attainment of eight specified goals, each having specific objectives. Two goals concern public education and information dissemination activities to increase public awareness of water resources. A third goal involves continued identification of current priority water problems and current information on critical problems. The remaining five goals address the solution of specific priority problems: developing a comprehensive resources management plan; land management plans for surface and groundwater protection; a sludge-disposal polity; improved routine water quality monitoring; and methods to promote an outdoor ethic. Delineation of 60 important water problems facing Virginia is included. (Zielinski-MAXIMA)
W82-05529

MICHIGAN FIVE-YEAR WATER RESOURCES RESEARCH AND DEVELOPMENT PLAN: FISCAL YEARS 1982-1986,

Michigan State Univ., East Lansing. Inst. of Water Research.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-231994, Price codes: A04 in paper copy, A01 in microfiche. Report, 1980. 47 p, 5 Tab, 15 Ref.

Descriptors: *Michigan, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Hazardous materials, Toxins, Water pollution, Nonpoint pollution sources, Pollution load, Eutrophic lakes, Wetlands, Groundwater pollution, Economic aspects, Water quality, Water use, Water supply.

As a background and basis for Michigan's five-year water resources research plan, this report provides a general overview of the status and problems of Michigan's water resources. While Michigan has an abundant and diverse source of freshwater due to its geographical location within the upper Great Lakes region, nearly all of its urban/industrial/agricultural wastes drain to the Great Lakes where their impact is accentuated due to the slow flushing rate of the Great Lakes system. Michigan's most critical water resource problem is, hence, water quality management. The continued availability of suitable water to meet diverse State and regional needs is dependent on actions to prevent water quality degradation. To assist the resolution of Michigan's water resources problems, this research plan is focused on three major areas: development of a comprehensive State water resources atlas; continuing and expanding technology transfer and information dissemination; and conducting a research program under six priority categories. These categories concern; fate/transport/effects of toxic/hazardous water pollutants; mechanisms influencing nonpoint source pollution; control and management strategies to minimize eutrophication impacts on lakes; defining functinal and economic value of wetlands and effects of physical/chemical/biological variables on groundwater quality and quantity. (Zielinski-MAXIMA)
W82-05530

A FIVE-YEAR PLAN FOR WATER RESEARCH IN COLORADO,

Colorado Water Resources Research Inst., Fort Collins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232059, Price codes: A07 in paper copy, A01 in microfiche. Report, January, 1981. 127 p, 20 Fig, 8 Tab, 15 Ref, 3 Append.

Descriptors: *Colorado, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Water quality control, Water supply, Water use, Water demand, Competing use, Runoff forecasting, Groundwater recharge, Heavy metals, Water pollution, Groundwater pollution, Saline water, Mineral industry.

This report covers a detailed description of Colorado water resources, the institutional interrelationships of Colorado water organizations, and the projected five-year water resources research plan. A listing of 22, 14, 21, 36 and 31 researchable water problems of high water priority for Colorado is given for the five generic research categories: atmospheric/hydrologic/hydraulic processes; ecological-environmental relationships; water quality processes/prediction/protection; water resources management; and institutional/political/legal/behavioral/economic analysis, respectively. These priority water problems reflect four primary objectives: maximize the beneficial use of the annual water supply; augment the annual supply; minimize water quality degradation; and resolve competitive demands for water. The five-year research program will be drawn from 49 research problem areas under these four primary objectives. The research needed for each of this area is tabulated. A programming guideline protocol for problem-solving water research using a programming and execution process which includes program evaluation is provided. An inventory of current water resources studies in Colorado is also included. (Zielinski-MAXIMA)
W82-05531

FIVE YEAR WATER RESOURCES RESEARCH PLAN FOR THE STATE OF CALIFORNIA,

California Univ., Davis. Water Resources Center.
R. W. Hinks, and J. H. Snyder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232034, Price codes: A05 in paper copy, A01 in microfiche. Report No 49, October, 1980. 73 p, 7 Fig, 9 Tab, 34 Ref. 14-34-0001-0480, UCLA-WRC-W-100.

Descriptors: *California, *Research priorities, *Planning, *Water management(Applied), *Water resources development, *Groundwater management, Competing use, Water use, Water demand, Water supply, Available water, Groundwater reservoirs, Wastewater renovation, Water conservation, Water quality, Environmental production, Institutional constraints.

This report presents an analysis of the current status of California's water resources problems and identifies areas of recorded research for a five-year planning period of fiscal year 1983-87. Priority classification tables are presented which indicate the relative importance of specific areas of research activity. A major characteristic issue of California water resources between now and the year 2000 is the inevitable competition between agricultural and nonagricultural uses for a strictly limited and fixed water supply. Background information is given on physical factors that influence California water resources, and the use of these resources is delineated with respect to water demand, development, management alternatives, and identified problem areas to meet the expected future demand. Problems included additional construction needs, and current management policy regarding groundwater, wastewater reclamation/conservation, environmental protection, and water quality. Research needs are proposed under six areas. Thirty-two research needs are prioritized under categories of very high, high, and medium priority. Very high priority research needs (of 9 identified), include: water quality related to health and salinity; water development and management alternatives; and improved information dissemination for all aspects of water research activities. (Zielinski-MAXIMA)
W82-05532

NEVADA WATER RESOURCES RESEARCH 1982-1987,

Nevada Univ. System, Reno. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236928, Price codes: A09 in paper copy, A01 in microfiche. Report, October, 1980. 80 p, 6 Fig, 20 Tab, 3 Append.

Descriptors: *Nevada, *Research priorities, *Planning, *Water management(Applied), *Water resources development, Groundwater recharge, Aeration zone, Flow characteristics, Groundwater availability, Water supply, Water use, Deep wells, Conjunctive use, Coal mining, Water quality, Water conservation, Water reuse, Institutional constraints, Legal aspects.

Water resources problems and research needs for Nevada are described. Water resources are detailed under categories of surface water, groundwater, and the available water supply. Uses of water resources (e.g., irrigation, livestock, mineral industry, electric power, municipal and industrial) and conflicts in water uses are discussed. The most urgent problem areas needing attention are: groundwater recharge, unsaturated zone flow mechanics, groundwater availability, deep aquifer studies, conjunctive use, water reuse, water conservation, legal/institutional issues, and effects of mining on water quality. These problem areas are described in matrix form relative to specific hydrographic regions. Identified research priorities are arranged under five broad categories: atmospheric/hydrologic/hydraylic processes (e.g., flow mechanics in the unsaturated zone, groundwater and aquifer recharging, modeling rainfall-runoff-recharge in arid regions); ecologic-environmental relationships (methodology to slow/reverse nutrient overloading, quantitative evaluation of algal growth processes); water quality (soil-water interactions regarding contaminants, groundwater contamination, pollutant transport); resources management (long-term effects of energy/mineral development, agricultural water conservation, water resources planning, water reuse innovations); and institutional/political/legal/behavioral/economic analysis. (Zielinski-MAXIMA)
W82-05533

INTERNAL RATES OF RETURN DERIVED FROM THE PAY-BACK PERIOD,

Hershev - The Inter-Kibbutz Economic Unit, Tel Aviv (Israel).
Y. Goldschmidt, and L. Shashua.
Omega - The International Journal of Management Science, Vol 8, No 6, 1980. p 695-696. 2 Tab. OWRT B-080-ARIZ(6).

Descriptors: *Rate of return, *Financial feasibility, *Economic yield, *Cost analysis, *Algorithms, Mathematical studies, Economic aspects, Economics of scale, Economic efficiency, Economic evaluation, Economic justification, Cost allocation, Econometrics, Financing, Input-output analysis, Investment, Payment, Management planning.

Simple tools (tables and rules of thumb) are developed for deriving the internal rate of return (IRR) from the pay-back perion (PBP), to bridge the gap over the disparity between theory and business practice regarding capital budgeting. The PBP of a proposal for an investment project is the time needed for accumulated expected cash flow (net returns) to reach the initial cost of the investment; the IRR of the project is the rate of discount which equates the present value of the expected cash flow to the initial cost of the investment.

Given the PBP and the expected service life, the IRR is derived directly from tables, or roughly approximated by simple rules of thumb. Initially, the PBP can be used to provide a rough screen of proposed investment projects; final screening is carried out by checking the IRR, using the tables. The table provide percentage values of service life (from 5-14 years) of the IRR and of the certainty equivalent rate of return, as a function of the number of years (2.0-7.0) of pay-back. If a proposed investment project is expected to yield a constant cash flow, uncertainty can be assumed by approaching the cash flow as if it would decline with time. Hence, using the appropriate table (or rule) provides both the expected and the certainty equivalent IRR of the investment. These tools enable decision-makers to introduce an uncertainty effect into the straight-forward PBP computation, which permits a check of the sensitivity of a proposed investment. (Zielinski-MAXIMA)
W82-05542

DOMESTIC WATER CONSERVATION RESEARCH PLAN,

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236613, Price codes: A02 in paper copy, A01 in microfiche. Report, July 7, 1978. 17 p, 5 Tab. (No 8544)(1).

Descriptors: *Water conservation, *Research priorities, *Metropolitan water management, *Domestic water, *Water costs, Water use, Planning, Policy making, Public policy, Economic evaluation, Management planning, Available water, Water supply, Heated water, Water management, Reclaimed water, Water reuse.

A four-year plan (1978-1982) is described which identifies research needs to improve domestic water conservation. The plan addresses various needed assessments concerning hardware and water management practices for both indoor (e.g., toilet water, bath and shower water, laundry water) and outdoor (landscape maintenance) domestic uses of water. Research needs concerning ten indoor water themes (e.g., water use and energy impacts, economic analysis, institutional incentives, user acceptance) and five outdoor water themes (e.g., baseline data, new device technology, use of reclaimed water) are delineated. Seventeen water resource issues that directly or indirectly relate to residential water conservation are birefly reviewed, with the fastest growing cost issue being energy needed for pumping and heating water. The objectives of this research program are targeted providing basic data needed by policy makers and water managers for implementing water conservation policy; and reducing current residential water usage by 50% by increasing water use efficiency. Assuming an annual domestic water use of 100,000 gallons at a cost of $0.55/1000 gallons, a savings of $2.2 billion dollars is possible in water costs alone; if energy is included, the savings could potentially exceed $8 billion dollars/year. (Zielinski-MAXIMA)
W82-05547

INSTITUTIONAL PROBLEMS OF WATER QUALITY PLANNING IN URBANIZING AREAS IN THE PACIFIC NORTHWEST,

Dornbusch (David M.) and Co., Inc., San Francisco, CA.
K. Wehbring.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-236688, Price codes: A05 in paper copy, A01 in microfiche. Report, September, 1980. 73 p, 1 Tab, 29 Ref, 1 append. OWRT C-90094-U(No 9433)(1), 14-34-0001-9433.

Descriptors: *Water quality management, *Planning, *Urbanization, *Institutional constraints, *Regional development, Urban watersheds, Water quality, Water quality control, Urban drainage, Urban areas, Urban hydrology, Urban planning, Legal aspects, Economic aspects, Goverament finance, Political aspects, Community development, Social aspects, Social needs.

Institutional obstacles (including legal, financial, organizational, inter-governmental, political, and social aspects) revealed in the 208 program water quality planning process of 12 Pacific Northwest urbanizing areas are analyzed to assess their impact on planning. Attention is focused on the identification and analysis of institutional obstacles related to wastewater management, urban stormwater runoff, and agricultural runoff. The 208 plans for the 12 areas studied are identified by the major regional city in the planning area; these cover three cities in Washington (Seattle, Everett, and Vancouver), five in Oregon (Portland, Salem, Eugene, and Medford/Ashland), three in Idaho (Boise, coeur d'Alene, and Pocatello), and one in Alaska (Anchorage). Wastewater management obstacles identified are: public opposition to increased water quality costs; land use and urban growth controversies; political aspects of annexation and incorporation; and the existing multilicity of sewerage agencies. Identified obstacles related to urban stromwater and agricultural runoffs are: lack of understanding of water quality problems and lack of will to undertake water quality improvement programs; lack of federal assistance for urban stormwater runoff control; fragmentation of authorities, both jurisdictional and inter-governmental, affecting water quality planning for agricultural and urban runoff; the absence of adequate codes and ordinances for enforcing water quality needs; and the lack of implementing authority by the councils of governmeat which developed the areawide 208 plans. (Zielinski-MAXIMA)
W82-05554

EFFICIENT WATER USE IN CALIFORNIA: CONJUNCTIVE MANAGEMENT OF GROUND AND SURFACE RESERVOIRS,

Rand Corp., Santa Monica, CA.
For primary bibliographic entry see Field 4B.
W82-05628

DROUGHT MANAGEMENT: EXPECTING THE UNEXPECTED,

Massachusetts Univ., Amherst. Dept. of Landscape Architecture and Regional Planning.
For primary bibliographic entry see Field 3D.
W82-05649

THE COST AND EFFECTIVENESS OF PUBLIC NOTIFICATION OF MCL VIOLATIONS,

Pittsburgh Univ., PA. School of Education.
For primary bibliographic entry see Field 5G.
W82-05669

DROUGHT-RELATED WATER CONSERVATION EFFORTS IN MISSOURI,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3D.
W82-05672

COMPARING TWO MEASURES OF WATER BASED RECREATION PARTICIPATION,

Wisconsin Univ.-Madison. Dept. of Forestry.
For primary bibliographic entry see Field 6D.
W82-05733

ECONOMIC EVALUATION OF WATERSHED PROJECTS--AN OVERVIEW METHODOLOGY AND APPLICATION,

Minnesota Univ., St. Paul. Coll. of Forestry.
K. N. Brooks, H. M. Gregersen, E. R. Berglund, and M. Tayaa.
Water Resources Bulletin, Vol 18, No 2, p 245-250, April, 1982. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Cost-benefit analysis, *Economic analysis, *Watershed management, Benefits, Rehabilitation, Project planning, Erosion, Sedimentation, Loukkos River, Morocco, Soil management, Land use, Channel improvement, Reforestation, Reservoirs, Irrigation.

A practical, low cost approach for integrating physical and biological considerations for economic analysis of proposed watershed rehabilitation projects is illustrated via a project for the Loukkos Basin in northern Morocco. The economic analysis is conducted in four steps: (1) defining present and proposed physical conditions of erosion, sedimentation, etc., (2) developing value estimates and value flow tables in terms of monetary values, (3) calculating project worth by such measures as net present worth or economic rate of return, and (4) testing the sensitivity of the measures of project worth to change in assumptions. The four steps are applied to an analysis of the 182,000 ha Loukkos watershed, which is physically degraded, with compacted soil surface, nutrient depletion, soil salinizatin, and mass movement problems. Proposed corrective measures include road construction, channel stabilization, reforestation, pasture management, and planting olive trees, at a total cost of $26.1 million. Analysis indicated that the net benefits would be negative for the first 7 years of the project and rise to $21.71 million per year by the fiftieth year. (Cassar-FRC)
W82-05735

LOCAL ATTITUDES TOWARD ALTERNATIVE USES OF A RESERVOIR PROJECT,

Ohio State Univ., Columbus. Dept. of Development Sociology.
T. L. Napier, M. V. Carter, and E. G. Bryant.
Water Resources Bulletin, Vol 18, No 2, p 211-219, April, 1982. 5 Tab, 27 Ref.

Descriptors: *Attitudes, *Reservoirs, *Water resources development, Public opinion, Social impact, Economic impact, Ohio, Alternative planning, Multipurpose reservoirs, Surveys, Benefits, Cost-benefit analysis, Recreation.

Residents of a dispersed rural central Ohio community were asked about their attitudes concerning the funds allotted for a multi-purpose reservoir built in that area about 10 years previously. As a group, the local people were satisfied that the lake project had been built with the available resources in preference to several other development options (industrial parks, better public services, state or national park, public water supply wells, aid to small business, help for the poor, construction of several smaller impoundments, and allocations for private recreational development). Only one option, keeping the land in its original state of forests and agriculture, was slightly favored over the lake project. A vested interest perspective was used to investigate socio-demographic, attitude, and cost assessment factors. The findings showed that costs and benefits were good predictors of attitudes toward the project. That is, persons who benefited from the lake project had favorable attitudes toward the lake, while those who experienced costs as a result of the project favored alternate options. Long-term residents tended to favor the alternative development options, whereas nonfarmers, persons with higher educational achievement and those with negative perceptions of recreationists tended to favor the lake project. (Cassar-FRC)
W82-05743

EFFECTS OF POTENTIAL WATER CONSERVATION EFFORTS IN EAST TENNESSEE,

East Tennessee State Univ., Johnson City. Dept. of Environmental Health.
For primary bibliographic entry see Field 3D.
W82-05745

WATER RESOURCES RESEARCH PRIORITIZATION AND MANAGEMENT--PROBLEMS AND PERSPECTIVES,

Utah Water Research Lab., Logan.
L. D. James, and J. Messer.
Water Resources Bulletin, Vol 18, No 1, p 1-7, February, 1982. 7 Tab, 4 Ref.

Descriptors: *Water resources development, *Research priorities, Water quality, Resources management, Planning.

Water resources research is essential to the protection of water quality and to the wise use of limited water resources. Research management must prioritize study topics and foster their productive completion in order to maximize research productivity. However, the water research management struc-

ture found in the Federal government and in the States is strongly influenced by pervasive trends toward consumerism, which identifies current users and makes them the judges of worth; fiscal constraint, which tends to focus research on user-recognized early payoffs; centralized management; and the use of research for other social objectives. The research prioritization and management structure which these trends have created was examined in the microcosm of its application at the Utah Water Research Laboratory. This review indicated that research productivity is seriously diluted by the failure of research users to communicate their particular needs to researchers and by the effects of consumerism in terms of ephemeral and volatile priorities which work against sustained research thrusts over the durations required to deliver research results to users who recognize their needs. Corrective approaches to research management might include incremental research prioritization and greater use of advisory councils to facilitate user-research interaction. The only firm conclusion drawn is that empirical studies of the performance of alternatives in research management structure are needed. (Carroll-FRC)
W82-05753

TURKS PRESS FORWARD WITH AMBITIOUS DAM PROGRAMME,

G. Tansey.
World Water, Vol 5, No 3, p 22-25, March, 1982. 1 Fig.

Descriptors: *Water resources development, *Financing, *Developing countries, *Turkey, Dam construction, Hydroelectric power, Irrigation, Reservoirs.

Rising oil costs have encouraged water resources development in Turkey, which currently uses only 10% of its 100 TWh potential hydropower. Installed capacity is 1171 MW. Thirteen projects (7219 MW capacity) are underway, and 34 projects (6529 MW) are in the planning stage. The Hasan Ugurlu, a 179 m high earthcore rockfill dam completed in 1979, was the first major dam built by a Turkish company with a Turkish workforce. Only 6 minihydro plants have been built, all in remote areas. No studies have been done on the minihydro potential. The goal for increasing the present 40,000 sq km of irrigated land is 100,000 ha per year. Irrigation projects have been moving rapidly near the Mediterranean and Aegean coasts, but more slowly in the central and east. Financing water projects has been a major deterrent to development. Water prices have been unrealistically low, and foreign money is hard to obtain. This lack of funds has slowed several major dam construction projects. Other difficulties are water rights conflicts with Syria and Iraq and a shortage of skilled workers. (Cassar-FRC)
W82-05758

A REVIEW OF THE BENEFIT-COST ANALYSES OF TWO SOUTHERN ALBERTA DAMS,

Calgary Univ. (Alberta). Dept. of Civil Engineering.
M. Gysi.
Canadian Water Resources Journal, Vol 5, No 1, p 76-86, 1980. 8 Ref.

Descriptors: *Cost-benefit analysis, *Benefits, Water management, *Canada, Dams, Oldman River Dam, Red Deer River Dam, *Alberta, Irrigation, Industrial development, Employment, Economic justification.

Benefit-cost ratios for the Red Deer River and Oldman River dams in southern Alberta were based on grossly inflated benefits. The Phase I Study for Oldman River Dam used a multiplier of 1.5 to compute the secondary benefits from the primary (irrigation) benefits. Using a more acceptable multiplier of 0.1 reduces benefits by $66 million. In addition, the primary and secondary employment wages benefits ($16.5 million) should not have been included, considering Alberta's fully employed economy. These deductions change the original benefit/cost ratio of 1.59 to 0.65. Phase II of the Oldman River Study removed huge farmers' costs of irrigation and added an unwarranted 45% regional secondary benefits. Benefit/cost ratios were subjected to sensitivity analysis fby four methods and the most favorable reported, rather than the more realistic 1.1-1.3. The Red Deer River Dam, a flow regulation dam already approved, listed employment benefits (dam and resulting industrial development) as the only benefits. The major error was the assumption that all industrial development was attributed to the dam. In fact, employment benefits from a petrochemical plant, approved for construction before any commitment to build the dam, were also attributed to the dam. The decision to build Red Deer Dam was political and not based on economic reasons. Alberta Environment has made efforts to improve and standardize benefit/cost methods. (Cassar-FRC)
W82-05766

UNIFIED RIVER BASIN MANAGEMENT,

Waterloo Univ. (Ontario). Dept. of Geography.
B. Mitchell.
Canadian Water Resources Journal, Vol 5, No 2, p 87-95, 1980.

Descriptors: *Water basin development, Water management, *Water policy, Planning, Management planning, Institutional constraints, Symposium.

A symposium on unified river basin management was presented May 4-7, 1980, at Gatlinburg, Tennessee, by the American Water Resources Association and Tennessee Valley Authority with assistance from other organizations. Three keynote addresses concerned the following subjects: the accomplishments and challenges of the TVA, the history and difficulties faced by integrated river basin development, and evolution of organizational arrangements for river basin management. Authors of the 61 papers did not agree on a definition or the universal need for unified river basin management. A variety of approaches have been successful in the past, depending on local physical characteristics, public attitudes, etc., and may not be suitable for the future. Success of a management program depends on whether the managers or the public are evaluating the program. Planners should be in closer contact with the realities of implementation. Trade-offs and compromises are necessary in river basin planning. Constraints should be recognized and incorporated into solutions rather than reaching for a theoretically optimum solution. (Cassar-FRC)
W82-05769

ROLE OF THE MICROCOMPUTER IN WATER MANAGEMENT,

Canadian Applied Technology, Buttonville, Ontario.
For primary bibliographic entry see Field 7B.
W82-05771

THE EIGHTIES--IMPLICATIONS FOR WATER MANAGEMENT,

Ministry of State for Economic Development, Ottawa (Ontario).
C. D. Burke.
Canadian Water Resources Journal, Vol 5, No 2, p 1-12, 1980. 46 Ref.

Descriptors: *Planning, *Water management, *Water demand, Canada, Long-term planning, Population dynamics, Employment, Energy, Biological treatment, Water pollution, Water quality, Climatology, River basins, Forecasting, Water conservation, Research priorities.

An address presented at the Keynote Session of the CWRAS National Conference in 1980 looks 10-20 years into the future for three reasons: to eliminate self-solving problems, to pick up growth-related problems, and to stay ahead of needs. Trends in population numbers and distribution, employment, fuels, and energy in Canada are predicted. In environmental issues there will be a shift in emphasis from the visible pollutants to the insidious pollutants (polychlorinated biphenyls, acid rain, etc.) and an emphasis of on global environmental problems such as climate change. Water management issues vital during the next 10 years are described. The river basins subject to most pressure in the next decade are those located in Southern Alberta, the Saskatchewan, the Fraser Estuary, the Mackenzie, and the Great Lakes. Municipal water demands will show less growth except in Calgary and Edmonton. Hydropower will concentrate on low-head dams, in-stream sites, and tidal power. Heavy water demands for energy development can be expected in Alberta. More attention will be given to water use efficiency, climate variability, biological sewage and water treatment, trace levels of pollutants in water, and the danger of a burgeoning government water management bureaucracy. (Cassar-FRC)
W82-05772

WATER MANAGEMENT IN THE METROPOLITAN TORONTO REGION,

Metropolitan Toronto and Region Conservation Authority, Downsview (Ontario). Water Resource Division.
M. R. Garrett.
Canadian Water Resources Journal, Vol 5, No 1, p 78-86, 1980. 2 Fig.

Descriptors: *Storm water, *Urban runoff, *Water management, *Metropolitan water management, Runoff, Land development, Land use, Land acquisition, Flood plains, Risks, *Toronto, Ontario, Planning, Watershed management, Urban hydrology, Urban drainage, Storm runoff, Flood control, Flood plain management, Flood protection, Urban planning, Urban watersheds.

The Metropolitan Toronto and Region Conservation Authority began its comprehensive watershed plan with a 3 year data gathering process. Some preliminary conclusions were developed. The hazard land acquisition program should be continued and vulnerable structures removed. An erosion control works program should be continued. Remedial works should be continued. Remedial works should be continued so that no development is exposed to the risk of a 100-year flood, or greater in some cases. Major flood damage areas can be redeveloped if the risk level has been reduced to a satisfactory level. Risk must be defined as risk to life and property, not minor inconvenience. The flood control program must recognize the varying valley characteristics. Objectives have been established for storm water management in the areas of provision of servicing, reduction of hazard, conservation, planning, and economics. (Cassar-FRC)
W82-05775

WATER MANAGEMENT IN THE MARITIMES,

New Brunswick Dept. of Fisheries and Environment, Frederiction.
W. F. G. Cardy.
Canadian Water Resources Journal, Vol 5, No 3, p 26-33, 1980.

Descriptors: *Water management, *Attitudes, *Water policy, Canada, Nova Scotia, New Brunswick, Prince Edward Island, Water supply, Water use, Public opinion, Water resources development, Planning, Hydroelectric plants, Multipurpose projects.

The abundant water resources of Canada's Maritime provinces, New Brunswick, Nova Scotia, and Prince Edward Island, have been more than sufficient to satisfy the demands of the 1.65 million population. Until recently, water problems such as pollution control, control of water course alterations, and water rights establishment have been handled on an individual basis. The present job of water managers is to shape public attitudes toward water resources. The concepts that must be communicated are that minor crises are usually part of a larger, developing problem and that water is a valuable resource. With a reshaping of attitudes toward water, management policies can be implemented with respect to multiple use of hydrostation reservoirs, protection of drinking water sources, and improved reservoir operation. (Cassar-FRC)
W82-05776

STORMWATER MANAGEMENT - ONE DEVELOPER'S EXPERIENCE,
Major Holdings Ltd., Kitchener (Ontario).
O. W. Wright.
Canadian Water Resources Journal, Vol 5, No 2, p 68-77, 1980. 3 Fig.

Descriptors: *Political constraints, *Storm water, *Urban drainage, Planning, Drainage engineering, Ontario, Urban development, Water policy, Water management.

Major Holdings Limited, and Ontario developer, planned advanced stormwater management for some large residntial developments but experienced political problems and resistance to innovative methods. Much enthusiasm for the plans was evident among designers and consultants. However, when the bureaucracy realized that policy changes were necessary, resistance developed. Responsibility for decisions on storm water management was passed from agency to agency. As a result, management designs have been abandoned for current practices, which are more expensive and produce less environmental benefits. (Cassar-FRC)
W82-05777

1980 NEEDS SURVEY: COMBINED SEWER SSITE STUDIES,
Water Resource Engineers, Gainesville, FL.
For primary bibliographic entry see Field 5D.
W82-05862

CONFLICT OVER WATER SOURCES PREDICTED BY GLOBAL STUDY.
World Water, Vol 5, No 4, p 49, 51, April, 1982. 3 Tab.

Descriptors: *Water supply, *Population dynamics, *Irrigation, Prediction, Water resources development, Environmental effects, Forests, Agriculture, Water pollution, Energy, River basins, Developing countries, Wastewater treatment.

The 766-page book, 'The Global 2000 Report to the President', commissioned in 1977 by former President Carter, predicts the status of world population, environmental conditions, and natural resources for the year 2000. The predictions have serious implications for water resource planners. The population increase to 5900-6800 million will be concentrated in already overpopulated and underdeveloped nations and in urban areas. Conflicts over water resources will intensify, especially in multinational basins. Disparities between rich and poor nations will increase. total irrigated land may rise from 223 million ha in 1975 to 273 million ha by 1990. Costs of improving ineffective irrigation and drainage systems are $36,000 million (1975 prices). Increasing irrigation will add to salinity problems downstream from projects. Deforestation, which profoundly affects water resources, will continue until about 2020, when the total forest area will stabilize at 18 million sq km. The environmental will suffer loss and deterioration of agricultural soil caused by soil erosion, stabilization, pollution, and water shortages. Burning of farm wastes for fuel reduce the nutrients and reduce the soil's ability to retain nutrients and water. Water withdrawals in 2000 will be 1800-2300 million cu m, 5 times the present level. The huge sums of money required for treatment of water pollution and wastewater may not be available in developing countries. (Cassar-FRC)
W82-05879

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

A SPATIAL COSTING SYSTEM FOR DRINKING WATER,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark, V. F. Fender, and J. I. Gillean.
Journal of the American Water Works Association, Vol 74, No 1, p 18-26, January, 1982. 11 Fig, 2 Tab, 7 Ref.

Descriptors: *Cost allocation, *Water treatment, *Water distribution, Metropolitan water management, Accounting, Costs, Data processing, *Kenton County, *Kentucky, Depreciation, Management planning.

A survey of the data collection and analysis procedures in large water utilities conducted throughout the United States beginning in 1974 revealed that the procedres varied widely and were generally inadequate for cost assessments. A technique has been developed for data collection and analysis to fulfill both managerial and accounting needs. This technique, based on a matrix, spatial assignment concept, was tested with a water supply simulation model and then implemented in Kenton County, Kentucky. The calculation of unit costs is based on revenue-producing water (RPW) rather than total water treated. Each month, the RPW by cost zone is entered onto a worksheet. costs are first charged to cost centers within the physical system and then transferred in increments from the cost centers to the appropriate cost zone, based on the flow of RPW within the zone. The system is designed to produce supplemental management reports and a cost analysis report. Examination of the report unit costs by zone will show trends or deviations from normal costs within a distribution area. A depreciation base was established for water district assets so that depreciation could be properly treated as an operating cost. The system supplied useful management reports and provided the basis for a proposed rate increase. (Carroll-FRC)
W82-04796

THE REAL PRICE OF URBAN WATER,
West Virginia Univ., Morgantown. Regional Research Inst.
P. C. Mann, and P. R. LeFrancois.
Journal of the American Water Works Association, Vol 74, No 1, p 22, January, 1982.

Descriptors: *Pricing, *Municipal Water, *Economic aspects, Water shortage, Water conservation, Public opinion, Industrial water, Maintenance, Water distribution, Inflation, History, *Water supply.

Public perception of the relative importance of water pricing appears to moving away from the neglect which it previously suffered. Recent water shortages have produced much activity among states and user groups to assure future supplies. Inflation and increased quality demands have resulted in more frequent rate increases in the recent past. Growing consumer militancy has generated sentiment to sheild low-income consumers of water service from higher rates, particularly in rural areas. Urban water underpricing has induced water utilities to defer both system maintenance and capital replacement. although the nominal price of water has been increased in most areas, the real price has, on the average declined in the past decade because of inflation. Only the real price of industrial water, not residential or commerical water, increased during 1970-81. If this underpricing is continued, urban water consumers may be confronted at some point with the prospect of either massive increases in rates to cover the renovation of the entire system, or substandard and unreliable water service. (Carroll-FRC)
W82-04797

ESTIMATION OF SUBSTITUTION POSSIBILITIES BETWEEN WATER AND OTHER PRODUCTION INPUTS,
EG and G Environmental Consultants, Waltham, MA.
F. G. Babin, C. E. Willis, and P. G. Allen.
American Journal of Agricultural Economics, Vol 64, No 1, p 148-151, February, 1982, 2 Tab, 16 Ref.

Descriptors: *Water demand, *Pricing, Water use, Industrial water, Economic aspects, *Water rates.

This study examines water use at the standard industrial classification two-digit industry level and employs improved water price information. The translog form used offers advantages in that the ability to model production relationships with several inputs exists without imposing stringent conditions on the elasticity of substitution. From data for the individual sector estimates, it was concluded that changes in the price of water will have little effect on water usage. However, a 1% rise in the price of water would result in a 0.16% drop in the use of capital for the paper and pulp industry. Such a small response makes sense due to the relatively small cost share of the water input. On the other hand, a 1% rise in the cost of capital services for the same industry would lead to a 0.71% reduction in water use. It cannot be assumed that the industries studied in this paper can be pooled on the basis of identical parameters. Estimates found capital and production labor to be substitutes in all industry groups analyzed. However, all other pairs of inputs ere found to be substitutes for some industries and complements for others. Water planners are thus likely to find that elasticities based on pooled data are unreliable indicators of price responsiveness for their specific industrial customers. (Baker-FRC)
W82-04889

RESTRUCTURATION OF THE WATER TARIFF SYSTEM FOR IRRIGATION DISTRICTS IN MEXICO.
Secretaria de Agricultura y Recurosos Hidraulicos, Mexico City.
A. Olaiz.
Journal of Hydrology, Vol 51, No 1-4, p 29-40, May, 1981. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Irrigation programs, *Design criteria, Planning, Model studies, Water use, *Mexico, Tariff, *Economic aspects, Cost sharing.

In the Federal Water Law of 1972, the Mexican government declared irrigation districts to be for the public benefit and established the obligation of all users to contribute to their self-sufficiently by covering the cost of the services they receive on an equitable basis as set by the law. In order to meet expected growth in population and water demand between the years 1975 and 2000, the total irrigated area must be doubled; the efficiency of water use in irrigated plots must be increased by 15% and efficiency increased 8% in total distribution systems. Three major goals were set for 1982: to reach financial self-sufficiency in operation, maintenance and repair annual costs; to deliver water by volume in irrigation plots and establish a water quota per hectare in accordance with resource availability and crop patterns; and to promote higher recovery of the public investment in infrastructure systems. If the method that has been devised is put into practice, the price of water for irrigation will be a powerful tool for improving the undesirable conditions which presently exist. It will also help in intermediate and long-term planning, and in deciding on the best allocation of regional water resources among alternative uses and crops. This would lead to better productive patterns in agricultural development. (Baker-FRC)
W82-04962

OPTIMAL WATER PRICING AND STORAGE: THE EFFECT OF DISCOUNTING,
Canterburg Univ., Christchurch (New Zealand). Dept. of Economics.
R. Manning, and D. Gallagher.
Water Resources Research, Vol 18, No 1, p 65-70, February, 1982. 2 Fig, 13 Ref.

Descriptors: *Pricing, *Water storage, *Discount rates, Economic aspects, Elasticity of demand, Optimization, Storage, Water demand, Interest rates.

Work by Riley and Scherer (1979) concerning the relationship of water pricing and storage policies is extended by considering the role of discounting (or time preference) in pricing policy. Optimal storage policies are described by an extension of Hotelling's rule. (1) The price of water in storage must rise with the rate of interest. The rate of water loss from leakage and evaporation may be included. (2) The initial price for stored water is such that the price of water rises enough to equate demand with natural inflow at the moment when contents are exhausted. (3) The price of storage contents must rise at no less than the rate of interest. When storage contents are exhausted the price must not

rise faster than the rate of interest and must eventually fall to a level that makes the next cycle of storage profitable. (4) The smaller the elasticity of demand, the rate of interest, or the longer the planning horizon, the larger the optimal storage capacity. (5) The price of water must increase over the cycle, but the discounted prices must be the same, and the initial price must be set so that the total demand equals total inflow over the cycle. (6) The price of water must increase over the cycle, but the discounted higher price will exceed the discounted lower price. These prices must be set so that at the end of the applicable intervals the storage contents can meet demand in the next period. (Cassar-FRC)
W82-05049

WATER AND WASTEWATER MANAGERS FACE THE FINANCIALLY TROUBLED 1980S,

Graham Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 6B.
W82-05166

CRISIS-RIDDEN WATER SYSTEMS SHOULD GO PRIVATE,

S. H. Hanke.
Journal of the American Water Works Association, Vol 74, No 2, p 14, February, 1982.

Descriptors: *Economic aspects, Water supply, *Municipal water, Planning, Wastewater treatment, Water demand, Pricing, *Commercial water supply.

Urban water systems are faced with the problem of being unable to raise enough capital to properly maintain and expand their existing systems. The market value of nearly all private water companies is below book value and most municipal systems need repair and renovation. Price controls have caused the capital shortage in the industry. One solution to the capital shortage problem requires a federal subsidy or bail-out program. However, by further politicizing the provision of water a federal subsidy would create great inefficiencies and inequities. A second option involves removing price controls. This would put water purveyors on a self-financing basis in which users would pay the real costs of their water. It would remove the need for water conservation through nonprice rationing programs. Most importantly, it would improve the suppliers' ability to provide adequate, high-quality services. The most desirable way to accomplish price decontrol would be to privatize and deregulate the industry. France has used such a system for many years. (Baker-FRC)
W82-05436

HYDRO-ECONOMIC ANALYSIS AND PROJECTION OF IRRIGATION WATER DEMANDS IN PENNSYLVANIA,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
D. F. Kibler, V. Crowley, R. L. Bartel, W. B. Detar, and E. L. White.
Report, April, 1981. 206 p, 44 Fig, 43 Tab, 66 Ref, 1 Plate, 5 Append.

Descriptors: *Irrigation efficiency, Crop yield, Soil moisture deficiency, *Projections, Model studies, *Water demand, Water stress, Economic justification, Economic yield, Economic prediction, Benefits, Hydrologic data collections, Hydrologic maps, Water allocation, Costs, Irrigation effects, River basins, *Pennsylvania, *Cost analysis.

A 1977 study of Pennsylvania's irrigation needs quantified potential water demands by crop and region by analyzing long-term soil moisture deficit. A more refined estimate of irrigation demand as it is affected by expected net returns to irrigation was desired. The objectives of this study were to: assess economic costs and benefits associated respectively with irrigation system costs and increased crop yield; evaluate new irrigation system and scheduling operations which are energy and water-efficient and that meet moisture-stress levels; project irrigation demand with water availability by DER river basin units; and map irrigable areas and potential water shortages in the DER river basins. A major finding of this study was that irrigation of moderate value cash crops, such as potatoes, is economically justified if irrigation can be applied near the optimal water-stress point for the crop. Net returns on profits will be highest under current economic conditions when higher cash value crops are irrigated with hand-moved, portable set irrigation systems at a trigger point of 0.40 FMD (fraction of moisture depleted). A second major finding involved determining a water shortage index for irrigation, i.e., the maximum acreage that can be irrigated under optimum conditions without depleting water supplies below the 2-year, 30-day drought level. A daily soil moisture model was used to compute moisture deficit in the crop rooting zone on a daily basis over the growing season. The model was then used to compute a seasonal water stress index (WSI). Yield increases above the no-irrigation policy were simulated for certain crops for the years 1948-1975. (Atkins-Omniplan)
W82-05558

ECONOMIC ANALYSIS OF WATER MAIN BREAKS,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 8A.
W82-05673

AN APPLICATION OF MATHEMATICAL PROGRAMMING TO WATER RESOURCES PLANNING: AN ECONOMIC VIEW,

New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources.
For primary bibliographic entry see Field 6A.
W82-05737

BILLING DATA AIDS UTILITY PLANNING,

Arlington County Dept. of Public Works, VA. Public Works Planning.
N. K. Hook, Jr.
Water/Engineering and Management, Vol 129, No 3, p 42, 44, March, 1982. 1 Fig.

Descriptors: *Utilities, *Management planning, *Water demand, Pricing, Prices, Economic aspects, Computers.

A new utility billing system was developed in the early part of 1979 for Arlington County, Virginia, in response to the Industrial Cost Recovery requirements defined in Public Law 92-500. An interactive system with many more capabilities than the older computer assisted operation was put into use. The new system improves the responsiveness for assisting the customer with inquiries concerning the account; provides adjustments to the account; undertakes immediate updates to basic account data needed by customers moving, meter changes or other actions; issues bills within days rather than months due to improvements being made in meter reading procedures and data entry; and permits immediate access to all customer information, thereby minimizing manual research. Currently the county has eight major water pressure zones or service areas. To allow for future flexibility in the system, a two digit code was used, with the first digit describing the pressure zone and the second digit left as a zero for future use. A third numeric code describes the geographic sanitary sewershed. The Refuse Code describes refuse services provided to the account and facilities planning for refuse collection. Many utility systems currently have a billing system which may be capable of providing sophisticated data for use in utility planning purposes. If a new billing system is contemplated, incorporation of such a data base is cost effective in terms of information which will be needed at some future date. (Baker-FRC)
W82-05786

PRICE OR PERSUASION,

Idaho Univ., Moscow. Dept. of Economics.
J. T. Wenders.
Water/Engineering and Management, Vol 129, No 3, p 32-34 March, 1982. 2 Fig, 2 Tab.

Descriptors: *Pricing, *Water demand, Water supply, Water conservation, Economic aspects, Tucson, Arizona.

Events occurring in Tucson, Arizona during the 1970's provided an opportunity to investigate the potentials of two methods of controlling water consumption. The first method considered raising the price as a stimulant to conservation. The second method relies on persuading the consumers to consume less. In Tucson, significant price increases and publicity campaigns were both instituted to encourage water conservation during this period of time. Analysis of the results suggests that the decrease in water usage occurred in response to the price increase and that any decrease in response to persuasion was negligible. However, a Beat-the-Peak campaign aimed at reducing the use of water during the hottest periods of the day has achieved a 20% reduction in water consumption during these times. Even so the separate effect of the Beat-the-Peak program on water consumption was small and was clearly superseded by the effect of the price increase. (Baker-FRC)
W82-05791

CURRENT TRENDS IN COST OF SERVICE STUDIES,

Coffin and Richardson, Boston, MA.
V. F. Pennacchio.
Journal of the New England Water Works Association, Vol 96, No 1, p 55-60, 1982.

Descriptors: *Water rates, *Water costs, *Prices, Water meters, Marginal costs, Cost allocation, Peak demand, Water conservation, Subsidies, Utilities.

Several methods of determining water rates are described. In general the current trend appears to be toward the proven methods of the 1960's and early 1970's. These include the American Water Works Association Base-Extra Capacity Method, which sells no water at less than base cost and charges more for excess demands. If properly designed, this type of structure will result in fair and equitable rates for all customers. Some of the newer concepts in water rates are evaluated. Most marginal cost pricing theories as applied to utilities are actually incremental cost approaches and include long run costs. Problems with these methods are a difference between actual costs and the revenues computed, as well as difficulties in assuming that price is elastic when in fact domestic water prices are nearly inelastic. Demand-type rates (time-of-day metering, peak demand metering, and ratchet rates) can be fair, but recording consumption on a continuous basis is not economically feasible except for very large users. Some of these methods can also encourage heavy use and resultant increased sewage flows during off-season of off-peak hours. Although conservation-type rates, which penalize large users, discourage waste, they can also discourage industrial growth. Lifeline rates are intended to establish a low subsidized rate for a minimum quantity of service to help low income families. This is not fair because low quantity users, whether affluent or poor or on vacation, will receive the subsidy. (Cassar-FRC)
W82-05806

COLORADO RIVER WATER ALLOCATION,

Colorado River Board of California, Los Angeles.
M. B. Holburt.
Water Supply and Management, Vol 6, No 1-2, p 63-73, 1982. 5 Tab.

Descriptors: *River basin development, *Water rights, *Water supply development, *Colorado River, *Water law, *Salinity, Water resources development, River basins, River systems, Potential water supply, Available water, Riparian rights, Water quality control.

The states drained by the Colorado River System have tried to obtain for their citizens maximum use of the water resources from the river. The water supplies of this system are already 90% utilized, with full use of Colorado River waters expected within the 1980's. The 'Law of the River', which controls the apportioning of river waters, is composed of many interstate compacts, federal laws, water delivery contracts, state legislation, a treaty and other agreements with Republic of Mexico, a United States Supreme Court decision and federal

administrative actions. By 1990, total water uses are expected to reach the dependable annual flow of 14 million acre feet. Since this figure is not as great as anticipated when the waters were apportioned, there is potential for serious future conflicts. Future water resource development projects will need to concentrate on meeting the obligations of the Mexican Water Treaty of 1973. Several salinity control measures must be enforced to ensure the quality of Colorado River water for Mexican and United States users as well. (Geiger-FRC)
W82-05888

6D. Water Demand

A NEW LOOK AT SMALL POWER PLANTS. 2. THE ENVIRONMENTAL EFFECTS,

California Univ., Berkeley.
D. B. Champion, and M. D. Williams.
Environment, Vol 22, No 3, p 25--32, April, 1980. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Environmental effects, *Powerplants, Electric powerplants, Water demand, Water supply, Water pollution, Water rights, *Comparison studies.

The Los Alamos Scientific Laboratory has conducted a study comparing the use of small coal-fired power plants with the use of large power plants for expanding electrical generating capacity in the Rocky Mountain West. The environmental aspects of constructing one 3000 megawatt power plant were compared with the environmental effects of three 500 megawatt and one 750 megawatt units; all units considered were proposed for construction in southeastern Utah. Water supply availability poses a significant problem in the construction of any coal-fired power plants, since in many cases the available supply is already fully used. Small plants would be more easily able to assemble the rights to surface water supplies by purchasing them from irrigators than would large plants. In either case, transferring water from irrigation to use by the power plants would have the beneficial effect of reducing irrigation return flows in the Colorado-Green River basin and salinity in the rivers. Since the power plants do not discharge waste water back to the rivers, no other significant water quality impacts would occur. It is concluded that although the cumulative impact of a series of smaller power plants might equal that of a large plant, the impact would be spread over a larger area and would therefore be more easily absorbed by the environment. (Caroll-FRC)
W82-04769

RECONSTRUCTION OF THE NORTHERN DONETS-DONBAS CANAL,

For primary bibliographic entry see Field 8A.
W82-04773

ICEBERGS: TECHNOLOGY FOR THE FUTURE,

Cambridge Univ. (England).
For primary bibliographic entry see Field 2C.
W82-04778

COMPETITION FOR WATER RESOURCES: COAL AND AGRICULTURE IN THE YELLOWSTONE BASIN,

Indiana Univ. at Bloomington.
T. D. Georgianna, and K. E. Haynes.
Economic Geography, Vol 57, No 3, p 225-237, July, 1981. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Water demand, *Forecasting, *Competing use, Water management, Resources management, Mathematical models, Optimization, Agriculture, Coal mining, Montana, *Yellowstone River basin.

The Yellowstone River Basin serves as an archtypical system in which to assess the competing demands made upon water resources by energy and agriculture. One method currently used for forecasting water demand in strip mining operations plots the relationship between water use in coal production and the amount of coal produced to approximate straight-line time series forecast. However, major assumptions underlying this methodology are shown to be false. An alternative scheme is presented which takes advantage of shadow pricing, permitting the formulation of a non-linear mathematical programming problem for the derivation of an optimal solution to the allocation of a limited resource among competing users. This formulation for minimizing the cost of water in an area where agriculture and coal production are in competition for limited water resources provides a workable formulation which yields information about the relationship between water uses in the two industries and about costs of water as incentives or disincentives for pollution. (Carroll-FRC)
W82-04805

NET ENERGY: RESULTS FOR SMALL-SCALE HYDROELECTRIC POWER AND SUMMARY OF EXISTING ANALYSES,

Energy Policy Studies, Inc., Omaha, NE.
M. W. Gilliland, J. M. Klopatek, and S. G. Hildebrand.
Energy, Vol 6, No 10, p 1029-1040, October, 1981. 7 Tab, 25 Ref.

Descriptors: *Powerplants, *Hydroelectric plants, *Economic efficiency, Energy conversion, Performance evaluation, *Dams, Retrofitting.

Net energy analysis is a potential tool for evaluating emerging energy technologies. A net energy analysis was performed for small scale hydroelectric power facilities to permit comparison with conventional hydroelectric plants and other technologies. The analysis was applied to seven projects based on retrofitting of existing dams, with powerplant capacities ranging from 1325 to 6500 kw. Unit capital costs ranged from $432 to $1488 per installed kw. Most of the power plants were to operate as run-of-the river facilities. Energy inputs were calculated as the sum of all primary energy required to construct and operate the plant. The net energy ratios of five of the seven facilities were remarkably consistent at 10-12:1. Thus the majority of small-scale hydroelectric retrofits should deliver 10-12 times more energy as electricity and 31-37 times more energy as fossil fuel equivalents than is required to build and operate them. Results were compared with conventional hydroelectric plants with capacities at least an order of magnitude larger than the small facilities. Net energy ratios for peak power dams were smaller than those for the small hydro facilities, while the ratio for the base-load examined was similar to the mean for the small-scale hydro facilities. These findings support the concept that substantial energy savings can be realized by making investments in retrofit of existing capital stocks. (Carroll-FRC)
W82-04806

WATER SUPPLY IN THE USSR.

Water Services, Vol 85, No 1029, p 568-569, 1981.

Descriptors: *Water supply development, *Water demand, *Potable water, Drinking water, Water supply, Water quality management, Water management, Water use, Consumptive use, Moscow, *USSR.

The 1981 to 1990 decade was declared the International Drinking Water Supply and Sanitation Decade by the UN General Assembly. Each individual in Moscow, on the average, consumes almost 700 liters of potable water daily. Most of the Soviet Union's freshwater flows to the Arctic Ocean and the Pacific in the scarcely populated areas of the country. The Soviet State Standard sets stringent demands on drinking water purity. Muscovites pay for part of the water they use, while the rest of the expenses are covered by the city's enterprises. Water supplies are fluorinated to comply with USSR legislation. Freshwater consumption is increasing rapidly and its use by factories is being restricted in some places. In deciding upon prices for water supply, the republican and local authorities are invariably trying to keep prices for household use as low as possible. Many establishments in the Soviet Union are studying the problems of water supply while the Main department of Water Protection of the USSR Ministry of Land Amelioration and Water Economy and local governments protect surface and underground water supplies. A new plan set forth in the Protection of the Environment section of the Guidelines for the Economic and Social Development of the USSR for 1981-1985 and for the Period Ending in 1990 intends to expand to use of recycled water, introduce more non-effluent closed-water circuits, and adopt water protection projects more quickly. (Geiger-FRC)
W82-04849

FRESH-WATER TRANSPORT BY SEA,

Oufresne and Henry Engineers, Inc., North Springfield, VT.
R. M. Dunlap.
Journal of Hydrology, Vol 51, No 1-4, p 313-318, May, 1981. 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Water transport, *Ships, *Transportation, Water supply, Arid lands, *Icebergs.

Researchers have recently begun to study the feasibility of transporting icebergs to help meet the water needs of arid lands. As an alternative, it is suggested that a submerged, flexible water container pulled by a semi-submerged tug boat could be used to transport fresh water from regions of abundant fresh water or from the mouths of such rivers as the Amazon and the Rhone to arid lands accessible by sea transport. This sea transport system is composed of the container and its ballast, the tug and a tow cable, and the terminals. The proposed container is a non-circular flexible cylinder fabricated of multilayer polyester sheet and having the cross-sectional shape of a fish. This fresh-water container would have a capacity of 5,000,00 cubic meters. The specially-designed low-speed, semi-submerged, highly-efficient diesel-powered twin screw tug boat would pull the container with a commercially available nylon cable. Upon arrival at its destination, the container would be anchored and secured and connected to the water distribution system, serving as a reservoir for the fresh water. Several potential transport routes, ranging from 900 to 4.700 kilometers, are suggested. Total capital costs are estimated to be $50,650,000. The total transport cost is estimated at about $0.03 per ton per 1,000 kilometers. (Carroll-FRC)
W82-04861

WATER TO THE SOUTH-WESTERN CAPE KEEPING UP WITH THE DEMAND.

For primary bibliographic entry see Field 3C.
W82-04887

STRIPMINING ARID NAVAJO LANDS IN THE US: THREATS TO HEALTH AND HERITAGE,

J. Radford.
Ambio, Vol 11, No 1, p 9-14, 1982. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Strip mines, *Water supply, Environmental protection, Water rights, Aquifers, Water quality, Water reuse, *Water demand, *Chaco region, *New Mexico.

Massive strip mining operations in the Chaco region of New Mexico's San Juan Basin may accelerate desertification, deplete already scarce water supplies, undermine the Navajo Indian way of life, dramatically degrade air quality, and compromise fossil and archeological resources of world importance. With an average precipatation of 9 inches or less, the Chaco is the most arid of the 12 national coal production regions designated by the US Department of Energy. The scarcity of water has important implications for the land's reclamation potential after stripmining, although current laws require that stripmined land be returned to its previous productive capacity or better. Total precipitation in the form of snow averages only 1.82 inches during a typical winter. Under certain conditions snow fences could help protect seeded areas from the Chaco's strong winds, but in any event this is considered a very expensive method

for widespread usage. Surface water and shallow aquifers cannot begin to meet the expected water demand in this area of the country. Alternative sources being considered include diverting water about 40 miles from the San Juan River to the north, drilling deep wells at numerous locations in the Chaco, and re-using water pumped out of uranium mines to the south. Use of the river water is highly contested, with the Native Americans claiming that their treaty rights to water are already abridged by over-allocations. (Baker-FRC)
W82-05036

WATER SYSTEM DESIGN MEETS MODERN CHALLENGES,

Watson and Co., Tampa, FL.
For primary bibliographic entry see Field 5F.
W82-05170

ABANDONED COAL MINES IN WEST VIRGINIA AS SOURCES OF WATER SUPPLIES,

West Virginia Geological and Economic Survey, Morgantown.
For primary bibliographic entry see Field 3C.
W82-05219

WATER USE IN OHIO, 1975,

Geological Survey, Columbus, OH. Water Resources Div.
R. M. Hathaway, and M. Eberle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-192980, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-17, 1981. 43 p, 6 fig, 7 Tab, 41 Ref.

Descriptors: *Water use, *Water supply, Surface water, Groundwater, Thermal powerplants, Industrial water, Municipal water, Livestock, Irrigation water, *Ohio, Water demand.

The estimated water use in Ohio for all purposes in 1975 was 16,431 million gallons per day. Of this total, 15,321 were taken from surface water while the remaining 1,110 represent ground-water withdrawals. Totals by category are as follows (in million gallons per day): Thermoelectric power generation, 12,404; self-supplied industrial use, 2,362; public water supplies, 1,423; rural domestic and livestock, 201; and irrigation, 40. Per capita water use was calculated to be 1,528 gallons per day for an Ohio population of 10,751,000 in 1975. Jefferson County led all Ohio counties in total water use with 3,447 million gallons per day. This was nearly three times the usage of second-ranking Gallia County where withdrawals were 1,242 million gallons per day. The heavy water use in both of these Ohio River counties is due to large withdrawals for thermoelectic power generation. Cuyahoga, Lorain, and Lake Counties, all in the Cleveland metropolitan area, rank third, fourth, and fifth in the State with respective totals of 1,061, 1,047, and 1,030 million gallons per day. Water use is more diverse in this area, with public supplies, industrial use, and thermoelectric power all making significant impacts. (USGS)
W82-05226

WATER RESOURCES OF THE WALKER RIVER INDIAN RESERVATION, WEST-CENTRAL NEVADA,

Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-05235

RIVER BASINS AND WATER MANAGEMENT IN NEW BRUNSWICK,

New Brunswick Dept. of Fisheries and Environment, Fredericton.
W. F. G. Cardy.
Canadian Water Resources Journal, Vol 6, No 4, p 66-79, 1981. 1 Fig, 3 Ref.

Descriptors: *Water management, *Planning, *New Brunswick, Water pollution control, River basins, Public participation, Administration, *Water policy, St. John River, Water resources development, Canada.

New Brunswick has abundant water, a small population, and little perceived need for water management. Sufficient water is available for use as well as for wastewater dilution in the river basins, but the coastal plains using limited groundwater are experiencing occasional shortages. Management activities have generally been on a provincial scale. A major planning exercise took place in the St. Johns River Basin during 1970-74. Comprehensive reports and 30 specialist reports were issued. A framework for water management with eight levels of decision was established. Implementation of the plan has been slow for three reasons: (1) the question of whether a comprehensive study was necessary when the major pollution arose from only a few well-identified sources, (2) changes were not suggested, but people were encouraged to find the solution themselves, and (3) loose administration and changing governmental policies. The study did, however, arouse public interest and discussion about the pollution problems. At present there is no need for further basin-wide planning in New Brunswick. Strategy should be directed toward solving problems on the local level as the needs arise. (Cassar-FRC)
W82-05391

COLD LAKE-BEAVER RIVER REGIONAL WATER RESOURCES STUDY,

Department of the Environment (Edmonton).
B. MacLock, and R. Hicks.
Canadian Water Resources Journal, Vol 6, No 4, p 119-140, 1981. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Oil shale, *Water demand, *Water management, *Planning, *Alberta, Cold lakes, Beaver River, Water pollution sources, Water use, Water quality, Decision making, Water resources development, River basins, Water allocation, Canada.

The Cold Lake-Beaver River Regional Resources Study was initiated in 1980 to develop a framework plan for the long-term management of the region's water resources. Within these basins are both vast oil sands deposits, extractable only by in situ mining, and a large percentage of the province's recreation and fishing lakes. Potential conflicts exist between these two uses. Specific study objectives were developed as part of a framework plan for long-term water management. From the objectives was formulated a study framework with 10 components: management issues, water supply (quantity, quality, and groundwater), water use, legal aspects, modelling, goals, management alternatives, public participation, synthesis and evaluation and plan formulation. Some of the obstacles in meeting the study objectives are: limited hydrometric and atmospheric data, uncertain water withdrawal forecasts for oil sands development, and lack of data in the instream fisheries field. The study will be undertaken in 4 phases over a 3.5 year period. (Cassar-FRC)
W82-05396

THE INTERACTION BETWEEN WATER SCARCITY AND WATER QUALITY DEGRADATION: ISRAEL AS A CASE STUDY,

Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
H. I. Shuval.
Water Science and Technology, Vol 14, No 1/2, p 453-463, 1982. 3 Fig, 5 Tab.

Descriptors: *Water management, *Water policy, *Water scarcity, *Israel, Desalination, Political aspects, Chlorides, Nitrates, Planning, Water reuse, Agriculture, Irrigation, Saline water intrusion, Eutrophication, Water shortage, Lake Kinneret, Semiarid lands, Water consumption, Wastewater irrigation, *Water demand, Coastal aquifers, Aquifers, Groundwater.

Israel is faced with severe water shortages and increasing degradation of water quality. Actual water consumption in 1981 was 1700 million cu m, using all the 1500 million cu m per year of replenishable fresh water and 200 million cu m per year of reused, brackish water or unreplenishable groundwater. By 2000 there may be a gap between demand and supply of 500 million cu m per year. About 25% of Israel's water resources are threatened by saline water instrusion into the coastal aquifer. The most effective remedy is reducing groundwater exploitation by half. Other schemes, diversion of Lake Kinneret water and shifting the site of groundwater exploitation, only delay the harmful effects for another generation to handle. Nitrates derived from human sources, have been increasing in water supplies at the rate of 1.35 mg per year. An effective strategy to combat nitrate pollution is 50% reduction in fertilizer application, tertiary treatment of all wastewater used for agricultural irrigation, and temporary groundwater recharge and exchange. Although wastewater reuse can help alleviate water scarcity problems, it causes its own difficulties--a burden of toxic chemicals and pathogens and disposal of effluents during the non-irrigation period. A practical scheme is to recycle treated wastewater for agricultural and industrial use, saving the highest quality water for domestic use. Desalination of seawater, included in many forecasts for 2000, is not economically feasible. (Cassar-FRC)
W82-05421

PROBLEMS OF THE MULTIPURPOSE USE OF WATER RESOURCES OF THE VOLGA-AKHTUBA FLOODPLAIN AND VOLGA DELTA,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 4A.
W82-05487

INTEGRATED WATER MANAGEMENT: SOME INTERNATIONAL DIMENSIONS,

Biswas and Associates, Ltd., Ottawa (Ontario).
A. K. Biswas.
Journal of Hydrology, Vol 51, No 1-4, p 369-379, May, 1981. 6 Tab.

Descriptors: *Water management, *Water supply development, Resources management, Social aspects, Environmental policy, Projections, Hydroelectric power, Agriculture, Developing Countries.

The continuing increase in world population and the rising standard of living throughout the world will result in demands for more and more water supplies to meet basic human needs. The global picture with respect to water use and availability is very uneven. A 1976 survey of developing countries showed that only 35% of the people in these countries had adequate water supply and sewerage services. In the rural areas of many countries, less than 5% of the people have access to safe water. Water is essential for agriculture, and the total area under irrigation must be increased if the world food crisis is to be solved. In addition, better use must be made of irrigation water. Industry is a major user of water resources. In the United States, industrial demand accounts for about 40% of total water requirements. In addition, industrial users discharge large amounts of industrial wastes to water systems. The effects of expanding industrial development in third world countries on water resources will depend on the availability of water supplies and on water quality and wastewater regulations set by these countries. While hydropower resources have been extensively developed in North America and Europe, there is a vast, unexploited potential in Africa, Asia, and Latin America. More attention needs to be focussed on the social and environmental implications of water development, particularly in developing countries. It is concluded that the question of the availability of adequate water to sustain future world population and development over the next two decades is primarily one of instituting rational management practice. (Carroll-FRC)
W82-05493

COSTA RICA STAYS TOP OF WATER LEAGUE,

World Water, Vol 5, No 2, p 14-15, February, 1982. 5 Fig.

Descriptors: *Water resources development, *Water demand, Costa Rica, Latin America,

Group 6D—Water Demand

Water supply, Reservoirs, Wastewater treatment, Drinking water.

Costa Rica is well ahead of other Latin American countries in terms of water supply and waste disposal, with 98% of the urban population receiving safe water and 61% in rural areas. For waste disposal, systems are available to 96% of the urban population and 86% of the country dwellers, although many of them involve discharge of untreated wastes into the rivers. The modern story began with the foundation of the Instituto Costarricense de Acuaductos y Alcantarillados (AyA) to deal with a water crisis at the beginning of the 1960s which greq out of the inabilities of individual municipalities making up the city and environs to cope with growing demands. AyA devoted most of its first 20 years to the task of establishing its own organization and providing for the various systems that had previously supplied districts in the canital and other areas. Large portions of the national budget were channeled into sanitation and water supply. The recently completed second phase of the AyA operations has been the replacement of much of the old network in the San Jose area and construction of certain key elements in the overall scheme after emergency work and a chlorine injection and pumping plant at Puente de Mulas and distribution systems for the whole area. With the effective completion of Phase 2 of the supply plan, AyA sought and secured from the British government assistance in the preparation of a mathematical model to determine the overall efficiency of the system to provide data for progress on Phase 3. A mathematical model is being devised which can be updated to grow with the progression of additional networks and the improvement of existing ones. (Baker-FRC)
W82-05500

HYDRO-ECONOMIC ANALYSIS AND PROJECTION OF IRRIGATION WATER DEMANDS IN PENNSYLVANIA,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 6C.
W82-05558

THE NILE WATERS: SUDAN'S CRITICAL RESOURCE, PART II,

Edinburgh Univ. (Scotland). Dept. of Electrical Engineering.
H. Dickinson, and K. F. Wedgwood.
International Water Power and Dam Construction, Vol 34, No 2, p 31-34, February, 1982. 24 Ref.

Descriptors: *Water resources development, *Planning, Sudan, Irrigation, Agriculture, Jonglei project, Nile River, Dams.

Major dams on the Blue Nile and the Atbara have succeeded in making better use of what were formerly seasonal waters, but the ecological impact of the Roseires dam has yet to be fully evaluated. The 1959 Nile Waters Agreement has been of benefit to Sudan, as has the development of rain-fed and underground-water-fed agriculture which play an important role in that country. However, the quantity of water from these later sources is small in relation to the contribution of the Nile river system. The growth of agriculture based on irrigation in Sudan is likely to be restricted by the provisions of the Nile Waters Agreement. Its cost is high and the risks involved in reducing the water entering the Sudd are also to be considered. To minimize these risks an extensive research program has been undertaken. Much of the environmental and ecological work is directed toward filed surveys, and the data collected will provide valuable base material against which the effects of the Jonglei canal may be judged. The energy-intensive desalination of water taken from the Red Sea is an option open to Sudan only if major oil finds should occur in the country. At present, therefore, even if the Jonglei project is successful in providing Sudan with a further annual supply of 3 or 4 billion cubic meters of water, it will only delay the time when further conventional agricultural development will be impossible without new water resources. (Baker-FRC)
W82-05601

LARGE WATER AND HYDROELECTRIC DEVELOPMENTS IN FIJI,

H. Bendler.
Search, Vol 13, No 1/2, p 26-30, February/March, 1982. 7 Fig, 1 Tab, 2 Ref.

Descriptors: *Water resources development, *Construction, Dams, Fiji Islands, Economic aspects, Powerplants, Hydroelectric plants, Hydroelectric power.

The construction of Vaturu Dam and the associated works of the Nadi and Lautoka Regional Water Supply Scheme will supply high quality drinking water to a great number of Fijians and their visitors. The Monasavu-Wailoa Power Project will save the country millions of dollars with its integrated power grid and the generation of hydroelectric power. Both of these large, complex projects will assist in making the country self-reliant. Carried out in situations where great natural obstacles were encountered, they are technical achievements in which expertise and knowledge has been gained which will facilitate further development of the water resources of Fiji. The dams are leading examples of modern construction. Although expatriate engineering staff is largely involved, considerable local skill has been demonstrated by technical and professional employees. The hydroelectric plant will significantly reduce the need for imported oil. (Baker-FRC)
W82-05614

WATER SUPPLY FOR NEW YORK CITY IN THE 1980S,

Olympia and York Battery Park Co., New York.
F. X. McArdle.
Journal of the American Water Works Association, Vol 74, No 3, p 137-139, March, 1982.

Descriptors: *Water supply, *Urban areas, *Water management,*New York City, Water quality, Water distribution, Financng Reliability, Metropolitan water management, Water treatment, Water demand, Water consumption, Capital costs, Maintenance, Drinking water, Drought.

New York City's water system faces problems of providing sufficient quantities, maintaining high quality, ensuring reliability of supply, and financing capital needs. Although the city's population has not grown, water demand has increased with the installation of more air conditioning and home appliances. It is unknown whether demands will continue to increase, in which case new water sources must be sought. In the short term, droughts will periodically force reductions in consumption. The lack of widespread metering in the city is a hindrance in water management during a period of shortage. New York's protected watersheds have provided raw water requiring only disinfection, fluoride, and algae control. Increased development in Westchester and Putnam counties necessitated construction of a $250 million filtration plant in the Croton system. Another water quality issue involves the use and disposal of toxic chemicals within the watersheds. To ensure reliability of the main system over $100 million must be spent in the next 10 years to maintain dams properly. A third water tunnel is expected to reach completion by 1990. The 10,720 km distribution system suffers from frequent breaks, at least two major ones per day. Most failures are a result of disturbances by traffic and subways. A 3-year program is designed to replace 38 km of Manhattan's 150 mm pipe to reduce breaks by 20% per year. Financing replacement and new facilities is difficult for large, older cities. It is hoped that the present capital replacement program can be maintained over the long term in spite of institutional strictures imposed by the state constitution. Unless the cities solve problems of quantity, quality, reliability, and financing in their drinking water system they face continual decline and disintegration. (Casser-FRC)
W82-05671

COMPARING TWO MEASURES OF WATER BASED RECREATION PARTICIPATION,

Wisconsin Univ.-Madison. Dept. of Forestry.
J. H. Gramann, and R. J. Burdge.
Water Resources Bulletin, Vol 18, No 2, p 339-341, April, 1982. 1 Tab, 4 Ref.

Descriptors: *Recreation, *Surveys, *Public participation, Lakes, Boating, Fishing, Public waters, Swimming, Fishing.

Two methods of measuring participation at water based recreation sites were compared at Lake Shelbyville, Illinois. Respondents were asked to name the main recreation activity in which they participated at the reservoir during an entry point interview and then by a questionnaire mailed to the home. The percentages of persons specifying the same main activity in both types of surveys were: boat fishing, 91.4; water skiing, 81.0; shore fishing, 74.0; power boating, 65.3; swimming, 60.4; and relaxing, 37.5. Inconsistencies were most common in activities which overlapped (power boating, water skiing, and boat fishing) and in generalized activities (relaxing). In general either method or combinations of both methods can provide reasonably unbiased measures of water based recreational use. (Casser-FRC)
W82-05733

MODELING OF WATER SUPPLY/DEMAND IN THE SOUTH PLATTE RIVER BASIN, 1970-2020,

Colorado State Univ., Fort Collins. Engineering Research Center.
D. W. Hendricks, B. A. Janonis, S. Gerlek, J. C. Goldbach, and J. L. Patterson.
Water Resources Bulletin, Vol 18, No 2, p 279-287, April, 1982. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Water supply, *Water demand, *Hydrologic budget, South Platte River Basin, *Colorado, Model studies, Water conservation, Planning, Long-term planning, Systems analysis, Water storage, Forecasting, Drought, Irrigation, Water reuse, Water transfer.

A water balance model was applied to the South Platte River Basin, Colorado, to determine solutions to the supply/demand problem for both average andd stress conditions for the years 1980, 2000, and 2020. The base year was 1970. The model was displayed in tabular form on 8ft x 8ft color-coded magnetic board. Solutions obtained for different conditions were produced for evalution by different interest groups. Some of the information obtained from this model as applied to the South Platte Basin included: the present per capita water use of 220 gpcd could be reduced to 167 gpcd without severe difficulties, an additional 280,000 acre feet could be imported from the Colorado River basin with minimum social and economic disruption, the potential role of large-scale water exchanges between urban and agricultural users should be explored, water reuse is necessary, irrigated acreage can be adjusted to the amount of available water, and increased storage facilities would capture excess flows. (Casser-FRC)
W82-05738

MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,

Policy Sciences Associates, Boulder, CO.
For primary bibliographic entry see Field 3D.
W82-05748

THE EIGHTIES--IMPLICATIONS FOR WATER MANAGEMENT,

Ministry of State for Economic Development, Ottawa (Ontario).
For primary bibliographic entry see Field 6B.
W82-05772

DEVELOPMENT ISSUES IN THE COLORADO RIVER BASIN,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 3-10, 1982.

Descriptors: *Water rights, *Colorado River, *Water resources development, *Water supply development, *Water allocation, *Irrigation practices, River basins, Water management, Resources management, Irrigation water, Irrigation-return flow, Available water, Salinity.

An overview of the historical settlement of the Colorado River Basin, its economic growth and water and energy development, and prospects for meeting future resource needs is presented. Mexico is already using its full entitlement of water from the river, while the Lower Basin will reach its maximum allowable usage in just a few years with the completion of the Central Arizona Project in the 1980's. The upper Basin has developed about two-thirds of its entitlement and must make many serious water allocation decisions before full development. Energy development and allocation of water to adjoining basins for urban growth are major considerations in the Upper Colorado River Basin. The Lower Basin is facing similar problems as its population increases. Salinity levels must be kept to a minimum to ensure maximum utility of available water supplies. This is done most effectively by on-farm irrigation projects. Water rights decisions for Indian reservations will play a significant role in the future development of the Colorado River Basin. (Geiger-FRC)
W82-05890

THE PHYSICAL ENVIRONMENT OF THE COLORADO RIVER BASIN,

Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
Water Supply and Management, Vol 6, No 1-2, p 11-27, 1982. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Water resources development, *Water supply development, *Colorado River, *Available water, *Resource development, *Groundwater mining, Water management, Groundwater management, Water use, Irrigation water, Recreation, Coal mining, Groundwater recharge, Land use, Geomorphology, Climates.

Some of the physical features, climatic conditions, water resources, land use, and scenic and recreational resources of the Upper and Lower Colorado River Basin are examined along the energy resource developments along this river basin. Water supplies of the basin are utilized heavily; about 30% of the water supply is exported to adjoining basins to serve primarily metropolitan areas. Approximately 15 million acre-feet of water originate in the Upper Basin, while 3 million acre-feet come from the Lower Basin. The Lower Basin states are now using nearly all of their entitlement to surface water supplies from the basin and mining groundwater for municipal, agricultural and industrial use at a rate faster than natural recharge rates. States of the Upper Colorado Basin have not fully utilized their entitlement and mine groundwater principally for industrial and municipal use. About 50% of the potential hydroelectric power of the basin has already been developed. The mining of uranium, coal, and shale oil in the Colorado basin will also create new water needs. (Geiger-FRC)
W82-05891

6E. Water Law and Institutions

TOWN OF DE BEQUE V. ENEWOLD: CONDITIONAL WATER RIGHTS AND SATUTORY WATER LAW,

M. Hope.
Denver Law Journal, Vol 58, No 4, p 837-845, 1981. 78 Ref.

Descriptors: *Water rights, *Water law, *Colorado, *State jurisdiction, Water management, Water allocation, Legal aspects, Land rights, Land tenure, Appripriation, Water use.

In the past history of Colorado water law, an opposing party bore the onus of challenging a conditional water right in court. As a result of the decisions of De Beque vs. Enewold and other recent water rights cases of the Colorado Supreme Court, the burden of successfully maintaining a conditional water right through strict compliance with the statute is now upon the holder. A conditional water right may expire after a certain lapse of time under section 37-92-301 of the Colorado Water Rights Determination Act of 1969 if the holder does not obtrain and file an application for a reasonable finding of beneficial use of the water as required by section 37-92-601 of the law. In 1975, an amendment to the 1969 Water Act, section 37-92–305, alleviated some of the pressure on the holder by requiring the court to give notice prior to the cancellation or expiration of a conditional water right. The significance of the decision, however, lies beyond the holding of the De Beque case, which exemplified strict interpretation of statutory water law and the court's deference to the lawmaking function of the general assembly. (Geiger-FRC)
W82-04801

BRYANT V. YELLEN: PERFECTED RIGHTS ACQUIRE NEW STATUS UNDER A BELATED CLARIFICATION OF ARIZONA V. CALIFORNIA,

J. D. Carver, and C. L. Kramlich.
Denver Law journal, Vol 58, No 4, p 847-860, 1981. 137 Ref.

Descriptors: *Water rights, *Irrigation districts, *Land tenure, *Reclaimed water, *Legal aspects, Water law, Irrigation water, State jurisdiction, Water allocation, Water reuse, Reclamation, Water use, Water demand, *Imperial Valley, Californir, Arizona.

The Federal Reclamation Act of 1902 states that single owner land holdings of 160 acres or less are ineligible for the delivery of reclamation water for irrigation purposes. This restriction and a residency requirement were included in the law to promote widespread land ownership and a more equitable distribution of federal benefits. Section 46 of the 1926 Omnibus Adjustment Act empowers the Secretary of the Interior to deny water to any landowner who refuses to dispose of his land in excess of 160 acres. In 1929, the Boulder Canyon Project Act was drawn up to allow the Imperial Valley to receive water from a reclamation project. In 1932, the Imperial Dam and All-American Canal were constructed. Some landowners in the Imperial Valley with vested water rights were declared immune from the 160-acre limitation law by the Project Act. The Bryant vs. Yellen court case signaled a change in the Supreme Court's position toward resolving conflicts between federal and state law over the delivery of reclamation water. By upholding the present perfected water rights, the court managed to avoid the controversial issue of reclamation policy which might be better addressed by Congress. (Geiger-FRC)
W82-04802

OIL SHALE AND WATER QUALITY: THE COLORADO PHOSPECTUS UNDER FEDERAL, STATE, AND INTERNATIONAL LAW,

Denver Univ., CO.
P. S. Dempsey.
Denver Law Journal, Vol 58, No 4, p 715-749, 1981. 244 Ref.

Descriptors: *Oil shale, *Legal aspects, Resources development, Water law, Legal review, Legislation, Water pollution, Environmental protection, *Water pollution control, *Colorado.

This article reviews the different levels of water pollution regulations and explores whether the United States' domestic oil shale reserves can be developed in a manner that not only promotes national energy policy but also accords with national environmental policy. An overview of the potential for water pollution associated with oil shale development is offered. The Federal regulatory scheme is discussed with emphasis on the federal water pollution contol act, including the National Pollutant Discharge limination System (NPDES) permit program and the dredge or fill permit program; the resource conservation and recovery act, including the hazardous waste management program and the solid waste disposal program; the safe drinking water act; and the effect of a federal permit. The Colorado Regulatory Scheme is discussed, including the state administration of the NPDES, RCRA, UIC, and section 404 programs; water quality protection via other means; water quality regulation and water rights; and federal preemption. The international environmental regime between the United States and Mexico is considered emphasizing the effect of the 1944 treaty between the countries in that the treaty does not specifically address water quality but does implicitly address it. The conventional and customary legal regimes are considered including the effect of United States Federal Precedent, International precedent, and the effect of customary international law. (Baker-FRC)
W82-04803

NON-INDIAN FEDERAL RESERVED WATER RIGHTS,

Hall and Evans, Denver, CO.
S. L. Waring, and K. S. Samelson.
Denver Law Journal, Vol 58, No 4, 783-799, 1981. 160 Ref.

Descriptors: *Reservation doctrine, *Water rights, Legal aspects, Water supply, Legal review, Legislation, Water law, Federal jurisdiction, State jurisdiction, Jurisdiction, *Montana.

The purpose of this article is to examine the extension of the Winters doctrine to non-Indian federal reservations and to consider some of the legal issues associated with this extension. Under the Winters doctrine, the United States Supreme Court determined that acquisition of the water rights for the Fort Balknap Indian Reservation was not governed by state law. Various types of Federal reservations and their sources of authorization are described, with a discussion of the applicability of the federal reserved water rights doctrine to each reservation. Special attention is given to a 1979 opinion of the Solicitor of the Department of the Interior, as this document represents the most comprehensive statement made by the Solicitor on federal reserved water rights. Recent trends and developments, however, suggest the declining fortunes of the doctrine of federal reserved water rights concludes. Many of the ambiguities of the reserved water rights doctrine will not be settled until they arise in the context of litigation. Congress has not enacted any legislation dealing explicitly with the reserved water rights doctrine. In contrast to congressional and executive inactivity, the Supreme Court limited the reserved water rights doctrine in the Mimbres decision, wherein the Court's restriction of reserved water rights to the primary purposes for which a particular reservation was originally created occurred even though Congress later enacted legislation expanding the purposes for which the reservation may be administered. This decision may mark the beginning of a trend toward a narrow construction of the reserved water rights doctrine and a step toward state control over water resources. (Baker-FRC)
W82-04804

GROUNDWATER MONITORING,

J. Josephson.
Environmental Science and Technology, Vol 15, No 9, p 993-996, September, 1981. 2 Fig.

Descriptors: *Groundwater, *Monitoring, *Water quality,. *Groundwater pollution, *Legislation, Measuring techniques, Water sampling.

It has been predicted that Federal legislation enacted during the last decade will result in the drilling and installation of over one million wells designed to monitor potential sources of groundwater pollution. Samples representative of aquifer conditions should be obtained in such a way that their chemical integrity is preserved to the fullest extent possible. Multilevel point sampling or other multilevel instruments amenable to use with individual positive-displacement pumping systems should be used for sample collection. Filtering and processing of the samples should be conducted in such a way that no volatiles are lost and that no change in pH, metal, or other oxidation-reduction sensitive constituents occurs. Oxygen invasion of

the sample must be avoided. A very detailed knowledge of the particular geologic and hydrologic formations and variables involved is essential to groundwater monitoring when the aquifer medium is porous carbonate rock. It may be advisable in many cases to run a geophysical survey to map aquifer size, shape, flow, and composition of the porous and impermeable media prior to the drilling of wells for monitoring. (Carroll-FRC)
W82-04809

SOME EMERGING RIGHTS IN AGRICULTURAL LAND,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden.
American Journal of Agricultural Economics, Vol 64, No 1, p 19-27, February, 1982. 36 Ref.

Descriptors: *Pollution control, *Legal aspects, Conservation, Wetlands, Land use, Water use, *Property rights, Economic aspects, Farming, *Agriculture.

A framework is set forth within which present reform efforts for soil conservation, nonpoint pollution control, wetlands protection and farmland preservation may be understood and from which flow implications for changes which are appropriate according to legal and economic criteria can be examined. In general society is well served by the liberal allocation of rights to farmland owners. The costs of monitoring and enforcing other arrangements would be prohibitive. Exceptions to this pattern are likely to occur where relatively little, easily identified land is involved, as with wetlands regulation. Much more change is apparent in the rules governing the exchange of rights. Where a reallocation of rights in response to new problems would be too costly or inconsistent with prevailing judicial sentiments, liability protections are attached to individuals' rights. This provides a mechanism by which the public interest can be served while providing fair compensation to owners whose rights are exchanged by fiat. It retains the flexibility of individual ownership and is consistent with the national ethic of maximum individual liberties consistent with the general welfare. (Baker-FRC)
W82-04890

ARIZONA GROUND-WATER REFORM: INNOVATIONS IN STATE WATER POLICY,
Arizona Univ., Tucson. Dept. of Political Science.
S. Hansen, and F. Marsh.
Ground Water, Vol, 20, No 1, p 67-72, 1982. 15 Ref.

Descriptors: *Water law, *Water policy, *Arizona, *Groundwater management, *Political aspects, *State jurisdiction, Economic aspects, Groundwater mining, Appropriation, Legal aspects, Judicial decisions, Administrative decisions, Water management, Groundwater depletion, Water rights, Policy making.

The major political forces in instituting reforms in Arizona groundwater law are described. Arizona groundwater policy is embodied mainly within the 1980 Groundwater Management Act. This legislation arose from Federal threats affecting a major reclamation project, special interest group pressures resulting from a 1976 decision restricting the transportation of ground water by municipal and industrial users, and the exploitation of groundwater causing dwindling supplies. The reform was achieved through structural decisions which delegated allocative decisions to the special interests directly affected by the ultimate policy. After basic decision costs had been incurred, the initiative was then ratified by the legislature in subsequent legislation without the need for the usual high legislative process costs. A Department of Water Resources was established by the 1980 Act which will be funded by a pump tax in addition to legislative appropriations. The Arizona Groundwater Management Act will only be as strong as it is flexible to handle economic, legal, and political shifts of the state through appropriate amendments in the future. (Geiger-FRC)
W82-04933

INSTITUTIONAL OBSTACLES TO WATER REUSE IN THE WESTERN UNITED STATES,
Dornbusch (David M.) and Co., Inc., San Francisco, CA.
For primary bibliographic entry see Field 6B.
W82-04958

STRIPMINING ARID NAVAJO LANDS IN THE US: THREATS TO HEALTH AND HERITAGE,
For primary bibliographic entry see Field 6D.
W82-05036

CONSEQUENCES AND RESPONSIBILITIES IN DROUGHT FORECASTING: THE CASE OF YAKIMA, 1977,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2E.
W82-05082

ACID RAIN: LEGAL AND POLITICAL FALLOUT,
ERT, Concord, MA.
M. R. Deland.
Environmental Science and Technology, Vol 16, No 1, p 27A, January, 1982.

Descriptors: *Acid rain, *Political aspects, *Legal aspects, Air pollution, Regulations, State jurisdiction, Public rights.

Acid precipitation presents a variety of legal and political problems. Many of the traditional mechanisms for environmental regulation are ineffective in dealing with acid rain, since pollutants originating in one area may result in acid rain in a far distant area which may be in another state, region, or even country. Efforts by the northeastern states to seek redress under the Interstate Pollution Abatement section of the Clean Air Act have met with extended delays within the Environmental Protection Administration. Several states have also filed suit in U.S. Circuit Courts of Appeals. These cases have not yet been resolved. Formal negotiations with Canada regarding acid rain have not resulted in agreement on this matter. A variety of legislative initiatives address acid rain either directly or indirectly and vary significantly in both the limitations on contributing pollutants and the enforcement remedies. There is significant disagreement regarding the effectiveness of the proposed measures in limiting acid rain, and many parties are suggesting further investigations before any action is taken. (Carroll-FRC)
W82-05147

NATIONAL WATER POLICY: THE NEED FOR INSTITUTIONAL REFORM,
Library of Congress, Washington, DC.
W. Viessman, Jr.
Environmental Management, Vol 6, No 1, p 35-41, January, 1982. 13 Ref.

Descriptors: *Water policy, *Resources development, Public policy, *United States, Water resources development.

The importance of modernizing and simplifying the United States' water management program on the national level has been reviewed. Since the early part of this century, over 20 commissions or committees have labored to identify water problems, evaluate the availability of water and consider new directions in water policy. Many of these efforts have been relegated to library shelves, and there is little to show from the work which went into them. This is explained in part by the fact that few of these reports acquired a strong political constituency. One major exception to the rule was the 1069 study by the Senate Select Committee on Water Resources. Only five general recommendations were made by this committee, but most of these saw legislative action. The Water Resources Council, the Office of Water Research and Technology, and the periodic national water resources assessment process are products of the work of that committee. The performance record of the committee was unusually good, due mostly to its Congressional membership which had the political strength to ensure that its findings would receive the attention of the Congress. Effective policy reform is considered urgently needed if this country is to avoid a major water crisis. (Baker-FRC)
W82-05180

IMPACT OF AMERICAN REGULATIONS ON INDUSTRIAL SLUDGE MANAGEMENT,
Metropolitan Sanitary District of Greater Chicago, IL.
C. Lue-Hing, D. Zenz, and D. Lordi.
Effluent and Water Treatment Journal, Vol 21, No 12, p 547-554, December, 1981. 12 Tab, 21 Ref.

Descriptors: *Industrial wastes, *Waste management, *Legal aspects, Political aspects, State jurisdiction, Federal jurisdiction, Wastewater management, Wastewater treatment, *Illinois, Regulations.

Federal, state, and local governments developed a variety of laws and regulations pertaining to the management of industrial waste residuals during the 1970s. Federal regulations pertaining to hazardous waste management and to the management of industrial wastes generally are reviewed. Illinois water pollution control legislation and solid waste management programs are reviewed as an example of state initiatives. Ordinances of the Metropolitan Sanitary District of Greater Chicago are used to illustrate local regulations. The two main sets of Federal regulations affecting industrial wastewaters are the Pretreatment Regulations, which govern the control of industrial wastes introduced into publicly-owned treatment works, and the Hazardous Waste Management System Regulations. Illinois regulates the disposal of industrial wastes through a program which requires the operator of a disposal site to obtain an additional permit for each type of industrial waste accepted and through the special waste hauling manifest program, which permits tracking of industrial wastes from their generation to final disposal by means of a permit and manifest system. The Chicago sanitary district regulates industrial wastes through concentration limits for 14 contaminants and limiting conditions for the discharge of industrial waste to the sanitary sewer system. Implementation of the Federal Resource Conservation and Recovery Act is expected to result in a reduction in groundwater pollution, a reduction in hazardous waste dumping, and shifting of the cost of hazardous waste disposal from the taxpayer to the industry. The costs for disposal of hazardous wastes may increase, and there may be a shortage of available disposal sites. However, many hazardous industrial wastes are disposed on site, exempting them from close scrutiny. (Carroll-FRC)
W82-05184

A CASE STUDY OF RURAL OPPOSITION TOWARD RIVER VALLEY PLANNING,
W. Bolstad, B. Mathur, and H. MacKnight.
Canadian Water Resources Journal, Vol 6, No 4, p 141-156, 1981. 3 Fig, 4 Ref.

Descriptors: *Water management, *Public opinion, *Rural areas, *Meewasin Valley Authority, *Saskatchewan, Public relations, Public participation, Recreation, Social aspects, South Saskatchewan River, Saskatoon, Water policy, Water law, Water resource development, River basins, Canada.

The Meewasin Valley Authority, established in October 1979 to protect and develop the South Saskatchewan River Valley's resources for recreational and other purposes, met opposition from the rural constituency soon after its organization. Initial opposition was from realtors and others with interests in land. The River Edge Heritage Association became the nucleus of the dissenters, who gained considerable political power. Several mistakes fueled the controversy. Committee members were not well informed about the objectives of the Authority prior to the planning process. As work progressed some realized they did not agree with the objectives. Of the public interest groups invited to praticipate in planning, none represented the rural interests. This was not a purposeful omission, but planners did not know that rural areas are rarely represented by well-organized interest

groups. The conceptual plan had not been based on recreational demand studies and included in the natural system jurisdiction much land for which there were no plans. As a result of public opposition the Authority's Act was amended and some powers were removed and diluted. An appeal mechanism was also added. (Cassar-FRC)
W82-05386

A FEDERAL PERSPECTIVE ON RIVER BASIN MANAGEMENT,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
R. L. Pentland.
Canadian Water Resources Journal, Vol 6, No 4, p 80-94, 1981.

Descriptors: *Water management, *Federal jurisdiction, *Water policy, Planning, *Canada, Water resources development, Public participation, Data collections, Research priorities, Governmental interrelations, Local governments, Provincial jurisdiction, Jurisdiction, River basins.

The role of Canada's Federal government in water management has evolved from that of primary developer to one of joint shared responsibility with provincial or local governments. Since the passage of the Canada Water Act in 1970 and other legislation, the expensive, time-consuming comprehensive approach to planning has been changed to a more action-oriented, site-specific approach. Examples of recent evaluation processes illustrate the informal customized approach. Some studies use a formal structured procedure, and others use only those steps necessary to obtain the desired results. The philosophy of data collection is to use existing data and analytical tools maximally, because time and resources for new data and tools are not usually available. Public consultation is applied extensively at all stages of planning. Methods of obtaining and transmitting information are tailored to the type of population, type and extent of communication networks, and existing level of awareness on environmental issues. During the next decade the trend toward further federal concentration international and interprovincial systems is expected to continue. Emphasis will be placed on defining numerical values of water quality and quantity. Comprehensive planning will be undertaken only when necessary, with more attention to local issues. Other major concerns will be balancing water supply and demand, research in the field of demand management, streamflow regulation and apportionment in interjurisdictional situations, and integration of model development and data collection. (Cassar-FRC)
W82-05388

RIVER BASIN PLANNING IN ALBERTA, CURRENT STATUS--FUTURE ISSUES,

C. L. Primus.
Canadian Water Resources Journal, Vol 6, No 4, p 44-50, 1981.

Descriptors: *Planning, *Water management, Land use, River basins,*Alberta, Water resources development, Water transfer, Water allocation, Water quality, Economic development, *Legislation, Canada.

In Alberta water resources are managed on a river basin basis. The six major basins are Oldman, Bow, Red Deer, North Saskatchewan, Athabasca, and Peace. The basic objective of water resources management is to support the overall economic and social objectives of the province and to ensure that good quality water is not a limiting factor in achieving these objectives. Legislative acts dealing with water resources management are the Water Resources Act (concerns only the water resource), the Public Lands Act, and the 1977 Planning Act (land use planning and regulation). To date 7 basin and sub-basin plans have been completed and are being implemented. More comprehensive long range planning for the major basins has started with the South Saskatchewan River basin. Major issues in water management are allocation of water between basins, reallocation of existing supplies to more beneficial uses, water supply and quality as constraints to development, and establishing minimum flow requirements for stream maintenance and fisheries habitat protection. (Cassar-FRC)
W82-05390

RIVER BASINS AND WATER MANAGEMENT IN NEW BRUNSWICK,

New Brunswick Dept. of Fisheries and Environment, Fredericton.
For primary bibliographic entry see Field 6D.
W82-05391

RIVER BASIN MANAGEMENT IN ONTARIO,

J. R. Powell.
Canadian Water Resources Journal, Vol 6, No 4, p 51-65, 1981. 1 Fig.

Descriptors: *Water management, *Political constraints, *Local governments, *Ontario, Canada, River basins, Conservation Authoriities, Institutional constraints, Governmental interrelations, Financing, Water policy, Water resources development.

River basin management in Ontario is carried out by 39 Conservation Autorities, corporate bodies established by order-in-Council at the request of two thirds of the participating municipalities. This implies local management of water resources with support of the provincial and federal governments. Although significant accomplishments have been made under this system, there are many shortcomings and problems, largely political, financial, or structural. Political impediments include unclear and irrelevant policies on water management objectives, the push to eliminate Conservation Authorities and other special-purpose bodies, and the fact that authority members are not directly elected. Financial impediments include conditional grants, the proliferation of government personnel in the paperwork and administration aspects of water management, and the use of money generated by natural resources (such as forests) for popular social programs rather than for reinvestment in the resources. Structural impediments are lack of authority and jurisdiction to carry out programs, the large number of river basins not included within a Conservation Authority, and fragmentation in the extension services and in the agencies which provide money to the Conservation Authorities. The most cost-effective way of handling water resource management is a major increase in local responsibility. Some ways of accomplishing this are direct election of Conservation Authority members, deconditionalizing of grants, charging users for services, a five-fold increase in budgets, development of comprehensive river basin plans, transfer of many of the resource management functions to the Conservation Authorities, and removal of political structures. (Cassar-FRC)
W82-05393

PROMISING STEPS TOWARD A NEW OTTAWA RIVER REGULATION,

A. Harvey.
Canadian Water Resources Journal, Vol 6, No 4, p 174-186, 1981. 2 Fig, 5 Ref.

Descriptors: *Flood control, *Reservoir operation, *Water management, *River basins, Flow regulation, Ottawa River, Montreal, *Quebec, Ottawa River Regulation Planning Committee, Planning, Reservoir storage, Optimization, *Water policy, Water resources development, Canada.

The Ottowa River Regulation Planning Committee was established in 1977 to recommend flood regulation measures for the 146,334 sq km basin, located in Quebec and Ontario. The river system was well developed, with 30 large reservoirs and many smaller ones, used for hydroelectric power generation, logging, recreation, flood control, and navigation. The Committee's final report, issued in December 1980, recommended an administrative structure and use of a flexible linear optimization model for integrated operation of the existing reservoir system. This integrated operation was expected to produce a 10% flow reduction, with expectation of further flow reduction with improvements in models and forecasting and construction of new reservoirs. (Cassar-FRC)
W82-05394

NEW STRATEGIES FOR WATER RESOURCE PLANNING IN BRITISH COLUMBIA,

Department of the Environment, Victoria (British Columbia).
J. O'Riordan.
Canadian Water Resources Journal, Vol 6, No 4, p 13-43, 1981. 6 Fig, 5 Tab.

Descriptors: *Water management, *Planning, *Watershed management, *British Columbia, Canada, *Water resources development, Regional planning, Water quality management, Fisheries, Okanagan River, Nicola River, Strategic planning, *Water policy, Water resources development, River basins.

British Columbia experiences a variety of problems in water quality and managment--sedimentation from forestry, lake eutrophication, pollution from industrial discharges, lake shore developments, reservoir level fluctuations, flooding, and hydropower, development in scenic rivers. Provincial response has usually been reactive, emphasizing allocation and regulation rather than long-term management. Some more comprehensive planning and implementation programs have been undertaken with less than satisfactory results. These shortcomings have led to a new approach, strategic planning, combining comprehensive planning with increased flexibility. This approach is characterized by a regional concept (one or more watersheds), integration of water and related issues, use of existing data, and commitment to implementation. The strategic planning system is two-tiered. A policy framework is provided for a set of operational activities on a more site-specific basis. This method is illustrated using improvement in water quality for streams in the Nicola Basin, balancing the irrigation interests against the fisheries interests. (Cassar-FRC)
W82-05395

THE STATUS OF GROUNDWATER LAW IN NEW YORK STATE,

S. J. Spiegel.
Clearwaters, Vol 11, No 4, p 15-16, 1981.

Descriptors: *Groundwater, *Legal aspects, *Water quality, *New York, Regulations, Legislation, Standards, *Groundwater management, Groundwater pollution.

Groundwater law in the urban, industrially oriented eastern United States has reflected the area's relatively abundant water supply. The policy of the common law has been to encourage consumption of water rather than to protect the resource from abuse. Regulations do not effectively address all aspects of the groundwater picture. Problems which have affected groundwater fall into four categories: direct wastewater discharge to the aquifer from septic tanks, etc.; land disposal of waste in landfills, where even relatively harmless solids can result in leachate contaminating surrounding waters; contamination by non-disposal activities such as petroleum exploration, mining, storage tank spills, irrigation return flow, and infiltrating stormwater, and the relationship between depletion and pollution, including instances where withdrawal modifies natural patterns of hydrologic flow. New York regulations which contain references to groundwater protection include the Groundwater Classifications, Quality Standards and Effluent Standards, which define groundwaters and provide quality standards for potable and consumptive uses; part of the State Sanitary Code, which defines the term source of water supply; the Solid Waste Management Facilities regulations, which also defines groundwater; the Freshwater Wetlands Act, which serves to protect wetland functions, including that of a recharge area for groundwater resources; and the State Environmental Quality Review Act. In most cases the groundwater management policy is only secondarily implemented through water quality, hazardous waste and general environmental regulations. This may not provide effective protection of the

groundwater resources, especially in light of modern technological knowledge. (Baker-FRC)
W82-05400

INSTITUTIONAL CHANGE - WATER QUALITY MANAGEMENT,

R. D. Hennigan.
Clearwaters, Vol 11, No 3, p 6-7, 9-12, September, 1981. 2 Tab.

Descriptors: *Water quality, *Water management, *Legal aspects, Water resources development, Legislation, Regulations, *New York, Watershed management, Local governments, Lake watersheds.

Findings from the Central New York Water Quality Management Project have been summarized. It was learned from the study that water quality management is complicated by numerous regulations which frustrate local leadership and initiative; that under New York State constitutional law it is impossible to form local multi-county agencies, that many of the counties of Central New York operate under the county law, forcing many water quality management issues to be evaluated on a short term and out of context of other county activities; that lake watersheds usually encompass many municapilities and often cross county boundaries; and that effective water quality management programming can be effected be developing a comprehensive monitoring system. It was recommended that thee state constitution be amended so that counties can form multi-county agencies at their discretion to carry out regional missions under local control and direction; that county law should be amended to explicitly allow the counties to form water quality management agencies; that counties be allowed to develop and adopt administrative codes; and that an institutional mechanism be created to allow residents and users of lake watersheds to implement local action programs to protect water quality. (Baker-FRC)
W82-05401

GROUNDWATER STRATEGY: PROTECTING A VITAL RESOURCE,

For primary bibliographic entry see Field 5B.
W82-05403

WATER RESOURCES IN THE LEGISLATIVE BALANCE, 1982,

Library of Congress, Washington, DC.
W. Viessman, and C. Copeland.
Water/Engineering and Management, Vol 128, No 12, p 32-33, December, 1981.

Descriptors: *Water resources development, *Wastewater treatment, *Dams, *Flood plains, *Economic aspects, Legal aspects, Water supply, Economic evaluation, Water pollution control, *Water quality standards, Legislation.

Water resource topics that are likely to appear on the Congressional agenda in 1982 are identified. These include: (1) revising the provision that allows the Enviromental Protection Agency to prescribe water supply system treatment techniques, (2) increasing the scientific burden of proof that must be met before establishing national drinking water standards, (3) reviewing the adequacy of the Safe Drinking Water Act and other laws protecting groundwater resources, and (4) continuing debate on the block grant approach to funding water projects. (Titus-FRC)
W82-05433

THE RECOMMENDATIONS OF THE UNITED NATIONS WATER CONFERENCE (MAR DEL PLATA, 1977) AND RELATED MEETINGS, ON NATIONAL WATER LAWS,

International Water Resources Association, Buenos Aires (Argentina).
C. J. Cano.
Journal of Hydrology, Vol 51, No 1-4, p 381-391, May, 1981. 29 Ref.

Descriptors: *Legal aspects, *Water management, *Federal jurisdiction, State jurisdiction, Regulations, Water law, Planning, International law, Conferences.

Lawyers must work together with hydrologists, hydraulic engineers, sociologists, economists, planners, and administrators if they are to develop water laws which provide workable legal solutions to water resource management problems. This paper, prepared by a lawyer, is designed to provide non-legal professionals with information on the state-of-the-art of legal water science in the world as of 1977. Recommendations with respect to national water legislation and administration prepared by the United Nations Water Conference (U.N.W.C.), held in Mar del Plata, Argentina in 1977, and other preparatory or related international conferences are reported. Recommendations developed by the Conference addressed water policy and law, problems in preparing national water legislation, the content of water legislation, water law and water administration, and problems related to inter-jurisdictionality. The recommendations addressed such specific subject matter as water ownership; water rights; water engineering works; use of water by agriculture, fisheries, and industries; pollution; environmental impact; taxation and economic incentives; floods and other emergencies; scenic rivers; and users' participation in planning and decision-making. Recommendations made by the u.N.W.C. with respect to training and research in the field of water law are also discussed briefly. (Carroll/Frc)
W82-05492

SERVICING GROWTH IN THE METROPOLITAN TORONTO REGION DURING THE EARLY YEARS OF THE ONTARIO WATER RESOURCES COMMISSION: 1956-1968,

R. Bordessa, and J. M. Cameron.
Canadian Water Resources Journal, Vol 5, No 1, p 1-29, 1980. 1 Fig, 14 Ref.

Descriptors: *Urban development, *Land use, *Political aspects, Wastewater treatment, Ontario Water Resources Commission, Metropolitan Toronto Planning Board, Toronto, Ontario, Decision making, Sewer systems, Planning, Water policy, Water management.

The impact of the Ontario Water Resources Commission (OWRC) on growth in the metropolitan Toronto region is examined from 1956, the year of its inception, to 1968, the year of its maximum influence and beginning of curtailment in power. The origins and mandate of the OWRC and the overlapping interests and jurisdiction with the Metropolitan Toronto Planning Board (MTPB) are discussed. Three case studies illustrate the details of planning for sewage provision in the fringe areas of the city. Markham Village's request for a wastewater treatment plant to serve 4000 persons showed the decreasing effectiveness of the MTPB in maintaining the principle that servicing agreements should be contingent on planning for land use. During the several years that this request was unresolved, OWRC increased in importance and finally convinced the officials to approve funds necessary for construction. The OWRC also dominated the decision to install a package treatment plant in Markham Township rather than connect with the metropolitan Toronto sewage system as proposed by the MTPB. The eventual outcome of this case was connection with the metropolitan sewage system and a reversal of the OWRC's position on upstream plants. The last vestiges of MTPB's control over growth in fringe areas were removed by the water and sewage services plan promoted by the OWRC in South Peel. This $80 million scheme services 200 sq miles and a projected 1 million people. Growth in the outlying areas of Toronto during this period was clearly a result of servicing decisions rather than planned land use decisions. (Cassar-FRC)
W82-05566

FEDERAL WATER POLLUTION REMEDIES: NON-STATUTORY REMEDIES ARE ELIMINATED,

L. T. Vance.
Land and Water Law Review, Vol 17, No 1, p 105-137, 1982. 205 Ref.

Descriptors: *Water law, *Judicial decisions, *Legal aspects, Legislation, Water pollution, Nuisance, Regulations, Common law, Liability, Remedies, Damage, Federal Water Pollution Control Act Amendments.

Three Federal water pollution remedies--the federal common law of nuisance, the Federal Water Pollution Control Act Amendment of 1972 (FWPCAA), and private remedies implied from the provisions of the FWPCCA--are examined. In several recent decisions the U.S. Supreme Court eliminated the implied rights of action to enforce the FWPCAA and federal common law nuisance actions which seek to enjoin approved conduct. The pertinent cases were Illinois v. City of Milwaukee (which preceded the FWPCAA of 1972 by a few months), City of Milwaukee v. Illinois and Michigan (1982), and Middlesex County Sewerage Authority v. National Sea Clammers Association (1982). However, the court's decisions have effectively protected dischargers from liability for damages caused by their pollution. The federal common law of nuisance, which could play a supplemental role in achieving the goals of the FWPCAA, should be preserved to encourage citizens and states to undertake litigation against polluters. (Cassar-FRC)
W82-05603

HISTORY, PRACTICE AND EMERGING PROBLEMS OF WETLANDS REGULATION: RECONSIDERING SECTION 404 OF THE CLEAN WATER ACT,

Popham, Haik, Schnobrich, Kaufman and Doty Ltd., Denver, CO.
G. E. Parish, and J. M. Morgan.
Land and Water Law Review, Vol 17, No 1, p 43-84, 1982. 138 Footnotes.

Descriptors: *Water law, *Wetlands, *Dredging, *Permits, Regulations, Clean Water Act, Fill permits, Water quality control, Legislation, Jurisdiction, Navigable waters, Legal aspects, Fish, Wildlife, Spoil disposal, Land use.

Section 404 of the Clean Water Act required potential dischargers to secure permits from the Corps of Engineers before dredge or fill materials are dumped into navigable waters. Securing a permit is very difficult, entailing complex application procedures and involvement with several federal agencies. This paper examines the Section's deviations from the Congressional purpose and constitutional foundations of water law, the process problems involved in securing a permit, and suggestions for facilitating the process. Jurisdictional problems arise in the definition of whether a wetland is water and which waters are considered navigable. Permits are not needed for dredged and fill material from several specified activities such as agriculture, structure maintenance, and construction of irrigation or drainage ditches and ponds. General permits, allowing some activities to take place without going through the application process, were intended to simplify the process but have produced the opposite result. Standards for permit review have been broken down into 12 general policies, the most important of which are public wildlife. Permit processing procedures are described for routine cases and cases in which controversy is expected. Suggestions for reform are discussed under the categories: legislative (jurisdictional, permit standards, permit procedures reform) and alternatives to wetland protection (regulatory and nonregulatory). (Cassar-FRC)
W82-05604

CONFLICT BETWEEN ESTABLISHMENT OF INSTREAM FLOWS AND OTHER WATER USES ON WESTERN STREAMS,

Colorado State Univ., Fort Collins.
R. L. Anderson.
Water Resources Bulletin, Vol 18, No 1, p 61-65, February, 1982. 7 Ref.

Descriptors: *Instream flow, *Legal aspects, *Water rights, *Water use, Water management, *Competing use, Water allocation, Water supply, *Western United States.

Concentrated efforts have been made in the past two decades to establish and legitimize public use of water for recreation, scenic, esthetic, water quality, fisheries, and similar instream uses. However, application of minimum instream flow policies and programs to western rivers can result in conflicts with other long established users as a result of climatic conditions. The economic and social structure of many western areas is dependent on utilization of limited and highly stochastic water supplies. In some cases, the specified flow required to meet the instream flow uses exceeds the average natural flow of the particular river. In many other cases, the specified instream flow requirement would necessitate diverting flow from uses already in place or from anticipated and already-planned uses. Many of the current users have made significant financial investments in systems which depend on access to given water supplies. In addition, water rights in western states constitute property rights subject to due process and compensation. Therefore, attempts to deprive these users of their current water supplies could be expected to result in intense legal proceedings with respect to constitutional rights and property rights. It is concluded that establishment of minimum instream flows on western streams will be difficult and costly in many cases, create conflict in almost all instances, and disrupt established water uses or threaten to disrupt water development plans of many users. (Carroll-FRC)
W82-05749

THE OKANAGAN BASIN AGREEMENTS--AN EXAMPLE OF INTEGRATED WATER RESOURCE PLANNING IN BRITISH COLUMBIA,
A. M. Thomson.
Canadian Water Resources Journal, Vol 5, No 3, p 6-14, 1980. 2 Fig.

Descriptors: *Water management, *Water policy, Okanagan River, *British Columbia, Canada, Planning, Water quality, Water supply, Recreation, Fisheries, Environmental effects, Social impact, Flood plain management, Flow regulation, Public opinion.

The Okanagan Basin Study and subsequent Implementation Agreement illustrate integrated water resources planning in British Columbia. Two major problems exist in this arid, warm region, 3165 sq miles in area: extremely variable annual runoff (80,000 to 800,000 acre feet) and deterimorating water quality caused by population growth. The Basin Study, undertaken jointly by the provincial and federal governments in 1969-73, developed a framework plan for water management to the year 2020. Goals were not limited to economic growth as in the past, but also included environmental quality and social betterment. In February 1976 the provincial and state governments entered into an Implementation Agreement. The main activities involve development actions to achieve plan objectives, monitoring of the effectiveness of these actions, and a comprehensive review in 1980 and 1981. Major components of development action are water quantity, water quality, fisheries, and recreation. Public response will be reflected during the implementation phase. (Cassar-FRC)
W82-05779

THE SAFE DRINKING WATER ACT ON REVIEW,
Johnson (C. C.) and Associates, Inc., Silver Spring, MD.
For primary bibliographic entry see Field 5G.
W82-05792

LAW FOR ENVIRONMENTALISTS,
For primary bibliographic entry see Field 5G.
W82-05813

THE NATIONAL INTERIM PRIMARY DRINKING WATER REGULATIONS, PART I - HISTORICAL DEVELOPMENT,
Northern Illinois Univ., DeKalb. School of Allied Health Professions.
For primary bibliographic entry see Field 5G.
W82-05814

THE NATIONAL INTERIM PRIMARY DRINKING WATER STANDARDS. PART II. IMPACT ON COMMUNITY WATER SYSTEMS. THE INDIANA EXPERIENCE,
Northern Illinois Univ., DeKalb. School of Allied Health Professions.
For primary bibliographic entry see Field 5G.
W82-05815

AMERICAN INDIAN WATER RIGHTS AND THE USE OF COLORADO RIVER WATER,
S. K. Smith.
Water Supply and Management, Vol 6, No 1-2, p 75-86, 1982. 1 Fig, 4 Tab.

Descriptors: *Riparian rights, *Water law, *Colorado River, *River basin development, *Water demand, Water rights, River basins, Water resources development, Water policy, Legal aspects, Resources development, Water supply development, Natural resources.

Indian Water rights are considered paramount over nonIndian water rights because nearly all Indian reservations were created prior to the diversion of waters from the rivers of the Western United States by nonIndian interests. This theory was reinforced by the Supreme Court decision in the case of Winters vs. U. S., in which it was stated that Indians has command of the lands and the waters on Indian reservations. The quantification of these water rights is still being litigated for Indian reservations in the Colorado River Bbasin. The waters of the Colorado River are important to the Indians not only for domestic and agricultural needs, but for sacred purposes and fishing as well. Significant energy resources are located on Indian lands, but many impediments exist to their development. More compromise between factions of varying interests will be needed in the future for the development of competing water demands and the definition of Indian water rights. (Geiger-FRC)
W82-05885

6F. Nonstructural Alternatives

FLOODS OF SEPTEMBER 16, 1975 IN TALLABOA VALLEY, PUERTO RICO,
Geological Survey, San Juan, PR. Water Resources Div.
K. G. Johnson.
Geological Water Resources Investigations, Open-File Report 80-1283, April 1981. 5 Sheets, 10 Fig, 1 Tab, 4 Ref.

Descriptors: *Floods, *Floods frequency, *Flood peak, *Flood plain management, Flood discharge, Flood recurrence interval, Flood profiles, Flood data, *Puerto Rico, *Tallaboa Valley.

The most severe flood since 1928 inundated the Rio Tallaboa Valley on the south coast of Puerto Rico on September 16, 1975. Peak discharge was about 666 cubic meters per second. The flood has an estimated recurrence interval of 20 years. The data provided in the report can be used in making rational decisions in formulating effective floodplain regulations that would minimize flood problems in the Tallaboa Valley. (USGS)
W82-05230

CAN THE GOALS OF THE UN DECADE ON WATER SUPPLY AND SANITATION BE ACHIEVED,
Amsterdam Water Works (Netherlands).
For primary bibliographic entry see Field 6B.
W82-05365

RIVER BASIN PLANNING IN ALBERTA, CURRENT STATUS--FUTURE ISSUES,
For primary bibliographic entry see Field 6E.
W82-05390

THE UNCERTAIN QUEST FOR A MANAGEMENT STRATEGY IN THE FRASER ESTUARY,
British Columbia Univ., Vancouver. Westwater Research Center.
A. H. J. Dorcey.
Canadian Water Resources Journal, Vol 6, No 4, p 95-118, 1981. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Water management, *Planning, *Decision making, Water quality management, *Fraser River, *Estuaries, River basins, Management, Data collections, Political constraints, Institutional constraints, Water policy, Water resources development, *British Columbia, Canada.

The growing pressure of conflicting interests in the Fraser River estuary led to intensive planning activities during the 1970's. The expansion of the Vancouver Airport was a catalyst in development of an estuary management plan. The Fraser River estuary study was initiated in 1977 to focus on all uses of estuarine resources. In Phase I reports were prepared on land use, transportation and port development, water quality, recreation, and habitats. This pointed out the need for a comprehensive management plan, designated as Phase II and scheduled for completion in 1982. Progress has been made in generating information necessary for decision making, especially from the required environmental impact assessments. Description knowledge is presently fair to very good in most fields, but functional knowledge (causes and effects) is still only poor to fair, except in hydrology. This lack of knowledge is a major constraint on decision making. Negotiations have been successful within the government but not among non-governmental interests. Phase I suggested new institutional arrangements for linking decision making with organizational arangements for planning. Three interagency groups were suggested: a constituency (all interested parties), a policy group (key agencies), and an estuary council (small group responsible for formalizing policies). (Cassar-FRC)
W82-05392

RIVER BASIN MANAGEMENT IN ONTARIO,
For primary bibliographic entry see Field 6E.
W82-05393

FLOODPLAIN ANALYSIS, SIMPLIFIED VS. COMPLEX METHODS: A CASE STUDY,
Enviroscience, Inc., Minneapolis, MN.
For primary bibliographic entry see Field 4A.
W82-05732

STRATEGIES FOR REUSE AND CONSERVATION,
Dames and Moore, Houston, TX.
For primary bibliographic entry see Field 3C.
W82-05790

6G. Ecologic Impact Of Water Development

AN ECOLOGICAL STUDY OF AN ANTARCTIC FRESHWATER POOL WITH PARTICULAR REFERENCE TO TARDIGRADA AND ROTIFERA,
Department of Science, Melbourne (Australia).
For primary bibliographic entry see Field 2H.
W82-04950

RARE AND ENDANGERED SPECIES: FRESHWATER GASTROPODS OF SOUTHERN NEW ENGLAND,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 5C.
W82-04968

ILLINOIS WETLANDS: THEIR VALUE AND MANAGEMENT,
Rock Valley Metropolitan Council, Rockford, IL.
H. E. Bell, III.
Illinois Institute of Natural Resources, Chicago, Document No 81/33, October 1981. 133 p 5 Fig, 12 Tab, 121 Ref.

Descriptors: *Wetlands, *Wildlife habitats, *Wildlife conservation, *Resources management, Ecology, *Drainage, Sediments, Water pollution control, Permits, Economic justification, Swamps, Marshes, Soil types, Soil saturation, Preservation, *Illinois.

In the last 100 years, approximately 99.5 percent of Illinois wetlands has been destroyed because they were considered useless and the land could be put to better use with higher economic yield. This report details the diverse value of wetlands and outlines the means of preserving, restoring, and managing them. Wetlands are valuable for many reasons: they provide a habitat for threatened and endangered species; they filter pollutants from rivers and lakes without the high cost of treatment plants, i.e., excessive nutrients are chemically locked into wetland soil or absorbed by plants; and they can act like sponges during floods by storing water in floodplain forests, in depressions like shrub swamps and marshes, or in sandy soils. There are also potential benefits in treating wastewater with artificial wetlands. Most Illinois wetlands are theatened with destruction; federal, state, and local laws---404 permits, Section 10 permits, the Endangered Species Act---do not provide adequate protection. Local citizens need to take a more active role in wetlands protection and management by voicing their concerns to the agencies responsible for administering the regulations, such as regional planning commissions and councils of governments. Wetlands can be protected by public acquisition, such as by the U.S. Fish and Wildlife Service and the Illinois Department of Conservation. Landowners must also protect their wetlands from adjacent land use that can disturb their hydrology or vegetation. Wetlands are not wastelands and should be managed for all the benefits they offer. Preservation is the best type of management. (Atkins-Omniplan)
W82-05053

THE ECOLOGY OF BOTTOMLAND HARDWOOD SWAMPS OF THE SOUTHEAST: A COMMUNITY PROFILE,

Georgia Univ., Athens. Inst. of Ecology.
C. H. Wharton, W. M. Kitchens, E. C. Pendleton, and T. W. Sipe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-199837, Price codes: A07 in paper copy, A01 in microfiche. Biological Services Program FWS/OBS-81/37, March, 1982. 145 p, 53 Fig, 17 Tab, 281 Ref, 1 Append.

Descriptors: *Bottomland, *Swamps, *Ecology, *Hydrology, *Flood plains, Wetlands, Runoff, River systems, Fauna, Plant populations, Geochemistry, Water level fluctuations, Erosion, Soil water, Flooding, Hardwood swamps, Southeast United States.

Bottomland hardwood forests and their fauna comprise remarkably productive riverine communities adapted to a fluctuating water level ecosystem characterized and maintained by a natural hydrologic regime of alternating annual wet and dry periods. This community profile has been prepared in part to provide information for management decisions. The entire bottomland over which flooding occurs is a functional part of the wetland system and must be considered as a unit when making resource decisions. Water is the driving force of the bottomland hardwood community. Sources of water to bottomlands include precipitation and runoff from mountains and Piedmont, groundwater from rainfall, underground aquifers, continuous seepage from sand aquifers, and tidal flow. The physicochemical environment of the floodplains is a function of the interactions or processes occurring in the water column, in soil, and at the soil-water interface. The plant species and communities that inhabit the floodplain can be considered as buffers that absorb and dissipate the physical energies of the riverine system. Water movement is slowed and erosion is held in check through the anchoring of sediments by root systems, the deposition of sediments that are dropped from the slowed water column, and the reduction of the water column by the spreading out of water. The buffering role of the plant communities is also evident in the biogeochemical cycles of the riverine-palustrine system. The moisture gradient and hydroperiods of floodplains provide a continuum for a diverse fauna. Bottomland swamps are integrally coupled to the surrounding uplands, downstream estuarine systems, and the atmosphere. (Moore-SRC)
W82-05054

MAN-MADE STORAGE OF WATER RESOURCES--A LIABILITY TO THE OCEAN ENVIRONMENT. PART II,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 4A.
W82-05126

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 2 - ENVIRONMENTAL CONTROL TECHNOLOGY,

California Univ., Livermore. Lawrence Livermore Lab.
For primary bibliographic entry see Field 5E.
W82-05213

AN ASSESSMENT OF GEOTHERMAL DEVELOPMENT IN THE IMPERIAL VALLEY OF CALIFORNIA; VOLUME 1 - ENVIRONMENT, HEALTH AND SOCIO-ECONOMICS,

California Univ., Livermore. Lawrence Livermore Lab.
L. Anspaugh, N. Crow, D. Ermak, C. Hall, and J. Kercher.
Department of Energy Report DOE/EV-0092, July 1980. 246 p, 53 Fig, 25 Tab, 203 Ref, 1 Append. Layton, D., ed. W-7405-ENG-48.

Descriptors: *Geothermal resources, *Environmental effects, *Social impact, *Economic impact, *Geothermal power, Resources development, Public health, Subsidences, Cooling water, Injection, Irrigation, Wastewater disposal, Irrigation-return flow, Salinity, Salton Sea, *Imperial Valley, California.

The Imperial Valley contains nearly a third of the nation's identified hot-water geothermal resources. The valley, with its 475,000 acres of irrigated lands and warm climate, also represents one of the more important agricultural resources of the United States. The most important potential impacts involve air quality changes resulting from emissions of hydrogen sulfide, and increases in the salinity of the Salton Sea resulting from the use of agricultural waste waters for power plant cooling. Extensive withdrawals of agricultural waste waters to support geothermal development will accelerate increases in the Salton Sea's salinity, putting added stress on its quasi-marine ecosystem. Large withdrawals of waste waters would not be necessary if steam condensate was used as the sole source of cooling water for flashed-steam power plants. A county policy favors the full injection of withdrawn geothermal fluids in order to protect against land subsidence, and therefore external sources of water will probably be needed for geothermal operations. For the most part, geothermal activities will be compatible with irrigated agriculture, but negative impacts of a site-specific nature caused by land subsidence, cooling tower drift, or accidental spills of geothermal fluids could occur. Residual geothermal fluids will be disposed of by subsurface injection to geothermal reservoirs. The socioeconomic consequences of geothermal development will generally be beneficial. (Moore-SRC)
W82-05214

DEVELOPMENT OF NATURAL SUBIRRIGATION OF LANDS AND ITS PREDICTION NEAR LARGE RESERVOIRS,

Northern Scientific Research Inst. of Hydraulic Engineering and Reclamation, Kazan (USSR).
For primary bibliographic entry see Field 4A.
W82-05238

THE ECOLOGICAL CASE FOR THE CREATION OF THE DANUBE-DNIEPER WATER RESOURCES UTILIZATION SYSTEM,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. D. Romanenko, O. P. Oksiyuk, V. N. Zhukinskiy, and Y. R. Shelyag-Sosonko.
Hydrobiological Journal, Vol 16, No 1-10, 1980. 3 Ref.

Descriptors: *Ecological effects, *Water resources development, *Aquatic life, *Danube River, *USSR, Reservoirs, Diversion structures, *Dnieper River, Black Sea, Rivers, Salinity, Waterlogging, Canals, Water conveyance, Algae, Phytoplankton, Fish management, Water quality, Self-purification, Geochemistry, Groundwater levels, Vegetation, Hydraulic structures.

The ecological results of the proposed Danube-Dnieper water diversion project must be considered in the planning stage. The project involves water bodies of different types: rivers, estuarine regions, salt water lagoons, canals, and conduits. Many changes in water quality and biological life will be produced by water resources development in this region. Closing the estaries will freshen water there, replacing marine ecosystems with fresh water ecosystems. Limitation of discharge into the Black Sea will change the salinity and the nature of the aquatic life there. Construction of the Ochakov barrage will transform the Dnieper-Bug salt lagoon into a fresh water body and act as an obstacle to diadromous fish spawning. However, reproduction of bream, pike, and perch will be improved. The nature of the artifical water courses (canals and closed conduits) and pumping stations can profoundly affect water quality and phytoplankton populations. Possible effects on the land include changes in groundwater levels, salinization, and vegetation changes. (Cassar-FRC)
W82-05329

FISHERY IMPORTANCE OF THE URAL-CASPIAN FISHING DISTRICT AND PROBLEMS OF ITS WATER SUPPLY,

For primary bibliographic entry see Field 8I.
W82-05342

THE SHUBENACADIE-STEWIACKE RIVER BASIN STUDY,

Department of the Environment, Halifax (Nova Scotia).
For primary bibliographic entry see Field 6B.
W82-05385

CALIFORNIA'S PERIPHERAL CANAL: SKIRTING THE DELTA - AND THE ISSUES,

For primary bibliographic entry see Field 4A.
W82-05411

ENVIRONMENTAL ASPECTS OF MULTIPURPOSE RESERVOIR PROJECTS IN DEVELOPING COUNTRIES,

H. F. Ludwig.
Water Science and Technology, Vol 14, No 1/2, p 269-280, 1982. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Environmental impact statement, *Developing countries, *Water resources development, *Thailand, *Multipurpose reservoirs, Planning, Reservoirs, Dam effects, Mekong River, Fisheries, Forestry, Wildlife, Economic impact, Social impact, Monitoring.

In Thailand water development projects have been planned to meet specific needs (power generation, irrigation, and flood control), with little attention paid to environmental impacts. This traditional attitude needs to be modified to consider effects of reservoirs on water quality and ecology to make them truly multipurpose. Fisheries, forestry, wildlife, agro- and other local industries, families in the zone of inundation, and villages outside the flooded region are all environmental issues which should be included in total planning. Continued monitoring of project impacts after construction, rarely done at present, can be valuable in planning future projects. Supplemental tables and graphs give suggested budget allowances for environmental impact assessment studies in Thailand and environmental impact guidelines for dams and reser-

voirs. For additional help 25 references on environmental impact statement methodologies which are applicable to dam and reservoir projects and six environmental impact statement reports on Thailand projects are given in the appendix. (Cassar-FRC)
W82-05426

THE LONG LAKE DIVERSION: AN ENVIRONMENTAL EVALUATION,

Ontario Ministry of Natural Resources, Thunder Bay.
S. E. Peet, and J. C. Day.
Canadian Water Resources Journal, Vol 5, No 3, p 34-48, 1980. 3 Fig, 15 Ref.

Descriptors: *Environmental effects, *Diversion structures, *Water transfer, Long Lake, Ontario, Lake Superior, Aguasabon River, Kenogami River, Albany River, Interbasin transfers, Social impact, Economic impact, Logging, Pulp and paper industry, Reservoirs, Canals, Rivers, Water management, Water quality, Water pollution effects, Recreation, Aesthetics, Erosion, Shores, Aquatic life, Fish, Hydroelectric stations, Dams.

The environmental effects of the Long Lake Diversion, northern Ontario, were evaluated. The first phase, consisting of two dams and a 5-1/4 mile diversion canal, redirected the northward flowing Kenogami River south to Lake Superior. The second phase, completed in 1948, added a dam and hydroelectric station. At that time power generation and interbasin pulpwood transportation began. Effects of the four types of hydrologic modifications were: (1) downstream--highly variable flow conditions, habitat losses, decreased biological production, esthetic impairment, little socioeconomic effect, (2) Long Lake receiving water body--alteration of 10 miles of the Kenogami River with resultant navigational and esthetic impairment, severe shoreline erosion, flooding, accumulation of logging debris, interference with a municipal water supply inlet, damage to an Indian cemetary, (3) diversion channel--disturbance of fish habitats and interbasin movement, temporary construction effects, increase in aquatic macroinvertebrates, damage to fish spawning beds, impairment of water quality and esthetic values, and (4) reservoir--minimal effects due to good planning. Forty years of log handling has negatively affected water quality, aquatic communities, and recreational users. However, economic analysis and a public opinion questionnaire indicated that the overall social and economic benefits have exceeded the negative effects. (Cassar-FRC)
W82-05568

STREAM IMPROVEMENT: THE CHICOD CREEK EPISODE,

Soil Conservation Service, Greenville, NC.
For primary bibliographic entry see Field 4D.
W82-05717

NORTHWESTERN ONTARIO RIVER DIMENSIONS,

Simon Fraser Univ., Burnaby (British Columbia).
J. C. Day, K. C. Bridger, S. E. Peet, and B. F. Friesen.
Water Resources Bulletin, Vol 18, No 2, p 297-305, April, 1982. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Diversion structures, *Environmental effects, *Reservoirs, *Canada, Long Lake Diversion, Ogoki Diversion, Ontario, Great Lakes, Social impact, Economic impact, Aquatic habitats, Recreation, Fish, Logging, Erosion, Silting, Hydroelectric power, Water transfer, Interbasin transfer, Turbidity, Benefits, River basins.

Biophysical and socioeconomic effects of the Ogoki Diversion and the Long Lake Diversion, two small basin water diversion projects in Ontario, are described. Both projects have produced valuable benefits--hydroelectric power, log transport, access roads, and economic development. Problems have been caused by failure to clear trees before inundation, water level fluctuations, erosion, siltation, reduced or increased river flows, and debris from log transport. As a result of the perturbations, aquatic communities have been eliminated or changed; recreation and commercial fishing have been adversely affected in some sections; 11 acres of property on an Indian Reserve partly occupied and partly of archeological interest, have been lost through erosion; wild river reaches have been drowned; water quality has been impaired by pulpwood leachates; and the shoreline appearance has been impaired. It is suggested that early public participation is desireable in planning projects of this type and scale. The esthetic and other environmental disturbances should be avoided. River regulation in the north should be confined to certain watersheds, while allowing other basins to remain unchanged. (Cassar-FRC)
W82-05742

WATER QUALITY MANAGEMENT IN BRITISH COLUMBIA,

Pollution Control Board (British Columbia).
For primary bibliographic entry see Field 5C.
W82-05767

A CITIZEN'S VIEW OF WATER MANAGEMENT IN THE OKANAGAN VALLEY,

J. Woodworth.
Canadian Water Resources Journal, Vol 5, No 3, p 15-25, 1980. 1 Fig.

Descriptors: *Water management, *Water policy, *Clearcutting, History, Okanagan River, British Columbia, Planning, Population dynamics, Water supply, Forest management, Public opinion, Irrigation, Recreation, Fish.

The desert-like Okanagan Valley, British Columbia, did not support a sizeable population until irrigation began in the early 1900's. Subsequent water resources development after World War I stimulated population growth so that at present the area is a suburb of neighboring Vancouver, Calgary, and Edmonton. Land use conflicts have developed among residents desiring to water lawns and gardens, farmers, loggers, cattlemen, skiers, and fisherman. In particular, clearcutting and insufficient reforestation in the uplands watershed is widespread but out of view of most of the residents in the valley. Although a Basin Study and Implementation Agreement has provided for water management, the Citizens Task Force review of 1980 agreed on 2 priorities: central, rather than fragmented, water management and serious examination of the effects of clearcutting in the mountains. (Cassar-FRC)
W82-05781

IMPACT OF ENERGY DEVELOPMENT UPON WATER AND SALINITY IN THE UPPER COLORADO RIVER BASIN,

For primary bibliographic entry see Field 3C.
W82-05886

THE COLORADO RIVER SALINITY PROBLEM,

Environmental Protection Agency, Ada, OK. Robert S. Kerr Environmental Research Lab.
For primary bibliographic entry see Field 5G.
W82-05889

7. RESOURCES DATA

7A. Network Design

HYDROLOGIC MONITORING IN THE COAL FIELDS OF CENTRAL UTAH, AUGUST 1978-SEPTEMBER 1979,

Geological Survey, Salt Lake City, UT. Water Resources Div.
G. C. Lines, and G. G. Plantz.
Geological Survey Open-File Report 81-138 (WRI), 1981, 56 p, 30 Fig, 1 Plate, 13 Tab, 17 Ref.

Descriptors: Surface water, *Monitoring, *Water quality, *Networks, Data collections, *Coal mines, Hydrologic cycle, Streamflow, Flow characteristics, Flow measurement, Sediments, Mine drainage, Groundwater storage, Groundwater movement, Chemical analysis, *Utah, Wasatch Plateau coal field, Book Cliffs coal field, Emery coal field.

Surface-water quantity and quality were monitored at 12 gaging stations down-stream from mine and lease areas in the Wasatch Plateau, Book Cliffs, and Emery coal fields in central Utah. Measurements of base flow were made at 52 other sites in the region. The report describes the hydrologic setting of this important coal region and summarizes the surface-water data collected at the monitoring sites from August 1978 through September 1979. Coal mining and lease activities in each of the monitored basins also are described. Where possible, hydrologic impacts of coal mining are evaluated. Impacts include increases in streamflow and degradation of surface-water quality due to water discharged from underground mines. Other impacts include removal of water from groundwater storage, changes in the natural ground-water flow system and possibly the diminution of spring flows. Adequacy of the monitoring network to detect hydrologic changes due to mining is evaluated. In order to fully assess and quantify the impacts, comprehensive studies and monitoring of the ground-water system and water produced in mines are needed. (USGS)
W82-04976

A RIVER CODING SYSTEM FOR WATER QUALITY ARCHIVES,

Fourth River Purification Board, Edinburgh (Scotland).
R. J. Sargent.
Water Pollution Control, Vol 80, No 5, p 682-686, 1981. 3 Fig, 1 Tab.

Descriptors: *Computers, *Coding systems, *River systems, Sites, Sampling, Gaging stations, Data collection, Data processing, Hydrologic data, Network design, Catchment basins, Great Britain.

The Forth River Purification Board in Edinburgh, Great Britain, has adopted a river coding system to describe the location of such features as sampling points, discharges, and gauging stations. The coding system was designed to facilitate the retrieval of information stored in various files on the computer, with respect to both available data relative to a given point and data relating to the position of a given geographical location within the river network. The constraints on the coding system were that the code should uniquely define a point on any and every watercourse, that the code should be as compact as possible, that the system should be sufficiently flexible to enable new watercourses to be added and varying densities of points to be identified, and that the system should have built into it the logic of the watercourse to enable accessing of upstream and downstream information from any given reference point. Each code has three parts: a number identifying the river catchment; a river number; and a distance number which gives the distance in river kilometers of the location from a defined starting point. Treatment of specific aspects of the hydrologic system and implementation on the coding system are described. (Carroll-FRC)
W82-05474

MEASURING RESERVOIR GROUND MOVEMENTS,

Nottingham Univ. (England).
For primary bibliographic entry see Field 8G.
W82-05773

THE MACKENZIE RIVER BASIN STUDY,

Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
For primary bibliographic entry see Field 4A.
W82-05778

7B. Data Acquisition

NEW DEVELOPMENTS IN AUTOMATED BIOSENSING FROM REMOTE WATER QUALITY STATIONS AND SATELLITE DATA RETRIEVAL FOR RESOURCES MANAGEMENT,

Tennessee Technological Univ., Cookeville.
E. L. Morgan, K. W. Eagleson, R. Hermann, and N. D. McCollough.
Journal of Hydrology, Vol 51, No 104, p 339-345, May, 1981. 2 Fig, 6 Ref.

Descriptors: *Sensors, *Remote sensing, *Bioindicators, *Water quality management, *Satellite technology, Fish, Fish behavior, Pollution load.

Increasing demands on water resources have intensified the need to maintain the environmental integrity of multipurpose drainage systems. As a result, there is increased interest in new, real-time methods for evaluating biological and physical-chemical water quality. A real-time automated biosensing unit has been designed which uses fish breathing rates as a measure of biological response or integration to water quality changes. Previous studies have shown that fish alter their typical breathing patterns in response to stressful conditions and that this function is a good physiological measure of chronic levels of a broad spectrum of toxic substances and environmental stresses. Biosensing units utilizing microprocessor-based monitors to measure fish breathing are interfaced to a remote data collection platform for satellite retrieval and transmission of data. The biosensor is used in conjunction with complex remote in-stream systems which collect information on a variety of physical parameters. These monitors, whiich are linked by radiotelemetry to central processing centers, may operate from such devices as buoys, mobile trailers, or stream-side stations. Real-time biological and physical data are transmitted to the data processing center, where they are readily available for interpretation by resource managers. (Carroll-FRC)
W82-04800

TOWARDS DIGITAL TECHNOLOGY IN THE MEASUREMENT AND CONTROL OF WATER LEVELS,

Churchill Controls Ltd., Reading (England).
J. W. Churchill.
Water Services, Vol 85, No 1030, p 599-600, 605, December, 1981. 5 Fig.

Descriptors: *Telemetry, *Remote sensing, *Water levels, Electronic equipment, Capacitance, Sensors, Transducers, Water depth, Automation, Computers, *Reservoirs.

The adoption of large digital telemetry systems by the service industries, including the water industry, is influencing the choice and development of the basic sensors and the forms of signalling they employ. The principle of capacitance for measuring liquid depth via immersion of a rod or wire is not new, but successful application of this principle was difficult. In a new device a concentric construction was adopted with a grounded tube surrounding a sensitive capacitance electrode, combined with a new form of electronic sensor. The water rises inside the tube to the same level as its surroundings and changes the capacitance of the wire in a manner strictly proportional to the water depth. The change in capacitance is substantial – on the order of 2500 pf per meter. The polarity reversal time of the capacitor forms a type of audio frequency oscillator, whose signals can be transmitted over an ordinary telephone line or radio link. The transducer calibration is not voltage dependent; batteries or line voltage may be employed. The receiving circuit in its simplest form comprises an analog converter, which may give a reading on a meter or actuate high and low level signals. For digital use, microprocessor chips receive the signal as a pulse count which is timed against the processor's crystal clock. Thus a direct measure of water depth is obtained which is entirely independent of analog voltage references and is suitable for intermittent interrogation. (Carroll-FRC)
W82-04847

MOISTURE ANALYSIS FROM RADIOSONDE AND MICROWAVE SPECTROMETER DATA,

Florida State Univ., Tallahassee. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W82-04900

HYDROLOGY OF THE WINTER HAVEN CHAIN OF LAKES, POLK COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-04977

CONTINUOUS MEASUREMENTS OF DISSOLVED OXYGEN IN WATER CULTURE BY A SELF-CALIBRATING MONITOR,

Ben-Gurion Univ. of the Negev, Beersheba (Isreal). Dept. of Electrical Engineering.
S. Ben-Yaakov, and Y. Ben-Asher.
Water Research, Vol 16, No 2, p 169-172, February, 1982. 5 Fig, 7 Ref.

Descriptors: *Dissolved oxygen, *Measuring instruments, Monitoring, Eutrophication, Water quality, Calibrations, Technology, *Analytical techniques.

A study was conducted to develop a self calibrating oxygen monitor for continuous measurements in water culture. The self-calibrating oxygen system (SCOS) developed is described. The probe is suitable for installation and in situ monitoring of oxygen concentration in hydroponics installations and other water bodies. The sensor comprises a gold cathode, a silver anode and a teflon membrane separating the internal electrolyte from the test solution. The current output of the sensor is fed to a temperature compensating current-to-voltage converter which is built around a commercial operational amplifier with a thermistor in the feedback loop. The thermistor was chosen to provide temperature independent reading of the partial pressure of oxygen. The sensor was mounted in a flow-through cell through which the solution was circulated by a submerged centrifugal pump. The flow-through cell design was such that it will empty when the circulation pump is stopped. This feature is applied during the autocalibration phase, in which air is used as a partial pressure oxygen standard. Specially designed self-adjusting electronic circuitry is activated during the autocalibration stage to adjust the overall gain of the instrument so that the output reading will reach the desired leve. The gain is then left constant until the next autocalibration cycle. The temperature dependence of the uncompensated sensor response followed the theoretical relationship. The present configuration of the flow cell permitted rapid and simple maintenance of the dissolved oxygen sensor. The maintenance routine requires cleaning of the sensor's head by fresh water once a month and replacement of membrane and internal solution every 3 months. When monitoring highly eutrophic solutions a more intensive maintenance schedule is needed. (Baker-FRC)
W82-05015

DEVICE FOR CONTINUOUS MEASUREMENT OF PRIMARY PRODUCTION OF WATER BODIES AND BIOCHEMICAL OXYGEN DEMAND,

Moscow State Univ. (USSR).
G. G. Shinkar, V. V. Sapozhnikov, and A. A. Georgiev.
Water Resources, Vol 8, No 2, p 205-209, March-April, 1981. 3 Fig, 1 Ref. Translated from Vodnye Resursy, No 2, p 156-160, March-April, 1981.

Descriptors: *Primary productivity, *Dissolved oxygen, Productivity, Algae, Oxygen, *Biochemical oxygen demand, Lakes, Measuring instruments, Technology.

A productiometer was developed to measure primary productivity from the difference of oxygen concentrations in light and dark bottles. The bottles are installed in the water body at 0.5 m depth. Water is pumped through both bottles at the same rate. Dissolved oxygen is measured in both light and dark bottles, and the difference is used to calculate the gross productivity of the phytoplankton. These measurements are read by remote detectors and recorded automatically on shore. Glass cylinders are more satisfactory than rectangular glass boxes. This continuous method gives higher results than the traditional optimal conditions for light and nutrient supply. (Cassar-FRC)
W82-05028

PROCEDURES FOR THE COLLECTION OF REPRESENTATIVE WATER QUALITY DATA FROM MONITORING WELLS,

Illinois State Water Survey Div., Campaign; and Illinois State Geological Survey Div., Champaign.
J. P. Gibb, R. M. Schuller, and R. A. Griffin.
Cooperative Groundwater Report 7, 1981. 22 Fig, 10 Tab, 27 Ref.

Descriptors: *Water sampling, *Water analysis, Monitoring, Well data, *Water quality, Sample preservation, Chemical properties, On-site tests, Water quality standards, Drawdown, Operating policies, Pumping tests, Submersible pumps, Well filters, *Waste dumps, *Leachates, *Illinois.

Regulatory agencies are charged with setting design and operational standards for waste disposal facilities to insure that the environment is not adversely affected. Well sampling is the usual method of monitoring the effects on goundwater. The purposes of this study were to determine: (1) if current sampling methods yield representative samples of the aquifer being monitored; (2) if field samples must be treated (filtered and acidified) on-site of if they can be taken to a lab for treatment and suffer no chemical alteration; and (3) which sampling and preservation methods should be accepted as standards for monitoring well sampling. Four types of pumping methods were used to collect samples from monitoring wells at six Illinois sites. The selection of the type of sampling device; sample preparation, preservation, and storage; and sampling procedures all must be tailored to the size and accessibility of the individual well, its hydrologic and chemical character, the chemical constituents of interest, the time of year, and the purpose for monitoring. Generally recommended sampling procedures include: (1) using peristalsis or submersible diaphragm type pumps; (2) conducting pump tests prior to sampling to determine sampling frequency and time and rate of pumping; (3) flushing the well by pumping 4-to-6 well volumes; (4) measuring pH, specific conductance, oxidation-reduction potential, and alkalinity at the time of sample collection; and (5) filtering samples immediately on-site through a 0.45 millimicron pore size filter and then preserving the samples immediately after filtration, according to U.S. EPA recommended procedures. (Atkins-Omniplan)
W82-05051

A LOW-COST MULTICHANNEL RECORDING PIEZOMETER SYSTEM FOR WETLAND RESEARCH,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
H. F. Hemond.
Water Resources Research, Vol 18, No 1, p 182-186, February, 1982. 5 Fig, 6 Ref.

Descriptors: *Piezometry, *Wetlands, *Automation, Marshes, Water table fluctuations, Measuring instruments, Tidal marshes, Sonar, Piezometers, Costs.

An acoustic system for continuous recording of piezometric head in wetlands is composed of a sonar transmitter-receiver, consisting of a pulse generator, receiver, timer, display, and switching unit; a digital data logger; transducers and their cables, built from ordinary earphones; a power supply (12-volt lead-acid motorcycle battery); and piezometers for saltwater use. Costs vary from $500 for manual operation to $1000 for automatic operation, not including the cost of the data logger and data cassette ($1000 each). This system has a rapid response, avoids disturbances in piezometric head caused by human weight on the compressible peat surfaces, and permits automatic readings at short time intervals, during storms, and for long periods. (Cassar-FRC)
W82-05076

ON THE DETERMINATION OF THE DEGREE OF WEEDAGE IN FLOWING WATERS (ZUR

ANSPRACHE DES ‘VERKRAUTUNGSZUSTANDES’ IN FLIESS-GEWASSERN),

E. Niemann.
Acta Hydrochimica et Hydrobiologica, Vol 8, No 1, p 47-57, 1980. 8 Fig, 2 Tab, 3 Ref. (No English summary).

Descriptors: *Data acquistion, *Aquatic plants, *Shoreline cover, Streams, Streamflow, Hydraulic properties, *Running waters, Bioindicators, Biological communities, *Numerical analysis, Seasonal distribution.

Weedage is defined as the development of the entire submerse and emerse phytobenthos within the summer median water level of flowing waters. The description of the weedage in order to draw conclusions regarding water treatment or evaluation necessitates consideration of both quantitative development and species composition. A simple, rapid procedure for obtaining this description was developed, comprising a ten-point scale derived from ecologic, developmental, hydraulic, and taxonomic considerations. A numerical rating, a descriptor category, and more detailed characterization are presented in a table. Detailed botanical knowledge is not required to utilize this classification scale. In addition, the vertical growth is quantified on a five-point scale and the horizontal growth (percent coverage of the water surface) on a nine-point scale. Tests of application revealed that this system required only a few minutes per application site, gave fairly constant evaluations for similar vegetation patterns on different water bodies, and permitted recognition of variation due to hydromorphological character, local changes in ecological factors, and seasonal patterns. Mapping using this system is also possible. Comparison with dry weight determinations at the same three recording points on three different dates showed that neither of these two procedures is ideal for all situations. However, the simplicity of the rating method means that larger numbers of assessments can be performed and the effects of random fluctuations minimized. (Carroll-FRC)
W82-05092

A PORTABLE SYSTEM FOR MEASURING WATER TEMPERATURE, CONDUCTIVITY, DISSOLVED OXYGEN, LIGHT ATTENUATION AND DEPTH OF SAMPLING,

Nature Conservancy, Grange-over-Sands (England). Merlewood Research Station.
D. G. Benham, and D. G. George.
Freshwater Biology, Vol 11, No 5, p 459-471, 1981. 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Measuring instruments, *Temperature, Monitoring, *Water quality, *Specific conductivity, Dissolved oxygen, Sample preparation, Sampling, Water sampling, Water analysis.

A description is offered of equipment designed to overcome the inconvenience of handling several specialized instruments for monitoring water temperature by incorporating all the sensing circuits into one self-contained unit. The system is powered by a rechargeable battery pack and provides instantaneous digital readings of temperature, conductivity, dissolved oxygen, light attenuation and depth of operation. Most of the measuring circuitry is of a novel design and incorporated selected, temperature-tested components to improve sensitivity and increase stability. The instrument can also provide continuous time-records of each variable, or X-Y plots of selected variables against depth, when connected to suitable chart recorders. The prototype instrument was tested extensively in the field over a three year period and has proved reliable in a wide range of applications, Results are presented to demonstrate the use of the temperature and depth transducers in X-Y mode, the use os the temperature/conductivity probe in flow-through mode, improvement in response time gained by fitting a water circulator to the oxygen electrode, and the use of the light-ratio meter as a crude transmisso-meter. (Baker-FRC)
W82-05105

SIMPLIFYING NEUTRON MOISTURE METER CALIBRATION,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
F. S. Nakayama, and R. J. Reginato.
Soil Science, Vol 133, No 1, p 48-52, January, 1982. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Moisture meters, *Calibrations, *Soil moisture meters, Nuclear moisture meters, Measuring instruments, Absorption.

A method is described for relating measurements of different neutron moisture meters with each other and using the relationships developed for calibrating other meters. The four neutron moisture meters used include a source strength mCi model, probe model, absorber-shield type, and scaler model. Soil moisture probes can be calibrated in the field by comparing them directly with a master reference probe, using the appropriate type of access tubing and covering a range of water contents. Plastic absorbers can be used as secondary standards and also for checking the performance of the individual probes. A whole series of interrelations between plastic absorbers and different soil types may be developed, to which the manufacturer or user could refer in obtaining a calibration curve suitable for the field site. Of the four methods compared, the simplest was found to be that of calibrating one master probe and comparing other probes with this under field conditions which were similar over a range of soil water contents. From the slope and intercept values which can be obtained, a reference regression equation can be developed that can be used to calibrate other probes in the laboratory. (Baker-FRC)
W82-05173

HANDLING AND MEASUREMENT TECHNIQUES FOR ANOXIC INTERSTITIAL WATERS,

Freshwater Biological Association, Windermere (England).
W. Davison, C. Woof, and D. R. Turner.
Nature (London), Vol 295, No 5850, p 582-583, February 18, 1982. 2 Fig, 23 Ref.

Descriptors: *Interstitial waters, *Measuring instruments, Chemical analysis, Water analysis, Polarography, *Iron, *Magnanese, *Sulfides.

A new method is presented for measuring Fe(II), MN(II) and sulfide ions in the interstitial waters of anoxic sediments which have been sampled using a simple corer. Rapid filtration directly into a polarographic vessel permits the extraction of interstitial water and the measurement of all three components, less than 5 minutes after subsampling the sediment. The non-destructive polarographic measurement is able to assess the extent of contamination by oxygen and to study subsequent reactions in the interstitial water. Because polarography is a nondestructive technique, any change may be continuously monitored on the same sample. Polarograms were made of the overlying lake water of Esthwaite Water, interstitial water of Esthwaite Water and interstitial water of Rostherne Mere. The interstitial water samples were taken from a sediment depth of 3-4 cm. The results for the overlying water were in good agreement with earlier studies. The interstitial waters seemed to exhibit a reduced solubility and, because the solid phase had more opportunity to age in the sediment than in the anoxic waters of the lake, support is given to the supposition that the aging solid phase controls the interstitial water concentrations. The method should be applicable to organic rich marine sediments. Because anodic stripping voltammetry uses the same equipment, this simple procedure could be used to measure trace metals in interstitial water. (Baker-FRC)
W82-05176

ENTRAINMENT MORTALITY OF ICHTHYOPLANKON: DETECTABILITY AND PRECISION OF ESTIMATES,

Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W82-05181

MICROCOMPUTER WATER QUALITY SIMULATION MODEL,

Camp, Dresser and McKee, Inc., Waltham, MA.
R. J. Hughto, and R. P. Schreiber.
Civil Engineering (New York), Vol 53, No 3, p 58-59, March, 1982. 2 Fig.

Descriptors: *Water quality, *Rivers, *Computers, Model studies, Mathematical models, Simulation analysis, *Fate of pollutants, Biological oxygen demand, Dissolved oxygen, Aberjona River, Massachusetts.

A water quality model computes concentrations of dissolved oxygen, BOD, and nitrogenous oxygen demand in a river or stream. Assumptions are: the river is divided into a series of reaches with uniform characteristics, steady-state conditions prevail, concentrations of dissolved oxygen, etc., and inflow rates are known at the upstream boundary and at all inflow points, longitudinal dispersion is negligible, and all variations occur in one dimension. The model program is listed with a sample run for a three-reach system. The program is interactive, prompting the user to input the parameters for each reach. The system was tested on the Aberjona River basin, Boston, Massachusetts, to obtain a preliminary analysis of the effect of existing pollutant sources on water quality and to predict the results of abatement measures. (Cassar-FRC)
W82-05191

A WIND-POWERED, GROUND WATER MONITORING INSTALLATION AT A RADIOACTIVE WASTE MANAGEMENT SITE IN IDAHO,

Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05233

A RELIABLE DISSOLVED OXYGEN PROBE FOR WASTE WATER TREATMENT PLANTS,

J. M. Hale.
Water and Waste Treatment, Vol 25, No 1, p 35-36, January, 1982. 3 Fig.

Descriptors: *Measuring instruments, *Wastewater analysis, *Dissolved oxygen, Oxygen, Monitoring, *Wastewater treatment, Orbisphere Laboratories, Control systems, Aeration, Sensors.

An oxygen detecting system was developed for use under the harsh conditions encountered in a wastewater treatment plant aeration basin. Orbisphere Laboratories' Model 2716 overcomes some of the problems normally encountered in dissolved oxygen sensors. The features include: (1) low flow requirements (1 cm per sec produces 95% of the high-flow limit and 29 cm per sec, 99%), (2) no interference from entangled fibrous material, (3) strong teflon membrane, cleanable with a toothbrush, (4) very tight stable seal between membrane and sensor body, (5) insensitivity to hydrogen sulfide, and (6) solid state digital electronic construction. In a 60-day test in a wastewater plant aeration basin no maintenance of the probe was necessary. Differences between the Model 2716 results and those from a test probe were always less than the 0.23 ppm error inherent in the test probe. (Cassar-FRC)
W82-05248

SAMPLING FREQUENCY OPTIMIZATION USING A WATER QUALITY INDEX,

Oregon State Dept. of Environmental Quality, Salem.
For primary bibliographic entry see Field 5A.
W82-05268

AUTOMATED BIOMONITORING APPLICATIONS IN REMOTE WATER QUALITY SURVEILLANCE AND TIME RATED TOXICOLOGICAL ASSAY,

Tennessee Technological Univ., Cookeville. Dept. of Biology.
E. L. Morgan, and K. W. Eagleson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224809,

Price codes: A04 in paper copy, A01 in microfiche. Research Report 86, April 1981. 51 p, 14 Fig, 5 Tab, 26 Ref. OWRT A-060-TENN, 14-34-0001-0145.

Descriptors: *Remote sensing, *Satellite technology, *Water quality, *Automation, *Data transmission, Sensors, Telemetry, Monitoring, Toxicity, Mortality, Respiration, Detection times, Computers, Buoys, Data collections, Bioindicators, Streams, Rivers, Water pollution, Stream pollution.

Applications of remote water quality platforms at key locations in selected drainages are becoming increasingly important for water quality assessment. Testing was made of remote site-specific biosensing units for real-time water quality monitoring from cold water streams in the Great Smoky Mountains National Park to a warm water site on the Tennessee Cumberland River. The designed sensors monitored fish respiratory responses. The sensors were interfaced to existing water quality monitoring stations equipped with remote microprocessor-controlled data collection platforms. Biological responses and physical parameters were transmitted from the stations to over-passing earth satellites which retransmitted the data to a central data collection and processing center. These applications provided verification that real-time biological responses can be remotely monitored and simultaneously retrieved with physical water quality information via radiotelemetry systems. Laboratory prototypes of an automated toxicity assay monitor and a buoy system were also studied for remote biosensing applications. The toxicity monitor was tested and verified in a series of time-rated mortality studies, and the buoy configuration was found to be effective. (Zielinski-MAXIMA)
W82-05305

A FIELD TECHNIQUE TO DIRECTLY MEASURE RIVER BANK EROSION,

Alberta Research Council, Edmonton.
H. R. Hudson.
Environment, Vol 24, No 3, p 381-383, April, 1982. 1 Fig, 14 Ref.

Descriptors: *Rivers, *Erosion, Mathematical studies, *Measuring instruments, *Bank erosion, Monitoring, Sediment transport.

A new method is presented for evaluating the mode and spatial and temporal aspects of bank erosion. The method calls for sequential bank profiling from a fixed baseline using a stadia rod for vertical control and another stadia rod, Brunton compass, and meter rule for horizontal control. The method yields a rapid, accurate representation of river bank changes, using inexpensive, readily available equipment. When repeat surveys are performed at a relatively close spatial interval, which depends on the complexity of the bank, a three dimensional map of the bank may be drawn and volumetric changes may be calculated. These surveys should be supported by a photographic record of the profile sites. The time required to produce a single profile for a complex bank of 2 meters in height is about 5 minutes. Repeat surveys show that the precision of the technique is within 5 cm for a complex bank and difficult conditions. The accuracy and precision of measurement improve with less complex banks. The major limitations are access to the base of the bank and up the bank and ability to define sufficient relevant points in the cross section to accurately describe the bank. It is suggested that the technique may provide details of bank erosion of intermediate magnitude over periods of days to years. (Baker-FRC)
W82-05410

SPECTRAL REFLECTANCES OF FRESH-WATER ICE AND SNOW FROM 340 THROUGH 1100 NM,

For primary bibliographic entry see Field 2C.
W82-05556

HUMIDITY MEASUREMENT BY INFRARED THERMOMETRY,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
S. B. Idso.
Remote Sensing of Environment, Vol 12, No 1, p 87-91, 1982. 2 Fig, 12 Ref.

Descriptors: *Vapor pressure, *Air temperature, *Humidity, Temperature, Water vapor, Infrared Thermometry, Thermometers, Water stress, Remote sensing, Measuring instruments.

Humidity measurements necessary for remote sensing of plant water stress were performed with a new technique. The same infrared thermometer used to measure foliage temperature was used to obtain the vapor pressure measurement by viewing the cloudless sky directly overhead. Both the brightness temperature at 10.5-12.5 microns and the air temperature readings were obtained simultaneously and the values inserted into equations to calculate vapor pressure. A graph of calculted vs. measured vapor pressure obtained over a year's work showed deviations from the 1:1 line of + or - 3 mb for all but the lowest vapor pressures, which showed deviations of + or - 6 mb. The deviations were most prevalent in hot dry summer conditions and cool dry winter conditions. The method can be used in partly cloudy weather if the zenith is clear. (Cassar-FRC)
W82-05611

GEOTECHNICAL APPLICATIONS OF LANDSAT IMAGE ANALYSIS OF BHAKRA DAM RESERVOIR, INDIA,

Indian Inst. of Tech., Bombay. Centre of Studies of Resources Engineering.
For primary bibliographic entry see Field 7C.
W82-05612

DIRECT SNOW-WATER EQUIVALENT MEASUREMENTS BY AIR-BORNE GAMMA-RAY SPECTROMETRY,

Geological Survey of Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 2C.
W82-05643

ESTIMATION OF ISOTOPIC EXCHANGE PARAMETERS, USING CONSTANT-FEED PANS,

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
For primary bibliographic entry see Field 2D.
W82-05648

A LAND RESOURCE INFORMATION SYSTEM (LRIS) FOR WATER QUALITY MANAGEMENT IN THE LAKE ERIE BASIN,

Corps of Engineers, Buffalo, NY.
J. R. Adams, T. J. Logan, T. H. Cahill, D. R. Urban, and S. M. Yaksich.
Journal of Soil and Water Conservation, Vol 37, No 1, p 45-50, January/February, 1982. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Maps, *Information systems, *Water quality management, Land use, Lake Erie Basin, Soil properties, Watershed management, Cultivation, Land Resource Information System, Data collections, Sediment transport, Phosphorus, Nonpoint pollution sources.

A Land Resource Information System (LRIS) was devised by the U.S. Army Corps of Engineers Lake Erie Wastewater Management Study (LEWMS) for water resources planning in the Lake Erie Basin. LRIS is a variable size (4-36 ha) system which encodes each cell for each parameter at a randomized point location within each cell. Information included is land use or cover, soil characteristics, and political and hydrological boundaries. Data were supplied from several agencies and previous studies. The LRIS can produce maps or tables. Color maps can be developed for the entire basin or any division down to the township level. These maps clearly show soil types, crop intensity, soil texture, and slope. Data from LRIS can be used in the ANSWERS model to simulate sediment and phosphorus transport under different conservation practices. (Cassar-FRC)
W82-05662

RECORDING RAINGAGE MODIFICATIONS,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
J. D. Greer.
Journal of Soil and Water Conservation, Vol 37, No 1, p 63-64, January/February, 1982. 2 Fig, 1 Ref.

Descriptors: *Rain gages, *Charts, *Measuring instruments, Precipitation, Rainfall, Experimental design.

Evaporation from a rain gage was minimized by installing a U-trap, similar to a lavatory drain trap, between the collecting funnel and the 5-quart jar with screw-on top. A small hole in the top relieved air pressure as rainwater flowed into the container. No evaporation from the rain gage between storms was evident. An FW-1 type water stage recorder was modified to record rain days for one month. A tipping bucket was constructed to indicate the date of rainfall starts and stops on a recording chart. (Cassar-FRC)
W82-05665

NORMALITY OF HYDROLOGICAL DATA,

Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, A. Sunchindah, and D. Patnaik.
Water Resources Bulletin, Vol 18, No 1, p 37-42, February, 1982. 6 Tab, 24 Ref.

Descriptors: *Hydrologic data, *Statistical analysis, Mathematical studies, *Stochastic process, Hydrologic models, Analysis of variance, Probabilistic process.

Although the normal distribution plays an important role in stochastic hydrology in which statistical techniques have been extensively employed, the assessment of the normality of hydrological data has been based largely on subjective judgments. Three computationally simple statistical tests are suggested for assessing the normality assumption with respect to hydrological sequences. Statistical tests for normality include standard moment ratios, analysis of variance tests, and tests based on probability plots. These statistical tests were applied to monthly and annual stream flow data from six stations to assess the validity of the assumption that these data, their square roots or logarithms are normal. This analysis showed that, for the stream flow data used, at least one of the three annual sequences (original, square root, and logarithmic) can be treated as normal; monthly stream flows cannot always be represented by normal distributions; and the square root and logarithmic transformations cannot render all the 12 monthly stream flow sequences normal. These results indicate that different transformations may be required for different months and that the assumption of normality for monthly stream flows under only one of the two transformations is less realistic. (Carroll-FRC)
W82-05752

ON HYDROLOGICAL DATA NEEDS IN CANADA,

British Columbia Univ., Vancouver. Dept. of Geography.
M. Church, and R. Kellerhals.
Canadian Water Resources Journal, Vol 5, No 4, p 1-24, 1980. 4 Fig, 1 Tab, 31 Ref.

Descriptors: *Data collections, Water management, *Streamflow, *Hydrologic data, *Canada, Rivers, Ice, Glacial streams, Stream gages, Gaging stations, Channel morphology, Sediments, Regional analysis, Data interpretation, Planning.

Canada's abundant surface water resources are different in some respects (extreme temperatures, highly seasonal runoff, postglacial topography, and gravel beds) from rivers in other parts of the world for which much hydrologic data has been collected and studied. Present sources of data for Canada rivers are stream gaging stations, engineering histories, and special studies. Existing data must be presented in more usable form, for example, listing data not by calendar year but by a period suitable for the hydrologic conditions, tabulation of extreme streamflows by type, routine frequency anal-

ysis by a central group, flow probability and flow duration summaries, indication of long-term trends, a central source for all data summaries, and indication of precision of data. Development of a hydrological data base should include more reliable and sophisticated stream gaging equipment, a systematic program to study ice formation and decay and problems caused by ice, documentation of river channel morphology, field studies of extreme events and biophysical processes, compilation of regional knowledge, and extension of suspended sediment monitoring sites. Suggestions are given for educational and institutional changes necessary to implement these changes in hydrological data collections. (Cassar-FRC)
W82-05764

TELEMETRY AND REAL TIME ENVIRONMENTAL DATA ACQUISITION (LA TELEMETRIE ET L'ACQUISITION EN TEMPS REEL DES DONNEES SUR L'ENVIRONNEMENT),
C. Pesant.
Canadian Water Resources Journal, Vol 5, No 4, p 25-39, 1980. 4 Fig, 3 Tab. English abstract.

Descriptors: *Remote sensing, *Telemetry, *Data acquisition, Satellite technology, Data collections, Hydrologic data collections, Quebec, Monitoring, Computers, Forecasting.

Quebec's telemetry network, which dates back to 1977, consists of 100 stations for collection of meteorological and hydrologic data. Communication in the system is by telephone lines in urban and rural areas and by the satellite GOES in more remote regions. A minicomputer, Nova 4, coordinates data acquisition and dissemination. Average efficiencies of the 100 stations were 96-99% during the year starting September 1979. Objectives of the network are to inventory surface waters and climate, to forecast water levels, to aid in design of reservoirs and hydroelectric stations, and to protect forests. Users of the information include Environment Quebec, Quebec Energy and Resources, James Bay Energy Society, and Alcan Canada Limited. (Cassar-FRC)
W82-05770

ROLE OF THE MICROCOMPUTER IN WATER MANAGEMENT,
Canadian Applied Technology, Buttonville, Ontario.
A. Tailor.
Canadian Water Resources Journal, Vol 5, No 2, p 28-37, 1980. 2 Fig, 4 Ref.

Descriptors: *Water management, *Computers, *Data collections, Measuring instruments, Automation, Control systems, Decision making, Monitoring, Streamflow forecasting, Information systems, Remote sensing.

The microcomputer has many possible functions in water management: data processing; automatic data collection; communication with other computers by telephone, radio, or satellite; selection of time intervals; monitoring water resources (ice formation and dissipation, resources management, flood warning, and flow forecasting); and remote data acquisition. The microcomputer can provide current information necessary for decision making in water management. Limitations are not in the computers but in automatic, reliable measuring instruments for the parameters of interest. (Cassar-FRC)
W82-05771

INFLUENCE OF DISSOLVED ORGANIC MATERIALS ON TURBID WATER OPTICAL PROPERTIES AND REMOTE-SENSING REFLECTANCE,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2K.
W82-05869

ON THE SAMPLING VARIANCE OF RAINGAGE NETWORKS,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
B. A. Silverman, L. K. Rogers, and D. Dahl.
Journal of Applied Meteorology, Vol 20, No 12, p 1468-1478, December, 1981. 3 Fig, 5 Tab, 24 Ref.

Descriptors: *Rainfall distribution, *Measuring instruments, Model studies, Variability, Rainstorms, Precipitation rate, Precipitation.

The sampling variance of raingage networks is examined, and this variance is related quantitatively to both the density of raingages and the characteristics of the isohyetal pattern. The variance due to sampling results from the necessity of estimating areal rainfall values from point measurements of a storm footprint that contains spatial gradients. This is especially true for convective storms. Depending on how a storm passes over the gage network, the precipitation is usually either under-or overestimated. A computer model of raincell isohyetal patterns is used to assess the sampling variance. The coefficient of variation was found to increase with decreasing gage density and increasing precipitation gradient. Contrary to the sampling error studies of other investigators, it was found that the mean precipitation remained unbiased as the gage density decreased, but its standard deviation increased. The theoretical isohyetal patterns were then related to observed isohyetal maps and the characteristics of their structure. The observations suggested a tendency for the precipitation gradient to be steepest, increasing rapidly toward the storm precipitation maximum, in short-duration convective storms of small areal extent. More uniform precipitation gradients tend to be found in steady type rains and large, long-lasting storms. Expressed in terms of the percentage of storm area containing 50% of the precipitation volume, the precipitation gradient varied from 15 to 30%. It was also found that convective raincell patterns tended to be elliptical in shape. (Baker-FRC)
W82-05875

7C. Evaluation, Processing and Publication

LINEBORO QUADRANGLE: HYDROGEOLOGY,
Geological Survey, Towson, MD. Water Resources Div.
M. T. Duigon, E. G. Otton, and J. T. Hilleary.
Maryland Geological Survey Quadrangle Atlas No 13, 1981. 5 Sheets, 5 Maps, 6 Fig, 30 Ref.

Descriptors: *Maps, *Geohydrologic units, *Groundwater, Water use, Land use, Percolation rate, Precipitation, Wells, Springs, *Water table, *Groundwater availability, Water supply, Effluents, Underground waste disposal, *Maryland, Lineboro quadrangle, Baltimore County, Carroll County.

This series of map atlases for the Lineboro quadrangle in Baltimore and Carroll Counties, MD., is designed to aid county, State, and Federal officials, engineers, land developers, and the general public in the wise use of the water and land resources. The maps and associated text show the location of several hundred wells and a few springs, the approximate depth to the water table, the availability of groundwater supplies, and geohydrologic conditions pertaining to shallow underground disposal of domestic sewage. (USGS)
W82-04969

HYDROLOGIC DATA OF THE SHAWSHEEN RIVER BASIN, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
F. G. Gay, and D. F. Delaney.
Massachusetts Hydrologic-Data Report No 22, 1981. 22 p, 1 Plate, 5 Tab, 21 Ref.

Descriptors: *Hydrologic data, *Groundwater, Test wells, Well logs, Water level, Chemical analysis, *Massachusetts, *Shawsheen River basin, Borings.

The Shawsheen River basin drains a 77-square-mile area into the Merrimack River. The basin is northwest of the Boston metropolitan area in eastern Massachusetts within Essex and Middlesex Counties. This report contains hydrologic data for all, or parts of, the cities and towns of Andover, Bedford, Billerica, Burlington, Concord, Lawrence, Lexington, Lincoln, North Andover, Tewksbury, Wilmington, and Woburn. Information in this report includes well, test-well, and boring data; chemical analyses of ground water compiled from 1972 to 1974; and a list of publications containing ground-water-level records. (USGS)
W82-04970

GROUNDWATER RESOURCES OF THE WILLIAMSPORT REGION, LYCOMING COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04971

GROUNDWATER AND GEOLOGY OF THE CUMBERLAND VALLEY, CUMBERLAND COUNTY, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div., and Esso Prospeccao Limitada, Rio de Janeiro, Brazil.
For primary bibliographic entry see Field 2F.
W82-04972

GROUNDWATER RESOURCES OF THE GETTYSBURG AND HAMMER CREEK FORMATIONS, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04973

HYDROGEOLOGIC DATA COLLECTED FROM THE KISSIMMEE PLANNING AREA, SOUTH FLORIDA WATER MANAGEMENT DISTRICT,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. E. Reece, R. Belles, and M. P. Brown.
South Florida Water Management District Report, 1981. 192 p, 3 Fig, 6 Tab, 31 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, *Water management, Aquifers, *Geohydrology, Potable water, Water use, Wells, Water level, Well logs, Specific capacity, Water analysis, *Florida, Kissimmee, Floridan aquifer.

The Floridan aquifer is the primary source of potable water in the populated northern part of the Kissimmee Planning Area of central Florida and the major source of water for agricultural use throughout the area. Because of the importance of the Floridan aquifer in the area, a reconnaissance study was conducted to collect data necessary to describe the geology, hydrologic properties, and water quality of the aquifer. This report contains the following data: well descriptions for 130 wells; water-level measurements for 122 wells; water-level hydrographs for 7 wells; geologic descriptions of drill cuttings for 7 wells; and geophysical logs for 43 wells. (USGS)
W82-04974

HYDROLOGIC DESCRIPTION OF LAKE JACKSON, SEBRING, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
K. M. Hammett.
Geological Survey Open-File Report 81-494 (WRI), 1981. 1 Sheet, 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Lakes, *Limnology, *Lake morphometry, *Hydrologic budget, Lake stages, Hydrologic data, Surface-groundwater relations, Bathymetry, Water quality, Chemical analysis, *Florida, Sebring, *Lake Jackson.

Available data were evaluated to document hydrologic conditions in the Lake Jackson basin, Florida. Bathymetric data indicate numerous dredged

holes around the perimeter of the lake. Away from the dredged holes, a firm sand bottom slopes gradually from the shore to a maximum depth of 22 feet. Lake Jackson's stage declined 3 feet from 1970 to 1973 and has remained below normal since that time. Rainfall was below average from 1970 to 1973, but the lake-level decline did not result solely from deficient precipitation. A water-budget analysis of the lake indicates that channelization downstream and groundwater withdrawals contributed significantly to the decline. Lake Jackson is used extensively for recreation. Available water-quality data indicate suitable conditions for recreation and the propagation and management of fish and wildlife. (USGS)
W82-04975

HYDROLOGIC MONITORING IN THE COAL FIELDS OF CENTRAL UTAH, AUGUST 1978-SEPTEMBER 1979,

Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 7A.
W82-04976

HYDROLOGY OF THE WINTER HAVEN CHAIN OF LAKES, POLK COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Sinclair, and R. C. Reichenbaugh.
Geological Survey Open-File Report 81-212 (WRI), 1981. 1 Sheet, 12 Fig, 1 Tab, 3 Ref.

Descriptors: *Lakes, Lake basins, Lake stages, *Limnology, Bathymetry, Geohydrology, Hydrologic data, Rainfall, Surface-groundwater relations, Pumpage, Aquifers, Water level, Hydrographs, Maps, *Florida, *Polk County, *Winter Haven Chain of Lakes, Floridan aquifer.

Fourteen interconnected lakes in and around the city of Winter Haven, Polk County, Fla., form the Winter Haven Chain of Lakes. Levels of the lakes during the spring of 1976 were at a record low stage for the 31 years of record. During 1960-76, rainfall had been below average for all but 2 years, and departure from average rainfall totaled 72.34 inches. Fluctuations in stage of Lake Howard, representative of the chain, and of Lake Otis, the nearest isolated lake that has a reasonably long record of stage, were compared with other hydrologic variables. Analyses of lake stage and rainfall records indicate that deficient rainfall has been the key factor in the decline of lake levels in the area. Manipulation of lake levels, pumpage from the lakes and underlying aquifer, and urbanization of the watershed probably have affected the lakes as well, but records are not available to determine the significance of their effects. The surficial aquifer drains to the lakes. Water level in the underlying Floridan aquifer is everywhere lower than in any of the lakes, thus water moves from the lakes and surficial aquifer through the confining clay layer to the Floridan aquifer. (USGS)
W82-04977

MAP SHOWING THE POTENTIOMETRIC SURFACE OF THE AQUIA AQUIFER, MAY 19-23, 1980,

Geological Survey, Towson, MD. Water Resources Div.
F. Chapelle, D. Drummond, and T. Curley.
Available from the OFSS, USGS Box 25425, Fed Ctr., Denver, CO 80225. Price: $1.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-416, 1981. 1 Sheet.

Descriptors: Maps, *Potentiometric level, *Aquifers, *Observation wells, Groundwater level, Coastal plains, *Maryland, *Aquia aquifer.

The map is based on water level measurements made May 19-23, 1980. The well network used included 83 wells which have been screened in the Aquia aquifer (Aquia Formation of Paleocene Age). Highest levels of the potentiometric surface, 20 to 35 feet above sea level, were measured near the outcrop or subcrop of the aquifer in the topographically high areas of Anne Arundel and Prince Georges Counties. The potentiometric surface slopes to the southeast. Four separate and extensive cones of depression have developed in the potentiometric surface in the vicinities of Lexington Park, Leonardtown, Prince Frederick, and Chesapeake Beach. The cones of Leonardtown and Lexington Park seem to be merging. (USGS)
W82-04978

DERIVATION OF HOMOGENEOUS STREAMFLOW RECORDS FOR THE GREEN RIVER BASIN, KENTUCKY,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliograpnic entry see Field 2E.
W82-04979

BASE FLOW OF STREAMS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-79,

Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-04980

LITTLETOWN QUADRANGLE: HYDROGEOLOGY,

Geological Survey, Towson, MD. Water Resources Div.
J. M. Weigle, and J. T. Hilleary.
Maryland Geological Survey Quadrangle Atlas No. 14, 1981. 5 Sheets, 5 Maps, 3 Fig, 30 Ref.

Descriptors: *Maps, *Geohydrologic units, *Groundwater, Water use, Land use, Percolation rate, Precipitation, Wells, Springs, Water table, Groundwater availability, Water supply, Effluents, Underground waste disposal, *Maryland, Littletown quadrangle, *Carroll County.

The maps in the atlas for the Littletown quadrangle in Carroll County, Md., are designed to aid specialists and the general public in planning the use of water and land resources. The maps show locations of wells and springs, approximate depth to the water table, availability of ground water, and geohydrologic conditions pertaining to shallow underground disposal of domestic sewage. (USGS)
W82-04984

INDEX TO WATER-RESOURCES DATA FOR LOUISIANA, SURFACE-WATER RECORDS, WATER-QUALITY RECORDS.

Geological Survey, Baton Rouge, LA. Water Resources Div.
Louisiana Department of Public Works Water Resources Basic Records Report No 10, 1981. 138 p, 3 Tab, 11 Ref.

Descriptors: *Data collections, *Surface water, *Water quality, Streamflow, Gaging stations, *Louisiana.

This index is a tabulation of descriptive information for all sites in Louisiana where streamflow or water-quality data have been collected by the U.S. Geological Survey, in cooperation with local, State, and Federal agencies, through September 30, 1980. (USGS)
W82-04985

GROUND-WATER HYDROLOGY OF JEFFERSON COUNTY, WEST VIRGINIA,

Geological Survey, Morgantown, WV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-04986

COMPILATION OF HYDROLOGIC DATA FOR THE EDWARDS AQUIFER, SAN ANTONIO AREA, TEXAS, 1934-79.

Geological Survey, San Antonio, TX. Water Resources Div.
Edwards Underground Water District Bulletin 39, October, 1981. 133 p, 4 Fig, 8 Tab, 82 Ref.

Descriptors: *Hydrologic data, *Aquifers, *Groundwater, Groundwater recharge, Wells, Springs, Discharge measurement, Water level, Groundwater storage, Water sampling, Water quality, Texas, *San Antonio area, *Edwards aquifer.

The average annual ground-water recharge to the Edwards aquifer in the San Antonio area, Texas, from 1934 through 1979, was 598,800 acre-feet. The recharge in 1979 was 1,117,800 acre-feet, which was the fifth highest estimated recharge since 1934. A maximum annual recharge of 1,711,200 acre-feet occurred in 1958, and a minimum annual recharge of 43,700 acre-feet occurred in 1956. The estimated annual discharge by wells and springs in 1979 was 914,500 acre-feet. A maximum annual discharge of 960,900 acre-feet occurred in 1977, and a minimum annual discharge of 388,800 acre-feet occurred in 1955. During 1979, water levels in wells in the Edwards aquifer fluctuated near record highs; consequently, the volume of ground water in storage in the aquifer also was near the record high. Analyses of water samples from 77 wells and 3 springs show no evidence of significant degradation of water quality in the Edwards aquifer, and the data show no trend of degradation in water quality. (USGS)
W82-04987

FLOOD AND DEBRIS FLOOD HAZARDS MAP, CARSON CITY QUADRANGLE,

Geological Survey, Carson City, NV. Water Resources Div.
T. Katzer, and C. V. Schroer.
Available from Nev. Bur. of Mines and Geo. Univ. of Nevada Reno, Nevada 89557, Price: $2.50. Nevada Bureau of Mines and Geology Map 1A1, 1981. 1 Sheet.

Descriptors: *Maps, *Floods, *Detritus, *Hazards, Flood peak, Flood plains, Flood flow, Erosion, Deposition, *Nevada, *Carson City quadrangle.

This map shows the flood and debris hazards on the Carson City quadrangle, Nevada. Estimates of the 100-year floodflow were made and the corresponding flood plains were outlined on the map for the principal drainages in the area. Degrees of hazard were assigned to the flood plains of these streams on the basis of floodflows and potential debris movement. (USGS)
W82-05217

TEST-HOLE DATA FOR THE EDWARDS AQUIFER IN THE SAN ANTONIO AREA, TEXAS,

Geological Survey, Houston, TX. Water Resources Div.
T. A. Small, and R. W. Maclay.
Texas Department of Water Resources LP-171, January 1982. 153 p, 9 Fig, 38 Tab, 21 Ref.

Descriptors: *Test holes, *Core drilling, *Aquifers, Data collections, Porosity, Permeability, Mineralogy, Water management, *Texas, San Antonio area, *Edwards aquifer, *Geohydrology.

This report contains descriptive geologic data collected by the U.S. Geological Survey during a test-hole program to develop a factual concept of the distribution of porosity and permeability within the framework of the Edwards aquifer in the San Antonio area, Texas. The test-hole program produced more than 4,000 feet (1,219 meters) of rock core from eight holes during May 1972 to April 1974. The selection of test-hole sites was based on considerations of possible water management problems, geologic conditions, and the limitations of the drilling and coring equipment. Cores were examined for composition, color, hardness, grain size, grain type, sedimentary structure, pore shape and size, and total porosity. Laboratory tests were used to determine porosity, pore-size distribution, permeability, grain density, formation factor, and mineralogy. (USGS)
W82-05218

BEDROCK AQUIFERS IN THE LOWER DIRTY DEVIL RIVER BASIN AREA, UTAH, WITH

SPECIAL EMPHASIS ON THE NAVAJO SANDSTONE,

Geological Survey, Salt Lake City, UT. Water Resources Div.
J. W. Hood, and T. W. Danielson.
Available from Utah Dept. of Natural Res. Div. of Water Rights 1636 West North Temple Room 220 Salt Lake City, Utah 84116. Utah Department of Natural Resources Technical Publication No 68, 1981. 143 p, 22 Fig, 4 Plates, 14 Tab, 48 Ref.

Descriptors: *Bedrock, *Aquifers, *Aquifer characteristics, *Surface-groundwater relations, Precipitation, Rainfall disposition, Hydrologic budget, Wells, Well logs, Water level, Well yields, Groundwater recharge, Groundwater movement, Groundwater storage, Water quality, Chemical analysis, Salinity, *Utah, *Dirty Devil River basin, Navajo Sandstone.

The lower Dirty Devil River basin area in southeastern Utah has an area of about 4,300 square miles. Precipitation is the main source of water and averages 1.55 million acre-feet annually in the long term. Rocks in the area range from Precambrian to Holocene. The section of sedimentary rocks ranges from 7,300 to 23,000 feet in thickness. Major aquifers are the Entrada, Navajo, Wingate, and Coconino Sandstones and rocks of Mississippian age. They contain fresh to briny water. Their permeability is affected by folding, faulting, and igneous intrusion. The annual water supply averages 1.6 million acre-feet, of which an estimated 96% is consumed by evapotranspiration. The estimated long-term annual gross ground-water recharge is 34,000 acre-feet, of which 5,000 acre-feet recharges the Navajo Sandstone. Recoverable fresh to moderately saline water stored in the Navajo, Wingate, and Coconino Sandstones is estimated to be 210 million acre-feet, of which 89 million acre-feet is stored in the Navajo alone. Long-term withdrawals from the Navajo Sandstone, of up to 12,000 gallons per minute, probably would diminish the flow of the Dirty Devil River, but would have a negligible effect on the volume of ground water in storage or the flow of the Colorado River. (USGS)
W82-05220

HYDROLOGIC RECONNAISSANCE OF THE SOUTHERN GREAT SALT LAKE DESERT AND SUMMARY OF THE HYDROLOGY OF WEST-CENTRAL UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
J. S. Gates, and S. A. Kruer.
Available from Utah Dept. of Natural Res. Div. of Water Rights 231 East 400 South Salt Lake City, Utah 84111. Utah Department of Natural Resources Technical Publication No 71, 1981. 55 p, 4 Fig, 4 Plates, 10 Tab, 38 Ref.

Descriptors: *Hydrologic data, *Hydrologic budget, *Groundwater, *Water quality, *Surface water, Arid climates, Evaluation, Water resources development, Potential water supply, Aquifer characteristics, Groundwater movement, Water storage, Wells, Springs, Well data, Chemical analysis, *Utah, *Great Salt Lake Desert, West-central Utah.

The report is the last of 19 hydrologic reconnaissances of the basins in western Utah. The purposes of this series of studies are (1) to analyze available hydrologic data and describe the hydrologic system, (2) to evaluate existing and potential water-resources development, and (3) to identify additional studies that might be needed. Part 1 of the report gives an estimate of recharge and discharge, an estimate of the potential for water-resources development, and a statement on the quality of water in the southern Great Salt Lake Desert part of west-central Utah. Part 2 deals with the same aspects of west-central Utah as a whole. Part 2 also summarizes the evidence of inter-basin groundwater flow in west-central Utah and presents a theory for the origin of the water discharged from Fish Springs. Annual ground-water recharge is about 241,000 acre-feet in west-central Utah and about 84,000 acre-feet in the southern Great Salt Lake Desert. Annual ground-water discharge is about 259,000 acre-feet from west-central Utah and about 84,000 acre-feet from the southern desert. Ground water in west-central Utah ranges from fresh in unconsolidated fill under the margins of the basins bordered by higher mountain ranges to briny under the mud- and salt-flat areas. About 17.4 million acre-feet of ground water, of which possibly two-thirds is fresh, is stored in the upper 100 feet of saturated basin fill in west-central Utah. Ground water flows into west-central Utah and between basins through consolidated rock. Most of the 26,000 acre-feet per year discharged at Fish Springs probably is recharged along the flanks of the Deep Creek Range and moves as interbasin flow through Snake Valley and possibly Tule Valley to Fish Springs Flat. (USGS)
W82-05221

CHEMICAL CHARACTER OF WATER IN THE RED RIVER ALLUVIAL AQUIFER, LOUISIANA,

Geological Survey, Baton Rouge, LA. Water Resources Div.
M. S. Whitfield, Sr.
Geological Survey Water Resources Investigation, Open-File Report 80-1018, 1980. 95 p, 3 Fig, 21 Plates, 5 Tab, 41 Ref.

Descriptors: *Water quality, *Groundwater, *Hydrologic data, *Chemical properties, Alluvial aquifers, Aquifer characteristics, Rainfall, *Groundwater recharge, Groundwater movement, Wells, Water level, Water yield, Chemical analysis, Pesticides, Maps, *Louisiana, *Red River Valley, Black River, Dissolved solids.

The Red River alluvial aquifer underlies 2,000 square miles in the Red River Valley of Louisiana and is the only source of fresh ground water in most of the valley. The aquifer consists mainly of sand and gravel and ranges from 40 to 150 feet in thickness. Recharge is by rainfall, by lateral movement of water from adjacent older formations, and by upward discharge from underlying aquifers. These varied sources of recharge cause both areal and vertical differences and variations in water quality. Water levels generally range from about 0 to less than 30 feet below land surface, and the aquifer is capable of yielding 1,000-2,000 gallons per minute to individual wells. Water is typically of the calcium magnesium bicarbonate type. It ranges in hardness from less than 100 to 2,300 mg/L (milligrams per liter) but generally is between 200 and 600 mg/L. Dissolved iron concentrations ranges from about 0.3 mg/L to as high as 49 mg/L but generally is 1 to 10 mg/L. Dissolved sulfate concentrations generally range from 0.5 to 50 mg/L but locally exceed 250 mg/L. The dissolved chloride concentrations typically is less than 50 mg/L but locally exceeds 250 mg/L and is as high as 4,400 mg/L in a few areas. (USGS)
W82-05228

MAPS SHOWING GROUND-WATER CONDITIONS IN THE SAN SIMON WASH AREA, PAPAGO INDIAN RESERVATION, ARIZONA--1979,

Geological Survey, Tucson, AZ. Water Resources Div.
K. J. Hollett.
Geological Survey Water Resources Investigations Open-File Report 81-530, April 1981. 2 Sheets, 27 Ref.

Descriptors: *Maps, *Groundwater, *Water quality, *Wells, *Water level, Geohydrology, Alluvium, Water yield, Water use, Dissolved solids, Fluorides, Arsenic, Hydrographs, *Arizona, *Papago Indian Reservation, San Simon Wash.

The San Simon Wash area includes about 2,300 square miles in the Papago Indian Reservation in south-central Arizona. The area is characterized by low mountains separated by broad alluvial basins. The main water-bearing unit is the alluvium, which consists of clay, silt, sand, gravel, and small amounts of evaporite deposits. Properly constructed and developed wells in the basin fill generally yield more than 50 gallons per minute. Less than 50 gallons per minute is obtained from the crystalline and consolidated sedimentary rocks and from thin alluvial deposits in the mountains. In 1979 about 2,700 acre-feet of ground water was withdrawn for irrigation, public-supply, and livestock uses. The maps show depth to water, altitude of the water level, well depth, dissolved-solids, fluoride, and arsenic concentrations. Scale is 1:125,000. (USGS)
W82-05231

MAPS SHOWING GROUND-WATER CONDITIONS IN THE AGUA FRIA AREA, YAVAPAI AND MARICOPA COUNTIES, ARIZONA-1979,

Geological Survey, Tucson, AZ. Water Resources Div.
G. R. Littin.
Geological Survey Water Resources Investigations Open-File Report 81-804, June 1981. 2 Sheets, 13 Ref.

Descriptors: *Maps, *Groundwater, *Water level, *Wells, Geohydrology, Aquifers, Specific conductivity, Fluorides, *Arizona, Yavapai County, Maricopa County, Agua Fria area.

The Agua Fria area includes about 1,500 square miles in central Arizona. The water-bearing characteristics of the units that make up the aquifers vary greatly because of large differences in rock type and extent of fracturing. In order of decreasing yield potential, the major water-bearing units are the unconsolidated deposits, conglomerate, volcanic clastic deposits, and lake deposits. The minor water-bearing units consist of basaltic to rhyolitic volcanic rocks; and schist, gneiss, and granite. Ground-water development has been slight, and in 1978 about 3,200 acre-feet was withdrawn for irrigation, public supply, and domestic and stock uses. The maps show depth to water, altitude of the water level, well depth, and specific conductance and fluoride concentration in the water. Scale is 1:125,000. (USGS)
W82-05232

ASSESSMENT OF WATER QUALITY IN STREAMS DRAINING COAL-PRODUCING AREAS IN OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05234

TECHNIQUES OF TREND ANALYSIS FOR MONTHLY WATER QUALITY DATA,

Geological Survey, Reston, VA.
R. M. Hirsch, J. R. Slack, and R. A. Smith.
Water Resources Research, Vol 18, No 1, p 107-121, February, 1982. 8 Fig, 5 Tab, 18 Ref.

Descriptors: *Water quality, *Monitoring, *Data interpretation, Statistical analysis, Trend analysis, Kendall tests, *Seasonal variation.

Three techniques (the seasonal Kendall test for trend, the seasonal Kendall slope estimator, and flow adjustment coupled with the seasonal Kendall test) are presented for identifying and quantifying monotonic trends in water quality with time. The methods overcome the difficulties produced by non-normal distribution, seasonality, flow relatedness, missing values, values below the detection limit, and serial correlation. The seasonal Kendall test for trends applies to data sets with seasonality, missing values, or values below the detection limit. The slope estimator test estimates trend magnitude. It estimates the slope of a linear trend more precisely than a regression estimator in the case of highly skewed data but less precisely where data are normal. The third procedure tests for changes over time in the relationship between constituent concentration and flow, overcoming the problems in identifying trends in water quality resulting from droughts. The flow adjusted concentration obtained can then be tested for trend by the seasonal Kendall test. These techniques eliminate subjectvie evaluation, which often concentrates on the extreme values rather than on the subtle but regular trends in the bulk of values nearer the mean. (Cassar-FRC)
W82-05344

GEOTECHNICAL APPLICATIONS OF LANDSAT IMAGE ANALYSIS OF BHAKRA DAM RESERVOIR, INDIA,

Indian Inst. of Tech., Bombay. Centre of Studies of Resources Engineering.
R. P. Gupta, and J. Bodechtel.
Remote Sensing of Environment, Vol 12, No 1, p 3-13, 1982. 5 Fig, 16 Ref.

Descriptors: *Remote sensing, *Reservoirs, *Monitoring, Bhakra Dam, India, Sutlej River, Landsat, Satellite technology, Geologic mapping, Mapping, rock properties, Water level, Geologic fractures, Drainage patterns, Water storage, Silting.

Analyses of Landsat images over the 240 m high concrete Bhakra Dam Reservoir on the Sutlej River, India, provided information on the geotechnical-structural nature of the area, reservoir monitoring, and silting hazards in the reservoir. Drainage patterns and tectonic features in the region were clearly discerned. A few well-developed lineaments run through the reservoir area, and some weakly marked structures are close to the dam site. No geologically recent structures approach the dam or reservoir. Determinations of temporal variations in lake area are most accurately done by digital processing of data from a 26 km length of stream bed which sensitively reflects lake levels. Landsat data identified 2 major silt-contributing zones in the reservoir. Both areas are characterized by low gradient slopes, wide valley sections, and mechanically weak rocks. Shales and clay-shales are found in Region A and fractures and defects in Region B. (Cassar-FRC)
W82-05612

FLOOD HAZARD MAPS AS PUBLIC INFORMATION: AN ASSESSMENT WITHIN THE CONTEXT OF THE CANADIAN FLOOD DAMAGE REDUCTION PROGRAM,

J. W. Handmer.
Canadian Water Resources Journal, Vol 5, No 4, p 82-110, 1980. 5 Fig, 4 Tab, 28 Ref.

Descriptors: *Public relations, *Maps, *Flood plains, Flood damage, Flood plain management, Flood plain zoning, Canadian Flood Damage Reduction Program, Information systems, Attitudes, Hazards, Carman, Manitoba, Oshawa, Ontario, Moosejaw, Saskatchewan, Publications, Risks, Zoning, Nonstructural alternatives.

The use of flood hazard maps as public information tools was evaluated by comparing attitudes of flood plain dwellers, commercial and industrial interests, and government officials with questionnaires and interviews. Carman, Manitoba (population 2400), Moosejaw, Saskatchewan (population 32,000), and Oshawa, Ontario (population 114,000) were chosen for the program. Results indicated that the substantially increased flood awareness among the group given flood hazard maps was not due to the maps alone but to increased publicity in all communications media. Methods of distributing maps which were not effective were passive distribution through public offices and libraries, printing copies of the maps in newspapers, and direct mailing. Although map dissemination is apparently ineffective in providing flood information to consumers, it is still a desirable practice. For maximum impact maps should involve local government officials, real estate agents, and mortgage companies. Maps should be visually striking, multicolored, and indicate each building clearly. Accompanying information should include brief, relevant explanations and mapping of a historic flood. (Cassar-FRC)
W82-05729

HYDROLOGY OF AREA 32, EASTERN REGION, INTERIOR COAL PROVINCE, INDIANA,

Geological Survey, Indianapolis, IN. Water Resources Div.
D. J. Wangsness, R. L. Miller, Z. C. Bailey, and C. Crawford.
Geological Survey Open-File Report 81-498 (WRI), August 1981. 76 p, 38 Fig, 12 Tab, 56 Ref, Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Geohydrology, Hydrologic cycle, Climates, Land use, Soil classification, Indiana, Eastern region, Interior Coal Province.

Hydrologic and water-quality information from the coal region in parts of 11 counties in southwestern Indiana are summarized. Pennsylvanian and Mississippian bedrock are overlain by drift and till from the Kansan, Illinoian, and Wisconsinan glaciers that covered two-thirds of the area. Most of the coal is mined from Pennsylvanian coal units. As of 1978, more than 1-billion short tons of coal had been mined from the 11 counties. More than 12-billion short tons remained in reserve. During 1978, 17.8-million short tons were mined. Coal mining disturbs less than 1% of the land in the study area. Sixty-two percent of the land use is agricultural, and 29% is forested. More coal is mined in the southern and western parts of the study area than elsewhere. Surface water in these parts had lower pH and alkalinity than water in the north and east parts. Specific conductance and concentrations of sulfate, iron, and manganese in surface water were higher in the south and west than elsewhere. (USGS)
W82-05825

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1979 TO SPRING 1980.

Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-05826

MAP SHOWING GROUND-WATER CONDITIONS IN THE SACRAMENTO VALLEY AREA, MOHAVE COUNTY, ARIZONA--1979,

Geological Survey, Tucson, AZ. Water Resources Div.
C. L. Pfaff, and D. M. Clay.
Geological Survey Open-File Report 81-418 (WRI), March 1981. 1 Sheet, 7 Ref.

Descriptors: *Maps, *Groundwater, *Wells, *Water level, *Water quality, Geohydrology, Aquifer characteristics, Specific conductivity, Fluorides, Water use, Groundwater potential, Hydrographs, *Arizona, Mohave County, Sacramento Valley area.

The Sacramento Valley area includes about 800 square miles in northwestern Arizona. The valley slopes gently southward and is filled with alluvium and volcanic rocks to depths of more than 4,000 feet. The alluvium is divided into three units--older, intermediate, and younger alluvium--and the volcanic rocks are divided into two units--older and younger volcanic rocks. The older alluvium is the main water-bearing unit and yields 20 to 1,300 gallons per minute of water to wells. In the Kingman area the younger volcanic rocks are about 1,400 feet thick and yield less than 1 to 300 gallons per minute. Ground-water development has been slight and, in general, has had little effect on water levels; however, water-level declines have occurred in places where ground water is withdrawn for industrial or municipal supplies. The map shows depth to water, altitude of the water level, well depth, specific conductance, and fluoride concentration. Hydrographs of the water level in selected wells and a table of historical pumpage also are included. Scale is 1:125,000. (USGS)
W82-05827

HYDROGEOLOGIC RECONNAISSANCE OF THE REPUBLICAN RIVER BASIN IN NEBRASKA,

Geological Survey, Lincoln, NE. Water Resources Div.
M. J. Ellis.
Geological Survey Open-File Report 81-531 (WRI), July 1981. 3 Sheets, 25 Ref.

Descriptors: *Maps, *Geohydrology, *Groundwater, *Aquifer characteristics, Bedrock, Water table, Water level, Water level fluctuations, Hydrologic data, *Nebraska, Republican River basin.

The Republican River basin in Nebraska includes about 9,710 square miles in the southwestern and south-central parts of the State. The principal sources of ground water in the basin are sand and gravel deposits overlying the Cretaceous bedrock. In the upland parts of the basin, these sands and gravels occur in both Pleistocene deposits and the Ogallala Formation. Along the Republican River valley the sands and gravels occur in undifferentiated Holocene and Pleistocene deposits. Information mapped includes: configuration of the Cretaceous bedrock surface and the configuration of the spring 1977 water table (scale, 1:250,000); and approximate outcrop of Cretaceous bedrock and approximate extent of White River Group (scale 1:1,000,000). (USGS)
W82-05828

CHLORIDE AND TOTAL HARDNESS CONCENTRATIONS OF WATER FROM THE UPPER PART OF THE FLORIDAN AQUIFER IN ST. JOHNS COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
P. S. Hampson, and E. C. Hayes.
Geological Survey Open-File Report 81-907 (WRI), 1982. 1 Sheet, 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Groundwater, *Water quality, *Aquifers, *Potentiometric level, Geohydrology, Data collections, Chlorides, Hardness, Salinity, Pumpage, Irrigation, *Florida, St. Johns County, Floridan aquifer.

Data collected from 1976 to 1979 indicate large water-quality variations in the upper 300 feet of the Floridan aquifer in St. Johns County, Florida. Chloride concentrations range from less than 10 milligrams per liter in the northwestern part of the county to more than 1,000 milligrams per liter in the southeast and extreme southwest. Total hardness concentrations range from 110 milligrams per liter in the northwest to 1,700 milligrams per liter in the southeast. In most of the county, high chloride and total hardness concentrations indicate the presence of saline water that entered the aquifer during the Pleistocene Epoch and has not been flushed out. Water quality in the aquifer has also been influenced by submarine discharge in the southeast and by heavy pumpage for irrigation in the southwest. High total hardness concentrations not accompanied by high chloride values in the western part of the county may be structurally controlled or may indicate the presence of gypsum evaporite beds in the upper 300 feet of the aquifer. (USGS)
W82-05829

HYDROGEOLOGIC SECTIONS THROUGH LEE COUNTY AND ADJACENT AREAS OF HENDRY AND COLLIER COUNTIES, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
D. H. Boggess, T. M. Missimer, and T. H. O'Donnell.
Geological Survey Open-File Report 81-638 (WRI), 1981. 1 Sheet, 6 Fig, 5 Ref.

Descriptors: *Groundwater, *Geohydrology, *Aquifers, *Water table, Aquifer characteristics, Geologic formations, Wells, Water yield, Water quality, *Florida, Lee County, Hendry County, Collier County.

The freshwater underlying Lee, western Hendry, and northern Collier Counties occurs within the marine terrace sands, the Fort Thompson, Caloosahatchee, Tamiami, and Hawthorn Formations. These are, respectively, the water-table aquifer, an aquifer in the Tamiami Formation, and an aquifer in the upper part of the Hawthorn Formation. These aquifers are separated by clay, marl, and marly limestone. Wells tapping the water-table aquifer are commonly less than 30 feet deep, with yields ranging from 5 to 500 gallons per minute. The water quality in the aquifer is usually good, except for iron, which generally exceeds 1 milligram per liter, and color, which ranges from 30 to 600 Platinum-Cobalt units. Wells tapping the Tamiami aquifer range in depth from about 60 to 300

feet; most are less than 100 feet deep. Yields range from 20 to 500 gallons per minute. The water quality in the Tamiami aquifer is good, except where affected by leakage from deep artesian wells. Wells tapping the upper Hawthorn aquifer range in depth from about 100 to 300 feet. Yields range from 10 to 500 gallons per minute. The water quality from the upper Hawthorn aquifer is good, except in areas where upward leakage from the deep artesian aquifer has occurred. (USGS)
W82-05830

HYDROLOGY OF AREA 3, EASTERN COAL PROVINCE, PENNSYLVANIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
W. J. Herb, L. C. Shaw, and D. E. Brown.
Geological Survey Open-File Report 81-537 (WRI), September 1981. 88 p, 65 Fig, 26 Tab, 29 Ref, Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Acid mine drainage, Water pollution sources, Streams, Flow characteristics, Chemical analysis, Metals, Permits, *Pennsylvania, Eastern Coal Province, Ohio River basin.

Hydrologic data are presented for area 3 of the Eastern Coal Province, 4,077 square miles of the lower Allegheny River basin in western Pennsylvania. Seventy-three streams were sampled three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity, dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and botom material samples were analyzed for metals. Sixteen streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved sulfate indicative of acid-mine drainage. These streams were most common in the Redbank and Blacklick Creek basins and in the Conemaugh and lower Kiskiminetas River basins. Benthic invertebrates were not found in 11 of 64 streams sampled. An additional 13 streams had low benthic invertebrate diversity indices. Low diversity indices were most common in the southern part of area 3. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 3. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, National Water Data Storage and Retrieval System, and Office of Water Data Coordination are explained. (USGS)
W82-05831

HYDROLOGY OF AREA 25, EASTERN REGION, INTERIOR COAL PROVINCE, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
E. E. Zuehls, G. L. Ryan, D. B. Peart, and K. K. Fitzgerald.
Geological Survey Open-File Report 81-636 (WRI), September 1981. 66 p.

Descriptors: *Hydrologic data, Water quality, *Groundwater, *Surface waters, *Coal mines, Geohydrology, Acid mine drainage, Water pollution sources, Strip mines, Soil classification, Agriculture, Chemical analysis, *Illinois, Interior Coal Province, Eastern region.

The eastern region of the Interior Coal Province has been divided into 11 hydrologic study areas. Area 25, located in west-central Illinois, includes the Spoon River and small tributaries to the Illinois River. Pennsylvanian age rocks underlie most of the study area. Illinois, with the largest reserves of bituminous coal, is second only to Montana in total coal reserves. Loess soils cover most of the study area. Agriculture is the dominant land use. Surface water provides 97% of all the water used. Precipitation averages 34 to 35 inches. Water-quality data has been collected at over 31 sites. Analysis for specific conductance, pH, alkalinity, iron, manganese, sulfate and many trace elements and other water-quality constituents have been completed. These data are available from computer storage through the National Water Data Storage and Retrieval System (WATSTORE). (USGS)
W82-05832

HYDROLOGY OF AREA 4, EASTERN COAL PROVINCE, PENNSYLVANIA, OHIO, AND WEST VIRGINIA,

Geological Survey, Columbus, OH. Water Resources Div.
D. K. Roth, and M. J. Engelke, Jr.
Geological Survey Open-File Report 81-343 (WRI), July, 1981. 62 p, 41 Ref, 3 Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Geohydrology, Acid mine drainage, Water pollution sources, Erosion, Sedimentation, Streams, Flow characteristics, *Ohio, *Pennsylvania, *West Virginia, Eastern Coal Province, Ohio River basin.

Area 4 (one of the 24 hydrologic areas defining the Eastern Coal Province) is located at the northern end of the Eastern Coal Province in eastern Ohio, northern West Virginia, and western Pennsylvania. It is part of the upper Ohio River basin, which includes the Beaver, Mahoning, and Shenango Rivers. The area is underlain by rocks of the Pottsville, Allegheny, Conemaugh, Monongahela Groups (or Formations) and Dunkard Group. Area 4 has a temperate climate with an annual average rainfall of 38 to 42 inches, most of its area is covered by forest. The soils have a high erosion potential where the vegetation cover is removed. In response to Public Law 95-87, 132 sites were added to the existing surface-water data-collection network in area 4. At these added sites, collected data includes discharge, water quality, sediment, and biology. The data are available from computer storage through the National Water Data Exchange (NAWDEX) or the published annual Water Resources Data reports for Ohio, Pennsylvania, and West Virginia. Hydrologic problems related to mining are: (1) Erosion and increased sedimentation, and (2) degradation of water quality. Erosion and sedimentation are associated chiefly with surface mining. Sediment yields increase drastically when vegetation is removed from the highly erosive soils. Degradation of water quality can be caused by acid-mine drainage from underground and surface mining. More than half the acid-mine drainage effluent in area 4 comes from underground mines. The rest seeps from abandoned surface mines. Usually in reclaimed surface mines the overburden is replaced in such a short time after the coal is taken out that oxidation of acid-forming minerals, commonly pyrite or marcasite, is not complete or is neutralized by the buffering action of calcareous minerals in the soils. (USGS)
W82-05833

HYDROLOGY OF AREA 5, EASTERN COAL PROVINCE, PENNSYLVANIA, MARYLAND, AND WEST VIRGINIA,

Geological Survey, Harrisburg, PA. Water Resources Div.
W. J. Herb, L. C. Shaw, and D. E. Brown.
Geological Survey Open-File Report 81-538 (WRI), September 1981. 92 p, 60 Fig, 22 Tab, 37 Ref, Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Acid mine drainage, Water pollution sources, Streams, Flow characteristics, Chemical analysis, Metals, Permits, *Pennsylvania, *Maryland, *West Virginia, Eastern Coal Province, Ohio River basin.

Hydrologic data are presented for area 5 of the Eastern Coal Province, the 7,384 square-mile Monongahela River basin in western Pennsylvania, western Maryland, and north-central West Virginia. One hundred thirty-four streams were sampled about three times during the 1979 and 1980 water years for specific conductance, pH, acidity, alkalinity dissolved and total iron, dissolved and total manganese, dissolved sulfate, and dissolved solids. Benthic invertebrate populations were determined and bottom material samples were analyzed for metals. Eleven streams had pH, acidity, alkalinity, total iron, total manganese, and dissolved-sulfate levels indicative of acid-mine drainage. These streams were most common in the Tygart Valley River basin, although indicators of acid-mine drainage were found throughout the Monongahela basin. No benthic invertebrates were found in 25 of 129 streams sampled. Such streams were most common in the Cheat and Tygart Valley River basins. Low flow, mean flow, peak flow, and flow duration data are presented for gaging stations in area 5. Techniques for estimating these data for ungaged sites are presented and referenced. The functions of, and access to, the National Water Data Exchange, WATSTORE, and indexes to water-data activities in coal provinces are presented. (USGS)
W82-05834

HYDROLOGY OF AREA 18, EASTERN COAL PROVINCE, TENNESSEE,

Geological Survey, Nashville, TN. Water Resources Div.
V. J. May.
Geological Survey Open-File Report 81-492 (WRI), August 1981. 78 p, 30 Ref. 3 Append.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, *Surface water, *Coal mines, Streams, Acid mine drainage, Geohydrology, Chemical analysis, Permits, *Tennessee, Eastern Coal Province, Cumberland River basin.

The Eastern Coal Province is divided into 24 hydrologic reporting areas. This report describes the hydrology of area 18 which is located in the Cumberland River basin in central Tennessee near the southern end of the Province. Hydrologic information and sources are presented as text, tables, maps, and other illustrations designed to be useful to mine owners, operators, and consulting engineers in implementing permit applications that comply with the environmental requirements of the 'Surface Mining Control and Reclamation Act of 1977.' Area 18 encompasses parts of three physiographic regions; from east to west the Cumberland Plateau, Highland Rim, and Central Basin. The Plateau is underlain by sandstones and shales, with thin interbedded coal beds, of Pennsylvanian age. The Highland Rim and Central Basin are underlain by limestone and dolomite of Mississippian age. Field and laboratory analyses of chemical and physical water-quality parameters of streamflow samples show no widespread water quality problems. Some streams, however, in the heavily mined areas have concentrations of sulfate, iron, manganese, and sediment above natural levels, and pH values below natural levels. Mine seepage and direct mine drainage were not sampled. Ground water occurs in and moves through fractures in the sandstones and shales and solution openings in the limestones and dolomites. Depth to water is variable, ranging from about 5 to 70 feet below land-surface in the limestones and dolomites, and 15 to 40 feet in the coal-bearing rocks. The quality of ground water is generally good. Locally, in coal-bearing rocks, acidic water and high concentrations of manganese, chloride, and iron have been detected. (USGS)
W82-05835

SUMMARY OF AVAILABLE DATA ON SURFACE WATER, STATE OF HAWAII. VOLUME I: ISLAND OF KAUAI,

Geological Survey, Honolulu, HI. Water Resources Div.
I. Matsuoka.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80025, Price: $75.25 in paper copy, $4.50 in microfiche. Geological Survey Open-File Report 81-1056, November 1981. 537 p, 2 Plates, 5 Ref.

Descriptors: *Data collections, *Surface water, *Water quality, *Streamflow, Flow characteristics, Flow duration, Discharge measurement, Gaging station, Sites, Sedimentation, Phytoplankton, *Hawaii, Kauai.

This report presents statistical summaries of surface-water discharge records and tabulations of surface-water-quality parameters at data-collection sites in Kauai, Hawaii. Data presented in this

report are mainly in tabular format. They consist of concise site description and information, flow-duration table, various monthly and annual discharges, lowest and highest mean discharges for each year for specified numbers of consecutive days, statistics for monthly and annual mean discharges, and tabulation and summary of surface-water-quality data. Water-quality parameters include sediment and phytoplankton data. Maps with surface-water data-collection sites, plotted with their respective hydrologic boundaries, are included. These data provide the information needed for deriving correlative associations and sound estimates that can be used in reaching surface-water management and control decisions. (USGS)
W82-05836

MAP SHOWING HOW THE POTENTIOMETRIC SURFACE OF THE MAGOTHY AQUIFER OF AUGUST 1980 DIFFERED FROM THE POTENTIOMETRIC SURFACE OF SEPTEMBER 1977, IN SOUTHERN MARYLAND,

Geological Survey, Towson, MD. Water Resources Div.
F. K. Mack, J. C. Wheeler, and S. E. Curtin.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $19.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-631, 1981. 1 Sheet.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Observations, Groundwater level, Coastal plains, *Maryland, Magothy aquifer, Cone of depression.

The map is based on the differences between two sets of water-level measurements made in 65 observation wells. One set was made in 1977, a relatively dry year, and the other set was made in 1980, another relatively dry year. The map shows that the potentiometric surface was higher in 1980, by as much as 9 feet, than it was in 1977, in a band a few miles wide near the outcrop and subcrop areas of the aquifer in northern Prince Georges County and central Anne Arundel County. In the remainder of the map area, the 1980 potentiometric surface was lower than it had been in 1977, with declines as great as 20 feet measured in well fields at Waldorf and Chalk Point. The network of observation wells was developed and is operated and maintained as part of the cooperative program between the U.S. Geological Survey and agencies of the Maryland Department of Natural Resources. (USGS)
W82-05838

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, SEPTEMBER 1981,

Geological Survey, Tampa, FL. Water Resources Div.
D. K. Yobbi, and G. R. Schiner.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $2.50 in paper copy, $.50 in microfiche. Geological Survey Open-File Report 82-101, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Geohydrology, *Florida, Southwest Florida, Southwest Florida Water Management District.

A September 1981 potentiometric-surface map of the Southwest Florida Water Management District depicts the annual high water-level period. Water levels in most wells measured in September 1981 are equal to or higher than in May 1981. Levels averaged about 26 feet higher in the southern part of the area and 5 feet in the north. In the agricultural sections of southern Hillsborough, Hardee, southwestern Polk, northwestern De Soto, and Manatee Counties, water levels increased 10 to 46 feet. From September 1980 to September 1981, water levels ranged from a decrease of 11 feet in Citrus County to an increase of 9 feet in southern Hillsborough County. (USGS)
W82-05840

DISCHARGE DATA AT WATER-QUALITY MONITORING STATIONS IN ARKANSAS, 1980 WATER YEAR,

Geological Survey, Little Rock, AR. Water Resources Div.
R. K. Knott.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $4.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-157, 1981. 35 p, 3 Tab.

Descriptors: *Streamflow, *Flow rates, *Discharge measurement, *Water quality, Gaging stations, Data collections, Water pollution control, *Arkansas.

Discharge data were computed for a network of water-quality monitoring stations operated by the Arkansas Department of Pollution Control and Ecology. Some of the sites are located at U.S. Geological Survey of U.S. Army Corps of Engineers daily-discharge stations, but most sites are at points where discharges are not regularly measured. (USGS)
W82-05841

QUALITY OF WATER IN JAMES CREEK, MONROE COUNTY, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05842

QUALITY OF WATER AND TIME OF TRAVEL IN GOODWATER AND OKATOMA CREEKS NEAR MAGEE, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05845

QUALITY OF WATER AND TIME OF TRAVEL IN LITTLE COPIAH CREEK NEAR CRYSTAL SPRINGS, MISSISSIPPI,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-05847

HYDROLOGIC RECONNAISSANCE OF THE NOATAK RIVER BASIN, ALASKA, 1978,

Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-05848

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1981,

Geological Survey, Tallahassee, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $3.50 in paper copy, $.50 in microfiche. Geological Survey Open-File Report 82-118, 1981. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Geohydrology, *Florida, East-central Florida, St. Johns River Water Management District.

This map presents the potentiometric surface of the Floridan acquifer in the St. Johns River Water Management District and vicinity for September 1981. The Floridan acquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area 20- and 40-foot intervals are used to show a deep cone of depression. The potentiometric surface ranged from 134 feet above NGVD (National Geodetic Vertical Datum of 1929) in Polk County to 90 feet below NGVD in Nassau County. Record low water levels for September were recorded in many counties due to lack of rainfall. September 1981 levels were as much as 10 feet and commonly 2 to 3 feet lower than the below normal September 1980 levels. Water levels rose from September 1980 levels on the coastline at St. Augustine and from Flagler Beach south to New Smyrna Beach. (USGS)
W82-05849

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, SEPTEMBER 1981,

Geological Survey, Orlando, FL. Water Resources Div.
L. A. Bradner.
Available from the OFFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $2.50 in paper copy, $.50 in microfiche. Geological Survey Open-File Report 82-259, 1982. 1 Sheet.

Descriptors: *Potentiometric level, *Groundwater, *Maps, *Aquifers, Water table, Wells, Water level fluctuations, Geohydrology, *Florida, Sumter County, Floridan aquifer.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Florida, for September 1981. The Floridan aquifer is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the high water-level period. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 85 feet in the southeast part of the county to less than 35 feet northwest of Lake Panasoffkee in the west-central area. (USGS)
W82-05850

MAP OF THE ANTELOPE VALLEY-EAST KERN WATER AGENCY AREA, CALIFORNIA, SHOWING GROUND-WATER SUBUNITS AND AREAS, AND DISSOLVED-SOLIDS CONCENTRATIONS, 1970-80,

Geological Survey, Laguna Niguel, CA. Water Resources Div.
C. E. Lamb, and T. L. Hadley.
Geological Survey Open-File Map 81-698, 1981. 1 Sheet.

Descriptors: *Maps, *Groundwater, *Wells, *Dissolved solids, Water quality, *California, Groundwater subunits.

A map (scale 1:125,000) shows ground-water subunits and areas and graphs of dissolved-solids concentrations, 1970-80, in the Antelope Valley-East Kern Water Agency area, California. (USGS)
W82-05851

8. ENGINEERING WORKS

8A. Structures

RECONSTRUCTION OF THE NORTHERN DONETS-DONBAS CANAL,

G. P. Zhuk, and V. A. Osadchuk.
Hydrotechnical construction, No 8, p 765-772, August, 1980. 3 Fig, 3 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 5-9, August, 1980.

Descriptors: *Water conveyance, *Conveyance structures, Water transport, Canal construction, Construction methods, Expansion, *USSR, *Donbas Canal, Water demand.

One of the major factors determining the further development of industrial centers in the Soviet Union is the availability of adequate water supplies. In many cases, an effort is made to improve the water supply by increasing the capacity of the main pipelines without reconstructing the existing carrier canals. The Northern Donets-Donbas canal, which began operations in 1958, has undergone two major reconsructions without ever being shut down. The canal is the main source of drinking and industrial water supply for the majority of the industrial regions of the Donbas. The main

canal has a total length of 131.6 kilometers, of which 101.4 kilometers are open channel. Sag pipes, pressure pipes for pumping stations, and closed stretches of the canal comprise the remaining length. The first reconstruction of the canal, accomplished between 1966 and 1972, increased the discharge from the canal from 25 cubic meters per second to 32 cubic meters per second. The second reconstruction, carried out between 1973 and 1979, increased this discharge to 43 cubic meters per second. Activities conducted during each of the reconstructions are discussed. It is concluded that stagewise reconstruction of open canals can be accomplished under conditions of uninterrupted operation and that reconstruction of the structures and channel of existing canals provides an economical and expedient means of increasing water supplies. (Carroll-FRC)
W82-04773

THE SEARCH FOR RESERVOIR SITES IN AN URBAN ENVIRONMENT,

Thames Water Authority, London (England).
C. S. Sinnott, and M. H. Davies.
Journal of Hydrology, Vol 51, No 1-4, p 219-230, May, 1981. 1 Fig, 4 Tab, 3 Ref.

Descriptors: *Reservoir sites, *Urban areas, *Site selection, Reservoir siting, Cost analysis, Dams, Economic aspects, Environmental effects, London, *Great Britain, Storage reservoirs, Water supply.

Increases in the demand for water have traditionally led to the construction of larger and larger reservoirs, both increasing the environmental impact and necessitating the location of these reservoirs at greater distances from the center of demand. The alternative to the development of these large and remote storage reservoirs to meet the needs of urban areas is to set aside engineering and size considerations and identify sites which are primarily acceptable in terms of land use and environmental value. The Thames Water Authority, which is responsible for the catchments of the Thames and Lee rivers and for the London area in Great Britain, initiated a systematic survey to identify all possible reservoir sites within the area. Plans of each site were used to measure the dam length, maximum depth of the dam, and surface area for each dammed site and the surface area and perimeter of embankment for each impounded site. Estimates of the total costs of constructing the reservoir and the cost per unit volume of water stored were calculated for each site. The geological suitability of each site was evaluated to determine the potential need for lining. Each site was visited to check its suitability and to identify current usage and recent developments in the area. In order to quantify environmental effects, suitability grades were assigned on the basis of the amount of land affected, the quality of the land, the quality of the surrounding environment, and the remoteness from water. Finally, details of the suitability assessment, unit costs, and other data relating to each site were evaluated to classify the site as possible, doubtful, or unsuitable. A discounted cost analysis showed that the use of smaller sites meeting environmental constraints need not lead to financial penalties over the use of large sites. (Carroll-FRC)
W82-04867

THE RIVIERSONDEREND-BERG RIVER-JONKERSHOEK PROJECT MOST OUTSTANDING CIVIL ENGINEERING ACHIEVEMENT OF 1980.

Civil Engineering in South Africa, Vol 23, No 11, p 517, 519, 520, November, 1981. 6 Fig.

Descriptors: *Water supply development, *Dams, Civil engineering, *South Africa, Construction, Tunnels, Rivers.

The Riversonderend-Berg River-Jonkershoek Project was designed to collect surplus winter run-off of the upper reaches of the Berg, Dwars and Eerste Rivers and their tributaries, and divert all this water to the neighboring South Western Cape where conventional sources have fallen short of water demand, especially during the summer months. The Theewaterskloff Dam in the Riviersonderend was chosen for storage. The dam receives water directly from the Riviersonderend catchment and via the tunnel system from the Berg catchment. Theewaterskloof is a conventional earth dam with a 38 meter high dam wall and a 680 meter crest length. A spillway, capable of handling a probable maximum flood of 394 cubic meters/second, is of the side channel type and the chute ends in a stilling basin. The tunnel construction was the most challenging part of the project. The largest problem occurred when the Franschhoek tunnel penetrated through the granite at a point where a major fault coincided with the granite/sandstone contact. Environmental considerations played an important role in the planning and execution of the project. Much research was done to combat the potential problem of windblown sand conditions at the Theewaterskloff Dam. During winter months water will be diverted under force of gravity from the 1 million cubic meter capacity Klein Drakenstein Dam in the Elands River to Theewaterskloof via the proposed pipeline and the Dasbos and Granschhoek tunnels. In summer water from Theewaterskloof will flow back through the tunnel system and the pipeline as part of the supply to the Berg River area from Dasbos. (Baker-FRC)
W82-04886

BOTTOM-ENTRY LARGE-DIAMETER WELLS,

Food and Agricultural Organization of the United Nations, Rome (Italy). Land and Water Development Div.
R. G. Thomas.
Ground Water, Vol 20, No 1, p 96-98, 1982. 1 Fig, 1 Tab, 2 Ref.

Descriptors: *Deep wells, *Open wells, *Partially penetrating wells, *Cost analysis, *Well hydraulics, Wells, Screened wells, Well screens, Screens, Laminar flow, Mathematical equations, Water storage, Drawdown, Aquifer characteristics.

In areas where there are highly permeable gravel aquifers of relatively shallow depth, the bottom entry large-diameter well should be considered as an alternative to drilled and screened wells. In constructing a large-diameter well, a concrete or other casing is sunk as digging proceeds. When the water table is reached, a grab bucket device is usually needed for dewatering to continue digging. In low permeable rocks, large-diameter wells provide storage of water. For a 75% penetrating well, discharge increases roughly by 70% for each doubling of the radius. Drawdown outside the casing is not very great, making these wells a poor choice for drainage purposes. Nonlaminar flow conditions were examined using the Forchheimer equation. To prevent sand filling, a natural gravel pack is allowed to form, or backfilling with coarser clean gravel is employed. The capital costs for large-diameter well operation will depend on the well location. The large diameter, bottom entry well can use a centrifugal pump rather than a turbine pump which is also a savings in energy costs. (Geiger-FRC)
W82-04919

CAVITY WELL,

Food and Agricultural Organization of the United Nations, Rome (Italy). Land and Water Development Div.
R. G. Thomas.
Ground Water, Vol 20, No 1, p 94-95, 1982. 1 Tab, 5 Ref.

Descriptors: *Well hydraulics, *Irrigation wells, *Well casing, *Fully penetrating wells, *Pump wells, Wells, Groundwater mining, Alluvial plains, Test wells, Well yield, Deep wells, Drawdown, Economic aspects.

Cavity wells have been used in India's Gangetic alluvial plain for the past 15 years. The alluvium sand stringers are often overlain with fine silt clays with reasonably developed soil profiles, root casts, and Kankars (calcium carbonate rock fragments). The cavity well is constructed with a tripod and bailer bit. When the water table is reached, blank casing is installed and drilling continues. The blank casing is then pulled back about 0.5 m into the clay layer and a centrifugal test pump is installed. The well is pumped at a low rate until the sand no longer comes out. The pumping rate is then increased in small stages until the discharge is somewhat greater than what the farmer will need. Such wells usually last at least 5 years and may be replaced with relative ease. In a comparative test, a fully penetrating well gave a discharge of 41.4 cu m/h while the cavity well discharged only 36.7 cu m/h. The cavity well seems to be economically feasible for this section of India. More research is needed into the conditions of stability for the construction of deeper wells. (Geiger-FRC)
W82-04920

THE OVERTOPPING OF THE PALAGNEDRA DAM,

Ecole Polytechnique Federale de Lausagne (Switzerland).
J. Bruschin, S. Bauer, P. Delley, and G. Trucco.
International Water Power and Dam Construction, Vol 34, No 1, p 13-19, January, 1982. 7 Fig, 3 Tab, 3 Ref.

Descriptors: *Flood damage, *Reservoirs, *Dams, *Palagnedra Dam, Rainfall, Precipitation, Floods, Bypass channels, Spillways, Design criteria, Overflow channels, Construction, *Switzerland.

During the floods of August, 1978, severe damage was sustained by the Palagnedra reservoir and other installations of the Verbano hydroelectric scheme in Ticino, Switzerland. Early on in the event the diversion tunnel was progressively opened. Later between 4 and 6 p.m. it was gradually closed, in response to a request by the police, in the hope of delaying the flooding of a camp ground about 10 km downstream from the dam. The flood had the following consequences: overtopping of the dam occurred along its full length, resulting in an erosion breech 30 meters deep and 25 meters wide in the morainic material supporting the diaphragm: about 25,000 cubic meters of wooden debris and logs of all dimensions from forests in the upper parts of the catchment found their way into the reservoir; about 1,800,000 cubic meters of sand and gravel from various centers of erosion entered the reservoir; the part of the reservoir upstream of the intermediate dam was completely filled up, so that the sill at the inlet of the diversion tunnel was covered by sand and logs 12 to 14 meters deep; the gauging station of the Melezza, near Camedo just upstream of the reservoir was destroyed at 7 pm; and the grating of the water intake was partly destroyed, blocking the bypass tunnel. The storm itself was exceptional both in its large area of high precipitation and in an unusual general meteorological situation. A physical model was constructed to better understand the behavior of the mass of wood carried by the bore in the canyon and to the spillway. Remedial work and efforts to improve forecasting are underway. The major lesson learned concerns the design of the spillway. (Baker-FRC)
W82-04952

APPLICATION OF A TWO-DIMENSIONAL MODEL OF FORMATION OF STORM RUNOFF TO CALCULATION OF THE RAIN-WATER COLLECTOR-DRAIN DISCHARGE FROM AN URBANIZED TERRITORY,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2A.
W82-05027

ESTIMATES OF RESILIENCE INDICES BY SIMULATION,

Harvard Univ., Cambridge, MA.
For primary bibliographic entry see Field 6A.
W82-05046

ESTIMATING RESILIENCE BY CANONICAL ANALYSIS,

Harvard Univ., Cambridge, MA.
For primary bibliographic entry see Field 6A.
W82-05047

RELIABILITY, RESILIENCY, AND VULNERABILITY CRITERIA FOR WATER RESOURCE SYSTEM PERFORMANCE EVALUATION,

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 6A.
W82-05078

HYDRAULIC CALCULATIONS OF STABLE UNLINED CANALS BY THE VERTICAL VELOCITY DISTRIBUTION METHOD,

G. P. Skrebkov.
Hydrotechnical Construction, Vol 15, No 6, p 346-350, June, 1981. 3 fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 25-28, June, 1981.

Descriptors: *Canal design, *Flow velocity, *Design *Channel erosion, Channel morphology, *Design criteria, Velocity distribution, Hydraulic design, Erosion, Stable channels, *Sediment transport, Soil mechanics, Siberia.

The permissible velocity method of designing unlined canals, unsuitable for very large canals used for runoff diversion of northern and Siberian rivers, was modified by considering the hydraulic stability of the channel on any stretch. The mean velocity of flow was replaced with the averaged velocity on a vertical. The permissible velocity of the flow was replaced with the permissible velocity of the same vertical. This allowed evaluation of the stability of channels composed of different soils and the selection of a hydraulically stable cross section. The permissible velocity distribution was plotted using equations for the permissible velocity for noncohesive soil on a horizontal bed with Lane's correction to account for the decrease in stability of the soil particles on the slope. A sample problem, calculation of a hydraulically stable canal for discharging 1000 cu m per sec in sand, illustrated the method. An approximate depth of 16-18 m and a parabolic shape was first estimated. Testing a 17 m depth in the equations showed that the cross section obtained would produce and erodible channel. Consideration of the sand dune formation produced a final channel of 6.5 m deep, 170 m surface width, 3700 sq m cross sectional area, mean velocity 0.27 m per sec, and velocity on the channel axis, 0.286 m per sec. This approached the shape of a natural river channel. (Cassar-FRC)
W82-05108

CONTROLLING THE QUALITY OF COMPACTION OF EARTH FILL IN THE CONSTRUCTION OF HIGH DAMS,

S. V. Bortkevich, V. I. Vutsel', A. G. Chernilov, and N. F. Roiko.
Hydrotechnical construction, Vol 15, No 5, p 263-269, May, 1981. 4 Fig, 2 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 9-12, May, 1981.

Descriptors: *Compaction, *Quality control, *Dam construction, Soil mechanics, Earth dams, Soil compaction, Soil physical properties, Nurek Dam, Density, Sampling, Soil density.

A method for quality control of compaction during earth dam construction was developed and tested during building of the Nurek Dam. Quality of compaction depended on elative density. Monolith samples weighing 3-5 kg were removed from the compacted area. Samples of fines from the same area were collected simultaneously. After weighing to ensure that samples contained no cracks, the content of the fines in the monolith and the monolith dry density were determined. the placement density of the fines and of the soil as a whole were determined by equations. This method required samples of 2-3 liters compared with up to 1000 liters for the pit sampling method. Maximum error was + or - 20 kg per cu m. (Cassar-FRC)
W82-05109

SHAFT SPILLWAYS COMBINED WITH A WATER INTAKE,

A. N. Aliferov.
Hydrotechnical Construction, Vol 15, No 5, p 311-314, May, 1981. 3 fig, 6 ef. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 53-55, May, 1981.

Descriptors: *Spillways, *Intakes, *Dam design, Hydraulic structures, Rivers, Hydroelectric plants.

A combination spillway and intake was designed to reduce costs and save space at hydrostations on mountain rivers. These structures discharge flood water, take in water from the reservoir, divert water temporarily, and empty the reservoir to flush sediment. A typical project has a horizontal tunnel, intake tower, inclined shaft, and a connecting structure. The spillway shaft is inclined at an angle of 60 degrees to the tunnel, providing a free-flow hydraulic regime over the length of the spillway passage. Extensive aeration is produced. A ski jump bucket is used to connect the flow from spillway to river. Large, strong rocks are placed at the point of impact to prevent scouring of the river bed. (Cassar-FRC)
W82-05111

STRESS-STRAIN STATE OF AN ARCH DAM BASED ON DATA OF LONG-TERM ON-SITE OBSERVATIONS,

I. F. Blinov, E. M. Mirzak, and Y. P. Shaikan.
Hydrotechnical Construction, Vol 15, No 6, p 360-365, June, 1981. 3 Fig, 3 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 34-38, June, 1981.

Descriptors: *Stress analysis, *Dam stability, *Concrete testing, Strain measurements, Hydroelectric plants, Temperature effects, Design criteria, *Arch dams, Safety, Dam foundations, Reservoirs.

Stress-strain monitoring equipment consisting of 885 transducers and meters was installed in a double arch dam 70 m high and 285 m long to study deformations and temperature changes during filling, October 1971 to 1980. Temperatures were governed by seasonal temperatures, structural features, and orientation toward the sun. The temperature difference between the surfce layer of the rock foundations and the concrete stabilized at 4 C in October 1971 when the water level reached 22 m. Deformations of intersectional joints in the dam were described. Most separations were less than 0.2 mm. After regrouting several joints which had opened to 2.1-4.3 mm, no further openings were observed in these sections. There was some disturbance of the joint between the concrete and the foundation during construction. After the reservoir was filled to 52 m, the maximum opening decreased to 0.05-0.5 mm. Vertical and horizontal movements by the dam varied within + or - 2.0 mm. Stresses observed were within those assumed in design. (Cassar-FRC)
W82-05112

DESIGN OF THE COMPOSITION OF TRANSITION LAYERS OF ASPHALTIC CONCRETE MEMBRANES IN EARTH DAMS,

Y. N. Kasatkin.
Hydrotechnical Construction, Vol 15, No 6, p 357-360, June, 1981. 3 Fig, 1 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, 32-34, June, 1981.

Descriptors: *Asphalt concrete, *Dam design, *Soil porosity, Concretes, *Earth dams, Soil mechanics, Pores, Transition zone, Rocks, Soil compaction, Compaction.

Equations were developed to describe the penetration of asphaltic concrete into soil pores. This is important in design of earth dams containing asphaltic concrete membranes. Use of the equations was illustrated in a sample problem in which available rock at a construction site was evaluated for suitability as a component of the transition layer of a membrane being made of plastic coarse-grained asphaltic concrete. (Cassar-FRC)
W82-05113

DAMMING OF THE KARA-BOGAZ-GOL STRAIT WITHOUT SIDE DIVERSION OF THE FLOW,

P. K. Osokin, D. L. Melamut, N. K. Golubev, and F. G. Zagirov.
Hydrotechnical Construction, Vol 15, No 6, p 324-328, June, 1981. 6 Tab, 1 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 11-14, June, 1981.

Descriptors: *Dam construction, *Hydraulic fill, Cofferdams, Water level, *Kara-Bogaz-Gol Gulf, *Caspian Sea, Engineering.

Damming of the 200-250 m wide, 7 km long strait between the Caspian Sea and the Kara-Bogaz-Gol gulf was accomplished without side diversion of the flow. There was a 2 m high waterfall in an erodible rock channel between the two water bodies, which had the potential for a breakthrough of water from the sea into the gulf, a natural evaporator. Although the hydrological conditions during the scheduled construction period, fall-winter 1979-1980, were more severe than were considered in planning, the project proceeded. The gap was narrowed by hydraulic filling with sand to the point where the flow eroded the added material. At this stage of 70 m opening remained. Local stone and cement-sand cubes were used to fill the space until a 23 m wide gap remained. The final stage of closure was the most strenuous. This was accomplished by first protecting the left bank and end of the cofferdam with old steel frameworks filled with scrap stone matrial. Sand-cement cubes, cabled together, were pushed into the gap and empty space filled with stone. An underwater still 40 m downstream helped to decreased the difference in water levels between the gulf and the sea to 1.21 m drom the original 2.03 m. (Cassar-FRC)
W82-05114

USE OF WATERTIGHT FILM FACINGS FOR REPAIR WORKS ON THE GREAT STAVROPOL CANAL,

For primary bibliographic entry see Field 8G.
W82-05117

APPLICATION OF AND GUIDELINES FOR USING AVAILABLE DAM BREAK MODELS,

Tennessee Univ., Knoxville. Dept. of Civil Engineering.
B. A. Tschantz, and R. M. Mojib.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224577, Price codes: A07 in paper copy, A01 in microfiche. Research Report No 83, May 1981. 84 p, 21 Fig, 7 Tab, 62 Ref, 3 Append. OWRT A-059-TENN(1), 14-34-0001-0145.

Descriptors: *Dam safety, *Dam failure; *Floods, Channel flow, Model studies, St. Venant Equations, Routing, NWS DAMBRK Model, HEC-1 Dam Safety Version Model, SCS simplified dam break procedure, Dams, Dam stability, *Dam design, Design criteria, *Comparison studies.

Potential dam break model users are guided in selection and application of available models. A high-hazard category test dam example provided a means for comparing and evaluating different approaches to dam break analysis. A review of dam failure model literature showed that few computerized models were ready for immediate general application. The National Weather Service (NWS) DAMBRK Model, the HEC-1 Dam Safety Version Model, and the Soil Conservation Service (SCS) Simplified Dam Break Procedure were chosen for testing and evaluation. Additionally, Keulegan's classic instantaneous dam-break equations were used to estimate and compare instantaneous peak flow at the failed test dam. These four approaches were applied to a 36-foot-high homogeneous earthen embankment for a design PMF inflow hydrograph. The downstream test reach extended one-half mile below the test dam. The computerized NWS and HEC-1 models are capable of handling a variety of complex dam breach problems. The hand-worked SCS and Classic methods provided a quick analysis of simple types of dam break problems. A self-explanatory comparative evaluation of the capabilities and costs of

different dam break models is presented to guide model users in choosing the appropriate models for specific dam break situations and for given resources.
W82-05152

SAFETY ANALYSES OF HIGH HAZARD DETERIORATING CONCRETE GRAVITY DAM-RESERVOIR SYSTEMS INCLUDING CORRECTIVE MEASURE - EARTHQUAKE AND DYNAMIC STUDY,

Delaware Univ., Newark. Dept. of Civil Engineering.
C. Y. Yang, V. Chiarito, and P. Dressel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224718, Price codes: A06 in paper copy, A01 in microfiche. Report, October 1981. 9 p, 35 Fig, 9 Tab, 43 Ref, 4 Append. OWRT A-047-DEL(4), 14-34-0001-1108.

Descriptors: *Concrete dams, *Safety, *Earthquake engineering, *Probabilistic process, *Gravity dams, *Reservoir design, *Dynamic programming, Dams, Construction, Earthquakes, Engineering, Assessments, Mathematical studies, Reservoir construction, Dam construction, Systems analysis, Durability, Hazards, Dam design, Design criteria.

Research was carried out to analyze the safety of high-hazard deteriorating concrete gravity dam-reservoir systems against earthquakes, using the Delaware Hoopes Dam as a model. Due to the uncertainty in earthquake occurance and magnitude, a probabilistic approach to the dam-reservoir-earthquake problem was sought. Design and analysis based on probability concepts were worked out in detail for the Hoopes Dam. The result of this study revealed a lower design earthquake than that currently used by engineers. In addition, the effectiveness of the post tension strengthening techniques currently used by engineers was studied using a crude dynamic analysis, with the finding that the strengthening technique is highly effective in resisting earthquake shocks, provided that the cable system is correctly designed and constructed. (Zielinski-MAXIMA)
W82-05296

PRESSURE DISTRIBUTION DESIGN FOR SEPTIC TANK SYSTEMS,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W82-05439

FROGMEN'S SUBTERRANEAN SWIM SITES SOURCE,

World Water, Vol 5, No 2, p 17-18, February, 1982. 4 Fig.

Descriptors: *Exploration, *Excavation, *Water resources development, Water demand, Water supply, Drinking water, Groundwater Aquifers, Financial aspects, Constsruction, France, Karst.

In May of 1973 divers entered the 35 m-diameter pond of Le Lez and penetrated 520 meters upstream to find the top of a seemingly bottomless pit. Based on their efforts, engineers constructed a new subterranean intake structure which will yield some 2 cubic meters/second for future use in the city of Montpellier, France and the surrounding areas. A pumping station was built 30 meters below the surface and immediately above this 'bottomless pit'. A 230 meter long, 1.8 meter diameter tunnel was cut, using liquid oxygen to freeze the ground. The tunnel will carry water from the underground pumphouse to the intake of the aqueduct of Le Lez spring. The underground pumphouse was also excavated using the liquid oxygen method, with a concrete lining poured behind shuttering for the vaulted roof in advance of excavating the main chamber. Three pumps will lift water through shafts to the newly driven supply tunnel. The construction project is now halfway to completion. Water consumption in the city of Montpellier has doubled over the past 20 years, making some basic improvement in supply a matter of urgent necessity. The groundwater has excellent quality and will be cheaper to use than surface water, which would need significant treatment. (Baker-FRC)
W82-0[illegible]01

SELECTING THE OPTIMUM CROSS-SECTION OF A CONCRETE GRAVITY DAM,

Ministry of Energy, Sofia (Bulgaria).
S. Iliev, and L. Kalchev.
International Water Power and Dam Construction, Vol 33, No 12, p 23-27, December, 1981. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Gravity dams, *Dam design, *Concrete dams, Dam construction, Computer programs, Design criteria, Mathematical equations.

The natural terrain, concrete qualities, and underground outline of a concrete gravity dam are characterized by a number of factors which directly affect the choice of its cross-section. A computer program has been developed which used 11 inputs to formulate an optimum cross-section of a dam which can then be subjected to comprehensive static investigations. The inputs include the design factor of friction between concrete and rock at the baseline, the design stress of adhesion between concrete and rock at the baseline, characteristics of the construction soil, density of the concrete, density of the water, the design factor of safety against sliding, the uplift factor at the upstream side, the uplift factor at the drainage curtain, the uplift factor at the downstream side, the ratio between the distance from the upstream edge of the line of intersection of the baseline with the drainage curtain and the length of the baseline, the design ratio between the vertical and main stress, and the dam height at the downstream edge of the baseline. The main objective of this method is to provide a rapid and adequate guide to an optimum solution and, by selected combinations of the factors influencing a dam's cross-section, to permit the best assessment of their importance. The program provides a number of solutions from which the engineer may choose the most appropriate. Additional sets of solutions can be obtained by altering the inputs. In addition, this proposed method of deriving a generalized criterion for choosing a cross-section can include factors such as compression caused by sediments or seismic forces without changing the structure of the equation expressing the generalized criterion. (Carroll-FRC)
W82-05510

SAFETY OF DAMS JUDGED FROM FAILURES,

COBA International Consultants, Lisbon (Portugal).
J. L. Serafim.
International Water Power and Dam Construction, Vol 33, No 12, p 32-35, December, 1981. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Dam failure, *History, Dams, Safety, Dam construction, Dam stability, Prediction, Mathematical studies, Disasters, Probabilistic process, Statistical studies.

Recent statistical studies based on the historical records of disasters and incidents associated with large dams have led to the development of failure probability predictions applied to dams of any kind built. It is suggested that such an assessment is misleading and erroneous, since the percentage of failures is currently falling and careful design, construction, and instrumentation is likely to reduce the failure rate even further. Review of the available data on failures of dams more than 15 meters high since 1796 which haae been registered at Electricite de France through 1979 shows that there are many qualifying conditions. Without considerration of such qualifying characteristics as height, type of dam and construction standards, age, number of inspections, maintenance conditions, and instrument monitoring, simple statistical numbers of disasters per year are meaningless. Review of the failures of 136 dams throughout the world showed that the large majority (90) occurred in dams between 15 and 30 meters high and that 80 of the failures involved earth dams. Dams in remote areas are more prone to failure. In addition, dams are much more vulnerable during and immediately after construction than after they become operative. The most frequent failures occur during the first complete filling of the reservoir. It is suggested that perhaps 70% of all dam failures could be prevented if first fillings of new dams were carefully controlled, supervised, and monitored with instruments and if all old dams were the object of careful inspection and calculation. (Carroll-FRC)
W82-05512

COMPARISON OF ISOSTATIC AND HYPERSTATIC PENSTOCKS AT SANTA ISABEL, BOLIVIA,

Montreal Engineering Co. Ltd. (Quebec).
J. L. Gordon, W. Bolliger, and J. S. Cary.
Canadian Journal of Civil Engineering, Vol 9, No 1, p 1-12, 1982. 12 Fig, 7 Tab, 4 Ref.

Descriptors: *Penstocks, *Design criteria, Construction, Dams, Water resources development, Planning, Santa Isabel, Boliva.

In 1973 work was completed on the construction of the Santa Isabel hydroproject in central Bolivia. The project includes a penstock, with the lower half comprising an unusual hyperstatic design with no expansion joints and anchors at alternate bends. The penstock was designed for a static head of 864 meters plus 15% waterhammer. It burst when filled with water on March 16, 1973 at a head of 735 meters. An improper weld at an unsupported bend in the hyperstatic section of the penstock was blaimed for this failure. In March 1981 consturction of a second parallel penstock was completed. Use was made of an isostatic upper half and hyperstatic lower half penstock at Santa Isabel; this was justified on the grounds of having to parallel an existing penstock of similar design. It became evident after work had been completed that an all-isostatic design would have been very close in cost to the combined isostatic-hyperstatic design. There was very little difference in the weight of steel between an isostatic penstock having expansion joints between anchors and a hyperstatic penstock where every alternate anchor is eliminated and the free bend allowed to move with thermal expansion and contraction. There is a substantial reduction in anchor block concrete in a hyperstatic penstock, compared with an isostatic penstock. There is also a substantial increase in pier concrete in a hyperstatic penstock compared with an isostatic one. Finally, there was very little net difference in total anchor and pier concrete between the two types of penstock. Notwithstanding this financial consideration, it was necessary at Santa Isabel to use the hyperstatic penstock design to avoid an unstable area. It is recommended that hyperstatic penstocks be used only when the geological or topographical conditions do not favor use of an isostatic design penstock. (Baker-FRC)
W82-05561

UPLIFT PRESSURE OF WATER ON THE BASE OF HYDRAULIC STRUCTURES IN LIMIT DESIGN STATES (DISCUSSION OF CONSTRUCTION SPECIFICATIONS),

R. N. Petrashen.
Hydrotechnical Construction, Vol 15, No 7, p 427-431, 1981. 1 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 33-35, July, 1981.

Descriptors: *Water pressure, *Dam foundations, Rock mechanics, Hydraulic structure, Uplift pressure, Pressure distribution, Dam design, Design criteria, Limiting factors, Dam failure, Seepage.

The equation for calculating total uplift pressure of water on the base of a structure may be expressed as $Q = a2qF$, where F = the total area of the base of the structure, f = the area of the close contacts where seepage water cannot penetrate, and $a2$ = a coefficient equal to $(1 - f/F)$. Current design practices call for calculations with respect to limit states (the condition existing just before failure). However, previous theoretical and experimental investigations of uplift did not indicate the state under investigation, nor did they account for changes in density and loads in fracture or shear zones. The coefficient a2 has been arbitrarily as-

signed values from 0.5 to 1. Calculations how that the coefficient a2 should be assumed equal to 1 in the limit state and in elastic states in the operating stages for all materials with relatively large values of water permeability and sufficiently long action of the head. It is possible that a2 can have a value of less than unity in the elastic state for massive rigid materials under moderate stresses. The exact values must be obtained experimentally. (Cassar-FRC)
W82-05582

SELECTION OF TEMPORARY DIVERSION TUNNELS AND TUNNEL SCHEMES FOR DISCHARGE OF WATER,

E. I. Karabaev.
Hydrotechnical Construction, Vol 15, No 8, p 476-488, 1981. 5 Fig. 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 30-38, August, 1981.

Descriptors: *Diversion structures, *Tunnels, *Hydroelectric plants, Construction, Rivers, Dam construction, Flow regulation, Hydraulic structures, Optimization, Design criteria.

Diversion tunnels in 38 Soviet and 105 foreign hydrostations are statistically analyzed. All temporary and combined tunnels can be classified into four groups: uncombined diversion tunnel spillways, combined diversion-service tunnel spillways, diversion-service tunnel structures combining functions with the turbine tunnels, and diversion-service tunnel structures partially combined with the headrace and tailrace tunnels. Types of diversion tunnels used are principally determined by the following parameters: width and shape of river canyons at the hydrostation site, character of the runoff hydrograph and design discharges, type and height of the dam, location and type of the power station, presence of permanent service tunnel structures as part of the hydrostation, and construction characteristics. A list of 5 basic principles for selecting tunnel schemes and parameters of diversion tunnels for specific cases is presented. To minimize cost the following basic principles apply: stage-by-stage examination of water diversion at the site, determination of the permanent set of components of the cost and structures of the system providing diversion at each state under the specific conditions of the hydrostation, calculation of the cost related to diversion under the given conditions of the investigated stage, and performance of the comparative technicoeconomic calculations of the diversion system for each alternative of tunnel parameters. (Cassar-FRC)
W82-05588

PROSPECTIVE ENGINEERING DESIGNS FOR UNDERGROUND HYDRAULIC STRUCTURES,

V. F. Ilyushin.
Hydrotechnical Construction, Vol 15, No 8, p 439-447, 1981. 8 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 9-14, August, 1981.

Descriptors: *Hydraulic structures, *Tunnel construction, *Underground structures, Spillways, Water conveyance, Intakes, Tunnel lining, Conduits, Grouting, Design criteria.

New engineering designs developed and used in construction of underground structures of the high-head Central Asian hydrostations are described. These stations operate under conditions of high water pressures and high flow velocities. Intake designs include automatic flow proportioning between different sections of a submerged intake to handle trash clogging, a surface intake-spillway, and a multilevel inlet adjustable to different degrees of siltation. The underground spillway transition section of the Papan Reservoir splits the flow to preclude overpressurization of the outlet tunnel, reduce hydrodynamic loads on the bottom and walls of the transition chamber. The Nurek hydrostation transition section of the service spillway contains a quick-knockdown concrete plug for switching channels. For pressure conduits, corrugated steel linings equipped with circular stiffeners with blind notches opposite the corrugations are proposed to improve the contact with surrounding rock. Steel interblock closures in tunnel spillways are being replaced with polymer concrete or other wear and cavitation resistant material. Drainage to protect tunnel linings can be accomplished by leaving a small layer of ungrouted rock between the tunnel lining and the grouted layer. Water entering this permeable layer is discharged through a drainage system. (Cassar-FRC)
W82-05589

THE EXPANSION OF TWO BOLIVIAN PLANTS,

Empresa Nacional de Electricidad, Cochabamba (Bolivia).
M. Zenteno, A. W. Williams, and J. L. Gordon.
International Water Power and Dam Construction, Vol 34, No 2, p 26-28, 29-31, February, 1982. 5 Fig. 3 Ref.

Descriptors: *Powerplants, *Construction, Construction materials, Design criteria, Dams, Reservoirs, Bolivia.

The central Bolivian electric system had two powerplants with a total installed capacity of 180 MW, the Corani and Santa Isabel hydroplants, regulated by the Corani storage reservoir. Construction of the first phase of the Corani development was completed in 1967 with the commissioning of two 15 MVA units. Flood relief is provided by a masonry weir spillway. The 659 meter long penstock, of conventional design, has expansion joints between the anchor blocks. The penstock varies in diameter from 1 meter at the upper end down to 0.9 meters at the lower end, where it bifurcates to the two units. The Corani powerhouse comprises a concrete slab with footings for a concrete column and beam superstructure and a steel truss supporting an aluminum roof, all founded on a dense clay soil containing large boulders. A re-regulating reservoir having a nominal storage of 100,000 cubic meters has been built between Corani tailrace and the Santa Isabel intake. The reservoir will be used to even out the usage and demand for water between the two powerplants and to store flash-flood flows from the Vinto river intakes. During construction of the Santa Isabel tunnel, an access adit was built from the Vinto river valley, which is now used as a water passage to direct the diverted water from the east and west branches of the Vinto river into the Santa Isabel tunnel. The Santa Isabel penstock with a length of just under 2.8 km constituted a major portion of the work required to expand the development. (Baker-FRC)
W82-05598

THE AGUS II SCHEME IN THE PHILIPPINES,

National Power Corp., Manila (Philippines).
S. J. de Jesus, and R. P. Clark.
International Water Power and Dam Construction, Vol 34, No 2, p 17-23, February, 1982. 8 Fig.

Descriptors: *Dams, *Construction, Environmental effects, Philippines, Agus River, Hydroelectric plants, Powerplants, Mindanao.

Lake Lanao has a surface area of 350 square kilometers and a total drainage area of 1680 km. The Agus river is the single outlet of the lake. A cascade of seven dams has been planned, with Lake Lanao serving as a natural regulating pond. The optimized operation of Lake Lanao based on maximized total energy output in the Agus project chain resulted in a capacity of 944 MW. The site of Agus II is 6 km downstream of Lake Lanao, with elevations ranging from 650 at the dam to 420 at the tailrace channel. The terrain varies from gently rolling to steep. The deeply weathered lava flows render the foundation unsuitable for a concrete dam, so that only an earth dam was feasible. The dam constructed is a homogeneous earth dam with a sloping filter drain leading into a downstream horizontal blanket. The spillway consists of two bays with bottom radial gates 11 m wide and 7.5 m high. The contract for the construction of the powerplant was awarded in December of 1974. Right-of-way problems prevented the immediate acquisition of the land for the dam and the main structures. Excavation of the powerhouse began in June 1975. Excavation of the spillway, intake structure and approach canal started in January 1976. Impounding of the reservoir began in April 1979, in stages as permitted by the advancement of the approach canal lining. (Baker-FRC)
W82-05599

AERATION AT HIGH VELOCITY FLOWS,

Parana Univ., Curitiba (Brazil).
N. L. de S. Pinto, S. H. Neidert, and J. J. Ota.
International Water Power and Dam Construction, Vol 34, No 2, p 34-38, February, 1982. 12 Fig.

Descriptors: *Entrainment, *Spillways, Design criteria, Model studies, High flow, Flow velocity, Cavitation, Aeration, Brazil, Dams, Foz do Areia Dam, Construction.

This article deals essentially with the phenomenon of air entrainment during high velocity flows down spillway chutes. Based on a general analysis of the air entrainment mechanism and of data from prototype and laboratory tests, an analytical treatment of the problem is developed, setting a basis for predicting the performance of aeration devices from hydraulic model studies. An aeration system during the design stage should be considered in the following light: at what velocity should first aeration be provided, what is the volume of air entrained at the aeration, and what is the spacing between aerators to maintain a given protection level. Tests were performed at the Foz do Areia spillway, on the Iguacu river in Brazil. During the initial phase of spillway operation, measurements of air flow entrained at each aerator for different water discharges from 500 to 3300 cubic meters/second were made. The water discharges were determined from spillway rating curves obtained in a 1:100 cale hydraulic model. Air discharges were calculated from pressures measured at the walls of the aeration towers, used as Venturi meters. Pressure distribution was also measured under the jet along the step wall of the aerator. (Baker-FRC)
W82-05602

CABLEGATION: I. CABLE CONTROLLED PLUGS IN PERFORATED SUPPLY PIPES FOR AUTOMATIC FURROW IRRIGATION,

Science and Education Administration, Kimberly, ID.
W. D. Kemper, W. H. Heinemann, D. C. Kincaid, and R. V. Worstell.
Transactions of the ASAE, Vol 24, No 6, p 1526-1532, 1981. 12 Fig, 1 Tab, 4 Ref.

Descriptors: *Irrigation engineering, *Plug flow, Pipe flow, Pipes, Cablegation, Design criteria.

To encourage farmers to reconsider surface irrigation, systems are needed that will provide uniformity of water distribution, have low initial and maintenance costs, minimize labor input, and do not hinder field operations. Such a system is described. A single pipe line serves both the transmission and distribution functions at the head of a furrowirrigated field. Pipe size was selected to be slightly less than full when carrying the flow rate available on the existing grade. Orifices were drilled in the pipe at 30 degrees from vertical toward the furrow side. Water was forced out of these orifices by a plug in the line. Position and movement of the plug were controlled by attaching it, with a cable through the pipe, to a reel at the inlet end with its rotation rate governed by a geared down, 12 v DC electric motor, regulated in turn by a rheostat. A computer model predicted and field tests corroborated that orifices near the plug had highest flow rates, with flow diminishing in orifices further upstream to zero flow at a distance determined by total flow, orifice, moving downstream at speeds from 3 to 6 miles per hour, flow begins at the maximum rate and then decreases with time until the flow ceases. Effects on flow times and rates from orifices of varying orifice size, total water supply rate and plug speed, and of using multiple plugs and sleeving, are illustrated. Assuming runs that are 300 meters long so the sytem serves 12 ha, then installation costs would be about $298/ha ($121/acre). If the pipe is left above ground, the life of the sytem is about 10 years. (Baker-FRC)
W82-05617

GENERATING POWER FROM COMPENSATING FLOW,

For primary bibliographic entry see Field 8C.
W82-05624

ISSUES IN SIMULATION MODEL DESIGN--A CASE STUDY,

Waterloo Univ., (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05627

ECONOMIC ANALYSIS OF WATER MAIN BREAKS,

Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, and A. Pelliccia.
Journal of the American Water Works Association, Vol 74, No 3, p 140-147, March, 1982. 8 Tab, 21 Ref.

Descriptors: *Economic analysis, *Pipes, *Rehabilitation, Water distribution, Water mains, Prediction, Aging, Binghamton, New York.

A simple quantitative method for determining which pipes in a water distribution system should be replaced is based on a history of recorded breaks. This study was initiated by the city of Binghamton, New York, whose 100-year old pipe system needed upgrading. Equations are presented for two approaches: replacing groups of pipes as a unit or on a pipe-by-pipe basis. A set of equations is given to predict the rate of pipe breaks depending on diameter, age, materials, temperature, and previous break history. An economic analysis estimates the cost of repairing a break, including the damage and inconvenience, and whether pipes need immediate or postponed repairs. Factors to consider in pipe replacement are: the cost of a break, price replacement pipe, total length of pipe, length of pipe to be replaced, pipe diameter, previous break history, interest rate, type of pipe, and aging rate of pipe. (Cassar-FRC)
W82-05673

SITE INVESTIGATION AND MATERIALS SAVE MONEY ON SALLENTE,

World Water, Vol 5, No 4, p 31-32, April, 1982, 3 Fig.

Descriptors: *Hydroelectric plants, *Geological surveys, *Concretes, Embankments, Dam design, Sallente Dam, Spain, Asphaltic concrete, Rockfill dams.

The Sallente Dam, under construction in the Spanish Pyrenees, is interesting for three reasons: its single layer asphaltic concrete upstream facing, the thorough site investigation which resulted in moving the dam's design location 100 m downstream to a site on a much shallower layer of glacial fill, and careful trials of embankment materials suitable for the low temperature and high altitude. Considerable cost savings and increased safety in design were attained as a result of the detailed studies. The dam is 398 m long, 89 m high, and 10 m wide at the crest, with a storage capacity of 6.2 cu hm. (Cassar-FRC)
W82-05878

HYDRO POWERS MINDANAO DEVELOPMENT PLANS,

A. Bingham.
World Water, Vol 5, No 4, p 23, 25, 27, April, 1982. 2 Fig.

Descriptors: *Hydroelectric power, *Water resources development, *Industrial development, Mindanao, Philippines, Agus River, Pulangi River.

Hydroelectric power development on the Agus and Pulangi Rivers in Mindanao, the Philippines, has encouraged economic development on this mineral-rich island, the scene of four centuiries of conflict between the government and a Moslem group. Potential power capacity of the rivers is 900 MW each. On the Agus River, which drops 700 m from Lake Lanao to the sea, two of seven planned dams have been completed, four are under construction, and one is in the planning stage. A 255 MW hydropower plant on the Pulangi River is scheduled for completion in 1985. Further development on the Pulangi faces expensive land acquisition costs. At present 75% of the island's generating capacity comes from hydropower plants with low operating costs. By 1986 the proportion is expected to be 90%. (Cassar-FRC)
W82-05881

8B. Hydraulics

THEORETICAL AND EXPERIMENTAL STUDIES ON DYNAMIC STRUCTURE-FLUID COUPLING,

Trabzon Univ. (Turkey).
D. Altinisik, H. Karadeniz, and R. T. Severn.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 71, No 3, p 675-704, September, 1981. 23 Fig, 4 Tab, 16 Ref.

Descriptors: *Fluid mechanics, *Dams, *Resonance, Earthquakes, Arch dams, Vibrations, Pressure distribution, Hydrodynamics, Finite element method, Computer programs.

The structure-fluid coupling process has been expanded by incorporating a greater variety of finite elements into the computer program, especially the three-dimensional isoparametric element for use with doubly curved structure-fluid interfaces, as exemplified by an arch dam. Tests on cones and thin cylinders containing water and on a model arch dam and reservoir produced results which agreed with calculated results. The objects were subjected to multipoint resonance testing and excitation on a shaking table. A simulated earthquake was applied to the model dam and reservoir. (Cassar-FRC)
W82-04755

MAXIMUM PRESSURE DURING WATER HAMMER ACCOMPANIED BY DISCONTINUITY OF THE FLOW,

V. V. Tarasevich.
Hydrotechnical Construction, No 8, p 784-790, August, 1980. 4 Fig, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 15-18, August, 1980.

Descriptors: *Flow characteristics, *Mathematical equations, Pipelines, *Pipe flow, *Design standards, Pressure heads, High pressure, Cavitation, *Hydraulic engineering.

Discontinuity of a fluid flow is often observed during water hammer in pipeline systems and conduits of hydroelectric stations in the form of various cavities. When these cavities collapse, a considerable increase of pressure can occur. Equations are developed for determining the maximum value of the excess of pressure which occurs upon the collapse of a cavity based on an approximate solution of the problem of water hammer accompanied by discontinuity of flow. These equations make it possible to avoid excessive factors of safety when designing pipelines. (Carroll-FRC)
W82-04772

CALCULATION OF LOCAL SCOUR OF ROCK FOUNDATIONS BY HIGH-VELOCITY FLOWS,

I. I. Taraimovich.
Hydrotechnical Construction, No 8, p 791-797, August, 1980. 4 Fig, 2 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 19-22, August, 1980.

Descriptors: *Spillways, *Flow characteristics, *Mathematical equations, Jets, *Scour, Rocky soils, Rocks.

In order to solve the problem of local scour in rocky soils occurring beyond spillways with buckets, it is first necessary to know the characteristics of the flow on the spillway for both the nappe and submerged jet. Data from seven spillways are used to develop equations for the determination of the curve of the change in the relative length of the jet with change in the Froude number, the curves of the relative thickness of the jet and core as a function of the relative length of the jet, the curves of the coefficient of breakup of the jet as a function of the Froude number, and the curves of the range of takeoff of the jet from the bucket as a function of the Froude number. Differences between the values determined through these calculations and laboratory values are discussed. (Carroll-FRC)
W82-04775

A FINITE-DIFFERENCE METHOD TO EVALUATE WATER HAMMER PHENOMENA,

Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
J. L. Sanchez Bribiesca.
Journal of Hydrology, Vol 51, No 1-4, p 305-311, May, 1981. 1 Fig, 2 Ref.

Descriptors: *Mathematical models, *Mathematical equations, *Finite difference methods, Water hammer, Cavitation.

The method of characteristics has generally been preferred for evaluating water hammer effects. However, in some instances, such as when water column separation is expected, finite-difference procedures may be more suitable. The development of a simple finite-difference method for evaluating water hammer phenomena which is as fast as the characteristics method is demonstrated. The method, which is based on some matrix properties, does not require the solution of a system of linear equations at each of the computing steps, as is usual with finite-difference models. In addition, this method can easily take into account more of the involved factors than are usually considered in the classical procedure. The procedure has been successfully applied to traditional problems. (Carroll-FRC)
W82-04799

THE ROTATING HYDRAULICS OF THE OPEN-CHANNEL FLOW BETWEEN TWO BASINS,

Washington Univ., Seattle. Dept. of Oceanography.
C. Y. Shen.
Journal of Fluid Mechanics, Vol 112, p 161-188, 1981. 10 Fig, 2 Tab, 13 Ref.

Descriptors: *Fluid mechanics, *Open-channel flow, Flow, *Hydraulics, *Flow characteristics, Weirs, Mathematical equations.

Theoretical and experimental investigations of rotating weir flow are presented. Three problems are discussed: constant potential vorticity flow over a submerged weir, in which sill height is below the free surface level of the fluid in the downstream reservoir as opposed to the case in which the free surface is below the sill; controlled zero potential vorticity flow through a channel of irregular cross section; and supercritical separation of the current. In the first problem flow is found to depend on the fluid level in the downstream basin when the fluid level there is high and to become independent of the fluid level downstream as soon as the level falls below a critical height. Transport of the flow decreases whenever rotation rate or upstream potential vorticity is increased. In the second problem transport of the flow increases at some moderate rotations if the channel floor has a cross-channel slope similar to that of the surface of the current. Otherwise, the transport always decreases with rotation rate. In the final problem where the current separates from the left wall of the channel, visual evidence is obtained and measurements of formation of such a boundary current are also secured. Comparisons between theory and experiment for the three cases are generally reasonable except when flow separates in the control section. The theory is not applicable to such separation. (Baker-FRC)
W82-05083

STEADY SHALLOW FLOW OVER A SPILLWAY,

Asian Inst. of Tech., Bangkok (Thailand).
N. S. Sivakumaran, R. J. Hosking, and T. Tingsanchali.
Journal of Fluid Mechanics, Vol 111, p 411-420, 1981. 9 Fig, 11 Ref.

Descriptors: *Fluid mechanics, *Spillways, Overflow channels, Flow, Fluid flow, *Spillway crests, Streamflow, Low flow, *Mathematical equations, Steady flow.

A simple derivation of recent shallow-flow equations is presented, with bed curvature. These equations are applied to steady flow over a high overflow spillway crest, to obtain the head discharge relationship and the crest pressure distribution is good agreement with experimental results. The equations are apparently valid for quite large negative curvatures. Their application to steady flow over a spillway toe indicates that they are valid for positive curvature to a more limited extent. (Baker-FRC)
W82-05086

FINITE-AMPLITUDE STABILITY OF AXISYMMETRIC PIPE FLOW,

Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.
A. T. Patera, and S. A. Orszag.
Journal of Fluid Mechanics, Vol 112, p 467-474, 1981. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Pipe flow, *Fluid mechanics, Flow, Pipes, Pipelines, *Mathematical equations, Navier-Stokes equations, Reynolds number, *Axisymmetric pipe flow.

Spectral methods were used to investigate numerically the behavior of finite-amplitude axisymmetric disturbances in pressure driven pipe flow. The basic question concerns the existence of finite-amplitude equilibrium states of this flow. If such states do not exist, then pipe flow is stable to all axisymmetric disturbances. No evidence was found of finite-amplitude equilibria at any of the wavenumber/Reynolds number combinations investigated, with all perturbations decaying on a time scale much shorter than the diffusive (viscous) time scale. Decay was obtained where amplitude-expansion perturbation techniques predict equilibria, thus indicating that these methods are not valid away from the neutral curve of linear stability theory. The results of this study indicate that the method of false problems is not a valid procedure for investigating finite-amplitude axisymmetric perturbations to pipe flow. (Baker-FRC)
W82-05087

DETERMINATION OF THE OPTIMAL HEIGHT OF THE BUCKET LIP OF A SKI-JUMP SPILLWAY,

A. N. Butakov.
Hydrotechnical Construction, Vol 15, No 6, p 335-341, June, 1981. 7 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 19-23, June, 1981.

Descriptors: *Spillways, *Design criteria, Hydraulics, Dams, Equations.

Equations are developed for determining the optimal lip height and corresponding angle of descent of a water jet from the lip for providing the maximum flight distance of the jet. These equations are suitable for calculating cantilever ski-jump spillways. Three examples are given to illustrate the equations in practical situations. The first example was that of determining the position of the lip of the chute providing the greatest flight of the jet. The second proposed determining the optimal position of the spillway lip providing maximum flight of the jet and the distance of the flight in the case of a discharge of floodwaters over a spillway of standard crest shape. In this case the effect of aeration of the flow on the flight distance of the jet had to be taken into account. The third case involved examining spillway designs in order to provide the greatest flight distance of the jet from the dam site in the case of an arch dam supporting a head of 225 m. Spillway variants were an overflow spillway with a crest head of 5.5 m and a rectangular spillway passing through the dam at a depth of 100 m from the upper pool level. (Cassar-FRC)
W82-05107

CALCULATION OF LARGE UNLINED CANALS,

R. I. Samedov.
Hydrotechnical Construction, Vol 15, No 5, p 289-293, May, 1981. 4 Tab, 15 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 25-28, May, 1981.

Descriptors: *Canal design, *Hydraulic properties, *Soil physical properties, *Scour, Soil mechanics, Channel scour, Diversion channels, Azerbaidzhan, Silting, Bank erosion, Soil stability, Stable channels, Deformation, *Geokchai River, *USSR.

Calculation of hydraulic properties of large unlined diversion canals should be based on physical and mechanical properties of the soils. For cohesive soils the angle of internal friction and the slope angle are frequently not equal. The diversion canal of the Geokchai River in Azerbaidzhan SSR was investigated. This canal receives unregulated river runoff. Hydraulic parameters and physical and mechanical properties of the soils for eight reaches of the 13 km canal are presented in a table. Scouring is occurring in the 2-5 km reach, and silting and bank deformation is found in the 10-13 km stretch. The scoured section has a relative channel width 10 fold less and a parameter M of about 1.4 in the scouring section and 0.5 in the silting section. The discharge was the same in all sections of the canal. Therefore, the parameter M cannot be used alone to characterize channel deformation. (Cassar-FRC)
W82-05131

HYDRAULIC MODEL STUDIES OF LANDSLIDE-GENERATED WATER WAVES-MORROW POINT RESERVOIR,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Pugh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-224452, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-82-9, April 1982. 60 p, 16 Fig, 2 Tab, 7 Ref, 2 Append, including 156 p of microfiche.

Descriptors: *Landslides, *Hydraulic models, *Wave height, *Model studies, Waves, Solitary waves, Reservoirs, Bores, Dams, Dam overtopping, *Marrow Point Dam, Colorado.

Morrow Point Dam is a double-curvature, thin-arch concrete dam located on the Gunnison River 40 km east of Montrose, Colorado. A number of major landslide areas are located upstream from the dam. Under certain conditions it is possible that a slide could break free and plunge into the reservoir at velocities greater than 30 m/s. A physical model study was conducted to determine the magnitude of waves in the event such a landslide occurs. The model of 4.8 km of the reservoir and 1.3 km of the downstream canyon was constructed to an undistorted scale of 1:250. A wedge-shaped slide was used. It was found that the direction of the landslide as well as the volume of water displaced and slide velocity are important to the wave height in the vicinity of the slide. Waves directly in line with the slide direction were two to three times higher than waves not in line with the slide. Waves distant from the slide were solitary waves. Waves in the river downstream were bore waves. The maximum wave height at the dam due to a slide at one of the selected sites was 7 m. Nondimensional relationships were developed to predict wave heights for Morrow Point Reservoir and other cases as a function of slide velocity, water depth at the slide, volume of water displaced, and distance from the slide. (Moore-SRC)
W82-05211

EROSION BY PLANE TURBULENT JETS,

Alberta Univ., Edmonton.
N. Rjaratnam.
Journal of Hydraulic Research, Vol 19, No 4, p 339-358, 1981. 11 Fig, 2 Tab, 20 Ref.

Descriptors: *Erosion, *Jets, Dimensional analysis, Scour, Channel erosion, Mathematical studies, Hydraulics, Sand, Gravel, Laboratory studies, *Hydraulic engineering, Soil types.

Erosion of loose beds of sand, gravel, and such other materials as clay and weak rock is a problem of considerable importance in hydraulic engineering. Such erosion may be caused by flow concentration, local flow acceleration, secondary flow, vortices, or high velocity jets. Previous studies have shown that at some point in the erosion process, the maximum depth of erosion or any other length scale of the erosion process increases linearly with the logarithm of time from the start of the erosion process and that, as times increases, the characteristic lengths eventually reach an end or asymptotic state. This paper presents the results of a continuing study of erosion caused by submerged plane wall jets of air and water on beds of sand and polystyrene and by submerged impinging plane jets of water and air on beds of sand. Dimensional analysis was used to study the characteristic features of the scroured bed in the asymptotic state. The maximum depth of erosion for the asymptotic state, in terms of the height of impingement, was found to be primarily a function of the densimetric Froude number and the total thickness of the jet. The functional relationship between these factors was different for air-sand and water-sand systems, apparently due to the mode of transport of the eroded bed material out of the scour hole. The profile of the eroded bed, at least in the scour hole portion, was found to be similar for the air and water series. (Carroll-FRC)
W82-05277

AN INVESTIGATION OF A JET-ASSISTED HYDRAULIC JUMP,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Civil Engineering.
P. W. France.
Journal of Hydraulic Research, Vol 19, No 4, p 325-337, 1981. 12 Fig, 5 Ref.

Descriptors: Dam design, *Hydraulic jump, *Jets, Fluid mechanics, Flow patterns, Kinetic energy, *Spillways.

Dissipation of the kinetic energy of the flow of water over a dam spillway is essential if dangerous scour in the natural channel below the structure is to be avoided. The most effective and widely used method for reducing the energy of the falling water is the formation of a hydraulic jump in a stilling basin at the toe of a spillway. Baffle piers, chute blocks, and sills are the traditional means used to stabilize the jump. The use of jets of water issuing from underneath the formation of a hydraulic jump which requires a smaller tailwater depth. theoretical analysis of the jet-assite hydraulic jump is presented in graphic form and verified experimentally using a specially designed model which fits into a small closed-circuit laboratory flume. Although the stabilization of the jump is dependent on a number of parameters, the angle of inclination of the jets appears to have the most significant effect. (Carroll-FRC)
W82-05279

SURVEY OF PRESENT KNOWLEDGE ON CAVITATION IN LIQUIDS OTHER THAN COLD WATER (THERMODYNAMIC EFFECT),

International Association of Hydrological Sciences, Paris (France).
J. Bonnin, M. L. Billet, F. G. Hammitt, and B. Chaix.
Journal of Hydraulic Research, Vol 19, No 4, p 278-305, 1981. 4 Fig, 31 Ref.

Descriptors: *Cavitation, *Thermodynamics, *Fluid mechanics, Hydraulics, Evaporation, Water pressure, Mechanical equipment, *Temperature effect.

Although in the past the study of bubble behavior from a purely mechanical point of view was considered adequate for explaining the main features of cavitation, it is now understood that thermodynamic effects may interfere with bubble behavoir when the physical properties of a liquid are other

than those of cold water. These thermodynamic effects are primarily the result of the greater specific mass of the vapor and the heat of vaporizaiton. This paper summarizes the current state-of-the-art with respect to research regarding thermodynamic effects on cavitation. The required net positive suction head for pump tests in hot water and other liquids is less than that for tests with cold water, and cavitation erosion is less violent. Cavitation inception is delayed by thermodynamic effects, which depend on numerous parameters. The heat of vaporization is drawn from the surrounding liquid, causing a drop in temperature in the cavity which is connected with a lower pressure of vaporization. Adequate grouping of parameters permits comparison between fluids and test facilities, and even transporition of test results between different models, such as ogives, venturis, and pumps. Cavitation erosion is influenced by a wide range of parameters, and it is not yet possible to classify the amount and rate of this erosion. (Carroll-FRC)
W82-05280

AN EVALUATION OF TWIN WELLS FOR USE WITH WATER SOURCE HEAT PUMPS,

Louisana State Univ., Baton Rouge. Dept. of Civil Engineering.
J. R. Buller, Jr.
M.S. Thesis, May 1981. 96 p, 15 Fig, 51 Tab, 20 Ref. OWRT A-046-LA(2).

Descriptors: *Heat exchangers, *Heat transfer, *Pump wells, *Cost-benefit analysis, Drilling, Heated water, Cooling, Wells, Pump testing, Pumping tests, Pumps, Cost analysis, Air conditioning, Economic feasibility, Economic evaluation, Economic efficiency, Input-output analysis, Water use, Saline water intrusion, Seepage, Groundwater, Installation, Civil engineering, Dug wells, Well water, Louisiana.

A cost-effectiveness assessment in two Louisiana Parishes on water source heat pumps (with a set of twin wells supplying the groundwater heat source/sink) and conventional air source heat pumps revealed that the former will reduce operating costs 20-30% relative to the latter. The installation costs of water source heat pumps are greater than conventional systems due to the drilling cost of the supply and recharge wells. The total well drilling depth controls the cost-effectiveness. The return of reusable heat pump effluent water via the twin well system will avoid harmful side effects of salt water intrusion and excessive lowering of water levels caused by groundwater withdrawals. The break-even drilling depths for water source heat pumps was 90 and 100, 170, and 125 and 80 ft for residential, commercial, and industrial pumps, respectively, for the two Parishes. For depths greater than the break-even point, conventional systems were computed to be less costly. However, high efficiency water source heat pumps having heating and cooling coefficients of performance of 4.5 and 4.0, respectively, are possible. The economic break-even point drilling depth may be increased if the costs of such pumps are below $250, $150, and $100 per ton for residential, commercial, and industrial heat pumps, respectively. (Zielinski-MAXIMA)
W82-05307

NORTHERN ELBE CULVERT,

Hamburg City Drainage (Germany, F.R.).
E. Kuntze.
Water Science and Technology, Vol 14, No 1/2, p 263-268, 1982. 3 Fig.

Descriptors: *Culverts, *Sewer systems, *Wastewater collections, Water conveyance, Storm water, Elbe River, *Hamburg, *Germany, Drainage systems, Air cushion culverts.

An air cushion culvert under the northern Elbe River is part of a sewer reconstruction in the city of Hamburg, West Germany. A large air pocket formed by pumping air into the pipe between bulkhead walls allows adjustment of the discharge cross section to fit variable flow. This procedure maintains a flow velocity high enough to prevent sediment accumulation. The Elbe culvert is 610 m long, with inflow and discharge diameters of 3500 mm and 2 pipelines of 2400 mm each. Equipment for operation of the culvert includes inlet and outlet piping in the shape of a siphon, air supply mechanisms, filling depth control, and ventilation. Trial operation using clean water begun in autumn of 1980 indicated that flow velocities had to be corrected upwards by 10-15%. (Cassar-FRC)
W82-05427

WATER HAMMER,

For primary bibliographic entry see Field 8C.
W82-05432

ESTIMATING WATER FLOW UNDER GATES,

A. Zanker.
International Water Power and Dam Construction, Vol 33, No 12, p 50-51, December, 1981. 2 Fig.

Descriptors: *Flow rates, *Mathematical equations, *Gates, Nomograms, Hydraulics, Water flow, Water levels.

The flow of water under a vertical gate may be assumed to be the same as the flow of water through a square orifice, provided that the opening height is small when compared with the upstream and the downstream water levels. Direct use of the equation for the rate of flow is made difficult by the uncertainty involved in measuring the depth of water at the vena contracta. Solution of the equation generally is accomplished through a lengthy procedure involving computation of the upsteam water level to gate opening height ratio and determination of two coefficients dependent on this ratio. This paper presents a simple method of estimating the flow rate under a straight gate using a nomogram. Both the nomogram and instructions for its use are included. (Carroll-FRC)
W82-05514

USE OF TWIN WELLS AND WATER-SOURCE HEAT PUMPS FOR ENERGY CONSERVATION IN LOUISIANA,

Louisiana Water Resources Research Inst., Baton Rouge.
R. G. Kazmann.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-232018, Price codes: A05 in paper copy, A01 in microfiche. Technical Report No 9, December, 1981. 68 p, 28 Fig, 22 Tab, 16 Ref, 1 Append. OWRT A-046-LA(3).

Descriptors: *Heat exchangers, *Heat transfer, *Wells, *Pump wells, *Cost-benefit analysis, Heated water, Drilling, Cooling, Pump testing, Pumping tests, Cost analysis, Civil engineering, Input-output analysis, Air conditioning, Water use, Economic efficiency, Economic evaluation, Aquifer management.

The feasibility of the installation and operation of twin wells and water source heat pumps was evaluated for two typical Louisiana parishes. The use of such a system for energy conservation was determined to be safe and feasible. The two wells should be used in an alternating manner as the water source; one for production, one to return water to the aquifer. This mode of operation is used to eliminate any impact on groundwater levels, and to prevent interfering with other users of the same aquifer. Tables are included for determining the physical spacing between the production and return wells for any combination of aquifer thickness, length of season, and rate of water production, such that the returned water will not appear in the production stream. Economic analyses covered residential, commercial, and industrial applications for the two parishes. All hydrogeological data required for the development of preliminary designs are provided on the included maps. It is concluded that a water-source heat pump and a single well combination is almost always the most significant efficient installation to produce the required heating and cooling. In many locations in the two parishes, the twin well heat pump system will be economical. (Zielinski-MAXIMA)
W82-05535

FORMATION OF A STABLE CANAL CHANNEL,

M. M. Selyametov.
Hydrotechnical Construction, Vol 15, No 7, p 418-423, 1981. 6 Fig, 2 Tab, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 27-30, July, 1981.

Descriptors: *Canal design, *Flow velocity, *Slope stabilization, Froude number, Design criteria, Channel scour, Sand, Velocity, Hydraulic engineering, Canal linings, Channel morphology, Stable channels.

Several methods of designing stable canal channels were investigated experimentally in sands of 0.2 mm particle size. Two accepted procedures were found: (1) choose a cross-sectional shape and a flow velocity regime so that the Froude number in any location does not exceed the permissible Froude number, and (2) reinforce the side slopes in regions where Froude numbers are too high. (Cassar-FRC)
W82-05584

WHERE TO PUT A STEADY DISCHARGE IN A RIVER,

Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 5G.
W82-05632

OPTIMUM DEPTH AND SPACING OF SUBSURFACE DRAINS,

Marathwada Agricultural Univ., Parbhani (India).
H. S. Acharya, and D. G. Holsambre.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR1, p 77-80, March, 1982. 1 Fig, 4 Ref.

Descriptors: *Mathematical studies, *Subsurface drains, *Drain spacing, *Construction costs, Mathematical equations, Drains, Tile drains, Drainage systems, Subsurface drainage, Tile drainage, Drainage practices, Water table profiles.

Proper choice of depth and spacing of drains can help to minimize the cost of installing a subsurface drain for use in agriculture. An analytical solution which yields formulas for the direct determination of depth and spacing that minimize the cost is presented. The present solution does not require numerical techniques, but rather utilizes various constraints on the water table height in the Hooghoudt's formula for estimating water table heights between tile drains. The optimum location for the subsurface drain is taken from one of the vertices of the set of feasible solutions to two simple equations, and the optimum solution is obtained by direct verification. (Geiger-FRC)
W82-05693

SOME CHARACTERISTICS AND IMPLICATIONS OF DRAINAGE BASIN LINEARITY AND NON-LINEARITY,

Nebraska Univ., Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05710

LINEAR AND NONLINEAR RUNOFF FROM LARGE DRAINAGE BASINS,

Nebraska Univ. at Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-05711

DISPERSION IN TUMBLING FLOW,

Canada Centre for Inland Waters, Burlington (Ontario).
S. Beltaos.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 591-612, April, 1982. 10 Fig, 4 Tab, 22 Ref.

Descriptors: *Flow profiles, *Turbulent flow, Flow measurement, Model studies, Mathematical equations, Streams, Rivers, Hydraulics.

Results are presented of several dispersion tests in a rectangular flume, plus an analysis based on two different theoretical models. The rectangular flume was divided into a series of pools by placing triangular weirs at equal distances along the flume, causing a flow pattern considered to represent a first approximation to the tumbling flow regime seen in prismatic laboratory channels and in many rivers. The study allowed several conclusions. The time of travel in a series of pools and falls can be calculated in a straight-forward manner. It is equal to the time of travel for one pool times the number of pools. With suitable choice of the dispersion parameters, the river dispersion model provides satisfactory predictions of observed dispersion characteristics. Moreover, the dispersion parameters appear to correlate plausibly with hydraulic stream characteristics. Thus, the river dispersion model may eventually prove realistic for mountain stream dispersion. However, field data are needed to enable practical application. With suitable choice of the pool residence time, the storage dispersion model gives satisfactory predictions of dispersion characteristics. However, it is unclear whether this model is realistic, and its partial agreement with the data may have been fortuitous. (Baker-FRC)
W82-05796

OUTFALL DIFFUSER BEHAVIOR IN STRATIFIED AMBIENT FLUID,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. J. Wright, D. R. Wong, K. E. Zimmerman, and R. B. Wallace.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 483-501, April, 1982. 12 Fig, 2 Tab, 19 Ref.

Descriptors: *Wastewater outfall, *Mathematical equations, Stratification, Mixing, Destratification, Model studies, Hydraulics.

A method is presented for the preparation of design charts for estimating the mixing behavior from outfall diffusers in stagnant stratified ambient fluids. Numerical analyses by traditional integral methods which consider the interaction and merging of individual port discharges are used to predict the diffuser behavior. Predictions for the maximum height of plume rise and minimum dilution at that point are presented in the form of design curves. Experimental data for the cases of a single and opposing rows of horizontal ports are presented and compared to the numerical results. Additional data on the thickness and vertical location of the horizontally spreading layer developed after the maximum rise is reached are presented. The numerical model was found to be inaccurate for cases of discharges with significant initial momentum. A criterion is developed to indicate when this effect will be important. (Baker-FRC)
W82-05797

FLOW RESISTANCE IN WIDE RECTANGULAR CHANNELS,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Civil Engineering.
W. R. C. Myers.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 471-482, April, 1982. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Flow resistance, *Open channels, Pipe flow, Mathematical equations, Hydraulics, Flow friction, Hydrantic friction, Reynolds number.

This work is part of a wider study into flow resistance in channels that have floodplains. Flow over the floodplains is characterized by low depths and velocities, low Reynolds numbers, high relative roughness and large width-to-depth ratios. Flow in the central channel will exhibit greater depths, velocities and Reynolds numbers, lower relative roughness, and smaller width-to-depth ratios. The work is aimed at investigating the variation of friction factor with Reynolds number and width-to-depth ratio for hydrodynamically smooth flow. Friction factors have been measured in a rectangular open channel covering width-to-depth ratios of 1-35 and Reynolds numbers of 6,000-168,000. The relationship between friction factor and Reynolds number has been found not to conform to the pipeflow relationship. On the average open channel factors are around 8% higher than those for pipes at the same Reynolds number. The results have been compared with other investigations, showing agreement on the general form of the friction factor and Reynolds number relationship, but differences of the numerical constraints in the equation. The relationship of friction factor to width-to-depth ratio has been shown to be complex, influenced by secondary circulation and channel shape. The methods of Pillai and Kazemipour and Apelt have been applied to the data, showing that their methods reduce the divergency between the open channel data and the pipeflow equation to less than 2%. Differences may be due to the inadequacy of the methods in taking into account the effects of secondary circulation. (Baker-FRC)
W82-05798

FLOW UNDER WEIR ON SCOURED BED,
Uttar Pradesh Irrigation Research Inst., Roorkee (India). Tehi Dam Div.
D. Kumar, G. C. Mishra, and S. Chandra.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY4, p 529-543, April, 1982. 8 Fig, 16 Ref.

Descriptors: *Weirs, *Flow profiles, Flow pattern, Flow rates, Barriers, Dams, Flow measurement, Flow characteristics, Flow around objects, Scour, Channel scour.

Using conformal mapping techniques an approximate analysis for seepage flow under a weir, resting on isotropic porous medium of infinite depth, with a vertical sheet pile at the toe and segmental circular scour commencing from the downstream end of the apron, has been obtained. An exact analysis for semicircular scour, using conformal mapping, is also presented. A comparison is made between the results of approximate and exact analysis for the semicircular scour of various depths. The maximum exit gradient is shown to be increased by about 75% in the case of semi-circular scour. For semi-circular scour profile, where s is the depth of sheet pile and b is the width of the floor, as s/b increases the point of maximum exit gradient shifts away from the sheet pile. The exit gradient distri[illegible] obtained from approximate analysis is very close to the one given by the exact analysis, but the potentials at salient points under the apron obtained from the two analyses compared closely for values of s/b up to 0.1. These analyses will be helpful to decide the value of safe exit gradient of hydraulic structures on permeable foundation. (Baker-FRC)
W82-05800

8C. Hydraulic Machinery

CALCULATION OF COMPLETE INTERCEPTION OF GROUNDWATER FLOW TO 'FULLY PENETRATING' EXCAVATIONS,
V. M. Grigor'ev.
Hydrotechnical Construction, Vol 15, No 6, p 351-356, June, 1981. 4 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 29-32, June, 1981.

Descriptors: *Seepage control, *Dewatering, *Excavation, Aquicludes, Aquifers, *Well hydraulics, Vacuum wells, Wells, fully penetrating wells, Capillary water, Pumping, Groundwater management, Interception, Design criteria.

Equations for calculation of complete interception of groundwater flow by vacuum wells are presented. These are useful in design and operation of wells and pumps for dewatering excavations which extend through an aquifer to the underlying aquiclude. The calculations include the physical seepage patterns and the temporal changes in water and air discharges. To simplify the calculations the dynamic level in the well and the vacuum in the above-water space are assumed constant. (Cassar-FRC)
W82-04902

RESONANCE IN HYDROPOWER STATIONS,
Chemin des Vignes, Pully Lausanne (Switzerland).
C. Jaeger.
International Water Power and Dam Construction, Vol 34, No 1, p 20-22, January, 1982. 16 ref.

Descriptors: *Hydroelectric plants, *Resonance, Mechanical equipment, *Design criteria, Pressure conduits, Turbines.

Possible resonance in pressure conduits can present difficulties for hydropower engineers. Several unforeseen pressure surges which occurred recently in large hydropower stations have caused increasing concern. Basic research in this area is summarized. The ability to foresee or predict resonance in hydropower stations calls for consideration of two points: the geometry of the system of conduits and the boundary condition. In some cases the period of the excitor is determined by its own physical characteristics. The calculations are far more difficult when there is reciprocal interaction between the boundary conditions and the system of conduits, causing auto-oscillations. When the period of the excitor is known, the danger of possible resonance can be checked on a model which could be either a laboratory model or a computer model. Higher harmonics developing in a system of three converging conduits can be analyzed with the generalized theory of waterhammer waves. It is likely that the location of the zero point next to the point of insertion of the three conduits is important for the formation of a system of steady waves. Any prediction on possible resonance occurrring in a system of hydraulic conduits requires spotting probable excitors. (Baker-FRC)
W82-04953

COMPUTER-AIDED EVALUATION OF PERU'S HYDROPOWER,
For primary bibliographic entry see Field 6B.
W82-04954

TURBINES FOR ITAIPU,
Itaipu Binacional, Rio de Janeiro (Brazil).
J. De Moraes, J. Rodriguez, J. H. Gummer, and F. Del Brenna.
International Water Power and Dam Construction, Vol 34, No 1, p 28-33, January, 1982. 9 Fig, 5 Tab, 23 Ref.

Descriptors: *Turbines, *Testing procedures, Mechanical equipment, Quality control, *Hydraulic turbines, Construction, *Design criteria, Hydroelectric plants, Dams, Itaipu, *Brazil.

A model test for turbines is described, which is used for draft tube and spiral case pressure fluctuations. In measuring draft tube oscillations, two separate phenomena were observed. These were: a rotating core which obviously gives fluctuations in pressure when measured at a fixed point in the draft tube but does not result in a change of net head, and possible pulsations of that core which result in a change of net head across the turbine and hence a change of flow. A pure rotational draft tube vortex presents no problem, but a pulsating vortex does. Specific requirements are detailed for runners, shaft, bearings, shaft seal, lower bend, spiral case and stayring, head cover and bottom ring, regulating mechanism, draft tube liner and pit liner, governor, and quality control and inspection. (Baker-FRC)
W82-04955

FIELD TESTING AND OPTIMIZING EFFICIENCY OF HYDRO TURBINES,
Department of Energy, Idaho Falls, ID. Idaho Operations Office.
L. H. Sheldon.
International Water Power and Dam Construction, Vol 34, No 1, p 22-28, January, 1982. 10 Fig, 8 Ref.

Descriptors: *Hydroelectric plants, *Evaluation, Mechanical equipment, *Turbines, *Testing procedures, On site studies.

The advantages and techniques of conducting both absolute and relative efficiency tests of hydraulic turbines are outlined. The performance of large turbines is usually determined initially in model tests. However, prototype turbine installations always show some differences from their models, which alter their performance characteristics. Turbine model tests are still needed to determine the full performance capabilities of a particular machine, no matter what prototype testing is done. Model efficiency curves are usually determined to a high degree of accuracy. Inherent differences between a model with its test-stand instrumentation and a prototype with its powerhouse features cause some differences between the efficiency curves of the two. These differences are caused by such factors as efficiency stepup, powerhouse head determination, site differences, manufacturing differences, deflection differences, and wear. The two basic types of efficiency testing are the absolute and the relative, denoting whether the discharge is measured absolutely or in relation to some other known parameter. The absolute methods include: Gibson, Allen salt velocity, weir, piezometer traverse, current meter, sonic, and thermodynamic. Results from index testing may be used in several ways. (Baker-FRC)
W82-05010

WATER SYSTEM EFFICIENCIES,

F. Gay.
Water Well Journal, Vol 36, No 3, p 54-55, March, 1982.

Descriptors: *Pumps, *Energy, Submersible pumps, Energy conservation, Operating principles, Pump efficiency.

The operating principles of jet pumps and submersible pumps are reviewed as guidelines for designing energy-efficient water systems. Jet pumps are available for shallow or deep well use. The shallow well pump consists of a centrifugal pump in series with an ejector pump. Dependent on atmospheric pressure for moving water from the well level to the venturi tube inlet, shallow well pumps are limited to 25 ft in practice. A deep well jet pump operates in a similar manner, except that the ejector pump is submersed. The practical limit for deep well jet pumps is 180 ft. Submersible pump consist of several individual centrifugal pumps mounted in series. They are more efficient and initially more expensive than jet pumps. Efficiency of a pumping system will be maixmal if pumps and pressure tanks of proper capacity are chosen, proper pressure switch settings are selected (normally 20/40 psi for piston and shallow well pumps and 30/50 psi for submersibles and deep well jets), piping size is selected to minimize friction loss, and motor efficiencies are improved. (Cassar-FRC)
W82-05281

WATER HAMMER,

E. Butts.
Water Well Journal, Vol 36, No 3, p 63-65, March, 1982. 2 Fig, 3 Ref.

Descriptors: *Water hammer, *Flow control, *Pipe flow, Pipelines, Hydraulic systems, Pumping, Flow velocity, Water flow.

Water hammer is caused by the sudden stopping of flowing water in a pipe system. Formulas are given for calculating water hammer and for understanding the factors in its formation. Major components in the formulas are pipeline velocity, time of flow stoppage, and length of pipeline. Maximum surge pressures are obtained in pipes made of unelastic material. Water hammer can be minimized by operating a system properly--eliminating air entrapment in the pipeline, allowing sufficient time in closing valves so that the flow pattern can modify, and avoiding excessive flow velocity. Devices or construction materials available for protection against water hammer are quick-closing check valves to prevent reverse flow acceleration, water hammer arrestors (a capped riser or small hydropneumatic tank), surge anticipator valves, and strong flexible pipe. (Cassar-FRC)
W82-05432

USE OF TWIN WELLS AND WATER-SOURCE HEAT PUMPS FOR ENERGY CONSERVATION IN LOUISIANA,

Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 8B.
W82-05535

THERMOCLINE DRAWDOWN ABOVE COOLING WATER INTAKES,

Ontario Hydro, Toronto. Flow Systems Lab.
E. E. M. Elsayed.
Canadian Journal of Civil Engineering, Vol 9, No 1, p 31-37, 1982. 7 Fig, 2 Tab, 3 Ref.

Descriptors: *Thermocline, *Drawdown, Cooling water, Mathematical equations, Design criteria.

The purpose of this work was to present the derivation of an analytical expression relating the critical discharge associated with the incipient thermocline drawdown condition to the thermal structure of the water body and the geometric properties of the intake structure, and then to present experimental results and field measurements to verify this relationship. The expression was developed for an incipient drawdown of a thermocline into a submerged intake equipped with a circular cover. For specific thermal conditions at the intake location, the relationship found can be used to determine limiting design requirements for the geometry of the intake structure to prevent withdrawal from the upper warm water layer. The use of this equation may also be extended to other engineerng applications involving causes of stratification other than temperature differences, such as salinity differences or variations in suspended sediment load. (Baker-FRC)
W82-05560

USE AND DESIGN FEATURES OF THE PUMP UNIT OF THE UVV-3-6KM VACUUM GROUNDWATER LOWERING INSTALLATION,

A. L. Zatevakhin, L. A. Titov, K. S. Bogolyubov, and B. S. Krakovskii.
Hydrotechnical Construction, Vol 15, No 7, p 405-410, 1981. 4 Fig, 1 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 19-23, July, 1981.

Descriptors: *Pumps, *Dewatering, *Groundwater level, Construction methods, Construction equipment, Design criteria, Performance evaluation.

The UV-3-6KM pump unit for lowering groundwater levels is described. This monoblock pump unit is smaller in weight and capacity than the well-known UVV-2 installation but belivers water to increased heights. Detailed descriptions and drawings of the new pump are given. Maximum water delivery is 12.5 liters per sec; maximum air delivery at a vacuum in the suction header of 0.075 MPa, 6.2 liters per sec; installed ejector capacity, 15 kW; weight, 790 kg; and size, 1800 x 780 x 1400 mm. It includes a 100 meter long suction header and 100 wellpoints. (Cassar-FRC)
W82-05587

USE AND INVESTIGATION OF WATER-JET PUMPS (EJECTORS) AT THE CHIRKEY HYDROELECTRIC STATION,

Z. L. Zelenevskii, V. V. Kononov, and I. N. Lukin.
Hydrotechnical Construction, Vol 15, No 7, p 411-413, 1981. 2 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 7, p 23-25, July, 1981.

Descriptors: *Pumps, *Hydraulic machinery, Jet pumps, Vibrations, Noise, Cooling, Hydroelectric plants, Chirkey hydroelectric station, USSR.

Water jet pumps were installed in parallel with the centrifugal pumps at the Chirkey hydrostation, USSR. The pumps are used to cool the generator and transformer. Other possible uses of water jet pumps at hydrostations are circulation of the water supply, pumping of the dam plug, emergency pumping of the hydrostation, drainage of the powerhouse, pumping water from turbine covers, and priming centrifugal pumps. Operating at a wide range of pressures (1.50-2 MPa), the pumps have efficiencies of 34-41%. The ejector pumps use about half the electrical energy of other pumps with similar capacity and reduce personnel requirements by 3%. Since the ejectors are very noisy (up to 107 dB), noise protection is required. Strong vibrations necessitate anchoring the pumps and connected pipes to walls or floors by steel anchors. (Cassar-FRC)
W82-05592

USING PUMPS AS SMALL TURBINES,

McGraw-Edison Co., Mountainside, NJ.
L. Shafer, and A. Agostinelli.
International Water Power and Dam Construction, Vol 33, No 11, p 58-59, November, 1981. 3 Fig.

Descriptors: *Pumps, *Turbines, Design criteria, Pump turbines, Hydroelectric plants, Cavitation, Performance evaluation.

Greater use of centrifugal pumps as turbines has been seen as a result of the increased interest in small hydro. Since these pumps are mass produced, they can cover a wider range of applications at a lower cost than comparable purpose-built turbines. The performance of a turbine can be predicted accurately from one set of operating conditions to another, and new turbine designs can be developed from existing designs. When a pump operates as a turbine, its mechanical operation is smooth and quiet, its peak efficiency as a turbine is essentially the same as its peak efficiency as a pump, and the head and flow at the best efficiency point as a turbine are higher than the pump input power at its best efficiency point. Just as with the pump, at any point in the machine where the local pressure drops to the vapor pressure of the liquid, cavitation damage can occur when vapor is formed. In most cases no design changes or modifications are needed for a pump to operate as a turbine. There is a rapidly increasing number of successful installations of pumps as power turbines. One such site is in New York City, where a 36 in pump is being used as a turbine and has been running without trouble since 1949. (Baker-FRC)
W82-05597

GENERATING POWER FROM COMPENSATING FLOW,

International Water Power and Dam Construction, Vol 33, No 11, p 59-60, November, 1981.

Descriptors: *Hydroelectric plants, Compensation, Powerplants, *Motz, *Rhone River, *France, Minimum flow, Hydropower units, Seasonal variation, Snowmelt, *Hydroelectric power.

A conventional hydroelectric powerplant was constructed on the Rhone River at Chautagne. It has two bulb units rated at 45 MW under a head of 17 m and a flow of 350 cu m/sec each. Following customary European practice, the station was constructed 'in the dry', and water is conveyed to it through a canal, bypassing a short section of river. A minimum flow, in this case 10 cu m/sec, is required to be maintained in the original flow channel, and is called the compensating flow. At Motz, few km above the Chautagne power station, a small hydro plant was installed to produce about 10 GWh per year from two turbines rated at 750 kW at a head of 9.5 m. One unit will operate in winter and both in summer, when the snowmelt increases flow. The generators (induction machines) are small and are less expensive than corresponding synchronous machines. The reactive power needed for the machines is supplied by capacitors. Monitoring and command programming differ slightly from those for other systems. Performance and condition are monitored by a programmable microprocessor covering parameters such as oil fow, temperature, speed, current, and voltage. The unit also switches the generators on and off according to a program which can be

modified on site. Motz will eventually be operated by remote control. The design will probably be replicated at other stations which the Compagnie Nationale du Rhone is planning to build. Use of compensating flow for power generation is being promoted by environmentalists in France. (Cassar-FRC)
W82-05624

USING PUMP CURVES AND VALVING TECHNIQUES FOR EFFICIENT PUMPING,
Hiladon and Sonnenburg, Memphis, TN.
C. W. Hiladon.
Journal of the American Water Works Association, Vol 74, No 3, p 157-159, March, 1982. 7 Fig, 2 Tab.

Descriptors: *Pumps, *Design criteria, *Graphical analysis, Pumping head, Pressure head.

System head curves are given to aid in pump selection for single- and multiple-pump installations. The total dynamic head (the difference between suction and discharge heads) is beneficial in determining the approximate pump size and required horsepower. The system head curve is developed by determining the total dynamic head at various capacities above and below the normal operation condition. The curve may be expanded to consider the variation in water surface levels of the storage vessels on both sides of the pump and to consider the effects of capacity regulation devices. System head curves are given for five situations: a typical single-stage constant-speed pump, variation of impeller diameter at constant speed, variation of centrifugal pump speed, parallel operation of more than one centrifugal pump, and series operation of more than one centrifugal pump. In general, for parallel centrifugal pump operation the capacities can be added, and for series centrifugal pump operation the heads can be added. (Cassar-FRC)
W82-05666

SEWAGE PUMPING STATION SPLIT FOR MAINTENANCE,
Wilson and Co., Witchita, KS.
For primary bibliographic entry see Field 5D.
W82-05719

COROBICI COMPLETION ENSURES COSTA RICA'S POWER OUTPUT.
World Water, Vol 5, No 3, p 17-19, March, 1982.

Descriptors: *Hydroelectric power, *Tunnels, Corobici, Arenal, *Costa Rica, Concrete technology, Hydraulic structures, Water resources development.

A year's delay was experienced in the construction of Costa Rica's Arenal-Corobici hydroelectric power system, total capacity 331 MW. A test filling of the Arenal tunnel and subsequent inspection revealed cracks 20-30 mm wide for a distance of 1 km upstream of the surge tank, which is unusually large (88 m high, 18 m diameter). Cracks were repaired with shotcrete and the rock surrounding the tunnel was further grouted. Canals are under construction to carry the water from the turbines to arid farmlands. (Cassar-FRC)
W82-05755

PUMP INSTALLATIONS FOR REVERSE OSMOSIS SYSTEMS,
Weber Industries, Inc., St. Louis, MO.
W. Gordon, and R. Hensel.
Water Well Journal, vol 36, No 3, p 56-58, March, 1982. 1 Fig.

Descriptors: *Reverse osmosis, *Pumps, Equipment, Performance evaluation, Hydraulics, Mathematical equations, Design criteria, Cavitation.

Suggestions for operating pumps in a reverse osmosis system are given. Pumps intended to supply multiple outlets must be sized according to the pressure and capacity at the extreme outlet. The booster pump, which develops the pressure required for the reverse osmosis process, must be operated dry, with insufficient pressure, or with air in the system. Available net positive suction head (the difference between total suction head at the pump suction and the vapor pressure of the liquid) must be equal to the required net positive suction head. The pump must be completely flooded before start-up. A diagram illustrates a typical priming system. All air must be expelled from the system when cartridges are changed. The supply line should exceed the inlet thread size 1 or 2 sizes. (Cassar-FRC)
W82-05882

8D. Soil Mechanics

CALCULATION OF THE TEMPERATURE REGIME OF HYDRAULIC FILL DAMS DURING THEIR CONSTRUCTION,
B. M. Skhundin, and Y. A. Popov.
Hydrotechnical Construction, Vol 15, No 5, p 273-278, May, 1981. 3 Fig, 11 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 5, p 15-18, May, 1981.

Descriptors: *Hydraulic fill, *Dam construction, *Soil temperature, Earth dams, Soil mechanics, Frozen ground, *Siberia, Boguchany Dam, *Temperature, Design criteria, Freezing, Thawing, Model studies, Mathematical models, Heat transfer, Ice.

A mathematical model permitted greater understanding of the temperature regime of the Boguchany hydraulic fill dam in Siberia. If the hydraulic filling season is started 22 days after the April 23 establishment of positive air temperatures, as the design specified, a 0.4-0.6 m thick thawed layer is present on the surface of the blocks at the start of filling. Complete thawing of the ground occurs by August 29. If the hydraulic filling season is started on April 23, a 0.6-0.8 m thick frozen soil layer remains in the block by the end of the hydraulic filling season. Improvements in construction methods suggested by the model were (1) remove thawed soil by bulldozers (2 cuts) so that filling can begin May 6 instead of May 15 and complete thawing can occur by the end of the season, (2) retain snow on the surface to reduce the depth of seasonal freezing, (3) heat the soil with an electric cable to reduce the depth of seasonal freezing, and (4) develop methods of using the natural heat stored in the soil of the borrow pit and in the water body. These measures extend the hydraulic filling season beyond the frost-free limits. (Cassar-FRC)
W82-04760

LARGE-SCALE EXPERIMENTAL INVESTIGATIONS OF FAILURE OF AN EMBANKMENT SLOPE UNDER DYNAMIC LOADS,
V. M. Lyatkher, Yu. K. Zaretskii, I. N. Ivashchenko, Yu. L. Zaslavskii, and G. S. Selezney.
Hydrotechnical Construction, No 8, p 773-777, August, 1980. 3 Fig, 2 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 10-12, August, 1980.

Descriptors: *Earth dams, *Dam stability, Dam foundations, Foundation failure, *Soil mechanics, Soil properties, Earthquakes, Seismic waves, Strength, Shear stress.

In order to develop more reliable methods for evaluating the seismic stability of earth dams, it is necessary to better define the mechanical properties of the soils used in the construction of these dams. A 35-meter-high embankment with a volume of about 40,000 cubic meters was constructed within the design contour of the upstream shoulder of the Nurek dam, and experimental collapsing of the slope of the embankment under the effect of seismic shooting was carried out. The experiments were conducted using materials of the actual granulometric composition placed with the use of the established procedure of dumping and compaction used in construction. Delayed firing of several rows of explosive charges was used to form a plane wave of seismic activity. The results of this large-scale experiment showed good agreement with calculations of the stress and strain and stability of an embankment slope under the effect of seismic shooting using current methods for the determination of the characteristics of the strength of coarse fragmental soils used for the construction of critical earth structures. (Carroll-FRC)
W82-04774

CONTROLLING THE QUALITY OF COMPACTION OF EARTH FILL IN THE CONSTRUCTION OF HIGH DAMS,
For primary bibliographic entry see Field 8A.
W82-05109

DESIGN OF THE COMPOSITION OF TRANSITION LAYERS OF ASPHALTIC CONCRETE MEMBRANES IN EARTH DAMS,
For primary bibliographic entry see Field 8A.
W82-05113

DYNAMIC ELASTIC AND ABSORBING PROPERTIES OF SOILS,
N. D. Krasnikov, G. S. Tolkachev, and L. A. Eisler.
Hydrotechnical Construction, Vol 15, No 5, p 279-284, May, 1981. 4 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 19-22, May, 1981.

Descriptors: *Stability analysis, *Seismic properties, *Soil dynamics, Soil mechanics, Dam stability, Soil physical properties, Dynamics, Elastic properties, Earthquake engineering, Shear stress, Ultrasonics, Stress analysis, Wave propagation, Earth dams, *Hydraulic structures, Design criteria, Foundation failure, Dam foundations.

The dynamic and seismic stability of hydraulic earth structures should consider the dynamic elastic and absorbing properties of soils, which depend on density, water content, static stress state, parameters of dynamic effects, and other factors. One group of methods for determining this dependence uses high frequencies (tens of hertz to hundreds of kilohertz) and low amplitude strains (about 10 to the minus 5th power). These methods (seismic propagation, seismic well logging, ultrasonics, and longitudinal and torisonal vibrations of specimens) produce higher moduli of elasticity and lower damping coefficients than observed, leading to overestimated loads for design purposes. A second group of methods (shear apparatus, stabilometers, stress-strain analysis, and propagation of blast waves) based on lower frequencies (units to tens of hertz) and higher amplitude strains (up to 0.1) produce estimates closer to those observed. Using these values can leas to more realistic design and avoid the extra costs of overdesign. It is advisable to conduct preliminary investigations of soil properties using the first group of methods followed by application of the second group to refine the results. (Cassar-FRC)
W82-05132

BEARING CAPACITY OF SAND BASES (DISCUSSION OF CONSTRUCTION SPECIFICATIONS),
V. N. Dombrovskii.
Hydrotechnical Construction, Vol 15, No 8, p 488-495, 1981. 7 Fig, 15 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 38-42, August, 1981.

Descriptors: *Load distribution, *Sand, *Dam foundations, Soil mechanics, Bearing capacity, Slopes, Model studies.

Scale models were used to study the bearing capacity of sand bases for retaining structures (dams, etc.). Results of these experiments and of previous work were developed into a method for calculating the bearing capacity of sand bases for changes of angle of slope from 0 to 90 degrees. The method is usable if the founding depth does not exceed 1.5 of the width of the lower surface of a rectangular footing under an inclined load and 5.0 of the width of the lower surface under a vertical load. The ultimate load on a sand base of average or above average density for a square lower surface is 20-30% more than that of a strip, provided that the

width of the lower surface is constant and is determined by the coefficient of the slope of the lower surface. For a fixed angle of slope of the load and depth of the lower surface of the footing there is a relation between the angle of internal friction of the soil and the relative bearing capacity of the base. The ultimate load depends nonlinearly on the footing depth, which may be determined by an equation. (Cassar-FRC)
W82-05583

EMBANKMENT CONSTRUCTION: NEW MELONES DAM,

Army Engineers District, Sacramento, CA.
C. E. Stanage.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT4, p 621-636, April, 1982. 7 Fig, 1 Tab, 1 Ref.

Descriptors: *Embankments, *Dam construction, *Construction, Soil mechanics, Earth dams, New Melones Dam, California, Rockfill dams, Geology, Dam foundations, Excavation, Grouting.

Construction of the multipurpose New Melones Dam across a canyon on the Stanislaus River, California, is described. This zoned earth and rockfill structure is 637 ft high at the maximum, 1560 ft in crest length, and 15.9 million cu yd in volume. The impervious core is inclined upstream. Details are given concerning the site geology five distinct rock groups, meta-volcanic under the dam foundation); foundation excavation, preparation, surface treatment, and grouting; embankment features, materials, and sources of materials; construction procedures for the different types of fill; and instrumentation. (Cassar-FRC)
W82-05822

HYDRODYNAMIC EFFECTS IN EARTHQUAKE RESPONSE OF EMBANKMENT DAMS,

California Inst. of Tech., Pasadena.
J. F. Hall, and A. K. Chopra.
Journal of the Geotechnical Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No GT4, p 591-597, April, 1982. 5 Fig, 8 Ref.

Descriptors: *Earthquake engineering, *Dam stability, *Hydrodynamics, Soil mechanics, Earth dams.

The significance of hydrodynamic effects in the earthquake response of embankment dams was evaluated using an analytical procedure based on the substructure method. Effects of dam-fluid interaction, water compressibility, and fluid-foundation interaction were all included. Hydrodynamic effects were relatively unimportant in the response of embankment dams to horizontal ground motion because the inertia forces associated with the large mass of the dam overshadowed the small hydrodynamic pressures produced by acceleration of the dam face. The dam response to vertical ground motion was small compared with that from horizontal ground motion. (Cassar-FRC)
W82-05823

SITE INVESTIGATION AND MATERIALS SAVE MONEY ON SALLENTE.

For primary bibliographic entry see Field 8A.
W82-05878

$12.6 M REPAIRS BILL FOR RUAHIHI CANAL.

World Water, Vol 5, No 4, p 8-9, April, 1982. 2 Fig.

Descriptors: *Canals, *Foundation failure, *Soil stability, Hydroelectric stations, Soil mechanics, Channel failure, Unstable channels, Artesian pressure, Seepage, Ruahihi Canal, New Zealand.

Repairs to the Ruhihi Canal, New Zealand, which collapsed on September 20, 1981, the day after the hydroelectric project was commissioned, will cost $12.6 million. A 1 km section of canal will be replaced by a steel or concrete pipeline. The remaining 2.35 km will be strengthened and drainage will be improved. The forebay structure, left stranded by the mishap, will be rebuilt 1 km upstream. The collapse, caused by unstable volcanic soils and artesian pressures, should have been predicted from borehole tests and knowledge of soil behavior. The insurers may refuse to honor the claim for damages because of design faults, and the Taurange Joint Generating Committee may have to look to the New Zealand government for financial help. (Cassar-FRC)
W82-05880

8E. Rock Mechanics and Geology

STRESS STATE OF A ROCK MASS WITH TWO PARALLEL TUNNELS WITH LOADING OF ONE OF THEM BY A UNIFORM INTERNAL PRESSURE,

R. A. Dunaevskii.
Hydrotechnical Construction, Vol 15, No 6, p 315-317, May, 1981. 1 Fig, 2 Tab, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 55-57, May, 1981.

Descriptors: *Tunnels, *Stress analysis, Rock mechanics, *Hydraulic structures, Contours, Diversion structures.

When two parallel unsupported tunnels are dug to discharge water during construction of hydraulic structures, it is desirable to calculate the stresses on the walls of unloaded and loaded tunnels. This paper considers tunnels with an inverted U cross section. In the loaded tunnel stresses on the half of the contour further from the unloaded tunnel are not dependent on the distance between the centers of the tunnel. However, at the closer wall, where it joins the bottom, stresses increase markedly with decreases in distance between tunnels. When the distance between tunnel centers is greater than 6 times the radius, the effects of the second tunnel can be neglected. Stresses on the contour of the unloaded tunnel also decreases in distance between tunnels. (Cassar-FRC)
W82-05116

STRUCTURE AND PERMEABILITY: GEOLOGIC CONTROLS ON INDUCED SEISMICITY AT NUREK RESERVOIR, TADJIKISTAN, USSR,

Columbia Univ., New York. Dept of Geological Sciences.
For primary bibliographic entry see Field 2F.
W82-05133

SEISMICITY IN THE MICA RESERVOIR (MCNAUGHTON LAKE) AREA: 1973-1978,

British Columbia Univ., Vancouver. Dept. of Geophysics and Astronomy.
R. M. Ellis, and B. Chandra.
Canadian Journal of Earth Sciences, Vol 18, No 11, p 1708-1716, November, 1981. 1 Tab, 6 Fig, 28 Ref.

Descriptors: *Reservoirs, *Seismology, *Earthquakes, *Dams, Stress, Seismographs, Damsites, Histograms, Faults, Geologic formations, Seasonal fluctuations, Water level, History, Geologic fractures, Structural geology. *McNaughton Lake area, *Canada.

Results of a program monitoring seismicity in the McNaughton Lake area of Canada are presented. The program began in 1973. It has located 212 earthquakes, most of which occurred in four sequences. Three sequences occurred in the Rocky Mountains near the McNaughton Lake Reservoir. The final sequence was located east of the Rocky Mountain Trench. Comparisons with historical records indicate that the seismicity pattern is similar to that of the historical record. It appears unlikely that impoundment induced the recent earthquakes. (Titus-FRC)
W82-05196

QUANTITATIVE RELATIONSHIP OF GROUTING TO THE REDUCTION OF GROUNDWATER FLOW THROUGH ROCK FOUNDATIONS,

Army Engineer District, St. Louis, MO.
M. J. Klosterman, T. F. Wolff, and N. G. Jahren.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 15-24, 1982. 7 Fig, 8 Ref.

Descriptors: *Grouting, *Seepage control, *Groundwater barriers, Rock testing, Foundation rocks, *Meramec Park Lake, *Missouri, Pumping tests, Dam foundations, Drill holes.

A test grout program was carried out at the proposed Meramec Park Lake damsite, Sullivan, Missouri. Two areas were grouted using two different methods: the modified stage-grouting method in the valley test area and the modified stop-grouting method in the upland area. Rock in the upland area was poor, with numerous small fractures. The test procedure involved pre- and post- grouting pumping tests from water wells surrounded by a 50-ft square grout curtain. After grouting, the specific capacity of the test wells was reduced by 81-97%. Considering that the bottom of the grout curtain box was open, it was determined that the grout effectively shut off groundwater flow. Optimum grout take was obtained with a mixture of 4:1 in primary and secondary holes and 6:1 in tertiary holes with addition of 2-4% bentonite. Pressures used were 1.5 psi per ft of hole depth except for the valley area, where artesian conditions required slightly higher pressures. There was no difference in grout take between AX size holes and NX size holes. Most grout injected did not spread more than 5 ft; most movement was along vertical joints rather than horizontal bedding planes. (Cassar-FRC)
W82-05201

8F. Concrete

CONSIDER SOIL-CEMENT FOR EROSION AND SEEPAGE CONTROL,

W. G. Dinchak.
American City and County, Vol 97, No 2, p 55-56, February, 1982.

Descriptors: *Erosion control, *Construction materials, *Cement, *Soil cement, *Linings, Soils, Erosion, Seepage, *Seepage control, Flood control, Drainage, Lagoons, Wastewater treatment, *Wastewater lagoons.

Soil-cement is a mixture of natural soils, portland cement, and water and has been used successfully as a paying material in the United States and Canada. Other uses have evolved due to its durability in exposures to sea water, domestic and industrial wastewaters, coal ash slurries, and brine solutions. Since 1965 soil-cement has been used in 25 wastewater treatment lagoons, the largest of which is in the Muskegon-Mona Lake facility in Michigan. Each of three lagoons is lined with eight inches of soil-cement. In Arizona, problems with runoff were solved by the use of soil-cement for embankment protection along arroyos. Soil-cement embankments constructed stairstep fashion also are used to protect about 6000 feet of shoreline at three villages on the north shore of the Gaspe Peninsula, Quebec, Canada. The soil-cement measures about 2.5 feet thick. A typical soil-cement mixture contains about 10% cement and 10% moisture. One particularly important property of soil-cement is its continuing strength gain after placement. High compressive strength is an important attribute when lining settling ponds and wastewater treatment lagoons. A soil-cement erosion-control facing can be placed in layers parallel to the slope. These layers also are typically about six inches in thickness. If the project includes seepage control, as in a lagoon, the bottom of the impoundment is covered with a 6 inch compacted layer of soil-cement. (Baker-FRC)
W82-05039

CONCRETE FOR SURFACES OF HIGH-HEAD SPILLWAYS,

L. N. Gomolko, I. S. Novikova, S. V. Sharkunov, and G. N. Tsedrov.

Group 8F—Concrete

Hydrotechnical Construction, Vol 15, No 5, p 302-307, May, 1981. 7 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 5, p 34-37, May, 1981.

Descriptors: *Cavitation, *Concrete mixes, *Spillways, Concrete additives, Erosion, Flow velocity, Aggregates, Ballast, Gravel.

A study of cavitation resistance of concrete showed that there was no clear-cut relationship between cavitation resistance and type of aggregate for high concrete grades. However, cavitation resistance was substantially increased by introducing additives or by reducing the water/cement ratio. Addition of sulfite yeast waste liquor (0.2% of weight of cement) increased cavitation resistance by 30-40%; hydrophobic silicone liquid (0.15%); and an epoxy compound containing diethylene glycol, by a factor of 3-5. A graph gives maximum permissible sizes of coarse aggregate as a function of flow velocity. Other graphs show the permissible height of an isolated projection for steady flow over concrete of 2 different grades. The permissible height of projections were plotted against flow velocity for ballast in concrete M300, for gravel in concrete M300, and for gravel plus ballast in concrete M400. The gravel-ballast in M400 permitted the largest projection height. These findings indicate that increased use of local gravel will reduce costs without increasing cavitation damage to concrete hydraulic structures. (Cassar-FRC)
W82-05110

SAFETY ANALYSIS OF HIGH HAZARD DETERIORATING CONCRETE GRAVITY DAM-RESERVOIR SYSTEMS INCLUDING CORRECTIVE MEASURE - EARTHQUAKE AND DYNAMIC STUDY,

Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W82-05296

RELAXATION IN CONCRETE,

Promon Engeharia SA, SAO Paulo (Brazil).
V. M. S. Lima, Q. M. Guedes, W. P. Andrade, and J. T. Bastos.
International Water Power and Dam Construction, Vol 33, No 12, p 27-32, December, 1981. 9 Fig, 3 Tab, 8 Ref.

Descriptors: *Concrete dams, *Creep, *Stress-strain curves, Stress analysis, Concrete technology, Mass concrete, Mathematical studies.

Concrete relaxation curves for mass concrete are usually calculated by numerical methods, using creep curves as a starting point. Details obtained from site tests of concretes used in the construction of the Tucurui and the Itumbiara hydroelectric plants in Brazil are used to assess the accuracy of three methods of calculating relaxation curves for concrete from creep data. Relaxation curves were calculated by the following three processes: numerical solution of the integral equation expressing the relaxation phenomenon; average logarithm; and Carlson's method, in which the relaxation function is determined using only the creep function plus the law of variation of the elasticity modulus with the concrete age. This analysis demonstrates that Carlson's process overestimates relaxation and that the relaxation function obtained by this process is not sufficient to preserve a strain equal to unity during the relaxation process. Application of Carlson's method demands that the creep phenomenon obeys the hypothesis used by Dischinger, which assumes parallelism of creep curves and which may not be valid. Two versions of the use of the integral equation which expresses the relaxation phenomenon are demonstrated. The first process determines the real value of relaxation through numerical solution of the integral equation. The second process, known as the average logarithm process, utilizes an alternative algorithm which leads to an entirely recurring expression. This second process results in a slight overestimation of relaxation, which diminishes as time elapses after application of the initial strain. (Carroll-FRC)
W82-05511

AN OVERVIEW OF POROUS PAVEMENT RESEARCH,

Municipal Environmental Research Lab., Edison, NJ. Storm and Combined Sewer Section.
For primary bibliographic entry see Field 5D.
W82-05744

ALTERNATIVE TUNNELLING METHOD FOR RELIEF SEWER,

Civil Engineering (London), p 18, February, 1982. 1 Fig.

Descriptors: *Tunneling, *Pipelines, Unitunnel, Tunnel construction, Sewer systems, Structural settlement.

The Unitunnel system is being used to drive a sewer tunnel 280 m long and 1300 mm in diameter under and near streets and buildings in Acton, West London. The tunneling system operates like an earthworm. Frictional resistance controlled by automatically operated rubber bladders between each pipe section drives the system foward, producing a worm-like movement through the ground. When tunneling is finished, the bladders are inflated, then removed, leaving a gap which may be sealed. Work with the Unitunnel apparatus proceeds about 2.5 times faster than with a digging machine. A rate of 33 mm per min was achieved at less than full potential. No settlement was measured after the tunneling had passed under railroad tracks and within 6 ft of buildings. Only 3 mm settlement was measured in gardens where the tunneling apparatus had been operating at a depth of 10 ft. (Cassar-FRC)
W82-05774

WEDGE-BLOCK TUNNELS IN WATER SUPPLY,

Thames Water Authority, London, (England).
P. Cooley.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 1, p 9-26, 1982. 7 Fig, 5 Tab, 17 Ref.

Descriptors: *Tunnel linings, *Conduits, *Water supply, Water distribution, Tunnel construction, Concrete construction, Wedge block tunnels, Load distribution, Leakage, Clays, Pressure conduits, Water conveyance.

Experience in England with the wedge-block tunneling method is described in detail. This technique, first used in the 1950's, eliminates the steel lining. Concrete hoops with an open space are put in position, and a closing wedge is driven into the remaining opening. Average short-term (12 months) hoop loads were 45-67% of the overburden load. Specifications developed for constructing wedge-block tunnels are as follows: 2.54 m diameter, 140 mm ring thickness, depth of 30-57 m in London Clay, and ram thrusts of 35 tons for 0.61 m long rings and 40 tons for 0.69 m rings. Wedges have a taper of 1 in 10 at each side. Concrete molds are most suitable for casting segments. Leakage at shafts can occur, especially if the shaft is dry, because of inadequate grouting. Two wedge-block tunnels at the same level within 1-5 m of each other increased hoop loads by 7%, not enough to cause concern. (Cassar-FRC)
W82-05803

8G. Materials

A PIPELINE FOR ALL ENVIRONMENTS,

Stanton and Stavely, Nottingham (England).
T. R. Smith, and M. J. Sherwin.
Aqua, No 1, p 17-19, 1980.

Descriptors: *Pipes, *Iron, *Ductility, Pipelines, *Materials engineering, Environmental effects, Physical properties, *Water supply systems, Design standards.

Ductile iron pipe is capable of withstanding stresses imposed on it by climatic, topographical, geological and anthropogenic conditions. In ductile iron, which is four times stronger than grey iron, graphite is present in spheroidal form. The pipe can withstand hydraulic pressures higher than normal working pressures, a capability important where water must be moved long distances in mountainous terrain. It can tolerate very high external loadings, eliminating the need for special embedments. Pipes installed above ground need supports only every 12 meters. Excellent resistance to impact loading is important during handling and transport, excavations, water hammers, and surges. Ductile iron pipes are also fire and earthquake resistant. Flexible joints perform best in most locations-- soft ground, steep inclines, tunnels, riverbeds, and areas where excavations are common. These joints prevent damage by thermal expansion and contraction and by galvanic action. (Cassar-FRC)
W82-04764

THE BEHAVIOR OF ASBESTOS-CEMENT PIPE UNDER VARIOUS WATER QUALITY CONDITIONS: PART 2, THEORETICAL CONSIDERATIONS,

Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
M. R. Schock, and R. W. Buelow.
Journal of the American Water Works Association, Vol 73, No 12, p 636-651, December, 1981. 27 Fig, 11 Tab, 91 Ref.

Descriptors: *Asbestos cement, *Corrosion control, Water distribution, Pipes, Zinc compounds, Acidic water, coatings, solubility, Water quality, Calcium carbonate, *Pipelines, Chemistry precipitation, Rehabilitation.

Several conclusions were made in a study of the reaction of asbestos cement pipe with water containing various constituents. (1) The traditional aggressiveness index based on calcite saturation is inadequate to describe the degradation of asbestos cement pipe. The presence of naturally-occurring protective materials, pH, carbonates, calcium, disinfectant concentrations, temperature, and organic matter must also be considered. (2) Some materials cause pipe matrix dissolution but do not necessarily release asbestos fibers. (3) The chloride, sulfate, and orthophosphate salts of zinc are satifactory corrosion inhibitors for asbestos cement pipe at the proper concentrations and pH. The mechanism involves formation of a zinc hydroxy carbonate precipitate which reacts with the pipe surface to form a harder zinc silicate coating. (4) Tthe Zn orthophosphate protects against corrosion in a metal-asbestos cement pipe system through the action of the orthophosphate rather than Zn. Zinc chloride and sulfate are not effective in these situations. (5) A degraded asbestos cement pipe with loose fibers cannot be readily rehabilitated by Zn treatment. (6) Results of Zn solubility modeling presented in this paper are also applicable to studies of new galvanized piping. (Cassar-FRC)
W82-04791

USE OF WATERTIGHT FILM FACINGS FOR REPAIR WORKS ON THE GREAT STAVROPOL CANAL,

Y. U. Baigorov, Y. M. Kosichenko, and B. I. Sergeev.
Hydrotechnical Construction, Vol 15, No 6, p 369-373, June, 1981. 5 Fig, 1 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 6, p 40-43, June, 1981.

Descriptors: *Seepage control, *Canal linings, Canal seepage, Polymers, Plastics, Maintenance, *Great Stavropol Canal, *USSR.

Seepage control measures at the Great Stavropol Canal in the North Caucasus were necessary because serious problems were observed during 1965-1979. Deformations, intense local seepage, threat of break-through, and rise in groundwater levels were caused by complex relief of the canal route, susceptibility of soils to subsidence and piping, absence of watertight facings, insufficient compaction of soil, and poor construction techniques. Small-scale installation of a soil-plastic film facing showed that the specific drainage flow in the section was reduced 17-30%. Installation of the soil-film facings involved stopping the streamflow in the construction area with cofferdams, excavating

a meter-thick soil layer, compacting the base, filling with high quality soil, laying butyl rubber film of 1.5 - 3 mm thickness, adding a protective layer of loam, and finishing with a protective gravel-rubble layer. (Cassar-FRC)
W82-05117

GALVANIZED STEEL STALLS TREATMENT PLANT CORROSION,

B. Harmon.
Water/Engineering and Management, Vol 129, No 2, p 42-43, February, 1982. 3 Fig.

Descriptors: *Wastewater facilities, *Corrosion, Zinc, *Galvanized steel, Construction, *Design criteria, Secondary wastewater treatment, Wastewater treatment, *Baltimore, Maryland.

The majority of the major structures and components of the Baltimore Back River Wastewater Treatment Plant have been virtually maintenance-free for over 30 years, largely due to the extensive use of hot dip galvanizing with zinc. The plant was constructed in 1911 and functions as a secondary treatment facility, occupying a 453 acre wooded site in eastern Baltimore County at the head of the Back River. Back River has three levels of treatment. The preliminary step includes bar screens and grit removal basins. Screening removes large floating objects which may clog or damage pipes, pumps or other devices. The grit removal basin is the next stage; here, the stream velocity is reduced and granular particles settle out. The wastewater is then conveyed to the primary tanks where smaller suspended organic particles settle in seven large sedimentation basins. About 30-50% of the suspended organic material normally settles and is removed as sludge. Secondary treatment is then accomplished by trickling filters and activated sludge. The sludge process uses aerobic microorganisms to feed on suspended organic material for growth and reproduction. Applications of the zinc-coated steel exposed to atmospheric corrosion are centered around the aeration process. Much of the structural steel, especially at the water line, is galvanized, as are the scum and flow troughts in the final settling tanks. Galvanized steel is prepared by immersing a precleaned fabricated part or structure into a kettle of molten zinc at a temperature of about 850 degrees F. The steel remains in the zinc bath until its temperature rises to that of the zinc. As the object is removed, a protective coating of zinc is bonded to the steel. (Baker-FRC)
W82-05167

THE BOOMING BUSINESS IN WICK DRAINS,

A. Morrison.
Civil Engineering (New York), Vol 53, No 3, p 47-51, March, 1982. 1 Fig.

Descriptors: *Drainage, *Dewatering, *Wick drains, Soil consolidation, Sand, Permeability.

Wick drains, introduced into the U.S. in 1978, have been replacing sand drains for soil consolidation. The Kjellman wick, invented before World War II in Sweden, consisted of three layers of cardboard, the inner one containing ten channels. Modern wick drains have many more channels than the original invention. Polyester or paper filters offer high permeability, wet strength, and shear resistance. Installation to 100 ft is possible. Most can be installed using a conventional vibrating hammer with a wick installation rig. Prices range from $0.70 to $1.20 per foot of drain installed compared to $3.50 to $6.50 per foot of sand drains. Five suppliers serve the U.S. with different types of products--paper or polyester filters, different permeabilities, and different drain capacities. Installation methods must consider the sensitivity of the soil. Suppliers and literature on wick drains are listed. (Cassar-FRC)
W82-05192

CASE STUDY OF PREDICTION OF SULFIDE GENERATION AND CORROSION IN SEWERS,

Brown and Caldwell, Sacramento, CA.
W. J. Meyer.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2666-2674, November, 1980. 3 Fig, 6 Tab, 5 Ref.

Descriptors: *Sulfides, *Corrosion, *Liners, Pipes, Concrete, Construction materials, Corrosion control, Wastewater treatment, *Sewer systems, Design criteria, Construction, *Case studies, *Sacramento, California.

A case study was performed to compare the results predicted by sulfide generation and corrosion equations with observed conditions in the Central Trunk sewers located in Sacramento County, California. Data have been accumulated on this trunk system by the county since the trunk was placed into operation in 1962. The Central Trunk serves the southeastern portion of the Sacramento metropolitan area. The sewer conveys both domestic and industrial wastewater from its tributary area and solids from the Northeast and Cordova wastewater treatment plants. No correlation was found between the measured and predicted sulfides using Thistlethwayte's equations. These equations result in sulfide predictions which are much higher than those observed. The sulfide buildup predicted by Pomeroy's equations assuming a less-conservative coefficient for sulfide losses of 0.96 correlates well with measured sulfide concentrations. The change in sulfide conditions occurring at major junctions should be considered when the characteristics of the wastewater in the tributary sewers vary significantly from the wastewater characteristic in the primary interceptor. Use of the Pomeroy equations for predicting sulfide generation and resultant corrosion provides a useful tool in the design of sewers. The designer has several options to assure an adequate service life: using acid-resistant materials, providing oxygen or other oxidant to the wastewater, adding chemical control of sulfide generation, providing sacrificial concrete covers over the reinforcing steel and/or using calcareous aggregate, using protective liners on the pipe and structures, or designing system hydraulics to avoid sulfide generation. (Baker-FRC)
W82-05267

GUIDEVANE EROSION AT MAO TIAO HE,

L. Xue-Zhong.
International Water Power and Dam Construction, Vol 34, No 2, p 23-26, February, 1982. 4 Fig.

Descriptors: *Powerplants, *Corrosion, Mao Tiao He river, China, Design criteria, Abrasion, Sand, Turbines, Cavitation, Pumps.

Unusual and severe wear erosion was experienced by the guidevanes of Unit II at the Fourth Stage power station on the Mao Tiao He river in China. The powerhouse of the station contains three Francis turbines operating under a net head of 53-65 meters and a draft head of -3.5 meters. Unit II went into operation in September of 1971. In March 1973 severe wear erosion caused by sand in the flow was found on all of the guidevanes. No similar damage was noted on the surfaces of other parts such as the spiral case, the stayvane and the runner. During the station's operation, Units II and III had each worked about 5000 hr, including about 500 hr of operation as condensers. The upper part of the inside of the casing of all guidevanes had suffered severe wear, affecting between a third and half of the inside area in the form of two wide, smooth horizontal grooves. No typical trace of cavitation erosion was noted in the wear area. The wear erosion only appeared on the upper part of the inside of the guidevanes. In Unit III under similar operating conditions, no such wear was found. The problem could not be traced to turbine wear through sand flow, although the worn surfaces appeared to be features of sand wear erosion. In studies of the water movement, the wearing was traced to the water in the runner chamber not being under pressure and the runner turning under the water during this operating condition. When a turbine operates as a pump, when idling, the sand carried by the water in the draft tube gradually accumulates in the corner formed by the protective plate and the upper part of the inside of the guidevanes. A circular space is created where the sand concentration increases according to the operating time, causing severe wear on the guidevanes. (Baker-FRC)
W82-05600

LOAD FACTORS AND NON-DESTRUCTIVE TESTING OF CLAY PIPE,

National Clay Pipe Inst., Crystal Lake, IL.
E. J. Sikora.
Journal of the Water Pollution Control Federation, Vol 52, No 12, p 2964-2976, December, 1980. 16 Fig, 1 Tab.

Descriptors: *Sewer systems, *Load factors, *Pipes, Nondestructive tests, Clay pipe, Bedding materials, Backfill, Trenches, Sand, Compaction, Soil compaction, Gravel, Flooding, Materials testing.

Nondestructive tests were conducted to determine the validity of load factors presently used in design of sewer systems with vitrified clay pipe. The current load factors for Classes B, C, and D bedding systems were found valid when stable bedding materials were used. The best all around choice of bedding material is a 19.2-6.3 mm gradation. Bedding materials of sizes 6,7, and 8 and combinations thereof are all capable of developing the required load factors. The load factor and quality of installation in Class B (except for sand) and Classes C and D are improved by shovel-slicing the bedding material under the pipe haunches. Stability of a bedding material increases with increasing particle size, but mixtures with particles larger than 19 mm are difficult to shovel-slice. Angular, well graded bedding materials are desirable in trenches with irregular bottoms or with difficult-to-maintain widths and in all Class B installations. Use of rounded bedding material is permissible in narrow trenches where bedding is confined. Although sand has performed well as a bedding material in all-sand regions (deltas and coastal areas) it should not be imported for this use because of its variable performance, especially under flooding conditions. (Cassar-FRC)
W82-05700

MEASURING RESERVOIR GROUND MOVEMENTS,

Nottingham Univ. (England).
V. Ashkenazi, A. H. Dodson, D. E. B. Jones, and N. Samson.
Civil Engineering (London), p 35,37,39, 41-43, February, 1982. 3 Fig, 3 Tab, 4 Ref.

Descriptors: *Reservoirs, *Surveying instruments, *Dam stability, Thames Water Authority, Queen Mother Reservoir, Dachet, *England, Embankments, Earthworks, Subsidence, Networks, Network design.

A geodetic surface reference system installed at the Queen Mother Reservoir, Dachet, England, accurately measured horizontal and vertical surface movements. The network consisted of 10 station pillars on the downstream crest, two remote pillars, a 700 m distant benchmark, and 64 detail points around the toe of the embankment. Angles were measured with a Wild T2 theodolite and distances with a Wild D 13S Distomat. Measurements over a 2-year period indicated that the embankment crest moved 15 mm outward and 12 mm downward during this time. (Cassar-FRC)
W82-05773

8H. Rapid Excavation

TUNNELLING MACHINE SAVES TIME AND MONEY,

International Water Power and Dam Construction, Vol 33, No 12, p 47-49, December, 1981. 1 Fig, 2 Tab.

Descriptors: *Water conveyance, *Tunneling, *Construction equipment, Rapid excavation, Mountains, Austria, Rock excavation.

An Atlas Copco Jarva tunnel boring machine is being used in the construction of the Wolla water tunnel in Karnten, Austria. The tunnel, which will

be 6.7 kilometers long and 3.5 meters in diameter, is part of a large hydroelecric complex in Karnten. Ten 11 hour shifts were required for assembly of the machine at the tunnel entrance. Atlas Copco provided two specialists during assembly, two for training, and one throughout the tunneling period. Conventional drill and blast procedures were used to excavate the first 135 meters of the tunnel, since this section was too narrow for the machine to bore and the rock was not suitable. The machine is generally able to work its way through the alpine gneiss and mica schists at an average rate of about 32.7 meters per 22-hour day. The tunnel boring machine is equipped with a roof shield for protection from falling rock, but the removal process required when overbreak falls below and beneath the machine is time-consuming. The cutters, also manufactured by Atlas Copco, usually last for bout 25 meters of tunnel. Use of the tunnel boring machine is resulting in savings of up to 50% in time and labor, 50% in energy, and 10% in costs in comparison with the estimated costs associated with using conventional drill and blast methods to create this tunnel. The tunnel boring machine also produces a smooth surface and regular shape. (Carroll-FRC)
W82-05513

EXPERIENCE IN PREPARING THE ROCK FOUNDATION OF THE DNESTR HYDROELECTRIC STATION,

A. E. Azarkovich, M. I. Shuifer, A. I. Tsvetkov, S. S. Gandzyuk, and E. L. Budnikov.
Hydrotechnical Construction, Vol 15, No 8, p 459-461, 1981. 1 Fig, 2 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 21-22, August, 1981.

Descriptors: *Explosives, *Foundation rocks, *Excavation, Blasting, Rock foundations, Dam foundations, Hydroelectric plants, Drilling, Dnestr Hydroelectric Station.

The Dnestr hydrostation foundation was prepared without jackhammer drilling at a labor reduction of 0.33 man days per sq m of foundation. Formerly, cracks in the rock foundations were avoided by removing the last rock layer in the following manner: a 4-5 m layer was removed by firing 0.11 m diameter long-hole charges in a close pattern, the next 1 m loosened by 1 m short-hole charges to a depth of 0.6 m, and the remaining 0.4 m removed manually by picks and wedges. The new scheme used long-hole charges of 0.15 m diameter arranged in the normal pattern for the upper 3-4 m layer. The lower 2 m was loosened by close spaced long-hole charges of the calculated diameter (in this case 0.085 m) in 0.11 m diameter boreholes. Little manual excavation was required after loosening rocks in this manner. Testing showed that the rock foundation quality was within specifications. (Cassar-FRC)
W82-05585

DRIVING LARGE HYDRAULIC TUNNELS BY THE STEPPED FACE METHOD,

V. M. Mostkov.
Hydrotechnical Construction, Vol 15, No 8, p 496-502, 1981. 3 Fig, 2 Tab, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo. No 8, p 47-51, August, 1981.

Descriptors: *Tunneling, *Hydraulic structures, *Excavation, Tunnel construction, Stepped face method.

The stepped-face method for excavating tunnels of large cross section involves dividing the tunnel into two to four levels, each 4-7 m high, and excavating each level at a 30-50 m lag behind the next higher level. This produces a stepped face which allows trucks, bulldozers, and cranes to move up or down a 20-25 degree blasted rock slope. Blasting and excavation proceed simultaneously on each step. This method is suitable for tunnels more than 10 m high in comparatively homogeneous rocks. The tunnel roof and walls are supported on each level by anchors and shotcrete. Concreting is done with a lag behind digging or after completion. A typical three-level tunnel will advance 2.5-3.5 m per day, about 1.5 times faster than with the lower bench method. (Cassar-FRC)
W82-05586

QUALITY OF CONTOURING WORKINGS WHEN DRIVING UNDERGROUND STRUCTURES AT THE NUREK HYDROSTATION,

M. D. Bondarenko.
Hydrotechnical Construction, Vol 15, No 8, p 453-458, 1981. 3 Fig, 5 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 8, p 17-20, August, 1981.

Descriptors: *Underground structures, *Tunnel construction, *Rock excavation, Tunneling, Tunnel linings, Quality control, Excavation, Blasting.

Graphs were prepared to determine the average linear overbreak of tunnels under construction for comparison with standards or regulations. Two graphs were constructed: one as a function of the specific perimeter of the tunnel and overbreak coefficient and the other as a function of the thickness of the concrete lining and overplacement coefficient. These were applied to an analysis of the quality of tunneling at the Nurek hydrostation, USSR. Average linear overbreak was 0.46 m, of which overbreak due to boring accounted for 0.22 m and overbreak due to geological factors accounted for 0.24 m. Tunneling quality is affected by two main factors: boring and blasting methods and structural geology of the rock mass. (Cassar-FRC)
W82-05590

8I. Fisheries Engineering

ENGINEERING ASPECTS OF FISH PROTECTION AT WATER INTAKES,

B. S. Malevanchik.
Hydrotechnical Construction, Vol 15, No 6, p 374-381, June, 1981. 6 Fig, 1 Tab, 9 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No 6, p 44-48, June, 1981.

Descriptors: *Fish guiding, *Protection, *Intakes, Fish barriers, Fish conservation, Diversion structures, Hydroelectric plants, Reservoirs, Headrace, Screens, Meanders, Canals, Fish eggs.

Three methods of protecting fish from entering water intakes of large hydroelectric installations are presently under research in the Soviet Union. Fish barriers, which retain the eggs and young fry on screens or shields, are labor intensive and not too effective in protecting fish at a large intake. Fish-enclosing methods withdraw intake water from boom-enclosed areas outside of fish habitats. During migration the water intake can be stopped or reduced to a safe level. However, enclosures are only effective when the fish distribution (diurnal and seasonal, vertical and horizontal) has been thoroughly documented for the individual water body. Fish diverting methods concentrate the drifting fry population into a narrow band along one of the stream banks and divert the flow into an area unaffected by the water intake. Studies of fish in meandering streams and in test flumes show that the fish movement obeys the laws of fluid motion. Maximum concentration of fry is near the concave bank of the stream where the transverse velocity component changes direction from the concave to the convex bank. A 7 degree bottom slope toward the concave bank intensifies the fish-concentrating effect. A curved headrace is of canal curvature/canal width of 3 to 5 and a 7-10 degree slope toward the convex bank. The second most important element is a fish diversion structure one third to one fifth the depth of water in the canal. Optimum water velocity in the headworks is 1.2-1.5 times greater than in the headrace. (Cassar-FRC)
W82-04759

HYPOLIMNION OXYGENATION STUDIES IN CLARK HILL LAKE,

Drexel Univ., Philadelphia, PA.
For primary bibliographic entry see Field 5G.
W82-05001

PREDICTIVE MODELS OF BENTHIC MACROINVERTEBRATE DENSITY FOR USE IN INSTREAM FLOW STUDIES AND REGULATED FLOW MANAGEMENT,

Wyoming Univ., Laramie. Water Resources Research Inst.
J. A. Gore, and R. D. Judy, Jr.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 11, p 1363-1370, November, 1981. 10 Fig, 3 Tab, 24 Ref.

Descriptors: *Stream fisheries, *Mathematical models, *Population density, *Macroinvertebrates, Prediction, Benthic fauna, Instream flow, *Regulated flow, Flow control, Aquatic insects, Mathematical equations, Computer models, Simulation analysis, Fish food, Water management.

If a streamflow management strategy is to assure optimum fish production, it must include a flow to maintain invertebrates, which are often the primary source of food for fish. The U.S. Fish and Wildlife Service, Cooperative Instream Flow Service Group, has developed the PHABSIM model, an incremental method for the determination of habitat suitability for sport fish species at various discharge levels. A similar method for determining optimum conditions for stream macroinvertebrates is proposed as an adjunct to the Fish and Wildlife Service model. This proposed method stresses predictions of density maxima and flow predictions for maintenance of suitable lotic habitat. The PHABSIM model was used to determine velocity, depth, and substrate preferenda for 19 aquatic invertebrates. The curve-fitting equations of the PHABSIM computer simulation showed high reliability in predicting physical habitat tolerance of selected aquatic insects. An example using Nectopsyche lahontonensis is presented. The new predictive model, which utilizes exponential polynominal analysis, provides a 'fine-tuning' function to allow a narrower confidence limit on regulated flow recommendations. This model also responds to criticisms of earlier models which do not include the dependence of velocity and depth in stream channel hydraulics. The added cross-product term in the model alters the predicted peak responses (density) with random changes in depth and velocity. The effectiveness of this model in stream management has not yet been tested. (Carroll-FRC)
W82-05194

PLACER MINING AND SALMON SPAWNING IN AMERICAN RIVER BASIN, CALIFORNIA,

Bureau of Reclamation, Sacramento, CA.
N. P. Prokopovich, and K. A. Nitzberg.
Bulletin of the Association of Engineering Geologists, Vol 19, No 1, p 67-76, 1982. 7 Fig, 2 Tab, 17 Ref.

Descriptors: *Spawning, Aquatic habitats, Stream beds, *American River, *California, *Salmon, Fish, *Mine wastes, *Dredging, Tailings, Spoil banks, Gravel, Gold, Channel improvement, Geology, Petrography, Alluvial deposits, *Water pollution effects.

The American River, near Sacramento, California, was apparently improved as a salmon spawning stream as the result of gold mine dredging operations. A 70 sq km tailing area, one of the largest in the state, is located on this river. Gold dredges appeared in California in the 1900's, and draglines were introduced in the 1930's. 1308 pebbles in 12 gravel-rich sites favorable for salmon spawning were examined by hand lens and classified into four groups: metamorphic, granitic, volcanic, and quartz. At five sites the pebble composition reflected the composition expected from upstream rocks. At five other sites the gravel composition was similar to that of the dredge tailings rather than the average composition of the water-shed or the average composition of rocks in the main and tributary canyons. Although no reliable data on pre- and post-dredging spawning conditions in the American River are available, some scientists feel that present-day spawning conditions are better than in pre-dredge times. (Cassar-FRC)
W82-05200

FISHERY IMPORTANCE OF THE URAL-CASPIAN FISHING DISTRICT AND PROBLEMS OF ITS WATER SUPPLY,
A. P. Musatov, and Y. N. Podushko.
Water Resources, Vol 8, No 2, p 132-135, March-April, 1981. 5 Ref. Translated from Vodnye Resursy, No 2, p 72-76, March-April, 1981.

Descriptors: *Fisheries, *Water management, *Water transfer, Sturgeon, Caspian Sea, *Ural River, Volga River, Canals, Spawning, Reservoirs, Lake Chelkar, Water resources development, Runoff, *USSR.

The effect of water management of the Ural River on sturgeon spawning is discussed. Sufficient flooding of the spawning grounds (total of 1700 ha) occurs when spring runoff exceeds 5 cu km per year. If the region between the Ural and the Volga is developed for grain farming and animal husbandry, water consumption will increase. This will produce annual runoffs less than 5 cu km in 17 to 30 years. Of these 17 years, 11 will have flows less than 3 cu km. During 1936-66 annual runoff was less than 5 cu km only six times. The authors believe that the discharge volume of the Ural can be maintained at amounts optimal for fish reproduction only by delivering Volga water to the Ural. A planned 425 km canal can supply enough water to meet fishery requirements. The necessary increase in regulating storage could be provided by using Lake Chelkar on the Ural banks to receive water from the proposed canal and deliver it to the Ural via the Solyanka River. An increase of 5 m in embankment height would provide a total of 2.5 cu km storage. This would permit annual Ural runoff of 75% and 50% probabilities of 7 and 10 cu km, annual runoff, respectively, assuring optimal conditions for reproduction and foraging of sturgeons and semimigratory fish in the eastern part of North Caspian Sea. (Cassar-FRC)
W82-05342

RESOLVING THE FISH VS FLOOD CONTROL CONTROVERSY ON THE VEDDER RIVER,
For primary bibliographic entry see Field 4A.
W82-05765

9. MANPOWER, GRANTS AND FACILITIES

9C. Research Facilities

WATER RESEARCH IN ACTION,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 6B.
W82-05292

SUBJECT INDEX

ABANDONED COAL MINES
- Abandoned Coal Mines in West Virginia as Sources of Water Supplies, W82-05219 3C

ABSORPTION
- Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage), W82-05021 5D
- Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta), W82-05311 5G
- Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case, W82-05347 5B
- Use of Synthetic Adsorbents in Chemical Processes, W82-05404 5D

ACCUMULATION
- Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration, W82-05491 5D

ACID MINE DRAINAGE
- Acid Pond Drainage, W82-05199 5G
- Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio, W82-05234 5B

ACID RAIN
- Acid Precipitation. 1. Causes and Consequences, W82-04771 5C
- Acid Precipitation in Historical Perspective, W82-04807 5B
- Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests, W82-04872 5C
- Rare and Endangered Species: Freshwater Gastropods of Southern New England, W82-04968 5C
- Acid Rain: Legal and Political Fallout, W82-05147 6E
- Effects of Acid Precipitation, W82-05149 5C
- Acid Precipitation in the Washington Cascades, W82-05287 5B
- The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems, W82-05534 5C
- An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania, W82-05843 5B

ACIDITY
- pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor, W82-05341 5D

ACTIVATED CARBON
- Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle), W82-04903 5D
- Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon, W82-05060 5G
- The use of Activated Carbon in Water Treatment, W82-05182 5F
- Containment and Treatment of the Love Canal Landfill Leachate, W82-05250 5D
- Extended Dechlorination Studies with Granular Activated Carbon Filters, W82-05257 5F
- Industrial Wastewater Treatment Technology--Recent Developments, W82-05348 5D
- Ozone and Activated Carbon, W82-05370 5F
- Safety Considerations in Handling Activated Carbon, W82-05442 5D
- Effects of Salts on Activated Carbon Adsorption of Fulvic Acids, W82-05667 5F
- Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies, W82-05670 5F
- Performance of Granular Activated Carbon for Total Organic Carbon Removal, W82-05677 5F
- Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies, W82-05680 5F
- Microbial Activity in Activated Carbon Filters, W82-05683 5F

ACTIVATED SLUDGE
- Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters, W82-04838 5D
- Nitrogen Control at Three Related Plants, W82-05434 5D
- Mechanisms and Methods for Polymer Conditioning of Activated Sludge, W82-05445 5D
- Potential Use of Earthworms as a Solution to Sludge Management, W82-05478 5E

ACTIVATED SLUDGE PROCESS
- Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System, W82-04824 5B
- The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test, W82-04825 5C
- Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process, W82-04829 5C
- Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System, W82-04832 5D
- Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System, W82-04833 5D
- Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters, W82-04838 5D
- Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge, W82-04854 5D
- Speciation of Copper and Manganese in Effluents from the Activated Sludge Process, W82-04937 5D
- Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater, W82-04990 5D
- Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process, W82-04991 5D
- Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors, W82-05011 5D
- Carbohydrates and Proteins Removals in Activated-Sludge Procedure, W82-05090 5D
- Biological Nitrification of Industrial Wastewater, W82-05129 5D
- Single Sludge Nitrogen Removal from Industrial Wastewater, W82-05245 5D
- Microbial Ecosystems Responsible for Anaerobic Digestion and Composting, W82-05252 5E
- Shock Load of Chromium (VI), W82-05253 5D
- Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment, W82-05258 5D
- Control of Sludge Bulking in the Brewing Industry, W82-05260 5D
- Studies of Nitrification in a Coke-Waste Activated Sludge Process, W82-05295 5D
- Design and Operation Interaction--An Example: Main Treatment Plant Vienna, W82-05356 5D
- Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid, W82-05417 5D
- Control of Bulking Sludge--Practical Experiences in Austria, W82-05423 5D
- The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process, W82-05431 5D
- Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration, W82-05491 5D
- The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants, W82-05504 5D
- Hydraulic Regime and Activated Sludge Performance, W82-05819 5D
- Filterability of Activated Sludge in Response to Growth Conditions, W82-05860 5D

ACTIVATED SLUDGE PROCESSES
Algorithm for Optimal Activated Sludge Operation,
W82-05682 5D

ACTIVITY COEFFICIENT
Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 2K

ADSORBENTS
Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 5D

ADSORPTION
Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 2H

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 5B

Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 5D

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 5D

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 5B

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 5F

Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 5C

ADVANCED WASTEWATER TREATMENT
Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 5D

Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 5D

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 5D

Phosphorus Reduction Studies,
W82-05408 5D

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

AERATED LAGOONS
A Low-Cost Secondary Treatment Alternative,
W82-05169 5D

AERATION
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 5D

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 5D

Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 5D

Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 5G

Oxygenation of the Avon River,
W82-05730 5G

AERATION ZONE
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 2G

AEROBIC BACTERIA
The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 5C

AEROBIC CONDITIONS
Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

AEROBIC DIGESTION
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 5D

AEROSOLS
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

AESTHETICS
Saving Water Scenically,
W82-05789 5D

AGRICULTURAL CHEMICALS
A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 5B

AGRICULTURAL HYDROLOGY
Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 4C

AGRICULTURAL RUNOFF
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 2A

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 2H

Agricultural Runoff and Water Pollution,
W82-05569 5B

Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 5C

AGRICULTURAL WATERSHEDS
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 2E

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 4D

AGRICULTURE
Some Emerging Rights in Agricultural Land,
W82-04890 6E

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 4B

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 3F

AIR POLLUTION
Estimation of Organic Compound Emissions from Waste Lagoons,
W82-05679 5C

Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 5B

AIR POLLUTION EFFECTS
Acid Precipitation in the Washington Cascades,
W82-05287 5B

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 5C

AIR TEMPERATURE
Humidity Measurement by Infrared Thermometry,
W82-05611 7B

AIR-WATER INTERFACES
A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 2L

ALABAMA
A Five-Year Plan of Water Resources Research.
W82-05527 6B

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 2E

ALAGAL HARVESTING
Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 5G

ALASKA
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 5G

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 4C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 2F

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 4A

ALBERTA
River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 6E

Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 6D

Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 2G

A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 6B

ALFALFA
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 3C

ALGAE
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 5B

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 5G

Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 5A

Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 5C

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1A

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 5C

Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 2H

Indoles in the Decomposition Products of Certain Blue-Green Algae,
W82-05505 2H

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 5B

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 2H

Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 5A

Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 5G

ALGAE HARVESTING
High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 5D

ALGAL
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

ALGAL GROWTH
Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 5C

ALGAL MATS
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

ALGORITHMS
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

ALLUVIAL CHANNELS
Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 2E

ALLUVIAL DEPOSITS
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

ALLUVIUM
Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

ALTERNATIVE PLANNING
Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 6A

ALUM
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

ALUMINUM
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

ALUMINUM COMPOUNDS
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 2K

AMAZON RIVER
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

AMERICAN RIVER
Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 8I

AMMONIA
Criteria for Nitrification in Fixed Film Reactors,
W82-05352 5D

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

AMMONIUM
Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

ANABAENA
Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

ANAEROBIC CONDITIONS
Anaerobic Treatment in Novel Contact Digester,
W82-05681 5D

Role of Surface Active Media in Anaerobic Filters,
W82-05816 5D

ANAEROBIC DIGESTION
Package Anaerobic Sludge Digestion.
W82-04850 5D

Anaerobic Treatment of High-Strength Wastes,
W82-04907 5D

Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digester,
W82-05341 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

ANALYTICAL TECHNIQUES
Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 7B

ANCHORAGE
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 5G

ANIMAL WASTES
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 5B

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 5B

Agricultural Runoff and Water Pollution,
W82-05569 5B

ANODIC STRIPPING VOLTAMMETRY
Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 5A

ANTARCTICA
A Mechanism for the formation of Large Icebergs,
W82-04798 2C

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

ANTIBODIES
Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 5A

ANTIMONY
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 5A

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 5A

AQUATIC BACTERIA
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 5B

AQUATIC ENVIRONMENT
Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 5A

Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 5C

AQUATIC FAUNA
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

AQUATIC HABITANTS
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

AQUATIC HABITATS
Pesticide Effects on Aquatic Habitats,
W82-05146 5C

AQUATIC LIFE
Overview and Assessment of Biological Sensing,
W82-05156 5C

New In-Situ Techniques in Biomonitoring,
W82-05157 5A

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 5B

Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C

AQUATIC PLANTS
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 7B

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 4A

AQUATIC WEED CONTROL
The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 4A

AQUIA AQUIFER
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

AQUIFER CHARACTERISTICS
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 2F

Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 2F

The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 4B

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 7C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

AQUIFER MANAGEMENT
Aquifer Management in Dade County,
W82-05784 5G

AQUIFERS
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79.
W82-04987 7C

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 2F

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 5B

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 2K

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 2F

Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 2F

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 7C

ARCH DAMS

Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 8A

ARCTIC

Evaporation at a High Arctic Site,
W82-04899 2D

ARGENTINA

Issues in Simulation Model Design--A Case Study,
W82-05627 4A

ARIZONA

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 7C

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 5D

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 7C

ARKANSAS

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 7C

AROMATIC COMPOUNDS

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 5D

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 5B

Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 5A

AROMATIC HYDROCARBONS

Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

ARSENIC

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 5A

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 5A

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 5A

Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry,
W82-05580 5A

ASBESTOS CEMENT

The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 8G

ASPHALT

Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 5A

ASPHALT CONCRETE

Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 8A

ASSESSMENTS

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

ASSIMILATIVE CAPACITY

A Consistent Methodology for Wasteload Allocations,
W82-05702 5G

ASSINIBOINE RIVER

Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 4A

ATMOSPHERIC PRECIPITATION

Identification of Independent Rainstorms,
W82-05708 2B

ATMOSPHERIC PRESSURE

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1B

ATMOSPHERIC WATER

Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 2B

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 2A

ATOMIC ABSORPTION SPECTROSCOPY

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 5A

ATTITUDES

Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 6B

Water Management in the Maritimes,
W82-05776 6B

AUSTRALIA

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 2L

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 2H

Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

AUSTRIA

Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 5D

AUTOMATION

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 5D

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 5D

Package Anaerobic Sludge Digestion.
W82-04850 5D

New Telemetry System for the Cambridge Water Company.
W82-04852 5F

A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076 7B

Lateral Move Irrigation Offers Advantages for Rectangular Fields.
W82-05080 3F

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 5A

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 5F

AUTOMATION

A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 5D

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 5D

Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 5F

The Chertsey Automation Project at North Surrey,
W82-05805 5F

AVAILABLE WATER

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 6B

Soil Water Availability,
W82-05623 2G

The Physical Environment of the Colorado River Basin,
W82-05891 6D

AXISYMMETRIC PIPE FLOW

Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 8B

BACKWASH

Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 5F

BACTERIA

Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 5C

Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

Isolation and Characterization of Cellulolytic Bacteria from Activatad Sludge,
W82-04854 5D

Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 2A

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 5B

Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 2L

Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 5A

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 5F

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 5A

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 5G

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 5A

Sulfur Bacterial Problems Revisted,
W82-05264 5B

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 5D

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1A

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 5D

Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 5B

Fecal Coliform Densities in a Western Watershed,
W82-05618 5B

Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 5D

Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 5A

BACTERIAL ANALYSIS

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 5A

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

BACTERIAL PHYSIOLOGY

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 5A

BACTERIOPLANKTON

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

BALTIC SEA

Investigations on the Sedimentation in the Darss-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 2L

Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimenteo Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Paremeter des Sedimentierten Materials),
W82-04762 2L

BALTIMORE

Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 8G

BANK EROSION

Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 2E

A Field Technique to Directly Measure River Bank Erosion,
W82-05410 7B

BASALTS

Ground-Water Management in Basalts,
W82-04931 4B

BASE FLOW

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

BASELINE STUDIES

Research on Piezodialysis - Sixth Report,
W82-05294 3A

BAYS

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Doctor,
W82-04808 5A

The Tidal Stream in the German Bight,
W82-05190 2L

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 5B

BDELLOVIBRIOS

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

BEAR CREEK

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 5C

BED LOAD

Bed Load Fluctuation: Applications,
W82-05000 2J

Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 2J

Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 2J

BEDROCK

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 2K

BEET SUGAR INDUSTRY
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 5D

BENEFITS
A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 6B

BENTHIC FAUNA
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 2H

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 5C

Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 2E

BENTHOS
Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 5C

BENZENES
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 5B

BERLIN
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 5D

BICARBONATES
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 5C

BIELERSEE
Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 2H

BIGHTS
The Tidal Stream in the German Bight,
W82-05190 2L

BIOACCUMULATION
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 5B

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 5B

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 5A

BIOASSAY
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 5C

Overview and Assessment of Biological Sensing,
W82-05156 5C

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 5A

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 5A

BIOCHEMICAL OXYGEN DEMAND
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 7B

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 5D

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 5D

BIOCHEMISTRY
Humic Substances,
W82-05148 5B

BIODEGRADATION
Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 5C

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 5D

Biodegradation of Hazardous Organic Pollutants,
W82-04910 5B

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 5G

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 5D

Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 2H

Microbial Removal of Hazardous Organic Compounds,
W82-05177 5D

Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 5B

BIODETECTION
Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 5A

BIOFILMS
Kinetics of Biofilm Nitrification,
W82-05374 5D

BIOFILTERS
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 5D

Biofiltration Design Based on Volumetric Loading,
W82-05698 5D

BIOINDICATORS
Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 5A

Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 5A

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 5A

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 5C

New In-Situ Techniques in Biomonitoring,
W82-05157 5A

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 5A

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 5A

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 5C

Biological Monitoring, Part V - Preference and Avoidance Studies,
W82-05340 5C

BIOLOGICAL FILTERS
Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 5D

BIOLOGICAL OXYGEN DEMAND
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 5D

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 5B

Chemometric Modeling of Wastewater Treatment Process,
W82-05858 5D

BIOLOGICAL PROCESSES
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

BIOLOGICAL PROPERTIES
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A

BIOLOGICAL TREATMENT
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 5D

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 5F

BIOLOGICAL WASTEWATER TREATMENT
Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 5D

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 5D

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 5D

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05859 5D

BIOMASS
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 2H

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 2E

The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 5D

BIOMONITORING
Overview and Assessment of Biological Sensing,
W82-05156 5C

New In-Situ Techniques in Biomonitoring,
W82-05157 5A

BIOTRANSFORMATION
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

BLACK SEA
Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 5B

BLUEBERRIES
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

BORON
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

BOSTON
Drought Management: Expecting the Unexpected,
W82-05649 3D

BOTSWANA
Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 [illegible]C

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 4B

BOTTOM SEDIMENTS
Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 2K

Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 5B

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

BOTTOMLAND
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

BOUNDRY LAYERS
A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 2C

BRAZIL
Turbines for Itaipu,
W82-04955 8C

BREWING INDUSTRY
Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

BRINE DISPOSAL
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

BRITISH COLUMBIA
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 5A

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 6F

New Strategies for Water Resource Planning in British Columbia,
W82-05395 6E

Water Quality Management in British Columbia,
W82-05767 5C

Irrigation Efficiency in Orchards,
W82-05768 3F

The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779 6E

BROMINE
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

BULKING SLUDGE
Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

CACHE LA POUDRE RIVER BASIN
Water Reuse Planning by Means of an Input-Output Table,
W82-04794 6A

CADILLAC
Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 5D

CADMIUM
The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 5A

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 5A

Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 5A

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

CALCIUM CARBONATE
Acid Pond Drainage,
W82-05199 5G

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 2H

CALIBRATIONS
Simplifying Neutron Moisture Meter Calibration, W82-05173 7B

CALIFORNIA
Barriers to Effective Ground-Water Management: The California Case, W82-04917 4B
Placer Mining and Salmon Spawning in American River Basin, California, W82-05200 8I
The Ecology of Southern California Coastal Salt Marshes: A Community Profile, W82-05215 2H
California's Peripheral Canal: Skirting the Delta - and the Issues, W82-05411 4A
Five Year Water Resources Research Plan for the State of California, W82-05532 6B
Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs, W82-05628 4B
Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80, W82-05851 7C
Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77, W82-05852 2J

CALIFORNIA BIGHT
Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean, W82-05142 5B

CALIFORNIAGRASS
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity, W82-05153 3C

CALOOSAHATCHEE RIVER
Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida, W82-05222 5C

CALORIMETRY
Calorific Value of Wastewater Plant Sludges, W82-04997 5E

CAMBRIDGE WATER COMPANY
New Telemetry System for the Cambridge Water Company. W82-04852 5F

CAMPSITES
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites, W82-04858 2G

CANADA
Weak Controls from Sea to Shining Sea, W82-05035 5B
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978, W82-05196 8E
Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada), W82-05205 5B
A Federal Perspective on River Basin Management, W82-05388 6E
Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water, W82-05398 5A
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977, W82-05635 5B
Oxygenation of the Avon River, W82-05730 5G
Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory, W82-05741 5B
Northwestern Ontario River Dimensions, W82-05742 6G
Selecting a Method for Estimating Substance Loadings, W82-05746 5B
Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta, W82-05762 2G
Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent), W82-05763 5B
On Hydrological Data Needs in Canada, W82-05764 7B
A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams, W82-05766 6B
Water Quality Management in British Columbia, W82-05767 5C
Irrigation Efficiency in Orchards, W82-05768 3F
The Mackenzie River Basin Study, W82-05778 4A

CANAL DESIGN
Discharge Capacity of Large Streams Under an Ice Cover, W82-05106 2E
Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method, W82-05108 8A
Calculation of Large Unlined Canals, W82-05131 8B
Formation of a Stable Canal Channel, W82-05584 8B

CANAL LININGS
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal, W82-05117 8G
Salinity Control Measures for Grand Valley, W82-05894 3F

CANALS
Resistance of Beauharnois Canal in Winter, W82-04998 2C
California's Peripheral Canal: Skirting the Delta - and the Issues, W82-05411 4A
Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals, W82-05593 5B
Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho, W82-05726 5B
$12.6 M Repairs Bill for Ruahihi Canal. W82-05880 8D

CANOPY
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem, W82-05538 3C

CAPE TOWN
Water to the South-Western Cape Keeping Up with the Demand. W82-04887 3C

CAPITAL COSTS
Municipal Pollution Abatement Report card: Significant Progress, W82-05861 5D

CARBARYL
Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry, W82-05019 5A

CARBOHYDRATES
Carbohydrates and Proteins Removals in Activated-Sludge Procedure, W82-05090 5D

CARBON CYCLE
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977, W82-05197 2K

CARBON DIOXIDE
Effects of Increased Atmospheric C02 on Great Lakes, W82-05209 2H
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds, W82-05373 5D
Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification, W82-05498 5D
Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns, W82-05574 2B

CARBON FILTERS
Extended Dechlorination Studies with Granular Activated Carbon Filters, W82-05257 5F

CARBON ISOTOPES
The Occurrence and Origin of Methane in Some Groundwater Flow Systems, W82-04925 2K

CARBON TETRACHLORIDE
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee, W82-05203 5B

CARCINOGENS
Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System, W82-04824 5B
Mutagens, Carcinogens and the Water Cycle, W82-05468 5A

CARROLL COUNTY
Littletown Quadrangle: Hydrogeology, W82-04984 7C

CARSON CITY QUADRANGLE
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

CASE STUDIES
Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 8G

CASPIAN SEA
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 8A

CATALYSTS
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 5F

CATCHMENTS
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 4C

CAVITATION
Concrete for Surfaces of High-Head Spillways,
W82-05110 8F

Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 8B

CEMENT
Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 8F

CENTRAL ILLINOIS
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

CENTRIFUGATION
Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 5E

CHACO REGION
Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 6D

CHALK AQUIFER
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

CHANNEL EROSION
Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 8A

CHANNEL FLOW
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

CHANNEL IMPROVEMENT
Stream Improvement: The Chicod Creek Episode,
W82-05717 4D

Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 4A

CHANNEL MORPHOLOGY
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

CHARTS
Recording Raingage Modifications,
W82-05665 7B

CHATTAHOOCHEE NATIONAL FOREST
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

CHELATING AGENTS
Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04875 5B

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 5D

CHELATION
Procedure for Investigating Metallic Ion Complexing in Natural Waters,
W82-05595 5A

CHEMICAL ANALYSIS
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 5A

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 5A

CHEMICAL COAGULATION
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

CHEMICAL COMPOSITION
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 2L

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 2H

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 2K

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory) as a Habitat of Artemia Salina,
W82-05455 2H

CHEMICAL DEGRADATION
Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 5D

CHEMICAL OXYGEN DEMAND
Calorific Value of Wastewater Plant Sludges,
W82-04997 5E

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

CHEMICAL PRECIPITATION
Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 5D

Phosphorus Reduction Studies,
W82-05408 5D

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

CHEMICAL PROPERTIES
On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 2H

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

CHEMICAL REACTION
Humic Substances,
W82-05148 5B

CHEMICAL REACTIONS
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 5B

The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-FeOOH) in Freshwaters,
W82-05140 2K

Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 2K

Ion Hydration and Ion Interaction,
W82-05310 2K

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 5F

CHEMICAL REDUCTION
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

CHEMICAL TREATMENT
Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

CHEMICAL WASTEWATER
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04830 5B
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

CHESAPEAKE BAY
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 5A
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

CHEZY EQUATION
Resistance of Beauharnois Canal in Winter,
W82-04998 2C

CHICAGO
Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

CHICAGO AREA
Nitrogen Control at Three Related Plants,
W82-05434 5D

CHILE IRRIGATION
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

CHLORINATED COMPOUNDS
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

CHLORINATED HYDROCARBONS
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A
Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 5A
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C
Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 5F
Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 5C

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 5F

CHLORINATION
Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 5F
Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 5A
GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 5A
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 5F

CHLORINE
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 5B
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

CHLORINE DIOXDE
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

CHLORINE DIOXIDE
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

CHLOROPHENOLS
Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 5A

CHLOROPHYLL
Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 2H

CHROMATOGRAPHY
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 5A
Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 5A
Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 5A

CHROMIUM
Shock Load of Chromium (VI),
W82-05253 5D
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 5D

CLARIFIED WASTEWATER
Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

CLASSIFICATION
Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 5A
Wetlands and Deepwater Habitats: A New Classification,
W82-05716 2L

CLAYS
Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 2H
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

CLEANUP OPERATIONS
Performance Testing of the Diperna Sweeper,
W82-05058 5G
Performance Testing of Four Skimming Systems,
W82-05059 5G
Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 5G
Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 5G
Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 5G
Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 5G
A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 5G
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 5G

CLEAR-CUTTING
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 4C

CLEARCUTTING
A Citizen's View of Water Management in the Okanagan Valley,
W82-05781 6G

CLIMATIC
Glaciers and Their Fluctuations,
W82-04777 2C

CLIMATOLOGY
Glaciers and Their Fluctuations,
W82-04777 2C
Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 2J
Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 2B

CLOSED BASINS
Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05636 4D

COAGULATION
Considering Sludge Production in the Selection of Coagulants,
W82-05675 3F

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

COAL
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 5D

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 5D

COAL MINES
Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 7A

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 7C

COAL MINING
Acid Pond Drainage,
W82-05199 5G

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 5C

COASTAL MARSHES
The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 2H

COASTAL PLAINS
Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 3B

COASTAL STREAMS
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

COASTAL WATERS
Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

Wastewater Management in Coastal North Carolina,
W82-05559 5E

COASTAL ZONE MENAGEMENT
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

CODING SYSTEMS
A River Coding System for Water Quality Archives,
W82-05474 7A

COLD REGIONS
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

COLIFORMS
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 5A

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 5A

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

Fecal Coliform Densities in a Western Watershed,
W82-05618 5B

COLIPHAGES
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 5D

COLLOIDALS
Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 2L

COLLOIDS
New Flocculation Units with High Efficiency,
W82-04840 5D

COLORADO
Water Reuse Planning by Means of an Input-Output Table,
W82-04794 6A

Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 6E

Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law,
W82-04803 6E

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 3C

Sludge Management in the Rocky Mountain State,
W82-05165 5E

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

A Five-Year Plan for Water Research in Colorado,
W82-05531 6B

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

COLORADO RIVER
The Wellton-Mohwak Dilemma,
W82-05883 3F

Future Water Development Policies,
W82-05884 5G

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 6E

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

Colorado River Development,
W82-05887 4A

Colorado River Water Allocation,
W82-05888 6C

The Colorado River Salinity Problem,
W82-05889 5G

Development Issues in the Colorado River Basin,
W82-05890 6D

The Physical Environment of the Colorado River Basin,
W82-05891 6D

International Problems on the Colorado River,
W82-05892 5G

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

Salinity Control Measures for Grand Valley,
W82-05894 3F

COLORIMETRY
Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 5A

COLUMBIA RIVER BASALTS
Ground-Water Management in Basalts,
W82-04931 4B

COMBINED SEWER OVERFLOWS
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

Stormwater Management in the Ottawa-Carleton Region,
W82-05563 5G

Improvement of Swirl Concentrator,
W82-05821 5D

COMBINED SEWERS
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

COMMERCIAL FARMING
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

COMMERCIAL WATER SUPPLY
Crisis-Ridden Water Systems Should Go Private,
W82-05436 6C

COMPACTION
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 8A

COMPARISON STUDIES
A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 6D

Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

Evaporation at a High Arctic Site,
W82-04899 2D

Treatment of Cooling Tower Blowdown,
W82-04908 5D

Application of and Guidelines for Using Available Dam Break Models,
W82-05152 8A

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 5B

COMPETING USE
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 6D

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 6E

COMPLETE WASTEWATER TREATMENT
Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 5D

COMPOSTING
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 5D

Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 5E

COMPUTER MODELS
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 2E

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 5B

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 6A

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

COMPUTER PROGRAMS
Computer-Aided Evaluation of Peru's Hydropower,
W82-05515 6A

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 2A

COMPUTERS
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 5F

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 5A

Microcomputer Water Quality Simulation Model,
W82-05191 7B

A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 5D

A River Coding System for Water Quality Archives,
W82-05474 7A

Evolution of Water Management Techniques,
W82-05565 6A

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 5D

Role of the Microcomputer in Water Management,
W82-05771 7B

CONCRETE DAMS
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 8A

Relaxation in Concrete,
W82-05511 8F

CONCRETE MIXES
Concrete for Surfaces of High-Head Spillways,
W82-05110 8F

CONCRETE TESTING
Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 8A

CONCRETES
Site Investigation and Materials Save Money on Sallente.
W82-05878 8A

CONDUITS
Wedge-Block Tunnels in Water Supply,
W82-05803 8F

CONFERENCES
The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 3A

CONFINED AQUIFERS
Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 2F

CONJUNCTIVE USE
Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 4B

CONNECTICUT
Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 5D

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

CONSTRUCTION
The Expansion of Two Bolivian Plants,
W82-05598 8A

The Agus II Scheme in the Philippines,
W82-05599 8A

Large Water and Hydroelectric Developments in Fiji,
W82-05614 6D

Embankment Construction: New Melones Dam,
W82-05822 8D

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 4D

CONSTRUCTION COSTS
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 8B

CONSTRUCTION EQUIPMENT
Tunnelling Machine Saves Time and Money,
W82-05513 8H

CONSTRUCTION MATERIALS
Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 8F

CONSUMPTIVE USE
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 2D

CONTACT STABILIZATION
Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 5D

CONTAMINATION
Contaminant Dispersion in Oscillatory Flows,
W82-05631 5B

CONTROL SYSTEMS
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

Advanced Supervisory Control System for Sludge Treatment,
W82-04841 5D

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 5F

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 5D

Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 5F

The Chertsey Automation Project at North Surrey,
W82-05805 5F

CONVEYANCE STRUCTURES
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 8A

COOLING TOWER
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 2D

COOLING TOWERS
Treatment of Cooling Tower Blowdown,
W82-04908 5D

COOLING WATER
Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 5B

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 2D

Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 5F

COPEPODS
Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 5C

COPPER
Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 5A

Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 5B

COPROSTANOL
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 5A

CORE DRILLING
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

CORE SAMPLING
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

CORN
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 2I

CORRELATION ANALYSIS
Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm,
W82-04864 2B

CORROSION
Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 8G

Sulfur Bacterial Problems Revisted,
W82-05264 5B

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 8G

Guidevane Erosion at Mao Tiao He,
W82-05600 8G

CORROSION CONTROL
The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 8G

COST ALLOCATION
A Spatial Costing System for Drinking Water,
W82-04796 6C

COST ANALYSIS
Anaerobic Treatment of High-Strength Wastes,
W82-04907 5D

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 4B

Bottom-Entry Large-Diameter Wells,
W82-04919 8A

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 5D

Robustness of Water Resources Systems,
W82-05077 6A

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 6C

The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 5G

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

COST-BENEFIT ANALYSES
Virginians Optimize Sludge Handling,
W82-05171 5D

An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 8B

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 3A

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 8B

Economic Evaluation of Watershed Projects—An Overview Methodology and Application,
W82-05735 6B

A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 6B

COSTA RICA
Corobici Completion Ensures Costa Rica's Power Output.
W82-05755 8C

COSTS
Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 5C

Cutting Irrigation Costs,
W82-05081 3F

CREEP
Relaxation in Concrete,
W82-05511 8F

CREOSOTE
Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 5B

CROP PRODUCTION
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 3F

Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 3C

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 3F

Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 3F

CROP YIELD
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 2I

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 3F

CROPPING PATTERNS
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 3F

CROSS-SECTIONS
A New Method of Cubature Using Spline Functions,
W82-05189 2L

CRUSTACEANS
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

CRYSTAL GROWTH
Configuration of Ice in Frozen Media,
W82-05615 2C

CRYSTAL LAKE
Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 5B

CUBATURE
A New Method of Cubature Using Spline Functions,
W82-05189 2L

CULTIVATION
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D

CULTURE MEDIA
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 5D

CULVERTS
Northern Elbe Culvert,
W82-05427 8B

CUMBERLAND COUNTY
Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 2F

CURRENTS
The Tidal Stream in the German Bight,
W82-05190 2L

CYANIDE
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 5D

CYANOPHYTA
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 5C

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

CYCLING NUTRIENTS
Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 2H

CZECHOSLOVAKIA
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 5B

DAIRY INDUSTRY
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 5B

Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 3C

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 5D

DAM CONSTRUCTION
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 8D

Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 8A

Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 8A

Embankment Construction: New Melones Dam,
W82-05822 8D

DAM DESIGN
Shaft Spillways Combined with a Water Intake,
W82-05111 8A

Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 8A

Application of and Guidelines for Using Available Dam Break Models,
W82-05152 8A

Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 8A

DAM EFFECTS
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 4A

DAM FAILURE
Safety of Dams Judged from Failures,
W82-05512 8A

DAM FAILURE; *FLOODS
Application of and Guidelines for Using Available Dam Break Models,
W82-05152 8A

DAM FOUNDATIONS
Uplift Pressure of Water on the Base of Hydraulic Structures in Limit Design States (Discussion of Construction Specifications),
W82-05582 8A

Bearing Capacity of Sand Bases (Discussion of Construction Specifications),
W82-05583 8D

DAM SAFETY
Application of and Guidelines for Using Available Dam Break Models,
W82-05152 8A

DAM STABILITY
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 8A

Measuring Reservoir Ground Movements,
W82-05773 8G

Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 8D

DAMS
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 8B

Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 6D

The Riviersonderend-Berg River-Jonkershoek Project Most Outstanding Civil Engineering Achievement of 1980.
W82-04886 8A

The Overtopping of the Palagnedra Dam,
W82-04952 8A

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 8E

Water Resources in the Legislative Balance, 1982,
W82-05433 6E

The Agus II Scheme in the Philippines,
W82-05599 8A

DANUBE RIVER
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

New Trends in Water Quality Management,
W82-05429 5G

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 5B

DAPHNIA
Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 5C

DATA ACQUISITION
Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 7B

DATA ACQUISTION
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 7B

DATA COLLECTIONS
Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 7C

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2E

DATA COLLECTIONS
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

On Hydrological Data Needs in Canada,
W82-05764 7B

Role of the Microcomputer in Water Management,
W82-05771 7B

The Mackenzie River Basin Study,
W82-05778 4A

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 7C

DATA INTERPRETATION
Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 7C

DATA TRANSMISSION
Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

DECISION MAKING
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 5G

Operational Research Techniques in River Basin Management,
W82-05387 6A

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 6F

Evolution of Water Management Techniques,
W82-05565 6A

DECOMPOSING ORGANIC MATTER
Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 2L

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 2H

Humic Substances,
W82-05148 5B

DECOMPOSITION
Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 2H

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 5B

Indoles in the Decomposition Products of Certain Blue-Green Algae,
W82-05505 2H

DEEP WELLS
Bottom-Entry Large-Diameter Wells,
W82-04919 8A

DEGRADATION
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

DELAWARE
Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

DELAWARE ESTUARY
Dynamic Estuary Model Performance,
W82-05319 2L

DELAWARE RIVER
Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 2E

DEMINERALIZATION
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

DENITRIFICATION
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 5D

Biological Denitrification for Potable Water Treatment,
W82-05247 5F

Nitrogen Control at Three Related Plants,
W82-05434 5D

Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 5B

DENSITY
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 2E

DENSITY CURRENTS
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 2E

DEPOSITION
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

DEPOSITION (SEDIMENTS)
Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 5B

DERBY
Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 5D

DESALINATION
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

Low Temperature Evaporation Plants,
W82-05118 3A

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 3A

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 3A

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05509 3A

Water and Salt Transport in Membranes,
W82-05537 3A

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 3A

Seawater Ro Heads Japan's Water Reuse Research.
W82-05756 3A

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

Salinity Control Measures for Grand Valley,
W82-05894 3F

DESALINATION APPARATUS
Research on Piezodialysis - Sixth Report,
W82-05294 3A

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 3A

DESALINATION PLANTS
VTE/VC for Sea Water,
W82-04909 3A

The Wellton-Mohwak Dilemma,
W82-05883 3F

DESALINTION
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 3A

DESERTS
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

DESIGN CONSIDERATIONS
How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme.
W82-05249 5D

DESIGN CRITERIA
Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

New Flocculation Units with High Efficiency,
W82-04840 5D

An Exercise in Sludge Consolidation,
W82-04848 5D

Resonance in Hydropower Stations,
W82-04953 8C

Turbines for Itaipu,
W82-04955 8C

Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 6C

Estimates of Resilience Indices by Simulation,
W82-05046 6A

Determination of the Optimal Height of the Bucket Lip of a Ski-Jump Spillway,
W82-05107 8B

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 8A

Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 8G

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 5D

Pressure Distribution Design for Septic Tank Systems,
W82-05439 5B

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 8A

Where to Put a Steady Discharge in a River,
W82-05632 5G

Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 8C

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 5D

Deep Shaft,
W82-05793 5D

DESIGN STANDARDS
Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 8B

DESIGN STORMS
An Evaluation of the Urban Design Storm Concept,
W82-04960 6A

DETENTION RESERVOIRS
Settleability of Urban Runoff Pollution,
W82-05320 5G

Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 2J

DETERGENTS
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 5G

DETRITUS
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

DEUTERIUM
The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759 2G

DEVELOPING COUNTRIES
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 5G

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 6B

Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 5F

Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 6G

Egypt Tackles Rural Supply Task,
W82-05754 5F

Turks Press Forward With Ambitious Dam Programme,
W82-05738 6B

DEWATERING
Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 5E

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 5D

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 8C

The Booming Business in Wick Drains,
W82-05192 8G

Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 5E

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 8C

Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 5D

DIATOMS
Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 5A

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 2H

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 5C

DIEL VARIATINS
Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

DIFFUSIVITY
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

DIGESTION
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

DIGITAL COMPUTERS
Advanced Supervisory Control System for Sludge Treatment,
W82-04841 5D

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 5D

DIOXINS
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

DIRTY DEVIL RIVER BASIN
Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

DISCHARGE
A New Method of Cubature Using Spline Functions,
W82-05189 2L

DISCHARGE CAPACITY
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 2E

DISCHARGE FREQUENCY
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2B

DISCHARGE HYDROGRAPHS
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2B

DISCHARGE MEASUREMENT
Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 7C

DISCHARGE MEASUREMENTS
A New Method of Cubature Using Spline Functions,
W82-04939 2L

DISCOUNT RATES
Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 6C

DISINFECTION
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

The Hygienic Control of Swimming Baths.
W82-04853 5F

Prospects of Using Radiation Water Treatment Methods,
W82-05026 5D

Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Qualques Exemples d'Actualite),
W82-05367 5F

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 5F

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

DISPERSANTS
Oil Slick Mechanics,
W82-05064 5G

DISPERSANTS
Dispersant Application System for the U.S. Coast Guard 82-Foot WPB,
W82-05069 5G

DISPERSION COEFFICIENT
Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 5B

DISPOSAL WELLS
Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 5G

DISSOLVED OXYGEN
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 7B

Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 7B

Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 5F

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 6A

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 7B

Do Model for Discharges from Deep Impoundments,
W82-05316 2H

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 5D

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 5B

DISSOLVED SOLIDS
Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05831 7C

Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 2K

DISTILLATION
Treatment of Cooling Tower Blowdown,
W82-04908 5D

VTE/VC for Sea Water,
W82-04909 3A

Low Temperature Evaporation Plants,
W82-05118 3A

DIVERSION
A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 5G

DIVERSION STRUCTURES
The Long Lake Diversion: An Environmental Evaluation,
W82-05368 6G

Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 8A

Northwestern Ontario River Dimensions,
W82-05742 6G

DNIEPER RIVER
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 2K

DOMESTIC WASTES
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

DOMESTIC WATER
Sampling and Analyzing Water,
W82-05263 5A

Domestic Water Conservation Research Plan,
W82-05547 6B

DONBAS CANAL
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 8A

DRAIN SPACING
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 8B

DRAINAGE
Illinois Wetlands: Their Value and Management,
W82-05053 6G

The Booming Business in Wick Drains,
W82-05192 8G

Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 4D

DRAINAGE ENGINEERING
Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 2A

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 4A

Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 4A

DRAINAGE PATTERNS
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 2G

DRAINAGE SYSTEMS
Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 2A

DRAINS
An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 2F

DRAWDOWN
Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

Thermocline Drawdown Above Cooling Water Intakes,
W82-05560 8C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980,
W82-05826 4B

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 2F

DREDGING
Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 2J

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 8I

History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 6E

DRINKING WATER
Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 5F

Potable Water Production in Holland.
W82-04851 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 5F

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 5D

Water System Design Meets Modern Challenges,
W82-05170 5F

The use of Activated Carbon in Water Treatment,
W82-05182 5F

An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 5A

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 6B

Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 5F

The Safe Drinking Water Act on Review,
W82-05792 5G

The National Interim Primary Drinking Water Regulations, Part I - Historical Development,
W82-05814 5G

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 5G

DROUGHT
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 3F

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 2E

Drought Management: Expecting the Unexpected,
W82-05649 3D

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 3D

DROUGHT RESISTANCE
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

DUCTILITY
A Pipeline for all Environments,
W82-04764 8G

DUSSELDORF
Ozone and Activated Carbon,
W82-05370 5F

DYE INDUSTRY WASTES
Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 5D

DYES
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 5B

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 5C

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 5B

DYNAMIC PROGRAMMING
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 2E

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

EARTH DAMS
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 8A

EARTH-WATER INTERFACES
Optimization Principle for Air and Water Movement,
W82-05172 2G

EARTHQUAKE ENGINEERING
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 8D

EARTHQUAKES
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 8E

ECOLOGICAL EFFECTS
Acid Precipitation. 1. Causes and Consequences,
W82-04771 5C

Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 5C

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 5A

Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 5C

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 4A

Pesticide Effects on Aquatic Habitats,
W82-05146 5C

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 5C

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

ECOLOGY
An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 2H

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 2H

The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 2H

ECONOMIC ANALYSIS
Economic Analysis of Water Main Breaks,
W82-05673 8A

Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 6B

ECONOMIC ASPECT
The Wellton-Mohwak Dilemma,
W82-05883 3F

ECONOMIC ASPECTS
The Real Price of Urban Water,
W82-04797 6C

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 6C

Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 6B

A Low-Cost Secondary Treatment Alternative,
W82-05169 5D

Water Resources in the Legislative Balance, 1982,
W82-05433 6E

Crisis-Ridden Water Systems Should Go Private,
W82-05436 6C

Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 6A

ECONOMIC EFFICIENCY
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 6D

ECONOMIC EVALUATION
Robustness of Water Resources Systems,
W82-05077 6A

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 3A

ECONOMIC IMPACT
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

ECONOMIC PREDICTION
An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 2F

ECONOMIC YIELD
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

ECONOMIES OF SCALE
Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 5C

ECOSYSTEMS
Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 5C

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 2H

ECOSYSTEMS
Biological Monitoring, Part III- Receiving System Methodology Based on Community Structure,
W82-05023 5A
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H
Overview and Assessment of Biological Sensing,
W82-05156 5C

EDWARDS AQUIFER
Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79,
W82-04987 7C
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

EFFLUENT LIMITATIONS
A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D
Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

EFFLUENT REUSE
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 3C

EFFLUENTS
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 5B

EGYPT
Egypt Tackles Rural Supply Task,
W82-05754 5F

ELASTICITY OF DEMAND
Municipal Water Supply Restrictions as Urban Growth Constraints,
W82-05748 3D

ELECTRIC FIELDS
Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 5G

ELECTRIC POWER INDUSTRY
Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 5C

ELECTRIC POWER PRODUCTION
Resistance of Beauharnois Canal in Winter,
W82-04998 2C
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05353 5B

ELECTRICAL PROPERTIES
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 2K

ELECTRO-OSMOSIS
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 5D

ELECTROCHEMISTRY
Electrochemical Processes for Wastewater Treatment,
W82-05422 5D

ELECTRODIALYSIS
Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility,
W82-05555 3A

ELECTROPHORESIS
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 2K

ELECTROPLATING
The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

EMBANKMENTS
Embankment Construction: New Melones Dam,
W82-05822 8D

EMBRYO-LARVAL TESTS
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

ENCINA WATER POLLUTION CONTROL FACILITY
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

ENDANGERED SPECIES
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 5C

ENERGY
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 5D
Water System Efficiencies,
W82-05281 8C
Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

ENERGY BALANCE
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 2L

ENERGY SOURCES
Calorific Value of Wastewater Plant Sludges,
W82-04997 5E
Energy Siting in Utah: A Programming Model,
W82-05297 6B
An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 6B
Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

ENERGY TRANSFER
Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 3A

ENGLAND
New Telemetry System for the Cambridge Water Company.
W82-04852 5F
The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 5C
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 5D
Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 4C
Measuring Reservoir Ground Movements,
W82-05773 8G

ENGLAND (HAMPSHIRE)
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

ENTEROVIRUSES
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D
Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

ENTRAINMENT
Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 5C
Aeration at High Velocity Flows,
W82-05602 8A

ENVIROMENTAL EFFECTS
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 5C
Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 4A

ENVIRONMENT
The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 5A

ENVIRONMENTAL CONTROL
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

ENVIRONMENTAL EFFECTS
A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 6D
Acid Precipitation. 1. Causes and Consequences,
W82-04771 5C
The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 2J

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 4A

Effects of Acid Precipitation,
W82-05149 5C

Metabolic Response of Fish to Stress,
W82-05159 5C

Sulphur in the Environment: A Review,
W82-05179 5B

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

Impact of Discharges as a Basis for Control Measures,
W82-05354 5B

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

The Long Lake Diversion: An Environmental Evaluation,
W82-05568 6G

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 4A

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 5D

Northwestern Ontario River Dimensions,
W82-05742 6G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

The Colorado River Salinity Problem,
W82-05889 3G

ENVIRONMENTAL IMPACT STATEMENT
Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 6G

ENVIRONMENTAL PROTECTION
Law for Environmentalists,
W82-05813 5G

ENZYMES
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 5C

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 5C

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 5A

Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 5C

EQUILIBRIUM
Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 2K

Ion Hydration and Ion Interaction,
W82-05310 2K

EROSION
Erosion by Submerged Circular Jets,
W82-05002 2J

Erosion by Plane Turbulent Jets,
W82-05277 8B

A Field Technique to Directly Measure River Bank Erosion,
W82-05410 7B

Erosion from Mountain Snowpack Melt,
W82-05664 2J

EROSION CONTROL
Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 8F

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D

Erosivity Values for Individual Design Storms,
W82-05694 4D

EROSION RATES
A Stochastic Model of Soil Erosion,
W82-05298 2J

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 2J

ERROR ANALYSIS
Erosivity Values for Individual Design Storms,
W82-05694 4D

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 5C

ESCHERICHIA COLI
Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 5A

ESTHWAITE WATER
The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

ESTIMATING EQUATION
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

ESTIMATING EQUATIONS
Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 2E

ESTONIA
Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 5A

ESTUARIES
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 2L

Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 2L

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 2L

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 2L

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 5B

The Tidal Stream in the German Bight,
W82-05190 2L

Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 2L

Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C

Dynamic Estuary Model Performance,
W82-05319 2L

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 6F

Contaminant Dispersion in Oscillatory Flows,
W82-05631 5B

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 5D

Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 2D

ESTUARINE ENVIRONMENT
Modeling: How and When to Use,
W82-04754 2L

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 2L

Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 2L

Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 5C

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 6A

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 5C

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

EUTROPHIC LAKES
The Rehabilitation of Norway's Largest Lake,
W82-05243 5G

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

EUTROPHICATION
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 2H

Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 2H

Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 5G

Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 5C

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 5D

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 2H

Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

Phosphorus Reduction Studies,
W82-05408 5D

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 2H

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 5C

EVALUATION
Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 6B

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 8C

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

Sampling Frequency Optimization Using a Water Quality Index,
W82-05268 5A

Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 6B

EVAPORATION
Shale Oil Wastewater Treatment by Evaporation,
W82-04905 5D

VTE/VC for Sea Water,
W82-04909 3A

Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 2H

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 2A

Low Temperature Evaporation Plants,
W82-05118 3A

Stability Effects on Great Lakes Evaporation,
W82-05634 2D

The Relationship Between O18 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759 2G

EVAPORATION PANS
Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648 2D

EVAPORATION RATE
A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 2D

Evaporation at a High Arctic Site,
W82-04899 2D

EVAPOTRANSPIRATION
Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 2D

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 2D

Soil Water Availability,
W82-05623 2G

A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 4C

New Evapotranspiration Crop Coefficients,
W82-05692 3F

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 2D

EVAPOTRANSPIRATION POTENTIAL
Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

EXCAVATION
Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 8C

Frogmen's Subterranean Swim Sites Source,
W82-05501 8A

Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 8H

Driving Large Hydraulic Tunnels by the Stepped Face Method,
W82-05586 8H

EXCESS RAINFALL
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 4B

EXPLORATION
Frogmen's Subterranean Swim Sites Source,
W82-05501 8A

EXPLOSIVES
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 8H

EXTENDED AERATION
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 5D

FALLOUT
The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 5C

FALLOWING
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

FARM WASTES
Package Anaerobic Sludge Digestion.
W82-04850 5D

Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 2A

FATE OF POLLUTANTS
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 5B

Biodegradation of Hazardous Organic Pollutants,
W82-04910 5B

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 5B

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 5B

Humic Substances,
W82-05148 5B

Microcomputer Water Quality Simulation Model,
W82-05191 7B

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 5B

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 5B

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

Radionuclides in Mono Lake, California,
W82-05461 5B

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 5B

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 5B

Elevated Concentrations of Actinides in Mono Lake,
W82-05520 5B

FATE OF POLLUTENTS

Random Differential Equations in River Water Quality Modeling,
W82-05343 6A

FEASIBILITY STUDIES

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

FEDERAL JURISDICTION

A Federal Perspective on River Basin Management,
W82-05388 6E

The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 6E

FEEDLOT RUNOFF

Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 5B

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 5B

FEEDS

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 5D

FEEDWATER TREATMENT

Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 5F

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 3A

FERMENTATION

Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

FERTILIZERS

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 2I

Irrigation Efficiency in Orchards,
W82-05768 3F

FIELD TESTS

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 5C

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 3A

FILTER MEDIA

Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 5D

Role of Surface Active Media in Anaerobic Filters,
W82-05816 5D

FILTER PERFORMANCE

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 5D

FILTRATION

Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 5F

Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 5D

On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012 5A

Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 5D

Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 5D

Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 5D

Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 5D

FINANCIAL FEASIBILITY

Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

FINANCING

Turks Press Forward With Ambitious Dam Programme,
W82-05758 6B

FINITE DIFFERENCE METHODS

A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 8B

FINITE ELEMENT METHOD

An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-03652 2F

FINLAND

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 2K

FISH

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 5B

Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 5A

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C

Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 5C

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 5C

Metabolic Response of Fish to Stress,
W82-05159 5C

Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 5C

The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 4A

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 5C

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 5C

Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 5C

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 5B

FISH BEHAVIOR
Metabolic Response of Fish to Stress,
W82-05159 5C

FISH FARMING
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 5D

The Impact of Fish Farming on Water Quality,
W82-05471 5B

FISH FOOD ORGANISMS
Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 2H

FISH GUIDING
Engineering Aspects of Fish Protection at Water Intakes,
W82-04759 8I

FISH POPULATIONS
Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 5C

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507 5C

Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 5C

Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 5C

FISHERIES
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 8I

Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 4A

FIVE-YEAR PLAN
Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 6B

FLOATING ICE
A Mechanism for the formation of Large Icebergs,
W82-04798 2C

Velocity Distributions Under Floating Covers,
W82-05562 2E

FLOCCULATION
New Flocculation Units with High Efficiency,
W82-04840 5D

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 2H

FLOOD CONTROL
New Methods of Designing Flood Control Measures,
W82-05030 2E

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A

Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 4A

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 6E

Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 4A

Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 6A

FLOOD DAMAGE
The Overtopping of the Palagnedra Dam,
W82-04952 8A

Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 2E

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 2E

FLOOD DATA
Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 2E

FLOOD DISCHARGE
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 2E

FLOOD FORECASTING
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 2A

FLOOD FREQUENCY
Investigations of Catastrophic Maximum Discharges of the Araks River,
W82-05591 2E

FLOOD HYDROGRAPHS
An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05099 2A

FLOOD INSURANCE
Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 4A

FLOOD PEAK
Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 2E

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 2E

Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 2A

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 4C

FLOOD PEAKS

Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 2A

FLOOD PLAIN MANAGEMENT

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 4A

FLOOD PLAINS

A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 2D

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

Water Resources in the Legislative Balance, 1982,
W82-05433 6E

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 4C

Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 7C

FLOOD PROFILES

Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 4A

FLOODS

A New Method of Cubature Using Spline Functions,
W82-05189 2L

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 2E

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 2E

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 2E

FLOODS FREQUENCY

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

FLOODWATER

Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 2E

FLORIDA

Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 2H

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 7C

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 4A

Aquifer Management in Dade County,
W82-05784 5G

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 2F

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 7C

FLOTATION

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05250 5D

Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 3A

Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

FLOW

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

FLOW CHARACTERISTICS

Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 8B

Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 8B

The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 8B

The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 2E

FLOW CONTROL

Water Hammer,
W82-05432 8C

FLOW DISCHARGE

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 2E

FLOW MEASUREMENT

Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 5D

On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 2J

FLOW PATTERN

Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 5D

FLOW PROFILE

Contaminant Dispersion in Oscillatory Flows,
W82-05631 5B

FLOW PROFILES

Circular Wall Jets in Coflowing Streams,
W82-04999 5B

Dispersion in Tumbling Flow,
W82-05796 8B

Flow Under Weir on Scoured Bed,
W82-05800 8B

FLOW RATES

Estimating Water Flow Under Gates,
W82-05514 8B

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 7C

FLOW RESISTANCE

Resistance of Beauharnois Canal in Winter,
W82-04998 2C

Flow Resistance in Wide Rectangular Channels,
W82-05798 8B

FLOW VELOCITY

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 5D

Circular Wall Jets in Coflowing Streams,
W82-04999 5B

Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 2E

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 8A

Formation of a Stable Canal Channel,
W82-05584 8B

Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 4C

FLUCTUATIONS
Bed Load Fluctuation: Applications, 2J
W82-05000

FLUID MECHANICS
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling, 8B
W82-04755

The Rotating Hydraulics of the Open-Channel Flow Between Two Basins, 8B
W82-05083

A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water, 2C
W82-05084

Steady Shallow Flow Over a Spillway, 8B
W82-05086

Finite-Amplitude Stability of Axisymmetric Pipe Flow, 8B
W82-05087

Several Plume Flows in Pure and Saline Water at Its Density Extremum, 2E
W82-05088

A Note on the Structure of the Head of an Intrusive Gravity Current, 2E
W82-05089

Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect), 8B
W82-05280

FLUORESCENCE
Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary, 2L
W82-04752

Fluorescence Cell Design and Use to Determine Crude Oil in Water, 5A
W82-05358

Use of Algal Fluorescence for an Automated Biological Monitoring System, 5A
W82-05728

FLUORIDES
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System, 5A
W82-05359

Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka, 5C
W82-05463

FLUSHING MEADOWS PROJECT
Rapid-Infiltration Research at Flushing Meadows Project, Arizona, 5D
W82-05334

FOAM SEPARATION
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis, 3A
W82-05290

FOAMING
Start-Up Problems of Sludge Dewatering Facility, 5D
W82-05444

FOOD CHAINS
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977, 2H
W82-05074

FORAGES
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions, 3C
W82-05265

FORECASTING
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin, 6D
W82-04805

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977, 2E
W82-05082

FOREST FIRES
Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska, 4C
W82-05715

FOREST HYDROLOGY
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration, 4C
W82-05647

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains, 2J
W82-05867

FOREST MANAGEMENT
Seasonal Stream Temperature Changes Following Forest Harvesting, 4C
W82-04870

Forest Management for Increased Water Yield--How Useful in Southern Alberta, 3B
W82-05760

FOREST SOILS
How Much Sewage Nitrogen on Forest Soils. A Case History, 5E
W82-05371

FOREST WATERSHEDS
Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests, 5C
W82-04872

Impact of Hexazinone on Invertebrates After Application to Forested Watersheds, 5C
W82-05206

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway, 2K
W82-05288

FOULING
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units, 5D
W82-05405

FOUNDATION FAILURE
$12.6 M Repairs Bill for Ruahihi Canal. 8D
W82-05880

FOUNDATION ROCKS
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station, 8H
W82-05585

FRANCE
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille), 5F
W82-04766

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite), 5F
W82-05367

Generating Power from Compensating Flow. 8C
W82-05624

FRASER RIVER
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary, 5A
W82-05384

The Uncertain Quest for a Management Strategy in the Fraser Estuary, 6F
W82-05392

FRAZIL ICE
Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River, 2C
W82-05736

FREEZING
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring, 2G
W82-05043

FREQUENCY ANALYSIS
Revised Rainfall Frequency Analysis for Houston, 2B
W82-05863

FROUDE NUMBER
Erosion by Submerged Circular Jets, 2J
W82-05002

Thermal Front Formation from Buoyant Surface Jets, 5C
W82-05004

FROZEN GROUND
Configuration of Ice in Frozen Media, 2C
W82-05615

FULLY PENETRATING WELLS
Cavity Well, 8A
W82-04920

FULVIC ACIDS
Effects of Salts on Activated Carbon Adsorption of Fulvic Acids, 5F
W82-05667

FUNGI
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration, 5D
W82-05497

FURROW DRAINAGE
Advance and Runoff-Surge Flow Furrow Irrigation, 3F
W82-05690

GALVANIZED STEEL
Galvanized Steel Stalls Treatment Plant Corrosion, 8G
W82-05167

GAMMA RADIATION
Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry, 2C
W82-05643

GAS CHROMATOGRAPHY
Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives, 5A
W82-04816

Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography, 5A
W82-04916

Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System, 5A
W82-05359

GAS CHROMATOGRPHY
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography, 5A
W82-05164

GASTROPODS
Rare and Endangered Species: Freshwater Gastropods of Southern New England, 5C
W82-04968

GATES
Estimating Water Flow Under Gates,
W82-05514 8B

GEOCHEMISTRY
The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 2K

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 5D

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 4B

The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801 2K

GEOHYDROLOGIC UNITS
Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

Littletown Quadrangle: Hydrogeology
W82-04984 7C

GEOHYDROLOGY
Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 5G

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 5B

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 2F

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 2F

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

GEOKCHAI RIVER
Calculation of Large Unlined Canals,
W82-05131 8B

GEOLOGIC FISSURES
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

GEOLOGIC FORMATIONS
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

GEOLOGICAL SURVEYS
Site Investigation and Materials Save Money on Sallente.
W82-05878 8A

GEOMORPHOLOGY
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 2A

GEOPHYSICS
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

GEORGIA
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 5C

GEOTHERMAL POWER
Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 5B

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

GEOTHERMAL RESOURCES
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

GEOTHERMAL STUDIES
A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 2F

Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 2F

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 2K

GERMAN BIGHT
The Tidal Stream in the German Bight,
W82-05190 2L

GERMANY
Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 5E

Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 2H

Disposing of Sewage Sludge at Sea,
W82-05127 5E

Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 5D

Northern Elbe Culvert,
W82-05427 8B

GETTYSBURG FORMATION
Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

GILA RIVER BASIN
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

GLACIAL AQUIFERS
Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

GLACIAL LAKES
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

GLACIERS
Glaciers and Their Fluctuations,
W82-04777 2C

GLATT RIVER
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

GRAIN CROPS
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

GRAPHICAL ANALYSIS
Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 8C

GRAVEL
Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 2E

Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 2J

GRAVITY DAMS
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 8A

GRAVITY FLOW
Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 2F

GRAVITY STUDIES
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 2E

GRAZING
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

GREASE
Oil and Grease in Stormwater Runoff,
W82-05557 5C

GREAT BRITAIN
The Search for Reservoir Sites in an Urban Environment,
W82-04867 8A

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 5B

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 5B

GREAT LAKES
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 5G

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 2H

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B

GREAT LAKES TRIBUTARIES
Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 5B

GREAT MARSH
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

GREAT MAZURIAN LAKES
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 2H

GREAT SALT LAKE DESERT
Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

GREAT SMOKY MOUNTAINS NATIONAL PARK
Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 5C

GREAT STAVROPOL CANAL
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 8G

GREEN RIVER
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 5C

GREEN RIVER BASIN
Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 2E

GROUNDWATER
Groundwater Monitoring,
W82-04809 6E

Potable Water Production in Holland,
W82-04851 5F

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 2K

Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 7C

Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 2F

Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 7C

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 2F

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79,
W82-04987 7C

Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 5B

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 7C

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

The Status of Groundwater Law in New York State,
W82-05400 6E

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 5B

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 2K

Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
W82-05799 5B

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 7C

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 7C

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 7C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 2F

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 7C

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 7C

GROUNDWATER AVAILABILITY

Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

Industry Helps Conserve Municipal Water,
W82-05674 3E

GROUNDWATER BARRIERS

Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 8E

GROUNDWATER BASINS

Ground-Water Management in Basalts,
W82-04931 4B

GROUNDWATER DEPLETION

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

GROUNDWATER LEVEL

Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 2G

Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 8C

GROUNDWATER MANAGEMENT

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 5D

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 4B

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 4B

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

Ground-Water Management in Basalts,
W82-04931 4B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 4B

The Status of Groundwater Law in New York State,
W82-05400 6E

Five Year Water Resources Research Plan for the State of California,
W82-05532 6B

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 4B

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 4B

GROUNDWATER MINING

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 4B

How Proper Prospecting Improves the Odds,
W82-05757 3B

The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 4B

The Physical Environment of the Colorado River Basin,
W82-05891 6D

GROUNDWATER MOVEMENT

A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 2F

Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 2F

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 2F

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 2F

GROUNDWATER POLLUTION

Groundwater Monitoring,
W82-04809 6E

The Occurrence of Flow Channels in Soils,
W82-04875 3C

The New Pollution--Groundwater Contamination,
W82-04938 5C

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 5B

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 5G

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 5A

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 5B

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 5G

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 5B

GROUNDWATER RECHARGE

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 5D

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 4B

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 4B

GROUNDWATER STORAGE

Ground-Water Management in Basalts,
W82-04931 4B

GROUTING

Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 8E

GROWTH RATES

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 5C

GROWTH STAGES

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

GUAM

Metal Concentrations in Guam Urban Runoff,
W82-05302 5B

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 5C

Water Quality Assessment for Agana Springs,
W82-05304 5A

GUAM

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

HABITATS
Wetlands and Deepwater Habitats: A New Classification,
W82-05716 2L

HALIFAC
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

HALOGENATED PESTICIDES
Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

HALOGENS
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

HAMBURG
Northern Elbe Culvert,
W82-05427 8B

HAMMER CREEK FORMATION
Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

HAWAII
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 7C

HAZARDOUS MATERIALS
Weak Controls from Sea to Shining Sea,
W82-05035 5B

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 5G

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 5G

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 5G

Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 5A

Microbial Removal of Hazardous Organic Compounds,
W82-05177 5D

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A

HAZARDS
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

Safety Considerations in Handling Activated Carbon,
W82-05442 5D

HEAT BUDGET
Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 2C

HEAT EXCHANGERS
An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 8B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 8B

HEAT FLOW
Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 5D

HEAT TRANSFER
A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 2F

Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 2H

An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 8B

Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 5D

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 8B

HEAT TREATMENT
Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 5E

HEAVY METALS
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 5A

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 5C

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 5B

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 5D

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 5A

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 5B

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 5D

Metal Concentrations in Guam Urban Runoff,
W82-05302 5B

Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 5C

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 5D

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 2K

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 5B

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 5C

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 5B

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 5B

HERBICIDES
Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 5C

Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 5A

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 5B

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 5C

HERSEY RIVER
Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 5B

HEXACHLOROBENZENE
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 5B

HIGHWAY EFFECTS
Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 5C

HISTORIC FLOODS
Investigations of Catastrophic Maximum Discharges of the Araks River,
W82-05591 2E

HISTORY
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 5C

The Continuing Struggle of Waterborne Illness,
W82-05366 5C

Safety of Dams Judged from Failures,
W82-05512 8A

HUMAN DISEASES
Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 5C

HUMIC ACIDS
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 2K

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

HUMIDITY
Humidity Measurement by Infrared Thermometry,
W82-05611 7B

HUSTON
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

HYDRATION
Ion Hydration and Ion Interaction,
W82-05310 2K

HYDRAULIC CAPACITY
Sludge Management in the Rocky Mountain State,
W82-05165 5E

HYDRAULIC ENGINEERING
Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 8B

Erosion by Plane Turbulent Jets,
W82-05277 8B

HYDRAULIC FILL
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 8D

Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 8A

HYDRAULIC JUMP
An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279 8B

HYDRAULIC MACHINERY
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 8C

HYDRAULIC MODELS
Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 8B

HYDRAULIC PROPERTIES
Calculation of Large Unlined Canals,
W82-05131 8B

HYDRAULIC STRUCTURES
Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116 8E

Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 8D

Driving Large Hydraulic Tunnels by the Stepped Face Method,
W82-05586 8H

Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 8A

HYDRAULIC TURBINES
Turbines for Itaipu,
W82-04955 8C

HYDRAULICS
The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 8B

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 4B

HYDROCARBONS
Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 5B

Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 5B

Volatile Constituents of the Produced Water Effluent from the Buccaneer Gas and Oil Field,
W82-05874 5A

HYDRODYNAMICS
Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 8D

HYDROELECTRIC PLANTS
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 6D

Resonance in Hydropower Stations,
W82-04953 8C

Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 6B

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 8C

Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 8A

Generating Power from Compensating Flow.
W82-05624 8C

Site Investigation and Materials Save Money on Sallente.
W82-05878 8A

HYDROELECTRIC POWER
Computer-Aided Evaluation of Peru's Hydropower,
W82-05515 6A

Generating Power from Compensating Flow.
W82-05624 8C

Corobici Completion Ensures Costa Rica's Power Output.
W82-05755 8C

Hydro Powers Mindanao Development Plans,
W82-05881 8A

HYDROGEN ION CONCENTRATION
Acid Precipitation. 1. Causes and Consequences,
W82-04771 5C

Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 2H

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 2H

Acid Precipitation in the Washington Cascades,
W82-05287 5B

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 5D

HYDROGEN SULFIDE
Sulfur Bacterial Problems Revisted,
W82-05264 5B

HYDROGEOLOGY
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 4B

HYDROLOGIC ASPECTS
The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 3B

HYDROLOGIC BUDGET
Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 7C

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 2A

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

HYDROLOGIC DATA
Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 7C

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79.
W82-04987 7C

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 2A

Normality of Hydrological Data,
W82-05752 7B

On Hydrological Data Needs in Canada,
W82-05764 7B

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 7C

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 4A

HYDROLOGIC MODELS
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 2A

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 2F

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

HYDROLOGICAL REGIME
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 2E

HYDROLOGY
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

HYPANIA
Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 2H

HYPOLIMNION
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

ICE
A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 2C

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 2C

ICE BREAKUUP
A Mechanism for the formation of Large Icebergs,
W82-04798 2C

ICE COVER
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 2E

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 5B

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 2C

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 5B

ICE FORMATION
Resistance of Beauharnois Canal in Winter,
W82-04998 2C

Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

Configuration of Ice in Frozen Media,
W82-05615 2C

Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 2C

ICEBERGS
Icebergs: Technology for the Future,
W82-04778 2C

A Mechanism for the formation of Large Icebergs,
W82-04798 2C

Fresh-Water Transport by Sea,
W82-04861 6D

IDAHO
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 3F

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

IDAHO NATIONAL ENGINEERING LABORATORY
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

ILLINOIS
Land Disposal of Sludge,
W82-04757 5E

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

Illinois Wetlands: Their Value and Management,
W82-05053 6G

Impact of American Regulations on Industrial Sludge Management,
W82-05184 6E

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

IMPAIRED WATER USE
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 3C

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

IMPERIAL VALLEY
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 6E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

IMPERVIOUS SOILS
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

IMPOUNDMENTS
Do Model for Discharges from Deep Impoundments,
W82-05316 2H

INDIA
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 2A

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

India: Every River Polluted, and Few Effective Controls,
W82-05033 5B

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 2I

Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120
2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121
2D

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122
2I

An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357
6B

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721
5A

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722
2D

INDIANA

Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811
5B

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815
5G

INDICATORS

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763
5A

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04816
5A

Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923
5A

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237
5A

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384
5A

Indicator Bacteria Survival under Laboratory Conditions,
W82-05853
5A

INDUSTRIAL DEVELOPMENT

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027
2A

Hydro Powers Mindanao Development Plans,
W82-05881
8A

INDUSTRIAL WASTES

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843
5D

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845
5A

Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895
5C

Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011
5D

Treating Phenol Resin Plant Wastes,
W82-05128
5D

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130
5D

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144
5B

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151
5A

Impact of American Regulations on Industrial Sludge Management,
W82-05184
6E

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195
5B

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224
5B

Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255
5A

An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606
5B

INDUSTRIAL WASTEWATER

Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780
5C

Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787
5D

Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815
5A

Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833
5D

Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903
5D

Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904
5D

Shale Oil Wastewater Treatment by Evaporation,
W82-04905
5D

Designing Wastewater Treatment Systems to Save Energy,
W82-04906
5D

Anaerobic Treatment of High-Strength Wastes,
W82-04907
5D

Biodegradation of Hazardous Organic Pollutants,
W82-04910
5B

Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041
5A

Single Sludge Nitrogen Removal from Industrial Wastewater,
W82-05245
5D

Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271
5D

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295
5D

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348
5D

Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372
5D

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443
5E

Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473
5D

INDUSTRIAL WATER

Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183
5F

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543
3A

Industry Helps Conserve Municipal Water,
W82-05674
3E

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846
2F

INFILTRATION

Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858
2G

Infiltration Inflow Analysis: Finding the Source,
W82-05038
5B

An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073
2G

Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317
5D

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334
5D

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657
4B

INFILTRATION CAPACITY

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300
2G

INFILTRATION RATE
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

INFILTRATION WATER
Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 5B

INFLUENT WATER
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

INFORMATION SYSTEMS
A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 7B

INHIBITION
Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 5D

Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 5C

INJECTION
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

INJECTION WELLS
Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

INPUT-OUTPUT ANALYSIS
Water Reuse Planning by Means of an Input-Output Table,
W82-04794 6A

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

INSECTICIDES
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 5B

INSECTICIDES *ENDOSULFAN
Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 5C

INSTITUTIONAL CONSTRAINTS
Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 6F

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 6B

INSTREAM AERATION
Oxygenation of the Avon River,
W82-05730 5G

INSTREAM FLOW
Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 6E

INTAKE GATES
Prediction of Water Level in Tidal Inlet,
W82-05005 4A

INTAKES
Engineering Aspects of Fish Protection at Water Intakes,
W82-04759 8I

Shaft Spillways Combined with a Water Intake,
W82-05111 8A

Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 5C

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 3F

INTERNATIONAL AGREEMENTS
International Problems on the Colorado River,
W82-05892 5G

INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE
Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 6B

INTERSTITIAL WATERS
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 7B

INVERTEBRATES
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C

Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

ION EXCHANGE
The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 5A

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

Research on Piezodialysis - Sixth Report,
W82-05294 3A

Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 2K

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

ION TRANSPORT
Ion Hydration and Ion Interaction,
W82-05310 2K

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 2K

Water and Salt Transport in Membranes,
W82-05537 3A

IONS
Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 2K

IRAQ
Wastewater from a Sugar Refining Industry,
W82-05337 5D

IRON
A Pipeline for all Environments,
W82-04764 8G

Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 7B

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801 2K

IRON OXIDES
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-FeOOH) in Freshwaters,
W82-05140 2K

IRRIGATION
Conservation Ethics for the 1980's,
W82-05009 3D

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 2D

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 2I

An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 6B

Rice Reigns Supreme as Indonesia Builds Up the Sawahs,
W82-05502 3B

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 2G

Conflict Over Water Sources Predicted by Global Study.
W82-05879 6B

IRRIGATION DESIGN
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 3F

IRRIGATION DISTRICTS
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 6E

IRRIGATION EFFECTS
The Wellton-Mohwak Dilemma,
W82-05883
3F

International Problems on the Colorado River,
W82-05892
5G

Salinity Control Measures for Grand Valley,
W82-05894
3F

IRRIGATION EFFICIENCY
Lateral Move Irrigation Offers Advantages for Rectangular Fields.
W82-05080
3F

Cutting Irrigation Costs,
W82-05081
3F

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308
3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312
3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313
3F

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558
6C

Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690
3F

Managing Salinity in Irrigated Agriculture,
W82-05691
3C

New Evapotranspiration Crop Coefficients,
W82-05692
3F

Irrigation Efficiency in Orchards,
W82-05768
3F

The Wellton-Mohwak Dilemma,
W82-05883
3F

Future Water Development Policies,
W82-05884
5G

Salinity Control Measures for Grand Valley,
W82-05894
3F

IRRIGATION ENGINEERING
Lateral Move Irrigation Offers Advantages for Rectangular Fields.
W82-05080
3F

Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617
8A

IRRIGATION PRACTICES
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959
3F

Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153
3C

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293
3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313
3F

The Colorado River Salinity Problem,
W82-05889
5G

Development Issues in the Colorado River Basin,
W82-05890
6D

IRRIGATION PRACTICES SOIL WATER POTENTIAL
Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539
3F

IRRIGATION PROGRAMS
Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962
6C

IRRIGATION REQUIREMENTS
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922
4B

Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120
2I

Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690
3F

New Evapotranspiration Crop Coefficients,
W82-05692
3F

IRRIGATION-RETURNFLOW
Salinity Control Measures for Grand Valley,
W82-05894
3F

IRRIGATION WATER
Fecal Coliform Densities in a Western Watershed,
W82-05618
5B

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721
5A

IRRIGATION WELLS
Cavity Well,
W82-04920
8A

The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548
3B

ISLE AUX MORTS
Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414
2K

ISOTHERMS
Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338
5D

Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680
5F

ISOTOPE STUDIES
Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644
2F

Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648
2D

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759
2G

ISRAEL
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074
2H

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355
5D

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373
5D

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421
6D

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644
2F

IVAN'KOVO RESERVOIR
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330
5C

JAMAICA BAY
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188
6A

JAPAN
Prediction of Water Level in Tidal Inlet,
W82-05005
4A

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244
5D

Seawater Ro Heads Japan's Water Reuse Research.
W82-05756
3A

JEFFERSON COUNTY
Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986
2F

JETS
Circular Wall Jets in Coflowing Streams,
W82-04999
5B

Erosion by Submerged Circular Jets,
W82-05002
2J

Thermal Front Formation from Buoyant Surface Jets,
W82-05004
5C

Erosion by Plane Turbulent Jets,
W82-05277
8B

An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279
8B

JUDICIAL DECISIONS
Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603
6E

KANSAS
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921
4B

KARA-BOGAZ-GOL GULF
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114
8A

KARST
Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

KENTON COUNTY
A Spatial Costing System for Drinking Water,
W82-04796 6C

KENTUCKY
A Spatial Costing System for Drinking Water,
W82-04796 6C

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 2E

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

KENYA
Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 2H

KETONES
Volatilization of Ketones From Water,
W82-05782 5C

KICKAPOO RIVER
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 2E

KIEV RESERVOIR
Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 2H

KINEMATIC WAVE THEORY
Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 4A

KINEMATIC WAVES
Nature of Wave Attenuation in Open Channel Flow,
W82-05003 2E

KINETICS
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 5C

Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 5D

Kinetics of Biofilm Nitrification,
W82-05374 5D

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 5D

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 5D

KJELDAHL PROCEDURE
Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 5D

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems.
W82-05437 5A

KREMENCHUG RESERVOIR
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

LABORATORY EQUIPMENT
Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 5A

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems.
W82-05437 5A

LABORATORY STUDIES
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 5C

LAGOONS
Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 5D

LAKE ALENASHALAN
On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012 5A

LAKE APOPKA
Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

LAKE CLASSIFICATION
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 2H

LAKE CONSTANCE
Determination of Recent Despoition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 5B

LAKE COUNTY
Land Disposal of Sludge,
W82-04757 5E

LAKE ERIE
Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 2J

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 2H

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 5C

Stability Effects on Great Lakes Evaporation,
W82-05634 2D

Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 5C

LAKE ERIE BASIN
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D

LAKE EVAPORATION
Stability Effects on Great Lakes Evaporation,
W82-05634 2D

LAKE HOUSTON
Urban Impacts of Water Supply Reservoir,
W82-05318 5G

LAKE HURON
Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 5C

LAKE JACKSON
Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 7C

LAKE KARIBA
The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 2H

LAKE KINNERET
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 2H

LAKE MALINOVOYE
Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 2H

LAKE MICHIGAN
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 5A

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 5B

LAKE MJOSA
The Rehabilitation of Norway's Largest Lake,
W82-05243 5G

LAKE MORPHOMETRY
Hydrologic Description of Lake Jackson, Sebring, Florida.
W82-04975 7C

LAKE ONTARIO
Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 2H

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

LAKE PAIJANNE
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

LAKE PONTCHARTRAIN
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

LAKE RESTORATION
The Rehabilitation of Norway's Largest Lake,
W82-05243 5G

Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 5G

LAKE SEDIMENTS
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 2H

Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 2K

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 2H

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 2H

Radionuclides in Mono Lake, California,
W82-05461 5B

Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 2J

Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 5B

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 5C

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 5B

LAKE SHORES
Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 5B

LAKE ST CLAIR
Stability Effects on Great Lakes Evaporation,
W82-05634 2D

LAKE SUPERIOR
Stability Effects on Great Lakes Evaporation,
W82-05634 2D

LAKES
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 2H

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 2H

An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 2H

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 7C

Prediction of Water Level in Tidal Inlet,
W82-05005 4A

Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 2H

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 5B

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 2H

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 2H

Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 2H

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 2H

Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 2H

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 2H

Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 2H

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 5G

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 5B

Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 5D

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 5B

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 2H

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 2H

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B

The Importance of Lacustrine Zooplankton to the Feeding Capacity of the Lizhma Lake-River System (Basin of Lake Onega),
W82-05508 2H

Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 5B

Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C

Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578 5B

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 2H

Stability Effects on Great Lakes Evaporation,
W82-05634 2D

Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 5G

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 5C

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 5G

Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 2H

LAND ACQUISITION
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

LAND APPLICATION
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 5D

How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 5E

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 5D

LAND APPLICATION

Land Application of Secondary Effluent at Lake George, NY, 5D
W82-05704

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater, 5B
W82-05810

LAND CLEARING

The Effects of Land-Clearing on a Small Watershed in Southern Guam, 5C
W82-05303

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington, 5C
W82-05306

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem, 5C
W82-05538

LAND DISPOSAL

Land Disposal of Sludge, 5E
W82-04757

Casein Whey Wastewater Effects on Soil Permeability, 3C
W82-04874

Leachate Collection Design for Containment Landfills, 5E
W82-04996

Revegetating Strip-Mined Land with Municipal Sewage Sludge, 5E
W82-05065

Industrial Waste Pretreatment and EPA Cadmium Limitations, 5E
W82-05443

Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater, 5D
W82-05706

LAND MANAGEMENT

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management, 4B
W82-05278

A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics, 2E
W82-05646

LAND RECLAMATION

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico, 2J
W82-05223

LAND TENURE

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California, 6E
W82-04802

LAND USE

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska, 5G
W82-04981

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use, 5B
W82-05143

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana, 4A
W82-05530

Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968, 6E
W82-05366

Preliminary Model of an Urban Floodplain Under Changing Land Use, 4C
W82-05642

Aquifer Management in Dade County, 5G
W82-05784

LANDFILLS

Land Disposal of Sludge, 5E
W82-04757

Decomposition of Chelates Leached from Waste Disposal Sites, 5B
W82-04879

Leachate Collection Design for Containment Landfills, 5E
W82-04996

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric, 5E
W82-05066

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills, 5B
W82-05075

Containment and Treatment of the Love Canal Landfill Leachate, 5D
W82-05250

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography, 5A
W82-05361

Dilution of Municipal Landfill Leachate, Franklin County, Indiana, 5B
W82-05811

Models of Landfill Leaching: Organic Strength, 5B
W82-05817

LANDSLIDES

Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir, 8B
W82-05211

LARVAE

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians, 5C
W82-05283

LATIN AMERICA

Water and Wastewater Treatment in Latin America--Applied Technology, 5F
W82-05425

LAUROX-9

Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna, 5C
W82-05328

LEACHATES

Decomposition of Chelates Leached from Waste Disposal Sites, 5B
W82-04879

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park, 5C
W82-04988

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells, 7B
W82-05051

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric, 5E
W82-05066

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills, 5B
W82-05075

An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee, 5B
W82-05203

Containment and Treatment of the Love Canal Landfill Leachate, 5D
W82-05250

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation, 5B
W82-05322

Changes to a Soil on Irrigation with a Sanitary Landfill Leachate, 5E
W82-05619

Dilution of Municipal Landfill Leachate, Franklin County, Indiana, 5B
W82-05811

Models of Landfill Leaching: Organic Strength, 5B
W82-05817

Models of Landfill Leaching: Moisture Flow and Inorganic Strength, 5B
W82-05818

LEACHING

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils, 5B
W82-04876

Leachate Collection Design for Containment Landfills, 5E
W82-04996

Heat Loss from Rapid Infiltration Basin in Winter, 5D
W82-05317

LEAD

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry, 5A
W82-05020

LEAD RADIOISOTOPES

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods, 5B
W82-05625

LEGAL ASPECTS

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California, 6E
W82-04802

Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law, 6E
W82-04803

Some Emerging Rights in Agricultural Land, 6E
W82-04890

Institutional Obstacles to Water Reuse in the Western United States, 6B
W82-04958

India: Every River Polluted, and Few Effective Controls, 5B
W82-05033

Weak Controls from Sea to Shining Sea, 5B
W82-05035

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977, 2E
W82-05082

Acid Rain: Legal and Political Fallout, 6E
W82-05147

Impact of American Regulations on Industrial Sludge Management, 6E
W82-05184

The Status of Groundwater Law in New York State,
W82-05400 6E

Institutional Change - Water Quality Management,
W82-05401 6E

The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 6E

Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603 6E

Stream Improvement: The Chicod Creek Episode,
W82-05717 4D

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 6E

The Safe Drinking Water Act on Review,
W82-05792 5G

LEGISLATION
Groundwater Monitoring,
W82-04809 6E

River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 6E

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 5B

LEICESTER
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 5D

LIFE HISTORY STUDIES
Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 5C

LIGHT PENETRATION
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

Effect of Water Turbulence on Illumination at Depth,
W82-05594 1A

LIMA
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

LIME
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

Piloting Mag-Carbonate Treatment,
W82-05794 5F

Liming Fish Ponds,
W82-05866 5G

LIMITING FACTORS
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 5C

LIMITING NUTRIENTS
The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 5C

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

LIMNOLOGY
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 2H

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 7C

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 2H

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 5C

LINEAR PROGRAMMING
Energy Siting in Utah: A Programming Model,
W82-05297 6B

LINEARITY
Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 4A

Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 4A

LINERS
Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 8G

LININGS
Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 8F

LIPIDS
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 5C

LIQUID WASTES
Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

LITERATURE REVIEW
Water Research in Action.
W82-05292 6B

LOAD DISTRIBUTION
Bearing Capacity of Sand Bases (Discussion of Construction Specifications).
W82-05583 8D

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 5B

LOAD FACTORS
Load Factors and Non-Destructive Testing of Clay Pipe,
W82-05700 8G

LOCAL GOVERNMENTS
River Basin Management in Ontario,
W82-05393 6E

LONG ISLAND
Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

LONG ISLAND SOUND
Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 2L

LOUGH NEAGH
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

Phosphorus Reduction Studies,
W82-05408 5D

LOUISIANA
Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 7C

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 2E

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 5C

LOVE CANAL
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 5D

LUMINESCENCE
Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 5A

LYCOMING COUNTY
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 2F

LYNCHBURG
Virginians Optimize Sludge Handling,
W82-05171 5D

LYSIMETERS
Evaporation at a High Arctic Site,
W82-04899 2D

MACKENZIE RIVER
The Mackenzie River Basin Study,
W82-05778 4A

MACROINVERTEBRATES
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 8I

MACROPHYTES
The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 5C

MAGNANESE
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 7B

MAGNESIUM CARBONATE
Piloting Mag-Carbonate Treatment,
W82-05794 5F

MAINE
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

MAINTENANCE
Sewage Pumping Station Split for Maintenance,
W82-05719 5D

MANAGEMENT PLANNING
Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 5C

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 5G

Protecting the Source,
W82-05785 5F

Billing Data Aids Utility Planning,
W82-05786 6C

MANITOBA
Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 4A

MANNINGS EQUATION
Resistance of Beauharnois Canal in Winter,
W82-04998 2C

MANURE
Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 2A

MAPS
Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 7C

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 7C

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 7B

Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-0582 7C

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 7C

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 7C

MARINE ANIMALS
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

MARINE SEDIMENTS
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 2L

Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 2K

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

MARKOV PROCESSES
Three-State Markov Model for Differential Persistence,
W82-05654 2E

MARROW POINT DAM
Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 8B

MARSEILLES
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 5F

MARSH MANAGEMENT
The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 2H

MARYLAND
Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 7C

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 2L

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

MASS SPECTROMETRY
GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 5A

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 5A

MASS TRANSFER
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

Volatilization of Ketones From Water,
W82-05782 5C

MASSACHUSETTS
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 5C

Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 7C

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 2F

MATERIALS ENGINEERING
A Pipeline for all Environments,
W82-04764 8G

MATHEMATICAL EQUATIONS
Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 8B

Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 8B

A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 8B

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 2E

Steady Shallow Flow Over a Spillway,
W82-05086 8B

Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 8B

Optimization Principle for Air and Water Movement,
W82-05172 2G

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 5D

Estimating Water Flow Under Gates,
W82-05514 8B

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 2E

Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797
8B

MATHEMATICAL MODELS
A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799
8B

Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838
5D

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844
5D

Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm,
W82-04864
2B

Leachate Collection Design for Containment Landfills,
W82-04996
5E

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055
5D

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188
6A

Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194
8I

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257
5F

Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524
6A

The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525
2E

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544
5B

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739
5C

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886
3C

MATHEMATICAL STUDIES
Circular Wall Jets in Coflowing Streams,
W82-04999
5B

Bed Load Fluctuation: Applications,
W82-05000
2J

Erosion by Submerged Circular Jets,
W82-05002
2J

Nature of Wave Attenuation in Open Channel Flow,
W82-05003
2E

Thermal Front Formation from Buoyant Surface Jets,
W82-05004
5C

Estimating Resilience by Canonical Analysis,
W82-05047
6A

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187
2H

A New Method of Cubature Using Spline Functions,
W82-05189
2L

The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523
6A

New Evapotranspiration Crop Coefficients,
W82-05692
3F

Optimum Depth and Spacing of Subsurface Drains,
W82-05693
8B

Erosivity Values for Individual Design Storms,
W82-05694
4D

MCNAUGHTON LAKE AREA
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196
8E

MEANDERS
Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085
2E

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651
2E

MEASUREMENT TECHNIQUES
A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477
5A

MEASURING INSTRUMENTS
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897
2B

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014
5A

Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015
7B

A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105
7B

Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176
7B

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248
7B

A Field Technique to Directly Measure River Bank Erosion,
W82-05410
7B

Recording Raingage Modifications,
W82-05665
7B

How Proper Prospecting Improves the Odds,
W82-05757
3B

On the Sampling Variance of Raingage Networks,
W82-05875
7B

MECHNICAL ENGINEERING
Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309
3A

MEDITERRANEAN SEA
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050
2A

MEEWASIN VALLEY AUTHORITY
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386
6E

MEMBRANE PROCESSES
Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284
5D

Water and Salt Transport in Membranes,
W82-05537
3A

Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660
3A

MEMBRANES
Research on Piezodialysis - Sixth Report,
W82-05294
3A

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314
3A

Water and Salt Transport in Membranes,
W82-05537
3A

Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660
3A

MERAMEC PARK LAKE
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201
8E

MERCURY
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819
5A

Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094
5B

METABOLISM
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074
2H

Metabolic Response of Fish to Stress,
W82-05159
5C

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406
5C

METAL COMPLEXES
Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136
2K

METAL-FINISHING WASTES
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259
5D

METALS
Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139
2H

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141
5A

METALS

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 5A

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

Procedure for Investigating Metallic Ion Complexing in Natural Waters,
W82-05595 5A

Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 5B

METHANE

Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 2K

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 2L

Methane in Water Wells,
W82-05262 5F

METHOXYCHLOR

Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 5B

METHYL CHLOROFORM

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

METHYLMERCURY

Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 5B

METROPOLITAN WATER MANAGEMENT

Domestic Water Conservation Research Plan,
W82-05547 6B

Water Management in the Metropolitan Toronto Region,
W82-05775 6B

MEXICO

Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 6C

MEXICO (YUCATAN PENINSULA)

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05630 4B

MICHIGAN

A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 5G

Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H

Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 5B

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 5B

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 5D

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 6B

MICROBIAL DEGRADATION

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 5B

MICROBIAL TREATMENT

Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 5G

MICROBIOLOGICAL STUDIES

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 5C

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

MICROORGANISMS

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 5B

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

MILWAUKEE

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 5D

MINE DRAINAGE

Acid Pond Drainage,
W82-05199 5G

MINE WASTES

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 8I

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 5B

MINERALS

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1B

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

MIRROW LAKE

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

MISSISSIPPI

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 2E

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 5B

MISSISSIPPI RIVER DELTA

The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 2J

MISSOURI

Acid Pond Drainage,
W82-05199 5G

Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 8E

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 3D

MIXED LIQUOR SOLIDS

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 5C

MIXING

Circular Wall Jets in Coflowing Streams,
W82-04999 5B

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

MMBRANE PROCESSES

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

MODEL STUDIES

Modeling: How and When to Use,
W82-04754 2L

Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 5F

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

Evaporation at a High Arctic Site,
W82-04899 2D

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 4B

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

Ground-Water Management in Basalts,
W82-04931 4B

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y., W82-04956 4B

Prediction of Water Level in Tidal Inlet, W82-05005 4A

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes, W82-05018 5B

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory, W82-05027 2A

A Screening Model to Quantify Resilience, W82-05044 6A

Estimates of Resilience Indices by Simulation, W82-05046 6A

Estimating Resilience by Canonical Analysis, W82-05047 6A

Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model, W82-05048 2H

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports. W82-05067 2D

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems, W82-05072 6A

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills, W82-05075 5B

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers, W82-05079 5B

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River, W82-05186 2E

Hydraulic Model Studies of Landalide-Generated Water Waves-Morrow Point Reservoir, W82-05211 8B

Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers, W82-05269 5D

Energy Siting in Utah: A Programming Model, W82-05297 6B

A Stochastic Model of Soil Erosion, W82-05298 2J

Do Model for Discharges from Deep Impoundments, W82-05316 2H

Dynamic Estuary Model Performance, W82-05319 2L

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor, W82-05335 5D

Random Differential Equations in River Water Quality Modeling, W82-05343 6A

State-of-the-Art of Modeling Surface Water Impoundments, W82-05351 2H

Some Perspectives in the Modelling of Biological Treatment of Wastewaters, W82-05430 5D

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models, W82-05545 2F

Classification and Management of Wetlands in the Western Kentucky Coal Field, W82-05549 5C

Evaluation of Snowmelt Forecasting Methods, W82-05552 4A

Soil Water Availability, W82-05623 2G

Issues in Simulation Model Design--A Case Study, W82-05627 4A

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977, W82-05638 5B

Managing Salinity in Irrigated Agriculture, W82-05691 3C

New Evapotranspiration Crop Coefficients, W82-05692 3F

Models of Landfill Leaching: Moisture Flow and Inorganic Strength, W82-05818 5B

Hydraulic Regime and Activated Sludge Performance, W82-05819 5D

Optimal Salinity Control Program for the Upper Colorado River Basin, W82-05893 5G

MODEL TESTING

Evaluation of Snowmelt Forecasting Methods, W82-05552 4A

MOISTURE METERS

Simplifying Neutron Moisture Meter Calibration, W82-05173 7B

MOISTURE PROFILES

Moisture Analysis from Radiosonde and Microwave Spectrometer Data, W82-04900 2B

MOLECULAR STRUCTURE

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2, W82-05055 5D

MONITORING

Apparatus Needs and Costs for Monitoring Priority Pollutants, W82-04779 5A

Groundwater Monitoring, W82-04809 6E

Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant, W82-04839 5E

Automatic Monitoring of Copper in Waste Water from Plating Shops, W82-04845 5A

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes, W82-04936 5B

Data Acquisition and Evaluation in Biological Monitoring Systems, W82-04944 5A

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979, W82-04976 7A

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices, W82-05013 5A

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry, W82-05019 5A

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure, W82-05023 5A

Biological Monitoring of Hazardous Wastes in Aquatic Systems, W82-05154 5A

Computer Interfaced Systems for Biological Monitoring of Water Quality, W82-05158 5A

Metabolic Response of Fish to Stress, W82-05159 5C

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water, W82-05161 5A

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants, W82-05163 5A

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho, W82-05233 5B

Sampling Frequency Optimization Using a Water Quality Index, W82-05268 5A

Techniques of Trend Analysis for Monthly Water Quality Data, W82-05344 7C

The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida, W82-05464 5A

A Pragmatic Approach to Water Quality Microbiology in a Clean River Area, W82-05575 5A

Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India, W82-05612 7C

MONTANA

Non-Indian Federal Reserved Water Rights, W82-04804 6E

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979, W82-05225 2E

MONTREAL

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace, W82-05397 5A

MOTZ

Generating Power from Compensating Flow. W82-05624 8C

MT ST HELENS
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

MULTIPLE FREQUENCY RESPONSE ANALYSIS
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

MULTIPURPOSE PROJECTS
Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 4A

MULTIPURPOSE RESERVOIRS
Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 6G

MUNICIPAL WASTES
Water Quality Assessment for Agana Springs,
W82-05304 5A

MUNICIPAL WASTEWATER
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 3C

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 5B

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 5D

Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 5D

The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476 5B

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 5D

Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 5D

MUNICIPAL WATER
The Real Price of Urban Water,
W82-04797 6C

Conservation Ethics for the 1980's,
W82-05009 3D

Crisis-Ridden Water Systems Should Go Private,
W82-05436 6C

MUTAGENS
The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 5A

Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 5A

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

Mutagens, Carcinogens and the Water Cycle,
W82-05468 5A

Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 5C

NATURAL WATERS
On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012 5A

The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 2A

NEBRAKA
Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 7C

NEBRASKA
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 4B

NETHERLANDS
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 2L

Potable Water Production in Holland.
W82-04851 5F

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 5A

NETWORKS
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 5F

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 7A

NEUTRALIZATION
Acid Pond Drainage,
W82-05199 5G

NEUTRON ACTIVATION ANALYSIS
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

NEVADA
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 6B

Nevada Water Resources Research 1982-1987,
W82-05533 6B

NEVADA TEST SITE
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 5B

NEW BRUNSWICK
River Basins and Water Management in New Brunswick,
W82-05391 6D

NEW ENGLAND
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 5C

NEW HAMPSHIRE
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

NEW JERSEY
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

NEW MEXICO
Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 6D

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 2J

NEW RIVER
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 5B

NEW SOUTH WALES
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

NEW YORK
Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 4B

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 6A

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 5D

Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 5A

Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 5D

The Status of Groundwater Law in New York State,
W82-05400 6E

Institutional Change - Water Quality Management,
W82-05401 6E

Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D

NEW YORK CITY
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

Water Supply for New York City in the 1980s,
W82-05671 6D

NEW ZEALAND
Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 4C

NEWFOUNDLAND
Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 2K

NEWTON CREEK WATER POLLUTION CONTROL PLANT
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

NIAGARA RIVER
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

NIGERIA
A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 2D

NITRATES
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

Biological Denitrification for Potable Water Treatment,
W82-05247 5F

Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 5B

Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 5B

NITRIFICATION
Biological Nitrification of Industrial Wastewater,
W82-05129 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 5D

Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 5D

Criteria for Nitrification in Fixed Film Reactors,
W82-05352 5D

Kinetics of Biofilm Nitrification,
W82-05374 5D

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 5D

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 5D

Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 5C

NITRILOTRIACETIC ACID
Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 5C

NITRITES
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 5A

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 5B

NITROGEN
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

Nitrogen Control at Three Related Plants,
W82-05434 5D

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems,
W82-05437 5A

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 3F

Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 3F

Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 5D

NITROGEN CYCLE
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 3C

NITROGEN DIOXIDE
Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 2K

NITROGEN REMOVAL
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 5D

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 5D

Single Sludge Nitrogen Removal from Industrial Wastewater,
W82-05245 5D

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 5D

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 5D

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 5D

NITROPHENOLS
Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 5A

NITROUS OXIDE
Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 5D

NIZHNEKAMSK
Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 2A

NON-POINT SOURCES
Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 5B

NONPOINT POLLUTION SOURCES
Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 2G

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

Agricultural Runoff and Water Pollution,
W82-05569 5B

NORTH CAROLINA
Wastewater Management in Coastal North Carolina,
W82-05559 5E

NORTHERN GREAT PLAINS
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

NORTHERN IRELAND
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

Phosphorus Reduction Studies,
W82-05408 5D

NORWAY
The Rehabilitation of Norway's Largest Lake,
W82-05243 5G

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 2K

NOVA SCOTIA
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

The Shubenacadie-Stewiacke River Basin Study,
W82-05385 6B

NOZZLES
Erosion by Submerged Circular Jets,
W82-05002 2J

NUCLEAR POWERPLANTS
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C

Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 5E

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 5B

NUCLEAR WASTES
The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 5B

NUCLEATION
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

NUMERICAL ANALYSIS
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 7B

NUREK RESERVOIR
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

NUTRIENT DYNAMICS
Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 5C

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 5C

NUTRIENT REMOVAL
Stream Transport of Nutrients Through a Wetland,
W82-04857 5B

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

NUTRIENT REQUIREMENTS
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

NUTRIENTS
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 2H

Stream Transport of Nutrients Through a Wetland,
W82-04857 5B

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 2H

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 2H

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

Urban Impacts of Water Supply Reservoir,
W82-05318 5G

Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 5G

Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 4C

A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 5B

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 2H

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 5B

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 5G

OBSERVATION WELLS
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

OBSERVATIONS
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

OCEAN CIRCULATION
The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 2A

OCEAN DUMPING
Disposing of Sewage Sludge at Sea,
W82-05127 5E

Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 5B

Wastewater Management in Coastal North Carolina,
W82-05559 5E

ODOR CONTROL
How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme.
W82-05249 5D

OFFICE OF WATER RESEARCH AND TECHNOLOGY
Water Research in Action.
W82-05292 6B

OGALLALA AQUIFER
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

OHIO
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

Water Use in Ohio, 1975,
W82-05226 6D

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

OIL
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 5A
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 5B

OIL INDUSTRY
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 5C
Shale Oil Wastewater Treatment by Evaporation,
W82-04905 5D
Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 5B

OIL POLLUTION
An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606 5B

OIL RECOVERY
Performance Testing of the Diperna Sweeper,
W82-05058 5G
Performance Testing of Four Skimming Systems,
W82-05059 5G
Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 5G

OIL REFINERIES
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 5D

OIL SHALE
Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law,
W82-04803 6E
Shale Oil Wastewater Treatment by Evaporation,
W82-04905 5D
Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 5A
Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 5C
Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 6D

OIL SHALE MINING
Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 5C

OIL SKIMMERS
Performance Testing of the Diperna Sweeper,
W82-05058 5G
Performance Testing of Four Skimming Systems,
W82-05059 5G

OIL SLICKS
Oil Slick Mechanics,
W82-05064 5G

OIL SPILLS
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 5C
Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 5G
Oil Slick Mechanics,
W82-05064 5G
Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 5G
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 5G

OIL WASTES
Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 5C

OIL-WATER INTERFACES
Oil Slick Mechanics,
W82-05064 5G

OILY WATER
Oil and Grease in Stormwater Runoff,
W82-05557 5C

OKLAHOMA
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B
Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute,
W82-05301 6B

ONONDAGA
Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 5A

ONTARIO
The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 5B
Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 5B
River Basin Management in Ontario,
W82-05393 6E
Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 2C

OPEN-CHANNEL FLOW
Resistance of Beauharnois Canal in Winter,
W82-04998 2C
Nature of Wave Attenuation in Open Channel Flow,
W82-05003 2E
The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 8B

OPEN CHANNELS
Circular Wall Jets in Coflowing Streams,
W82-04999 5B
On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 2J
The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 2E
Flow Resistance in Wide Rectangular Channels,
W82-05798 8B

OPEN WELLS
Bottom-Entry Large-Diameter Wells,
W82-04919 8A

OPERATING POLICIES
Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A
Modified Standard Operation Rules for Reservoirs,
W82-05658 4A

OPERATIONS RESEARCH
Operational Research Techniques in River Basin Management,
W82-05387 6A

OPTIMIZATION
Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 6A
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A
Modified Standard Operation Rules for Reservoirs,
W82-05658 4A
Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 2E
Algorithm for Optimal Activated Sludge Operation,
W82-05682 5D
An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 6A
Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 5G

OPTIMUM DEVELOPMENT PLANS
Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 2E
Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

ORCHARDS
Irrigation Efficiency in Orchards,
W82-05768 3F

OREGON
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 5C
Infiltration Inflow Analysis: Finding the Source,
W82-05038 5B
Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 2J

ORGANIC CARBON
Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 5F

ORGANIC CHEMICALS
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

ORGANIC COMPOUNDS
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 5A

Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

Biodegradation of Hazardous Organic Pollutants,
W82-04910 5B

Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

The New Pollution--Groundwater Contamination,
W82-04938 5C

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 5B

GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 5A

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 5G

Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 5A

Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 5D

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

Microbial Removal of Hazardous Organic Compounds,
W82-05177 5D

The use of Activated Carbon in Water Treatment,
W82-05182 5F

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 5D

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 5B

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 5D

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 5D

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 5A

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 5C

Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 5F

Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 5C

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 5F

Volatilization of Ketones From Water,
W82-05782 5C

ORGANIC LOADING
Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

Biofiltration Design Based on Volumetric Loading,
W82-05698 5D

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 5D

ORGANIC MATTER
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 5B

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 5B

The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-FeOOH) in Freshwaters,
W82-05140 2K

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 2H

Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 5E

ORGANIC PESTICIDES
Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

ORGANIC POLLUTION
Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 2H

ORGANOCHLORINE
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

ORGANOPHOSPHORUS PESTICIDES
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B

OSMOSIS
Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 3A

OTTAWA RIVER
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

OWLS HEAD TREATMENT PLANT
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D

OXIDATION
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 5F

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 5D

OXIDATION PONDS
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

OXYGEN
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 5F

Criteria for Nitrification in Fixed Film Reactors,
W82-05352 5D

Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 5D

OXYGEN DEMAND
Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 5A

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 5D

A Comparison of the Carbonaceous Oxygen Demands of a Domestic and Industrial Sewage,
W82-05467 5D

OXYGEN ISOTOPES

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation, W82-05759 2G

OXYGEN TRANSFER

Studies on Oxygen Transfer Models, W82-05349 1A

OXYGEN UPTAKE

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary, W82-04751 2L

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters, W82-05326 1A

Biofiltration Design Based on Volumetric Loading, W82-05698 5D

OXYGENATION

Hypolimnion Oxygenation Studies in Clark Hill Lake, W82-05001 5G

Oxygenation of the Avon River, W82-05730 5G

OZONATION

Kinetic Modeling of the Ozonation of Phenol in Water, W82-04780 5C

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations, W82-04795 5F

Ozone and Activated Carbon, W82-05370 5F

OZONE

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations, W82-04795 5F

PACKED-BED REACTOR

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor, W82-05335 5D

PACKED BEDS

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor, W82-05335 5D

PALAGNEDRA DAM

The Overtopping of the Palagnedra Dam, W82-04952 8A

PANNONIAN PLAIN

On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia, W82-04929 2H

PAPAGO INDIAN RESERVATION

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979, W82-05231 7C

PARASITES

The Occurrence of Sewage-Borne Pathogens in the UK, W82-05476 5B

PARTIALLY PENETRATING WELLS

Bottom-Entry Large-Diameter Wells, W82-04919 8A

PARTICLE SIZE

Bed Load Fluctuation: Applications, W82-05000 2J

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement, W82-05285 5D

PARTICULATE MATTER

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment, W82-05353 5B

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion, W82-05416 2K

PARTITION COEFFICIENTS

Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish, W82-04820 5B

PATH OF POLLUTANTS

Water Quality in a Stream Receiving Dairy Feedlot Effluent, W82-04860 5B

Decomposition of Chelates Leached from Waste Disposal Sites, W82-04879 5B

Sulfate Washout Ratios in Winter Storms, W82-04898 5B

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A., W82-04949 5B

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol, W82-04965 5B

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers, W82-05022 5B

Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States, W82-05138 5B

Sulphur in the Environment: A Review, W82-05179 5B

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada), W82-05205 5B

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography, W82-05361 5A

Fate of Suspended Biological Solids Discharged to Receiving Waters, W82-05448 5B

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea, W82-05458 5B

Contaminant Dispersion in Oscillatory Flows, W82-05631 5B

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977, W82-05638 5B

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario, W82-05640 5B

Selecting a Method for Estimating Substance Loadings, W82-05746 5B

Quality of Water in James Creek, Monroe County, Mississippi, W82-05842 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi, W82-05845 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi, W82-05847 5B

PATH OFF POLLUTANTS

Circular Wall Jets in Coflowing Streams, W82-04999 5B

PATHOGENS

The Continuing Struggle of Waterborne Illness, W82-05366 5C

The Occurrence of Sewage-Borne Pathogens in the UK, W82-05476 5B

Criteria for Achieving Pathogen Destruction During Composting, W82-05697 5D

PATUXENT RIVER

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay, W82-04924 2L

Composition of Estuarine Colloidal Material: Major and Trace Elements, W82-05137 2L

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline, W82-05198 2J

PAVING

An Overview of Porous Pavement Research, W82-05744 5D

PEACHES

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes, W82-05312 3F

PEAK DISCHARGE

Investigations of Catastrophic Maximum Discharges of the Araks River, W82-05591 2E

PEANUTS

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages, W82-05293 3F

PEARL RIVER

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi, W82-05216 2E

PEFORMANCE EVALUATION

Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen, W82-05859 5D

PENNSYLVANIA

Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania, W82-04971 2F

Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania, W82-04972 2F

PENNSYLVANIA

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 6C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 5B

PENSTOCKS
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 8A

PENTACHLOROPHENOL
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 5G

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 5A

PERFORMANCE EVALUATION
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 5D

A Screening Model to Quantify Resilience,
W82-05044 6A

Alternative Indices of Resilience,
W82-05045 6A

Robustness of Water Resources Systems,
W82-05077 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 6A

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 5E

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 5D

PERMEABILITY
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

PERMITS
History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 6E

PERU
Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 6B

PESTICIDE KINETICS
The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 5B

PESTICIDES
Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 5A

Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 5G

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

Pesticide Effects on Aquatic Habitats,
W82-05146 5C

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 5A

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 5B

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 5B

PHENOL
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 5C

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 5G

PHENOLS
Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 5A

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

Treating Phenol Resin Plant Wastes,
W82-05128 5D

Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 5A

Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 5C

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 5A

PHOSHORUS REMOVAL
The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 5D

PHOSPHATE REMOVAL
Electrochemical Processes for Wastewater Treatment,
W82-05422 5D

PHOSPHATES
Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 5D

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 5G

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 2K

PHOSPHOROUS REMOVAL
New Flocculation Units with High Efficiency,
W82-04840 5D

PHOSPHORUS
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 5G

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 5B

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 5B

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 5D

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 5C

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 5B

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 5C

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 5B

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D

The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 5C

PHOSPHORUS REMOVAL

Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 5D

The Rehabilitation of Norway's Largest Lake,
W82-05243 5G

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

Phosphorus and Nitrogen Removel at Cadillac, Michigan,
W82-05270 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 5D

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 5D

Phosphorus Reduction Studies,
W82-05408 5D

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

Phosphorus Inactivation by *Zirconium* in a Eutrophic Pond,
W82-05856 5G

PHOSPHORUS RUNOFF

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B

PHOSPHORUS UPTAKE AND RELEASE

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 5B

PHOTOCHEMICAL REACTIONS

Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

PHOTOSYNTHESIS

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 2H

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

PHYSICOCHEMICAL PROPERTIES

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 5B

PHYSICOCHEMICAL TREATMENT

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

PHYTOPLANKTON

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 2L

Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 2H

Primary Production in Saline Lakes,
W82-04926 2H

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 2H

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1A

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 2H

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 5C

Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 5C

PIEZOMETRY

A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076 7B

PIKE

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

PILOT PLANTS

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 3A

PIPE FLOW

Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 8B

Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 8B

Water Hammer,
W82-05432 8C

PIPELINES

The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 8G

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 2J

Alternative Tunnelling Method for Relief Sewer.
W82-05774 8F

PIPES

A Pipeline for all Environments,
W82-04764 8G

Economic Analysis of Water Main Breaks,
W82-05673 8A

Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 5A

Load Factors and Non-Destructive Testing of Clay Pipe.
W82-05700 8G

PLANKTON

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 2L

Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 2H

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 2H

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 2H

PLANNING

Estimating Resilience by Canonical Analysis,
W82-05047 6A

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 6B

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 6E

River Basins and Water Management in New Brunswick,
W82-05391 6D

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 6F

New Strategies for Water Resource Planning in British Columbia,
W82-05395 6E

Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 6D

Five-Year Plan of the Water Resources Research Center,
W82-05526 6B

A Five-Year Plan of Water Resources Research.
W82-05527 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 6B

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 6B

A Five-Year Plan for Water Research in Colorado.
W82-05531 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 6B

Nevada Water Resources Research 1982-1987,
W82-05533 6B

Multiple Objective Planning of Land/Water Interface in Medium Site Cities: Application to West Lafayette, Indiana,
W82-05550 4A

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 6B

The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 6D

The Eighties--Implications for Water Management,
W82-05772 6B

1980 Needs Survey: Combined Sewer Siste Studies,
W82-05862 5D

PLANT GROWTH
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

PLANT PATHOLOGY
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 5C

PLUG FLOW
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 8A

PLUMES
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 2E

River Plume Studies in Distorted Froude Models,
W82-05864 2E

POLAND
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 2H

Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 5B

POLAR REGIONS
An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 2H

Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 2H

POLITICAL ASPECTS
Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 6B

Acid Rain: Legal and Political Fallout,
W82-05147 6E

Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 6E

POLITICAL CONSTRAINTS
Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

River Basin Management in Ontario,
W82-05393 6E

Stormwater Management - One Developer's Experience,
W82-05777 6B

POLK COUNTY
Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 7C

POLLUTANT IDENTIFICATION
Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 5A

Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 5A

Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 5A

Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 5A

Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 5A

Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 5A

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 5A

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

Determination of 2,3,7,8-Tetrachlorodibenzo-P-Diozin in Fresh Water Fish,
W82-04883 5A

Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 5A

Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 5A

Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 5A

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 5A

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 5A

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 5A

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 5C

Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 5A

Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 5A

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 5A

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 5A

Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 5A

Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 5A

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 5A

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 5A

Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 5A

Volatile Constituents of the Produced Water Effluent from the Buccaneer Gas and Oil Field,
W82-05874 5A

POLLUTANTS
Mutagens, Carcinogens and the Water Cycle,
W82-05468 5A

A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 5A

POLLUTION CONTROL
Some Emerging Rights in Agricultural Land,
W82-04890 6E

POLLUTION IDENTIFICATION
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 5A

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

POLLUTION LOAD
A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 5B

POLYAROMATIC HYDROCARBONS
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 5A

POLYCHLORINATED BIPHENYLS
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 5A

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 5B

Poisons in the Hudson,
W82-05705 5G

POLYELECTROLYTES
Research on Piezodialysis - Sixth Report,
W82-05294 3A

POLYMERS
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

PONDS
Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 5C

Liming Fish Ponds,
W82-05866 5G

POPULATION DENSITY
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 8I

POPULATION DYNAMICS
Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 2L

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 2H

Conflict Over Water Sources Predicted by Global Study,
W82-05879 6B

PORE SIZE
Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 3A

POROSITY
On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 2G

POROUS MEDIA
A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 2F

An Overview of Porous Pavement Research,
W82-05744 5D

PORTAGE LAKES
Algal Bicassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

POTABLE WATER
Water Supply in the USSR.
W82-04849 6D

Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 5A

POTENTIOMETRIC LEVEL
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 7C

POTOMAC ESTUARY
Dynamic Estuary Model Performance,
W82-05319 2L

POTOMAC RIVER
Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered

Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

POTTER CREEK AREA
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 5G

POWERPLANTS
A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 6D

Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 6D

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 5C

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 2D

Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 5C

Developments in Wastewater Handling at Power Plants,
W82-05517 5D

The Expansion of Two Bolivian Plants,
W82-05598 8A

Guidevane Erosion at Mao Tiao He,
W82-05600 8G

PRECIPITATION
New Flocculation Units with High Efficiency,
W82-04840 5D

Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 2B

Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870 2A

PRECISION
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 5A

PREDICTION
Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 2A

Chemometric Modeling of Wastewater Treatment Processe,
W82-05858 5D

PRESSURE DISTRIBUTION
Pressure Distribution Design for Septic Tank Systems,
W82-05439 5E

PRETREATMENT OF WATER
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 3A

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

PRICES
Current Trends in Cost of Service Studies,
W82-05806 6C

PRICING
The Real Price of Urban Water,
W82-04797 6C

Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 6C

Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 6C

Price or Persuasion,
W82-05791 6C

PRIMARY PRODUCTIVITY
Primary Production in Saline Lakes,
W82-04926 2H

Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 2H

Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 7B

PRIMARY TREATMENT
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 5D

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

PRIORITIES
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 5G

PROBABILISTIC PROCESS
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 5C

PROBABLE MAXIMUM PRECIPITATION
Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 2B

PROCESS CONTROL
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

Advanced Supervisory Control System for Sludge Treatment,
W82-04841 5D

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 5D

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 5A

Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

PRODUCTIVITY
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 2L

PROJECT PLANNING
Water Reuse Planning by Means of an Input-Output Table,
W82-04794 6A

A Screening Model to Quantify Resilience,
W82-05044 6A

Alternative Indices of Resilience,
W82-05045 6A

Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-05564 6A

Water Yield Estimation in Western United States,
W82-05689 4D

Colorado River Development,
W82-05887 4A

PROJECTIONS
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 6C

PROPERTY RIGHTS
Some Emerging Rights in Agricultural Land,
W82-04890 6E

PROTECTION
Engineering Aspects of Fish Protection at Water Intakes,
W82-04759 8I

PROTEINS
Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 5D

Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 5D

PROTOZOA
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H

PUBLIC HEALTH
The New Pollution--Groundwater Contamination,
W82-04938 5C

The Continuing Struggle of Waterborne Illness,
W82-05366 5C

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

PUBLIC OPINION
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 6E
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 5B

PUBLIC PARTICIPATION
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 6D

PUBLIC RELATIONS
The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 5G
Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 7C

PUBLIC UTILITY DISTRICTS
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 5B

PUERTO RICO
Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

PULP AND PAPER INDUSTRY
Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 5C

PULP WASTES
Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 5D

PUMP WELLS
Cavity Well,
W82-04920 8A
An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 8B
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 8B
Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

PUMPAGE
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F
Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 4B

PUMPING
Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 2F

PUMPING PLANTS
Sewage Pumping Station Split for Maintenance,
W82-05719 5D

PUMPS
Cutting Irrigation Costs,
W82-05081 3F
Water System Efficiencies,
W82-05281 8C
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 8C
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 8C
Using Pumps as Small Turbines,
W82-05597 8C
Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 8C
Pump Installations for reverse Osmosis Systems,
W82-05882 8C

PYRAMID LAKE
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

QUALITY CONTROL
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 8A

QUEBEC
Promising Steps Toward a New Ottawa River Regulation,
W82-05394 6E

RADIOACTIVE TRACES
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 5B

RADIOACTIVE WASTE DISPOSAL
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

RADIOACTIVE WASTES
Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 5E
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 5B
The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05176 5B
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 5B

RADIOACTIVITY
Prospects of Using Radiation Water Treatment Methods,
W82-05026 5D
Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 2K

RADIOACTIVITY TECHNIQUES
High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 5A
Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 2C

RADIOCHEMICAL ANALYSIS
Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 5A

RADIOISOTOPES
Radionuclides in Mono Lake, California,
W82-05461 5B
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 5B
Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 5B
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 5C

RADIUM
Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 2K

RADIUM RADIOISOTOPES
Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 5A
High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 5A

RAILROAD YARDS
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 5D

RAILROADS
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 5D

RAIN
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 2B

RAIN GAGES
Recording Raingage Modifications,
W82-05665 7B

RAINDROP SIZE
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 2B

RAINFALL
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 2G
Revised Rainfall Frequency Analysis for Houston,
W82-05863 2B
An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 2A
Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 2B

RAINFALL DISTRIBUTION
On the Sampling Variance of Raingage Networks,
W82-05875 7B

RAINFALL INFILTRATION
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 2G

RAINFALL-RUNOFF RELATIONSHIPS
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 4A

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 5B

RAINSTORMS
Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm,
W82-04864 2B

Identification of Independent Rainstorms,
W82-05708 2B

RANGE MANAGEMENT
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

RATE OF RETURN
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

RAVENGLASS ESTUARY
The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 5B

RAW WATER
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

RECHARGE
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

RECLAIMED WATER
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 6E

Colorado River Development,
W82-05887 4A

RECREATION
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 6D

RED RIVER VALLEY
Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

REFLECTANCE
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 2G

REGENERATION
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 5D

Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 5F

Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 5F

REGIONAL DEVELOPMENT
Energy Siting in Utah: A Programming Model,
W82-05297 6B

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 6B

REGIONAL PLANNING
An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 6A

REGRESSION ANALYSIS
Prediction of Water Level in Tidal Inlet,
W82-05005 4A

Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 2F

REGULATED FLOW
Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 4A

Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 8I

REGULATIONS
Weak Controls from Sea to Shining Sea,
W82-05035 5B

Disposing of Sewage Sludge at Sea,
W82-05127 5E

The National Interim Primary Drinking Water Regulations, Part I - Historical Development,
W82-05814 5G

REHABILITATION
Economic Analysis of Water Main Breaks,
W82-05673 8A

RELIABILITY
Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

REMOTE CONTROL
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 5F

REMOTE SENSING
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 7B

Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 2B

Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 2G

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 2C

Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 7C

Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 2C

Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 7B

Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 2K

RESEARCH NEEDS
Water Research in Action,
W82-05292 6B

RESEARCH PRIORITIES
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 5G

Water Research in Action,
W82-05292 6B

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute,
W82-05301 6B

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 3F

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 5D

Five-Year Plan of the Water Resources Research Center,
W82-05526 6B

A Five-Year Plan of Water Resources Research,
W82-05527 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming,
W82-05528 6B

Virginia Water Resources Research Center Five-Year Plan,
W82-05529 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986,
W82-05530 6B

A Five-Year Plan for Water Research in Colorado,
W82-05531 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 6B

Nevada Water Resources Research 1982-1987,
W82-05533 6B

Domestic Water Conservation Research Plan,
W82-05547 6B

Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-05564 6A

Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 2B

Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 6B

RESERVATION DOCTRINE
Non-Indian Federal Reserved Water Rights,
W82-04804 6E

RESERVOIR DESIGN
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 2E

RESERVOIR OPERATIN
Modified Standard Operation Rules for Reservoirs,
W82-05658 4A

RESERVOIR OPERATION
Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 6E

The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 6A

RESERVOIR RELEASES
New Methods of Designing Flood Control Measures,
W82-05030 2E

Modified Standard Operation Rules for Reservoirs,
W82-05658 4A

RESERVOIR SITES
The Search for Reservoir Sites in an Urban Environment,
W82-04867 8A

RESERVOIRS
Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 2H

Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 7B

The Overtopping of the Palagnedra Dam,
W82-04952 8A

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 2E

Estimates of Resilience Indices by Simulation,
W82-05046 6A

Estimating Resilience by Canonical Analysis,
W82-05047 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 6A

Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 2H

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 2H

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 8E

Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 4A

Urban Impacts of Water Supply Reservoir,
W82-05318 5G

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A

Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 2H

State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 2H

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 2H

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 2H

Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 4A

Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 6A

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 2H

Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 7C

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 4B

Northwestern Ontario River Dimensions,
W82-05742 6G

Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 6B

Measuring Reservoir Ground Movements,
W82-05773 8G

RESIDUAL CHLORINE
Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 5F

RESILIENCE
Alternative Indices of Resilience,
W82-05045 6A

Estimates of Resilience Indices by Simulation,
W82-05046 6A

Estimating Resilience by Canonical Analysis,
W82-05047 6A

RESINS
Treating Phenol Resin Plant Wastes,
W82-05128 5D

Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 5D

RESISTIVITY
How Proper Prospecting Improves the Odds,
W82-05757 3B

RESONANCE
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling.
W82-04755 8B

Resonance in Hydropower Stations,
W82-04953 8C

RESOURCE DEVELOPMENT
The Physical Environment of the Colorado River Basin,
W82-05891 6D

RESOURCES DEVELOPMENT
National Water Policy: The Need for Institutional Reform,
W82-05180 6E

Colorado River Development,
W82-05887 4A

The Colorado River Salinity Problem,
W82-05889 5G

RESOURCES MANAGEMENT
Illinois Wetlands: Their Value and Management,
W82-05053 6G

RETENTION TIME
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

REVEGETATION
Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 5E

REVERSE OSMOSIS
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 3A

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 3A

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05509 3A

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 3A

Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 3A

Seawater Ro Heads Japan's Water Reuse Research.
W82-05756 3A

Pump Installations for reverse Osmosis Systems,
W82-05882 8C

REVIEWS

Acid Precipitation in Historical Perspective,
W82-04807 5B

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 5A

Biological Monitoring. Part V - Preference and Avoidance Studies,
W82-05340 5C

A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 4C

RHINE RIVER

Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 5A

Ozone and Activated Carbon,
W82-05370 5F

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

RHIZOPUS

The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 5D

RHONE RIVER

Generating Power from Compensating Flow.
W82-05624 8C

RIPARIAN RIGHTS

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 6E

RISKS

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 5G

A Screening Model to Quantify Resilience,
W82-05044 6A

Alternative Indices of Resilience,
W82-05045 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 6A

Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 5D

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A

Impact of Discharges as a Basis for Control Measures,
W82-05354 5B

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

RIVER BASIN DEVELOPMENT

Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 2E

Future Water Development Policies,
W82-05884 5G

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 6E

Colorado River Water Allocation,
W82-05888 6C

RIVER BASINS

The Shubenacadie-Stewiacke River Basin Study,
W82-05385 6B

Operational Research Techniques in River Basin Management,
W82-05387 6A

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 6E

River-Basin Simulation in Systems with Large Response Time,
W82-05496 2A

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

RIVER BEDS

Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 2E

New Trends in Water Quality Management,
W82-05429 5G

RIVER FLOW

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 5B

River Plume Studies in Distorted Froude Models,
W82-05864 2E

RIVER MECHANICS

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 2E

RIVER SYSTEMS

A River Coding System for Water Quality Archives,
W82-05474 7A

RIVERS

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 5B

Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 5B

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 5B

Microcomputer Water Quality Simulation Model,
W82-05191 7B

Random Differential Equations in River Water Quality Modeling,
W82-05343 6A

A Field Technique to Directly Measure River Bank Erosion,
W82-05410 7B

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 2K

A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 5B

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 2E

ROACH

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 5C

ROCK EXCAVATION

Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 8H

ROOT ZONE

Soil Water Availability,
W82-05623 2G

ROTATION SPEED

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 5D

ROTIFERS

An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 2H

ROUTT COUNTY

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

RUHR VALLEY

Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 5D

RUNNING WATERS

On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 7B

RUNOFF

On-Site Stormwater Detention: An Overview,
W82-04758 4A

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 4C

Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 4A

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 5B

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05524 2E

RUNOFF FORECASTING
Evaluation of Snowmelt Forecasting Methods,
W82-05552 4A

RUNOFF RATES
Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 2A

RUNOFF VOLUME
Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 4A

Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 4A

RURAL AREAS
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 6E

Egypt Tackles Rural Supply Task,
W82-05754 5F

RUSSIA
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

SACRAMENTO
Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 8G

SACRAMENTO RIVER
California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411 4A

SAFETY
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

Safety Considerations in Handling Activated Carbon,
W82-05442 5D

SAGINAW BAY
Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 5C

SALAMANDERS
Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 5C

SALINE-FRESHWATER INTERFACES
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 2E

SALINE LAKES
Primary Production in Saline Lakes,
W82-04926 2H

Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 2H

Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 2H

Elevated Concentrations of Actinides in Mono Lake,
W82-05520 5B

SALINE SOILS
Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 4D

SALINE WATER
The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 2L

Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 2K

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 2F

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana),
W82-05721 5A

SALINITY
The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 2J

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 2H

Managing Salinity in Irrigated Agriculture,
W82-05691 3C

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

The Wellton-Mohawk Dilemma,
W82-05883 3F

Future Water Development Policies,
W82-05884 5G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

Colorado River Water Allocation,
W82-05888 6C

The Colorado River Salinity Problem,
W82-05889 5G

International Problems on the Colorado River,
W82-05892 5G

Salinity Control Measures for Grand Valley,
W82-05894 3F

SALMON
Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 8I

SALT BALANCE
Managing Salinity in Irrigated Agriculture,
W82-05691 3C

SALT DOMES
Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 5B

SALT MARSHES
The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 2J

The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 2H

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

SALTS
Ion Hydration and Ion Interaction,
W82-05310 2K

Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 2K

Effects of Salts on Activated Carbon Adsorption of Fulvic Acids,
W82-05667 5F

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

SAMPLING
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

Sampling and Analyzing Water,
W82-05263 5A

SAN ANTONIO AREA
Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79,
W82-04987 7C

SAN FRANCISCO
Drought Management: Expecting the Unexpected,
W82-05649 3D

SAN FRANCISCO BAY
Oil and Grease in Stormwater Runoff,
W82-05557 5C

SAN JUAN BASIN
Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 2J

SAN LUIS PASS
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

SAND
Bearing Capacity of Sand Bases (Discussion of Construction Specifications),
W82-05583 8D

SAND FILTERS
Biological Denitrification for Potable Water Treatment,
W82-05247 5F

Land Application of Secondary Effluent at Lake George, NY,
W82-05704 5D

SANDS
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05637 4B

SANTIAGO
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

SASKATCHEWAN
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 6E

Operational Research Techniques in River Basin Management,
W82-05387 6A

SATELLITE TECHNOLOGY
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

SATURATED SOILS
On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 2G

SCALING
Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

SCHELDE BASIN
A New Method of Cubature Using Spline Functions,
W82-04939 2L

SCHELDT ESTUARY
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 5A

SCOTLAND
Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 2H

SCOUR
Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 8B

Calculation of Large Unlined Canals,
W82-05131 8B

SCREENS
How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 5D

SEA LEVEL
Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

SEASONAL VARIATION
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 2G

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 2H

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 4A

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 7C

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

SEASONAL VARIATIONS
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 4C

Tracking Seasonal Load Variations,
W82-05787 5D

SEAWATER
VTE/VC for Sea Water,
W82-04909 3A

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1B

SECONDARY WASTEWATER TREATMENT
A Low-Cost Secondary Treatment Alternative,
W82-05169 5D

SEDIMENT DISTRIBUTION
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 2L

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

SEDIMENT EROSION
Bed Load Fluctuation: Applications,
W82-05000 2J

SEDIMENT LOAD
Sources of Sediment-Induced Reductions in Water Quality Appraised from Catchment Attributes and Land Use,
W82-05494 2J

SEDIMENT TRANSPORT
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 2L

Modeling: How and When to Use,
W82-04754 2L

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 2J

Bed Load Fluctuation: Applications,
W82-05000 2J

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 8A

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 5B

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 2J

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

New Trends in Water Quality Management,
W82-05429 5G

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 2J

SEDIMENT YIELD
Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 2J

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 4D

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 4D

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 2J

SEDIMENTATION
Modeling: How and When to Use,
W82-04754 2L

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 2L

Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials),
W82-04762 2L

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment, W82-05353 5B

SEDIMENTATION RATES

Settleability of Urban Runoff Pollution, W82-05320 5G

Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods, W82-05625 5B

SEDIMENTOLOGY

Sedimentary Record of Rainfall Variations on a Sub-Humic Lake, W82-05516 2J

SEDIMENTS

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants, W82-04823 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry, W82-04893 5A

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries, W82-04994 5B

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry, W82-05020 5A

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments, W82-05034 2H

Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source, W82-05042 5B

Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments, W82-05094 5B

Downcore Variation in Sediment Organic Nitrogen, W82-05124 2H

Urban Impacts of Water Supply Reservoir, W82-05318 5G

Enzyme Activity and Kinetics in Substrate-Amended River Sediments, W82-05336 5C

Benthos Investigations: Sediment Boxes or Natural Bottom, W82-05378 5C

The Role of Agricultural Sediments and Chemicals in Eutrophication, W82-05447 2H

Fate of Suspended Biological Solids Discharged to Receiving Waters, W82-05448 5B

Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway, W82-05605 5B

An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York, W82-05606 5B

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie, W82-05633 5C

Poisons in the Hudson, W82-05705 5G

Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems, W82-05724 5C

Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77, W82-05852 2J

SEEPAGE

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska, W82-05663 4B

SEEPAGE CONTROL

Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations, W82-04902 8C

Consider Soil-Cement for Erosion and Seepage Control, W82-05039 8F

Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal, W82-05117 8G

Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations, W82-05201 8E

SEINE RIVER

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne), W82-04763 5A

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne), W82-05364 5F

SEISMIC PROPERTIES

Dynamic Elastic and Absorbing Properties of Soils, W82-05132 8D

SEISMOLOGY

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR, W82-05133 2F

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978, W82-05196 8E

SELENIUM

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation, W82-05360 5A

SELF-PURIFICATION

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers, W82-05237 5A

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters, W82-05326 1A

Studies on Oxygen Transfer Models, W82-05349 1A

SEMIARID LANDS

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur), W82-05102 2H

Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation, W82-05610 3F

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration, W82-05722 2D

SENSITIVITY ANALYSIS

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling, W82-05739 5C

SENSORS

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management, W82-04800 7B

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment, W82-04842 5D

SEPARATION TECHNIQUES

An Exercise in Sludge Consolidation, W82-04848 5D

How Screen Mounting Affects Microscreening Hydraulics, W82-05168 5D

Extended Dechlorination Studies with Granular Activated Carbon Filters, W82-05257 5F

Ion-Precipitate Flotation of Iron-Cyanide Complexes, W82-05259 5D

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes, W82-05284 5D

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate, W82-05382 5A

Investigations of Natural Hungarian Zeolite for Ammonia Removal, W82-05482 5D

SEPTIC SLUDGE

Septage and Wastewater Treatment in the Activated Sludge Process, W82-05699 5D

SEPTIC TANKS

Pressure Distribution Design for Septic Tank Systems, W82-05439 5E

Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting, W82-05536 5D

Treatability of Type A Zeolite in Wastewater--Part II, W82-05688 5D

Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia, W82-05812 5D

SEPTIC WASTEWATER
Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 5B

SESTON
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

SETTLING TANKS
Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

SEWAGE SLUDGE
Disposing of Sewage Sludge at Sea,
W82-05127 5E

SEWER INFILTRATION
Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 5D

Infiltration Inflow Analysis: Finding the Source,
W82-05038 5B

SEWER SYSTEMS
On-Site Stormwater Detention: An Overview,
W82-04758 4A

Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 4B

Infiltration Inflow Analysis: Finding the Source,
W82-05038 5B

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 8G

Northern Elbe Culvert,
W82-05437 8B

Sewers and Cities: France and the United States Compared,
W82-05684 5D

Treatability of Type A Zeolite in Wastewater–Part I,
W82-05687 5D

Load Factors and Non-Destructive Testing of Clay Pipe,
W82-05700 8G

SHALES
Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

SHALLOW WELLS
The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 3B

SHAWSHEEN RIVER BASIN
Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 7C

SHEAR STRESS
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 2E

SHIPS
Fresh-Water Transport by Sea,
W82-04861 6D

SHOALS
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 2L

SHORELINE COVER
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 7B

SHUBENACADIE-STEWIACKE RIVER
The Shubenacadie-Stewiacke River Basin Study,
W82-05385 6B

SIBERIA
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 8D

SIMULATION ANALYSIS
Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 5D

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 2H

River-Basin Simulation in Systems with Large Response Time,
W82-05496 2A

Applications of Simulation to Specific Water Projects,
W82-05522 6A

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 4A

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

Issues in Simulation Model Design–A Case Study,
W82-05627 4A

Modified Standard Operation Rules for Reservoirs,
W82-05658 4A

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 5C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 2F

SIMULATION MODEL
An Evaluation of the Urban Design Storm Concept,
W82-04960 6A

SINKS
Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

SITE SELECTION
The Search for Reservoir Sites in an Urban Environment,
W82-04867 8A

SKANE
Robustness of Water Resources Systems,
W82-05077 6A

SLOPE STABILIZATION
Formation of a Stable Canal Channel,
W82-05584 8B

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 5D

SLUDGE
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 5D

Sludge Management in the Rocky Mountain State,
W82-05165 5E

Virginians Optimize Sludge Handling,
W82-05171 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 5D

Nitrogen Control at Three Related Plants,
W82-05434 5D

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

SLUDGE BULKING
Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

Control of Bulking Sludge–Practical Experiences in Austria,
W82-05423 5D

SLUDGE CAKE
Virginians Optimize Sludge Handling,
W82-05171 5D

Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

SLUDGE CONDITIONING
Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 5E

Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 5D

Treatability of Type A Zeolite in Wastewater–Part II,
W82-05688 5D

SLUDGE DIGESTION
Advanced Supervisory Control System for Sludge Treatment,
W82-04841 5D

Package Anaerobic Sludge Digestion.
W82-04850 5D

Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 5D

Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 5E

Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 5D

Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 5B

SLUDGE DISPOSAL
Land Disposal of Sludge,
W82-04757 5E

Designing Wastewater Treatment Systems to Save Energy,
W82-04906 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 5E

Disposing of Sewage Sludge at Sea,
W82-05127 5E

Sludge Management in the Rocky Mountain State,
W82-05165 5E

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 5E

Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 5E

Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 5D

How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 5E

Potential Use of Earthworms as a Solution to Sludge Management,
W82-05478 5E

SLUDGE DRYING
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 5D

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

SLUDGE EXCESS
Considering Sludge Production in the Selection of Coagulants,
W82-05675 5F

SLUDGE FILTERS
Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 5D

SLUDGE RECONDITIONING
Sludge Management in the Rocky Mountain State,
W82-05165 5E

SLUDGE THICKENING
An Exercise in Sludge Consolidation,
W82-04848 5D

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 5E

SLUDGE TREATMENT
Advanced Supervisory Control System for Sludge Treatment,
W82-04841 5D

SLUDGE UTILIZATION
Calorific Value of Wastewater Plant Sludges,
W82-04997 5E

SLUDGE VOLUME INDEX
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 5D

SLURRIES
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 5D

SMALL WATER SYSTEMS
Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 5C

SMALL WATERSHEDS
Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 2J

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 5C

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 2A

SMITH MOUNTAIN LAKE
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

SNOW
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 2C

Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 5B

SNOW WATER EQUIVALENT
Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 2C

SNOWMELT
Evaluation of Snowmelt Forecasting Methods,
W82-05552 4A

Erosion from Mountain Snowpack Melt,
W82-05664 2J

Effect of Ashfall on Snowmelt Rate at Paradise, Mount Rainier, Washington,
W82-05871 2C

SOCIAL IMPACT
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

SOIL CEMENT
Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 8F

SOIL CHEMISTRY
Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 4C

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 2G

SOIL CONSERVATION
Erosivity Values for Individual Design Storms,
W82-05694 4D

SOIL CONTAMINATION
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 5G

SOIL DENSITY
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

SOIL DYNAMICS
Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 8D

SOIL EROSION
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 2J

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 2J

A Stochastic Model of Soil Erosion,
W82-05298 2J

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D

SOIL MANAGEMENT
Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 3F

SOIL MECHANICS
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

SOIL MOISTURE
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 2G

SOIL MOISTURE METERS
Simplifying Neutron Moisture Meter Calibration,
W82-05173 7B

SOIL MOISTURE RETENTION
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

SOIL PHYSICAL PROPERTIES
Calculation of Large Unlined Canals,
W82-05131 8B

SOIL POROSITY
Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 8A

Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 5E

SOIL STABILITY
$12.6 M Repairs Bill for Ecahihi Canal.
W82-05880 8D

SOIL TEMPERATURE
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 8D

SOIL TYPES
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 3F

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

SOIL WATER
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 2G

An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

Optimization Principle for Air and Water Movement,
W82-05172 2G

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 2G

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 3F

On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 2G

Soil Water Availability,
W82-05623 2G

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

SOIL-WATER-PLANT RELATIONSHIPS
Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 2D

Soil Water Availability,
W82-05623 2G

Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

SOLAR RADIATION
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

SOLID WASTES
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 5A

SOLUBILITY
Oil Slick Mechanics,
W82-05064 5G

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1B

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 2K

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 2K

SOLUTE TRANSPORT
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 5B

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 5G

Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 5B

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 5B

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 5B

SORBENT MATERIALS
Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 5G

SORPTION
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 5D

SOUTH AFRICA
The Riviersonderend-Berg River-Jonkershoek Project Most Outstanding Civil Engineering Achievement of 1980.
W82-04886 8A

Water to the South-Western Cape Keeping Up with the Demand.
W82-04887 3C

Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

SOUTH CAROLINA
Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 2A

SOUTHEAST ASIA
Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 5F

SPAIN
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

SPAWNING
Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 8I

SPECIES COMPOSITION
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 2H

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 5C

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

SPECIES DIVERSITY
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 5C

SPECIFIC CONDUCTIVITY
A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 7B

SPECIFIC HUMIDITY
Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 2D

SPECTRAL REFLECTANCE
Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 2C

SPECTROMETERS
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 2B

SPECTROPHOTOMETRY
Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 5A

SPECTROSCOPY
High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 5A

SPILLS
Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 5G

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

SPILLWAY CRESTS
Steady Shallow Flow Over a Spillway,
W82-05086 8B

SPILLWAYS
Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 8B

Steady Shallow Flow Over a Spillway,
W82-05086 8B

Determination of the Optimal Height of the Bucket Lip of a Ski-Jump Spillway,
W82-05107 8B

Concrete for Surfaces of High-Head Spillways,
W82-05110 8F

Shaft Spillways Combined with a Water Intake,
W82-05111 8A

An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279 8B

Aeration at High Velocity Flows,
W82-05602 8A

SPOIL DISPOSAL
Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 2J

SPRINGFIELD
Infiltration Inflow Analysis: Finding the Source,
W82-05038 5B

SPRINGS
Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 4A

ST. LAWRENCE ESTUARY
Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 2L

Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 5B

ST. LAWRENCE RIVER
Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 2C

STABILITY ANALYSIS
Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 8D

STABLE CHANNELS
Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 2E

STANDARDS
The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 5G

STATE JURISDICTION
Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 6E

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

STATISTICAL ANALYSIS
Water Yield Estimation in Western United States,
W82-05689 4D

Identification of Independent Rainstorms,
W82-05708 2B

Selecting a Method for Estimating Substance Loadings,
W82-05746 5B

Normality of Hydrological Data,
W82-05752 7B

STATISTICAL METHODS
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A

STATISTICS
Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 5D

STATSTICAL ANALYSIS
Chemometric Modeling of Wastewater Treatment Processe,
W82-05858 5D

STEEL INDUSTRY
Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 5B

STEPPES
Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 2D

STOCHASTIC PROCESS
Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 2E

A Stochastic Model of Soil Erosion,
W82-05298 2J

Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 6A

Normality of Hydrological Data,
W82-05752 7B

STOCHASTIC PROCESSES
Random Differential Equations in River Water Quality Modeling,
W82-05343 6A

STORAGE
Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 4A

STORAGE TANKS
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

STORM RUNOFF
Sulfate Washout Ratios in Winter Storms,
W82-04898 5B

Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 5C

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 2A

Oil and Grease in Stormwater Runoff,
W82-05557 5C

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 4C

Erosivity Values for Individual Design Storms,
W82-05694 4D

STORM SEWERS
An Evaluation of the Urban Design Storm Concept,
W82-04960 6A

The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

STORM WASTEWATER
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

Stormwater Management in the Ottawa-Carleton Region,
W82-05563 5G

STORM WATER
On-Site Stormwater Detention: An Overview,
W82-04758 4A

An Overview of Porous Pavement Research,
W82-05744 5D

Water Management in the Metropolitan Toronto Region,
W82-05775 6B

Stormwater Management - One Developer's Experience,
W82-05777 6B

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 5B

STORMS
Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 2J

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 2E

STRATIGRAPHY
The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 3B

STREAM DISCHARGE
Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2E

Dynamic Estuary Model Performance,
W82-05319 2L

STREAM FISHERIES
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 8I

STREAM POLLUTION
A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 5G

STREAM PROFILES
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 2E

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

STREAMFLOW
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 2E

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2E

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 2A

Velocity Distributions Under Floating Covers,
W82-05562 2E

On Hydrological Data Needs in Canada,
W82-05764 7B

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 7C

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 7C

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 5B

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 4A

STREAMFLOW DEPLETION
Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

STREAMFLOW FORECASTING
Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 2E

New Methods of Designing Flood Control Measures,
W82-05030 2E

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 2F

Three-State Markov Model for Differential Persistence,
W82-05654 2E

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

STREAMS
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 2E

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southeramost Norway,
W82-05288 2K

Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 5B

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 5B

STRESS ANALYSIS
Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 8A

Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116 8E

STRESS-STRAIN CURVES
Relaxation in Concrete,
W82-05511 8F

STRIP MINE WASTES
Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 5C

STRIP MINES
Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 6D

Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 5E

STRYI RIVER
New Methods of Designing Flood Control Measures,
W82-05030 2E

SUBIRRIGATION
Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 4A

SUBLETHAL EFFECTS
Metabolic Response of Fish to Stress,
W82-05159 5C

SUBSTRATES
Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 2L

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 5D

SUBSURFACE DRAINS
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 8B

SUBSURFACE FLOW
Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 4C

SUCCESSION
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

SUFFOLK COUNTY
Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 4B

SUGAR CROPS
Wastewater from a Sugar Refining Industry,
W82-05337 5D

SULFATES
Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 5A

Sulfate Washout Ratios in Winter Storms,
W82-04898 5B

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 5A

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 2K

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 2K

SULFIDES
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 7B

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 8G

Sulphide Control in Rising Mains,
W82-05465 5D

A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 5A

SULFUR
Sulphur in the Environment: A Review,
W82-05179 5B

Sulfur Bacterial Problems Revisted,
W82-05264 5B

SULFUR COMPOUNDS
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

SULFURIC ACID
Acid Precipitation in the Washington Cascades,
W82-05287 5B

SUNSPOTS
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 2A

SURFACE-GROUNDWATER RELATIONS

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 2F

SURFACE IRRIGATION

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 3F

SURFACE RUNOFF

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 2G

A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 2E

Erosion from Mountain Snowpack Melt,
W82-05664 2J

SURFACE SEALING

The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

SURFACE TENSION

Characterization of Properties of Water,
W82-05540 1A

SURFACE WATER

Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 5F

Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 7C

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1B

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 7C

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 7C

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 5B

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 4A

Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 2K

SURFACE WATERS

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

SURFACTANTS

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 5D

Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 5C

Characterization of Properties of Water,
W82-05540 1A

SURVEYING INSTRUMENTS

Measuring Reservoir Ground Movements,
W82-05773 8G

SURVEYS

The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 5B

Comparing Two Measures of Water Based Recreation Participation,
W82-05733 6D

SURVIVAL

Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 5A

SUSPENDED SEDIMENT

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 2J

SUSPENDED SEDIMENTS

Sources of Sediment-Induced Reductions in Water Quality Appraised from Catchment Attributes and Land Use,
W82-05494 2J

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

SUSPENDED SOLIDS

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 5D

How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 5D

Virginians Optimize Sludge Handling,
W82-05171 5D

Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 5B

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B

Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 5D

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 5B

SWAMP FOREST

Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 5C

SWAMPS

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

SWAN-AVON RIVER SYSTEM

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 2L

SWEDEN

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 2H

Robustness of Water Resources Systems,
W82-05077 6A

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

SWIMMING POOLS

The Hygienic Control of Swimming Baths.
W82-04853 5F

SWITZERLAND

The Overtopping of the Palagnedra Dam,
W82-04952 8A

SYMPOSIUM

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 4B

SYSTEMS ANALYSIS

Alternative Indices of Resilience,
W82-05045 6A

A Report on: Research Needs...Water Conservation in Agriculture,
W82-05308 3F

TALLABOA VALLEY
Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

TAMARISK
Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05677 2H

TAME RIVER
The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 5C

TAMPA
Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

Water System Design Meets Modern Challenges,
W82-05170 5F

TECHNOLOGY
Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 5F

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 5A

TECHNOLOGY TRANSFER
The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 3A

TECTONICS
Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

TELEMETRY
Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 7B

New Telemetry System for the Cambridge Water Company.
W82-04852 5F

Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 7B

TEMPERATURE
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 8D

A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 7B

TEMPERATURE EFFECT
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 8B

TEMPERATURE EFFECTS
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 2E

Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

Biological Monitoring. Part V - Preference and Avoidance Studies,
W82-05340 5C

Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 5D

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 5D

TEMPORAL DISTRIBUTION
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 2B

TENNESSEE
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 7C

TERRAIN ANALYSIS
A Stochastic Model of Soil Erosion,
W82-05298 2J

TERTIARY WASTEWATER TREATMENT
Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 5D

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 5D

Electrochemical Processes for Wastewater Treatment,
W82-05422 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

Land Application of Secondary Effluent at Lake George, NY,
W82-05704 5D

TEST HOLES
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

TESTING PROCEDURES
Turbines for Itaipu,
W82-04955 8C

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 8C

Infiltration Inflow Analysis: Finding the Source,
W82-05038 5B

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 5A

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 5C

TEXAS
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 5B

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 4C

TEXAS HIGH PLAINS
Conservation Ethics for the 1980's,
W82-05009 3D

TEXTILE MILL WASTES
Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 5E

THAILAND
Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 6G

THEORETICAL ANALYSIS
Water and Salt Transport in Membranes,
W82-05537 3A

THERMAL POLLUTION
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 5C

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 5C

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 5C

THERMAL PROPERTIES
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 2H

THERMAL STRESS
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C

THERMAL WATER
Thermal Front Formation from Buoyant Surface Jets,
W82-05004 5C

THERMOCLINE
Thermocline Drawdown Above Cooling Water Intakes,
W82-05560 8C

THERMODYNAMICS
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 8B

Ion Hydration and Ion Interaction,
W82-05310 2K

TIDAL BASINS
A New Method of Cubature Using Spline Functions,
W82-04939 2L

TIDAL EFFECTS
Dynamic Estuary Model Performance,
W82-05319 2L

Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 4B

TIDAL FLATS
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

TIDAL RIVERS
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 5A

TIDE LANDS
A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 2L

TIDES
Prediction of Water Level in Tidal Inlet,
W82-05005 4A

A New Method of Cubature Using Spline Functions,
W82-05189 2L

TIME SERIES ANALYSIS
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 2E

The Tidal Stream in the German Bight,
W82-05190 2L

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 2A

TOPOGRAPHY
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B

TORONTO
Water Management in the Metropolitan Toronto Region,
W82-05775 6B

TOXICITY
Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 5C

Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 5D

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 5C

Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 5C

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 5C

Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 5C

TOXINS
Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 5A

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 5A

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 5A

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 5B

TRACE ELEMENTS
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 2H

TRACE METALS
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 5B

Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 2B

TRACERS
Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 5B

TRANSMISSIVITY
Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 2F

TRANSPIRATION
Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

TRANSPORTATION
Fresh-Water Transport by Sea,
W82-04861 6D

TRAP EFFICIENCY
Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 2J

TREATED MUNICIPAL WASTEWATER
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

TRICKLE IRRIGATION
Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

TRICKLING FILTERS
Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

TRIHALOMETHANES
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 5F

Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 5F

TRINITROTOLUENE
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

TROPHIC LEVEL
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 2H

TROUT

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 5B

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05396 5C

Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 5C

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

TUNNEL CONSTRUCTION

Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 8A

Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 8H

TUNNEL LININGS

Wedge-Block Tunnels in Water Supply,
W82-05803 8F

TUNNELING

Tunnelling Machine Saves Time and Money,
W82-05513 8H

Driving Large Hydraulic Tunnels by the Stepped Face Method,
W82-05586 8H

Alternative Tunnelling Method for Relief Sewer,
W82-05774 8F

TUNNELS

Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116 8E

Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 8A

Corobici Completion Ensures Costa Rica's Power Output,
W82-05755 8C

TURBIDITY

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 5A

TURBINES

Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 6B

Turbines for Itaipu,
W82-04955 8C

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 8C

Using Pumps as Small Turbines,
W82-05597 8C

TURBULENT FLOW

Studies on Oxygen Transfer Models,
W82-05349 1A

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

Effect of Water Turbulence on Illumination at Depth,
W82-05594 1A

Dispersion in Tumbling Flow,
W82-05796 8B

TURKEY

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

Turks Press Forward With Ambitious Dam Programme,
W82-05758 6B

TYNE RIVER

How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme.
W82-05249 5D

ULTRAFILTRATION

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

ULTRAVIOLET RADIATION

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

UNDERGROUND STRUCTURES

Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 8A

Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 8H

UNDERGROUND WASTE DISPOSAL

Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 5B

UNITED KINGDOM

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

UNITED NATIONS

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 6B

UNITED STATES

National Water Policy: The Need for Institutional Reform,
W82-05180 6E

UNSATURATED FLOW

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

UPPER COLORADO RIVER

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

UPPER COLUMBIA RIVER BASIN

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2E

UPPER YOBE RIVER

A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 2D

URAL RIVER

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 8I

URANIUM

The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 5D

URANIUM RADIOISOTOPES

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 2F

URBAN AREAS

The Search for Reservoir Sites in an Urban Environment,
W82-04867 8A

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 2A

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 4C

Water Supply for New York City in the 1980s,
W82-05671 6D

URBAN DEVELOPMENT

Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 6E

URBAN DRAINAGE

An Evaluation of the Urban Design Storm Concept,
W82-04960 6A

Urban Impacts of Water Supply Reservoir,
W82-05318 5G

Stormwater Management - One Developer's Experience,
W82-05777 6B

URBAN EFFECTS

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

URBAN RUNOFF

On-Site Stormwater Detention: An Overview,
W82-04758 4A

Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Inhibiting the Green River, Massachusetts,
W82-04947 5C

An Evaluation of the Urban Design Storm Concept,
W82-04960 6A

Metal Concentrations in Guam Urban Runoff,
W82-05302 5B

Settleability of Urban Runoff Pollution,
W82-05320 5G

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 4A

Oil and Grease in Stormwater Runoff,
W82-05557 5C

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 4A

An Overview of Porous Pavement Research,
W82-05744 5D

Water Management in the Metropolitan Toronto Region,
W82-05775 6B

URBAN WATERSHEDS
Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 4C

URBANIZATION
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 6B

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 4C

UREA
Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 2H

USSR
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 8A

Water Supply in the USSR,
W82-04849 6D

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 5D

New Methods of Designing Flood Control Measures,
W82-05030 2E

Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 2E

Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 8G

Calculation of Large Unlined Canals,
W82-05131 8B

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 4A

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 3C

Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 2H

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 8I

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 2H

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 2H

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 2K

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 5A

UTAH
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 5A

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 7A

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

Energy Siting in Utah: A Programming Model,
W82-05297 6B

Erosion from Mountain Snowpack Melt,
W82-05664 2J

UTILITIES
Billing Data Aids Utility Planning,
W82-05786 6C

VAPOR COMPRESSION DISTILLATION
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D

VAPOR PRESSURE
Humidity Measurement by Infrared Thermometry,
W82-05611 7B

VARIABILITY
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 5A

VEGETATION
The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 4A

VEGETATION EFFECTS
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 4C

Forest Management for Increased Water Yield--How Useful in Southern Alberta,
W82-05760 3B

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 2J

VEGETATION REGROWTH
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

VELOCITY
Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 5D

VELOCITY DISTRIBUTION
Velocity Distributions Under Floating Covers,
W82-05562 2E

VENTILATION
Methane in Water Wells,
W82-05262 5F

VERMONT
A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 5C

VIBRATIONS
A Mechanism for the formation of Large Icebergs,
W82-04798 2C

VIENNA
Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 5D

VIRGIN ISLANDS
Five-Year Plan of the Water Resources Research Center,
W82-05526 6B

VIRGINIA
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

Virginia Water Resources Research Center Five-Year Plan,
W82-05529 6B

Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 5D

VIRUSES
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

VOLATILE COMPOUNDS
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 5A

VOLATILE SOLIDS
Calorific Value of Wastewater Plant Sludges,
W82-04997 5E

VOLATILITY
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

Volatilization of Ketones From Water,
W82-05782 5C

VOLCANOES
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B

Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C

Effect of Ashfall on Snowmelt Rate at Paradise, Mount Rainier, Washington,
W82-05871 2C

VOLGA RIVER
Hypania Invalida in the Volga Reservoirs and Hydrobiological Monitoring,
W82-05331 2H

WALES
Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 5C

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

WALKER RIVER INDIAN RESERVATION
Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 6B

WASHINGTON
Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 2E

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 5C

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 5B

WASHINGTON CASCADES
Acid Precipitation in the Washington Cascades,
W82-05287 5B

WASTE DISPOSAL
Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 5B

Weak Controls from Sea to Shining Sea,
W82-05035 5B

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

Estimation of Organic Compound Emissions from Waste Lagoons,
W82-05679 5C

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 5D

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 5G

Law for Environmentalists,
W82-05813 5G

WASTE DUMPS
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

WASTE LOAD
A Consistent Methodology for Wasteload Allocations,
W82-05702 5G

WASTE MANAGEMENT
Leachate Collection Design for Containment Landfills,
W82-04996 5E

Impact of American Regulations on Industrial Sludge Management,
W82-05184 6E

WASTE POLLUTION PREVENTION
Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 5B

WASTEWATER
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 5D

WASTEWATER ANALYSIS
Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 5A

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 7B

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems,
W82-05437 5A

WASTEWATER COLLECTIONS
Northern Elbe Culvert,
W82-05427 8B

WASTEWATER COMPOSITION
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

WASTEWATER DISPOSAL
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 3C

Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 5D

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 5G

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 5D

Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 5B

Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 5D

Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 5D

WASTEWATER FACILITES
Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 5D

WASTEWATER FACILITIES
An Exercise in Sludge Consolidation,
W82-04848 5D

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 4B

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 6A

Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 8G

A Low-Cost Secondary Treatment Alternative,
W82-05169 5D

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 5D

Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 5D

Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 5D

A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 5D

WASTEWATER IRRIGATION
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 3C

Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 3C

The Occurrence of Flow Channels in Soils,
W82-04875 3C

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 5D

Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 5E

WASTEWATER LAGOONS
Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 5D

Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 8F

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 5D

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 5D

Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 5D

WASTEWATER MANAGEMENT
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

Sludge Management in the Rocky Mountain State,
W82-05165 5E

Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 6B

Wastewater Management in Coastal North Carolina,
W82-05559 5E

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 5D

WASTEWATER OUTFALL
Wastewater Management in Coastal North Carolina,
W82-05559 5E

Where to Put a Steady Discharge in a River,
W82-05632 5G

Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 8B

WASTEWATER OXIDATION
A Comparison of the Carbonaceous Oxygen Demands of a Domestic and Industrial Sewage,
W82-05467 5D

WASTEWATER POLLUTION
Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 5A

WASTEWATER RENOVATION
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 5D

WASTEWATER TREATMENT
Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 5D

Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 5C

Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 5D

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 5B

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 5D

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 5D

Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

New Flocculation Units with High Efficiency,
W82-04840 5D

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 5D

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 5D

Package Anaerobic Sludge Digestion,
W82-04850 5D

Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 5D

Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 5D

Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D

Shale Oil Wastewater Treatment by Evaporation,
W82-04905 5D

Anaerobic Treatment of High-Strength Wastes,
W82-04907 5D

Treatment of Cooling Tower Blowdown,
W82-04908 5D

Biodegradation of Hazardous Organic Pollutants,
W82-04910 5B

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 5D

Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 5D

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 5D

Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 5D

GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 5A

Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 5D

Prospects of Using Radiation Water Treatment Methods,
W82-05026 5D

Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 5D

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 5D

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

Carbohydrates and Proteins Removals in Activated-Sludge Procedures,
W82-05090 5D

Treating Phenol Resin Plant Wastes,
W82-05128 5D

Biological Nitrification of Industrial Wastewater,
W82-05129 5D

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 5D

How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 5D

Virginians Optimize Sludge Handling,
W82-05171 5D

Microbial Removal of Hazardous Organic Compounds,
W82-05177 5D

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 5E

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 7B

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

Shock Load of Chromium (VI),
W82-05253 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 5D

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 5D

Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 5D

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 5D

Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 5D

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 5D

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 5D

Wastewater from a Sugar Refining Industry,
W82-05337 5D

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 5D

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 5D

Criteria for Nitrification in Fixed Film Reactors,
W82-05352 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 5D

Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 5D

Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 5D

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

Kinetics of Biofilm Nitrification,
W82-05374 5D

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 5D

Electrochemical Processes for Wastewater Treatment,
W82-05422 5D

Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 5D

Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 5F

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 5D

Water Resources in the Legislative Balance, 1982,
W82-05433 6E

Nitrogen Control at Three Related Plants,
W82-05434 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

Safety Considerations in Handling Activated Carbon,
W82-05442 5D

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 5D

Wastewater Management in Coastal North Carolina,
W82-05559 5E

Anaerobic Treatment in Novel Contact Digester,
W82-05681 5D

Sewers and Cities: France and the United States Compared,
W82-05684 5D

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 5D

Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 5D

Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 5D

Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

Biofiltration Design Based on Volumetric Loading,
W82-05698 5D

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 5D

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 5D

Tracking Seasonal Load Variations,
W82-05787 5D

Right Velocity Keeps the Solids Up,
W82-05788 5D

Saving Water Scenically,
W82-05789 5D

Deep Shaft,
W82-05793 5D

1980 Needs Survey: Combined Sewer Ssite Studies,
W82-05862 5D

WASTEWATER TREATMENT FACILITIES
How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme.
W82-05249 5D

WATER ALLOCATION
Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 2E

Development Issues in the Colorado River Basin,
W82-05890
6D

WATER ANALYSIS
Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779
5A

Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811
5A

High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855
5A

Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891
5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912
5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913
5A

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935
5A

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040
5A

Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041
5A

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051
7B

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141
5A

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158
5A

Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164
5A

Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212
5A

Sampling and Analyzing Water,
W82-05263
5A

Acid Precipitation in the Washington Cascades,
W82-05287
5B

Metal Concentrations in Guam Urban Runoff,
W82-05302
5B

Water Quality Assessment for Agana Springs,
W82-05304
5A

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438
5A

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457
5A

High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541
5A

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620
5B

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725
5A

WATER BALANCE
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050
2A

WATER BASIN DEVELOPMENT
Unified River Basin Management,
W82-05769
6B

WATER CIRCULATION
Numerical Modeling Study of Lake Pontchartrain,
W82-05006
2A

WATER CONSERVATION
Conservation Ethics for the 1980's,
W82-05009
3D

Cutting Irrigation Costs,
W82-05081
3F

Water Research in Action.
W82-05292
6B

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308
3F

Domestic Water Conservation Research Plan,
W82-05547
6B

Drought-Related Water Conservation Efforts in Missouri,
W82-05672
3D

Industry Helps Conserve Municipal Water,
W82-05674
3E

Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745
3D

Municipal Water Supply Restrictions as Urban Growth Constraints,
W82-05748
3D

Saving Water Scenically,
W82-05789
5D

Strategies for Reuse and Conservation,
W82-05790
3C

WATER CONVEYANCE
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773
8A

Tunnelling Machine Saves Time and Money,
W82-05513
8H

WATER COSTS
Domestic Water Conservation Research Plan,
W82-05547
6B

Current Trends in Cost of Service Studies,
W82-05806
6C

WATER CURRENTS
Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870
2A

WATER DEMAND
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805
6D

Water Supply in the USSR.
W82-04849
6D

Water to the South-Western Cape Keeping Up with the Demand.
W82-04887
3C

Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889
6C

Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036
6D

Cold Lake-Beaver River Regional Water Resources Study,
W82-05396
6D

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421
6D

Costa Rica Stays Top of Water League,
W82-05500
6D

Rice Reigns Supreme as Indonesia Builds Up the Sawahs,
W82-05502
3B

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558
6C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738
6D

The Eighties--Implications for Water Management,
W82-05772
6B

Billing Data Aids Utility Planning,
W82-05786
6C

Price or Persuasion,
W82-05791
6C

American Indian Water Rights and the Use of Colorado River Water,
W82-05885
6E

WATER DISTRIBUTION
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756
5F

Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766
5F

A Spatial Costing System for Drinking Water,
W82-04796
6C

WATER HAMMER
Water Hammer,
W82-05432
8C

WATER HYACINTH
Pollution: Cleaning Up with the Water Hyacinth,
W82-04770
5D

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936
5B

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Stor-

age by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 5C

WATER LAW
Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 6E

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603 6E

History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 6E

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 6E

Colorado River Water Allocation,
W82-05888 6C

WATER LEVEL
Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 7C

WATER LEVEL FLUCTUATIONS
A New Method of Cubature Using Spline Functions,
W82-04939 2L

Prediction of Water Level in Tidal Inlet,
W82-05005 4A

Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 4B

Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 4A

WATER LEVELS
Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 7B

WATER MAINS
Sulphide Control in Rising Mains,
W82-05465 5D

WATER MANAGEMENT
Ground-Water Management in Basalts,
W82-04931 4B

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 6B

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 4B

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 6B

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 8I

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 2F

The Shubenacadie-Stewiacke River Basin Study,
W82-05385 6B

A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 6E

Operational Research Techniques in River Basin Management,
W82-05387 6A

A Federal Perspective on River Basin Management,
W82-05388 6E

Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 4A

River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 6E

River Basins and Water Management in New Brunswick,
W82-05391 6D

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 6F

River Basin Management in Ontario,
W82-05393 6E

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 6E

New Strategies for Water Resource Planning in British Columbia,
W82-05395 6E

Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 6D

Institutional Change - Water Quality Management,
W82-05401 6E

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 6D

Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 4A

The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 6E

Integrated Water Management: Some International Dimensions,
W82-05493 6D

Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-05564 6A

Evolution of Water Management Techniques,
W82-05565 6A

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 4A

Water Supply for New York City in the 1980s,
W82-05671 6D

Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 3D

Role of the Microcomputer in Water Management,
W82-05771 7B

The Eighties--Implications for Water Management,
W82-05772 6B

Water Management in the Metropolitan Toronto Region,
W82-05775 6B

Water Management in the Maritimes,
W82-05776 6B

The Mackenzie River Basin Study,
W82-05778 4A

The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779 6E

A Citizen's View of Water Management in the Okanagan Valley,
W82-05781 6G

WATER MANAGEMENT (APPLIED)
Five-Year Plan of the Water Resources Research Center,
W82-05526 6B

A Five-Year Plan of Water Resources Research.
W82-05527 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 6B

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 6B

A Five-Year Plan for Water Research in Colorado,
W82-05531 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 6B

Nevada Water Resources Research 1982-1987,
W82-05533 6B

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 4B

WATER POLICY
The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 4B

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933
6E

National Water Policy: The Need for Institutional Reform,
W82-05180
6E

A Federal Perspective on River Basin Management,
W82-05388
6E

River Basins and Water Management in New Brunswick,
W82-05391
6D

Promising Steps Toward a New Ottawa River Regulation,
W82-05394
6E

New Strategies for Water Resource Planning in British Columbia,
W82-05395
6E

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421
6D

Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745
3D

Water Quality Management in British Columbia,
W82-05767
5C

Unified River Basin Management,
W82-05769
6B

Water Management in the Maritimes,
W82-05776
6B

The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779
6E

A Citizen's View of Water Management in the Okanagan Valley,
W82-05781
6G

Future Water Development Policies,
W82-05884
5G

WATER POLLUTION

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155
5C

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158
5A

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160
5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161
5A

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162
5A

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163
5A

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544
5B

WATER POLLUTION CONTROL

On-Site Stormwater Detention: An Overview,
W82-04738
4A

Oil Shale and Water Quality: The Colorado Phosphate under Federal, State, and International Law,
W82-04803
6E

Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812
5C

India: Every River Polluted, and Few Effective Controls,
W82-05033
5B

Performance Testing of Four Skimming Systems,
W82-05059
5G

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062
5G

Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065
5E

Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210
5G

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242
5C

Water-Pollution Research and Its Application in Developing Countries,
W82-05246
5G

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270
5D

The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274
4A

Impact of Discharges as a Basis for Control Measures,
W82-05354
5B

Groundwater Strategy: Protecting a Vital Resource,
W82-05403
5B

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661
4D

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750
5G

WATER POLLUTION EFFECTS

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788
5G

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814
5C

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825
5C

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836
5C

Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884
5C

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965
5B

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125
2H

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200
8I

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229
5C

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330
5C

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375
5C

Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507
5C

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534
5C

WATER POLLUTION PREVENTION

Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839
5E

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846
5D

Performance of a Large Advanced Waste Treatment Plant,
W82-05251
5D

WATER POLLUTION SOURCES

Acid Precipitation in Historical Perspective,
W82-04807
5B

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824
5B

Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860
5B

Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911
5B

Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017
5B

India: Every River Polluted, and Few Effective Controls,
W82-05033
5B

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207
5B

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234
5B

WATER POLLUTION SOURCES

Sulfur Bacterial Problems Revisited,
W82-05264 5B

Metal Concentrations in Guam Urban Runoff,
W82-05302 5B

Settleability of Urban Runoff Pollution,
W82-05320 5G

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 5B

Radionuclides in Mono Lake, California,
W82-05461 5B

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 5B

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578 5B

Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
W82-05799 5B

WATER POLLUTION TREATMENT
Poisons in the Hudson,
W82-05705 5G

WATER PRESSURE
Uplift Pressure of Water on the Base of Hydraulic Structures in Limit Design States (Discussion of Construction Specifications),
W82-05582 8A

WATER PROPERTIES
Characterization of Properties of Water,
W82-05540 1A

WATER QUALITY
Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 5A

Groundwater Monitoring,
W82-04809 6E

Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 5B

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 5A

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 7A

Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 7C

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 2F

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 5A

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 5A

A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 7B

New In-Situ Techniques in Biomonitoring,
W82-05157 5A

Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 5A

Microcomputer Water Quality Simulation Model,
W82-05191 7B

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

Methane in Water Wells,
W82-05262 5F

Sampling Frequency Optimization Using a Water Quality Index,
W82-05268 5A

Water Quality Assessment for Agana Springs,
W82-05304 5A

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

Random Differential Equations in River Water Quality Modeling,
W82-05343 6A

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 7C

State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 2H

The Continuing Struggle of Waterborne Illness,
W82-05366 5C

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 5F

The Status of Groundwater Law in New York State,
W82-05400 6E

Institutional Change - Water Quality Management,
W82-05401 6E

The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 2H

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 2H

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 5A

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B

Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 5C

The Impact of Fish Farming on Water Quality,
W82-05471 5B

Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 5B

Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 4A

A Pragmatic Approach to Water Quality Microbiology in a Clean River Area,
W82-05575 5A

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 4C

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721 5A

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 5F

Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763
5B

Protecting the Source,
W82-05785
5F

The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801
2K

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809
5C

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825
7C

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827
7C

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829
7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831
7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833
7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834
7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835
7C

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836
7C

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841
7C

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842
5B

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843
5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845
5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847
5B

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857
5B

WATER QUALITY CONTROL
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001
5G

Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115
5G

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242
5C

Water Research in Action,
W82-05292
6B

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475
5B

The Colorado River Salinity Problem,
W82-05889
5G

International Problems on the Colorado River,
W82-05892
5G

WATER QUALITY MANAGEMENT
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800
7B

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345
5G

The Shubenacadie-Stewiacke River Basin Study,
W82-05385
6B

New Trends in Water Quality Management,
W82-05429
5G

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554
6B

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662
7B

Water Quality Management in British Columbia,
W82-05767
5C

WATER QUALITY STANDARDS
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786
5G

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788
5G

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025
5D

Metal Concentrations in Guam Urban Runoff,
W82-05302
5B

Impact of Discharges as a Basis for Control Measures,
W82-05354
5B

Water Resources in the Legislative Balance, 1982,
W82-05433
6E

The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669
5G

A Consistent Methodology for Wasteload Allocations,
W82-05702
5G

WATER QUANTITY
Water System Design Meets Modern Challenges,
W82-05170
5F

WATER RATES
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889
6C

Current Trends in Cost of Service Studies,
W82-05806
6C

WATER RECLAMATION
Wastewater Technologies in South Africa: Research and Application,
W82-05330
5D

WATER REQUIREMENTS
A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722
2D

WATER RESOURCE DEVELOPMENT
Five-Year Plan of the Water Resources Research Center,
W82-05526
6B

WATER RESOURCES DEVELOPMENT
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981
5G

A Screening Model to Quantify Resilience,
W82-05044
6A

Alternative Indices of Resilience,
W82-05045
6A

Estimates of Resilience Indices by Simulation,
W82-05046
6A

Estimating Resilience by Canonical Analysis,
W82-05047
6A

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072
6A

Robustness of Water Resources Systems,
W82-05077
6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078
6A

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235
6B

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301
6B

Water Quality Assessment for Agana Springs,
W82-05304
5A

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329
6G

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365
6B

New Strategies for Water Resource Planning in British Columbia,
W82-05395
6E

Groundwater Strategy: Protecting a Vital Resource,
W82-05403
5B

California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411
4A

Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426
6G

Water Resources in the Legislative Balance, 1982,
W82-05433
6E

Costa Rica Stays Top of Water League,
W82-05500 6D

Progman's Subterranean Swim Sites Source,
W82-05501 8A

Can Hard-Rock Wells Solve Africa's Irrigation Problem,
W82-05503 3B

A Five-Year Plan of Water Resources Research.
W82-05527 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 6B

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 6B

A Five-Year Plan for Water Research in Colorado,
W82-05531 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 6B

Nevada Water Resources Research 1982-1987,
W82-05533 6B

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 6D

Large Water and Hydroelectric Developments in Fiji,
W82-05614 6D

An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 6A

Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 6B

Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 6B

Turks Press Forward With Ambitious Dam Programme,
W82-05758 6B

Hydro Powers Mindanao Development Plans,
W82-05881 8A

Future Water Development Policies,
W82-05884 5G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

Colorado River Development,
W82-05887 4A

Development Issues in the Colorado River Basin,
W82-05890 6D

The Physical Environment of the Colorado River Basin,
W82-05891 6D

WATER RESOURCES INSTITUTES
Water Research in Action.
W82-05292 6B

WATER REUSE
Water Reuse Planning by Means of an Input-Output Table,
W82-04794 6A

The Occurrence of Flow Channels in Soils,
W82-04875 3C

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 6B

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

Seawater Ro Heads Japan's Water Reuse Research.
W82-05756 3A

Strategies for Reuse and Conservation,
W82-05790 3C

WATER RIGHTS
Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 6E

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 6E

Non-Indian Federal Reserved Water Rights,
W82-04804 6E

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 6E

Colorado River Water Allocation,
W82-05888 6C

Development Issues in the Colorado River Basin,
W82-05890 6D

WATER SAMPLING
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

WATER SCARCITY
The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 6D

WATER SHORTAGE
Five-Year Plan of the Water Resources Research Center,
W82-05526 6B

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 3D

WATER SOFTENING
Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 5F

Piloting Mag-Carbonate Treatment,
W82-05794 5F

WATER STORAGE
A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 2D

Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 6C

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 4A

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

WATER STRESS
Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 3F

WATER SUPPLY
Icebergs: Technology for the Future,
W82-04778 2C

The Real Price of Urban Water,
W82-04797 6C

Potable Water Production in Holland.
W82-04851 5F

New Telemetry System for the Cambridge Water Company.
W82-04852 5F

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 5A

Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 6D

Water System Design Meets Modern Challenges,
W82-05170 5F

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

Water Use in Ohio, 1975,
W82-05226 6D

Sampling and Analyzing Water,
W82-05263 5A

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 3A

Drought Management: Expecting the Unexpected,
W82-05649 3D

Water Supply for New York City in the 1980s,
W82-05671 6D

Industry Helps Conserve Municipal Water,
W82-05674 3E

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

Egypt Tackles Rural Supply Task,
W82-05754 5F

Wedge-Block Tunnels in Water Supply,
W82-05803 8F

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 2F

Conflict Over Water Sources Predicted by Global Study.
W82-05879 6B

WATER SUPPLY DEVELOPMENT
Water Supply in the USSR.
W82-04849 6D

The Riviersonderend-Berg River-Jonkershoek Project Most Outstanding Civil Engineering Achievement of 1980.
W82-04886 8A

Water to the South-Western Cape Keeping Up with the Demand.
W82-04887 3C

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 4B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

A Report on: Research Needs...Water Conservation in Agriculture,
W82-05308 3F

Integrated Water Management: Some International Dimensions,
W82-05493 6D

Applications of Simulation to Specific Water Projects,
W82-05522 6A

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 3A

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 4B

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

Colorado River Water Allocation,
W82-05888 6C

Development Issues in the Colorado River Basin,
W82-05890 6D

The Physical Environment of the Colorado River Basin,
W82-05891 6D

WATER SUPPLY SYSTEMS
A Pipeline for all Environments,
W82-04764 8G

Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 5A

WATER SURFACE PROFILES
Characterisation of Properties of Water,
W82-05540 1A

WATER TABLE
Linsboro Quadrangle: Hydrogeology,
W82-04969 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

WATER TABLE DECLINE
The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 4B

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

WATER TABLE FLUCTUATIONS
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

WATER TEMPERATURE
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 4C

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 2H

Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 5C

WATER TRANSFER
Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 8I

The Long Lake Diversion: An Environmental Evaluation,
W82-05568 6G

WATER TRANSPORT
Icebergs: Technology for the Future,
W82-04778 2C

Fresh-Water Transport by Sea,
W82-04861 6D

WATER TREATMENT
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 5C

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 5F

A Spatial Costing System for Drinking Water,
W82-04796 6C

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

Potable Water Production in Holland.
W82-04851 5F

The Hygienic Control of Swimming Baths.
W82-04853 5F

Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 5F

Prospects of Using Radiation Water Treatment Methods,
W82-05026 5D

Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

Water System Design Meets Modern Challenges,
W82-05170 5F

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

The use of Activated Carbon in Water Treatment,
W82-05182 5F

Biological Denitrification for Potable Water Treatment,
W82-05247 5F

Methane in Water Wells,
W82-05262 5F

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 3A

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 5F

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 5F

Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 5F

Ozone and Activated Carbon,
W82-05370 5F

Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D

Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 5F

Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 5F

Microbial Activity in Activated Carbon Filters,
W82-05683 5F

Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 5F

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 5F

Improvement of Swirl Concentrator,
W82-05821 5D

WATER TREATMENT FACILITIES
Right Velocity Keeps the Solids Up,
W82-05788 5D

WATER USE
Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 2F

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

Water Use in Ohio, 1975,
W82-05226 6D

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 6B

Applications of Simulation to Specific Water Projects,
W82-05522 6A

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 6E

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 2F

Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 2D

WATER USE EFFICIENCY
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 2I

Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 2D

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 2I

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 3F

Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 3F

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 4B

WATER VAPOR
Characterization of Properties of Water,
W82-05540 1A

WATER WELLS
Methane in Water Wells,
W82-05262 5F

WATER YIELD
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 4C

Water Yield Estimation in Western United States,
W82-05689 4D

WATER YIELD IMPROVEMENT
Forest Management for Increased Water Yield--How Useful in Southern Alberta,
W82-05760 3B

WATERBORNE DISEASES
The Continuing Struggle of Waterborne Illness,
W82-05366 5C

WATERLOGGING
Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 4A

WATERSHED MANAGEMENT
New Strategies for Water Resource Planning in British Columbia,
W82-05395 6E

Water Yield Estimation in Western United States,
W82-05689 4D

Stream Improvement: The Chicod Creek Episode,
W82-05717 4D

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 4D

Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 6B

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 4D

WATERSHEDS
Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 2A

WAVE ACTION
Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 2J

WAVE HEIGHT
Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 8B

WAVES
Nature of Wave Attenuation in Open Channel Flow,
W82-05003 2E

WEATHER FORECASTING
Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 2B

WEATHER PATTERNS
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 2A

WEATHERING
Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 2K

WEED CONTROL
Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 4A

WEIRS
Flow Under Weir on Scoured Bed,
W82-05800 8B

WELL CASING
Cavity Well,
W82-04920 8A

WELL HYDRAULICS
Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 8C

Bottom-Entry Large-Diameter Wells,
W82-04919 8A

Cavity Well,
W82-04920 8A

Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 4B

WELL WATER
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

WELLS
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

Water System Design Meets Modern Challenges,
W82-05170 5F

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 7C

Can Hard-Rock Wells Solve Africa's Irrigation Problem,
W82-05503 3B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 8B

An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 2F

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 7C

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 7C

WEST VIRGINIA
Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 2F

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834
7C

WESTCHESTER COUNTY

Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399
5D

WESTERN UNITED STATES

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918
4B

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958
6B

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749
6E

WESTERN US

Water Yield Estimation in Western United States,
W82-05689
4D

WETLAND

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989
2L

WETLANDS

Stream Transport of Nutrients Through a Wetland,
W82-04857
5B

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927
2H

Illinois Wetlands: Their Value and Management,
W82-05053
6G

A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076
7B

The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215
2H

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549
5C

History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604
6E

Wetlands and Deepwater Habitats: A New Classification,
W82-05716
2L

WHEAT

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119
2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121
2D

WICK DRAINS

The Booming Business in Wick Drains,
W82-05192
8G

WILDLIFE

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375
5C

WILDLIFE CONSERVATION

Illinois Wetlands: Their Value and Management,
W82-05053
6G

WILDLIFE HABITATS

Illinois Wetlands: Their Value and Management,
W82-05053
6G

WIND

An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357
6B

WIND TIDES

Numerical Modeling Study of Lake Pontchartrain,
W82-05006
2A

WINTER HAVEN CHAIN OF LAKES

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977
7C

WISCONSIN

Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236
2E

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275
2H

WYOMING

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming,
W82-05528
6B

YAKIMA VALLEY

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082
2E

YAQUINA BAY

Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895
5C

YELLOWKNIFE BAY

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205
5B

YELLOWSTONE NATIONAL PARK

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449
2K

YELLOWSTONE RIVER BASIN

Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805
6D

YODO RIVER

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244
5D

YORKSHIRE WATER AUTHORITY

Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756
5F

YUGOSLAVIA

On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929
2H

YUMA DESALTING TEST FACILITY

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983
3A

YUZHNOYE RESERVOIR

The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453
2H

ZAMBIA

The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804
4B

ZEOLITE

Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687
5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688
5D

ZEOLITES

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482
5D

ZERO DISCHARGE

Developments in Wastewater Handling at Power Plants,
W82-05517
5D

ZIMBABWE

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945
2H

ZINC

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948
5A

Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518
5B

ZIRCONIUM

Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856
5G

ZOOPLANKTON

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761
2L

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946
5C

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074
2H

The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327
5D

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379
2H

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451
2H

The Importance of Lacustrine Zooplankton to the Feeding Capacity of the Lizhma Lake-River System (Basin of Lake Onega),
W82-05508
2H

ZOOPLANKTON

Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 5G

ZURICH

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

AUTHOR INDEX

ABIDI, S. L.
Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022
5B

ACAVIA, D.
Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613
2H

ACHARYA, H. S.
Optimum Depth and Spacing of Subsurface Drains,
W82-05693
8B

ACHER, A. J.
The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479
5B

ADAMS, J. R.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661
4D

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662
7B

ADAMS, T. G.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061
5D

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948
5A

ADRIAN, D. D.
Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857
5B

AGES, A.
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384
5A

AGOSTINELLI, A.
Using Pumps as Small Turbines,
W82-05597
8C

AHLERT, R. C.
Oil Slick Mechanics,
W82-05064
5G

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186
2E

AHMAD, I.
Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362
5A

AHMAD, S.
Wastewater from a Sugar Refining Industry,
W82-05337
5D

AHO, M.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819
5A

AHUJA, L. R.
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859
5B

AIKEN, G. R.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983
3A

ALBURY, W. W.
Safety Considerations in Handling Activated Carbon,
W82-05442
5D

ALEKPEROV, I. K.
Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454
2H

ALEKSANDROV, V. V.
Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707
5G

ALEXANDER, S. S.
Research on Piezodialysis - Sixth Report,
W82-05294
3A

ALI, E. M.
A Stochastic Model of Soil Erosion,
W82-05298
2J

ALIFEROV, A. N.
Shaft Spillways Combined with a Water Intake,
W82-05111
8A

ALLEMAN, J. E.
Nitrification in the Sequencing Batch Biological Reactor,
W82-05254
5D

ALLEN, P. G.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889
6C

ALLISON, G. B.
Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648
2D

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759
2G

ALQUIER, M.
Improvement of Swirl Concentrator,
W82-05821
5D

ALSOP, G. M.
Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785
5E

ALTINISIK, D.
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755
8B

ALTUNIN, V. S.
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106
2E

ALVAREZ, G.
Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824
5B

ALVAREZ, G. H.
Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833
5D

ALVAREZ, H. G.
Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832
5D

ALVAREZ, Z. W.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133
2F

AMBROSE, R. B. JR.
Dynamic Estuary Model Performance,
W82-05319
2L

AMBROSINO, G.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325
4A

ANDERSON, H. W.
Sources of Sediment-Induced Reductions in Water Quality Appraised from Catchment Attributes and Land Use,
W82-05494
2J

ANDERSON, R.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143
5B

ANDERSON, R. F.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520
5B

ANDERSON, R. L.
Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749
6E

ANDRADE, W. P.
Relaxation in Concrete,
W82-05511
8F

ANGELO, C. G.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234
5B

ANLIKER, R.
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820
5B

ANSPAUGH, L.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214
6G

ANTONOFF, D. P.
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290
3A

ANUGWELEM, U. A.
Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019
5A

ARCEMENT, G. J.
Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216
2E

ARDEN, R. S.
Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637
5C

ARENDARCHUK, V. V.
Indoles in the Decomposition Products of Certain Blue-Green Algae,
W82-05505
2H

ARGAMAN, Y.
Single Sludge Nitrogen Removal from Industrial Wastewater,
W82-05245
5D

ARMANTROUT, G.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

ARMSTRONG, N. E.
Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 2H

ARNOLD, C. L.
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

ARNOLD, D. E.
Effects of Acid Precipitation,
W82-05149 5C

ARNOLDY, P.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

ASAHARA, T.
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 5A

ASAY, K. H.
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

ASHKENAZI, V.
Measuring Reservoir Ground Movements,
W82-05773 8G

ASIKAINEN, M.
Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 2K

ASPLUND, R.
Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 5B

ASTON, S. R.
The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 5B

ATCHISON, G. J.
The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

ATKINSON, G.
Ion Hydration and Ion Interaction,
W82-05310 2K

AUBERT, R.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

AUFREITER, S.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

AULENBACH, D. B.
Land Application of Secondary Effluent at Lake George, NY,
W82-05704 5D

AUSTFORD, V. M.
Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 4A

AVNIMELECH, Y.
Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04879 5B

Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 2H

AZARKOVICH, A. E.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 8H

AZOV, Y.
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

BAALSRUD, K.
The Rehabilitation of Norway's Largest Lake,
W82-05243 5G

BABICH, H.
Acid Precipitation. 1. Causes and Consequences,
W82-04771 5C

BABIN, F. G.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 6C

BABITSKIY, V. A.
Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

BACA, E.
Urban Impacts of Water Supply Reservoir,
W82-05318 5G

BACCINI, P.
Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 5B

BACHMANN, R. W.
The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 2H

BACK, W.
Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 4B

BACON, M. P.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 5B

BAGBY, J. C.
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

BAIGOROV, Y. U.
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 8G

BAILEY, R. H.
The Shubenacadie-Stewiacke River Basin Study,
W82-05385 6B

BAILEY, Z. C.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

BALACHANDRAN, W.
Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 5D

BALL, R. O.
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

BALLESTERO, T. P.
Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A

BALLINGER, D.
A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 5A

BAMBA, E.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

BANDLER, H.
Large Water and Hydroelectric Developments in Fiji,
W82-05614 6D

BANKS, N. B.
The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 5D

BARANOVA, V. V.
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 5C

BARAZE, A.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

BARKER, J. F.
The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 2K

BARKLEY, J. J. JR.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

BARNARD, J. L.
The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 5D

BAROSS, J. A.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

BARRACLOUGH, J. T.
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

BARRETT, W. J.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 5A

BARTEL, R. L.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 6C

BARTESZEWSKI, K.
Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 5D

BARTH, E. F.
International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

BARTHOLDY, J.
On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 2J

BASTOS, J. T.
Relaxation in Concrete,
W82-05511 8F

BATE, G. C.
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

BATES, V. T.
Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05859 5D

BATH, A. H.
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 4B

BAUER, S.
The Overtopping of the Palagnedra Dam,
W82-04952 8A

BAUGHMAN, G. L.
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

BAUMGARDNER, M. F.
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 2G

BAUSUM, H. T.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

BAYAZIT, M.
Three-State Markov Model for Differential Persistence,
W82-05654 2E

BAYS, J. S.
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 2H

BAZZA, M.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

BEASLEY, D. B.
Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 4D

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 4D

BEAVER, J. R.
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 2H

BECHER, A. E.
Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 2F

BECK, B. F.
The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 3B

BECKER, E.
Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

BEDFORD, K. W.
A Stochastic Model of Soil Erosion,
W82-05298 2J

BEDIENT, P. B.
Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 4C

Revised Rainfall Frequency Analysis for Houston,
W82-05863 2B

Urban Impacts of Water Supply Reservoir,
W82-05318 5G

BEDNAR, G. A.
Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 5B

BEG, S. A.
Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 5C

BEGIN, Z. B.
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 2E

BELL, H. E. III.
Illinois Wetlands: Their Value and Management,
W82-05053 6G

BELLES, R.
Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

BELLINGER, E. G.
A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 5B

BELTAOS, S.
Dispersion in Tumbling Flow,
W82-05796 8B

BEN-ASHER, Y.
Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 7B

BEN-YAAKOV, S.
Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 7B

BENECKE, G.
Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 5A

BENEDEK, P.
New Trends in Water Quality Management,
W82-05429 5G

BENEFIELD, L. D.
The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 5D

BENFIELD, E. F.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 5B

BENHAM, D. G.
A Portable System for Measuring Water Temperature. Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling.
W82-05105 7B

BENJAMIN, E.
The Chertsey Automation Project at North Surrey,
W82-05805 5F

BENOIT, F. M.
Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

BENYAMINI, Y.
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

BERESFORD, J. D.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

BERGLUND, E. R.
Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 6B

BERMAN, S. S.
Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

BEVERS, J.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 5D

BHALME, H. N.
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 2A

BHATTACHARYYA, D.
Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 5D

BIANCHINE, J. R.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

BIERMAN, V. J.
Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 5C

BIGELOW, S. M.
Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

BIGGS, D. C.
Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 5F

BIHLER, S.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

BILLET, M. L.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 8B

BINGHAM, A.
Hydro Powers Mindanao Development Plans,
W82-05881 8A

BIRGE, W. J.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

BISHOP, A. A.
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 3F

BISHOP, C. S.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 3D

BISWAS, A. K.
Integrated Water Management: Some International Dimensions,
W82-05493 6D

BLACK, E.
Infiltration Inflow Analysis: Finding the Source,
W82-05038 5B

BLACK, J. A.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

BLACK, J. J.
Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 5B

BLAIR, W. R.
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Doctor,
W82-04808 5A

BLINOV, I. F.
Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 8A

BLUME, H. P.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

BODECHTEL, J.
Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 7C

BODEWIG, F. G.
Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry,
W82-05580 5A

BOELHOUWER, C.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

BOELTER, D. H.
Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 5D

BOESE, B. L.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 5C

BOGARDI, I.
Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 5G

BOGATOVA, I. B.
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 5D

BOGGESS, D. H.
Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

BOGOLYUBOV, K. S.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 8C

BOISON, P. J.
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

BOLDING, M. E.
Piloting Mag-Carbonate Treatment,
W82-05794 5F

BOLLIGER, W.
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 8A

BOLSENGA, S. J.
Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 2C

BOLSTAD, W.
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 6E

BOLTON, F. E.
Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 3F

BOLZERN, P.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A

BOM, C. M.
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 5A

BOMBERGER, D. C. JR.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

BONAZOUNTAS, M.
Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 2E

BONDARENKO, M. D.
Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 8H

BONHAM, E.
Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 4A

BONNIN, J.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 8B

BOOMAN, G. L.
Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 3A

BOPP, R. F.
Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

BORDESSA, R.
Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 6E

BORGHARD, W. G.
Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 5D

BORNKAMM, R.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

BORRELLI, J.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

BORST, M.
Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 5G

BORTKEVICH, S. V.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 8A

BORTON, D. L.
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 5B

BOSCH, J. M.
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 4C

BOSSERMAN, R. W.
Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 5C

BOTHWELL, P. D.
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

BOUGHTON, W. C.
Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 4A

BOULEGUE, J.
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

BOUMA, J.
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

BOURGET, E.
Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 2L

BOUVETTE, T. C.
Revised Rainfall Frequency Analysis for Houston,
W82-05863 2B

BOUWER, H.
Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 5D

BOWEN, J. E.
Cutting Irrigation Costs,
W82-05081
3F

BOWLER, D. S.
Random Differential Equations in River Water Quality Modeling,
W82-05343
6A

BOWMAN, J. O.
Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812
5D

BOWYER-LOWE, J.
Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802
5F

BOYD, C. E.
Liming Fish Ponds,
W82-05866
5G

BRADDOCK, R. D.
Optimization Principle for Air and Water Movement,
W82-05172
2G

BRADEN, J. B.
Some Emerging Rights in Agricultural Land,
W82-04890
6E

BRADNER, L. A.
Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850
7C

BRADSTREET, K. A.
Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037
5D

BRASS, H. J.
Procedures for Analyzing Contaminants in Drinking Water,
W82-05438
5A

BRAUN, H. E.
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635
5B

BRESLIN, M. K.
Performance Testing of Four Skimming Systems,
W82-05059
5G

Performance Testing of the Diperna Sweeper,
W82-05058
5G

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063
5G

BREWER, P. G.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520
5B

BRIDGER, K. C.
Northwestern Ontario River Dimensions,
W82-05742
6G

BRIGGS, R.
Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842
5D

BRILL, E. D. JR.
Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072
6A

BRINCKMAN, F. E.
Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151
5A

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808
5A

BRITTER, R. E.
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089
2E

BROACH, G. T.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745
3D

BROCKMANN, C.
The Tidal Stream in the German Bight,
W82-05190
2L

BROOKS, K. N.
Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735
6B

BROTHERSON, J. D.
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951
5A

BROWN, A. E.
An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843
5B

BROWN, B. E.
Effect of Ashfall on Snowmelt Rate at Paradise, Mount Rainier, Washington,
W82-05871
2C

BROWN, D.
The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825
5C

BROWN, D. E.
Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831
7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834
7C

Infiltration Inflow Analysis: Finding the Source,
W82-05038
5B

BROWN, J. H.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858
2G

BROWN, K. A.
Sulphur in the Environment: A Review,
W82-05179
5B

BROWN, K. W.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313
3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293
3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312
3F

Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727
5C

BROWN, L.
A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577
5B

BROWN, M. P.
Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974
7C

BRUECK, T. M.
Computer-Based Implementation of Combined Sewer Control,
W82-04783
5D

BRUEGGEMANN, G.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787
5D

BRUSCHIN, J.
The Overtopping of the Palagnedra Dam,
W82-04952
8A

BRUSENTSEVA, S. A.
Prospects of Using Radiation Water Treatment Methods,
W82-05026
5D

BRUSLETTO, R.
Control of Alum Addition in Wastewater Treatment,
W82-04837
5D

BRYANT, E. G.
Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743
6B

BUCHERT, H.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828
5A

BUCK, J. D.
Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894
2L

BUCKHOUSE, J. C.
Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867
2J

BUCSH, R. O.
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259
5D

BUDNIKOV, E. L.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585
8H

BUELOW, R. W.
The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791
8G

BUGENYI, F. W. B.
Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578
5B

BUIKEMA, A. L. JR.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A
Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 5C

BULICH, A. A.
Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 5A

BULLER, J. R. JR.
An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 8B

BURBANK, N. C.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

BURDGE, R. J.
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 6D
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

BURGE, W. D.
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 5D

BURGH, J.
Saving Water Scenically,
W82-05789 5D

BURKE, C. D.
The Eighties--Implications for Water Management,
W82-05772 6B

BURKE, T.
Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 5F

BURMASTER, D. E.
The New Pollution--Groundwater Contamination,
W82-04938 5C

BURRIS, C. B.
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

BURSZTYNSKY, T. A.
Oil and Grease in Stormwater Runoff,
W82-05557 5C

BURTON, D. T.
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C

BURTON, H. R.
Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 2H

BUSCH, J. R.
Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 3F

BUSET, H.
Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

BUSH, P. B.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

BUSHWAY, R. J.
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

BUSO, D. C.
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

BUTAKOV, A. N.
Determination of the Optimal Height of the Bucket Lip of a Ski-Jump Spillway,
W82-05107 8B

BUTH, D.
The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 5D

BUTTERWORTH, B. C.
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

BUTTS, E.
Water Hammer,
W82-05432 8C

BUTWELL, A. J.
The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 5D

BYKOVSKIY, V. I.
Effect of Water Turbulence on Illumination at Depth,
W82-05594 1A

BYROADE, J. D.
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 5G

CAHILL, T. H.
A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 7B

CAIRE, R.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

CAIRNS, J.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H
Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 5A

CAIRNS, J. JR.
Biological Monitoring, Part III- Receiving System Methodology Based on Community Structure,
W82-05023 5A
Biological Monitoring, Part V - Preference and Avoidance Studies,
W82-05340 5C
Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 5A

CAIRNS, J. K. JR.
Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 5C

CAIRNS, J. R.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A

CAIRO, P. R.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 5F

CALKINS, J.
Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

CAMBOULIVES, J. M.
Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 2E

CAMERON, J. M.
Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 6E

CAMPANA, R. J.
The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 5C

CAMPBELL, W.
An Exercise in Sludge Consolidation,
W82-04848 5D

CANO, C. J.
The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 6E

CANTON, S. P.
Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 5C

CARBON, B. A.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

CARDILE, R.
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 5D

CARDY, W. F. G.
River Basins and Water Management in New Brunswick,
W82-05391 6D
Water Management in the Maritimes,
W82-05776 6B

CAREY, W. P.
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

CARLYLE, R. M.
Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 5D

CARPENTER, S. R.
Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 2H

CARR, R. S.
A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 5A

CARSWELL, L. D.
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 2F

CARTER, J. C.
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

CARTER, J. C. H.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

CARTER, J. L.
Water System Design Meets Modern Challenges,
W82-05170 5F

CARTER, M. V.
Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 6B

CARVER, J. D.
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04902 6E

CARY, J. S.
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 8A

CASSIDY, R. M.
Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 5A

CATHEY, D. D.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

CHACEY, K. A.
Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 5F

CHAIX, B.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 8B

CHAMBLEE, J. A.
Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 5D

CHAMPION, D. B.
A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 6D

CHAMPNEY, R. U.
Five-Year Plan of the Water Resources Research Center,
W82-05526 6B

CHAN, C. H.
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

CHAN, K. Y.
Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 5E

CHANDRA, B.
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 8E

CHANDRA, S.
Flow Under Weir on Scoured Bed,
W82-05800 8B

CHANG, A. C.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

CHANG, C.
Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 2G

CHANG, S. Y.
Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 6A

CHAPELLE, F.
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

CHAPMAN, B. M.
Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 5B

CHAPMAN, D. E.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 5C

CHAPPELL, T. E.
A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 5D

CHAPRA, S. C.
A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 5B

CHAUHAN, S.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

CHENG, C-S.
Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 5D

CHERNILOV, A. G.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 8A

CHERNOCK, G.
Egypt Tackles Rural Supply Task,
W82-05754 5F

CHERRY, D. S.
Biological Monitoring. Part V - Preference and Avoidance Studies,
W82-05340 5C

CHIARITO, V.
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

CHIBA, K.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 5A

CHICHESTER, F. W.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

CHIEUX, P.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

CHIGBO, F. E.
Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 5B

CHILDERS, J. M.
Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 4A

CHO, C. Y.
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 5B

CHOPRA, A. K.
Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 8D

CHRISTOPHERSEN, N.
Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 2K

CHROSTOWSKI, P. C.
Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 5F

CHU, R.-L.
Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 5D

CHUDOBA, J.
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 5D

CHURCH, M.
On Hydrological Data Needs in Canada,
W82-05764 7B

CHURCH, R. L.
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

CHURCH, T. M.
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

CHURCHILL, J. W.
Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 7B

CHURCHLAND, L. M.
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 5A

CHURCHWELL, R. L.
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

CILLIE, G. G.
Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

CIRELLO, J.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

CLAPP, C. E.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

CLARK, C. K.
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

CLARK, C. S.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

CLARK, R. M.
Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 5C

A Spatial Costing System for Drinking Water,
W82-04796 6C

CLARK, R. P.
The Agus II Scheme in the Philippines,
W82-05399 8A

CLARK, R. R.
Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 5A

CLARKE, E. A.
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 5B

CLAY, D. M.
Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 7C

CLAYTON, J. R. JR.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 5C

CLESCERI, N. L.
Land Application of Secondary Effluent at Lake George, NY,
W82-05704 5D

CLINGER, R. C.
Safety Considerations in Handling Activated Carbon,
W82-05442 5D

CLUFF, C. B.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 3C

COFFEY, A.
Stream Improvement: The Chicod Creek Episode,
W82-05717 4D

COHEN, A.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 5D

COLACICCO, D.
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 5D

Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

COLBECK, S. C.
Configuration of Ice in Frozen Media,
W82-05615 2C

COLE, J. J.
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

COLER, R. A.
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 5C

COLES, D. G.
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 5B

COLTHURST, J. M.
Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 5F

CONNELL, D. W.
An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606 5B

CONNELL, N.
Tracking Seasonal Load Variations,
W82-05787 5D

CONNELLY, P. J.
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 5D

CONWAY, R. A.
Impact of Discharges as a Basis for Control Measures,
W82-05354 5B

Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 5E

COOK, B.
Right Velocity Keeps the Solids Up,
W82-05788 5D

COOKE, D.
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-FeOOH) in Freshwaters,
W82-05140 2K

COOLEY, K. R.
Erosivity Values for Individual Design Storms,
W82-05694 4D

COOLEY, P.
Wedge-Block Tunnels in Water Supply,
W82-05803 8F

COOLIDGE, P. S.
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 3F

COOMBS, E. G.
High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 5A

COPELAND, C.
Water Resources in the Legislative Balance, 1982,
W82-05433 6E

COPLAND, D.
The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

CORBETT, E. S.
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 4C

CORLISS, D. A.
The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 5D

CORMACK, J. W.
Land Disposal of Sludge,
W82-04757 5E

COSTA, H. S.
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 5B

COUILLARD, D.
Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 5B

COUTANT, C. C.
Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 2B

COVAY, K. J.
Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

COWARDIN, L. M.
Wetlands and Deepwater Habitats: A New Classification,
W82-05716 2L

COWING, D. J.
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 5G

COWLING, E. B.
Acid Precipitation in Historical Perspective,
W82-04807 5B

COYLE, J. T.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 5F

CRAMER, W. N.
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 5D

CRATE, J.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

CRAVEN, H.
Treating Phenol Resin Plant Wastes,
W82-05128 5D

CRAWFORD, C.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825
7C

CRESSWELL, C. F.
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098
5G

CREWE, W.
The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476
5B

CRISMAN, T. L.
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943
2H

CRITES, R. W.
Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258
5D

CRITTENDEN, J. C.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269
5D

CROCKET, J. H.
Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640
5B

CROSS, W. H.
Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257
5F

Role of Surface Active Media in Anaerobic Filters,
W82-05816
5D

CROW, N.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214
6G

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213
5E

CROWLEY, V.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558
6C

CRUTCHER, A. J.
Leachate Collection Design for Containment Landfills,
W82-04996
5E

CULLEY, J. L. B.
Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880
2A

CUNNINGHAM, R. L.
The Occurrence of Flow Channels in Soils,
W82-04875
3C

CURLEY, T.
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978
7C

CURRAN, H. M.
Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309
3A

CURTIN, S. E.
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838
7C

CZUBA, M.
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570
5C

DADSWELL, M. J.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379
2H

DAGUE, R. E.
Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323
5D

DAHL, D.
On the Sampling Variance of Raingage Networks,
W82-05875
7B

DAHM, C. N.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125
2H

DALELA, R. C.
Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571
5C

DALY, E. L. JR.
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789
5A

DAMHAUG, T.
Control of Alum Addition in Wastewater Treatment,
W82-04837
5D

DANCHUK, W. J.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236
2E

DANIELSON, T. W.
Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220
7C

DANIELSSON, L. G.
On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012
5A

DARVES-BORNOZ, R.
Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278
4B

DAUBERT, J. T.
Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932
4B

DAUGHERTY, J. L.
'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720
5D

DAVID, L.
Dual Objective Control of Nutrient Loading into a Lake,
W82-05750
5G

DAVIDAR, D. J.
India: Every River Polluted, and Few Effective Controls,
W82-05033
5B

DAVIES, M. H.
The Search for Reservoir Sites in an Urban Environment,
W82-04867
8A

DAVIS, D. L.
Acid Precipitation. 1. Causes and Consequences,
W82-04771
5C

DAVIS, J. J.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670
5F

DAVIS, R. A.
'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720
5D

DAVISON, W.
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176
7B

DAY, A. D.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873
3C

DAY, J. C.
The Long Lake Diversion: An Environmental Evaluation,
W82-05568
6G

Northwestern Ontario River Dimensions,
W82-05742
6G

DAY, J. P.
A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577
5B

DAY, J. W. JR.
Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622
5C

DDORE, M.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678
5F

DE ALMEIDA, M.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050
2A

DE DECKER, P.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940
2H

DE GREEF, E.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913
5A

DE JESUS, S. J.
The Agus II Scheme in the Philippines,
W82-05599
8A

DE LAAT, J.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678
5F

DE MAEYER-CLEEMPOEL, S.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923
5A

DE MORAES, J.
Turbines for Itaipu,
W82-04955
8C

DE S, N. L.
Aeration at High Velocity Flows,
W82-05602 8A

DE VRIES, A.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 5A

DE VRIES, R. T. P.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

DE WET, F. J.
Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

DE WULF, E.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 5A

DEBALAK, K. A.
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 5C

DECK, B. L.
Radionuclides in Mono Lake, California,
W82-05461 5B

DEKKER, L. W.
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

DEL BRENNA, F.
Turbines for Itaipu,
W82-04955 8C

DELAND, M. R.
Acid Rain: Legal and Political Fallout,
W82-05147 6E

DELANEY, D. F.
Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 7C

DELANEY, R. H.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

DELLEUR, J. W.
Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 4A

DELLEY, P.
The Overtopping of the Palagnedra Dam,
W82-04952 8A

DELMAS, D.
Improvement of Swirl Concentrator,
W82-05821 5D

DEMARRE, J.
Sampling and Analyzing Water,
W82-05263 5A

DEMIDOV, V. N.
Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 2A

DEMPSEY, P. S.
Oil Shale and Water Quality: The Colorado Prospectus under Federal, State, and International Law,
W82-04803 6E

DEN BLANKEN, J. G.
Microbial Activity in Activated Carbon Filters,
W82-05683 5F

DEPINTO, J. V.
Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 5B

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

DERECKI, J. A.
Stability Effects on Great Lakes Evaporation,
W82-05634 2D

DESAULNIERS, J. A. H.
Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

DETAR, W. R.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 6C

DEVOL, A. H.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B

DICKINSON, H.
The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 6D

DIERCKX, P.
A New Method of Cubature Using Spline Functions,
W82-04939 2L

A New Method of Cubature Using Spline Functions,
W82-05189 2L

DIETRICH, A. M.
Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 5F

DIETRICH, C. C.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

DILLAHA, T. A. III
Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 4D

DINCHAK, W. G.
Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 8F

DISSANAYAKE, C. B.
Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 5C

DOBOSZ, J.
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 5D

DODSON, A. H.
Measuring Reservoir Ground Movements,
W82-05773 8G

DOHANYOS, M.
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 5D

DOLAN, D. M.
Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 5C

DOLAN, F.
Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 5F

DOLIN, P. I.
Prospects of Using Radiation Water Treatment Methods,
W82-05026 5D

DOMBROVSKII, V. N.
Bearing Capacity of Sand Bases (Discussion of Construction Specifications),
W82-05583 8D

DOMINIK, J.
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 5B

DONNELLON, J. J.
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D

DONNELLY, K. C.
Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 5C

DOORIS, G. M.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 5C

DOORIS, P. M.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 5C

DORCEY, A. H. J.
The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 6F

DOUGLASS, J. E.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

DOWDY, R. H.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

DOWELL, J. C.
Sewage Pumping Station Split for Maintenance,
W82-05719 5D

DRESSEL, P.
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

DRUMMOND, D.
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

DUBETZ, S.
Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 2G

DUCKSTEIN, L.
Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 5G

DUDDRIDGE, J. E.
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 5C

DUIGON, M. T.
Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

DUKE, M. L.
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 5D

DUKE, T. W.
Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 5C

DUNAEVSKII, R. A.
Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116 8E

DUNCAN, L. C.
Acid Precipitation in the Washington Cascades,
W82-05287 5B

DUNLAP, R. M.
Fresh-Water Transport by Sea,
W82-04861 6D

DUNN, D. L.
An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 6A

DUNN, I. J.
Kinetics of Biofilm Nitrification,
W82-05374 5D

DUNN, S. J.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

DUNNETTE, D. A.
Sampling Frequency Optimization Using a Water Quality Index,
W82-05268 5A

DUPUY, A. E. JR.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

DUPUY, G.
Sewers and Cities: France and the United States Compared,
W82-05684 5D

DUPUY, J.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

DUSSART, G.
A Pragmatic Approach to Water Quality Microbiology in a Clean River Area,
W82-05575 5A

DYER, T. G. J.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 2B

DZUBAN, N. A.
Hypania Invalida in the Volga Reservoirs and Hydrobiological Monitoring,
W82-05331 2H

EADIE, B. J.
Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 2H

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

EAGLESON, K. W.
Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

EAGLESON, P. S.
Identification of Independent Rainstorms,
W82-05708 2B

EARL, K. D.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 3C

EBERLE, M.
Water Use in Ohio, 1975,
W82-05226 6D

ECKENFELDER, W. W.
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 5D

ECKENFELDER, W. W. JR.
Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 5D

ECKMANN, D. E.
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

EDGEHILL, R. U.
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 5G

EDGREN, M.
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C

EDMOND, J. M.
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

EDZWALD, J. K.
A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

EGANHOUSE, R. P.
Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 5B

EISENHAUER, D. E.
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 4B

EISLER, L. A.
Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 8D

EKERN, P. C.
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 3C

EL-SAYED, M. K.
Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 5B

EL-SEBAE, A. H.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 5B

ELAMAYEM, M. M. A.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 5B

ELCHUK, S.
Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 5A

ELLIS, B. G.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

ELLIS, M. J.
Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 7C

ELLIS, R. M.
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 8E

ELSAYED, E. E. M.
Thermocline Drawdown Above Cooling Water Intakes,
W82-05560 8C

ELZERMAN, A. W.
Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 5A

EMANUEL, R. P.
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 5G

EMMERMANN, D. K.
VTE/VC for Sea Water,
W82-04909 3A

ENCK, E. D.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

ENGELKE, M. J. JR.
Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

ENGELS, C.
Ozone and Activated Carbon,
W82-05370 5F

ENGLESSON, G. A.
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 2D

ERICKSON, A. E.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

ERICKSON, K. A.
Evaluation of Snowmelt Forecasting Methods,
W82-05552 4A

ERMAK, D.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

ESMAEIL-BEIK, S.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 2E

EVANS, R. G.
Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

Salinity Control Measures for Grand Valley,
W82-05894 3F

EVENSON, W. E.
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 5A

EVERITT, D. A.
An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 2H

FACY, G.
Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 5F

FALKE, W.
Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 5A

FALKLER, W. A. JR.
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

FANCEY, L. L.
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 5C

FAROOQ, S.
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 5A

FAROOQUI, R.
Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 5C

FARQUHAR, G. J.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 5B

FARR, J. L.
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 4B

FARRINGTON, P.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

FAUST, W.
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

FENDER, V. F.
A Spatial Costing System for Drinking Water,
W82-04796 6C

FENG, Y. J.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 5D

FERGUSON, J. F.
Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 5B

FERRADOU, C.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

FEUILLADE, J.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 5C

FEUILLADE, M.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 5C

FIELD, R.
An Overview of Porous Pavement Research,
W82-05744 5D

FIELD, W. G.
Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 4A

FIERING, M. B.
Alternative Indices of Resilience,
W82-05045 6A

Estimates of Resilience Indices by Simulation,
W82-05046 6A

Estimating Resilience by Canonical Analysis,
W82-05047 6A

A Screening Model to Quantify Resilience,
W82-05044 6A

FINANCE, C.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

FINN, R. K.
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 5G

FINNEY, B. A.
Random Differential Equations in River Water Quality Modeling,
W82-05343 6A

FINNEY, V. L.
Acid Pond Drainage,
W82-05199 5G

FINSTEIN, M. S.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

FISCHER, R. A.
Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 3F

FISH, R. H.
Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 5A

FISHER, J. B.
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 2H

FISHER, S. G.
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

FITCH, J. H. JR.
A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 5B

FITZGERALD, K. K.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

FLAKE, R. H.
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 6A

FLEISSNER, J. T.
Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 5A

FLINT, R. W.
Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 5C

FLORA, M. D.
The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 5A

FLORET, C.
Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 2D

FLUG, M.
Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

FOERSTEL, H.
The Mackenzie River Basin Study,
W82-05778 4A

FOGG, G. E.
Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 5B

FORD, D.
Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 4A

FORD, D. L.
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

FORIS, W. J.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

FORLIN, L.
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

FORSBERG, C.
Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

FOSBERG, T. M.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D

FOSTER, S. S. D.
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 4B

FOX, I. K.
Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-05564 6A

FOY, R. H.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

FRALISH, M. C.
Shock Load of Chromium (VI),
W82-05253 5D

FRANCE, P. W.
An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279 8B

FRANK, R.
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B
Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 5B

FRANKEL, R. J.
Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 5F

FREDERICK, V. R.
Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 5C

FREILING, K.
The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 5D

FRENCH, R. H.
State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 2H

FREUDENBURG, W. R.
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 5B

FRIANT, S. L.
The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 5A

FRIELING, J. L.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

FRIESEN, B. F.
Northwestern Ontario River Dimensions,
W82-05742 6G

FRITZ, P.
The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 2K

FRONCZAK, R.
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 5D

FRONZA, G.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A

FROOMER, N. L.
The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 2J

FRUH, E. G.
Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 2H

FU-SHENG, W.
Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 5A

FUJIE, K.
Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 5D

FUJIOKA, R. S.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

FUKSMAN, Y. L.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

FUNGLADDA, N.
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 5A

FUSCO, R. A.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 5D

GABER, M. S.
Methane in Water Wells,
W82-05262 5F

GAITHER, R. E.
Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 2J

GALAT, D. L.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

GALITSYN, M. S.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 5D

GALLAGHER, D.
Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 6C

GALLOWAY, J. N.
Effects of Acid Precipitation,
W82-05149 5C

GANDZYUK, S. S.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 8H

GARCIN, J. F.
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 5F

GARDNER, A. M.
Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 5D

GARDNER, W. S.
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

GAROFALO, F.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 4A

GARRETT, M. R.
Water Management in the Metropolitan Toronto Region,
W82-05775 6B

GARRISON, W. E.
Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

GARTSIDE, P. S.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

GASET, A.
Surfactant Adsorption on the Wool Carbonising Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 5D

GASS, T.
Sampling and Analyzing Water,
W82-05263 5A

GATES, J. S.
Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

GATES, W. H.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

GAUDY, A. F. JR.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 5D

GAUDY, E. T.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 5D

AUTHOR INDEX

GAUNTLETT, R.
Biological Denitrification for Potable Water Treatment,
W82-05347 5F

GAVRILOVA, V. A.
An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

GAVRISHOVA, N. A.
Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 5A

GAY, F.
Water System Efficiencies,
W82-05281 8C

GAY, F. G.
Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 7C

GAYLE, G. A.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting.
W82-05536 5D

GEAR, D.
Can Hard-Rock Wells Solve Africa's Irrigation Problem,
W82-05303 3B

GEATING, J.
Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 5D

GEBHART, B.
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 2E

GEDDES, M. C.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

GELMAN, S. R.
Treating Phenol Resin Plant Wastes,
W82-05128 5D

GEORGE, D. G.
A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 7B

GEORGIANNA, T. D.
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 6D

GEORGIEV, A. A.
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 7B

GERBA, C. P.
Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 5B

GERLEK, S.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

GHASSEMI, M.
Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

GHERING, G. E.
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

GIAM, C. S.
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

GIBB, J. P.
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

GIBSON, B. W.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

GIBSON, C. E.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

GIGER, W.
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

GILBERT, R. G.
Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 5D

GILLEAN, J. I.
A Spatial Costing System for Drinking Water,
W82-04796 6C

GILLILAND, M. W.
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 6D

GILLOOLY, J. F.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 2B

GIVLER, C.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

GLADKOV, E. G.
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 2E

GLANTZ, M. H.
Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 2E

GLASS, N. R.
Effects of Acid Precipitation,
W82-05149 5C

GLAZE, W. H.
GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 5A

GLEED, J.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

GLIWICZ, Z. M.
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 2H

GLOVER, T. F.
Energy Siting in Utah: A Programming Model,
W82-05297 6B

GLYNN, J. E.
A Mechanism for the formation of Large Icebergs,
W82-04758 2C

GODFREY, P. J.
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Inhibiting the Green River, Massachusetts,
W82-04947 5C

GOEL, P. K.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

GOICHON, J.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 5F

GOLDBACH, J. C.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

GOLDMAN, J.
Oxygenation of the Avon River,
W82-05730 5G

GOLDROSEN, J. J.
Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

GOLDSCHMIDT, Y.
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

GOLDSMITH, F. B.
Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 2H

GOLDSTEIN, R. M.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

GOLUBEV, N. K.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 8A

GOMOLKO, L. N.
Concrete for Surfaces of High-Head Spillways,
W82-05110 8F

GONENG, E.
Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

GOPAL, B.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

GOPHEN, M.
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 2H

GORDON, J. L.
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 8A

The Expansion of Two Bolivian Plants,
W82-05598 8A

GORDON, M.
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 5A

GORDON, W.
Pump Installations for reverse Osmosis Systems,
W82-05882 8C

GORE, J. A.
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 8I

GORELICK, S. M.
Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 5G
Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 5G

GORGENS, A. H. M.
An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 2A

GOSINK, J. P.
Thermal Front Formation from Buoyant Surface Jets,
W82-05004 5C

GOSSOM, W. J.
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 5D

GOVE, G. W.
Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 5D

GOYAL, S. M.
Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 5B

GRACZYK, D.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 5A

GRAESER, H. J.
Conservation Ethics for the 1980's,
W82-05009 3D

GRAMANN, J. H.
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 6D

GRANT, D. L.
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 3F

GRANTHAM, D.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

GRASTY, R. L.
Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 2C

GRAU, P.
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 5D

GRAY, A. V.
Phosphorus Reduction Studies,
W82-05408 5D

GREEN, M.
Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 5D

GREENBERG, M.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

GREENE, M. C.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

GREER, J. D.
Recording Raingage Modifications,
W82-05665 7B

GREGERSEN, H. M.
Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 6B

GRIFFIN, R. A.
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

GRIFFITHS, G. A.
Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 2E

GRIFFITHS, I. W.
Sulphide Control in Rising Mains,
W82-05465 5D

GRIGOR'EV, V. M.
Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 8C

GRIMM, N. G.
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

GRODZINSKA, K.
Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 5B

GROHMANN, A.
New Flocculation Units with High Efficiency,
W82-04840 5D

GROSCH, C. E.
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 2L

GRUBER, D.
Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 5A

GSCHWEND, P. M.
Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 5B

GUEDES, Q. M.
Relaxation in Concrete,
W82-05511 8F

GUILBAULT, G. G.
Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 5A

GUMMER, J. H.
Turbines for Itaipu,
W82-04955 8C

GUPTA, R. K.
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 3I

GUPTA, R. P.
Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 7C

GUSYNSKAYA, S. L.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

GUTH, E.
Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

GUTHRIE, R. K.
Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 5A

GUTTMAN, J.
Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 2F

GYSI, M.
A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 6B

HACKBARTH, D. A.
Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 4B

HADLEY, T. L.
Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 7C

HAGERTY, D.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

HALE, J. M.
A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 7B

HALE, T. W.
Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 2E

HALL, C.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 6G

HALL, E. J.
Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

HALL, J. F.
Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 8D

HALL, L. W. JR.
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C

HALLERMEIER, R. J.
Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 2J

HALVORSON, A. D.
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

HAMILTON, G. D.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

HAMILTON, J. R.
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 3F

HAMMER, U. T.
Primary Production in Saline Lakes,
W82-04926 2H

HAMMETT, K. M.
Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 7C

HAMMITT, F. G.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 8B

HAMPSON, P. S.
Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 7C

HANDLEY, L. L.
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 3C

HANDMER, J. W.
Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 7C

HANKE, S. H.
Crisis-Ridden Water Systems Should Go Private,
W82-05436 6C

HANNUKSELA, J. S.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 2E

HANSEN, B. E.
Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

HANSEN, S.
Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

HANSON, D. W.
The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 5C

HANSSON, T.
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

HANUSOVA, J.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 5B

HAPPEY-WOOD, C. M.
Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

HARAGUCHI, H.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 5A

HARBOE, R.
Applications of Simulation to Specific Water Projects,
W82-05522 6A

HARING, J. A.
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 5A

HARKER, R. J.
Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 5B

HARKINS, J. R.
Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 2E

HARKNESS, N.
The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 5C

HARLESS, R. L.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

HARMON, B.
Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 8G

HARREMOES, P.
Criteria for Nitrification in Fixed Film Reactors,
W82-05352 5D

HARRISS, R. C.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 2K

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 2L

HART, G. E.
Erosion from Mountain Snowpack Melt,
W82-05664 2J

HARTENSTEIN, R.
Potential Use of Earthworms as a Solution to Sludge Management,
W82-05478 5E

HARTIG, J. H.
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 5G

HARVEY, A.
Promising Steps Toward a New Ottawa River Regulation,
W82-05394 6E

HASHIMOTO, T.
Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 6A

Robustness of Water Resources Systems,
W82-05077 6A

HATCHER, M. L.
Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 5B

HATHAWAY, R. M.
Water Use in Ohio, 1975,
W82-05226 6D

HAUGAN, B.-E.
Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

HAUGH, R. S.
Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

HAVLIK, B.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 5B

HAWERMAN, B.
Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

HAWKES, H. A.
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 5D

HAWLEY, M. E.
Water Yield Estimation in Western United States,
W82-05689 4D

HAYDU, K. J.
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 2B

HAYES, C. R.
The use of Activated Carbon in Water Treatment,
W82-05182 5F

HAYES, E. C.
Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C

HAYNES, D. L.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

HAYNES, K. E.
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 6D

HAYS, A. J. JR.
A Consistent Methodology for Wasteload Allocations,
W82-05702 5G

HEADWORTH, H. G.
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

HEATH, M. S.
Wastewater Management in Coastal North Carolina,
W82-05559 5E

HECKMAN, C. W.
Pesticide Effects on Aquatic Habitats,
W82-05146 5C

HEERTJES, P. M.
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 5D

HEINEMANN, W. H.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 8A

HEINKE, G. W.
Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

HELDER, W.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

HELLBERG, T.
The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 2H

HELSEL, D. R.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

HELZ, G. R.
Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 2L

HEMOND, H. F.
A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076 7B

HENDERSON, J. E.
GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 5A

HENDERSON, R. J. A.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

HENDREY, G. R.
Effects of Acid Precipitation,
W82-05149 5C

HENDRICKS, D. W.
Fecal Coliform Densities in a Western Watershed,
W82-05618 5B

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

Water Reuse Planning by Means of an Input-Output Table,
W82-04794 6A

HENEBRY, M. S.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H

HENNEY, R. C.
Shock Load of Chromium (VI),
W82-05253 5D

HENNIGAN, R. D.
Institutional Change - Water Quality Management,
W82-05401 6E

HENSEL, R.
Pump Installations for reverse Osmosis Systems,
W82-05882 8C

HENZEN, M. R.
Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

HERB, W. J.
Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

HERMANN, R.
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

HERRICKS, E. E.
Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 5A

HESTER, W. H.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 3D

HEWLETT, J. D.
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 4C

HICKEY, J. J.
Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

HICKMAN, E.
Characterization of Properties of Water,
W82-05540 1A

HICKS, R.
Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 6D

HIGGINS, A. J.
Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 5E

HIGGINS, G.
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

HIGGINS, J. M.
Do Model for Discharges from Deep Impoundments,
W82-05316 2H

HILDEBRAND, S. G.
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 6D

HILER, E. A.
A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 3F

HILL, D. E.
Optimization Principle for Air and Water Movement,
W82-05172 2G

HILL, D. R.
Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 5A

HILLEARY, J. T.
Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 7C

HILSDON, C. W.
Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 8C

HINES, M. E.
Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 2L

HINKS, R. W.
Five Year Water Resources Research Plan for the State of California,
W82-05532 6B

HINRICHS, R. L.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 5D

HIPEL, K. W.
Operational Research Techniques in River Basin Management,
W82-05387 6A

HIRAYAMA, K.
Studies on Oxygen Transfer Models,
W82-05349 1A

HIRSCH, R. M.
Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 7C

HITES, R. A.
Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 5B

HITZ, H. R.
The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 5C

HJORT, J.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

HLAVAY, J.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

HO, Y. B.
Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 2H

HOBBA, W. A. JR.
Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 2F

HODGDON, R. B.
Research on Piezodialysis - Sixth Report,
W82-05294 3A

HOFFMAN, D.
Low Temperature Evaporation Plants,
W82-05118 3A

HOFKER, E.
How Proper Prospecting Improves the Odds,
W82-05757 3B

HOFSTEE, A. W. M.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 5A

HOLBURT, M. B.
Colorado River Water Allocation,
W82-05888 6C

International Problems on the Colorado River,
W82-05892 5G

HOLDRINET, H.
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B

HOLDSWORTH, G.
A Mechanism for the formation of Large Icebergs,
W82-04798 2C

HOLLETT, K. J.
Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

HOLLOD, G. J.
Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 5F

HOLLON, B. F.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 5B

HOLMAN, W. F.
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 5D

HOLMES, K. T.
Infiltration Inflow Analysis: Finding the Source,
W82-05038 5B

HOLSAMBRE, D. G.
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 8B

HONEYCUTT, F. G. JR.
Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 6B

HOOD, J. W.
Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

HOOK, N. K. JR.
Billing Data Aids Utility Planning,
W82-05786 6C

HOOVER, J. R.
Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 2G

HOPE, M.
Town of De Beque V. Enewold: Conditional Water Rights and Statutory Water Law,
W82-04801 6E

HOPKINS, L. D.
Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 6A

HOPPING, W. D.
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 5D

HORNSBY, A. G.
The Colorado River Salinity Problem,
W82-05889 5G

HORSFALL, F. L. III.
Chemometric Modeling of Wastewater Treatment Processes,
W82-05858 5D

HORSLEY, R. W.
Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 5B

HORVATH, F. J.
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 5G

HOSKING, R. J.
Steady Shallow Flow Over a Spillway,
W82-05086 8B

HOULE, E. H.
Treatment of Cooling Tower Blowdown,
W82-04908 5D

HOUSTON, J. F. T.
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 4B

HOWELL, T. A.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

HU, M. C.
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 2D

HUANG, J-C.
Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05859 5D

HUBBARD, R. K.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

HUBER, D.
Oxygenation of the Avon River,
W82-05730 5G

HUDON, C.
Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 2L

HUDSON, H. R.
A Field Technique to Directly Measure River Bank Erosion,
W82-05410 7B

HUGGINS, L. F.
Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 4D

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 4D

HUGHES, C. H.
VTE/VC for Sea Water,
W82-04909 3A

HUGHES, D. A.
An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 2A

HUGHES, M. C.
Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 2K

HUGHES, P. E.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 2E

HUGHEY, P. W.
Algorithm for Optimal Activated Sludge Operation,
W82-05682 5D

HUGHTO, R. J.
Microcomputer Water Quality Simulation Model,
W82-05191 7B

HULTMAN, B.
Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

HUNT, C. D. JR.
Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

HUNT, L. L.
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

HUNTER, J. V.
Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 5E

Settleability of Urban Runoff Pollution,
W82-05320 5G

HUPPERT, H. E.
Icebergs: Technology for the Future,
W82-04778 2C

HUTHMANN, G.
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

IDSO, S. B.
Humidity Measurement by Infrared Thermometry,
W82-05611 7B

IKEDA, S.
Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 2E

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 2E

ILIAS, S.
Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 5C

ILIEV, S.
Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 8A

ILLANGASEKARE, T.
Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 2F

ILYUSHIN, V. F.
Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 8A

IMAMURA, T.
Advanced Supervisory Control System for Sludge Treatment,
W82-04841 5D

IMHOFF, K. R.
Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 5D

INCZEDY, J.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

INKINA, G. A.
Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

INNERFELD, H.
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

IRVINE, R. L.
Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 5D

ISAAC, P.
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 5G

IVANOVA, T. N.
Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 4A

IVASHCHENKO, I. N.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

IVERSON, W. P.
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 5A

IWAI, S.
Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 5D

JACKSON, J. A. A.
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 5A

JACOBS, A.
Trends in Sludge Management,
W82-05435 5E

JACQUEZ, R. B.
Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 5F

JAEGER, C.
Resonance in Hydropower Stations,
W82-04953 8C

JAGGI, I. K.
Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 2D

JAHNKE, A.
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

JAHREN, N. G.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 8E

JAL, J. F.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

JAMES, A.
Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 5D

JAMES, C. R.
Considering Sludge Production in the Selection of Coagulants,
W82-05675 5F

JAMES, L. D.
Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 6B

JAMES, R. H.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 5A

JANONIS, B. A.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

JAQUETTE, D. J.
Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 4B

JARRETT, A. R.
Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 2G

JENKINS, C. R.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

JENKINS, D.
Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

JENKINS, S. H.
Disposing of Sewage Sludge at Sea,
W82-05127 5B

JENNETT, J. C.
Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 5D

JENSEN, R. G.
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

JEPSEN, C. P.
Effects of Salts on Activated Carbon Adsorption of Fulvic Acids,
W82-05667 5F

JERVIS, R. E.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

JEWELL, T. K.
Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 5B

JEWETT, K. L.
Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 5A

JOFRE, J.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

JOHN, P.
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 5A

JOHNSON, C. C. JR.
The Safe Drinking Water Act on Review,
W82-05792 5G

JOHNSON, D. A.
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

JOHNSON, D. P.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

JOHNSON, H. P.
Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 5B

JOHNSON, K. G.
Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

JOHNSON, K. L.
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

JOHNSON, P. R.
Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

JOHNSON, R. S.
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 2E

JOHNSON, V. G.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 5C

JOHNSTON, J. B.
Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 5A

JOKINEN, E. H.
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 5C

JOLLER, T.
Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 5B

JONASSON, R.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

JONES, D. D.
Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 5D

JONES, D. E. B.
Measuring Reservoir Ground Movements,
W82-05773 8G

JONES, G. L.
Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 5D

JONES, K.
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 2B

JONES, M. J.
Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 5B

JONES, P. H.
Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 5D

JONES, R. A.
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 5G

JOSBERGER, E. G.
A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 2C

JOSE, C.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

JOSEPHSON, J.
Groundwater Monitoring,
W82-04809 6E

Humic Substances,
W82-05148 5B

JOUBERT, P. J.
Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 5D

JUDKINS, J. R. JR.
Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 5E

JUDY, R. D. JR.
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 8I

JUNE, J. A.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 5C

JUNOR, F. J. R.
The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 2H

KABIR, A.
Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 5B

KACHTICK, J. W.
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

KALCHEV, L.
Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 8A

KALFF, J.
The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 5C

KALKE, R. D.
Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 5C

KALKHOFF, S. J.
Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 5B

KAN, G.
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 5A

KANWAR, R. S.
Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 5B

KAPLAN, I. R.
Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 5B

KAPLOVSKY, A. J.
Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 5E

KARABAEV, E. I.
Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 8A

KARADENIZ, H.
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 8B

KARICKHOFF, S. W.
Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 5B

KASATKIN, Y. N.
Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 8A

KATZ, D.
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D

KATZER, T.
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

KAVANAGH, B. V.
Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 5D

KAYSER, W. V.
Characterization of Properties of Water,
W82-05540 1A

KAZMANN, R. G.
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 8B

KEATING, T.
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

KECK, R. G.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

KEECH, D. K.
Methane in Water Wells,
W82-05262 5F

KEENE, J.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

KEITH, J. E.
Energy Siting in Utah: A Programming Model,
W82-05297 6B

KELLERHALS, R.
On Hydrological Data Needs in Canada,
W82-05764 7B

KEMP, G. P.
Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 5C

KEMPA, E. S.
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843
5D

KEMPER, W. D.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617
8A

KEMPF, T.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767
5A

KENNEDY, A.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143
5B

KENNEDY, J. H.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949
5B

KENYON, K. F.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830
3C

KEOHAN, P. W.
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071
5D

KERCHER, J.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214
6G

KERFOOT, W. B.
Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322
5B

KERKHOFF, M. A. T.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916
5A

KERNODLE, D. R.
Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848
4A

KERR, S. N.
Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065
5E

KESWICK, B. H.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446
5D

KHAN, I. A.
Determination of Aquifer Parameters Using Regression Analysis,
W82-05734
2F

Managing Salinity in Irrigated Agriculture,
W82-05691
3C

KHAN, K. A.
Role of Surface Active Media in Anaerobic Filters,
W82-05816
5D

KIBLER, D. F.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558
6C

KIM, B. R.
Do Model for Discharges from Deep Impoundments,
W82-05316
2H

KINCAID, D. C.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617
8A

KING, J. E.
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687
5D

KIRKHAM, D.
Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709
5B

KITAGISHI, H.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844
5D

KITCHENS, W. M.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054
6G

KLEMER, A. R.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175
5C

KLENUS, V. G.
Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326
1A

KLETKE, D.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922
4B

KLINGEMAN, P. C.
Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795
2J

KLOOZ, D.
Sequential Water Reuse Effect on Stream Salinity,
W82-05731
3C

Water Reuse Planning by Means of an Input-Output Table,
W82-04794
6A

KLOPATEK, J. M.
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806
6D

KLOSTERMAN, M. J.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201
8E

KNAP, A. H.
Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144
5B

KNAPP, K.
Barriers to Effective Ground-Water Management: The California Case,
W82-04917
4B

KNAPP, V.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964
2E

KNAUER, G. A.
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776
5A

KNOTT, R. K.
Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841
7C

KOBAYASHI, H.
Microbial Removal of Hazardous Organic Compounds,
W82-05177
5D

KOCH, R.
Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093
5A

KODUKALA, P. S.
Biodegradation of Hazardous Organic Pollutants,
W82-04910
5B

KOIVUSARRI, U.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827
5A

KOMINEK, E.
Anaerobic Treatment of High-Strength Wastes,
W82-04907
5D

KONDO, O.
Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891
5A

KONONOV, V. V.
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592
8C

KONOPLYANTSEV, A. A.
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043
2G

KOOL, H. J.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913
5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912
5A

KORSAK, N. B.
The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453
2H

KOSICHENKO, Y. M.
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117
8G

KOSKINEN, J. R.
Chemometric Modeling of Wastewater Treatment Processe,
W82-05858
5D

KOUTSANDREAS, J. D.
Overview and Assessment of Biological Sensing,
W82-05156
5C

KOVAL'CHUK, A. A.
Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332
2H

KOWALCZEWSKI, A.
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Masurian Lakes, Poland,
W82-05103 2H

KOYAMA-ITO, H.
Pine Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

KOZAR, A. V.
New Methods of Designing Flood Control Measures,
W82-05030 2E

KOZIARSKI, S.
Anaerobic Treatment in Novel Contact Digester,
W82-05681 5D

KRAINOV, S. R.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 5D

KRAKOVSKII, B. S.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 8C

KRAMER, J. R.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

KRAMLICH, C. L.
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 6E

KRASNIKOV, N. D.
Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 8D

KRATKY, B. A.
Cutting Irrigation Costs,
W82-05081 3F

KRATZER, K.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 5B

KREITLER, C. W.
Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 5B

KRENKEL, P. A.
State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 2H

KRESGE, P. O.
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

KRISHNA, J. H.
A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 2E

KRISHNAMURTI, T. N.
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 2B

KRISHNAN, A.
Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 2I

KRISHNASWAMI, S. K.
Protecting the Source,
W82-05785 5F

KRONFELD, J.
Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 2F

KRUER, S. A.
Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

KRUGLOVA, A. N.
The Importance of Lacustrine Zooplankton to the Feeding Capacity of the Lizhma Lake-River System (Basin of Lake Onega).
W82-05508 2H

KU, H. F. H.
Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

KU, Y.
Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 5D

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 5B

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 5D

KUAN, S. S.
Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 5A

KUBOTA, H.
Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 5D

KUCZERA, G.
On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 2A

KUEHL, D. W.
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 5A

KUIJVENHOVEN, L. J.
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 5D

KUMAR, D.
Flow Under Weir on Scoured Bed,
W82-05800 8B

KUMAR, K. D.
Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 5C

KUNTZE, E.
Northern Elbe Culvert,
W82-05427 8B

KUNZ, H.
Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 5E

KUZ'MENKO, M. I.
Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1A

KYLE, S. W.
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

LA ROSE, H. R.
Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

LAANE, R. W. P. M.
Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 2L

LABEL, G. L.
Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

LABELLE, R.
Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 5C

LACINA, W. V.
Shock Load of Chromium (VI),
W82-05253 5D

LAMB, C. E.
Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 7C

LAMBERT, J. L.
Revised Rainfall Frequency Analysis for Houston,
W82-05863 2B

LAMBOU, V. W.
Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 5A

LAN, B. Y.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

LANCE, J. C.
Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 5D

LANDSBERGER, S.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

LANGE, W.
The Tidal Stream in the German Bight,
W82-05190 2L

LANGOWSKA, I.
Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 5G

LARONNE, J. B.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

LARSON, R. A.
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

LARSON, W. E.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

LATTERELL, J. J.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

LAU, L. S.
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

LAU, Y. L.
Velocity Distributions Under Floating Covers,
W82-05562 2E

LAUER, W. L.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 5G

LAW, J. P. JR.
The Colorado River Salinity Problem,
W82-05889 5G

LAYTON, D. W.
Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 5B

LEAN, D. R. S.
Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 5B

LEANEY, F. W.
Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648 2D

LEBOFF, J. P.
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 5G

LEE, F. N.
Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 2E

LEE, G. F.
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 5G

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

LEE, J. J.
Effects of Acid Precipitation,
W82-05149 5C

Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 5C

LEE, Y.-N.
Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 2K

LEFRANCOIS, P. R.
The Real Price of Urban Water,
W82-04797 6C

LEHMAN, J. T.
Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 2H

LEHMAN, O. R.
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B

LEHR, J.
Sampling and Analyzing Water,
W82-05263 5A

LEIGHTON, J. P.
Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 4B

LEINSTER, P.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 5A

LEITH, W.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

LEITNER, P.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

LEONARD, E. N.
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

LEPILOVA, YE. A.
An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

LERDTHUSNEE, W.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

LESSER, J. M.
Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 4B

LESSING, P.
Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

LESTER, J. N.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 5A

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 5C

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 5D

LETTENMAIER, D. P.
Evaluation of Snowmelt Forecasting Methods,
W82-05552 4A

LETTERMAN, R. D.
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

LEUNG, T. S.
Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 5C

LEVI-MINZI, R.
Humic Substances in Sewage Sludges,
W82-05576 5E

LEVINE, P. R.
Industry Helps Conserve Municipal Water,
W82-05674 3E

LEWIS, B. J.
Safety Considerations in Handling Activated Carbon,
W82-05442 5D

LEWIS, R. G.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

LEWIS, W. J.
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 4B

LIBARDI, P. L.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

LICHTE, H. W.
Performance Testing of Four Skimming Systems,
W82-05059 5G

LICK, W. J.
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

LIDER, E. L.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

LIKENS, G. E.
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

LILLEY, M. D.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

LIMA, V. M. S.
Relaxation in Concrete,
W82-05511 8F

LINDEN, D. R.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 3C

LINDSAY, B. E.
An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 6A

LINDSTROM-SEPPA, P.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

LINES, G. C.
Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 7A

LINNIK, P. N.
Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 2K

Procedure for Investigating Metallic Ion Complexing in Natural Waters,
W82-05595 5A

LIONEL, T.
Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

LITMANEN, R.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

LITTEN, W.
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

LITTIN, G. R.
Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 7C

LIU, C. C. K.
Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 5B

LLOYD, A.
A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 5A

LLOYD, O. B. JR.
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 2F

LOBANSKAYA, N. P.
Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 2A

LOCK, J.
Deep Shaft,
W82-05793 5D

LOCK, M. A.
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 5B

LOCKYEAR, C. F.
Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 5E

LOGAN, T. J.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 7B

LOGANATHAN, G. V.
Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 4A

LOH, P. C.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 5D

LOIJENS, H. S.
Stormwater Management in the Ottawa-Carleton Region,
W82-05563 5G

LONDON, W. B.
Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 6B

LONGLEY, K. E.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

LOOMIS, S. A.
Erosion from Mountain Snowpack Melt,
W82-05664 2J

LORD, C. J. III
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 2K

LORD, W. B.
Municipal Water Supply Restrictions as Urban Growth Constraints,
W82-05748 3D

LORDI, D.
Impact of American Regulations on Industrial Sludge Management,
W82-05184 6E

LOUCKS, D. P.
Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 6A

Robustness of Water Resources Systems,
W82-05077 6A

LOWER, G. W.
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 5D

LOWRY, J. H.
Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 5A

LOZINSKAYA, E. A.
Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 2D

LUBBERS, J. R.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

LUCENA, F.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

LUDWICK, J. C.
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 2L

LUDWIG, H. F.
Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 6G

LUE-HING, C.
Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

Impact of American Regulations on Industrial Sludge Management,
W82-05184 6E

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5B

LUKASIK, E. D.
Nitrogen Control at Three Related Plants,
W82-05434 5D

LUKIN, I. N.
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 8C

LUM, L. W. K.
Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 2H

LUNDBLAD, P. O.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

LYATKHER, V. M.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

LYNCH, D. R.
Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 5B

Models of Landfill Leaching: Organic Strength,
W82-05817 5B

LYNCH, J. A.
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 4C

MABEY, W. R.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

MACEINA, M. J.
The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 4A

MACGREGOR, A. N.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 3C

MACK, F. K.
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

MACKAY, D. C.
Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 2G

MACKAY, G. H.
Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 4A

MACKENZIE, C. J. G.
Water Quality Management in British Columbia,
W82-05767 5C

MACKNIGHT, H.
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 6E

MACLAY, R. W.
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

MACLOCK, B.
Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 6D

MADDOCK, T. III.
An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 2F

MAEDA, H.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 5A

MAHMOUD, T. A.
Wastewater from a Sugar Refining Industry,
W82-05337 5D

MAJETI, V. A.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

MALCOLM, R. L.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

MALEVANCHIK, B. S.
Engineering Aspects of Fish Protection at Water Intakes,
W82-04739 8I

MALINA, J. F. JR.
Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 5A

MANAHAN, S. E.
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 5D

MANBECK, D. M.
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 4B

MANGINI, A.
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 5B

MANKA, J.
Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

MANN, P. C.
The Real Price of Urban Water,
W82-04797 6C

MANNING, R.
Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 6C

MAPP, H.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

MAR, B. W.
Total Suspended Solids in Highway Runoff in Washington State,
W82-05320 5B

MARGREY, S. L.
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C

MARINO, M. A.
The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 6A

MARSH, F.
Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

MARSH, P.
Evaporation at a High Arctic Site,
W82-04899 2D

MARSHALL, B. E.
The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 2H

MARTIN, D. F.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 5C

MARTIN, D. J.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

MARTIN, J. H.
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 5A

MARTIN, R. S.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

MARTIN, S.
A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 2C

MARTIN, S. C.
Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 5B

MARTINOLA, B.
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 5F

MASLOVA, O. V.
Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507 5C

MASON, J. M. JR.
On-Site Stormwater Detention: An Overview,
W82-04758 4A

MASTEN, S. J.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

MASTERS, H.
An Overview of Porous Pavement Research,
W82-05744 5D

MATHEW, J.
Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 5A

MATHIEU, G.
Radionuclides in Mono Lake, California,
W82-05461 5B

MATHUR, B.
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 6E

MATISOFF, G.
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 2H

MATSCHE, N. F.
Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 5D

MATSUO, T.
Studies on Oxygen Transfer Models,
W82-05349 1A

MATSUOKA, I.
Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 7C

MATTHEWS, R. A.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A

MATTHEWS, R. C. JR.
Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 5C

MATTHIESSEN, P.
Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 5C

MAXWELL, M. J.
Sludge Management in the Rocky Mountain State,
W82-05165 5E

MAY, S. C.
Treatment of Cooling Tower Blowdown,
W82-04908 5D

MAY, V. J.
Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 7C

MAYACK, D. T.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

MCANALLY, W. H. JR.
Modeling: How and When to Use,
W82-04754 2L

MCARDLE, F. X.
Water Supply for New York City in the 1980s,
W82-05671 6D

MCAULIFFE, K. W.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 3C

MCBAIN, W.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

MCBEAN, E. A.
Issues in Simulation Model Design--A Case Study,
W82-05627 4A

Leachate Collection Design for Containment Landfills,
W82-04996 5E

MCCALL, P. L.
Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 2H

MCCALLUM, D. D.
An Exercise in Sludge Consolidation,
W82-04848 5D

MCCLIMANS, T. A.
River Plume Studies in Distorted Froude Models,
W82-05864 2E

MCCOLLOUGH, N. D.
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

MCCONNELL, J. B.
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

MCCUEN, R. H.
Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 2E

Water Yield Estimation in Western United States,
W82-05689 4D

MCCURDY, K. L.
A Stochastic Model of Soil Erosion,
W82-05298 2J

MCDANIEL, D. D.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

MCDONALD, R. J.
Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 4C

MCDONNELL, W. E.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

MCDOUGALL, W. J.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 5D

MCFARLAND, M. J.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

MCHUGH, J. O.
Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 5A

MCINTYRE, A. E.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 5A

MCKEOWN, J. J.
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 5B

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 5D

MCLEAN, D. G.
Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 2J

MCMAHON, B. R.
Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 5D

MCMAHON, G. C.
Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 6B

MCMILLAN, R. K.
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B

MCNAUGHTON, B.
Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 5B

MCPHERSON, B. F.
Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

MCQUAT, E. R.
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 5A

MEHTA, B. M.
Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 2E

MEHTA, G. D.
Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 3A

MELACK, J. M.
Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 2H

MELAMUT, D. L.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 8A

MENDIA, L.
Electrochemical Processes for Wastewater Treatment,
W82-05422 5D

MEREDITH, D. D.
Algorithm for Optimal Activated Sludge Operation,
W82-05682 5D

MERLET, N.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 5F

MESSER, J.
Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 6B

MEYER, C. R.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

MEYER, W. J.
Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 8G

MEYERS, M.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 5D

MICHAELI, A.
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

MICHALCZYK, B.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

MIDDLEBROOKS, E. J.
Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 5D

MIDDLEDITCH, B. S.
Volatile Constituents of the Produced Water Effluent from the Buccaneer Gas and Oil Field,
W82-05874 5A

MIDDLETON, A. C.
Algorithm for Optimal Activated Sludge Operation,
W82-05682 5D

MIJARES, G. R.
Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 5F

MIKHAILENKO, L. E.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

MIKHEYEVA, T. M.
Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 2H

MILES, M. L.
Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 5B

MILL, R.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

MILLER, H. C.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 5A

MILLER, J.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 5F

MILLER, R. D.
Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 5D

MILLER, R. L.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

MILLERO, F. J.
The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1B

MINCKLEY, W. L.
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

MINEAR, R. A.
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

MINEMOTO, M.
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 5A

MINGMIN, H.
Bed Load Fluctuation: Applications,
W82-05000 2J

MINK, J. F.
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 2F

MIRZAK, E. M.
Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 8A

MISHRA, G. C.
Flow Under Weir on Scoured Bed,
W82-05800 8B

MISSIMER, T. M.
Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

MITCHELL, B.
Unified River Basin Management,
W82-05769 6B

MITCHELL, J. K.
Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 2A

MITRA, R. I.
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 5D

MITSCH, W. J.
Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 5C

MITTELSTAEDT, E.
The Tidal Stream in the German Bight,
W82-05190 2L

MIYATA, H.
Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 5A

MIZUMURA, K.
Prediction of Water Level in Tidal Inlet,
W82-05005 4A

MOELLER, J. R.
Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

MOENCH, W. L. JR.
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 5C

MOHN, N.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

MOJIB, R. M.
Application of and Guidelines for Using Available Dam Break Models,
W82-05152 8A

MOLENKAMP, C. R.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

MOLINIER, J.
Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 5D

MOLLENDORF, J. C.
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 2E

MONKE, E. J.
Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 4D

MONTIEL, A.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

MOODIE, S. P.
Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 5D

MOOLEY, D. A.
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 2A

MOONEY, G. A.
Treating Phenol Resin Plant Wastes,
W82-05128 5D

MOORE, B. E.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

MOORE, J. W.
Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 5B

MORAINE, R.
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 5D

MORALES, M.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

MORARIU, S.
Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 6B

Computer-Aided Evaluation of Peru's Hydropower,
W82-05515 6A

MOREL-SEYTOUX, H. J.
Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 2F

MORGAN, E. L.
Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 5C

MORGAN, J. M.
History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 6E

MORGAN, W. L.
Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 5B

MORIN, J.
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

MORREY, M. J.
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 4B

MORRIS, J. C.
Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 5D

MORRIS, M. L.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

MORRIS, W. F.
Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 5B

MORRISON, A.
The Booming Business in Wick Drains,
W82-05192 8G

MORSE, W. J.
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

MORTIMER, D. C.
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
5C
W82-05570

MORTON, D. W.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
2H
W82-04940

MOSER, P.
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
5B
W82-04820

MOSLEY, M. P.
Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
4C
W82-05712

MOSSAAD, M. E.
A Stochastic Model of Soil Erosion,
2J
W82-05298

MOSTAGHIMI, S.
Peak Runoff Model Comparison on Central Illinois Watersheds,
2A
W82-05489

MOSTKOV, V. M.
Driving Large Hydraulic Tunnels by the Stepped Face Method,
8H
W82-05586

MOTHES, G.
Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
2H
W82-05091

MOYER, J. L.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
3C
W82-05265

MUDRY, N.
Flood Control and Flow Regulation Problems on the Assiniboine River,
4A
W82-05389

MUELLER, D. L.
Calorific Value of Wastewater Plant Sludges,
5E
W82-04997

MUHLBALER, J.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
5A
W82-0506

MUILWIJK, C. J.
A Field Method for Measuring Short-Circuiting in Clay Soils,
2G
W82-05626

MUKHOPADHYAY, D.
Selecting Energy-Efficient Wastewater Treatment Systems,
5D
W82-04904

MULJADI, S.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
5A
W82-04767

MULLER, F.
Glaciers and Their Fluctuations,
2C
W82-04777

MULLER, G.
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods,
5B
W82-05625

MUNRO, D. S.
On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
2G
W82-05616

MURK, J. S.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
5D
W82-05272

MURPHY, R. J.
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
5B
W82-05145

MURRAY, H. E.
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
5A
W82-04823

MUSATOV, A. P.
Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
8I
W82-05342

MUSQUERE, P.
Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
5F
W82-05364

MYAKUSHKO, V. K.
The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
2H
W82-05453

MYERS, W. R. C.
Flow Resistance in Wide Rectangular Channels,
8B
W82-05798

NABIVANETS, B. I.
Forms of the Migration of Metallic Ions in Fresh Water,
2K
W82-05456

NAGASHIMA, M.
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
5D
W82-04990

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
5D
W82-04991

NAI-KUI, S.
Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
5A
W82-05041

NAKARI, T.
Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
5C
W82-05377

NAKAYAMA, F. S.
Simplifying Neutron Moisture Meter Calibration,
7B
W82-05173

NALEPA, T.
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
5A
W82-04882

NANSON, G. C.
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
2E
W82-04862

NAPARAXAWONG, K.
Modified Standard Operation Rules for Reservoirs,
4A
W82-05658

NAPIER, T. L.
Local Attitudes Toward Alternative Uses of a Reservoir Project,
6B
W82-05743

NAPIORKOWSKI, J. J.
The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
2E
W82-05525

NAQVI, N. Z.
Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
5C
W82-04814

NAQVI, S. M.
Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
5C
W82-04814

NAUSCH-STENGEL, M.
Investigations on the Sedimentation in the Darss-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
2L
W82-04761

NAUSCH-STENGL, M.
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
2L
W82-04762

NAYMIK, T. G.
Assessment of a Regional Aquifer in Central Illinois,
2F
W82-05052

NEARY, D. G.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
5C
W82-05206

NEFF, J. M.
A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
5A
W82-05725

NEIDERT, S. H.
Aeration at High Velocity Flows,
8A
W82-05602

NEILL, C. R.
Forest Management for Increased Water Yield--How Useful in Southern Alberta,
3B
W82-05760

NELLER, R. J.
Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
4A
W82-05572

NELSON, G. L.
Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 2F

NELSON, S. G.
Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

NESTMANN, E. R.
Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

NEU, H. J. A.
Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 4A

NEUBAUER, C. P.
The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 5C

NEUKRUG, H. M.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 5F

NEVISSI, A. E.
Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B

NEWBERN, L. A.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 5B

NEWBRY, B. W.
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 5G

NEWTON, R. J.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

NGANA, J. O.
Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 2A

NICHOLS, D. S.
Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 5D

NIEDERLEHNER, B. R.
Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 5C

NIEMANN, E.
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 7B

NIERSTEDT, R. J.
Wastewater Management in Coastal North Carolina,
W82-05559 5E

NIIMI, A. J.
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 5B

NIJU, S.
Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

NITZBERG, K. A.
Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 8I

NODA, H.
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 5A

NOGUCHI, S.
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 5D

NOGUEIRA, V. P.
River-Basin Simulation in Systems with Large Response Time,
W82-05496 2A

NORDIN, R. N.
Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 5G

NORDSTROM, D. K.
The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 2K

NORIN, H.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

NORTON, S. A.
The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 5C

NOSS, C. I.
Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 5D

NOVAK, J. T.
Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

NOVAK, R.
Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 5D

NOVIKOVA, I. S.
Concrete for Surfaces of High-Head Spillways,
W82-05110 8F

NOYCE, J. R.
Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 5A

NURNBERG, H. W.
Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry,
W82-05580 5A

NYE, J. A.
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

NYGAARD, D. D.
Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 5A

NYSTROM, R. R.
Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 5C

O'BRIEN, R. P.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 5D

O'DONNELL, T. H.
Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

O'MELIA, C. R.
Considering Sludge Production in the Selection of Coagulants,
W82-05675 5F

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 5D

Wastewater Management in Coastal North Carolina,
W82-05559 5E

O'NEAIL, T. M.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D

O'NEILL, K.
A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 2F

O'RIORDAN, J.
New Strategies for Water Resource Planning in British Columbia,
W82-05395 6E

OBAYASKI, A. W.
Anaerobic Treatment of High-Strength Wastes,
W82-04907 5D

OBENG, L. A.
Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 5C

OBUKHOVA, I. V.
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 2G

ODAI, S.
Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 5D

OGIL'VI, N. A.
Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 2F

OGILVIE, D. M.
Weak Controls from Sea to Shining Sea,
W82-05035 5B

OGURA, K.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 5A

OIKARI, A. O. J.
Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 5C

OKHIYUK, O. P.
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 5D

OKUN, D. A.
Wastewater Management in Coastal North Carolina,
W82-05559 5E

OLAIZ, A.
Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 6C

OLASZI, V.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

OLEA, R. A.
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

OLECKNO, W. A.
The National Interim Primary Drinking Water Regulations, Part I - Historical Development,
W82-05814 5G

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 5G

OLESZKIEWICZ, J. A.
Biofiltration Design Based on Volumetric Loading,
W82-05698 5D

Biological Nitrification of Industrial Wastewater,
W82-05129 5D

OLESZKIWICZ, J. A.
Anaerobic Treatment in Novel Contact Digester,
W82-05681 5D

OLIVE, J. H.
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

OLSEN, C. R.
Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

OLSEN, R.
Urban Impacts of Water Supply Reservoir,
W82-05318 5G

OLSSON, M.
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C

OLTHOF, M.
Biological Nitrification of Industrial Wastewater,
W82-05129 5D

OLUFEAGBA, B. J.
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 6A

ONUSCHAK, E. JR.
Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 2J

ORELLI, J. V.
Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 2H

ORHON, D.
Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

ORSZAG, S. A.
Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 8B

OSADCHUK, V. A.
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 8A

OSADCHYKH, V. F.
Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 2E

OSAMOR, C. A.
Oil Slick Mechanics,
W82-05064 5G

OSOKIN, P. K.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 8A

OSTLUND, H. G.
The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 2A

OSWALD, E. O.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 5A

OTA, J. J.
Aeration at High Velocity Flows,
W82-05602 8A

OTIS, R. J.
Pressure Distribution Design for Septic Tank Systems,
W82-05439 5E

OTSON, R.
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 5F

OTT, C. R.
Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 5D

OTTERBY, M. A.
An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 5B

OTTON, E. G.
Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

OUVRARD, J.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

OVERCASH, M. R.
Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 5B

OVERMAN, A. R.
Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05332 5D

OWEN, J. R.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 5B

OWEN, R. R.
The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476 5B

OWER, J.
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

OZAKI, M.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 5A

PAASIVIRTA, J.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

PACHUR, H. J.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

PACKMAN, M. J.
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

PAEPCKE, B. H.
Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 5D

PAGE, G. W.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

PAGE, S. W.
Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 5D

PALM, J. C.
Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

PALMER, H. J.
Characterization of Properties of Water,
W82-05540 1A

PANO, A.
Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 5D

PAOLINI, A. E.
Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 5D

PARISH, G. E.
History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 6E

PARKER, B. C.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

PARKER, C. D.
Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 5D

PARKER, D. S.
Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 5D

PARKER, G.
Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 2J

Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 2E

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 2E

PARKINSON, D. B.
Evaluation of Snowmelt Forecasting Methods,
W82-05552 4A

PARLANGE, J-Y.
Optimization Principle for Air and Water Movement,
W82-05172 2G

PARR, J. F.
Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

PASCHETTO, J. E.
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

PASKINS, A. R.
Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 5D

PASSINO, D. R. M.
Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05135 5C

PATERA, A. T.
Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 8B

PATNAIK, D.
Normality of Hydrological Data,
W82-05752 7B

PATTERSON, G. G.
Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 2A

PATTERSON, J. L.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

PATTERSON, J. W.
Biodegradation of Hazardous Organic Pollutants,
W82-04910 5B

PATTON, P. C.
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

PAVLENCO, G. F.
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports,
W82-05067 2D

PAYNE, J. F.
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 5C

PEARSON, D. E.
Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

PEART, D. B.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

PEET, S. E.
The Long Lake Diversion: An Environmental Evaluation,
W82-05568 6G

Northwestern Ontario River Dimensions,
W82-05742 6G

PEIXOTO, J. P.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 2A

PELLEREJ, M.
Improvement of Swirl Concentrator,
W82-05821 5D

PELLICCIA, A.
Economic Analysis of Water Main Breaks,
W82-05673 8A

PENDLETON, E. C.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

PENG, T.-H.
Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

PENNACCHIO, V. F.
Current Trends in Cost of Service Studies,
W82-05806 6C

PENTECOST, A.
Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

PENTLAND, R. L.
A Federal Perspective on River Basin Management,
W82-05388 6E

PERINEAU, F.
Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 5D

PERRY, R.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 5A

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 5C

PESANT, C.
Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 7B

PESCOD, W.
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 5G

PETERSON, D. F.
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

PETERSON, F. L.
Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

PETERSON, J. B.
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 2G

PETRASHEN, R. N.
Uplift Pressure of Water on the Base of Hydraulic Structures in Limit Design States (Discussion of Construction Specifications),
W82-05582 8A

PETROV, G. N.
Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 4A

PETROVIC, G.
On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929 2H

PETTIGREW, F.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

PETTYJOHN, W.
Sampling and Analyzing Water,
W82-05263 5A

PEVERLY, J. H.
Stream Transport of Nutrients Through a Wetland,
W82-04857 5B

PFAFF, C. L.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 7C

PFAFF, T.
California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411 4A

PHATARFOD, R. M.
Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 6A

PHIEN, H. N.
Normality of Hydrological Data,
W82-05752 7B

PHILLIPS, P. A.
Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 2A

PIESSENS, R.
A New Method of Cubature Using Spline Functions,
W82-04939 2L

A New Method of Cubature Using Spline Functions,
W82-05189 2L

PIETILA, K. A.
Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 5D

PINCKNEY, D. J.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

PINDER, G. F.
A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 2F

PLANTZ, G. G.
Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 7A

PLAYLE, R.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

PLUMLEY, A.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

PODUSHKO, Y. N.
Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 8I

POGGE, E. C.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 2E

POLAND, R.
Leachate Collection Design for Containment Landfills,
W82-04996 5E

POLLOCK, G. A.
Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 5B

PONCE, V. M.
Nature of Wave Attenuation in Open Channel Flow,
W82-05003 2E

PONDICK, J.
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 5C

PONTANIER, R.
Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 2D

POOLE, L. R.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 2K

POPKIN, B. P.
Strategies for Reuse and Conservation,
W82-05790 3C

POPOV, Y. A.
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 8D

POPOWCHAK, T.
Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

PORTER, K.
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

POST, G.
Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 5C

POWELL, J. R.
River Basin Management in Ontario,
W82-05393 6E

POWERS, C. F.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 5G

PRAKASH, A.
Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
W82-05799 5B

PRASAD, S. D.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 2I

PRASAD, U. K.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 2I

PRASILOVA, J.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 5B

PRATHER, B. V.
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 5D

PRATT, J. M.
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Inhabiting the Green River, Massachusetts,
W82-04947 5C

PREPEJCHAL, W.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

PRIIMACHENKO, A. D.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

PRIMUS, C. L.
River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 6E

PRINCE, A. B.
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 5D

PROKOPOVICH, N. P.
Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 8I

PSARIS, P. J.
Fecal Coliform Densities in a Western Watershed,
W82-05618 5B

PSHENICHNAYA, L. I.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

PUGH, C. A.
Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 8B

PYYSALO, H.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

QAZI, M. A.
Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

QI-PING, Q.
Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 5A

QIWEI, H.
Bed Load Fluctuation: Applications,
W82-05000 2J

QUAGHEBEUR, D.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 5A

QUINLIVAN, S.
Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

QUON, T. K.
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

QURESHI, M.
A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

RADFORD, J.
Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 6D

RADOSEVICH, G. E.
Future Water Development Policies,
W82-05884 5G

RADTKE, D. B.
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

RAGHI-ATRI, F.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

RAHAL, C. M.
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 5F

RAJARATNAM, N.
Circular Wall Jets in Coflowing Streams,
W82-04999 5B

Erosion by Submerged Circular Jets,
W82-05002 2J

RAM, N. M.
Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 5D

RAMAKRISHNAN, P. S.
Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 4C

RAMASAMY, K.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 5D

RAMBAL, S.
Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 2D

RAMEY, B. A.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

RAMSPOTT, L. D.
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 5B

RAND, M. C.
Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 5D

RANDALL, C. W.
The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 5D

RANDTKE, S. J.
Effects of Salts on Activated Carbon Adsorption of Fulvic Acids,
W82-05667 5F

RANI, S.
Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 5C

RAO, G. R.
A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 2D

RAPINAT, M.
Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 5F

RATHBUN, R. E.
Volatilization of Ketones From Water,
W82-05782 5C

RATHORE, H. S.
A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

RAVEH, A.
Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04879 5B

RAWLS, W. J.
Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 2E

RAY, D.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

RAY, L. E.
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

REBHUN, M.
Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 5D

REDDELL, D. L.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

REDDY, G. B.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

REDDY, K. R.
Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

REDDY, M. R.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

REECE, D. E.
Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

REED, G. D.
Drought-Related Water Conservation Efforts in Missouri,
W82-05672 3D

REED, J. C. JR.
Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

REED, L. W.
Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 2H

REGINATO, R. J.
Simplifying Neutron Moisture Meter Calibration,
W82-05173 7B

REICHARDT, K.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 2G

REICHENBAUGH, R. C.
Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 7C

REITER, M.
New Flocculation Units with High Efficiency,
W82-04840 5D

REMSON, I.
Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 5G

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 5G

RENBERG, I.
The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 2H

RENBERG, L.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 5F

Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 5A

RESTREPO-POSADA, P. J.
Identification of Independent Rainstorms,
W82-05708 2B

REUTERGARDH, L.
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 5C

RICE, R. C.
Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 5D

RICH, L. G.
A Low-Cost Secondary Treatment Alternative,
W82-05169 5D

RICHEY, J. E.
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

RIDDELL, M. D. R.
Land Disposal of Sludge,
W82-04757 5E

Nitrogen Control at Three Related Plants,
W82-05434 5D

RIDLINGTON, J. W.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 5C

RIEKERK, H.
How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 5E

RIFFALDI, R.
Humic Substances in Sewage Sludges,
W82-05576 5E

RIGAL, S.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

RIPPEY, B.
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 2J

RIPPINGALE, R. J.
The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 2L

RISHEL, G. B.
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 4C

RITCHIE, J. T.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

Soil Water Availability,
W82-05623 2G

RITTENHOUSE, R. C.
Developments in Wastewater Handling at Power Plants,
W82-05517 5D

RITTER, J. R.
An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 5B

RITTER, W. F.
Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

RITTMANN, B. E.
Microbial Removal of Hazardous Organic Compounds,
W82-05177 5D

RIZET, M.
Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 5A

RJARATNAM, N.
Erosion by Plane Turbulent Jets,
W82-05277 8B

ROBERTS, F. J.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

ROBERTS, P. V.
Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 5F

ROBERTS, R. J.
Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 5C

ROBERTS, S. A.
Protecting the Source,
W82-05785 5F

ROBERTSON, S. R.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

RODGERS, J. H. JR.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A

RODGERS, P.
Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 5B

RODRIGUEZ, J.
Turbines for Itaipu,
W82-04955 8C

ROESCH, S. E.
Dynamic Estuary Model Performance,
W82-05319 2L

ROFF, J. C.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

ROGERS, A. N.
Treatment of Cooling Tower Blowdown,
W82-04908 5D

ROGERS, L. K.
On the Sampling Variance of Raingage Networks,
W82-05875 7B

ROGERS, W. F.
Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 4A

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 4A

ROHDE, F. G.
Modified Standard Operation Rules for Reservoirs,
W82-05658 4A

ROIKO, N. F.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 8A

ROMANENKO, V. D.
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

ROMANYUTINA, Z. D.
New Methods of Designing Flood Control Measures,
W82-05030 2E

ROOS, A.
An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 5B

ROOT, S. I.
Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 2F

ROPER, H. P.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

ROPER, R. E.
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 4C

ROSCOE, J. V.
Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 5B

ROSE, C. W.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

ROSEN, R. D.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 2A

ROSENDAHL, P. C.
The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 5A

ROSS, S. M.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 5D

ROTH, D. K.
Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

ROTH, J. A.
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 5C

ROUSE, W. R.
Evaporation at a High Arctic Site,
W82-04899 2D

ROVERS, F. A.
Leachate Collection Design for Containment Landfills,
W82-04996 5E

BOYER, M. D.
Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 5G

BOYER, T. C.
Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870 2A

ROZHANSKAYA, L. I.
Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 5B

RUBITSCHUN, C.
Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

RUGGIERO, D.
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

RUGGLES, R. W.
Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 2C

RUMBAUGH, M. D.
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

RUSHBROOK, E. L. JR.
Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

RUSHFORTH, S. R.
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 5A

RUSSELL, D. S.
Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

RUSSELL, S. O.
Evolution of Water Management Techniques,
W82-05565 6A

RUTGERS VAN DER LOEFF, M. M.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

RUTHERFORD, J. C.
Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 4C

RYABOV, V. L.
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 2E

RYAN, B. J.
Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 2F

RYAN, G. L.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

SAAD, M. A. H.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 5B

SAAVA, A. E.
Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 5A

SACHS, E. F.
Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 5D

SAEGROV, S.
River Plume Studies in Distorted Froude Models,
W82-05864 2E

SAKATA, M.
A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 5A

SALARZ, S. E.
Oil and Grease in Stormwater Runoff,
W82-05557 5C

SALEH, F. Y.
Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

SALISBURY, D.
Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 5B

SALO, E. O.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

SALSTEIN, D. A.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 2A

SAMEDOV, R. I.
Calculation of Large Unlined Canals,
W82-05131 8B

SAMELSON, K. S.
Non-Indian Federal Reserved Water Rights,
W82-04804 6E

SAMSON, N.
Measuring Reservoir Ground Movements,
W82-05773 8G

SANCHEZ BRIBIESCA, J. L.
A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 8B

SANCHO, J.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

SANVILLE, W. D.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 5G

SAPOZHNIKOV, V. V.
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 7B

SARFERT, F.
Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux uses pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 5D

SARGENT, R. J.
A River Coding System for Water Quality Archives,
W82-05474 7A

SARKKA, J.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

SARTORI, F.
Humic Substances in Sewage Sludges,
W82-05576 5E

SASTRI, A. S. R. A. S.
Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 2I

SATOH, Y.
Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 2H

SAVENKO, V. S.
Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 2K

SAWAI, K.
Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 2E

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 2E

SAWYER, B.
Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

SCHAEFER, D. H.
Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 6B

SCHAEFER, L.
The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 5C

SCHAFFNER, C.
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

SCHALACHA, E. B.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

SCHANZ, F.
Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

SCHAUB, S. A.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

SCHELL, W. R.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 5C

SCHILLER, E. J.
Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 2A

SCHINER, G. R.
Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C
Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

SCHINK, B.
Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 2H

SCHLAIS, J. F.
Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 5D

SCHLICHTING, H. E. JR.
New In-Situ Techniques in Biomonitoring,
W82-05157 5A

SCHLOTZHAUER, P. F.
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K
Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

SCHLUNGBAUM, G.
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 2L

SCHMIDT, C.
Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 5A

SCHMITTGEN, M. C.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 2G

SCHNEIDER, G.
The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 5G

SCHNEIDER, G. R.
Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 5G

SCHOCK, M. R.
The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 8G

SCHOCKE, K.
Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalsperre, Nordhessen)),
W82-04768 2H

SCHOFIELD, R.
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 5D

SCHOLL, J. E.
1980 Needs Survey: Combined Sewer Ssite Studies,
W82-05862 5D

SCHOONBEE, H. J.
The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 5C

SCHOTT, P.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

SCHREIBER, R. P.
Microcomputer Water Quality Simulation Model,
W82-05191 7B

SCHREINER, S. P.
Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 5C

SCHROEDER, E. D.
Reliability and Stability of Trickling Filter Processes,
W82-04784 5D

SCHROER, C. V.
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

SCHUETZLE, D.
Chemometric Modeling of Wastewater Treatment Processe,
W82-05858 5D

SCHULLER, R. M.
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

SCHULTZ, G. A.
Applications of Simulation to Specific Water Projects,
W82-05522 6A

SCHUMM, S. A.
Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 3B

SCHUYTEMA, G. S.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 5G

SCHWARTZ, H. G. JR.
Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

SCHWARTZ, S. E.
Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 2K

SCHWARTZBROD, L.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 5A

SCHWINTZER, C. R.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H

SCOLES, F. G.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 2G

SCOTT, B. C.
Sulfate Washout Ratios in Winter Storms,
W82-04898 5B

SCOTTER, D. R.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 3C

SEBACHER, D. I.
A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 2L

SEDELL, J. R.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C
Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

SEDITA, S. J.
Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

SEDOVA, V. K.
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 2G

SEGALL, B. A.
Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05599 5D

SELEZNEY, G. S.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

SELLARS, C. D.
A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 2D

SELLERS, D. R.
Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 5A

SELYAMETOV, M. M.
Formation of a Stable Canal Channel,
W82-05584 8B

SENARATNE, A.
Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 5C

SEPHTON, H. H.
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 3A

SERAFIM, J. L.
Safety of Dams Judged from Failures,
W82-05512 8A

SERGEEV, B. I.
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 8G

SEVERN, R. T.
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 8B

SEWELL, J. I.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 5B

SHAFER, L.
Using Pumps as Small Turbines,
W82-05597 8C

SHAIKAN, Y. P.
Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 8A

SHARAF, I. F.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 5B

SHARKUNOV, S. V.
Concrete for Surfaces of High-Head Spillways,
W82-05110 8F

SHARMA, K. P.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

SHARMA, N. N.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 2I

SHARMA, R. C.
Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721 5A

SHARPLEY, A. N.
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B

SHASHUA, L.
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

SHAW, L. C.
Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

SHAW, T. L.
Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 4C

SHAY, D. E.
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

SHCHERBAN, E. P.
Some Features of the Toxic Action of the Nonionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 5C

SHEINDORF, C.
Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 5D

SHEINTUCH, M.
Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 5D

SHELDON, L. H.
Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 8C

SHELEF, G.
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 5D

SHELTON, M. L.
Ground-Water Management in Basalts,
W82-04931 4B

SHELYAG-SOSONKO, Y. R.
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

SHEN, C. Y.
The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 8B

SHEN, H. T.
Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 2C

SHEN, H. W.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

SHEN, T. T.
Estimation of Organic Compound Emissions from Waste Lagoons,
W82-05679 5C

SHERMAN, J. W.
The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 5A

SHERWANI, J. K.
Wastewater Management in Coastal North Carolina,
W82-05559 5E

SHERWIN, M. J.
A Pipeline for all Environments,
W82-04764 8G

SHIELDS, R. R.
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2E

SHIMMEN, T.
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

SHIMODA, O.
A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 5A

SHINKAR, G. G.
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 7B

SHIREMAN, J. V.
The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 4A

SHOEMAKER, C. A.
Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 4B

SHOLKOVITZ, E. R.
The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

SHORE, F. L.
Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 5B

SHRADER, M. L.
Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 2E

SHUIFER, M. I.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 8H

SHULTZ, B.
Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 5F

SHUVAL, H. I.
Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 5D

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 6D

SIBLEY, T. H.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 5C

SIDDIQI, R. H.
Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 5C

SIGLEO, A. C.
Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 2L

SIKORA, E. J.
Load Factors and Non-Destructive Testing of Clay Pipe,
W82-05700 8G

SIKORA, L. J.
Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

SIKORA, V.
Law for Environmentalists,
W82-05813 5G

SIKORA, V. A.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 3D

SILVERMAN, B. A.
On the Sampling Variance of Raingage Networks,
W82-05875 7B

SILVERMAN, G.
Oil and Grease in Stormwater Runoff,
W82-05557 5C

SIMMONS, D. L.
Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

SIMMONS, G. M. JR.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

SIMONOVIC, S. P.
The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 6A

SIMPSON, D. W.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

SIMPSON, H. J.
Radionuclides in Mono Lake, California,
W82-05461 5B

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

SIMPSON, J. E.
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 2E

SIMPSON, R. W.
Optimization Principle for Air and Water Movement,
W82-05172 2G

SIMPSON, T. W.
The Occurrence of Flow Channels in Soils,
W82-04875 3C

SINCLAIR, W. C.
Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 7C

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

SINGER, M.
An Overview of Porous Pavement Research,
W82-05744 5D

SINGER, P. C.
Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 5F

SINGH, D. P.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 2I

SINGH, S. D.
Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 2I

SINGHAL, A. K.
Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 5D

SINHA, S. B.
Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 2D

SINNOTT, C. S.
The Search for Reservoir Sites in an Urban Environment,
W82-04867 8A

SINNOTT, W. B.
Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 5D

SIPE, T. W.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

SIRENKO, L. A.
Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 5G

SIVAKUMARAN, N. S.
Steady Shallow Flow Over a Spillway,
W82-05086 8B

SKHUNDIN, B. M.
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04/60 8D

SKINNER, S. M. JR.
Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 5B

SKOGERBOE, G. V.
Colorado River Development,
W82-05887 4A

Development Issues in the Colorado River Basin,
W82-05890 6D

Future Water Development Policies,
W82-05884 5G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

The Physical Environment of the Colorado River Basin,
W82-05891 6D

Salinity Control Measures for Grand Valley,
W82-05894 3F

SKREBKOV, G. P.
Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 8A

SLACK, J. R.
Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 7C

SLOBODCHIKOV, N. B.
Hypania Invalida in the Volga Reservoirs and Hydrobiological Monitoring,
W82-05331 2H

SMALL, M. J.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

SMALL, T. A.
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

SMALLEY, T. L.
Water Quality Assessment for Agana Springs,
W82-05304 5A

SMART, N.
Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 2H

SMETS, E.
A New Method of Cubature Using Spline Functions,
W82-04939 2L

A New Method of Cubature Using Spline Functions,
W82-05189 2L

SMITH, D. J. G.
Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 6A

SMITH, D. L.
Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

SMITH, D. P.
Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 4C

SMITH, E. D.
Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 5D

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 5D

SMITH, G. F.
Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 5G

Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 5G

Performance Testing of Four Skimming Systems,
W82-05059 5G

SMITH, J. H.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

SMITH, R.
Contaminant Dispersion in Oscillatory Flows,
W82-05631 5B

Where to Put a Steady Discharge in a River,
W82-05632 5G

SMITH, R. A.
Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 7C

SMITH, R. E. H.
The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 5C

SMITH, R. V.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

SMITH, R. W.
Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 5B

SMITH, S.
Sulfur Bacterial Problems Revisited,
W82-05264 5B

SMITH, S. K.
American Indian Water Rights and the Use of Colorado River Water,
W82-05885 6E

SMITH, T. R.
A Pipeline for all Environments,
W82-04764 8G

SMYKOWSKI, K.
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 5A

SNYDER, D. L.
Energy Siting in Utah: A Programming Model,
W82-05297 6B

SNYDER, J. H.
Five Year Water Resources Research Plan for the State of California,
W82-05532 6B

SNYDER, W. M.
Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 2E

SOETJE, K. C.
The Tidal Stream in the German Bight,
W82-05190 2L

SOHN, M. L.
Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 2K

SOILEAU, C. W.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

SOKOLOV, I. Y.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 5D

SOLOMATINA, V. D.
Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 5C

SOMMERFELDT, T. G.
Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 2G

SOPHOCLEOUS, M.
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

SOPPER, W. E.
Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 5E

SORBER, C. A.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

SOTNIKOV, V. N.
Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 5B

SOUTAR, I.
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 5A

SOYUPAK, S.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 5B

SPANGGORD, R. J.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A

SPECKER, B.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 5B

SPEECE, R. E.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

SPIEGEL, S. J.
Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 5A

The Status of Groundwater Law in New York State,
W82-05400 6E

SPIEGLER, K. S.
Water and Salt Transport in Membranes,
W82-05537 3A

SPIGARELLI, S. A.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

SPIRANDI, O. B.
Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 5B

SPOTTISWOOD, D. J.
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 5D

SPRULES, W. G.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

SRICHAROENCHAITKIT, P.
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

SRIKANTHAN, R.
Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 6A

STALEY, J. T.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C

STALKER, M. J.
Circular Wall Jets in Coflowing Streams,
W82-04999 5B

STALLARD, R. F.
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

STANAGE, C. E.
Embankment Construction: New Melones Dam,
W82-05822 8D

STANDER, G. J.
Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

STANNERS, D. A.
The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 5B

STARY, J.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 5B

STAUFFER, R. E.
Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 2K

STAY, F. S.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 5G

STEDINGER, J. R.
Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 6A

Robustness of Water Resources Systems,
W82-05077 6A

STEDNICK, J. D.
Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 4C

STEEN, W. C.
Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 5B

STEFAN, H. G.
Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 5D

STEGMAN, C. E.
The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 5G

STENDAHL, K.
Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 5D

STENSEL, H. D.
Anaerobic Treatment of High-Strength Wastes,
W82-04907 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

STENSTROM, M. K.
Oil and Grease in Stormwater Runoff,
W82-05557 5C

STEPHANOU, E.
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

STEPHENS, F.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 5E

STERLING, M. J. H.
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 5F

STERRITT, R. M.
Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 5D

STEVENS, C.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 5A

STEVENS, R. J.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

STEVENSON, D. S.
Irrigation Efficiency in Orchards,
W82-05768 3F

STEVIE, R. G.
Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 5C

STOL'BERG, F. V.
Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 5B

STOL, P. T.
Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm,
W82-04864 2B

STOLTZ, R. L.
Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 5B

STONES, T.
A Comparison of the Carbonaceous Oxygen Demands of a Domestic and Industrial Sewage,
W82-05467 5D

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 5D

STORK, T. H.
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 4B

STOTZKY, G.
Acid Precipitation. 1. Causes and Consequences,
W82-04771 5C

STOW, C. D.
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 2B

STRAUB, W. A.
Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 5B

Models of Landfill Leaching: Organic Strength,
W82-05817 5B

STRAYER, D. L.
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 2H

STRINGER, C. E.
Piloting Mag-Carbonate Treatment,
W82-05794 5F

STROM, P. F.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

STROUD, A. D.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

STRUBITSKIY, I. V.
Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 2H

STRUDGEON, G. E.
Safety Considerations in Handling Activated Carbon,
W82-05442 5D

STRUPCZEWSKI, W. G.
The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 2E

STRZEPEK, K.
River-Basin Simulation in Systems with Large Response Time,
W82-05496 2A

STUMM, W.
Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 5B

STURGEON, R. E.
Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

SUFFET, I. H.
Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 5F

Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 5F

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 5F

SUIDAN, M. T.
Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 5F

Role of Surface Active Media in Anaerobic Filters,
W82-05816 5D

SULAIMAN, A. M.
A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

SULER, D. J.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

SULLIVAN, P. F.
Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 2H

SULLIVAN, P. J.
Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 5B

SUMARAH, R.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

SUMMER, R. M.
Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 2J

SUMMERS, R. S.
Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 5F

SUNCHINDAH, A.
Normality of Hydrological Data,
W82-05752 7B

SUNDARAM, K. M. S.
The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 5B

SUNDAY, G.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

SURMA-AHO, K.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

SUTA, B. E.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A

SUZUKI, T.
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 5D

SWANEPOEL, J. H.
The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L.,
W82-05895 5C

SWENSON, C. M.
Research on Piezodialysis - Sixth Report,
W82-05294 3A

SWINGLE, R. S.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 3C

SWITZENBAUM, M. S.
A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

SYKES, J. F.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 5B

SYKES, R. M.
Hydraulic Regime and Activated Sludge Performance,
W82-05819 5D

SZETO, S.
The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 5B

TADMOR, J.
Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 5D

TAI, D. Y.
Volatilization of Ketones From Water,
W82-05782 5C

TAILOR, A.
Role of the Microcomputer in Water Management,
W82-05771 7B

TALLING, I. B.
Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 5B

TANABE, K.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 5A

TANAKA, H.
Kinetics of Biofilm Nitrification,
W82-05374 5D

TANJI, K. K.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

TANSEY, G.
Turks Press Forward With Ambitious Dam Programme,
W82-05758 6B

TARAIMOVICH, I. I.
Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 8B

TARAPCHAK, S. J.
Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

TARASEVICH, V. V.
Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 8B

TARHANEN, J.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 5A

TARR, J. A.
Sewers and Cities: France and the United States Compared,
W82-05684 5D

TARVER, D. P.
Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 4A

TATE, S. L.
A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 2D

TAY, A. J.
Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

TAYAA, M.
Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 6B

TAYLOR, E. W.
The Continuing Struggle of Waterborne Illness,
W82-05366 5C

TAYLOR, T. E.
Piloting Mag-Carbonate Treatment,
W82-05794 5F

TAYLOR, W. D.
Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 5B

TELTSCH, B.
Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 5D

TEMMERMAN, M.
A New Method of Cubature Using Spline Functions,
W82-04939 2L

A New Method of Cubature Using Spline Functions,
W82-05189 2L

TEMPLETON, M. E.
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 5D

TERVET, D. J.
The Impact of Fish Farming on Water Quality,
W82-05471 5B

TERWEY, L.
How Proper Prospecting Improves the Odds,
W82-05757 3B

TESTER, D. J.
Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 5B

TEWARI, S. K.
An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 6B

THACKER, W. E.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 5D

THAKUR, D. K.
Characterization of Properties of Water,
W82-05540 1A

THARP, T. M.
An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 2F

THOMAS, D. W.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

THOMAS, M. H.
Virginians Optimize Sludge Handling,
W82-05171 5D

THOMAS, P.
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 5F

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 5A

THOMAS, R. G.
Bottom-Entry Large-Diameter Wells,
W82-04919 8A

Cavity Well,
W82-04920 8A

THOMAS, R. L.
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 5B

THOMMES, M. M.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

THOMPSON, M. E.
Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 2K

THOMSON, A. M.
The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779 6E

THURMAN, E. M.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

TIBBALS, C. H.
Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 2F

TIETJEN, W. L.
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

TINGSANCHALI, T.
Steady Shallow Flow Over a Spillway,
W82-05086 8B

TIPPING, E.
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-FeOOH) in Freshwaters,
W82-05140 2K

TISUE, T.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 5A

TITOV, L. A.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 8C

TOBIASON, J. E.
Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 5D

TOBIN, R. L.
Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

TOBIN, R. S.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

TOEI, K.
Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 5A

TOGGWEILER, J. R.
Radionuclides in Mono Lake, California,
W82-05461 5B

TOKY, O. P.
Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 4C

TOLKACHEV, G. S.
Dynamic Elastic and Absorbing Properties of Soils,
W82-0C132 8D

TOMAR, A. S.
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 2I

TOMAR, S. S.
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 2I

TOMASI, C.
Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 2B

TOPPING, M.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

TORTORICI, L. D.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 5D

TREMBOVEL'SKII, G. T.
Investigations of Catastrophic Maximum Discharges of the Araks River,
W82-05591 2E

TRIER, R. M.
Radionuclide: in Mono Lake, California,
W82-05461 5B

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

TRIPP, L. N.
Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05713 4C

TRIVEDY, R. K.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

TROEGER, B. W.
Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 2H

TRUCCO, G.
The Overtopping of the Palagnedra Dam,
W82-04952 8A

TRUJILLO, L. F.
Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 2J

TSANG, G.
Resistance of Beauharnois Canal in Winter,
W82-04998 2C

TSCHANTZ, B. A.
Application of and Guidelines for Using Available Dam Break Models,
W82-05152 8A

TSEDROV, G. N.
Concrete for Surfaces of High-Head Spillways,
W82-05110 8F

TSEZOS, M.
The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 5D

TSUTSUI, R. N.
Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

TSVETKOV, A. I.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 8H

TUCKER, T. C.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 3C

TUCKER, W. A.
Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 2H

TURNER, C. D.
Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

TURNER, D. R.
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 7B

TURNPENNY, A. W. H.
Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 5C

TWEDELL, A. M.
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 5G

TYE, R. J.
Mutagens, Carcinogens and the Water Cycle,
W82-05468 5A

UIGA, A.
Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 5D

ULLRICH, C.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

UPTON, J.
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 5D

URANO, K.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 5A

URBAN, D. R.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 7B

USRY, J. W.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 2K

VALENTA, P.
Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry,
W82-05580 5A

VAN BRUNT, M. R.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

VAN DAM, D.
Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 5D

VAN DELFT, W.
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 5A

VAN DEN HEUVEL, J. C.
pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 5D

VAN DER MEER, R. R.
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 5D

VAN DER VEEN, C.
Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 6B

VAN ES, F. B.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 2L

VAN KRANEN, H. J.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 5A

VAN KREIJL, C. F.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 5A

VAN LOON, J. C.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

VAN SCHILFGAARDE, J.
The Wellton-Mohwak Dilemma,
W82-05883 3F

VAN STADEN, J. F.
Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 5A

VAN VUUREN, L. R. J.
Treatment of Water from Eutrophied Impoundments,
W82-05368 5F

VANCE, L. T.
Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603 6E

VANDERBROOK, S. G.
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

VANHUMBEECK, J. B.
Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 5A

VANNESS, R.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 5E

VARADE, S. B.
A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 2D

VARIALI, G.
Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 5D

VAUGHAN, D. S.
Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 5C

VAUX, H. J. JR.
Barriers to Effective Ground-Water Management: The California Case,
W82-04917 4B

VEAL, D.
Oxygenation of the Avon River,
W82-05730 5G

VEITH, G. D.
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

VERA, I.
Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05509 3A

VERACHTERT, H.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 5D

VERGARA, I.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 5B

VERHOFF, F. H.
Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 2J

VERMA, S. R.
Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 5C

VERMAAK, J. F.
The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 5C

VETTER, R. J.
The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

VICORY, A. H. JR.
Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 5A

VIESSMAN, W.
Water Resources in the Legislative Balance, 1982,
W82-05433 6E

VIESSMAN, W. JR.
National Water Policy: The Need for Institutional Reform,
W82-05180 6E

VIGG, S.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

VIGH, G.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

VILAGINES, R.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

VILJOEN, M. F.
Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 6A

VIMMERSTEDT, J. P.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 2G

VOLESKY, B.
The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 5D

VON DER EMDE, W.
Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 5D

VON OERTZEN, J. A.
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Enegy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials),
W82-04762 2L

VOORHEES, M. L.
An Evaluation of the Urban Design Storm Concept,
W82-04960 6A

VOROPAEV, G. V.
Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 4A

VUTSEL', V. I.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 8A

WADA, H.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 5A

WAINWRIGHT, M.
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 5C

WAITE, W. M.
Mutagens, Carcinogens and the Water Cycle,
W82-05468 5A

WAKAMIYA, W.
Shale Oil Wastewater Treatment by Evaporation,
W82-04905 5D

WALKER, D. J.
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations,
W82-04959 3F

WALKER, W. R.
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 3F

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 3C

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

Salinity Control Measures for Grand Valley,
W82-05894 3F

WALKER, W. W.
A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 5C

WALLACE, R. B.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 8B

WALLACE, R. R.
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 5B

WALSKI, T. M.
Economic Analysis of Water Main Breaks,
W82-05673 8A

WALTEMEYER, S. D.
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2E

WALTON, N. R. G.
The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801 2K

WANG, C.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

WANG, J.
Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 5A

WANGSNESS, D. J.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

WARD, A. K.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 2H

WARD, J. V.
Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 5C

WARING, S. L.
Non-Indian Federal Reserved Water Rights,
W82-04804 6E

WARREN, C. S.
Poisons in the Hudson,
W82-05705 5G

WARREN, C. W.
Groundwater Strategy: Protecting a Vital Resource,
W82-05403 5B

WARREN, J.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 4B

WARRY, N. D.
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

WATLING, H. R.
Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 2B

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 5B

WATLING, R. J.
Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 2B

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 5B

WATSON, K. K.
Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 5B

WEBER, D. E.
Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 5C

WEBER, J. B.
Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 5B

WEBSTER, J. R.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 5B

WEDGWOOD, K. F.
The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 6D

WEEKES, M. C.
Treatment of Cooling Tower Blowdown,
W82-04908 5D

WEGMAN, R. C. C.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 5A

WEHRING, K.
Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 6B

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 6B

WEIGLE, J. M.
Littletown Quadrangle: Hydrogeology,
W82-04984 7C

WEINS, J. H.
Agricultural Runoff and Water Pollution,
W82-05569 5B

WENDERS, J. T.
Price or Persuasion,
W82-05791 6C

WENZEL, H. G. JR.
An Evaluation of the Urban Design Storm Concept,
W82-04960 6A

WERSHAW, R. L.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

WERTAM, J.
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 5B

WESTERMAN, A. G.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 5C

WESTLAKE, D. W. S.
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 5B

WESTPHAL, J. W.
The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 4B

WHALEN, R. C.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D

WHARTON, C. H.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

WHEATER, H. S.
Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 4C

WHEATLEY, A. D.
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 5D

WHEELER, J. C.
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

WHIPPLE, W. JR.
Settleability of Urban Runoff Pollution,
W82-05320 5G

WHITE, E. L.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 6C

WHITE, I.
Characterization of Properties of Water,
W82-05540 1A

WHITE, S. T.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

WHITEBLOOM, S.
Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

WHITFIELD, M. S. SR.
Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

WHITFIELD, P. H.
Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 5B

WHITFORD, C. J.
The use of Activated Carbon in Water Treatment,
W82-05182 5F

WHITLEY, W. G.
Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 5B

WHITLOCK, C. H.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 2K

WICKLUND, A.
Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 5F

WICKSTROM, K.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

WIESMANN, U.
New Flocculation Units with High Efficiency,
W82-04840 5D

WILDE, E. W.
Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 5F

WILKE, D. A.
Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

WILKE, K.
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

WILLIAMS, A. W.
The Expansion of Two Bolivian Plants,
W82-05598 8A

WILLIAMS, D. T.
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 5F

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 5F

WILLIAMS, H. N.
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

WILLIAMS, J. R.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

WILLIAMS, L. R.
Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 5A

WILLIAMS, M. D.
A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 6D

WILLIAMS, P. J. LEB.
Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 5B

WILLIAMS, R.
Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 5C

WILLIAMS, W. D.
The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

WILLIS, C. E.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 6C

WILLSON, G. B.
Materials Balance in Aerated Static Pile Composting,
W82-05696 5D

WILSON, D. J.
Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

WILSON, J. L.
River-Basin Simulation in Systems with Large Response Time,
W82-05496 2A

WILSON, T. E.
Nitrogen Control at Three Related Plants,
W82-05434 5D

WILSON, W. E.
Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

WINDHAM, M. P.
Random Differential Equations in River Water Quality Modeling,
W82-05343 6A

WINDLE, M. R.
A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 5D

WINSTON, A.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

WINTER, F. J.
Land Disposal of Sludge,
W82-04757 5E

WIRTH, J.
Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 5D

WISNIEWSKI, R. L.
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 5B

WISSMAR, R. C.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

WITTE, W. G.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 2K

WITTMANN, J. W.
How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 5D

WOHLSCHLAG, D. E.
Metabolic Response of Fish to Stress,
W82-05159 5C

WOLCOTT, A. R.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

WOLF, H. W.
Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 5D

WOLFF, T. F.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 8E

WONG, B. W. C.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 5D

WONG, D. R.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 8B

WOO, M.-K.
Evaporation at a High Arctic Site,
W82-04899 2D

WOO, V.
Drought Management: Expecting the Unexpected,
W82-05649 3D

WOOD, C. R.
Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

WOOD, S.
Sewage Pumping Station Split for Maintenance,
W82-05719 5D

WOODWORTH, J.
A Citizen's View of Water Management in the Okanagan Valley,
W82-05781 6G

WOOF, C.
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 7B

WOOLDRIDGE, G. L.
Energy Siting in Utah: A Programming Model,
W82-05297 6B

WORSTELL, R. V.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 8A

WRIGHT, A. F.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 2C

WRIGHT, G. W.
Stormwater Management - One Developer's Experience,
W82-05777 6B

WRIGHT, J. L.
New Evapotranspiration Crop Coefficients,
W82-05692 3F

WRIGHT, R. F.
Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 2K

WRIGHT, S. J.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 8B

WU, T. H.
A Stochastic Model of Soil Erosion,
W82-05298 2J

WU, Y. C.
Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 5D

WUKASCH, R. F.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

WYCOFF, R. L.
1980 Needs Survey: Combined Sewer Ssite Studies,
W82-05862 5D

XUE-ZHONG, L.
Guidevane Erosion at Mao Tiao He,
W82-05600 8G

YAKSICH, S. M.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 4D
A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 7B
Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 2J

YALYNSKAYA, N. S.
Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 2H

YAMAMURA, M.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

YAMASHITA, T.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

YAMAWAKI, S.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

YAMAZAKI, T.
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

YANG, C. Y.
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

YDE, M.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 5A

YEROFEYEVA, Z. I.
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 5D

YOBBI, D. K.
Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

YODER, D.
Aquifer Management in Dade County,
W82-05784 5G

YOMTOVIAN, I.
Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 4A

YONGUE, W. H.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H

YONGUE, W. H. JR.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

YOO, K. H.
Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 3F

YOSHIDA, K.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 5A

YOST, K. J.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

YOUNG, R. A.
An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 5B
Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

YOUNG, R. W.
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

YOUNG, T. C.
Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 5B
A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 5D

YU, K.
Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

YU, Y-S.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 2E

ZABEL, T. F.
Biological Denitrification for Potable Water Treatment,
W82-05247 5F

ZACCOR, J. V.
A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 5G

ZAGIROV, F. G.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 8A

ZAJAC, P. K.
Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 5B

ZANKER, A.
Estimating Water Flow Under Gates,
W82-05514 8B

ZANONI, A. E.
Calorific Value of Wastewater Plant Sludges,
W82-04997 5E
Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 5A

ZARETSKII, YU. K.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

ZARZANA, A. L.
Oil and Grease in Stormwater Runoff,
W82-05557 5C

ZASLAVSKII, YU. L.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 8D

ZATEVAKHIN, A. L.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 8C

ZEDLER, J. B.
The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 2H

ZEIKUS, J. G.
Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 2H

ZELENEVSKII, Z. L.
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 8C

ZENTENO, M.
The Expansion of Two Bolivian Plants,
W82-05598 8A

ZENZ, D.
Impact of American Regulations on Industrial Sludge Management,
W82-05184 6E

ZENZ, D. R.
Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B
Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

ZEPP, R. G.
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

ZHUK, G. P.
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 8A

ZHUKINSKIY, V. N.
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

ZIA, H. A.
Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 4A

ZIMMERMAN, H. S.
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

ZIMMERMAN, K. E.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 8B

ZOETEMEYER, R. J.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 5D

ZOLAN, W. J.
Metal Concentrations in Guam Urban Runoff,
W82-05302 5B

Water Quality Assessment for Agana Springs,
W82-05304 5A

ZUEHLS, E. E.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

[illegible]

YAMAMOTO, M.
A Dynamic Model Modification of the Fungal Decomposing Process.
W73-[illegible] [illegible]

YAMASHITA, Y.
A Dynamic Model Identification of the Fungal Decomposing Process.
W73-[illegible] [illegible]

YANAGAWA, S.
A Dynamic Model Identification of the Fungal Decomposing Process.
W73-[illegible] [illegible]

YANAGASE, T.
The Trace Element Analysis of [illegible] [illegible]
W73-[illegible] [illegible]

[illegible]

YEH, W.
Conceptual and Practical Aspects of [illegible] [illegible] in the [illegible]
W73-[illegible] [illegible]

[illegible]
The Use of Continuous-Bound [illegible] of [illegible] [illegible] First [illegible]
W73-[illegible] [illegible]

[illegible]

YOUNG, R. A.
[illegible]
W73-[illegible] [illegible]

[illegible]

YOUNG, J. A.
[illegible]
W73-[illegible] [illegible]

A [illegible] of [illegible]
W73-[illegible] [illegible]

YU, S.
[illegible]
W73-[illegible] [illegible]

[illegible]

[illegible]
A Model [illegible] for [illegible]
W73-[illegible] [illegible]

[illegible]

ZIMMERMAN, [illegible]
[illegible]
W73-[illegible] [illegible]

[illegible]

ORGANIZATIONAL INDEX

ACADEMY OF MINING AND METALLURGY, KRACOW (POLAND). INST. OF ENVIRONMENTAL PROTECTION.
Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 5B

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, BENEDICT, MD. BENEDICT ESTUARINE RESEARCH LAB.
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 5C

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA. DIV. OF LIMNOLOGY AND ECOLOGY.
The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 5A

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF ZOOLOGY.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 2H

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 2H

AGRICULTURAL RESEARCH AND EDUCATION CENTER, SANFORD, FL.
Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 2H

AGRICULTURAL RESEARCH SERVICE, PROSSER, WA. IRRIGATED AGRICULTURE RESEARCH AND EXTENSION CENTER.
Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 5G

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF ELECTRICAL ENGINEERING.
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 6A

AKADEMIE DER WISSENSCHAFTEN DER DDR, BERLIN. INST. FUER GEOGRAPHIE UND GEOOKOLOGIE.
Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 2H

AKADEMIYA NAUK AZERBAIDZHANSJOI SSR, BAKU. INST. ZOOLOGII.
Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 2H

AKADEMIYA NAUK SSSR LENINGRAD. INST. OZEROVEDENIYA.
Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 5G

AKADEMIYA NAUK SSSR, MOSCOW. INST. BIOLOGII VNUTRENNYKH VOD.
An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 2A

Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 2D

Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 2F

Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 4A

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 2H

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1A

Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 5C

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 6G

The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 2H

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 2K

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 5A

Indoles in the Decomposition Products of Certain Blue-Green Algae,
W82-05505 2H

Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 5C

Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507 5C

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 5B

Effect of Water Turbulence on Illumination at Depth,
W82-05594 1A

Procedure for Investigating Metallic Ion Complexing in Natural Waters,
W82-05595 5A

AKADEMIYA NAUK USSR, PETROZAVODSK. INST. OF BIOLOGY.
The Importance of Lacustrine Zooplankton to the Feeding Capacity of the Lizhma Lake-River System (Basin of Lake Onega).
W82-05508 2H

AKRON UNIV., OH. DEPT. OF BIOLOGY.
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 2H

ALABAMA UNIV., BIRMINGHAM. DEPT. OF BIOLOGY.
Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 5D

ALASKA UNIV., FAIRBANKS. GEOPHYSICAL INST.
Thermal Front Formation from Buoyant Surface Jets,
W82-05004 5C

ALASKA UNIV., FAIRBANKS. INST. OF MARINE SCIENCE.
Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870 2A

ALBERTA ENVIRONMENTAL CENTER, VEGREVILLE.
Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 5A

ALBERTA ENVIRONMENTAL CENTRE, VEGREVILLE.
Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 5B

ALBERTA RESEARCH COUNCIL, EDMONTON.
A Field Technique to Directly Measure River Bank Erosion,
W82-05410 7B

ALBERTA UNIV., EDMONTON.
Circular Wall Jets in Coflowing Streams,
W82-04999 5B

Erosion by Plane Turbulent Jets,
W82-05277 8B

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Erosion by Submerged Circular Jets,
W82-05002 2J

ALCOA OF AUSTRALIA, PINJARRA.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 4B

ALEXANDRIA UNIV. (EGYPT). DEPT. OF OCEANOGRAPHY.
Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 5B

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 5B

ALL-UNION SCIENTIFIC RESEARCH INST. OF HYDROGEOLOGY AND ENGINEERING GEOLOGY.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 5D

ALLIED CHEMICAL CORP., IDAHO. IDAHO CHEMICAL PROGRAMS-OPERATIONS OFFICE.
Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 3A

ALVORD, BURDICK AND HOWSON, CHICAGO, IL.
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 5D

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF CHEMICAL TECHNOLOGY.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 5D

AMSTERDAM WATER WORKS (NETHERLANDS).
Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 6B

ANDERSON-NICHOLS AND CO., INC., CONCORD, NH.
Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 5D

ANDERSON-NICHOLS AND CO., INC., PROVIDENCE, RI.
Industry Helps Conserve Municipal Water,
W82-05674 3E

ANGLIAN WATER AUTHORITY (ENGLAND).
The use of Activated Carbon in Water Treatment,
W82-05182 5F

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 5B

ARGONNE NATIONAL LAB., IL.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 5A

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 5C

ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 3C

ARIZONA STATE UNIV., TEMPE. DEPT. OF ZOOLOGY.
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 2K

ARIZONA UNIV., TUCSON.
An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 2F

ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL ECONOMICS.
Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 4B

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 5G

ARIZONA UNIV., TUCSON. DEPT. OF POLITICAL SCIENCE.
Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 6E

ARLINGTON COUNTY DEPT. OF PUBLIC WORKS, VA. PUBLIC WORKS PLANNING.
Billing Data Aids Utility Planning,
W82-05786 6C

ARMY ENGINEER DISTRICT, ST. LOUIS, MO.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 8E

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Modeling: How and When to Use,
W82-04754 2L

Economic Analysis of Water Main Breaks,
W82-05673 8A

ARMY ENGINEERS DISTRICT, SACRAMENTO, CA.
Embankment Construction: New Melones Dam,
W82-05822 8D

ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LAB., FORT DETRICK, MD.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 3C

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 5D

ASIAN INST. OF TECH., BANGKOK (THAILAND).
Steady Shallow Flow Over a Spillway,
W82-05086 8B

Normality of Hydrological Data,
W82-05752 7B

ASPINWALL HYDROTECHNICAL SERVICES LTD. (ENGLAND), (UNITED KINGDOM).
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 4B

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Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
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Evolution of Water Management Techniques,
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On Hydrological Data Needs in Canada,
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The Uncertain Quest for a Management Strategy in the Fraser Estuary,
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On the Sampling Variance of Raingage Networks,
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Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
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Ground-Water Management in Basalts,
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W82-05381 5B

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 5B

Dispersion in Tumbling Flow,
W82-05796 8B

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Infiltration Inflow Analysis: Finding the Source,
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Resonance in Hydropower Stations,
W82-04953 8C

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Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
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Towards Digital Technology in the Measurement and Control of Water Levels,
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Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
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A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
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Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
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A Low-Cost Secondary Treatment Alternative,
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Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
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Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 2J

COBA INTERNATIONAL CONSULTANTS, LISBON (PORTUGAL).
Safety of Dams Judged from Failures,
W82-05512 8A

COFFIN AND RICHARDSON, BOSTON, MA.
Current Trends in Cost of Service Studies,
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A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
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Configuration of Ice in Frozen Media,
W82-05615 2C

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Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 5C

COLLEGE OF THE VIRGIN ISLANDS, ST. THOMAS.
Five-Year Plan of the Water Resources Research Center,
W82-05526 6B

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Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 2H

COLORADO RIVER BOARD OF CALIFORNIA, LOS ANGELES.
Colorado River Water Allocation,
W82-05888 6C

International Problems on the Colorado River,
W82-05892 5G

COLORADO STATE UNIV., FORT COLLINS.
Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 6E

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Future Water Development Policies,
W82-05884 5G

Colorado River Development,
W82-05887 4A

Development Issues in the Colorado River Basin,
W82-05890 6D

The Physical Environment of the Colorado River Basin,
W82-05891 6D

Salinity Control Measures for Grand Valley,
W82-05894 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 5G

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 4A

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 5B

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Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
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Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
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COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.
Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 2F

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 3C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 6D

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A Five-Year Plan for Water Research in Colorado,
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COLUMBIA GAS SYSTEM SERVICE CORP., WILMINGTON, DE.
Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
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COLUMBIA UNIV., NEW YORK. DEPT OF GEOLOGICAL SCIENCES.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 2F

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Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
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Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
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The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759 2G

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Production and Conditioning of Sludges from a High-Rate Biological Filter,
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Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
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Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
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On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 2J

CORNELL UNIV., ITHACA, NY.
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W82-05104 2H

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRONOMY.
Stream Transport of Nutrients Through a Wetland,
W82-04857 5B

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Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
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Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
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CORPS OF ENGINEERS, BUFFALO, NY.
A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 7B

CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
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W82-04872 5C

Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 5G

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Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 5C

DADE COUNTY DEPT. OF ENVIRONMENTAL RESOURCES MANAGEMENT, MIAMI, FL. ENVIRONMENTAL PLANNING DIV.
Aquifer Management in Dade County,
W82-05784 5G

DALLAS CITY WATER UTILITIES DEPT., TX.
Piloting Mag-Carbonate Treatment,
W82-05794 5F

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Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
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Strategies for Reuse and Conservation,
W82-05790 3C

DELAWARE UNIV., NEWARK. DEPT. OF AGRICULTURAL ENGINEERING.
Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 5B

DELAWARE UNIV., NEWARK. DEPT. OF CIVIL ENGINEERING.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 5D

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 8A

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Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law,
W82-04803 6E

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Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
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Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
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DEPARTMENT OF AGRICULTURE, SUMMERLAND (BRITISH COLUMBIA). RESEARCH STATION.
Irrigation Efficiency in Orchards,
W82-05768 3F

DEPARTMENT OF ENERGY, IDAHO FALLS, ID. IDAHO OPERATIONS OFFICE.
Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 8C

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
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W82-05486 5B

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Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 5A

DEPARTMENT OF SCIENCE, MELBOURNE (AUSTRALIA).
An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 2H

DEPARTMENT OF THE ENVIRONMENT (EDMONTON).
Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 6D

DEPARTMENT OF THE ENVIRONMENT, HALIFAX (NOVA SCOTIA).
The Shubenacadie-Stewiacke River Basin Study,
W82-05385 6B

DEPARTMENT OF THE ENVIRONMENT, VANCOUVER (BRITISH COLUMBIA). INLAND WATER DIRECTORATE (PACIFIC REGION).
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 5A

DEPARTMENT OF THE ENVIRONMENT, VANCOUVER (BRITISH COLUMBIA). INLAND WATERS DIRECTORATE (PACIFIC REGION).
A Federal Perspective on River Basin Management,
W82-05388 6E

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 5B

DEPARTMENT OF THE ENVIRONMENT, VICTORIA (BRITISH COLUMBIA).
New Strategies for Water Resource Planning in British Columbia,
W82-05395 6E

Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 5G

DEPARTMENT OF THE ENVIRONMENT, VICTORIA (BRITISH COLUMBIA). ASSESSMENT AND PLANNING DIV.
Agricultural Runoff and Water Pollution,
W82-05569 5B

DEPT. OF FISHERIES AND OCEANS, ST. JOHN'S (NEWFOUNDLAND).
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 5C

DEUTSCHES HYDROGRAPHISCHES INST., HAMBURG (GERMANY, F.R.).
The Tidal Stream in the German Bight,
W82-05190 2L

DORNBUSCH (DAVID M.) AND CO., INC., SAN FRANCISCO, CA.
Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 6B

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 6B

DREXEL UNIV., PHILADELPHIA, PA.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 5G

DU PONT DE NEMOURS (E. I.) AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 5F

DUNCAN, LAGNESE AND ASSOCIATES, INC., PITTSBURGH, PA.
Anaerobic Treatment in Novel Contact Digester,
W82-05681 5D

DUNDEE UNIV. (SCOTLAND). DEPT. OF BIOLOGICAL SCIENCES.
Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 2H

EAST AFRICAN FRESHWATER FISHERIES RESEARCH ORGANIZATION, JINJA (UGANDA).
Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578 5B

EAST TENNESSEE STATE UNIV., JOHNSON CITY. DEPT. OF ENVIRONMENTAL HEALTH.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 3D

ECOLE NATIONALE SUPERIEURE DE CHIMIE, TOULOUSE (FRANCE). LABORATOIRE DE CHIMIE ORGANIQUE ET D'AGROCHIMIE.
Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 5D

ECOLE POLYTECHNIQUE FEDERALE DE LAUSAGNE (SWITZERLAND).
The Overtopping of the Palagnedra Dam,
W82-04952 8A

ECOLOGICAL AND TOXICOLOGICAL ASSOCIATION, BASEL (SWITZERLAND).
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 5B

EDECO, INC., TULSA, OK.
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 5D

EDINBURGH UNIV. (SCOTLAND). DEPT. OF ELECTRICAL ENGINEERING.
The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 6D

EDINBURGH UNIV. (SCOTLAND). DEPT. OF GEOLOGY.
The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 2K

EG AND G ENVIRONMENTAL CONSULTANTS, WALTHAM, MA.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 6C

EIDGENOESSESCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). TECHNISCH-CHEMISCHES LAB.
Kinetics of Biofilm Nitrification,
W82-05374 5D

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHUTZ, ZURICH (SWITZERLAND).
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 5A

ORGANIZATIONAL INDEX

EIDGENOESSISCHE ANSTALT FUER WASSERVORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHUTZ, KASTIENBAUM (SWITZERLAND). LAKE RESEARCH LAB.
Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 5B

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND).
Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 5B

EMA, INC., ST. PAUL, MN.
Computer-Based Implementation of Combined Sewer Control,
W82-04783 5D

EMPRESA NACIONAL DE ELECTRICIDAD, COCHABAMBA (BOLIVIA).
The Expansion of Two Bolivian Plants,
W82-05598 8A

ENERGY POLICY STUDIES, INC., OMAHA, NE.
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 6D

ENGINEERING-SCIENCE INC., AUSTIN, TX.
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 5D

ENVIREX INC., WAUKESHA, WI.
How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 5D

ENVIROGENICS SYSTEMS CO., EL MONTE, CA.
VTE/VC for Sea Water,
W82-04909 3A

ENVIRONMENTAL LAW INST., WASHINGTON, DC.
Acid Precipitation. 1. Causes and Consequences,
W82-04771 5C

ENVIRONMENTAL MONITORING SYSTEMS LAB. LAS VEGAS, NV.
Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 5A

ENVIRONMENTAL PROTECTION AGENCY, ADA, OK. ROBERT S. KERR ENVIRONMENTAL RESEARCH LAB.
The Colorado River Salinity Problem,
W82-05889 5G

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 5A

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 8G

ENVIRONMENTAL PROTECTION AGENCY, CORVALLIS, OR.
Effects of Acid Precipitation,
W82-05149 5C

ENVIRONMENTAL PROTECTION AGENCY, GROSSE ILE, MI. LARGE LAKES RESEARCH STATION.
Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 5B

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 5C

ENVIRONMENTAL PROTECTION AGENCY, NEW YORK.
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 5D

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 5D

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF RESEARCH AND DEVELOPMENT.
Overview and Assessment of Biological Sensing,
W82-05156 5C

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 5B

Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 2K

Dynamic Estuary Model Performance,
W82-05319 2L

ENVIRONMENTAL RESEARCH LAB.-DULUTH, MN.
Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 5A

ENVIRONMENTAL SERVICES, INC., CLEVELAND, OH.
Safety Considerations in Handling Activated Carbon,
W82-05442 5D

ENVIROSCIENCE, INC., MINNEAPOLIS, MN.
Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 4A

ERT, CONCORD, MA.
Acid Rain: Legal and Political Fallout,
W82-05147 6E

FAIRFAX COUNTY DIV. OF ENVIRONMENTAL HEALTH, VA.
Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 5D

FEDERAL INST. OF HYDROLOGY, COBLENZ (GERMANY F.R.).
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 2E

FINLAND TECHNICAL RESEARCH CENTER, ESPOO.
Contents of Chlordane, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 5A

FISH AND WILDLIFE SERVICE, JAMESTOWN, ND. NORTHERN PRAIRIE WILDLIFE RESEARCH CENTER.
Wetlands and Deepwater Habitats: A New Classification,
W82-05716 2L

FLORIDA DEPT. OF NATURAL RESOURCES, TALLAHASSEE BUREAU OF AQUATIC PLANT RESEARCH AND CONTROL.
Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 4A

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF METEOROLOGY.
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 2B

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 5D

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 2H

FLORIDA UNIV., GAINESVILLE. SCHOOL OF FOREST RESOURCES.
How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 5E

FLORIDA UNIV., GAINESVILLE. SCHOOL OF FOREST RESOURCES AND CONSERVATION.
The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 4A

FOOD AND AGRICULTURAL ORGANIZATION OF THE UNITED NATIONS, ROME (ITALY). LAND AND WATER DEVELOPMENT DIV.
Bottom-Entry Large-Diameter Wells,
W82-04919 8A

Cavity Well,
W82-04920 8A

FOOD AND DRUG ADMINISTRATION, WASHINGTON, DC. DIV. OF CHEMICAL TECHNOLOGY.
Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 5B

Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 5D

FOOD AND DRUG ADMINISTRATION, WASHINGTON, DC. DIV. OF CHEMICAL TECHNOLOGY.
Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 5D

FORD MOTOR CO., DEARBORN, MI.
Chemometric Modeling of Wastewater Treatment Processe,
W82-05858 5D

FOREST PEST MANAGEMENT INST., SAULT STE. MARIE (ONTARIO).
The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 5B

FOREST RESEARCH INST. CHRISTCHURCH (NEW ZEALAND).
Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 4C

FORESTRY SCIENCES LAB., GRAND RAPIDS, MN.
Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 5D

FOURTH RIVER PURIFICATION BOARD, EDINBURGH (SCOTLAND).
A River Coding System for Water Quality Archives,
W82-05474 7A

FRANKLIN RESEARCH CENTER, PHILADELPHIA, PA.
Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 5D

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 5B

FRESHWATER BIOLOGICAL ASSOCIATION, CUMBRIA (ENGLAND).
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 2K

FRESHWATER BIOLOGICAL ASSOCIATION, WINDERMERE (ENGLAND).
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 7B

GARLAND WASTEWATER TREATMENT DEPT., TX.
Right Velocity Keeps the Solids Up,
W82-05788 5D

GEOLOGICAL SURVEY, ANCHORAGE, AK. WATER RESOURCES DIV.
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 5G

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 2F

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 4A

GEOLOGICAL SURVEY, BATON ROUGE, LA. WATER RESOURCES DIV.
Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 7C

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 2E

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 7C

GEOLOGICAL SURVEY, BOSTON, MA. WATER RESOURCES DIV.
Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 7C

GEOLOGICAL SURVEY, CARSON CITY, NV. WATER RESOURCES DIV.
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 7C

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 6B

GEOLOGICAL SURVEY, COLUMBIA, SC. WATER RESOURCES DIV.
Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 2A

GEOLOGICAL SURVEY, COLUMBUS, OH. WATER RESOURCES DIV.
Water Use in Ohio, 1975,
W82-05226 6D

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 5B

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 7C

GEOLOGICAL SURVEY, DENVER, CO.
Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 2E

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 3A

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 2J

GEOLOGICAL SURVEY, DORAVILLE, CA. WATER RESOURCES DIV.
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 5C

GEOLOGICAL SURVEY, DORAVILLE, GA. WATER RESOURCES DIV.
Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 2E

GEOLOGICAL SURVEY, HARRISBURG, PA. WATER RESOURCES DIV.
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 2F

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 7C

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 5B

GEOLOGICAL SURVEY, HARRISBURG, PA. WATER RESOURCES DIV., AND ESSO PROSPECCAO LIMITADA, RIO DE JANEIRO, BRAZIL.
Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 2F

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 2E

GEOLOGICAL SURVEY, HONOLULU, HI. WATER RESOURCES DIV.
Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 7C

GEOLOGICAL SURVEY, HOUSTON, TX. WATER RESOURCES DIV.
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 7C

GEOLOGICAL SURVEY, IDAHO FALLS, ID. WATER RESOURCES DIV.
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 5B

GEOLOGICAL SURVEY, INDIANAPOLIS, IN. WATER RESOURCES DIV.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 7C

GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.
Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 5B

GEOLOGICAL SURVEY, LAGUNA NIGUEL, CA. WATER RESOURCES DIV.
Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 7C

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 2F

GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 7C

GEOLOGICAL SURVEY, LITTLE ROCK, AR. WATER RESOURCES DIV.
Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 7C

GEOLOGICAL SURVEY, MADISON, WI. WATER RESOURCES DIV.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 2E

GEOLOGICAL SURVEY, MENLO PARK, CA.
Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 5G

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 2K

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 2J

GEOLOGICAL SURVEY, MORGANTOWN, WV. WATER RESOURCES DIV.
Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 2F

GEOLOGICAL SURVEY, NASHVILLE, TN. WATER RESOURCES DIV.
Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 7C

GEOLOGICAL SURVEY, NSTL STATION, MS. GULF COAST HYDROSCIENCE CENTER.
Volatilization of Ketones From Water,
W82-05782 5C

GEOLOGICAL SURVEY OF CANADA, OTTAWA (ONTARIO).
Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 2C

GEOLOGICAL SURVEY OF ISRAEL, JERUSALEM.
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 2E

GEOLOGICAL SURVEY, ORLANDO, FL. WATER RESOURCES DIV.
Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05350 7C

GEOLOGICAL SURVEY, PROVIDENCE, RI.
Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 2F

GEOLOGICAL SURVEY, RESTON, VA.
Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 7C

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 4B

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 7A

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 7C

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 7C

GEOLOGICAL SURVEY, SAN ANTONIO, TX. WATER RESOURCES DIV.
Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79,
W82-04987 7C

GEOLOGICAL SURVEY, SAN JUAN, PR. WATER RESOURCES DIV.
Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 6F

GEOLOGICAL SURVEY, SYOSSET, NY. WATER RESOURCES DIV.
Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 2E

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 7C

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 7C

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 2F

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 5C

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 5B

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 7C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 2F

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 7C

GEOLOGICAL SURVEY, TAMPA, FL. WATER RESOURCES DIV.
Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 7C

GEOLOGICAL SURVEY, TOWSON, MD. WATER RESOURCES DIV.
Lineboro Quadrangle: Hydrogeology,
W82-04969 7C

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 7C

GEOLOGICAL SURVEY, TUCSON, AZ. WATER RESOURCES DIV.
Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980,
W82-05826 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 7C

GEOLOGICAL SURVEY, TUSCALOOSA, AL. WATER RESOURCES DIV.
Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 2E

GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 7C

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 5F

GEORGIA SOUTHWESTERN COLL., AMERICUS. DEPT. OF BIOLOGY.
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 5B

GEORGIA SOUTHWESTERN COLL., AMERICUS. DEPT. OF GEOLOGY AND PHYSICS.
The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 3B

GEORGIA UNIV., ATHENS. DEPT. OF POULTRY SCIENCE.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 5C

GEORGIA UNIV., ATHENS. INST. OF ECOLOGY.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 6G

GOETEBORG UNIV. (SWEDEN). DEPT. OF ZOOPHYSIOLOGY.
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 5C

GOSUDARSTVENNYI NAUCHNO-ISSLEDOVATELSKII INST. OZERNOGO I RECHNOGO RYBNOGO KHOZYAISTVA, LENINGRAD (USSR).
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 5C

GRAHAM ASSOCIATES, INC., DALLAS, TX.
Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 6B

ORGANIZATIONAL INDEX

GREELEY AND HANSEN, CHICAGO, IL.
Nitrogen Control at Three Related Plants,
W82-05434 5D

GRIFFITH UNIV., NATHAN (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 5B

Optimization Principle for Air and Water Movement,
W82-05172 2G

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 4A

GUAM UNIV., AGANA. WATER AND ENERGY RESEARCH INST.
Metal Concentrations in Guam Urban Runoff,
W82-05302 5B

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 5C

Water Quality Assessment for Agana Springs,
W82-05304 5A

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 5G

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 4D

GUELPH UNIV., (ONTARIO). DEPT. OF ZOOLOGY.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 2H

HADASSAH MEDICAL SCHOOL, JERUSALEM (ISRAEL). ENVIRONMENTAL HEALTH LAB.
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W82-05421 6D

HALL AND EVANS, DENVER, CO.
Non-Indian Federal Reserved Water Rights,
W82-04804 6E

HAMBURG CITY DRAINAGE (GERMANY, F.R.).
Northern Elbe Culvert,
W82-05427 8B

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W82-05146 5C

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A Screening Model to Quantify Resilience,
W82-05044 6A

Alternative Indices of Resilience,
W82-05045 6A

Estimates of Resilience Indices by Simulation,
W82-05046 6A

Estimating Resilience by Canonical Analysis,
W82-05047 6A

HARVARD UNIV., CAMBRIDGE, MA. DIV. OF APPLIED SCIENCES.
Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 5D

HAWAII UNIV. AT MANOA, HONOLULU. WATER RESOURCES RESEARCH CENTER.
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
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HAWAII UNIV., HONOLULU. DEPT. OF CIVIL ENGINEERING.
Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 5B

HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER.
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 3C

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 4B

HAYS AND LINDSEY, INC., AUSTIN, TX.
A Consistent Methodology for Wasteload Allocations,
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Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
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HEIDELBERG UNIV. (GERMANY, F. R.). LAB. FOR SEDIMENTOLOGY.
Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
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Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
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HERIOT-WATT UNIV., EDINBURGH (SCOTLAND). DEPT. OF CHEMISTRY.
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
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HERSHEV - THE INTER-KIBBUTZ ECONOMIC UNIT, TEL AVIV (ISRAEL).
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 6B

HILSDON AND SONNENBURG, MEMPHIS, TN.
Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 8C

HITTMAN ASSOCIATES, INC., COLUMBIA, MD.
Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 3A

HOUSTON UNIV., TX. DEPT. OF BIOCHEMICAL AND BIOPHYSICAL SCIENCES.
Volatile Constituents of the Produced Water Effluent from the Buccaneer Gas and Oil Field,
W82-05874 5A

HUMBOLDT STATE UNIV., ARCATA, DEPT. OF ENGINEERING.
Random Differential Equations in River Water Quality Modeling,
W82-05343 6A

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Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 5D

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Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 3F

IDAHO UNIV., MOSCOW. DEPT. OF ECONOMICS.
Price or Persuasion,
W82-05791 6C

IDAHO UNIV., MOSCOW. TWIN FALLS COOPERATIVE EXTENSION SERVICE.
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W82-04907 5D

ILLINOIS STATE WATER SURVEY DIV., CAMPAIGN; AND ILLINOIS STATE GEOLOGICAL SURVEY DIV., CHAMPAIGN.
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 7B

ILLINOIS STATE WATER SURVEY DIV., CHAMPAIGN; AND ILLINOIS STATE GEOLOGICAL SURVEY DIV., CHAMPAIGN.
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 2F

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ECONOMICS.
Some Emerging Rights in Agricultural Land,
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Peak Runoff Model Comparison on Central Illinois Watersheds,
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W82-05259 5D

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The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 2G

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Low Temperature Evaporation Plants,
W82-05118 3A

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Turbines for Itaipu,
W82-04955 8C

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Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
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Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 2D

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The Safe Drinking Water Act on Review,
W82-05792 5G

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W82-04819 5A

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Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 5B

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Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 4B

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A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
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W82-04768 2H

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W82-05580 5A

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A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 5D

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Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
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Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
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W82-04991 5D

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The Decline of Salvinia Molesta on Lake Kariba,
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Radionuclides in Mono Lake, California,
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Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 2J

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The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
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LAWRENCE LIVERMORE NATIONAL LAB., CA.
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
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Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
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Algorithm for Optimal Activated Sludge Operation,
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Start-Up Problems of Sludge Dewatering Facility,
W82-05444 5D

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An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
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Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 5C

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Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
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A New Method of Cubature Using Spline Functions,
W82-04939 2L

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W82-05189 2L

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Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
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Septage and Wastewater Treatment in the Activated Sludge Process,
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Virginians Optimize Sludge Handling,
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Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
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A Computer Model for Heavy Metal Transport within the Penobscot River,
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A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
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The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
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Flood Control and Flow Regulation Problems on the Assiniboine River,
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Shock Load of Chromium (VI),
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Optimum Depth and Spacing of Subsurface Drains,
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A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
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Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 5A

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Calorific Value of Wastewater Plant Sludges,
W82-04997 5E

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Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 2L

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Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 2L

Ion Hydration and Ion Interaction,
W82-05310 2K

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Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 5D

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 2E

Water Yield Estimation in Western United States,
W82-05689 4D

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Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 5G

MASON AND HANGER-SILAS MASON CO., INC., LEONARDO, NJ.
Performance Testing of the Diperna Sweeper,
W82-05058 5G

Performance Testing of Four Skimming Systems,
W82-05059 5G

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 5G

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 5G

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W82-05708 2B

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Finite-Amplitude Stability of Axisymmetric Pipe Flow,
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Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Inhibiting the Green River, Massachusetts,
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Casein Whey Wastewater Effects on Soil Permeability,
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The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
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The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
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Using Pumps as Small Turbines,
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Evaporation at a High Arctic Site,
W82-04899 2D

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF GEOLOGY.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 5A

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 5B

MEIDENSHA ELECTRIC MFG., CO., TOKYO, (JAPAN).
Advanced Supervisory Control System for Sludge Treatment,
W82-04841 5D

MEIRING (P. G. J.) AND PARTNERS (SOUTH AFRICA).
The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 5D

METCALF AND EDDY, INC., PALO ALTO, CA.
Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 5D

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, IL.
Impact of American Regulations on Industrial Sludge Management,
W82-05184 6E

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 5B

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 5E

METROPOLITAN TORONTO AND REGION CONSERVATION AUTHORITY, DOWNSVIEW (ONTARIO). WATER RESOURCE DIVISION.
Water Management in the Metropolitan Toronto Region,
W82-05775 6B

MIAMI UNIV., FL. DEPT. OF MECHANICAL ENGINEERING.
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 5A

MICHIGAN AGRICULTURAL EXPERIMENT STATION, EAST LANSING.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 5B

MICHIGAN DEPT. OF NATURAL RESOURCES, LANSING.
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 5G

MICHIGAN DEPT. OF PUBLIC HEALTH, LANSING.
Methane in Water Wells,
W82-05262 5F

MICHIGAN STATE UNIV., EAST LANSING. INST. OF WATER RESEARCH.
Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 6B

MICHIGAN TECHNOLOGICAL UNIV., HOUGHTON.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 5D

MICHIGAN TECHNOLOGICAL UNIV., HOUGHTON. DEPT. OF CHEMISTRY AND CHEMICAL ENGINEERING.
Water and Salt Transport in Membranes,
W82-05537 3A

MICHIGAN UNIV., ANN ARBOR.
Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 2H

MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 8B

MIDWEST RESEARCH INST., KANSAS CITY, MO.
Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 5A

MINISTRY OF AGRICULTURE, BELFAST (NORTHERN IRELAND). AGRICULTURAL AND FOOD CHEMISTRY DIV.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 5B

MINISTRY OF ENERGY, SOFIA (BULGARIA).
Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 8A

MINISTRY OF STATE FOR ECONOMIC DEVELOPMENT, OTTAWA (ONTARIO).
The Eighties--Implications for Water Management,
W82-05772 6B

MINISTRY OF WORKS AND DEVELOPMENT, CHRISTCHURCH (NEW ZEALAND).
Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 2E

MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST. PAUL.
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W82-04881 3C

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINERAL ENGINEERING.
Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 5D

MINNESOTA UNIV., MINNEAPOLIS, ST. ANTHONY FALLS HYDRAULIC LAB.
Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 2E

Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 2J

MINNESOTA UNIV., ST. PAUL. COLL. OF FORESTRY.
Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 6B

MISSOURI UNIV.-COLUMBIA.
Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 5D

MISSOURI UNIV., COLUMBIA. DEPT. OF ATMOSPHERIC SCIENCE.
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W82-05900 2B

MISSOURI UNIV., ROLLA. DEPT. OF CIVIL ENGINEERING.
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W82-05859 5D

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W82-04957 5F

Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 5D

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 2A

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF MATHEMATICS.
Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 6A

MONTGOMERY (JAMES M.), INC., RESTON, VA.
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W82-05675 5F

MONTREAL ENGINEERING CO. LTD. (QUEBEC).
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 8A

MOSCOW STATE UNIV. (USSR).
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 7B

Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 2K

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Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 5A

MOSUL UNIV. (IRAQ).
Wastewater from a Sugar Refining Industry,
W82-05337 5D

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
International Nutrient Control Technology for Municipal Effluents,
W82-05321 5D

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
A Spatial Costing System for Drinking Water,
W82-04796 6C

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., EDISON, NJ. STORM AND COMBINED SEWER SECTION.
An Overview of Porous Pavement Research,
W82-05744 5D

NALCO CHEMICAL CO., OAK BROOK, IL.
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W82-05130 5D

NAPLES UNIV. (ITALY). DEPT. OF SANITARY ENGINEERING.
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W82-05422 5D

NATIONAL AERONAUTICAL LAB., BANGALORE (INDIA).
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W82-05357 6B

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A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 2L

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W82-05869 2K

NATIONAL BUREAU OF STANDARDS, WASHINGTON, DC.
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W82-04808 5A

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Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 5A

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.
Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 2E

NATIONAL CLAY PIPE INST., CRYSTAL LAKE, IL.
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W82-05700 8G

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT, INC., MEDFORD, MA.
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 5B

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER, DENVER, CO.
Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 5A

NATIONAL FISHERY RESEARCH LAB., LA CROSSE, WI.
Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 5B

NATIONAL HYDROLOGY RESEARCH INST., OTTAWA (ONTARIO).
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W82-04798 2C

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
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W82-05368 5F

NATIONAL INST. OF ENVIRONMENTAL MEDICINE, STOCKHOLM (SWEDEN).
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W82-04826 5F

NATIONAL MARINE FISHERIES SERVICE, ANN ARBOR, MI. GREAT LAKES FISHERY LAB.
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W82-05155 5C

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 5A

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 5B

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 2H

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 5A

Stability Effects on Great Lakes Evaporation,
W82-05634 2D

NATIONAL PARK SERVICE, HOMESTEAD, FL.
The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 5A

NATIONAL PHYSICAL RESEARCH LAB., PRETORIA (SOUTH AFRICA).
Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 5B

Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 2B

NATIONAL POWER CORP., MANILA (PHILIPPINES).
The Agus II Scheme in the Philippines,
W82-05599 8A

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W82-05570 5C

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Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 5A

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W82-05684 5D

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, STOCKHOLM.
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W82-04836 5C

NATIONAL WATER RESEARCH INST., BURLINGTON, (ONTARIO).
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W82-04998 2C

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W82-05105 7B

NEBRASKA UNIV. AT OMAHA. DEPT. OF CIVIL ENGINEERING.
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W82-05711 4A

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRICULTURAL ENGINEERING.
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 4B

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W82-05710 4A

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W82-04751 2L

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W82-04752 2L

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W82-05351 2H

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W82-05533 6B

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W82-05776 6B

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W82-05391 6D

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W82-05737 6A

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Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 5A

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W82-05161 5A

NEW ORLEANS UNIV., LA. DEPT. OF GEOGRAPHY.
The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 2J

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). SCHOOL OF CIVIL ENGINEERING.
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W82-05347 5B

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). LIMNOLOGY LAB.
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W82-05516 2J

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). SCHOOL OF CIVIL ENGINEERING.
Flow Resistance in Wide Rectangular Channels,
W82-05798 8B

NEW YORK CITY ENVIRONMENTAL PROTECTION ADMINISTRATION.
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 5D

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W82-05679 5C

NEWCASTLE UNIV. (AUSTRALIA). DEPT. OF CIVIL ENGINEERING AND SURVEYING.
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W82-05714 4A

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 5G

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 5D

NIAGARA FALLS WASTEWATER TREATMENT PLANT, NEW YORK.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 5D

NOAA DATA BUOY OFFICE, NSTL STATION, MS.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 2A

NORSK INST. FOR VANNFORSKNING, OSLO.
Control of Alum Addition in Wastewater Treatment,
W82-04837 5D

The Rehabilitation of Norway's Largest Lake,
W82-05243 5G

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIV., GREENSBORO. DEPT. OF PLANT SCIENCE AND TECHNOLOGY.
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W82-05536 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH.
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W82-04807 5B

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W82-04965 5B

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W82-05559 5E

NORTH CAROLINA UTILITIES COMMISSION, RALEIGH.
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W82-04793 5C

NORTH SURREY WATER CO. (ENGLAND).
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W82-05802 5F

NORTH TEXAS STATE UNIV., DENTON. DEPT. OF CHEMISTRY.
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W82-05016 5A

NORTH TEXAS STATE UNIV., DENTON. INST. OF APPLIED SCIENCES.
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W82-05481 5D

NORTH WEST WATER AUTHORITY (ENGLAND), RIVERS DIV.
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W82-05575 5A

NORTHEASTERN HILL UNIV., SHILLONG (INDIA). DEPT. OF BOTANY.
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W82-05573 4C

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W82-05780 4B

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W82-05814 5G

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W82-05815 5G

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W82-05238 4A

NORTHROP SERVICES, INC., CORVALLIS, OR.
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W82-04895 5C

NORWEGIAN HYDRODYNAMICAL LABS., TRONDHEIM. RIVER AND HARBOUR LAB. DIV.
River Plume Studies in Distorted Froude Models,
W82-05864 2E

NOTRE DAME UNIV., IN. DEPT. OF BIOLOGY.
Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 2H

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Measuring Reservoir Ground Movements,
W82-05773 8G

O'BRIEN AND GERE ENGINEERS, INC., SYRACUSE, NY.
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W82-05255 5A

OAK RIDGE NATIONAL LAB., TN.
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W82-05181 5C

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
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W82-05574 2B

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER.
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W82-04858 2G

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W82-04779 5A

OHIO STATE UNIV., COLUMBUS. DEPT. OF AGRONOMY.
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W82-05661 4D

OHIO STATE UNIV., COLUMBUS. DEPT. OF CIVIL ENGINEERING.
A Stochastic Model of Soil Erosion,
W82-05298 2J

Hydraulic Regime and Activated Sludge Performance,
W82-05819 5D

OHIO STATE UNIV., COLUMBUS. DEPT. OF DEVELOPMENT SOCIOLOGY.
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W82-05743 6B

OHIO STATE UNIV., COLUMBUS. DEPT. OF PHARMACOLOGY.
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W82-05057 5F

OKAYAMA UNIV. (JAPAN). DEPT. OF CHEMISTRY.
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W82-04891 5A

OKLAHOMA STATE UNIV., STILLWATER.
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W82-04918 4B

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W82-04922 4B

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W82-05301 6B

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W82-04753 2L

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W82-05671 6D

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W82-05560 8C

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W82-05637 5C

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W82-05635 5B

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 5B

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W82-05568 6G

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W82-05730 5G

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W82-05268 5A

OREGON STATE UNIV., CORVALLIS. DEPT. OF CROP SCIENCE.
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W82-05609 3F

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W82-05867 2J

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W82-05125 2H

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W82-05521 2A

OUFRESNE AND HENRY ENGINEERS, INC., NORTH SPRINGFIELD, VT.
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W82-04861 6D

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W82-05602 8A

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W82-05415 2K

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W82-05065 5E

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
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W82-05300 2G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES.
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W82-04875 3C

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W82-05558 6C

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W82-04870 4C

PHILADELPHIA WATER DEPT., PA.
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W82-05670 5F

PIRNIE (MALCOLM), INC., WHITE PLAINS, NY.
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W82-05785 5F

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W82-05604 6E

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Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 5D

PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF CHEMISTRY.
Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 5A

PROCTER AND GAMBLE CO., CINCINNATI, OH.
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 5D

PROMON ENGEHARIA SA, SAO PAULO (BRAZIL).
Relaxation in Concrete,
W82-05511 8F

PURDUE UNIV., LAFAYETTA, IN.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 5D

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 4D

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF PHARMACY AND PHARMACAL SCIENCES.
The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 5A

PURDUE UNIV. LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 2G

PURDUE UNIV., LAFAYETTE, IND. WATER RESOURCES RESEARCH CENTER.
Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 4A

QUEBEC UNIV., RIMOUSKI. INST. NATIONAL DE LA RECHERCHE SCIENTIFIQUE.
Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 5B

RAJASTHAN UNIV. JAIPUR (INDIA). DEPT. OF BOTANY.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 2H

RAJENDRA AGRICULTURAL UNIV., SAMASTIPUR (INDIA).
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 2I

RAND AFRIKAANS UNIV., JOHANNESBURG (SOUTH AFRICA). RESEARCH GROUP FOR FRESHWATER BIOLOGY.
The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 5C

RAND CORP., SANTA MONICA, CA.
Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 4B

RESEARCH INST. FOR ENVIRONMENTAL DEVELOPMENT, WROCLAW (POLAND).
Biofiltration Design Based on Volumetric Loading,
W82-05698 5D

RESOURCES CONSERVATION CO., SEATTLE, WA.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 5D

RH2 ENGINEERING, SEATTLE, WA.
Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 5B

RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). DEPT. OF GEOGRAPHY.
An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05099 2A

RICE UNIV., HOUSTON, TX. DEPT. OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 4C
Revised Rainfall Frequency Analysis for Houston,
W82-05863 2B

RIDEAU RIVER STORMWATER MANAGEMENT STUDY, OTTAWA (ONTARIO).
Stormwater Management in the Ottawa-Carleton Region,
W82-05563 5G

RIJKSINSTITUUT VOOR DRINKWATERVOORZIENING, LEIDSCHENDAM (NETHERLANDS).
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 5A

RIJKSINSTITUUT VOOR DRINKWATERVOORZIENING, LEIDSCHENDAM (NETHERLANDS). CHEMICAL BIOLOGICAL DIV.
The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 5A
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 5A

RIJKSINSTITUUT VOOR VISSERIJONDERZOEK,IJMUIDEN (NETHERLANDS).
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 5A

ROCHESTER UNIV., NY. DISTILLATION RESEARCH LAB.
Characterization of Properties of Water,
W82-05540 1A

ROCK VALLEY METROPOLITAN COUNCIL, ROCKFORD, IL.
Illinois Wetlands: Their Value and Management,
W82-05053 6G

ROCKWELL INTERNATIONAL, NEWBURY PARK, CA.
Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 5G

ROHM AND HAAS LTD., CROYDON (ENGLAND).
Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 5D

ROME UNIV. (ITALY). IST. DI CHIMICA APPLICATA ED INDUSTRIALE.
Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 5D

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE, MIAMI, FL.
The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1B
The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 2A

ROSTOCK UNIV. (GERMAN, D.R.).
Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 2L
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials),
W82-04762 2L

ROSWELL PARK MEMORIAL INST., BUFFALO, NY.
Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 5B

RUHRVERBAND, ESSEN (GERMANY, F.R.).
Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 5D

RURAL DEPARTMENT FOR WATERS AND FORESTRY, PARIS (FRANCE).
Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 4B

RUTGERS - THE STATE UNIV., BRUNSWICK, NJ.
Oil Slick Mechanics,
W82-05064 5G

RUTGERS-THE STATE UNIV., NEW BRUNSWICK, NJ.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 5B

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 5E

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. DEPT. OF CHEMICAL AND BIOCHEMICAL ENGINEERING.
Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 2E

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. DEPT. OF ENVIRONMENTAL SCIENCE.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 5E

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. WATER RESOURCES RESEARCH INST.
Settleability of Urban Runoff Pollution,
W82-05320 5G

SAITAMA UNIV. URAWA (JAPAN). DEPT. OF FOUNDATION ENGINEERING.
Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 2E

SAN DIEGO STATE UNIV., CA.
Nature of Wave Attenuation in Open Channel Flow,
W82-05003 2E

SAN DIEGO STATE UNIV., CA. DEPT. OF BIOLOGY.
The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 2H

SASKATCHEWAN DEPT. OF THE ENVIRONMENT, REGINA. INLAND WATERS DIRECTORATE.
The Mackenzie River Basin Study,
W82-05778 4A

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF BIOLOGY.
Primary Production in Saline Lakes,
W82-04926 2H

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Materials Balance in Aerated Static Pile Composting,
W82-05696 5D
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 5D

SCIENCE AND EDUCATION ADMINISTRATION, BOISE, ID. NORTHWEST WATERSHED RESEARCH CENTER.
Erosivity Values for Individual Design Storms,
W82-05694 4D

SCIENCE AND EDUCATION ADMINISTRATION, COLUMBIA, MO.
Acid Pond Drainage,
W82-05199 5G

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 5B
Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 2H

SCIENCE AND EDUCATION ADMINISTRATION, KIMBERLY, ID.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 8A

SCIENCE AND EDUCATION ADMINISTRATION, KIMBERLY, ID. SNAKE RIVER CONSERVATION RESEARCH CENTER.
New Evapotranspiration Crop Coefficients,
W82-05692 3F

SCIENCE AND EDUCATION ADMINISTRATION, LEWIS, TN. DAIRY EXPERIMENTAL STATION.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 5B

SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.
An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 5B

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Recording Raingage Modifications,
W82-05665 7B

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.
Simplifying Neutron Moisture Meter Calibration,
W82-05173 7B

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 5D

Humidity Measurement by Infrared Thermometry,
W82-05611 7B

SCIENCE AND EDUCATION ADMINISTRATION, RIVERSIDE, CA. SALINITY LAB.
The Wellton-Mohawk Dilemma,
W82-05883 3F

SCIENCE AND EDUCATION ADMINISTRATION, SIDNEY, MT.
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 3F

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. GRASSLAND, SOIL AND WATER RESEARCH.
Soil Water Availability,
W82-05623 2G

SCIENTIFIC SERVICE, INC., REDWOOD CITY, CA.
A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 5G

SEATEC INTERNATIONAL, BANGKOK (THAILAND).
Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 5F

SECRETARIA DE AGRICULTURA Y RECUROSOS HIDRAULICOS, MEXICO CITY.
Restructuration of the Water Tariff System for Irrigation Districts in Mexico,
W82-04962 6C

SECRETARY OF STATE FOR SCOTLAND, EDINBURGH. SCOTTISH DEVELOPMENT DEPT.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 5D

SERVICE DE CONTROLE DES EAUX DE LA VILLE DE PARIS (FRANCE).
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 5F

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 5C

SEVERN-TRENT WATER AUTHORITY (ENGLAND).
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 5D

Sulphide Control in Rising Mains,
W82-05465 5D

Mutagens, Carcinogens and the Water Cycle,
W82-05468 5A

SHEFFIELD UNIV. (ENGLAND). DEPT. OF CONTROL ENGINEERING.
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 5F

SHEFFIELD UNIVERSITY (ENGLAND) DEPT. OF MICROBIOLOGY.
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 5C

SIEMENS NAAMLOZE VENNOOTSCHAP, OOSTKAMP (BELGIUM).
Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 5A

SIMON FRASER UNIV., BURNABY (BRITISH COLUMBIA).
Northwestern Ontario River Dimensions,
W82-05742 6G

SOCIETE DES EAUX DE MARSEILLE (FRANCE). DEPT. ADDUCTION ET EXPLOITATION.
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 5F

SOCIETE LYONNAISE DES EAUX ET DE L'ECLAIRAGE (FRANCE).
Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 5A

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 5F

SOHIO RESEARCH CENTER, CLEVELAND, OH.
Microbial Removal of Hazardous Organic Compounds,
W82-05177 5D

SOIL CONSERVATION SERVICE, GREENVILLE, NC.
Stream Improvement: The Chicod Creek Episode,
W82-05717 4D

SOIL SURVEY INST., WAGENINGEN (NETHERLANDS). DEPT. OF SOIL PHYSICS.
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 2G

SOLWAY RIVER PURIFICATION BOARD (SCOTLAND).
The Impact of Fish Farming on Water Quality,
W82-05471 5B

SOUTHAMPTON UNIV. (ENGLAND).
Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 5D

SOUTHERN RESEARCH INST. BIRMINGHAM, AL. ANALYTICAL AND PHYSICAL CHEMISTRY DIV.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 5A

SOUTHERN UNIV., BATON ROUGE, LA. DEPT. OF BIOLOGICAL SCIENCES.
Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 5C

SOUTHERN WATER AUTHORITY (ENGLAND).
A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 5A

Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 2F

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, BROOKSVILLE.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 5C

SRI INTERNATIONAL, MENLO PARK, CA.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 5B

Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 5B

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 5A

SRI LANKA UNIV., PERADENIYA. DEPT. OF GEOLOGY.
Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 5C

STANFORD UNIV., CA. DEPT. OF APPLIED EARTH SCIENCES.
Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 5G

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 5F

STANTON AND STAVELY, NOTTINGHAM (ENGLAND).
A Pipeline for all Environments,
W82-04764 8G

STATE POLLUTION CONTROL COMMISSIONS, LIDCOMBE (AUSTRALIA).
Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 5E

STATE UNIV. OF NEW YORK AT BUFFALO, AMHERST. DEPT. OF MECHANICAL AND ENGINEERING AEROSPACE.
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 2E

STATE UNIV. OF NEW YORK AT STONY BROOK. MARINE SCIENCES RESEARCH CENTER.
An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606 5B

STATE UNIV., OF NEW YORK COLL. AT BUFFALO. GREAT LAKES LAB.
Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 5C

STATE UNIV. OF NEW YORK COLL. AT PURCHASE.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 5C

STATE UNIV. OF NEW YORK COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY, SYRACUSE.
Potential Use of Earthworms as a Solution to Sludge Management,
W82-05478 5E

STOCKHOLM UNIV. (SWEDEN).
Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 5A

STRAUSS AND ROBERTS, PORTERVILLE, CA.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 5D

SVERDRUP AND PARCEL AND ASSOCIATES, INC., ST. LOUIS, MO.
Control of Sludge Bulking in the Brewing Industry,
W82-05260 5D

SWISS FEDERAL INST. OF TECH., ZURICH.
Glaciers and Their Fluctuations,
W82-04777 2C

SWISS REINSURANCE CO., ZURICH.
Water Reuse Planning by Means of an Input-Output Table,
W82-04794 6A

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 5F

TAHAL--WATER PLANNING FOR ISRAEL, LTD., TEL AVIV (ISRAEL).
Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 2F

TALLIN POLYTECHNIC INST. (USSR).
Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 5A

TECHNICAL UNIV. OF DENMARK, COPENHAGEN. DEPT. OF SANITARY ENGINEERING.
Criteria for Nitrification in Fixed Film Reactors,
W82-05352 5D

TECHNICAL UNIV. OF ISTANBUL (TURKEY). DEPT. OF CIVIL ENGINEERING.
Three-State Markov Model for Differential Persistence,
W82-05654 2E

TECHNICAL UNIV. OF ISTANBUL (TURKEY). ENVIRONMENTAL SCIENCES DIV.
Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 5B

TECHNION-ISRAEL INST. OF TECH., HAIFA. DEPT. OF AGRICULTURAL ENGINEERING.
Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04879 5B

TECHNION-ISRAEL INST. OF TECH., HAIFA. DEPT. OF CIVIL ENGINEERING.
High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 5D

TECHNION-ISRAEL INST. OF TECH., HAIFA. DIV. OF ENVIRONMENTAL AND WATER RESOURCES ENGINEERING.
Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 5D

TECHNION-ISRAEL INST. OF TECH., HAIFA. ENVIRONMENTAL AND WATER RESOURCES ENGINEERING.
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 5D

TECHNION - ISRAEL INST. OF TECH., HAIFA. ENVIRONMENTAL ENGINEERING LABS.
Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 5D

TECHNISCHE HOCHSCHULE, AACHEN (GERMANY, F.R.). HYDROPOWER DIV.
Modified Standard Operation Rules for Reservoirs,
W82-05658 4A

TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS). DEPT. OF CIVIL ENGINEERING.
Microbial Activity in Activated Carbon Filters,
W82-05683 5F

TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS). LAB. OF CHEMICAL ENGINEERING.
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 5D

TECHNISCHE UNIV., BERLIN (GERMANY, F.R.). INST. FUER OKOLOGIE.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 5A

TECHNISCHE UNIV., VIENNA (AUSTRIA).
Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 5D

Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 5D

TENNESSEE TECHNOLOGICAL UNIV., COOKEVILLE.
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 7B

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 5C

TENNESSEE TECHNOLOGICAL UNIV., COOKEVILLE. DEPT. OF BIOLOGY.
Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 7B

TENNESSEE UNIV., KNOXVILLE. DEPT. OF CIVIL ENGINEERING.
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 5D

Application of and Guidelines for Using Available Dam Break Models,
W82-05152 8A

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 3D

TENNESSEE VALLEY AUTHORITY, CHATTANOOGA.
Do Model for Discharges from Deep Impoundments,
W82-05316 2H

TEXAS A AND M UNIV., COLLEGE STATION.
Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 3F

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CHEMISTRY.
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 5A

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CIVIL ENGINEERING.
On-Site Stormwater Detention: An Overview,
W82-04758 4A

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF SOIL AND CROP SCIENCE.
Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 5C

TEXAS A AND M UNIV., COLLEGE STATION. WATER RESOURCES INST.
Water Research in Action.
W82-05292 6B

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 3F

TEXAS UNIV. AT AUSTIN. BUREAU OF ECONOMIC GEOLOGY.
Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 5B

TEXAS UNIV. AT AUSTIN. DEPT. OF CIVIL ENGINEERING.
Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 2H

TEXAS UNIV. AT AUSTIN, PORT ARANSAS. MARINE SCIENCE INST.
Metabolic Response of Fish to Stress,
W82-05159 5C

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 5C

TEXAS UNIV., HOUSTON. SCHOOL OF PUBLIC HEALTH.
Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 5A

THAMES WATER AUTHORITY, LONDON (ENGLAND).
The Search for Reservoir Sites in an Urban Environment,
W82-04867 8A

Wedge-Block Tunnels in Water Supply,
W82-05803 8F

THORN CREEK BASIN SANITARY DISTRICT WATER, CHICAGO HEIGHTS, IL.
'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 5D

TOKYO INST. OF TECH., YOKOHAMA. RESEARCH LAB. OF RESOURCES UTILIZATION.
Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 5D

TOKYO UNIV. (JAPAN).
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 5A

TOKYO UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 5A

TOKYO UNIV. (JAPAN). DEPT. OF URBAN ENGINEERING.
Studies on Oxygen Transfer Models,
W82-05349 1A

TORONTO UNIV. (ONTARIO). DEPT. OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 5A

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 5D

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 5D

TORONTO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 2G

TRABZON UNIV. (TURKEY).
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 8B

TRW ENVIRONMENTAL ENGINEERING DIV., REDONDO BEACH, CA.
Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 5G

TUFTS UNIV., MEDFORD, MA.
Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 5D

ULM UNIV. (GERMANY, F. R.).
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 5A

UMEA UNIV. (SWEDEN). DEPT. OF ECOLOGICAL BOTANY.
The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 2H

UNION CARBIDE CORP., SOUTH CHARLESTON, WV.
Impact of Discharges as a Basis for Control Measures,
W82-05354 5B

UNION CARBIDE CORP., SOUTH CHARLESTON, WV. RESEARCH AND DEVELOPMENT DEPT.
Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 5E

UNION COLL., SCHENECTADY, NY. DEPT. OF CIVIL ENGINEERING.
Statistical Analysis to Derive Improved Stormwater Quality Models,
W32-05857 5B

UNITED ENGINEERS AND CONSTRUCTORS, INC., PHILADELPHIA, PA.
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports,
W82-05067 2D

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO, MEXICO CITY. INST. DE INGENIERIA.
A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 8B

UNIVERSIDADE CENTRAL DE VENEZUELA, CARACAS. DEPT. OF SANITARY ENGINEERING.
Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 5F

UNIVERSITY COLL., LONDON (ENGLAND). DEPT. OF BOTANY AND MICROBIOLOGY.
Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 2H

UNIVERSITY COLL. OF NORTH WALES, BANGOR. SCHOOL OF PLANT BIOLOGY.
Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 2H

UNIVERSITY OF NEW ULSTER, COLERAINE (NORTHERN IRELAND). LIMNOLOGY LAB.
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 5B

UNIVERSITY OF OCCUPATIONAL AND ENVIRONMENTAL HEALTH, KITAKYUSHU (JAPAN). SCHOOL OF MEDICINE.
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 5A

UNIVERSITY OF PUGET, TOCOMA, WA. DEPT. OF PHYSICS.
Effect of Ashfall on Snowmelt Rate at Paradise, Mount Rainier, Washington,
W82-05871 2C

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA). DEPT. OF BOTANY AND MICROBIOLOGY.
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 5G

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF. DEPT. OF APPLIED BIOLOGY.
Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 5C

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF. DEPT. OF CIVIL ENGINEERING.
An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279 8B

UNIVERSITY OF WESTERN ONTARIO, LONDON. DEPT. OF ZOOLOGY.
Weak Controls from Sea to Shining Sea,
W82-05035 5B

UPPSALA UNIV. (SWEDEN). DEPT. OF LIMNOLOGY.
Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 5D

UTAH STATE UNIV., LOGAN. COLLEGE OF ENGINEERING.
Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 5D

UTAH STATE UNIV., LOGAN. CROPS RESEARCH LAB.
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 3F

UTAH STATE UNIV., LOGAN. DEPT. OF AGRICULTURAL AND IRRIGATION ENGINEERING.
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 3F

UTAH STATE UNIV., LOGAN. WATERSHED SCIENCE UNIT.
Erosion from Mountain Snowpack Melt,
W82-05664 2J

UTAH WATER RESEARCH LAB., LOGAN.
Energy Siting in Utah: A Programming Model,
W82-05297 6B

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 5B

Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 6B

UTTAR PRADESH IRRIGATION RESEARCH INST., ROORKEE (INDIA). TEHI DAM DIV.
Flow Under Weir on Scoured Bed,
W82-05800 8B

VANDERBILT UNIV., NASHVILLE, TN.
Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 5D

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CHEMICAL ENGINEERING.
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 5C

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CHEMISTRY.
Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 5D

VASSAR COLL., POUGHKEEPSIE, NY.
Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 5F

VERSAR, INC., SPRINGFIELD, VA.
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 5G

VESZPREMI VEGYIPARI EGYETEM (HUNGARY). INST. FOR ANALYTICAL CHEMISTRY.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 5D

VICTORIA GENERAL HOSPITAL, HALIFAX (NOVA SCOTIA). DIV. OF LABORATORIES.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 5F

VICTORIA UNIV. OF MANCHESTER (ENGLAND). POLLUTION RESEARCH UNIT.
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 5D

A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. CENTER FOR ENVIRONMENTAL STUDIES.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 2H

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 5A

VIRGINIA POLYTECHNIC INST., AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 5B

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 5A

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 2H

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 5C

Biological Monitoring, Part V - Preference and Avoidance Studies,
W82-05340 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.
The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. VIRGINIA WATER RESOURCES RESEARCH CENTER.
Virginia Water Resources Research Center Five-Year Plan,
W82-05529 6B

VIRGINIA POLYTECNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 5A

VIZGAZDALKODASI TUDOMANYOS KUTATO INTEZET, BUDAPEST (HUNGARY). INST. FOR WATER POLLUTION CONTROL.
New Trends in Water Quality Management,
W82-05429 5G

VSESOYUZNYI NAUCHNO-ISSLEDOVATELSKII INST. PRODOVOGO RYNOGO KHOZIAISTVA RYBNOE (USSR).
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 5D

WARSAW UNIV. (POLAND). CHAIR OF HYDROBIOLOGY.
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 2H

WASHINGTON STATE UNIV., PULLMAN.
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 5B

WASHINGTON UNIV., SEATTLE. COLL. OF FISHERIES.
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 2K

WASHINGTON UNIV., SEATTLE. COLL. OF OCEAN AND FISHERIES SCIENCES.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 5C

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Evaluation of Snowmelt Forecasting Methods,
W82-05552 4A

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 8B

A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 2C

WASHINGTON UNIV., SEATTLE. FISHERIES RESEARCH INST.
Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 5B

Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 5C

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 5C

WASSERWIRTSCHAFTSAMT BRAKE (GERMANY, F. R.).
Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 5E

WATER RESEARCH CENTER STEVENAGE (ENGLAND).
Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 5D

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 5D

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Predicting Full-Scale Batch Thickener Performence Using the Frozen-Image Centrifuge,
W82-05185 5E

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 5F

WATER RESEARCH COMMISSION, PRETORIA (SOUTH AFRICA).
Wastewater Technologies in South Africa: Research and Application,
W82-05350 5D

WATER RESOURCE ENGINEERS, GAINESVILLE, FL.
1980 Needs Survey: Combined Sewer Ssite Studies,
W82-05862 5D

WATER SCIENCE LAB., MELBOURNE (AUSTRALIA).
Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 5D

WATERLOO UNIV., ONTARIO.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 5B

WATERLOO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Leachate Collection Design for Containment Landfills,
W82-04996 5E

Issues in Simulation Model Design--A Case Study,
W82-05627 4A

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 2K

WATERLOO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Unified River Basin Management,
W82-05769 6B

WATERLOO UNIV. (ONTARIO). DEPT. OF SYSTEMS DESIGN ENGINEERING.
Operational Research Techniques in River Basin Management,
W82-05387 6A

WATSON AND CO., TAMPA, FL.
Water System Design Meets Modern Challenges,
W82-05170 5F

WEBER INDUSTRIES, INC., ST. LOUIS, MO.
Pump Installations for reverse Osmosis Systems,
W82-05882 8C

WESLEYAN UNIV., MIDDLETOWN, CT. DEPT. OF EARTH AND ENVIRONMENTAL SCIENCES.
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 4C

WEST VIRGINIA GEOLOGICAL AND ECONOMIC SURVEY, MORGANTOWN.
Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 3C

WEST VIRGINIA UNIV., MORGANTOWN. DEPT. OF CHEMICAL ENGINEERING.
Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 2J

WEST VIRGINIA UNIV., MORGANTOWN. REGIONAL RESEARCH INST.
The Real Price of Urban Water,
W82-04797 6C

WEST VIRGINIA UNIV. MORGANTOWN. WATER RESEARCH INST.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 5F

WESTERN AUSTRALIA INST. OF TECH., PERTH. DEPT. OF BIOLOGY.
The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 2L

WILSON AND CO., WITCHITA, KS.
Sewage Pumping Station Split for Maintenance,
W82-05719 5D

WISCONSIN UNIV.-MADISON. DEPT. OF BACTERIOLOGY.
Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 2H

WISCONSIN UNIV.-MADISON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Pressure Distribution Design for Septic Tank Systems,
W82-05439 5E

WISCONSIN UNIV.-MADISON. DEPT. OF FORESTRY.
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 6D

WISCONSIN UNIV.-MADISON. WATER CHEMISTRY LAB.
Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 2K

WOLLONGONG UNIV. (AUSTRALIA). DEPT. OF GEOGRAPHY.
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 2E

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA. DEPT. OF CHEMISTRY.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 5B

WOODWARD-CLYDE CONSULTANTS, HOUSTON, TX.
Urban Impacts of Water Supply Reservoir,
W82-05318 5G

WORCESTER COUNTY SANITARY DISTRICT, MD.
Tracking Seasonal Load Variations,
W82-05787 5D

WRIGHT-PIERCE ARCHITECTS/ ENGINEERS, PORTSMOUTH, NH.
Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 5D

Models of Landfill Leaching: Organic Strength,
W82-05817 5B

Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 5B

WRIGHT STATE UNIV., DAYTON, OH. DEPT. OF GEOLOGY.
An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 2F

WROCLAW TECHNICAL UNIV. (POLAND). INST. OF ENVIRONMENT PROTECTION ENGINEERING.
Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 5D

WROCLAW TECHNICAL UNIV. (POLAND). INST. OF ENVIRONMENTAL PROTECTION ENGINEERING.
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 5D

WROCLAW TECHNICAL UNIV. (POLAND). INST. OF INORGANIC CHEMISTRY AND METALLURGY OF RARE ELEMENTS.
Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 5G

WYOMING UNIV., LARAMIE.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 3C

WYOMING UNIV., LARAMIE. WATER RESOURCES RESEARCH INST.
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 8I

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming,
W82-05528 6B

YAMAGATA UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 2H

YOKOHAMA NATIONAL UNIV. (JAPAN). DEPT. OF SAFETY AND ENVIRONMENTAL ENGINEERING.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 5A

YOUNGSTOWN STATE UNIV., OH. DEPT. OF CIVIL ENGINEERING.
Managing Salinity in Irrigated Agriculture,
W82-05691 3C

Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 2F

Z. H. COLL. OF ENGINEERING AND TECHNOLOGY, ALIGARH (INDIA).
A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 5A

ZURICH UNIV. (SWITZERLAND). HYDROBIOLOGY-LIMNOLOGY STATION.
Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 2H

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YOKOHAMA NATIONAL UNIV. (JAPAN). DEPT. OF SAFETY AND ENVIRONMENTAL ENGINEERING.

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ZURICH UNIV. (SWITZERLAND). [illegible]

[illegible]

WISCONSIN UNIV.-MADISON. [illegible]

[illegible]

WATERLOO UNIV. (ONTARIO). [illegible]

The Occurrence and Origin of [illegible] in Groundwater Flow Systems.

[illegible]

WATERLOO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.

[illegible]

WATSON AND CO., TAMPA, FL.

[illegible]

ACCESSION NUMBER INDEX

W82-04751	2L
W82-04752	2L
W82-04753	2L
W82-04754	2L
W82-04755	8B
W82-04756	5F
W82-04757	5E
W82-04758	4A
W82-04759	8I
W82-04760	8D
W82-04761	2L
W82-04762	2L
W82-04763	5A
W82-04764	8G
W82-04765	5F
W82-04766	5F
W82-04767	5A
W82-04768	2H
W82-04769	6D
W82-04770	5D
W82-04771	5C
W82-04772	8B
W82-04773	8A
W82-04774	8D
W82-04775	8B
W82-04776	5A
W82-04777	2C
W82-04778	2C
W82-04779	5A
W82-04780	5C
W82-04781	5B
W82-04782	5D
W82-04783	5D
W82-04784	5D
W82-04785	5E
W82-04786	5G
W82-04787	5D
W82-04788	5G
W82-04789	5A
W82-04790	5F
W82-04791	8G
W82-04792	5F
W82-04793	5C
W82-04794	6A
W82-04795	5F
W82-04796	6C
W82-04797	6C
W82-04798	2C
W82-04799	8B
W82-04800	7B
W82-04801	6E
W82-04802	6E
W82-04803	6E
W82-04804	6E
W82-04805	6D
W82-04806	6D
W82-04807	5B
W82-04808	5A
W82-04809	6E
W82-04810	5F
W82-04811	5A
W82-04812	5C
W82-04813	2H
W82-04814	5C
W82-04815	5A
W82-04816	5A
W82-04817	5B
W82-04818	5A
W82-04819	5A
W82-04820	5B
W82-04821	5A
W82-04822	5A
W82-04823	5A
W82-04824	5B
W82-04825	5C
W82-04826	5F
W82-04827	5A
W82-04828	5A
W82-04829	5C
W82-04830	3C
W82-04831	5D
W82-04832	5D
W82-04833	5D
W82-04834	5A
W82-04835	5B
W82-04836	5C
W82-04837	5D
W82-04838	5D
W82-04839	5E
W82-04840	5D
W82-04841	5D
W82-04342	5D
W82-04843	5D
W82-04844	5D
W82-04845	5A
W82-04846	5D
W82-04847	7B
W82-04848	5D
W82-04849	6D
W82-04850	5D
W82-04851	5F
W82-04852	5F
W82-04853	5F
W82-04854	5D
W82-04855	5A
W82-04856	5B
W82-04857	5B
W82-04858	2G
W82-04859	5B
W82-04860	5B
W82-04861	6D
W82-04862	2E
W82-04863	2D
W82-04864	2B
W82-04865	2E
W82-04866	2E
W82-04867	8A
W82-04868	2G
W82-04869	5F
W82-04870	4C
W82-04871	5D
W82-04872	5C
W82-04873	3C
W82-04874	3C
W82-04875	3C
W82-04876	5B
W82-04877	5B
W82-04878	2J
W82-04879	5B
W82-04880	2A
W82-04881	3C
W82-04882	5A
W82-04883	5A
W82-04884	5C
W82-04885	5B
W82-04886	8A
W82-04887	3C
W82-04888	2F
W82-04889	6C
W82-04890	6E
W82-04891	5A
W82-04892	5A
W82-04893	5A
W82-04894	2L
W82-04895	5C
W82-04896	2A
W82-04897	2B
W82-04898	5B
W82-04899	2D
W82-04900	2B
W82-04901	2B
W82-04902	8C
W82-04903	5D
W82-04904	5D
W82-04905	5D
W82-04906	5D
W82-04907	5D
W82-04908	5D
W82-04909	3A
W82-04910	5B
W82-04911	5B
W82-04912	5A
W82-04913	5A
W82-04914	2K
W82-04915	2K
W82-04916	5A
W82-04917	4B
W82-04918	4B
W82-04919	8A
W82-04920	8A
W82-04921	4B
W82-04922	4B
W82-04923	5A
W82-04924	2L
W82-04925	2K
W82-04926	2H
W82-04927	2H
W82-04928	2H
W82-04929	2H
W82-04930	2K
W82-04931	4B
W82-04932	4B
W82-04933	6E
W82-04934	2H
W82-04935	5A
W82-04936	5B
W82-04937	5D
W82-04938	5C
W82-04939	2L
W82-04940	2H
W82-04941	2L
W82-04942	2H
W82-04943	2H
W82-04944	5A
W82-04945	2H
W82-04946	5C
W82-04947	5C
W82-04948	5A
W82-04949	5B
W82-04950	2H
W82-04951	5A
W82-04952	8A
W82-04953	8C
W82-04954	6B
W82-04955	8C
W82-04956	4B
W82-04957	5F
W82-04958	6B
W82-04959	3F
W82-04960	6A
W82-04961	5A
W82-04962	6C
W82-04963	2G
W82-04964	2E
W82-04965	5B
W82-04966	4C
W82-04967	5G
W82-04968	5C
W82-04969	7C
W82-04970	7C
W82-04971	2F
W82-04972	2F
W82-04973	2F
W82-04974	7C
W82-04975	7C
W82-04976	7A
W82-04977	7C
W82-04978	7C
W82-04979	2E
W82-04980	2E
W82-04981	5G
W82-04982	2F
W82-04983	3A
W82-04984	7C
W82-04985	7C
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W82-05000	2J
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W82-05079	5B
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W82-05081	3F
W82-05082	2E
W82-05083	8B
W82-05084	2C
W82-05085	2E
W82-05086	8B

ACCESSION NUMBER INDEX

W82-05087	8B
W82-05088	2E
W82-05089	2E
W82-05090	5D
W82-05091	2H
W82-05092	7B
W82-05093	5A
W82-05094	5B
W82-05095	2H
W82-05096	2H
W82-05097	2H
W82-05098	5G
W82-05099	2H
W82-05100	2H
W82-05101	2H
W82-05102	2H
W82-05103	2H
W82-05104	2H
W82-05105	7B
W82-05106	2E
W82-05107	8B
W82-05108	8A
W82-05109	8A
W82-05110	8F
W82-05111	8A
W82-05112	8A
W82-05113	8A
W82-05114	8A
W82-05115	5G
W82-05116	8E
W82-05117	8G
W82-05118	3A
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W82-05124	2H
W82-05125	2H
W82-05126	4A
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W82-05128	5D
W82-05129	5D
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W82-05131	8B
W82-05132	8D
W82-05133	2F
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W82-05148	5B
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W82-05152	8A
W82-05153	3C
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W82-05155	5C
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W82-05160	5A
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W82-05162	5A
W82-05163	5A
W82-05164	5A
W82-05165	5E
W82-05166	6B
W82-05167	8G
W82-05168	5D
W82-05169	5D
W82-05170	5F
W82-05171	5D
W82-05172	2G
W82-05173	7B
W82-05174	5D
W82-05175	5C
W82-05176	7B
W82-05177	5D
W82-05178	5B
W82-05179	5B
W82-05180	6E
W82-05181	5C
W82-05182	5F
W82-05183	5F
W82-05184	6E
W82-05185	5E
W82-05186	2E
W82-05187	2H
W82-05188	6A
W82-05189	2L
W82-05190	2L
W82-05191	7B
W82-05192	8G
W82-05193	2L
W82-05194	8I
W82-05195	5B
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W82-05198	2J
W82-05199	5G
W82-05200	8I
W82-05201	8E
W82-05202	5B
W82-05203	5B
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W82-05205	5B
W82-05206	5C
W82-05207	5B
W82-05208	3F
W82-05209	2H
W82-05210	5G
W82-05211	8B
W82-05212	5A
W82-05213	5E
W82-05214	6G
W82-05215	2H
W82-05216	2E
W82-05217	7C
W82-05218	7C
W82-05219	3C
W82-05220	7C
W82-05221	7C
W82-05222	5C
W82-05223	2J
W82-05224	5B
W82-05225	2E
W82-05226	6D
W82-05227	2F
W82-05228	7C
W82-05229	5C
W82-05230	6F
W82-05231	7C
W82-05232	7C
W82-05233	5B
W82-05234	5B
W82-05235	6B
W82-05236	2E
W82-05237	5A
W82-05238	4A
W82-05239	2K
W82-05240	5D
W82-05241	5D
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W82-05243	5G
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W82-05265	3C
W82-05266	5D
W82-05267	8G
W82-05268	5A
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W82-05296	8A
W82-05297	6B
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W82-05299	4A
W82-05300	2G
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W82-05311	5G
W82-05312	3F
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W82-05315	6B
W82-05316	2H
W82-05317	5D
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W82-05320	5G
W82-05321	5D
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W82-05600	8G
W82-05601	6D
W82-05602	8A
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W82-05606	5B
W82-05607	2J
W82-05608	3F
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W82-05610	3F
W82-05611	7B
W82-05612	7C
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W82-05616	2G
W82-05617	8A
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W82-05623	2G
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W82-05661	4D
W82-05662	7B
W82-05663	4B
W82-05664	2J
W82-05665	7B
W82-05666	8C
W82-05667	5F
W82-05668	5F
W82-05669	5G
W82-05670	5F
W82-05671	6D
W82-05672	3D
W82-05673	8A
W82-05674	3E
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W82-05676	5A
W82-05677	5F
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W82-05728	5A
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W82-05730	5G
W82-05731	3C
W82-05732	4A
W82-05733	6D
W82-05734	2F
W82-05735	6B
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W82-05738	6D
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W82-05740	5G
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W82-05742	6G
W82-05743	6B
W82-05744	5D
W82-05745	3D
W82-05746	5B
W82-05747	5C
W82-05748	3D
W82-05749	6E
W82-05750	5G
W82-05751	3B
W82-05752	7B
W82-05753	6B
W82-05754	5F
W82-05755	8C
W82-05756	3A
W82-05757	3B
W82-05758	6B

ACCESSION NUMBER INDEX

W82-05759	2G
W82-05760	3B
W82-05761	5F
W82-05762	2G
W82-05763	5B
W82-05764	7B
W82-05765	4A
W82-05766	6B
W82-05767	5C
W82-05768	3F
W82-05769	6B
W82-05770	7B
W82-05771	7B
W82-05772	6B
W82-05773	8G
W82-05774	8F
W82-05775	6B
W82-05776	6B
W82-05777	6B
W82-05778	4A
W82-05779	6E
W82-05780	4B
W82-05781	6G
W82-05782	5C
W82-05783	5B
W82-05784	5G
W82-05785	5F
W82-05786	6C
W82-05787	5D
W82-05788	5D
W82-05789	5D
W82-05790	3C
W82-05791	6C
W82-05792	5G
W82-05793	5D
W82-05794	5F
W82-05795	2J
W82-05796	8B
W82-05797	8B
W82-05798	8B
W82-05799	5B
W82-05800	8B
W82-05801	2K
W82-05802	5F
W82-05803	8F
W82-05804	4B
W82-05805	5F
W82-05806	6C
W82-05807	2F
W82-05808	4A
W82-05809	5C
W82-05810	5B
W82-05811	5B
W82-05812	5D
W82-05813	5G
W82-05814	5G
W82-05815	5G
W82-05816	5D
W82-05817	5B
W82-05818	5B
W82-05819	5D
W82-05820	5B
W82-05821	5D
W82-05822	8D
W82-05823	8D
W82-05824	2B
W82-05825	7C
W82-05826	4B
W82-05827	7C
W82-05828	7C
W82-05829	7C
W82-05830	7C
W82-05831	7C
W82-05832	7C
W82-05833	7C
W82-05834	7C
W82-05835	7C
W82-05836	7C
W82-05837	2F
W82-05838	7C
W82-05839	2A
W82-05840	7C
W82-05841	7C
W82-05842	5B
W82-05843	5B
W82-05844	2F
W82-05845	5B
W82-05846	2F
W82-05847	5B
W82-05848	4A
W82-05849	7C
W82-05850	7C
W82-05851	7C
W82-05852	2J
W82-05853	5A
W82-05854	5E
W82-05855	5C
W82-05856	5G
W82-05857	5B
W82-05858	5D
W82-05859	5D
W82-05860	5D
W82-05861	5D
W82-05862	5D
W82-05863	2B
W82-05864	2E
W82-05865	4D
W82-05866	5G
W82-05867	2J
W82-05868	2J
W82-05869	2K
W82-05870	2A
W82-05871	2C
W82-05872	2A
W82-05873	2K
W82-05874	5A
W82-05875	7B
W82-05876	2D
W82-05877	2H
W82-05878	8A
W82-05879	6B
W82-05880	8D
W82-05881	8A
W82-05882	8C
W82-05883	3F
W82-05884	5G
W82-05885	6E
W82-05886	3C
W82-05887	4A
W82-05888	6C
W82-05889	5G
W82-05890	6D
W82-05891	6D
W82-05892	5G
W82-05893	5G
W82-05894	3F
W82-05895	5C
W82-05896	6A
W82-05897	5B
W82-05898	2B
W82-05899	2A
W82-05900	2B

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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED WATER RESOURCES ABSTRACTS

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

KINETICS OF COMPRESSIBILITY IN TWO-PHASE FLUID FLOWS,

Worcester Polytechnic Inst., MA. Dept. of Mechanical Engineering.
C. L. Feldman, R. P. Kokernak, R. Lisauskas, and S. Nydick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243346, Price codes: A05 in paper copy, A01 in microfiche. Final Report 1981. 72 p, 23 Fig, 47 Ref. OWRT (1165/No 2736)(1).

Descriptors: *Compressible flow, *Kinetics, *Multiphase flow, *Model studies, *Sound waves, Compressibility, Fluid flow, Friction, Fluid mechanics, Hydraulics, Hydrodynamics, Mathematical studies, Model testing, Linear programming, Experimental design, Experimental data, Theoretical analysis, Acoustics, Mechanical engineering.

A linearized model for transmission of a plane wave through a single component two-phase bubbly mixture was developed. Data from assessment of the compressibility of a single bubble under a pressure pulse were used in a scattering model to predict the speed of sound, and resulting in the determination of the speed of sound as a function of frequency. The results clearly demonstrate the effects of phase change and heat transfer at low frequencies with resonance and cut-off at higher frequencies. The experimental model generated speed of sound measurement by passing an acoustic tone-burst through the medium and measuring transit time (directly or as a phase lag), using a mixture created by passing saturated vapor through a porous metal filter and allowing the bubbles to rise in a saturated liquid. A partially successful attempt was made to measure the vapor fraction at the level of the acoustic transducers with a differential pressure measurement using both water and Refrigerant-12; qualittive verification was possible, with some quantitative discrepancies in the resonant frequency. Application of the sound speed model to flow in two-phase devices was also studied; various critical two-phase flow theories were examined and a model for predicting weak shock thickness was developed. This model was compared with recent experimental reports on pressure waves in boiling water. (Zielinski-MAXIMA)
W82-05910

2. WATER CYCLE

2A. General

COMBINING SITE-SPECIFIC AND REGIONAL INFORMATION: AN EMPIRICAL BAYES APPROACH,

Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
G. Kuczera.
Water Resources Research, Vol 18, No 2, p 306-314, April, 1982. 4 Fig, 5 Tab, 20 Ref.

Descriptors: *Hydrologic models, *Probability distribution, *River basins, *Flood frequency, Data interpretation, Model studies, Mathematical models, Basins, Flood forecasting, Flood peak, Regional analysis, Frequency analysis.

The empirical Bayes theory, adapted to a hydrologic context, was used to develop a format for making inferences about unmonitored river basin sites by combining site-specific and regional data. Information from similar basins is used to improve upon inferences at a particular basin. The superpopulation concept of the Bayesian approach uses a probability distribution to randomly assign basin parameters. This concept closely resembles regionalization models and is inferred from observable regional data. The superpopulation distribution expresses the degree of similarity between two basins and treats regionalized estimators as a special case using procedures similar to James-Stein estimators. The method of moments approach which is used to infer the superpopulation is described. Although the empirical Bayes approach can have definite advantages over site-specific procedures, the latter offer better performance for basins which are very different from the majority. The empirical Bayes procedure was applied to two examples of food frequency analysis. (Geiger-FRC)
W82-05903

TOPOLOGIC MODEL FOR DRAINAGE NETWORKS WITH LAKES,

Univerity of Western Ontario, London. Dept. of Geography.
D. M. Mark, and M. F. Goodchild.
Water Resources Research, Vol 18, No 2, p 275-280, April, 1982. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Hydrologic models, *Networks, *Open-channel drainage, *Drainage, *Glacial lakes, Model studies, Channel inflow, Channels, Mathematical models, Catchment areas.

Although R. L. Shreve's probabilistic-topologic model for channel networks is successful at predicting many of the overall properties of drainage networks and drainage basins, it cannot be directly applied to networks containing lakes fed by multiple inlets. An extension of Shreve's model is presented in which networks can be represented by integer strings directly analogous to the binary strings used for trivalent channel networks without lakes. The validity limitations on integer strings are presented, along with combinatorial results and techniques for generating topologically random networks. In the case of a 596-link network in northern Ontario, when it is assumed that network element degree and type are independent of position within the integer string, good predictions of the relative frequencies of various classes of small subnetworks are obtained. When the number of lakes in the network equals zero, the model collapses to Shreve's. (Geiger-FRC)
W82-05905

LAG TIME FOR DIVERGING OVERLAND FLOW,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and N. Agiralioglu.
Nordic Hydrology, Vol 13, No 1, p 39-48, 1982. 6 Fig, 9 Ref.

Descriptors: *Mathematical studies, *Kinematic wave theory, *Flow friction, *Overland flow, *Rainfall-runoff relationships, *Watersheds, Darcy-Weisbach equation, Chezy equation, Friction, Mannings equation, Surface runoff, Surface water, Mathematical equations.

Analytical and nomographic solutions were developed for the surface water lag time for diverging overland flow using kinematic wave theory. These solutions show that lag time for a given watershed is not constant but changes with rainfall characteristics. In order to utilize these solutions, some knowledge of the geometric parametes and friction characteristics of the watershed under study is required. Uses of the Chezy equation, Manning equation, and Darcy-Weisbach relations for friction in the calculation of lag time are presented. (Geiger-FRC)
W82-05944

ASPECTS OF HYDROLOGY IN THE PROVINCE OF NORTH SUMATRA, INDONESIA,

Binnie and Partners, London (England).
J. Wild, and J. K. Hall.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 1, p 85-108, March, 1982. 15 Fig, 4 Tab, 25 Ref.

Descriptors: *Hydrology surveys, Developing countries, North Sumatra, *Indonesia, Rainfall, Runoff, Water quality, Oil erosion, Networks, Gaging stations, *Data collections, Groundwater, Streamflow, Evaporation, Sediment.

Results of an extensive hydrologic survey (1976-80) in North Sumatra, Indonesia, are described. The province has a considerable number of hydrometeorological stations for a developing country--85 river gages, 20 climatologic stations, and 500 rain gages for a 71,000 sq km area. However, there are gaps in data because of operating and administrative problems. Gaging equipment is concentrated in the eastern coastal area and sparse in the central highlands. Little data are available for 1941-early 1950's. In North Sumatra rainfall is influenced by the monsoon systems of southeast Asia and Australia, the equatorial double rainy seasons, and local orographic influences. Mean annual rainfall varies from 2000 mm on the east coast to 4000 mm on the western slopes of the Bukit Barisan. Nevertheless, in low rainfall regions irrigation is required for all crops from May to August and throughtout the year for bunded rice. Mean annual runoff is 900 mm to over 2000 mm. The short period off records requires that conservative growth factors be used in estimating design floods. The little available information on water quality and sediment indicates that there are high levels off bacterial pollution , and waterborne diseases are endemic. Water is satisfactory for irrigation except in some volcanic areas (hot and sulfurous) and swampy regions (acid). Soil erosion is a major problem, with average denudation rates oof 1-10 mm per year. About 250,000 groundwater wells supply 80-90% of rural water. Springs are numerous, and groundwater potential greatly exceeds demand in most regions. Some large projects are in progress--two hydroelectric stations, hydrologic surveys off the Sei Deli/Belaway estuary, water supply schemes, flood control, and irrigation. (Cassar-FRC)
W82-05949

AN EVALUATION OF FLOOD FREQUENCY ESTIMATES BASED ON RAINFALL/RUNOFF MODELING,

Geological Survey, Reston, VA.
W. O. Thomas, Jr.
Water Resources Bulletin, Vol 18, No 2, p 221-230, April, 1982. 2 Fig, 8 Tab, 12 Ref.

Descriptors: *Flood frequency, *Rainfall-runoff relationships, *Flood forecasting, Runoff, Streamflow forecasting, Model studies, Hydrologic models, Flood discharge, Flood recurrence interval.

Flood frequency estimates obtained from a rainfall-runoff model by Dawdy, et al. (1972) were evaluated by two methods: (1) partition of variance method by Lichty and Liscum (1978), a computation of the equivalent years of record for regional estimating equations based on 50 small stream sites in Oklahoma, and (2) the prediction variance method developed in this paper, a computation of the bias for synthetic flood estimates as compared to observed estimates at 97 small stream sites in eight eastern states with at least 20 years of record. Method 2 was more appropriate than Method 1 because it was not as dependent on as many assumptions as Method 1. The Dawdy model tended to underestimate extreme flood discharges based on observed record (11-29% less than observed values for a 100-year flood discharge). Since synthetic flood frequency curves based on rainfall/runoff models are highly correlated, little or no regional (spatial) information can be added to the network. The equivalent years of record for the regional estimating equation based totally on synthetic flood discharge was considerably less than the length of rainfall record used to simulate the runoff. The degree of correlation between observed and synthetic flood frequency estimates at the same site appeared to vary with recurrence interval. (Casser-FRC)
W82-06068

WATER RESOURCES OF THE OCHLOCKONEE RIVER AREA, NORTHWEST FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
C. A. Pascale, and J. R. Wagner.
Geological Survey Open-File Report 81-1121 (WRI), 1982. 114 p, 35 Fig, 16 Tab, 43 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Surface water, *Water quality, Data collections, Geohydrology, Rainfall-runoff relationships, Water supply, Aquifers, Groundwater movement, Aquifer characteristics, Wells, Water yield, Potentiometric level, Drawdown, Saline water, Streamflow, Flow characteristics, Chemical analysis, *Florida, Ochlockonee River basin, Floridan aquifer.

The Ochlockonee River area, in the northwest Florida panhandle, receives an average of 57 inches of rainfall per year. Water use in 1975 averaged 11.4 million gallons per day. Much of the rainfall that is not lost to evaporation enters the surficial sand aquifer, seeps to streams, or enters the water-bearing zone of the upper confining unit above the Floridan aquifer. The water-bearing zone of the upper confining unit is important for rural domestic supplies, storage of water and recharge to the Floridan aquifer. The Floridan aquifer underlies all the area and is the principal source of municipal supplies. The potentiometric surface of the upper part of the Floridan aquifer ranges from about 50 feet higher than that of the middle and lower part of the aquifer in southwestern Gadsden County to about 10 feet higher in southeastern Gadsden County. Saline water occurs naturally at relatively shallow depths within the Floridan aquifer. Stream discharge is about 1,000 million gallons per day; minimum discharge is about 285 million gallons per day. The chemical quality of most streams in the study area is acceptable for most uses. (USGS)
W82-06132

THE DEPENDENCE OF DRAINAGE DENSITY ON CLIMATE AND GEOMORPHOLOGY,

Universidad Simon Bolivar, Caracas (Venezuela)> Graduate Program in Hydrology and Water Resources.
For primary bibliographic entry see Field 2E.
W82-06199

A DISCRETE SYSTEM STORAGE MODEL FOR ANALYZING RAINFALL-RUNOFF RELATIONSHIPS,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, and J. K. Mitchell.
Transactions of the ASAE, Vol 25, No 2, p 362-366, 371, 1982. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Agricultural watersheds, *Hydrographs, *Storage equation, *Rainfall-runoff relationships, Model studies, Rainfall intensity, Runoff rates, Flood peak, Excess rainfall, Storms, *Illinois, *Unit hydrographs.

A unit hydrograph method and a discrete system storage model, derived from a generalized system storage relationship proposed by Chow and Kulandaiswamy (1971), were used to quantify the quasi-linear effects of rainfall-runoff relationships for small agricultural watersheds. The two watersheds near Monticello, Illinois, were less than 40 ha in size with silt loam soils and slopes up to 8%. The unit hydrographs from 30 storms varied with the storm characteristics when the ratios of peak discharge to total runoff were less than unity. Use of a discrete system storage model showed that 6 hydrologic variables of rainfall intensity and runoff rates were necessary to explain system storage relationships. Simulations of storms by both methods produced peak discharges in good agreement with observed results. Neither method accurately simulated double peaks. (Cassar-FRC)
W82-06219

ON THE RELATIONSHIP BETWEEN KRIGING AND STATE ESTIMATION,

Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-06323

ACID RAIN MODEL: HYDROLOGIC MODULE,

Tetra Tech. Inc., Lafayette, CA.
For primary bibliographic entry see Field 5B.
W82-06360

ADVANCED CALIBRATION METHODOLOGY FOR HYDROLOGIC RAINFALL - RUNOFF SIMULATION MODELS,

Case Western Reserve Univ., Cleveland, OH.
S. Sorooshian, V. K. Gupta, J. L. Fulton, and F. Arfi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256603, Price codes: A08 in paper copy, A01 in microfiche. Technical Report No LSSPA-81-6, December, 1981. 146 p, 25 Fig, 15 Tab, 59 Ref, 2 Append. OWRT B-081-OHIO and C-90320-G(9442)(2). 14-34-0001-9442.

Descriptors: *Simulation analysis, *Rainfall-runoff relationships, *Mathematical models, *Stochastic hydrology, *Surface runoff, Mathematical studies, Least squares method, Model studies, Stochastic process, Probabilistic process, Streamflow, Computer models, Watersheds, Rainfall intensity, Rainfall index, Rainfall rate, Runoff, Runoff coefficient.

Stochastic estimation techniques are presented which are capable of improving hydrologic conceptual rainfall-runoff model calibrations by accounting for streamflow measurement uncertainties (and other, additive, errors). Specifically, the autocorrelated and the heteroscedastic (changing variance) error cases are considered. The methods are shown to perform well in simulation studies, and application of the techniques to the calibration of the U.S. National Weather Services soil moisture accounting model showed superiority of the new procedures over the commonly-used simple least squares criterion. The procedures were compared under different data conditions and starting parameter values. Results indicate important phenomena needing study and accountability. Its consideration gave more consistent and conceptually-realistic parameter sets, independent of starting value and/or data characteristics. However, despite these improvements, a unique parameter set for the watershed under study was not obtained. Probable reasons for this are given. Sensitivity measures capable of aiding examination of the criterion response surface in the region of the optimum are also discussed, and their applicability demonstrated. (Zielinski-MAXIMA)
W82-06366

GEOMORPHIC PARAMETERS OF REPRESENTATIVE BASINS AND THEIR HYDROLOGIC SIGNIFICANCE,

New South Wales Univ., Kensington (Australia). School of Geography.
F. C. Bell, and P. C. Vorst.
Australian Water Resources Council, Camberra, Technical Paper No 58, 1981. 131 p, 18 Fig, 13 Tab, 83 Ref, 2 Append.

Descriptors: *Hydrologic models, *Model studies, *Parametric hydrology, *Geomorphology, *Catchment basins, Hydrologic properties, Hydrologic budget, Hydrologic aspects, Hydrologic equation, Hydrologic data, Basins, Stochastic hydrology, Mathematical models, Mathematical studies, Model testing, Surveys, Data acquisition, Channel flow.

Geomorphic parameter types most relevant to the Australian Representative Basins program were investigated, along with their likely applications in hydrologic problems. Some emphasis is placed on stream channel parameters and field information for use in deterministic modeling of hydrologic processes; attention is also given to efficient surveying techniques and the serious problems of sampling and inference caused by the high spatial variability of parameters in most basins. A developed scheme for field measurements and data presentation is delineated which was exemplified and tested in 3 Basins having contrasting characteristics. Several other Basins were briefly studied to ensure inclusion of a wide range of catchment conditions. An examination of possible applications of the data in hydrologic modeling showed that measured channel parameters can be used for satisfactory estimates of the Laurenson Runoff Routing Model constants. Further study of the physical relationships between measurable catchment attributes and model constants is needed, which should be enhanced by application of the recommended scheme for geomorphic surveying and data presentation to as many basins as practicable. (Zielinski-MAXIMA)
W82-06384

COMPARING URBAN RUNOFF MODELS,

V. P. Singh.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division Vol 61, No 2, p 53-59, February, 1981. 2 Fig, 6 Tab, 32 Ref.

Descriptors: *Hydrographs, *Urban runoff, *Model studies, Urban watersheds, Statistics, Oakdale, Chicago, Illinois, Calvin Park, Kingston, Ontario, Computers, Rainfall-runoff relationships, Hydrologic models, Runoff, Urban hydrology, Storm water.

Three urban runoff models were compared with data on two urban watersheds, Oakdale in Chicago, Illinois (5.42 ha of residential area, 45.8% impervious) and Calvin Park in Kingston, Ontario (36.2 ha of residential area, 27% impervious). The runoff models were the Road Research Laboratory Model (RRLM), the University of Cincinnati Urban Runoff Model (CURM), and the EPA Storm Water Management Model (SWMM). Using the hydrograph peak and its time for evolution showed that no one model was uniformly better than another. For hydrograph peak time estimates, RRLM was better than SWMM and CURM on both watersheds. For hydrograph peak estimation SWMM was better than CURM and RRLM on Oakdale wateshed; RRLM was better than SWMM and CURM on Calvin Park watershed. Therefore, the choice of a model depends on the criterion of comparison and the watershed in question. (Cassar-FRC)
W82-06447

ANTECEDENT MOISTURE CONDITION PROBABILITIES,

Purdue Univ., Lafayette, IN. Dept. of Hydromechanics.
D. D. Gray, P. G. Katz, S. M. Demonsabert, and N. P. Cogo.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 107-114, June, 1982. 5 Tab, 16 Ref.

Descriptors: *Antecedent moisture, *Probability distribution, Model studies, Precipitation, Rainfall-runoff relationships, Hydrologic models, *Indiana, *Kentucky, Tennessee, Runoff forecasting.

Growing season Antecedent Moisture Condition (AMC) probability estimates are presented for 17 locations in Kentucky, Tennessee, and Indiana. They refer to the AMC classes used in the runoff models, Soil Conservation Service (SCS) Runoff Equation (curve number method) and the Illinois Urban Drainage Area Simulator (ILLUDAS). The three SCS Classes are I, II, and III, described as lowest, average, and highest runoff potential, respectively, with < 1.4, 1.4-2.1, and > 2.1 inches of 5-day antecedent rainfall, respectively, in the growing season. The four ILLUDAS classes range from bone dry to saturated with 5-day antecedent rainfall of 0 > 1 inches. The locations studied had a mean of 84.8% in the SCS Class I and a more even distribution of the ILLUDAS classes, 27.3%, 37.8%, 16.6%, and 23.6% in Classes I through IV, respectively. Equations are given for computing probability of occurrence of the AMC classes for other areas. (Cassar-FRC)
W82-06451

FITTING A GAMMA DISTRIBUTION OVER A SYNTHETIC UNIT HYDROGRAPH,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
G. Aron, and E. L. White.
Water Resources Bulletin, Vol 18, No 1, p 95-98, February, 1982. 3 Fig, 2 Tab, 6 Ref. OWRT-A049-PA.

Descriptors: *Unit hydrographs, *Distribution graphs, *Flood peaks, Flood hydrographs, Flood discharge.

Synthetic unit hydrographs, which are used to estimate flood peak and volume for ungaged watersheds, should be easy to construct without a major watershed data collection effort, should have a smooth and single valued shape, and should contain a runoff volume equal to one unit (inch, centimeter, or millimeter) of rainfall excess. Most of the methods for generating these artificial unit hydrographs involve hand fitting a curve over a few selected points on the unit hydrograph. This task may be subjective and, in addition, the user may neglect or find it difficult to adjust the generated unit graph to a runoff value of one unit. A simple method which can be used to fit a smooth gamma distribution over a single point specified by the unit hydrograph peak and the time to peak with a guaranteed unit depth of runoff is demonstrated. The two values used can be determined by conventional synthetic hydrograph procedures. A comparison of this method with Snyder unit hydrographs indicated that the gamma distribution may tend to produce a somewhat broader crest than the Snyder graph, compensated by a steeper recession limb. An added advantage of the gamma distribution is that it can be convoluted analytically with several shapes of rainfall distributions. (Carroll-FRC)
W82-06586

MATHEMATICAL MODELS FOR CALCULATING THE DYNAMICS AND QUALITY OF COMPLEX WATER SYSTEMS,

Z. N. Debrovol'skaya, G. P. Epikhov, P. P. Koryavov, and N. N. Moiseev.
Water Resources, Vol 8, No 3, p 226-241, May/June, 1981. 4 Fig, 25 Ref. Translated from Vodnye Resursy, No 3, p 33-51, May/June, 1981.

Descriptors: *Model studies, *Water quality, *Hydrodynamics, *Mathematical models, Flow, Prediction, Water management, Channel flow, Groundwater movement, Fate of pollutants, Boundary conditions, Lakes, Water Currents, Water circulation, Wind-driven currents, Numerical analysis, Hydraulics.

Results of recent work on mathematical modeling of the dynamics and quality of water are reviewed. Mathematical modeling at the Academy of Sciences of the USSR is aimed at creating a software system for automated design of water management problems. One-dimensional models of channel flow, the simplest mathematical models for studying unsteady flow in canals and river systems, are based on the classical system of St. Venant equations. The interaction of surface waters and groundwater of an arbitrary river basin may be modeled by adding the Boussinesq equations describing groundwater movement in a horizontal seepage approximation to the one-dimensional channel flow models. Two-dimensional models describe more complex hydrodynamic processes and can handle a broader class of applied problems. There are two types of such models: horizontal plane and vetical plane. Three-dimensional models can provide information on complex spatial movements in water bodies of an artibrary from under the effect of various physical factors. Examples of the model equations and sample problems are given. (Cassar-FRC)
W82-06613

SENSITIVITY OF SCS MODELS TO CURVE NUMBER VARIATION,

Maryland Univ., College Park. Dept. of Civil Engineering.
T. R. Bondelid, R. H. McCuen, and T. J. Jackson.
Water Resources Bulletin, Vol 18, No 1, p 111-116, February, 1982. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Mathematical models, *Sensitivity analysis, *Runoff coefficient, Error analysis, Remote sensing, Flood peak, Hydrologic models, Runoff volume, Pennsylvania.

The Soil Conservation Service (SCS) hydrologic models are being used increasingly for hydrologic design due to their relative accuracy, their flexibility, and their ability to use remotely sensed data. The primary input parameter for the SCS models is the runoff curve number, which is defined in terms of land use treatments, hydrologic condition, antecedent soil moisture, and soil type, permitting easy application of the models to ungaged watersheds. The accuracy of models using the runoff curve number for estimating design peak discharge and runoff volume is especially sensitive to the estimated curve number values. This study was designed to quantify in as straightforward a manner as possible the changes in runoff volume and peak discharge computations as a function of changes in curve number estimates. The hydrologic effects of curve number variation are evaluated in terms of the proportional changes in total runoff and peak discharge for a unit change in curve number. A series of curves is developed which demonstrates that the effects of variation in curve number decrease as design rainfall depth increases, such as for larger storm events. The value and use of these sensitivity curves are demonstrated using a comparison of Landsat and conventionally derived curve numbers for three watersheds in Pennsylvania. (Carroll-FRC)
W82-06631

HYDROLOGY OF SALT WELLS CREEK--A PLAINS STREAM IN SOUTHWESTERN WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div., and Geological Survey, Tacoma, WA. Water Resources Div.
H. W. Lowham, L. L. Delong, K. R. Collier, and E. A. Zimmerman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-201211, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-62, April 1982. 52 p, 32 Fig, 2 Tab, 24 Ref.

Descriptors: *Small watersheds, *Hydrologic cycle, *Intermittent streams, *Geochemistry, Streamflow, Snowmelt, Storm runoff, Rainfall runoff relationships, Flushing, Salts, Sediment yield, Channel morphology, Aquatic environment, Energy, *Wyoming, Colorado River basin, Green River basin, Salt Wells Creek.

Development of energy minerals in plains areas of Wyoming is expanding rapidly. Such development may affect water resources and hydrologic relations of the plains; however, little information exists concerning hydrologic processes for these areas. This report summarizes results of a hydrologic study made during 1975-78 of Salt Wells creek, a drainage area of about 500 square miles located southeast of Rock Springs, Wyoming. The area is typical of arid and semiarid plains areas in southwestern Wyoming where mineral development is occurring. Salt Wells Creek is predominately an intermittent stream. Numerous springs in the headwaters cause small perennial flows in some upstream tributaries, but evaporation, freezeup, and seepage deplete these flows so that the middle and lower reaches of the main channel have only intermittent flows. The intermittent nature of streamflow affects water quality. It was observed that a flushing of dissolved solids and suspended sediment occurs during the first flows of a runoff event. A striking feature of the stream is its deeply incised channel. The downcutting is attributed to the cummulative effects of: (1) a change in the relative climate, amounts of annual precipitation occurring as rain and snow, (2) change in base level due to downstream channelization, and (3) changes in land use. Because of the incision, erosion is now expanding to include intervening tributaries. (USGS)
W82-06679

HYDROLOGY AND MODEL OF NORTH FORK SOLOMON RIVER VALLEY, KIRWIN DAM TO WACONDA LAKE, NORTH-CENTRAL KANSAS,

Geological Survey, Lawrence, KS. Water Resources Div.
D. G. Jorgensen, and L. E. Stullken.
Available Univ. of Kansas Publ. Lawrence, Kansas. Kansas Geological Survey Irrigation Series 6, 1981. 34 p, 11 Fig, 2 Plates, 2 Tab, 11 Ref.

Descriptors: *Surface-groundwater relations, *Agriculture, *Aquifer characteristics, *Drought, Water shortage, Model studies, Irrigation water, Reservoirs, Rainfall-runoff relationships, Natural recharge, Groundwater storage, Water use, Wells, Water level, *Kansas, North Fork Solomon River valley.

Reservoir releases are the principal source of irrigation water in the North Fork Solomon River valley between Kirwin Dam and Waconda Lake. An extended drought in the 1970's caused severe water shortages. Ground water has been pumped from the alluvial aquifer in the valley to supplement irrigation supplies. Although annual pumpage increased to about 12,300 acre-feet in 1976, storage in the aquifer increased about 45,000 acre-feet from 1946 to 1976 as a result of recharge from surface-water irigation. A digital model was used to simulate aquifer conditions prior to closure of Kirwin Dam. Model results estimated recharge of 11,700 acre-feet per year from precipitation and discharge of 11,500 acre-feet per year from the aquifer to the river. Since 1946, discharge to the river has increased about 4,000 acre-feet per year. The analysis is inconclusive regarding effects of additional development, but the aquifer probably could sustain pumpage at the 1976 rate for several consecutive years of drought. (USGS)
W82-06684

GENERATION OF WEEKLY STREAMFLOW DATA FOR A LARGE HYDROLOGICAL SYSTEM-AN AUTOREGRESSIVE MULTIVARIATE MULTI-LAG-MODEL(SIMULATION WOCHENTLICHER ABFLUSSE FUR EIN GROSSRAUMIGES HYDROLOGISCHES SYSTEM-EIN AUTOREGRESSIVES, MULTIVARIATES MULTI-LAG-MODELL-),

Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulic und Gewasserkunde.
For primary bibliographic entry see Field 4A.
W82-06826

A STATISTICAL-DYNAMICAL CLIMATE MODEL WITH A SIMPLE HYDROLOGY CYCLE,

Scripps Institution of Oceanography, La Jolla, CA.
For primary bibliographic entry see Field 2B.
W82-06838

APPLICATION OF SCS INFILTRATION MODEL,

For primary bibliographic entry see Field 4D.
W82-06872

2B. Precipitation

VARIATIONS IN MOISTURE DEFICITS OVER THE MAIZE-GROWING REGION OF SOUTH AFRICA I. SPATIAL ASPECTS,

Missouri Univ.-Columbia. Dept. of Atmospheric Sciences.
J. F. Gillooly, and T. G. J. Dyer.
Water S. A., Vol 8, No 1, p 1-8, January, 1982. 11 Fig, 18 Ref.

Descriptors: *Rainfall, *Spatial distribution, South Africa, Distribution, Precipitation, Precipitation rate, Depth-area-duration analysis, Moisture deficiency, Moisture availability, Moisture, Evapotranspiration, Plants.

This paper deals with the spatial variations of the aridity index, termed the moisture deficits, over the officially defined maize-growing region of South Africa. This area produces about 95% of the total maize production and covers about 530,000 square kilometers. Measurements were taken of aridity for each of 25 weather stations. The total accumulated moisture deficit from July to the end of March provided the needed measure. It is noted that areas of high production coincided with areas experiencing large total moisture deficits. High production intensities were obtained through large areas being cultivated rather than high yields per se. When the intra-annual variation of mean monthly moisture deficits was determined over the maize growing

area, it was noted that the greatest variation occurred in the west and decreased in an easterly direction. Due to the erratic nature of rainfall over South Africa, monthly deficits of moisture were highly variable over time. Confidence limits were useful in determining the reliability of obtaining a particular monthly deficit in any given region. These results were then compared to the spatial patterns exhibited by the lower, median and upper quantities of rainfall, and found to be strongly related to the seasonal progression of rainfall from east to west across the maize growing area. (Baker-FRC)
W82-05901

ON PREDICTING THE ONSET OF THE AUSTRALIAN WET SEASON AT DARWIN,

Australian Numerical Meteorology Research Center, Melbourne.
N. Nicholls, J. L. McBride, and R. J. Ormerod.
Monthly Weather Review, Vol 110, No 1, p 14-17, January, 1982. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Rainfall, *Forecasting, *Prediction, *Weather forecasting, Weather data collections, Weather, Monsoons, *Australia, Darwin.

An index of the data of onset of the North Australian wet season is defined based on rainfall received at a single station at Darwin. This index can be predicted some months ahead of the onset. The total rainfall received over the period of the wet season is only weakly related to the onset index. Mid-late (December-May) season rainfall is totally independent of the date of onset and of the amount of early (September-November) rainfall. As noted in earlier research, the North Australian wet season is monsoonal in character. The current evidence suggests that the monsoon onset is preceded by a transition season, which at Darwin accounts for about 30% of the total wet-season rainfall, and there is also considerable temporal organization of transition season rainfall. This finding is supported by the fact that the date of accumulation of as little as 50 mm of rain is related to earlier months' pressure observations. (Baker-FRC)
W82-06208

ON A STATISTICAL RELATIONSHIP BETWEEN AUTUMN RAINFALL IN THE CENTRAL EQUATORIAL PACIFIC AND SUBSEQUENT WINTER PRECIPITATION IN FLORIDA,

Scripps Institution of Oceanography, La Jolla, CA.
A. V. Douglas, and P. J. Englehart.
Monthly Weather Review, Vol 109, No 11, p 2377-2382, November, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Rainfall, *Prediction, *Weather forecasting, *Florida, Gulf of Mexico, North Atlantic, North Pacific.

Attention is drawn to one strong and apparently useful teleconnection between autumn rainfall in the central equatorial Pacific and subsequent winter precipitation in south-central Florida. The regression equation relating the fall rainfall index and winter precipitation in south central Florida is based on 28 years of data. While a strong statistical relationship appears to exist between rainfall in Florida and the equatorial Pacific, the physical mechanisms associated with the teleconnection are undoubtedly complex. Examination of Northern Hemisphere 700 mb anomaly maps for wet and dry years along the equator has provided some insight. In preparing these maps, winter height anomalies were composited for six years with high autumn rainfall along the equator and six years with below-normal rainfall. Large scale circulation changes associated with warming events in the eastern tropical Pacific are noted. After the establishment of a warm-set regime in the eastern Pacific, the winter circulation becomes abnormally strong across the eastern North Pacific, Gulf of Mexico and western North Atlantic. The development of heavy precipitation in Florida is probably a result of a vigorous low-latitude mean flow across North America and increased frontal activity in the Gulf of Mexico. Cyclogenesis in the Gulf of Mexico may also increase during these winters. (Baker-FRC)
W82-06209

AUTOCORRELATIONS OF MOISTURE PARAMETERS ON ISENTROPIC SURFACES,

State Univ. of New York at Albany. Dept. of Atmospheric Science.
J. S. Boyle.
Monthly Weather Review, Vol 109, No 11, p 2401-2404, November, 1981. 1 Fig, 20 Ref.

Descriptors: *Specific humidity, Mathematical studies, *Moisture, *Humidity, Atmospheric water, Atmosphere, Weather, *Weather forecasting, Prediction.

This note presents some spatial autocorrelation results for moisture variables on isentropic surfaces. These results appear to impact on the selection of an optimal technique for synoptic-scale moisture analyses. It was found that, within the context of the procedures used and for the case studied, the values of autocorrelation for specific humidity were greater than that of relative humidity for all separation distances considered, and that for almost all distances considered, the autocorrelation of specific humidity displayed a more gradual decrease with separation distance than did that of relative humidity. These findings are in concert with meteorological experience and indicate that some gains may be made in the accuracy of the moisture analysis by using specific humidity as the analyzed quantity. It is noted that an objective analysis scheme can make more effective use of the available moisture information if the analysis is made of specific humidity on isentropic surfaces rather than relative humidity on pressure or isentropic surfaces. (Baker-FRC)
W82-06210

RAINFALL AND ATMOSPHERIC CIRCULATION DURING DROUGHT PERIODS AND WETTER YEARS IN WEST AFRICA,

National Center for Atmospheric Research, Boulder, CO.
S. E. Nicholson.
Monthly Weather Review, Vol 109, No 10, p 2191-2208, October, 1981. 17 Fig, 4 Tab, 33 Ref.

Descriptors: *Rainfall, *Variability, Atmospheric water, Drought, Sahara Desert, Arid climates, Africa, *West Africa, Climatology, *Rainfall distribution, Precipitation.

Rainfall variations of the present century over a large section of the African continent were investigated. The general climatology of the areas of the African continent were investigated. The general climatology of the areas in question is reviewed along with a summary of modern rainfall fluctuations in various regions, and recent extreme rainfall anomalies are described. During recent decades the Sahel and other sub-Saharan regions experienced two periods of anomalous rainfall conditions, the wet 1950's and the drought of 1968-73. A comparison of sub-Saharan droughts and wetter years suggests that a northward displacement of the Intertropical Convergence Zone may account for wetter years, but that a weakened 'intensity' of the rainy season, independent of ITCZ position, is the most likely cause of drought in the sub-Saharan region. Increased subsidence and decreased low-level convergence over the sub-Sahara and a decrease of moisture flux and upper level easterly flow into that region accompany drought years. The last factor weakens the combined barotropic-baroclinic instability mechanism which maintains the rain-producing West African disturbances, and it probably diminishes the westward steering of these disturbances. The synchronous rainfall changes on both sides of the Sahara, indicating a change in both the tropical summer rainfall regime and the extratropical winter rainfall regime, strongly imply a general intensification of the Hadley cell and perhaps an expansion of its descending branch. Further evidence of this derives from increased rainfall in equatorial regions during sub-Saharan droughts, usually associated with a contraction of the equatorial 'rainy' zone, the ascending branch of the Hadley circulation. (Baker-FRC)
W82-06211

A MOISTURE ANALYSIS PROCEDURE UTILIZING SURFACE AND SATELLITE DATA,

Pennsylvania State Univ., University Park. Dept. of Meteorology.
S. W. Wolcott, and T. T. Warner.
Monthly Weather Revies, Vol 109, No 9, p 1989-1998, September, 1981, 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Rainfall, *Forecasting, Weather forecasting, Prediction, Satellite technology, Wind, Precipitation, Remote sensing, Model studies, Mathematical studies, *Moisture.

A moisture analysis procedure is presented that uses satellite, precipitation and surface specific humidity data to augment the standard radiosonde observation (RAOB) of moisture. Mesoscale forecasts were made to determine the effect of the high-resolution moisture analysis on the forecast of precipitation. The analysis procedure uses the RAOBs as the primary source of synoptic scale information, with the other sources adding mesoscale detail to the analysis. Precipitation data and satellite-determined cloud data provide the basis for a relative humidity constraint with the potential for providing high-resolution information, whereas the surface specific humidity analysis introduces fine scale information on low level moisture patterns. All forecasts produced rainfall amounts considerably smaller than those observed, even though the positioning of the rain events was good. The most realistic rainfall amounts were produced by the mode when the saturation constraint was imposed by the use of satellite and surface observed 'present weather' data. Rain rates during the first 4 hr of these forecasts were 100% larger and more realistic than the rain rates produced when these data were not used. The fine scale structure to the moisture field at the lowest model level as provided by surface based specific humidity data did not significantly affect the precipitation prediction. A strong synergistic effect exists between the initial latent heat release in the model and the divegence field that exists in the model initial conditions. The extent of the positive influence of the satellite and surface present weather data, at least during the early hours of the forecast, was probably related to the existence of the relatively sophisticated divergent wind initialization. (Baker-FRC)
W82-06212

THE 1980 SUMMER HEAT WAVE AND DROUGHT IN HISTORICAL PERSPECTIVE,

National Climatic Center, Asheville, NC.
T. R. Karl, and R. G. Quayle.
Monthly Weather Review, Vol 109, No 10, p 2055-2073, October, 1981. 16 Fig, 1 Tab, 17 Ref.

Descriptors: *Drought, *Weather patterns, Weather data collections, Soil moisture, United States, Climates.

The summer of 1980 is put into historical perspective with the aid of state temperature and precipitation averages for the 48 contiguous states of the United States 1985. Several other variables and indices were also derived to assess the oppressive weather during this particular summer. These indices include the Palmer Drought Severity Index (PDSI) and Palmer's soil moisture abnormality index (Z Index). Population-weighted cooling degree days as related to electrical energy sales and the deficit of the precipitation minus the potential evapotranspiration were also used in the assessment. The heat during the summer of 1980 was near record levels in many states throughout the Southern Plains and eastward along the Gulf Coast to the Atlantic. Probably the most notable aspect was the most anomalous areas followed two decades of relatively cool summers. the cooling degree day total across the nation during the cooling season of May-October was the highest since 1939. Electicity consumption reached new peaks, partly as a result of natural growth and partly because of the increased air conditioning load. Economic losses during this hot, dry summer were estimated at $16 billion. However, during the 1930's and 1950's even worse conditions had existed. (Baker-FRC)
W82-06213

TROPICAL CYCLONE RAINFALL CHARACTERISTICS AS DETERMINED FROM A SATELLITE PASSIVE MICROWAVE RADIOMETER,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
E. B. Rodgers, and R. F. Adler.
Monthly Weather Review, Vol 109, No 3, p 506-521, March, 1981. 13 Fig, 2 Tab, 25 Ref.

Descriptors: *Satellite technology, *Rainfall distribution, Nimbus, Remote sensing, Data collections, Precipitation, Rainfall, Cyclones, Tropical cyclones, Storms, Hurricanes, Pacific Ocean.

Results are presented from the calculation of the magnitude and distribution of rainfall in Pacific Ocean tropical cyclones using the EMSR-5 data (Nimbus-5 Electrically Scanning Microwave Radiometer). Approximately 70 satellite passes over tropical cyclones in various states of development were used. All storms examined reached typhoon or hurricane stage sometime during their lifetime. The data have been useful in determining the rainfall characteristics of these storms and appear to be potentially useful in monitoring and making short term predictions of their intensity. Comparison of the ESMR-5 derived total storm rainfall calculations with previous estimates based on moisture budget computations or composited rainfall statistics indicate good agreement for both mature systems (typhoons) and disturbances, except in the inner core, where ESMR-5 measurements seem to underestimate rainfall rate. The calculations confirm that total typhoon rainfall is about twice that found in disturbances. Case studies as well as composite studies indicate that the increase in the ESMR-5 derived latent heat release corresponds to storm intensification. In addition, the relative contribution of the heavier rainfall rates to the total storm rainfall also increases as tropical cyclones intensify. A tendency was also noted for the rainfall to concentrate toward the center during intensification. Comparisons of eastern Pacific Ocean hurricanes and western Pacific Ocean typhoons shows that the eastern storms have less LHR, are more compact and have less intense rainfall. (Baker-FRC)
W82-06214

OBJECTIVE ANALYSES AND MAPPING TECHNIQUES FOR RAINFALL FIELDS: AN OBJECTIVE COMPARISON,

Centre National de la Recherche, Scientifique, Grenoble (France). Inst. de Mecanique.
J. D. Creutin, and C. Obled.
Water Resources, Vol 18, No 2, p 413-431, April, 1982. 13 Fig, 37 Ref.

Descriptors: Rainfall, *Mapping, *Precipitation, *Isohyets, *Statistical analysis, Spatial distribution, estimating, Regression analysis, Mathematical studies, Correlation analysis, Field investigations, Isotropy.

Techniques to estimate point or average values of rainfall fields at ungaged sites are reviewed. Some theorectical developments and practical aspect of various techniques are cited. In general, it was concluded that interpolation methods provide better results than smoothing techniques. No statistical methods are able to fully account for both the climatological and spatial properties of rainfall fields. A case study is presented for a region with particularly high rainfall variability, the Massif Central in France, to compare the sensitivity of various techniques. Correlation and contingency analyses were conducted. Results suggest that the Gandin method is preferred by hydrologists, because it requires only one calibration, it provides the estimation error variance as a by-product, and it is the most computationally efficient. (Titus-FRC)
W82-06327

CALCULATIONS OF HAILSTONE GROWTH IN A SLOPING STEADY UPDRAFT,

Chicago Univ., IL. Dept. of Geophysical Sciences.
W. D. Robinson, and R. C. Srivastava.
Atmosphere-Ocean, Vol 20, No 1, p 76-89, 1982. 8 Fig, 24 Ref.

Descriptors: *Hail, *Cloud physics, Precipitation, Model studies, Air circulation, Fleming storm, Rainstorms.

Hail growth in a model cloud was investigated with analytical solutions to equations of growth and motion in hailstones in updrafts. Cloud water contents varied linearly with height. The two-dimensional steady state model of a storm consisted of several sections in the horizontal and the vertical in each of which the vertical air velocity and the effective cloud water content were linear or piecewise linear functions of height and were consistent in the horizontal direction. This procedure approximated the Fleming storm. Hail embryos (0.1 cm in diameter) were introduced at several positions in the updrat from 5 to 10 km. Spacings were 1 km and 0.5 km in the vertical and horizontal dimensions, respectively. The largest hailstones (up to 5.7 cm) were formed from embryos starting near the (right) downshear edge of the updraft. These embryos recirculated, with the number of recirculations and final size being greatest in those embryos originating nearest to the turnover location of the updraft. Small hailstones (< 0.5 cm), likely to melt before reaching the ground, were formed from embryos starting in the central portions of the updraft and near the upshear edge of the updraft. (Cassar-FRC)
W82-06526

ON THE GRAPHICAL PRESENTATION OF RAINDROP SIZE DATA,

South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
P. L. Smith.
Atmosphere-Ocean, Vol 20, No 1, p 4-16, 1982. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Rain, *Fluid drops, *Particle size distribution, Graphical analysis, Mathematical studies.

Five graphical methods for describing raindrop size data are discussed. These methods can determine the form and estimate the parameters of drop size distribution functions. Each gives a different view of drop size distribution and each has certain advantages in different applications. All methods show that drop size distribution is approximately exponential. The pioneering work of Marshall and Palmer (1948) is less satisfactory for many purposes than subsequently developed methods. The most useful forms for fitting functions to observed drop size data are the semilogarithmic plot of the inverse cumulative drop size distribution vs. drop diameter and a plot of normalized cumulative mass concentration vs. normalized drop diameter. They are also useful in examining the possibility of truncation of distribution. (Cassar-FRC)
W82-06529

A RAIN ATTENUATION MODEL FOR THE SIRIO-SHF EXPERIMENT,

Centro Studi Telecommunicazioni Spaziali e Politecnico, Milan (Italy).
For primary bibliographic entry see Field 7B.
W82-06530

THE OUTLOOK FOR PRECIPITATION MEASUREMENTS FROM SPACE,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W82-06531

ON ACCUMULATION OF WATER SUBSTANCE IN A COLUMN OF RISING AIR,

National Severe Storms Lab., Norman, Ok.
E. Kessler.
Atmosphere-Ocean, Vol 20, No 1, p 62-68, 1982. 1 Fig, 11 Ref.

Descriptors: *Condensation, *Air circulation, *Storms, Clouds, Model studies, Precipitation, Updrafts, Meteorology, Hail.

The accumulation of condensed water in moist rising air is related to the ratio of air speed to the fall speed of precipitation. Maximum accumulation occurs when the ration is near unity. Accumulation of water is considered in one-dimensional time-dependent distributions in three model situations: (1) updrafts are substantially less than precipitation fall speeds (weak updrafts), (2) updrafts and fall speeds are about equal (moderate updrafts), and (3) updrafts are substantially greater than fall speeds (strong updrafts). The accumulation is described by equations reflecting the relative importance of vertical advection, condensation, and three-dimensional divergence of rising air. Equations also define the times required for almost steady conditions to be achieved in the saturated rising columns. The length of the transient phase is proportional to the inverse of the precipitation fall speed in weak updrafts and to the inverse of air speed in moderate or strong updrafts. An idealized figure reveals how precipitation predominates at the base of weak updrafts and throughout most of the depth of moderate updrafts. A strong updraft is marked by cloud at lower altitudes, with precipitation mostly confined to altitudes above the updraft maximum. (Cassar-FRC).
W82-06581

THE EFFECT OF PRESSURE ON THE BREAKUP OF ONE PAIR OF RAINDROPS,

Toronto Univ. (Ontario). Dept. of Physics.
R. List, and C. Fung.
Atmosphere-Ocean, Vol 20, No 1, p 17-27, 1982. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Fluid drops, *Rain, *Coalescence, Kinetics, Precipitation, Atmospheric pressure.

A new apparatus measured the effect of pressure on the breakup types and fragment spectra resulting from water drops with diameters of 2.61 and 1.17 mm colliding while moving vertically at terminal speed. The same types of breakup were observed at 50 to 100 kPa. Pressure did not appear to affect fragment size distribution for breakup into filaments, sheets, and disk patterns; average fragment numbers; or coalescence efficiency. Whenever the larger drop was hit in a glancing fashion, a neck of filament was formed. A more central collision led to a two-dimensional sheet of water ripping out of the larger drop, with the smaller drop disappearing. A central hit produced a horizontal disk. These breakup types occurred at about the same frequency as with the 3.0, 1.0 mm pair of drops at 100 kPa in a previous experiment. At kPa 2250 attempted collisions produced 104 actual collisions. Of these 104 collisions three disk modes coalesced, and 101 led to breakup. The empirical equation developed by Low (1977) and Low and List (1982) predicted the dependence of fragment numbers and size distributions on drop diameters when extrapolated from 100 to 50 kPa. However, the collision kinetic energy factor had to be adjusted by a multiplication factor. (Cassar-FRC)
W82-06761

ESTIMATION OF RUNOFF-PRODUCING PRECIPITATION WITH THE AID OF SATELLITE IMAGERY (ERMITTLUNG ABFLUSSWIRKSAMER NIEDERSCHLAGE AUS SATELLITENDATEN),

Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Wasserwirtschaft and Umwelttechnik.
L. -R. Kruger, and G. A. Schultz.
Wasserwirtschaft, Vol 72, No 1, p 1-5, 1982. 8 Fig, 7 Ref.

Descriptors: *Satellite technology, *Rainfall, *Runoff, *Convection, *Infrared imagery, Water resources development, *West Germany, Mathematical models, Mathematical equations, Clouds, Temperature effects, Air temperature, Cloudbursts, Precipitation, Rainfall intensity, Rainfall-runoff relationships, Rainstorms, *Remote sensing, *Metrostat.

The use of data from the infrared channel of the geostationary satellite METEOSTAT to locate and analyze convection precipitation is described. The technique can be used to partly fill gaps in hydrological data that have, particularly in the

developing countries, hindered the smooth functioning of water resources projects. The METEOSTAT provides the extensive scan in terms of both time and space required to analyze the origin of convection rainfall in its local variability and quick occurrence. Rainfall data can then be converted to runoff with the aid of a deterministic precipitation/runoff model. The satellite is located 36,000 km above the equator at 0 degrees longitude and possesses the same angular velocity as the earth (hence it is geostationary). The infrared channel (10.5-12.5 micrometers) delivers information on the temperature of ground, water, and cloud surfaces. The satellite covers 25 sq km at the subsatellite point and above 45 sq km over central Europe. It delivers an image of almost half the earth's surface about every 30 min. Using a test area of southern Germany, the data indicated that the lower the temperature of the cloud surface, the higher the probability of the existence of ice crystals and their growth (these eventually fall to the earth as rain) and the more powerful the extent of the convection cell and hence the greater the precipitation efficiency. The data also showed that a large temporal temperature change of the upper edge of the cloud is an expression of the inner dynamics of the convectional cell; a temperature drop indicates a fast rise of the cumulonimbus. The parameter that allows rain volume to be calculated from rain intensity is the area of the cloud. An equation is given for this. In principle, METEOSTAT provides infrared information for every catchment area on earth, but research is required to devise more accurate methods of interpreting the data. (Gish-FRC)
W82-06823

A STATISTICAL-DYNAMICAL CLIMATE MODEL WITH A SIMPLE HYDROLOGY CYCLE,
Scripps Institution of Oceanography, La Jolla, CA.
G. K. Vallis.
Tellus, Vol 34, No 3, p 211-227, June, 1982. 17 Fig, 2 Tab, 45 Ref.

Descriptors: *Model studies, *Climates, *Climatic zones, *Climatology, Mathematical studies, Hydrology, Hydrologic models, Hydrologic cycle, *Statistical studies.

A zonally averaged statistical dynamical climate model is described, and various experiments are performed with it. The model is based on the primitive equations of motion, except that the zonally averaged zonal wind is constrained to be in a 'spherical geostrophic equilibrium' with the geopotential. The effects of large scale eddies on zonally averaged flow are parameterized using a scheme based on the work of Green. The solar and infrared radiation schemes allow interaction with the cloud cover predicted via a hydrology cycle. When integrated, the model produces realistic energetics and fields of momentum, temperature and relative humidity. The effects of moisture on the model circulation are examined. Its inclusion intensifies and narrows the upward branch of the Hadley cell, although the total width is unaltered. The response of the surface temperature to changes in the solar constant is reduced by moisture, especially at low latitudes. Relative humidity is found to have an inverse relationship to surface temperature if surface albedo is fixed. However, the presence of an ice sheet reduces low level relative humidity. Implications for simple energy-balance models and climate sensitivity are discussed. (Baker-FRC)
W82-06838

SPATIAL COHERENCE OF MONTHLY PRECIPITATION IN THE UNITED STATES,
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
J. E. Walsh, M. B. Richman, and D. W. Allen.
Monthly Weather Review, Vol 110, No 4, p 272-286, April, 1982. 10 Fig, 6 Tab, 37 Ref.

Descriptors: *Spatial distribution, *Air circulation, *Weather patterns, Precipitation, Factor analysis, Synoptic analysis, Cyclones, Seasonal variation, Areal precipitation, Meteorology, Weather forecasting.

Synoptic-scale regions of the U.S. over which monthly precipitation amounts showed the greatest spatial coherence were identified by factor analysis and an orthogonal rotation to the varimax criterion. Data consisted of monthly precipitation amounts for the years 1900-77 at 61 stations. Results showed nine patterns, which permitted delineation of the large-scale circulation features most closely associated with fluctuations of regional precipitation. Correlations between regional precipitation and parameters of the 700 mb height field were significant locally and corresponded to 10-50% of the monthly precipitation variance. Patterns were consistent with previously documented cyclone trajectories, and the corresponding time series of the factor scores were highly correlated with values of the Palmer Drought Index. The seasonal continuity of the patterns was disrupted only in summer, when the predominance of convective precipitation resulted in a minimum of spatial coherence. Sea level pressure anomalies over broad areas of the Atlantic and Pacific Oceans were associated with regional precipitation in the central and eastern U.S. The correlations with precipitation along the West Coast were more localized. These results may be useful in long-range prediction of precipitation. (Cassar-FRC)
W82-06894

COLORADO RIVER ENHANCED SNOWPACK TEST ENVIRONMENTAL ASSESSMENT AND DESIGN PHASE FINDING OF NO SIGNIFICANT IMPACT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
For primary bibliographic entry see Field 6G.
W82-06967

ESTIMATION OF THE PRECIPITABLE WATER FROM THE IR CHANNEL OF THE GEOSTATIONARY SATELLITE,
Meteorological Satellite Center, Tokyo (Japan).
For primary bibliographic entry see Field 7B.
W82-06995

2C. Snow, Ice, and Frost

THE IMPORTANCE OF REFREEZING ON THE DIURNAL SNOWMELT CYCLE WITH APPLICATION TO A NORTHERN SWEDISH CATCHMENT,
Luleap Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Nordic Hydrology, Vol 13, No 1, p 1-12, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Snowmelt, *Mathematical models, *Freezing, *Snow pack, Model studies, Temperature effects, Thaw, Snow cover, Snow melting, Mathematical studies, *Sweden.

A method for calculating night-time refreezing of the top layer of a snowpack which may be used in the degree-day technique for computing daily snowmelt rates is presented. For days with considerable variations in temperature, the total snowmelt will not be calculated accurately by the degree-day method, unless overnight refreezing is accounted for. For such days, the daytime conditions rather than the mean conditions over the whole day determine the snowmelt that takes place. The corrected model was applied to an open field and a forested area of the Bensbyn catchment area of northern Sweden. Whereas the simple degree-day method showed too fast a snowmelt rate, the refreezing-degree-day method was found to be very accurate for describing the snowmelt process. The refreezing-degree-day approach should prove easy to incorporate into existing conceptual mathematical runoff models. (Geiger-FRC)
W82-05942

COLD REGIONS ENGINEERING IN NORWAY,
Norwegian Road Research Lab., Oslo.
For primary bibliographic entry see Field 8A.
W82-06000

AN OPERATIONAL NET SHORTWAVE RADIATION MODEL FOR GLACIAL BASINS,
Toronto Univ. (Ontario), Dept. of Geography.
D. S. Munro, and G. J. Young.
Water Resources Research, Vol 18, No 2, p 220-230, April, 1982. 8 Fig, 1 Tab, 24 Ref.

Descriptors: *Net radiation, *Model studies, *Snowmelt, *Reflectance, *Glaciology, *Mapping, Radiation, Runoff, Glaciers, Ablation, Glaciohydrology, Snowline, Melting, River basins.

An operational net shortwave radiation model which is useful in mapping the distribution of shortwave radiation arriving at sloping surfaces throughout a glacier basin is described. The model is constructed by modifying existing total spectrum approaches to minimize the need for observational data during operation. Radiation distribution may be mapped under clear or cloudy skies, and knowledge of the surface reflectance field must be incorporated to estimate the net shortwave radiation absorbed by ice and snow. The model was successfully applied using topography data, monitoring of the snowline, and routine weather studies at Peyto Glacier Basin, Alberta. Model net shortwave radiation estimates were fair approximations of energy equivalents of ablation derived from stake measurements. The net shortwave radiation measurement was recommended for use in modeling the meltwater discharge of glacier basins. (Geiger-FRC)
W82-06064

EVAPORATION FROM THE SURFACE OF THE ARCTIC TUNDRA ON AXEL HEIBERG ISLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
For primary bibliographic entry see Field 2D.
W82-06065

DETERMINATION OF SULPHUR IN SNOW BY PROTON INDUCED X-RAY EMISSIONS (PIXE) METHOD,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
For primary bibliographic entry see Field 5A.
W82-06082

BACTERIA UNDER THE ICE,
For primary bibliographic entry see Field 5A.
W82-06561

ALBEDO SURVEY ON ANDREI GLACIER, ISKUT RIVER BASIN, B. C., MIDSUMMER, 1980,
Department of the Environment, Ottawa (Ontario).
S. Fogarasi.
National Hydrology Institute, NHRI Paper No 15, 1981. 13 p 6 Fig, 5 Tab, 1 append.

Descriptors: Water resources, *Geological survey, *Glaciers, *Data analysis, *Statistics, Surface Contamination, *British Columbia, *Albedo, Andrei Glacier.

At nine sites on Andrei Glacier, B.C., albedo measurements were carried out on ice surfaces which were contaminated to varying degrees. Four albedo classes were derived in terms of the amount of aeolian dirt that was deposited on the ice surface. Each albedo class was associated with one of the 'white', 'whitish', 'dirty' or 'very dirty' surfaces, and each class had signigicantly different albedos, the means of which ranged from 22% to 68%. Values in each albedo group were normally distributed over time. Albedos from wet ice surfaces were found between the -2 and -3 standard deviation band of each albedo class distribution. Albedo values measured on freshly frozen ice surfaces tended to occupy the upper tail of the Gaussian normal distribution, i.e., between +2 and +3 standard deviations. Albedo values have been tabulated and plotted along a grid of 500-m mesh. Finally, suggestions are given on how to model

hourly ice surface albedo distribution over the glacier. (WATDOC).
W82-06578

2D. Evaporation and Transpiration

LIQUID LEVEL INTERFEROMETER,
Arizona Univ., Tucson. Optical Sciences Center.
For primary bibliographic entry see Field 7B.
W82-05929

REGIONAL WATER BALANCE ON THE ARCTIC TUNDRA IN SUMMER,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
A. Ohmura.
Water Resources Research, Vol 18, No 2, p 301-305, April, 1982. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Tundra, *Evaporation, *Precipitation, *Arctic zone, *Altitude, *Hydrologic budget, Evaporation rate, Energy, Lysimeters, Runoff, Snowmelt, Hydrologic data collections, Snow cover.

During the summers of 1969 and 1970, the regional distributions of evaporation and precipitation were examined on the arctic tundra on Axel Heiberg Island, Northwest Territory, Canada. Measurements were made using small weighing lysimeters and Canadian standard rain gauges stationed at eight locations ranging in altitude from sea level to 800 m above the means sea level. During the snow-free period, the means evaporation rate increases slightly with altitude. At higher altitudes, the total evaporation for the snow-free period is shorter due to the longer duration of the snow cover. The total summer evaporation is at a maximum in the 100-600 m altitude range, while total summer precipitation increases steadily with altitude, exceeding evaporation at about 500 m. Below 500 m, most of the annual runoff occurs during and immediately after the winter snowmelt. Above this altitude, runoff takes place throughout the summer. (Geiger-FRC)
W82-06061

EVAPORATION FROM THE SURFACE OF THE ARCTIC TUNDRA ON AXEL HEIBERG ISLAND,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Geography.
A. Ohmura.
Water Resources Research, Vol 18, No 2, p 291-300, April, 1982. 6 Tab, 3 Fig, 18 Ref.

Descriptors: *Arctic zone, *Tundra, *Evaporation rate, *Snowmelt, *Precipitation, *Runoff value, Arctic, Hydrologic data collections, Evaporation, Sublimation, Lysimeters, Snow cover, Rime, Snowdrift, Energy, Hydrologic budget.

Hourly and daily evaporation rates were recorded on arctic tundra during an energy balance program of the Axel Heiberg Island Expedition in spring and summer of 1969, 1970, and 1972. Objective criteria were developed to accept or reject the aerodynamic profile method of data collection for the Bowen ration energy balance procedure. Readings from the snow lysimeter and the ordinary weighting lysimeter were affected by snowfall, snowdrifting, rime deposition and lack of ventilation. The annual total evaporation for the base camp of the Axel Heiberg Island Expedition was estimated at 140 mm. This rate increases slowly from April to the beginning of the melt in mid-June, while the ratio of latent heat flux to net radiation decreases. The maximum annual evaporation rate is observed immediately after the melt. Total evaporation during the snow-free period accounts for about 85% of the annual total evaporation. Winter snow cover at the base camp contains an average water equivalent of 76 mm, while summer precipitation averages 95 mm. It was estimated that as much as 80% of the annual precipitation is lost into the atmosphere through evaporation, leaving only 20% for runoff, which occurs mostly during and immeditely after the melt period. (Geiger-FRC)
W82-06065

PALAEOCLIMATES AT LAKE TURKANA, KENYA, FROM OXYGEN ISOTOPE RATIOS OF GASTROPOD SHELLS,
Rhode Island Univ., Kingston. Dept. of Chemistry.
P. I. Abell.
Nature (London), Vol 297, No 5864, p 321-323, May 27, 1982. 3 Fig, 20 Ref.

Descriptors: *Lake evaporation, *Isotope studies, *Paleoclimatology, *Oxygen, *Lake sediments, *Sedimentology, *Gastropods, Evaporation, Isotopic tracers, Climatology, Water level fluctuations, Lakes, Air temperature, Relative humidity, *Kenya, Lake Turkana.

The well-preserved mollusc shells in the sedimentary column of Lake Turkana, Kenya were utilized to study the palaeoclimatology of the area using an oxygen isotope technique. The shells of three species of abundant gastropods were ground to a powder and examined for aragonite/calcite ratios and oxygen isotope (O18/O16) ratios. The sensitive oxygen isotope record varied over a range of 7%, reflecting higher evaporative levels of the heavier oxygen isotope in lake waters during periods when the lake was closed, alternating with isotopically lighter freshwater during periods when the lake was open. The mapped climatic trends derived from this technique are comparable to those observed in parts of Africa today. The warm/dry periods which have characterized much of the past at Lake Turkana and which prevail today have also been noted in oxygen isotope ratios from modern gastropods at Lakes Victoria, Edward, Albert, and Kivu, suggesting that temperature rather than relative humidity is the major factor controlling the evaporative concentration of O18. (Geiger-FRC)
W82-06216

TRANSPIRATIONAL SUPPLY AND DEMAND: PLANT, SOIL, AND ATMOSPHERIC EFFECTS EVALUATED BY SIMULATION,
Northeastern Forest Experiment Station, Durham, NH.
C. A. Federer.
Water Resources Research, Vol 18, No 2, p 355-362, April, 1982. 5 Tab, 6 Fig, 23 Ref.

Descriptors: *Simulation analysis, *Mathematical models, *Transpiration, *Atmosphere, *Soil environment, Stomatal transpiration, Water loss, Transpiration depletion, Flow roots, Plant-water potential, Water potentials, Field investigations, *Maine.

The accuracy and usefulness of two forms of water demand functions and two forms of water supply functions are considered. The effects of various soil and plant factors on transpiration are examined using a simulation model to produce transpiration values. The model simulates diurnal and seasonal behavior of plant and soil water potentials, stomatal conductance, and transpiration, and has been tested on two hardwood forests. Data from a birch-oak-pine forest in southern Maine were used. The study showed that the best estimate of atmospheric demand, unstressed transpiration, can be obtained by the Penman equation for short vegetation, but with forest canopies, transpiration is highly variable. The best estimate of supply incorporates depth variation of soil water potential and of root and soil properties, but a more practical index can be used which measures the fraction and available water in the root zone. Results of the study suggest that supply is less than demand only when the soil is very dry. (Titus-FRC)
W82-06320

POTENTIAL EVAPORATION IN THE PEACE REGION OF BRITISH COLUMBIA,
British Columbia Ministry of Environment, Victoria.
R. L. Davis, and J. A. Davies.
Atmosphere-Ocean, Vol 19, No 3, p 251-260, 1981. 5 Fig, 13 Ref.

Descriptors: *Evaporation, *Net radiation, *Energy, Model studies, Peace River, *Briish Columbia, Pastures, Solar radiation, Radiation.

The Priestly and Taylor (1972) model for potential evaporation performed well when tested with micrometeorological data collected over pasture in the Peace River region, British Columbia. Data were collected from mid-May until late August, 1977, during which a total of 285 mm of precipitation fell on 55 days. The volumetric soil moisture content of the root zone always exceeded 32%, insuring evaporation at the potential rate. The root mean square error was less than 10% of the mean evaporation rate on a daytime basis using an alpha rate (vapor pressure deficit) of 1.26. Net radiation, rarely measured in remote areas, was estimated from more readily available meteorological data. On the average, calculated results of net radiation were 7% higher than observed values, producing a 7% overestimate of evaporation. Calculated results of net radiation were also within 20% of measured values on a daily basis and within 10% on a 5-day mean basis. (Cassar-FRC)
W82-06528

AN AUTOMATED RECORDING SYSTEM FOR EVAPORATION PANS,
Bureau of Land Management, Denver, CO.
B. P. Van Haveren.
Water Resources Bulletin, Vol 18, No 3, p 533-536, June, 1982. 6 Fig, 2 Ref.

Descriptors: *Measuring instruments, *Evaporation pans, Evaporation, Flow discharge, Remote sensing, Telemetry, Automation.

A simple, reliable, and relatively inexpensive automated recording system for evaporation plans is described. With this system, a continuous record of pan evaporation is obtained. The evaporation station may be left unattended for periods of up to 30 days, and with incorporation of a data telemetry system, could be operated on a real-time basis. Measurement sensitivity and frequency of maintenance trips can be determined by the investigator simply by choice of reservoir diameter and volume. The system is particularly well suited for remote evaporation stations. The major advantages of the system over conventional, manually read evaporation pans are: (1) savings in manpower and travel expenses, (2) continuous recoding function, and (3) adaptability to real time data acquisitions systems. Data retrieval and storage can be by conventional paper strip chart, punch tape, cassette tape data logger, or telemetry. The system could be operated in cold weather by substituting a mixture of methanol and water for water in the evaporation pan. For more sophisticated applications, the float valve can be replaced by an electronic circuit to sense water lever and a solenoid valve to control water flow to the pan. (Baker-FRC)
W82-06780

PRACTICABLE FORMULAE FOR THE ENERGY EXCHANGE AT THE BOUNDARY LAYER BETWEEN WATER SURFACE AND AIR (BRAUCHBARE ENERGIEUMSATZFORMELN FUR DEN GRENZBEREICH GEWASSEROBERFLACHE/LUFT),
Munich Univ. (Germany, F.R.). Fachbereich Geowissenschaften.
J. Werner.
Wasserwirtschaft, Vol 72, No 1, p 18-22, 1982. 6 Fig, 15 Ref.

As a result of several years' investigation of energy exchange at the boundary of water and air, equations for the calculation of this phenomenon are given whose practicability has been proven. The use of these equations in an arithmetic model opens up the possibility of extrapolation to extreme situations, whether these caused by a long period of extraordinary atmospheric conditions or changes in the natural temperature balance of a body of water induced by man (e.g., warmth from a wastewater stream). Developments in microprocessor technology have made it possible to monitor energy exchange at water surfaces continuously by means of a floating buoy and to balance them in situ. The buoy allows determination of evaporation loss as well as arithmetic simulation of equilibrium temperatures. The simplest form of such a buoy is furnished with a device for measuring radiation balance, a cup anemometer and an evaporation psychrometer. The buoy

should be about 1 m high so that maintenance can be carried out comfortably from a boat, and this permits calculation of energy exchange up to 3.3 m above the water surface. In running water a flow meter should be installed to distinguish the relative movement between water and air from wind speed actually affecting the surface. Equations are given for the calculation of short- and long-wave radiation exchange and of the vertical flows of latent and perceptible heat. The temperature of water is determined by the total radiation exchange, which in turn is determined by energy gain from global radiation and by heat loss through reflected radiation as well as by evaporation loss and the exchange of perceptible heat. (Gish-FRC)
W82-06824

COMPARISON OF TECHNIQUES FOR ESTIMATING ANNUAL LAKE EVAPORATION USING CLIMATOLOGICAL DATA,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
M. E. Andersen, and H. E. Jobson.
Water Resources Research, Vol 18, No 3, p 630-636, June, 1982. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Model studies, *Lake evaporation, *Evaporation, Lakes, Mathematical models, Maps, Temperature effects, Humidity, *Climatic data, Water loss.

A numerical model and an evaporation map were used to determine mean annual evaporation estimates for 30 lakes. The map used had been derived from a computer model with contour lines showing average annual lake evaporation in the southeastern United States which had been superimposed on a map that was created using 10 year average values of pan evaporation and related meteorological data along with observed evaporation from 10 lakes. The evaporation map thus produced provides annual evaporation estimates that are more consistent with observations than those determined by use of the numerical model. The map cannot provide monthly estimates, however, and is only available for the contiguous United States. The numerical model can provide monthly estimates for shallow lakes and is based on monthly observations of temperature, humidity, and sunshine duration. (Baker-FRC)
W82-06850

2E. Streamflow and Runoff

FINITE ELEMENT MODELING OF STREAMFLOW ROUTING,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
A. K. Tyagi.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243429, Price codes: A02 in paper copy, A01 in microfiche. Report, December 1981. 18 p, 3 Fig, 25 Ref. OWRT A-103-OKLA(1), 14-34-0001-1138.

Descriptors: *Streamflow forecasting, *Model studies, *Model testing, *Routing, *Finite element models, Forecasting, Prediction, Projections, Mathematical studies, Flow index, Diversion, Discharge capacity, Discharge coefficient, Flow discharge, Flow measurement, Computer models, Mathematical models, Mathematical analysis.

Application of finite element (FE) methods to unsteady flow equations is presented for predicting depth, velocity, and volume flow rate in a stream. Two simplified FE models (the explicit and weighted-implicit FE models) are proposed as methods appropriate to streamflow routing. The equation of continuity (conserving the mass of flow) is completely retained; the equation of momentum (conserving the flow momentum) is modified to account only for the friction and gravity terms. This study sought to develop an efficient simple model capable of accurately predicting discharges with little or no computational problems; the weighted-implicit model was developed and tested for this purpose for a flood routing problem. The flood hydrograph results obtained from testing both FE models agree closely with a previously-found solution. The weighted-implicit FE model was determined to yield accurate results, with a maximum time interval of 10 minutes and a weighting factor in a range of 0.55-1.00. Delineation of the mass and momentum conservation equations for the overall mathematical model is provided. (Zielinski-MAXIMA)
W82-05918

ADAPTIVE REAL-TIME STREAMFLOW FORECASTING MODEL FOR HYDROSYSTEM OPERATIONAL PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. C. Lazaro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243502, Price codes: A11 in paper copy, A01 in microfiche. PhD Thesis, Fall, 1981. 212 p, 28 Fig, 16 Tab, 94 Ref, 2 Append. OWRT B-201-COLO(2).

Descriptors: *Streamflow forecasting, *Water use efficiency, *Computer models, *Management planning, *Operating policies, Streamflow, Planning, Water demand, Water supply, Model testing, Model studies, Forecasting, Water conservation, Water requirements, Simulation analysis, River basin development, Prediction, Flow discharge.

Due to increased competition for available water supplies in the western U.S. and political and financial considerations that new water supply development, recent attention has been focused on more effective operations to enhance water supply and use efficiency. A package of computerized management models is offered for monthly operational planning of complex water resource systems supplied by snow-fed streams. The three basic parts of the package consist of: a state-space water supply forecasting model (accounting for future streamflow uncertainties); a methodology for treating substantially different streamflows; and a river basin management model having simulation and optimization capabilities. Model parameters, forecasts, and the resultant operational plan can be adaptively updated as new information is obtained in real-time. The forecasting model is based on historical patterns identified from derived monthly streamflow records; forecasted monthly streamflow serves as an input to the river basin management model to simulate water storage and system flows. The Cache La Poudre river basin in north-central Colorado was used as the case study to show capability and use of the management package. Package application reduced waste surface water leaving the system. System outflow reduction is dependent on the reservoir maximum safe storage volume and the minimum amount that can be wasted or no longer diverted for storage. (Zielinski-MAXIMA)
W82-05926

STATISTICAL FLOOD FLOW ESTIMATION,
E. Reinius.
Nordic Hydrology, Vol 13, No 1, p 49-64, 1982. 5 Fig, 8 Tab, 9 Ref.

Descriptors: *Flood frequency, *Graphical methods, *Frequency analysis, *Frequency distribution, Mathematical studies, Graphical analysis, Flood peak, Probability distribution, Mathematical equations, Flood discharge, Flood flow.

When the frequency analysis of flood flows is calculated by the grapical method of plotting on probability paper the results obtained are different from results calculated by the analytical method. If both methods were correct, the position should coincide with the mean of the probabilities which the observation of a rank has in a great number of samples, each with the same size. A study using synthetic samples demonstrated that these positions do not coincide with the line of population. Another study indicated that the positions of the probabilities of the expected-mean-values of the largest observation coincide with the line of the population. It was therefore concluded that the logarithm of the annual peak flows should obtain a plotting probability equal to the probability of the expected value of the logarithm of the observations. A new plotting position formula based on these observations is derived. (Geiger-FRC)
W82-05945

LESSONS LEARNED FROM THE 1981 LAINGSBURG FLOOD,
Department of Water Affairs, Forestry and Environment Conservation, Pretoria (South Africa).
C. P. R. Roberts, and W. J. R. Alexander.
Civil Engineer in South Africa, Vol 24, No 1, p 17-21, 24, 25, 27, January, 1982. 16 Fig, 5 Tab, 4 Ref.

Descriptors: *Floods, *Urban areas, Metropolitan areas, Laingsburg, *South Africa, Flood plain zoning, Floodwater, Historic floods, Flood damage, Flood control, Planning, Flood profiles.

The objective of this paper is to highlight the circumstances of the Laingsburg flood, South Africa 1981, which aggravated the loss of life and damage and the considerations which were taken into account in establishing the re-development line for the town. General conclusions drawn from these events are applicable to urban development on flood plains. Laingsburg is situated about 230 km northeast of Cape Town on the banks of the Buffels River, which flows in a southerly direction to join the Touws River, forming the Groot River, eventually turning into the Gouritz River. The Floriskraal Dam is located 20 km downstream of Laingsburg and was completed in 1957. The flood caused the loss of much property and 90 lives. Damage resulted from a combination of a number of aggravating circumstances. The flood arose from a typical black south-eastern weather situation and was estimated to be one of the largest recorded in South Africa, taking the size of the catchment area into account. Aggravating circumstances included the location of Laingsburg itself; the effect of tributary rivers; demolition and scour effects of the flood waters; the deposition of sediment particularly nearest to the enlarged river channel, where there is a rapid decrease in the velocity of the flowing water; floating debris which caused much damage in the town; and structural collapse of many buildings due to high water lovels alone. The effects of bridges across the Buffels River were a problem, as the flood size was 4 to 6 times greater than the size of the flood that would normally be taken into account for the design of road and rail bridges. The primary factor causing the high loss of life was that people could not anticipate that the water would reach such high levels, as there was no historical precedent for this. (Baker-FRC)
W82-05997

THE USE OF RIVER FLOW DATA TO PREDICT LOW FLOWS AS AN AID TO TROUT FARM MANAGEMENT,
Anglian Water Authority (England).
J. W. East, and T. F. Colesc.
Fisheries Management, Vol 13, No 1, p 11-17, 1982. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Streamflow forecasting, Fish, *Low flow, Forecasting, *Trout, Hydrographs, Flow pattern, Springs.

A method for predicting streamflow in groundwater dominated streams allows prediction of low flows several months in advance so that trout farm management may be improved. Annual hydrographs for Belleau Springs, Lincolnshire, from summer and fall of 1971-77 were analyzed to prepare a master recession curve (discharges vs. time). The master recession curve was positioned over the annual hydrograph at the point where flow measurements began to decline, and the predicted values were read. Since it is assured that no runoff or recharge occurs, the estimates are conservative. (Cassar-FRC)
W82-06083

SALT UPTAKE IN NATURAL CHANNELS TRAVERSING MANCOS SHALES IN THE PRICE BASIN, UTAH,

Utah Water Research Lab., Logan.
J. P. Riley, D. J. Chadwick, Jr., L. S. Dixon, L. D. James, and W. J. Grenney.
Water Resources Planning Series UWRL/P-82/02, March 1982. 194 p, 63 Fig, 31 Tab, 79 Ref, 5 Append. 14-06-D-7691.

Descriptors: *Salt uptake, *Salinity, Surface flow, *Overland flow, Model studies, Groundwater movement, Channel efflorescence, Irrigation effects, Simulation, Agricultural runoff, Mountains, Surface runoff, *Utah, *Salt River Basin.

Within the Price River valley, salt enters the river as it is carried by overland flow from natural areas, agricultural drainage, and groundwater inflow entering the stream from natural and man-caused sources. Field and laboratory measurements of process rates for runoff and salt movement were used to develop and calibrate a hydrosalinity model of outflows from the Price River Basin at Woodwide, Utah. The field measurements were specifically used to formulate a model for estimating surface flow in the Coal Creek Basin on the valley floor. The basin simulation assessment model (BSAM) was used to combine local flows and model total outflow from the Price River. As to field data, observed salt loading rates reached 518 lb/sq m daily, groundwater inflow declined steadily throughoout the summer but maintained constant salt concentrations, channel efflorescence varied more than 100 fold with the largest concentrations occurring in saturated bed material, and turbulent mixing and cyclic drying added to salt dissolution rates. Extrapolation of the results with the Coal Creek model showed only a very small percentage of the salt loading from the valley floor to originate from natural lands. BSAM showed average annual salt leaving the Basin at Woodside to be 190,000 tons, 114,000 coming from the mountain area and 76,000 from the valley floor. Of the valley floor contribution, only 3,500 tons are produced by surface runoff from nonirrigated areas. (Moore-SRC)
W82-06093

FLOOD OF MAY 5 AND 6, 1981, MOBILE, ALABAMA,

Geological Survey, Montgomery, AL. Water Resources Div.
C. O. Ming, and G. H. Nelson.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $14.25, Microfiche $2.00. Geological Survey Open-File Report 81-1054, 1981. 4 Sheets.

Descriptors: *Floods, *Rainfall, *Flood peak, *Flood damage, Flash flood, Streamflow, Discharge measurement, High water mark, Rainfall intensity, Runoff, Historic floods, Hydrographs, Flood profiles, Flood plain management, Maps, *Alabama, Mobile.

Heavy and intense rainfall in the late evening and early morning hours, May 5 and 6, 1981, caused widespread flooding along streams and low-lying areas in the port city of Mobile, Ala. More than 12 inches of rain fell between 6 p.m. May 5, and 3 a.m. May 6. Damage caused by flooding was estimated by the Mobile Department of Public Works to be millions of dollars. Maximum water surface elevations on streams in the area were 2 to 3 feet higher than those that occurred during a similar flood in April 1980. The approximate extent of flooding delineated on maps using flood profiles obtained by field surveys will provide a basis for formulating effective flood plain zoning that could minimize existing and future flood problems. (USGS)
W82-06128

STATISTICAL SUMMARIES OF STREAMFLOW AND WATER-QUALITY DATA FOR STREAMS OF WESTERN NORTH DAKOTA, 1977-80,

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06133

A STOCHASTIC STREAMFLOW MODEL OF THE PLATTE RIVER AT OVERTON, ODESSA, AND GRAND ISLAND, NEBRASKA,

Geological Survey, Denver, CO. Water Resources Div.
A. V. Vecchia, Jr.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, Colo. 80225, Paper copy $6.00, Microfiche $3.50. Geological Survey Open-File Report 81-1188, 1981. 42 p, 12 Fig, 10 Tab, 9 Ref.

Descriptors: *Model studies, *Streamflow, *Simulation analysis, *Flow characteristics, Evaluation, Monte Carlo method, Time series analysis, *Nebraska, Platte River, Overton, Odessa, Grand Island.

A stochastic model is developed to simulate flows for three seasons (September through February, March and April, May through August) at Overton, Odessa, and Grand Island, Nebraska on the Platte River. The model preserves the first and second order moment properties of the historical flow series, including significant autocorrelations within each station and cross-correlations between the stations. Higher order moments are preserved by a transformation technique that allows the residuals from the model to be approximately normal. An algorithm is given for simulation of combined-stations flows, and some simulations are carried out to determine the likelihood of specified flow shortages that could be detrimental to the wildlife habitat in the reach of the Platte River between Overton and Grand Island. (USGS)
W82-06139

A METHOD OF ESTIMATING FLOOD-FREQUENCY PARAMETERS FOR STREAMS IN IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
L. C. Kjelstrom, and R. L. Moffatt.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $21.25, Microfiche $5.50. Geological Survey Open-File Report 81-909, September 1981. 99 p, 6 Fig, 3 Plates, 1 Tab.

Descriptors: *Flood forecasting, *Distribution patterns, *Frequency analysis, *Floods, Snowmelt, Rainstorms, Storm runoff, Regression analysis, Data collections, *Idaho, Snake River basin, Basin characteristics, Skew coefficients.

Skew coefficients for the log-Pearson type III distribution are generalized on the basis of some similarity of floods in the Snake River basin and other parts of Idaho. Generalized skew coefficients aid in shaping flood-frequency curves because skew coefficients computed from gaging stations having relatively short periods of peak flow records can be unreliable. Generalized skew coefficients can be obtained for a gaging station from one of three maps in this report. The map to be used depends on whether (1) snowmelt floods are domiant (generally when more than 20 percent of the drainage area is above 6,000 feet altitude), (2) rainstorm floods are dominant (generally when the mean altitude is less than 3,000 feet), or (3) either snowmelt or rainstorm floods can be the annual miximum discharge. For the latter case, frequency curves constructed using separate arrays of each type of runoff can be combined into one curve, which, for some stations, is significantly different than the frequency curve constructed using only annual maximum discharges. For 269 gaging stations, flood-frequency curves that include the generalized skew coefficients in the computation of the log-Pearson type III equation tend to fit the data better than previous analyses. Frequency curves for ungaged sites can be derived by estimating three statistics of the log-Pearson type III distribution. The mean and standard deviation of logarithms of annual maximum discharges are estimated by regression equations that use basin characteristics as independent variables. Skew coefficient estimates are the generalized skews. The log-Pearson type III equation is then applied with the three estimated statistics to compute the discharge at selected exceedance probabilities. Standard errors at the 2-percent exceedance probability range from 41 to 90 percent. (USGS)
W82-06142

EVALUATION OF GROUNDWATER RESOURCES IN TOKAR DELTA, SUDAN,

Khartoum Univ. (Sudan). Dept. of Geology.
M. T. Hussein.
Hydrological Sciences Bulletin, Vol 27, No 2, p 139-145, June, 1982. 5 Fig, 1 Tab, 2 Ref.

Descriptors: *Aquifers, *Water resources development, Tokar Delta, *Sudan, Deltas, Water quality, Water supply, Water supply development.

Groundwater resources in Tokar Delta are estimated. The delta is an area lying on the Sudanese coast of the Red Sea. Groundwater occurs in clastic sediments deposited in an arcuate prograding delta in which there are lagoons and barrier islands. It occurs at a depth of 7-9 meters in the upstream part of the delta, at 10-12 meters in the center and at 3-6 meters in the downstream portion of the delta. The general flow is paralled to the direction of the surface flow. Main recharge is from the waters of the Khor Baraka and other small ephemeral streams. The hydraulic gradient obtained averages 0.002. The wide range of transmissivity values reveals the heterogeneous nature of the sediments. The storage coefficient varies from about 0.003 in the lagoonal zones to 0.26 in barrier islands and upstream sediments. The hydrodynamic data are characteristic of an unconfined aquifer in the upstream portion of the delta that fingers downstream in semi-confined conditions. As concerns water quality, Tokar Delta is divided into four zones: A fresh water zone, a transitional zone, a zone of sea water intrusion, and a low yield lagoonal zone with poor quality water. The quantity of water that can be safely exploited is 5,5200,000 cubic meters/year. (Baker-FRC)
W82-06197

GROUNDWATER AND MELTWATER IN THE SNOWMELT INDUCED RUNOFF,

Lulea Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Hydrological Sciences Bulletin, Vol 27, No 2, p 147-158, June, 1982. 8 Fig, 10 Ref.

Descriptors: *Groundwater, *Snowmelt, Streamflow, LRunoff, Melting, Basins, Catchment areas.

Various snowmelt-induced runoff processes are discussed. The influence of the diurnal snowmelt cycle on the runoff from basins of different type is analyzed. Through the analysis of measured hydrographs it is shown that conclusions about the origin of streamflow can be drawn from these anlyses. The study concludes that the low in small streams originates from groundwater and overland flow, with the ratio between the two different kinds of flow depending on basin characteristics. The character of the two flows is very different. The discharge in a stream in a basin which is dominated by overland flow follows the diurnal snowmelt fluctuations and is high from the first day of snowmelt. Streamflow originating from groundwater also reacts to snowmelt fluctuations, but the fluctuations are small, and the mean daily flow is increasing during the snowmelt period. One analyzed discharge hydrograph of a stream draining a small watershed has such a character that the streamflow in the first phase of the snowmelt period must mainly originate from overland flow from a large open meadow. In the final phase of the snowmelt period the streamflow is mostly due to groundwater flow recharged on a forested area, but overland flow also constitutes an important part of the total runoff. (Baker-FRC)
W82-06198

THE DEPENDENCE OF DRAINAGE DENSITY ON CLIMATE AND GEOMORPHOLOGY,

Universidad Simon Bolivar, Caracas (Venequela)> Graduate Program in Hydrology and Water Resources.
I. Rodriguez-Iturbe, and L. A. Escobar.
Hydrological Sciences Bulletin, Vol 27, No 2, p 129-137, June, 1982. 5 Fig, 13 Ref.

Descriptors: *Drainage density, *Kinetics, Climates, Geomorphology, Basins, Hydrology, Streamflow, Runoff, Catchment areas.

The link is explored between the potential energy of the effective rainfall and the kinetic energy of the streamflow at the outlet of a basin. As water from rainfall flows downstream it will convert its potential energy into kinetic energy and friction loss or heat. The kinetic energy thus generated is the tool with which the flow can carve the channels forming the drainage network. Hence, the energy losses in a stream network should have a determining effect on the structure of the network. The lower the kinetic energy at the outlet for a given potential energy, the larger is the energy expenditure inside the basin and the larger one may expect to find the drainage density. This analysis shows that the drainage density cannot be analyzed on the basis of climate alone and that it is necessary to take into account the response characteristics of the basin in any spatial or climatic study of drainage densities. It appears that an energy expenditure framework may be a fruitful approach to providing a more concrete and objective understanding of climatic and geographical variation of the drainage densities of river basins. (Baker-FRC)
W82-06199

RELATIONSHIP BETWEEN THE YEARLY MAXIMA OF PEAK AND DAILY DISCHARGE FOR SOME BASINS IN TUSCANY,

Florence Univ. (Italy).
P. Canuti, and U. Moisello.
Hydrological Sciences Bulletin, Vol 27, No 2, p 111-128, June, 1982. 9 Fig, 2 Tab, 47 Ref.

Descriptors: *Basins, *Flood discharge, Discharge measurement, *Tuscany, Hydrology, Hydrologic models.

This paper deals with the estimation of the probability distribution of the yearly maximum of the peak discharge Q by means of the distribution of the maximum of the daily discharge q and the distribution of the ration R=Q/q. Data for the study related to a group of basins in Tuscany. It was found that the parameters of R can be expressed as a function of basin order, mean altitude, basin magnitude, basin relief, circularity ration and channel slope. In the case where basin order and magnitude, which are difficult to determine, should not be taken into account, the parameters of R can be expressed as a function of mean altitude, relief ratio, circularity ratio, length and basin relief. It is possible also to obtain satisfactory results by assigning constant values, equal to the mean values observed for the basins taken into consideration, to the parameters of R. Basin area did not appear to be one of the most strongly determining geomorphic parameters. However, the distribution of R is affected by the basin size through such parameters as basin magnitude or basin length. The parameters characterizing the distribution of Q can then be worked out as a function of the parameters of q and the parameters of R. Discharge values with pre-set return period obtained in this way show a satisfactory agreement with the values directly derived from a statistical analysis of the observed values; the errors are on the order of 20%. (Baker-FRC)
W82-06200

ROBUST FLOOD FREQUENCY MODELS,

Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
G. Kuczera.
Water Resources Research, Vol 18, No 2, p 315-324, April, 1982. 1 Fig, 11 Tab, 28 Ref.

Descriptors: *Floods, *Flood frequency, *Mathematical models, *Simulation, *Estimation, Flood data, Statistical analysis, Probability distribution, Field investigations, Historical flood data.

The concept of a robust model is explored and possible robust flood frequency models are identified. A robust model is one which can produce reliable predictions. Such models possess at least two properties, resistance and efficiency. Resistance is the ability to estimate extreme events; it is desirable in situations where assumptions of the model are uncertain. In flood frequency models the normal distribution produces more resistant estimators than do other distributions. Efficiency refers to sampling variation. Efficiency can be improved by reformulating the model problem or by extending the data base; it is often improved by combining regional and site-specific data. Various simulation studies using Wakeby distributions were conducted. The resistances of various regional and site-specific estimators were examined. Results suggest that the two-parameter log normal distribution approximates the Wakeby distribution for return periods up to about 200 years; it is both most resistant and efficient. The gumbel procedures employing either maximum likelihood or probability-weighted moments displayed comparable resistance. It was observed that site-specific estimators become more preferable as site record length increases. (Titus-FRC)
W82-06319

STOCHASTIC TRIGGER MODEL FOR FLOOD PEAKS 1. DEVELOPMENT OF THE MODEL,

Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas.
Water Resources Research, Vol 18, No 2, p 383-398, April, 1982. 4 Fig, 25 Ref. OWRT B-112-IND.

Descriptors: *Flood peak, *Flooding, *Statistical analysis, *Mathematical models, *Seasonal variation, Discharge, Model studies, Rivers, Flood recurrence interval, Flood frequency, Estimating equations, Poisson ratio, Turkey.

The flood peak occurrences at a river cross section may be treated as a two-dimensional stochastic counting process in the time-discharge plane. Statistical and conceptual analyses were performed on the flood peaks data of the Karahacili station on the Goksu River in Turkey. A two-dimensional nonhomogeneous stochastic trigger model for the flood peaks is developed in terms of its univariate, bivariate, and multivariate probability generating functions. The first and second theoretical moments and the theoretical one- and two-dimensional probability mass functions of the flood peak counts in the time-discharge plane are derived from the probability generating functons. First, the flood trigger mechanism is modeled as a Poisson process, based on the assumption that flood peaks in non-overlapping time intervals are independent events. Then, flood peaks are modeled as a function of time, starting time, and discharge. Trigger models are appealing because they require minimal computation. (Titus-FRC)
W82-06325

STOCHASTIC TRIGGER MODEL FOR FLOOD PEAKS 2. APPLICATION OF THE MODEL TO THE FLOOD PEAKS OF GOKSU-KARAHACILI,

Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas.
Water Resources Research, Vol 18, No 2, p 399-411, April, 1982. 3 Tab, 9 Fig, 4 Ref. OWRT B-112-IND.

Descriptors: *Flooding, *Flood peak, *Statistical analysis, *Mathematical models, Discharge, Seasonal variation, Model studies, Rivers, Flood recurrence interval, Flood frequency, Estimating equations, *Xurkey, Goksu River, *Stochastic process.

The stochsatic trigger process is applied to the flood peaks data of the Karahacili gaging station on the Goksu River, Turkey, for several flood seasons. The flood peak process in each flood season is treated as a transient stochastic process which starts at the beginning of the season and ends at the end of the season. In the selection of the time boundaries of the flood seasons the basic criterion is that the stochastic structure of the flood peaks must be roughtly time-homogeneous within a flood season. Also, for statistical computation convenience the time sampling interval is 15 days, so the length of seasons should be a multiple of 15 days. For each season, the thoeretical two-cimensional probability mass function of the variable discharge exceedence level is calculated from the calibrated trigger model. Goodness of fit of the model is tested with the chi square criterion. In all of the seasons examined, the model passed the goodness of fit test at the 5 per cent significance level. This corresponds to a river stage that is 1 meter above the river bank stage on the Goksu. (Titus-FRC)
W82-06326

DISPERSION IN MOUNTAINOUS NATURAL STREAMS,

Sarajevo Univ. (Yugoslavia). Inst. of Water Resources Engineering.
H. Bajraktarevic-Dobran.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 502-514, June, 1982. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Streamflow, *Mountains, Model studies, Mathematical equations, *Turbulent flow, *Path of pollutants, Water pollution sources, *Dispersion.

The mixing of pollutant conservatives in natural, open turbulent mountainous streams was investigated. Considerable turbulency, with relatively limited width and corresponding spatial velocity distribution, make mountainous streams very suitable for the application of the longitudinal turbulent dispersion theory. Tracer study data are used to analyze a simple, relatively accurate and inexpensive method for the calculation of the longitudinal dispersion coefficient in natural open mountainous streams, based on the commonly observed flow parameters. Based on this study it appears that the most convenient methods today for calculating dispersion coefficients in natural and even nonuniform streams are Fischer's methods; the method of flow parameters and methods based on tracer study, the routing procedure, and the method of variance change. Fischer's method of flow parameters applied to mountainous streams gives dispersion coefficients with predicted accuracy within a factor of 4. It has been discovered that Fischer's other two methods, routing procedure and variance change, when used for mountainous streams also yield the predicted accuracy. Calculating the adjusted time scale by a new expression for characteristic length was seen to be convenient and to yield good results for winding and nonuniform streams, which is convenient for natural mountainous streams as well. If there are a number of mainstreams in a cross section, this should be considered when establishing a time scale. (Baker-FRC)
W82-06357

GEOMORPHIC PARAMETERS OF REPRESENTATIVE BASINS AND THEIR HYDROLOGIC SIGNIFICANCE,

New South Wales Univ., Kensington (Australia). School of Geography.
For primary bibliographic entry see Field 2A.
W82-06384

DIGITIZING AND ROUTINE ANALYSES OF HYDROLOGICAL DATA,

Natal Univ., Pietermaritzburg (South Africa).
R. E. Schulze, and H. Arnold.
Report, 1980. 137 p, 3 Fig, 9 Tab, 23 Ref, 5 Append.

Descriptors: *Streamflow, *Computer programs, *Rainfall-runoff relationships, *Hydrologic data collections, *Digital computers, Rainfall intensity, Runoff, Flow rates, Flow measurement, Flow discharge, Flow, Precipitation intensity, Rainfall index, Data collections, Data interpretation, Hydrologic data, Computer models.

Procedures are described for the reduction of data contained on rainfall and streamflow recorder charts, and subsequent routine rainfall/streamflow data analyses. Flow charts and the computer program listings concerning data analyses are present-

ed. Rainfall records reduced by the break-point digitizing procedure are processed in monthly data batches by the program RAINX which outputs one or more of six options (a master file; daily, hourly, and quarter-hourly rainfall summaries; the 24-hour rainfall distributiion; and extreme rainfall intensities). The six options are described, followed by a review of the RAINX program structure as an introduction to the detailed flow charts and program listings of RAINX and its subroutines. Streamflow records digitized by the break-point procedure are processed by the program RUNOF which out-puts one or more of three options (a master file; storm hydrograph data; and a daily summary of streamflow variables). As with RAINX, the output options and a review of the RUNOF program structure, flow charts, program listings and subroutines are described. The digitizing programs, CDPROC, is also delineated, along with its program listing. While the three computer programs are already versatile in their present forms, their refinements based on experience and specific applications are an ongoing process. (Zielinski-MAXIMA)
W82-06386

LOWER FLOW REGIME BEDFORMS: RATIONAL CLASSIFICATION,

London Coll. (New Zealand). Dept. of Agricultural Engineering.
T. R. H. Davies.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 343-360, March, 1982. 6 Fig, 42 Ref.

Descriptors: *Classification, *Flow channels, *Streambeds, Alluvial channels, Physical properties, Sedimentation, Erosion, Streamflow, Low flow, Bedforms, Dunes, Ripple marks, Sedimentary structures.

There is at present no generally accepted explanation for the occurrence and behavior of lower flow regime bedforms, in spite of the many field, laboratory, and theoretical investigations addressing this problem. This lack of understanding of bedform processes presents a major obstacle to the development of rational solutions for sediment problems. The use of systems of bedform classification which are qualitative in nature has thwarted efforts to test quantitative theories of bedform behavior. A more quantitative basis for the description of bedforms, which is based on consideration of the effect of water flow on the shape and size of bedforms, is suggested. This classification system identifies three orders of bedform size (Small, medium, and large) and three bedform shapes (Sharp-crested, flat-crested, and flat), which give rise to seven possible types of bedform. The predictions of this analysis were found to be in agreement with data from a variety of sources relating bedform characteristics to mean flow depth and velocity. This classification system appears to provide a consistent framework by means of which bedforms in widely different circumstances can be interrelated. The system also suggests logical explanations for several previously puzzling aspects of bedform behavior, such as ripples on dunes. Further research is needed to develop more precise divisions among the seven forms and to test critically, and perhaps modify, previously developed models of bedform behavior. (Carroll-FRC)
W82-06421

ACCURACY CRITERIA IN DIFFUSION ROUTING,

San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W82-06423

STOCHASTIC GENERATION OF MONTHLY STREAMFLOWS,

Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06427

CARRYING CAPACITY OF FLOOD PLAINS,

Illinois State Water Survey Div., Champaign.
N. G. Bhowmik, and M. Demissie.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 443-452, March, 1982. 6 Fig, 21 Ref.

Descriptors: *Flood plains, *Carrying capacity, *Flow channels, Flood flows, Streamflow, Flood discharge, Flood frequency.

Field measurements during floods in several natural channels were analyzed to determine the distribution of flow in the main channel and in the flood plains. The carrying capacity of the flood plains was found to vary from a few percent to more than 80% of the total flow for the floods analyzed. Major factors determining the carrying capacity of the flood plains were the size, shape or form, width, depth, and nature of the flood plains and the main stream and the frequency of the flood event. The carrying capacity of the flood plain was found to increase with increases in the return period of the flood event. The flood plains act as a combination of conveyance channel and storage reservoir during low flood events. However, the flood plain and the main channel appear to behave as a single unit carrying a proportionate share of the discharge during flood events with return periods of 40 years or more. The character of the flood plains appears to change from a storage channel to a conveyance channel as flood events increase in magnitude. (Carroll-FRC)
W82-06428

THE 1980-1981 DROUGHT IN ILLINOIS: CAUSES, DIMENSIONS, AND IMPACTS,

Illinois State Water Survey Div., Champaign.
S. A. Changnon, Jr., G. L. Achtemeier, S. D. Hilberg, H. V. Knapp, and R. D. Olson.
Illinois Department of Energy and Natural Resources, Report of Investigation No 102, 1982. 13 p, 39 Fig, 28 Tab, 46 Ref.

Descriptors: *Drought, *Water shortage, *Climatology, *Water levels, *Hydrology, Climactic data, Water costs, Evapotranspiration, Weather, Groundwater, Precipitation, Streamflow, Water supply development, Water supply systems, Weather data collections, Planning.

This report focuses on the hydrlogic, meteorologic, and climatological aspects of the 1980-1981 drought. An important goal of the study was to provide information necessary for future institutional planning and actions to handle future Illinois droughts. This drought, the severest since the early 1950s, was most intense in the southwestern and extreme southern sections of Illinois. These areas had the lowest precipitation, highest temperatures, and greatest departures from normal wind speeds, which produced the state's greatest evaporation and transportation values and subsequent low streamflows and groundwater deficiencies. Five general societal and economic impacts were revealed: 1) increased costs of water and water-related activities, decreased crop yields and land values, and increased costs to ship farm products; 2) increased energy consumption and adverse effects on the area's natural resources; 3) effects on human behavior, i.e., anxiety about finding and conserving water, and a reduction in recreational activities; 4) additional direct and indirect costs to government; and 5) some benefits, i.e., improved and/or larger and better water supply systems. This research has lead to four general recommendations. The first is to develop better informed and organized local and state programs for addressing droughts. The second recommendation is to renovate older water supply systems. The third relates to water conservation, water reuse, and higher water prices. The last recommendation is to develop and use new technologies to help increase water supplies and to aid in better water management. (Atkins-Omniplan)
W82-06523

A PRACTICAL METHOD OF ESTIMATING PEAK FROM MEAN DAILY FLOWS WITH APPLICATION TO STREAMS IN ONTARIO,

Inland Waters Directorate, Environment Canada, Ottawa, Ontario.
B. P. Sangal.
National Hydrology Research Institute, NHRI Paper No 16, IWD Technical Bulletin No 122, 1981. 242 p, 6 Fig, 7 Tab, 5 Ref.

Descriptors: *Mean daily flows, *Peak flow, *Flow rates, *Fuller's method, *Langbein's method, *Ontario, Streamflow foredasting, Hydrographs, *Data collections, Statistical Analysis.

A practical method has been suggested for estimating peak flow. The method uses variables that are the mean daily flows of three consecutive days, with the maximum mean daily flow occupying the middle position. A parameter, the value of which lies etween zero and two, is designated as base factor K and has a governing influence on the estimated peak. The predicting formula employed assumes that the K value is equal to one. The method has been applied to streams in Ontario, involving a total of 387 stations equipped with recording gauges, the drainage areas of which vary from less than 1 sq km to more than 100 000 sq km. The number of instantaneous peak data available was 3946 in the period of record ending in 1979. About 57% of the predicted peaks lie within plus or minus 10% and about 79%, within plus or minus 20% of the actual values. About 62% of the peaks have been overpredicted. The parameter K must be estimated for rainfall floods occurring on small streams; its value will generally be less than one for such cases. Some methods are suggested for its estimation. (WATDOC)
W82-06568

BIOGEOCHEMISTRY OF MOUNTAIN STREAM WATERS: THE MARMOT SYSTEM,

Calgary Univ., (Alberta) Kananaskis Centre for Environmental Research.
For primary bibliographic entry see Field 5B.
W82-06569

CALIBRATING A MOUNTAIN WATERSHED IN WYOMING,

Wisconsin Univ., Stevens Point. Coll. of Natural Resources.
N. E. Spangenberg.
Water Resources Bulletin, Vol 18, No 1 p 133-134, February, 1982. 2 Tab, 5 Ref.

Descriptors: *Calibrations, *Watersheds, *Mountains, Regression analysis, Mathematical studies, Streamflow, Small watersheds, *Wyoming.

Although all investigators who have studied the problem of watershed calibration agree that a minimum pretreatment period is necessary for reliable analysis, in some cases management plans necessitate the use of very sparse existing data as pretreatment information. The calibration of a mountain watershed in Wyoming under such conditions is reported. Imminent timber harvesting forced calibration on the basis of stream flow records for a 5-year period, precipitation data for 10-year period, and stream flow data for another watershed for a 15-year period. Regression equations were tested using the noncentral 't' and associated power graphs to calculate the probabilities of detecting a real difference of 15% of the mean annual flow given the pre and post treatment time periods likely to be available during management. The data suggest that if the Walnut Gulch trapezoidal flume previously used to measure the basin can be reactivated, and if stream flow measured values after treatment are consistent with values before treatment, it will be possible to detect a 15% difference in flow. The longer the calibration period, the higher the probability of detecting a real difference in flow. (Carroll-FRC)
W82-06583

SUMMARY OF BASIN AND FLOOD CHARACTERISTICS FOR UNREGULATED BASINS IN NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06671

Group 2E—Streamflow and Runoff

AN ASSESSMENT OF STREAMFLOW, WATER QUALITY, AND THE EFFECTS OF CONSTRUCTING AN IMPOUNDMENT ON BRIDGE CREEK AT AUGUSTA, WISCONSIN,

Geological Survey, MS. Water Resources Div.
L. B. House.
Geological Survey Open-File Report 81-1192 (WRI), December 1981. 25 p, 4 Fig, 1 Plate, 10 Tab, 5 Ref.

Descriptors: *Streamflow, *Water quality, *Preimpoundment, *Postimpoundment, Reservoirs, Water temperature, Dissolved oxygen, Model studies, Aquatic weeds, Nuisance algae, Chemical analysis, *Wisconsin, Augusta, Bridge Creek watershed.

This study documents streamflow, temperature, and water-quality conditions of a small stream and evaluates the potential effects of a proposed small shallow impoundment. The study was made in cooperation with the Wisconsin Department of Natural Resources. Streamflow and water-quality data were obtained for the 1980 water years. The average streamflow was 45.5 cubic feet per second. The average summer water temperature was 21.0 C, and the average summer dissolved-oxygen concentration was 7.1 milligrams per liter. Computer models were used to simulate the effects of the proposed impoundment on downstream temperature and dissolved oxygen. The simulated average summer downstream temperature rose to 22.5 with a surface-level outlet from the impoundment, and 21.9 C with a bottom-draw outlet. Dissolved oxygen exceeded 6.0 milligrams per liter in both cases. (USGS)
W82-06677

EFFECTS OF FLOODING UPON WOODY VEGETATION ALONG PARTS OF THE POTOMAC RIVER FLOOD PLAIN,

Geological Survey, Reston, VA. Water Resources Div.
T. M. Yanosky.
Available from Distr. Branch, USGS 604 S. Pickett St. Alexandria, VA 22304 $3.50. Geological Survey Professional Paper 1206, 1982. 21 p, 18 Fig, 7 Tab, 27 Ref.

Descriptors: *Flood plains, *Flood damage, *Vegetation regrowth, *Revegetation, Floods, Flooding, Historic floods, Channel flow, Flood peak, Flood frequency, Flood recurrence interval, *Potomac river, Washington DC, Hurricane Agnes.

A two-part study along the Potomac River flood plain near Washington, D.C., was undertaken to investigate the effects of flooding upon woody vegetation. Floods abrade bark, damage branches and canopies, and often uproot trees. The first study was of vegetation in five monumented flood-plain plots which differed in the frequency and severity of floodflow over a 10-year period. Basal area and survival of trees appears to be related to velocity of floodflow, which in turn is related to flood magnitude and channel shape. However, the effects of flooding also depend on the nature of the flood-plain surface and size and growth habit of vegetation. In the second study, a catastrophic flood after Hurricane Agnes in June 1972 was found to cause large-scale changes in the age, form, and species composition of flood-plain forest below Great Falls, Va. The impact of the flood depended primarily on the flow regime of the river; destruction was greatest in areas exposed to the maximum flood foce, and minimal at sheltered locations. Age determinations from dead trunks and surviving trees suggest that most trees in severely damaged areas started to grow since the last great flood, which occurred in 1952. Trees along sheltered reaches survived several previous catastrophic floods. In addition, species varied in ability to withstand damage from the Hurricane Agnes flood. Least likely to recover were species growing on infrequently flooded surfaces, which may explain, in part, their absence at lower flood-plain elevations. (USGS)
W82-06683

QUALITATIVE STABILITY ANALYSIS OF GEOLOGIC SYSTEMS, WITH AN EXAMPLE FROM RIVER HYDRAULIC GEOMETRY,

Pennsylvania State Univ., University Park. Dept. of Geosciences.
R. Slingerland.
Geology, Vol 9, No 10, 1981, p 491-493. 1 Fig, 9 Ref.

Descriptors: *Mathematical studies, *Hydraulic geometry, *Friction, *Systems analysis, Roughness coefficient, Equilibrium, Stability analysis, Velocity, Bedload, Bedload discharge.

An example of how stability analysis can be used to analyze partially specified geologic systems is presented. A partially specified system is one in which the direction of feedback is known, but the exact functional relationships are not. The example presented is an analysis of the response of a stream's hydraulic geometry to disturbance. Five variables with various positive and negative feedback loops specify the system. The variables include stream velocity, friction, hydraulic radius, bedload transport rate, and bed slope. The system's response to perturbation is described by analyzing the eigenvalues derived from the coefficient matrix of the system equations evaluated near an equilibrium point. When applied to the example, this process predicts that the stream is metastable provided that the rates of change of the friction factor, hydraulic radius, and slope are highest, intermediate, and lowest, respectively. Streams violating this ranking are unstable. (Titus-FRC)
W82-06717

MICROBIAL DYNAMICS OF AN EPILITHIC MAT COMMUNITY IN A HIGH ALPINE STREAM,

Montana State Univ., Bozeman. Dept. of Microbiology.
T. K. Haack, and G. A. McFeters.
Applied and Environmental Microbiology, Vol 43, No 3, p 702-707, March, 1982. 4 Fig, 1 Tab, 30 Ref.

Descriptors: *Microbiological studies, *Alpine regions, Cold regions, Mountains, Orography, Streams, Bacteria, Algae, Lakes.

The seasonal dynamics of an epilithic algal-bacterial mat community are described, the trophic complexity of which was greatly reduced because of the highly oligotrophic nature of the stream. The study site was the outlet stream of Pine Creek Lake, an alpine cirque lake situated at 2,740 meters in the Absaroka mountains. The lake is fed primarily from springs and snow runoff and is surrounded almost entirely by rock, with little vegetation present in the drainage area. The slippery surface properties of the mat community suggested that extracellular polymeric material was one major component. The mat consisted primarily of diatoms, bacteria, and some filamentous algal forms, all embedded with a dense gelatinous matrix. Water temperature rose from 1.5 to 13 degrees C during the study period. Due to the short duration of warm weather, the mat was active only a few months out of the year. The growth of the phototrophic community peaked at the same time of year as did stream water temperature. All aspects of bacterial heterotrophic activity showed dramatic increases with seasonal progression, indicating maximal uptake rate of a given substrate by the population. The heterotrophic bacterial population in the mat responded to a decline in the phototrophic community with higher catabolic rates. These rates may have increased in response to quantitative or compositional changes in the soluble organic compounds excreted by the phototrophs as their population was waning. However, bacterial consumption rates were highest when primary productivity was lowest, indicating that bacteria were substrate limited at this time of the season with respect to algal extracellular products. It is likely therefore that the accelerated bacterial catabolic activity was triggered in response to an accumulation of algal lysis products. (Baker-FRC)
W82-06729

SYNTHESIS OF STREAMFLOW INFORMATION RELATING TO THE SEMI-ARID KAROO BIOME OF SOUTH AFRICA,

Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
For primary bibliographic entry see Field 4A.
W82-06835

REAL-TIME, STATISTICALLY LINEARIZED, ADAPTIVE FLOOD ROUTING,

Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 4A.
W82-06855

FLOODFLOW CHARACTERISTICS OF HONCUT CREEK AT STATE HIGHWAY 70 BRIDGES NEAR LIVE OAK, CALIFORNIA,

Geological Survey, Sacramento, Calif. Water Resources Division.
For primary bibliographic entry see Field 4A.
W82-06945

HYDROLOGIC AND MORPHOLOGIC CHANGES IN CHANNELS OF THE PLATTE RIVER BASIN: A HISTORICAL PERSPECTIVE,

Geological Survey, Denver, Colo. Water Resources Division.
T. R. Eschner, R. F. Hadley, and K. D. Crowley.
Open-File Report 81-1125, 1981. 57 p. 14 Fig, 5 Tab, 61 Ref.

Descriptors: *Surface water, *Streamflow, *Alluvial channels, *Channel morphology, Water use, Vegetation effects, Flood peak, Flow characteristics, Flow duration, Low flow, Wildlife habitats, *Colorado, Nebraska, Platte River basin.

The channels of the South Platte River in Colorado and Nebraska and the North Platte and Platte Rivers in Nebraska have undergone major changes in hydrologic regime and morphology since 1860. These changes are attributed to agricultural, municipal, and industrial water use. Diversion and storage of water have changed streamflow patterns throughout the basin. At some stations, significant changes in flood peaks, annual mean discharges, and shapes of flow-duration curves have been observed. Changes in streamflow patterns are manifested by changes in morphology of channels of the Platte River. Prior to water development in the 19th century, the Platte was a wide (2 kilometers), shallow (1.8 to 2.4 meters) river characterized by bankfull spring flows and low summer flows. The width of the Platte River in 1979 ranged from 8 to 92 percent of the channel width in 1860, increasing in a downstream direction. Above the confluence with the Loup River, overbank flows evidently have become more common. Moreover, the annual number of low flow days has increased and the days of no flow have decreased giving the channels a more perennial character. Width reduction has occurred by progressive encroachment of vegetation and consequent vertical and horizontal accretion on sand bars in the channel. (USGS)
W82-06946

FLOOD OF AUGUST 20, 1979, ON A TRIBUTARY OF CHICKAMAUGA CREEK, NEAR GALLIPOLIS, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-06947

HYDRAULIC ANALYSIS, PAINT CREEK AT STATE ROUTE 772, CHILLICOTHE, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
For primary bibliographic entry see Field 8B.
W82-06948

2F. Groundwater

CHARACTERIZATION OF DRAINED AND UNDRAINED RESPONSE OF THERMALLY LOADED REPOSITORY ROCKS,

Illinois Univ. at Urbana-Champaign. Dept. of Geology.
V. V. Palciauskas, and P. A. Domenico.

Water Resources Research, Vol 18, No 2, p 281-290, April, 1982. 5 Tab, 22 Ref.

Descriptors: *Rock mechanics, *Radioactive waste disposal, *Groundwater management, *Thermal pollutiion, *Geologic fractures, Waste management, Resources management, Rock properties, Fluid mechanics, Radioactive wastes, Thermal conductivity, Heat transfer, Thermal expansion.

The fluid pressure and mechanical response of a potential nuclear waste repository rock to heating was characterized by isothermal parameters of the classic stress-strain theory for a porous medium plus some nonisothermal parameters describing the fluid, solid, and pore volume expansivities. By formulating the fluid response within the limits of drained and undrained behavior, the isothermal coefficients may be described in terms of more easily interpretable parameters. The ideal repository for nuclear wastes would appear to favor an undrained response within the isolated pores and cracks of a fracture rock medium. Cases of fluid pressure increases in excess of temperature-induced increases under in situ stress, elastic strain and the potential for inelastic crack propagation, and porosity-permeability augmentation are presented. These examples illustrate an irreversible effect of temperature due to the differential thermal expansion of the composite mineral grains and the generation of new grain boundaries. During such a heating event, the increase in porosity may be calculated and is empirically related to increases in permeability. (Geiger-FRC)
W82-05904

INFILTRATION RATES OF RAINWATERS IN SRI LANKA MEASURED BY USING TRITIUM TRACER,

Sri Lanka Univ., Colombo.
J. K. Dharmasiri, K. G. Dharmawardena, M. W. P. Wijesinghe, P. Thiranagama, and I. D. T. De Mel.
Nordic Hydrology, Vol 13, No 1, p 13-27, 1982. 10 Fig, 3 Tab, 11 Ref.

Descriptors: *Radioactive tracers, *Tritium, *Natural recharge, *Rainfall infiltration, *Rainfall-runoff relationships. Tracers, Radioisotopes, Recharge, Infiltration rate, Groundwater recharge, Soil water, Moisture profiles, Geohydrology, Groundwater hydrology, *Sri Lanka.

Some experiments were conducted on top soil of Sri Lanka to study the infiltration rates of rainfall using artificial tritium as a tracer. For two well-established aquifers, Mannar and Vanathavillu, the recharge of groundwater is close to 30%, while the inflitration rate is much higher. Fractional recharge values at Madhu Road sites vary from 15 to 32%. Moisture movement in this area resembles piston flow. In the central highland sections which are covered with fractured rocks overlain by only a few meters of top soil, the rate of infiltration is very high. (Geiger-FRC)
W82-05941

A NUMERICAL MODEL OF AQUIFER TESTS IN MULTI-LAYERED AQUIFER/AQUITARD SYSTEMS,

Komenskeho Univ., Bratislava (Czechoslovakia).
I. Mucha, and H. Kaergaard.
Nordic Hydrology, Vol 13, No 1, p 27-38, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Mathematical models, *Aquifer systems, *Aquifer testing, *Leaky aquifers, *Aquitards, *Drawdown, *Pumping, Model studies, Numerical analysis, Mathematical studies, Confined aquifers, Groundwater movement, Pump wells, Test wells, Aquicludes.

A numerical model was devised for computing drawdowns (resulting from pumping a single well) anywhere in a multiaquifer/aquitard system. Since the model cannot handle inhomogeneities in horizontal directions, it is of a radial, symmetric type. The model has proven useful in studying drawdown evolutions during aquifer tests in stratified geohydrologic systems. It was designed to compute the effects of stratification on the results of pumping tests. In order to understand the behavior of the model, drawdowns in a hypothetical system were computed and compared with standard aquifer test formulas. Application of the model in interpreting two previously reported aquifer tests for Horsens Municipal Water Supply and the Torkildstrup-Lillebraende Waterworks of Denmark showed good agreement of simulated and field results. The model has been especially helpful in revealing the limitations involved with using standard aquifer test formulas in such systems. (Geiger-FRC)
W82-05943

THE CHEMISTRY AND ISOTOPIC COMPOSITION OF SALINE GROUNDWATERS FROM THE SUDBURY BASIN, ONTARIO,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. K. Frape, and P. Fritz.
Canadian Journal of Earth Sciences, Vol 19, No 4, p 645-661, April, 1982. 8 Fig, 4 Tab, 44 Ref.

Descriptors: *Groundwater, *Chemical analysis, Sudbury Basin, Dating, *Ontario, Canada, Water analysis, Calcium, Sulfates, Sodium, Chlorides, Meteoric water.

A detailed survey was undertaken in 1979-1980 to evaluate the occurrence, chemistry, origin, and genesis of saline groundwaters across the Canadian Shield, with early work focusing on the chemical and isotopic compositions of deep groundwaters from the Sudbury Basin. The Basin is a elliptical body about 60 km long and 30 km across with an east-northeast trending long axis. Several large faults, which extend to considerable depth, intersect many of the rock units along the north edge of the basin. It appears that the faults and dikes, particularly on the north side of the basin, play a major role in the transport and storage of groundwaters at depth. Groundwater samples were obtained from Falconbridge's Fraser, North, and Lockerby mines and INCO's Copper Cliff South and Garson mines. Two very distinctive groundwater types were found. Above 914 meters the waters are of meteoric origin, showing a gradual increase in dissolved load with depth, and seldom exceeded 5000 mg/liter salt concentration. With increasing depth these waters usually showed considerable increase in sodium, calcium, chloride and sulfate, while decreasing in concentrations of magnesium, potassium, and carbonate. The water with a meteoric origin has a considerable volume less than 30 years in age. Highly saline waters and brines were encountered below 914 meters. The brines appear to represent very old, stagnant groundwaters which may have undergone prolonged chemical and isotopic alteration since their original emplacement. (Baker-FRC)
W82-05990

DEVELOPMENT OF PREDICTION EQUATIONS FOR A PHREATIC AQUIFER IN RESPONSE TO INFILTRATION: DIMENSIONAL ANALYSIS,

Mississippi Univ., Oxford. Dept. of Civil Engineering.
S.-Y. Liong, and D. G. DeCoursey.
Water Resources Bulletin, Vol 18, No 2, p 307-310, April, 1982. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Aquifers, *Infiltration, *Dimensional analysis, Subsurface flow, Phreatic aquifers, Streamflow, Prediction, Unconfined aquifers, Groundwater movement.

Dimensional analysis was used to study the response of a phreatic aquifer to infiltration. Relationships between dependent and independent variables were developed in this preliminary work, which provided an understanding of the dependence of subsurface contributions to streamflow on the dimensions of the flow domain, soil properties, infiltration rate and duration, and the initial hydraulic gradient of the water table. This information will be used to develop prediction equations. (Cassar-FRC)
W82-06066

HELIUM ISOTOPES IN GEOTHERMAL SYSTEMS: ICELAND, THE GEYSERS, RAFT RIVER AND STEAMBOAT SPRINGS,

Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, and W. J. Jenkins.
Geochimica et Cosmochimica Acta, Vol 46, No 5, p 739-748, May, 1982. 1 Fig, 6 Tab, 58 Ref.

Descriptors: Geothermal resources, *Helium, Isotope, *Iceland, Groundwater, *Geothermal studies, *Hawaii, *The Geysers, *Raft River, *Steamboat springs, Volcanoes, Volcanic springs.

Helium isotope ratios can be used to evaluate a variety of geologic and hydrologic problems. The helium isotope composition of geothermal fluids is used to evaluate the local tectonic environment in the light of possible overprint mechanisms and to infer a probable source for the thermal anomaly. Geothermal fluids studied were from Iceland, The Geysers, Raft River, Steamboat Springs, and Hawaii. The helium isotope ratios were interpreted in terms of the processes which supply helium in distinct isotopic ratios and in terms of processes which can change the isotopic ratio. Iceland was found to be an area of hot spot magmatic helium, implying an active volcanic source, although data are suggestive of high temperature weathering release of crustal helium incorporated in the geothermal fluids. According to a comparison with fumarolic gases from Hawaii and Juan De Fuca and Cayman Trench Basaltic glass samples, The Geysers contains mid-ocean ridge type magmatic helium, again implying an active volcanic source, possibly a leaky transform related to the San Andreas Fault System. Raft River contains only crustal helium, indicating no active volcanic sources. Steamboat Springs helium isotope ratios are distinctly less than typical plate margin volcanics but must still have a magmatic source. A preliminary assessment of the cause for this low ratio is made, assuming an aging magma source. (Baker-FRC)
W82-06085

HYDROGEOLOGIC DATA FROM SELECTED WELLS AND TEST HOLES IN SUFFOLK COUNTY, LONG ISLAND, NEW YORK, 1972-80,

Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06131

POTENTIOMETRIC MAP OF THE SPARTA AQUIFER SYSTEM IN MISSISSIPPI, FALL 1980,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06135

WATER-LEVEL MAP OF THE MISSISSIPPI DELTA ALLUVIUM IN NORTHWESTERN MISSISSIPPI, APRIL 1981,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06138

GROUND-WATER HYDROLOGY OF STRIP-MINE AREAS IN EASTERN OHIO (CONDITIONS DURING MINING OF TWO WATERSHEDS IN COSHOCTON AND MUSKINGUM COUNTIES),

Geological Survey, Columbus, OH. Water Resources Div.
J. O. Helgesen, and A. C. Razem.
Geological Survey Open-File Report 81-913 (WRI), 1981. 25 p, 14 Fig, 2 Tab, 3 Ref.

Descriptors: *Groundwater, *Strip mines, *Small watersheds, *Coal mining, Spoil banks, Aquifers, Groundwater movement, Sedimentary rocks, Perched water, Observation wells, Water level, Base flow, Model studies, Water quality, Chemical analysis, Data collections, Hydrographs, *Ohio, Coshocton County, Muskingum County.

Ground-water conditions during coal strip-mining in two small watersheds are described as part of an ongoing study of effects of mining on hydrologic systems. Each watershed was underlain by stratified sedimentary rocks containing two perched aquifers above clays which underlaid the major coal seams. Mining involved removing the overburden rocks, including the top aquifer, stripping the top coal seam, and recontouring the overburden spoils to the approximate premining shape of the watershed. Water-levels in the top aquifer declined as mining neared the watersheds, but destruction of observation wells precluded a record of the decline during mining of the watersheds. Depletion of the top aquifer was reflected in stream base flow, which was reduced and more highly mineralized after mining. Initial saturated thickness of replaced overburden spoils ranged from 0 to 4 feet, based on data from observation wells installed immediately after reclamation. Down-hole specific conductance measurements of water in the spoils suggest the presence of more highly mineralized water than that in the premining top aquifer. No immediate significant effects of mining are evident on groundwater levels or quality beneath the stripped coal. (USGS)
W82-06141

CHLORIDE ION CONCENTRATIONS AS AN AID TO ESTIMATING RECHARGE TO THE WOBURN,

National College of Agricultural Engineering, Silsoe (England).
W. M. Irving.
Quarterly Journal of Engineering Geology, Vol 15, No 1, p 47-54, 1982. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Natural recharge, *Groundwater recharge, *Clays, Mathematical studies, *Chlorine, *Groundwater hydrology, Recharge, Drawdown, *Chlorides, Saline water, Evapotranspiration, Geohydrology, Groundwater movement, Surface runoff, *England, Woburn Sands.

The principal representative of the Lower Greensand on the north side of the London basin is the Woburn Sands, which outcrop in Bedfordshire and Cambridgeshire. Where the outcrop is covered with till, recharge waters contain higher levels of chloride than waters recharged in drift-free areas. This was attributed to higher evapotranspiration rates where the soil is underlain by boulder clay. Localized increases in chloride concentrations ere also noted due to indirect recharge from influent streams and mizing with old saline waters. The average annual natural direct recharge for untilled areas agreed closely with published figures determined by Penman and Grindley's equations. These equations may be used to calculate approximate values for recharge through boulder clay when losses to surface water as runoff and inteflow are taken into account. The amount of indirect recharge from influent streams is also calculated. (Geiger-FRC)
W82-06234

STEADY STATE PERCHED GROUNDWATER MOUNDS ON THICK SUBLAYERS,

California State Univ., Fullerton. Dept. of Civil Engineering.
R. R. Brock.
Water Resources Research, Vol 18, No 2, p 376-382, April, 1982. 2 Tab, 6 Fig, 5 Ref.

Descriptors: *Groundwater, *Permeability, *Perched groundwater, *Aquifers, *Mathematical models, Darcy's law, Profiles, Water table profiles, Recharge basins, Estimating equations, Statistical analysis, Model studies, Groundwater recharge.

Perched groundwater mounds that develop beneath a strip recharge basin are considered using the potential theory for a saturated flow. The mounds are assumed to develop upon an aquitard or sublayer whose thickness is large enough so that the vertical velocity at the base of the mound does not vary with distance from the centerline of the basin. A finite difference technique was used to solve the potential theory, and 20 mound profiles were determined for various permeability ratios and recharge rates. It is found that for a sufficiently large value of the permeability ratio, the Dupuit-Forchheimer theory will accurately predict mound thickness. For smaller values, the equipotential theory must be used. (Titus-FRC)
W82-06317

EVALUATION OF THE GROUNDWATER RESOURCES OF THE AGAG BASIN, SAIPAN,

Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
J. F. Ayers.
Technical Report No 31, November 1981. 82 p, 12 Fig, 6 Tab, 20 Ref, 2 Append. S 80-161.

Descriptors: *Groundwater availability, *Groundwater basins, *Groundwater depletion, *Recharge, *Water management, Pumping tests, Permeability, Water level, Water table fluctuation, Water table profiles, Aquifers, Driling samples, Driller logs, Head loss, Monitoring, Water deficit.

The Agag groundwater basin has long been a reliable source of high-quality water. Because little was known about the basin, this study was undertaken to investigate the hydrogeological characteristics of the basin to determine the optimal or sustained yield of the aquifer. Exploratory drilling, water-level monitoring, and analyses of past and current field data were employed. The basin is a three-dimensional mosaic of interbedded and interfingered units of the Tagpochau limestone of Miocene age. Pump-test analyses put the permeability range of the marly facies between 25-70 ft/day. A strong correlation was found between water-table fluctuations and seasonal rainfall, with a ten foot variance between wet and dry seasons not unusual. Water-table data plotted against time (since 1973) indicate a decline of 1.25 ft/yr with the overdraft occurring in the dry season. Annual recharge is about 40-to-46 percent of the yearly rainfall and occurs during wet-season months; none occurs in the dry months. Because recharge is seasonal, two values of sustained yield have been determined: 300,000 gpd in the dry season (January-June) and 600,000 gpd in the wet season. Proper management of the basin requires a stable water-table level so that wet-season recharge will replenish the stored groundwater removed during the dry-season production period. Recommendations include moving one well to overcome interference from other wells, continuation of water-level monitoring, installing piezometers in all production wells, and implementing a two-season pumping schedule. (Atkins-Omniplan)
W82-06524

CALCULATIONS OF THE CAPACITY OF WATER INTAKES WITH CONSIDERATION OF GROUNDWATER LEAKAGE THROUGH STEEPLY DIPPING, POORLY PERMEABLE DEPOSITS,

Moscow Combined Geological and Geophysical Expedition (USSR).
A. M. Prosekov.
Water Resources, Vol 8, No 3, p 336-340, May/June, 1981. 2 Fig, 3 Ref. Translated from Vodnye Resursy, No 3, p 176-181, May/June, 1981.

Descriptors: *Well yield, *Seepage, *Groundwater availability, *Artesian capacity, Geohydrology, Aquifer systems, Capacity, Permeability, Model studies, Numerical analysis, Oka-Tsna arch, Groundwater potential, Mathematical models, Hydrodynamics, *USSR.

The capacity of groundwater intake, considering leakage of groundwater through steeply dipping, poorly permeable deposits, was calculated for the 200 km long crest part of the Oka-Tsna arch, a submeridional positive tectonic structure in the region of the Moscow artesian basins. A linear row of wells at the foot of the arch along its axis intercepts one aquifer, separated from a second aquifer by a poorly permeable clay layer, but receiving some seepage. The results of the calculations more reliably reflected natural conditions than a model with an impermeable boundary or an inhomogeneous bed. (Cassar-FRC)
W82-06617

LINEAMENTS AND FRACTURE TRACES, JENNINGS COUNTY AND JEFFERSON PROVING GROUND, INDIANA,

Geological Survey, Indianapolis, IN. Water Resources Div.
T. K. Greeman.
Geological Survey Open-File Report 81-1120, December 1981. 17 p, 3 Fig, 1 Plate, 16 Ref.

Descriptors: *Geological fractures, *Groundwater availability, *Water demand, *Aquifer characteristics, Wells, Drilling, Water yeild, Bedrock, Groundwater movement, Potential water supply, Maps, *Indiana, Jennings County, Jefferson Proving Ground, Lineaments, Fracture traces.

Location of vertical or near-vertical bedrock fractures observed throughout the study area in Indiana are shown on a lineament and fracture trace map. Wells drilled on these mapped features may yield adequate supplies for domestic use. Large yields may be available in southwest Jennings County. Two nearly horizontal sequences of middle-Paleozic limestone and dolomite, separated by a thin discontinuous shale unit, constitute the prinicpal aquifer. Many wells in this aquifer fail to supply household needs, whereas others supply several households. All wells in the aquifer have been located for the owners' convenience and are randomly located in relation to lineaments and fracture traces. Pleistocene drift, averaging 25-30 feet in thickness, did not restict lineament nad fracture-trace mapping. Well placement is important in this area, as fractures are a principal source of water to wells. In fractured bedrock areas, the most productive wells are at mapped lineament or fracture-trace intersections and at the lowest local altitude. Use of the lineament and fracture-trace map will not guarantee a sufficient ground-water supply, but it will minimize the chance of drilling an inadequate well. (USGS)
W82-06675

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1980,

Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06676

SUMMARY OF HYDROLOGIC TESTING IN TERTIARY LIMESTONE AQUIFER, TENNECO OFFSHORE EXPLORATORY WELL-ATLANTIC OCS, LEASE-BLOCK 427 (JACKSONVILLE NH 17-5),

Geological Survey, Atlanta, GA. Water Resources Div.
R. H. Johnston, P. W. Bush, R. E. Krause, J. A. Miller, and C. L. Sprinkle.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Water-Supply Paper 2180, 1982. 15 p, 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Groundwater, *Test wells, *Confined aquifers, *Geochemistry, Geohydrology, Geohydrologic units, Limestone, Drilling, Continental shelf, Saline-freshwater interfaces, Data collections, *Atlantic outer-continental shelf, Drill-stem tests.

A summary of hydrologic testing in an offshore oil-test well drilled for Tenneco, Inc. 55 miles east of Fernandina Beach, Fla., is presented. The interval tested (1,050 to 1,070 feet below sea level) is in a calcarenite that is equivalent to the Ocala Limestone (late Eocene) of onshore Florida and South Georgia. Onshore the Ocala forms the highly productive Tertiary limestone aquifer system of the southeastern United States. Pressure-head measurements indicate an equivalent freshwater head of 24 to 29 feet above sea level. This pressure-head measurement and an earlier one made in the nearby JOIDES J-1 hole are the only hydraulic head determinations to date in the offshore extensions of any of the aquifers underlying the Atlantic Coastal Plain. The drill-stem test recovered water samples containing about 7,000 milligrams per liter chloride. However, seawater used in the drilling process apparently contaminated the samples and the

formation water is considered slightly fresher. The head and salinity data from the Tenneco well suggest that the sampled interval lies in the transition zone between fresh and seawater in the limestone aquifer. These data, when viewed with similar data from JOIDES J-1, show the transition zone to the slope very slightly landward. Heads at both wells are compatible with the onshore flow system as it existed prior to development. (USGS)
W82-06685

GROUND WATER IN THE PIEDMONT UPLAND OF CENTRAL MARYLAND,

Geological Survey, Towson, MD. Water Resources Div.
C. A. Richardson.
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, $3.00. Geological Survey Water-Supply Paper 2077, 1982. 42 p, 7 Fig, 7 Tab, 28 Ref.

Descriptors: *Groundwater, *Aquifers, *Groundwater availability, *Geohydrology, Aquifer characteristics, Water table, Wells, Water yield, Water quality, Water use, Water supply, *Maryland, Maryland Piedmont.

Aquifers in a 130-square-mile area of the central Maryland and Piedmont, are shown to be the sole or principal source of water. The study area is underlain chiefly by crystaline rocks and partly by unaltered sandstones and siltstones. The ground water is derived from local precipitation and generally occurs under water-table condtions. Its movement is restricted by the lack of interconnected openings, and most ground water occurs within 300 feet of the land surface. Hydrographs indicate no long-term change in ground-water storage. A few wells yield more than 100 gallons per minute, but about 70 percent of 286 inventoried wells yield 10 gallons per minute or less; most specific capacities are less than 1.0 gallon per minute per foot. The ground-water quality is generally satisfactory without treatment and there are no known widespread pollution problems. Estimated daily figures on ground-water use are as follows: 780,000 gallons for domestic purposes; 55,000 for commercial purposes; and 160,000 for public supply. Although part of the area is served by an existing surface-water supply and could be served by possible extension of those and other public-supply water mains, much of the rural population is dependent on the ground water available from private wells, tapping the single aquifer that underlies any given location. Neither the ground-water conditions nor this dependence on individual wells is unique to the study area, but, rather, applies to the entire Piedmont province. (USGS)
W82-06686

POROUS MEDIA EQUIVALENTS FOR NETWORKS OF DISCONTINUOUS FRACTURES,

California Univ., Berkeley. Lawrence Berkeley Lab.
J. C. S. Long, J. S. Remer, C. R. Wilson, and P. A. Witherspoon.
Water Resources Research, Vol 18, No 3, p 645-658, June, 1982. 12 Fig, 4 Tab, 36 Ref.

Descriptors: *Porous media, *Model studies, Capillary water, Porosity, Soil porosity, Rocks, Rock properties, *Permeability, *Fracture permeability, Groundwater movement, Hydrology.

The theory of flow through fractured rock and homogeneous anisotropic porous media is used to determine when a fractured rock behaves as a continuum. A fractured rock can be said to behave like an equivalent porous medium when there is an insignificant change in the value of the equivalent permeability with a small addition or subtraction to the test volume and when an equivalent permeability tensor exists which predicts the correct flux when the direction of a constant gradient is changed. Field studies of fracture geometry are reviewed, and a realistic two-dimensional fracture system model is developed. The shape, size, orientation, and location of fractures in an impermeable matrix are random variables in the model. These variables are randomly distributed according to field data currently available in the literature. The fracture system models are subjected to simulated flow tests. The results of the flow tests are plotted as permeability ellipses. The size and shape of these permeability ellipses show that fractured rock does not always behave as a homogeneous, anisotropic porous medium with a symmetric permeability tensor. Fracture systems behave more like porous media when fracture density is increased, apertures are constant rather than distributed, orientations are distributed rather than constant, and larger sample sizes are tested. Preliminary results indicate that the use of this new tool will enhance the ability to analyze field data on fractured rock systems. The tool can be used to distinguish between fractured systems which can be treated as porous media and fractured systems which must be treated as a collection of discrete fracture flow paths. (Baker-FRC)
W82-06851

AN UPSTREAM FINITE ELEMENT METHOD FOR SOLUTION OF TRANSIENT TRANSPORT EQUATION IN FRACTURED POROUS MEDIA,

California Univ., Berkeley. Lawrence Berkeley Lab.
J. Noorishad, and M. Mehran.
Water Resources Research, Vol 18, No 3, p 588-596, June, 1982. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Solute transport, *Mathematical studies, *Porosity, *Porous media, Capillary water, *Finite element method, Groundwater, Geologic fractures, *Fractured porous media.

The problem of two-dimensional transient transport of solutes in fractured porous media is considered using an upstream finite element scheme. The processes of advection, dispersion, diffusion, adsorption, and first-order reaction in the fracture and porous matrix are included in the mathematical model. The numerical algorithm first solves the fluid flow problem in the region of interest and then by an auxiliary finite element routine the nodal point velocities of the continuum elements are determined. This procedure ensures continuity of velocity across element boundaries, and also it is required for implementation of upstream weighting functions. Fracture element velocities are average velocities calculated directly from endpoint pressures. Knowing the fluid flow field, the code then solves the transport equation using its own nonsymmetric solver. A unique feature of this study is the representation of discrete fractures by two-nodal point elements. This facilitates the mesh generation and numbering of the elements as well as enhancing the computation efficiency and reducing the required computer storage. The validity of the numerical scheme was established through comparison with existing one- and two-dimensional analytic solutions. (Baker-FRC)
W82-06858

IDENTIFICATION OF AQUIFER TRANSMISSIVITIES: THE COMPARISON MODEL METHOD,

Milan Univ. (Italy). Inst. of Geofisica.
G. Ponzini, and A. Lozej.
Water Resources Research, Vol 18, No 3, p 597-622, June, 1982. 27 Fig, 1 Tab, 17 Ref.

Descriptors: *Model studies, *Aquifer properties, Hydrogeology, *Groundwater, *Transmissivity, Geology, Hydrology, Piezometric head, Mathematical studies, Water resources development, Groundwater management.

A method is presented for solving the inverse problem in hydrogeology. The method is suitable for computing the interblock transmissivities (harmonic mean or others) referred to the sides of the network blocks of a nonhomogeneous, anisotropic aquifer in steady state flow. The interblock transmissivities computing procedure is based on the comparison between real gradients and those generated by a comparison model whose initial transmissivity value is arbitrarily chosen and constant throughout the surveyed area. Alternative solutions of interblock transmissivities, one for each constant initial transmissivity value utilized in the comparison model, are obtained. In general these solutions differ from each other, but all present characteristics of being able to reproduce the real piezometric heads, respecting the geometry and the boundary conditions of the real aquifer. The selection of the value or set of values of the initial transmissivity to put into the permit selection of a value or a set of values of initial transmissivity. These criteria exploit only the data needed for the solution of the inverse problem and lead to a suitable initial transmissivity which allows one to obtain a good and meaningful solution of computed interblock transmissivities. The comparison model method and the two aforementioned criteria have been applied to a numerical case study, giving good results. (Baker-FRC)
W82-06859

A DIMENSIONLESS PARAMETER APPROACH TO THE THERMAL BEHAVIOR OF AN AQUIFER THERMAL ENERGY STORAGE SYSTEM,

California Univ., Berkeley. Lawrence Berkeley Lab.
C. Soughty, G. Hellstrom, and C. F. Tsang.
Water Resurces Research, Vol 18, No 3, p 571-587, June, 1982, 19 Fig, 1 Tab, 26 Ref.

Descriptors: *Aquifers, *Thermal water, Storage, Aquifer properties, *Thermal pollution, Heated water, Plumes, Thermal power, Hydrothermal studies, Heat, Model studies.

Thermal behavior around a storage well is considered in the case when buoyancy effects can be neglected. A dimensionless formulation of the energy transport equations for the aquifer system is presented, and the key dimensionless parameters are discussed. A numerical model using a steady flow field is used to simulate heat transport in the aquifer and confining layers around the injection/production well during the aquifer thermal energy storage (ATES) cycle. The key parameters are varied to understand their influence on the percent of the injected energy that can be recovered and the temperature of the extracted water. The storage volume appeared as a fundamental parameter of the system. The relative heat loss was roughly proportional to the surface to volume ratio. The thermal behavior of the storage system was very sensitive to the value of the effective thermal conductivity in the aquifer. After an initial transient period, the heat loss through the upper surface of the aquifer was determined by the thickness of the cap rock. The cycle is divided into periods of injection, storage, production and rest in accordance with the supply and demand of heat. The relative duration of these periods appears to have a fairly small influence on the recovery factor when the length of the cycle is constant. The recovery factor when the length of the cycle is constant. The recovery factor increased with the number of storage cycles. During each cycle heat was lost to the cold surroundings. The thermal pollution appears to spread out at a rather slow rate when there is no regional flow in the aquifer. The shape of the heated volume should be as compact as possible to minimize the heat loss. (Baker-FRC)
W82-06861

NUMERICAL TREATMENT OF LEAKY AQUIFERS IN THE SHORT TIME RANGE,

Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Investigaciones en Matematicas Aplicadas y en Sistemas.
B. Chen, and I. Herrera.
Water Resources Research, Vol 18, No 3, p 557-562, June, 1982. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Aquifers, *Leakage, Mathematical equations, Model studies, Mathematical models, *Leaky aquifers, Water loss, Permeability.

A procedure is presented which permits the avoidance, to a large extent, of several difficulties in the numerical treatment of leaky aquifers in the short time range. The method is based on the integrodifferential equations approach. A method that can be applied to control the error is also presented. Leaky aquifers are characterized by the fact that the permeabilities of the semipervious layers sepa-

rating the main aquifers are very small. When the difference in permeabilities between the main aquifers and the aquitards is one order of magnitude or more, the flow can be taken as vertical in the aquitards. Attention is restricted to the case of one main aquifer limited above by one aquitard and overlying an impermeable bed. The analysis is applicable, however, to a multiaquifer system in the short time range because in this range the interaction between the main aquifers is not perceptible. Also, if the main aquifer overlies another aquitard, the modification of the arguments is straightforward. (Baker-FRC)
W82-06863

SALTWATER ENCROACHMENT IN AN AQUIFER: A CASE STUDY,
Asian Inst. of Tech., Bangkok (Thailand).
A. D. Gupta, and P. N. D. D. Yapa.
Water Resources Research, Vol 18, No 3, p 546-556, June, 1982, 14 Fig, 18 Ref.

Descriptors: *Aquifers, *Saline water intrusion, Model studies, Encroachment, Saline water, Salinity, Brines, Seawater, *Thailand, Bangkok.

A study was undertaken to provide an insight into the mechanism of saltwater contamination based on the phenomenon of hydrodynamic dispersion. An approach considering both analytical and numerical models for assessing the saltwater encroachment phenomenon in an aquifer was found to be quite efficient in field situations with limited information available on salt concentration and parametric variations. A case study of saltwater encroachment in Bangkok, Thailand was used to illustrate this approach in identifying the sources of contaminating water and in evaluating the effectiveness of the water quality monitoring network. The important point to be noted is the advantage of doing a one-dimensional model analysis and a two-dimensional model analysis simultaneously. By this means computing effort will be minimized, and in addition, a proper assessment for the approximation of the parameters can be made. It was concluded that saltwater encroachment in the Phra Pradaeng aquifer does not occur only from the sea. Connate water bodies entrapped in sediments from the time of deposition under marine coditions are predominant in the contamination of fresh water supplies. These bodies are located to the west and southwest of the Chao Phraya River, where the average initial chloride concentration was about 8000 mg/liter. Either vertical leakage of saltwater from the upper aquifer of brackish water content occurs, or some wells from which wate samples had been collected were improperly grouted. Both conditions may have existed. Attempts will be made in Thailand to simulate salt water movement, along with the simulation of the flow regimes. (Baker-FRC)
W82-06864

GEOPHYSICAL RECONNAISSANCE OF LEMMON VALLEY, WASHOE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
D. H. Schaefer, and D. K. Maurer.
Open-File Report 80-1123 (WRI), 1981. 29 p, 18 Fig, 12 Ref.

Descriptors: *Groundwater, *Geophysis, *Gravity studies, Aluvial deposits, Bedrock, Resistivity, Playas, Water quality, *Nevada, Washoe County, Lemmon Valley, Silver Lake.

Rapid growth in the Lemmon Valley area, Nevada, during recent years has put increasing importance on knowledge of stored ground water for the valley. Data that would fill voids left by previous studies are depth to bedrock and depth to good-quality water beneath the two playas in the valley. Depths to bedrock calculated from a gravity survey in Lemmon Valley indicate that the western part of Lemmon Valley is considerably deeper than the eastern part. Maximum depth in the western part is about 2,600 feet below land surface. This depression approximately underlies the Silver Lake playa. A smaller, shallower depression with a maximum depth of about 1,500 feet below land surface exists about 2.5 miles north of the playa. The eastern area is considerably shallower. The maximum calculated depth to bedrock is about 1,000 feet below land surface, but the depth throughout most the eastern area is only about 400 feet below land surface. An electrical resistivity survey in Lemmon Valley consisting of 10 Schlumberger soundings was conducted around the playas. The maximum depth of poor-quality water (characterized by a resistivity less than 20 ohm-meters) differed considerably from place to place. Maximum depths of poor-quality water beneath the playa east of Stead varied from about 120 feet to almost 570 feet below land surface. At the Silver Lake playa, the maximum depths varied from about 40 feet in the west to 490 feet in the east. (USGS)
W82-06949

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF KINGS AND QUEENS COUNTIES, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4B.
W82-06952

2G. Water In Soils

SOIL MOISTURE FLOW FOR POINT AND LINE SOURCES - COMPUTER PROGRAMS FOR LINEARIZED SOLUTIONS,
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
A. W. Warrick, D. O. Lomen, and P. J. Tonellato.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243528, Price codes: A05 in paper copy, A01 in microfiche. Report, 1981. 78 p, 2 Fig, 6 Tab, 18 Ref, 4 Append. OWRT B-097-ARIZ(1).

Descriptors: *Soil moisture, *Water pollution sources, *Computer programs, *Trickle irrigation, *Numerical analysis, Groundwater runoff, Linear programming, Mathematical studies, Statistical analysis, Algorithms, Experimental design, Water use, Mathematical models, Algorithms, Plant growth, Ecological effects, Simulation analysis, Soil water.

Theory, computer program subroutines, and applications are described which demonstrate ready application of available solutions descriptive of flow from line and point sources. The linearized forms presented are the only analytical (as opposed to numerical) forms currently available, which are relevant to trickle irrigation geometries. The basic approach has been to document ready-to-use FORTRAN programs which can be used, in whole or in part, to give numerical answers. The programs can be directly used without studying their derivations. Applications are illustrated in eight examples appropriate to trickle irrigation, with the data and output presented. The examples range from a steady-state line source, to a cyclical point source with a cylindrical sink to simulate plant water uptake from the soil. Two of the computer programs presented are set up to solve important two- and three-dimensional problems. For cases not covered by these two programs, subroutines are given as a shortcut to compose algorithms needed to compute the solution. Answers are expressed in tabular and plot formats, giving distributions of matric flux potentials and pressure heads. (Zielinski-MAXIMA)
W82-05928

EVALUATING NEAR-SURFACE SOIL MOISTURE USING HEAT CAPACITY MAPPING MISSION DATA,
Texas A and M Univ., College Station. Remote Sensing Center.
For primary bibliographic entry see Field 7B.
W82-05956

A COMPARISON OF THREE INFILTRATION MODELS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
B. N. Wilson, D. C. Slack, and R. A. Young.
Transactions of the ASAE, Vol 25, No 2, p 349-356, March/April, 1982. 3 Fig, 6 Tab, 30 Ref.

Descriptors: *Infiltration, *Surface sealing, *Soil water, Model studies, Green-Ampt-Mein-Larson models, Ponding.

The theoretical development and performance of three infiltration models are compared. The models were an unmodified Green-Ampt-Mein-Larson model (GAML-UNMOD), a similar model modified to account for entrapped air (GAML-ETA), and a model which includes air entrapment and air resistance effects (GAML-ART). The GAML-UNMOD model, conceptually the simplest, did not predict time to surface ponding accurately. The errors were probably a result of unmodified saturated hydraulic conductivity values. The GAML-ETA predicted time to ponding reasonable well but greatly overestimated infiltration on wetter soils. The GAML-ART model produced the best overall results but tended to overestimate on wet soils. This problem with overprediction on wet soils may be a result of partial surface sealing during preceding dry runs. Field data were obtained in Minnesota on four soil types (loam, loamy sand, and two clay loams) using a sprinkling infiltometer. These infiltration models should be used with caution on disturbed watersheds and on soil susceptible to surface sealing. (Cassar-FRC)
W82-05965

FURROW INTAKE RATES AND WATER MANAGEMENT,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W82-05968

FIELD EVALUATION OF FURROW INFILTRATION AND ADVANCE FUNCTIONS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W82-05969

A SALT AND WATER BALANCE MODEL FOR SILT LOAM SOIL CROPPED TO RICE AND SOYBEAN,
Arkansas Univ., Fayetteville. Water Resources Research Center.
J. T. Gilmour, J. A. Ferguson, and B. R. Wells.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254962, Price codes: A04 in paper copy, A01 in microfiche. Publication No 82, December 1981. 57 p, 16 Fig, 5 Tab, 4 Ref, 1 Append. OWRT A-045-ARK(1), 14-34-0001-8004.

Descriptors: *Computer models, *Salt balance, *hydrologic budget, *Rice, *Soybean, *Irrigation practices, Model studies, Mathematical models, Mathematical studies, Computer programs, Irrigation water, Irrigation, Physiographic balance, Physiographic provinces, Soil water, Silt, Loam, Soil types.

A computer model was developed for describing selt and water balances for a silt loam soil common to the Arkansas Grand Praire physiographic region. This model was used to assess ten years (1966-75) of weather data for two divergent cases with respect to salt accumulation: one, a rice-soybean rotation, with soybean irrigated; the other, a rice-soybean-soybean rotation, with soybean not irrigated. The salts considered were: calcium, magnesium, sodium, sulfate, chloride, and the precipitate, calcium carbonate. Without soybean irrigation, less evapotranspiration, greater infiltration, and less runoff were observed during the fallow season than when soybeans were irrigated. Other water balance differences were small. Further, annual salt additions were notably larger when soybeans were irrigated and rice occurred more frequently in the rotation. Most salt additions occurred during the rice season for either case stud-

ied. Accumulation of a given soil salt increased linearly with an increase in irrigation water concentration for that salt, with the rate of increase greatest for sulfate and least for magnesium. The weather data file and the computer program for the model are delineated. (Zielinski-MAXIMA)
W82-06172

SIZE AND SHAPE IN RAISED MIRE ECOSYSTEMS: A GEOPHYSICAL MODEL,

Dundee Univ. (Scotland). Dept. of Biological Sciences.
H. A. P. Ingram.
Nature (London), Vol 297, No 5864, P 300-303, May, 27, 1982. 5 Fig, 1 Tab, 36 Ref.

Descriptors: *Bogs, *Model studies, Waterlogging, Drainage, Wetlands, *Peat bogs, Mathematical studies, Geophysics.

The development of raised mires or raised bogs is marked by the accumulation of peat deposits which, in surface profile, resemble inverted clock glasses. The growth of such a deposit is possible because it remains perennially waterlogged almost to its upper surface. The central parts of the surface may lie at altitudes up to 10 meters above the marginal lagg steams into which the deposit of raised mires is examined. Having identified impeded drainage as the mechanism, implications for the shapes of these ecosystems are then considered. A groundwater mound hypothesis is presented, which appears to have a secure physical foundation and is considered with evidence from various sources. The model used involves impeded drainage and is in good accordance with the structure of the peat and basic tenets of soil physics. At Dun Moss, a small raised mire in east Perthshire, enough hydrological and soil physical data were available to conduct a preliminary test, and the elliptical shape and proportions of the mire surface profile are in agreement with the model used. (Baker-FRC)
W82-06215

VADOSE ZONE PERMEABILITY TESTS: SUMMARY,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 623-639, May, 1982. 9 Fig, 1 Tab, 30 Ref. OWRT A-076-ARIZ.

Descriptors: *Mathematical studies, *Boreholes, *Permeability coefficient, *Soil water, *Vadose water, Infilitration, Groundwater movement, Hydraulic permeability, Permeability, Mathematical equations, Soil water table, Water table fluctuations, Capillary water.

The accuracy of existing formulas for evaluating the saturated hydraulic conductivity or permeability coefficient in constant head infiltration tests is examined in the first part of a three part study on borehole technology. Formulas are available for open and partly cased boreholes and deep and shallow water table conditions. Not all the available solutions are compatible with each other, and some may lead to values of saturated hydraulic conductivity which differ by as much as several hundred percent from values obtained by other formulas under the same test conditions. None of the solutions account for capillary effects, soil heterogeneity, anisotropy or the possibility that part of the flow may take place under unsaturated conditions. Problems of application of Cecen's methodology to actual field situations are discussed. The United States Bureau of Reclamation formulas may also be inaccurate for an open-hole test above an impermeable layer since, in reality, the flow is not purely horizontal and takes place under nonsteady-state conditions. (Geiger-FRC)
W82-06301

VADOSE ZONE PERMEABILITY TESTS: STEADY STATE RESULTS,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics, Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 640-659, May, 1982. 16 Fig, 1 Tab, 29 Ref. OWRT A-076-ARIZ.

Descriptors: *Boreholes, *Soil water, *Infiltration, *Vadose water, *Permeability coefficient, Mathematical studies, Model studies, Groundwater movement, Water table fluctuations, Mathematical models, Saturation.

The mathematical accuracy of formulas used to determine the saturated conductivity from constant head borehole infiltration tests above the water table was tested under the assumption that the concept of free surface flow is valid. The effects that unsaturated soil conditions may have on the validity of the free surface concept were also studied using free surface and saturated-unsaturated flow models. Free surface model steady state simulations agreed well with analytical solutions but gave a distorted view of the infiltration process. Saturated-unsaturated models used to describe quasi-steady state conditions showed that only a small volume of soil near the borehole is completely saturated with water. An empirical solution was developed for deep table conditions to calculate the saturated hydraulic conductivity with improved accuracy. The development of a completely general formula is extremely difficult due to the effects of borehole geometry, unsaturated soil characteristics, water table depth, heterogeneity, and anisotropy. (Geiger-FRC)
W82-06302

VADOSE ZONE PERMEABILITY TESTS: UNSTEADY FLOW,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, and S. P. Neuman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 660-677, May, 1982. 14 Fig, 2 Tab, 15 Ref. OWRT A-076-ARIZ.

Descriptors: *Boreholes, *Infiltration, *Soil water, *Vadose water, *Permeability coefficient, Mathematical studies, Model studies, Water table fluctuations, Mathematical models, Graphical methods, Saturation, Soil properties, Groundwater movement, Flow rates, Permeability.

During constant head borehole infiltration tests in the vadose zone, saturated-unsaturated flow models were used to simulate transient conditions. The time required to reach steady state, the volume of injected water required to reach steady state, and the question of whether early time data from a borehole infiltration test could be used to estimate saturated hydraulic conductivity were also examined. Infiltration rate varied directly with saturated hydraulic conductivity and was affected by unsaturated soil properties, antecedent moisture conditions, anisotropy and borehole conditions. Saturated hydraulic conductivity may be overestimated if the U.S. Bureau of Reclamation method of determining when to terminate a test is used. By using a graphical method which utilizes extrapolation of data collected during the early portion of a test, lengthy tests and the need for large volumes of water are eliminated when estimating flow rate at steady state. (Geiger-FRC)
W82-06303

SIMULATION OF SOLUTE TRANSPORT USING A TRANSFER FUNCTION MODEL,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury.
Water Resources Research, Vol 18, No 2, p 363-368, April, 1982. 4 Fig, 20 Ref.

Descriptors: *Simulation analysis, *Mathematical studies, *Soil water, Water transport, *Mathematical models, Flow, Soil solution, *Solutes, Spatial distribution, Probability distribution, Infiltraiion, Prediction, Velocity, Soil environment.

A transfer function model is proposed for simulating solute transport under natural field conditions where substantial variability exists in water transport properties. A transfer function model is a device commonly used by electrical engineers and hydrologists to characterize systems whose internal mechanisms are unknown or unknowable. This approach measures the distribution of solute travel times from the soil surface to a reference depth. Using the distribution function, it is possible to simulate average solute concentration for a given depth or time, and to predict the probability of extremely long or short travel times for a mobile chemical. Since in the few existing studies of soil water distributions, it was found that a lognormal function describes the relevant parmeter, that is the distribution to which the travel time density function is fitted in this study. (Titus-FRC)
W82-06318

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 1. THEORY AND HYPOTHESIS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2I.
W82-06321

ESTIMATING SOIL WATER RETENTION FROM SOIL PROPERTIES,

Science and Education Administration, Beltsville, MD. Hydrology Lab.
W. J. Rawls, and D. L. Brakensiek.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 166-171, June, 1982. 1 Tab, 18 Ref.

Descriptors: *Soil moisture retention, *Soil properties, Soil types, Soil water, *Matric potential.

Three levels of regression equations for predicting soil water retention at 12 matric potentials (-0.04 to -15 bar) were developed based on: (1) percent sand silt, and clay, percent organic mater, and bulk density; (2) number 1 variables plus -15 bar soil water retention value; and (3) number 2 variables plus -0.33 bar soil water retention value. Data for this study included 500 soils consisting of 2543 soil horizons from 18 states and covered a wide variety of soil types. Addition of the -0.44 bar and -15 bar soil retention values greatly increased the accuracy of the equations. These equations can be used to estimate water retention characteristics without expensive laboratory determinations. (Cassar-FRC)
W82-06332

A FIELD TEST OF THE TRANSFER FUNCTION MODEL FOR PREDICTING SOLUTE TRANSPORT,

California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, L. H. Stolzy, and P. Shouse.
Water Resources Research, Vol 18, No 2, p 369-375, April, 1982. 1 Tab, 8 Fig, 13 Ref.

Descriptors: *Mathematical models, *Solutes, Field investigation, *Probability distribution, Water transport, Chloride, Irrigation, Soil water, Soil solution, Saturation, Statistical analysis, Leaching, Calibrations.

A model proposed for predicting average values of solute concentration as a function of depth and time, based on a transfer function model, is tested on a field experiment. The model, which requires knowledge of the distribution of solute travel times to a given depth within a field, predicts average soil solute concentrations and the probability of extreme behavior. The experiment consisted of an initial calibration of a pulse of solute past numerous samplers at a constant depth. The shape of the solute pulse was then predicted for different depths, with good agreement between predicted and measured values. A further test of the model involved taking soil cores after 170 days. Good agreement was found in this test as well. The experiment suggests that the number of replicate samples required depends on the degree to which extreme values are important. (Titus-FRC)
W82-06339

ANALYTICAL SOLUTIONS OF THE ONE-DIMENSIONAL CONVECTIVE-DISPERSIVE SOLUTE TRANSPORT EQUATION,

Science and Education Administration, Riverside, CA. Salinity Lab.
M. T. van Genuchten, and W. J. Alves.
Technical Bulletin No 1661, June 1982. 151 p, 5 Fig, 1 Tab, 45 Ref, 2 Append.

Descriptors: *Solute transport, *Mathematical models, *Computer models, *Soil water, Convection, Adsorption, Laplace equation.

The rate at which a chemical constituent moves through soil is determined by several transport mechanisms. This compendium lists available mathematical models and associated computer programs for solution of the one-dimensional convective-disperaive solute transport equation. The governing transport equations include terms accounting for convection, diffusion and dispersion and linear equilibrium adsorption. In some cases, the effects of zero-order production and first-order decay have also been taken into account. Some of the listed solutions have been published previously. Others were not available and have been derived to make the list of solutions more complete. User-oriented FORTRAN IV computer programs of several analytical solutions are given in an appendix. All programs were successfully tested on an IBM 370/155 computer. Results of each program were compared with results based on a numerical solution of the governing transport equation, in order to check the programming accuracy of each solution. A list of Laplace transforms used to derive the analytical solutions is also provided. (Moore-SRC)
W82-06408

A COMPARISON OF NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL UNSATURATED FLOW AND MASS TRANSPORT EQUATIONS,

Agriculture Research Service, Riverside, CA. Salinity Lab.
M. T. Van Genuchten.
Advances in Water Resources, Vol 5, No 1 p 47-55, March, 1982. 8 Fig, 1 Tab, 20 Ref.

Descriptors: *Solute transport, *Numerical analysis, *Soil water, *Finite element method, *Finite difference methods, Unsaturated flow, Saturated flow, Fate of pollutants, Model studies, Infiltration, Mathematical models, Hydrodynamics.

The accuracy and computational efficiency of four numerical methods for solving governing one-dimensional flow and mass transport equations are compared. The methods are those of finite differences (FD), linear finite elements (LFE), mass-lumped linear finite elements (MFE), and Hermitian cubic finite elements (HFE). These equations are useful for studying movement of fertilizers, pesticides, salts, and domestic and industrial wastes in the soil. The sample problem is a field infiltration experiment in which water and chlorides infiltrate into a deep, homogeneous soil profile. All four numerical schemes give accurate results, but the HFE scheme most nearly duplicates the correct solution. Computer times vary widely, depending on the number and size of elements, number of time steps, etc. The GFD and MFE schemes generate the most stable conditions in the presence of a steep moisture front (infiltration in a dry soil); the HFE scheme is better for locating the correct spatial position of the moisture front. Selection of a numerical scheme should consider its potential use. Factors affecting accuracy and computational efficiency are programming details of the iterative scheme, magnitude of the time step, the presence of adsorption and decay reactions, and the required accuracy. (Cassar-FRC)
W82-06547

AN EMPIRICAL METHOD FOR DETERMINING AVERAGE SOIL INFILTRATION RATES AND RUNOFF, POWDER RIVER STRUCTURAL BASIN, WYOMING,

Geological Survey, Cheyenne, WY. Water Resources Div.
J. G. Rankl.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-201732, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-76, April 1982, 38 p, 18 Fig, 10 Ref.

Descriptors: *Soil water, *Infiltration rate, *Surface runoff, *Rainfall-runoff relationships, Rainfall intensity, Antecedent moisture, Channel storage, Water storage, Permeability, Soil types, Soil classification, *Wyoming, Powder River basin, Incipient ponding.

This report describes a method to estimate infiltration rates of soils for use in estimating runoff from small basins. Average rainfall intensity is plotted against storm duration on log-log paper. All rainfall events are designated as having either runoff or nonrunoff. A power-decay-type curve is visually fitted to separate the two types of rainfall events. This separation curve is an incipient-ponding curve and its equation describes infiltration parameters for a soil. For basins with more than one soil complex, only the incipient-ponding curve for the soil complex with the lowest infiltration rate can be defined using the separation technique. Incipient-ponding curves for soils with infiltration rates greater than the lowest curve are defined by ranking the soils according to their relative permeabilities and optimizing the curve position. A comparison of results for six basins produced computed total runoff for all events used ranging from 16.6 percent less to 2.3 percent more than measured total runoff. (USGS)
W82-06692

A KINEMATIC MODEL FOR SURFACE IRRIGATION: AN EXTENSION,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mathematics.
For primary bibliographic entry see Field 3F.
W82-06852

A UNIVARIATE VERSUS A MULTIVARIATE PARAMETER DISTRIBUTION IN A STOCHASTIC-CONCEPTUAL ANALYSIS OF UNSATURATED FLOW,

Agricultural Research Organization, Bet Dagan (Israel). Inst. of Soils and Water.
D. Russo, and E. Bresler.
Water Resources Research, Vol 18, No 3, p 438-488, June, 1982. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Unsaturated flow, *Stochastic process, Mathematical studies, Probabilistic process, Stochastic hydrology, Soil water, Infiltration, Salts.

Comp[illegible]s were made between solutions of stochastic-conceptual flow problems obtained by using two approaches: assuming that the spatial variability of soil hydraulic properties is expressed by a single stochastic parameter or assuming that this variability is described by five random parameters. Two cases of one-dimensional vertical flow were analyzed: piston flow of solute under steady uniform surface water recharge and transient water flow when a uniform recharge rate is applied on the surface. Under steady vertical infiltration, expressing the variability of the hydraulic conductivity function by the single stochastic variate gives essentially the same results as the case when the variability is expressed by three stochastic variates. The agreement between the simulated average solute concentration profiles obtained by the two methods improved as the recharge rate increased and a larger portion of the field was under ponding conditions. Similar results were found for the simulated potential runoff. For the case of the transient flow of water the variability in the hydraulic conductivity function as well as the variability in the soil water retentivity function is expressed by a scaling factor obtained from hydraulic conductivity data. Using this scaling factor as the only stochastic variate resulted in mean water content profiles which are in relatively good agreement with the mean profiles obtained when expressing the variability of the hydraulic conductivity function and the soil water retentivity function by five stochastic variates. It is concluded that the scaling factor, as a single stochastic variate, can be successfully used for stochastic analysis of water and solute flows under steady and transient infiltration conditions. (Baker-FRC)
W82-06856

MOISTURE AND HEAT TRANSPORT IN HYSTERETIC, INHOMOGENEOUS POROUS MEDIA: A MATRIC HEAD-BASED FORMULATION AND A NUMERICAL MODEL,

Massachusetts Inst. of Tech. Cambridge. Dept. of Civil Engineering.
P. C. D. Milly.
Water Resources Research, Vol 18, No 3, p 489-498, June, 1982. 8 Fig, 35 Ref.

Descriptors: *Soil porosity, *Model studies, *Porosity, Soil properties, *Porous media, Evapotranspiration, Groundwater recharge, Runoff, Precipitation, Rainfall, Model studies, Mathematical models.

The theory of Philip and de Vries and of de Vries is used as the basis for the formulation of a more general mathematical model of moisture and heat flow in porous media. Specifically, matric head rather than moisture content is used as a dependent variable. This makes it possible to incorporate moisture retention hysteresis and soil inhomogeneities into the theory. A physically realistic generalization of existing conceptual models of hysteresis is proposed in order that they may be applied to non-isothermal problems. The one-dimensional forms of the governing partial differential equations are solved numerically using the Galerkin finite element method. A computer code of the proposed solution algorithm is tested for accuracy in the solution of several problems. The limitation of the assumptions of local thermodynamic equilibrium are discusse e computational results demonstrate the reliability of the numerical model. (Baker-FRC)
W82-06857

COMPARISON OF METHODS OT ESTIMATE DEEP PERCOLATION RATES,

New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
T. W. Sammis, D. D. Evans, and A. W. Warrick.
Water Resources Bulletin, Vol 18, No 3, p 465-470, June, 1982, 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Percolation, Estimating, *Darcy's equation, Temperature effects, *Evapotranspiration, Irrigation, Soil moisture, *Root zone, Tracers, Tritium.

Three alternative methods of estimating deep percolation below the root zone when knowledge about the history of applied water and evapotranspiration is not available are evaluated. The methods studied included: the solutions of Darcy's equation for steady state conditions; the estimation of deep percolation rates based upon the distortion caused by the vertical flux of water and of the normal vertical temperature profile in the zone below 15 meters; and the use of tritium as a tracer of water movement. A field site for determining the deep seepage rate by all three methods was selected in a field west of Phoenix, Arizona. The water table was at a depth of 42 meters and the field had been under irrigation since 1950. Cropping history included field crops for the previous 18 years and vegetable crops before that time. At the principal study site the Darcy velocity of flow ranged from 9 cm per year determined by the temperature method to 40 cm per year determined by the tritium method. Darcy's equation to calculate seepage rates resulted in an estimation of deep seepage of 18 cm per year. An average deep percolation rate at the principal study site of 22 cm per year was determined using the average of all three methods. Results for other sites based on the temperature method indicated a lower seepage rate. If the three methods, the hydraulic approach offered the most direct measurement of seepage rate. However, it is also the most laborious and expensive. (Baker-FRC)
W82-06867

SEASONAL VARIATION OF INFILTRATION CAPACITIES OF SOILS IN WESTERN OREGON,

Coconino National Forest, Flagstaff, AZ.
M. G. Johnson, and R. L. Beschta.
Pacific Northwest Forest and Range Experiment Station Research Note PNW-373, 1981. 8 p, 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Infiltration capacity, *Forest soils, *Seasonal variation, *Soil organic matter, *Oregon, Wettability, Water repellent soils, Coniferous forests, Climates.

Infiltration measurements were made at two locations in Oregon: the Coyote Creek watersheds, located in the South Umpqua Experimental Forest; and the Hi-15 watersheds, located in the H. J. Andrews Experimental Forest. Both areas have relatively dry, warm summers and wet, mild winters. Douglas-Fir dominates the cverstory vegetation of undisturbed sites at both areas. Infiltration capacities for the Coyote Creek and Hi-15 watersheds averaged about 50% higher in the fall than during the summer. All data on infiltration capacity appear to be normally distributed. The pattern of greater infiltration in fall, compared with summer, was found in both disturbed and undisturbed soils at both study areas. The cause of this seasonal increase in infiltration capacity is not known. Field observations indicate that during the summer months the soil surface presents a nonwettable condition. This condition may result from changes in characteristics of the soil organic matter caused by the hot and dry climate of summer. This surface-limiting condition apparently changes after the first fall rains. In contrast to the results of this study, most other investigators have found fall infiltration capacities 30-80% lower han those occurring during summer. (Moore-SRC)
W82-06961

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, CHICKASHA, OKLA., 1980 REPORT,

Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 7B.
W82-06969

2H. Lakes

NUTRIENT CONTROL OF BLUE-GREEN ALGAE IN A SOUTHWESTERN RESERVOIR,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-05912

GRAPHIC RETRIEVAL, ANALYSIS AND SPATIAL PORTRAYAL: AN INFORMATION SYSTEM FOR IDAHO'S FRESHWATER LAKES,

Idaho Univ., Moscow. Dept. of Geography.
N. B. Hultquist.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243387, Price codes: A05 in paper copy, A01 in microfiche. Report, January 1982, 82 p, 7 Fig, 1 Append. OWRT A-073-IDA(1).

Descriptors: *Mapping, *Lakes, *Data storage and retrieval, *Data processing, *Computer programs, Topographic mapping, Lake classification, Data collections, Data interpretations, Computer models, Model studies, Model testing, Mathematical models, Mathematical studies, Mathematical analysis.

Activities on a data processing project related to the Clean Lakes study, designated as GRASP (Graphic Retrieval and Spacial Portrayal), are described. The rationale, description, and application of GRASP are delineated. The objective of GRASP is to develop a computer based storage and retrieval system having analysis capacities to facilitate graphic and or spatial portrayal of raw data or of derived information needed by Clean Lakes researchers. An exhaustive search was made by the researchers to identify all Idaho lakes. The final form of this search includes lakes, reservoirs, and ponds. Each water body is uniquely identified by name, location, elevation, and size. A total of 123 high priority lakes are tagged in the system and given a water quality status (trophic status index) The information within the GRASP system can be displayed, corrected, or expanded using the editing function of the Conversational Monitoring System. Sorting, logical operations, and analyses are possible, using interactive statistical analysis system routines. Simple maps (and other graphics) are optional products available to the researchers, and lakes of interest can be spatially portrayed at the appropriate level within Idaho State/county outlines. (Zielinski-Maxima)
W82-05914

EPIDEMIOLOGY OF HUMAN SCHISTOSOMA HAEMATOBIUM INFECTION AROUND VOLTA LAKE, GHANA, 1973-75,

World Health Organization Schistosomiasis Control Project, Accra (Ghana).
For primary bibliographic entry see Field 5C.
W82-05988

BIOCONCENTRATION OF A HEXACHLOROBIPHENYL IN GREAT LAKES PLANKTONIC ALGAE,

New York State Dept. of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5B.
W82-05991

FACTORS INFLUENCING ORTHOPHOSPATE TURNOVER TIMES: A COMPARISION OF CANADIAN AND NEW ZEALAND LAKES,

Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
E. White, G. Payne, S. Pickmere, and F. R. Pick,.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 469-474, March 1982. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Phosphates, *Turnover time, *Nutrients, Lakes, *Canada, *New Zealand, Limiting nutrients, Phosphorus, Nitrogen, Phytoplankton, Particulat matter, Seston, *Orthophosphates.

Water samples from 21 New Zealand and 9 Canadian lakes were analyzed for dissolved phosphate, particulate phosphorus, and particulate nitrogen. The particulate N was used to indicate phytoplankton biomass; the ratio of particulate N to particulate P was used to indicate P sufficiency or deficiency. Phosphate turnover times were positively related to the size of the dissolved phosphate pool, negatively related to biomass. Where P deficiency existed, phosphate turnover times were short. Particulate N/particulate P ratios for Canadian and New Zeland lake water averaged 26.96 and 12.71, respectively. In the 3 New Zeland lake groups the average particulate N/P ratios ranged from 8.61 to 16.06. The lower ratios were found in New Zealand lakes located in P-rich regions of volcanic ash and fed by P-rich springs. (Cassar-FRC)
W82-05992

APPLICATION OF X-RAY MICROANALYSIS FOR THE DETECTION OF HEAVY METAL IN GREAT LAKES ALGAE,

Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-05993

INFLUENCE OF A HEXACHLOROBIPHENYL IN GREAT LAKES PHYTOPLANKTON IN CONTINUOUS CULTURE,

New York State Department of Health, Albany. Div. of Labs. and Research.
For primary bibliographic entry see Field 5C.
W82-05994

PALEOLIMNOLOGICAL EVIDENCE OF EARLY EUTROPHICATION IN LAKE ERIE,

McMaster Univ., Hamilton (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-05995

PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF SEVERAL FRESHWATER ALGAE TO A MIXTURE OF METALS,

Canada Center for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W82-05996

RECENT ADVANCES IN ASSESSING IMPACT OF PHOSPHORUS LOADS ON EUTROPHICATION-RELATED WATER QUALITY,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06034

ANALYSIS OF LAKE VICTORIA LEVELS,

G. W. Kite.
Hydrological Sciences Bulletin, Vol 27, No 2, p 99-110, June, 1982. 6 Fig, 4 Tab, 8 Ref.

Descriptors: *Lakes, *Water level, *Lake Victora, Model studies, Mathematical studies, Hydrologic models, Mathematical models, Water level fluctuations.

An analysis was made of time series of levels of Lake Victoria as measured at four points for trends, periodicities and autoregressive components. Comparisons were made with results of time series analysis of Lake Superior, which is similarly sized lake. Checks were made for evidence of differential crustal movement using differences between time series on opposiste sides of the lake. The time series of beginning of month lake levels for the period 1900-1978 contains trends, contains periodicities and contains a strong autoregressive component. The trend component of the time series is generally associaed with changes in the structure of the series caused by natural or manmade phenomena. The presence of periodic functions is generally attributed to various astromnomical events such as the phases of the moon and the rotation of the earth. All of the Lake Victoria time series show a similar distribution of variance and are in marked conrast to the distribuion of variance for the lake level time series from Marquette on LakeSuperior. The Lake Victoria series contain large (greater than 50%) linear trends, while the Marquette series contains a large periodic component. All series contain a large autoregressive component. The linear trand components in the Lake Victoria series are largely caused by the step inlake levels in the early 1960's. Since it appears that this rise in lake level is not manmade, the time series cannot be legitimately homogenized by removing the steps, and any method of analysis which is to be of use in modeling must incorporate a random jump component. (Baker-FRC)
W82-06201

PALAEOCLIMATES AT LAKE TURKANA, KENYA, FROM OXYGEN ISOTOPE RATIOS OF GASTROPOD SHELLS,

Rhode Island Univ., Kingston. Dept. of Chemistry.
For primary bibliographic entry see Field 2D.
W82-06216

HEAVY METALS IN ANIMALS OF LAKE BALATON,

Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
For primary bibliographic entry see Field 5C.
W82-06284

GROUNDWATER SEEPAGE AS A NUTRIENT SOURCE TO A DRAINAGE LAKE; LAKE MENDOTA, WISCONSIN,

Wisconsin Univ.-Madison. Dept. of Bacteriology.
For primary bibliographic entry see Field 5B.
W82-06285

EFFECT OF NITRATE CONCENTRATION IN LAKE WATER ON PHOSPHATE RELEASE FROM THE SEDIMENT,

Arhus Amtsvandvaesen (Denmark).
For primary bibliographic entry see Field 5C.
W82-06313

HYPOLIMNETIC REDOX AND PHOSPHORUS CYCLING IN HYPEREUTROPHIC LAKE SEBASTICOOK, MAINE,

Maine Univ. at Orono. Dept. of Geological Sciences.
L. M. Mayer, F. P. Liotta, and S. A. Norton.
Water Research, Vol 16, No 7, p 1189-1196, July, 1982. 10 fig, 2 Tab, 42 Ref. OWRT A-039-ME.

Descriptors: *Nutrients, *Lakes, Eutrophication, *Cycling nutrients, *Phosphorus, Alkalinity, Oxygen demand, Hypolimnion, Thermal stratification, Ammonium, Methane, Iron, Manganese, Sulfides, Sediments, *Maine, Lake Sebasticook.

The types of reduced species delivered to the metalimnion of a hypereutrophic lake are examined. The dynamics of hypolimnetic water chemistry were considered through the summer stratification period with emphasis on the factors controlling the introduction of reduced species to the water column, internal cycling of these species and their effect on phosphate delivery to the epilimnion. Lake Sebasticook is a hypereutrophic lake used for the investigation. The establishment of winter and summer anoxic hypolimnia in Lake Sebasticook followed a pattern typical of a eutrophic dimictic lake. Summer fluctuations of the oxycline represented intrusions of hypoxia into the metalimnion and lower epilimnion rather than massive reoxygenation of the hypolimnion. The response of iron and manganese to this anoxic period was release of both metals from the sediments immediately after the onset of hypolimnetic anoxia, increased in concentration in the hypolimnion throughout the summer, manganese developing an upper hypolimnetic maximum in the late summer-early fall and iron retaining a lower hypolimnetic maximum indicative of release from the sediments. Total phosphorus showed a pattern similar to the metals, building up intensively in the hypolimnion and to a much lesser extent in the epilimnion. Potassium was also apparently released from the sediments during the summer, perhaps resulting from an ion exchange reaction in which potassium was displaced by ammonium derived from deamination of organic material. Considerable alkalinity was also released from the sediments. (Baker-FRC)
W82-06337

OPTIMIZING THE EVALUATION OF LAKE WATER QUALITY THROUGH ANALYSIS OF EXISTING REMOTELY SENSED DATA,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 7C.
W82-06370

EUTROPHICATION OF WATERS: MONITORING, ASSESSMENT AND CONTROL.

Organization for Economic Co-Operation and Development, Paris (France).
For primary bibliographic entry see Field 5C.
W82-06383

DESTRATIFICATION OF LAKES AND RESERVOIRS TO IMPROVE WATER QUALITY,

Australian Water Resources Council, Canberra.
For primary bibliographic entry see Field 5G.
W82-06385

STUDIES OF THE EFFECTS OF OPERATING THE MT. ELBERT PUMPED-STORAGE POWERPLANT ON TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
J. F. LaBounty, and J. J. Sartoris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237074, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-82-7, December 1981. 59 p, 41 Fig, 9 Tab, 48 Ref.

Descriptors: *Limnology, *Plankton, *Nutrients, *Productivity, *Twin Lakes, *Pumped storage, Reservoirs, Chlorophyll, Phosphorus, Nitrates, Benthos, Water temperature, Conductivity, Dissolved oxygen, *Colorado, Twin Lakes.

This report presents the results of studies done in 1980 as part of the preoperational investigations of the limnology of Twin Lakes. Maximum water temperatures were recorded in August 1980 and were about 17 and 18 C for the upper and lower lakes, respectively. The lowest measured dissolved oxygen concentration was 1.3 mg/l at the bottom of the lower lake in October. The pH ranged between 6.3 and 8.3, and the conductivity levels were between 64 and 90 micro S/cm. Total phosphorus concentrations never exceeded 2 micro g/l during 1980, while nitrate nitrogen ranged from less than 10 to 90 micro g/l. Average daily primary productivity rates ranged from a low of 1.6 mg C/ (sq m/d) in the upper lake during January to a high of 143.5 in the lower lake during November. Chlorophyll a concentrations ranged from 0.6 mg/cu m below 14 m in the lower lake during April to 18.0 mg/cu m near the bottom of the epilimnion in the upper lake during September. Average phytoplankton and zooplankton densities reached maximum of just over 13,000 and 125.8/L, respectively, during August in the lower lake. Phytoplankton populations were dominated by diatoms and dinoflagellates, while zooplankton populations were dominated by copepods, oppossum shrimp, and rotifers. The benthos of Twin Lakes is dominated by chironomids, oligochaetes, and fingernail clams reaching maximum densities respectively of 2922, 800, and 974/sq m in the lower lake, and 1969, 2813, and 173/sq m in the upper lake. (Moore-SRC)
W82-06403

HYDROTHERMAL ANALYSIS OF LAKES AND RESERVOIRS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. R. F. Harleman.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 301-325, March, 1982. 16 Fig, 40 Ref.

Descriptors: *Hydrothermal studies, *Mathematical studies, Fluid mechanics, Lakes, Reservoirs, Physical properties, Thermal properties, Prediction.

This paper, of 'First Hunter Rouse Hydraulic Engineering Lecture', reviews the impact of Hunter Rouse's work on the application of fluid mechanics to hydraulic engineering practice in the United States. The development of physical and mathematical techniques for the prediction of the hydrothermal structure of lakes and reservoirs provides an example of the application of concepts put forth by Rouse. One-dimensional models for the vertical temperature structure of lakes and reservoirs may be either diffusion models or mixed-layer models. The development and testing of early mathematical models based on the vertical diffusion concept depended heavily on the use of laboratory models. These models are very sensitive to variations in turbulent diffusivity, internal heat absorption, and vertical advection due to inflows and outflows. A wind-mixing model is proposed as an alternative to specification of temporal and spatial variations in the vertical diffusivity. A wind-mixing algorithm converts turbulent kinetic energy input by wind shear to potential energy through entrainment of hypolimnetic water across the thermocline. A heat balance based on meteorological inputs averaged over hourly or daily time steps is achieved through the use of an interactive technique. This ability to predict the thermal structure of lakes and reservoirs a short time intervals permits the inclusion of this factor in water quality models. Temperature predictions of the numerical model are compared with field data for several lakes and reservoirs. (Carroll-FRC)
W82-06425

PRIMARY PRODUCTIVITY AND NUTRIENTS IN THE SEDIMENT RETENTION BASIN OF LAKE MONROE,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W82-06470

ZOOPLANKTON AND THEIR RELATIONSHIPS WITH WATER QUALITY AND FISHERIES,

Leicester Univ. (England). Dept. of Adult Education.
D. M. Harper, and A. J. D. Ferguson.
Hydrobiologia, Vol 88, No 1-2, p 135-145, March, 1982. 10 Fig, 23 Ref.

Descriptors: *Zooplankton, *Plankton, *Reservoirs, Water supply, *Water quality data, Fish, *Reservoir operation, Succession, Water treatment, Water sampling, Water quality, Seasonal variation, Rutland Water, England.

Zooplankton population structure in Rutland Water changed over the first five years of the reservoir's existence. Daphnia pulex, initially dominant, was replaced by D. hyalina in late 1975, and since 1979 the latter has coexisted with Bosmina longirostris. Population fluctations of all the main crustacean zooplankters were erratic in the first three years, but have since become more regular. The pattern of zooplankton population change is now similar to that of other lowland reservoirs. The seasonal changes in the populations of the main grazers are becoming predictable, but the effect of grazing upon the algae and their succession during the summer is not yet clear. It is anticipated that a clearer understanding of grazing pressure will be of value to the future management of the reservoir. (Titus-FRC)
W82-06472

RUTLAND WATER PHYTOPLANKTON: THE DEVELOPMENT OF AN ASSET OR A NUISANCE,

Anglian Water Authority, Peterborough (England), Welland and Nene River Div.
A. J. D. Ferguson, and D. M. Harper.
Hydrobiologia, Vol 88, No 1-2, p 117-133, March, 1982. 2 Tab, 11 Fig, 34 Ref.

Descriptors: *Phytoplankton, *Pumping, *Succession, *Reservoirs, Water supply, England, Catchment areas, Water quality control, Water quality, Prediction, Lakes, Algal blooms, Filtration, Water quality data, Rutland Water.

The development of a seasonal succession of phytoplankton species in Rutland Water is described, and the factors controlling their succession and abundance are discussed. At present, input of water from the catchment and by pumping from the rivers flowing into the reservoir has the greatest influence on phytoplankton abundance. Temperature, fluorescence and oxygen percentage saturation were continuously monitored, as were meteorological factors. Chemical and algal sampling was carried out at weekly intervals at each of thirteen sites. Results of the monitoring showed that increasing stabilization of phytoplankton successional dominance occurred. Currently, the predictive capabilities that result from the study rely on observed changes in growth patterns and experience gained from past data on species succession. The factor considered most readily manipulable in the control of algal populations is the degree of stratification. Examination of the relationships between the mixed depth algal concentrations and species succession have not produced any predictable relations to date. (Titus-FRC)
W82-06473

VERTICAL MOVEMENTS OF THE SURFACE WATER AND THERMAL STRATIFICATION IN RUTLAND WATER,

University Coll. of Swansea (Wales). Dept. of Oceanography.
S. L. Maddocks.

Hydrobiologie, Vol 88, No 1-2, p 79-87, March, 1982. 5 Tab, 5 Fig, 6 Ref.

Descriptors: *Thermal stratification, *Stratification, *Thermocline, *Reservoirs, *Seiches, Thermal capacity, Wind-driven currents, Currents, Oscillatory waves, Dams, Upwelling, Eutrophication, Topography, Water treatment, Stress, Rutland Water, England.

Vertical movements of the water surface in Rutland Water were examined using water level gauges. The timing and extent of the surface seiches and slopes due to wind stress were not well correlated with wind speed and direction: this is thought to be due to the complex shape of the reservoir. Where the lake consists of many bays and dendritic parts, the oxygen concentration is very different, and each unit often operates as essentially an individual lake. Therefore, the structure of oxygen distribution becomes highly variable horizontally, vertically, and temporally. Unexplainable diel oscillations of the water surface were observed, and an examination of the thermal stratification showed the presence of upwelling and downwelling. The ability to predict seiching is important to engineers for upkeep and dam construction, since seiching (oscillations) helps keep inlets in the reservoir clear of sediment buildup, while producing extra stress on the dam. (Titus-FRC)
W82-06476

INSHORE-OFFSHORE SEDIMENTATION DIFFERENCES RESULTING FROM RESUSPENSION IN THE EASTERN BASIN OF LAKE ERIE,

Eidenossische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewasserschutz, Zurich (Switzerland).
For primary bibliographic entry see Field 2J.
W82-06494

A COMPARISON OF DIFFERENT PHOSPHORUS FRACTIONS AS PREDICTORS OF PARTICULATE PIGMENT LEVELS IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,

McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06496

METHANOGENESIS IN BIG SODA LAKE, NEVADA: AN ALKALINE, MODERATELY HYPERSALINE DESERT LAKE,

Geological Survey, Menlo Park, CA.
R. S. Oremland, L. Marsh, and D. J. DesMarais.
Applied and Environmental Microbiology, Vol 43, No 2, p 462-468, February, 1968. 5 Fig, 2 Tab, 35 Ref.

Descriptors: *Methanogenesis, *Methane, *Saline lakes, Methanol, Lake sediments, Biochemistry, Chemical reactions, Salinity, Microbiological studies, Methane bacteria, Lakes, Big Soda Lake, *Nevada.

Although methanogenesis has been studied in a wide variety of aquatic environments, there have been few reports on methanogenesis in hypersaline environments in spite of the apparent phylogenetic link between methanogens and extreme halophiles. This paper reports on methanogenic activity in the sediments of Big Soda Lake, a moderately hypersaline, alkaline desert lake in Nevada. Incubated sediment slurries from the lake produced significant levels of methane. Methane production by the sediment slurries had a pH optimum of 9.7 and was stimulated by methanol, trimethylamine, and methionine. Methanogenesis was inhibited by 2-bromoethanesulfonic acid and by autoclaving. Hydrogen, acetate, and formate amendments were found to provide only slight or no stimulation of methanogenesis in these slurries. A methanol-grown enrichment culture containing a small epifluorescent coccus as the predominant organism was recovered from sediments. This enrichment grew best when ferric sulfide (FeS) or autoclaved sediment particles were included in the media, had a pH optimum of 9.7, and produced 14CH4 from 14CH3OH. The methane formed by methanol-grown enrichment cultures was depleted in 13C by 72% to 77% relative to the methanol. (Carroll-FRC)
W82-06535

TERMINOLOGICAL CONFUSION--LAKE VS. RESERVOIR,

Bureau of Reclamation, Sacramento, CA. Mid-Pacific Region.
N. P. Prokopovich.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 203-205, 1982.

Descriptors: *Lakes, *Reservoirs, *Lake classification, *Nomenclature, Definitions, Arid Climates, Water level fluctuations, Climates, Silting, Sedimentation, Reservoir releases.

The difference between the terms 'lake' and 'reservoir', which are often used interchangeably, is clarified. Lakes are natural water bodies, and reservoirs are manmade. Lakes are formed from natural processes such as faulting, volcanism, glaciation, and others, whereas reservoirs are formed by interfering with natural processes. Lakes are abundant in humid regions, but reservoirs may be built anywhere, even in arid or semi arid places as long as imported water is available. Lakes occupy closed depressions; reservoirs are open at one end and man-enclosed at the other. Most lakes are older than modern civilization, but reservoirs are relatively recent. Lakes have a longer life span than reservoirs, which are readily filled with sediments. Lakes are in harmony with the natural environment; reservoirs alter the biological communities, sometimes favorably and sometimes unfavorably. In lakes water exchange, circulation, and water levels are rather uniform. Reservoirs often have rapid releases and water level fluctuations up to 70 m (Shasta Reservoir). Lakes become more eutrophic with time while reservoirs are flushed more frequently, delaying eutrophication. Although lakes were very important economically in ancient times, the economic impact of reservoirs is now much greater. (Cassar-FRC)
W82-06551

A STUDY OF SELECTED GREAT LAKES COASTAL MARSHES,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06570

CALCULATION OF CURRENTS IN LAKE ONEGA WITH CONSIDERATION OF ANTHROPOGENIC INFLUENCES,

Z. N. Dobrovol'skaya, P. P. Koryavof, and A. I. Simonov.
Water Resources, Vol 8, No 3, p 278-281, May/June, 1981. 1 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 100-104, May/June, 1981.

Descriptors: *Water currents, *Wind-driven currents, *Diversion, Lakes, Water circulation, Lake Onega, Water transfer, Model studies, Numerical analysis, Mathematical models, River flows, Svri' River, Vytegra River, Runoff, Hydraulics, *USSR, Hydrodynamics.

The dynamics of currents in lakes were described by a two-dimensional hydrodynamic model in which the wind effect, river outflow, bottom friction, and Coriolis forces were considered. The particular problem considered was that of determining the zone of Lake Onega in which changes in the current were localized as a result of water being diverted from the Svir' River to the Vytegra River. The numerical method observed that the boundary of the zone of influence of redistribution of the runoff (established on the basis of a 10% difference in current speeds) varied depending on wind direction and volume of redistributed water. The variations were localized in the southern part of the lake at a distance of less than 19 km from the southern boundary for all wind conditions investigated, except a complete calm. (Cassar-FRC)
W82-06612

NUMERICAL MODELING OF WIND-DRIVEN CURRENTS IN LAKE CHUDSKOE,

Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
G. V. Volkova, V. I. Kvon, and T. N. Filatova.
Water Resources, Vol 8, No 3, p 271-278, May/June, 1981. 3 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 3, p 91-99, May/June, 1981.

Descriptors: *Water currents, *Water circulation, Wind-driven currents, Bottom currents, Lake Chudskoe, *USSR, Model studies, Mathematical models, Lake circulation, Numerical analysis, Hydraulics, Hydrodynamics.

A mathematical model for calculating wind-driven currents in seas and inland water bodies was evaluated by comparing model results with 1971-77 field data from Lake Chudskoe, 2670 sq km in area and 7.8 m deep. Calculations of the wind-driven currents showed that currents in the surface layer coincided with wind direction and agreed within 1-3% of observed values. In the bottom layer two circulations developed in the presence of WNW winds: northern anticyclonic and southern cyclonic, the centers of which were in shallow places. Model results of the bottom layer corresponded well with field data. For WNW winds maxiumum current speeds (15-19 cm per sec) were seen in cyclonic circulation; for WSW winds (10-14 cm per sec) in the anticyclonic circulation. The model predicted slightly lower current speeds than were observed. There was also some discrepancy in the region covered by the anticyclonic circulation in case of WSW winds. (Cassar-FRC)
W82-06615

USING DIFFERENCES AMONG CARLSON'S TROPHIC STATE INDEX VALUES IN REGIONAL WATER QUALITY ASSESSMENT,

Metropolitan Council, St. Paul, MN.
R. A. Osgood.
Water Resources Bulletin, Vol 18, No 1, p 67-74, February, 1982. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Trophic level, *Water quality, Regional analysis, Data interpretation, Lakes, Lake classification, Chlorophyll, Phosphorus, Secchi disks.

The principal advantage of Carlson's trophic state index used in water quality assessments is that it presents the trophic condition on a 1 to 100 scale easily understood by both the public and the scientific community. However, the ability of the index to communicate trophic information is lessened when three values are reported: trophic state index calculated from total phosphorus, from chlorophyll a, and from Secchi disk transparency. There is at present no systematic way to account for differences among the three index values. Large differences in the three index values may result from either or both of two sources: regional relationships between chlorophyll and either Secchi depth or phosphorus may be different than those used to originally derive the index, and/or a modifying process may be altering the relationship on one of the trophic state index values with respect to the others. Two methods which can be used to account for differing trophic state index values on a regional basis are proposed. The first provides a simple procedure for transforming the trophic state index information to make it consistent with regional relationships between chlorophyll and either Secchi depth or phosphorus. The second uses the three index values to identify modifying processes in a lake and may indicate which value, or combination of values, best reflects the lake's trophic condition. Limnetic data from 60 lakes in the Twin Cities (Minnesota) metropolitan area are used to demonstrate these techniques. Only minor modifications should be needed to apply the procedures to other regional situations. (Carrol-FRC)
W82-06625

SECCHI DISC RELATIONSHIPS,

Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French, J. J. Cooper, and S. Vigg.

Water Resources Bulletin, Vol 18, No 1, p 121-123, February, 1982. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Secchi disks, *Reservoirs, *Mathematical equations, Trophic level, Lake classification, Turbidity, Water quality, Transparency, Artificial lakes, Optical properties, Eutrophication.

The problem of estimating bulk light extinction coefficients in surface water impoundments is addressed. Since artificial impoundments tend to be more turbid than natural impoundments, their optical properties, and therefore the Secchi disk depth, tend also to differ from natural impoundments. An accurate method for estimating the bulk extinction coefficient from the Secchi disk depth is demonstrated. The derived equation differs signigicantly from that derived by Poole and Atkins in 1929. The empirical expression developed for the extinction coefficient is then used to derive a semi-empirical expression for the eutrophic depth as a function of the Secchi disk depth. The relationships derived provide reasonably accurate fits of the data collected by several investigators under diverse conditions in a number of artificial impoundments. It is recommended that the results of this effort be applied only in artificial impoundments. (Carroll-FRC)
W82-06627

INTERNAL PHOSPHORUS LOADING IN A SHALLOW EUTROPHIC LAKE,

Washington Univ., Seattle. Dept. of Civil Engineering.
J. M. Jacoby, D. D. Lynch, E. B. Welch, and M. A. Perkins.
Water Research, Vol 16, No 6, p 911-919, June, 1982. 8 Fig, 3 Tab, 22 Ref.

Descriptors: *Lakes, *Phosphorus, Eutrophication, Sediments, *Lake sediments, Lake restoration, Cycling nutrients, Macrophytes, Decomposition, Decomposing organic matter, Drawdown, Long Lake, *Washington.

The respective roles of sediment and aquatic macrophytes in contributing to high phosphorus and algal content during the summer in a shallow, eutrophic lake were investigated. The 137 ha lake studied, Long Lake in western Washington, has a mean depth of 2 meters and a rather high flushing rate ranging from 3.6 to 8.0/yr. The water is soft, with alkalinity ranging from 20 to 40 mg/liter as calcium carbonate. Short-term water and phosphorus budgets were calculated for about 2 week intervals from 1976 through 1980. Results from P distribution in the lake and sediment core analyses implicate sediments as the major source of internal P loading during the summer months. Macrophyte mining of P removes AI-P (total available inorganic P) and enriches the organic P fraction in the surface sediment, thereby decreasing the AI-P pool. Anaerobic release of P was not considered significant in this lake, as stratification does not occur and oxygen depletion near the sediment has not been noted. Instead, at high pH, substantial release of P occurs from Long Lake sediment. As a component of a restoration program, the lake was drawn down nearly 2 meters for 4 months during the summer and fall of 1979, resulting in an 84% reduction in macrophyte biomass in 1980 but only minimal sediment consolidation. Winter decomposition of the much smaller macrophyte crop apparently provided insufficient phosphorus in the spring to stimulate phytoplankton and to enrich midlake sediments, which probably occurred in previous years. During the summer of 1980 internal loading of phosphorus was reduced and total phosphorus remained below 50 micrograms/liter. (Baker-FRC)
W82-06663

BATHYMETRY AND AQUATIC PLANTS OF LAKE WARAMAUG, CONNECTICUT,

Geological Survey, Hartford, CT. Water Resources Div.
K. P. Kulp.
Geological Survey Open-File Report 81-477 (WRI), 1981. 1 Sheet, 3 Ref.

Descriptors: *Maps, *Bathymetry, *Lakes, *Aquatic plants, Lake morphometry, Fathometers, Sounding, Data collections, Sampling, *Connecticut, Lake Waramaug.

The Bathymetry of Lake Waramaug is shown at 5-foot intervals, and the location and identification of significant concentrations of aquatic plants is indicated. The bathymetry shows the lake to be relatively steep-sided and flat-bottomed, with a maximum depth of between 40 and 45 feet. Aquatic plants were confined to the edges of the lake in depths of less than 15 feet. Nine species of aquatic plants occcur in significant numbers in the lake. Lake bathymetric data were collected using a recording fathometer and sounding rod; aquatic plant data were collected by visual survey; and the collection of samples using a weed rake. (USGS)
W82-06678

ONE-DIMENSIONAL RESERVOIR-LAKE TEMPERATURE AND DISSOLVED OXYGEN MODEL,

Geological Survey, NSTL Station, MS. Water Resources Div.
L. B. House.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-200 726, Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-5, 1981. 114 p, 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Computer models, *Forecasting, *Dissolved oxygen, *Water temperature, Lakes, Reservoirs, Documentation, Thermal stratification, Oxygen demand, Heat transfer, Vertical distribution, Mixing, Selective withdrawal, Reservoir releases.

This report describes and documents a one-dimensional computer model that predicts dissolved-oxygen and temperature profiles in a lake or reservoir. Downstream release dissolved-oxygen concentrations and temperatures also are computed based on a user-specified outflow withdrawal elevation. The model can, therefore, be used to compare top-draw versus bottom-draw outlet configuration effects on downstream dissolved-oxygen and temperature conditions. The dissolved-oxygen and temperature profiles are computed for a conceptual vertical water column located at the deepest point in the lake or reservoir. The water column is divided into a series of uniform thickness horizontal layers for computation purposes. The model operates on a daily simulation interal, with summary output given for each day and detailed depth profiles printed on user-specified days. Model options allow the simulation of 5-day biochemical oxygen demand, sediment oxygen demand, and the density current effects of inflowing suspended sediment. The model is a modification of the U.S. Army Corps of Engineer's 'WESTEX' model number 722-F5-E1011. The user-specified withdrawal elevation, dissolved oxygen, biochemical oxygen demand, sediment oxygen demand, and suspended sediment simulation capabilities were not present in the earlier 'WESTEX' model. The model is capable of simulating a stratified reservoir pool environment. (USGS)
W82-06687

WATER QUALITY OF ALIMAGNET, FARQUAR, AND LONG LAKES IN APPLE VALLEY, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
M. R. Have, G. A. Payne, and M. A. Ayers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-219235, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-40, 1981. 38 p, 12 Fig, 10 Tab, 27 Ref.

Descriptors: *Limnology, *Lakes, *Water quality, *Environmental effects, Chemical properties, Biological properties, Physical properties, Water sampling, Water analysis, Data collections, Eutrophication, Cyanophyta, *Minnesota, Apple Valley, Alimagnet Lake, Farquar Lake, Long Lake.

Alimagnet, Farquar, and Long Lakes, in Apple Valley, Minn., were sampled from 1973-79 to determine their physical and chemical characteristics. A storm-sewer inlet to Alimagnet Lake was also sampled during two storms in 1978. The 1976-77 drought caused a more noticeable effect on the quality of the lakes than any other factor. Chloride concentrations were 10 to 15 milligrams per liter before the drought, but increased 2 to 4 times during the drought. Dissolved solids reacted similarity. Dissolved oxygen and pH were governed mainly by biological activity. In February 1977, dissolved-oxygen concentration was less than 0.5 milligrams per liter in the three lakes. Ratios between mean total nitrogen and mean total phosphorus ranged from 22:1 to 26:1. Trophic-state indices indicate that the lakes are eutrophic. Blue-green algae dominated the phytoplankton populations. Storms sampled at a storm-sewer inlet to Alimagnet Lake showed higher concentrations of chromium, copper, nickel, and zinc than of lead, arsenic, cadmium, and mercury. Total phosphorus for the September 1978 storm had a concentration of 1.7 milligrams per liter, which means that approximately 29 pounds entered the lake during the 5.5-hour sampling period. (USGS)
W82-06690

80 YEARS OF LAKE BALDENEY - SOME ASPECTS OF ITS CHARACTERISTICS IN TERMS OF WATER MANAGEMENT (80 JAHRE BALDENEYSEE - EINIGE ASPEKTE SEINER WASSERWIRTSCHAFTLICHEN BESONDERHEITEN),

Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
For primary bibliographic entry see Field 5G.
W82-06716

BIOTRANSFORMATION OF PCB BY NATURAL ASSEMBLAGES OF FRESHWATER MICROORGANISMS,

Massachusetts Univ., Boston. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06719

A SURVEY OF DISCHARGES FROM A NATURAL GAS DRILLING OPERATION IN LAKE ERIE,

Lehigh Univ., Bethlehem, PA. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06720

IMPACT OF MOUNT ST. HELENS ERUPTION ON BACTERIOLOGY OF LAKES IN THE BLAST ZONE,

Washington Univ., Seattle. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5C.
W82-06746

APPARENT AND MEASURED RATE OF NITRIFICATION IN THE HYPOLIMNION OF A MESOTROPHIC LAKE,

Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5C.
W82-06749

PHYTOPLANKTON COMMUNITY ANALYSIS IN LAKES OF KUMAUN HIMALAYA,

Kumaun Univ., Nainital (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06764

ANNUAL VARIATIONS IN ABUNDANCE OF ZOOPLANKTON IN LAKE VALENCIA (VENEZUELA),

For primary bibliographic entry see Field 5C.
W82-06765

SAMPLING CHARACTERISTICS OF MACROPHYTE BIOMASS,

Wisconsin Univ. Extension, Madison. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5A.
W82-06779

METHANE FLUX IN THE GREAT DISMAL SWAMP,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
R. C. Harriss, D. I. Sebacher, and F. P. Day.
Nature (London), Vol 297, No 5868, p 673-674, June 24, 1982. 1 Fig, 33 Ref.

Descriptors: *Methane, *Swamps, Peat bogs, Bogs, Sinks, Atmosphere, Wetlands, Marshes, Cycling nutrients, *Great Dismal Swamp, *Virginia.

A study was made of plant ecology, soils and nutrient cycling in the Great Dismal Swamp, Virginia. This study provided an opportunity to examine ecological and climatological factors in relation to temporal variations in methane flux. All of the methane flux measurements reported were taken in a maple-gum habitat. Seasonal inundation of the maple-gum habitat varied in depth and frequency, reflecting local rainfall. All fluxes reported were obtained from soil or water surfaces without vegetation in open or closed sampling chambers. Measured emissions of methane from waterlogged soils to the atmosphere ranged from a low of .0013 g methan/sq m/day in December to a high of 0.0197 g methane/sq m/day in April. From September to December, the methane emission rate decreased as soil temperature decreased. During March and April, the methane emission rate increased as soil temperature increased. It is suggested that microbial activity in the soil profile is stratified, with methane oxidizing microorganisms living in the shallow aerobic surface layer and methane producing microorganisms living at depth in an oxygen depleted habitat. Methane fluxes to the atmosphere from maple-gum peat soils in the Dismal Swamp were generally lower than flux rates measured for other wetland soils. During the reversal of the flux from July 1980 to February 1981, the Great Swamp acted as a sink for atmospheric methane. Methane removal from ambient air over the soil surface is associated with drought conditions. The water table dropped below the bottom of the surface peat, producing a relatively dry, porous soil. From October 1980 to February 1981 the methane flux from the atmosphere to the soil decreased as soil temperature decreased. These findings raise questions concerning the generally accepted estimates of global methane emissions from wetlands and the assumption that soils are not a significant sink for atmospheric methane. (Baker-FRC)
W82-06840

RESERVOIR WATER QUALITY SAMPLING DESIGN,

Ford, Thornton, Norton and Associates, Ltd., Vicksburg, MS.
K. W. Thornton, R. H. Kennedy, A. D. Magoun, and G. E. Saul.
Water Resources Bulletin, Vol 18, No 3, p 471-480, June, 1982. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Reservoirs, *Water quality sampling, *Sampling, *Water sampling, Gradients, Monitoring, Lakes, Limnology, *Arkansas, DeGray Lake.

Several differences are described between reservoirs and lakes, and their influence on sampling design is discussed. A comparison of 309 natureal lakes and 107 reservoirs has indicated that the reservoirs had greater drainage and surface areas, drainage/surface area ratios, mean and maximum depths, shoreline development ratios, and areal water loads than did natural lakes. Reservoirs also had shorter hydraulic residence times and lower total phosphorus and chlorophyll concentrations, despite higher total phosphorus and nitrogen loadings. Reservoirs also exhibited pronounced longitudinal gradients, a phenomenon not unexpected considering the importance of advective and unidirectional transport in reservoirs. Intensive water quality transect samplings were conducted on DeGray Lake, a reservoir located in southern Arkansas, to describe and characterize lateral, longitudinal, and vertical water quality gradients. DeGray Lake exhibited marked longitudinal and vertical variation during all sample trips. Longitudinal variations were attributed to the existence of gradients from head water to dam. Turbidity and total phosphorus concentrations in the epilimnion, metalimnion, and hypolimnion decreased with the distance downstream during all trips. Epilimnetic chlorophyll a concentrations were lower and similar for all transects during the January sampling, but decreased in a downstream direction in July and October. The identification of the general location of gradients prior to the initiation of a monitoring program would allow logical positioning of sampling stations. The sampling program design should be reviewed at least on an annual basis. (Baker-FRC)
W82-06868

PHYSICAL PROCESS AND EUTROPHICATION,

Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06875

PEDIASTRUM AND SCENEDESMUS (CHLOROCOCCALES) IN SEDIMENTS FROM LAKE VAXJOSJON, SWEDEN,

Lund Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 5C.
W82-06878

FREE SURFACE OSCILLATIONS IN LAKE KINNERET,

Kinnert Limnology Lab., Tiberias (Israel).
S. Serruya, and E. Hollan.
Archiv fur Hydrobiologie, Vol 92, No 2, p 137-160, September, 1981. 14 Fig, 5 Tab, 7 Ref.

Descriptors: *Lakes, *Oscillatory waves, *Seiches, Waves, Lake Kinneret, *Israel, Management, Surface water, Coriolis force, Water level, Water level fluctuations, Water management.

Using the two-dimensional theory of Rao and Schwab, the lowest 10 normal modes of Lake Kinneret were determined. The calculations were carried out neglecting the Coriolis force, which is of minor influence on the oscillations due to the medium size of the lake. The lake itself is roughly elliptic, with a longitudinal axis of 22 km in the north-south direction and a transverse axis of 12 km length. The maximum depth of the lake is 43 meters and the mean depth is 25.6 meters. During late winter and spring, when highest water levels usually occur, the free oscillation on the lake can contribute to inundation damage, mostly during stormy periods of easterly wind which are then dominant. For a future option of lake management the normal modes have also been calculated for a water level lowered by 4 meters, 15.7% reduction of the lake's volume. The theoretical periods were verified by spectral analysis of 26 cases of observed water level fluctuations. Verification of the calculated structure was only partially achieved due to the scarcity of existing simultaneous measurements. The structures of the normal modes are discussed in detail in terms of their character, their location of nodal lines and the distribution of relative elevations. (Baker-FRC)
W82-06879

THE WATERS OF MEROM: A STUDY OF LAKE HULEH 7. DIATOM STRATIGRAPHY OF THE 54-M CORE,

Academy of Natural Sciences of Philaelphia, PA.
For primary bibliographic entry see Field 5C.
W82-06880

KINETIC ANALYSIS OF COMPETITION BETWEEN SULFATE REDUCERS AND METHANOGENS FOR HYDROGEN IN SEDIMENTS,

Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
D. R. Lovley, D. F. Dwyer, and M. J. Klug.
Applied and Environmental Microbiology, Vol 43, No 6, p 1373-1379, June, 1982. 2 Fig, 4 Tab, 31 Ref.

Descriptors: *Bacteria, *Methane bacteria, *Sulfate-reducing bacteria, Sediments, *Lake sediments, Hydrogen, Eutrophic lakes, Sulfates, *Eutrophication, Wintergreen Lake, *Michigan.

The competition between sulfate-reducing and methanogenic bacteria for hydrogen was studied during summer stratification at two sites in eutrophic Wintergreen Lake, Michigan. In the upper 0-2 cm sediment layer sulfate reduction and methane production coexisted, but methane production was the dominant terminal process. Adding 10-20 nM sulfate to the naturally low-sulfate sediments produced a decrease in H partial pressure and an inhibition of methane production. Inhibition of sulfate reduction by molybdate in the sulfate-enriched sediment increased H partial pressure and methanogenesis to the rates seen in sediments unamended with sulfate. The half-saturation constants for H uptake were 141 pascal for the sulfate-reducer population and 597 pascal for the methanogen population. Thus, in the presence of sufficient sulfate, the lower half-saturation constant of the sulfate reducers allowed them to lower H partial pressures to levels unusable by methanogens. Then sulfate was not limiting, the competition between the two bacterial populations depended on the rate of H production, relative population size, and sulfate concentration. In this lake methane bacteria successfully competed with sulfate reducing bacteria because wulfate is limited. The competition for acetate is expected to have mechanisms similar to those for H competition. (Cassar-FRC)
W82-06886

THE BREAKDOWN AND DECOMPOSITION OF ALLOCHTHONOUS AND AUTOCHTHONOUS PLANT LITTER IN AN OLIGOTROPHIC LAKE (LLYN FRONGOCH),

University Coll. of Wales, Aberystwyth. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06895

SEASONAL AND LONG-TERM CHANGES IN SURFACE COVER OF AQUATIC PLANTS IN A SHALLOW POND, OJAGA-IKE, CHIBA, JAPAN,

Tokyo Metropolitan Univ., (Japan). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06900

DYNAMICS OF A SUBTROPICAL PLANKTON COMMUNITY, WITH EMPHASIS ON THE COPEPOD MESOCYCLOPS EDAX,

Maryland Univ., College Park. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W82-06906

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES IN THE LITTORAL ZONE OF SOME NORTH CAROLINA LAKES,

Wake Forest Univ., Winston-Salem, NC, Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06911

UV-SENSITIVE COMPLEX PHOSPHORUS: ASSOCIATION WITH DISSOLVED HUMIC MATERIAL AND IRON IN A BOG LAKE,

Oklahoma State Univ., Stillwater, Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06930

GROWTH DYNAMICS OF CLADOPHORA GLOMERATA IN WESTERN LAKE ERIE IN RELATION TO SOME ENVIRONMENTAL FACTORS,

Water Research Lab., Columbus, OH., Div. of Water.
For primary bibliographic entry see Field 5C.
W82-06932

MODERN LACUSTRINE STROMATOLITES, WALKER LAKE, NEVADA,

University of Southern California, Los Angeles, Dept. of Geological Sciences.
For primary bibliographic entry see Field 5C.
W82-06934

ENVIRONMENTAL FACTORS CONTROLLING PHYSIOLOGICAL CHANGES IN CLADOPHORA IN LAKE ERIE,
State Univ. of New York Coll. at Fredonia, Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06935

PROJECTED CLADOPHORA GROWTH IN SOUTHERN GEORGIAN BAY IN RESPONSE TO PROPOSED MUNICIPAL SEWAGE TREATMENT PLANT DISCHARGES TO THE MARY WARD SHOALS,
Ontario Ministry of the Environment, Rexale, Limnology and Taxonomy Section.
For primary bibliographic entry see Field 5C.
W82-06936

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: I. PROGRAM DESCRIPTION AND FIELD MONITORING OF GROWTH DYNAMICS,
Michigan Technological Univ. Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06939

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: 2. PHOSPHORUS UPTAKE KINETICS,
Michigan Technological Univ., Houghton, Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06940

BIOMASS AND DISTRIBUTION OF CLADOPHORA GLOMERATA IN RELATION TO SOME PHYSICAL-CHEMICAL VARIABLES AT TWO SITES IN LAKE ERIE,
Ecology and Environment, Incorporated, Buffalo, New York.
For primary bibliographic entry see Field 5C.
W82-06941

MONITORING CLADOPHORA GROWTH CONDITIONS AND THE EFFECT OF PHOSPHORUS ADDITIONS AT A SHORELINE SITE IN NORTHEASTERN LAKE ERIE,
Limnos Limited, Toronto, Ontario.
For primary bibliographic entry see Field 5C.
W82-06942

EFFECTS OF NATURALLY SENESCING AQUATIC MACROPHYTES ON NUTRIENT CHEMISTRY AND CHLOROPHYLL A OF SURROUNDING WATERS,
Indiana Univ., Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06943

COLONIZATION AND GROWTH OF ATTACHED ALGAE AT THE LAKE MICHIGAN WATER LINE,
Wisconsin Univ.-Milwaukee, Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06976

COMPARATIVE PHOTOHETEROTROPHY, CHEMOHETEROTROPHY, AND PHOTOLITHOTROPHY IN A EUTROPHIC RESERVOIR AND AN OLIGOTROPHIC LAKE,
North Texas State Univ., Denton. Dept. of Biological Sciences.
B. K. Ellis, and J. A. Stanford.
Limnology and Oceanography, Vol 27, No 3, p 440-454, May, 1982. 6 Fig, 2 Tab, 43 Ref.

Descriptors: *Microbiological studies, Lakes, Reservoirs, *Eutrophication, *Oligotrophic lakes, Oligotrophy, Trophic level, Microorganisms, Plankton, Seasonal variation, *Lake Texoma, Algae, *Texas, *Oklahoma.

The relative contributions of various organisms to photolithotrophic, chemoheterotrophic, and photoheterotrophic activities in plankton of two sizes in two diverse lentic systems were investigated. The study site was Lake Texoma, a eutrophic impoundment of the Red and Washita Rivers in Texas and Oklahoma, and Flathead Lake, a deep, glacial lake on the Flathead River in northwestern Montana. Lake Texoma is a monomictic reservoir with a surface area of 359.6 square kilometers and a depth of 35 meters. Ultraplankton dominated plankton numbers and metabolic activity in both systems. An increase in photolithotrophy during the fall was due to an increase in the activity, numbers/ml or both of specific phytoplankters rather than an increase in the percentage of viable cells. Many of the most abundant species were not the most productive in terms of inorganic C fixation. Single species dominated total inorganic C fixation in both systems. Light mediated uptake of glucose was extensive in Flathead Lake. Light bottle uptake averaged 365% of dark bottle uptake. Autoradiographs indicated that bacteria were responsible for the observed light-mediated uptake of glucose in both lakes. Chemoheterotrophy dominated all Lake Texoma samples. Simultaneous in situ NaHCO3 and glucose incubations in Lake Texoma revealed an ability of Oscillatoria agardhii (Gomont) to be mixotrophic as well as photoheterotrophic. (Baker-FRC)
W82-06978

EFFECTS OF PHOSPHORUS ENRICHMENT AND WAVE SIMULATION OF POPULATIONS OF ULOTHRIX ZONATA FROM NORTHERN LAKE SUPERIOR,
Utah State Univ., Logan. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06979

INVESTIGATION OF EUTROPHICATION PROCESSES BY CONTINUOUS RECORDING OF PRODUCTION AND DESTRUCTION,
All-Union Scientific Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
For primary bibliographic entry see Field 5C.
W82-06982

HYPEREUTROPHICATION OF AN HAWAIIAN ALPINE LAKE,
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W82-06991

2I. Water In Plants

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART II. ECONOMIC ANALYSIS,
Wright McLaughlin Engineers, Denver, CO.
For primary bibliographic entry see Field 6B.
W82-05966

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART I: MODELING RESERVOIR SIZE YIELD RELATIONSHIPS,
Wright McLaughlin Engineers, Denver, CO.
W. L. Palmer, B. J. Barfield, and C. T. Haan.
Transactions of the ASAE, Vol 25, No 2 p 372-376, March/April, 1982. 3 Fig, 4 Tab, 23 Ref.

Descriptors: *Crop yield, *Irrigation, *Reservoir storage, Model studies, *Corn, Reservoir design, Soil-water-plant relationships, Rainfall-runoff, relationships, Hydrologic models, *Supplemental irrigation, *Kentucky, Watershed management.

A watershed runoff model and a corn yield model were combined to describe corn yields as a function of reservoir size. Components of the model were; crop growth-soil function, water supply function-runoff model, reservoir water balance-reservoir sizing routine, site characterization, and climatic simulation. A hypothetical farming operation was simulated, assuming a 100 acre corn planting and 300 acre watershed in central Kentucky. A series of probability curves (corn yield vs. reservoir storage volume) were produced. For this example, a 6000 cu m reservoir would allow yields of 8000 kg per ha or greater 96% of the time. (Cassar-FRC)
W82-05967

EFFECT OF IRRIGATION ON THE STABILITY OF LEAF SIZE OF WHEAT, TRITICALE AND BARLEY,
Indian Agricultural Research Inst., New Delhi.
G. S. Chaturvedi, P. K. Aggarwal, and S. K. Sinha.
Indian Journal of Agricultural Sciences, Vol 51, No 10, p 738-745, October, 1981. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Water stress, Plant growth, *Barley, Irrigation, Irrigation requirements, Moisture stress, Crop yield, Moisture availability, Stress, *Wheat, *Triticale, *India.

The response of flag-leaf and other leaves to water availability was studied in several cultivars of Triticum aestivum Linn. emend. Thell., T. durum Desf., triticale and Hordeum vulgare Linn. emend. Bowden. Twenty-one cultivars were grown in the field under two moisture regimes: no irrigation versus five irrigations at different growth stages comprising crown-root initiation, jointing, booting, flowering, and grain filling. The stability of the flag-leaf size in relation to water stress was assessed. The findings indicate that in comparison with other leaves the size of the flag-leaf in different groups, and the flag-leaf size did not show the capacity to recover from the adverse effect of early stress even when water availability was adequate during the later growth period. Stress-induced reduction in flag-leaf was compensated by an increase in photosynthesis rate, as suggested by the increase in specific leaf weight. Considerable variability apparently exists in this respect within each of the groups. (Baker-FRC)
W82-05972

EFFECTS OF IRRIGATION FREQUENCY ON GERMINATION AND ON ROOT AND SHOOT YIELDS OF ACACIA SPECIES,
Shambat (Sudan). Faculty of Agriculture.
F. F. Bebawi, and S. M. Mohamed.
Plant and Soil, Vol 65, No 2, p 275-279, 1982. 2 Tab, 6 Ref.

Descriptors: *Soil-water-plant relationships, *Semiarid lands, Arid lands, Acacia species, Irrigation, Vegetation establishment, Germination.

Two experiments were performed to determine the effects of irrigation frequency on germination of Acacia seeds and growth yield of young seedlings of Acacias. In the first study there were 5 irrigation treatments replicated 4 times, including waterlogged soil, daily irrigation, irrigation at 3 days frequency, irrigation at 6 days frequency, and no irrigation (control). In the second study there were 4 treatments replicated 3 times, comprising daily irrigation (Control) and irrigation at 2,4 or 8 day frequencies. Highly different germination responses were found between species tested. Maximum germination response was realized by A. albida and minimum by A. nilotica. Over all species there were highly different responses between irrigation treatments. Daily irrigation induced the best germination response of about 57.9%, while waterlogged soil gave the second best germination response of about 10.4%. Highly significant differences were noted in root plus shoot yields between species, treatments, and species times treatment interaction. The greatest growth yield (root plus shoot) was manifested by A. nubica, while the lowest was revealed by A. nilotica, with a growth yield difference of about 59% between them. In general species of relatively dry habits were more sensitive to water supply compared with those of relatively wet habitats. This was reflected at the establishment phase by the greater production of root plus shoot yields by species of drier zones than by those of wetter ones. It is concluded that variations in water supply may account for species

adaptation and distribution in semi-arid zones. (Baker-FRC)
W82-06229

EFFECT OF WATER MANAGEMENT AND BED HEIGHT ON SUGARCANE YIELD,

Science and Education Administration, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
C. R. Camp.
Soil Science, Vol 133, No 4, p 232-238, April, 1982. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Water table, *Drainage effects, *Soil water table, *Sugarcane, Crop yield, Water management, *Louisiana, Subsurface drainage.

Sugarcane was grown in Mhoor silty clay loam in Louisiana under three water management regimes and two bed heights from 1973 to 1976. The three water management treatments were: (1) subsurface drainage with the water table at least 1.5 m below the surface, (2) water table maintained constant at 0.3 m below the surface, and (3) no subsurface drainage and variable water table responding to rainfall. The two bed heights were flat and 0.3 m high. Rainfall frequency and amount varied widely over the experimental period. Yields were adversely affected in flat beds during wet years. However, in the dry year flat bed planted sugarcane produced higher yields than raised beds. A water table depth of 0.3-1.5 m produced the best yields. During the wet years subsurface drained treatments gave significantly higher yields than the high, constant water table and variable water table (undrained) treatments. During the dry year the high, constant water table treatment produced higher yields than the low and variable water table treatments. (Cassar-FRC)
W82-06231

TRANSPIRATIONAL SUPPLY AND DEMAND: PLANT, SOIL, AND ATMOSPHERIC EFFECTS EVALUATED BY SIMULATION,

Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 2D.
W82-06320

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 1. THEORY AND HYPOTHESIS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson.
Water Resources Research, Vol 18, No 2, p 325-340, April, 1982. 1 Tab, 20 Fig, 34 Ref.

Descriptors: *Soil environment, *Plant-water potentials, Mathematical studies, *Canopy, *Atmosphere, *Transpiration, Runoff, Climate, Porosity, Field investigations, Water yield, *Optimization, Systems analysis, Equilibrium, Prediction.

The literature concerning ecological optimality of natural soil-vegetation systems has been reviewed and used as a guide to formulate hypotheses governing the equilibrium of water-limited systems with respect to canopy density, species water use, and hydraulic properties of the soil. A statistical-dynamic water balance is used to quantify these hypotheses. In moist climate-soil systems the soil moisture becomes insensitive to vegetation changes and can be maximized only with respect to canopy density. In humid systems the species may be subject to ecological pressure for longer-term change toward higher biomass productivity. These hypotheses result in a relationship specifying the time average evapotranspiration efficiency of landsurfaces given only the density of the vegetation canopy, a water table parameter, and a surface retention parameter. This relationship is independent of the soil properties and could produce estimates of the water and heat balances given only the properties of the climate. Combination of short-term optimal canopy density and long-term optimal biomass productivity can lead to specification of the climax vegetation canopy density and the species water use coefficient, as well as some hydraulic properties of the soil. If verified, these hypothesized relations should help in the design of land-reclamation. (Titus-FRC)
W82-06321

ECOLOGICAL OPTIMALITY IN WATER-LIMITED NATURAL SOIL-VEGETATION SYSTEMS 2. TESTS AND APPLICATIONS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson, and T. E. Tellers.
Water Resources Research, Vol 18, No 2, p 341-354, April, 1982. 7 Tab, 19 Fig, 28 Ref.

Descriptors: *Soil environment, *Plant water potentials, Mathematical studies, *Canopy, *Optimization, Systems analysis, Atmosphere, Climate, Runoff, Transpiration, Porosity, Field investigations, Prediction, Equilibrium, California, Massachusetts.

Tests to verify correlations between canopy density and species weter use in various climates were conducted. Field observations were made at sites in Massachusetts and California. The long-term optimal climatic soil-vegetation system is defined in terms of effective porosity and plant water use, and a relationship between average evapotranspiration and optimum vegetation canopy density is derived and compared with the field observations. It was found that the predicted water balance behavior is in reasonable accord with observations. However, more research is needed, particularly for arid climates. (Titus-FRC)
W82-06322

WATER STRESS OF FOUR WINDBREAK TREE SPECIES DURING SOIL DRYING,

Northern Great Plains Research Center, Mandan, ND.
A. B. Frank.
Journal of Soil and Water Conservation, Vol 37, No 3, p 189-192, May/June, 1982. 4 Fig, 12 Ref.

Descriptors: *Water stress, *Windbreaks, Shelterbelts, *Trees, Crops, Available water, *Soil moisture deficiency, Moisture deficiency, Green ash, Hackberry, American elm, Siberian elm, *Northern Great Plains.

Water is a major limiting factor to plant growth in the Northern Great Plains. Windbreak trees are thus susceptible to severe water stress. Stress occurs when water uptake through the roots cannot keep pace with transpiration. The rate of stress development differs among species. Water relations for green ash, hackberry, American elm, and Siberian elm trees were evaluated to determine the response to increasing soil water deficits and to relate results to field observations on competition among trees and adjacent crops and to tree growth characteristics. Leaf water potentials of green ash and hackberry, in comparison with American and Siberian elm, declined at different rates during a 2 year field study. From the initial sample data at full leaf expansion to thefinal sample data at leaves senescencing, leaf water potential dropped 30.1 bars for green ash and 27.9 bars for hackberry. These reductions compared with 10.1 and 6.2-bar reductions for American and Siberian elm, respectively. In a controlled-environment chamber, transpiration rates at high soil water potentials were considerably higher for Siberian elm than for green ash or American elm. The higher water stress in leaves of green ash and hackberry contributed to early growth cessation and leaf drop during late summer, which should reduce total soil water use by the trees and leave more water for adjacent crops. If Siberian elm were selected for early leaf drop, it would probably initiate hardening processes earlier and impart greater tolerance to winter injury and stress-related disease and insect attack. (Baker-FRC)
W82-06793

2J. Erosion and Sedimentation

CLIMATE VARIATION AND THE MOBILITY AND STORAGE OF SEDIMENT IN WATERSHEDS,

Wisconsin Univ.- Madison. Dept. of Geography.
For primary bibliographic entry see Field 4D.
W82-05931

DEPOSITIONAL MODEL FOR A CHENIER PLAIN, GULF OF CARPENTARIA, AUSTRALIA,

Australian Inst. of Marine Science, Townsville.
E. G. Rhodes.
Sedimentology, Vol 29, No 2, p 201-221, April, 1982, 13 Fig, 2 Tab, 67 Ref.

Descriptors: *Sedimentation, *Coastal plains, *Ridging, Tidal flats, Progradation, Chenier plains, Gulf of Carpentaria, *Australia, Runoff, Alluvial plains, Rainfall, Sediment transport.

A chenier plain (widely separated coastal ridges oriented nearly parallel to the modern coast and spread over a broad plain) in the Gulf of Carpentaria, Northern Australia, has prograded over 30 km since the Middle Holocene. This was caused by deposition of low tide muds over subtidal muds during periods of increased sediment input by rivers. The plain, extending for 150 km, consists of a series of discontinuous shell ridges resting on muddy substrates. Upland tree species grow on the ridges. Between the ridges are unvegetated mud flats or thinly vegetated clay dunes. The chenier ridges, formed during periods of reduced sediment flux by wave induced sorting and redistribution, reflected the increases and decreases in sediment flux from the rivers as a result of temporal fluctuations in rainfall over the watershed draining into the gulf. Techniques used to study the plain were core samples, geomorphic mapping, and radiocarbon dating. These findings reinforced the traditional explanations of chenier plain development. (Cassar-FRC)
W82-05957

BED-MATERIAL SIZE AND THE RIFFLE-POOL SEQUENCE,

Newcastle upon Tyne Univ. (England). Dept. of Geography.
J. A. Milne.
Sedimentology, Vol 29, No 2, p 267-278, April, 1982. 10 Fig, 4 Tab, 34 Ref.

Descriptors: *Bed sediment, *Particle size, *Riffles, Sedimentation, Streams, Sediment distribution, Sediment sorting, Gravel, Channel morphology, *Scotland, Kingleadoors Burn.

Relationships between bed material characteristics and local riffle-pool oscillations along a channel are described. The stream examined was Kinglesdoors Burn, a small gravel bed stream in upland Scotland. The downstream sequences of bed material size were highly variable and showed no trend except for slight persistence in data over distances of 1-1.5 channel width. Riffles tended to coincide with coarser bed material sequences. Mean particle size was the most useful criterion for distinguishing between bed forms, bars being the most distinctive features. Riffles and pools were considered as downstream oscillations in elevation of a single coarser gravel sedimentary unit. Plan geometry and coarse sediment supply also influenced bed material size distributions. Tightly curved pools had the finest pool sediments and the least difference between bar and pool sediments. Larger sizes of materials in pools were negatively correlated with the index of cross section asymmetry. (Cassar-FRC)
W82-05958

QUANTITATIVE RELATIONSHIPS BETWEEN NUMBERS OF FLUVIAL CYCLES, BULK LITHOLOGICAL COMPOSITION AND NET SUBSIDENCE IN A SCOTTISH NAMURIAN BASIN,

Institute of Geological Science, London (England).
W. A. Read, and J. M. Dean.
Sedimentology, Vol 29, No 2, p 181-200, April, 1982. 9 Fig, 4 Tab, 57 Ref.

Descriptors: *Sedimentary basins, *Fluvial sediments, *Subsidence, Sedimentary rocks, Alluvial deposits, Sedimentology, Sedimentation, Sand, Stratigraphy, Geology, *Scotland, Rivers, Kincardine Basin.

Fluvial deposits in the subsiding Namurian Basin, Kincardine Basin in the Midland Valley of Scotland, were studied as a background for future computer simulation experiments and for comparison with other ancient basins. The succession of rock strata under investigation consisted almost entirely of fluvial deposits. More than 94% of the semicycles containing sand were upward-fining, leading to the conclusion that rivers were dominantly meandering. The numbers of rooting horizons and grain-size cycles and the total thicknesses of sandstone and mudstone-siltstone showed a linear relationship with the total thickness of strata and net subsidence. The average thickness of grain-size cycles showed trends toward an inverse linear relationship with net subsidence, reflecting the presence of thin stacked channel fills within persistent channel belts. These belts were localized in areas of greatest subsidence in the basin and followed courses similar to channels in the underlying delta sediments. Sand was most commonly found at points on the margin where channels entered the basin from the northwest and northeast and left to the southwest. Mudstone and siltstone were on the flanks of the basin. Coal seams were found on the flanks of the basin. The rooting horizons were most numerous in areas of low subsidence remote from main channel belts. (Cassar-FRC)
W82-05959

SPLASH EROSION MODELING: PHYSICAL ANALYSIS,

Illinois Univ., Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, J. K. Mitchell, and G. G. Bubenzer.
Transactions of the ASAE, Vol 25, No 2, p 357-361, March/April, 1982. 4 Fig, 20 Ref.

Descriptors: *Erosion, *Splash erosion, *Rain, Soil erosion, Model studies, Impact velocity, Water depth, Slopes, Interril erosion.

The splash erosion process was expressed mathematically using dimensional analysis. It is generally limited to interrill areas where erosion takes place within two different domains, drop-solid and drop-liquid-solid. The drop-solid domain was described with analytical relationships from the law of conservation of momentum. The drop-liquid-solid domain was characterized using the ratio of water depth to drop diameter. The models considered raindrop, sediment, and system parameters affecting splash erosion. Experimental data from the literature were used to evaluate the effects of various parameters affecting splash erosion. When drops were too small or their impact velocity was to low to overcome the inertia of the soil particles, no splash erosion occurred. Splash erosion increased slightly to a critical water depth of about 1 drop diameter and decreased sharply as the water depth increased beyond that point. Splash erosion was time-dependent. The horizontal displacement of sediment increased linearly as the slope angle increased, but the vertical displacement decreased nonlinearly with slope. It is possible that the effects of Froude number may be appreciable. (Cassar-FRC)
W82-05970

TRANSPORT OF IRON, MANGANESE, CADMIUM, COPPER, AND ZINC BY MAGELA CREEK, NORTHERN TERRITORY, AUSTRALIA,

Caulfield Inst. of Tech., Caulfield (Australia). Water Studies Centre.
For primary bibliographic entry see Field 5B.
W82-06054

CHANGES IN BOTTOM TOPOGRAPHY OF THE WESTERN SHELF ON THE NILE DELTA SINCE 1922,

National Research Center, Cairo (Egypt).
S. A. Toma, and M. S. Salama.
Marine Geology, Vol 36, No 3/4, p 325-339, July, 1980. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Topography, *Deltas, *Nile Delta, Aswan High Dam, Dams, Bathymetry, Sediments, Rivers, Flow discharge, Sediment discharge, Erosion, Sediment distribution, Bottom sediments, Geomorphology, Continental shelf, Mediterranean Sea.

Significant changes have been noted in bottom morphology of the western continental shelf of the Nile Delta since 1922. Most of these changes were already in progress before the completion of the Aswan High Dam in 1964. The Rosetta Canyon appears to influence bottom currents and the pattern of bottom-sediment distribution. The water flow and sediment flow discharged from the Rosetta mouth toward the Rosetta canyon overcomes the current flow to the east, which prevails, or to the west, which also occurs. Thus the Rosetta Canyon serves as a sink for the eroded sediments transported offshore from Abu Quir Bay and the Rosetta fan. For sand movements on the Burullus shelf, the bottom-current velocities are of minor magnitude and only capable of transporting fine-grained material. Wave-induced currents must be the energy source for sand movements on the shelf. Stormy weather conditions are of prime importance. It is suggested that net erosion in the area off the Rosetta mouth and the retreat of the adjacent coastline probably reulted from the drastic decline of sediment on completion of the Aswan High Dam. (Baker-FRC)
W82-06094

THE ROLE OF THE AKOSOMBO DAM ON THE VOLTA RIVER IN CAUSING COASTAL EROSION IN CENTRAL AND EASTERN GHANA (WEST AFRICA),

Ghana Univ., Legon. Dept of Geology.
C. K. Ly.
Marine Geology, Vol 37, No 3/4, p 323-332, September, 1980. 9 Fig, 4 Ref.

Descriptors: *Erosion, *Dams, *Volta River, West Africa, *Ghana, Sediment discharge, Sediments, Sand, Rivers, Topography, Shore protection, Shores, Coasts, Erosion rates, *Beach erosion.

Since the building of the hydroelectric dam on the Volta River at Akosombo, West Africa, the supply of sand from the river has been greatly reduced. Whether this reduction in sand contributes to the erosion of the coast of Ghana has been investigated. About 99.5% of the river drainage basin is blocked by the dam. Comparisons were made of the average rates of shoreline retreats as determined from aerial photographs and maps during the periods before and after dam construction. The shoreline of central and eastern Ghana appears to be characterized by a general recession. This recession was not extensive on the western portion of the central coast between Cape Three Points and Winneba, where there are many protruding rock headlands. Shoreline recessions on the order of 2 to 6 meters per year are experienced on many remaining parts of the coast. The rate of shoreline recession to the west of the Volta River has remained constant before and after dam construction and thus is apparently not influenced by the dam. Since dam construction there has been a general increase in shoreline recession rates to the east of the Volta River, caused by reduction of sand supply from the river following dam construction. (Baker-FRC)
W82-06100

MINERALOGICAL INPUT OF SUSPENDED MATTER BY INDIAN RIVERS INTO THE ADJACENT AREAS OF THE INDIAN OCEAN,

Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian.
Marine Geology, Vol 36, No 3/4, p M29-M34, July, 1980. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Sediment transport, *Rivers, *Indian Ocean, Sediments, Minerals, Mineralogy, Oceans, Kaolinite, Illite, Quartz, Fluvial sediments, Sediment discharge, Suspended sediments, Bay of Bengal, Arabian Sea, Rivers.

Preliminary results are reported on the mineralogy of suspended sediments at the mouths of the Ganges, Brahmaputra, Narmada, Tapti, Mahanadi, Godavari, Krishna, and Cauvery Rivers and their relationship to the reported mineralogy of bed sediments in the Bay of Bengal and the Arabian Sea. The data suggest that kaolinite, illite, and chlorite are carried in suspended particulates of the Ganges-Brahmaputra, while the southern rivers carry high amounts of montmorillonite and small amounts of mixed-layer clays to the Bay of Bengal. The presence of montmorillonite and mixed-layer clays in the suspended sediments of the Narmada, Tapti, Mahanadi, Godavari, Krishna, and Cauvery Rivers would support the observations made earlier about a montmorillonite belt surrounding India. On the western coast of India, the Narmada and Tapti Rivers contribute abundant chlorite, illite, and kaolinite, and minor amounts of montmorillonite. The four southern rivers, Mahanadi, Godavari, Krishna, and Cauvery, are characterized by the absence of chlorite, abundance of montmorillonite, and presence of trace amounts of mixed-layer clays and small Jamuna, are characterized by the presence of large amounts of illite, equal quantities of kaolinite and chlorite, and little or no mixed-layer clays and montmorillonite. Central rivers such as Narmada and Tapti have mineralogical characteristics between those of the southerly and the Himalayan drainage systems. (Baker-FRC)
W82-06102

WAVES GENERATED BY RIVER AND WIND ON THE ILLINOIS AND MISSISSIPPI RIVERS,

Illinois State Water Survey, Urbana.
N. G. Bhowmik, M. Demissie, and C-Y. Guo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254897, Price codes: A05 in paper copy, A01 in microfiche. Illinois Water Resources Center, Urbana, WRC Research Report No 167, March 1982. 90 p, 33 Fig, 11 Tab, 33 Ref. OWRT A-104-ILL(1), 14-34-0001-0115.

Descriptors: *Wind waves, *Waves, *Wave height, Rivers, *Bank erosion, *Regression analysis, Wind, Wind gages, Wind-driven currents, Translatory waves, Wave action, Wave wash, Ships, Barges, Boats, Mathematical studies, Drawdown, Illinois River, *Mississippi River.

Data on waves generated by river traffic/winds on the Illinois and Mississippi Rivers as representative U.S. waterways were collected systematically to address specific questions (the characteristics of waves from tows/barges/boats in an inland waterway; similarities/dissimilarities between these waves and those produced by natural effects; wave intensity changes as a function of increased river traffic) and the associated effect of bank erosion. The data were obtained in six field trips to four river test sites. Maximum wave heights ranged from 0.1-1.08 feet, while maximum drawdown ranged from 0.05-0169 foot. These data were compared to those expected from predictive equations, and the correlations were found to be low. However, multivariate regression analyses between measured values and hydraulic/geometric parameters which were felt to influence the generation of waves/draw downproduced two equations which predict maximum wave heights and drawdowns fairly well. In general, observed and calculated waves from river traffic and wind are both sufficient to cause stream bank erosion along the Rivers. Drawdown from loaded tows was also significant, changing flow characteristics of small tributary streams. (Zielinski-MAXIMA)
W82-06163

SEDIMENT CHARACTER AND PROVENANCE IN A COMPLEX FJORD; HOWE SOUND, BRITISH COLUMBIA,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Center.
J. P. M. Syvitski, and R. D. Macdonald.
Canadian Journal of Earth Sciences, Vol 19, No 5, P 1025-1044, May, 1982. 19 Fig, 1 Tab, 38 Ref.

Descriptors: *Estuarine environment, Sediment analysis, *Sedimentation, Fjords, British Columbia, Howe Sound, Geology, Geomorphology, Squamish River, Fraser River, Copper, Zinc, Mine wastes, Sediment transport, *Canada.

Sediment pathways are traced from the following sources: glacially derived sediment from the Squamish River, suspended sediment from the nearby Fraser delta complex, reworked Pleistocene tills, and mine tailings from an abandoned copper-zinc mine. Howe Sound was chosen for the study as it is an estuary located close to a large urban population. Grain size data have been used to differentiate depositional versus nondepositional environments. In addition, surficial sediment samples collected from depositional basins could be modeled in terms of their size-frequency distribution and distance from source. Those that deviate from a predicted grain size distribution were found to be bimodal. Partitioning of their probability curves allowed the establishment of mixing ratios of the major sediment sources, and indicated that the Squamish-derived sediment accounted for between 80 and 100% of recent Howe Sound deposition. Semi-Quantitative X-ray diffraction analysis results can resolve the dispersion directions of each source and show that mica can be used to trace the Squamish sediment source, the chlorite pattern indicates the Fraser sediment source, and quarts is useful in delineating pathways of sediment resuspended from lag deposits. These pathways are also substantiated by gradients in copper, nickel and zinc concentrations in the sediments. Such studies are useful for areas such as this one which is too complex to model in terms of water circulation. (Baker-FRC)
W82-06189

ORIGIN OF STEP-POOL SYSTEMS IN MOUNTAIN STREAMS,

Lincoln Coll. (New Zealand). Dept of Agricultural Engineering.
J. G. Whittaker, and M. N. R. Jaeggi.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 758-773, June, 1982. 5 Fig, 4 Tab, 52 Ref.

Descriptors: *Streambeds, *Stable channel, *Sediment transport, Stream stabilization, Stream erosion, Antidunes, Step-pool systems, Mountain streams, Erosion, Riffles, Deformation, Sediment sorting.

A tilting laboratory flume and a graded sediment (2-50- mm particle size) were used to study the mechanisms of step-pool formation in steep mountain streams. In highly sloped beds (.0.075), step-pool structures formed during high flow by an initial bed deforming process. The heterogeneity of the sediment caused formation of a coarse armored layer, resistant to deformation. This formed a stream bed which was very stableat low flow. At slopes <0.075, high flow formed antidunes. When the flow was reduced, the streambed had a riffle-pool appearance. (Cassar-FRC)
W82-06335

MATHEMATICAL MODEL FOR ERODIBLE CHANNELS,

San Diego State Univ., CA.
H. H. Chang.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY5, p 678-689, May, 1982. 5 Fig, 15 Ref.

Descriptors: *Channel erosion, *Mathematical models, *Alluvial channels, *Aggradation, *Stream degradation, *Stream erosion, Channel flow, Erosion, Sedimentation, Stream profiles, Stream beds, Model studies.

A mathematical model was developed for predicting morphological changes in erodible channels while accounting for alterations in both channel width and bed profile of aggrading and degrading streams. The model employs methods for water and sediment routing as well as an additional condition based on the concept of minimum stream power as the width predictor. Application of the model shows that the total stream power of a reach is reduced if the widths at all cross sections are adjusted to reduce the variation in energy gradients at these sections. A varied flow will gradually develop into a uniform flow while the stream power reaches a minimum. The model has been substantiated with field data and demonstrates the validity of the concept of minimum stream power as a physical principle governing the morphology of alluvial streams. It also furnishes a basic understanding of the changes in streams in response to various environmental and hydraulic parameters. (Geiger-FRC)
W82-06336

GEOMORPHIC AND LITHOLOGIC CONTROLS OF DIFFUSE-SOURCE SALINITY, GRAND VALLEY, WESTERN COLORADO,

Colorado State Univ., Fort Collins. Dept. of Earth Resources.
R. K. Johnson, and S. A. Schumm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256587, Price codes: A06 in paper copy, A01 in microfiche. Completion Report No 10, April, 1982. 99 p, 20 Fig, 11 Tab, 29 Ref, 1 Append. OWRT B-203-COLO(1). 14-34-0001-0210.

Descriptors: *Salinity, *Saline soils, *Sediment transport, *Water pollution sources, *Dissolved soilds, *Surface runoff, Erosion, Saltation, Salt flats, Saline water, Sedimentation, Salts, Runoff, Sediment erosion, Sediment load, Water quality, Water quality control, Sediment discharge, Pollution load, Sandstones, Shales, Colorado River, Grand Valley.

Grand Valley Mancos shale, composed of a thick sequence of interbedded shale and sandstone, is a significant contributor of dissolved solids to the upper Colorado River. Research was carried out to describe the area geomorphology and soluble mineral content relationships of surficial materials in erosionally-unstable landforms, to relate geomorphic stability to salt release processes from the area, and to recommend land use and/or salt control measures for reducing salt load alluvial valley floors, and badlands, with the latter having the greatest surface area. The badlands are the least stable landform, releasing more sediment and salt into runoff than the other landforms. Pediments are capped by cemented gravels and are the most stable landform, while the alluvial valley floors are generally also stable to sediment/salt production. Recommendations for understanding erosional and salinity characteristics of runoff from the badlands and for reducing erosion/salinity related to current land use include examining the effectiveness of existing sediment retention structures, comparing sediment load and salinity of runoff from two drainage basin lithologies, and reducing gully erosion caused by road drainage ditches/culverts. (Zielinski-MAXIMA)
W82-06364

A NEW METHOD FOR REPORTING AND INTERPRETING TEXTURAL COMPOSITION OF SPAWNING GRAVEL,

Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
For primary bibliographic entry see Field 8I.
W82-06395

LOWER FLOW REGIME BEDFORMS: RATIONAL CLASSIFICATION,

London Coll. (New Zealand). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W82-06421

SEDIMENT TRANSPORT AND UNIT STREAM POWER FUNCTION,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang, and A. Molinas.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 774-793, June, 1982. 7 Fig, 2 Tab, 24 Ref.

Descriptors: *Sediment transport, *Energy dissipation, *Turbulent flow, Bed load, Sediment load, Sediment concentration, Sediment discharge, Fluid mechanics, Open channel flow, Channel flow, Flow characteristics, Suspended sediment, Unit stream power, Flumes, Rivers, Steady flow, Sediment discharge, Mathematical equations.

Suspended sediment concentrations at a given depth of an open channel flow are a function of the turbulence energy production rate at that depth. This hypothesis was verified by applying basic flow mechanics and turbulence theories. By integrating the rate of turbulence energy production over depth of flow, depth-averaged suspended sediment concentration was expressed as a function of unit stream power. Total sediment concentration was also described as a function of unit stream power by the process and a procedure similar to that used by Einstein. Seven total load equations were evaluated by comparing the computed results with 1093 sets of laboratory data and 166 sets of river data. Results from equations based on the concept that the rate of sediment transport in a open channel flow is related to the rate of energy dissipation of the flow produced good agreement with measured results. This group included equations proposed by Yang, Englund, Hansen, and Ackers and White. Equations by Shen and Huang and by Maddock, which lacked depth parameters, were applicable to laboratory flumes and small streams but not to large rivers. The Colby method underestimated total bed load material loads in natural rivers and was not suitable for laboratory flumes. (Cassar-FRC)
W82-06424

SEDIMENT ANALYSES FOR URBANIZING WATERSHEDS,

Army Engineer District, St. Louis, MO.
G. R. Dyhouse.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 399-418, March, 1982. 15 Fig, 9 Ref.

Descriptors: *Urban watersheds, *Urbanization, *Sedimentation, *Urban runoff, Storm runoff, Land use, Prediction, Mathematical models, Dredging, Sediment discharge, Flood plains, Sediment transport, Computer programs, St. Louis, *Missouri, *Illinois.

Preconstruction planning for the Harding Ditch portion of the East St. Louis, Illinois and Vicinity Interior Flood Control Project, which is the main drainage canal for two urbanizing watersheds near St. Louis, Missouri, required an analysis of sediment deposition under current and future land use conditions and of the efects of channel modifications on the sediment regime and on the frequency and quantity of dredging required to maintain a larger channel. A grid cell data bank was used to break down each watershed by land use category and to establish the percent of the watershed in each category. Four major computer programs or methods were used to model mass runoff of water and sediment from the watersheds and deposition-erosion along Harding Ditch for existing and future (2020) land use conditions. Estimates of sediment washoff parameters for each land use category were used to compute hourly values of discharge and tons of sediment washoff per event from each watershed for 20 years of rainfall data for existing and future land use. Comparison of the current and future thalweg profiles indicated that future land use conditions will result in less sediment deposition as more and more erodable soil is covered by impervious material. If upstream erosion control measures are instituted during the construction process, any downstream depositional problems should be reduced further. Although periodic dredging will be needed to maintain the required channel geometry for any channel modification project, dredging at 10-year intervals should be sufficient to maintain a with-project rating curve relationship. (Carroll-FRC)
W82-06426

INSHORE-OFFSHORE SEDIMENTATION DIFFERENCES RESULTING FROM RESU-

SPENSION IN THE EASTERN BASIN OF LAKE ERIE,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
J. Bloesch.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 748-759, May, 1982. 7 Fig, 8 Tab, 27 Ref.

Descriptors: *Sediment transport, *Lake sediments, *Lake Erie, *Sedimentation rates, *Model studies, Sediments, Sedimentation, Sediment distribution, Suspended sediments, Particulate matter, Organic carbon, Nitrogen, Phosphorus.

Sediment traps moored at three stations along an inshore-offshore transect in the Eastern Basin of Lake Erie from June to October of 1978 were used to examine differences in sedimentation processes of the near-shore and offshore environments in terms of dry weight, particulate organic carbon (POC), particulate nitrogen (PN) and particulate phosphorus (PP). Settling fluxes recorded at traps close to the lake bottom were nearly the same at all three stations during the summer stratification. At the offshore monitoring site, a comparison of the hypolimnetic traps with the epilimnetic traps showed that considerable resuspension takes place even in the summer. During the fall, however, storm-induced bottom resuspension resulted in higher nearshore sedimentation rates. A resuspension model for dry weight, POC, and PN was developed by comparing trap catches with sediment cores from all three stations. Data showed that newly formed organic material is resuspended and redeposited more frequently at nearshore locations than offshore, thus enhancing decomposition of detritus, as indicated by the low relative phytoplankton activity in the hypolimnetic traps. These cycles cause horizontal transport of fine-grained organic matter in the offshore direction and explain the significant POC and PN concentration differeces observed in the inshore and offshore sediments. (Geiger-FRC)
W82-06494

SUSPENDED SEDIMENT IN A WAVE FIELD,
Canada Center for Inland Waters, Burlington (Ontario).
M. G. Skafel, and B. G. Krishnappan.
Atmosphere-Ocean, Vol 19, No 3, p 274-278, 1981. 5 Fig, 3 Ref.

Descriptors: *Suspended sediments, *Sediment transport, *Wave action, Shear, Photography, Vortices.

A series of photographs illustrate the ripple form and the kinematics of suspended sediments in a wave field. Experiments were conducted in a wave flume in which sieved glass beads covered the bottom. Water depth was 0.15 m, wave period was 1 sec, wave height was 55 mm, mean ripple length was 37 mm, and mean ripple height was 4.6 mm. No imposed currents were present. The strong shear on the local upstream side of the ripples and the subsequent vortex developed on the downstream side were visible. Sediment was evident in the fluid above the bed to a height equal to about half the wavelength of the ripples. (Cassar-FRC)
W82-06527

SEDIMENT TRANSPORT STUDY ALONG A DELTA SHORELINE,
CH2M Hill, Bellevue, WA.
J. L. Scott.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 101-116, 1982. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Sediment transport, *Deltas, *Intertidal areas, Shores, Nisqualiy River, *Washington, Puget Sound, Beaches, Wave action, Sandpits, Particle size distribution, Water currents, Sediment distribution.

Sediment transport was studied along the east shoreline of the Nisqually River Delta, Puget Sound, Washington, to provide baseline data and to determine the possible effects of shoreline construction proposed by a timber company. Sediment transport on the beach was determined by interpretation by beach profiles and sediment texture and by a beach grain tagging experiment. Sediment movement on the delta platform was estimated from sediment trap data and an historical chart comparison. Several conclusions were reached from the studies. Waves are responsible for the small amount of sediment transported on the beach, and tidal currents cause sediment transport over the delta platform. The small amount of sediment transported in the intertidal zone occurs in a northerly direction, reflecting the predominance of southerly winds. The intertidal sediment consists of poorly sorted sandy gravels; the delta sediments, moderately sorted silty sands. On the delta platform sediment transport rates are 0.00004 g per cm-sec or less, with local increases due to bioperturbation. Tidal currents determine the direction of transport. The sediment grain size data indicate a depositional or no-transport environment along the eastern shore of Nisqually Reach, a U-shaped trough offshore from the delta. A man-made sandspit perpendicular to the shore, located between the proposed timber company wharf and the delta, is being gradually eroded. It has negligible effects on sediment transport in the delta platform and intertidal zones. The present wharf, north of the delta, attenuates wave energy from the north. An enlarged, improved wharf should be designed to allow nonrestricted movement of sediments and currents. (Cassar-FRC)
W82-06553

EROSION AND SEDIMENT,
Soil Conservation Service, Lanham, MD.
W. F. Mildner.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 161-166, 2 Fig, 9 Ref.

Descriptors: *Erosion, *Sedimentation, Sediment yield, Slopes, Rainfall, Vegetation effects, Sediment delivery ratio, Universal Soil Loss Equation, Suspended load, Suspended sediments, Particle size, Watersheds, Sheet erosion, Soil erosion, Reviews.

Methods of measuring erosion and sediment are described. The most commonly accepted equation for determining soil loss is the Universal Soil Loss Equation, which predicts the average annual soil loss (sheet plus rill erosion) in tons per acre. The six factors comprising the equation (rainfall, soil erodibility, slope length, slope gradient, cropping management, and erosion control practice) are discussed. Sediment yields may be determined from gross erosion and sediment delivery ratios by measuring sediment accumulation, by sampling suspended sediment loads, or by using predictive equations expressing sediment yield as a function of measurable independent variables. Sediment delivery ratios are essential to the sediment yield equation mentioned above. Factors influencing the sediment delivery ratio are types of sediment sources (channel or sheet), magnitude and proximity of sediment sources, transport system, (clogged or open channels, meandering or straight, etc.) size of eroded material (small particles are more easily transported), areas of deposition (foot of slopes, in valley flats, at the heads of lakes, etc), and watershed characteristics (high relief produces high sediment delivery ratios). One procedure for estimating sediment delivery ratio requires statistical analysis of available data where the sediment delivery ratio is a dependent variable and measureable watershed factors are the independent variables. Previous workers have also related the sediment delivery ratio to the size of drainage area, relief-length ratio, and sources of deposition. (Cassar-FRC)
W82-06554

USE OF THE FINITE-ELEMENT METHOD FOR SOLVING THE TRANSFER EQUATION,
Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Kharkov (USSR).
A. M. Anikeenko, O. N. Litvin, and I. A. Sherenkov.
Water Resources, Vol 8, No 3, p 263-266, May/June, 1981. 2 Fig, 6 Ref. Translated from Vodnye Resursy, No 3, p 80-84, May/June, 1981.

Descriptors: *Finite element method, *Turbulent flow, *Sediment transport, Suspended solids, Suspended sediment, Settling basins, Eddy diffusion, Settling velocity, Numerical analysis, Model studies, Hydrodynamics, Mathematical models.

Transport of suspended matter in turbulent flows is examined for the separate class of problems in which small-sized, small volume concentration particles predominate (examples: suspended sediment transport, settling basins, recycled water ponds). In these cases suspended matter transport may be described by a boundary value problem for the turbulent difference diffusion equation. Where the widths of flow are small compared to the lengths (canals, horizontal settling basins, long water bodies) two-dimensional solutions can be used. Several problems are solved by the finite element method using the Ritz procedure and the concept of local potential. (Cassar-FRC)
W82-06620

LAND WATER INTERACTIONS: EFFECTS OF INTRODUCED NUTRIENTS AND SOIL PARTICLES ON RESERVOIR PRODUCTIVITY,
Oklahoma Univ., Norman. Dept. of Zoology.
B. L. Kimmel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256843, Price codes: A06 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute Report, April 1981, Stillwater. 95 p, 27 Fig, 6 Tab, 107 Ref. OWRT A-088-OKLA(2), 14-34-0001-0138.

Descriptors: *Surface runoff, *Euphotic zone, *Influent seepage, *Photosynthetic bacteria, *Suspended solids, *Reservoir stages, Watershed management, Reservoirs, Phytoplankton, Photosynthesis, Nutrient requirements, Suspended load, Field tests, Bacteria, Organic matter, Aquatic plants, Essential nutrients, Suspended sediments, Runoff.

Laboratory studies with experimental water columns and field studies in a lake were undertaken to examine the effects of introduced nutrients and suspended soil particles (SSP) on organic matter production in man-made impoundments. Watershed runoff experiments and in place monitoring of inflow events in the lake showed that turbidity associated with river-borne (SSP reduced the euphotic layer thickness, inducing light-limited phytoplankton (PP) photosynthesis in a larger portion of the water column. Nutrient desorption from SSP enhanced nutrient availability for PP and bacterioplankton (BP) production, and was dependent on soil nutrient composition. Increased nutrient availability associated with watershed inflow stimulated PP production in the water column euphotic layer. The presence of SSP did not significantly stimulate microheterotrophy. Highly turbid watershed runoff caused vertical displacement of PP cells in laboratory water columns and during runoff events in the lake. These results indicate ultra-PP and free-living bacteria are coflocculated in high SSP concentrations. In both laboratory and field studies, the PP-BP response to turbid inflow occurred in 3 district phases: light limitations of photosynthesis; partial removal of PP and bacteria from the water column by combined advective-vertical displacement; and nutrient stimulation of euphotic layer PP. An analogous sequence should occur in reservoirs having similar inflow characteristics. (Zielinski-MAXIMA)
W82-06710

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto, T. C. Young, and S. C. Martin.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 855-862, June, 1982. 122 Ref.

Descriptors: *Literature reviews, *Sediments, *Fate of pollutants, *Metals, *Reviews, Sedimentation, Sediment transport, Sampling, Chemical analysis, Heavy metals, Nutrients, Organic compounds, Benthic fauna, Invertebrates, Model studies, Phosphorus, Nitrogen, Lake sediments, Reservoirs, Bacteria.

A review of recent papers on aquatic sediments includes analytical and sampling methods, heavy metals, nutrients, biological activity, organic pollutants, and modeling and sediment transport. Analytical methods described the use of neutron activation for trace metal analysis, a method for Be7 direct measurement, methods for simultaneous determination of 15 and 20 metals, and procedures for detection of Zn, Cd, Ca, Pb, Fe, Al, Hg, Ba, and Ra. Chromatography and/or mass spectrometry techniques were applied to determination of organic compounds. Sediment core sampling and sediment traps were the subject of several papers. Heavy metals investigations showed that suspended solids levels under estuarine conditions did not remove dissolved chromate from the water column. In a wastewater effluent receiving stream Mn remained dissolved, and other heavy metals were associated with the colloidal and particulate fraction. In uranium mine effluent Ba(Ra)S04 was a predominant particulate phase. Relationships between nutrients, especially P, and sediments were discussed. Release of nutrients from sediments was related to oxygen status, redoxpotential, and mineral phases. Investigations of biological activity in sediments included oxygen demand, activity of nitrifying organisms in different layers of a lake, metabolism of sediment bacteria under anaerobic conditions, bacterial degradation of organic pollutants in sediments, and effects of pollutants on benthic fauna. Case studies of organic pollution incidents and models for transport or organic compounds were discribed. Several sediment transport models concerned agricultural runoff, sediment yield from forested watersheds and streams, sediment behavior in reservoirs and lakes, and sediment-water exchange models. (Cassar-FRC)
W82-06806

AN UPSTREAM FINITE ELEMENT METHOD FOR SOLUTION OF TRANSIENT TRANSPORT EQUATION IN FRACTURED POROUS MEDIA,

California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W82-06858

CALCULATION OF CUMULATIVE PERCENTAGE AT SELECTED PARTICLE SIZES FROM BOTTOM WITHDRAWAL TUBE ANALYSIS,

Department of the Environment, Ottawa (Ontario). Computing and Applied Statistics Directorate.
C. S. Lam.
Water Resources Bulletin, Vol 18, No 3, p 525-528, June, 1982. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Particle size, *Suspended sediments, Computers, Sediments, *Oden curve, Mathematical studies, Statistical studies, *Sedimentation.

A new method is proposed for obtaining a single continuous Oden curve in a sediment particle size analysis. A time scale transformation is introduced, and the cumulative percentage of a selected particle size is analytically determined by cubic spline coefficients in the tangent intercept on the curve. Of the 124 tested samples, 113 samples could be fitted by a four-knot pline function. Six of the failed 11 samples could be fitted by a five-knot spline function. Three of the remaining 5 samples could be fitted by a five-knot spline function after deletion of one bad data point. Only two samples failed all attempts. The economy of this new approach over the manual graphical method is obvious. A more significant point is that the percent finer of a selected particle size is determined through a single continuous curve. The accuracy of the result obtained by averaging two approximated tangents of two overlapping segments, in which the continuity of the Oden curve is in question in the graphical method, is no longer an argument in the new approach. On a CYBER 74 computer, it took 14.15 seconds to calculate the equivalent percentages in a 100 cm high suspension of sediment and corresponding settling times for 124 samples from laboratory measured data. The calculation of percent finer at 15 selected particle sizes for all samples took 20.25 seconds. (Bakr-FRC)
W82-06873

A DYNAMIC SYSTEM MODEL FOR SIMULATING SEDIMENT DISCHARGE,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W82-06876

FIRE AND GEOMORPHIC PROCESSES,

F. J. Swanson.
In: Proceedings of the Conference on Fire Regimes and Ecosystem Properties, December 11-15, 1978, Honolulu, Hawaii, General Technical Report WO-26, Forest Service, Washington, D.C., June 1981, p 401-420, 4 Fig, 81 Ref.

Descriptors: *Fires, *Geomorphology, *Soil erosion, *Sediment yield, *Hydrology, *Vegetation, Sediment transport, Forest fires, Soil water, Overland flow, Sediment erosion, Accelerated erosion, Watershed management.

Fire alters vegetation and soil properties; these changes alter the hydrologic regime of a site with the collective effect of changing the movement of soil and sediment through watersheds. Interactions among fire, hydrology, and geomorphology vary with the time scale on which a landscape ecosystem is considered. On the short time frame of immediate effects of a single fire on hydrology and geomorphology, fire operates principally through alteration of vegetation and soil properties to alter hydrologic and geomorphic processes. The effects are generally increased soil water and overland flow which result in accelerated erosion by a variety of surface and mass movement processes. The contribution of fire-induced accelerated erosion to overall sediment yield can be assessed on the intermediate time scale of several fire rotations. Highly erosive landscapes with frequent, intense fire may have more than 70% of their long-term sediment yield exported during the period of accelerated erosion immediately following a fire. The magnitude of geomorphic effects of fire in an ecosystem depends on the frequency and intensity of fire, and the sensitivity of geomorphic systems to disturbance. Geomorphic sensitivity is controlled by hillslope and channel steepness and the effectiveness of vegetation in regulating physical processes. A variety of hydrologic and geomorphic features function as firebreaks. (Moore-SRC)
W82-06963

PRELIMINARY POST-ERUPTION SEDIMENT BUDGET FOR THE NORTH FORK TOUTLE RIVER DRAINAGE, JUNE 1980-MAY 1981,

Humboldt State Univ., Arcata, CA., Dept. of Geology.
For primary bibliographic entry see Field 4D.
W82-06970

SEDIMENT INFLUX TO THE TOUTLE RIVER FROM EROSION OF TEPHRA, MAY 1980-MAY 1981,

Washington Univ., Seattle. Dept. of Geological Sciences.
For primary bibliographic entry see Field 4D.
W82-06971

LABORATORY INVESTIGATION OF DEFORMATIONS OF CANALS IN SAND,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 8B.
W82-06990

2K. Chemical Processes

THE CHEMISTRY AND ISOTOPIC COMPOSITION OF SALINE GROUNDWATERS FROM THE SUDBURY BASIN, ONTARIO,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W82-05990

WEAK ACID CONCENTRATIONS AND RIVER CHEMISTRY IN THE TOVDAL RIVER, SOUTHERN NORWAY,

Central Electricity Research Labs., Leatherhead (England).
A. H. Webb.
Water Research, Vol 16, No 5, p 641-648, May, 1982. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Seasonal variation, *Chemical composition, *Acids, Tovdal River, *Norway, Physicochemical properties, Acid rain, Nitrates, Sulfates, Chlorides, Aluminum, Silica, Snowmelt, Hydrogen ion concentration, Sodium, Potassium, Calcium, Magnesium, Ammonium, Water analysis, Leaching, Organic carbon.

Chemistry of water in the Tovdal River, Norway, was investigated by analysis of weekly samples from August 1978 to December 1979. The pH varied slightly over the study period, 4.64 to 5.14, and was lowest in winter. Concentrations of both the air pollution derived species (sulfates, nitrates, and ammonium) and groundwater derived minerals (Ca, Mg, and K) increased steadily in river water during summer and winter to a broad peak during spring and decreased to a minimum in summer. The rapid metabolism of nitrate and ammonium produced some irregularities in their patterns. The broad peak in spring of the acid rain constituents (sulfates and nitrates) coincided with the peak in alkalis because of leaching from the ground during the snowmelt period. Sulfate levels were higher in the fall of 1979 than in the fall of 1978, alkalis were lower, and therefore pH was lower. Total weak acid concentrations (silica, Al, and ammonium) also showed spring maximums and summer minimums. These were correlated with total organic carbon concentrations, but the inorganic weak acid species largely controlled the seasonal variations in weak acid content. (Cassar-FRC)
W82-06052

A FAUNAL ANALYSIS OF THE SPRINGS OFF THE OUACHITA MOUNTAINS, ARKANSAS,

Arkansas Univ., Fayetteville. Water Resources Research Center.
H. W. Robison.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254871, Price codes: A03 in paper copy, A01 in microfiche. Publication No 83, September 1981. 33 p, 1 Fig, 3 Tab, 39 Ref. OWRT A-047-ARK(1). 14-34-0001-9004.

Descriptors: Benthic Fauna, *Aquatic animals, *Springs, *Microinvertebrates, Surveys, Fauna, Aquatic life, Aquatic habitats, Aquatic populations, Aquatic soils, Aquatic environment, Ecosystems Isopods, Crustaceans, Amphipods, Caddisflies, Aquatic insects, Calcium Carbonate, *Arkansas, Ouachita Mountains, Pollutant identification.

A faunal survey was made of 33 spring ecosystems in a 135 by 80 km study area in the Arkansas Ouachita Mountains physiographic province, extending west from Hot Springs to the Oklahoma line. Springs in this province were characterized as being generally faunistically-poor, with often only a single species (e.g., the isopod, Lirceus H. hoppinae) being the dominant faunal element with respect to both numbers and biomass. A total of 40 invertebrate species and eight vertebrate species were collected from the spring environs during the course of the study; five additional invertebrate species (two amphipods, three caddisflies) were discovered from a detailed literature search, making a total finding of 53 aquatic invertebrate and vertebrate species that characterize the springs in this mountain physiographic province. Water quality of the springs is characterized as potable, with calcium (calcium bicarbonate) as the major element due to the widespread distribution of limestone and calcaeous cements throughout the area of study. An annotated list of the 45 benthic macroinvertebrates and eight vertebrates collected in this survey is provided. (Zielinski-MAXIMA)
W82-06161

LIQUID-LIQUID EXTRACTION COMBINED WITH ATOMIC-ABSORTPION SPECTROMETRY FOR DETERMINATION OF COPPER IN WATERS, FOODS AND ANALYTICAL REAGENTS USING 1,2-NAPHTHOQUINONE THIOSEMICARBAZONE,

Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W82-06179

GEOCHEMICAL FACTORS CONTROLLING THE ACCUMULATION AND DISPERSAL OF HEAVY METALS IN THE BAY OF FUNDY SEDIMENTS,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
D. H. Loring.
Canadian Journal of Earth Sciences, Vol 19, No 5, p 930-944, May, 1982. 3 Fig, 7 Tab, 28 Ref.

Descriptors: *Sediments, *Heavy metals, *Path of pollutants, *Bay of Fundy, Zinc, Copper, Lead, Cobalt, Nickel, Chromium, Vanadium, Mercury, Beryllium, Arsenic, Barium, Selenium, Bays, *Canada.

This study reports on the sedimentological, mineralogical, chemical and anthropogenic factors that control the sedimentary abundances and gradients of zinc, copper, lead, chromium, vanadium, cobalt, nickel, mercury, beryllium, arsenic, barium and selenium as well as an estimation of the potential bioavailability of zinc, copper, lead, cobalt, nickel, chromium, and vanadium in the fundy sediments. Sediment samples were collected at 100 locations, Total Zn, Cu, Pb, Co, Ni, Cr, V, Be, Hg, As, Se, and Ba concentrations varied regionally and with textural differences in the sediments. Except for local anomalies, the concentrations are at or near natural levels when compared with texturally equivalent sediments from unpolluted areas of the eastern Canadian coastal areas. The nature, grain size, and abundance of the metal-bearing minerals, amorphous compounds, and organic matter are the main factors controlling the metal gradients in the bay of Fundy. Of the total metal content, 73-99% is not readily available to the biota but is held in various sulfide, oxide and silicate minerals. The host minerals have accumulated at the same rates as other detrital material, except for particles of zinc oxide that have been derived from industrial sources adjacent to the bay. Relatively high metal concentrations did occur near a dredge dispersal site off St. John Harbor and may reflect the initial impact of anthropogenic inputs on the natural levels of metals in the Fundy sediments. (Baker-FRC)
W82-06188

DISCHARGE OF METALS FROM THE ST. LAWRENCE RIVER,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 5B.
W82-06190

INFLUENCE AND PREVENTION OF BIRD-DROPPINGS IN PRECIPITATION CHEMISTRY EXPERIMENTS,

Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
For primary bibliographic entry see Field 5B.
W82-06245

THE POTENTIAL ACIDITY ASSOCIATED WITH DEWS, FROSTS, AND FOGS,

Flow General Inc., McLean, VA.
J. Wisniewski.
Water, Air, and Soil Pollution, Vol 17, No 4, p 361-377, 1982. 3 Fig, 1 Tab, 51 Ref.

Descriptors: *Acidity, *Condensation, *Frost, Chemical composition, *Fog, *Dew, *Pollutant identification, Precipitation, Chemical analysis, Corrosion, Vegetation effects.

In general special events of dews, frosts, and fogs are the result of water vapor condensation or sublimation in the layers of the atmosphere closest to the ground. The meteorology of these special events is briefly reviewed, including mechanisms of their formation as well as their frequency of occurrence. While research into the chemistry of the water involved in these special events is sparse, there is direct and indirect evidence available which indicates a potential acidity. The chemistry of this water is primarily dependent on two factors. The first is the amount and type of material absorbed by dew and fog directly from the atmosphere. The second controlling factor is the presence of substances, on the surface of which the moisture is deposited. The source of most of these materials is dry deposition of natural and anthropogenic substances from the atmosphere, including soil particles, fly ash, pollen, microbes, trace metals, aerosols, and adsorbed gases. Values of pH associated with these events have been observed to be below 3.0 for fog. Theoretical calculations indicate that synergistic acidity from dew combined with previous acidic dry deposition may result in pH values of less than 2.0. Neutralization due to leaching of plant metabolites or surface reactions on contact could raise the pH, but either of these two processes would damage the plant or material surface in question. (Baker-FRC)
W82-06246

THE EFFECT OF METAL IONS ON THE ULTRAVIOLET SPECTRA OF HUMIC ACID, TANNIC ACID AND LIGNOSULFONIC ACID,

Savannah River Ecology Lab., Aiken, SC.
J. J. Alberts.
Water Research, Vl 16, No 7, p 1273-1276, July, 1982. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Water analysis, *Spectrophotometry, Metals, Iron, Aluminum, Manganese, *Humic acids, *Tannic acids, *Lignosulfonic acids, Organic compounds, Chemical analysis, Chemical reactions, Natural waters, *Metal ions.

A study was conducted to assess the consequences of metal-organic interactions on the quantification of fulvic acid, tannin and lignin in natural waters. Solutions were prepared so that the final concentrations of humic acid, tannic acid and lignosulfonic acid were each 5.00 ppm. Ferric iron was added to individual solutions to final concentrations of 0.0, 0.1, 0.5, 1.0, and 5.0 ppm. Changes in the ultraviolet spectra of the three acids as a function of increasing iron concentration wre demonstrable. In all cases the highest iron concentration showed the dominance of the iron spectrum. At lower iron concentrations it was apparent that the spectral alterations occurring for humic acid and lignosulfonic acid were different from those for tannic acids. While the spectra of both humic acid and lignosulfonic acid in the presence of ferric iron appear to be additive with that of the metal, the spectral changes of the tannic acid in the presence of ferric iron show a dimunution of the peak height at 280 nm with the attendant appearance and increase of a shoulder in the spectra at 320-340 nm. These changes indicate alteration of the electron configuration due to interaction with the iron either through complexation or due to steric considerations. These findings suggest that the concentrations of metals in natural waters are important when attempting to determine the concentrations of humic or fulvic acids, tannins and lignin in natural waters using a method based on ultraviolet spectrophotometry. (Baker-FRC)
W82-06273

AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF TOTAL KJELDAHL NITROGEN,

Foras Forbartha, Dublin (Ireland).
For primary bibliographic entry see Field 5A.
W82-06314

TRACE METAL RELATIONSHIPS AT THE SEDIMENT-WATER INTERFACE,

Vermont Univ., Burlington. Dept. of Geology.
J. C. Drake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256561, Price codes: A05 in paper copy, A01 in microfiche. Report, December, 1980. 77 p, 5 Fig, 1 Tab, 75 Ref, 1 Append. OWRT A-039-VT(1).

Descriptors: *Trace metals, *Sediment-water interfaces, *Chemical analysis, *Chemical stratification, *Sediments, Interstitial water, Phosphorus, Copper, Lead, Water quality control, Water quality, Organic matter, Trace elements, Trace levels, Toxicity, Metals, Chemical properties, Water analysis, Chemical composition, Mud-water interfaces, Cores, Bays.

Interstitial waters from nine cores of near-surface sediments from four bodies of water were analyzed for trace elements (reactive phosphorus, (P), iron, manganese, copper (Cu), lead (Pb), titration alkalinity, wet sediment porosity and redox potential, to assess the capability for chemical exchange at the sediment-water interface. Only Pb and Cu did not show significant enrichment in pore waters relative to overlying lake waters. Iron generally increased with depth; P often showed more than one peak concentration with depth. The data indicated that pore water chemistry differed significantly among samples from various sites, caused by organic matter decomposition. Diffusion of Cu and Pb out of the sediments is not considered significant, but bottom sediments constitute an enormous reservoir of chemically mobile iron, manganese and P which could potentially be released into overlying lake waters (especially when surface sediments become anoxic). St. Albans Bay P chemistry should be studied further, due to the extremely high concentrations of P in interstitial waters and the very low redox potential observed for St. Albans Bay surface sediments. (Zielinski-MAXIMA)
W82-06362

OCCURRENCE OF FLUORIDE BEARING GROUNDWATERS AND THEIR RELATIONSHIP WITH WATER TABLE FLUCTUATIONS,

Andhra Univ., Waltair (India).
V. V. J. Sarma, and A. N. Swamy.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 77-81, February, 1981. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Fluorides, *Groundwater, *Water table fluctuations, Water quality,Chemical composition, Apatite, Seasonal variation, Wells, Shallow wells, Visakhapatnam Basin, India, *Pollutant identification.

A 12-month study of fluoride levels in 130 shallow wells up to 60 ft deep in the Visakhapatnam Basin India, showed that the fluoride content of the water was maximal during the season of minimum water table in February-May and minimal during October when the water table was highest. For example, water in Well 43 varied from 5.0 to 8.0 ppm fluoride and water in Well 23 varied from 0.6 to 1.8 ppm fluoride. The designation of isofluores, lines of equal fluoride content, clearly located possible areas of fluoride bearing minerals, probably apatite. (Cassar-FRC)
W82-06443

CHANGES IN EXTRACTABLE METAL CONCENTRATIONS DURING STORAGE OF SURFACE WATER SAMPLES CONTAINING SEDIMENTS,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
E. Michnowsky, L. M. Churchland, P. A. Thomson, and P. H. Whitfield.
Water Resources Bulletin, Vol 18, No 1, p 129-132, February, 1982. 1 Fig, 12 Ref.

Descriptors: *Measurement techniques, *Metals, Water analysis, *Sample preservation, Water sampling, Suspended sediments, Trace metals, *British Columbia, Fraser River.

Although acidification is a common method used for the preservation of river and estuarine water samples collected for metal analysis, the effect of such treatment when high levels of suspended sedi-

ments are present has not been evaluated. Water samples with high concentrations of suspended sediments were collected from the Fraser River in British Columbia, Canada. These samples were acidified on site, taken to the laboratory, and analyzed for concentrations of extractable copper, zinc, lead, cobalt, cadmium, manganese, nicke, and iron at various intervals of over a 6 month period. The metal concentrations in these water samples were found to be unstable, with the concentrations of extractable metals generally increasing during storage. The largest increases in concentration typically occurred between 10 and 40 days. Many of these metals maintained a constant concentration during the first week of storage and/or after 100 days. These results indicate that the extractable metal technique is not suitable for analysis of water samples containing suspended sediments, since it is not restrictive enough to ensure reproducible results. Comparisons between samples stored for varying periods of time would also not be reliable. (Carroll-FRC)
W82-06630

THE ADSORPTION OF CU, MN, AND ZN BY IRON OXYHYDROXIDE IN MODEL ESTUARINE SOLUTIONS,

Plymouth Polytechnic (England). Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W82-06668

HYDROGEN ION BUDGET OF AN AGGRADING FORESTED ECOSYSTEM,

State Univ. of New York, Syracuse. Dept. of Civil Engineering.
C. T. Driscoll, and G. E. Likens.
Tellus, Vol 34, No 3, p 283-292, June, 1982. 4 Fig, 37 Ref.

Descriptors: *Hydrogen ion concentration, *Forests, Ecosystems, Aluminum, Nitric acid, Sulfuric acid, Acidity, Precipitation, Water quality, *New Hampshire, Forest watersheds.

A detailed evaluation was made of the hydrogen ion budget for the Hubbard Brook Experimental Forest in West Thornton, New Hampshire. Hydrogen ion sources were found to approximately balance hydrogen ion sinks. Atmospheric hydrogen ion inputs contributed 52% of the total hydrogen ion sources for the ecosystem. Based on this budget, projections of changes in precipitation hydrogen ion loading on water quality were made. To make such prediction it was necessary to make some assumptions concerning the response of a forested ecosystem to increases and decreases in atmospheric hydrogen ion inputs. To estimate changes in water quality due to changes in hydrogen ion loading, a modified chemical equilibrium model was used. The model was incrementally titrated with strong acid or strong base corresponding to the incremental change in hydrogen ion loading. Three changes in precipitation loading of hydrogen ion to the ecosystem were examined. These changes were made as nitric acid, as sulfuric acid, and as a combination of nitric and sulfuric acids, corresponding to the ambient stoichiometry in precipitation. The magnitude of these hydrogen ion loading changes ranged from a 50% increase to the lowest possible decrease based on the concentration of nitrate and sulfate in ambient precipitation. The form of the acid input is important in the response of stream water quality to changes in hydrogen ion inputs. Another important consideration is the role of aluminum in the buffering of hydrogen ion in this ecosystem, (Baker-FRC)
W82-06836

COMPARISON OF TECHNIQUES FOR ESTIMATING ANNUAL LAKE EVAPORATION USING CLIMATOLOGICAL DATA,

Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
For primary bibliographic entry see Field 2D.
W82-06850

STABILITY OF BETA-MNOOH AND MANGANESE OXIDE DEPOSITION FROM SPRINGWATER,

Geological Survey, Menlo Park, CA.
J. D. Hem, C. E. Roberson, and R. B. Fournier.
Water Resources Reseearch, Vol 18, No 3, p 563-570, June, 1982. 4 Fig, 6 Tab, 11 Ref.

Descriptors: *Natural waters, *Manganese oxides, *Chemistry of precipitation, Chemical reactions, Spring water, Springs, Chemical composition, Thermodynamics, *Oxidation-reduction potential.

Beta-MnOOH is precipitated preferentially at temperatures near zero degrees C when Mn(2+) is oxidized in aerated aqueous solutions. On aging in solutions open to the atmosphere a slurry of beta-MnOOH tends to disproportionate to form manganese dioxide and MN(2+). In such aged solutions, Mn(2+) and H(+) activities can be constant and both the oxidation reaction and the disproportionation reaction can have positive reaction affinities. It is not possible for both reactions to be in thermodynamic equilibrium in the same system unless oxygen is almost completely absent. Analytical data for manganese-depositing springwater samples are consistent with a nonequilibrium model involving disproportionation of either beta-MnOOH or Mn304. (Baker-FRC)
W82-06862

SEDIMENTARY LOSSES OF PHOSPHORUS IN SOME NATURAL AND ARTIFICIAL IOWA LAKES,

Florida University, Gainesville School of Forest Resources and Conservation.
For primary bibliographic entry see Field 5C.
W82-06901

A 'DIPSTICK' SAMPLER FOR RAPID, CONTINUOUS CHEMICAL PROFILES IN SEDIMENTS,

Alaska Univ., Fairbanks, Inst. of Marine Science.
For primary bibliographic entry see Field 5A.
W82-06931

2L. Estuaries

GAMMA EMITTING FISSION PRODUCTS IN SURFACE SEDIMENTS OF THE RAVENGLASS ESTUARY,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-05984

MERCURY IN THE RIVER MERSEY, ITS ESTUARY AND TRIBUTARIES DURING 1973 AND 1974,

Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W82-06049

A SAMPLING STUDY OF THE BROWN SEAWEED, ASCOPHYLLUM NODOSUM AS A MARINE MONITOR FOR TRACE METALS,

Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-06050

THE ECOLOGY OF NEW ENGLAND HIGH SALT MARSHES: A COMMUNITY PROFILE,

Rhode Island Univ., Kingston. Graduate School of Oceanography.
S. W. Nixon.
Fish and Wildlife Service, Biological Services Program Report FWS/OBS-81/55, March 1982, Wahington, DC. 81 p, 29 Fig, 14 Tab, 154 Ref.

Descriptors: *Salt marshes, *Ecology, *Tidal marshes, *Environmental effects, Marsh management, Sediments, Tidal effects, Sea level, Vegetation, Productivity, Land use, Flooding, Drainage, Mosquitos, Pollutants, Sludge.

The high salt marshes of New England have evolved in response to sea-level rises through accretion of sediments entrapped by marsh vegetation. The shape and appearance of high marshes result from unique, complex interactions of local topography and bathymetry, sea level rise, tides, sediment supply and vegetation. These factors particularly the major influences of tides and short-term changes in sea-level, are incorporated in short-term processes that define and mold the ecology of the high marsh. Short-term and long-term mechanisms have produced approximate zonation of vegetation in the high marsh. High marshes are contrasted to Spartina-dominated low marsh in terms of plant and animal species and the relative importance of the dynamics of production, export, decomposition, and accumulation of materials in the sediments. Since the mid 1600's, the marshes in New England have been flooded or drained, impounded or diked, ditched or filled. High marshes have been used as hay fields. Ditching for mosquito control has affected a large part of the New England high marshes. Human activities have polluted the marshes with metals, oil chemicals, and trash. Habitat management considerations today include mosquito control and sewage sludge treatment. (Moore-SRC)
W82-06096

SEDIMENT CHARACTER AND PROVENANCE IN A COMPLEX FJORD; HOWE SOUND, BRITISH COLUMBIA,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Geoscience Center.
For primary bibliographic entry see Field 2J.
W82-06189

RETENTION OF RIVERINE IRON IN ESTUARIES,

Maine University at Orono, Walpole.
For primary bibliographic entry see Field 5B.
W82-06191

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: III. HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS,

National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
For primary bibliographic entry see Field 5B.
W82-06387

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: II. KNYSNA ESTUARY,

National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
R. J. Watling, and H. R. Watling.
Special Report FIS 203, January, 1980. Council for Scientific and Industrial Research, Pretoria, South Africa. 122 p, 15 Fig, 57 Tab, 17 Ref, 3 Append.

Descriptors: *Trace metals, *Chemical analysis, *Water analysis, *Pollutant identification, *Water pollution sources, Trace elements, Trace levels, Lagoons, Estuaries, South Africa, Water quality, Environmental quality, Sediment-water interfaces, Heavy metals, Pollutants, Rivers, Nonpoint pollution sources, Sediments, Cores, Metals, Water quality control, Surveys, Atomic absorption spectroscopy.

Detailed surveys undertaken during 1975-78 to study the trace metal content of the Knysna River and Lagoon are summarized. Surface sediment, water, and sediment core samples were taken over an 11.5 sea mile distance, and analyzed by atomic absorption spectroscopy for 16, 13, and 16 elements, respectively. Interelement relationships and absolute metal concentrations were examined prior to data interpretation. Water salinity was also measured at certain sites, and biological material was taken from the Heads region and analyzed for 9 elements. The results indicated the presence of specific sites of metal input into the Lagoon and the distribution of drains/seepages which also contaminate the area. The metal concentrations found, however, were generally low, and such anomalies as do occur appear to be transitory in nature since little metal accumulation was found to occur in the sediment column. The area cannot be strictly considered as polluted, although certain metal concen-

trations were elevated above true background values as determined for other southeastern Cape estuaries. Metal concentrations in biological material from Knysna estuary were much lower than many of the reported values for the material species, indicating that the estuary is unpolluted by zinc, cadmium, copper, iron, manganese, and nickel. (Zielinski-MAXIMA)
W82-06388

STATISTICAL SEARCH FOR HIGH WATER AT BOARD LANDING BRIDGE, TRURO, NOVA SCOTIA,

G. Godin, P. A. Bolduc, D. G. Mitchell, and S. Yuen.
Marine Sciences and Information Directorate, Manuscript Report Series No 58, 1981. Department Of Fisheries and Oceans, Ottawa, Ontario. 43 p, 7 Fig, 7 Tab, 7 Ref, 1 Append.

Descriptors: *Prediction, *Mathematical studies, *Tides, *Correlation analysis, *High water mark, *Bridges, Statistical methods, Probability distribution, Tidal waves, Tidal amplitude, Tidal currents, Forecasting, Water level fluctuations, Model studies, Regression analysis, Computer programs.

In order to obtain an estimate of the height of the high water at a Nova Scotia bridge, a statistical search was made of the two-year data of tidal observations at the bridge. Strong shallow-water distortion in the area precluded the use of a direct harmonic analysis; therefore, correlations were calculated between the time of travel of high water to the bridge and its height there against the high water height of nearby reference stations. The random portion of the signal was evaluated following a regression analysis with Saint John and other stations. The predicted height of high water at Saint John gave the best fit, suggesting a coupling between non-tidal events at the two sites. A height of 33.3 feet with a return period of about 90 years was inferred from the results. In order to check on the recurrence interval of extreme tides in the Bay of Fundy, 100 years of predictions covering the interval of 1981-2080 for Saint John were prepared. Further, it is felt that studies on the dynamics of Minas Basin will eventually have to be undertaken; to a good first approximation, the Basin may be viewed as being cut off from the Bay of Fundy as far as disturbances are concerned. (Zielinski-MAXIMA)
W82-06394

MINERALIZATION OF DETRITAL LIGNOCELLULOSES BY SALT MARSH SEDIMENT MICROFLORA,

Georgia Univ., Athens. Dept. of Microbiology.
A. E. Maccubbin, and R. E. Hodson.
Applied and Environmental Microbiology, Vol 40, No 4, p 735-740, October, 1980. 2 Fig, 2 Tab, 28 Ref. OWRT A-082-GA. 14-34-0001-9011.

Descriptors: *Pine trees, *Salt marshes, *Microorganisms, Carbon cycle, Mineralization, *Degradation, Carbon, Detritus, *Lignocelluloses.

The rates of degradation of specifically radiolabeled, extractive-free lignocelluloses from S. alterniflora and Pinus elliotii were determined in incubations approximating conditions in the aerobic surface layers of various marsh and estuarine habitats. The pine lignocellulose was included as it is a lignocellulose of terrestrial origin that is likely to be transported into the estuarine environment by stream runoff. A 10- to 14-fold difference was found in the rates of mineralization of the lignin moieties of lignocelluloses from S. alterniflora and P. eliottii, which was probably indicative of basic structural differences between the lignins of grasses and gymnosperms. Data collected confirmed the widely held assumption that lignocellulose accounts for a large percentage of the standing stock of plant material in salt marsh estuaries. Knowledge of thee factors controlling rates of lignin and cellulose degradation in marsh and coastal sediments can enhance the understanding of carbon flow in detritus-based systems. This will have wide applicability in studies of microbial processes in marsh-dominated coastal marine environments. (Small-FRC)
W82-06410

VEGETATION STRUCTURE AND DIVERSITY COMPONENTS OF A FRASER ESTUARY TIDAL MARSH,

British Columbia Univ., Vancouver. Dept. of Botany.
G. E. Bradfield, and G. L. Porter.
Canadian Journal of Botany, Vol 60, No 4, p 440-451, 1982. 4 Fig, 3 Tab, 35 Ref.

Descriptors: *Estuaries, Vegetation, *Tidal marshes, *Species diversity, *Marsh plants, Tidal rivers, Species composition, Tidal floods, Drainage effects, Community development, *Fraser River estuary, *British Columbia.

Vegetation data from a predominantly freshwater-influenced tidal marsh near the mouth of the Fraser River in southwestern British Columbia were analyzed to examine compsitional variation in the vegetation in relation to inferred gradients of tidal flooding and drainage. Another goal of the study was to evaluate various diversity components of marsh vegetation types and assess their value for heuristic investigation of vegetation-environment relations in tidal marsh ecosystems. Three main vegetation zones were recognized. Regularly flooded and drained sedge areas were dominated by Carex lyngbyei. A grass-willow zone along the crests of infrequently flooded levees was dominated by Festuca arundinacea. A mixed-forb zone in areas of poor drainage where the water table remained permanently high was dominated by Menyanthes trifoliata. Principal components analysis and reciprocal averaging gave similar results except for a 90 degree rotation of ordination axes. The combined results from cluster analysis and ordination provided a useful summary of the marsh vegetation structure and a useful background for making comparisons and evaluating factors that affect community development. (Geiger-FRC)
W82-06465

VEGETATION-ENVIRONMENT RELATIONS IN A BRACKISH MARSH, LULU ISLAND, RICHMOND, B.C.,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Geography.
I. Hutchinson.
Canadian Journal of Botany, Vol 60, No 4, p 452-462, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Marsh plants, *Succession, *Species diversity, *Estuaries, Brackish water, *Tidal marshes, *Salinity, Ecology, Species composition, Salt marshes, Tide lands, Interstitial water, Marine sediments, Fluvial sediments, Elevation, British Columbia.

The relationship between plant species distribution and the physical factors of submergence, pore water salinity, sediment texture, and substrate water content was examined in the foreshore marshes of Lulu Island in the Fraser River delta. Analysis of tidal records revealed three elevational zones - a low marsh dominated by two Scirpus species, a middle marsh dominated by Carex lyngbyei, Triglochin maritimum and S. maritimus, and a high marsh community with four dominant plant species. Results of an analysis of variance procedure showed that elevation and elevation-salinity interactions were the main factors controlling plant distribution. Substrate texture and moisture content were significantly associated with variations in species abundance. The Lulu Island marshes are similar in flora and ecology to estuarine and deltaic marshes of Oregon and Washington and are influenced by fluvial regimes which affect salinity and sediment characteristics. (Geiger-FRC)
W82-06497

VARIABILITY OF TEMPERATURE, SALINITY AND TIDALLY-AVERAGED DENSITY IN THE MIDDLE ESTUARY OF THE ST. LAWRENCE,

Bayfield Lab. for Marine Science and Surveys, Burlington (Ontario).
L. R. Muir.
Atmosphere-Ocean, Vol 19, No 4, p 320-336, 1981. 4 Fig, 4 Tab.

Descriptors: *Mixing, *Temperature, *Salinity, Tidal effects, Tidal energy, Estuaries, Water temperature, Density, *St. Lawrence Estuary, Statistical analysis, Ontario, *Path of pollutants.

Variations in temperature (T), salinity (S), and density of water in the Middle St. Lawrence Estuary between Riviere du Loup and St. Roch were complex. Surveys produced 15,000 T-S pairs distributed over 62 13-hour profiling stations. The T-S curves at each station were linear, but it was impossible to relate temperature and salinity over the whole Middle Estuary for a month or two. The lack of correlation could not be explained in terms of linear combinations of the parameters for location in the estuary, the upstream water properties, the phase of the spring-neap tides, and the tidal energies. The tidally-averaged density structure was separable into horizontal and vertical components. The vertical variation over the whole estuary was explained by any one of three functional forms, but the horizontal variation was not explicable by any linear combinations of the parameters previously mentioned. Plots of horizontal variations in temperature, salinity, or density are not meaningful unless data are collected synoptically and over a period longer than one tidal cycle. Although the mixing process in the estuary appeared conservative and linear at a given instant in space and time, it was non-linear over space and time. (Cassar-FRC)
W82-06533

INFLUENCE OF SALINITY AND ORGANIC NUTRIENT CONCENTRATION ON SURVIVAL AND GROWTH OF VIBRIO CHOLERAE IN AQUATIC MICROCOSMS,

Maryland Univ., College Park. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-06534

SEASONAL VARIABILITY AND TRANSPORT OF SUSPENDED MICROFUNGI IN A SOUTHEASTERN SALT MARSH,

South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Science and Coastal Research.
T. H. Chrzanowski, L. H. Stevenson, and J. D. Spurrier.
Applied and Environmental Microbiology, Vol 43, No 2, p 392-396, February, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Salt marshes, *Fungi, *Seasonal variation, Microorganisms, Suspended load, Water currents, Estuaries, Bioindicators, *Path of pollutants, Water pollution sources.

Microfungi are potentially useful as indicators of water mass movements and resuspension in estuaries and salt marshes. As part of a continuing investigation of their usefulness for this purpose, tidally induced and seasonal variations of suspended microfungi concentrations were assessed and the presence of microfungi in water exiting from a salt marsh was studied. Samples were collected at three depths from three stations positioned at a transect in a large salt marsh creek in South Carolina. Samples were taken every 1.5 hours for 50 consecutive hours during neap tides and for 50 consecutive hours during the corresponding spring tides. Microfungi concentrations were found to be relatively consistent from season to season. Tidally induced variability was more dramatic, with microfungi concentrations fluctuating out of phase with the tidal rhythm during both neap and spring tides. Over 90% of the tidal cycles monitored showed a net movement of microfungi out of the marsh, indicating that the microfungi should be useful in tracing a water mass after it has exited a marsh. These study results suggest that seasonal variations in the concentrations of suspended microfungi should not limit their usefulness as water mass indicators in salt marsh environments. (Carroll-FRC)
W82-06536

SULFATE REDUCTION AND METHANOGENESIS IN THE SEDIMENT OF A SALTMARSH ON THE EAST COAST OF THE UNITED KINGDOM,

Essex Univ., Colchester (England). Dept. of Biology.
E. Senior, E. B. Lindstrom, I. M. Banat, and D. B. Nedwell.
Applied and Environmental Microbiology, Vol 43, No 5, p 987-996, May, 1982. 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Salt marshes, *Chemical reactions, *Sulfate reduction, Marshes, Tidal marshes, Acidity, Sulfates, *Methanogenesis, Sediments, *England, Estuaries, Coastal waters, Coastal marshes.

A program of regular field sampling was initiated in the Colne Point salt marsh, Essex, United Kingdom. The main objectives of the program were to determine whether any spatial or temporal separation(s) between sulfate reduction and methanogenesis were apparent which might explain their coexistence, to determine the annual magnitudes of each process, and to investigate some of the environmental variables which might significantly influence the processes. These two processes are the major terminal oxidation steps in the flow of carbon and electrons in anaerobic environments. The rate of sulfate reduction, methanogenesis, and methane loss were measured in salt marsh sediment at monthly intervals. In addition, dissolved methane and sulfate concentrations together with pS(2-) and pH were determined. Methane formation from carbon dioxide, but not from acetate, was detected within the same horizon of sediment where sulfate reduction was most active. Sulfate reduction was about 3 orders of magnitude greater than annual methanogenesis. The two processes were not separated either spatially or temporally, but occurred within the same layer of sediment at the same time of the year. Their coexistence did not seem to be the result of sulfate-depleted microenvironments within which methanogenesis could occur, but the methanogenic bacteria persisted at very low rates of activity within the same environment as the sulfate reducers. The observed discrepancy between in situ methanogenesis and methane loss from the sediment surface was interpreted as a real phenomenon, possibly due to methanogenesis from substrates other than acetate or bicarbonate. (Baker-FRC)
W82-06541

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,

Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
G. P. Steven.
Advances In Water Resources, Vol 5, No 1, p 29-34, March, 1982. 9 Fig, 1 Tab, 6 Ref.

Descriptors: *Finite element method, *Interfaces, *Boundaries, Model studies, Fate of pollutants, Mixing, Stratification, Thermal pollution, Mathematical studies.

Restructuring of coefficient matrices of a finite element solution gave good results for problems in which physical parameters had discontinuities at the interfaces. In this work one-dimensional model studies were done using four schemes for accommodating a moving interface across which there are discontinuities in physical parameters. The effective schemes were: development of a special element which allowed the interface to move across it, and using an adaptive grid so the interface always remained at an element boundary. However, only the first was suitable for use in two- and three-dimensional problems. These solutions may be applied to problems such as salt-fresh water interaction in an estuary, stratification in water bodies, thermal outputs from power stations, sewage discharges, and injection of one fluid into another. (Cassar-FRC)
W82-06546

THE ADSORPTION OF CU, MN, AND ZN BY IRON OXYHYDROXIDE IN MODEL ESTUARINE SOLUTIONS,

Plymouth Polytechnic (England). Dept. of Marine Science.
G. E. Millward, and R. M. Moore.
Water Research, Vol 16, No 6, p 981-985, June, 1982. 4 Fig, 1 Tab, 34 Ref.

Descriptors: *Estuarine environment, *Trace metals, Estuaries, *Copper, *Manganese, *Zinc, *Iron, Model studies, *Adsorption, Acidity, Salinity, Chemical reactions.

The sorption of behavior of copper, manganese and zinc on to freshly precipitated iron oxyhydroxide was investigated as a function of acidity and salinity, in order to more fully understand the behavior of these metals in estuaries. In distilled water the acidity of the onset of adsorption was in increasing order from Cu, Zn to Mn, which qualitatively follows the hydrolysis of the metals in the bulk solution. The pH of the adsorption edges could not be quantitatively predicted from the hydrolysis data, and it is necessary to resort to the use of surface complexation constants for cation adsorption. The hypothesis of metal uptake involving coulombic interactions between the precipitate and the metal species in solution did not fit the observations, and it was concluded that a detailed knowledge of surface complexation reactions was needed, as is shown for copper. The adsorption isotherms for copper were independent of salinity while those for zinc and manganese showed an increase in the pH of the adsorption edge with increases in salinity. It was suggested that the major cations of calcium and magnesium were probably co-adsorbed, and competition from these species for adsorption sites increased with increasing salinity. These results will aid in the development of predictive models for the fate of trace metals injected into estuarine systems, where iron compounds may be freshly precipitated. (Baker-FRC)
W82-06668

SURVIVAL OF VIBRIO CHOLERAE AND ESCHERICHIA COLI IN ESTUARINE WATERS AND SEDIMENTS,

Univerity of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06742

DENITRIFICATION, NITRATE REDUCTION, AND OXYGEN CONSUMPTION IN COASTAL AND ESTUARINE SEDIMENTS,

Tokyo Univ. (Japan). Ocean Research Inst.
For primary bibliographic entry see Field 5C.
W82-06748

ON THE DIEL RHYTHM FOR PHYTOPLANKTON PRODUCTIVITY IN SHATT AL-ARAB AT BASRAH, IRAQ,

Rostock Univ. (Germany, D.R.).
For primary bibliographic entry see Field 5C.
W82-06763

TURBIDITY MAXIMUM AND MUD SHOALING IN THE WESER ESTUARY,

Institute fuer Meeresforschung (Germany, D.R.).
For primary bibliographic entry see Field 5B.
W82-06766

YORK RIVER DESTRATIFICATION: AN ESTUARY-SUBESTUARY INTERACTION,

Virginia Inst. of Marine Science, Gloucester Point.
D. Hayward, C. S. Welch, and L. W. Haas.
Science, Vol 216, No 4553, p 1413-1414, June 25, 1982. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Destratification, *Estuaries, Estuarine environments, Coastal workers, Rivers, Bays, Chesapeake Bay, *York River, *Salinity, Saline water intrusion, Stratification, Seasonal variations, Tidal rivers, Tides, Tidewater, *Virginia.

Destratification in the York River was investigated. A conceptual model for the onset and disappearance of vertical homogeneity was developed from a examination of salinity data collected during intensive studies of two destratification events that were predicted on the basis of earlier work. The intrusion of relatively fresh water, which initiated the destratification process, is indicated by the sharp downward displacement of isohalines on 16 August 1978 and 26 August 1980. In each case this was followed by a progressive reduction of stratification in the water column. The introduction of fresher water into the river mouth caused a reversal of the longitudinal salinity gradient, producing a midriver salinity maximum. The assumption is made that the salinity changes at the station are caused in large part by the advection of water of differing salinity up and down the river by tidal currents. Depressions in the isohaline, indicating the presence of freshwater water, coincide with slack before ebb through 28 august, the data of greatest tidal heights. After that date the isohaline at 23 per mil showed a phase reversal. The depressions are coincident with slack before flood, indicating the reestablishment of the normal longitudinal salinity gradient. While tidal heights were increasing, there was a continuing source of fresher water. As tidal heights reached, more saline water was once again present in the river mouth. The Chesapeake Bay was the only reasonable source for the relatively fresh water. The tidally synchronized advection of the relatively freshwater into the river mouth during sufficiently strong spring tides occurs as a result of the relationship of the tidal current phases of the river and the bay. During neap or mean tidal cycles the tidal excursion is insufficient to introduce relatively fresh water into the river. (Baker-FRC)
W82-06787

A STEADY STATE MODEL FOR BUOYANT SURFACE PLUME HYDRODYNAMICS IN COASTAL WATERS,

Delaware Univ., Newark. Coll. of Marine Studies.
R. W. Garvine.
Tellus, Vol 34, No 3, p 293-306, June, 1982. 11 Fig, 14 Ref.

Descriptors: *Coastal waters, *Plumes, Model studies, Hydrology, Hydrodynamics, Flow characteristics, Fluid mechanics, Buoyancy, *Connecticut River, *Long Island Sound, *Steady flow.

The horizontally two-dimensional, steady flow problem posed by the discharge of a shallow layer of buoyant fluid from an outlet channel at a coast into an unbounded domain of ambient water having uniform alongshore motion has been modeled. An ambient current is a necessary conditions for a steady state, since in its absence time dependent spreading of the buoyant layer would continue indefinitely. Thus the problem includes the basic features of horizontal gravitational spreading, frontal boundaries, and an ambient current. In this model earth rotation was neglected. Frontal jump conditions developed in an earlier paper were applied to match the flow at the frontal boundary with the remainder of the plume. Numerical solutions for the entire flow are found by the method of characteristics, but much of the flow can be determined by simpler analytic computation. The computed flow fields show that a frontal boundary forms on the upstream or offshore side of the plume, where the oncoming ambient current contains the gravitational spreading of the buoyant water. No front forms on the corresponding downstream, inshore side. In the body of the plume the flow simultaneously expands and turns downstream toward alignment with the ambient current. Relatively little change in plume water speed occurs, but the pressure field required for turning the flow downstream results in deepening of the plume interface offshore near the front. This in turn concentrates the plume volume flux along its offshore side near the front. The maximum angle through which the flow may be turned initially is less than 66 degrees. Outlet channel angles greater than this produce plumes which are separated from the shoreline by ambient water. The model results explain many of the observed features of the Connecticut River plume in Long Island Sound. (Baker-FRC)
W82-06837

NITROGEN FIXATION IN THE TEMPERATE ESTUARINE INTERTIDAL SEDIMENTS OF THE RIVER LUNE,

Lancaster University (United Kingdom), Department of Biological Sciences.

Group 2L—Estuaries

For primary bibliographic entry see Field 5C.
W82-06944

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION DIRECTORY 1981.

Elsevier Scientific Publishing Co., Amsterdam (Netherlands).
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-248709, Price codes: A12 in paper copy, A01 in microfiche., Desalination, Vol 37, No 1, 2, May 1981. 255 p. OWRT C-90414-T(No 0401)(1).

Descriptors: *Desalination, *Water treatment, *Information exchange, *Technology transfer, *International commissions, Desalination plants, Desalination wastes, Desalination apparatus, Pretreatment of water, Clarification, Information systems, Documentation, Technology, Organizations, Industrial plants, Water use.

A first edition of an international directory of participants involved in desalination and water purification is presented. This directory should serve as a central tool to enhance communications among members of the world-wide desalting community. Overviews of activities in desalination and water purification are provided by individuals, organizations, and companies listed in the directory. The directory, hence, provides a useful information network for technology transfer in the desalination and water purification areas. Directory entries are both by alphabetical and geographical listings. A separate alphabetical listing of individuals, their affiliations, and addresses, is also included. Owing to the limitations encountered in preparing an initial directory, the narrative entries reflect the nature and scope of the organizations providing information, but are not necessarily proportional to the size, importance, or level of excellence of the organizations. This first edition also will serve as a checklist so that companies, institutions, and individuals can check their entries on their own merit and in relation to each other. A second edition, under preparation and planned for release in 1-2 years, will also include interests and society memberships of individuals, and a subject index. (Zielinski-MAXIMA)
W82-05908

KINETICS OF COMPRESSIBILITY IN TWO-PHASE FLUID FLOWS,

Worcester Polytechnic Inst., MA. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 1A.
W82-05910

TWO-PHASE FLOW THERMOSIPHONING FOR EVAPORATOR APPLICATION,

Westinghouse Research Lab., Pittsburgh, PA.
T. E. Lippert, J. M. Cardito, and R. M. Chamberlin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243403, Price codes: A04 in paper copy, A01 in microfiche. Final Report, January 1974. 53 p, 10 Fig, 12 Tab, 5 Ref, 1 Append. OSW (No 2880)(1), 14-30-2880.

Descriptors: *Saline water, *Thermosiphoning, *Evaporators, *Desalination apparatus, Design criteria, flow profiles, Photography, Laminar flow, Theoretical analysis, Mechanical engineering, Siphons, Process control, Water treatment, *Flash evaporation, Performance evaluation, Desalination, Water use, Water treatment.

Operation of an 11-foot long, 6-inch diameter thermosiphon was assessed, covering the two-phase flow-regime, determination of thermosiphon performance with regard to various system operating and design parameters, and a comparison of the resultant data with an existing homogeneous flow theory. Data were obtained on tap water, tap water with surfactant, and tap water with sea-salt. The results of this assessment demonstrated that the thermosiphon performed in a stable manner over the range of operating conditions examined. The predominant flow regime was churn bubbly, and was found to be essentially independent of the operating test conditions. High-speed movies clearly showed the character of the chugging action of the flow: the flow did not reverse direction, but rather represented an acceleration-deceleration phenomenon with a surrling pattern superimposed. Despite this apparent complexity, the time-average character of the flow was consistent and repeatable, and the thermosiphon did not stall, nor did the set point conditions on the flow loop drift significantly during operation. The operating temperature range studied, over which stable thermosiphon operating was noted, would correspond generally to the high temperature stages of a multistage flash evaporator. (Zielinski-MAXIMA)
W82-05916

CONDENSATION OF BUTANE VAPOR IN A GRAVITY-DRAINED ICE BED,

Cornell Univ., Ithaca, NY. School of Chemical Engineering.
R. L. Von Berg, P. Harriott, H. F. Wiegandt, and D. B. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243411, Price codes: A05 in paper copy, A01 in microfiche. Report, August 1974. 83 p, 23 Fig, 6 Tab, 19 Ref, 2 Append. OSW (3072)(1).

Descriptors: *Desalination, *Desalination apparatus, *Ice-brine systems, *Heat transfer, Saline water, Seawater, Brine disposal, Brines, Free water, Ice-water interfaces, Melting, Ice thickness, Process control, Mechanical engineering, Water treatment, Theoretical analysis, *Condensation.

Direct condensation of n-butane in ice particle beds was investigated to assess the effect of driving force, bed depth, and ice particle size on operation of a melter-condenser (MC) as part of an overall freezing process for salt water desalination. Ice melting rate for 2-12 inch thick ice particle beds was studied in a 3 foot by 2 or 4 inch inside diameter plastic column, using 0.1-17 mm diameter ice particles. Studies with the MC indicated that: ice melting rate in shallow ice beds is proportional to the true driving force for driving forces up to at least 0.5 F; ice melting rate per ice volume in the MC decreases with increased bed depth and is a function of ice particle size; and that the rate due to axial vapor velocity through the bed is proportional to the vapor velocity to the 1/4 power. The most severe restriction on melting rate of deep ice beds is imposed by liquid and vapor flow limitations through the melting bed. Butane condensation in shallow beds occurs throughout the entire bed, but the topmost ice particles melt faster than those deeper in the bed. Experimentally-determined heat transfer coefficients (for total particle area at 10% melt) for 3 and 12 inch ice beds were about 2/3 and 1/3 of those predicted from theory. (Zielinski-MAXIMA)
W82-05917

OPERATING EXPERIENCES ON A REVERSE OSMOSIS PLANT WHICH CONVERTS SEA WATER INTO BOILER FEED WATER,

R. M. Quinn.
Industrial Water Engineering, Vol 19, No 1, p 20-33, January/February, 1982. 2 Tab.

Descriptors: *Desalination, *Reverse osmosis, Membrane processes, Economic aspects, Water treatment, Sea water, Brackish water, Water quality, Membranes, Industrial water, *Boiler water.

Points of interest in the operation and design of the Planta Centro seawater plant installation are offered. The pretreatment system was designed to meet the variable conditions found in using an open sea intake and, in particular, an intake located in a channel, making it subject to the effects of land based contamination. One of the major concerns was the ability of the B-10 membrane in the reverse osmosis system to stand up to the rigorous conditions of seawater treatment. While operating costs appear high compared to conventional water treatment plants, they are comparable to those experienced in treatment of seawater by evaporation. Total power consumption in the primary and secondary system is quite low, due to the relatively low cost of power in Venezuela. Chemical costs are greater than had been anicipated due to the high cost of chemicals in Venezuela, an open sea intake requiring the use of in line coagulation, and the high frequency of cleanup required to maintain the membrane's operation, which overcomes problems with corrosion in the pumps. This final cause of high costs should be eliminated in the future. Overall this plant confirms that in actual operation seawater reverse osmosis systems are viable and effective tools for the production of potable water. Reverse osmosis systems when combined with brackish membranes and conventional ion exchange can produce any level of quality water required by industry, all the way from potable to the ultimate water required by highly sophisticated electronics plants. (Baker-FRC)
W82-05976

WORK POTENTIAL: AN OBJECTIVE BASIS FOR THE COMPARISON OF DESALINATION PROCESSES,

A. N. Rogers.
Industrial Water Engineering, Vol 19, No 1, p 10, 12-19, January/Februrary, 1982. 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Desalination, *Energy, Energy loss, Energy equation, Water quality, Water reuse, Water treatment, Brackish water, Seawater.

This paper introduces factors which permit the energy consumptions of various desalination processes to be reduced to a common basis. It is demonstrated that under some conditions thermal distillation processes compare favorably with membrane and freezing processes and with vapor compression distillation from the standpoint of energy consumption. In such a comparison it is essential to consider not only the amount of energy consumed but also the thermodynamic level of the energy. Energy requirements are calculated as Work Potential, that is the electrical energy which the prime heat or power source could generate in a power plant and deliver to a power grid. These calculations indicate that for the desalination of sea water or other concentrated feeds, the thermal evaporative processes of multi-stage flash, vertical tube evaporator, or HTME compare favorably with other desalination techniques. For the desalination of water of low salinity such as brackish water or dilute aqueous wastes streams, thermal desalination requires a slightly greater Work Potential. When supplied with waste heat, however, the Work Potential requirments of thermal distillation are practically identical with those of the membrane processes. (Baker-FRC)
W82-05977

DIFFUSIVE AND HYDRAULIC TRANSFER OF SOLUTES THROUGH HOMOGENEOUS MEMBRANES,

Kyoto Univ. (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W82-06006

AN ION-EXCHANGE PROCESS WITH THERMAL REGENERATION XIV THERMALLY REGENERABLE RESIN SYSTEMS WITH HIGH CAPACITIES,

Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Chemical Technology.
B. A. Bolto, K. H. Eppinger, M. B. Jackson, and R. V. Siudak.
Desalination, Vol 34, No 3, p 171-188, September, 1980. 3 Fig, 14 Tab, 13 Ref.

Descriptors: *Desalination processes, Ion exchange, *Resins, *Polymers, Desalination, Thermal regeneration, *Ion exchange resins, Acrylic acid, Triallyamine hydrochloride, Polymers.

The development of later generations of thermally regenerable (TR) ion-exchange resins is traced from those formed from a solution of the monomers acrylic acid and triallylamine hydrochloride, which gives resins with no TR capacity, to those which have a TR capacity of 2.1 meq/g. The resins include those prepared from a solution or emulsion of monomers, amphoteric resins in which acidic and basic groups are attached to a preformed polymer by a chemical reaction, resins made by polymerizing a monomer (or monomer + crosslinker) inside a crosslinked resin, resins prepared by the graft polymerization of monomers onto polymers on which radicals have been generated and resins prepared by the polymerization of monomers around polymeric microparticles. (Balaban-Boston)
W82-06101

SCALE INHIBITION OF CALCIUM SULFATE BY A FLUIDIZED BED,

Technische Hogeschool, Delft (Netherlands).
J. A. M. Meijer, and G. M. Van Rosmalen.
Desalination, Vol 34, No 3, p 217-232, September, 1980. 7 Fig, 27 Ref.

Descriptors: Desalination, Desalination processes, *Desalination apparatus, *Flash distillation, Fluidized bed evaporator, *Heat exchanger tube, *Scale inhibition, *Calcium sulfate, Scanning electron microscopy.

In a heat exchanger tube of the MSF-FBE the scale inhibiting capacity of the fluidized bed with respect to calcium sulfate was investigated. In all experiments at concentration factors between 1 and 2, the hemihydrate solubility line could be passed to a certain extent within scale formation. The ultimately formed scale consisted of anhydrite except at the largest super-saturation for hemihydrate, where hemihydrate was formed. The highest top temperatures were reached when the brine was deaerated and nuclei were excluded. Scale deposition is prevented better by 2 mm glass particles than by 1 mm glass particles. The very first scale layer at the metal surface shows a very poor crystal habit. (Balaban-Boston)
W82-06104

HYDRODYNAMICS OF CONDENSATE FILMS ON FLUTED TUBE SURFACES. PART I,

Middle East Technical Univ., Ankara (Turkey). Dept. of Chemical Engineering.
T. G. Somer, and C. Ozgen.
Desalination, Vol 34, No 3, p 233-247, September, 1980. 1 Tab, 10 Fig, 8 Ref.

Descriptors: Desalination, Hydrodynamics, *Desalination processes, *Liquid films, *Fluted tubes, *Navier-Stokes equation, *Heat transfer coefficients.

Hydrodynamic characteristics of liquid films in downward motion on the outer surface of fluted tubes have been investigated, both experimentally and theoretically. The solution of the Navier-Stokes equation is aimed at expressing velocity distribution, volumetric flow-rate, friction and cross-sectional area as a function of flute geometry and operating conditions. A general practical relationship has also been derived for the liquid carrying capacity of different flutes. The results provide sufficient information pertaining to the thickness of the condensate film and its variation, thus enabling the prediction of heat transfer coefficients in desalination. (Balaban-Boston)
W82-06105

EFFECT OF SURFACE CONFIGURATION ON HEAT TRANSFER BY THE CONDENSATION OF STEAM OVER FLUTED SURFACES. PART II,

Middle East Technical Univ., Ankara (Turkey). Dept. of Chemical Engineering.
T. G. Somer, and C. Ozgen.
In: Desalination, Vol 34, No 3, p 249-265, September, 1980. 3 Tab, 9 Fig, 10 Ref.

Descriptors: Desalination, *Desalination apparatus, Hydrodynamics, Pilot plants, *Heat transfer, *Film coefficients, *Fluted tubes, Condensation.

Heat transfer characteristics of fluted tubes have been determined by a pilot-plant study. Film coefficients (inside, outside and overall) have been expressed as a function of average liquid velocity. The performance of fluted tubes has been evaluated with respect to flute geometry and operating conditions by considering the hydrodynamic state of the condensate film. A 'geometric criterion' has been formulated to compare fluted tubes of different geometric designs with respect to their performance in heat transfer. (Balaban-Boston)
W82-06106

TRANSFER CHARACTERISTICS OF CONVEX AND CONCAVE RIVULET FLOW ON INCLINED SURFACES WITH STRAIGHT-EDGED GROOVES,

Technion - Israel Inst. of Tech., Haifa.
R. Semiat, D. Moalem-Maron, and S. Sideman.
In: Desalination, Vol 34, No 3, p 267-287, September, 1980. 13 Fig, 25 Ref.

Descriptors: Desalination, *Desalination apparatus, *Heat transfer coefficients, Convex-Concave rivulet flow.

The flow and temperature fields are solved for convex rivulet flow on the crest of a straight-edged groove and for concave rivulet flow in the bottom of the groove. The effect of the plane inclination in the range of 0 < alpha < pi is accounted for. The general solution converges to the case of flow on a vertical wall where alpha = pi/2. Solutions for the heat transfer coefficients are presented for boundary conditions of constant flux, constant temperature or constant resistance at the wall. The results are presented for aluminium-water system at 70 deg C with a constant contact angle of 37.7 deg. (Balaban-Boston)
W82-06107

ENHANCED HEAT TRANSFER IN HORIZONTAL EVAPORATOR-CONDENSERS WITH STRAIGHT-EDGED GROOVED TUBES,

Technion-Israel Inst. of Tech., Haifa (Israel). Dept. of Chemical Engineering.
D. Moalem-Maron, R. Semiat, and S. Sideman.
Desalination, Vol 34, No 3, p 289-309, September, 1980. 13 Fig, 21 Ref.

Descriptors: Desalination, Desalination processes, Distillation, *Desalination apparatus, *Heat transfer, *Evaporator-condensers(Horizontal).

The flow characteristics on a grooved surface depend on the external feeding rate and the overflow from the crest to the valley between the crests. Energetic considerations affecting transition from convex to concave rivulets are presented. The limiting bounds for minimum and maximum flow with full wetting of the groove determine the desired range of practical operation with different groove dimensions. The corresponding average groove-side heat transfer coefficients are presented. Overall heat transfer coefficients for the simultaneous evaporation-condensation process were calculated for various operating conditions and different grooved surfaces. Comparison with experimental data is satisfactory, but nevertheless indicates lack of availability of reliable data for the dynamic solid-liquid contact angle. (Balaban-Boston)
W82-06108

STUDIES ON SYNETHESES AND PERMEABILITIES OF SPECIAL POLYMER MEMBRANES.28. PERMEATION CHARACTERISTICS AND STRUCTURE OF INTERPOLYMER MEMBRANES FROM POLY(VINYLIDENE FLUORIDE) AND POLY(STYRENE SULFONIC ACID),

Kansai Univ., Osaka (Japan). Dept. of Chemistry.
T. Uragami, M. Fujimoto, and M. Sugihara.
Desalination, Vol 34, No 3, p 311-323, September, 1980. 2 Tab, 6 Fig, 15 Ref.

Descriptors: Desalination, *Membranes, *Membrane processes, *Polymer membranes, Poly(vinylidene fluoride), Poly(styrene sulfonic acid).

The permeation characteristics of poly(vinylidene fluoride) -poly(styrene sulfonic acid) interpolymer membranes in the separation of polymers, poly(ethylene glycols), from their aqueous solutions were investigated under various conditions. The permeation characteristics were influenced markedly by the casting solution composition and operating temperature. It was seen by scanning electron photomicrographs that the changes of ratio of poly (vinyliden fluoride)-poly(styrene sulfnic acid) were related to the changes of microporous structure of the resulting membranes. The permeation rates for aqueous solutions of poly(ethylene glycols) were greater than for pure water. It was found that this phenomenon was dependent on the physical and chemical natures of the membranes and the permeating molecules. The permeation mechanism through the interpolymer membranes was not only the viscous flow. (Balaban-Boston)
W82-06109

RO, MSF AND VTE/VC DESALINATION: A COMPARATIVE EVALUATION,

Envirogenics Systems Co., El Monte, CA.
I. Kamal, D. K. Emmermann, and G. F. Tusel.
Desalination, Vol 33, No 3, p 229-240, June, 1980. 5 Fig, 3 Tab, 3 Ref.

Descriptors: Desalination plants, *Desalination processes, *Reverse osmosis, Cost comparisons, *Multistage flash distillation, *Evaporators.

For seawater conversion in single-purpose plants, reverse osmosis is shown to be more economical than multistage flash desalinatiion over a wide range of unit size and fuel cost. Attention is focused on vertical tube evaporation/vapor compression, a self-contained, low-energy consuming thermal process which is potentially competitive with RO. (Balaban-Boston)
W82-06110

MAGNESIUM OXIDE PRODUCTION FROM CONCENTRATED BRINES,

L'Aquila Univ. (Italy). Faculty of Engineering.
D. Barba, V. Brandani, G. Di Giacomo, and P. U. Foscolo.
Desalination, Vol 33, No 3, p 241-250, June, 1980. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Desalination wastes, Desalination plants, *Brine wastes, *Magnesium oxide, Calcium sulfate, Capital costs, Operating costs.

Magnesium oxide production from concentrated brines wasted in sea water desalting plants has been investigated. Unlike traditional Mg recovery plants from sea water, it is necessary to undertake purification of the precipitated magnesium hydroxide by means of a carbonation-decarbonation section in order to remove calcium sulphate impurities. Such an operation gives flexibility to the whole plant and allows a high purity product to be obtained. This note illustrates all the stages of the proposed process together with the relevant operating conditions. In comparison with the traditional Mg recovery plants from sea water, it has also been found that the capital and operating costs related to the carbonation-decarbonation section are substantially balanced by the elimination of the sea water intake and of the feed pretreatments, as well as by the reduction of the flow rates to be handled in the first plant section. (Balaban-Boston)
W82-06111

HEAT TRANSFER IN A ROTATING DISK EVAPORATOR,

California Univ., Berkeley. Sea Water Conversion Lab.
C. S. Wang, R. Greif, and A. D. K. Laird.
Desalination, Vol 33, No 3, p 259-268, June, 1980. 8 Fig, 9 Ref.

Descriptors: Desalination, *Desalination equipment, *Heat transfer, *Evaporators, Rotating disk evaporator, Copper, Monel.

Experiments were carried out in a rotating disk evaporator with and without a wiper on the evaporation side. The tests were carried out with copper and with monel disks. Overall heat transfer coefficients were obtained directly from the measurements. In addition, evaporation heat transfer coefficients were calculated and the results were correlated. The effectiveness of the wiped film evaporator was clearly manifested in the larger heat transfer coefficients that were obtained. (Balaban-Boston)
W82-06112

SOME BASIC OBSERVATIONS ON HEAT TRANSFER AND EVAPORATION IN THE HORIZONTAL FLASH EVAPORATOR,

Pennsylvania Univ., Philadelphia.
N. Lior, and R. Greif.
Desalination, Vol 33, No 33, p 269-286, June, 1980. 10 Fig, 1 Tab, 24 Ref.

Descriptors: Desalination, *Distillation, Horizontal flash evaporator, *Heat transfer, *Evaporators.

This paper describes a study of the heat, mass and momentum transport associated with vapor release in a horizontal stage of a flash evaporator. A scaled-down, well-controlled flash evaporator, which also allows good visual observation, has been designed constructed and used in the experiments. In paticular, temperature profiles in the stage have been measured to an accuracy of + 0.02 deg C and better. It has been determined that the subcritical flow in the flash stage consists of two principal regions: submerged sluice gate flow with the associated hydraulic pump overlayed by a backflow roller, followed by open channel flow. The flashing of NaCl solutions was accompanied by strong foaming, which has reduced the fractional non-equilibrium allowance by a factor of two or three, without impairing the purity of the distillate. (Balaban-Boston)
W82-06113

MYTHS ABOUT FREEZE DESALTING,

Cornell Univ., Ithaca, NY. School of Chemical Engineering.
H. F. Wieandt, and R. L. Von Berg.
Desalination, Vol 33, No 3, p 287-298, June, 1980. 4 Fig, 2 Tab, 13 Ref.

Descriptors: Desalination, *Desalination processes, Freezing, *Freeze desalting.

Since the inception of freezing as a process for desalting sea water, a variety of misconceptions about the process have evolved and persisted, even when countered with scientific and engineering information to the contrary. Such misconceptions or myths have been very damaging to the commercial development of freezing as a competitive desalination process. A number of these myths are explored with respect to their engineering validity and a comparison is made between freezing and other important desalination processes. (Balaban-Boston)
W82-06114

FREEZING PROCESSES - THE STANDARD OF THE FUTURE - AN UPDATE,

Schroeder Process Corp., Santa Ana, CA.
P. J. Schroeder.
Desalination, Vol 33, No 3, p 299-310, June, 1980. 3 Fig, 6 Ref.

Descriptors: *Desalination plants, Desalination processes, Freezing, *Freeze desalting.

A previous work took the position that freezing processes would be the standard of the future, at least in cases where the feedwater has the concentration of sea-water or higher. It then summarized Fluor's ongoing work on a 10,000 gpd eutectic freezing pilot plant and a freeze desalting plant using the 'cold' from an LNG plant. This work focuses primarily on the progress in coupling a freeze desalting plant to an LGC vaporizer. (Balaban-Boston)
W82-06115

A COMPREHENSIVE FORMAL APPROACH TO THE EVALUATION OF BIDS FOR DESALINATION PLANTS USING VERBAL JUDGEMENT,

Science Applications, Inc., Ames, IA.
R. Kenarangui, A. Husseiny, and Z. Sabri.
Desalination, Vol 33, No 3, p 311-331, June 1980. 10 Fig, 6 Tab, 5 Ref.

Descriptors: Desalination, *Desalination plants, Economics, Social aspects, Safety, Environmental consideration, Political aspects, *Cost analysis.

Evaluation of competitive bids for large engineering projects such as desalination plant construction requires careful consideration of several factors other than pure economic merits; namely, technical characteristics of bids, the socio-political situation, safety merits, environmental aspects, public acceptance and other non-financial aspects. A method is developed here based on verbal judgement and fuzzy set theory to allow for comprehensive and systematic formal evaluation of bids. The method is applied to a case study and can be directly used by the technical team to make the final conclusion. The method is implemented in the form of a computer code (MAFDA) which is suitable for interactive computer facilities. (Balaban-Boston)
W82-06116

WASTE WATER RECYCLING BY ION-EXCHANGE: I. COMPLETE DESALINATION,

Ben-Gurion Univ. of the Negev, Beersheba (Israel).
Y. Egozy, E. Korngold, N. C. Daltrophe, and M. Rebhun.
Desalination, Vol 33, No 2, p 123-138, May, 1980. 5 Fig, 6 Tab, 15 Ref.

Descriptors: *Recycling, Waste recovery, *Ion exchange, Desalination, Wastewater treatment, Operating costs.

Recycling of waste water by ion-exchange was studied on a bench scale. Secondary municipal effluent, which had undergone lime fluocculation, served as a feed for the ion-exchange system. It was found that both the salt concentration and the organic matter content of the effluent could be reduced to produce high quqlity water, suitable foor a wide range of agricultural and industrial applications. Salt concentrations was reduced from 15 meq/1 (750 ppm as CaCO3) to about 1 meq/1 (50 ppm as CaCO3) and the organic matter, from 70-100 mg/1 COD (chemical oxygen demand) to 20 mg/1. The anion exchanger was regenerated with Ca(OH)2 according to a new method recently developed. The treatment cost for a 2000 m(3)/day plant was calculated to be 18.0 cents/cu m. (Balaban-Boston)
W82-06118

MASS TRANSFER IN THE U-TURN OF AN ELECTRODIALYZER,

Korea Advanced Inst. of Science, Seoul. Dept. of Chemical Engineering.
I. H. Kim, I. S. Kang, and H. N. Chang.
Desalination, Vol 33, No 2, p 139-161, May, 1980. 12 Fig, 2 Tab, 13 Ref.

Descriptors: Desalination, Desalination processes, *Electrodialysis, Hydrodynamics, *Mass transfer, Spacers.

As a link in the chain of the hydrodynamic theories on electrodialysis, the mass transfer rate in the U-turn of a tortuous spacer was investigated. Besides, the solutions by Sonin and Probstein (1968) for a straight channel geometry were modified using a concentration profile approximated with a third order polynomial. The flow in a U-turn geometry at low Reynolds numbers was analyzed with the aid of the potential flow theory, and the related mass transfer problem was solved in connection with the flow field solution for the U-turn and the revised concentration distribution. Theoretical analysis showed that the desalting efficiency in the U-turn was nearly the same as that in the straight channel for low polarization but the efficiency was lower for high polarization. Experimental results for the U-turn geometry were in good agreement with the theory for the case of low polarization. However the discrepancy between the two was noticeable for the case of high polarization. Also the disagreement became more pronounced at higher flow velocities possibly owing to the formation of a secondary flow caused by centrifugal forces. (Balaban-Boston)
W82-06119

MORPHOLOGY OF INHIBITOR-TREATED CACO3 PRECIPITATE,

Mobil Oil A.G., Celle (Germany, F.R.).
G. Wilken.
Desalination, Vol 33, No 2, p 21-210, May, 1980. 4 Fig, 18 Ref.

Descriptors: Water purification, *Scale formation, Additives, Crystal growth inhibitors, *Scaling, *Calcium carbonate prevention.

Additives which act non-stoichiometrically during the threshold treatment process are of interest for the control of water formed deposits in water purification or circulation systems. The relevant literature describes the mechanism of the process to prevent precipitation of calcium carbonate. Scale deposition can be reached by adding certain compounds, which are generally polymers or polyelectrolytes, to the solution. Such additives act as crystal growth inhibitors by being adsorbed onto the growing faces of submicroscopic crystals or crystallites. At low supersaturation this gives a stable colloid which can be carried out of the reaction zone by the fluid. In the particular case of a highly supersaturated solution the common additives are not sufficiently effective in preventing scale deposition. The purpose of this paper is to develop a water treatment based on the crystal growth distortion by the scale-inhibitors to produce aggregates which are removable by gas or liquid. The present investigation examines the ability of commercially available scale-inhibitors, stable in aqueous solutions above 100 degree C, to prevent regular calcium carbonate crystal growth. The effectiveness of scale-inhibitors is predominantly concerned with alterations in crystal habit and in characteristics of the precipitate morphology. (Balaban-Boston)
W82-06120

CRITICAL ANALYSIS OF A PROPOSED SOLAR ASSISTED HTE DESALINATION SYSTEM,

Sidney Univ. (Australia).
G. G. Fenton, and J. P. Gerofi.
Desalination, Vol 33, No 2, p 211-220, May, 1980. 6 Fig, 6 Ref.

Descriptors: Desalination, Desalination processes, *Solar assisted desalination, Cost analysis.

A solar assisted desalination system proposed by Gasparini et al. is reviewed. The authors show that there are errors and misconceptions in the paper that render its conclusion invalid. Factors that should be considered in a rigorous analysis of the problem are outlined. Contrary to the original conclusions the current analysis shows that a flat plate collector system is a more attractive proposition than a concentrating option, and that the actual payback periods for the options proposed are unacceptably long at present fuel oil prices. (Balaban-Boston)
W82-06121

ANALYSIS OF LARGE DESALINATION PLANTS,

L'Aquila Univ. (Italy). Faculty of Engineering.
D. Barba, D. Bogazzi, A. Germana', and G. Tagliaferri.
Desalination, Vol 33, No 1, p 1-10, April, 1980. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Desalination, *Desalination plants, *Desalination processes, Distillation, *Multi-flash distillation, Construction, Operation, Reliability, Economics, Unit size.

The experience achieved in the construction and operation since 1973 of the largest MSF desalination unit in the world (8 migd) is the basis for a detailed analysis aimed at contributing to the determination of the practical top size of such units. Taken into account are the reliability and engineering problems as well as economic aspects deriving from the multi-stage flash (MSF) unit size. The problem assumes particular interest when related to the actual trend to limit the maximum unit size normally to 5 migd and in a few cases 6 migd so that consequently some water stations have a large number of parallel units. (Balaban-Boston)
W82-06122

ENERGY AND WATER CONSERVATION THROUGH RECYCLE OF DYEING WASTEWATER USING DYNAMIC ZR(IV)-PAA MEMBRANES,

Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5D.
W82-06123

MSF DESALINATION PLANTS, AVAILABILITY, RELIABILITY AND SAFETY ANALYSES,

Science Applications, Inc., Palo Alto, CA.
A. Unione, E. Burns, and A. A. Husseiny.
Desalination, Vol 33, No 1, p 49-84, April, 1980. 14 Fig, 6 Tab, 51 Ref.

Descriptors: Desalination, *Desalination plants, *Performance evaluation, *Multistage flash distillation, Seawater, Availability, Reliability, Safety analysis.

While good MSF desalination plant performance exerts a positive influence on plant economics, as part of water supply systems in isolated regions, the availability of the desalination system becomes a major design criterion. Reliability problems have historically been a major cause of poor performance for desalination plants. The emphasis of this paper is on the importance of availability modeling methodology to MSF desalination plant reliability problems by providing a context in which the effect of unit unavailability can be quantified. An assessment is made of failures and outages which impact the availability of MSF desalination plants. Limited fault tree logic for system failures is developed and reliability data from the literature is incorporated, where possible. The impact of other water supply system failures on the reliability requirements of the desalination plant is quantified as are the effects of increased average water system demands. The single largest influence on the effective capacity of a water supply system based on MSF desalination of sea water is found to be the availability and maintainability of the desalination plant. Forced outages as a result of equipment failure are significant, but other dominant contributions to unit unavailability include externally caused problems, such as silting. The design configuration of the desalination plant is also found to have an impact on the acceptability of water supply system performance. (Balaban-Boston)
W82-06124

ABSORPTION FREEZING VAPOR COMPRESSION - PROCESS SELECTION, PILOT PLANT DESIGN, PROCESS ECONOMICS,

Concentration Specialists, Inc., Andover, MA.
James H. Fraser.
Desalination, Vol 33, No 1, p 85-98, April, 1980. 4 Fig, 7 Tab.

Descriptors: *Desalination plants, Desalination processes, *Freezing, *Vapor compression, Economics, Pilot plants, Capital costs, Operating costs.

A 25,000 gpd Absorption Freezing Vapor Compression (AFVC) pilot plant was built. Additional studies were conducted in order to prepare capital and operating cost estimates on 100,000 and 1,000,000 gpd plants. AFVC is a new freezing process for desalination and other concentration/separation applications that uses an absorption cycle powered by a heat pump. Power consumption of 42 and 38 kWh/1000 gal. were calculated for the 100,000 and 1,000,000 gpd plants respectively. The 25,000 gpd pilot plant consists of three major process vessels freezer/absorber, wash column/melter, and generator - and two equipment skids - one for the refrigeration equipment and one for the pumps, air removal equipment and heat exchangers. (Balaban-Boston)
W82-06125

MATERIAL SPECIFICATION AND THE AVAILABILITY AND LIFE OF DESALINATION EQUIPMENT IN BOTH SAUDIA ARABIA AND THE ARABIAN GULF,

Conan/Temperley and Associates, Jeddah (Saudi Arabia).
Tom G. Temperley.
Desalination, Vol 33, No 1, p 99-108, April, 1980.

Descriptors: Desalination, *Desalination equipment, *Specifications, *Evaporators, *Materials engineering, *Saudi Arabia, Arabian Gulf.

The author describes operational experience with various materials of construction in both low temperature polyphosphate treated evaporators and also in high temperature evaporators using acid treatment. The author references the repeated use of unsuitable materials and proposes a solution by the development of more detailed and positive specifications for plant and equipment. A problem faced by many manufacturers is the fact that as a result of broad, open specifications they are forced to use inferior materials in order to remain competitive. The author discusses the use of both corrosion resistant linings and operating experience. In summary, the paper correlates the operating conditions with selection of materials. (Balaban-Boston)
W82-06126

SALBUKH REVERSE OSMOSIS PLANT ON STREAM,

Vattenbyggnadsbyran Ltd., Stockholm (Sweden). Dept. of Water, Soil and Environment Development.
B. Ericsson.
Desalination, Vol 33, No l, p 109-114, April, 1980. 1 Fig, 3 Tab, 1 Ref.

Descriptors: Desalination, *Desalination plants, *Reverse osmosis, Pretreatment, Performance evaluation, Salbukh.

An inspection test on the RO plant at Salbukh treatment plant was carried out for 96 hours. The RO plant was successfully brought into operation and the requirements on water quality, water production and water losses satisfied. Based on the performance test, VBB recommends that the RO installation be accepted. Raw water cooling in the pretreatment plant is, however, not acceptable at present. The RO feed water temperature was about 38-40 degree C instead of about 35 degree C due to the lower efficiency of the coolers than calculated, a failure to be rectified by the Contractor. During the last few months the pretreatment of raw water from Well 54 at Buwayb has been investigated by Ames Crosta Babcock by means of final operation of a pilot plant. Based on these results, the use of 140 mg/1 lime and 100 mg/1 soda for chemical softening has been recommended by VBB. The high TDS of the raw water in Well 54 indicates that the final blended water at the same water production rate as originally designed, will contain around 750 mg/1 TDS. However, there is now an indication that the average TDS with all the deep wells in operation will be around 650 mg/1 in blended water due to the low average TDS in the raw water. The pretreatment plant at Buwayb was partly brought into operation in October/November, and the pretreated water is discharged into the water diaribution net and blended with desalinated water from Salbukh. (Balaban-Boston)
W82-06127

THE DEVELOPMENT OF DRY-RO MEMBRANES FROM CELLULOSIS AND NONCELLULOSIS POLYMERS BEARING QUATERNARY AMMONIUM GROUPS,

Puropore, Inc., Tustin, CA.
R. E. Kesting.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243676, Price codes: A03 in paper copy, A01 in microfiche. Report, June 1981. 43 p, 3 Fig, 20 Tab. OWRT C-00133-S(0463)(1), 14-34-0001-0463.

Descriptors: *Reverse osmosis, *Cellulose acetate membranes, *Membranes, *Ion exchange, *Synthesis, Membrane processes, Chlorination, Wastewater treatment, Membrane filters, Polymers, Physicochemical properties, Structure, Physical properties, Chemical properties, Chemical reactions, Fabrication, Evaluation, Water treatment.

Studies were carried out on reverse osmosis (RO) membranes prepared from both cellulosic and noncellulosic materials. For cellulosic membranes produced from quarternized cellulose triesters (QCTE), a successful resolution was achieved to the problems of their high cost and less than optimum reproducibility for dry RO membranes. Blends of QCTE polymer which contained two and three times the optimum ion-exchange capacity (x) could be blended with one or two parts, respectively, of neutral cellulose acetate to yield blend membranes with equivalent performance to those prepared from a homopolymer QCTE with an ion-exchange capacity of x. For noncellulosic membranes, it was found impractical to introduce quarternary ammonium groups into polysulfone. In attempting to find other suitable noncellulosic polymers, aromatic polyamides (specifically, various piperazine phthalamides) were investigated. It was discovered that piperazine ortho-phthalates were sufficiently soluble in methylene chloride/isopropanol (an excellent dry process solvent system) as to permit fabrication of integrally-skinned wet-dry reversible RO membranes. This class of polyamides are thermally-stable and chlorine-resistant, and may lead to a universally applicable RO membrane. (Zielinski-MAXIMA)
W82-06152

ORIENTED MONOLAYER ASSEMBLIES TO MODIFY FOULING PROPENSITIES OF MEMBRANES,

Southern Research Inst., Birmingham, AL.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254913, Price codes: A06 in paper copy, A01 in microfiche. Report SORI-EAS-81-635, July 1981. 108 p, 52 Fig, 7 Tab, 50 Ref, 1 Append. OWRT C-000-99-S(0440)(1), 14-34-0001-0440.

Descriptors: *Membrane processes, *Anion exchange, *Membranes, *Monomolecular films, *Fouling, Ion exchange, Synthesis, Thin films, Polarization, Microscopic analysis, Humic acid, Biodegradation, *Desalination processes, Desalination apparatus, Demineralization, Saline water.

Research was conducted to test whether oriented monomolecular-layer assemblies bearing positive charges would mitigate the fouling propensities of anion-exchange membranes, especially if the oriented layers were fluorinated. Fouling tests with membranes coated by oppositely and similarly charged multilayers should also demonstrate the relative importance of several membrane surface characteristics earlier shown to play roles in initiation of autocatalytic concentration polarization and fouling. Membrane surfaces were modified by coating with individually-oriented layers of amphiphilic modules (having polar and non-polar ends), using the classical Blodgett dipping technique. It was determined that, with appropriate selection of amphiphilic compounds and packing densities, it was possible to independently vary hydrophilicity, homogeneity, and rugosity, thereby establishing the relative importance of these factors in the fouling process. Even a single deposited oriented monolayer of 20 A thickness strikingly modified the microscopic appearance and the electrical and fouling behaviors of anion-exchange membranes. (Zielinski-MAXIMA)
W82-06167

A MICROPROCESSOR-BASED CONTROLLER FOR THE PLUGGING FACTOR MONITOR,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
S. C. Stitt, C. A. Loeser, J. M. Hodgson, and G. Brown.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-234162, Price codes: A10 in paper copy, A01 in microfiche. Report REC-ERC-81-14, May 1981. 217 p, 32 Fig, 2 Tab, 4 Ref, 7 Append.

Descriptors: *Monitoring, *Desalination plants, *Plugging factor, *Water treatment, Particulate matter, Colorado River, Drainage water, Computers, Salinity.

The Yuma Desalting Test Facility was constructed to provide data needed for the design of the proposed Yuma Desalting Plant, near Yuma, Arizona. This plant would provide drainage water treatment for the Wellton-Mohawk Irrigation and Drainage District. The plant would subsequently reduce the salinity of Colorado River water delivered to Mexico. The instrumentation requirements for the test facility include monitoring the plugging factor of the water at various points in the water pretreatement process. The measurement of this factor is used to indicate the amount of organic and inorganic particulate matter which is suspended in the water. To automate the measurement process, a controller was needed for the measuring device. The function of the Plugging Factor Monitor Electronic Controller is to provide plugging factor measurements on any or all of the six possible sample streams. The Plugging Factor monitor can be incorporated into any water treatment facility where the measurement of a plugging factor is required. (Moore-SRC)
W82-06398

APPARATUS FOR DESALINATING WATER,
R. E. Diggs.
U.S. Patent No 4,203,806, 18 p, 21 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 975-976, May 20, 1980.

Descriptors: *Patents, *Water treatment, Water purification, *Desalination processes, Desalination apparatus, Solar radiation, Desalination wastes, Distillation, Vapor compression distillation, Solar distillation.

Contaminated water flows across a grid and into a storage tank. The grid utilizes solar energy to heat that water to a predetermined temparature. A heat transfer structure which is dome-shaped and receives water from the storage tank and a preheater utilizing solar energy heats the water to a further predetermined temperature. An evaporator receives the heated water and exposes it to a vacuum condition so that the temperature of the water is above the saturation temperature. The water is thus vaporized, and solid contaminants dissolved. The solids are deposited on moving belts and are then moved into a solids removal system comprising trap door pairs upon which the solids are deposited and which are sequentially opened so that the vacuum conditions existing in the evaporator are not disturbed. Vapor transferring means remove the water vapor from the evaporator and transfers it to the heat transfer structure where it is condensed to form distillate which is free of contamination. The distillate is removed to a collection tank. (Sinha - OEIS)
W82-06711

MOLECULAR (OSMOTIC AND ELECTRO-OSMOTIC) BACKWASH OF CELLULOSE ACETATE HYPERFILTRATION MEMBRANES,
California Univ. Berkeley. Sea Water Conversion Lab.
K. S. Spiegler, and J. H. Macleish.
Journal of Membrane Science, Vol 8, No 2, p 173-192, March, 1981. 9 Fig, 24 Ref.

Descriptors: *Backwash, *Desalination apparatus, *Hyperfiltration, Membrane processes, *Cellulose acetate, membranes, *Osmosis, *Electro-osmosis, *Molecular backwash, Salt rejection, Filtration, Saline water.

A molecular backwash technique, developed to clean and rejuvenate contaminated asymmetric cellulose acetate membranes used in desalting plants, was based on osmosis and/or electro-osmosis. When the membranes were contaminated with ferric hydroxide, they showed substantial resistance to mass transfer and considerable flux decrease. Four types of backwashing experiments were performed: (1) osmotic backwash with no flushing, (2) osmotic backwash with flushing with deonized water, (3) and (4) electro-osmotic backwashing with and without flushing, applying as electric current (typical current density,-32mA per sq cm) to the membrane for 20-30 min. In all cases the hyperfiltration pressure was lowered to 5-30 psi during backwashing and raised to 6000 psi to continue filtration. After molecular backwashing, flux loss recoveries were 30-100%. In some cases the salt rejection loss which had occurred during contamination was partially restored. Electro-osmotic backwash was more beneficial than osmotic backwash. (Cassar-FRC)
W82-06792

TREATMENT OF WASTEWATERS AND DEMINERALIZATION OF SALINE WATERS BY REVERSE OSMOSIS AND ULTRAFILTRATION,
Scientific Research Inst. of Plastics, (USSR).
For primary bibliographic entry see Field 5D.
W82-06988

3B. Water Yield Improvement

CHINA'S AGRO-ECOSYSTEM,
Manitoba Univ., Winnipeg. Dept. of Geography.
V. Smil.
Agro-Ecosystems, Vol 7, No 1, p 27-46, 1981. 2 Fig, 4 Tab, 45 Ref.

Descriptors: *Agriculture. *Irrigation, Water resources development, *Environmental effects, Land management, *China, Soil erosion, Water pollution, Aquaculture, Drainage, Water transfer, Pumping, Water management.

Regional lack of moisture is a critical environmental constraint to China's agro-ecosystem. The climate ranges from subtropical in the southeast to arid in the north and northwest. Mean annual precipitation varies from 577 mm to 1720 mm. In some areas evaporation exceeds precipitation by up to 4 times. Water resources development and control have been an integral part of China's agriculture for centuries. As of 1979 the irrigation system included 80,000 reservoirs, 5000 canal networks, and 2 million power operated wells. Several large multipurpose water projects are under construction. Aquaculture has deteriorated in recent years because of pollution, dam building, and land reclamation. The capacity of agricultural pumps for drainage and irrigation was 47 GW in 1978, a large increase from 0.13 GW in 1950. China's agricultural system faces many problems. The mechanical irrigation systems are not efficient. Leaks and seepage losses are 50-60%, power shortages idle the pumps for long periods, and sprinkler irrigation is in an early stage of development. Soil erosion is a wide-spread and serious environmental problem, caused by land mismanagement. A proposed water transfer from the Yangzi basin to the chronically dry north also poses environmental hazards. (Cassar-FRC)
W82-06019

AVAILABILITY AND QUALITY OF WATER FROM UNDERGROUND COAL MINES IN JOHNSON AND MARTIN COUNTIES, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
D. S. Mull, S. Cordiviola, and D. W. Risser.
Geological Survey Open-File Report 81-690 (WRI), 1981. 51, p 14 Fig, 2 Plates, 12 Tab, 35 Ref.

Descriptors: *Groundwater, *Available water, *Water quality, *Coal mines, Mine drainage, Recharge, Precipitation, Streams, Water demand, Water analysis, Chemical analysis, Potential water supply, *Kentucky, Johnson County, Martin County.

The location and mine volume is shown for all abandoned coal mines that contained water in Johnson and Martin Counties, Ky. The principal factors that affect the occurrence of water in coal mines is mine size, intensity and duration of precipitation and the location of the mine relative to the nearest perennial stream. Water usually flows from mines that were developed above drainage whereas water usually must be pumped from flooded galleries of mines below drainage. Ten above-drainage mines discharged from 12 to 1,700 gallons of water per minute. Sustained discharge from the largest above-drainage mine ranged from 750 to 1,200 gallons per minute. Eight below drainage mines are considered potential sources of water. Test pumping and hydrographs indicate the seasonal recharge rate into below drainage mines varies from 660 to 103,500 gallons per day. Estimates of water stored in individual mines ranged from 22 to 1,462 million gallons. This water could sustain a supply through periods of limited recharge to the mine. Most mine water is a calcium magnesium sulfate type. Hardness ranged from soft to very hard and pH ranged from 3.1 to 8.0 units. The concentration of most dissolved constituents was lower in water from below-drainage mines than in water from those above-drainage. (USGS)
W82-06136

ATMOSPHERIC ISSUES IDENTIFIED IN STATE WATER RESOURCE PLANNING,
Illinois State Water Survey, Champaign.
For primary bibliographic entry see Field 6B.
W82-06176

CAVE WATER–JAVA'S HIDDEN RESOURCE,
A. Bingham.
World Water, Vol 5, No 5, p 49-51, May, 1982. 1 Fig.

Descriptors: *Water supply, *Developing countries, *Caves, Wells, Groundwater availability, Aquifers, Exploitation, Sinkholes, Underground streams, Java, *Indonesia.

In the dry summer season villagers in the Yogyakarta region of Indonesia must walk up to 15 km to obtain drinking water from clay floor sinkholes and caves in the fissured limestone hills. The presence of water in these places has prompted renovation of the sinkholes by sinking shaft wells. This water supply, filtered by the clay, is cleaner and more reliable than surface pools. Most cave water is obtained from shallow dirty pools near the entrances. However, underground streams and large pools have been discovered in some caves. It is believed that these less accessible, but more abundant, supplies may be tapped by sinking well shafts, removing rock, or installing pumps. (Cassar-FRC)
W82-06605

3C. Use Of Water Of Impaired Quality

SALT- AND DROUGHT-TOLERANT CROP PLANTS FOR WATER CONSERVATION,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
M. W. Nabors.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243445, Price codes: A07 in paper copy, A01 in microfiche. Report No 109, October 1981. 133 p, 16 Ref, 7 Append. OWRT B-208-COLO(1), 14-34-0001-0211.

Descriptors: *Culturing techniques, *Water stress, *Salt tolerance, *Water use efficiency, Plant pathology, Stress, Median tolerance limit, Plant growth, Crop production, Crop yield, Water use, Tobacco, Oats, Wheat, Coastal plains, Coastal waters, Arid climates.

Research has been carried out which demonstrates the usefulness of tissue culture to assess stress tolerance in plants. This technological approach is shown to be a useful vehicle for the assessment of

agriculturally-useful plants that exhibit tolerance to low irrigation water supplies or salt water for enhancing food production in arid or coastal areas. The available methodology was improved and new methodology established. Available tissue culture methodology can be used to rapidly select NaCl-tolerant cell lines and to regenerate whole plants from those lines in tobacco, oats, and wheat. In tobacco, regenerated plants are salt-tolerant, pass this tolerance on to two generations of offspring, and give rise to tolerant callus when returned to tissue culture. Regenerated oat plants require a short period of exposure at 30 degrees to become established in pot culture, and exposure to about 20 degrees during the rest of the life cycle to set seed. In addition, initial studies on the mechanism of salt tolerance in cultured cells and regenerated plants have been completed. Future research should focus on the development and implementation of tissue culture methods to obtain increased efficiency of water utilization for agriculturally-useful plants. (Zielinski-MAXIMA)
W82-05920

WASTEWATER IRRIGATION OF FRUIT TREES,

Tuskegee Inst., AL. Dept. of Agricultural Sciences.
F. M. Basiouny.
BioCycle, Vol 23, No 2, p 51-53, March/April, 1982. 1 Tab, 52 Ref.

Descriptors: *Wastewater irrigation, *Irrigation water, *Fruit crops, Reviews, Orchards, Water reuse, Land application, Accumulation, Saline water, Heavy meals, Metals, Pathogens, Nutrients.

Wastewater irrigation of fruit trees has a two-fold benefit: addition of mineral and organic nutrients and renovation of the wastewater. This practice can save 25-50% in production costs. Most non-industrial wastewaters have salinity levels of 300-700 ppm, within the salinity range suitable for irrigation water. However, foliar spraying should be avoided in orchards. Potential problems in wastewater irrigation are toxicity or plant uptake of heavy metals and transmission of disease organisms. The heavy metal problems can be controlled with careful management. Pathogenic contamination of fruit tree products is very unlikely, since bacteria and viruses can be effectively removed by primary and secondary treatment. (Cassar-FRC)
W82-06008

EFFECT OF IRRIGATION LOAMY SAND SOIL BY SEWAGE EFFLUENTS ON ITS CONTENT OF SOME NUTRIENTS AND HEAVY METALS,

Riyadh University (Saudi Arabia). Coll. of Agriculture.
For primary bibliographic entry see Field 5E.
W82-06228

EFFLUENT IN TRICKLE IRRIGATION OF COTTON IN ARID ZONES,

Ben-Gurion Univ. of the Negev, Sde-Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron, J. Ben-Asher, and Y. DeMalach.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p115-126, June, 1982. 11 Fig, 4 Tab, 14 Ref.

Descriptors: *Wastewater irrgation, *Irrigation water, *Trickle irrigation, *Cotton, Arid lands, Beer-Sheva Vally, *Israel, Nutrients, Fertilizers, Crop yield.

Treated wastewater from facultative oxidation ponda was aplies to cotton on loess soil by tickle irrigation in the arid Beer-Sheva Valley, Israel, during 1980. Six trickle irrigation treatments and a sprinkler irrigation treatment were applied. Irritation itervals were 2,3,7, and 12 days; emitter discharges were 2,4, and 8 liters per hour; emitter spacing between rows, 1.92 and 2,88 m; and mitter spacing on laterals, 1.0. m. Cumulative water application was about 600 mm for the season in all treatments. The highest cotton yield, 604.1 kg per 1000 sq m, was produced by the smallest emitter discharge, smaller eitter spacing, and 2-day irrgation interval. The lowest yield, 375.6 kg per 1000 sq m, was produced by the largest emitter discharge, larger emitter spacing, and 12 day irrigation interval. No additional fertilizers were applies in any treatments. Proper screen filtration eliminated emitter clogging. (Cassar-FRC)
W82-06333

CHARACTERIZATION OF LAVERKIN SPRINGS WATER AND METHODS FOR ITS REUSE IN ENERGY DEVELOPMENT,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 5G.
W82-06400

EXPANDING OPTIONS FOR GREYWATER TREATMENT,

Lombardo and Associates, Boston, MA.
For primary bibliographic entry see Field 5D.
W82-06491

RECYCLED FOOD PROCESSING WASTES REDUCE TREATMENT COSTS,

CH2M/Hill, Redding, CA.
S. C. Ebe, and S. M. Stroud.
Public Works, Vol 113, No 3, p 68-69, March, 1982.

Descriptors: *Food-processing wastes, *Impaired water use, *Land application, Wastewater treatment, Merced, California, Land disposal, Wastewater irrigation, Irrigation water, Crop land, Monitoring.

High strength food processing wastewaters are applied to city owned crop land in Merced, California, during the canning season, mid-August to mid-October. This procedure relieves the seasonal overload on the municipal wastewater system and allows the discharges to meet state requirements. The 985 acre disposal site, adjacent to the treatment plant, was plowed to a depth of 3.5 ft and gypsum added. Oat hay and wheat grain are grown. The system, which became operational in August 1979, consists of seven 80 acre fields with pump stations and piping. Wastewater can be delivered to any one or any combination of the seven fields via a 14 inch pipe. The flow is channeled through a head ditch to individual border checks. Runoff is returned to the head ditch. In the spring irrigation season secondary municipal effluent may be used as a supplement. The versatile system also allows the food wastewater to enter the municipal treatment plant during periods of low flow in winter and early summer. Drainage control structures were created for flood control. An adjacent 385 acre wetlands area receives secondary treated effluent. The project includes a water quality monitoring program. (Cassar-FRC)
W82-06507

WATER CONSERVATION AT WASTEWATER TREATMENT PLANTS,

Williamsport Sanitary Authority, PA.
M. H. Gerardi, O. A. DeParasis, and W. H. Falk.
Public Works, Vol 113, No 3, p 59-60, March, 1982. 1 Fig, 2 Tab.

Descriptors: *Water conservation, *Impaired water use, Wastewater treatment, *Treatment plants, Effluents, Williamsport, Pennsylvania.

Two Williamsport, Pennsylvania, wastewater treatment plants reduced water usage by about 60% during a period of drought in early 1981. Average daily consumption for the Central plant was 12,500 gal in 1979-80 and 6,000 gal in 1981; for the West plant, 6,000 gal in 1979-80 and 2,000 gal in 1981. Conservation measures consisted of minimizing use of potable water and maximizing use of secondary effluent. Flow restrictors, new water faucet washers, and three-minute showers saved potable water. Effluent was used to wash equipment, floors, vehicles and treatment tanks, and to launder rags. Other uses of effluent included sprinkling scum on secondary clarifiers, packing glands for the raw sewage pumps, concrete curing, cleaning bar screens, hosing foam, flushing lines, and lubricating sludge pump pistons. (Cassar-FRC)
W82-06512

A COMPARISON OF THE EFFECTS OF SALINITY ON PHOTOSYNTHETIC PHYSIOLOGY OF A SALT SENSITIVE GRASS, PANICUM OBTUSUM, AND A SALT TOLERANT GRASS, DISTICHLIS SPICATA,

New Mexico State Water Resources Research Inst., Las Cruces.
P. R. Kemp, and G. L. Cunningham.
New Mexico Water Resources Research Institute, Report No 143, March 1982. 19 p, 6 Fig, 1 Tab, 28 Ref.

Descriptors: *Salinity, *Saline soils, *Saline water, *Salt tolerance, *Grasses, Photosynthesis, Assimilative capacity, Stomata, Growth rates, Growth media, Halophytes, Temperature effects, Plant water potential.

Utilizing salt tolerant crops could potentially increase agricultural productivity in the southwest by using brackish water from vast underground resources or through increased growth on salt-damaged fields. Selecting and breeding salt tolerant crops requires an understanding of the physiological and anatomical mechanisms of salt tolerance. A salt sensitive grass and a salt tolerant grass were the subject of this experiment on the effects of substrate salinity. There were three experimental treatments, all in a controlled environment, for each species. Preliminary results showed marked differences in salinity tolerance. D. spicata grows well in solution cultures up to 500 mM NaC1. P. obtusum dies rapidly in salinities over 250 mM NaC1 and will not grow in salinity greater than 125 mM NaC1. An unexplained difference is P. obtusum's poor growth in solution culture as compared to D. spicata. The temperature response curves of net photosynthesis show that maximal rates occur near 40 C for both species with no added NaC1. However, rates of net photosynthesis were quite different between species at all leaf temperatures when grown without NaC1---the rates of D. spicata were twice those of P. obtusum. Growing plants at high salinity reduced net photosynthesis in both species by causing increases in both stomatal and internal resistances to CO2 assimilation. Resistance of P. obtusum was higher than D. spicata in all treatments; thus, D. spicata has a more efficient internal CO2 assimilation mechanism. Leaf water potentials in both species declined with increasing salinity. (Atkins-Omniplan)
W82-06521

AQUACULTURE FOR WASTE MANAGEMENT,

Nebraska Univ., Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5D.
W82-06556

FEASIBILITY OF FINANCIAL INCENTIVES TO REUSE LOW QUALITY WATERS IN THE COLORADO RIVER BASIN,

Denver Research Inst., CO.
J. G. Milliken, L. C. Lohman, and C. W. Howe.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256694, Price codes: A05 in paper copy, A01 in microfiche. OWRT/RU-81/7 Report, August 1981. 87 p, 2 Fig, 13 Tab, 53 Ref, 4 Append. OWRT C-80228-R(8820)(1).

Descriptors: *River basins, *Impaired water use, *Economic aspects, *Saline water, *Monetary benefits, Water reuse, Cost-benefit analysis, Salinity, Tangible benefits, Water quality, Industrial water, Cooling water, Irrigation water, Electric powerplants, Benefits, Reclaimed water, *Colorado River basin.

The cost-effectiveness of selected financial incentives for encouraging reuse of low quality/saline water collected by the U.S. Bureau of Reclamation (USBR) system for electric power plant cooling is analyzed. Penalty costs to water users presently

using saline waters for agricultural/domestic purposes and the potential economic benefits in salinity reduction are identified. Non-quantifiable salinity control benefits were identified as well, in terms of existing/potential beneficial water uses in the 7 Colorado River basin States and general amenity benefits. Further the institutional/regulatory environment in which electric power plants must operate was examined and is described. Comparative costs for saline water reuse for power plant cooling were ascertained. In addition, financial/policy incentives were studied for their relevance to the public power utility and the utility regulatory agency, and for their implementation potential. The most like incentive (capital cost subsidy) was analyzed with existing representative power plant cost data to assess its economic potential. The average cost was below a number of current USBR salinity control projects under consideration for construction. Reuse of saline water by an electric power utility could be a viable and cost-effective method of salinity control. (Zielinski-MAXIMA)
W82-06693

IMMUNE RESPONSE TO A FORMALIN-TREATED BACTERIAL EXOTOXIN (TOXOID) OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,

Memphis State Univ., TN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06707

INFILTRATION CAPACITY CURVES FOR SODIUM AFFECTED SOILS,

South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
S. T. Chu, and C. G. Carlson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256850, Price codes: A03 in paper copy, A01 in microfiche. South Dakota Water Resources Institute Report, May, 1982. 28 p, 7 Fig, 1 Tab, 38 Ref, 1 Append. OWRT A-074-SDAK(1), 14-34-0001-0144.

Descriptors: *Infiltration capacity, *Irrigation design, *Saline soils, *Soil water, *Mathematical equations, Infiltration coefficient, Infiltration index, Infiltration, Infiltration rate, Free water, Irrigation, Soil conservation, Soil contamination, Basins, Runoff coefficient, Sodium, Soil types, Field tests, Mathematical studies, Electrolytes.

Soil infiltration capacity (IC) must be considered for irrigation system design, soil conservation planning, and for evaluating basin runoff yields. The relationship of IC (inches/hour) as a function of electrolyte concentration (EC, meq/liter) of the saturation extract and the exchangeable sodium (Na) percentage (ESP) was examined, as well as ways to improve the mathematical equations used to analytically described IC curves. A field infiltrometer was designed and constructed for field studies; a method incorporating the initial moisture in the profile (antecedent moisture) was developed due to field study difficulties. As an alternative to field study, IC curves were determined on undisturbed soil cores of varying salinity and 2-year irrigation treatment, planted to alfalfa. Study of the curves indicated that there is a continuous effect caused by increasing the Na adsorption ratio from 7.5-30. Watering with high EC water apparently reduces the Na dispersion, an argument having ramifications in sub-humid areas where over half the watering occurs with rainfall of low EC. Analytical study of the mathematical equations describing IC curves indicated that no universal analytical procedure can presently provide consistent estimates of the infiltration characteristics of moist soil over wide soil moisture and cover conditions. (Zielinski-MAXIMA)
W82-06712

A UNIVARIATE VERSUS A MULTIVARIATE PARAMETER DISTRIBUTION IN A STOCHASTIC-CONCEPTUAL ANALYSIS OF UNSATURATED FLOW,

Agricultural Research Organization, Bet Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 2G.
W82-06856

3D. Conservation In Domestic and Municipal Use

WATER CONSERVATION INCENTIVES AND STRATEGY,

Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
W. Whipple, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243312, Price codes: A04 in paper copy, A01 in microfiche. Report, October 1981. 53 p, 4 Tab, 7 Fig, 69 Ref. OWRT C-90184-C(1), 14-34-0001-9454.

Descriptors: *Water conservation, *Economics, *Water policy, *Drought, Water quantity, Water analysis, Water availability, Water control, Water deficit, Water loss, Water management, Water rates, Water reuse, Water shortage, Groundwater mining, *Renewable resources, *Drought contingency plans.

In 1976, President Carter announced that water conservation would be the cornerstone of his water policy, defining the term to mean reducing inefficiency, wastage and unnecessary usage (and excluding the aspect of 'conserving' water by storing it for future use). Water conservation thus defined has become a popular goal, sometimes advocated with a fervor bordering on the religious. New Jersey,in formulating a Statewide Water Supply Master Plan, has had to deal with water conservation along with economic objectives and engineering methodology. Analysis of the economic theory of Water Resources Development and Planning has been applied to evaluate various policies and issues. This analysis indicates that water conservation has been a slogan rather than a coherent program, that following it as a goal may sometimes be counter productive, and that there is often confusion between a conservation 'ethic' which is an end in itself, and conservation as a means of obtaining various economic objectives. Analysis indicates that outside of groundwater 'mining', water is usually a renewable and reusable resource. During periods of normal precipitation, water conservation should be employed only when the value of the water saved exceeds the cost of affecting the savings. Water conservation is most valuable as a drought contingency tactic. Water conservation as a substitute for structural provision to meet normal water needs is apt to prove shortsighted. (Author abstract)
W82-05906

INCENTIVES AND INSTITUTIONS FOR WATER CONSERVATION,

California Univ., Los Angeles.
E. A. Engelbert.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243460, Price codes: A04 in paper copy, A01 in microfiche. Report, August 1978. 48 p, 26 Ref. OWRT (8571)(1).

Descriptors: *Water conservation, *Institutional constraints, *Environmental effects, *Economic aspects, *Decision making, Institutions, Legal aspects, Public participation, Attitudes, Social participation, Regulations, Equitable apportionment, Water law, Water policy, Public policy, Organizations, Federal jurisdiction, Political constraints.

Ten aspects related to incentives and institutions for water conservation are separtely addressed, with general observations and research/action objectives discussed for each. These aspects include: available literature; water conservation concepts (changing perceptions; water needs); public knowledge and awareness (information gaps; cultural patterns/beliefs; education/communication); ethical/equity considerations (individual/group equity; community welfare); environmental aesthetic considerations (environmental water conservation as an integrative-systems process); social/political considerations (community living patterns and life styles; dynamics of social decision-making; the participatory process for citizens in water policy formulation); economic considerations (the pricing system; taxes/subsidies and other financial incentives); water policies (lack of a national conservation policy; integrating water supply and water quality policies and programs; conjunctive management for surface/ground waters; water reclamation/reuse); law and regulations (legal relationships modification; administrative flexibility enhancement; legal conservation incentives); and organizations and administrative arrangements (organizational pluralism/integration; federal-state relationships; political decision-making; bureaucratic attitudes/committments). (Zielinski-MAXIMA)
W82-05922

LEAK LOCATION ENTERS COMPUTER AGE,

New York City Dept. of Environmental Protection, Bureau of Water Supply.
For primary bibliographic entry see Field 7A.
W82-06018

THE IMPACT OF MASS DISTRIBUTION OF WATER CONSERVATION DEVICES AND A WATER CONSERVATION RATE STRUCTURE ON RESIDENTIAL WATER USE,

Pennsylvania State Univ., University Park. Coll. of Agriculture.
W. E. Sharpe, C. E. Young, and K. R. Kinsley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243700, Price codes: A04 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and Water Resources, University Park, Report, April 1982. 49 p, 5 Fig, 12 Tab, 25 Ref, 1 Append. OWRT B-112-PA(1), 14-34-001-9092.

Descriptors: *Surveys, *Water rates, *Water use efficiency, *Water users, *User charges, Water use, Water demand, *Water conservation, Urban areas, Water distribution, Water costs, Evaluation, Competing use, Consumptive use, Reasonable use, Conservation, Water supply, Economic aspects, Water control, District of Columbia, Maryland, *Washington Suburban Sanitary Commission.

A study of 545 residential customers of the Washington Suburban Sanitary Commission in the suburban Washington, DC area was undertaken to determine the impacts of mass water conservation device distribution and a water conservation water rate on their long-term water demand. An econometric model was used to assess the impact of the water conservation rate. The study showed a 17% decline in the quantity of water use over the 1974-79 study period. The majority of customers reported changing their habits to use less water; 42% also reported installing water conservation devices. The model output showed a greater decline in water use after the water conservation rate was implemented. High water users reduced their water demand most in response to the rate change. The water conservation rate appeared to increase the use of water conservation devices, and to stimulate greater water use habit modification. Most customers (51%) had no opinion when asked whether they liked/disliked the water conservation rate policy; however, given the choice between decreasing/increasing/uniform rate schedules, only 10% of the residential customers responding preferred the decreasing type of rate schedule. (Zielinski-MAXIMA)
W82-06155

WATER RATE STUDIES AND RATE MAKING PHILOSOPHY,

Stanley Consultants, Inc., Muscatine, IA.
For primary bibliographic entry see Field 6C.
W82-06222

WATER RATES AND RESIDENTIAL WATER CONSERVATION,

National Bureau of Standards, Washington, DC.
B. C. Lippiatt, and S. F. Weber.
Journal of the American Water Works Association, Vol 74, No 6, p 278-281, June, 1982. 4 Tab, 14 Ref.

Descriptors: *Water conservation, *Pricing, Water rates, Domestic water, Water users, Economic aspects, Conservation.

The five major types of water rate schedules are explained and discussed in terms of their conservation incentives. Then the rate schedules of a national sample of 90 water utilities are analyzed. Sample means are calculated for selected rate schedule variables, including the correct price for valuing a unit of conserved water and the average price of water. The results indicate that when estimated bill reductions are based on average price, overinvestment in water conservation is likely to result. In addition, the significant price variation found in the results highlights the importance of using local rate schedules, rather than national averages, to value conserved water. (Baker-FRC)
W82-06276

COST-BASED WATER RATE DESIGN,
Norville (Rodney L.) and Co., Houston, TX.
For primary bibliographic entry see Field 6C.
W82-06277

HOW RATE STRUCTURES AND ELASTICITIES AFFECT WATER CONSUMPTION,
Florida Univ., Gainesville. Dept. of Food and Resources Economics.
For primary bibliographic entry see Field 6C.
W82-06351

POLICING DEMAND THROUGH PRICING,
Fairfax County Water Authority, Merrifield, VA.
For primary bibliographic entry see Field 6D.
W82-06352

EVALUATION OF DEMAND MANAGEMENT POLICIES FOR CONSERVING WATER IN URBAN OUTDOOR RESIDENTIAL USES,
Policy Sciences Associates, Boulder, CO.
W. B. Lord, J. A. Chase, and L. A. Winterfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256686, Price codes: A04 in paper copy, A01 in microfiche. Research Report 82-1, January 28, 1982. 58 p, 13 Tab, 3 Fig, 24 Ref, 1 Append. OWRT C-90123-C(1), 14-34-0001-0530.

Descriptors: *Water conservation, *Municipal water, *Water demand, *Evaluation, Attitudes, Behavior, Elasticity of demand, Lawns, Pricing, Rationing(Water), Social values, Alternative regulatory mechanisms, Public acceptability.

A study of public acceptability and potential water use response to a variety of municipal water conservation policy options was conducted in three Colorado Front Range communities in the 10,000 to 100,000 population range. The study was focused upon water used for lawn watering, because it accounts for nearly half of total residential water use and for a much greater share of both consumptive water use and water system peak load requirements. Policies which provided water conservation information were the most acceptable. Policies which rewarded people who took conservation actions and some policies which included restrictions on water use were acceptable to most. Penalties and restrictions perceived to be inequitable or severe were unacceptable. Conservation pricing was moderately acceptable and was one of the more effective policies in achieving water use reductions. Most respondents preferred increasing or inverted block pricing to the more common declining block pricing policy. Public information would be a desirable component of any municipal water conservation program. Conservation pricing deserves prime consideration for a utility emphasizing either effectiveness or financial feasibility. A utility emphasizing acceptability will face a difficult choice, because there tends to be an inverse relationships between acceptability and effectiveness. (Author abstract)
W82-06669

TRUCKEE MEADOWS WATER USE - PRESENT AND FUTURE,
Nevada Univ. System, Reno. Desert Research Inst.
J. W. Fordham.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256793, Price codes: A04 in paper copy, A01 in microfiche. Publication No 41073, April, 1982. 58 p, 9 Fig, 18 Tab, 37 Ref. OWRT A-095-NEV(1).

Descriptors: *Water use, *Mathematical models, *Projections, *Hydrologic budget, *Competing use, Computer models, Mathematical studies, Model studies, Forecasting, Prediction, Water availability, Induced infiltration, Water requirements, Alternative water use, Groundwater recharge, Urbanization, *Nevada, Truckee Meadows.

Water use changes during the past decade and water use projections to the year 2000 are described for the truckee Meadows valley, which hosts one of the fastest growing metropolitan areas in the U.S. (Reno/Sparks). Identified and quantified are: the added urban use in previously undeveloped areas; the water need changes for areas transformed from agriculture to urban; the reduction in induced groundwater recharge to the Truckee Meadows. A simplified water balance model which incorporated inflow of tributary streams, average river flows, precipitation, and temperatures was used to develop current and projected water budgets, providing a balance by diverting waters by source, river, tributary, or groundwater, and accounting for losses and returns to the river system. The projected total diversion for the Meadows from surface sources in the year 2000 (132,000 acre-feet/year) remains below total water rights currently allocated. Induced recharge is projected to decline (by about 25%) by 5040 acre-feet/year due to urbanization. Urban runoff is projected to increase about 4350 acre-feet/year for the same reason. The results depict a water balance for the Meadows at the current area development rate, since growth rate and land use change have slowed significantly since 1979. The net difference between inflow and outflow is equal to the total annual loss expected under each level of development. (Zielinski-MAXIMA)
W82-06705

COUNTY PROVIDES A RURAL WATER SUPPLY SYSTEM,
URS Engineers, Seattle, WA.
W. L. Berschauer, and N. Miller.
Public Works, Vol 113, No 7, p 63-65, July, 1982.

Descriptors: *Public utility districts, *Political aspects, *Water supply, Water distribution, Municipal water, Gardiner, *Washington, Jefferson County, Utilities.

The 200 residents of Gardiner, Washington, lacking sufficient groundwater supplies, petitioned the Jefferson County Public Utility District (PUD) 1 in 1976 to investigate the feasibility of a community water system. After a test well located a large aquifer with excellent water quality, the Farmers Home Administration agreed to finance the project with a $1 million loan. After a public hearing in November 1979, Local Utility District No. 1 was established. The system, comprising 7 miles of distribution main, two concrete storage tanks, two pressure reducing stations, a booster pump station, and a well pumping station, was placed in service in August 1981. The PUD is currently studying other requests for similar water systems in its jurisdiction. (Cassar-FRC)
W82-06843

3E. Conservation In Industry

REORGANIZATION OF GROUNDWATER UTILIZATION SOUGHT (NEUORDNUNG DER GRUNDWASSERVERWENDUNG ANGESTREBT),
H. Keune.
Wasser, Luft and Betrieb, Vol 26, No 1/2, p 14-16, 1982. 1 Tab, 15 Ref. (No English summary).

Descriptors: *Groundwater management, *Industrial water, *Water districts, *Water law, Water supply, Water scarcity, Surface water, Costs, Water conveyance, Economic aspects, Administrative regulations, Public policy, Federal Republic of Germany.

The 1981 'water crisis' in the Federal Republic of Germany precipitated efforts to reduce industrial consumption of groundwater. While this actually decreased between 1975 and 1977, some statistics did not reflect this, because recharged groundwater and bank filtrate were counted as surface water by the public water authorities, but as groundwater by industry. The fact that industrial demand is significantly less than public demand and that only in certain regions is there competition for the groundwater supply means that this issue can be resolved locally. The suggestion that industry release water from its wells to the public supply in exchange for nonpotable water at no cost to either party is impractical due to lack of suitable water and pipelines, administrative difficulties, and costs. The suggestion that industry be permitted to use groundwater only when this comes from the public supply is also impractical, as chlorinated or otherwise disinfected water is not always suitable for industrial use. Rationing plans are not likely to be instituted in the foreseeable future due to technical difficulties. The only remaining option is conventional water law, which can provide restrictions on the issuing of permits and concessions for groundwater use. (Gish-FRC)
W82-06022

ESTIMATING WATER DEMAND SCHEDULES FOR SELECTED INDUSTRIES IN ARKANSAS,
Arkansas Water Resources Research Center, Fayetteville.
For primary bibliographic entry see Field 6D.
W82-06160

WASTE-HEAT VERTICAL TUBE FOAM EVAPORATION FOR COOLING TOWER BLOWDOWN RENOVATION/RECYCLE,
Envirotech-Sephton Development Center, Emeryville, CA.
H. H. Sephton, and K. Someahsaraii.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256629, Price codes: A07 in paper copy, A01 in microfiche. Report, February, 1982. 114 p, 32 Fig, 9 Tab, 22 Ref. OWRT C-90052D(0427)(1).

Descriptors: *Cooling towers, *Power plants, *Heat transfer, *Waste heat, *Water reuse, Cooling water, Industrial water, Heat exchangers, Heat, Water use, Reclaimed water, Industrial plants, Thermal water, Heated water, Environmental engineering, Engineering, Energy loss.

A prototype waste-heat vertical tube foam evaporation (WH-VTFE) plant was designed, constructed, and field-tested for reducing power plant cooling tower blowdown to a small residual volume of solids slurried in brine, while producing distilled water for reuse. Facility design was based on previously-developed pilot plant test data. The WH-VTFE facility was constructed for initial parametric testing in demonstration phase was conducted at a power plant site using turbine exhaust steam for the up to 50-fold cooling tower blowdown concentration in a foamy-flow seed-slurried mode of downflow vertical tube evaporation. The VTFE heat transfer coefficient ranged between 5600-9000 W/sq m/degree, a sufficient temperature difference is available within a typical power plant heat rejection system to operate a WH-VTFE when the plant load is above 50% of its design capacity. Scale formed from inadequate brine recycle rates was readily removed by recycling fresh water through the evaporator to restore the high heat transfer performance of the WH-VTFE. It was concluded that WH-VTFE was demonstrated as feasible and commerically viable. (Zielinski-MAXIMA)
W82-06169

THE BENEFITS OF WATER MANAGEMENT IN ENERGY AND AGRICULTURAL DEVELOPMENT IN THE SAN JUAN RIVER BASIN OF NEW MEXICO,
Energy Policy Studies, Inc., Omaha, NE.
M. W. Gilliland, and L. B. Fenner.
Resources and Conservation, Vol 6, No 3/4, p 167-185, 1981. 5 Fig, 4 Tab, 18 Footnotes.

Descriptors: *Water conservation, *Energy, *Agriculture, *Water management(Applied), Irrigation efficiency, Canal linings, Cooling water, Electric power industry, San Juan River, *New Mexico, Colorado River Basin, Coal mining, Gasification, Water requirements.

Impacts of five water management options and non-management are described for the San Juan County, New Mexico, region in the Upper Colorado River Basin. The five strategies chosen for evaluation are canal lining, canal lining with sprinkler irrigation, all dry cooling of energy producing plants, combination wet/dry cooling of energy producing plants, and reuse of uranium mining discharge water as cooling water for gasification plants. Results of evaluating water quantity, instream flows, and water quality showed that improved agricultural irrigation efficiencies and dry cooling in the energy industry will have little effect on water quantity and quality over the next 20-25 years. In the San Juan River, water flow at Shiprock will decrease from 56,200 liters per sec at present to 35,300 liters per sec with no management. Conservation measures are expected to produce flows of 35,700-38,300 liters per sec. During 1 to 3 months of the year, flows will be insufficient to maintain good instream conditions, depending on the water management strategy used vs. 3 months with no management. Likewise, salinity at three stations will increase by 17% with no management and slightly less with the management options studied. Overall, dry cooling in the energy industry would reduce projected water depletion by 10%, salinity by 2%, and instream impacts by 8%. The agricultural conservation measures would not change water depletion, and would reduce projected salinity increases by 5% and instream impacts by 4%. The minor improvements are cost effective for the energy industry but not for agriculture. (Cassar-FRC)
W82-06517

3F. Conservation In Agriculture

AN ECONOMIC COMPARISON OF THE IRRIGATION OF CORN IN HUMID AND ARID REGIONS OF THE UNITED STATES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6B.
W82-05909

SALT- AND DROUGHT-TOLERANT CROP PLANTS FOR WATER CONSERVATION,
Colorado State Univ., Fort Collins. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 3C.
W82-05920

HERBICIDE LOSS IN RUNOFF WATER AND SEDIMENT AS AFFECTED BY CENTER PIVOT IRRIGATION AND TILLAGE TREATMENTS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W82-05921

ANALYZING AND PREDICTING IRRIGATION DIVERSIONS IN SOUTHEASTERN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
S. Kim.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243486, Price codes: A07 in paper copy, A01 in microfiche. Report, September 1981. 122 p, 21 Fig, 16 Tab, 49 Ref, 5 Append. OWRT B-041-IDA(4). 14-34-0001-8079.

Descriptors: *Irrigation practices, *Flow discharge, *Prediction, *Irrigation requirements, *Time series analysis, Irrigation districts, Irrigation water, Influent water, Water use, Model studies, Forecasting, Projections, Water use efficiency, Model testing, Statistical methods, Mathematical studies, Computer programs, Evapotranspiration, *Idaho.

Daily water flow data from two large irrigation districts in the Upper Snake River over three irrigation seasons (1978-1980) were analyzed and methodology was investigated for the predictions of daily water diversions. Crop consumptive water use, estimated by the combination method on a daily basis, varied greatly on a daily basis, and its pattern was quite different from year-to-year. In addition, seasonal irrigation use levels were different for different years for the districts, while seasonal water use patterns were similar for the different years and districts. Fluctuations, and relations among inflow, outflow, evapotranspiration, and precipitation were assessed using graphical and statistical methods. A slight change in evapotranspiration was found to cause a rather large change in inflow. A weekly cycle was found to exist within outflows, but no significant frequency was found within inflows. Time and diversion interrelationships were established, and, based on the time effects, proper consumptive irrigation requirements were estimated at the district level. The methodology developed for predicting water diversions took the form of a computer program, and was observed to provide reasonable predictions for the study area. (Zielinski-MAXIMA)
W82-05924

CABLEGATION: II. SIMULATION AND DESIGN OF THE MOVING-PLUG GATED PIPE IRRIGATION SYSTEM,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
D. C. Kincaid, and W. D. Kemper.
Transactions of the ASAE, Vol 25, No 2, p 388-395, March/April, 1982. 13 Fig, 1 Tab, 12 Ref.

Descriptors: *Cablegation, *Irrigation design, *Pipe flow, Furrow irrigation, Infiltration, Automation, Orifice flow.

The cablegation irrigation system consists of a surface pipe, laid on a slope at the head end of a field, which serves as both the conveyance and distribution pipe. Gates or holes near the top of the pipe are left open. Water is introduced at a flow rate less than the free surface flow capacity of the pipe. A plug, restrained by a cable, is allowed to move down the pipe at a slow rate, causing water to flow out of the holes upstream from the plug, and thus moving the entire flow across the field. This paper develops a simulation model to predict the time distribution of orifice flow, the distribution of infiltrated water across a field, and runoff rates. The model is usable for designing cablegation systems for fields with variable pipe slopes and variable furrow lengths. To obtain the optimum net water application and keep furrow stream sizes within acceptable limits the orifice size along the pipeline and the plug travel speed are varied. The system has been successfully operated at pipe slopes between 0.0026 and 0.022. It is especially well suited to cases where the furrow width is narrow relative to the total width of the field. (Cassar-FRC)
W82-05963

FURROW INTAKE RATES AND WATER MANAGEMENT,
Science and Education Administration, Kimberly, ID. Snake River Conservation Research Center.
W. D. Kemper, B. J. Ruffing, and J. A. Bondurant.
Transactions of the ASAE, Vol 25, No 2 p 333-339, 343, March/April, 1982. 7 Fig. 2 Tab. 15 Ref.

Descriptors: *Irrigation practices, *Infiltration rate, *Compacted soils, *Furrow irrigation, Water management, Soil compaction, Sprinkler irrigation, Soil properties, Water temperature.

Many farmers have abandoned the energy-intensive sprinkler irrigation method in favor of a return to furrow irrigation. One problem with furrow irrigation is decreased crop yields caused by nonuniform water distribution. A study of furrow intake rates produced several suggestions for improving uniformity of water distribution. Intake uniformity can be improved by restricting tractor traffic to tracks that are not used for irrigation, compacting corrugates in which water will run so that the soil on the perimeter has a lower infiltration rate than the rest of the soil, reducing flow rate, using longer runs and smaller pipe sizes, compacting soil in selected areas, applying straw to furrows where increased infiltration is desired, and decreasing the slope at the lower ends of the fields. (Cassar-FRC)
W82-05968

FIELD EVALUATION OF FURROW INFILTRATION AND ADVANCE FUNCTIONS,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
R. L. Elliot, and W. R. Walker.
Transactions of the ASAE, Vol 25, No 2, p 396-400,March/April, 1982. 4 Tab, 8 Ref.

Descriptors: *Infiltration, *Irrigation, *Furrow irrigation, *Colorado, Advance functions, Kostiakov-Lewis function, Soil properties, Volume balance method, Field tests, Soil water, Mathematical equations.

Furrow infiltration and advance functions were evaluated in three Colorado farm soils (clay loam, loamy soil, and loam to clay loam). Lengths of irrigated runs were 350-625 m and furrow slopes 0.25-1%. Data were used to study infiltration and advance relations based on a kinematic or volume balance approach. The Kostiakov-Lewis function modified by a term for the asymptotic long time infiltration rate was highly effective in simulating infiltrated volumes when reliable estimates of the steady infiltration rate could be obtained. The power curve form of the advance function was better fitted using the two-point method than using regression. (Cassar-FRC)
W82-05969

IRRIGATION REQUIREMENT OF HIGH-YIELDING RICE VARIETIES GROWN ON SOILS HAVING SHALLOW WATER-TABLE,
Central Rice Research Inst., Cuttack (India).
K. P. Jha, D. Chandra, and Challaiah.
Indian Journal of Agricultural Sciences, Vol 51, No 10, p 732-737, October, 1981. 5 Tab, 10 Ref.

Descriptors: *Irrigation requirements, *Rice, *Water use efficiency, *India, Water table, Grain crops, Crop yield.

High-yield rice varieties under limited irrigation produced grain yields comparable to rice grown under continuous or partial flooding of fields. The study, conducted during the winters of 1976-78 in sandy loam alluvial soil with a winter water table depth of 35-52 cm, used four irrigation treatments: I1, continuous flooding; I2, irrigation (7 cm) at moist conditions, 2-3 days after disappearance of ponded water from the field; I3, flooding at tillering and flowering but irrigation at moist conditions at other stages; and I4, irrigation (7 cm) at 30-35 mm of cumulative pan evaporation. Treatment I1 required 1403-1600 mm irrigation water, I2, 887-910 mm; I3, 1073-1097; and I4, 793-840 mm. Water use efficiencies were: I1, 2.48-2.97; I2, 4.17-4.42; I3, 3.26-3.77; and I4, 3.84-5.27 kg grain/mm water. The short duration Pusa variety (114 days) had higher water use efficiency than the other varieties, Supriya (132 days) and Vani (143 days). (Cassar-FRC)
W82-05971

EFFECT OF IRRIGATION ON THE STABILITY OF LEAF SIZE OF WHEAT, TRITICALE AND BARLEY,
Indian Agricultural Research Inst., New Delhi.
For primary bibliographic entry see Field 2I.
W82-05972

THE EFFECT OF SHORT-TERM WATERLOGGING DURING FURROW IRRIGATION OF COTTON IN A CRACKING GREY CLAY,
New South Wales Dept. of Agriculture, Narrabri (Australia). Agricultural Research Station.
A. S. Hodgson, and K. Y. Chan.
Australian Journal of Agricultural Research, Vol 33, No 1, p 109-116, 1982. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Irrigation, *Cotton, Crop yield, Crop production, *Waterlogging, Irrigation practices, Agriculture, *Furrow irrigation.

The effects of waterlogging on plant and soil were studied by subjecting cotton to periods of inundation at successive irrigations ranging from 4 to 16 hours in a cracking grey clay. The growing season was hot and dry and effects of waterlogging were not aggravated by rainfall or excessively overcast conditions. Plant growth was virgorous and visual symptoms of waterlogging were limited to a low section of the field where plant leaves became chlorotic in late February and prematurely senesced. Similar symptoms were noted for cotton which was waterlogged during flowering and boll setting in other reports from northern Australia valleys. Waterlogging treatment in this experiment had little effect on leaf area index, dry matter per square meter and plant height. In most cases the 8, 12, or 16 hour treatment effects were not significantly different. Any existing differences were reflected in final lint yields, where the 4 hr treatment yields were significantly higher than the 12 and 16 hr yields, and the 8, 12, and 16 hr yields were not significantly different. It was concluded that lint yield is likely to increase if cotton crops are irrigated and drained faster to reduce contact time. The farmer may achieve this by using larger siphons, more siphons per furrow, shorter fields or steeper slopes. (Baker-FRC)
W82-06010

THE EFFECT OF ELECTRICITY PRICES, LIFT, AND DISTANCE ON IRRIGATION DEVELOPMENT IN IDAHO,

Idaho Univ., Moscow.
J. R. Hamilton, G. S. Barranco, and D. J. Walker.
American Journal of Agricultural Economics, Vol 64, No 2, p 280-285, May, 1982. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Irrigation, Model studies, *Irrigation practices, Crop yield, *Idaho, Economic aspects, Agriculture, Crop production, Prices.

Parametric budgeting was used to simulate the impacts of variations in farm size, crop prices, crop yields, electricity rates, lift height, and distance from the river on the private economic feasibility criterion currently being used by the US Bureau of Land Management. Maximum feasible lift heights and carry distances are identified, and developable acreage through irrigation programs is estimated. An obvious limitation of the parametric budgeting procedure used is its omission of financial tax incentives which may accrue to some operators. The model is also limited by its partial equilibrium nature. Management options such as irrigation system alternatives or crop changes in response to higher electricity prices were not considered. Results of the study indicate that per acre returns on irrigated tracts increase slightly with farm size. Under base conditions all farm sizes examined could sustain nearly a 10% decline in crop price or yields. Given the base lift, 550 feet, and the base distance, 5 miles, all farm sizes considered could sustain a 100% increase in electric rates. However, with a 200% power rate increase, irrigation feasibility would be limited to the largest farms with lifts less than 550 feet and distances less than 4 miles. Of the lands in the BLM study area, all but the highest and most distant could be developed under base yields, prices, and power rates. However, plausible increases in power rates could limit development to low lift land near the river, sharply reducing the total feasible acreage. The criteria being used by the BLM would permit development of more land than meets social criteria but not enough to meet private demands. (Baker-FRC)
W82-06017

MOISTURE CONSERVATION OF INTERSEEDED GRASSLANDS THROUGH THE USE OF ANNUAL AND PERENNIAL CROP BARRIERS,

South Dakota State Univ., Brookings. Dept. of Plant Science.
F. R. Vigil.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243635, Price codes: A04 in paper copy, A01 in microfiche. South Dakota Water Resources Institute, Brookings, Report, December 1981. 53 p, 17 Tab, 11 Ref, 4 Append. OWRT A-069-SDAK(1), 14-34-0001-9044.

Descriptors: *Soil moisture deficiency, *Grasslands, *Standing crops, *Alfalfa, Moisture content, Moisture stress, Seed treatment, Seeds, Snow management, Soil water, Barriers, Crop production, Wheatgrasses, Sorghum, Planting management, Drilling equipment.

Interseeding, a method of introducing alfalfa into the range with only a partial disturbance of the existing vegetation, is used to improve forage resources in South Dakota. Since moisture was considered as the principal factor in determining whether a stand would succeed or fail, perennial (Tall wheatgrass) and annual (sorghum and sunflowers) crop barriers were planted on native ranges from 1978-81 in an effort to conserve moisture through snow retention. These barriers failed to establish in all four years, which may be due in large part to fungalnematode interactions. Large areas in the State were discovered to be having difficulty in establishing legumes, even under irrigation. Fungicide seed and soil treatment, nematicides, and biological control methods for controlling damping-off disease (caused by Pythium spp. and nematodes) were tested for alfalfa stand establishment. Other causes for failure of establishing annual/perennial crop barriers into a growing grass sod are suggested. A newly-developed drill for interseeding into semi-arid rocky environments is reported. (Zielinski-MAXIMA)
W82-06148

COMPETITION BETWEEN IRRIGATION AND HYDROPOWER WATER USE IN WASHINGTON STATE,

Washington State Univ., Pullman. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W82-06156

SPRINKLER LEVELER AND WIND COMPENSATING DEVICE,

Wade (R. M.) and Co., Portland, OR.
G. Cornelius.
U.S. Patent No 4,204,643, 8 p, 4 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 994, No 4, p 1261, May 27, 1980.

Descriptors: *Patents, *Irrigation, *Sprinkler irrigation, *Application equipment, Irrigation efficiency, Irrigation practices, Irrigation operation and maintenance.

A main irrigation pipe with wheels has mounted along its length movable sprinkler heads. Each sprinkler head has a flat, bladelike member, the weight of which aids in urging that sprinkler head toward an erect position. Meanwhile the bladelike member compensates for wind by leaning the sprinkler head into the wind to provide a more even distribution of water. (Sinha-OEIS)
W82-06164

A SALT AND WATER BALANCE MODEL FOR SILT LOAM SOIL CROPPED TO RICE AND SOYBEAN,

Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 2G.
W82-06172

EFFECT OF IRRIGATION FREQUENCY AND NITROGEN ON GROUNDNUT YIELD AND NUTRIENT UPTAKE,

Andhra Pradesh Agricultural Univ. (India). Dept. of Agronomy.
S. R. Reddy, P. S. Chalam, G. H. S. Reddi, and A. P. Raju.
Plant and Soil, Vol 65, No 2, p 257-263, 1982. 2 Tab, 13 Ref.

Descriptors: *Irrigation efficiency, *Crop yield, *Groundnuts, *Potassium, *Nitrogen, Nutrients, Phosphorus, Soil moisture, Moisture availability.

Field experiments were conducted during the summers of 1979 and 1980 to study the effect of irrigation frequency and levels of nitrogen on yield and uptake of the major nutrients by Spanish groundnut. The soil was sandy loam, with a low moisture retentive capacity, low in available nitrogen and low in available potassium. The soil was moderately alkaline in reaction with a pH of 8.3. Four irrigation frequencies were used during the study, including irrigation at 1,4,6, and 8 cm cumulative can evaporation (CCE) corresponding to irrigation once in 3,5,7, and 10 days, respectively. Four levels of nitrogen were also used, 0,20,40 and 60 kg N/ha. Nitrogen, phosphorus (35 Kg P/ha) and potassium (60 kg K/ha) were applied in the form of urea, single superphosphate and potash, respectively. Pod yield of groundnut was highest at 3,293 kg/ha when irrigations were scheduled at 4 cm cumulative can evaporation, equivalent to once every 5 days. The addition of N did not increase pod yield. N and P uptake by the crop was greatest with high frequency of irrigatica of scheduling irrigation at 4 cm CCE. The highest uptake of N and P was with a combination of 20 kg N/ha and high frequency irrigation. Potassium uptake was low with low irrigation frequency, while it was highest at 20 kg N/ha. (Baker-FRC)
W82-06230

DESIGNING FOR DEFICIT IRRIGATION,

Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
M. J. English, and G. S. Nuss.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 91-106, June, 1982. 2 Fig, 8 Tab, 8 Ref. OWRT 14-31-0001-2139.

Descriptors: *Irrigation practices, *Irrigation design, *Deficit irrigation, Wheat, Oregon, Water conservation, Economic analysis, Crop yield, Cost analysis, Evapotranspiration, Energy, Capital costs, Benefits.

Two irrigation systems, one for full irrigation and one for deficit irrigation, were designed for a farm in eastern Oregon growing winter wheat. A comparison of costs and performances for the two systems showed that deficit irrigation increased farm income and reduced energy, water, and capital requirements. The full irrigation system schedule was two sets per day (11 hours each set), 2.3 inches gross water applied per set, 32 inches gross water applied per season, and a 6 day minimum interval between irrigations. The root zone would not be depleted by more than 50% between irrigations. The deficit irrigation scheme specified soil moisture depletion in excess of 50% of available water during times of peak demand. The irrigation schedule was two sets per day (11 hours each set), 3.15 inches gross water applied per set, 20 inches gross water applied per season, and a 12 day minimum interval between irrigations. Using the water saved by deficit irrigation allowed the 92 acre plot to be extended to 143 acres, increasing net farm income by 42%. The amounts of benefits from deficit irrigation are dependent on system design and many other factors. Each case must be completely analyzed individually to determine the merits of deficit irrigation. (Casaar-FRC)
W82-06334

ECONOMIC EFFECT OF ENERGY PRICE AND ECONOMIC FEASIBILITY AND POTENTIAL OF NEW TECHNOLOGY AND IMPROVED MANAGEMENT FOR IRRIGATION IN TEXAS,

Texas Water Resources Inst. College Station.
D. Lacewell, C. Hardin, J. A. Petty, and E. Whitson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256678, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 119, May, 1982. 52 p, 16 Tab, 1 Fig, 26 Ref. OWRT A-045-TEX(3). 14-34-0001-9046, 0146, and 1146.

Descriptors: *Irrigation, Water efficiency, Economics, *Texas High Plains, Texas Trans-Pecos, Ogallala, Economic impact, Model studies, Linear programming.

Recursive linear programming models for a typical Texas High Plains irrigated farm were developed to evaluate expected impact of energy and crop price changes, tenure and new technology. The model includes a Fortran sub-routine that adjusts irrigation factors each year based on the linear programming solution of the previous year. Increased natural gas prices impact heavily on returns above variable costs (up to 15 percent reduction for a 60 percent natural gas price increase). Annual net returns were reduced by as much as 30 percent, and the present value of returns to water was reduced by as much as 80 percent as the natural gas price was increased annualy by $0.25 per mcf (from $1.50 per mcf). Increasing pump efficiency from 50 to 75 percent can improve farm profits over time; e.g., the present value of groundwater was increased 33 percent for a typical farm with an aquifer containing 250 feet of saturated thickness and 15 percent for 75 feet of saturated thickness. Results indicate that irrigation can be extended by 11 or more years with 50 percent improved distribution efficiency. In addition, the increase in present value of groundwater on the 1.69 million irrigated acres of the Texas High Plains was estimated to be $995 million with 50 percent improved efficiency. Wind assisted irrigation pumping could be an economically viable alternative if costs decrease and stabilize. The results are limited by uncertainties of the long-term characteristics of wind system operation.
W82-06374

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 1.

Ministerio de Obras Publicas y Urbanismo, Madrid, Spain. 1981. 1082 p. Heras, R. (Ed.). (No English summary).

Descriptors: *Irrigation engineering, *Irrigable land, *Agricultural hydrology, *Hydrologic aspects, Hydraulic engineering, Engineering, Soil engineering, Agricultural engineering, Land use, Irrigation, Irrigation practices, Hydrology, Hydrologic systems, Hydraulic equipment, Agronomy, Agriculture, Crop production, Cultivated lands.

This first volume of a 2-volume textbook set covers 7 topic areas concerning engineering aspects of irrigated lands. Following a general introduction covering human, social, economic, administrative, financial, and technical aspects, detailed attention is given to hydrologic and hydraulic topics related to irrigated land. Specific topics address the areas of: meteorology and climatology; surface hydrology; hydraulics and hydrology of underground waters; use of underground waters; evaluation and classification of soils; and farming and irrigated land. Meteorologic/climatologic aspects include specifics on solar radiation, precipitation, drought, and erosion. Surface hydrology materials includes deep valley characteristics, laws of distribution, copious water, flooding, and calculation methods. Underground water topics include hydraulics and movement, water balance, methods of variation, water quality and analysis, and recovery systems. The discussion on soils includes chemical composition, reactions, erosion characteristics and modeling, and sedimentation. Farming aspects cover farming and climate, and limitations in the choice of proper surface farming. Twelve additional topic areas covering engineering aspects of irrigated lands are covered in Volume 2. (Zielinski-MAXIMA)
W82-06375

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 2,

Ministerio de Obras Publicas y Urbanismo, Madrid, Spain. 1981. 1236 p. Heras, R. (Ed.). (No English summary).

Descriptors: *Irrigation engineering, *Irrigable land, *Agricultural hydrology, *Hydrologic aspects, Hydraulic engineering, Engineering, Soil engineering, Agricultural engineering, Land use, Irrigation, Irrigation practices, Hydrology, Hydrologic systems, Hydraulic equipment, Agronomy, Agriculture, Crop production, Cultivated lands.

This second volume of a 2-volume textbook set covers 12 topic areas concerning engineering aspects of irrigated lands. Specifically, these topic areas address: equipment and methods of irrigation; networks of irrigation by gravity networks of irrigation by pressure; practical methods of investigation of irrigated canals; agricultural drainage; road networks; electrical limits; grading of lands; agricultural and hydraulic development; economic feasibility; organization and legislation; and a model of agrarian planning. A detailed annotated list of definitions of hydroagronomy terms is also included. Seven additional topic areas concerning engineering aspects of irrigated lands are covered in Volume 1. (Zielinski-MAXIMA)
W82-06376

LIMITS FOR PRACTICAL LEVEL-BASIN DESIGN,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and A. R. Dedrick.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 18, No IR2, p 127-141, June, 1982. 10 Fig, 8 Ref.

Descriptors: *Irrigation design, *Basin irrigation, Infiltration, Design criteria, Mathematical equations, Gravity flow, Soil classification.

A previous method for designing level irrigation basins is extended to cover a wider range of infiltration conditions. The limit of the basin length is determined. It depends on application depth, infiltration conditions, roughness, and the desired uniformity. A 6-step procedure for designing level basins is detailed and an example given for alfalfa on a silt loam with moderate infiltration rate. The steps are as follows: (1) determine design conditions (uniformity, net infiltration depth, time required to infiltrate net depth, exponent of infiltration function, and roughness from 004 for bare soil to 0.25 for dense sod crops): (2) calculate reference values for basin length and unit flow rate; (3) determine approximate limit on basin length; (4) determine a value for basin width; (5) determine application time (equations are given for uniform or irregular basins); and (6) consider other limitations such as soil variability, practical considerations of field dimensions, and surface roughness of the field. Design conditions should be evaluated for different types of crops and for different conditions throughout the growing season. (Cassar-FRC)
W82-06452

RESPONSES OF 6-YEAR-OLD DIAMOND GRAPEVINES TO THE CHANGE FROM SPRINKLER TO TRICKLE IRRIGATION AND TO THE TIME AND METHOD OF APPLYING NITROGEN,

Department of Agriculture, Summerland (British Columbia). Research Station.
D. S. Stevenson.
Canadian Journal of Soil Science, Vol 61, No 4, p 571-575, November, 1981. 4 Tab, 7 Ref.

Descriptors: *Nitrogen, *Trickle irrigation, *Crop yield, *Sprinkler irrigation, Irrigation effects, Irrigation practices, Fruit crops, Fertilizers, *Grapevines, *Pacific Northwest U.S.

Little research has been conducted on the performance of grapevines under trickle irrigation in the Pacific Northwest, where wine grapes have become an important crop. A vineyard which had received regular cyclical sprinkler irrigation for the first 6 years of its existence was changed to trickle irrigation to determine how well the mature vines would adapt to the point-source method of irrigation. Water application was reduced by about 20% under trickle irrigation. The Diamond grape yield was measured for 3 years, after which nitrogen fertilizer tests were conducted for 3 years to determine whether significant changes in the fertilizer program were needed with trickle irrigation. The change from sprinkler to trickle irrigation caused no detectable growth or yield changes of the grapevines or fruit. Fertilizer tests under trickle irrigation demonstrated no significant Diamond grape yield differences between fall and spring broadcast nitrogen fertilizer or between either of those treatments and spot placement of nitrogen under trickle emitters in two of three seasons. None of the treatments had any effect on soluble solids or the titratable acidity of the grape berries or on the percent petiole nitrogen. (Carroll-FRC)
W82-06492

THE BENEFITS OF WATER MANAGEMENT IN ENERGY AND AGRICULTURAL DEVELOPMENT IN THE SAN JUAN RIVER BASIN OF NEW MEXICO,

Energy Policy Studies, Inc., Omaha, NE.
For primary bibliographic entry see Field 3E.
W82-06517

AUTOMATION OF A SPRINKLER IRRIGATION SYSTEM BY THE UTILIZATION OF REAL TIME WEATHER INFORMATION,

Nebraska Univ. Panhandle Station at Scottsbluff.
A. Weiss.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256710, Price codes: A03 in paper copy, A01 in microfiche. Nebraska Water Resources Center, Lincoln. June 1982. 39 p, 4 Fig, 1 Tab, 39 Ref. OWRT A-064-NEB(1), 14-34-0001-1129.

Descriptors: *Sprinkler irrigation, *Mathematical equations, *Evapotranspiration, *Crop yield, *Weather data collections, *Automation, Irrigation, Evapotranspiration control, Irritation efficiency, Irrigation engineering, Irrigation practices, Irrigation design, Irrigation water, Soil water, Soil moisture deficiency, Farming, Weather patterns.

A method is described for quantitatively calculating reference crop evapotranspiration (ET), based on sound physical principles with a minimum of empiricisms. The method uses the Doorenbos and Pruitt version of the Penman equation for ET calculation. Using refeence crop ET as an input, the actual crop ET, acutal and percentage soil water depletion are determined using crop coefficient curves based on growing degree days. This approach to irrigation scheduling was used in conjunction with an automated weather station to schedule irrigation of two fields of dry edible beans grown under center pivot systems. Yields obtained from both fields were above-average, compared to the average yield for the region. However, actual automation of an irrigation system was not accomplished due to reluctance of the cooperative farmer allied to the study in permitting independent automated control of his center pivot irrigation system. While irrigation scheduling information is a valuable tool to the farmer, he desires to reserve the right to decide when to irrigate. Nonetheless, the procedural information developed in this study can assist the use of networks of automated weather stations to provide information on irrigation scheduling on a regional basis. (Zielinski-MAXIMA)
W82-06695

INFILTRATION CAPACITY CURVES FOR SODIUM AFFECTED SOILS,

South Dakota State Univ., Brookings. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3C.
W82-06712

COMPUTER SIMULATION OF SURFACE IRRIGATION BY MEANS OF NUMERICAL METHODS FOR FINDING OPTIMAL PARAMETERS,

Vsesoyuznyi Nauchno-Issledovatelskii Inst. Gidrotekhniki i Melioratsii, Moscow (USSR).
R. M. Kiladze.
Water Resources, Vol 8, No 3, p 312-318, May/June, 1981. 2 Fig, 3 Tab, 23 Ref. Translated from Vodnye Resursy, N0 3, p 146-153, May/June, 1981.

Descriptors: *Irrigation efficiency, *Numerical analysis, *Optimization, Computers, Surface irrigation, Border irrigation, Furrow irrigation, *Simulation analysis, Model studies, Mathematical models, Infiltration.

The best sets of controlling parameters in surface irrigation, border and furrow types, were determined by use of a numerical model. Four criteria for evaluating quality of irrigation were obtained and expressed as equations: degree of moistening of the active soil layer, efficiency of water use, productivity of mechanisms (dependent on length of furrows or border strips), and productivity of labor (dependent on labor, slope, and type of soil). Constraints were derived, including maximum permissible velocity of the irrigation stream, maximum permissible depths during irrigation, and desired rate of irrigation (ha per day). In an example, irrigation was simulated for each possible set of controlling parameters. A set of results which satisfied the constraints was presented in a table. These Pareto-optimal solutions can be further evaluated by the persons responsible for decision making. (Cassar-FRC).
W82-06781

FARM WATER MANAGEMENT GETS FAO BOOST,

World Water, Vol 5, No 6, p 33, 35-36, June, 1982.

Descriptors: *Water management, (applied), *Irrigation efficiency, *Developing countries, Education, Food and Agriculture Organization, Farm management, Organizations, Pilot tests.

In October 1980 the U.N. Food and Agriculture Organization (FAO) started a program for assisting governments of developing countries in promoting improved irrigation efficiency among small farmers. To overcome the shortage of personnel for training the farmers in the field, special courses were given high priority in educational institutions. Demonstration projects at the farm and village level were conducted in several countries. A pilot project in Pakistan, established before the FAO's action, contributed much background information in this effort. The social and physical constraints on good farm water management are usually inadequate operation of the main system, unreliable water delivery, inadequate operation of the main system, unreliable water delivery, inadequate farm size, tenure systems, and water rights. In the Philippines a pilot irrigation management project begins with a community organizer who lives in the locality and identifies needs through contact with the people. Later an engineer prepares a project design and cost estimates. A farmers' association is formed, and financing is provided by contributing labor and long-term loans. The Philippine program has produced 180 new irrigation systems since 1980 and substantial increases in rice production. Similar projects are underway in Sri Lanka, Egypt, Malaysia, Panama, Indonesia, Thailand, Bangladesh, South Yemen, Tanzania, Ghana, and Kenya. (Cassar-FRC)
W82-06815

DOUBTS REMAIN ABOUT BURA ECONOMICS,

World Water, Vol 5, No 6, p 46, 49, June, 1982. 1 Fig.

Descriptors: *Developing countries, *Irrigation, *Economic aspects, *Benefits, Bura Project, Tana River, *Kenya, Capital costs, Farms, Semiarid lands, Water resources development, Canals, Irrigation Canals.

The Bukra project in eastern Kenya has far exceeded original cost estimates, leaving the government with massive debts to repay. The project is opening a previously unfarmed, sparsely populated 6700 ha of semiarid land to settlers. High capital costs of $30,000 per family settling on 1.25 ha plots include housing, water supply, and other facilities. A recent economic evaluation estimated a return of 6.75% over the next 50 years, much less than the 13% predicted by the World Bank in 1977. Some major factors are the drop in cotton prices since the plan was conceived, increased costs, delays in construction, and high management and operation costs. The Bura scheme obtains water from the Tana River by diesel pumping through a 27 km supply canal, a 25 km main canal, 4 main branch canals, innumerable feeder canals, and siphon tubes. (Cassar-FRC)
W82-06816

COMPUTER-GUIDED LINEAR IRRIGATOR MARCHES ON,

World Water, Vol 5, No 6, p 53-54, June, 1982.

Descriptors: *Irrigation efficiency, *Computers, Water conservation, Wind, Spray irrigation, Mist irrigation, Irrigation equipment.

The Noble linear low pressure overhead irrigation system has been effective in the hot (up to 50 C) and windy (up to 80 km per hour) Mojave Desert. The diesel-powered apparatus combines computer technology and sophisticated nozzles for mist spray water delivery. Water is supplied through a buried mainline with risers onto which grabber tractors fix by computer command, ensuring constant distribution, Spraying is uninterrupted because one grabber is supplying water while the second is seeking out the next riser. Wind problems are almost eliminated because the spray booms are just above the head of the crop. Water savings are about 25%. Runoff, fertilizer teaching, and soil erosion are virtually eliminated. Computer cards allow the operator to quickly reprogram the apparatus for a chosen speed, water delivery ratio, or program. (Cassar-FRC)
W82-06817

BRANTAS DAMS TRIGGER NEW JAVANESE DEVELOPMENT,

World Water, Vol 5, No 6, p 40-41, June, 1982. 1 Fig.

Descriptors: *Irrigation, *Developing countries, *Dam construction, *Irrigation design, Water resources development, Dams, Brantas River, Java, *Indonesia, Crop yield, Lodoyo Project.

The Lodoyo irrigation project, soon to be completed in Java, will cover about 15,000 ha of land of which 9600 ha were not formerly cultivated and 6000 ha produced only one crop per year instead of the 2-3 crops per year possible with the new irrigation project. Water comes from below the Wlingi Dam on the Kali Brantas, a river which runs in a circular course around an active volcano. The Lodoyo project, consisting of a 32 km main canal, secondary and tertiary canals, will benefit about 450,000 people. Agricultural extension services are a part of the project. (Cassar-FRC)
W82-06818

A KINEMATIC MODEL FOR SURFACE IRRIGATION: AN EXTENSION,

New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mathematics.
B. Sherman, and V. P. Singh.
Water Resources Research, Vol 18, No 3, p 659-667, June, 1982. 7 Fig, 21 Ref.

Descriptors: *Model studies, *Surface irrigation, Kinematic waves, Kinematic wave theory, Soil water, Mathematical studies, Waves, Irrigation, Infiltration, Infiltration rate.

The kinematic model for surface irrigation as reported previously by Sherman and Singh is extended. Depending on the duration of irrigation and time variability of infiltration, three cases are distinguished. Explicit solutions are obtained when infiltration is constant. For infiltration varying over time, a numerical procedure is developed which is stable and has fast convergence. A rigorous theoretical justification is developed foı computation of the depth of water at and the time history of the front wall of water advancing down an infiltrating plane or channel. A derivation is given of the continuity and momentum equations when there is lateral inflow and infiltration into the channel bed. (Baker-FRC)
W82-06852

CONSUMPTIVE USE OF WATER BY MAJOR CROPS IN THE SOUTHWESTERN UNITED STATES,

Science and Education Administration, Phoenix, AR. Water Conservation Lab.
L. J. Erie, O. F. French, D. A. Bucks, and K. Harris.
Conservation Research Report No 29, May 1982. 42 p, 11 Ref, 2 Append.

Descriptors: *Consumptive use, *Irrigation requirements, *Evapotranspiration, *Soil water, *Agriculture, Crop production, Water use, Water management, *Arizona, *Southwest U.S.

Water is a limiting factor in the expansion of irrigated areas and in the production of food for all Western States. Knowledge of consumptive use is necessary in planning farm irrigation and drainage systems, for improving irrigation practices, conserving energy, and assisting in irrigation scheduling. Consumptive use data are presented for 33 cash, oil, hay, bermuda lawn, small grain, forage, fruit, vegetable, and green manure crops as grown in central Arizona. Estimates of seasonal use, semimonthly use, and soil profile moisture depletion are included. Peak-use rates may be estimated from the consumptive use curves. Tentative irrigation schedules can be calculated directly from the consumptive use curves. Data from the figures can be used for irrigation scheduling in areas having growing seasons comparable to those in the Salt River Valley of Arizona. The seasonal consumptive use totals and peak consumptive use rates can be used for planning irrigation projects or farm irrigation systems. A simple method of utilizing this information in different but somewhat similar areas is the Blaney-Criddle formula. The main advantage of this method is that only temperature and sunshine hours are required. (Moore-SRC)
W82-06964

SOME CHARACTERISTICS OF CALCULATING THE WATER REQUIREMENT WHEN DESIGNING IRRIGATION MEASURES,

All-Union Scientific Research Inst. of Water Management Economics and Administration, Moscow (USSR).
T. F. Sokolovskaya, and G. A. Mitrofanov.
Water Resources, Vol 8, No 4, p 355-365, July/August, 1981. 4 Fig, 5 Tab, 12 Ref. Translated from Vodnye Resursy, No 4, p 48-59, July/August, 1981.

Descriptors: *Irrigation design, *Water transfer, *Water requirements, *Irrigation requirements, *Irrigation efficiency, Water conveyance, Probability distribution, Climatic zones, Crop rotation, Water management, Water deficit, Water supply, Seasonal variations, Winter wheat, Grain crops, *USSR.

Irrigation requirements are determined using the concept of asynchronism on fluctuation in the water requirement deficity of irrigated crops. This information allows efficient water transfer among basins, knowing climatic conditions at a particular weather station, the nature of the crops, and the probability percentage of the water requirement deficit. The method considers the probabilities of maximum mean daily water requirement deficits in 10-day periods, instead of assuming that the soil becomes increasingly and uniformly drier as the season progresses. The most efficient of 13 crop rotations may be chosen to manipulate the asynchronism artificially so as to gain the most efficient use of irrigation water. For example, in one climatic zone winter wheat requires the most water between the last third of March and the end of April. Decreasing the proportion of winter wheat in favor of alfalfa, spring wheat, or grain corn can shift maximum water requirements to other periods of the growing season. (Cassar-FRC)
W82-06984

APPLICATION OF THERMAL INFRARED IMAGERY TO CANAL LEAKAGE DETECTION,

Kansas State Univ. Manhattan. Dept. of Geography.

For primary bibliographic entry see Field 7B.
W82-06994

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

FINITE ELEMENT MODELING OF STREAMFLOW ROUTING,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05918

ANALYZING AND PREDICTING IRRIGATION DIVERSIONS IN SOUTHEASTERN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
For primary bibliographic entry see Field 3F.
W82-05924

EVALUATION OF MODELS AND PROCEDURES USED FOR RIVER OPERATIONS AND PLANNING IN THE UPPER SNAKE AND BOISE RIVERS IN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
K. H. Yoo, and J. R. Busch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243494, Price codes: A03 in paper copy, A01 in microfiche. Report, August 1981. 42 p, 5 Fig, 7 Ref. OWRT A-071-IDA(1). 14-34-001-0114.

Descriptors: *Model testing, *Rivers, *Prediction, *Runoff forecasting, Model studies, River regulations, River basin development, River forecasting, Projections, Planning, Operating policies, Runoff, Forecasting, Streamflow, Reservoir stages, Water demand, Watersheds, *Idaho, *Upper Snake River, *Boise River.

Update planning models and procedures used by seven operational agencies in two Idaho river basins were investigated. These models and procedures were developed and updated to both improve accuracy and meet changing conditions by public agencies and private companies in the area. Each model and procedure has different objectives, in accordance with the intended purposes of each organization. While most of the models and procedures are computerized, some are still operated manually and most have no published references. They are used to predict runoff (from snow pack data), natural stream flows (from various hydrologic data), and reservoir levels, as well as to account for water diversions from rivers and to evaluate the effects of future demands on surface/ground water in a hydrologic basin. River operations and planning procedures depend on the ability to predict various parameters; however, while accurate streamflow prediction has received considerable attention, it is one of the weakest links in many of the predictive and modeling procedures. The results of this investigation are presented in the form of a narrative summary of the information collected from each organization using a prescribed outline format covering organizational objectives, descriptions of the models and procedures used, and evaluations by the organization. (Zielinski-MAXIMA)
W82-05925

ADAPTIVE REAL-TIME STREAMFLOW FORECASTING MODEL FOR HYDROSYSTEM OPERATIONAL PLANNING,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-05926

FLOODPLAIN REGULATIONS AND RESIDENTIAL LAND VALUES IN OREGON,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 6F.
W82-05930

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART I: MODELING RESERVOIR SIZE YIELD RELATIONSHIPS,
Wright McLaughlin Engineers, Denver, CO.
For primary bibliographic entry see Field 2I.
W82-05967

REVIEW OF TREATIES ON CONSUMPTIVE UTILIZATION OF WATERS OF LAKE VICTORIA AND NILE DRAINAGE SYSTEM,
Nairobi Univ. (Kenya). Inst. for Development Studies.
For primary bibliographic entry see Field 6E.
W82-05987

EVALUATING SEDIMENT BLANKETS AND A SCREEN FOR MACROPHYTE CONTROL IN LAKES,
Wisconsin Dept. of Natural Resources, Madison.
S. Engel.
Report, April 1982. 33 p 9 Fig 3Tab 17 Ref.

Descriptors: *Lake basins, *Macrophytes, *Sediment control, *Algal control, Algal growth, Bottom sediments, Lake restoration, Biomass, Screens, Lake ice, Gravel, Vegetation.

Sediment blankets have been used to seal basins against seepage and groundwater pollution, but they might also be useful for plant control. Three types of sediment blankets (plastic liners, Bidim, Typar) and a polyvinyl-coated fiberglass screen (Aquascreen) were tested for their ability to control submersed macrophytes in two Wisconsin lakes. Conventional plastic liners, covered by sand or gravel to anchor them were densely overgrown when sampled 3, 4, and 7 years later. Bidim and Typar Blankets were covered with pea gravel, placed on one lake's ice cover and allowed to melt through. At other sites they were placed directly on the lake bottom and anchored with bricks. Bidim and Typar blankets are light and gas gets trapped beneath them, so it was difficult to keep them on the lake bottom. Algae and macrophytes took only a year to spread over the blankets. The plants grew just as well on gravel-covered blankets as on those without gravel. Because new Blankets must be added every few years, they have limited use for rehabilitating lakes. Aquascreen was easier to handle, trapped less gas, prevented macrophyte growth in spring, and eliminated growing plants in summer. A few stems penetrated the screen's mesh, but most plants grew on pockets of sediment. Relocating the screens in summer and removing them in the fall prevented sediments from accumulating. Aquascreen can be effective in temporarily suppressing macrophytes in limited areas of lakes. They can be set on the lake bottom or directly over the plants at any time in spring or summer. Aquascreen may be a practical, economical, and environmentally sound alternative to more traditional lake rehabilitation strategies. (Atkins-Omniplan)
W82-06097

INVESTIGATION OF OBJECTIVE FUNCTIONS AND OPERATION RULES FOR STORAGE RESERVOIRS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
V. Yevjevich, W. A. Hall, and J. D. Salas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254996, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Report No 111, September 1981. 32 p, 12 Ref. OWRT B-195-COLO(6). 14-34-0001-9060.

Descriptors: *Reservoir storage, *Mathematical equations, *Operating policies, *Reservoir operation, *Optimum development plans, Water storage, Storage tanks, Balancing reservoirs, Reservoirs, Equalizing reservoirs, Mathematical studies, Flood-control storage, Flood control, Planning, Design criteria.

Research was carried out toward assistig water authorities in determinig optimal operatig policies for reservoir systems. This research sought, amont other factors, to develop a methodology (including policy criteria, principles, techniques) for designing the objective functions for planning/operating water storage reservoirs, and to introduce a time factor into the objective functions to represent their continuous evolution. Based on these results, changes are recommended in defining criteria for optimal state reservoirs. Conceptualization of an equivalent reservoir (as an alternative to multireservoir operational schemes/algorithms) was also accomplished. Assessment of the anticipated decision influence period (ADIP) and risk quantification indicated promising approaches; the use of ADIP to develop indices of operational decisions on risks avoidance and operational benefits is theoretically treated employing mass balance equations for discrete time periods (considering inflow, demand, evaporation loss, seepage, spill loss). Further risk formulated rules gave considerable improvement over normal operations for small reservoirs, with even greater improvement for large reservoirs. The use of ADIP in flood operational policies is also considered. (Zielinski-MAXIMA)
W82-06175

CHOICE OF SPACE AND TIME STEPS IN THE MUSKINGUM-CUNGE FLOOD ROUTING METHOD,
Institute of Hydrology, Wallingford (England).
S. B. Jones.
Proceedings of the Institution of Civil Engineers. Part 2, Research and Theory, Vol 71, No 3, p 759-772, September, 1982. 6 Fig, 17 Ref.

Descriptors: *Flood routing, *Model studies, Routing, Floods, Flood control, Flood forecasting, Flood flow, *Muskingum-Cunge Model, Mathematical models, Mathematical equations.

Hydraulic and hydrologic problems frequently require techniques for modeling the propagation of flood waves along river channels and sewer pipes. The basic equations for gradually varying, unsteady flow in an open channel of small bed slope are the St. Venant equations; these have no analytical solutions, but several numerical techniques have been proposed to solve them, including the method of characteristics and implicit or explicity finite-difference schemes. An example of the last-named type of approach is the explicit variable parameter Muskingum-Cunge method. A modification of this method is presented in which the space and time increments can be chosen objectively to take into account the observed fact that the solution to the convection-diffusion parameter must be selected, depending on channel morphology. Values of the space step and the time step may be selected according to one of three approaches, depending on whether or not one of them is more clearly defined by the physical model under consideration. (Baker-FRC)
W82-06227

ACCURACY OF FIRM YIELD ESTIMATES OF DIRECT SUPPLY RESERVOIRS WITH LIMITED DATA,
Ecole Nationale des Ponts et Chaussees, Paris (France).
J. M. Gaillard, and J. A. Mawdsley.
Hydrological Sciences Bulletin, Vol 27, No 2, p 159-171, June, 1982. 1 Fig, 7 Tab, 22 Ref.

Descriptors: *Reservoirs, *Estimating, Water supply, *Yield, Flow discharge, Water resources development, Error analysis, Errors, Europe.

The error of the estimate of the yield of a direct supply reservoir due to limited data was investigated for conditions prevailing in the northwest of Europe using the errors of the 2% design drought for durations up to 36 months as a measure of this error. Two methods of estimating the 2% drought were considered. First, the monthly design

drought, and second, an empirical procedure which required only rainfall data were the two measures employed. The expected errors for both the direct estimation and the empirical methods are a function of the flow variability of the data records chosen. Since the records used are thought to be representative of European runoff, the comments made are valid only for this region. Other regions with similar flow variability may be able to use these findings. The errors for the design drought were found by splitting a 500 year monthly flow record into shorter records. The 500 year record was obtained by extending an historic record of 111 years using the Thomas Fiering model. To estimate errors of the empirical procedure, the widely used method of Law, which uses rainfall data and the mean annual losses to estimate the design drought, was applied to 13 catchments with historic records greater than 30 years. The error of the empirical procedure was found from the differences between the empirical procedure and the estimate from the historic data. When the results from the two analyses were compared, the accuracy of the empirical procedure for all durations was equal to the accuracy obtained from a record of between 10 and 20 years. (Baker-FRC)
W82-06300

HABITAT RECOVERY IN THE NORTH FORK OF THE TETON RIVER.
Soil Conservation Service, Boise, ID.
For primary bibliographic entry see Field 6G.
W82-06409

STOCHASTIC GENERATION OF MONTHLY STREAMFLOWS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 419-441, March, 1982. 8 Fig, 4 Tab, 15 Ref.

Descriptors: *Streamflow, *Stochastic process, *Mathematical models, Comparison studies, Monthly distribution.

Models which have been developed to generate monthly flows for use in the design and operation of water resources systems can be broadly classified as monthly flow models or as disaggregation processes. The monthly flow models use an autoregressive model for the generation of monthly flows. The disaggregation models distribute annual flows generated by an annual model into monthly flows. A review of variations of these models is followed by a comparison of three monthly models: the Thomas-Fiering monthly model, which automatically takes seasonal variations into acount in the generating equation; the two-tier model, in which monthly flows generated by a Thomas-Fiering monthly model are adjusted against the annual flows generated by an appropriate annual model; and the method of fragments, which is a disaggregation process in which the observed monthly flows are first standardized year by year, followed by disaggregation of the annual flows obtained from any of the annual models into monthly flows using the sets of standardized monthly flows in each year selected at random. Application of these three models to several streams in Australia showed that the Thomas-Fiering monthly model preserved the seasonal monthly parameters for all the streams, although it gave smaller storage estimates than the historical values. The two-tier model and the method of fragments gave improved storage estimates and preserved the annual parameters. All the models gave similar results for the overall parameters for less variable streams, although the modified two-tier model preserved the seasonal monthly parameters better than the other models. It is suggested that a modified two-tier model be used for less variable streams. The method of fragments is recommended for use with highly variable streams, since it yielded smaller values for skewness than the modified two-tier model for these streams, even though it did not preserve the seasonal monthly parameters as well as the two-tier model. (Carroll-FRC)
W82-06427

REREGULATION ON AN INTERNATIONAL RIVER--A CASE STUDY,
Department of the Environment, Dartmouth (Nova Scotia). Inland Waters Directorate.
For primary bibliographic entry see Field 6G.
W82-06429

TVA HYDRO SCHEDULING MODEL: THEORETICAL ASPECTS,
Tennessee Valley Authority, Norris.
K. C. Gilbert, and R. M. Shane.
Journal of the Water Resources Planning and Managemet Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR1, p 21-36, March, 1982. 1 Fig, 38 Ref.

Descriptors: *Multireservoir networks, *Mathematical studies, *Reservoir operation, Computer programs, Mathematical models, Simulation analysis, Electric power production, Forecasting, Water level fluctuations, Flow discharge.

The hydro system simulation (HYDROSIM) model has been developed by the Tennessee Valley Authority to model long-term week-to-week variations in water level, discharge and electric power generation for its complex reservoir system. The basic optimization step in the HYDROSIM model determines optimal end-of-week storage for individual reservoirs, given beginning-of-week storage and weekly unregulated inflows. Scheduling of the 42-reservoir system poses a stochastic, nonlinear, multireservoir problem with both nonviolable physical constraints and violable operating constraints. An 'observe flow then determine release' stochastic formulation is used to simulate operation for 1 to 20 weeks into the future using historical flow sequences. A system of preemptive priority operating constraints is implemented using separable linear programming with upper bounding. A nonlinear power cost function is then minimized subject to the system of priority constraints. The search procedure involves solution of a sequence of linear programs in order to solve the nonlinear optimization problem. (Carroll-FRC)
W82-06430

TVA HYDRO SCHEDULING MODEL: PRACTICAL ASPECTS,
Tennessee Valley Authority, Norris. Water Systems Development Branch.
R. M. Shane, and K. C. Gilbert.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR1, p 1-19, March, 1982. 7 Fig, 2 Tab, 6 Ref.

Descriptors: *Multireservoir networks, *Mathematical studies, *Reservoir operation, *Computer programs, Mathematical models, Simulation analysis, Electric power production, Forecasting, Water level fluctuations, Flow discharge.

Computer programs and mathematical methods have been developed to model long-term week-to-week variations in water level, discharge, annd electric power generation for the complex reservoir system operated by the Tennessee Valley Authority. The model has been developed for use in day-to-day planning for operation of the 42 reservoirs and for policy and project studies. The models were intended to meet the need for more efficient use of historical data, better evaluation of new operating requirements, improved long-range guidance, and integration of weather forecasts with guides for operations planning. The hydro system simulation model has been designed to be used by TVA reservoir management personnel to evaluate the impact of new operating requirements on established objectives; to continually check the current reservoir system status to warn of possible future problems; to forecast reservoir operation in terms of possible and likely pool level and discharge variations, constraint violations, and generation characteristics expected in the next 1 to 52 weeks of operation, and to develop new long-range operating guides. The model includes the capability to observe important system operating constraints and priorities; extreme event analysis capability; a special linear programming structure which provides the flexibility necessary to modify operating objectives and to experiment with new types of long-range efficiency guides; and interactive CRT graphical output analysis. (Carroll-FRC)
W82-06431

RESERVOIR SYSTEMS OPTIMIZATION,
California Univ., Davis. Dept. of Civil Engineering.
O. J. Helweg, R. W. Hinks, and D. T. Ford.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 169-179, June, 1982. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Reservoir operation, *Optimization, *Model studies, Systems analysis, Central Valley Project, California, Tennessee Valley Authority, Drought, Multipurpose projects, Hydroelectric plants, Computers, Data processing.

Optimizzation models for reservoir operation, available for over a decade, are not used at present by any major reservoir system or real time operation. Model development and implementation experiences at representative systems, the Central Valley Project in California and the Tennessee Vally Authority, were examined. At the Central Valley Project a pilot study begun in 1965 led to a series of investigations designed to improve the applicability of optimization techniques to a real-life situation. Monthly and daily models were developed. A complicated hourly model was in the development stage when severe drought hit California in 1976. The models were unable to handle the related data inputs. Modifications to the model, made without help from the model builder, produced an inconvenient and unmanageable model. After the drought, work on omptimization models was discontinued. It was estimated that the use of optimization models would produce a benefit-cost ratio of over 17. Computers were first used in the 34 reservoir Tennessee Valley Authority system in 1951. In 1971 an effort to develop models to aid in choosing optimal operations strategies began. At present progress has attained the model validation stage. As of late 1979 no optimization models had been implemented. Basic problems identified in this investigation were lack of upper management support, lack of well qualified and interested personnel involved in the modeling effort, inadequacies of the models (inflexibility, large data requirements, unrealism), and chance occurrences such as the drought, personnel changes, and computer system incompatibilities. The author feels that these problems are all solvable and that adoption of optimization models would substantially increase savings for reservoir operations. (Cassar-FRC)
W82-06433

COMPARING URBAN RUNOFF MODELS,
For primary bibliographic entry see Field 2A.
W82-06447

SENSITIVITY OF SCS MODELS TO CURVE NUMBER VARIATION,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-06631

EVALUATION OF THE WATER RESOURCES POTENTIAL OF THE LOWER MISSOURI RIVER VALLEY ALLUVIUM,
Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 6B.
W82-06696

WATER SUPPLY MANAGEMENT IN THE DISTRICT OF COLUMBIA: AN INSTITUTIONAL ASSESSMENT,
George Washington Univ., Washington, DC. Program of Policy Studies in Science and Technology.
For primary bibliographic entry see Field 6B.
W82-06704

QUALITATIVE STABILITY ANALYSIS OF GEOLOGIC SYSTEMS, WITH AN EXAMPLE FROM RIVER HYDRAULIC GEOMETRY,

Pennsylvania State Univ., University Park. Dept. of Geosciences.
For primary bibliographic entry see Field 2E.
W82-06717

GENERATION OF WEEKLY STREAMFLOW DATA FOR A LARGE HYDROLOGICAL SYSTEM-AN AUTOREGRESSIVE MULTIVARIATE MULTI-LAG-MODEL(SIMULATION WOCHENTLICHER ABFLUSSE FUR EIN GROSSRAUMIGES HYDROLOGISCHES SYSTEM-EIN AUTOREGRESSIVES, MULTIVARIATES MULTI-LAG-MODELL-),

Technische Univ., Munich (Germany, F.R.). Inst. fuer Hydraulic und Gewasserkunde.
W. Wahliss, and L. A. Siegerstetter.
Wasserwirtschaft, Vol 72, No 1, p 12-17, 1982. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Multivariate analysis, *Regression analysis, *Time series analysis, *Stream discharge, *West Germany, Danube river, Main river, Diversion, Mathematical models, Projections, Statistical analysis, Flow discharge, Hydrologic systems, Hydrologic models.

An autoregressive multivariate multilag model is presented with which hydrologic time series that are correlated along both the time and space axes can be simulated. Stepwise linear regression is used to determine the regression coefficients. This method establishes a relationship between a goal value and several influencing values that only contains significant regressors. Raw data obtained through the model must be transformed into the normal distribution and standardized before the model can be analyzed. The model was applied to a hydrological system for diverting water from the Altmuhl and Danube rivers to the Regnitz-Main region in West Germany. The system consists of three reservoirs and the natural and manmade channels that connect them. Streamflow was simulated with an autoregressive process with a power of three in eight of the system's water gages. Data collected over a period of 47 years were used to simulate weekly flow. For transformation of the data into the normal distribution, the logarithmic method was best (used in 64% of cases), followed by the Pearson-III function (about 30%). In 100-year series the results showed large chance fluctuations, which was not true of 500-year series. A slight tendency to the overestimation of correlations was seen with increasing lag. The model may also be used to generate monthly and 10-yearly streamflow. (Gish-FRC)
W82-06826

SYNTHESIS OF STREAMFLOW INFORMATION RELATING TO THE SEMI-ARID KAROO BIOME OF SOUTH AFRICA,

Rhodes Univ., Grahamstown (South Africa). Hydrological Research Unit.
A. H. M. Gorgens, and D. A. Hughes.
South African Journal of Science, Vol 78, No 2, p 58-68, February, 1982. 8 Fig, 7 Tab, 28 Ref.

Descriptors: *Semiarid lands, *Streamflow, Hydrology, Arid lands, Semiarid climates, Karoo Biome, *South Africa, Statistical models, Water resources development.

An overview of the extant streamflow monitoring network and available relevant publications concerning the Karoo Biome is presented, along with an analysis of the statistical characteristics of annual and monthly streamflow volumes, low-flow phenomena and flood peaks of a representative set of river basins. Comparisons with other studies and the streamflow characteristics of other climatic zones are also drawn. Implications are discussed for the proper assessment of the surface water resources potential of the Karoo Biome. Such an assessment would be seriously constrained by the twin problems of the poor spatial distribution of reliable streamflow-gauging stations and the paucity of streamflow records of long duration and acceptable quality. A technique that may ease these constraints is that of deterministic rainfall-runoff modeling. The generation of synthetic streamflow records for assessments of water resources potential is also possible by means of stochastic time series modeling, albeit restricted to gauged catchments. The erratic nature of runoff, poor natural carry-over storage, and the low runoff proportions from rainfall in the Karoo catchments may be seen as end effects of a rather tenuous hydrological equilibrium. The response of these catchments to rainfall is likely to be very sensitive to changes induced by land use and management. This hydrological sensitivity underlies the fragile nature of all semi-arid ecosystems and may manifest itself in changes in runoff quality as well as quantity. (Baker-FRC)
W82-06835

REAL-TIME, STATISTICALLY LINEARIZED, ADAPTIVE FLOOD ROUTING,

Massachusetts Inst. of Tech., Cambridge.
K. P. Georgakakos, and R. L. Bras.
Water Resources Research, Vol 18, No 3, p 513-524, June, 1982. 9 Fig, 4 Tab, 9 Ref.

Descriptors: *Model studies, *Flood routing, Bird Creek Basin, *Oklahoma, Routing, Floods, Flood control, Statistical models.

A linearization scheme was developed that makes it possible to use nonlinear routers in an accurate and effective way within the realm of the common linear estimation techniques. The technique also offers the advantage of simultaneous automatic parameter estimation in a simple manner. The Bird Creek example is included to show the feasibility of actual implementation and the effectiveness of the technique. It was concluded that nonlinear routing improves the behavior of the National Weather Service (NWS) model with a linear router. The adaptive nonlinear router is an improvement over its own off-line behavior. Statistical linearization in conjunction with the Taylor Gauss methodology is a powerful tool of analysis for the flood forecasting problem. The conceptual nonlinear flood routing model used can reproduce most of the characteristics of observed output hydrographs, while it does not require high quality input data for the determination of initial parameter values. The automatic parameter estimation scheme is effective and shows promising convergence properties. The use of the model for different flood events in different catchments would increase its credibility. (Baker-FRC)
W82-06855

COMPUTATION OF RUNOFF REDUCTION CAUSED BY FARM PONDS,

Science and Education Administration, Chickasha, OK. Southern Plains Watershed and Water Quality Lab.
R. R. Schoof, and G. A. Gander.
Water Resources Bulletin, Vol 18, No 3, p 529-532, June, 1982. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Runoff, *Ponds, Water storage, Mathematical models, Data collection, Agricultural runoff, Rainfall-runoff relationships, Rainfall, Watersheds, Surface water, Surface runoff, Farm ponds.

A simple accounting method is given for relating the runoff contributing area of watersheds to an index of water in farm pond storage. The procedure was tested on three watersheds. The farm pond storage index, FPSI, could be used with any surface water runoff model on watersheds with several farm ponds and reasonably linear distribution of storage capacity among the ponds. A daily accounting of water stored in all the farm ponds on a watershed was made by daily adjustment of the FPSI, which is defined as the number of inches of watershed runoff stored in the pond that had the largest storage per unit of its drainage area. Rainfall and evapotranspiration computed by a Jensen-Haise equation were input to the model. A linear relationship was assumed between the storage index and the portion of the controlled drainage area that was contributing to runoff. Adjusting the computed runoff with the FPSI reduced the coefficient of variation of monthly measured versus computed surface runoff for each of the three watersheds. The correlation coefficients for the same comparisons were increased. The annual predicted surface runoff was improved for 12 of the 17 station years of data tested. A test of the significance of the improved simulation using the FPSI indicated at the 95% confidence level that there was some improvement. The farm pond storage index could be used with any surface runoff model to improve the prediction of runoff from watersheds with drainage areas greater than 1 square mile and with about 20% or more of the drainage area controlled by farm ponds. (Baker-FRC)
W82-06874

FREE SURFACE OSCILLATIONS IN LAKE KINNERET,

Kinnert Limnology Lab., Tiberias (Israel).
For primary bibliographic entry see Field 2H.
W82-06879

FLOODFLOW CHARACTERISTICS OF HONCUT CREEK AT STATE HIGHWAY 70 BRIDGES NEAR LIVE OAK, CALIFORNIA,

Geological Survey, Sacramento, Calif. Water Resources Division.
J. C. Blodgett.
Open-File Report 81-1010, March 1982. 32 p, 11 Fig, 11 Tab, 8 Ref.

Descriptors: *Flood flow, *Streamflow, *Flow characteristics, *Bridges, Levees, Channel morphology, Flow rates, Discharge measurements, Flood profiles, Agriculture, Flood plains, Flood data, *California, Honcut Creek.

State Highway 70 crosses Honcut Creek about 3.2 miles upstream from its confluence with the Feather River, by three bridges separated by short approach embankments. The California Department of Transportation is planning to replace or widen these bridges; this report evaluates flow characteristics of the existing and proposed crossings. Agricultural improvements on the flood plain and low levees affect the magnitufe and distribution of flow to the bridges. Water-surface elevations of Honcut Creek are affected by levees on the flood plain, a natural channel constriction about 3,000 feet downstream from the bridges, and by high water levels on the Feather River. The average recurrence interval for overbank flow is less than 2 years. A flood with an average recurrence interval of 50 years would be about 19,000 cubic feet per second. For flows of 20,000 cubic feet per second on Honcut Creek, and with present bridge conditions, backwater caused by the bridge is about 0.4 foot. If the left-bank bridge is eliminated, backwater would increase to 0.5 foot. The bridges and approach embankments occupy about 66 percent of the channel. The average velocity of flow at the bridge ranges from 1 to 3.2 feet per second. For present channel and bridge conditions, overbank flows are distributed among the three bridges in a proportion of about 10, 40, and 50 percent for flows between 2,850 and 8,480 cubic feet per second. (USGS)
W82-06945

HYDROLOGIC AND MORPHOLOGIC CHANGES IN CHANNELS OF THE PLATTE RIVER BASIN: A HISTORICAL PERSPECTIVE,

Geological Survey, Denver, Colo. Water Resources Division.
For primary bibliographic entry see Field 2E.
W82-06946

FLOOD OF AUGUST 20, 1979, ON A TRIBUTARY OF CHICKAMAUGA CREEK, NEAR GALLIPOLIS, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
R. I. Mayo, and E. E. Webber.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $1.25, Microfiche $4.50. Open-File Report 81-414, 1981. 7 p, 2 Fig, 5 Ref.

Descriptors: *Floods, *Flood flow, *Flood discharge, *Flood recurrence interval, Flood frequency, Hydrologic data, *Ohio, Gallipolis, Chickamauga Creek basin.

An intense summer rain estimated at 4 to 5 inches in 2.5 hours caused flooding on a Chickamauga Creek tributary 4.5 miles northwest of Gallipolis, Ohio. Computation of a peak discharge of 1,350 cubic feet per second from 3.03 square miles of drainage area (446 cubic feet per second per square mile) indicates a greater-than-100-year flood. (USGS)
W82-06947

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 1. APALACHICOLA, CHOCTAWATCHEE, BLACKWATER, ESCAMBIA, PERDIDO, AND ALABAMA RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06953

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 2. TOMBIGBEE, MOBILE, DOG, PASCAGOULA, AND TENNESSEE RIVER BASINS,
Geological Survey, Univ., AL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06954

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2A. SOUTH FLORIDA SURFACE WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06955

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06957

VARIABILITY OF THE DNEPR RUNOFF UNDER THE EFFECT OF ECONOMIC ACTIVITIES,
Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
For primary bibliographic entry see Field 4C.
W82-06983

4B. Groundwater Management

THE GROUND WATER LEGAL REGIME AS INSTRUMENT OF POLICY OBJECTIVES AND MANAGEMENT REQUIREMENTS,
Hunter Coll., New York.
For primary bibliographic entry see Field 6E.
W82-05938

THE DEVELOPMENT OF INTERNATIONAL GROUNDWATER LAW,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 6E.
W82-05939

THE LAW OF INTERNATIONAL AQUIFERS,
Hunter Coll., New York.
For primary bibliographic entry see Field 6E.
W82-05940

A NUMERICAL MODEL OF AQUIFER TESTS IN MULTI-LAYERED AQUIFER/AQUITARD SYSTEMS,
Komenskeho Univ., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 2F.
W82-05943

SENSIBLE ENERGY STORAGE IN AQUIFERS. 2. FIELD EXPERIMENTS AND COMPARISON WITH THEORETICAL RESULTS,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty, A. C. Gringarten, H. Fabris, D. Thiery, and A. Menjoz.
Water Resources Research, Vol 18, No 2, p 253-265, April, 1982. 11 Fig, 3 Tab, 18 Ref.

Descriptors: *Water storage, Water resources development, *Model studies, *Thermal water, *Injection wells, *Confined aquifers, Resources development, Aquifers, Project planning, Aquifer management, Resources management, Water temperature.

Hot water storage in a single well or in a pair of wells (doublet) in the French Jura was examined in ten successive experiments conducted in 1976-1977 in a confined aquifer 2.5 m thick. Injected volumes ranged from 500 to 1700 cu m, and temperature profiles were taken daily in 12 boreholes distributed along two perpendicular axes within 13 m of the injection well. Individual temperatures were recorded by thermistors placed in the caprock, and results were used to calibrate two mathematical models. An axisymmetric model allows the calibration of average values of the parameters, while a three-dimensional model determines their spatial variation in the horizontal plane and identifies a nonhomogeneous transmissibility field for both hydraulic and thermal contour curves. The water content of the caprock and the thermal dispersion in the aquifer proved important to the recovery ratio. Use of the model in Auburn showed adequate predictions of water temperature during the production phases. (Geiger-FRC)
W82-06058

SENSIBLE ENERGY STORAGE IN AQUIFERS. 1. THEORETICAL STUDY,
Bureau de Recherches Geologiques et Minieres, Orleans (France).
J. P. Sauty, A. C. Gringarten, A. C. Menjoz, and P. A. Landel.
Water Resources Research, Vol 18, No 2, p 245-252, April, 1982. 7 Fig, 4 Tab, 14 Ref.

Descriptors: Water resources development, *Project planning, *Water storage, *Mathematical models, *Injection wells, *Economic aspects, *Aquifer management, Resources development, Geothermal resources, Planning, Aquifers, Model studies, Thermal water, Heated water, Groundwater storage.

A general study was undertaken to assess the economic feasibility of aquifer heat storage projects using a single well. A mathematical model shows that storage efficiency and temperature are influenced by a limited number of dimensionless groups that are controlled by the aquifer's physical properties and its storage operating characteristics. A numerical model is compared with analytical solutions before being used to evaluate the variation with time of the well temperture when production volume and flow rate are equal to the injection volume and flow rate. These results are utilized to plot type curves for several sets of dimensionless parameters covering a range of practical applications. Suggestions are made for efficient storage projects, and the effects of unequal injection, production periods, standby periods, and other conditions of operation are also examined. (Geiger-FRC)
W82-06059

DAILY OPERATIONAL TOOL FOR MAXIMUM BENEFICIAL USE MANAGEMENT OF SURFACE AND GROUND WATERS IN A BASIN,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. J. Morel-Seytoux, K. L. Verdin, and T. H. Illangasekare.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254988, Price codes: A03 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Report No 112, March 1982. 39 p, 18 Fig, 2 Tab, 7 Ref. OWRT B-199-COLO(4), 14-34-0001-9109.

Descriptors: Hydrologic models, *Geohydrology, *Surface water, *Surface-groundwater relations, *Water management, *Basins, Management planning, Numerical analysis, Computer models, Model studies, Hydrologic systems, Hydrologic data, Hydrologic equation, Hydrologic systems, Hydrologic aspects, Hydrologic budget, Groundwater budger, Groundwater, Mathematical studies, Subsurface water.

A developed two-dimensional groundwater hydrologic model, based on numerical-analytical procedure, is preseted and tested. This model incorporates, the discrete kernel modeling approach, a scanning sub-system and sequential reinitialization. Further, it possesses an ability to compute drawdowns at particular locations rather than only average values over cells to provide new input to standard modeling approaches. The model was tested for accuracy and economy. It was found that it consistently will provide results of at least comparable accuracy to that attained with standard finite difference techniques, provided that its variables are properly selected. In addition, the developed model, in certain cases, provides solutions closer to the true solution. The model can also generate solutions with comparable accuracy at reduced cost relative to other computer models, provided that judicious selection of the model's input for sub-system size and reinitialization period is made. The model is particularly efficient if more than one simulation run is to be made on the same system. Appropriate use of the model should substantially reduce the cost of management studies on conjunctive use of surface water and groundwater. (Zielinski-MAXIMA)
W82-06174

ENVIRONMENTAL PROBLEMS AND GEOTHERMAL PERMITTING,
Windrem, Feeney and Williams, Lakeport, CA.
For primary bibliographic entry see Field 6G.
W82-06217

WATER LAW AND THE DEVELOPMENT OF GEOTHERMAL RESOURCES,
O'Melveny and Myers, Los Angeles, CA.
For primary bibliographic entry see Field 6E.
W82-06218

DESIGN OF HEAT PUMP RETURN WELLS,
Michigan Dept. of Public Health, Lansing.
For primary bibliographic entry see Field 8C.
W82-06294

VADOSE ZONE PERMEABILITY TESTS: SUMMARY,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06301

VADOSE ZONE PERMEABILITY TESTS: STEADY STATE RESULTS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06302

VADOSE ZONE PERMEABILITY TESTS: UNSTEADY FLOW,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W82-06303

GROUND WATER QUALITY AND QUANTITY IN FRACTURE ZONES IN THE PIEDMONT OF NORTHWESTERN SOUTH CAROLINA,
Clemson Univ., SC. Dept. of Chemistry and Geology.
S. Snipes.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256553, Price codes: A06 in paper copy, A01 in microfiche. South Carolina Water Resources Research Institute, Clemson, Publication No 93, June 1981. 87 p, 18 Fig, 9 Tab, 40 Ref, 8 Append. OWRT A-047-SC(1).

Descriptors: Water quantity, Water quality, *Lineaments, *Fracture traces, *Fracture zones, Joints, Faults, *Metamorphic rocks, Drilled wells, Bored wells, Hand dug wells, Springs, *South Carolina, Piedmont, *Chemical analysis, Coliform bacteria, Pollutant identification, *Water wells.

More than 200 water well locations have been plotted in Anderson and Oconee Counties in the Piedmont of northwestern South Carolina. The coherent rocks of this metamorphic terrain are virtually impermeable and the median yield of water wells randomly situated in them is only 4 gpm. Moreover, the risk of a dry hole in such wells is 1 in 4. In contrast, water wells situated in fracture zones have a median yield of 20 gpm while the probability of a dry hole is 1 in 71. Nearly all of the wells with yields of greater than 50 gpm are situated in fracture zones and yields of more than 400 gpm have been reported. Aerial photographs and topogrphic maps were analyzed to locate fracture traces and lineaments. Field studies have shown that most of them are attributed to vertically dipping systematic joints or fault zones. More than 400 linear features have been mapped; 43 of them are fault zones, while most of the remainder are attributed to systematic joints. Fifty-eight ground water samples were analyzed for their chemical properties and 48 samples were analyzed for their content of coliform bacteria. Most of the ground water samples had good to excellent chemical properties. Twenty-four percent of the rural, shallow, hand dug wells had fecal contamination and 1 of the 8 spring samples showed fecal contamination. The drilled and bored wells contained very little bacteria and no fecal contamination. (Author abstract)
W82-06309

A TWO-DIMENSIONAL, FINITE ELEMENT MODEL OF SALT WATER INTRUSION IN GROUNDWATER SYSTEMS,
Guam Univ., Agana. Water Research Inst. of the Western Pacific.
D. N. Contractor.
Technical Report No 26, October 1981. 64 p, 9 Fig, 16 Ref, 4 Append.

Descriptors: *Model studies, *Saline-freshwater interfaces, *Saline water intrusion, *Aquifers, Coastal waters, Water boundary, Groundwater movement, Flow rates, Computer programs, Fortran.

Careful management of aquifers with coastal boundaries is essential to guard against excessive salinity concentrations. Management includes knowing the location of the saltwater under present and future pumping conditions. A numerical model can help estimate the location of the saltwater for given sets of hydraulic conditions. This report describes the development and use of a sharp interface model to simulate salt-water intrusion into coastal and insular groundwater aquifers. The model, using linear triangular elements, can simulate steady or unsteady conditions in confined or unconfined aquifers. Three types of boundary conditions can be specified: head as a function of time; flow as a function of time; and a mixed boundary condition for freshwater flowing into a coastal boundary. Freshwater wells can be located at any node. Freshwater and saltwater toes can be tracked with time, and the direction and velocity in each element can be identified. In addition, aquifers containing only freshwater can be simulated by specifying the saltwater head at all nodes to be much less than expected freshwater heads. The model has been used to simulate several natural aquifers, with complex boundaries, and varied basement topography and boundary conditions. The results were compared with analytic solutions and, in all cases, the comparisons were good. The availability of such a model enables the manager of an aquifer to explore the advantages and disadvantages of various options relating to the development of the resource. The computer program has been written in FORTRAN. (Atkins-Omniplan)
W82-06525

A MODEL FOR MANAGING IRRIGATED AGRICULTURE,
Youngstown State Univ., OH Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-06584

AN OPTIMIZATION ALGORITHM IN A SYSTEM FOR MANAGEMENT OF THE REGIONAL SAFE GROUNDWATER YIELD,
Moscow State Univ. (USSR). Inst. of Mechanics Research.
E. V. Guseva.
Water Resources, Vol 8, No 3, p 329-336, May/June, 1981. 1 Fig, 3 Tab, 3 Ref. Translated from Vodnye Resursy, No 3, p 167-175, May/June, 1981.

Descriptors: *Safe yield, *Aquifer management, Groundwater management, Seepage, Numerical analysis, Model studies, Suzak Basin, *USSR, Optimization, Geohydrology, Wells, Mathematical models, Hydrodynamics.

A linear problem for conditions of confined seepage was examined. The numerical calculations of the prediction of cones of depression for a period up to 30 years were done using data from the Suzak artesian basin in Central Asia. The objective was to obtain the maximum possible amount of water in a given region with prescribed restrictions on the decline of the water table. Two variants of the problem were considered: (1) locations of the water intakes were fixed, and (2) the locations of the water intakes were unknown and to be determined. The method was satisfactory for managing safe regional yields. (Cassar-FRC)
W82-06616

ARTIFICIAL RECHARGE OF COLORADO RIVER WATER IN LAS VEGAS VALLEY: MANAGEMENT OPTIONS AND POTENTIAL AQUIFER SYSTEM RESPONSES,
Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 6B.
W82-06694

INSTITUTIONAL ASPECTS AFFECTING MANAGEMENT OF GROUNDWATER IN CALIFORNIA,
California Univ., Riverside. Dept. of Soil and Environmental Science.
For primary bibliographic entry see Field 6B.
W82-06700

NUMERICAL MODELING OF UNSTEADY FLOWS IN OPEN CHANNELS,
Novosibirsk State Univ. (USSR).
For primary bibliographic entry see Field 7C.
W82-06784

WHO OWNS NEBRASKA'S GROUND WATER,
Nebraska Univ. Lincoln.
For primary bibliographic entry see Field 6E.
W82-06819

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-06831

GEOPHYSICAL RECONNAISSANCE OF LEMMON VALLEY, WASHOE COUNTY, NEVADA,
Geological Survey, Carson City, NV. Water Resources Div.
For primary bibliographic entry see Field 2F.
W82-06949

DATA FROM GEOTHERMAL TEST WELLS NEAR MOUNT HOOD, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W82-06950

RECONNAISSANCE OF THE GROUND-WATER RESOURCES OF KINGS AND QUEENS COUNTIES, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
H. T. Buxton, J. Soren, A. Posner, and P. K. Shernoff.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225 Paper copy $8.25 Microfiche $3.50. Open-File Report 81-1186, 1981. 59 p, 28 Fig, 2 Tab, 25 Ref.

Descriptors: *Groundwater, *Water quality, *Groundwater potential, *Water supply, Water management, Available water, Urban hydrology, Water use, Saline water intrusion, Contamination, Aquifer characteristics, Wells, Water level, Chemical anlaysis, *New York, *Long Island, Kings County. Queens County.

Western Long Island's ground-water resources are being considered for redevelopment as a supplemental source of public water supply. The ground-water reservoir in Kings and Queens Counties had supplied an average of more than 120 million gallons per day for industrial and public water supply from 1904 to 1947. However, deterioration of groundwater quality from induced encroachment of salty ground-water caused the total cessation of pumping for public supply in Kings County in 1947 and in western Queens County in 1974. This investigation was designed to make a preliminary evaluation of the present groundwater quality and to review hydrologic information pertinent to the formulation of an appropriate development plan. Detailed hydrogeologic mapping was done to define the geometry of the ground-water system. The history of ground-water development and the consequent responses of ground-water levels and quantity were summarized. A well network was established to monitor ground-water levels and ground-water quality in Kings and Queens Counties. The distribution of chloride and nitrate in ground-water was used to identify contamination from salt-water intrusion and surface sources. A limited source of potable ground-water is available in the Magothy-Jameco and Lloyd aquifers; however, an accurate estimate of the quantity of water available or a draft rate suitable for maintaining a useable ground-water quality is undetermined. (USGS)
W82-06952

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2B. SOUTH FLORIDA GROUND WATER,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06956

4C. Effects On Water Of Man's Non-Water Activities

THE ECOLOGY OF NEW ENGLAND HIGH SALT MARSHES: A COMMUNITY PROFILE,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 2L.
W82-06096

URBAN CREEKSIDE DESIGN FEATURES PARALLEL STREETS,
Santa Clara Valley Water District, CA.
L. C. Fowler, and S. N. Wolfe.
Civil Engineering (New York), Vol 52, No 6, p 72-74, June, 1982. 3 Fig.

Descriptors: *Flood control, *Community development, *Urban planning, Construction, Design criteria, *Land use planning, Parallel streets.

Proper land use restraints and creative design can be used to prevent flooding and preserve the natural wildlife habitat which forms along a waterway, even in an urban setting. Streets parallel to waterways in developed areas separate the streams from neighboring houses, emphasizing open space and providing neighborhood privacy and security. Communities benefit more if creeks and channels are kept in the open where the public can see and use them. Maintenance is easier because of convenient access, and minor erosion or silt deposition does not create an immediate hazard to adjoining property. The design of parallel streets reduces the number of bridges required along the channels, thus reducing total cost to the community. Variations in the pattern of streets on both sides of and parallel to creeks can be made by looping streets or using dead-end streets, which reach to the creek margins. In valleys where the stream channel is located on higher elevations, levees are needed along the banks of the stream to contain the floodwaters. By setting the levees back away from the actual stream channels, the natural corridor is maintained and the carrying capacity enlarged to reduce the flood potential to the urban areas adjacent to the streams. (Baker-FRC)
W82-06184

MATHEMATICAL MODEL FOR ERODIBLE CHANNELS,

San Diego State Univ., CA.
For primary bibliographic entry see Field 2J.
W82-06336

SEDIMENT TRANSPORT STUDY ALONG A DELTA SHORELINE,

CH2M Hill, Bellevue, WA.
For primary bibliographic entry see Field 2J.
W82-06553

FIRST-YEAR EFFECTS OF CLEARCUTTING AN OAK-HICKORY WATERSHED ON WATER YIELD,

Illinois Univ. at Urbana, Champaign. Dept. of Forestry.
R. J. Brozka, G. L. Rolfe, and L. E. Arnold.
Water Resources Bulletin, Vol 18, No 1, p 139-145, February, 1982. 1 Fig, 5 Tab, 35 Ref.

Descriptors: *Water yield, *Forest watersheds, *Clear-cutting, Forest management, Forest hydrology, Water quality, Nutrients, *Illinois.

Although water has always been a dominant consideration in forest management objectives, it is only recently that the effects of forest harvesting on water quality have been investigated intensely. The present study evaluated the effects on water quality of clear-cutting in southern Illinois, where soils are generally shallow, easily eroded, nutrient deficient, and on steep slopes, and where rainfall is relatively heavy. Two intermittent streams on oak-hickory watersheds were gaged with a V-notch weir and sampled with an automatic water sampler. Baseline data collected for 3 years showed large variations in flow volume between years and between watersheds. Analysis of water samples for sodium, potassium, calcium, magnesium, orthophosphorus, and nitrate-nitrogen (NO3-N) showed that water quality was consistently high, although there were significant differences between the watersheds, there was a 95% increase in flow volume, although there was no evidence of increased sedimentation. Stream water concentrations of potassium, magnesium, and nitrate-nitrogen increased 18%, 8%, and 274% respectively. Nutrient budgets for the site were not adversely affected by the harvest, due largely to the care taken to avoid disturbance to the site during logging, the careful layout of the harvest operation, and the below-normal precipitation the first year following the harvest. These results indicate that clearcuts of moderate size which are carefully planned and carried out should not pose a threat to water quality nor degrade site productivity. (Carroll-FRC)
W82-06589

REDUCTION OF URBAN RUNOFF THROUGH ECONOMIC INCENTIVES: BOULDER, COLORADO,

Colorado Univ., Longmont.
S. A. Thompson.
Water Resources Bulletin, Vol 18, No 1, p 125-127, February, 1982. 4 Ref.

Descriptors: *Urbanization, *Urban runoff, *Runoff volume, *Storm runoff, Economic incentives, Economic aspects, Flood control, Regulations, Boulder, *Colorado.

The process of urbanization results in fundamental alterations of interrelationships within the natural environment. The most obvious of these changes is the increased percentage of precipitation which becomes direct surface runoff as a result of the transformation of the land surface from a permeable to an impermeable covering. In 1974 the city of Boulder, Colorado, adopted storm drainage and flood control fee designed to charge property owners for altering the natural environmental relationships among precipitation, infiltration, and runoff and to encourage these owners to decrease their contributions to surface runoff. Single family residential lots are assessed $1.00 per month. All new developments other than single family lots which are not part of a larger development are required to install on-site detention storage facilities capable of controlling the runoff associated with a storm having a 5-year frequency, in return for which they receive a 20% reduction in the normally computed fee. If it provides storage capable capable of controlling runoff from storms with return frequencies of 10, 20, or 100 years, the parcel receives a 40, 60, or 80% reduction in the fee, respectively. Although most new developments have included detention storage facilities exceeding the minimum required, there have been no reports of retrofitting existing developments with such facilities. Also, only three single family residences have installed detention facilities. It is suggested that more could be done to encourage and assist homeowners to install detention facilities and to ensure that owners of existing developments understand the benefits of retrofitting their properties with detention storage. (Carroll-FRC)
W82-06629

EVALUATION OF EFFECTS OF STORMWATER DETENTION IN URBAN AREAS,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5G.
W82-06698

STREAMFLOW CHANGES AFTER LOGGING 130-YEAR-OLD DOUGLAS FIR IN TWO SMALL WATERSHEDS,

Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
R. D. Harr, A. Levno, and R. Mersereau.
Water Resources Research, Vol 18, No 3, p 637-644, June, 1982. 7 Fig, 3 Tab, 24 Ref.

Descriptors: *Watershed management, *Water resources development, Watersheds, Forest watersheds, Logging, *Oregon, Streamflow, *Douglas fir trees.

A case history was prepared of changes in streamflow observed after harvesting in two small experimental watersheds. The study area consists of three small watersheds located between the 865 and 1155 meter elevations on the south aspect of Blue Ridge, the major divide between the Blue River drainage to the north and the Lookout Creek watershed which comprises the H. J. Andrews Experimental Forest. Timber harvest in watersheds containing 130 year old timber increased annual water yield up to 42 cm. For 4 years after logging, yield increases averaged 38 cm at a 13.0 ha clearcut watershed and 20 cm at a 15.4 ha watershed where timber was shelterwood cut. Increased summer flows were indicated by the much smaller number of low-flow days after logging, particularly at the clearcut watershed. During the 1977 drought year, only eight and two low-flow days occurred at the clearcut and shelterwood cut watersheds, respectively, compared to 143 and 135 low-flow days predicted by the calibration relationship. Neither the size nor the timing of peak flows changed significantly after logging at either watershed. (Baker-FRC)
W82-06849

STORM WATER RUNOFF QUALITY FROM THREE LAND-USE AREAS IN SOUTH FLORIDA,

Geological Survey, Orlando, FL.
For primary bibliographic entry see Field 5B.
W82-06877

DECREASE IN STREAM GRAVEL PERMEABILITY AFTER CLEAR-CUT LOGGING: AN INDICATION OF INTRAGRAVEL CONDITIONS FOR DEVELOPING SALMONID EGGS AND ALEVINS,

Maine Cooperative Fishery Research Unit, Orono.
For primary bibliographic entry see Field 5C.
W82-06910

FOREST MANAGEMENT AND ANADROMOUS FISH HABITAT PRODUCTIVITY,

Forest Service, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 5C.
W82-06965

VARIABILITY OF THE DNEPR RUNOFF UNDER THE EFFECT OF ECONOMIC ACTIVITIES,

Central Scientific-Research Inst. of Multipurpose Use of Water Resources (USSR).
V. S. Perekhrest, and S. M. Perekhrest.
Water Resources, Vol 8, No 4, p 365-369, July/August, 1981. 1 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No 4, p 60-65, July/August, 1981.

Descriptors: *Land management, *River flow, *Drainage effects, Water management, Runoff, Dnepr River, *USSR, Irrigation effects, Lakes, Reservoirs, Agriculture, Water use, Precipitation, Rainfall-runoff relationships, Economic development, Flow, Environmental effects, Ecological effects.

The Dnepr Basin is an example of several basins in the European SSR which display noticeable changes in river runoff as a result of anthropogenic influences such as irrigation, drainage, construction of reservoirs and ponds, and erosion control. Examination of the chronological variation of precipitation and runoff and the residual mass runoff curves for the Kiev gaging station revealed 3 cycles of variations in discharge volume of the Dnepr. The first period (1881-1919) was characterized by little economic activity in the area except some drainage work. During the second period (1920-1942) runoff was still under nearly natural conditions. Drainage work involved only 350,000 ha out of 6.5 million ha. Some land improvement and erosion control projects begun in the 1930's were interrupted by World War II. In the third period (1943-1971) extensive drainage projects, reservoir construction, forest improvement, and erosion control produced considerable effects, both positive and negative, on river runoff. Annual runoff values corrected for climatic and physiographic factors for the second and third periods were 45.4 and 42.2 cu km, respectively, at the Kiev gaging station and 54.8 and 50.2 cu km, respectively, at the Lotmanskaya Kamenka gaging station. (Cassar-FRC)
W82-06983

4D. Watershed Protection

CLIMATE VARIATION AND THE MOBILITY AND STORAGE OF SEDIMENT IN WATERSHEDS,

Wisconsin Univ.- Madison. Dept. of Geography.
J. C. Knox, S. J. Cary, and F. J. Magilligan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243544, Price codes: A04 in paper copy, A01 in microfiche.

Technical Report WIS WRC 81-03, 1981. 56 p, 19 Fig, 3 Tab, 62 Ref. OWRT A-079-WIS(2). 14-34-0001-8053/9053.

Descriptors: *Sediment yield, *Climatic data, *Seasonal variation, *Model studies, *Watersheds, Sediment transport, Sediment load, Sediment discharge, Sedimentary basins, Precipitation rate, Snowmelt, Environmental effects, Streams, Land use, Time series analysis, Storms, Storm runoff, *Wisconsin, *Black Earth Creek.

Variations in sediment availability were examined to assess the probable impacts of the documented environmental changes for sediment production in upper Balck Earth Creek. Analysis of the monthly sediment transport relationship permitted quantification of seasonal and within-season variations of sediment availability in response to precipitation variations. Sediment availability in the Creek (as indicated by the exponent of the regression equation describing the power functional relationship between sediment and water yields) was high in early summer, and low at other times. Monthly precipitation was negatively associated with sediment availability at all times of the growing season, except for the early spring following snowmelt. A relatively high Creek sediment production in the 1954-60 period was attributed to the frequent occurrence of large storms in late spring/early summer. The relatively low annual sediment production from 1961-65 was attributed to the shift of most large storms to the late summer months. Observed land use changes toward a greater erosion potential were less important than climatic factors for determining annual Creek sediment production between 1954-65. (Zielinski-MAXIMA)
W82-05931

A REMOTE SENSING TECHNIQUE FOR ESTIMATING WATERSHED RUNOFF,

Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W82-06151

A BENEFIT COST ANALYSIS OF A SOIL EROSION CONTROL PROGRAM FOR THE NORTHERN WATERSHED OF LAKE CHICOT, ARKANSAS,

Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
C. T. Osborn, A. D. McQueen, and R. N. Shulstad.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254947, Price codes: A03 in paper copy, A01 in microfiche. Arkansas Water Resources Research Center, Fayetteville, Bulletin 856, November 1981. 23 p, 5 Fig, 4 Tab, 8 Ref. OWRT A-056-ARK(1).

Descriptors: *Cost-benefit analysis, *Soil erosion, *Erosion control, *Watersheds, *Recreation, Cost analysis, Costs, Economic aspects, Recreation facilities, Public waters, Project planning, Forecasting, Bank erosion, Planning, Forecasting, Benefits, *Arkansas, Lake Chichot.

A study was conducted to determine the most cost effective soil erosion control program to maintain current recreational viability for the northern basin of Lake Chicot, and to establish, through benefit-cost analysis, whether such a program could be justified economically. Using mathematical approaches for estimating costs and benefits discretely, it was possible to calculate a benefit-cost ratio (b/c) for a soil erosion control program that would at least maintain the present water quality of the northern Lake basin. With a b/c ratio greater than unity representing a program economically desirable, a ratio of 112 was obtained using the consumer's surplus limiting case benefit over the present value of costs for a project life of 50 years, while a ratio of 81 was obtained using a 20-year planning horizon while retaining all other assumptions. Further, in the worst case, the b/c ratio was found to be 33. Hence, the magnitude of these b/c ratios clearly implies the high desirability of initiating a soil erosion control program from society's standpoint. Recreational benefits are by far the most significant; their preservation is the primary goal of the proposed program. (Zielinski-MAXIMA)
W82-06170

EVALUATION OF THE STREAM REACH INVENTORY AND CHANNEL STABILITY INDEX FOR INSTREAM HABITAT ANALYSIS,

Wyoming Univ., Laramie. Water Resources Research Inst.
W. H. Eifert, and A. Wesche.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256546, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Series No 82, May 1982. 106 p, 13 Fig, 15 Tab, 81 Ref, 2 Append. OWRT A-033-WYO(1), 14-34-0001-1154.

Descriptors: *Channel stability, *Aquatic habitat, *Trout, *Ocular survey, Standing crops, *Wyoming, Indicators, Bioindicators, *Correlation analysis, *SRICSI methodology, Montane streams.

In 1975, the Northern Region of the U.S. Forest Service developed an ocular watershed evaluation methodology entitled 'Stream Reach Inventory and Channel Stability Index' (SRICSI). Designed to assess the physical aspects of channel and streamback stability, the SRICSI's value as an aquatic habitat evaluation technique was basically unknown. During the spring and summer of 1981, 17 representative study sites on two 2nd order montane streams were evaluated through application of the SRICSI procedure and three aquatic habitat assessment methodologies. Salmonid population estimates were also obtained for each site. Trout standing crop estimates were statistically compared to study site SRICSI scores, the results obtained from the habitat evaluation procedures, and to data collected on 63 habitat-related independent variables. Results indicate a significant relationship exists between SRICSI scores and both trout population estimates and to two of the three habitat evaluation procedures. All correlations were negative, thereby suggesting that as SRICSI scores increase, trout standing crops and subsequent habitat conditions decreases. Additionally, 40 habitat variables displayed significant correlations to trout standing crop data, with 15 selected for possible inclusion in the SRICSI. Inclusion of those variables found compatible with the SRICSI procedure should increase its biological sensitivity thereby broadening its use in aquatic habitat studies.
W82-06308

GEOMORPHIC AND LITHOLOGIC CONTROLS OF DIFFUSE-SOURCE SALINITY, GRAND VALLEY, WESTERN COLORADO,

Colorado State Univ., Fort Collins. Dept. of Earth Resources.
For primary bibliographic entry see Field 2J.
W82-06364

SEDIMENT ANALYSES FOR URBANIZING WATERSHEDS,

Army Engineer District, St. Louis, MO.
For primary bibliographic entry see Field 2J.
W82-06426

EROSION CONTROL AT A DELICATE HIGHWAY CONSTRUCTION SITE,

Oregon Dept. of Transportation, Salem.
J. H. Versteeg, and J. J. Earley.
Public Works, Vol 113, No 3, p 82-83, March, 1982.

Descriptors: *Erosion control, *Highway relocation, *Soil erosion, Construction, *Oregon, Dikes, Dams, Mulches, Channel improvement, Fish conservation, Slope stabilization, Landslides, Water quality control, Monitoring, Sediment control.

Reconstruction of a section of Interstate 5 in Oregon included several features designed to prevent adverse environmental effects during construction. To control stream turbidity heavy equipment was kept out to the stream channel as much as possible and stream crossing-sediment traps were constructed. Dikes were built to isolate construction activities from the flowing stream. Straw bales underlaid with drain rock were placed in slope gullies. Seed and straw mulch were put on slopes. Slopes were terraced to reduce soil erosion. Shrubs and willow trees were planted to control erosion and maintain cooler water temperatures. Six potential slides are being monitored so that stabilization may be undertaken if necessary. No work was done in existing streams during October 15 through June 1, so that fish spawning was not disturbed. Sediment dams and straw bale sediment barriers were installed after June 1 and were removed before October 15. Most dams trapped 8-24 inches of mud, which was cleaned out before the fall rains. Water quality, as measured by pH, dissolved oxygen, turbidity, and temperature, was within acceptable limits. Notched weirs were located in 21 sites where stream gradient and water velocity were excessive. (Cassar-FRC)
W82-06510

USE OF THE FINITE-ELEMENT METHOD FOR SOLVING THE TRANSFER EQUATION,

Vsesoyuznyi Nauchno-Issledovatelskii Inst. Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenernoi Gidrogeologii, Kharkov (USSR).
For primary bibliographic entry see Field 2J.
W82-06620

THE ANNABRUCKE RIVER POWER STATION ON THE DRAU, CONSTRUCTIONS TAKEN TO PREVENT EROSION IN THE VICINITY OF THE BARRAGE ON AN EXCEPTIONAL SUBSOIL (DAS DRAUKRAFTWERK ANNABRUCKE, MASSNAHMEN ZUR VERHINDERUNG DER EROSION IN BEREICH DES BAUWERKES AUF AUSSERGEWOHNLICHEM UNTERGRUND),

For primary bibliographic entry see Field 8E.
W82-06636

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1978,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06672

SUBSURFACE DRAINAGE EFFECTS ON EROSION,

North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
R. W. Skaggs, A. A. Nassehzadeh-Tabrizi, and G. R. Foster.
Journal of Soil and Water Conservation, Vol 37, No 3, p 167-172, May/June, 1982. 7 Fig, 2 Tab, 17 Ref.

Descriptors: *Erosion control, *Subsurface drainage, Drainage, Erosion, Groundwater movement, Subsurface drains, Drains, *Model studies, *North Carolina, Goldsboro, Soil types, Sand, Loam, Surface runoff, Simulation analysis.

A computer simulation method for characterizing the effects of artificial drainage on erosion is presented, and the use of this method is demonstrated on a soil in eastern North Carolina. The drainage simulation model, DRAINMOD, was coupled with the CREAMS model for simulation erosion. Use of the coupled model was demonstrated for Goldsboro sandy loam soil. The simulation showed that erosion on Goldsboro soil with an average slope of 2% could be reduced appreciably with subsurface drainage. For example, predicted average annual rates of erosion declined by a factor of 10, from 9 to 0.9 metric tons per hectare, upon changing the drainage system from one with good surface drainage and poor subsurface drainage to one with poor surface drainage and good subsurface drainage. Subsurface drainage, therefore, should be considered as a possible best management practice for reducing erosion on relatively flat land, since it increases available profile storage and reduces surface runoff. On the negative side, intensive subsurface drainage generally increases nitrate loss from agricultural land. Whether increased loss of nitrates counteracts the beneficial effect of reducing sediment and associated nutrient and pesticide losses depends on the site and the quality of the receiving waters. Use of artificial

drainage can significantly affect the rate and flow path of water leaving the field. (Baker-FRC)
W82-06795

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: A COST ANALYSIS,

Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
A. D. McQueen, R. N. Shulstad, and C. T. Osborn.
Journal of Soil and Water Conservation, Vol 37, No 3, p 182-185, May/June, 1982. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Erosion control, *Farm management, *Soil loss, Erosion, North Lake Chicot, *Arkansas, Crops, Watershed management, Cost-benefit analysis, Water Quality, Water pollution effects.

The costs of alternative methods of erosion control in a specific watershed were investigated. The watershed under study was North Lake Chicot, a 5,025 acre oxbow lake created by the past meandering of the Mississippi River. While the lake at one time offered excellent fishing and other recreation, channelization and levee construction in nearby areas diverted drainage and floodwaters from about 350 square miles of agricultural land into Connerly Bayou and ultimately into Lake Chicot. A levee was constructed across the lake just north of the point where Connerly Bayou enters it. The southern basin's impact has been substantial over the ensuing years, but the northern basin remained quite clean and free of significant pollution until recently. Erosion control policies were evaluated using a linear programming model, which incorporated constraints on the amount of field equipment, irrigation equipment, and time available for agricultural production. Seven crop rotations and four management practices were evaluated. The analysis indicated that soil loss could be reduced 24% per year while increasing net revenues by 28% with proper soil management and cropping patterns. Both cover cropping and the use of an average soil loss restriction were more cost effective than the Soil Conservation Service structural plan for reducing soil erosion in the watershed. (Baker-FRC)
W82-06796

EFFECT OF CATTLE MANURE ON SOIL EROSION BY WATER,

Allahabad Univ. (India). Dept. of Chemistry.
S. Chandra, and S. K. De.
Soil Science, Vol 133, No 4, p 228-231, April, 1982. 4 Tab, 13 Ref.

Descriptors: *Manure, *Erosion rates, *Soil stabilization, Fertilizers, *Animal wastes, Farm wastes, *Soil erosion, Erosion control, *India, Cattle, Soil texture, Bacteria, Soil bacteria, Soil amendments, Soil treatment.

Cattle manure was applied at concentrations of 1% and 2% to soils from six sites in India in a laboratory study to determine erosion coefficient at 15 and 30 days incubation. The 1% concentration decomposing for 30 days effectively reduced soil erosion. Erosion coefficients were 68.8-8.1 compared with 82.9-9.6 in untreated soils. The 2% concentration was only slightly better than the 1% concentration. At the 15 day incubation point erosion coefficients were higher than those of untreated soils. This was caused by a temporary increase in C02 and soil pH during decomposition of the manure. Manure application was more effective in light textured soils with higher erosion coefficients. The four treatments were ranked in order of efficiency: 2%, 30 days > or = 1%, 30 days > 1%, 15 days > 2%, 15 days. (Cassar-FRC)
W82-06834

APPLICATION OF SCS INFILTRATION MODEL,

S. Kumar, and S. C. Jain.
Water Resources Bulletin, Vol 18, No 3, p 503-507, June, 1982. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Infiltration, *Model studies, Rainfall, Runoff, Hydrology, Flow, Rainfall-runoff relationships, Overland flow.

Application of the Soil Conservation Service (SCS) infiltration model to the watershed of the north branch of Ralston Creek, northeast of Iowa City, Iowa, is considered. The 3.01 square mile watershed is largely rural and agricultural. It has a channel length of four miles and a drop in elevation of about 140 feet. The valley has fairly steep slopes in its southern and eastern sections, with a gently rolling configuration over the western and northwestern parts. The SCS infiltration model was modified to suit the type of rainfall data needed for predicting overland flood hydrographs. Hourly runoff and loss rates were computed using the SCS model. The precipitation in five-minute intervals was superimposed on the hourly loss rate. The hourly loss rates were then adjusted such that the volume of rainfall excess computed using five-minute data agreed with the hourly runoff predicted by the modified SCS model. A trial and error procedure was adopted to determine the curve number, AMC, and MIR for the distributed watershed. The complete distributed watershed model including the modified SCS model was tested for two storms. The results indicate that the infiltration model satisfactorily described the distribution of losses and that the technique of calculating rainfall excess hyetographs to develop overland flood hydrographs is adequate. (Baker-FRC)
W82-06872

A DYNAMIC SYSTEM MODEL FOR SIMULATING SEDIMENT DISCHARGE,

Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, and J. K. Mitchell.
Water Resources Bulletin, Vol 18, No 3, p 415-421, June, 1982. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Model studies, *Sediment discharge, Sedimentation, Sediments, Mathematical studies, Erosion, Dynamics, Watersheds, Small watersheds, *Watershed management.

A dynamic system sediment discharge model based on upland erosion mechanics was developed and tested. The system model was intended to simulate sediment discharge with short time increments using simple hydrologic variables such as rainfall intensity and runoff. This would allow the model to be incorporated into hydrologic models. The model was developed from an expansion of splash and flow erosion relationships under steady state conditions. It incorporated eight parameters such as rainfall intensities, runoff rates, and previous sediment discharges. The model was tested on two small watersheds, with simulation results which were highly satisfactory relative to the data. The resulting linear model explained variations with coefficients of determination averaging 0.99. Parameter coefficients varied with storm characteristics, suggesting that the proposed model is a quasi-linear model. This leads to a conclusion that sediment discharge systems may not be properly represented by any single flow-sediment discharge relationship. The model was also tested with snowmelt events as well as with storm oriented runoff. (Baker-FRC)
W82-06876

SUPERCRITICAL FLOW FLUMES FOR MEASURING SEDIMENT-LADEN FLOW,

Science and Education Administration, Fort Collins, CO.
For primary bibliographic entry see Field 8B.
W82-06959

FIRE AND GEOMORPHIC PROCESSES,

For primary bibliographic entry see Field 2J.
W82-06963

MANAGEMENT OF WATERSHED REHABILITATION- REFLECTIONS FROM MT. ST. HELENS AND REDWOOD CREEK,

Forest Service, Corvallis, OR. Forestry Sciences Lab.
F. J. Swanson, and S. D. Veirs Jr.
In: Proceedings of a Symposium on Watershed Rehabilitation in Redwood National Park and Other Pacific Coastal Areas, August 24-28, 1981, Arcata, California, Center for Natural Resource Studies, Sacramento, California, 1982, p 11-16. 1 Fig, 1 Ref.

Descriptors: *Watershed management, *Erosion control, *Cost analysis, Planning, *Political aspects, Sediments, Evaluation, Road construction, Logging, Volcanoes, Governmental interrelations, *Mount St Helens, *California, Redwood Creek.

Many major watershed rehabilitation projects begin in an uneasy, high-profile, hurried, politically charged environment. Despite differences in physical setting, ultimate objectives, and other considerations, these political factors result in a set of problems common to many watershed rehabilitation projects. Watershed rehabilitation projects at Redwood Creek, California, and Mt. St. Helens, Washington, present some instructive contrasts and similarities. Legislation expanding Redwood National Park provided for rehabilitation of lands affected by road construction and timber harvest. This project is funded for an anticipated program of 10 to 15 years, planned and conducted in part by scientists, and managed by a single Federal agency. The 1980 erruption of Mt. St. Helens, on the other hand, triggered a mix of responses by many agencies and organizations working with overlapping responsibilities in a crisis environment. Planning horizons for treating watershed problems at Mt. St. Helens have generally spanned only a matter of months to a few years, in part because funding for rehabilitation and hazard control has come in short-term allocations for specific projects. Examination of these two quite different projects reveals five criteria for successful, efficient design and execution of a large watershed rehabilitation project: state long-term and short-term objectives; use an interdisciplinary approach at all stages; consider erosion processes and fate of sediment in planning erosion control measures; define costs of full, partial, and no treatment; and provide independent evaluation of programs. (Moore-SRC)
W82-06968

PRELIMINARY POST-ERUPTION SEDIMENT BUDGET FOR THE NORTH FORK TOUTLE RIVER DRAINAGE, JUNE 1980-MAY 1981,

Humboldt State Univ., Arcata, CA., Dept. of Geology.
A. K. Lehre, B. Collins, and T. Dunne.
In: Proceedings from the Conference Mt. St. Helens: Effects on Water Resources, October 7-8, 1981, Jantzen Beach, Oregon, State of Washington Water Research Center, Pullman, Washington, April, 1982, p 215-234. 6 Fig, 6 Tab, 11 Ref.

Descriptors: *Volcanoes, *Sediment erosion, *Sediment transport, *Mount St. Helens, Landslides, Mudflows, Tephra, Particle size, Aerial photography, Gravel, Sand, Silt, Mass wasting, Toutle River, *Washington.

The 18 May 1980 eruption of Mt. St. Helens greatly altered the drainage basin of the North Fork Toutle River. The lateral blast destroyed vegetation and deposited up to a meter of gravelly and sandy ash on hillslopes in 336 sq km of the drainage north and west of the mountain; subsequent airfall mantled these deposits with 0.02-0.06 m of poorly-permeable silty ash. A massive rockslide-avalanche filled 60 sq km of the upper North Fork Valley with volcanic rubble 5-195 m thick. Volcanic mudflows covered the banks and floodplain of the North Fork with 0.5-5 m of sand, silt, and gravel. Rapid erosion of these deposits has created major sediment management problems on the North Fork and its tributaries. Simple field and airphoto measurements were used to estimate the quantity and particle-size distribution of sediment contributed from each source. From June 1980-May 1981, a total of 55,000,000 cu m of sediment (35% gravel, 47% sand 18% silt/clay) was eroded in the drainage, chiefly (77%) from the debris avalanche. Between 33 and 45% of this sediment was redeposited in the system. Net sediment yield to the Main Toutle was 30,000,000 to 37,000,000 cu m, of which 39% was gravel, 46% sand, and 15% silt/clay. It is anticipated that sediment yields over the next several years will be no larger than that of the first year; yields will continue on the order of

10,000,000 to 30,000,000 cu m/yr, with the avalanche the most important source. (Moore-SRC)
W82-06970

SEDIMENT INFLUX TO THE TOUTLE RIVER FROM EROSION OF TEPHRA, MAY 1980-MAY 1981,

Washington Univ., Seattle. Dept. of Geological Sciences.
B. Collins, T. Dunne, and A. K. Lehre.
In: Proceedings from the Conference Mt. St. Helens: Effects on Water Resources, October 7-8, 1981, Jantzen Beach, Oregon, State of Washington Water Research Center, Pullman, Washington, April 1982, p 82-97. 10 Fig, 7 Tab, 11 Ref. PNW-80-179.

Descriptors: *Volcanoes, *Sediment erosion, *Erosion rates, *Mount St. Helens, Tephra, Sheet erosion, Rill erosion, Sediment transport, Slopes, Vegetation, *Washington, Toutle River.

The 1980 eruptions of Mount St. Helens resulted in the widespread destruction of vegetation and deposition of 70,000,000 cu m of tephra on hillslopes covering a 352 sq km area in the drainage basin of the North Fork Toutle, South Fork Toutle, and Green Rivers. Since the eruption, these tepha and underlying colluvium have been eroded into the streams of the Toutle River System by sheet wash and rill wash. Local rates of erosion ranged between 500 and 74,500 cu m/sq km/year and were controlled by surface cover, hillslope gradient, tephra thickness, and tephra texture. During the first post-eruption year, 7,600,000 cu m of tephra and 1,300,000 cu m of colluvium eroded from the basin. These values represent erosion rates of 21500 cu m/sq km/year and 3600 cu m/sq km/year of tephra and colluvium, respectively, equivalent to a denudation of 25.1 mm/year. Thirty-one percent of all sediment eroded from hillslopes was trapped in lakes impounded by the debris avalanche that filled the North Fork Toutle River valley on 18 May 1980. Of the remaining 8,000,000 t of sediment that entered streams of the Toutle River system, 36% was clay and silt, 58% was sand, and 6% was gravel. (Moore-SRC)
W82-06971

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DEVELOPING AN ATP INDEX FOR DEGRADATION OF DRINKING WATER QUALITY BY ATTACHED MICROBES,

Missouri Water Resources Research Center, Columbia.
For primary bibliographic entry see Field 5F.
W82-05932

EVALUATION OF BACTERIAL BINDING AND RELEASE OF CADMIUM FROM AQUATIC SEDIMENTS,

Ohio State Univ., Columbus. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-05934

IDENTIFICATION OF ATYPICAL COLIFORMS FROM PUBLIC WATER SUPPLIES IN MISSOURI,

Missouri Univ., Columbia. Dept. of Civil Engineering.
S. K. Banerji, and L. Laohaviranit.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243585, Price codes: A03 in paper copy, A01 in microfiche. Report, March 1982. 17 p, 5 Tab, 16 Ref, 1 Append. OWRT A-121-MO(1), 14-34-0001-0127.

Descriptors: *Coliforms, *Pseudomonas, *Bacterial analysis, Water pollution sources, *Drinking water, Bacteria, Water analysis, *Water treatment, Contamination, Pollutants, Water conveyance, Culture media, Culturing techniques, Water pollution, Water pollution control, Water pollution treatment, Water quality, *Missouri.

Membrane filter plates containing atypical coliform colonies in water samples were obtained from Columbia and seven other Missouri manicipalities. Of the 71 pink-to-red atypical coliform colinies isolated, 94% were gram- negative rods, with the remainder being gram-negative Coccobacilli. The rods were identified as: Pseudomonas (44.8%), Enterobacter (22.3%), Klebsiella (6%), Aeromonas (4.5%), Alcaligenes (4.5%), and Citrobacter (2.9%). Those colonies unidentified included: fermetative-oxidase-positive and -negative (6% each), and nofermentative-oxidase-positive and-hegative (1.5% each) bacteria. The gram-negative Coccobacilli were classifies as either Pasteurella, Haemophilis, of Actinobacillus, due to uncertainites in the assay method. Many of these atypical coliforms have the potential of being a human/animal pathogen. Futher sutdy is needed to assess the significance of the presence of these organisms on the health of the populations served by these water supplies. Research is also needed to assess, the survival characteristics of these organisms during various water treatment operations. (Zilelinski-MAXIMA)
W82-05935

A PRACTICAL AND RELIABLE METHOD FOR MONITORING THE TOXICITY OF AQUATIC SAMPLES,

Beckman Instruments, Inc., Carlsbad, CA.
A. A. Bulich.
Process Biochemistry, Vol 17, No 2, p 45-47, March/April, 1982. 6 Tab, 5 Ref.

Descriptors: *Bioassay, *Toxicity, *Industrial wastewater, Water pollution effects, Monitoring, Microtox, Fish, Daphnia, Bacteria, *Pollutant identification.

The toxicity of aquatic samples was monitored by a bioassay method (Microtox), based on changes in the light output of luminescent bacteria as measured with a photometer. A freeze dried preparation of Photobacterium phosphoreum was reconstituted, the sample was diluted to 5 concentrations from 5 to 50% and light measurements were made initially and 5 min later. LC50 was readily calculated from a formula. A total of 257 samples of wastewaters and effluents were tested. The Microtox test results agreed with in 1.5 orders of magnitude for 97.5% of fish toxicity vs. Microtox results and 96.1% of Daphniz toxicity vs. Microtox results. The Daphnia test was more sensitive that the Microtox bioassay. The Microtox system, which requires only 30 min, provides a rapid, low cost method of monitoring effluents, screening new chemical products, and determining the toxicity of fluids prior to disposal. (Cassar-FRC)
W82-05951

EVALUATION OF GENERAL AND SPECIFIC STRESS INDICES IN MUSSELS COLLECTED FROM POPULATIONS SUBJECTED TO DIFFERENT LEVELS OF HEAVY METAL POLLUTION,

Genoa Univ. (Italy). Fisiologia Generale.
For primary bibliographic entry see Field 5C.
W82-05983

APPLICATION OF X-RAY MICROANALYSIS FOR THE DETECTION OF HEAVY METAL IN GREAT LAKES ALGAE,

Canada Center for Inland Waters, Burlington (Ontario).
T. Bistricki, and M. Munawar.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 506-509, March, 1982. 4 Fig, 5 Ref.

Descriptors: *Metals, *Algae, *Electron microscopy, *Pollutant identification, *Heavy metals, Diatoms, Flagellates, Phytoplankton, Chlorophyta, *Great Lakes, Bioaccumulation, Accumulation, X-ray spectroscopy.

Heavy metals were determined in samples of phytoplankton by electron microscopy combined with an energy dispersive x-ray spectrometer and a computer-based processing system. Spectra of several species showed inherent structural components as well as elevated levels of some metals. Staurastrum paradoxum, a green alga, contained elevated levels of Mn, Cu, Fe, and Al. Cyclotella sp., a diatom, contained Cu even though the water was low in Cu (2 micrograms per liter). Rhodomonas minuta, a phytoflagellate, showed peaks of Pb, Fe, Cu, and Os. These findings confirm that certain nanoplankters can be used as indicators of heavy metal pollution. (Cassar-FRC)
W82-05993

APPLICATION OF NUCLEAR DOUBLE RESONANCE TECHNIQUE FOR DETECTION OF PESTICIDES IN WATER AT LOW CONCENTRATIONS,

Institut Jozef Stefan, Ljubljana (Yugoslavia).
R. Osredkar, and P. K. Kadaba.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 513-518, May, 1982. 4 Fig, 5 Ref.

Descriptors: *Pollutant identification, *Pesticides, *Nuclear magnetic resonance, *Wastewater analysis, Carbamate pesticides, Organic pesticides, Triazine pesticides, Industrial wastes, Pollutants, Separation techniques.

The nuclear double resonance (NDR) technique was applied to the detection of organochlorine and carbamate pesticides at low concentrations in water. The method utilizes the strong nuclear magnetic resonance signal of an abundant spin system to detect the weak nuclear resonance of the spin species. Bromoform is used as solvent for the extraction of chlorinated pesticides, and chloroform is used in the case of non-chlorinated carbamate pesticides. The minimum detectable concentrations of the test compounds cabanolate, barban, CIPC, atrazine, and simazine were 20, 20, 20, 100, and 100 ppb, respectively. The NDR method in its present form is less sensitive than the electron capture gas chromatography method, but requires less eleborate clean-up and separation procedures. NDR may be used to analyze organochlorine and triazine pesticides in wastewater provided the concentration of these contaminants is between 10 and 100 micrograms/liter. In its present form, the instrument is not recommended for routine analysis. Improvements in sensitivity may be realized by using a liquid nitrogen-cooled ferrite-cored electromagnet, increasing the polarizing field, and introducing a two-magnet system. (Geiger-FRC)
W82-06004

SIMPLE PROCEDURES FOR ENRICHMENT OF CHLORINATED AROMATIC POLLUTANTS FROM FAT, WATER AND MILK FOR SUBSEQUENT ANALYSIS BY HIGH-RESOLUTION METHODS,

Karolinska Inst. Stockholm (Sweden). Dept. of Physiological Chemistry.
B. Egestad, T. Curstedt, and J. Sjovall.
Analytical Letters, Vol 15, No 3, p 293-307, 1982. 5 Tab, 26 Ref.

Descriptors: *Pesticides, *Gel chromatography, Pollutant identification, DDT, *Chlorinated hydrocarbons, *Aromatic compounds, Water analysis, Insecticides, Sample preparation, Polychlorinated biphenyls.

Lipidex 1000 and 5000, lipophilic gels, were suitable for extraction and purification of nonpolar chlorinated aromatic pollutants (DDT, polychlorinated biphenyls, and tetrachlorodibenzodioxin) in water, milk, and butter. A 1-liter water sample containing 50,000 cpm DDT labeled with C14 was passed through a 2 ml gel bed (Lipidex 1000) at the rate of 50 ml per min. Recovery of DDT by elution with 10 ml methanol was 96.6%. (Cassar-FRC)
W82-06015

HEADSPACE CHROMATOGRAPHIC DETERMINATION OF WATER POLLUTANTS,

Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. Otson, and D. T. Williams.
Analytical Chemistry, Vol 54, No 6, p 942-946, May, 1982. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Water analysis, *Gas chromatography, Drinking water, Potable water, Organic compounds, Chemical analysis, Water quality, *Pollutant identification.

A modified purge and trap technique is presented for the evaluation of potentially hazardous volatile organics in Canadian potable water supplies. The method employs on-column trapping and simultaneous use of flame ionization and electrolytic conductivity detectors to develop a dynamic headspace gas chromatographic technique. Forty-two organics in water were evaluated, with detection limits of less than 1 microgram/liter. Linear plots of peak area against concentration were obtained in the range of 0.25-16 micrograms/liter for 32 compounds. At aqueous concentrations of 4 and 16 micrograms/liter, peak area precision of less than 10% relative standard deviation for triplicate sample analyses and purging efficiencies of greater than 75% were generally obtained. Storage of aqueous composite standard solutions at 4 and 16 micrograms/liter for 6 weeks at 4 degrees centigrade did not usually affect the analytical results by more than 15%. Poor precision of results was often due to inconsistent and inaccurate peak area integration, which generally occurred for small peaks or when peaks were closely clustered. These problems were primarily due to the fact that integration parameters were established at the start of the automated gas chromatographic analyses and could not be optimized for each sample and compound. (Baker-FRC)
W82-06016

THE PLANKTON OF THE RIVER VISTULA IN THE REGION OF WARSAW IN THE YEARS 1977-1979,

Research Inst. on the Environmental Development, Warsaw (Poland). Water Utilization Dept.
H. Klimowicz.
Acta Hydrobiologica, Vol 23, No 1, p 47-67, 1981. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Zooplankton, Water quality, Water pollution effects, *Vistula River, Warsaw, *Poland, Rivers, Plankton, Wastewater pollution, Saprophytic bacteria, Species composition, Bacteria.

An investigation of plankton in a 59 km reach of the River Vistula at Warsaw, Poland, indicated a saprobity index of 1.9 for phytoplankton and 2.1 for zooplankton and a water quality class of 2, requiring treatment before consumption. The sampling was done twice a month over two annual cycles, from February 1977 to April 1979. A total of 128 plant taxa and 152 animal taxa were identified. The most common were Rotatoria (72 species), Bacillariophyta (67), Ciliata (54), Euglenophyta, (15), and Cladocera (9). The composition and numbers of plankton depended on water fertility, season, and water temperature. The same plankton species dominated the community in the same seasons of both years. Species compositions were similar above and below sewage inflow points, probably because the Vistula is deep and wide. (Cassar-FRC)
W82-06021

CONTINUOUS MONITORING OF CYANIDE CONCENTRATION IN SURFACE WATER (KONTINUIERLICHE UBERWACHUNG DER CYANID-KONZENTRATION IN OBERFLACHENWASSER),

Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
F. Dietz, H. D. Frank, and G. Teske.
Wasser, Luft und Betrieb, Vol 26, No 1/2, p 17-21, 1982. 6 Fig, 2 Tab, 15 Ref. (No English summary).

Descriptors: *Cyanide, Surface water, *Monitoring, Pollutants, Rivers, Potassium compounds, Heavy metals, Cadmium, Copper, Zinc, On-site investigations, Laboratory equipment, Potentiostatic measurement, *Federal Republic of Germany, *Ruhr River, *Pollutant identification.

The potentiostatic method of Schwarz and Simon for the continuous monitoring of cyanide concentrations in water was tested in the laboratory for accuracy and, following successful results, in situ on the bank of the Ruhr River in the Federal Republic of Germany. With this method, the substance to be measured does not participate in the charge exchange on the measuring electrode but reacts with the metal ions of the electrode (in this case, cyanide reacts with silver). The apparatus used in the method is the DIGOX CN-2. Distilled water was used as a control. Ruhr water with an added concentration of 50 micrograms CN/liter was tested, and the DIGOX CN-2 registered 76% of potassium cyanide compared with control, all cyanide in copper, zinc, and cadmium complexes, but only 4-7% in nickel complexes; registering of cyanide-iron complexes was expectedly low. Results showed that the added cyanide ions were not taken up by heavy-metal solutions even after several days. In situ, the apparatus was set up in a guage station. The efficiency of the system was tested by dosing the analysis block with a solution of 50 micrograms CN/liter with a stabilized solution of 500 micrograms/liter potassium cyanide. The solution was practically unchanged after a week. The practicalities of setting up and maintaining the system are discussed. (Gish-FRC)
W82-06023

ON THE LIMITS OF DETECTION OF TRACES OF VOLATILE ORGANICS IN WATER, USING AMBERLITE XAD-2 RESIN,

La Trobe Univ., Bundoora (Australia). Dept. of Physical Chemistry.
R. Care, J. D. Morrison, and J. F. Smith.
Water Research, Vol 16, No 5, p 663-665, May, 1982. 2 Tab, 16 Ref.

Descriptors: *Ion exchange, *Organic compounds, *Detection limits, *Pollutant identification, Resins, Trace levels, Hydrocarbons, Water analysis, Amberlite XAD-2 resin.

XAD-2 resin proved unsuitable for detection of very low levels of organic compounds in water. In blank Experiments the well-cleaned resin continued to emit trace amounts (0.1-1 ppb) of toluene, styrene, benzene, undecane, and substituted benzenes when extracted with diethyl ether. The source of the hydrocarbons may be breakdown of the resin or residues from breakdown under the Soxhlet cleaning procedure. (Cassar-FRC)
W82-06028

THE MOLECULAR MASS DISTRIBUTION OF ORGANIC COMPOUNDS IN ACTIVATED SLUDGE PLANT EFFLUENT DETERMINED BY MEANS OF GEL PERMEATION CHROMATOGRAPHY,

National Inst. for Water Research, Pretoria (South Africa).
R. A. van Steenderen, and A. Malherbe.
Water Research, Vol 16, No 5, p 745-748, May, 1982. 3 Fig, 16 Ref.

Descriptors: *Wastewater analysis, *Organic compounds, *Pollutant identification, Gel permeation chromatography, Activated sludge process, Organic carbon.

Determination of molecular mass distribution of dissolved organic carbon in wastewater effluent by gel permeation chromatography produced serious errors. About 57% of the dissolved organic carbons were in the undefined region spread over 90 fractions, many of which contained sub-milligram quantities of organic carbon. The largest error was produced by background interference from the gel column. (Cassar-FRC)
W82-06030

A BIOASSAY TECHNIQUE USING TETRAHYMENA PYRIFORMIS FOR THE RAPID ASSESSMENT OF TOXICANTS IN WATER,

National Inst. for Water Research, Pretoria (South Africa).
J. L. Slabbert, and W. S. G. Morgan.
Water Research, Vol 16, No 5, p 517-523, 1982. 6 Fig, 2 Tab, 34 Ref.

Descriptors: *Bioassay, *Oxygen uptake, *Toxicity, *Pollutant identification, Water pollution effects, Tetrahymena pyriformis, Protozoa, Water analysis, Industrial wastewater, Ammonium, Cadmium, Copper, Cyanide, Lead, Mercury, Parathion, Pentachlorophenol, Phenol, Zinc.

The respiratory response of the protozoan, Tetrahymena pyriformis, was used in a bioassay procedure to detect toxic substances. The simple technique produced results within 10 min. Oxygen uptake rates of the organisms in test solutions were compared with that of the control, 7.2% per min. Minimum concentrations in mg per liter of the toxic substances detectable by this method were: ammonium-N, 270-275; cadmium, 0.1-0.5; copper, 0.1-0.5; cyanide, 0.013-0.014; lead, 0.001-0.01; mercury, 0.1-0.5; parathion, 0.01-0.05; pentachlorophenol,0.005-0.01; phenol, 85-90; and zinc, 0.1-0.5. Although this method is not sensitive enough to detect most substances at the levels used in drinking water standards, it is suitable for monitoring industrial effluents. (Cassar-FRC)
W82-06032

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS--III. PHENOLS AND AROMATIC ACIDS IN POLLUTED AND UNPOLLUTED WATERS,

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
G. Matsumoto.
Water Research, Vol 16, No 5, p 551-557, May 1982. 2 Fig, 2 Tab, 33 Ref.

Descriptors: *Organic compounds, *Phenols, *Aromatic compounds, *Pollutant identification, Water pollution sources, *Fate of pollutants, *Tokyo, Japan, Organic acids, Phenolic acids.

Samples of polluted river waters in the Tokyo area and unpolluted river, brook, reservoir, and pond waters from the Ogasawara (Bonin) Islands were analyzed for phenols and aromatic acids. The phenolic acids (p-hydroxybenzoic, vanillic, syringic, p-coumaric, and ferulic acids) and o- and m-hydroxybenzoic acids were found at concentrations of < 1 micrograms per liter in both polluted and unpolluted waters. The major sources of the phenolic acids were vascular plants and their detritus. Pentachlorophenol, Bisphenol A, and terephthalic and trimesic acids, found in polluted waters but not in unpolluted waters, were attributed to human activity (pesticides, industrial wastes). The ratios of p-coumaric and ferulic acids exressed as carbon/total organic carbon and the ratios of these acids expressed as carbon/extractable organic carbon with ethyl acetate suggest that the contributions of vascular plants to polluted and unpolluted waters are not nearly equal. Ratios of syringic acid (not found in most gymnosperms) to vanillic acid were higher in polluted waters, indicating a smaller contribution of angiosperms relative to gymnosperms in polluted waters than in unpolluted waters. (Cassar-FRC)
W82-06033

INFLUENCE OF TEMPERATURE AND TIME OF INCUBATION ON THE ESTIMATION OF BACTERIAL NUMBERS IN TROPICAL SURFACE WATERS,

Singapore Univ. Dept. of Microbiology.
W. C. Jen, and R. G. Bell.
Water Research, Vol 16, No 5, p 601-604, May, 1982. 2 Fig, 13 Ref.

Descriptors: *Bacterial analysis, *Incubation, *Temperature effects, *Pollutant identification, Tropical regions, Water analysis, Heterotrophic bacteria, Singapore.

An incubation regime of 30 C for 72 hours was recommended as a standard procedure for Aerobic Plate Counts of bacteria in warm tropical surface waters. This conclusion was reached after statistical analysis of results from incubation experiments

on water samples collected from a flowing storm drain in Singapore, April-September 1980. Samples were incubated at 20, 25, 20, 35, and 40 C for periods of 24, 48, 72, 96 and 120 hours. Using a reference point of 20 C and 120 hours incubation, the 30 C regime had 120% of the cumulative plate counts, 25 and 35 C had about 95%, and 40 C had about 50%. All temperature curves leveled off at or before 72 hours. The results are consistent with the knowledge that bacteria in the tropics are well adapted to growing at 18-30 C. (Cassar-FRC)
W82-06037

DETERMINATION OF PHOSPHATE IN WASTEWATER BY ION-EXCLUSION CHROMATOGRAPHY WITH FLOW COULOMETRIC DETECTION,

Government Industrial Research Inst., Nagoya (Japan).
K. Tanaka, and T. Ishizuka.
Water Research, Vol 16, No 5, p 719-723, May, 1982. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Phosphates, *Wastewater analysis, *Chromatography, Ion exchange, Ion exclusion chromatography, *Pollutant identification, Resins, Industrial wastewater.

Phosphates were determined in wastewater samples by ion exclusion chromatography on a cation exchange resin in H+ form by elution with acetone-water. A flow coulometric detector was more effective than a conductometric detector. The chemical reaction of H+ ion formed from H3PO4 and p-benzoquinone was monitored at a constant applied potential (+0.45V vs. Ag-AgI). Reasonable separation of phosphate from coexisting strong acid ions (chloride, sulfate, and nitrate) and carbonate was attained by elution with 60% (v/v) acetone-water. The calibration graph with the flow coulometric detector was linear over the concentration range 1-150 ppm. Results of analysis of influents and effluents from domestic and industrial wastewater samples by the present method and by the molybdenum blue method showed excellent agreement. (Cassar-FRC)
W82-06040

SCANNING ELECTRON MICROSCOPE EVALUATION OF ROTATING BIOLOGICAL CONTACTOR BIOFILM,

Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06047

A RAPID METHOD FOR DETERMINING THE TOXICITY OF CHEMICALS TO ACTIVATED SLUDGE,

Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
For primary bibliographic entry see Field 5D.
W82-06048

WEAK ACID CONCENTRATIONS AND RIVER CHEMISTRY IN THE TOVDAL RIVER, SOUTHERN NORWAY,

Central Electricity Research Labs., Leatherhead (England).
For primary bibliographic entry see Field 2K.
W82-06052

POLYCHLORINATED BIPHENYL AND ORGANOCHLORINE INSECTICIDE CONCENTRATIONS IN FORTY SEWAGE SLUDGES IN ENGLAND,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. E. McIntyre, and J. N. Lester.
Environmental Pollution, Series B, Vol 3, No 3, p 225-230, 1982. 1 Fig, 1 Tab, 23 Ref.

Descriptors: *Organic compounds, *Sludge, Pollutant identification, Water pollution sources, Industrial wastes, Pesticides, *Insecticides, *Organochlorines, *Polychlorinated biphenyls, England, *Path of pollutants.

A study was undertaken to assess the magnitude and range of polychlorinated biphenyl (PCB) and organochlorine insecticide (OCL) concentration in a representative sample of British sewage sludges and to consider the possible implications of the results of sewage sludge disposal options. Grab samples of sludges from primary, mixed primary, and digested treatment stages were collected from forty sewage treatment works in England, covering seven Water Authority areas. The method of analysis involved solvent extraction with hexane, cleanup by alumina/alumina-silver nitrate column chromatography, fractionation of PCB and OCL on a silica gel column, and analysis by electron capture gas-liquid chromatography. PCB concentrations appear to have diminished in England since 1970. Concentrations of lindane, DDE and dieldrin were found to be in the low microgram/gram range or less. Possible sources of these micropollutants in sewage and sludges are discussed. Dieldrin has been used both in industry as a mothproofing compound for woollen products and in agriculture as a pesticide, but its use has recently been restricted. Lindane is used in industry and in the home for wood preserving in insecticidal formulations in addition to its agricultural use. (Baker-FRC)
W82-06081

DETERMINATION OF SULPHUR IN SNOW BY PROTON INDUCED X-RAY EMISSIONS (PIXE) METHOD,

Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
S. Landsberger, R. E. Jervis, R. Lecomte, P. Paradis, and S. Monaro.
Environmental Pollution, Series B, Vol 3, No 3, p 215-223, 1982. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Sulfur, *Snow, *Pollutant identification, Monitoring, *X-ray emission, Chemical analysis, Montreal, Canada, Path of pollutants.

This paper reports the use of PIXE techniques in the quantitative determination of the total sulfur concentration in snow from the highly industrialized city of Montreal. Proton induced X-ray emission (PIXE) employs a proton beam of 1.6 MeV to bombard the targets. A simple pre-concentration technique enabled the method to achieve detection limits as low as 19 ng/g for total sulfur concentration in snow. An overall precision of 10% was achieved. Snow samples were gathered over a 24-hr period at four different locations around the perimeter of the island of Montreal. The latter part of February 1979 was chosen as the time to obtain the maximum amount of undisturbed snow in a single season. The northwest site, which is generally perceived as a less polluted area, had a sulfur concentration less than three times lower than the southeast site. The southeast site had shown one of the highest detectable amounts of sulfur dioxide in an earlier study. The PIXE method is recommended as a convenient, non-destructive technique for rain, lake or river water analyses. (Baker-FRC)
W82-06082

WASTE WATER RECYCLING BY ION EXCHANGE: II. PARTIAL DESALINATION,

Ben-Gurion Univ. of the Negev, Geersheba (Israel).
Y. Egozy, E. Korngold, N. C. Daltrophe, and M. Rebhun.
Desalination, Vol 33, No 3, p 333-346, June, 1980. 4 Tab, 5 Fig, 14 Ref.

Descriptors: Wastewater, *Recycling, *Ion exchange, Cost analysis, Desalination, Municipal effluent, Water reuse, Wastewater treatment.

Recycling of waste water by ion exchange was studied on a bench scale. Secondary municipal effluent, which had undergone lime flocculation, served as a feed for the ion-exchange system. Partial desalinatin was achieved by allowing part of the feed to bypass the strong acid cation exchanger. The salt concentration was decreased from 15meq/1 (750 ppm as CaC03) to 7-10 meq/1 (350-500 ppm as CaCO3) and the organic matter, from 70-100 mg /1 COD (Chemical oxygen demand) to about 25 mg/1. The leakage of organic matter in the partial desalination mode was somewhat higher than that found in complete desalination. The resins were found to be highly resistant to an attack of organic matter over a period of one year. Three possible resin arrangements were investigated, and a cost analysis for one of them is presented. Since inexpensive chemicals, such as H2SO4 and Ca(OH)2, can be used for regeneration the system provides an economical method for recycling waste water for industry and agriculture. (Balaban-Boston)
W82-06117

DIATOM ASSEMBLAGES AS INDICATORS OF WATER QUALITY IN FRESHWATER HABITATS OF GUAM,

Guam Univ., Agana. Water and Energy Research Inst.
W. J. Zolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243619, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 29, September 1981. 47 p, 8 Fig, 8 Tab, 49 Ref, 1 Append. OWRT A-012-GUAM(1), 14-34-0001-9012.

Descriptors: *Diatoms, *Water analysis, *Bioindicators, *Microscopic analysis, Water sampling, Nitzschia, Gomphonema, Water quality, Impaired water quality, Aquatic life, Aquatic populations, Urban runoff, *Indicators, Nutrient requirements, Nutrients, Nitrates, Phosphates, *Guam, Periphyton, *Pollutant identification.

Periphytic diatoms were collected on immersed glass slides in five bodies of polluted/unpolluted freshwater for 10-14 days, concomitant to the collection of water samples on three separate days. The water samples were analyzed for 22 water quality parameters. Natural surfaces (plants, rocks, sediments) were also sampled for comparison of inhabitant diatom assemblages with the glass slide collections. Data from counting at least 750 diatom frustules on randomly-selected slide areas were used to calculate species diversity indices, a sample similarity index, and to determine whether diatom assemblages occur according to water quality or habitat type. Bodies of water from urban runoff had diatoms dominated by Nitzschia palea and low species diversity, particularly where nutrient (nitrate and phosphate) enrichment occurred. Gomphonema parvulum diatoms dominated ponded habitats where mineral nutrients were excessively low (below 0.020 mg/liter). High sample similarity between river stations over time indicated that district diatom assemblages exist accordig to water quality and habitat type. It was also noted that less diatom species numbers (over 33%) and species diversity occurred on the slides than on the natural substrata samples. (Zielinski-MAXIMA)
W82-06146

TRIHALOMETHANE FORMATION IN WATER TREATMENT PLANTS IN NORTH CAROLINA,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5F.
W82-06158

APPLICATION OF A NEW METHOD FOR QUANTITATIVE EVALUATION OF STREAM BENTHIC ALGAL POPULATIONS,

Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 5C.
W82-06168

RADIONUCLIDES IN DARDANELLE LAKE IN THE AREA OF THE NUCLEAR I FACILITY: 1979-1981,

Arkansas Univ., Fayetteville. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W82-06169

ORGANIC CONSTITUENTS OF MUTAGENIC SECONDARY EFFLUENTS FROM WASTEWATER TREATMENT PLANTS,

Illinois University at Urbana-Champaign. Inst. for Environmental Studies.
For primary bibliographic entry see Field 5D.
W82-06178

LIQUID-LIQUID EXTRACTION COMBINED WITH ATOMIC-ABSORTPION SPECTROMETRY FOR DETERMINATION OF COPPER IN WATERS, FOODS AND ANALYTICAL REAGENTS USING 1,2-NAPHTHOQUINONE THIOSEMICARBAZONE,

Cordoba Univ. (Spain). Dept. of Analytical Chemistry.
M. Silva, and M. Valcarcel.
Analyst, Vol 107, No 1274, p 511-518, May, 1982. 2 Fig, 5 Tab, 37 Ref.

Descriptors: *Copper, *Water analysis, *Pollutant identification, *Atomic absorption spectrometry, Heavy metals, Trace metals, Analytical techniques.

This paper describes a sensitive method for the determination of trace amounts of copper by atomic absorption spectrometry after extraction using 1,2-naphthoquinone (NQT) and isobutyl methyl ketone (IBMK). The NQT complex is stable in IBMK medium. The method has been successfully applied to the determination of copper in water, food and analytical reagents. By this method copper concentrations in the nanogram per milliliter range can be determined. It is possible to extract the complex over a wide range of acidities, and the complex is very stable in IBMK solution. In most instances the method offers a greater sensitivity for the determination of copper. The coefficient of variation is generally smaller than that found in other determinations. By the NQT method, higher ratios of foreign ions can be tolerated than is the case when other reagents are used. By extraction into IBMK the formation of toxic products in the flame is avoided. (Baker-FRC)
W82-06179

DETERMINATION OF SULPHIDE IN INDUSTRIAL WASTE WATERS AND SEWAGE WATERS WITH AN IODIDE-SELECTIVE ELECTRODE,

Sofia Univ. (Bulgaria). Faculty of Chemistry.
M. Novkirishka, G. Michailov, and R. Christova.
Fresenius' Zeitschrift fuer Analytische Chemie, Vol 305. No 1, p 411-412, March, 1981. 1 Tab, 2 Ref.

Descriptors: *Sulfides, *Pollutant identification, *Industrial wastes, Sewage, Chemical analysis, Water analysis, Iodometry, Potentiometers, Photometry, *Leather industry.

The sulfide content in leather industry waste waters and in sewage waters was determined in order to apply an indirect potentiometric method for the determination of sulfide by means of an iodide ion-selective electrode. The results obtained were compared with those obtained by means of standard methods such as photometry with dimethyl-n-phenylenediamine and iodometry. The reproducibility of the potentiometric method was similar to that of the photometric one. The standard deviation of both methods is of the same order of magnitude. The photometric method could not be applied to the determination of sulfides in sewage water, as their concentration is close to the detection limit. The iodometric method could not be used for these samples, as its sensitivity is quite poor and it has a high blank. The potentiometric method with the iodide ion-selective electrode was very fast, about 30 minutes per analysis, sensitive at 0.02 mg/liter, and reproducible. The method applied, using sulfide separation from the interferences, can be used for the determination of sulfides in samples with various and complex composition. (Baker-FRC)
W82-06192

CRITERIA FOR THE USE OF REGRESSION ANALYSIS FOR REMOTE SENSING OF SEDIMENT AND POLLUTANTS,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 7C.
W82-06233

THE BENEFITS OF PRE-OPERATIONAL BASELINE AQUATIC BIOLOGY STUDIES,

CH2M/Hill, Atlanta, GA.
J. C. Nemeth, and T. H. Eck.
Tappi, Vol 65, No 5, p 171-175, May, 1982. 2 Fig, 8 Ref.

Descriptors: *Baseline studies, *Environmental effects, Case studies, *Bioindicators, *Pulp wastes, Data collections, Benthos, Water pollution effects, Pulp and paper industry, Industrial wastes, Physical properties, Water properties, Chemical properties, Water quality, *Georgia, Oconee River.

Site-specific baseline biological studies in receiving waters of pulp and paper mill effluents provide the basis for logical, non-inferential comparison of before-and after conditions. They also allow more efficient environmental impact studies for obtaining permit renewal and /or facility-expansion permits. A pre-operational aquatic biology study should include seasonal records on biotic factors, especially indicator organisms such as benthic macroinvertebrates, periphyton, and fish, and physical factors such as dissolved oxygen, air and water temperature, conductivity, pH, discharge rate and stage elevation and tape-down. The study plan for baseline data collections on the Oconee River near Dublin, Georgia, at a site which would receive discharge from a newly planned paper mill is described. In this case study, the information gained was adequate to characterize the existing quality of the water at a relatively low cost. (Geiger-FRC)
W82-06235

MULTISTEP APPROACH TO IDENTIFICATION OF LIMITING NUTRIENTS IN NORTHERN ADRIATIC EUTROPHIED COASTAL WATERS,

Istituto di Ricerca sulle Acque, Milan (Italy).
For primary bibliographic entry see Field 5C.
W82-06267

ON THE PRESENCE OF IRON(II) IN OXYGENATED SURFACE WATERS: ANALYTICAL IMPLICATIONS,

Northern Michign Univ., Marquette. Dept. of Chemistry.
D. L. Macalady, C. P. Granlund, J. G. Granlund, and S. L. Vervacke.
Water Research, Vol 16, No 7, p 1277-1283, July, 1982. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Iron, *Water analysis, Surface waters, Lakes, Rivers, Chemical analysis, Colorimetry, Measuring instruments, Pollutant identification.

Iron(II) analyses were conducted on oxygenated surface waters using bathophenanthroline. In the presence of dissolved, colloidal or complexed iron(III), the BPN method for iron(II) analysis employing pH values lower than 6.5 at extraction will unavoidably overestimate the concentration of iron(II) by a small but significant amount. The interference will increase dramatically as the pH at extraction is lowered. This potential for error must be added to results reported previously which were ascribed to the reduction of iron(III) under the influence of sunlight, acid and/or dissolved organic matter. A plausible explanation for this additional interference is the formation in the presence of FeOH(2+) of a complex which is spectroscopically similar to the BPN-iron(II) complex. The variable magnitude of this interference can therefore be ascribed to the presence of variable amounts of ferrous hydroxide in natural waters. This depends on the pH, the levels of colloidal iron(III) and organically complexed iron(III), and the analytical conditions used. These findings cast serious doubt on earlier claims made in the literature that measurable levels of ferrous iron and higher levels of acid digestible ferrous iron exist in the oxygenated surface waters of lakes. Several interferences from ferrous hydroxide in colorimetric analyses for iron(II) might also be expected using other complexing agents. (Baker-FRC)
W82-06271

A METHOD FOR MONITORING MINERALIZATION OF 14C-LABELED COMPOUNDS IN AQUEOUS SAMPLES,

Alberta Univ., Edmonton. Dept. of Microbiology.
P. M. Fedorak, J. M. Foght, and D. W. S. Westlake.
Water Research, Vol 16, No 7, p 1285-1290, July, 1982. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Mineralization, *Microorganisms, Lakes, Rivers, Surface water, *Monitoring, Fate of pollutants, Organic compounds, Biodegradation, Wastewater, *Pollutant identification.

A method is described for monitoring the mineralization of compounds in aqueous samples. In this method aliquots of both headspace gas and culture liquid were removed for analysis at various times. A single culture flask whose headspace gas was flushed periodically could not be used, since any carbon dioxide present is partitioned between the gas and liquid phases. The culture flask used contains 200 ml of sample with labeled substrate, and one control-replacement flask is readied with 200 ml of sterile sample with labeled substrate. At each sampling time, 1/40th of the liquid and headspace gas was removed from the culture flask for 14-CO2 recovery. This method was used to study mineralization of amino acids, starch, n-hexadecane and anthracene by microorganisms in river water, and of n-hexadecane and n-hexadecanoic acid by microorganisms in sewage effluent. To obtain a reasonable evaluation of the mineralization ability of an aquatic environment, representative samples must be subjected to the chosen analytical procedure, and the larger the sample volume, the more reliable the evaluation will be. The need for a larger sample volume is particularly important when dealing with unpolluted aquatic environments which have low densities of heterotrophic bacteria. (Baker-FRC)
W82-06272

THE EFFECT OF METAL IONS ON THE ULTRAVIOLET SPECTRA OF HUMIC ACID, TANNIC ACID AND LIGNOSULFONIC ACID,

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2K.
W82-06273

DETERMINATION OF ORGANOCHLORINES IN RIVER SEDIMENT BY CAPILLARY GAS CHROMATOGRAPHY, APPLICATION TO DUTCH RIVER SEDIMENT,

Rijksinstituut voor de Volksgezondheid, Bilthoven (Netherlands).
R. C. C. Wegman, and A. W. M. Hofstee.
Water Research, Vol 16, No 7, p 1265-1272, July, 1982. 6 Fig, 5 Tab, 11 Ref.

Descriptors: *Water analysis, *Gas chromatography, Sediments, *Organochlorines, Rivers, *Netherlands, Organic compounds, Chemical analysis, *Pollutant identification, Monitoring.

Studies were conducted to develop a reliable method for the determination of a great number of organochlorines, including analyses in the presence of interfering PCBs and other co-extractives in river and harbor basin sediment. As an example of the practical application of this method, the results of a monitoring program in river and harbor basin sediment in the Netherlands are given. The sediment sample was shaken twice with acetone, followed by water partitioning. The decanted water-acetone phase was extracted twice with petroleum ether. Recoveries with this method were carried out for clay soil, peat soil and river sediment. Mean recoveries and SD of 15 organochlorines were determined. The recoveries for compounds C-601 and C-773, by-products of the aldrin and dieldrin synthesis, were only determined in river sediment 7 days after spiking and were 90% for both compounds. In the period 1979-1980 water samples from Boven Merwede and Lake Ketelmeer were

analyzed for 17 different organochlorines. Only HCB, alpha-HCH and gamma-HCH were found. The mean concentrations for the three were 0.09, 0.02 and 0.06 micrograms/liter in both water bodies. (Baker-FRC)
W82-06274

NONSTANDARD METHODS FOR ENUMERATING BACTERIA IN DRINKING WATER,

Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
For primary bibliographic entry see Field 5F.
W82-06278

ANALYTICAL NOTE: EVALUATION OF THE M-SPC METHOD AS A SUBSTITUTE FOR THE STANDARD PLATE COUNT IN WATER MICROBIOLOGY,

Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5F.
W82-06280

GROUND WATER QUALITY AND QUANTITY IN FRACTURE ZONES IN THE PIEDMONT OF NORTHWESTERN SOUTH CAROLINA,

Clemson Univ., SC. Dept. of Chemistry and Geology.
For primary bibliographic entry see Field 4B.
W82-06309

AN AUTOMATED PROCEDURE FOR THE DETERMINATION OF TOTAL KJELDAHL NITROGEN,

Foras Forbartha, Dublin (Ireland).
L. J. Lennox, and M. J. Flanagan.
Water Research, Vol 16, No 7, p 1127-1133, July, 1982. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Nitrogen, *Water analysis, Measuring instruments, Organic compounds, Industrial waste, Natural waters, *Kjeldahl procedure, *Pollutant identification.

A method of analyzing large numbers of samples accurately with the minimum amount of inconvenience is presented for determining total Kjeldahl nitrogen in surface fresh waters and organic wastes. The method calls for the conversion of organic nitrogen compounds to ammonium sulfate by a catalytic (red mercuric oxide) acid-sulfate digestion. The digestion time is 3 hr and allows a maximum of 36 samples, 2 blanks, and 2 standards to be processed simultaneously. No pH adjustment is required after the digestion. Calibration curves covering the ranges of 0.5 - 100 micrograms ammonium-nitrogen/liter and 10-1000 micrograms ammonium-nitrogen/liter were linear within 2%. The detection limit of the method was 0.5 micrograms total Kjeldahl nitrogen/liter. The concentration range of TKN for which the method is usable is 0.5 micrograms nitrogen/liter to 30 mg nitrogen/liter. The method displays a high tolerance to interferences from copper, iron, mercury and hardness. The digestion procedure gave a high recovery and reproducibility over a wide range of nitrogen compounds tested. The digestion procedure requires no supervision while in progress, and the colorimetric step for the determination of ammonia using a continuous flow method proceeds at a rate of 60 samples per hour. (Baker-FRC)
W82-06314

MONITORING OF SELECTED TRACE ORGANICS DURING BIOLOGICAL WASTEWATER TREATMENT,

Canviro Consultants Limited, Kitchener (Ontario).
For primary bibliographic entry see Field 5D.
W82-06392

ANALYSIS OF GEOTHERMAL WATERS BY SPARK SOURCE MASS SPECTROMETRY,

Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
R. Vandelannoote, W. Blommaert, R. Gijbels, and R. Van Grieken.
Fresenius Zeitschrift fur Analytische Chemie, Vol 309, No 4, p 291-294, 1981. 2 Tab, 18 Ref.

Descriptors: *Pollutant identification, *Mass spectroscopy, *Trace elements, *Thermal water, Water analysis, Geothermal resources, Trace metals, Heavy metals, Thermal springs, Neutron activation analysis.

The analysis of trace elements in geothermal waters by the time consuming but sensitive method of spark-source mass spectrometry (SSMS) is described. To collect elements having quite different chemical properties such as alkalies, transition elements, and elements occurring in anionic form, a physical preconcentration step is recommended. Chemical preconcentration is carried out by cocrystallization on 1-(2-pyridylazo)-2-naphthol or chelation by 8-hydroxyquinoline followed by adsorption onto activated carbon. The relative sensitivity factors appear to be independent of the salt content of the graphite electrodes, but the precision of SSMS is slightly poorer than that obtained for neutron activation. However, SSMS has a more uniform elemental sensitivity and allows for the determination of elements for which neutron activation is not suitable, such as lead and tin. (Geiger-FRC)
W82-06464

DETERMINATION OF METHOMYL AND METHOMYL-OXIME IN FRUIT CROPS AND WATER BY HPLC,

Tieraerztlichen Hochschule, Hanover (Germany, F.R.). Chemical Inst.
M. A. Alawi, and H. A. Russel.
Fresenius Zeitschrift fuer Analytische Chemie, Vol 309, No 1, p 8-12. 1981. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Pollutant identification, *Insecticides, *High performance liquid chromatography, *Methomyl, Separation techniques, Water analysis, Carbamate pesticides, Pesticides, Pesticide residues, *Chromatography, Fruit crops.

A simple and specific quantitative high performance liquid chromatography (HPLC) technique for determining methomyl residues in water and fruit samples is described. Extraction is done with ethyl acetate, and HPLC separation is carried out on a reversed phase column with ultraviolet (UV) detection. The method allows simultaneous detction of methomyl and its degradation product, methomyl-oxime. Using a combined detection system of UV- and electrochemical detectors in series, methomyl could be determined at the 1 nanogram/milliliter level and methomyl-oxime at the 100 picogram/milliliter level in water. The recovery rate in the range of 0.01-1 micrograms/gram was 101.4 plus or minus 6% in fruit crops (apples) and 93.7 plus or minus 4% in water. (Geiger-FRC)
W82-06466

NEW HIGH-PERFORMANCE ANALYTICAL PROCEDURE FOR THE VOLTAMMETRIC DETERMINATION OF NICKEL IN ROUTINE ANALYSIS OF WATER, BIOLOGICAL MATERIALS AND FOOD,

Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Dept of Chemistry.
B. Pihlar, P. Valenta, and H. W. Nurnberg.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 307, No 5, p 337-346, 1981. 8 Fig, 4 Tab, 35 Ref.

Descriptors: *Nickel, Water analysis, *Metals, *Heavy metals, *Pollutant identification, *Voltammetry.

Trace levels of nickel were determined in water, wastewater, and other materials by voltammetry. DC or differential pulse voltammetry was applied after prior interfacial accumulation by an adsorption layer of dimethygloyoximate at the hanging mercury drop electrode. In aqueous media as little as 1 ng per lier of Ni may be detected with good precision and accuracy. The pretreatment for natural water involved filtration of particulate matter; ultraviolet irradiation to release heavy metals bound to organic matter; determination of Cu, Pb, Cd, and Zn in acid solutions; determination of Ni and Co after neutrelization with 0.5 ml of 4M ammonia-ammonium chloride buffer, and addition of 20 microliters of 0.1 M dimethylglyoxime to a 20 ml sample. Nickel levels (in micrograms per kg) in some aqueous samples were 0.187 in a tap water; municipal wastewater, 1.49; municipal wastewater effluent, 3.96; and rain water at Dortmund, Germany, 4.73. (Cassar-FRC)
W82-06467

A RAPID HIGH-PERFORMANCE LIQUID-CHROMATOGRAPHIC METHOD FOR SIMULTANEOUSLY DETERMINING THE CONCENTRATIONS OF TFM AND BAYER 73 IN WATER DURING LAMPRICIDE TREATMENTS,

Fish and Wildlife Service, La Crosse, WI.
V. K. Dawson.
Canada Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 778-782, May, 1982. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Chromatography, *Lampricides, High performance liquid chromatography, Water analysis, Pesticides, Lamprey, Spectrophotometry, Pesticides, *TFM, *Bayer 73.

A high-performance liquid-chromatography (HPLC) method was developed for detecting as little as 0.005 milligram/liter of 3-trifluoromethyl-4-nitrophenol (TFM) and Bayer 73 lampricides simultaneously in water. The procedure requires only minutes per sample and is specific. A combined buffer and internal standard reagent is added to the water sample, which is then injected through a Sep Pak C18 disposable cartridge. The cartridge adsorbs and retains both the lampricides and the internal standard. Elution with methanol provides cleanup and concentration of the sample before HPLC analysis on an MCH 10 reverse phase column. A methanol:acetate buffer acts as the mobile phase at 2 milliliter/min and detection occurs by ultraviolet spectrophotometry at 330 (or 254) nanometers. A microprocessor data system quantifies off-scale peaks and gives results directly in milligram/liter. (Geiger-FRC)
W82-06495

EVALUATION OF COLIPHAGE DETECTION AS A RAPID INDICATOR OF WATER QUALITY,

Atlantic Research Corp., Alexandria, VA.
R. S. Wentsel, P. E. O'Neill, and J. F. Kitchens.
Applied And Environmental Microbiology, Vol 43, No 2, p 430-434, February, 1982. 3 Fig, 4 Tab, 6 Ref.

Descriptors: *Bioindicators, Water quality, *Coliforms, Bacteriophage, *Coliphage, Bacterial analysis, Microbiological studies, *Pollutant identification.

Thirteen water quality laboratories throughout the United States participated in a program to evaluate the effectiveness of ARCAT (a rapid coliphage analysis technique) in enumerating coliphages in natural waters and to verify correlations between coliforms and coliphages in these water systems. Water samples were analyzed for fecal and total coliforms and for coliphages detected by the broadrange Escherichia coli C host. The data were analyzed statistically to determine whether a relationship existed between fecal or total coliforms and coliphages. A linear relationship was found to exist between coliphages detected with the E. coli C host and fecal or total coliforms. These correlations were highly significant. These study results demonstrate that the ARCAT procedure provides a rapid, inexpensive means for enumerating coliphages in waters containing at least six coliphages per 100 milliliters within 6 hours. The coliphage levels can then be related to coliforms to give a quick indication of the number of coliform bacteria in potentially contaminated waters. The sensitivity of the test must be improved before it can be used for potable water systems. (Carroll-FRC)
W82-06537

DETERMINATION OF THE NUMBER OF RESPIRING THIOBACILLUS FERROOXIDANS CELLS IN WATER SAMPLES BY USING COMBINED FLUORESCENT ANTIBODY-2-(P-IO-

DOPHENYL)-3-(P-NITROPHENYL)-5-PHENYLTETRAZOLIUM CHLORIDE STAINING,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. H. Baker, and A. L. Mills.
Applied and Environmental Microbiology, Vol 43, No 2, p 338-344, February, 1982. 2 Fig, 2 Tab, 40 Ref.

Descriptors: *Population density, *Bacteria, *Microbiological studies, *Fluorescence, Respiration, Chloride, Phenols, *Bacterial analysis, Natural waters, *Standing crops, *Pollutant identification.

Direct counting of microbial cells stained with fluorescent dyes is a commonly used method for determining the total standing crop of microorganisms in natural habitats, but it cannot differentiate specific types of bacteria nor distinguish between live and dead cells. The reduction of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyltetrazolium chloride (INT) to extractable formazan has been shown to be correlated with oxygen uptake and respiratory activity. A simple method has been developed for combining fluorescent antibody staining and INT reduction to determine the numbers of viable Thiobacillus ferrooxidans cells in aquatic habitats. The procedure, called FAINT, provides a rapid, accurate measure of species-specific numbers of active cells and is more sensitive than conventional cultural techniques by at least one order of magnitude. The technique was used to investigate the distribution of T. ferrooxidans in both acidic and nonacidic sites. Comparisons among the FAINT technique and fluorescent antibody staining alone or most-probable-number determinations in 9K broth showed that the use of most-probable-number techniques resulted in an underestimation of the number of viable cells by one to three orders of magnitude, while the fluorescent antibody counts resulted in overestimation of the number of viable cells. The amount of difference varied with the sample site. (Carroll-FRC)
W82-06542

FRACTIONATION OF METAL FORMS IN NATURAL WATERS BY SIZE EXCLUSION CHROMATOGRAPHY WITH INDUCTIVELY COUPLED ARGON PLASMA DETECTION,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
W. S. Gardner, P. F. Landrum, and D. A. Yates.
Analytical Chemistry, Vol 54, No 7, p 1196-1198, June, 1982. 2 Fig, 16 Ref.

Descriptors: *Metals, *Magnesium, *Calcium, *Pollutant identification, Water analysis, *Chromatography, Trace metals, Chelation, Chemical analysis, Separation techniques.

Distilled water size exclusion chromatography with inductively coupled argon plasma detection was used to fractionate and measure forms of dissolved metals in natural water filtrates. Chromatograms for Ca and Mg showed three peaks each, suggesting the existence of three forms of each metal (possibly two associated with dissolved organic matter and the third with metal carbonates) in the samples of Grand River and Lake Michigan waters. The separation mechanisms involve both molecular size and component polarity. For example, hydration enlarges molecular size. The type and size of the complexing anions also influence the fractionation behavior. (Cassar-FRC)
W82-06545

AMES SALMONELLA MUTAGENICITY ASSAYS ON WATER: DICHLOROMETHANE EXTRACTS VERSUS PREPARATION OF GROWTH MEDIA WITH TEST SAMPLES,

National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, W. O. K. Grabow, and C. A. Hilner.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6, p 641-646, June, 1982. 2 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Assay, *Testing procedures, *Sensitivity analysis, *Drinking water, bioassay, Water analysis, Secondary wastewater, Activated sludge, Separation techniques, Membrane filters, Humus sludge.

A direct method of preparing water samples for use in Ames Salmonella/microsome mutagenicity assays uses samples filtered through a membrane before mixing with agar to prepare the bottom agar layer for plate incorporation assays. This technique was compared to a procedure of testing dichloromethane liquid-liquid extracts of settled sewage, humus tank effluent, activated sludge effluent and tap water samples. Results showed that in the direct test method, much smaller volumes of test samples are required, while time-consuming, expensive and complex extraction procedures are eliminated. When settled sewage and secondary treated wastewater were used, the direct test method proved more sensitive than the extraction test method because it yielded positive results more often and was not affected by toxic constituents. Although it could not match the sensitivity of the tests on highly concentrated extracts, and may be sufficient for screening drinking water supplies. (Geiger-FRC)
W82-06548

DETERMINATION OF ALDICARB RESIDUES IN WATER BY COMBINED HIGH PERFORMANCE LIQUID CHROMATOGRAPHY MASS SPECTROMETRY,

Environmental Protection Agency, Research Triangle Park, NC.
L. H. Wright, M. D. Jackson, and R. G. Lewis.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6, p 740-747, June, 1982. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Pollutant identification, *Mass spectrometry, *Carbamate pesticides, *High performance liquid chromatography, *Aldicarb, Separation techniques, *Chromatography, Pesticide residues, Water analysis.

A rapid and sensitive method for the determination of aldicarb, aldicarb sulfoxide, and aldicarb sulfone by a method based on combined liquid chromatography/mass spectrometry (LC/MS) is described. Analytical standards were extracted with dichloromethane and dried by passage through a glass wool/sodium sulfate column. After drying, the column was rinsed with hexane; the rinse was combined with the extracts, and the whole sample was reduced to about 0.5 milliliters under a stream of dry nitrogen before reconstitution to 5 milliliters by the addition of hexane. The extracts were refrigerated until LC/MS analysis, when they were reduced to 1.0 milliliters under a stream of liquid nitrogen. Average recoveries were 57% for aldicarb, 110% for aldicarb sulfone, and 101% for aldicarb sulfoxide. MS compares favorably with other detectors in terms of sensitivity, and the selectivity of the MS and minimum cleanup time required are added advantages. (Geiger-FRC)
W82-06549

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,

Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06558

AN INTRODUCTORY STUDY OF SEASONAL VARIATION IN THE AEROBIC HETEROTROPHIC BACTERIAL POPULATION OF THE SAINT JOHN RIVER USING CLASSICAL SYSTEMATICS,

M. J. Chalifour, and M. A. Holder-Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change, Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 16-23, Tab, Fig.

Descriptors: *Saint John River, *Aerobic populations, *Heterotrophic bacteria, Study, Enzyme activity, Seasonal factors, Alcaligenes, Flavobacterium, Pseudomonas, Zoogloea, Xanthomonas, Chromobacterium, Enterobacteriacae, Growth factors, Isolates, Oxygen levels, Pollutants, *New Brunswick, *Systematics.

Subsurface water samples were collected from the Saint John River in October, February and August, one mile above and one mile below the effluent outflows of a food processing plant and a dairy. Aerobic heterotrophic bacteria were isolated, enumerated and identified where possible. The isolates were also examined for enzyme activity. The temperature and pH of the river water were determined at the time of sampling and the 24 hour mean flow rate between sampling locations was recorded. The fluctuation in the genera of bacteria observed indicated that seasonal factors influenced the bacterial population. Many of the isolates required growth factors; the most common one was cyanocobalamin. The ability to store poly-beta-hydroxybutyrate was prevalent in the summer isolates, rare in the winter bacteria. The predominant bacteria in the winter samples were Alcaligenes, Flavobacterium, fluorescent Pseudomonas and Xanthomonas species. Zoogloea species were dominant in August. Chromobacterium, Enterobacteriaceae and non-fluorescent Pseudomonas, as well as Zoogloea, were predominant in the October samples. (WATDOC)
W82-06559

AN ECOLOGICAL APPROACH TO THE STUDY OF BACTERIA AT THE FLORENCEVILLE SITE IN SEPTEMBER AND FEBRUARY,

T. Kaneko, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change, Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 24-33, Tab, Fig.

Descriptors: *Saint John River, Florenceville Site, *Bacterial study, *Heterotrophic bacteria, Numerical analysis, Isolates, Eutrophication, Taxonomy, Population shifts, Organic loading, Methodology, Water quality, Temperature variations, *New Brunswick.

Seasonal river water samples obtained at the point source of the effluent from the McCain food processing plant have been analyzed for numbers and types of heterotrophic bacteria by numerical taxonomy and for temperature and pH. Bacterial counts varied from 10,000 to 1 million (CFU/ml). Forty per cent of the September river samples required growth factor and 17-32% required unknown growth factors. This growth factor requirement was shown again to be seasonal. The February isolates were more versatile nutritionally and more of the isolates utilized a wide range of substrates. The winter organisms were able to grow well at a wide temperature range in contrast with the September isolates which did not grow at 4 C. The starch discharged by the food processing plant did not produce an increase in starch hydrolyzing bacteria. The samples obtained above and below the point source of the effluent yielded isolates of similar characteristics, whereas the effluent isolates were distinctly different indicating that the effluent bacteria were not retained as a major segment of the river bacterial population. It was concluded that the effluent bacteria were diluted by the river to numbers below detection by the methods employed in this study. (WATDOC).
W82-06560

BACTERIA UNDER THE ICE,

T. Kaneko, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change Scientific Series No 124, 1981. Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 34-42, Fig, Tab.

Descriptors: *Taxonomy, *Numerical analysis, *Bacterial populations, *Ice, *Pollutant Identification, Water quality, Reference strains, Pseudomonas fluorescens, Aeromonas, Derxia, Flavobacterium, Effluent clusters, Alcaligenes, Biotypes, Runoff, DNA analysis.

All February isolates which survived the culturing procedures were analyzed by numerical taxonomy. The analysis included reference strains and effluent isolates which rarely clustered with their river counterparts. The clustered strains were identified by classical methods and the identification was supported by DNA analysis. The predominant species found at both river sites were P. fluorescens biotypes B, E and F and Flavobacterium. P. stutzeri as well as other nonspeciated Pseudomonas were also observed. River clusters were identified also as Klebsiella, Aeromonas, Sphaerotilus natans and Azotobacter. The effluent clusters, which contained only strains from the effluent, included Derxia, Aeromonas, Pseudomonas, Alcaligenes and Pseudomonas sp. The data base of the numerical taxonomy made it possible to group strains to simplify the classification and to identify their locations. The bacteria isolated from the river two miles apart showed great similarities and the dilution of the effluent strains indicated that bacteria introduced into the river by the effluent did not become part of the free-floating population downstream. These findings supported the preliminary work of Chalifour and Holder-Franklin. (WATDOC)
W82-06561

SEASONAL AND DIURNAL CHANGES IN THE PREDOMINANT HETEROTROPHIC BACTERIAL SPECIES OF THE MEDUXNEKEAG RIVER,

C. J. Cormier, and M. A. Holder-Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 43-77, Fig, Tab.

Descriptors: *Heterotrophic bacteria, *Meduxnekeag River, *New Brunswick, *Population shifts, *Taxonomy, *Seasonal variations, *Diurnal changes, Heterogeneity, Bacterial species, Pollutants, Genera, Isolates, Cluster analysis, Temperature variations, Aeromonas, Flavobacterium, Pseudomonas, Xanthomonas campestris, Water quality.

Seasonal and diurnal changes in the heterotrophic bacterial community isolated from the Meduxnekeag River at the Environment Canada monitor, Belleville, N.B., were observed in March, July, September and October. A detail of the numerical taxonomy is presented to show the efficacy of using this method to detect population shifts. The variety of species observed in these samples indicated a complexity of the bacterial flora not observed previously. Although temperature is a highly selective environmental parameter, it was shown in this study that a very diverse population was present in September and October in samples taken two weeks apart and at the same temperature. Aeromonas, Flavobacterium and non-fluorescent Pseudomonas were predominant in September, whereas in October owing to the diurnal variation certain species predominated according to sampling time. Beginning at noon, Pseudomonas carophylli, a non-fluorescent organism, and Xanthomonas campestris were preeminent. At early evening, P. fluorescens obtained a clear majority and only two strains of P. carophylli remained. Another shift placed the Flavobacterium in greater numbers by midnight. The March samples demonstrated very low numbers clustering with great heterogeneity in the samples. The shift to fluorescent Pseudomonas observed in other winters at other sampling sites was not seen. A variety of organisms were isolated in July with a slight shift to the more fermentative groups. Diurnal variation was not as apparent in March and July.(WATDOC)
W82-06562

DIURNAL VARIATIONS OF THE HETEROTROPHIC BACTERIA IN THE SEDIMENT AND WATER OF A SMALL WOODLAND STREAM,

C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 78-89, Tab, Fig.

Descriptors: *Heterotrophic bacteria, *Dunbar River, *Bacterial enumeration, *Diurnal variations, Water quality, Sediment populations, Water populations, Mathematical analysis, Taxometric analysis, Physico-chemical parameters.

Diurnal variation in certain biological, physical and chemical parameters was observed in water samples collected from the Dunbar River, a pristine woodland stream, periodically during a 56-hour period in August. A reduction in 02, pH, C and P was accompanied by a decrease in chlorophyll and bacterial counts in water and sediment incubated at 20 C. As darkness descended, the turnover time took a noticeable upswing followed by buildup in N03 and eventual peaking of the Vmax. Dusk also brought an increase in sediment counts at 5 C. Another peak was observed in these sediment psychrophiles at dawn. Species varied somewhat- an increase in fermentative enterics was observed during the day, with the converse true of the aerobic, non-fermentative group. The modest cycling of species in ;this study was also observed in the Meduxnekeag in a previous summer study. The factor analysis demonstrated the clear differences in the sediment and water populations. Links between these populations are only speculative from the results reported here. (WATDOC)
W82-06563

INTERACTIONS OF HETEROTROPHIC BACTERIA IN THE SEDIMENT WATER PHASES OF TWO CONTRASTING RIVERS,

C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
In: Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change. Scientific Series No 124, Inland Waters Directorate, Ottawa, Ontario, Canada, 1981. p 90-98, Tab.

Descriptors: *Meduxnekeag River, *Dunbar River, *Nutrient transformations, *Population shifts, Aquatic ecosystems, Sediment samples, Heterotrophs, River isolates, Pseudomonas fluorescens, Delafieldi, Acidovorans, Cytophaga fermentus, Taxonomy, *New Brunswick.

The Meduxnekeag and Dunbar rivers, in addition to having differing water uses and physico-chemical parameters, show large differences in sediment structure. The Meduxnekeag has a dark grey silty mud, whereas the Dunbar has a coarse gravel. The sediment counts are always at least one order of magnitude greater than the river counts. Counts in the Meduxnekeag sediment are about ten times higher than counts in the Dunbar sediment. Correlations between total heterotrophic counts in sediment and water are insignificant. There is thus little overall interchange in numbers. The Meduxnekeag sediment is highly typical of these river systems in lacking fluorescent pseudomonads. The Dunbar sediment harbours twice as many obligate aerobes as does the overlying water. The sediment populations in both rivers accumulate more PBH than the water populations, have a lower frequency of anaerobiosis and fermentation, are more mesophilic and less proteolytic and lipolytic. Four factors express the variability in the Meduxnekeag populations. Only three factors emerge for the Dunbar populations. These three factors all have a strong oxidative bias. Oxidative bacteria are believed to reside in the Dunbar sediment and possibley seed the overlying water. These populations are more affected by changes in water parameters than the water populations. Fermentative bacteria are believed to reside in the Meduxnekeag sediment and seed the overlying water. The Meduxnekeag sediment populations are largely unaffected by changes in the physico-chemical nature of the water. Viable counts in the Meduxnekeag water are influenced primarily by rainfall and organic C. Sediment populations are only effected by NH4. Ammonia is the key variable influencing both sediment and water counts in the Dunbar. These differences between sediment populations are attributable largely to the difference in sediment structure. (WATDOC)
W82-06564

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION; CANADIAN CONTRIBUTION, SUMMARY REPORT,

Canada Centre for Inland Waters, Burlington (Ontario).
L. L. Janus, and R. A. Vollenweider.
National Water Research Institute, Scientific Series No 131, 1981. 347 p 107 Fig, 31 Tab, 143 Ref.

Descriptors: *Canada, *Eutrophication, *Nutrient reduction, *Loading estimates, Phosphorus, Chlorophyll, Oxygen depletion, Diagnosis, *Oliogotrophic lakes, Secchi transparency, Hydraulic load, Lake Classification, Pollutant identification.

The OECD International Programme on Eutrophication has been designed for cross sectional comparison of lakes to provide management with simple tools to evaluate nutrient reduction, particularly phosphorus, necessary to alleviate excessive eutrophication. The scope of the Canadian programme was to test the applicability of the overall OECD results on a set of data not included in the original elaboration with three main objectives in mind; clarification of the extent to which lakes of an unspecified nature exhibit statistical properties similar to the OECD lakes, clarification and identification of the limits of transferability, identification of conditions which need further evaluation. The Canadian lakes data base represents a collection of information from personal communication with various workers involved in major limnological projects as well as that contained in the literature. It has been subdivided into seven major geographical regions which are treated separately. In a diagnostic sense, the majority of Canadian lakes tested show statistical behaviour similar to that of the OECD lakes, particularly in regard to the relationships between annual mean chlorophyll and annual mean phosphorus, annual mean phosphorus and flushing corrected inflow phosphorus concentration, and annual mean chlorophyll and flushing corrected inflow phosphorus concentration. However, application of the results for predictive purposes requires care. A number of limiting conditions were identified under which applicability and transferability of OECD results are either questionable or should be done with utmost care. These include situations where: euphotic zone depth/mean depth is substantially greater than one; hydraulic load is high (q sub s is greater than 50 m/y). flushing rate is more than twice/year and/or lakes with irregular flushing regimes either seasonally or over consecutive years; high mineral turbidity or a high degree of humic staining exists; N/P ratios are greater than 5 and/or P execeeds 100 mg/cu m; phosphorus is relatively inert (e.g. as apatite) or internal loading is substantial and dynamic equilibrium has not been attained as in the case of increasing or decreasing nutrient loads. (WATDOC)
W82-06566

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION CANADIAN CONTRIBUTION, SUMMARY REPORT, (SUPPLEMENT),

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 7C.
W82-06567

A STUDY OF SELECTED GREAT LAKES COASTAL MARSHES,

Canada Centre for Inland Waters, Burlington (Ontario).
A Mudroch.
Scientific Series No 122, 1981. 44 p, 14 Fig, 35 Tab, 106 Ref.

Descriptors: *Great lakes, *Coastal lake marshes, St. Lukes, Dover, Cootes Paradise, Balmoral, Big Creek, Walpole Island, *Chemical composition, *Trace elements, Nutrients, Water quality, Marsh water, Sediments, Geochemistry, Wetlands, Macrophytes, Metals, Nitrogen, Phosphorus, *Pollutant identification, *Lake Erie, *Lake Ontario, *Lake St. Clair.

Six marshes adjacent to the Great Lakes were investigated to evaluate their beneficial and/or detrimental effects on the water quality of the lakes. The nutrient (N and P) and trace element (Pb, Cu, Cr, Ni, Cd, As and Hg) concentration changes in marsh water, the geochemistry of sediments, and the nutrient and trace element uptake by marsh plants and their biomass production were investigated. The marsh water retained pH values of between 7.8 and 8.4, and the sediments were submerged mineral soils with pH ranging between 6.9 and 7.2 with more than half of the particles in the silt size (2-63 micro m) fraction. Concentrations of nutrients and trace elements in march water and sediment were compared with those found in lakes Ontario and Erie. Large differences were observed between the concentrations of various forms of nitrogen present in marsh, lake and stream water. Most of the nitrogen present in the marsh water was in the form of organic nitrogen. Dissolved oxygen concentration in the marsh water during summer months remained relatively high (4-8 mg per L). The nutrient input to the marshes affected the aboveground biomass production and the species composition in the marshes. Submerged macrophytes accumulated higher concentrations of Pb, Cr, Ni, Cd, Co and Cu than the emergent macrophytes. All of the marshes studied showed a high capacity to retain nutrients and metals. The degree of this retention depended on the hydrological regime and species composition in the marsh. It was calulated that a complete discharge of the marshes into the adjacent lakes would contribute only negligible quantities of N Nd P in relation to the loadings from other sources. (WATDOC)
W82-06570

DISSOLVED OXYGEN MODELLING OF THE ST. CROIX RIVER, MAINE - NEW BRUNSWICK,

Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-06572

SEASONAL VARIATION OF NITROGEN AND PHOSPHORUS SPECIES IN THE RED RIVER,

Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
For primary bibliographic entry see Field 5B.
W82-06573

NATIONAL INTERLABORATORY QUALITY CONTROL STUDY NO 27, PCBS, IN NATURALLY CONTAMINATED DRY SEDIMENTS,

Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5B.
W82-06574

NATIONAL INTERLABRATORY QUALITY CONTROL STUDY NO 25, PCBS IN WET SEDIMENTS,

Canada Centre for Inland Water, Burlington (Ontario).
H. B. Lee, and A. S. Y. Chau.
National Water Research Institute, Report Series No 71, 1981. 9 p, 1 Fig, 7 Tab, 8 Ref.

Descriptors: *Polychlorinated biphenyls, *Pollutant identification, *Sediments, Dixon procedure, Webb-McCall procedure, Comparable levels, Extraction, Organics, Contamination, Quality control, Homogeneity, Interlabratory studies, Data collections.

This study describes an interlaboratory comparison of the analysis of polychlorinated biphenyls (PCBs) (a 1:1 mixture of Aroclors 1254 and 1260) at concentrations of about 1 ppm in 10 to 20 spiked wet sediment. The average coefficient of variation (16.2%) of the present study is very similar to previously reported results in other interlaboratory PCB studies at comparable levels. The variation of results among laboratories in this study appears to be due to the variation in quantitation methods more than to the variation in extraction and cleanup procedures. The laboratories that used the Webb-McCall quantitation procedure gave better accuracy and precision than those that used other quantitation procedures. (WATDOC)
W82-06575

WATER QUALITY OF THE UPPER NIAGARA RIVER, 1975 AND 1979,

Canada Centre for Inland Water, Burlington (Ontario).
K. W. Kuntz, and C. H. Chan.
Scientific Series No 129, 1982. 22 p, 13 Tab, 7 Fig, 12 Ref.

Descriptors: *Upper Niagara River, Tonawanda Channel, Chippawa Channel, Quality control, *Chemical analysis, Statistical data, Nutrients, Trace metals, Microbiology, Organic contaminants, Ion concentration, *Pollutant identification.

In 1975 and 1979, surface water samples were collected on the Upper Niagara River for a wide variety of analyses including nutrients, major ions, trace metals, toxic organic contaminants and microbiological parameters. Results indicated higher concentrations of nutrients, trace metals and bacteriological parameters in the Tonawanda Channel than in the Chippawa Channel of the Upper Niagara River. Major ion Concentrations have remained relatively constant between 1975 and 1979. Nutrients data remain unchanged except for an increase in nitrate nitrogen and a decrease in particulate organic carbon. Total iron concentrations and total and fecal coliform counts in the Tonawanda Channel frequently exceeded water quality objectives of the 1972 Canada/United States Great Lakes Water Quality Agreement. (WATDOC)
W82-06576

SOME PALEOLIMNOLOGICAL ASPECTS OF THE MOST RECENT SEDIMENTS OF LAC LAFLAMME (LAURENTIDES PROVINCIAL PARK, QUEBEC) IN RELATION TO ATMOSPHERIC TRANSPORTATION OF POLLUTANTS,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Ouellet.
Environment Canada, Inland Waters Directorate, Quebec, Canada, Scientific Series No 123, 1981. 37 p 99 Ref, 4 Tab, 14 Fid.

Descriptors: *Lac Laflamme, *Quebec, *Paleolimnology, *Geochemistry, *Geochronology, Fallout, *Air Pollution, *Stratigraphic distribution, Precipitation, Acid rain, Acidification, *Sediments, Ecosystems, Plankton, Water quality, *Pollutant identification.

The present paleolimnological study, which deals essentially with the geochemical and biological characteristics of the most recent sediments of Lac Laflamme, is part of an integrated research program recently initiated by Environment Canada. This research program is aimed at achieving a better understanding of the effects produced on the environment by the fallout of pollutants transported over long distances in the atmosphere. This report deals with the geochronological and geochemical aspects, and with the composition and abundance of the fossil groups of algae and crustaceans over time. The stratigraphic increase in 137Cs, Na, Cu S, Ca, Hg, Ni, Pb and Zn, beginning primarily in the levels corresponding to the 1940s, reflects the quantities of these elements released into the atmosphere by various anthropogenic activities. However, for the same period of time, there is a slight decline in A1 and Ca levels in the sediments of Lac Laflamme, which may be attributable to the greeter mobility of these elements as a result of the effects of precipitation acidification. To date, the high capacity of the loose sediments in the lake for ion exchange has prevented acifification of the lake's waters, which still maintain a pH level of approximately 6.1. This neutralization capacity has thus enabled the paleocommunities of algae and cladocerans to remain in equilibrium over the past several hundred years. (WATDOC)
W82-06577

EVALUATION OF A SYSTEM TO AUTOMATICALLY SAMPLE ZOOPLANKTON FROM THE DISCHARGE OF DAMS,

Cooperative Fishery Research Unit, Amherst, Massachusetts
R. A. Rosen.
Water Resources Bulletin, Vol 18, No 1, p 147-152, February, 1982. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Zooplankton, *Measuring instruments, Dams, Flow discharge, Crustaceans, *Sampling, Water quality, *Automatic sampling, *Massachusetts, Connecticut River, Holyoke Pool.

Although zooplankton are excellent biological indicators of water quality, they can be difficult or time consuming to routinely monitor. Swanson proposed a means to automatically sample plankton from the intake water at dams in 1965. However, although this system can reduce or nearly eliminate the labor involved in an extensive sampling program and can sample at any time for any duration, it has received only modest use. Two samplers were operated continuously for more than two years to monitor the crustacean zooplankton influx into and discharge from the Holyoke Pool of the Connecticut River in Massachusetts. The sampling efficiency of these two samplers was evaluated and compared to that of a conventional towed-net sampler. The automatic samplers efficiently sampled most species and size classes of crustacean zooplankton in a similar, but not consistently identical, manner to the towed-net plankton sampler. The automatic sampler captured the smallest sized zooplankton more efficiently than the largest representatives. Mesh selection and sampler avoidance exerted different influences on the automatic samplers and on the towed-nets. The study results indicate that direct use of the results from automatic samplers, individually or in comparison with results from other automatic samplers, provides a valid and accurate assessment of plankton density and species composition in waters passing through a dam. (Carroll-FRC)
W82-06628

CHANGES IN EXTRACTABLE METAL CONCENTRATIONS DURING STORAGE OF SURFACE WATER SAMPLES CONTAINING SEDIMENTS,

Department of the Environment, Vancouver (British Columbia). Inland Waters Directorate (Pacific Region).
For primary bibliographic entry see Field 2K.
W82-06630

RIGHT PLACE, TIME AND TECHNIQUE: RIGHT SAMPLE,

ISCO, Inc., Lincoln, NE.
D. M. Grant.
Water-Engineering and Management, Vol 129, No 7, p 28-32, June, 1982. 3 Fig, 3 Tab.

Descriptors: *Sample preservation, *Water sampling, *Sampling, *Pollutant identification, Wastewater analysis, Sample preparation.

The importance of proper sampling techniques, representative samples, and sample preservation in water and wastewater analysis are emphasized. Reliable analytical data are vital in water pollution control in the key areas of policy planning, program planning, and enforcement. The best method for obtaining the most representative sample depends on flow data, character and variability of the source, and the objective of the program. Two types of samples are discrete (grab) and composite. Discrete samples are preferred when the source does not flow continuously, when extreme conditions must be detected, when the source is relatively constant, and when time variations are needed. Composite samples may be simple, flow-proportional, or sequential. They give a good indication of average characteristics. Types of sample gathering systems are described: mechanical, forced flow,

and suction lift. Frequency of sampling depends on the variability of the source. Volume depends on the type of analysis. A table lists the required volume, type of container, preservative measures, and recommended holding time for about 50 wastewater constituents. Generally, the minimum volume for discrete samples is 100 ml; for individual aliquots of composite samples, 25 ml, with a total composite volume of 4 liters or more. Refrigeration is the most common sample preservation method to prevent chemical and microbiological activity during storage. Obviously, immediate analysis is preferable to storing samples. (Cassar-FRC)
W82-06642

ALGAE AND CRUSTACEANS AS INDICATORS OF BIOACTIVITY OF INDUSTRIAL WASTES,

Environmental Research Lab., Gulf Breeze, FL.
G. E. Walsh, K. M. Duke, and R. B. Foster.
Water Research, Vol 16, No 6, p 879-883, June, 1982. 2 Fig, 5 Tab, 14 Ref.

Descriptors: *Pollutant identification, *Industrial wastes, *Bioindicators, Toxicity, Water pollution sources, Bioassay, Pulp wastes, Pulp and paper industry, Algal growth, Crustaceans, Laboratory studies.

The effects of 10 industrial waste samples on Selenastrum capricornutum, a freshwater alga, and Skeletonema costatum, a marine alga, were studied in laboratory bioassays. Effects on growth of these algae were compared to toxicity to crustaceans that are considered to be pollutant-sensitive species: Daphnia magna (freshwater) and Mysidopsis bahia (marine). The effluents tested included wastes from three paper mills, two textile mills, two fiber plants, an oil refinery, a chemical manufacturing plant and a tannery. None was strongly inhibitory to algal growth, but all stimulated growth at low concentrations. No waste type appeared to be either more or less bioactive than any other. From the results it was concluded that algal growth bioassays with complex industrial wastes need not be conducted for longer than 4 days. Daphnia magna and Mysidopsis bahia were less sensitive to the wastes than were the algae. Algal data were valuable in calculating the 7-day, 10-year, low flow rates required for safe disposal of the effluents. Algal data indicated need for greater dilution and thus afforded a greater margin of safety than did animal data. (Baker-FRC)
W82-06654

DESIGN AND OPERATION OF A COLORIMETRIC DETECTOR CONTROLLER,

Natal Univ., Durban (South Africa).
R. H. Turnbull.
Water Research, Vol 16, No 6, p 801-808, June, 1982. 10 Fig, 3 Tab, 2 Ref.

Descriptors: *Design criteria, *Colorimetry, Water analysis, Water quality, Measuring instruments, *Pollutant identification.

This report covers the design and operation of a suitable colorimeter based on the ADMI color method. The colorimetric detector controller is suitable for industrial applications with a color detection range of 100 ADMI units. The design is based on the measurement of the response in the blue, green, and red light bands covering the 400-700 nm spectrum. The fourth detector is used for detecting ferric ions in the range of 0-5 mg/liter, by detecting the color complex ferri-ferro-cyanide. With decreasing water quality, shorter light path lengths will be required, with corresponding reduction in sensitivity. (Baker-FRC)
W82-06656

A WATER QUALITY INDEX FOR LAKE BEACHES,

Eco-Recherche Ltd., Pointe-Claire (Quebec).
For primary bibliographic entry see Field 5G.
W82-06650

ASSESSMENT OF WATER QUALITY IN CANALS OF EASTERN BROWARD COUNTY, FLORIDA, 1969-74,

Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller, and W. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-194960, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-3, 1982. 70 p, 23 Ref, 20 Tab, 27 Ref.

Descriptors: *Water quality, *Canals, *Wastewater, *Environmental effects, Land use, Urban runoff, Pollutants, Water sampling, Sediments, Nutrients, Pesticides, Water analysis, Data collections, *Florida, Broward County.

An intensive water-quality monitoring program was started in 1969 to determine the effects of man-induced contaminants on the water quality in the primary canal system of eastern Broward County, Florida. This report covers the first 6 years of the program and provides a data base that can be used to compare future changes in water-quality conditions. Most data indicate that beyond the small seasonal fluctuation in constituent level, the greatest adverse effect on the quality of water is caused by discharge of sewage and treated sewage effluent to the canals. The areas affected by sewage have greater concentrations of macronutrients, trace metals, and pesticides than unaffected areas. Major-ion concentrations were affected only by season and local lithology. Over the 6-year study a gradual decrease in macronutrient concentration and an increase in dissolved oxygen have occurred. This improvement in water quality is attributed to a decrease of sewage discharge into canals and better treatment of sewage effluents. (USGS)
W82-06682

ORGANIC SOLUTES IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY,

Geological Survey, Lakewood, CO. Water Resources Div., and Geological Survey, Idaho Falls, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-06688

ORGANOCHLORINE RESIDUES IN FISH FROM LAKE MJOSA IN NORWAY,

Institutt for Energiteknikk, Kjeller (Norway).
E. M. Brevik.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 5, p 679-680, May, 1981. 1 Tab, 6 Ref.

Descriptors: *Pesticide residues, *Fish, *Chlorinated hydrocarbons, Pollutant identification, Air pollution, Polychlorinated biphenyls, DDT, Organic compounds, Hexachlorobenzene, *Lakes, Aquatic life, Norway, Mjosa Lake.

Levels of total DDT, polychlorinated biphenyls (PCB), and HCB in livers of lagesild (Coregonus albula) from Lake Mjosa, Norway, did not change significantly, according to annual sampling from 1974 to 1979. Total DDT ranged from an average of 0.7 to 3.1 ppm (fat weight basis); PCBs, 1.5 to 6.7 ppm; and HCB, 0.11 to 0.29 ppm. These freshwater fish samples contained only one fifth the levels of organochlorine compounds normally found in ocean fish from relatively un-contaminated fjords and open ocean. (Cassar-FRC)
W82-06697

THE DISTRIBUTION OF HEAVY METALS IN THE BOTTOM SEDIMENTS OF THREE STREAMS IN THE KANSAS CITY, MISSOURI, METROPOLITAN AREA,

Missouri Univ., Kansas City. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06702

ON THE DETECTION OF MUTAGENIC/CARCINOGENIC ACTIVITIES IN WATER WITH THE SALMONELLA/MICROSOME TEST (AMES TEST)(ZUM NACHWEIS MUTAGENER/KANZEROGENER AKTIVITATEN IN WASSERN MIT DEM SALMONELLA/MIKROSOMEN-TEST (AMES-TEST)),

Mainz Univ. (Germany, F.R.). Hygiene Inst.
E. H. Pfeiffer.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 39-41, January, 1982. 16 Ref. English summary.

Descriptors: *Drinking water, *Ames test, *Carcinogens, *Pollutant identificaion, *Mutagens, Testing procedures, Water quality, Pollutants, Salmonella, Toxins, Bioindicators.

The Ames test is described and its use for detecting mutagenic and carcinogenic substances in various waters is evaluated. The use of this test to identify carcinogens rests upon the assumption that a correlation exists between the mutagenic and carcinogenic effects of a given substance. However, this relationship appears to be restricted to compounds that react directly with DNA or that can be transformed metabolically into electrophilic alkylating substances. It is estimated that 75-90% of known carcinogens in the Ames test are also mutagens, and false negatives and positives each account for about 10% of substances tested. The Ames test is usually applied to newly developed chemicals, and its use in complex substances such as drinking water and dust opens up a new field. The test can indicate the presence of harmful substances in drinking water and point to multiplication and summation effects in the presence of certain other substances. Substances with antagonistic or inhibitory effects may affect the result, and the possibility also exists that a substance may not be present in a concentration high enough to give a positive result. Thus the usefulness of the Ames test may be affected by the chemical preparation of the water sample for the test. Nevertheless the Ames test can be used to screen water for possible mutagenic and/or carcinogenic substances, after which further mutagenicity tests (e.g. cell culture) should be conducted. Animal experiments are necessary to test for carcinogenicity. (Gish-FRC)
W82-06715

MULTIPLE POTENTIOMETRIC SYSTEM FOR CONTINUOUS DETERMINATION OF CHLORIDE, FLUORIDE, NITRATE, AND AMMONIA IN NATURAL WATERS,

Warsaw Univ. (Poland). Dept. of Chemistry.
M. Trojanowicz, and R. Lewandowski.
Fresenius' Zeitschrift fur Analytische Chemie, Vol 308, No 1, p 7-10, 1981. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Monitoring, *Water analysis, *Potentiometers, *Pollutant identification, *Chlorides, *Fluorides, *Nitrates, *Ammonia.

Chloride, fluoride, nitrate, and ammonia were simultaneously determined in natural waters using a flow-through system suitable for routine monitoring. Sensors used were solid state chloride and fluoride electrodes, a nitrate PVC membrane electrode with solid silver contact, and a gas-sensing ammonia ORION 95-10 electrode. The incoming samples were segmented by air and mixed with appropriate buffering solutions before entering the measuring cells. The method was tested over the concentration ranges (in ppm) of 30-150 for Cl, 0.08-0.4 for F, 5-20 for nitrate, and 0.05-0.5 for ammonia. The system was used to monitor tap water for 6 months and to monitor river quality at Warsaw for 2 months. Accuracy was about + or - 10%. Time for analysis was 15 min. (Cassar-FRC)
W82-06718

THE USE OF AN ALGA CHLORELLA PYRENOIDOSA AND A DUCKWEED LEMNA PERPUSILLA AS TEST ORGANISMS FOR TOXICITY BIOASSAYS OF SPENT BLEACHING LIQUORS AND THEIR COMPONENTS,

State Univ. of New York Upstate Medical Center, Syracuse. Dept. of Pediatrics.
For primary bibliographic entry see Field 5C.
W82-06721

COMPARISON OF FILTRATION TECHNIQUES FOR SIZE DISTRIBUTION IN FRESHWATERS,

Edinburgh Univ. (Scotland). Grant Inst. of Geology.
D. P. H. Laxen, and I. M. Chandler.
Analytical Chemistry, Vol 54, No 8, p 1350-1355, July, 1982. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Pollutant identification, *Filtration, *Natural waters, Water analysis, Particle size, Filters, Screens, Separation techniques, Particulate matter, Suspended solids, Trace metals, Water pollution control, Sample preparation.

A more systematic insight into the filtration of freshwaters was sought with emphasis on the following points: to compare depth filters (Sartorius) and screen filters (Nuclepore) of different nominal pore size with a view toward determining their respective suitability for size distribution studies; to compare filtration using stirred and unstirred samples, the former being designed to prevent or minimize accumulation of material on the filter; to compare size distributions based on immediate filtration in the field with filtration performed several hours later in the laboratory; and to compare filtration through glass fiber filters with membrane filters. It was concluded that screen filters (Nuclepore) provided more accurate size fractionation, so long as the filter was not allowed to clog. No benefit was derived from stirring the sample during filtration. Field filtration was necessary to achieve the most reliable size fractionation. The criteria used to evaluate filtration properties are iron and manganese filtrate concentrations and scanning electron microscope examination of the filtered particulates. (Baker-FRC)
W82-06731

SALMONELLA SPP. IN THE WORKING ENVIRONMENT OF SEWAGE TREATMENT PLANTS IN OSLO, NORWAY,

Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene.
G. Langeland.
Applied and Environmental Microbiology, Vol 43, No 5, p 1111-1115, May, 1982. 3 Tab, 21 Ref.

Descriptors: Wastewater facilities, *Bacteria, Salmonella, Human diseases, Oslo, *Norway, Sludge, Occupational hazard, *Pollutant identification.

The presence of Salmonella spp. in the working environment and sewage sludge at three sewage works in Oslo was investigated. Ten series of samples were taken at intervals of 2 months from April 1979 to November 1980. The last three series also included samples from plant influent and effluent. Salmonella bacteria were isolated from surfaces and areas with hand contact in the treatment plant, from floor surfaces in the changing rooms, and in one case from floor surfaces in an eating room. The sewage sludge contained from 140 to 140,000 Salmonella spp per 100 g dry weight. Raw and treated sewage contained an average of 130 and 3 of these bacteria per 100 ml, respectively. There were poor correlation between the pattern of serotypes isolated from the sewage works and the patterns of those which were registered among the population of Oslo during the investigation. Neither enteropathogenic bacteria nor parasite eggs were found in fecal samples from employees at the plant. The health aspects of the situation are considered. With the exception of Salmonella paratyphia-B, the Salmonella strains found are unlikely to cause disease after oral intake at these levels. However, if contamination of a suitable foodstuff occurs, multiplication of these Salmonella strains could reach the level required for an infective dose. (Baker-FRC)
W82-06734

EVALUATION OF CELL LINES AND IMMUNOFLUORESCENCE AND PLAQUE ASSAY PROCEDURES FOR QUANTIFYING REOVIRUSES IN SEWAGE,

Utah State Univ., Logan. Dept. of Biology.
D. N. Ridinger, R. S. Spendlove, B. B. Barnett, D. B. George, and J. C. Roth.
Applied and Environmental Microbiology, Vol 43, No 4, p 740-746, April, 1982. 6 Tab, 25 Ref.

Descriptors: *Viruses, *Wastewater, Cultures, Water pollution control, Water analysis, Water quality, *Reoviruses, *Pollutant identification.

A versatile assay method is needed for the more than 100 different viruses excreted by humans into sewage. Reoviruses have been suggested for use in developing such an assay technique. The sensitivities to reoviruses of 12 continuous cell lines were compared. Three of these 12 cell lines were then compared using unserotyped reovirus precipitated from sewage by protamine sulfate. The most sensitive cell line was subsequently used in a comparative study of the plaque and the ICC assay procedures. Madin-Darby bovine kidney (MDBK), rhesus monkey kidney (LLC-MK2) and human embryonic intestinal (intestinal 407) cells were most sensitive to reovirus types 1, 2, and 3 respectively. MDBK cells were more sensitive than LLC-MK2 and Buffalo green monkey (BGM) cells to sewage-isolated, protamine-precipitated reoviruses which had not been serotyped and had no previous cell contact. Sewage-isolated, protamine-precipitated reoviruses were also used in conjunction with MDBK cells in a comparative evaluation of immunofluorescent cell count and plaque assay procedures. The immunofluorescence assay is more sensitive and more rapid than the plaque assay. Reoviruses in excess of 10000/liter of raw sewage were detected by the immunofluorescent cell count assay. Reoviruses were concluded to possess the characteristics required for water pollution test viruses. MDBK cells are sufficiently sensitive to reoviruses to permit reovirus detection in < 24 hr. (Baker-FRC)
W82-06735

DYE-COUPLED ELECTRODE SYSTEM FOR THE RAPID DETERMINATION OF CELL POPULATIONS IN POLLUTED WATER,

Kurita Water Industries Ltd., Yokohama (Japan).
S. Nishikawa, S. Sakai, I. Karube, T. Matsunaga, and S. Suzuki.
Applied and Environmental Microbiology, Vol 43, No 4, p 814-818, April, 1982. 9 Fig, 1 Tab, 7 Ref.

Descriptors: Water analysis, *Microbiological studies, Water treatment, Wastewater treatment, Water pollution control, Bacteria, *Pollutant identification.

A new electrode system using a fuel cell-type electrode, a redox dye, and a porous acetylcellulose membrane filter for trapping microorganisms is described. The electrode was constructed from a platinum anode, a silver peroxide cathode, and a membrane filter for retaining microorganisms. The principle of cell number determination was based on sensing with the electrode a redox dye reduced by the microorganisms. Sample solutions containing microorganisms were membrane filtered, and the resulting filter containing microbial cells was attached to the surface of a platinum anode. The electrode was immersed in phosphate buffer solution containing a redox dye, and the current generated was measured. The response time of the electrode system was 10 to 20 minutes, and the current generated was proportional to cell populations above 10,000 cells/ml. (Baker-FRC)
W82-06743

COMPARISON OF FOUR MEMBRANE FILTER METHODS FOR FECAL COLIFORM ENUMERATION,

Ontario Ministry of the Environment, Rexdale.
J. E. Pagel, A. A. Qureshi, D. M. Young, and L. T. Vlassoff.
Applied and Environmental Microbiology, Vol 43, No 4, p 787-793, April, 1982. 8 Tab, 17 Ref.

Descriptors: *Membrane processes, *Coliforms, Membrane filters, Filters, Membranes, Bacteria, Water analysis, Water quality, Water pollution control, *Pollutant identification.

The relative performance of four membrane filter (MF) enumeration methods for fecal coliforms was evaluated by determining performance characteristics. Three pure cultures of fecal coliforms were used for the study: E. coli 104, E. coli B, and Klebsiella pneumoniae. Recovery accuracy with pure cultures ranged from 89 to 100% for m-FC, mTEC and m-FC2 methods, but was less than 60% for the MacConkey membrane broth method. These figures dropped by about 40 to 55% when the cultures were subjected to temperature stress. Nearly 800 colonies were verified to determine specificity. False positive colonies occurred most frequently (18%) with the m-FC2 method, whereas false negative colonies were most common on MacConkey membrane broth (26%). In counting range experiments using a variety of samples, the highest upper counting limit was 130 colonies per filter with the mTEC procedure. Recovery comparisons were based on more than 130 samples, including raw surface waters, raw sewage, and chlorinated and unchlorinated sewage effluents. Recoveries were generally higher with the m-FC2 and mTEC methods. However, on m-FC2, growth of nontarget background organisms was also higher in most cases. Highest recoveries from chlorinated sewage effluents were obtained by the mTEC method, and the addition of a similar resuscitation period to the m-FC procedure improved fecal coliform recovery from such samples. The best overall performance for fecal coliform enumeration was obtained with the mTEC method, giving high recovery and low levels of background colonies, good specificity and accuracy, and high upper counting limit. This procedure also offers the advantage of enumerating. E. coli within 24 hr. (Baker-FRC)
W82-06744

ISOLATION AND CHARACTERIZATION OF ULTRAMICROBACTERIA FROM A GULF COAST ESTUARY,

University of West Florida, Pensacola. Dept. of Biology.
M. T. MacDonell, and M. A. Hood.
Applied and Environmental Microbiology, Vol 42, No 3, p 566-571, March, 1982. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Estuaries, *Bacteria, Coastal waters, Gulf Coast, *Estuarine environment, Marine waters, Nutrients, Vibrio, Aeromonas, Pseudomonas, Alcaligenes, Microorganisms, Ultramicrobacteria, *Alabama, Perdido Bay.

The warm waters of a Gulf Coast estuary were examined for the presence of ultramicrobacteria, and an attempt was made to isolate these organisms and to phenotypically characterize them. Water samples were taken from about 10 cm below the surface at four sites in Perdido Bay, Alabama, during April-June 1981. These sites were less impacted by human actvities and represented a wide range of salinities. Visual confirmation of bacteria in the water was made through fluorescent microscopy. Of the 27 isolates, 89% were initially incapable of growth in any of several full strength nutrient rich broths. Further more, no isolate was capable of a single positive reaction in full strength biochemical media. Several dilutions of various media were tried until the optimum concentration of an eight-fold dilution was obtained, which permitted the organism to grow while providing enough indicator for classical color reactions to be noted. The organisms were being inhibited by the rich nutrient concentrations. Adaptation to a nutrient-rich medium was accomplished and was accompanied by a pronounced increase in size. The majority of the isolates were oxidase positive and catabase positive. All were gram negative, and with a single exception, all were motile. With three exceptions every isolate was string test positive. Some phenotypic environmental Aeromonas spp are also able to produce positive string test reactions. Because of the high incidence of positive reactions produced by the Perdido Bay isolates, the string test may be a meaningful characteristic, although the significance of the test is unclear at this time. The abundance and the nutritional requirements of the ultramicrobacteria found imply that they represent a class of microorganisms which have successfully adjusted to poor nutrient conditions. (Baker-FRC)
W82-06747

PREVALENCE OF YERSINIA ENTEROCOLITICA IN WATERS OF THE LOWER CHIPPEWA RIVER BASIN, WISCONSIN,

Wisconsin Univ., Eau Claire. Dept. of Biology.
C. A. Meadows, and B. H. Snudden.
Applied and Environmental Microbiology, Vol 43, No 4, p 953-954, April, 1982. 2 Tab, 5 Ref.

Descriptors: *Enterobacter, *Water analysis, Human diseases, Diseases, Bacteria, Yersinia enterocolitica, Rivers, Bacterial analysis, Water pollution effects, Public health, Seasonal variations, *Wisconsin, Chippawa River basin.

A total of 303 water samples were collected between March 1978 and May 1979 in the lower Chippewa River drainage basin, including the river, tributary streams, and storm sewer outflows. Samples were tested for Yersinia enterocolitica, which causes serious gastrointestinal illness in humans. Selective media included MacConkey-Tween 80 agar and Y-M agar. A new method of isolation was developed. Fecal coliform tests demonstrated a considerable variation in water quality at sample sites. Fecal coliforms counts increased in spring and summer and decreased in winter. Woodland streams had lower coliform counts than polluted urban storm sewer effluent or streams which were subject to agricultural runoff. Of the 303 water samples, 78 had greater than 200 fecal coliforms per 100 ml sample. Y. enterocolitica occurred in 25 samples, 22 of which were from rural areas and 3 from urban areas. No common source was evident. Twenty-four of the isolates were obtained with the anaerobic-aerobic technique, and one was obtained with the Y-M agar plate technique. A seasonal variation in Y. enterocolitica occurrence was noted, with only one isolation being recorded outside of the period from November through April. The ability to withstand low temperature was evident. In general Y. enterocolitica was isolated more frequently in the winter season. (Baker-FRC)
W82-06751

TETRAZOLIUM REDUCTION-MALACHITE GREEN METHOD FOR ASSESSING THE VIABILITY OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5D.
W82-06752

USE OF HOECHST DYES 33258 AND 33342 FOR ENUMERATION OF ATTACHED AND PLANKTONIC BACTERIA,

Naval Research Lab., Washington, DC. Environmental Sciences Div.
J. H. Paul.
Applied and Environmental Microbiology, Vol 43, No 4, p 939-944, April, 1982. 2 Fig, 3 Tab, 20 Ref.

Descriptors: Water analysis, *Bacteria, Measuring instruments, Dyes, Water quality, Acridine orange, Bacterial analysis, *Pollutant identification.

The bisbenzimide dyes Hoechst 33258 and 33342 are examined as stains for epifluorescent enumeration attached and free-living bacteria, attached to smooth surfaces and in natural waters. The method has distinct advantages over acridine orange (AO) staining when enumerating bacteria on surfaces which bind this dye. The presence of greater numbers of autofluorescent particles in natural water samples when viewed in the blue excitation wavelengths required for AO may also cause an overestimation of bacteria during AO counting. The use of DNA-specific stains with UV excitation such as the Hoechst dyes 33258 and 33342 and DAPI can ameliorate this problem. Cultures of estuarine bacteria gave identical counts when stained with Hoechst 33258 or AO, whereas natural populations of aquatic bacteria gave 92 to 98.5% of the acridine orange counts. (Baker-FRC)
W82-06754

USE OF NITRIFIER ACTIVITY MEASUREMENTS TO ESTIMATE THE EFFICIENCY OF VIABLE NITRIFIER COUNTS IN SOILS AND SEDIMENTS,

Cawthron Inst., Nelson (New Zealand).
L. W. Beiser, and E. L. Mays.
Applied and Environmental Microbiology, Vol 43, No 4, p 945-948, April, 1982. 2 Tab, 14 Ref.

Descriptors: *Nitrification, *Bacteria, *Sediments, Soils, Oxidation, Ammonium, Microbiological studies, Biomass, *Pollutant identification.

A simple method for measuring maximum activities of indigenous ammonium oxidizer populations was applied to a number of soils and intertidal sediments. A shaken soil or sediment slurry was incubated, and the second step of nitrification, nitrite oxidation, was inhibited by chlorate. Under these conditions the rate of ammonium oxidation was equal to the rate of nitrite accumulation. Nitrapyrin, a specific inhibitor of nitrification, was added during the incubation to demonstrate that nitrite was produced from autotrophic ammonium oxidation. The most probable number (MPN) counts ranged between 150 to 3000 cells/gram in sediments and between 4400 to 19000 cells/g in soils. These counts were only 0.1 to 5.0% of the estimated populations that would be needed to produce the observed activity. Similar efficiency calculations were made for data already in the literature, and these calculations gave much higher percentages. Thus it was concluded that for the soils and sediments studied, the MPN counting technique greatly underestimated the populations present and that the efficiency calculation could be used as a counting efficiency index. (Baker-FRC)
W82-06755

REDUCTION OF CYTOTOXICITY IN VIRUS CONCENTRATES FROM ENVIRONMENTAL SAMPLES,

Murray State Univ., KY. Dept. of Biological Sciences.
T. W. Hejkal, C. P. Gerba, and V. C. Rao.
Applied and Environmental Microbiology, Vol 43, No 3, p 731-733, March, 1982. 3 Tab, 10 Ref.

Descriptors: *Viruses, *Public health, Toxicity, Wastewater, Settling basins, Raw wastewater, Water analysis, Water quality, Water pollution control, Pollutant identification, Filtration, Centrifugation.

The widespread use of tissue cultures for virus assays requires that cytotoxicity of virus concentrates be minimized. The reduction of cytotoxicity in virus concentrates from environmental samples was accomplished through high-speed centrifugation and by filtration of the samples through positively charged depth filters. The level of toxicity reduction depended on the type of sample used. Water samples studied included those from raw and treated wastewater and from pond sediments. Of the various treatments for reducing cytotoxicity of sewage concentrates, filtration through positively charged depth filters (Zeta-plus, type 50D) was the most effective and reduced the toxicity in 24 of 25 samples tested. The type 5S filter, which has a larger pore size, was much less effective. The negatively charged type 50D and Millipore types GS and HA were also less effective than the 50S filter. Centrifugation at 34,000 x g for 1 hr was the second most effective treatment, with four of six samples showing improvement. Centrifugation at 8,500 x g for 1 hr improved 37% of the samples tested. Treatment with XAD-2 resin columns improved 6 of 11 samples. Freon treatment was the least effective technique, with only 1 of 15 samples improving. Concerning the degree of toxicity reduction, filtration through 50S filters gave 1.2 to 4.4-fold reductions in cytotoxicity. Generally, as the degree of cytotoxicity in the original sample increasd, the reduction in toxicity by 50S filtration decreased. Centrifugation of concentrates from sewage pond sediments at 8500 x g for 1 hr followed by assay of the supernatant revealed a 3.4 fold decrease in toxicity. Whether a treatment which reduces cytotoxicity also reduces the number of infectious virus particles in the sample was also investigated. The 50S filters removed more than 99.9% of the Escherichia coli from suspensions containing 10,000 cells per ml of 0.05 M glycine with or without tryptose phosphate broth or beef extract, but no appreciable loss of virus particles was seen. (Baker-FRC)
W82-06757

MUTAGENIC ACTIVITY OF FISH AND SEDIMENTS IN THE SHEEP RIVER, ALBERTA,

Calgary Univ., Alberta. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06770

APPLICABILITY OF LIGHT ABSORBANCE AS A MEASURE OF OGANIC CARBON IN HUMIC LAKE WATER,

Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, T. De Boer, H. A. Kramer, and J. Voerman.
Water Research, Vol 16, No 6, p 1047-1050, June, 1982. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Chemical oxygen demand, *Organic carbon, *Pollutant identification, Ultraviolet radiation, Tjeukemeer, *The Netherlands, *Humic acids, Lakes, Turbidity, Water analysis, Oxygen demand.

Ultraviolet absorbance at 250 nm (E250) was a suitable estimator of dissolved organic carbon in humic, eutrophic water from Tjeukemeer, the Netherlands. The correlation of E250 with COD of filtered water samples did not change from year to year during 1970-1980 (with the exception of 1970-72, during a period of sediment resuspension) and was independent of sampling stations. Absorbance at 365 nm showed linear correlations but was more variable. The variability of the water quality (from oligohaline, transparent, and eutrophic in summer to fresh, highly colored, and eutrophic in winter) did not interfere with the method. Although turbidity measurements at 436, 530, and 620 nm and COD data from unfiltered water samples were linearly correlation coefficients and slopes of the correlation varied irregularly. (Cassar-FRC)
W82-06773

SAMPLING CHARACTERISTICS OF MACROPHYTE BIOMASS,

Wisconsin Univ. Extension, Madison. Dept. of Environmental Sciences.
S. A. Nichols.
Water Resources Bulletin, Vol 18, No 3, p 521-523, June, 1982. 3 Tab, 9 Ref.

Descriptors: *Biomass, *Sampling, Aquatic plants, Stratification, Stratified flow, Lakes, Lilly Lakes, *Wisconsin, *Pollutant identification.

The value of a stratified random system for improving the efficiency of biomass sampling is discussed along with factors which might be used to stratify samples. A case study is demonstrated at Lilly Lake, Wisconsin, where a statified random sampling reduced sampling effort by about 37%. During the summer of 1976 a sampling plan was devised to estimate macrophyte biomass of Lilly Lake. At that time the lake area was 36.6 hectares, with a maximum depth of 2.4 meters. The lake was dredged after 1976. The bottom was primarily muck, with sand and gravel predominating in the shallow water along the southeast shore. Ten strata were constructed. A preliminary survey was undertaken on August 10, 1976, to determine the biomass variability of the strata. Biomass variations within and between strata were analyzed using a one-way analysis of variance test. A significant difference in mean biomass was demonstrated. According to the data collected, about 308 samples would be needed to adequately sample the lake in a completely random fashion. In the case of Lilly Lake approximately three person days of effort would be saved for each time it was necessary to adequately sample the biomass of the lake using the stratified random sampling system proposed. This procedure can be used to design similar sampling strategies where information about species composition or growth curves for important macrophyte species is desired. (Baker-FRC)
W82-06779

SEPARATION OF AQUEOUS ORGANIC MIXTURES BY PERVAPORATION AND ANALYSIS BY MASS SPECTROMETRY OR A COU-

PLED GAS CHROMATOGRAPH-MASS SPECTROMETER,

Centre de Recherches Rhone-Poulenc Industries, Aubervilliers (France).
H. Eustache, and G. Histi.
Journal of Membrane Science, Vol 8, No 2, p 105-114, March, 1981. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Pervaporation, *Organic compounds, *Membrane processes, *Pollutant identification, Water analysis, Wastewater analysis, Industrial wastewater, Mass spectrometry, *Chlorinated hydrocarbons, *Aromatic compounds, Volatile compounds, Separation techniques, Gas chromatography.

A quick method for analysis of volatile organic compounds in dilute aqueous solution includes separation by pervaporation coupled with mass spectrometry or gas chromatography/mass spectrometry. The pervaporation process uses a membrane with the liquid mix on one side and a vacuum on the other. As the compounds pass through the membrane they are directly analyzed by mass spectrometry. Of the 4 membranes studied, TS-605, a cross-linked polydimethylsiloxane on a polyester support, has the highest enrichment factors for most compounds tested (benzene, styrene, chloroform, 1,2-dichloroethane, ethanol, acetone, acetic acid, n-butyl acetate, ethyl ether, pyridine, acetaldehyde, and vinyl chloride). Covitep, a low density polyethylene, is better than TS-605 for toluene, n-hexane, and cyclohexane. Polyethylene terephthalate and cross-linked polyvinyl alcohol membranes show little evidence of enrichment. Four examples are described: assay of trace levels of styrene in water, assay of trace levels of vinyl chloride in water, identification of oxygenated impurities of 1,2-dichloroethane, and analysis of industrial wastewater before treatment. (Cassar-FRC)
W82-06791

BIOASSAYS - PROCEDURES AND RESULTS,

Ecological Analysts, Inc., Sparks, NV.
A. F. Maciorowski, L. W. Little, L. F. Raynor, R. C. Sims, and J. L. Sims.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 830-848, June, 1982. 325 Ref.

Descriptors: *Literature reviews, *Bioassays, *Reviews, Water quality, Fish, Aquatic life, Monitoring, Bioindicators, *Pollutant identification, Pollutants, Water pollution control.

Recent research conducted in the area of bioassays to describe, evaluate, and predict potential hazards related to water pollution is cited in this literature review. Biodegradation testing methodology of chemicals as well as their fate in aquatic environments formed the subject of a symposium. The development and applicability of US EPA water quality criteria were reviewed. Biological monitoring took on a variety of meanings. A tiered approach to effluent monitoring using both chemical and biological test protocols was prepared. Sentinel organisms to indicate contamination of natural waters by pollutant accumulation and uptake constituted another approach to biological monitoring. The radionuclides americium-241 and plutonium-237 were found to turn over differentially in the mussel Mytilus galloprovincalis, and were discribed as the sum of three exponential functions. Work was also carried on in the areas of design, interpretation, and strategy of toxicity test systems; in the use of bacteria to detect pollutant effects; in assays with algae and other plants; on the use of invetebrates to detect toxic substances; on fish and amphibians as bioassay test organisms; on comparative testing in microcosms; and in health effects assays. (Baker-FRC)
W82-06810

MODIFICATION OF THE HYDROGEN PEROXIDE METHOD OF DETERMINATION OF TOTAL PHOSPHORUS IN NATURAL WATERS,

Centro de Edafologia y Biologia Aplicada del Cuarto, Seville (Spain).
F. Cabrera, E. Diaz, C. G. Toca, and P. De Arambarri.
Water Research, Vol 16, No 6, p 1061-1064, June, 1982. 3 Tab, 8 Ref.

Descriptors: *Water analysis, *Phosphorus, Natural waters, Marshes, Rivers, Chemical analysis, Digestion, *Pollutant identification.

Possible explanations for apparently conflicting analyses in the determination of 'total dissolved and suspended phosphate' and 'filterable orthophosphate' are discussed. A modification to the hydrogen peroxide-sulfuric acid digestion method used for determining total dissolved and suspended phosphorus in natural waters is presented in order to avoid loss of phosphorus by adsorption on hydrous iron and aluminum oxides formed during neutralization prior to filtration. By adding an extra volume of sulfuric acid after neutralization so that such oxides are dissolved, thus permitting the adsorbed phosphorus to pass into solution, more reliability for the method is obtained. Water samples were studied from the Guadiamar river and Guadalquivir marshes. The results indeed confirm that the presence of iron and/or aluminum materials in these natural waters may cause a loss of phosphorus when it is determined by the hydrogen peroxide-sulfuric acid method. The loss of phosphorus is dependent upon the final acidity of the digestion liquor filtrate and is overcome if the acidity is high enough to dissolve the hydrous oxide precipitated by neutralization with sodium hydroxide. The evidence suggests that a period of 30 minutes after the addition of 0.5 ml of 5N sulfuric acid was sufficient time to dissolve the iron and aluminum precipitation before filtering. (BakerFRC)
W82-06828

MICROBIOLOGICAL EXAMINATION OF SEBEEL WATER,

Kartoum Univ., (Sudan). Dept. of Agricultural Botany.
For primary bibliographic entry see Field 5C.
W82-06882

IMPROVED METHOD FOR DETERMINATION OF RESPIRING INDIVIDUAL MICROORGANISMS IN NATURAL WATERS,

Naval Research Lab., Washington, DC.
P. S. Tabor, and R. A. Neihof.
Applied and Environmental Microbiology, Vol 43, No 6, p 1249-1255, June, 1982. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Microorganisms, *Microscopy, *Respiration, Bacteria, *Pollutant identification, Fluorescence, Estuarine environment, Microbiological studies.

Individual respiring microorganisms and the total microbial population were determined by a combination of two methods: detection of electron transport system activity and epifluorescence microscopy. 2-(p-iodophenyl-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) was reduced by the active cellular electron transport system to INT-formazan, visible as opaque intracellular deposits upon staining the microorganisms with acridin orange. Microorganisms were transferred from a filter to a gelatin film on a cover glass, then coated with additional gelatin to produce a transparent matrix. This method detected 2- to 10-fold more respiring microorganisms in a Chesapeake Bay water sample (56-61%) than were previously reported for marine or fresh water samples. Significant losses in microorganism counts were experienced when samples were prepared with immersion oil or Nuclepore filters. (Cassar-FRC)
W82-06883

SAMPLING DESIGN AND ENUMERATION STATISTICS FOR BACTERIA EXTRACTED FROM MARINE SEDIMENTS,

South Carolina Univ., Columbia. Dept. of Biology.
P. A. Montagna.
Applied and Environmental Microbiology, Vol 43, No 6, p 1366-1372, June, 1982. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Bacteria, *Sampling, *Sediments, Microscopy, Mud, Sand, *Pollutant identification, Marine sediments, North Inlet, South Carolina, Statistical analysis.

The spatial and temporal distribution of marine bacteria in two types of sediments, muddy and sandy, were examined at a subtidal site at North Inlet, South Carolina. The experiment was designed to study the statistical aspects of sampling bacteria in the sediment, where bacteria are numerous and adhere to particles. The cell count, determined by acridine orange epifluorescence microscopy, fit a log-normal distribution. Bacterial numbers were 100 billion per g dry weight of mud and 1 billion per g dry weight of sand. Vvariations due to subsampling procedures were always statistically significant. The common practice of counting 20 fields from 1 filter preparation, adequate for bacterial counts in the water column, was not suitable for determining the bacterial population variance in marine sediments. It was recommended that replication of the subsampling level be performed. Data indicated that bacteria were more homogeneously distributed in sand than in mud. (Cassar-FRC)
W82-06884

DEVELOPMENT OF A METHOD FOR DETECTION OF HUMAN ROTAVIRUS IN WATER AND SEWAGE,

Texas Univ. Medical Branch at Galveston. Dept. of Microbiology.
E. M. Smith, and C. P. Gerba.
Applied and Environmental Microbiology, Vol 43, No 6 p 1440-1450, June, 1982. 4 Fig, 8 Tab, 47 Ref.

Descriptors: *Wastewater analysis, *Microbiological studies, Rotaviruses, Water analysis, *Pollutant identification, Houston, *Texas, Pathogens, Diseases.

A method for concentrating rotaviruses from tap water, treated sewage, and raw sewage was developed using the simian rotavirus SA11. The method was based on adsorption to and elution from Filterite fiberglass epoxy filters. Optimal conditions for adsorption of the virus were 0.5 nM AlC13 at pH 3.5 and for elution, 0.05 M glycine-NaOH supplemented with 10% tryptose phosphate broth at pH 10. The SA11 was counted by plaque assay; the human rotavirus, by immunofluorescence. Rotavirus was detected in raw and treated dewage from two Houston, Texas, treatment plants. Several criteria confirmed that the rotavirus was a human strain: immunofluorescence, neutralization with convalescent sera from humans infected by a rotavirus, neutralization or immunofluorescence with preimmune or preillness sera, sensitivity to pH 11 and other inactivating agents, byoyant density of 1.36 g per cu m (comparable to that reported for complete, infectious rotavirus particles), and a double-shelled particle diameter of 67.1 nm. The electron micrograph of cell lysates inoculated with sewage isolate showed particles similar to rotavirus in morphology. (Cassar-FRC)
W82-06885

FLUOROMETRIC DETERMINATION OF DNA IN AQUATIC MICROORGANISMS BY USE OF HOECHST 33258,

Naval Research Lab., Washington, DC.
J. H. Paul, and B. Myers.
Applied and Environmental Microbiology, Vol 43, No 6, p 1393-1399, June, 1982. 6 Fig, 1 Tab, 24 Ref.

Descriptors: *Bacteria, *Deoxyribonucleic acid, *Fluorometry, *Pollutant identification, Microorganisms, Water analysis, Microbiological studies, Dyes, Hoechst 33258, *DNA.

Microbial DNA was detected at 0.05-10 microgram levels in bacterial cultures and natural water samples by a method based on the use of Hoechst 33258 dye, which increases in fluorescence in the presence of DNA. The simple process involved extraction of DNA and determination of DNA by fluorometry. A study of extraction methods showed that sonication after suspension in SSC (NaCl, trisodium citrate solution at pH 7.0) and sonication of cells on membrane filters released

100-104% of the DNA. Treatment of extracts with DNase I showed that 95-100% of the observed fluorescence was from DNA. DNA was correlated with bacterial cell numbers as determined by the acridine orange direct count. DNA in environmental samples ranged from 165 ng per ml in eutrophic Potamac River water to 27 ng per ml for coastal Atlantic Ocean water. (Cassar-FRC)
W82-06889

COMPARISON OF METHODS FOR RECOVERING INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,

Health Effects Research Lab., Cincinnati, OH.
D. A. Brashear, and R. L. Ward.
Applied and Environmental Microbiology, Vol 43, No 6, p 1413-1418, June, 1982. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Viruses, *Sludge analysis, Wastewater analysis, Pollutant identification, *Elution, Centrifugation, Flocculation, Freon, waste treatment.

Five methods for recovering viruses from raw domestic wastewater sludge were compared. All methods included elution, concentration, and disinfection steps. Methods were: (1) freon elution, (2) water elution, (3) beef extract elution, (4) ASTM-1, aluminum chloride and beef extract, designed for primary and digested sludges, and (5) ASTM-2, beef extract and sonication, designed for anaerobically digested sludge. The most effective method was freon elution, followed by centrifugation and disinfection with ether. Concentration by centrifugation was more effective than by flocculation. Average relative virus recoveries, based on freon elution centrifugation results as 1.0, were: Method 2 with centrifugation, 0.72; Method 3 with centrifugation, 0.59; Method 4 unconcentrated, 0.57; and Method 5, 0.27. Efficiency of recovery was greatest in BGM cells, followed by RD and MA-104 cells. (Cassar-FRC)
W82-06890

ISOLATION OF PITTSBURGH PNEUMONIA AGENT FROM A HOSPITAL SHOWER,

Veterans Administration Medical Center, Pittsburgh, PA.
For primary bibliographic entry see Field 5B.
W82-06891

THE INFLUENCE OF PHYTOPLANKTON COMPOSITION ON THE RELATIVE EFFECTIVENESS OF GRINDING AND SONIFICATION FOR CHLOROPHYLL EXTRACTION,

Michigan University, Ann Arbor. Great Lakes Research Division.
W. Y. B. Chang, and R. Rossmann.
Hydrobiologia, Vol 88, No 3 p 245-249, May, 1982. 3 Tab, 13 Ref.

Descriptors: *Chlorophyll, *Phytoplankton, *Sample preparation, Algae, *Sonification, *Grinding, Diatoms, Cyanophyta, Water analysis, *Lake Michigan.

The chlorophyll recovery efficiencies of control, ground, and sonificated samples of phytoplankton were compared with samples collected at a depth of 5.5 m in the intake forebay of the Donald C. Cook Nuclear Plant on Lake Michigan. The six treatments used were: (1) control, (2) 45 sec sonification in an ice bath, (3) 45 sec sonification in an ice bath with vigorous shaking, (4) 3 min sonification in an ice bath, (5) 3 min grinding, and (6) 3 min grinding in an ice bath. Chlorophyll b levels were very low; no significant differences in recovery efficiencies were discerned. However, significant increases in concentrations of chlorophylls a and c were found between control and ground samples but not between controls and sonificated samples. Increasing sonification time or using an ice bath during grinding did not improve pigment recovery efficiency. Results of the 1976 samples tested (containing centric diatoms and filamentous blue-green alga) showed that ground samples exhibited 22-40% more chlorophyll a and 62-87% more chlorophyll c than sonificated samples. However, the 1977 samples, except for one showed no significant differences. Grinding recovered more chlorophyll c than sonification when total phytoplankton numbers were high. Grinding is the preferred method for sample preparation, but in some cases it may not improve recovery compared to no grinding. These situations include phytoplankton populations under severe nutrient limitation or subjected to extensive herbivore predation or to disease. (Cassar-FRC)
W82-06902

MULTIPLE ADDITION BIOASSAY OF TJEUKEMEER WATER,

Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 5C.
W82-06907

ECOLOGY OF STREAMS DRAINING FORESTED AND NON-FORESTED CATCHMENTS IN AN AREA OF CENTRAL SCOTLAND SUBJECT TO ACID PRECIPITATION,

Freshwater Fisheries Lab.
For primary bibliographic entry see Field 5C.
W82-06909

MICROBIOLOGY: METHODOLOGY AND QUALITY ASSURANCE,

Environmental Protection Agency, Cincinnati, OH.
R. H. Bordner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 024-1037, June, 1982. 156 Ref.

Descriptors: *Literature reviews, *Microbiological studies, *Water analysis, *Wastewater analysis, *Bacterial analysis, Microorganisms, Quality control, *Pollutant identification, *Reviews, Pathogens, Coliforms, Salmonella, Sampling, Monitoring, Bioassay, Toxicity, Mutagens, Bacteria, Vibrio, Water quality, Aeromonas, Klebsiella.

A review of recent literature on microbiological methods in water and wastewater analysis includes the 15th edition of 'Standard Methods for the Examination of Water and Wastewater.' About 75 papers are noted which concern new isolation and enumeration procedures. Many of these are comparisons of different procedures such as membrane filter, most probable number and its variations, plating, and direct count using coliforms and other fecal bacteria. Selective procedures are given for microorganisms such as Legionella pneumophila, Yersinia, Campylobacter, Vibrio, Aeromonas, Klebsiella, Salmonella, and Listeria. There is great interest in commercially available diagnostic kits, multitest systems, and automated computerized methods for bacterial identification, as evidenced by about 25 publications on testing and comparison of these systems. Sampling considerations include special problems of collecting specimens from boats, under ice cover, in stratified waters, from aquifers, in streams, wastewaters, boiler water, industrial effluents, sediments, at bathing beaches, and in deep waters. New approaches to rapid methods for bacterial enumeration are discussed. Examples are radiometric, serological, electrochemical, enzyme, chromatographic, and chemiluminescent methods. Bacteria are used in bioassays for toxic or mutagenic substances, for example, Nitrobacter for assessing wastewater toxicity, effects of dyes on bacterial action, and improvements and development of the Ames Salmonella test. Quality control schemes are described, using control cultures and statistical methods. Several possible sources of error are mentioned, such as stacking plates, and nonuniform cooling rates. Health hazards to laboratory workers include infections from pathogens used in the Ames test and typhoid fever from the very infectious Salmonella typhi, sometimes used in testing disinfectants. (Cassar-FRC)
W82-06919

ORGANICS,

Washington Univ., Seattle. School of Public Health and Community Medicine, Department of Environmental Health.
F. B. DeWalle, C. Lo, J. Sung, D. Kalman, and E. S. K. Chian.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, 555-576, June, 1982. 8 Tab, 242 Ref.

Descriptors: *Literature reviews, *Organic compounds, *Water anaylsis, *Wastewater analysis, *Fate of pollutants, *Pollutant identification, *Reviews, Organic matter, Biological oxygen demand, Organic carbon, Hydrocarbons, Pesticides, Insecticides, Herbicides, Sediments, Quantitative analysis, Detergents, Surfactants, Chlorinated hydrocarbons, Sludge, Polychlorinated biphenyls, Aquatic animals, Runoff, Drinking water, Groundwater, Surface water, Industrial wastewater, Degradation, Aromatic compounds.

Recent publications concerning analysis of organics in water are reviewed. An overview of nonspecific methods (total organic carbon, COD, and BOD) is followed by group methods and compound specific methods. The group methods include techniques for determination of total amounts of acids, aldehydes and hydrocarbons. Compound specific methods quantitate individual compounds. The references are grouped into 8 tables with the following headings: methods of detection and identification of detergents and related compounds; methods of identification and quantification of aliphatic and aromatic hydrocarbons; presence, degradation, and attenuation of aliphatic and aromatic hydrocarbons; methods for identification and quantification of pesticides, chlorinated hydrocarbons, and related compounds; presence, degradation, and attenuation of pesticides, chlorinated hydrocarbons, and related compounds; methods for identification and quantification of naturally occurring organics; methods for identification of organics present in surface and groundwater, drinking water, wastewater, and other media; and degradation and attenuation of organics in surface and groundwater and wastewater. These tables list the sample type (for example, sediment, wastewater, soil runoff), the compound(s) being determined, methods, and significant results. (Cassar-FRC)
W82-06922

A 'DIPSTICK' SAMPLER FOR RAPID, CONTINUOUS CHEMICAL PROFILES IN SEDIMENTS,

Alaska Univ., Fairbanks, Inst. of Marine Science.
W. S. Reeburgh, and R. E. Erickson.
Limnology and Oceanography, Vol 27, No 3, p 556-559, May, 1982. 3 Fig, 7 Ref.

Descriptors: *Pollutant identification, *Sampling, *Sediments, *Chemical analysis, Chemical composition, Bays, Sulfides, Measuring instruments, Interstitial waters.

An approach is presented to obtaining rapid, continuous profiles of chemical components of sediments which involves in situ equilibration of a thin band of polyacrylamide gel cast in a Lucite support or dipstick. The support-gel combination is inserted into sediments or cores and equilibrates rapidly with adjacent interstitial waters. The gels are transparent and relatively inert chemically for short exposures. They have high water content, are nonionic and are durable enough to resist tearing in sandy sediments. The gels can be dosed with specific color-forming reagents which react with components in the sediments and provide a visual semiquantitative indication of depth distributions. They can also be used as equilibration samplers and sectioned for extraction and analysis after retrieval. Results of sediment analysis using these dipstick samplers are presented for sulfide containing sediments in Skan Bay. This bay is a silled basin on the northwest side of Unalaska Island (Aleutian Islands) with anoxic sediments. Dipstick samplers, when dosed with appropriate reagents, give rapid, continuous, semiquantitative measurements of sulfide in anoxic marine sediments. (Baker-FRC)
W82-06931

CHANGE IN COMPOSITION OF ORGANIC MATTER IN THE TAMA AND THE ARA RIVER SEDIMENTS BY POLLUTION, (IN JAPANESE),

Tokyo Science Univ. (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, Y. Yokoyama, and S. Suzuki.
Japanese Journal of Limnology, Vol 43, No 1, p 5-10, January, 1982. 6 Fig, 2 Tab, 9 Ref.

Descriptors: Rivers, *Organic compounds, Aromatic hydrocarbons, Aliphatic hydrocarbons, *Sediments, Ara River, Tama River, *Japan, Organochlorine compounds, Phthalate esters, Chemical analysis, Water analysis, Water pollution, Industrial wastes.

An approach for characterizing organic pollutants in sediments of an urban river is presented. The organic matter content of sediments in the downstream areas of the Tama and the Ara Rivers was 2-5 times as great as that of sediment upstream. The sedimentary organic matter was extracted successively with water, n-hexane, ethyl acetate, methanol, and 1 N NaOH. The amounts of organic water extracted with n-hexane or ethyl acetate from the downstream sediment in the Tama River were remarkably higher than those from stream sediment. In the downstream areas of the Ara River the amounts of n-hexane, water and 1 N NaOH extracts were higher than those in the upstream ones. The n-hexane extract obtained from the sediment downstream in the Tama River was further separated into three fractions by silica gel and silica gel/alumina column chromatography. These sub-fractions were characterized by IR, NMR, GC, TLC, and elemental analyses. The analyses indicated that the organic compounds present in larger amounts downstream were aliphatic and aromatic hydrocarbons, organochloine compounds and phthalate ester. (Baker-FRC)
W82-06974

MECHANISMS FOR TRACE METAL ENRICHMENT AT THE SURFACE MICROLAYER IN AN ESTUARINE SALT MARSH,

Cornell Univ., Ithaca, NY., Dept., of Environmental Engineering.
L. W. Lion, R. W. Harvey, and J. O. Leckie.
Marine Chemistry, Vol 11, No 3, p 235-244, 1982. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Estuarine environment, *Trace metals, Copper, Cadmium, Lead, Estuaries, *Salt marshes, Microorganisms, Microenvironment, San Francisco Bay, Bays, Particulate matter, *Organic carbon.

The relative importance of metal complexation with dissolved surface-active organic ligands, metal adsorption to particle surfaces, and bacterial uptake of metals were evaluated as processes which control the partitioning of cadmium, copper and lead in the surface microlayer of an estuarine salt marsh. The importance of each mechanism was evaluated by comparing observed trace metal enrichment in the dissolved and particulate forms with the enrichment of dissolved organic carbon (DOC), particles and bacteria. Salt marsh field samples were obtained at the confluence of a salt marsh drainage channel with the South San Francisco Bay estuary. Little or no partioning of DOC was noted in either tidal cycle, while particle numbers and bacteria were found to be enriched at the surface microlayer in several instances. The lack of DOC partitioning suggests that little or no partitioning of dissolved Cd, Cu or Pb would be expected. Study revealed that particulate Cd, Cu, and Pb were partitioned during events in which particle enrichment was observed, and with the exception of dissolved Pb in the first sample of each tidal cycle, minimal partitioning of dissolved metals was noted in both tidal studies. The observed levels of partitioning of dissolved, particulate and total Cd, Cu and Pb and the correlation between the partitioning of particulate metals and particle numbers strongly suggest that microlayer enrichment of trace metals is controlled by the behavior of particles, for example, bacteria, organic detrital materials and inorganic components such as clay minerals. The observed distributions of Cd, Cu and Pb between the dissolved and particulate phase were consistent with their calculated chemical speciation in computer-simulated surface microlayer and bulk seawater. (Baker-FRC)
W82-06975

INORGANICS,

Pope Scientific Inc., Menomonee Falls, WI.
D. S. Polcyn.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 520-540, June, 1982. 15 Tab, 379 Ref.

Descriptors: *Literature reviews, *Inorganic compounds, *Water analysis, *Spectroscopy, *Reviews, *Pollutant identification, Computers, Quality control, Sample preservation, Trace metals, Chemical analysis, Chelation, Speciation, Metals, Heavy metals, Chromatography, Hydrogen ion concentration, Electrodes, Conductance, Atomic absorption spectroscopy, Emission spectroscopy, X-ray spectroscopy, Flow injection analysis, Voltammetry, Reagents, Potentiometers, Ion-selective electrodes.

A review of the recent literature on analysis of inorganics in water includes new books and reviews, the use of computers and microprocessors in analysis, data analysis and quality control, interactions of samples with containers, preparation of high purity reagents, corrections for air buoyancy in weighing granular or powdered materials, sample concentration, detection and distribution of trace metals, complexation, speciation, and interlaboratory studies. A table lists various constituents found in water (metals, chlorine, silicon, and other selected elements) and references concerning studies of their speciation. The remainder of the literature references on inorganic analysis is organized into 14 tables: chromatographic methods (gas, ion, and liquid); pH (analysis and methods); selective ion electrodes (reviews, theory, and application); voltammetry (reviews, theory, and applications); voltammetry and stripping analysis (anodic and potentiometric); conductance; atomic absorption spectroscopy (reviews, theory, and application); atomic absorption spectroscopy and hydride formation; flame emission spectroscopy; inductively coupled plasma emission spectroscopy; X-ray spectroscopy (emission and fluorescence); miscellaneous instrumental methods; flow injection analysis; and analysis for specific constituents. The constituents are arranged alphabetically by name and include elements, cyanide, and thiocyanate. (Cassar-FRC)
W82-06999

5B. Sources Of Pollution

HERBICIDE LOSS IN RUNOFF WATER AND SEDIMENT AS AFFECTED BY CENTER PIVOT IRRIGATION AND TILLAGE TREATMENTS,

Nebraska Univ.-Lincoln. Dept. of Agronomy.
L. N. Mielke, and J. R. C. Leavitt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243452, Price codes: A02 in paper copy, A01 in microfiche. Report, June 1981. 17 p, 7 Tab, 9 Ref. OWRT A-062-NEB(1). 14-34-0001-0129.

Descriptors: *Herbicides, *Agricultural runoff, *Irrigation, *Surface runoff, *Pesticide toxicity, Pesticide drift, Sediment transport, Sediments, Sprinkling, Sprinkler irrigation, Spray irrigation, Water pollution, Water pollution sources, Irrigation practices, Irrigation effects, Environmental effects, Pollutants, Pollutant load, Water pollution effects.

Herbicide runoff losses for atrazine and alachlor were studied under three types of center pivot irrigation with conventional and minimum tillage: conventional high-pressure impact sprinkling; low-pressure impact sprinkling; and low-pressure spraying. Tillage practices that emphasize the use of the disk and minimum tillage enhance the potential for herbicide runoff. Nonetheless, herbicide losses can be minimized under topographic and soil conditions conducive to runoff by selecting the proper irrigation system. Herbicide water solubility affects the runoff pattern: water-soluble herbicides are susceptible to initial runoff events, with more of loss associated with water solubility. However, the amount of herbicide carried on the sediment is minimal, even with a relatively insoluble herbicide (e.g., atrazine). Accumulative herbicide runoff loss after three consecutive events did not exceed 0.1% of the amount applied, even under conditions favoring runoff. Furthermore, the amount of herbicide in runoff material, coupled to the degree of dilution that normally occurs between the site of runoff and herbicide-sensitive crops, is sufficient to make phytotoxic events due to herbicide runoff rare. (Zielinski-MAXIMA)
W82-05921

ENVIRONMENTAL IMPACT OF UPLAND STREAMS ON THE OKEFENOKEE SWAMP,

Georgia Univ., Athens. Inst. of Ecology.
E. R. Blood.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243569, Price codes: A10 in paper copy, A01 in microfiche. Report ERC 06-81, September, 1981. 194 p, 30 Fig, 26 Tab, 96 Ref. OWRT B-138-GA(1).

Descriptors: *Surface runoff, *Stream upflow, *Water analysis, *Hydrologic models, *Swamps, Surface water, Streams, Streamflow, Stream profiles, Stream discharge, Bogs, Marshes, Water quality, *Environmental effects, Hydrology, Model studies, Chemical analysis, *Okefenokee Swamp, Georgia, Florida.

Surface water runoff to the swamp from upland streams is not uniformly distributed. Low topographic relief, highly leached sandy soils, and land use practices contribute to low flow, low sediment yields and low nutrient characteristics of the upland surface water. Investigation of the swamp system level biogeochemistry and hydrology, and several factors influencing them (geomorphology, environmental variables, anthropogenic perturbations) provided some insight of swamp ecosystem homeostasis. Upland surface water low salinity and low sediment yields are a function of the predominance of silvicultural practices on the uplands. Low agricultural use and little urbanization minimize anthropogenic inputs of sediments and nutrients to the streams. The model developed provides new insights into swamp hydrology and some weaknesses of using a static model to reflect a hydrologically dynamic ecosystem. System level biogeochemistry was assessed through the biogeochemistry of the major hydrologic components. The swamp surface water is similar to other blackwater systems, having low pH and ionic strength, high organic carbon which influences water quality and chemistry, and a predominance of organic or reduced nutrient forms. Seasonal dynamics, precipitation, upland stream channelization, and cation/anion distributions are discussed. (Zielinski-MAXIMA)
W82-05933

GEOCHEMISTRY OF LEACHATES FROM SELECTED COAL MINING AND COMBUSTION WASTES,

Kansas Water Resources Research Inst., Manhattan.
E. E. Angino, and D. A. Kopsick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243593, Price codes: A06 in paper cpy, A01 in microfiche. Report and Supplement to Contribution No 211, June, 1981. 110 p, 24 Fig, 16 Tab, 9 Plates, 62 Ref, 4 Append. OWRT A-087-KAN(2). 14-34-0001-8018.

Descriptors: Fly Ash, Bottom Ash, *Leachates, Water Quality, *Coal mining, *Mine wastes, *Gob, Groundwater pollution, *Geochemistry, Inorganic wastes, *Missouri.

During the coal, large amounts of inorganic material (gob) are removed with thee coal. After cleaning of the coal, this waste is deposited adjacent to the mined area. One of these gob piles, located in Barton County, Missouri, is evaluated as to chemi-

cal composition of the waste, leaching characteristics of the waste and mineralogy of secondary minerals deposited at the pile. This waste material is enriched in Pb, Zn, Cd and Cu, relative to the abundances of these elements in average shales. Leachate from this material shows elevated concentrations of Zn and Cd. After twenty-five years of weathering, this gob is still producing leachate with high concentrations of Cd, Mn, Cu, Zn and Fe. Various hydrous states of ferrous sulfate, ranging from szomolnokite, FeS04H2O, to melanterite, FeS04.7H2O were identified from minerals collected at the pile. Analysis of the monohydrate form showed enrichment in Fe, Mg, Zn, Cd, Cu and Mn, relative to the whole gob sample and leachate sample. Two types of coal combustion wastes, fly ash and bottom ash, from five coal producing provinces of the United States are discussed in relation to Ca, Mg, Na, K, Mn, Fe, Cu, Zn and Pb concentrations in the whole sample and in the leachate generated from these ashes. Fly ash from northeast Missouri coal yields a leachate enriched in Pb, Zn, Cu, Fe, Mn and Cd, relative to other leachates, which is indicative of mineralization from nearby lead-zinc deposits. Leachates from two Wyoming fly ashes and bottom ashes exhibit low trace metal concentrations and high Ca, Mg, Na and K concentrations. Intermediate between these two samples are the coompositions of leachates generated from the ashes of eastern Kentucky and southern Illinois coal. An evaluation of geology, hydrogeology, soil chemistry and groundwater chemistry at an ash disposal site of a coal-fired power plant showed elevated concentrations of Ca, Mg and Na plus K in the leachate of the coal ash relative to native groundwater. Only trace amounts of Mn, Fe, Cu, Zn are present in the ash leachate and no degradation of the local groundwater quality is predicted for this site. (See also W80-04604)
W82-05936

INVESTIGATIONS OF DISPERSAL IN AN AREA OF COMPLEX CIRCULATION - THE OUTER THAMES ESTUARY,

Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.
J. W. Talbot.
Ocean Science and Engineering, Vol 6, No 3, p 301-333, 1981. 13 Fig, 1 Tab, 23 Ref.

Descriptors: Estuaries, Water currents, *Thames estuary, *England, Mathematical models, *Model studies, *Wastewater disposal, Sludge, Sludge disposal, Ocean dumping, *Path of pollutants, Water circulation.

The problem of the dispersal of the products of sewage sludge dumping in the Thames Estuary was examined using a mathematical model in conjunction with conventional field measurements. The conventional methods employed included moored recording current meters, sea-bed drifters and a radioactive-tracer release. Some 5 million tons of digested sludge are dumped each year in the Barrow Deep channel of the outer estuary. The Thames Estuary is an area of moderate tidal velocities, in some parts 2 knots being exceeded on spring tides. It is also an area of shallow water with a complicated bottom topography, including a system of sandbanks, many of which dray out at low water and which alternate with channels whose maximum depth is about 20 meters. It was also necessary to consider the effects of the residual component, as the estuary lies between a southerly flow down the English east coast and a northeasterly flow through the Dover Strait. Dispersal is thus likely to be complex. Current meter records indicated that water takes between 2 and 2.5 hours to move from the position of a patch at 1450 hr to the position of the center of a patch found on the sea bed. The labeled sludge began to fall in the water column as high water approached, but the main deposition on the bed occurred close under the East Barrow sandbank between 2 and 2.5 hours after high water. Two major conclusions of the study were that the movement was in general to the south. However, there was some strong evidence for a northerly drift close to the Essex coast, and drifters released in the Wallet probably moved initially to the northeast before joining the general southerly drift further offshore. No evidence was found to indicate a general near-bed transport into the Thames. (Baker-FRC)
W82-05946

SOIL AND GROUNDWATER CHANGES UNDER LAND TREATMENT OF WASTEWATER,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5D.
W82-05964

GAMMA EMITTING FISSION PRODUCTS IN SURFACE SEDIMENTS OF THE RAVENGLASS ESTUARY,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Marine Pollution Bulletin, Vol 13, No 4, p 135-138, April, 1982. 2 Fig, 2 Tab, 13 Ref.

Descriptors: Estuaries, *Radioactive wastes, *Ravenglass Estuary, *Cesium-137, Sediments, Pollutant identification, Nuclear energy, Fuel, *Path of pollutants, *England.

Ravenglass Estuary is located about 10 km south of the Sellafield nuclea[illegible] reprocessing facility. A survey is reported of the important gamma emitting fission products found in the surface sediments of the estuary in May of 1978. The influence of the silt sized content of the surface sediments on the geographical distribution of fission products is discussed. The results are compared with recent annual mean results published by the Ministry of Agriculture, Fisheries and Fodd (MAFF) for their monitoring of the Newbiggin site. Sediment samples were collected by carefully removing the uppermost 0.5 cm over a 1 square meter area at each location. A detailed survey of gamma emitting fission products in the surface sediments of the estuary shows that considerable variations occur, and that for cesium-137 and to a lesser extent for other radionuclides, the proportion of silt present is an important control of their distributions. The annual mean surface sediment activities reported by MAFF for a single site sampled at monthly intervals are significantly lower than those found at the majority of sites in the overall estuary. (Baker-FRC)
W82-05984

BIOCONCENTRATION OF A HEXACHLOROBIPHENYL IN GREAT LAKES PLANKTONIC ALGAE,

New York State Dept. of Health, Albany. Div. of Labs. and Research.
T. C. Lederman, and G-Y. Rhee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 380-387, March, 1982. 6 Fig, 2 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Algae, *Bioaccumulation, *Hexachlorobiphenyl, Aromatic compounds, Chlorinated hydrocarbons, *Great Lakes, Accumulation, Adsorption, Phytoplankton, Insecticides, Biomass, Desorption, Fate of pollutants, Fragilaria crotonensis, Ankistrodesmus falcatus, Microcystis.

Bioconcentration factors for 2,4,5,2', 4', 5'-hexachlorobiphenyl (HCB)were in the range off 100,000 to 1 million for Great Lakes algae Fragilaria crotonensis, Ankistrodesmus falcatus, and Microcystis sp. Bioconcentration factors were higher in A. falcatus than in the other 2 species, twice as high in dead cells as compared to live cells, lower in greater biomas es per unit volume of culture, and an order of magnitude lower for frustules than live and dead cells. Surface absorption was not an important fator in HCB bioaccumulation. F. Crotonensis cells with a mucilagenous layer had bioconcentration factors twice as high as cells with the layer removed. The concentration of HCB within the range used (up to 630 ng per liter) did not change the order of magnitude of the bioconcentration factor. Desorption rates of HCB were much lower than adsorption rates, with A. falcatus showing the greatest desorption and Microcystis the least. (Cassar-FRC)
W82-05991

VARIABILITY OF STREAM WATER QUALITY IN SOME LAND MANAGEMENT SYSTEMS IN THE SOUTHERN KAKIOKA BASIN, JAPAN,

Tokyo Univ. (Japan). Dept. of Botany.
T. Hirose, and N. Kuramoto.
Agro-Ecosystems, Vol 7, No 1, p 47-61, 1981. 4 Fig, 7 Tab, 23 Ref.

Descriptors: *Water quality, *Land use, *Forest watersheds, *Agricultural watersheds, Kakioka Basin, *Japan, Land management, Cropland, Nitrates, Nitrites, Ammonium, Phosphates, Potassium, Sodium, Calcium, Magnesium, Fertilizers, Livestock, Principal component analysis, Nutrients, Fate of pollutants, Seasonal variation.

The effects of land use on stream water quality and the diurnal and seasonal patterns of water quality were investigated at four sites in the predominantly rural Kakioka Basin, Japan. Concentrations of eight inorganic ions were determined (nitrate, nitrite, ammonium, phosphate, potassium, sodium, calcium, and magnesium). Site 2 and 4 were forest-covered. Sites 9 and 11 were cropland (paddy fields and upland fields) and livestock raising regions, but Site 11 was more heavily populated and had more livestock and fertilizer use than Site 9. Concentrations of all ions except phosphate increased with increasing land cultivation and human settlement. Principal component analysis determined that monthly veriations in ion concentrations were highly significant for all ions. Diurnal variations were significant for ammonium, Ca, and MG at Site 4; Mg at Site 9; and nitrite, ammonium, phosphate, K and Na at Site 11. At Sites 2 and 4 diurnal variations in stream water quality were small compared to monthly variations and to diurnal variations in streams under human influence. At Sites 9 and 11 diurnal variations were quite large, sometimes exceeding monthly variations. (Cassar-FRC)
W82-06020

COMPARATIVE STUDY ON ORGANIC CONSTITUENTS IN POLLUTED AND UNPOLLUTED INLAND AQUATIC ENVIRONMENTS--III. PHENOLS AND AROMATIC ACIDS IN POLLUTED AND UNPOLLUTED WATERS,

Tokyo Metropolitan Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-06033

THE ROLE OF SUSPENDED SOLIDS IN THE ESTUARINE GEOCHEMISTRY OF MERCURY,

Lancaster Univ. (England). Dept. of Environmental Sciences.
J. E. Rae, and S. R. Aston.
Water Research, Vol 16, No 5, p 649-654, May, 1982. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Suspended solids, *Mercury, *Estuary, Fate of pollutants, Adsorption, Wyre Estuary, England, Tides, Industrial wastes, Organic carbon, Mixing, Particle size, Sediments.

The mercury budget in surface waters of the Wyre Estuary, England, was studied at eight stations during a tidal cycle. This system is contaminated with industrial wastes, including chlor-alkali plant effluents. Mercury was strongly associated with suspended solids; the soluble fraction was never more than a few percent of total Hg present. At high chlorinity periods Hg concentrations in suspended solids decreased significantly and were correlated with increases in particle grain size (decreased surface area and decreased organic carbon content). Hg concentrations in suspended solids were linearly correlated with percentage organic carbon. Laboratory leaching experiments proved that Hg was not easily desorbed from particulate matter but was associated with the organic carbon fraction of the sediments. (Cassar-FRC)
W82-06035

A SIMPLIFIED BUFFER CAPACITY MODEL FOR SANITARY LANDFILL LEACHATE,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. Gibs, R. J. Schoenberger, and I. H. Suffet.
Water Research, Vol 16, No 5, p 699-705, May, 1982. 8 Fig, 4 Tab, 16 Ref.

Descriptors: *Buffer capacity, *Landfills, *Leachates, Carbonates, Model studies, Sanitary landfills, Organic acids, Acids, Degradation, Hydrogen ion concentration, Anaerobic conditions, Fate of pollutants.

A model of the buffer capacity of sanitary landfill leachate, based on the products of anaerobic decomposition, assumes that all organic acids are acetic acid. This simplification reduces the number and complexity of required chemical analyses and the calculations. The model was tested on two samples (winter and summer) of Bucks County, Pennsylvania, Landfill. The model predicted maximum buffer capacity pH within 0.35 of the actual value, but underpredicted the magnitude by 8-16%. It was accurate over a pH range of 6 to 10 for the winter sample and 3 to 10 for the summer sample. Carbonate contributed a minimum of 67% to the maximum buffer capacity. (Cassar-FRC)
W82-06038

ESTIMATION OF PRE- AND POST-DEVELOPMENT NONPOINT WATER QUALITY LOADINGS,

General Development Corporation, Miami, Florida, Environmental Planning and Programs Department.
A. N. Shahane.
Water Resources Bulletin, Vol 18, No 2, p 231-237, April, 1982. 2 Fig, 10 Tab, 16 Ref.

Descriptors: *Pollution load, *Land use, *Community development, *Nonpoint pollution sources, Water quality, Water pollution sources, Fate of pollutants, Runoff, Florida, Urban development, Nitrogen, Phosphorus, Suspended solids, Biological oxygen demand.

Three approaches were used to estimate pre- and post-development water quality loadings from two proposed Florida residential communities. Results from the second approach most closely resembled the results of the time-consuming third approach, a conventional hydrologic budget model combined with pollutant concentrations. The second approach involved summing existing annual data for recorded storms to produce pounds per acre per year loadings for suspended solids, total nitrogen, total phosphorus, and BOD5, determining the land use types for each phase of community development, and estimating pre- and post-development water quality loadings in terms of areal coverages of different land uses at various phases of development. Land use types included highways, flatwood/range, woodland, swamp, pasture, improved pasture, cultivated, residential multifamily, and commercial. (Cassar-FRC)
W82-06043

MERCURY IN THE RIVER MERSEY, ITS ESTUARY AND TRIBUTARIES DURING 1973 AND 1974,

Liverpool Univ. (England). Dept. of Oceanography.
D. Airey, and P. D. Jones.
Water Research, Vol 16, No 5, p 565-577, May, 1982. 5 Fig, 2 Tab, 50 Ref.

Descriptors: *Mercury, *Particulate matter, *Industrial wastes, *Path of pollutants, Fate of pollutants, Mersey Estuary, Dredging, Liverpool Bay, Pollution load, Rivers, Estuaries, Sediments.

Mercury levels were measured in water and suspended matter at 53 stations in the Mersey River system, quarterly from August 1973 to June 1974. A graph depicts the Hg load on particulate matter (micrograms per g), suspended Hg (micrograms per liter), and dissolved Hg (ng per liter). Highest mean Hg levels were found in the River Water (270 ng per liter dissolved Hg, 1.92 micrograms per liter particulate Hg, and > 80 micrograms per g Hg load) and in the Manchester Ship Canal (249 ng per liter, 1.2 micrograms per liter, and 24.3 micrograms per g, respectively). Most Hg was associated with particulates, more than 80% in a heavily polluted section where fresh water and seawater met. The load of Hg on particulates was low in August. Dissolved Hg concentrations and Hg load on particulate matter were always greater in freshwater than in tidal waters except during a flood. Low dissolved Hg levels were found in fresh water in August and in seawater in November; high levels were found in fresh water in June. Suspended Hg concentrations were higher in tidal areas than at fresh water stations. The estimated mean annual weight of Hg entering Liverpool Bay during the study period was 1.55 tons transported by water flow and 17 tons by dredging the channel and dumping spoils in the Bay. (Cassar-FRC)
W82-06049

A SAMPLING STUDY OF THE BROWN SEAWEED, ASCOPHYLLUM NODOSUM AS A MARINE MONITOR FOR TRACE METALS,

Queen's Univ., Kingston (Ontario). Dept. of Chemistry.
M. E. Woolston, W. G. Breck, and G. W. VanLoon.
Water Research, Vol 16, No 5, p 687-691, May 1982. 1 Fig, 6 Tab, 8 Ref.

Descriptors: *Metals, *Bioindicators, *Algae, Fate of pollutants, Copper, Cadmium, Zinc, Manganese, Trace levels, Heavy metals, Ascophyllum nodosum, Seaweeds, Indicators, Accumulation, Bioaccumulation, Estuaries, St. Croix Estuary, Passamaquoddy Bay.

Concentrations of Cu, Cd, Mn, and Zn were determined in samples of the brown seaweed, Ascophyllum nodosum, collected in the St. Croix Estuary and Passamaquoddy Bay, between Maine and New Brunswick. There were greater statistical differences in concentrations of Mn, Cd, and Zn (but not Cu) between sites than between samples. Metal concentrations at different sites indicated trends, areas of uniformity, and local pollution sources. However, within any element there was no constancy of concentration factors (ratio of concentration of a particular element in the plant to that of the element in the water). (Cassar-FRC)
W82-06050

TRANSPORT OF IRON, MANGANESE, CADMIUM, COPPER, AND ZINC BY MAGELA CREEK, NORTHERN TERRITORY, AUSTRALIA,

Caulfield Inst. of Tech., Caulfield (Australia), Water Studies Centre.
B. T. Hart, S. H. R. Davies, and P. A. Thomas.
Water Research, Vol 16, No 5, p 605-612, May, 1982. 6 Fig, 2 Tab, 18 Ref.

Descriptors: Metals, *Sediment transport, *Pollution load, *Fate of pollutants, Heavy metals, Magela Creek, Australia, *Iron, *Manganese, *Zinc, *Copper, *Cadmium, Suspended solids, Conductivity, Denudation, Tropical regions, Weathering, Baseline studies.

Water quality in Magela Creek, Australia, was determined during five major floods during the 1978-79 wet season. This highly weathered undisturbed watershed contains uranium deposits recently approved for mining. Conductivity was low, 10-21 micros per cm. Suspended solids were 5-46 mg per liter, highest during the early stages of a flood event. It was calculated that in an average year 5300 tons of sediment were transported past the sampling point, representing a very low annual denudation rate. Trace metals loads were very low. Mean metals concentrations (micrograms per liter) were: Fe, 281; Mn, 7.8; Zn, 2.8; Cu, 0.41; and Cd, 0.04. Trace metals were also very low. Total amounts (in kg per sq km) transported during the wet season were: Fe, 117; Mn, 3.6; Zn, 1.3; Cu, 0.2; and Cd, 0.02. (Cassar-FRC)
W82-06054

EFFECTS OF DISSOLVED ORGANIC MATTER ON ADSORPTION OF HYDROPHOBIC ORGANIC COMPOUNDS BY RIVER- AND SEWAGE-BORNE PARTICLES,

Wisconsin Univ.-Madison. Water Chemistry Program.
J. P. Hassett, and M. A. Anderson.
Water Research, Vol 16, No 5, p 681-686, May, 1982. 4 Fig, 2 Tab, 18 Ref.

Descriptors: *Adsoprtion, *Particulate matter, *Organic compounds, *Cholesterol, Polychlorinated biphenyls, Suspended solids, *Fate of pollutants, Dissolved organic carbon, Organic carbon, Organic matter, Wastewater.

Adsorption of labeled cholesterol and 2,2',5,5'-tetrachlorobiphenyl by suspended solids from river water and treated sewage was studied in distilled water, sewage and river water and was compared to adsorption in solutions of organic matter concentrated by ultrafiltration. Sewage particulate matter was more effective in adsorption than river particulates. Dissolved organic matter reduced sorption of the two hydrophobic compounds by the particulate matter. Possible reasons for this interference are formation of complexes between the study compounds and the dissolved organic matter or competitive adsorption. Partition coefficients and standard free energies of adsorption are listed. (Cassar-FRC)
W82-06056

STORM RELATED DILUTION OF CONDUCTANCE IN THREE HYDROLOGICALLY DIFFERENT WATER BODIES,

State Univ. of New York at Syracuse, Coll. of Environmental Science and Forestry.
V. A. Ferro.
Water Resources Bulletin, Vol 18, No 2, p 311-316, April, 1982. 2 Fig, 13 Ref.

Descriptors: *Conductance, *Storm water, *Urban runoff, Fate of pollutants, Water quality, Ponds, Canals, Streams, Syracuse, New York, Butternut Creek, Runoff, Overland flow.

Electrial conductance was monitored in three water bodies on the fringe of metropolitan Syracuse, New York, in the summer of 1980 to determine the effect of precipitation on water quality. Results of measurements in a groundwater pond, Butternut Creek, and a canal showed that water quality was a function of hydrologic, precipitation, and watershed characteristics. In the groundwater pond means dry weather conductance was 1250 micromhos per cm. Precipitation and overland flow produced dilutions of 50-150 micromhos per cm in the littoral zone. A seasonal peak of 1400 micromhos per cm was attained in late August during a period of evaporative losses and low rainfall. In the creek the mean dry weather conductance was 740 micromhos per cm. Dilution, which decreased this value from 50 to 200 micromhos per cm, was governed by the orientation of the summer storm track (from the west) to the creek orientation (northerly). Extreme fluctuations in conductance (50-750 micromhos per cm) were measured in the Butternut Feeder Canal (mean base flow conductance 1175 micromhos per cm). These were a result of differences in land use. The steep urbanized areas contributed high amounts of dissolved solids to the canal. (Cassar-FRC)
W82-06067

SEDIMENT-WATER INTERACTIONS OF CU, ZN, AND PB DISCHARGED FROM A DOMESTIC WASTE WATER SOURCE INTO A BAY OF LOUGH NEAGH, NORTHERN IRELAND,

New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Rippey.
Environmental Pollution, Series B, Vol 3, No 3, p 199-214, 1982. 3 Fig, 8 Tab, 61 Ref.

Descriptors: *Sediment-water interfaces, Metals, *Zinc, *Copper, *Lead, Phosphorus, Sediments, Wastewater disposal, Path of pollutants, Trace metals, Municipal wastewater, *Ireland(Northern).

This study describes the influence of a mainly domestic wastewater discharge on the trace metal

regimes of Kinnego, Closet and Derryadd Bays, Southwest Lough Neagh, Northern Ireland, by means of their sediments. Lough Neagh is a shallow eutrophic lake which has developed to its present state through progressive cultural eutrophication. Two sewage disposal works discharge into the area, dumping sewage from primarily domestic sources. Surficial and pre-contamination concentrations of nickel, copper, zinc, lead, and phosphorus were measured at fourteen sites in the bays. Copper, zinc, lead, and phosphorus contamination was found in Kinnego Bay. The contamination increased towards the trace metal source, and copper was incorporated more rapidly into the sediment than the other metals. There was no contamination in the other bays. The current chemical models of trace metal behavior in aquatic systems were examined, and the selective incorporation of copper into the sediment was in agreement with model predictions. It was concluded that chemisorption to the sediment is the main sediment-water interaction of copper, zinc, and lead discharged in the waste water. (Baker-FRC)
W82-06080

POLYCHLORINATED BIPHENYL AND ORGANOCHLORINE INSECTICIDE CONCENTRATIONS IN FORTY SEWAGE SLUDGES IN ENGLAND,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W82-06081

SALT UPTAKE IN NATURAL CHANNELS TRAVERSING MANCOS SHALES IN THE PRICE BASIN, UTAH,

Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 2E.
W82-06093

WATER QUALITY AND HYDROLOGY IN A COASTAL REGION OF THE NETHERLANDS,

Institute for Land and Water Management Research, Wageningen (Netherlands).
E. Van Rees Vellinga, C. G. Toussaint, and K. E. Wit.
Journal of Hydrology, Vol 50, No 1/3, p 105-127, March, 1981. 15 Fig, 1 Tab, 24 Ref.

Descriptors: *Water quality, *Saline water intrusion, *Surface water, *Netherlands, Agriculture, Fertilizers, Groundwater, Wastewater, Water pollution sources, *Rhine River, Hydrology, Aquifers, Geology, Geohydrology, Seepage, Chlorides, Polders, Path of pollutants, Cooling water, Phosphates, Nitrogen compounds, Infiltration, Transmissivity.

This paper summarizes the results of a 1976 multidisciplinary investigation on the geology, hydrology, and quality of surface water and groundwater in a 2000 sq km area of central-west Netherlands, where water quality has been deteriorating. The main problems are the pollution of the Rhine River water, used for water level control and flushing of polders; saline intrusion caused by harbor enlargement and deepening and by lowered polder levels; increases in demand for water in domestic and insturial uses, glasshouse horticulture, and agriculture; and increases in quantities of wastewater. The main source of salt contamination is seepage of saline groundwater; human activities are of minor importance. The geology of the region is described in detail. There are generally two aquifers, separated in some places by dividing layers and in other places forming a single thick aquifer. Transmissivities and flow intensity computations indicate 3 kinds of areas: seepage zones, infiltration zones, and zones with little seepage or infiltration. In the seepage zones surfce water quality reflects that of the groundwater. Infiltration zones require addition of Rhine River water during dry periods. The zones with little water movement are sensitive to digging, subsoiling, and channel improvement, all of which can change seepage rates. Groundwater in the area is generally hard and high in Fe, Mn, N, and phosphates. Chloride present in the water bearing strata of the region is about 430,000 metric tons; total net quantity welling up in the region, 150 metric tons per year. A table lists the sources and amounts of chloride inputs into surface waters. The gravest concern is the quality of the Rhine River water, which directly affects surface water quality in this area. Although seepage from natural sources cannot be changed to a great degree, water management has reduced the contributions of pollutants from cooling waters (via a direct pipeline to the North Sea), domestic wastewater, gas wells, and road defrosting. Fertilizer use is not expected to decrease. (Cassar-FRC)
W82-06103

THE OILSPILL RISK ANALYSIS MODEL OF THE U.S. GEOLOGICAL SURVEY,

Geological Survey, Reston, VA. Water Resources Div.
R. A. Smith, J. R. Slack, T. Wyant, and K. J. Lanfear.
Available from Br. of Distr., USGS 604 S. Pickett St. Alexandria, VA 22304 $3.25. Geological Survey Professional Paper 1227, 1981. 40 p, 13 Fig, 10 Tab, 35 Ref.

Descriptors: *Oil spills, *Risks, *Water pollution sources, *Computer models, Model studies, Monte Carlo method, Simulation analysis, Probability distribution, Leases, Oil pollution, Environmental effects, Ecology, Water pollution control, Path of pollutants, Public lands, *Outer Continental Shelf.

The U.S. Geological Survey has developed an oilspill risk analysis model to aid in estimating the environmental hazards of developing oil resources in Outer Continental Shelf (OCS) lease areas. The large, computerized model analyzes the probability of spill occurrence, as well as the likely paths or trajectories of spills in relation to the locations of recreational and biological resources which may be vulnerable. The analytical methodology can easily incorporate estimates of weathering rates, slick dispersion, and possible mitigating effects of cleanup. The probability of spill occurrence is estimated from information on the anticipated level of oil production and method of route of transport. Spill movement is modeled in Monte Carlo fashion with a sample of 500 spills per season, each transported by monthly surface current vectors and wind velocities sampled from 3-hour wind transition matrices. Transition matrices are based on historic wind records grouped in 41 wind velocity classes, and are constructed seasonally for up to six wind stations. Locations and monthly vulnerabilities of up to 31 categories of environmental resources are digitized within an 800,000 square kilometer study area. Model output includes tables of conditional impact probabilities (that is, the probability of hitting a target, given that a spill has occured), as well as probability distributions for oilspills occurring and contacting environmental resources within preselected vulnerability time horizons. (USGS)
W82-06145

PROBLEMS AND PROCESSES IN WATER QUALITY MANAGEMENT,

Wisconsin Univ., Milwaukee. Dept. of Urban Planning.
For primary bibliographic entry see Field 5G.
W82-06147

SURVIVAL AND FATE OF ENTERIC VIRUSES IN SOIL TREATMENT SYSTEMS FOR WASTEWATER,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W82-06150

THE MEDITERRANEAN ACTION PLAN: DESIGN AND IMPLEMENTATION,

World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
J. I. Waddington.
Water Pollutiion Control, Vol 80, No 2, p 149-162, 1981. 2 Tab, 21 Ref.

Descriptors: *Water pollution control, *Planning, Environmental protection, *Mediterranean Sea, Mediterranean Action Plan, International agreements, International commissions, Organizations, International law, Legal aspects, International waters.

By the year 1965 it was clear that many coastal reaches along the Mediterranean Sea were rapidly becoming affected by increasing pollution levels. Efforts to prevent further deterioration of the area were needed, along with significant steps to improve the situation. A great range of activities is now in progress at local, national, and international levels, having been catalyzed by the Mediterranean Action Plan. The plan was outlined less than six years ago at the Barcelona Convention. The political will to cooperate in safeguarding the resources of the Mediterranean has been amply demonstrated, and there are more solid grounds for optimism than would have seemed possible only a short time ago. A monitoring program is being carried out by networks involving 84 research centers in 16 Mediterranean states. Eleven components of this program were carried out in 1975-1980, including studies on monitoring of petroleum hydrocarbons, heavy metals, and chlorinated hydrocarbons; effects of pollutants, coastal pollutant transport, role of sedimentation, and pollutants from land-based sources. A priority action program is being implemented. (Baker-FRC)
W82-06154

RELIABILITY ANALYSIS OF BOD KINETICS IN A SOUTHERN STREAM GOVERNED BY THE DISCHARGE OF AN OXIDATION POND,

Louisiana Water Resources Research Inst., Baton Rouge.
S. M. Crane, and R. F. Malone.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243742, Price codes: A07 in paper copy, A01 in microfiche. Report, June 1982. 123 p, 10 Fig, 7 Tab, 62 Ref, 8 Append. OWRT B-014-LA(1).

Descriptors: *Model studies, *Biochemical oxygen demand, *Streams, *Kinetics, *Statistical analysis, *Probabilistic process, Computer models, Mathematical studies, Mathematical models, Predictin, Statistical methods, Statistical models, Monte carlo method, Stochastic process, Water quality management, Water quality standards, Oxidation ponds, Effluent seepage.

Nineteen sets of observed biochemical oxygen demand (BOD) data were collected from a low-flow southern stream which received an oxidation pond effluent. These data were used to assess the predictive reliability of a modified BOD model (Dobbins) for the stream environment. A strong correlation was found between chlorophyll-a (an indicator of algal productivity) and BOD, indicating that most of the BOD was in the form of algae from the upstream pond discharge. The modified model, however, predicted BOD stream values unreliably. The stabilized value of the standard error (SE) of prediction was 5.9 mg/liter (44% of the mean BOD value), based on a simulation experiment using 12 calibration data sets. The Monte Carlo method and split-sample testing were used to assess model performance in the calibration and verificatin phases, with stochastically-converged values of the SE of estimate and prediction used as statistical measures of model performance in each phase, respectively. The amount of data was a critical factor for model calibration, but not for model verification. It was concluded that probabilistic models of BOD in streams are better suited for use in making water quality management decisions. (Zielinski-MAXIMA)
W82-06159

EFFECTS OF URBANIZATION ON STREAM ECOSYSTEMS,

Georgia Inst. of Tech., Atlanta. School of Biology.
For primary bibliographic entry see Field 5C.
W82-06165

RADIONUCLIDES IN DARDANELLE LAKE IN THE AREA OF THE NUCLEAR I FACILITY: 1979-1981,

Arkansas Univ., Fayetteville. Water Resources Research Center.
D. M. Chittenden, II.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254939, Price codes: A03 in paper copy, A01 in microfiche. Publication No 81, December 1981. 38 p, 7 Fig, 4 Tab, 18 Ref, 4 Append. OWRT A-050-ARK(1), 14-34-0001-0104.

Descriptors: *Radioactive wastes, *Nuclear reactors, *Cooling water, Adsorption, Water pollution sources, Nuclear power plants, Cooiing, *Cesium radioisotopes, *Strontium radioisotopes, Cerium, Lake sediments, Suspended sediments, Alkaline-earth metals, Radiochemical analysis, Radioactivity techniques, Reservoirs, *Arkansas, Dardanelle Lake.

Concentration variations for strontium 90 (Sr90) and cesium 137 (Cs137) were analyzed at four stations in the Dardanelle Reservoir as functions of two parameters: the concentration of ionic species; and the activity released (AR) from the two 900 Mw reactors which use the Reservoir as a coooling water source. Multiple regression analyses were performed on the radionuclide concentrations using these two parameters as predictors. The results indicated that Sr90 is in equilibrium between solution and the suspended sediment, with the equilibrium position sensitive to changes in alkaline earth cation (M-II) concentrations. Hence, the M-II concentration has a substantial effect on Sr90 removal from the water column. On the other hand, the Cs137 concentration varied with AR, indicating that solution-sediment equilibrium has not been attained (since the time for newly-released Cs137 to equilibrate is greater than the mean water residence time in the Reservoir. Further, the Reservoir occurrence of cerium (Ce144 - praseodymium 144 seems a consequence of reactor refueling/maintenance, with Ce141 (and Ce144) derived from an airborne source with runoff to the Reservoir. (Zielinski-MAXIMA)
W82-06169

TRANSPORT OF PCBS IN AQUATIC LABORATORY MODEL ECOSYSTEMS FROM SEDIMENT TO THE ATMOSPHERE VIA THE SURFACE MICROLAYER,

Lund Univ. (Sweden). Limnological Inst.
A. Sodergren, and P. Larsson.
Ambio, Vol 11, No 1, p 41-45, 1982. 3 Fig, 8 Tab, 30 Ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Sediment-water interfaces, *Tubificids, *Midges, Aquatic animals, Lakes, Eutrophic lakes, Model studies, Anaerobic conditions, Particulate matter, Atmosphere, Jet drops, Surface microlayer, Sediment gas, *Sweden.

The effects of bottom-living organisms and anaerobic conditions on the distribution of PCBs in aquatic model ecosystems consisting of Chironomous plumosus and Tubifex sp. were studied. Sediment and water from the eutrophic Lake Havgardssjon in Sweden were incubated at 5 C and at 18 C with 2,3,4,4'-tetrachlorobiphenyl, 2,3',4,4'5-pentachlorobiphenyl and Clophen A 50, with the Clophen A 50 injected 5 mm (5 C) or 20 mm (18 C) below the sediment surface. Results showed a transport of PCBs to overlying water both in systems containing macroorganisms and in anaerobic systems. The presence of particles determined the amount of PCBs detected in the water. PCBs were taken up from sediment and accumulated in the macroorganisms. The accumulation was more pronounced when chironomids and tubificids were incubated together. PCBs left the water by jet drops and were recovered 7 cm above the water surface in all but fixed systems, the lowest amounts recorded being from undisturbed sediment cores. A similar pattern in anaerobic systems was caused by gas that developed in the sediment. The surface microlayers also contained PCBs, with the highest levels in very turbid anaerobic systems. PCBs moved toward the sediment surface in undisturbed cores incubated at 18 C. Incubation at 5 C rather than at 18 C produced a higher level of PCBs in water, animals, surface microlayer and jet drops. Surprisingly low amounts of PCBs were released to the water when injected at 20 mm, though low amounts were used. If these results apply to field conditions, the sediment may act as a source rather than a sink. (Gish-FRC)
W82-06180

SPILLED PETROLEUM RECOVERED FROM ATOP WATER TABLE OF MISSISSIPPI AQUIFER,

Mathes (John) and Associates, Inc., Columbia, IL.
For primary bibliographic entry see Field 5G.
W82-06185

GEOCHEMICAL FACTORS CONTROLLING THE ACCUMULATION AND DISPERSAL OF HEAVY METALS IN THE BAY OF FUNDY SEDIMENTS,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
For primary bibliographic entry see Field 2K.
W82-06188

DISCHARGE OF METALS FROM THE ST. LAWRENCE RIVER,

Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
P. A. Yeats, and J. M. Bewers.
Canadian Journal of Earth Sciences, Vol 19, No 5, p 982-992, May, 1982. 2 Fig, 6 Tab, 45 Ref.

Descriptors: *Heavy metals, *Rivers, *St. Lawrence River, Path of pollutants, Aluminum, Iron, Manganese, Cobalt, Nickel, Copper, Zinc, Cadmium, Magnesium, Calcium, Silicon, Sediments, Canada.

Measurements of the dissolved and particulate forms of aluminum, iron, manganese, cobalt, nickel, copper, zinc, and cadmium made during a two year period at the mouth of the St. Lawrence River are reported. The sampling site was just upstream of the landward limit of salt intrusion. Some of the measurements taken were used to estimate metal fluxes for the purpose of determining the oceanic residence times of trace metals. Variability in the concentration of the dissolved metals was unrelated to changes in water flow or suspended load. Particulate Al, Fe, Mn, and Zn concentrations were related to water flow. The metal/aluminum ratios of particulate Mn, Cu, Zn, and Cd were elevated with respect to crustal rocks or coastal marine sediments, with the enrichment occurring in the nondetrital, or weak acid soluble, fraction. Annual dissolved metal discharges and nndetrital and total particulate metal discharges that take into account monthly variations in metal concentrations have been calculated for the St. Lawrence River. These calculated discharges are compared with estimates based on other rivers. The importance of nondetrital particulate metal fluxes is emphasized by these findings. (Baker-FRC)
W82-06190

RETENTION OF RIVERINE IRON IN ESTUARIES,

Maine University at Orono, Walpole.
L. M. Mayer.
Geochimica et Cosmochimica Acta, Vol 46, No 6, p 1003-1009, June, 1982. 7 Fig, 29 Ref.

Descriptors: *Estuaries, *Iron, Rivers, Seawater, Mixing, Maine, Salinity, Flocculation, Suspended sediments, Tannery effluents, Bottom sediments, Path of pollutants, Chemistry of precipitation, Chemical composition, Gulf of Maine, Canada.

Both the dissolved and particulate iron concentrations were examined in a series of estuarine water parcels, under low turbidity conditions, to determine whether iron removed from a filtrable state was actually lost from the water parcel. The potential roles of gravity and suspended sediment in removing iron from water parcels were examined by experimentation. The study area was the Gulf of Maine and three of itrs associated estuaries. The estuaries are all drowned river valleys, receiving freshwater runoff from watersheds similar in climate and vegetation. Riverine Fe was found to remain fairly conservative with salinity, implying that the process of flocculation does not necessarily remove Fe from water parcels. Laboratory experiments corroborated the field data by demonstrating that neither gravity nor suspended sediment was very effective in removing flocculated Fe from suspension. Input of a tannery effluent did appear to result in scavenging of Fe from estuarine waters. Flocculated riverine Fe was found to increase considerably the Fe concentrations of estuarine bottom sediments, with the amount of iron per sediment specific surface area dependent on mean river flow entering an estuary. While no long term retention efficiencies could be calculated for these estuaries, it seems likely that a significant portion of flocculated riverine Fe escapes to shelf waters. (Baker-FRC)
W83-06191

MERCURY CONTAMINATION OF THE LERDERDERG RIVER, VICTORIA, AUSTRALIA, FROM AN ABANDONED GOLD FIELD,

Monash Univ., Clayton (Australia). Dept. of Chemistry.
B. M. Bycroft, B. A. W. Coller, G. B. Deacon, D. J. Coleman, and P. S. Lake.
Environmental Pollution, Series A, Vol 28, No 2, p 135-147, 1982. 3 Fig, 5 Tab, 25 Ref.

Descriptors: *Mercury, *Mine wastes, *Gold, Rivers, *Australia, *Lerderderg River, Water pollution sources, Sediments, Fish, Path of pollutants, *Mine wastes.

This paper reports the distribution of mercury in water, sediments and fish from the Lerderderg River and the relationship between mercury levels and gold mining activities around Blackwood, where alluvial gold was first discovered in 1851. It has been at least 50 years since direct amalgamation was used routinely on the blackwood field. The Lerderderg River rises on the southern edge of the Great Dividing Range, about 110kkm northwest of Melbourne, Australia. State forest covers most of the catchment. The river flows in a southeasterly direction, passing through the settlements of Blackwood and Darley before joining the Werribee River. Recently a weir and a diversion tunnel were constructed on the river to divert water from the upper Lerderderg to Merrimu Reservoir, which supplies drinking and irrigation water to surrounding districts. Water, sediment and fish samples were collected from sites along the Lerderderg River and tributaries with sampling points focused around Blackwood. Mercury levels in water ranged from 0.01 to 0.31 micrograms/liter. Mercury levels in sediments ranged from less than 0.02 to 68.50 micrograms/gram dry weight, with an additional reading of 120.00 micrograms/g at a tailings sump on the bank of Yankee Creek. Mercury levels in brown trout ranged from 0.03 to 0.35 micrograms/g and for river blackfish, from 0.03 to 0.64 micrograms/g. The mercury levels in water samples showed no clear correlation with sampling sites. Sediment levels revealed a clear correlation with past mining activities. (Baker-FRC)
W82-06194

ENTERIC BACTERIA IN SUGARBEET REFINERY PROCESSING WASTE WATERS,

North Dakota State Univ., Fargo. Dept. of Bacteriology.
For primary bibliographic entry see Field 5D.
W82-06195

POLYCHLORINATED BIPHENYLS (PCBS): AN AUSTRALIAN VIEWPOINT ON A GLOBAL PROBLEM,

Victoria Ministry for Conservation, Melbourne (Australia). Marine Science Labs.
B. J. Richardson, and J. S. Waid.
Search, Vol 13, No 1/2, p 17-25, February/March, 1982. 3 Fig, 6 Tab, 50 Ref.

Descriptors: *Waste disposal, *Hazardous materials, *Polychlorinated biphenyls, *Australia, Organic compounds, Incineration, Waste dumps, Environmental effects, Mining industry, *Water pollution sources, Ports, Bays, Mussels, Sediments, *Path of pollutants.

The major routes of environmental entry of polychlorinated biphenyls (PCBs) include vaporization from open burning or incomplete incineration of solid wastes, and from paints, coatings and plastics; leaks and disposal of industrial fluids by improper means, including contamination of sewage which may ultimately be dumped at sea or on land; disposal on dumps and landfills, with subsequent leaching and volatilization; and inclusion in pesticides. In Australia the use of PCBs as hydraulic fluids in the mining industry is allowable, dispite risks of escape, especially in the marine situation such as drilling on coral reefs. The available evidence for the presence of PCBs in soils, sedimens and waters in Australia is very meager. The distribution of PCBs in sediments, fish and molluscs from Australian coastal waters is under investigation. In 1978 it was noted that PCBs had been found in mussels taken from Corio Bay. Mussel samples were then taken from Port Phillip and Corio Bay, with the result that PCBs were present in every sample, highest concentrations being found in localities adjacent to industrial activity or with heavy shipping traffic. The results of sediment analysis reinforced the mussel data. The greatest potential threat lies in delay in tackling the problem of finding efficient ways to destroy PCBs. A large quantity of PCBs awaits disposal under inadequate storage methods. (Baker-FRC)
W82-06232

INFLUENCE AND PREVENTION OF BIRD-DROPPINGS IN PRECIPITATION CHEMISTRY EXPERIMENTS,

Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
W. A. H. Asman, T. B. Ridder, H. F. R. Reijnders, and J. Slanina.
Water, Air, and Soil Pollution, Vol 17, No 4, p 415-420, 1982. 1 Fig, 3 Tab, 2 Ref.

Descriptors: *Chemical composition, *Rain, Birds, Contamination, Chemical analysis, Phosphates, Nitrates, Potassium, Ammonia, Sampling, Precipitation, *Netherlands, *Pollutant identification.

Problems caused by bird-droppings in precipitation chemistry experiments in the Netherlands are discussed. Two specific projects are discussed, each of which used a collector consisting of a polyethylene funnel. The rim of the funnel was at 1.50 meters above the ground and the internal diameter was 22.3 cm. Each day during sampling for one of the projects the samplers were inspected for bird excrement, which was then carefully removed and the funnel cleaned with demineralized water. Even so, bird excrement may enter the bottle without being noted, particularly during rainy weather. In the two year period of the study, a total of 67 bird-droppings were counted. In the autumn of 1978 the samplers were equipped with a bird scarer device which did cut down on the number of droppings recorded. During the second project the collection bottles were changed once a week, the number of bird-droppings was counted and the collector was carefully cleaned. The pH of the rainwater was influenced by the droppings; in all cases except one the samples became more alkaline. An analysis of six bird-droppings revealed that the chemical composition of the rainfall collected is influenced most heavily in the amount of phosphates, potassium, and ammonia present. In some cases nitrates can also be influenced. To check on the possible occurrence of bird-droppings it is suggested that the phosphate content of the precipitation samples be checked. (Baker-FRC)
W82-06245

IMMEDIATE AND DELAYED OXYGEN DEPLETION IN RIVERS,

Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5G.
W82-06269

EFFECT OF TEMPERATURE ON HEAVY METAL BINDING BY ANAEROBICALLY DIGESTED SLUDGES,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W82-06270

ON THE PRESENCE OF IRON(II) IN OXYGENATED SURFACE WATERS: ANALYTICAL IMPLICATIONS,

Northern Michign Univ., Marquette. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W82-06271

A METHOD FOR MONITORING MINERALIZATION OF 14C-LABELED COMPOUNDS IN AQUEOUS SAMPLES,

Alberta Univ., Edmonton. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-06272

GROUNDWATER SEEPAGE AS A NUTRIENT SOURCE TO A DRAINAGE LAKE; LAKE MENDOTA, WISCONSIN,

Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. D. Brock, D. R. Lee, D. Janes, and D. Winek.
Water Research, Vol 16, No 7, p 1255-1263, July, 1982. 2 Fig, 8 Tab, 18 Ref.

Descriptors: *Cycling nutrients, *Groundwater, *Lakes, Nitrogen, Ammonia, Phosphorus, Eutrophication, Lake Mendota, *Wisconsin, Drainage area, Intersitial water.

Results of the first pore water nutrient assays at locations of known groundwater inflow in a lake are presented. Seepage water was assumed to be equivalent to the sediment pore water in the sediments lying just below the sediment-water interface. Lake Mendota has a fairly regular shoreline, and its shallow sediments are composed of sand which is fairly uniform. A total of 107 separate measurements at different locations were made around the Lake and used to calculate seepage rate. A total of 20 separate samplings for chemical analysis of seepage water were done at 11 separate sites around the lake. Phosphorus concentrations in seepage water varied from a low of 10 to over 500 micrograms/liter. Nitrate values varied from about 50 to 1000 micrograms/liter of nitrate-N. Ammonia values ranged from a low of 50 to a high of 400 micrograms/liter ammonia-N. These findings indicate that groundwater can be a significant source of water to a drainage lake, accounting for about 1/3 of the inflowing water in Lake Mendota. Groundwater can also be a route of nutrient loading to a drainage lake, especially for P. Seepage was continuously high in P and ammonia and lower in nitrate than well, spring or surface water, suggesting that the P and ammonia of seepage might be derived from the lake itself rather than from the surrounding land. (Baker-FRC)
W82-06285

BACTERIAL POLLUTION OF MARINE WATERS FROM THE DISPOSAL OF SEWAGE AND SEWAGE SLUDGE TO SEA,

North West Water Authority, Warrington (England).
F. Jones.
Water Science and Technology, Vol 14, No 3, p 61-70, 1982. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Bacteria, *Ocean dumping, *Sludge disposal, Fate of pollutants, Water pollution sources, Wastewater disposal, Self purification, Coliforms, Fylde Coast, Liverpool Bay, North Wirral, Beaches, Outfalls, *England.

Bacterial concentrations in marine waters receiving sewage sludge were documented at three locations in northwest England. Untreated sewage discharged through the 3-mile North Wirral outfall at Meols did not cause high bacterial levels at beaches in the immediate area. Total coliforms ranged from 1000-585- per 100 ml at six stations about 9 km east of the outfall to 10-220 per 100 ml at the other 15 stations closer to the outfall. Offshore samples ranged from 7120 per 100 ml total coliforms at the outfall to 40-39- per 100 ml at distances 1 and 2 km on all sides of the outfall. In Liverpool Bay total coliforms were 27 per 100 ml at the ship dumping site and 13,580 per 100 ml at the mouth of the River Mersey. Six outfalls along a 25 km stretch of coast produced high and variable bacterial levels (1000-114,000 per 100 ml) at beaches at Fleetwood near the River Wyre. In this area occasional high turbidity greatly inhibits the natural purification process. (Cassar-FRC)
W82-06288

EFFECTS OF TURBULENT SUSPENSION ON TRAJECTORIES OF SETTLING PARTICLES,

Camp, Dresser and McKee Inc., Boston, MA.
For primary bibliographic entry see Field 5E.
W82-06289

HERBICIDES IN KANSAS WATERS--EVALUATIONS OF THE EFFECTS OF AGRICULTURAL RUNOFF AND AQUATIC WEED CONTROL ON AQUATIC FOOD CHAINS,

Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5C.
W82-06304

OXIDATION PRODUCTS AND RATES OF REACTION IN THE OZONOLYSIS OF DIEBENZOFURAN,

Wesleyan Univ., Middletown, CT. Dept. of Chemistry.
D. T. Pentek.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256512. Price codes: A04 in paper copy, A01 in microfiche. MA Thesis, May 1981. 57 p, 72 Ref. OWRT B-017-CT (1).

Descriptors: *Ozonolysis, Polyhalogenated aromatic compounds, *Dibenzofuran, Industrial wastes, *Chemical wastes, Effluents, Oxidation, Wastewater treatment.

Ozonolyses of dibenzofuran were carried out in methylene chloride with reductive work up at -23 C, O C and 14 C, and in water at 14 C. Pseudo first order and second order rate constrants were calculated for all reactions. The second order rate constant in water was k sub 2(H O) = 1000M(-1)s(-1) and in methylene chloride was k sub 2 = 0.88M(-1)s(-1). The three orders of magnitude difference is thought to be caused by a competing free radical mechanism for dibenzofuran occurring in water. Oxidation products identified from the ozonolysis of dibenzofuran in methylene chloride were: salicylic acid, carbon dioxide, glyoxal, formaldehyde, and oxalic acid. A percentage of 40 of the initial carbon present in dibenzofuran is accounted for. The major product is salicylic acid and the major pathway for ozonolysis of dibenzofuran proceeds through salicylic acid. A total of 3.5 mmole ozone/mmole dibenzofuran was required to degrade 99% of the dibenzofuran present (in methylene chloride).
W82-06305

SOME EFFECTS OF SHORELINE COTTAGE DEVELOPMENT ON LAKE BACTERIOLOGICAL WATER QUALITY,

Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, and E. A. Leggatt.
Water Research, Vol 16, No 7, p 1217-1222, July, 1982. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Water quality, *Bacteria, Lakes, Recreational facilities, Coliforms, Fecal bacteria, Bioindicators, Pollutant identification, Indicators, Canada, *Ontario.

Present bacteriological water quality was documented for a number of developed recreational lakes and for one undeveloped lake in the Ontario area. This was achieved by determining the density and distribution of fecal bacteria and the location and sources of major inputs of fecal indicator bacteria in these lakes. Lakes were surveyed for 5 consecutive days, in the spring, summer and often the fall of the year, at inflows, outflows and a

number of locations representative of shoreline features and development. Fecal coliform and fecal streptococcus levels in the 18 developed lakes samples varied in a seemingly erratic way. When the bacterial densities at different points on the lake were examined by an analysis of variance, the locations with significantly higher densities of fecal coliforms and fecal streptococci were most often along the cottaged shoreline. Total coliform densities did not show this relationship. In addition, after rainfall, a large increase in the numbers of fecal coliforms were found in the cottaged lakes but not in the uncottaged lake. These findings suggest that the cottaged shoreline was a greater source of fecal indicator bacteria than the uncottaged shoreline. However, the highest concentrations of fecal indicator bacteria in these lakes were found in the inflowing streams. The bacteria in these streams arose from stormwater from undeveloped forested watersheds and were probably of soil or animal origin. (Baker-FRC)
W82-06310

ACID RAIN MODEL: HYDROLOGIC MODULE,

Tetra Tech. Inc., Lafayette, CA.
C. W. Chen, J. D. Dean, S. A. Gherini, and R. A. Goldstein.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 455-472, June, 1982. 12 Fig, 5 Tab, 22 Ref.

Descriptors: *Acid rain, *Model studies, Watersheds, Catchment areas, Drainage area, Basins, Percolation, Chemical analysis, Lakes, Chemical reactions, Evapotranspiration, Freezing, Snowmelt, Melting, Hydrology, Hydrologic models.

An Integrated Lake-Watershed Acidification Study (ILWAS) model is presented and findings based on simulation applications of the model to date are evaluated. The ILWAS model includes hydrologic, canopy chemistry, snowmelt chemistry, soil chemistry, and stream and lake water quality modules. For modeling purposes a drainage basin is divided into terrestrial subcatchments, stream segments, and a lake. Vertically, each subcatchment is further segmented into canopy, snow pack, and soil layers. The lake is also vertically layered. All these physical compartments are coupled to form a network that allows water to be routed through the system to the lake outlet. The physical compartments are described by geometric input parameters such as area, aspect, slope, and soil layer thickness. Subcatchments are allowed to have different percentage distributions of deciduous and coniferous trees and open areas. The hydrologic module of the ILWAS model realistically simulated the total outflow from a lake basin and the hydrology of the subcatchments. The flowpath calculations are supported inn part by observations of the soil solution and lake water pH values. The flowpaths of rain and snowmelt water through the terrestrial system are important factors in determining the susceptibility of lakes to acidification by atmospheric deposition. Several mechanisms can force rain and snowmelt water to become lateral flow in the upper soil horizons instead of percolating into the inorganic horizons.Low hydraulic conductivity in any soil layer may result in lateral flows in overlying layers. (Baker-FRC)
W82-06360

NON-POINT SOURCE POLLUTION: DIRECTIONS FOR VERMONT,

Vermont Water Resources Research Center, Burlington.
For primary bibliographic entry see Field 5G.
W82-06372

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: III. HARTENBOS, LITTLE BRAK AND GREAT BRAK RIVERS,

National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
R. J. Watling, and H. R. Watling.
Special Report FIS 205, March, 1980. 44 p, 1 Fig, 19 Tab, 6 Ref.

Descriptors: *Trace metals, Water analysis, *Water pollution sources, *Sediment-water interfaces, Heavy metals, Pollutants, Pollutant identification, Estuaries, *South Africa, Rivers, Nonpoint pollution sources, Toxicity, Chemical analysis, Water quality, Sediments, Metals, Water quality control, Cores, *Path of pollutants.

Trace metal surveys were conducted during July 1978 on three estuaries which enter the Indian Ocean in Mossel Bay. Surface sediment, water, and sediment core samples were collected at selected sites in each river for trace metal analyses (13 elements for water samples; 16 elements for all other samples) by atomic absorption spectroscopy. Inter-element relationships and absolute metal concentrations were examined before interpreting the resultant data. The results indicate that all three rivers experience some degree of metal contamination. However, with the exception of the extremely high chromium levels (containing up to 1.13% chromium) found in sediment in part of one river (Great Brak) from an unknown source, trace element concentrations were found not to represent a significant pollution threat; nonetheless, monitoring should be continued. All three rivers exhibited some indications of other than natural metal buildup. The chromium anomaly will be resurveyed in more detail for potential source identification. Remobilization of the chromium contamination via flooding could induce mass mortality of local flora/fauna. Trace element concentrations are given for all sample types and correlation matrices are given for the core samples. (Zielinski-MAXIMA)
W82-06387

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES: II. KNYSNA ESTUARY,

National Physical Research Lab., Pretoria (South Africa). Applied Spectroscopy Div.
For primary bibliographic entry see Field 2L.
W82-06388

EXPERIMENTS ON COAXIAL HEATED WATER DISCHARGES,

Karlsruhe Univ. (Germany, F.R.).
W. Rodi, and K. Weiss.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 737-746, June, 1982. 7 Fig, 4 Ref.

Descriptors: *Heated water, *Thermal pollution, *Mixing, Fate of pollutants, Flow characteristics, Open channel flow, Water temperature, Buoyancy.

Heated water was discharged coaxially into rectangular open channel flow from a slot placed at the channel center. The discharge and channel velocities were the same. The temperatures studies were 9 and 20 C in excess of ambient. Temperature distribution was determined by thermistors, and surface motions was recorded by photographing surface floats. Several effects associated with the density differences between heated and ambient water were visible. The warm water spreading at the surface formed a warm surface layer and isolated warm water pools. Colder ambient water was drawn toward the center plane to replace the warm water. The warm water spreading at the surface formed a sharp straight front with an angle to the center line that increased with increasing density differences. The warm surface layer dampened the turbulent mixing with the colder water, so the isolated warm water pools stayed hot for considerable distances from the discharge. The flow geometry investigated here was simple enough to use as a test case for calculation procedures simulating buoyancy effects on mean flow and turbulent mixing. (Cassar-FRC)
W82-06422

GROUNDWATER POLLUTION FROM INDUSTRIAL WASTE DISPOSAL, A CASE STUDY,

Saint Lawrence Univ., Canton, NY.
G. R. Harris, C. Garlock, L. LeSeur, S. Mesinger, and R. Wexler.
Journal of Environmental Health, Vol 44, No 6, p 287-295, May/June, 1982. 10 Fig, 7 Tab, 9 Ref.

Descriptors: *Groundwater pollution, *Waste disposal, *Water pollution sources, *Land disposal, *Leaching, *Groundwater movement, Waste management, Wastes, Industrial wastes, Geohydrology, Soil types, Leachates.

An organic and inorganic waste disposal pit operated by Sealand Restoration Incorporated (SRI) of Oswego, New York, was improperly constructed and violated state permits. The pit was not lined with impermeable materials, and an underlying groundwater interception ditch was too shallow, resulting in area groundwater pollution. Following periods of high precipitation, migration of leachate was observed at downgradient sampling sites. Minimum geologic and hydrologic considerations for industrial waste disposal sites include soil type, depth to groundwater and bedrock, slope, and distance to surface water. According to these criteria, the existing disposal pit was found to have severe limitations for the disposal of industrial wastes. Investigations into the suitability of other SRI sites for waste disposal were inconclusive due to insufficient characterization of soil and land properties. (Geiger-FRC)
W82-06434

EXAMINATION OF PROBABLE CAUSES OF INDIVIDUAL WATER SUPPLY CONTAMINATION,

Wright State Univ., Dayton, OH. Dept. of Biological Sciences.
W. S. Brewer, and J. Lucas.
Journal of Environmental Health, Vol 44, No 6, p 305-307, May/June, 1982. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Coliforms, *Groundwater pollution, *Aquifers, *Infiltration, *Wells, Fate of pollutants, Water pollution sources, Percolation, Groundwater recharge, Water supply, Mathematical studies, Surveys.

A previous study of water supply records from 1972-1975 in a rural county in Ohio revealed a correlation between the probability of contamination and the location of wells with respect to their supply aquifers. To test the validity of the hypothesis that contaminated aquifers were the cause of high coliform levels in wells, county records from 1978-79 were surveyed to determine the extent of contaminated wells in each of two aquifers serving the county. Of the 613 wells surveyed, 113 wells were found to have coliform counts greater than 1 colony/100 milliliters. Comparison of contamination rates showed that one aquifer was more likely to contain contaminated wells than the other, but efforts to establish a causal relationship were unsuccessful. Analysis of variance showed that the formations overlying the well (depth, consolidated or unconsolidated strata, surface water infiltration rate) exerted a stronger influence on the outcome of the study than did the aquifer correlation. A cause-effect relationship was proposed between insufficient filtration of percolating surface water and contamination. (Geiger-FRC)
W82-06435

NOMOGRAPHS FOR RAPID SOLUTIONS FOR THE STREETER-PHELPS EQUATIONS,

Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Div.
G. B. McBride.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 378-384, April, 1982. 5 Fig, 7 Ref.

Descriptors: Mathematical equations, *Nomographs, *Rivers, *Water pollution sources, Biochemical oxygen demand, Dissolved oxygen, Mathematical models, Prediction, *Streeter-Phelps equations, *Path of pollutants.

Nomographs have been developed which allow rapid calculation of the worst effects of emergency discharges for rivers for which a convenient operational model does not already exist. The nomographs are based on the equations of the Streeter-Phelps model, which allow calculation of the concentrations of river biochemical oxygen demand (BOD) and river dissolved oxygen deficit (DOD) downstream of some initial point at which BOD

and DOD values are known. Solutions for the location and magnitude of the maximum downstream river DOD are presented in simple nomograph form. A nomograph for calculation of the maximum permissible initial river 5-day BOD given the initial river DOD and the maximum permissible downstream DOD is also presented. The use of these nomographs involves three simple steps: the formation of three dimensionless ratios, the reading of a nomograph, and the calculation of the required answer by a simple arithmetic formula. Use of the nomographs requires the following data: initial river DOD in grams per cubic meters the BOD decay coefficient evaluated for the standard laboratory BOD test, the river deoxygenation coefficient, and the river reaeration coefficient. The nomographs can only be strictly applied to rivers which comply with the requirements of the Streeter-Phelps model, although they will provide reasonable predictions for most rivers when rapid and approximate answers are required. (Carroll-FRC)
W82-06460

PCB UPTAKE BY FIVE SPECIES OF FISH IN LAKE MICHIGAN, GREEN BAY OF LAKE MICHIGAN, AND CAYUGA LAKE, NEW YORK,

Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen, S. A. Spigarelli, and M. M. Thommes.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 700-709, May, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Fate of pollutants, Model studies, Fish, *Uptake, *Polychlorinated biphenyls, Trout, Salmon, Whitefish, *Lake Michigan, Absorption, Accumulation, Metabolism, Habitats, Kinetics, Path of pollutants, *Green Bay, *Cayuga Lake, Wisconsin, New York.

A bioenergetic model was used to describe the uptake of polychlorinated biphenyls (PCBs) by trout, whitefish, and salmon of Lake Michigan and trout of Cayuga Lake in New York. PCB uptake was defined in terms of metabolism, food consumption, size, and growth. PCB levels differed significantly among species according to habitat. PCB was taken up by brown trout in a pattern distinct from that of other species. An increase in the exponent of weight for metabolism changed the shape of the relation between PCB concentration and body weight from asymptotic to non-asymptotic. In all species tested except brown trout, PCB uptake was not asymptotic and concentrations did not approach equilibrium. Simulation analyses showed that differences in PCB levels among species and in the same species among different habitats were most likely due to differences in metabolic parameters, exposure, size, and rate of growth. (Geiger-FRC)
W82-06493

ENRICHMENT OF INORGANIC NUTRIENTS IN THE INNER SARONIKOS GULF (1973-1976),

Institute of Oceanographic and Fisheries Research, Athens (Greece).
M. Friligos.
Marine Pollution Bulletin, Vol 13, No 5, p 154-158, 1982. 1 Fig, 7 Tab, 11 Ref.

Descriptors: *Nutrients, *Wastewater pollution, Fate of pollutants, Water pollution sources, Saronikos Gulf, Elefsis Bay, *Greece, Outfalls, Nitrates, Nitrites, Ammonium, Silicates, Phosphates, Wastewater disposal, Ocean disposal, Wastewater outfall.

Waters in the Inner Saronikos Gulf and Elefsis Bay, near Athens, Greece, were sampled during 16 cruises January 1973 to September 1976. The semi-enclosed Gulf is 70-90 m deep in the eastern main body and 130-400 m deep in the western portion. An outfall discharges raw sewage from the Athens metropolitan area into the sea water of the Inner Gulf. The 30 m deep Elefsis Bay, at the north end of the Gulf, is connected by two narrow and shallow channels to Keratsini Bay and the Saronikos Gulf. It is polluted with industrial effluents and sewage. Background levels (in micrograms atoms per liter) of nutrients in the relatively unpolluted Outer Bay were: phosphate-P, 0.12; silicate-Si, 1.22; nitrite-N, 0.16; nitrate-N, 0.42; and ammonium-N, 0.36. Concentrations of nutrients in the Inner Gulf were 2.5 times the background level for phosphate, 1.39 for silicate, 1.55 for nitrite, 2.60 for nitrate, 4.10 for ammonium, and 3.03 for total N. Elefsis Bay contained 9 times the inoganic N, 15 times the ammonia, 7 times the nitrates, 3 times the nitrite, 5 times the phosphate, and 4 times the silicate as the background. (Cassar-FRC)
W82-06499

PHENOLS IN MUNICIPAL SOLID WASTE LEACHATES AND THEIR ATTENUATION BY CLAY SOILS,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. Artiola-Fortuny, and W. H. Fuller.
Soil Science, Vol 133, No 4, p 218-227, April, 1982. 4 Fig, 6 Tab, 22 Ref.

Descriptors: *Leachates, *Phenols, Landfills, Sanitary landfills, Organic compounds, Municipal wastes, Chemical reactions, Adsorption, Clays, Aeration, Humic acids, Fulvic acids, Fate of pollutants.

Municipal solid waste leachates contained varying amounts of natural phenols, depending on age. The youngest leachate, 1 year, was higher in acidity, total organic carbon, and electric conductivity (EC) than leachates aged 3 to 7 years. Over a 12 month sampling period all leachates decreased in total organic carbon. The youngest leachate increased in pH and EC, while the older leachates remained constant in pH and EC. Natural phenols migrated through 10 cm of clay soils in 7 pore volume displacements or fewer. Leachates of low pH and high total organic carbon moved rapidly through the soil. Phenols moved more slowly in fine textured, iron oxide-rich clays than in other soils. Leachates enriched with phenol, 2,6-dimethylphenol, o- and p-cresol, 2,4-dichlorophenol, and p-nitrophenol were more reactive with younger leachates than with older ones. The high level of humic and fulvic acids in younger leachates appeared to be correlated with the rapid reaction of phenols. Of all the phenols tested, the strongly polar nitrophenols were least reactive with leachates. Phenol levels were rapidly reduced by aeration of leachates. (Cassar-FRC)
W82-06518

ACTINOMYCETES AND FUNGI IN SURFACE WATERS AND IN POTABLE WATER,

National Board of Waters, Helsinki (Finland).
R. M. Niemi, S. Knuth, and K. Lundstrom.
Applied and Environmental Microbiology, Vol 43, No 2, p 378-388, February, 1982. 8 Fig, 5 Tab, 28 Ref.

Descriptors: *Actinomyces, *Fungi, Thermophilic bacteria, Mesophytes, Water supply, Lakes, Rivers, Water treatment, Bacteria, Finland, Drinking water, Path of pollutants, Filtration, Disinfection, Artificial recharge, Groundwater pollution.

The occurrence of mesophilic and thermophilic actinomycetes and fungi in finnish lakes and rivers used as water supplies and in treated water and distribution systems was investigated. Mesophilic fungi and actinomycetes were common in Finnish lakes and rivers used as water supplies, while thermophilic fungi and actinomycetes were present only in low concentrations. Eutrophic and mesotrophic lakes had higher concentrations of fungi and actinomycetes than did oligotrophic lakes. Thermophilic actinomycetes and fungi and mesophilic actinomycetes were more abundant in river water than in lake water. The correlation between concentrations of actinomycetes and fungi and the chemical and physical parameters of the water, as well as the correlations between microbes and the percentage of cultivated land in the drainage basin, probably reflect the importance of runoff for the occurrence of these microbes in lakes and rivers under normal conditions. A comparison of the efficiencies of different water treatments in removing these organisms showed that while chemical coagulation removed actinomycetes and fungi efficiently, sand filtration sometimes contributed to the populations of thermophilic actinomycetes. Actinomycetes and fungi were present in many raw water supplies and were able to pass through both sand filtration and disinfection, resulting in the occurrence of these bacteria in drinking water. Also, mesophilic actinomycete concentrations were higher in artificial groundwater produced for groundwater recharge than they were in eutrophic raw water. (Carroll-FRC)
W82-06543

CORRELATIONS BETWEEN PREDOMINANT HETEROTROPHIC BACTERIA AND PHYSICOCHEMICAL WATER QUALITY PARAMETERS IN TWO CANADIAN RIVERS,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
C. R. Bell, M. A. Holder-Franklin, and M. Franklin.
Applied and Environmental Microbiology, Vol 43, No 2, p 269-283, February, 1982. 2 Fig, 13 Tab, 42 Ref.

Descriptors: *Heterotrophic bacteria, *Bacterial analysis, *Physicochemical properties, Water quality, Bacteria, Factor analysis, Population dynamics, Rivers, *Canada, Dunbar River, Meduxnekeag River, Saint John River, Water pollution effects.

A multivariate statistical analysis of data from two branches of the Saint John River in New Brunswick, Canada, was performed to investigate the interactions of the bacterial populations with the physicochemical parameters of the water. One of the branches, the Dunbar, is a pristine woodland stream, while the other, the Meduxnekeag River, is a larger stream receiving some domestic and agricultural wastewaters. The heterotrophic bacterial populations of the two streams were analyzed as total heterotrophic counts; as species numbers, using numerical taxonomy; by diversity indices; and by factor analysis. Factors which profiled the bacterial community and which were common to both rivers included, in order of decreasing importance, fermentative metabolism, inorganic nitrogen metabolism, fluorescence-oxidative metabolism, and lack of starch hydrolysis. The correlations found between the bacterial populations and physicochemical parameters of the water suggested an intricate algal-bacterial interaction. In one river, correlation of the oxidative metabolism factor with rainfall suggested that the oxidative bacteria may be washed into the river from the surrounding land. The oxidative-fermentative factor correlated negatively with sunshine in the second river. While factor analysis was found to be the most effective method for revealing correlations between bacterial characteristics and the environmental parameters, the use of a variety of methods provided more insight into the ecological apsects. (Carroll-FRC)
W82-06544

THE MOVING INTERFACE PROBLEM WITH FINITE ELEMENTS,

Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
For primary bibliographic entry see Field 2L.
W82-06546

A COMPARISON OF NUMERICAL SOLUTIONS OF THE ONE-DIMENSIONAL UNSATURATED FLOW AND MASS TRANSPORT EQUATIONS,

Agriculture Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W82-06547

SELECTION OF WASTE DISPOSAL SITES,

Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W82-06550

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,

Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-06558

BIOGEOCHEMISTRY OF MOUNTAIN STREAM WATERS: THE MARMOT SYSTEM,

Calgary Univ., (Alberta) Kananaskis Centre for Environmental Research.
S. A. Telang, B. L. Baker, J. W. Costerton, T. Ladd, and R. Mutch.
Environment Canada, Inland Waters Directorate, Ottawa, Ontario, Scientific Series No 101, 1982. 101 p, 66 Ref, 5 append.

Descriptors: *Marmot, basin, *Alberta, Rocky Mountains, *Biogeochemistry, *Organic compounds, Drainage, Basin, Stream basins, *Mountain basins, Water Quality, Stream organics, Organic loading, Streamwater, Stream flow, *Path of pollutants.

The Marmot basin is a mountain drainage basin in the eastern slopes of the Rocky Mountains 600 km north of the Canadian-United States border. It illustrates the hydrology of eastern slopes drainage. The present study focussed on biogeochemical processes occurring naturally in the waters of Marmot creek. These were revealed by measurements of the transport and conversion of organic substances in that cold, clear mountain stream just below the alpine tree-line. Naturally-occurring organic substances ranged widely in biogeochemical lability and afforded a comprehensive evaluation of the in-stream processes of change. Organic substances of the streams are in a dynamic state with marked processes of transfer and conversion discernible in a short, 2.2 km, section of the Marmot system even under winter conditions. Detailed calculations based on stream monitoring revealed the effects of those processes by comparing mass transport in and out of the 2.2 km test section. Processes of conversion and transport within the test section were apparent for each compound and group of compounds. Three different seasonal patterns of alterations are noted. Processes of change involve biosynthesis, maceration and leaching, oxidation, up-take, photodegradation, mineralization, absorption/desorption and biodegradation. Some processes were related to land disturbance, as in the case of forest clear-cutting; this modified contributions to the stream from soil leaching. At the biogeochemical frontiers, three new approaches involved adaptation of aniytical technologies from related disciplines; 1) carbon preference indices for n-alkanes in the stream water clearly showed instream biosynthesis of hydrocarbons in the low-molecular weight range and the leaching of terrestrial hydrocarbons in higher mass ranges; 2) heterotrophic-potential measurements carried out in-situ and in thelaboratory confirmed the up-take of labile organic compunds in the stream (attributed largely to sessile rather than planktonic microbes); and 3) analogue-depletion calculations showed the potential of this method for evaluating stream processes when stream gauging is not available. The adoption of naturally-occurring inorganic ions as reference substances in the stable-labile system of depletion led clearly to a sharp definition of in-situ depletion. It is now possible (a) to use heterotrophic-potential experiments to predict the depletion of a given microbial substrate in a stream depletion, without the addition of tracers or the gauging of the stream. (WATDOC)
W82-06569

DISSOLVED OXYGEN MODELLING OF THE ST. CROIX RIVER, MAINE - NEW BRUNSWICK,

Canada Centre for Inland Water, Burlington (Ontario).
W. Boutot, and T. A. Clair.
Technical Bulletin No 121, 1981. 23 p, 5 Fig, 5 Tab, 7 Ref.

Descriptors: *St. Croix River, *New Brunswick, *Maine, *Hydraulic models, *Oxygen levels, Water quality, Mathematical models, Pollutant loads, Salmon migration, Calibration, Model simulation, Data analysis, *Dissolved oxygen.

Mathematical modelling techniques have been applied to study the dissolved oxygen concentration in the lower reach of the St. Croix River. A hydraulic routing model, HEC-2, was used to describe the flow regime, and the WATQUAL moddel was used to simulate dissolved oxygen levels under different conditions of temperature, flow and biological oxygen demand. The results indicate that waste loading to the river should be restricted during periods of high temperature and minimum river discharge in order to permit fish migration. (WATDOC)
W82-06572

SEASONAL VARIATION OF NITROGEN AND PHOSPHORUS SPECIES IN THE RED RIVER,

Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.
V. T. Chacko, B. C. S. Chu, and W. D. Gummer.
Scientific Series No 128, 1981. 12 p, 10 Fig, 3 Tab, 17 Ref.

Descriptors: *Red River(of the North), *Saskatchewan, *Minnesota, *Load distribution, *Seasonal ratios, *Nitrogen, *Phosphorus, Nitrate concentrations, Amonia, Species, Runoff.

The Red River flows from the United States through Manitoba and into the south basin of Lake Winnipeg. Significant seasonal variations in nitrogen and phosphorus species, concentration and ratios occurred in the Red River during a study conducted at the border between Canada and the United States. Nitrate-N was as much as 60% of total-N during the spring high flow. During summer nitrate-N was so low that it might have been a limiting factor for phytoplankton growth (the inorganic-N to ortho-P ratio exceeded 10 on one occasion only). Particulate-N was usually less than 30% of total-N. Ammonia was up to 30% of total-N in February. The ortho-P concentration constituted between 25% and 80% of total-P. Dissolved organic-P never exceeded 16% of total-P, and particulate-P was as much as 70% of total-P. Particulate P:N:C ratios differed from the stoichiometric ratios of plant cells. On this basis, it is concluded that much of the particulate-P was in mineral form. (WATDOC)
W82-06573

NATIONAL INTERLABORATORY QUALITY CONTROL STUDY NO 27, PCBS, IN NATURALLY CONTAMINATED DRY SEDIMENTS,

Canada Centre for Inland Water, Burlington (Ontario).
H. B. Lee, and A. S. Y. Chau.
National Water Research Institute, Report Series No 72, 1981. 10 p, 2 Fig, 9 Tab, 4 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, Water quality control, Contamination, Spiked samples, Homogeneity, Pollutant levels, Interlaboratory studies, Statistical analysis, Data collections, *Path of pollutants, *Pollutant identification.

This report describes an interlaboratory study on the analysis of polychlorinated biphenyls (PCBs) in naturally contaminated dry sediment reference materials and in isooctane solutions. The quality of data submitted by the participants varied widely. Among the more comparable laboratories, the average interlaboratory coefficient of variation (C.V.) of the sediment samples is 29.0%. This result is significantly worse than the interlaboratory C.V. (16.2%) on sediment samples spiked with PCBs, as reported in interlaboratory quality control study No. 25. The less reliable PCB results, as found on real sediment samples, are likely due to problems in recovery, interference and quantitation of PCB mixtures. (WATDOC)
W82-06574

NATIONAL INTERLABRATORY QUALITY CONTROL STUDY NO 25, PCBS IN WET SEDIMENTS,

Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06575

SOME PALEOLIMNOLOGICAL ASPECTS OF THE MOST RECENT SEDIMENTS OF LAC LAFLAMME (LAURENTIDES PROVINCIAL PARK, QUEBEC) IN RELATION TO ATMOSPHERIC TRANSPORTATION OF POLLUTANTS,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5A.
W82-06577

EFFECTS OF PH, TEMPERATURE, AND EH ON THE UPTAKE OF CADMIUM BY BACTERIA AND AN ARTIFICIAL SEDIMENT,

Ohio State Univ. Columbus. Dept. of Microbiology.
J. A. Titus, and R. M. Pfister.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 6 p 697-704, June, 1982. 2 Fig, 2 Tab, 8 Ref,OWRT A-042-OHIO Grant 712437.

Descriptors: *Fate of pollutants, *Adsorption, *Hydrogen ion concentration, *Sediments, *Pseudomonas, Path of pollutants, Temperature, Uptake, Heavy metals, *Cadmium, Conductivity, Water temperature, Oxidation-reduction potential, Laboratory studies.

Bacteria are known to facilitate the movement of heavy metals from sediment to the water column during their metabolic activities. Acid production by bacteria also aids in the breakdown of the sulfides of zinc (Zn), cadmium (Cd) and lead (Pb). The adsorption of Cd by a Cd-resistent bacterium (Pseudomonas sp.) and a sediment matrix under various conditions of pH, temperature and Eh (redox potential) was examined in four separate kettles. Uptake of Cd by the artificial sediment matrix in a water-sediment system was related to the incubation conditions in a manner similar to that found with bacteria. After 4 days at pH 7 and a temperature of 35 degrees, Cd adsorption was greatest by sediment and bacteria. Incubation at a higher pH lowered sediment adsorption, while lowering the Eh resulted in higher 2-day Cd adsorption by sediment. These effects were less pronounced in bacteria. The amount of Cd taken up by bacteria averaged about 10 times greater than that adsorbed by the sediment on a dry weight basis. These studies showed that the uptake of Cd by a Cd-resistant bacterium was influenced by environmental factors in the same manner as that by sediment. (Geiger-FRC).
W82-06580

RELATIONSHIP OF WATER QUALITY AND POLLUTANT LOADS TO LAND USES IN ADJOINING WATERSHEDS,

Ontario Ministry of the Environment, Toronto. Water Resources Branch.
R. C. Ostry.
Water Resources Bulletin, Vol 18, No 1, p 99-104, February, 1982. 1 Fig, 6 Tab, 3 Ref.

Descriptors: *Water quality, *Pollution load, *Land use, Water pollution sources, *Watersheds, *Ontario, Grand River, Sangeen River.

The Grand and Saugeen Rivers in southern Ontario, Canada, were selected for investigation as pilot watersheds under the Pollution from Land Use Activities Reference Group study. These watersheds, which have adjacent headwater areas, are physically similar in geology, physiography, and climate. Land use and population constitute the major differences between the two watersheds and appear to be responsible for the significant differences in water quality between the watersheds at their outlets. The major pollution sources in the two watersheds were identified as trace elements from urban runoff and point source discharges, phosphorus from agricultural and urban runoff and private waste disposal, chloride from transportation corridors, and sediment and nitrogen from agricultural runoff. Suspended sediment loadings were similar for the two watersheds at their outlets, while all other unit area loads were higher in the Grand River than in the Saugeen River. Phosphorus, nitrogen, chloride, and lead loadings were

two to three times as high in the Grand River as in the Saugeen River. The higher phosphorus and nitrogen levels in the Grand River were attributed to larger point source inputs and to the higher proportion of agricultural activity in the Grand River basin, while the higher chloride and lead levels were attributed to the higher proportion of urban lands in the Grand River basin as compared to the Saugeen River basin. (Carroll-FRC)
W82-06587

CONTROL OF TOXIC METALS AT SEWAGE TREATMENT WORKS,

Thames Water Authority, London (London).
For primary bibliographic entry see Field 5E.
W82-06592

SLUDGE DISPOSAL TO SEA IN SOUTH AFRICA,

For primary bibliographic entry see Field 5E.
W82-06599

PROPORTION OF METHYLMERCURY TO THE TOTAL AMOUNT OF MERCURY IN RIVER WATERS IN CANADA AND JAPAN,

National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
A. Kudo, H. Nagase, and Y. Ose.
Water Research, Vol 16, No 6, p 1011-1015, June, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Mercury, Rivers, Natural waters, Wastewater, Water analysis, *Methylmercury, Fish, *Pollutant identification, Ions, *Canada, *Japan, Ottawa River, Nagara River, Suimon River.

The concentrations of methylmercuric ion mercuric ion, and the total amount of mercury in three rivers are discussed: the Suimon and the Nagara Rivers in Japan and the Ottawa River in Canada. The Nagara River is very clean, but the Ottawa and Suimon Rivers have been polluted by industrial effluents containing mercury. During the past several years these two rivers have been cleaned up. Total mercury concentrations were 19.3 and 25.9 ng/liter in the Nagara and Suimon rivers respectively and 6.6 ng/liter in the Ottawa River. The average methylmercury concentration for the Ottawa River was 2.2 ng/liter, with the average proportion of methylmercury to the total amount of mercury being 33%, very similar to the results for the Nagara and Suimon Rivers. Sewage effluent from Ogaki City contained 39.6 ng/liter total mercury, and the proportion of methylmercury in the effluent (29%) was close to that of the river waters, 30%. These high proportions of methylmercury relative to total mercury may explain why fish in clean rivers and lakes in Northern Canada contain high concentrations of mercury, most of which is in the form of methylmercury. (Baker-FRC)
W82-06609

IMPACT OF COAL ASH FROM ELECTRIC POWER PRODUCTION ON CHANGES IN WATER QUALITY,

Texas Univ. at Houston. School of Public Health.
R. K. Guthrie, E. M. Davis, D. S. Cherry, and J. R. Walton.
Water Resource Bulletin, Vol 18, No 1, p 135-138, February, 1982. 4 Tab, 21 Ref.

Descriptors: *Electric power production, *Coal, *Water pollution sources, Environmental effects, Water Quality, Water reuse, Wastewater management, Waste management.

The use of coal in the United States has increased much more rapidly than was predicted since 1972, with electric power generating plants accounting for much of the increased use. Solid wastes generated by coal combustion include bottom and fly ashes, which consist primarily of inorganic materials. The majority of chemical elements present in coal are concentrated in the fly ash. The sulfate content of the fly ash lowers the pH of water with which it comes in contact, affecting the chemical and physical state of other elements present in the fly ash. Detrimental effects of coal ash effluent runoff in the aquatic environment may result from suspended solids, sedimentation, accumulation of heavy metals in different trophic levels, passage of some of the metals through food chains, and changes in pH and chemical balance. Proper construction and operation of ash settling basins can, however, control the detrimental effects of these effluents and may even result in improvement of the water quality parameters of the effluent as compared with the source water. Special attention must be paid to the solubility or deposition in sediment of potentially toxic chemical elements from fly ash. This study suggests that the aquatic environment need not be adversely affected by solid waste materials from coal combustion and that the potential effects of reuse of effluent water from ash settling basins should be investigated. (Carroll-FRC)
W82-06623

THERMODYNAMIC CONTROLS ON QUALITY OF WATER FROM UNDERGROUND COAL MINES IN COLORADO,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5G.
W82-06624

NONPOINT SOURCE LOADING RATES FROM SELECTED LAND USES,

Wisconsin Univ.-Madison. Dept. of Soil Science.
T. C. Daniel, R. C. Wendt, P. E. McGuire, and D. Stoffel.
Water Resources Bulletin, Vol 18, No 1, p 117-120, February, 1982. 2 Fig, 17 Ref.

Descriptors: *Nonpoint pollution sources, *Pollution load, *Land use, *Runoff volume, Phosphorus, Barn wastes, Dairy industry, Construction, Industrial wastewater, Water pollution sources.

Nonpoint source loading rates derived from monitoring natural runoff from selected land uses in a dairying watershed were compared in an effort to identify priority problems. Runoff volumes, sediment, and nutrient fractions from construction sites, barnyards, and dairying were monitored and expressed as areal loadings for comparison purposes. Sediment yield and total phosphorus loss was found to be directly proportional to runoff, with construction sites having the highest levels and general dairying the lowest. Runoff from barnyard areas had soluble phosphorus and ammonium nitrogen concentrations about 10 times higher than those of the other land uses investigated. Areal loss from nitrate nitrogen was highest from the construction site and was attributed to the higher volume of runoff per unit area. The results of this study show that barnyards in a dairying watershed contribute the highest areal loadings of sediment and nutrients, and especially of dissolved nutrients having the potential for such immediate adverse effects on water quality as rapid algae blooms and aquatic weed growth. Although the runoff and sediment yields were higher from the construction site, the dissolved phosphorus and ammonium nitrate loadings were low. Dairying activity showed the lowest sediment yield of the land uses investigate, reflecting the high amount of land area protected by cover crops. The particular effects of individual sites on water quality will also depend on proximity to surface water bodies and on other watershed characteristics affecting the delivery ratios of contaminants. (Carroll-FRC)
W82-06626

QUALITY OF STORMWATER RUNOFF FROM MOTORWAYS (DIEBESCHAFFENHEIT DER NIEDERSCHLAGSABFLUSSE VON AUTOBAHNEN),

Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wassergute- und Abfallwirtschaft.
H. Klein.
Wasserwirtschaft, Vol 72, No 2, p 37-43, February, 1982. 6 Fig, 6 Tab, 12 Ref. English Summary.

Descriptors: *Storm runoff, *Roads, *Pollutant identification, *Rainfall-runoff relationships, Precipitation, Pollutants, Heavy metals, Chlorides, Highways, Wastewater treatment, Drains, Storm drains, *West Germany, Runoff, Traffic, Water pollutant sources.

The quality of stormwater runoff from road surfaces was examined along three stretches of heavily-trafficked highway in West Germany. Routes A 81 and A 6 are flanked by high rims so that runoff is collected exclusively in storm drains, whereas Route A 8/B 10 has a grass verge over which runoff flows before entering a drain containing a sump. While median monthly rainfall was similar for all three roads, mean monthly runoff varied (599, 358, and 178 cu m/hectare for A 81, A 6, and A 8/B 10, respectively). This was attributed mainly to the difference in drainage systems. Annual mean concentration of chloride was 50-500 times greater in runoff than in rainwater collected at the same sites. Of all filterable material collected, only 4-7% originated in rain. Compared with discharge from a mechanical/biological sewage treatment plant, runoff contained significantly higher concentrations of most pollutants: a maximum of twice as much COD and cadmium, up to five times as much lead, copper, and zinc, up to 17 times as much filterable material, and 50-60 times as much polycyclic hydrocarbons. Smaller amounts of ammonium nitride and total phosphorus were present in runoff. Almost all runoff samples exceeded the maximal permissible limits for filterable material, iron, COD, mineral oil, and chloride. With the exception of chloride, pollutants were found in lesser amounts in runoff from Route A 8/B 10 than in that from the other two roads due to runoff permeating the grass verge. (Gish-FRC)
W82-06635

CONSEQUENCES OF CONTAMINATION BY HEAVY METALS IN TIDAL ESTUARIES BY THE EXAMPLE OF THE RIVER ELBE (AUSWIRKUNGEN DER SCHWERMETALLBELASTUNG VON TIDEGEWASSERN AM BEISPIEL DER ELBE),

Storm- und Hafenbau, Hamburg (Germany, F.R.). Behorde fuer Wirtschaft, Verkehr und Landwirtschaft.
For primary bibliographic entry see Field 5E.
W82-06637

CADMIUM IN GAMMARIDAE (AMPHIPODA: CRUSTACEA) OF THE RIVERS WERRA AND WESER-II. SEASONAL VARIATION AND CORRELATION TO TEMPERATURE AND OTHER ENVIRONMENTAL VARIABLES,

Bremen Univ. (Germany, F.R.).
G-P. Zauke.
Water Research, Vol 16, No 6, p 785-792, June, 1982. 4 Tab, 59 Ref.

Descriptors: Rivers, *Cadmium, Crustaceans, *Gammarus, *Seasonal variations, Temperature effects, Metals, Fate of pollutants, Werra River, Weser River, *Federal Republic of Germany.

This study represents an attempt to realize the approach of a field study using multivariate statistical methods. The relationship between seasonal variation of cadmium in natural populations of Gammarus tigrinus and selected environmental variables was investigated. Results of a correlation analysis indicated that the observed variation of cadmium in G. tigrinus was related to the cadmium concentration of the river Weser and to the water temperature. However, partial correlation coefficient anlaysis showed water temperature to be the most important factor. The relationship between cadmium levels in G. tigrinus and in the water of the Weser turned out to be an imaginary correlation. Highest cadmium levels were noted in populations of G. tigrinus collected in winter, lowest in populations collected in summer. These findings are discussed in view of the hypothesis of an increased elimination of cadmium via exuvia in the summer population. (Baker-FRC)
W82-06659

AREAL EXTENT OF A PLUME OF MINERALIZED WATER FROM A FLOWING ARTESIAN WELL IN DADE COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
B. G. Waller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-199852, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-20, 1982. 20 p, 10 Fig, 2 Tab, 7 Ref.

Descriptors: *Water quality, *Groundwater, *Path of pollutants, *Saline water intrusion, Aquifers, Specific conductivity, Chlorides, Water pollution, *Florida, Dade county, Everglades, Floridan aquifer, Biscayne aquifer.

A flowing artesian well that taps the Floridan aquifer at Chekika Hammock State Park is contaminating the overlying Biscayne aquifer with saline water. The plume of mineralized water extends approximately 7 miles southeast of the well and ranges in width from 1 to 2 miles. The areal extent of contamination in the primary plume is approximately 12 square miles. The principal ions contaminating the Biscayne aquifer are chloride, sodium, and sulfate. (USGS)
W82-06680

FLOW CHARACTERISTICS AND WATER-QUALITY CONDITIONS IN THE SPOKANE RIVER, COEUR D'ALENE LAKE TO POST FALLS DAM, NORTHERN IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
H. R. Seitz, and M. L. Jones.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price $7.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 82-102, October 1981. 56 p, 9 Fig, 10 Tab, 18 Ref.

Descriptors: *Water quality, *Streamflow, *Path of pollutants, *Data collections, Outlet channels, Cross sections, Discharge measurement, Velocity, Water analysis, Nutrients, Bacteria, Trace metals, *Idaho, Spokane River, Coeur d'Alene Lake, Post Falls Dam.

The Spokane River leaves the northern end of Coeur d'Alene Lake, flows westward past the cities of Coeur d'Alene and Post Falls, Idaho, through the Spokane Valley, and joins the Columbia River west of Spokane, Wash. Cross-sectional properties and water-quality characteristics were determined for flows of 6,100 to 8,440 cubic feet per second during June 8 to 12; 750 to 1,760 cubic feet per second during August 24 to 27; and 1,790 to 1,630 cubic feet per second during November 3 to 7, 1980. Cross-sectional areas measured ranged from 4,620 square feet to 17,000 square feet. Flow velocities ranged from 2.00 feet per second during June to less than 0.10 foot per second during August and November. Water quality in the reach was generally good. A small increase of total ammonia nitrogen occurred downstream of the Coeur d'Alene sewage-treatment plant. (USGS)
W82-06681

EVALUATION OF A PREDICTIVE GROUND-WATER SOLUTE-TRANSPORT MODEL AT THE IDAHO NATIONAL ENGINEERING LABORATORY, IDAHO,

Geological Survey, Idaho Falls, ID. Water Resources Div.
B. D. Lewis, and F. J. Goldstein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-204066, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-25, March 1982. 71 p, 26 Fig, 2 Tab, 34 Ref.

Descriptors: *Water quality, *Groundwater, *Radioactive waste disposal, *Path of pollutants, Computer models, Solute transport, Chemical wastes, Chlorides, Tritium, Geohydrology, Observation wells, Monitoring, Groundwater movement, Chemical analysis, *Idaho, Idaho National Engineering Laboratory, Snake River Plain aquifer.

Aqueous chemical and radioactive wastes discharged to shallow ponds and to shallow or deep wells on the Idaho National Engineering Laboratory (INEL) since 1952 have affected the quality of the ground water in the underlying Snake River Plain aquifer. The aqueous wastes have created large and laterally dispersed concentration plumes within the aquifer. The waste plumes with the largest areal distribution are those of chloride, tritium, and with high specific conductance values. The data from eight wells drilled near the southern INEL boundary during the summer of 1980 were used to evaluate the accuracy of a predictive modeling study completed in 1973, and to simulate 1980 positions of chloride and tritium plumes. Data interpretation from the drilling program indicates that the hydrogeologic characteristics of the subsurface rocks have marked effects on the regional ground-water flow regimen and, therefore, the movement of aqueous wastes. As expected, the waste plumes projected by the computer model for 1980, extended somewhat further downgradient than indicated by well data due to conservative worst-case assumptions in the model input and inacurate approximations of subsequent waste discharge and aquifer recharge conditions. (USGS)
W82-06689

HYDROLOGIC AND CHEMICAL EVALUATION OF THE GROUND-WATER RESOURCES OF NORTHWEST ELKHART COUNTY, INDIANA,

Geological survey, Indianapolis, IN. Water Resources Div.
T. E. Imbrigiotta, and A. Martin, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-197369, Price codes A08 in paper copy, A01 in microfiche. Geological Survey Water Resources Investigations 81-53, October 1981. 140 p, 49 Fig, 14 Tab, 42 Ref.

Descriptors: *Groundwater, *Groundwater availability, *Water quality, *Water pollution effects, Landfills, Leachate, Observation wells, Aquifer characteristics, Flow system, Glacial drift, Organic compounds, Plumes, Groundwater movement, Water level fluctuation, Drawdown, Computer models, Chemical analysis, *Indiana, Elkhart County.

A study of the aquifer system underlying northwest Elkhart County, Indiana, has defined the general flow and quality of the area's ground water. The regional ground-water flow is toward the St. Joseph River. A ground-water-flow model was used to simulate pumpings of 7.5-, 10-, and 20-million gallons per day at the airport. The model-generated water-level maps indicated that only for the 20-million-gallons-per-day simulated pumping could a small part of the total flow into the pumping center come from the Himco landfill area. The general ground-water quality was characterized by slightly basic pH (7-8), average hardness greater than 150 milligrams per liter as calcium carbonate, and a calcium bicarbonate water type. Eight volatile organic compounds were detected in samples from an industrial park area in east Elkhart. Concentrations of dissolved solids, bicarbonate, bromide, chloride, sulfate, ammonia, calcium, magnesium, manganese, potassium, sodium, and dissolved organic in the leachate were at least five times their background concentration. The leachate plume was primarily in the shallow aquifer and extended between 3,100 and 5,600 feet downgradient from the Himco landfill. (USGS)
W82-06691

THE DISTRIBUTION OF HEAVY METALS IN THE BOTTOM SEDIMENTS OF THREE STREAMS IN THE KANSAS CITY, MISSOURI, METROPOLITAN AREA,

Missouri Univ., Kansas City. Dept. of Biology.
D. H. Stern, and M. S. Stern.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256769, Price codes: A06 in paper copy, A01 microfiche. Report, May 1982, Water Resources Research Center, Columbia, MO. 106 p, 5 fig, 1 Tab, 42 Ref, 2 Append. OWRT A-128-MO(1), 14-34-0001-1127.

Descriptors: *Water pollution sources, *Heavy metals, *Pollution load, *Sediments, *Bottom sampling, Environmental protection, Nonpoint pollution sources, Population exposure, Sublethal effects, Cobalt, Cadmium, Chromium, Copper, Iron, Rural areas, Streams, Urban areas, Sampling, Surface runoff, Rivers, Trace metals, *Missouri, Kansas City.

The concentration and distribution of sediment heavy metals were determined in the major stream of each of 3 adjacent watersheds in the Kansas City (Missouri) metropolitan area. The metals were examined in bottom sediments of each stream during 4 seasons under various precipitation/flow conditions. The effects of human activities/urbanization on sediment metal levels/distribution in the streams was assessed. Kansas City area sediments contained higher levels of many metals than sediments of other watercourses. Downstream Blue River stations indicated urban industrial pollution (e.g., runoff from highly active roads, rail lines, bankside steel fabricators, automobile salvage yards). Blue River concentrations of a number of metals (cadmium, chromium, copper, iron, lead, manganese, nickel, zinc) downstream, exceeded those at residential/park/ pastoral upstream locations and those in the other two (suburban and rural) streams studied. Only cobalt was higher in rural areas than urban areas. Stations near the confluence of each stream with the Missouri River had metal concentrations exceeding literature data for many of the metals analyzed. Iron levels appeared slightly higher in January than at other times of the year; other metals showed no seasonable variation. Water quality data at the sediment sampling stations are also reported. (Zielinski-MAXIMA)
W82-06702

BIOTRANSFORMATION OF PCB BY NATURAL ASSEMBLAGES OF FRESHWATER MICROORGANISMS,

Massachusetts Univ., Boston. Dept. of Biology.
M. P. Shiaris, and G. S. Sayler.
Environmental Science and Technology, Vol 16, No 6, p 367-369, June 1982. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Polychlorinated biphenyls, *Biotransformation, *Microbial degradation, Reservoirs, Water sampling, Oxidation, Chlorine, Biodegradation, Path of pollutants, Water pollution, Biological oxidation, Mineralization, *Tennessee, Center Hill Reservoir.

The ability of natural mixed microbial populations in lake water to oxidize PCBs was investigated. A preliminary examination of PCB removal (by hexane extraction) in samples of water from Center Hill Reservoir, Tennessee, that had been exposed to PCBs indicated a significant reaction of PCBs with microbial populations but did not assess the fate of PCBs. Incubation of water samples from the reservoir with a PCB mixture containing 54% chlorine by weight resulted in no oxidation. This indicates that for complex mixtures of PCB, mineralization was insignificant relative to adsorption, volatilization, and cellular accumulation, which occur kinetically at a much faster rate. However, incubation of samples with 2-chlorobenzoic acid and chlorobenzoylformic acid (chlorophenylglyoxylic acid). The results indicate that chlorobenzoic acids can be expected to accumulate during degradation of the lesser chlorinated biphenyls in the environment and support the hypothesis that aquatic ecosystems have detectable potential for PCB biodegradation. (Gish-FRC)
W82-06719

A SURVEY OF DISCHARGES FROM A NATURAL GAS DRILLING OPERATION IN LAKE ERIE,

Lehigh Univ., Bethlehem, PA. Dept. of Biology.
J. I. Parker, and J. G. Ferrante.
Environmental Science and Technology, Vol 16, No 6, p 363-367, June 1982. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Offshore platforms, *Natural gas, *Discharge measurement, *Organic compounds, *Inorganic compounds, Plumes, Pollutant identification, Sodium, Magnesium, Sulfate, Chloride, Hydrocarbons, Volatile hydrocarbons, Methane, Ethane, Nephelometry, Lakes, *Lake Erie, Canada, Environmental Effects, Water pollution sources.

Turbid discharge plumes from a Canadian offshore natural gas drilling rig in Lake Erie were mapped by continuous-flow nephelometry, and the concentrations of certain organic and inorganic constituents in the plumes were measured. Buoyant surface plumes A and B were tracked and mapped on 5.30.1979, while plume C was monitored on 5.31.1979. Plumes A and B drifted eastward about 600-1,500 m before dispersing to background total suspended solids (TSS) levels (< or = 0.4 mg/L). They achieved maximum widths of about 200 m and included areas of approximately 10-25 ha. TSS concentrations ranged from 0.4 to 1.2 mg/L. Plume C covered about 3.5 ha and drifted only about 320 m before TSS concentrations declined to background level. However, TSS levels were higher in plume C, reaching a maximum of 5.3 mg/L about 25 m downcurrent of rig discharge. The survey of plume chemistry showed that sodium, sulfate, and chloride concentrations were not elevated in plume C at distance > 25 m and that these constituents dispersed rapidly after discharge. At a distance of 25 m from the rig, magnesium concentrations were significantly higher than at other locations within the plume and at reference stations, but rapidly declined to ambient lakewater levels throughout the remainder of the plume, suggesting that the area of high concentration was < 1 ha. Volatile hydrocarbon analysis showed minor increases of methane and ethane (less than a factor of 2 above ambient levels) in plume C, and these declined rapidly at distances > 100 m from the rig. Absolute levels were < 25 micrograms/L. The potential for adverse environmental effects resulting from these discharges is considered minimal. (Gish-FRC)
W82-06720

HORIZONTAL RECIRCULATION IN WATER BODIES DUE TO THERMAL DISCHARGE,

Military Engineering Services, Hyderabad (India).
For primary bibliographic entry see Field 5C.
W82-06723

PHYSICOCHEMICAL PROPERTIES AS USEFUL TOOLS FOR PREDICTING THE ENVIRONMENTAL FATE OF ORGANIC CHEMICALS,

Battelle-Inst. e.V., Frankfurt am Main (Germany, F.R.).
W. Klopffer, G. Rippen, and R. Frische.
Ecotoxicology and Environmental Safety, Vol 6, No 3, p 294-301, 1982. 2 Fig, 3 Tab, 17 Ref.

Descriptors: *Organic compounds, *Environmental effects, Physicochemical properties, Persistence, Sinks, Vapor pressure, Volatility, Solubility, Adsorption, Path of pollutants, *Fate of pollutants, Chemicals, Organic wastes,.

The physical and chemical properties of a chemical largely determine the distribution of that chemical between the environmental media of air, water and soil/sediment. Relatively inexpensive measurements can be used to predict roughly the distribution of these chemicals. In particular such estimates are very important in the assessment of new chemicals. In the case of new chemicals, nothing is known about the behavior of the substance in the natural environment. Models still remain to be developed for calculating the distribution on the basis of physicochemical data for different environmental conditions or, alternatively, by using globally averaged data. It is shown that, except in the case of highly persistent chemicals, distribution can only be considered in conjunction with (biotic and abiotic) degradation processes. According to the knowledge at present, the key properties with regard to the environmental fate included vapor pressure, water solubility, absorption and desorption behavior, partition coefficient (octanol/water), volatility from aqueous solution, and hydrolysis and photochemical reactivity in the air, water, and when absorbed at surfaces (aerosol, soil, organic matter). An interesting consequence of the close interrelation of persistence and mobility is that if a chemical has a strong tendency to enter a specific medium or sector of the environment such as water and there is no sink for it in this sector but only in another sector, such as in the air, then the transfer velocity between these sectors will determine the persistence. Thus in certain cases mobility may control persistence. (Baker-FRC)
W82-06727

PRELIMINARY STUDY OF THESSALONIKI BAY FOR CONTAMINATION BY MERCURY AND LEAD,

Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
G. S. Vasilikiotis, N. A. Voulouvoutis, D. G. Themelis, and M. C. Sofoniou.
Chemosphere, Vol 11, No 5, p 479-496, May, 1982. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Heavy metals, *Wastewater disposal, Thessaloniki Bay, *Greece, *Mercury, *Lead, Industrial wastes, Municipal sewage, Water pollution sources, Path of pollutants.

Thermaikos Gulf is estimated to receive more than 80,000 cubic meters per day of domestic sewage and some 25,000 cubic meters per day of industrial wastewater. Mercury and lead concentrations were examined in the Gulf as possible indicators of pollution levels. The northern part of the Gulf was selected for study due to its geological configuration and the fact that the municipal sewage and factory wastes enter this particular basin directly. The amounts of mercury and lead in the sea water and sediment samples taken from this basin were significantly increased in regions close to the outfalls of sewage and wastewater. Contamination peaks were seasonally correlated with various maintenance programs carried out in the industrial plants. At these times the industrial wastewaters even more heavily contaminated with the heavy metals. The high metal content of the seawater at the start of the winter season could also be due to the rainfall washing out to sea the street dust which is rich in heavy metal dust particles. At this same time the increased wind and wave activity in the water body would be stirring up metal particles which had settled to the bottom sediment layer. Analysis showed that the heavy metal concentration in the sediment layer was related to the sediment content of organic residues. (Baker-FRC)
W82-06728

RATES OF MINERALIZATION OF TRACE CONCENTRATIONS OF AROMATIC COMPOUNDS IN LAKE WATER AND SEWAGE SAMPLES,

Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
H. E. Rubin, R. V. Subba-Rao, and M. Alexander.
Applied and Environmental Microbiology, Vol 43, No 5, p 1133-1138, May, 1982. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Lakes, *Mineralization, Wastewater, Metabolism, Microorganisms, Organic compounds Aromatic compounds, Phenols, Microbiological studies, Kinetics Eutrophication, Oligotrophic lakes, *New York.

This investigation was designed to determine the kinetics of mineralization of several compounds in samples of freshwater and sewage. For this purpose a method was developed to test the rates at chemical concentrations lower than those studied heretofore. The rates of mineralization of phenol, benzoate, benzylamine, p-nitrophenol, and di(2-ethylhexyl) phthalate added to lake water at concentrations ranging from a few picograms to nanograms per milliliter were directly proportional to chemical concentration. At levels of less than 1 pg of phenol or p-nitrophenol per ml the rates were still linear, but they were below the predicted value at 1.53 pg of 2,4-dichlorophenoxyacetate per ml. Mineralization of 2,4-dichlorophenoxyacetate was not detected in samples of lake water containing 200 ng of the chemical per ml. The slope of a plot of the rate of phenol mineralization in samples of three lakes as a function of its initial concentration was lower at levels of 1 to 100 micrograms/ml than at higher concentrations. In lake water and sewage supplemented with less than 60 ng ogf C14-labeled benzoate or phenylacetate per ml, 95 to 99% of the raioactivity disappeared from solution, indicating that the microflora assimilated little or none of the carbon. The extent of mineralization of some compounds in samples of two lakes and sewage was least in the water with the lowest nutrient levels. No mineralization of 2,4-dichlorophenoxyacetate and the phthalate ester was observed in samples from an oligotrophic lake. These data suggest that mineralization of some chemicals at concentrations of less that 1 microgram per ml is the result of activities of organisms that metabolize the chemicals at low concentrations but assimilate little or none of the substrate carbon. (Baker-FRC)
W82-06738

SURVIVAL OF ESCHERICHIA COLI IN LAKE BOTTOM SEDIMENT,

Wisconsin Univ. La Crosse, River Studies Center.
P. LaLiberte, and D. J. Grimes.
Applied and Environmental Microbiology, Vol 43, No 3, p 623-628, March, 1982. 2 Fig, 2 Tab, 39 Ref.

Descriptors: *Lake sediments, *Bacteria, Lakes, *Bottom sediment, Sediment, Sedimentation, Escherichia Coli, Fecal Coliforms, Coliforms, Lake Onalaska, Mississippi River, Water quality, Culturing techniques, Dialysis cultures, *Minnesota.

The in situ survival of the fecal coliform Esherichia coli in lake bottom sediment was investigated using dialysis culture techniques. The study sites were located in Lake Onalaska, an impoundment of lock and dam no. 7 on the Mississippi River at Dresback, Minnesota. The lake surface area was 2,146 hectares, with an average depth of 155 cm. The pool receives water from the Mississippi and Black Rivers and has water chemistry characteristics similar to those of the Mississippi. Lake Onalaska does not stratify, has an average annual alkalinity of 125 mg/liter, supports extensive growths of rooted, aquatic vegetation, has a high nutrient trapping efficiency, and is quickly progressing toward hypereutrophic conditions. Daily most probable number determinations indicated that E. Coli populations in unsterile inoculated sediment fluctuated between 530 and 2200 bacteria per g of silty clay and between 3000 and 14000 bacteria per g of sand. Autoclaved silty clay sediment inoculated with 1,000,000 bacteria per g showed increases to 220,000,000 bacteria per g in 3 days. During the same period, autoclaved sand sediment inoculated with 120,000 cells per g increased to 54,000,000 bacteria per g. By day 5, populations in both cultures had decreased by 1 log. The ability of E. coli to survive for several days in aquatic sediment in situ suggests that fecal coliforms in water may not always indicate recent fecal contamination of that water, but rather resuspension of viable sediment-bound bacteria. (Baker-FRC)
W82-06741

USE OF NITRIFIER ACTIVITY MEASUREMENTS TO ESTIMATE THE EFFICIENCY OF VIABLE NITRIFIER COUNTS IN SOILS AND SEDIMENTS,

Cawthron Inst., Nelson (New Zealand).
For primary bibliographic entry see Field 5A.
W82-06755

KINETICS AND EXTENT OF MINERALIZATION OF ORGANIC CHEMICALS AT TRACE LEVELS IN FRESHWATER AND SEWAGE,

Cornell Univ., Ithaca, NY. Dept. of Agronomy.
R. V. Subba-Rao, H. E. Rubin, and M. Alexander.
Applied and Environmental Microbiology, Vol 43, No 5, p 1139-1150, May, 1982. 5 Fig, 8 Tab, 15 Ref.

Descriptors: *Mineralization, *Organic compounds, *Kinetics, Metabolism, Microorganisms, Lakes, Eutrophication, Oligotrophic lakes, Natural waters, Wastewater.

The mineralization of low levels of several C14-labeled organic compounds was studied in natural waters. Attempts were also made to enhance microbial activity by supplementing the waters with

readily available carbon and energy sources. Lake waters with different natural nutrient levels wre used to assess the effect of nutrient status on the extent of mineralization. A sensitive and rapid method to detect mineralization was developed. From 93 to 98% of benzoate, benzylamine, aniline, phenol and 2,4-dichlorophenoxyacetate at one or more concentrations below 300 ng/ml was mineralized in samples of lake waters and sewage, indicating little or no incorporation of carbon into microbial cells. Assimilation of C-14 by the cells mineralizing benzylamine in lake water was not detected. Mineralization in lake waters was linear with time for aniline at 5.7 pg to 500 ng/ml, benzylamine at 310 ng/ml, phenol at 102 fig to 10 mg/ml, 2,4-dichlorophenoxyacetate at 1.5 pg/ml, and di(2-ethylhexyl)phthalate at 21 pg to 200 ng/ml, but it was exponential at several p-nitrophenol concentrations. The rate of mineralization of 50 and 500 ng of aniline per ml and 200 pg and 2.0 ng of the phthalate per ml increased with time in lake waters. The phthalate and 2,4-dichlorophenoxyacetate were mineralized in samples from a eutrophic but not an oligotrophic lake. Results obtained on addition of benzoate-utilizing bacteria, glucose or phenol to the lake water showed that the kinetics of mineralization, the capacity of the aquatic community to assimilate carbon from the substrate or the extent of assimilation, and the sensitivity of the mineralizating populations to organic compounds are different at trace levels than at higher concentrations of organic compounds. (Baker-FRC)
W82-06756

MODEL ECOSYSTEM FOR ENVIRONMENTAL TRANSPORT OF XENOBIOTICS,

Jyvaskyla Univ. (Finland). Dept. of Cell Biology.
M. T. Virtanen, M. Kihlstrom, A. Roos, and H. Kainulainen.
Archives of Environmental Contamination and Toxicology, Vol 11, No 4, p 419-424, 1982. 5 Fig, 2 Tab, 10 Ref.

Descriptors: *Xenobiotics, *Environmental effects, *Pesticides, Soil contamination, Model studies, Ecosystems, DDT, Ecology, Soil properties, Organic compounds, Agricultural chemicals, Soil solution, Leaching, *Path of pollutants, Laboratory studies.

A compartmentalized model is reported to study the transport of agricultural chemicals in soil drainage. In this model drainage from the soil is channeled into the aquatic system together with groundwater, providing a slow, fluctuating water flow. C-14 labeled DDT was used as a reference toxicant. The variability of the model exosystem was evaluated, and some recommendations are given for future work. The terrestrial part was built of washed gravel and soil in a container. The aquatic part was an aquarium provided with an overflow pipe. A layer of gravel was scattered on the bottom of the aquarium. The behavior of DDT in this system may be considered to mimic its behavior in a soil/water system under natural conditions. DDT became tightly bound to the soil, which acted as a reservoir. A compound with a high partition coefficient (highly lipophilic) such as DDT has a strong tendency to accumulate in aquatic biota, but its transfer to the aquatic environment is limited by its adsorptive properties, and its availability to aquatic biota is accordingly reduced. (Baker-FRC)
W82-06760

DIFFERENTIAL PHOSPHORUS ASSIMILATION IN ATTACHED VS. UNATTACHED MICROORGANISMS,

North Carolina Univ., Morehead City. Inst. of Marine Sciences.
H. W. Paerl, and S. M. Merkel.
Archiv fur Hydrobiologie, Vol 93, No 2, p 125-134, January, 1982. 3 Tab, 21 Ref.

Descriptors: *Microorganisms, *Phosphorus, *Absorption, *Path of pollutants, Estuaries, Estuarine environment, Lakes, Eutrophication, Metabolism, Nutrients, Bacteria, Natural waters, Suspended sediments, Oligotrophic lakes, Trophic levels, Particulate matter, *Waste assimilative capacity.

One aspect of particle-related phosphorus uptake was investigated - differential uptake activities of attached vs. free floating bacteria in natural aquatic ecosystems. This is significant in determining the relative importance of phosphorus uptake and cycling on particle-bound vs. free-floating microorganisms. Microautoradiography was used to study the uptake of phosphorus. A variety of aquatic ecosystems was studied, exhibiting a range of trophic states. Lake Tahoe, California, a deep ultra-oligotrophic lake, was studied, as was Heart Lake, Ontario, which is a small, shallow, eutrophic lake, and Lake Taupo on the North Island of New Zealand, which is a deep oligo-mesotrophic lake. Samples were also taken from the Newport River Estuary in North Carolina. In all systems studied particle-rich waters showed higher uptake rates per unit volume than particle-poor waters. Bacteria associated with particles were responsible for elevated uptake rates and exhibited higher relative uptake rates per cell than free-living bacteria. Differences in cellular phosphorus uptake between attached and unattached bacteria were greatest under oligotrophic and least under eutrophic conditions. The significance of these findings with regard to particles as nutrient-concentrating microenvironments in natural waters is discussed. (Baker-FRC)
W82-06762

TURBIDITY MAXIMUM AND MUD SHOALING IN THE WESER ESTUARY,

Institute fuer Meeresforschung (Germany, D.R.).
S. Wellershaus.
Archiv fur Hydrobiologie, Vol 92, No 2, p 161-198, September, 1981. 21 Fig, 1 Tab, 66 Ref.

Descriptors: *Estuarine environment, *Turbidity, Estuaries, Marine environment, Coastal waters, Mud flats, Sedimentation, *Suspended sediments, Tidal waves, Tidal marshes, Tidal effects, Water currents, Weser Estuary, *West Germany.

The accumulation of particles with low settling velocities along a mud shoal is shown to be due to a combination of transport of particles from other areas, formation of particles in the salt wedge area, and trapping of particles due to hydrographic mechanisms. The tidal Weser Estuary was the study site; it experienced a turbidity maximum and mud shoal near the tip of the salt wedge. Non-tidal estuaries may have a mud shoal, but since alteration and strength of tidal currents are lacking, a strong turbidity maximum may also be absent. In all undisturbed tidal coastal plain estuaries the same mechanisms may lead to effects similar to those in the Weser. However, the channel will be much shallower, and in the turbidity maximum the seston concentration may be less. It is noted that fractionation of particles into subclasses may also lead to fraction of pollutants that may be constituents of particles in one of these fractions. It is expected that dredging will initiate chemical and biological reactions that would not occur in an undisturbed estuary. Thus some types of suction dredging select the heavier particles such as fine sand and larger pieces, while the lighter aggregates escape out of the hold together with the overflowing water and remain in the turbidity maximum. Thus natural processes are hindered by maintenance dredging. The main cause for the muddy character of the sediment is the non-tidal estuarine circulation, which results in collection, amassment and settling of particles with low settling velocities in the salt wedge area. Tidal oscillation, causing alternating sedimentation and resuspension of the particles, is the main source of visual turbidity in an estuary not disturbed by man. (Baker-FRC)
W82-06766

HEAVY METAL POLLUTION IN THE CHAO PHRAYA RIVER ESTUARY, THAILAND,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert.
Water Research , Vol 16, No 6, p 775-784, June, 1982. 3 Fig, 3 Tab, 37 Ref.

Descriptors: *Heavy metals, *Public health, Mercury, Lead, Copper, Chromium, Cadmium, Chao Phraya River, *Thailand, Estuaries, Seasonal variations, bottom sediments, Fish.

Heavy metal pollution was examined in the Chao Phraya River estuary. Seasonal variations were noted, but the patterns were not the same for different heavy metals of different sampling stations along the river. The relatively high concentrations of heavy metal in the river mouth vicinity indicated a possible accumulation of heavy metals which may have been due to the movement of pollutants from upstream, sources from wastewater discharges from the Bangkok Metropolis and industrial estates south of Bangkok, and the physical characteristics of the estuary and tidal movements that tended to stagnate water in this area. Twenty-seven species of fish of various sizes were also studied. The results indicate that the Chao Phraya River estuary is being polluted by heavy metals, and that the accumulation of Cd, Cu, Cr, and Pb in water in the vicinity of the river mouth is significant. If pollution were to continue, long term accumulation of heavy metals in sediments and fish in the river mouth could occur because the water pH in this area is between 7 and 8 and because the bio-accumulation and bio-magnification of fish reared in heavy metal polluted water have been reported elsewhere. The probable ingestion of mercury and lead in fish from this region is a matter for concern. (Baker-FRC)
W82-06774

YORK RIVER DESTRATIFICATION: AN ESTUARY-SUBESTUARY INTERACTION,

Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W82-06787

DEGRADATION OF TERBUTRYN IN SEDIMENTS AND WATER UNDER VARIOUS REDOX CONDITIONS,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, and A. L. Yarechewski.
Journal of Emvironmental Science and Health, Part B, Vol 17, No 4, p 363-380, 1982. 3 Fig, 4 Tab, 16 Ref.

Descriptors: *Agricultural chemicals, *Degradation, *Fate of pollutants, Laboratory studies, Degradation products, *Terbutryn, *Herbicides, Water pollution, Organic compounds, Environmental effects, *Oxidation-reduction potential, *Sediments, Rivers, Ponds, Bottom sediments.

The major degradation pathways of terbutryn in sediment and water were studied under laboratory conditions which simulated the use of this herbicide in aquatic environments. Degradation of terbutryn in static culture flask incubations proceeded slowly, with half-lives of about 380 days in both river and pond sediments. The disappearance of terbutryn in water was more rapid , with half-lives of 240 days and 180 days in water above pond and river sediments, respectively. Redox potentials in these static systems following 200 days of incubation averaged +384 mv in water and +364 mv in sediment, indicating that aerobic conditions prevailed. Degradation proceeded much more slowly in autoclaved sediments and water, suggesting that biological activity was essential in order for rapid degradation to occur. The major degradation product from static incubations was hydroxyterbutryn (HT). Also eluting on the chromatogram was a peak corresponding to N-deethyl hydroxy terbutryn (DEHT) as a minor product. A second major product was terbutryn sulfoxide (TS). A comparison of these studies with field studies on the fate of terbutryn in small ponds indicated that the laboratory studies closely simulated the persistence of the herbicide. Breakdown of terbutryn in laboratory sediment-water systems appears to be inversely related to redox potential, as the degradation rate was slowed dramatically at low potential. Measurement of redox potential in sediments from treated water bodies in field experiments may be a useful means of predicting terbutryn persistence under field conditions. (Baker-FRC)
W82-06790

COAL AND COAL MINE DRAINAGE,

Tennessee Valley Authority, Chattanooga.
H. Olem.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 717-723, June, 1982. 2 Tab, 67 Ref.

Descriptors: *Literature review, *Coal mining, *Mine drainage, *Mine wastes, *Reviews, Water pollution sources, Fate of pollutants, Strip mines, Coal mines, Acid mine drainage, Water pollution effects, Regulation, Water pollution control, Wastewater treatment, Leachates, Slurries, Sulfur, Sulfates, Wastewater treatment.

The role of coal and mine drainage in water pollution is the subject of a literature review. A table presents the subjects and authors of selected papers from the 1981 symposium on surface mining hydrology, sedimentology, and reclamation. Studies on formation of coal mine drainage included identifying potential acid-producing strata, the good correlation between carbonate-sulfur ratio and effluent quality, and pyrite oxidation. The effects of coal mining on hydrology and stream water quality are reported from various locations in the U.S. Acid mine drainage and groundwater deterioration were reported in many cases. In the western U.S., total dissolved solids is the major problem associated with coal mining. Methods for treating mine drainage include chemical neutralization, settling ponds, and limed plots of land. Reclamation techniques involve acid-tolerant macrophytes in streams and lakes and use of municipal sludge in revegetation. The impact of coal cleaning was evaluated in 17 projects sponsored by the EPA. Generally, physical coal cleaning is more economical than other sulfur-removal strategies such as flue gas desulfurization and use of low-sulfur coal. Problems with coal transportation are mentioned: formation of carcinogens in chlorinated coal-slurry pipeline water and corrosion on combustion of coal slurried with salt water. Some work has been done on the subject of coal pile drainage. (Cassar-FRC)
W82-06802

GROUND WATER,
SMC-Martin, King of Prussia, PA.
G. H. Emrich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 784-786, June, 1982. 29 Ref.

Descriptors: *Literature reviews, *Groundwater, *Reviews, Sampling, Sample preparation, Water sampling, Model studies, Monitoring, Water quality, Organic compounds, Mathematical models, Groundwater pollution, Path of pollutants.

Recent research in the area of groundwater pollution is cited in this review of the current literature. The main emphasis during 1981 has been the need for determining the occurrences, extent, and sampling of groundwater pollution in response to the implementation of federal and state programs. A manual of groundwater sampling procedures was prepared. A grab sampler for obtaining highly volatile organic compounds from unsaturated zones was presented. Several researchers indicated a need for improving the quality of information obtained from groundwater sampling programs. Implementation of the underground injection control phase of the State Safe Drinking Water Act of 1974 began in earnest. A digital model of a buried channel aquifer contaminated by hydrocarbons was used to evaluate three management alternatives. Laboratory-determined chemical parameter values were used in simulation of transport of ion-exchanging solutes governed by local chemical equilibrium. A kinematics mathematical model was used to develop flow and arrival time plots of groundwater contaminants. Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, recognizing the need for a systematic approach to setting priorities for the investigation and cleanup of hazardous waste sites. Two roles that surface geophysical methods can play in groundwater monitoring were defined - direct measurement of contaminated water and the determination of boundary conditions. A method was presented for calculating apparent resistivities for application in delineating plumes of contaminated ground water. Surface resistivity was used in a monitoring program. A combination of four surface geophysical methods was used to investigate groundwater pollution and locate buried drums at a chemical dump. (Baker-FRC)
W82-06807

AN EXPERIMENTAL APPARATUS FOR EVALUATING KINETICS OF AVAILABLE PHOSPHORUS RELEASE FROM AQUATIC PARTICULATES,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto.
Water Research, Vol 16, No 6, p 1065-1070, June, 1982. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Phosphorus, *Kinetics, Path of pollutants, Measuring instruments, Chemical reactions, Particulate matter, Water pollution control, Suspended solids, Water analysis.

The design, testing and application of an experimental apparatus which has proved useful to the kinetic description of two aspects of phosphorus dynamics in aquatic systems are described. The apparatus is referred to as a Dual Culture Diffusion Apparatus (DCDA), and it is designed so that two microbial populations can interact in a syntrophic manner through substances dissolved in the liquid phase. The apparatus permits the extraction of process kinetic data for several types of particulate-water interactions. The apparatus is useful and flexible for characterizing and quantifying certain biochemical processes in aquatic systems. It may also be used for adsorption-desorption process studies as a function of time without disturbing the vessel housing the process of interest. Other applications include microbial mediated recycle or transformation of organics bound to particles, biological partitioning and microbial degradation or release of the partitioned compounds, and many types of microbial species interactions. (Baker-FRC)
W82-06829

FIELD STUDY OF ORGANIC WATER QUALITY CHANGES DURING GROUNDWATER RECHARGE IN THE PALO ALTO BAYLANDS,
Stanford Univ., CA. Dept. of Civil Engineering.
P. V. Roberts, J. Schreiner, and G. D. Hopkins.
Water Research, Vol 16, No 6, p 1025-1035, June, 1982. 13 Fig, 8 Tab, 13 Ref.

Descriptors: *Groundwater recharge, *Water quality, Aquifers, Recharge, *Artificial recharge, Injection, Replenishment, Water supply development, Water supply, *California, Palo Alto Baylands, *Organic compounds, Biodegradation.

A field study was performed wherein reclaimed water was injected directly into an aquifer in the Palo Alto Baylands, near San Francisco Bay. The injection rate was 6 liters/second of reclaimed municipal wastewater. The concentrations of organic constituents were affected by processes such as adsorption and biodegradation during recharge even though the recharged water had received advanced treatment including granular activated carbon. The influence of adsorption was observed as retardation of the transport of trace organic compounds, which are retained to varying degrees in the aquifer. The effects of biodegradation are evidenced by decreasing concentrations of total organic carbon, chemical oxygen demand, and dissolved oxygen as the water spread out from the injection point. In general the concentrations of TOC and COD responded rapidly to fluctuations in input concentration, indicating that the bulk of organic constituents in the reclaimed water did not engage in sorptive interaction with the aquifer material. Halogenated organic compounds showed no evidence of retardation or retention during aquifer passage. Organic pollutants remaining after water reclamation treatment pose a potential health threat if the reclaimed water is to be directed to potable reuse. Groundwater recharge by direct injection affords protection by affording opportunities for adsorption and degradation and by smoothing concentration fluctuations. (Baker-FRC)
W82-06831

HYDROGEN ION BUDGET OF AN AGGRADING FORESTED ECOSYSTEM,
State Univ. of New York, Syracuse. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W82-06836

PURGE AQUIFER TO REMOVE VOLATILE ORGANIC CONTAMINATION,
Plainville Water Co., CT.
For primary bibliographic entry see Field 5G.
W82-06842

THE EFFECTS OF ACID RAIN ON FOREST NUTRIENT STATUS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W82-06860

A DIMENSIONLESS PARAMETER APPROACH TO THE THERMAL BEHAVIOR OF AN AQUIFER THERMAL ENERGY STORAGE SYSTEM,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 2F.
W82-06861

SALTWATER ENCROACHMENT IN AN AQUIFER: A CASE STUDY,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 2F.
W82-06864

A CASE STUDY OF A CHEMICAL SOIL: POLYCHLORINATED BIPHENYLS (PCBS) 1. HISTORY, DISTRIBUTION, AND SURFACE TRANSLOCATION,
National Research Council of Canada, Ottawa (Ontario).
J. R. Roberts, J. A. Cherry, and F. W. Schwartz.
Water Resources Research, Vol 18, No 3, p 525-534, June, 1982. 5 Fig, 2 Tab, 31 Ref.

Descriptors: *Polychlorinated biphenyls, *Translocation, Water pollution sources, Organic chemicals, Industrial wastes, Leaching, Permeability, Soil porosity, *Saskatchewan,.

This paper presents background information about the spill, explains techniques used in sample collection, preparation and analysis, and describes the distribution and surface movement of PCBs at the spill site, a transformer manufacturing plant in Regina, Saskatcheqan, Canada. Between 6,800 and 21,000 liters of transformer oil containing Aroclor 1254 and chlorobenzenes were spilled at an underground pipe break. Large quatities of PCBs were found to have migrated both vertically and horizontally at the site. PCBs at concentrations of about 1000 mg/kg moved downward through granular fill and 9 meters of fractured Regina clay. Contaminant migration along the interface of the clay and the upper unit of permeable granular fill probably accounted for the extensive lateral movement. It was argued that because of the low organic content of the geological units at the site and the hydrophobicity of chlorinated organics like PCBs, contaminants at many locations exist in three phases: a dissolved aqueous phase, an adsorbed phase, and an oily liquid phase. Movement of the oily liquid seems to be the most likely explanation for the migration of large quantities of PCBs downward through fractures in the clay and laterally through the granular fill. (Baker-FRC)
W82-06865

A CASE STUDY OF A CHEMICAL SPILL: POLYCHLORINATED BIPHENYLS (PCBS). 2. HYDROGEOLOGICAL CONDITIONS AND CONTAMINANT MIGRATION,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, J. A. Cherry, and J. R. Roberts.
Water Resources Research, Vol 18, No 3, p 535-545, June, 1982. 8 Fig, 2 Tab, 21 Ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Polychlorinated biphenyls, Water pollution sources, Organic chemicals, Leaching, Permeability, Soil porosity, Aquifers, Drinking water, Wells, Well water, Geology.

The hydrogeology of a spill site in Regina, Canada is described as it relates to the observed patterns of PCB contamination. Six major hydrostratigraphic units were identified from detailed test drilling and sampling. From the surface downward there are a thin surface fill, Regina clay, Condie silt, till zone, interglacial silt, and Regina aquifer system. This later unit is a significant source of potable groundwater. At present the nearest wells are hundreds of meters from the spill site. The permanent water table is situated below the Condie silt in sandy glacial till. An active perched groundwater system was developed within the thin fill layer beneath the floor of the plant. The extensive lateral flow of groundwater in this zone has contributed significantly to the spreading of PCBs at this site. The PCBs have also moved downward through fractures in the Regina clay and upper part of the Condie silt. It can be expected that capillary forces will halt the downward movement as fractures narrow or stop. However, the possible existence of fractures connecting the contaminated zone to the Regina aquifer system or the potential for transport as a dissolved phase in the groundwaters may permit PCBs to migrate downward to the aquifer or to flow laterally off-site. The most significant hazard is the potential for contamination of future water supply wells that may be placed near the site or aquifer contamination that could result if future drilling provides pathways for contaminants through poorly sealed wells or test holes. (Baker-FRC)
W82-06866

PESTICIDE ACCUMULATION IN A NEW IMPOUNDMENT IN IOWA,

Minnesota Pollution Control Agency, Roseville.
S. Y. T. Leung, and J. J. Richard.
Water Resources Bulletin, Vol 18, No 3, p 485-493, June, 1982. 2 Fig, 4 Tab, 54 Ref.

Descriptors: *Pesticide residues, *Pesticide, *Reservoirs, Accumulation, Lakes, Insecticides, *Agricultural chemicals, Atrazine, Alachlor, Cyanazine, Dieldrin, DDE, Des Moines River, Rivers, *Iowa, Suspended sediments.

From September 1977 through November 1978 single 4-liter water samples were collected weekly or every 2 weeks beneath the surface and at mid-depth or near the bottom to estimate amounts of selected pesticides entering and leaving Saylorville Reservoir, a new partly filled impoundment on the Des Moines River in Iowa. Atrazine, alachlor, andd cyanazine, which have low affinity for suspended sediment and are highly soluble in water, were found only in the dissolved fraction of Des Moines River water. Atrazine levels in water ranged from 0 to 1,356 ng/l, with an overall mean of 223 ng/l. Alachlor concentrations ranged from 0 to 1,450 ng/l, with an overall mean of 89 ng/l. Cyanazine concentrations ranged from 0 to 660 ng/l and followed a seasonal trend similar to alachlor, with higher levels occurring in June and July. Dieldrin concentrations in water ranged from 1 to 33 ng/l, and that compound was found in both dissolved and suspended fractions of river water. Dissolved p,p'-DDE levels were mostly less than 1 ng/liter, with suspended concentrations ranging from 0 to 66 ng/l and averaging 7 ng/liter, with suspended concentrations ranging from 0 to 66 ng/l and averaging 7 ng/liter. The estimated deposition in the reservoir from September 1977 to October 1978 was 281 kg atrazine, 251 kg alachlor, 26 kg cyanazine, 16 kg dieldrin, and 20 kg p,p'-DDE. (Baker-FRC)
W82-06871

STORM WATER RUNOFF QUALITY FROM THREE LAND-USE AREAS IN SOUTH FLORIDA,

Geological Survey, Orlando, FL.
R. A. Miller, and H. C. Mattraw, Jr.
Water Resources Bulletin, Vol 18, No 3, p 513-519, June 1982. 1 Fig, 6 Tab, 11 Ref.

Descriptors: *Storm water, *Runoff, Water quality, Regression analysis, Land use, Basins, Fort Lauderdale, *Florida, Nitrogen, Phosphorus, Zinc, Oxygen demand, Mathematical studies.

Storm water runoff studies were made of three small basins in the Fort Lauderdale area of Florida to estimate annual loads through the use of linear regressions for a variety of water quality constituents, to define the range of constituent concentrations and loads typical of storm water in south Florida, to develop methods for transferring the information concerning concentrations and loads to other similar areas, and to meet information requirements of the various county and state agencies in Florida. Due to the large amount of data collected, a data management system was developed to store, analyze, and output data. Most of the storm water leaving the basins originated as rainfall on the hydraulically effective impervious area (HEIA). A large part of each of the constituent loads also originated on the hydraulically effective impervious area. Additional regression analysis showed that multiplicative models are superior to additive models for total residue and total lead. For total nitrogen, total phosphorus, total carbon, andd total zinc the additive models were superior to the multiplicative models. Total nitrogen and phosphorus HEIA yields were highest in the single family residential basin, whereas chemical oxygen demand and lead yields were highest in the commercial basin. In the highway drainage basin, total N and total P inputs exceeded outputs. Total zinc input exceeded output in both the highway and commercial areas. (Baker-FRC)
W82-06877

ATTACHED AND FREE-FLOATING BACTERIA IN A DIVERSE SELECTION OF WATER BODIES,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
C. R. Bell, and L. J. Albright.
Applied and Environmental Microbiology, Vol 43, No 6, p 1227-1237, June, 1982. 2 Fig, 8 Tab, 25 Ref.

Descriptors: *Bacteria, *Heterotrophic bacteria, *Particulate matter, Amino acids, Glucose, *British Columbia, Salinity, Fate of pollutants.

The contributions of attached and free-floating bacteria to the bacterial numbers and heterotrophic uptake in 44 aquatic environments (marine, estuarine, lake, river, and creek) were studied in the southwest corner of British Columbia. Cluster analysis placed the 44 sites into five distinct environmental types based on three factors (salinity, heterotrophic uptake, and particulate load) which accounted for 33.6% of the variation. The five groups were: A, marine with low turnover times and low particulate load; B, marine, with high turnover times and no particulate load; C, fresh water with high turnover times; D, fresh water with a range of turnover times and heavy particulate loads. The order of clusters with increasing attached-fraction uptake of amino acids was A < B < E < C < D and for glucose, A < B < C < E < D. Clusters D and E had much higher bacterial counts than A, B, and C. Heavy particulate loads were associated with an increased percentage uptake of amino acids and glucose from the attached bacteria. In oligotrophic fresh water, uptake response was substrate specific. Amino acid uptake was more associated with the attached fraction; glucose uptake, with the free-floating fraction. (Cassar-FRC)
W82-06887

ISOLATION OF PITTSBURGH PNEUMONIA AGENT FROM A HOSPITAL SHOWER,

Veterans Administration Medical Center, Pittsburgh, PA.
A. Brown, V. L. Yu, M. H. Magnussen, R. M. Vickers, and G. M. Garrity.
Applied and Environmental Microbiology, Vol 43, No 3, p 725-726, March, 1982. 15 Ref.

Descriptors: *Aerosols, *Human disease, *Bacteria, Microorganisms, Air pollution, Fallout, Sediment, Pneumonia, Legionella, *Tatlockia, Public health, Water pollution sources, Epidemiology, *Pittsburgh pneumonia agent.

The isolation of Tatlockia (Legionella) micdadei, the Pittsburgh pneumonia agent (PPA), from sediment obtained from a hospital shower is reported. Sediment was scraped with a sterile Dacron swab from the shower heads and mixing valves of 25 showers on 10 wards at the Pittsburgh Veterans Administration Medical Center. All recovered sediment was suspended in buffered yeast extract broth. Cultures were prepared and incubated aerobically and observed daily. Whereas several of the samples contained L. pneumophila, one contained a gram-negative rod which grew on the supplemented yeast extract agars but not on sheep blood agar. On the dye-containing buffered charcoal-yeast extract agar it grew as a blue-grey, nonfluorescing colony, typical of T. micdadei. It is suggested that the isolation of this organism from shower heads may be clinically significant because it provides further evidence that a water associated reservoir exists within the hospital. In addition, since an aerosol is produced by showering, this is a plausible source for the transmission of an organism producing pneumonia. (Baker-FRC)
W82-06891

MANGANESE-54 ACCUMULATION BY CHLORELLA SPP., DAPHNIA MAGNA AND YELLOW PERCH (PERCA FLAVESCENS),

Department of Energy, Argonne, Illinois, Operational and Environmental Safety Division.
P. K. Kearns, and R. J. Vetter.
Hydrobiologia, Vol 88, No 3, p 277-280, May, 1982. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Radioisotopes, *Accumulation, *Aquatic life, Fate of pollutants, *Manganese radioisotopes, Fish, Algae, Invertebrates, Radioactive wastes, Daphnia, *Chlorella, *Perch, Bioaccululation, Nuclear powerplants.

The concentration factor and biological half-life of Mn54 were determined in three members of a food chain. Green algae (Chlorella), Daphnia magna, and yellow perch (Perca flavescens) were exposed for 168 hours to water containing 5 micro Ci, 20 micro Ci, and 5 micro Ci of Mn54, respectively. Mn54 was added as necessary to keep the levels constant throughout the experiment. Concentration factors for algae, Daphnia, and perch were 4230, 17,000 and 11, respectively. The data suggest that these aquatic organisms can concentrate Mn54 rapidly, which could result in significant exposures to man. Nuclear power generation is one source of this radionuclide. (Cassar-FRC)
W82-06904

THE DISTRIBUTION OF AQUATIC OLIGOCHAETES IN BRACKISH INLAND WATERS IN THE SW NETHERLANDS,

Provincial Water Authority, Zwolle (The Netherlands). Department of Watershed Management.
P.F.M. Verdonschot, M. Smies, and A.B. J. Sepers.
Hydrobiologia, Vol 89, No 1, p 29-38, April, 1982. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Oligochaetes, *Saline water intrusion, Chlorides, *Benthic fauna, Estuarine environment, *Brackish water, *The Netherlands, Scheldt Estuary, Deltas, Aquatic invertebrates, Salinity, Species composition.

Benthic macrofauna were sampled at 37 sites in the Delta region of The Netherlands (Scheldt Estuary) from January to June 1979. Waters in this unstable environment, below sea level and immediately behind the sea walls, have water temperature fluctuations of < 0 to > 20 C from winter to summer and sudden, irregular chlorinity variations up to 20 o/oo chloride at a single station. The distribution of the 23 species of oligochaetes was related to median chlorinity at the sampling station. There were 10 Tubificidae, 11 Naididae, 1 Lumbriculidae, and 1 Lumbricidae. Nais elinguis occurred throughout the chlorinity range. Oligochaetes formed two groups: brackish-marine and brackish-limnetic. The dividing line was about 1.5 o/oo

chloride. The brackish-marine group was resistant to high chlorinities and to wide fluctuations in chlorinity. (Cassar-FRC)
W82-06905

FACTORS AFFECTING THE DISTRIBUTION OF LIGNICOLOUS MARINE FUNGI IN HONG KONG,

Hong Kong Univ., Dept. of Botany.
L. L. P. Vrijmoed, I. J. Hodgkiss, and L. B. Thrower.
Hydrobiologia, Vol 87, No 2, p 143-160, 1982. 3 Fig, 7 Tab, 62 Ref.

Descriptors: *Coastal waters, Fungi, *Aquatic fungi, *Hong Kong, Salinity, Temperature effects, Acidity, Dissolved oxygen, Biochemical oxygen demand, Nutrients, Nitrogen, Phosphorus, Light penetration, Sediments, Estuaries, Estuarine environment, *Marine fungi, Pearl River Estuary.

The effect of a range of environmental factors on the distribution of lignicolous marine fungi was studied in Hong Kong coastal waters. Five sites were chosen for study of the higher saprobic fungi of the lignicolous marine mycota. The Pearl River Estuary exerts an influence on the coastal waters especially during the wet season, when salinity, nutrient levels and the amount of sediment are affected. Throughout the year the average salinity increases, while the nutrient level and organic load decrease from west to east across the coastal waters. Among the 51 species recorded, 3 species remained unidentified. Of the 48 remaining species, 28 were considered either facultative or oligate marine forms; the remaining 20 species were probably either from marine sediments or were of terrestrial origin. Periconia prolifica was the most frequent fungus in the coastal waters. Other frequent species were probably either from marine sediments or were of terrestrial origin. Periconia prolifica was the most frequent fungus in the coastal waters. Other frequent species included Halosphaeria quadricornuta, Cirrenalia macrocephala, Ceriosporopsis halima, and Trichocladium achrasporum. These species were found at all test sites. Regarding the abundance of species, frequency of occurrence and species composition of this group of more frequent lignicolous marine fungi, it appeared that two major patterns emerged. For mixed-mesohaline waters there was only one dominant fungus and many fortuitous species. For the mixo-polyhaline zones there was one dominant fungus and several important fungi co-existing but with fewer fortuitous species. There was no increase in the number of species nor any appreciable change in the Ascomycotina/Deuteromycotina ratio with increasing salinity. (Baker-FRC)
W82-06908

FLUCTUATIONS OF THE ICHTHYO-FAUNA IN THE ELBE ESTUARY: AN INDICATOR FOR A DISTURBED ECOSYSTEM (FLUKTUATIONEN DER FISCHFAUNA IM ELBEASTUAR ALS INDIKATOR FUR EIN GESTORTES OKOSYSTEM).

Hamburg Univ.(Germany, F.R.), Zoologisches Inst.
For primary bibliographic entry see Field 5C.
W82-06913

MICROBIOLOGY: WATER,

Environmental Protection Agency, Cincinnati, OH., Drinking Water Research Division.
E. E. Geldreich.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 931-943, June, 1982. 173 Ref.

Descriptors: *Literature reviews, *Bioindicators, *Microbiological studies, *Reviews, Bacteria, Public health, Lakes, Impoundments, *Indicators, Water pollution effects, Environmental effects, Ecosystems, Rivers, Water pollution sources, Coastal waters, Corrosion, Water quality, Swimming pools, Drinking water, Antibiotic resistance.

Recent research in the area of water microbiological studies is cited in this review of the literature. Research into the use of microbial indicators of pollution included the development of multiple test kits for speciation of many waterborne aerobic and anaerobic organisms, changes in the heterotrophic bacterial density and subgroups as an indicator of qualitative changes in physicochemical characteristics of the Yodo River in Japan, the isolation of Aeromonas hydrophila from frogs and tadpoles, the potential human health hazard from toxigenic bacteria in water, the relationship between isolation of mycobacteria and classical microbiological and chemical indicators of water quality in swimming pools, bacteria in public water supplies, and the health risk of human exposure to wastewater. Microbial ecology of water was investigated in the light of solar radiation and naturally occurring microbial predators as important forces in the natural self-purification of polluted surface waters, short term exposure of E. coli to oligotrophic natural waters, the use of fecal indicators, biocumulation of copper and lead in aquatic life forms, the corrosion potential of four tropical Desulfovibrio desulfuricans isolates, microbial bioconcentration of organic pollutants from aquatic systems, and the microbial degradation of petroleum hydrocarbon. Much research was also conducted on the microbiology of river systems in coastal areas and on the microbiology of natural lakes and impoundments. (Baker-FRC)
W82-06924

MICROBIOLOGY: DETECTION, OCCURRENCE AND REMOVAL OF VIRUSES,

Louisiana State Univ., Baton Rouge, Dept. of Civil Engineering.
D. Roy, and M. E. Tittlebaum.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 984-986, June, 1982. 31 Ref.

Descriptors: *Literature reviews, *Viruses, *Reviews, *Microbiological studies, Water pollution control, *Pollutant identification, Path of pollutants, Bioindicators, Enteroviruses, Bacteriophage, Coliphages, Land disposal, Wastewater treatment, Shellfish.

Recent research in the area of detection, occurrence and removal of viruses is cited in this literature review. Detection methodology advanced in the areas of recovery of viruses from large volumes of water and wastewater using membrane filtration with microporous filters, in the efficiency of recovery of rotavirus from domestic wastewater by an adsorption elution technique followed by centrifugation, in the concentration of viruses from water samples using soluble ultrafilters composed of gelified alginate, in methods for concentrating bacteriophages from water and wastewater, in the recovery of viruses by elution from sludge flocs, and in the isolation of viruses using various concentration techniques. Survival of viruses was examined in systems following the transport of enteroviruses through sil at a wastewater irrigation site, in samples of wastewater, primary effluent and secondary effluent in Australia, in water to determine its effect on survival and transport of viruses into receiving waters and potentially back to humans, and in regard to the isolation of ribonucleic acid caliphages from raw wastewater samples in Japan. Research on the removal of viruses by treatment processes includes studies of the efficiency of waste stabilization ponds. Different factors were examined in the removal of viruses in soil-sludge systems, and the fate of sludge-associated viruses was investigated during sludge lagoon detention and after land application. Viruses were studied in shellfish, and indicators for viruses were sought. (Baker-FRC)
W82-06927

SOLID WASTES AND WATER QUALITY,

Envirodyne Engineers, Knoxville, TN.
G. R. Brower, and R. Ramkrishnadas.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 749-754, June, 1982. 54 Ref.

Descriptors: *Literature reviews, *Solid wastes, *Reviews, Water quality, Industrial wastes, Municipal wastes, Waste disposal, Hazardous wastes, Radioactive wastes, Monitoring, Groundwater pollution, Environmental effects, Chemical analysis, Water analysis, Public health.

Current research in the field of solid wastes and water quality is cited in this literature review. The EPA groundwater protection strategy is defined. Environmental impact studies conducted on the Niagara River pollution, Salmonellosis occurrences in Scotland, volcanic ash leachate from Mt. St. Helens, and effects of waste disposal sites on groundwater quality are cited. Disposal of residues from solid waste treatment on ash ponds, by land application or through sanitary landfills was considered. The extent of contamination in groundwater of Missouri was investigated. Monitoring techniques used at waste disposal sites were described. Additional studies concerned with design, collection and attenuation included a study of the pollution threat to the water supply of Frederikssund, Denmark, the effect of differences of travel times in unsaturated zones between low and high leaching in groundwater table levels, factors affecting variations in phosphorus in irrigation return water, concentrations and losses of dissolved phosphorus from a tile drained silt loam before and after manure applications, and potential health problems associated with the presence of persistent organic chemicals in wastewater. In the area of characterization and treatment of solid wastes the chemical and mineralogical characterization of coal solid wastes was investigated along with the concentration of arsenic in coal ash, the chemical characterization of leachates from unretorted mined oil shales, and a comparison of analysis of leachate samples by different laboratories. Hazardous wastes were examined as to the behavior of such wastes in landfills, analyses of water and sediment samples near waste disposal sites, monitoring methods, regulations regarding hazardous waste disposal, and the denitrification of radioactive waste. (Baker-FRC)
W82-06929

ABUNDANCE PATTERNS OF DIATOMS ON CLADOPHORA IN LAKE HURON WITH RESPECT TO A POINT SOURCE OF WASTEWATER TREATMENT PLANT EFFLUENT,

Michigan University, Ann Arbor, Great Lakes Research Division.
For primary bibliographic entry see Field 5C.
W82-06937

RESIDUES OF PCB IN A CLADOPHORA COMMUNITY ALONG THE LAKE HURON SHORELINE,

Wisconsin University, Platteville.
For primary bibliographic entry see Field 5C.
W82-06938

STABLE CARBON ISOTOPE RATIO OF SUBMERGED FRESHWATER MACROPHYTES,

Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5C.
W82-06972

THE USE OF REMOTE SENSING TO MAP THE AREAL DISTRIBUTION OF CLADOPHORA GLOMERATA AT A SITE IN LAKE HURON,

National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
J. F. Lekan, and T. A. Coney.
Journal of Great Lakes Research, Vol 8, No 1, p 144-152, 1982. 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Remote sensing, Mapping, *Algal growth, *Lakes, *Lake Huron, Great Lakes, Eutrophication, Nutrients, Phosphorus, Nitrogen, Model studies, Mathematical models, Areal distribution, Path of pollutants, *Cladophora.

An intensive field and laboratory program was designed to gain a more complete understanding of the ecology of the alga Cladophora glomerata in Lake Huron. Key elements are a knowledge of the spatial distribution and seasonal growth characteristics of the organism. Remote sensing data were

obtained for a 2.8 km section of Lake Huron shoreline at Harbor Beach, Michigan. The data were collected using an eleven channel modular multispectral scanner mounted in an aircraft on a clear, calm day over the lake. Cladophora was determined by a conventional maximum likelihood statistical supervised classification technique employing three of the scanner bands. An intensive field survey of the study site indicated that the computer classified imagery is representative of the Cladophora distrbution at Harbor Beach. Classification accuracy was not determined, as the site was not mapped by ground surveys. The percent of areal coverage of model cells by Cladophora ranged from 0 to 93%. Calculations based on these percentages indicate that the alga occupies an area of 38,704 square meters at the study site. Overlapping flight lines resulted in duplicate measurements of many model cells. The reproducibility of results for these areas was good when suitable well defined Cladophora training sites are common to adjacent data sets. The reproducibility decreases in the absence of this condition. (Baker-FRC)
W82-06973

PHOSPHORUS RELEASE BY SUBMERGED MACROPHYTES: SIGNIFICANCE TO EPIPHYTON AND PHYTOPLANKTON,

McGill Univ., Montreal,(Quebec). Dept. of Biology.
R. Carignan, and J. Kalff.
Limnology and Oceanography, Vol 27, No 3, p 419-427. May, 1982. 3 Fig, 2 Tab, 20 Ref.

Descriptors: *Macrophytes, *Phosphorus, *Nutrients, Microorganisms, Microenvironment, Path of pollutants, Epiphytes, Hydrophytes, Aquatic plants, Microbiological studies, *Quebec, Lake Memphremagog, *Myriophyllum.

The use of fully labeled macrophytes in quantifying the importance of macrophytes to the phosphorus nutrition of their epiphytes, the release rates of phosphorus by Myriophyllum spicatum L., and the availability of the released phosphorous are discussed. The study was performed in Lake Memphremagog in a protected bay classified as mesotrophic with mean aestival total, soluble and soluble reactive phosphorus concentrations of 10.5, 2.2, and 0.5 micrograms/liter, respectively. The epiphytes of nine species of fully labeled macrophytes were collected between July and September 1977. The epiphytes derived only 3.4-9.0% of their P from the supporting macrophyte, indicating that previously suggested macrophyte-epiphyte nutrient interactions are of relatively minor importance. Although high diurnal P release rates were observed for the Myriophyllum-epiphyte complex, Myriophyllum accounted for only 9.9% of the total P released. The Myriophyllum-derived P was, however, released in a highly available soluble form. During the growing season, Myriophyllum thus appears to be principally important as a physical support for an active microbial community rather than as a P source to its epiphyton and surrounding waters. (Baker-FRC)
W82-06977

INVESTIGATION OF THE DISTRIBUTION OF WARM WATER DISCHARGE INTO SHALLOW WATER BODIES,

All Union Designing, Surveying, and Scientific Research Inst. Hydroproject, Moscow (USSR).
A. N. Militeev.
Water Resources, Vol 8, No 4, p 378-388, July/August, 1981. 5 Fig, 16 Ref. Translated from Vodnye Resursy, No 4, p 77-90, July/August, 1981.

Descriptors: *Reservoirs, *Powerplants, *Thermal pollution, Fate of pollutants, Shallow water, Cooling ponds, Heated water, Nuclear powerplants, Water temperature, Temperature, Unsteady flow, Model studies, Numerical analysis, Air-water interfaces, Hydrothermal studies, Ponds, Reservoirs, Mathematical equations, *USSR.

The distribution of water temperature in unstratified water bodies impacted by warm water discharge was investigated by numerical modeling and by using hydrothermal models with a given function characterizing heat exchange at the water-air interface. Ordinary cooling ponds and water bodies at powerplants were examined. These are characterized by markedly unsteady flow. The equations were applied to the planned three-reservoir system in South Ukraine: Aleksandrovsk Reservoir, which will receive water from a nuclear power station through the Tashlyk Reservoir and ambient-temperature water from the Konstantinovka Reservoir hydroelectric station. Calculations showed that under the proposed operating regime, temperatures over the 28.1 C limit would prevail over 1/3 of the Aleksandrovsk Reservoir and a small part of the Konstantinovka. It was predicted that the entire cooling pond of the Smolensk nuclear power station would be 31-47 C during the hottest month of the year. (Cassar-FRC)
W82-06981

5C. Effects Of Pollution

NUTRIENT CONTROL OF BLUE-GREEN ALGAE IN A SOUTHWESTERN RESERVOIR,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
D. Toetz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243361, Price codes: A04 in paper copy, A01 in microfiche. Report, January 1982. 40 p, 8 Fig, 8 Tab, 25 Ref. OWRT A-091-OKLA(1), 14-34-0001-0138.

Descriptors: *Nitrogen, *Phosphorus, *Reservoirs, *Algal control, *Nitrogen fixing bacteria, Algae, Nutrient requirements, Lakes, Rivers, Reservoir operation, Water supply, Nitrogen compounds, Nitrogen fixation, Nitrogen cycle, Nitrates, Ammonia, *Oklahoma, *Lake Hefner.

Research was carried out to determine if low nitrogen (N) to phosphorus (P) ratios in Lake Hefner loadings were related to the development of populations of N-fixing algae in the lake. The hypothesis was also tested that, if N/P ratios in the lake loadings were 5 or less, N-fixing algae would contribute significant N amounts to the total lake budget; thus, the lake would compensate for low N/P ratios of the loadings. This lake is a terminal offset water supply reservoir (1044 ha area, 1.96 years residence time, 8.86 m mean depth), and is entrophic with a history of taste and odor problems in its finished water. All lake loading N/P ratios wrere 7.2, and N-fixing blue-green algae developed populations but did not fix substantial amounts of N (only 0.5% of total input). The concentrations of nitrate and ammonia in the euphotic zone probably suppressed N-fixation, hence, the lake responded as predicted. Annual loadings for P and N were 10 and 65 mg/sq m, respectively. Regulated flows from the North Canadian River (the major source of water for the lake) accounted for about 83% of the N and 93% of the P entering the lake annually. Precipitation contributed 15% and 6% of the N and P. respectively. River nutrient input to the lake represents the best control point for lake nutrient input to control lake water taste and odor. (Zielinski-MAXIMA)
W82-05912

STREAM REHABILITATION FOLLOWING TREATMENT FOR PHOSPHORUS REMOVAL: PRE-TREATMENT ASSESSMENT,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-05919

CARRYING CAPACITY FOR THE ILLINOIS RIVER,

Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 6G.
W82-05927

EVALUATION OF BACTERIAL BINDING AND RELEASE OF CADMIUM FROM AQUATIC SEDIMENTS,

Ohio State Univ., Columbus. Dept. of Microbiology.
R. M. Pfister.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243577, Price codes: A06 in paper copy, A01 in microfiche. Report No 712437, January, 1982. 115 p, 10 Fig, 18 Tab, 207 Ref, 5 Append. OWRT B-079-OHIO(1).

Descriptors: *Cadmium, *Bacterial analysis, *Aquatic soils, *Heavy metals, *Toxicity, Sediments, Microorganisms, Water quality, Hazardous materials, Spectral analysis, Chemical analysis, Water analysis, Water quality control, Microenvironment, Environmental effects, Microbiological studies.

Research was conducted to examine how cadmium (Cd) may effect bacteria in laboratory microcosms and natural sediment populations. The study results demonstrated that the effects of Cd on natural sediment bacterial populations and on laboratory microcosm populations can be related; acclimation of bacteria to the toxic effects of Cd may occur in both systems. Bacteria of diverse biotypes could overcome Cd toxic effects after Cd exposure. However, bacteria in a laboratory water column were found to be more affected by Cd exposure than sediment bacteria. Absorption of Cd by bacteria and sediment showed higher absorption by bacteria than the sediment on a dry weight basis. The results provide an improved understanding of how Cd may influence bacteria in the environment and in other systems (e.g., waste treatment facilities), and of how bacteria may compete with particulate matter for available Cd in the water column and interstitial water. Bacterial uptake of Cd could result in the mobilization of Cd into the food chain where Cd accumulation might represent a potential human health hazard. Analyses of Cd were carried out by a reported atomic absorptoin spectrophotometry method. (Zielinski-MAXIMA)
W82-05934

A PRACTICAL AND RELIABLE METHOD FOR MONITORING THE TOXICITY OF AQUATIC SAMPLES,

Beckman Instruments, Inc., Carlsbad, CA.
For primary bibliographic entry see Field 5A.
W82-05951

HIGH RATE BIOLOGICAL TREATMENT OF TMP EFFLUENT,

Eco-Research Ltd., Inc., Point-Claire (Quebec).
For primary bibliographic entry see Field 5D.
W82-05955

EVALUATION OF GENERAL AND SPECIFIC STRESS INDICES IN MUSSELS COLLECTED FROM POPULATIONS SUBJECTED TO DIFFERENT LEVELS OF HEAVY METAL POLLUTION,

Genoa Univ. (Italy). Fisiologia Generale.
A. Viarengo, M. Pertica, G. Mancinelli, S. Palmero, and G. Zanicchi.
Marine Environmental Research, Vol 6, No 3, p 235-243, 1982. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Heavy metals, *Monitoring, *Water pollution effects, *Mussels, Bioindicators, Pollutant identification, Water quality, Chemical analysis, Coastal waters, Italy, Metabolism, Proteins, Stress, Cadmium, Mercury, Zinc, Copper.

Whether or not mussels collected from a heavy metal polluted area exhibited a stress syndrome which can be detected through variations in several biological parameters was studied. Species of Mytilus galloprovincialis Lam. were collected from La Spezia (polluted) and Portofino (unpolluted) from November 20 to December 5, 1979.The study demonstrated that the values of the rates of amino acid uptake and protein synthesis in the gills and digestive glands of the animals collected from the polluted area are significantly lower than those of the mussels sampled from the baseline area. The synthesis of RNA in nuclei obtained from the digestive gland of the mussels collected from the population of La Spezia was significantly reduced. Since temperature, salinity and pH values were similar in both areas studied and all animals were in

the same stage of the reproductive cycle, it is possible to speculate that the decrease in the values of the biological parameters examined reveals a stress syndrome which could be related to the increased metal concentration in the tissues of the mussels from the polluted area. The results allow the conclusion that mussels may be used as a self-integrating index of pollution in monitoring programs and indicate that the accumulation of pollutants in mussel tissues may result in a stress syndrome, as revealed by variations in several biological parameters. (Baker-FRC)
W82-05983

THE ACUTE TOXICITY OF MOTOR FUELS TO BRACKISH WATER ORGANISMS,

National Environment Protection Board, Studsvik (Sweden). Brackish Water Toxicology Lab.
M. Tarkpea, and O. Svanberg.
Marine Pollution Bulletin, Vol 13, No 4, p 125-127, April, 1982. 1 Tab, 3 Ref.

Descriptors: *Brackish water, *Fuel, *Toxicity, Seawater, Organisms, Aquatic organisms, Water pollution effects, Invertebrates, Methanol, Fish, Methyl tertiary butyl ether, Baltic Sea.

This study was performed to determine whether the acute toxicities to representative species from the Baltic Sea of blended fuels containing methanol or methyl tertiary butyl ether differed from those of base fuel, gasoline or low leaded gasoline. Alburnus alburnus (bleak) and the harpacticoid Nitocra spinipes were chosen as representative species. Low leaded gasoline, base fuel and blend fuel M15 15% methanol were rather highly acute toxic to the bleak. Of the three additives methanol, isobutanol and MTBE, the first was practically non-toxic, while isobutanol and MTBE were slightly toxic. Sublethal effects such as disturbed balance, surface swimming and overturning were noted in the bleak after only a couple of minutes of exposure to MTBE. Several individuals recovered before the experiment was ended. The 96 hour median lethal dose values for Nitocra spinipes varied between about 150 and 250 mg/liter for the actual motor fuels. For the bleak, the toxicity of the three additives was less than that of the actual motor fuels. The results of the study demonstrate that the acute toxicity of base fuel to aquatic organisms was not increased by the addition of 15% methanol of 5% MTBE. The risk of increasing the toxicity by the use of solvents with the potency of dissolving more of the hydrocarbons into the water phase was not verified in the experiment. (Baker-FRC)
W82-05985

EPIDEMIOLOGY OF HUMAN SCHISTOSOMA HAEMATOBIUM INFECTION AROUND VOLTA LAKE, GHANA, 1973-75,

World Health Organization Schistosomiasis Control Project, Accra (Ghana).
D. Scott, K. Senker, and E. C. England.
Bulletin of the World Health Organization, Vol 60, No 1, p 89-100, 1982, 1 Fig, 9 Tab, 11 Ref.

Descriptors: *Epidemiology, Diseases, *Parasites, Schistosomiasis, Lakes, *Volta Lake, *Ghana, *Human diseases, Water pollution effects.

The prevalence of urinary schistosomiasis rose dramatically around Volta Lake within a year of full impoundment in 1968. During 1973-75 the incidence of the disease was investigated in 26 communities along 80 km of lake shore. In the total population 72.0% and 73.7% were infected in 1973 and 1974, respectively. Age, sex, and ethnic affiliation (indigenous Krobo farmers and immigrant Ewe fishermen) influenced the prevalence and intensity (egg output) of infection. In general, prevalence (over 90%) and egg output reached a peak in the 10-14 year age group and declined with increasing age. Males had higher egg outputs than females beginning in the 5-9 year age group and higher prevalence beginning in the 15-24 year age group. Egg output in the Krobos increased and decreased more rapidly with age than among the Ewe. Persons living in the Pawmpawm branch of the lake had lower prevalence (65%) and intensity of infection than those living among the Afram branch (80-84% prevalence). Transmission of the disease was greater from January to April during the period of high lake level and the early part of the drawdown. The number of infected Bulinus truncatus rohlfsi, the snail intermediate host, and the abundance of Ceratophyllum demersum, an aquatic weed closely associated with the snail, were highest in areas of highest human transmission and in seasons of highest human transmission. Human water contact was also correlated with intensity of infection. Children, males, Krobo children, and Ewe adults, more frequently in contact with water, had a correspondingly higher intensity and prevalence of the disease. (Cassar-FRC)
W82-05988

MALIGNANT MELANOMA AND DRINKING WATER CONTAMINATION,

Miami Univ., FL.
T. E. Aldrich, and A. J. Peoples.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 519-523, May, 1982. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Water pollution effects, *Human diseases, *Drinking water, *Organic compounds, *Mathematical studies, Water treatment, Chloroform, Chlorination, Municipal water, Model studies, Water analysis, *Epidemiology, Public health, Halogens.

When a major medical facility of Brevard County, Florida, reported potential clustering of malignant melanoma in 1975-1977, an investigation was carried out to see whether cases of this cancer could be significantly correlated with the trihalomethan (THM) levels in the municipal water supplies. Cluster analyses of data involved a cell occupancy method and an interval approach based upon the Knox model, involving definitions of spatial and temporal thresholds. Use of these techniques gave values extremely different from those calculated from the Third National Cancer Survey data. However, when the community experience was distributed according to population density, no clustering was observed. Results of the interval approach also showed no clustering. A dramatic north-south gradient of THM levels was generated from water analysis data. These data also indicate that increased THM formation in south Brevard County results from normal treatment of water. Blood sample analyses supported the north-south pattern of exposure, with high serum chloroform levels in areas where high THM levels existed in water. (Geiger-FRC)
W82-05989

INFLUENCE OF A HEXACHLOROBIPHENYL IN GREAT LAKES PHYTOPLANKTON IN CONTINUOUS CULTURE,

New York State Department of Health, Albany. Div. of Labs. and Research.
T. C. Lederman, and G. Y. Rhee.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 3, p 388-394, March, 1982. 8 Fig, 22 Ref.

Descriptors: *Algae, *Inhibition, Growth rate, *Hexachlorobiphenyl, *Polychlorinated biphenyls, Aromatic compounds, Chlorinated hydrocarbons, *Great Lakes, *Phytoplankton, Insecticides, Water pollution effects, Toxicity, Chlorophyll a, Nutrients, Phosphates, Fragilaria crotonensis, Ankistrodesmus falcatus, Microcystis.

The effects of 2,4,5,2',4',5'-hexachlorobiphenyl (HCB) at low levels (0.,2-1.2 micrograms per liter) on the growth of algae were investigated in continuous culture under nutrient sufficient conditions and phosphate limited conditions. Under nutrient sufficient conditions only Fragilaria crotonensis growth rate was inhibited by cellular HCB concentrations as low as 0.8 micrograms per g dry weight. There was a dose-response relationship between cellular HCB and growth rate. Microcystis sp. and Ankistrodesmus falcatus growth rates were not inhibited by 3.6 and 11.5 micrograms per g dry weight or less, respectively, under nutrient sufficient conditions. Under P limiting conditions F. crotonensis, but not Microcystis and A. falcatus, showed growth rate inhibition. The pattern observed in F. crotonensis growth curves under P-limitation was a marked increase in cell numbers for 2 days followed by a decrease to levels lower than the control; this was not seen under nutrient-sufficient conditions. In both nutrient sufficient and nutrient limiting conditions in F. crotonensis cultures the cellular chlorophyll a concentration decreased with accumulation of HCB, and the C13 assimilation rate per unit chlorophyll a increased. Cellular P concentration in the P-limited cells also decreased with HCB accumulation. These results suggested that contamination with polychlorinated biphenyls can alter community composition in an aquatic environment. (Cassar-FRC)
W82-05994

PALEOLIMNOLOGICAL EVIDENCE OF EARLY EUTROPHICATION IN LAKE ERIE,

McMaster Univ., Hamilton (Ontario). Dept. of Biology.
G. P. Harris, and R. A. Vollenweider.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 4, p 618-626, April, 1982. 1 Fig, 2 Tab, 62 Ref.

Descriptors: *Lakes, *Eutrophication, *Lake Erie, Great Lakes, Plankton, Phytoplankton, *Limnology, Phosphorus, Seasonal variations, *Paleolimnology.

A reinterpretation is made of existing reviews of the changing assemblages of phytoplankton in Lake Erie in the light of new data on the history of phosphorus loadings to the lake, new information on the history of anoxia, and in terms of new data on the diatom remains in a core from the central basin of the lake. The picture that evolves from this re-evaluation suggests that Lake Erie had undergone initial eutrophication as early as 1850, although the main evolution toward a eutrophic system occurred during this century. Those persons concerned with water quality management should be aware that, for a given lake, the relationships between parameters such as total phosphorus, phytoplankton biomass, and the species of the assemolage are modifiable by processes operating on a scale of years, and that management schemes based on only a few years' data may need to be revised as new data become available. It is considered from this review that the initial disturbance to the metabolism of Lake Erie was the most important one in its eutrophis history. Events in the Lake Erie Basin over the last 50 to 60 years must be viewed in the light of these long term fluctuations and must be interpreted with great care. (Baker-FRC)
W82-05995

PHYSIOLOGICAL AND BIOCHEMICAL RESPONSES OF SEVERAL FRESHWATER ALGAE TO A MIXTURE OF METALS,

Canada Center for Inland Waters, Burlington (Ontario).
P. T. S. Wong, Y. K. Chau, and D. Patel.
Chemosphere, Vol 11, No 4, p 367-376, 1982. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Algae, *Metals, *Toxicity, Water pollution effects, Heavy metals, Primary productivity, Productivity, Scenedesmus, Aminoisobutyric acid, *Great Lakes, Water quality standards, Phytoplankton, Nitrogenase activity, Synergistic effects.

A mixture of 10 metals at the Great Lakes Water Quality Objective individual levels reduced the primary productivity of cultured algae and a natural phytoplankton community from Lake Ontario. The metal levels (in micrograms metal per liter) in the full strength mixture were: As, 50; Cd, 0.2; Cr, 50; Cu, 5; Fe, 300; Pb, 25; Hg, 0.2; Ni, 25; Se, 10; and zn, 30. The full strength mixture reduced primary productivity to 31%, 45%, 37%, 45%, and 59% of the originaal levels in Scenedesmus, Chlorella, Anabaena, Navicula, and the natural community, respectively. Metal solutions of 0.1 and 0.5 of the original strength reduced productivity to a lesser degree. In Anabaena flos-aquae, an indicator of nitrogenase activity as reduced to 74% (not preincubated with metals) and 59% (pre-incu-

bated for 24 hours) by the full strength mixture and to 37% and 21%, respectively, by a 10-fold strength solution. The metal mixture also caused a reduction in reproduction and in transport of alpha-aminoisobutyric acid by Ankistrodesmus falcatus. (Cassar-FRC)
W82-05996

PERIPHERAL EFFECTS OF CADMIUM ON THE BLOOD AND HEAD KIDNEY IN THE BROWN BULLHEAD (ICTALURUS NEBULOSUS),

Bergen Community Coll., Paramus, NJ. Div. of Natural Sciences and Mathematics.
J. S. Garofano, and H. I. Hirshfield.
Bulletin of Environmental Contamination and Toxicology, Vol 28, No 5, p 552-556, May, 1982. 3 Tab, 8 Ref.

Descriptors: *Water pollution effects, *Cadmium, *Catfish, *Monitoring, *Bioindicators, Kidneys, Blood, Heavy metals, Metals, Fish, Bioassay, Indicators, Pollutant identification, Fish toxins, Fish physiology, Absorption, Uptake.

Since the chemical leakage of cadium (Cd)-containing refuse can lead to the contamination of drinking water supplies, there is need for an accurate biological monitor for the presence of Cd in water. Studies were undertaken on brown bullhead catfish (Ictalurus nebulosus) to determine the amount and rate of Cd uptake via atomic absorption measurements and to determine whether acute Cd exposure (61 ppm) alters blood and head kidney cytology. Results showed that the peripheral blood cell differential counts and head kidney hemopoietic cell lines of indigenous fish species feeding in the area of a Cd-containing dump site provide the best immediate monitor for water quality. Chemical analyses demonstrate that the head kidney may be an initial target organ for Cd toxicity. The uptake, storage and clearance of Cd from the peripheral blood and head kidney are described for time periods of immediately after and 2 hr after exposure. (Geiger-FRC)
W82-06003

THE PLANKTON OF THE RIVER VISTULA IN THE REGION OF WARSAW IN THE YEARS 1977-1979,

Research Inst. on the Environmental Development, Warsaw (Poland). Water Utilization Dept.
For primary bibliographic entry see Field 5A.
W82-06021

BIOASSY TRIALS WITH TWENTY THREE PESTICIDES TO A FRESH WATER TELEOST, SACCOBRANCHUS FOSSILIS,

D.A.V. Coll., Muzaffarnagar (India). Dept. of Zoology.
S. R. Verma, S. K. Bansal, A. K. Gupta, N. Pal, and A. K. Tyagi.
Water Research, Vol 16, No 5, p 525-529, May, 1982. 4 Tab, 15 Ref.

Descriptors: *Pesticides, *Fish, *Toxicity, Insecticides, *Bioassy, Carbamate pesticides, Halogenated pesticides, Organic pesticides, Organophosphorus pesticides, Water pollution effects, Saccobranchus fossils.

Toxicities of 23 pesticides were determined in static tests using the fresh water teleost, Saccobranchus fossilis. The acute toxic ranges and LC50 values for 24, 48, 72, and 96 hours and the relative potency with respect to abate, the least toxic pesticide, were listed for all pesticides. Active toxic ranges (mg per liter) were: thiotox, 0.0060-0.0085; thiodan, 0.0105-0.0132; heptachlor, 0.080-.118; chlordane, 0.32-0.72; aldrin, 0.42-0.85; lindane, 5.00-7.49; BHC, 2.00-3.99; phosalon, 0.083-0.88; quinalphos, 1.50-3.00; diazion, 1.00-3.99; dimehtoate, 4.50-5.90; dichlorvos, 6.00-10.00; Malatox, 7.99-14.00; thiometon, 750-13.96; fenitrothion, 10.00- 17.99; metasystox, 13.84-24.60; malathion, 15.00-20.00; leptophos, 20.00-29.00; dipterex, 29.0037.92; formothion, 140.00160-.70; abate, 200.00-240.20;carbofuran, 0.50-0.80; and carbaryl, 15.07-24.77. The relative order of toxicity was organochlorines > organophosphorus compounds > carbamates. Safe concentrations were listed for all 23 chemicals. These ranged from 4.9584 mg per liter for abate to 0.00014 mg per liter for thiotox. (Cassar-FRC)
W82-06031

A BIOASSAY TECHNIQUE USING TETRAHYMENA PYRIFORMIS FOR THE RAPID ASSESSMENT OF TOXICANTS IN WATER,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-06032

RECENT ADVANCES IN ASSESSING IMPACT OF PHOSPHORUS LOADS ON EUTROPHICATION-RELATED WATER QUALITY,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. A. Jones, and G. F. Lee.
Water Research, Vol 16, No 5, p 503-515, May, 1982. 8 Fig, 2 Tab, 32 Ref.

Descriptors: *Eutrophication, *Model studies, *Phosphorus, Nutrients, Water quality management, Lakes, Reservoirs, Limnology, Pollution load, Algae, Reviews, Nitrogen, Water pollution effects, Chlorophyll, Turbidity, Organization for Economic Cooperation and Development.

The Organization for Economic Cooperation and Development (OECD) undertook at 5-year study to quantitatively define the relationship between the phosphorus load to a water body and its eutrophication-related water quality response. This work resulted in the development of models by Vollenweider and others for use in water quality management programs. Since the completion of the study the OECD models have evaluated the P load-eutrophication response relationships for 40 U.S. water bodies in addition to the 34 previously studied. The remainder of the 200 water bodies investigated worldwide followed the general relationships of the OECD models, showing their wide applicability to different climates, water depths, water body sizes, and natural vs. manmade lakes. The most reliable water quality indicator is chlorophyll concentratin, with Secchi depth concentrations an adequate secondary parameter. A relationship has also been developed between P load and fish yield. At present several model constraints must be considered. The models are applicable only to water bodies in which algal growth is limited by P. They apply only to eutrophication as manifested by planktonic algal growth, not sanitary quality, toxicants, or siltation. Hydraulic residence time must be at least 2 weeks. Only small to moderate inorganic turbidity and color can be present. Other factors affecting model results are water level fluctuations, water withdrawals from the bottom, differences in load-response relationships in arms of a lake, and high suspended solids. (Cassar-FRC)
W82-06034

A METHOD FOR ESTIMATING THE RESPIRATION OF MUD COMMUNITIES IN SHALLOW RUNNING WATER,

Centre Univ. de Savoie, Chambery (France).
D. Fontvieille, and M. Renaud.
Water Research, Vol 16, No 5, 593-599, May, 1982. 5 Fig, 1 Tab, 25 Ref.

Descriptors: *Respiration, *Benthic environment, *Carbon dioxide, Organic matter, Sediments, Bottom sediments, Field tests, River beds, Aquatic life.

A system for determining the respiration of benthic fresh water communities by measuring their carbon dioxide production was evaluated in an organically polluted brook. Carbon dioxide production per unit of water surface decreased as the total carbon concentration of the mud decreased. Errors were greater in samples near the river bank than in those in the middle of the stream. The field apparatus consisted of an incubation chamber held in place by a tripod. Connections to the chamber allowed measurement of CO2 concentration, pH, and other parameters. Total organic matter levels in the experiment were 15,729-34,728 kcal per sq m, and CO2 production, 21.3-63.6 kcal per sq m per joule. (Cassar-FRC)
W82-06036

QUALITATIVE AND QUANTITATIVE STUDIES ON THE IN SITU ADSORPTION, DEGRADATION AND TOXICITY OF ACRYLAMIDE BY THE SPIKING OF THE WATERS OF TWO SEWAGE WORKS AND A RIVER,

Plymouth Polytechnic (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5D.
W82-06044

EFFECTS OF EFFLUENTS FROM A COAL-FIRED, ELECTRIC-GENERATING POWERPLANT ON LOCAL GROUND WATER NEAR HAYDEN, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
S. R. Ellis, and P. G. Mann.
Geological Survey Open-File Report 81-1196 (WRI), 1981. 90 p, 11 Fig, 7 Plates, 8 Tab, 14 Ref.

Descriptors: *Effluents, *Thermal powerplants, *Water pollution effects, *Water quality, Induced infiltration, Water storage, Groundwater, Wells, Groundwater movement, Data collections, Boron, Selenium, Fly ash, Chemical analysis, *Colorado, Yampa River basin, Lewis Shale.

Data were collected at the Hayden, Colo., powerplant for about a year during 1978-79 to monitor the effects of effluent and raw-water storage ponds on the local ground water, Sage Creek, and the Yampa River. The concentration of boron in wells downgradient from the effluent ponds indicated that the ponds were leaking, increasing the average boron concentrations in the ground water to a level in excess of the standards for agricultural use of water. Water from seeps, probably the best indicators of downgradient water quality, had average concentrations of boron two times that of the Colorado Department of Health (1977) standard for agricultural use of water. Chemical analyses of water from wells and the discharge weir downgradient from the raw-water storage ponds indicated these ponds are leaking. The effect of this leakage is that the water in wells downgradient from these ponds has a lower specific conductance and a lower boron concentration than the water in wells downgradient from the effluent ponds. The concentration of trace elements in the water from the wells and the discharge weir generally declined during the study, probably because the ground water was recovering from the effects of a plume from the raw-water pond previously used for fly-ash disposal. The effluents from the Hayden powerplant lowered the specific conductance and the iron and manganese concentrations, increased the concentration of boron, and had little or no effect on the selenium concentration in Sage Creek. Sage Creek had no discernible effect on the Yampa River because the volume of water in the Yampa River was so much greater. The effluents from the powerplant also had no discernible effect on the Yampa River. (USGS)
W82-06137

DIATOM ASSEMBLAGES AS INDICATORS OF WATER QUALITY IN FRESHWATER HABITATS OF GUAM,

Guam Univ., Agana. Water and Energy Research Inst.
For primary bibliographic entry see Field 5A.
W82-06146

A CONCEPTUAL MODEL OF PRIMARY PRODUCTIVITY IN SHALLOW STREAMS USING BIOMASS SIMULATION,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
J. C. Elliott, and A. J. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243684, Price codes: A07 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and

Water Resources, University Park, Report, June 1982. 129 p, 18 Fig, 15 Tab, 62 Ref, 4 Append. OWRT A-003-PA(6), 14-34-0001-0140.

Descriptors: *Biomass, *Primary productivity, *Macrophytes, *Computer models, *Streams, *Simulation analysis, Aquatic productivity, Dissolved oxygen, Oxygen, Photosynthesis, Respiration, Benthic environment, Benthos, Aquatic life, Benthic flora, Model studies, Mathematical models, Mathematical studies, Computer programs, Shallow water, Water quality, Eutrophication.

A conceptual model for primary productivity was developed for application to rooted aquatic macrophytes in streams to assist studies of eutrophication and control of water quality in supplementing outputs of dissolved oxygen (DO) models of pollution loads. This model included a first-order differential equation of biomass, with specific rates for photosynthesis, respiration, and death. A model component was developed to describe available light spatially/temporally in the weed bed, as reduced from extraterrestrial solar radiation. A DO model component included terms for photosynthetic production, plant respiration, and a benthal sink due to dead plant matter decay. The latter, a first-order exponential oxygen sink, had not been previously included in DO models. Model parameters and growth rates were determined for a Pennsylvania creek plant population. Data analysis required simulating the plant biomass throughout an annual cycle for each creek reach using stoichiometric relationships between DO productivity and biomass. Simulation was achieved by computer analysis, refined by comparison with selected evaluation criteria for population dynamics and growth rates versus environmental conditions. The model was applied to the study system and tested for sensitivity to variations in basic model parameters. The computer programs for the model are delineated. (Zielinski-MAXIMA)
W82-06153

EFFECTS OF URBANIZATION ON STREAM ECOSYSTEMS,

Georgia Inst. of Tech., Atlanta. School of Biology.
A. C. Benke, G. E. Willeke, F. K. Parrish, and D. L. Stites.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254905, Price codes: A04 in paper copy, A01 in microfiche. Georgia Environmental Resources Center, Atlanta, Report ERC 07-81, November 1981. 64 p, 22 Fig, 12 Tab, 16 Ref, 2 Append. OWRT A-055-GA(1).

Descriptors: *Urbanization, *Water quality, *Nonpoint pollution sources, *macroinvertebratees, *Water analysis, Aquatic populations, Watersheds, Streams, Aquatic life, Fauna, Aquatic animals, Ecosystems, Water stress, Urban planning, Urban areas, Urban runoff, *Georgia, Atlanta.

The effects of urbanization on 21 stream ecosystems were studied in the Atlanta area in 1-3 sq mile watersheds varying from 3-100% green space, from 0-98% residential-commercial, and with house densities from 0-941 sq miles. The primary index of stream quality was community composition of aquatic macroinvertebrates. The streams were in a single area where physico-chemical conditions and composition of macroinvertebrates should be very similar under natural conditions. While there were widely-varying degrees of urbanization, pollution (as indicated by standard water quality measures) was not at all obvious, and differentiation of stream communities was more subtle than is often encountered in studies of gross pollution. A significant relationship was found between urbanization and number of species/families (but not with species/family diversity, indicating less utility for a diversity index). Hence, identifying macroinvertebrates to the family level is sufficient in assessing differing degrees of stress in streams. Cluster analysis distinguished three major groups of streams: clean, intermediate, and degraded. High residential land use, low levels of green space, and high house densities were associated with degraded streams. (Zielinski-MAXIMA)
W82-06165

APPLICATION OF A NEW METHOD FOR QUANTITATIVE EVALUATION OF STREAM BENTHIC ALGAL POPULATIONS,

Arkansas Univ., Fayetteville. Water Resources Research Center.
R. L. Meyer, and N. Woomer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254921, Price codes: A03 in paper copy, A01 in microfiche. Publication No 80, September 1981. 28 p, 1 Fig, 3 Tab, 24 Ref. OWRT A-053-ARK(1). 14-34-0001-0104.

Descriptors: *Benthic flora, Water sampling, *Water analysis, *Algae, *Baseline studies, Benthic environment, Benthos, Aquatic life, Aquatic plants, Aquatic populations, Ecosystems, Biological samples, Water quality, Streams, Algal growth, Algae harvesting, Seasonal variation, Pollutant identification.

Stream biota response to changing water quality or other ecosystem perturbations is an important means of assessing water quality, but the dynamic nature of streams produces significant sampling/measurement problems. However, smaller streams lack a true algal plankton subcommunity and attachment to stones and other stable surfaces at the substrate-water interface represents the major location for algae production. A newly-developed substrate sampler, composed of portland cement, was tested to determine residence time, qualitative similarity between natural/sampler populations, methods for determining primary algae production roles, seasonal succession, and colonization rates. This new approach has been applied, for comparative purposes, to two streams: one influenced by treated municipal sewage; the other, a non-impacted stream. It was determined that the concrete hemispherical samplers are colonized by the same algae in generally the same proportions as those found in adjacent natural rock substrates. These samplers are comparable in size, texture, shape, placement, and position, to the natural rock substrate in this streams study, and are applicable for inter-stream studies. Physical and chemical stream water quality data, biological data, and algae production data are presented. (Zielinski-MAXIMA)
W82-06168

EFFECTS OF APPLE ORCHARD RUNOFF ON THE AQUATIC MACROFAUNA OF A MOUNTAIN STREAM,

North Carolina Dept. of Natural Resources and Community Development, Raleigh. Div. of Environmental Management.
D. L. Penrose, and D. R. Lenat.
Archives of Environmental Contamination and Toxicology, Vol 11, No 3, p 383-388, 1982. 3 Fig, 5 Tab, 22 Ref.

Descriptors: *Pesticides, *Invertebrates, *Orchards, Water pollution effects, Endrin, Species diversity, Cox Creek, *North Carolina, Macroinvertebrates, Benthic fauna, Apples, Nonpoint pollution sources.

The effects of pesticides in apple orchard runoff were determined at three stations in Cox Creek, North Carolina. Aquatic macroinvertebrates were sampled 10 times from March 1977 to March 1978. The control site, No. 1, was upstream of the orchards; sites 2 and 3 were within and downstream of the orchard area. Stations 2 and 3 showed moderate to severe stress in the macroinvertebrate populations. Numbers per sample were: control, 274; Site 2, 253; and Site 3, 65. Taxa richness indexes were: control, 37.9; Site 2, 30.2; and Site 3, 12.6. Diversity indexes were: control, 3.2; Site 2, 2.9; and Site 3, 2.4. Biotic index values developed by a North Carolina biological monitoring group were: control, 2.3; Site 2, 2.2, and Site 3, 2.7. Periods of low taxa richness and diversity wre associated with spring cover spraying and fall after-harvest sprays. Station 3 was a permanently stressed area, whereas Station 2 goes through repeated stress and recovery. Plecoptera were especially sensitive to apple orchard runoff. Organisms dominant at Station 3 included several stress tolerant species. (Cassar-FRC)
W82-06177

MULTISTEP APPROACH TO IDENTIFICATION OF LIMITING NUTRIENTS IN NORTHERN ADRIATIC EUTROPHIED COASTAL WATERS,

Istituto di Ricerca sulle Acque, Milan (Italy).
G. Chiaudani, and M. Vighi.
Water Research, Vol 16, No 7, p 1161-1166, July, 1982. 5 Fig, 23 Ref.

Descriptors: *Nutrients, *Coastal waters, Eutrophication, Phosphorus, Nitrogen, Phosphatase, *Adriatic Sea, *Algal growth, Pollutant identification.

This study was planned to make use of several approaches to the problem of identifying algal growth-limiting nutrient. The time course of total and free specific phosphatase activities and the changes in soluble reactive phosphorus concentration during algal growth under three different experimental conditions were examined. In cultures grown in medium without phosphorus, phosphatse activity, both total and free dissolved, showed a large increase during the first 7 days, and at the 7th day free phosphatase activity represented 40% of the total activity. In control cultures and in cultures grown in medium without nitrogen, specific phosphatase activities were always detectable, but at very low levels. Phosphorus addition in phosphorus starved cultures caused a drastic drop in the phosphatase activity, reaching levels of control cultures after 3 days. A drop in phosphatase activity of 85% was noted in 24 hr following phosphorus addition. No difference in algal growth rate was noted in cultures spiked with organic or inorganic phosphorus because organic phosphorus quickly became available by means of enzymatic hydrolysis. It was concluded from this study that the most useful indicators of specific nutrient deficiency that can be applied to natural waters are the measurement of phosphatase activity and estimation of the ammonium ion enhancement ratio. Field study results indicated that the phytoplankton populations were phosphorus limited. Nitrogen deficiency was never found during the whole sampling period. (Baker-FRC)
W82-06267

HEAVY METALS IN ANIMALS OF LAKE BALATON,

Magyar Tudomanyos Akademia, Tihany. Biological Research Inst.
J. Salanki, K. V.-Balogh, and E. Berta.
Water Research, Vol 16, No 7, p 1147-1152, July, 1982. 1 Fig, 8 Tab, 11 Ref.

Descriptors: *Lakes, *Heavy metals, Cadmium, Copper, Manganese, Iron, Zinc, Mercury, Lead, Aquatic animals, Monitoring, Water quality, *Hungary, Lake Balaton.

The concentrations of mercury, cadmium, lead, copper, iron, manganese, and zinc were investigated in mid-living larvae, in zooplankton, and in various organs of bivalves and fish and in the water of Lake Balaton, situated in the western part of Hungary. This lake is the largest shallow lake in Europe, with a surface area of 600 square kilometers and a water content of about 1.8 cubic km. The highest mercury levels were in Chironomidae larvae. Comparatively high concentrations were found in crustacean plankton, in the gills of the mussels and in the kidneys of the fish. Cadmium concentration was highest in the gills of the mussel. Copper concentrations were high in the liver of Abramis brams L. and in the crustacean plankton. The lead concentration was highest the gills of Anodonta. Zinc values were highest in the gills of mussels, highest iron concentrations occurred in Chironomidae larvae, and manganese was extremely variable. The concentration factors (tissue levels vs. water levels) characteristic of Anodonta and Unio underline the importance of mussels in biomonitoring. (Baker-FRC)
W82-06284

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL BY DUMPING FROM SHIPS,

Marine Lab., Aberdeen (Scotland).
A. D. McIntyre.
Water Science and Technology, Vol 14, No 3 p 137-143, 1982. 19 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, Reviews, Environmental effects, Sedimentation, Heavy metals, Metals, Pathogens, Dissolved oxygen, Water pollution effects, Public health, Shellfish, Aquatic life, Benthic fauna, Nutrients, Zooplankton, Phytoplankton, Fish, Organic matter.

A review of sludge disposal at sea by ships concerns the environmental effects on the sea surface, water column, and sea bottom. When sludge is dumped from a ship, the primary effects are a transient surface slick, a turbid plume, and deposition on the sea bottom. Little is known about the effects of sludge dumping on the neuston (surface community of organisms). but significant damage is unlikely. The water column contains increased nutrient levels. However, algal blooms sometimes attributed to sludge dumping grounds are often a result of input from rivers. Reduced dissolved oxygen has been recorded seasonally below the thermocline. The finely divided organic material serves as food for planktonic organisms. The main impact of sludge dumping is on the sea bottom. Dumping grounds are classified, although not rigidly, as accumulating and dispersing. Effects are most noticeable in accumulating dumping grounds. The sediment increases in organic content and may be deoxygenated below the surface, replacing the normal benthic community with a low diversity, high biomass assemblage, mostly worms. Toxic heavy metals and organochlorines accumulate in the dumping grounds and enter the food chain. Thus far, levels in seafood products have not been harmful. Pathogens may present a hazard to public health by contaminating shellfish. Some fin fish diseases are associated with sewage exposure. Impacts of sludge dumping on the ecosystem are generally local and reversible. (Cassar-FRC)
W82-06287

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL FROM A PIPELINE,

Coastal Water Research Project, Long Beach, CA.
W. Bascom.
Water Science and Technology, Vol 14, No 3, p 41-52, 1982. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Environmental effects, Santa Monica Bay, California, Outfalls, Invertebrates, Fish, Aquatic animals, Toxicity, Canyons, Species distribution, Species diversity.

A steep-sided submarine canyon in Santa Monica Bay, California, has received about 1.25 million metric tons dry weight of sewage sludge over the past 22 years. Near the discharge at 100 m depth 41 species of fish and 40 species of invertebrates were found. Dominat species of fish at the outfall were soles, rockfish, croakers, sanddabs, perch, combfish, ratfish, and plainfin midshipman. Water was moderately clear away from the pipe. The ecosystem in a 3 sq km area of the canyon has experienced both beneficial and detrimental changes. Species numbers are greatly reduced, sometimes to as few as 10, and the Infaunal Trophic Incexes often reach zero. At most of the canyon stations the number of individuals and the biomass was almost double that at the control stations. However, species are limited to those which can utilize the sludge as food. Individual fish were larger in the canyon area. (Cassar-FRC)
W82-06290

RECENT DEVELOPMENTS IN THE FIELD OF EUTROPHICATION PREVENTION,

Verlag Chemie, Weinheim (Germany, F. R.).
H. Bernhardt.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 1, p 14-26, February, 1981. 14 Fig, 7 Tab, 67 Ref.

Descriptors: *Water quality control. *Water pollution prevention, *Eutrophication, *Phosphorus removal, *Wastewater treatment, Drinking water, Nutrient removal, Filtration, Reservoirs, Nitrogen, Water suply, Water pollution control, Water pollution effects, Potable water.

The causes of eutrophication of still waters are reviewed along with processes for reducing phosphorus levels in the effluents of urban sewage treatment plants. Methods of contact filtration, chemical precipitation and adsorption of phosphorus compounds and the biological elimination of phosphorus and nitrogen are described. The international OECD investigation program was applied in calculating the tolerable phosphorus load of lakes and drinking water supply reservoirs in relation to the morphological conditions of the water bodies. Seepage filtration which reduces phosphorus input into reservoirs and lakes is examined. Alumina filtration is used to treat the effluents of fish hatcheries. The Wahnbach Reservoir Association has designed a process to eliminate phosphorus contributed from large tributaries of a reservoir. Similar measures which are utilized in the lakes of West Berlin that supply potable water are discussed. (Geiger-FRC)
W82-06299

HERBICIDES IN KANSAS WATERS--EVALUATIONS OF THE EFFECTS OF AGRICULTURAL RUNOFF AND AQUATIC WEED CONTROL ON AQUATIC FOOD CHAINS,

Kansas Water Resources Research Inst., Manhattan.
F. deNoyelles, and D. Kettle.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256504, Price codes: Axx in paper copy, A01 in microfiche. Contribution No 219, December 1980. 48 p, 1 Fig, 15 Tab, 59 Ref. OWRT A-092-KAN(1), 14-34-0001-8018.

Descriptors: *Herbicides, *Aquatic weed control, Pollutants, Water pollution effects, *Agricultural runoff, *Atrazine, Kansas, *Aquatic food chains, *Phytoplankton, *Triazine herbicides, *Photosynthetic inhibitors, Zooplankton, Fish, Experimental ponds.

Experimental ponds were used for studying the effects of an agricultural herbicide on aquatic food chains. Atrazine, one of the most heavily used herbicides in Midwest agriculture, was added to ponds and the ensuing responses were followed through four months. With single 20 mu g/liter additions to the ponds, effects were recorded throughout the food chain. After one day of exposure rates of phytoplankton photosynthesis declined at both levels, with the higher level causing an almost complete inhibition. Phytoplankton succession was altered within a few days at both levels, with resistant species increasing in abundance. The actual resistance of these species to atrazine, which is known to be a photosynthetic inhibitor affecting a wide variety of plants, was verified in the laboratory. The grazing zooplankton were also affected within the first few weeks of exposure as their phytoplankton food source was altered. The growth of aquatic flowering plants was also reduced at both levels. Some members of the aquatic food chain were unaffected, particularly the benthic insects, although effects were recorded at the highest level of these food chains, the fish. Of the three types of fish (bluegill sunfish, channel catfish, gizzard shad) originally stocked in the ponds, all survived but with reduced growth at the 500 mu g/liter level. The only fish to reproduce in the ponds, bluegill sunfish, showed greatly reduced numbers of progeny at both levels. The concentrations of atrazine in the ponds were monitored, showing its persistence with 75% of the original concentration present after 114 days. In Midwest waters concentrations of 500 mu g/liter are recorded in waters directly associated with agricultural operations, such as irrigation waters while 20 mu g/liter is at the high extreme of concentrations found more widespread. Though data from monitoring atrazine concentrations in natural habitats is sparce 1 mu g/liter to 5 mu g/liter seem common in many Midwest waters. In laboratory experiments with these more common concentrations we also demonstrated reductions in phytoplankton phytosynthesis. This indicates the possibility, awaiting further demonstration, that even at common concentrations atrazine may be affecting phytoplankton photosynthesis in many Midwest waters. Other herbicides studies in this project included 5 other triazine herbicides (propazine, metribuzin, terbutryn, cyanazine, simazine) which in the laboratory were similar to atrazine in the intensity of reducing phytoplankton photosynthesis. In the State of Kansas triazine herbicides accounted for one-third of the total herbicide usage in 1978.
W82-06304

SOME EFFECTS OF SHORELINE COTTAGE DEVELOPMENT ON LAKE BACTERIOLOGICAL WATER QUALITY,

Ontario Ministry of the Environment, Rexdale.
For primary bibliographic entry see Field 5B.
W82-06310

EFFECT OF NITRATE CONCENTRATION IN LAKE WATER ON PHOSPHATE RELEASE FROM THE SEDIMENT,

Arhus Amtsvandvaesen (Denmark).
J. M. Andersen.
Water Research, Vol 16, No 7, p 1119-1126, July, 1982. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Lakes, *Eutrophication, Phosphorus removal, *Phosphates, *Nitrates, Nitrogen, Sediments *Lake sediments, Hypolimnion, Thermal stratification, Stratification, Nutrients, *Denmark.

Results are given of eutrophication investigations in some 31 Danish lakes, focusing especially on the relationships between the concentration of oxidized nitrogen in the lake water and the binding or release of phosphorus to or from the lake sediment. Nine lakes were dimictic, with anoxic hypolimnia, and 22 were very productive and shallow polymictic lakes. Phosphate release from the sediment resulted in large increases in phosphate concentrations in the anoxic hypolimnion, if concentrations of oxidized nitrogen in the hypolimnion were less thant about 0.1 g N/cubic meters. If concentration of oxidized nitrogen in the hypolimnion was about 1 g N/cubic meter or higher, no release of phosphate from the sediment to the anoxic hypolimnion occurred. In lakes with no summer stratification a release of phosphate from the sediment to the well oxygenated water resulted in summer maxima of phosphate in the lake water when nitrate concentration in the water was less than about 0.5 g N/cubic meter, but no release took place if nitrate concentration exceeded about 0.5 g N/cubic meter. This effect of oxidized nitrogen in preventing phosphate release from the sediment demonstrates the ability of oxidized nitrogen to buffer the redox potential of the surface sediment at a level high enough to prevent a release of phosphate. Thus, among the efforts to limit phytoplankton biomass in lakes an artificial enrichment with nitrate may in some cases be an important supplement to the usually necessary reduction in phosphorus loading, but the possibility of a stimulation of phytoplankton growth through the addition of nitrate must be carefully considered. (Baker-FRC)
W82-06313

SOME EFFECTS OF PULP AND PAPER WASTEWATER ON MICROBIOLOGICAL WATER QUALITY OF A RIVER,

Ontario Ministry of the Environment, Rexdale.
G. S. Hendry, S. Janhurst, and G. Horsnell.
Water Research, Vol 16, No 7, p 1291-1295, July, 1982. 3 Tab, 20 Ref.

Descriptors: *Water quality, *Industrial wastes, Rivers, Water pollution effects, *Pulp and paper industry, Bacteria, Public health, Recreational facilities, Fecal bacteria, Coliforms, Escherichia coli.

The source of fecal indicator bacteria was sought in a river downstream from Sturgeon Falls. A small sewage treatment plant treating 1 million gallons per day and serving the town of Sturgeon Falls discharges effluent to the river 2 km below the falls. Two 5-day bacteriological water quality surveys were carried out between June 25 and 29,

and August 10 and 14, 1977. Data were obtained from samples taken at 40 river locations. Above Sturgeon Falls the water quality in the river was fairly good. The principal input of fecal indicator bacteria was traced to the paper mill at Sturgeon Falls; however, other sources of indicator bacteria could have been masked by the large numbers of bacteria discharged by the mill. The principal fecal coliform was Klebsiella pneumoniae. In pulp mill wastes the fecal origin of this bacterium can be disputed. K. pneumoniae can cause illness in humans. Pseudomonas aeruginosa was detected in the pulp mill wastewater and at a level of 82 PA/100 ml in recreational waters. This level was considered hazardous to the water users. Escherichia coli was detected in mill wastewater at about 200 EC/100 ml; this probably indicated some measure of fecal pollution though probably of animal origin. Finally, the nutrient-rich wastewater led to an about 50-fold increase in density of aerobic heterotrophic bacteria in the river water, as well as the production of a slimy filamentous growth on surfaces, stones, and wooden pilings in the river. The principal organism in this slime was the fungus Leptomitus. (Baker-FRC)
W82-06315

THE IMPACT OF COMBINED SEWER OVERFLOWS ON THE DISSOLVED OXYGEN CONCENTRATION OF A RIVER,

Aalborg Univ. (Denmark). Dept. of Environmental Engineering.
T. Hvitved-Jacobsen.
Water Research, Vol 16, No 7, p 1099-1105, July, 1982. 10 Fig, 10 Ref.

Descriptors: *Dissolved oxygen, Rivers, *Storm water, *Storm-overflow sewers, Storm runoff, Storms, *Combined sewer overflows, Storm wastewater, Oxygen, *Denmark, Skravad River.

The impact on the water quality of receiving streams was studied for combined sewer overflows in Denmark. The investigation was carried out in the river Skravad, a small tributary to the river Skals located in the middle of Jutland, Denmark. The total length of the Skravad River is 25 km; the part studied has a length of about 4 km, and on the average a width of 2.5 meters and a depth of 0.25 meters. About 5.5 km upstream from the confluence with the Skals River the stream receives biologically treated wastewater from the Moldrup sewage treatment plant. Moldrup township has a combined sewerage system and covers an area of about 70 ha. The storm overflows discharge through a ditch to the river Skravad just downstream from the outfall from the sewage treatment plant. Immediate oxygen comsumption takes place during the passage of the bulk discharge due to degradation in the water phase and absorption at the bed. A delayed effect was noted on the dissolved oxygen concentration due to the degradation at the bed of settle particulate matter and/or adsorbed organic matter. The observed effect cannot be due to the delay of polluted water in the dead zone volume of the stream. Depending on the actual adsorption, sedimentation, desorption and resuspension, the observed delayed effect on the dissolved oxygen concentration will vary from one discharge event to another. The flow conditions in the stream may also be important. Due to the delayed effect, the oxygen depletion extends over a longer period than just the duration of the overflow. In the investigated river the oxygen concentration returned to dry weather conditions within 12-24 hours. (Baker-FRC)
W82-06316

THE EFFECT OF BOAT ACTIVITY ON TURBIDITY IN A SHALLOW BROADLAND RIVER,

Freshwater Biological Association, Windmere (England).
J. Hilton, and G. L. Phillips.
Journal of Applied Ecology, Vol 19, No 1, p 143-150, April, 1982. 4 Fig. 2 Tab, 7 Ref.

Descriptors: *Turbidity, *Boating, Rivers, Lakes, Recreation facilities, Water quality, Model studies, Mathematical equations, Algal growth, Eutrophication, Water pollution sources.

A new approach was developed to explain the possible mode of action of boat activity in a narrow, shallow river and by its application, answer some problems of recreational management. The study site was the River Ant, a tributary of one of the principal Broadland rivers, the River Bure. The river flows throught Barton BroaD, a shallow lake of 1 meter in depth, 70 ha in area. During the summer the Broad and the river downstream contain a very high standing crop of phytoplankton. Above the Broad very little phytoplankton develops. the river is navigable for several miles above the Broad, and two large boat-hire yards are located in these upper reaches. Boat activity throughout the navigable reaches can be as high as 100 boats moving per hour. A simple experimental model was proposed and tested. It describes the mechanism by which boats can influence turbidity. Of the three constants derived from the model, two were shown to be closely related to measured physical variables. The model was used to predict water turbidities from typical boat movement patterns. This demonstrated that long term buildup of boat-induced turbidity through the holiday season was unlikely and that the major part of the turbidity in and below Barton Broad on the River Ant was due to algae and not to boating activity. (Baker-FRC)
W82-06330

VIRUSES IN A COMMUNITY WATER SUPPLY ASSOCIATED WITH AN OUTBREAK OF GASTROENTERITIS AND INFECTIOUS HEPATITIS,

Murray State Univ., KY. Dept. of Biological Sciences.
T. W. Hejkal, B. Keswick, R. L. LaBelle, C. P. Gerba, and Y. Sanchez.
Journal of the American Water Works Association, Vol 74, No 6, p 318-321, June, 1982. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Well water, *Human diseases, Drinking water, Bacteria, Potable water, Contamination, Leaching, Gastroenteritis, Hepatitis, Viruses, *Kentucky, Georgetown.

This report describes the Georgetown experience of an outbreak of gastroenteritis and hepatitis in order to illustrate the problems of viral contamination of small community water supplies. This marks the first reported instance of hepatitis A virus (HAV) antigen detection in well water samples taken prior to a hepatitis epidemic. In June of 1980 an outbreak of gastrointestinal illness occurred in the town. The outbreak began on June 1 and was over by June 23, with the peak number of cases occurring on June 13. Illness was associated with drinking of water from the central city wells. The attack rate among the 10,000 people living in areas supplied by these wells was about 79%. An increase in the number of cases of hepatitis A began to appear in July of that year. Again the cause was traced to central city wells. Heavy rainfalls had preceded the outbreaks of both gastroenteritis and hepatitis. Samples were taken from sewage, well water, and tap water for virological analysis. It was concluded that the Georgetown outbreak may have occurred due to heavy fecal contamination of the groundwater source near the central-city wells. What would normally be adequate treatment for an uncontaminated groundwater source was clearly inadequate when that source became unexpectedly contaminated. Human enteric viruses were isolated from the potable water in spite of a total chlorine residual of 0.8 mg/L. Sources of the contamination may include leakage from nearby sewer lines, contamination from nearby abandoned or private wells or septic tanks, and relatively long-distance contamination from surface contaminants in the recharge area of the Edwards aquifer. There is a fault line in the area adjacent to the wells and the aquifer is exposed to the surface just west of the fault line. (Baker-FRC)
W82-06348

ANTAGONISM OF SELENIUM AND CADMIUM PRETREATMENTS TO SUBSEQUENT EMBRYOTOXIC DOSES OF MERCURY AND CADMIUM IN FISH EMBRYOS,

South Dakota Univ., Vermillion. Water Resources Inst.
J. F. Heisinger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256645, Price codes: A02 in paper copy, A01 in microfiche. Report, December, 1981. 20 p, 2 Fig, 1 Tab, 31 Ref. OWRT A-075-SDAK(1). 14-34-0001-0144.

Descriptors: *Selenium, *Liver, *Embryonic growth stage, *Heavy metals, *Fish toxins, Mercury, Cadmium, Toxicity, Trace metals, Trace elements, Trace levels, Fish, Water pollution, Pollutants, Environmental protection, Fish populations, Population exposure.

Research was carried out to assess the protective role of selenium (Se) and cadmium (Cd) pre-exposures to fish embryos in attentuating toxic doses of mercury (Hg) and Cd. Experiments were carried out under laboratory-controlled conditions using Japanese ricefish (Oryzias latipes). Results indicated a protective role of Se pretreatment against Hg and Cd exposures in fish embryos once the liver has developed. In addition, pretreatment of post-liver embryos with sublethal concentrations of Cd also affords protection against subsequent potentially lethal Cd exposures. These antagonistic interactions, however, appear not to occur prior to liver development. Since numerous antagonistic metal and metalloid interactions have been reported in adult vertebrates, and since it is established that most metal-polluted waters contain anomolous quantities of more than one toxic element, it might be expected that the toxicity of these waters would be less than the sum of the toxic effects of the individual metals. However, during early embryo development the requisite morphological and molecular characteristics for antagonistic interactions appear to be lacking; consequently, younger embryos will lack sufficient resistance to multiple toxic metal exposures and lethality may occur. The results confirm the hypothesis that, during early embryonic development, the protective effects of Se or Cd will be nonexistant or minimal. (Zielinski-MAXIMA)
W82-06371

EUTROPHICATION OF WATERS: MONITORING, ASSESSMENT AND CONTROL.

Organization for Economic Co-Operation and Development, Paris (France).
Report, 1982. 154 p, 46 Fig, 24 Tab, 154 Ref, 7 Append.

Descriptors: *Eutrophication, *Eutropic lakes, *Water quality control, *Phosphorus removal, *International commissions, Algal growth, Aquatic productivity, Inland waterways, Water quality, Phosphorus, Nutrient removal, Nutrients, Nitrogen, Monitoring, International agreements, Trophic level, Lake morphology, Limnology.

The principal results are presented of a multi-year, 18-country international cooperative program aimed at establishing a basis for eutrophication control of inland waters (especially lakes and reservoirs) and developing improved guidelines for fixing nutrient load criteria compatible with water use objectives. The program was carried out by establishing four main regional projects covering a wide variety of geographic and limnological situations (Alpine; Nordic; reservoir and shallow lakes; and North Anerica); a fifth report has been developed which tests the results on bodies of water not included in the analytical part. The main control strategy offered is reduction of the external load; where this is impractical/impossible, alternate management measures are necessary which can only be defined using advanced modeling techniques. While nitrogen (or another factor) may occasionally outweigh the role of phosphorus (P) as the limiting factor, attention is focused on phosphorus control. The program results showed that, in most cases, P is the factor which determines eutrophication development; even when another element (e.g., nitrogen) is the limiting factor, P may still be made to play the limiting factor role through appropriate control. Specific findings concerning monitoring, nutrient load assessment, trophic assessment, and loading criteria and nutrient

reduction goals are discussed. (Zelinski-MAXIMA)
W82-06383

STUDIES OF BOD INHIBITION IN PRESENCE OF INORGANIC HEAVY METALS,

Associated Industrial Consultants, Bombay (India).
C. M. Deshpande, and S. S. S. Bhende.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 111-113, June, 1981. 4 Tab, 5 Ref.

Descriptors: *Biochemical oxygen demand, *Chemical interference, Water Analysis, *Heavy metals, Toxicity, Water pollution effects, Inhibition, Biodegradation, Cadmium, Chromium, Mercury, Coppper, Dissolved oxygen, Sewage bacteria, Industrial wastes.

The method of estimating biochemical oxygen demand (BOD) on the basis of rate of oxygen consumption may lead to erroneous results when inorganic toxicants, either individually or in combination, are present in samples of sewage or polluted water. Copper (Cu), chromium (Cr), cadmium (Cd), mercury (Hg), and other electroplating wastes may kill the microbial population in the sample, leading to a reduced depletion of dissolved oxygen concentration. BOD inhibition due to Cu, Cr, Cd, and Hg, individually and in combination, was determined by adding different concentrations of the metals for different dilution factors of sewage and dilution water. Toxicity behavior analysis showed that percent inhibition of BOD fluctuated for concentrations of 0.01 to 0.1 ppm for all of the toxicants. For 0.01 to 0.1 ppm levels of the metals, toxicity to microbial populations was within the range of 25% inhibition of BOD. For the concentration of 0.1 to 1.0 ppm, Cr seemed to be the least toxic and Hg the most. In the case of each metal tested, biodegradation activity as almost soppped in the concentration range of 1.0 to 10 ppm. Metals in combination were less toxic than individually. (Geiger-FRC)
W82-06436

PRIMARY PRODUCTIVITY AND NUTRIENTS IN THE SEDIMENT RETENTION BASIN OF LAKE MONROE,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
W. Y. B. Chang.
Hydrobiologia, Vol 87, No 3, p 193-200, March, 1982. 2 Tab, 4 Fig, 19 Ref.

Descriptors: *Primary productivity, *Algae, *Sediment, *Settling basins, *Transparency, Phosphorus, Eutrophication, Water treatment, Water quality, Reservoirs, Water supply, Sewage effluent, River basin development, Silt, Reservoir operation, Lake Monroe, Indiana.

Lake Monroe is the largest body of water in Indiana. Studies were undertaken to determine the annual production rates and trophic status of the lake. The result then served as a basis for interpreting data on the subsequent nutrient enrichments. C-14 bioassays with enrichments of major and minor nutrients were conducted, and algal response to different light availability conditions was investigated. The diurnal changes in major nutrients and carbon, nitrogen, and phosphrous ratios were examined. Results indicated that phosphorus is the major limiting nutrient on algal photosynthesis in this lake. Surface photo-inhibition may be used to indicate the sufficiency of light for the species of algae in the water. The low productivity in December, January, February, and early March can be attributed to light limitation due to the low water transparency. (Titus-FRC)
W82-06470

CIRCULATION PATTERNS: THEIR INVESTIGATION AND PREDICTION,

Leicester Polytechnic (England). School of Life Sciences.
For primary bibliographic entry see Field 5F.
W82-06477

DIATOM DISTRIBUTION AND STATUS OF ORGANIC POLLUTION IN SEWAGE DRAINS,

Delhi Univ., New Delhi (India). Dept. of Botany.
K. M. M. Dakshini, and J. K. Soni.
Hydrobiologia, Vol 87, No 3, p 205-209, March, 1982. 1 Tab, 1 Fig, 14 Ref.

Descriptors: *Diatoms, *Sewage, *Nitrate, *Indicator species, *Organic wastes, Nitrogen, Water quality, Organic matter, Organic loading, Correlation analysis, Water sampling, Ammonia, Sewers, India, River Yamura.

Data on the limnology of various sewage drains discharging into the River Yamuna in Delhi, India, suggest that the diatom distribution and concentration of nitrate nitrogen vary with the degree of organic pollution. Surface water samples were collected from each drain in three different seasons throughout a one year period. The samples were analyzed for physiochemical characteristics and diatom composition. In the drains investigated, diatoms, nitrate nitrogen and dissolved oxygen were generally highest in winter, high in the post-monsoon period and low in summer. Such a uniform seasonal trend was not evident for ammonia nitrogen and chemical oxygen demand. Detailed autecological studies are required before a final relationship between diatom density and the organic content of sewage can be stated. (Titus-FRC)
W82-06484

A COMPARISON OF DIFFERENT PHOSPHORUS FRACTIONS AS PREDICTORS OF PARTICULATE PIGMENT LEVELS IN LAKE MEMPHREMAGOG AND ITS TRIBUTARIES,

McGill Univ., Montreal (Quebec). Dept. of Biology.
R. H. Peters, and M. Bergmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 5, p 785-790, May, 1982. 1 Fig, 3 Tab, 25 Ref.

Descriptors: *Phosphorus, *Lakes, *Regression analysis, *Particulate matter, *Seston, Nutrients, Phosphorus compounds, Phosphates, Water analysis, Surface water, Mathematical studies, Rivers, Reflectance, Lake Memphremagog, Quebec.

The amounts of colored particulate matter measured by reflectance in the surface waters of Lake Memphremagog and its tributaries were regressed against levels of total phosphorus (P), particulate P, soluble reactive P, orthophosphate, large molecular weight P (> 5000) and small molecular weight P (< 400) to see which fraction was the best predictor of seston concentration, and to determine if riverine samples differed from lake waters in the relationship between P levels and suspended particulates. Total P correlated with colored particulates better than any other fraction in both lotic and lentic environments. Regression lines describing the relations were similar in both lakes and rivers, although river samples showed greater variation than lake samples. These findings, confirm the retention of total P as the simplest and most meaningful measure of this important nutrient in both lakes and rivers. (Geiger-FRC)
W82-06496

ENVIRONMENTAL IMPROVEMENT AT PORT ALICE, B. C.,

E. V. S. Consultants, Inc. Seattle, WA.
E. M. Tokar, J. P. Campbell, and R. Tollefson.
Pulp and Paper Canada, Vol 83, No 5, p 50-53, May, 1982. 4 Fig, 2 Ref.

Descriptors: *Pulp and paper industry, *Fish, *Toxicity, Water pollution effects, Aqutic life, Salmon, Dissolved oxygen, Water quality, Benthic fauna, Pulp wastes, Port Alice, British Comumbia, Neroutsos Inlet.

Pollution control equipment (including an incineration system) installed at the Western Forest Products Ltd. pulp mill at Port Alice, British Columbia, during 1971-77, dramatically improved dissolved oxygen concentrations and suspended solids in the receiving waters. Neroutsos Inlet on Vancouver Island. Surveys during 1978-80 showed a reduction in BOD discharge from a high of 227,000 to 70,000 kg per day. Average dissolved oxygen increased from 3 to 5 ppm. Primary productivity and intertidal organism numbers and diversity decreased in waters close to the mill, but the size of the affected zone has decreased. Chum salmon appeared to avoid certain areas of the inlet near the mill. In laboratory tests the biomass of juvenile chum salmon was not affected until effluent concentrations were 0.10-0.25 of the 96 hour LC50 on a continuous basis. Nevertheless, healthy fish populations exist in the inlet, as they apparently did even during the years before pollution abatement measures were started. (Castar-FRC)
W82-06515

INFLUENCE OF SALINITY AND ORGANIC NUTRIENT CONCENTRATION ON SURVIVAL AND GROWTH OF VIBRIO CHOLERAE IN AQUATIC MICROCOSMS,

Maryland Univ., College Park. Dept. of Microbiology.
F. L. Singleton, R. W. Attwell, M. S. Jangi, and R. R. Colwell.
Applied and Environmental Microbiology, Vol 43, No 5, p 1080-1085, May, 1982. 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Estuaries, *Microbiological studies, *Water pollution effects, *Vibrio cholerae, Aquatic life, Laboratory studies, Salinity, Nutrients, *Organic matter, Decomposing organic matter.

An investigation was performed on the possibility of employing microcosms to determine the influence of selected environmental parameters on growth and survival of a toxigenic strain of Birio cholerae in the aquatic environment as a means of establishing the autochthonous estuarine source of V. cholerae. Over the range of conditions tested, this strain of V. cholerae showed maximum response, as determined by increased plate counts and direct microscopic counts in microcosms prepared with a chemically defined sea salts solution at a salinity of 25%. With lower or higher salinity levels, the maximum population size declined. When added organic concentrations of less than 1,000 micrograms/liter were present, a marked salinity effect on the growth of V. cholerae was detected. However, at or above an organic nutrient concentration of 1,000 micrograms/liter, the need for an optimum salinity level was spared. From the results of this study it was concluded that V. cholerae can grow under conditions of organic nutrient concentration and salinity typical of estuaries. Results obtained support the hypothesis that V. cholerae is an autochthonous member of the estuarine microbial community. (Baker-FRC)
W82-06534

EFFECT OF HARD DETERGENTS ON ALGAE IN A HIGH-RATE-OXIDATION POND,

Technion--Israel Inst. of Tech., Haifa.
Y. Azov, G. Shelef, and N. Narkis.
Applied And Environmental Microbiology, Vol 43, No 2, p 491-492, February, 1982. 2 Fig, 7 Ref.

Descriptors: *Algae, *Detergents, *Oxidation ponds, Municipal wastewater, *Wastewater treatment, Algal toxins, Israel, Water pollution effects, Wastewater farming.

High-rate oxidation ponds are used in Israel to combine wastewater treatment with the production of algal biomass to be used as a protein-rich animal feed. There has been some conoern regarding the inhibitory effects of anionic non-biodegradable detergents on algal growth in these oxidation ponds. This study of the effect of detergents on algal production showed that regular concentrations of hard detergents in domestic wastewater did not affect algal growth in high-rate oxidation ponds. The addition of nonionic hard detergent at concentrations exceeding 60 milligrams per liter decreased algal concentration in the batch culture. Concentrations of detergent exceeding 100 milligrams per liter had a severe effect on algal morphology, with complete lysis of the algal cells occurring within a few days. These results indicate that only a considerable increase in the use of hard nonionic detergents or feeding the pond with in-

dustrial wastewaters which contain high concentrations of hard detergents would cause a severe inhibition of algal production. (Carroll-FRC)
W82-06538

EFFECT OF SULFIDE ON NITROGEN FIXATION IN A STREAM SEDIMENT-WATER SYSTEM,

Waterloo Univ. (Ontario). Dept. of Biology.
T.-Y. Tam, C. I. Mayfield, W. E. Inniss, and R. Knowles.
Applied and Environmental Microbiology, Vol 43, No 5, p 1076-1079, May, 1982. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Nitrogen fixation, *Sediments, Streams, Chemical reactions, Sulfides, Hydrogen sulfide, Acidity, Oxidation-reduction potential, Nitrogen, Carbon dioxide, Ethylene, Anaerobic conditions, Coastal waters, Laboratory studies, Marine waters, Estuaries, *Ontario.

Nitrogen fixation in a sediment-water system was studied under anaerobic laboratory conditions. Sediment and water samples were obtained from a stream near Floradale, Ontario, Canada. The presence of Na2S at concentrations from 2 to 8 micromol/ml of stream water stimulated nitrogen fixation by the system. A twofold increase in total ethlyene produced compared with the controls was noted when the sulfide concentration was 8 micromol/ml. Na2S concentrations of 16 to 32 micromol/ml inhibited nitrogen fixation, with total inhibition occurring at 64 micromol/ml. Ethylene production was not noted in sterile controls. Carbon dioxide production was inhibited by sulfide at concentrations from 8 to 128 micromol/ml. The degree of inhibition increased as the concentration of sulfide increased, and complete inhibition of carbon dioxide production occurred at 128 micromol/ml. Titanium(III) citrate, a strong reducing agent, stimulated both nitrogen fixation and carbon dioxide production. Sulfide additions caused pH changes in the sediment, and when the sediment was adjusted and maintained at pH 7.0 all concentrations of sulfide inhibited nitrogen fixation activity. From considerations of the redox equilibria of hydrogen, hydrogen sulfide, and other sulfur species at various pH values, it appeared that hydrogen sulfide was the toxic entity and that HS(-) was less toxic. The observed stimulation of activity was apparently due to a pH change coupled with the concurrent production of HS(-) from hydrogen sulfide. (Baker-FRC)
W82-06540

METHODS OF STUDYING POPULATION SHIFTS IN AQUATIC BACTERIA IN RESPONSE TO ENVIRONMENTAL CHANGE,

Windsor Univ. (Ontario). Dept. of Biology.
M. A. Holder-Franklin.
Environment Canada, Inland Waters Directorate, Ottawa, Ontario, Scientific Series No 124, 1981. 107 p 28 Fig, 40 Tab, 147 Ref.

Descriptors: *Saint John River, *Meduxnekeag River, *Dunbar River, Taxonomy, Methodology, Aquatic populations, Organisms, Sediments, Diurnal variations, Mathematical models, Pollutants, *Bacterial populations, Physico-chemical parameters, Isolates, Culturing procedures, Temperature factors, Oxygen levels, Nutrients, *New Brunswick, Maine, *Heterotrophic bacteria.

Population shifts in heterotrophic aquatic bacteria from a watershed with several months of ice cover annually and a temperature range of 0C to 28C have been studied by classical and numerical taxonomy, factor analysis and species diversity. Mathematical techniques have been utilized to demonstrate correlations between changes in the bacterial populations and certain physico-chemical environmental parameters. A complete methodology has been developed, beginning with isolation and culturing procedures and proceeding through the taxometrics to the multivariate statistics and the selection of correlation coefficients. This series of reports is a retrospective of work over a period of ten years and describes the seasonal and diurnal changes in the predominant flora in the free-flowing river and the sediment. The major environmental influences in each econiche are related to the bacterial flora. Although the bacterial population can be shown to fluctuate diurnally and seasonally, the overall predominant taxonomic groups in all locations in all seasons are the Pseudomonas, with the fluorescent group generally predominant in the winter and the non-fluorescent species prevailing during other seasons. The most important group are the gram-negative rods and of these the aerobic group dominate. The aerobes are followed by the facultative aerobes and members of the Enterobacteriaceae appear with moderate frequency in the high-profile segment of the population. The environmental parameters which have the most significant influence on the flora are the temperature; oxygen levels; the nutrients, particularly the amount and form of nitrogen; and the specific conductivity. (WATDOC)
W82-06558

AN ECOLOGICAL APPROACH TO THE STUDY OF BACTERIA AT THE FLORENCEVILLE SITE IN SEPTEMBER AND FEBRUARY,

For primary bibliographic entry see Field 5A.
W82-06560

SEASONAL AND DIURNAL CHANGES IN THE PREDOMINANT HETEROTROPHIC BACTERIAL SPECIES OF THE MEDUXNEKEAG RIVER,

For primary bibliographic entry see Field 5A.
W82-06562

INTERACTIONS OF HETEROTROPHIC BACTERIA IN THE SEDIMENT WATER PHASES OF TWO CONTRASTING RIVERS,

For primary bibliographic entry see Field 5A.
W82-06564

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION; CANADIAN CONTRIBUTION, SUMMARY REPORT,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-06566

A REVIEW OF BENZOTHIAZOLES IN THE AQUATIC ENVIRONMENT,

Canada Centre for Inland Water, Burlington (Ontario).
B. Brownlee, J. H. Carey, and M. E. Fox.
National Water Research Institute, Scientific Series No 126, 1981. 5 p, 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Reviews, *Pollutant identification, *Benzothiazoles, Chemical properties, Biological properties, Aquatic environment, Toxicity, Water extracts, Air emissions, Waste water, Gas chromatography, Environmental contaminants.

The following aspects of benzothioazoles are reviewed: (1) physical and chemical properties, (2) analysis and occurrence, (3) biological properties and (4) mammalian toxicity and human health. Six reports were found in the literature on the occurrence of benzothioazoles in the following areas of the aquatic environment: river water (1-2ppb), drinking water, and tire plant wastewater (20-60ppb). Benzothiazoles display a wide range of biological activity and are used commercially as fungicides. No data were found for toxicity to aquatic organisms, although acute mammalian toxicity is low. Future research areas are identified, the most important of which are (1) physical properties, (2) persistence and (3) aquatic toxicity. (WATDOC)
W82-06571

SLUDGE DISPOSAL TO SEA IN THE FEDERAL REPUBLIC OF GERMANY,

Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5E.
W82-06600

HYDROGEN SULFIDE CORROSION OF THE BAGHDAD TRUNK SEWERAGE SYSTEM,

M. I. Aldred, and B. G. Engles.
Water Pollution Control, Vol 18, No 1, p 80-96, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Hydrogen sulfide, *Corrosion, *Main sewers, Sewer systems, Concretes, Baghdad, *Iraq, Middle East.

The corrosion of the trunk sewer and its main branches in Baghdad, Iraq, was investigated. The city, built on the East and West Banks of the River Tigris, is situated on a flat alluvial plain having little natural fall for drainage systems. As a result, sewage lift stations must be installed at frequent intervals. Construction on the East Bank's outfall sewer began in 1959, while the construction of the trunk sewers on the West Bank began in 1970. The main factors contributing to the production of hydrogen sulfide in the Baghdad sewerage system include the hot dry climate, low flow conditions, the high-strength sewage, the storage or retention period within the sewerage system, and poor natural ventilation of the system. Examination of the concrete sewers at about 190 manholes on the East Bank showed that all had been subject to attack by hydrogen sulfide and that the lower portions of the access ladders were surrounded with fallen pasty cementitious mass. Manhole ventilations did not appear to be related to attack by this gas. Sampling of industrial effluents entering the sewer system indicated that treatment of these effluents was generally limited to grease traps and small sedimentation tanks. Nearly all the discharges exceeded limitations on pollutants. Available methods of sulfide control include ventilation and odor control, pH control, aeration, chlorination, nitrate dosing, injection of hydrogen peroxide and oxygen, improved treatment of industrial effluents, and improved sewer maintenance. In the new system, pretreatment with hydrogen peroxide or oxygen at the pumping station should help keep sulfides low. Several recommended remedial actions are discussed. (Carroll-FRC)
W82-06651

EFFECTS OF SUSPENDED VOLCANIC SEDIMENT ON COHO AND CHINOOK SALMON IN THE TOUTLE AND COWLITZ RIVERS,

Washington Univ., Seattle. Fisheries Research Inst.
Q. J. Stober, B. D. Ross, C. L. Melby, P. A. Dinnel, and T. H. Jagielo.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256801, Price codes: A09 in paper copy, A01 in microfiche. Report FRI-UW-8124, November, 1981. 146 p, 48 Fig, 25 Tab, 36 Ref, 1 Append. OWRT C-00238-V(No 1417)(1), 14-34-0001-1417.

Descriptors: *Salmon, *Bioassay, *Volcanoes, *Fallout, *Suspended sediments, Suspended solids, Water quality, Assay, Histology, Sediments, Suspended load, Biological properties, Chemical analysis, Water analysis, Gills, Fish physiology, *Washington, Cowlitz River, Toutle River.

Toleranes of Coho and Chinook salmon to suspended volcanic (Mount St. Helens) sediment were determined by live-box and static laboratory bioassays. The 96-hour LC-50 suspended sediment levels determined by live-box bioassay for presmolt and smolt Coho, and fall Chinook smolts were 1217, 509, and 488 mg/liter, respectively. Static 96-hour LC-50 values for Coho and fall Chinook smolts in mudflow sediment were 29,580 and 11,000 mg/liter. While live-box bioassays integrate numerous water quality parameters, only suspended sediment was tested. Other tests run in artificial streams (0.5-1.5 liter/sec flowrate) having known suspended sediment levels (0-16% of 96-hour LC-50 value) evaluated for sublethal effects (swim performance, seawater entry test) showed no consistant effect. Histological analysis of field/laboratory-tested salmon showed no suspended sediment effect on gill tissue. The results are compared to actual Coho presmolt mortality data following the Mount St. Helens eruption. Water quality data (e.g. trace metals) and sediment particulate size measurements are included. The volcanic ash had

particle sizes equivalent to silt-fine sand and was high in silica, magnesium, and iron. (Zielinski-MAXIMA)
W82-06706

IMMUNE RESPONSE TO A FORMALIN-TREATED BACTERIAL EXOTOXIN (TOXOID) OF CHANNEL CATFISH MAINTAINED IN A RECIRCULATING WATER-REUSE SYSTEM,

Memphis State Univ., TN. Dept. of Biology.
D. D. Ourth.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256819, Price codes: A02 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No 81, December, 1981, Knoxville. 13 p, 1 Fig, 2 Tab, 16 Ref. OWRT A-057-TENN(1), 14-34-0001-0145.

Descriptors: *Toxins, *Water reuse, *Catfish, *Recirculated water, Fish toxins, Hazardous materials, Fish, Neutralization, Biological properties, Biochemical tests, Bioassay, Assay, Antibiotics, Proteins, Toxicity, Wastewater renovation, Water quality.

Channel catfish serum contains an immunoglobulin (IgM), 14S-macroglobulin. It was determined that the catfish immune serum could neutralize tetanus toxin (TT) at the 1.28 antitoxin units (AU/ml) level, and that catfish 14S-macroglobulin (11.3 mg/ml) from Sephadex G-200 gel filtration could neutralize TT at the 0.32 AU/ml level. The 0.01 AU/ml level of TT neutralization is considered to be the minimal level needed for protection in humans. After 2-mercaptoethanol (2ME) reduction and alkylation, no TT neutralization by the catfish immune serum or by the 14S globulin remained. The catfish 7S globulin (40 mg/ml) had no TT neutralizing ability either before/after 2ME reduction and alkylation. Decreases in 14 S and 7S globulin titers after 2ME reduction and alkylation indicated that both globulin fractions were sensitive to sulfhydryl reduction. Catfish reciprocal indirect hemaglutination titers were 2048 10 days after primary immunization and did not rise above 8192 even after 10 months post-primary immunization. Not until after the first booster dose of 0.5 ml toxoid was given at 10 months, post-primary immunization was a protective TT neutralization level (0.08 AU/ml) found, with titers still at 8192. This indicates an IgM antibody memory response for TT neutralization by the channel catfish. (Zielinski-MAXIMA)
W82-06707

LAND WATER INTERACTIONS: EFFECTS OF INTRODUCED NUTRIENTS AND SOIL PARTICLES ON RESERVOIR PRODUCTIVITY,

Oklahoma Univ., Norman. Dept. of Zoology.
For primary bibliographic entry see Field 2J.
W82-06710

THE USE OF AN ALGA CHLORELLA PYRENOIDOSA AND A DUCKWEED LEMNA PERPUSILLA AS TEST ORGANISMS FOR TOXICITY BIOASSAYS OF SPENT BLEACHING LIQUORS AND THEIR COMPONENTS,

State Univ. of New York Upstate Medical Center, Syracuse. Dept. of Pediatrics.
E. L. Rowe, R. J. Ziobro, C. J. K. Wang, and C. W. Dence.
Environmental Pollution, Series A, Vol 27, No 4, p 389-396, April, 1982. 3 Tab, 20 Ref.

Descriptors: *Bleaching wastes, *Algae, Toxicity, Chlorination, Chlorine, *Chlorophenols, *Chlorinated hydrocarbons, Aquatic plants, *Duckweed, *Bioassays, Water quality.

The toxicity of a number of compounds, primarily chlorophenols, present in spent pulp bleaching liquors was investigated toward a freshwater unicellular alga, Chlorella pyrenoidosa, and a duckweed, Lemna perpusilla. In addition to individual compounds, the effect of the whole spent chlorination and caustic extraction liquors on the alga was also determined. Test chemicals included catechol, 4,5-dichlorocatechol, 3,4,5-trichlorocatechol, tetrachlorocatechol, phenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, guaiacol, 4,5-dichloroguaiacol, 4,5,6-trichloroguaiacol, 9,10-epoxystearic acid, p-cymene, monobromo-p-cymene, and dichloro-p-cymene. The study indicated that the toxicity of the chlorine substituted compounds was greater than that of the parent compounds and that increasing numbers of chloro substituents resulted in increased toxicity. Spent chlorination liquor was more toxic to the alga than spent caustic extraction liquor. The comparatively severe toxic effects of the catechol compounds on the alga and duckweed in this study duplicate the findings of earlier studies with Daphnia. The comparatively low toxicity of epoxystearic acid toward the alga and duckweed were compatible with findings on juvenile rainbow trout, Salmo gairdneri. Both test organisms used in this study proved satisfactory for evaluating the toxicity of compounds identified in spent chlorination and caustic extraction liquors and were superior for this purpose to the fungi examined in previous studies. (Baker-FRC)
W82-06721

FURTHER OBSERVATIONS ON THE EFFECT OF ABATE ON FISH CATCHES,

Ghana Inst. of Aquatic Biology, Achimota.
E. K. Abban, and J. Samman.
Environmental Pollution, Series A, Vol 27, No 4, p 245-254, April, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Fish populations, *Larvicides, Pesticides, Rivers, Volta Basin, *Ghana, Savanna rivers, *Abate, Seasonal variations, Aquatic life, Ecosystems.

A short term evaluation was made of the effects of Abate in relation to fish and fisheries. Specifically, effects of the weekly application on fish catches during the long dry season from November to May in Northern Ghana are reported. Such dry periods are typical of the savanna regions of the Onchocerciasis Control Program (OCP) area of the World Health Organization. The study was conducted on the White Volta, a major river in the Volta Basin. The river at this time existed mainly as a series of slow flowing pools connected by relatively shallower and faster flowing sections. The study period lasted 11 days, during which time Abate was applied aerially directly to the river. Fish samples were taken about 1 km from the dosing point. In the OCP Abate is applied at a dosage rate of 0.04 ppm for each 10 minutes of river discharge. Each sample consisted of fish caught in a battery of nets in 12 hr. Following the larvicide application on 20 May, six day and six night samples were taken before the next treatment on 27 May. No fish kills were noted that could be associated with Abate treatment on the river. Fish normally avoided the larvicide by moving downstream. However, when the fishes' movements were restricted due to the low water, they did undergo stress-movements, which increased their proneness to capture in nets. It is evident that during the dry season regular treatment of rivers may expose fish to the larvicide for longer periods than expected. (Baker-FRC)
W82-06722

HORIZONTAL RECIRCULATION IN WATER BODIES DUE TO THERMAL DISCHARGE,

Military Engineering Services, Hyderabad (India).
R. C. Sehgal, and Y. Jaluria.
Energy, Vol 7, No 5, p 419-428, May, 1982. 7 Fig, 17 Ref.

Descriptors: *Thermal pollution, *Flow pattern, Powerplants, Thermal powerplants, *Thermal water, Heated water, Waste heat, Temperature effects, *Model studies, Isotherms, Temperature gradients, Thermoclines.

The turbulent recirculation that occurs due to thermal discharge to a shallow water body has been studied. A horizontal, two-dimensiional model was developed to determine the nature of the flow field generated. The model assumes complete mixing in the vertical direction and steady ambient conditions. Various configurations of the intake and outfall are considered, and the intake water temperature is determined as a function of the heat rejected. It is found that the spread of the flow region is a strong function of the flow configuration and of the distance between the outfall and the intake. The intake temperature was found to be insensitive to the amount of heat rejected at low values of the rejection rate. At large values, however, a strong dependence is observed, and the intake temperature rises sharply with heat rejected. The effect of turbulent mixing in the water body due to winds, inflow, level changes and other causes is considered in terms of the eddy diffusivities, and a relatively weak dependence over the range of interest is indicated. The streamlines and isotherms under various conditions of inflow, ambient conditions and amount of heat rejected per unit area are determined. The results are compared with a simple one-dimensional model. The study indicates the water surface region over which significant transport processes occur. These results can be employed in one-dimensional vertical models to obtain the effective surface area for heat rejection, determine the stratification that results, and find the transient behavior of the water body. The results are directly applicable to shallow water bodies and to those in which good vertical mixing exists. The study provides a basis for the design of such heat rejection systems, particularly with respect to the horizontal separation of the intake and outfall. (Baker-FRC)
W82-06723

EFFECTS ON GLOBAL SUPPLIES OF FRESHWATER,

Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
K. G. Wetzel.
Ambio, Vol 11, No 2/3, p 126-131, 1982. 5 Fig, 1 Tab, 8 Footnotes.

Descriptors: *Water supply, *Nuclear explosions, *Radioisotopes, *Drinking water, Disasters, Agriculture, Industrial water, Groundwater pollution, Surface water, Fate of pollutants, Radioactivity, Air pollution, Streams, Rivers, Reservoirs, Aquifers, Lakes, Public health, Toxicity, Water pollution effects, Fallout, Rain, Disasters, War.

The radioactive contamination of freshwater supplies after a global nuclear war is estimated for a lowland temperate climate. Regions exposed to local fallout would be contaminated with the persistent and toxic I-131, Sr-89, Sr-90, and Ru-106 and with other radioisotopes with shorter half-lives; regions exposed to global fallout only, with I-131. The most serious contamination would come from radioactive rain water, followed by rivers, lakes, and least affected, groundwater reservoirs. In the most severely impacted areas, rain water would be so highly loaded with I-131 that skin contact would produce visible changes to the skin within several days. Rainfall could also wash radioactive fallout into concentrated areas, enhancing radioactivity levels by 10 to 100 times. Well-mixed lakes with long residence times would dilute radioactivity better than other lakes. Stream water in direct fallout regions would exceed maximum drinking water concentrations for about 4 weeks and in global fallout regions, for 2 weeks. Groundwater would be reasonably safe for drinking except in aquifers with short residence times (a few years or less), aquifers covered by sediments low in ion exchange capacity, or soil layers less than 1 meter thick. In general groundwater contamination in directly exposed regions would have about one-tenth the radioactivity of stream water. Much worse contamination of surface water would be expected in montiform, karstic, permafrost, desert, and marshland regions. Semi-arid regions would have higher contamination than tropical regions, which would receive about half the fallout of temperate regions. The Southern Hemisphere would be less affected by a factor of 0.03. (Cassar-FRC)
W82-06733

PRODUCTION AND VERTICAL FLUX OF ATTACHED BACTERIA IN THE HUDSON RIVER OF THE NEW YORK BIGHT AS STUDIED WITH FLOATING SEDIMENT TRAPS,

Lamont-Doherty Geological Observatory, Palisades, NY.
H. W. Ducklow, D. L. Kirchman, and G. T. Rowe.
Applied and Environmental Microbiology, Vol 43, No 4, p 769-776, April, 1982. 3 fig, 5 Tab, 30 Ref.

Descriptors: *Plumes, *Bacteria, Rivers, *Hudson River, Sedimentation, Measuring instruments, Sediment sampler, Fluctuations, Diatoms, Particulates, Mineralization, Organic carbon, Organic compounds, Water temperature, Nutrients, *New York Bight.

The growth and vertical flux of attached bacteria were investigated with floating sediment traps in the Hudson River Plume of the New York Bight during the spring diatom blooms. Traps were floated at the base of the mixed layer for 1 day periods. After recovery bacterial abundance and rates of (methyl-3H)thymidine incorporation were measured in the trap samples. The vertical flux of attached bacteria was estimated with a model formulated to distinguish between bacterial accumulation in traps due to in situ growth and that due to vertical flux. The results indicated that in situ growth of bacteria in sediment traps was unimportant as a source of bacterial increase when compared with vertical flux during this study. The vertical flux of attached bacteria removed 3 to 67% of the total daily bacterial production from the water column. Particulate organic carbon was not significantly mineralized by attached bacteria during its descent to the sea floor in the plume area during this period, when water temperature and grazing rates were at their annual minima. (Baker-FRC)
W82-06736

EFFECTS OF ACID ON PLANT LITTER DECOMPOSTION IN AN ARCTIC,

Cincinnati Univ., OH., Dept. of Biological Sciences.
V. L. McKinley, and J. R. Vestal.
Applied and Environmental Microbiology, Vol 43, No 5, p 1188-1195, May, 1982. 5 Fig, 1 Tab, 37 Ref.

Descriptors: *Decomposing organic matter, *Hydrogen ion concentration, *Lakes, Polar regions, Arctic, Arctic zone, Acid rain, Precipitation, Litter, Plants, Acidity, Microbial degradation, Aquatic plants, Toolik Lake, *Alaska, Oligotrophic lakes.

The effects of acidic pH on the microbial decomposition of plant litter were studied during the summer of 1980 in microcosms from Toolik Lake, Alaska. Toolik Lake is a large, deep water lake on the north slope of the Brooks Range of mountains within the Trans-Alaska Pipeline corridor. It is very oligotrophic and its waters have very little buffering capcaity. Microbial decompostition of Carex in response to acidification was evaluated directly by determinations of weight loss and changes in C/N rations of the litter over time. Microbial biomass and activity associated with the litter were evaluated by the measurement of adenosine triphosphatase concentrations and by determination of the rates of acetate incorporation into microbial lipids, respectively. The community structure of the microbiota on the litter surface was examined by scanning electron microscopy and the effects of acid on the mineralization of Carex lignocellulose were also examined. Microbial activities associated with Carex litter were significantly reduced within 2 days at pH values of 3.0 and 4.0, but not 5.0, 5.5, or 6.0. ATP levels were significantly reduced at pH 30., but not at the other pHs tested. After 18 days microbial activity significantly correlated with weight loss, nitrogen content, and C/N ratios of the litter but did not correlate with ATP levels. Fungi present at ambient pH did not become dominant at pH below 5.5, diatoms were absent below pH 4.0, and bacterial numbers and extracellular slime were reduced at pH 4.0 and below. It was concluded that if the pH of the water from this slightly buffered lake were sufficiently reduced, rates of litter decomposition whould be significantly reduced. (Baker-FRC)
W82-06737

SURVIVAL OF VIBRIO CHOLERAE AND ESCHERICHIA COLI IN ESTUARINE WATERS AND SEDIMENTS,

University of West Florida, Pensacola. Dept. of Biology.
M. A. Hood, and G. E. Ness.
Applied and Environmental Microbiology, Vol 43, No 3, p 578-584, March, 1982. 9 Fig, 20 Ref.

Descriptors: *Estuaries, *Bacteria, *Escherichia coli, Estuarine environment, Coastal waters, Marine waters, *Vibrio cholerae, Coliforms, *Florida, Apalachicola Bay.

The survival of strains of Vibrio cholerae in estuarine waters was studied and compared to that Escherichia coli. Water and sediment samples were collected from Apalachicola Bay, Florida. The enviromnetal V. cholerae serotype 01 strain (WF/1) survived well in estuarine waters and sediments. The survival of WF/1 was examined in sediments and waters collected from two different sites. One site had a lower mean salinity than the site at which the organism was originally found. Although the salinities of the waters at the sites were 6 and 15% there was no significan difference in the survival of the organism. The survival of WF/1 varied with the time of the year when samples were taken. The temperature at which the survival chambers were incubated had a significant effect on organism survival. Comparison of different V. Cholerae strains revealed no significant differences in the survival of serotype 01 and non-01 isolates in sterile or nonsterile sediments or waters. E. coli ATCC 25922 did not survive well in estuarine waters and could not be recovered by plating or most probable number procedures after 7 days in nonsterile water and 14 days in sterile water. These findings may explain the recent observations that V. cholerae levels do not correlate well with fecal coliform concentrations in estuarine waters. Futhermore, the results add increasing evidence to support the theory that V. cholerae is an autochthonous bacterium in estuaries. (Baker-FRC)
W82-06742

INTERMEDIARY METABOLISM OF ORGANIC MATTER IN THE SEDIMENTS OF A EUTROPHIC LAKE,

Michigan State Univ., Hickory Corners, W. K. Kellogg Biological Station.
D. R. Lovley, and M. J. Klug.
Applied and Environmental Microbilogy, Vol 43, No 3, p 552-560, March, 1982. 4 Fig, 5 Tab, 37 Ref.

Descriptors: *Lake sediments, *Decomposing organic matter, Organic matter, Decomposition, *Metabolism, *Eutrophication, Fatty acids, Methanogenesis, Fermentation, Anaerobic conditions, Sedments, Sedimentation, *Michigan, Wintergreen Lake.

The rates of production and fates of the fermentation intermediates were investigated in the profundal sediments of a eutrophic lake (Wintergreen Lake, Michigan) in order to identify the central intermediates in carbon metabolism. The relative importances of sulfate reduction and methanogenesis in controlling the turnover of fermentation intermediates were also examined. C-14 labeled fatty acids were directly injected into sediment subcores for turnover rate measurements. The highest rates of acetate turnover were in surface sediments of up to 2 cm depth. Methane was the dominant product of acetate metabolism at all depths. Simultaneous measurements of acetate, propionate, and lactate turnover in surface sediments gave turnover rates of 159, 20, and 3 microM/hr respectively. Inhibition of methanogenesis with chloroform resulted in an immediate accumulation of volatile fatty acids and hydrogen. Hydrogen inhibited the metabolism of C3-C5 volatile fatty acids. The rates of fatty acid production were estimated from the rates of fatty acid accumulation in the presence of chloroform or hydrogen. The mean molar rates of production were acetate, 82%; propionate, 13%; butyrates, 2%; and valerates, 3%. A working model for carbon and electron flow is presented which illustrates that fermentation and methanongenesis are the predominant steps in carbon flow and that there is a close interaction between fermentative bacteria, acetogenic hydrogen-producing bacteria, and methanogens. (Baker-FRC)
W82-06745

IMPACT OF MOUNT ST. HELENS ERUPTION ON BACTERIOLOGY OF LAKES IN THE BLAST ZONE,

Washington Univ., Seattle. Dept. of Microbiology and Immunology.
J. T. Staley, L. G. Lehmicke, F. E. Palmer, R. W. Peet, and R. C. Wissmar.
Applied and Environmental Microbiology, Vol 43, No 3, p 664-670, March, 1982. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Volcanoes, *Lakes, Subalpine zone, Climatic zones, *Mt St Helens, Washington, Coliforms, *Bacteria, Disasters, Bacterial analysis, Limnology.

Changes in the bacterial communities in lakes near Mt. St. Helens were studied during the summer of 1980 and the spring and summer of 1981. Four subalpine lakes that lie immediately outside the blast zone were designated as controls. All other lakes studied were in the scorched, timber blow down, debris avalanche area within the blast zone. Two new lakes (Coldwater and Castle) were formed by the debris avalanche damming tributaries of the North Fork of the Toutle River. Lakes that were severely affected by the eruption and debris avalanches had higher microscopic bacterial counts than controls. All lakes affected by the eruption yielded higher viable numbers of heterotrophic bacteria than controls. Ryan and Castle lakes, with the highest microscopic counts initially, had the lowest viable counts of all of the blast zone lakes. Vertical profiles of Sprit and Castle Lakes indicated that the bacterial numbers were quite uniform from surface to bottom. Total or fecal coliform bacteria were not found in the control lakes. In contrast, all of the blast zone lakes had detectable total coliform bacteria, and some had fecal coliform bacteria after the eruption. Coliform bacteria were more numerous than expected in blast zone lakes, but they were not the most abundant bacteria in any of the lakes. It was concluded that blast zone lakes were significantly affected by the eruption. (Baker-FRC)
W82-06746

ISOLATION AND CHARACTERIZATION OF ULTRAMICROBACTERIA FROM A GULF COAST ESTUARY,

University of West Florida, Pensacola. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06747

DENITRIFICATION, NITRATE REDUCTION, AND OXYGEN CONSUMPTION IN COASTAL AND ESTUARINE SEDIMENTS,

Tokyo Univ. (Japan). Ocean Research Inst.
T. Nishio, I. Koike, and A. Hattori.
Applied and Environmental Microbiology, Vol 43, No 3, p 648-653, March, 1982. 5 Fig, 2 Tab, 12 Ref.

Descriptors: Estuarine environments, *Denitrification, *Nitrogen, *Oxygen, Coastal waters, Estuaries, Marine waters, Tokyo Bay, Bays, Tama Estuary, Odawa Bay, *Japan, *Nitrates, Bacteria, *Sediments, Sedimentation, Microorganisms.

Denitrification rates were examined in an experimental sediment-water system in which filtered seawater containing N-15-labeled nitrate flowed at a constant rate over undisturbed coastal and estuarine sediments. The rates of oxygen and nitrate consumption were determined simultaneously and were compared with the rate of denitrification. Seawater and sediment samples were collected at Tama Estuary, Odawa Bay and Tokyo Bay. The concentrations of nitrate plus nitrite in the overlying waters ranged from 17.4 to 114 microM, but those in the sedimentary pore waters were very low. The concentrations of dissolved oxygen and nitrate changed similarly over time. The concentrations of nitrite remained about the same throughout the study. Steady levels of dissolved oxygen and nitrate in the effluent were achieved

within 3 hr, and these levels were maintained for 20 to 30 hr. A later decline in dissolved oxygen and nitrate concentrations was attributed at least in part to the growth of microorganisms on the walls of the Plexiglas tubes and connecting tubes and on the bottom surfaces of the rubber stoppers. The oxygen and nitrate concentrations in the effluent actually increased when the inner surfaces of the rubber stoppers were cleaned with gauze and the connecting tubes replaced. The amounts of nitrogen evolved were found to increase initially, but after 10 hr from the onset of the study the concentration remained fairly constant. This indicates that most of the denitrification occurred near the surface of sediments, as bacterial nitrate consumption was fast, and that the concentration of evolved nitrogen in the sedimentary pore water near the sediment-water interface reached a steady level within 10 hr. (Baker-FRC)
W82-06748

APPARENT AND MEASURED RATE OF NITRIFICATION IN THE HYPOLIMNION OF A MESOTROPHIC LAKE,

Freshwater Biological Association, Ambleside (England).
G. H. Hall.
Applied and Environmental Microbiology, Vol 43, No 3, p 542-547, March, 1982. 4 Fig, 2 Tab, 49 Ref.

Descriptors: *Lakes, *Nitrification, *Hypolimnion, Plankton, Metabolism, Thermal stratification, Stratification, Nitrogen, Biotransformation, Grasmere Lake, Ammonia, Nitrates, Mesotrophic lakes.

The chemical evidence for planktonic nitrification in the hypolimnion of lakes was investigated. The C-14 labeled carbon dioxide inhibitor method was tested for measuring rates of nitrification. Three distinct phases were noted in the change of dissolved inorganic nitrogen concentrations. An initial increase in ammonia concentration was followed by decreasing ammonia and increasing nitrate concentrations. The final phase was characterized by decreasing nitrate and increasing ammonia concentrations. The second phase was typical of the nitrification process. However, changes observed in inorganic nitrogen concentrations in the water column may not have been a result of in situ microbial activity, as production in and diffusion from sediments can affect the observed concentrations, particularly in the lower hypolimnion. Observations on nitrate concentration gradients between surface sediments and the water column and experiments using the nitrification inhibitor N-Serve indicated the in situ activity of chemolithotrophic nitrifying organisms. Nitrification rates were estimated throughout the period of stratification by using the N-Serve and C-14 labeled bicarbonate uptake method. Comparison of the field nitrate concentrations with the predicted nitrate concentrations from estimates of the nitrification rate indicated that the method underestimated the true rate of nitrification. (Baker-FRC)
W82-06749

PREVALENCE OF YERSINIA ENTEROCOLITICA IN WATERS OF THE LOWER CHIPPEWA RIVER BASIN, WISCONSIN,

Wisconsin Univ., Eau Claire. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06751

EFFECTS OF POLYCHLORINATED BIPHENYLS AND ENVIRONMENTAL BIO-TRANSFORMATION PRODUCTS ON AQUATIC NITRIFICATION,

Tennessee Univ., Knoxville. Dept. of Microbiology.
G. S. Sayler, M. P. Shiaris, W. Beck, and S. Held.
Applied and Environmental Microbiology, Vol 43, No 4, p 949-952, April, 1982. 3 Fig, 25 Ref.

Descriptors: *Nitrification, *Polychlorinated biphenyls, Organic compounds, Chemical reactions, Water pollution effects, Microorganisms, Nitrogen, Oxidation.

The impact of polychlorinated biphenyls on autotrophic nitrification in freshwater environments was investigated. Possible biotransformation products were examined to determine whether they represent a potential nitrification perturbation. Center Hill Reservoir, a relatively pristine aquatic habitat, and Fort Loudon Reservoir, a ccntaminated nutrient-rich habitat, were used for studies on the effect of PCBs on nitrification. The effects observed were unclear. PCBs at concentrations greater than 10 micrograms/liter inhibited nitrification, principally ammonium oxidation, in one of the two natural reservoir environments. However, this inhibition could not be reproduced in pure high-cell-density cultures or in previously contaminated reservoir waters. The PCB environmental biotransformation product p-chlorophenylglyoxylic acid and p-chloromandelic acid had no effect on nitrification. It is noted that the studies reported here employed acute dosing conditions which ranged to concentrations that exceeded both the solubility of Aroclor 1254 (120 micrograms/liter) and concentrations likely to be encountered in the environment. It appeared that the primary target of inhibition was located at the level of the ammonium-oxidizing microorganisms. However, transient high levels of NO2(-) may accumulate due to a lesser inhibition in NO2(-) oxidation, and elevated NO2(-) concentrations may serve to further inhibit NO2(-) oxidation. (Baker-FRC)
W82-06753

ON THE DIEL RHYTHM FOR PHYTOPLANKTON PRODUCTIVITY IN SHATT AL-ARAB AT BASRAH, IRAQ,

Rostock Univ. (Germany, D.R.).
U. Schiewer, H. A. Al-Saadi, and H. A. Hameed.
Archiv fur Hydrobiologie, Vol 93, No 2, p 158-172, January, 1982. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Phytoplankton, *Tidal effects, Shatt al-Arab, Estuaries, Basrah, *Iraq, Aquatic life, Nutrients, Rivers, Water pollution effects, Canals, Tides, Tidal currents, Wastewater disposal, Raw wastewater, Wastewater, *Diel rhythm.

A short distance below the confluence of the Euphrates and the Tigris, the Shatt al-Arab receives all the untreated sewate of Basrah, a town with more than half a million inhabitants. In addition to seasonal changes in water level, the whole stretch of the Shatt al-Arab is subject to tidal influences, with the mean fluctuation in water due to tidal influences being 1.7 meters. The effect of these tidal influences on the hydrography and production biology of the Shatt al-Arab and on one of the main canals in the town of Basrah was examined in order to draw conclusions regarding the dynamics of the overall system in the upper reaches of Shatt al-Arab. The study showed that there was little sign of diel rhythms in the Shatt al-Arab, while a tide-induced diel rhythm was evident in the canal. Phytoplankton productivity of the Shatt al-Arab was low in December. Nutrient content and phytoplankton productivity in the canal were high, mainly due to fecal sewage. A cyclotella meneghiniana bloom was present during the studies. According to these findings the east shore of the Shatt al-Arab can be described as a system lying between the oligotrophic and eutrophic states. Conditions in the Al-Khandak Canal, in contrast, are allotrophic. The tides have a double beneficial effect on the Canal in that they not only flush the sewage away during the ebb, but also mix the top and middle layers of the canal water with oxygen rich water during the flood. (Baker-FRC)
W82-06763

PHYTOPLANKTON COMMUNITY ANALYSIS IN LAKES OF KUMAUN HIMALAYA,

Kumaun Univ., Nainital (India). Dept. of Zoology.
A. P. Sharma, S. Jaiswal, V. Negi, and M. C. Pant.
Archiv fur Hydrobiologie, Vol 93, No 2, p 173-174, January, 1982. 4 Fig, 11 Tab, 35 Ref.

Descriptors: *Phytoplankton, *Lakes, *Ecology, Kumaun Himalaya, Himalayas, Nainital Lake, Khurpatal Lake, Bhimtal Lake, *India, Natural waters, Nutrients, Wastewater disposal, Water pollution sources, Altitude, Elevation, Species diversity.

Information on the phytoplankton community of three representative lakes in the Kumaun Himalaya region was sought by using various coefficients commonly employed by terrestrial ecologists. The lakes studied were Nainital, Bhimtal and Khurpatal; they are situated in an area with a radius of about 20 km, taking Nainital as the center. There are 24 open drains in the catchment of Nainital, carrying household refuse, garbage, silt and unmeasured amounts of sewage and other waste products into the lake. Bhimtal is characterized by only one perennial drain carrying only a small amount of waste products and no sewage. Khurpatal has no perennial drain, but runoff water enters along all hill slopes of the watershed. Waters of Nainital have frequent blooms and subsequent collapses of green and blue-green algae, while the algal population in Khurpatal was monopolized by dinoflagellates throughout the year. Bhimtal had a representative plankton assemblage composed of green algae, diatoms and dinoflagellates. The dominance of dinoflagellates in Khurpatal can be attributed to the low levels of phosphorus present. The communities were strongly heterogeneous even on a monthly basis. Beta-diversity was higher in Lakes Nainital and Khurpatal and lower in Bhimtal, indicating that the beta-values increased with the elevation of the lakes. The dominance in Nainital and Khurpatal was centered around a few taxa, while in Bhimtal the number of dominant species was large. Nainital had low equitability and high species richness. Bhimtal had intermediate equitability and richness, and Khurpatal was poorest in species and had low equitability. (Baker-FRC)
W82-06764

ANNUAL VARIATIONS IN ABUNDANCE OF ZOOPLANKTON IN LAKE VALENCIA (VENEZUELA),

A. delnfante.
Archiv fur Hydrobiologie, Vol 93, No 2, p 194-208, January, 1982. 10 Fig, 1 Tab, 30 Ref.

Descriptors: *Zooplankton, *Seasonal variations, *Population dynamics, Aquatic life, Lake Valencia, *Venezuela, Fish populations, Rotifers, Copepods, Cladocerans, Algae, Temperature effects, Nutrients.

Duplicate samples were taken at five sites at 2 meter vertical intervals every two weeks from Lake Valencia and subjected to analysis to determine annual variations in abundance of zooplankton in the lake. The lake is warm monomictic. Phytoplankton consists of about 100 species. Blue-green algae are dominant, followed by diatoms and green algae. Zooplankton include 36 rotifer, 8 copepod and 10 cladoceran species. Two annual periods of maximal abundance of zooplankton occur: December through January and March through May. Each of these times is associated with increases in nutrients and phytoplankton in the lake. Two annual periods of minimal abundance were noted in June and November. Annual variations of the most important Copepoda, Cladocera and Rotifera species were related to variations in food availability and predators in the lake. (Baker-FRC)
W82-06765

THE EFFECT OF SEWAGE SLUDGE LAND DISPOSAL ON THE MICROBIOLOGICAL QUALITY OF GROUNDWATER,

Canada Centre for Inland Water, Burlington (Ontario).
D. Liu.
Water Research, Vol 16, No 6, p 957-961, June, 1982. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Groundwater pollution, *Sludge disposal, Water quality, Water pollution sources, Land disposal, Wastes disposal, Wastewater disposal, Microorganisms, Leaching, Infiltration, Percolation.

This study was intended to investigate the long term effect of farmland disposal of anaerobically digested chemical sewage sludge on the microbial quality of groundwater. Sludge application rates to the lysimeters were based on total Kjeldahl nitro-

gen loading and ranged from 0 to 1500 kg TKN/ha/yr. The successive application of sewage sludge to the lysimeters from 1973 through 1976 resulted in an accumulation of high concentrations of sludges on most lysimeters except the control ones. The chemical and microbiological parameters of the three digested sewage sludges were determined. The average chemical compositions suggested that they possessed low-grade fertilizing potential for crop growth provided potassium was supplemented. Coliform baceria were a very minor group throughout the study of the total heterotrophic bacterial populations in the anaerobically digested sludges. The movements of the sludge microorganisms were followed in loamy sand and silt loam soil systems after 1-4 years of land disposal. The soils apparently had an enormous capacity to retain all microorganisms, and consequently over 90% of the surviving heterotrophic bacteria were still detained in the top 30 cm layer of both soil systems. Mass balance calculations indicated that over 95-98% of the original heterotrophic bacteria in the sludges had perished during this period of time. About three times more bacterial biomass and leachate were lost from the coarser loamy sand than from the finer silt loam after sludge application. Microbiological contamination of groundwater by the practice of sludge farmland disposal seems unlikely to occur, provided that the groundwater table is not high and the soils are not excessively wet. (Baker-FRC)
W82-06767

MUTAGENIC ACTIVITY OF FISH AND SEDIMENTS IN THE SHEEP RIVER, ALBERTA,

Calgary Univ., Alberta. Dept. of Biology.
L. L. Osborne, R. W. Davies, K. R. Dixon, and R. L. Moore.
Water Research, Vol 16, No 6, p 899-902, June, 1982. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Fish, *Sediments, Rivers, Sheep River, *Alberta, Canada, *Mutagenic activity, Salmonella, Benthos, Ames test, Chlorination, Effluent, Wastewater treatment, Pollutant identification.

The purpose of this study was to determine whether increased mutagenic activity in fish and benthic sediments was developing as a result of the discharge of chlorinated sewage effluent into a section of the Sheep River, Alberta. The Ames Salmonella/ mammalian microsome assay was used to assay the mutagenic activity of the fish and sediment samples. Collection sites for the benthic sediments were from areas inside and outside of the chlorinated sewage plume. There was no indication of increased mutagenic activity in the sediments collected from within the chlorinated sewage plume, indicating that the mutagenic activity of the macroinvertebrates was not due to direct accumulation from the benthic sediment food source. One trend noted in the TA 100 results was an inverse relationship between sample volume and the number of colonies. This trend may have been a result of DMFA toxicity to bacteria, which could mask or comlicated the interpretation of dose mutagenic relationships. A significant increase in the mutagenic activity was observed in the fish samples collected from the chlorinated sewage plume. (Baker-FRC)
W82-06770

HEAVY METAL POLLUTION IN THE CHAO PHRAYA RIVER ESTUARY, THAILAND,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
For primary bibliographic entry see Field 5B.
W82-06774

FISH RESPONSES TO TEMPERATURE TO ASSESS EFFECTS OF THERMAL DISCHARGE ON BIOLOGICAL INTEGRITY,

West Virginia Dept. of Natural Resources, Charleston. Wildlife Resources Div.
D. A. Cincotta, J. R. Stauffer, Jr., and C. H. Hocutt.
Water Resources Bulletin, Vol 18, No 3, p 437-450, June, 1982. 14 Fig, 4 Tab, 52 Ref.

Descriptors: *Thermal water, *Fish populations, Heated water, Pulp and paper industry, Water pollution effects, Industrial wastes, *Thermal pollution, Thermal stress, *West Virginia, Codorus Creek.

Literature relating to 11 designated temperature criteria for six representative important species (RIS) was reviewed. The applicability of the Environmental Protection Agency (USEPA) water quality criteria to a nonutility thermal dishcarge was also reviewed, and an evaluation was made of the importance of behavioral data in thermal impact assessments. It was found that by applying only USEPA suggested criteria a complete and satisfactory evaluation was not obtained. Temperature behavior data, specifically preference and avoidance information, coupled with field sapling was needed to properly assess the effects of the thermal effluent. An application of this technique indicated that the thermal discharge of a paper company such as the one considered should have minimal effects on the fish community of the stream, Codorus Creek, which receives the thermal effluent from the plant. (Baker-FRC)
W82-06777

INVIRONMENTAL SIGNIFICANCE OF PESTICIDE RESIDUES ASSOCIATED WITH AQUATIC SEDIMENTS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
G. F. Lee, R. A. Jones, and F. Y. Saleh.
Journal of Environmental Science and Health, Part B, Vol 17, No 4, p 409-437, 1982. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Pesticide residues, *Water quality standards, *Pesticides, *Water pollution effects, Agricultural chemicals, Water pollution sources, *Sediments, Bottom sediments, Rivers, Ponds, Toxicity, Bioassays, Bioaccumulation, Aquatic life, Standards, *Egypt, Regulations, Environmental effects, Particulate matter.

A recommended approach for establishing pesticide water quality standards and use regulations in Egypt is presented. The approach involves collecting and critically evaluating existing residue data; developing a monitoring program to fill data gaps; development of Egyptian water quality criteria and standards and organism tolerance levels; and comparing the critical concentration of pesticides developed for Egypt to existing concentrations. If excessive concentrations are found, then site-specific studies should be conducted to evaluate the role of soil pesticide residues in causing the excessive concentrations. Emphasis is placed in this approach on the importance of aquatic particulate matter in influencing the hazard that a specific pesticide represents to a particular beneficial use of a given aquatic system. The principles of hazard assessment are reviewed, including aquatic toxicity through organism toxicity and bioaccumulation; environmental fate; tiered testing; and the implications for pesticide use and labeling restrictions. The significance of sediments in hazard assessment is discussed, with emphasis on the presence of particulates, pesticide-particulate matter interactions, chlorinated hydrocarbon release from sediments, the effect of concentration on release from sediments, the implications of sediment concentrations of pesticides for use regulations, various bioassay techniques to determine contamination levels, the bioaccumulation of pesticides by benthic and epibethic organisms, and the use of deterministic models of pesticide behavior to determine sediment contamination probabilities. Cost effectiveness of specific hazard assessment vs. worst case regulations governing pesticide use is also considered. (Baker-FRC)
W82-06789

DEGRADATION OF TERBUTRYN IN SEDIMENTS AND WATER UNDER VARIOUS REDOX CONDITIONS,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5B.
W82-06790

ACID PRECIPITATION, A REVIEW,

Northeastern Forest Experiment Station, Parsons, WV. Timber and Watershed Lab.
J. D. Helvey, S. H. Kunkle, and D. R. DeWalle,.
Journal of Soil and Water Conservation, Vol 37, No 3, p 143-148, May/June, 1982. 3 Fig, 44 Ref.

Descriptors: *Acid precipitation, *Reviews, *Literature reviews, Soil properties, Acidity, Rainfall, Aquatic plants, Fish populations, Water pollution effects, Water pollution sources, Nonpoint pollution sources, Snowmelt.

The pH of rainfall under normal conditions is about 5.6. The measured pH of rain falling in the northeastern United States during the last decade averaged between 4.0 and 4.6, depending on location. The hydrogen ion concentration in precipitation today is 6 to 40 times higher than the theoretical value that would occur at the nonpolluted pH level of 5.6. Some researchers have concluded that the principal ause of higher precipitation acidity is increased fossil fuel combustion and use of taller smokestacks. A major concern is the effect of acid precipitation on aquatic ecosystems, and particularly on fish populations.Areas with poorly buffered streams and areas with crystalline or metamorphic bedrock having shallow, acid soils with a low buffering capacity are especially sensitive to acid precipitation. In some locations the snowpack appears to store the acid, releasing it during sudden thaws, and thus rapidly depressing stream pH. The potential effect of acid precipitation on trees and other vegetation is of concern as well. Long term effects of acid precipitation on the growth rates of vegetation and soil fertility are hard to ascertain and will demand long term research. Some experts in the field, however, feel that the current concern represents overreaction to the issue. (Baker-FRC)
W82-06794

FRESHWATER MACROINVERTEBRATES,

National Oceanographic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
M. A. Quigley.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 868-877, June, 1982. 183 Ref.

Descriptors: *Literature reviews, *Invertebrates, *Toxicity, *Environmental effects, *Reviews, Sediments, Macroinvertebrates, Water pollution effects, Lakes, Streams, Species composition, Indicators, Bioindicators, Organic compounds, Streamflow, Temperature effects, Turbidity, Floods, Drought, Logging, Recreation, Urban development, Thermal pollution, Aquatic habitats, Habitats, Predation, Benthic fauna, Seasonal variation, Productivity, Sampling.

The effects of pollution on freshwater macroinvertebrates were reviewed. Several books and two new journals appeared in 1981. A biotic index, a biological water quality index, an index focused on interaction of lake sediments with toxic substances, a modified Hill's ratio, and use of oligochaetes as indicator species were proposed. Case studies of pollution were described: experimental acidification, urban storm water runoff, road salt, synthetic crude oil, copper, zinc, tannery effluent, and ash. Macroinvertebrates were also affected by alteration of the physical environment of lakes and streams (temperature, stream flow and depth, turbidity, dissolved oxygen concentration, and water level fluctuations) produced by channelization, sedimentation, flash floods, drought, logging, recreational activities, thermal discharge, and urban development. Species distribution was also a function of predation, substrate, vegetation type, flow conditions, available food, water quality, and season. Production was discussed in relation to environmental factors, including trophic status. Invertebrate penetration of the sediments produced significant sediment mixing and phosphorus release. Many invertebrate sampling techniques and methods of statistical analysis were developed. (Cassar-FRC)
W82-06797

EFFECTS OF POLLUTION ON FRESHWATER FISH,

Environmental Research Lab. Duluth, MN.
R. L. Spehar, G. M. Christensen, C. Curtis, A. E. Lemke, and T. J. Norberg.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 877-922, June, 1982. 1 Tab, 353 Ref.

Descriptors: *Literature reviews, *Fish, *Toxicity, *Pesticides, *Reviews, *Water pollution effects, Fate of pollutants, Accumulation, Bioaccumulation, Water quality, Dissolved oxygen, Oxygen, Nitrogen, Ammonia, Acidic water, Hydrogen ion concentration, Hydrocarbons, Insecticides, Herbicides, Piscicides, Metals, Heavy metals, Industrial wastes, Effluents, Nitrites, Surfactants, Organic compounds, Chlorine, Wastewater pollution, Pulp and paper industry, Radiation, Turbidity.

A review of recent studies of effects of pollution on fresh water fish features a table summarizing the acute and chronic toxicity of about 250 inorganic and organic pollutants. The substances are listed alphabetically, followed by the fish species, Lc50 values, type of exposure, water temperature, and test conditions. The materials include insecticides, herbicides, piscicides, anesthetics, inorganic compounds and metals, organic compounds, industrial and municipal effluents, chlorine, and pulp and paper effluents. The review also describes 28 reviews and symposia on the subject. The effects of water quality (excesses and deficiencies of dissolved gases such as nitrogen, oxygen, ammonia, and HCN) and pH and acid stress are discussed. The effects of X-irradiation, nuclear waste, chronic turbidity, and reservoir discharge are also mentioned. (Cassar-FRC)
W82-06803

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
A. L. Buikema, Jr., E. F. Benfield, and B. R. Niederlehner.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 862-868, June 1982. 83 Ref.

Descriptors: *Literature reviews, *Invertebrates, *Toxicity, *Reviews, *Water pollution effects, Aquatic animals, Aquatic insects, Insects, Heavy metals, Metals, Cladocerans, Zooplankton, Leachates, Surfactants, Shale oil, Amphipods, Isopods, Decapods, Mollusks, Worms, Protozoa, Pesticides, Insecticides, Organic compounds, Industrial wastes.

Recent work on the effects of pollution on invertebrates included several reviews (acid precipitation, powerplant effluents, and hazard assessment). New test methods for pesticide residues, chlorine, petroleum products, and synfuel components were described. Effects of toxic materials were discussed according to the following divisions: invertebrate communities, cladocerans, other zooplankters, amphipods, isopods, decapods, aquatic insects, mollusks, worms, and protozoa. Among the many pollutants studied were metals (Cd, Cu, Cr, Zn, and Sr), solvents, pesticides, insect growth regulators, bird control chemicals, acridine, quinoline, vinylidene chloride, coal process conversion products, phenanthrene, naphthalene, oil shale wastewater, boric acid, surfactants, chlorine, dye wastes, municipal wastewater sludges, textile mill effluents, paper mill effluents, fly ash, phenolic compounds, and thermal discharges. (Cassar-FRC)
W82-06804

MARINE AND ESTUARINE POLLUTION,

California State Univ., Long Beach.
D. J. Reish, G. G. Geesey, F. G. Wilkes, P. S. Oshida, and A. J. Mearns.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 786-812, June, 1982. 6 Tab, 392 Ref.

Descriptors: *Literature reviews, *Marine environment, *Water pollution effects, *Reviews, *Estuarine environment, Estuaries, *Pesticides, Microbiological studies, Human diseases, Waste disposal, Oil pollution, Sediments.

Recent research in the field of marine and estuaring pollution is cited in this literature review. Major areas considered included pesticides, acute effects, sublethal effects, fate, bioaccumulation, microbiology, and residues; microbiology; diseases and abnormalities; drilling fluids and muds; dredge and solids disposal; surveys; residues and related topics; oil pollution, residue analysis, residues in water and sediment, residue fate and weathering, residues in biota, dispersants, microbes, bioaccumulation, field studies, toxicity and sublethal effects and complex effluents and environments. (Baker-FRC)
W82-06808

THERMAL EFFECTS,

Rexnord Inc., Milwaukee, WI.
J. B. Cravens.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 812-829, June, 1982. 9 Tab, 206 Ref.

Descriptors: *Literature reviews, *Thermal pollution, *Reviews, Thermal water, *Heated water, Powerplants, Thermal powerplants, *Thermal stress, Fish populations, Aquatic life, Water temperature, Temperature effects, Thermal stress, Model studies, Mathematical models, Mathematical studies, Reservoirs, Lakes, Rivers, Mediterranean Sea, Estuaries, Great Lakes, Water pollution effects.

Recent research in the area of thermal effects on water pollution are cited in this literature review. Various reviews and models were considered, including mathematical models of the temperature and time from fertilization to 50% hatch for five species of salmonid fishes, the relationship between the maximum daily food consumption and water temperature for two species, the mathematicalthermodynamic analysis of the anomalies of water, and mathematical models of the behavior and activity of thermal plumes formed when power plants discharge heated water. Site studies were performed at cooling lakes and reservoirs in various streams and rivers, at the Great Lakes, in the Mediterranean, and in various estuarine and marine systems regarding the effects of thermal plumes on aquatic life. The effects of thermal plumes on growth and reproduction of various forms of aquatic life were considered along with these effects on higher plants. Thermal effects on the reproductive cycles of adult tench Tinca tinca were presented in several studies. Thermal tolerance and temperature preference ranges were investigated fo numerous fishes and aquatic invertebrates. The interaction of temperature and other stresses was studied in aquatic flora and fauna. Biochemical reaction studies were also performed using the hermaeid ascoglossan slug Costasiella lilianae. The effect of water temperature and dissolved oxygen on the rate of biodegradation of nitrilotriacetate from samples collected from the Rur River in Belgium was studies. (Baker-FRC)
W82-06809

DISSOLVED OXYGEN IN STREAMS AND RESERVOIRS,

Tennessee Valley Authority, Chattanooga.
C. E. Bohac.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 778-784, June, 1982. 3 Tab, 72 Ref.

Descriptors: *Literature reviews, *Dissolved oxygen, Reservoirs, Streams, *Reviews, Water quality, Environmental effects, Aquatic life, Fish populations, Aquatic plants Model studies, *Destratification, *aeration, Stratification.

Current literature in the field of dissolved oxygen (DO) in streams and reservoirs is reviewed. Efforts make in the area of stream standards have included a system of effluent taxes to achieve water quality standards, the concept of transferable discharge permits for BOD control, and production theory and marginal cost analyses to find the optimal combination of treatment for all wastewaters generated within an urban area. Water quality in streams and reservoirs was examined with respect to the occurrence and distribution of dissolved oxygen and organic compounds in mountain streams, the environmental impacts associated with pumped-storage hydroelectric development, and the economic value of DO levels to fishery tailwater. Aquatic effects were investigated as a function of DO, along with the effects of hypolimnetic discharges and trace minerals. Conference proceedings contained papers dealing with surface water impoundments, stormwater impact on reservoirs, and urban storm runoff. Water quality models were developed to simulate hydraulic behavior, DO, and BOD of a river network, multiple linear correlations for computing DO concentrations as a function of stream distance, differential inequality techniques to determine the upper and lower envelope of DO concentrations, river models for DO and BOD reductions to a simple function of downstream distance, and a review of the receiving-water impacts subprogram. Oxygen demand and response to waste loads were considered, along with papers dealing with reaeration and destratification as well as gas transfer and measurement. (Baker-FRC)
W82-06811

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
C. B. Murphy, Jr., and S. J. Spiegel.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 849-854, June, 1982. 84 Ref.

Descriptors: *Literature reviews, *Bioacculation, *Heavy metals, *Reviews, Cadmium, Copper, Mercury, Lead, Zinc, Manganese, Toxicity, Fish, Aquatic plants, Aquatic life, Diatoms, Nickel, Vanadium, Iron, Mussels, Estuaries.

Current research in the field of bioaccumulation and toxicity of heavy metals and related trace elements is cited in this literature review. Specific metals investigated in various aquatic environments inluded mercury in the muscle tissue of fish from northern lakes; trace elements in tropical marine fish from Bougainville Island, Papua-New Guinea: the occurrence and distribution of zinc, copper, iron, manganese and cadmium in the water column and different parts of Tikpia fish from Lake Mariut, Egypt; and the elemental composition of aquatic plants from the Okefenokee Swamp in Georgia. Bioconcentration research touched on the copper acculation and tissue injury in the gills of the sabellid polychaete Eudistylia vancouveri, on the distribution of cadmium within captive crabs, on the concentration of V, Mn, Ni, Cu, Zn, and Cd in bay mussels, on the relation between mercury concentration and size in the mako shark Isurus oxyrhinchus, on cadmium concentrations inducing morphological changes in the diatom Tabellaria flocculosa, and on concentrations of elements in a marine food chain. Toxicity studies were conducted for cadmium, copper, other metals, synergistic and combined elements. Research was also conducted on the detoxification of heavy metals and on applications of heavy metal toxicity. (Baker-FRC)
W82-06812

LIGHT ADAPTATION AND INHIBITION: PROCESSES IMPORTANT IN MODELLING THE GROWTH OF ALGAE IN DRINKING WATER BASINS,

Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.
J. K. Liou, and G. C. Van Eybergen.
Water Research, Vol 16, No 6, p 765-773, June, 1982. 13 Fig, 2 Tab, 20 Ref.

Descriptors: *Algal growth, *Model studies, Light penetration, *Light intensity, Lighting, Drinking water, Water quality.

The importance of the consideration of light adaptation and inhibition for the models for algal growth is evaluated. A model is proposed to de-

scribe the photosynthesis-light relationship, including adaptation and inhibition. By comparing time constants it was made clear that one has to seriously consider taking adaptation into account. With high measuring frequencies and especially long vertical circulation times (large mixing depths) it should be realized that this process can be important. In field situations inhibitions will not play an important role. However, for laboratory situations inhibition can have a considerable effect on the photosynthetic production. The model as presented compared with experimental results given in the literature. The results of comparison seemed satisfactory, but further experimental work is needed. (Baker-FRC)
W82-06827

AN EXPERIMENTAL APPARATUS FOR EVALUATING KINETICS OF AVAILABLE PHOSPHORUS RELEASE FROM AQUATIC PARTICULATES,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W82-06829

THE EFFECT OF INCREASED NICKEL ION CONCENTRATIONS ON MICROBIAL POPULATIONS IN THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,

York Univ. (England). Dept. of Biology.
For primary bibliographic entry see Field 5D.
W82-06832

METHANE FLUX IN THE GREAT DISMAL SWAMP,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
For primary bibliographic entry see Field 2H.
W82-06840

KANEOHE BAY SEWAGE DIVERSION EXPERIMENT: PERSPECTIVES ON ECOSYSTEM RESPONSES TO NUTRITIONAL PERTURBATION,

Hawaii Inst. of Marine Biology, Honolulu.
For primary bibliographic entry see Field 5G.
W82-06846

THE EFFECTS OF ACID RAIN ON FOREST NUTRIENT STATUS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
D. W. Johnson, J. Turner, and J. M. Kelly.
Water Resources Research, Vol 18, No 3, p 449-461, June, 1982. 1 Fig, 4 Tab, 123 Ref.

Descriptors: *Acid rain, *Reviews, Acidity, Air pollution, Fallout, Rainfall, *Forest management, Leaching, *Litter, Organic matter, *Decomposing organic matter, Adsorption, Soil properties, *Nutrient cycling.

A review was conducted of actual and potential effects of acid rain on forest nutrient status, using the conceptual nutrient cycling model as a guideline. The effects of acid rain on the processes of gaseous output, root turnover, leaching, uptake, litterfall, streamflow, crownwash, runoff, redistribution, and decomposition are considered, as well as the effects of all these processes on the composition of water entering and leaving the forest ecosystem. Acid rain appears to be a global phenomenon, with areas downwind from major centers of fossil fuel combustion being especially affected. Changes in precipitation quality are well documented in the northeastern US, Norway, Sweden, and northern Germany, along with other locations in both the northern and southern hemispheres. Forests growing in areas currently experiencing elevated rainfall acidity are generally on sites which are relatively infertile for one reason or another. The input by hydrogen ions along with other elements in rainfall is further compounded by washoff of materials deposited on plant surfaces due to the atmospheric stripping action of forest canopy. The implications of acid rainfall must be assessed on a total ecosystem basis, and the specific processes isolated and quantified. It is noted that the impacts on a given site can be positive, negative, or both, in the sense of counteracting influences. Consequently the conduct of management practices will need to be keyed to the particular situation to treat certain inputs as assets while minimizing or reducing the impacts of detrimental substances. (Baker-FRC)
W82-06860

EFFECT OF THE PAPER INDUSTRY ON WATER QUALITY OF THE LOWER FOX RIVER,

California Inst. of Tech. Pasadena. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5D.
W82-06870

PESTICIDE ACCUMULATION IN A NEW IMPOUNDMENT IN IOWA,

Minnesota Pollution Control Agency, Roseville.
For primary bibliographic entry see Field 5B.
W82-06871

PHYSICAL PROCESS AND EUTROPHICATION,

Windsor Univ. (Ontario). Dept. of Biology.
G. D. Haffner, D. J. Poulton, and B. Kohli.
Water Resources Bulletin, Vol 18, No 3, p 457-464, June, 1982. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Harbors, *Eutrophication, Retention, Physical properties, Retention time, Phytoplankton, Lakes, Nearshore processes, Oscillations, Nutrients, Currents, *Lake Ontario, Great Lakes.

Two considerably different physical regimes of culturally enriched water bodies were compared. Biological responses to physical-chemical processes were examined in Toronto and Hamilton Harbors of Lake Ontario. Nutrient loadings of both harbors are large and of similar magnitudes, yet the trophic conditions are different. Lake oscillations apparently determined the flushing rates and environmental stability of the harbors. Low residence times (less than 10 days) resulted in homogeneous chemical conditions in Toronto Harbor, preventing the establishment of large phytoplankton crops. The longer retention time found in Hamilton Harbor permitted larger phytoplankton crops to become established. A critical retention time probably exists where nutrient input events persist for a sufficient period of time for the algal community to adapt to and exploit the environmental conditions of nearshore areas. These findings suggest that steady state theory must be applied carefully to the Great Lakes Nearshore zone. Models using steady state conditions to predict response of the system to nutrient controls should be viewed with great caution. The effects of physical processes on eutrophication must be considered. It is apparent that in neither harbor examined would the traditional expectations of nutrient control programs be realized due to the physical processes inherent to nearshore zones of large lakes. (Baker-FRC)
W82-06875

PEDIASTRUM AND SCENEDESMUS (CHLOROCOCCALES) IN SEDIMENTS FROM LAKE VAXJOSJON, SWEDEN,

Lund Univ. (Sweden). Inst. of Limnology.
G. Cronberg.
Archiv fur Hydrobiologie, Supplement 60, No 4, p 500-507, February, 1982. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Lake sediments, *Algae, Algal growth, Sediments, Lakes, Eutrophication, Nutrients, Oligotrophic lakes, Trophic level, Indicators, Bioindicators, *Sweden, Lake Vaxjosjon, Wastewater, disposal, Industrial wastes.

Lake Vaxjosjon is situated in the town of Vaxjo, south central Sweden, downstream from the restored Lake Trummen. The number and species of Pediastrum and Scenedesmus present in the lake were studied in a sediment core covering the period 1200 to 1970 A.D.. In recent times the lake was utilized as a recipient for sewage and industrial waste water from the town. The pollution was maintained at a high level from 1880-1930, when diversion of sewage started. During the worst pollution period a black anaerobic gyttja developed. The overall study demonstrated that the occurrence of Pediastrum and Scenedesmus species is of a complex nature, increasing in number when the nutrient concentration increases, changing in species composition in connection with eutrophication or oligotrophication processes, and developing (Pediastrum) in dependence on the macrophyte vegetation. Eutrophication first stimulates the macrophytes, and then both eutrophication and this macrophyte substrate act together to stimulate an increase in chlorococcal density. The Pediastrum species can be used as indicators of lake trophic status and history. (Baker-FRC)
W82-06878

THE WATERS OF MEROM: A STUDY OF LAKE HULEH 7. DIATOM STRATIGRAPHY OF THE 54-M CORE,

Academy of Natural Sciences of Philaelphia, PA.
J. W. Sherman, and R. Patrick.
Archiv fur Hydrobiologie, Vol 92, No 2, p 199-221, September, 1981. 9 Fig, 11 Ref.

Descriptors: *Paleolimnology, *Radioactive dating, *Cores, *Diatoms, Lakes, Limnology, Morphology, Aquatic life, Nutrients, Taxonomy, Stratigraphy, Lake Huleh, *Israel, Population dynamics, Oligotrophy, Mesotrophy.

The diatom stratigraphy of a 54-meter core taken from Lake Huleh, Israel was examined. The analysis of 500 specimen counts from each of 43 samples studied in this core indicated various historical changes in the condition of the water in the lake over the past 32,000 years. There is evidence that considerable reworking of sediments has occurred in certain horizons of the core, as evidenced by a high proportion of broken valves. In the early horizons of the profile the lake was shallow and somewhat swampy, with aquatic plants being fairly common. Toward the end of this period the lake deepened, and a well-formed deep lake existed for a period of time. During this deep stage the flora decreased greatly as the lake moved into a time of somewhat shallower, warmer and more eutrophic conditions. Later a swamplike condition occurred again in the lake, but there was still some open water areas that supported a plankton flora. The diatoms indicated that calcium was richer in this period than others and that the lake was somewhat warmer. Oligotrophic to mesotrophic conditions existed through most of the horizons except for one period when the nutrient levels may have been higher. (Baker-FRC)
W82-06880

MULTIPLICATION OF LEGIONELLA PNEUMOPHILA IN UNSTERILIZED TAP WATER,

Pittsburgh Univ., PA. Dept. of Microbiology.
R. B. Yee, and R. M. Wadowsky.
Applied and Environmental Microbiology, Vol 43, No 6, p 1330-1334, June, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Bacteria, Plumbing, *Heated water, Hospitals, Legionella pneumophila, Incubation, Cooling water, Fate of pollutants, Public health, Human diseases.

Legionella pneumophila, obtained from a hospital shower head and from tap water in a surgical intensive care unit in another hospital, multiplied in unsterilized tap water at 25, 37, and 37 C for the length of the 35 day experiment. At 42 C L. pneumophila in the shower head sample began to die off after 17 days, but those in the intensive care unit samples continued to multiply for 35 days. Non-L. pneumophila bacteria increased in number for 2 days at 25, 32, and 37 C, then remained relatively constant for 35 days. At 42 and 45 C the shower head non-L. pneumophila bacteria decreased over 2 days to 100 CFU or less per ml.The intensive care unit non-L. pneumophila bacteria at 45 C incubation decreased to zero by the 14th day; at 42 C they multiplied as at the lower temperatures. These differences were caused by the different bacterial populations from the two sources. L.

pneumophila taken from the bottom of a hot water tank also multiplied when cultured at 37 C. These results indicate that L. pneumophila may multiply in warm water environments such as hot water plumbing fixtures, hot water tanks, and cooling towers. (Cassar-FRC)
W82-06881

MICROBIOLOGICAL EXAMINATION OF SEBEEL WATER,

Kartoum Univ., (Sudan). Dept. of Agricultural Botany.
Z. H. Hammad, and H. A. Dirar.
Applied and Environmental Microbiology, Vol 43, No 6, p 1238-1243, June, 1982. 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Bacteria, *Water quality, *Drinking water, Microbiological studies, Khartoum, *Sudan, Water supply, Coliforms, Zeers, Sebeel water, Developing countries, Pollutant identification, Fate of pollutants, Seasonal variation, Public health.

Sebeels are watering stands, consisting of 1 or more 30-40 liter baked clay jars (zeers), which provide cool drinking water throughout Khartoum and other communities in the Sudan. A microbiological examination of sebeel water (51 samples from streets, 15 from mosques, 10 from homes, and 7 from schools) showed that coliforms, fecal coliforms, and fecal streptococci were present in 100%, 69.88% and 91.56% of the samples, respectively. Predominant bacterial genera were Staphylococcus, Aerococcus, Micrococcus, Streptococcus, Bacillus, Listeria, Lactobacillus, and Arthrobacter. Colony counts were on the order of 100,000 cells per ml and were higher in school and street samples than in mosque and home samples. However, counts of coliforms were much higher for home sebeels than for the other types, probably a result of children's poor hygiene habits. There was no relationship between total colony count and fecal contamination. Total colony counts did not vary with the season, but total coliforms and fecal bacterial counts were much higher in summer than in winter, due to increased human use and increased bacterial regrowth in the warmer water. Likewise, fecal coliforms counts were much higher during dust storms than when dust was not blowing. Three types of zeer construction were evaluated with respect to water quality. After a month there was no fecal contamination in a zeer fitted with a faucet and firmly fitted lid. Within 2 days the other two types of zeers (movable lid with no faucet and movable lid with faucet) were contaminated. (Cassar-FRC)
W82-06882

IMPROVED METHOD FOR DETERMINATION OF RESPIRING INDIVIDUAL MICROORGANISMS IN NATURAL WATERS,

Naval Research Lab., Washington, DC.
For primary bibliographic entry see Field 5A.
W82-06883

SAMPLING DESIGN AND ENUMERATION STATISTICS FOR BACTERIA EXTRACTED FROM MARINE SEDIMENTS,

South Carolina Univ., Columbia. Dept. of Biology.
For primary bibliographic entry see Field 5A.
W82-06884

DEVELOPMENT OF A METHOD FOR DETECTION OF HUMAN ROTAVIRUS IN WATER AND SEWAGE,

Texas Univ. Medical Branch at Galveston. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W82-06885

ATTACHED AND FREE-FLOATING BACTERIA IN A DIVERSE SELECTION OF WATER BODIES,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W32-06887

COMPARATIVE ASPECTS OF SULFUR MINERALIZATION IN SEDIMENTS OF A EUTROPHIC LAKE BASIN,

Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
G. M. King, and M. J. Klug.
Applied and Environmental Microbiology, Vol 43, No 6, p 1406-1412, June, 1982. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Sulfur cycle, *Mineralization, Sediments, Sulfates, Sulfides, Organic sulfur compounds, *Lake sediments, Eutrophic lakes, Wintergreen Lake, *Michigan, Proteins.

Mineralization of organic sulfur compounds in the surface sediments of eutrophic Lake Wintergreen, Michigan, was estimated from a mass balance budget of S inputs and sediment S concentrations. Net mineralization was < 50% complete. Total S mineralization was 45% complete; ester sulfate S, 42% complete; and protein S, 75% complete. Therefore organic S accumulates in the sediment. Organic S comprosed > 80% of the total S in the sediment. Of the organic S fraction protein S was < 20%; ester sulfate, 44%; and nonprotein carbon bonded S (sulfolipids, vitamins, etc), 36%. Sulfate reduction was the most important process affecting the quantity of S transformed in the sediment. Sulfate reduction was the most important process affecting the quantity of S transformed in the sediment. Sulfate reduction rates averaged 7 nmol per sq m per day, 19-fold greater than net rates or organic S mineralization and 65-fold greater than sulfate ester hydrolysis, on an annual basis. (Cassar-FRC)
W82-06888

SEWAGE DIVERSION EFFECTS ON THE WATER COLUMN OF A SUBTROPICAL ESTUARY,

Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and D. G. Redalje.
Marine Environmental Research, Vol 6, No 4 p 265-279, 1982. 4 Fig, 4 Tab, 39 Ref.

Descriptors: *Nutrients, *Wastewater pollution, *Ecosystems, *Kaneohe Bay, Hawaii, Diversion, Nutrient cycling, Phytoplankton, Nitrogen, Phosphorus, Benthos, Biomass, Water pollution effects, Growth rates, Subtropical regions, Bays, Organic matter, Particulate matter, Organic carbon, Chlorophyll a, Corals, Reefs.

Dissolved organic nitrogen and dissolved organic phosphorus concentrations in the water column were much higher than expected after diversion of secondary treated sewage from Kaneohe Bay, Hawaii, to the ocean. This was caused by decomposition of 400 tons of benthic organisms during the first year after diversion. Nitrogen was the limiting nutrient before and after diversion. Internal nutrient cycling accounted for 70-90% of the phytoplankton nutrient uptake. The biomass and growth rate of the phytoplankton declined after sewage diversion, from 37% to 28% of the maximum growth rate of 1.5 fold per day. The adverse effects of the sewage discharge on the coral community were mainly caused by increases in competing benthic macrophytes and elevated plankton concentrations, which attenuated light and stimulated growth of filter feeders. Although the inorganic nutrient levels returned to presewage levels within a year after diversion, the benthic community had not yet reached an equilibrium. (Cassar-FRC)
W82-06892

EFFECTS OF MACROALGAL MATS ON THE ECOLOGY OF INTERTIDAL,

Southern Water Authority, Otterbourne (England).
P. G. Soulsby, D. Lowthion, and M. Houston.
Marine Pollution Bulletin, Vol 13, No 5, p 162-166, May, 1982. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Invertebrates, *Algae, *Intertidal areas, Mud flats, Biomass, Water pollution effects, Langstone Harbor, *England, Species diversity, Aquatic habitats, Polychaetes, Snails, Birds.

The biomass and distribution of the invertebrate fauna in intertidal mudflats, covered with algae and unaffected by algae, were sampled on several occasions in 1977-78 at several sites in Langstone Harbor, south England. This study was part of investigations on the effects of discharging sewage effluents into the harbor. Algal-covered mud had higher invertebrate biomass than uncovered mud. Mean total invertebrate biomass values in autumn samples were 40-42 g per sq m dry weight in muds with > 75% algal mat cover and 12-14 g per sq m dry weight in muds with < 25% algal mat cover. Invertebrate biomasses under algal mats were lowest in January and highest in early fall. The dominant invertebrate was a snail, Hydrobia ulvae. The Shannon-Werner species diversity index showed very little difference between sites, but a log normal plot showed slight stress in the high-algal cover communities. The opportunistic polychaete, Streblospio shrubsoli, was significantly decreased in number at the high algal cover sites. The effects of algal mat cover on the aquatic bird population were discussed, using data from previous studies. It was concluded that algal mat, although perhaps undesirable, would have little effect on the bird population. (Cassar-FRC)
W82-06893

THE BREAKDOWN AND DECOMPOSITION OF ALLOCHTHONOUS AND AUTOCHTHONOUS PLANT LITTER IN AN OLIGOTROPHIC LAKE (LLYN FRONGOCH),

University Coll. of Wales, Aberystwyth. Dept. of Zoology.
R. D. G. Hanlon.
Hydrobiologia, Vol 88, No 3, p 281-288, May, 1982. 3 Fig, 2 Tab, 28 Ref.

Descriptors: *Litter, *Decomposition, *Energy conversion, Invertebrates, Oligotrophic lakes, Lakes, Llyn Frongoch, *Wales, Leaves, Aquatic plants, Macrophytes, Nutrients, Organic matter.

The breakdown and decomposition of leaf litter from two deciduous trees and from two species of aquatic macrophytes were investigated in an oligotrophic lake, Llyn Frongoch, Wales. During the one year's submergence in the lake, starting in November, the litter in coarse mesh bags decomposed more rapidly than litter in fine mesh bags. This was probably a result, not of invertebrate feeding, but of loss of leaf fragments through the coarse mesh. The fastest decaying litter was Isoetes lacustris L., followed by the other aquatic macrophyte, Potamogeton perfoliatus L., and the two deciduous leaf litters, Salix veminalis L. (common osier) and Fagus sylvatica L. (beech). Litter degenerated rapidly for the first month or two of leaching, then more slowly as a result of low temperature and low nutrient concentrations in the lake water. Only Isoetes in coarse bags degenerated totally before the beginning of the next year's leaf deposition, suggesting that this lake is accumulating organic matter. (Cassar-FRC)
W82-06895

COMMUNITY PHOTOSYNTHESIS AND RESPIRATION IN EXPERIMENTAL STREAMS,

Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.
S. P. Sheldon, and M. K. Taylor.
Hydrobiologia, Vol 87, No 1, p 3-10, February, 1982. 4 Tab, 38 Ref.

Descriptors: *Photosynthesis, *Respiration, *Aquatic plants, Streams, Oxygen, Benthos, Macrophytes, Phytoplankton, Algae, Productivity, Open channels, Riffles, Epiphytes, Lotic environment.

Monticello experimental riffle-pool, open canopy, constant-flow channels were used to estimate changes in relative contributions to total stream photosynthetic and respiratory rates by various components of a stream community (plankton, benthos, macrophytes, and epiphytes). Macrophytes quickly became established in the pools during early spring. This produced self-shading, little growth during summer, and a die-back to the rhizomes in the fall. In the macrophyte-epiphyte

community (pool) photosynthesis rates (g oxygen per sq m per day) were 29.26 on June 13, 4.12-7.67 during the summer, and 0.14 on October 6; respiration rates (g oxygen per sq m per day) were 13.11 on June 13, 9-11 during the summer, and 0.77 on October 6. Riffles were colonized by benthic algal mats, established early in the spring. Photosynthesis rates (g oxygen per sq m per day) in the riffle benthos were 3.32 on June 13 and 8-11 during the summer, declining to 0.80 by October 6; respiration rates (g oxygen per sq m per day) were 11.87 on June 13, 8-11 during the summer and 1.57 on October 6. Planktonic photosynthesis and respiration were very low (maximum 1.5 g oxygen per sq m per day) in both pools and riffles. The pools were autotropic in spring, changing to heterotrophic by fall; the benthos, initially heterotrophic, became autotrophic after algal mat establishment and remained so until the fall. (Cassar-FRC)
W82-06896

EFFECT OF ARTIFICIAL DESTRATIFICATION ON IRON, MANGANESE, AND ZINC IN THE WATER, SEDIMENTS, AND TWO SPECIES OF BENTHIC MACROINVERTEBRATES IN AN OKLAHOMA LAKE,

Oklahoma State Univ., Stillwater. School of Biological Sciences.
For primary bibliographic entry see Field 5G.
W82-06897

THE REMOVAL OF A HEADED DISCHARGE FROM A LAKE AND THE EFFECT UPON AN EPIPHYTIC ALGAL COMMUNITY,

Alberta Univ., Edmonton. Dept. of Botany.
M. Hickman.
Hydrobiologia, Vol 87, No 1, p 21-32, February, 1982. 6 Fig, 5 Tab, 35 Ref.

Descriptors: *Thermal pollution, *Algae, *Lakes, Water pollution effects, Heated water, Power plants, Ephiphytes, Lake Wabamun, *Alberta, Standing crops, Species composition.

The effects of eliminating a powerplant heated water discharge on epiphytic algae in Lake Wabamun, Alberta, were documented from 1975 to 1978. Average surface water temperatures during the time of thermal pollution were 14-19 C warmer than ambient lake temperatures in winter and 8-9 C warmer in summer in the eastern part of the lake. Flow stopped on December 13, 1975. Peak seasonal standing crops were 209.6 mg per sq m chlorophyll a in 1971-72, 1491.7 mg per sq m in 1976, 469.0 mg per sq m in 1977, and 974.9 mg per sq m in 1978. Cocconeis placentula and Cladophora glomerata, dominant during the period of heated discharge, continued their dominance after 1975, but with greatly reduced population sizes. Oedogonium sp., Spirogyra sp., Stigeoclonium tenue, and Achnanthes minutissima decreased in sumbers. After 1975 the following species increased in importance: Epithema turgida, Rivularia haematities, Scytonema alatum, Mougeotia sp., Amphipleura pellucida, Nitzschia fonticola, Rhopalodia gibba, and Phormidium sp. (Cassar-FRC)
W82-06898

FACTORS AFFECTING DEPTH DISTRIBUTION OF DRAGONFLIES AND OTHER BENTHIC INSECTS IN A THERMALLY DESTABILIZED RESERVOIR,

Savannah River Ecology Lab., Aiken, SC.
J. H. Thorp, and M. R. Diggins.
Hydrobiologia, Vol 87, No 1, p 33-34, February, 1982. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Thermal pollution, *Cooling ponds, *Benthic fauna, Water pollution effects, Savannah River, *South Carolina, Nuclear powerplants, Insects, Aquatic insects, Midges, Dragonflies, Damselflies, Caddishflies, Mayflies, Invertebrates, Macroinvertebrates, Reservoirs, Species composition, Water depth.

The distribution and abundance of benthic macroinvertebrates were studies in Par Pond, a 1100 ha cooling reservoir located at the Savannah River nuclear plant, South Carolina. Sediment samples were taken at 10 water depths from 0.16 to 5 m during January-April 1978 at two sites: (A) intermittently heated by thermal discharges and (B) at ambient temperatures. The relationship between abundance of organisms and water depth was more complex than the inverse relationship generally reported in the literature. Generally, odonates occurred at depths < 1 m and were more abundant at Site B. Of the dipterans, Ceratopogonidae (biting midges) had the most even distribution with depth, Chironomids (true midges) were found mostly at 1-3 m depths, and chaoborus (phantom midges) were usually in deeper water. Diptera abundances were similar at both stations, but earlier hatching occurred at Station A. The abundance of Caenis (a mayfly) and Trichoptera did not vary significantly with depth. Caenis was far more abundant at Station A, and Trichoptera was more abundant at Station B. Size was not a significant function of depth or sampling location for most genera of Odonata and Trichoptera. (Cassar-FRC)
W82-06899

SEASONAL AND LONG-TERM CHANGES IN SURFACE COVER OF AQUATIC PLANTS IN A SHALLOW POND, OJAGA-IKE, CHIBA, JAPAN,

Tokyo Metropolitan Univ., (Japan). Dept. of Biology.
H. Kunii, and K. Maeda.
Hydrobiologia, Vol 87, No 45-55, February, 1982. 5 Fig, 3 Tab, 33 Ref.

Descriptors: *Seasonal variation, Water quality, *Aquatic plants, Ponds, Lakes, Eutrophic lakes, Ojaga-ike, *Japan, Dissolved oxygen, Plant populations, Population dynamics, Macrophytes.

Seasonal and long-term changes in aquatic plants were studied in Ojaga-ike, a shallow eutrophic pond near Tokyo, Japan. Part of a continuing study started in 1971, this paper reports results of 1978 observations. Five species of the 10 floating-leaved and submerged plants in the pond showed changes in surface cover during the year. Potamogeton crispus and Elodea nuttallii occupied 53-5% of the total pond surface in May; Trapa natans and Nelumbo nucifera, 79.1% in July; N. nucifera and Hydrilla verticillata, 62.0% in September; and N. nucifera, 41.2% in November. The plant population and water quality were strongly related during the summer. The aquatic plants produced high dissolved oxygen concentrations in the surface water, while decomposition of plant materials caused oxygen depletion near the bottom. This condition caused an unfavorable encironment for some plants, including Charophyceae. Long-term changes were observed since 1971. Nymphyoides, Myriophyllum, and Hydrilla have been decreasing in number and range, whereas two newly established plants, Nelumbo and Elodea, have become dominant. These changes were probably a result of light completion and drying of exposed tubers during water level lowering in winter. The present order of plant dominance is Nelumbo > Trapa > Elodea = Myriophyllum > Vallisneria > Najas. It is expected that the pond will become monotypic, with Nelumbo being the main species. (Cassar-FRC)
W82-06900

SEDIMENTARY LOSSES OF PHOSPHORUS IN SOME NATURAL AND ARTIFICIAL IOWA LAKES,

Florida University, Gainesville School of Forest Resources and Conservation.
D. E. Canfield, J. R. Jones, and R. W. Bachmann.
OWRT A-063-IA, Hydrobiologia, Vol 87, No 1, p 65-76, February, 1982. 2 Fig, 8 Tab, 44 Ref.

Descriptors: *Phosphorus removal, *Eutrophic lakes, *Sedimentation rates, Fate of pollutants, *Iowa, *Lake sediments, Trophic level, Seasonal variation, Chemistry of precipitation.

Mean phosphorus sedimentation rates, as determined by sediment traps, were 13.3 to 218 mg per sq m per day in four natural and four artificial Iowa lakes. Although P sedimentation rates for the natural lakes as a group were not significantly different from rates for artificial lakes, there were significant differences in P sedimentation rates for individual lakes, at different locations within a lake, at different depths within a location, and during different seasons. However, P sedimentation rates were strongly correlated with inorganic sediment concentrations and inorgaic matter sedimentation rates. The trophic status of the lakes as measured by chlorophyll a concentrations was also a function of P sedimentation rate. For example, a lake with mean P sedimentation rate of 13.3 mg per sq m per day had a chlorophyll a concentration rate of 4.0 mg per cu m; a lake with a 218.1 mg per sq m per day P sedimentation rate had a chlorophyll a concentration of 81.0 mg per cu m. Sedimentation traps did not measure net sedimentation rates, and should not be used unless resuspension and resedimentation of bottom sediments are minimal. (Cassar-FRC)
W82-06901

THE INFLUENCE OF PHYTOPLANKTON COMPOSITION ON THE RELATIVE EFFECTIVENESS OF GRINDING AND SONIFICATION FOR CHLOROPHYLL EXTRACTION,

Michigan University, Ann Arbor. Great Lakes Research Division.
For primary bibliographic entry see Field 5A.
W82-06902

MODIFICATION OF BENTHIC INSECT COMMUNITIES IN POLLUTED STREAMS: COMBINED EFFECTS OF SEDIMENTATION AND NUTRIENT ENRICHMENT,

Wake Forest University, Winston-Salem, North Carolina, Department of Biology.
A. D. Lemly.
Hydrobiologia, Vol 87, No 3, p 229-245, March, 1982. 7 Fig, 10 Tab, 59 Ref.

Descriptors: *Benthic fauna, *Silting, *Nutrients, Water pollution effects, Aquatic habitats, Habitats, Awuatic insects, Insects, Acidic water, Species diversity, Turbidity, Suspended solids, Plecoptera, Diptera, Synergistic effects, Sedimentation, Nitrates, Phosphates, Bacteria, Sphaerotilus natans, Biomass, Streams, Cullowhee Creek, *North Carolina, Caddisflies, Filamentous bacteria.

Water quality, substrate composition, and benthic insect populations were monitored in three zones of Cullowhee Creek, located in the Applachian mountains of North Carolina, over an 8-month period. Zone 1 had no sediment or nutrient enrichment; Zone 2, sediment only; Zone 3, sediment and nutrient enrichment with low levels of livestock pasture runoff. Water in the two zones receiving sediment had high turbidities, suspended solids, and bed load; minimum dissolved oxygen levels of 7.6 mg per liter; and pH, 6.6; the maximum substrate temperature was 19 C in August. Water in Zone 3, receiving livestock runoff, had higher nutrient levels, 0.076-0.140 mg per liter phosphate and 0.93-1.41 mg per liter nitrate. The species richness, diversity, and total biomass of filter feeding Trichoptera and Diptera, predaceous Plecoptera, and certain Ephemeroptera were significantly reduced in sediment-polluted zones. The primary factors affecting the filter feeders were filling of interstitial spaces in the substrate and deposition of sediment on insect body surfaces and respiratory structures. The nutrients promoted growth of the filamentous bacteria, Sphaerotilus natans, on the insects and on the surfaces of stones. This growth, combined with the fine sediments, contributed to the smothering effect. The accumulation of sediment and S. natans in gill structures was shown in several photographs. The acid sensitive species, Plecoptera and Ephemeroptera, were also affected by the depressed pH at the substrate in streams with already acid waters. Synergism of sediment and nutrient-promoted bacterial growth eliminated a significantly greater number of taxa than one pollutant alone. (Cassar-FRC)
W82-06903

MANGANESE-54 ACCUMULATION BY CHLORELLA SPP., DAPHNIA MAGNA AND YELLOW PERCH (PERCA FLAVESCENS),

Department of Energy, Argonne, Illinois, Operational and Environmental Safety Division.

For primary bibliographic entry see Field 5B.
W82-06904

THE DISTRIBUTION OF AQUATIC OLIGOCHAETES IN BRACKISH INLAND WATERS IN THE SW NETHERLANDS,

Provincial Water Authority, Zwolle (The Netherlands). Department of Watershed Management.
For primary bibliographic entry see Field 5B.
W82-06905

DYNAMICS OF A SUBTROPICAL PLANKTON COMMUNITY, WITH EMPHASIS ON THE COPEPOD MESOCYCLOPS EDAX,

Maryland Univ., College Park. Dept. of Zoology.
G. A. Wyngaard, J. L. Elmore, and B. C. Cowell.
Hydrobiologia, Vol 89, No 1, p 39-48, April, 1982. 4 Fig, 35 Ref.

Descriptors: *Seasonal variation, *Population dynamics, Zooplankton, *Copepods, *Mesocyclops edax, Chlorophyll a, Eutrophic lakes, Lakes, Subtropic zone, Lake Thonotosassa, *Florida, Growth rates.

The zooplankton community of eutrophic Lake Thonotosassa, Florida, (345 ha, 2.5 km long, 1.5 km wide, mean depth 3.5 m) was studied from July 1976 to June 1977. The numerically dominant crustacean, Mesocyclops edax, had a stationary age distribution from July to March. The per capita growth rate was near zero through most of the year, showing an equilibrium between birth and death rates. In spring and summer death rates were higher, a result of predation by Diaptomus dorsalis, rotifers, and fish. In contrast to M. edax, other plankton (rotifers, D. dorsalis), chlorophyll a, and temperature showed marked seasonal variations. Zooplankton species composition was low and cladocerans were scarce compared with temperate lakes. (Cassar-FRC)
W82-06906

MULTIPLE ADDITION BIOASSAY OF TJEUKEMEER WATER,

Limnological Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, J. B. W. Wanders, and J. R. Moed.
Hydrobiologia, Vol 88, No 3, p 233-244, May, 1982. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Chelation, *Bioassay, Phosphorus, Nitrogen, Silicon, Copper, Algae, Growth rates, Heavy metals, Metals, Humic acids, Fulvic acids, Oscillatoria, Iron, Tjeukemeer, *The Netherlands, Toxicity, Water pollution effects.

The multiple addition bioassay technique, using phytoplankton populations present in the test water, was applied to water from eutrophic Lake Tjeukemeer, the Netherlands. This shallow water body, used for water level regulation, has transparent, chloride-rich water in summer and brown, nutrient-rich humic water in winter. Nitrogen, not phosphorus, was the principal factor limiting algal growth during May-November, 1979, a period in which Oscillatoria agardhii was dominant. On some sampling dates P was the second most important limiting nutrient. Omitting chelated Fe (Fe-ethylenediamine tetraacetic acid) from the algal cultures was growth limiting during periods of low dissolved Fe concentrations in the water. However, omitting inorganic Fe increased growth. The presence of the chelating agent may have affected growth by detoxifying toxic metals. Omitting the trace elements B, Co, Cu, Mn, Mo, and Zn during the summer and fall season also promoted algal growth. Although the natural Cu levels in the water were not determined, it is suspected that these have reached toxic levels in Tjeukemeer. The results of this study suggest that trace metals inhibit growth when the lake contains humus-poor water with low metal binding capacity. (Cassar-FRC)
W82-06907

FACTORS AFFECTING THE DISTRIBUTION OF LIGNICOLOUS MARINE FUNGI IN HONG KONG,

Hong Kong Univ., Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-06908

ECOLOGY OF STREAMS DRAINING FORESTED AND NON-FORESTED CATCHMENTS IN AN AREA OF CENTRAL SCOTLAND SUBJECT TO ACID PRECIPITATION,

Freshwater Fisheries Lab.
R. Harriman, and B. R. S. Morrison.
Hydrobiologia, Vol 88, No 3, p 251-263, May, 1982. 4 Fig, 6 Tab, 54 Ref.

Descriptors: *Forest watersheds, *Acid rain, *Streams, Watersheds, Salmon, Trout, Fish, Mayflies, Invertebrates, Acid streams, Acidic soils, *Scotland, Water pollution effects, Spruce trees, Trees, Fish eggs, Air pollution, Water quality.

Precipitation, water, invertebrates, and fish were studied in 12 streams flowing through forested and non-forested catchments west of Aberfoyle, Scotland. Bedrock in this region is predominantly quartzite, schists, and slates with little buffering capacity. Precipitation has an annual mean pH of 4.2-4.5. The most common tree species is Sitka spruce (Picea sitchensis Carriere). Forest streams were more acid than adjacent moorland streams (mature forest, 4.16-4.75; young forest, 4.83-5.25; and moorland, 4.90-5.80). Concentrations of aluminum were also higher in old forested streams (100-350 micrograms per liter) than in young forest and moorland streams ((< 100 micrograms per liter). Manganese concentrations were 90 micrograms per liter in forest streams and 30 micrograms per liter in non-forested streams. Among the mature forest streams only one had brown trout (Salmo trutta L.); all non-forested streams had trout. Planted salmon eggs (Salmo salar L.) died within a few weeks in forested streams but survived in non-forested streams. The only mayfly nymph found in acid streams during summer was Siphlonurus lacustris Eaton. In winter samples mayfly nymphs, Heptagenia lateralis Curtis, were found in one forest stream, but several species were present in non-forested streams. Data suggest that spruce forests collect acid pollutants and denude the soil of neutralizing elements, producing higher acidity in streams draining forested catchments. (Cassar-FRC)
W82-06909

DECREASE IN STREAM GRAVEL PERMEABILITY AFTER CLEAR-CUT LOGGING: AN INDICATION OF INTRAGRAVEL CONDITIONS FOR DEVELOPING SALMONID EGGS AND ALEVINS,

Maine Cooperative Fishery Research Unit, Orono.
J. R. Moring.
Hydrobiologia, Vol 88, No 3, p 295-298, May, 1982. 1 Fig, 30 Ref.

Descriptors: *Permeability, *Streambeds, *Logging, Gravel, Fish eggs, Clear-Cutting, Forest watersheds, Water pollution effects, *Oregon, Sediment, Hatching, Salmon, Trout, Tributary streams.

Three second-order tributary streams of the Alsea River, Oregon, were studied from 1962 to 1973 to determine the effects of logging on stream gravel permeability. Needle Branch drainage basin was 82% clear-cut, Deer Creek was 25% clear-cut with 30 m wide uncut buffer strips along the stream banks, and Flynn Creek, the control, was uncut. Road construction was completed in 1965, and logging was finished by 1967. The average gravel permeabilities decreased significantly in the clear-cut basin, from about 4900 cm per hour prelogging to 1100 cm per hour the first year after logging, increasing to 2400 cm per hour for the next 6 years. In the control and partially cut basins gravel permeabilities were not significantly different throughout the study. Monitoring gravel permeability may be more useful than determination of sediment fines in assessing the suitability of gravel conditions for salmonid eggs and alevins. (Cassar-FRC)
W82-06910

STRUCTURE AND DYNAMICS OF ZOOPLANKTON COMMUNITIES IN THE LITTORAL ZONE OF SOME NORTH CAROLINA LAKES,

Wake Forest Univ., Winston-Salem, NC, Dept. of Biology.
A. D. Lemly, and J. F. Dimmick.
Hydrobiologia, Vol 88, No 3, p 299-307, May, 1982. 3 Fig, 2 Tab, 53 Ref.

Descriptors: *Species composition, *Zooplankton, *Littoral zone, Population dynamics, Lakes, *North Carolina, Eutrophic lakes, Oligotrophic lakes Predation, Invertebrates, Seasonal variation, Cladocera, Copepods, Rotifers, Ostracoda, Cyclops.

Species composition and seasonal dynamics of zooplankton in the littoral zone of three North Carolina lakes were studied from October 1978 to September 1979. Belews Lake was considered oligotrophic; Salem Lake and Lake 150, eutrophic. A total of 32 species were found in the three lakes. Although the oligotrophic lake had as many species as the eutrophic lakes, many were rotifers, not truly littoral species, Belews Lake had 7 species of Cladocera vs. 11 in the eutrophic lakes. The eutrophic lakes had considerably more aquatic macrophytes in the littoral zone than the oligotrophic lake, providing a habitat able to support a greater number of zooplankton species. The littoral fauna, represented by certain taxa of Cladocera and Copepoda, had seasonal dynamics different from those of the limnetic fauna (Rotifera and Ostracoda), possibly as a result of predator pressure. There were no predators among the true littoral fauna, which were represented by Alona, Chydorus, Pleuroxus, Sida, Simocephalus, and Eucyclops. These genera showed very similar seasonal dynamics even in widely separated geographical regions, indicating that the population fluctuations were not dependent on climatic or chemical variables. Intrazooplankton predation by the limnetic species, mainly Cyclops bicuspidatus, appeared to be the major factor influencing the seasonal dynamics of the true littoral species. (Cassar-FRC)
W82-06911

OBSERVATIONS ON THE IMMATURE CHIRONOMIDEA OF POLLUTED LOWLAND BROOK-POND SYSTEM (ANTWERP, BELGIUM), AERATED BY THE PHALLUS PROCESS,

Rijksuniversitair Centrum te Antwerpen (Belgium), Laboratory of Ecology.
For primary bibliographic entry see Field 5G.
W82-06912

FLUCTUATIONS OF THE ICHTHYO-FAUNA IN THE ELBE ESTUARY: AN INDICATOR FOR A DISTURBED ECOSYSTEM (FLUKTUATIONEN DER FISCHFAUNA IM ELBEASTUAR ALS INDIKATOR FUR EIN GESTORTES OKOSYSTEM).

Hamburg Univ.(Germany, F.R.), Zoologisches Inst.
A. Kohler.
Helgolander Meeresuntersuchungen, Vol 34, No 3, p 263-285, 1981. 7 Fig, 2 Tab, 36 Ref.

Descriptors: *Estuaries, *Fish, *Oxygen depletion, *Nuclear powerplants, Fishkill, Bioindicators, *Elbe river, *West Germany, Flounders, Eel, Smelt, Fish migration, Spawning, Entrainment, Water temperature, Water pollution, Cooling water, Industrial water, Seasonal variation, Rivers, Water pollution effects.

Continuous sampling of 22 species of fish (focusing on Platichthys flesus L., Osmerus eperlanus L., and Anguilla anguilla L.) was performed during 1978 at the intake of the cooling system of the nuclear power plant at Brunsbuttel in the Elbe estuary (West Germany). The goal of the study was to assess the influence of the abiotic factors water temperature, inflow from the upper Elbe and oxygen content of the river on the natural fluctuations of the fish community at various seasons and to investigate doubts about the efficacy of the fish-repelling device ('fish scarecrow') at the plant. It was found that seasonal changes in water temperature determined spawning times and migration.

The fish drawn into the cooling system formed a representative picture of the ichthyofauna of the estuary. The fish-repelling device was ineffective; it was estimated that when the cooling system was working at its full capacity of 130,000 cu m/hour at least 190,000 kg of fish and shrimp were drawn in and killed. Although the heavy pollution of the lower Elbe did not appear to affect water temperature, the oxygen content was largely dependent on the inflow of fresh water from the upper Elbe. The smelt spawning period was at least 44 days long, compared with 26.8 days at the end of the 1950s, and the fish only migrated upstream to the spawning areas at times of high freshwater inflow. A two-week period of severe oxygen depletion (5.19-6.2.1978) resulted in the largest fishkill in 30 years. This affected certain age groups of smelt and eel, while most flounder were able to migrate. A failure of the industrial filter plants at Brunsbuttel may have caused the oxygen depletion. (Gish-FRC)
W82-06913

SUBSTRATE-ASSOCIATED MICROFAUNA,

Environmental Protection Agency Region VI, Dallas, TX.
G. A. Burton, Jr., and J. M. Lazorchak.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 922-931, June, 1982. 88 Ref.

Descriptors: *Literature reviews, *Microenvironment, *Reviews, Benthic fauna, Aquatic animals, Benthos, Fauna, Benthic environment, Indicators, Bacteria, Heavy metals, Agricultureal chemicals, Pesticides, Water pollution effects, Microbiological studies, Water quality, Toxicity.

Current research in the area of substrate-associated microfauna is cited in this literature review. Methodology papers included discussions of sampling techniques, sampling devices, methods for studying benthic communities, and methods for investigating wastewater plant organisms. Ecology studies included the investigation of fouling communities and colonization of substrates, the distribution of substrate-associated microfauna, a one year study of water quality in Big Thicket National Preserve, factors affecting the distribution of littoral invertebrates, the distribution of micro-, meio-, and macrofauna biomass (suggesting nutrient inputs from intrusions of deep Gulf Stream waters) at the self break on the Georgia Bight, macro- and meiobenthos of Lake Michigan, benthic distribution studies in Antarctica, planktonic and benthic meiofaunal studies in saline lakes of Antarctica, the energetics of sandy beaches along South Africa, ciliates typical of waste treatment systems, effects of resource variation on the ciliate Tokophrya lemnarium, spatial distributions and interactions of Paramecium aurelia complex in littoral zones, protozoa and vascular vegetation in various wetlands, morphometric variability of the tardigrade Isohypsibius saltursus and several studies on the relationship between invertebrates and food uptake. Toxicity studies were made concerning thermal tolerances, chronic chlorination, petroleum responses, chlordane, endosulfan, methyl mercuric chloride, heavy metals, and wastewater pollution. Technical advances have been made in pollution studies. (Baker-FRC)
W82-06925

DISEASE OUTBREAKS CAUSED BY DRINKING WATER,

Health Effects Research Lab., Cincinnati, OH.
A. P. Dufour.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 980-983, June, 1982. 24 Ref.

Descriptors: *Literature reviews, *Public health, *Reviews, *Drinking water, *Water pollution effects, *Human diseases, Salmonella, Legiionella pneumophila, Campylobacter jejuni, Pulmonary disease, Giardiasis, Gastroenteritis, Viruses, Cholera, Sparganosis, Epidemiology.

Current research into disease outbreaks cause by drinking water contaminants is cited in this literature review. During 1979 41 waterborne disease outbreaks were reported to the Centers for Disease Control and the US EPA. In epidemiological studies the incidence of amoebic and bacillary dysentery, infectious hepatitis, enterobiasis, and giardiasis before the afte construction of water tower reservoirs and automatic chlorination plants was considered in the Wadi Shati area in Libya. During 1981 only one waterborne clolera outbreak occurred in the US and was investigated. The incidence of cholera in a randomly selected sample of families in rural Bangladesh was followed over a 10 year period. Giardiasis was studied after a community wide outbreak of gastrointestinal illness occurred in Berlin, New Hampshire. Outbreaks of giardiasis were also studied in a small northwestern Pennsylvania town and in Arizona. Viral gastroenteritis was studied in cases caused by a virus serologically related to Norwalk virus near Tacoma, Washington in May of 1978. An outbreak of acute gastrointestinal illness at a camp in North Carolina was linked to a Norwalk type virus. A common-surce waterborne epidemic of viral hepatitis was diagnosed in Kashmir, India. Campylobacter enteritis was studied after its occurrence in central Sweden, having been spread through infected water mains. Sparganosis was noted in persons haveing drunk water not from the local public water supply. Pulmonary disease was linked with shower fixtures from which Legionella pneumophila was isolated. Studies were also made of Mycobacterium xenopi as another pulmonary pathogen frequently isolated from tap water. (Baker-FRC)
W82-06928

UV-SENSITIVE COMPLEX PHOSPHORUS: ASSOCIATION WITH DISSOLVED HUMIC MATERIAL AND IRON IN A BOG LAKE,

Oklahoma State Univ., Stillwater, Dept. of Botany.
D. A. Francko, and R. T. Heath.
Limnology and Oceanography, Vol 27, No 3, p 564-569, May, 1982. 4 Fig, 27 Ref.

Descriptors: *Bogs, *Chemical reactions, *Phosphorus, *Iron, *Humic acids, Ultraviolet radiation, Radiation, Light intensity, Lakes, *Bog lakes, *Ohio, Crazy Eddie Bog.

The release of orthophosphate from UV-sensitive complex P compounds was studied as a potentially ecologically important photodependent process involving the photoredution of iron. Lake water samples were collected from Crazy Eddie Bog, a shallow humic bog lake in northeastern Ohio. The lake is in a small old-field watershed surrounded by a marsh community dominated by Sphagnum. The concentration of dissolved humic substances in the water substances varied seasonally, being lowest in early spring, increasing in June, and reaching the highest concentration in late summer and early autumn. Throughout the season daytime concentrations of UV-sensitive complex P were linearly related to cochromatographic dissolved high molecular weight humic matter (DHM) adsorbance eluted in each chromatographed sample. The relationship was consistent in both relatively unstained and highly stained water samples. This fits in with the view that DHM had formed a complex with phosphate and that this complex can be broken by low doses of UV light. The UV in sunlight may have altered the DHM/phosphorus compounds, resulting in the release of phosphate. A diurnal fluctuation was noted both in the concentration of DHM and in the amount of UV-sensitive complex P. The amounts of DHM and UV-sensitive complex P were also linearly related. The rate of photoreduction of DHM/iron was the same as the rate of photoreduction of ferric citrate under similar conditions. Reduced DHM/iron was auto-oxidizable; ferrous citrate was not. These data support the view that orthophosphate sorbed to ferric iron/DHM complexes may be released by a mechanism involving UV-induced photoreduction of ferric iron to the ferrous state. (Baker-FRC)
W82-06930

GROWTH DYNAMICS OF CLADOPHORA GLOMERATA IN WESTERN LAKE ERIE IN RELATION TO SOME ENVIRONMENTAL FACTORS,

Water Research Lab., Columbus, OH., Div. of Water.
R. C. Lorenz, and C. E. Herdendorf.
Journal of Great Lakes Research, Vol 8, No 1, p 42-53, 1982. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Lakes, *Algal growth, *Lake Erie, Great Lakes, *Eutrophication, Phosphorus, Nitrogen, Nutrients, Seasonal variations.

In situ growth rates, densities and distribution of Cladophora were examined in the western basin of Lake Erie, and possible relationships between environmental conditions and Cladophora growth were examined. The findings showed that Cladophora colonized the littoral zone throughout western Lake Erie wherever suitable substrate was available. Within this littoral zone two distinctive growth patterns, representative of two different environments, are exhibited. The eulittoral zone supports growth from May to December, in contrast to the bimodal growth pattern of the infralittoral zone, which lacks growth in the late summer, August and September. Light and substrate availability limit the extent of Cladophora growth in western Lake Erie. Field observations indicated that light levels of about 50 microE/square meter-second or less are limiting. In the island region an extensive infralittoral zone composed of bedrock shorelines and reefs provides an excellent substrate for the alga to colonize. Much of the remaining Ohio and Michigan shorelines consists of low lying marshes and unconsolidated sediment, unsuitable for colonization. Available forms of phosphorus and nitrogen are abundant and do not become limiting, as evidenced by tissue nutrient analysis. The absence of the alga in the infralittoral zone during the late summer months of July and August is the result of a negaive energy balance. Respiration surpasses productivity as temperatures rise in the summer. The decreasing biomass of the infralittoral zone in the summer is accompanied by increasing epiphyte colonization and declining, but not limiting, tissue phosphorus and nitrogen levels. (Baker-FRC)
W82-06932

SECONDARY BENTHIC PRODUCTION IN A TROPICAL ISLAND STREAM,

Indiana State Board of Health, Indianapolis.
G. R. Bright.
Limnology and Oceanography, Vol 27, No 3, p 472-480, May, 1982. 3 Fig, 3 Tab, 25 Ref.

Descriptors: *Tropical regions, *Benthos, Aquatic life, Climatic zones, Seasonal variations, Caroline Islands, Rainfall, Streams, Temperature effects, *Palan Islands, Ngerekiil River.

Benthic production was measured in a tropical stream on an oceanic island, the largest of the Palau group. The Palau Islands lie in the equaorial Pacific, 90 km east of the Philippines and an equal distance north of New Guinea. The climate is tropical and wet, with temperatures never deviating more than 6 degrees from a mean of 27 degrees C and rainfall averages of about 375 cm per year. The driest months are February through April. The study stream flows from its source about 150 meters above sea level for a 5 km distance and joins the larger Ngerekiil River near its estuary. The area of the watershed is 3.5 square km. Both the stream and the watershed are nearly pristine. There was no general pattern of synchronized life cycles tuned to seasonal changes as is typical in benthos of temperate streams. However, at least two important benthic species underwent population cycles possible related to seasonal precipitation changes. The shrimp A. pilipes had a peak population and standing crop in February, while the largest number of mature individuals was found in October. Larvae of the blackfly Simulium palauensis had a peak density and peak standing crop biomass in November, with the highest percentage of last instars in April. The outcrop and riffle communities in the stream were composed mainly of rheophilic species, but the community structures, mean densities, mean standing crops, and productions differed considerably. (Baker-FRC)
W82-06933

MODERN LACUSTRINE STROMATOLITES, WALKER LAKE, NEVADA,

University of Southern California, Los Angeles. Dept. of Geological Sciences.
R. H. Osborne, G. R. Licari, and M. H. Link.
Sedimentary Geology, Vol 32, No 1/2, p 39-61, 1982. 8 Fig, 1 Tab, 38 Ref.

Descriptors: *Carbonates, *Algae, *Chemical precipitation, *Stromatolites, Walker Lake, *Nevada, Lakes, Shores, Cladophora, Ulothrix, Photosynthesis, Siliciclastic lakes, Chlorophyta, Cyanophyta, Carbon dioxide, Bicarbonates, Calcite, Benthic flora, Epilithic algae.

The occurrences of generalized and columnar stromatolites in a modern, closed siliciclastic lacustrine basin, Walker Lake, Nevada, and their formation by benthic and epilithic algal communities are documented. The two most abundant algae in the stromatolite community are Cladophora glomerata and a Ulothrix species. These are able to remove carbon dioxide from bicarbonate during photosynthesis, resulting in the precipitation of calcium carbonate, which is trapped and bound by an understory of green and blue-green algae. In the siliciclastic lakes stromatolite development seems to be restricted to shoreline and near shore environments. This characteristic can be useful in locating ancient lake shores. The biological and physical factors most important in the formation of stromatolites in this lake are summarized. Bedrock and stable pebble- to boulder- size clasts are suitable substrates for the benthic and epilithic algae. The best algal growth occurs in shallow, well-mixed, well-aerated, nonturbid water. Low Mg calcite precipitation, associated with the algal community, occurs in shoreline areas. Small generalized stromatolites form initially. These give rise to columnar forms. Periodic wave action erodes the stromatolites, providing a local source of carbonate sediments, usable for further stromatolite formation in an otherwise carbonate-poor lake. (Cassar-FRC)
W82-06934

ENVIRONMENTAL FACTORS CONTROLLING PHYSIOLOGICAL CHANGES IN CLADOPHORA IN LAKE ERIE,

State Univ. of New York Coll. at Fredonia, Dept. of Biology.
K. E. Mantai, P. E. Garwood, and L. E. Peglowski.
Journal of Great Lakes Research, Vol 8, No 1, p 61-65, 1982. 2 Fig, 7 Ref.

Descriptors: *Algal growth, *Lakes, Nutrients, Phosphorus, Nitrogen, *Lake Erie, Great Lakes, Eutrophication, *Cladophora.

Biomass and several physiological and environmental parameters were measured dealing with Cladophora samples collected from two sites in eastern Lake Erie. Samples were collected from Point Gratiot and a Niagara Mohawk Paper Company breakwall. These sites are about 1 kilometer apart near the habor at Dunkirk, New York. Seasonal variation in standing crop was dramatic, with increases during early June, followed by a rather stable period culminating in a sharp decrease in Mid-July. The fluctuations in standing crop observed during June appeared to be caused by loss of algal material due to physical detachment of the filaments, followed by rapid regrowth. The data suggest that there is a maximum biomass level which, when attained, makes the cells more vulnerable to breakage. At the Niagara Mohawk Paper Company site the maximum biomass level was about 400 g dry wt/square meter. The mid-July drop in biomass represents the typical summer dieoff observed in many studies. A significant correlation was noted between biomass and chlorophyll content. Chlorophyll content tended to be high or increasing during periods of rapid growth, but was lower at times when biomass density decreased. Changes can occur rapidly in the time span of one day. Neither nitrogen nor phosphorus were limiting to the growth of Cladophora at the sites sampled. The mid-summer dieoff does not appear to be due to a simple nutrient deficiency. (Baker-FRC)
W82-06935

PROJECTED CLADOPHORA GROWTH IN SOUTHERN GEORGIAN BAY IN RESPONSE TO PROPOSED MUNICIPAL SEWAGE TREATMENT PLANT DISCHARGES TO THE MARY WARD SHOALS,

Ontario Ministry of the Environment, Rexdale, Limnology and Taxonomy Section.
M. B. Jackson, and Y. S. Hamdy.
Journal of Great Lakes Research, Vol 8, No 1, p 153-163, 1982. 7 Fig, 3 Tab, 35 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Huron, Great Lakes, Eutrophication, Nutrients, Phosphorus, *Cladophora, Georgian Bay.

The potential for Cladophora growth in the vicinity of a proposed municipal sewage treatment plant discharge to the Mary Ward Shoals area of southern Georgian Bay was investigated. A simple model is presented for predicting seasonal Cladophora production at three alternative discharge sites. Light, temperature, water movement and substrate characteristics of southern Georgian Bay provided favorable growth conditions for Cladophora. Growth appears limited by nutrient availability, as the alga grows only in association with local and well defined sources of nutrients such as harbor areas, municipal sewage treatment plant discharge locations, river and stream mouths, storm sewers, septic systems, and gull rookeries. Cladophora growth was severely phosphorus limited on the Mary Ward Shoals. Mean phosphorus concentrations on the Mary Ward Shoals at station SHB are above the suggested lower level for Cladophora growth. In spite of this, however, the alga is essentially absent from the shoal area. The reason is that average phosphorus concentrations in shallow nearshore areas do not necessarily reflect sustained or predominant external nutrient conditions. It was concluded that any proposed outfall should be long enough to ensure that the zone of impact does not encompass any water with depth shallower than 10 meters. Also, the sewage system should have a good outfall diffuser and the plant should be designed to produce an effluent quality of 500 micrograms phosphorus/liter or less. (Baker-FRC)
W82-06936

ABUNDANCE PATTERNS OF DIATOMS ON CLADOPHORA IN LAKE HURON WITH RESPECT TO A POINT SOURCE OF WASTEWATER TREATMENT PLANT EFFLUENT,

Michigan University, Ann Arbor, Great Lakes Research Division.
R. J. Stevenson, and E. F. Stoermer.
Journal of Great Lakes Research, Vol 8, No 1, p 184-195, 1982. 9 Fig, 2 Tab, 20 Ref.

Descriptors: *Diatoms, *Lakes, *Lake Huron, Great Lakes, Algal growth, *Cladophora, Wastewater disposal, Nutrients, Wastewater pollution, Water pollution sources.

The population and taxocene patterns of diatoms on Cladophora in Lake Huron were investigated as a function of distance from a point source of municipal wastewater treatment plant effluent. The diatom proportion of the Cladophora-epiphyte assemblage biomass was also investigated. The study area was located near Harbor Beach, Michigan, on Lake Huron. Epiphytic diatoms were collected from July to September 1979 at various distances from a point source of municipal wastewater treatment plant effluent entering Lake Huron. Diatom accumulation rates were positively related to the distance from the point source. Despite higher nutrient concentrations nearest the point source, low accumulation rates of Cladophora epiphyte assemblage biomass and epiphytic diatoms indicated moderate growth inhibition by an undetermined factor. Evaluation of epiphytic diatom population abundance and ecology plus diatom taxocene species diversity supported the conclusions. A curvilinear relationship between diatom species diversity and impacts of growth inhibition is proposed. The diatom proportion of Cladophora epiphyte assemblage biomass was positively related to distance from the point source of sewage effluent. (Baker-FRC)
W82-06937

RESIDUES OF PCB IN A CLADOPHORA COMMUNITY ALONG THE LAKE HURON SHORELINE,

Wisconsin University, Platteville.
M. L. Anderson, C. P. Rice, and C. C. Carl.
Journal of Great Lakes Research, Vol 8, No 1, p 196-200, 1982. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Polychlorinated biphenyls, *Lakes, *Lake Huron, Great Lakes, *Cladophora, Organic chemicals, Industrial wastes, Accumulation, Algae, Water pollution sources, Food chains.

The accumulation of polychlorinated biphenyls by Cladophora along the Lake Huron shoreline was investigated. Detectable quantities of PCB were found in all of the water samples that were collected. The chromatograms for the residues were composed of a mixture of Aroclors, with most of the peaks accounted for by standard mixtures of Aroclor 1242 and Aroclor 1254. The concentration of Aroclor 1242 in the water samples averaged 91 ng/liter, while Aroclor 1254 was 63 ng/liter. Total PCB concentration of 154 ng/liter included both dissolved (52%) and particulate (48%) phases. Two days pior to sample collection in the area a major storm eent passed through, causing a significant resuspension of the sediments in the zone. The Cladophora averaged 92 ng/g dry weight of total PCBs. About 58% of this total was in the Aroclor 1242 fraction. The PCB concentration of fish in the area ranged from 40 ng/g to 4,400 ng/g as wet weight of whole fish. The accumulation factors observed in the progression from Cladophora to net plankton to fish were 1:15:30. It was concluded that Cladophora may effectively moderate the passage of PCB through the nearshore food chain. The role of Cladophora as a source of PCBs seems more supportable than as a sink. (Baker-FRC)
W82-06938

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN LAKE HURON: I. PROGRAM DESCRIPTION AND FIELD MONITORING OF GROWTH DYNAMICS,

Michigan Technological Univ. Houghton, Dept. of Civil Engineering.
M. T. Auer, R. P. Canale, H. C. Grundler, and and Y. Matsuoka.
Journal of Great Lakes Research, Vol 8, No 1, p 73-83, 1982. 15 Fig, 15 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Huron, Eutrophication, Great Lakes, *Monitoring, *Model studies, Mathematical models, *Cladophora, Nutrients, Phosphorus, Nitrogen.

The ecology of Cladophora glomerata in Lake Huron was examined in a three year study. A mathematical model was developed which would prove useful in evaluating various management strategies for the control of this algal growth. A municipal wastewater treatment plant discharge point at Harbor Beach, Michigan was linked with several nuisance occurrences of this alga in Lake Huron. An intensive field monitoring program was started to record weather conditions daily and levels of dissolved and stored phosphorus and standing crop of Cladophora. The distribution of Cladophora was essentially symmetrical about the nutrient source. Seasonal variation in biomass was noted following the pattern of early spring growth, stabilization and midsummer senescence. The high degree of spatial and temporal heterogeneity in the nearshore environment was clearly evident. Wind direction and velocity importantly affect dissolved phosphorus distribution. Internal phosphorus levels reflect long term trends in wind and current regimes. The growth of Cladophora is importantly influenced by internal phosphorus levels, while the loss of algal material through sloughing is closely correlated with wind-storm events. The observations of nearshore dynamics point to the need for high sampling frequency in such systems. (Baker-FRC)
W82-06939

ECOLOGICAL STUDIES AND MATHEMATICAL MODELING OF CLADOPHORA IN

LAKE HURON: 2. PHOSPHORUS UPTAKE KINETICS,

Michigan Technological Univ., Houghton, Dept. of Civil Engineering.
M. T. Auer, and R. P. Canale.
Journal of Great Lakes Research, Vol 8, No 1, p 84-92, 1982. 13 Fig, 1 Tab, 19 Ref.

Descriptors: *Algal growth, *Lakes, Great Lakes, *Lake Huron, Eutrophication, *Model studies, Mathematical models, Kinetics, Phosphorus, *Cladophora.

The factors of dissolved phosphorus availability and internal phosphorus pool size were examined as they pertained to field populations of Cladophora glomerata in Lake Huron. Kinetic coefficients needed for modeling the uptake process are developed. The studies showed that Michaelis-Menten kinetics describe substrate/uptake interactions appropriately. Results from 35 experiments conducted over two field seasons emphasized that the phosphorus uptake rate increased as dissolved phosphorus availability increased. Negative feedback on uptake rate by internal phosphorus pool size reduced the maximum phosphorus uptake rate by internal phosphorus pool size reduced the maximum phosphorus uptake rate as internal pools approach saturation. The absolute maximum phosphorus uptake rate for Cladophora was 4.5 % P/day. Values for the half-saturation constant for uptake varied with internal phosphorus pool size and ranged between 30 and 250 microgams phosphorus/liter. The data were fit to published mathematical expressions which describe uptake as a function of internal and external phosphorus levels. The expressions may be used in mathematical models simulating the growth of Cladophora. (Baker-FRC)
W82-06940

BIOMASS AND DISTRIBUTION OF CLADOPHORA GLOMERATA IN RELATION TO SOME PHYSICAL-CHEMICAL VARIABLES AT TWO SITES IN LAKE ERIE,

Ecology and Environment, Incorporated, Buffalo, New York.
G. C. Millner, R. A. Sweeney, and V. R. Frederick.
Journal of Great Lakes Research, Vol 8, No 1, p 35-41, 1982. 5 Fig, 15 Ref.

Descriptors: *Algal growth, *Lakes, *Lake Erie, Great Lakes, Eutrophication, Nutrients, Nitrogen, Phosphorus, Seasonal variations, Biomass, Ammonia, *Cladophora.

The biomass and distribution of Cladophora were monitored at Lake Erie, and an attempt was made to determine possible relationships between environmental conditions and Cladophora biomass. Cladophora biomass reached peak values in late June and early July at both the Hamburg and Walnut Creek collection sites. Maximum biomass at the Hamburg sites was generally found at the 3 meter depth. The depth at which maximum biomass occurred at Walnut Creek varied with the time of year. However, the greatest biomass density generally occurred at the 12 meter and 1 meter sampling depths. The occurrence of biomass maxima at the 3 meter depth at the Hamburg site is thought to be more directly a function of physical disturbance at the shallower depths than of the presence of optimal growth conditions in deeper waters. The depth distribution of Cladophora at the Hamburg site may have been more greatly influenced by wave activity and drifting sand than at the Walnut Creek site. Greater sand accretion by waves associated with increased fetch between Hamburg and Walnut Creek and the prevailing southwest winds may be responsible for differences in Cladophora abundance with depth between the Hamburg and Walnut Creek sites. Reductions in Cladophora internal nutrient levels corresponded to decreased nutrients in the water. Internal total phosphorus levels showed a significant positive correlation with Cladophora biomass. Cladophora was nitrogen-limited at the Walnut Creek site during part of the study period. Nitrate + nitrite nitrogen showed a significant positive correlation with Cladophora biomass at that site. (Baker-FRC)
W82-06941

MONITORING CLADOPHORA GROWTH CONDITIONS AND THE EFFECT OF PHOSPHORUS ADDITIONS AT A SHORELINE SITE IN NORTHEASTERN LAKE ERIE,

Limnos Limited, Toronto, Ontario.
J. H. Neil, and M. B. Jackson.
Journal of Great Lakes Research, Vol 8, No 1, p 30-34, 1982. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Lakes, *Algal growth, *Phosphorus, *Lake Erie, Great Lakes, Seasonal variations, *Cladophora, Eutrophication, Nutrients.

Environmental conditions, Cladophora standing crop, and internal nutrient levels were determined in Lake Erie. The role of phosphorus in Cladophora growth was also investigated. The Rathfon Point study site was characterized by a series of shelving limesone points which annually support a heavy growth of Cladophora. The temperature at this spot reached 20 degrees C in late June and generally remained above this level until early September. Water clarity was variable, due principally to suspended materials associated with wind conditions. Phosphorus and nitrogen parameters which describe the nutrient environment showed some sample-to-sample variability but lacked any trend consistent with the observed changes in Cladophora standing crop. Nitrate-nitrogen levels showed a consistent reduction throughout the growing season, while soluble reactive phosphorus levels remained very low, approaching the limit of detection most of the time. The percent of coverage by Cladophora increased with increases in fertility, suggesting that growth within the physical limits established by the environment will vary directly with the availability of plant nutrients. Optimum growth occurred between temperatures of 10 and 20 degrees C. Data indicated that above 20 degrees C the plant becomes chlorotic, growth is limited and the biomass may be detached from the substrate. Phosphorus additions did not affect Cladophora growth until the fall, when water temperatures fell below 20 degrees C and vigorous growth was resumed in the vicinity of the experimental phosphorus discharge pipe. (Baker-FRC)
W82-06942

EFFECTS OF NATURALLY SENESCING AQUATIC MACROPHYTES ON NUTRIENT CHEMISTRY AND CHLOROPHYLL A OF SURROUNDING WATERS,

Indiana Univ., Bloomington. Dept. of Biology.
D. H. Landers.
Limnology and Oceanography, Vol 27, No 3, p 428-439, May, 1982. 11 Fig, 5 Tab, 37 Ref. OWRT B-009-IND.

Descriptors: *Macrophytes, *Nutrients, Phosphorus, Nitrogen, Seasonal variation, Reservoirs, Lakes, Impoundments, Myriophyllum spicatum, Water analysis, *Chlorophyll, *Indiana, Decomposing organic matter, Phytoplankton, Biomass, Monroe Reservoir.

The effects of senescing stands of Myriophyllum spicatum on water chemistry and chlorophyll a were investigated in a large soft-water Indiana reservoir having an area of 16.8 square kilometers and a mean depth of 5.2 meters. A causeway divides the reservoir into two basins, and one narrow cut allows exchange between them. Annual and seasonal growing conditions for submerged aquatic plants in Monroe Reservoir can vary drastically. Most seasonal variation results from water level fluctuations far greater than in a natural lake of similar size. Differential temperature effects on decomposition were discounted as inconsequential. Replicate enclosures were used to isolate water columns over monospecific stands of M. spicatum until annual dieback began. Systems were sampled routinely for 119 days before, during and after fall dieback. Decomposing macrophytes supplied significant inputs of nitrogen and phosphorus to surrounding waters. Nitrogen inputs were sharply pulsed and never accounted for more than 2.2% of the annual allochthonous inputs. Phosphorus inputs from senescing plants equaled up to 18% of the annual total phosphorus loading for the reservoir. Annual dieback occurred in late summer and early autumn when conditions were suitable for phytoplankton response. Phytoplankton biomass showed significant increases in response to senescing macrophytes. (Baker-FRC)
W82-06943

NITROGEN FIXATION IN THE TEMPERATE ESTUARINE INTERTIDAL SEDIMENTS OF THE RIVER LUNE,

Lancaster University (United Kingdom), Department of Biological Sciences.
K. Jones.
Limnology and Oceanography, Vol 27, No 3, p 455-460, May, 1982. 3 Fig, 4 Tab, 25 Ref.

Descriptors: *Estuarine environment, *Nitrogen fixation, Estuaries, Environment, *England, Coastal waters, Sediments, River Lune estuary, Rivers, Temperature effects.

Acetylene reduction was studied in Morecambe Bay, which is comprised of large areas of tidal flats off the northwest coast of England. The sediments are soft enough to allow insertion of hollow cylinders without disturbing the particle distribution and moist enough to form gas-tight seals so that changes in the composition of gases in the cylinders can be monitored. Experiments were conducted in the Lune estuary near Lancaster. The results of in situ assays performed at monthly intervals indicate that nitrogen fixation occurs only from May through October and that the highest values coincided with the highest temperatures. Nitrogen fixing bacteria were most numerous in the surface layer, and only the Enterobacteriaceae and Desulfovibrio were abundant. The effects of temperature on acetylene reduction by cores were studied in the laboratory. Rates were maximal between 30 and 35 C and there was little activity below 10 C. Bacterial isolates tested for the effects of temperature on acetylene reduction showed a pattern similar to that found in the sediments. That is, they exhibited little activity at low temperatures and had optima at just above 30 degrees C. The dominating aquatic influence on the estuary was marine. Although the sediments contained low numbers of photosynthetic bacteria and cyanobacteria, some of those present are salinity tolerant and may contribute some fixed nitrogen to the sediments. It is unlikely that photosynthetic microorganisms play a significant part in sediment nitrogen fixation. Considerable increases in acetylene reduction were noted when cores were primed with carbon substrates. (Baker-FRC)
W82-06944

FOREST MANAGEMENT AND ANADROMOUS FISH HABITAT PRODUCTIVITY,

Forest Service, Corvallis, OR. Forestry Sciences Lab.
F. H. Everest, and W. R. Meehan.
In: Transactions of the 46th North American Wildlife and Natural Resources Conference, 1981, Wildlife Management Institute, Washington, D.C., p 521-530, 21 Ref.

Descriptors: *Forest management, *Range management, *Aquatic habitats, *Anadromous fish, *Logging, Erosion, Road construction, Grazing, Stream banks, Scour, Detritus, Organic matter, Dissolved oxygen, Water pollution sources, *Pacific Northwest U.S., Alaska.

The anadromous fishery resources of western North American are produced largely within forested watersheds. Forest and rangeland management activities that can influence the quality of anadromous fish habitat include timber harvest, road construction, and livestock grazing. Organic debris from forested watersheds of the Pacific Northwest and Alaska enters streams through direct litterfall, landslides, debris torrents, timber felling, and streambank erosion, plus blowdown of trees and branches. Large woody debris can create habitat for rearing salmonids, but may cause sedimentation in spawning areas. Large, naturally occurring debris can promote streambank stability and reduce streambed scour. Large accumulations of fine organic debris can adversely affect habitat by reducing dissolved oxygen and producing toxic leachates. Total removal of debris can result in a completely open channel, promoting streambed

scour, steambank instability, and loss of fish habitat productivity. Debris torrents, a common mass erosion event in the Pacific Northwest, have a negative impact on habitat and production of anadromous salmonids in small streams immediately downstream from the torrent egress. Studies within a 1-mile reach of Knowles Creek, however, indicate that the total effect of debris torrents in that sediment-poor watershed tends to be positive. Preliminary results of a livestock grazing study do not show profound effects on fish populations among various grazing systems or between one to three years of season-long grazing and ungrazed controls. (Moore-SRC)
W82-06965

EFFECTS OF A DAM AND SEWAGE OUTFLOW ON A SMALL OLIGOTROPHIC STREAM IN THE SOUTHERN APPALACHIANS,

Southeastern Forest Experiment Station, Asheville, NC.
T. J. Harshbarger, and P. E. Porter.
Forest Service Research Note SE-308, June, 1982. 10 p, 3 Fig, 3 Tab, 19 Ref.

Descriptors: *Dam effects, *Environmental effects, *Wastewater pollution, *Fish populations, *Water pollution effects, Invertebrates, Nutrients, Oligotrophy, Fish migration, Fish food organisms, Biomass, Bacteria, Periphyton, Trout, *Appalachian region.

Bent Creek is a third-order stream which supports a put-and-take trout fishery in North Carolina. An undisturbed section of the stream, Station 1, was located 250 m above Lake Powhatan, a 1.6-ha recreational impoundment. Impacted sites were Station 2, 100 m below Powhatan Dam; Station 3, 3,300 m below Station 2 and immediately below the confluence of Wesley Branch; and Station 4, 300 m below Wesley Branch. Wesley Branch is a first-order stream which receives 380,000 l/d of secondary sewage from a treatment plant. Treated sewage added to Bent Creek increased bacterial production by 476%, periphyton production by 191%, and the number of benthic macroinvertebrates by 441% biomass of fish decreased 56%. At Station 4, fish biomass was significantly greater than it was at upstream unenriched sections. Over the 300-m reach of water below Wesley Branch, nutrients decreased dramatically. The dam influenced fish distribution and upstream migration. The dam did not appreciably affect the number of macroinvertebrate taxa, but it did increase the abundance of some, particularly filter-feeding caddisflies and midges. It did not greatly alter physiochemical characteristics of the stream during the period of study. Tentatively, results indicate that sewage will change the ecology of oligotrophic streams like Bent Creek, but if it does enhance the production of a desired species, it may not be considered harmful. (Moore-SRC)
W82-06966

STABLE CARBON ISOTOPE RATIO OF SUBMERGED FRESHWATER MACROPHYTES,

Ontario Ministry of the Environment, Rexdale.
B. D. LaZerte, and J. E. Szalados.
Linnology and Oceanography, Vol 27, No 3, p 413-418, May, 1982. 3 Fig, 1 Tab, 36 Ref.

Descriptors: *Macrophytes, *Natural waters, Plants, Carbon, Lakes, Dissolved inorganic carbon, Lake Memphremagog, Fluctuations, Radioactive tracers, Isotope studies, *Quebec, Path of pollutants.

The stable carbon isotope ratio of submerged freshwater macrophytes was examined and an initial estimate was offered as to whether the organic carbon in a submerged macrophyte bed is autochthonous or of terrestrial origin. Major terrestrial carbon sources were wood and deciduous leaf litter. The results indicated that all stable carbon isotope ratios of the submerged macrophytes were substantially higher than those of terrestial C3 leaf litter and higher than the organic carbon ratios of a few preliminary sediment samples from one macrophyte bed in Lake Memphremagog. Epilimnetic dissolved inorganic carbon (DIC) ranged from 0.08 to 0.95 mM and pH from 7.4 to 8.1 over the summer season and along the main axis of the lake. The carbon ratio of the DIC was lower than that of DIC in equilibrium with the atmosphere; however, actual values varied widely. Variation was greatest at the southern end of the lake, where the influence of the inflowing rivers was most pronounced. It was concluded that the organic carbon of submerged freshwater macrophytes has a stable carbon isotope ratio distinctly higher than that of terrestrial C3 plants. This difference is probably a result of differences in diffusion resistance to carbon dioxide rather than of carbon dioxide fixation pathways, but is also influenced by the stable carbon isotope ratio of the DIC in the water. As a result, the stable carbon isotope ratio of these submerged freshwater macrophytes can be used to distinguish between them and terrestrial C3 material as sources of carbon in littoral communities. (Baker-FRC)
W82-06972

THE USE OF REMOTE SENSING TO MAP THE AREAL DISTRIBUTION OF CLADOPHORA GLOMERATA AT A SITE IN LAKE HURON,

National Aeronautics and Space Administration, Cleveland, OH. Lewis Research Center.
For primary bibliographic entry see Field 5B.
W82-06973

CHANGE IN COMPOSITION OF ORGANIC MATTER IN THE TAMA AND THE ARA RIVER SEDIMENTS BY POLLUTION, (IN JAPANESE),

Tokyo Science Univ. (Japan). Faculty of Pharmaceutical Sciences.
For primary bibliographic entry see Field 5A.
W82-06974

MECHANISMS FOR TRACE METAL ENRICHMENT AT THE SURFACE MICROLAYER IN AN ESTUARINE SALT MARSH,

Cornell Univ., Ithaca, NY., Dept., of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W82-06975

COLONIZATION AND GROWTH OF ATTACHED ALGAE AT THE LAKE MICHIGAN WATER LINE,

Wisconsin Univ.-Milwaukee, Dept. of Botany.
J. L. Blum.
Journal of Great Lakes Research, Vol 8, No 1, p 10-15, 1982. 5 Fig, 5 Ref.

Descriptors: *Algae, *Lakes, *Lake Michigan, Great Lakes, *Algal growth, Eutrophication, *Lake shorelines.

The seasonal development and spatial variation in the major components of attached algal populations on breakwalls and at other harbor and offshore sites on the western Lake Michigan shoreline are described. The discussion is presented on a seasonal basis, with the development of each algal component described chronologically. Evidence indicates that temperature, insolation, nutrient levels, wave action, and water level are important environmental factors which determine this pattern . Specific factors which determine the relative abundance of species within the waterline algal community may only be defined through careful autecological analysis. Field observations indicate that light requirements, resistance to desiccation and ice scour, and reproductive strategies are highly important features of the algal population dynamics of the nearshore environment. Of the three major filamentous algal forms present in this habitat, Bangia appears as a permanent resident, while Ulothrix may be considered a seasonal and opportunistic plant, responding rapidly to changes in water level. Cladophora is a perennial, but plants above a depth of about 30 cm tend to grow as annuals due to conditions of ice scour. It is suggested that seasonal and spatial variation in the abundance of particular species is related to the physical growth requirements of the species. (Baker-FRC)
W82-06976

PHOSPHORUS RELEASE BY SUBMERGED MACROPHYTES: SIGNIFICANCE TO EPIPHYTON AND PHYTOPLANKTON,

McGill Univ., Montreal,(Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W82-06977

EFFECTS OF PHOSPHORUS ENRICHMENT AND WAVE SIMULATION OF POPULATIONS OF ULOTHRIX ZONATA FROM NORTHERN LAKE SUPERIOR,

Utah State Univ., Logan. Dept. of Biology.
R. D. R. Parker, and D. B. Drown.
Journal of Great Lakes Research, Vol 8, No 1, p 16-26, 1982. 11 Fig, 1 Tab, 35 Ref.

Descriptors: *Lakes, *Algal growth, Eutrophication, *Phosphorus, Nutrients, *Ulothrix zonata, *Lake Superior, Great Lakes, Phosphates.

The impact of phosphorus enrichment was determined and wave action was simulated on new and previously established populations of Ulothrix zonata from the north shore of Lake Superior. Baseline information was provided on the composition and magnitude of the periphyton community of Lake Superior. Tanks received constant flow of lake water and were exposed to the same insolation and climatic conditions as the lake for a 10-week period during July, August, and September 1972. A rocking tank and a stationary tank were enriched to maintain an average concentration of 0.16 mg/liter of phosphate phosphorus. Two remaining tanks, receiving only lake water, served as controls. Each week, algal material was harvested from the tanks and analyzed for chlorophyll a, ash-free dry weight, and abundance of U. zonata and associated non-filamentous periphytic algae. Diatoms comprised, on the average, 95% of the total non-filamentous periphytic algae. The results demonstrated that phosphorus enrichment had marked effects on established populations of U. zonata in addition to favoring recolonization of U. zonata on bare rock substrates. Statistical analysis of the data revealed that phosphorus enrichment caused a significant increase in Ulothrix biomass and chlorophyll a in the enriched tanks. Wave simulation caused a significant reduction in total numbers of non-filamentous algae associated with Ulothrix in the rocking tanks. (Baker-FRC)
W82-06979

INVESTIGATION OF EUTROPHICATION PROCESSES BY CONTINUOUS RECORDING OF PRODUCTION AND DESTRUCTION,

All-Union Scientific Research Inst. of Marine Fisheries and Oceanography, Moscow (USSR).
V. V. Sapozhnikov, G. G. Shinkar, and A. A. Georgiev.
Water Resources, Vol 8, No 4, p 443-448, July/August, 1981. 3 Fig, 7 Ref. Translated from Vodnye Resursy, No 4, p 161-167, July/August, 1981.

Descriptors: *Eutrophication, *Oxygen, *Algae, Photosynthesis, Biological oxygen demand, Primary productivity, Reservoirs, Organic matter, Mozhaisk Reservoir, Measuring instruments, Wave action, Producitivity, Diurnal distribution, Hydrogen ion concentration, *USSR.

Oxygen concentration, primary production, and destruction were continuously measured by a production meter in the waters of Mozhaisk Reservoir.Galvanic-type electrochemical sensors using Ag and Pb in a 3M KOH solution were used as electrodes for measuring oxygen concentration. The meter recorded temperature, underwater illumination, and oxygen concentration; pH was determined by a separate meter. Diurnal variations of oxygen concentration ranged from 8.3 mg per liter at midnight to 8.6 mg per liter at 1400-1500 hours. At 1430 hours there was a temporary decrease to 8.4 mg per liter. The pH followed the same pattern from an 8.6 minimum to 8.8 maximum, with a slight, temporary decrease at 1430 hours. Gross and net production were illustrated in graphs for August 16, 1978. Net production measured by the production meter was 7.85 mg oxygen per liter, 6

times more than measured by the bottle technique. Maximum destruction values were recorded in the morning and at 4-4:30 pm. The maximum BOD recorded by the production meter was 0.20 mg oxygen per 30 min, 9 times higher than that measured by the bottle technique. During stormy weather, heavy cloud cover and wave action increased BOD markedly due to a reduction in photosynthesis, an increase in suspended matter, and the death of cells. (Cassar-FRC)
W82-06982

COMPARATIVE CHARACTERISTICS OF THE BACTERIOPLANKTON OF RIVERS,
Belorussian State Univ., Minok (USSR).
G. A. Inkina.
Water Resources, Vol 8, No 4, p 448-452, July/August, 1981. 4 Tab, 20 Ref. Translated from Vodnye Resursy, No 4, p 168-173, July/August, 1981.

Descriptors: *Bacteria, *Wastewater pollution, *Self-purification, Water pollution effects, Rivers, *USSR, Plankton, Growth rates, Respiration, Microbiological studies.

The total number of planktonic bacteria, generation time, respiration rate, and efficiency of food assimilation were reported for several USSR rivers with varying anthropogenic loads. Volumes of individual bacterial cells varied from 0.10 to 0.27 cu microns for cocci and 0.50-0.76 cu microns for bacilli. Average numbers of bacteria ranged from 2.6 million cells per ml in the Volga to 17.72 million cells per ml in the polluted Svislock's River. There were significant increases in bacteria, up to 6-fold, below most municipal wastewater outfalls. Generation times were 18-44 hours, least in the Volga and most in the Dnepr. Downstream from wastewater outfalls the rates of reproduction were generally depressed. Average reproduction rates in unpolluted and mildly polluted rivers were 0.13 + or - 0.02 times 10 to the minus 9th power at 20 C. Wastewater from certain large cities increased this rate up to 10 times. The efficiency of use of assimilated energy by bacteria for their growth was 3-67%, average 33%. Values for sites downstream of cities were up to 10-fold less than upstream values. (Cassar-FRC)
W82-06986

EFFECT OF PHYTOPLANKTON ON WATER QUALITY IN THE NORTHERN DONETS-DONBAS CANAL,
Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).
A. I. Kovrizhnykh, and L. I. Glavish.
Water Resources, Vol 8, No 4, p 452-456, July/August, 1981. 1 Fig, 11 Ref. Translated from Vodnye Resursy, No 4, p 174-179, July/August, 1981

Descriptors: *Phytoplankton, *Self-purification, *Eutrophication, Water pollution effects, Water quality, Northern Donets-Donbas Canal, Canals, Diatoms, Nutrients, Algae, Organic matter, Heterotrophic bacteria, Bacteria, Biological oxygen demand, Stephanodiscus hantzshii, Cyanophyta, *USSR.

The phytoplankton of the flatland, river-fed Northern Donets-Donbas Canal, USSR, was dominated by diatoms, particularly Stephanodiscus hantzshii Grun., in the winter-spring period. The maximum number of S. hantzshii was 19,400-108,000 cells per ml during 1969-78, except for 1976, when the number did not exceed 5900 cells per ml. In some years several species of blue-green algae entered the canal from the Krasnooskol'skoe Reservoir, the incoming water containing from 17,900 to 223,800 blue-green algal cells per ml. During the periods of bloom water quality improved due to uptake of biogenic elements by the algae. Levels of ammonium, nitrite, nitrate, silicon, Fe, and phosphate were less than levels in incoming water. However, the organic matter comprising the phytoplankton greatly increased the load on water treatment plants, to a total of 52.8 tons per day fresh weight on one occasion. Although BOD5 increased during algal blooms, the relationship was not directly proportional. Generally the BOD in water leaving the canal was 10-99% greater than that entering it; on extreme occasions 133% and 214% increases were observed. In the presence of negligible diatom populations there was a 19-24% decrease in organic matter in outflowing water compared with inflowing water. As the diatoms died and decomposed, heterotrophic bacteria increased in number to 35-194% greater than in incoming water. These values were up to 14 times higher on certain occasions. Blue-green algae affected water quality similarly, but to a lesser degree, because they exist in lesser numbers. (Cassar-FRC)
W82-06987

HYPEREUTROPHICATION OF AN HAWAIIAN ALPINE LAKE,
Hawaii Univ., Honolulu. Dept. of Oceanography.
E. A. Laws, and A. H. Woodcock.
Pacific Science, Vol 35, No 3, p 257-261, July, 1981. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Eutrophication, *Drought, *Water level fluctuations, *Phytoplankton, Lakes, Eutrophied lakes, Mountain lakes, Alpine regions, Perched groundwater, Groundwater movement, Chlorophyll a, Nutrients, Interstitial water, Volcanos, Lake Waiau, *Hawaii, Nitrogen, Algae, Water pollution effects.

A drought during 1976-78 caused hypereutrophication in Lake Waiau, Hawaii, a small perched alpine lake near the top of the dormant volcano, Mauna Kea. This lake is remote from human influence. The volume of the lake decreased from 11,600 cu m to 3,700 cu m from May 1977 to March 1978. The lake level dropped from the normal yearly low of 25-30 cm below the overflow level to 180 cm below overflow in 1978. August chlorophyll a concentrations were (in mg per cu m): 17 in 1977, 6800 in 1978, 413 in 1979, and 280 in 1980. The usual phytoplankton community of diatoms and chlorophytes was replaced by an almost complete monoculture of the chlorophyte Nannochloris bacillaris. Nutrients to support this bloom were supplied by inflow of nutrient-rich interstitial water, especially in the nearshore areas, as a result of a 20-70 cm hydrostatic head between the perched groundwater around the lake and the lake surface. Two years after the drought's end, chlorophyll a levels were still higher than predrought levels. (Cassar-FRC)
W82-06991

5D. Waste Treatment Processes

A NOTE ON THE EFFECT OF CHLORINATION OF SEWAGE EFFLUENTS ON FAECAL COLIFORM TO FAECAL STREPTOCOCCI RATIOS IN THE DIFFERENTIATION OF FAECAL POLLUTION SOURCES,
Hydrological Research Inst., Pretoria (South Africa).
P. A. E. Rosser, and D. P. Sartory.
Water S. A., Vol 8, No 1, p 66-68, January, 1982. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Chlorinatiion, *Sewage bacteria, Bacteria, Coliforms, Streptococci, Wastewater treatment, Disinfection, Microbiological analysis, Water pollution sources, Effluents, Secondary wastewater treatment, Feces.

Data are presented on the effect of chlorination of purified sewage effluents on fecal coliform (FC):fecal steptococci (FS) ratios. Samples were routinely collected over a period of six months from the sewage works northeast of Pretoria, covering periods before and after commencement of chlorination of the effluent. Secondary purified unchlorinated sewage effluent samples were also collected from this sewage works for study. Results indicate that fecal streptococci are more resistant to chlorination than are fecal coliforms. This greater resistance to chlorine by fecal streptococci results in a significant lowering of the FC:FS ratio following chlorination of purified sewage effluents. When purified effluents are chlorinated, greatly reduced FC:FS ratios are recorded, in some cases indicating animal fecal pollution from a domestic sewage source. Thus the indicative power of the PC:FS ratio to differentiate pollution types is abrogated. Under present circumstances, where even small scale sewage works chlorinate their effluent, the use of the FC:FS ratio to predict fecal pollution type must be treated with great caution. (Baker-FRC)
W82-05902

WASTEWATER REUSE USING MICROGRAS DISPERSION STRIPPING,
Shaler (Amos J.), Inc., State College, PA.
A. J. Shaler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243353, Price codes: A09 in paper copy, A01 in microfiche. Report OWRT/RU-81/4, May 1981. 180 p, 29 Fig, 46 Tab, 35 Ref, 4 Append. OWRT-C-802620-R(8807)(1).

Descriptors: *Water reuse, *Flotation, *Wastewater treatment, *Industrial wastewater, Water quality control, *Water pollution prevention, Industrial development, Process control, Industrial wastes, Water treatment, Design criteria, Water quality, Pollutants, Water pollution treatment, Environmental control, Water pollution sources, Liquid wastes, Wastewater management.

Investigation was made of micro gas dispersion (MGD) flotation of heavily-loaded complex wastewaters, a new flotation process, which focused on wastes from an industrial laundry since they represented the kinds of mixed contaminations found in wastes from the laundry's industrial clients. Wastewaters from some client plants and from nonlaundry clients which produce simpler but more heavily-laden wastewaters were also studied. The overall investigation sought to produce a recyclable effluent. All wastewaters were successfully clarified in two flotation steps. This process (tested in test-tube batteries, separating funnels, and in a two-column test stand) included automatic pH correction, flotation with an MGD, a second pH correction, and a second MGD flotation. Optimum composition of the MGDs were sought. The successful MGDs contained 40-60% air by volume, water which became recycled, about 100 ppm of surfactants, and about 1000 ppm of a flocculant. For industrial laundry wastewaters, non-metallic contaminants were reduced from thousands of ppm at removal ratios of 3-275 (67-99.6% removal); metallic constituents were reduced from up to 25 ppm at ratios up to 10,000 (99.99% removal). Wastewaters from other sources were generally more easily clarified. (Zielinski-MAXIMA)
W82-05911

ENVIRONMENTAL ASPECTS OF SOME ALTERNATIVE PULP BLEACHING TECHIQUES,
North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
P. B. Belt, T. W. Joyce, and H-M. Chang.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243379, Price codes: A06 in paper copy, A01 in microfiche. Report No 175, November 1981. 97 p, 12 Fig, 25 Tab, 71 Ref, 5 Append. OWRT A-116-NC(1), 14-34-0001-0135.

Descriptors: *Pulp washing, Pine trees, *Chlorination, *Bleaching wastes, Pulp and paper industry, Kraft mills, *Pulp wastes, Industrial wastes, Chlorine, Pollutants, Water pollution sources, Water pollution control, Effluents, Tensile strength, Environmental control, Water quality control, *Wastewater treatment.

The strength and effluent characteristics of variously bleached southern pine kraft pulps were assessed. High-brightness pulps were produced in sequences of chlorination (C), alkaline extraction (E) and chlorine dioxide (C) treatment, with/without oxygen pre-bleaching. Sequences used were CEDED (conventional bleaching) and CED (oxygen pre-bleaching), with first-stage sequential chlorine dioxide substitution. Effluents from the various stages were tested for BOD, COD, color, chlorides, mutagenicity and Daphnia toxicity. sim-

ulated whole mill effluents for each sequence were applied to bench-scale aerated lagoons to assess their biological treatability in a conventional wastewater treatment system. The results indicated that substantial pollutant output reductions can be achieved by use of oxygen bleaching and total recycle of the oxygen stage effluent: Use of D in the first stage chlorination had little effect on BOD and COD. Effluents from the aerated lagoon were non-toxic and non-mutagenic. The results of pulp strength tests indicated that oxygen pre-bleaching successfully produces a high-brightness pulp with strength characteristics similar to that produced by conventional bleaching sequences. (Zielinski-MASIMA)
W82-05913

UV DISINFECTION FOR ONSITE SAND FILTER EFFLUENT,

Maine Univ. at Orono. Dept. of Civil Engineering.
J. D. Lowry, and S. Romatzick.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243601, Price codes: A03 in paper copy, A01 in microfiche. May, 1982. 32 p, 11 Fig, 1 Tab, 9 Ref. OWRT A-051-ME(1).

Descriptors: *Disinfection, effluents, *Sand filters, *Wastewater treatment, *Ultraviolet disinfection, Cost analysis, *Cost comparisons, Feasibility studies.

The technical and economic feasibility of using ultraviolet (uv) light as a viable alternative to chlorine as the required disinfectant for onsite sand filter effluents discharged to surface waters in Maine was determined. To obtain a reliable cross section of performance for sand filters in Maine, 74 filters were selected for an effluent characterization program. The effluent characterization study allowed general conclusions to be made with regard to the potential of uv disinfection. A simple suspended lamp uv disinfection unit was designed, constructed, and tested in the laboratory and in the field. The efficiency of the uv disinfection unit was determined through field testing at 10 of the 74 sand filter sites used in the effluent characterization program. The 10 test sites accurately reflected the broad spectrum of effluent quality that exists in the field, ensuring that the results of the study would be generally applicable to all sand filters. Performance testing demonstrated that the suspended lamp disinfection unit is capable of nearly complete disinfection for fecal coliform over the range of effluent quality which exists in the field. An economic comparison of the uv unit vs. the tablet chlorinator demonstrated that the initial equipment costs for the two systems are approximately equal; however, the annual operating cost for the uv unit is less than for the tablet chlorinator. In addition, the maintenance requirements and potential field problems were estimated to be far fewer than those associated with a tablet chlorinator. (Author abstract)
W82-05937

WASTE TREATMENT SYSTEM RETROFITTED WITHIN DEADLINE,

B. B. Hall, T. L. Shepard, and P. A. Peterson.
Power Engineering, Vol 86, No 5, p 58-59, May 1982. 1 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Electric powerplants, *Chemical treatment, Effluent limitations, Coal, Chemical precipitation, Settling basins, Air pollution, Fly ash, Filtration, Vacuum filters, Weirs, Wastewater facilities, Waste disposal, *Minnesota.

In 1975, the Minnesota Pollution Control Agency issued a permit authorizing the wastewater discharges from the Fox Lake power station of the Interstate Power Company in accordance with the limitations of the Federal Water Pollution Control Act. In 1979, Litz, Daily and Brain studied the discharge requirements of the power plants practical and economical way to handle wastes. It was decided that a new treatment facility costing over $1.5 million would be fully retrofitted by March 1981. Under the new system, each waste stream will be handled separately. Dry flyash handling was recommended for potential resale to concrete mix plants, while treatment of boiler blowdown and air heater washwater is carried out by chemical precipitation and filtration in batch treatment. After precipitation, the wastewater is pumped from an equalization basin to a diatomaceous earth precoat vacuum filter which combines other miscellaneous wastes before discharge to the lake. Diversion channels were constructed around the coal storage area to collect rainfall runoff, while a retention basin was provided for the settling of suspended solids from the runoff. An overflow weir was included at the outlet of the basin to regulate the discharge and control the carryover of coal fines. (Geiger-FRC)
W82-05947

NITROGEN REMOVAL IN CONTINUOUS-FLOW SEQUENTIALLY AERATED ACTIVATED SLUDGE SYSTEMS,

State Pollution Control Commission, Sydney (Australia).
M. C. Goronszy, and D. Barnes.
Process Biochemistry, Vol 17, No 1, p 13-19, January/February, 1982. 5 Fig, 4 Tab, 36 Ref.

Descriptors: *Activated sludge process, *Denitrification, *Nitrification, *Wastewater treatment, Nitrogen removal, Aerobic conditions, Anaerobic conditions, Dissolved oxygen, Nitrates, Oxygen uptake, Organic loading, Ammonia, Aeration, Temperature effects.

A 3-year study on nitrogen removal in full scale continuous activated sludge systems used intermittent aerobic-anoxic conditions and domestic wastewater as a carbon source and electron donor. The plant operated in four 6-hour cycles. Mean total N. removals were greater than 85%, with most off the residual N in the organic form; residual ammonia-N was zero or nearly zero. Temperatures below 10 C reduced removal efficiencies by about 10%. When the dissolved oxygen concentrations present during the aerobic sequence (optimum 4 mg per liter) were adjusted to the applied organic load, anoxic conditions were maximized. In a conventional system using methanol and a sludge with a denitrification rate of 12 g nitrate N per g MLSS per day at 25 C, an anoxic retention time of 2 hours (of the 6 hour cycle) was necessary to denitrify 25 mg per liter of Nitrate in 24 hrs. In the continuous feed sequential system a total of 28 g of oxidized N can be denitrifiod every 24 hours during the anoxic sequence with a food/microorganism ratio of 0.05 and an average denitrification rate of 0.03 kg nitrate-N per kg MLSS per day. Additional denitrification occurs during the aerobic sequence for a total of 35 mg per liter per day. (Cassar-FRC)
W82-05950

SOLVING A POOR OXYGEN TRANSFER PROBLEM.

Public Works, Vol 113, No 5, p 88, May, 1982.

Descriptors: *Oxygen transfer, *Aeration, *Wastewater treatment, Energy, Diffusers, Montecito, *California, Cost analysis.

An investment of $17,000 saved $19,000 in energy costs the first year at the Montecito, California, wastewater treatment plant. The extended aeration plant receives somewhat more than its 0.75 mgd capacity. As a result adequate dissolved oxygen was hard to maintain in the reactors during 1978-79. The existing 392 coarse bubble diffusers were replaced with FMC Corporation SP35 Pearlcomb fine bubble diffusers. In addition to saving energy costs for blower operation, blower wear has been reduced and clogging of diffusers has been eliminated. (Cassar-FRC)
W82-05952

HIGH RATE BIOLOGICAL TREATMENT OF TMP EFFLUENT,

Eco-Research Ltd., Inc., Point-Claire (Quebec).
S. M. Shere, and P. G. Daly.
Pulp and Paper Canada, Vol 83, Convention Issue, p 62-66, March, 1982. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Pulp and paper industry, *Biological treatment, *Toxicity, Fish, Trout, Mortality, *Wastewater treatment, Industrial wastewater, Mixing, Oxygenation, *Thermomechanical pulping process, *Pulp wastes.

Wastewater from the thermomechanical pulping process (TMP) was treated biologically in a laboratory aerobic fermenter using high oxygen concentrations (above 3 mg per liter) and rapid mixing (900 rpm and Reynolds number greater than 100,000). The pH and temperature were maintained at 7.0 and 30 C, respectively. Total BOD removal was 96% at food/microorganism ratios of 0.9-1.7 per day and 74% at ratio of 3.6-4.5. Total COD removals were 80% amd 61%, respectively. Raw wastewater contained 1000 mg per liter total BOD and 2650 mg per liter total COD. In toxicity tests juvenile rainbow trout suffered 100% mortality when exposed to 18% influent for 96 hours. No mortality was seen in fish exposed to 100% effluent for the same time. (Cassar-FRC)
W82-05955

COPPER REMOVAL BY AN ADSORBING COLLOID FOAM FLOTATION PILOT PLANT,

Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. McIntyre, J. J. Rodriguez, and E. L. Thackston.
Separation Science and Technology, Vol 17, No 2, p 359-367, 1982. 1 Fig, 7 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Copper, Heavy metals, Industrial wastes, *Metal-finishing wastes, Metals, Colloids, Adsorption, Separation techniques, Recycling, *Foam separation, *Flotation.

A project was designed to test the foam flotation process on metal plating wastes. The results obtained by a large continuous flow pilot plant treating a simulated copper-bearing waste are presented. Ferric chloride was added to the wastewater to form a ferric hydroxide precipitate which acted as the adsorbent in the adsorption process. Adjustment of the pH was accomplished using sodium hydroxide, and sodium lauryl sulfate was the surfactant. Simulated copper bearing wastewaters were prepared by dissolving copper sulfate in tap water, then adjusting the pH to prevent the precipitation of copper carbonate. The variables having an influence on the efficiency of the system which were studied are pH, Fe(III) and sodium lauryl sulfate concentrations, wastewater hydraulic loading rate, ionic strength, and air flow rate. At pH values higher than 7.4, the decrease in flotation efficiency leads to the presence of some ferric hydroxide in the effluent. The optimum Fe(III) concentration seems to be between 90 and 100 mg/liter. For sodium lauryl sulfate the concentration of 15 mg/liter seemed sufficient to maintain a good, stable foam pattern in the column. Increasing the hydraulic loading rate let to a decrease in copper removal efficiency. Air flow rates of 11 to 13 nitrogen cubic meters/square meter/hour were sufficient to provide a good performance of the flotation column. Increasing ionic strength has a negative influence on the treatment efficiency. Good results were achieved up to 0.5 M sodium chloride concentrations. The results indicate that sodium lauryl sulfate recovery from the foamate and recycling back to the system are possible after sodium hydroxide treatment. (Baker-FRC)
W82-05960

RECOVERY OF FINE-PARTICLE COAL BY COLLOID FLOTATION,

Ohio State Univ., Columbus. Water Resources Center.
A. J. Rubin, and R. J. Kramer, III.
Separation Science and Technology, Vol 17, No 4, p 535-560, 1982. 11 Fig, 35 Ref.

Descriptors: *Coal, *Flotation, *Mine wastes, *Colloids, Bubbles, *Wastewater treatment, Surfactants, Wash water.

Colloid flotation was applied to removal of extremely small coal particles from wash water prior

to discharge into receiving waters. The process used micro-bubbles generated at low nitrogen gas flow rates. Oxidized coal particles had greater negative mobility and an isoelectric point at a lower pH than unoxidized coal. Hexadecyltrimethylammonium bromide (CTAB), a cationic surface collector, successfully adsorbed the negatively charged coal particles. Sodium lauryl sulfate, an anionic surfactant, was ineffective in flotation. At CTAB doses of 10 mg per liter and less, foaming was poor, especially at higher pH. At 25 mg per liter CTAB foam was stable at all pH. The pH, gas flow rate, and frother (ethanol) dose were varied to study the effects of these parameters on flotation. Rates of removal were greatest at low pH. At 60 min recoveries were 80-90% at pH 1.52 and 2.50, 20-25% at pH 5.35 and 8.50. At pH 3.50 an irregular removal pattern occurred, with eventual 90% removal. Foaming was maximum at pH 1.52 and 2.50, absent at 5.35 and 8.50, and slow to form at pH 3.50. Greater gas flow rates improved coal removal. Recovery was 100% in 20 min at 62 ml per min, 100% in 50 min at 31 ml per min, and 80% in 60 min at 16 ml per min. Varying the doses of frother showed that 100% removal was attained in 25 min at 1.71 ml per 400 ml coal suspension, in 50 min at 0.95 ml, and at $>$ 80 min a 0.44 ml. No foam formed with 0.29 ml frother. (Cassar-FRC)
W82-05961

REMOVAL OF HEAVY METALS FROM AQUEOUS SOLUTIONS USING MICROGAS DISPERSIONS,

Rhode Island Univ., Kingston.
S. Ciriello, S. M. Barnett, and F. J. DeLuise.
Separation Science and Technology, Vol 17, No 4, p 521-534, 1982. 7 Fig, 3 Tab, 12 Ref.

Descriptors: Metals, *Metal-finishing wastes, *Flotation, *Heavy metals, Chromium, Nickel, Copper, Lead, Zinc, Iron, *Wastewater treatment, Industrial wastewater, Bubbles, Chitosan, Chelation, Surfactants, Jewelry industry, *Microgas dispersions.

Batch flotation using microgas dispersions was used to remove heavy metals from individual solutions and from industrial plating effluents. Either ethylhexadecyldimethylammonium bromide or sodium dodecylbenzene sulfonate at 300 ppm was used to prepare the bubble structure. Removal was highest in the pH range 6-10, depending on the metal. Initial concentrations and % removals from individual solutions were; Cu, 8.46ppm, 100%; Ni, 19.50 ppm, 98.5%; Zn, 18.11 ppm, 95.1%;Cr, 10.10 ppm, 26.7% and Pb, 10.92 ppm, 79.1%. In a synthethic mixed metal wastewater containing about 10 ppm each of Cu, Ni, and Zn, 3.80 ppm of Cr, and 0.233 ppm Pb, removals were 95-98% for Cu, Ni, and Zn, 20.8% for Cr, and 100% for Pb. In a wastewater effluent from a plating plant with 0.1-2.6 ppm each, Cu, Ni, Fe, Cr, and Zn removals were 14.1-84.5%. Chitosan improved removals to 50.9-100% in another sample containing 0.2-3.9 ppm each of Cu, Ni, Fe, Cr, and Zn. Reducing hexavalent Cr to the trivalent state using sodium sulfite produced removal efficiencies of $>$ 90% for all 5 metals tested (Cu, Cr, Ni, Zn, and Pb). (Cassar-FRC)
W82-05962

SOIL AND GROUNDWATER CHANGES UNDER LAND TREATMENT OF WASTEWATER,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
A. R. Overman, and W. G. Leseman.
Transactions of the ASAE, Vol 25, No 2, p 381-387, March/April, 1982. 9 Fig, 9 Tab, 15 Ref.

Descriptors: *Land application, *Wastewater irrigation, *Groundwater pollution, Fate of pollutants, Wastewater disposal, Land disposal, Municipal wastewater, Wastewater treatment, Tallahassee, *Florida, Nitrates, Soil disposal fields, Grasses, Nutrients, Hydrogen ion concentration, Potassium, Sodium, Calcium, Magnesium, Phosphorus.

Municipal wastewater effluent from the Tallahassee, Florida, treatment plant was applied to sandy soil planted to various grasses. The appplication was started in 1966. The characteristics of wastewater, soil, and groundwater were measured starting in 1971. Essentially all suspended soils, BOD, fecal bacteria, and phosphorous were removed by the soil. Water in a field well had an average pH of 7.7, 49 mg per liter chloride, and 18.6 mg per liter N (mostly nitrate) compared with the background well water of 8.3 pH, 2 mg per liter chloride, and $<$ 1 mg per liter nitrate. The 31.3 mg per liter total N in the effluent was reduced to 1816 mg per liter by bacterial reduction and plant uptake. The coastal bermuda grass plot removed more N from the effluent than the plot with mixed vegetation. Ca passed through the soil unchanged. K was removed by the crop. Soil pH (5.8-6.3) was essentially constant with depth and intermediate between background soil of pH 5.5 and effluent of pH 7.5. The sum of extractable bases decreased with depth, exchangeable K and Na were constant with depth, and Ca and Mg decreased slightly with depth. At an irrigation rate of 20 cm per week, nitrate entered the groundwater, exceeding the drinking water standard of 10 mg per liter. (Cassar-FRC)
W82-05964

CARBON-DIOXIDE NEUTRALIZATION OF AN ALKALINE EFFLUENT,

Diamond Shamrock Corp., Muscle Shoals, AL.
M. J. Griffith, and D. B. Burgener.
Industrial Wastes, Vol 28, No 2, p 18, 24-45, March/April, 1982. 3 Fig.

Descriptors: *Wastewater treatment, *Neutralization, *Carbon dioxide, Design criteria, Effluent streams, Alkalinity, Industrial wastewater, Alabama.

A chloralkali plant in Muscle Shoals, Alabama, located on a 60 acre site adjacent to the Tennessee River has been converted from a manually controlled sulfuric acid pH control system for neutralizing the effluent to an automatic carbon dioxide process which is engineered to treat the caustic plant effluent before releasing it into the nearby river. The control system has allowed the plant to reduce the pH of 17 mgd of wastewater from a maximum of 11.75 down to 8.3, well within the 6.0 to 9.0 pH limits. This was done at lower cost than with a conventional acit treatment system. The availability of carbon dioxide, particularly during the winter months, was one factor influencing the decision, as the system had to operate continuously. The only disadvantage of using carbon dioxide is that it tends to lower the dissolved oxygen content to about 4.5% at the point of injection; this is not considered a problem in this application. The plant uses a unique sidestream pH control system to reduce the amount of carbon dioxide lost to the atmosphere by mixing a small volume of highly carbonated water with the remaining effluent flow. Since the pH is controlled with a supersaturated carbon dioxide-water solution, there is little of this gas being released from the discharge manifold into the effluent stream, and thus losses are negligible. The sidestream injection manifold is probably the simplest and most important component of the entire system. Extensive laboratory and on-site testing were performed to determine the direction, size and layout of the 20 removable orifices on the manifold. The system has performed in accordance with design parameters since its installation in 1978. (Baker-FRC)
W82-05973

COMMON FACILITY TREATMENT OF INDUSTRIAL WASTEWATERS,

Gulf Coast Waste Disposal Authority, Houston, TX.
J. P. Teller.
Industrial Wastes, Vol 28, No 2, p 26-28, March/April, 1982. 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Industrial wastes, Design criteria, Secondary wastewater treatment, Activated sludge process, *Texas.

The Gulf Coast Waste Disposal Authority concentrates on the disposal of wastewater, both municipal and industrial, and on the disposal of industrial solid wastes. The range of authority spans three counties, Chambers, Galveston, and Harris. Wastes from various sources are combined in different ways but treated at the same facility. In addition to industrial wastes the authority operates 26 municipal plants, seven of which are centralized for joint treatment. A case history of the Washburn Tunnel Facility is presented as an example of the process of developing a joint waste treatment program. The advantages of the joint approach to treatment include tax-free capital investment, ad-valorem tax exemption, sales tax-free purchases, savings in chemical costs, and the elimination of multiple laboratory functions. At the Washburn Tunnel Facility secondary treatment is provided for up to 52 mgd. This represents one-third of the industrial biological demand produced by Houston Ship Channel Industries. The activated sludge process removed 95% of the biochemical oxygen demand and 90% of suspended solids coming into the plant. Organic pollutants are brought into contact with bacteria and converted to harmless carbon dioxide, water and more bacteria. Regional waste treatment facilities can work and yield a cost effective program for joint industrial waste treatment through careful planning and attention to detail. (Baker-FRC)
W82-05974

WASTEWATER TREATMENT AT AN ELECTRICAL GENERATION STATION,

Illinois Power Company, Decatur.
R. W. Walden.
Industrial Wastes, Vol 28, No 2, p 14-17, March/April, 1982. 1 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Electric power production, Hydroelectric power, Industrial wastes, Effluents, Water quality, Aeration, Chlorination, Ponds, Lagoons, Powerplants, *Illinois, Regulations.

The plan used by the Illinois Power Company in achieving compliance with water pollution control limitations revolves around the combining of various wastewater streams at coal burnign sites. For example, fly ash sluice waters and certain plant wastewaters have flocculation properties which aid in the cleanup of other wastewater streams when all are joined within the ash pond system. Other benefits of this approach include the operation of a complete water analysis laboratory, the minimum use of remote monitoring and control equipment needed for compliance, and the resulting cost effective installation, operation and maintenance methods associated with water pollution control efforts. The ash pond system was designed to include a majoy collection pond followed by two clarification ponds in series to control total suspended solids. A former sanitary treatment facility was replaced by an extended aeration system such that the sanitary effluent regularly satisfies the limits of 30 ppm for BOD-5, 30 ppm total suspended solids, 200 counts per 100 ml for fecal coliforms, 0.75 ppm for total chlorine residual and pH range of 6 to 9. The original units at the Havana Power Station, adjacent to the Illinois River system, have once-through river water cooling condensers. At the powerplant, a small portion of the low sulfur fly ash generated tends to float. Most of it is trapped in the first two ponds and appears as a white substance around pond shorelines. A carbon dioxide system has been installed for controlling ash pond pH during temporary excursions in plant operations. (Baker-FRC)
W82-05975

VERIFICATION OF A MODEL FOR FOAM FLOTATION COLUMN OPERATION,

Vanderbilt Univ., Nashville, TN.
J. E. Kiefer, J. Rodriguez, G. McIntyre, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 3, p 453-563, 1982. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Water analysis, *Model studies, Surfactants, Effluents, Foam separation, *Wastewater treatment, *Foam flotation.

Experimental data were collected during testing of the validity of a mathematical model for the time-

dependent operation of a continuous flow floating column for industrial wastewater treatment. The surfactant being removed was sodium lauryl sulfate (NLS). A comparison was made of the responses of the column in steady-state operation and under the influence of rectangular pulses in terms of NLS concentration and of hydraulic loading rate with the results of computer simulation. Under all conditions effluent surfactant concentrations were well simulated. The fraction of liquid in the Plateau borders varied somewhat with the hydraulic loading rate, thus causing some discrepancy between calculated and observed collapsed foamate flow rates. It is noted that for a model which describes the column operation exactly, one must develop an expression for the fraction of liquid in the Plateau borders which depends on factors such as the total liquid fraction and the particulate concentration. Since effluent concentration is almost independent of this parameter, this expression is not needed to make the model useful as presented in this paper. Another addition which would improve the model would be to account for the mixing in the liquid pool below the air disperser. Such a change would allow one to predict more accurately the effluent concentration as a function of time as the influent conditions are abruptly changed. (Baker-FRC)
W82-06001

IMMOBILIZED MICROBES AND A HIGH-RATE, CONTINUOUS WASTE PROCESSOR FOR THE PRODUCTION OF HIGH BTU GAS AND THE REDUCTION OF POLLUTANTS,

Corning Glass Works, NY. Research and Development Labs.
R. A. Messing.
Biotechnology and Bioengineering, Vol 24, No 5, p 1115-1123, May, 1982. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Anaerobic digestion, *Methane bacteria, *Porous media, Ceramics, Wastewater treatment, *Biological treatment, Bacteria, Carbon dioxide.

A very efficient reactor for anaerobic digestion of sewage was based on microbes densely packed within the pores of controlled-pore ceramics. Some of the ceramic materials used were extruded Cordierite (pore diameter, 1-9 microns), Duralite Noire extruded brick (pore diameter 0.8-30 microns), and insulating firebrick (pore diameter 2-15 microns). Pore volumes were 0.29-1.0 cu cm per g. Laboratory-scale two-stage reactors consisted of the vertically mounted hydrolytic-redox stage, which reduced the size of the waste molecules (cellulose, protein), and the horizontally mounted anaerobic digestion stage, which converted the small molecules of carbon dioxide, acetic acid, etc. to methane. These reactors have operated continuously for 2 years, efficiently converting carbon to methane. The reactors were operated at 20, 30, and 40 C for residence times of 2-5.5 hours. Total COD of the sewage was 800-2600 mg per liter. 32-54% of the influent carbon was recovered as methane, and total COD reduction was 63-89%. The resulting gas was 90% methane and < 5% CO2. (Cassar-FRC)
W82-06005

MODIFIED SLUDGE DIGESTION WITH IMPROVED GAS YIELD (MODIFIZIERTE SCHLAMMFAULUNG MIT VERBESSERTER GASAUSBEUTE).

Wasser, Luft und Betrieb, Vol 26, No 1/2, p 24-25, 1982. 1 Fig. (No English summary).

Descriptors: *Sludge digestion, *Anaerobic digestion, *Energy conversion, Heat exchangers, *Wastewater treatment, Biodegradation, Biological treatment, Costs, Pendulum mixer, Zenith-Biomax system.

A modified system of anaerobic alkaline sludge digestion, the Zenith Biomax, is described. The system seeks to reduce energy costs as well as investment and maintenance costs and allows for the addition of prepasteurization capabilities. The heat supply is built exclusively on external heat-exchanger systems. The system is equipped to allow loading of fresh sludge to correspond to energy demand, resulting in maximal energy yield. The Biomax system is also capable of enabling the user to calculate energy demand in advance. A special method of turning the digestion tank, which is highly significant with regard to gas yield and digestion time, was developed: the Zenith pendulum mixer. This provides a settling and thickening zone in the bottom area of the digestion tank. Through the centrifugal effect in the turning zone the sedimentation of mineralized substances is markedly improved, and the proportion of mineralized substances in the end product greater. A further advantage of the pendulum mixer is that movement in the main sluice runs from bottom to top. This must be reversed occasionally for technical reasons, and the dual tangential outflow results in rotation of the tank. This effect is used in the separation of floating sludge, which can be done several times daily without significantly impairing gas production. An optimal bacterial culture in the upper area of the tank and easier gas extraction is also achieved by using the pendulum mixer. The Biomax system can improve gas yield by up to 30%. Further utilization of this gas will be economically feasible in larger plants. (Gish-FRC)
W82-06024

DOMES, BUBBLES, AND PAPER WASTE,

Badger Paper Mills, Inc., Peshtigo, WI.
R. Kinzel, and H. Rushton.
Water/Engineering and Management, Vol 129, No 4, p 47-48, April, 1982.

Descriptors: *Pulp and paper industry, Aeration, *Bubbles, *Wastewater treatment, Industrial wastewater, Badger Paper Mills, Peshtigo, Wisconsin, Activated sludge process.

The Badger Paper Mills, Inc., built a 6 mgd wastewater treatment plant for joint use by the mill and the town of Peshtigo, Wisconsin. This system replaced a mechanically aerated 2-lagoon plant. The new treatment plant incorporated a dome diffusion aeration system, which generates fine bubbles from porous ceramic diffuser domes equally spaced on the floors of the concrete basins. The plant receives 95% of its waste load from the paper mill and 5% from municipal sources. Power costs have been reduced 35-40% and detention time by 14 days compared with the lagoon system. The concrete basins required only one-fourth the land area taken by the lagoons. Splashing, spray cooling, and winter freezing, frequently problems in the lagoon operation, have been eliminted. Sludge is more easily dewatered. (Cassar-FRC)
W82-06025

REMOVAL OF HEAVY METALS FROM ELECTROPLATING RINSEWATERS BY PRECIPITATION, FLOCCULATION AND ULTRAFILTRATION,

Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and J. T. Delwiche.
Water Research, Vol 16, No 5, p 729-737, May, 1982. 6 Fig, 8 Tab, 15 Ref.

Descriptors: Metals, *Electroplating, Industrial wastewater, *Wastewater treatment, Metal-finishing wastes, *Heavy metal, Chemical precipitation, *Flocculation, *Filtration, *Ultrafiltration, Chromium, Copper, Zinc, Nickel, Cyanides, Sodium hydroxide, Iron compounds.

Heavy metals were effectively removed from four separate electroplating rinsewaters by precipitation, flocculation, and ultrafiltration. Hexavalent Cr was first reduced to the trivalent state with ferrous sulfate and then precipitated with NaOH. Ni rinsewaters were treated with NaOH and FeC13 and again with NaOH. Cyanides in Cu and Zn rinsewaters were oxidized with NaOCl before precipitation of the hydroxides with FeCl3 and NaOH. Filtration through a plate-and-frame ultrafiltration apparatus with acrylic membranes of 0.20-.80 micron pore size reduce the effluent metal concentrations (mg per liter) to 0.17 (trivalent Cr), 0.26 (Ni), 0.30 (Cu), and 1.84 (Zn). Water recoveries (the fraction of the feed stream that permeates the membrane) were: Ni,24%; Cr. 10%; Cu, 6.5% and Zn, 3.7%. High water recoveries were associated with the maximum volume of filtered water in a given time and at a given pumping power. The metal levels were in good agreement with theoretical solubility curves, except for Cu, where the formation of stable Cu cyanide complexes appears to increase the solubility by 2 orders of magnitude over the solubility predicted from equilibrium constants for copper hydroxides and oxides. (Cassar-FRC)
W82-06029

THE MOLECULAR MASS DISTRIBUTION OF ORGANIC COMPOUNDS IN ACTIVATED SLUDGE PLANT EFFLUENT DETERMINED BY MEANS OF GEL PERMEATION CHROMATOGRAPHY,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-06030

EFFECT OF CHEMICAL COAGULATION ON ANAEROBIC DIGESTIBILITY OF ORGANIC MATERIALS,

Cornell Univ., Ithaca, NY. Dept of Environmental Engineering.
S. K. Dentel, and J. M. Gossett.
Water Research, Vol 16, No 5, p 707-718, May, 1982. 14 Fig, 5 Tab, 36 Ref.

Descriptors: *Sludge digestion, *Coagulation, *Organic matter, *Wastewater treatment, Digestion, Alum, Ferric chloride, Anaerobic digestion, Proteins, Carbohydrates, Acids, Organic acids, Amino acids, Chemical reactions, Phosphates, Biodegradation.

Chemical coagulation of wastewater with alum or ferric chloride reduced the biodegradability of sludges in anaerobic digestion. This paper investigated different substrates: raw wastewater, activated sludge, three proteins (gluten, ovalbumin, and zein), glycine, cellulose, glucose, butyric acid, and palmitic acid. In general, the sludges from the less water-soluble substrates and the substrates containing readily ionizable groups were most adversely affected. This group included amino acids, proteins, and long chain fatty acids, but not glucose and butyric acids. Cellulose was moderately affected, suggesting that physical enmeshment may be a factor. The observed coagultion effects were distinct from any effects of increased loading or differences in pH or alkalinity and were not attributable to toxicity, increased fixed solids concentrations, or phosphate limitation. Smaller particles were less easily digested than larger, settleable particles. During the flocculation process the organic substrate is enmeshed in the floc, rendering it less susceptible to digestion. Chemical interactions also may affect digestibility. (Cassar-FRC)
W82-06039

PRODUCT INHIBITION IN THE ACID FORMING STAGE OF THE ANAEROBIC DIGESTION PROCESS,

Amsterdam Univ. (Netherlands).
R. J. Zoetemeyer, A. J. C. M. Matthijsen, A. Cohen, and C. Boelhouwer.
Water Research, Vol 16, No 5, p 633-639, May, 1982. 5 Fig, 8 Tab, 19 Ref.

Descriptors: *Anaerobic digestion, *Inhibition, *Acids, *Wastewater treatment, Volatile acids, Butyric acid, Organic acids, Fatty acids, Organic compounds, Glucose, Nutrients, Kinetics, Chemical reactions, Biodegradation, Sulfates, Carbonhydrates.

Inhibition of the anaerobic digestion process by formation of volatile fatty acids was studied using glucose as a carbon source and a complete nutrient medium to ensure carbon limitation. Glucose monohydrate concentrations were 2.5, 5, 10, 30, 50, and 75 g per liter. The main products (butyrate, acetate, and lactate) increased with increasing glucose concentrations; ethanol and propionate were fairly constant; formate was < 10 ppm C. Product recoveries averaged 90%. Yields decreased from 16-19% at lower concentrations to 9-10% at higher glucose concentrations. Maximum dilution rates

changed from 0.46 at the lowest glucose concentrations to 0.04 at the highest. A relationship was observed between maximum dilution rate and log of concentration of acids produced. At a constant glucose input concentration of 10 g per liter inorganic nutrients were increased from 1 to 5%. No reaction inhibition occurred during gradual nutrient increases, but sudden large changes caused reactor failure. Sulfate reduced to sulfide at sulfate concentrations > 140 ppm, but no inhibition was noted. Addition of 1100 mg C per liter butyrate to the reactor decreased butyrate and propionate production and increased lactate production. At higher butyrate influent levels, glucose appeared in the effluent, a small amount at 1700 mg C per liter butyrate dose and large amounts at 2500 mg C per liter. The reactor returned to a steady state after 3 days. (Cassar-FRC)
W82-06041

QUALITATIVE AND QUANTITATIVE STUDIES ON THE IN SITU ADSORPTION, DEGRADATION AND TOXICITY OF ACRYLAMIDE BY THE SPIKING OF THE WATERS OF TWO SEWAGE WORKS AND A RIVER,

Plymouth Polytechnic (England). Dept. of Environmental Sciences.
L. Brown, M. M. Rhead, D. Hill, and K. C. C. Bancroft.
Water Research, Vol 16, No 5, p 579-591, May, 1982. 1 Fig, 9 Tab, 20 Ref.

Descriptors: *Acrylamide, *Organic compounds, *Toxicity, Water pollution effects, Fate of pollutants, Activated sludge process, Biological treatment, Invertebrates, Aquatic fauna, Insects, Species diversity, Acclimatization, Wastewater treatment, Biodegradation, Degradation, Adsorption.

Acrylamide, a toxic monomer, was added to an activated sludge sewage works, a biological filter sewage works, and a river during the period October 1979 to July 1980. Little in situ degradation of acrylamide occurred in the primary or final settlement tanks in either sewage plant. However, the high microbial activity in the activated sludge tanks and in the biological filter beds reduced the acrylamide by 50-70%. In another study acrylamide was dosed into a stream for 74 days. No in situ loss of acrylamide by degradation or adsorption occurred within 4-5 hours. There was an apparent slight increase in degradative ability of the micro-organisms with long-term exposure to acrylamide. The insect fauna in the river showed reduced species diversity and population size within 5 hours of dosing to 50 micrograms per liter acrylamide. After a week's exposure only Hydropsche instabilis did not suffer adverse effects or total elimination. Several species recolonized within 4 to 8 weeks after the final acrylamide dose. (Cassar-FRC)
W82-06044

SCANNING ELECTRON MICROSCOPE EVALUATION OF ROTATING BIOLOGICAL CONTACTOR BIOFILM,

Maryland Univ., College Park. Dept. of Civil Engineering.
J. E. Alleman, J. A. Veil, and J. T. Canaday.
Water Research, Vol 16, No 5, p 543-550, May, 1982. 7 Fig, 2 Tab, 25 Ref.

Descriptors: *Microscopic analysis, *Microorganisms, *Biological treatment, *Wastewater treatment, *Rotating biological contactors, Bacteria, Beggiatoa, Desulfovibrio, Biofilms, Sulfides, Sulfur bacteria, Filamentous bacteria, Heterotrophic bacteria, Anaerobic bacteria, Aerobic bacteria.

A rotating biological contactor biofilm from a treatment facility in Alexandria, Virginia, was examined by scanning electron microscope to characterize the nature of filamentous surface growth. Layers of morphologically diverse microorganisms were found. The white surface layer was composed of a dense interwoven mat of bacterial filaments, dominated by Beggiatoa . The black lower layer contained straight and comma-shaped rods dominated by Desulfovibrio, a sulfide producing bacteria. The black color is believed to be a ferrous sulfide deposit. The sulfide diffuses toward the surface layer and serves as an energy source for the Beggiatoa. The filamentous growth is a symptom of reduced oxygen availability and high substrate loadings. (Cassar-FRC)
W82-06047

A RAPID METHOD FOR DETERMINING THE TOXICITY OF CHEMICALS TO ACTIVATED SLUDGE,

Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
R. J. Larson, and S. L. Schaeffer.
Water Research, Vol 16, No 5, p 675-680, May, 1982. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Activated sludge process, *Toxicity, *Inhibition, Wastewater treatment, Water pollution effects, Mercury, Sodium azide, Hypochlorites, Dichlorophenol, Phenols, Trimethylammonium chloride, Organic compounds, Sodium hypochlorite.

Toxicity of chemicals to activated sludge was determined by measuring inhibition of C14-labeled glucose uptake after 15 min. The IC50 value (the concentration of chemical inhibiting uptake by 50%) was determined by nonlinear regression analysis of the decrease in glucose uptake as a function of the log of test chemical concentration. Uptake in the presence of both inorganic and organic chemicals showed significant dose-dependent decreases as the concentration of test material increased. Some IC50 values (in mg per liter) were: 3,5-dichlorophenol, 13.4; alkyl trimethyl ammonium chloride, chain length, C14-C18, 28.4; hypochlorite, 20.0; and sodium azide, 1041.8 (essentially nontoxic to sludge). IC50 for Hg(++) depended on the level of volatile suspended solids, decreasing from 6.1 to 1.6 mg per liter with a four-fold dilution. The results obtained in this study agreed with values from previous studies on materials which adversely affect wastewater treatment processes. (Cassar-FRC)
W82-06048

EFFECT OF MAGNESIUM AND CALCIUM PRECIPITATION ON COAGULATION-FLOCCULATION WITH LIME,

Ministry of Transport and Public Work, Middelburg (Netherlands). Environmental Research Div.
J. Leentvaar, and M. Rebhun.
Water Research, Vol 16, No 5, p 655-662, May, 1982. 10 Fig, 5 Tab, 10 Ref.

Descriptors: *Lime, *Magnesium hydroxide, *Coagulation *Wastewater treatment, *Calcium hydroxide, Chemical precipitation, Flocculation, Adsorption, Organic matter, Organic carbon.

Two major mechanisms were demonstrated in coagulation-flocculation of sewage with lime-magnesium hydroxide treatment: (1) sweep coagulation by calcium carbonate and (2) adsorption-coagulation of stable organic colloids by magnesium hydroxide. On the average, 45% of total organic carbon (TOC) and 85% of light absorbing matter were removed by calcium carbonate precipitation. An additional 16% TOC and 7% of light absorbing matter were removed by magnesium hydroxide, leaving a non-removable fraction of 39% of TOC and 8% of light absorbing matter. The relationship between TOC or light absorbing matter removal and magnesium hydroxide precipitation was expressed as an adsorption isotherm similar to a Freundlich adsorption isotherm. Maximum adsorption capacity was 1.5-3.0 mg TOC per mg Mg. (Cassar-FRC)
W82-06053

ALGAL GROWTH IN PRIMARY SETTLED SEWAGE--THE EFFECTS OF FIVE KEY VARIABLES,

Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
S. Y. Ip, J. S. Bridger, C. T. Chin, W. R. B. Martin, and W. G. C. Raper.
Water Research, Vol 16, No 5, p 621-632, May, 1982. 6 Fig, 5 Tab, 32 Ref.

Descriptors: *Algal growth, *Wastewater lagoons, *Wastewater treatment, Photoperiodism, Temperature effects, Carbon dioxide, Nitrogen removal, Phosphorus removal, Biomass, Bicarbonates, Nitrates, Ammonium nitrate, Cyanophyta, Chlorophyta, Algae harvesting, Productivity.

The effects of photoperiod, temperature, carbon dioxide, bicarbonate, and nitrogen on algal growth in wastewater ponds were investigated in bench scale experiments at high and low levels for each factor. High and low levels were: photoperiod, 12 and 6 hours; temperature, 30 and 15 C; carbon dioxide, 1% and 0.03%; bicarbonate, 100 mg per liter NaHCO3 added and sewage as received; and nitrogen, 30 mg per liter ammonium nitrate added and sewage as received. Domestic sewage from a Melbourne suburb was used. Photoperiod at 3240 lx light intensity was the primary limiting factor on algal growth. At a retention time of 7 days, a total effective photoperiod of > 6 hours per day was required to produce algae at concentrations above 500 mg per liter. Increasing dissolved carbon dioxide levels encouraged production of green algae, which were unicellular and hard to harvest. The lower level of CO2 favored the more gelatinous and filamentous blue-green algae. Low temperature (15 C) promoted algal growth by increasing CO2 solubility. Algal production was increased by addition of carbonate and was decreased by addition of excess ammonium nitrate. In this experiment nitrogen removal was 3 mg per 100 mg biomass produced; phosphorus removal was 0.5 mg per 100 mg biomass produced. (Cassar-FRC)
W82-06055

ENERGY CONSERVATION IN MUNICIPAL WASTEWATER PLANTS,

New York State Energy Office, Albany.
E. R. Bogardus.
Clearwaters, Vol 12, No 1, p 10, 11-14, March, 1982. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Municipal wastewater, *Energy conservation, Wastewater treatment, Cost analysis, Economic aspects, Anaerobic digestion, Maintenance, Training.

The role of the New York State Energy Office in the development and coordination of an overall state energy program is discussed. Results of a recently completed Energy Office study on eleven New York State wastewater plants wasting digester gas are presented. Plans for the 1982 Energy Office wastewater program are detailed. The State Energy Master Plan provides the framework for energy decisions throughout the State. Conservation is the cornerstone for the energy plans. New York has been disproportionately affected by events related to escalating petroleum prices and supply shortages. While New York is the sixth largest energy user among all the states, only 9.5% of the total demand is satisfied from resources produced within the state. The Energy Office conservation program focuses on existing wastewater treatment facilities. Process reliability has been linked in the past to the high use and ready availability of energy for pumping, compressing air, and handling sludge. The key to the successful operation of an anaerobic digester is to maintain proper environmental conditions so that a balance exists between the acid-forming and the methane-forming bacteria. Vital to energy conservation and production is increased wastewater operator training, as these individuals are the key to a program's success or failure. The Energy Office expects the shift from site-specific activity to broad-based information dissemination to help meet this need. (Baker-FRC)
W82-06070

NEW DIRECTIONS IN WATER POLLUTION CONTROL,

Environmental Protection Agency, New York. Region II.
For primary bibliographic entry see Field 5G.
W82-06071

WATER TREATMENT BY AQUATIC ECOSYSTEM: NUTRIENT REMOVAL RESERVOIRS AND FLOODED FIELDS,

Florida Univ., Sanford. Agricultural Research and Education Center.
K. R. Reddy, P. D. Sacco, D. A. Graetz, K. L. Campbell, and L. R. Sinclair.
Environmental Management, Vol 6, No 3, p 261-271, 1982. 6 Fig, 6 Tab, 33 Ref.

Descriptors: *Nutrient removal, *Water treatment, Nitrogen, Phosphorus, Phosphates, Aquatic plants, Storage ponds, Ponds, Reservoirs, Wastewater treatment.

An evaluation was made of the potential use of reservoirs and flooded fields stocked with aquatic plants for reducing the nutrient levels of organic soil drainage water. Treatment systems included: a large single reservoir stocked with waterhyacinth, elodea, and cattails (R1); three small reservoirs in series with waterhyacinth, elodea, and cattails grown in independent reservoirs R2, R3, and R4, respectively; a control reservoir (R5) with no cultivated plants; a large single flooded field planted to cattails; three small flooded fields in a series planted to cattails; and a flooded field with no cultivated plants. Drainage water was pumped daily into these systems for 27 months. Water samples were collected at the inlet and outlet of each treatment system and analyzed for nitrogen and phosphorus forms. The series of reservoirs stocked with aquatic plants functioned effectively in the removal of N and P from agricultural drainage water, compared to a single large reservoir. Allowing the water to flow through the reservoir stocked with waterhyacinth plants with a residence time of 3.6 days was adequate to remove about 50% of the incoming inorganic nitrogen. Allowing water to flow through a series of two small reservoirs with a residence time of 7.3 days was needed to remove about 60% of the incoming orthophosphates. Flooded fields were effective in the removal of inorganic nitrogen, but showed poor efficiency in the removal of ortho-phosphates. (Baker-FRC)
W82-06078

COMPARISON OF THE EXTRACTABILITIES OF ZN, CU, NI AND CR FROM SEWAGE SLUDGES PREPARED BY TREATING RAW SEWAGE WITH THE METAL SALTS BEFORE OR AFTER ANAEROBIC DIGESTION,

Rothamsted Experimental Station, Harpenden (England).
C. Bloomfield, and S. P. McGrath.
Environmental Pollution, Vol 3, No 3, p 193-198, 1982. 1 Fig, 2 Tab, 14 Ref.

Descriptors: Metals, *Anaerobic digestion, Sludge, *Nickel, *Copper, *Chromium, *Zinc, Wastewater treatment, Extraction techniques.

The extractabilities of zinc, copper, nickel and chromium from sludge prepared by anaerobic digestion of relatively uncontaminated raw sewage was compared in the presence of salts of the metals with those from sludge prepared from the same batch of raw sewage and equilibrated with the metals subsequent to anaerobic digestion. The digestion and sorption metal treatments enriched the sludge to roughly the same extents. Such differences as there were probably resulted from the heterogeneity of the original sewage and the consequent unequal amounts of dry matter in the various batches. Neither the digestion nor the sorption treatments had any sifnificant effect on the total contents of the metals native to the original sewage, although it is possible that the nickel sorption treatment may have displaced some zinc. All three extractants removed metals sorbed on predigested sludge more readily than those incorporated during the digestion process. Barely significant amounts of zinc, copper or chromium, either native or applied, were extracted by neutral ammonium acetate from sludge formed in the presence of the metals, but nearly 26% of the added nickel was removed by this reagent. Only slightly more nickel was extracted from the sorption product, but ammonium acetate removed between 7 and 8 times as much sorbed as digested zinc and copper. The amounts of chromium extracted by ammonium acetate from the two preparations did not differ significantly. Similarly the availabilities of the metals as determined by extraction with acetic acid or EDTA were considerably less in sludge formed by digestion in the presence of the metals than in sludge obtained by treatment with the salts subsequent to the digestion process. (Baker-FRC)
W82-06079

WASTE WATER RECYCLING BY ION EXCHANGE: II. PARTIAL DESALINATION,

Ben-Gurion Univ. of the Negev, Geersheba (Israel).
For primary bibliographic entry see Field 5A.
W82-06117

WASTE WATER RECYCLING BY ION-EXCHANGE: I. COMPLETE DESALINATION,

Ben-Gurion Univ. of the Negev, Beersheba (Israel).
For primary bibliographic entry see Field 3A.
W82-06118

ENERGY AND WATER CONSERVATION THROUGH RECYCLE OF DYEING WASTEWATER USING DYNAMIC ZR(IV)-PAA MEMBRANES,

Florida Inst. of Tech., Melbourne. Dept. of Mechanical Engineering.
Ali M. El-Nashar.
Desalination, Vol 33, No 1, p 21-48, April, 1980. 18 Fig, 4 Tab, 13 Ref.

Descriptors: *Wastewater treatment, *Membranes, Energy conservation, Water conservation, Membrane processes, *Recycling, Water reuse.

Textile dyeing operations consume large amounts of process water and thermal energy. The wastewater resulting from these operations contains various types of contaminants of organic and inorganic origin. This wastewater has an above average temperature. The possibility of renovating and recycling a major portion of this wastewater would reduce the water and energy consumption by these dyeing operations. This paper presents pilot plant test results using Zr(IV)-PAA dynamic RO membrane modules for treating dyeing wastewater. Using these results, a mathematical model was presented to evaluate the design parameters and economic feasibility of a 1000m3/day plant for treating and recyclig dyeing wastewater. The economic results show that a net profit could be obtained by recycling product water. (Balaban-Boston)
W82-06123

SURVIVAL AND FATE OF ENTERIC VIRUSES IN SOIL TREATMENT SYSTEMS FOR WASTEWATER,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, C. H. Dean, R. R. Jacobs, M. E. Knuckles, and R. E. Wagner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243650, Price codes: A03 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Report No 168 (UNC-WRRI-81-168), June 1981. 39 p, 1 Fig, 15 Tab, 25 Ref. OWRT A-090-NC(6), 14-34-0001-7070.

Descriptors: *Enteroviruses, *Wastewater treatment, *Soil types, *Soil absorption capacity, *Wastewater treatment, Path of pollutants, Viruses, Soil chemistry, Soil saturation, Clays, Organic soils, Sand, Sorption, Retention, Retention capacity, Adsorption, Adsorbents, Soil treatment systems.

Laboratory and pilot-scale studies were carried out on the interactions and survival of representatives of two different enteric virus groups (poliovirus type 1 and reovirus type 3) in 11 different soil materials in settled sewage. Three were marked differences in the abilities of the soil materials to remove/retain viruses from the sewage, but for each soil material the behavior of the two viruses was often similar. Virus absorption to soils was rapid, mostly occurring in 15 minutes. Clayey materials effectively absorbed both viruses from wastewater over a range of pH and total dissolved solids (TDS). Sands and organic soils were relatively poor sorbents, but, in some cases, their viral sorption ability increased at low pH and with the addition of TDS or divalent cations. In pilot-scale studies with 5-foot long columns (3-foot unsaturated upper zones; 2-foot, saturated bottom zones), extensive reductions of the two viruses occurred when septic tank effluent (30,000-60,000 viral plaque-forming units/ml) was applied at 1.3 inches/day over 8-week periods; no viruses were detected in extracts from the column soil materials that had relatively poor virus sorbent capabilities. It appears that extensive virus reduction can occur in such soils when there is sufficient depth of unsaturated flow; the effects of periodic rainfall, however, must be further investigated. (Zielinski-MAXIMA)
W82-06150

AUTOMATION AT NORWICH SEWAGE-TREATMENT WORK: FIVE YEARS' EXPERIENCE,

Anglian Water Authority (England).
P. Cotton.
Water Pollution Control, Vol 80, No 2, p 243-259, 1981. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Wastewater facilities, *Computers, Planning, Design criteria, Water Treatment facilities, *Norwich, Great Britain.

The Norwich sewage treatment works of the Anglian Water Authority is described. The works serves the City of Norwich and surrounding districts, and has a design DWF of 55 tcmd derived from a contributing population of 200,000 since undergoing extensions between 1973 and 1975. Preliminary treatment comprises rotary-cup screens, disintegrators and detritors. After separation of storm sewage at about 3 DWF, sewage is proportioned between two plants operating in paralled. One comprises primary sedimentation tanks , bioligical filters and humus tanks, and the other primary sedimentation tanks, diffused-air activated-sludge plant and secondary settlement tanks. Sludge treatment is also effected through two paralled plants, one comprising consolidation tanks, primary heated anaerobic digestion tanks, and open secondary digestion tanks, and the other, storage tanks and the pressure-filtration plant. Plant operations are monitored and controlled from the central control room, where the operator communicates with the computer system via the operator control panel and the logging printer. Cost analysis information is included. (Baker-FRC)
W82-06157

APPROPRIATE SELECTION OF WATER/WASTEWATER TREATMENT PROCESSES FOR SMALL CITIES AND RURAL AREAS,

Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
G. W. Reid, A. Law, and T. Chaudhry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254889, Price codes: A05 in paper copy, A01 in microfiche. Oklahoma Water Resources Research Institute, Stillwater, Report, March 1982. 78 p, 2 Fig, 11 Tab, 15 Ref, 5 Append. OWRT A-100-OKLA(1), 14-34-0001-1138.

Descriptors: *Rural areas, *Computer models, *Water treatment, *Wastewater treatment, *Water quality control, Mathematical models, Model studies, Computer programs, Mathematical studies, Social participation, Public participation, Water use, Water supply development, Water pollution control, Water pollution prevention, Project planning, Planning, Alternative planning, Water quality, *Wastewater facilities.

Small communities often have to resort to usage of highly inappropriate and sophisticated systems that are difficult to operate and maintain with regard to their water supply and sanitation needs. A computer application model is presented that will aid engineers/planners in determining a community's needs and resources. Two versions of this model

were developed: one, for use on a low-cost microcomputer; the other, for use with a hand-held calculator. Both of these versions consider the socio-technological level of the community, as well as indigenous information covering water quality and demographic data. Four communities in the rural and urban fringe in Oklahoma were selected for testing the validity of this model. The model identifies water and waste treatment alternatives which are compatible with local available resources and manpower capabilities; application of appropriate technology substantially enhances the ability of the community to satisfy its water and wastewater treatment objectives. Community information was obtained from the use of two survey questionaires to assist identification of appropriate technology for water/wastewater treatment. (Zielinski-MAXIMA)
W82-06162

APPARATUS FOR HIGH-EFFICIENT MICROBIOLOGICAL OXIDATION TREATMENT,

Hitachi Ltd. (Japan). (Assignee).
N. Shimizu, Y. Odawara, T. Yamaguchi, S. Saitou, and A. Nakaoka.
U.S. Patent No 4,203,841, 8 p, 5 Fig, 11 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 986-987, May 20, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Organic wastes, Aeration, Activated sludge, Oxygen, Equipment, Bacteria, Oxygen demand, Oxidation, *Biological oxidation, Oxygen transfer rate.

Waste water containing organic materials is introduced into an aeration tank, and is subjected to aeration treatment in the presence of activated sludge, while supplying oxygen to the aeration tank. The tank is provided with an air diffusion pipe at the bottom of the tank, an air dispersion device above the air diffusion pipe and a number of inside cylinders above the air dispersion device. An overall circulating stream and partial circulating streams are generated in the aeration tank. (Sinha-OEIS)
W82-06166

FACTORS AFFECTING FLOG FORMATION AND BULKING IN THE ACTIVATED SLUDGE PROCESS FOR TREATMENT OF TEXTILE WASTE WATERS,

Auburn Univ., AL. Dept. of Botany, Plant Pathology, and Microbiology.
W. T. Blevins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254954, Price codes: A03 in paper copy, A01 in microfiche. Report, January 1982. 23 p, 1 Fig, 4 Tab, 3 Ref. OWRT A-073-ALA(1), 14-34-0001.

Descriptors: *Textile mill wastes, *Microbiological studies, *Activated sludge, *Sludge volume index, Industrial wastes, Solid wastes, Microorganisms, Microscopic analysis, Microscopy, Bacterial analysis, Bacteria, Sewage bacteria, Sodium, Sludge, Sludge disposal, *Wastewater treatment.

A textile and municipal wastes activated-sludge facility was studied microbiologically during normal sludge settling/bulking periods, and factors influencing the degree of microbial flocculation and effluent quality were examined. Total viable numbers of bacteria were determined, and isolates were taxonomically characterized. A filamementous bacterium (resembling Eikelboom's Type 0961, known to predominate some activated-sludge reactors with low food/microorganism ratios) was the most prevalent in bulking sludge. Prevalent genera indicated relative stability in the community population structure at this facility. Predominant bacteria were species of Acinetobacter, Alcaligenes, Pseudomones, and Flavobacterium. All bacteria isolates flocculated well in synthetiuc media and/or sterilized wastewaters. Unusually high COD/BOD ratios suggested an effluent of chemically low quality, and the dominance of small flagellates (Bodo sp. and Notoscelenus sp.) implicated a resultant low quality effluent. Temperatures of 20-25 degrees and pH 8.5 support optimal settleability and lowest sludge volume index values. High sodium ion levels from the textile mill dramatically affected settleability, which improves with increasing divalent cation levels. (Zielinski-MAXIMA)
W82-06171

ORGANIC CONSTITUENTS OF MUTAGENIC SECONDARY EFFLUENTS FROM WASTEWATER TREATMENT PLANTS,

Illinois University at Urbana-Champaign. Inst. for Environmental Studies.
D. D. Ellis, C. M. Jone, R. A. Larson, and D. J. Schaeffer.
Archives of Environmental Contamination and Toxicology, Vol 11, No 3, p 373-382, 1982. 4 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Mutagens, *Organic compounds, *Effluents, Pollutant identification, Carcinogens, *Secondary wastewater, Priority pollutants, Hydrocarbons, Aromatic compounds, Phenols, Fatty acids, Chlorinated compounds, Nitrogen compounds, Pesticides, Phthalates.

Samples of mutagenically active effluents from Illinois industrial and municipal wastewater treatment plants were analyzed by capillary gas chromatography/mass spectroscopy. A total of 243 organic compounds were tentatively identified. Twenty of these were priority pollutants, and 33 were not previously detected in water samples. Among the compounds found wre hydrocarbons (straight chain, aromtic, and polyaromatic), phenols, alcohols, terpenes, ketones, aldehydes, organic acids and esters (including fatty acids and fats), plasticizers, ethers, halogenated compounds, nitrogen compouns (pyridines, anilines, etc.) and pesticides. The only known carcinogenic or mutagenic materials were N-nitrosodimethylamine and o-toluidine. However, most of the compounds detected in the effluents have not been tested for genetic activity. It is also possible that active mutagens may be present but undetected by the method of analysis used. (Casar-FRC)
W82-06178

WATER POLLUTION CONTROL PLANT UPGRADED TO MEET EPA REGS.

Civil Engineering (New York), Vol 52, No 6, p 56-57, June, 1982.

Descriptors: *Water treatment facilities, *Water pollution control, Regulations, design criteria, Philadelphia, Energy conservation, Delaware River, Water quality, River basins, Computers, Automation, Wastewater treatment, Industrial waste, Municipal waste.

A $300 million addition was made to the Southwest Water Pollution Control Plant in Philadelphia which nearly doubles the plant capacity to 210 mgd. Plant operators were consulted extensively during the design, and considerable time was spent converting operating experiences into engineering data and plans. One outcome was a computerized control system. To expedite the treatment process, the plant uses pure oxygen rather than air. The plant produces its own oxygen by using a cryogenic fractional distillation oxygen unit. Since construction took place during normal plant operation, special techniques were used to keep the process going. The waste gas is collected at low pressure from the sludge digestion tanks and is compressed by two 125-horsepower rotary gas compressors for distribution throughout the plant. Sludge gas is used for sludge heating, space heating, scum incineration and grit incineration. (Baker-FRC)
W82-06187

THE INFLUENCE OF TRANSIENT TEMPERATURE CHANGES ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
L. A. Obeng, R. Perry, and J. N. Lester.
Environmental Pollution, Series A, Vol 28, No 2, p 149-161, 1982. 8 Fig, 1 Tab, 35 Ref.

Descriptors: *Activated sludge process, *Temperature effects, Sludge, Metals, Biodegradation, Cadmium, Lead, Zinc, Copper, Heavy metals, *Wastewater treatment, *Nitrilotriacetic acid, Detergents.

Experiments were performed to determine the effects of transient reductions in temperature to values of about 12 degrees C and values of less than 10 degrees C on the biodegradation of NTA (nitrilotriacetic acid) and any consequent effects on effluent metal concentrations. To determine the effect of transient reductions in temperature, four experiments were undertaken. In each experiment two activated sludge simulations were subjected to an identical temperature shock. The two were in a comparable condition prior to treatment, except that the influent to one contained 10 mg/liter of NTA, which was being consistently biodegraded. Two temperature shocks were examined, first from 17.5 to 12.5 degrees C over 4 hr. remaining at that temperature for 8 hr, and second, from 17.5 to 9.5 degrees C in 8 hr, remaining there for 6 hr before returning to 17.5 during the following 10 hr. The results demonstrate that there were no adverse effects on the biodegradation of NTA and no effect on effluent metal concentrations when the temperature was decreased from 17.5 to 12.5 degrees C. However, a drop from 17.5 to about 9.5 resulted in incomplete biodegradation of NTA and an associated increase in effluent concentrations of cadmium, copper, lead, and zinc. These effects were reversed as the temperature was allowed to return to 17.5 degrees C. (Baker-FRC)
W82-06193

ENTERIC BACTERIA IN SUGARBEET REFINERY PROCESSING WASTE WATERS,

North Dakota State Univ., Fargo. Dept. of Bacteriology.
K. R. Mitchell, and B. R. Funke.
Environmental Pollution, Series A, Vol 28, No 2, p 81-88, 1982. 4 Tab, 20 Ref. OWRT A-057-NDAK.

Descriptors: *Bacteria, *Food-processing industry, Flumes, *Industrial wastes, *Food-processing wastes, Wastewater, Coliforms, Salmonella, Fecal bacteria, Beets, Spray irrigation, *Enteric bacteria.

Refinery processing waters at the Red River Valley and Minnesota sugarbeet processing plants were examined for enteric bacteria. At the Hillsboro, North Dakota sugarbeet refining plant the processing waters are circulated in a closed system. Water used in the flume and washer is obtained from a freshwater reservoir and, after use, is pumped through a clarifier to remove settleable solids and returned for reuse. During processing additional water accumulates from the beet. Lime is used during sugar purification and enters the wastewater stream through the clarifier. Underflow containing settleable solids from the clarifier is pumped into the lime mud pond. Water from this pond can then be pumped to a sequence of small lagoons, then through an activated sludge treatment system into the freshwater reservoir for reuse. When the reservoir is full, water is transferred into an irrigation lagoon for eventual disposal by spray irrigation. All of the tested processing waters were positive for Salmonella at least once. The soil adhering to beets was tested for Salmonella and fecal coliforms, and substantial numbers were found in some samples. While determining the source of the problem was not part of the study, all of the farmers from whose land Salmonella-containing sugarbeet originated were contacted and denied use of animal manures on their land. Samples of alfalfa grown on the irrigated plot showed no Salmonellae or fecal coliforms. Concern for aerosol transmission of Salmonella in the spray irrigation process is voiced. At present the presence of Salmonella and fecal coliforms in sugar beet refining processing waters does not appear to represent a public health hazard in relation to their disposal by spray irrigation. However, the Salmonella populations found in the early part of the processing season in flume waters, in excess of one million per 100 ml, could be a hazard for workers coming in contact with flume waters. (Baker-FRC)
W82-06195

ELIMINATION OF ODOR FROM ANAEROBIC LAGOONS,

Greeley Dept. of Public Works and Utilities, CO.
C. W. Hargett, Jr., and M. H. Rybus.
Public Works, Vol 113, No 5, p 82-83, May, 1982. 1 Fig.

Descriptors: *Odor control, *Lagoons, *Meat processing industry, *Anaerobic lagoons, Wastewater lagoons, *Wastewater treatment, Greeley, *Colorado, Biological oxygen demand, Aeration, Scum.

An anaerobic lagoon system treating meat packing plant wastes in Greely, Colorado, had persistent odor problems since its startup in 1973. Methods of odor control which were ineffective included channeling flow to only one lagoon of the four, aeration on the surface, pouring gasoline on the surface and igniting it, adding grease to improve the quality of the scum blanket, and deodorant spraying. The odor problem was eventually overcome by using heavy organic loadings (12 pounds BOD per 1000 cu ft of water) and loading one lagoon at a time to form a thick and strong scum blanket to prevent odors from escaping. (Cassar-FRC)
W82-06221

TREATMENT OF PULP AND PAPER INDUSTRY WASTEWATERS IN AN ANAEROBIC FLUIDIZED BED REACTOR,

Enso-Guzeit Osakeyhtio, Imatra (Finland).
R. Hakulinen, and M. Salkinoja-Salonen.
Process Biochemistry, Vol 17, No 2, p 18-22, March/April, 1982. 7 Fig, 5 Tab, 30 Ref.

Descriptors: *Pulp and paper industry, *Anaerobic digestion, *Fluidized beds, *Wastewater treatment, Industrial wastewater, Aerobic digestion, Biological treatment, Mutagens, Toxicity, Daphnia, Trickling filters, Bleaching wastes, Pulp wastes, Chlorophenols.

Three pulp and paper mill wastewaters (spent bleach liquor from kraft pulping, thermomechanical pulping effluent, and debarking wastewater) were treated by fluidized bed anaerobic digestion followed by secondary aerobic treatment. In the pilot plant BOD removals were: bleach liquor, 61-73% at hydraulic loadings of 1.5-3 cu m per cu m of total reactor volume; thermomechanical pulping effluent without dithionite, 94% for a loading of 1 cu m per cu m; 90% for thermomechanical pulping effluent with dithionite for a loading of 1 cu m per cu m; and 82% for debarking wastewater at a loading of 0.66 cu m per cu m. 93-95% of chlorophenolic compounds from bleach liquor at the 1.5 cu m per cu m loading were mineralized to CO2 and chloride ions. All mutagenicity (monitored by the Ames test) and toxicity to Daphnia were removed from the wastewaters. (Cassar-FRC)
W82-06226

HOW APPLETON REDUCED PHOSPHORUS,

Wastewater Treatment Plant, Appleton, WI.
P. Wachs, and E. L. Laurent.
Water/Engineering and Management, Vol 129, No 5, p 32, 34, May, 1982. 2 Tab.

Descriptors: *Phosphorus removal, *Wastewater treatment, Water treatment facilities, Appleton, *Wisconsin, Alum, Biochemical oxygen demand, Oxygen demand, Regulations, Chemical coagulation, Seasonal variations, Flow, Industrial waste.

Chemical processing facilities were installed in the late 1930s in the city of Appleton, Wisconsin, to treat domestic and industrial wastewater. The plant performed seasonal chemical treatment during periods of low river flow. Industries in the area included paper mills, canneries, dairies and small industries. The plant could not meet the modern state phosphorus concentration requirements. In the early days rduction of phosphorus was accomplished by adding metal salts. Recently, the return of the sludge oxidation decant liquor to the head of the aeration tanks interfered with the ability of the added metal salt to react with phosphorus. Liquid alum was applied in 1980 at the end of the aeration process and successfully reduced phosphorus to the required levels. The alum was compatible as a coagulant with the sludge oxidation decant liquor, and this solids reduction method is currently in use. Solids which are recovered are then concentrated and spread over nearby farm land as fertilizers. Activated sludge is moved from secondary clarifiers to four dissolved air flotation units for thickening. Primary clarifier sludge is added to the thickened sludge, and the mixture passes to a wet oxidation stage. Oxidized sludge is transferred to decant taxes. The plant now meets the state phosphorus limit of 1 mg/liter in the effluent. Increased removal efficiencies of BOD and suspended solids have also been achieved. In the returned activated sludge, total suspended solids vary from 9,000 to 11,000 mg/liter. Mixed liquor TSS range from 2,500 to 4,000 mg/liter. Sludge volume index remains between 60 and 70, which indicates very good settling. (Baker-FRC)
W82-06249

POLYMER PLAYS PLANT IMPROVEMENT ROLE,

W. VanCott, and J. F. Moore.
Water/Engineering and Management, Vol 129, No 5, p 48, 50, May, 1982.

Descriptors: *Wastewater treatment, *Phosphate removal, Economic aspects, Activated sludge process, Polymers, *Ohio, Management, Toledo.

Changes have been instituted at the Bay View Water Reclamation Plant in toledo to improve performance and stay within the limits imposed by the Ohio Environmental Protection Agency. These changes include a reduction in operating personnel, control of maintenance overtime, adoption of a preventive maintenance program, institution of chemical and energy reduction programs, implementation of operator training and safety seminars, and negotiation of a new sludge hauling and land spreading contract. A significant change in phosphate removal with resultant savings in chemicals and direct labor was also brought about through the use of a new gel polymer installation at the primary clarification stage. A steel mill waste pickle liquor was used in place of ferric chloride in the preaeration tanks, with resultant chemical cost savings of over 90%. The anionic polymer was needed to settle the iron phosphate precipitate that formed. The polymer is injected into the inlet channels of the primary clarifiers, where it contacts the phosphate floc in the wastewater stream and begins to promote settling. A gel grinding unit was installed as part of the completely automatic mixing system. This significantly reduced the time spent in the chemical building to maintain equipment and keep the area clean. Phosphorus concentration in the treated effluent averaged 0.6 mg/liter during 1980, and the plant kept within standards during 1981. (Baker-FRC)
W82-06250

A LEGACY FROM CONSTRUCTION GRANTS,

Donohue and Associates, Inc., Sheboygan, WI.
J. S. Kipp.
Water/Engineering and Management, Vol 129, No 5, p 38-40, May, 1982.

Descriptors: *Sewer systems, *Maintenance, Federal jurisdiction, Environmental Protection Agency, Grants, Construction.

Communities must begin to face wastewater related problems in innovative ways. Participation in scores of wastewater collection and treatment projects has provided consulting firms with the opportunity to observe a broad range of system conditions and configurations. During sewer system studies the full spectrum of system maintenance situations has been encountered, from emergency-only responses to planned and full scale sewer maintenance programs. The new approaches, along with recently developed repair methods and products, represent long term benefits of the declining Construction Grants Programs. A comprehensive program for collection system maintenance includes a series of support functions, inspection techniques and repair methods. Planned and carried out on a regular basis, such a program identifies, documents and repairs sewer system defects to mitigate the effects of existing deficiencies and prevent the development of new problems. A typical sewer maintenance program can consist of three distinct phases: smoke testing, surface survey of manholes and manhole frame testing; dye water flooding and complete man-hole inspection; and sewer cleaning, internal television inspection and root control. System size, sewer age, existing problems, present maintenance staff and future areas for expansion all need to be addressed when establishing a program. (Baker-FRC)
W82-06251

SEWER MAINTENANCE AND REHAB OPTIONS,

Burns and McDonnell, Kansas City, MO.
P. L. Andrews, and S. A. Yonker.
Water/Engineering and Management, Vol 129, No 5, p 38-40, 42, 46, May, 1982. 2 Tab.

Descriptors: *Sewer systems, *Maintenance, Linings, Pipes, Inspection, *Rehabilitation.

The Environmental Protection Agency has a requirement in its construction Grants proram that excessive amounts of infiltration/inflow entering sewer systems be eliminated. Concern for cost, safety and reliability has spawned new sewer cleaning and rehabilitation techniques, materials and methods. Sewer deterioration can be caused by a number of different circumstances, including corrosion or structural failure. For many years sewer cleaning was the only method other than replacement used to rehabilitate sewers. The variety of methods available for sewer cleaning includes rodding machines, bucket machines, and hydraulic cleaning devices. The effectiveness of sewer cleaning equipment will vary depending upon local conditions. Accessibility to the sewer is also a determining factor. Inspection of the sewer system is needed if other sewer rehabilitation steps are to be taken. Television inspection is the most prominent of the techniques for inspection which are available. The inspection is made to identify the type and location of defects. Rehabilitation methods once the problem is located include various methods and materials, most involving replacement or restoration of the interior surface of the pipe and the integrity of the pipe joints. Procedures external to the pipe are potentially effective as well. External methods involve methods involve the use of various grouts. Replacement or restoration of the interior pipe wall may call for slip lining, which involves inserting a polyethylene pipe with an outside diameter slightly smaller than the inside diameter of the original pipe being repaired. A recent adaptation of slip lining involves use of a resin-saturated fabric tube. (Baker-FRC)
W82-06253

THE QUANTIFICATION OF THE EMISSIONS AND DISPERSION OF ODOURS FROM SEWAGE-TREATMENT WORKS,

Warren Spring Lab., Stevenage (England). Pollution Div.
A. W. C. Keddie.
Water Pollution Control, Vol 81, No 2, p 266-279, 1982. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Odor control, Odors, Public opinion, Air pollution. Air circulation, Atmosphere.

In this paper the relative importance of sewage treatment/disposal as a source of odor complaints is briefly reviewed and then some of the problems of identifying and quantifying odorous emissions are described. The role and limitations of atmospheric dispersion in diluting odors to acceptable levels are outlined. According to a recent survey carried out in the United Kingdom, sewerage and sewage treatment still accounts for a significant number of identified sources of odors and for numerous complaints from the general public. There are many potential odor sources within a treatment works, including incoming sewage, primary sedimentation, biological treatment and holding tanks, sludge digestion and sludge disposal. While it is hard to quantify the volume flow of odorous air

and consequently the odor emission rate, these difficulties can be partly overcome by making use of the knowledge of atmospheric dispersion. Chemical analysis of odorous compounds emitted from sewage works, using methods based on gas chromatography, has met with only limited success in respect to identifying source and quantification. Using relatively simple dispersion formulae, corrected for the fact that the human nose responds to stimuli of only a few seconds duration, and given an estimate of the total emission from a works it is possible to calculate the potential for complaints from the public for a works in question. (Baker-FRC)
W82-06255

EXPERIMENTAL DATA ABOUT WASTEWATER TERTIARY TREATMENT WITH OZONE,

Trailigaz Co. (France). Research and Application Dept.
J. P. Legeron.
Water Pollution Control, Vol 81, No 2, p 166-176, 1982. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Ozone, *Tertiary wastewater treatment, Advanced wastewater treatment, Sewage, Coliforms, Bacteria, Disinfection.

Ozone treatment was tested in a pilot plant on semi-industrial effluents, which also included waste from hospitals and clinics. The wastewater in question had previously been given treatment comprising screening, grit and oil removal, primary sedimentation, biilogical treatment by activated sludge and secondary settlement. It was then discharged into a river reaching the sea less than 10 km downstream. The risk of health and hygiene problems had to be reduced by disinfection because oyster farms and bathing areas were located near the mouth of the river. The pilot plant includes an ozone generator and a gas-liquid contact system. With this equipment 36 g of ozone can be produced per hour at a 2% concentration by weight. With a distribution pattern of 40%, 40%, 15% and 15% and a dosage rate of 10 mg ozone per liter of effluent, a total coliform content of no more than 1000/100 ml can be obtained in most cases. A retention period of 11 minutes 20 seconds proved more effective than 20 minutes. While a relation was found between the effective dosage rate and the ozone content in the carrier gas, the reduction in coliforms also depended on water quality. Ozone can also be injected so that only traces of dissolved ozone will be present in the water at the outlet from the first column, with a concentration of 0.3 mg/liter in the effluents from the other three columns, without impairing the degree of disinfection. Such a factor can be used for setting up a process control system linking ozone production to the quality variations of the sewage effluent. (Baker-FRC)
W82-06257

SEWAGE SLUDGE PUMPING - RECENT RESEARCH AND APPLICATION,

North-West Water Authority (England).
A. P. Michaelson, J. L. Thompson, A. M. Bruce, and R. C. Frost.
Water Pollution Control, Vol 81, No 2, p 220-240, 1982. 14 Fig, 2 Tab, 19 Ref.

Descriptors: *Sludge, *Pumping, *Reviews, Economic aspects, Conveyance, Rheology, *Wastewater treatment, Pipelines, Hydraulics, Design criteria, Viscosity, Mathematical studies, Model studies, Sludge thickening, Pumps.

This paper provides a broad account of the results obtained from two studies, one related particularly to the use of pipelines for transporting sludges over very long distances, and the other on sludge pumping. The rheological behavior of sewage sludges is generally described as 'non-Newtonian' and is more complex and variable than that of Newtonian fluids. In designing a system for pumping sludges it is essential to obtain an accurate estimate of the friction losses likely to occur over the range of designflow rates and likely pipe diameters. Rule of thumb assumptions about the flow behavior of sludges may lead to substantial errors in prediction of head losses under some flow conditions. Even pipelone systems of relatively short length, such as within a system, can present design uncertainties, especially where thickened sludges are to be pumped. For most types of sludge, friction head losses in pieplines when flow is in the turbulent range are normally no greater than 1.5 times those for water flowing at the same velocity. To predict head losses it is necessary to determine the actual flow characteristics of the particular sludge. The resistance to flow of different sludges is variable and influenced by solids content. The design philosophy should be based on an operating velocity which is high enough to ensure transitional flow for the thickest sludge. (Baker-FRC)
W82-06258

THE USE OF OXYGEN IN SEWAGE TREATMENT,

Wessex Water Authority (England).
R. G. Toms, and M. G. Booth.
Water Pollution Control, Vol 81, No 2, p 151-165, 1982. 4 fig, 6 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Oxygenation, *Reviews, Aeration, Activated sludge process, Sludge, *Oxygen, Wastewater treatment facilities, Unox process, Nitrification.

A broad review is offered of the use of oxygen in the treatment of sewage. A high rate oxygen activated sludge treatment process was first developed in the early 1960s, using oxygen in place of air to accomplish biochemical oxidation. Such treatment was begun in 1976 by the Wessex Water Authority due to the small land requirement for the process to be effective. This was the first Unox plant to be built in the United Kingdom, and its efficiency has been studies in detail. Oxygen treatment was also used to uprate an activated plant at Holdenhurst. An examination of the plant showed that the aerators in the activated sludge process were not able to maintain a satisfactory dissolved oxygen content of 4% saturation half-way along the aeration lanes with a minimum of 10% saturation at the outlet. The low DO content caused the plant to produce an effluence below acceptable standards. An additional 5.5 tonnes/day of oxygenation capacity were needed for full nitrification. Additional oxygenation capacity, once installed, resulted in a good quality effluent being produced, with about 91% of the BOD load and 13% of the ammonia load being removed. Oxygen was also used to treat sewage in a rising main. The Saltford sewage treatment works became overloaded and in the early 1970s did not produce an acceptable effluent. Peformance at the plant was seriously affected by a poor-settling activated sludge, associated with the presence of filamentous bacteria in the influent, whose presence was attributed to the fact that the crude sewage was septic. Oxygen was injected into the bottom of the rising main in the pumping station, eliminating the filamentous bacteria, but not improving settleability of the activated sludge. (Baker-FRC)
W82-06262

MAINTENANCE OF ANALOG INSTRUMENT SYSTEMS,

Turbitrol Co., Atlanta, GA.
E. F. Morey.
In: Water/Engineering and Management, Reference Handbook--1982, p 6-7, May, 1982.

Descriptors: *Maintenance, *Measuring instruments, Operating costs, Planning, Electrical equipment, Hydraulic equipment, Laboratory equipment, Mechanical equipment.

Basic ideas and principles of instrument maintenance in water and wastewater treatment plants are considered. Instrument maintenance may be divided into two main areas - the management aspect and the technical phase. Management involves decisions about how to establish the manpower that will be needed to peform the work and procedures for establishing the acutal maintenance programs. The technical areas involve the aspects of maintaining, adjusting, and repairing instrument maintenance shop available where bench service work can be performed. Good documentation is essential for proper operation of an instrument maintenance department. Some type of record system is needed to permit maintaining a chronological history of the maintenance and repair work done on each instrument device. For pneumatic and electronic instruments it is essential that the system be protected from problems associated with a bad air supply and a 'noisy' power supply. Electronic instrumentation should be provided with filters for the supply to the devices. Well-designed instrumentation and control systems have the potential of providing significant increases in plant operating efficiency. In order for proper maintenance to be done the operating staff will have to have that level of confidence that will result in a better job performed with higher efficiency. (Baker-FRC)
W82-06263

HOW TO SET UP A PREVENTIVE MAINTENANCE PROGRAM,

Operation Management Services, Wilton, CT.
B. W. Dahl.
In: Water/Engineeing and Management, Reference Handbook-1982, p 8-12, May, 1982. 2 Fig, 1 Tab.

Descriptors: *Maintenance, *Planning, *Wastewater facilities, Electric equipment, Hydraulic equipment, Mechanical equipment, Laboratory equipment, Measuring instruments.

A preventive maintenance program in a wastewater treatment plant calls for secheduled cleaning, lubrication and minor adjustment of parts that do not require major overhaul or repair. The basis of such planned maintenance is scheduled inspection of all facilities, including inspection of all electrical switch gear and instruments as well as the mechanical equipment. This leads to discoveries of equipment that could cause breakdowns or harmful deterioration to occur. The first step in developing such a system is to determine the needed information. The second step is to make a preliminary assessment of the size and scope of the plant and the resultant preventive maintenance system so that one can intelligently select the hardware appraoch to be used. General components of the system must be defined, including an equipment identification system, a record of facts on each piece of equipment, a schedule for documentation of service performance, and a format for monitoring inventory of spare parts. Aside from the basic hardware all systems have the same pattern of data flow, consisting of the equipment lists along with all the specific data and schedules on each piece of equipment. This data forms the data base for system operation. The development of a preventive maintenance system calls for the initial survey of the size of the system needed and selection appropriate hardware, the assembly of all specific information on the equipment, and the fine tuning of the system. (Baker-FRC)
W82-06264

REMOVAL OF INORGANIC MERCURY FROM WATER BY BITMUMINOUS COAL,

Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
M. P. Pandey, and M. Chaudhuri.
Water Research, Vol 16, No 7, p 1113-1118, July, 1982. 4 Fig, 4 Tab, 15 Ref.

Descriptors: *Mercury, *Water treatment, Sorption, Adsorption, Coal, Oxidation, Activated carbon, Carbon, *Wastewater treatment.

Results are presented from a study conducted to screen a number of Indian bituminous coal samples for mercury sorption in water and improve the sorption capacity of the most promising one through chemical pretreatment. Continuous column studies were also conducted using mercury levels that are commonly encountered in natural water supplies or industrial wastewaters. The kinetics of mercury sorption onto activated carbon and coal samples was investigated. The two activated carbon samples were used as references to compare the performance of the coal samples. For all the sorbents the time required to attain equilibri-

um sorption was about 12 hr. Filtrasorb 400 and Laxmi Carbon were comparable in terms of their initial rates of sorption as well as equilibrium mercury sorption capacities. Inital rates of sorption for Margherita and Makum coals were slightly lower compared to those for Giridih and singareni coals. Mercury sorption onto Giridih coal was temperature dependent and decreased with rising pH as well as chloride and calcium concentrations. Sorption follows the Freundlich equation and involves a rapid interaction between mercury and the active sites on the external surface of coal, followed by intraparticle diffusion of mercury for further rection. Chemical pretreatment of coal such as with nitirc acid oxidation, sulfonation and sulfurization further improved the sorpiton capacity. Column studies indicated the feasibility of using coal for removing mercury from water supplies or industrial wastewater. (Baker-FRC)
W82-06265

OPERATION OF HIGH-RATE OXIDATION PONDS: THEORY AND EXPERIMENTS,

Technion-Israel Inst. of Tech., Haifa (Israel).
Y. Azov, and G. Shelef.
Water Research, Vol 16, No 7, p 1153-1160, July, 1982. 6 Fig, 4 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Oxidation ponds, Oxidation lagoons, Lagoons, Temperature effects, Seasonal variation, Algal growth, Eutrophication, Solar radiation.

This study was aimed at achieving maximum algal biomass production and wastewater reclamation from a high oxidation pond through designing an operational strategy that would require minimal pond area for year round aerobic operation of the pond. It was assumed that increasing the algal portion of the total biomass produced in the pond would result in increased nutritional value of the biomass, subsequently harvested for use as protein rich animal feed. Theoretical considerations and year round outdoor pilot plant experiments were studied to compare the different basic approaches of large scale high-rate oxidation ponds (HROP) operation aimed at optimizing the performance of the system. Major factors affecting pond performance were solar radiation and water temperature: the former mainly determines maximal algal productivity, and the latter determines optimal retention time operation. Pond area and depth are the only true independent variables which may be manipulated to produce optimal retention time in year round operation. In the tropical regions, a constant retention time is most adequate for optimal operation, as water temperature is fairly constant year round and a constant area and depth strategy can be adopted. In moderate climates seasonally variable retention time is preferred, and it was found to be most economically achieved by varying pond depth at constant area. Another plausible strategy with possible economic advantages is a combination of dual function ponds, operating solely for wastewater treatment during winter, while some are converted into fish-rearing ponds during summper. (Baker-FRC)
W82-06266

A REVIEW OF THE MECHANISM OF POWDERED ACTIVATED CARBON ENHANCEMENT OF ACTIVATED SLUDGE TREATMENT,

C-E Natco, Tulsa, OK.
K. L. Sublette, E. H. Snider, and N. D. Sylvester.
Water Research, Vol 16, No 7, p 1075-1082, July, 1982. 1 Fig, 1 Tab, 47 Ref.

Descriptors: *Activated sludge process, *Reviews, *Wastewater treatment, Carbon, Sludge, *Activated carbon, Chemical reactions, Synergistic effects.

This paper reviews the available literature concerning powdered activated carbon enhancement of activated sludge treatment. Much investigative work has been devoted in the past 10 years to understanding the interaction of carbon adsorption and biological activity. Simple addition of effects seems unlikely, and an apparent synergism has been suggested. The source of this synergistic effect has been attributed to stimulation of biological activity through removal of inhibitory substances or concentration of nutrients and to bioregeneration of the adsorptive capacity of activated carbon. The relative importance of these synergistic mechanisms appears to depend largely on the characteristics of the wastewater and the nature of the organisms that make up the biomass. Removal of inhibitory substances and bioregeneration are most important with regard to activated sludge treatment of complex wastewaters. More study is needed to elucidate the complex relationship between the presence of an adsorptive surface and the performance of a biological treatment system. Considerable insight could be gained from using simple nutrient solutions containing single organic carbon sources as feeds. If extracellular enzymes can be detected in a biological reactor by virture of the production of metabolic intermediates in the bulk medium, an investigation of the effects of activated carbon on the degradative activity of medium made cell free could be enlightening. (Baker-FRC)
W82-06268

EFFECT OF TEMPERATURE ON HEAVY METAL BINDING BY ANAEROBICALLY DIGESTED SLUDGES,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences.
M. S. Gould, and E. J. Genetelli.
Water Research, Vol 16, No 5, p 749-753, May, 1982. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Heavy metals, *Digested sludge, *Adsorption, *Fate of pollutants, *Regression analysis, Mathematical models, Cadmium, Nickel, Copper, Zinc, Hydrogen ion concentration, Statistical analysis, Temperature effects, Mathematical studies, Enthalpy, Entropy, Model studies, *New Jersey.

The effect of temperature on the binding of Cu, Zn, Cd, and Ni to anaerobically digested sludge was investigated using sludge from the sewage treatment plant at the Marlboro State Hospital in New Jersey. Two different procedures were used for equilibrating and adjusting the pH of heavy metal salt and sludge mixtures. Solids metal content, soluble metal concentration and pH were determined after each equilibration, and results were analyzed by regression analysis using the Statistical Analysis System. The effect of pH, temperature, and solute concentration on heavy metal partitioning with sludge solids was estimated using the van't Hoff equation combined with the Freundlich isotherm and a pH term. Enthalpies for Zn, Ni, and Cd reflect overall endothermic behavior, while results for Cu show that changes in temperature have very little effect. Entropy effects were more suitable than enthalpy effects in explaining the high stability associated with heavy metal/sludge binding. When the temperature is decreased, Zn, Ni, and Cd are solubilized. (Geiger-FRC)
W82-06270

BIOLOGICAL EQUILIBRIUM IN A WASTEWATER RESERVOIR,

Ben Gurion Univ., Sed. Boker (Israel). Lab. for Applied Environmental Microbiology.
A. Abeliovich.
Water Research, Vol 16, No 7, p 1135-1138, July, 1982. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Wastewater lagoons, Reservoirs, *Anaerobic conditions, Algae growth, Oxidation, Municipal wastes, *Israel, Ram reservoir.

Observations were carried out during 1979-1980 in the Ram reservoir, located 2 km east of Beer-Sheva, Israel. The reservoir is 6 meters deep, its area is 20 acres, and it is able to store up to 500,000 cubic meters of effluent from the local municipal oxidation ponds. At present the deep Ram wastewater reservoir behaves as a biologically stable water body with respect to both algal species and algal concentration, in spite of the great diurnal and seasonal variability in water quality and the fluctuations in the various physicochemical and biological parameters measured such as temperature, concentration of biochemical oxygen demand, and ammonia. This stability suggests the presence of factors that prevent any succession of species and development of blooms of any algae. A crucial factor in maintaining aerobic conditions at the surface seems to be water depth. During the summer, as long as the water was deep enough to build a stable thermocline to trap all sulfides, ammonia, and particulate organic matter, the surface water could be safely pumped for irrigation. During the winter, water depth and organic load did not play such a critical role in the reservoir, which was generally anaerobic throughout the water column except for the upper 50-100 cm during the day and 10-25 cm during the night. (Baker-FRC)
W82-06282

OXIDATION OF AQUEOUS PHENOL SOLUTIONS IN THE PRESENCE OF POLYELECTROLYTES,

Wollongong Univ. (Australia). Dept. of Chemistry.
J. Land, and J. Ellis.
Water Research, Vol 16, No 7, p 1139-1145, July, 1982. 3 Fig, 6 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Phenols, Industrial wastes, Toxicity, Chemical coagulation, *Biological wastewater treatment, Chemical reactions, Oxidation, Separation techniques, Polyelectrolytes, Electrolytes.

A study was made of the oxidation of phenols with Fenton's reagent in the presence of polyelectrolyte, to explore the possibility of binding phenol oxidation products to the polyelectrolyte and thus removing them by sedimentation instead of by exhaustive oxidation. The polyelectrolytes selected for study were polyethyleneimine (PEI) and polypropyleneimine (PPI). The precipitation of early oxidation products with PEI provided an alternative to exhaustive chemical oxidation as a means of detoxifying phenolic effluents. The properties of the PEI/oxidized phenol adduct showed some similarities to those of corresponding precipitates obtained with complex humic materials and colored substances. Any substituted phenol which can be chemically oxidized to a 1,2-dihydroxybenzene can be aerially oxidized to products which form an insoluble adduct with PEI. The efficiency of this reaction and its tolerance to varying PH and overdose of PEI increases with increasing molecular weight of the PEI. Although the procedure does not alone reduce the phenol concentration to the desired 0.1 mg/liter for discharge, it does show potential for use as a chemical pre-treatment step of high strength effluents which would otherwise be very harmful to a biological treatment system. (Baker-FRC)
W82-06283

DESIGN CRITERIA FOR A COAGULATION-FLOCCULATION PLANT FOR SEWAGE,

Ministry of Transport and Public Works, Middleburg (Netherlands).
J. Leentvaar, R. E. Roersma, and T. S. J. Ywema.
Zeitschrift fuer Wasser und Abwasser Forschung, Vol 14, No 1, p 1-6, February, 1981. 7 Fig, 9 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Design criteria, Sludge, *Flocculation, *Coagulation, Sewage, Pilot plants.

The aim of this study is to obtain some design criteria for a coagulation flocculation plant that operates with domestic sewage. Parallel to these pilot plant experiments jar-tests were carried out to determine the optimal detention time in the different units and the optimal mixing intensity. Experiments were carried out with raw unsettled sewage of the village of Bennekom, which is mainly of domestic origin. The batch experiments demonstrated that a short and intensive mixing period of sewage and coagulant was favorable, although air burst within the fluid was disadvantageous. It was evident that the rapid mix period in the reactor should be equal to or longer than the mixing time required for complete mixing of the liquid in the tank. In batch experiments a G value of about 700/

sec for 7 s gave the best results. In pilot plant studies it was nearly impossible to measure exactly the G value of the rapid mix unit. Also in the pilot plants a higher G value was advantageous together with a plug flow system. The design of the flocculator involves selection of reactor configuration, velocity grdients and detention time. Previous experiments and general design foundations indicated that square tanks would be favorable. The pilot plant experiments indicated that the total organic carbon removal increased strongly using a floc blanket in the sedimentation tank. The sludge properties were not influenced strongly by the design variations of flocculator or sedimentation tank. (Baker-FRC)
W82-06298

OXIDATION PRODUCTS AND RATES OF REACTION IN THE OZONOLYSIS OF DIEBENZOFURAN,

Wesleyan Univ., Middletown, CT. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-06305

WASTEWATER CHARACTERIZATION AND TREATMENT SYSTEM DEVELOPMENT FOR A BLUE CRAB PROCESSING PLANT,

Maryland Univ., College Park. Water Resources Research Center.
F. W. Wheaton, K. M. Lomax, and G. Geiger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256520, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 65, April 1981. 29 p, 4 Fig, 6 Tab, 14 Ref. OWRT A-044-MD(1), 14-34-0001-0122.

Descriptors: Blue crabs, Waste disposal, Seafood, Filtration, *Food-processing wastes, Industrial wastes, *Wastewater treatment, *Crabs, Effluent.

Blue crab processing plant liquid effluent was divided into washdown, hand sink and retort effluent. Each stream was characterized using standard water quality parameters. The wastewater was then subjected to settling, flocculation with alum and chitin, centrifuging, foam fractionation, microscreening or aerobic or anaerobic biological treatment and the resultant water quality determined. Aerobic biological treatment appeared to be the most promising method for meeting water quality guidelines. A wastewater treatment system, consisting of a 60-mesh screen, aerated biological treatment with about a two day retention time and chlorine disinfection, was installed in a blue crab processing plant. The 60-mesh screen significantly reduced total suspended solids (TSS) concentrations but not the BOD sub 5. Aerated biological treatment had reduced BOD sub 5 significantly but had little effect on TSS, volatile and non-volatile solids. Chlorination adequately reduced bacterial populations to below 70 MPN/100 ml. (Author abstract)
W82-06306

WATER REUSE BY METAL REMOVAL FROM INDUSTRIAL PLATING EFFLUENTS,

Rhode Island Univ., Kingston.
F. J. DeLuise, and S. M. Barnett.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256538, Price codes: A02 in paper copy, A01 in microfiche. Report, September 1981, 22 p, 11 Fig, 9 Ref. OWRT A-073-RI (1). 14-34-0001-1142.

Descriptors: *Metal-finishing wastes, *Water reuse, Industrial wastes, Flotation, *Microgas dispersions, Effluents, *Wastewater treatment, Copper, Nickel, Chromium, Lead, Zinc.

Microgas dispersions (MGD) have been used in a flotation process to remove copper, chromium, nickel, lead, and zinc from aqueous solutions. Solutions of each metal individually, and mixtures of all the metals were synthetically prepared and treated for removal. Removal of these metals from an actual industrial plating effluent was also studied. Metal removals of up to 100 per cent were obtained from solutions of metals ranging in concentration from 2 to 20 ppm. In addition, plating wastes containing several metals were successfully treated. The most efficient treatment system employed the use of a cationic surfactant with precipitate floatation.
W82-06307

ADSORPTION OF ARSENITE AND ARSENATE ON AMORPHOUS IRON HYDROXIDE,

Arizona State Univ., Tempe. Dept. of Chemistry.
M. L. Pierce, and C. B. Moore.
Water Research, Vol 16, No 7, p 1247-1253, July, 1982. 8 Fig, 3 Tab, 13 Ref.

Descriptors: *Arsenic, *Adsorption, Sediments, *Iron hydroxide, *Arsenates, Mining wastes, Industrial wastes, *Wastewater treatment.

This study was undertaken to establish quantitatively the isotherms of arsenite and arsenate adsorption on amorphous iron hydroxide at concentrations which range over four orders of magnitude and a wide range of pH. The adsorption capacity of amorphous iron hydroxide was extremely high for arsenic. Adsorption continued to take place even at the highest concentrations of arsenic studied. For initial arsenic concentrations up to 667 micromoles/liter (50 ppm) removals on the order of 35% at a pH of 4 were found, which amounted to an adsorption of 50 millimoles/g. At low concentrations the isotherms obeyed equations of the Langmuir type. At higher concentrations the adsorption isotherms were linear, indicating the existence of more than one type of surface site on the amorphous iron hydroxide adsorbent. Removal of arsenite and arsenate by amorphous iron hydroxide throughout the concentration range were determined as a function of pH. By careful seletion of the relative concentration of arsenic and amorphous iron hydroxide and pH, removals on the order of 92% can be achieved. (Baker-FRC)
W82-06311

ANAEROBIC FILTER TREATMENT OF MOLASSES DISTILLERY SLOPS,

Agriculture and Forestry Univ., Vienna (Austria). Dept. of Applied Microbiology.
R. Braun, and S. Huss.
Water Research, Vol 16, No 7, p 1167-1171, July, 1982. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Anaerobic digestion, *Food-processing wastes, *Distillery wastes, Industrial wastes, *Wastewater treatment, Anaerobic conditions, Beet molasses.

Laboratory and pilot scale anaerobic filter digestion of beet molasses distillery slops were examined as a method of treating these high-strength industrial wastewaters. The slops used had an average dry matter content of between 4.8 and 63% (w/v). Methane fermentations were initiated by adding sludge from municipal sewage sludge digesters at a concentration corresponding to 30% (v/v) of the water filled filters and a dosage of diluted molasses slops (slops:water = 1:). Initial retention times were set between 4 and 6 days. As the volatile fatty acid concentration decreased, the volumetric load was gradually increased by reducing the retention time. Anaerobic flter treatment proved feasible without either pretreatment or water dilution of the slops at comparably high volumetric loadings and low residence times. There was no difference in the efficiencies of the laboratory and the pilot scale reactors. After continuous operation for 1 year there was no obvious sign of clogging. After dismantling the filter the bacterial sludge was easily rinsed from the packing material. The major part of the sludge was submerged in the void space of the filter packing. A considerable improvement in the gas productivity could be achieved through the addition of iron sulfate. Volumetric loadings of up to 50 kg organic dry matter/cubic meter/day, corresponding to a hydraulic residence time of about 1 day, were achieved. (Baker-FRC)
W82-06312

MODELLING OF THE ACTIVATED SLUDGE PROCESS FOR MICROPROCESSOR-BASED STATE ESTIMATION AND CONTROL,

Helsinki Univ. of Technology, Espoo (Finland).
A. Holmberg.
Water Research, Vol 16, No 7, p 1233-1246, July, 1982. 13 Fig, 5 Tab, 32 Ref.

Descriptors: *Activated sludge process, *Model studies, Computers, *Microprocessors, *Wastewater treatment, Mathematical studies, Biochemical oxygen demand, Oxygen demand, Sludge, Oxygen uptake, Algorithms, *State estimation.

This study was aimed at developing and implementing a microprocessor based estimation and control system for the activated sludge process. A simple dynamic process model suitable for state estimation and control using microprocessors is presented. An estimation algorithm for estimation of the biochemical oxygen demand loads of the influent and effluent was developed and implemented using micro-processors. The algorithm also estimated the concentration of sludge and active mass in the different stages of the process and also sludge growth, using available on-line measurements and the oxygen utilization rate, for which a separate estimation method was needed. An algorithm was developed for on-line determination of the oxygen utilization rate and the oxygen transfer coefficient, which are prerequisites for state estimation. A comparison was made of control strategies. The study comprised two experimental periods at a research plant corresponding in size to a municipal treatment plant for 1000-1500 inhabitants. Control of the activated sludge process is discussed and concluded to be a hierarchical two-level problem. The upper level control actions are aimed at bringing the process to an optimal state of operation. For this purpose verbally formulated control laws are used. On the lower level the control task is to maintain the process in the optimal state. (Baker-FRC)
W82-06324

EFFECTIVE PROJECT MANAGEMENT,

CH2M/Hill Inc., Corvallis, OR.
J. Van Munster.
In: Water/Engineering and Management, Reference Handbook-1982, p 17-18, 20-22, May, 1982. 3 Fig.

Descriptors: *Management, *Planning, Construction, Management planning, Project planning, Personnel management.

Construction management is a system than can be implemented as a professional instrument on water and wastewater projects to complete them successfully in spite of the increasingly complex constraits of the marketplace. The principal phases of construction management program are project setup, which establishes the management tools and guidelines for the project; project delivery analysis and management plan, which defines the management tools and technique for selected delivery approach; and implemeting the contruction management approach, which describes the application of the construction management program during design and construction. The advantages that such a management process offers include a comprehensive management program, which provides continuity from project conception through completion; implementation of a management system specificaly tailored to the particular requirements of the project; a flexible management approach that permits the owner to select only those services needed to augment his capabilities; a single source of responsibility for all phases of the work; the management expertise and needed tools to manage problems associated with communication, responsibility definition or coordination throughout the life of the project; and a potential savings from reduced overhead cost of all team members who have less management responsibility. (Baker-FRC)
W82-06328

EXTRACTION OF PHENOLIC COMPOUNDS AND ORGANIC ACIDS BY LIQUID MEMBRANES,

Exxon Research and Engineering Co., Linden, NJ. Corporated Research Technology Feasibility Center.
R. E. Terry, N. N. Li, and W. S. Ho.
Journal of Membrane Science, Vol 10, No 2/3, p 305-323, 1982. 11 Fig, 5 Tab, 12 Ref.

Descriptors: *Separation techniques, *Perselective membranes, *Membrane processes, Phenols, *Organic acids, *Wastewater treatment, Membranes, Industrial wates. Semipermeable membranes, Permeability, Model Studies, Mass Transfer.

The application of liquid membrane technology in removing phenolic and organic acid contaminants from wastewater streams is described. As the phenolic compounds and organic acids permeate throught the liquid membranes into emulsion droplets, they react with caustic, the main reactive agent, and become ionized. The ionized species which cannot permeate the liquid membranes are held in the emulsion droplets. A mass transfer model is presented which describes the extraction process. More than 99% of phenol and cresol can be extracted in see than 1 minute, while acetic and propionic acids can be extracted at a much slower rate. The phenolic compounds are extracted at a pH of 7, while the acids can only be extracted low pH. The extraction rates for acetic acid and phenol are the same in individual-compound and binary-mixture permeations. (Geiger-FRC)
W82-06331

REMOVAL OF ZEOLITE TYPE A DURING PRIMARY SEDIMENTATION AND ITS EFFECT ON METAL REMOVAL,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
A. C. Rossin, R. Perry, and J. N. Lester.
Water Research, Vol 16, No 7, p 1223-1232, July, 1982. 2 Fig, 6 Tab, 26 Ref.

Descriptors: *Zeolites, *Wastewater treatment, Zeolite process, Sedimentation, Lead, Copper, Zinc, Chromium, *Heavy metals, Suspended solids.

The removal of zeolite type A in a pilot scale primary sedimentation system operating in the field, and its effect on metal removal, are reported. With one zeolite free pilot plant acting as a control to the other it was also possible to determine the effect of zeolite on suspended solids and heavy metal removal over a range of hydraulic loadings. At both influent concentrations of zeolite studied (30 and 60 mg/liter) zeolite removal was substantial under all conditions. No evidence of enhanced removal of suspended solids in the presence of zeolite was noted. Removals of lead, zinc, copper and chromium were slightly enhanced in some experiments. The observed improvements in metal removal appeared to be strongly influenced by the sewage matrix. (Baker-FRC)
W82-06338

OPERATING COLLECTION SYSTEMS UNDER FISCAL STRESS,

Charlotte-Mecklenburg Utility Dept., NC.
C. L. Hamilton.
In: Water/Engineering and Management, Reference Handbook-1982, p 23-25, May, 1982.

Descriptors: *Financial aspects, *Management, Personnel management, Management planning, Planning, Mechanical equipment.

Municipal managers have been forced into a painful reassessment of existing operations due to the current conditions of fiscal retrenchment at the national level, coupled with the fact that local revenue sources have reached practical political limits. In Charlotte, North Carolina, three critical objectives were sought: to minimize redundancy and maximize efficiency of existing cleanup programs through development of a problem-history-based preventive maintenance effort; to re-examine existing methods of personnel and equipment usage with the aim of detecting and eliminating nonutilized time and correspondingly increasing productivity and efficiency; and to develop comprehensive management information systems that would facilitate implementation and monitoring of the other two objectives. While this effort did not reach all available alternatives in dealing with budgetary retrenchment, there was no question that the effort would continue to pressure for further reductions in the cost of services. (Baker-FRC)
W82-06340

ROTATING BIOLOGICAL CONTACTOR SCALE-UP AND DESIGN,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, and D. F. Kincannon.
In: Water/Engineering and Management, Reference Handbook-1982, p 48, 50-54, May, 1982. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Design criteria, *Rotating biological contactor, Kinetics, Biochemical oxygen demand, Oxygen demand.

Experience gained over the past ten years in the scale-up and design of rotating biological contactor systems is reviewed. Performance data, operating information and kinetic data can be obtained from bench and pilot scale RBC systems for designing full scale systems. One major consideration in using RBC systems is whether the removal efficiency is dependent on the substrate concentration of the wastewater or the hydraulic flow rate. In fact, both flow rate and organic concentration exhibit definite relationships with substrate removal rate and efficiency. Another design approach considers the amount of soluble substrate removed per unit of surface area for each stage of a multistage RBC system. Any design method based on zero, first or second order rate kinetics will be limited to loading conditions within a specific loading range for design of RBCs. The total organic loading design method can accurately predict the amount of biochemical oxygen demand removed per applied BOD loading regardless of apparent zero, first or second order kinetics. The excellent fit of the Monod-type relationship to BOD removed vs. BOD applied allows prediction of BOD removal for any applied loadings desired by application of monomolecular kinetic analysis. The primary mechanism of oxygen transfer in RBC systems appears to be transfer from the gas phase into the liquid flowing over the media during rotation. To effectively accomplish scale-up of RBCs from pilot data, the oxygen transfer capabilities and limitations of the full scale systems must be defined. (Baker-FRC)
W82-06344

DESIGN AND OPERATION OF ANAEROBIC SLUDGE DIGESTION SYSTEMS,

Los Angeles County Sanitation Districts, Whittier, CA.
W. E. Garrison, C. A. Nagel, and R. S. Easley.
In: Water/Engineering and Management, Reference Handbook-1982, p 68-72, May, 1982. 2 Fig, 1 Tab.

Descriptors: *Sludge digestion, *Design criteria, Anaerobic conditions, Anaerobic digestion, Digestion, Biological treatment, Biodegradation, Sludge, Wastewater treatment, Sludge disposal, Digested sludge, Fuel.

Various design and operting principles used over recent years in the Sanitation Districts of Los Angeles County have demonstrated that anaerobic digestion can be a very reliable and safe unit operation in a modern sewage treatment plant. The benefits derived in energy return and lack of plant nuisance make the effort rewarding. Rapid acceleration of energy costs in future years will make the anaerobic digestion of sludge solids a vital part of many modern sewage treatment systems. The basic advantages of such a plan include energy recovery, reduced odor potential in subsequent handling, reduced health risk for composting and recycle, and sludge storage and equalization for subsequent dewatering stages. The California plant described treats 15 cubic meters/ sec of sewage in an advanced primary system and currently produces 160,000 cubic meters per day of digester gas, of which 50% is used in the plant and the balance sold to an adjacent oil refinery. Digester gas is used by reciprocating engines to drive large pumps and generiors and as a fuel source in boilers to produce steam for digester heating. Specifics are discussed for the master plan for circular digesters, digester sizing, the mixing system, the heating system, the cleanout system, and safety features. (Baker-FRC)
W82-06347

ROTATING BIOLOGICAL CONTACTOR SYSTEM DESIGN,

Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, and E. D. Smith.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 578-588, June, 1982. 11 Fig, 3 Tab, 19 Ref.

Descriptors: *Design criteria, *Wastewater treatment, *Rotating biological contactor, Biochemical oxygen demand, Oxygen demand, Wastewater treatment facilities.

The practical application of Wu's model for the prediction of soluble biochemical oxygen demand removal in rotating biological contactor systems is discussed extensively for various operating conditions. In the predictive model wastewater with or without pretreatment is fed on a once-through basis to RBC systems for biological oxidation of waste matter. Recycling of RBC effluent back to the early stages of the system has not been practiced, as no significant increase in treatment efficiency could be related to this practice. Apparently the major factors which directly influence the efficiency of RBC wastewater treatment systems are: influent wastewater characteristics, flow rate and surface hydraulic loading, disc rotation speed, submerged disc depth, liquid retention time, and wastewater temperature. By using the proposed mathematical model, design of mechanical-drive RBC plants for carbonaceous removal can be easily and precisely performed. Calculating the required surface hydraulic loading rate, variables such as influent soluble BOD concentration, wastewater temperature, and others can be thoroughly investigated and determined. The total disc surface area required is equal to the design wastewater flow divided by the calculated surface hydraulic loading. The precision for the percentage of biochemical oxygen demand removal resulting from the use of this model was about 4.64% for the data sets tested. (Baker-FRC)
W82-06355

NITRIFICATION KINETICS AND ITS RBC APPLICATION,

Norton AFB, CA.
C. -S. Huang.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 473-487, June, 1982. 9 Fig, 39 Ref.

Descriptors: *Nitrification, Kinetics, *Wastewater treatment, Ammonia, Nitrogen, Nitrogen removal, *Rotating biological contactor, Filtration.

A stationary, inclined plate on which a nitrifying biological film was developed was used to investigate the nitrification surface reaction model, and a second study on the bench scale was performed with a rotating biological contactor to see whether the findings of the first study were also applicable to the rotating biological film process. Based on the results of these two studies, it was concluded that the nitrification process follows a zero-order reaction both in stationary fixed-film systems and in rotating fixed-film systems. The pseudohomogeneous surface reaction model can be applied to both trickling filter systems and RBC systems. That is, the nitrification efficiency in a trickling filter process depends on the characteristics of the packing media used and the reciprocal of the two-thirds power of the hydraulic loading. Thus, in a RBC nitrification system, ammonia-nitrogen removal is a function of the square root of the rotation speed up to a certain speed. The active microbial film in a nitrifying RBC unit may be

estimated by locating the optimum ammonia-nitrogen removal rotation speed and the corresponding liquid film thickness at that rotation speed. The RBC unit used in this study has an active (or effective) slime thickness of about 72 micrometers. (Baker-FRC)
W82-06356

DESIGN APPROACH TO DUAL-POWER AERATED LAGOONS,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 532-548, June, 1982. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Design criteria, *Aerated lagoons, Lagoons, Oxidation, *Wastewater treatment, Biochemical oxygen demand, Oxygen demand, Kinetics.

Completely and partially suspended lagoon cells are defined and their use in dual-power level, multicellular systems is discussed. A procedure is presented for designing a dual-power level, multicellular aerated lagoon system on a rational basis using biokinetic coefficient data. The aeration cells can be designed as inverted, truncated pyramids. Center depth should be no less than 3 meters, and for many earth materials in which a cell is constructed, a slope no steeper than 1:3 (vertical:horizontal) should be used. Influent pipes to all the aeration cells should discharge at a shallow depth below the aerators. Effluent from the first cell should be withdrawn from behind a surface baffle. Effluents from all the other aeration cells should be withdrawn at the surface without surface baffling so as to avoid retention of any algae that might be generated in the system Riprap or a concrete apron should be placed at the water line to prevent erosion. The size combination selected for the design should reflect the following considerations: capital cost, operating cost, algal growth potential, and depth of sludge accumulation in the partially-suspended cells. (Baker-FRC)
W82-06358

PERFORMANCE OF MODIFIED CHLORINE CONTACT CHAMBER,

Worcester Polytechnic Inst., MA. Dept. of Civil Engineering.
F. L. Hunt, and Z. Vogiatzis.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EE3, p 549-561, June, 1982. 6 Fig, 8 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Disinfection, *Chlorine, *Chlorination, Economic aspects, Baffles, Design criteria.

A field study was conducted to determine the effectiveness of perforated baffles was to increase the hydraulic efficiency and lower the required dosage of chlorine. Field evaluations were conducted at the Maynard, Massachusetts, Municipal Wastewater Treatment Plant Chlorine Contact Chamber. This study did not distinguish between applied chlorine dose and actual chlorine dose. The chlorine demand is considered to be negligible. In addition no distinction was made between a free chlorine residual disinfection response and a combined chlorine residual disinfection response. The findings suggest that tracer responses from the model unit and the field unit were similar. Future model scale studies to further quantify disinfection process responses while varying disinfectant types or modes of application of the model unit can be attempted. Field tracer responses in the unmodified and modified field units correspond closely with the curve generated through a specific equation. Use of the batch reactor data and tracer data is therefore acceptable for the chlorine contact chamber unit evaluated in this study. Tracer data comparing the unmodified and modified CCC units show an improvement in the modified unit. Installations of these baffles in this CCC unit parallel the performance of a CCC unit that has a length-of-flow to width ratio of 25/1. Disinfection efficiency was improved 24% in the modified unit. About a 10% lower chlorine dose was needed. A cost evaluation indicates that these baffles should be cost effective, with the percentage saved depending on the average applied dose. In addition to cost savings, the benefit of lowering chlorine usage and lessening the release of chlorinated organics in wastewater effluents will reduce potential pollution dangers. (Baker-FRC)
W82-06359

EVALUATION OF THE 'LECTRO CLEAR Z' ELECTRO-COAGULATION PROCESS FOR MEAT PACKING WASTEWATER TREATMENT.

Western Industrial Labs. Ltd., Edmonton (Alberta).
Environment Canada, Ottawa, Environmental Protection Service, Report No EPS 4-WP-82-1, January, 1982. 92 p, 4 Fig, 4 Tab, 4 Append.

Descriptors: *Wastewater treatment, *Water quality control, *Meat processing industry, Electrical equipment, *Coagulation, Suspended solids, Biological oxygen demand, Industrial waste, Sanitary engineering, Design criteria, Process control, Engineering, Civil engineering, Cost analysis, Industrial plants, Food processing industry, Catchment basins, Discharge capacity, Economic evaluation, Wastewater facilities, Sewer systems, *Electro-coagulation.

Serious sewage treatment problems were encountered in Lethbridge, Alberta, due to its large number of food processing plants. An eight-week detailed evaluation was conducted in 1980 to assess the operation of a Lectro Clear Z (LCA) unit installed at a Lethbridge meat packing sewage system. As a result of this evaluation, it was determined that the LCZ unit could achieve BOD and suspended solids reduction of about 55-65% on the total existing catch basin effluent. In addition to achieving an acceptable level of treatment, it was confirmed that by-product recovery from the LCZ skimmings was possible. While the subject plant had an existing pretreatment basin, new plants or plants without existing basins must consider some kind of sedimentation and equilization for preparing wastewater prior to the LCZ unit. Further, unexpected occurrence and persistence of electrical problems for the LCZ unit suggests that tighter manfacturing specifications, installation, and operation of the electrical components should be considered. Specific recommendations are given for various topics concerning LCZ operation, includ[illegible] wastewater conductivity, pH adjustment, LCZ influent temperature, hydrogen sulfide formation, and turbulence in the coagulation section of the unit. An economic evaluation of the system was also made. (Zielinski-MAXIMA)
W82-06378

EVALUATION OF BIOLOGICAL NITRIFICATION - DENITRIFICATION AT PENTICTON, BRITISH COLUMBIA,

International Environmental Consultants Ltd., Islington (Ontario).
K. L. Murphy, and R. W. Wilson.
Environment Canada, Ottawa, Environmental Protection Service, Report SCAT-10, 1981. 72 p, 13 Fig, 13 Tab, 33 Ref, 2 Append.

Descriptors: *Biological wastewater treatment, *Municipal wastewater, Design criteria, *Denitrification, *Sanitary engineering *Cost analysis, Biological treatment, *Wastewater treatment, Wastewater, Process control, Nitrogen removal, *Nitrification, Organic carbon, Engineering, Civil engineering, Water quality control, Water quality, Activated sludge.

A study was undertaken to review proven methods for removing biological nitrogen (N) from municipal wastewater, to select suitable design parametrers, and to prepere process designs and capital/operating cost estimates for process alternatives appropriate for Penticton, British Columbia. Detailed process option evaluations were made for: two-sludge nitrification plus denitrification; one-sludge post-denitrification; and one-sludge pre-denitrification. Process designs were based on achieving up to 5 mg/liter nitrate-N and 1 mg/liter TKN in the treated effluent throughout the year. The pre-denitrification process was found to be the most cost effective, the design being based on a 20-day solids residence time (SRT) for the nitrification basin and a 10-day SRT for the denitrification basin to ensure efficient N removal at a minimum operating temperature of 8 degrees. The cost of combined carbon and N removal be pre-denitrification was estimated to be about 25% higher than for carbon removal by activated sludge, and 10% higher than for carbon removal and nitrification alone. Land disposal, ammonia stripping, and ion exchange were estimated as more costly than biological N removal methods. General costs are given for N removal at wastewater treatment facilities handling 5000-45000 cu m/day. (Zielinski-MAXIMA)
W82-06379

PILOT SCALE ASSESSMENT OF THE BIOLOGICAL FLUIDIZED BED PROCESS FOR MUNICIPAL WASTEWATER TREATMENT.

Dearborn Environmental Consulting Services, Mississauga (Ontario).
Environment Canada, Ottawa, Environmental Protection Service, Report SCAT-11, 1981. 148 p, 73 Fig, 43 Tab, 69 Ref.

Descriptors: *Biological wastewater treatment, Pilot plants, *Fluidized bed process, *Municipal wastewater, *Wastewater, *Oxidation, *Wastewater treatment, Nitrification, Biological oxygen demand, Activated sludge process, Suspended solids, Municipal wastes, Sewer systems, Wastewater facilities, Fluidized beds, Ammonia, Process control.

Pilot-scale studies of the oxygenic biological fluidized bed process demonstrated that the system is a technically-feasible alternative to carbon oxidation and nitrification of municipal wastewaters. The design organic loading of the bed is limited by the ability of the process to remove suspended particulates. A treated effluent containing below 15 mg/liter filterable BOD-5 was consistently produced at a loading rate of 10 kg BOD-5 cu m/day (an order-of-magnitude higher than for conventional suspended growth systems (CSGS). Operation at a volumetric loading similar to CSGS was necessary to attain below 15 mg/liter total BOD-5 without effluent polishing, due to the contribution of suspended solids in the final effluent BOD-5. The bed responded rapidly to influent condition changes and was less susceptible to influent disturbances than the activated sludge and rotating biological contactor processes in terms of effluent filterable organic carbon concentration. Significant deterioration occurred in effluent quality in terms of suspended solids levels under diurnally-varying flow/concentration conditions. Separate stage nitrification studies did not show the order-of magnitude increases in volumetric ammonia oxidation rates claimed by other workers. Despite apparent limitation concerning suspended solids removal during separate stage nitrification of high quality secondary effluent, the process demonstrated a potential for use in several wastewater treatment areas. (Zielinski-MAXIMA)
W82-06380

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME 2: USER'S MANUAL,

Department of the Environment, Ottawa (Ontario).
E. B. Boisselle, and P. Cote.
Report No EPS 3-WP-80-7E, February, 1982. 130 p, 7 Fig, 5 Append.

Descriptors: *Wastewater treatment, *User charges, *Computer programs, *Combined wastewater, *Cost allocation, Industrial wastewater, Municipal wastewater, Economic evaluation, Economic feasibility, Groundwater pollution, Storm runoff, Pollution load, Water-carrying capacity, Economic aspects, Cost analysis, Mathematical studies, Domestic wastes.

Joint treatment of industrial and municipal wastewaters requires a system for computing equitable charges to treatment facility users. A computer program (TAREP) has been developed for this purpose. Information is presented for using the TAREP program to establish a distribution of costs for wastewater treatment. Also included are instructions for coding data, a description of the TAREP subroutines, the program (in FORTRAN) taken from a run on the University of Montreal's CYBER 173, and the results of that run. TAREP is applicable in municipalities where there is joint industrial /municipal wastewater treatment, and can be used to establish charges to ratepayers where treatment facilities are already in place, as well as for preliminary studies leading to the construction of such facilities (thereby enabling municipalities and users to judge whether joint treatment is economically sound). The principles underlying TAREP and case histories conducted using this program are described in the first volume of this 2-volume set. (Zielinski-MAXIMA)
W82-06381

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME I: STUDY REPORT,

Department of the Environment, Ottawa (Ontario).
E. B. Boisselle, and P. Cote.
Report No EPS 3-WP-80-6E, February, 1982. 209 p, 17 Fig, 1 Tab, 39 Ref, 14 Append.

Descriptors: *Wastewater treatment, *User charges, *Computer programs, *Combined wastewater, *Cost allocation, Industrial wastewater, Municipal wastewater, Economic evaluation, Economic feasibility, Groundwater pollution, Storm runoff, Pollution load, Water-carrying capacity, Economic aspects, Cost analysis, Mathematical studies, Domestic wastes.

Joint treatment of industrial and municipal wastewater raises the problem of establishing equitable charges to treatment facility users, since industrial wastewaters carry higher contaminant loads than domestic wastes. The technical background, development, and testing of a computer program for the allocation of user costs for wastewater treatment systems are described. The second volume of this 2-volume set represents the user's manual for this program (TAREP). User charges provided by the program are based on wastewater volume and pollutant loading. Twelve cost factors are provided for use in the program (4 each relating to current users, future industrial use, and property), which can be used/discarded depending on the case under consideration. Case studies were conducted for the program in Waterloo and Granby, Quebec. Data used in these studies included: wastewater flows from various sources (domestic, industrial, groundwater infiltration, public uses, stormwater runoff); average pollutant loadings in such flows; design capacities of the treatment plants and sewers; costs associated with construction/operation/maintenance of facilities; property assessments and areas; saver type serving each property. A program was also developed to evaluate the sensitivity of the charges generated by TAREP to cost breakdown changes. Estimated implementation costs for TAREP are $4500 plus $0.11/inhabitant. (Zielinski-MAXIMA)
W82-06382

APPLICATION OF ULTRAVIOLET DISINFECTION IN A TERTIARY WASTEWATER TREATMENT PLANT,

Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
K. W. A. Ho.
Research Report No 87, January, 1982. 53 p, 10 Fig, 10 Tab, 31 Ref, 2 Append.

Descriptors: *Ultrviolet radiation, *Tertiary wastewater treatment, *Municipal wastewater, *Sewage bacteria, *Economic evaluation, *Mathematical models, Disinfection, Wastewater treatment, Chemical oxygen demand, Prediction, Municipal wastes, Wastewater disposal, Nitrification, Chlorination, Economic aspects, Economic feasibility, Water treatment, Coliforms.

Applicability of ultraviolet (UV) disinfection technology was investigated for a well-nitrified sand-filtered municipal sewage effluent. Disinfection by UV irradiation is an effective and cost-competitive alternative to a chlorination plus dechlorination (CPD) process. The UV disinfection unit employed consistently reduced effluent total and fecal coliforms to 2500 and 200 per 100 ml, respectively, when operated according to maufacturer's recommendations. In addition, the effluent chemical oxygen demand concentration was found to be a useful surrogate parameter for predicting UV disinfection efficiency, as affected by effluent quality changes. Costs (amortized capital plus operating) for UV disinfection in the sewage effluent was estimated at $0.0433-0.0467/cu m, a cost about 1.2-1.3 times that for a CPD process. This cost, however, is only 49% and 55% that of ozone and chlorine dioxide disinfection costs, respectively. The UV unit quartz sheaths were hand-brushed every 24 hours of continuous operation to free them from fouling by deposits, indicating the need for an automatic sheath wiping system for future UV disinfection units. Development of a semi-mechanistic model for UV disinfection data analysis and its application are reported. (Zielinski-MAXIMA)
W82-06390

A SURVEY OF AERATED LAGOON PERFORMANCE,

Ontario Ministry of the Environment, Toronto. Pollution Control Branch.
W. Lewandowski, and B. Bradley.
Research Publication No 85, October 1981. 58 p, 28 Tab, 3 Ref.

Descriptors: *Aerated lagoons, *Organic loading, *Wastewater treatment, *Stabilization ponds, Surveys, Lagoons, Biological oxygen demand, Aeration, Oxidation, Aerators, Evaluation, Organic Matters, Organic wastes, Suspended solids, Stabilization lagoons, Pretreatment of Water, Wastewater facilities, Water quality control.

Construction of an aerated cell (AC) ahead of a waste stabilization pond (lagoon) system can be used to reduce the organic load to the existing system. Five wastewater treatment systems were surveyed to determine if completely mixed ACs or facultative ACs represent viable means of pretreatment for reducing organic loads to existing stabilization ponds. It was determined that substantial reductions in BOD-5 and suspended solids are achieved by the pretreatment ACs; however, the pretreatment cells do not prevent anaerobic conditions in the stabilization ponds that follow during ice and snow cover periods. Hence, conversion of the ponds to aerated facultative ponds (through sub-surface aeration or post-treatment for hydrogen sulfide removal) may be necessary. Further, with respect to ammonia-nitrogen, the pretreatment cells will not achieve appreciable reductions unless they are modified to achieve complete nitrification throughout the year. The aeration equipment performed satisfactorily at loads close to the design organic load of 463 kg BOD-5/day (1020 lbs BOD-5/day). At comparable organic loads, treatment efficiency with respect to BOD-5 removal is quite similar for both pretreatment processes, but facultative ACs usually produce effluents with considerably lower effluent suspended solids concentrations. (Zielinski-MAXIMA)
W82-06391

MONITORING OF SELECTED TRACE ORGANICS DURING BIOLOGICAL WASTEWATER TREATMENT,

Canviro Consultants Limited, Kitchener (Ontario).
E. E. Shannon, H. D. Monteith, and A. K. W. Ho.
Research Report No 82, February 1982. Ontario Ministry of Environment, Toronto. 102 p, 3 Fig, 20 Tab, 70 Ref, 2 Append.

Descriptors: *Organic compounds, *Biological wastewater treatment, *Monitoring, *Chemical industry, *Industrial waste water, Wastewater treatment, Raw sewage, Industrial plants, Industrial wastes, Chemical analysis, Gas chromatography, Mass spectrometry, Quantitative analysis, Fate of pollutants, Path of pollutants, Trace levels, Activated sludge process, Anaerobic digestion.

Research was carried out in two study phases, representing the first Ontario effort to monitor the fate of trace organic contaminants in their passage through a conventional activated sludge plant. In the first phase a field sampling program was conducted in a full-scale plant receiving about 26% by volume of its raw sewage from a single organics manufacturing plant. Analysis of sample extracts by gas chromatography/mass spectrometry detected benzothiazole, diethyl phthalate, dioctyl phthalate, diphenylamine, 2-methyl-mercapto benzothiazole, and aniline as the major organics in all influent, effluent, and sludge samples. In the second phase, an attempt was made to determine the fate of these six contaminants passing through two pilot-scale activated sludge reactors and a pilot-scale anaerobic digester. While mass balances for the six compounds around the three reactors were unattainable due to poor quantitative measurement accuracy, results strongly indicated that aniline removal occurred during activated sludge treatment and dioctyl phthalate accumulated in the activated sludge solids. A more extensive effort towards extraction and analytical methods development is recommended to improve quantitative results before carrying out any further organics monitoring program.(Zielinski-MAXIMA)
W82-06392

ENVIRONMENTAL RESIDUALS AND CAPITAL COSTS OF ENERGY RECOVERY FROM MUNICIPAL SLUDGE AND FEEDLOT MANURE,

Argonne National Lab., IL.
For primary bibliographic entry see Field 5E.
W82-06405

DETERMINATION OF REACTION RATE CONSTANT AND TEMPERATURE COEFFICIENT CONSTANT FOR DADAR SEWAGE, BOMBAY,

Associated Industrial Consultants, Bombay (India).
C. M. Deshpande, and S. S. S. Bhende.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 107-110, June, 1981. 3 Fig, 5 Tab, 4 Ref.

Descriptors: *Fate of pollutants, *Mathematical equations, *Temperature effects, *Wastewater treatment, *Microbial degradation, *Graphical methods, Biochemical oxygen demand, Organic wastes, Inorganic compounds, Industrial wastes, Domestic wastes, Biodegradation, Bombay, India.

When industrial and domestic wastes are discharged into water bodies, they are slowly degraded and stabilized by microorganisms, leading to self-purification of water bodies to some extent. The reaction rate of stabilizing such organic and inorganic wastes in what is known as a bochemical oxygen demand (BOD) reaction is temperature dependent. The validity of this first order reaction rate constant under the conditions of the Dadar sewage treatment plant of Bombay, India was determined at different sets of temperatures. The temperature coefficients for Dadar sewage were found to be 1.044, 1.049, and 1.039 for dilution factors of 1:40, 1:50, and 1: 62.5, respectively. Little variation was noted in the reaction rate constant at different sets of temperatures under Indian conditions. The average reaction rate constants were calculated to be 0.19, 0.32, and 0.38 for 20, 27, and 37 degrees, respectively. (Geiger-FRC)
W82-06438

ON-SITE WASTEWATER MANAGEMENT--RECENT TRENDS,

T. Viraraghavan.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 60-61, February, 1981. 8 Ref.

Descriptors: *Wastewater management, *Developing countries, India, Rural areas, Septic tanks, *Wastewater disposal, Sanitary engineering.

The 'Management District' concept may help implement a long-term program of on-site wastewater disposal in rural areas of developing

countries. A management district is a publicly owned and operated utility which assumes responsibility for on-site sewers in a designated area. This involves site surveys, septic tank and disposal field design installation of new systems, replacement of faulty systems, monitoring, inspection, and maintenance. The author proposes that India be divided into four such districts for a three-phase study of the system. The phases would consist of: (1) analysis of experiences in the U. S. and Canada and determination of feasibility, (2) site-specific analyses, and (3) implementation. (Cassar-FRC)
W82-06439

GENERATION AND UTILIZATION OF OZONE IN WASTE WATER TREATMENT,

Roorkee Univ., (India).
A. K. Mittal, I. Mehrotra, and R. P. Mathur.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 82-84, February, 1981. 4 Fig, 10 Ref.

Descriptors: *Ozonation, *Ozone, Advanced wastewater treatment, Disinfection, *Wastewater treatment, Tertiary wastewater treatment, Water treatment, Organic compounds, Industrial wastewater treatment, Oxidation.

An ozone generator based on the electric discharge principle was developed and tested for use in treating wastewater effluents, industrial wastes, and water supplies. The equipment, with a 2400 sq cm average electrode surface area and discharge gap of 2.5 mm, was performance tested to produce a set of curves correlating oxygen feed rate with power requirements for desired ozone concentrations and flow rates. The most economical ozone production was 30 mg per liter ozone at a rate of 5 g per hour at an oxygen feed of 190 liters per hour and power requirements of 109 W. Beyond this point slight increases in concentration required sharp increases in power requirements. A graph of ozone production vs. flow rate at voltages from 100 to 150 V was also prepared. (Cassar-FRC)
W82-06442

MEMBRANE SEPARATION PROCESSES,

Forschungsinstitut Berghof G.m.b.H., Tubingen (Germany, F.R.).
H. Strathmann.
Journal of Membrane Science, Vol 9, No 1/2, p 121-189, 1981. 29 Fig, 6 Tab, 121 Ref.

Descriptors: *Membrane processes, *Filtration, *Separation techniques, Reviews, Microfiltration, Ultrafiltration, Reverse osmosis, Electrodialysis, Dialysis, Wastewater treatment, Water treatment, Industrial water, Industrial wastewater treatment, Food-processing wastes, Potable water, Chemical wastewater, Metal-finishing wastes, Pulp and paper industry, Desalination, Advanced wastewater treatment, Secondary wastewater treatment, Tertiary wastewater treatment, Demineralization.

A comprehensive review of membrane separation processes includes fundamentals, chemical engineering aspects, practical experiences, and future perspectives. The principles and applications of separation processes (microfiltration, ultrafiltration, diafiltration, reserve osmosis, electrodialysis, and gas separations) are given. Commercial membranes, their structure, properties, and uses, are discussed in detail. Membrane processes are used in production of potable and industrial water. Microfiltration produces ultrapure water for the electronics industry and removes undesirable substances from process water for chemical, food, and drug industries. Ultrafiltration produces ultrapure water for the electronics industry and sterile, pyrogen-free water for the chemical and drug industries. Reverse osmosis desalinizes sea and brackish water, removes hardness from boiler feed water, deionizes water for electronics and electroplating industries, and sterilizes and deionizes water for the chemical and drug industries. Electrodialysis desalinizes brackish water and softens industrial process water. These processes are also useful in treating industrial and municipal wastewaters. Microfiltration is used for filtration of colloidal and turbid solutions. Ultrafiltration separates oil/water mixtures, recovers electrophoretic paints from rinse water, recovers proteins from food-processing wastewaters, recovers polyvinyl chloride from textile wastewaters, recovers lanolin from wool rinse water, and treats pulp and paper effluents. Reverse osmosis recovers sustances from food-processing industries, treats effluents from the pulp and paper industry, provides secondary or tertiary municipal wastewater effluent treatment, and desalts industrial effluents. Electrodialysis removes heavy metal ions from metal plating rinse water and removes salts from food-processing and industrial effluents. (Cassar-FRC)
W82-06445

AMMONIA NITROGEN REMOVAL IN FACULTATIVE WASTEWATER STABILIZATION PONDS,

Culp/Wesner/Culp, Denver, CO.
A. Pano, and E. J. Middlebrooks.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 344-351, April, 1982. 3 Fig, 10 Tab, 10 Ref.

Descriptors: *Ammonia, *Nitrogen, *Stabilization ponds, Nitrification, *Wastewater treatment, Mathematical equations, *Biological wastewater treatment.

Although ammonia removal from wastewaters is currently associated almost entirely with advanced wastewater treatment processes, ammonia nitrogen removal may be accomplished in facultative wastewater stabilization ponds. Methods by which such removal may take place include gaseous ammonia stripping to the atmosphere ammonia assimilation in algal biomass, and biological nitrification. Low concentrations of nitrates and nitites in pond effluents indicate that nitrification does not normally account for any significant proportion of the ammonia nitrogen removal. Analysis of data from three wastewater stabilization pond systems located in different areas of the United States showed that annual ammonia nitrogen removals above 90% were obtained. There was a statistically significant relationship between ammonia nitrogen removal in the primary ponds and the pH value, water temperature, and hydraulic loading rate. An equation for the ammonia nitrogen removal in facultative stabilization ponds is developed which incorporates water temperature, pH value, and hydraulic loading rate as variables. Application of this model to the ponds showed that ammonia nitrogen removal increases as the pH value, detention time, and temperature increase. At 20 C with a pH value of 8.0 in the primary pond (8.4 in the other ponds), and at a 100-day detention time, the predicted ammonia removal is about 98%. Model coefficients decrease with temperatures above 20 C, probably as a result of thermal stratifiction in the pond system and poor mixing conditions. Verification of the model showed excellent agreement between model predictions of ammonia nitrogen removals and data collected from the test systems and from facultative wastewater stabilization ponds with configurations and climatic conditions similar to those used for model development. (Carroll-FRC)
W82-06454

FATE OF NITROGEN IN AEROBIC SLUDGE DIGESTION,

British Columbia Univ., Vancouver.
D. S. Mavinic, and D. A. Koers.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 352-360, April, 1982. 10 Fig, 20 Ref.

Descriptors: *Nitrogen, *Aerobic digestion, *Sludge digestion, Nitrification, Denitrification, *Wastewater treatment, Temperature effects, Activated sludge, Sludge disposal, Sludge excess, *Fate of pollutants.

Little literature is available pertaining to design and operating criteria for aerobic digestion systems handling waste activated sludges. This study investigated nitrogen mineralization, nitrification, and denitrification processes occurring in several modes of digestion at temperatures of 20 C, 10 C, and 5 C. The modes of digestor operation studied included batch feeding and aeration; once-daily feed with once-daily, manual decanting; and continuous feed with continuous, automatic decanting. Organic nitrogen measurements of aerobic digestor mixed liquor were found to be practically constant, per unit of cell mass, for all systems and sludge ages. This constant organic nitrogen content of the cell mass, together with the absence of organic nitrogen in the supernatants, suggests that volatile solids destruction in aerobic digestion results in almost 100% mineralization of organic nitrogen to ammonia in solution. As a result, a considerable amount of soluble nitrogen may be returned to the treatment process with the digester supernatant. Considerable nitrification and denitrification were found to occur in all systems and at all temperatures. While nitrification and denitrification decreased with decreasing temperature and sludge age in the continuous feed system, a markedly higher degree of nitrification and denitrification occurred at 5 C than at higher temperatures in the daily feed, manual decant system. Similar trends were observed for the batch systems. Further research with respect to the effects of pH on these nitrogen processes and studies involving a more complete nitrogen balance are recommended. (Carroll-FRC)
W82-06455

NITROGEN DYNAMICS IN WASTE STABILIZATION PONDS,

Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and C. B. Avci.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 361-369, April, 1982. 8 fig, 4 Tab, 22 Ref.

Descriptors: *Nitrogen compounds, *Wastewater treatment, *Stabilization ponds, Mathematical models, Nitrogen removal, Sedimentation, Ammonia.

Nitrogen transformations and removal mechanisms in a waste stabilization pond were investigated via a time-variable model. The relative importances of ammonia volatilization, organism uptake, and sedimentation as nitrogen removal mechanisms were evaluated. The model developed for use in this study is designed to evaluate the percent reduction in waste load which occurs in the stabilization pond, rather than the percent reduction in concentration of pollutants. The primary mechanism of nitrogen removal was found to be the settling of organic nitrogen and subsequent accumulation of non-biodegradable material in the sediment zone. These solids consist of non-living organic material, including bacterial and algal cells. Cell growth results in the conversion of soluble inorganic nitrogen to particulate organic nitrogen, which is removed by sedimentation. Biological activity is the primary mechanism for the removal of ammonia, although ammonia volatilization may contribute to total nitrogen removal at high pH, temperature, and concentrations of ammonia-nitrogen. While some nitrogen removal is achieved through denitrification, the amount of nitrogen removal that can occur through this mechanism is limited by the amount of nitrate introduced into the pond via the influent, which is generally very small. Dynamic models such as the one used in this study can indicate the form of nitrogen or other constituents in the pond effluent. In conjunction with solids removal techniques, this information can be used to develop predictions of overall treatment efficiency and operation and maintenance requirements relating to solids loadings and frequency of filter backwashing. (Carroll-FRC)
W82-06456

INDUSTRIAL WASTES AS CARBON SOURCES IN BIOLOGICAL DENITRIFICATION,

Washington State Univ., Pullman.
J. R. Skrinde, and S. K. Bhagat.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 370-377, April, 1982. 6 Fig, 11 Tab, 17 Ref.

Descriptors: *Denitrification, *Organic carbon, *Industrial wastes, *Biological wastewater treatment, Carbon Methanol, Wastewater treatment, Activated carbon, Anaerobic digestion.

Wastewater contributions of nitrogen, in the form of nitrates, organic nitrogen, and ammonia, have led to eutrophic and toxic conditions in many waterways. Biological nitrification and denitrification appear to be the most promising processes for removing nitrogen from wastewaters. The addition of an organic carbon source, typically methanol, is generally required for denitrification. This study investigated the effectiveness of four industrial waste products (corn silage derivative, excess yeast from a brewery, liquid whey waste from a dairy, and spent sulfite liquor from a paper mill) as alternatives to the relatively expensive methanol. These industrial waste products were all found to be suitable carbon source alternatives and yielded denitrification efficiencies comparable to those observed with methanol. Yeast, methanol, and spent sulfite liquor were found to yield optimum denitrification with a chemical oxygen demand to nitrate-nitrogen ratio of 3 to 1. The rate of denitrification decreased linearly at lower ratios for these three carbon sources. Increased levels of denitrification result in additional 5-day biochemical oxygen demand (BOD) and, to some extent, suspended solids in the effluent. A compromise between desired levels of nitrate and of 5-day BOD in the effluent may be necessary. Denitrification was achieved efficiently and effectively in a fluidized anaerobic activated-carbon system, which required shorter detention times to effect high levels of denitrification than those required by other biological denitrification systems. (Carroll-FRC)
W82-06457

COMPARISON OF BOD RELATIONSHIPS FOR TYPICAL EDIBLE AND PETROLEUM OILS,

Kraft, Inc., Glenview, IL.
J. C. Groenewold, R. F. Pico, and K. S. Watson.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 398-405, April, 1982. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Food-processing wastes, *Biochemical oxygen demand, Grease, *Petroleum products, Industrial wastewater, Rregulations, *Wastewater treatment, Wastewater management, Biodegradability.

Although food processing plant wastes are generally recognized to be completely compatible with sanitary wastewater, many municipalities and sanitary districts have adopted unrealistic regulations with respect to discharges containing nonfloating fats, oils, and greases (FOG). These regulations need to allow for basic differences between petroleum-based fats, oils, and greases and the edible FOG produced by the food industry. A laboratory program was undertaken to measure various wastewater parameters of selected edible and petroleum oils. The average 5-day biochemical oxygen demand (BOD) to FOG ratio for edible oils was about three times higher than the value for petroleum oils. The average 5-day BOD to chemical oxygen demand ratio for edible oils was significantly higher than the accepted values for biodegradable wastes or for petroleum oils. The average BOD rate constant for edible oils was found to be almost twice the value for typical municipal wastewater and over three times that for petroleum oils. No relationship was found between the chain length or degree of saturation of the edible oil fatty acids and the parameters tested. The edible oils stabilized in a shorter time than did petroleum oils. Short-chain hydrocarbons appear to biologically degrade faster than long-chain hydrocarbons and may be easier to treat biologically. The study results clearly demonstrate that edible oils are considerably more biodegradable than petroleum oils and suggest that there should be no limits for edible oils in wastewater discharges other than a prohibition on oils in floating form. (Carroll-FRC)
W82-06458

TYPE A ZEOLITE IN THE ACTIVATED SLUDGE PROCESSES - I: TREATMENT PARAMETERS,

Imperial Coll. of Science and Technology, London (England).
M. J. T. Carrondo, R. Perry, and J. N. Lester.
Journal of the Water Pollution Control Federation, Vol 52, No 11, p 2796-2806, November 1980. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Phosphorus removal, *Detergents, *Zeolites, *Activated sludge, *Wastewater treatment, Phosphates, Eutrophication, Nutrient removal, Ammonia, Suspended solids, Chemical oxygen demand, Separation techniques.

Phosphate derived from detergent formulations in which sodium tripolyphosphate (STPP) was used as a builder accounted for about 50% of the phosphorus in domestic wastewater. For this reason, reduction of the level of STPP in detergents was seen as a convenient approach to the control of eutrophication of surface waters. An aluminosilicate, zeolite type A, is being considered as a partial substitute for STPP. Removal of zeolite type A in wastewater treatment is carried out by primary settling and activated sludge processes. The compound reportedly aids in sludge settling and has no adverse effects on the activated sludge process. The effects of zeolite type on various wastewater treatment plant parameters were examined at two activated sludge pilot plants. The chemical oxygen demand and suspended solids in the effluents of the test units were not statistically different from the control units. When levels of ammonia, total phosphate and orthophosphate differed significantly between the test and control units, they were usually lower in the test unit than in the control unit. Sludge volume indices also indicate better settleability of the activated sludge in test units compared to control units. (Geiger-FRC)
W82-06459

IMPACT OF PRETREATMENT ON SLUDGE CONTENT OF HEAVY METALS,

Camden County Municipal Utilities Authority, NJ.
C. M. Koch, J. G. Stroka, R. K. Perna, and R. E. Foerster.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 339-343, April, 1982. 2 Fig, 10 Tab, 5 Ref.

Descriptors: *Heavy metals, *Sludge, *Wastewater treatment, *Industrial wastewater, Combined wastewater, Combined treatment, Regulations, Sludge disposal, Land disposal, New Jersey.

The Camden County Municipal Utilities Authority is responsible for wastewater management throughout Camden County, New Jersey. A review of existing wastewater treatment plants showed that many were violating water quality standards. The authority recommended that two upgraded and expanded regional wastewater facilities be constructed to treat all wastewater in the Delaware Basin and that three of the existing four plants in the Atlantic Basin be upgraded. An industrial wastewater survey and sampling program was conducted to develop data for a mass balance for heavy metals, with emphasis on seven key metals considered most likely to limit to land application of sludge or sludge products. This mass balance showed that about 70% of the heavy metal loading observed at the 44 existing wastewater treatment plants was contributed by industrial and domestic sources. Industries were the primary sources of cadmium and chromium. The impact of implementing an industrial pretreatment program was estimated using a typical industrial sewer ordinance. In the absence of industrial pretreatment, cadmium is the heavy metal limiting the sludge application rate. Industrial pretreatment could result in removal of 70% of the cadmium in one service area. However, copper would then become the limiting metal restricting the increase in the allowable sludge land application rate to about 10%. It is concluded that the implementation of industrial pretreatment would have only a minor effect on the permissible land application rate for sludge and on the cost effectiveness of land application as a means of sludge disposal, and then only in some areas. (Carroll-FRC)
W82-06461

DEVELOPMENT OF WASTEWATER PURIFICATION IN THE RUHR CATCHMENT AREA AND ITS EFFECTS ON WATER QUALITY IN THE 1970'S (ENTWICKLUNG DER ABWASSERREINIGUNG IM RUHR EINZUGSGEBIET UND IHRE AUSWIRKUNGEN AUF DIE GEWASSERGUTE IN DEN SIEBZIEGER JAHREN),

Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.
R. Klopp, H. Herkelmann, and A. Stozek.
GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 1-16, January 1982. 19 Fig, 5 Tab, 59 Ref. English summary.

Descriptors: *Wastewater treatment, *Biological oxygen demand, *Biological wastewater treatment, *Ruhr river, *West Germany, Activated sludge process, Filtration, Wastewater facilities, Water treatment facilities, Water quality, Municipal wastewater, Effluents.

The results of monitoring investigations into wastewater plants in the Ruhr area of West Germany for the period 1972-1980 are reported in terms of trends in plant construction and in purification, especially in the parameter five-day BOD (BOD). Although the pollution load of inflow remained the same over the reporting period, BOD levels in plant effluents were reduced (median value 30 mg/1 in 1972, 15 mg/1 in 1980; arithmetic mean 60 and 30 mg/1, respectively). For one-stage activated sludge plants, BOD concentration in effluent was reduced by 50% from 1972 to 1976, after which it remained almost constant at about 10 mg/1. Median BOD was reduced from 30 to 16 mg/1 for one-stage percolating filter plants. For all plants, the degree of BOD purification achieved rose from 73% to 85%; for activated sludge plants from 87% to 93% (this was due to a decrease in mean sludge load to 0.3 BOD/kg day or a median of 0.15 kg BOD/kg day). During the reporting period, 32 plants were constructed or rebuilt. In 1972 there were 112 plants, 76 (68%) of which were biological and 36% (32%) chemical. In 1980 the figures were 120, 101 (84%) and 19 (16%). The new plants achieved a BOD purification rate of 96% (mean 7.3 mg/1 BOD in effluent), though they were built to accommodate increased loads and are not always operating to capacity. BOD effluent loads were reduced by 34%, indicating improved water quality over the reporting period. (Gish-FRC)
W82-06469

BENEFICIAL DISPOSAL OF PICKLE LIQUOR,

Great Lakes Steel, Detroit, MI.
J. N. Howell.
Industrial Wastes, Vol 28, No 3, p 21-22, May/June, 1982. 1 Fig.

Descriptors: *Hydrochloric acid, *Phosphorus removal, *Wastewater treatment, *Chemical precipitation, *Steel industry, *Industrial wastewater, Chemical treatment, Sulfuric acid, Phosphates, Industrial wastes, Wastewater disposal, Waste disposal, Detergents, Domestic wastes.

Cooperation between the city of Detroit and the Great Lakes Division of National Steel of Ecorse, Michigan has eliminated two major pollutants from the Detroit River and Lake Erie. The Detroit Sewage Treatment plant began using pickling liquor generated during the production of strip steel to remove phosphates. Testing showed that pickling done with hydrochloric acid rather than sulfuric acid would be less likely to add sulfate ions to the pickling liquor which would pass through the sewage treatment plant and possibly contribute to the pollution of the lake. By May of 1966, pilot tests were concluded showing that iron in the waste pickling acid was forming an iron phosphate compound which would precipitate, removing up to 65% of the phosphate present in raw sewage. In 1968, storage tanks and pipes were erected to store the waste acid. In 1969, provisions were made for phosphorus removal by ferrous chloride until facilities for pickling wastes could be constructed. Results from 1981 show a 75% savings to the city using pickling liquor for phosphate removal rather

than ferrous chloride. The steel mill saves about $160 thousand per month in hauling and waste contracts for disposal of acid wastes. This operation has been working successfully since 1970. (Geiger-FRC)
W82-06486

EXPANDED WASTEWATER TREATMENT AT A METAL WORKING PLANT,

Gilbert/Commonwealth, Jackson, MI.
S. P. Gambhir, and R. Johnston.
Industrial Wastes, Vol 28, No 3, p 14-16, May/June, 1982. 1 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Design criteria, *Wastewater facilities, *Industrial wastes, *Metal-finishing wastes, Storm sewers, Oil wastes, Separation techniques, Flocculation, Wastewater management, Waste management, Expansion.

Since its startup in 1975, the Saginaw Steering Gear Division of the General Motors Corporation has consistently met or exceeded state standards in its wastewater treatment plant. Wastewater from the plant originates from the cleanup, spillage and blowdown that occurs during plant operation and from tank truck loading docks and coal pile runoff. An onsite wastewater treatment facility and an auxiliary waste sewer were installed, along with a storm and sanitary sewer. Stormwater flows to retention ponds, where it may be inspected before release to an adjacent wildlife management area. The AW treatment plant began operation in 1976 to handle effluent from two manufacturing plants. During plant expansion, a deep sewer and API separators were installed. Unit processes include free oil removal by gravity and emulsified oil removal by pH adjustment, the breaking of organic polymer emulsions, and flocculation by sodium aluminate. Final effluent is monitored for turbidity, oil content and pH. The new plant was fully integrated into an existing facility while assuring reliability, safety and operational flexibility. (Geiger-FRC)
W82-06487

EXPANDING OPTIONS FOR GREYWATER TREATMENT,

Lombardo and Associates, Boston, MA.
P. Lombardo.
Biocycle, Vol 23, No 3, p 45-49, May/June, 1982. 3 Fig, 15 Ref.

Descriptors: *Water reuse, *Wastewater treatment, *Greywater treatment, *Greywater, Septic tanks, Filters, Sand, Reverse osmosis, Biological wastewater treatment, Sedimentation, Chlorine, Disinfection, Iodine, Ultraviolet radiation, Irradiation, Irrigation, Disposal, Compost toilets.

Greywater is defined as all household wastewater except water used for toilet flushing. The use of compost toilets, fairly well accepted in Scandinavian countries, is gaining acceptance only slowly in the United States. Some provision for managing greywater has to be built into all compost toilet systems. Segregating human wastes and greywater in this manner is atrractive for various reasons. Along with its pollution control qualities, a compost toilet reduces household water consumption by about 40%. Greywater can be used or disposed of in a number of different ways. Treatment and reuse schemes discussed include septic tank, sand filtration, rack filtration, biological treatment units, reverse osmosis, sedimentation/filtration, and physical/chemical treament. Three different disinfectants, tablet chlorine, iodine crystals, and ultraviolet irradiation, are particularly useful for preparing treated greywater for either onsite surface discharge, in-the-house reuse, or outside reuse. Greywater may also be treated and disposed of on soil absorption fields, or through irrigation, greenhouse usage, recirculating showers, or suds-savers. (Baker-FRC)
W82-06491

BACTERIA SOLVE PROBLEMS CREATED BY PRISONERS,

Public Works, Vol 113, No 6, p 57, June, 1982.

Descriptors: *Bacteria, *Organic loading, *Shock loads, Wastewater lagoons, Lagoons, Biological oxygen demand, Sodium nitrate, *Wastewater treatment.

The wastewater lagoon system at the Jean, Nevada, prison was upset by the accumulation of grease in the system (caused by non-maintenance of grease traps) and, in a separate incident several months later, by large amounts of powdered milk and rice dumped into the system during a protest. A high pressure jet cleaned the lines of excess grease. Addition of bacteria concentrate (DBC Plus) and sodium nitrate restored the functioning of a lagoon which was very heavily loaded with organic matter (rice and grease). Since these incidents the bacterial supplement has been added on a maintenance basis at the rate of a quarter pound per day. After prisoners introduced diesel fuel into the waste system, a 1 inch layer of oil accumulated on the surface of both ponds. This problem was solved by burning off small areas over a period of a week. (Caswer-FRC)
W82-06505

LOW-COST TREATMENT OF WASTEWATER,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Public Works, Vol 113, No 6, p 52-54, June, 1982. 5 Fig, 6 Ref.

Descriptors: *Sludge lagoons, *Stabilization ponds, *Aeration, *Wastewater treatment, Lagoons, Ponds, Aerated lagoons.

Mechanically simple alternatives to highly technical, complex wastewater treatment systems include aerated lagoons and benthal stabilization ponds. Although these treatment methods are land intensive, they are often applicable in smaller communities that cannot afford complex plants. Multicellular aerated lagoons can consistently produce effluents with both BOD and total suspended solids levels below 30 mg per liter. Power usage is 68% and construction costs are 40% of those for an activated sludge plant of similar size. A desirable depth is 9-12 ft. Either mechanical aeration or air diffusers may be used. Design of aerated lagoons and retention times can be determined according to equations which consider wastewater characteristics and temperatures. Benthal stabilization of waste activated sludge solids takes place in a deposit at the bottom of a water body by anaerobic or anaerobic/aerobic biological processes. The process is stable and odor free as long as the dissolved oxygen level above the deposit is 2 mg per liter or above. Benthal stabilization systems are over 50% cheaper to construct and over 75% cheaper to operate than an aerobic digester system with sandbed drying. Equations are available to compute the pond area (usual depth 18 ft.) from air temperature, wastewater composition, and solids retention time of the activated sludge process. Sludge solids are removed to a land disposal site about once year, usually during a period of high evapotranspiration. (Cassar-FRC)
W82-06506

CONTROLLING SULFIDES AND ODORS IN SEWERS, PART ONE,

Johnson (Bernard), Inc., Houston, TX.
M. A. Vivona, and G. A. Whalen.
Public Works, Vol 113, No 3, p 73-76, March, 1982. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Sulfides, *Aeration, *Odor control, *Wastewater treatment, Hydrogen sulfide, Hydrogen peroxide, Pumping stations, Force mains, Sewer systems, Gloucester County, New Jersey, Compressed air.

The Gloucester County (New Jersey) Utilities Authority installed equipment in three pump stations to control sulfides and odors in sewers by force main aeration and hydrogen peroxide treatment. Aeration at 3-15 cfm produces a wastewater low in color and odor, dissolved oxygen of 0.15 mg per liter or more, less than 0.05 mg per liter unionized hydrogen sulfide, low sulfide concentrations, and increased sulfate concentrations. Equipment for aeration consists of air compressors and associated controls. At the Westville station average flow is 0.37 mgd and the minimum daily flow rate is 15,000 gal per hour in a system with a 46,800 gal volume. Detention time is 3.12 hours. Oxygen use for the 3-hour detention period is 36 mg per liter. The safe design concentration is as great as 125 mg per liter for summer peak loading, assuming 40% efficiency. The unit cost of energy is $6.66 per million gal pumped. At Westville the installed cost of the aeration equipment was $13,500, and annual maintenance costs, $750. Hydrogen peroxide alone did not control odor or suppress sulfide formation. Peroxide use at Westville was reduced By 70% after aeration equipment was installed. (Cassar-FRC)
W82-06509

TIME-SHARED COMPUTER TECHNOLOGY FOR THE WATER AND WASTEWATER INDUSTRIES,

Metcalf and Eddy, Inc., Boston, MA.
W. A. Peterson, R. W. Cornville, and E. T. Garvey.
Public Works, Vol 113, No 3, p 65-67, March, 1982.

Descriptors: *Data storage and retrieval, *Computers, *Wastewater treatment, *Water treatment, Information systems, Records, Operations, Data Analysis.

A customized time-shared records and operations data system was designed [illegible] wastewater treatment plants [illegible] operational data. This system, Records and Operations Data Analysis (RODA), is individualized for each facility. Highly flexible software allows programming by each facility without major changes in the base program. Although RODA cannot shorten time required for collection and logging of data, it permits ready access to pertinent data in the desired form so that operators can concentrate on optimizing plant operation. Up to 500 individual parameters may be handled at one plant. A typical plant generated 100-150 parameters, has several pages of monthly report, and 10-12 multiparameter trend plots. Samples of the program's menu and different forms of output (performance reports, trent plots) are given. Costs depend on the size of the plant: $1500-$10,000 yearly operating costs, $3000-$7000 professional assistance, $2,000-$3,000 for a computer terminal, and $7,500-$15,000 for startup, customization, and training. (Cassar-FRC)
W82-06511

WATER CONSERVATION AT WASTEWATER TREATMENT PLANTS,

Williamsport Sanitary Authority, PA.
For primary bibliographic entry see Field 3C.
W82-06512

NEW BUBBLE DIFFUSERS REDUCE TREATMENT COSTS,

Wheaton Sanitary District, IL.
R. L. Clavel, and M. A. Scalise.
Public Works, Vol 113, No 6, p 46-47, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Aeration, *Energy, *Costs, *Wastewater treatment, *Bubble diffusers, Dissolved oxygen, Wyss Flex-A-Tube diffusers, Diffusers, *Illinois.

The Wheaton Sanitary District in Illinois has reduced energy consumption by 30-40% in its activated sludge plant by installing fine bubble diffusers in one aeration tank. The Wyss Flex-A-Tube diffuser, made by Water Cleaning, Inc., is a flexible plastic tube covering a non-deteriorating frame molded from acetal polymers. The diffusers resistant to fouling by biological growths and internal clogging. Before installation of the diffusers three blowers were generally used. With the diffusers it was possible to operate the system with only one or two blowers, reducing the average monthly power demand from 300 to 198 KW. (Cassar-FRC)
W82-06513

AN ION EXCHANGE PROCESS TO RECOVER NUTRIENTS FROM SEWAGE,

Istituto di Ricerca Sulle Acque, Bari (Italy).
L. Liberti, and R. Passino.
Resources and Conservation, Vol 6, No 3/4, p 263-273, 1981. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Ion exchange, *Nutrient removal, Phosphorus removal, Nitrogen removal, Cation exchange, Anion exchange, Wastewater treatment, Resins, Fertilizers, Magnesium ammonium phosphate.

Selective ion exchange was successfully used to recover nutrients from municipal wastewater effluent. The system, containing clinoptilolite in the cation exchange section and a porous Type I quaternary resin in the anion exchange section, removed eutrophicating materials, filtered suspended matter, and partially adsorbed non-biodegradable organic matter. Ammonia removal was 88% and phosphate removal, 89%. After addition of MgCl2 and MgHPO4 the nutrients were recovered as a commercial, insoluble, slow-release fertilizer, MgNH4PO4 x 6H2O. Column regeneration was accomplished with 0.6 M NaCl. Prior to design of a 240 cu m per day demonstration plant, a three column operation with three cationic and three anionic columns connected in series was also operated in continuous fashion, so that two columns were in service at a time while the third column was being regenerated. (Cassar-FRC)
W82-06516

BIOLOGICAL PROCESSES FOR CONCENTRATING TRACE ELEMENTS FROM URANIUM MINE WATERS,

New Mexico Bureau of Mines and Mineral Resources, Socorro.
C. L. Brierley, and J. A. Brierley.
New Mexico Water Resources Research Institute, Report No 140, December 1981. 93 p, 1 Fig, 26 Tab, 76 Ref, 1 Append.

Descriptors: *Pollutants, *Inorganic compounds, *Mine drainage, *Mine wastes, *Wastewater treatment, *Uranium, *Selenium, *Molybdenum, Ponding, Resins, Tailings, Algal growth, Waste treatment facilities, Filters, Solubility.

New Mexico's uranium and molybdenum mine operations must remove large amounts of inorganic agents from their waters, but current methods are often ion specific and expensive. The objective of this study was to assess the role of biological agents in removal of inorganic trace contaminants from uranium mine wastewaters. The Kerr-McGee Corporation, using two mines, has developed a treatment process for water. Particulates are settled by ponding, and the waters are passed through an ion exchange resin to remove uranium; barium chloride is added to precipitate sulfate and radium from the mine waters. The waters then pass through three consecutive algae ponds prior to discharge. Water sediment and biological samples were collected and analyzed over a 4-year period. Some conclusions derived from these analyses are: the concentrations of soluble uranium, selenium and molybdenum in the waters were not diminished by passage through the treatment facility's impoundments; the mine water's particulate concentrations were reduced about ten-fold by passage through the impoundments; the ponds were well oxygenated; the pH was near normal indicating that the major soluble species of trace contaminants are molybdate, uranyl carbonate species and selenite; plant microbial life can remain viable at 10 degrees C. or higher; concentrations of phosphate and nitrate were high enough to support some algal and microbial activity; the sediments wee anoxic; the algae act as bio-filters for accumulation of particulate pollutants in ponds; and stimulation of algal growth and increased pond size are necessary for effective removal of trace contaminants. (Atkins-Omniplan)
W82-06520

EFFECT OF UV LIGHT DISINFECTION ON ANTIBIOTIC-RESISTANT COLIFORMS IN WASTEWATER EFFLUENTS,

Environmental Protection Agency, Cincinnati, OH.
M. C. Meckes.
Applied and Environmental Microbiology, Vol 43, No 2, p 371-377, Feburary, 1982. 7 Tab, 34 Ref.

Descriptors: *Coliforms, *Ultraviolet radiation, *Activated sludge process, Effluents, *Wastewater treatment, Escherichia coli, Antibiotics, Disinfection, Antibiotic resistance, Resistance factors, Transferable resistance.

Wastewater, both treated and untreated, is a major contributor of bacteria to the aquatic environment. Several studies have shown that significant numbers of multiple drug-resistant coliforms occur in rivers, bays, bathing beaches, and coastal canals. This is a source of considerable concern, since bacteria carrying transmissible R-factors are capable of transferring antibiotic resistance to antibiotic-sensitive bacteria, raising the potential for transfer of antibiotic resistance to pathogenic species. The effect of ultraviolet (UV) light disinfection on antibiotic resistant coliforms in municipal wastewater effluents was investigated. Total coliforms and total coliforms resistant to streptomycin, tetracycline, or chloramphenicol were isolated from filtered activated sludge effluents before and after UV light irradiation. The wastewater effluent was effectively disinfected by the UV irradiation, but the percentage of the total surviving coliform population resistant to tetracycline or chloramphenicol was significantly higher than the percentage of the total coliform population resistant to those antibiotics prior to treatment. UV treatment did not affect the percentages of coliform resistant to streptomycin. Analysis of the multiple drug resistance patterns of 300 total coliform isolates revealed that 82% were resistant to two or more antibiotics. In addition, 46% of these isolates were capable of transferring antibiotic resistance to a sensitive strain of Escherichia coli. (Carroll-FRC)
W82-06532

EFFECT OF HARD DETERGENTS ON ALGAE IN A HIGH-RATE-OXIDATION POND,

Technion--Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 5C.
W82-06538

AQUACULTURE FOR WASTE MANAGEMENT,

Nebraska Univ., Lincoln. Dept. of Agronomy.
L. Cchesnis.
Biocycle, Vol 23, No 3, p 52-55, May/June, 1982. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Reviews, *Aquaculture, Wastewater management, Wastewater disposal, Water resources development, Fish farming, Fish, Nutrients, Sludge disposal, Aeration, Lagoons, Ponds, Microbial degradation, Biodegradation.

The current status of aquaculture research in the area of waste resource utilization indicates that a significant though largely untapped potential exists for the production of aquatic protein for human and animal consumption. Findings from various studies investigating the utilization of animal wastes have indicated that fish production was 1.8 times greater when manure was introduced directly into the environment as compared to supply only manure-grown algae as a feed source, that fish had a beneficial effect on water quality in ponds receiving wastes from two lots of pigs insofar as dissolved oxygen and BOD were concerned, that fish grew well in ponds receiving wastes from pig pens, that greater productions of Chinese carp and freshwater prawns were obtained in a polyculture system when the ponds were supplied fresh swine manure than when supplied with aged swine manure, and that inputs of manure and commercial feed has similar protein yield relationships in hybrid tilapia production. The incresed use of human wastes and sewage for fish production depends mainly on public acceptance. Studies have shown that human to fish ponds have resulted in higher yields than in ponds supplied with commercial fish feeds. Sewage treatment ponds stocked with fish had higher dissolved oxygen concentrations and pH than similar ponds without fish. Industrial wastes, such as distillers' wet grains, were successfully fed to fish and crayfish as the only source of food. With sufficient aeration and retention time for microbial decomposition it would appear that high biological oxygen demand organic wastes could be used to provide the substrate for a polyculture aqatic system. (Baker-FRC)
W82-06556

FRENCH PREMIERE FOR WASTEWATER DISINFECTION USING OZONE,

World Water, Vol 5, No 5, p 43-44, May, 1982.

Descriptors: *Ozone, *Disinfection, *Wastewater oxidation, *Wastewater treatment, Tertiary wastewater treatment, Guethary, *France.

The first French wastewater treatment plant to use ozone for final disinfection is Guethary, a resort town on the Atlantic Ocean. The plant handles a population equivalent of 1250 in winter and 13,000 in summer. Since effluent is discharged into the ocean in the bathing area, it is necessary to remove biological pollution completely. The treatment process is activated sludge with prior clarification-flocculation during the tourist season. Tertiary treatment is provided by a rapid gravity sand filter. The ozone dose is 10 g per cu meter of effluent treated. (Cassar-FRC)
W82-06607

METAL REMOVAL 'A LA CARTE',

For primary bibliographic entry see Field 5F.
W82-06608

THE ROLE OF ELEMENTAL OXYGEN DEMAND IN TOTAL OXYGEN DEMAND FOR WATER POLLUTANTS,

Government Industrial Research Inst., Nagoya (Japan).
K. Nakajima, T. Ishizuka, and H. Sunahara.
Water Research, Vol 16, No 6, p 1003-1009, June, 1982. 1 Fig, 7 Tab, 5 Ref.

Descriptors: *Oxygen demand, *Water quality, Industrial wastewater, Nitrogen, Oxygen, Water pollution control, Biochemical oxygen demand, Wastewater treatment.

The fundamental relationship between total oxygen demand (TOD) and elemental oxygen demand (EOD) for various organic and inorganic compounds in water was studied using a total organic carbon (TOC)-TOD analyzer and a TN (total nitrogen) analyzer on the influent and effluent in an activated sludge pilot plant. The EOD values of carbon and nitrogen in the constituent units of water pollutants were measured, and the relative TOD levels were discussed. The COD/TOD and NOD/TOD ratios of several organic compounds, proteins, and microbes in activated sludge were above 0.6 and below 0.25, respectively. However, in the effluent of a pilot plant the NOD/TOD value was larger than the COD/TOD value, indicating the NOD plays a more important role in the TOD value than in the COD value. The concept of EOD can also be used to characterize the TOD of pollutants in environmental waters such as river water, lake water and other water bodies. (Baker-FRC)
W82-06611

FLOW CONTROL AT STORMWATER OVERFLOWS AND STORMWATER TANKS (ABFLUSSSTEUERUNG VON REGENWASSERBEHANDLUNGSANLAGEN),

For primary bibliographic entry see Field 8C.
W82-06633

INVESTIGATIONS ON LOADING AND QUALITY OF DISCHARGE OF MUNICIPAL SEWAGE TREATMENT PLANTS IN THE CASE OF STORMWATER INFLOW (UTERSUCHUNGEN UBER BELASTUNG UND ABLAUFBESCHAFFENHEIT KOMMUNALER

KLARANLAGEN BEI MISCHWASSERZUFLUSS),

Bayerisches Landesamt fuer Wasserwirtschaft, Muinich (Germany, F.R.).
P. Schleypen, and P. Wolf.
Wasserwirtschaft, Vol 72, No 2, p 53-59, February, 1982. 7 Fig, 5 Tab, 5 Ref. English summary.

Descriptors: *Municipal wastewater, *Storm wastewater, *Suspended solids, *Biological oxygen demand, *Chemical oxygen demand, Activated sludge process, *Wastewater treatment, Pollutants, Percolating filters, Wastewater lagoons, Biological wastewater treatment, Water law, *West Germany, Design standards, Hydraulic engineering.

Inflow, BOD, COD, and suspended solids were examined at 21 West German municipal biological wastewater treatment plants in dry and rainy weather to determine whether the plants could handle the increased demands made by stormwater. The facilities comprised two two-stage biological plants, one nonaerated sewage pond, three percolating filter plants, and six activated sludge plants with and six without presettling. Results showed that in rainy weather an increase in plant discharge of five-day BOD and COD with respect to dry weather must be expected. This increase is insignificant when measured over 24 hours, but over a 2-hour period a mean increase of 30% for five-day BOD may occur. Stormwater created an increased hydraulic demand on the plants, leading to an increase in the pollution load of their discharge of 2.5-3 times of that in dry weather when hydraulic load was increased twofold. For the mean values measured, percolating filter and activated sludge plants performed similarly, but percolating filter plants performed less well for maximum values due to operating problems in the control of filter loading and postsettling-basin size. Activated sludge plants with low capacity loading are capable of handling stormwater because of their large buffer volume. Sewage ponds of adequate dimensions behave in a similar fashion to activated sludge plants with low loads. With the exception of sewage ponds, suspended solids concentration in the discharge of municipal plants can increase greatly in rainy weather even where postsettling conforms to standard. A change in water law is therefore necessary, and this should double the permissible level of suspended solids in discharge when stormwater is being processed. This is prudent for technical, operational, and economic reasons. (Gish-FRC)
W82-06634

HOW MUCH AIR,

Montgomery (James M) Inc., Pasadena, CA.
M. L. Arora.
Water/Engineering and Management, Vol 129, No 7, p 43-44, 47, June, 1982. 2 Fig, 5 Tab.

Descriptors: *Aeration, *Activated sludge proces, *Oxygen transfer, Design criteria, Temperature effects, Altitude, *Wastewater treatment, Oxygenation, Dissolved oxygen.

Several approaches are available for calculating the air requirements and aeration system horsepower for activated sludge systems. First the theoretical field condition requirements are computed. Then these are converted to standard conditions (20 C liquid temperature, zero mg per liter dissolved oxygen in the aeration basin, sea level, and tap water). The effects of several parameters on aeration equipment performance are discussed. Alpha, the relative rate of oxygen transfer in wastewater as compared to tap water, is a function of the type of waste and the type of aeration equipment. It varies from 0.4 to 1.0. Higher values of alpha reduce the required horsepower. Surfactants and fine bubble diffusers tend to lower alpha values. Beta, the relative oxygen saturation value in wastewater as compared to clean water under standard conditions of temperature and altitude, is strictly a function of the type of waste. Higher values are beneficial. For normal domestic sewage the range of beta values is 0.8 to 0.95. Oxygen concentration is often overdesigned. A 2.0 mg per liter concentration during normal operation or 1.0 mg per liter during short-term peak loads is satisfactory. Higher air and wastewater temperatures can significantly decrease oxygen saturation concentrations. This condition, as well as the higher oxygen uptake ratios at higher temperatures, must be considered in designing equipment. Altitude effects are similar to temperature effects. For example, a plant at 7000 ft altitude may require 877 horsepower vs 610 horsepower for a sea level plant for 1000 lb per hour aeration equipment, providing other conditions are the same. (Cassar-FRC)
W82-06638

PAC PROCESS,

Zimpro, Inc., Rothschild, WI.
J. A. Meidl.
Water/Engineering and Management, Vol 129, No 7, p 33-36, June, 1982. 4 Fig, 4 Tab.

Descriptors: *Activated carbon, *Activated sludge process, *Wastewater treatment, *Powdered activated carbon, Zimpro, Incorporated, Costs, Organic compounds, Priority pollutants, Sludge, Nitrogen removal, Oxygen transfer, Disinfection, Odor control.

Patents on use of powdered activated carbon (PAC) in the aeration tank of the activated sludge system were developed by DuPont and purchased by Zimpro, Inc. Since 1977 the system has been used for treating a diverse range of wastewaters in plants of 500 kl to 54 mgd capacity. The wet air regeneration process recovers 95% of the carbon with no dewatering or added heat. There are several advantages to the PAC process: improved organics (including priority pollutants) and nitrogen removal; and reduced sludge volume index, power requirements (up to 20%), disinfection requirements, and sludge quantity. In addition, odor control costs are minimized. The process' status as an innovative technology allows 10% extra EPA funds. The process using wet air regeneration is cost competitive with conventional activated sludge treatment and granular activated carbon treatment. Design guidelines and experiences at operating plants are discussed. (Cassar-FRC)
W82-06643

DESIGN AND OPERATIONAL ASPECTS OF SCREENING INSTALLATIONS AT SEA OUTFALLS ON THE NORTHUMBRIAN COAST,

Northumbrian Water Authority (England).
For primary bibliographic entry see Field 5E.
W82-06645

MICROSTRAINER THEORY AND THE FILTRABILITY INDEX OF SEWAGE EFFLUENTS,

Lanchester Polytechnic, Coventry (England). Dept. of Civil Engineering.
J. A. Anderson.
Water Pollution Control, Vol 81, No 1, p 120-126, 1982. 7 Fig, 9 Ref.

Descriptors: *Filtration, *Secondary wastewater, *Suspended solids, *Wastewater treatment, Solids contact processes, Mathematical equations, Process efficiency.

Microstraining refers to the mechanical separation of solids from liquids resulting from the passage of a secondary effluent through a porous fabric having apertures of less than 100 microns. The filtrability of a fluid is a function of the fluid, the suspended solids, and the filter medium. Boucher (1947) introduced the term 'filtrability index', which relates the head loss across the microstrainer to the flow rate. The error inherent in this previously accepted equation is demonstrated through a discussion of the theory of microstrainers. A simple piece of equipment, marketed under the name Filtester, can be used to measure the filtrability index. This equipment produces a filtrate almost identical to that obtained from an operating microstrainer, which can be analyzed for suspended solids and biochemical oxygen demand removal efficiences. Effluents from biological filters, humus tanks, and rapid gravity sand filters were used to investigate measurement of the filtrability index. The results of these tests demonstrated a strong correlation between the filtrability index and the concentration of suspended solids removed by the microstrainer. The correlation between the suspended solids removal efficiency and the ratio of filtrability index to the suspended solids concentration in the effluent was not as strong. The Filtester was found to provide a simple and inexpensive means for assessing the performance of a proposed microstrainer installation with respect to any given effluent. Microstrainers can be used effectively for tertiary treatment only if the suspended solids in the secondary effluent are present in the form of easily filterable floc particles. Factors which may affect the removal of suspended solids include particle size, particle shape and structure, shear resistance, and compressibility. (Carroll-FRC)
W82-06647

PILOT-SCALE ADVANCED WASTE-WATER TREATMENT AT DAVYHULME,

North West Water Authority (England).
T. E. Wallbank, and T. A. Parry.
Water Pollution Control, Vol 81, No 1, p 127-141, 1982. 9 Fig, 9 Tab, 22 Ref.

Descriptors: *Pilot plants, *Advanced wastewater treatment, Experimental design, *Wastewater facilities, Physicochemcial treatment, Biological treatment, Cost analysis, Process efficiency, Effluents, *United Kingdom, Davyhulme.

An advanced wastewater treatment pilot plant was constructed at the Davyhulme works in the United Kingdom to evaluate the use of physicochemical and biological processes in various combinations, to investigate the potential for production of effluents suitable for industrial reuse, and to determine the cost benefits of these processes. The principal experiments conducted during the 5-year study are summarized. Flocculation of crude sewage with lime was found to significantly increase the removal of suspended solids in primary sedimentation, reducing the biochemical oxygen demand loading on the subsequent biological stage. Settled sewage having a pH value as high as 11.5 could be treated successfully by the activated sludge process. Primary lime dosing to pH 10 removed about 80% of the suspended solids, while using lime to pH 9 plus aluminum sulfate achieved slightly better results at marginally higher costs. Tertiary treatment by dual-media filtration and granular activated carbon resulted in production of high quality effluents, perhaps suitable for industrial reuse. Primary lime treatment appeared to slightly enhance the activity of nitrifying microorganisms in two completely-mixed activated-sludge units. Considerable variations were found in the conditioner types and dose rates required for mechanical dewatering of the chemical and biological sludges produced by the plant. The performance predictions developed by using data from the plant in the sewage treatment optimization model were found to be accurate over a wide range of flows. (Carroll-FRC)
W82-06649

PERFORMANCE OF ROTATING BIOLOGICAL CONTACTORS UNDER FIELD CONDITIONS,

Water Research Centre, Stevenage (England).
E. B. Pike, C. H. Carlton-Smith, R. H. Evans, and D. W. Harrington.
Water Pollution Control, Vol 81, No 1, p 10-27, 1982. 4 Fig, 7 Tab, 54 Ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, Industrial wastewater, *Performance evaluation, Wastewater composition, Wastewater oxidation, On-site studies, *Rotating biological contactors.

Factors affecting the performance of commercial rotating biological contactor units installed at wastewater treatment facilities were investigated. Specific factors found to adversely affect performance at units in facilities serving small communities included organic overloading and mixing of liquors between treatment units. Performance was best at the two facilities which had two and three stages of disks in series and which had separate primary treatment and humus settlement units, suggesting that characteristics tending to plug-flow were de-

sirable in the disk compartment. The sets of data for composition of sewage and effluents were distributed approximately log-normally, and, for sets of samples taken throughout treatment, the variance of biological oxygen demand and suspended solids was related to the arithmetic mean by a power law. If this relationship is general, it could be used to calculate percentile values for any given mean value of effluent quality for use in performance modeling. A two-year study of a 30-population-equivalent unit found that on the average performance and rates of treatment were greater, and sludge production was lower in the year when flow varied over a diurnal cycle than in the year of operation with steady flow at a uniform average rate. The results of analysis of variance tests suggested that attempts to reduce variability in effluent quality on a daily basis should not be undertaken without a critical assessment of the temporal components of variability at the facility. (Carroll-FRC)
W82-06650

ESHOLT--PAST, PRESENT AND FUTURE,

Yorkshire Water Authority (England). Western Div.
J. O'Neill.
Water Pollution Control, Vol 81, No 1, p 28-36, 1982. 4 Fig.

Descriptors: *Wastewater treatment, *Industrial wastewater, History, Wool scouring, *Textile mill wastes, *Dye industry wastes, Wastewater facilities, Municipal wastewater, Combined wastewater, Combined treatment, Bradford, *United Kingdom.

The city of Bradford, England has been a center of the textile and wool-combing industry since the early part of the 19th century. The city constructed sewers in 1862, which removed the wastes from the town's environs but resulted in serious pollution of the River Aire. The first waste treatment facilities were established in 1872. Waste treatment facilities constructed by the city in 1912 included a sludge presshouse for the treatment of sludge from chemical precipitation of combined wastewater with sulfuric acid. Over the next 50 years, the Esholt wastewater treatment facility was expanded to include precipitation tanks, biological filters, detritus and storm-sewage tanks, humus tanks, a clarification lake, and grease recovery facilities. In 1973, a multiple-hearth sludge incinerator was added. Changes in the wool industry have resulted in a 90% decrease in the amount of grease recovered at Esholt. However, the sewage treated, which gets about 60% of its organic load from industry, remained strong. A complete reevaluation of the treatment facility in 1977 resulted in a decision to discontinue sludge processing and dewatering operations and to replace these with sludge consolidation followed by disposal of liquid sludge either to the land or to the sea. This change in operations resulted in a significant improvement in effluent quality, primarily as the result of improved settlement and the change of the bacteriological environment of the filter beds from acidic to nonacidic. (Carroll-FRC)
W82-06653

RECOVERY OF PROTEIN AND OIL FROM FISHERY BLOODWATER WASTE, EFFECT OF PH AND TEMPERATURE,

Instituto Nacional de Technologia Industrial, Mar del Plata (Argentina).
E. M. Civit, M. A. Parin, and H. M. Lupin.
Water Research, Vol 16, No 6, p 809-814, June, 1982. 7 Fig, 2 Tab, 39 Ref.

Descriptors: Fisheries, *Wastewater treatment, *Industrial wastewater, *Proteins, *Oils, Acidity, *Temperature effects, *Hydrogen ion concentration, Heat treatment, Coagulation.

The study investigated the conditions of temperature and optimum pH for protein coagulation and oil recovery from fisheries bloodwater. Information about the variation of the chemical oxygen demand (COD) of the effluent and about the kind of proteinaceous material recovered and remaining in solution was also obtained. Heating must be carried out above 65 degrees C, but temperatures above 75-80 degrees C will not improve recovery. The optimum range for the adjustment of pH was between 5.6-5.9. The maximum reduction in COD was found in the same temperature and pH ranges. The combination of heating and pH adjustment was shown to be more effective than each process by itself. Delay in processing increased the non protein nitrogen and diminished the protein recovery and the COD reduction. (Baker-FRC)
W82-06655

CELLULOSE ACETATE MEMBRANES FOR THE REVERSE OSMOSIS TREATMENT OF SEWAGE EFFLUENTS. IS LONG TERM PERFORMANCE A LIMITING FACTOR,

Portsmouth Polytechnic (England). Dept. of Civil Engineering.
B. A. Winfield.
Water Research, Vol 16, No 6, p 797-799, June, 1982. 2 Fig, 7 Ref.

Descriptors: *Reverse osmosis, *Membranes, *Membrane processes, Membrane filters, *Wastewater treatment, *Cellulose acetate membranes.

The performance of cellulose acetate reverse osmosis membranes was examined in the treatment of secondary sewage effluents over a three year period. A commercially available 'spaghetti' type unit was used for the study. This unit was fed with pH adjusted (5.5-6.0) secondary sewage effluent during normal operation. It was flushed monthly with a 0.5% formaldehyde solution. The exposure of the membranes to sewage treatment conditions produced changes in their performance which differed markedly from anything which had been anticipated. The observed increase in permeability for the sulfate ion was 1.5 times and for the sodium ion 1.2 times. Observed trends in water permeability also deviated from the predicted behavior. Hydrolysis should result in an increase in water flow per unit area, while in fact the reverse occurred. Thus any loss of permselectivity is likely to be minimized by the deposition of fouling over porous regions of the membrane created by hydrolysis and also microbiological activity. Another effect of the deposition of fouling over imperfect regions of the membrane is that it effectively contributes to a loss of the active membrane surface. (Baker-FRC)
W82-06657

RECOVERY OF CHROMIUM(VI) FROM WASTEWATERS WITH IRON(III) HYDROXIDE-I. ADSORPTION MECHANISM OF CHROMIUM(VI) ON IRON(III) HYDROXIDE,

Osaka Prefecture Univ. (Japan). Coll. of Engineering.
T. Aoki, and M. Munemori.
Water Research, Vol 16, No 6, p 793-796, June, 1982. 7 Fig, 12 Ref.

Descriptors: *Wastewater treatment, *Chemical reactions, *Chromium, *Iron, Hydroxide, Adsorption, Metals, Ion exchange, Anion exchange, *Hydroxides.

The mechanism of chromium(VI) adsorption on iron(III) hydroxide was investigated. As pH decreased, the coprecipitation of Cr(VI) with iron(III) hydroxide increased; no coprecipitation occurred above a pH of 8.5. An increase in the coprecipitation also occurred with an increase in the amount of iron(III) hydroxide. When the suspension (pH 4.5) containing ironIII hydroxide was mixed with a solution (pH 4.5) containing Cr(VI), the pH of the mixed suspension increased and became constant after 20-30 minutes. When the suspension of pH 4.5 stood for a month, its pH decreased from 4.5 to 3.8, and a small percent of Cr(VI) was desorbed from the iron(III) hydroxide. The decrease of pH was not due to carbon dioxide from the air. Thus it is assumed that the oxolation of iron(III) hydroxide caused a decrease in pH over time. To formulate the forces governing the exchange between adsorbed HCr04(-) and other anions, desorption of Cr(VI) was examined in the presence of various anions. Desorption of HCr04(-) increased with increase of the added anion. It appeared that the main factor governing adsorption of the anions is ion bonding and a specific chemical bonding with the surface of the iron(III) hydroxide. The adsorption of Cr(VI) was increased in the presence of metal ions because the positive charge due to adsorption of metal ions on iron(III) hydroxide increased and attracted HCr04(-) to the surface of iron(III) hydroxide and because the metal hydroxides partially formed below pH 8.5 and increased anion exchangeable sites. (Baker-FRC)
W82-06658

THE KINETICS OF OZONE-PHENOL REACTION IN AQUEOUS SOLUTIONS,

Cornell Univ., Ithaca, NY. School of Chemical Engineering.
M. G. Joshi, and R. L. Shambaugh.
Water Research, Vol 16, No 6, p 933-938, June, 1982. 3 Fig, 4 Tab, 30 Ref.

Descriptors: *Ozonation, *Kinetics, Chemical reactions, *Phenols, Water pollution, *Ozone, *Wastewater treatment, Laboratory studies, Oxidation, Chlorination, Industrial wastewater, Coal gasification.

Rate constants were determined for the reaction of ozone and phenol in water. Careful account was made of the mass transfer of ozone from gas phase to aqueous phase, and the effect of pH and various soluble salts on the rate constant for phenol ozonation was studied. Rate constants were determined for the solid catalyzed reaction of ozone and phenol in water using four different catalysts. Initially a few experiments were carried out to check for mass transfer limitations. In these experiments only the flow rate of ozone-oxygen mixture fed to the reactor was varied, keeping everything else the same. The results indicated that mass transfer resistance was not likely to be a limiting factor. The effects of the pH of the reaction mixture, the solid catalysts, and the presence of certain solutes in the reaction mixture on the reaction kinetics were also investigated. The study concluded that the reaction of ozone with phenol in aqueous solution can be adequately represented by a second order rate equation and does not involve hydroxide ion radicals. The catalysts which are effective in the oxidation of aqueous phenol by molecular oxygen are not effective in enhancing the rate of ozonation of aqueous phenol. Hence, the mechanism of ozonation is quite different from that of oxidation with simple oxygen. (Baker-FRC)
W82-06661

INFLUENCE OF MULTICELLULAR CONFIGURATIONS ON ALGAL GROWTH IN AERATED LAGOONS,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water Research, Vol 16, No 6, p 929-931, June, 1982. 3 Fig, 7 Ref.

Descriptors: *Aerated lagoons, *Algal growth, Aeration, Lagoons, Anaerobic lagoons, Eutrophication, *Wastewater treatment, *Municipal wastewater.

The combined influence of the multicellular configuration and retention time on algal growth in aerated lagoons is considered. In lagoons treating domestic wastewaters, growth is controlled by light and carbon dioxide. Beyond the first cell in a dual-power level system, light penetration is relatively uniform from cell to cell due to the low and equal levels of aeration employed in that part of the lagoon system. The carbon dioxide concentration will also be relatively uniform from cell to cell. In an experiment aimed at calculating the annual mean concentrations of suspended solids in the effluents of two polishing pond systems receiving a secondary effluent from a domestic wastewater treatment plant, one system consisted of a single cell and the other of four cells in series. At retention times less than 2 days, the effluent suspended solids from both systems decreased as a result of sedimentation of suspended solids in the secondary effluent; the subsequent increase reflected the generation of algae in the pond systems. The increase in effluent suspended solids occurred at a

much greater rate in the single cell system than in the four cell system. The difference in performance can be explained in terms of the hydraulics of an ideal system. Only 6.2% of the effluent from the three cell system has a retention time greater than twice the average retention time, as compared with 13.5% for the single-cell system. For a four-cell system, the percentage drops to 4.2. This reduction in the percent of effluent with long retention times is responsible for the suppressive effect on growth which was noted. (Baker-FRC)
W82-06662

DERIVATION OF AN EMPIRICAL SORPTION RATE EQUATION BY ANALYSIS OF EXPERIMENTAL DATA,

Colorado State Univ., Fort Collins. Dept of Civil Engineering.
D. W. Hendricks, and L. G. Kuratti.
Water Research, Vol 16, No 6, p 829-837, June, 1982. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Sorption, *Mathematical equations, Regression analysis, Kinetics, Model studies, Mathematical models, Continuous flow, Filters, Packed beds, Reactors, *Wastewater treatment.

In this work five postulated sorption rate equations are tested in terms of their fits to experimental data. The data were generated by sorption uptake tests in batch reactors. The range of experimental conditions included two sorbate-sorbent combinations, four temperatures, and 30 initial concentrations of sorbate, giving a total of 240 tests. A sorption uptake curve was plotted for each experimental test; the rate coefficients for the five rate equations were determined by the differential method from the uptake curves. The fits of the different rate coefficients plotted against solution concentrations were evaluated by visual indication of scatter and by regression analysis. Through this screening process the validity of one of the equations was ascertained. Uptake rate was dependent on degree of sorbent saturation with sorbate and liquid phase sorbate concentration. The rate equation verified above was documented over a wide range of experimental conditions. The equation is a basis for routine lab tests of sorption uptake with time. The coefficients for the particular system of interest can be obtained from these tests. Further work is needed to ascertain the validity of the equation over a broad range of hydrodynamic conditions. The larger goal is to ascertain an easy to use kinetic model which has application in reactor design. (Baker-FRC)
W82-06664

DYNAMICS OF BIOFILM PROCESSES: METHODS,

Montana State Univ., Bozeman. Coll. of Engineering.
W. G. Characklis, M. G. Trulear, J. D. Bryers, and N. Zelver.
Water Research, Vol 16, No 7, p 1207-1216, July, 1982. 10 Fig, 5 Tab, 40 Ref.

Descriptors: *Biofilms, *Bacteria, Measuring instruments, *Wastewater treatment, Laboratory studies, On-site studies.

This paper reviews methods for measuring biofilm development processes in the laboratory and in the field. Two reactor geometries were used to study biofilm development and destruction. The circular type was used, as it is the prevalent geometry in heat exchangers. The rotating annular reactor was also tested because of its compactness and ease of operation. Direct measurement of biofilm quantity is essential in calibration of indirect measurement techniques for determining biofilm quantity, in the use of mass conversion equations for determining process rates and stoichiometry, and in relating biofilm development to fluid frictional resistance and heat transfer resistance in a rational manner. Indirect measurement of biofilm quantity using a specific biofilm constituent has certain advantages, including the facts that some of the indirect methods are more sensitive, and that indirect measures provide information regarding biofilm composition and hence stoichiometry of biofilm processes. Indirect measurement of biofilm quantity through microbial activity within the biofilm is useful in certain instances, such as in determining the physiological state of the organisms in the biofilm, in some measurements of biofilm activity which are extremely sensitive, and in substrate removal rates which are needed when employing mass conservation equations. The choice of analytical method for monitoring biofilm processes will be dependent on the questions which prompt the investigation. (Baker-FRC)
W82-06666

THE BEHAVIOUR OF NITRILOTRIACETIC ACID DURING THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,

Imperial Coll. of Science and Technology. London (England). Public Health Engineering Lab.
P. W. W. Kirk, J. N. Lester, and R. Perry.
Water Research, Vol 16, No 6, p 973-980, June, 1982. 6 Fig, 2 Tab, 31 Ref.

Descriptors: *Anaerobic digestion, *Nitrilotriacetic acid, Chelating agents, Sludge digestion, Sludge, Digestion, Biodegradation, Anaerobic conditions, Activated sludge process, *Wastewater treatment, Land disposal, Sludge disposal.

The fate of nitrilotriacetic acid (NTA) in anaerobic digesters fed with mixed primary sludge was investigated. Each of four digesters was initially seeded with 1 liter fresh digested sludge and 0.5 liters of mixed primary sludge. Subsequent additions consisted of mixed primary only, diluted with distilled water. Two sequential additions of 1.5 g calcium hydroxide were made to each digester on days 6 and 8. From days 12-24 prolonged purging of the digester was undertaken with oxygen-free nitrogen following each addition of influent sludge. After stabilization periods of 50 days, NTA was spiked into three digesters to produce concentrations of 10, 20 and 30 mg/liter in the digesting sludge. All subsequent feeds to these three digesters contained NTA concentrations of 10, 20 or 30 mg/liter respectively. The percentage removal of NTA from solution during anaerobic digestion decreased with increasing influent concentration. Addition of sodium azide, which prevented anaerobic degradation of the volatile solids, did not increase soluble NTA concentrations in the digesters, indicating that the removal observed was not the result of biodegradation. It was apparent that the current widespread application of anaerobic digestion in sewage treatment would result in a large percentage of any NTA present passing through this treatment unaffected, with unknown consequences for the application of this sludge to agricultural land. (Baker-FRC)
W82-06667

APPARATUS FOR CLEANING WATER CONTAINING FOREIGN PARTICLES SUCH AS SUSPENDED MATTERS OR OIL,

H. Ino, and R. Ino.
U.S. Patent No 4,203,849, 7 p, 14 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 994, No 3, p 989-990, May 20, 1980.

Descriptors: *Patents, *Waste water treatment, *Water pollution treatment, *Separation techniques, Oil pollution, Suspended solids, Equipment.

The object of this invention is to provide an apparatus for cleaning water which is characterized by a number of inclined partition plates that are placed in a container at regular intervals in such a way that the plates are slanted with respect to the horizontal and vertical planes. The basic principal lies in the fact that the separation chamber is separated by partition plates into a number of oblique passages which make the settling distance (that is the distance the particles travel before settling on the plates) of the suspended particle short and which also changes the direction of movement of the suspended particles relative to the direction of the water so that the suspended particles are completely separated from the water. (Sinha-OEIS)
W82-06699

FERRATE ION: POTENTIAL USES IN ADVANCED WASTEWATER TREATMENT,

Nebraska Univ., Lincoln. Dept. of Chemistry.
J. D. Carr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256751, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Report, June, 1982, Lincoln, Nebr. 39 p, 5 Fig, 5 Tab, 10 Ref. OWRT A-053-NEB(3), 14-34-0001-9029.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Iron, *Oxidation, *Kinetics, *Organic compounds, Wastewater, Organic wastes, Wastes, Organic matter, Organic loading, Oxidized wastewater, Oxidation process, Wastewater oxidation, Chemical oxygen demand, Spectrophotometry, Spectral analysis, Iron compounds, Chemical analysis, Water analysis.

The potential use of ferrate (VI) ion in the treatment of industrial wastewater containing particularly objectionable organic compounds in the absence of a high biochemical oxygen demand was explored. The oxidation kinetics of a variety of aqueous organic solutes by ferrate (VI) ion and the identification of potential reaction products were carried out. Kinetic measurements were made by visible spectrophotometry at conventional and stopped-flow speeds. The oxidation of water by ferrate (VI) occurs by two parallel pathways; one being first-order in ferrate (VI); the other being second-order. The former (and its pH dependence) was interpreted in terms of the rapid decomposition of H2Fe04; the latter, in terms of the rapid decomposition of Fe207 divalent anion. Both species are transient intermediates which are directly unobservable due to their short lifetimes. A new method for interpreting mixed-order kinetics was developed. Iron (II) was unexpectedly observed as an intermediate in the reduction of iron (VI) to iron (III). The overall conclusion of these studies was that there are many situations where ferrate (VI) can be used to advantage in wastewater decontamination, especially in industrial situations in which specific objectionable organics are produced in the presence of a low biochemical oxygen demand. The oxidation kinetics of nitrilotriacetic acid, aliphatic alcohols, ammonia and alkylamines, ethylene glycol, cyanide, phenol, and diethyl-sulfide are reported. (Zielinski-MAXIMA)
W82-06701

PILOT PLANT STUDIES OF COPPER, ZINC, AND TRIVALENT CHROMIUM REMOVAL BY ADSORBING COLLOID FOAM FLOTATION,

Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. T. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256827, Price codes: A05 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center Research Report No 88, August, 1981, Knoxville. 74 p, 7 Fig, 20 Tab, 31 Ref. OWRT A-064-TENN(1), 14-34-0001-1145.

Descriptors: *Industrial wastewater, *Metal-finishing wastes, *Copper, *Zinc, *Chromium, *Wastewater treatment, Wastewater, Heavy metals, Industrial wastes, Colloids, Gels, Flotation, Foam separation, Hydraulic loading, Trace metals, Coagulation, Chemical coagulation, Water treatment, Adsorbents, Adsorption.

Design parameters were considered for adsorbing colloid foam flotation (ACFF) for treating metal finishing industry wastewaters. Combinations of copper, zinc, and chromium (III) were studied, as well as the effects of pH, hydraulic loading rate, coagulant and surfactant doses, ionic strength, and air flowrate on metal removal. These data led to the development of mathematical expressions relating coagulant dose with metal removal. The study results indicated that ACFF is a feasible method for treating heavy metal-bearing wastewaters. Coagulant doses of about 100 mg/liter lowered metal concentrations from 20 mg/liter at optimum pH (7.0-7.6) and low ionic strength (below 0.05), to

0.1-0.5 mg/liter. Hydraulic loadings up to 15 cu m per sq m per hour. Economic analysis of the ACFF process indicated it to be less expensive than alkaline precipitation. The ACFF process found to be simple and rapid, requiring low space and energy for operation, and yielding small concentrated sludge volumes. The low residual metal levels consistently achieved were below currently mandated regulatory effluent standards, as well as the 1984 BAT-equivalent guidelines. (Zielinski-MAXIMA)
W82-06708

APPLICATION OF OZONE TO ELIMINATE TERTIARY TREATMENT OF WASTEWATER USED FOR INDUSTRIAL COOLING,

Brown and Caldwell, Walnut Creek, CA.
For primary bibliographic entry see Field 5F.
W82-06709

INVESTIGATIONS INTO THE NITRIFICATION OF SYDNEY'S WASTEWATERS,

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
P. J. Bliss, D. Barnes, and B. A. Windshuttel.
Effluent and Water Treatment Journal, Vol 22, No 4, p 137-140, 142-143, 145, April, 1982, 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Nitrification, *Design criteria, *Activated sludge process, *Wastewater treatment, Sydney, *Australia, Retention time, Dissolved oxygen, Oxygen, Ammonium, Seasonal variation, Aeration.

Design requirements for nitrification in the activated sludge process were studied in full-scale runs at the Castle Hill treatment plant in Sydney, Australia. Mean cell residence time requirements to initiate nitrification were 20 days for winter (13-14 C) and 4 days in summer under optimum conditions: dissolved oxygen of 4-5 mg per liter and flow equalization (peak-to-average ammonium ratios less than 1.7). These conditions produced an effluent with ammonium concentrations of 2 mg per liter average and 5 mg per liter peak. Higher effluent ammonium concentrations resulted under transient loads or at lower dissolved oxygen levels. At high mixed liquor suspended solids concentrations, solids were lost in the clarifier effluent. A pH range of 6.5-8.0 was suitable for nitrification. For a optimal design of nitrifying activated sludge plants the system components must be balanced. For example, the design mean cell residence time and aeration tank volume are minimal at higher (4-5 mg per liter) dissolved oxygen concentrations and with flow equalization. However, the higher dissolved oxygen requires a larger aeration system, and flow equalization requires larger storage capacity. At higher mixed liquor suspended solids concentrations the aeration tank volume may be reduced, but the clarifier capacity must be increased. There is also evidence that sludge settleability is reduced at high dissolved oxygen concentrations. (Cassar-FRC)
W82-06724

PUT PRESSURE ON SEWAGE,

Greenhorne and O'Mara, Inc., Riverdale, MD.
L. N. Rydland.
American City and County, Vol 97, No 6, p 47-48, June, 1982.

Descriptors: *Sewar systems, *Wastewater collection, *Septic tanks, *Wastewater treatment, Pumps, Rural areas, Grinder pumps, Pressure sewer systems.

Pressure sewer systems are available to convey sewage from rural homes with faulty on-site disposal systems to establish sewer networks. The septic tank effluent pump (STEP) system consists of a receiving tank, a pump, control sensors, piping, and valves. The grinder pump (GP) system has a grinder, pump, check valve, automated controls, holding tank, and venting system. In the STEP system the existing septic tank must be intact and working properly; otherwise it is removed or bypassed. The GP system involves a totally new on-lot installation. It eliminates reliance on septic tanks, requires less property disruption and piping, and pumps aerobic, rather than anaerobic, sewage to the treatment plant. (Cassar-FRC)
W82-06732

SALMONELLA SPP. IN THE WORKING ENVIRONMENT OF SEWAGE TREATMENT PLANTS IN OSLO, NORWAY,

Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene.
For primary bibliographic entry see Field 5A.
W82-06734

EVIDENCE THAT MICROORGANISMS CAUSE INACTIVATION OF VIRUSES IN ACTIVATED SLUDGE,

Health Effects Research Lab., Cincinnati, OH.
R. L. Ward.
Applied and Environmental Microbiology, Vol 43, No 5, p 1221-1224, May, 1982. 2 Fig, 26 Ref.

Descriptors: *Activated sludge process, *Viruses, *Wastewater treatment, Poliovirus, Microorganisms, Wastewater disposal, Waste disposal, Land disposal, Microbial degradation, Microbiological studies.

The role played by microorganisms in virus removal during activated sludge treatment was investigated. Mixed-liquor suspended solids (MLSS) of activated sludge were seeded with a standard enteric virus, and the loss of virus plaque-forming units (PFU) was measured over time. The virus used was the LSc2ab strain of poliovirus 1. The first experiment was done to determine the effect of MLSS on the recovery of poliovirus after different periods of incubation. The results indicated a rapid decrease in recoverable PFU occurring during the first 16 hr of incubation, relative to a control. The second experiment was done to determine the role of different MLSS components in virus loss. The MLSS were centrifuged, the supernatant was removed, and the pellet was suspended in an equal volume of distilled water. This suspension and the supernatant fraction were then seeded witn poliovirus. The loss of recoverable PFU was at least as rapid in the suspended pellet as in the original MLSS. The supernatant fraction intitially had almost no effect on virus recovery, but the expression of antiviral activity in this material became evident within 48 hr and progressed steadily through the 13 day incubation period. The third experiment was done to measure the effects of different disinfection methods on the antiviral activities in the pellet and supernatant fractions. Results indicated that MLSS contain a component which inactivates poliovirus, most likely a microorganism or group of microbial species. The identity of this organism, the mechanism by which it decreases poliovirus recovery, and its effect on other enteric viruses remain to be determined. (Baker-FRC)
W82-06739

DYE-COUPLED ELECTRODE SYSTEM FOR THE RAPID DETERMINATION OF CELL POPULATIONS IN POLLUTED WATER,

Kurita Water Industries Ltd., Yokohama (Japan).
For primary bibliographic entry see Field 5A.
W82-06743

ISOLATION OF ENTEROVIRUSES FROM OXIDATION POND WATERS,

University of Southern Mississippi, Hattiesburg. Dept. of Microbiology.
V. L. Sheladia, R. D. Ellender, and R. A. Johnson.
Applied and Environmental Microbiology, Vol 43, No 4, p 971-974, April, 1982. 1 fig, 2 Tab, 14 Ref.

Descriptors: *Viruses, *Oxidation lagoons, Ponds, Enteroviruses, *Wastewater treatment, Oxidation, Lagoons, Seasonal variations, Aeration, Chlorination.

Enteroviruses were isolated from two types of oxidation lagoons. One lagoon complex involved 140 hectares of surface area, average input of 8000000 gallons/day, a retention time of 98 days, and effluent biological oxygen demand and suspended solids of 1,070 and 1,859, respectively. The other lagoon complex was smaller and processed a lower volume, employing mechanical aeration as well as effluent chlorination. Together the complexes serve about 45,000 people in primarily a light industrial area. During the 18 month study isolations, performed by sewage concentration and direct assay, were low in number and did not follow a seasonal trend. The newer treatment system, using aeration and effluent chlorination, was more efficient at removing viruses than the older, static complex. (Baker-FRC)
W82-06750

TETRAZOLIUM REDUCTION-MALACHITE GREEN METHOD FOR ASSESSING THE VIABILITY OF FILAMENTOUS BACTERIA IN ACTIVATED SLUDGE,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
G. Bitton, and B. Koopman.
Applied and Environmental Microbiology, Vol 43, No 4, p 964-966, April, 1982. 3 Fig, 16 Ref.

Descriptors: *Bacteria, *Activated sludge, Bacterial analysis, Sludge, Wastewater treatment, Activated sludge process, Chlorination, Wastewater analysis, *Pollutant identification, *Tetrazolium.

Bright-field microscopy and a new staining technique were used for the examination of the activity of filamentous bacteria in activated sludge after chlorine addition. A continuous-flow activated-sludge unit consisting of a 20-liter aeration basin with an integral clarifier was seeded with activated sludge culture from a wastewater treatment plant. The assessment of the activity of filamentous bacteria involved the incubation of activated sludge with 2(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride, followed by staining with malachite green. Both cells and 2(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride-formazan crystals can be observed in prepered specimens by using bright field microscopy. This method allowed the distinction to be made between inactive and actively metabolizing filaments after chlorine application to control the bulking of activated sludge. The procedure is simple, eliminates the use of epifluorescence, and allows the observation of inactive and active cells. (Baker-FRC)
W82-06752

REDUCTION OF CYTOTOXICITY IN VIRUS CONCENTRATES FROM ENVIRONMENTAL SAMPLES,

Murray State Univ., KY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W82-06757

SEWER RENEWAL BY PIPE INSERTION,

For primary bibliographic entry see Field 8A.
W82-06759

REMOVAL OF TOXICANTS DURING DIRECT AND INDIRECT REUSE OF WASTEWATER EVALUATED BY MEANS OF A MAMMALIAN CELL CULTURE TECHNIQUE,

National Inst. for Water Research, Pretoria (South Africa).
R. Kfir, and O. W. Prozesky.
Water Research, Vol 16, No 6, p 823-828, June, 1982. 4 Fig, 1 Tab, 31 Ref.

Descriptors: Water quality, *Reclaimed water, Drinking water, *Water reuse, *Wastewater renovation, Water supply development.

The quality of drinking waters originating from secondary effluents was investigated using the cloning efficiency technique. A comparison was made between direct and indirect reuse of wastewater in terms of their comparative efficiencies in removal of toxicants. Indirect reuse of wastewater was tested by investigating a system in which secondary effluents are discharge into a

river flowing into an artificial reservoir. After conventional treatment, water from this reservoir was supplied as potable water. Direct reuse was tested by studying the removal of toxicants by the unit processes in a water reclamation plant. Various stages of both the direct and indirect reuse systems were tested in order to determine which stage resulted in the greatest removal of toxicants. Judging from the results obtained by using the tissue culture cloning efficiency technique for testing both direct and indirect reuse of treated wastewater, both purification processes proved equally effective in removing most of the toxicants originally present in the secondary treated wastewater. The study suggests that reclamation of wastewater for direct reuse in arid regions can solve the problem of water shortages without increasing the health hazard to the consumer. (Baker-FRC)
W82-06768

THE KINETICS OF HEXAVALENT CHROMIUM REDUCTION BY METALLIC IRON,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
J. P. Gould.
Water Research, Vol 16, No 6, p 871-877, June, 1982. 10 Fig, 2 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Chromium, Industrial wastes, Cooling towers, *Kinetics, Chemical reactions, *Iron, Chemical reduction, Oxidation-reduction potential.

The use of metallic iron as a reductant for Cr(VI) is reported. Metallic iron reacted efficiently with Cr(VI) under acid conditions in a complex reaction. Reaction kinetics were 0.5 order in both hydrogen ion and hexavalent chromium and first order in iron surface area. Since the iron consumed is proportional to the Cr(VI) concentration, careful system design will obviate the need for measuring and dispensing various treatment chemicals. Substantially less iron is needed to reduce a given quantity of Cr(VI) than would be the case for Fe(2+). In effect, each iron molecule provides 1.5-2.5 electrons in the reduction rather than the single electron available from the ferrous iron. The highly efficient utilization of iron in the reduction suggests that hydrogen generated during iron dissolution may be acting as a reductant for the Cr(VI). Since iron utilization efficiency improves as Cr(VI) concentration increases, such a treatment system implies that a significant advantage will be associated with segregation of high concentration Cr(VI) bearing wastes. The resulting effluent containing ferric ion and the relatively non-toxic chromic ion might be usable as a coagulant where needed. (Baker-FRC)
W82-06771

FATE OF PATHOGENS IN THERMOPHILIC AEROBIC SLUDGE DIGESTION,

Cornell Univ., Ithaca, NY. Dept. of Agricultural Enginerring.
R. M. Kabrick, and W. J. Jewell.
Water Research, Vol 16, No 6, p 1051-1060, June, 1982. 4 Fig, 4 Tab, 38 Ref.

Descriptors: *Pathogens, *Sludge digestion, *Digested sludge, Bacteria, Coliforms, Viruses, Parasites, Wastewater treatment, Salmonella, Pseudomonas, Anaerobic digestion, Thermophilic digestion, Mesophilic digestion.

The effect of two types of sludge digestion on pathogen survival was studied in two full-scale, continuous systems: autoheated aerobic thermophilic digestion and conventional mesophilic anaerobic digestion. The aerobic digester was operated at 45-65 C and variable loading conditions. the anaerobic digester was operated at a constant temperature of 35 C and constant loading rates. Mean bacterial counts per 100 ml of wet sludge were: feed sludge, 37 million fecal coliforms and 27 million fecal streptococci; anaerobic sludge, 840,000 fecal coliforms and 930,000 fecal streptococci; and aerobic sludge, 18,000 fecal coliforms and 82,000 fecal streptococci. The aerobic digester reduced Salmonella sp. to nondetectable levels and pseudomonads to lower levels except for one sampling date on which the digester was operating poorly. The anaerobic digester reduced Salmonella sp. and pseudomonads less efficiently. The aerobic digester reduced viruses to the nondetectable level, and the anaerobic reduced viruses as much as 98.6%. The aerobic process did not completely eliminate parasitic ova, but it was more effective than the anaerobic process. The thermophilic aerobic digester can be improved by using series-fed reactors or sequencing batch units to compensate for inadequate temperatures during start-up or shut-down. (Cassar-FRC)
W82-06772

AN OVERVIEW OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S STORM AND COMBINED SEWER PROGRAM COLLECTION SYSTEM RESEARCH,

Municipal Environmental Research Lab., Edison, NJ.
For primary bibliographic entry see Field 5G.
W82-06775

EFFECT OF CARBON-OXYGEN AND CARBON-SULFUR SURFACE COMPLEXES ON THE ADSORPTION OF MERCURIC CHLORIDE IN AQUEOUS SOLUTIONS BY ACTIVATED CARBONS,

Universidad Nacional de Educational a Distancia, Madrid (Spain).
J. de D. Lopez-Gonzales, C. Moreno-Castilla, A. Guerrero-Ruiz, and F. Rodriguez-Reinoso.
Journal of Chemical Technology and Biotechnology, Vol 32, No 5, p 575-579, May, 1982. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Carbon, *Adsoprtion, *Wastewater treatment, *Mercuric chloride, Chlorides, Acidity, *Activated carbon, Water treatment, Temperature effects.

The adsoprtion of mercuric chloride from aqueous solution onto activated carbons previously treated to introduce carbon-oxygen and carbon-sulfur surface complexes was studied to determine their effect on the adsorptive capacity of the original carbons. The findings demonstrated that the existence of hydroquinone, phenolic and hydrosulfide groups on the surface of the carbon caused reduction of Hg(II) to Hg(I). However, there was an increase in the adsorption of Hg(II) when sulfide or hydrowulfide groups were present on the surface of the carbon. The effect of the pH of the solutions on mecuric chloride adsorption was also studied. When the pH was changed from 1 to 7 the adsorption of mercuric chloride by the activated carbons was enhanced. (Baker-FRC)
W82-06788

ELECTROPLATING AND CYANIDE WASTES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
W. R. Knocke, and J. Kunjur.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6 p 733-737, June, 1982. 45 Ref.

Descriptors: *Literatuure reviews, *Electroplating, *Metal-finishing wastes, *Cyanide, wastes, Industrial wastewater, *Wastewater treatment, Metals, Heavy metals, Regulations, Chemical precipitation, Sludge dewatering, Sludge disposal, Chromium, Copper, Nickel, Zinc, Membrane processes, Wastewater analysis, Ozonation, Aeration, *Reviews.

A review of recent literature on electroplating and cyanide wastes included several topics: regulatory aspects, heavy metals treatment and recovery, cyanide detection and treatment, and sludge treatment and disposal. In general, effluent standards became less stringent and more flexible during 1981. Some compliance dates were extended, and pretreatment standards for electroplaters generating less than 38,000 liters per day of waste flow were established. Many papers concerned heavy metals treatment. Among the newer or better methods mentioned were carbonate precipitation, soluble sulfide precipitation, amine ligands for Cu and Ni precipitation, sodium hydroxide precipitation, sodium borohydride, electrocoagulation, reverse osmosis, ultrafiltration, and adsorption on a confined soil bed. Developments in cyanide determination included the use of sodium ethylenediamine tetraacetic acid for masking interfering ions, polarographic methods for low levels (< 0.1 mg per liter) of cyanide, and automatic monitoring of cyanide and other wastewater constituents. Cyanide waste treatment methods discussed were high temperature and high pressure hydrolysis to convert cyanide to ammonia and formate, use of iron sulfide compounds, percolation through mixed pyrrhotite-pyrite, oxygen/hydrogen catalytic treatment, fixed bed columns containing ceramic material or graphite, ozonation, and hydrolytic assist extended aeration. Sludge treatment and disposal innovations were a new silicate material for concentrating sludge, use of sludge as an admixture for concrete, metals immobilization by acid fixing in a proprietary siliceous polymer and solidification in cement, and immobilizing chemicals such as lanthanum compounds, Magnesium chromate, ferrite sludges, and a carbonate/silicon oxide mixture. (Cassar-FRC)
W82-06798

STEEL INDUSTRY WASTES,

Canada Centre for Inland Waters, Burlington (Ontario).
D. T. Vachon, J. W. Schmidt, and N. W. Schmidtke.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 729-733, June, 1982. 61 Ref.

Descriptors: *Steel industry, wastes, *Literature reviews, *Metal-finishing wastes, *Industrial wastes, *Reviews, *Wastewater treatment, Coke, Biological treatment, Water reuse, Nitrification, Thiocyanates.

A review on the characteristics and treatment of steel industry wastes included general papers and reports on coke production, iron and steel making and forging, pickling operations, and metal finishing processes. An additional $10 billion in pollution control equipment is projected for this industry by 1989. As effluent limitations become more stringent, the cost effectiveness of control measures decreases. Recycling and recirculation are becoming increasingly important. Research on wastewater from coke production effluents concerned alkaline chlorination with filtration and dechlorination, thiocyanate removal by ion exchange, ozonation, treatment with long chain quaternary amines to remove iron cyanides, stripping in a distillation tower, removal of oil and grease with coagulation/flocculation/dissolved air flotation/caustic soda treatment, biological treatment, biological nitrification, use of activated carbon in nitrification/denitrification, and mixing at 10% with municipal wastewater. Several processes were successful in treating blast furnace gas cleaning wastewater, steel manufacturing wastewater, pickling effluents, and metal processing wastes.(Cassar-FRC)
W82-06799

SYNTHETIC FUEL EFFLUENTS,

Argonne National Lab., IL. Energy and Environmental Systems Div.
M. F. Torpy, and E. L. Stover.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 726-729, June, 1982. 2 Tab, 30 Ref.

Descriptors: *Literature reviews, *Oil shale, *Synthetic fuels, *Coal gasification, *Reviews, Fuel, Toxicity, Water pollution effects, Wastewater analysis, Biological treatment, Tar sands, Waste disposal, Fate of pollutants, *Wastewater treatment.

A review of synthetic fuel effluents and their impact on water quality reveals that several meetings and symposia included information on this subject. Several waste stream treatment methods were mentioned--a separate biological nitrification unit to handle high thiocyanate levels, ammonia stripping, solvent extraction, and wet air oxidation. Coal liquefaction products were more toxic to

fresh water algae than shale oil products and petroleum products. Topics in the field of oil shale and tar sands were studies: the wet scrubbing system; water reuse options; adsorption of retort water by soil; chemical characterization of effluents, up to 238 constituents identified; methods of determining ammonia; mobility of trace elements; treatment of wastewater by biological treatment, reverse osmosis, or evaporation; mutagenicity of effluents; solids disposal problems; migration of organic constituents through the soil; and vegetative stabilization of retorted shales. (Cassar-FRC)
W82-06800

PETROLEUM PROCESSING WASTES,

Oklahoma State Univ., Stillwater. School of Civil Engineering.
E. L. Stover, and M. F. Torpy.
Journal of the Water Pollutin Control Federation (Literature Review Issue), Vol 54, No 6, p 723-726, June, 1982. 52 Ref.

Descriptors: *Literature reviews, *Oil refineries, *Hydrocarbons, *Industrial wastes, *Wastewater treatment, Petroleum products, Oil industry, Oil wastes, Organic compounds, Membrane processes, Oil shale, Activated carbon, Coagulation, Land disposal, Sludge, Water polution prevention, *Reviews.

Recent work on the environmental effects and treatment of petroleum processing wastes was reviewed. Characterization of wastewater effluents showed that priority pollutants were associated with certain products and processes that use certain precursors and generic process combinations. Sour condensates from conventional crude oil cracking produced straight chain alkanes, and pyridines and anilines were present in shale oil sour condensates. Heavy metal levels were low in most process effluents. The oil/water separation techniques data base has been updated by the American Petroleum Institute to include 166 citations. New papers in this field concerned the use of flocculation and flotation, electrochemical purification, electroflotation-coagulation, and an emulsion breaker/alum system. Biological wastewater treatment plants at several refineries were described. Special topics included carbon dioxide treatment of spent alkalis in refinery wastewater to decrease phenols and sulfur compounds and use of activated carbon. Several papers discussed the special problems of shale oil wastewater. Methds of protecting streams and groundwater in tar sands regions included monitoring, toxicity testing, and spill prevention. Petroleum refinery wastewaters were also treated by several membrane processes. Sludges were handled by solidification with hydrophobically adjusted Ca-containing chemicals, reuse in sealants and roofing or as fuel, and land disposal and microbial degradation. (Cassar-FRC)
W82-06801

CHEMICALS AND ALLIED PRODUCTS,

Union Carbide Corp., South Charleston, WV.
T. W. Siegrist.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 737-749, June, 1982. 152 Ref.

Descriptors: *Literature reviews, *Chemical wastewater, *Industrial wastewater, *Organic compounds, *Reviews, Wastewater treatment, Activated carbon, Adsorption, Phenol, Polychlorinated biphenyls, Chlorinated hydrocarbons, Incineration, Biodegradation, Pesticides, Physiocochemical treatment, Metals, Oxidation, Surfactants, Activated sludge process, Biological treatment, Drugs, Encapsulation, Nitrification, Microorganisms, Ultrafiltration, Membrane processes.

A review of recent literature on wastewater treatment in the chemical industry was organized according to product type and type of treatment (source, biological, and physical/chemical). For treating phenol and mixtures the following techniques were tried: anaerobic granular activated carbon bioreactors, anaerobic fixed-film bioreactors packed with granular activated carbon, carbon-sulfur compounds, liquid membranes, electrochemical oxidation, and horseradish peroxidase and hydrogen peroxide. Polychlorinated biphenyls and related chlorinated compounds were degraded or removed by incineration, chemical dechlorination, ultraviolet-ozone treatment, ultraviolet-light irradiation, polyurethane foam filtration, a particulate elastromeric polymer, algae, and microorganisms. Pesticides production wastewaters were treated by microbial degradation and a variety of chemical techniques specific to the nature of the wastewater. In addition papers on treatment of wastewaters from paint and ink plants, pharmaceutical manufacture, chlorinated organic wastes, detergent manufacture, and dozens of miscellaneous organic chemicals were summarized. Many waste products were recovered, some for sale, from process streams, for example, recovery of naphthalene hydrocarbons from petrochemical wastewater by adsorption on activated carbon and recovery of dispersed elemental Hg used as the oxide as a catalyst in vinyl acetate production by treatment with hydrazine hydrate. Biological treatment, especially with adapted activated sludges, was used for many chemicals. Powdered activated carbon, closed pure oxygen systems, and genetically-engineered microorganisms were among the modifications to the activated sludge process. Many studies were done on the factors affecting the activated sludge process. (Cassar-FRC)
W82-06805

SIMPLIFIED CLARIFIER AXES TREATMENT STAGES,

World Water, Vol 5, No 5, p 22-23, 25, May, 1982. 6 Fig.

Descriptors: *Clarification, *Oxidation ditches, *Biological treatment, *Wastewater treatment, Little Blue Valley Sewer District, Jackson County, *Missouri, Pilot tests, Design criteria, Land application, Aeration, Aerobic digestion, Dewatering, Sludge disposal.

The Little Blue Valley Sewer District biological sewage treatment plant in Jackson County, Missouri, was ranked as one of 1982's ten outstanding engineering achievements by the National Society of Professional Engineers. The 5000 cu m per day pilot plant uses only 6 of 13 originally planned treatment components to reduce costs to a minimum. The unconventional process comprises screening, oxidation ditch with integral clarification device, sludge waste pump, aerobic digester with integral clarification device, sludge dewatering, and land application. The heart of the simplified system is an intrachannel clarification device which eliminates the secondary clarifier and the secondary return sludge pump and piping. A section of the oxidation ditch opposite the aerator is deepened and partially blocked to force the normal ditch flow downwards, creating a quiescent zone for clarification. V-section cross pieces isolate the quiescent zone from the normal mixed liquor flow beneath, allowing mixed liquor to pass upward through the sections. Sludge falls back into the mixed liquor flow. Effluent is drawn from near the surface of the quiescent zone. Further experience showed that the grit removal step was also unnecessary. Average effluent BOD5 is 10-25 mg per liter with detention times as low as 6 hours. (Cassar-FRC)
W82-06820

THE REMOVAL OF MIXTURES OF METALS BY AN ADSORBING COLLOID FOAM FLOTATION PILOT PLANT,

Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. T. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 5, p 683-693, April, 1982. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Flotation, *Metals, *Foam separation, *Separation techniques, Industrial wastewater treatment, *Wastewater treatment, Zinc, Copper, Chromium, Heavy metals, Adsorption, Sodium lauryl sulfate, Surfactants, Flocculation, Aluminum hydroxide, Ferric hydroxide, Economic analysis, Costs, Lime, Chemical precipitation.

A foam flotation pilot plant removed Cu(+++), Zn(++), and Cr(3+) from a simulated industrial wastewater containing 20 mg per liter each of these ions. At optimal conditions the residuel levels of the ions were: Cu, < 1 mg per liter; Zn, 0.5 mg per liter; and Cr, 0.2 mg per liter. Hydraulic loading rates were 6.9 cu m per sq m per hour; air flow rate, 14 N cu m per sq m per hour; pH, 7.0-8.0; Fe(3+) as a flocculant, 100-115 mg per liter, Al(3+) as a flocculant, 75-100 mg per liter; and sodium lauryl sulfate foaming agent, 25-30% of total Fe and Al dose by weight. Economic analysis showed that adsorbing foam flotation could remove metals at a cost of 51 cents per 1000 liters vs. 60 cents per 1000 liters for a lime precipitation plant. This did not include the expensive filtration step and the 8 times greater area required for the lime precipitation process. (Cassar-FRC)
W82-06821

REMOVAL OF ZINC BY ADSORBING COLLOID FOAM FLOTATION: PILOT PLANT STUDY,

Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Separation Science and Technology, Vol 17, No 5, p 673-682, April, 1982. 3 Fig, 6 Tab, 15 Ref.

Descriptors: *Flotation, *Foam separation, *Separation techniques, *Metals, *Zinc, Copper, Aluminum hydroxide, Hydraulic loading, Heavy metals, Industrial wastewater treatment, *Wastewater treatment, Adsorption, Sodium lauryl sulfate, Surfactants, Flocculation.

A foam flotation pilot plant removed zinc from a simulated industrial wastewater containing 20 mg per liter Zn(++). Effluent Zn concentrations were below 1 mg per liter when the following optimum parameters were used: pH, 7.5-7.8; Al(3+) as aluminum hydroxide, 100 mg per liter; sodium lauryl sulfate surfactant, 30-40 mg per liter; hydraulic loading rate, 6.9-13.8 cu m per sq m per hour; and air flow rate, 12-13 N cu m per sq m per hour. Optimum Al(3+) dose depended on the influent Zn(++) concentrations. To produce effluent Zn(++) concentrations of < 1 mg per liter, a 50 mg per liter Al(3+) dose was sufficient for influent Zn(++) of 10 mg per liter concentration, and 150 mg per liter Al(3+) was necessary for influent Zn(++) of 30 mg per liter. Substituting Fe(OH)3 for Al(OH)3 and Cu(++) for Zn(++), trends were similar but residual Cu(++) was lower. Increasing ionic strength above 0.05M was detrimental to Zn(++) removal. (Cassar-FRC)
W82-06822

CONTINUOUS DENTRIFICATION BY IMMOBILIZED CELLS (DENITRIFICATION EN CONTINU A L'AIDE DE MICROORGANISMES IMMOBILISES SUR DES SUPPORTS SOLIDES),

Departement de Genie Biochimique, Tolouse (France).
M. Vossoughi, M. Laroche, J. M. Navarro, G. Faup, and A. Leprince.
Water Research, Vol 16, No 6, p 995-1002, June, 1982. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Denitrification, *Wastewater treatment, Nitrates, Nitrogen, Nitrification, Kinetics, Chemical reactions, Colorimetry, *Biological wastewater treatment, Pseudomonas, Bacteria.

A study of biological denitrification by immobilized cells is described. Nitrates are reduced in sterile solutions by Pseudomonas aeruginosa immobilized in a fixed bed reactor, and in synthetic wastewater by mixed cultures immobilized in a fluidized bed reactor. The fixed bed reactor was a Plexiglas column filled with corn stovers. Nitrates and nitrites were determined by a colorimetric method. The reactor efficiency remained constant for over 40 days. Nitrates and nitrites were measured inside the reactor for flow varying from 2 to 16 ml/minute. Reductions of nitrates and nitrites seem to be two first-order reactions, and the constant rate increases with flow rate. The fluidized bed reactor used was a Plexiglas column filled with earthenware. The reduction of nitrates and nitrites

again appeared as two first-order reactions, and the constant rate values, higher than in fixed bed reactors, increased with flow. The reactor was more greatly affected by a flow shift than by a nitrate concentration shift in fresh medium; the biomass bound to the carrier was about 76 mg of dry matter/g of earthenware. The fluidized bed column was able to reduce 560 mg of nitrate nitrogen/hr/liter of empty reactor, with a liquid retention time of less than 3 minutes. (Baker-FRC)
W82-06830

THE EFFECT OF INCREASED NICKEL ION CONCENTRATIONS ON MICROBIAL POPULATIONS IN THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,

York Univ. (England). Dept. of Biology.
N. V. Ashley, M. Davies, and T. J. Hurst.
Water Research, Vol 15, No 6, p 963-971, June, 1982. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Anaerobic digestion, *Nickel, Microorganisms, *Biological treatment, Digestion, Biodegradation, Anaerobic conditions, Sludge digestion, Activated sludge process, *Wastewater treatment, Water pollution effects, Metals, Heavy metals.

The effects of increased nickel ion concentrations on physiological groupings of microorganisms were examined to determine the toxic effects upon the degradative populations of bacteria in an anaerobic digester and to estimate a realistic toxic level of nickel in a population of organisms adapted to it by prolonged exposure at relatively low concentration. The concentration of dissolved nickel remained low (0.35 to 1.1 mg/liter) following addition of nickel at 25 and 50 mg/liter to the digester feed, presumably due to much of the nickel being present as the sparingly soluble sulfide or otherwise bound. At progressively higher additions (100, 150 and 250 mg/liter) the dissolved nickel increased substantially, probably due to a depletion in the available sulfide levels caused by the earlier nickel addition. The maximum dissolved nickel level obtained was 15 mg/liter. The nickel had exerted appreciable toxicity below this concentration. The nickel level in the control digester never exceeded 0.2 mg/liter. There appeared to be only a slight increase in relative numbers of acid producing organisms in the digester at low nickel additions, more so at a level of 50 mg/liter. The populations of amylolytic bacteria exhibited an initial increase in relative number with changes in nickel additions, followed by a decrease in number. Apart from these growth-stimulating effects at initial addition, the major effect of nickel was to lower the amylolytic bacterial population to a level below that of the control digester. The populations of proteolytic organisms were generally higher in the nickel challenged digester than in the control. A marked increase in the proleolytic population was found with the addition of 100 mg/liter of nickel, after which the population decreased, only to increase again under the influence of a further nickel increase. Nickel apparently favors a degradative population of bacteria primarily adapted to amino acid fermentation and inhibits carbohydrate metabolism in a population of proteolytic and amylolytic bacteria. (Baker-FRC)
W82-06832

BASIC STUDIES ON CARBON DIOXIDE/AIR CONTROL SYSTEM FOR ACTIVATED SLUDGE PROCESSES,

Hitachi Ltd., Ibaragi (Japan).
S. Nogita, S. Watanabe, and K. Baba.
Water Research, Vol 16, No 6, p 1017-1024, June, 1982. 14 Fig, 6 Tab, 4 Ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Carbon dioxide, Oxygen, Dissolved oxygen, Sludge, Municipal wastewater, Aeration tanks.

Basic facts about the production of carbon dioxide by activated sludge in an aeration tank are summarized, and the experimental results obtained with a carbon dioxide/air control system are reported. A continuous-flow-type apparatus was used to gather the data. Under the given conditions of the experiment the composition of the inflow and the air flow rate had little effect on the carbon dioxide production rate of activated sludge, and the carbon dioxide production rate was a function of the organic load. Since the organic load change caused a change in the carbon dioxide production rate in minutes instead of hours, a carbon dioxide/air control system in an activated sludge pilot plant was used to study carbon dioxide production. A control system was developed which effectively stabilized the carbon dioxide concentration. It was concluded that a carbon dioxide/air control system that can maintain a dissolved oxygen concentration within 0.5 mg/liter of a selected value functions in the same way as a dissolved oxygen/air control system, when exhausted air is analyzed in the former system. The system tested maintained the carbon dioxide concentration within 0.000.5 vol% of a selected value with a typical diurnal sewage flow rate pattern and maintained the dissolved oxygen content in mixed liquor within 0.4 mg/liter of a selected value. (Baker-FRC)
W82-06833

EFFECT OF THE PAPER INDUSTRY ON WATER QUALITY OF THE LOWER FOX RIVER,

California Inst. of Tech. Pasadena. Dept. of Environmental Engineering Science.
P. S. K. Leung, and N. J. Sell.
Water Resources Bulletin, Vol 18, No 3, p 495-502, June, 1982. 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Water quality, *Pulp and paper industry, *Pulp wastes, Industrial wastes, Fox River, *Wisconsin, Water pollution sources, Water pollution control, Biological oxygen demand, Suspended solids, Dissolved oxygen, Toxicity, Organic chemicals, *Wastewater treatment, Primary wastewater treatment, Secondary wastewater treatment.

Eighteen paper mills, producing greater than 5300 tons of paper per day, located along the Lower Fox River, Wisconsin, were asked to participate in a study of the effectiveness of the waste treatment methods each employed. Nine plants agreed to participate. On-site visits were made and discussions held with appropriate management and operating personnel. Technical data regarding the general operation of the plant, water pollutants, and methods for primary and secondary treatment were included in the study. In general the paper companies without any pulping processes or which produce relatively small quantities of paper per day either install only the primary treatment system or send the waste stream to a nearby municipal system. Companies with pulping processes or large quantities of paper being produced usually also install a secondary treatment system. Primary treatment is basically a settling pond. The overall efficiencies of these primary treatment systems are about 95% and 30-55% for removing suspended solids and BOD, respectively. Secondary treatment in all cases consisted of activated sludge systems, including an aeration tank where most of the microbiological activity occurs and a secondary clarifier where the activated sludge settles out. The maximum temperatures of the discharges reached 110 F, although most effluents ranged from 70 to 90 F. All plants discharged only about 40-50% of the allowable suspended solids. Similarly, most discharged less than 50% of the allowable BOD. Even so, the water quality of the river, particularly as regards dissolved oxygen, remains unsatisfactory at times. Several types of regulatory changes are possible. Flow and temperature related permits would probably be the most effective in improving DO levels, but would also be the most difficult to comply with. (Baker-FRC)
W82-06870

COMPARISON OF METHODS FOR RECOVERING INDIGENOUS VIRUSES FROM RAW WASTEWATER SLUDGE,

Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-06890

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,

Calocerinos and Spina Co., Liverpool, NY.
P. E. Moffa, S. D. Freedman, E. M. Owens, R. Field, and C. Cibik.
Journal of the Water Pollution Control Federation, (Literature Review Issue). Vol 54, No 6, p 675-677, June, 1982. 32 Ref.

Descriptors: *Literature reviews, *Urban runoff, *Combined sewer overflows, *Storm water, *Reviews, Model studies, Detention basins, Water management, Storm wastewater, Wastewater treatment, Rainfall, Monitoring, Water quality, Trace metals, Copper, Lead, Zinc, Settleable solids.

A review of urban runoff literature dealt with characteristics, impacts on receiving waters, control, treatment, and management. The great variability of storm water quality was handled by some simplified modeling and monitoring techniques and other methods of estimating pollutant levels and impact on receiving waters. Snowmelt was lower in nutrients, but higher in total solids, oil and grease, and colloidal material, than was rainfall runoff. It was estimated that combined sewer overflows and surface runoff contribute 30% of BOD and 74% of suspended solids discharged from municipal sources. Models and planning methods were also developed for aiding in design of storm water storage and treatment systems. Treatment considerations included underground circulation systems, facultative lagoons, biological treatment, sewer flushing, polymer injection, flow regulations, and upstream storage. In settleability tests hydrocarbon, lead, and total suspended solids were reduced by 70% over 32 hours; BOD, Cu, and Ni settled more slowly, 20-50% in the same time; and Zn settled the slowest. Methods of estimating flow rates for managing storm water flows included use of digital recording weather radar, computer based models, and statistical techniques. (Cassar-FRC)
W82-06914

TEXTILE WASTES,

Krebs (Paul B.) and Associates, Inc., Birmingham, AL.
J. F. Judkins, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 702-704, June, 1982. 25 Ref.

Descriptors: *Literature reviews, *Industrial wastewater, *Textile mill wastes, *Dyes, *Wastewater treatment, *Reviews, Wool scouring, Polymers, Ultrafiltration, Membrane processes. Textiles, Fabrics, Wool, Dye industry wastes, Ozonation, Activated sludge process, Flocculation, Chemical coagulation.

Recent literature on treatment and disposal of textile wastes described processes for handling dyeing wastewaters, wool scouring effluents, synthetic fiber wastewaters, and polymeric sizing agents. Good results were obtained from unspecified textile wastewaters by alum coagulation, followed by activated sludge treatment and by powdered activated carbon treatment. Dyeing wastewaters were successfully treated with alum and organic polymers, ozonation (acid and direct dyes), recovery of dyes without changing their chemical nature, electrochemical treatment of acid monoazo dyes, and landfilling of concentrated dyes with hypochlorination of dilute dye effluents. Techniques used for wool scouring effluents were a horizontal decanter centrifuge with addition of bittern flocculant or MgC12; a hot acid flocculation process; solvent extraction of wool wax from dewatered sludge; activated sludge process; a Humboldt SI-1 decanter; a physical-chemical process consisting of chlorination, electrocoagulation/flotation in acid, neutralization and further flotation; and separation of waste streams to reduce the organic load to the biological treatment process. Several synthetic fiber plants initiated recycling of wastes treated by coagulation/filtration/adsorption/ozonation, activated carbon adsorption, or flotation. Ultrafiltration was effective in recovery of polymeric sizing agents. Zirconium oxide, cellulose acetate, and polyamide membranes were considered. Water reuse treatments for polymer size recovery included high-temperature ultrafiltration, hypofiltration, and coagulation with recovered salt solutions. Kapron

and nylon-548 production wastes were polymerized to form glue-type polymers with excellent adhesion properties. (Cassar-FRC)
W82-06916

FERMENTATION INDUSTRY,

Notre Dame Univ., IN., DepT. of Civil Engineering.
S. C. Chiesa, R. L. Irvine, and J. F. Manning, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 695-700, June, 1982. 70 Ref.

Descriptors: *Literature reviews, *Fermentation, *Industrial wastewater, *Wastewater treatment, *Reviews, Anaerobic digestion, Aerobic treatment, Biomass, Feeds, Methane, Drugs, Antibiotics, Fertilizers, Yeasts, Fuel.

Recent work on treatment of fermentation wastes was reviewed. In addition to reuse, recycling and recovery techniques such as production of ethanol, methane, biomass, animal feed, fertilizers, and building materials, other treatment alternatives were proposed. Brewery wastewaters were treated with activated sludge and biological filters, dilution with municipal wastewater, adsorption of heavy metal ions on immobilized tannin, the aeroaccelator system (high-rate biological treatment), bacterial methods, pure oxygen activated sludge, and anerobic processes. Common biological treatment methods were successful in treating yeast factory wastewaters; high temperature and metallic catalysts were tried by one investigator. Several investigators characterized distillery wastes. Treatment methods included incineration, composting, extended aerobic biological treatment, anaerobic treatment (contact process and two-phase system), and the Anamet anaerobic/aerobic process. Winery wastewaters were purified by electrochemical means or with yeast cells. Shock chlorine doses controlled excessive foaming and bulking in an activated sludge system. Pharmaceutical wastes were treated by a variety of methods depending on the nature of the pharmaceutical process: ammonium ions were removed by physical/chemical treatment with clinoptiolite; organic solvents, by Amberlite resins; antibiotics, by coagulation with ferrous sulfate and polyacrylamide and centrifugation or combustion; and tellurium oxide, by reduction with SnC12 and coprecipitation with ferric hydroxide. Several references dealt aerobic and/or anaerobic treatment of wastes. Removal efficiencies of 26 priority pollutants were compared for several treatments, the best of which was activated sludge with added activated carbon. (Cassar-FRC)
W82-06917

FRUIT, VEGETABLE, AND GRAIN PROCESSING WASTES,

Post, Buckley, Schuh and Jernigan, Inc., Orlando, FL.
R. A. Morrell, and H. E. Schmidt, Jr.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 692-695, June, 1982. 32 Ref.

Descriptors: *Literature reviews, *Food-processing wastes, *Fruit crops, *Vegetable crops, *Industrial wastewater, *Reviews, *Wastewater treatment, Biological treatment, Activated sludge process, Anerobic digestion, Lagoons, Wastewater lagoons, Filtration, Water pollution prevention, Land disposal, Grain crops, Canneries.

Two books and an operations manual for biological treatment were among the new literature on food processing wastes. Several papers on treatment processes for a variety of food wastes included information on a lamella-type separator for removing suspended solids, a low-load activated sludge wastewater treatment plant for combined domestic and food wastes, and the application of land disposal techniques. Treatment systems designed for fruit wastes included a highly loaded two-stage stone media biofilter. Tomato waste treatments included a physical-chemical system with aeration and carbon filter bed, as well as spray irrigation, land application, and anaerobic digestion. For citrus wastes methane fermentation was discussed. The following processes and equipment were developed for handling wastewaters from vegetable processing: a rotating drum screen for liquid-solid separation and a blancher using steam that produces one-tenth the volume of effluent and one-fourth the BOD levels. For beet sugar wastewaters suggestions included Fe coagulation/flocculation, vacuum filtration, treatment in a municipal plant after pretreatment, and irrigation with effluent. For potato wastewater use of a horizontal anaerobic filter with 90% BOD removal, 2 anaerobic lagoons in parallel followed by anaerobic filter and aeration were considered. Controlled culture fermentation was successful in treatment of pickle, greens, olive, and bean processing liquids. An experimental washer for greens produced lower pollutant levels than an industrial washing system. Olive processing wastes were composted in a tank containing soil. Bean-blanching wastes were treated in anerobic fixed film reactors. (Cassar-FRC)
W82-06918

DAIRY WASTES,

Kraft, Inc., Glenview, IL.
J. C. Groenewold.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 700-702, June, 1982. 47 Ref.c

Descriptors: *Literature reviews, *Dairy industry, *Food-processing wastes, *Industrial wastewater, *Reviews, Wastewater treatment, Regulations, Economic aspects, Legislation, Biological treatment, Lagoons, Fermentation, Membrane processes, Land disposal, Wastewater disposal, Activated sludge process, Animal wastes, Bacteria.

A review of the past year's information on treatment of dairy wastes listed several general papers: the types of dairy wastewater treatment in Poland; literature reviews, including pollution from milk losses (considered trivial), and sampling and flow measuring techniques. Other general subjects included combined municipal-dairy effluent treatment and the unit processes of an ideal dairy waste treatment system. Among the papers on regulations, legislation, and economics, several favored land applicatiion. Whey disposal options included fermentation, land disposal by spraying, animal feed production, extraction of lactose and other useful components, and reverse osmosis followed by evaporation or ultrafiltration. Several case histories were described. The nutrient application in long-term land disposal should not exceed the nutrient amounts removed as forage. A biospiral system and drum filter tertiary treatment unit for creamery effluent reduced BOD to 3 mg per liter. Other treatment systems in actual use were anaerobic-aerobic lagoons, bacterial bed treatment using a variety of media, extended aeration, and physical-chemical treatment. Research efforts involved combined farm waste-milk waste lagooning, a rotating biological contactor, a multistage bubble separator, pretreatment and discharge into the municipal system, enzymatic prehydrolysis (unsuccessful), the effect of light wavelength on bacterial production of ethanol, characterization of various dairy wastes, and isolation of a new bacteria from dairy waste activated sludge. (Cassar-FRC)
W82-06921

ANAEROBIC PROCESSES,

Institute of Gas Technology, Chicago, IL.
K. F. Fannin, J. R. Conrad, V. J. Srivastava, D. E. Jerger, and D. P. Chynoweth.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 612-623, June, 1982. 1 Tab, 130 Ref.

Descriptors: *Literature reviews, *Anaerobic conditions, *Reviews, Agricultural wastes, Digestion, Anaerobic digestion, *Wastewater treatment, Municipal wastewater, Industrial wastes, Bacteria, Microbiological studies, Methanogenesis, Design criteria, Economic aspects.

Recent research in the area of anaerobic processes is cited in this literture review. Reviews published dealing with the entire subject included works on the status of work in the United States on biomass and waste-to-energy processes and various digester types used in European farm anaerobic digestion before 1970. In the area of microbiology papers dealing with classification and characterization included efforts made toward the isolation of a filamentous, facultative anaerobic microorganism which attached lignified tissue in forage grasses, on the diversity of microorganisms involved in cellulose fermentation, and on the electrical potential and intracellular pH of two methanogenic bacteria. Microbiology papers also dealt with cellulose hydrolysis, acidogenesis, and methanogenesis. Process stability was considered in studies dealing with acid and alkaline phosphatase activity used as biochemical predictors of digestor failure. Process optimization research dealt with general methodology, attached-film reactors, sludge bed reactors, two-phase reactors, stirred-tank reactors, peat and landfill digestion, and ethanol fermentation. Energy and economic assessment was also considered. Process application research centered on municipal wastewater studies, municipal solid wastes, process wastes, and agricultural wastes. Patents which were obtained are briefly noted. (Baker-FRC)
W82-06923

MICROBIOLOGY: WASTEWATER TREATMENT,

Drexel Univ., Philadelphia, PA., Dept. of Biological Sciences.
W. O. Pipes, and H. A. Minnigh.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 987-989, June, 1982. 45 Ref.

Descriptors: *Literature reviews, *Wastewater treatment, *Reviews, Activated sludge process, Sludge, Sludge disposal, Land disposal, Industrial wastes, Bacteria, Stabilization ponds, Anaerobic condition, *Microbiological studies, Nutrients, Phosphorus removal.

Recent research in the field of wastewater treatment is cited in this literature review. Microbiological oxidation of reduced nitrogen compounds in aerobic wastewater treatment processes and particularly the conditions that lead to inhibition of such oxidation were topics of research in 1981. Interactions among microorganisms in anaerobic sludge digestion were also reported. Activated sludge research centered on the isolation of floc-forming bacteria from activated sludge on casitone-glycerol-yeast extract agar, on a laboratory model flocculation system based on pure cultures of Escherichia coli, on cell residence time and its influence on microbial composition of activated sludge produced in a completely mixed laboratory system of treated domestic wastewater fortified with sugars and organic acids, on hydrazine inhibition of Nitrobacter and Nitrosomonas in activated sludge, on absorption of uranium and thorium by activated sludge, and on the occurrence of cysts of Entamoeba histolytica and Giaridia lamblia and the ova of Ascaris, Trichuris, and Hymenolopsis in wastewater and effluents from activated sludge systems in India. Stabilization ponds were studied concerning their effectiveness in wastewater treatment for nitrogen and phosphorus removal and for reduction of virus content. Land disposal was examined with regard to Salmonella havana persistence. Sludge treatment processes were investigated using staged anaerobic digestion, and included work on the formation of diethyl amine from creatinine in digesting wastewater sludge and on the survival of microorganisms after anaerobic digestion and prolonged periods of lagooning. Industrial wastes were also considered. (Baker-FRC)
W82-06926

PRELIMINARY STUDIES ON THE DEWATERING OF COAL-CLAY WASTE SLURRIES USING A FLOCCULANT,

Bureau of Mines, Tuscaloosa, AL. Tuscaloosa Research Center.
J. R. Zatko, B. J. Scheiner, and A. G. Smelley.
Report of Investigations RI 8636, 1982. 18 p, 7 Fig, 9 Tab, 6 Ref.

Descriptors: *Mine wastes, *Dewatering, *Slurries, *Flocculation, Coal mining, Clays, Water reuse, *Wastewater treatment, Polyethylene oxide.

In the preparation of coal to produce low-ash material, a waste product containing fine coal and clay is generated. This waste product, generally minus 28 mesh in size with the major portion being minus 325 mesh, is difficult to handle due to the slow settling of the fine-sized clay particles. In laboratory-scale and small-scale continuous tests, coal-clay waste slurries from two commercial preparation plants were dewatered using polyethylene oxide (PEO) as a flocculant. Slurries containing up to 50-wt-pct solids using 0.5 lb of PEO per ton of feed solids in small-scale continuous tests. The tests also indicated that a pH of at least 9 was required for West Virginia slurry, while a pH of 7 for the Alabama slurry was adequate. Initial solids content had little effect on dewatering. Water recovered from dewatering was used as dilution water for 0.25-wt-pct PEO solutions without any deleterious effect. (Moore-SRC)
W82-06958

ELECTROKINETIC DENSIFICATION OF SOLIDS IN A COAL MINE SEDIMENT POND-A FEASIBILILTY STUDY, (IN TWO PARTS), 1. LABORATORY AND FIELD TESTS,

Bureau of Mines, Spokane, WA. Spokane Research Center.
R. H. Sprute, and D. J. Kelsh.
Report of Investigations RI 8666, 1982, 36 p, 15 Fig, 8 Tab, 5 Ref.

Descriptors: *Electrophoresis, *Electro-osmosis, *Mine water, *Dewatering, *Sludge, Water reuse, Strip mine wastes, Underflow, Densification, *Washington, *Wastewater treatment.

The Washington Irrigation and Development Company (WIDCO) operates a large, multiseamed surface mine in western Washington to supply coal for a steam-electric generating plant. The mine's preparation plant thickener typically discharges about 2,600 gpm of underflow. Disposal is unusually difficult because of the large volume, suspended particles that are extremely resistant to natural settlement, and physical properties that ghange significantly and unpredictably as mining progresses. The watery underflow is pumped into a large pond where solids settle slowly and surface water is decanted for reuse in the plant. Since startup in 1970, the pond has grown to 100 acres or more with a center depth of 110 ft. Laboratory and field test results show that coal waste sludge in the WIDCO impoundment can be effectively consolidated by applying direct current between floating and buried electrodes. Treatment develops clear surface water for decanting, while 75 to 80% of the residue gradually densifies into a firm claylike product. The process becomes economically feasible when power is applied with low current density (5 to 6 ma/sq ft) and a potential of 25 v or less. Test results projected in an operational system for the WIDCO pond include a 21-acre surface electrode, submerged iron anodes, and a 12,000-amp dc power supply. Treatment would be continuously applied for 2 to 3 years. (Moore-SRC)
W82-06960

DECONTAMINATION OF OVERLAND RUNOFF FROM POPULATED AREAS,

Ministry of Reclamation and Water Management, Moscow (USSR).
Y. P. Belichencko.
Water Resources, Vol 8, No 4, p 415-149, July/August, 1981. 11 Ref. Translated from Vodnye Resursy, No 4, p 126-131, July/August, 1981.

Descriptors: *Storm wastewater, *Urban runoff, *Combined sewers, Storm sewers, Storm runoff, Storm water, Overland flow, Sewer systems, Water quality, Snowmelt, Runoff, Rainfall-runoff relationships, Water treatment, *Wastewater treatment, *USSR.

Storm water runoff from urban areas contains a variety of organic and inorganic pollutants: BOD, 12.5-145 mg per liter; suspended solids, 450-5000 mg per liter; petroleum products; asphalt, 50 g per 1 sq m paving; tire material; rubbish; leaves; and dust. Pollutant concentrations are highest at the beginning of a rain storm and at the start of the warm period in April. Snowmelt water generally has higher pollutant levels and greater variation in quality than rain water. Factors controlling the pollution levels in storm water runoff are type and condition of paving, street cleaning regime, traffic intensity, population density, and industrial activity. Treatment systems presently available are: combined sewers, separate sewer systems (industrial-domestic wastewaters delivered to treatment plants and storm water delivered untreated to the nearest surface water), and semiseparate sewers. In the semiseparate sewers all industrial-domestic wastewaters are delivered for treatment. Only the more polluted storm waters are routed to the treatment plant. This includes street washing water, rainfall from low-intensity storms, and melt waters. The nearly unpolluted runoff from heavy rainfall may be discharged into surface waters without treatment. Storage of storm waters in ponds or tanks for later treatment is advantageous because it evens the load on the treatment plant. (Cassar-FRC)
W82-06980

TREATMENT OF WASTEWATERS AND DEMINERALIZATION OF SALINE WATERS BY REVERSE OSMOSIS AND ULTRAFILTRATION,

Scientific Research Inst. of Plastics, (USSR).
N. E. Kozhevnikova, and K. M. Saldadze.
Water Resources, Vol 8, No 4, p 436-443, July/August, 1981. 4 Tab, 36 Ref. Translated from Vodnye Resursy, No 4, p 153-160, July/August, 1981.

Descriptors: *Desalination, *Membrane processes, *Reverse osmosis, *Ultrafiltration, *USSR, Industrial wastewater, Brackish water, *Wastewater treatment, Water treatment, Reviews, Electrodialysis, Separation techniques, Demineralization, Saline water, Seawater.

Membrane methods (electrodialysis, reverse osmosis, and ultrafiltration) for wastewater treatment, desalination, and water treatment are reviewed. These processes have been used widely in the U.S. since 1967. In the USSR pilot plants are being set up for cellulose acetate reverse osmosis and ultrafiltration. Single stage plants can be used for mildly saline waters, but multistage plants are necessary for highly concentrated solutions and seawater. The problem of disposing of the concentrated wastes produced by inland desalting plants can be handled by recovering waste materials for resale. An economic analysis shows that water with < 2 g per liter salt is processed more economically by ion exchange; 3-8 g per liter by reverse osmosis; and > 20 g per liter by reverse osmosis and distillation. Tables list data for five U.S. plants desalting water by the reverse osmosis method and possibilities for extracting byproducts from industrial wastewaters by membrane processes. Several examples of treating chemical and industrial wastewaters are discussed. (Cassar-FRC)
W82-06988

PROSPECTS OF USING MAGNETIC WASTEWATER TREATMENT,

Gosudarstvennyi Nauchno-Issledovatelskii Inst. Gornokhimicheskogo Syrya, Lyubertsii (USSR).
V. I. Klassen.
Water Resources, Vol 8, No 4, p 431-436, July/August, 1981. 1 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No 4, p 146-151, July/August, 1981.

Descriptors: *Magnetic wastewater treatment, *Water properties, *Wastewater treatment, *USSR, Industrial wastewater, Municipal wastewater, Chemical wastewater, Reviews, Activated sludge process, Biological treatment, Parasites, Light extinction, Suspended solids, Coagulation, Organic compounds.

Developments in magnetic wastewater treatment in the Soviet Union are reviewed. This technique is currently in use for controlling boiler scale and treating industrial and natural waters. Important factors to consider are magnetic field strength, its gradient, its frequency, velocity of the water, and pressure drop in the interpolar space. Subjecting water containing impurities to magnetic treatment changes many of its properties temporarily, for hours or days. Among the changes are an increase of light extinction, a decrease in the stability of diamagnetic ions such as Mg and Ca, changes in infrared spectra, and a 2-4-fold increase in cohesive forces on particles in a suspension. The apparatus for magnetic wastewater treatment consists of several pairs of magnets, either permanent or electromagnetic, between the poles of which the water flows at a velocity of 1-2 m per sec. Those being manufactured at present have a maximum capacity of 25 cu m per hour. Magnetic treatment has produced good results when used alone or in combination with other treatment techniques. Examples of these applications are treatment of wastewater containing suspended solids, organochlorine manufacturing wastewater, industrial wastewater containing nonferrous metals such as Zn, iron-containing acid solutions, copper ore flotation recycling water, livestock wastewater, and municipal wastewater., In chemical and industrial wastewater, magnetic treatment enhances the removal of organic impurities by the activated sludge process. 100% of helminth eggs were killed during a magnetic treatment of a pig farm wastewater with a field strength of 300-500 Oe and frequency of 8-16 Hz with the addition of 50 mg per liter ferromagnetic powder. (Cassar-FRC)
W82-06989

COMPONENTS FOR A TREATMENT PLANT SAFETY PROGRAM,

Williamsport Sanitary Authority, PA.
For primary bibliographic entry see Field 5G.
W82-06992

THE ELECTROLYTIC PROCESS FOR CHROMATE REMOVAL IN COOLING TOWERS,

First Chemical Corp., Pascagoula, MS.
T. T. Taylor.
Chemical Engineering Progress, Vol 78, No 6, p 70-72, June, 1982. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Cooling water, *Wastewater treatment, *Separation techniques, *Chromium, *Electrolysis, Industrial water, Water cooling, Cooling towers, Heavy metals, Electrodes, Corrosion control, Drinking water, Standards.

Since blowdown water from cooling towers contains all the constituents that are in the cooling tower water itself, it must be processed before discharge so that it meets environmental standards. Chromate, a corrosion inhibitor in cooling water, is limited to a maximum level of 0.05 ppm as hexavalent chromium in drinking water. To remove chromate from cooling tower blowdown, an efficient electrolytic metal removal process is recommended. This electrochemical process consists of sacrificial iron electrodes that have direct current applied to the anodes and cathodes to produce ferrous hydroxide. Chromate is then reduced from the hexavalent state to the insoluble trivalent form by the ferrous hydroxides. The electrolytic method has consistently removed chromate to less than 0.05 ppm chromium at an estimated operating cost of $0.13/cu m of cooling tower blowdown treated. (Geiger-FRC)
W82-06996

MEAT-, FISH-, AND POULTRY-PROCESSING WASTES,

Battelle Columbus Lab., OH.
J. H. Litchfield.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 688-692, June, 1982. 1 Tab, 65 Ref.

Descriptors: *Literature reviews, *Food-processing wastes, *Meat-processing industry, *Wastewater treatment, *Industrial wastewater, Poultry, Fish, Activated sludge process, Biological treatment, Aminodan process. Ultrafiltration, Flotation, Coagulation, Reviews, Anaerobic digestion, Biodegradation, Aerobic conditions.

Recent developments in handling meat-, fish-, and poultry-processing wastes were discussed in reviews and in individual papers. Fats and proteins

were the major contributors to COD. Some treatment techniques for meat-processing wastes included physicochemical processes, anaerobic filtration, activated sludge with mechanical aeration, coagulation with ferric sulfate-magnesium chloride-aluminum sulfate, cellulose activated with inorganic salts, lignite treated with sulfuric acid, a modular waste treatment plant featuring flocculation with anionic and cationic polymers and filtration through fiberglass cartridges, activated carbon adsorption, membrane processes, lagoons, flotation, electrocoagulation, sulfide liquor as a coagulant, calcium carbonate or calcium peroxide, anaerobic systems, the Aminodan process, sedimentation, heating followed by centrifugation, ultrafiltration, and combinations of the preceeding. Fish and seafood wastes were treated with fish scale coagulant, ultrafiltration, an anaerobic-aerobic shipboard system, electroflotation/electrocoagulation, coagulation, pressure flotation and separation of protein at the isoelectric point, aeration with a rotating disk, activated sludge process, activated sludge-activated carbon, and dissolved air flotation. Plant and pilot scale studies of poultry- and egg-processing wastewater treatment were summarized in a table. All of the following treatment processes were 90% effective in removing BOD, COD, suspended solids, ammonia, and phosphate: dissolved air flotation with counter-current aeration; activated sludge with 6-hour detection time; equalization dissolved air flotation with draft tube oxidation channel, clarifiers, facultative and polishing lagoons, and chlorination; and aerobic reaction for 8 days plus anaerobic digestion for 18 days. Other techniques included lime-polymer conditioning and solvent extraction. (Cassar-FRC)
W82-07000

5E. Ultimate Disposal Of Wastes

CHARACTERIZATION OF DRAINED AND UNDRAINED RESPONSE OF THERMALLY LOADED REPOSITORY ROCKS,

Illinois Univ. at Urbana-Champaign. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-05904

GEOCHEMISTRY OF LEACHATES FROM SELECTED COAL MINING AND COMBUSTION WASTES,

Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 5B.
W82-05936

INVESTIGATIONS OF DISPERSAL IN AN AREA OF COMPLEX CIRCULATION - THE OUTER THAMES ESTUARY,

Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Fisheries Radiobiological Lab.
For primary bibliographic entry see Field 5B.
W82-05946

SLUDGE MANAGEMENT: A RESEARCH UPDATE,

Duke Univ., Durham, NC.
P. A. Vesilind.
BioCycle, Vol 23, No 2, p 39-41, March/April, 1982. 28 Ref.

Descriptors: *Sludge digestion, *Sludge disposal, Wastewater treatment, Sludge filters, Sludge thickening, Pathogens, Composting, Dewatering, Reviews, Mixing.

Sludge management was the subject of reports, booklets, and about 20 journal articles during 1981. A mathematical model for regional management of sludge handling facilitates evaluation of alternate treatment and disposal options. Studies on head losses in sludg pipelines led to conclusions that the pipelines should be designed for turbulent flow and a safety factor of 50%. A procedure for calculating the movement of sludge by rakes was developed. A survey of thickening practices in Great Britain produced some conclusions helpful in designing thickeners. In the field of dewatering, belt filters and centrifuges were compared in 3 full-scale studies with mixed results. Low speed dewatering centrifuges performed as well as high-speed machines and used less power. Plugging of filter fabrics followed a first-order relationship. Two methods of determining the maturity of compost were phytotoxicity to bean seeds and rate of oxygen use. Indicator viruses were used to study the fate of viruses in wastewater treatment. Some areas ripe for more research are sludge decomposition ad mixing in anaerobic digesters. (Cassar-FRC)
W82-06007

LAND TREATMENT OF INDUSTRIAL WASTES: PRINCIPLES AND PRACTICES. PART II,

Science and Education Administration, Beltsville, MD.
G. B. Willson, J. F. Parr, J. M. Taylor, and L. J. Sikora.
BioCycle, Vol 23, No 2, p 59-61, March/April, 1982. 1 Fig, 7 Ref.

Descriptors: *Land application, *Chemical wastes, *Composting, Waste disposal, Degradation, Sludge disposal, Aeration.

Land application of chemical wastes is a viable treatment alternative if the physical, chemical, and biological limits of the soil are respected. Composting of industrial wastes or composting with sewage sludges may minimize toxicity to soil microflora and damage to the environment when the wastes are applied to the soil. Another approach to land treatment is preconditioning a site with sewage sludge prior to direct application of chemical wastes. Several insecticides, but not DDT, degraded rapidly when composted with cannery wastes. Composting petroleum refinery sludges reduced grease and oil significantly. Guidelines for preventing contamination of surface and groundwaters at land treatment sites were suggested in the May 19, 1980, Federal Register. Runoff and soil erosion should be minimized, and groundwater quality should be monitored before, during and after application. (Cassar-FRC)
W82-06009

A SIMPLIFIED BUFFER CAPACITY MODEL FOR SANITARY LANDFILL LEACHATE,

Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5B.
W82-06038

A COST-EFFECTIVE SYSTEM FOR THE AEROBIC STABILIZATION AND DISPOSAL OF WASTE ACTIVATED SLUDGE SOLIDS,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Water Research, Vol 16, No 5, p 535-542, May, 1982. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Sludge disposal, *Construction costs, *Aerobic treatment, Sludge lagoons, Sludge solids, Lagoons, Stabilization lagoons, Design criteria, Land disposal, *Activated sludge, Kinetics, Costs, Sludge thickening.

Construction costs, power usage, and operating features of five types of aerobic stabilization systems were compared. Using the continuous post-thickening system as 1.00, the pre-thickening single cell system had a ratio of 0.99; pre-thickenig with five-cell system with or without variable retention time, 0.78; and semi-batch system, 1.90 for the pre-thickening single cell system, and 0.72 for the pre-thickening five-cell system with variable retention time. Kinetic data for the aerobic stabilization of waste activated sludge solids were reviewed and evaluated. Guidelines are given for the design and operation of three systems: a multicellular aerobic stabilizer, a 12 months stabilized solids storage lagoon, and a dedicated land disposal activity. (Cassar-FRC)
W82-06046

SLUDGE TANKERING ECONOMICS - A FRESH APPROACH,

Severn Trent Water Authority, Birmingham (England).
C. E. Brade, and J. M. Harwood.
Effluent and Water Treatment Journal, Vol 22, No 3, p 111, 114, 115-121, March, 1982. 7 Fig, 2 Tab, 14 Ref.

Descriptors: *Sludge disposal, *Solid waste disposal, *Economic aspects, Sludge thickening, Waste disposal, Waste load, Land disposal, Costs, Cost analysis, Sludge solids, Sludge utilization, England.

In 1975, 68% of all sludge in the United Kingdom was disposed to land. When hauling sludge by tankers, 2,000 gallon tankers are more economical for short hauls (less than 10 miles round trip) than larger tankers. The 3,000 gallon tanker is more economical for longer hauls. The 3,000 gallon take offers better off-the-road performance than the 2,000 gallon tanker and is less sensitive ot increases in labor costs. It is best to operate the tanker fleet for the longest possible working day, even if overtime wages must be paid. Fuel is a small factor in the overall cost of tankering sludge on the round-trip journeys common to water authority work. Money may be saved by reducing the load, fill and empty cycle time and increasing sludge thickness as much as possible. (Geiger-FRC)
W82-06076

FINAL ENVIRONMENTAL IMPACT STATEMENT; DEFENSE WASTE PROCESSING FACILITY, SAVANNAH RIVER PLANT, AIKEN, S.C.

Department of Energy, Washington, DC.
For primary bibliographic entry see Field 6G.
W82-06087

EFFECT OF IRRIGATION LOAMY SAND SOIL BY SEWAGE EFFLUENTS ON ITS CONTENT OF SOME NUTRIENTS AND HEAVY METALS,

Riyadh University (Saudi Arabia). Coll. of Agriculture.
M. El-Nennah, T. El-Kobbia, A. Shehata, and I. El-Gamal.
Plant and Soil, Vol 65, No 2, p 289-292, 1982. 4 Tab, 17 Ref.

Descriptors: *Irrigation, *Wastewater disposal, Heavy metals, Chemical composition, Soil-water-plant relationships, Public health, Cairo, *Egypt, Contamination.

This paper investigates the levels of specific nutrients and heavy metals in soils as influenced by sewage effluent deposition for various lengths of time. Surface and subsoil samples were taken from areas cultivated with citrus trees. Four of the sampling sites were from two farms irrigated with sewage effluents for 23 and 47 years. The control area samples were irrigated with artesian water. Using sewage effluents in irrigation year after year was shown to increase the available phosphorus and both total and soluble nitrogen in the soil. Surface layers generally contained higher amounts of elements than the subsurface ones. The same results were noted for water soluble boron and total and extractable heavy metals. Cairo sewage effluents were seen to contain higher accumulations of soluble salts, boron, and heavy metals than the tap water in the city, due to pollution of wastewater with industrial wastes and household laundry chemicals. It is concluded that the use of Cairo sewage effluents for crop irrigation has increased the levels of water soluble boron and heavy metals in the loamy sand soil. The increase of heavy metals and their subsequent uptake by plants should be considered a potential problem. (Baker-FRC)
W82-06228

POLYCHLORINATED BIPHENYLS (PCBS): AN AUSTRALIAN VIEWPOINT ON A GLOBAL PROBLEM,

Victoria Ministry for Conservation, Melbourne (Australia). Marine Science Labs.

For primary bibliographic entry see Field 5B.
W82-06232

DISCHARGE TO THE NORTH SEA,

Tayside Regional Council (England).
A. Cockburn.
Water/Engineering and Management, Vol 129, No 5, p 30-32, May, 1982.

Descriptors: *Outfall sewers, *Wastewater disposal, Wastewater outfall, Outfall, *North Sea, Wastewater dilution, Wastewater treatment, Wastewater management, Municipal wastewater, *Scotland, Arbroath, Industrial wastes, Construction, Pipelines.

Arbroath, with a population of 21,000, lies on the North Sea coast of Scotland, 10 miles from the estuarine mouth of the River Tay. Arbroath is an important engineering center with other industries as well, including textiles, fishing, fish-processing and leisure industries. Wastewater treatment problems in the last decade have caused a ban on new building. Hydrographic and geophysical survey work was begun in 1976 with a view to building a long sea outfall. It was recommended that an overall length of about 3,100 feet would be needed, extending some 650 foot section of diffusers. An ultimate discharge flow of just under 350 gal/sec was decided upon. Protective treatment to the pipe was important due to the effects of heavy seas, tidal movements and the corrosive nature of sea water. Internal corrosion protection was achieved through a factory-applied isocyanate-cured coal tar epoxy resin with a minimum dry film thickness of 500 micrometers. External protection was accomplished with a quarter-inch thick bitumen enamel wrap, incorporating glass fiber fabric. This long sea outfall contract is the penultimate phase of the project which will bring about satisfactory sea disposal of much of Arbroath's sewage. Final phase of the project is construction of a pumping station and pretreatment facilities for screening and grit removal prior to discharge by the sea outfall. (Baker-FRC)
W82-06248

DISPOSAL OF SEWAGE SLUDGE TO SEA--ENGINEERING ASPECTS,

Strathclyde Regional Council, Glasgow (Scotland).
W. T. Greer.
Water Science and Technology, Vol 14, No 3, p 9-15, 1982. 4 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, Ships, Ozonation, Odor control, Activated carbon, Scotland, North Sea, Firth of Clyde.

In Scotland sewage sludge ocean dumping sites have been selected for economic, political, and environmental reasons rather than engineering considerations. Since 1974 all disposal sites must be approved by appropriate governmental departments. Shore facilities specific to sludge dumping include elevated sludge storage tanks for loading within a 1.5 hour period, sufficient pumping capacity, and loading pipes which adjust to the changes in level as the ship rises and falls with filling and the tides. Odor has been controlled by scrubbing foul air with ozone enriched water or treating with activated carbon. Sludge ships are modified tanker ships. The sludge load can be discharged by gravity within 15 min by incorporating large buoyancy spaces beneath the sludge tanks, placing the level of the top of the sludge above sea lovel. Newer ships discharge sludge by air pressure. As the lighter-than-water sludge enters the sea, it is dispersed by the ship's propellers to a 200-400 fold dilution, leaving a slick which is quickly broken up by wave action. (Cassar-FRC)
W82-06286

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL BY DUMPING FROM SHIPS,

Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W82-06287

BACTERIAL POLLUTION OF MARINE WATERS FROM THE DISPOSAL OF SEWAGE AND SEWAGE SLUDGE TO SEA,

North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 5B.
W82-06288

EFFECTS OF TURBULENT SUSPENSION ON TRAJECTORIES OF SETTLING PARTICLES,

Camp, Dresser and McKee Inc., Boston, MA.
J. A. French.
Water Science and Technology, Vol 14, No 3, p 25-31, 1982. 5 Fig, 4 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Sedimentation, Turbulent flow, Suspended sediments, Advection, Particulate matter, Settling velocity.

The particles from sewage sludge dumped into the ocean move downward and laterally, depending on particle density and ocean currents. Classical stream sedimentation analysis is used to describe three types of particle settling: unaffected by turbulence, influenced by turbulence, and dominated by turbulence. Equations are given for predicting the particles' trajectories, which are curved. (Cassar-FRC)
W82-06289

EFFECTS ON THE ECOSYSTEM OF SEWAGE SLUDGE DISPOSAL FROM A PIPELINE,

Coastal Water Research Project, Long Beach, CA.
For primary bibliographic entry see Field 5C.
W82-06290

TECHNICAL CONTROL OF SEWAGE SLUDGE DISPOSAL TO SEA,

Thames Water Authority, London (England).
A. G. Cockburn.
Water Science and Technology, Vol 14, No 3, p 17-24, 1982. 4 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Water quality standards, Regulations, Legislation, Monitoring, Water quality control, International agreements, Industrial wastewater, United Kingdom.

Technical control of sludge disposal at sea is carried out to protect the environment from toxic substances and excessive concentrations of organic matter. Control is exercised by legislation and international agreements. In England control is carried out by the disposer (a regional water authority), the licensing authority (Ministry of Agriculture, Fisheries and Food), and industry. The sludge must meet quality and quantity standards. If not, appropriate treatment or process changes are required. At all stages scientific methods are used to monitor sludge composition, water quality, and environmental changes. (Cassar-FRC)
W82-06291

SLUDGE DISPOSAL TO SEA IN U.K.,

Thames Water Authority, London (England).
L. H. Thompson.
Water Science and Technology, Vol 14, No 3, p 79-91, 1982. 2 Fig, 5 Tab, 10 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *United Kingdom, Thames Estuary, Ships.

Sludge disposal in the sea in the United Kingdom is summarized. Currently 12 water authorities (31 sewage works) dispose of sludge by dumping or pipeline. The three largest activities--London, Manchester, and Glasgow--have been operating for 80 or more years. A map depicts the origin of the sludge and the dumping grounds as well as populations and amounts of sludge produced. The Thames Estuary dumping operation is described in detail, and ten other operations are summarized. Ocean dumping of sludge has increased in the United Kingdom during the last two decades, contrary to the trends in the U.S. and Europe. The United Kingdom's strategy for the future is to incinerate heavily industrialized and special sludges, digest sludges, store and thicken sludges prior to land or sea disposal, ensure that sludge quality is suitable for disposal, choose sludge disposal sites according to economics with preference to land application in marginal cases, and consider each case individually. (Cassar-FRC)
W82-06292

DISPOSAL OF SEWAGE SLUDGE TO SEA--RESEARCH NEEDS,

Water Research Center, Stevenage (England).
A. R. Agg.
Water Science and Technology, Vol 14, No 3, p 71-77, 1982. 1 Tab, 12 Ref.

Descriptors: *Research priorities, *Ocean dumping, *Sludge disposal, Fate of pollutants, Nutrients, Particulate matter, Water pollution effects, Degradation, Organic compounds, Algae, Heavy metals, Sedimentation.

The need for further research on the environmental effects of ocean dumping of sewage sludge is discussed with reference to the United Kingdom. Major effort should be directed toward determining the assimilative capacity at selected sites and the effects of improving sludge quality on the quantity of sludge which can be disposed of. Special topics for which further information is needed are: (1) determination of relative inputs of potential contamination from all land-based sources, (2) physical processes controlling dispersion, sedimentation, and degradation of sludge solids, (3) mechanisms which control mobilization and transfer of metals and organic chemicals from sludge, and (4) the role of nutrients and other sludge components in development of certain algal blooms. (Cassar-FRC)
W82-06293

SELECTION OF A SLUDGE HANDLING DISPOSAL SYSTEM,

Malcolm Pirnie, Inc., Paramus, NJ.
A. F. Hess, and M. J. Barnes.
In: Water/Engineering and Management, Reference Handbook-1982, p 61-64, 66-67, May, 1982. 2 Fig, 40 Ref.

Descriptors: *Sludge disposal, *Design criteria, Wastewater treatment, Water treatment facilities, Coagulants, Filtration, Sludge dewatering, Lagoons.

The problem and expense of ultimate disposal of water treatment plant sludge are discussed. Estimating the quantity of solids produced at a water treatment plant is the first step involved in the selection and sizing of a sludge handling and disposal facility. The solids load is a function of the raw water suspended solids and color, the dosage and type of chemicals used in the treatment process and the quantity of water treated at the plant. Waste volumes are dependent on the solids loads and the estimated solids concentration of the sludge. The quantity and characteristics of sludge produced during water treatment is affected significantly by the design and performance of the treatment processes, especially rapid and slow mixing, points of chemical addition and short circuiting. The principal methods for reducing sludge quantities are source control, coagulant conservation, coagulant substitution, coagulant aids, process optimization, process modifications, coagulant recovery, and direct filtration. Various dewatering systems have been tested on all types of water treatment plant sludges. Feasible alternatives for dewatering sludge include: sand drying beds, lagoon, vacuum filtration, pressure filtration, centrifugation, belt filtration, and recalcination. Ultimate disposal of sludge from a water treatment plant is primarily dependent on the characteristics of the processed and dewatered sludge, especially the water content of the sludge cake. Based on the characteristics of dewatered sludge potential methods include contract or joint disposal, landfilling, use as cover material at landfill or strip mine, use as a soil conditioner, and conversion to a usable or salable product. (Baker-FRC)
W82-06346

DESIGN AND OPERATION OF ANAEROBIC SLUDGE DIGESTION SYSTEMS,

Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5D.
W82-06347

A LOOK AT CO-DISPOSAL,

Temple Univ., Philadelphia, PA. Coll. of Engineering Technology.
B. P. Butz, and L. B. Calhoun.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 108, No EY2, p 79-90, June, 1982. 11 Ref.

Descriptors: *Waste disposal, *Incineration, *Sludge disposal, Sludge, Solid wastes, Wastewater treatment, Municipal wastes, *Co-disposal, Recycling, Energy conservation, Financing, Performance evaluation.

One alternative that a municipality might consider for the disposal of solid waste and sludge is combined disposal, or co-disposal. Resource and energy recovery systems are often incorporated in co-disposal designs, which are considered innovative in the United States. Thermal co-disposal in either solid waste or sludge burning equipment has been shown to be feasible technologically. Co-incineration in solid waste burning incinerators is the best developed and proven co-disposal technology. Pyrolysis is a high risk technology. These plants are generally complex, expensive, and subject to breakdowns. The benefits of resource recovery techniques seem to be overvalued. The poor track record of co-disposal plants presents potential investors with a theoretically promising technology, but one that has high risk. Unless this risk can be minimized, co-disposal projects will have a difficult time securing financing. The environmental impact of a particular co-disposal plant will depend on the particular process selected and the characteristics of the geographical area in which the plant will be located. Insufficient data exist to quantify the adverse environmental impacts. Some impacts, such as those on water quality, should be no greater than for separate incineration of sludge and solid waste. (Baker-FRC)
W82-06354

LAND DISPOSAL OF SEWAGE SLUDGE, A SUMMARY OF RESEARCH RESULTS, 1972-1980,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
Y. K. Soon, and T. E. Bates.
Ontario Ministry of the Environment, Toronto, Report, 1981. 167 p, 15 Fig, 103 Tab, 26 Ref.

Descriptors: *Land disposal, *Wastewater, *Sludge disposal, *Application rates, *Wastewater farming, Wastewater treatment, Wastewater disposal, Soil disposal fields, Broad irrigation, Phosphorus removal, Chemical treatment, Digested sludge, Fertilizers, Greenhouses, Crop yield, Crop production, Soil organic matter, Coliforms.

Land application of fluid sewage sludge from chemical treatment for phosphorus removal was studied to determine safe rates of sludge application to agricultural soils without polluting ground/surface waters with elements/bacteria harmful to humans/animals or without reducing the quantity/quality of the crops produced. The various study phases involved: runoff assessment with fall/winter/spring-applied sewage sludge; rate and source of sludge field studies with corn and bromegrass; nitrogen studies; microbial studies; pedological study and characterization of sludge-treated soils; a greenhouse study on metal uptake with sludges; and a greenhouse and laboratory study to select a chemical extractant for plant-available heavy metals in polluted soils. Runoff losses of nutrients/metals can be acceptable provided the sludges are applied at less than 1.5 cm/application, are applied at least 48 hours before predicted heavy rains, and are not applied to steep slopes, near waterways, or to ice/snow/frozen soils. Low sludge rate applications produced corn/bromegrass yields as high as ammonium nitrate plus phosphate fertilizers. While fluid-digested sludges contained considerable total and fecal coliforms and streptococci, its application to crop land did not result in a greatly-increased level of these microorganisms in runoff waters. Multiple regression analysis of 9 extractants tested showed diethylenetriamine pentaacetic acid as the most suitable for cadmium, nickel, and zinc. (Zielinski-MAXIMA)
W82-06377

ENVIRONMENTAL RESIDUALS AND CAPITAL COSTS OF ENERGY RECOVERY FROM MUNICIPAL SLUDGE AND FEEDLOT MANURE,

Argonne National Lab., IL.
S. W. Ballou, L. Dale, R. Johnson, W. Chambers, and H. Mittelhauser.
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EV-0107, Price codes: A03 in paper copy, A01 in microfiche. Department of Energy Report DOE/EV-0107, September 1980. 44 p, 5 Fig, 30 Tab, 21 Ref.

Descriptors: *Feedlot wastes, *Sludge, *Anaerobic digestion, *Manure, *Energy conversion, *Incineration, Cost analysis, Biological treatment, Fuel, Treatment facilities, Pyrolysis, Water pollution, Air pollution, Environmental effects.

Literature on waste processing and energy conversion, and interviews with manufacturers was used for baseline data for construction of theoretical models using three energy conversion processes: anaerobic digestion, incineration, and pyrolysis. Anaerobic digestion of municipal sludge can be used to recover energy from sludge while simultaneously destroying pathogenic organisms and odors associated with the sludge. Digester gas can be used as fuel at the wastewater treatment plant that produces the sludge feed to the digester. Anaerobic digestion of manure yields gas with a heating value of 600 Btu/cu ft. Digested manure is considered a good source of animal feed, in addition to its utility as fertilizer. Recovery of energy by sludge incineration involves raising steam by cooling the hot flue gases. The steam may be used for heating but the most attractive possibility is to use steam turbines to drive motors directly or to produce electricity for the same use, in an associated wastewater treatment plant. Pyrolysis is a potentially efficient method for recovering energy from sewage sludge: the products can provide a significant portion of the energy required by municipal wastewater treatment plants. For manure, energy production by pyrolysis is assumed to occur near markets for the recovered energy. Although the systems would provide benefits in terms of waste disposal as well as energy production, they would also involve additional pollution of air and water. (Moore-SRC)
W82-06405

IMPACT OF PRETREATMENT ON SLUDGE CONTENT OF HEAVY METALS,

Camden County Municipal Utilities Authority, NJ.
For primary bibliographic entry see Field 5D.
W82-06461

RECOVERY OF ZINC FROM WASTEWATER TREATMENT SLUDGE,

Bureau of Mines, Rolla, MO. Rolla Research Center.
J. B. Stephenson, E. R. Cole, and D. L. Paulson.
Resources and Conservation, Vol 6, No 3/4, p 203-210, 1981. 6 Tab, 5 Ref.

Descriptors: *Zinc, *Metal-finishing wastes, *Sludge treatment, *Wastewater treatment, Industrial wastes, Electroplating.

Zinc was recovered from metal finishing wastewater treatment sludge by a process using roasting, leaching-purification, and electrowinning. The sludge, containing metal hydroxides, oil, organics, and water, was roasted at 600-800 C to avoid excessive Zn volatilization. The roasted filter cake contained 31.1% Zn, 2.9% Pb, 1.5% Sn, and 1% or less of Cu, Fe, C, and Ni. Leaching with dilute sulfuric acid for 2 hours at 348 K at a solids concentration of 300 g per liter produced a liquor containing (in g per liter): Zn, 154; Cu, 3.0; Ni, 0.6; and Fe, 0.2; with a pH of 1.9. About 90% of the Zn was extracted. The high concentration of Ni and other interfering impurities required modification of the standard purification process. Iron was removed with potassium permanganate. Zn dust purification did not reduce the Ni lvel to the desired 0.1 ppm. A second Zn dust treatment produced a filtrate satisfactory for electrowinning. The electrolyte was mixed with water and sulfuric acid. Lead dioxide-coated Ti anodes were used with 1100 alloy Al cathodes to electrowin the Zn at 560 A per sq m and 308 K. Deposit morphology was fairly good, but current efficiency was about 76%. (Cassar-FRC)
W82-06485

POTATO AND CORN BY-PRODUCTS USED AS CATTLE FEED,

Frito-Lay, Inc., Dallas, TX.
J. L. Revel.
Industrial Wastes, Vol 28, No 3, p 27-31, May/June, 1982. 3 Tab.

Descriptors: *Sludge disposal, *Food-processing wastes, *Waste recovery, *Feeds, Food processing industry, Industrial wastes, Cattle, Waste management, Recycling, Solid waste disposal, Land disposal, Cost analysis.

Frito-Lay, a division of PepsiCo Incorporated, has maintained primary and secondary wastewater treatment facilities for its potato and corn snack manufacturing plants for several years. The company faced sludge disposal problems and began to examine wet sale markets for by-products, sludge-by-product mixtures, and secondary treatment biosolids. Wet sale of potato and corn wastes can be profitable if shipping costs to buyers, mainly cattle raisers, can be kept down. Frito-Lay currently operates three plants with an installed potato starch recovery module. Secondary biosolids are being disposed of mainly via land application and municipal digesters. Frito-Lay is studying the feasibility of using biosolids as an animal feed ingredient. Procedures for registering animal feed by-products are explained. Efforts must be made to prevent contamination of by-products with substances which may be injurious to animal health. Hauling of commodities is regulated by various state and federal agencies and should include a contract for services to establish legal responsibilities. A back-up system for disposal is recommended. Frito-Lay has planned feed trials with dairy and beef cattle to increase acceptance of this cost-effective disposal method. (Geiger-FRC)
W82-06488

FEED FROM SEWAGE: PROSPECTS AND CONSTRAINTS,

New Mexico State Univ., Las Cruces. Dept. of Animal, Range and Wildlife Sciences.
G. S. Smith.
Biocycle, Vol 23, No 3, p 34-36, May/June, 1982. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Waste disposal, *Feeds, *Sewage, *Livestock, Cattle, Sheep, Feedlots, Reviews, Sludge disposal, Heavy metals, Adsorption, Cadmium, Nutrient requirements, Nutrients, Nutrition, Diets, Animal populations, *Recycling, *New Mexico, Las Cruces, Albuquerque.

For the past six years New Mexico State University (NMSU) has been conducting extensive research on the feasibility of recycling sewage products as livestock feedstuffs. Sewage solids used in the NMSU research were collected as primary settled solids at treatment plants of Albuquerque and Las Cruces, NM, both of which have minor inflows from industry and low levels of cadmium. Sludges were dried, bagged, sealed and gamma-irradiated to an absorbed dosage of 1 mega-rad using cesium-137. In most of the studies conducted with ruminants, the digestibility of the energy content in sewage products was about 60%, digestibility of nitrogen was about 70%, and retention of absorbed nitrogen was about 60-70%. Experimental supplements containing one-half or more of the dry matter as dried, irradiated sewage solids were

fed to cows on arid range during three or four months each year for over four years. Improved performance was recorded compared to unsupplemented diets. Two feedlot trials were conducted with cattle fed sewage solids as 12 to 15% of diet for two or three months to measure uptake of heavy metals and halogenated hydrocarbons into organs and tissues. A bioassay of meat quality was performed as a multi-generation feeding trial with albino rats. Overall the data suggest that dried sewage solids from primary sludge can be sterilized and substituted for conventional, higher-priced feeds for ruminants without adverse effects on reproductive or feedlot performance. Feeding dried gamma-irradiated sewage solids to ruminants produced no evidence of animal toxicity nor a hazard to human health during six years of study. (Baker-FRC)
W82-06489

OCEAN DUMPING BATTLE MARCHES ON,

N. Goldstein.
Biocycle, Vol 23, No 3, p 27-31, May/June, 1982. 2 Fig.

Descriptors: *Sludge disposal, *Ocean dumping, Waste disposal, Sludge, Wastewater management, Legislation.

A study by the National Advisory Committee on Oceans and Atmosphere was released in January of 1981 which stated that the role of the oceans is a positive one in waste management strategy, and that the ocean has the ability to assimilate waste products. Ocean disposal of sewage sludge was encouraged in the report as an option in areas where no unreasonable degradation of the environment would result. Appropriate management conditions and adequate monitoring safeguards were considered essential. This finding enabled New York City to file suite against the EPA for refusing to grant an extension to the city's interim ocean dumping permit. The House Oceanography, Fisheries and Wildlife Conservation, and Environmental Subcommittees have endeavored to present amendments which would close the loophole through which New York City had passed. Joint hearings on the draft legislation were held in Washington in late March 1982. The amendments offered to the Marine Protection, Research and Sanctuaries Act were starting point for clearing up some of the ambiguities of the present Ocean Dumping Act; a second draft was proposed in late April. The basic thrust of the bill/amendments is to allow EPA some leeway in reviewing ocean dumping application permits. If a sludge is deemed suitable for ocean dumping, the bill is set up to give the EPA administrator a chance for a second test to determine if the sludge is clean enough to be applied to land. (Baker-FRC)
W82-06490

RECYCLED FOOD PROCESSING WASTES REDUCE TREATMENT COSTS,

CH2M/Hill, Redding, CA.
For primary bibliographic entry see Field 3C.
W82-06507

PHENOLS IN MUNICIPAL SOLID WASTE LEACHATES AND THEIR ATTENUATION BY CLAY SOILS,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 5B.
W82-06518

SELECTION OF WASTE DISPOSAL SITES,

Illinois State Geological Survey Div., Champaign.
K. Cartwright.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 197-201. 1982. 37 Ref.

Descriptors: *Waste disposal, *Site selection, *Leachates, *Fate of pollutants, Landfills, Geohydrology, Groundwater pollution, Groundwater movement, Hydraulic conductivity, Groundwater recharge.

Selection of sites for waste disposal must consider the hydrological factors of hydraulic conductivity, relationship to groundwater systems, and the geochemical interaction of the leachate with the media. In general, earth materials with low hydraulic conductivity (on the order of 10 to the minus 6th power cm per sec or less) reduce contaminants to acceptable levels within tens of ft from the disposal site. Any contamination is associated with springs or streams on or very near the site. If hydraulic conductivity of the earth materials is on the order of 0.01 cm per sec or greater or the rocks are fractured, contaminants at dangerous concentrations may travel for hundreds or thousands of ft. The presence of a sand layer will amplify the horizontal movement of the groundwater flow. In humid regions it is almost impossible to find a disposal site not in a groundwater recharge or discharge area. Recharge areas require more thorough investigation of the groundwater flow path because of the downward movement. In discharge areas leachate paths are generally short, near the surface, and easier to confirm. It is often practical to recover all or part of the leachate in discharge areas. Disposal below the water table may produce large volumes of leachate, odorous gases, and operational difficulties with earth moving machinery. Disposal above the water table may be difficult because low water table regions often have very permeable overlying material, unsaturated earth may transmit undesirable gases, and leachate may be difficult to collect. The hydraulic conductivity of the earth is much more important than whether a site is above or below the water table. The geochemical reactions in a waste disposal site are complex. However, in general, reactions are controlled by anion and cation exchange, buffering capacity of the soil, and dilution. (Cassar-FRC)
W82-06550

LANDSPREADING OF SLUDGE IN NEW YORK STATE,

D. A. Fagan.
Biocycle, Vol 23, No 3, p 57-61, May/June, 1982.

Descriptors: *Sludge disposal, *Land disposal, Sludge, Wastewater management, Waste disposal, Soil disposal fields, Legislation, Regulations, Legal aspects, *New York, Wastewater disposal, Wastewater treatment.

A moratorium on the landspreading of sewage sludge on certain agricultural soil types was executed in New York State in March of 1981. The purpose of the two year moratorium was to provide sufficient time for the federal government to establish a definitiv policy on the use of sewage sludge for land application purposes. Currently the Department of Environment and Conservation (DEC) in conjunction with Agriculture and Markets is completing a draft Environmental Impact Statement (EIS) on the sludge moratorium. Tentative plans called for this draft to be completed in March of 1982, with public hearings following 30 days later. Current sludge management regulations in New York are contained in two sections of the State Environmental conservation Law. In May of 1981 DEC published guidelines designed to help solid waste management applicants, including sludge landspreaders, meet the regulations so as to obtain the construction or operating permits needed. The most important aspect of the guidelines and regulations involves the requirement for permit applicants to develop a management plan including a monitoring and recordkeeping program. Compared to past landspreading practices, the major changes in the guidelines and regulations relate tothe requirements for incorporating surface applied sludge into the soil the same day it is spread, and the prohibition of surface application to frozen or snowcovered ground. The effects of these guidelines on cost of operating a land disposal system are discussed. (Baker-FRC)
W82-06557

OCEAN DUMPING OF SLUDGE VS. THE ALTERNATIVES,

Clinton-Bogert Associates, Fort Lee, NJ.
I. L. Bogert, and L. J. Sokol.
Water Science and Technology, Vol 14, No 3, p 1-8, 1982. 3 Tab, 7 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Land disposal, Water pollution effects, Bergen County, New Jersey, Environmental effects, Cadmium, Mercury, Polychlorinated biphenyls, DDT, Heavy metals, Landfills, Incineration, Fish, Aquatic life, Bioaccumulation, Regulations.

The environmental effects of ocean dumping of sludge and land-based disposal alternatives were evaluated using Bergen County, New Jersey, digested sludge. Problems with land disposal include airborne Aspergillus fumigatus spores emanating from the composting site and high heavy metal concentrations in the sludge. Bergen County digested sludge contained (in micrograms per liter liquid phase): Hg, 45.2; Cd, 330; polychlorinated biphenyls, 4.4; and DDT, < 0.05. If this sludge is discharged in the ocean at the permitted barge speed and discharge rate, dilution is 5200:1, producing diluted concentrations of less than the water quality criteria. Bioassays of the suspended particulate phase of the sludge indicated that the LC50 in the worst case was 150:1 dilution of sea water: sludge or 6700 mg per liter. Ten days of exposure of grass shrimp, hard clams, and Atlantic silversides to the suspended particulate phase (containing Cd, Hg, PCB, and petroleum hydrocarbons) indicated no statistical difference in bioaccumulation as compared with controls. The authors conclude that ocean dumping is less environmentally damaging than land disposal and that the site 12 miles from shore in the New York Bight should not be abandoned for a proposed 106 mile distant site. (Cassar-FRC)
W82-06590

CONTROL OF TOXIC METALS AT SEWAGE TREATMENT WORKS,

Thames Water Authority, London (London).
J. L. Dakers, and R. P. King.
Water Science and Technology, Vol 14, No 3, p 53-59, 1982. 2 Tab, 2 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Industrial wastewater, Fate of pollutants, Land disposal, Thames Water Authority, Mercury, Cadmium, Nickel, Zinc, *Heavy metals, Metals, Wastewater analysis, Water quality standards, *England.

Toxic heavy metals levels in sewage sludge discharged into the ocean from the Thames Water Authority plants were reduced by controlling metals levels reaching the municipal treatment plants. The high concentration of Hg in Beckton plant sludge was reduced from 19 mg per kg in 1975-76 to 14 mg per kg by limiting Hg in effluents from a single organo-mercurials manufacturing plant. Cd, Cu, Ni, and Zn in sludges from the Mogden plant, which are applied to land, were also decreased by control of metals in trade effluents. Effluents from potential metal discharges in several sewage works regions were sampled regularly for several months to a year to provide information on the total load of metals entering the sewage works and the total load contributed by industry. The difference between the two values was the amount derived from domestic sources. As an example, the data for Cd are given for several treatment plants. Existing Cd loads received at two of the works were 7.9 and 7.7 kg per day, producing sludge concentrations of 46 and 40 mg per kg, respectively. Contributions by trade effluents were 61-70%. Reducing the Cd concentrations in effluents received at the plant to 1 mg per liter would reduce the Cd in finished sludge to 32 and 16 mg per kg, respectively. Although uniform limits on metal levels are superficially attractive, flexibility in administering the guidelines is urged to prevent expensive and stringent controls in cases where these will not significantly improve the quality of the sludge. (Cassar-FRC)
W82-06592

SLUDGE DISPOSAL TO SEA IN FRANCE,

Centre d'Estudes et de Recherches de Biologie et d'Oceanographie-Medicale, Nice (France).
M. Aubert, M. J. Gauthier, and J. Aubert.
Water Science and Technology, Vol 14, No 3, p 169-182, 1982. 8 Fig, 2 Tab, 13 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Bacteria, Wastewater treatment, Wastewater disposal, *France, Particulate matter, Fate of pollutants, Outfalls, Suspended solids, Self purification.

A review of the nature of the polluting elements of sewage water and the interactions between bacteria and particulates in sludge is presented. A mathematical formulation of the dynamics of suspended matter in the sea is established. The initial concentration of bacteria at the point of surfacing is obtained from the concentration of bacteria in the sewage water before release, drift time, a depth of discharge coefficient, an outfall coefficient, and a coefficient for bactericidal action of sea water. Another similar equation expresses the spread of matter not subject to bactericidal action. Injecting wastewater below the thermocline reduces chances of rapid resurfacing, especially if diffusers are used. At the lower depths self-purification is not very efficient. Several types of wastewater treatment are used in France: pretreatment (removal of solids, oil, and grease--usually burned); primary treatment (carried out in lagoons or pools); and secondary or tertiary treatment (purification by chemical or biological means with sludge digestion in anaerobic digesters). The digested sludge produced by these processes is disposed of on land as fertilizer or as fill in road surfaces. Sea disposal of sludge has been tried with poor economic success at St. Tropez. The Interministerial Group for Problems of Sea Pollution in 1973 condemned the practice of coastal communities discharging untreated sewage into the sea. For financial reasons the establishment of treatment plants has been delayed. Of first concern is removal of solid matter, oil, and bacteria. (Cassar-FRC)
W82-06593

MATHEMATICAL MODEL INVESTIGATION OF FAR-FIELD TRANSPORT OF OCEAN-DUMPED SEWAGE SLUDGE RELATED TO REMOTE SENSING,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
C. Y. Kuo.
Water Science and Technology, Vol 14, No 3, p 33-39, 1982. 2 Fig, 8 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, Fate of pollutants, Model studies, Mathematical models, *Remote sensing, Diffusion coefficients, Plumes, Particle distribution, Particle size.

The far-field transport processes of sewage dumped in the New York Bight were examined by a modification of a three-dimensional Eulerian-Lagrangian finite difference model. The model provides information on the effect of the magnitude of the horizontal and vertical diffusion coefficients and the particle density and size distribution on the sludge plume as it changes with time. The sludge plume was also studied for general trends of spreading, contours of equal concentration, and maximum sludge concentration at a given time after dumping. Model inputs were velocity field, sea conditions, diffusion coefficients, sludge characteristics, and dumping rate. Both ground truth data and remote sensing data were compared with model results. Agreement on trend of plume growth was fairly good between model results and remote sensing data. Concentrations obtained from averaging over the top 2, 4, and 8 ft were significantly different. Generally, integration over the top 8 ft indicated higher concentrations than the others. (Cassar-FRC)
W82-06594

DISPOSAL OF SLUDGE TO SEA,

Oslo Commission (Norway).
H. R. Neilson.
Water Science and Technology, Vol 14, No 3, p 145-152, 1982.

Descriptors: *International agreements, *Sludge disposal, *Ocean dumping, Land disposal, Oslo Commission, Paris Commission, Helsinki Convention, Barcelona Convention, Water quality control, Legislation, Legal aspects, London Dumping Convention.

The role of international conventions in marine dumping of sludge was the subject of the introductory paper in a conference on disposal of sludge to the sea. The aim of the International Conventions (Oslo Commission on sea dumping, Paris Commission on pipeline discharges, Helsinki Convention on the Baltic, and the Barcelona Convention on the Mediterranean) is to prevent marine pollution through the coordination of the separate control measures exercised by individual countries. The conventions provide a forum for discussion and try to make decisions by mutual agreement rather than by vote. Problems facing waste disposal personnel are increasing amounts of sewage, expanding and increasingly complex industrial wastes, environmental lobbies, and the world economic recession. The international conventions can lead the effort to coordinate scientific resources to tackle recycling of sludges and long term strategies. The author suggests that regional conventions can control marine pollution better than global conventions because each region requires individual consideration. The global London Dumping Convention is the ideal body for coordination of regional conventions. In 1984 the end of the first decade of the Oslo Convention will be celebrated by publishing the achievements and results of scientific and monitoring studies. (Cassar-FRC)
W82-06595

SLUDGE DISPOSAL STRATEGY: A UK VIEWPOINT,

National Water Council, London (England).
D. L. Walker.
Water Science and Technology, Vol 14, No 3, p 127-136, 1982.

Descriptors: *Sludge disposal, *Ocean dumping, United Kingdom, Land disposal, Agriculture, Incineration, International agreements, Research priorities, Water policy.

This paper describes the world attitudes and the United Kingdom policies toward sewage sludge disposal. The Water Act of 1973, which organized 10 all-purpose water authorities in England and Wales, placed sewage disposal under the jurisdiction of the water authorities. This responsibility belongs to regional councils in Scotland and to the Department of Environment in Northern Ireland. Water authorities must dispose of sludge within legal constraints and must consider farmer's attitudes toward land disposal. The Ministry of Agriculture Fisheries and Food issues permits for sludge disposal at sea. In England and Wales the 1.2 million tons (dry weight) per year of sludge produced was disposed of in 1977 in the following ways: 48% on farm land, 24% on landfills, 24% at sea, and 4% incinerated. Methods, guidelines, hazards, safeguards, and problems associated with disposal of sludge on land, at sea, by incineration, and by other methods are described. England and Wales do not dump sludge unsuitable for land treatment into the ocean. Pretreatment is required to control levels of toxic metals or other materials. Contaminated sludge is incinerated. Water authorities favor sea disposal as an economic method for sludge disposal. Water authorities are concerned with the total load of pollutants entering waters from all sources. Restraints will not be applied to sludge disposal without also controlling discharges to rivers and tidal waters. The costs of sludge disposal represent 10% of total consumer bills. Sophisticated methods of sludge disposal can easily double disposal costs without significantly improving safeguards to the environment. The water authorities plan to retain flexibility of choice in sludge disposal options. (Cassar-FRC)
W82-06596

OCEAN DISPOSAL LEGISLATION IN THE UNITED STATES,

Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
C. F. Guarino, and S. Townsend.
Water Science and Technology, Vol 14, No 3, p 153-161, 1982. 9 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, *Legislation, Water law, Judicial decisions, Regulations, Legal aspects, Permits, Water quality control, Water pollution effects, Heavy metals, Philadelphia, Pennsylvania, New York.

Sludge disposal legislation in the U.S. is complex and confusing. At least 12 different Federal laws govern sludge disposal. In addition, there are conflicting regulations and policies for implementing the laws. The Marine Protection Act (1972) was designed to regulate dumping into ocean waters of any material which would adversely affect humans, the marine environment, ecological systems, or economic potentials. Permits were required to regulate the amount of hazardous materials entering the ocean. Case studies of sludge disposal in two cities are given. Philadelphia, Pennsylvania, was required to end ocean dumping of sludge after issuance of an EPA report, widely criticized for its lack of objectivity and of scientific evidence of harm to the environment. As a result, ocean dumping was ended by the required deadline and land disposal was implemented at significantly greater costs. In contrast, New York was allowed to continue dumping sludge in the heavily polluted New York Bight after the December 31, 1981, deadline prescribed by the law. (Cassar-FRC)
W82-06597

SLUDGE DISPOSAL TO SEA: NORTH AMERICAN VIEWPOINT,

W. F. Garber.
Water Science and Technology, Vol 14, No 3, p 109-125, 1982. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Ocean dumping, *Sludge disposal, Legislation, Water law, Legal aspects, Water quality standards, Waste disposal, Water pollution control, Philadelphia, Pennsylvania, Los Angeles, California, Outfalls, Environmental effects, Wastewater treatment, Wastewater disposal, Pulp wastes, Toxicity, Aquatic life, Santa Monica Bay, Heavy metals, Metals.

Sludge disposal to the sea in the United States is a subject of controversy. Laws and regulations concerning waste disposal are conflicting and make environmentally responsible solutions to problems difficult or impossible to attain. Legislation treats air, water, and land pollution separately. For example, an industry or municipality wishing to dispose of its wastes may find it prohibitory or difficult to incinerate (Clean Air Act), to dispose at sea or in inland waters (Federal Water Pollution Control Act), to dump from ocean barges (Marine Protection, Research, and Sanctuaries Act), and to dispose on land or in deep wells (Safe Drinking Water Act). Case studies of three cities are given to illustrate existing attitudes. Philadelphia, Pennsylvania, was prohibited by the EPA from dumping sewage sludge into the ocean despite lack of evidence of harm to the marine environment. Los Angeles, California's Hyperion treatment facility was allowed to continue sewage disposal through three ocean outfalls when it was shown that this disposal method was the most environmentally sound. Two paper companies discharging carbohydrate wastes deep in the ocean in an area of excellent mixing were ordered to dispose waste on land in spite of the negative environmental impact of land disposal. These cases illustrate the disadvantages of applying laws uniformly throughout the nation without considering the great differences in individual situations. Recent regulations result in standards sometimes lower than the best techniques can detect and in standards lower than concentrations in pristine water supplies. However, some trends toward more consideration of scientific evidence and evaluation of individual cases are apparent. (Cassar-FRC)
W82-06598

SLUDGE DISPOSAL TO SEA IN SOUTH AFRICA,

D. C. Macleod.
Water Science and Technology, Vol 14, No 3, p 93-107, 1982. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *Sludge disposal, *Outfalls, *Ocean dumping, Durban, *South Africa, Heavy metals, Water quality, Bacteria, Aquatic life, Invertebrates, Water pollution effects, Wastewater disposal, Settleable solids, Fate of pollutants.

The performance and effects on the marine environment of two sea outfalls at Durban, South Africa, are reported. Previously published monitoring data on ocean currents, dilution, and onshore frequency are reviewed. Originally the outfalls were designed for discharge of settle effluent but during 1970-71 it was necessary to discharge raw sewage through Bluff Outfall. As of January 1978 the 1 ml per liter settleable solids limit was changed to 2 ml per liter to allow for discharge of sludge with the settle effluent. Scum, grease, and floatable objects are totally removed so that the sludge is in finely divided form. Surf zone water quality is shown on a bar graph for 26 stations and at the two outfalls for the years 1964-1981. In general, water quality at the beaches near the Southern (Umlaas) Outfall is poorest. Predominant organisms from sediment samples are nematodes, polychaetes, oligochaetes, archiannelids, and isopoda. (Cassar-FRC)
W82-06599

SLUDGE DISPOSAL TO SEA IN THE FEDERAL REPUBLIC OF GERMANY,

Umweltbundesamt, Berlin (Germany, F.R.).
D. Fuchs.
Water Science and Technology, Vol 14, No 3, p 163-168, 1982. 7 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *Land disposal, *Federal Republic of Germany, Aquatic life, Fish, Hamburg, Landfills, Agriculture, Heavy metals, Metals, Land application, Industrial wastes, Permits Legislation, Water pollution effects.

In Germany land disposal of sludge is given priority over sea dumping. Only sewage sludge is dumped into the ocean. Industrial wastes are treated on land. The only city dumping sludge into the sea is Hamburg, which has disposed of 18,000 metric tons (dry weight) each year since 1962 in the North Sea)Inner German Bight). This amounts to 1% of the 1.8 million tons (dry) of sewage sludge produced in the country. The present dumping permit for Hamburg, which expires in 1983, is not expected to be renewed or extended. The dumping area is considered an endangered biological system according to scientific studies. For example, fish have suffered increased sublethal damage and disease and decreases in species numbers and richness. Heavy metals contents in sediments are suspended matter have increased, and bottom waters suffer from oxygen depletion in summer. Sludge disposal on land has been 40% for agriculture, 55% by land fill, 10% by incineration, and 5% other. (Cassar-FRC)
W82-06600

CONSEQUENCES OF CONTAMINATION BY HEAVY METALS IN TIDAL ESTUARIES BY THE EXAMPLE OF THE RIVER ELBE (AUSWIRKUNGEN DER SCHWERMETALLBELASTUNG VON TIDEGEWASSERN AM BEISPIEL DER ELBE),

Storm- und Hafenbau, Hamburg (Germany, F.R.). Behorde fuer Wirtschaft, Verkehr und Landwirtschaft.
L. Tent.
Wasserwirtschaft, Vol 72, No 2, p 60-62, February 1982. 2 Fig, 3 Tab, 18 Ref. English Summary.

Descriptors: *Heavy metals, *Spoil banks, Agriculture, Harbors, *Dredging, Suspended solids, Cadmium, Waste disposal, Soil properties, Hydrogen ion concentration, Alkalinity, Plant growth, Estuaries, Elbe river, Rivers, Tidal rivers, Water currents, *West Germany.

Polders made up of material dredged from the harbor of Hamburg, West Germany, were tested for suitability for agricultural application. The port of Hamburg is situated in the upper limnic portion of the tidal Elbe River estuary, where the current is weak. Consequently, suspended solids transported from upriver accumulate in the harbor. Heavy metals have been found in dredged material in concentrations ranging from 7-25 mg/kg for cadmium, 250-400 mg/kg for copper, and 1500-2500 mg/kg for zinc. Cadmium levels measured in polders formed before 1970 and used for agriculture and in those formed after 1970 and not used agriculturally showed no clear reduction with time. The nutrient content of the polder soil is high and favorable to plant growth, and the high chalk content and buffer capacity mean that the soil is weakly alkaline and that the heavy metals are not taken up by plants. However, if the chalk used by plants or leached out is not replaced adequately, the pH is reduced and plants begin to absorb heavy metals. This has led to a decrease in the quality of grain produced on some polders. Research into methods of improving soil contaminated in this way, into the hydrology of polders, and into new technology for treatment and disposal of dredged material is being performed. (Gish-FRC)
W82-06637

DESIGN AND OPERATIONAL ASPECTS OF SCREENING INSTALLATIONS AT SEA OUTFALLS ON THE NORTHUMBRIAN COAST,

Northumbrian Water Authority (England).
J. M. Eno.
Water Pollution Control, Vol 81, No 1, p 37-44, 1982. 4 Fig, 2 Ref.

Descriptors: *Outfall sewers, *Ocean dumping, Wastewater outfall, Water pollution sources, Water pollution prevention, Wastewater treatment, Wastewater facilities, Screens, United Kingdom, Coastal waters, Performance evaluation.

There are more than 100 outfalls of various sizes discharging sewage or surface water to the sea along the Northumbrian coastline. However, only 13 of the 64 foul-sewage outfalls currently employ any form of preliminary treatment. Although the 26 district councils are responsible for the pretreatment facilities at the head of coastal outfalls from public sewerage systems, the Northumbrian Water Authority has been involved in the design and operation of these facilities since 1974. Pretreatment plant design criteria are outlined. Screens in a rotating drum configuration have been found to be the only screening devices capable of ensuring 100% compliance with maximum particle size requirements for discharges. The design configurations and process performance of four existing screening installations at ocean outfalls on the northeast coast are described. Reviews of the operation of these plants have led to several significant conclusions regarding factors affecting the process reliability of drum screening installations. The diameter of the holes forming the mesh in thin steel plates appears to be critical to continuity of process performance. These holes should be no larger than 4 millimeters in diameter. For optimal results, thicker plastic plate is preferable to thin steel plates. Techniques for the continuous cleansing of screen surfaces in both cup and drum configurations also appear to be critical to process performance. The principle of recycling generally results in more economical development and operation of screening installations at pretreatment plants on coastal outfalls as compared with batch-type operations requiring extraction, processing, and removal of screenings. Large plants are preferably to be located in the open air, provided that adequate attention is given to such amenity considerations as odor and unobtrusiveness of the plant. (Carroll-FRC)
W82-06645

HEAVY METALS IN SLUDGE--ARE THEIR TOXIC EFFECTS ADDITIVE,

Oxford Univ. (England). Dept. of Agricultural Science.
P. H. T. Beckett, and R. D. Davis.
Water Pollution Control, Vol 81, No 1, p 112-119, 1982. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Heavy metals, *Toxicity, *Sludge, Sludge disposal, *Copper, *Zinc, *Nickel, Regulations, Crop yield, Barley, Pollution load, Land disposal, Phytotoxicity.

The amount of sewage sludge which can be safely disposed to agricultural land is highly dependent on whether or not the toxic effects of the copper, nickel, and zinc components are additive. While draft regulations in the United States and several European countries assume that these effects are not additive, those for the United Kingdom assume that they are. The concentrations of copper, nickel, and zinc in soil solutions of sludge-treated soils were investigated and the toxicity to young barley of solutions containing individual metals or mixtures of two metals was examined in an effort to establish the likely extent of additivity. These tests showed that, in the range of solution concentrations that is of practical concern, the relationship between tissue concentrations and soil solution concentrations is roughly linear, and that the relationship between soil solution concentration and heavy metal load is concave downwards. Tissue concentrations of copper, nickel, and zinc in crops on sludge-treated soils are likely to be proportional, or less than proportional, to the heavy metal load of the soil. Copper, nicke, or zinc are not likely to contribute to the total toxicity unless their quantity exceeds 50 to 67% of the quantity that would be just sufficient to cause toxicity in the absence of the other elements. These results indicate that the three elements show less additivity than is assumed in the draft regulations in the United Kingdom, but a little more than is assumed in the U.S. regulations. It would appear that sludge application rates in the United Kingdom could be doubled without increasing the risk of environmental pollution. (Carroll-FRC)
W82-06646

THE EFFECT OF SEWAGE SLUDGE LAND DISPOSAL ON THE MICROBIOLOGICAL QUALITY OF GROUNDWATER,

Canada Centre for Inland Water, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W82-06767

FATE OF PATHOGENS IN THERMOPHILIC AEROBIC SLUDGE DIGESTION,

Cornell Univ., Ithaca, NY. Dept. of Agricultural Enginerring.
For primary bibliographic entry see Field 5D.
W82-06772

LAND APPLICATION OF WASTEWATER,

Montgomery (James M.), Salt Lake City, UT.
J. H. Reynolds.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 673-675, June, 1982. 26 Ref.

Descriptors: *Literature reviews, *Water reuse, *Reclaimed water, *Irrigation water, *Land disposal, *Reviews, Impaired water use, Nutrients, Nitrogen, Phosphates, Pathogens, Bacteria, Viruses, Microorganisms, Municipal wastewater, Forages, Pastures, Water pollution effects, Soil properties, Wastewater disposal, Wastewater irrigation, Fate of pollutants, Sugarcane, Cotton, Public health.

The published literature on recent developments in land application of wastewater was reviewed. Case studies of successful application of secondary wastewater effluents were reported for grassland, sugarcane and cotton crops, and in a southern Appalachian forest. Nitrogen removal and heavy metal accumulation by different forage crops were studied. Nitrogen balances at wastewater disposal sites showed that a significant fraction of nitrogen was lost by denitrification and volatilization. Drained, cultivated, organic soils; flooded organic soils; and shallow reservoirs efficiently removed nutrients from wastewater effluents. Microbiological die-off exhibited first-order kinetics. Die-off rates were 1.14 per day for fecal coliforms, 1.33 per day for Salmonella, and 1.45 per day for viruses. Depth to groundwater was an important factor in the attenuation of pathogens in the soil. Effects of land application on the health of workers and other exposed populations, on the quality of ground and surface waters, on the food chain, and on soil physical properties were studies. (Cassar-FRC)
W82-06915

RADIOACTIVE WASTES,

Oak Ridge National Lab., TN., Environmental Sciences Div.
B. G. Blaylock, and H. J. Alexander.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 1002-1023, June, 1982. 4 Tab, 193 Ref.

Descriptors: *Literature reviews, *Waste disposal, *Radioactive waste disposal, *Nuclear wastes, Waste storage, Water pollution sources, Fate of pollutants, Underground waste disposal, Solid wastes, Regulations, Geohydrology, Landfills, Ocean dumping, *Reviews, Incineration, Storage, Waste management, Aquatic life, Monitoring, Risks, Powerplants, Environmental effects, Financing, Economic aspects.

A review of the radioactive waste literature for 1981 listed the contents of 3 symposia in tabular form. Recent regulations published by the Nuclear Regulatory Commission, Department of Energy, and EPA were highlighted. Studies on the isolation of radioactive wastes included hydrogeological investigations of the suitability of different host rocks and sites for waste burial. It was determined that groundwater moves mainly through macrofissures and is nearly stationary in the adjacent micropores. Pressure gradients caused by the temperature differences were important. Shallow land burial of low-level waste in polyethylene drums was done satisfactorily. Several handbooks and reviews on geologic repositories were mentioned. Other authors discussed testing and modeling of the suitability of various sites for disposal with consideration of temperature changes, creep in salt formations, effects of seismic events on underground facilities, and ocean disposal. Waste treatment methods reviewed were solidification (such as spent ion exchange beads), vitrification (for example, the MODOX process for immobilizing Na ions and radionuclides in a glass matrix), volume reduction (melt refining, treatment of ion exchange resin waste, glass furnace, use of metals and slags, and chemical reactions plus filtrate of I131 wastes), and incineration. Studies on migration of radionuclides in the environment included monitoring of aquatic and terrestrial organisms, sediments, and water. Several models were developed to describe transport of radioactive materials in water, soil, and food webs. Methods used for monitoring at radioactive materials facilities such as powerplants included soil sampling, collecting wind-suspended dust, and sampling of drainage ditch water. Other topics discussed were waste management, storage, transportation, risk assessment, remedial action such as sealing uranium mill tailings sites with asphalt emulsion barriers, decomissioning nuclear facilities, and socioeconomic factors. (Cassar-FRC)
W82-06920

A CASE FOR REGIONAL SLUDGE MANAGEMENT,

R. K. Allen.
Public Works, Vol 113, No 7, p 59-62, July, 1982. 3 Fig, 4 Tab, 7 Ref.

Descriptors: *Sludge disposal, *Incineration, *Transportation, Maynard, *Massachusetts, Wastewater treatment, Regional planning, Sludge thickening, Liquid sludge, Dewatering, Landfills, Land disposal, Costs, Operating costs.

Regional sludge management was advantageous for the town of Maynard, Massachusetts, for two reasons: cost effectiveness and improvement of effluent quality. The 1 mgd wastewater treatment plant at Maynard had experienced many problems with its fluidized bed sludge incinerator since startup in 1975, and management resorted to on-site landfilling of undigested sludge. In addition, discharge standards were violated 55 and 26 days per year for BOD and total suspended solids, respectively. The problems were solved by trucking liquid sludge to the Greater Lawrence Sanitary District, a 39 mgd capacity secondary treatment facility, equipped for sludge thickening, dewatering, and incineration. Costs per dry ton were as follows: onsite landfill, $250; fluidized bed incinerator, $620; and liquid sludge hauling, $323. Although landfilling was the cheapest alternative, there had been many complaints of obnoxious odors. Hauling sludge also decreased the number of days on which maximum discharge standards were violated to 15 and 18 for BOD and total suspended solids, respectively. A figure compares the annual operation and maintenance costs of on-site incineration and hauling for 10-100 miles, one-way, at flows up to 100 mgd. Cost effectiveness is also shown in graph form. It is more cost effective to incinerate on site above 10 mgd. At lesser flows, the cost effectiveness depends on hauling distance. For example, for a 2 mgd plant it is more cost effective to haul sludge up to 80 miles one-way; for a 6 mgd plant, it pays to haul only 15 miles one-way or less. (Cassar-FRC)
W82-06993

5F. Water Treatment and Quality Alteration

INFLUENCE OF OZONATION ON SULFUR, NITROGEN, CHLORIDE AND PHOSPHORUS SYSTEMS IN PUBLIC DRINKING WATER SUPPLIES,

South Dakota State Univ., Brookings. Dept. of Chemistry.
D. C. Hilderbrand.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243320, Price Codes: xx in paper copy, A01 in microfiche. Report, May 1982. 15 p, 7 Tab, 4 Ref. OWRT B-069-SDAK(1), 14-34-0001-1264.

Descriptors: *Ozone, *Water treatment, *Sulfur, *Nitrogen, *Chloride, *Phosphorous, Ammonia, Public utility, *Ozonation, Water supply, Sulfate, Phosphate, Drinking water, Potable water.

The use of ozone as a treatment process for public drinking water is of interest because other methods include a concern relative to the ingestion of chloroform and other trihalomethanes. Ozone which decomposes rapidly in water to form oxygen deters the possibility of formation of other hazardous species. Most studies on ozonation have dealt with sterilization, color, taste, and odor removal. This study investigated the effect of ozonation on the concentration of selected phosphorus, sulfur, nitrogen and chloride species present in raw drinking water supplies. The following observations were made. No effect on the concentration of either phosphate or chloride was detected. The concentration of sulfide and sulfite was reduced to below detection limit of the method used when intermediate or high concentrations of ozone was applied. The concentration of sulfide was only slightly elevated corresponding to the conversion of limited amounts of sulfite to sulfate. For the nitrogen system no effect was detected for treatment of samples containing ammonia. The nitrite concentration however was reduced to below the detection limit for the method when intermediate and high levels of ozone treatment were employed.
W82-05907

DESALINATION DIRECTORY 1981.

Elsevier Scientific Publishing Co., Amsterdam (Netherlands).
For primary bibliographic entry see Field 3A.
W82-05908

DEVELOPING AN ATP INDEX FOR DEGRADATION OF DRINKING WATER QUALITY BY ATTACHED MICROBES,

Missouri Water Resources Research Center, Columbia.
M. M. Ghosh, and T. M. Prakash.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243551, Price codes: A04 in paper copy, A01 in microfiche. Report, January, 1982. 55 p, 9 Fig, 10 Tab, 39 Ref. OWRT A-122-MO(1). 14-34-0001-1127.

Descriptors: *Water quality control, *Microbial degradation, *Drinking water, *Biochemical tests, *Bioindicators, Microorganisms, Potable water, Water analysis, Bacterial analysis, Stream degradation, Biochemistry, Organic carbon, Natural waters, Monitoring, Pollutant identification.

Research was focused on delineating the role of microorganisms in drinking water quality degradation, which can occur during water transport in pipe networks. Biofouling kinetics were studied at very low (glucose) substrate levels in simulated systems using continuous stirred-tank reactors. Biofilm growth was measured on glass slides suspended in single reactors inoculated with indigenous microorganisms present in the University tap water. Extremely dilute feed solutions were used to simulate low (5-15 mg/liter) total organic carbon (TOC) conditions typical of actual water distribution systems. Biofouling was quantitatively estimated from biofilm thickness, attached biomass and its ATP level, biofilm polysaccharides, and changes in TOC and dissolved oxygen. It was found that biofilm kinetics under low substrate conditions were similar to literature values. The substrate penetrated the entire biofilm thickness, indicating no substrate limitation. Substrate consumption rate was linear with substrate loading rate and oxygen consumpion rate. It was concluded that ATP measurement of the biofilm is a good indicator of biological activity. An ATP index is proposed for possible use for water quality change monitoring. (Zielinski-MAXIMA)
W82-05932

PLANT EXPANSION VIA HIGH-RATE PRETREATMENT,

Alabama Water Works, Birmingham.
C. D. Colee, and K. W. Henderson.
Public Works, Vol 113, No 5, p 84-86, May 1982. 1 Fig, 3 Tab.

Descriptors: *Settling tanks, *Turbidity, *Water treatment, Tube settlers, *Alabama, Birmingham, *Pretreatment.

Tube settlers were chosen as a cost saving means of expanding the capacity of the Western Filter plant in Birmingham, Alabama. A 7-month study compared operation of Basin No 2, operating at the 5 mgd conventional rate without tube settlers, and Basin No. 1, operating at rates up to 20 mgd and equipped with 3600 sq feet of tube settlers and an additional 480 linear ft of weirs. Settled water turbidities from the 2 basins were comparable. Total capacity of the plant will be expanded from 440 to 60 mgd when tube settlers are also installed in Basin No. 2. (Cassar-FRC)
W82-05953

DIFFUSIVE AND HYDRAULIC TRANSFER OF SOLUTES THROUGH HOMOGENEOUS MEMBRANES,

Kyoto Univ. (Japan). Dept. of Chemical Engineering.
E. Sada, S. Katoh, K. Miyai, M. Terashima, and S. Yoshida.
Biotechnology and Bioengineering, Vol 24, No 5, p 1137-1144, May, 1982. 8 Fig, 1 Tab, 4 Ref.

Descriptors: *Solute transport, *Membrane processes, Permeability, Filtration, Sieving coefficients, Hydraulic properties, Water treatment.

Homogeneous kappa-carrageenan and bovine serum albumin membranes used in reverse osmosis and other applications were evaluated. Solutes included urea, B vitamins, enzymes, and other substances with molecular weights from 60 to 68,000. The rates of hydraulic transport of water, solute permeabilities, and sieving coefficients increased with the water content of membranes. Water content, in turn, was related to pore radius. As the molecular weight of the solute increased, the ratio of diffusion coefficient of the solute in the membrane to the diffusion coefficient of the solute in water decreased, the reciprocal of the membrane thickness times the membrane resistance increased, and the sieving coefficient decreased. (Cassar-FRC)
W82-06006

CONSTRUCTION CRITERIA OF THE MERY-SUR-OISE STORAGE BASIN - IMPROVEMENTS IN WATER QUALITY OBTAINED,

Compagnie Generale des Eaux, Paris (France).

For primary bibliographic entry see Field 5G.
W82-06013

PACKAGED PLANT TREATS TURBIDITY,

Mesa Engineering and Surveying Co., Inc., Montrose, CO.
R. A. Burnham, and W. C. Trnka.
Water/Engineering and Management, Vol 129, No 4, p 56-57, April, 1982.

Descriptors: *Turbidity, *Water treatment, Ridgway *Colorado, Flocculation, Package plants, Drinking water, Snowmelt.

The water supply of Ridgeway, Colorado, population 270, is pure at the source but becomes contaminated with organic and inorganic matter during its travel through 6 miles of open ditch. Turbidity is especially high during the spring snowmelt period. A package plant was installed (total cost $780,000) to upgrade water quality. The treatment process consists of flocculation with alum and cationic polymer, a depth clarifier, sand depth filters, and chlorination. The equipment treats 130,000 gpd. The facility delivers water 10 times better in quality than minimum specified standards. (Cassar-FRC)
W82-06026

FLORIDA STYLE WATER SUPPLY AND TREATMENT,

CH2M Hill, Gainesville, FL.
O. K. Buros, T. A. Ridgik, C. R. Sproul, M. R. Vilaret, and R. A. Yorton.
Water/Engineering and Management, Vol 129, No 4, p 30-33, April 1982. 3 Ref.

Descriptors: Water supply, *Water softening, *Aquifers, *Water treatment, Coastal aquifers, Sulfides, Desalination, Trihalomethanes, Chlorinated hydrocarbons, Organic matter, Hardness, Saline water intrusion, Flocculation, Aeration, Chlorination, Activated carbon, Brackish water, Water quality control, Reverse osmosis, Electrodialysis, Membrane processes, Distillation, *Florida.

Florida's abundant precipitation (163 million acre feet per year) recharges the very productive Floridan aquifer underlying most of the state and the smaller Biscayne aquifer under the southeast coast. Groundwater provides almost 90% of the state's public supply. Florida's most prevalent problems with its water supply are hardness (high Ca, low Mg), high hydrogen sulfide levels, salt water intrusion, and trihalomethane (THM) formation. As a result, treament methods have evolved. Water softening with lime or lime-soda ash is widespread. Many softening plants use potato starch as a flocculant aid to improve the sludge handling characteristics. Surface water quality is variable; it is often high in organic color. Treatment usually required is coagulation, settling, filtration, and activated carbon. Aeration has been a common process for removing hydrogen sulfide from waters. However, Orlando is using a new process based on oxidation of sulfides with chlorine prior to passage through a granular activated carbon bed. Methods of handling the salt water intrusion problem include artificial recharge of an aquifer with river water, control of large withdrawals in sensitive areas, raising canal control elevations, and relocation of wells further inland. In areas of abundant brackish water supplies desalination by electrodialysis or reverse osmosis is in use. The combination of high dissolved organic matter and bromide ions in Florida waters favors THM formation. Three possible treatment strategies are available: removal of THM precursors, removal of THM after chlorination, and alternate disinfectants. (Cassar-FRC)
W82-06027

REMOVAL OF HUMIC SUBSTANCES FROM NATURAL WATERS BY REVERSE OSMOSIS,

Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
H. Odegaard, and S. Koottatep.
Water Research, Vol 16, No 5, p 613-620, May, 1982. 7 Fig, 5 Tab, 5 Ref.

Descriptors: *Reverse osmosis, *Membrane processes, *Humic acids, Water treament, Color removal, Organic matter, Sagelva River, *Norway.

Removal of humic substances from water by reverse osmosis was studied in laboratory units. The raw water from the Sagelva River, Trondheim, Norway, was high in color (average 54 mg Pt per liter). About 72% of the humic substances had molecular weights above 5000. Three reverse osmosis units were used: Osmonics spiral wound Model OSMO 519-SB, DDS plate and frame module Model 20-Lab, and PCI single tube module Model bro mk2. Membrane pore size was the most significant factor influencing permeate quality and product water flux. Pressure had no significant effect on permeate quality but was linearly related to product water flux. The concentration of humic substances in the raw water did not affect the water flux, indicating that the osmotic pressure of the humic materials did not affect the transport mechanism. The best membranes for each unit were: Osmonics SEPA 89 (permeate flux 25 liters per sq m per hour at 15 bars), DDS 865 (permeate flux 1201 sq m per hour at 40 bars) and PCI T2A (permeate flux 90 liters per sq m per hour at 15 bars). Removal efficiencies of the best membranes were 80-97% in terms of permanganate number. The presence of suspended solids in the raw water decreased removal efficiencies. In the case of 130 mg per liter suspended solids as bentonite, reduction was 50% during 3-4 hours. The suspended solids had greater effects at higher operating pressures. (Cassar-FRC)
W82-06045

THE CORROSION OF COPPER BY CHLORINATED DRINKING WATERS,

Massachusetts Univ., Amherst. Dept of Chemistry.
D. Atlas, J. Coombs, and O. T. Zajicek.
Water Research, Vol 16, No 5, p 693-698, May, 1982. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Corrosion, *Copper, *Chlorine, *Pipes, Chlorination, Plumbing, Water treatment, Drinking water, Hypochlorites, Hypochlorous acid.

Corrosion of copper water piping was investigated by exposing copper drillings to different concentrations of free chlorine (0 to 10 mg per liter) and different pH (5 and 8) for 24 hours and determining the dissolved copper at different intervals. Free Chlorine, rather than dissolved oxygen, was the agent most responsible for copper corrosion by chlorinated water supplies. Chlorination was more corrosive at the lower pH because of the pH dependence of the HOCl electrode reactions and the fact that hydrochlorous acid is a stronger oxidizing agent than hydrochlorite ion. To minimize copper pipe corrosion it was recommended that the water supply be adjusted to pH of 7-8 after chlorination, using sodium carbonate rather than sodium hydroxide, and that free chlorine be maintained at a level no higher than 2 mg per liter. (Cassar-FRC)
W82-06051

THEY DON'T ACTIVATE THEIR SLUDGE IN LAGOS OR LAHORE,

Loughborough Univ. of Technology (England). WEDC Group.
J. Pickford.
Effluent and Water Treatment Journal, Vol 22, No 3, p 105-107, March, 1982.

Descriptors: *Water treatment, *Developing countries, *Drinking water, *International Hydrological Decade, *Sanitation, Water management, Wastewater treatment, Rural areas, Urban areas, Water supply development, Water scarcity, Potable water, Waste disposal, Latrines.

The 1981-1990 decade, the International Drinking Water Supply and Sanitation Decade, was planned to provide a safe and accessible supply of drinking water to all of the world's population. The greatest benefit of improved water supplies in underdeveloped countries is accessibility of water. Most poor people do not connect disease and health with water quality. Most human excreta disposal in underdeveloped nations is by latrines, as sewerage systems require too much water flow to operate correctly. Where most tap supplies of safe or publicly-treated water are intermittent, contamination in the distribution system often occurs. When more advanced nations provide funds for constructing sewage treatment works, often local authorities lack the funds to staff and maintain the facilities. Unstable governments, politics, and local regious traditions and taboos may also add to the difficulties of providing water and sanitation. It is suggested that developed countries should not try to impose their technology on underdeveloped nations, but rather work with them in finding the sewage disposal and water treatment systems which would operate best within their existing way of life. Reliability in performing routine jobs on schedule and well is seen as a valuable asset to be encouraged in developing nations seeking to establish improved water management technlogies. (Geiger-FRC)
W82-06075

ECONOMIC IMPACT STUDY OF R81-11 TRIHALOMETHANE STANDARDS FOR PUBLIC WATER SUPPLIES,

Illinois Dept. of Energy and Natural Resources, Chicago.
S. L. Jarrell.
Document No 82/05, February 1982. 75 p, 16 Tab, 26 Ref, 1 Append.

Descriptors: *Trihalomethanes, *Water quality standards, *Water supply systems, Pollutants, *Economic impact, *Chlorination, Drinking water, Public waters, Cost, Government supports, *Cost analysis, Cost-benefit analysis, Water sampling, Groundwater, Treated water, Surface water.

Trihalomethanes (THMs) have been associated with human cancer and genetic defects in tests conducted by the U.S. Environmental Protection Agency. Proposed changes to Chapter 6 of the Illinois Public Water Supply Regulations contained in regulatory proposal R81-11 seek to control THM concentrations in Illinois' public drinking water. The EPA has set a maximum contaminant level of 0.10 mg/l for Total THMs; all Illinois public water supplies (PWS) serving more than 75,000 people must try to comply by November 5, 1981 and those serving 10,000-75,000 just approach compliance by November 5, 1983. Most (85%) of Illinois' water comes from groundwater sources and Lake Michigan, which historically have had negligible levels of TTHM. Forty-three PWS serve more than 10,000 people. Typical surface water treatments are coagulation, filtration and chlorination. Groundwater must also be chlorinated. Many PWS can lower their TTHM levels by changing chlorination points and/or replacing chlorine with another disinfectant. Estimating compliance costs is difficult for lack of statewide sampling results. TTHM sampling done in private labs will cost the PWS $45/sample vs. $22.50/sample in state labs. For 1200 samples the first year, adopting the proposal would save $27,000, and $9,622.50 a year therafter for 428 samples. Illinois would also continue receiving $1.2 million in federal funding. Economic impacts on agriculture and commerce would be negligible; the chemical industry might see minor increases. The incremental benefits of adopting the measure outweigh the costs by the $1.2 million in federal assistance plus any difference in analytical cost. (Atkins-Omniplan)
W82-06098

TRIHALOMETHANE FORMATION IN WATER TREATMENT PLANTS IN NORTH CAROLINA,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
P. C. Singer, J. J. Barry, III, G. M. Palen, and A. E. Scrivner.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243734, Price codes: A07 in paper copy, A01 in microfiche. North Carolina Water Resources Research Institute, Raleigh, Report UNC-WRRI-82-179, April

1982. 127 p, 26 Fig, 31 Tab, 48 Ref, 1 Append. OWRT B-126-NC(1), 14-34-0001-9035.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Carcinogens, *Drinking water, Water treatment, Urban areas, Chlorine, Wastewater treatment, Gas chromatogaphy, Potable water, Water quality control, Water quality, Chemical treatment, Water treatment facilities, Impaired water quality, Water analysis, Chemical analysis, Chemical reactions, *North Carolina, *Trihalomethane, Pollutant identification.

Analyses for trihalomethanes (THMs) in drinking water (by gas chromatography with electrolytic conductivity detection) showed that they are formed during water treatment in nine of the larger cities in North Carolina. Furthermore, concentrations of these suspect carcinogens often exceeded the established maximum contaminant level at three of these locations. Examination of potential surrogate measures of THMs suggests that ultraviolet/absorbance and total organic carbon are good indicators of THMs and their precursors. Statistical analysis of the data was ued to identify seasonal variations, temperature effects, geographical trends, and other water quality characteristics and water treatment practices which contribute to THM formation. A standardized THM formation potential method was found particularly useful in this regard. Chlorination/coagulation practices at a Wilmington water treatment plant were studied in an attempt to assess approaches to THM reduction; it was found that THM concentrations in finished water could be substantially reduced by shifting the point of initial chlorine application to a point following sedimentation. Similar results were obtained on a laboratory scale for Chapel Hill and Raleigh waters. (Zielinski-MAXIMA)
W82-06158

APPROPRIATE SELECTION OF WATER/ WASTEWATER TREATMENT PROCESSES FOR SMALL CITIES AND RURAL AREAS,

Oklahoma Univ., Norman. Bureau of Water and Environmental Resources Research.
For primary bibliographic entry see Field 5D.
W82-06162

INVESTIGATION OF THE CHEMICAL NATURE AND POSSIBLE TOXICITY OF PRODUCTS FORMED DURING THE OZONE DISINFECTION OF DRINKING WATER CONTAINING ORGANIC SUBSTANCES,

Auburn Univ., AL. Dept. of Chemistry.
W. C. Neely.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-254970, Price codes: A02 in paper copy, A01 in microfiche. Report, January 1981. 18 p, 3 Fig, 2 Tab, 18 Ref. OWRT A-070-ALA(1), 14-34-0001-0101.

Descriptors: *Ozonation, *Drinking water, *Chemical reactions, *Chemical analysis, *Carcinogens, Ozone, *Water treatment, Potable water, Chemical properties, Oxidation, Organic compounds, Phenols, Industrial wastes, Catalysts, Toxicity, Hazardous materials, Pollutants, Pollution sources.

The potential for formation of carcinogenic epoxides of polycyclic aromatic hydrocarbons (3,4-benzopyrene and napthalene) in drinking water through action of ozone on their dissolved or suspended forms was explored. Within the limits of the techniques used, no conclusive evidence for epoxide formation from either compound was found; Ames bioassay produced no evidence for existence of their mutagenicity following ozone treatment. In addition, the ozonization of a model organic (phenol) in aqueous solution was studied using two approaches (ultraviolet (UV) light irradiation, and metal ion catalysts) for accelerating the rate of ozonolysis in aqueous solution. It was concluded that UV-induced ozone decomposition is responsible for photo-assisted ozonization, allowing for direct calculation of the light intensity needed to obtain a given degree of accelerated ozonization under specified conditions. Testing the catalytic ability of 25 transition metals and lanthanides revealed that vanadium pentoxide, uranium dioxide, and cobalt(II) catalysed ozone decomposition, with the latter effectively tested for phenol ozonization. The results all indicate that aqueous phenol ozonization proceeds through initial ozone decomposition to a reactive species, for which the hydroxyl radical is proposed; this is in distinct contrast to established mechanisms in nonaqueous solution. (Zielinski-MAXIMA)
W82-06173

SUPPLYING WATER TO THE RURAL COMMUNITY,

DeWild Grant Rockert and Associates Co., Rock Rapids, IA.
M. Whye, and D. Holman.
Public Works, Vol 113, No 5, p 58-60, May, 1982. 1 Fig, 1 Tab.

Descriptors: *Rural areas, *Water supply, Water distribution, Water treatment, Lincoln-Pipestone Rural Water System, *Minnesota, Pipelines, Water quality.

The Lincoln-Pipesteon Rural Water System, southwest Monnesota, is an example of a modern rural water system. It serves 900 customers in 11 communitites spread over a 70 x 25 mile area. After a feasibility study, funding was arranges ($4 milliongrant and $6.4 million loan). The completed system obtains its water from four 60-70-ft deep gravel packed wells of 400-450 gpm capacity each, fieed with submersible pumps. Water is of good quality, requiring only chlorination and fluoridation. Water is delivered by sin pumping stations/ groundwater storage reservoirs with combined storage capacity of 1.1 million gallons. Outlying stations are served by four high pressure pumps. The major construction cost was the distribution system, 645 miles of main pies and 70 miles of service pipes. Billing is done according to meter reading supplies monthly by the users. Aneffective rural water system must, first of all, have enough subscribers to justify costs. Second, water must be affordable. Consumers in a rural water system have good qualtiy, reliable water for hone and livestock use. However, fire protection and irrigation water are not generally provided. (Cassar-FRC)
W82-06223

OVERHAULING A WATER SYSTEM,

Kupper (Charles J.), Inc., Piscataway, NJ.
C. H. Witte.
Public Works, Vol 113, No 5, p 74-75, May, 1982.

Descriptors: *Water distribution, *Rehabilitation, *Water treatment, Water supply, Water mains, Water storage, Tuckerton, *New Jersey, Water metering.

Water problems in Tuckerton, New Jersey, led to the acquisition of the Tuckerton Water Company by the borough municipal utilities authority. The town of 2412 year-round population and 8000 peak summer population had an antiquated distribution system, an inoperable treatment facility, and an undersized, deteriorated storage tank. Estimated costs of improvements were $2.8 million, for which financing was obtained by a loan and a grant. Renovation of the system began with the water treatment facility, in which the old filter was repaired and a new one added and new pumping and feed equipment installed. A 6 inch water main was constructed to loop the system and stabilize the pressure. A 12 inch ductile iron main replaced a 4 inch concrete main. Other improvements were an additional supply well, a 1.4 million gallon storage standpipe, replacement of 60% of the distribution system, and installation of water meters. Future work includes more improvements to the water treatment plant. (Cassar-FRC)
W82-06224

MICROPROCESSORS AND COMPUTERS IN ANALYSIS IN THE WATER INDUSTRY,

Technicon Instruments Co. Ltd. (England).
D. G. Thomson.
Water Pollution Control, Vol 81 No 2, p 193-199, 1982. 2 Fig, 7 Ref.

Descriptors: *Data processing, *Microprocessors, Automation, Computers, Laboratories, Research facilities, Equipment.

In the early 1970s computer controlled water treatment plants appeared as the fist sign of revolutionary changes in the water industry in the United Kingdom. This first step towards automation of water analysis provided a solution to the problem of coping with large sample numbers, but it has since become apparent that the computation of the data which all forms of instrumentation produce is now a major problem. The fast handling of samples is meaningless if the information gained from the analyses cannot be managed efficiently. The most recent approach to such problems is the use of microprocessing equipment. The use of such equipment in an attempt to improve the performance of the analytical instrument and to increase the degree of automation involved consideration of the following features as basic in the design: flexibility in routine operation, total automation of the autoanalyzer, validation of data, direct interfacing to existing systems, and improvement in the chemical performance. The LDM system is described; it includes a SEMS solar computer which is modular and can be upgraded as the workload or organization changes. (Baker-FRC)
W82-06259

MAINTENANCE OF ANALOG INSTRUMENT SYSTEMS,

Turbitrol Co., Atlanta, GA.
For primary bibliographic entry see Field 5D.
W82-06263

REMOVAL OF INORGANIC MERCURY FROM WATER BY BITMUMINOUS COAL,

Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06265

NONSTANDARD METHODS FOR ENUMERATING BACTERIA IN DRINKING WATER,

Trondheim Univ. (Norway). Div. of Hydraulic and Sanitary Engineering.
L. Fiksdal, E. A. Vik, A. Mills, and J. T. Staley.
Journal of the American Water Works Association, Vol 74, No 6, p 313-318, June, 1982. 4 Fig, 5 Tab, 22 Ref.

Descriptors: *Drinking water, *Bacteria, Water treatment, Potable water, Chlorination, Temperature effects, Disinfection, Pollutant identification.

In order to determine the optimum conditions for maximizing viable counts of bacteria from drinking water samples, various enumeration procedures were examined. Nonstandard procedures which increased bacterial count included: media that were more dilute than Standard Methods Agar, incubation periods that ranged from 2 to 13 or 14 days and longer, and an incubation temperature of 20 degrees C. The differences between the results obtained with these nonstandard methods suggests that there may be regional differences in bacterial flora which account for the differences in efficacy of enumeration procedures. Additionally, strain diversity was estimated for heterotrophic bacteria from nonchlorinated and chorinated waters. In this examination, untreated source waters had a greater diversity of bacteria than did chlorinated samples. This suggests that chlorination allows few species to survive in distribution systems. (Baker-FRC)
W82-06278

ADVANCED WATER TREATMENT FOR COLOR AND ORGANICS REMOVAL,

Dillon (M. M.) Ltd., London (Ontario).
T. A. Constantine.
Journal of the American Water Works Association, Vol 74, No 6, p 310-313, June, 1982. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Water treatment, *Drinking water, Potable water, Chlorination, Disinfection, Ozonation, Activated carbon, Color removal, Humic acids, *Filtration, *Biological activated filtration.

This paper discusses and evaluates a relatively new process called biological activated filtration (BAF) in comparison to the conventional physical-chemical process that traditionally has been used to remove color and organic compounds from drinking water supplies. The BAF process can offer reduced capital and operating costs, lower chemical dosage requirements, and lessen sludge-disposal problems for treatment of highly colored waters than conventional treatment programs. BAF processes would suit commonly occurring raw water conditions, and consist of the following steps: ozonation - carried out in gravity flow through contact tanks with twenty minutes' detention time after ozone contact, providing for the reaction of the most refractory organic compounds; GAC adsorption carried out in either gravity or pressure vessels, with a 20 minute period in the carbon beds being needed; stabilization via a hydrated lime slurry injected into the treated water from the BAF units to stabilize the corrosive tendency of the water; and postchlorination prior to delivery to the distribution system and storage facilities to ensure that residual concentrations sufficient for disinfection are present in the system up to each user's service. (Baker-FRC)
W82-06279

ANALYTICAL NOTE: EVALUATION OF THE M-SPC METHOD AS A SUBSTITUTE FOR THE STANDARD PLATE COUNT IN WATER MICROBIOLOGY,

Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, M. A. Meyer, and M. S. Paller.
Journal of the American Water Works Association, Vol 74, No 6, p 322, June, 1982. 1 Fig, 3 Ref.

Descriptors: *Drinking water, Microorganisms, *Standard plate count, Membranes, *Membrane filters, Pollutant identification, Water treatment, Treatment facilities.

In this study the membrane filter Standard Plate Count (m-SPC) procedure was compared with the SPC procedure using samples collected from two New England water treatment plants and distribution systems. Samples at each plant included raw water, partially treated water immediately after post-chlorination, and three samples taken within the distribution system of the plant at various transit times following treatment up to about 1 week. Computerized analyses performed on the data collected indicate that the m-SPC method is a satisfactory alternative to the SPC method. Moreover, the m-SPC method is more sensitive than SPC because it can handle sample volumes in excess of 1.0 mL. However, it is noted that the SPC procedure itself, and thus the m-SPC procedure as well, is imprecise, as it fails to enumerate a sizable portion of potable water organisms, since the choice of incubation time and medium is arbitrary. (Baker-FRC)
W82-06280

GROUNDING OF ELECTRIC CIRCUITS TO WATER SERVICES: ONE UTILITY'S EXPERIENCE,

Suffolk County Water Authority, Oakdale, NY.
A. A. Guerrera.
Journal of the American Water Works Association, Vol 72, No 2, p 82-87, February, 1980. 7 Fig, 11 Ref.

Descriptors: *Electrical grounding, *Pipelines, Equipment, *Electric currents, Water transport, Accidents, Hazards, Safety, Water quality, Sulfides, Copper, Corrosion.

The use of water service pipes for grounding of electric circuits has resulted in numerous and documented cases of deterioration of water quality, increased rates of corrosion of copper plumbing, and potential hazards to water supply personnel. The Suffolk County Water Authority in Oakdale, New York, still has more than 230,000 active services acting as secondary grounding electrodes, despite the availability of effective and approved alternate grounding systems. It has been demonstrated that if two or more electric utility customers are fed from one transformer, and there is a water pipe ground connection for each customer, some current will always flow over the grounding connections under normal conditions. This results in the utilization of water utility piping and its appurtenances for purposes other than those for which it was designed and installed. It has further been demonstrated empirically that corrosion of tubing or deterioration of water quality occurs in areas receiving the same treated water where the only apparent variable is the presence of stray electric currents. In homes where copper corrosion of the pipes has resulted in deterioration of water quality, a recording clamp-on ammeter has been used to determine whether there was current flow between the affected residences and a common transformer and to note the peaks in the current flow. In many cases the problem of copper corrosion disappeared after an insulating coupling was installed on the corporation stop at the main. A poor or damaged ground in one residence has also been shown to affect the flow of electricity and the water quality in a neighboring residence. Changes in taste and odor have also occurred where water containing sulfur was affected by a substantial current flow, with the sulfur reduced to sulfide. (Baker-FRC)
W82-06281

DRINKING WATER DISINFECTION,

Strauss and Roberts, Inc., Porterville, CA.
K. E. Longley, and B. Roberts.
Water/Engineering and Management, Reference Handbook-1982, p 26, 28-30, May, 1982. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Drinking water, *Disinfection, Chlorination, Chlorine dioxide, Ammonia, Chloramines, Ozonation, Water treatment.

The design and selection of a disinfection system requires the development and analysis of treatment objectives together with the economic and operation factors which impact on the optimization of disinfection process. The first step is good engineering practice to be followed in the selection of disinfectants and the subsequent process optimization. Primary and secondary treatment objectives for water of a known quality must be assessed, and then the disinfectant dose to attain the desired objectives must be determined. Ozone is an outstanding disinfectant that has been used extensively in Europe. Ozonation systems may be divided into four sub-systems: oxygen generation or air pretreatment; ozone generation; off-gas ozone destruction; and process control. Chlorination of drinking water is a practice undergoing only slow evolutionary change during the past few decades. Sulfur dioxide is the usual choice for a dechlorinating agent for facilities practicing chlorination. Water treatment plants using hypochlorination typically have a storage area for bulk storage of chemical. The chloramine disinfection process fell into disuse generally due to the superior quality of the water product after using hypochlorous acid. A variant of the chloramine or chlorine-ammonia process is the introduction of ammonia to the water stream after a controlled contact time with free chlorine. An effective disinfectant producing minimal trihalomethanes in the presence of their precursors is chlorine dioxide. Its use is growing for taste and odor control. Disinfectant selection requires evaluation of treatment objectives, including interrelated engineering economic, operation, health and safety considerations. (Baker-FRC)
W82-06341

PROCESSES FOR REMOVAL OF INORGANIC CONTAMINANTS FROM WATER,

Cullen Coll. of Engineering, Houston, TX.
D. Clifford.
In: Water/Engineering and Management, Reference Handbook-1982, p 31-32, 34, 36-38, May, 1982. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Water treatment, *Water supply development, Fluorides, Nitrates, Arsenic, Selenium, Reverse osmosis, Potable water, Drinking water, Electrodialysis, Alumina, Resins.

A project has been undertaken to evaluate the single contaminant removal process versus the desalting processes. This project is designed to help small communities which have inorganic contaminant problems. The single contaminant removal processes available for the engineer to chose from include alumina adsorption or ion exchange. The desalting processes include reverse osmosis or electrodialysis. To make the proper choice both technically and economically, consideration must be given to the raw water total dissolved solids level, speciation of contaminant, concentration of ions competing for adsorption or ion exchange sites, silt density index, public health risk in event of process failure or contaminant breakthrough, quality of water required for distribution, and buffer capacity to be overcome for pH adjustment. In order to design an effective process the fundamentals must be understood particularly in relation to selectivity sequence, percent contaminant passage expected, and pretreatment, post treatment and waste disposal requirements. (Baker-FRC)
W82-06342

VIRUSES IN A COMMUNITY WATER SUPPLY ASSOCIATED WITH AN OUTBREAK OF GASTROENTERITIS AND INFECTIOUS HEPATITIS,

Murray State Univ., KY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W82-06348

POTABLE WATER TREATMENT BY DISSOLVED AIR FLOTATION AND FILTRATION,

Krofta Engineering Corp., Lenox, MA.
M. Krofta, and L. K. Wang.
Journal of the American Water Works Association, Vol 74, No 6, p 305-310, June, 1982. 3 Fig, 7 Tab, 16 Ref.

Descriptors: *Potable water, *Water treatment, Domestic water, Drinking water, Disinfection, *Flotation, Filtration, *Dissolved air flotation.

This report discusses bench and pilot plant tests of a potable water treatment system consisting of chemical feeding, dissolved air flotation, gravity filtration, and disinfection. The report describes the conceptual design of the purification system, a technical feasibility study, an economic feasibility study and recommendation for future research. The system was proposed for the city of Pittsfield, 60,000 inhabitants, located in the Berkshire Hills of western Massachusetts. The water sources consist of three surface reservoirs supplying about 56 ML/day to the city and communities surrounding it. The system emphasizes the use of a dissolved air flotation (DAF) unit for water purification. Carbon absorption is proposed for removing toxic organic substances. Successful treatment of Pittsfield raw water was obtained by this system. The total annual costs for the proposed system are estimated to be $233,708, $846,888 and $4,551,998 for plants with flow rates at 3.7, 37, and 370 ML/day, respectively, which are lower than costs of a conventional system. (Baker-FRC)
W82-06353

BIOCLEANSING WITH AQUATIC WEEDS: A MEANS OF REMOVING ASBESTIFORM FIBERS FROM WATER,

Ohio State Univ., Columbus. Dept. of Microbiology.
R. M. Pfister.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256579, Price codes: A02 in paper copy, A01 in microfiche. Project Completion Report No 712431, December, 1980. 14 p, 1 Fig, 19 Ref. OWRT A-057-OHIO(1).

Descriptors: *Asbestos, *Drinking water, *Aquatic plants, *Electron microscopy, *Water quality control, *Elodea, Municipal water, Aquatic life, Submerged plants, Reservoirs, Potable water, Microscopy, Water supply, Reservoir operation, Quality control, Adsorption, Water storage, Water use, Water treatment.

Research was conducted to find a suitable aquatic plant for the removal of asbestos from municipal water supplies. Aquatic plants were grown in 35 and 200 liter aquaria and exposed to known concentrations of equal parts of chrysotile and tremolite asbestos with water circulation provided by air stones. Water samples and thin plant sections were taken for asbestos analysis by electron microscopy. All plant types removed asbestos fibers to some degree, with elodea removing the greatest number per gram of plant material. Data were also obtained for pondweed, scirpus, and sagittaria. The amount of asbestos fibers removed was directly proportional to the surface area of the plant. Analysis revealed that the fibers accumulate externally on the plant surface, possibly through an electrochemical reaction. Elodea, with its many leaves, has a far greater surface area than other plants tested and also has the greater rate of growth. The study results suggest that plants should be left in reservoirs to scavenge asbestos fibers. Further study should be directed towards the use of plants in outdoor holding ponds to assess their efficacy for eliminating asbestos from drinking water at relatively low costs. (Zielinski-MAXIMA)
W82-06363

A MICROPROCESSOR-BASED CONTROLLER FOR THE PLUGGING FACTOR MONITOR,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 3A.
W82-06398

GETTING YOUR MONEY'S WORTH FROM FILTRATION,

Environmental Protection Agency, Cincinnati, OH.
G. S. Logsdon, and K. Fox.
Journal of the American Water Works Association, Vol 74, No 5, p 249-256, May, 1982. 15 Fig, 2 Tab, 36 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Filter media, *Diatomaceous earth, Protozoa, Bacteria, Asbestos, Coagulation, Flocculation, Sedimentation, Backwash, Viruses, Giardia, Sand filters, Coliforms, Reviews.

Effective operation of diatomaceous earth (DE), slow sand, and rapid granular media water filtration plants is described. Among the particles which must be removed by filtration are asbestos, bacteria, clay, protozoan cysts, fine rock particles, and viruses. In DE filtration small quantities of DE as a filter aid are continuously added to the feed. Filtration takes place on a permeable septum precoated with a thin layer of DE. Coagulants are rarely used. DE filtration may be done under pressure or vacuum. Removal of Giardia cysts can reach 99.99%; asbestos fibers, 99.99%; and plankton, 100%. Turbidities of 0.10 NTU are attainable. The granular media filtration process, most commonly used in the U.S., usually includes coagulation, flocculation, sedimentation, and filtration. If raw water quality is good, sedimentation and sometimes flocculation may be omitted. Continuous monitoring of turbidity can quickly detect early filter breakthrough. Filters should be backwashed before turbidity reaches the 1 NTU level. Giardia cysts and asbestos fibers removal is effective when turbidities do not exceed 0.1 NTU. Slow sand filtration, a biological process developed in the 19th century, effectively removes bacteria. The system is most suitable for small communities because capital costs are low and large areas of land are required for the filter beds. (Cassar-FRC)
W82-06412

WATER SUPPLY AND DISTRIBUTION IN LARGER COMMUNITIES,

R. A. Pavia.
Journal of the American Water Works Association, Vol 74, No 5, p 20, May, 1982. 1 Ref.

Descriptors: *Financing, *Water treatment facilities, *Public utility districts, Chicago, Water supply, *Water distribution, Capital costs, Utilities, Rehabilitation, *Urban areas.

Water systems and other public utilities face financing crises as physical facilities age, costs increase, and consumers resist rate increases. The Chicago, Illinois, water system's financial condition is described as an example of a utility serving a large community. Although the city's allowance of $18.7 million per year for capital improvements appears to be far short of the ideal $30-50 million per year other factors must be considered. Replacement of small water mains is being delayed because redevelopment plans for some areas are not yet known. The two water purification plants (built in 1947 and 1964) are in good condition and have excess capacity for new customers. Future customers will pay the costs of extending the distribution system. Therefore, the utility expects to make a $8 million per year profit from new service by 1985. Much of this revenue will be available for capital improvements. The city is now benefiting from building a system larger than was needed at the time of construction. (Cassar-FRC)
W82-06413

ENERGY-INPUT-CONTROLLED DIRECT FILTRATION TO CONTROL PROGRESSIVE EUTROPHICATION,

Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt, and H. Schell.
Journal of the American Water Works Association, Vol 74, No 5, p 261-268, May, 1982. 11 Fig, 5 Tab, 32 Ref.

Descriptors: *Eutrophied lakes, *Phosphorus removal, *Filtration, Reservoirs, Water treatment, Algae, Flocculation, Wahnbach Reservoir, West Germany, *Direct filtration, West Germany, Wahnbach Reservoir.

Phosphorus input to the Wahnbach Reservoir, near Bonn, West Germany, has been reduced since 1977 by an energy-input-controlled direct filtration process. The phosphorus elimination plant, located on the reservoir's main tributary, pumps water from a prereservoir and precipitates the dissolved phosphate with 4-10 mg per liter ferric salts. The colloidal iron compounds are destabilized by mixing during a 20 sec period. Further mixing in the agglomeration basins develops flocs large enough to filter easily. The filter medium is composed of granular activated carbon on the top, hydroanthracite in the middle, and fine sand on the bottom. Particle size decreases from 3-5 mm in the top layer to 0.7-1.2 mm in the bottom layer. The total filter area of 1200 sq m treats 432 ML per day. Removal efficiencies are: total P, 96.3%; total coliforms, 99.87%; total plate counts, 97.9%; chlorophyll, 94.9; turbidity, 99.3%; COD, 77%; dissolved organic carbon, 57.8%. Effluent water contains < 10 micrograms per liter P. The trophic state of the reservoir has changed for eutrophic to mesotrophic since the phosphorus elimination plant was put into operation. Secchi depth has increased from 3 to 6 m. Species composition of algae has changed. Blue-green algae have completely disappeared, and Chlorella are present only in small quantities. (Cassar-FRC)
W82-06414

THE EFFECT OF BACKWASHING RATE ON FILTER PERFORMANCE,

Minneapolis Water Works, MN.
N. Qureshi.
Journal of the American Water Works Association, Vol 74, No 5, p 242-248, May, 1982. 8 Fig, 3 Tab, 15 Ref.

Descriptors: *Filtration, *Backwash, *Fluidized beds, Turbidity, *Water treatment, Minneapolis, Minnesota, Head loss, Filter media, Dual media filters, Mixed media filters.

Backwashing at fluidization rates (11.8 mm per sec) and subfluidization rates (8.4 mm per sec) was conducted on a plant scale in Minneapolis' Fridley water filtration plant using identical pairs of mixed media (coal, sand, ilmenite) and identical pairs of dual media (coal, sand). The plant treats Mississippi River water with lime softening followed by alum coagulation and filtration. At both backwashing rates the mixed media filters had higher turbidity during the first half hour of the runs. The low backwashing rate produced a higher turbidity peak than the high rate. After an hour into the run turbidity gradually decreased to a low at about 20 hours, then gradually increased until the end of the run at 70 hours. Head losses were similar for low and high backwashing rates in the mixed media filters. In the dual media filters turbidity peaks were also reached during the first hour, higher turbidity being produced by the low backwashing rate. At both backwashing rates turbidity leveled off at about 10 hours and remained constant until 50 hours, when it gradually increased to the end of the run, about 62 hours. Head losses were consistently higher in the low rate dual media filter than in the high rate dual media filter. Two peaks of turbidity were evident during the early stages of filter runs, the first and small peak about 1 min after the start of the run and the second and larger peak at about 10 min. Methods of handling the initial stage of turbidity include wasting the poor quality effluent or use of polymer during backwashing. Lower backwashing rates save energy and permit use of smaller tank and piping sizes. However, filter runs are somewhat shorter. No mudball formation was observed during use of low backwashing rates. (Cassar-FRC)
W82-06415

LOW-DOSAGE HIGH-RATE DIRECT FILTRATION,

Water and Air Research, Inc., Gainesville, FL.
E. G. Wagner, and H. E. Hudson, Jr.
Journal of the American Water Works Association, Vol 74, No 5, p 256-261, May, 1982. 7 Tab, 20 Ref.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Direct filtration, Pilot tests, Reviews, Alum, Coagulation.

The advantages of low-dosage direct filtration water treatment are emphasized in a review of the author's experiences and a review of the literature. Direct filtration is an economical process, saving costs by reduced chemical consumption, reduced single sludge load, and lower initial capital costs. Generally, in the U.S. the raw water treated by direct filtration should not have more than 15 platinum cobalt method color units and 1 NTU turbidity. Jar tests can determine the minimum doses of coagulent and polymers. Plants operating in the conventional mode can use direct filtration part-time. Pilot plant tests in several locations are described. In a California plant larger-scale tests used consistently less polymer dosage and filters performed better than the bench-scale tests indicated. Tests in Guam; Brasilia, Brazil; and Amman, Jordan, were carried out during periods of high turbidity. With proper choice of chemical dosage, filter media, and in one case, presettlement of solids, turbidities of < 1 NTU were obtained at relatively high filter rates. In several West African countries, the high cost of alum makes low-dosage direct filtration attractive. Laboratory tests on water from these regions indicate that water of turbidity < 5 NTU (World Health limit) can be produced by direct filtration. The literature describes many more cases of low-dosage filtration, suggesting that this process is becoming increasingly accepted throughout the world. (Cassar-FRC)
W82-06416

LOW COST FILTRATION PLANTS FOR WATER SUPPLY OF ARDHA-KUMBHA MELA, 1980 AT HARDWAR,

J. P. Nigam.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 3, p 117-118, June, 1981. 1 Fig.

Descriptors: *Drinking water, *India, *Water supply development, *Filters, *River beds, Ganges River, Potable water, *Water treatment, Coliforms, Water quality control, Chlorination, Turbidity, Suspended solids, Filtration, Sand filters, Percolating filters.

To supply drinking water to the pilgrims attending the Ardha-Kumbha Mela of 1980 at Hardware, a

low cost filter unit was installed below the Ganges River near Bijnor. The filter unit uses the river bed itself as the filter media, eliminating the need for chemicals and backwashing. The unit is connected to a pump and pipeline and a chlorination device. Comparisons of raw and filtered water showed reductions in turbidity from 75 to 2 ppm and complete elimination of coliforms. Suspended matter was removed down to 0.1 microns. The manufacturing and installation costs of this filter unit are very small and its installation is much easier in comparison with pressure filters. Once installed, the unit may be used for years without complications. (Geiger-FRC)
W82-06437

EVOLVING HIGH RATE FILTER AND USE OF CRUSHED STONE AS FILTER MEDIA,

Madhya Pradesh State Planning Board, Bhopal (India).
D. R. J. Rao.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 92-96, February, 1981. 4 Tab.

Descriptors: *Filter media, *Filtration, *Water treatment, Sand filters, Crushed stone, Rapid flow, Gravity filters, India, Laxim Narain Giri.

Selected local crushed stone filter media and sand were used in high rate filtration for over a year at the Laxmi Narain Giri water treatment plant in India. These local materials were tested as substitutes for the commonly used anthracite coal, unabailable in India. Crushed stone effective sizes were 0.4-0.7 mm, and sand effective sizes were 0.45-.7 mm. Average removal of turbidity was 76.7% in sand and 80.44% in crushed stone at a filtration rate of 80 lpm per sq m; 77.18% in sand and 87.60% in crushed stone at a filtration rate of 160 lpm per sq m. Average removal of bacteria was 69.5% in sand and 97.07% in crushed stone at a filtration rate of 80 lpm per sq m; 92.2% in sand and 95.45% in crushed stone at a filtration rate of 160 lpm per sq m. (Cassar-FRC)
W82-06440

SETTLING CHARACTERISTICS OF FLOCCULENT SUSPENSION IN DEFLUORIDATION OF WATER BY NALGONDA TECHNIQUE,

National Environmental Engineering Research Inst., Nagpur (India).
W. G. Nawlakhe, B. N. Pathak, K. R. Bulusu, and R. Paramasivam.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 85-88, February, 1981. 1 Fig, 5 Tab, 4 Ref.

Descriptors: *Settling basins, *Flocculation, *Fluorides, Turbidity, Suspended solids, Design criteria, *Nalgonda technique, *Water treatment, Settling velocity, *Defluoridation.

The Nalgonda technique, which removes excess floride from drinking water, comprises addition in sequence of sodium aluminate or lime, bleaching powder and filter alum, followed by flocculation sedimentation, and filtration. Batch laboratory settling column tests (200 cm x 30 cm diameter) using this procedure were run to obtain information for designing settling basins. A curve of percentage suspended solids removal vs. surface overflow rate (SOR) was prepared. For example, for 90% removal of suspended solids the SOR was 75 cu m per sq m per day; for 60% removal, 105 cu m per sq m per day. For application to an actual design, a factor of 1.50-2.00 should be applied to compensate for the differences between theoretical and actual behavior. A factor of 2.0 would change the above SOR to 37.5 cu m per sq m per day and 52.5 cu m per sq m per day, respectively. (Cassar-FRC)
W82-06441

PRESEDIMENTATION TANKS FOR HIGH TURBID RAW WATER,

H. A. Sabannavar.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 67-74, February, 1981. 9 Fig, 3 Tab.

Descriptors: *Suspended solids, *Industrial water, *Settling tanks, *Water treatment, Sand, Turbidity, Ganges River, India, Pumping plants, Damage, Sedimentation.

Two presedimentation tanks were designed to eliminate difficulties experienced in the water treatment plant of the Antibiotics Plant, Virbhadra, India. Suspended solids concentrations in the Ganges River, the source of the raw water, reached 36,000 mg per liter during abnormal flooding and 5,000-10,000 mg per liter during normal monsoon flooding. The treatment plant was designed for a maximum of 3,000 mg per liter turbidity. Some of the problems caused by this extreme turbidity were pump and scraper damage, choking of pipes and filter beds, deposition of sand in the intake well, and frequent shutdowns for cleaning. Several modifications had been attempted--changing the course of the river, altering the bank projections, taking in water from the surface, water jets to keep sand suspended in the pump system, and additional pumps. These changes reduced sand deposits to some extent. The presedimentation system consisted of the two 37.5 x 61.5 m tanks, a pump house with four centrifugal pumps, a rising main, a 2.5 x 2.5 x 2.7 m main tank which acted as a stilling chamber, and a sludge gate. The tanks, of which one can serve as a standby, removed 78%-84% of suspended solids from 3.2-3.5 million cu m of water during a 45 day test in 1975. Suspended solids in the raw water were 200-3975 mg per liter, and total sand-silt deposits in the two tanks were 4029 and 6631 cu m, respectively. Turbidity removals averaged 10%. During an abnormal 31,000 mg per liter suspended solids period in 1976, the tanks functioned at 85% efficiency for suspended solids removal. (Cassar-FRC)
W82-06444

MEMBRANE SEPARATION PROCESSES,

Forschungsinstitut Berghof G.m.b.H., Tubingen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W82-06445

M B SETTLER: A MORE ECONOMICAL ALTERNATIVE TO CONVENTIONAL SETTLER,

A. S. Gupta, and S. V. Patwardhan.
Journal of the Institution of Engineers (India), Part EN, Environmental Engineering Division, Vol 61, No 2, p 62-66, February, 1981. 6 Fig, 3 Tab, 6 Ref.

Descriptors: *Settling tanks, *Turbidity, Tube settlers, Sludge solids, *Water treatment, Wastewater treatment, Multibottom settling tanks, Bacteria, Flocculation, Design criteria, Developing countries, Rural areas, Economic aspects.

A multibottom settling tank (MBST) was developed and tested as a simple and economic water treatment option for rural and small communities. The 3 cu m pilot plant MBST consisted of four clearly divided zones: inlet, settling, outlet, and sludge. The settling zone was made of four units. Each unit consisted of 15 inclined plates. The plant performed as well as a conventional treatment plant at a flow depth of 50 cm or greater, an angle of inclination of 45 degrees, horizontal velocity of 12 cm per sec. surface loading of 6.66 liters per sq m per min, and detention time of 15 min. Total depth of flow, long runs, or shock loading had no significant effect on turbidity removal efficiency. Residual turbidity increased with increasing angle of inclination of the plates, with increases of horizontal velocity above 10 cm per min, and with increases in surface loading. Combining the MBST with a solid media flocculator containing hard coke produced bacterial removals of 83-96% (MPN test). The combined unit requires little electricity or skilled labor. Costs are 67-89% less than for a clariflocculator. (Cassar-FRC)
W82-06446

WATER DISTRIBUTION NETWORK ANALYSIS USING INTERACTIVE GRAPHICS,

University of Manchester Inst. of Science and Technology (England). Dept. of Electrical Engineering and Electronics.
K. R. Stimson, and A. Brameller.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 154-157, March, 1982. 2 Fig, 1 Ref.

Descriptors: *Network design, *Water distribution, *Computer programs, Simulation analysis.

An interactive graphical computer program, a version of the WATNET program, for network analysis of a water distribution system is described. This offers an improvement over the batch process, which requires a significant amount of work before and after computer processing. The graphical program, written in FORTRAN, may be used for network design, reinforcement, simulation, contingency planning, operation, and loss minimization. (Cassar-FRC)
W82-06453

THE PRODUCTION OF PUBLIC SUPPLY DRINKING WATER FROM RUTLAND WATER AT THE WING TREATMENT WORKS,

Anglian Water Authority, Northampton (England). Pitsford Lab.
D. B. Ford, B. E. Drage, and T. J. Roberts.
Hydrobiologia, Vol 88, No 1-2, p 103-116, March, 1982. 1 Tab, 6 Fig, 1 Ref.

Descriptors: *Reservoirs, *Water supply, *Drinking water, *Water treatment, *Water storage, Water quality, Potable water, Reservoir storage, Water treatment facilities, Chemical treatment, Haloforms, Bacteria, Sludge, Chlorine, Water quality data, Rutland Water, England.

Water is taken from Rutland Water for treatment to potable standards at the Wing Water Works. Since the Wing Water Works opened in 1977, chemical and bacteriological samples of the component waters of the reservoir have been analzyed. In general, turbidity, color, and residual iron have all been low with a high degree of consistency following treatment. Nitrate and sulfate were both fairly high when the reservoir was first filled, but they have steadily declined. Trace quantities of haloforms are produced in the treatment process at Wing. The predominant one is dichlorobromethane; chloroform and dibromochloromethane are also produced at lower and roughly similar concentrations. Although no formal limit exists, a tentative guide level of 100 micrograms per liter for total haloforms has been suggested. (Titus-FRC)
W82-06474

CIRCULATION PATTERNS; THEIR INVESTIGATION AND PREDICTION,

Leicester Polytechnic (England). School of Life Sciences.
E. J. Myers, R. S. Oldham, and A. J. D. Ferguson.
Hydrobiologia, Vol 88, No 1-2, p 67-77, March, 1982. 1 Tab, 7 Fig, 7 Ref.

Descriptors: *Wind, *Currents, *Algae, *Model studies, Water treatment, England, Reservoirs, Water supply, Water quality, Algal growth, Algal control, Eutrophication, Rivers, Biomass, Primary productivity, Wind-driven currents, Rutland Water.

The effect of wind on the water currents in Rutland Water is being studied with a view to predicting algal distribution patterns so that, by exercising different abstraction options, water treatment problems can be avoided. Investigations using a physical scale model of the reservoir in a wind tunnel suggest that under most wind directions the circulations tend to separate the water body into three distinct topographic regions. Water currents in the reservoir itself have been plotted by tracking the paths of drogues using theodolites. This has indicated that in the central basin the circulation may be of the 'conveyor belt' type rather than the solely horizontal type of the model. Surface chlorophyll readings are shown to indicate wind-driven water currents. Algal distribution has been predicted from wind data; however, the analysis requires modification in order to apply to all wind conditions. Wind will mix surface blooms of algae into deeper water. Strong winds acting on water with weak or non-existent stratification can cause

mixing throughout the whole depth of the reservoir so that abstracting from depth to avoid surface blooms is not feasible. However, provided there is strong stratification, this mixing may only occur within the upper layer of water, in which case water abstracted from below the thermocline will have a reduced algal content. (Titus-FRC)
W82-06477

OPTIMUM USE OF CHLORINE IN CIRCULATING WATER,

Indianapolis Power and Light Co., IN.
G. Brown, and C. McCloskey.
Industrial Wastes, Vol 28, No 3, p 24-26, May/June, 1982. 3 Fig.

Descriptors: *Electric powerplants, *Cost analysis, *Fouling, *Condensers, *Chlorine, Biocides, Chlorination, Electrical equipment, Slime, Cooling water, Operating costs, *Water treatment, Industrial water.

The H. T. Pritchard power station, which provides electrical power during periods of peak usage for the Indianapolis Power & Light (IPL) Company, is cooled by once-through river water and often experiences biological fouling of the condensers. In 1974, a program was started to optimize the use of chlorine (used to control biological fouling) to reduce operating costs and maintain chlorine discharge levels within the range of anticipated future standards. The Pritchard facility is located downstream from the discharge of the Indianapolis sewage treatment plant, which contributed tremendously to biofouling and loss of generation efficiency, especially during summer months. Studies to optimize chlorine use involved the testing of chlorine enhancer to help the biocide penetrate the fibrous slime masses generated by microorganisms. Comparison of turbine generator units with and without the penetrator showed a faster development of slime after chlorine use without the penetrating agent. Tests were conducted in 1979 to optimize the feed rate of the penetrating agent and the plant's operations in warmer weather. Experiments in 1980 used a small sidestream condenser as a control unit from which to extrapolate chlorination rates for the larger IPL units. Cost savings as a result of these efforts amount to $6,250 annually. (Geiger-FRC)
W82-06498

TIME-SHARED COMPUTER TECHNOLOGY FOR THE WATER AND WASTEWATER INDUSTRIES,

Metcalf and Eddy. Inc., Boston, MA.
For primary bibliographic entry see Field 5D.
W82-06511

INFLUENCE OF STABILIZER CONCENTRATION ON EFFECTIVENESS OF CHLORINE AS AN ALGICIDE,

Arizona State Univ., Tempe. Dept. of Botany and Microbiology.
M. R. Sommerfeld, and R. P. Adamson.
Applied And Environmental Microbiology, Vol 43, No 2, p 497-499, February, 1982. 3 Fig, 7 Ref.

Descriptors: *Algicides, *Chlorine, Toxicity, Swimming pools, *Water treatment, Chemical treatment, Chlorination, *Cyanuric acid.

Cyanuric acid or the compounds of chlorinated cyanurates are frequently used in swimming pools to reduce the loss of free chlorine by ultraviolet radiation. Several studies have investigated the influence of cyanuric acid on the bactericidal efficiency of chlorine; however, the effect of this stabilizer on the algicidal efficiency of chlorine has not been studied. This investigation showed that cyanuric acid has a relatively minor effect on the algicidal efficiency of free chlorine. When inhibiting, but less than algicidal, concentrations of chlorine were used, the addition of 25 milligrams of cyanuric acid per liter slightly reduced the toxicity of free chlorine to three swimming pool algae. Higher stabilization concentratins, ranging from 50 to 200 milligrams per liter, generally resulted in no further reduction in the algicidal efficiency of free chlorine. (Carroll-FRC)
W82-06539

ACTINOMYCETES AND FUNGI IN SURFACE WATERS AND IN POTABLE WATER,

National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W82-06543

FACTORS THAT AFFECT USE OF DIRECT FILTRATION IN TREATING SURFACE WATERS,

West Virginia Inst. of Tech., Montgomery. Dept. of Civil Engineering.
R. F. McCormick, and P. H. King.
Journal of the American Water Works Association, Vol 74, No 5, p 234-242, May, 1982. 5 Fig, 5 Tab, 29 Ref, OWRT A-081-VA.

Descriptors: *Filtration, *Turbidity, *Water treatment, *Direct filtration, *Virginia, Surface water, Alum, Coagulation, Polymers, Filter media, Color removal, Algae, Bacteria.

Surface waters from five locations in Virginia were treated by direct filtration in a pilot plant. Raw water quality was variable: 1.2-24 NTU turbidity, 0-42 APHA color units, 40-20,000 algal colonies per ml, 0-2300 per 100 ml total coliforms, and 1.5-13.5 C temperatures. The most effective treatment was a 3 minute rapid mix with alum and a cationic polymer. Filtration at 3.5 mm per sec through 51 cm of 1.3 mm anthracite coal and 25 cm of 0.45 mm silica sand was more effective than the other two filters tested--a mixed media filter of coal, sand, and garnet, and a dual coal-sand filter with 1.7 mm size coal. The filtered water met the 0.1 NTU standard if raw water characteristics were within the following ranges: turbidity, 0-10 NTU; color, 0-15 APHA units; algae, 0-1000 clumps per ml. Water with high individual parameters was succesfully treated if the other parameter values were low. Runs made at temperatures of 4 and 6 C were satisfactory, indicating that low temperatures did not adversely affect the filtration process. (Cassar-FRC)
W82-06579

METAL REMOVAL 'A LA CARTE',

J. C. Ginnocchio.
World Water, Vol 5, No 5, p 30, 32-33, May, 1982. 8 Fig, 1 Tab.

Descriptors: *Metals, *Flocculation, *Water treatment, *Wastewater treatment, Heavy metals, Iron, Manganese, Silver, Arsenic, Barium, Cadmium, Chromium, Copper, Mercury, Selenium, Lead, Zinc, Industrial wastewater, Alumina, Activated carbon, Trace metals, Chemical precipitation, Sedimentation, Filtration, Hydrogen ion concentration, Adsorption.

Methods of removing undesirable trace metals from drinking water are described. Fe and Mn levels are reduced by aerating the water and filtering the precipitated, oxidized metals. Fe-humic complexes may be removed by flocculation-filtration. Flocculation-sedimentation can be used to remove Ag, As(5+), Ba, Cd, Cr(3+), Cu, Hg, Se(4+), Ni, Pb, and Zn. The process is pH-dependent. Removals at pH 6.5-7.0 using 5 mg per liter of trivalent iron are 90% for Pb, As(5+), and Cr(3+), almost zero for Ba and Cr(6+), and 24%-78% for the other metals. A pH of 7.5-8.5 and the same flocculant dose improves Ag, Cd, and Hg removal but decreases Se(4+) removal. Ba and Cr(6+) are not affected. Addition of ferrous sulfate, however, removes 95% of Cr(6+). A pH of 10.0-10.5 separates most of the metallic ions in sloped tube settlers. Cr(6+) and Se(4+) levels are not satisfactorily decreased (< 25% removal). Flocculation-filtration removes metals (Pb, Cd, Cu, Ag, and Zn) from industrial wastewater, but Ag and Ni levels are not significantly decreased. Activated alumina can remove Se and As with maximum efficiency at pH 5.0-5.5. Activated carbon filters eliminate inorganic and organic Hg compounds. (Cassar-FRC)
W82-06608

MAKING CHLORINATION TRUSTWORTHY,

Fischer and Porter Co., Warminster, PA.
W. H. Nagel.
Water/Engineering and Management, Vol 129, No 7, p 38-39, June, 1982. 6 Fig.

Descriptors: *Monitoring, *Chlorination, *Control systems, *Water treatment, Electrical equipment, Disinfection.

Several methods are suggested to ensure that chlorine concentrations in the water treatment process remain within the desired range. Limit switches automatically signal by alarm light or horn that an abnormal condition is present. High and low vacuum switches indicate a variety of troubles in the system. The high vacuum switch detects deplated chlorine supplies, clogging, and blockages. It may be connected to a well pump to prevent pumping of unchlorinated water. The low vacuum switch indicates ejector failure and closing of valves in water or chlorine solution lines. A direct current signal monitors the chlorine gas flow and signals departures from the set limits. The above three systems provide instantaneous information to the operator. Trip switches may be attached to a chlorine residual recorder. This measures the most reliable parameter, chlorine residual, but there is a 4-8 min delay period, during which no chlorination may be taking place. Another approach involves supervision of incoming electrical signals from a mainline water flow transmitter and/or chlorine residual analyzer controller. The methods listed in this paper may be used in various combinations to increase the reliability of the monitoring system. (Cassar-FRC)
W82-06639

APPLICATION OF OZONE TO ELIMINATE TERTIARY TREATMENT OF WASTEWATER USED FOR INDUSTRIAL COOLING,

Brown and Caldwell, Walnut Creek, CA.
D. T. Merrill, and D. S. Parker.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256835, Price codes: A04 in paper copy, A01 in microfiche. OWRT Report, February, 1982, U.S. Department of the Interior, Washington, DC. 42 p, 9 fig, 15 Tab, 5 Ref, 3 Append. OWRT C-90070-R(No 9413)(1), 14-34-0001-9413.

Descriptors: *Industiral water, *Tertiary wastewater treatment, *Sealing, *Corrosion control, *Ozonation, *Cooling water, Cooling, Cooling towers, Air conditioning, Economic aspects, Municipal wastewater, Ozone, Corrosion, Fouling, Deterioration, Water treatment, Calcium compounds.

Study was undertaken to determine whether the beneficial performance of ozone (biofouling, corrosion, and chemical scaling control), when used as the sole source of cooling water treatment for air-conditioning systems, could be obtained at higher cooling water temperatures typical of industrial cooling with secondary municipal effluent (SME) used as the cooling medium. A pilot cooling system was constructed, and a 6-month experimental study initiated to determine process limits, mechanisms of scaling inhibition by ozone, and to evaluate factors influencing technical/economic feasibility. It was found that, while ozone used adequately controlled corrosion and biofouling, chemical scaling could not be prevented at conditions necessary for significant economic justification. Calculations indicate that the makeup waters (SME) used will become saturated with respect to calcium phosphate at less than 2 cycles of concentration; hence, a scaling potential exists at conditions less stringent than those used in the present study. It is recommended that ozone for scaling elimination in recirculating industrial cooling systems be dropped from further consideration where the makeup water is SME. (Zielinski-MAXIMA)
W82-06709

ULTRAVIOLET SYSTEMS IN WATER TREATMENT,

C. Jevons.
Effluent and Water Treatment Journal, Vol 22, No 4, p 161-162, April, 1982. 1 Tab.

Descriptors: *Disinfection, *Ultraviolet radiation, *Microorganisms, *Water treatment, Bacteria, Yeasts, Molds, Viruses, Protozoa, Algae, Parasites.

Guidelines are presented for selection and application of ultraviolet (UV) systems for disinfection in water treatment plants. Selection of an accurate sensor, which only responds to the germicidal wavelength, can prevent loss or reductions in intensity caused by lamp failure, malfunctions, or deterioration and poor water quality. It can be incorporated in an alarm system or automatic shut-off valve to prevent inadequately treated water from passing into the distribution system. Automatic switches are available to shut off lamps during no-flow periods. This prevents overheating of the equipment. A UV sterilizer unit must be selected so that it does not operate beyond its design capacity. A table is given describing the required energy for various microorganisms. These are (in microwatt sec per sq cm) 2,500-26,400 for bacteria, 6,600-17,600 for yeasts, 11,000-330,000 for mold spores, 6,600-440,000 for viruses, 22,000 for Chlorella, 200,000 for paramecium, and 9,200 for nematode eggs. The proper location of the UV unit should be as near as possible to the first take-off point in a straight line system for no storage or dead legs. A system with storage, ion exchange, filters, etc. offers many opportunities for bacterial growth. To prevent bacterial contamination in systems with raw water containing < 100 bacteria per ml, a UV unit should be installed prior to any other water treatment step. For less contaminated raw water, periodic sterilization is sufficient. Suggestions for location of the UV unit are given for systems with a treated water storage tank (on a continuous loop with 2 hours circulation time), large systems (point-of use), and high purity systems (prior to the submicron filter). (Cassar-FRC)
W82-06726

GEOSMIN AND 2-METHYLISOBORNEOL FROM CYANOBACTERIA IN THREE WATER SUPPLY SYSTEMS,

Southern California Metropolitan Water District, La Verne.
O. Izaguirre, C. J. Hwang, S. W. Krasner, and M. J. McGuire.
Applied and Environmental Microbiology, Vol 43, No 3, p 708-714, March, 1982. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Water treatment, *Drinking water, *Organoleptic properties, *Water supply systems, Water quality, Taste, Odors, Odor-producing algae, Taste-producing algae, Algae, *California, Reservoirs, Pipelines, Lakes, Geosmin, 2-Methylisoborneol, Cyanobacteria, Bacteria.

In efforts to solve objectionable taste and odor problems in drinking water in California, four different filamentous cyanobacteria were isolated from three water supply systems. The first, Oscillatoria curviceps, was isolated from a widespread infestation in the littoral zone of Lake Mathews. The second, O. tenuis var. levis Gardner, was isolated from a sediment sample taken from Phoenix Lake. A third, O. simplicissima Gomont, was isolated from a raw water pipeline downstream from Lake Mathews, where it was growing among a tangled mass of dead Cladophora. The fourth, Anabaena scheremetievi Elenkin, was isolated from a mixed bloom in Tinemaha Reservoir. Each of the water supply systems served by these water bodies had experienced taste and odor problems. Unialgal cultures, free of actinomycetes, were purged using the Grob closed-loop stripping analysis method, and the resulting methylene chloride extracts were analyzed on a gas chromatograph/mass spectrometer. Geosmin was produced by O. simplicissima and A. scheremetievi, and 2-methylisoborneol was produced by O. curviceps and O. tenuis. These compounds are the two major causes of earthy-musty tastes and odors in water. In three instances, the major odorant found in culture was previously identified in the water or sediment sample from which the respective organism was isolated. O. curviceps was implicated in a taste and odor episode involving 2-methylisoborneol in a major reservoir. Geosmin and 2-methylisoborneol were easily detected with culture samples of only 4 to 25 ml. (Baker-FRC)
W82-06740

REMOVAL OF TOXICANTS DURING DIRECT AND INDIRECT REUSE OF WASTEWATER EVALUATED BY MEANS OF A MAMMALIAN CELL CULTURE TECHNIQUE,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5D.
W82-06766

TREATMENT OF COOLING SYSTEMS CONTAINING HIGH LEVELS OF LEGIONELLA PNEUMOPHILA,

Du Pont de Nemours and Co., Aiken, SC. Savannah River Lab.
C. B. Fliermans, G. E. Bettinger, and A. W. Fynsk.
Water Research, Vol 16, No 6, p 903-909, June, 1982. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Cooling towers, *Bacteria, Public health, Water treatment, Chlorination, Human diseases, Legionella pneumophila , Industrial water, Water pollution sources.

Open recirculating cooling tower systems and evaporative cooling air conditioners were studied for levels of Legionella pneumophila. The cooling towers studied were mechanical updraft systems with circulation rates of 750-83,000 gal/minute. Sources of make-up water were varied but included well water and public and private potable water. In most cases the cooling towers were chlorinated intermittently, with the treatment dose adjusted to achieve a free residual chlorine level of 0.2 to 1.0 mg/liter for a given frequency. Regardless of the biocidal treatment, the source water or the frequency of biocidal addition, every tower tested contained L. pneumophila at detectable levels. The survey data from the South Carolina towers indicated that those supplied from underground wells had lower densities of L. pneumophila than towers receiving surface water. None of the systems showed an obvious seasonality trend for the bacteria densities. The data suggest that if continuous chlorination were stopped before L. pneumophila concentrations declined to levels comparable to densities in the source water, rapid infection of the tower would occur. Thus it was concluded that even in a well maintained cooling system, L. pneumophila does occur, and elevated numbers may be reduced through chorination. (Baker-FRC)
W82-06769

COMPLEX SEQUENCE TREATS FLUCTUATING FLOWS,

World Water, Vol 5, No 6, p 30-31, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Industrial water, *Ion exchange, *Water softening, *Water treatment, Martfui Vegetable Oil Works, Tisza River, *Hungary, Boiler water, Cooling water, Process water, Firefighting water, Suspended solids, Filtration.

An unusual, complicated water treatment system produces industrial water for four purposes at the Martfui Vegetable Oil Works in Hungary from Tisza River, a highly variable raw water source. The plant requires boiler feed water, cooling water, process water, and firefighting water. Suspended solids in the river water fluctuate from 10 to 3000 mg per liter; oxygen demand, from 3 to 20 mg per liter potassium permanganate; and total hardness, 5 to 16 degrees, (German Scale). The process water and firefighting water are produced by heating the raw water to 20 C with waste stream, passing it through lime-softening reactors, and pressure filtration. The process water is treated further by ion exchange desalination to make high quality boiler feed water and by chlorination and addition of algicides, bactericides, and sodium hexametaphosphate corrosion inhibitor to make cooling water. (Cassar-FRC)
W82-06814

A GUIDE TO TREATMENT FOR BACTERIAL PROBLEMS,

National Water Well Association, Worthington, OH.
S. Smith.
Water Well Journal, Vol 36, No 7, p 46-47, July, 1982.

Descriptors: *Bacteria, *Disinfection, Wells, *Chlorination, *Water treatment, *Well water.

Wells may be disinfected with two complementary techniques--shock treatment (single-dose cleaning and disinfection) and an in-well disinfection device (chlorination by chemical feed pumps or pellet dispensers). Activated charcoal filters are available to remove chlorine taste and organic compounds, if desired. Ceramic micropore filters can serve as a final quality control for bacteria-free water. For prevention and treatment of bacterial problems in wells, the following are recommended: chlorinate drilling water and disinfect downhole equipment and casing, chlorinate the new well with a 25 ppm C1 residual, wash gravel packing in chlorinated water, test water samples regularly for bacterial count, use shock chlorination at 1000 ppm for 24-48 hours if low concentrations of bacteria are found, and install permanent chlorination if iron or sulfur-oxidizing bacteria are a continuing problem. (Cassar-FRC)
W82-06847

5G. Water Quality Control

ENVIRONMENTAL ASPECTS OF SOME ALTERNATIVE PULP BLEACHING TECHIQUES,

North Carolina State Univ. at Raleigh. Dept. of Wood and Paper Science.
For primary bibliographic entry see Field 5D.
W82 05913

STREAM REHABILITATION FOLLOWING TREATMENT FOR PHOSPHORUS REMOVAL: PRE-TREATMENT ASSESSMENT,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
R. M. Wright, and A. J. McDonnell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243437, Price codes: A07 in paper copy, A01 in microfiche. Report, January 1982. 128 p, 28 Fig, 17 Tab, 76 Ref, 7 Append. OWRT A-056-PA(1), 14-34-0001-1140

Descriptors: *Phosphorus removal, *Mathematical models, *Aquatic productivity, *Environmental effects, *Stream improvement, Phosphorus, Water quality standards, Respiration, biomass, Aquatic productivity, Nutrient requirements, Domestic wastes, Wastewater, Model testing, Aquatic plants, Aquatic populations, ecological effects, Rehabilitation, Regeneration.

Assessment was made of water quality and growth magnitude of rooted aquatic plants in a nutrient-enriched shallow stream system to provide a basis for evaluating the recovery of the ecosystem following implementation of a phosphorus (P) removal program. this program utilized spray irrigation of treated domestic waste water. Field studies were used to define temporal and spatial changes of aquatic plant biomass in selected study areas. A plant biomass model was evaluated, refined and calibrated to predict macrophyte biomass change as a function of varying environmental factors. The potential of this model as a management tool to assess the impact of nutrient reductions on stream oxygen budgets was studied. the model defined the biomass production rate as a function of specific photosynthetic and respiration rates, advective loss, and plant mortality. An empirical equation defining photosynthetic rates as a function of irradiance, nutrient availability, temperature, and plant maturity was formulated. From Michaelis-Menton kinetics, half-saturation constants of 313 kcal/sq m/day and 4.7 micrograms/liter P were estimated for light intensity and P functions, respectively. The empirically-derived value for the maximum specific photosynthetic rate for the study stream was 0.572/day. Monthly plant respiration rates were deducted from biomass simulations using literature-derived plant mortality rates. (Zielinski-MAXIMA)
W82-05919

EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND AQUATIC MACROINVERTEBRATE POPULATIONS,

Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
For primary bibliographic entry see Field 6G.
W82-05923

FEDERAL WATER POLLUTION CONTROL ACT'S NOTICE REQUIREMENT LIBERALLY CONSTRUED,

For primary bibliographic entry see Field 6E.
W82-05986

CONSTRUCTION CRITERIA OF THE MERY-SUR-OISE STORAGE BASIN - IMPROVEMENTS IN WATER QUALITY OBTAINED,

Compagnie Generale des Eaux, Paris (France).
F. Damez, and M. Rapinat.
Aqua, No 2, p 397-406, 1982. 24 Fig, 28 Ref.

Descriptors: *Water quality control, *Water treatment, *Reservoir construction, *Design criteria, *Multipurpose reservoirs, Reservoirs, Storage reservoirs, Ammonia, Turbidity, Water quality management, Mixing, Injection, Water supply, Organic compounds, Equalizing basins.

The Mery-sur-Oise storage basin was designed to allow sheets of pollution from the Oise river to pass by while raw water supplies continue to feed in to the Oise water treatment plant. The basin was also intended to homogenize water quality by a process similar to that governing the biological purification taking place in waterways. Limnological studies were conducted to check whether the biological development of the reservoir, and of algae in particular, entails a deterioration of water quality. Results showed that the action of the injectors brought algae into constant contact with zoopiankton which destroyed them. Pilot operations showed that storage allowed turbidity abatements of about 60%, a drop in the organic content of 30%, and an ammonia reduction of approximately 30%. The technical developments of the basin have successfully combined water quality objectives with water supply goals. (Geiger-FRC)
W82-06013

IMPACT OF THERMAL STANDARDS ON POWER PLANT WATER CONSUMPTION,

Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta, and T. E. Croley,II.
Water Resources Bulletin, Vol 17, No 3, p 423-430, June, 1981. 5 Fig, 1 Tab, 10 Ref. A-061-IA. 14-34-0001-9017.

Descriptors: *Thermal discharges, *Standards, *Powerplants, Cooling water, Effluent standards, Thermal water, Water consumption, Missouri River, Mississippi River, Water loss, Evaporation, Rivers, Electric powerplants.

The EPA has mandated that powerplant thermal discharges into natural rivers will not be permitted after July 1, 1983. This paper shows the powerplant water consumption (evaporative water loss) for free discharge, no discharge, and several temperatures between these extremes for existing and proposed plants along the Missouri and Upper Mississippi Rivers in the Mid-Continent Area Power Pool. For the Upper Mississippi River, the difference in annual water consumption between free discharge (105.6 million cu meters, no cooling towers) and no discharge (148.1 million cu meters, enclosed cooling systems) is 42 million cu meters or 40%. For a temperature rise of 3 F above normal, water consumption would be 128.9 million cu meters, the same as the existing situation (37.3 million cu meters evaporation from the river surface and 91.5 million cu meters evaporation from cooling towers). Temperatures 1 or 2 F above normal produce almost the same evaporative loss, about 129 million cu meters. Figures for the Missouri River show a 6.5 million cu meter spread (10%) between free discharge (61.3 million cu meters) and no discharge (67.8 million cu meters). There is no significant increase in water consumption at 2 or 3 decrement from the allowable 5 F temperature rise. In areas where existing temperature standards overprotect the environment at the expense of increased water losses and energy usage, the standards should be adjusted to reflect a desirable balance between environmental protection and the costs of energy production cooling. (Caesar-FRC)
W82-06057

NEW DIRECTIONS IN WATER POLLUTION CONTROL,

Environmental Protection Agency, New York. Region II.
R. T. Dewling.
Clearwaters, Vol 12, No 1, p 7, March, 1982.

Descriptors: *Water pollution control, *Reviews, Legal aspects, Federal jurisdiction, Management, Planning, *Environmental Protection Agency.

Reform processes currently being undertaken in the water pollution control program as directed by the Environmental Protection Agency (EPA) are outlined briefly. The recent amendment of the municipal wastewater treatment construction grants program focuses efforts on achieving results through reduced federal involvement and increased state delegation. A problem of inefficiency of wastewater treatment plants in region II seems to result from a non-compliance factor. A diagnostic review of treatment plants in the region has been started, involving four phases: preliminary investigation, on-site inspection of every aspect of plant operations, identification of problems and drawing conclusions, and solution and implementation planning with both short and long term corrective actions. EPA has also begun a campaign of collecting overdue bills, which amount to millions of dollars nationally. Use of funds on actions which work directly toward improving water quality is stressed. Ocean dumping of sludge is being investigated. (Baker-FRC)
W82-06071

EVALUATING SEDIMENT BLANKETS AND A SCREEN FOR MACROPHYTE CONTROL IN LAKES,

Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 4A.
W82-06097

ECONOMIC IMPACT ANALYSIS OF COMBINED SEWER OVERFLOW REGULATIONS ON EAST ST. LOUIS, R81-12

Huff and Huff, Inc, Chicago, IL.
L. L. Huff, and J. E. Huff.
Illinois Department of Energy and Natural Resources, Chicago, Doc No 82/08, April, 1982. 78 p, 5 Fig, 21 Tab, 14 Ref, 1 Append.

Descriptors: *Combined sewer overflows, *Water quality standards, *Economic impact, *Primary wastewater treatment, *Secondary wastewater treatment, Wastewater, Effluents, Cost, Environmental effects, Heavy metals, Bacteria, Cost-benefit analysis, Biological oxygen demand.

East St. Louis discharges to the Mississippi River a primary effluent as well as combined sewer overflow (CSO); a regional plant is under construction to provide secondary effluent treatment. The city has petitioned the Pollution Control Board to exempt it from Rule 602. To comply with the rule would cost $20.9 million plus annual cost of $3.19 million. Treating first flush only would still require a $14.3 million investment. The city examined four control alternatives including combinations of first flush storage and treatment, treatment in the new plant, chlorination, and use of bar screens. The environmental effects of CSO discharges were categorized as to heavy metals, bacterial concerns, and deoxygenating waste characteristics. Iron and fluorides were potential problems, but if East St. Louis meets all water quality standards, the environmental effects would be nil. Bacterial levels can be controlled by regional disinfection. Deoxygenating wastes from CSO is the main factor in determining CSO control. Present CSO loading is about 0.81 million pounds of BOD5 per year. The treatment plant annually discharges about 6.1 million pounds; therefore, the city is one factor in maintaining overall water quality. With existing conditions, the maximum DO violation rate is about 1.1days/year; first flush treatment could lower the rate to 0.33 but the unit costs triple. Full compliance with Rule 602 would lower the violation rate to 0.26 days/year. The cost to East St. Louis of secondary treatment could boost sewerage expenses 3 to 4 1/2 times (total annual cost: $4.4 to $5.6 million), and such increased obligations would cause serious adverse effects on other municipal services. (Atkins-Omniplan)
W82-06099

PROBLEMS AND PROCESSES IN WATER QUALITY MANAGEMENT,

Wisconsin Univ., Milwaukee. Dept. of Urban Planning.
D. S. Sawicki, L. B. Judd, G. Eggleston, C. Bluemke, and D. Dupies.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243627, Price codes: A04 in paper copy, A01 in microfiche. Wisconsin Water Resources Center, Madison, Technical Report WIS WRC 82-01, 1982. 59 p, 6 Tab, 11 Ref, 1 Append. OWRT A-089-WISC(1), 14-34-0001-1153.

Descriptors: *Water quality management, *Nonpoint pollution sources, *Institutional constraints, *Urban planning, Surveys, Water quality, Water quality control, Pollution load, Institutions, Water pollution prevention, Urban areas, Urban runoff, Water pollution control, Management planning, Water pollution sources, Urbanization.

Two approaches to address problems associated with nonpoint water pollution sources and institutions and processes charged with solving these problems are discussed. The first approach considered nonpoint source problems (especially for urbanizing areas) and available methods for their control. Problem solutions were classified, and used to further the understanding of institutional considerations for controlling nonpoint water pollution sources. The second approach undertook an examination of seven urbanizing communities in southeastern Wisconsin, assessing their abilities and willingness to deal with nonpoint water pollution sources, and considered the need for encouragement/reward by a higher unit of government. It was concluded that pollution reduction must be established as an objective for each of many administrative units with one unit as the prime motivator; the State has the administrative/technical/financial resources to measure problems, identify solutions, and delegate authority for effecting the solutions where appropriate. A third approach, considering an analysis of current nationwide efforts to implement nonpoint source controls for water pollution, is addressed in a separate report. (Zielinski-MAXIMA)
W82-06147

A CONCEPTUAL MODEL OF PRIMARY PRODUCTIVITY IN SHALLOW STREAMS USING BIOMASS SIMULATION,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W82-06153

THE MEDITERRANEAN ACTION PLAN: DESIGN AND IMPLEMENTATION,

World Health Organization, Copenhagen (Denmark). Regional Office for Europe.
For primary bibliographic entry see Field 5B.
W82-06154

RELIABILITY ANALYSIS OF BOD KINETICS IN A SOUTHERN STREAM GOVERNED BY THE DISCHARGE OF AN OXIDATION POND,

Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 5D.
W82-06159

TRAGEDY OF THE SAN FRANCISCO BAY COMMONS,

San Francisco Bay Inst., CA.
For primary bibliographic entry see Field 6E.
W82-06182

SPILLED PETROLEUM RECOVERED FROM ATOP WATER TABLE OF MISSISSIPPI AQUIFER,

Mathes (John) and Associates, Inc., Columbia, IL.
G. M. Mathes.
Civil Engineering (New York), Vol 52 No 6, p 58-59, June, 1982. 2 Fig.

Descriptors: *Aquifers, *Oil pollution, Groundwater pollution, Water quality, Wells, Monitoring, Pipelines, Water pollution prevention, Water pollution sources, Hartford, *Illinois, Oil refineries, Oil recovery.

Fires and odors kept reccurring in and around the Village of Hartford, Illinois, during the period from 1966 through 1978, with greater frequency of occurrence being noted in the spring of 1978. Study indicated that man-made and natural sources of combustible air-gas mixtures were present in and near Hartford. Some of the odors were coming from an underground accumulation of spilled petroleum products trapped on top of groundwater of the Mississippi aquifer which underlies a major part of the East St. Louis metropolitan area. Petroleum products in the spill were presumably lost from underground pipelines which traverse the Village between the refineries and shipping terminals on the Mississippi River. Early containment and recovery of any major quantities of the spilled petroleum products were of paramount concern. A comprehensive network of monitoring wells was installed throughout a significant portion of the Village. These wells permitted the preparation of contour maps and cross section drawings. Three main pools of the petroleum product were located. Two containment and recovery system designs were prepared. These allowed for recovery of spilled petroleum in virtually pure form and included consideration of the seasonal and historical fluctuations in the aquifer, the possible need for low volume pumping to create local increases in the gradient at a future date to expedite flow, and the possible need for high capacity wells to change flow gradients throughout the area should migration begin. Reports of odors have decreased. The performance and the economic efficiency of the recovery systems have minimized the cost of managing the spill. (Baker-FRC)
W82-06185

PRETREATMENT REMOVAL CREDITS: FACT OR FICTION,

Metropolitan Sanitary District of Greater Chicago, Research and Development Department.
D. T. Lordi, C. Lue-Hing, S. Whitebloom, and R. Lanyon.
Industrial Wastes, p 16-18, 20, 25, March-April, 1981. 4 Tab.

Descriptors: Water quality control, *Industrial wastewater, *Water quality standards, *Mathematical studies, Water pollution prevention, Water pollution control, Water pollution, Industrial wastes, Heavy metals, Cadmium, Sludge.

The calculation of removal credits, the credit given by Publically Owned Treatment Works (POTW) to industries attempting to control their output of water pollutants, is described and some restrictions and conditions which must be met in order for a POTW to grant removal credits are discussed. The basic determination and calculation of removel credits are discussed. The basic determination and calculation of removal credits are presented, along with some restrictions on the calculation of consistent removal. For POTW that bypass untreated wastewater to receiving waters at least once annually, two alternatives exist for applying for removal credits. Under the first alternative, specific conditions must be met by the POTW and the industries involved, while under the second alternative, a calculation for removal credits is provided which lowers the amount of the credit by the fraction of time that bypassing occurs. No removal credit can be applied to pollutants such as Cd that accumulate in POTW sludges. In order to continue a removal credit program with EPA approval, the POTW must monitor and report, twice annually, the POTW removal capabilities, a requirement which will most likely lead to changing standards. (Geiger-FRC)
W82-06207

DETROIT-STYLE CSO STUDIES,

Black and Veatch, Kansas City, MO.
M. J. Graham.
Water/Engineering and Management, Vol 129, No 5, p 22-23, 25-26, May, 1982. 4 Fig.

Descriptors: *Combined sewer overflows, Planning, *Storm wastewater, *Storm-overflow sewers, *Overflow, *Detroit, Model studies, Municipal wastewater, Rouge River, Detroit River, Data collections, Michigan.

One of the most comprehensive combined sewer overflow (CSO) studies to date was completed by the Detroit Water and Sewerage Department in the fall of 1980. Data from the study are to be used to calibrate and verify a number of interacting computer models which assess the potential improvement in water quality in the Rouge and Detroit Rivers resulting from overflow control. Five separate models were developed to assess the most cost-effective CSO management alternative. These models were: System, a simplified skeletonized sewer system model with major sewers and interconnections, routed dry weather flow supplemented with storm flow to treatment, storage or overflow; Detroit Sewerage Treatment Plant Simulator, in which effluent quality discharged to the receiving stream was computed based on influent quality and quality from the system model; Rouge River, in which water quality of the Rouge River in various reaches was computed based on fractors of CSO quantity and quality and on background river quality; Detroit River, in which river quality was given based on upstream background, CSOs, Rouge River quantity and quality, and DWWTP effluent; and Detroit River Plumes, which modeled quantity and quality of CSOs from the system to give near-shore quality. The sampling process employed to secure enough data for study was massive. Almost 25,000 individual analyses were entered into the data bank for the system model alone, and an additional 10,000 analyses, including instantaneous flow measurements, were collected for the river models. About 5,000 additional pieces of information on flow and quality were entered for calibration of the treatment plant model. This was probably one of the most comprehensive data collection programs performed for facilities planning purposes. (Baker-FRC)
W82-06247

THE USE OF WATER QUALITY OBJECTIVES IN SEINE-NORMANDIE,

Agence Financiere de Bassin Seine-Normandie (France).
A. Lesouef.
Water Pollution Control, Vol 81, No 2, p 255-265, 1982. 2 Fig, 2 Tab, 2 Ref.

Descriptors: *Water quality, *Regulations, *France, Seine-Normandie Basin, Basins, Industrial wastes, Public policy, Public participation, Public opinion.

The Seine-Normandie Basin covers an area of about 96,000 square kilometers and a population of more than 15 million. Industry is important in the basin, with the result that river water quality is affected by both the main cities and industrial activities. With the exception of the sewage treatment plant of Acheres, little was achieved in the way of water quality control until the 1960s. The basin was divided into convenient sub-basins for each of which the following steps were carried out: identification of water use, water quality control, and current water quality assessment. Uses identified included drinking, fishing, swimming and recreation, and industrial usage. Due to its possible consequences on the socioeconomic activities of a particular region, a water quality objective approach should rely on a fair degree of commitment from the public who will have to support its consraints and also benefit from it. Negotiations to establish such a program are long. The different steps of this long process include the preparation of technical files and recommendations, the presentation of the material to administrative services, the presentation of the agreement to a delegated basin commission, presentation of the agreement to a delegated basin commission, presentation to the sub-basin committee, presentation to regional chambers of commerce and industry as well as regional chambers of ariculture, public hearings, summaries of public meetings, proposals to all groups, implementation, and follow-up. Despite the high amount of time and effort needed to follow this long path, it is considered that this approach is worthwhile in France. (Baker-FRC)
W82-06254

LABORATORY SERVICES IN REGIONAL WATER AUTHORITIES,

Anglian Water Authority (England). Scientific Services.
A. W. Davies.
Water Pollution Control, Vol 81, No 2, p 177-184, 1982. 3 Fig, 1 Tab, 1 Ref.

Descriptors: *Water analysis, *Scientific personnel, Personnel, *Laboratories, Research facilities, Water supply development, Water resources development, Chemical analysis, England, Anglian Water Authority.

The importance of laboratories and scientific staff in fulfilling the commitment to provide a wholesome supply of water to the public is considered. There are three basic types of water laboratories: quality control laboratories associated with sewage and water treatment plant operations; laboratories concerned with the mesurement of pollutants in rivers, distribution systems, reservoirs, industrial effluents and dewage, and industrial waste discharges; and central or regional laboratories, whose tasks include inter- and intra-laboratory calibration of methods of quality measurement against standards, the development of new scientific methods to accommodate changing requirements, and the coordination of scientific applications in operational laboratories. The laboratories in the Anglian region during the year 1980 produced about 2.6 million items of information, for which the most important uses include: compliance data representing the analytical results of samples taken of industrial and agricultural consent and unconsented discharges to surface and other waters; operational data to manage a sewage treatment or water supply works efficiently; investigative data required for many different purposes; and administrative data to satisfy national commitments, to answer specific questions, to satisfy water quality directives, and to identify quality trends. Specific responsibilities of the water scientist are listed. Several generalizations are listed which are intended to increase appreciation for the science of water quality. (Baker-FRC)
W82-06256

IMMEDIATE AND DELAYED OXYGEN DEPLETION IN RIVERS,

Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
P. Harremoes.
Water Research, Vol 16, No 7, p 1093-1098, July, 1982. 6 Fig, 4 Ref.

Descriptors: *Rivers, *Oxygen depletion, Depletion, Oxygen, Organic matter, Decomposing organic matter, Organic carbon, Sedimentation, Kinetics, Chemical reactions, Fate of pollutants.

A theoretical analysis has shown that removal of organic matter from rivers can adequately be simulated with a first order removal by both extraction and sedimentation, which will fix the organic matter at the bottom. The condition is that the river can be considered vertically well mixed as compared to the rate of removal. It is argued that the removal gives rise to an immediate and a delayed oxygen demand on the river water in

accordance with the original suggestions made by Velz and Gannon. These phenomena are important for the oxygen depletion experienced in rivers, especially in case of abrupt discharges. Investigation of oxygen depletion generated by a steady-state discharge of partly treated sewage showed a significantly faster removal than can be explained by degradation in the water phase and a significant accumulation of organic matter at the bottom. A simplified theoretical analysis of an abrupt discharge showed that both the immediate and the delayed oxygen consumption can adequately be handled by modifications to the traditional oxygen sag analysis. This analysis shows the extreme importance of making a distinction between the biochemical oxygen demand that will be removed with an immediate oxygen consumption and the fraction that will be removed with a delayed consumption. The final conclusion is that additional study is needed to reveal the importance of this distinction. (Baker-FRC)
W82-06269

THE FEDERAL RESPONSE TO GROUND WATER PROTECTION,

For primary bibliographic entry see Field 6E.
W82-06295

GROUND WATER LAW IN PUERTO RICO.

For primary bibliographic entry see Field 6E.
W82-06296

GROUND WATER AND THE STATES,

For primary bibliographic entry see Field 6E.
W82-06297

RECENT DEVELOPMENTS IN THE FIELD OF EUTROPHICATION PREVENTION,

Verlag Chemie, Weinheim (Germany, F. R.).
For primary bibliographic entry see Field 5C.
W82-06299

MANAGING POTOMAC WATER QUALITY: EVOLVING APPROACHES,

Metropolitan Washington Council of Government, DC.
For primary bibliographic entry see Field 6B.
W82-06361

NON-POINT SOURCE POLLUTION: DIRECTIONS FOR VERMONT,

Vermont Water Resources Research Center, Burlington.
E. A. Cassell, D. W. Meals, Jr., and P. Daukas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256652, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1981. 53 p, 25 Tab, 1 Ref, 2 Append. OWRT A-036-VT(2).

Descriptors: *Nonpoint pollution sources, *Public opinion, *Public participation, *Water pollution control, *Surveys, Priorities, Planning, Pollution load, Water pollution sources, Attitudes, Vermont, Public policy, Environmental protection, Resources management, Water management, Management planning, Water conservation, Water quality, Water quality control.

Opinion surveys were conducted in 1978 which were designed to ascertain public perceptions concerning nonpoint source (NPS) pollution, its causes, and its control. The survey results were assessed under two basic public categories: resource operators (farmers, loggers, and buildings contractors) and resource managers (scientists, planners, and resource managers in Vermont local, State, and Federal agencies). The results of the resource operators survey indicated a good general understanding of the NPS pollution problem, and a belief that NPS pollution could be avoided using proper practices. Also expressed was a willingness to help solve NPS pollution, but the lack of technical advice, guidelines, and finances were considered principal deterrents to participation. Results of the resource managers survey identified NPS pollution as an important Vermont issue over the next decade, with major priorities for NPS pollution control being careful problem assessment, basic data collection, public education, and development/implementation of useful conservation practices. Based on the results of these two public surveys, recommendations for enhancing Vermont NPS pollution control are advanced. Individual survey questionnaires used for farmers, contractors, loggers, and managers are included, and the definitive results of the surveys are tabulated. (Zielinski-MAXIMA)
W82-06372

DESTRATIFICATION OF LAKES AND RESERVOIRS TO IMPROVE WATER QUALITY,

Australian Water Resources Council, Canberra.
Proceedings, Joint United States/Australia Seminar and Workshop, February 19-24, 1979, Melbourne. Australian Government Publishing Service, Canberra 1981. 915 p. Burns, F. L., and Powwling, I. J. (Eds.).

Descriptors: *Destratificatiion, *Thermal stratification, *Water quality, *Lakes, *Reservoirs, *Mixing, Water quality control, International commissions, Lake restoration, Stratification, Turnover time, Density stratification, Lake morphology, Water currents, Environmental quality, Environmental engineering, Environmental effects, Environmental control, Aquatic environment, Hydraulic engineering.

A workshop was convened to discuss destratification and its use to improve water quality in reservoirs and lakes. The proceedings incorporates the 40 papers presented, together with the ensuing discussing and descriptions of field presentations, covering engineering and science efforts in this field in the United States and Australia. The theme is progressively developed from the consideration of the stratified reservoir, through the techiques of destratification, to the consideration of the effects of such action. This is then followed by case studies from the two countries, and culminates in a general discussion bringing together those topics needing further elaboration. The various lake/reservoir mixing projects are also enumerated, with details provided on the methods and equipment used and the results obtained, covering 37 projects. The workshop was undertaken since the two countries cover roughly complementary latitudes north and south of the equator, and since it was felt that the solutions being tried in destratifying thermally-stratified waters would be similar and hence provide a mutual international benefit to advancing the understanding of lake/reservoir destratification approaches. (Zielinski-MAXIMA)
W82-06385

PHYSICAL-CHEMICAL TREATMENT AND DISINFECTION OF STORMWATER,

Ontario Ministry of the Environment, Toronto.
H. Kronis.
Research Report No 88, March, 1982. 112 p, 31 Fig, 30 Tab, 17 Ref, 2 Append.

Descriptors: *Water treatment, *Storm water, *Physiochemical treatment, *Sedimentation, *Disinfection, *Urban runoff, Water quality, Water quality control, Flocculation, Settling basins, Rainfall intensity, Runoff coefficient, Storm runoff, Suspended solids, Water pollution control, Pollutants, Iron, Chemical oxygen demand, Biological oxygen demand, Water analysis, Pollution load.

Urban runoff from a 22.7 hectare (essentially residential) metropolitan Toronto watershed was studied May-October, 1977, and April-July, 1978. Hydrologic events and stormwater quality were characterized, and simple treatment methos (coagulation/sedimentation and disinfection at the bench/pilot-scale level) were applied. Hydrologic parameters (rainfall intensity, runoff, storm sewer flowrates, total runoff volumes/event, antecedent dry periods, runoff coefficients) varied widely. Stormwater pollutant concentrations also varied widely, especially for suspended solids and chemical oxygen demand (COD). Typical average percentage pollutant removals by natural (NS) or chemically-assisted (CA) settling, respectively, for thirteen 1977 storm events were: 88 and 95% (suspended solids); 36 and 68% (BOD-5); 57 and 62% (COD); and 47 and 79% (total phosphorus). For CA settling, alum was the preferred flocculant (30mg/liter, foolowed by at least two hours of quiescent settling); about 10 hours of quiescent settling was estimated to be needed for NS. Indicator bacterial densities in raw stormwater did not vary significantly between events. Disinfection with NaOCl reduced bacterial densities to well below pollution objectives. Of eight trace elements analyzed, only iron levels violated the model industrial waste bylaw. Total phosphorus and nitrogen runoff levels were consistently low and varied little. (Zielinski-MAXIMA)
W82-06389

CHARACTERIZATION OF LAVERKIN SPRINGS WATER AND METHODS FOR ITS REUSE IN ENERGY DEVELOPMENT,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. J. Eisenhauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237199, Price codes: A02 in paper copy, A01 in microfiche. Report REC-ERC-81-16, November 1981. 19 p, 2 Fig, 7 Tab, 10 Ref, 1 Append.

Descriptors: *Desalination, *Saline water, *Springs, *Water reuse, *Water tretment, *Impaired water quality, Laverkin Springs, Colorado River, Water quality, Water use, Cooling water, Coal slurry pipelines, Deep well injection, Wastewater disposal, Pretreatment of water, Radioactivity, Demineralization, *Utah.

LaVerkin Springs (LVS) are highly saline springs which discharge into the Virgin River (a tributary of the Colorado River) in Washington County, Utah. The high salt content and moderate flow rates significantly contribute to the salinity of the Colorado River. Methods were evaluated for preventing high salinity LVS water from entering the Virgin River and for utilizing the process water in energy development. Analytical water data obtained from a 9-month test program at LVS test site were evaluated. The raw water typically contains 750 mg/l of dissolved carbon dioxide and has a pH near 6.0. It contains the following concentrations in mg/l: 820 of calcium, 150 of magnesium, 1266 of bicarbonate, 1860 of sulfate, 2220 of sodium, and 3345 of chloride. The raw water contains significant amounts of silica, boron, strontium, and sulfide, and a measurable amount of radioactivity. The relative merits of different methods of treatment, disposal, and reuse of LVS water were studied. The disposal of water by deep well injection, use as a secondary coolant in a binary cooling tower, use in solar salt-gradient ponds, and use as a transport media for coal slurry pipelines was found to be technically feasible. Use of LVS water to transport coal to a consuming powerplant and subsequent reuse in a binary cooling tower or solar salt-gradient ponds would achieve both objectives of salt reduction and energy conservation. (Moore-SRC)
W82-06400

HAZARDOUS MATERIAL SPILLS--ARE YOU READY,

East Bay Municipal Utility District, Oakland, CA. Water Quality Div.
K. E. Carns, and K. B. Stinson.
Journal of the American Water Works Association, Vol 74, No 5, p 224-228, May, 1982. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Chemical wastes, *Contamination, *Water supply, *Water pollution sources, Water pollution prevention, Water treatment facilities, Disasters, Water distribution, Waste disposal, Reservoirs, Highways, Oil spills, Protection, Spills.

Water utilities can reduce the disastrous consequences of hazardous material spills on highways and in or near public water supplies by preparing a written response plan and training personnel in emergency procedures. The East Bay Municipal Utility District serving 30 communities east of San Francisco Bay has developed such a plan, which is

composed of five chronological phases: (1) discovery and notification, (2) evaluation and initiation of action (includes notification of public agencies and key utility management personnel), (3) containment and countermeasures (directed by the spill coordinator with help available from CHEMTREC communicator, public notified if necessary), (4) cleanup, mitigation, and disposal (spill is cleaned up promptly, preferably by the spiller), and (5) documentation and cost recovery (written report of the event and assignment of costs). The response procedures are given in outline form, in flow diagram form, and in detailed form. The response plan was tested in two drills of hypothetical events (a tank truck of poisonous chemical sunk in a raw water supply reservoir and pesticide injected into the distribution system). Two actual emergencies in which no water contamination resulted illustrated the value of the plan. These were a spill of transformer oil into a stream and the discovery of several drums of illegally dumped hazardous waste near the district's largest reservoir. (Cassar-FRC)
W82-06417

FATE OF NITROGEN IN AEROBIC SLUDGE DIGESTION,

British Columbia Univ., Vancouver.
For primary bibliographic entry see Field 5D.
W82-06455

RUTLAND WATER PHYTOPLANKTON: THE DEVELOPMENT OF AN ASSET OR A NUISANCE,

Anglian Water Authority, Peterborough (England), Welland and Nene River Div.
For primary bibliographic entry see Field 2H.
W82-06473

RUTLAND WATER RAW WATER QUALITY - PROBLEMS AND MANAGEMENT,

Anglian Water Authority, Peterborough (England).
N. F. Low.
Hydrobiologia, Vol 88, No 1-2, p 93-101, March, 1982. 8 Fig, 10 Ref.

Descriptors: *Reservoirs, *Raw water, *Water treatment, Water supply, *Water quality management, Water quality, Land treatment, Sewage effluent, Drought, Reclaimed water, River basin development, Pumping, Pumps, Water quality control, Rutland Water, England.

The options available to control the expected water quality problems in Rutland Water are identified and their use is discussed. Water quality problems result from the eutrophic character of the input waters and from the excessive depth of the reservoir. Two groups of options are available: those which operate on input waters, and those which operate on the stored water. Both types of options will be used, since increased demand for water will result in the reduction of the retention time of the stored water and an increase in nutrient loading. (Titus-FRC)
W82-06475

MODELS OF ANNUAL CYCLES IN LENTIC WATER BODIES,

Salford Univ. (England), Dept. of Civil Engineering.
B. Henderson-Sellers, and P. B. R. Archer.
Hydrobiologia, Vol 88, No 1-2, p 89-91, March, 1982. 4 Tab, 2 Fig, 5 Ref.

Descriptors: *Mathematical models, *Computer models, *Water quality, *Lentic environment, *Stochastic models, *Deterministic models, Calibration, Ecological models, Standing water, Parametric hydrology.

Reasons for modeling water quality are discussed, and a summary of the relevant parameters is presented. The two major types of models, stochastic and deterministic, are described. Stochastic models are those in which elements of the model vary in a random fashion. Inaccuracies are decreased because the input data are not condensed in any way. Results may be more realistic, since they are associated with some degree of uncertainty; however, these models are time-consuming and costly. Deterministic models always produce the same result for a given set of data; they are functional representations of a system. Such models are more economical because they are easier to implement. With any model, a full validation is necessary before any confidence can be placed in the results it produces. Validation involves comparing the computed results with data from previous time periods. (Titus-FRC)
W82-06483

A MODEL FOR MANAGING IRRIGATED AGRICULTURE,

Youngstown State Univ., OH Dept. of Civil Engineering.
I. A. Khan.
Water Resources Bulletin, Vol 18, No 1 p 81-87, February, 1982. 3 Fig, 28 Ref.

Descriptors: *Mathematical models, *Irrigation, *Management planning, Irrigation design, Irrigation efficiency, Water management, Agriculture, *Salinity, Simulation analysis, Optimization.

Problems which may result from irrigated agriculture in arid and semiarid regions include accumulation of salts, destruction of soil texture, waterlogging, decline in fertility and yield, and eventual abandoning of the land. Many of these problems result from the failure of managers to understand that irrigated land is a system consisting of several interdependent components and that the health of each of these components individually is important to the overall health of the system. The important components of an irrigated system include the quantity and quality of the irrigation water, the quantity and quality of the irrigation return flows, the unsaturated zone, the saturated zone, the water balance of the irrigated system, the salt balance of the irrigated system, and the crop yield. A management model is described which considers each of these nine components in an effort to devise management strategies to halt or at least retard the salinization and waterlogging processes in irrigated agriculture. An optimization model is used to maximize net farm income, encourage conjunctive use of surface and ground water, devise water pumping and application strategies designed to maintain continuous movement of salts out of the system, maintain proper hydrologic balance within the irrigated system, and meet the concentration requirements of the drainage water needed to optimize the yield of individual crops. Simulation models are used to assess the impact of agricultural activities on the unsaturatdd zone and the saturated zone. (Carroll-FRC)
W82-06584

DISPOSAL OF SLUDGE TO SEA,

Oslo Commission (Norway).
For primary bibliographic entry see Field 5E.
W82-06595

NEW PROBLEMS WITH UPLAND WATERS,

Saint David's Univ. Coll., Lampeter (Wales).
D. Kay, and A. McDonald.
Water Services, Vol 86, No 1031, p 29, 31, January, 1982. 27 Ref.

Descriptors: *Landuse, *Catchment areas, Agriculture, *Great Britain, *Research priorities, *Water quality, *Forestry, Elevation, Terrain analysis, Nutrients, Bacteria, Escherichia coli, Enteric bacteria, Watersheds.

In a paper by Youngman and Lack, published in Water Services, 85, (1019), 13-14, 1981, it was suggested that the increased use of upland areas for either lamb production or afforestation will cause problems of nutrient enrichment in catchment streams and impoundments. The direction of research effort suggested by these authors to control the water quality of catchment areas is questioned. Instead of concentrating on upland area nutrient transport, an examination of the microbiological factors involved in water quality is recommended. The investigation of water quality in a multiple-use catchment area in a similar location to areas of pristine moorland is advocated to predict microbiological water quality deteriorations. Monitoring of E. soli levels in Yorkshire catchments has revealed that afforested areas produce lower enteric bacterial concentrations than sheep farming areas. An integrated management approach is advocated which would focus on water quantity and quality, nutrient transport, microbiological deterioration and recreational and agricultural activities. (Geiger-FRC)
W82-06602

A MODEL FOR THE DESIGN OF HYPOLIMNETIC AERATORS,

York Univ., Toronto (Ontario). Dept. of Biology.
C. T. Taggart, and D. J. McQueen.
Water Research, Vol 16, No 6, p 949-956, June, 1982. 9 Fig, 2 Tab, 33 Ref.

Descriptors: *Design criteria, *Aerators, Hydolimnio, *Aeration, *Wastewater treatment, Oxidation, Model studies, Performance evaluation.

An empirically derived model is presented for use in designing hypolimnetic aerators, which ensures maximum flow efficiency but may not maximize oxygen transfer efficiency. Diffusor depth, air flow rates, rise velocity and cross-sectional area of the riser tube are the major variables considered. Water flow values predicted by the model were correlated with those observed in twenty published field experiments. The model determined that some aerators are inefficient and their design could be improved. A discussion is presented of the required oxygen input during aeration in which the problems of hypolimnetic oxygen depletion rates and oxygen transfer efficiencies are considered. (Baker-FRC)
W82-06610

IMPACT OF COAL ASH FROM ELECTRIC POWER PRODUCTION ON CHANGES IN WATER QUALITY,

Texas Univ. at Houston. School of Public Health.
For primary bibliographic entry see Field 5B.
W82-06623

THERMODYNAMIC CONTROLS ON QUALITY OF WATER FROM UNDERGROUND COAL MINES IN COLORADO,

Geological Survey, Denver, CO.
J. T. Turk.
Water Resources Bulletin, Vol 18, No 1, p 75-80, February, 1982. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Water quality control, *Thermodynamics, *Mine drainage, Coal mines, Groundwater pollution, Dissolved solids, Chemical precipitation, Geochemistry, *Colorado.

Coal production in Colorado has increased significantly in the period since 1965, raising questions concerning the effects of mine drainage on water quality. Major dissolved ions that contribute to the overall salinity of the water, restricting its suitability for various uses, are frequently found in water from underground coal mines. Thermodynamics provides an effective tool for the assessment of the origin of seepage from underground coal mines and for prediction of compliance with water quality criteria of seepage from other mines within the same geologic formations. Analysis of samples from 13 of the 14 mines studied indicated that calite saturated water had probably reacted with sodium rich marine shales to produce the seepage, which was saturated or supersaturated with respect to calcite. Samples showing evidence of being most completely reacted were composed almost entirely of sodium and bicarbonate ions and had a calcium to sodium activity ratio similar to that of seawater. The one sample not saturated with calcite was saturated with respect to gypsum, probably as a result of simple dissolution of gypsum from the strata through which the groundwater percolated. The primary problems which might result from reuse of the mine drainage would be damage or destruction of crops if the drainage water were used for irrigation. Also, the

chloride and sulfate concentrations in some samples were in excess of recommended standards for public water supplies. (Carroll-FRC)
W82-06624

THE MATHEMATICAL MODELLING OF WATER QUALITY WITH PARTICULAR REFERENCE TO THE INDUSTRIAL RIVERS OF YORKSHIRE,

Yorkshire Water Authority (England). Directorate of Resource Planning.
P. R. Holmes.
Water Pollution Control, Vol 81, No 1, p 45-58, 1982. 4 Fig, 9 Ref.

Descriptors: *Mathematical models, *Water quality, *Industrial wastewater, Rivers, River flow, River forecasting, Management planning, Water management, Decision making, Water quality management, *United Kingdom.

There has been considerable reluctance in the United Kingdom to use models for river quality management. River modelling studies may be designed to aid river surveillance by interpolating flow and water quality between sampling points to draw attention to inconsistencies in routine data, or to predict future flow and water quality conditions, assuming that present inputs and outputs will remain unchanged except for discrete changes which are to be tested. The main categories of mathematical models are described and compared. The application of mathematical models to practical planning problems in the industrialized river catchments of Yorkshire is examined. This modeling concentrated on steady state mass balance modeling of flow and biochemical oxygen demand, supported by suspended solids and ammonium nitrogen, and using chloride to assist in the balancing due to its conservative nature. The resulting model is basically simple in structure and extensive rather than intensive in its representation of the real river and in its requirements for data. The steady state requirement limits the model to fairly low river flow conditions if catchment-wide modeling is to be conducted. Application of this model to the River Aire catchment is discussed. Data collection and analysis, model calibration, and use of the modeling results in management planning are described. Major deficiencies of the model are examined. It is concluded that this approach to river modeling has provided a simple, economic planning tool for river management. (Carroll-FRC)
W82-06644

A REVIEW OF INDUSTRIAL EFFLUENT CONTROL EXPERIENCE,

Thames Water Authority (England).
P. Brindley, D. C. Carter, and M. J. Linsmith.
Water Pollution Control, Vol 81, No 1, p 59-79, 1982. 20 Fig, 13 Tab, 16 Ref.

Descriptors: *Industrial wastewater, *Water pollution control, Wastewater treatment, Regulations, Water pollution sources, Water quality standards, Effluent limitations, Effluent charges, *Reviews, *Waste assimilative capacity.

Pollution control measures are used to regulate the demands on the assimilative capacity of the environment to be compatible with use requirements. The formation of water authorities in the United Kingdom in 1974 led to considerable standardization of the diverse control and charging systems previously used to regulate industrial effluents. The general procedures used in the Chiltern Division of the Thames Water Authority in developing consent agreements with respect to effluent discharges with individual companies are described. The steps taken in the establishment of an industrial waste treatment plant, and the limitations placed on that plant, are outlined. These limitations included limitations on wastes to be treated, effluents, and plant operations. The Thames Water Authority has also established a catchment quality control function to assess and, where possible, control the extent and nature of continuous contamination of lowland water resources with persistent chemicals. The methods used to achieve these goals are described. The factors which determine the industrial effluent limits are directly associated with the quality objectives of the products of sewage treatment. Metal standards relating to sludge applied to land and to river water quality have become more precisely defined since 1970. Since all treated sludges in the Chiltern Division are distributed to land for agricultural purposes, standards for industrial effluents contributing to these sludges have also become more strict. Industrial effluent testing procedures are discussed briefly. (Carroll-FRC)
W82-06648

THE CONTROL OF EFFLUENT AND WATER QUALITY IN AN IMPORTANT WATER SUPPLY CATCHMENT,

Severn-Trent Water Authority (England). Derwent Div.
K. Selby, and T. D. A. Tricker.
Water Pollution Control, Vol 81, No 1, p 97-111, 1982. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Water quality control, *Water quality management, *Catchment areas, River catchments, Water supply, Industrial wastewater, Water pollution control, Effluent limitations, Wastewater treatment, *United Kingdom, River Derwent.

The River Derwent in Derbyshire is one of the most highly utilized water-supply rivers in the United Kingdom and has a finer resource/demand balance than most rivers. The Severn-Trent Water Authority has had responsibility for the control of effluents and for water quality in this catchment since 1974. The River supplied significant quantities of water to textile and other industries in the district and is used extensively for recreational pursuits. A high proportion of the river flow is used water, much of which is derived from industry. The Authority's Directorate of Scientific Services is responsible for water quality control functions, which include the control of effluents from sewage treatment works and industries discharging directly to a watercourse, the protection of underground water resources, and the monitoring of the quality of water supplies. The issue and enforcement of consents to discharge are the major means used to protect the quality of surface and ground water resources. River water quality objectives for the catchment are presented, and efforts being made to achieve these objectives are discussed. The industrial discharges, and private septic tank systems on water quality and efforts being made to minimize their impacts are described. Water quality problems particular to the River Derwent include pollution emergencies, high dissolved oxygen concentrations, damage to sewage treatment processes due to the high proportion of industrial effluents in the sewage, problems with color due to the large number of textile effluents, problems with organic micro-pollutants related to industrial wastewaters, and organoleptic problems in water supplies. Sources of these problems and methods being used to ameliorate them are discussed, (Carroll-FRC)
W82-06652

A WATER QUALITY INDEX FOR LAKE BEACHES,

Eco-Recherche Ltd., Pointe-Claire (Quebec).
N. St. Louis, and P. Legendre.
Water Research, Vol 16, No 6, p 945-948, June, 1982. 2 Fig, 2 Tab, 10 Ref.

Descriptors: Water quality, Recreational facilities, Bacteria, *Coliforms, *Streptococci, Beaches, Lakes, Lake beaches, *Bacterial analysis, *Pollutant identification.

A water quality index was developed, based on total and fecal coliforms and streptococci concentrations. A linear combination of these three bacterial variations was sought, thus making it possible to weight them differentially. The index described results from the comparison of a group of beaches, all in the same area and subjected to similar uses. A total of 5651 samples were obtained from 42 sampling stations on 7 beaches and analyzed for bacterial concentrations. The study period was 10 years. Discriminant analysis of the data led to a cononical vector accounting for most of the variability of the three microbial count variables recorded. This discriminant axis ordered the beaches along a cline of increasing pollution. It is then transformed into a microbial water quality index calibrated for the given set of beaches, which is in turn used to study the medium-term variability and the long-term evolution of water quality of the beaches. (Baker-FRC)
W82-06660

INTERNAL PHOSPHORUS LOADING IN A SHALLOW EUTROPHIC LAKE,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W82-06663

STATUS OF POROUS PAVEMENT RESEARCH,

Municipal Environmental Research Lab., Edison, NJ.
For primary bibliographic entry see Field 8G.
W82-06665

EVALUATION OF EFFECTS OF STORMWATER DETENTION IN URBAN AREAS,

Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256736, Price codes: A07 in paper copy, A01 in microfiche. Report, May 1982. 139 p, 24 fig, 7 Tab, 48 Ref. OWRT B-244-TEX-(1), 14-34-0001-1267.

Descriptors: *Storm water, *Urban areas, *Computer models, *Watersheds, *Detention reservoirs, Mathematical models, Mathematical studies, Model studies, Land use, Ponds, Storm runoff, Storm surges, Urban runoff, Catchment areas, Rainfall intensity, Rainfall-runoff relationships, Rainstorms, Flood peak, Storage reservoirs, Suspended solids.

Research was carried out to assess stormwater detention effects on water quality and flood control in urban ares using computer models and measurement data. The technical efficiency of pollutant removal and flood control were measured and modeled for several existing pond systems. Further, stormwater management alternatives were defined at the watershed level, based upon detention storage analysis and watershed modeling. A developed optimum scheme is described for locating detention ponds within urban areas. In addition to the development of management alternatives, economic feasibility and implementation needs were examined at the subdivision and watershed level. It was concluded that maximum hydrologic input due to full urban development of a 1 sq mile catchment occurs between a 50-75% development phase, accounting for about 40% of the flow increase for peak flows. Detention storatge land requirements at the catchment level for reducing peak flows to undeveloped levels range from 6% of the load area (for a 10-ft outfall depth) to 16% (4-ft outfall). Model results for locating detention storage throughout a 10-mile watershed indicate no need for any storage at the most down stream pond system was found efficient for suspended solids removal (1200 mg/liter inflows reduced to 100 mg/l at outflows) over a range of storm flows and durations. (Zielinski-MAXIMA)
W82-06698

LAND USE POLICY AND WATER PROCUREMENT (AGRARSTRUKTURPOLITIK UND WASSERGEWINNUNG),

Bundesforschungsanstalt fuer Landeskunde und Raumordnung, Bonn (Germany, F.R.).
For primary bibliographic entry see Field 6F.
W82-06714

50 YEARS OF LAKE BALDENEY - SOME ASPECTS OF ITS CHARACTERISTICS IN TERMS OF WATER MANAGEMENT (50 JAHRE BALDENEYSEE - EINIGE ASPEKTE SEINER

WASSERWIRTSCHAFTLICHEN BESONDERHEITEN),

Ruhrverband, Essen (Germany, F.R.). Chemisches und Biologisches Lab.

P. Koppe, K. H. Kornatzki, E. A. Nusch, F. Dietz, and G. Reinnarth.

GWF, das Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 17-29, January, 1982. 9 Fig, 13 Tab, 26 Ref. English summary.

Descriptors: *Lakes, *Lake sediments, *Ecosystems, *Nitrification, Ecology, Hydrology, Denitrification, *West Germany, Lake Baldeney, Nitrogen fixing bacteria, Mineralization, Sediments, Lake morphology, Limnology, Artificial lakes, Ruhr River, Water resources development, Aeration, Dredging, Heavy metals, Pollutants, Water quality.

Lake Baldeney, an impoundment of the Ruhr river in West Germany, is a hydrological hybrid which can be described in a simplified form as a double-channel two-layer model. The layers comprise a shallow lentic area with a low speed of flow and thick sediment layer and a deeper lotic area in which flow speed is significantly higher and almost no sediment is deposited in some spots. The mineralization of sediment from the lentic zone and the reduction in organic material in solution show that the lake is highly capable of water purification. Heavy metals are also deposited in the lake, whence they can be removed by dredging. Denitrification processes and the release of ammonia (mostly from sediment) also influence water quality. When a sudden high pollution load occurs (e.g. through a heavy rainstorm) the lake acts as a buffer. The nitrification rate is significantly higher at the inflow to the lake than at the outflow; this is attributable to a reduction in the number of nitrifying bacteria, probably because they adhere to suspended solids which are deposited in lake sediment. Gas exchange (nitrogen, carbon dioxide, oxygen) with the atmosphere cannot be measured accurateley, as the sediment acts as a store for organic and inorganic material as well as producing its own organic material. Research should therefore be performed on the interaction between sediment, suspended solids and water as well as on ecological interactions within the biological community. Lake Baldeney should be monitored constantly and aeration should be performed when oxygen metabolism so demands. Dredging will eventually be necessary due to continuing sedimentation. (Gish-FRC)

W82-06716

CALCULATING CONSENT CONDITIONS TO ACHIEVE RIVER QUALITY OBJECTIVES,

Anglian Water Authority (England). Dept. of Operational Planning.

A. E. Warn.

Effluent and Water Treatment Journal, Vol 22, No 4, p 152-153, 155, April, 1982. 12 Ref.

Descriptors: *Water quality standards, *Effluent standards, *River regulations, Water quality control, Standards, Regulations, Flow regulation, *Monte Carlo method, Sampling, Errors.

River Quality Objectives (RQO) are defined as the river quality needed to protect the intended uses of rivers. Their purpose is to ensure a proper allocation of resources to problems of river quality. Methods for calculating consent conditions to use in RQO are discussed. The Combining Distributions Methods (CD) are analytical solutions. They are simple to use and can be done on a programmable calculator. The Monte Carlo Method or Simulation Method requires more computer resources, but can be applied to a wider range of problems. The disadvantages of the simple mass balance equations are shown, for example, the adoption of unachievable RQO and underestimation of the self-purification capability. Use of the CD or Monte Carlo methods shows that river flow regulation is a senseless way of achieving river quality objectives. (Cassar-FRC)

W82-06725

EFFECTS ON GLOBAL SUPPLIES OF FRESHWATER,

Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.

For primary bibliographic entry see Field 5C.

W82-06733

TREATMENT OF COOLING SYSTEMS CONTAINING HIGH LEVELS OF LEGIONELLA PNEUMOPHILA,

Du Pont de Nemours and Co., Aiken, SC. Savannah River Lab.

For primary bibliographic entry see Field 5F.

W82-06769

AN OVERVIEW OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY'S STORM AND COMBINED SEWER PROGRAM COLLECTION SYSTEM RESEARCH,

Municipal Environmental Research Lab., Edison, NJ.

R. Field.

Water Research, Vol 16, No 6, p 859-870, June, 1982. 19 Fig, 2 Tab, 33 Ref.

Descriptors: *Combined sewers, *Reviews, *Storm-overflow sewers, Sewers, Storm water, Storm runoff, Retention basins, Catchbasins, Flushing, Design criteria, Polymers, Infiltration, Storage.

A state-of-the-art assessment is made of the activities of the Environmental Protection Agency's Storm and Combined Sewer Program over the past 15 years. The topics relate to collection systems and in particular to the management of collection systems for the dual purposes of drainage and pollution control, along with maintenance of such systems. Specific topics touched upon include catchbasins, new sewer design, sewer flushing, polymer injection, infiltration/inflow controls (Insituform, impregnated concrete pipe, and trenchless sewer), upstream storage/attenuation, flow routing and in-pipe storage, new types of flow regulators (swirl and helical bend regulator/concentrators, fluidic regulator, and hydrobrake), and new tide gates. In many cases where revision is necessary, the emphasis is placed upon optimal utilization of the existing facilities. (Baker-FRC)

W82-06775

LAKE RESTORATION BY SEDIMENT REMOVAL,

Corvallis Environmental Research Lab., OR.

S. A. Peterson.

Water Resources Bulletin, Vol 18, No 3, p 423-435, June, 1982. 5 Fig, 88 Ref.

Descriptors: *Sediment control, *Lake restoration, *Lake sediments, Sedimentation, Sediments, Dredging, Eutrophication, Phosphorus, Nutrients, Macrophytes, Aquatic plants, Cost analysis, Water quality.

Information on the effectiveness of sediment removal as a lake restoration technique is updated. Sediment removal is usually undertaken to deepen a lake and increase its volume to enhance fish production, to remove nutrient rich sediment, to remove toxic or hazardous material, or to reduce the abundance of rooted aquatic plants. In reviewing more than 60 projects and five case histories, it is revealed that the first three objectives are usually met through sediment removal. Dredging to control aquatic plants has not been well documented. Disadvantages of dredging include cost, temporary phosphorus release from sediment, increased phytoplankton productivity, noise, lake drawdown, temporary reduction in benthic fish food organisms, potential for toxic material release to the overlying water, and potential for environmental degradation at the dredged material disposal site. The technique is recommended for deepening and for long range reduction of phsophorus release from sediment. Sediment removal to control toxic materials is possible with minimal environmental impact when proper equipment s used, but it may more than double the cost. Lack of definitive information about rooted plant regrowth rates in dredged areas prohibits explicit recommendations on sediment removal to control plant growth. (Baker-FRC)

W82-06776

FISH RESPONSES TO TEMPERATURE TO ASSESS EFFECTS OF THERMAL DISCHARGE ON BIOLOGICAL INTEGRITY,

West Virginia Dept. of Natural Resources, Charleston. Wildlife Resources Div.

For primary bibliographic entry see Field 5C.

W82-06777

A FUZZY SETS MODEL FOR MEASURING THE EFFECTIVENESS OF PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING,

Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.

For primary bibliographic entry see Field 6B.

W82-06778

INVIRONMENTAL SIGNIFICANCE OF PESTICIDE RESIDUES ASSOCIATED WITH AQUATIC SEDIMENTS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5C.

W82-06789

PLANNED MEASURES FOR WATER REGULATION CONSTRUCTING THE NEW MUNICH AIRPORT (GEPLANTE WASSERWIRTSCHAFTLICHE MASSNAHMEN BEIM BAU DES NEUEN FLUGHAFENS FUR MUNCHEN),

Oberste Baubehorde im Bayrischen Staatsministerium des Inneren, Munich (Germany, F.R.).

For primary bibliographic entry see Field 8A.

W82-06825

LIGHT ADAPTATION AND INHIBITION: PROCESSES IMPORTANT IN MODELLING THE GROWTH OF ALGAE IN DRINKING WATER BASINS,

Technische Hogeschool, Delft (Netherlands). Lab. of Chemical Engineering.

For primary bibliographic entry see Field 5C.

W82-06827

EFFECT OF CATTLE MANURE ON SOIL EROSION BY WATER,

Allahabad Univ. (India). Dept. of Chemistry.

For primary bibliographic entry see Field 4D.

W82-06834

STORMWATER MANAGEMENT IN A SENSITIVE AREA.

Public Works, Vol 113, No 7, p 67, July, 1982.

Descriptors: *Water management, *Saline water intrusion, *Storm water, Water quality management, Nutrient removal, Environmental effects, Jonathan's Landing, *Florida, Mangrove swamps, Water level, Storm wastewater.

The water management system at the 600-acre Jonathan's Landing, Florida, development has been called a model system. Major challenges in this golf-oriented, environmentally sensitive area were preserving the mangrove ecosystem, creating a 120-acre system of interconnecting fresh water lakes and tidal channels while preventing salt water intrusion, controlling storm water runoff pollutants, and preserving the esthetic appearance of the system. The water control structures include wells to manipulate fresh water levels, monitoring wells to detect shifts in the fresh water/salt water interface, and a broken tile filtration system to control nonpoint source pollution (nutrients and particulates removed by a system of grass swales). (Cassar-FRC)

W82-06841

PURGE AQUIFER TO REMOVE VOLATILE ORGANIC CONTAMINATION,

Plainville Water Co., CT.
L. E. Bordeau, and G. P. Fulton.
Public Works, Vol 113, No 7, p 72-73, July, 1982. 2 Fig.

Descriptors: *Water pollution treatment, *Organic compounds, *Wells, Groundwater pollution, Municipal water, Plainville, *Connecticut, *Chlorinated hydrocarbons, Industrial wastes, Water pollution sources, Fate of pollutants.

The Plainville Water Company, Connecticut, relying on two well fields, detected organic chemical pollution of its newer well field in 1975. Trichloroethylene levels were over 400 ppb; trichloroethane, 1000 ppb; and chloroform, 600 ppb. The source of the contamination, waste industrial solvent from an industrial park adjacent to the well field, was located and dumping stopped immediately. The aquifer was purged by pumping the more severely contaminated well to a waste collection area. Chloroform levels, used as an indicator, dropped to below 30 ppb by July 1975, below 10 ppb for most of 1976, and below 1 ppb by the middle of 1977. Levels of trichloroethylene and trichloroethane paralleled those of chloroform. (Cassar-FRC)
W82-06842

WATERTIGHT MANHOLES CUT INFLOW.

Public Works, Vol 113, No 7, p 52, July, 1982.

Descriptors: *Waterproofing, *Rehabilitation, *Sewer systems, Plastics, Infiltration, Manholes, Hitchcock, *Texas.

Sewer Guard water tight manhole inserts are being installed in the Hitchcock, Texas (population 6000) sewer system as part of a $8 mission wastewater system rehabilitation. The disk-shaped plastic inserts, resistant to corrosion and damage by sewer gas or road oils, form a virtually leakproof seal with the manhole frame. There are two self-cleaning relief valves. Sealed manholes effectively prevent inflow of storm water and debris. This is especially important in low-lying areas where water stands for some time after a storm. Groundwater infiltration is prevented by brushing two coats of waterproofing compound onto the manhole surface, starting at the top and working down to the invert shelf. (Cassar-FRC)
W82-06844

THE CHALLENGE OF UPGRADING ROADSIDE REST AREAS,

Iowa Dept. of Transportation, Ames.
H. Dolling.
Public works, Vol 113, No 7, p 50-51, July, 1982.

Descriptors: *Rehabilitation, *Recreation, *Roads, Sanitation, Highways, Wastewater treatment, Wastewater lagoons, Lagoons, *Iowa.

Iowa rehabilitated four pairs of the 19 and 1/2 pairs of rest areas on its interstate system during 1979-80. Originally built in 1966, the rest stops were inadequate for today's traffic. Costs for reconstruction were about $1 million for each pair of rest stops. Wastewater lagoon improvements at the first stop to be rehabilitated cost nearly $200,000. Some of the problems facing engineers were: poor surface drainage at the flat sites, freezing of wastewater transmission lines, and sidewalk heaving in the heavy clay soils. A grinder pump was installed to move recreation vehicle wastewater in one rest area. Some toilets were replaced with low water volume fixtures. Lagoon improvements were deferred until more funds are available. (Cassar-FRC)
W82-06845

KANEOHE BAY SEWAGE DIVERSION EXPERIMENT: PERSPECTIVES ON ECOSYSTEM RESPONSES TO NUTRITIONAL PERTURBATION,

Hawaii Inst. of Marine Biology, Honolulu.
S. V. Smith, W. J. Kimmerer, E. A. Laws, R. W. Brock, and T. W. Walsh.
Pacific Science, Vol 35, No 4, p 279-395, October, 1981. 52 Fig, 51 Tab, 142 Ref.

Descriptors: *Nutrients, *Wastewater pollution, *Ecosystems, Marine biology, *Kaneohe Bay, *Hawaii, Diversion, Nutrient cycling, Phytoplankton, Zooplankton, Nitrogen, Phosphorus, Detritus, Heterotrophs, Benthos, Biomass, Water pollution effects, Subtropical regions, Bays, Nonpoint pollution sources, Fish, Organic matter, Particulate matter, Organic carbon, Chlorophyll a, Sediments, Lagoons, Reefs, Corals.

Domestic sewage secondary effluent entering Kaneohe bay, Hawaii, was diverted to the ocean in December 1977 (municipal) and May 1978 (Marine Corps) to study the responses of the ecosystem to sewage diversion. Nitrogen was the limiting nutrient. All of the inorganic N and most of the inorganic P added to the system were taken up biologically, mostly by phytoplankton. The rapid rate of nutrient cycling between the dissolved state, phytoplankton, zooplankton, microheterotrophs, and detritus supported a rate of productivity far exceeding the rate of nutrient loading. The nutrients reaching the benthos produced a large increase in detritivorous heterotrophs. The benthic community biomass was controlled by particulate loading. In the benthos the nutrients cycled among the dissolved state, heterotrophs, autotrophs, and the detritus. Eliminating the sewage input rapidly reduced biomass of plankton and benthos. Responses of variables to diversion fell into three groups: (1) moderate diversion and spatial responses (dissolved inorganic N, particulate organic carbon, phytoplankton biomass, phytoplankton growth rate, macroplankton dry weight, microplankton ash-free dry weight, lagoon floor N release, and extinction coefficient); (2) large diversion and wide range of spatial responses (dissolved inorganic P, hard bottom algal biomass, hard bottom cryptofaunal biomass, and lagoon floor biomass); and (3) little diversion and slight-to-large spatial responses (detritus, zooplankton, benthic algae and macrofauna, and fish). The benthic community did not return to the presewage state by the end of the study in August 1979, partly because some of the key organisms are long-lived and partly because nonpoint pollution sources continue to add sediment and runoff. (Cassar-FRC)
W82-06846

MULTIPLICATION OF LEGIONELLA PNEUMOPHILA IN UNSTERILIZED TAP WATER,

Pittsburgh Univ., PA. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-06881

SEWAGE DIVERSION EFFECTS ON THE WATER COLUMN OF A SUBTROPICAL ESTUARY,

Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W82-06892

EFFECT OF ARTIFICIAL DESTRATIFICATION ON IRON, MANGANESE, AND ZINC IN THE WATER, SEDIMENTS, AND TWO SPECIES OF BENTHIC MACROINVERTEBRATES IN AN OKLAHOMA LAKE,

Oklahoma State Univ., Stillwater. School of Biological Sciences.
E. Cover, and J. Wilhm.
Hydrobiologia, Vol 87, No 1, p 11-16, February, 1982. 3 Tab, 24 Ref.

Descriptors: *Destratification, *Lakes, *Metals, Manganese, Iron, Zinc, Heavy metals, Water sediments, Mixing, Ham's Lake, *Oklahoma, Benthic fauna, Accumulation, Bioaccumulation, Lake restoration, Fate of pollutants.

Water and sediment samples were collected from a destratified section and from a stratified arm of Ham's Lake, Oklahoma, in the spring, summer, and fall of 1978 and 1979. Total Mn in water was 38-119 micrograms per liter in spring and fall for both stratified and unstratified stations. However, in summer total Mn in water ranged from 109 to 5510 micrograms per liter, highest in the hypolimnion of the stratified arm. Soluble Mn comprised 8-65% of the total, average 28%. Mn in sediments ranged from 140 to 1562 micrograms per g with highest concentrations in summer and fall. Macroinvertebrates contained 39-1039 micrograms Mn per g, but variations between stations were not significant. Mean iron concentrations were: water (total Fe), 158-661 micrograms per liter; water (dissolved Fe), 16-176 micrograms per liter; sediments, 2-7 micrograms per g; and invertebrates, 544-6226 micrograms per g. Zn levels were very low in water (6-21 micrograms per liter) and sediments (0.5-1.4 micrograms per g). Concentration factors for Chaoborus punctipennis and Chironomus riparius were: Mn, less than 1; Fe, 1021 and 5111, respectively; Zn, 658 and 920, respectively. (Cassar-FRC)
W82-06897

THE REMOVAL OF A HEADED DISCHARGE FROM A LAKE AND THE EFFECT UPON AN EPIPHYTIC ALGAL COMMUNITY,

Alberta Univ., Edmonton. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W82-06898

FACTORS AFFECTING DEPTH DISTRIBUTION OF DRAGONFLIES AND OTHER BENTHIC INSECTS IN A THERMALLY DESTABILIZED RESERVOIR,

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5C.
W82-06899

OBSERVATIONS ON THE IMMATURE CHIRONOMIDEA OF POLLUTED LOWLAND BROOK-POND SYSTEM (ANTWERP, BELGIUM), AERATED BY THE PHALLUS PROCESS,

Rijksuniversitair Centrum te Antwerpen (Belgium), Laboratory of Ecology.
W. H. O. de Smet.
Hydrobiologia, Vol 87, No 2, p 171-189, 1982. 11 Fig, 10 Tab, 32 Ref.

Descriptors: *Ponds, *Aeration, *Midges, *Aerated lagoons, Oxidation, *Belgium,, Water pollution effects, Mud, *Phallus process.

An aeration system based on the principle of the water jet vacuum pump (Venturi system, Phallus process) was used to aerate a lowland brook-pond system polluted by organic waste. The effect of this aeration on immature chironomids was investigated. Forty-two species or species groups were found. A total of 224 samples were taken from 70 sampling stations. The changes in community composition, species richness, diversity, redundancy, abundance and biomass were studied in the light of the recovery after treatment. Before aeration started, chironomids were absent in the aeration basin. After 8.5 months of aeration a chironomid community characterized by low species richness (four species) and high redundancy was established. Prolonged aeration resulted in a further increase of the species diversity, and during the last survey, after about 2 years of aeration, the chironomid species richness had increased to 18 species. Similar trends could be found for the downstream sampling stations. The longitudinal recovery pattern probably restored the original zonation of the chironomid species, resulting from an ecological gradient created by the linear change in physiography of the water body. Orthocladiinae dominated in the brook stretch, whereas Chironominae and to a lesser extent Tanypodinae dominated in the ponds. (Baker-FRC)
W82-06912

COMPARATIVE CHARACTERISTICS OF THE BACTERIOPLANKTON OF RIVERS,

Belorussian State Univ., Minsk (USSR).
For primary bibliographic entry see Field 5C.
W82-06986

EFFECT OF PHYTOPLANKTON ON WATER QUALITY IN THE NORTHERN DONETS-DONBAS CANAL,

Central Water Monitoring, Research, Planning, and Surveying Lab. (USSR).

For primary bibliographic entry see Field 5C.
W82-06987

COMPONENTS FOR A TREATMENT PLANT SAFETY PROGRAM,
Williamsport Sanitary Authority, PA.
M. H. Gerardi.
Public Works, Vol 113, No 7, p 68-69, July, 1982. 1 Fig.

Descriptors: *Safety, *Personnel, *Accidents, Wastewater treatment, Education, Management, Attitudes, Williamsport, *Pennsylvania.

The Williamsport Sanitary Authority, Pennsylvania, established a safety program in 1980. The plan consisted of five basic components: (1) a review of common causes and types of wastewater accidents (obtained from experienced employees, reports at safety meetings, literature, correspondence, the accident file, and job site inspections), (2) promotion of a safety awareness effort (through the safety coordinator, bulletin board, safety meetings, and literature), (3) motivation of employee attitudes and participation (by bonuses, personnel evaluation, awards, photographs, safety meetings, literature, and memberships in safety organizations), (4) education and instruction of employees in safe work practices (by audiovisual material, drills, job site inspections, required reading and tests, good housekeeping, and safety meetings), and (5) acquisition and maintenance of safety equipment. The safety program, originated by management, has been taken over by the employees, who also organized existing safety notes into a 25-page booklet for distribution among workers. (Cassar-FRC)
W82-06992

SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, NY.
J. Stedinger, D. Pei, and T. Cohn.
Journal of the Water Pollution Control Federation (Literature Review Issue). Vol 54, No 6, p 508-511, June, 1982. 68 Ref.

Descriptors: *Literature reviews, *Systems analysis, *Water quality management, *Model studies, *Reviews, Monitoring, Water Pollution control, Wastewater treatment, Water reuse, Optimization, Nonpoint pollution sources, Planning, Water management, Water quality, Wastewater renovation.

Applications of systems analysis to water management were reviewed under several categories: water quality management, water quality assessment, pollution control, water quality modeling, and wastewater treatment and reuse. Water quality management topics concerned improvement of both public welfare and private profit through pollution control, methods for estimating stream assimilation capacities and waste load allocations, and effluent charges. Water quality assessment models were devised which linked pollution sources at the county level with major water bodies and which investigated the impact of energy production on water quality. Water quality control planning should consider all possible alternatives, marginal costs and benefits, seasonal variations in assimilative capacity, Nonpoint pollution sources, and use of reservoir releases. Water quality modeling methods were developed and improved with respect to urban storm water pollution, calibration and verification of models, proper sampling programs, phosphorus in lakes, and thermal and other discharges from powerplants. Models for wastewater treatment and reuse included a multilevel optimization model for multiobjective, multiprocess wastewater treatment problems, optimization of a 6-unit wastewater treatment plant subject to designated constraints, minimizing operations and maintenance costs, fault tree analysis for monitoring of small unattended plants, and water reuse planning. (Cassar-FRC)
W82-06997

ECONOMICS,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
J. C. Hite, and R. K. McConnell.
Journal of the Water Pollution Control Federation (Literature Review Issue), Vol 54, No 6, p 511-513, June, 1982. 19 Ref.

Descriptors: *Literature reviews, *Economic aspects, *Water quality management, *Cost-benefit analysis, Benefits, Urban runoff, Agriculture, Nonpoint pollution sources, *Reviews, Agricultural runoff, Taxes, Water pollution control.

Economists contributed a diverse body of information to the recent year's literature on water quality. Articles ranged from technical analysis of cost structure in water-using industries to studies on the effect of alternative pollution control policies on regional economies. Several studies concerned the economic aspects of nonpoint source pollution in agriculture and urban areas. Complex interrelationships between environmental quality regulations, farm price support and export policies, and farm income led to the conclusion that national policy on agricultural non-point-source pollution must be integrated with agricultural price and production policies to achieve success. Cost effectiveness, information and administrative costs, associated effects and acceptability of control options were considered for non-point-source pollution control in urban areas. Quantifying costs and benefits of water quality improvement was documented in several cases. Cost-effectiveness of meeting standards in wastewater systems, both municipal and industrial, was discussed. Several authors stated that economic incentives and pollution taxes are ineffective in water quality management. (Cassar-FRC)
W82-06998

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DEVELOPMENT OF MODELS FOR THE PLANNING OF LARGE-SCALE WATER-ENERGY SYSTEMS,
Texas Univ. at Austin. Dept. of Civil Engineering.
J. Matsumoto, L. W. Mays, and G. A. Rohlich.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243395, Price codes: A15 in paper copy, A01 in microfiche. Technical Report CRWR-187, January 1982. 321 p, 34 Fig, 17 Tab, 37 Ref, 8 Append. OWRT B-231-TEX(2), 14-34-0001-0251.

Descriptors: *Energy, *Mathematical models, *Water demand, *Future planning, *Economic aspects, Fuel, Water use efficiency, Water requirements, Algorithms, Model testing, Forecasting, Prediction, Projections, Mathematical studies, Model studies.

A mathematical optimization model was developed to assist the investigation of various alternatives for future water-energy systems. The capacity expansion problem of water-energy systems considers future water-energy demands (for water, electricity, gas, coal) and the availability of water and coal, and requires the determination of the location, timing, and size of facilities to satisfy demands at minimum cost (including operating and capacity costs). The system consists of four subsystems (water, coal, electricity, and gas), the interactions of which are novelly expressed explicitly in mathematical terms and equations. Decomposition techniques are extensively applied because of the large scale nature of the problem. To accomplish this, an in-depth study was made of the mathematical structure of the problem. Benders decomposition was applied to the problem, decomposing it into a three-level problem: the capacity, production, and distribution sub-problems. These sub-problems were solved by the use of special algorithms: the generally upper-bounded, the simply upper-bounded, and the generalized network flow algorithms, respectively. Model uniqueness characteristics, major accomplishments towards solving the water-energy problem, comparisons with the other models, and suggested further work are described. (Zielinski-MAXIMA
W82-05915

EVALUATION OF MODELS AND PROCEDURES USED FOR RIVER OPERATIONS AND PLANNING IN THE UPPER SNAKE AND BOISE RIVERS IN IDAHO,
Idaho Univ., Moscow. Coll. of Engineering.
For primary bibliographic entry see Field 4A.
W82-05925

MULTIOBJECTIVE RIVER BASIN PLANNING WITH QUALITATIVE CRITERIA,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
M. Gershon, L. Duckstein, and R. McAniff.
Water Resources Research Vol 18 No 2, p 193-202-, April, 1982. 4 Fig, 8 Tab, 21 Ref.

Descriptors: *Management planning, *Mathematical models, *River basin development, Water resources development, Resources development, Planning, Environmental impact, Resources management, Mathematical studies, Model studies, River basins, Water use, Semiarid climates.

The ELECTRE I and II methodologies were applied to multiobjective water problems in a semiarid environment. A multicriterion viewpoint was used to assess the impact of alternative river basin strategies on the Santa Cruz River in the vicinity of Tucson. Alternatives were ranked by the ELECTRE I method to obtain preference graphs to use as input into ELECTRE II. A complete ordering system based on quantifiable and nonquantifiable ordinal criteria was generated which allowed different weights to be assigned to different criteria to affect the outcome of results. In the case study presented, the preferred systems to solve water use conflicts of urban, agricultural, Indian and mining interests were reservoirs and channelization, while the least preferred solutions included areas of groundwater development. (Geiger-FRC)
W82-06062

A MULTIOBJECTIVE BRANCH-AND-BOUND METHOD FOR PLANNING WASTEWATER AND RESIDUAL MANAGEMENT SYSTEMS,
Kentucky Water Resources Research Inst., Lexington.
M. Nakamura, and S. M. Alexander.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243643, Price codes: A06 in paper copy, A01 in microfiche. Research Report No 130, January 1982. 109 p, 21 Fig, 7 Tab, 136 Ref, 3 Append. OWRT A-083-KY(1). 14-34-0001-0119/1119.

Descriptors: *Multiobjective planning, *Algorithms, *Wastewater management, *Management planning, *Water costs, Planning, Mathematical studies, Optimization, System analysis, Mathematical analysis, Network design, Regional analysis, Regional planning, Numerical analysis, Wastewater, Mathematical equations.

A multi-objective branch-and-bound (BOB) algorithm method is proposed for use in analyzing multi-objective fixed-charge network-flow problems commonly found in water resources planning situations. A multi-objective imputed value analysis is also proposed, which makes use of the BOB tree-structure and allows comparison of the importance of facilities in the network. The imputed values obtained for a given problem provide information difficult to obtain efficiently using conventional mathematical optimization techniques. The method is capable of systematically and efficiently identifying a set of good planning alternatives. The method was applied to two hypothetical example problems dealing with regional wastewater treatment and residual management systems to demonstrate its potential usefulness. While the proposed method is designed to deal with network-flow structured problems, application of the BOB concept to general mult-objective planning analysis itself is appealing. The BOB tree can be extended to any desired set of objective cut-off values, and a set of noninferior solutions can be identified among the generated alternatives. The mathematical for-

mulation and the analysis procedure of the method was described. (Zielinski-MAXIMA)
W82-06149

COMPETITION BETWEEN IRRIGATION AND HYDROPOWER WATER USE IN WASHINGTON STATE,
Washington State Univ., Pullman. Dept. of Agricultural Economics.
J. L. Findeis, and N. K. Whittlesey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243718, Price codes: A12 in paper copy, A01 in microfiche. Washington Water Research Center, Pullman, Report 44, May 1982. 257 p, 3 Fig, 77 Tab, 91 Ref, 6 Append. OWRT A-100-WASH(1), 14-34-001-9051.

Descriptors: *Model studies, *Input-output analysis, *Cost analysis, *Economic impact, *Irrigation requirements, *Hydroelectric power, Computer models, Mathematical models, Mathematical studies, Economic aspects, Economic evaluation, Water use, Electric power rates, Electric power costs, Thermal power, Irrigation, Irrigation water, Water demand, *Washington.

Research was carried out to analyze the competitive relationship between irrigation and hydropower uses of water, and to determine the impact of irrigation development on economy for the State of Washington. Estimations of irrigation and hydro-generation trade-offs were made using an updated version of the 1972 Washington State input-output model. Two irrigation projects were chosen for study, encompassing 796,000 acres. Undertaking both projects would yield an estimated additional agricultural output of $209 million/year (1972 prices), but substantially electrical losses for irrigation energy and energy lost through water diversions would occur. Replacing this power by thermal power would increase State wholesale electricity rates by as much as 43% above 1980 levels. Input-output analysis measured statewide impacts of simultaneous electricity rate and agricultural output impacts and assessed the distributional effects of additional irrigation. Even with higher electricity rates, State output, employment, and income will increase due to irrigation development, but distributional impacts will be significant. Undertaking both projects, residential electric bills will increase $11.36/person/year and certain industries will experience net residual income losses ($18 million/year for the aluminum industry alone at 1972 dollars. (Zielinski-MAXIMA)
W82-06156

INVESTIGATION OF OBJECTIVE FUNCTIONS AND OPERATION RULES FOR STORAGE RESERVOIRS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06175

RESERVOIR PLANNING FOR BRAZILIAN DAMS,
Brazilian National Committee on Large Dams; and Technical Commission on Dams and the Environment.
F. M. G. Budweg.
International Water Power and Dam Construction, Vol 34, No 5, p 48-49, May, 1982.

Descriptors: *Multipurpose projects, *Reservoirs, *Water resources development, Planning, Brazil, Dams, Institutional constraints, Water law, Hydroelectric power, Developing countries.

Brazil's Codigo das Aguas, a collection of laws relevant to water resources, was compiled in 1934, before the industrial and population explosion and before large-scale water resources development. Pollution control regulations are still in an initial phase. Hydropower development is the responsibility of Electrobras, the federal holding company. Permits for construction of dams must be obtained from the Ministry of Mines and Energy. To date most reservoirs built in Brazil have been single-purpose. Little regional planning was done until 1979, when the federal government established a special committee on integrated watershed studies. This is responsible for regional planning and multipurpose development of streams and rivers. Increasing numbers of dam owners and designers favor multipurpose uses of reservoirs. Planning is done in three stages: (1) a baseline survey of hydrology, geology, biota, water quality, social impact, economic impact, etc., (2) appraisal of environmental effects, and (3) actual planning phase. (Cassar-FRC)
W82-06206

TVA HYDRO SCHEDULING MODEL: THEORETICAL ASPECTS,
Tennessee Valley Authority, Norris.
For primary bibliographic entry see Field 4A.
W82-06430

TVA HYDRO SCHEDULING MODEL: PRACTICAL ASPECTS,
Tennessee Valley Authority, Norris. Water Systems Development Branch.
For primary bibliographic entry see Field 4A.
W82-06431

RESERVOIR SYSTEMS OPTIMIZATION,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W82-06433

DEVELOPMENT OF AN ENVIRONMENTAL GEOLOGY DATA BASE FOR LAND USE PLANNING,
Missouri Univ., Kansas City. Dept. of Geosciences.
S. E. Hasan, and T. R. West.
Bulletin of the Association of Engineering Geologists, Vol 19, No 2, p 117-132 1982. 7 Fig, 9 Tab, 15 Ref.

Descriptors: *Land use planning, *Geology, *Decision making, Maps, Planning, Computers, *Indiana, Waste disposal, Solid waste disposal, Septic tanks, Soil types, Bedrock, Soil classification, Erosion, Flood data, Water table, Permeability, Zoning, Data interpretation, Groundwater, Surface water, Networks, Data requirements.

A computerized data base for land use planning at the county level was developed using Boone County, Indiana, as the study area. The purpose of the work was to select the physical characteristics that best describe the land for planning purposes and to select the optimum size of the data cell. After the physical characteristics (or variables) were selected, the relative importance of each was evaluated. The subcategories of each variable were then ranked in order or importance. Computer processing assigned a weighting for each data point for a specific land use. The 23 variables included soil type, slope class, erosion class, flood potential, drainage class, depth to seasonal high water table, permeability, and agricultural productivity. A sample problem determined the suitability of a site for solid waste disposal. The solution was produced in the form of a computer generated map. The optimum cell size, dependent on the scale of the original data and the scope of planning, was 500 ft on a side for this study. The differences between results from smaller cells (250 and 100 ft on a side) were not great, but the data requirements of the smaller cells are much greater. (Cassar-FRC)
W82-06552

6B. Evaluation Process

WATER CONSERVATION INCENTIVES AND STRATEGY,
Rutgers - The State Univ., New Brunswick, NJ. Water Resources Research Inst.
For primary bibliographic entry see Field 3D.
W82-05906

AN ECONOMIC COMPARISON OF THE IRRIGATION OF CORN IN HUMID AND ARID REGIONS OF THE UNITED STATES,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
W. L. Miller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243338, Price codes: A03 in paper copy, A01 in microfiche. Technical Report No 142, June, 1982. 24 p, 17 Ref. OWRT A-059-IND(1).

Descriptors: *Irrigation economics, *Cost analysis, *Subsidies, *Arid areas, *Humid areas, Irrigation, Irrigation water, Public policy, Water policy, Corn.

The objectives of the research presented in the report was (1) to measure the marginal product of water in the production of corn in arid and humid regions of the United States and (2) to suggest implications of this analysis for public policy decisions in the future. The analysis involved estimations of production functions for irrigated corn in several states based upon agronomic data from experimental test plots. Alternative functional forms were examined and the three-halves polynomial function was selected to compare the marginal products among the states. The results indicated differences exist among states in the maginal product of water in corn production. Since these differences are not directly related to the areas where irrigation development has been publicly financed in contrast to privately supported, future public policy should take that into consideration. Policy options should include alternative subsidy programs for irrigation water supply systems, policies to influence the price of inputs other than water, policy to adjust the price of corn and elimination of all public support of irrigation development. The results of the analysis are limited by considerations of the marginal products of other crops and the marginal product of water in other uses. Neither of these issues were examined in this study because the research concentrated upon the single crop of corn which is grown and irrigated in many regions of the United States. (Author abstract)
W82-05909

HYDROELECTRIC POWER OFFERS STABLE, CHEAP ENERGY SOURCE FOR INDUSTRY,
Parsons, Brinckerhoff, Quade and Douglas, Inc., New York.
B. J. Van Weele, and E. M. McClung.
Pulp and Paper, Vol 56, No 2, p 114-115, February, 1982. 3 Fig.

Descriptors: *Hydroelectric power, *Pulp and paper industry, Economic aspects, Design criteria, Construction.

The pulp and paper industry is in a unique position to capitalize on hydropower, as many of the existing sites were selected and developed for this purpose by pulp and paper companies more than a century ago. Several economic considerations of hydropower development from the viewpoints of both new construction and the rehabilitation of abandoned sites are described. The best hydroelectric power plant sites tend to be located in forested areas with streams. The major advantage of a hydrosite to the developer is that it constitutes a long term energy source. Initial development cost may be high, but maintenance costs will be low, and the costs of energy production will rise less rapidly than the prices of energy from most other sources. The hydropower site also includes as advantages pollution free operation and no waste disposal problems. Four types of sites are likely to be candidates for hydropower development: existing sites with hydroelectric facilities that can be rehabilitated, existing sites with hydroelectric facilities that can be upgraded, sites where power generating capability can be added to existing hydraulic facilities, and new sites where full facilities can be constructed. With escalating electrical costs, small hydropower plants offer paper companies a viable means of reducing energy bills and, in many cases, can provide a source of revenue. (Baker-FRC)
W82-05954

SIZING FARM RESERVOIRS FOR SUPPLEMENTAL IRRIGATION OF CORN. PART II. ECONOMIC ANALYSIS,

Wright McLaughlin Engineers, Denver, CO.
W. L. Palmer, B. J. Barfield, and C. T. Haan.
Transactions of the ASAE, Vol 25, No 2, p 377-380, 387, March/April, 1982. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Economic analysis, *Irrigation, *Reservoir storage, Model studies, Crop yield, *Corn, Reservoir design, Soil water, Soil-water-plant relationships, Hydrologic models, Investment.

A method for determining optimum reservoir size, based on economics, was developed for a supplemental irrigation water supply. Crop yields were calculated for irrigated and nonirrigated conditions as well as daily irrigation water requirements using the Duncan-SIMAIZ model. The Haan Water Yield Model was used to calculate daily water yields into a water supply reservoir. The models were used with a reservoir water balance and present worth economics procedure to estimate the economics of investing in supplemental irrigation and to determine the optimum reservoir size. For a sample 100 acre farm planted with 30,000 corn plants per acre in a 300 acre watershed with specified infiltration rate, seepage rate, seepage/runoff ratio, soil moisture capacity, and irrigation management scheme a 40,000 cu m reservoir would produce a return on investment in 50% of the years if $13,000 or less were invested in the irrigation system (pipes, pumps, etc.). In humid areas the major benefits of irrigation would be evident in drought years only. This analysis can also be used to tell an investor the probability of recovering enough return on his investment in a given year to meet the payment on the system at a given interest rate. (Cassar-FRC)
W82-05966

SENSIBLE ENERGY STORAGE IN AQUIFERS. 2. FIELD EXPERIMENTS AND COMPARISON WITH THEORETICAL RESULTS,

Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W82-06058

SENSIBLE ENERGY STORAGE IN AQUIFERS. 1. THEORETICAL STUDY,

Bureau de Recherches Geologiques et Minieres, Orleans (France).
For primary bibliographic entry see Field 4B.
W82-06059

IMPROVED PRINCIPLES, STANDARDS, AND PROCEDURES FOR EVALUATING FEDERAL WATER PROJECTS,

Wright Water Engineers, Inc., Denver, Co.
L. M. Eisel, G. D. Seinwill, and R. M. Wheeler, Jr.
Water Resources Research, Vol 18, No 2, p 203-210, April, 1982. 43 Ref.

Descriptors: *Water resources development, *Project planning, *Cost analysis, *Nonstructural alternatives, *Water conservation, Planning, Management planning, Economic aspects, Hydroelectric power, Navigation, Recreation, Flood damage, Evaluation.

Many attempts have been made to improve the evaluation criteria for Federal water resources development projects over the past forty years. With the advent of multiobjective planning formulated in the 1973 principles and standards adopted by the U. S. Water Resources Council, the scope of project evaluations has increased. The Council recently revised the 1973 principles and standards for recreation, hydropower, inland navigation, irrigation, flood damage and drainage and developed an auxiliary manual for evaluating the overall attractiveness of alternate plans for water resoruces development. Although these revised procedures for weighing the economic advantages and disadvantages of water resources development are more consistent with theoretical principles, in some cases they require compromises due to limited data, computational complexity, and legal and political constraints. Since the revised principles and standards stress nonstructural alternatives and water conservation, they are expected to be more responsive to the need for cost efficient and environmentally acceptable measures for water resources development. (Geiger-FRC).
W82-06063

RICE FIELDS OF SOUTH CAROLINA: A RESOURCE INVENTORY AND MANAGEMENT POLICY EVALUATION,

Clemson Univ., Columbia, SC. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
C. A. Gresham, and D. D. Hook.
Coastal Zone Management Journal, Vol 9, No 2, p 183-203, 1982. 2 Fig, 9 Tab, 5 Ref.

Descriptors: *Rice, *Water resources development, *South Carolina, Vegetation, Wetlands, Management, Regulations.

This report documents and discusses selected biological attributes and management considerations of the former rice fields of South Carolina. A brief historical background is presented, followed by an inventory made to determine the present biological and management status of the rice fields. State and federal legislation affecting the management of the rice fields is discussed to relate the biological and legal aspects of this resource. Sixteen vegetation cover types were recognized and described. Four types were considered to be managed types; seven types were dominated by marsh grasses and tree species. Of the three drainage system studied, one had a unique cover type composition. It differed from the other two due to flooding associated with the diversion of the Santee River in the 1930s. During the inventory of the drainage systems, 74,113 acres of former rice fields were located. The Waccamaw, Pee Dee, Black system contained 28,076 acres; the Santee system contained 25,456 acres; and the Wando, Cooper and Ashley system contained 20,572 acres. Owners of the former rice fields were managing the rice fields for waterfowl predominately, with snipe, sanctuary, and fish or seafood management clearly secondary. Only 32% of the former rice fields were under management. The owners also indicated that wildlife hunting and fiber production were the preferred future uses of the rice fields. Most of the former rice fields are wetlands under the definition of wetlands in Section 404 of CWA. Thus state and federal permit requirements complicate manipulation and management of former rice fields, which in turn practically prohibits scientific investigation of new compatible uses. (Baker-FRC)
W82-06072

A BENEFIT COST ANALYSIS OF A SOIL EROSION CONTROL PROGRAM FOR THE NORTHERN WATERSHED OF LAKE CHICOT, ARKANSAS,

Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W82-06170

ATMOSPHERIC ISSUES IDENTIFIED IN STATE WATER RESOURCE PLANNING,

Illinois State Water Survey, Champaign.
S. A. Changnon, Jr., and R. G. Semonin.
Bulletin of the American Meteorological Society, Vol 63, No 4, p 399-406, April, 1982. 3 Fig, 21 Ref.

Descriptors: *Water resources development, *Weather modification, *Illinois, Artificial precipitation, Cloud seeding, Irrigation, Water supply, Water demand, Farming, Legal aspects, Water rights, Political aspects, Climatic data, Climates, *Climatology, *Weather.

The issues of climate change and prediction, inadvertent weather and climate modification, and planned weather modification are addressed as they relate to a comprehensive statewide water plan being completed in Illinois. The quality and quantity of water resources in that state are seen as irrevocably linked to and dependent upon the climate. Precipitation contributes all available water, even though much of it does not fall in the state but runs through it underground. Conflicts relating to climate result largely from the impacts of short term changes in climate extremes. These conflicts involve both local ones over water use and inter-agency assistance conflicts to determine who should receive aid. In cases of inadvertent weather modification, the conflict centers around determining who is at fault. The goal of state policy relating to inadvertent modifications is to understand the changes caused by Illinois and their impacts, and to establish policy positions and regulations regarding unfavorable modifications, for the benefit of the area and the nation. Planned weather modification offers a potential means to increase water supplies in Illinois. Farmers and agribusinesses have spent $0.5 million in the past five summers to support cloud seeding projects. Federal agencies have financed $7.8 million for research on weather modification in Illinois. Purposeful rainfall enhancement, if it can be done, has decided cost advantages over irrigation. Conflict in this area may center on moral, religious or environmental grounds. Interstate conflicts are also possible. To serve climate data and information needs a center with a real time access system is recommended. (Baker-FRC)
W82-06176

MANAGING POTOMAC WATER QUALITY: EVOLVING APPROACHES,

Metropolitan Washington Council of Government, DC.
A. S. Librach, C. Wiegand, S. Freudberg, M. Sullivan, and R. N. Magill.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineering, Vol 108, No EE3, p 562-577, June, 1982. 9 Fig, 5 Ref.

Descriptors: *Estuaries, *Water resources development, Washington, District of Columbia, *Potomac River, Rivers, Water pollution control, Management, Water quality, Water pollution sources, Nonpoint pollution sources, Water quality management.

This paper presents an overview of the evolution of water quality management philosophy in the Washington, D.C., area, and describes an emerging approach to comprehensive water quality management. To define the problem, the total pollutant loadings to the Potomac Estuary from all sources are described. This is followed by an historical overview of water quality trends in the Estuary and the management response to perceived water quality problems. The estimated costs of providing increasingly higher levels of sewage treatment are then presented. Finally, the paper describes an evolving approach based on an analysis of tradeoffs between the various pollution control options available to determine the most cost effective and practical ways of achieving specific and realistic water quality goals. The new management approach evolving may replace the region's traditional and almost exclusive reliance on control of point source loadings to meet rigidly defined and interpreted water use definitions and quality standards. This new approach is more flexible and practical in the consideration of the impacts, controllability, and costs to control all loading sources. The approach would employ return frequency and economic considerations in tandem with sophisticated water quality model simulations to help identify the most cost-effective management solutions. To support a long term management strategy, a state of the art eutrophication model for the Potomac Estuary is being developed. (Baker-FRC)
W82-06361

WATER SUPPLY DEVELOPMENT IN THAILAND,

Water Services, Vol 84, No 1008, p S14-S16, S19, S20, February, 1980. 4 Fig, 2 Tab.

Descriptors: *Water supply development, *Planning, *Thailand, Water resources development, Water conveyance, Water supply.

It is estimated that the population of Thailand in 1977 was about 44,000,000, corresponding to an

average density of 85 persons per square kilometer. The Metropolitan Water Works Authority was founded in 1967 when the Thai Government combined the four municipal water authorities of Bangkok, Thonburi, Nonthaburi, and Samut Prakarn under the Ministry of Interior. The source of Bangkok's surface water is the Chao Phya River at Sam Lae, about 35 meters north of Bangkok. The water is relatively unpolluted and is above the reach of sea tides. Capital improvement programs and future work plans for the increasing population are reviewed. Water systems, construction programs, budgets and typical costs for water service in the rural areas are also noted. (Baker-FRC)
W82-06367

THE WHITE CLAY CREEK PROJECT: A PROTOTYPE STRATEGY FOR PROTECTING SMALL STREAM VALLEYS.

Delaware Univ., Newark. Water Resources Center.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256611, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1982. 52 p, 10 Fig, 20 Ref. OWRT C-90191-G(9443)(1).

Descriptors: *Streams, *Environmental protection, *Public participation, *Public policy, *Public waters, Environmental impact statement, Environmental quality, Water quality control, Water quality, Valley springs, Valleys, Urban planning, Public opinion, Attitudes, Public lands, Land development, Storm runoff, Management planning.

The use of citizen panels was explored for interpreting technical information and for serving as intermediates between the unaffiliated public and institutions/governments, which hold the technical information. A Nominal Group Transaction mode is used to generate recommendations, and short-subject videotape movies are used as a communication device in a process for enhancing public participation in protecting/improving a stream valley environment. The results of this study are presented as a prototype for general application. The White Clay Creek Valley functioned as a study case area, with several recommendations being developed for application to stream valleys. These are that: the stream proposals evaluated for potential adverse environmental impacts; the stream valley core should be reserved for low-intensity uses (recreation, nature preserves, woodlands); a planning program for conservation/management practices should be established to treat streams of different order; and that a citizen's council should be established to monitor/inform/serve the public interest in the watershed on important issues (e.g., future development, stormwater management, maintaining biological diversity, recreation). (Zielinski-MAXIMA)
W82-06368

ECONOMIC EFFECT OF ENERGY PRICE AND ECONOMIC FEASIBILITY AND POTENTIAL OF NEW TECHNOLOGY AND IMPROVED MANAGEMENT FOR IRRIGATION IN TEXAS,

Texas Water Resources Inst. College Station.
For primary bibliographic entry see Field 3F.
W82-06374

A 'REGRETTABLE NECESSITY' - THE DECISION TO CONSTRUCT,

North Yorkshire County Council (England).
P. Lawson.
Hydrobiologia, Vol 88, No 1-2, p 19-26, March, 1982. 6 Ref.

Descriptors: *Economic aspects, Evaluation, *Prediction, *Reservoirs, *Water demand, Cost analysis, Water rates, Economic evaluation, Economic prediction, Public policy, Projections, Forecasting, Growth rates, Economic justification, Water supply, Rutland Water, England.

Arguments for and against reservoir development in Rutland, United Kingdom, are presented. The process of decision-making which took place in the mid-1960s highlighted basic conflicts between urban expansion and rural agriculture. Debate at the local level and in Parliament raised issues which are still unresolved. Because the Rutland Water scheme involved changing the course of a river, the consent of Parliament was required. Local objections concerned land use disruption, effects on the local economy, landscape impact, and drawdown effects. Arguments for the project were that per capita consumption of water was expected to increase, existing water sources were overextended, and no alterntives were available as short-term solutions. (Titus-FRC)
W82-06480

INTRODUCTION - RUTLAND WATER 1970-1981,

Leicester Univ. (England), Dept. of Adult Education.
D. M. Harper.
Hydrobiologia, Vol 88, No 1-2, p 1-5, March, 1982. 4 Fig, 9 Ref.

Descriptors: *Reservoirs, *Reservoir operation, *Economic aspects, Evaluation, *Project planning, Water supply, Water demand, Public opinion, Public policy, Water policy, Construction, *Rutland Water, England.

Rutland Water (Empingham Reservoir) was officially established in May 1970 by the Mid-Northamptonshire Water Act. Within 10 years, the completed reservoir had reached its top water level and the dam had been inspected; about half its design capacity was being used for water supply and it had received national acclaim for its wildfowl populations. The Rutland Water Research Group sponsored a conference to review the changes associated with the reservoir in its first decade. The controversy which arose during the planning of this pumped-storage reservoir, primarily due to its size and location, still exists despite the success of its recreational provisions and water supply management. (Titus-FRC)
W82-06482

FACT FINDING HEARING - COTTONWOOD CREEK INSTREAM BENEFICIAL USE PROGRAM,

California Regional Water Quality Control Board, Sacramento.
Staff report, June 1982. 150 p, 5 Fig, 10 Tab, 42 Ref, 5 Append.

Descriptors: *Streams, *Rivers, *Beneficial use, *Water quality management, *Water permits, *Public hearings, Water policy, Water rights, Water supply, Water temperature, Fisheries, Recreation demand, Wildlife management.

The California State Water Resources Control Board's responsibilities include issuing water rights applications and permits in an effort to protect the public interest and to mitigate adverse environmental impacts. Both quality and quantity determine the amount of water to be left in a source to protect instream beneficial uses. The primary instream beneficial uses of the Cottonwood Creek System, which includes part of the Sacramento River, are recreation (boating/fishing) and fisheries. This report presents three options comprising seven alternatives for the system's instream use management. The alternatives are: 1) to maintain the existing levels of instream beneficial uses in both systems, but with temperature and turbidity/siltation controls; 2) to maintain reduced levels of instream uses in both systems, i.e., 50% of the total present salmon fishery, 97% of the present recreation at Cottonwood and 75% at Sacramento; 3) to maintain 50% of the present salmon fishery at Cottonwood and existing levels of instream use at Sacramento; 4) to maintain current levels of instream uses at Cottonwood and decrease levels at Sacramento; 5) to maintain instream uses at Cottonwood and increase fishery and recreation levels at Sacramento; 6) to increase Cottonwood's instream uses and maintain existing instream uses at Sacramento. Alternative 7, the recommended program, includes water temperature control, stream channel/streambank protection, best management practices to control nonpoint sources of pollution, and gravel cleaning and replenishment. The above objectives would be implemented by federal, state and local agencies. (Atkins-Omniplan)
W82-06522

THE 1980-1981 DROUGHT IN ILLINOIS: CAUSES, DIMENSIONS, AND IMPACTS,

Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2E.
W82-06523

ARTIFICIAL RECHARGE OF COLORADO RIVER WATER IN LAS VEGAS VALLEY: MANAGEMENT OPTIONS AND POTENTIAL AQUIFER SYSTEM RESPONSES,

Nevada Univ. System, Reno. Desert Research Inst.
R. C. Broadbent, S. C. Weaver, J. W. Fordham, and G. F. Cochran.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256702, Price codes: A06 in paper copy, A01 in microfiche. Publication No. 41074, January 1982. 132 p, 61 Fig, 14 Tab, 39 Ref. OWRT B-104-NEV(1), 14-34-0001-8099.

Descriptors: *Artificial recharge, *Aquifer management, *Water resources development, *Surface-groundwater relationships, *Mathematical models, Aquifer systems, Aquifer testing, Rivers, Planning, Forecasting, Water loss, Water costs, Economic aspects, Computer models, Mathematical studies, Model studies, Groundwater availability, *Colorado River, *Nevada.

Study was undertaken to assess whether and how southern Nevada can take maximum advantage of excess Colorado Rriver (CR) diversion capacity that is expected to exist over the next 20 years through the southern Nevada water supply system. Analysis of the water resource system defined a range of potential groundwater(GW)-surface water management scenarios defined by the resource system model. Chemical equilibria calculations and sediment-water mixing experiments were also conducted. The study results led to conclusions that: the apparent least-cost management strategy is to continue GW pumping at the current rate without salvaging lost CR water, but failure to build a water reserve for future use and the problems inducible by such failure may make this strategy undesirable; artificial recharge of CR water is technically feasible but probably undesirable economically; reduction in current total GW pumpage to 40,000-45,000 acre/foot/year would permit salvage of CR water by maximizing its use and allowing GW reservoir replenishment, however reduced GW pumpage would induce higher water costs. (Zielinski-MAXIMA)
W82-06694

EVALUATION OF THE WATER RESOURCES POTENTIAL OF THE LOWER MISSOURI RIVER VALLEY ALLUVIUM,

Missouri Water Resources Research Center, Columbia.
J. M. Sharp, Jr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256728, Price codes: A03 in paper copy, A01 in microfiche. Report, January 1982. 27 p, 4 Fig, 4 Tab, 26 Ref. OWRT A-129-MO(2), 14-34-0001-0127.

Descriptors: *Alluvial aquifers, *Alluvium, *Computer models, *Hydraulic properties, *Water exchange, Water resources development, Computer programs, Model studies, Mathematical studies, Mathematical models, Surface water, Flow discharge, Water storage, Induced infiltration, Recharge basins, Instream flow, Consumptive use, *Missouri River.

Research was conducted: to estimate the water resources potential of the lower Missouri River Valley alluvial aquifer (AA) from Rulo, Nebraska to St. Charles, Missouri; to provide mechanisms for improving hydraulic property estimates of the AA; and to ascertain the problem or future problem potential regarding the AA and associated surface waters. Drill hole and pump test data for the AA were re-evaluated. Flow rates of the Mis-

souri River and its major tributaries in the study area were tabulated. A flow-storage-recharge-pumping model (consisting of about 50 submodels, each covering about 10 miles of the 498 mile AA length) was developed for conjunctive use of the stream/aquifer system. Qualitative assessment was made of instream flow problems of the lower Missouri River system. It was concluded that: better data are needed on groundwater/river interactions and stream channel changes; that water use data are highly variable, making accurate projections of Missouri water demands presently impossible; that, due to local demands and projected upstream dimensions and consumptive use, water resources of the lower River AA system are deemed as potentially critical. New determinations of stream-flow needs for lower River fish/wildlife will offer a constraint on available groundwater in the Alluvium. Detailed analyses of river-aquifer water exchange indicate local inhomogeneities control the near river response patterns. (Zielinski-MAXIMA)
W82-06696

INSTITUTIONAL ASPECTS AFFECTING MANAGEMENT OF GROUNDWATER IN CALIFORNIA,

California Univ., Riverside. Dept. of Soil and Environmental Science.
H. J. Vaux. Jr., and M. Neiman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256744, Price codes: A03 in paper copy, A01 in microfiche. Water Report, September, Davis, Calif. 1980, 22 p, 2 Tab.

Descriptors: *Institutional constraints, *Groundwater management, *California, *Economic aspects, *Model studies, Water management, Groundwater basins, Institutions, Water law, Legal aspects, Feasibility studies, Public participation, Hydrologic systems, Mathematical models, Cost-benefit analysis, Future planning, Estimated benefits, Surface water availability.

The effectiveness of existing groundwater management institutions, using economic models and institutioal analysis to identify alternative institutional arrangements and their feasibility, was examined. Using existing groundwater basins, a sensitivity analysis assessed the change in economic incentive with a change in various parameters (e.g., discount rate; surface water availability). It was concluded that California water institutions/laws developed in a period having characteristics differing sharply from California's current groundwater situation. Further, Californians have preferred supply-augmenting solutions involving broad public participation, often being economically inefficient. New water management institutions cannot be expected to operate effectively unless they are designed to at least partially accomodate prevailing public attitudes/preferences, existing hydrologic and engineering of current water supply systems, and the perception that economic efficiency is not always paramount. Analysis of the southern San Joaquin indicated that in the absence of supplemental supplies, groundwater management may still be justified in economic grounds, provided such management costs are modest. A revised institutional structure will be needed to meet future groundwater demands. A dynamic optimization model is described which was used to establish the existence of net benefits from groundwater management, (Zielinski-MAXIMA)
W82-06700

WATER SUPPLY MANAGEMENT IN THE DISTRICT OF COLUMBIA: AN INSTITUTIONAL ASSESSMENT,

George Washington Univ., Washington, DC. Program of Policy Studies in Science and Technology.
D. P. Beard.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256785, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Center, Washington, DC., Report No 36, February 1982. 183 p, 26 Fig, 67 Ref, 8 append. OWRT A-016-DC(1).

Descriptors: *Water supply, *District of Columbia, *Management planning, *Institutional constraints, *Regional planning, Water costs, User charges, Water shortage, Available water, Urban planning, Planning, Future planning, Drought, Water deficit, Economic aspects, River basins, Evaluation, Water resources development, Water requirements.

The water supply management structure and its operation are described for the District of Columbia, as well as the issue it will face in the 1980's and how the District is prepared to deal with these issues. These issues include: adequacy of future water supplies; regional cooperation; water supply emergency and drought management; water supply system rehabilitation; water billing/collection; aud rate increases and conservation pricing. Major emphasis is given to detailed definition of the Potomac River basin, the legal and institutional management of the River, the overall water supply network in the Washington metropolitan region, and the water supply management functions in the District. The District water supply was found to be reliable, inexpensive and of good quality. Other than some administrative concerns (e.g., billing/collection), the District water management system performs adequately. Recent studies do not forecast water supply shortages, and regional cooperation appears to be improving. However, while the water supply future in the District area appears optimistic, caution is urged to ensure continued and improved cooperation as a critical factor in meeting future water supply needs. (Zielinski-MAXIMA)
W82-06704

A FUZZY SETS MODEL FOR MEASURING THE EFFECTIVENESS OF PUBLIC PARTICIPATION IN WATER RESOURCES PLANNING,

Georgia Inst. of Tech., Atlanta. School of Industrial and Systems Engineering.
A. O. Esogbue, and Z. M. Ahipo.
Water Resources Bulletin, Vol 18, No 3, p 451-456, June, 1982. 4 Fig, 11 Ref. OWRT B-147-GA.

Descriptors: *Water resources development, *Planning, *Public participation, Public relations, Nonpoint pollution sources, Pollution load, Attitudes, Social participation, Future planning, *Fuzzy sets, *Model studies, Mathematical studies, Algorithms.

An effort to apply the technique of fuzzy set modeling to an important problem in an areawide based approach to managing a scarce and diminishing natural resources is reported. Research in nonpoint water pollution control planning via fuzzy sets is aimed at planning under uncertainty and in a fuzzy environment, especially with respect to fuzzy goals/objectives and enforcement problems; to the scientific determination of best management practices (BMP's); to measure the effectiveness of BMP's as control procedures for nonpoint source pollution; and to measure and improve the effectiveness of public participation in water resources planning from a quality viewpoint. Specifically, a fuzzy set model is developed for quantifying and measuring the effectiveness of public participation. The model is essentially cascade in nature and employes the concepts of fuzzy pessimistic and optimistic aggregation to cluster and analyze the evaluations of the basic factors. Sample computations of the model are provided. (Baker-FRC)
W82-06778

EVALUATING INLAND WATERWAY NAVIGATION IMPROVEMENT PROJECTS: THE CASE OF THE BONNEVILLE LOCK,

Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economic.
M. V. Martin, and L. M. Arthur.
Water Resources Bulletin, Vol 18, No 3, p 481-484, June, 1982. 1 Fig, 13 Ref.

Descriptors: *Inland waterways, *Navigation, Planning, Canals, Navigable rivers, Waterways, Feasibility studies, Financial feasibility, Cost-benefit analysis, Bonneville Lock, Columbia River, *Oregon.

One cause of delays in projects to develop inland waterway transportation is a lack of analytical credibility associated with the project. This was examined in connection with the proposal to construct a new, expanded lock at the Bonneville Dam on the Columbia River. At present commercial waterborne transport extends 465 miles upriver and accommodates barges of up to 3,200 tons capacity. Between 1938 and 1975 eight locks were built on the Snake-Columbia system, primarily as co-serve facilities with hydroelectric dams, but the lock system has also contributed to irrigation of cropland. Therefore, any proposed changes must consider all these aspects as well. In evaluating the benefits and costs of a proposed waterway project, two scenarios must be compared: projected economic development with the project vs. development expected to occur without the project. By following a carefully defined set of analytical guidelines, specific enough to ensure consistency and completeness, yet flexible in application, it is hoped that some of the delays currently caused by a lack of definitive project analyses will be diminished. (Baker-FRC)
W82-06869

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COUNT ON UNCLE SAM LESS,

Office of the Secretary of the Army, Washington, DC.
W. R. Gianelli.
Civil Engineering (New York), Vol 52, No 4, p 49-52, April, 1982. 3 Fig.

Descriptors: Water resources development, *Planning, Design criteria, Financial aspects, *Government finance, *Government supports, Economic aspects, Federal jurisdiction, *Political aspects.

Under the present federal budget crunch, old ways of managing water resources projects will no longer work. New directions are needed which will call for increased participation of other sectors in planning, cost-sharing, and financing proposed federal water projects. Estimates suggest that as much as $20 billion could be invested in the coming decade for potential water projects, including areas such as navigation, flood damage reduction, hydropower, and municipal and industrial water supplies. The number of new federal project construction starts has decreased steadily over the past few years. The Administration plans to identify what the federal role in various water projects should be. One key feature is the establishing of national economic development output of proposed projects. Water projects with only local or regional beneficiaries may not qualify as they have in the past for federal financing. However, federal expertise in the planning and construction of water projects may continue to be available. One way to assure that the planning process concentrates on those projects with the highest likelihood of being implemented is for project sponsors to participate in study financing. It is proposed that the new Corps of Engineers studies be done in two stages. The federally financed reconnaissance stage would require 12-18 months, with the subsequent feasibility stage being cost-shared 50/50 with the federal government and another project sponsor. (Baker-FRC)
W82-05998

COST OF WASH HOUSES AND COMFORT STATIONS AT RECREATION AREAS,

Army Engineers Waterways Experiment Station, Vicksburg, MS.
A. K. Lindsey, and T. M. Walski.
Water Resources Bulletin, Vol 18, No 2, p 331-334, April, 1982. 3 Fig, 4 Ref.

Descriptors: *Recreation wastes, *Sanitary engineering, *Costs, Estimated costs.

Cost functions are presented for comparison of different types of sanitary facilities (vault toilets, wash houses, and comfort stations) built at water resources projects. Functions for exterior costs are computed for plywood siding with asphalt or cedar shingles, concrete masonry units with asphalt or cedar shingles, concrete masonry units

with brick veneer and asphalt shingles, concrete units with brick veneer and cedar shingles, and cedar siding with cedar shingles. Interior cost functions are given according to type and number of toilets and fixtures. An equation for total construction costs includes exterior and interior costs, the elaborateness of design, and an allowance for inflation. Area of the building may be determined by an equation which includes number and type of fixtures and a spaciousness factor. An example is given in which the type and cost estimates for a wash house are prepared. (Cassar-FRC)
W82-06042

HOW EQUITABLE ARE EFFLUENT CHARGES,

Furness (C. D.) and Associates Ltd. (England).
C. D. Furness.
Effluent and Water Treatment Journal, Vol 22, No 3, p 99-100, 102-103, March, 1982. 5 Tab, 8 Ref.

Descriptors: *Effluent charges, *Effluent limitations, *Industrial wastes, *Mathematical studies, Accounting, Pollution taxes, Water quality standards, Effluents, Cost allocation, Cost sharing, Water quality management.

Evidence is given to substantiate the contention that the apportioning of the costing elements in the Mogden-type charging formula for effluent discharges which has been used in Great Britain since 1974 is imprecise and therefore unequitable. Figures are given to illustrate that there are significant variations in the total charges imposed on industrial dischargers by the Regional Water Authorities for the reception and treatment of their regional average strength effluents. Thus these charges do not provide a true basis for comparison. Comparisons have been attempted by calculating the charges levied by each authority for the reception and treatment of a fixed weight of pollutant when contained in the relevant volume of regional average-strength effluent for a particular region. Another method of comparing the charges levied by each authority is unit costing of a given weight of water or pollutant received for treatment. Charges for COD, BOD, and the solids strength of the effluent are still used by many water authorities. It was concluded that an increased degree of uniformity with respect to the assessment of polluting strengths and the apportionment of the charging elements would remove any anomalies in the charges imposed and ensure more equitable charging in the future. (Geiger-FRC)
W82-06074

ECONOMIC IMPACT STUDY OF R81-11 TRIHALOMETHANE STANDARDS FOR PUBLIC WATER SUPPLIES,

Illinois Dept. of Energy and Natural Resources, Chicago.
For primary bibliographic entry see Field 5F.
W82-06098

ECONOMIC IMPACT ANALYSIS OF COMBINED SEWER OVERFLOW REGULATIONS ON EAST ST. LOUIS, R81-12

Huff and Huff, Inc, Chicago, IL.
For primary bibliographic entry see Field 5G.
W82-06099

PRETREATMENT REMOVAL CREDITS: FACT OR FICTION,

Metropolitan Sanitary District of Greater Chicago, Research and Development Department.
For primary bibliographic entry see Field 5G.
W82-06207

WATER RATE STUDIES AND RATE MAKING PHILOSOPHY,

Stanley Consultants, Inc., Muscatine, IA.
R. H. Stanley, and R. L. Luiken.
Public Works, Vol 113, No 5, p 70-73, 116, May, 1982. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Water rates, *Water costs, *Peak demand, Water metering, Utilities, Prices.

Utility rate structures should encourage conservation, efficiency, and equitable rates. The rate system should also produce a stable revenue for the company. The rate making process consists of several major steps: determine revenue requirements for the selected year, allocate the cost of service to each rate class, and design rates consistent with the results of costs of service analyses. The cost of service methodology involves three major steps: arrange investments and operating costs into major divisions such as supply, treatment, fire protection, etc.; determine appropriate customer, demand, and commodity allocation factors for each rate class; and allocate costs to each rate class. This procedure is illustrated in detail. Allocation of demand-related costs to the different rate classes is important and difficult. The American Water Works Association Base-Extra Capacity methodology is recommended for this. The rate structure for each class should produce revenues matching the overall cost of service for that class. In general, seasonal and ratchet rates result in more equitable charges than the traditional annual rate approach. They are also effective in reducing peak day and peak hour demands. However, the seasonal and ratchet rates result in less revenue stability because they are more dependent on weather and customer summer usage habits. It is predicted that in the future there will be greater use of seasonal rates, fewer declining blocks and less price differential between blocks, and recovery of customer-related costs by separate customer or service charges. (Cassar-FRC)
W82-06222

STATISTICAL COST FUNCTION FOR WATER MAINS,

Canadian Department of Supply and Services, Ottawa, Ontario. Bureau of Management Consulting.
B. M. Firestone.
Water/Engineering and Management, Vol 129, No 5, p 50-52, May, 1982. 4 Ref.

Descriptors: *Cost analysis, *Water mains, Mathematical equations, Planning, Statistical analysis, Mathematical studies, Installation, Water conveyance, Pipelines.

A statistical function relating costs and flow volumes is needed for a determination of optimal pipe diameters when planning for water main installation.. Such a function will help avoid the installation of excessive capacity and unnecessarily high costs. Premature duplication of water mains and unnecessary disruption will also be avoided. The ratio of pipe cost per unit length to flow will decrease as capacity or flow increases. The existence of a 'two-thirds rule' has been suggested - costs rise as the two-thirds power of output capacity. this rule is used by engineers in estimating the cost of new process equipment. In this paper the hypothesis suggests that total in situ pipe costs per unit length (TC) can be expressed as a function of flow capacity (Q) and length of section laid (L). An equation is suggested, and data derived from melbourne and the Metropolitan Board of Works records is used to demonstrate its effectiveness. The findings suggest that set-up costs act as a fixed cost, invariant with pipe diameter or the length of section laid. A decrease in predicted replacement costs per mile noted, which also results from short sections commonly being laid in developed areas where main laying costs are very high. Thus longer sections will show a lower cost per mile. To estimate increasing returns to scale with flow, the confounding influence of length of section laid must be removed. The conclusion is drawn that efforts should be directed toward laying the longest possible continuous section lengths at any one time. Planners should also consider the substantial scale economies existing with respect to flow when determining optimal pipe sizes. (Baker-FRC)
W82-06252

WATER UTILITY COSTS AND RATE DESIGN FOR FIRE PROTECTION SERVICES,

CH2M/Hill, Portland, OR.
C. W. Corssmit, and D. D. Green.
Journal of the American Water Works Association, Vol 74, No 6, p 270-277, June, 1982. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Pricing, *Water users, Economic aspects, Alaska, Fire protection, Water rates, Water demand.

A 1981 cost-of-service analysis was made of water and fire flow demands. Rates for water provided by Central Alaska Utilities for fire protection were based on data from that study. Fire protection costs were then allocated to all water system users, who are charged for each block of fire flow demand required to protect their properties. In order to design such a system the database used must be significantly comprehensive to enable the identification of annual revenue requirements by appropriate cost functions. The capacity cost method provides some important advantages over the incremental cost method. All functions of the system are treated on an equal basis for cost allocations, and there is no need to declare primary versus secondary purposes. Incremental cost calculations, which can be cumbersome when multiple cost functions are involved for a number of utility components, are not needed. Finally, the capacity cost method conforms with the base extra capacity cost allocation method that is used to delineate both the capital and the operation and maintenance costs and therefore all demand data can be used on a coincidental demand basis. The advantages and disadvantages of several alternatives are described. (Baker-FRC)
W82-06275

WATER RATES AND RESIDENTIAL WATER CONSERVATION,

National Bureau of Standards, Washington, DC.
For primary bibliographic entry see Field 3D.
W82-06276

COST-BASED WATER RATE DESIGN,

Norville (Rodney L.) and Co., Houston, TX.
R. B. Matthews, and S. Webster.
Journal of the American Water Works Association, Vol 74, No 6, p 282-284, June, 1982. 3 Tab.

Descriptors: *Water use, *Pricing, Conservation, *Water rates, Economic aspects, Water conservation, *Cost-based water rates.

In order to finance major capital expenditures needed for improvements to water systems, some manner of making the necessary rate increases more palatable to the public must be found. Often the solution may be the use of a cost based rate design as an alternative to the traditional declining block rate structure. A system of rate structures that more clearly links the cost of meeting demands with the customers who impose the peak requirements appears to be a positive approach. Such a rate structure requires a definition of peaking characteristics and of groups of customers with similar peaking characteristics. Among residential customers in both single-family and multifamily dwellings, peaking intensifies as consumption increases. Once water use reaches a sufficient level to meet basic consumption and housekeeping needs, additional consumption results from discretionary intermittent water consumption. Among industrial and commercial customers, peaking decreases as consumption increases. If cost based rates are the objective of rate structures, the first step in implementation is to acquire data to define the relevant classes of customers. Cost based rate design is not a conservation rate in the sense of implying conscious bias in rate design against large volume users. It is based only on an objective cost of service analysis. The only change from traditional practices is a redefined customer classification scheme. A cost based rate structure effectively correlates cost with the individual customer who has the ability to pay. The retention of declining rate blocks for commercial and industrial customers eliminates the lack of incentive for industrial and commercial development inherent in many rate structures that seek to motivate water conservation. (Baker-FRC)
W82-06277

STATISTICAL SAMPLING TECHNIQUE FOR CONTROLLING THE ACCURACY OF SMALL WATER METERS,

Hackensack Water Co., Harrington Park, NJ.
P. Tao.
Journal of the American Water Works Association, Vol 74, No 6, p 296-304, June, 1982. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Water metering, *Measuring instruments, *Statistical methods, Maintenance.

Through the use of a statistical sampling program based on random sampling theory, drawbacks associated with the periodic age change program for water meters can be corrected. The two drawbacks associated with the periodic age change program for meters are that more than 90% of the meters repaired under the periodic age change program are still serviceable, and therefore the cost of unnecessary meter repair imposes a burden on the water utility and its customers, and second, once the meters are set on the customers' premises, no regular program is undertaken to check the accuracy of the meters until the next age repair. The statistical sampling scheme, as a substitute for the periodic meter age change program, will solve these problems. Such a program proposed for Hackensak, New Jersey, will reduce the number of meter changes and repairs by 6000 per year at a saving of $94,000, based on 1977 costs. A further effect of the proposed program will be to reduce unaccounted for water by a small percentage., The core of the program is the design phase and making the decision as to whether to accept the premise that 70% of the meters or more are accurate and 10% or less of the meters are fast. This meter sampling program went into effect in 1980. The program will be re-evaluated in 1983, but at the moment the results appear promising, and it is felt that statistical sampling will successfully replace the 15-year meter change program. (Baker-FRC)
W82-06350

HOW RATE STRUCTURES AND ELASTICITIES AFFECT WATER CONSUMPTION,

Florida Univ., Gainesville. Dept. of Food and Resources Economics.
D. Comer, and R. Beilock.
Journal of the American Water Works Association, Vol 74, No 6, p 285-287, June, 1982. 2 Tab, 3 Ref.

Descriptors: *Water conservation, *Pricing, Water users, Water rates, Economic aspects, Conservation.

Decision makers must analyze the implications of alternative rate structure devices carefully, with respect both to the projected results from implementing a new rate structure and to the sensitivity of those results to the underlying assumptions that are made to generate the projections. Decision makers need to examine the implications of alternative pricing structures by varying the underlying assumptions so that a range of projections from which to choose a new rate structure is available. The sensitivity of the results of a declining rate structure to changes in the accompanying underlying assumptions is examined. The example considered was used to demonstrate how a declining rate structure can be more effective in conserving water than either an inclining or a single rate structure. Three assumptions are crucial to the results of this method. First, the revenues collected cannot be greater than the revenues needed. The second asssumption concerns the relative sizes of the high- and low-use groups. For water conservation purposes, a declining rate structure becomes less effective as the high use groups become larger in relation to the low use groups. When a pricing system is designed to promote consumption by one group relative to another, the larger the group enjoying lower prices, the greater will be total consumption. The third assumption concerns the relative price elasticities between the groups. The absolute value of the elasticity indicates the responsiveness of quantity demanded to a change in price, and the sign of the elasticity indicates the type of response that occurs. (Baker-FRC)
W82-06351

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME 2: USER'S MANUAL,

Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W82-06381

A METHOD FOR WASTEWATER TREATMENT SYSTEM USER COST ALLOCATION, VOLUME I: STUDY REPORT,

Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5D.
W82-06382

CRISIS: FINANCING WATER AND WASTEWATER,

Thames Water Authority, London (England).
E. J. Gilliland, and S. H. Hanke.
Water/Engineering and Management, Vol 129, No 7, p 41-43, June, 1982. 4 Ref.

Descriptors: *Financing, *Accounting, *Depreciation, *Water treatment, *Wastewater treatment, Economic aspects, Capital, Water rates, Pricing, Grants, Loans, User charges.

Developments in financing water and wastewater treatment are discussed. Four methods of financing capital investments are available: contributions by new customers (connection charges, etc.), government grants, loans, and self-financing. The preponderance of external financig over self-financing has produced several effects on the utilities' financial policies: inadequate charges, dependence on bond issues, favoring low capital cost outlays which may entail higher long-term operating costs, inhibitation of capital investments, and inadequate cash for replacement. To remedy these problems depreciation charges on the current written-down value of assets should be included. The problems of inflation, replacement or rehabilitation of aging assets, and shortage of capital has led to some recommendations by groups in Australia and the United Kingdom. Basically, they call for depreciation on the current cost basis, increased self-financing, more realistic charges for use, integration of financial planning in the management process, and a uniform cost accounting practice. (Cassar-FRC)
W82-06641

FEASIBILITY OF FINANCIAL INCENTIVES TO REUSE LOW QUALITY WATERS IN THE COLORADO RIVER BASIN,

Denver Research Inst., CO.
For primary bibliographic entry see Field 3C.
W82-06693

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: A COST ANALYSIS,

Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W82-06796

METHODS FOR APPORTIONING THE COST OF A WATER RESOURCE PROJECT,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. P. Heaney, and R. E. Dickinson.
Water Resources Research, Vol 18, No 3, p 476-482, June, 1982. 3 Fig, 1 Tab, 15 Ref.

Descriptors: Water resources projects, *Cost allocation, *Pricing, Economic aspects, Cost analysis, Costs, Model studies, Mathematical studies, Mathematical equations, Game theory, Tennessee Valley Authority.

Existing methods for examining the problem of apportioning costs among project participants in a fair manner are reviewed. Concepts from cooperative n-person game theory are offered as providing a unified conceptual framework for doing these analyses. Finally, a new method, the minimum costs, remaining savings (MCRS) method is proposed as an improvement over existing techniques. The MCRS method can be viewed as a generalization of the presently used separable costs, remaining benefits method. (Baker-FRC)
W82-06853

COST ALLOCATION IN WATER RESOURCES DEVELOPMENT,

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
H. P. Young, N. Okada, and T. Hashimoto.
Water Resources Research, Vol 18, No 3, p 463-475, June, 1982. 3 Fig, 10 Tab, 31 Ref.

Descriptors: *Water resources development, *Cost allocation, Pricing, Economic aspects, Cost analysis, Costs, Mathematical studies, Mathematical equations, Multipurpose reservoirs, Game theory, Sweden.

It is necessary to choose rationally among the many different methods of allocating the costs of a joint water resource facility among the different area users. Using a definite computational procedure itself provides some semblance of rationality. However, the justification of a method lies in its behavior in practice, and it is thus necessary to compare the different methods on the basis of principle. Among the most important of these principles are individual rationality, group rationality, insensitivity to the definition of direct costs, monotonicity in costs, and no payments to dummies. A more general principle is simplicity in terms of computational and informational demands. Game theory methods all suffer from the disadvantage that they are fairly complicated and require detailed information on costs. All the methods except for the simplest proportional allocation schemes rely on information about demands and the optimal scale of development that in practice may be unreliable or nonexistent. This is particularly true for long term investment projects. It is therefore not surprising to find that a simple scheme based on allocating costs in proportion to the population was the one actually chosen. (Baker-FRC)
W82-06854

6D. Water Demand

THE ENERGY RESOURCES OF KENYA,

Ewbank and Partners Ltd., Brighton (England).
P. W. Fielder, and T. W. Berrie.
International Water Power and Dam Construction, Vol 4, No 4, p 39-41, April, 1982. 4 Fig, 3 Tab.

Descriptors: *Hydroelectric power, *Economic aspects, Hydroelectric plants, Powerplants, Electric power, *Kenya, South Africa, Developing countries, Regional development, Energy.

In attempting to meet the high cost of imported fossil fuels, Kenya is trying to develop its local energy sources such as hydropower, as well as strengthen the interconnecting links with surrounding countries. Commercial energy consumption in Kenya is below that for the average low-income countries, but its energy imports as a percentage of merchandise exports are high, due to the very high cost of oil imports. The main indigenous energy resource is hydroelectric power with a potential of about 5500 MW. About half of this is scattered among small rivers, many of which are economically exploitable. The main source of hydroelectric power is the Tana River. The main thermal station, Kipevu, is on the coast of Mombasa. There are diesel plants at Nairobi and other load centers with gas turbines for peaking at both Mombassa and Nairobi. The most important factor for ensuring optimum generation is making the best use of the Tana River flow which is a function of rainfall patterns. (Baker-FRC)
W82-05978

AVAILABILITY AND QUALITY OF WATER FROM UNDERGROUND COAL MINES IN JOHNSON AND MARTIN COUNTIES, KENTUCKY,

Geological Survey, Louisville, KY. Water Resources Div.

For primary bibliographic entry see Field 3B.
W82-06136

ESTIMATING WATER DEMAND SCHEDULES FOR SELECTED INDUSTRIES IN ARKANSAS,

Arkansas Water Resources Research Center, Fayetteville.
J. A. Ziegler, and S. E. Bell.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243759, Price codes: A05 in paper copy, A01 in microfiche. Publication No 85, September 1981. 86 p, 17 Tab, 81 Ref. OWRT A-048-ARK(1), 14-34-0001-9999.

Descriptors: *Cost analysis, *Water demand, *Industrial water, *Estimated costs, Mathematical studies, Cooling water, Economic aspects, Costs, Projections, Prediction, Water costs, Planning, Water use, User charges, Water use efficiency, *Chemical industry, *Pulp and paper industry, Evaluation, Estimating equations, *Arkansas.

Water demand functions were estimated for the paper and chemical industries in Arkansas using data collected from individual industrial plants throughout the state. Water demand functions were estimated using regression analysis on data derived from information on: water intake and gross use by source; recirculated water use; costs of acquiring, treating, and discharging water; plant output; plant employment; and plant level of technology. The demand for water intake was primarily estimated as an exponential function of the average water costs and the level of technology. Cost elasticities of demand were estimated as being approximately equal to one for both industry types (-0.94 for chemical plants; -1.06 for paper plants). It was determined that the results could be used to assess the effects of various public policies (e.g., water quality standards) on water withdrawal for industrial purposes. From historical analysis and water demand function estimates, it appeared that industrial water use has followed national trends, particulqrly for the heaviest industrial water user, the paper industry. However, the data indicated that the two Arkansas industries examined are somewhat more responsive to water cost changes than is true nationally. (Zielinski-MAXIMA)
W82-06160

AN INVESTIGATION OF SOME FACTORS INFLUENCING THE PERFORMANCE OF A RECREATIONAL TROUT FISHERY,

Severn-Trent Water Authority, Birmingham (England), Scientific Services.
K. A. Bryan.
Journal of Applied Ecology, Vol 19, No 1, p 113-131, April, 1982. • Fig, 5 Tab, 29 Ref.

Descriptors: *Fish populations, *Recreation facilities, Fishing, Water quality, Tittesworth Reservoirs, Lakes, Drawdown, Drought, Water demand.

Following complaints from fishermen that the fish in the Titteworth Reservoir 'put and take' trout fishery were emaciated and difficult to catch, an investigation was conducted comparing these fish with fish from other sources, as well as monitoring water quality and phytoplankton samples. The trout were shown to have suffered a temporary setback in 1976, which was primarily atrributable to the drought of 1975/76. Phytoplankton numbers, which prior to 1976 were considered large enough to warrant annual treatment with copper slufate, dropped significantly and had not recovered by 1979. Chemical analyses had not revealed any change in water quality. Nitrate and silicate concentrations showed no trends during 1969-79, although phosphate levels decreased very slightly. The severe drawdown and reduced retention time of the reservoir in 1975-76 was perhaps the reason for the diminished phytoplankton, although it is more commonly thought that the greatly increased zooplankton population contributed to the algal loss through grazing. Analysis of the gut contents of trout in 1977 and 1978 revealed that large amounts of plant material and indigestible items had been eaten. Fish stomachs in both years were frequently empty. It was concluded that the repeated drawdown of the reservoir for water supply, including the effects of the 1975-76 drought, may have reduced the numbers and species diversity of food organisms available. (Baker-FRC)
W82-06329

POLICING DEMAND THROUGH PRICING,

Fairfax County Water Authority, Merrifield, VA.
F. P. Griffith, Jr.
Journal of the American Water Works Association, Vol 74, No 6, p 288-291, June, 1982.

Descriptors: *Water demand, *Pricing, Conservation, Economic aspects, Water conservation, Water rates, Fairfax County Water Authority, *Virginia.

The Fairfax County Water Authority provides water service to a large segment of the northern Virginia population, comprising all or part of three municipal jurisdictions. The authority acts as the county's billing agent for sewer service charges based on water consumption. The area has an annual average rainfall of 12 meters. The case for water use management or conservation stems not from a scarcity of water but rather from the unwillingness of the citizenry to construct unwarranted water and sewer facilities. The water use management goal for this area is aimed at utilizing the water economically and assessing the cost for various activities equitably. The objective is to avoid wasting water regardless of the water use activity the customer selects, without passing judgment on the merits of the activity. The four most sifnificant activities for fostering a more acceptable customer attitude for direct water conservation include alerting customers to unusually high consumption prior to billing and investigating the cause, issuing pressure-reducing valves without cost to customers whose plumbing predates the existing Code, submitting suggestions for plumbing code revisions relative to water conservation to the jurisdictions served by the authority, and utilizing a peak use charge as part of a rate schedule to lower the maximum or peak demands The peak use charge applied in this county is acceptable to customers because it economically encourages water conservation during peak seasons, it is a fair and equitable rate, it is not punitive, it has an economic basis, it affects only the one fourth of the customers who create the demand, and customers who minimize winter consumption and who do not exceed their peak period allowance can maintain an economical annual water and sewer cost. (Baker-FRC)
W82-06352

DISTRIBUTING THE RISKS OF INTERBASIN WATER TRANSFERS UNDER DROUGHT CONDITIONS: THE DILEMMA POSED BY COAL SLURRY PIPELINES.

Teknekron, Inc., Berkeley, CA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256595, Price codes: A10 in paper copy, A01 in microfiche. Report, March, 1982. 201 p, 13 Fig, 41 Tab, 98 Ref, 4 Append. OWRT C-90202-G (0419) (1) 14-34-0001-0419.

Descriptors: *Interbasin transfers, *Pipelines, *Coal, *Drought, *Water supply, Water transfer, Conveyance structures, Pipes, Slurries, Coal mining, Water deficit, Water shortage, Water demand, Water conveyance, Water requirements, Interstate compacts, Water use, Alternative water use.

Problems are examined concerning the use of western water to transport coal in slurry pipelines from mines to generating facilities during western water shortages. Potential water shortage risks to the parties-at-interest were identified and reviewed. It was found that, while each of three pipelines considered originates in an arid western state (Wyoming, Colorado, Utah), the water availability level, water use for irrigation, and the likelihood of local water shortages in the surrounding community varies considerably in each locale. The risks associated with western water use for pipelines fall heaviest on agricultural users who might need such water during water shortage periods. It is concluded that, to mitigate this problem, pipeline companies must analyze their selection of a water source for pipelines more carefully; as a condition of directing this water, they should participate in further water resource development and conservation projects beneficial to the surrounding community, and they should seek to alter adverse public perceptions associated with coal slurry pipelines in the western states. Further, additional study must be made on the hydrologic characteristics of water sources that may be used for pipeline diversions, and on the precedential effect of using Missouri River water for the ETSI pipeline (running from Wyoming's Powder River Basin to Oklahoma, Arkansas, and Louisiana). (Zielinski-MAXIMA)
W82-06365

MUNICIPAL AND INDUSTRIAL WATER DEMANDS OF WESTERN U.S.,

Southern Univ., Baton Rouge, LA. Dept. of Civil Engineering.
E. S. Joseph.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil engineers, Vol 108, No WR2, p 204-216, June, 1982. 4 Fig, 11 Tab, 18 Ref.

Descriptors: *Water requirement, *Industrial water use, *Municipal water, Water demand, Water consumption, Water conservation, Water use, Western states, Prediction, Energy, Mining, Arid lands.

Water requirements for the western U.S. are separated into residential, municipal and industrial uses. In 1980 the average per capita residential use in 17 western states was 125 gal per day; average municipal and industrial use, 195 gal per day. The ratio of maximum to average total water use was 1.88. Factors affecting water requirements are population, degree and type of industrial development, level of economic development, climate, metering and pricing, water pressure and leaks, and degree of residential conservation. The ratios of projected water requirements to 1980 requirements for the west as a whole are 1.05 for 1985 and 1.20 for 2000. Similar ratios for industrial water use are 1.08 for 1985 and 1.13 for 2000. Ratios for combined municipal and industrial use are 1.07 for 1985 and 1.16 for 2000. Manufacturing uses 38% of industrial water in the west at present; energy, 43%; and mining, 19%. By the year 2000 mining's share is expected to increase 22% and manufacturing to decrease to 30%. No significant changes are anticipated in per capita municipal water use. Although the industrial sector is expected to save water by conservation, the ratio of consumption (the part of withdrawal which is evaporated) to industrial withdrawal is expected to nearly double (0.26 to 0.49) from 1980 to 2000. The tables in this paper are further subdivided, giving separate listings of the above projections for nine western areas, for residential and commercial-public municipal use, for three types of industries (manufacturing, energy, and mining), and for eight categories of manufacturing. (Cassar-FRC)
W82-06463

RUTLAND WATER NATURE RESERVE: CONCEPT, DESIGN AND MANAGEMENT,

Leicestershire and Rutland Trust for Nature Conservation (England).
T. P. Appleton.
Hydrobiologia, Vol 88, No 1-2, p 211-224, March, 1982. 5 Tab, 2 Fig, 8 Ref.

Descriptors: *Wilderness areas, *Wildlife, *Wildlife habitats, *Conservation, Reservoirs, England, Water supply, Land use, Zoning, Land resources, Project planning, Design criteria, Recreation, Water sports, Forest watersheds, Rutland water, Multipurpose reservoirs.

Practical conservation management has helped to create a nature reserve of international importance for wildfowl at Rutland Water. The reserve is composed of three sections - one with public access, one undisturbed, and one with restricted access for naturalists. Disturbance to the wildfowl was further minimized by separating conflicting recreational activities from animal habitats, by es-

tablishing a 50 meter sanctuary zone around the reservoir, and by constructing special wildfowl lagoons. Reservoir operation must be carefully planned to foster wildfowl populations. (Titus-FRC)
W82-06471

ESCAPING FROM PRISON: AN ECONOMIC REASSESSMENT OF RUTLAND WATER,

Leicester Univ. (England). Dept. of Economics.
P. R. Herrington.
Hydrobiologia, Vol 88, No 1-2, p 27-42, March, 1982. 5 Tab, 30 Ref.

Descriptors: *Economic aspects, *Evaluation, *Water demand, *Public policy, *Reservoirs, Cost analysis, Water rates, Economic evaluation, Economic prediction, Water supply, Water supply systems, Forecasting, Projections, Growth rates, Rutland Water, *England.

Recently in the water industry interest has been growing regarding solutions to the widening supply-demand gaps. In this vein, the 1970 decision to build Rutland Water is reassessed. The reassessment reveals that the expected population growth had been overestimated and the water demand forecasts were inaccurate. In the projections no distinction was made between unmetered and metered consumption. Although very little data was available at the time the construction decision was made, the expectation of rapid population growth at the time was sufficient to lead to the decision to build the reservoir. By 1981 a dramatic reduction in expected population and per capita water supply growth had occurred; had the choice of building a reservoir been faced in 1981, the decision would probably have been not to build. (Titus-FRC)
W82-[illegible]479

A 'REGRETTABLE NECESSITY' - THE DECISION TO CONSTRUCT,

North Yorkshire County Council (England).
For primary bibliographic entry see Field 6B.
W82-06480

RUTLAND WATER - FROM CONCEPTION TO OPERATION,

Anglian Water Authority, Leicestershire (England).
E. A. Knights.
Hydrobiologia, Vol 88, No 1-2, p 7-17, March, 1982. 1 Tab, 4 Fig.

Descriptors: *Reservoirs, *Reservoir operation, *Economic aspects, *Public opinion, England, *Project planning, Evaluation, Water supply, Water demand, Public policy, Water policy, Construction, Rutland Water, Multipurpose reservoirs.

Rutland Water was planned in the 1960s to meet the water needs of the East Midlands region of England. Chosen from 64 possible sites, it was approved in 1970, subject to the following restrictions: (1) the economic burden should not fall entirely on the local ratepayers; (2) perimeter lands should be returned to agricultural use; (3) new roads and services should replace those lost to flooded areas; (4) adequate compensation flow was required in the river below the dam, and (5) the character of the landscape and the rivers involved should be retained. Construction began in 1971 and filling of the reservoir began in 1975; pumping from the rivers began in 1976; the reservoir was completely filled by 1979. It requires relatively little maintenance, although siltation has produced colonies of submerged plants in some areas and erosion has occurred at the margins of the reservoir. Recreational uses of the reservoir--especially fishing and sailing--are integrated with its water supply function. (Titus-FRC)
W82-06481

EVALUATION OF DEMAND MANAGEMENT POLICIES FOR CONSERVING WATER IN URBAN OUTDOOR RESIDENTIAL USES,

Policy Sciences Associates, Boulder, CO.
For primary bibliographic entry see Field 3D.
W82-06669

TRUCKEE MEADOWS WATER USE - PRESENT AND FUTURE,

Nevada Univ. System, Reno. Desert Research Inst.
For primary bibliographic entry see Field 3D.
W82-06705

ALLOCATION OF WATER FOR RESOURCE DEVELOPMENT,

Clyde, Pratt, Gibbs, and Cahoon, Salt Lake City, UT.
E. W. Clyde.
Natural Resources Lawyer, Vol 14, No 3, p 519-540, 1982. 48 footnotes.

Descriptors: *Water rights, *Energy, *Water allocation, Water storage, Water conservation, Water transfer, Water supply, Water law, Legal aspects, Water management, Appropriation, Permits, Industrial water, Irrigation water, Excess water, Institutional constraints, Interbasin transfers, Contracts, Public rights, State jurisdiction.

The large quantities of water required for energy development in the western U.S. may be obtained by several means. This paper reviews the historical development of water rights and the changing allocation system. Statutes are beginning to recognize public interest as a significant factor in assigning water rights. 'New' water available during high water in random years may be stored under a permit system. Good management of surplus flows can also produce 'new' water, for example, using excess surface water during wet years instead of pumping groundwater. Water shortages can be created by legal constraints: prohibition of interbasin and interstate transfers, legislative control of large appropriations, and legal uncertainties such as Indian water rights and the ownership of wastewater effluents. There are several ways for energy companies to assemble water rights for a large project--purchase of early priorities, storage in underground basins or reservoirs, contracting to buy water when needed, replacing lost crops during dry years in exchange for primary water rights, building storage or improving irrigation efficiencies for local farmers, and direct purchase of water with no conditions attached. (Cassar-FRC)
W82-06839

6E. Water Law and Institutions

THE GROUND WATER LEGAL REGIME AS INSTRUMENT OF POLICY OBJECTIVES AND MANAGEMENT REQUIREMENTS,

Hunter Coll., New York.
R. D. Hayton.
Natural Resources Journal, Vol 22, No 1, p 119-138, January, 1982. 1 Fig, 12 Ref.

Descriptors: Legal aspects, Water resources development, *Groundwater management, Water supply, Water demand, Regulations, Management.

The search for and extraction of groundwater supplies has been of interest only in recent times. Man is waking up the disastrous consequences of unrestrained groundwater use and abuse. The essentials of traditional groundwater law are reviewed. The widespread agreement among specialists that underground water law and administration should now be treated as part of all freshwater resources law and administration has more meaning than simply the placement of the ground water rules in the same law or regulatory document where surface water norms are found. It means that the same basic development, use and conservation policies should be applied to the resource as a whole. Identical treatment in the law and regulations is not intended. Integrated management is sought in order to achieve the optimum sustained yield of a nation's total water resources. Peculiar physical incidents in the appearance, movement and availability of groundwater that require special regulations and a particular administration are noted. Even so, the makers of development and environmental protection policy need to have at their disposal the entire picture of the quality and quantity of the water resources within their jurisdiction, including underground water resources, and to be able to work toward optimum use of the whole, without major sacrifice of other values enshrined in the community they serve. (Baker-FRC)
W82-05938

THE DEVELOPMENT OF INTERNATIONAL GROUNDWATER LAW,

New Mexico Univ., Albuquerque.
A. E. Utton.
Natural Resources Journal, Vol 22, No 1, p 95-118, January, 1982. 88 Ref.

Descriptors: *Legal aspects, *Groundwater management, Legislation, Regulations, Water demand, Water resources development, *International law, International agreements.

Increasing demands on water supply and a lack of adequate laws and legal institutions for the management of groundwater or the resolution of disputes will lead to problems in the future. Increased population means increased competition for water. While the United Nations reports that there is no actual physical global shortage of water, there is an uneven distribution of the resource. It is imperative that available supplies be managed prudently and utilized efficiently. The laws governing groundwater nationally are inadequately developed. Developments in national groundwater law are reviewed, along with developments in transboundary groundwater law. Recommendations are offered for the management of transboundary groundwaters. Some management alternatives are offered, including equitable apportionment, case-by-case negotiation, comprehensive management, the allocation process, and studies of water quality. (Baker-FRC)
W82-05939

THE LAW OF INTERNATIONAL AQUIFERS,

Hunter Coll., New York.
R. D. Hayton.
Natural Resources Journal, Vol 22, No 1, p 71-93, January, 1982. 62 Ref.

Descriptors: *Legal aspects, *Aquifers, Groundwater, Water resources development, Regulations, *International law, International agreements.

An accounting was made of the efforts exerted to date at the international level, both intergovernmental and nongovernmental, toward consideration of transnational groundwater in conjunction with surface water and within intergovernmental institutions tailored to the purpose. In the future conjunctive use and integrated protection of groundwater and surface water may become a reality, from the planning stage to the delivery of water services. Perceptions at the international level are described as of 1966, when the Helsinki Rules were adopted. International developments since 1966 are noted. Events are noted in the field of groundwater law and administration at the national level. In most countries the legal regimes governing groundwater are still substantially separated from the legislation or case law governing surface waters. Groundwater rights are usually appurtenances to the land, but even where restrictions, including permit systems, have been imposed, the owner of the overlying land still enjoys a preferred position. The trend is clearly in the direction of severing water rights from the property law concept of ownership in the classical, strict sense. Surface waters nearly everywhere today are subject to significant use regulation. The growing willingness of communities to exercise some control over groundwater can be seen in the widespread, quantitative limitations on pumping. (Baker-FRC)
W82-05940

FEDERAL WATER POLLUTION CONTROL ACT'S NOTICE REQUIREMENT LIBERALLY CONSTRUED,

J. Pruett.
Natural Resources Journal, Vol 22, No 1, p 243-245, January, 1982. 12 Ref.

Descriptors: *Water pollution control, *Legal aspects, Wastewater discharge, Legislation, Jurisdiction, Legal review, *Shenango River, *Pennsylvania.

A citizens' suit was filed in federal district court pursuant to the Federal Water Pollution Control Act. The complaint in this suit alleged that members of the Board of the North and South Shenango Joint Municipal Authority and various conctractors and construction corporations were releasing untreated sewage into the Shenango River and its tributaries. Eventually the court found that the Authority had violated state discharge limits and ordered the Authority to prepare a timetable containing plans to reduce its discharge to legal limits. There was lengthy discussion that proper notice had not been given, and the defendants argued for dismissal on those grounds. However, the courts followed a broad interpretation of the absolute notice requirement. In the exercise of the court's discretion, however, it had closely followed the legislative intent behind the notice requirement. All defendants had time to investigate the alleged violations and correct them, or to prepare a defense. This approach should be followed in other courts, as it both satisfies legislative intent and also conserves judicial resources. (Baker-FRC)
W82-05986

REVIEW OF TREATIES ON CONSUMPTIVE UTILIZATION OF WATERS OF LAKE VICTORIA AND NILE DRAINAGE SYSTEM,

Nairobi Univ. (Kenya). Inst. for Development Studies.
C. O. Okidi.
Natural Resources Journal, Vol 22, No 1, p 161-199, January, 1982. 192 Ref.

Descriptors: *Water resources development, *Treaties, Legal aspects, Legislation, International agreements, *Nile River, *Lake Victoria, Drainage basins, Consumptive use, Africa, Water use, Planning.

All of the states sharing the Nile and Victoria basins have achieved political independence since 1960, yet there have been no agreements concluded since that time on the uses of the Nile. Since 1960 the range of uses to which the water is put presumably has increased, and there may be many plans under consideration for still wider water usage, so that the safeguards in the pre-1960 treaties will prove inadequate. This paper analyzes the range of instruments that has been signed in an attempt to create cooperation in the consumptive uses of the waters of the Nile Basin, the adequacy of existing treaties to cope with the full range of possible and actual uses of those waters, and some recent developments in terms of actual or planned projects in the basin states, which indicate an urgent need for an up to date framework for dealing with Nile and Lake Victoria waters. Geographical and technical perspectives are considered. Agreements on the Nile and Lake Victoria waters are reviewed, including pre- and post World War I agreements, the Owen Falls Dam agreements, the 1959 agreement for full utilization of the Nile waters, the protocol concerning the permanent joint technical commission, the agreement for the hydrometeorological survey of Lakes Victoria, Kyoga, and Albert, and the agreement for the establishment of the organization for management and development of the Kagera River basin. Post-1959 agreements for Egypt, Sudan, Ethiopia, Tanzania, and Kenya are presented. What seems abundantly clear throughout these agreements is the desirability of a framework for consultation and exchange of information on actual or intended projects involving utilization of the basin waters. (Baker-FRC)
W82-05987

SMALL SCALE HYDROELECTRIC DEVELOPMENT AND FEDERAL ENVIRONMENTAL LAW: A GUIDE FOR THE PRIVATE DEVELOPER,

Boston Coll., Chestnut, MA.
S. H. Burke.
Boston College Environmental Affairs Law Review, Vol 9, No 4, p 815-861, 1981. 315 Ref.

Descriptors: *Hydroelectric power, *Legal aspects, Electric power generation, *Federal jurisdiction, Regulations, Reviews, Licensing, Planning, Water use, Water resources management, Environmental effects.

This article provides a general guide to the major federal environmental laws affecting the planning and construction of hydroelectric facilities and shows how the federal licensing process has been affected by these laws. Each statute is described in sufficient detail to familiarize the reader with the scope and purpose of the law and to allow him to predict generally its impact on a particular proposal. The article is divided into three broad areas: disclosure and consideration of environmental impacts, which describes the role of federal regulatory agencies in the evaluation of the general and resource-specific environmental impacts of proposed hydroelectric facilities before authorizing their construction; federal resource management, which provides for the protection, conservation, and management of particularly sensitive resources; and compliance with licensing procedures to ensure environmental protection. While the development of the hydroelectric potential of the country's rivers and streams will continue to be strongly influenced by the wealth of federal environmental legislation passed in the last two decades, regulatory agencies may not authorize a project before the environmental effects of the facility have been identified and considered. Special attention must be given to preservation of endangered species, fish and wildlife resources and historic resources. Proponents of hydroelectric development should be familiar with the requirements of federal environmental law and should consult with appropriate federal agencies to identify environmental impacts of such facilities. (Baker-FRC)
W82-06002

DISCUSSION ON AN ECONOMIC ANALYSIS OF WATER CONSERVATION POLICY, BY WILLIAM WHIPPLE,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
L. Shabman.
Water Resources Bulletin, Vol 18, No 2, p 345-347, April, 1982. 7 Ref.

Descriptors: *Water policy, *Political aspects, *Water conservation, Legal aspects, Economic analysis, Conservation, Reservoirs, Water resources development, Water storage, Dam construction, Legislation.

A comment on the above paper, originally published in Water Resources Bulletin, Vol. 17, No. 5, p 814-819, extends the discussion of the failure of the Carter administration water policy reform proposals. Although the original proposal included groundwater management, fish and wildlife habitat maintenance, and a broadening of management alternatives, halting of construction projects and water conservation were strongly emphasized. A battle developed between congressional committees (in control of water policy for many years) and the administration over the definition of conservation, whether or not conservation included surface water storage. The debate centered on demand reduction (administration) vs. surface storage (opponents), and the two branches of government never arrived at an effective policy reform. The proposed technical assistnace grants program designed to improve the states' water resources planning capacity was eliminated by the Senate because approval would have meant agreement with the administration's definition of conservation. (Cassar-FRC)
W82-06069

APPLICATION PROCEDURES FOR HYDROPOWER LICENSES, EXEMPTIONS AND PRELIMINARY PERMITS,

Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Report FERC-0097, April 1982. 192 p, 2 Tab, 2 Append.

Descriptors: *Hydroelectric plants, *Licensing, *Legal aspects, *Permits, Regulations, Construction, Dams, Electric powerplants, Feasibility studies.

The Federal Energy Regulatory Commission assumed most of the responsibilities for regulating non-Federal hydroelectric power projects. The commission issues preliminary permits and licenses, and grants exemptions from licensing for the purpose of authorizing construction and operation of non-Federal hydroelectric projects. The Commission has revised its regulations to simplify and expedite the hydropower licensing process. The amount of information required for each type of application is directly related to the complexity of the proposed action. The Commission's revised regulations and the basic requirements for filing each type of application are presented. The Commission's regulations provide a range of alternatives for development of a hydropower project. A prospective developer may elect to apply for a preliminary permit, which allows a specific term for the developer to determine the feasibility of developing a hydropower project at a specific site, and to perform studies to support a license application. The Commission's regulations for licensing group proposed projects according to the level of anticipated complexity and potential impact into three categories: major unconstructed projects and major modified projects greater than 5 MW; major projects greater than 5 MW at existing dams; and minor projects and major projects 5 MW or less. The exemption procedure was instituted for small hydroelectirc projects which meet certain characteristics and have an installed capacity of 5 MW or less. (Moore-SRC)
W82-06088

UNITED STATES V. WARD: FWPCA CIVIL PENALTY PROSECUTION, NOT A CRIMINAL CASE FOR THE FIFTH AMENDMENT,

M. G. Grace.
Columbia Journal of Environmental Law, Vol 8, No 1, p 115-135, 1981. 129 Ref.

Descriptors: *Water law, *Environmental protection, *Civil law, *Federal jurisdiction, *Judicial decisions, Legal aspects, Case studies, *Water quality standards, Civil defense, Water pollution control, Jurisdiction.

The Federal Water Pollution Control Act (FWPCA) is designed to restore and maintain the chemical, physical, and biological integrity of the Nation's water. Under section 1321 of the act, failure to report oil spills or spills involving other contaminants is a criminal offense punishable by a fine of up to $10 thousand and/or imprisonment. In the Supreme Court case of the United States v. Ward, the court had the opportunity to define the constitutional limits on compulsory self-reporting in a leading environmental protection statute carrying a penalty labeled as civil. An in-depth study of section 1321 would have established guidelines for future challenges to the congressional labeling of penalty provisions and prevented trends toward administrative streamlining which endangers the right against self-incrimination. Instead, the Supreme Court ignored the guidance laid down in an earlier case and subordinated the rights of individual defendants by upholding the civil penalty feature of the act and denying offenders the rights accorded to criminal offenders. (Geiger-FRC)
W82-06181

TRAGEDY OF THE SAN FRANCISCO BAY COMMONS,

San Francisco Bay Inst., CA.
W. T. Davoren.
Coastal Zone Management Journal, Vol 9, No 2, p 111-153, 1982. 2 Fig, 61 Ref.

Descriptors: *Bays, *Water resources development, Water supply development, San Francisco Bay, California, California Coastal Act, Legal aspects, Legislation, Planning.

In 1968 the attention given to the problems of San Francisco Bay was reaching its peak. The California Coastal Commission was established in 1966, and in 1981 it was again before the Legislature for fine tuning. However, the San Francisco Bay area was not included in the more rigorous requirements which were applied to the coast from 1973

to 1976, nor in the 1976 Coastal Act. At present the Bay Conservation and Development Commission is directed to rely on the Federal Coastal Zone Management Act's consistency features to overview the Corps of Engineers' actions on permits in many areas. Much of the history of California revolves around water and its development for man's use. Much of the history of California revolves around water and its development for man's use. Two giant public water development projects, one federal and one state, have dominated California water issues since the 1930s. These were the Central Valley Project of the Bureau of Reclamation and the State Water Project. Both the state and federal projects are readying for a new round of expansion. State water politics are currently dividing along lines that define its seven or more water regions. Several studies have been made of the bay's progress and prosperity, including the Reber Plan, the SERL Studies, Kaiser Engineers Report, and others. During the period of deep environmental concern of the 1970s, little was accomplished as far as the San Francisco Bay's predicament is concerned. Two federal projects, the super dam and the drain, will have great influence in the future on the Bay area. A brief summary of what the Bay's own agencies have been doing is presented. (Baker-FRC)
W82-06182

WATER LAW AND THE DEVELOPMENT OF GEOTHERMAL RESOURCES,

O'Melveny and Myers, Los Angeles, CA.
O. Olpin, and B. H. Thompson.
Natural Resources Lawyer, Vol 14, No 4, p 635-654, 1982. 44 Ref.

Descriptors: *Geothermal resources, *Legal aspects, Resources development, Natural resources, Geothermal power, Electric power production, Water law, Federal jurisdiction, Public rights.

Two distinct types of legal problems may emerge in geothermal developments: the need to seed water from outside the geothermal system for cooling and other uses, and the need to produce geothermal fluids as the transfer medium for the heat energy. Various approaches to the second type of problem are reviewed, problems associated with the fluids, in liquid or gaseous form, produced by geothermal wells. A brief survey of western water law is presented, concerning both surface and groundwater. Problems for hydrothermal systems using groundwater arise through the need to abide by state water laws which may have been designed for other contexts and thus call for inappropriate procedures. Even more significant problems arise from various state rules and regulations designed to protect prior appropriators' groundwater sources. The geothermal developer may find that the desired development is in a designated critical basin or is connected to an aquifer that is being depleted. Under these conditions it will be difficult to obtain an appropriation permit, at least for the amount of fluids that he foresees his development will need. In many states it is also necessary that the proposed appropriation be in the public interest, which may mean that the developer will have to convince another layer of the state government that the development is in the public interest as that agency sees the situation. The doctrine of 'developed water' may be helpful in some states, as one who develops water which would not otherwise have been generally available is entitled to appropriate the water without regard to normal state water rules. The use of Federal reserved water rights may also be helpful. Several recommendations are offered to ease the situation for geothermal entrepreneurs. (Baker-FRC)
W82-06218

IMPLICATIONS FOR THE WATER INDUSTRY OF THE NOTIFICATION SCHEME FOR NEW CHEMICALS,

Department of the Environment, London (England).
N. J. King.
Water Pollution Control, Vol 81, No 2, p 245-254, 1982. 5 Ref.

Descriptors: *Data collections, *Chemical compounds, Chemical properties, Toxicity, Solubility, Permeability, Chemical reactions, Environmental effects, International commissions, International agreements, Legal aspects.

The notification scheme for new chemicals requires that all new chemicals with a sale of greater than 1 tonne per year must be reported to the national competent authority, including information in the notification regarding use, production level, properties, and special handling, storage, labeling and disposal requirements; that the competent authority may require additional information at any time but must consider the need for such information as various levels of production and sales are reached; that certain categories of substances are exempted and others are already subject to similar directives under other laws; as well as additional requirements. While the directive requires the Commission of the European Communities and the member states to keep confidential information secret, the final decision on what is confidential rests with the compent authority. At its simplest, the scheme is a means of monitoring industry's compliance with the general duties to take steps to ensure the safety of its products and to protect the environment. As the information accumulates, it would in time serve as an invaluable source of data should an emergency occur. Others in the water industry, for example, may need information on toxicity, degradability, or other properties of chemicals and would now be able to secure such information. Such an accumulation of substance-related information is also likely to be a valuable tool in developing knowledge of structure-activity relationships, particularly if it can be linked to data collected in the field. In this respect the water industry may be able to contribute field experience, (Baker-FRC)
W82-06261

TECHNICAL CONTROL OF SEWAGE SLUDGE DISPOSAL TO SEA,

Thames Water Authority, London (England).
For primary bibliographic entry see Field 5E.
W82-06291

THE FEDERAL RESPONSE TO GROUND WATER PROTECTION,

By K. McCray.
Water Well Journal, Vol 36, No 6, p 42-43, June, 1982.

Descriptors: *Groundwater management, *Legislation, Water pollution control, Water resources development, Mining wastes, Hazardous wastes, Legal aspects, Water conservation, Drinking water.

The use of the nation's groundwater resources has been significantly affected by five items of federal legislation. The Clean Water Act was in reality a series of 1972 amendments to the Federal Water Pollution Control Act of 1948 whose main objective was to protect surface water. With its emphasis on surface waters, the Act has been thought to have increased groundwater pollution by diverting pollutants from surface waters to the ground. The Safe Drinking Water Act of 1974 was created to protect the drinking water supplies by providing for the establishment of primary and secondary standards for levels of contaminants in water supplies, the creation of an underground injection control program, and the protection of soil-source aquifers. The Resource Conservation and Recovery Act of 1976 is the federal government program for managing solid wastes and hazardous wastes that may significantly contribute to serious illness or that may impose a hazard to human health or the environment when improperly managed. The Surface Mining Control and Reclamation Act of 1977 is intended to prevent imminent danger to the health and safety of the pubic or harm to land, air or water resources resulting from both surface and underground mining operations. The Comprehensive Emergency Response, Compensation and Liability Act of 1980 expands the federal government's response authority to hazardous waste dangers to include pollutants or contaminants which may present an imminent and substantial danger to the public health or welfare. (Baker-FRC)
W82-06295

GROUND WATER LAW IN PUERTO RICO,

Water Well Journal, Vol 36, No 6, p 64-66, June, 1982.

Descriptors: *Groundwater management, *Legislation, *Puerto Rico, *Groundwater protection, Groundwater pollution, Water resources development, Water pollution control.

In 1981 the Rio Piedras Agricultural Station published a first inventory of wells to have been conducted in Puerto Rico. The inventory provides hydrometric information on spring and well water for wells within the jurisdiction of the agricultural station. The residents of rural areas may be the largest users of well water. Puerto Rico has laws for protecting the purity of groundwater. In 1948 the groundwater was felt to be of a quality generally safe to drink, whereas most of the surface waters were polluted and unsafe to drink without prior treatment. Until a few years ago Puerto Rican groundwater had no legal institutional framework to guide its management. No state agency was authorized to control water extraction wells. There was no clear definition of functions and responsibilities related to groundwater. In 1972 the Natural Resources Law created the Department of Natural Resources and transferred most powers and responsibilities to it, including the granting of permits for water use and for drilling of water wells. In 1976 the Law for the Conservation, Development and Utilization of Water Resources in Puerto Rico made waters and water bodies public wealth, and the government was entrusted with managing and protecting this national wealth. The Department of Natural Resources is the agency responsible for monitoring the extraction rate of groundwater, the recharge rate of the aquifers, the reduction of the phreatic level and possible contamination of the aquifers. The Environmental Quality Board is responsible for the preparation and publication of groundwater regulations and standards. The Department of Health protects the purity of the water supplies through monitoring. The Aqueduct and Sewer Authority plans, designs and builds drinking water treatment plants and facilities to serve residential, industrial and commercial areas. The United States Geological survey operates observation wells to detect saline intrusion problems and has performed the majority of the groundwater studies in Puerto Rico. (Baker-FRC)
W82-06296

GROUND WATER AND THE STATES,

By K. McCray.
Water Well Journal, Vol 36, No 6, p 47-50, June, 1982.

Descriptors: *Groundwater management, *Legislation, Legal aspects, Groundwater pollution, Aquifers, *State jurisdiction, Water pollution control, Regulations.

A sampling of legislation that has been or is being considered for the use and protection of groundwater is offered. Other regulatory actions that have taken place in some states are also cited. In Arizona a ruling was made which upheld the constitutionality of the 1980 Ground Water Management Act. In Colorado consideration is being given to a bill that would require persons owning water rights to register such ownership and a current address with the state engineer. In Iowa the Natural Resources Council has called for requirements that specify the need for embankments around quarries to block runoff and for test wells around a quarry to monitor the quality of nearby groundwater. In Kansas the Governor has recognized the state's efforts to control water supplies with a new statewide plan for management of groundwater quality. In Louisiana the water laws are under study regarding ownership, water rights, regulation of chemical waste injection wells, protection of drinking water, and other aspects of water control. In Massachusetts reaction was favorable to increased federal protection of Cape Cod drinking water sources. In Michigan after three years of rejection the Joint Administrative Rules Committee adopted the latest draft from the Department of Natural Resources for compliance with the Solid Waste Management Act, signed into law in 1978.

Mississippi is considering new injection well regulations. Montana has a proposed regulation aimed at preventing aquifer pollution from mining, industrial, municipal and private sources. Nebraska is tightening state policies on reusing irrigation water. New York is studying groundwater use and distribution. Oregon exempted pump installers from registering under various conditions. Laws being considered in Pennsylvania, Rhode Island, South Carolina, Virginia, West Virginia, and Wisconsin are also briefly noted. (Baker-FRC)
W82-06297

GROUNDWATER POLICY: A PATCHWORK OF PROTECTION,

Environmental Law Inst., Washington, DC.
A. Horne.
Environment, Vol 24, No 3, p 6-11, 35, April, 1982. 1 Fig, 71 Ref.

Descriptors: *Groundwater pollution, *Groundwater management, *Legal aspects, *Water pollution control, *Legislation, *Water policy, Water resources development, Groundwater, Regulations, Water management, Local governments, Environmental control, Environmental protection.

The existing legal framework for groundwater protection has come under attack in recent years. This article focuses on the legal framework for groundwater protection rather than on the problem itself. Each of the federal statutes pertaining to groundwater protection (Federal Water Pollution Control Act Amendments of 1972, Safe Drinking Water Act of 1974, Toxic Substances Control Act, Resource Conservation and Recovery Act of 1976, and Surface Mining Control and Reclamation Act of 1977) is briefly described and a summary of state laws is provided. EPA proposed policies for groundwater management assume that federal, state, and local governments already possess sufficient authority and resources to protect existing supplies. Response to these policies have been mixed, with industries declaring the regulations too stringent and environmentalists claiming they are too weak. In 1981, task groups were formed to review groundwater problems. Unresolved issues consist of deciding on the level of water quality desired, relegating authority among federal, state, and local governments, finding proper strategies for the monitoring of groundwater supplies, translating a desired level of protection into specific regulatory tools, and finding methods of land use controls to protect recharge zones. (Geiger-FRC)
W82-06411

OCEAN DUMPING BATTLE MARCHES ON,

For primary bibliographic entry see Field 5E.
W82-06490

LANDSPREADING OF SLUDGE IN NEW YORK STATE,

For primary bibliographic entry see Field 5E.
W82-06557

MINERAL LAW SINCE NEPA,

Bureau of Land Management, Boise, ID. Idaho State Office.
T. S. Maley.
Idaho Law Review, Vol 18, No 1, p 73-95, 1982. 149 Ref.

Descriptors: *Legislation, *Minerals, Legal aspects, Environmental effects, Watershed protection, Water pollution prevention, Mining, Industrial wastes.

The primary purpose of this article is to identify and describe most of the major legislative and regulatory programs established since the National Environmental Policy Act of 1969 was put into effect that will significantly affect the future of exploration, mining and ore processing operations. In addition to the multitude of environmental laws designed to protect air and water quality, solid waste management, endangered species and cultural resources during this period, there have been several major new leasing programs covering geothermal resources, coal, outer continental shelf oil and gas, and deep seabed hard minerals. Specifically, discussion is offered on public land withdrawals including roadless area review and evaluation programs; environmental laws including the coastal Zone Management Act of 1972, the Resource Conservation and Recovery Act of 1976, water quality reviews, the Uranium Mill Tailings Radiation Control Act of 1978, air quality reviews, endangered species act, cultural resources, and state environmental law and zoning; mine land reclamation and mine safety and the mangement of minerals aquired by lease or permit. The geothermal steam act is discussed as it permits leasing of geothermal resources in federal lands. (Baker-FRC)
W82-06582

ORGANIZATIONAL AND POLITICAL CONSIDERATIONS IN THE MUNICIPAL DEVELOPMENT OF SMALL HYDROPOWER,

Maine Office of Energy Resources, Augusta.
P. A. Heidell, and P. H. Kirshen.
Water Resources Bulletin, Vol 18, No 1, p 105-110, February, 1982, 9 Ref.

Descriptors: *Hydroelectric power, *Local governments, *Political aspects, Dams, Public participation, Political constraints, New England.

There is considerable potential for small-scale hydroelectric power development at existing dams in New England, where over 10,000 dams are currently in existence. Although small-scale hydroelectric powerplants have many economic and environmental advantages, a variety of constraints may hinder development efforts. Efforts by three New England municipalities in unique positions to develop hydropower demonstrate the role of organizational and political considerations in development. Organizational elements and political processes which were integral to the success of these development efforts included cooperation and interaction among citizens, government, and the private sector; community interest and education; and strong resolve. Government support and a social, political, and institutional atmosphere conducive to public development of energy resources were also necessary. Information dissemination and citizen education efforts were found to be crucial factors, especially in municipalities requiring majority approval for municipalization, acquisition of facilities, and grant and loan applications. State and Federal governments can, and do, both assist and hinder a municipality's efforts to develop hydroelectric power. (Carroll-FRC)
W82-06588

OCEAN DISPOSAL LEGISLATION IN THE UNITED STATES,

Guarino (Carmen F.) Engineers Ltd., Philadelphia, PA.
For primary bibliographic entry see Field 5E.
W82-06597

SLUDGE DISPOSAL TO SEA: NORTH AMERICAN VIEWPOINT,

For primary bibliographic entry see Field 5E.
W82-06598

WHO OWNS NEBRASKA'S GROUND WATER,

Nebraska Univ. Lincoln.
J. Fussell.
Water Well Journal, Vol 36, No 6, p 44-46, June, 1982.

Descriptors: *Groundwater *Legal aspects,*Ownership, *Nebraska, Supreme Court, Public policy, Policy making, Water policy, Public lands, Public rights, Irrigation, State jurisdiction.

The question of ownership of groundwater in Nebraska becomes more important each year as greater demands are placed on the dwindling supply. Much of the state is underlain by the Ogallala aquifer, one of the largest natural underground reservoirs of water in the nation. Interpreters of Nebraska law indicate that this question falls between the so-called English Rule and the modified American Rule. Under the former rule, the rights to the groundwater belong to the owner of the overlying land. The latter rule holds that the owner of the land is entitled to appropriate subterranean waters found under his land, with the provision that he cannot appropriate such water in excess of a reasonable and beneficial use upon the land he owns, especially if such use is injurious to others who have substantial rights to the water. If the natural underground supply is insufficient for all owners, each is entitled to a reasonable proportion of the whole. On May 1, 1981 the Nebraska Supreme Court filed an opinionin the Douglas vs Sporhase case. Their decision was hailed as unanimous support for the view that groundwater is a public resource. The impact of this decision wil be felt beyond the borders of Nebraska. Not only may its conclusions be cited as legal precedent, but also its reasoning and even the directness of its language incorporated in the court's opinion may be borrowed by persons in various other states. One effect will be to buttress conservation measures in Nebraska and to further sensitize irrigators to the interests of the public. This case has been referred to the US Supreme Court and is being heard under the heading of Sporhase and Moss vs. State of Nebraska, a decision is expected in the summer of 1982. (Baker-FRC)
W82-06819

ALLOCATION OF WATER FOR RESOURCE DEVELOPMENT,

Clyde, Pratt, Gibbs, and Cahoon, Salt Lake City, UT.
For primary bibliographic entry see Field 6D.
W82-06839

6F. Nonstructural Alternatives

INCENTIVES AND INSTITUTIONS FOR WATER CONSERVATION,

California Univ., Los Angeles.
For primary bibliographic entry see Field 3D.
W82-05922

FLOODPLAIN REGULATIONS AND RESIDENTIAL LAND VALUES IN OREGON,

Oregon State Univ., Corvallis. Dept. of Geography.
K. W. Muckleston, M. F. Turner, and R. T. Brainerd.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243536, Price codes: A05 in paper copy, A01 in microfiche. Report WRRI-73, December, 1981. 77 p, 10 Fig, 5 Tab, 33 Ref. OWRT A-054-ORE(1).

Descriptors: *Flood plain management, *Land appraisals, *Regulations, *Environmental effects, *Property value, Flood plain zoning, Flood plains, Flow channels, Land management, Legal aspects, Political contraints, Economic aspects, Political aspects, Social aspects, Real property, *Oregon.

A study was made of floodplain regulation impacts on western Oregon residential land values, hypothesizing that the mean rates of appreciation for regulated lands would be significantly less than for similar proximate unregulated lots. Six study areas were used to test this hypothesis, with the finding that the hypothesis could be rejected in most cases. Where the hypothesis was acceptable, flood damage (rather than floodplain regulations) appeared to be the cause. The hypothesis converse was not uncommon: the mean appreciation rates for regulated land increased significantly faster than for unregulated control parcels. It was concluded that this probably reflects the amenity values of waterfront properties and the recent marked improved water quality of the Willamette River. Hence, most of the evidence of this 6-site study suggests that floodplain regulations have not had a significant negative impact on residential land values. Limitations to this study, carried out under less than ideal conditions, which restrict the attainment of final conclusions are discussed. Nonetheless, the study data illustrate that floodplain regulations do not appear to play an important role in the assessment process. (Zielinski-MAXIMA)
W82-05930

LESSONS LEARNED FROM THE 1981 LAINGSBURG FLOOD,

Department of Water Affairs, Forestry and Environment Conservation, Pretoria (South Africa).
For primary bibliographic entry see Field 2E.
W82-05997

MANAGING FLOOD RISK: TECHNICAL UNCERTAINTY IN THE NATIONAL FLOOD INSURANCE PROGRAM,

Bracken and Baram, Boston, MA.
M. S. Baram, and J. R. Miyares.
Columbia Journal of Environmental Law, Vol 7, No 2, p 129-164, 1980. 132 Footnotes.

Descriptors: *Flood plain management, *Insurance, *National Flood Insurance Program, *Risks, *Flood plain zoning, Nonstructural alternatives, Mapping, Surveys, Land use, Decision making, Federal Emergency Management Agency.

The National Flood Insurance Program (NFIP), established in 1968, seeks to control the risk of flood damage by encouraging local government to control land use. Two problems, both attributable to technological uncertainties and changing circumstances, have emerged under the NFIP. First, restudies of a community's flood risk, etc. have used increasing amounts of the total study funds. There are no clear guidelines for determining if a restudy is justified. Second, new technical developments in flood plain mapping and risk prediction are continually being made. It is difficult to determine when new methods should be adopted. Restudies may be necessary because of scientific or technical error, the sudden availability of new data (such as an unprecedented flood), judicial mandate, or community request. This paper proposes that criteria be articulated to guide the Federal Emergency Management Agency (FEMA) in deciding when restudies should be undertaken or new study methods adopted. Several objective, generic criteria suggested by an FEMA contractor are presented as a basis for developing a structured system to decide the need for restudy. They include: extension of study areas, revision of base data, and update of prior studies due to improved methods. (Cassar-FRC)
W82-06073

OFFICIAL AND FOLK FLOOD WARNING SYSTEMS: AN ASSESSMENT,

National Center for Atmospheric Research, Boulder, CO.
R. Schware.
Environmental Management, Vol 6, No 3, p 209-216, 1982. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Flood protection, *Warning systems, West Bengal, *India, Floods, Warning systems, Developing countries, Regional development.

The inadequacies of the flood warning system became clear recently in West Bengal, India. Some socioeconomic constraints on the communication of flood warning messages are reviewed. Perceptions of, and responses by, villagers in a flood prone region of West Bengal to official and to folk flood warnings are considered. Most of the major flood-producing rivers originate beyond the jurisdictional limits of West Bengal. Thus to a large extent this riparian state is at the mercy of policies of flood control, water utilization and soil erosion of the neighboring states of Bihar and Assam as well as of Nepal, Bangladesh, Bhutan, and Sikkim. Flooding results from reduction in the drainage capacity of rivers due to excessive sedimentation, breaches in the Zamindari embankments, incomplete construction of new embankments, lack of maintenance of excavated drainage channels, and blockage of inland stream flow by sea tides. Individual responses to flood warnings are conditioned by age, educational level, cultural background, and knowledge or experience of previous situations. Both the increasing encroachment of population into low and alluvial lands of the lower Damodar Valley and the piecemeal attempts to control floods in the region since independence have given rise to problems that affect agricultural production, health, and industrial development. Flood warning messages are not always effectively disseminated to flood-affected communities. At least some reappraisal of the existing approach to flood warnings should be considered. (Baker-FRC)
W82-06077

FLOOD OF MAY 5 AND 6, 1981, MOBILE, ALABAMA,

Geological Survey, Montgomery, AL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06128

WORK MANAGEMENT STANDARDS,

Tampa Water Dept., FL.
D. L. Tippin, and G. M. Barron.
Journal of the American Water Works Association, Vol 74, No 6, p 292-295, June, 1982. 1 Fig, 2 Tab.

Descriptors: *Management planning, *Water supply, Water demand, Tampa, *Florida, Planning.

The Tampa, Florida, Water Department designed and implemented a systems approach to management effectiveness in water services based on standards for both service levels and performance in order to incorporate accountability for the relationship between service provided and dollars spent. Standards provide control for the work management system. They control the kinds and amounts of work performed on each activity through the performance standards established. By defining specific resources, standards allow estimation of the resources needed to complete the goals as outlined by the policy makers. By reporting work accomplished, data are accumulated for the next year's budget, adherence to the current budget is monitored, and the utility is able to determine whether resources are being used effectively. Prior to the distribution division's developing performance standards, maintenance employees were about 30-40% effective in their work performance. It is now estimated that they are more than 70% efficient and show continued improvement. Crew size on all major crews has been reduced by careful analysis of the manpower needs for each activity, and cost savings have resulted from the increased production and work method improvements. (Baker-FRC)
W82-06349

FLOOD RISK PERCEPTIONS AND OVERDEVELOPMENT IN THE FLOODPLAIN,

Tennessee Univ., Knoxville. Dept. of Agricultural Economics and Rural Sociology.
W. M. Park, and W. L. Miller.
Water Resources Bulletin, Vol 18, No 1, p 89-94, February, 1982. 2 Tab, 21 Ref.

Descriptors: *Flood plain management, *Floods, *Risks, Social aspects, Land development, Land use, Land appraisals, Insurance, Economic aspects, Flood damage, *Indiana.

There is a long-standing hypothesis that imperfect information about potential flood hazard, an exception of liberal disaster relief, and anticipation of future structural protection have resulted in overdevelopment of the nation's flood plains. Data for a case study area--Logansport, Indiana--were analyzed using multiple regression techniques in an effort to investigate this hypothesis. The effect of the introduction of the National Flood Insurance Program (NFIP) on residential property values was investigated in order to determine whether flood plain residential property values were fully discounted for expected flood damages. The case study analysis showed that residential property values in the flood plain were less than fully discounted for the existing flooding potential prior to the introduction of the NFIP. Such low cost information as lot elevation and distance from the river were found to affect sale price, apparently due to its role in the formation of flooding potential perception. Flood plain management policy alternatives which would provide better information on flooding potential and eliminate the perverse incentives created by the expectation of liberal disaster relief include simple zoning and actuarial insurance. Simple delineation of the 100-year flood plain with zoning restrictions would involve relatively low implementation costs, while the development of actuarially accurate premiums for flood insurance would be relatively costly. In any case, the study results indicate that unless policy changes eliminating the perverse incentives of past policies are adopted, overdevelopment of flood plains will continue. (Carroll-FRC)
W82-06585

LAND USE POLICY AND WATER PROCUREMENT (AGRARSTRUKTURPOLITIK UND WASSERGEWINNUNG),

Bundesforschungsanstalt fuer Landeskunde und Raumordnung, Bonn (Germany, F.R.).
D. Kampe.
GWF, das Gas- un Wasserfach: Wasser/Abwasser, Vol 123, No 1, p 30-38, January, 1982. 4 Tab, 22 Ref. English summary.

Descriptors: *Water policy, *Agriculture, *Water management, *Resources management, Public policy, Hydrology, Drinking water, Water quality, Land use, Water resources developement, *West Germany.

The conflict between drinking water procurement and the needs of the increasingly intensified agricultural production in West Germany are discussed. Within the federal government there is a large gap between the officially proclaimed goals of environmental protection within agricultural policy and the actions of that policy. Strategies and instruments for agricultural land use compatible with water procurement are presented. These include planning to determine the suitability of land for specific types of agriculture based on hydroecological mapping, field clearing to match land and agricultural type, the promotion of agricultural businesses prepared to forego intensification and their financial compensation in the case of lost revenues, the laying fallow of land, the building up of an advisory structure particularly for the subjects of fertilizers and pesticides, aid in marketing of goods produced under conditions favorable to water procurement, and development of a national price policy. All these measures should be carried out within the context of water priority areas which already exist in some regions of the country. However, it will be difficult to persuade the government to institute such a program due to the lobbying power of the agricultural industry. (Gish-FRC)
W82-06714

6G. Ecologic Impact Of Water Development

EFFECTS OF REDUCED STREAM DISCHARGE ON FISH AND AQUATIC MACROINVERTEBRATE POPULATIONS,

Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
R. G. White, J. H. Milligan, A. E. Bingham, R. A. Ruediger, and T. S. Vogel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-213478, Price codes: A13 in paper copy, A01 in microfiche. Report, September, 1981. 283 p, 74 Fig, 37 Tab, 124 Ref, 6 Append. OWRT B-045-IDA(1). 14-34-0001-8080.

Descriptors: *Stream discharge, *Hydraulic models, *Model studies, *Instream flow, *Fish populations, Streamflow, Streamflow depletion, Flow discharge, Flow characteristics, Flow channels, Hydraulic similitude, Simulation, Aquatic habitats, Channel flow, Channel morphology, Insect behavior, Population dynamics, Riffles, Fish migration, Trout, Oregon, Grande Ronde River.

A study was made of the responses of aquatic insects and juvenile rainbow-steelhead trout to flow-related changes in habitat, and of the predictive capebility of three hydraulic simulation models that are currently used to make instream flow recommendations. Tests were conducted in the spring, summer, and fall in two large near-natural artificial stream channels having run-riffle

channel configurations: one channel was maintained at constant discharge; flow in the second channel was reduced incrementally. Flow reduction produced increased behavioral/catastrophic insect drift which increased at night and varied with season, degree of flow reduction, and type and developmental stage of aquatic insects. Flow reduction also resulted in decreased trout numbers with large test fish more affected than small fish. It appeared that larger trout responded primarily to physical habitat parameters than to a decrease in food availability. No single hydraulic parameter studied (velocity, depth, surface area, wetted perimeter), consistently correlated with test fish response. Flow-related changes in cover, however, appeared to influence juvenile trout habitat utilization. The hydraulic simulation models tested generally predicted the parameters they were designed for accurately, but the models varied in ease of calibration, application, and useful extrapolation range. It was found that transect placements for hydraulic simulation data collection in run-riffle channels were more important than the number of transects used. (Zielinski-MAXIMA)
W82-05923

CARRYING CAPACITY FOR THE ILLINOIS RIVER,

Oregon State Univ., Corvallis. School of Forestry.
B. Shelby, and R. B. Colvin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-243510, Price codes: A04 in paper copy, A01 in microfiche. Report, June, 1981. 56 p, 12 Tab, 4 Append. OWRT A-999-ORE(28).

Descriptors: *Wild rivers, *Camp sites, *Public waters, *Carrying capacity, *Frequency analysis, Rivers, Rapid flow, Boating, Boat-launching ramps, Recreation wastes, Navigable rivers, Public access, Public waters, Environmental effects, *Oregon, *Illinois River(Oregon).

A total of 51 miles of the Illinois River in southwestern Oregon has been proposed for inclusion in the Wild and Scenic Rivers system; this study focused on the use of the 29-mile wild section between Briggs and Nancy Creeks for wild river excursions. These trips last from 2-5 days, with an average trip size of 7 persons for private and 11 persons for commercial groups, covering a season from early March to mid-June. The physical capacity of the river is limited by available campsites; ecological capacity particularly concerns human impacts on campsite ecology; social capacity, the limiting factor, focuses on experience factors among groups. The field study measured use levels, encounters among parties, and selected user perceptions. During the mid-April to early June 1979 study period, 50% of the days had no launches, and 59% of launch days were Fridays and Saturdays. With 1 or 2 trips launching per day, party encounters ranged from 0-2/day; with 3-5 launches, encounters increased to 1-3/day. Trips spent an average of 1 of 7 nights (16%) within sight/sound of another party. It was concluded that camp encounters are not correlated with use level; competition for campsites occurs in particular sections of the river, the location of which depends on the length of the trips. (Zielinski-MAXIMA)
W82-05927

ENVIRONMENTAL IMPACT OF UPLAND STREAMS ON THE OKEFENOKEE SWAMP,

Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 5B.
W82-05933

CHINA'S AGRO-ECOSYSTEM,

Manitoba Univ., Winnipeg. Dept. of Geography.
For primary bibliographic entry see Field 3B.
W82-06019

FINAL ENVIRONMENTAL IMPACT STATEMENT; DEFENSE WASTE PROCESSING FACILITY, SAVANNAH RIVER PLANT, AIKEN, S.C.

Department of Energy, Washington, DC.
Report DOE/EIS-0082, February, 1982. 575 p, 31 Fig, 104 Tab, 221 Ref, 17 Append.

Descriptors: *Radioactive waste disposal, *Environmental effects, *Environmental impact statement, *Underground waste disposal, Wastewater treatment, Sludge disposal, Waste disposal, Radioactive wastes, *South Carolina, *Savannah River Plant.

The Savannah River Plant is a major installation for the production of nuclear materials for national defense. Approximately 8300 cu m (22 million gal) of high-level radio-active waste (HLW) are currently stored in tanks at the plant. The purpose of this study is to provide environmental input into both the selection of an appropriate strategy for the permanent disposal of the HLW currently stored at the plant and subsequent decision to construct and operate a Defense Waste Processing Facility (DWPF) at the Savannah River Plant site. The proposed DWPF would process the liquid HLW generated into a stable form for ultimate disposal. The HLW is composed of three components: an insoluble sludge 15%; a crystallized salt cake (60%); and a supernatant aqueous solution (25%). The preferred alternative for disposal of the HLW is geological disposal or long-term isolation in a mined geologic repostitory, with very deep hole and subseabed disposal being retained as backup technologies. The proposed DWPF will immobilize the waste into an appropriate form for placement in a repository. Three immobiliazation alternatives were analyzed in detail to show the possible range of environmental impacts associated with the construction and operation of a DWPF. All three immobiliaztion alternatives require the processing of the waste into two fractions: a high-level raioactivity fraction for immobilization and offsite geologic disposal and a partially decontaminated salt fraction for solidification and disposal as low-level waste on the site. The preferred alternative is the staged process alternative in which a facility to treat the sludge would be constructed first, and then a facility to treat the salt cake and supernatant would be constructed. (Moore-SRC)
W82-06087

EVALUATION OF IMPACTS ASSOCIATED WITH REREGULATION OF WATER LEVELS IN LAKE MOHAVE,

Lake Mead Limnological Research Center, Las Vegas.
J. R. Baker, and L. J. Paulson.
Technical Report No 4. March 1980. 23 p, 8 Fig, 4 Tab, 8 Ref. 14-06-30002218.

Descriptors: *Lake Mohave, *Reservoir releases, *Water level fluctuations, *Thermal stratification, *Fish populations, *Environmental effects, Hoover Dam, Recreation, Water temperature, Plankton, Hydroelectric plants, Reservoir operation, Reservoir fisheries, *Nevada.

The Water and Power Resources Service is considering reregulating Lake Mohave water levels to increase the net power benefit from Hoover Dam. By generating more power during those periods when energy has a higher market value, more net monitary benefit can be derived. To optimize power generation from Hoover Dam, water levels will fluctuate from elevations of 600 to 640 ft. The proposed alternatives will increase the instability of Lake Mohave, which in turn will affect every component of the biota. It is reasonably certain that the largemouth bass fishery will decline as a result of the reregulated water levels. The lower water will also tend to reduce the total carrying capacity of Lake Mohave for all types of fisheries. Fluctuating water levels and high Hoover Dam discharges, during low water levels, will increase the instability in Lake Mohave resulting in partial destratification and cooler water temperatures. Instability will produce changes in the plankton communities, but nuisance conditions will probably not occur due to increased turbulence and lower water temperatures. Cooler water temperatures can be considered a water quality problem because the total area in Lake Mohave available for water contact sports will be reduced. (Moore-SRC)
W82-06089

THE LIMNOLOGICAL STATUS OF LAKE MEAD AND LAKE MOHAVE UNDER PRESENT AND FUTURE POWERPLANT OPERATIONS OF HOOVER DAM,

Lake Mead Limnological Research Center, Las Vegas.
L. J. Paulson, J. R. Baker, and J. E. Deacon.
Technical Report No 1, January 1980. 229 p, 70 Fig, 27 Tab, 76 Ref. 14-06-300-2218.

Descriptors: *Lake Mead, *Lake Mohave, *Dam effects, *Reservoir releases, Limnology, *Pumped storage, Hydroelectric plants, Reservoir operation, Nutrients, Physical properties, Chemical properties, Plankton, Productivity, Environmental effects, Thermal stratification, Water temperature, Fisheries, *Utah.

Several proposed alternatives for modifying Hoover Dam to increase peak-power output would require a peak discharge in excess of current levels (25-30,000 cu ft/sec). Investigations were conducted on Lake Mead and Lake Mohave to assess the impacts of these power modifications on the limnology of the reservoirs. Temperature, oxygen, pH, conductivity, light, nitrogen, phosphorus, chlorophyll-a, phytoplankton productivity, and plankton species composition measurements were made monthly at 15 reservoir stations in Lake Mead and 5 in Lake Mohave. Nutrients were also measured monthly in the Colorado River at Pierce Ferry and below Hoover Dam and in Las Vegas Wash. Upgrading of existing generating units or addition of new units will require an increase in peak-discharge to 49,000 and 56,000 cu ft/sec and minimum flows of 2000 cu ft/sec. Alternating high and low discharge will cause an oscillation of the thermocline in Black Canyon, near the dam. At low lake elevations, warmer water will probably be pulled to the intake gates, increasing the temperatures of the discharge. The alternating high and low discharge will have the greatest impact on Lake Mohave. Thermal stratification will be disrupted, and the interface between river and reservoir water will shift down-lake under high discharge and up-lake at low discharge. Operation of a pump-storage unit at Hoover Dam will require a peak-discharge of 76,000 cu ft/sec, periods of no flow and reverse flows of 25,000 cu ft/sec. Fluctuations in temperature of the river, interspersed with periods of no flow will create problems for recreational use and fisheries in Black Canyon between Hoover Dam and Willow Beach. (Moore-SRC)
W82-06090

INFLUENCE OF DREDGING AND HIGH DISCHARGE ON THE ECOLOGY OF BLACK CANYON,

Lake Mead Limnological Research Center, Las Vegas.
L. J. Paulson, T. G. Miller, and J. R. Baker.
Technical Report No 1, 1980. 59 p, 16 Fig, 8 Tab, 33 Ref. 14-06-300-2218.

Descriptors: *Forebays, *Dredging, *Environmental effects, *Reservoir releases, *Productivity, Fish food organisms, Dam effects, Hydroelectric plants, Colorado River, Hoover Dam, Pumped storage, Periphyton, Invertebrates, Scour, Silting, Trout, Sucker, Chubs, *Black Canyon, *Utah.

The Water and Power Resources Service is considering dredging in Black Canyon to create a larger forebay to accommodate higher peak-discharges and reverse flows for proposed modifications to Hoover Dam, such as the addition of one or more conventional hydroelectric generating units, and the addition of reversible pump-storage hydroelectric units. The Black Canyon area supports a heavily utilized trout fishery and is important habitat for the razorback sucker and possibly bonytail chub. The food chain in Black Canyon is relatively simple and consists of a few invertebrate and fish species that are wholly supported by periphyton productivity occurring in the canyon. Dredging in the area above Ringbolt Rapids will significantly reduce periphyton and invertebrate productivity, and could reduce the trout and endemic fish populations because they are wholly dependent on these autochthonous resources for

food. Higher current velocities created by increased peak-discharges could have a more permanent impact than dredging. Siltation occurs below the tailrace during low discharge periods. These materials are flushed downstream during peak-discharge periods and scour the bottom of periphyton and invertebrates. If dredging is conducted, consideration should be given to disposal of dredge spoils (cobble and boulder size) along the river banks in Black Canyon, since boulder and cobble substrate would probably enhance productivity. (Moore-SRC)
W82-06091

EVALUATION OF POSSIBLE TEMPERATURE FLUCTUATIONS FROM PROPOSED POWER MODIFICATIONS OF HOOVER DAM,

Lake Mead Limnological Research Center, Las Vegas.
J. R. Baker, and L. J. Paulson.
Technical Report No 3, March 1980, 23 p, 10 Fig, 2 Tab, 4 Ref. 14-06-30002218.

Descriptors: *Water temperature, *Dam effects, *Environmental effects, *Pumped storage, *Reservoir operation, Reservoir releases, *Hoover Dam, Hydroelectric plants, Lake Mead, Thermal stratification, Intakes, *Utah.

Planned alternatives for increasing the generation capacity of Hoover Dam to help meet peak power demands include uprating existing units, adding generating units, and adding reversible pumped-storage hydroelectric units. The upper intake gates (1045 ft), with few exceptions, have not been used since 1934, but with the addition of generating units or the installation of reversible pumped-storage units, one upper gate on the Arizona Tower would be used in conjunction with the four lower gates to facilitate the higher flows. In order to evaluate the effects of discharge rate from the upper and lower gates on temperature and temperture structure in Lake Mead, Hoover Dam was alternately operated from the four lower gates and four upper gates in consecutive 24-hour periods over the daily power cycles on 18-19 August and 22-23 August 1979. The rate of discharge had no obvious effect on discharge temperatures when either the lower or upper gates were used. The planned operation of using one of the upper gates in conjunction with the four lower gates will cause only a slight increase in discharge temperature. The cumulative effect of continual alternation of pumping and discharging with reversible pumped storage could substantially disrupt thermal stratification in Black Canyon and parts of Boulder Basin. (Moore-SRC)
W82-06092

ENVIRONMENTAL PROBLEMS AND GEOTHERMAL PERMITTING,

Windrem, Feeney and Williams, Lakeport, CA.
P. F. Windrem, and G. L. Marr.
Natural Resources Lawyer, Vol 14, No 4, p 675-685, 1982. 1 Tab, 58 Ref.

Descriptors: *Geothermal resources, *Legal aspects, Resources development, Natural resources, Geothermal power, Electric power production, Water law, *California, Geysers, Water quality, Water pollution sources, Environmental effects.

This paper describes the stages of geothermal development, the attendant environmental hazards, and the jurisdictions of the various government agencies. Most examples of environmental hazards are drawn from the electric power production in the geysers of northern California. Major environmental effects of geothermal development are observed on air quality, land (soil erosion, seismic activity and subsidence, wildlife habitat and visual quality), and water quality. In California development occurs on private lands, federal land, federal mineral reserve land, state land, and state mineral reserve land, each subject to different regulatory agencies. Geothermal development occurs in five stages: exploration, full field development, power plant construction, field operation, and field abandonment. Primary threats to water quality are sedimentation of streams from soil erosion caused by earth work, spills of liquid wastes such as drilling fluids and power plant steam condensate, and well casing failure. The most serious incidents of water pollution at the geysers in California have resulted from spills of steam condensate into nearby streams, caused by condensate pond overflow, condensate pipeline rupture, or reinjection problems. The pollution results from the toxicity of the waste water. A number of different agencies have jurisdiction over various aspects of the process. (Baker-FRC)
W82-06217

THE WHITE CLAY CREEK PROJECT: A PROTOTYPE STRATEGY FOR PROTECTING SMALL STREAM VALLEYS.

Delaware Univ., Newark. Water Resources Center.
For primary bibliographic entry see Field 6B.
W82-06368

THE RELATIVE ABUNDANCE OF OPOSSUM SHRIMP, MYSIS RELICTA, IN TWIN LAKES, COLORADO USING A BENTHIC TRAWL,

Colorado Div. of Wildlife, Fort Collins.
T. P. Nesler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-234493, Price codes: A03 in paper copy, A01 in microfiche. Bureau of Reclamation Report REC-ERC-82-3, September 1981. 25 p, 12 Fig, 5 Tab, 17 Ref.

Descriptors: *Shrimp, *Biological samples, *Sampling, Aquatic populations, Twin Lakes, *Pumped storage, Environmental effects, Benthos, Trawling, Seasonal distribution, *Colorado.

The study of the opossum shrimp (Mysis relicta Loven) at Twin Lakes, Colorado, is part of an investigation into the potential impacts of pumped-storage power generation on the two lakes. Since 1974, large and small benthic sled-type trawls have been used monthly to determine relative abundance of the shrimp. A comparison of the two trawls based on replicate sampling indicated that the mean shrimp density for the large trawl was 68% of the small trawl estimate. This difference was not statistically significant because of a large sample variation. An off-bottom sampling bias affected by the speed of the trawl was determined in a separate study using the small trawl. Corrections for this potential bias in the small trawl data collected in 1977 and 1979 indicated that shrimp densities may have been underestimated by 22 to 77%. Comparison of mean shrimp densities for the two trawl sizes using corrected small trawl data showed the large trawl estimate to be only 42% of the small trawl estimate. Shrimp length frequency analyses concur with this difference, indicating the smaller, juvenile shrimp were missed by the large trawl because of the larger mesh size. Adjusting for trawl sampling efficiency and sampling bias, yearly shrimp densities may have ranged from 88 to 348 shrimp/sq m in the lower lake and from 57 to 174 shrimp/sq m in the upper lake. This sampling variability precluded all but the most general comparisons of Mysis densities. Monthly estimates of shrimp densities in each of 4 years sampled showed a characteristic increase from June to September with declines in October and November in the lower lake. Over the 1974 to 1979 study period, seasonal mean estimates of shrimp density and indicated an increasing abundance of Mysis since 1975 in the lower lake, and a fluctuating population in the upper lake. (Author's abstract)
W82-06399

TWIN LAKES STUDIES: A CHARACTERIZATION OF THE TWIN LAKES FISHERY VIA CREEL CENSUS WITH AN EVALUATION OF POTENTIAL EFFECTS OF PUMPED-STORAGE POWER GENERATION,

Colorado Div. of Wildlife, Fort Collins.
T. P. Nesler.
Bureau of Reclamation Report REC-ERC-82-4, November 1981. 56 p, 12 Fig, 28 Tab, 42 Ref.

Descriptors: *Environmental effects, *Trout, *Lake fisheries, Twin Lakes, *Pumped storage, Fish populations, Sport fishing, Recreation, Fishkill, Turbidity, Water level fluctuations, *Colorado.

Creel census data are presented for the period December 1976 to September 1979. The creel census studies have resulted in estimates of seasonal fisherman effort, harvest, and catch rates with a precision suitable for use in the detection of impacts from the operation of the Mt. Elbert Pumped-Storage Powerplant. For the 1973-79 summer seasons, total fishermen effort estimates ranged from 66,677 to 89,820 man-hours on the lower lake and from 19,721 to 29,139 man-hours on the upper lake. Harvests ranged from 19,955 to 32,496 fish on the lower lake and from 6411 to 12,457 fish on the upper lake. Fifty-four to 56% of the fisherman effort and harvest occurred on weekends. Rainbow trout composed 94% or greater of the summer harvests. For the winter seasons on the lower lake from 1974 to 1979, fishermen effort estimates ranged from 3900 to 8800 man-hours and harvest estimates ranged from 400 to 1200 fish. Lake trout composed 87% or greater of the harvests in most winter seasons. Potential powerplant impacts via increased mortality to rainbow trout, daily and seasonal water-level fluctuations, and shoreline turbidity may have the greatest negative impact upon the Twin Lakes shore fishery for rainbow trout. Because the estimates from the winter harvest, the boat fishery, and the monthly creel census for both shore and boat categories are less precise, only large-scale changes in these components will reflect statistical significance. Operation of the powerplant during the weekends in the summer may have a greater impact on fishermen effort if large-scale turbidity or fishskills are observed. (Moore-SRC)
W82-06401

COLORADO COOPERATIVE FISHERY RESEARCH UNIT STUDIES AT TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,

Colorado Cooperative Fishery Research Unit., Fort Collins.
E. P. Bergersen, and M. Maiolie.
Bureau of Reclamation Report REC-ERC-82-8, December 1981, 66 p, 40 Fig, 2 Tab, 18 Ref, 1 Append.

Descriptors: *Environmental effects, *Water currents, *Limnology, *Trout, *Water level fluctuations, *Shrimp, *Suspended sediments, *Twin Lakes, *Pumped storage, Monitoring, Water circulation, Spawning, Fish eggs, Eutrophication, Vegetation, Productivity.

The objectives of these studies were to gather baseline data on the Twin Lakes system during the preoperational phase of the Mt. Elbert Pumped Storage Powerplant, and to develop aquatic environmental monitoring techniques suitable for use during post-construction operating periods. Natural, seasonal patterns in surface and bottom currents were characterized and documented in the two-lake system, to allow detection of changes in current patterns produced by the powerplant. Suspected shoreline spawning habitats were searched for lake trout eggs to a depth of 1.5 m in 1979 and 1980. Results indicate that it is unlikely that lake trout in Twin Lakes spawn in water less than 1.5 m deep, and thus the expected daily water fluctuation of 0.7 to 1.1 m should not result in the exposure of lake trout eggs. A photographic method of estimating Mysis shrimp populations was developed. Shrimp are at least 2.4 times as abundant in Twin Lakes as previously thought, with densities in the vicinity of the powerplant as high as 232 shrimp/sq m. Both sediment traps and inflow/outflow suspended sediment sampling were used to estimate sedimentation rates in Twin Lakes. Estimates from these two methods differ greatly. The best time to monitor impacts on sediment movement and deposition would be during the winter months. Potential input to the energy budget from inundated terrestrial vegetation was estimated to be over four times the average annual primary productivity of the system. (Moore-SRC)
W82-06402

ENVIRONMENTAL ASSESSMENT; GEOTHERMAL DIRECT HEAT PROJECT; MARLIN TEXAS.

Department of Energy, Washington, DC.

Available from the National Technical Information Service, Springfield, VA 22161 as DOE/EA-0117, Price codes: A04 in paper copy, A01 in microfiche. Report DOE/EA-0117, August 1980. 68 p, 11 Fig, 14 Tab, 10 Ref, 2 Append.

Descriptors: *Geothermal resources, *Environmental effects, *Wastewater disposal, *Brazos River, Wells, Water quality, Groundwater pollution, Water pollution sources, Thermal pollution.

The project construction activities consist of well drilling, pipeline construction, heating system modification, and fluid disposal provision for the Torbett-Hutchings-Smith Memorial Hospital to provide an environmentally acceptable, operational geothermal space heating and hot water system. It was necessary to drill one supply well in order to confirm the reservoir and to obtain fluids for analysis in order to assess the environmental effects of fluid disposal. Fluid from operation will be disposed of by discharging it directly into existing street drains, which will carry the fluid to Park Lake and eventually the Brazos River. The spent fluids will be discharged at approximately 50 C and at a maximum of 13 l/s. It is anticipated that because of the utilitarian nature of the City Park Lake, Bean Branch and McCullough Slough; the long-term public use and acceptance of Marlin geothermal waters for bathing and drinking purposes; and the fact that these bodies of water are not used for irrigation, the geothermal discharge will not require pretreatment. No significant effects on water quality in the project area are expected during operation. At minimum flow rate for the Brazos River, the maximum discharge of geothermal water (25 l/s) will increase the river's flow by only 0.26%. The possibility of contamination of aquifers will be minimized through careful design and construction of the well. Depletion or subsidence problems are not likely to occur. The proposed drilling site is in a developed urban area, so no disturbance of natural vegetation or wildlife habitat will occur. (Moore-SRC)
W82-06404

ENVIRONMENTAL ASSESSMENTAL, GEOTHERMAL ENERGY, HEBER GEOTHERMAL BINARY-CYCLE DEMONSTRATION PROJECT; IMPERIAL COUNTY, CALIFORNIA.

Department of Energy, Washington, DC. Div. of Geothermal Energy.
Report DOE/EA-119, October 1980. 314 p, 25 Fig, 18 Tab, 173 Ref, 9 Append.

Descriptors: *Geothermal power, *Environmental effects, *Cooling water, *Injection wells, Wastewater disposal, Irrigation-return flow, Powerplants, Water use, Effluents, Salt drift, Thermal pollution, Irrigation water, Blowdown.

The power plant will utilize a simple binary conversion process consisting of three fluid loops: a geothermal fluid loop, a hydrocarbon working fluid loop, and a cooling water loop. The geothermal well field will consist of a production island with 13 production wells and an injection island with 7 injection wells. A mechanical draft cooling tower using approximately 8.8 cu m/s of cooling water will be utilized. Approximately 0.22 cu m/s of make-up water is required by the project. Water for the first five years of operation will be Colorado River irrigation water obtained from the Imperial Irrigation District. After the initial five years of operation, water will be obtained from the New River, irrigation return flows, or both. The geothermal resource to be developed is located at a depth of 610 m to 3048 m. The available resource is estimated to be 17 cu km at temperatures ranging from 165 C to 182 C. The principal effluents are salt drift and blowdown released from the cooling tower. Geological impacts resulting from the project are gradual reservoir depletion, and displacement of prime farmland soils. Hydrological impacts result from water depletion, effluent discharge, and thermal enrichment. These impacts will be mitigated by compliance with California Regional Water Quality Control Board permit requirements. (Moore-SRC)
W82-06406

GOWANUS CREEK CHANNEL; BROOKLYN, NEW YORK; REVIEW OF REPORTS (SURVEY); MAIN REPORT AND ENVIRONMENTAL IMPACT STATEMENT.

Army Corps of Engineers, New York.
Report, September 1981. 81 p, 6 Fig, 10 Tab, 25 Ref.

Descriptors: *Dredging, *Channel improvement, *Waterways, *Environmental impact statement, Oil spills, Turbidity, Estuaries, Environmental effects, Sediments, Fish migration, Water quality, Water pollution control, *New York, Gowanus Creek Channel.

The 30 ft mean low water existing Federal navigation channels in Gowanus Creek, Brooklyn, New York, are not deep enough to allow present deep draft and other large ocean-going vessels to use them in a fully loaded condition. The recommended plan consists of deepening the channels to 35 ft below mean low water. Additional dredging from 35 to 40 ft may be accomplished at non-Federal cost. All material would be disposed of in a sanitary land fill in Fresh Kills, Staten Island. The dredging will significantly reduce present navigation problems in this waterway, with minimal adverse environmental impact and an overall net improvement due to removal of polluted bottom sediments from the aquatic environment. It will also reduce the occurrence of oil spills by reducing the lightering of petroleum products. Since Gowanus Creek Channel is impoverished in aquatic and benthic life, and because the surrounding area is devoted to shipping and industrial activities, the environmental impact of dredging will be minimal. An increase in turbidity in Gowanus Bay may marginally interfere with fish migrations. The impact of dredging on the Hudson fishery will be reduced if dredging activities are limited to the late autumn or early winter. Indications are that there will be no change in the tidal dynamics of the creek. (Moore-SRC)
W82-06407

HABITAT RECOVERY IN THE NORTH FORK OF THE TETON RIVER.

Soil Conservation Service, Boise, ID.
Report, March 1982. 98 p, 23 Fig, 14 p, 34 Ref, 2 Append.

Descriptors: *Channeling, *Stream stabilization, *Environmental effects, *Flood damage, *Aquatic habitats, Invertebrates, Dam failure, Species diversity, Irrigation water, Trout, Productivity, *Idaho, Teton River.

Teton Dam collapsed on June 5, 1976, while it was being filled for the first time. The North Fork of the Teton River was badly damaged by the flooding. In August 1976, water was diverted from the North Fork to facilitate the clean-up operation and restore its capacity for carrying flood flows. The stream-bed remained dry until mid-December when the temporary diversion dam was removed. A study was initiated to determine the effect of the Teton Dam flood and subsequent channel dewatering and channelization on the North Fork. Four stations in the North Fork were established as routine sample locations, plus one station in the main river. Examination of the data on total numbers of benthic invertebrates indicates that at least some parts of the North Fork have recovered. Its failure to do so at one station is due to excessive withdrawal for irrigation and not to factors associated with the flood. Data on the number of taxa suggested that only one station on the North Fork had fully recovered in terms of richness and that the other stations support 8 to 26 taxa fewer than would be expected. Values for richness and diversity did not peak until the second year at the downstream stations. There are steps which could have been taken as a part of the channel rehabilitation project which would have enhanced the rate of recovery and level of productivity. Failure to do so has prevented recovery of this portion of the river even three years later, and the attainment of its full potential as a productive trout stream. (Moore-SRC)
W82-06409

REREGULATION ON AN INTERNATIONAL RIVER--A CASE STUDY,

Department of the Environment, Dartmouth (Nova Scotia). Inland Waters Directorate.
J. E. Peters, and L. J. Bergen.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 217-233, June, 1982. 4 Fig, 8 Tab, 4 Ref.

Descriptors: *Reservoir operation, *Environmental effects, *Hydroelectric plants, Reservoir releases, St. Croix River, New Brunswick, Maine, Water supply, Rivers, Water use, Shores, Erosion, International Joint Commission, Spednic Lake, Flow regulation, Water level fluctuations, Fish, Wildlife, Attitudes, Public opinion, Model studies, Georgia Pacific Corporation, Vanceboro Dam.

The St. Croix River, which straddles the international border between Maine and New Brunswick, was the scene of water use conflicts in the early 1970's. Residents and camp owners on Spednic Lake complained about adverse effects of hydropower practices on recreation, water supplies, and shorefront properties. Among the problems cited were wrecking of boats on boulders during low water, reduction in fish numbers, poor access to the lake during low water periods, serious bank erosion, debris accumulation, dry wells in summer, and unreliable flows downstream of the dam. The International Joint Commission initiated studies to determine the effects of changes in the level of Spednic Lake and the flow fluctuations immediately downstream of the lake's impoundment, Vanceboro Dam. The system is operated by the Georgia Pacific Corporation for hydroelectric power production. The study included a public attitude survey, modeling of alternative operating procedures, and an independent study by the Georgia Pacific Corporation's consultants. A new operating procedure based on a rule curve was agreed upon. This guarantees certain minimum flows and lake levels near to the desirable summer level of 378.5 ft. Provisions were made to store sufficient water to compensate for a loss of capacity in a thermal plant in the system. The new operating procedure produces more favorable summer water levels in the lake and higher streamflows for water quality and fish. No major complaints from the public of government agencies have been received since the new operating policy has been instituted. (Cassar-FRC)
W82-06429

THE LANDSCAPE OF RUTLAND WATER,

S. Crowe.
Hydrobiologia, Vol 88, No 1-2, p 43-46, March, 1982.

Descriptors: *Reservoir, *Water supply, *Land management, *Design criteria, *Planting management, Drawdown, Land use, Zoning, Land resources, Forest management, Forest watersheds, Recreation, Wilderness areas, Water sports, Rutland Water, England.

Landscape problems encountered at Rutland Water included reconciliation of the reservoir and its works with the rural surroundings, siting and treatment of all ancillary works, mitigation of exposure of shore line by drawdown, provision of opportunities for recreation without damage to the environment, and nature conservation. The means adopted to solve these problems were forward planning, consultation with all interests concerned, extensive planting of native species, and arrangemens for appropriate maintenance. The landscaping process began with an extensive survey of the character of the site. Fortunately, reservoir topography resulted in a diversified shape of acceptable scale. Special attention was paid to avoiding incongruities caused by drawdown, and long dam, the pumphouses, and the canalized stream below the dam. To minimize time and cost of maintenance, most of the perimeter land is either grazed by sheep or maintained as woodland. (Titus-FRC)
W82-06478

POWER PLANT SITING,

Ebasco Services Inc., Greensboro, NC.
N. R. Tilford.
Bulletin of the Association of Engineering Geologists, Vol 19 No 2, p 187-196, 1982. 4 Tab.

Descriptors: *Site selection, *Powerplants, *Decision making, Nuclear powerplants, Hydroelectric plants, Electric powerplants, Water use, Water requirement, Thermal pollution, Environmental effects, Pumped storage, Water pollution effects, Reservoirs, Cooling water, Land use, Flood forecasting, Aquatic life, Licenses, Dams.

Water is the main requisite involved in siting any powerplant, hydroelectric, nuclear, or fossil-fueled. The ideal hydroelectric plant is located close to consumers in a high narrow gorge immediately downstream from a large valley. The best rock formations are massive, strong, and impermeable. Pumped storage facilities should meet the same requirements as the primary reservoir, but the effects of the daily or weekly filling and draining cycle must be considered. Cooling water is important in fossil-fueled electric plants, particularly coal-fired plants. For example, a 600 MW coal-fired plant uses 20 cu ft of water per sec. This water is returned to the biosphere at temperatures 8-15 F above ambient intake temperatures, possibly causing unfavorable environmental effects. Other siting factors for a coal-fired plant are transmission distance, fuel handling facilities, and waste disposal space. A method for siting electric plants is introduced. This is based on a series of criteria: exclusion criteria, avoidance criteria, and prefeence criteria, which can be applied to any geographical area. The system is weighted to help quantify the many subjective decisions. The procedure is illustrated in an evaluation of a nuclear power plant site. Candidate sites are graded on a scale of 100 with respect to engineering cost related items, nuclear licensing considerations, and environmental considerations. Among the water-related factors in the nuclear licensing category are meteorology, relative weight, 10% of total; hydrology, 10%; and depth to groundwater (a consideration under geology and seismology), 60%. Environmental considerations include aquatic ecology, relative weight, 35%; terrestrial ecology, 15%; ocean hydrogynamics, 35% (including heat dispersion capability of a water body and recirculating potential), and fresh water use, 15%. A numerical score derived for each site allows easy ranking of possible sites. (Cassar-FRC)
W82-06555

AN ASSESSMENT OF STREAMFLOW, WATER QUALITY, AND THE EFFECTS OF CONSTRUCTING AN IMPOUNDMENT ON BRIDGE CREEK AT AUGUSTA, WISCONSIN,
Geological Survey, MS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06677

EFFECTS OF A DAM AND SEWAGE OUTFLOW ON A SMALL OLIGOTROPHIC STREAM IN THE SOUTHERN APPALACHIANS,
Southeastern Forest Experiment Station, Asheville, NC.
For primary bibliographic entry see Field 5C.
W82-06966

COLORADO RIVER ENHANCED SNOWPACK TEST ENVIRONMENTAL ASSESSMENT AND DESIGN PHASE FINDING OF NO SIGNIFICANT IMPACT,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
E. R. Harris.
Report, April, 1981. 39 p, 1 Fig, 18 Ref.

Descriptors: *Cloud seeding, *Snowpack, *Environmental effects, *Water yield improvement, *Colorado River Basin, Orographic precipitation, Weather modification, Water resource development, Streamflow, Runoff, Flood control.

The action proposed is to seed winter storm clouds in the Rocky Mountains of the Colorado River Basin to increase snowpack, runoff, and streamflow, thereby providing increased water yield to help meet future resource demands. Proposed alternatives include: no action: a 10-year program, with an initial 5-year phase for tests in two subbasins followed by a 5-year randomized seeding program; an 8-year program in which the initial phase is reduced to 3 years; and a 6-year program with a 2-year initial phase followed by a 4-year second phase. In each of the cloud seeding options, the initial phase involves installation of meteorological and hydrological observation and data collection networks. Seeding opportunity, climatological studies, seeding mode studies, and ground-based seeding studies would be included in the initial phase for the 10-year and 8-year options. No significant impact is expected from the initial phase. Each of the three cloud seeding options includes a second, randomized demonstration phase. An operational winter cloud seeding program could result in a 10 to 15% percipitation increase. Avalanche conditions and flood hazards will be included in suspension criteria for this project. It is expected that the use of seeding agents in this precipitation management research will have no environmental impact. A Finding of No Significant Impact for the Design Phase of the Colorado River Enhanced Snowpack Test is included. (Moore-SRC)
W82-06967

ECOLOGICAL PRINCIPLES OF THE CREATION OF AN OPTIMAL WATER REGIME IN THE VOLGA DELTA AND NORTH CASPIAN SEA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. P. Musatov, G. F. Krasnozhon, and E. A. Fedoseev.
Water Resources, Vol 8, No 4, p 341-354, July/August, 1981. 5 Fig, 4 Tab, 33 Ref. Translated from Vodnye Resursy, No 4, p 21-37, July/August, 1981.

Descriptors: *Water management, *Fish management, *River regulations, Ecological effects, Volga Delta, North Caspian Sea, Fisheries, Deltas, Spawing, Water distribution, River flow, Salinity, Runoff, Productivity, Sturgeon, Fish passages, Canals, Aquatic habits, Reservoir releases, Estuarine environment, Estuaries, *USSR, Environmental effects, Flow control, Water resources development.

The North Caspian Sea and the Volga, Ural, and Terek basins should be considered as a single biome for the purposes of water management, according to a review of published data. Factors affecting fish reproduction and growth and allowing water regimes to achieve optimum development of fisheries are discussed. In the Volga delta the regulation of river runoff has changed the location and character of the fish spawning grounds, has caused the dates of the maximum and the end of the flood cycle to occur significantly earlier, has lowered the temperature of runoff, and has significantly decreased the abundance of fish caught in the region. In the North Caspian Sea salinity regimes are affected by river regulation. Productivity of the deep zones increases during wet years, and productivity in the shallow zone increases during dry years. Proper operation of the water distributor at the apex of the Volga delta is suggested for regulating the ecosystems in this region. This would increase freshening of the North Caspian waters and preserve the habitat for the brackish water complex of fish. Although operating the distributor disturbs the sturgeon migration, the author feels that these problems can be solved by fish passages, large scale transportation of spawners upstream, and changing the balance of releases between eastern and western parts of the Caspian. River regulation has also changed the physical nature of the Volga delta and lowered the level of the Caspian Sea. The number of distributary channels has doubled since 1912, reducing current velocity, increasing siltation and shoaling, salinizing the estuarine nearshore zone, and destroying connections between the sea and some fishways. Specific suggestions for improving the flow to the eastern fishways of the Volga are given. These include construction of additional canals. (Cassar-FRC)
W82-06985

7. RESOURCES DATA

7A. Network Design

LEAK LOCATION ENTERS COMPUTER AGE,
New York City Dept. of Environmental Protection, Bureau of Water Supply.
D. S. Greeley.
American City and County, Vol 97, No 5, p 14, 17, 18, May, 1982. 3 Fig.

Descriptors: *Water conservation, *Leakage, Water loss, *New York City, Measuring instruments, Water distribution.

With drought conditions facing New York, the city turned to the use of a computerized leak detection patrol to stop wastage of valuable water. After it had been in use for one year, the method had located some 43 mgd in leaks. When the first mobile leak detection van arrived in December of 1980 the manufacturer provided an intensive classroom training session to familiarize the laborers with the New York City water supply system, fundamentals of leak detection, and the principle behind the leak location system. The equipment provided so useful that three more leak detection vans were purchased in June of 1981 as the drought conditions intensified. The leak detection unit is about the size of a portable radio and allows a surveyor to listen to live valves, hydrant valves, and service lines along a water main. When a leak noise is picked up, the surveyor brackets the leak by identifying the points of maximum noise on the main. He then marks the distribution system map and continues surveying. The maps of each surveyor are referred to a follow-up crew in a leak detection van which wires the transducer connections into the console inside the van. By use of a microprocessor and oscilloscope and knowing the diameter of the water main the operator in the van can pinpoint the precise location of the leak. The savings of 43 mgd represented more than 500 leaks. (Baker-FRC)
W82-06018

WATER-QUALITY ASSESSMENT OF CACHE CREEK, YOLO, LAKE, AND COLUSA COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
S. K. Sorenson, and A. L. Elliott.
Geological Survey Open-File Report 81-677 (WRI), July 1981. 41 p, 14 Fig, 1 Plate, 2 Tab, 34 Ref.

Descriptors: *Water quality, *Water quality standards, *Data collections, *Water supply, Water use, Surface water, Streamflow, Suspended sediments, Sampling, Monitoring, Sites, Dissolved oxygen, Pesticides, Potential water supply, *California, Cache Creek, Clear Lake, Yolo Bypass.

Cache Creek and its tributaries from Clear Lake to Yolo Bypass have been the subject of quality and quantity of water studies by several governmental agencies since the early 1900's. Water-quality data from these studies showed that water in the basin is of good quality for most of the beneficial uses defined by the California State Water Resources Control Board. Concentrations of dissolved constituents are substantially higher in the water in the two largest tributaries than in Cache Creek. Seasonal variations in dissolved constituents are also greater in the tributaries than in Cache Creek. Clear Lake has a major effect on water quality, resulting in little seasonal fluctuation in water quality in Cache Creek. Excessive voron and suspended-sediment concentrations are the greatest water-quality problems, according to existing data. Both of these problems are from natural sources. Water-quality monitoring is presently being conducted monthly at four sites by the California Department of Water Resurces and at several other sites by other agencies. Modifications in current monitoring are proposed to gain further information on diel dissolved-oxygen cycles, pesticides, and bio-

logical constituents that may adversely affect beneficial uses. (USGS)
W82-06130

THE BENEFITS OF PRE-OPERATIONAL BASELINE AQUATIC BIOLOGY STUDIES,

CH2M/Hill, Atlanta, GA.
For primary bibliographic entry see Field 5A.
W82-06235

DEVELOPMENT OF AN ENVIRONMENTAL GEOLOGY DATA BASE FOR LAND USE PLANNING,

Missouri Univ., Kansas City. Dept. of Geosciences.
For primary bibliographic entry see Field 6A.
W82-06552

THE PRACTICAL HANDLING OF WATER QUALITY MONITORING DATA,

Department of the Environment, Reading (England). Water Data Unit,
For primary bibliographic entry see Field 7C.
W82-06591

DATA FROM GEOTHERMAL TEST WELLS NEAR MOUNT HOOD, OREGON,

Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Robison, L. S. Forcella, and M. W. Gannett.
Open-File Report 81-1002, 1981. 24 p, 3 Fig, 1 Tab.

Descriptors: *Data collections, *Geothermal studies, *Test wells, *Drillers logs, Temperature, *Oregon, Mount Hood.

This report includes well specifications, drillers' logs, and temperature logs of geothermal test wells drilled at 7 sites near Mt. Hood, Oreg. The wells were drilled in 1979 and 1980 under contract to the U.S. Geological Survey. The project, funded by the U.S. Department of Energy, was part of an interagency effort to determine the geothermal potential of Mt. Hood. The agencies involved were, U.S. Department of Energy, U.S. Forest Service, U.S. Geological Survey, and Oregon Department of Geology and Mineral Industries. (USGS)
W82-06950

7B. Data Acquisition

LIQUID LEVEL INTERFEROMETER,

Arizona Univ., Tucson. Optical Sciences Center.
S. F. Jacobs, and J. G. Small.
Applied Optics, Vol 20, No 20, p 3508-3513, October, 1981. 10 Fig, 6 Ref. OWRT A-091-ARIZ(2).

Descriptors: *Interferometry, *Water level recorders, *Water level fluctuations, *Evaporation rate, *Measuring instruments, Lasers, Water level, Water loss, Reservoirs, Design criteria, Sensors, Reservoir evaporation, Field tests, On-site tests, Ponds.

An inexpensive field instrument was designed and constructed to measure changes in water levels, appropriate to ponds and reservoirs, to an accuracy of lambda/8. A novel magnetic suspension is used to position the floating retroreflector of the laser interferometer. Direction-sensing is achieved by dual optical channels phased near quadrature by means of an absorbing beam-splitter. Field measurements were made for an open pond having a surface area of about 600 sq. m. A typical recording of evaporation over a 36-hour period is shown, including the detection of a brief period of precipitation. Using an electric fan blowing across 0.1 sq. m of water in a laboratory test, an evaporation rate in the order of one micron/minute was measured. By measuring the slopes of a 4-day recording, a record of evaporation rate was determined as a function of time of day: in addition to the expected midday peak, reproducible peaks (possibly due to morning and evening winds) were observed in the morning and evening. The laser was an inexpensive He-Ne laser which produces multiple longitudinal modes which reduce fringe contrast for large unequal paths of the interferometers arms. The instrument achieves 0.08 micron sensitivity despite moderate water turbulence, possesses directional sensing, and includes a measurement of its own temperature for thermal expansion correction. (Zielinski-MAXIMA)
W82-05929

EVALUATING NEAR-SURFACE SOIL MOISTURE USING HEAT CAPACITY MAPPING MISSION DATA,

Texas A and M Univ., College Station. Remote Sensing Center.
J. L. Heilman, and D. G. Moore.
Remote Sensing of Environment, Vol 12, No 2, p 117-121, 1982. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Remote sensing, *Soil water, *Soil temperature, Satellite technology, Heat Capacity Mapping Mission, Mapping, Vegetation effects, Soil types, Land use.

Heat Capacity Mapping Mission (HCMM) data were analyzed to determine their suitability for estimating near-surface soil moisture in a complex agricultural landscape with several soil types and crop types. The area monitored was a 8 x 24 km section of the Big Sioux River Basin, South Dakota. The HCMM radiometric temperatures did not correlate with soil water content for the four dates analyzed (June 5, July 13, August 8, and September 4, 1978). There was a mixture of land uses and soil covers within each pixel. However, when soil surface temperatures were empirically estimated from HCMM temperatures and percentage cover of each pixel, a highly significant correlation was obtained between estimated soil temperature and near surface soil water content. (Cassar-FRC)
W82-05956

A MOISTURE ANALYSIS PROCEDURE UTILIZING SURFACE AND SATELLITE DATA,

Pennsylvania State Univ., University Park. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W82-06212

TROPICAL CYCLONE RAINFALL CHARACTERISTICS AS DETERMINED FROM A SATELLITE PASSIVE MICROWAVE RADIOMETER,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2B.
W82-06214

PORTABLE WATER ELEVATION MEASURING GAGE,

Bureau of Reclamation, Denver, CO., Engineering and Research Center.
M. Gutierrez.
Report GR-81-14, September 1981. 31 p, 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Monitoring, *Groundwater level, *Water measurement, *Groundwater availability, *Well discharge, Salinity, Water level, Well casings, Recharge, Permeability.

One of the initial activities usually undertaken in ground-water investigations is an inventory of existing ground water availability and collection of water in wells. A portable system was developed for continuously monitoring the water elevation in wells by measuring the capacitance of an insulated wire placed in the water. The gage provides continuous readout, fast response to water elevation changes, and insensitivity to internal pressures. There is no effect on readings because of cascading water action. The gage can be initialized to read zero at various water elevations, and readings are not affected by water salinity. Results from a limited amount of testing indicate the feasibility of the measuring gage. The well under test had flaws in the well casing, and these irregularities of the well casing are shown in the test results. The detection of these irregularities led to speculation on other possible applications for the measuring gage in soil permeability testing and in detection of fractures in concrete and rock. Three methods for groundwater measurement are possible using this instrument: measurement of well discharge by water withdrawal or by disperson using air pressure in the well casing; measurement of the recharge rate after withdrawal of water; and measurement of the water elevation of normal conditions. (Moore-SRC)
W82-06396

A RAIN ATTENUATION MODEL FOR THE SIRIO-SHF EXPERIMENT,

Centro Studi Telecommunicazioni Spaziali e Politecnico, Milan (Italy).
G. Drufuca, and G. Macchiarella.
Atmosphere-Ocean, Vol 20, No 1, p 69-75, 1982. 4 Fig, 12 Ref.

Descriptors: *Remote sensing, *Rainfall rate, *Rainfall intensity, Precipitation intensity, Spina d'Adda, Italy, Radar, *SIRIO-SHF experiment, Model studies, Rain attenuation, Storms.

A model of rain attenuation, a bidimensional version of the synthetic storm technique, was developed and successfully tested by comparing the attenuation probability distribution from a year of measurements at 11.6 GHz and 32 degree elevation angle at the Spino d-Adda, Italy, receiving station with the rainfall rates measured at that station. Two different vertical rain profiles (rectangular and trapezoidal) reproduced the attenuation statistics, but each showed a different dependence on elevation angle, depicted on a graph for elevation angles from 5 to 45 degrees. Both models predicted lower attenuation than did the cosecant law for small elevation angles and higher attenuation for elevations above 30 degrees, particularly for the trapezoid model. (Cassar-FRC)
W82-06530

THE OUTLOOK FOR PRECIPITATION MEASUREMENTS FROM SPACE,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
D. Atlas, J. Eckerman, R. Meneghini, and R. K. Moore.
Atmosphere-Ocean, Vol 20, No 1, p 50-61, 1982. 2 Fig, 21 Ref.

Descriptors: *Remote sensing, *Rainfall, *Measuring instruments, Radar, Precipitation, Storms, Microwaves, Infrared imagery, Meteorology, Radiometry, Sampling.

The visible/infrared techniques, microwave radiometry, and radar can help in obtaining useful precipitation measurements from space. No single instrument or method currently satisfies the two requirements: adequate spatial and temporal sampling of the storm and sufficient accuracy in precipitation intensity estimates. The visible/infrared instruments provide good temporal sampling and rain area depiction. Microwave obtains quantitative rainfall estimates. Radar can overcome the inadequacies of microwave radiometric measurements over land. The accuracy, dynamic size, and system implementation of several radar methods are discussed: modified altimeter (simplest, least costly, but restricted to nadir measurements), short wavelength scanning radar (can scan cross-track to provide a swath measurement), surface target attenuation radar or STAR (variations include the surface comparison and the frequency agility methods), and the adaptive pointing beam. A hybrid approach that combines the surface reference technique (STAR), the frequency agility system, the short wavelength reflecting schemes, the adaptive pointing approach, and microwave radiometry may be a starting point in development of a suitable system. (Cassar-FRC)
W82-06531

TWO TECHNIQUES FOR LOCATING AND SAMPLING BROWN TROUT MICROHABITAT UNDER COMPLETE ICE COVER,

Wyoming Univ., Laramie. Water Resources Research Inst.
D. L. Wichers, T. A. Wesche, L. S. Johnson, and J. A. Gore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256777, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Series Report No 83, May 1982. 48 p, 7 Fig, 2 Tab, 25 Ref. OWRT B-038-WYO(3), 14-34-0001-8130.

Descriptors: *Trout, *Aquatic habitats, *Fish migration, *Telemetry, Radiometry, Radioisotopes, Radioactivity, Radioactivity techniques, Antimony, Microenvironment, Wildlife habitats, Environment, Fish behavior, Fish populations, Remote sensing, Sensors, Ice cover.

Two techniques were devised and evaluated for locating and sampling instream brown trout microhabitat under complete ice cover conditions. Radiotelemetry (RT) using surgically-implanted transmitters (SIT) was superior to implantation of radioisotope (antimony-124) capsules for tracking under-ice movements and locating microhabitat locations. The wax-acrylic coated transmitters (15-20g) were about 2.2 inches long, and had a lifespan estimated at 6 months. Fish could be located/tracked by a receiver by walking on the ice or by flying at 300-1000 feet above the ice. The advantages of the RT method were that the use of SIT does not present a potentially hazardous situation, that locating implanted fish by RT is unimpaired by severe weather, and that signals could be sensed up to 200 m and were unaffected by water depth, ice, snow, dense undercut banks, and temperature. The major problem with SIT was battery failure. Measurements of trout movements under ice cover indicated that freezing water temperatures significantly decreased trout activity. Trout preferred to remain within focal areas as resting microhabitats, with their activity decreasing as winter conditions progress. The microhabitat preference data developed should assist recommendations of suitable winter instream flows for medium-sized trout streams which develop total ice cover during winter. (Zielinski-MAXIMA)
W82-06703

AN AUTOMATED RECORDING SYSTEM FOR EVAPORATION PANS,

Bureau of Land Management, Denver, CO.
For primary bibliographic entry see Field 2D.
W82-06780

ESTIMATION OF RUNOFF-PRODUCING PRECIPITATION WITH THE AID OF SATELLITE IMAGERY (ERMITTLUNG ABFLUSSWIRKSAMER NIEDERSCHLAGE AUS SATELLITENDATEN),

Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Wasserwirtschaft and Umwelttechnik.
For primary bibliographic entry see Field 2B.
W82-06823

PRACTICABLE FORMULAE FOR THE ENERGY EXCHANGE AT THE BOUNDARY LAYER BETWEEN WATER SURFACE AND AIR (BRAUCHBARE ENERGIEUMSATZFORMELN FUR DEN GRENZBEREICH GEWASSEROBERFLACHE/LUFT),

Munich Univ. (Germany, F.R.). Fachbereich Geowissenschaften.
For primary bibliographic entry see Field 2D.
W82-06824

COMPARISON OF AUTOMATED SATELLITE SYSTEMS WITH CONVENTIONAL SYSTEMS FOR HYDROLOGIC DATA COLLECTION IN WEST-CENTRAL FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
W. M. Woodham.
Available from OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225 Paper copy $3.50 Microfiche $3.50. Open-File Report 81-1180, 1982. 23 p, 3 Fig, 5 Tab, 1 Ref.

Descriptors: *Hydrologic data collections, *Telemetry, *Remote sensing, *Data transmission, Monitoring, Sites, Satellite technology, Comparison studies, Cost analysis. *Florida, West-central Florida, GOES, Southwest Florida Water Management District.

This report provides results of reliability and cost-effective studies of the goes satellite data-collection system used to operate a small hydrologic data network in west-central Florida. The GOES system, in its present state of development, was found to be about as reliable as conventional methods of data collection. Benefits of using the GOES system include some cost and manpower reduction, improved data accuracy, near real-time data availability, and direct computer storage and analysis of data. The GOES system could allow annual manpower reductions of 19 to 23 percent with reduction in cost for some and increase in cost for other single-parameter sites, such as streamflow, rainfall, and ground-water monitoring stations. Manpower reductions of 46 percent or more appear possible for multiple-parameter sites. Implementation of expected improvements in instrumentation and data handling procedures should further reduce costs. (USGS)
W82-06951

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, CHICKASHA, OKLA., 1980 REPORT,

Agricultural Research Service, Beltsville, MD. Hydrology Lab.
T. J. Jackson, P. E. O'Neill, G. C. Coleman, and T. J. Schmugge.
Agricltural Research Results ARR-NE-14, July, 1982. 18 p, 4 Fig, 6 Tab, 2 Ref.

Descriptors: *Remote sensing, *Soil water, *Hydrologic data, *Aerial photography, *Infrared imagery, Agricultural hydrology, Soil temperature, *Oklahoma.

The study sites in Oklahoma were in the Washita River Experimental Watershed, Chickasha area. Data flights were made and ground samples collected on June 24, August 14, and September 9, 1980. Soil moisture samples were collected using a gravimetric technique for depth intervals of 0-2.5, and 5-15 cm. Soil temperature samples were obtained at depths of 2.5 and 15 cm. The NASA 929 (C-130B) aircraft was the sensor platform used in these experiments. The sensor configuration included color infrared photography, a modular multispectral scanner, a thermal infrared radiometer, L and C band radiometer, a passive microwave scanner, and four active microwave sensors (K, C, L, and P band scatterometers). Generally the soil moisture conditions were relatively wet on the date of the first flight and very dry on the last two flights. These results were ideal because the wet condition data provided verification of the sensor performance in 1978 and the dry condition data allowed the extension of the 1978 data set. The report includes soil moisture measurements, climatic observations, and the remote sensing data collected in order to evaluate aircraft remote sensing techniques. (Moore-SRC)
W82-06969

APPLICATION OF THERMAL INFRARED IMAGERY TO CANAL LEAKAGE DETECTION,

Kansas State Univ. Manhattan. Dept. of Geography.
M. D. Nellis.
Remote Sensing of Environment, Vol 12, No 3, p 229-234, 1982. 4 Fig, 4 Ref.

Descriptors: *Canal seepage, *Leakage, *Remote sensing, Infrared imagery, Conveyance structures, Water conveyance, Seepage, Aircraft, *Oregon, North Unit Irrigation District, Soil water, Irrigation canals, Water loss.

Canal leakage sites were detected by a HRB Singer AN/AAS 14 optical-electronic thermal infrared scanning system, sensing in the 8-14 micron range. The apparatus was flown in an aircraft on May 21, 1979, at 2100 hours and 900 m altitude over the main North Unit Canal in central Oregon. Moist sites emitted more radiation during the evening hours and less during peak solar radiation hours than the low moisture, or nonleaking sites. Out of 39 sites showing the characteristics of leakage sites, 12 were verified as actual leakage sites by field analyses. Inspection of the canal uncovered no leakage sites not appearing on the imagery. The sites misinterpreted as leakage sites featured dense natural vegetation, farm canals, drainage ditches, small holding ponds, or natural depressed drainage areas. This interference could be reduced by taking simultaneous color photographs. This economical and practical leakage detection method could help save some of the 58,800 acre feet (or 1 acre-ft per acre of irrigated land) 0.6-7.3 m, and lengths were 12.2.-91.4 m. 75% were oblong in shape, and the remainder were irregular. (Cassar-FRC)
W82-06994

ESTIMATION OF THE PRECIPITABLE WATER FROM THE IR CHANNEL OF THE GEOSTATIONARY SATELLITE,

Meteorological Satellite Center, Tokyo (Japan).
T. Aoki, and T. Inoue.
Remote Sensing of Environment, Vol 12, No 3, p 219-228, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Remote sensing, *Atmospheric water, *Precipitable water, *Infrared imagery, *Pacific Ocean, *Geostationary Meteorological Satellite, Seasonal variation, Meteorology, Water vapor,Marine climates, Air temperature, Water temperature, Temperature, Satellite technology, Tropical regions.

Total precipitable water over the tropical oceans was determined from infrared radiometer data in the atmospheric window region using data from the Geostationary Meteorological Satellite of Japan. The information about sea surface temperature, atmospheric temperature, and atmospheric water vapor involved in the observed radiation in the atmospheric window region varied greatly with the amount of water vapor in the atmosphere and thus with the latitude. At low latitudes the atmospheric window region contained much information about water vapor and mean temperature of the lower atmosphere but very little information about the sea surface teperature. Satellite derived values agreed well with radiosonde data, within 0.53 g per sq cm rms difference. The weekly man distribution of precipitable water over the tropical section of the western Pacific Ocean was obtained for summer and winter. July 1-7, 1979, values varied from 5.0 g per sq cm north of New Guinea at latitudes 10 degrees south to 10 degrees north to 4.0 g per sq cm further from the equator. January 1-7, 1979, values showed a shift of the maximum precipitable water, 3.0 g per sq cm, to the south. Results agreed reasonably with data from other authors and measured climatological data. (Cassar-FRC)
W82-06995

7C. Evaluation, Processing and Publication

SOIL MOISTURE FLOW FOR POINT AND LINE SOURCES - COMPUTER PROGRAMS FOR LINEARIZED SOLUTIONS,

Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.
For primary bibliographic entry see Field 2G.
W82-05928

HYDROGEOLOGIC DATA FROM TWO WELLS AT MYAKKA HEAD, MANATEE COUNTY, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
W. C. Sinclair.
Available from OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. Paper copy $3.50, Microfiche $3.50. Geological Survey Open-File Report 81-1070, 1982. 21 p, 15 Fig.

Descriptors: *On-site data collections, *Observation wells, *Well data, *Water quality, Geohydrology, Water level, Chlorides, Well logs, Hydrographs, *Florida, Manatee County, Myakka Head, Southwest Florida Water Management.

Well construction data, lithologic and geophysical logs, and water-quality data are presented for a deep (1,210 feet) well drilled at myakka Head, Manatee County, Florida. A shallow well (600 feet) was drilled at the same site. The wells were drilled as part of the Southwest Florida Water Management District's Regional Observation and Monitor-Well Program. The deep well is cased to a depth of 909 feet and open from 909 to 1,210 feet. The shallow well is cased to a depth of 563 feet and open from 563 to 600 feet. Chloride concentration of water from the deep well is 17 milligrams per liter. (USGS)
W82-06129

HYDROGEOLOGIC DATA FROM SELECTED WELLS AND TEST HOLES IN SUFFOLK COUNTY, LONG ISLAND, NEW YORK, 1972-80,

Geological Survey, Syosset, NY. Water Resources Div.
R. K. Krulikas.
Geological Survey Open-File Report 81-500 (WRI), 1981. 27 p, 2 Fig, 1 Plate, 2 Tab, 11 Ref.

Descriptors: *Areal hydrogeology, *Data collections, *Aquifer systems, *Groundwater, *Wells, Test holes, Geohydrologic units, Geology, Well data, Urbanization, Water use, Water supply, Available water, *New York, *Long Island, Suffolk County.

The population of Suffolk County, New York, an area of 922 square miles, has increased rapidly, from less than 200,000 in 1940 to about 1.3 million in 1978. Ground-water pumpage has increased from an average of 42 million gallons per day in 1950 to about 257 million gallons per day in 1978. To help supply the hydrologic information needed to anticipate and prevent shortages, this report presents hydrogeologic and well-completion data on over 700 wells and test holes. (USGS)
W82-06131

STATISTICAL SUMMARIES OF STREAMFLOW AND WATER-QUALITY DATA FOR STREAMS OF WESTERN NORTH DAKOTA, 1977-80,

Geological Survey, Bismarck, ND. Water Resources Div.
N. D. Haffield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-xxxxxx, Price codes: Axx in paper copy, A01 in microfiche.
Geological Survey Open-File Report 81-1066, July 1981. 78 p, 1 Fig, 11 Ref.

Descriptors: *Hydrologic data, *Water quality, *Surface water, Streams, Sediment, Gaging stations, Sites, Sampling, Water analysis, *North Dakota.

Statistics for the streamflow and water-quality data collected at 67 stations in western North Dakota from October 1977 through September 1980 are presented in a format that will make the data more useful to those who are making water-resources planning and development decisions. (USGS)
W82-06133

GROUND-WATER DATA FOR THE BERYL-ENTERPRISE AREA, ESCALANTE DESERT, UTAH,

Geological Survey, Salt Lake City, UT. Water Resources Div.
R. W. Mower.
Geological Survey Open-File Report 81-340, 1981. 64 p, 1 Fig, 1 Plate, 6 Tab.

Descriptors: *Data collections, *Groundwater, *Wells, *Water level, *Water quality, Chemical analysis, Water yield, Observation wells, Drillers logs, Well data, *Utah, Escalante Desert, Beryl-Enterprise area.

This report contains a compilation of selected ground water data for the Beryl-Enterprise area, Iron and Washington Counties, Utah. The records of the wells include such information as driller's logs, yield, drawdown, use, and temperature of the well water. There are also records of water levels in selected wells for the period 1973-79, chemical analyses of ground water, records of selected springs, and a tabulation of ground-water withdrawals for 1937-78. (USGS)
W82-06134

POTENTIOMETRIC MAP OF THE SPARTA AQUIFER SYSTEM IN MISSISSIPPI, FALL 1980,

Geological Survey, Jackson, MS. Water Resources Div.
B. E. Wasson.
Geological Survey Open-File Report 81-1051 (WRI), 1980. 1 Sheet, 25 Ref.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Groundwater, Natural recharge, Water level, Observation wells, Water level fluctuations, Geohydrology, Hydrographs, *Mississippi, Sparta aquifer system, Sparta Sand.

This potentiometric map of the Sparta aquifer system is the tenth in a series of maps, prepared by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Land and Water Resources, delineating the potentiometric surfaces of the major aquifers in Mississippi. In the outcrop area of the Sparta, the potentiometric surface is strongly affected by recharge from precipitation, by topography, and by drainage of the aquifer into streams. The potentiometric surface slopes downward generally to the west away from the area of outcrop and is strongly affected by large ground-water withdrawals in the Jackson, Yazoo City, Cleveland, Clarksdale, and Memphis areas. Historically, water levels in or near the outcrop of the Sparta have shown little or no long-term changes, but during the past 20 years, in much of the confined part of the aquifer, water levels have declined from 1 to 3 feet per year. (USGS)
W82-06135

EFFECTS OF EFFLUENTS FROM A COAL-FIRED, ELECTRIC-GENERATING POWER-PLANT ON LOCAL GROUND WATER NEAR HAYDEN, COLORADO,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-06137

WATER-LEVEL MAP OF THE MISSISSIPPI DELTA ALLUVIUM IN NORTHWESTERN MISSISSIPPI, APRIL 1981,

Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
Geological Survey Open-File Report 81-1123 (WRI), 1981. 1 Sheet, 8 Ref.

Descriptors: *Maps, *Water level, *Groundwater, *Alluvial aquifer, Aquifer characteristics, Deltas, Wells, Precipitation, Water level fluctuations, Pumping, Irrigation, Geohydrology, Hydrographs, *Mississippi, Mississippi River valley alluvial aquifer.

Water levels were measured in 454 wells in the alluvial sediments in northwestern Mississippi during the period April 13-24, 1981. Ground-water levels are higher after winter and spring rains and lower after heavy agricultural and industrial pumping. Locally, water levels fluctuate as rivers and streams fluctuate. Because of the drought conditions in April 1981, most water wells had risen several feet. In some areas, however, water levels had not recovered from the relatively low levels measured in September 1980. (USGS)
W82-06138

SELECTED BIOLOGICAL CHARACTERISTICS OF STREAMS IN THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,

Geological Survey, Salt Lake City, UT. Water Resources Div.
R. W. Naten, and R. H. Fuller.
Geological Survey Open-File Report 81-644 (WRI), 1981. 38 p, 26 Fig, 4 Tab, 12 Ref.

Descriptors: *Data collections, *Biological samples, *Water quality, Oil shale, Environmental effects, Bacteria, Benthic fauna, Ecological distribution, *Utah, *Colorado, Uinta Basin.

Biological sampling was carried out during 1976-78 in five streams in the southeastern Uinta Basin, Utah and Colorado, in order to provide baseline water-quality data for an area of potential oil-shale development. The biological activity in the streams sampled generally is limited by physical factors more so than by chemical constituents and plant nutrients. Characteristics of streamflow, such as high turbidity, fluctuating water levels, and moderate to high salinity, limit production of flora and fauna biomass. Samples were collected for the determination of bacterial and periphyton concentrations and benthic-invertebrate communities. Bacterial concentrations were generally small, with some fecal contamination, primarily from livestock and wildlife. Members of the order Chlorophyta (green algae) were the major periphytic algae present in three of the streams sampled. Bitter Creek was dominated by members of the order Cyanophyta (blue-green algae), and pennate diatoms were the predominant algae in Willow Creek. The benthic-invertebrate communities generally reflect a nonpolluted environment. Shannon-Weiner diversity indices ranged from 1.14 to 3.08. (USGS)
W82-06140

A METHOD OF ESTIMATING FLOOD-FREQUENCY PARAMETERS FOR STREAMS IN IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-06142

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 2. WESTERN OREGON.

Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190364, Price codes: A22 in paper copy, A01 in microfiche.
Geological Survey Water-Data Report OR-80-2, December 1981. 491 p, 5 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Oregon, Western Oregon.

Water resources data for the 1980 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 287 gaging stations, stage only records for 10 gaging stations, stage and contents for 41 lakes and reservoirs, water quality for 98 gaging stations, water levels for 68 observation wells, and water quality for 6 precipitation stations. Also included are 49 crest-state partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W82-06143

SAN JUAN RIVER BASIN,

Geological Survey, Lakewood, CO. Water Resources Div.

Available from the National Technical Information Service, Springfield, VA 22161 as PB82-202045, Price codes: A20 in paper copy, A01 in microfiche. Geological Survey Water-Data Report CO-80-3, 1981. 452 p, 4 Fig, 5 Tab, 42 Ref.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Colorado, Dolores River basin, Green River basins, San Juan River basin.

Water-resources data for Colorado for the 1980 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for about 460 gaging stations, stage and contents of 22 lakes and reservoirs, 4 partial-record low-flow stations, 30 crest-stage patial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 300 miscellaneous sites; and water levels for 55 observation wells. A few pertinent stations in bordering States also are included. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Colorado. (USGS)
W82-06144

A REMOTE SENSING TECHNIQUE FOR ESTIMATING WATERSHED RUNOFF,

Ohio State Univ., Columbus. Dept. of Civil Engineering.
O. Mintzer, and F. Askari.
Available from the National Technical Information Service, Springfield, VA 22161, as PB82-243668, Price codes: A04 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus, Report No 712508, October 1980. 53 p, 14 Fig, 13 Tab, 32 Ref, 7 Append. OWRT A-063-OHIO-(1).

Descriptors: *Remote sensing, *Mathematical models, *Regression analysis, *Spectral analysis, *Runoff coefficients, Aerial photography, Satellite technology, Sensors, Telemetry, Infrared imagery, Watershed management, Runoff, Mathematical studies, Data interpretation, Experimental data, Watersheds, Model studies, *Ohio, Mill Creek.

Research was carried out to derive runoff coefficients for watersheds of Mill Creek in Coshocton County, Ohio, from LANDSAT multispectral data by including the more detailed (level II) surface conditions and soil types along with land cover (level I) types in the analysis techniques. Regression models were developed from treating the runoff coefficient of each sample site as the dependent variable, and the mean radiance measurements in the four LANDSAT channels as the independent variables. The models were then extended over the area, and the classification results consisted of digital color-coded maps illustrating spatial variability of runoff potential for the surface. The computer-derived patterns were confirmed with known features within the area, and individual test fields and watersheds were selected for verification of the model results. The model-derived runoff coefficients compared favorably with those obtained from ground truth. It was concluded that, for the sampled sites of the given land cover conditions and soil type, the multispectral data analysis technique described provided reasonable values of runoff coefficients for the watersheds tested. (Zielinski-MAXIMA)
W82-06151

CRITERIA FOR THE USE OF REGRESSION ANALYSIS FOR REMOTE SENSING OF SEDIMENT AND POLLUTANTS,

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
C. H. Whitlock, C. Y. Kue, and S. R. LeCroy.
Remote Sensing of Environment, Vol 12, No 2, p 151-168, 1982. 6 Fig, 5 Tab, 19 Ref.

Descriptors: *Remote sensing, *Regression analysis, *Pollutant identification, Radiance, Network design, Satellite technology, Errors, *Sediments.

The limitations, requirements, and precision of linear multiple regression techniques for quantifying marine environmental parameters such as sediments and pollutants were evaluated. Radiance was the independent variable. Both environmental and optical physics conditions were defined for which an exact solution to the signal response equation is of the same form as the multiple regression equation. One problem with using this regression technique is that the independent variables (Upwelled radiaces) contained errors which were often correlated with each other. This situation required a large number of statistical parameters when performing the regression analysis. Examination of field experiments showed that the magnitude of the data noise required data smoothing before Daniel and Wood's criteria could be satisfied for the least-square multiple regression process. To minimize data smoothing requirements and associated physical errors, ground truth locations whould be carefully chosen. Specific suggestions for environmental and ground truth conditions are given. (Cassar-FRC)
W82-06233

MICROPROCESSORS AND COMPUTERS IN ANALYSIS IN THE WATER INDUSTRY,

Technicon Instruments Co. Ltd. (England).
For primary bibliographic entry see Field 5F.
W82-06259

ACCURACY OF FIRM YIELD ESTIMATES OF DIRECT SUPPLY RESERVOIRS WITH LIMITED DATA,

Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 4A.
W82-06300

ON THE RELATIONSHIP BETWEEN KRIGING AND STATE ESTIMATION,

Princeton Univ., NJ. Dept. of Civil Engineering.
G. R. Chirlin, and E. F. Wood.
Water Resources Research, Vol 18, No 2, p 432-438, April, 1982. 1 Fig, 17 Ref.

Descriptors: *Spatial distribution, *Estimating equations, *Statistical analysis, Model studies, *Probability distributions, Stationary process, Hydrologic data, Mathematical studies, *Kriging, *State estimation.

Universal kriging is one method of interpolating sampled random spatial processes which has applications in hydrology. The interpolation task is complicated by process noise and data measurement error. Kriging is a technique which refers to a family of stochastic process models plus associated parameter estimation procedures. It is based on a theory of 'differencing' of n-dimensional spatial processes and is well developed for the delineation of mineral deposits. Universal kriging interpolates a discrete stationary spatial process obtained by polynomial filtering through spatial differencing of the original nonstationary process. In this paper, the universal kriging axioms, calculation of some statistics of the kriging system variables, definition and solution of the state space version of the kriging problem, and an example are presented. (Titus-FRC)
W82-06323

OPTIMIZING THE EVALUATION OF LAKE WATER QUALITY THROUGH ANALYSIS OF EXISTING REMOTELY SENSED DATA,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. R. Philipson, K. Kozai, and E. L. Mills.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256637, Price codes: A03 in paper copy, A01 in microfiche. Report, December, 1981. 29 p, 8 Fig, 4 Tab, 49 Ref, 1 Append. OWRT A-091-NY(1). 14-34-0001-1134.

Descriptors: *Water quality, *Eutrophic lakes, *Remote sensing, *Satellite technology, *Regression analysis, Evaluation, Sensors, Telemetry, Mathematical models, Computer models, Mathematical studies, Model studies, Water quality control, Lakes, Chlorophyll A, Density stratification, Air temperature, Wind, Lake breezes.

A methodology development was undertaken for use in selecting optimum sampling locations for water quality assessment in a large eutrophic New York State lake (Oneida Lake). The methodology approach was based on the premises that Landsat satellite image densities can be modeled, and that homogeneous water quality areas could be thereby predicted. Patterns of Lake density on 24 Landsat band-5 images (0.6-0.7 microns) were traced from a density-slicer screen, following standardization of the color assignments with dark- and a light-toned feature. The Lake was griddled into 161 cells (1.25 km by 1.25 km each), and density levels from each image were encoded for each cell. Cell density levels were used as the dependent variable in correlations and multiple regressions with degree days, and resultant wind speed and direction. Further, equation-predicted density levels in selected cells were correlated with measured values of chlorophyll-A, chlorophyll-a plus pheophytin, and Secchi disk transparency. It was found that the use of degree days and wind in evaluating water quality represents a promising and improved approach. While reliability of the regression equations was too low to develop an effective lake sampling strategy, results suggest further study appears justified. (Zielinski-MAXIMA)
W82-06370

DIGITIZING AND ROUTINE ANALYSES OF HYDROLOGICAL DATA,

Natal Univ., Pietermaritzburg (South Africa).
For primary bibliographic entry see Field 2E.
W82-06386

ON THE GRAPHICAL PRESENTATION OF RAINDROP SIZE DATA,

South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W82-06529

THE OECD COOPERATIVE PROGRAMME ON EUTROPHICATION CANADIAN CONTRIBUTION, SUMMARY REPORT, (SUPPLEMENT),

Canada Centre for Inland Waters, Burlington (Ontario).
L. L. Janus, and R. A. Vollenweider.
National Water Research Institute, Scientific Series No 131-S, Background Data Supplement, 1981. 121 p, Tab.

Descriptors: *Canada, *Eutrophication, Nutrient reduction, Phosphorus, Nitrogen, Chlorophyll, Hypolimetic oxygen rate, Loadings, Data, Lakes, Basins, Graphs, *Data collections, *Pollutant identification.

This background data supplement contains information sheets listing the most pertinent background information for the lakes and basins discussed in the main report; The OECD Cooperative Programme on Eutrophication Canadian Contribution, (Scientific Series No. 131). (WATDOC)
W82-06567

A PRACTICAL METHOD OF ESTIMATING PEAK FROM MEAN DAILY FLOWS WITH APPLICATION TO STREAMS IN ONTARIO,

Inland Waters Directorate, Environment Canada, Ottawa, Ontario.
For primary bibliographic entry see Field 2E.
W82-06568

FITTING A GAMMA DISTRIBUTION OVER A SYNTHETIC UNIT HYDROGRAPH,

Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-06586

THE PRACTICAL HANDLING OF WATER QUALITY MONITORING DATA,

Department of the Environment, Reading (England). Water Data Unit,
R. V. Moore, and D. W. C. Rodda.
Water Science and Technology, Vol 13, No 11/12, p 707-714, 1981. 2 Fig, 7 Ref.

Descriptors: *Water quality, *Monitoring, *Data storage and retrieval, Computers, Data management, Data collections, *United Kingdom, Water quality data, Hydrologic data collections.

Ten regional authorities in England and Wales have responsibility for all aspects of the water cycle, including monitoring of water quality. These authorities collect data for their own water management needs, for assessing the effectiveness of water pollution legislation, and for determining the rate of improvement or deterioration of water resources. The need for similar types of information and for information which can be compared among the regions has led to the development of the Water Archive System, which provides a cost-effective solution to the organization and control of data for the authorities. The Water Archive System manages water quality data; hydrological, biological, and meteorological data; and data on water supply and wastewater disposal. The objectives and applications of this national computer-based system are described. The computer system is simple in concept and use, but capable of handling a wide range of data. A high level of user participation in project management has been encouraged in order to promote commitment to the project. A System for achieving national agreement with respect to data definitions has helped to promote data comparability. The Water Archive System is currently used by seven of the regional water authorities, as well as by the British Department of the Environment and by the Ministry of Agriculture, Fisheries, and Food. (Carroll-FRC)
W82-06591

MATHEMATICAL MODELS FOR CALCULATING THE DYNAMICS AND QUALITY OF COMPLEX WATER SYSTEMS,

For primary bibliographic entry see Field 2A.
W82-06613

WATER RESOURCES DATA FOR TENNESSEE, WATER YEAR 1980.

Geological Survey, Nashville, TN. Water Resources Div.
Geological Survey Water-Date Report TN-80-1, 1981. 313 p, 6 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water levels, Data collections, Sites, *Tennessee.

Water resources data for the 1980 water year for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 108 gaging stations, stage only records for one lake gaging station, elevation and contents for 27 lakes and reservoirs, water quality for 82 stations and 21 wells, and water levels for 26 observation wells. Also included are 127 crest-stage partial-record stations, 73 low-flow partial-record stations, and 80 coal-hydrology partial-record stations. Additional water data were collected at various stream and spring sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses, or as seepage investigations of discharge and water quality. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Tennessee. (USGS)
W82-06670

SUMMARY OF BASIN AND FLOOD CHARACTERISTICS FOR UNREGULATED BASINS IN NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
R. P. Thomas, and A. Dunne.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $31.50, Microfiche $3.50. Geological Survey Open-File Report 81-1071, August 1981. 230 p, 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Floods, *Basins, *Streamflow, *Flood data, Surface water, Flood peak, Flow characteristics, Flood frequency, Flood recurrence interval, Gaging stations, Monitoring, *New Mexico, Log Pearson type III analysis.

Selected basin characteristics, flood characteristics, flood statistics and peak flows are summarized for 277 unregulated basins in New Mexico and adjacent areas of conterminous States. Station descriptions are included in the peak flow listing; a State map shows areal location. (USGS)
W82-06671

HYDROLOGIC DATA FOR URBAN STUDIES IN THE SAN ANTONIO, TEXAS METROPOLITAN AREA, 1978,

Geological Survey, Austin, TX. Water Resources Div.
R. Perez.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $11.75, Microfiche $3.50. Geological Survey Open-File Report 81-922, August, 1981. 91 p, 1 Fig, 5 Tab, 5 Ref.

Descriptors: *Urban hydrology, *Rainfall-runoff relationships, *Storm runoff, *Urban runoff, *Hydrologic data, Small watersheds, Streamflow, Flow rates, Flood peak, Flood profiles, Watershed Management, *Texas, San Antonio.

This report contains rainfall, runoff, and water-quality data collected during the 1978 water year for the San Antonio metropolitan area. The information will be useful in determining the effects of various stages of ubanization on flood discharge and runoff and in determining chemical constituents in surface-water runoff from floods of various magnitudes during all seasons of the year from areas with different types of urban development. Detailed rainfall-runoff computations are presented for several storm periods during the 1978 water years. (USGS)
W82-06672

WATER-RESOURCES INVESTIGATIONS OF THE U. S. GEOLOGICAL SURVEY IN ARKANSAS--FISCAL YEAR 1981.

Geological Survey, Little Rock, AR. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Paper copy $6.50, Microfiche $3.50. Geological Survey Open-File Report 81-1003, 1981. 44 p, 20 Fig. (Gurley, M. O., Compiler).

Descriptors: *Data collections, *Groundwater, *Water quality, *Surface water, Gaging stations, Sites, Streamflow, Flow characteristics, Sediments, Dye releases, Sampling, Water level, Wells, Water use, *Arkansas.

During fiscal year 1981 there were 20 water-resources investigations in progress by the Arkansas District of the U. S. Geological Survey's Water Resources Division. Investigations that mainly involved data collection included surface-water gaging, water-level measuring, water-quality sampling, sediment sampling, and water-use inventorying. Interpretive studies included three that were principally of ground-water resources, four that were of surface-water flow charateristics, four that were of surface-water quality characteristics, and three that were interdisciplinary. (USGS)
W82-06673

WATER RESOURCES DATA, LOUISIANA, WATER YEAR 1981--VOLUME 1. CENTRAL AND NORTHERN LOUISIANA.

Geological Survey, Baton Rouge, LA. Water Resources Div.
Geological Survey Water-Date Report LA-81-1, 1981. 424 p, 10 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Louisiana, Central and Northern Louisiana.

Water resources data for the 1981 water year for Lousiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in three volumes, contains records for water discharge at 81 gaging stations (including stage of 76 of these stations); stage only for 37 gaging stations and 10 lakes; contents for 1 reservoir; water quality for 142 surface-water stations (including 35 gaging stations), 27 miscellaneous sites, 10 lakes, and 286 wells; and water levels for 679 observation wells. Also included are data for 250 crest-stage and flood-profile stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States are also included in this report. These data represent that part of the National Water Data system operated by the U.S. Geological Survey and cooperating State and Federal agencies in Louisiana. (USGS)
W82-06674

POTENTIOMETRIC MAP OF THE COCKFIELD AQUIFER IN MISSISSIPPI, FALL 1980,

Geological Survey, Jackson, MS. Water Resources Div.
B. E. Wasson.
Geological Survey Open-File Report 81-1053 (WRI), 1981. 1 Sheet, 22 Ref.

Descriptors: *Maps, *Potentiometric level, *Aquifers, *Goundwater, Natural recharge, Water level, Observation wells, Water level fluctutations, Geohydrology, Hydrographs, *Mississippi, Cockfield formation, Cockfield aquifer.

This potentiometric map of the Cockfield aquifer is the eleventh in a series of maps, prepared by the U.S. Geological Survey in cooperation with the Mississippi Department of Natural Resources, Bureau of Land and Water Resources, delineating the potentiometric surfaces of the major aquifers in Mississippi. In the outcrop area of the Cockfield quifer the potentiometric surface is strongly affected by recharge from precipitation, by topography, and by drainage of the aquifer by streams. The potentiometric surface slopes downward generally to the west away from the area of outcrop and is strongly affected by large ground-water withdrawals in the Jackson and Greenville areas. Historically, water levels in or near the outcrop of the Cockfield aquifer have shown little or no long-term changes, but in much of the confined part of the aquifer during the past 20 years, water levels have declined from 1 to 2 feet per year. (USGS)
W82-06676

FLOW CHARACTERISTICS AND WATER-QUALITY CONDITIONS IN THE SPOKANE RIVER, COEUR D'ALENE LAKE TO POST FALLS DAM, NORTHERN IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 5B.
W82-06681

ASSESSMENT OF WATER QUALITY IN CANALS OF EASTERN BROWARD COUNTY, FLORIDA, 1969-74,

Geological Survey, Tallahassee, FL.. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-06682

ORGANIC SOLUTES IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY,

Geological Survey, Lakewood, CO. Water Resources Div., and Geological Survey, Idaho Falls, ID. Water Resources Div.
J. A. Leenheer, and J. C. Bagby.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-195280, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 82-15, March 1982. 39 p, 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Organic compounds, *Groundwater, *Water quality, *Path of pollutants, Observation wells, Monitoring, Sampling, Pesticides, Radioactive waste disposal, Aquifers, Groundwater movement, Geochemistry, *Idaho, Snake River Plain aquifer, Idaho National Engineering Laboratory.

In August 1980, the U.S. Geological Survey started a reconnaisscace survey of organic solutes in drinking water sources, ground-water monitoring wells, perched water table monitoring wells, and in select waste streams at the Idaho National Engineering Laboratory. The survey was to be a two-phase program. In the first phase, 77 wells and 4 potential point sources were sampled for dissolved organic carbon (DOC). Four wells and several potential point sources of insecticides and herbicides were sampled for insecticides and herbicides. Fourteen wells and four potential organic sources were sampled for volatile and semivolatile organic compounds. The results of the DOC analyses indicate no high level organic contamination of ground water. The only detectable insecticide or herbicide was a DDT concentration of 10 parts per trillion (0.01 microgram per liter) in one observation well. The volatile and semivolatile analyses do not indicate the presence of hazardous organic contaminants in significant amounts (>10 micrograms per liter) in the samples taken. Due to the lack of any significant organic ground-water contamination in this reconnaissance survey, the second phase of the study, which was to follow up the first phase by additional sampling of any contaminated wells, was cancelled. (USGS)
W82-06688

WATER QUALITY OF ALIMAGNET, FARQUAR, AND LONG LAKES IN APPLE VALLEY, MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2H.
W82-06690

HYDROGEOTHERMAL MAPPING OF THE ACTIVE WATER-EXCHANGE ZONE IN THE USSR,

All Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
N. M. Frolov.
Water Resources, Vol 8, No 3, p 319-328, May/June, 1981. 2 Fig, 3 Tab, 11 Ref. Translated from Vodnye Resursy, No 3, p 154-166, May/June, 1981.

Descriptors: *Maps, *Geohydrology, *Heat flow, Groundwater, *USSR, Temperature gradient, Geologic mapping, *Geothermal studies, Heat transfer.

The existing USSR hydrogeothermal maps of the active water exchange zone are described and analyzed. The first hydrogeothermal map of the USSR was prepared in 1962. Geothermal maps, compiled without consideration of hydrogeological features, had been prepared before this date. The 'Hydrogeothermal Atlas of the USSR,' published in 1975-77, included maps of geoisotherms of the neutral layer (average long-term groundwater temperature), geoisotherms of depths of 125 and 250 m, and other related maps. Thermometric investigations showed that the mean differences between regional geotemperature field and actual temperature measurements were 0.2 C at 25 m depth and -3.0 C at 125 m depth. Conclusions reached on the basis of these maps were that low heat fluxes are present for depths of 250 m in the northern regions of the country and that the geotemperature and thermal fields to at least 250 m were formed under exogenic rather than endogenic influences. The neutral Layer iiin the USSR is mainly within 15-25 m in regions of clays, peats, and loams. In central regions of the European USSR the thickness of the layer of annual variable temperature exceeds 35 m because of the predominance of sands and loam sands and the confinement of the regions to the zone of surplus water. (Cassar-FRC)
W82-06782

NUMERICAL MODELING OF UNSTEADY FLOWS IN OPEN CHANNELS,

Novosibirsk State Univ. (USSR).
M. T. Gladyshev.

Recent work (1974-80) on numerical methods for calculating flows in hydraulic engineering, as developed at Novosibirsk University, is reviewed. The methods are based on numerical solutions of St. Verant equations for one-dimensional unsteady flows. A General Statement of the problem of two-dimensional unsteady flows was formulated, allowing isolation of the breakthrough wave and moving boundary along a dry bottom. Three types of problems were solved by finite difference methods: smooth flows in a channel with vertical walls, discontinuous flows in a channel with vertical walls, and propagation of a breakthrough wave along a dry and wet bottom with isolation of the leading edge. Two-dimensional flows were calculated for the problem of dam failure in the case of a dry and wet bottom. Many experiments were carried out for the case of moving boundaries of liquid layers. For example, the method of moving meshes was used in problems of the inflow of a heavy liquid into a channel with a light and also on failure of a dam with a two-layer reservoir. (Cassar-FRC)
W82-06784

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 1. APALACHICOLA, CHOCTAWATCHEE, BLACKWATER, ESCAMBIA, PERDIDO, AND ALABAMA RIVER BASINS,

Geological Survey, Univ., AL. Water Resources Div.
Water-Data Report AL-80-1, 1981. 225 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Alabama, Apalachicola River basin, Choctawatchee River basin, Blackwater River basin, Escambia River basin, Perdido River basin, Alabama River basin.

Water resources data for the 1980 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs, and water levels in wells. This report contains discharge records for 49 gaging stations, stage only for 15 gaging stations, stage and contents for 8 lakes and reservoirs, water quality for 34 gaging stations, and water levels for 11 observation wells. Also included are 21 low-flow partial-record stations, 16 crest-stage partial-record stations, 7 flood hydrograph partial-record stations, and 8 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W82-06953

WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1980--VOLUME 2. TOMBIGBEE, MOBILE, DOG, PASCAGUOULA, AND TENNESSEE RIVER BASINS,

Geological Survey, Univ., AL. Water Resources Div.
Water-Data Report AL-80-2, 1981. 483 p, 7 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Stream-flow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Alabama, Tombigbee River basin, Mobile River basin, Dog River basin, Pascagoula River basin, Tennessee River basin.

Water resources data for the 1980 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 48 gaging stations, stage only for 7 gaging stations, stage and contents for 4 lakes and reservoirs, water quality for 46 gaging stations, and water levels for 46 observation wells. Also included are 3 low-flow partial-record stations, 4 crest-stage partial-record stations, 4 flood hydrograph partial-record stations, and 101 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systeatic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (USGS)
W82-06954

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2A. SOUTH FLORIDA SURFACE WATER,

Geological Survey, Tallahassee, FL. Water Resources Div.
Water-Data Report FL-80-2A, 1981. 564 p, 14 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Data collections, Sites, *Florida, South Florida.

Water resources data for the 1980 water year for south Florida include continuous or daily discharge for 82 streams, periodic discharge for 1 stream, peak discharge for 2 streams, continuous or daily stage for 21 streams, periodic stage for 37 streams, continuous elevations for 15 lakes, periodic elevations for 4 lakes, and quality of water for 136 surface-water sites. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State, and Federal agencies in Florida. (USGS)
W82-06955

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1980--VOLUME 2B. SOUTH FLORIDA GROUND WATER,

Geological Survey, Tallahassee, FL. Water Resources Div.
Water-Data Report FL-80-2B, 1981. 322 p, 18 Fig, 1 Tab, 16 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Water quality, Water analysis, Water temperature, Chemical analysis, Wells, Water level, Data collections, Sites, *Florida, South Florida.

Water resources data for the 1980 water year for south Florida include continuous ground water levels for 178 wells, periodic ground water levels for 178 wells, miscellaneous water level measurements for 539 wells, and quality of water for 282 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida. (USGS)
W82-06956

WATER RESOURCES DATA FOR OREGON, WATER YEAR 1980--VOLUME 1. EASTERN OREGON.

Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-190356, Price codes: A12 in Paper copy, A01 in Micro-

fiche. Water-Data Report OR-80-1, 1981. 244 p, 5 Fig, 1 Tab.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Oregon, Eastern Oregon.

Water resources data for the 1980 water year for Oregon consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and resrvoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 287 gaging stations, stage only records for 10 gaging stations, stage and contents for 41 lakes and reservoirs, water quality for 98 gaging stations, water levels for 68 observation wells, and water quality for 6 precipitation stations. Also included are 49 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Oregon. (USGS)
W82-06957

8. ENGINEERING WORKS

8A. Structures

DEVON FLOODS AND THE WATERWAYS OF BRIDGES,

A. B. George.
Proceedings of the Institution of Civil Engineers. Part 2: Research and Theory, Vol 73, No 1, p 125-134, March, 1982. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Bridges, *Channel scour, *Flood damage, Flood channels, Flood control, Flood flow, Flood frequency, Devon, Rivers, Design criteria, Highways, Annual floods, Historic floods, Channel improvement.

Floods in Devon in 1952, 1960, 1968, and 1979 caused widespread bridge destruction. Damage in the region was caused by the intensive energy of the flowing water in the steep terrain and by inundation. Return peiods of the floods varied from 6 to 600 years and reatios of major flood to mean annual flood were up to 3.31. It is suggested that mean annual flood be calculated using an equation with more independent variables (area, soil type, and one day net rainfall for a 5 -year return period) than the commonly used formula, which uses area as its only dependent variable. Bridges should be designed to withstand a 1000-year flood at a location immediately downstream of a community, a 150-year flood for bridges carrying motorways and trunk roads, a 30-150-year flood for bridges carrying less important roads, and a 5-year flood for submersible bridges in very rural areas. All bridges should pass the mean annual flood at or below bank-full level. (Cassar-FRC)
W82-05948

PLANNING SRI LANKA'S VICTORIA SCHEME,

Preece, Cardew and Rider, Brighton (England).
J. C. Bennett, and T. G. Carpenter.
International Water Power and Dam Construction, Vol 34, No 5, p 67-73, May, 1982. 8 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Dam design, Irrigation, Victoria Dam, *Sri Lanka, Mahaweli Ganga, Reservoirs, Planning, Arch dams.

The planning process for Sri Lanka's Victoria multipurpose dam scheme on the Mahaweli Ganga is described. The proposed project, scheduled for completion in 1984-85, will provide power and irrigation water for the region until 1990. At that time the installed capacity will be doubled to about 420 MW to handle peak demands. A double-curvative arch dam of 118 m maximum height and normal top water level of 438 m was found suitable for the site at Victoria Falls near Kandy. (Cassar-FRC)
W82-05979

COLD REGIONS ENGINEERING IN NORWAY,

Norwegian Road Research Lab., Oslo.
K. Flaate.
Civil Engineering (New York), Vol 52, No 4, p 68-69, April, 1982. 5 Fig.

Descriptors: *Ice, *Road construction, Frost heaving, Cold regions, Roadbanks, Highways, Paving, Design criteria, Construction, Tunnels, Freezing, Ice formation, *Norway.

In much of Norway and other cold regions, damage from frost-heaving, icing of roads, freezing of water pipes, and reduced bearing capacity of subsoil are common. In the last two decades Norwegian engineers have concentrated their efforts on research and practical solutions to these problems, with excellent results. Cracking of asphalt paving can be reduced by reinforcement with steel mesh or a mesh of other suitable materials. Monitoring is performed throughout the year to evaluate the bearing capacity of the roads. If the freezing index exceeds a given level, it is necessary to insulate the drainage system around a tunnel. Since there is not much loss of heat due to radiation inside a tunnel, the icing problem is not as severe as in the open, and a rather thin pavement above the insulation will be sufficient. (Baker-FRC)
W82-06000

DESIGN TECHNIQUE DEVELOPMENT FOR DAMS IN SOUTH AFRICA,

Department of Environmental Affairs (South Africa).
W. C. S. Legge.
Aqua, No 2, p 378-380, 1982.

Descriptors: *Design criteria, *Dam design, *Dam construction, Concrete dams, Earth dams, Rockfill dams, *Reservoir construction, *South Africa, Dams, Dam foundations, Dam stability, Rock mechanics, Soil mechanics, Tensile stress, Reservoirs, Construction, Technology, Engineering.

Over the past 80 years, the construction of dams and reservoirs in South Africa has been influenced by developments in engineering technology. In the 1930's, the science of soil mechanics was applied to dam construction, while the instrumentation of early concrete arch dams was confined to deflection surveys. After World War II, the design of arch dams was improved from the trial load method through wire models and deflection models to the analytical methods of finite element type presently in use. Improvements in techniques for placing mass concrete aided in the construction of several large dams, while a better understanding of the elasticity of earthen embankments was developed. The ability to move large volumes of earth and rockfill has allowed the construction of earth and rockfill embankments where the construction of concrete dams is not feasible. The latest design technologies allow engineers to test dam safety features as well as the tensile forces on the upstream face of arch dams. (Geiger-FRC)
W82-06011

SOME GEOTECHNICAL ASPECTS OF THE CONSTRUCTION OF THE 'SAFETY RESERVOIR BROECHEM',

Antwerp Water Works (Belgium). Dept. of Civil Engineering.
H. Crommeliack, and J. Diricks.
Aqua, No 2, p 385-396, 1982. 19 Fig.

Descriptors: *Reservoir storage, *Reservoir construction, *Earth dams, *Storage reservoirs, *Design criteria, Construction, Reservoirs, Reservoir linings, Hydraulic-fill dams, Reservoir siting, Site selection, Storage, Drinking water, Water supply, Water supply development, Earthworks.

The Antwerp Water Works of Belgium has decided to erect a security reservoir to ensure that the surface waters of the river Meuse will be able to supply drinking water to about 1 million people. A construction site along the adduction area of the Albertcanal and in the vicinity of the Oelegem treatment plant was chosen for the Brochem Reservoir, which will support a useful capacity of 4.5 million cu m raw water. Water will be transported by gravity to the nearby treatment works. After pilot studies on compaction techniques, the earth dam was compacted by vibroflotation and squeezing of mud with compacted gravel. Sounding tests showed adequate compaction by these methods of the clayey deposit and sandy hydraulic fill to be used as the foundation of the 10 m high reservoir. After extensive calculations of membrane requirements, a membrane composed of mainly nylon-reinforced bitumen with a polyethylene sheet was chosen to line the slopes of the reservoir. The bottom of the reservoir was waterproofed by clayey particles from the raw water of the Albertcanal. A permanent drain was constructed to handle accidental seepage through the bottom of the reservoir due to cracks of fissures in the waterproof membrane. The reservoir may be used in 1982 after the electro-mechanical installation is completed. (Geiger-FRC)
W82-06012

THE BIESBOSCH WATER STORAGE SCHEME,

Biesbosch Water Storage Corp. (Netherlands).
P. L. Knoppert, and E. G. H. Vreedenburgh.
Aqua, No 2, p 381-384, 1982. 3 Fig.

Descriptors: *Reservoir construction, *Reservoir design, *Reservoir storage, Safe yield, Multipurpose reservoirs, Water supply development, Reservoirs, Water quality control, Reservoir linings, Reservoir sites, Storage reservoirs, Multireservoir networks, Dikes, Earthworks, Construction.

The western and northern parts of the Netherlands rely mainly on fresh surface water from the Rhine and Meuse Rivers for their drinking water supplies. Problems with salt water intake into water treatment plants in 1963 caused the local governments to look to the river Maas to supply a higher quality drinking water source for the Rotterdam area. The construction of reservoirs in the Biesbosch, a deltaic area south of Rotterdam, was necessary to store water from the Maas to bridge periods of low flow and improve water quality. Calculations to determine the safe yield, required volume for bridging functions, and required volume for improved water quality were made for the three reservoirs of the Biesbosch water storage scheme. A second planning phase will provide for an extension with a fourth reservoir. Reservoirs were constructed partly by raising the water level above the surrounding area by dikes and partly by excavating the ground between the dikes. Dikes were lined with a membrane of nylon fabric placed on sand-tight fabric overlined with stone. The completed reservoir area was landscaped to maximize the recreational functions of the area while minimizing interference with the natural deltaic creek system and existing agricultural polders as much as possible. The safe yield storage of the first three reservoirs amounts to 250 million cu m/yr, a figure which will increase to 500 million cu m/yr when the fourth reservoir is built to meet increased water quality and quantity demands. (Geiger-FRC)
W82-06014

BLOOMINGTON LAKE - POTOMAC RIVER WATER RESOURCES PROJECT,

Army Engineer District, Baltimore, MD.
J. W. Peck.
Civil Engineering (New York), Vol 52, No 6, p 47-49, June, 1982.

Descriptors: *Dams, *Construction, *Design criteria, Construction materials, Water quality, Flood control, Bloomington Lake, *Bloomington Dam, *Potomac River, Maryland, *Earth dams, Cofferdams, Rockfill dams, Rolled-earth dams, Dikes, Earthworks.

The Bloomington Dam is located about a 4 hr drive west of Baltimore on the Potomac River.

The complex planning of the project took almost 19 years, and it consists of a main embankment, dike, spillway, intake tower, tunnel, and other structures. In order to construct the dam, relocation of a railroad, highways, and utilities was required. Twenty construction contracts were awarded, for a total construction cost of $174,300,000. The dam embankment is a rolled earth and rockfill structure founded on bedrock throughout. It has a maximum height of 296 feet above streambed, a crest length of 2,130 feet, and is comprised of a total volume of 10.5 million cubic yards of earth and rock fill. In a saddle a short distance from the left abutment of the dam is a dike embankment which is a rolled earth and rockfill structure having a height of 89 feet, a crest length of 880 feet and a total volume of over 1 million cubic yards. One of the major concerns with embankment construction is the contact surface between the embankment and foundation surface. Extensive use was made of mini-cam photogrpahy equipment to constantly record various features of the work as it progressed. A small dike was constructed to divert the river into the completed outlet tunnel so the cofferdam and foundation preparation work could be done. Flood control will provide major benefits to the downstream communities some 25 miles below the dam. Water quality accounts for 51% of the benefits of this project. Value engineering was used effectively throughout the construction of the project, with over $3 million in savings realized. (Baker-RC)
W82-06183

OLMOS DAM MODIFICATION.

Civil Engineering (New York), Vol 52, No 6, p 54-55, June, 1982. 2 Fig.

Descriptors: *Dams *Flood control, Construction, Olmos Dam, Design criteria, Spillways, *Texas, San Antonio River.

Olmos Dam is located on Olmos Creek, which is a tributary of the San Antonio River northeast of the central business district of San Antonio, Texas. In 1973 a study disclosed that flood routings produced by severe storms over the drainage basin would overtop the dam by varying amounts, and the structure would be overstressed beyond the permissible limits of current design. The reduced factors of safety could have resulted in failure. Olmos dam is a dry reservoir dam, holding water only as a result of heavy rains flooding the area. The safety study suggested several modifications, including provisions of an ogee spillway section with flip bucket at the central portion of the dam structure with crest at elevation 728, 1287 feet long, capable of passing the probable maximum flood. The Olmos Drive roadway across the top of the dam was to be removed. A new gate operating room was to be built atop the non-overflow section. Increased stability of the spillway portion was achieved by addition of mass concrete. Dam stability was increased in the non-overflow portions by vertical prestressing of the dam structure. Modifications to retain the 200 year flooding flow with zero outflow for some hours for staged release in consideration of potential impact on the downtown area of a flood were made. The relocation and reconstruction within the dam structure of major telephone trunk line were performed and an inspection gallery was provided. One problem during construction was excessive groundwater in the limestone stratum at the contact plane for the dam. (Baker-FRC)
W82-06186

SAFETY ASPECTS IN THE DESIGN AND INSPECTION OF DAMS,

COBA-CONSULPRESA, Lisbon (Portugal).
J. L. Serafim.
International Water Power and Dam Construction, Vol 34, No 5, p 45-47, May, 1982. 8 Ref.

Descriptors: *Dam failure, *Design criteria, *Safety, Gravity dams, Buttress dams, Arch dams, Earth dams, Rockfill dams, Spillways, Outlets, Errors, Insipection, Dam construction, Dam design, Dam foundations, Dam stability.

A listing of scenarios for rupture and hazard scenarios (serious incidents) can help in design of new dams, in judging the safety and reliability of old dams, and in avoiding most human errors. Dam failures depend on height (low dams fail more often than high dams), type of dam (arch dams are are most stable), materials (earth dams are most vulnerable) location, age (very new and very old dams are most likely to fail), and quality of design. Overtopping accounts for a third of disasters. Other causes are piping, abnormal uplift, foundation defects and wearness, earthquakes, weak materials, erroneous design, and poor construction. A listing of hazard scenarios is given for all types of dams. This includes sudden filling of a lake and overtopping of a dam, closure of a valley by mountain movement, piping, ground differential motion at the foundation, inadequate design, faulty construction, and subsidence of the foundation from earthquakes or subterranean water drainage. Additional hazard scenarios are given for specific types of dams: gravity, buttress, arch, muluple arch, earth, rockfill, spillways, and outlets. (Cassar-FRC)
W82-06203

THE ITAIPU HOLLOW GRAVITY DAM,

Promon Engenharia, Sao Paulo (Brazil).
D. M. Cane, L. P. Eigenheer, J. Uriarte, A. Szpilman, and A. Gallico.
International Water Power and Dam Construction, Vol 34, No 5, p 30-44, May, 1982. 19 Fig, 5 Tab, 14 Ref.

Descriptors: *Hydroelectric plants, *Dam design, Itaipu Dam, Brazil, Paraguay, *Parana River, Hollow dams, *Gravity dams, Dam construction, Concrete dams, Hydraulic structures, Dam foundations, Grouting, Drainage, Stress analysis, Dam stability, *Hollow construction dams.

The civil works at the Itaipu hollow gravity dam on the Parana River, Brazil-Paraguay, are scheduled for completion by the end of 1982. The structure is 612 m long and consists of 18 blocks each 34 m wide. The blocks range from 100 to 196 m high, making Itaipu the highest hollow gravity dam in the world. The 1260 MW final capacity and annual generation of 75,000 GWh will make this the largest power station in the world when it is completed in 1988. The hollow construction requires 25% less concrete than solid construction, has better stability against overtopping, better head dissipation, greater construction flexibility, less hydraulic uplift, more effective drainage, and 12% lower costs. However, the concrete for a hollow dam requires a higher proportion of cement, more framework, more complex concrete shapes, a complex benched excavation on sloping abutments, some steel reinforcement, and higher engineering costs. Nevertheless, the the Itaipu dam the hollow construction gave a savings of 1.3 million cu m of concrete and 6 months of construction time. Detailed descriptions and drawings are given for the hollow block shape, longitudinal and transverse contraction joints, and concrete temperature control. The foundation's geology, configuration, treatment, grouting, and drainage are described. Stress and stability tests are also discussed. (Cassar-FRC)
W82-06205

INVESTIGATION OF THE OVERFLOW SPILLWAY OF THE VELISHCHAI RESERVOIR,

Z. A. Musaev.
Hydrotechnical Construction, Vol 15, No 7, p 414-417, 1981. 2 Fig, 2 Tab, 2 Ref. Translated From Gidroteknicheskoe Stroitel'stvo, No 7, p 25-27, July, 1981.

Descriptors: *Spillways, *Reservoirs, *Intake gates, *Design criteria, *Dam construction, *Model studies, *Wave action, Dams, Reservoir storage, Mathematical studies, Mathematical models, Aeration.

The proposed design of the overflow spillway of the Velischai reservoir which was constructed to irrigate the lands of the Masally region of the Azerbaidzhan SSR was investigated. The height of the side walls was determined without considering the occurrence of aeration of the flow and rolling waves. Experimental data on aeration and wave formation on the conveyance flume was obtained for a parapet design with one-way overflow of water. Studies on two-way overflow revealed an improved hydraulic regime of flow both in the intake and in the horizontal section of the spillway model. By arranging the intake flume angles at 80 degrees to the axis of the dam, a two way intake in the given layout of the hydrodevelopment was achieved. With a specific parapet design, the useful storage of the reservoir was increased by raising the elevation of the spillway sill of the intake part without increasing the amount of works on the dam. This produces additional net income during the payback period, resulting in greater annual savings. (Geiger-FRC)
W82-06220

REGIONAL DETENTION BASINS FOR STORMWATER CONTROL,

Whiteley-Jacobsen and Associates, Portland, OR.
G. E. DiLoreto.
Public Works, Vol 113, No 5, p 61-62, May, 1982. 1 Fig.

Descriptors: *Storm water, *Detention reservoirs, *Drainage systems, Storm runoff, St. Helens, *Oregon, Design criteria, Runoff, Urban Runoff, Controlled drainage.

Regional detention basins were chosen as the best storm water control option at St. Helens, Oregon, since the topsoil overlying impermeable basalt is only 1-2 feet deep, precluding economical construction of drainage pipes and open channels. Maintenance costs associated with a few large regional basins are much less than costs of hundreds of small detention ponds. Design considerations for regional detention basins are: sediment traps, consideration of soil characteristics and groundwater table, a bank slope of 3:1 horizontal and vertical, low flow bypass channels, emergency spillways for events exceeding the design storm, maximum depth of 4 ft with 1 ft of freeboard, a 1% bottom slope toward the low flow bypass channel, and stabilized banks. (Cassar-FRC)
W82-06225

SAFETY OF DAMS (SICHERHEIT VON TALSPERREN),

Technische Univ., Munich (Germany, F. R.). Lehrstuhl fuer Wasserbau.
H. Blind.
Wasserwirtschaft, Vol 72, No 3, p 84-90, 1982. 8 Fig, 4 Tab. English Summary.

Descriptors: *Safety, *Dams, *Dam failure,*Design criteria, Dam design, Control systems, Statistics, Data collections, Accidents, Erosion, Subsoil, Flooding, Dam stability, Geology, Hydrology, Hydraulic engineering.

Dam failures and their causes are discussed, and measures to improve the safety of dams are suggested. Registration of all new dams and the reporting of damage thereto is urged so that the analysis of these data may lead to improved design and construction. It is not possible to extrapolate a probability figure for dam failure. Problems with data so far collected (e.g., the International Conference on Large Dams World Register of Dams) include insufficient information, the necessity of using simplified definitions because each case is individual, lack of investigation of the cause of accidents, and differences in environment, design, and construction. Statistics show that causes of failure for earth dams include flooding at high water due to failure of spillways or gates, internal erosion near the foundation, settling of the dam or foundation, contact erosion, inhomogeneity of subsoil, liquefaction, and piping effect; for masonry and concrete dams, causes include insufficient shear strength in the foundation bottom, too great an upward hydraulic pressure on the foundation, lack of stability of the dam, abnormal plasticity of the subsoil and high permeability, and seepage and erosion in the foundation bottom due to permeability. To improve dam safety, certain principles of design and construction should be followed. These include the use of well-qualified engineers and

reliable business firms, thorough site studies, especially in hydrology and geology, careful consideration of design flood and the hydraulic requirements of tail flow, study of the plasticity of the dam and subsoil, a constructive conception of bottom sealing for permeable rock, installation of an observation and control system, the capability of performing future renovations, and the ability to build the dam in a given time. (Gish-FRC)
W82-06236

INFLUENCE OF REMEDIAL MEASURES ON THE MOHNE GRAVITY DAM (EINFLUSS DER SANIERUNGSMASSNAHMEN AUF DIE MOHNEMAUER),

Ruhetalsperrenverein, Essen (Germany, F. R.).
K. -H. Idel, and P. Rissler.
Wasserwirtschaft, Vol 72, No 3, p 130-134, 1982. 4 Fig, 3 Tab, 1 Ref. English Summary.

Descriptors: *Gravity dams, *Renovations, *Grouting, *Drainage engineering, Reservoirs, Mohne reservoir, *West Germany, Maintenance, Seepage, Water pressure, Thermal stress, Strength, Hydraulic engineering, Permeability, Construction, Dam construction, Damage, Aging.

Renovations were carried out on the masonry gravity dam of the Mohne Reservoir, West Germany, between 1972 and 1978 to counteract the destructive effects of aging and of air raids during World War II. In 1943 the middle section of the dam was destroyed in an air attack, and hasty repairs resulted in uncontrollable seepage in this section. Damage appearing in later years included increasing permeability of the dam, damage to the face masonry, thermal stressing of the parapet, and increasing seepage under and around the dam. The greatest permeability was measured in the subsoil of the barrage sides. Comprehensive grouting and drainage procedures were necessary to renew the sealing of the dam and subsoil and to control water pressure distribution in the dam and foundation joint. A work, drainage, and control gallery was constructed at the bottom of the dam wall for grouting. In addition, the head of the wall was compressed from above. Drainage bores were laid out at 1-m intervals to reduce water pressure. The crown of the dam wall was also renovated. A pendulum sounding lead and three single extensometers were installed to measure slippage, and control bores were drilled to measure bottom pressure and seepage. Analysis of slippage measurements made before and after renovations showed greater horizontal slippage after renovation and suggested that compression work had caused an irreversible slippage of the foot of the wall 3-5 mm toward the air side. However, in general, water-level dependent distortion was reduced by the renovations. It was concluded that the dam crown had become stiffer as a result of compression. The drainage system was successful in both removing water and reducing bottom pressure, the latter being important for the shock and slip resistance of the dam. (Gish-FRC)
W82-06239

SECURITY ASPECTS AT THE DESIGN AND CONSTRUCTION OF SEALING FOR DAMS (SICHERHEITSASPEKTE BEI KONSTRUKTION UND AUSFUHRUNG VON DAMMIDICHTUNGEN),

For primary bibliographic entry see Field 8G.
W82-06241

AERATION AT FLOOR OFFSETS IN BOTTOM OUTLETS (BELUFTUNG AN SOHLSPRUNGEN VON GRUNDABLASSEN),

Technische Hochschule, Aachen (Germany, F. R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 8C.
W82-06242

OPTIMAL RISK-BASED HYDRAULIC DESIGN OF BRIDGES,

Nevada Univ. System, Reno. Dept. of Civil Engineering.
Y.-K. Tung, and L. W. Mays.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WR2, p 191-203, June 1982. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Hydraulic design, *Bridge design, *Flood damage, Hydraulic structures, Optimization, Risks, Embankments, Leaf River, Hattiesburg, Mississippi. Model studies, Hydrologic models, Highways, Damage, Cost analysis, Backwater, Erosion, Bank erosion, Design criteria, Construction costs.

Hydrologic uncertainties annd socioeconomic effects are incorporated into the hydraulic design of highway bridges to determine the best design for the lowest cost. Using this method, bridge openings and embankment heights can be chosen to avoid overdesign. The cost components involved in risk-based hydraulic design of bridges are construction cost, flood damage cost, backwater damage cost, traffic interruption cost, and embankment repair cost. The optimization technique, the Hooke-Jeeves pattern search, is applied to design of a bridge on the Leaf River near Hattiesburg, Mississippi. Results show that the optimal bridge openings are the same length for the various probability models (normal, lognormal, Gumbel, Pearson III, log-Pearson III, and composite) and parameter estimation procedures, but the embankment heights vary by 1.8 ft. In this example the jacknife and bootstrap methods produce nearly the same optimal solutions. Construction costs were computed at $217,800 and expected annual damage costs from $55,000 to $110,800 depending on the hydrological probability model used. (Cassar-FRC)
W82-06432

PROBLEMS IN TUNNELLING BY PIPE JACKING AT TILEHURST,

Thames Water Authority, London (England).
S. H. Shurlock.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 151-153, March, 1982. 2 Fig.

Descriptors: *Tunnel failure, *Pipe jacking, Tunnel construction, Tunneling, Reading, England, Tilehurst.

Pipe jacking was the technique chosen for a 130 m tunnel project, part of a new outlet system from the Tilehurst service reservoir at Reading, England. The tunnel drive began through stiff blue London Clay. After 10 m brown clay appeared and at 24 m the face collapsed, dumping 3 cu m of gravel and soft clay plus a large quantity of water. The blue clay layer totally disappeared and wet conditions prevailed thereafter. After 37 m into the tunnel some joints were broken or displaced, and gravel and water became a constant problem. Of 54 joints, 19 were visibly damaged and 6 others showed groundwater inflow. The tunnel varied from a straight line by + or - 72 mm in level and + or - 84mm in line. Direction changes reached the 1 degree maximum recommended deflection. A welded steel lining was eventually inserted to repair the damage. The actual tunnel cost was 112,000 pounds vs. the planned 72,000 pounds. Several conclusions were reached from this experience: (1) test boreholes should have been much closer together, (2) pipe jacking is a good procedure, but the joints are a major weakness, (3) existing techniques are suitable for short drives but not adequate for long drives unless very good conditions prevail, and (4) apparently sound joints can be badly spalled on the outside. (Cassar-FRC)
W82-06448

THE APPLICATION OF MICROCOMPUTERS TO THE DESIGN OF STORM SEWER SYSTEMS FOR SMALL AREAS,

Sunderland Polytechnic (England). Dept. of Civil Engineering.
B. Archer.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 113-117, March, 1982. 5 Ref.

Descriptors: *Sewer systems, *Pipes, *Drainage systems, Computers, Design criteria, Rainfall intensity, Urban drainage, Storm sewers.

Microcomputers can advantageously be used to design storm sewer systems. Charts and tables for pipe sizing and for rainfall intensity are replaced by rapid calculations from the basic equations. Pipe sizes are determined within seconds, compared with the several hours necessary for manual methods involving tables. Effects of changing depths, pipe inverts, pipe lengths, or areas to be drained can be quickly determined. An appendix describes the outline flow chart for the prgrams, lists the program, and illustrates use of the program. (Cassar-FRC)
W82-06449

LIMITS FOR PRACTICAL LEVEL-BASIN DESIGN,

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W82-06452

WATER DISTRIBUTION NETWORK ANALYSIS USING INTERACTIVE GRAPHICS,

University of Manchester Inst. of Science and Technology (England). Dept. of Electrical Engineering and Electronics.
For primary bibliographic entry see Field 5F.
W82-06453

MAJOR FACTORS IN SEWER VENTILATION,

Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
M. B. Pescod, and A. C. Price.
Journal of the Water Pollution Control Federation, Vol 54, No 4, p 385-397, April 1982. 10 Fig, 9 Tab, 4 Ref.

Descriptors: *Sewer systems, *Ventilation, *Air circulation, Temperature effects, Corrosion, Hydrogen sulfide, Dissolved oxygen, Corrosion control.

As part of an effort to develop a design to produce a maximum ventilating air flow within a sewer system having ventilation stacks without using mechanical means, an investigation of the major factors affecting naturally-occurring air flows in sewers and undertaken. The five factors considered to be the major contributors to sewer ventilation are the action of wind passing across the ventilation stack, the friction at the air-water interface resulting from the wastewater flowing down the sewer (wastewater drag), the rise and fall of the wastewater level, temperature differentials between the air and the sewer, and differences in the barometric pressure across various parts of the system. The influence of the last three factors can be treated in an analytical manner by representation in terms of the volume of air turnover produced by the rise and fall of the wastewater, having either assumed or measured a pattern of flow, or as an additional driving pressue head in the cases of the temperature and barometric pressure differentials. Full-scale ventilation stacks were tested in a low-velocity wind tunnel using various terminals for the educt stack to try to find a stack shape which would maximize the wind across stack effect. The wastewater drag effect was investigated through measurement of air velocities using a gas tracer technique. The wind tunnel tests resulted in the identification of extraction rates that can be produced by low wind speeds at the educt stack location from which a typical daily or weekly extraction rate can be estimated under natural conditions. The wastewater drag effects appear to be subservient to wind extraction. The variability of wastewater level in a sewer system results in addition fresh air being drawn in during a fall in level and sewer air being exhausted during a rise in level. Temperature differentials in the summer can be expected to increase resistance to air movement in the sewer. Significant differences in barometric pressure would not be expected to arise during the summer months in the United Kingdom. (Carroll-FRC)
W82-06462

Field 8—ENGINEERING WORKS

Group 8A—Structures

THE CHOICE OF HYDRAULIC ENERGY DISSIPATOR FOR DAM OUTLET WORKS BASED ON A SURVEY OF PROTOTYPE USAGE,

P. J. Mason.
Proceedings of the Institution of Civil Engineers, Part I, Design and Construction, Vol 72, No 2, p 209-219, May, 1982. 4 Fig, 44 Ref.

Descriptors: *Energy dissipation, *Dam design, *Outlets, Flip buckets, Hydraulic design, Ski jumps, Jets, Damage, Erosion, Cavitation, Hydraulic jump, Discharge capacity, Rock basins, Baffles.

A survey was conducted at 370 prototype energy dissipators from dams in 61 countries to establish the ranges of head and flow for which designers have selected various dissipators and at which problems are most likely to occur. Rock basins are predominantly used for head differences below 30 m. Damages are most likely at head differences above 40 m or in the presence of weak rocks. Simple hydraulic jump stilling basins in concrete are commonly used at head drops of 1-10 m and 30-50 m. At 50 m or above special techniques and materials are necessary to avoid failure. Baffle basins, generally trouble-free over a head drop range of 10-30 m, show erosion, cavitation, and complete destruction at higher head differences. Free trajectory jet dissipators (simple overfalls, ski jumps, and flip buckets) are relatively problem-free for almost any head drop, over 200 m in some cases. A few reported cases of erosion are related to unacceptable scour in the downstream plunge pool. One case of cavitation erosion is documented. A graph shows that free trajectory jet dissipators are rarely used in the range to the left of a line defined by a head drop of 8 m and discharge capacity of zero and a head drop of 48 m and discharge capacity of 10,000 cu m per sec. Results of this survey are summarized on a graph revealing the most practical energy dissipator designs for different combinations of head drop and discharge capacity. (Cassar-FRC)
W82-06500

THE KIELDER TRANSFER WORKS,

D. J. Coats, N. S. M. Berry, and D. J. Banks.
Proceedings of the Institution of Civil Engineers, Part 1, Design and Construction, Vol 72, No 2, p 177-208, May, 1982. 24 Fig, 3 Tab, 38 Ref.

Descriptors: *Pipelines, *Tunnel construction, *Water transfer, Tunnel linings, Kielder Dam, *England, Tees River, Wear River, Tyne River, Water resources development, Reservoirs, Weirs, Pumping plants, Dam construction, Aqueducts, Hydraulic valves.

The transfer works of the Northumbrian Water Authority Kielder water scheme connects the water stored at Kielder Water on the River North Tyne with the rivers Wear and Tees for purposes of flow regulation and water abstraction. Operations are scheduled to begin in 1982. Water abstracted from the River Tyne at the Riding Mill pumping station 56 km downstream from Kielder Dam will flow through 6.2 km of pump main and 32 km of a gravitational system, with connections at the rivers Wear and Tees. The Airy Holm headpond, about 8 km from Riding Mill, permits correction of imbalances between rates of pumping and tunnel discharge. At Riding Mill weirs have been installed to increase the water depth and provide storage. The pumping station contains 12 pump units, each with 91,000 cu m per day capacity. The 65 m long intake has a maximum intake velocity of 0.3 m per sec. The steel pump main rises about 200 m. Air venting houses and access places for cleaning are built into the pipeline. The Airy Holm dam was built with a 180 m long and 20 m high concrete gravity section in the central portion, with earth embankments on the flanks to give a dam 500 m long. A concrete-lined gravity flow tunnel with air shafts and discharge valves at the rivers complete the transfer works. Steel pipe 2.89 m in diameter carries the aqueduct over two river valleys. There are no in-line valves, all control being effected by the discharge valves at the rivers Wear and Tees. The discharge structures are largely underground. (Cassar-FRC)
W82-06502

THE KIELDER WATER SCHEME,

D. J. Coats, and N. J. Ruffle.
Proceedings of the Institution of Civil Engineers, Part I, Design and Construction, Vol 72, No 2, p 135-147, May, 1982. 5 Fig, 1 Tab, 5 Ref.

Descriptors: Water resources development, *Flow regulation, *Water transfer, Kielder Reservoir, Tyne River, Wear River, Tees River, *England, Reservoirs, Flow augmentation, Recreation, Environmental effects, Water storage, Industrial water, Water supply, Aeration, Water quality control, Public relations, Fish.

The Kielder water scheme was constructed during 1975-82 in northeast England to regulate the Rivers Tyne, Wear, and Tees for supplying water to a region with rising industrial water usage. It is under the jurisdiction of the Northumbrian Water Authority. Kielder Water, a 188 million cu m reservoir on the River North Tyne, provides water for regulation of all three rivers via a north-south transfer works. This consists of a weir and pumping station on the River Tyne, 6.2 km of 2 m diameter pumping main, 32 km of 2.9 m diameter tunnel, and a small head pond at Airy Holm. Aeration was installed in the reservoir to prevent thermal stratification and resulting problems from Fe and Mn compounds, sulfides, and ammonia. During construction truck traffic was limited to an approved route. Public relations with the community remained good throughout construction because of Liaison Officer, located near the headworks, was available for resolving problems and for guiding visitors. Prehistoric, Roman, and medieval sites were investigated before innundation, and the historic 1862 Kielder Viaduct was preserved. The irregularly shaped 1086 ha reservoir, set in coniferous forest, is available for recreational activities such as fishing, boating, camping, and other activities. Since much salmon spawning gravel was inundated, a fish hatchery has been built upstream to release 160,000 juvenile salmon per year. (Cassar-FRC)
W82-06503

THE KIELDER HEADWORKS,

D. J. Coats, and G. Rocke.
Proceedings of the Institution of Civil Engineers. Part I, Design and Construction, Vol 72, No 2, p 149-176, May, 1982. 21 Fig, 2 Tab, 4 Ref.

Descriptors: *Dam construction, *Reservoirs, *Embankments, Kielder Dam, Bakethin Dam, England, Earth dams, Weirs, North Tyne River, Culverts.

Construction details of the Northumbrian Water Authority's Kielder Water are described. This reservoir is part of a scheme to regulate the River Tyne in northeast England. Construction work started in 1975 with relocation of a highway. Preliminary site studies revealed an underlying rock sequence of sandstones, shales, mudstones, and coal seams. The superficial deposits were glacial boulder clay and alluvial material. Bakethin Dam, a 17 m high and 165 m long submerged sand and gravel weir, was built within the main reservoir to retain water in the upper reaches for amenity reasons when Kielder Water is drawn down. The draw-off works consists of a reinforced concrete culvert about 15 m wide containing a 1900 mm diameter scour pipe, a 2000 mm diameter draw-off pipe, an access roadway, instruments, and a valve tower. Construction details and diagrams of the clay core, earth-fill Kielder Dam are described. The dam is 1140 m long, 52 m high. The reservoir is 11.1 km long, 1086 ha in surface area, and stores 188 million cu m of water. Impounding started on December 15, 1980. (Cassar-FRC)
W82-06504

BRIDGING THE WATER SUPPLY GAP,

Bogert (Clinton) Associates, Fort Lee, NJ.
W. Wheeler, and E. Cruz.
Public Works, Vol 113, No 3, p 62-63, March, 1982.

Descriptors: *Pipelines, *Water supply, *Water transfer, Construction, New York, New Jersey, Drought, Bridges, George Washington Bridge, Expansion, Water shortage.

Water from New York's supply system was diverted to drought-stricken northeast New Jersey by a 10,5000 ft long, 24 inch diameter steel pipeline built across the George Washington bridge over a 4-month period. It was completed on July 1, 1981. The pipeline has a capacity of 20 mgd. Special problems included 9 ft. of expansion and contraction and a 7 ft. sway, heavy vehicular traffic on the bridge (250,000 vehicles per day), the age of the bridge (50 years), and procuring the necessary materials, Since custom expansion joints could not be disigned and made within the time limits, units with 10 inch axial movement each were combined, five for the 48 inch movement at the main span of each tower and two for the 18 inch movement at the side spans. The pipeline is anchored to the bridge only at the center, the unanchored part floating on roller guides. If desired, the pipeline may be dismantled and stored in an abandoned tunnel. (Cassar-FRC)
W82-06508

TEXAS GULF COAST PROJECT ANSWERS VITAL WATER NEED,

Southwest and Texas Water Works Journal, Vol 64, No 2, p 6-7, May, 1982.

Descriptors: *Water supply, *Pipelines, *Reservoirs, Dams, Point Comfort, Texas, Earth dams.

A pipeline and reservoir system is currently under construction to supply water to the Point Comfort region near Houston, Texas. The project consists of the earth-filled, 1.3 mile long, 58 ft high Palmetto Bend Dam, the 11,000 acre Lake Texana, one mile of 36 inch steel above-ground transmission line, and 13 miles of underground pipeline. The dam is constructed with specially covered slopes and extra steel anchors in the concrete spillway to protect against hurricane damage. Initially the reservoir will provide 20,000 acre ft of water per year to the region. (Cassar-FRC)
W82-06519

STANDARD PRACTICE FOR INSERTION OF FLEXIBLE POLYETHYLENE PIPE INTO EXISTING SEWERS--ASTM F585-78

Water Services, Vol 86, No 1033, p 106-108, March, 1982. 2 Fig, 6 Ref.

Descriptors: *Pipelines, *Sewer systems, *Rehabilitation, Plastics, Standards, Excavation, Inspection, Flow characteristics, Design criteria, American Society for Testing and Materials.

The standard practice reprinted and adapted here (ASTM F585-78) describes the design and selection considerations and installation procedures for construction of new sanitary and storm sewers by inserting polyethylene pipe through existing pipe and along the previously existing line and grade. This procedure minimizes traffic disruption, surface damage, and restoration, with little or no interruption of service. General guidelines emphasize that existing pipe conditions must be determined to see if the pipe insertion is feasible. Generally, piping with outside diameter 10% smaller than the original sewer is practical. To account for external loading, formulas are given for calculating the standard dimensiion ratio of pipe required and the minimum allowable radius of curature for any size and weight of pipe. Other subjects treated under design and selection characteristics are anchoring and encasement, pulling force and length. Procedures are detailed for inspection and cleaning; excavation; storage, handling, and joining of polyethylene pipe; insertion and termination; finishing and restoration; and inspection and acceptance. (Cassar-FRC)
W82-06601

OUT OF SIGHT--OUT OF MIND,

Civil Engineering (London), p 45, 47, May 1982. 1 Tab, 2 Ref.

Descriptors: *Tunnel linings, *Rehabilitation, *Sewer systems, Linings, Polyester resins, Resins, *England.

Rehabilitation of aging sewers in England has generally been limited to repairing acute failures with the limited available funds. Relining with polymers has been receiving increased attention in spite of its high initial cost. A comparison of the costs for installing several types of polyester concrete, glass reinforced polyester, and other methods showed that these relining methods are generally 4-5 times more expensive than hand repointing. Since relining is still in its infancy, many contractors use it only in sections unsuitable for digging. The problem of detecting voids around the barrel of the sewer is being studied. Base-band radar and gamma ray backscatter have been successful in locating dry voids. Closed-circuit television has also been used to view the condition of the sewer interiors. (Cassar-FRC)
W82-06713

CANAL TUNNEL REPAIR OPTIONS.

Civil Engineering (London), p 56, 58, May, 1982. 1 Fig.

Descriptors: *Tunnel linings, *Canal linings, *Rehabilitation, Linings, Concrete construction, Blisworth Tunnel, *England.

The 2812 m long brick lined Blisworth tunnel, part of Britain's 2000 mile canal system, has been closed to boat traffic since October 1980 because of failures and deterioration. The option chosen for rehabilitation of the 200-year-old structure involves removal of a section of existing tunnel lining and some of the surrounding material and replacing this with an external segmental concrete lining. Although the 4.25 million pound cost is the most expensive of the five renovation alternatives in the short term, maintenance is expected to be minimal. In addition the tunnel's 15 ft width will not be further reduced, retaining the 2-way traffic pattern. Work is expected to start in late 1982. (Cassar-FRC)
W82-06758

SEWER RENEWAL BY PIPE INSERTION.

Civil Engineering (London), p 66-67, May, 1982.

Descriptors: *Sewer systems, *Linings, *Rehabilitation, Polyethylene, Pipes, Plastics.

Insertion of polyethylene pipe into aging sewers provides total renewal for structurally unsound systems as well as corrosion resistance. The winching method of insertion can be used for lengths up to 500 m without diverting flows. Hydraulic jacking needs an insertion pit only 1 m longer than an individual section. However, it is more expensive because smaller lengths and more joints are required. Flows must be diverted. In high water table regions no dewatering or trenching is necessary. There are minimum disturbances to agricultural crops, buildings, and traffic. The small decrease in finished pipe diameter is counteracted by the low friction, infiltration resistant smooth plastic lining. (Cassar-FRC)
W82-06759

REDEVELOPMENT OF AQUEDUCT CROSSING OF MANCHESTER SHIP CANAL AND RIVER MERSEY,

R. J. Baty.
Journal of the Institution of Water Engineers and Scientists, Vol 36, No 2, p 97-112, March, 1982. 6 Fig.

Descriptors: *Aqueducts, *Tunnel construction, Pipelines, Tunnel linings, Frozen ground, Manchester Ship Canal, Mersey River, Vyrnwy Aqueduct, Diversion structures, *England.

The aqueducts crossing the Manchester Ship Canal and the River Mersey were first put into service in 1892. The section under the canal was a 3658 mm diameter brick tunnel, built before the ship canal was filled with water. The section under the river was a 2748 mm diameter tunnel built of cast-iron sections bolted together. Within these tunnels pipelines were installed in 1892 and 1905. A third pipeline, added in 1938, fit within the canal tunnel. However, in order to pass under the river it was necessary to construct a second tunnel crossing the Mersey. Water resources developments during the 1960's required further modifications to the system. Deterioration of some of the old pipe necessitated remedial work. The North West Water Authority accomplished this by linking the two existing river crossing tunnels and replacing the pipes with a single pressure lining occupying the full area of the tunnel. This paper discribes the reconstruction work in detail. After construction of a temporary diversion pipework, the connecting shaft was built using a local ground freezing technique and precast concrete segments. The old brickwork and cast-iron segment tunnels, in excellent condition, were lined with pressure-resistant steel 16 mm thick in 6 and 3.6 m lengths. At the tops of the shafts shear walls penetrating the bedrock were constructed to compensate for thrust forces. The project began in October 1978 and was completed in spring 1981. (Cassar-FRC)
W82-06813

PLANNED MEASURES FOR WATER REGULATION CONSTRUCTING THE NEW MUNICH AIRPORT (GEPLANTE WASSERWIRTSCHAFTLICHE MASSNAHMEN BEIM BAU DES NEUEN FLUGHAFENS FUR MUNCHEN),

Oberste Baubehorde im Bayrischen Staatsministerium des Inneren, Munich (Germany, F.R.).
J. Bauer.
Wasserwirtschaft, Vol 72, No 1, p 6-11, 1982. 7 Fig.

Descriptors: *Airports, *Hydraulic engineering, *Diversion ditches, *Water table, *Wastewater facilities, Storm wastewater, Storm sewers, Drainage ditches, Drainage effects, Environmental effects, Construction, Engineering, Agriculture, *West Germany, Drinking water, Soil mechanics, Geology.

Water-related problems caused by the site selection for the new Munich (West Germany) airport and the solutions to these problems are described. The site is at the northern edge of the Munich gravel plain, with a topsoil that was once peat but is now used for intensive agriculture. Under the permeable quaternary gravel lies an impermeable layer that separates the groundwater into upper and lower regions, the lower region being used for drinking water. It was important that airport construction not disturb this arrangement. Several small streams running from southwest to northwest would be diverted around the airport by channels built to a design flood of 20 years, the main outfall ditch being built to a 100-year flood. The airport would also be protected by a dike along the channel walls. The groundwater table would be lowered by means of drainage ditches to prevent frost formation on the runways. In order to avoid a negative effect on the surrounding agricultural lands, a plan was chosen such that the lowering of the water table is only noticeable to the south (upstream) of the airport, and then only after a long dry spell; in order to avoid negative effects to the north, water collected in the drainage ditches would be allowed to seep out through 120 vertical shafts along the northern perimeter of the airport. Stormwater would be channeled into a combined system for domestic and industrial wastewater as well as stormwater from streets and parking lots and a separate stormwater system for lightly polluted stormwater and stormwater overflow. The construction of an underground rail line connecting the airport with the city posed the problem of avoiding a build-up of groundwater, since the tunnel would cut off its flow. It was decided to collect water on the upstream side in horizontal filters and carry it to downstream horizontal filters by means of control shafts along the tunnel walls which would be connected to deep siphons. (Gish-FRC)
W82-06825

EVALUATING INLAND WATERWAY NAVIGATION IMPROVEMENT PROJECTS: THE CASE OF THE BONNEVILLE LOCK,

Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economic.
For primary bibliographic entry see Field 6B.
W82-06869

HYDRAULIC MODEL STUDIES - YELLOWTAIL AFTERBAY DAM SLUICEWAY,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
M. F. Young.
Report GR-82-5, July, 1982. 47 p, 24 Fig, 2 Tab, 3 Ref.

Descriptors: *Supersatuation, *Hydraulic models, *Dam effects, *Gases, *Flow deflectors, *Sluiceways, Model studies, Fishkill, Dam design, Stilling basins, Flow velocity, Debris, *Montana.

Yellowtail Afterbay Dam is on the Big Horn River 3.5 km below Yellowtail Dam and Powerplant. Releases from the afterbay dam are used to provide uniform daily flow in the Big Horn River, leveling the peaking power generation from Yellowtail Powerplant. At times, gas supersaturation has occurred downstream from Yellowail Afterbay Dam, resulting in serious fish kills. A 1:24 scale model of Yellowtail Afterbay sluiceway was constructed to study the placement of flow deflectors designed to keep the water jets issuing from the sluiceway gates near the tailwater surface. Deflector plates installed on the curved invert of the sluiceway will reduce jet submegence, a cause of supersaturation. Measurements show no subatmospheric pressures present on the flow deflector lips. Waves within the stilling basin will be larger with the deflectors in place than with the existing configuration, while waves outside the basin will be the same size or smaller. With the flow deflectors in place, the largest velocities, and therefore the most flow, occur near the surface where the pressure is close to atmospheric. With the deflectors in place, material will not be brought back into the basin, although any material thrown into the basin will remain there. (Moore-SRC)
W82-06962

8B. Hydraulics

ON CONDUCTING THE MODIFIED 'SLUG' TEST IN TIGHT FORMATIONS,

Geological Survey, Reston.
C. E. Neuzil.
Water Resources Research, Vol 18, No 2, p 439-441, April, 1982. 5 Fig, 3 Ref.

Descriptors: *Well hydraulics, *Hydraulic properties, *Test wells, *Rock mechanics, Permeability coefficient, Storage coefficient, Equilibrium, Head loss, Compressibility, Transmissivity, Wells, Hydraulics, Shales, Pumps, Slug test.

An improved version of a modified 'slug' test (Brdehoeft, J. D., and Papadopulos, S. S., 'A method for determining the hydraulic properties of tight formations, 'Water Resources Research, Vol. 16, No. 1, p 233-238, 1980) is presented. With the original method, the borehole is filled with water prior to the test, usually resulting in significant transient flow; the necessary condition of approximate equilibrium is therefore not met. Additionally, while the compressibility of water (Cw) should be used to account for storage change in the shut-in well, actual compressibility in this well can be larger than Cw. With the improved method, the borehole is filled with water and two packers are placed close together. Pressure is monitored by two transducers, one between the packers and one below the lower packer. The test section is shut in, and pressures in both sections are monitored until near-equilibrium exists. To compute compressibility in the well, the volume of water pumped in to achieve the pressure 'slug' must be known; this is calculated by measuring the amount of water pumped from a container at the surface. The possibility of generating a suction in the uppermost part of the shut-in volume and the creation of a free surface is prevented by locating the valve used to shut the well near the packers. (Gish-FRC)
W82-06060

BICYCLE-SAFE GRATE INLETS STUDY; VOLUME 5 - HYDRAULIC DESIGN OF GENERAL SLOTTED DRAIN INLETS,

Water and Power Resources Service, Denver, Colorado.
C. A. Pugh.
Federal Highway Administration Report FHWA/RD-80/081, October 1980. 145 p, 120 Fig, 6 Tab, 1 Ref. PO-5-3-0166.

Descriptors: *Inlets, *Hydraulic design, *Hydraulic models, *Storm drains, Model studies, Flow characteristics, Interception, Slopes, Flow capture.

Hydraulic tests and analysis were conducted to generalize the hydraulic design of slotted drain installations. Slotted drains with solid vertical spacers at 6-in spacing were used in all testing. Slot widths of 1, 1.75, and 2.50 inches and slot lengths of 8, 24 and 48 ft were used. The tests at slot length of 8 and 24 ft were conducted to determine efficiencies over a range of flows. At 48 ft, testing was limited to total flow capture lengths. In order to cover a range of slope conditions, logitudinal slopes of 0.005, 0.02, and 0.09 were tested at cross slopes of 1/16, 1/32, and 1/64. Back slopes of 1/16 and 1/24 were tested at a curb distance of 15 in for all installations. All installations were also tested with the curb adjacent to the slot. A series of 4 or 5 discharges ws tested for each condition. For most field conditions weir flow controls the total capture length. Based on data from these studies, new equations were developed to cover a wider range of conditions. Back slope does not affect the partial flow interception efficiency in the range measured. (Moore-SRC)
W82-06095

CANALS IN SAND CHANNELS,

S. Kh. Abal'yants.
Hydrotechnical Construction, Vol 15, No 8, p 471-475, 1981. 1 Fig, 2 Tab, 19 Ref. Translated From Gidrotekhnicheskoe Stroitel'stvo, No 8, p 28-30, August, 1981.

Descriptors: *Canal design, *Mathematical studies, *Flow characteristics, *Hydraulics, *Channel flow, *Channel morphology, *Flow velocity, Canal construction, Design criteria, Stable channels, Canals, Flow friction, Mathematical equations, Roughness coefficient, Chezy equation, Sand, Canal linings, Channel erosion.

The mobility of material in a canal constructed in noncohesive sand soils is substantially affected by the turbulence of the flow, a factor not adequately reflected in the working formulas. Preliminary data indicates that Studenichnikov's formula for the critical velocity with a slighly reduced numerical coefficient and replacement of depth by the hydraulic radius without corrections for the channel shape is applicable for sands with a particle size to 1.5-2.0 mm. Equations were formulated establishing the existence of a stable quasihomogeneous flow whose conditions can be regarded as an expression of minimum energy dissipation. The influence of the roughness coefficient on the equations' parameters is discussed. Other factors such as traveling surges, wind and ship waves, local curves of the route, infiltration, nonuniform strength properties of the soils, and special conditions of the winter regime should also be considered when designing and constructing new canals. (Geiger-FRC)
W82-06196

CHOICE OF SPACE AND TIME STEPS IN THE MUSKINGUM-CUNGE FLOOD ROUTING METHOD,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W82-06227

CAVITATION PROBLEMS IN HIGH-HEAD INSTALLATIONS (KAVITATIONSPROBLEME IN GRUNDABLASSEN).

Karlsruhe Univ. (Germany, F. R.). Inst. fuer Hydromechanick.
E. Naudascher.
Wasserwirtschaft, Vol 72, No 3, p 104-110, 1982. 14 Fig, 27 Ref. English Summary.

Descriptors: *Cavitation, *Design criteria, *Dams, Fluid mechanics, Erosion, Bottom outlets, Mathematical equations, Water currents, Vortices, Eddies, Flow, Turbulent flow, Aeration, Shear, Pakistan, *High-head installations.

The significance of cavitation for high-head installations was demonstrated by the collapse of a bottom outlet of the Tarbela Dam in Pakistan in 1974, which was caused by erosions of up to 5 m under the inlet structure and hollowing out of the piers. Damage from cavitation sets in principally when, in addition to the usual preconditions, vortex formations occur. Equations for calculating the cavitation figure (Ka), an estimate of the onset of cavitation, its extent and consequences, and for the size of Ka at the onset of cavitation (Ka krit) are given. Areas particularly susceptible to caviation are current boundaries with crooked edges or breaks. Shear zones form along the breaks in which turbulent vortices form. An equation to calculate Ka krit along smooth and rough walls and in free shear currents is given. Other conditions under which cavitation occurs are discussed. Design principles for avoiding cavitation are the streamlining of flow passages to keep pressure and velocity of the current within acceptable limits, the transfer of zones favoring cavitation to the inner areas of the current so that the walls are protected from erosion, and artificial aeration as well as the fostering of spontaneous aeration. Examples of all these principles are described and illustrated, and special protection measures and extraordinary operating conditions are discussed. Further research on the behavior of currents is called for. (Gish-FRC)
W82-06237

DESIGN FLOOD AND HYDROLOGICAL RISK FOR SPILLWAYS OR RESERVOIRS AND FLOOD PROTECTION BASINS (BEMESSUNGSHOCHWASSER UND HYDROLOGISCHES VERSAGENSRISIKO FUR TALSPERREN UND HOCHWASSERRUCKHALTEBECKEN),

Karlsruhe Univ. (Germany, F. R.). Inst. Wasserbau III.
E. J. Plate.
Wasserwirtschaft, Vol 72, No 3, p 91-97, 1982. 6 Fig, 14 Ref. English Summary.

Descriptors: *Design criteria, *Reservoirs, *Flood protection, *Dam failure, *Spillways, Floods, Flood control, Flood plain management, Risks, Reliability theory, Mathematical analysis, Design standards, Standards, Maximum probable floods, Hydraulic design, Reservoir design, Costs, Acceptable risk.

A concept for improving the design of spillways is presented, which can be used to supplement the rules of German Standard DIN 19700 for reservoirs and flood protection basins. The Standard is not far-reaching enough because its only design criterion is the probability of flood waters exceeding reservoir capacity, whereas the probability of dam overflow should also be considered, since there is no direct connection between the two. The first stage of the concept consists of calculating the overflow probability, which is also the probability of dam failure due to hydrological causes, by means of Freudenthal's reliability integral. The use of reliability theory leads to significantly longer recurrence intervals of overflow than those previously calculated. Sample calculations are given for a small potable-water reservoir, giving a recurrence interval of 34,528 years, and for a small flood protection basin, giving an interval of 642 years. Whether the small interval of the second example is significant or not depends on the damage that would be caused by overflow, and this leads to the second stage of the concept, that of acceptable risk. Rather than measuring total damage done by one flood, hydrological risk should be understood as a figure proportional to the expected value of damage expected per year following overflow. Methods of determining this are given, though as yet no concept exists to measure the acceptable level of non-monetary damage. This total concept can aid in economical design and help satisfy public demand for knowledge or risks to which they are subjected. (Baker-FRC)
W82-06238

CONFLUENCE OF TWO JETS CREATED BY TWO PARALLEL SEGMENT GATES OF A BOTTOM OUTLET (SCHUSSSTRAHL-ZUSAMMENFUHRUNG BEI EINEM GRUNDABLASS MIT NEBENEINYANDERLIEGENDEN SEGMENTSCHUTZEN).

Technische univ., Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
H. J. Hoch.
Wasserwirtschaft, Vol 72, No 3, p 110-114, 1982. 11 Fig, 6 Ref. English Summary.

Descriptors: *Jets, *Bottom outlets, *Gates, Model studies, Reservoirs, Plumes, Hydraulic design, Design criteria, Hydraulic engineering, Cavitation, Trails, Water currents, Tunnels, Irrigation, Irrigation engineering, *Sri Lanka, Rangenigala Reservoir.

Model studies were conducted to examine the confluence of jets behind two parallel segment gates in the bottom outlet of the Rangenigala Reservoir, Sri Lanka. The bottom outlet also functions as an irrigation outlet, which necessitated the construction of two gates at the end of the pressure tunnel for operational safety. The result of this is separation of flow by a dividing wall which for static reasons must be 2.6 m wide. Because of the high velocity (43.2 m/sec) of the two jets, which converged at a relatively large angle behind the wall, water plumes of up to 15 m in height ensued under certain conditions when an elliptical model wall was used. Theoretical calculations and reference to previous experiments led to a model in which pier width was kept constant at 2.6 m under the segment gates. Though the effect of jets crashing into each other when both gates were equally open and against the opposite channel wall when the gates were open at different levels was reduced by 70%, and a narrow plume of only 5 m in geight was formed, these conditions were not adequate to ensure the safety of the nonpressure tunnel. For this reason an extension to the wall was built, 35 m in length, with a height of 1.9 m at the wall, diminishing to 0.5 m. In this way the lower portion of the jet was channeled, while the upper portion gradually broadened out along the extending trail, and in the area of jet convergence water depth and Froude number were constantly changing. This trail was an improvement on previously built rails in that its side walls ran at an angle of 1 degree so that the flow cross-section of the jet broadened continuously, its form was prismatic to fix separation of flow along the edges, and it had a box profile to allow aeration of the trail end for the avoidance of cavitation. (Gish-FRC)
W82-06243

HYDRAULIC JUMP, AIR ENTRAINMENT AND SLUG FLOW IN BOTTOM OUTLETS (WECHSELSPRUNG, LUFTEINTRAG UND SCHWALLFORMIGER ABFLUSS IN GRUNDABLASSEN),

Technische Univ., Munich (Germany, F. R.). Versuchsanstalt Fuer Wasserbau.
J. Knauss.
Wasserwirtrschaft, Vol 72, No 3, p 115-119, 1982. 6 Fig, 1 Ref.

Descriptors: *Bottom outlets, *Air entrainment, *Hydraulic jump, *Closed-conduit flow, *Slug flow, Fluid mechanics, Flow, Flood protection, Vibrations, Supercritical inflow, Submerged outflow, Ventilation, Model studies, Design criteria, Hydraulic design, Hydraulic engineering, West Germany.

Conditions under which slug flow can occur and possible remedies for the situation are discussed with reference to operational installations planned for the flood protection basin at Schonstadt an der Itz, West Germany. Slug flow can arise in closed channels when submerged outflow conditions act on supercritical inflow so that a hydraulic jump fills the conduit. The consequences of this are dynamic stress reversals in the conduit, pulsating and discontinuous flow, and the danger of vibrations. Model studies showed that the planned positioning of the spillway and two bottom outlets close together on top of one another in a single casing under the dam would lead to slug flow due

to a hydraulic jump entraining air within the conduit. Two remedies were possible, changing the outlet route or installing ventilation units to remove the entrained air. Because in this case air entrainment was unavoidable due to gate position and accumulation in the channel, it was decided to build two ventilation units in each bottom outlet. In this case the bottom outlets had an inclination of 5% and a cross-section of 2 x 2 m; the model studies also investigated channel inclinations of 3%, 6% and 12% with prismatic cross-sections of 20/15 cm (compact) and 20/30 cm (superelevated). Installation of ventilation systems may be avoided by designing bottom outlets with an appropriate vertical route for the channel to prevent accumulation. (Gish-FRC)
W82-06244

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 1.

For primary bibliographic entry see Field 3F.
W82-06375

MANUAL OF ENGINEERING OF IRRIGATED LANDS (MANUAL DE INGENIERIA DE REGADIOS), VOL. 2,

For primary bibliographic entry see Field 3F.
W82-06376

CANADIAN WAVE CLIMATE STUDY: ORGANIZATION AND OPERATION,

J. R. Wilson, and W. F. Baird.
Marine Sciences and Information Directorate, Manuscript Report Series No 59, 1981. Department Of Fisheries and Oceans, Ottawa, Ontario. 26 p, 9 Fig, 1 Tab, 31 Ref.

Descriptors: *Wave height, *Wave propagation, *Data collections, *Design criteria, *Breakwaters, Canada, Wave action, Wave crest, Wave direction, Waves, Kinematic waves, Wind waves, Buoys, Structural engineering, Port facilities, Histograms, Data acquisition, Data interpretation, Design standards, Sea walls.

The Canadian Wave Climate Study was established in 1968 to provide information to assist the design of marine facilities (e.g., deep water ports, breakwaters, offshore structures), and has led to wave data collections at about 200 locations in marine and inland waters on both the east and west coasts of Canada. Recent activities have led to the development of a standard analysis procedure and a set of data presentations useful to design engineering. These activities are delineated, along with the instrumentation employed, its reliability, and its operation characteristics. Specifically, the performance and calibration of the basic instrument employed, the waverider buoy, are described. Calibrations were carried out with a variable-speed mechanical oscillator capable of rotating a waverider in a fixed plane at a number of selectable fixed frequencies. Data control and analysis are discussed, and examples of data reporting products are given (e.g., scatter diagrams, peak-period histograms, wave height exceedence diagrams, wave height time-course plots, spectrum diagrams, surface elevation traces). In addition to the standard data products, wave data are available on magnetic tape in digital form in both computed spectral and surface elevation files (covering over 300,000 records in each of these files). (Zielinski-MAXIMA)
W82-06393

SEWER NETWORK ROUTING BY DYNAMIC WAVE CHARACTERISTICS,

Middle East Technical Univ., Ankara (Turkey). Dept. of Civil Engineering.
A. S. Sevuk, and B. C. Yen.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 379-398, March, 1982. 13 Fig, 3 Tab, 12 Ref.

Descriptors: *Routing, *Sewer hydraulics, *Wave action, *Flow characteristics, Unsteady flow, Simulation anlaysis, Mathematical models, Networks.

Although flow in storm sewer networks is usually unsteady, nonuniform, turbulent, and subject to mutual backwater effects of joining sewers, it is only recently that complete dynamic wave equations capable of accounting for the downstream backwater effect have been adopted in sewer network flow simulation. Numerical schemes for solving the dynamic wave equations are computationally costly and at times unstable. The Illinois Storm Sewer System Simulation Model uses the method of characteristics to solve these dynamic wave equations. The use of this model to route unsteady open-channel flow in dendritic sewer networks is reported. Application of the model to a 48-pipe sewer system confirmed the following characteristics of unsteady open-channel flow in sewer networks: the backwater effect of the junctions cannot be ignored in modeling these systems and, under certain circumstances, reversal flow may occur; the depth-discharge relationship is not unique and a loop-type rating curve exists; and the occurrence of maximum discharge in a sewer need not, and usually does not, coincide with maximum depth. The model is also applied to the example sewer network given in an American Society of Civil Engineers Manual of Engineering Practice in order to demonstrate how a dynamic wave routing model can be used to evaluate and improve a sewer system. Although several refinements to the model are desirable, the computed results of the model presented appear to be in good agreement with the expectations based on physical reasoning. (Carroll-FRC)
W82-06418

DILUTION ANALYSIS FOR UNIDIRECTIONAL DIFFUSERS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 327-342, March, 1982. 9 Fig, 18 Ref.

Descriptors: *Diffusion coefficent, *Wastewater disposal, Cooling water, Mixing, Prediction, Mathematical studies, Powerplants, Design criteria, Flow discharge, Fluid mechanics.

Submerged multiport diffusers provide an efficient means for the rapid dilution of large volumes of wastewater discharged into ambient receiving waters. The mixing mechanics of two types of unidirectional diffusers used to discharge heated water from steam-electric powerplants into shallow, laterally unbounded receiving waters are examined. The diffusers analyzed include a coflowing diffuser, in which the discharge ports are oriented in the direction of the ambient current, and a tee diffuser, in which the discharge ports are oriented at right angles to the ambient current. An analytical theory for the dilution of a coflowing diffuser has been developed and was shown to yield good agreement with available measurements. Comparison of this theory with anlaysis governing other diffuser types indicated that the coflowing diffuser is the best choice for maximizing dilution in open receiving waters with predominant currents in one direction. The symmetrical orientation of a tee diffuser makes it the preferred choice over a coflowing diffuser when the receiving waters are characterized by weak bidirectional currents. A semi-empirical theory was used to illustrate the dependence of tee difusser dilution on ambient current speed, suggesting that the highest practical discharge velocity should be used to obtain the most efficient mixing with this type of diffuser. Comparison of dilution obtained with a tee diffuser with that expected for staged diffuser indicated that staged diffusers provide the best dilution for receiving waters with strong idirectional currents. (Carroll-FRC)
W82-06420

EXPERIMENTS ON COAXIAL HEATED WATER DISCHARGES,

Karlsruhe Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W82-06422

ACCURACY CRITERIA IN DIFFUSION ROUTING,

San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce, and F. D. Theurer.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY6, p 747-757, June, 1982. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Channel flow, *Flood routing, Muskingum model, Model studies, Routing, *Diffusion model, Hydrographs, Streamflow.

The Muskingum diffusion model, in which the channel routing parameters are calculated based on channel and grid characteristics, is evaluated. Numerical experiments are done to provide information on the criterion for spatial resolution to preserve the accuracy of the method. For very large values of the space step, unrealistic negative flows occur. The numerical experiments show that one of the routing coefficients, C2, should be equal to or greater than 0.33 for most practical applications. The upper limit for the space step can be calculated from an equation which includes the terms Courant length, characteristic reach length, and an accuracy parameter of 2. (Cassar-FRC)
W82-06423

THE V-SHAPED BROAD-CRESTED WEIR,

Waterloopkundig Lab., Delft (Netherlands).
W. Boiten, and R. H. Pitlo.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 108, No IR2, p 142-160, June, 1982. 18 Fig, 4 Tab, 15 Ref.

Descriptors: *Weirs, *Discharge measurement, *Crest gages, Hydraulic stuctures, Roughness coefficient, Flow measurement, Discharge coefficient, Flow velocity, Design criteria.

The V-shaped broad-crested weir, a widely used measuring structure in irrigation and hydrologic studies, was investigated to discover the influence of free flow and submerged flow with shape angles of 90, 120, and 150 degrees and to study the thickness of the boundary layer and its effects on the discharge coefficient. A horizontal broad-crested weir was used to study the influence of the crest material. The characteristic discharge coefficient was affected by three inteacting components: boundary layer effects related to crest roughness, lateral contraction upstream and downstream of the critical section Scaling effects may be caused by boundary layer effects if the Reynolds number is less than 300,000. The Froude number in the head measurement section should not exceed 0.2-0.5. The shape angle should not be less than 60 degrees. The modular limit for V-shaped broad-crested weirs is a submergence ratio of 80% if the ratio of the energy head tocrest length does not exceed 0.45. Above this value the modular limit is reduced. Submerged flow can be calculated by introducing a drowned flow reduction factor usable for submergence ratios of 80-93%. The structure is suitable for measuring small and moderate discharges. Rules for design and application are given. (Cassar-FRC)
W82-06450

TURBULENT FRICTION IN A VISCOUS SUBLAYER AND IN THE TRANSITION REGION OF THE FLOW OF WATER IN A FLAT DUCT,

Ye. S. Mikhaylova, and Ye. M. Khabakphasheva.
Fluid Mechanics-Soviet Research, Vol 9, No 6, p 37-51, November/December, 1980. 8 Fig, 5 Tab, 13 Ref.

Descriptors: *Turbulent flow, *Flow friction, Hydraulics, *Graphical methods, *Reynolds number, Flow, Flow measurement, Energy, Mathematical studies, Flow characteristics, Hydraulic properties, Flow velocity.

Reynolds stresses have been useful in studying turbulent energy in turbulent wall flow. In the present study, they are utilized in describing measurements in the central part of a flat duct with a

1:10 aspect ration (1 by 10 sq cm). The viscous sublayer and the zone of intensive turbuent energy generation ($y(+) <$ or $= 60$) in immediate proximity to the wall were examined on a specially developed water loop apparatus. Within the viscous sublayer ($y(+) < 5$), turbulent shear stresses account for only a few percent of the total friction, whereas at $y(+) > 30$, viscous friction virtually ceases to have any effect. The effects of fluctuations in u' and v' of various signs and scales on turbulent friction are examined. The role of large fluctuations in turbulent transport of momentum within the viscous sublayer is greater than in the transition layer, where the strips of ordered flow break down at a high rate, while random mixing of the liquid takes place. Results afe compared with previously recorded data on the structure of the viscous sublayer. (Geiger-FRC)
W82-06468

THE CHOICE OF HYDRAULIC ENERGY DISSIPATOR FOR DAM OUTLET WORKS BASED ON A SURVEY OF PROTOTYPE USAGE,

For primary bibliographic entry see Field 8A.
W82-06500

SOLUTIONS OF THE COLEBROOK-WHITE FUNCTION FOR RESISTANCE TO UNIFORM TURBULENT FLOW,

University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
D. I. H. Barr.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 71, No 2, p 529-535, June, 1981. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Mathematical studies, *Reynolds number, *Turbulent flow, *Hydraulics, *Flow velocity, Mathematical equations, Flow characteristics, Flow, Model studies, Flow friction, Resistance.

For many years, less effective approximations for the Colebrook's smooth turbulent value of the Colebrook-White function approximation for resistance to uniform turbulent flow were widely used. The determination of the diameter when the discharge or the mean velocity is given is examined. Accuracy in approximating the Colebrook-White function requires the application of a correction factor to the smooth turbulent element of the approximation. Except when programmable calculators are applied to the intermittent solution of limited numbers of problems at a time, the conventional approach of iteration to attain a chosen limit of change in value between successive solutions is a wasteful process. A single accurate approximation solution is usually preferred, not only in the simple Colebrook-White function, but in developments for its use. The function may be combined with the Poiseuille equation for continuous laminar-turbulent coverage or used with generalization components to cover transition routes other than those delineated by the simple function. (Geiger-FRC)
W82-06501

NUMERICAL METHODS IN HYDRAULICS,

S. V. Voropaev, and V. M. Lyatkher.
Water Resources, Vol 8, No 3, p 225-226, May/June, 1981. Translated from Vodnye Resursy, No 3, p 32-33, May/June, 1981.

Descriptors: *Symposium, *Hydraulics, *Fluid mechanics, *Numerical analysis, Flow, Heat transfer, Mass transfer, Seepage, Waves, Flow around objects, Model studies, Mathematical models, Hydrodynamics.

The All-Union symposium on numerical methods in hydraulics was held on April 14-18, 1980, in Telavi, Georgian SSR. The symposium's main goal was to compare and analyze the results obtained on solving practical problems of hydraulics by numerical methods. Reports covered the following main subjects: flow around bodies and jet stream; free flows, waves on a water surface; flows in pressure systems; two- and three-dimensional problems of free flows; heat and mass transfer; and seepage. A trend toward the mutual concerns and merger of hydraulics and fluid mechanics was recognized. (Cassar-FRC)
W82-06614

HEREDITARY PHENOMENA IN TURBULENT BOUNDARY LAYERS,

Leningrad Polytechnic Inst. (USSR).
L. G. Loitsyanskii.
Water Resources, Vol 8 No 3 p 241-246, May/June, 1981. 5 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 52-59, May/June, 1981.

Descriptors: *Turbulent flow, *Flow velocity, *Boundary layers, Eddy viscosity, Boussinesq equations, Velocity, Flow characteristics, Numerical analysis, Hydrodynamics, Mathematical models, Model studies.

The Boussinesq formula and its modifications are suitable for use under the conditions of gradual variation of the mean velocity gradient, when the time scale of the variation considerably exceeds the time scale of turbulence. However, these equations do not give satisfactory results when the velocity varies abruptly on a small time scale compared to that of turbulence. Representations which reflect the prior history of the flow are required. This paper examines a general differential equation of transport devoid of local restrictions and a simplification proposed by Hinze and Builtjes, which accounts for the memory effect. Experimental data are compared with results obtained with various equations. (Cassar-FRC)
W82-06618

NUMERICAL METHOD OF SOLVING CERTAIN INVERSE PROBLEMS OF HYDRAULICS,

Akademiya Nauk SSSR, Novosibirsk. Inst. of Hydrodynamics.
A. F. Voevodin, and V. S. Nikiforovskaya.
Water Resources, Vol 8, No 3, p 288-292, May/June, 1981. 1 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 114-118, May/June, 1981.

Descriptors: *Roughness coefficient, *Channel flow, *Flow characteristics, Water level, Unsteady flow, Steady flow, Numerical analysis, Hydraulic properties, Model studies, Mathematical models, Hydrodynamics.

A numerical method for identifying hydraulic parameters (roughness coefficient, coefficient of wind stress, etc.) from data of actual measurements of the level of the free surface or depth of flow is proposed. The flow of water in a channel is described by St. Venant equations. It is assumed that the flow is gradually varied and the identification parameters are constant over the entire length of the investigated reach of the channel. Two sample problems, in which the roughness coefficient is reconstructed, are given. The necessary accuracy in determining the water level is determined by an iterative process. (Cassar-FRC)
W82-06619

TURBULENT TWO-DIMENSIONAL FLOW OF AN INCOMPRESSIBLE FLUID AROUND OBSTACLES WITH SEPARATION,

Central Scientific Research Inst. of Aviation Engine Construction (USSR).
L. V. Gogish, and G. Y. Stepanov.
Water Resources, Vol 8, No 3, p 267-271, May/June, 1981. 3 Fig, 4 Ref. Translated from Vodnye Resursy, No 3, p 85-90, May/June, 1981.

Descriptors: *Turbulent flow, *Flow around objects, *Flow separation, Numerical analysis, Hydrodynamics, Model studies, Mathematical models, Fluid flow, Hydraulics, Boundary layers, Flow velocity.

The integral method of calculation is the simplest and most reliable method of solving the problem of flow around obstacles with separation at high Reynolds numbers. The method uses empirical information about the general scheme of the flow, quasi-one-dimensional formulations of the problems for region of the layer and wake type, and the usual model of flow of an ideal fluid around a displacement body. Examples of calculating the velocity distribution in the case of turbulent flow around three types of objects (ledge, cylindrical segment projection, and a semicylinder, all located on a plane wall) are given. The complete solution of the problem of flow around an obstacle with separation contains five empirical coefficients. Three are concerned with the local conditions of the boundary-layer separation (increase in pressure, interaction length, and angle of deflection of the displacement body). Two characterize turbulent mixing in the near wake and in the isobaric bottom region. (Cassar-FRC)
W82-06621

INVESTIGATION OF THE TRANSFORMATION OF BREAKTHROUGH WAVES IN THE LOWER POOL OF A HYDROSTATION WITH THE USE OF COMPUTERS,

Georgian Scientific Research Inst. of Power and Hydraulic Structures (USSR).
G. N. Gvazava, L. L. Kvaratskheliya, and I. D. Muzaev.
Water Resources, Vol 8, No 3, p 304-307, May/June, 1981. 3 Fig, 5 Ref. Translated from Vodnye Resursy, No 3, p 135-138, May/June, 1981.

Descriptors: *Dam failure, *Wave propagation, Breakthrough waves, Numerical analysis, Model studies, Mathematical models, Hydraulics, Hydrodynamics, Computers.

The characteristics of the breakthrough waves formed by failure of dams and other water impounding structures were studied with a large-scale model and by numerical analysis. The test station was 1000 m long; channel width, 10-12 to 50-60 m; water volume in the upper pool, 550 cu m; and backwater height, 1.02 m. Two types of experiments were conducted: (1) instantaneous removal of the barrier and (2) blasting followed by breaks and washing away of the dam. The duration of collapse had little effect on the final results of the motion. Maximum depths of the breakthrough wave were the same; in the gradually collapsing situation maximum depths were delayed. Results of the numerical model agreed well with the observed results. Applying the numerical model to a high-head dam showed that collapse of a 100 m dam caused a breakthrough wave propagating at 30-35 m per sec, at which speed the air drag was a significant factor. Subsequently, the model was modified to account for air drag. (Cassar-FRC)
W82-06622

FINITE ELEMENT APPROXIMATIONS TO FLOW PROBLEMS,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Mathematics.
G. J. Fix.
Advances in Water Resources, Vol 5, No 1, p 17-20, March, 1982. 3 Fig, 7 Ref.

Descriptors: *Flow, *Finite element method, *Fluid flow, Fluid mechanics, Hydraulics.

Two sample problems using finite element methods to approximate fluid flows are illustrated. The first is a two-dimensional incompressible flow past an obstacle using the stream function and vorticity formulation. An appropriate variational method is developed using the classical Galerkin method. The second example is a three-dimensional incompressible flow using primative variables. The standard Galerkin method is also used, but it can only produce stable and accurate approximations with selected finite element spaces. The two necessary conditions are that the space of pressures must be related to the velocity space by a given equation and that the velocity space must satisfy a decomposition property analogous to the classical decomposition of a vector field into a curl free part and a divergence free part. (Cassar-FRC)
W82-06730

NUMERICAL INVESTIGATIONS OF PLANS OF FLOW IN CHANNELS WITH A COMPLEX BOTTOM RELIEF,

All-Union Designing, Surveying and Surveying and Scientific Research Inst. Hydroproject, Moscow (USSR).
A. N. Militeev, and S. Y. Shkol'nikov.
Water Resources, Vol 8, No 3, p 298-303, May/June, 1981. 3 ig, 9 Ref. Translated from Vodnye Resursy, No 3, p 126-134, May/June, 1981.

Descriptors: *Channel flow, *Flow pattern, *Roughness coefficient, Reservoirs, Flood plains, Numerical analysis, flow characteristics, Flow velocity, Bottom currents, Lower Kama Reservoir, cheboksary Reservoir, *USSR, Model studies, Mathematical models, Hydrodynamics.

Practical problems in channel flow were investigated by numerical modeling using two-dimensional St. Venant equations. Graphic representations of flow in fragments of reservoirs were obtained, allowing the region of interest, such as the inlet section, to be studied without having to calculate flows for the entire reservoir. To substantiate the use of the numerical method, results were compared with results from air pressure model experiments conducted on a 49.3 km reach of the Lower Kama Reservoir. This was partitioned into three fragments. The calculated and experimentally determined velocities agreed well, but the physical experiments detected some eddy regions absent from the calculations. The effects of roughness of the flood plain and channel were investigated for fragments of the Cheboksary Reservoir. In the first study the roughness coefficient of the flood plain was 0.07 and the roughness coefficient of the channel 0-0.07. In this case the channel roughness had little effect on the result; the flows generally followed the direction of the channel. In the second series of experiments the roughness coefficient of the channel was zero and of the flood plain, 0-0.1. For a flood plain roughness coefficient > 0.02 the moduli of the velocity within the channel increased negligibly with increases in roughness coefficient and decreased on the flood plain. Velocity differences were < 0.02, the character of the flow changed markedly and the jet going through reached the flood plain, forming eddies of different spatial scales. (Cassar-FRC)
W82-06785

EXPERIMENTAL INVESTIGATION OF ACCELERATED TRANSITIONAL FLOW IN PIPES,

Tallinn Polytechnic Inst. (USSR).
U. R. Liiv.
Water Resources, Vol 8, No 3, p 307-312, May/June, 1981. 6 Fig, 5 Ref. Translated from Vodyne Resursy, No 3, p 139-145, May/June, 1981.

Descriptors: *Pipe flow, *Transition flow, *Flow characteristics, Unsteady flow, Turbulent flow, Flow velocity, Velocity, Shear stress, Accelerated flow.

The distribution of velocity and intensity of turbulence over the cross section of a flow and the corresponding shear stress values at a pipe wall were studied during the replacement of one steady flow regime by another. The experimental device used a LISA hot wire anemometric apparatus with appropriate detectors for detecting the local characteristics of unsteady turbulent flow. Considerable changes occurred in the flow structure, expresses in deformation of velocity diagrams and in a change in the distribution of the relative intensity of turbulence. Shear occurred within the relative radius of 0.66-0.79, separating the flow into two parts, core and near-wall regions. Although the new level of turbulence was mainly generated in the near-wall region, the final flow characteristics were established more slowly than in the core. The core of the flow was more sensitive to changes in a pressure gradient between ends of the pipe. Eddy stresses were noticeable in the layers between core and near-wall regions during transition flows. (Cassar-FRC)
W82-06786

LOCATING MONITORING WELLS,

Wright-Pierce, Topsham, ME.
B. Caswell.
Water Well Journal, Vol 36, No 5, p 42-43, May, 1982.

Descriptors: *Well hydraulics, *Monitoring, *Path of pollutants, Seepage, Groundwater movement, Vertical flow, Flow velocity, Stratigraphy, Plumes, Geohydrology.

Monitoring wells are used to measure groundwater potentials and obtain water samples for chemical analysis. The hydrogeological factors involved in location of long-term monitoring wells are discussed. Monitoring wells must be located so that they intercept groundwater flowing either into or away from a contaminant source. Long well screens obtain integrated samples, and short screens obtain samples from a specific layer. It may be sufficient to estimate horizontal flow at the site by observation of local topography, but more detailed informaton from observation wells or seismic refraction data may be needed in some cases. Stratigraphy is important. Wells in sand are easy to locate, but wells in granite must be located in specific fractures. Clay layers may interfere with transmission of contaminants; the well screen must be placed in the layer to be monitored. Knowledge of vertical flow patterns is important because contaminants may be moved beneath a too-shallow well in a recharge area, or a too-deep well in a discharge area may intercept only upward moving uncontaminated water. Seepage velocity is important in determining the desirable distance between source and monitoring wells. Dispersion and the geometry of the slug or plume of contamination must also be considered in selecting number location of wells. The density of the contaminant will determine whether the substance will migrate downward and across normal groundwater flow lines. Existing aquifer stresses can alter flow directions and seepage velocities. (Cassar-FRC)
W82-06848

HYDRAULIC ANALYSIS, PAINT CREEK AT STATE ROUTE 772, CHILLICOTHE, OHIO,

Geological Survey, Columbus, OH. Water Resources Div.
R. I. Mayo, and W. P. Bartlett, Jr.
Open-File Report 81-350, 1981. 13 p, 17 Feg, 1 Tab, 4 Ref.

Descriptors: *Bridge design, *Hydraulics, *Flood profiles, *Flood flow, Flood recurrence interval, Flood frequency, Flood discharge, Hydrologic data, *Ohio, Chillicothe, Paint Creek.

The Ohio Department of Transportation, Division of Highways, proposes to replace a three-span arch bridge across Paint Creek on South Paint Stree in Chillicothe, Ohio with a new deck-type structure resting on four sets of piles and four piers. Profiles of the 10-, 25-, 50-, and 100-year floods under present conditions and under conditions modified by construction of the new bridge are presented in this report. The results indicate that the construction of the new bridge will not cause significant changes in the flood profiles or the areas inundated. (USGS)
W82-06948

SUPERCRITICAL FLOW FLUMES FOR MEASURING SEDIMENT-LADEN FLOW,

Science and Education Administration, Fort Collins, CO.
R. E. Smith, D. L. Chery, Jr., K. G. Renard, and W. R. Gwinn.
Technical Bulletin No 1655, July, 1982. 70 p, 43 Fig, 3 Tab, 12 Ref, 4 Append.

Descriptors: *Flumes, *Sediment load, *Discharge measurement, Open channel, Flow discharge, Rapid flow, Velocity, Sediment transport, Supercritical flow flume.

High natural velocities and sediment concentrations in many locations prohibit the use of ordinary subcritical flow flumes because these flumes require such low approach velocities that sediment is deposited. Supercritical flumes have been developed to provide flow measurement for conditions of heavy sediment where ordinary flumes do not perform satisfactorily. A general type of supercritical flow flume, called the Walnut Gulch flume, has been developed over many years of experience and testing in discharge measurements at the Walnut Gulch experimental watershed, Tombstone, Arizona. Methods have been developed to analyze flows that exhibit lateral asymmetry in cross sectional profile, and porous dikes have been developed to considerably reduce asymmetry in the alluvial approach section to these flumes. The experience with the Walnut Gulch flumes has led to an improved design of supercritical flume, called the Santa Rita flume. The flume was intended for use in small channel flow measurement, generally less than 4 cu m/s. The slope of the floor breaks at the entrance to the curved approach, and the curvature of the approach wall has been reduced somewhat to decrease the tendency of waves to develop in the throat when flow direction changes too rapidly. (Moore-SRC)
W82-06959

LABORATORY INVESTIGATION OF DEFORMATIONS OF CANALS IN SAND,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
L. I. Vikulova, O. N. Shishova, and E. A. Selivanova.
Water Resources, Vol 8, No 4, p 389-397, July/August, 1981. 6 Fig, 4 Tab, 9 Ref. Translated from Vodnye Resursy, No 4, p 91-102, July/August, 1981.

Descriptors: *Sediment transport, *Canals, *Sand, *Canal embankments, Deformation, Channel erosion, Channel morphology, Erosion, Unstable channels, Bank erosion, Open-channel flow, Channel flow, Flow velocity, Rivers, Dunes, Shoals, Flumes.

Deformation of canals in sand was studied in a 20 x 4 x 1 m flume formed from sand. Several conclusions were reached. Transverse transport of sediment along troughs of underwater sand dunes is an important factor in the channel formation process. The transport of sediment from the banks along the troughs of oblique dunes causes slope instability, eventually widening the channel. Transverse sediment transport within the channel distributes suspended sediment over the entire width of the channel and promotes formation of large bed forms. The two stages of channel development are (1) initial (the channel widens, shoals, loses capacity, and develops transverse dunes, which cause bowing of the flow), and (2) transition (formation of large bed formations as are seen in rivers). The third stage could not be modeled in the laboratory because vegetation is a major factor. The formation of shoals and secondary dunes occurs at constant water discharge. The rate of widening of the channel is dependent on current velocity. (Cassar-FRC)
W82-06990

8C. Hydraulic Machinery

RESONANT WATERHAMMER: A CASE STUDY,

Empresas Publicas, Medellin (Colombia).
H. Perez.
International Water Power and Dam Construction, Vol 34, No 4, p 42-43, April, 1982. 1 Fig, 2 Tab.

Descriptors: *Hydroelectric plants, *Maintenance, Electric power, Powerplants, Electric power production, Water supply development, Water resources development, Valves, *Waterhammers.

A description is offered of a case of resonant waterhammer on a 270 MW, 550 m gross head project in Colombia. Pressure fluctuation measurements are included and the remedial measures taken to safeguard the installations. The water supply system consists of a 160 meter long tunnel and two penstocks. The total length of the pipes is quite small to cover the height difference between the valve house and the powerplant. Two butterfly valves are provided to control the flow, one at the upstream end of each of the penstocks and six spherical ones at the downstream end, just before the entrance to the scroll case of each of the turbines. The first stage of the project came into operation in 1962. and the second stage in 1965/66. Resonance has occurred on two occasions. After

the phenomenon was studied, it was concluded that typical self-excited resonance had taken place, and that the only element which could have caused the problem was the spherical valve. After a while the conditions for penstock-valve vibration and pressure oscillation of the hydraulic system were tracked down, and the phenomenon could be reproduced at will. Resonance occurred on penstock 1 if the needle valves of units 1 and 2 were open, and a complete shutdown of the system was carried out independently of which one of the units 1 to 6 was taken out of operation. Resonance occurred during a complete outage, though with lower intensity if the needle valves of either 1 or 2 were open. Resonance was noted in penstock 1 and the spherical valve of the unit of which the needle valves were open. No resonance occurred if units 3 to 6 were in operation and units 1 and 2 were stopped, regardless of whether the needle valves of these units were left open or not. (Baker-FRC)
W82-05981

SIMULATING AND IMPROVING HYDRO PLANT CONTROL,

Bochum Univ. (Germany, F.R.). Dept. of Mechanical Engineering.
K. H. Fasol, and M. Hoppe.
International Water Power and Dam Construction, Vol 34, No 5, p 73-78, May, 1982. 6 Fig, 13 Ref.

Descriptors: *Hydroelectric plants, *Control systems, *Simulation analysis, Turbines, Computers, Model studies, Flow regulation.

Analog simulation of a small hydro station with two 40 MW Francis turbines was carried out to provide information on the dynamic performance of the plant. As a result as additional stabilizing compensating circuit was designed, tested by simulation, and then tested in a prototype version. Field tests of frequency response and isolatd network operations confirmed the reliabiity of the simulation. The problem facing this station was the lack of a surge tank within the 6 km long water supply tunnel. Only very small rates of change in the guidevane opening were permitted before instability was reached. (Cassar-FRC)
W82-06202

AERATION AT FLOOR OFFSETS IN BOTTOM OUTLETS (BELUFTUNG AN SOHLSPRUNGEN VON GRUNDABLASSEN),

Technische Hochschule, Aachen (Germany, F. R.). Inst. fuer Wasserbau und Wasserwirtschaft.
M. Horster, S. Rabben, and G. Rouve.
Wasserwirtschaft, Vol 72, No 3, p 157-159, 1982. 6 Fig, 3 Ref. English Summary.

Descriptors: *Aeration, *Bottom outlets, *Dams, *High-velocity jets, Floor offsets, Cavitation, Velocity, Energy transfer, Reservoirs, *Gates, *Tunnels, Design criteria, Water pressure, Hydraulic engineering.

Bottom outlet tunnels usually have a very large cross-section due to a small energy gradient drop during operation. The main gate can be placed either at the beginning of the outlet or in the middle of the tunnel. In both cases the gate is the critical transition from pressure to nonpressure flow, where potential energy is transformed into kinetic energy and the question of adequate aeration from above arises. This question can be avoided by placing the gate at the end of the tunnel. The tunnel floor should then be curved in the direction of flow and should be furnished with a connecting offset. In this way, high velocity jets discharging below the gate can be aerated from below as well as naturally from above. Cavitation is also prevented because in the area of the concave curve, pressure forces arise that exceed by far the static pressure. (Gish-FRC).
W82-06242

CONFLUENCE OF TWO JETS CREATED BY TWO PARALLEL SEGMENT GATES OF A BOTTOM OUTLET (SCHUSSSTRAHL-ZUSAMMENFUHRUNG BEI EINEM GRUNDABLASS MIT NEBENEINYANDERLIEGENDEN SEGMENTSCHUTZEN).

Technische univ., Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
For primary bibliographic entry see Field 8B.
W82-06243

SEWAGE SLUDGE PUMPING - RECENT RESEARCH AND APPLICATION,

North-West Water Authority (England).
For primary bibliographic entry see Field 5D.
W82-06258

DESIGN OF HEAT PUMP RETURN WELLS,

Michigan Dept. of Public Health, Lansing.
D. K. Keech.
Water Well Journal, Vol 36, No 6, p 32-33, June, 1982. 1 Fig, 1 Tab.

Descriptors: *Wells, *Design criteria, *Heat pumps, Return wells, Groundwater recharge, Artificial recharge, Recharge, Induced infiltration.

A return well for groundwater heat pumps must be isolated from possible sources of pollution as required by various state or local codes. Construction of the return well should be equal in materials and workmanship to that of a production well and also meet all construction code requirements for the area. In Michigan a clamp-on type of pitless adapter is generally used as the frostproof casing connection to the well. Pressurization of gaskets is a requirement for approval of this design and is important from a public health standpoint on either a production or a return well. Pressurization of the discharge line also has a practical value in preventing water from draining from the drop pipe. It is recommended that 10 psi of pressure be maintained on the line between the heat pump and return well. The back pressure valve must be calibrated to meet the head pressures caused by the static water level for each individual return well. The water level in a return well is elevated in order to apply the higher head that is needed to transmit the water into the aquifer. The specific capacity should be compared to the proposed rate of discharge into the return well. A return well with a specific capacity greater than 1 gpm/ft of drawdown will generally indicate a usable return well, providing the static water level is at a depth of 20 to 25 feet below ground level. One modification which may improve a marginal return well or aid wells with a higher static head is the use of a drawdown seal. (Baker-FRC)
W82-06294

DESIGN CONSIDERATIONS IN WATERWORKS PUMPS SELECTION,

McGraw-Edison Co., N.Y.
W. C. Krutzsch.
In: Water/Engineering and Management, Reference Handbook-1982, p 40-43, May, 1982. 3 Fig, 4 Tab.

Descriptors: *Water treatment facilities, *Pumps, Design criteria, Wastewater facilities, Cavitation.

To ensure the selection of pumps which will provide maximum efficiency, it is necessary to consider specific speed. It has been estblished that the most efficient pumps are those having specific speeds falling in a range of about 2,000 to 2,500. Values below 1,500 are seldom acceptable for networks applications except where the pumps are small and power requirements low. For any given combination of capacity and head, specific speed is directly proportional to pump speed, and higher values of the former can be achieved only by increasing the latter. This situation is unacceptable because the net positive suction head required (NPSHR) of the pump at higher speeds cannot be provided by the system. Pump performance will be unsatisfactory due to cavitation, with resulting noise, vibration, and possibly serious damage to the impeller and to other pump components as well. Recirculation will develop independently at the impeller inlet and outlet as capacity is reduced, most frequently at different capacities for each of these regions. Its cause is inherent in the nature of the centrifugal pump and the uses to which it is put. High specific speed pumps are less suited to waterworks services than optimum specific speed designs. They are most susceptible to recirculation and tend to have more limited operating ranges. The beneficial effects of increased NPSHR on the operating range of a pump can only be realized if the pump manufacturer can take advantage of it. While economic advantages of high specific speed pumps are often publicized, their disadvantages must be noted, and may not become apparent until after installation, making it a costly process. (Baker-FRC)
W82-06343

VARIABLE FREQUENCY DRIVES - SOME APPLICATION PRINCIPLES.

Robicon Corporation, Pittsburgh, PA.
R. N. Hamilton.
In: Water/Engineering and Management, Reference Handbook-1982, p 55-56, 58-60, May, 1982. 5 Fig.

Descriptors: *Water treatment facilities, *Design criteria, Energy conservation, Wastewater treatment, Pumps, Hydraulic engineering, Hydraulic design, Hydraulic equipment.

A review of one of the major energy saving potentials typical of the water treatment industry is offered. Use of a variable speed drive can accomplish reduced flow conditions by slowing down the speed of the pump impeller, allowing the motor pump combination to deliver the lower flow at a lower head. With many centrifugal pumps, this means of reduction will require horsepower input proportional to the speed cubed. It is the substitution of variable speed of the prime mover for throttling or bypass of a portion of the pumped fluid to accomplish flow modulation that is the basic idea and will bring about energy savings to the industry. If a system will operate with a control valve to maintain flow at 80% or less for 25% of its operating time, the economies of a variable speed drive for centrifugal machinery should be investigated. If a system is operating with a variable speed drive at 80% flow or less for 50% of its operating time, substitution of a more efficient solid state drive should be investigated. Employment of a variable frequency drive will provide a secondary benefit for the starting of the motor. By using a variable-frequency drive to start the motor, breakdown torque as a limit is available on starting rather than locked-rotor and pull-up torque. This will prove useful to hydraulic engineers confronted with severe limitations of a power system. Other applications include high pressure fans, blowers or compressors used to introduce air to increase oxygen content. (Baker-FRC)
W82-06345

PUMP SUMP DESIGN EXPERIENCE: SUMMARY,

Engineering Hydraulics, Inc., Longmont, CO.
C. E. Sweeney, R. A. Elder, and D. Hay.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 108, No HY3, p 361-377, March, 1982. 8 Fig, 2 Tab, 16 Ref.

Descriptors: *Design criteria, *Sumps, *Pumps, Hydraulic models, Performance evaluation, Flow characteristics, Hydraulic machinery, Cooling water, Vibration, Model studies.

The capacity of vertical mixed flow pumps used to provide cooling water for industrial purposes and power generation has been increasing in recent years. However, since the thickness of the casing wall and the rigidity of the support do not increase in the same proportion as the hydrodynamic loading on the pump, larger pumps are more susceptible to vibration and rough running and better entrance flow conditions are needed to ensure satisfactory performance. The conditions of flow entering a pump are the net result of approach flow to, and the hydraulic design of, the sump in which the pump is operated. Hydraulic conditions which may result in pump performance problems, standards currently used in sump design, and criteria used to judge the acceptability of sump designs on the basis of the performance of hydraulic models are discussed. The designs of seven wet well sumps

for vertical mixed flow pumps modified through hydraulic mode tests are presented and compared with design standards currently in use. Although currently published standards for basic sump dimensions provide a good starting point, modifications are needed to achieve satisfactory hydraulic performance by large pumps. Performance criteria used in the development of the existing standards may not have been as stringent as those required for current large capacity pumps. A variety of suggestions for sump modifications and dimensions are presented which may provide a basis for developing conceptual or trial designs for sumps for large capacity pumps. A hydraulic model study should be performed when designing any major pumping facility to assure satisfactory performance. (Carroll-FRC)
W82-06419

SWIFT ACTION BY STATE OFFICIALS PREPARES FOR WATER SUPPLY CRISIS.

Public Works, Vol 113, No 3, p 64-65, March, 1982.

Descriptors: *Water transfer, *Water supply, *Pumping plants, New York, New Jersey, Drought, Pipelines, Water shortage.

New Jersey installed a 20 mgd temporary, portable 24 inch water main across the George Washington Bridge, to supply water to the drought-stricken northeast section of the state in 1981. The source of the water was the upper Delaware River, from which New Jersey had not previously used its full allotment. A permanent pumping station was built in an unused tunnel at 179th and Amsterdam Avenue, New York. Suitable pumps, which normally require months to fabricate, were diverted from shipment to a petroleum company in the Southwest. The pump and pipeline system is available for use in water emergencies and can be dismantled and stored in years of adequate rainfall. (Cassar-FRC)
W82-06514

ZIMBABWEAN HAND PUMP PASSES VILLAGE-LEVEL ENDURANCE TESTS.

Water Water, Vol 5, No 5, p 36-37, May, 1982.

Descriptors: *Pumps, *Developing countries, Rural areas, Wells, Water supply, *Zimbabwe.

The low cost, rugged Blair/Prodorite hand water pump, developed in Zimbabwe, appears to fulfill the criteria for a village level operation and maintenance pump. Costing $75 in kit form, the pump is made of lightweight plastic. Only the galvanized iron pump handle, which doubles as the water spout, is visible above ground. Below ground the pump consists of two plastic cylinders, one inside the other, fitted with identical valves at the base. The inner pipe is the piston/push rod. The upstroke draws water into the cylinder through the lower fixed foot valve. The downstroke closes the foot valve and forces water up the hollow portion to the surface. The pump is usable to depths up to 15 m. It lifts 20 liters per min, and 30-40 strokes by a young person can fill a bucket. Installation requires only the simplest tools and little technical expertise. Maintenance is confined to occasional clearing of debris from the foot value. In a factory test the pump was continuously pumped for 6 million strokes (90 years of use for a single family) with no detectable wear. (Cassar-FRC)
W82-06606

FLOW CONTROL AT STORMWATER OVERFLOWS AND STORMWATER TANKS (ABFLUSSSTEUERUNG VON REGENWASSERBEHANDLUNGSANLAGEN),

H. Brombach.
Wasserwirtschaft, Vol 72, No 2, p 44-52, February, 1982. 6 Fig, 1 Tab, 17 Ref. English Summary.

Descriptors: *Control systems, *Storm-overflow sewers, *Storm wastewater, *Hydraulic equipment, Wastewater facilities, Wastewater treatment, Valves, Flow control, Flow characteristics, Hydraulic engineering, Decision making, Planning, West Germany.

Various controllers for stormwater treatment plants are discussed in terms of performance and suitability for different types of facility. Pipe throttles are the most common type of controller in the West German sewage system, though they are not easily adapted to differences in quality and quantity of flow. The throttle slide valve is suitable for stormwater overflows and purification basins due to its low height and space requirements, large discharge, and subquadratic discharge pattern. Vortex throttles can significantly undercut the minimum discharge of the pipe throttle and are especially useful for small stormwater basins. The automatic vortex valve has roughly the same discharge span as the vortex throttle but is safer during operation; it is suited to storm overflow basins because it switches on less often and later than other controllers and produces its own short flushing surges. The float flap with nonlinear kinematics is well suited to stormwater overflow basins and flood protection basins, while the closed-loop controller (a hybrid using both electromechanical and hydraulic energy) is employed exclusively in exposed stormwater basins. The stop-and-go controller is used for stormwater basins with outflow of < 10 l/sec, because continuous control provides too small a sweeping force and too great a risk of blockage. A complex diagram to aid in the choice of a controller is presented, as is a method for installing a cortex valve. A five-step plan for controller strategy for a serial system of overflow basins is described. Transition to automatic systems is presented in the form of a three-stage plan. (Gish-FRC)
W82-06633

PUT PRESSURE ON SEWAGE,

Greenhorne and O'Mara, Inc., Riverdale, MD.
For primary bibliographic entry see Field 5D.
W82-06732

8D. Soil Mechanics

THE VALUE OF INSPECTION GALLERIES,

Lahmeyer International G.m.b.H., Frankfurt am main (Germany, F. R.).
C. Kutzner.
International Water Power and Dam Construction, Vol 34, No 5, p 78-84, May, 1982. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Inspection galleries, *Dam design, *Seepage control, Earth dams, Rockfill dams, Grouting, Drainage systems, Dam foundations, Foundation rocks.

Inspection galleries, also known as grouting galleries, inspection tunnels, drainage galleries, or control galleries, are often built inside or below dams. This paper discusses the advantages of inspection galleries in earth and rockfill dams. Seepage monitoring and control can be readily accomplished by piezometers installed in the inspection gallery. Release holes for preventing or reducing uplift below the downstream dam body can be readily drilled from the gallery. Underground settlement and displacements can be monitored from the gallery. Grouting work can be performed from the gallery without disturbing the embankment filling process. If necessary, grouting can also be done after impoundment. The negative aspects of galleries include extra costs and the possibility of disturbing foundation rock. Design and construction details for inspection galleries are given. (Cassar-FRC)
W82-06204

THE GROSSE DHUNN DAM AND THE FACILITIES FOR THE CONTROL OF STABILITY AND FUNCTIONING (DIE GROSSE DHUNNTALSPERRE UND DIE MESSEINRICHTUNGEN ZUR UBERWACHUNG DER STANDSICHERHEIT UND DER FUNKTIONSTUCHTIGKEIT DES DAMMES),

Talsperrenabteilung des Wupperverbandes (Germany, F. R.).
F. Cords.
Wasserwirtschaft, Vol 72, No 3, p 119-123, 1982. 9 Fig, 1 Tab, 2 Ref. English Summary.

Descriptors: *Dams, *Measuring instruments, *Rockfill dams, *Dam construction, Hydraulic engineering, Drinking water, Reservoirs, Water resources development, Water supply, Soil mechanics, Seepage, Safety, *West Germany, Grosse Dhunn Dam.

The Wupperverband constructed the Grosse Dhunn Dam 10 km east of Leverkusen, West Germany, to ensure an adequate drinking water supply for the Bergisches Land to the year 2000 and beyond. This is a rockfill dam (built 1979-1980) with bituminous core sealing and a grout curtain (finished in 1981) with double rows to 25 m and single row to 50 m under foundation level. The dam is 63 m high, 380 m long, and 8.5 m wide. Its capacity is 81 cu hm. The planning, subsurface exploration, construction, and installation of measurement and control equipment is described. The rockfill-type dam was chosen as esthetically pleasing in the given landscape. Soil mechanics studies resulted in the bituminous core being bent toward the air side in the upper third and in the division of the dam cross-section into core zones with fill of small rocks and outer zones where less sealing was required. Particular care was taken to perform quality control on the bituminous core, as after installation this can no longer be inspected. Numerous measurement points were installed to observe all movement and sealing properties of the dam during and after construction. External deformations could be detected by above-ground measurement points at five dam cross-sections, while internal deformations could be measured on the air side by a shaft lying along the third above-ground cross-section. Techniques applied were leveling, angle measurement, electrooptical distance measurement and optical sounding in the shaft. Tension measurement was also performed. To control the sealing properties, the transition zone on the air side of the bituminous core was constructed of coarse ballast without fill to allow for seepage. (Gish-FRC)
W82-06240

TEST AND CONTROL PROGRAMME FOR TWISTE DAM SITUATED IN SANDSTONE AND WITH RESTRICTED EXTENT OF SUBSURFACE SEALING (MESS- UND UBERWACHUNGSPROGRAMM EINER STAUANLAGE IM BUNTSANDSTEIN BEI BEGRENZTER UNTERGRUNDABDICHTUNG AM BEISPIEL DER TWISTETALSPERRE),

G. Bjornsen.
Wasserwirtschaft, Vol 72, No 3, p 135-139, February, 1982. 6 Fig, 4 Ref. English Summary.

Descriptors: *Dam design, Geology, *Sandstones, *Soil mechanics, *Rockfill dams, *Groundwater movement, *Sealing, Safety, Design criteria, Dam construction, Dams, Hydraulic engineering, Twiste Dam, *West Germany, Seepage, Permeability, Drainage, Testing procedures.

Geological conditions at the site of the Twiste Dam, West Germany, are unfavorable. The dam is situated in new red sandstone, and the valley gravel and sides and the underlying rock are permeable. Groundwater streams are forced to change direction around the dam shoulders and into a neighboring valley. The dam itself is permeable, as it is filled with new red sandstone, but water pressure is reduced by the carpet of river clay on the valley floor and by weathered rock on its sides. Soil mechanics and projections of groundwater flow under and around the dam by means of potential theory determined the dam design. The fill was compressed in layers to reduce permeability, and a trench-furrows drainage system was built on the air side embankment to lessen possible negative effects of compression on the surface filter. Because of the soft plastic clay foundation, the dam was built very wide with a flat embankment; to improve the watertightness of the clay, additional clay sealing and compression of the basin floor were performed. Reduction of water flow around the dam was achieved by extension of the injection curtain about 20 m beyond the shoulder. A five-year test program, during which the dam was filled to capacity in stages, confirmed the theoretical model and led to the introduction of additional

safety measures. For example, meadows below the dam became waterlogged and a drainage system was constructed; seepage into the neighboring valley necessitated an extension of the valley-side sealing to the height of greatest operating capacity. The program demonstrated the importance of separate geohydraulic systems: on the one hand, bank prefilling, valley-side permeability and trench-furrowed drains; on the other, basin sealing, rock foundation, dam, and surface drains. The influence of anisotropy should be taken into account at the planning stage. (Gish-FRC)
W82-06632

8E. Rock Mechanics and Geology

INVESTIGATIONS FOR NORWAY'S LONGEST UNLINED PRESSURE SHAFT,

Geoteam A/S, Oslo (Norway).
J. Bergh-Christensen, and R. Kjelberg.
International Water Power and Dam Construction, Vol 34, No 4, p 31-35, April, 1982. 9 Fig, 2 Tab, 3 Ref.

Descriptors: *Excavation, Water resources development, *Norway, Construction, Stability, Mathematical studies, Computers, Model studies, Design criteria, Geological surveys, Tunnels.

An unlined pressure shaft is described which will sustain the highest water pressure in Norway, and probably in the world. The geology of the site is described, along with studies undertaken to determine the design criteria. The pressure shaft is 1130 meters long, with a static head of about 1000 m. The topography of the sites is complex, and the main part of the scheme is at an evaluation varying between 1000 and 1200 meters, where the terrain is mountainous and rugged. From the reservoir the water is fed through a headrace tunnel to the top of the pressure shaft at an altitude of 800 meters. The pressure shaft itself will have an inclination of 45 degrees, with its lower end just inside the powerplant. The method used for evaluation of the shaft siting is based on a calculation of total stresses by finite element plain strain analysis. The main condition imposed by this approach is that the minimum total stress should be higher than the water pressure at every point along the shaft, to avoid the risk of failure by hydraulic fracturing. The computer program used gives, for this type of finite-element analysis, the stress distribution along a vertical plane normal to the contour lines of the terrain model. The shaft has to be located, in this case, obliquely in relation to the valley side, and consequently the standard program does not give the complete stress distribution along the shaft in a single run. The results of the model studies indicated that the maximum total stress was mainly parallel to the valley side. The preliminary location of the shaft should be sufficiently safe, from these studies, and this location was chosen for the final site. (Baker-FRC)
W82-05980

DESIGNING AND EXCAVATING UNDERGROUND POWERPLANTS,

Trondheim Univ. (Norway). Dept. of Geology.
E. Broch.
International Water Power and Dam Construction, Vol 34, No 4, p 19-25, April, 1982. 8 Fig, 8 Ref.

Descriptors: *Powerplants, *Design criteria, Construction, Tunnels, *Underground structures, Stability analysis, *Norway, Geologic fractures, Geology.

Norwegian experience in the field of underground powerhouses is reported, noting that about half the world's underground stations are located in that country. Until recently the conventional drill and blast technique has been the dominating method of excavation. Approximately two thirds of the country consists of Precambrian rocks, with different types of gneisses dominating. Other major rock types from this era include granites, gebbros and quartzites. There are also provinces dominated by arkosic sandstones and shales. Norwegian bedrock is very old and, from an engineering geological point of view, one could describe it as a typical hard-rock province. With knowledge of geological conditions, a geological engineer may give advice so that construction problems for an underground opening in rock may be avoided or solved in an economical way. Geological conditions include the types of rocks and the mechanical properties of each, the jointing of the rock masses, the weakness zones of the bedrock, stress conditions in the rock masses and the water conditions in the rock masses. The most important part of a feasibility study for an underground opening is to find the right place and position. Certain unfavorable types of rock should be avoided. Soapstones, serpentinites and periodotites together with jointed tectonites with clay coated joints and fissures have caused severe stability problems in underground openings. Considerations for the orientation of the long axis of the powerhouse, shaping of underground openings, dimensioning of underground openings, and design considerations for unlined shafts and tunnels are discussed. (Baker-FRC)
W82-05982

THE ANNABRUCKE RIVER POWER STATION ON THE DRAU, CONSTRUCTIONS TAKEN TO PREVENT EROSION IN THE VICINITY OF THE BARRAGE ON AN EXCEPTIONAL SUBSOIL (DAS DRAUKRAFTWERK ANNABRUCKE, MASSNAHMEN ZUR VERHINDERUNG DER EROSION IN BEREICH DES BAUWERKES AUF AUSSERGEWOHNLICHEM UNTERGRUND),

H. Breth.
Wasserwirtschaft, Vol 72, No 3, p 152-157, 1982. 15 Fig. English Summary.

Descriptors: *Powerplants, *Weirs, *Subsoil, *Erosion, Hydroelectric plants, Erosion control, Geologic mapping, Geologic formations, Sealants, Silt, Dams, Water resources development, Filters, Screens, Drau River, *Austria, Control systems, Seepage control, Design criteria, Hydraulic engineering.

The power station Annabrucke and the accompanying weir were constructed on the River Drau in Austria on a subsoil endangered by erosion. The subsoil is composed of very permeable river gravel under which a layer of semi-permeable silt of varying thickness is found; within the latter, sands and occasional pockets of gravel occur caused by the steep angle of these strata. Under the main barrage and turbine and weir outlets lies the largest pocket of gravel containing dangerous inlays of uniform-sized grains. In order to use the silt layer as a sealing element, the power station and weir, as well as the two dams adjoining them on either side were joined to the silt layer by a sealing screen. The braking effect of the silt meant that seepage water would flow through the three-level surface filter behind the main structure into the bottom water almost without pressure. A further louvered slide was built behind the surface filter to cut of the uniform grain layers and force groundwater through the filter. An electrical analogy model confirmed the sealing and braking concept. The decision to build a power-station complex on such a foundation requires extensive site investigation using numerous bores to construct a model as well as a thorough observation system so that runoff can be controlled not only under the main structure but also under the basin and dams bordering the basin, behind the dams and in the bottom water under the main structure. A year after operation began, measurements showed that the braking effect of the silt and the draining effect of the uniform-grain layers ensured that seepage was dissipated before it reached the turbine and weir outlets so that the danger of erosion in the susceptible layers was eliminated. (Gish-FRC)
W82-06636

INVESTIGATION OF THE PARAMETERS OF WAVES ON A RESERVOIR SURFACE IN THE EPICENTRAL ZONE OF AN EARTHQUAKE,

Akademiya Nauk URSR, Kiev. Inst. of Hydromechanics.
B. N. Ostroverkh.
Water Resources, Vol 8, No 3, p 282-288, May/June, 1981. 4 Fig, 4 Ref. Translated for Vodnye Resursy, No 3, p 105-113, May/June, 1981.

Descriptors: *Reserviours, *Earthquakes, *Wave propagation, *Oscillatory waves, Mthematical models, Seismic waves, Model studies, Numerical analysis, Wave height, Rock mechanics.

The effect of earth quake zone parameters on surface waves in reservoirs was investigated using a numerical model to vary depth of the zone, rate of dislocation diffusion, remoteness from the epicenter, and the direction of tangent stresses along the displacement walls of the fissure. Figures showed the value of the maximum displacement of the water (the wave height) as a finction of: (1) the distance of the earthquake focus and (2) the depth of focus. Modeling results indicated that consideration of the combined oscillations of the elastic region and fluid region had a negligible effect on the oscillations of the elastic region, i.e., the oscillations of the surface of the wet and dry bottom were not significantly different from one another. However, it was necessary to consider the residual deformations of the bottom, formed in the case of a shallow-focus earthquake.(Cassar-FRC)
W82-06783

8F. Concrete

WORLD'S FIRST ALL-ROLLCRETE DAM,

Army Engineer District, Walla Walla, WA. North Pacific Div.
E. K. Schrader.
Civil Engineering (New York), Vol 52, No 4, p 45-48, April, 1982. 2 Fig.

Descriptors: *Dams, *Construction materials, Construction, Design criteria, Water resources development, Water supply, *Concrete, Oregon.

The use of roller-compacted concrete was explored in the construction of a 400,000 cubic yard of concrete by more than two-thirds. Willow Creek Dam will be the world's first gravity dam to be built entirely with roller compacted concrete. Other such dams are now under construction. By using this method, Willow Creek Dam will be built with 75% less material than was required for the originally designed rockfill structure. The dam will be built in about one year instead of the three years previously planned. The spectacular savings in both time and money are due to the lower cement content required and the substitution of efficient earthmoving equipment and techniques for the far more labor intensive bucket-by-bucket procedure for placing conventional concrete. One of the main advantages of the design at Willow Creek was the elimination of a separate side channel spillway otherwise required for a rockfil or embankment dam. (Baker-FRC)
W82-05999

MIX DESIGN PARAMETERS FOR CONCRETE CONTAINING CHEMICAL ADMIXTURES,

E. L. Ore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-237082, Price codes: A03 in paper copy, A01 in microfiche. Bureau of Reclamation Report REC-ERC-81-6, December 1981. 27 p, 12 Fig, 5 Tab. 0-07-DV-00109.

Descriptors: *Concrete additives, *Concrete technology, *Concrete mixes, Compressive strength, Cements, Temperature effects, Aging, Setting time, Water-cement ratio.

Concrete samples having water to cement ratios ranging from 0.35 to 0.65 with various quantities of WRA (water-reducing and set-controlling admixtures) ranging from 0.00 to 0.40% at three temperatures were prepared and periodically tested at intervals up to 1 year. An average quality aggregate was used to provide adequately conservative concrete design data. The effect was evaluated for each condition of WRA on the rate of hardening at early ages, as shown by the resistance to penetrate of the wet-screened mortar, and at extended aging, as shown by the compressive strength. The larger dosages of WRA generally resulted in lower water requirements; however concrete with 0.10% WRA required slightly more water than the reference

concrete. From 21 to 32 C, the water requirement increased 4.5% for each 5.5 degree temperature change. The setting time of mortar, wet-screened from concrete, increased as the WRA dosage increased. Larger amounts of WRA resulted in 1-day compressive strengths which were lower than the reference concrete, but by 3 days all concrete samples with WRA were stronger than the reference concrete. All concretes containing WRA were stronger than those without WRA except for the 0.40% WRA concrete where the 1-day strengths were slightly less. The use of WRA's was most effective in concrete with lower water-cement ratios and higher temperatures. A comparison of concretes with equal 28-day strengths but different water-cement ratios showed that the concrete without WRA was stronger at 90 days and 1 year than that with WRA. (Moore-SRC)
W82-06397

WATER TANKS IN REINFORCED CONCRETE,

Norwest Holst Construction Ltd., Watford (Englandd).
W. M. Pedder.
Water Services, Vol 86, No 1033, p 117-119, March, 1982. 2 Fig, 1 Tab.

Descriptors: *Concrete construction, *Water tanks, Reinforced concrete, Water storage, Design criteria, Joints.

Reinforced concrete water storage tanks are commonly constructed in pairs, buried and landscaped for esthetic reasons. A typical design is 2 tanks each 25 m square, 4.5 m deep. Each tank roof is covered with gravel for grainage and soil for a grass cover. Expansion joints are not usually required up to about 70 m length. Columns to support the roof are conveniently spaced on a 4.8 m square grid. All vertical wall joints, except corners, and internal movement joints should be full contraction joints. Roof joints are partial contraction joints. Metal or polyvinyl chloride water bars and sealant are usually provided at all joints. Details for design of walls and roof slabs are given. (Cassar-FRC)
W82-06604

8G. Materials

THE CORROSION OF COPPER BY CHLORINATED DRINKING WATERS,

Massachusetts Univ., Amherst. Dept of Chemistry.
For primary bibliographic entry see Field 5F.
W82-06051

MORPHOLOGY OF INHIBITOR-TREATED CACO3 PRECIPITATE,

Mobil Oil A.G., Celle (Germany, F.R.).
For primary bibliographic entry see Field 3A.
W82-06120

SECURITY ASPECTS AT THE DESIGN AND CONSTRUCTION OF SEALING FOR DAMS (SICHERHEITSASPEKTE BEI KONSTRUKTION UND AUSFUHRUNG VON DAMMIDICHTUNGEN),

By H. Steffen.
Wasserwirtschaft, Vol 72, No 3, p 144-147, 1982. 3 Fig, 3 Ref. English Summary.

Descriptors: *Sealants, *Dams, *Errors, *Design criteria, Core seals, Surface seals, Materials, Hydraulic engineering, Stress, Seepage, Erosion, Construction, Stress, Construction joints, Expansion.

The installation of sealing in dams is discussed with emphasis on the interaction between the sealing and transition materials, foundation and support structures. For surface sealing, the foundation should be laid so that as little movement as possible occurs through consolidation, or transition materials should be chosen that allow the sealing to move in the direction of the expected stress. Copper is preferable to plastic where the transition material must carry high water pressure. Common errors are failure to place an expansion joint in the area where movement is expected or a too-massive construction of the transition joint. Plastic materials are more susceptible to erosion. Core sealing may experience fission forces if distortions occur in the supporting structure; these may lead to seepage and erosion. Distortion of the core is another cause of damage. For asphalt cores, transition zones are recommended. Quality control of the sealing during and after installation is important: for core sealing, an area may be singled out as a test zone, and test cores should be extracted from the main core; the success of surface sealing can be determined by isotope sounding. Four examples of sealing errors are given: a too-porous material was used in the first-ever bituminous core seal, and led to permeability; in an asphalt membrane seal a tear above the joint led to slippage of the shear stress of the seal away from the joint, which caused a tear; a too-large joint in an asphalt seal caused a lack of give with expansion stress and let to the seal separating from the dam; and a tear occurred between strips of plastic sealing, allowing water to flow into the dam. None of these failures presented a danger to dam security, due to well-planned design and inspection measures. (Gish-FRC)
W82-06241

SEWERAGE: PRIORITIES FOR ACTION,

Water Research Center (England).
D. Fiddes, and M. J. Rouse.
Water Pollution Control, Vol 81, No 2, p 280-287, 1982. 12 Ref.

Descriptors: *Sewer systems, *Rehabilitation, Maintenance, Structural engineering, Physical properties, Construction materials, Hydraulic profiles.

This paper considers both the structural and hydraulic problems involved in planning proper sewage transport and treatment and suggests priorities for action by the industry. Evidence for the scale of sewer derclietion in the United Kingdom is collected from two sources: collapse and sample surveys. Data collection has been a major problem, as historic data were scarce. A collapse is defined as any sewer failure where excavation is required to effect the repair. The UK collapse rate appears to be about 5000 incidents per year. The current collapse rate would suggest a mean service life for the current sewer population of about 1000 years. Evidence from closed circuit television surveys shows that after reaching about 70 years of age, brick sewers deteriorate rapidly. The amount of money spent annually to rehabilitate sewers in raponse to collapse incidents roughly equates to the estimated expenditures on all sewerage rehabilitation. It may therefore be concluded that very little planned renewal is being undertaken. Work is currently underway to divide the existing sewer system into three zones - Zone A will contain the dewers where rapid devrioration has a high probability, Zone B will have less frequent surveys and only gross defects will be dealt with, and zone C will have maintenance only in response to incidents. Assessment of the hydraulic performance of sewerage systems is even more difficult. The lack of analysis techniques and the known presence of many unrecorded storm overflows together with the transient and infrequent occurrence of flood-producing rainfall make it inevitable that many of the older sewer systems are also performing indifferently in the hydraulic sense. (Baker-FRC)
W82-06260

ADVANCED COATINGS FOR THE WATER INDUSTRY.

Water Services, Vol 86, No 1033, p 124-125, March, 1982.

Descriptors: *Coatings, *Corrosion control, *Water tanks, Waterproofing, Plastics.

Several protective coatings for use in the water industry are described. They waterproof but are generally vapor permeable. Decadex, for external tank use, is solar reflective. It protects stone, brick, concrete, slate, wood, and tile from water, weather, and most chemicals by a seamless application. Steridex, a fungistatic protective finish, is used in drinking water plants. Sterepel not only is fungistatic, it also kills insects and rodents. Firecheck is a flameproof coating. Isoclad protects metal structures from rust and salt spray attack. Soladex is an elastomeric solvent-based high-build barrier coating which protects a wide range of substrates from water penetration and corrosion. It is ideal for use in low temperature areas. These products are manufactured by Liquid Plastics Limited, Preston, England. (Cassar-FRC)
W82-06603

CROSS-COUNTRY FORCE MAIN,

Water/Engineerig and Management, Vol 129, No 7, p 47-48, June, 1982.

Descriptors: *Pipelines, *Wastewater disposal, *Plastics, Force mains, Hortonville, *Wisconsin, Polyethylene.

A $370,000 12 inch diameter high density polyethylene force main buried 7-9.5 ft deep carries wastewater effluent from the Hortonville, Wisconsin, treatment plant to the river 2.5 miles away. The route was chosen to bypass the town and reduce costs of digging up streets. A wildlife marsh was located only 50 ft from the plant, but effluent discharge there was not allowed without expensive tertiary treatment. Pipe sections were joined by heat fusion to form an essentially continuous conveyance, except for planned air release and access points. The flexible pipe is expected to perform well in the shifting, corrosive soil. (Cassar-FRC)
W82-06640

STATUS OF POROUS PAVEMENT RESEARCH,

Municipal Environmental Research Lab., Edison, NJ.
R. Field, H. Masters, and M. Singer.
Water Research, Vol 16, No 6, p 849-858, June, 1982. 11 Fig, 1 Tab, 8 Ref.

Descriptors: *Paving, *Porosity, *Infiltration, Storm runoff, Water pollution sources, Aquifer recharge, Flood control, Water pollution control.

The Porous Pavement Research Program of the Environmental Protection Agency is discussed, including information on the economics, advantages, potential applications, and status and future research needs of porous pavements. Such pavements are an available stormwater management technique which can be used on parking lots and low volume roadways to reduce both stormwater runoff volume and pollution. In addition, groundwater recharge is enhanced. Also, cost reductions result due to elimination of curbs, drains, and small sized storm sewers. Porous asphalt pavements consist of a relatively thin course of open graded asphalt mix over a deep base of large size crushed stones. Water can be stored in the crushed stone base until it can percolate into the subbase or drain laterally. Other porous pavement types include concrete lattice blocks and a porous concrete mix. If the possibility exists that water infiltrating the ground could reach a water supply aquifer, adequate protective means should be undertaken to determine that the surface runoff is not still contaminated when it reaches the aquifer. (Baker-FRC)
W82-06665

8H. Rapid Excavation

PRACTICAL CALCULATIONS AND RECOMMENDATIONS ON THE USE OF GUNPOWDER ROCK BREAKERS IN HYDROTECHNICAL CONSTRUCTION,

N. Ya. Orlov.
Hydrotechnical Construction, Vol 15, No 8, p 502-506, 1981. 3 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stov, No 8, p 51-53, August, 1981.

Descriptors: *Rock excavation, *Hydraulic equipment, *Hydraulic properties, *Mathematical analysis, *Hydraulic engineering, Hydraulic design, Equations, Hydraulic geometry, Rock properties, Strength, Explosives, Gundpower Rock Breakers.

The effectiveness of gunpowder rock breakers in fracturing old foundations and structures depends largely on the parameters of the hydraulic pulse. Fracture of the medium is possible where the maximum pressure in the pulse is > or = to the compressive strength strength of the medium. Equations are given to analyze the water-hammer phenomenon that occurs in the compressive phase of the pulse and determines the processes of dynamic compression of the fluid with interference of the shock waves and without outflow of the fluid into cracks. These take into account the design of the rock breaker, the geometry of the shothole, and the physical properties of the medium. They show that the elastic volume in the area of the anchor device greatly affects the reflection of the incident waves and slows the pressure increase in the pulse. The half-phases of the annular section and of the perforated part of the tube are important in attaining maximum pulse amplitude, and the inertia of the annular section is influential in shaping the pulse. Equations for measuring cracks occurring at the end of the compression phase and for determining the duration of the discharge phase are also given. Finally, calculations are given for fracturing a mass by means of several rock breakers acting simultaneously. (Gish-FRC)
W82-06086

8I. Fisheries Engineering

NOTES ON THE CONSTRUCTION, INSTALLATION AND ENVIRONMENTAL EFFECTS OF HABITAT IMPROVEMENT STRUCTURES IN A SMALL LOWLAND RIVER IN SHROPSHIRE,
Liverpool Univ. (England). Dept. of Zoology.
S. Swales.
Fisheries Management, Vol 13, No 1, p 1-10, 1982. 8 Fig, 1 Tab, 22 Ref.

Descriptors: *Aquatic habitats, *Dams, *Deflection, *Fish management, Water depth, Habitats, Perry River, England, Turbulent flow, Channel improvement, Riffles, Flow velocity, Water currents.

Fish Habitat improvement structures were placed in the River Perry, a small lowland river in England, The channel had been dredged and widened on several occasions since 1900 to improve drainage conditions. In a 600 m reach two low dams (< 1 m high) and two current deflectors were installed. One deflector was put in a shallow fast-flowing area and the other in a deeper slow-flowing section. A floating plywood artificial cover was added to simulate overhanging bank vegetation and undercut banks. The dams increased water depth and reduced current velocity above the impoundment and decreased water depth and increased current velocity (maximum 80 cm per sec) downstream. Below the dams the greatly increased water turbulence scoured bed material, producing a pool and ripple pattern. Both current deflectors increased flow velocity (maximum 60 cm per sec) by narrowing the river channel, but only the one installed in the shallower, fast-flowing part of the river produced a pool-ripple pattern. The temporary covers effectively simulated natural cover but were damaged by winter floods. (Cassar-FRC)
W82-06084

HYDROACOUSTIC ASSESSMENT OF PELAGIC FISH STOCKS: A POTENTIAL NEW MANAGEMENT TOOL,
Vermont Univ., Burlington.
G. W. LaBar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-256660, Price codes: AXX in paper copy, A01 in microfiche. Report, February, 1981. 35 p, 23 Fig, 4 Tab, 2 Ref. OWRT A-037-VT(1).

Descriptors: *Sonar, *Sound waves, *Fish populations, *Remote sensing, *Trawling, Fathometers, Sounding, Water depth, Aquatic populations, Populations, Aquatic life, Fisheries, Marine environment, Technology, Commercial fishing, Fish harvest, Aquatic animals, Fish, Smelt, Biomass, Aquatic productivity, Fish management, Acoustics.

Hydroacoustic assessment, a tool for employing sonar to assess fish area populations in fisheries and the marine environment, is receiving increased attention. Studies were carried out to develop a method of analyzing echograms employing echo density and variability concepts, to compare mean echo densities on echograms with catches from a midwater trawl and to compare echograms from various Lake Champlain sites at various time periods. Specifically, a dot-grid was used for analysis of echo density on the echograms in an attempt to determine relative abundance of pelagic fish. Highest echo-densities were generally noted between 60-100 feet. While significant echo count differences were found between depths, between Lake sites, and between times, no real pattern of echo count differences emerged. Correlation coefficients relating midwater trawl smelt catch numbers to mean echo counts at trawling depth were -0.02 for large (45 ft square mouth) and 0.37 for small (16 ft square mouth) trawls. However, the relationship between echo counts and biomass is unknown. While a combination of echo sounding needed before other standard assessment techniques can be eliminated. The method developed herein, however, has been demonstrated to Vermont fish and game personnel. (Zielinski-MAXIMA)
W82-06373

A NEW METHOD FOR REPORTING AND INTERPRETING TEXTURAL COMPOSITION OF SPAWNING GRAVEL,
Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.
F. B. Lotspeich, and F. H. Everest.
Forest Service Research Note PNW-369, January 1981. 11 p, 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Gravel, *Spawning gravel, Streambeds, *Sediment sampler, *Aquatic habitats, Larval growth stage, Permeability, Pore size.

Textural composition of spawning gravel influences survival and emergence of salmonid embryos. A new method has been developed for collecting, sorting, and interpreting gravel quality. Because both sediment distribution and redd site selection by salmonids are nonrandom events, the location from which samples are drawn should be identified by an experienced fishery biologist. Samples are collected with a tri-tube freeze-core device and dry-sorted using sieves based on the Wentworth scale. An index to the quality of gravel is obtained by dividing geometric mean particle size by the sorting coefficient (a measure of the distribution of grain sizes) of a sample. The resulting number is called the 'fredle index' and is proposed as a standard for evaluating the reproductive potential of spawning gravel. The magnitude of fredle numbers is a measure of both pore size and relative permeability, both of which increase as the index number becomes larger. Permeability and pore size control movement of water and alevins through gravel. This method of calculating a quality index for stream sediments allows identification of the quality of gravel used for reproduction by salmonids. Comparisons can be made of gravel quality within and between strams, and temporal changes in texture and permeability can be monitored. The technique should be especially useful for measuring changes in gravel quality resulting from sedimentation from nonpoint sources in managed forest watersheds. (Moore-SRC)
W82-06395

TWO TECHNIQUES FOR LOCATING AND SAMPLING BROWN TROUT MICROHABITAT UNDER COMPLETE ICE COVER,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 7B.
W82-06703

ECOLOGICAL PRINCIPLES OF THE CREATION OF AN OPTIMAL WATER REGIME IN THE VOLGA DELTA AND NORTH CASPIAN SEA,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6G.
W82-06985

9. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

WATER RESOURCES RESEARCH SUPPORT PROGRAM 1981 - 1982.
Department of the Environment, Ottawa (Ontario).
1981. 12p, English and French.

Descriptors: Water resources, *Research projects, inland waters, Universities, Quality, Pollutants, Modelling, Contamination, Hydraulics, Data collections, *Canada.

The Department of the Environment, on the recommendation of the Water Resources Research Support Program Review Group, has agreed to provide a total of $250,000 for water-related environmental research during 1981-81 to the Canadian university research community. The Water Resources Research Support Program provides for innovative research relevant to departmental concerns and responsibilities for water resources research in the natural and social sciences with emphasis on water management issues. By fostering the interest of university researchers, it thereby utilizes their knowledge and expertise in solving water research problems and provides opportunities for their participation in socially relevant environmental research. Fifteen universities across Canada will share the $250,000, which will be used to support both unidisciplinary research projects and multi- or interdisciplinary programs aimed at solving regional and national water research issues. (WATDOC)
W82-06565

10. SCIENTIFIC AND TECHNICAL INFORMATION

10F. Preparation Of Reviews

FRESHWATER MACROINVERTEBRATES,
National Oceanographic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W82-06797

ELECTROPLATING AND CYANIDE WASTES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06798

STEEL INDUSTRY WASTES,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5D.
W82-06799

SYNTHETIC FUEL EFFLUENTS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 5D.
W82-06800

PETROLEUM PROCESSING WASTES,
Oklahoma State Univ., Stillwater. School of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06801

COAL AND COAL MINE DRAINAGE,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5B.
W82-06802

EFFECTS OF POLLUTION ON FRESHWATER FISH,
Environmental Research Lab. Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-06803

EFFECTS OF POLLUTION ON FRESHWATER INVERTEBRATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-06804

CHEMICALS AND ALLIED PRODUCTS,
Union Carbide Corp., South Charleston, WV.
For primary bibliographic entry see Field 5D.
W82-06805

AQUATIC SEDIMENTS,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2J.
W82-06806

MARINE AND ESTUARINE POLLUTION,
California State Univ., Long Beach.
For primary bibliographic entry see Field 5C.
W82-06808

THERMAL EFFECTS,
Rexnord Inc., Milwaukee, WI.
For primary bibliographic entry see Field 5C.
W82-06809

BIOASSAYS - PROCEDURES AND RESULTS,
Ecological Analysts, Inc., Sparks, NV.
For primary bibliographic entry see Field 5A.
W82-06810

DISSOLVED OXYGEN IN STREAMS AND RESERVOIRS,
Tennessee Valley Authority, Chattanooga.
For primary bibliographic entry see Field 5C.
W82-06811

BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5C.
W82-06812

URBAN RUNOFF AND COMBINED SEWER OVERFLOW,
Calocerinos and Spina Co., Liverpool, NY.
For primary bibliographic entry see Field 5D.
W82-06914

LAND APPLICATION OF WASTEWATER,
Montgomery (James M.), Salt Lake City, UT.
For primary bibliographic entry see Field 5E.
W82-06915

TEXTILE WASTES,
Krebs (Paul B.) and Associates, Inc., Birmingham, AL.
For primary bibliographic entry see Field 5D.
W82-06916

FERMENTATION INDUSTRY,
Notre Dame Univ., IN., DepT. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-06917

MICROBIOLOGY: METHODOLOGY AND QUALITY ASSURANCE,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W82-06919

RADIOACTIVE WASTES,
Oak Ridge National Lab., TN., Environmental Sciences Div.
For primary bibliographic entry see Field 5E.
W82-06920

DAIRY WASTES,
Kraft, Inc., Glenview, IL.
For primary bibliographic entry see Field 5D.
W82-06921

ORGANICS,
Washington Univ., Seattle. School of Public Health and Community Medicine, Department of Environmental Health.
For primary bibliographic entry see Field 5A.
W82-06922

ANAEROBIC PROCESSES,
Institute of Gas Technology, Chicago, IL.
For primary bibliographic entry see Field 5D.
W82-06923

MICROBIOLOGY: WATER,
Environmental Protection Agency, Cincinnati, OH., Drinking Water Research Division.
For primary bibliographic entry see Field 5B.
W82-06924

SUBSTRATE-ASSOCIATED MICROFAUNA,
Environmental Protection Agency Region VI, Dallas, TX.
For primary bibliographic entry see Field 5C.
W82-06925

MICROBIOLOGY: WASTEWATER TREATMENT,
Drexel Univ., Philadelphia, PA., Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W82-06926

MICROBIOLOGY: DETECTION, OCCURRENCE AND REMOVAL OF VIRUSES,
Louisiana State Univ., Baton Rouge, Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W82-06927

DISEASE OUTBREAKS CAUSED BY DRINKING WATER,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W82-06928

SOLID WASTES AND WATER QUALITY,
Envirodyne Engineers, Knoxville, TN.
For primary bibliographic entry see Field 5B.
W82-06929

SYSTEMS ANALYSIS,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5G.
W82-06997

ECONOMICS,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 5G.
W82-06998

INORGANICS,
Pope Scientific Inc., Menomonee Falls, WI.
For primary bibliographic entry see Field 5A.
W82-06999

MEAT-, FISH-, AND POULTRY-PROCESSING WASTES,
Battelle Columbus Lab., OH.
For primary bibliographic entry see Field 5D.
W82-07000

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SUBJECT INDEX

ABATE
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 5C

ABSORPTION
Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

ACCIDENTS
Components for a Treatment Plant Safety Program,
W82-06992 5G

ACCOUNTING
Crisis: Financing Water and Wastewater,
W82-06641 6C

ACCUMULATION
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 5B

ACID PRECIPITATION
Acid Precipitation, A Review,
W82-06794 5C

ACID RAIN
Acid Rain Model: Hydrologic Module,
W82-06360 5B

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 5C

ACIDITY
The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 2K

ACIDS
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 2K

ACRYLAMIDE
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

ACTINOMYCES
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 5B

ACTIVATED CARBON
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

PAC Process,
W82-06643 5D

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

ACTIVATED SLUDGE
A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 5E

Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 5D

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 5D

ACTIVATED SLUDGE PROCES
How Much Air,
W82-06638 5D

ACTIVATED SLUDGE PROCESS
Nitrogen Removal in Continuous-Flow Sequentially Aereated Activated Sludge Systems,
W82-05950 5D

A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 5D

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 5D

A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 5D

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 5D

PAC Process,
W82-06643 5D

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 5D

Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 5D

ADRIATIC SEA
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 5C

ADSOPRTION
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

ADSORPTION
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

ADVANCED WASTEWATER TREATMENT
Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 5D

AERATED LAGOONS
Design Approach to Dual-Power Aerated Lagoons,
W82-06358 5D

A Survey of Aerated Lagoon Performance,
W82-06391 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 5D

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 5G

AERATION
Solving a Poor Oxygen Transfer Problem.
W82-05952 5D

Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

Low-Cost Treatment of Wastewater,
W82-06506 5D

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 5D

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

A Model for the Design of Hypolimnetic Aerators,
W82-06610 5G

How Much Air,
W82-06638 5D

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 5C

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 5G

AERATORS
A Model for the Design of Hypolimnetic Aerators,
W82-06610 5G

AERIAL PHOTOGRAPHY
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

AEROBIC DIGESTION
Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D

AEROBIC POPULATIONS
An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 5A

AEROBIC TREATMENT
A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 5E

AEROSOLS
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

AGGRADATION
Mathematical Model for Erodible Channels,
W82-06336 2J

AGRICULTURAL CHEMICALS
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

AGRICULTURAL HYDROLOGY
Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1.
W82-06375 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 3F

AGRICULTURAL RUNOFF
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

AGRICULTURAL WATERSHEDS
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A

AGRICULTURE
China's Agro-Ecosystem,
W82-06019 3D

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 3E

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 2A

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 6F

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

AIR CIRCULATION
Major Factors in Sewer Ventilation,
W82-06462 8A

On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 2B

Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 2B

AIR ENTRAINMENT
Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 8B

AIR POLLUTION
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

AIRPORTS
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

ALABAMA
Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 2E

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 5A

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascaguoula, and Tennessee River Basins,
W82-06954 7C

ALASKA
Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 5C

ALBEDO
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 2C

ALBERTA
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 5C

ALDICARB
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

ALFALFA
Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 3F

ALGAE
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 5B

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 5C

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 5C

Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 5C

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 5C

Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 5C

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

ALGAL CONTROL
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 4A

ALGAL GROWTH
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 5C

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 5D

Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 5C

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 5C

Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 5C

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

ALGICIDES
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 5F

ALGORITHMS
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

ALLUVIAL AQUIFER
Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 7C

ALLUVIAL AQUIFERS
Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

ALLUVIAL CHANNELS
Mathematical Model for Erodible Channels,
W82-06336 2J

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

ALLUVIUM
Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

ALPINE REGIONS
Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 2E

ALTITUDE
Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 2D

AMES TEST
On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 5A

AMMONIA
Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 5D

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

ANADROMOUS FISH
Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

ANAEROBIC CONDITIONS
Biological Equilibrium in a Wastewater Reservoir,
W82-06282 5D

Anaerobic Processes,
W82-06923 5D

ANAEROBIC DIGESTION
Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 5D

Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute).
W82-06024 5D

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 5D

Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 5D

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 5D

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

ANAEROBIC LAGOONS
Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

ANIMAL WASTES
Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

ANION EXCHANGE
Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 3A

ANTECEDENT MOISTURE
Antecedent Moisture Condition Probabilities,
W82-06451 2A

APPALACHIAN REGION
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

APPLICATION EQUIPMENT
Sprinkler Leveler and Wind Compensating Device,
W82-06164 3F

APPLICATION RATES
Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 5E

AQUACULTURE
Aquaculture for Waste Management,
W82-06556 5D

AQUATIC ANIMALS
A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 2K

AQUATIC FOOD CHAINS
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

AQUATIC FUNGI
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 5B

AQUATIC HABITAT
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

AQUATIC HABITATS
Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 8I

A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 8I

Habitat Recovery in the North Fork of the Teton River.
W82-06409 6G

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

AQUATIC LIFE
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 5B

AQUATIC PLANTS
Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 2H

Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 5C

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 5C

AQUATIC PRODUCTIVITY
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

AQUATIC SOILS
Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 5C

AQUATIC WEED CONTROL
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

AQUEDUCTS
Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 8A

AQUIFER CHARACTERISTICS
Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 2F

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 2A

AQUIFER MANAGEMENT
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 4B

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

AQUIFER PROPERTIES
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 2F

AQUIFER SYSTEMS
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

AQUIFER TESTING
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

AQUIFERS
The Law of International Aquifers,
W82-05940 6E

Florida Style Water Supply and Treatment,
W82-06027 5F

Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 2F

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 7C

Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 5G

Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 2E

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 2F

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 4B

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 7C

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 2F

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 2F

Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 2F

Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 2F

AQUITARDS
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

ARCTIC ZONE
Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 2D

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 2D

AREAL HYDROGEOLOGY
Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

ARID AREAS
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 6B

ARIZONA
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

ARKANSAS
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 2K

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 7C

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

Reservoir Water Quality Sampling Design,
W82-06868 2H

AROMATIC COMPOUNDS
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

ARSENATES
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

ARSENIC
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

ARTESIAN CAPACITY
Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 2F

ARTIFICIAL RECHARGE
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

ASBESTOS
Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F

ASSAY
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

ATLANTIC OUTER-CONTINENTAL SHELF
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Explora-

tory Well–Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

ATMOSPHERE
Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

ATMOSPHERIC WATER
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

ATOMIC ABSORPTION SPECTROMETRY
Liquid-Liquid Extraction Combined with Atomic-Absorptoin Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 5A

ATRAZINE
Herbicides in Kansas Waters–Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

AUSTRALIA
Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 2J

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

AUSTRIA
The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 8E

AUTOMATIC SAMPLING
Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 5A

AUTOMATION
Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F

AVAILABLE WATER
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

BACKWASH
The Effect of Backwashing Rate on Filter Performance,
W82-06415 5F

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

BACTERIA
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 5F

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 5B

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 5B

Bacteria Solve Problems Created by Prisoners,
W82-06505 5D

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

Sludge Disposal to Sea in France,
W82-06593 5E

Dynamics of Biofilm Processes: Methods,
W82-06666 5D

Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 5A

Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 5B

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 5C

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 5A

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 5D

Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 5A

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 5A

Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 5F

Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 5C

Microbiological Examination of Sebeel Water,
W82-06882 5C

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 5A

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 5B

Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 5A

Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 5C

BACTERIAL ANALYSIS
Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 5C

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 5A

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

A Water Quality Index for Lake Beaches,
W82-06660 5G

Microbiology: Methodology and Quality Assurance,
W82-06919 5A

BACTERIAL ENUMERATION
Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 5A

BACTERIAL POPULATIONS
Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

Bacteria Under the Ice,
W82-06561 5A

BACTERIAL STUDY
An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 5A

BANK EROSION
Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

BARLEY
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

BASELINE STUDIES
Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 5C

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

BASIN IRRIGATION
Limits for Practical Level-Basin Design,
W82-06452 3F

BASINS
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 2E

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 7C

BATHYMETRY
Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 2H

BAY OF FUNDY
Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 2K

BAYER 73
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 5A

BAYS
Tragedy of the San Francisco Bay Commons,
W82-06182 6E

BEACH EROSION
The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 2J

BED SEDIMENT
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 2J

BELGIUM
Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 5G

BENEFICIAL USE
Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 6B

BENEFITS
Doubts Remain About Bura Economics,
W82-06816 3F

BENTHIC ENVIRONMENT
A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 5C

BENTHIC FAUNA
Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 5C

Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 5C

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

BENTHIC FLORA
Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 5C

BENTHOS
Secondary Benthic Production in a Tropical Island Stream,
W82-06933 5C

BENZOTHIAZOLES
A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 5C

BIOACCULULATION
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 5C

BIOACCUMULATION
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

BIOASSAY
A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 5A

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 5A

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

BIOASSAYS
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

Bioassays - Procedures and Results,
W82-06810 5A

BIOASSY
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

BIOCHEMICAL OXYGEN DEMAND
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 5C

Comparison of BOD Relationships for Typical Edible and Petroleum Oils,
W82-06458 5D

BIOCHEMICAL TESTS
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

BIOFILMS
Dynamics of Biofilm Processes: Methods,
W82-06666 5D

BIOGEOCHEMISTRY
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

BIOINDICATORS
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 5C

A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 5B

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 5A

Microbiology: Water,
W82-06924 5B

BIOLOGICAL ACTIVATED FILTRATION
Advanced Water Treatment for Color and Organics Removal,
W82-06279 5F

BIOLOGICAL OXIDATION
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

BIOLOGICAL OXYGEN DEMAND
Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Des Siebzieger Jahren),
W82-06469 5D

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Untersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

BIOLOGICAL SAMPLES
Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 7C

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 6G

BIOLOGICAL TREATMENT
High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 5D

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

Simplified Clarifier Axes Treatment Stages,
W82-06820 5D

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

BIOLOGICAL WASTEWATER TREATMENT
Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 5D

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 5D

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 5D

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 5D

BIOMASS
A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Sampling Characteristics of Macrophyte Biomass,
W82-06779 5A

BIOTRANSFORMATION
Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 5B

BLACK CANYON
Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

BLACK EARTH CREEK
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

BLEACHING WASTES
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

BLOOMINGTON DAM
Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

BOATING
The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 5C

BOG LAKES
UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

BOGS
Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 2G

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

BOILER WATER
Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 3A

BOISE RIVER
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

BOREHOLES
Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

BOTTOM OUTLETS
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 8B

Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 8B

BOTTOM SAMPLING
The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

BOTTOM SEDIMENT
Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 5B

BOUNDARIES
The Moving Interface Problem with Finite Elements,
W82-06546 2L

BOUNDARY LAYERS
Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 8B

BRACKISH WATER
The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 5C

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

BRAZOS RIVER
Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
W82-06404 6G

BREAKWATERS
Canadian Wave Climate Study: Organization and Operation,
W82-06393 8B

BRIDGE DESIGN
Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 8A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 8B

BRIDGES
Devon Floods and the Waterways of Bridges,
W82-05948 8A

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 4A

BRIISH COLUMBIA
Potential Evaporation in the Peace Region of British Columbia,
W82-06528 2D

BRINE WASTES
Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

BRITISH COLUMBIA
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 2C

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 5B

BUBBLE DIFFUSERS
New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

BUBBLES
Domes, Bubbles, and Paper Waste,
W82-06025 5D

BUFFER CAPACITY
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 5B

CABLEGATION
Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 3F

CADMIUM
Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 5C

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 5C

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 5B

CALCIUM
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

CALCIUM CARBONATE PREVENTION
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 3A

CALCIUM HYDROXIDE
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 5D

CALCIUM SULFATE
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

CALIBRATIONS
Calibrating A Mountain Watershed in Wyoming,
W82-06583 2E

CALIFORNIA
Solving a Poor Oxygen Transfer Problem.
W82-05952 5D

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 7A

Environmental Problems and Geothermal Permitting,
W82-06217 6G

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 4A

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

CAMP SITES
Carrying Capacity for the Illinois River,
W82-05927 6G

CANADA
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 2K

Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 2J

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

Water Resources Research Support Program 1981 - 1982.
W82-06565 9D

The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 7C

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

CANAL DESIGN
Canals in Sand Channels,
W82-06196 8B

CANAL EMBANKMENTS
Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

CANAL LININGS
Canal Tunnel Repair Options.
W82-06758 8A

CANAL SEEPAGE
Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 7B

CANALS
Assesment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 5A

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

CANOPY
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 2I

CARBAMATE PESTICIDES
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

CARBON
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

CARBON DIOXIDE
Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 5D

A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 5C

Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 5D

CARBONATES
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

CARCINOGENS
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 5A

CARRYING CAPACITY
Carrying Capacity for the Illinois River,
W82-05927 6G

Carrying Capacity of Flood Plains,
W82-06428 2E

CATCHMENT AREAS
New Problems with Upland Waters,
W82-06602 5G

The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 5G

CATCHMENT BASINS
Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

CATFISH
Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 5C

Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 5C

CAVES
Cave Water--Java's Hidden Resource,
W82-06605 3B

CAVITATION
Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen).
W82-06237 8B

CAYUGA LAKE
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

CELLULOSE ACETATE
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

CELLULOSE ACETATE MEMBRANES
The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 3A

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 5D

CESIUM-137
Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

CESIUM RADIOISOTOPES
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

CHANNEL EROSION
Mathematical Model for Erodible Channels,
W82-06336 2J

CHANNEL FLOW
Canals in Sand Channels,
W82-06196 8B

Accuracy Criteria in Diffusion Routing,
W82-06423 8B

Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 8B

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 8B

CHANNEL IMPROVEMENT
Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 6G

CHANNEL MORPHOLOGY
Canals in Sand Channels,
W82-06196 8B

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

CHANNEL SCOUR
Devon Floods and the Waterways of Bridges,
W82-05948 8A

CHANNEL STABILITY
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

CHANNELING
Habitat Recovery in the North Fork of the Teton River.
W82-06409 6G

CHELATION
Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

CHEMICAL ANALYSIS
The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 2F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 2K

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 5A

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 5A

CHEMICAL COMPOSITION
Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 2K

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

CHEMICAL COMPOUNDS
Implications for the Water Industry of the Notification Scheme for New Chemicals,
W82-06261 6E

CHEMICAL INDUSTRY
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

CHEMICAL INTERFERENCE
Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 5C

CHEMICAL OXYGEN DEMAND
Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

Applicability of Light Absorbance as a Measure of Organic Carbon in Humic Lake Water,
W82-06773 5A

CHEMICAL PRECIPITATION
Beneficial Disposal of Pickle Liquor,
W82-06486 5D

Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

CHEMICAL REACTIONS
Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

CHEMICAL STRATIFICATION
Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 2K

CHEMICAL TREATMENT
Waste Treatment System Retrofitted Within Deadline,
W82-05947 5D

CHEMICAL WASTES
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 5E

Oxidation Products and Rates of Reaction in the Ozonolysis of Diebenzofuran,
W82-06305 5B

Hazardous Material Spills--Are You Ready,
W82-06417 5G

CHEMICAL WASTEWATER
Chemicals and Allied Products,
W82-06805 5D

CHEMISTRY OF PRECIPITATION
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 2K

CHINA
China's Agro-Ecosystem,
W82-06019 3B

CHLORELLA
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 5B

CHLORIDE
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

CHLORIDES
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

CHLORINATED HYDROCARBONS
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 5A

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

CHLORINATIION
A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Streptococci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 5D

CHLORINATION
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 5F

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

Performance of Modified Chlorine Contact Chamber,
W82-06359 5D

Making Chlorination Trustworthy,
W82-06639 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 5F

CHLORINE
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

Performance of Modified Chlorine Contact Chamber,
W82-06359 5D

Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 5F

CHLOROPHENOLS
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

CHLOROPHYLL
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 5C

CHOLESTEROL
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B

CHROMATOGRAPHY
Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 5A

Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 5A

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

CHROMIUM
Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 5D

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 5D

CIVIL LAW
United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 6E

CLADOPHORA
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 5C

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

CLARIFICATION
Simplified Clarifier Axes Treatment Stages,
W82-06820 5D

CLASSIFICATION
Lower Flow Regime Bedforms: Rational Classification,
W82-06421 2E

CLAYS
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

CLEAR-CUTTING
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 4C

CLIMATES
A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 2B

CLIMATIC DATA
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 2D

CLIMATIC ZONES
A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 2B

CLIMATOLOGY
Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 6B

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-C6838 2B

CLOSED-CONDUIT FLOW
Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 8B

CLOUD PHYSICS
Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 2B

CLOUD SEEDING
Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 6G

CO-DISPOSAL
A Look at Co-Disposal,
W82-06354 5E

COAGULATION
Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 5D

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 5D

COAGULATION *WASTEWATER TREATMENT
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 5D

COAL
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 6D

Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

COAL GASIFICATION
Synthetic Fuel Effluents,
W82-06800 5D

COAL MINES
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

COAL MINING
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 2F

Coal and Coal Mine Drainage,
W82-06802 5B

COALESCENCE
The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 2B

COASTAL LAKE MARSHES
A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

COASTAL PLAINS
Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 2J

COASTAL WATERS
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 5C

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 2L

Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 5B

COATINGS
Advanced Coatings for the Water Industry.
W82-06603 8G

COLIFORMS
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 5D

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

A Water Quality Index for Lake Beaches,
W82-06660 5G

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

COLIPHAGE
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

COLLOIDS
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

COLORADO
Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 3F

Packaged Plant Treats Turbidity,
W82-06026 5F

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 5C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 7C

San Juan River Basin,
W82-06144 7C

Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 5G

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 4C

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

COLORADO RIVER
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

COLORADO RIVER BASIN
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 6G

COLORIMETRY
Design and Operation of a Colorimetric Detector Controller,
W82-06656 5A

COMBINED SEWER OVERFLOWS
Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 5G

Detroit-Style CSO Studies,
W82-06247 5G

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 5C

Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

COMBINED SEWERS
An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 5G

Decontamination of Overland Runoff from Populated Areas,
W82-06980 5D

COMBINED WASTEWATER
A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 5D

COMMUNITY DEVELOPMENT
Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 5B

Urban Creekside Design Features Parallel Streets,
W82-06184 4C

COMPACTED SOILS
Furrow Intake Rates and Water Management,
W82-05968 3F

COMPETING USE
Truckee Meadows Water Use - Present and Future,
W82-06705 3D

COMPOSTING
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 5E

COMPRESSIBLE FLOW
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

COMPUTER MODELS
Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 2E

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 2G

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 2H

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 5G

COMPUTER PROGRAMS
Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 2H

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 5D

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 4A

Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 5F

COMPUTERS
Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 5D

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

Computer-Guided Linear Irrigator Marches on,
W82-06817 3F

CONCRETE
World's First All-Rollcrete Dam,
W82-05999 8F

CONCRETE ADDITIVES
Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 8F

CONCRETE CONSTRUCTION
Water Tanks in Reinforced Concrete,
W82-06604 8F

CONCRETE MIXES
Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 8F

CONCRETE TECHNOLOGY
Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 8F

CONDENSATION
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 2K

On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 2B

CONDENSERS
Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

CONDUCTANCE
Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 5B

CONFINED AQUIFERS
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

CONNECTICUT
Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 2H

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

CONNECTICUT RIVER
A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 2L

CONSERVATION
Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 6D

CONSTRUCTION
Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

CONSTRUCTION COSTS
A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 5E

CONSTRUCTION MATERIALS
World's First All-Rollcrete Dam,
W82-05999 8F

CONSUMPTIVE USE
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

CONTAMINATION
Hazardous Material Spills--Are You Ready,
W82-06417 5G

CONTROL SYSTEMS
Simulating and Improving Hydro Plant Control,
W82-06202 8C

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflusssteuerung von Regenwasserbehandlungsanlagen),
W82-06633 8C

Making Chlorination Trustworthy,
W82-06639 5F

CONVECTION
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

COOLING PONDS
Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 5C

COOLING TOWERS
Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 3E

Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 5F

COOLING WATER
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 6G

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 5D

COPEPODS
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

COPPER
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 5B

Liquid-Liquid Extraction Combined with Atomic-Absorptpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 5A

Heavy Metals in Sludge–Are Their Toxic Effects Additive,
W82-06646 5E

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

CORES
The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

CORN
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

CORRELATION ANALYSIS
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

CORROSION
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 5C

CORROSION CONTROL
Advanced Coatings for the Water Industry,
W82-06603 8G

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

COST ALLOCATION
A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 5D

Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 6C

Cost Allocation in Water Resources Development,
W82-06854 6C

COST ANALYSIS
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 6B

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 5F

A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 3A

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

Statistical Cost Function for Water Mains,
W82-06252 6C

Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

Management of Watershed Rehabilitation– Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

COST-BASED WATER RATES
Cost-Based Water Rate Design,
W82-06277 6C

COST-BENEFIT ANALYSIS
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Economics,
W82-06998 5G

COST COMPARISONS
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

COSTS
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 6C

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

COTTON
The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 3F

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

CRABS
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 5D

CREST GAGES
The V-Shaped Broad-Crested Weir,
W82-06450 8B

CROP YIELD
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 3F

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F

CULTURING TECHNIQUES
Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 3C

CURRENTS
Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

CYANIDE
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A

Electroplating and Cyanide Wastes,
W82-06798 5D

CYANURIC ACID
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 5F

CYCLING NUTRIENTS
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

DAIRY INDUSTRY
Dairy Wastes,
W82-06921 5D

DAM CONSTRUCTION
Design Technique Development for Dams in South Africa,
W82-06011 8A

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 8D

The Kielder Headworks,
W82-06504 8A

Brantas Dams Trigger New Javanese Development,
W82-06818 3F

DAM DESIGN

Planning Sri Lanka's Victoria Scheme,
W82-05979 8A

Design Technique Development for Dams in South Africa,
W82-06011 8A

The Value of Inspection Galleries,
W82-06204 8D

The Itaipu Hollow Gravity Dam,
W82-06205 8A

The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 8A

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

DAM EFFECTS

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

DAM FAILURE

Safety Aspects in the Design and Inspection of Dams,
W82-06203 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 8A

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 8B

Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 8B

DAMS

World's First All-Rollcrete Dam,
W82-05999 8F

Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 8I

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 2J

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 8A

Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen).
W82-06237 8B

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 8D

Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 8G

Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

DAMS *FLOOD CONTROL

Olmos Dam Modification.
W82-06186 8A

DARCY'S EQUATION

Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 2G

DATA ANALYSIS

Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 2C

DATA COLLECTIONS

Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 2A

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 7A

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 7C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 7C

Implications for the Water Industry of the Notification Scheme for New Chemicals,
W82-06261 6E

Canadian Wave Climate Study: Organization and Operation,
W82-06393 8B

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 7C

A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 7C

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 5B

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

DATA PROCESSING

Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 2H

Microprocessors and Computers in Analysis in the Water Industry,
W82-06259 5F

DATA STORAGE AND RETRIEVAL

Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 2H

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

The Practical Handling of Water Quality Monitoring Data,
W82-06591 7C

DATA TRANSMISSION

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 7B

DECISION MAKING

Incentives and Institutions for Water Conservation,
W82-05922 3D

Development of an Environmental Geology Data Base for Land Use Planning,
W82-06352 6A

Power Plant Siting,
W82-06555 6G

DECOMPOSING ORGANIC MATTER

Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 5C

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

DECOMPOSITION

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 5C

DEFICIT IRRIGATION

Designing for Deficit Irrigation,
W82-06334 3F

DEFLECTION

Notes on the Construction, Installation and Environmental Effects of Habitat Improvement

Structures in a Small Lowland River in Shropshire,
W82-06084 8I

DEFLUORIDATION
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

DEGRADATION
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 2L

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

DELTAS
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 2J

Sediment Transport Study Along a Delta Shoreline,
W82-06553 2J

DENITRIFICATION
Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 5D

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 5D

DENMARK
Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 5C

DEOXYRIBONUCLEIC ACID
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 5A

DEPRECIATION
Crisis: Financing Water and Wastewater,
W82-06641 6C

DESALINATION
Desalination Directory 1981.
W82-05908 3A

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 3A

Work Potential: An Objective Basis for the Comparison of Desalination Processes,
W82-05977 3A

Analysis of Large Desalination Plants,
W82-06122 3A

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

DESALINATION APPARATUS
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 3A

Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 3A

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

DESALINATION EQUIPMENT
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 3A

Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 3A

DESALINATION PLANTS
Freezing Processes - The Standard of the Future - An Update,
W82-06115 3A

A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 3A

Analysis of Large Desalination Plants,
W82-06122 3A

MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 3A

Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 3A

Salbukh Reverse Osmosis Plant on Stream,
W82-06127 3A

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

DESALINATION PROCESSES
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 3A

Myths about Freeze Desalting,
W82-06114 3A

Analysis of Large Desalination Plants,
W82-06122 3A

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 3A

Apparatus for Desalinating Water,
W82-06711 3A

DESALINATION WASTES
Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

DESIGN CRITERIA
Designing and Excavating Underground Powerplants,
W82-05982 8E

Design Technique Development for Dams in South Africa,
W82-06011 8A

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 5G

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

Safety Aspects in the Design and Inspection of Dams,
W82-06203 8A

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 8A

Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen),
W82-06237 8B

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 8B

Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 8G

Design of Heat Pump Return Wells,
W82-06294 8C

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 5D

Variable Frequency Drives - Some Application Principles,
W82-06345 8C

Selection of a Sludge Handling Disposal System,
W82-06346 5E

Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 5D

Rotating Biological Contactor System Design,
W82-06355 5D

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 5D

Canadian Wave Climate Study: Organization and Operation,
W82-06393 8B

Pump Sump Design Experience: Summary,
W82-06419 8C

The Landscape of Rutland Water,
W82-06478 6G

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 5D

A Model for the Design of Hypolimnetic Aerators,
W82-06610 5G

Design and Operation of a Colorimetric Detector Controller,
W82-06656 5A

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

DESTRATIFICATIION
Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 5G

DESTRATIFICATION
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 5C

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 5G

DETECTION LIMITS
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

DETENTION RESERVOIRS
Regional Detention Basins for Stormwater Control,
W82-06225 8A

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 5G

DETERGENTS
Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 5D

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

DETERMINISTIC MODELS
Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

DETROIT
Detroit-Style CSO Studies,
W82-06247 5G

DEVELOPING COUNTRIES
They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 5F

On-Site Wastewater Management--Recent Trends,
W82-06439 5D

Cave Water--Java's Hidden Resource,
W82-06605 3B

Zimbabwean Hand Pump Passes Village-Level Endurance Tests.
W82-06606 8C

Doubts Remain About Bura Economics,
W82-06816 3F

Brantas Dams Trigger New Javanese Development,
W82-06818 3F

DEW
The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 2K

DEWATERING
Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

DIATOMACEOUS EARTH
Getting Your Money's Worth from Filtration,
W82-06412 5F

DIATOMS
Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 5C

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 5C

DIBENZOFURAN
Oxidation Products and Rates of Reaction in the Ozonolysis of Diebenzofuran,
W82-06305 5B

DIEL RHYTHM
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 5C

DIFFUSION COEFFICENT
Dilution Analysis for Unidirectional Diffusers,
W82-06420 8B

DIFFUSION MODEL
Accuracy Criteria in Diffusion Routing,
W82-06423 8B

DIGESTED SLUDGE
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 5D

DIGITAL COMPUTERS
Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

DIMENSIONAL ANALYSIS
Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 2F

DIRECT FILTRATION
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 5F

Low-Dosage High-Rate Direct Filtration,
W82-06416 5F

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F

DISCHARGE MEASUREMENT
The V-Shaped Broad-Crested Weir,
W82-06450 8B

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 8B

DISINFECTION
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

Drinking Water Disinfection,
W82-06341 5F

Performance of Modified Chlorine Contact Chamber,
W82-06359 5D

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 5D

Ultraviolet Systems in Water Treatment,
W82-06726 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 5F

DISPERSION
Dispersion in Mountainous Natural Streams,
W82-06357 2E

DISRIBUTION GRAPHS
Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 2A

DISSOLVED AIR FLOTATION
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 5F

DISSOLVED OXYGEN
The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 5C

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 2H

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 5C

DISSOLVED SOILDS
Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

DISTILLATION
Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 3A

DISTILLERY WASTES
Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 5D

DISTRIBUTION PATTERNS
A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 2E

DISTRICT OF COLUMBIA
Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 6B

DIURNAL CHANGES
Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

DIURNAL VARIATIONS
Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 5A

DIVERSION
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 2H

DIVERSION DITCHES
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

DNA
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 5A

DOUGLAS FIR TREES
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

DRAINAGE
Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

DRAINAGE DENSITY
The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 2E

DRAINAGE EFFECTS
Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 2I

Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 4C

DRAINAGE ENGINEERING
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 8A

DRAINAGE SYSTEMS
Regional Detention Basins for Stormwater Control,
W82-06225 8A

The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
W82-06449 8A

DRAWDOWN
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

DREDGING
Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 6G

Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 5E

DRILLERS LOGS
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

DRINKING WATER
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 5F

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 5F

Advanced Water Treatment for Color and Organics Removal,
W82-06279 5F

Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 5F

Drinking Water Disinfection,
W82-06341 5F

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 5F

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 5A

Effects on Global Supplies of Freshwater,
W82-06733 5C

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

Microbiological Examination of Sebeel Water,
W82-06882 5C

Disease Outbreaks Caused by Drinking Water,
W82-06928 5C

DROUGHT
Water Conservation Incentives and Strategy,
W82-05906 3D

The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 2B

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines,
W82-06365 6D

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 2A

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 5C

DROUGHT CONTINGENCY PLANS
Water Conservation Incentives and Strategy,
W82-05906 3D

DUCKWEED
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

DUNBAR RIVER
Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

DYE INDUSTRY WASTES
Echolt--Past, Present and Future,
W82-06653 5D

DYES
Textile Wastes,
W82-06916 5D

EARTH DAMS
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

EARTHQUAKES
Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 8E

ECOLOGY
The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 2L

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

ECONOMIC ANALYSIS
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

ECONOMIC ASPECTS
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

Incentives and Institutions for Water Conservation,
W82-05922 3D

The Energy Resources of Kenya,
W82-05978 6D

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

Sludge Tankering Economics - A Fresh Approach,
W82-06076 5E

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 6B

Rutland Water - From Conception to Operation,
W82-06481 6D

Introduction - Rutland Water 1970-1981,
W82-06482 6B

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

Doubts Remain About Bura Economics,
W82-06816 3F

Economics,
W82-06998 5G

ECONOMIC EVALUATION
Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

ECONOMIC IMPACT
Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 5F

Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 5G

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06136 6A

ECONOMICS
Water Conservation Incentives and Strategy,
W82-05906 3D

ECOSYSTEMS
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 5C

EFFLUENT CHARGES
How Equitable Are Effluent Charges,
W82-06074 6C

EFFLUENT LIMITATIONS
How Equitable Are Effluent Charges,
W82-06074 6C

EFFLUENT STANDARDS
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 5G

EFFLUENTS
Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 5C

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

EGYPT
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

ELBE RIVER
Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 5C

ELECTRIC CURRENTS
Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 5F

ELECTRIC POWER PRODUCTION
Wastewater Treatment at an Electrical Generation Station,
W82-05975 5D

Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

ELECTRIC POWERPLANTS
Waste Treatment System Retrofitted Within Deadline,
W82-05947 5D

Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

ELECTRICAL GROUNDING
Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 5F

ELECTRO-COAGULATION
Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 5D

ELECTRO-OSMOSIS
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

ELECTRODIALYSIS
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 3A

ELECTROLYSIS
The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 5D

ELECTRON MICROSCOPY
Applicaton of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F

ELECTROPHORESIS
Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

ELECTROPLATING
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

Electroplating and Cyanide Wastes,
W82-06798 5D

ELODEA
Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F

ELUTION
Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 5A

EMBANKMENTS
The Kielder Headworks,
W82-06504 8A

EMBRYONIC GROWTH STAGE
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 5C

ENERGY
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

Work Potential: An Objective Basis for the Comparison of Desalination Processes,
W82-05977 3A

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 3E

Potential Evaporation in the Peace Region of British Columbia,
W82-06528 2D

Allocation of Water for Resource Development,
W82-06839 6D

ENERGY CONSERVATION
Energy Conservation in Municipal Wastewater Plants,
W82-06070 5D

ENERGY CONVERSION
Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute).
W82-06024 5D

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 5C

ENERGY DISSIPATION
Sediment Transport and Unit Stream Power Function,
W82-06424 2J

The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 8A

ENGLAND
Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 5B

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 5B

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

The Kielder Transfer Works,
W82-06502 8A

The Kielder Water Scheme,
W82-06503 8A

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

Out of Sight--Out of Mind.
W82-06713 8A

Canal Tunnel Repair Options.
W82-06758 8A

Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 8A

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 5C

ENTERIC BACTERIA
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

ENTEROBACTER
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 5A

ENTEROVIRUSES
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

ENVIRONMENTAL EFFECTS
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

Incentives and Institutions for Water Conservation,
W82-05922 3D

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

China's Agro-Ecosystem,
W82-06019 3B

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 6G

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 2L

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 5C

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas,
W82-06404 6G

Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 6G

Habitat Recovery in the North Fork of the Teton River.
W82-06409 6G

Reregulation on an International River--A Case Study,
W82-06429 6G

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 5A

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 5B

Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

Freshwater Macroinvertebrates,
W82-06797 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 6G

ENVIRONMENTAL IMPACT STATEMENT
Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 6G

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 6G

ENVIRONMENTAL PROTECTION
United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 6E

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 6B

ENVIRONMENTAL PROTECTION AGENCY
New Directions in Water Pollution Control,
W82-06071 5G

EPIDEMIOLOGY
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

EROSION
Splash Erosion Modeling: Physical Analysis,
W82-05970 2J

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 2J

Erosion and Sediment,
W82-06554 2J

The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 8E

EROSION CONTROL
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Erosion Control at a Delicate Highway Construction Site,
W82-06510 4D

Subsurface Drainage Effects on Erosion,
W82-06795 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

EROSION RATES
Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

ERRORS
Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 8G

ESCHERICHIA COLI
Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 5C

ESTIMATED COSTS
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

ESTIMATING
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 4A

ESTIMATING EQUATIONS
On the Relationship Between Kriging and State Estimation,
W82-06323 7C

ESTIMATION
Robust Flood Frequency Models,
W82-06319 2E

ESTUARIES
Retention of Riverine Iron in Estuaries,
W82-06191 5B

Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 5C

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 5A

York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 5C

ESTUARINE ENVIRONMENT
Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 2J

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 5A

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 5B

Marine and Estuarine Pollution,
W82-06808 5C

Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 5C

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 5A

ESTUARY
The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 5B

EUPHOTIC ZONE
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

EUTROPHIC LAKES
Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

EUTROPHICATION
Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 5C

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 5C

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 5C

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 5C

The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 7C

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

Physical Process and Eutrophication,
W82-06875 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 5C

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 5C

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 5C

EUTROPHIED LAKES
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 5F

EUTROPIC LAKES
Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 5C

EVALUATION
Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

EVAPORATION
Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 2D
Potential Evaporation in the Peace Region of British Columbia,
W82-06528 2D
Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 2D

EVAPORATION PANS
An Automated Recording System for Evaporation Pans,
W82-06780 2D

EVAPORATION RATE
Liquid Level Interferometer,
W82-05929 7B
Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 2D

EVAPORATOR-CONDENSERS (HORIZONTAL)
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 3A

EVAPORATORS
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 3A
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 3A
Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 3A
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 3A

EVAPOTRANSPIRATION
Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 2G
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

EXCAVATION
Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 8E

FALLOUT
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

FARM MANAGEMENT
Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

FATE OF POLLUTANTS
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D
Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D
Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B
Selection of Waste disposal sites,
W82-06550 5E
Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 5B
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B
Aquatic Sediments,
W82-06806 2J
Organics,
W82-06922 5A

FEDERAL JURISDICTION
Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 6E
United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 6E

FEDERAL REPUBLIC OF GERMANY
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A
Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 5E
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 5B

FEEDLOT WASTES
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

FEEDS
Potato and Corn By-Products Used as Cattle Feed,
W82-06488 5E
Feed from Sewage: Prospects and Constraints,
W82-06489 5E

FERMENTATION
Fermentation Industry,
W82-06917 5D

FILM COEFFICIENTS
Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 3A

FILTER MEDIA
Getting Your Money's Worth from Filtration,
W82-06412 5F
Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 5F

FILTERS
Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 5F

FILTRATION
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D
Advanced Water Treatment for Color and Organics Removal,
W82-06279 5F
Getting Your Money's Worth from Filtration,
W82-06412 5F
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 5F
The Effect of Backwashing Rate on Filter Performance,
W82-06415 5F
Low-Dosage High-Rate Direct Filtration,
W82-06416 5F
Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 5F
Membrane Separation Processes,
W82-06445 5D
Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F
Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 5D
Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 5A

FINANCIAL ASPECTS
Operating Collection Systems Under Fiscal Stress,
W82-06340 5D

FINANCING
Water Supply and Distribution in Larger Communities,
W82-06413 5F
Crisis: Financing Water and Wastewater,
W82-06641 6C

FINITE DIFFERENCE METHODS
A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 2G

FINITE ELEMENT METHOD
The Moving Interface Problem with Finite Elements,
W82-06546 2L

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 2G

Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 2J

Finite Element Approximations to Flow Problems,
W82-06730 8B

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

FINITE ELEMENT MODELS
Finite Element Modeling of Streamflow Routing,
W82-05918 2E

FIRES
Fire and Geomorphic Processes,
W82-06963 2J

FISH
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

Environmental Improvement at Port Alice, B. C.,
W82-06515 5C

Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 5A

Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

Effects of Pollution on Freshwater Fish,
W82-06803 5C

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem),
W82-06913 5C

FISH MANAGEMENT
Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 8I

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

FISH MIGRATION
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

FISH POPULATIONS
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

An Investigation of Some Factors Influencing the Performance of a Recreational Trout Fishery,
W82-06329 6D

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 8I

Further Observations on the Effect of Abate on Fish Catches,
W82-06722 5C

Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

FISH TOXINS
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 5C

FLASH DISTILLATION
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

FLASH EVAPORATION
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

FLOCCULATION
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

Metal Removal 'A La Carte',
W82-06608 5F

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

FLOOD CONTROL
Urban Creekside Design Features Parallel Streets,
W82-06184 4C

FLOOD DAMAGE
Devon Floods and the Waterways of Bridges,
W82-05948 8A

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 2E

Habitat Recovery in the North Fork of the Teton River,
W82-06409 6G

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 8A

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 2E

FLOOD DATA
Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 7C

FLOOD DISCHARGE
Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 2E

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 4A

FLOOD FLOW
Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 4A

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 8B

FLOOD FORECASTING
An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 2A

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 2E

FLOOD FREQUENCY
Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 2A

Statistical Flood Flow Estimation,
W82-05945 2E

An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 2A

Robust Flood Frequency Models,
W82-06319 2E

FLOOD PEAK
Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 2E

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

FLOOD PEAKS
Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 2A

FLOOD PLAIN MANAGEMENT
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 6F

FLOOD PLAIN ZONING
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

FLOOD PLAINS
Carrying Capacity of Flood Plains,
W82-06428 2E

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 2E

FLOOD PROFILES
Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 8B

FLOOD PROTECTION
Official and Folk Flood Warning Systems: An Assessment,
W82-06077 6F

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 8B

FLOOD RECURRENCE INTERVAL
Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 4A

FLOOD ROUTING
Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 4A

Accuracy Criteria in Diffusion Routing,
W82-06423 8B

Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 4A

FLOODING
Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

FLOODS
Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 2E

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 2E

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 2E

Robust Flood Frequency Models,
W82-06319 2E

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 6F

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 7C

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 4A

FLORIDA
Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 5D

Florida Style Water Supply and Treatment,
W82-06027 5F

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 7C

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 2A

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 2B

Work Management Standards,
W82-06349 6F

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 5B

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 5A

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 5C

Stormwater Management in a Sensitive Area,
W82-06841 5G

Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 5B

Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 7B

Water Resources Data for Florida, Water Year 1980–Volume 2A. South Florida Surface Water,
W82-06955 7C

Water Resources Data for Florida, Water Year 1980–Volume 2B. South Florida Ground Water,
W82-06956 7C

FLOTATION
Wastewater Reuse Using Microgas Dispersion Stripping,
W82-05911 5D

Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 5F

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

FLOW
Finite Element Approximations to Flow Problems,
W82-06730 8B

FLOW AROUND OBJECTS
Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 8B

FLOW CHANNELS
Lower Flow Regime Bedforms: Rational Classification,
W82-06421 2E

Carrying Capacity of Flood Plains,
W82-06428 2E

FLOW CHARACTERISTICS
A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 2E

Canals in Sand Channels,
W82-06196 8B

Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 8B

Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 8B

Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 8B

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 4A

FLOW DEFLECTORS
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

FLOW DISCHARGE
Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 3F

FLOW FRICTION
Lag Time for Diverging Overland Flow,
W82-05944 2A

Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 8B

FLOW PATTERN
Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 5C

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 8B

FLOW RATES
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

FLOW REGULATION
The Kielder Water Scheme,
W82-06503 8A

FLOW SEPARATION
Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 8B

FLOW VELOCITY
Canals in Sand Channels,
W82-06196 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 8B

Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 8B

FLUID DROPS
On the Graphical Presentation of Raindrop Size Data,
W82-06529 2B

The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 2B

FLUID FLOW
Finite Element Approximations to Flow Problems,
W82-06730 8B

FLUID MECHANICS
Numerical Methods in Hydraulics,
W82-06614 8B

FLUIDIZED BED PROCESS
Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 5D

FLUIDIZED BEDS
Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 5D

The Effect of Backwashing Rate on Filter Performance,
W82-06415 5F

FLUMES
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 8B

FLUORESCENCE
Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

FLUORIDES
Settling Characteristics of Flocculent S[illegible]sion in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 2K

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

FLUOROMETRY
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 5A

FLUTED TUBES
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 3A

FLUVIAL SEDIMENTS
Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 2J

FOAM FLOTATION
Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

FOAM SEPARATION
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

FOG
The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 2K

FOOD-PROCESSING INDUSTRY
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

FOOD-PROCESSING WASTES
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 5D

Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 5D

Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 5D

Potato and Corn By-Products Used as Cattle Feed,
W82-06488 5E

Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 3C

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

Dairy Wastes,
W82-06921 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 5D

FOREBAYS
Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

FORECASTING
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 2B

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 2H

FOREST MANAGEMENT
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

FOREST SOILS
Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 2G

FOREST WATERSHEDS
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 4C

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 5C

FORESTRY
New Problems with Upland Waters,
W82-06602 5G

FORESTS
Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 2K

FOULING
Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 3A

Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

FRACTURE PERMEABILITY
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

FRACTURE TRACES
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

FRACTURE ZONES
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

FRACTURED POROUS MEDIA
An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

FRANCE
The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 5G

Sludge Disposal to Sea in France,
W82-06593 5E

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 5D

FRASER RIVER ESTUARY
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

FREEZE DESALTING
Myths about Freeze Desalting,
W82-06114 3A

Freezing Processes - The Standard of the Future - An Update,
W82-06115 3A

FREEZING
The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 2C

Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 3A

FREQUENCY ANALYSIS
Carrying Capacity for the Illinois River,
W82-05927 6G

Statistical Flood Flow Estimation,
W82-05945 2E

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 2E

FREQUENCY DISTRIBUTION
Statistical Flood Flow Estimation,
W82-05945 2E

FRICTION
Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 2E

FROST
The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 2K

FRUIT CROPS
Wastewater Irrigation of Fruit Trees,
W82-06008 3C

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

FUEL
The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 5C

FULLER'S METHOD
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

FUNGI
Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 2L

Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 5B

FURROW IRRIGATION
Furrow Intake Rates and Water Management,
W82-05968 3F

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 3F

The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 3F

FUTURE PLANNING
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

FUZZY SETS
A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 6D

GAMMARUS
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 5B

GAS CHROMATOGRAPHY
Headspace Chromatographic Determination of Water Pollutants,
W82-06016 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 5A

GASES
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

GASTROPODS
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

GATES
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 8B

GEL CHROMATOGRAPHY
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

GEOCHEMISTRY
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

GEOCHRONOLOGY
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

GEOHYDROLOGY
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 2F

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 7C

GEOLOGIC FRACTURES
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 2F

GEOLOGICAL FRACTURES
Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 2F

GEOLOGICAL SURVEY
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 2C

GEOLOGY
Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 6A

GEOMORPHOLOGY
Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

Fire and Geomorphic Processes,
W82-06963 2J

GEOPHYSIS
Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 2F

GEORGIA
Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

GEOSTATIONARY METEOROLOGICAL SATELLITE
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

GEOTHERMAL POWER
Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 6G

GEOTHERMAL RESOURCES
Environmental Problems and Geothermal Permitting,
W82-06217 6G

Water Law and the Development of Geothermal Resources,
W82-06218 6E

Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
W82-06404 6G

GEOTHERMAL STUDIES
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 7C

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

GHANA
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 2J

Further Observations on the Effect of Abate on Fish Catches,
W82-06722 5C

GLACIAL LAKES
Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

GLACIERS
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 2C

GLACIOLOGY
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

GOB
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

GOLD
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

GOUNDWATER
Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 7C

GOVERNMENT FINANCE
Count on Uncle Sam Less,
W82-05998 6C

GOVERNMENT SUPPORTS
Count on Uncle Sam Less,
W82-05998 6C

GRAPEVINES
Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 3F

GRAPHICAL METHODS
Statistical Flood Flow Estimation,
W82-05945 2E

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 8B

GRASSES
A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

GRASSLANDS
Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 3F

GRAVEL
A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 8I

GRAVITY DAMS
The Itaipu Hollow Gravity Dam,
W82-06205 8A

Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 8A

GRAVITY STUDIES
Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 2F

GREAT BRITAIN
New Problems with Upland Waters,
W82-06602 5G

GREAT DISMAL SWAMP
Methane Flux in the Great Dismal Swamp,
W82-06840 2H

GREAT LAKES
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

GREECE
Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

GREEN BAY
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

GREYWATER
Expanding Options for Greywater Treatment,
W82-06491 5D

GREYWATER TREATMENT
Expanding Options for Greywater Treatment,
W82-06491 5D

GRINDING
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

GROUNDNUTS
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

GROUNDWATER
The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 2F

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 2A

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 7C

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 7C

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 7C

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 2F

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 7C

San Juan River Basin,
W82-06144 7C

Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 2E

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 2F

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 2K

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 7C

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 7C

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 5B

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 2F

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 5B

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 5B

Ground Water,
W82-06807 5B

Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 2F

Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 2F

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascaguoula, and Tennessee River Basins,
W82-06954 7C

Water Resources Data for Florida, Water Year 1980--Volume 2B. South Florida Ground Water,
W82-06956 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 7C

GROUNDWATER AVAILABILITY
Portable Water Elevation Measuring Gage,
W82-06396 7B

Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 2F

Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 2F

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 2F

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 2F

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 5B

GROUNDWATER BASINS
Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 2F

GROUNDWATER DEPLETION
Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 2F

GROUNDWATER HYDROLOGY
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

GROUNDWATER *LEGAL ASPECTS
Who Owns Nebraska's Ground Water,
W82-06819 6E

GROUNDWATER LEVEL
Portable Water Elevation Measuring Gage,
W82-06396 7B

GROUNDWATER MANAGEMENT
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 2F

The Ground Water Legal Regime as Instrument of Policy Objectives and Management Requirements,
W82-05938 6E

The Development of International Groundwater Law,
W82-05939 6E

Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 3E

The Federal Response to Ground Water Protection,
W82-06295 6E

Ground Water Law in Puerto Rico.
W82-06296 6E

Ground Water and the States,
W82-06297 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 6E

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

GROUNDWATER MOVEMENT
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- ond Uberwachungsprogranim Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

GROUNDWATER POLLUTION
Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 5D

Groundwater Policy: A Patchwork of Protection,
W82-06411 6E

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 5C

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 5B

GROUNDWATER POTENTIAL
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

GROUNDWATER PROTECTION
Ground Water Law in Puerto Rico.
W82-06296 6E

GROUNDWATER RECHARGE
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

GROUTING
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanieringsmassnahmen Auf Die Mohnemauer),
W82-06239 8A

GUAM
Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

HAIL
Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 2F

HARBORS
Physical Process and Eutrophication,
W82-06875 2C

HAWAII
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 5C

HAZARDOUS MATERIALS
Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

HEAT EXCHANGER TUBE
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

HEAT FLOW
Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 7C

HEAT PUMPS
Design of Heat Pump Return Wells,
W82-06294 8C

HEAT TRANSFER
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 3A

Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 3A

Heat Transfer in a Rotating Disk Evaporator,
W82-06112 3A

Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 3A

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 3E

HEAT TRANSFER COEFFICIENTS
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 3A

HEATED WATER
Experiments on Coaxial Heated Water Discharges,
W82-06422 5B

Thermal Effects,
W82-06809 5C

Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 5C

HEAVY METAL
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

HEAVY METALS
Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 5C

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 2K

Discharge of Metals from the St. Lawrence River,
W82-06190 5B

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

Heavy Metals in Animals of Lake Balaton,
W82-06284 5C

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 5D

Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 5C

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 5C

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 5E

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 5E

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 5B

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 5C

HELIUM
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

HERBICIDES
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

HETEROTROPHIC BACTERIA
Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 5A

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 5A

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 5B

HEXACHLOROBIPHENYL
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

HIGH-HEAD INSTALLATIONS
Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen).
W82-06237 8B

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

HIGH-VELOCITY JETS
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen).
W82-06242 8C

HIGH WATER MARK
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

HIGHWAY RELOCATION
Erosion Control at a Delicate Highway Construction Site,
W82-06510 4D

HOLLOW CONSTRUCTION DAMS
The Itaipu Hollow Gravity Dam,
W82-06205 8A

HONG KONG
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 5B

HOOVER DAM
Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

HUDSON RIVER
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

HUMAN DISEASE
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

HUMAN DISEASES
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

Disease Outbreaks Caused by Drinking Water,
W82-06928 5C

HUMIC ACIDS
Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 5F

The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 2K

Applicability of Light Absorbance as a Measure of Organic Carbon in Humic Lake Water,
W82-06773 5A

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

HUMID AREAS
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 6B

HUMIDITY
Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 2B

HUNGARY
Heavy Metals in Animals of Lake Balaton,
W82-06284 5C

Complex Sequence Treats Fluctuating Flows,
W82-06814 5F

HYDRAULIC DESIGN
Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 8B

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 8A

HYDRAULIC ENGINEERING
Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 8H

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

HYDRAULIC EQUIPMENT
Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 8H

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflusssteuerung von Regenwasserbehandlungsanlagen),
W82-06633 8C

HYDRAULIC GEOMETRY
Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 2E

HYDRAULIC JUMP
Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 8B

HYDRAULIC MODELS
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 8B

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

HYDRAULIC PROPERTIES
On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 8B

Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 8H

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

HYDRAULICS
Canals in Sand Channels,
W82-06196 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 8B

Numerical Methods in Hydraulics,
W82-06614 8B

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 8B

HYDROCARBONS
Petroleum Processing Wastes,
W82-06801 5D

HYDROCHLORIC ACID
Beneficial Disposal of Pickle Liquor,
W82-06486 5D

HYDRODYNAMICS
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

HYDROELECTRIC PLANTS
Planning Sri Lanka's Victoria Scheme,
W82-05979 8A

Resonant Waterhammer: A Case Study,
W82-05981 8C

Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits,
W82-06088 6E

Simulating and Improving Hydro Plant Control,
W82-06202 8C

The Itaipu Hollow Gravity Dam,
W82-06205 8A

Reregulation on an International River--A Case Study,
W82-06429 6G

HYDROELECTRIC POWER
Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 6B

The Energy Resources of Kenya,
W82-05978 6D

Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 6E

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 6E

HYDROGEN ION CONCENTRATION
Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

Effects of Acid on Plant Litter Decomposition in an Arctic,
W82-06737 5C

Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 2K

HYDROGEN SULFIDE
Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 5C

HYDROGRAPHS
A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A

Comparing Urban Runoff Models,
W82-06447 2A

HYDROLOGIC ASPECTS
Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1,
W82-06375 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 3F

HYDROLOGIC BUDGET
Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 2D

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

Truckee Meadows Water Use - Present and Future,
W82-06705 3D

HYDROLOGIC CYCLE
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

HYDROLOGIC DATA
Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 2A

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 7C

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 7C

San Juan River Basin,
W82-06144 7C

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 7C

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 7C

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascaguoula, and Tennessee River Basins,
W82-06954 7C

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 7C

Water Resources Data for Florida, Water Year 1980--Volume 2B. South Florida Ground Water,
W82-06956 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 7C

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

HYDROLOGIC DATA COLLECTIONS

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 7B

HYDROLOGIC MODELS

Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 2A

Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

HYDROLOGY

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

Fire and Geomorphic Processes,
W82-06963 2J

HYDROLOGY SURVEYS

Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 2A

HYDROTHERMAL STUDIES

Hydrothermal Analysis of Lakes and Reservoirs,
W82-06425 2H

HYDROXIDES

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

HYPERFILTRATION

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

HYPOLIMNION

Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 5C

ICE

Cold Regions Engineering in Norway,
W82-06000 8A

Bacteria Under the Ice,
W82-06561 5A

ICE-BRINE SYSTEMS

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

ICELAND

Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

IDAHO

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 3F

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 3F

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 2E

Habitat Recovery in the North Fork of the Teton River.
W82-06409 6G

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 5B

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 5B

ILLINOIS

Wastewater Treatment at an Electrical Generation Station,
W82-05975 5D

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 6B

Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 5G

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A

Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 4C

ILLINOIS RIVER (OREGON)

Carrying Capacity for the Illinois River,
W82-05927 6G

IMPAIRED WATER QUALITY

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

IMPAIRED WATER USE

Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 3C

Water Conservation at Wastewater Treatment Plants,
W82-06512 3C

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

INCINERATION

A Look at Co-Disposal,
W82-06354 5E

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

A Case for Regional Sludge Management,
W82-06993 5E

INCUBATION

Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 5A

INDIA

Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 3F

Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

Official and Folk Flood Warning Systems: An Assessment,
W82-06077 6F

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 5F

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

INDIAN OCEAN

Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 2J

INDIANA

Antecedent Moisture Condition Probabilities,
W82-06451 2A

Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 6A

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 6F

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 2F

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 5B

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 5C

INDICATOR SPECIES
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 5C

INDICATORS
Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

Microbiology: Water,
W82-06924 5B

INDONESIA
Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 2A

Cave Water--Java's Hidden Resource,
W82-06605 3B

Brantas Dams Trigger New Javanese Development,
W82-06818 3F

INDUSTIRAL WATER
Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

INDUSTRIAL WASTE WATER
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

INDUSTRIAL WASTES
Common Facility Treatment of Industrial Wastewaters,
W82-05974 5D

Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 5B

How Equitable Are Effluent Charges,
W82-06074 6C

Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 5C

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 5D

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 5D

Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 5A

Steel Industry Wastes,
W82-06799 5D

Petroleum Processing Wastes,
W82-06801 5D

INDUSTRIAL WASTEWATER
Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 5D

A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 5A

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

Beneficial Disposal of Pickle Liquor,
W82-06486 5D

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 5G

A Review of Industrial Effluent Control Experience,
W82-06648 5G

Esholt--Past, Present and Future,
W82-06653 5D

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

Chemicals and Allied Products,
W82-06805 5D

Textile Wastes,
W82-06916 5D

Fermentation Industry,
W82-06917 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

Dairy Wastes,
W82-06921 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 5D

INDUSTRIAL WATER
Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 3E

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 5F

Complex Sequence Treats Fluctuating Flows,
W82-06814 5F

INDUSTRIAL WATER USE
Municipal and Industrial Water Demands of Western U.S.,
W82-06463 6D

INFILTRATION
A Comparison of Three Infiltration Models,
W82-05965 2G

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 3F

Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 2F

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

Status of Porous Pavement Research,
W82-06665 8G

Application of SCS Infiltration Model,
W82-06872 4D

INFILTRATION CAPACITY
Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 2G

INFILTRATION RATE
Furrow Intake Rates and Water Management,
W82-05968 3F

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 2G

INFLUENT SEEPAGE
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

INFORMATION EXCHANGE
Desalination Directory 1981.
W82-05908 3A

INFRARED IMAGERY
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

INHIBITION
Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 5D

INJECTION WELLS
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 6G

INLAND WATERWAYS
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 6B

INLETS
Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 8B

INORGANIC COMPOUNDS
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

Inorganics,
W82-06999 5A

INPUT-OUTPUT ANALYSIS
Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

INSECTICIDES
Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

INSPECTION GALLERIES
The Value of Inspection Galleries,
W82-06204 8D

INSTITUTIONAL CONSTRAINTS
Incentives and Institutions for Water Conservation,
W82-05922 3D

Problems and Processes in Water Quality Management,
W82-06147 5G

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 6B

INSTREAM FLOW
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

INSURANCE
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

INTAKE GATES
Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

INTERBASIN TRANSFERS
Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 6D

INTERFACES
The Moving Interface Problem with Finite Elements,
W82-06546 2L

INTERFEROMETRY
Liquid Level Interferometer,
W82-05929 7B

INTERMITTENT STREAMS
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

INTERNATIONAL AGREEMENTS
Disposal of Sludge to Sea,
W82-06595 5E

INTERNATIONAL COMMISSIONS
Desalination Directory 1981.
W82-05908 3A

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 5C

INTERNATIONAL HYDROLOGICAL DECADE
They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 5F

INTERNATIONAL LAW
The Development of International Groundwater Law,
W82-05939 6E

The Law of International Aquifers,
W82-05940 6E

INTERTIDAL AREAS
Sediment Transport Study Along a Delta Shoreline,
W82-06553 2J

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

INVERTEBRATES
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 5C

Freshwater Macroinvertebrates,
W82-06797 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

ION EXCHANGE
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 5A

Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 3A

The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 3A

An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 5D

Complex Sequence Treats Fluctuating Flows,
W82-06814 5F

ION EXCHANGE RESINS
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

IOWA
The Challenge of Upgrading Roadside Rest Areas,
W82-06845 5G

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

IRAQ
Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06351 5C

On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 5C

IRELAND (NORTHERN)
Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 5B

IRON
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

Retention of Riverine Iron in Estuaries,
W82-06191 5B

On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 5A

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 5D

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

IRON HYDROXIDE
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

IRRIGABLE LAND
Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1.
W82-06375 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 3F

IRRIGATION
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 3F

The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 3F

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 3F

China's Agro-Ecosystem,
W82-06019 3B

Sprinkler Leveler and Wind Compensating Device,
W82-06164 3F

Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 3F

A Model for Managing Irrigated Agriculture,
W82-06584 5G

Doubts Remain About Bura Economics,
W82-06816 3F

Brantas Dams Trigger New Javanese Development,
W82-06818 3F

IRRIGATION DESIGN
Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 3F

Designing for Deficit Irrigation,
W82-06334 3F

Limits for Practical Level-Basin Design,
W82-06452 3F

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

Brantas Dams Trigger New Javanese Development,
W82-06818 3F

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

IRRIGATION ECONOMICS
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 6B

IRRIGATION EFFICIENCY
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 3F

Computer-Guided Linear Irrigator Marches on,
W82-06817 3F

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

IRRIGATION ENGINEERING
Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1.
W82-06375 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 3F

IRRIGATION PRACTICES
Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 3F

Furrow Intake Rates and Water Management,
W82-05968 3F

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 3F

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

Designing for Deficit Irrigation,
W82-06334 3F

IRRIGATION REQUIREMENTS
Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 3F

Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 3F

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

IRRIGATION WATER
Wastewater Irrigation of Fruit Trees,
W82-06008 3C

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

Land Application of Wastewater,
W82-06915 3E

ISOHYETS
Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 2B

ISOTOPE STUDIES
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

ISRAEL
Biological Equilibrium in a Wastewater Reservoir,
W82-06282 5D

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

Free Surface Oscillations in Lake Kinneret,
W82-06879 2H

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

JAPAN
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 5C

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 5A

JETS
Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 8B

JUDICIAL DECISIONS
United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 6E

KANEOHE BAY
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 5C

KANSAS
Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 2A

KENTUCKY
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

Antecedent Moisture Condition Probabilities,
W82-06451 2A

KENYA
The Energy Resources of Kenya,
W82-05978 6D

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

Doubts Remain About Bura Economics,
W82-06816 3F

KINEMATIC WAVE THEORY
Lag Time for Diverging Overland Flow,
W82-05944 2A

KINETICS
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 2E

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 5B

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 5D

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
W82-06829 5B

KJELDAHL PROCEDURE
An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 5A

KRIGING
On the Relationship Between Kriging and State Estimation,
W82-06323 7C

LABORATORIES
Laboratory Services in Regional Water Authorities,
W82-06256 5G

LAC LAFLAMME
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

LAGOONS
Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

LAKE BASINS
Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 4A

LAKE CLASSIFICATION
Terminological Confusion--Lake VS. Reservoir,
W82-06551 2H

LAKE ERIE
Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 5C

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 2J

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 5C

Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-0694[illegible] 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

LAKE EVAPORATION
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 2D

LAKE FISHERIES
Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 6G

LAKE HEFNER
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

LAKE HURON
Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 5C

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

LAKE MEAD
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

LAKE MICHIGAN
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 5C

LAKE MOHAVE
Evaluation of Impacts Associated with Regulation of Water Levels in Lake Mohave,
W82-06089 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

LAKE ONTARIO
A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

Physical Process and Eutrophication,
W82-06875 5C

LAKE RESTORATION
Lake Restoration by Sediment Removal,
W82-06776 5G

LAKE SEDIMENTS
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 2J

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 5B

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

Lake Restoration by Sediment Removal,
W82-06776 5G

Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 5C

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

LAKE SHORELINES
Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 5C

LAKE ST. CLAIR
A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

LAKE SUPERIOR
Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

LAKE TEXOMA
Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

LAKE VICTORA
Analysis of Lake Victoria Levels,
W82-06201 2H

LAKE VICTORIA
Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 6E

LAKES
Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 2H

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 5C

Analysis of Lake Victoria Levels,
W82-06201 2H

Heavy Metals in Animals of Lake Balaton,
W82-06284 5C

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 5G

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

Terminological Confusion--Lake VS. Reservoir,
W82-06551 2H

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 2H

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 5A

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 5C

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 5B

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 5C

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

Free Surface Oscillations in Lake Kinneret,
W82-06879 2H

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 5G

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 5C

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 5C

Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 5C

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 5C

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

LAMPRICIDES
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 5A

LAND APPLICATION
Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 5D

Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 5E

Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 3C

LAND APPRAISALS
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

LAND DISPOSAL
Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 5E

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

Landspreading of sludge in New York State,
W82-06557 5E

Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 5E

Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 5E

Land Application of Wastewater,
W82-06915 5E

LAND MANAGEMENT
The Landscape of Rutland Water,
W82-06678 6G

Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 4C

LAND USE
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 5B

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 5B

Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

LAND USE PLANNING
Urban Creekside Design Features Parallel Streets,
W82-06184 4C

Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 6A

LANDFILLS
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 5B

LANDUSE
New Problems with Upland Waters,
W82-06602 5G

LANGBEIN'S METHOD
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

LARVICIDES
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 5C

LEACHATES
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 5B

Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 5B

Selection of Waste disposal sites,
W82-06550 5E

LEACHING
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

LEAD
Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

LEAKAGE
Leak Location Enters Computer Age,
W82-06018 7A

Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 2F

Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 7B

LEAKY AQUIFERS
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 2F

LEATHER INDUSTRY
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

LEGAL ASPECTS
The Development of International Groundwater Law,
W82-05939 6E

The Law of International Aquifers,
W82-05940 6E

Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 6E

Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 6E

Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 6E

Environmental Problems and Geothermal Permitting,
W82-06217 6G

Water Law and the Development of Geothermal Resources,
W82-06218 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 6E

LEGISLATION
The Federal Response to Ground Water Protection,
W82-06295 6E

Ground Water Law in Puerto Rico.
W82-06296 6E

Ground Water and the States,
W82-06297 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 6E

Mineral Law Since Nepa,
W82-06582 6E

Ocean Disposal Legislation in the United States,
W82-06597 5E

LENTIC ENVIRONMENT
Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

LERDERDERG RIVER
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

LICENSING
Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 6E

LIGHT INTENSITY
Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 5C

LIGNOCELLULOSES
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 2L

LIGNOSULFONIC ACIDS
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 2K

LIME
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 5D

LIMNOLOGY
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

LINEAMENTS
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

LININGS
Sewer Renewal by Pipe Insertion.
W82-06759 8A

LIQUID FILMS
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

LITERATURE REVIEW
Coal and Coal Mine Drainage,
W82-06802 5B

LITERATURE REVIEWS
Acid Precipitation, A Review,
W82-06794 5C

Freshwater Macroinvertebrates,
W82-06797 5C

Steel Industry Wastes,
W82-06799 5D

Synthetic Fuel Effluents,
W82-06800 5D

Petroleum Processing Wastes,
W82-06801 5D

Effects of Pollution on Freshwater Fish,
W82-06803 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

Chemicals and Allied Products,
W82-06805 5D

Aquatic Sediments,
W82-06806 2J

Ground Water,
W82-06807 5B

Marine and Estuarine Pollution,
W82-06808 5C

Thermal Effects,
W82-06809 5C

Bioassays - Procedures and Results,
W82-06810 5A

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 5C

Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

Land Application of Wastewater,
W82-06915 5E

Textile Wastes,
W82-06916 5D

Fermentation Industry,
W82-06917 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

Microbiology: Methodology and Quality Assurance,
W82-06919 5A

Radioactive Wastes,
W82-06920 5E

Dairy Wastes,
W82-06921 5D

Organics,
W82-06922 5A

Anaerobic Processes,
W82-06923 5D

Microbiology: Water,
W82-06924 5B

Substrate-Associated Microfauna,
W82-06925 5C

Microbiology: Wastewater Treatment,
W82-06926 5D

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

Disease Outbreaks Caused by Drinking Water,
W82-06928 5C

Solid Wastes and Water Quality,
W82-06929 5B

Systems Analysis,
W82-06997 5G

Economics,
W82-06998 5G

Inorganics,
W82-06999 5A

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 5D

LITERATUURE REVIEWS
Electroplating and Cyanide Wastes,
W82-06798 5D

LITTER
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 5C

LITTORAL ZONE
Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 5C

LIVER
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 5C

LIVESTOCK
Feed from Sewage: Prospects and Constraints,
W82-06489 5E

LOAD DISTRIBUTION
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

LOADING ESTIMATES
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

LOCAL GOVERNMENTS
Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 6E

LOGGING
Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 5C

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

LONG ISLAND
Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

LONG ISLAND SOUND
A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 2L

LOUISIANA
Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 2I

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 7C

LOW FLOW
The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 2E

MACROINVERTEBRATES
Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

MACROPHYTES
Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 4A

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 5C

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

MAGNESIUM
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

MAGNESIUM HYDROXIDE
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 5D

MAGNESIUM OXIDE
Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

MAGNETIC WASTEWATER TREATMENT
Prospects of Using Magnetic Wastewater Treatment,
W82-06989 5D

MAIN SEWERS
Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 5C

MAINE
Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

MAINTENANCE
Resonant Waterhammer: A Case Study,
W82-05981 8C

A Legacy from Construction Grants,
W82-06251 5D

Sewer Maintenance and Rehab Options,
W82-06253 5D

Maintenance of Analog Instrument systems,
W82-06263 5D

How to Set Up a Preventive Maintenance Program,
W82-06264 5D

MANAGEMENT
Effective Project Management,
W82-06328 5D

Operating Collection Systems Under Fiscal Stress,
W82-06340 5D

MANAGEMENT PLANNING
Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 2E

Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 6A

A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

Work Management Standards,
W82-06349 6F

A Model for Managing Irrigated Agriculture,
W82-06584 5G

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 6B

MANGANESE
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

MANGANESE OXIDES
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 2K

MANGANESE RADIOISOTOPES
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 5B

MANURE
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

MAPPING
Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 2H

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 2B

MAPS
Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 7C

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 7C

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 7C

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 2H

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 7C

MARINE ENVIRONMENT
Marine and Estuarine Pollution,
W82-06808 5C

MARINE FUNGI
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 5B

MARMOT
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

MARSH PLANTS
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

MARYLAND
Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 2F

MASS SPECTROMETRY
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

MASS SPECTROSCOPY
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

MASS TRANSFER
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 3A

MASSACHUSETTS
Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 5A

A Case for Regional Sludge Management,
W82-06993 5E

MATERIALS ENGINEERING
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 3A

MATHEMATICAL ANALYSIS
Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 8H

MATHEMATICAL EQUATIONS
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

Secchi Disc Relationships,
W82-06627 2H

Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 5D

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

MATHEMATICAL MODELS
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 2C

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 6A

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 2F

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 2G

Robust Flood Frequency Models,
W82-06319 2E

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

Mathematical Model for Erodible Channels,
W82-06336 2J

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 2G

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 2G

Stochastic Generation of Monthly Streamflows,
W82-06427 4A

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

A Model for Managing Irrigated Agriculture,
W82-06584 5G

Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 2A

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 5G

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 3D

MATHEMATICAL STUDIES

Lag Time for Diverging Overland Flow,
W82-05944 2A

Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

How Equitable Are Effluent Charges,
W82-06074 6C

Canals in Sand Channels,
W82-06196 8B

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 2G

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

Hydrothermal Analysis of Lakes and Reservoirs,
W82-06425 2H

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 4A

TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 4A

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 8B

Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 2E

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

MATRIC POTENTIAL

Estimating Soil Water Retention from Soil Properties,
W82-06332 2G

MEAN DAILY FLOWS

A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

MEASUREMENT TECHNIQUES

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

MEASURING INSTRUMENTS

Liquid Level Interferometer,
W82-05929 7B

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 8D

Maintenance of Analog Instrument systems,
W82-06263 5D

Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 6C

The Outlook for Precipitation Measurements from Space,
W82-06531 7B

Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 5A

An Automated Recording System for Evaporation Pans,
W82-06780 2D

MEAT PROCESSING INDUSTRY

Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 5D

MEDITERRANEAN SEA

The Mediterranean Action Plan: Design and Implementation,
W82-06154 5B

MEDUXNEKEAG RIVER

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

MEMBRANE FILTERS

Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 5F

MEMBRANE PROCESSES

Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 5F

Studies on Synetheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 3A

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 3A

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

Membrane Separation Processes,
W82-06445 5D

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 5D

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

MEMBRANES

Studies on Synetheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 3A

Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 5D

The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 3A

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 3A

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 5D

MERCURIC CHLORIDE

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

MERCURY

The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 5B

Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 5B

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

Removal of Inorganic Mercury from Water by Bitmuminous Coal,
W82-06265 5D

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

MESOCYCLOPS EDAX
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

METABOLISM
Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

METAL-FINISHING WASTES
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 5D

Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

Electroplating and Cyanide Wastes,
W82-06798 5D

Steel Industry Wastes,
W82-06799 5D

METAL IONS
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 2K

METALS
Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 5B

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

Metal Removal 'A La Carte',
W82-06608 5F

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

Aquatic Sediments,
W82-06806 2J

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 5G

METAMORPHIC ROCKS
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

METHANE
Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 2H

Methane Flux in the Great Dismal Swamp,
W82-06840 2H

METHANE BACTERIA
Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 5D

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

METHANOGENESIS
Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 2H

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

METHOMYL
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

METHYLMERCURY
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

METROSTAT
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

MICHIGAN
Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 5C

MICROBIAL DEGRADATION
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 5B

MICROBIOLOGICAL STUDIES
Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 5D

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 2E

Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 5A

Microbiology: Water,
W82-06924 5B

Microbiology: Wastewater Treatment,
W82-06926 5D

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

MICROENVIRONMENT
Substrate-Associated Microfauna,
W82-06925 5C

MICROGAS DISPERSIONS
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 5D

MICROINVERTEBRATES
A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 2K

MICROORGANISMS
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 2L

Ultraviolet Systems in Water Treatment,
W82-06726 5F

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 5A

MICROPROCESSORS

Microprocessors and Computers in Analysis in the Water Industry,
W82-06259 5F

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 5D

MICROSCOPIC ANALYSIS

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

MICROSCOPY

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 5A

MIDGES

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 5G

MINE DRAINAGE

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 5G

Coal and Coal Mine Drainage,
W82-06802 5B

MINE WASTES

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

Coal and Coal Mine Drainage,
W82-06802 5B

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

MINERALIZATION

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 5B

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 5B

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 5C

MINERALS

Mineral Law Since Nepa,
W82-06582 6E

MINNESOTA

Waste Treatment System Retrofitted Within Deadline,
W82-05947 5D

Supplying Water to the Rural Community,
W82-06223 5F

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 5B

MISSISSIPPI

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 7C

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 7C

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 7C

MISSISSIPPI RIVER

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

MISSOURI

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

Simplified Clarifier Axes Treatment Stages,
W82-06820 5D

MISSOURI RIVER

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

MIXING

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 5G

Experiments on Coaxial Heated Water Discharges,
W82-06422 5B

Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 2L

MODEL STUDIES

Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

Finite Element Modeling of Streamflow Routing,
W82-05918 2E

Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 5B

Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 5C

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 2E

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 2G

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 4A

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 5D

Acid Rain Model: Hydrologic Module,
W82-06360 5B

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

Reservoir Systems Optimization,
W82-06433 4A

Comparing Urban Runoff Models,
W82-06447 2A

Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 2J

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 4B

Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 5C

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 6B

Subsurface Drainage Effects on Erosion,
W82-06795 4D

Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 5C

A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 2B

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 2D

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 3F

Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 4A

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 2G

Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 2F

Application of SCS Infiltration Model,
W82-06872 4D

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 4D

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

Systems Analysis,
W82-06997 5G

MODEL TESTING
Finite Element Modeling of Streamflow Routing,
W82-05918 2E

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

MOISTURE
Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 2B

A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 2B

MOLECULAR BACKWASH
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

MOLYBDENUM
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

MONETARY BENEFITS
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

MONITORING
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 5C

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

Portable Water Elevation Measuring Gage,
W82-06396 7B

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

The Practical Handling of Water Quality Monitoring Data,
W82-06591 7C

Making Chlorination Trustworthy,
W82-06639 5F

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

Locating Monitoring Wells,
W82-06848 8B

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

MONOMOLECULAR FILMS
Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes,
W82-06167 3A

MONTANA
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

MONTE CARLO METHOD
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 5G

MOUNT ST HELENS
Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

MOUNTAIN BASINS
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

MOUNTAINS
Dispersion in Mountainous Natural Streams,
W82-06357 2E

Calibrating A Mountain Watershed in Wyoming,
W82-06583 2E

MT ST HELENS
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

MULTI-FLASH DISTILLATION
Analysis of Large Desalination Plants,
W82-06122 3A

MULTIOBJECTIVE PLANNING
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

MULTIPHASE FLOW
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

MULTIPURPOSE PROJECTS
Reservoir Planning for Brazilian Dams,
W82-06206 6A

MULTIPURPOSE RESERVOIRS
Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 5G

MULTIRESERVOIR NETWORKS
TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 4A

TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 4A

MULTISTAGE FLASH DISTILLATION
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 3A

MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 3A

MULTIVARIATE ANALYSIS
Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abfluese fur Ein Groesraumiges Hydrologisches System-Ein Autoregressiven, Multivariates Multi-Lag-Modell-),
W82-06826 4A

MUNICIPAL WASTEWATER
Energy Conservation in Municipal Wastewater Plants,
W82-06070 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 5D

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 5D

MUNICIPAL WATER
Municipal and Industrial Water Demands of Western U.S.,
W82-06463 6D

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

MUSKINGUM-CUNGE MODEL
Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 4A

MUSSELS
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

MUTAGENIC ACTIVITY
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

MUTAGENS
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 5A

MYRIOPHYLLUM
Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

NALGONDA TECHNIQUE
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

NATIONAL FLOOD INSURANCE PROGRAM
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

NATURAL GAS
A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

NATURAL RECHARGE
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

NATURAL WATERS
Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 5A

Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 2K

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 5C

NAVIER-STOKES EQUATION
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

NAVIGATION
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 6B

NEBRASKA
A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 2E

Who Owns Nebraska's Ground Water,
W82-06819 6E

NET RADIATION
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

Potential Evaporation in the Peace Region of British Columbia,
W82-06528 2D

NETHERLANDS
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography. Application to Dutch River Sediment,
W82-06274 5A

NETWORK DESIGN
Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 5F

NETWORKS
Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

NEUTRALIZATION
Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 5D

NEVADA
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 2H

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 3D

Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 2F

NEW BRUNSWICK
Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 5A

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

NEW HAMPSHIRE
Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 2K

NEW JERSEY
Overhauling a Water System,
W82-06224 5F

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

NEW MEXICO
Feed from Sewage: Prospects and Constraints,
W82-06489 5E

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 3E

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 7C

NEW YORK
Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 6G

Landspreading of sludge in New York State,
W82-06557 5E

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 5B

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

NEW YORK BIGHT
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

NEW YORK CITY
Leak Location Enters Computer Age,
W82-06018 7A

NEW ZEALAND
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

NICKEL
Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 5E

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

NILE DELTA
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 2J

NILE RIVER
Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 6E

NITRATE
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 5C

NITRATES
Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

NITRIFICATION
Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 5D

Nitrification Kinetics and Its RBC Application,
W82-06356 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 5C

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 5C

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 5A

NITRILOTRIACETIC ACID
The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 5D

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 5D

NITROGEN
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 5A

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 5D

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 3F

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

NITROGEN COMPOUNDS
Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 5D

NITROGEN FIXATION
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 5C

NITROGEN FIXING BACTERIA
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

NOMENCLATURE
Terminological Confusion--Lake VS. Reservoir,
W82-06551 2H

NOMOGRAPHS
Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 5B

NONPOINT POLLUTION SOURCES
Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 5B

Problems and Processes in Water Quality Management,
W82-06147 5G

Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

Nonpoint Source Loading Rates from Selected Land Uses,-
W82-06626 5B

NONSTRUCTURAL ALTERNATIVES
Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

NORTH CAROLINA
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 5C

Subsurface Drainage Effects on Erosion,
W82-06795 4D

Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 5C

Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 5C

NORTH DAKOTA
Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 7C

NORTH SEA
Discharge to the North Sea,
W82-06248 5E

NORTHERN GREAT PLAINS
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 2I

NORWAY
Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 8E

Designing and Excavating Underground Powerplants,
W82-05982 8E

Cold Regions Engineering in Norway,
W82-06000 8A

Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 5F

Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 2K

Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 5A

NORWICH
Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 5D

NUCLEAR EXPLOSIONS
Effects on Global Supplies of Freshwater,
W82-06733 5C

NUCLEAR MAGNETIC RESONANCE
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 5A

NUCLEAR POWERPLANTS
Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 5C

NUCLEAR REACTORS
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

NUCLEAR WASTES
Radioactive Wastes,
W82-06920 5E

NUMERICAL ANALYSIS
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 2G

Bacteria Under the Ice,
W82-06561 5A

Numerical Methods in Hydraulics,
W82-06614 8B

Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 3F

NUTRIENT CYCLING
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

NUTRIENT REDUCTION
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

NUTRIENT REMOVAL
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 5D

An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 5D

NUTRIENT TRANSFORMATIONS
Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

NUTRIENTS
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 5C

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 5B

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 5C

Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 5C

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

OBSERVATION WELLS
Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 7C

OCEAN DUMPING
Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 5E

Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 5C

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 5B

Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 5E

Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 5C

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 5E

Sludge Disposal to Sea in U.K.,
W82-06292 5E

Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 5E

Ocean Dumping Battle Marches On,
W82-06490 5E

Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 5E

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

Sludge Disposal to Sea in France,
W82-06593 5E

Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 5E

Disposal of Sludge to Sea,
W82-06595 5E

Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 5E

Ocean Disposal Legislation in the United States,
W82-06597 5E

Sludge Disposal to Sea: North American Viewpoint,
W82-06598 5E

Sludge Disposal to Sea in South Africa,
W82-06599 5E

Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 5E

Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 5E

OCULAR SURVEY
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

ODEN CURVE
Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 2J

ODOR CONTROL
Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 5D

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 5D

OFFSHORE PLATFORMS
A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

OHIO
Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 2F

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

Polymer Plays Plant Improvement Role,
W82-06250 5D

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 8B

OIL POLLUTION
Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 5G

OIL REFINERIES
Petroleum Processing Wastes,
W82-06801 5D

OIL SHALE
Synthetic Fuel Effluents,
W82-06800 5D

OIL SPILLS
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

OILS
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

OKEFENOKEE SWAMP
Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

OKLAHOMA
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 4A

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 5G

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06960 7B

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

OLIGOCHAETES
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

OLIGOTROPHIC LAKES
Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

OLIOGOTROPHIC LAKES
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

ON-SITE DATA COLLECTIONS
Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 7C

ONTARIO
The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 2F

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 5B

Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 5B

OPEN-CHANNEL DRAINAGE
Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

OPERATING POLICIES
Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 2E

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

OPTIMIZATION
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 2I

Reservoir Systems Optimization,
W82-06433 4A

Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 3F

OPTIMUM DEVELOPMENT PLANS
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

ORCHARDS
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 5C

OREGON
Carrying Capacity for the Illinois River,
W82-05927 6G

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 7C

Regional Detention Basins for Stormwater Control,
W82-06225 8A

Erosion Control at a Delicate Highway Construction Site,
W82-06510 4D

Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 6B

Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 5C

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 7C

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 2G

Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 7B

ORGANIC ACIDS
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

ORGANIC CARBON
Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 5D

Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 5A

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 5A

ORGANIC COMPOUNDS
Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A

Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 7C

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 5B

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 5B

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

Chemicals and Allied Products,
W82-06805 5D

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

Organics,
W82-06922 5A

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 5A

ORGANIC LOADING
A Survey of Aerated Lagoon Performance,
W82-06391 5D

Bacteria Solve Problems Created by Prisoners.
W82-06505 5D

ORGANIC MATTER
Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 5D

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

ORGANIC WASTES
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 5C

ORGANOCHLORINES
Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 5A

ORGANOLEPTIC PROPERTIES
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

ORTHOPHOSPHATES
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

OSCILLATORY WAVES
Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 8E

Free Surface Oscillations in Lake Kinneret,
W82-06879 2H

OSMOSIS
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

OUTER CONTINENTAL SHELF
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

OUTFALL SEWERS
Discharge to the North Sea,
W82-06248 5E

Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 5E

OUTFALLS
Sludge Disposal to Sea in South Africa,
W82-06599 5E

OUTLETS
The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 8A

OVERFLOW
Detroit-Style CSO Studies,
W82-06247 5G

OVERLAND FLOW
Lag Time for Diverging Overland Flow,
W82-05944 2A

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

OWNERSHIP
Who Owns Nebraska's Ground Water,
W82-06819 6E

OXIDATION
Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment,
W82-06380 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

OXIDATION DITCHES
Simplified Clarifier Axes Treatment Stages,
W82-06820 5D

OXIDATION LAGOONS
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 5D

OXIDATION PONDS
Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 5D

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

OXIDATION-REDUCTION POTENTIAL
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 2K

OXYGEN
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

The Use of Oxygen in Sewage Treatment,
W82-06262 5D

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

OXYGEN DEMAND
The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 5D

OXYGEN DEPLETION
Immediate and Delayed Oxygen Depletion in Rivers,
W82-06269 5G

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 5C

OXYGEN LEVELS
Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

OXYGEN TRANSFER
Solving a Poor Oxygen Transfer Problem.
W82-05952 5D

How Much Air,
W82-06638 5D

OXYGEN UPTAKE
A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 5A

OXYGENATION
The Use of Oxygen in Sewage Treatment,
W82-06262 5D

OZONATION
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 5D

Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 5D

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

OZONE
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 5D

Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 5D

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 5D

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

OZONOLYSIS
Oxidation Products and Rates of Reaction in the Ozonolysis of Diebenzofuran,
W82-06305 5B

PACIFIC NORTHWEST U.S
Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 3F

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

PACIFIC OCEAN
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

PALAN ISLANDS
Secondary Benthic Production in a Tropical Island Stream,
W82-06933 5C

PALEOCLIMATOLOGY
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

PALEOLIMNOLOGY
Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 5C

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

PARAMETRIC HYDROLOGY
Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

PARANA RIVER
The Itaipu Hollow Gravity Dam,
W82-06205 8A

PARASITES
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

PARTICLE SIZE
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 2J

Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 2J

PARTICLE SIZE DISTRIBUTION
On the Graphical Presentation of Raindrop Size Data,
W82-06529 2B

PARTICULATE MATTER
Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 5B

Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 5B

PATENTS
Sprinkler Leveler and Wind Compensating Device,
W82-06164 3F

Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 5D

Apparatus for Desalinating Water,
W82-06711 3A

PATH OF POLLUTANTS
Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 5B

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 5B

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 2K

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

Dispersion in Mountainous Natural Streams,
W82-06357 2E

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 5B

Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 2L

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 2L

Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 5B

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 5B

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 5B

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 5B

Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

Locating Monitoring Wells,
W82-06848 8B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 5B

PATHOGENS
Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 5D

PAVING
Status of Porous Pavement Research,
W82-06665 8G

PEAK DEMAND
Water Rate Studies and Rate Making Philosophy,
W82-06223 6C

PEAK FLOW
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

PEAT BOGS
Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 2G

PENNSYLVANIA
Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 6E

Components for a Treatment Plant Safety Program,
W82-06992 5G

PERCH
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 5B

PERCHED GROUNDWATER
Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 2F

PERCOLATION
Comparison of Methods ot Estimate Deep Percolation Rates,
W62-06867 2G

PERFORMANCE EVALUATION
MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 3A

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

PERMEABILITY
Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 2F

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 5C

PERMEABILITY COEFFICIENT
Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

PERMITS
Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 6E

PERSELECTIVE MEMBRANES
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

PERSONNEL
Components for a Treatment Plant Safety Program,
W82-06992 5G

PERVAPORATION
Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

PESTICIDE
Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

PESTICIDE RESIDUES
Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 5A

Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

PESTICIDE TOXICITY
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

PESTICIDES
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 5A

Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 5C

Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

Effects of Pollution on Freshwater Fish,
W82-06803 5C

Marine and Estuarine Pollution,
W82-06808 5C

PETROLEUM PRODUCTS
Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 5D

PHALLUS PROCESS
Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 5G

PHENOLS
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A

Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 5D

Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 5B

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

PHOSPHATE REMOVAL
Polymer Plays Plant Improvement Role,
W82-06250 5D

PHOSPHATES
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 5A

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

PHOSPHOROUS
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

PHOSPHORUS
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 5C

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters.
W82-06828 5A

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
W82-06829 5B

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

PHOSPHORUS REMOVAL
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

How Appleton Reduced Phosphorus,
W82-06249 5D

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 5C

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 5C

Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 5F

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 5D

Beneficial Disposal of Pickle Liquor,
W82-06486 5D

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

PHOTOSYNTHESIS
Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 5C

PHOTOSYNTHETIC BACTERIA
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

PHOTOSYNTHETIC INHIBITORS
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

PHYSICOCHEMICAL PROPERTIES
Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

PHYSIOCHEMICAL TREATMENT
Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

PHYTOPLANKTON
Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 5A

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 2H

On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 5C

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 5C

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 5C

PILOT PLANTS
Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 5D

PINE TREES
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 2L

PIPE FLOW
Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 3F

Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 8B

PIPE JACKING
Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 8A

PIPELINES
Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 5F

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Faced by Coal Slurry Pipelines.
W82-06365 6D

The Kielder Transfer Works,
W82-06502 8A

Bridging the Water Supply Gap,
W82-06508 8A

Texas Gulf Coast Project Answers Vital Water Need,
W82-06519 8A

Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers--ASTM F585-78.
W82-06601 8A

Cross-Country Force Main.
W82-06640 8G

PIPES
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
W82-06449 8A

PITTSBURGH PNEUMONIA AGENT
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

PLANKTON
Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

PLANNING
Count on Uncle Sam Less,
W82-05998 6C

The Mediterranean Action Plan: Design and Implementation,
W82-06154 5B

How to Set Up a Preventive Maintenance Program,
W82-06264 5D

Effective Project Management,
W82-06328 5D

Water Supply Development in Thailand.
W82-06367 6B

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 6B

PLANT-WATER POTENTIALS
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 2I

PLANTING MANAGEMENT
The Landscape of Rutland Water,
W82-06478 6G

PLASTICS
Cross-Country Force Main.
W82-06640 8G

PLUGGING FACTOR
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

PLUMES
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 2L

POLAND
The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 5A

POLITICAL ASPECTS
Count on Uncle Sam Less,
W82-05998 6C

Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 6E

Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 6E

County Provides a Rural Water Supply System,
W82-06843 3D

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

POLLUTANT IDENTIFICAION
On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 5A

POLLUTANT IDENTIFICATION
A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 5A

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 5A

Headspace Chromatographic Determination of Water Pollutants,
W82-06016 5A

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A

On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 5A

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A

Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 5A

Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 5A

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

Liquid-Liquid Extraction Combined with Atomic-Absortpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 5A

Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 2K

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 5A

An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 5A

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 2K

Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 5A

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

Bacteria Under the Ice,
W82-06561 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 7C

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 5C

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 5A

Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 5A

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 5B

Right Place, Time and Technique: Right Sample,
W82-06642 5A

Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 5A

Design and Operation of a Colorimetric Detector Controller,
W82-06656 5A

A Water Quality Index for Lake Beaches,
W82-06660 5G

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 5A

Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 5A

Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 5D

Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 5A

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 5A

Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 5A

Sampling Characteristics of Macrophyte Biomass,
W82-06779 5A

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

Bioassays - Procedures and Results,
W82-06810 5A

Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 5A

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 5A

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 5A

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 5A

Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 5A

Organics,
W82-06922 5A

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 5A

Inorganics,
W82-06999 5A

POLLUTANTS
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

POLLUTION LOAD
Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 5B

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 5B

Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

POLYCHLORINATED BIPHENYLS
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 5A

Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 5B

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 5C

A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 5B

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

POLYMER MEMBRANES
Studies on Synetheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 3A

POLYMERS
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

PONDS
Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 4A

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 5G

POPULATION DENSITY
Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining.
W82-06542 5A

POPULATION DYNAMICS
Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 5C

Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

POPULATION SHIFTS
Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

POROSITY
Status of Porous Pavement Research,
W82-06665 8G

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 2G

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

POROUS MEDIA
Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 5D

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 2G

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

POSTIMPOUNDMENT
An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 2E

POTABLE WATER
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 5F

POTASSIUM
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

POTENTIOMETERS
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

POTENTIOMETRIC LEVEL
Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 7C

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 7C

POTOMAC RIVER
Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 2E

POWDERED ACTIVATED CARBON
PAC Process,
W82-06643 5D

POWER PLANTS
Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 3E

POWERPLANTS
Designing and Excavating Underground Powerplants,
W82-05982 8E

Impact of Thermal Standards on Power Plant Water Consumption,
W82-06037 5G

Power Plant Siting,
W82-06555 6G

The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 8E

Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 5B

PRECIPITABLE WATER
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

PRECIPITATION
Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 2D

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 2D

Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 2B

PREDICTION
Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 3F

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 2B

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 6B

PREIMPOUNDMENT
An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 2E

PRETREATMENT
Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

PRICING
Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 6C

Water Rates and Residential Water Conservation,
W82-06276 3D

Cost-Based Water Rate Design,
W82-06277 6C

How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 6C

Policing Demand Through Pricing,
W82-06352 6D

Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 6C

PRIMARY PRODUCTIVITY
A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 5C

PRIMARY WASTEWATER TREATMENT
Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, Ril-12
W82-06099 5G

PROBABILISTIC PROCESS
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

PROBABILITY DISTRIBUTION
Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-0590[illegible] 2A

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06[illegible] 2G

Antecedent Moisture Condition Probabilities,
W82 0645[illegible] 2A

PROBABILITY DISTRIBUTIONS
On the Relationship Between Kriging and State Estimation,
W82-06323 7C

PRODUCTIVITY
Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

PROJECT PLANNING
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

Rutland Water - From Conception to Operation,
W82-06481 6D

Introduction - Rutland Water 1970-1981,
W82-06482 6B

PROJECTIONS
Truckee Meadows Water Use - Present and Future,
W82-06705 3D

PROPERTY VALUE
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

PROTEINS
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

PSEUDOMONAS
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B

PUBLIC HEALTH
Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 5A

Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 5B

Disease Outbreaks Caused by Drinking Water,
W82-06928 5C

PUBLIC HEARINGS
Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 6B

PUBLIC OPINION
Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

Rutland Water - From Conception to Operation,
W82-06481 6D

PUBLIC PARTICIPATION
The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 6B

Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 6B

PUBLIC POLICY
The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 6B

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

PUBLIC UTILITY DISTRICTS
Water Supply and Distribution in Larger Communities,
W82-06413 5F

County Provides a Rural Water Supply System,
W82-06843 3D

PUBLIC WATERS
Carrying Capacity for the Illinois River,
W82-05927 6G

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 6B

PUERTO RICO
Ground Water Law in Puerto Rico.
W82-06296 6E

PULP AND PAPER INDUSTRY
Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 6B

High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

Domes, Bubbles, and Paper Waste,
W82-06025 5D

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 5D

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 5C

Environmental Improvement at Port Alice, B. C.,
W82-06515 5C

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

PULP WASHING
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

PULP WASTES
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

PUMPED STORAGE
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

PUMPING
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 2H

PUMPING PLANTS
Swift Action by State Officials Prepares for Water Supply Crisis.
W82-06514 8C

PUMPS
Design Considerations in Waterworks Pumps Selection,
W82-06343 8C

Pump Sump Design Experience: Summary,
W82-06419 8C

Zimbabwean Hand Pump Passes Village-Level Endurance Tests.
W82-06606 8C

QUEBEC
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

RADIOACTIVE DATING
The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

RADIOACTIVE TRACERS
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

RADIOACTIVE WASTE DISPOSAL
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 2F

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 6G

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 5B

Radioactive Wastes,
W82-06920 5E

RADIOACTIVE WASTES
Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

RADIOISOTOPES
Effects on Global Supplies of Freshwater,
W82-06733 5C

Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 5B

RAFT RIVER
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

RAIN
Splash Erosion Modeling: Physical Analysis,
W82-05970 2J

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

On the Graphical Presentation of Raindrop Size Data,
W82-06529 2B

The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 2B

RAINFALL
Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 2B

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 2E

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 2B

Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 2B

A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 2B

The Outlook for Precipitation Measurements from Space,
W82-06531 7B

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

RAINFALL DISTRIBUTION
Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 2B

Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 2B

RAINFALL INFILTRATION
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

RAINFALL INTENSITY
A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 7B

RAINFALL RATE
A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 7B

RAINFALL-RUNOFF RELATIONSHIPS
Lag Time for Diverging Overland Flow,
W82-05944 2A

An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 2A

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 5B

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 7C

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 2G

RAINFALL-RUNOFF RELATIONSHIPS, TRACERS
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

RANGE MANAGEMENT
Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

RAVENGLASS ESTUARY
Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

RAW WATER
Rutland Water Raw Water Quality - Problems and Management,
W82-06475 5G

RECHARGE
Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 2F

RECIRCULATED WATER
Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 5C

RECLAIMED WATER
Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 5D

Land Application of Wastewater,
W82-06915 5E

RECREATION
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

The Challenge of Upgrading Roadside Rest Areas,
W82-06845 5G

RECREATION FACILITIES
An Investigation of Some Factors Influencing the Performance of a Recreational Trout Fishery,
W82-06329 6D

RECREATION WASTES
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 6C

RECYCLING
Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 3A

Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 3A

Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 5D

Feed from Sewage: Prospects and Constraints,
W82-06489 5E

RED RIVER (OF THE NORTH)
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

REFLECTANCE
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

REGIONAL PLANNING
Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 6B

REGRESSION ANALYSIS
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 4A

REGULATIONS
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 5G

REHABILITATION
Overhauling a Water System,
W82-06224 5F

Sewer Maintenance and Rehab Options,
W82-06253 5D

Sewerage: Priorities for Action,
W82-06260 8G

Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers--ASTM F585-78.
W82-06601 8A

Out of Sight--Out of Mind.
W82-06713 8A

Canal Tunnel Repair Options.
W82-06758 8A

Sewer Renewal by Pipe Insertion.
W82-06759 8A

Watertight Manholes Cut Inflow.
W82-06844 5G

REHABILITATION

The Challenge of Upgrading Roadside Rest Areas,
W82-06845 5G

REMOTE SENSING

Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 7B

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 8I

A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 7B

The Outlook for Precipitation Measurements from Space,
W82-06531 7B

Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 5E

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 7B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 7B

Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

RENEWABLE RESOURCES

Water Conservation Incentives and Strategy,
W82-05906 3D

RENOVATIONS

Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06232 8A

REOVIRUSES

Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

RESEARCH PRIORITIES

Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 5E

New Problems with Upland Waters,
W82-06602 5G

RESEARCH PROJECTS

Water Resources Research Support Program 1981 - 1982,
W82-06565 9D

RESERVIOURS

Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 8E

RESERVOIR

The Landscape of Rutland Water,
W82-06478 6G

RESERVOIR CONSTRUCTION

Design Technique Development for Dams in South Africa,
W82-06011 8A

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 5G

The Biesbosch Water Storage Scheme,
W82-06014 8A

RESERVOIR DESIGN

The Biesbosch Water Storage Scheme,
W82-06014 8A

RESERVOIR OPERATION

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

Reregulation on an International River--A Case Study,
W82-06429 6G

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 4A

TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 4A

Reservoir Systems Optimization,
W82-06433 4A

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

Rutland Water - From Conception to Operation,
W82-06481 6D

Introduction - Rutland Water 1970-1981,
W82-06482 6B

RESERVOIR RELEASES

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

RESERVOIR STAGES

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

RESERVOIR STORAGE

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

The Biesbosch Water Storage Scheme,
W82-06014 8A

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

RESERVOIRS

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

Reservoir Planning for Brazilian Dams,
W82-06206 6A

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 8B

Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 4A

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 5G

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 2H

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

Rutland Water Raw Water Quality - Problems and Management,
W82-06475 5G

Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 2H

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 6B

Rutland Water - From Conception to Operation,
W82-06481 6D

Introduction - Rutland Water 1970-1981,
W82-06482 6B

The Kielder Headworks,
W82-06504 8A

Texas Gulf Coast Project Answers Vital Water Need,
W82-06519 8A

Terminological Confusion--Lake VS. Reservoir,
W82-06551 2H

Secchi Disc Relationships,
W82-06627 2H

Reservoir Water Quality Sampling Design,
W82-06868 2H

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 5B

RESINS
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

RESOURCES MANAGEMENT
Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 6F

RESPIRATION
A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 5C

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 5A

Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 5C

REVEGETATION
Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 2E

REVERSE OSMOSIS
Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 3A

Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 5F

RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 3A

Salbukh Reverse Osmosis Plant on Stream,
W82-06127 3A

The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 3A

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 5D

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

REVIEWS
New Directions in Water Pollution Control,
W82-06071 5G

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

The Use of Oxygen in Sewage Treatment,
W82-06262 5D

A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

Aquaculture for Waste Management,
W82-06556 5D

A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 5C

A Review of Industrial Effluent Control Experience,
W82-06648 5G

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 5G

Acid Precipitation, A Review,
W82-06794 5C

Freshwater Macroinvertebrates,
W82-06797 5C

Electroplating and Cyanide Wastes,
W82-06798 5D

Steel Industry Wastes,
W82-06799 5D

Synthetic Fuel Effluents,
W82-06800 5D

Petroleum Processing Wastes,
W82-06801 5D

Coal and Coal Mine Drainage,
W82-06802 5B

Effects of Pollution on Freshwater Fish,
W82-06803 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

Chemicals and Allied Products,
W82-06805 5D

Aquatic Sediments,
W82-06806 2J

Ground Water,
W82-06807 5B

Marine and Estuarine Pollution,
W82-06808 5C

Thermal Effects,
W82-06809 5C

Bioassays - Procedures and Results,
W82-06810 5A

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 5C

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

Land Application of Wastewater,
W82-06915 5E

Textile Wastes,
W82-06916 5D

Fermentation Industry,
W82-06917 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

Microbiology: Methodology and Quality Assurance,
W82-06919 5A

Radioactive Wastes,
W82-06920 5E

Dairy Wastes,
W82-06921 5D

Organics,
W82-06922 5A

Anaerobic Processes,
W82-06923 5D

Microbiology: Water,
W82-06924 5B

Substrate-Associated Microfauna,
W82-06925 5C

Microbiology: Wastewater Treatment,
W82-06926 5D

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

Disease Outbreaks Caused by Drinking Water,
W82-06928 5C

Solid Wastes and Water Quality,
W82-06929 5B

Systems Analysis,
W82-06997 5G

Economics,
W82-06998 5G

Inorganics,
W82-06999 5A

REYNOLDS NUMBER
Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 8B

RHINE RIVER
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

RICE
Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 3F

Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 6B

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

RIDGING
Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 2J

RIFFLES
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 2J

RISKS
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 6F

RIVER BASIN DEVELOPMENT
Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 6A

RIVER BASINS
Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 2A

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

RIVER BEDS
Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 5F

RIVER FLOW
Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 4C

RIVER REGULATIONS
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 5G

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

RIVERS
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 2J

Discharge of Metals from the St. Lawrence River,
W82-06190 5B

Immediate and Delayed Oxygen Depletion in Rivers,
W82-06269 5G

Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 5B

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 6B

ROAD CONSTRUCTION
Cold Regions Engineering in Norway,
W82-06000 8A

ROADS
Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 5B

The Challenge of Upgrading Roadside Rest Areas,
W82-06845 5G

ROCK EXCAVATION
Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 8H

ROCK MECHANICS
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 2F

On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 8B

ROCKFILL DAMS
The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 8D

Test and Control Programme for Twirte Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

ROOT ZONE
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 2G

ROTATING BIOLOGICAL CONTACTOR
Rotating Biological Contactor Scale-Up and Design,
W82-06344 5D

Rotating Biological Contactor System Design,
W82-06355 5D

Nitrification Kinetics and Its RBC Application,
W82-06356 5D

ROTATING BIOLOGICAL CONTACTORS
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

Performance of Rotating Biological Contactors Under Field Conditions,
W82-05650 5D

ROUGHNESS COEFFICIENT
Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 8B

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 8B

ROUTING
Finite Element Modeling of Streamflow Routing,
W82-05918 2E

Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 8B

RUHR RIVER
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

RUNOFF
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 4A

Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 5B

RUNOFF COEFFICIENT
Sensitivity of SCS Models to Curve Number Variation,
W82-06631 2A

RUNOFF COEFFICIENTS
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

RUNOFF FORECASTING
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

RUNOFF VALUE
Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 2D

RUNOFF VOLUME
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 4C

RURAL AREAS
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

Supplying Water to the Rural Community,
W82-06223 5F

RUTLAND WATER
Introduction - Rutland Water 1970-1981,
W82-06482 6B

SAFE YIELD
An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 4B

SAFETY
Safety Aspects in the Design and Inspection of Dams,
W82-06203 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 8A

Components for a Treatment Plant Safety Program,
W82-06992 5G

SAINT JOHN RIVER
Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 5A

SALINE-FRESHWATER INTERFACES

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 4B

SALINE LAKES

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 2H

SALINE SOILS

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

SALINE WATER

Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

SALINE WATER INTRUSION

Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 4B

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 5B

Stormwater Management in a Sensitive Area.
W82-06841 5G

Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 2F

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

SALINITY

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 2L

A Model for Managing Irrigated Agriculture,
W82-06584 5G

York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

SALMON

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

SALT BALANCE

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

SALT MARSHES

The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 2L

Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 2L

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 2L

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 5A

SALT RIVER BASIN

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

SALT TOLERANCE

Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 3C

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

SALT UPTAKE

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

SAMPLE PREPARATION

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

SAMPLE PRESERVATION

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

Right Place, Time and Technique: Right Sample,
W82-06642 5A

SAMPLING

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 6G

Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 5A

Right Place, Time and Technique: Right Sample,
W82-06642 5A

Sampling Characteristics of Macrophyte Biomass,
W82-06779 5A

Reservoir Water Quality Sampling Design,
W82-06868 2H

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 5A

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 5A

SAND

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

SAND FILTERS

UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

SANDSTONES

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

SANITARY ENGINEERING

Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 6C

SANITARY ENGINEERING *COST ANALYSIS

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

SANITATION

They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 5F

SASKATCHEWAN

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 5B

SATELLITE TECHNOLOGY

Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 2B

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

SAUDI ARABIA
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 3A

SAVANNAH RIVER PLANT
Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 6G

SCALE FORMATION
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 3A

SCALE INHIBITION
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

SCALING
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 3A

SCIENTIFIC PERSONNEL
Laboratory Services in Regional Water Authorities,
W82-06256 5G

SCOTLAND
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 2J

Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 2J

Discharge to the North Sea,
W82-06248 5E

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 5C

SEALANTS
Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 8G

SEALING
Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

SEASONAL RATIOS
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

SEASONAL VARIATION
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 2K

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 2E

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 2L

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 5C

Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 2G

SEASONAL VARIATIONS
Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 5B

Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 5C

SECCHI DISKS
Secchi Disc Relationships,
W82-06627 2H

SECONDARY WASTEWATER
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 5D

SECONDARY WASTEWATER TREATMENT
Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 5G

SEDIMENT
Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 5C

SEDIMENT CONTROL
Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 4A

Lake Restoration by Sediment Removal,
W82-06776 5G

SEDIMENT DISCHARGE
A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 4D

SEDIMENT EROSION
Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

SEDIMENT LOAD
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 8B

SEDIMENT SAMPLER
A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 8I

SEDIMENT TRANSPORT
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 2J

Origin of Step-Pool Systems in Mountain Streams,
W82-06335 2J

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

Sediment Transport and Unit Stream Power Function,
W82-06424 2J

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 2J

Suspended Sediment in a Wave Field,
W82-06527 2J

Sediment Transport Study Along a Delta Shoreline,
W82-06553 2J

Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 2J

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

SEDIMENT-WATER INTERFACES
Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 5B

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 2K

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

SEDIMENT YIELD
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

Fire and Geomorphic Processes,
W82-06963 2J

SEDIMENTARY BASINS

Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 2J

SEDIMENTATION

Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 2J

Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 2J

Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 5E

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

Erosion and Sediment,
W82-06554 2J

Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 2J

SEDIMENTATION RATES

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 2J

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

SEDIMENTOLOGY

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

SEDIMENTS

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 2K

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 2K

Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 5A

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 5A

Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

Aquatic Sediments,
W82-06806 2J

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 5A

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 5A

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 5A

SEEPAGE

Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 2F

SEEPAGE CONTROL

The Value of Inspection Galleries,
W82-06204 8D

SEICHES

Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 2H

Free Surface Oscillations in Lake Kinneret,
W82-06879 2H

SELENIUM

Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 5C

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

SELF-PURIFICATION

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 5C

SEMIARID LANDS

Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 2I

Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 4A

SENSITIVITY ANALYSIS

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 2A

SEPARATION TECHNIQUES

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

Membrane Separation Processes,
W82-06445 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 5D

SEPTIC TANKS

Put Pressure on Sewage,
W82-06732 5D

SESTON

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

SETTLING BASINS

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 5C

SETTLING TANKS

Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 5F

M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 5F

SEWAGE

Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 5C

Feed from Sewage: Prospects and Constraints,
W82-06489 5E

SEWAGE BACTERIA

A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Strepto-

cocci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 5D

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

SEWAR SYSTEMS
Put Pressure on Sewage,
W82-06732 5D

SEWER HYDRAULICS
Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 8B

SEWER SYSTEMS
A Legacy from Construction Grants,
W82-06251 5D

Sewer Maintenance and Rehab Options,
W82-06253 5D

Sewerage: Priorities for Action,
W82-06260 8G

The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
W82-06449 8A

Major Factors in Sewer Ventilation,
W82-06462 8A

Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers--ASTM F585-78.
W82-06601 8A

Out of Sight--Out of Mind.
W82-06713 8A

Sewer Renewal by Pipe Insertion.
W82-06759 8A

Watertight Manholes Cut Inflow.
W82-06844 5G

SHENANGO RIVER
Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 6E

SHOCK LOADS
Bacteria Solve Problems Created by Prisoners.
W82-06505 5D

SHRIMP
The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

SILTING
Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 5C

SIMULATION
Robust Flood Frequency Models,
W82-06319 2E

SIMULATION ANALYSIS
A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 2E

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Simulating and Improving Hydro Plant Control,
W82-06202 8C

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 2G

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 3F

SIRIO-SHF EXPERIMENT
A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 7B

SITE SELECTION
Selection of Waste disposal sites,
W82-06550 5E

Power Plant Siting,
W82-06555 6G

SLUDGE
Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 5E

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

SLUDGE ANALYSIS
Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 5A

SLUDGE DIGESTION
Sludge Management: A Research Update,
W82-06007 5E

Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute),
W82-06024 5D

Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 5D

Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 5D

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D

Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 5D

SLUDGE DISPOSAL
Sludge Management: A Research Update,
W82-06007 5E

A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 5E

Sludge Tankering Economics - A Fresh Approach,
W82-06076 5E

Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 5E

Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 5C

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 5B

Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 5E

Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 5C

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 5E

Sludge Disposal to Sea in U.K.,
W82-06292 5E

Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 5E

Selection of a Sludge Handling Disposal System,
W82-06346 5E

A Look at Co-Disposal,
W82-06354 5E

Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 5E

Potato and Corn By-Products Used as Cattle Feed,
W82-06488 5E

Ocean Dumping Battle Marches On,
W82-06490 5E

Landspreading of sludge in New York State,
W82-06557 5E

Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 5E

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

Sludge Disposal to Sea in France,
W82-06593 5E

Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 5E

Disposal of Sludge to Sea,
W82-06595 5E

Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 5E

Ocean Disposal Legislation in the United States,
W82-06597 5E

Sludge Disposal to Sea: North American Viewpoint,
W82-06598 5E

Sludge Disposal to Sea in South Africa,
W82-06599 5E

Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 5E

The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 5C

A Case for Regional Sludge Management,
W82-06993 5E

SLUDGE LAGOONS
Low-Cost Treatment of Wastewater,
W82-06506 5D

SLUDGE TREATMENT
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

SLUDGE VOLUME INDEX
Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 5D

SLUG FLOW
Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 8B

SLUICEWAYS
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

SLURRIES
Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

SMALL WATERSHEDS
Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 2F

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

SNOW
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

SNOW PACK
The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 2C

SNOWMELT
The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 2C

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 2D

Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 2E

SNOWPACK
Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 6G

SOIL ABSORPTION CAPACITY
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

SOIL ENVIRONMENT
Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 2I

SOIL EROSION
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Erosion Control at a Delicate Highway Construction Site,
W82-06510 4D

Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

Fire and Geomorphic Processes,
W82-06963 2J

SOIL LOSS
Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

SOIL MECHANICS
Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

SOIL MOISTURE
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

SOIL MOISTURE DEFICIENCY
Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 3F

Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 2I

SOIL MOISTURE RETENTION
Estimating Soil Water Retention from Soil Properties,
W82-06332 2G

SOIL ORGANIC MATTER
Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 2G

SOIL POROSITY
Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 2G

SOIL PROPERTIES
Estimating Soil Water Retention from Soil Properties,
W82-06332 2G

SOIL STABILIZATION
Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

SOIL TEMPERATURE
Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 7B

SOIL TYPES
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

SOIL WATER
Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 7B

A Comparison of Three Infiltration Models,
W82-05965 2G

Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 2G

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 2G

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 2G

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 2G

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

SOIL-WATER-PLANT RELATIONSHIPS
Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 2I

SOIL WATER TABLE
Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 2I

SOLAR ASSISTED DESALINATION
Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121 3A

SOLID WASTE DISPOSAL
Sludge Tankering Economics - A Fresh Approach,
W82-06076 5E

SOLID WASTES
Solid Wastes and Water Quality,
W82-06929 5B

SOLUTE TRANSPORT
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 2G

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 2G

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

SOLUTES
Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 2G

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 2G

SONAR
Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 8I

SONIFICATION
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

SORPTION
Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 5D

SOUND WAVES
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 8I

SOUTH AFRICA
Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 2E

Design Technique Development for Dams in South Africa,
W82-06011 8A

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

Sludge Disposal to Sea in South Africa,
W82-06599 5E

Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 4A

SOUTH CAROLINA
Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 6B

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 6G

Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 5C

SOUTHWEST U.S
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

SOYBEAN
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

SPATIAL DISTRIBUTION
Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 2B

On the Relationship Between Kriging and State Estimation,
W82-06323 7C

Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 2B

SPAWNING GRAVEL
A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 8I

SPECIES COMPOSITION
Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 5C

SPECIES DIVERSITY
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

SPECIFIC HUMIDITY
Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 2B

SPECIFICATIONS
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 3A

SPECTRAL ANALYSIS
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

SPECTROPHOTOMETRY
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 2K

SPECTROSCOPY
Inorganics,
W82-06999 5A

SPILLWAYS
Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 8B

SPLASH EROSION
Splash Erosion Modeling: Physical Analysis,
W82-05970 2J

SPOIL BANKS
Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 5E

SPRINGS
A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 2K

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

SPRINKLER IRRIGATION
Sprinkler Leveler and Wind Compensating Device,
W82-06164 3F

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 3F

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F

SRI LANKA
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

Planning Sri Lanka's Victoria Scheme,
W82-05979 8A

Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schusstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 8B

SRICSI METHODOLOGY
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

ST. CROIX RIVER
Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

ST. LAWRENCE ESTUARY
Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 2L

ST. LAWRENCE RIVER
Discharge of Metals from the St. Lawrence Rives,
W82-06190 5B

STABILIZATION PONDS
A Survey of Aerated Lagoon Performance,
W82-06391 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 5D

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 5D

Low-Cost Treatment of Wastewater,
W82-06506 5D

STABLE CHANNEL
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 2J

STANDARD PLATE COUNT
Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 5F

STANDARDS
Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 5G

STANDING CROPS
Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 3F

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

STATE ESTIMATION
On the Relationship Between Kriging and State Estimation,
W82-06323 7C

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 5D

STATE JURISDICTION
Ground Water and the States,
W82-06297 6E

STATISTICAL ANALYSIS
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

On the Relationship Between Kriging and State Estimation,
W82-06323 7C

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 2B

STATISTICAL METHODS
Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 6C

STATISTICAL STUDIES
A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 2B

STATISTICS
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 2C

STEADY FLOW
A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 2L

STEAMBOAT SPRINGS
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

STEEL INDUSTRY
Beneficial Disposal of Pickle Liquor,
W82-06486 5D

Steel Industry Wastes,
W82-06799 5D

STOCHASTIC HYDROLOGY
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

STOCHASTIC MODELS
Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

STOCHASTIC PROCESS
Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

Stochastic Generation of Monthly Streamflows,
W82-06427 4A

A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 2G

STORAGE EQUATION
A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A

STORAGE RESERVOIRS
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

STORM DRAINS
Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 8B

STORM-OVERFLOW SEWERS
Detroit-Style CSO Studies,
W82-06247 5G

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 5C

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflusssteuerung von Regenwasserbehandlungsanlagen),
W82-06633 8C

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 5G

STORM RUNOFF
Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 4C

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 5B

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 7C

STORM WASTEWATER
Detroit-Style CSO Studies,
W82-06247 5G

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflusssteuerung von Regenwasserbehandlungsanlagen),
W82-06633 8C

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

Decontamination of Overland Runoff from Populated Areas,
W82-06980 5D

STORM WATER
Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 5B

Regional Detention Basins for Stormwater Control,
W82-06225 8A

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 5C

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 5G

Stormwater Management in a Sensitive Area,
W82-06841 5G

Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 5B

Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

STORMS
On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 2B

STRATIFICATION
Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 2H

STRATIGRAPHIC DISTRIBUTION
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

STREAM DEGRADATION
Mathematical Model for Erodible Channels,
W82-06336 2J

STREAM DISCHARGE
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive

Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 4A

STREAM EROSION
Mathematical Model for Erodible Channels,
W82-06336 2J

STREAM IMPROVEMENT
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

STREAM STABILIZATION
Habitat Recovery in the North Fork of the Teton River.
W82-06409 6G

STREAM UPFLOW
Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

STREAMBEDS
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 2J

Lower Flow Regime Bedforms: Rational Classification,
W82-06421 2E

Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 5C

STREAMFLOW
A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 2E

Dispersion in Mountainous Natural Streams,
W82-06357 2E

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

Stochastic Generation of Monthly Streamflows,
W82-06427 4A

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 7C

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 2E

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 5B

Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 4A

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 4A

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

STREAMFLOW FORECASTING
Finite Element Modeling of Streamflow Routing,
W82-05918 2E

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 2E

The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 2E

STREAMS
A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 6B

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 6B

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 5C

STREETER-PHELPS EQUATIONS
Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 5B

STREPTOCOCCI
A Water Quality Index for Lake Beaches,
W82-06660 5G

STRIP MINES
Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 2F

STROMATOLITES
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-05934 5C

STRONTIUM RADIOISOTOPES
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

SUBSIDENCE
Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 2J

SUBSIDIES
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 6B

SUBSOIL
The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 8E

SUBSURFACE DRAINAGE
Subsurface Drainage Effects on Erosion,
W82-06795 4D

SUCCESSION
Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 2H

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

SUDAN
Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 2E

Microbiological Examination of Sebeel Water,
W82-06882 5C

SUGARCANE
Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 2I

SULFATE-REDUCING BACTERIA
Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

SULFATE REDUCTION
Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

SULFIDES
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 5D

SULFUR
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

SULFUR CYCLE
Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 5C

SUMPS
Pump Sump Design Experience: Summary,
W82-06419 8C

SUPERSATUATION
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

SUPPLEMENTAL IRRIGATION
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

SURFACE-GROUNDWATER RELATIONS
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 2A

SURFACE-GROUNDWATER RELATIONSHIPS
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

SURFACE IRRIGATION
A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 3F

SURFACE RUNOFF
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 2G

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

SURFACE SEALING
A Comparison of Three Infiltration Models,
W82-05965 2G

SURFACE WATER
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 2A

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 7C

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 7C

San Juan River Basin,
W82-06144 7C

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 7C

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 7C

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascagoula, and Tennessee River Basins,
W82-06954 7C

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 7C

SURVEYS
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

SUSPENDED SEDIMENTS
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Suspended Sediment in a Wave Field,
W82-06527 2J

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 5B

Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 2J

SUSPENDED SOLIDS
The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 5B

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 5F

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Untersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 5D

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

SWAMPS
Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

Methane Flux in the Great Dismal Swamp,
W82-06840 2H

SWEDEN
The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 2C

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 5C

SYMPOSIUM
Numerical Methods in Hydraulics,
W82-06614 8B

SYNTHESIS
The Development of Dry-RO Membranes from Cellulosic and Noncellulosic Polymers Bearing Quaternary Ammonium Groups,
W82-06152 3A

SYNTHETIC FUELS
Synthetic Fuel Effluents,
W82-06800 5D

SYSTEMATICS
An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 5A

SYSTEMS ANALYSIS
Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 2E

Systems Analysis,
W82-06997 5G

TANNIC ACIDS
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 2K

TATLOCKIA
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

TAXONOMY
Bacteria Under the Ice,
W82-06561 5A

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

TECHNOLOGY TRANSFER
Desalination Directory 1981.
W82-05908 3A

TELEMETRY
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 7B

TEMPERATURE
Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 2L

TEMPERATURE EFFECTS
Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 5A

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 5D

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

TENNESSEE
Water Resources Data for Tennessee, Water Year 1980.
W82-06670 7C

Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 5B

TERBUTRYN
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

TERTIARY WASTEWATER TREATMENT
Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 5D

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

TEST WELLS
On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 8B

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

TESTING PROCEDURES
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

TETRAZOLIUM
Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 5D

TEXAS
Common Facility Treatment of Industrial Wastewaters,
W82-05974 5D

Olmos Dam Modification.
W82-06186 8A

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 7C

Watertight Manholes Cut inflow.
W82-06844 5G

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 5A

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

TEXAS HIGH PLAINS
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 3F

TEXTILE MILL WASTES
Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 5D

Esholt--Past, Present and Future,
W82-06653 5D

Textile Wastes,
W82-06916 5D

TFM
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 5A

THAILAND
Water Supply Development in Thailand.
W82-06367 6B

Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 5B

Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 2F

THAMES ESTUARY
Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 5B

THE GEYSERS
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

THE NETHERLANDS
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 5A

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

THERMAL DISCHARGES
Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 5G

THERMAL POLLUTIION
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 2F

THERMAL POLLUTION
Experiments on Coaxial Heated Water Discharges,
W82-06422 5B

Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 5C

Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

Thermal Effects,
W82-06809 5C

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 2F

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 5C

Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 5C

Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 5B

THERMAL POWERPLANTS
Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 5C

THERMAL STRATIFICATION
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 5G

Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 2H

THERMAL STRESS
Thermal Effects,
W82-06809 5C

THERMAL WATER
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 5C

Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 2F

THERMOCLINE
Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 2H

THERMODYNAMICS
Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 5G

THERMOMECHANICAL PULPING PROCESS
High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

THERMOSIPHONING
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

TIDAL EFFECTS
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 5C

TIDAL MARSHES
The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 2L

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

TIDES
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

TIME SERIES ANALYSIS
Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 3F

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 4A

TOKYO
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A

TOPOGRAPHY
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 2J

TOXICITY
Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 5C

A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 5A

High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 5C

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

Bioassay Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 5A

Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 5D

Environmental Improvement at Port Alice, B. C.,
W82-06515 5C

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 5E

Freshwater Macroinvertebrates,
W82-06797 5C

Effects of Pollution on Freshwater Fish,
W82-06803 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

TOXINS
Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 5C

TRACE ELEMENTS
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

TRACE METALS
Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 2K

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 5A

TRANSITION FLOW
Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 8B

TRANSLOCATION
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 5B

TRANSMISSIVITY
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 2F

TRANSPARENCY
Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 5C

TRANSPIRATION
Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

TRANSPORTATION
A Case for Regional Sludge Management,
W82-06993 5E

TRAWLING
Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 8I

TREATIES
Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 6E

TREATMENT PLANTS
Water Conservation at Wastewater Treatment Plants,
W82-06512 3C

TREES
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 2I

TRIAZINE HERBICIDES
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

TRICKLE IRRIGATION
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 3F

TRIHALOMETHANE
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

TRIHALOMETHANES
Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 5F

TRITICALE
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

TRITIUM
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

TROPHIC LEVEL
Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 2H

TROPICAL REGIONS
Secondary Benthic Production in a Tropical Island Stream,
W82-06933 5C

TROUT
The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 2E

Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an

Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

TUBIFICIDS
Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

TUNDRA
Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 2D

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 2D

TUNNEL CONSTRUCTION
The Kielder Transfer Works,
W82-06502 8A

Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 8A

TUNNEL FAILURE
Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 8A

TUNNEL LININGS
Out of Sight--Out of Mind.
W82-06713 8A

Canal Tunnel Repair Options.
W82-06758 8A

TUNNELS
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

TURBIDITY
Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

Packaged Plant Treats Turbidity,
W82-06026 5F

The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 5C

Getting Your Money's Worth from Filtration,
W82-06412 5F

Low-Dosage High-Rate Direct Filtration,
W82-06416 5F

M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 5F

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 5B

TURBULENT FLOW
Dispersion in Mountainous Natural Streams,
W82-06357 2E

Sediment Transport and Unit Stream Power Function,
W82-06424 2J

Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 8B

Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 8B

Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 2J

Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 8B

TURKEY
Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

TURNOVER TIME
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

TUSCANY
Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 2E

TWIN LAKES
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

ULOTHRIX ZONATA
Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

ULTRAFILTRATION
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

ULTRAVIOLET DISINFECTION
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

ULTRAVIOLET RADIATION
Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 5D

Ultraviolet Systems in Water Treatment,
W82-06726 5F

ULTRVIOLET RADIATION
Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

UNDERGROUND STRUCTURES
Designing and Excavating Underground Powerplants,
W82-05982 8E

UNDERGROUND WASTE DISPOSAL
Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 6G

UNIT HYDROGRAPHS
A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A

Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 2A

UNITED KINGDOM
Sludge Disposal to Sea in U.K.,
W82-06292 5E

The Practical Handling of Water Quality Monitoring Data,
W82-06591 7C

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 5G

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 5D

The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 5G

Esholt--Past, Present and Future,
W82-06653 5D

UNSATURATED FLOW
A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 2G

UPPER NIAGARA RIVER
Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 5A

UPPER SNAKE RIVER
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

UPTAKE
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

URANIUM
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

URBAN AREAS
Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 2E

Water Supply and Distribution in Larger Communities,
W82-06413 5F

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 5G

URBAN HYDROLOGY
Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 7C

URBAN PLANNING
Problems and Processes in Water Quality Management,
W82-06147 5G

Urban Creekside Design Features Parallel Streets,
W82-06184 4C

URBAN RUNOFF
Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 5B

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

Comparing Urban Runoff Models,
W82-06447 2A

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 4C

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 7C

Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

Decontamination of Overland Runoff from Populated Areas,
W82-06980 5D

URBAN WATERSHEDS
Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

URBANIZATION
Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 4C

USER CHARGES
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume 1: Study Report,
W82-06382 5D

USSR
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 2H

Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 2H

An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 4B

Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 2F

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 7C

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 8B

Decontamination of Overland Runoff from Populated Areas,
W82-06980 5D

Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 5B

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 4C

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 5C

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

Prospects of Using Magnetic Wastewater Treatment,
W82-06989 5D

UTAH
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 7C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 7C

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

VADOSE WATER
Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

VAPOR COMPRESSION
Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 3A

VARIABILITY
Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-05211 2B

VEGETABLE CROPS
Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

VEGETATION
Fire and Geomorphic Processes,
W82-06963 2J

VEGETATION REGROWTH
Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 2E

VENEZUELA
Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 5C

VENTILATION
Major Factors in Sewer Ventilation,
W82-06462 8A

VIBRIO CHOLERAE
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 5C

VIRGINIA
Policing Demand Through Pricing,
W82-06352 6D

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F

York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

Methane Flux in the Great Dismal Swamp,
W82-06840 2H

VIRUSES
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 5D

Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 5D

Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 5A

Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 5A

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

VISTULA RIVER

The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 5A

VOLCANOES

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

VOLTA LAKE

Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

VOLTA RIVER

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 2J

VOLTAMMETRY

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

WALES

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 5C

WARNING SYSTEMS

Official and Folk Flood Warning Systems: An Assessment,
W82-06077 6F

WASHINGTON

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

Sediment Transport Study Along a Delta Shoreline,
W82-06553 2J

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

County Provides a Rural Water Supply System,
W82-06843 3D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

WASHINGTON SUBURBAN SANITARY COMMISSION

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

WASTE ASSIMILATIVE CAPACITY

A Review of Industrial Effluent Control Experience,
W82-06648 5G

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

WASTE DISPOSAL

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

A Look at Co-Disposal,
W82-06354 5E

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

Feed from Sewage: Prospects and Constraints,
W82-06489 5E

Selection of Waste disposal sites,
W82-06550 5E

Radioactive Wastes,
W82-06920 5E

WASTE HEAT

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 3E

WASTE RECOVERY

Potato and Corn By-Products Used as Cattle Feed,
W82-06488 5E

WASTE WATER TREATMENT

Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 5D

WASTEWATER

Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 5E

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment,
W82-06380 5D

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 5A

Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

WASTEWATER ANALYSIS

Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 5A

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 5A

Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 5A

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 5A

Organics,
W82-06922 5A

WASTEWATER COLLECTION

Put Pressure on Sewage,
W82-06732 5D

WASTEWATER DISPOSAL

Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 5B

Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

Discharge to the North Sea,
W82-06248 5E

Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
W82-06404 6G

Dilution Analysis for Unidirectional Diffusers,
W82-06420 8B

On-Site Wastewater Management--Recent Trends,
W82-06439 5D

Cross-Country Force Main.
W82-06640 8G

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

WASTEWATER FACILITIES

Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 5D

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

How to Set Up a Preventive Maintenance Program,
W82-06264 5D

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 5D

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 5D

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante

Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

WASTEWATER FARMING
Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 5E

WASTEWATER IRRGATION
Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

WASTEWATER IRRIGATION
Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 5D

Wastewater Irrigation of Fruit Trees,
W82-06008 3C

WASTEWATER LAGOONS
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

Biological Equilibrium in a Wastewater Reservoir,
W82-06282 5D

WASTEWATER MANAGEMENT
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

On-Site Wastewater Management--Recent Trends,
W82-06439 5D

WASTEWATER OXIDATION
French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 5D

WASTEWATER POLLUTION
Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 5B

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

Sewage Diversion Effects on the Water Column ot a Subtropical Estuary,
W82-06892 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 5C

WASTEWATER RENOVATION
Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 5D

WASTEWATER TREATMENT
Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 5D

Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

Waste Treatment System Retrofitted Within Deadline,
W82-05947 5D

Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 5D

Solving a Poor Oxygen Transfer Problem.
W82-05952 5D

High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 5D

Common Facility Treatment of Industrial Wastewaters,
W82-05974 5D

Wastewater Treatment at an Electrical Generation Station,
W82-05975 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute).
W82-06024 5D

Domes, Bubbles, and Paper Waste,
W82-06025 5D

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 5D

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 5D

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 5D

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 5D

Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 5D

How Appleton Reduced Phosphorus,
W82-06249 5D

Polymer Plays Plant Improvement Role,
W82-06250 5D

The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 5D

Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 5D

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

The Use of Oxygen in Sewage Treatment,
W82-06262 5D

Removal of Inorganic Mercury from Water by Bituminous Coal,
W82-06265 5D

Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 5D

A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 5D

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 5C

Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 5D

Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 5D

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 5D

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 5D

Rotating Biological Contactor System Design,
W82-06355 5D

Nitrification Kinetics and Its RBC Application,
W82-06356 5D

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 5D

Performance of Modified Chlorine Contact Chamber,
W82-06359 5D

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 5D

A Survey of Aerated Lagoon Performance,
W82-06391 5D

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 5D

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 5D

Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 5D

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

Beneficial Disposal of Pickle Liquor,
W82-06486 5D

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 5D

Expanding Options for Greywater Treatment,
W82-06491 5D

Bacteria Solve Problems Created by Prisoners.
W82-06505 5D

Low-Cost Treatment of Wastewater,
W82-06506 5D

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 5D

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 5D

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

Aquaculture for Waste Management,
W82-06556 5D

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 5D

Metal Removal 'A La Carte',
W82-06608 5F

A Model for the Design of Hypolimnetic Aerators,
W82-06610 5G

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

How Much Air,
W82-06638 5D

Crisis: Financing Water and Wastewater,
W82-06641 6C

PAC Process,
W82-06643 5D

Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 5D

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

Esholt--Past, Present and Future,
W82-06653 5D

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 5D

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 5D

Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 5D

Dynamics of Biofilm Processes: Methods,
W82-06666 5D

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

Put Pressure on Sewage,
W82-06732 5D

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 5D

Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 5D

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 5D

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

Electroplating and Cyanide Wastes,
W82-06798 5D

Steel Industry Wastes,
W82-06799 5D

Synthetic Fuel Effluents,
W82-06800 5D

Petroleum Processing Wastes,
W82-06801 5D

Simplified Clarifier Axes Treatment Stages,
W82-06820 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes immobilises sur des Supports Solides),
W82-06830 5D

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 5D

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

Textile Wastes,
W82-06916 5D

Fermentation Industry,
W82-06917 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

Anaerobic Processes,
W82-06923 5D

Microbiology: Wastewater Treatment,
W82-06926 5D

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

Decontamination of Overland Runoff from Populated Areas,
W82-06980 5D

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

Prospects of Using Magnetic Wastewater Treatment,
W82-06989 5D

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 5D

WATER ALLOCATION
Allocation of Water for Resource Development,
W82-06839 6D

WATER ANALYSIS
Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

Headspace Chromatographic Determination of Water Pollutants,
W82-06016 5A

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 5C

Liquid-Liquid Extraction Combined with Atomic-Absorpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 5A

Laboratory Services in Regional Water Authorities,
W82-06256 5G

On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 5A

The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 2K

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 5A

An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 5A

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 5A

Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 5A

Inorganics,
W82-06999 5A

WATER ANAYLSIS
Organics,
W82-06922 5A

WATER CIRCULATION
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 2H

WATER CONSERVATION
Water Conservation Incentives and Strategy,
W82-05906 3D

Incentives and Institutions for Water Conservation,
W82-05922 3D

Leak Location Enters Computer Age,
W82-06018 7A

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 6E

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

Water Rates and Residential Water Conservation,
W82-06276 3D

How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 6C

Water Conservation at Wastewater Treatment Plants,
W82-06512 3C

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 3E

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

WATER COSTS
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

Water Rate Studies and Rate Making Philosophy,
W82-06222 6C

WATER CURRENTS
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 2H

Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 2H

WATER DEMAND
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

Policing Demand Through Pricing,
W82-06352 6D

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 6B

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 2F

WATER DISTRIBUTION
Overhauling a Water System,
W82-06224 5F

Water Supply and Distribution in Larger Communities,
W82-06413 5F

Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 5F

WATER DISTRICTS
Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 3E

WATER EXCHANGE
Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

WATER LAW
Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 3E

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 6E

WATER LEVEL
Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 7C

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 7C

Analysis of Lake Victoria Levels,
W82-06201 2H

WATER LEVEL FLUCTUATIONS
Liquid Level Interferometer,
W82-05929 7B

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 5C

WATER LEVEL RECORDERS
Liquid Level Interferometer,
W82-05929 7B

WATER LEVELS
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

WATER MAINS
Statistical Cost Function for Water Mains,
W82-06252 6C

WATER MANAGEMENT
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 2F

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 6F

Farm Water Management Gets Fao Boost,
W82-06815 3F

Stormwater Management in a Sensitive Area.
W82-06841 5G

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

WATER MANAGEMENT (APPLIED)
The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 3E

WATER MEASUREMENT
Portable Water Elevation Measuring Gage,
W82-06396 7B

WATER METERING
Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 6C

WATER PERMITS
Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 6B

WATER POLICY
Water Conservation Incentives and Strategy,
W82-05906 3D

Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 6E

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 6F

WATER POLLUTION CONTROL
Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 6E

New Directions in Water Pollution Control,
W82-06071 5G

The Mediterranean Action Plan: Design and Implementation,
W82-06154 5B

Water Pollution Control Plant Upgraded to Meet EPA Regs.
W82-06187 5D

Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

Groundwater Policy: A Patchwork of Protection,
W82-06411 6E

A Review of Industrial Effluent Control Experience,
W82-06648 5G

WATER POLLUTION EFFECTS
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 5C

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 5C

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 5B

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

Effects of Pollution on Freshwater Fish,
W82-06803 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

Marine and Estuarine Pollution,
W82-06808 5C

Disease Outbreaks Caused by Drinking Water,
W82-06928 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

WATER POLLUTION PREVENTION
Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 5D

WATER POLLUTION SOURCES
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

Hazardous Material Spills--Are You Ready,
W82-06417 5G

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 5B

Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

WATER POLLUTION TREATMENT
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 5D

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

WATER PROPERTIES

Prospects of Using Magnetic Wastewater Treatment,
W82-06989 5D

WATER QUALITY

Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 7C

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 7A

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 2A

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 7C

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 5C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 7C

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 7C

San Juan River Basin,
W82-06144 7C

Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 5G

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 5B

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 5C

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 5G

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 5B

The Practical Handling of Water Quality Monitoring Data,
W82-06591 7C

New Problems with Upland Waters,
W82-06602 5G

The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 5D

Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 2H

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 5G

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 7C

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 7C

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 2E

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 5B

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 5B

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 5A

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 5B

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 5B

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

Microbiological Examination of Sebeel Water,
W82-06882 5C

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascagoula, and Tennessee River Basins,
W82-06954 7C

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 7C

Water Resources Data for Florida, Water Year 1980--Volume 2B. South Florida Ground Water,
W82-06956 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 7C

WATER QUALITY CONTROL

Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 5G

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 5D

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 5C

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 5G

The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 5G

WATER QUALITY CONTROL, *WATER POLLUTION PREVENTION

Recent Developments in the Field of Europhication Prevention,
W82-06299 5C

WATER QUALITY DATA

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

WATER QUALITY MANAGEMENT

Problems and Processes in Water Quality Management,
W82-06147 5G

Rutland Water Raw Water Quality - Problems and Management,
W82-06475 5G

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 6B

WATER QUALITY MANAGEMENT

The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06682 5G

Systems Analysis,
W82-06997 5G

Economics,
W82-06998 5G

WATER QUALITY SAMPLING

Reservoir Water Quality Sampling Design,
W82-06868 2H

WATER QUALITY STANDARDS

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 5F

Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 5G

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 7A

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 6E

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 5E

Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 5G

Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

WATER RATES

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

Water Rate Studies and Rate Making Philosophy,
W82-06222 6C

Cost-Based Water Rate Design,
W82-06277 6C

WATER REQUIREMENT

Municipal and Industrial Water Demands of Western U.S.,
W82-06463 6D

WATER REQUIREMENTS

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

WATER RESOURCES DEVELOPMENT

Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 6E

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 6B

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 6B

Tragedy of the San Francisco Bay Commons,
W82-06182 6E

Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 2E

Reservoir Planning for Brazilian Dams,
W82-06206 6A

Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 6B

Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

Cost Allocation in Water Resources Development,
W82-06854 6C

WATER REUSE

Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 5D

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 3E

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

Expanding Options for Greywater Treatment,
W82-06491 5D

Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 5C

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 5D

Land Application of Wastewater,
W82-06915 5E

WATER RIGHTS

Allocation of Water for Resource Development,
W82-06839 6D

WATER SAMPLING

Right Place, Time and Technique: Right Sample,
W82-06642 5A

Reservoir Water Quality Sampling Design,
W82-06868 2H

WATER SHORTAGE

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

WATER SOFTENING

Florida Style Water Supply and Treatment,
W82-06027 5F

Complex Sequence Treats Fluctuating Flows,
W82-06814 5F

WATER STORAGE

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

WATER STRESS

Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 3C

Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 2I

WATER SUPPLY

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 7A

Supplying Water to the Rural Community,
W82-06223 5F

Work Management Standards,
W82-06349 6F

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 6D

Hazardous Material Spills--Are You Ready,
W82-06417 5G

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

The Landscape of Rutland Water,
W82-06478 6G

Bridging the Water Supply Gap,
W82-06508 8A

Swift Action by State Officials Prepares for Water Supply Crisis.
W82-06514 8C

Texas Gulf Coast Project Answers Vital Water Need,
W82-06519 8A

Cave Water--Java's Hidden Resource,
W82-06605 3B

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 6B

Effects on Global Supplies of Freshwater,
W82-06733 5C

County Provides a Rural Water Supply System,
W82-06843 3D

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

WATER SUPPLY DEVELOPMENT

Processes for Removal of Inorganic Contaminants from Water,
W82-06342 5F

Water Supply Development in Thailand.
W82-06367 6B

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 5F

WATER SUPPLY SYSTEMS

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 5F

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

WATER TABLE

Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 2I

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

WATER TABLE FLUCTUATIONS

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 2K

WATER TANKS

Advanced Coatings for the Water Industry.
W82-06603 8G

Water Tanks in Reinforced Concrete,
W82-06604 8F

WATER TEMPERATURE

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 2H

WATER TRANSFER

The Kielder Transfer Works,
W82-06502 8A

The Kielder Water Scheme,
W82-06503 8A

Bridging the Water Supply Gap,
W82-06508 8A

Swift Action by State Officials Prepares for Water Supply Crisis.
W82-06514 8C

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

WATER TREATMENT

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

Desalination Directory 1981.
W82-05908 3A

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 5G

Packaged Plant Treats Turbidity,
W82-06026 5F

Florida Style Water Supply and Treatment,
W82-06027 5F

They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 5F

Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 5D

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

Overhauling a Water System,
W82-06224 5F

Removal of Inorganic Mercury from Water by Bitmuminous Coal,
W82-06265 5D

Advanced Water Treatment for Color and Organics Removal,
W82-06279 5F

Processes for Removal of Inorganic Contaminants from Water,
W82-06342 5F

Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 5F

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

Getting Your Money's Worth from Filtration,
W82-06412 5F

The Effect of Backwashing Rate on Filter Performance,
W82-06415 5F

Low-Dosage High-Rate Direct Filtration,
W82-06416 5F

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 5F

Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 5F

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 5F

M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 5F

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

Rutland Water Raw Water Quality - Problems and Management,
W82-06475 5G

Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 5F

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F

Metal Removal 'A La Carte',
W82-06608 5F

Making Chlorination Trustworthy,
W82-06639 5F

Crisis: Financing Water and Wastewater,
W82-06641 6C

Apparatus for Desalinating Water,
W82-06711 3A

Ultraviolet Systems in Water Treatment,
W82-06726 5F

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

Complex Sequence Treats Fluctuating Flows,
W82-06814 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 5F

WATER TREATMENT FACILITIES

Water Pollution Control Plant Upgraded to Meet EPA Regs.
W82-06187 5D

Design Considerations in Waterworks Pumps Selection,
W82-06343 8C

Variable Frequency Drives - Some Application Principles,
W82-06345 8C

Water Supply and Distribution in Larger Communities,
W82-06413 5F

WATER TRETMENT

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

WATER USE

Cost-Based Water Rate Design,
W82-06277 6C

Truckee Meadows Water Use - Present and Future,
W82-06705 3D

WATER USE EFFICIENCY

Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 3C

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 2E

Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 3F

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

WATER USERS
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 6C

WATER WELLS
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

WATER YIELD
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 4C

WATER YIELD IMPROVEMENT
Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 6G

WATERHAMMERS
Resonant Waterhammer: A Case Study,
W82-05981 8C

WATERLOGGING
The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 3F

WATERPROOFING
Watertight Manholes Cut Inflow.
W82-06844 5G

WATERSHED MANAGEMENT
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 4D

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

WATERSHEDS
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

Lag Time for Diverging Overland Flow,
W82-05944 2A

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Calibrating A Mountain Watershed in Wyoming,
W82-06583 2E

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 5B

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 5G

WATERWAYS
Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 6G

WAVE ACTION
Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 8B

Suspended Sediment in a Wave Field,
W82-06527 2J

WAVE HEIGHT
Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

Canadian Wave Climate Study: Organization and Operation,
W82-06393 8B

WAVE PROPAGATION
Canadian Wave Climate Study: Organization and Operation,
W82-06393 8B

Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 8B

Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 8E

WAVES
Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

WEATHER
Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 6B

WEATHER DATA COLLECTIONS
Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F

WEATHER FORECASTING
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 2B

Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 2B

WEATHER MODIFICATION
Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 6B

WEATHER PATTERNS
The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 2B

Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 2B

WEIRS
The V-Shaped Broad-Crested Weir,
W82-06450 8B

The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 8E

WELL DATA
Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 7C

WELL DISCHARGE
Portable Water Elevation Measuring Gage,
W82-06396 7B

WELL HYDRAULICS
On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 8B

Locating Monitoring Wells,
W82-06848 8B

WELL WATER
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

A Guide to Treatment for Bacterial Problems,
W82-06847 5F

WELL YIELD
Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 2F

WELLS
Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 7C

Design of Heat Pump Return Wells,
W82-06294 8C

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

WEST AFRICA
Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 2B

WEST GERMANY
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 8A

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 8D

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre

Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 5B

Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 5E

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 6F

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 5B

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 4A

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 5C

WEST VIRGINIA
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

WHEAT
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

WILD RIVERS
Carrying Capacity for the Illinois River,
W82-05927 6G

WILDERNESS AREAS
Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 6D

WILDLIFE
Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 6D

WILDLIFE HABITATS
Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 6D

WIND
Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

WIND-DRIVEN CURRENTS
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 2H

WIND WAVES
Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

WINDBREAKS
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 2I

WISCONSIN
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

How Appleton Reduced Phosphorus,
W82-06249 5D

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

Cross-Country Force Main.
W82-06640 8G

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 2E

Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 5A

Sampling Characteristics of Macrophyte Biomass,
W82-06779 5A

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

WYOMING
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

Calibrating A Mountain Watershed in Wyoming,
W82-06583 2E

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 2G

X-RAY EMISSION
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

XENOBIOTICS
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

YIELD
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 4A

YORK RIVER
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

ZEOLITES
Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 5D

ZIMBABWE
Zimbabwean Hand Pump Passes Village-Level Endurance Tests.
W82-06606 8C

ZINC
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 5B

Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 5E

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

ZOOPLANKTON
The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 5A

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 5A

ZOOPLANKTON

Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 5C

Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 5C

AUTHOR INDEX

ABAL'YANTS, S. KH.
Canals in Sand Channels,
W82-06196 8B

ABBAN, E. K.
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 5C

ABELIOVICH, A.
Biological Equilibrium in a Wastewater Reservoir,
W82-06282 5D

ABELL, P. I.
Paleoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

ACHTEMEIER, G. L.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

ADAMS, E. E.
Dilution Analysis for Unidirectional Diffusers,
W82-06420 8B

ADAMSON, R. P.
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 5F

ADLER, R. F.
Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 2B

AGG, A. R.
Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 5E

AGGARWAL, P. K.
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

AGIRALIOGLU, N.
Lag Time for Diverging Overland Flow,
W82-05944 2A

AHIPO, Z. M.
A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 6B

AIREY, D.
Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 5B

AL-SAADI, H. A.
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 5C

ALAWI, M. A.
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

ALBERTS, J. J.
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 2K

ALBRIGHT, L. J.
Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 5B

ALDRED, M. I.
Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 5C

ALDRICH, T. E.
Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

ALEXANDER, H. J.
Radioactive Wastes,
W82-06920 5E

ALEXANDER, M.
Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 5B

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 5B

ALEXANDER, S. M.
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

ALEXANDER, W. J. R.
Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 2E

ALLEMAN, J. E.
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

ALLEN, D. W.
Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 2B

ALLEN, R. K.
A Case for Regional Sludge Management,
W82-06993 5E

ALVES, W. J.
Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 2G

ANDERSEN, J. M.
Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

ANDERSEN, M. E.
Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06856 2D

ANDERSON, J. A.
Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 5D

ANDERSON, M. A.
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B

ANDERSON, M. L.
Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

ANDREWS, P. L.
Sewer Maintenance and Rehab Options,
W82-06253 5D

ANGINO, E. E.
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

ANIKEENKO, A. M.
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 2J

AOKI, T.
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

APPLETON, T. P.
Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 6D

ARCHER, B.
The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
W82-06449 8A

ARCHER, P. B. R.
Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

ARFI, F.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

ARNOLD, H.
Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

ARNOLD, L. E.
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 4C

ARON, G.
Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 2A

ARORA, M. L.
How Much Air,
W82-06638 5D

ARTHUR, L. M.
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 6B

ARTIOLA-FORTUNY, J.
Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 5B

ASHLEY, N. V.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

ASKARI, F.
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

ASMAN, W. A. H.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

ASTON, S. R.
Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 5B

ATLAS, D.
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

The Outlook for Precipitation Measurements from Space,
W82-06531 7B

ATTWELL, R. W.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

AUBERT, J.
Sludge Disposal to Sea in France,
W82-06593 5E

AUBERT, M.
Sludge Disposal to Sea in France,
W82-06593 5E

AUER, M. T.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

AVCI, C. B.
Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 5D

AYERS, J. F.
Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 2F

AYERS, M. A.
Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

AZOV, Y.
Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 5D

BABA, K.
Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 5D

BACHMANN, R. W.
Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

BAGBY, J. C.
Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 7C

BAIRD, W. F.
Canadian Wave Climate Study: Organization and Operation,
W82-06393 8B

BAJRAKTAREVIC-DOBRAN, H.
Dispersion in Mountainous Natural Streams,
W82-06357 2E

BAKER, B. L.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

BAKER, J. R.
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

BAKER, K. H.
Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

BALLOU, S. W.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

BANAT, I. M.
Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

BANCROFT, K. C. C.
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

BANERJI, S. K.
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

BANKS, D. J.
The Kielder Transfer Works,
W82-06502 8A

BANSAL, S. K.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

BARAM, M. S.
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

BARBA, D.
Analysis of Large Desalination Plants,
W82-06122 3A

Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

BARFIELD, B. J.
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

BARNES, D.
Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 5D

BARNES, M. J.
Selection of a Sludge Handling Disposal System,
W82-06346 5E

BARNETT, B. B.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

BARNETT, S. M.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 5D

BARR, D. I. H.
Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 8B

BARRANCO, G. S.
The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 3F

BARRON, G. M.
Work Management Standards,
W82-06349 6F

BARRY, J. J. III
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

BARTLETT, W. P. JR.
Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 8B

BASCOM, W.
Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 5C

BASIOUNY, F. M.
Wastewater Irrigation of Fruit Trees,
W82-06008 3C

BATES, T. E.
Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 5E

BATY, R. J.
Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 8A

BAUER, J.
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

BEARD, D. P.
Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 6B

BEBAWI, F. F.
Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 2I

BECK, W.
Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 5C

BECKETT, P. H. T.
Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 5E

BEDIENT, P. B.
Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 5G

BEILOCK, R.
How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 6C

BELICHENCKO, Y. P.
Decontamination of Overland Runoff from Populated Areas,
W82-06980 5D

BELL, C. R.
Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 5b

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

BELL, F. C.
Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

BELL, R. G.
Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 5A

BELL, S. E.
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

BELSER, L. W.
Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 5A

BELT, P. B.
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

BEN-ASHER, J.
Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

BENFIELD, E. F.
Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

BENGTSSON, L.
Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 2E

The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 2C

BENKE, A. C.
Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

BENNETT, J. C.
Planning Sri Lanka's Victoria Scheme,
W82-05979 8A

BERGEN, L. J.
Reregulation on an International River--A Case Study,
W82-06429 6G

BERGERSEN, E. P.
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

BERGH-CHRISTENSEN, J.
Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 8E

BERGMANN, M.
A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

BERNHARDT, H.
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 5F

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 5C

BERRIE, T. W.
The Energy Resources of Kenya,
W82-05978 6D

BERRY, N. S. M.
The Kielder Transfer Works,
W82-06502 8A

BERSCHAUER, W. L.
County Provides a Rural Water Supply System,
W82-06843 3D

BERTA, E.
Heavy Metals in Animals of Lake Balaton,
W82-06284 5C

BESCHTA, R. L.
Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 2G

BETTINGER, G. E.
Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 5F

BEWERS, J. M.
Discharge of Metals from the St. Lawrence River,
W82-06190 5B

BHAGAT, S. K.
Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 5D

BHENDE, S. S. S.
Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 5C

BHOWMIK, N. G.
Carrying Capacity of Flood Plains,
W82-06428 2E

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

BINGHAM, A.
Cave Water--Java's Hidden Resource,
W82-06605 3B

BINGHAM, A. E.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

BISTRICKI, T.
Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

BITTON, G.
Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 5D

BJORNSEN, G.
Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 8D

BLAYLOCK, B. G.
Radioactive Wastes,
W82-06920 5E

BLEVINS, W. T.
Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 5D

BLIND, H.
Safety of Dams (Sicherheit Von Talsperren),
W82-06236 8A

BLISS, P. J.
Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

BLODGETT, J. C.
Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 4A

BLOESCH, J.
Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 2J

BLOMMAERT, W.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

BLOOD, E. R.
Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 5B

BLOOMFIELD, C.
Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

BLUEMKE, C.
Problems and Processes in Water Quality Management,
W82-06147 5G

BLUM, J. L.
Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 5C

BOELHOUWER, C.
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

BOGARDUS, E. R.
Energy Conservation in Municipal Wastewater Plants,
W82-06070 5D

BOGAZZI, D.
Analysis of Large Desalination Plants,
W82-06122 3A

BOGERT, I. L.
Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 5E

BOHAC, C. E.
Dissolved Oxygen in Streams and Reservoirs,
W82-06811 5C

BOISSELLE, E. B.
A Method for Wastewater Treatment System User Cost Allocation, Volume 1: Study Report,
W82-06382 5D
A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 5D

BOITEN, W.
The V-Shaped Broad-Crested Weir,
W82-06450 8B

BOLDUC, P. A.
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

BOLTO, B. A.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

BONDELID, T. R.
Sensitivity of SCS Models to Curve Number Variation,
W82-06631 2A

BONDURANT, J. A.
Furrow Intake Rates and Water Management,
W82-05968 3F

BOOTH, M. G.
The Use of Oxygen in Sewage Treatment,
W82-06262 5D

BORDEAU, L. E.
Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

BORDNER, R. H.
Microbiology: Methodology and Quality Assurance,
W82-06919 5A

BOUTOT, W.
Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

BOYLE, J. S.
Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 2B

BRADE, C. E.
Sludge Tankering Economics - A Fresh Approach,
W82-06076 5E

BRADFIELD, G. E.
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

BRADLEY, B.
A Survey of Aerated Lagoon Performance,
W82-06391 5D

BRAINERD, R. T.
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

BRAKENSIEK, D. L.
Estimating Soil Water Retention from Soil Properties,
W82-06332 2G

BRAMELLER, A.
Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 5F

BRANDANI, V.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

BRAS, R. L.
Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 4A

BRASHEAR, D. A.
Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 5A

BRAUN, R.
Anaerobic Filter Treatment of Molasses Distillery Slope,
W82-06312 5D

BRECK, W. G.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 5B

BRESLER, E.
A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 2G

BRETH, H.
The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 8E

BREVIK, E. M.
Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 5A

BREWER, W. S.
Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

BRIDGER, J. S.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

BRIERLEY, C. L.
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

BRIERLEY, J. A.
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

BRIGHT, G. R.
Secondary Benthic Production in a Tropical Island Stream,
W82-06933 5C

BRINDLEY, P.
A Review of Industrial Effluent Control Experience,
W82-06648 5G

BROADBENT, R. C.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

BROCH, E.
Designing and Excavating Underground Powerplants,
W82-05982 8E

BROCK, R. R.
Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 2F

BROCK, R. W.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

BROCK, T. D.
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

BROMBACH, H.
Flow Control at Stormwater Overflows and Stormwater Tanks (Abflusssteuerung von Regenwasserbehandlungsanlagen),
W82-06633 8C

BROWER, G. R.
Solid Wastes and Water Quality,
W82-06929 5B

BROWN, A.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

BROWN, G.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A
Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

BROWN, L.
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

BROWNLEE, B.
A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 5C

BROZKA, R. J.
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 4C

BRUCE, A. M.
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

BRYAN, K. A.
An Investigation of Some Factors Influencing the Performance of a Recreational Trout Fishery,
W82-06329 6D

BRYERS, J. D.
Dynamics of Biofilm Processes: Methods,
W82-06666 5D

BUBENZER, G. G.
Splash Erosion Modeling: Physical Analysis,
W82-05970 2J

BUCKS, D. A.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

BUDWEG, F. M. G.
Reservoir Planning for Brazilian Dams,
W82-06206 6A

BUIKEMA, A. L. JR.
Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

BULICH, A. A.
A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 5A

BULUSU, K. R.
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

BURGENER, D. B.
Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 5D

BURKE, S. H.
Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 6E

BURNHAM, R. A.
Packaged Plant Treats Turbidity,
W82-06026 5F

BURNS, E.
MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 3A

BUROS, O. K.
Florida Style Water Supply and Treatment,
W82-06027 5F

BURTON, G. A. JR.
Substrate-Associated Microfauna,
W82-06925 5C

BUSCH, J. R.
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

BUSH, P. W.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

BUTZ, B. P.
A Look at Co-Disposal,
W82-06354 5E

BUXTON, H. T.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

BYCROFT, B. M.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

CABRERA, F.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 5A

CALHOUN, L. B.
A Look at Co-Disposal,
W82-06354 5E

CAMP, C. R.
Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 2I

CAMPBELL, J. P.
Environmental Improvement at Port Alice, B. C.,
W82-06515 5C

CAMPBELL, K. L.
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 5D

CANADAY, J. T.
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

CANALE, R. P.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

CANFIELD, D. E.
Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

CANUTI, P.
Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 2E

CARDITO, J. M.
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

CARE, R.
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

CAREY, J. H.
A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 5C

CARIC, D. M.
The Itaipu Hollow Gravity Dam,
W82-06205 8A

CARIGNAN, R.
Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

CARL, C. C.
Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

CARLSON, C. G.
Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

CARLTON-SMITH, C. H.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

CARNS, K. E.
Hazardous Material Spills--Are You Ready,
W82-06417 5G

CARPENTER, T. G.
Planning Sri Lanka's Victoria Scheme,
W82-05979 8A

CARR, J. D.
Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

CARRONDO, M. J. T.
Type a Zeolite in the Activated Sludge Process - I: Treatment Parameters,
W82-06459 5D

CARTER, D. C.
A Review of Industrial Effluent Control Experience,
W82-06648 5G

CARTWRIGHT, K.
Selection of Waste disposal sites,
W82-06550 5E

CARY, S. J.
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

CASSELL, E. A.
Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

CASWELL, B.
Locating Monitoring Wells,
W82-06848 8B

CCHESNIN, L.
Aquaculture for Waste Management,
W82-06556 5D

CHACKO, V. T.
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

CHADWICK, D. J. JR.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

CHALAM, P. S.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

CHALIFOUR, M. J.
An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 5A

CHALLAIAH,
Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 3F

CHAMBERLIN, R. M.
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

CHAMBERS, W.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

CHAN, C. H.
Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 5A

CHAN, K. Y.
The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 3F

CHANDLER, I. M.
Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 5A

CHANDRA, D.
Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 3F

CHANDRA, S.
Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

CHANG, H. H.
Mathematical Model for Erodible Channels,
W82-06336 2J

CHANG, H-M.
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

CHANG, H. N.
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 3A

CHANG, W. Y. B.
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 5C

CHANGNON, S. A. JR.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 6B

CHARACKLIS, W. G.
Dynamics of Biofilm Processes: Methods,
W82-06666 5D

CHASE, J. A.
Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

CHATURVEDI, G. S.
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

CHAU, A. S. Y.
National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 5B

National Interlaboratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 5A

CHAU, Y. K.
Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

CHAUDHRY, T.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

CHAUDHURI, M.
Removal of Inorganic Mercury from Water by Bitmuminous Coal,
W82-06265 5D

CHEN, B.
Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 2F

CHEN, C. W.
Acid Rain Model: Hydrologic Module,
W82-06360 5B

CHERRY, D. S.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

CHERRY, J. A.
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 5B

CHERY, D. L. JR.
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 8B

CHIAN, E. S. K.
Organics,
W82-06922 5A

CHIAUDANI, G.
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 5C

CHIESA, S. C.
Fermentation Industry,
W82-06917 5D

CHIN, C. T.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

CHIRLIN, G. R.
On the Relationship Between Kriging and State Estimation,
W82-06323 7C

CHITTENDEN, D. M. II.
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

CHRISTENSEN, E. R.
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

CHRISTENSEN, G. M.
Effects of Pollution on Freshwater Fish,
W82-06803 5C

CHRISTOVA, R.
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

CHRZANOWSKI, T. H.
Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 2L

CHU, B. C. S.
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

CHU, S. T.
Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

CHURCHLAND, L. M.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

CHYNOWETH, D. P.
Anaerobic Processes,
W82-06923 5D

CIBIK, C.
Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

CINCOTTA, D. A.
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

CIRIELLO, S.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

CIVIT, E. M.
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

CLAIR, T. A.
Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

CLAVEL, R. L.
New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

CLEMMENS, A. J.
Limits for Practical Level-Basin Design,
W82-06452 3F

CLIFFORD, D.
Processes for Removal of Inorganic Contaminants from Water,
W82-06342 5F

CLYDE, E. W.
Allocation of Water for Resource Development,
W82-06839 6D

COATS, D. J.
The Kielder Headworks,
W82-06504 8A

The Kielder Transfer Works,
W82-06502 8A

The Kielder Water Scheme,
W82-06503 8A

COCHRAN, G. F.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

COCKBURN, A.
Discharge to the North Sea,
W82-06248 5E

COCKBURN, A. G.
Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 5E

COGO, N. P.
Antecedent Moisture Condition Probabilities,
W82-06451 2A

COHEN, A.
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

COHN, T.
Systems Analysis,
W82-06997 5G

COLE, E. R.
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

COLEE, C. D.
Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

COLEMAN, D. J.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

COLEMAN, G. C.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

COLESC, T. F.
The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 2E

COLLER, B. A. W.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

COLLIER, K. R.
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

COLLINS, B.
Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

COLVIN, R. B.
Carrying Capacity for the Illinois River,
W82-05927 6G

COLWELL, R. R.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

COMER, D.
How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 6C

CONEY, T. A.
The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

CONRAD, J. R.
Anaerobic Processes,
W82-06923 5D

CONSTANTINE, T. A.
Advanced Water Treatment for Color and Organics Removal,
W82-06279 5F

CONTRACTOR, D. N.
A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 4B

COOMBS, J.
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

COOPER, J. J.
Secchi Disc Relationships,
W82-06627 2H

CORDIVIOLA, S.
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

CORDS, F.
The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 8D

CORMIER, C. J.
Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

CORNEILLE, R. W.
Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

CORNELIUS, G.
Sprinkler Leveler and Wind Compensating Device,
W82-06164 3F

CORSSMIT, C. W.
Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 6C

COSTERTON, J. W.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

COTE, P.
A Method for Wastewater Treatment System User Cost Allocation, Volume 1: Study Report,
W82-06382 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 5D

COTTON, P.
Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 5D

COVER, E.
Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 5G

COWELL, B. C.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

CRANE, S. M.
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

CRAVENS, J. B.
Thermal Effects,
W82-06809 5C

CREUTIN, J. D.
Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 2B

CROLEY, T. E. I.
Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 5G

CROMMELINCK, H.
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

CRONBERG, G.
Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 5C

CROWE, S.
The Landscape of Rutland Water,
W82-06478 6G

CROWLEY, K. D.
Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

CRUZ, E.
Bridging the Water Supply Gap,
W82-06506 8A

CUNNINGHAM, G. L.
A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

CURSTEDT, T.
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

CURTIS, C.
Effects of Pollution on Freshwater Fish,
W82-06803 5C

DAHL, B. W.
How to Set Up a Preventive Maintenance Program,
W82-06264 5D

DAKERS, J. L.
Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

DAKSHINI, K. M. M.
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 5C

DALE, L.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 3E

DALTROPHE, N. C.
Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 3A

DALY, P. G.
High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

DAMEZ, F.
Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 5G

DANIEL, T. C.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

DARDEN, D.
Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 7C

DAUKAS, P.
Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

DAVIES, A. W.
Laboratory Services in Regional Water Authorities,
W82-06256 5G

DAVIES, J. A.
Potential Evaporation in the Peace Region of British Columbia,
W82-06528 2D

DAVIES, M.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

DAVIES, R. W.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

DAVIES, S. H. R.
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

DAVIES, T. R. H.
Lower Flow Regime Bedforms: Rational Classification,
W82-06421 2E

DAVIS, E. M.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

DAVIS, R. D.
Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-05646 5E

DAVIS, R. L.
Potential Evaporation in the Peace Region of British Columbia,
W82-06528 2D

DAVOREN, W. T.
Tragedy of the San Francisco Bay Commons,
W82-06182 6E

DAWSON, V. K.
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 5A

DAY, F. P.
Methane Flux in the Great Dismal Swamp,
W82-06840 2H

DE ARAMBARRI, P.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 5A

DE BOER, T.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 5A

DE HAAN, H.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 5A

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

DE MEL, I. D. T.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

DE, S. K.
Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

DE SMET, W. H. O.
Observations on the Immature Chironomidae of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 5G

DEACON, G. B.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

DEACON, J. E.
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

DEAN, C. H.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

DEAN, J. D.
Acid Rain Model: Hydrologic Module,
W82-06360 5B

DEAN, J. M.
Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 2J

DEBROVOL'SKAYA, Z. N.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

DECOURSEY, D. G.
Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 2F

DEDRICK, A. R.
Limits for Practical Level-Basin Design,
W82-06452 3F

DEINFANTE, A.
Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 5C

DELONG, L. L.
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

DELUISE, F. J.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 5D

DELWICHE, J. T.
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

DEMALACH, Y.
Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

DEMISSIE, M.
Carrying Capacity of Flood Plains,
W82-06428 2E

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

DEMONSABERT, S. M.
Antecedent Moisture Condition Probabilities,
W82-06451 2A

DENCE, C. W.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

DENOYELLES, F.
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

DENTEL, S. K.
Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 5D

DEPARASIS, O. A.
Water Conservation at Wastewater Treatment Plants,
W82-06512 3C

DEPINTO, J. V.
Aquatic Sediments,
W82-06806 2J

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
W82-06829 5B

DESHPANDE, C. M.
Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 5C

DESMARAIS, D. J.
Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 2H

DEWALLE, D. R.
Acid Precipitation, A Review,
W82-06794 5C

DEWALLE, F. B.
Organics,
W82-06922 5A

DEWLING, R. T.
New Directions in Water Pollution Control,
W82-06071 5G

DHARMASIRI, J. K.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

DHARMAWARDENA, K. G.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

DI GIACOMO, G.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

DIAZ, E.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 5A

DICKINSON, R. E.
Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 6C

DIETZ, F.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflacheuwasser),
W82-06023 5A

DIGGINS, M. R.
Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 5C

DIGGS, R. E.
Apparatus for Desalinating Water,
W82-06711 3A

DILORETO, G. E.
Regional Detention Basins for Stormwater Control,
W82-06225 8A

DIMMICK, J. F.
Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 5C

DINNEL, P. A.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

DIRAR, H. A.
Microbiological Examination of Sebeel Water,
W82-06882 5C

DIRICKX, J.
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

DIXON, K. R.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

DIXON, L. S.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

DOBROVOL'SKAYA, Z. N.
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 2H

DOLLING, H.
The Challenge of Upgrading Roadside Rest Areas,
W82-06845 5G

DOMENICO, P. A.
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 2F

DOUGLAS, A. V.
On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 2B

DRAGE, B. E.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

DRAKE, J. C.
Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 2K

DRISCOLL, C. T.
Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 2K

DROWN, D. B.
Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

DRUFUCA, G.
A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 7B

DUCKLOW, H. W.
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

DUCKSTEIN, L.
Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 6A

DUFOUR, A. P.
Disease Outbreaks Caused by Drinking Water,
W82-06928 5C

DUKE, K. M.
Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 5A

DUNNE, A.
Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 7C

DUNNE, T.
Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

DUPIES, D.
Problems and Processes in Water Quality Management,
W82-06147 5G

DWYER, D. F.
Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

DYER, T. G. J.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 2B

DYHOUSE, G. R.
Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

EAGLES, B. G.
Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 5C

EAGLESON, P. S.
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 2I

EARLEY, J. J.
Erosion Control at a Delicate Highway Construction Site,
W82-06510 4D

EASLEY, R. S.
Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 5D

EAST, J. W.
The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 2E

EBE, S. C.
Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 3C

ECK, T. H.
The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

ECKERMAN, J.
The Outlook for Precipitation Measurements from Space,
W82-06531 7B

EGESTAD, B.
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

EGGELESTON, G.
Problems and Processes in Water Quality Management,
W82-06147 5G

EGOZY, Y.
Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 3A

EIFERT, W. H.
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

EIGENHEER, L. P.
The Itaipu Hollow Gravity Dam,
W82-06205 8A

EISEL, L. M.
Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

EISENHAUER, R. J.
Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

EL-GAMAL, I.
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

EL-KOBBIA, T.
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

EL-NASHAR, ALI M.
Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 5D

EL-NENNAH, M.
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

ELDER, R. A.
Pump Sump Design Experience: Summary,
W82-06419 8C

ELLENDER, R. D.
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 5D

ELLIOT, R. L.
Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 3F

ELLIOTT, A. L.
Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 7A

ELLIOTT, J. C.
A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

ELLIS, B. K.
Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

ELLIS, D. D.
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

ELLIS, J.
Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 5D

ELLIS, S. R.
Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 5C

ELMORE, J. L.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

EMMERMANN, D. K.
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 3A

EMRICH, G. H.
Ground Water,
W82-06807 5B

ENGEL, S.
Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 4A

ENGELBERT, E. A.
Incentives and Institutions for Water Conservation,
W82-05922 3D

ENGLAND, E. C.
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

ENGLEHART, P. J.
On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 2B

ENGLISH, M. J.
Designing for Deficit Irrigation,
W82-06334 3F

ENO, J. M.
Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 5E

EPIKHOV, G. P.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

EPPINGER, K. H.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

ERICKSON, R. E.
A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 5A

ERICSSON, B.
Salbukh Reverse Osmosis Plant on Stream,
W82-06127 3A

ERIE, L. J.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

ESCHNER, T. R.
Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

ESCOBAR, L. A.
The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 2E

ESOGBUE, A. O.
A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 6B

EUSTACHE, H.
Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

EVANS, D. D.
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 2G

EVANS, R. H.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

EVEREST, F. H.
Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 8I

FABRIS, H.
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

FAGAN, D. A.
Landspreading of sludge in New York State,
W82-06557 5E

FALK, W. H.
Water Conservation at Wastewater Treatment Plants,
W82-06512 3C

FANNIN, K. F.
Anaerobic Processes,
W82-06923 5D

FASOL, K. H.
Simulating and Improving Hydro Plant Control,
W82-06202 8C

FAUP, G.
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 5D

FEDERER, C. A.
Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

FEDORAK, P. M.
A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

FEDOSEEV, E. A.
Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

FELDMAN, C. L.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

FENNER, L. B.
The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 3E

FENTON, G. G.
Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121 3A

FERGUSON, A. J. D.
Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 2H

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

FERGUSON, J. A.
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

FERRANTE, J. G.
A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

FERRARA, R. A.
Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 5D

FERRO, V. A.
Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 5B

FIDDES, D.
Sewerage: Priorities for Action,
W82-06260 8G

FIELD, R.
An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 5G

Status of Porous Pavement Research,
W82-06665 8G

Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

FIELDER, P. W.
The Energy Resources of Kenya,
W82-05978 6D

FIKSDAL, L.
Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 5F

FILATOVA, T. N.
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 2H

FINDEIS, J. L.
Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

FIRESTONE, B. M.
Statistical Cost Function for Water Mains,
W82-06252 6C

FIX, G. J.
Finite Element Approximations to Flow Problems,
W82-06730 8B

FLAATE, K.
Cold Regions Engineering in Norway,
W82-06000 8A

FLANAGAN, M. J.
An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 5A

FLIERMANS, C. B.
Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 5F

FOERSTER, R. E.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

FOGARASI, S.
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 2C

FOGHT, J. M.
A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

FONTVIEILLE, D.
A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 5C

FORCELLA, L. S.
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

FORD, D. B.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

FORD, D. T.
Reservoir Systems Optimization,
W82-06433 4A

FORDHAM, J. W.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 3D

FOSCOLO, P. U.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

FOSTER, G. R.
Subsurface Drainage Effects on Erosion,
W82-06795 4D

FOSTER, R. B.
Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 5A

FOURNIER, R. B.
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 2K

FOWLER, L. C.
Urban Creekside Design Features Parallel Streets,
W82-06184 4C

FOX, K.
Getting Your Money's Worth from Filtration,
W82-06412 5F

FOX, M. E.
A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 5C

FRANCKO, D. A.
UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

FRANK, A. B.
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 2I

FRANK, H. D.
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A

FRANKLIN, M.
Bacteria Under the Ice,
W82-06561 5A

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

FRAPE, S. K.
The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 2F

FRASER, JAMES H.
Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 3A

FREDERICK, V. R.
Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 5C

FREEDMAN, S. D.
Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

FRENCH, J. A.
Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 5E

FRENCH, O. F.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

FRENCH, R. H.
Secchi Disc Relationships,
W82-06627 2H

FREUDBERG, S.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

FRILIGOS, M.
Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 5B

FRISCHE, R.
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 5B

FRITZ, P.
The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 2F

FROLOV, N. M.
Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 7C

FROST, R. C.
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

FUCHS, D.
Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 5E

FUJIMOTO, M.
Studies on Syntheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 3A

FULLER, R. H.
Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 7C

FULLER, W. H.
Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 5B

FULTON, G. P.
Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

FULTON, J. L.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

FUNG, C.
The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 2B

FUNKE, B. R.
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

FURNESS, C. D.
How Equitable Are Effluent Charges,
W82-06074 6C

FUSSELL, J.
Who Owns Nebraska's Ground Water,
W82-06819 6E

FYNSK, A. W.
Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 5F

GAILLARD, J. M.
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 4A

GALLICO, A.
The Itaipu Hollow Gravity Dam,
W82-06205 8A

GAMBHIR, S. P.
Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 5D

GANDER, G. A.
Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 4A

GANNETT, M. W.
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

GARBER, W. F.
Sludge Disposal to Sea: North American Viewpoint,
W82-06598 5E

GARDNER, W. S.
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

GARLOCK, C.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

GAROFANO, J. S.
Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 5C

GARRISON, W. E.
Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 5D

GARRITY, G. M.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

GARVEY, E. T.
Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

GARVINE, R. W.
A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 2L

GARWOOD, P. E.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

GAUTHIER, M. J.
Sludge Disposal to Sea in France,
W82-06593 5E

GEESEY, G. G.
Marine and Estuarine Pollution,
W82-06808 5C

GEIGER, G.
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 5D

GELDREICH, E. E.
Microbiology: Water,
W82-06924 5B

GENETELLI, E. J.
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

GEORGAKAKOS, K. P.
Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 4A

GEORGE, A. B.
Devon Floods and the Waterways of Bridges,
W82-05948 8A

GEORGE, D. B.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

GEORGIEV, A. A.
Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

GERARDI, M. H.
Components for a Treatment Plant Safety Program,
W82-06992 5G

Water Conservation at Wastewater Treatment Plants,
W82-06512 3C

GERBA, C. P.
Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 5A

Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 5A

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

GERMANA', A.
Analysis of Large Desalination Plants,
W82-06122 3A

GEROFI, J. P.
Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121 3A

GERSHON, M.
Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 6A

GHERINI, S. A.
Acid Rain Model: Hydrologic Module,
W82-06360 3B

GHOSH, M. M.
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

GIANELLI, W. R.
Count on Uncle Sam Less,
W82-05998 6C

GIAQUINTA, A. R.
Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 5G

GIBS, J.
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 5B

GIJBELS, R.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

GILBERT, K. C.
TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 4A

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 4A

GILLILAND, E. J.
Crisis: Financing Water and Wastewater,
W82-06641 6C

GILLILAND, M. W.
The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 3E

GILLOOLY, J. F.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 2B

GILMOUR, J. T.
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

GINNOCCHIO, J. C.
Metal Removal 'A La Carte',
W82-06608 5F

GLADYSHEV, M. T.
Numerical Modeling of Unsteady Flows in Open Channels,
W82-06784 7C

GLAVISH, L. I.
Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 5C

GODIN, G.
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

GOGISH, L. V.
Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 8B

GOLDSTEIN, F. J.
Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 5B

GOLDSTEIN, N.
Ocean Dumping Battle Marches On,
W82-06490 5E

GOLDSTEIN, R. A.
Acid Rain Model: Hydrologic Module,
W82-06360 5B

GOODCHILD, M. F.
Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

GORE, J. A.
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

GORGENS, A. H. M.
Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 4A

GORONSZY, M. C.
Nitrogen Removal in Continuous-Flow Sequentially Aereated Activated Sludge Systems,
W82-05950 5D

GOSSETT, J. M.
Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 5D

GOULD, J. P.
The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 5D

GOULD, M. S.
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

GRABOW, W. O. K.
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

GRACE, M. G.
United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 6E

GRAETZ, D. A.
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 5D

GRAHAM, M. J.
Detroit-Style CSO Studies,
W82-06247 5G

GRANLUND, C. P.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 5A

GRANLUND, J. G.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 5A

GRANT, D. M.
Right Place, Time and Technique: Right Sample,
W82-06642 5A

GRAY, D. D.
Antecedent Moisture Condition Probabilities,
W82-06451 2A

GREELEY, D. S.
Leak Location Enters Computer Age,
W82-06018 7A

GREEMAN, T. K.
Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 2F

GREEN, D. D.
Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 6C

GREER, W. T.
Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 5E

GREIF, R.
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 3A

Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 3A

GRENNEY, W. J.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

GRESHAM, C. A.
Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 6B

GRIFFITH, F. P. JR.
Policing Demand Through Pricing,
W82-06352 6D

GRIFFITH, M. J.
Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 5D

GRIMES, D. J.
Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 5B

GRINGARTEN, A. C.
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

GROENEWOLD, J. C.
Comparison of BOD Relationships for Typical Edible and Petroleum Oils,
W82-06458 5D

Dairy Wastes,
W82-06921 5D

GRUNDLER, H. C.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

GUARINO, C. F.
Ocean Disposal Legislation in the United States,
W82-06597 5E

GUERRERA, A. A.
Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 5F

GUERRERO-RUIZ, A.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

GUMMER, W. D.
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

GUO, C-Y.
Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 2J

GUPTA, A. D.
Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 2F

GUPTA, A. K.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

GUPTA, A. S.
M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 5F

GUPTA, V. K.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

GUSEVA, E. V.
An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 4B

GUTHRIE, R. K.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

GUTIERREZ, M.
Portable Water Elevation Measuring Gage,
W82-06396 7B

GVAZAVA, G. N.
Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 8B

GWINN, W. R.
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 8B

HAACK, T. K.
Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 2E

HAAN, C. T.
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

HAAS, C. N.
Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 5F

HAAS, L. W.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

HADLEY, R. F.
Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 2E

HAFFIELD, N. D.
Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 7C

HAFFNER, G. D.
Physical Process and Eutrophication,
W82-06875 5C

HAKULINEN, R.
Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 5D

HALL, B. B.
Waste Treatment System Retrofitted Within Deadline,
W82-05947 5D

HALL, G. H.
Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 5C

HALL, J. K.
Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 2A

HALL, W. A.
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

HAMDY, Y. S.
Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 5C

HAMEED, H. A.
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 5C

HAMILTON, C. L.
Operating Collection Systems Under Fiscal Stress,
W82-06340 5D

HAMILTON, J. R.
The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 3F

HAMILTON, R. N.
Variable Frequency Drives - Some Application Principles,
W82-06345 8C

HAMMAD, Z. H.
Microbiological Examination of Sebeel Water,
W82-06882 5C

HANKE, S. H.
Crisis: Financing Water and Wastewater,
W82-06641 6C

HANLON, R. D. G.
The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 5C

HARDIN, C.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 3F

HARGETT, C. W. JR.
Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

HARLEMAN, D. R. F.
Hydrothermal Analysis of Lakes and Reservoirs,
W82-06425 2H

HARPER, D. M.
Introduction - Rutland Water 1970-1981,
W82-06482 6B

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 2H

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

HARR, R. D.
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

HARREMOES, P.
Immediate and Delayed Oxygen Depletion in Rivers,
W82-06269 5G

HARRIMAN, R.
Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 5C

HARRINGTON, D. W.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

HARRIOTT, P.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

HARRIS, E. R.
Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 6G

HARRIS, G. P.
Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 5C

HARRIS, G. R.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

HARRIS, K.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

HARRISS, R. C.
Methane Flux in the Great Dismal Swamp,
W82-06840 2H

HARSHBARGER, T. J.
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

HART, B. T.
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

HARVEY, R. W.
Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 5A

HARWOOD, J. M.
Sludge Tankering Economics - A Fresh Approach,
W82-06076 5E

HASAN, S. E.
Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 6A

HASHIMOTO, T.
Cost Allocation in Water Resources Development,
W82-06854 6C

HASSETT, J. P.
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B

HATTORI, A.
Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

HAVE, M. R.
Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

HAY, D.
Pump Sump Design Experience: Summary,
W82-06419 8C

HAYTON, R. D.
The Ground Water Legal Regime as Instrument of Policy Objectives and Management Requirements,
W82-05938 6E

The Law of International Aquifers,
W82-05940 6E

HAYWARD, D.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

HEANEY, J. P.
Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 6C

HEATH, R. T.
UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

HEIDELL, P. A.
Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 6E

HEILMAN, J. L.
Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 7B

HEISINGER, J. F.
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 5C

HEJKAL, T. W.
Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 5A

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

HELD, S.
Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 5C

HELGESEN, J. O.
Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 2F

HELLSTROM, G.
A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 2F

HELVEY, J. D.
Acid Precipitation, A Review,
W82-06794 5C

HELWEG, O. J.
Reservoir Systems Optimization,
W82-06433 4A

HEM, J. D.
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 2K

HENDERSON, K. W.
Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

HENDERSON-SELLERS, B.
Models of Annual Cycles in Lentic Water Bodies,
W82-06483 5G

HENDRICKS, D. W.
Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 5D

HENDRY, G. S.
Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 5C

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 5B

HERDENDORF, C. E.
Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 5C

HERKELMANN, H.
Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

HERRERA, I.
Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 2F

HERRINGTON, P. R.
Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

HESS, A. F.
Selection of a Sludge Handling Disposal System,
W82-06346 5E

HICKMAN, M.
The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 5C

HILBERG, S. D.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

HILDERBRAND, D. C.
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

HILL, D.
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

HILNER, C. A.
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

HILTON, J.
The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 5C

HINKS, R. W.
Reservoir Systems Optimization,
W82-06433 4A

HIROSE, T.
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

HIRSHFIELD, H. I.
Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 5C

HISTI, G.
Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 5A

HITE, J. C.
Economics,
W82-06998 5G

HO, A. K. W.
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

HO, K. W. A.
Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

HO, W. S.
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

HOCH, H. J.
Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 8B

HOCUTT, C. H.
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

HODGKISS, I. J.
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong.
W82-06908 5B

HODGSON, A. S.
The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 3F

HODGSON, J. M.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

HODSON, R. E.
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 2L

HOFSTEE, A. W. M.
Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 5A

HOLDER-FRANKLIN, M. A.
Bacteria Under the Ice,
W82-06561 5A

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 5A

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 5A

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 5A

HOLLAN, E.
Free Surface Oscillations in Lake Kinneret,
W82-06879 2H

HOLMAN, D.
Supplying Water to the Rural Community,
W82-06223 3F

HOLMBERG, A.
Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 5D

HOLMES, P. R.
The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 5G

HOOD, M. A.
Isolation and Characterisation of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 5A

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06748 5C

HOOK, D. D.
Rice Fields of South Caroline: A Resource Inventory and Management Policy Evaluation,
W82-06072 6B

HOPKINS, G. D.
Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

HOPPE, M.
Simulating and Improving Hydro Plant Control,
W82-06202 8C

HORNE, A.
Groundwater Policy: A Patchwork of Protection,
W82-06411 6E

HOUSNELL, G.
Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 5C

HORSTER, M.
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

HOUSE, L. B.
An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 2E

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 2H

HOUSTON, M.
Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

HOWE, C. W.
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

HOWELL, J. N.
Beneficial Disposal of Pickle Liquor,
W82-06486 5D

HUANG, C. -S.
Nitrification Kinetics and Its RBC Application,
W82-06356 5D

HUDSON, H. E. JR.
Low-Dosage High-Rate Direct Filtration,
W82-06416 5F

HUFF, J. E.
Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 5G

HUFF, L. L.
Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 5G

HUGHES, D. A.
Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 4A

HULTQUIST, N. B.
Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-03914 2H

HUNT, F. L.
Performance of Modified Chlorine Contact Chamber,
W82-06359 5D

HURST, T. J.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

HUSS, S.
Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 5D

HUSSEIN, M. T.
Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 2E

HUSSEINY, A.
A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 3A

HUSSEINY, A. A.
MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 3A

HUTCHINSON, I.
Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

HVITVED-JACOBSEN, T.
The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 5C

HWANG, C. J.
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

IDEL, K. -H.
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 8A

ILLANGASEKARE, T. H.
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

IMBRIGIOTTA, T. E.
Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 5B

INGRAM, H. A. P.
Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 2G

INKINA, G. A.
Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 5C

INNISS, W. E.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

INO, H.
Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 5D

INO, R.
Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 5D

INOUE, T.
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

IP, S. Y.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

IRVINE, R. L.
Fermentation Industry,
W82-06917 5D

IRVING, W. M.
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

ISHIZUKA, T.
Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 5A

The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 5D

IZAGUIRRE, G.
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

JACKSON, M. B.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 5C

JACKSON, M. D.
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

JACKSON, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 2A

JACOBS, R. B.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

JACOBS, S. F.
Liquid Level Interferometer,
W82-05929 7B

JACOBY, J. M.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

JAEGGI, M. N. R.
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 2J

JAGIELO, T. H.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

JAIN, S. C.
Application of SCS Infiltration Model,
W82-06872 4D

JAISWAL, S.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

JALURIA, Y.
Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 5C

JAMES, L. D.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

JANES, D.
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

JANGI, M. S.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

JANHURST, S.
Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 5C

JANUS, L. L.
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 7C

JARRELL, S. L.
Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 5F

JEN, W. C.
Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 5A

JENKINS, W. J.
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

JENSEN, A. L.
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

JERGER, D. E.
Anaerobic Processes,
W82-06923 5D

JERVIS, R. E.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

JEVONS, C.
Ultraviolet Systems in Water Treatment,
W82-06726 5F

JEWELL, W. J.
Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 5D

JHA, K. P.
Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 3F

JOBSON, H. E.
Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 2D

JOHNSON, D. W.
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

JOHNSON, L. S.
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

JOHNSON, M. G.
Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 2G

JOHNSON, R.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

JOHNSON, R. A.
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 5D

JOHNSON, R. K.
Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

JOHNSTON, R.
Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 5D

JOHNSTON, R. H.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well–Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

JONE, C. M.
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

JONES, D. B.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

JONES, F.
Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 5B

JONES, J. R.
Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 5C

JONES, K.
Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 5C

JONES, M. L.
Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 5B

JONES, P. D.
Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 5B

JONES, R. A.
Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 5C

JONES, S. B.
Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 4A

JORGENSEN, D. G.
Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 2A

JOSEPH, E. S.
Municipal and Industrial Water Demands of Western U.S.,
W82-06463 6D

JOSHI, M. G.
The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

JOYCE, T. W.
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

JUDD, L. B.
Problems and Processes in Water Quality Management,
W82-06147 5G

JUDKINS, J. F. JR.
Textile Wastes,
W82-06916 5D

JURY, W. A.
A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 2G

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 2G

KABRICK, R. M.
Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 5D

KADABA, P. K.
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 5A

KAERGAARD, H.
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

KAINULAINEN, H.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

KALFF, J.
Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

KALMAN, D.
Organics,
W82-06922 5A

KAMAL, I.
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 3A

KAMPE, D.
Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 6F

KANEKO, T.
Bacteria Under the Ice,
W82-06561 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 5A

KANG, I. S.
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 3A

KARL, T. R.
The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 2B

KARUBE, I.
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

KATOH, S.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

KATZ, P. G.
Antecedent Moisture Condition Probabilities,
W82-06451 2A

KAVVAS, M. L.
Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

KAY, D.
New Problems with Upland Waters,
W82-06602 5G

KEARNS, P. K.
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens),
W82-06904 5B

KEDDIE, A. W. C.
The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 5D

KEECH, D. K.
Design of Heat Pump Return Wells,
W82-06294 8C

KELLY, J. M.
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

KELSH, D. J.
Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

KEMP, P. R.
A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

KEMPER, W. D.
Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 3F

Furrow Intake Rates and Water Management,
W82-05968 3F

KENARANGUI, R.
A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 3A

KENNEDY, R. H.
Reservoir Water Quality Sampling Design,
W82-06868 2H

KESSLER, E.
On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 2B

KESTING, R. E.
The Development of Dry-RO Membranes from Cellulosic and Noncellulosic Polymers Bearing Quaternary Ammonium Groups,
W82-06152 3A

KESWICK, B.
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

KETTLE, D.
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

KEUNE, H.
Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 3E

KFIR, R.
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 5D

KHABAKPHASHEVA, YE. M.
Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 8B

KHAN, I. A.
A Model for Managing Irrigated Agriculture,
W82-06584 5G

KIEFER, J. E.
Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

KIHLSTROM, M.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

KILADZE, R. M.
Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 3F

KIM, I. H.
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 3A

KIM, S.
Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 3F

KIMMEL, B. L.
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

KIMMERER, W. J.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

KINCAID, D. C.
Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 3F

KINCANNON, D. F.
Rotating Biological Contactor Scale-Up and Design,
W82-06344 5D

KING, G. M.
Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 5C

KING, N. J.
Implications for the Water Industry of the Notification Scheme for New Chemicals,
W82-06261 6E

KING, P. H.
Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F

KING, R. P.
Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

KINSLEY, K. R.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

KINZEL, R.
Domes, Bubbles, and Paper Waste,
W82-06025 5D

KIPP, J. S.
A Legacy from Construction Grants,
W82-06251 5D

KIRCHMAN, D. L.
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

KIRK, P. W. W.
The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 5D

KIRSHEN, P. H.
Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 6E

KITCHENS, J. F.
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

KITE, G. W.
Analysis of Lake Victoria Levels,
W82-06201 2H

KJELBERG, R.
Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 8E

KJELSTROM, L. C.
A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 2E

KLASSEN, V. I.
Prospects of Using Magnetic Wastewater Treatment,
W82-06989 5D

KLEIN, H.
Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 5B

KLIMOWICZ, H.
The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 5A

KLOPFFER, W.
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 5B

KLOPP, R.
Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

KLUG, M. J.
Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 5C

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

KNAPP, H. V.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

KNAUSS, J.
Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 8B

KNIGHTS, E. A.
Rutland Water - From Conception to Operation,
W82-06481 6D

KNOCKE, W. R.
Electroplating and Cyanide Wastes,
W82-06798 5D

KNOPPERT, P. L.
The Biesbosch Water Storage Scheme,
W82-06014 8A

KNOWLES, R.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

KNOX, J. C.
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

KNUCKLES, M. E.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

KNUTH, S.
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 5B

KOCH, C. M.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

KOERS, D. A.
Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D

KOHLER, A.
Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem),
W82-06913 5C

KOHLI, B.
Physical Process and Eutrophication,
W82-06875 5C

KOIKE, I.
Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

KOKERNAK, R. P.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

KOOPMAN, B.
Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 5D

KOOTTATEP, S.
Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 5F

KOPPE, P.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

KOPSICK, D. A.
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

KORNATZKI, K. H.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

KORNGOLD, E.
Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 5A

KORYAVOF, P. P.
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 2H

KORYAVOV, P. P.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

KOVRIZHNYKH, A. I.
Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 5C

KOZAI, K.
Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

KOZHEVNIKOVA, N. E.
Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

KRAMER, H. A.
Applicability of Light Absorbance as a Measure of Organic Carbon in Humic Lake Water,
W82-06773 5A

KRAMER, R. J. III.
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

KRASNER, S. W.
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

KRASNOZHON, G. F.
Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

KRAUSE, R. E.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

KRISHNAPPAN, B. G.
Suspended Sediment in a Wave Field,
W82-06527 2J

KROFTA, M.
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 5F

KRONIS, H.
Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

KRUGER, L. -R.
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

KRULIKAS, R. K.
Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 7C

KRUTZSCH, W. C.
Design Considerations in Waterworks Pumps Selection,
W82-06343 8C

KUCZERA, G.
Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 2A

Robust Flood Frequency Models,
W82-06319 2E

KUDO, A.
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

KUE, C. Y.
Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

KULP, K. P.
Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 2H

KUMAR, S.
Application of SCS Infiltration Model,
W82-06872 4D

KUNII, H.
Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 5C

KUNJUR, J.
Electroplating and Cyanide Wastes,
W82-06798 5D

KUNKLE, S. H.
Acid Precipitation, A Review,
W82-06794 5C

KUNTZ, K. W.
Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 5A

KUO, C. Y.
Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 5E

KURAMOTO, N.
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

KURATTI, L. G.
Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 5D

KUTZNER, C.
The Value of Inspection Galleries,
W82-06204 8D

KVARATSKHELIYA, L. L.
Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 8B

KVON, V. I.
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 2H

LABAR, G. W.
Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 8I

LABELLE, R. L.
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

LABOUNTY, J. F.
Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

LACEWELL, D.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 3F

LADD, T.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

LAIRD, A. D. K.
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 3A

LAKE, P. S.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

LALIBERTE, P.
Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 5B

LAM, C. S.
Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 2J

LAND, J.
Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 5D

LANDEL, P. A.
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

LANDERS, D. H.
Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 5C

LANDRUM, P. F.
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

LANDSBERGER, S.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

LANFEAR, K. J.
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

LANGELAND, G.
Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 5A

LANYON, R.
Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

LAOHAVIRANIT, L.
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

LAROCHE, M.
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 5D

LARSON, R. A.
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

LARSON, R. J.
A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 5D

LARSSON, P.
Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

LAURENT, E. L.
How Appleton Reduced Phosphorus,
W82-06249 5D

LAW, A.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

LAWS, E. A.
Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 5C

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 5C

LAWSON, P.
A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 6B

LAXEN, D. P. H.
Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 5A

LAZARO, R. C.
Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 2E

LAZERTE, B. D.
Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 5C

LAZORCHAK, J. M.
Substrate-Associated Microfauna,
W82-06925 5C

LEAVITT, J. R. C.
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

LECKIE, J. O.
Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 5A

LECOMTE, R.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

LECROY, S. R.
Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

LEDERMAN, T. C.
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

LEE, D. R.
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

LEE, G. F.
Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 5C

LEE, H. B.
National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 5A

LEENHEER, J. A.
Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 7C

LEENTVAAR, J.
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 5D

LEGENDRE, P.
A Water Quality Index for Lake Beaches,
W82-06660 5G

LEGERON, J. P.
Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 5D

LEGGATT, E. A.
Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 5B

LEGGE, W. C. S.
Design Technique Development for Dams in South Africa,
W82-06011 8A

LEHMICKE, L. G.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

LEHRE, A. K.
Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

LEKAN, J. F.
The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

LEMKE, A. E.
Effects of Pollution on Freshwater Fish,
W82-06803 5C

LEMLY, A. D.
Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 5C

Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 5C

LENAT, D. R.
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 5C

LENNOX, L. J.
An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 5A

LEPRINCE, A.
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 5D

LESEMAN, W. G.
Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 5D

LESEUR, L.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

LESOUEF, A.
The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 5G

LESTER, J. N.
The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 5D

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 5D

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 5D

LEUNG, P. S. K.
Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

LEUNG, S. Y. T.
Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

LEVNO, A.
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

LEWANDOWSKI, R.
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

LEWANDOWSKI, W.
A Survey of Aerated Lagoon Performance,
W82-06391 5D

LEWIS, B. D.
Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 5B

LEWIS, R. G.
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

LI, N. N.
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

LIBERTI, L.
An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 5D

LIBRACH, A. S.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

LICARI, G. R.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

LIIV, U. R.
Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 8B

LIKENS, G. E.
Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 2K

LINDSEY, A. K.
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 6C

LINDSTROM, E. B.
Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

LINK, M. H.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

LINSMITH, M. J.
A Review of Industrial Effluent Control Experience,
W82-06648 5G

LION, L. W.
Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 5A

LIONG, S.-Y.
Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 2F

LIOR, N.
Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 3A

LIOTTA, F. P.
Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

LIOU, J. K.
Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 5C

LIPPERT, T. E.
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

LIPPIATT, B. C.
Water Rates and Residential Water Conservation,
W82-06276 3D

LISAUSKAS, R.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

LIST, R.
The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 2B

LITCHFIELD, J. H.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 5D

LITTLE, L. W.
Bioassays - Procedures and Results,
W82-06810 5A

LITVIN, O. N.
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 2J

LIU, D.
The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 5C

LO, C.
Organics,
W82-06922 5A

LOESER, C. A.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

LOGSDON, G. S.
Getting Your Money's Worth from Filtration,
W82-06412 5F

LOHMAN, L. C.
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

LOITSYANSKII, L. G.
Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 8B

LOMAX, K. M.
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 5D

LOMBARDO, P.
Expanding Options for Greywater Treatment,
W82-06491 5D

LOMEN, D. O.
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

LONG, J. C. S.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

LONGLEY, K. E.
Drinking Water Disinfection,
W82-06341 5F

LOPEZ-GONZALES, J. DE D.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

LORD, W. B.
Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

LORDI, D. T.
Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

LORENZ, R. C.
Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 5C

LORING, D. H.
Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 2K

LOTSPEICH, F. B.
A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 8I

LOVLEY, D. R.
Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

LOW, N. F.
Rutland Water Raw Water Quality - Problems and Management,
W82-06475 5G

LOWHAM, H. W.
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

LOWRY, J. D.
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

LOWTHION, D.
Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

LOZEJ, A.
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 2F

LUCAS, J.
Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

LUE-HING, C.
Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

LUIKEN, R. L.
Water Rate Studies and Rate Making Philosophy,
W82-06222 6C

LUNDSTROM, K.
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 5B

LUPIN, H. M.
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

LY, C. K.
The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 2J

LYATKHER, V. M.
Numerical Methods in Hydraulics,
W82-06614 8B

LYNCH, D. D.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

MACALADY, D. L.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 5A

MACCHIARELLA, G.
A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 7B

MACCUBBIN, A. E.
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 2L

MACDONALD, R. D.
Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 2J

MACDONELL, M. T.
Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 5A

MACIOROWSKI, A. F.
Bioassays - Procedures and Results,
W82-06810 5A

MACLEISH, J. H.
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

MACLEOD, D. C.
Sludge Disposal to Sea in South Africa,
W82-06599 5E

MADDOCKS, S. L.
Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 2H

MAEDA, K.
Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 5C

MAGILL, R. N.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

MAGILLIGAN, F. J.
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

MAGNUSSEN, M. H.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

MAGOUN, A. D.
Reservoir Water Quality Sampling Design,
W82-06868 2H

MAIOLIE, M.
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 6G

MALEY, T. S.
Mineral Law Since Neps,
W82-06582 6E

MALHERBE, A.
The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 5A

MALONE, R. F.
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

MANCINELLI, G.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

MANN, P. G.
Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 5C

MANNING, J. F. JR.
Fermentation Industry,
W82-06917 5D

MANTAI, K. E.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

MARK, D. M.
Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

MARR, G. L.
Environmental Problems and Geothermal Permitting,
W82-06217 6G

MARSH, L.
Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 2H

MARTIN, A. JR.
Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 5B

MARTIN, M. V.
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 6B

MARTIN, S. C.
Aquatic Sediments,
W82-06806 2J

MARTIN, W. R. B.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

MASON, P. J.
The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 8A

MASTERS, H.
Status of Porous Pavement Research,
W82-06665 8G

MATHES, G. M.
Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 5G

MATHUR, R. P.
Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 5D

MATSUMOTO, G.
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A

MATSUMOTO, J.
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

MATSUNAGA, T.
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

MATSUOKA, AND Y.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

MATTHEWS, R. B.
Cost-Based Water Rate Design,
W82-06277 6C

MATTHIJSEN, A. J. C. M.
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

MATTRAW, H. C. JR.
Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 5B

MAURER, D. K.
Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 2F

MAVINIC, D. S.
Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D

MAWDSLEY, J. A.
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 4A

MAYER, L. M.
Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

Retention of Riverine Iron in Estuaries,
W82-06191 5B

MAYFIELD, C. I.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

MAYO, R. I.
Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 8B

MAYS, E. L.
Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 5A

MAYS, L. W.
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 8A

MCANIFF, R.
Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 6A

MCBRIDE, G. B.
Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 5B

MCBRIDE, J. L.
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

MCCLOSKEY, C.
Optimum Use of Chlorine in Circulating Water,
W82-06498 5F

MCCLUNG, E. M.
Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 6B

MCCONNELL, R. K.
Economics,
W82-06998 5G

MCCORMICK, R. F.
Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F

MCCRAY, BY K.
The Federal Response to Ground Water Protection,
W82-06295 6E

Ground Water and the States,
W82-06297 6E

MCCUEN, R. H.
Sensitivity of SCS Models to Curve Number Variation,
W82-06631 2A

MCDONALD, A.
New Problems with Upland Waters,
W82-06602 5G

MCDONNELL, A. J.
A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

MCFETERS, G. A.
Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 2E

MCGRATH, S. P.
Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

MCGUIRE, M. J.
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

MCGUIRE, P. E.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

MCINTYRE, A. D.
Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 5C

MCINTYRE, A. E.
Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 5A

MCINTYRE, G.
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

MCINTYRE, G. T.
Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

MCKINLEY, V. L.
Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 5C

MCMAHON, T. A.
Stochastic Generation of Monthly Streamflows,
W82-06427 4A

MCQUEEN, A. D.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

MCQUEEN, D. J.
A Model for the Design of Hypolimnetic Aerators,
W82-06610 5G

MEADOWS, C. A.
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 5A

MEALS, D. W. JR.
Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

MEARNS, A. J.
Marine and Estuarine Pollution,
W82-06808 5C

MECKES, M. C.
Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 5D

MEEHAN, W. R.
Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 5C

MEHRAN, M.
An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

MEHROTRA, I.
Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 5D

MEIDL, J. A.
PAC Process,
W82-06643 5D

MEIJER, J. A. M.
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

MELBY, C. L.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

MENEGHINI, R.
The Outlook for Precipitation Measurements from Space,
W82-06531 7B

MENJOZ, A.
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

MENJOZ, A. C.
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

MERKEL, S. M.
Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

MERRILL, D. T.
Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

MERSEREAU, R.
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

MESINGER, S.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

MESSING, R. A.
Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 5D

MEYER, M. A.
Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 5F

MEYER, R. L.
Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 5C

MICHAELSON, A. P.
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

MICHAILOV, G.
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

MICHNOWSKY, E.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

MIDDLEBROOKS, E. J.
Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 5D

MIELKE, L. N.
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

MIKHAYLOVA, YE. S.
Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 8B

MILDNER, W. F.
Erosion and Sediment,
W82-06554 2J

MILITEEV, A. N.
Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 5B

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 8B

MILLER, J. A.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

MILLER, N.
County Provides a Rural Water Supply System,
W82-06843 3D

MILLER, R. A.
Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 5B

MILLER, T. G.
Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

MILLER, W. L.
Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 5A

An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 6B

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 6F

MILLIGAN, J. H.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

MILLIKEN, J. G.
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 3C

MILLNER, G. C.
Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 5C

MILLS, A.
Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 5F

MILLS, A. L.
Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

MILLS, E. L.
Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

MILLWARD, G. E.
The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

MILLY, P. C. D.
Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 2G

MILNE, J. A.
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 2J

MING, C. O.
Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 2E

MINNIGH, H. A.
Microbiology: Wastewater Treatment,
W82-06926 5D

MINTZER, O.
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

MITCHELL, D. G.
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

MITCHELL, J. K.
A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A
A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 4D
Splash Erosion Modeling: Physical Analysis,
W82-05970 2J

MITCHELL, K. R.
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

MITROFANOV, G. A.
Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

MITTAL, A. K.
Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 5D

MITTELHAUSER, H.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

MIYAI, K.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

MIYARES, J. R.
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

MOALEM-MARON, D.
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 3A
Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 3A

MOED, J. R.
Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

MOFFA, P. E.
Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

MOFFATT, R. L.
A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 2E

MOHAMED, S. M.
Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 2I

MOISEEV, N. N.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 2A

MOISELLO, U.
Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 2E

MOLINAS, A.
Sediment Transport and Unit Stream Power Function,
W82-06424 2J

MONARO, S.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

MONTAGNA, P. A.
Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 5A

MONTEITH, H. D.
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

MOORE, C. B.
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

MOORE, D. G.
Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 7B

MOORE, J. F.
Polymer Plays Plant Improvement Role,
W82-06250 5D

MOORE, R. K.
The Outlook for Precipitation Measurements from Space,
W82-06531 7B

MOORE, R. L.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

MOORE, R. M.
The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

MOORE, R. V.
The Practical Handling of Water Quality Monitoring Data,
W82-06591 7C

MOREL-SEYTOUX, H. J.
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

MORENO-CASTILLA, C.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

MOREY, E. F.
Maintenance of Analog Instrument systems,
W82-06263 5D

MORGAN, W. S. G.
A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 5A

MORING, J. R.
Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 5C

MORRELL, R. A.
Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

MORRISON, B. R. S.
Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 5C

MORRISON, J. D.
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

MOWER, R. W.
Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 7C

MUCHA, I.
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

MUCKLESTON, K. W.
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

MUDROCH, A
A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

MUIR, D. C. G.
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

MUIR, L. R.
Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 2L

MULL, D. S.
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

MUNAWAR, M.
Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

MUNEMORI, M.
Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

MUNRO, D. S.
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

MURPHY, C. B. JR.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 5C

MURPHY, K. L.
Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

MUSAEV, Z. A.
Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 8A

MUSATOV, A. P.
Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

MUTCH, R.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

MUZAEV, I. D.
Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 8B

MYERS, B.
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 5A

MYERS, E. J.
Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

NABORS, M. W.
Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 3C

NAGASE, H.
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

NAGEL, C. A.
Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 5D

NAGEL, W. H.
Making Chlorination Trustworthy,
W82-06639 5F

NAKAJIMA, K.
The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 5D

NAKAMURA, M.
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

NAKAOKA, A.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

NARKIS, N.
Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

NASSEHZADEH-TABRIZI, A. A.
Subsurface Drainage Effects on Erosion,
W82-06795 4D

NATEN, R. W.
Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 7C

NAUDASCHER, E.
Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen).
W82-06237 8B

NAVARRO, J. M.
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 5D

NAWLAKHE, W. G.
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

NEDWELL, D. B.
Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

NEELY, W. C.
Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

NEGI, V.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

NEIHOF, R. A.
Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 5A

NEIL, J. H.
Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

NEILSON, H. R.
Disposal of Sludge to Sea,
W82-06595 5E

NEIMAN, M.
Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

NELLIS, M. D.
Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 7B

NELSON, G. H.
Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 2E

NEMETH, J. C.
The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

NESLER, T. P.
The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 6G

NESS, G. E.
Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 5C

NEUMAN, S. P.
Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

NEUZIL, C. E.
On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 8B

NICHOLLS, N.
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

NICHOLS, S. A.
Sampling Characteristics of Macrophyte Biomass,
W82-06779 5A

NICHOLSON, S. E.
Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 2B

NIEDERLEHNER, B. R.
Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

NIEMI, R. M.
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 5B

NIGAM, J. P.
Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 5F

NIKIFOROVSKAYA, V. S.
Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 8B

NISHIKAWA, S.
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

NISHIO, T.
Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

NIXON, S. W.
The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 2L

NOGITA, S.
Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 5D

NOORISHAD, J.
An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

NORBERG, T. J.
Effects of Pollution on Freshwater Fish,
W82-06803 5C

NORTON, S. A.
Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

NOVKIRISHKA, M.
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

NURNBERG, H. W.
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

NUSCH, E. A.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

NUSS, G. S.
Designing for Deficit Irrigation,
W82-06334 3F

NYDICK, S.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

O'NEILL, J.
Esholt--Past, Present and Future,
W82-06653 5D

O'NEILL, P. E.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

OBENG, L. A.
The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 5D

OBLED, C.
Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 2B

ODAWARA, Y.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

ODEGAARD, H.
Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 5F

OHMURA, A.
Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 2D

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 2D

OKADA, N.
Cost Allocation in Water Resources Development,
W82-06854 6C

OKIDI, C. O.
Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 6E

OLDHAM, R. S.
Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

OLEM, H.
Coal and Coal Mine Drainage,
W82-06802 5B

OLPIN, O.
Water Law and the Development of Geothermal Resources,
W82-06218 6E

OLSON, R. D.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 2E

ORE, E. L.
Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 8F

OREMLAND, R. S.
Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 2H

ORLOV, N. YA.
Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 8H

ORMEROD, R. J.
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

ORON, G.
Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

OSBORN, C. T.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

OSBORNE, L. L.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

OSBORNE, R. H.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

OSE, Y.
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

OSGOOD, R. A.
Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 2H

OSHIDA, P. S.
Marine and Estuarine Pollution,
W82-06808 5C

OSREDKAR, R.
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 5A

OSTROVERKH, B. N.
Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 8E

OSTRY, R. C.
Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06387 5B

OTSON, R.
Headspace Chromatographic Determination of Water Pollutants,
W82-06016 5A

OUELLET, M.
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 5A

OURTH, D. D.
Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 5C

OVERMAN, A. R.
Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 5D

OWENS, E. M.
Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

OZGEN, C.
Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 3A

Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

PAERL, H. W.
Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

PAGEL, J. E.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

PAL, N.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

PALCIAUSKAS, V. V.
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 2F

PALEN, G. M.
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

PALLER, M. S.
Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 5F

PALMER, F. E.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

PALMER, W. L.
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

PALMERO, S.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Sub-

jected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

PANDEY, M. P.
Removal of Inorganic Mercury from Water by Bituminous Coal,
W82-06265 5D

PANO, A.
Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 5D

PANT, M. C.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

PARADIS, P.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

PARAMASIVAM, R.
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

PARIN, M. A.
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

PARK, S. W.
A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 2A

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 4D

Splash Erosion Modeling: Physical Analysis,
W82-05970 2J

PARK, W. M.
Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 6F

PARKER, D. S.
Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

PARKER, J. I.
A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

PARKER, R. D. R.
Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

PARR, J. F.
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 5E

PARRISH, F. K.
Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

PARRY, T. A.
Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 5D

PASCALE, C. A.
Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 2A

PASSINO, R.
An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 5D

PATEL, D.
Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

PATHAK, B. N.
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

PATRICK, R.
The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

PATWARDHAN, S. V.
M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 5F

PAUL, J. H.
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06859 5A

Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 5A

PAULSON, D. L.
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

PAULSON, L. J.
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

PAVIA, R. A.
Water Supply and Distribution in Larger Communities,
W82-06413 5F

PAYNE, G.
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

PAYNE, G. A.
Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 2H

PECK, J. W.
Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

PEDDER, W. M.
Water Tanks in Reinforced Concrete,
W82-06604 8F

PEET, R. W.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

PEGLOWSKI, L. E.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

PEI, D.
Systems Analysis,
W82-06997 5G

PENROSE, D. L.
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 5C

PENTEK, D. T.
Oxidation Products and Rates of Reaction in the Ozonolysis of Dibenzofuran,
W82-06305 5B

PEOPLES, A. J.
Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

PEREKHREST, S. M.
Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 4C

PEREKHREST, V. S.
Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 4C

PEREZ, H.
Resonant Waterhammer: A Case Study,
W82-05981 8C

PEREZ, R.
Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 7C

PERKINS, M. A.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

PERNA, R. K.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

PERRY, R.
The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 5D

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 5D

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 5D

PERTICA, M.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

PESCOD, M. B.
Major Factors in Sewer Ventilation,
W82-06462 8A

PETERS, J. E.
Reregulation on an International River--A Case Study,
W82-06429 6G

PETERS, R. H.
A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

PETERSON, P. A.
Waste Treatment System Retrofitted Within Deadline,
W82-05947 5D

PETERSON, S. A.
Lake Restoration by Sediment Removal,
W82-06776 5G

PETERSON, W. A.
Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

PETTY, J. A.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 3F

PFEIFFER, E. H.
On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 5A

PFISTER, R. M.
Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F
Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B
Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 5C

PHILIPSON, W. R.
Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 7C

PHILLIPS, G. L.
The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 5C

PICK, F. R.
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

PICKFORD, J.
They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 5F

PICKMERE, S.
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

PICO, R. F.
Comparison of BOD Relationships for Typical Edible and Petroleum Oils,
W82-06458 5D

PIERCE, M. L.
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

PIHLAR, B.
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

PIKE, E. B.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

PIPES, W. O.
Microbiology: Wastewater Treatment,
W82-06926 5D

PITLO, R. H.
The V-Shaped Broad-Crested Weir,
W82-06450 8B

PLATE, E. J.
Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 8B

POLCYN, D. S.
Inorganics,
W82-06999 5A

POLPRASERT, C.
Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 5B

PONCE, V. M.
Accuracy Criteria in Diffusion Routing,
W82-06423 8B

PONZINI, G.
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 2F

PORTER, G. L.
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

PORTER, P. E.
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

POSNER, A.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

POULTON, D. J.
Physical Process and Eutrophication,
W82-06875 5C

PRAKASH, T. M.
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

PRICE, A. C.
Major Factors in Sewer Ventilation,
W82-06462 8A

PROKOPOVICH, N. P.
Terminological Confusion--Lake VS. Reservoir,
W82-06551 2H

PROSEKOV, A. M.
Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 2F

PROZESKY, O. W.
Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 5D

PRUETT, J.
Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 6E

PUGH, C. A.
Bicycle-Safe Grate Inlets Study; Volume 3 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 8B

QUAYLE, R. G.
The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 2B

QUIGLEY, M. A.
Freshwater Macroinvertebrates,
W82-06797 5C

QUINN, R. M.
Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 3A

QURESHI, A. A.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

QURESHI, N.
The Effect of Backwashing Rate on Filter Performance,
W82-06415 5F

RABBEN, S.
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

RAE, J. E.
The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 5B

RAJU, A. P.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

RAMKRISHNADAS, R.
Solid Wastes and Water Quality,
W82-06929 5B

RANKL, J. G.
An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 2G

RAO, D. R. J.
Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 5F

RAO, V. C.
Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 5A

RAPER, W. G. C.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 5D

RAPINAT, M.
Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 5G

RAWLS, W. J.
Estimating Soil Water Retention from Soil Properties,
W82-06332 2G

RAYNOR, L. F.
Bioassays - Procedures and Results,
W82-06810 5A

RAZEM, A. C.
Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 2F

READ, W. A.
Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 2J

REBHUN, M.
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 5D

Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 5A

REDALJE, D. G.
Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 5C

REDDI, G. H. S.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

REDDY, K. R.
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 5D

REDDY, S. R.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

REEBURGH, W. S.
A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 5A

REID, G. W.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

REIJNDERS, H. F. R.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

REINIUS, E.
Statistical Flood Flow Estimation,
W82-05945 2E

REINNARTH, G.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

REISH, D. J.
Marine and Estuarine Pollution,
W82-06808 5C

REMER, J. S.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

RENARD, K. G.
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-0693[illegible] 8B

RENAUD, M.
A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 5C

REVEL, J. L.
Potato and Corn By-Products Used as Cattle Feed,
W82-06488 5E

REYNOLDS, J. H.
Land Application of Wastewater,
W82-06915 5E

RHEAD, M. M.
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

RHEE, G-Y.
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

RHODES, E. G.
Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 2J

RICE, C. P.
Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

RICH, L. G.
A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 5E

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 5D

Low-Cost Treatment of Wastewater,
W82-06506 5D

RICHARD, J. J.
Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

RICHARDSON, B. J.
Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

RICHARDSON, C. A.
Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 2F

RICHMAN, M. B.
Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 2B

RIDDER, T. B.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

RIDGIK, T. A.
Florida Style Water Supply and Treatment,
W82-06027 5F

RIDINGER, D. N.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

RILEY, J. P.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

RIPPEN, G.
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 5B

RIPPEY, B.
Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 5B

RISSER, D. W.
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 3B

RISSLER, P.
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 8A

ROBERSON, C. E.
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 2K

ROBERTS, B.
Drinking Water Disinfection,
W82-06341 5F

ROBERTS, C. P. R.
Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 2E

ROBERTS, J. R.
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 5B

ROBERTS, P. V.
Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

ROBERTS, T. J.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

ROBINSON, W. D.
Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 2B

ROBISON, H. W.
A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 2K

ROBISON, J. H.
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 7A

ROCKE, G.
The Kielder Headworks,
W82-06504 8A

RODDA, D. W. C.
The Practical Handling of Water Quality Monitoring Data,
W82-06591 7C

RODGERS, E. B.
Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 2B

RODI, W.
Experiments on Coaxial Heated Water Discharges,
W82-06422 5B

RODRIGUEZ-ITURBE, I.
The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 2E

RODRIGUEZ, J.
Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

RODRIGUEZ, J. J.
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

RODRIGUEZ-REINOSO, F.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

ROERSMA, R. E.
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

ROGERS, A. N.
Work Potential: An Objective Basis for the Comparison of Desalination Processes,
W82-05977 3A

ROHLICH, G. A.
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

ROLFE, G. L.
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 4C

ROMATZICK, S.
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

ROOS, A.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

ROSEN, R. A.
Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 5A

ROSS, B. D.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

ROSSER, P. A. E.
A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Streptococci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 5D

ROSSIN, A. C.
Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 5D

ROSSMANN, R.
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

ROTH, J. C.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

ROUSE, M. J.
Sewerage: Priorities for Action,
W82-06260 8G

ROUVE, G.
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

ROWE, E. L.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

ROWE, G. T.
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

ROY, D.
Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

RUBIN, A. J.
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

RUBIN, H. E.
Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 5B

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 5B

RUEDIGER, R. A.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

RUFFING, B. J.
Furrow Intake Rates and Water Management,
W82-05968 3F

RUFFLE, N. J.
The Kielder Water Scheme,
W82-06503 8A

RUSHTON, H.
Domes, Bubbles, and Paper Waste,
W82-06025 5D

RUSSEL, H. A.
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

RUSSO, D.
A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 2G

RYBUS, M. H.
Elimination of Odor from Anaerobic Lagoons,
W82-06221 5D

RYDLAND, L. N.
Put Pressure on Sewage,
W82-06732 5D

SABANNAVAR, H. A.
Presedimentation Tanks for High Turbid Raw Water,
W82-06444 5F

SABRI, Z.
A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 3A

SACCO, P. D.
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 5D

SADA, E.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

SAITOU, S.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

SAKAI, S.
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

SALAMA, M. S.
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 2J

SALANKI, J.
Heavy Metals in Animals of Lake Balaton,
W82-06284 5C

SALAS, J. D.
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

SALDADZE, K. M.
Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 5D

SALEH, F. Y.
Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

SALKINOJA-SALONEN, M.
Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 5D

SAMMAN, J.
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 5C

SAMMIS, T. W.
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 2G

SANCHEZ, Y.
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

SANGAL, B. P.
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 2E

SAPOZHNIKOV, V. V.
Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

SARMA, V. V. J.
Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 2K

SARTORIS, J. J.
Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

SARTORY, D. P.
A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Streptococci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 5D

SAUL, G. E.
Reservoir Water Quality Sampling Design,
W82-06868 2H

SAUTY, J. P.
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

SAWICKI, D. S.
Problems and Processes in Water Quality Management,
W82-06147 5G

SAYLER, G. S.
Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 5B

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 5C

SCALISE, M. A.
New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

SCHAEFER, D. H.
Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 2F

SCHAEFFER, D. J.
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 5D

SCHAEFFER, S. L.
A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 5D

SCHEINER, B. J.
Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

SCHELL, H.
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 5F

SCHIEWER, U.
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 5C

SCHLEYPEN, P.
Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

SCHMIDT, H. E. JR.
Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

SCHMIDT, J. W.
Steel Industry Wastes,
W82-06799 5D

SCHMIDTKE, N. W.
Steel Industry Wastes,
W82-06799 5D

SCHMUGGE, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

SCHOENBERGER, R. J.
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 5B

SCHOOF, R. R.
Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 4A

SCHRADER, E. K.
World's First All-Rollcrete Dam,
W82-05999 8F

SCHREINER, J.
Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

SCHROEDER, P. J.
Freezing Processes - The Standard of the Future - An Update,
W82-06115 3A

SCHULTZ, G. A.
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

SCHULZE, R. E.
Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

SCHUMM, S. A.
Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

SCHWARE, R.
Official and Folk Flood Warning Systems: An Assessment,
W82-06077 6F

SCHWARTZ, F. W.
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 5B

SCOTT, D.
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

SCOTT, J. L.
Sediment Transport Study Along a Delta Shoreline,
W82-06553 2J

SCRIVNER, A. E.
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

SEBACHER, D. I.
Methane Flux in the Great Dismal Swamp,
W82-06840 2H

SEHGAL, R. C.
Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 5C

SEINWILL, G. D.
Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

SEITZ, H. R.
Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 5B

SELBY, K.
The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 5G

SELIVANOVA, E. A.
Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

SELL, N. J.
Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

SEMIAT, R.
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 3A

SEMONIN, R. G.
Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 6B

SENIOR, E.
Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 2L

SENKER, K.
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

SEPERS, A.B. J.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

SEPHTON, H. H.
Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 3E

SERAFIM, J. L.
Safety Aspects in the Design and Inspection of Dams,
W82-06203 8A

SERRUYA, S.
Free Surface Oscillations in Lake Kinneret,
W82-06879 2H

SEVUK, A. S.
Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 8B

SHABMAN, L.
Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 6E

SHAHANE, A. N.
Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 5B

SHALER, A. J.
Wastewater Reuse Using Microgas Dispersion Stripping,
W82-05911 5D

SHAMBAUGH, R. L.
The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

SHANE, R. M.
TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 4A

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 4A

SHANNON, E. E.
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

SHARMA, A. P.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

SHARP, J. M. JR.
Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

SHARPE, W. E.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

SHEHATA, A.
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

SHELADIA, V. L.
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 5D

SHELBY, B.
Carrying Capacity for the Illinois River,
W82-05927 6G

SHELDON, S. P.
Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 5C

SHELEF, G.
Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 5D

SHEPARD, T. L.
Waste Treatment System Retrofitted Within Deadline,
W82-05947 5D

SHERE, S. M.
High Rate Biological Treatment of TMP Effluent,
W82-05955 5D

SHERENKOV, I. A.
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 2J

SHERMAN, B.
A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 3F

SHERMAN, J. W.
The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

SHERNOFF, P. K.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06932 4B

SHIARIS, M. P.
Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 5B

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 5C

SHIMIZU, N.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

SHINKAR, G. G.
Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

SHISHOVA, O. N.
Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

SHKOL'NIKOV, S. Y.
Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 8B

SHOUSE, P.
A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 2G

SHULSTAD, R. N.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

SHURLOCK, S. H.
Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 8A

SIDEMAN, S.
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 3A

SIEGERSTETTER, L. A.
Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregresives, Multivariates Multi-Lag-Modell-),
W82-06826 4A

SIEGRIST, T. W.
Chemicals and Allied Products,
W82-06805 5D

SIKORA, L. J.
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 5E

SILVA, M.
Liquid-Liquid Extraction Combined with Atomic-Absorpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 5A

SIMONOV, A. I.
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 2H

SIMS, J. L.
Bioassays - Procedures and Results,
W82-06810 5A

SIMS, R. C.
Bioassays - Procedures and Results,
W82-06810 5A

SINCLAIR, L. R.
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 5D

SINCLAIR, W. C.
Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 7C

SINGER, M.
Status of Porous Pavement Research,
W82-05665 8G

SINGER, P. C.
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

SINGH, V. P.
Comparing Urban Runoff Models,
W82-06447 2A

A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 3F

Lag Time for Diverging Overland Flow,
W82-05944 2A

SINGLETON, F. L.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

SINHA, S. K.
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 2I

SIUDAK, R. V.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 3A

SJOVALL, J.
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

SKAFEL, M. G.
Suspended Sediment in a Wave Field,
W82-06527 2J

SKAGGS, R. W.
Subsurface Drainage Effects on Erosion,
W82-06795 4D

SKRINDE, J. R.
Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 5D

SLABBERT, J. L.
A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 5A

SLACK, D. C.
A Comparison of Three Infiltration Models,
W82-05965 2G

SLACK, J. R.
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

SLANINA, J.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

SLINGERLAND, R.
Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 2E

SMALL, J. G.
Liquid Level Interferometer,
W82-05929 7B

SMELLEY, A. G.
Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

SMIES, M.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

SMIL, V.
China's Agro-Ecosystem,
W82-06019 3B

SMITH, E. D.
Rotating Biological Contactor System Design,
W82-06355 5D

SMITH, E. M.
Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 5A

SMITH, G. S.
Food from Sewage: Prospects and Constraints,
W82-06489 3E

SMITH, J. F.
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

SMITH, P. L.
On the Graphical Presentation of Raindrop Size Data,
W82-06529 2B

SMITH, R. A.
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

SMITH, R. E.
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 8B

SMITH, S.
A Guide to Treatment for Bacterial Problems,
W82-06847 5F

SMITH, S. V.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

SNIDER, E. H.
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

SNIPES, S.
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 4B

SNUDDEN, B. H.
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 5A

SOBSEY, M. D.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

SODERGREN, A.
Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

SOFONIOU, M. C.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

SOKOL, L. J.
Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 5E

SOKOLOVSKAYA, T. F.
Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

SOMEAHSARAII, K.
Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 3E

SOMER, T. G.
Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 3A

Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

SOMMERFELD, M. R.
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 5F

SONI, J. K.
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 5C

SOON, Y. K.
Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 5E

SOREN, J.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 4B

SORENSON, S. K.
Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 7A

SOROOSHIAN, S.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 2A

SOUGHTY, C.
A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 2F

SOULSBY, P. G.
Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

SPANGENBERG, N. E.
Calibrating A Mountain Watershed in Wyoming,
W82-06583 2E

SPEHAR, R. L.
Effects of Pollution on Freshwater Fish,
W82-06803 5C

SPENDLOVE, R. S.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A

SPIEGEL, S. J.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 5C

SPIEGLER, K. S.
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

SPIGARELLI, S. A.
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

SPRINKLE, C. L.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 2F

SPROUL, C. R.
Florida Style Water Supply and Treatment,
W82-06027 5F

SPRUTE, R. H.
Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), I. Laboratory and Field Tests,
W82-06960 5D

SPURRIER, J. D.
Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 2L

SRIKANTHAN, R.
Stochastic Generation of Monthly Streamflows,
W82-06427 4A

SRIVASTAVA, R. C.
Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 2B

SRIVASTAVA, V. J.
Anaerobic Processes,
W82-06923 5D

ST, N.
A Water Quality Index for Lake Beaches,
W82-06660 5G

STALEY, J. T.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 5F

STANFORD, J. A.
Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

STANLEY, R. H.
Water Rate Studies and Rate Making Philosophy,
W82-06222 6C

STANNERS, D. A.
Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

STAUFFER, J. R. JR.
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

STEDINGER, J.
Systems Analysis,
W82-06997 5G

STEFFEN, BY H.
Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 8G

STEPANOV, G. Y.
Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 8B

STEPHENS, D. B.
Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

STEPHENSON, J. B.
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

STERN, D. H.
The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

STERN, M. S.
The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

STEVEN, G. P.
The Moving Interface Problem with Finite Elements,
W82-06546 2L

STEVENSON, D. S.
Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 3F

STEVENSON, L. H.
Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 2L

STEVENSON, R. J.
Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 5C

STIMSON, K. R.
Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 5F

STINSON, K. B.
Hazardous Material Spills--Are You Ready,
W82-06417 5G

STITES, D. L.
Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

STITT, S. C.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

STOBER, Q. J.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

STOERMER, E. F.
Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 5C

STOFFEL, D.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

STOLZY, L. H.
A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 2G

STOVER, E. L.
Petroleum Processing Wastes,
W82-06801 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 5D

Synthetic Fuel Effluents,
W82-06800 5D

STOZEK, A.
Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

STRATHMANN, H.
Membrane Separation Processes,
W82-06445 5D

STROKA, J. G.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

STROUD, S. M.
Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 3C

STULLKEN, L. E.
Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 2A

SUBBA-RAO, R. V.
Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 5B

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 5B

SUBLETTE, K. L.
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

SUBRAMANIAN, V.
Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 2J

SUFFET, I. H.
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 5B

SUGIHARA, M.
Studies on Syntheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 3A

SULLIVAN, M.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

SUNAHARA, H.
The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 5D

SUNG, J.
Organics,
W82-06922 5A

SUZUKI, J.
Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 5A

SUZUKI, S.
Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 5A

Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

SVANBERG, O.
The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 5C

SWALES, S.
Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 8I

SWAMY, A. N.
Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 2K

SWANSON, F. J.
Fire and Geomorphic Processes,
W82-06963 2J

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

SWEENEY, C. E.
Pump Sump Design Experience: Summary,
W82-06419 8C

SWEENEY, R. A.
Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 5C

SYLVESTER, N. D.
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

SYVITSKI, J. P. M.
Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 2J

SZALADOS, J. E.
Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 5C

SZPILMAN, A.
The Itaipu Hollow Gravity Dam,
W82-06205 8A

TABOR, P. S.
Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 5A

TAGGART, C. T.
A Model for the Design of Hypolimnetic Aerators,
W82-06610 5G

TAGLIAFERRI, G.
Analysis of Large Desalination Plants,
W82-06122 3A

TALBOT, J. W.
Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 5B

TAM, T.-Y.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

TANAKA, K.
Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 5A

TAO, P.
Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 6C

TARKPEA, M.
The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 5C

TAYLOR, J. M.
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 5E

TAYLOR, M. K.
Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 5C

TAYLOR, T. T.
The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 5D

TELANG, S. A.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

TELLER, J. P.
Common Facility Treatment of Industrial Wastewaters,
W82-05974 5D

TELLERS, T. E.
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 2I

TEMPERLEY, TOM G.
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 3A

TENT, L.
Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 5E

TERASHIMA, M.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

TERRY, R. E.
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 5D

TESKE, G.
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A

THACKSTON, E. L.
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

THEMELIS, D. G.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

THEURER, F. D.
Accuracy Criteria in Diffusion Routing,
W82-06423 8B

THIERY, D.
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

THIRANAGAMA, P.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

THOMAS, P. A.
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 5B

THOMAS, R. P.
Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 7C

THOMAS, W. O. JR.
An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 2A

THOMMES, M. M.
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

THOMPSON, B. H.
Water Law and the Development of Geothermal Resources,
W82-06218 6E

THOMPSON, J. L.
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

THOMPSON, L. H.
Sludge Disposal to Sea in U.K.,
W82-06292 5E

THOMPSON, S. A.
Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 4C

THOMSON, D. G.
Microprocessors and Computers in Analysis in the Water Industry,
W82-06259 5F

THOMSON, P. A.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

THORNTON, K. W.
Reservoir Water Quality Sampling Design,
W82-06868 2H

THORP, J. H.
Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 5C

THROWER, L. B.
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 5B

TILFORD, N. R.
Power Plant Siting,
W82-06555 6G

TIPPIN, D. L.
Work Management Standards,
W82-06349 6F

TITTLEBAUM, M. E.
Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

TITUS, J. A.
Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B

TOCA, C. G.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 5A

TOETZ, D.
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

TOKAR, E. M.
Environmental Improvement at Port Alice, B. C.,
W82-06515 5C

TOLLEFSON, R.
Environmental Improvement at Port Alice, B. C.,
W82-06515 5C

TOMA, S. A.
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 2J

TOMS, R. G.
The Use of Oxygen in Sewage Treatment,
W82-06262 5D

TONELLATO, P. J.
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

TORGERSEN, T.
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

TORPY, M. F.
Petroleum Processing Wastes,
W82-06801 5D

Synthetic Fuel Effluents,
W82-06800 5D

TOUSSAINT, C. G.
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

TOWNSEND, S.
Ocean Disposal Legislation in the United States,
W82-06597 5E

TRICKER, T. D. A.
The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 5G

TRNKA, W. C.
Packaged Plant Treats Turbidity,
W82-06026 5F

TROJANOWICZ, M.
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

TRULEAR, M. G.
Dynamics of Biofilm Processes: Methods,
W82-06666 5D

TSANG, C. F.
A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 2F

TUNG, Y.-K.
Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 8A

TURK, J. T.
Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 5G

TURNBULL, R. H.
Design and Operation of a Colorimetric Detector Controller,
W82-06656 5A

TURNER, J.
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

TURNER, M. F.
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

TUSEL, G. F.
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 3A

TYAGI, A. K.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

Finite Element Modeling of Streamflow Routing,
W82-05918 2E

UNIONE, A.
MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 3A

URAGAMI, T.
Studies on Syntheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 3A

URIARTE, J.
The Itaipu Hollow Gravity Dam,
W82-06205 8A

UTTON, A. E.
The Development of International Groundwater Law,
W82-05939 6E

V, K.
Heavy Metals in Animals of Lake Balaton,
W82-06284 5C

VACHON, D. T.
Steel Industry Wastes,
W82-06799 5D

VALCARCEL, M.
Liquid-Liquid Extraction Combined with Atomic-Absorptipon Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 5A

VALENTA, P.
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

VALLIS, G. K.
A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 2B

VAN EYBERGEN, G. C.
Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 5C

VAN GENUCHTEN, M. T.
Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 2G

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 2G

VAN GRIEKEN, R.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

VAN HAVEREN, B. P.
An Automated Recording System for Evaporation Pans,
W82-06780 2D

VAN MUNSTER, J.
Effective Project Management,
W82-06328 5D

VAN REES VELLINGA, E.
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

VAN ROSMALEN, G. M.
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

VAN STEENDEREN, R. A.
The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 5A

VAN WEELE, B. J.
Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 6B

VANCOTT, W.
Polymer Plays Plant Improvement Role,
W82-06290 5D

VANDELANNOOTE, R.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

VANLOON, G. W.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 5B

VASILIKIOTIS, G. S.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

VAUX, H. J.
Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

VECCHIA, A. V. JR.
A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 2E

VEIL, J. A.
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

VEIRS JR, S. D.
Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 4D

VERDIN, K. L.
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

VERDONSCHOT, P.F.M.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

VERMA, S. R.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 5C

VERSTEEG, J. H.
Erosion Control at a Delicate Highway Construction Site,
W82-06510 4D

VERVACKE, S. L.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 5A

VESILIND, P. A.
Sludge Management: A Research Update,
W82-06007 5E

VESTAL, J. R.
Effects of Acid on Plant Litter Decomposition in an Arctic,
W82-06737 5C

VETTER, R. J.
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens),
W82-06904 5B

VIARENGO, A.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

VICKERS, R. M.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

VIGG, S.
Secchi Disc Relationships,
W82-06627 2H

VIGHI, M.
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 5C

VIGIL, F. R.
Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 3F

VIK, E. A.
Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 5F

VIKULOVA, L. I.
Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

VILARET, M. R.
Florida Style Water Supply and Treatment,
W82-06027 5F

VIRARAGHAVAN, T.
On-Site Wastewater Management--Recent Trends,
W82-06439 5D

VIRTANEN, M. T.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

VIVONA, M. A.
Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 5D

VLASSOFF, L. T.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

VOERMAN, J.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 5A

VOEVODIN, A. F.
Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 8B

VOGEL, T. S.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

VOGIATZIS, Z.
Performance of Modified Chlorine Contact Chamber,
W82-06359 5D

VOLKOVA, G. V.
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 2H

VOLLENWEIDER, R. A.
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 7C

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 5C

VON BERG, R. L.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

Myths about Freeze Desalting,
W82-06114 3A

VOROPAEV, S. V.
Numerical Methods in Hydraulics,
W82-06614 8B

VORST, P. C.
Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

VOSSOUGHI, M.
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 5D

VOULOUVOUTIS, N. A.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

VREEDENBURGH, E. G. H.
The Biesbosch Water Storage Scheme,
W82-06014 8A

VRIJMOED, L. L. P.
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 5B

WACHS, P.
How Appleton Reduced Phosphorus,
W82-06249 5D

WADDINGTON, J. I.
The Mediterranean Action Plan: Design and Implementation,
W82-06154 5B

WADOWSKY, R. M.
Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 5C

WAGNER, E. G.
Low-Dosage High-Rate Direct Filtration,
W82-06416 5F

WAGNER, J. R.
Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 2A

WAGNER, R. E.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

WAHLISS, W.
Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 4A

WAID, J. S.
Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

WALDEN, R. W.
Wastewater Treatment at an Electrical Generation Station,
W82-05975 5D

WALKER, D. J.
The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 3F

WALKER, D. L.
Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 5E

WALKER, W. R.
Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 3F

WALLBANK, T. E.
Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 5D

WALLER, B. G.
Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 5B

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 5A

WALSH, G. E.
Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 5A

WALSH, J. E.
Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 2B

WALSH, T. W.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 5G

WALSKI, T. M.
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 6C

WALTON, J. R.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

WANDERS, J. B. W.
Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

WANG, C. J. K.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

WANG, C. S.
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 3A

WANG, L. K.
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 5F

WARD, R. L.
Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 5A

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 5D

WARN, A. E.
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 5G

WARNER, T. T.
A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 2B

WARRICK, A. W.
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 2G

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

WASSON, B. E.
Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 7C

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 7C

WATANABE, S.
Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 5D

WATLING, H. R.
Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

WATLING, R. J.
Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

WATSON, K. S.
Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 5D

WEAVER, S. C.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

WEBB, A. H.
Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 2K

WEBBER, E. E.
Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 4A

WEBER, S. F.
Water Rates and Residential Water Conservation,
W82-06276 3D

WEBSTER, S.
Cost-Based Water Rate Design,
W82-06277 6C

WEGMAN, R. C. C.
Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 5A

WEISS, A.
Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F

WEISS, K.
Experiments on Coaxial Heated Water Discharges,
W82-06422 5B

WELCH, C. S.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

WELCH, E. B.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

WELLERSHAUS, S.
Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 5B

WELLS, B. R.
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

WENDT, R. C.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

WENTSEL, R. S.
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

WERNER, J.
Practicable Formulae for the Energy Exchange at the Boundary Layer Between Water Surface and Air (Brauchbare Energieumsatzformeln fur den Grenzbereich Gewasseroberflache/Luft),
W82-06824 2D

WESCHE, A.
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

WESCHE, T. A.
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

WEST, T. R.
Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 6A

WESTLAKE, D. W. S.
A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

WETZEL, K. G.
Effects on Global Supplies of Freshwater,
W82-06733 5C

WEXLER, R.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 5B

WHALEN, G. A.
Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 5D

WHEATON, F. W.
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 5D

WHEELER, R. M. JR.
Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

WHEELER, W.
Bridging the Water Supply Gap,
W82-06508 8A

WHIPPLE, W. JR.
Water Conservation Incentives and Strategy,
W82-05936 3D

WHITE, E.
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 2H

WHITE, E. L.
Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 2A

WHITE, R. G.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 6G

WHITEBLOOM, S.
Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

WHITFIELD, P. H.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 2K

WHITLOCK, C. H.
Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

WHITSON, E.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 3F

WHITTAKER, J. G.
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 2J

WHITTLESEY, N. K.
Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

WHYE, M.
Supplying Water to the Rural Community,
W82-06223 5F

WICHERS, D. L.
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

WIEANDT, H. F.
Myths about Freeze Desalting,
W82-06114 3A

WIEGAND, C.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

WIEGANDT, H. F.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 3A

WIJESINGHE, M. W. P.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

WILD, J.
Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 2A

WILHM, J.
Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 5G

WILKEN, G.
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 3A

WILKES, F. G.
Marine and Estuarine Pollution,
W82-06808 5C

WILLEKE, G. E.
Effects of Urbanization on Stream Ecosystems,
W82-06165 5C

WILLIAMS, D. T.
Headspace Chromatographic Determination of Water Pollutants,
W82-06016 5A

WILLSON, G. B.
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 5E

WILSON, B. N.
A Comparison of Three Infiltration Models,
W82-05965 2G

WILSON, C. R.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

WILSON, D. J.
Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

WILSON, J. R.
Canadian Wave Climate Study: Organization and Operation,
W82-06393 8B

WILSON, R. W.
Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

WINDREM, P. F.
Environmental Problems and Geothermal Permitting,
W82-06217 6G

WINDSHUTTEL, B. A.
Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

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Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

WINFIELD, B. A.
Cellulose Acetate Membranes for the Reverse Osmosis Treatment of, Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 5D

WINTERFIELD, L. A.
Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

WISNIEWSKI, J.
The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 2K

WISSMAR, R. C.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

WIT, K. E.
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 5B

WITHERSPOON, P. A.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

WITTE, C. H.
Overhauling a Water System,
W82-06224 5F

WOLCOTT, S. W.
A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 2B

WOLF, P.
Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

WOLFE, S. N.
Urban Creekside Design Features Parallel Streets,
W82-06184 4C

WONG, P. T. S.
Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

WOOD, E. F.
On the Relationship Between Kriging and State Estimation,
W82-06323 7C

WOODCOCK, A. H.
Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 5C

WOODHAM, W. M.
Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 7B

WOOLSTON, M. E.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 5B

WOOMER, N.
Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 5C

WRIGHT, L. H.
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 5A

WRIGHT, R. M.
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

WU, Y. C.
Rotating Biological Contactor System Design,
W82-06355 5D

WYANT, T.
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 5B

WYNGAARD, G. A.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

YAMAGUCHI, T.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 5D

YANG, C. T.
Sediment Transport and Unit Stream Power Function,
W82-06424 2J

YANOSKY, T. M.
Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 2E

YAPA, P. N. D. D.
Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 2F

YARECHEWSKI, A. L.
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 5B

YATES, D. A.
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

YEATS, P. A.
Discharge of Metals from the St. Lawrence River,
W82-06190 5B

YEE, R. B.
Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 5C

YEN, B. C.
Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 8B

YEVJEVICH, V.
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

YOKOYAMA, Y.
Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 5A

YONKER, S. A.
Sewer Maintenance and Rehab Options,
W82-06253 5D

YOO, K. H.
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 4A

YORTON, R. A.
Florida Style Water Supply and Treatment,
W82-06027 5F

YOSHIDA, S.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

YOUNG, C. E.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

YOUNG, D. M.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

YOUNG, G. J.
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

YOUNG, H. P.
Cost Allocation in Water Resources Development,
W82-06854 6C

YOUNG, M. F.
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

YOUNG, R. A.
A Comparison of Three Infiltration Models,
W82-05965 2G

YOUNG, T. C.
Aquatic Sediments,
W82-06806 2J

YU, V. L.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

YUEN, S.
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 2L

YWEMA, T. S. J.
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

ZAJICEK, O. T.
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

ZANICCHI, G.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 5C

ZATKO, J. R.
Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06938 5D

ZAUKE, G-P.
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 5B

ZELVER, N.
Dynamics of Biofilm Processes: Methods,
W82-06666 5D

ZIEGLER, J. A.
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

ZIMMERMAN, E. A.
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 2A

ZIOBRO, R. J.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

ZOETEMEYER, R. J.
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

ZOLAN, W. J.
Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 5A

[illegible]

WILSON, [illegible]
Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, [illegible] Species of Benthic Macroinvertebrates [illegible]
W[illegible]

[illegible]
Marine and Estuarine Pollution.
W[illegible]

[illegible]

WYNGAARD, G. A.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops edax.
W[illegible]

ORGANIZATIONAL INDEX

AALBORG UNIV. (DENMARK). DEPT. OF ENVIRONMENTAL ENGINEERING.
The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 5C

ACADEMY OF NATURAL SCIENCES OF PHILAELPHIA, PA.
The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 5C

AGENCE FINANCIERE DE BASSIN SEINE-NORMANDIE (FRANCE).
The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 5G

AGRICULTURAL RESEARCH ORGANIZATION, BET DAGAN (ISRAEL). INST. OF SOILS AND WATER.
A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 2G

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. HYDROLOGY LAB.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 7B

AGRICULTURE AND FORESTRY UNIV., VIENNA (AUSTRIA). DEPT. OF APPLIED MICROBIOLOGY.
Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 5D

AGRICULTURE RESEARCH SERVICE, RIVERSIDE, CA. SALINITY LAB.
A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 2G

AKADEMIE DER WISSENSCHAFTEN DER DDR, LEIPZIG. ZENTRALINSTITUT FUER ISOTOPEN- UND STRAHLENFORSCHUNG.
Effects on Global Supplies of Freshwater,
W82-06733 5C

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 6G

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 8B

AKADEMIYA NAUK SSSR, NOVOSIBIRSK. INST. OF HYDRODYNAMICS.
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 2H

Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 8B

AKADEMIYA NAUK URSR, KIEV. INST. OF HYDROMECHANICS.
Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 8E

ALABAMA WATER WORKS, BIRMINGHAM.
Plant Expansion Via High-Rate Pretreatment,
W82-05953 5F

ALASKA UNIV., FAIRBANKS, INST. OF MARINE SCIENCE.
A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 5A

ALBERTA UNIV., EDMONTON. DEPT. OF BOTANY.
The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 5C

ALBERTA UNIV., EDMONTON. DEPT. OF GEOLOGY.
A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 5B

ALBERTA UNIV., EDMONTON. DEPT. OF MICROBIOLOGY.
A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 5A

ALL UNION DESIGNING, SURVEYING, AND SCIENTIFIC RESEARCH INST. HYDROPROJECT, MOSCOW (USSR).
Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 5B

ALL-UNION DESIGNING, SURVEYING AND SURVEYING AND SCIENTIFIC RESEARCH INST. HYDROPROJECT, MOSCOW (USSR).
Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 8B

ALL UNION SCIENTIFIC RESEARCH INST. OF HYDROGEOLOGY AND ENGINEERING GEOLOGY, MOSCOW (USSR).
Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 7C

ALL-UNION SCIENTIFIC RESEARCH INST. OF MARINE FISHERIES AND OCEANOGRAPHY, MOSCOW (USSR).
Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 5C

ALL-UNION SCIENTIFIC RESEARCH INST. OF WATER MANAGEMENT ECONOMICS AND ADMINISTRATION, MOSCOW (USSR).
Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 3F

ALLAHABAD UNIV. (INDIA). DEPT. OF CHEMISTRY.
Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 4D

AMSTERDAM UNIV. (NETHERLANDS).
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 5D

ANDHRA PRADESH AGRICULTURAL UNIV. (INDIA). DEPT. OF AGRONOMY.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 3F

ANDHRA UNIV., WALTAIR (INDIA).
Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 2K

ANGLIAN WATER AUTHORITY (ENGLAND).
The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 2E

Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 5D

ANGLIAN WATER AUTHORITY (ENGLAND). DEPT. OF OPERATIONAL PLANNING.
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 5G

ANGLIAN WATER AUTHORITY (ENGLAND). SCIENTIFIC SERVICES.
Laboratory Services in Regional Water Authorities,
W82-06256 5G

ANGLIAN WATER AUTHORITY, LEICESTERSHIRE (ENGLAND).
Rutland Water - From Conception to Operation,
W82-06481 6D

ANGLIAN WATER AUTHORITY, NORTHAMPTON (ENGLAND). PITSFORD LAB.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 5F

ANGLIAN WATER AUTHORITY, PETERBOROUGH (ENGLAND).
Rutland Water Raw Water Quality - Problems and Management,
W82-06475 5G

ANGLIAN WATER AUTHORITY, PETERBOROUGH (ENGLAND), WELLAND AND NENE RIVER DIV.
Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 2H

ANTWERP UNIV., WILRIJK (BELGIUM). DEPT. OF CHEMISTRY.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 5A

ANTWERP WATER WORKS (BELGIUM). DEPT. OF CIVIL ENGINEERING.
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 8A

ARGONNE NATIONAL LAB., IL.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 5E

ARGONNE NATIONAL LAB., IL. ENERGY AND ENVIRONMENTAL SYSTEMS DIV.
Synthetic Fuel Effluents,
W82-06800 5D

ARHUS AMTSVANDVAESEN (DENMARK).
Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 5C

ARIZONA STATE UNIV., TEMPE. DEPT. OF BOTANY AND MICROBIOLOGY.
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 5F

ARIZONA STATE UNIV., TEMPE. DEPT. OF CHEMISTRY.
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 5D

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER, AND ENGINEERING.
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 2G

Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 5B

ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS AND INDUSTRIAL ENGINEERING.
Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 6A

ARIZONA UNIV., TUCSON. OPTICAL SCIENCES CENTER.
Liquid Level Interferometer,
W82-05929 7B

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 4D

ARKANSAS UNIV., FAYETTEVILLE. WATER RESOURCES RESEARCH CENTER.
A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 2K

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 5C

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 5B

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 2G

ARKANSAS WATER RESOURCES RESEARCH CENTER, FAYETTEVILLE.
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 6D

ARMY CORPS OF ENGINEERS, NEW YORK.
Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 6G

ARMY ENGINEER DISTRICT, BALTIMORE, MD.
Bloomington Lake - Potomac River Water Resources Project,
W82-06183 8A

ARMY ENGINEER DISTRICT, ST. LOUIS, MO.
Sediment Analyses for Urbanizing Watersheds,
W82-06426 2J

ARMY ENGINEER DISTRICT, WALLA WALLA, WA. NORTH PACIFIC DIV.
World's First All-Rollcrete Dam,
W82-05999 8F

ARMY ENGINEERS WATERWATE EXPERIMENT STATION, VICKSBURG, MS.
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 6C

ASIAN INST. OF TECH., BANGKOK (THAILAND).
Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 2F

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 5B

ASSOCIATED INDUSTRIAL CONSULTANTS, BOMBAY (INDIA).
Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 5C

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 5D

ATLANTIC RESEARCH CORP., ALEXANDRIA, VA.
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 5A

AUBURN UNIV., AL. DEPT. OF BOTANY, PLANT PATHOLOGY, AND MICROBIOLOGY.
Factors Affecting Plog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 5D

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 5F

AUSTRALIAN INST. OF MARINE SCIENCE, TOWNSVILLE.
Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 2J

AUSTRALIAN NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF EARTH SCIENCES.
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 2F

AUSTRALIAN NUMERICAL METEOROLOGY RESEARCH CENTER, MELBOURNE.
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 2B

AUSTRALIAN WATER RESOURCES COUNCIL, CANBERRA.
Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 5G

BADGER PAPER MILLS, INC., PESHTIGO, WI.
Domes, Bubbles, and Paper Waste,
W82-06025 5D

BATTELLE COLUMBUS LAB., OH.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 5D

BATTELLE-INST. E.V., FRANKFURT AM MAIN (GERMANY, F.R.).
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 5B

BAYERISCHES LANDESAMT FUER WASSERWIRTSCHAFT, MUINICH (GERMANY, F.R.),
Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Untersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 5D

BAYFIELD LAB. FOR MARINE SCIENCE AND SURVEYS, BURLINGTON (ONTARIO).
Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 2L

BECKMAN INSTRUMENTS, INC., CARLSBAD, CA.
A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 5A

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA). ATLANTIC GEOSCIENCE CENTER.
Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 2J

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA). ATLANTIC OCEANOGRAPHIC LAB.
Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 2K

Discharge of Metals from the St. Lawrence River,
W82-06190 5B

BELORUSSIAN STATE UNIV., MINOK (USSR).
Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 5C

BEN-GURION UNIV. OF THE NEGEV, BEERSHEBA (ISRAEL).
Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 3A

BEN-GURION UNIV. OF THE NEGEV, GEERSHEBA (ISRAEL).
Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 3A

BEN-GURION UNIV. OF THE NEGEV, SDE-BOKER (ISRAEL). JACOB BLAUSTEIN INST. FOR DESERT RESEARCH.
Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 3C

BEN GURION UNIV., SED. BOKER (ISRAEL). LAB. FOR APPLIED ENVIRONMENTAL MICROBIOLOGY.
Biological Equilibrium in a Wastewater Reservoir,
W82-06282 5D

BERGEN COMMUNITY COLL., PARAMUS, NJ. DIV. OF NATURAL SCIENCES AND MATHEMATICS.
Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus).
W82-06003 5C

BIESBOSCH WATER STORAGE CORP. (NETHERLANDS).
The Biesbosch Water Storage Scheme,
W82-06014 8A

BINNIE AND PARTNERS, LONDON (ENGLAND).
Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 2A

BLACK AND VEATCH, KANSAS CITY, MO.
Detroit-Style CSO Studies,
W82-06247 5G

BOCHUM UNIV. (GERMANY, F.R.). DEPT. OF MECHANICAL ENGINEERING.
Simulating and Improving Hydro Plant Control,
W82-06202 8C

BOCHUM UNIV. (GERMANY, F.R.). LEHRSTUHL FUER WASSERWIRTSCHAFT AND UMWELTTECHNIK.
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 2B

BOGERT (CLINTON) ASSOCIATES, FORT LEE, NJ.
Bridging the Water Supply Gap,
W82-06508 8A

BOSTON COLL., CHESTNUT, MA.
Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 6E

BRACKEN AND BARAM, BOSTON, MA.
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 6F

BRAZILIAN NATIONAL COMMITTEE ON LARGE DAMS; AND TECHNICAL COMMISSION ON DAMS AND THE ENVIRONMENT.
Reservoir Planning for Brazilian Dams,
W82-06206 6A

BREMEN UNIV. (GERMANY, F.R.).
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 5B

BRITISH COLUMBIA MINISTRY OF ENVIRONMENT, VICTORIA.
Potential Evaporation in the Peace Region of British Columbia,
W82-06528 2D

BRITISH COLUMBIA UNIV., VANCOUVER.
Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 5D

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF BOTANY.
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 2L

BROWN AND CALDWELL, WALNUT CREEK, CA.
Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 5F

BUNDESFORSCHUNGSANSTALT FUER LANDESKUNDE UND RAUMORDNUNG, BONN (GERMANY, F.R.).
Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 6F

BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES, ORLEANS (FRANCE).
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 4B

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 4B

BUREAU OF LAND MANAGEMENT, BOISE, ID. IDAHO STATE OFFICE.
Mineral Law Since Nepa,
W82-06582 6E

BUREAU OF LAND MANAGEMENT, DENVER, CO.
An Automated Recording System for Evaporation Pans,
W82-06780 2D

BUREAU OF MINES, ROLLA, MO. ROLLA RESEARCH CENTER.
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 5E

BUREAU OF MINES, SPOKANE, WA. SPOKANE RESEARCH CENTER.
Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 5D

BUREAU OF MINES, TUSCALOOSA, AL. TUSCALOOSA RESEARCH CENTER.
Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 5D

BUREAU OF RECLAMATION, DENVER, CO. DIV. OF ATMOSPHERIC RESOURCES RESEARCH.
Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 6G

BUREAU OF RECLAMATION, DENVER, CO., ENGINEERING AND RESEARCH CENTER.
Portable Water Elevation Measuring Gage,
W82-06396 7B

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 3A

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 5G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 2H

Sediment Transport and Unit Stream Power Function,
W82-06434 2J

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 8A

BUREAU OF RECLAMATION, SACRAMENTO, CA. MID-PACIFIC REGION.
Terminological Confusion--Lake VS. Reservoir,
W82-06551 2H

BURNS AND MCDONNELL, KANSAS CITY, MO.
Sewer Maintenance and Rehab Options,
W82-06253 5D

C-E NATCO, TULSA, OK.
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 5D

CALGARY UNIV., ALBERTA. DEPT. OF BIOLOGY.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 5C

CALGARY UNIV., (ALBERTA) KANANASKIS CENTRE FOR ENVIRONMENTAL RESEARCH.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 5B

CALIFORNIA INST. OF TECH. PASADENA. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCE.
Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 5D

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, SACRAMENTO.
Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 6B

CALIFORNIA STATE UNIV., FULLERTON. DEPT. OF CIVIL ENGINEERING.
Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 2F

CALIFORNIA STATE UNIV., LONG BEACH.
Marine and Estuarine Pollution,
W82-06808 5C

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 2F

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 2F

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 2F

CALIFORNIA UNIV., BERKELEY. SEA WATER CONVERSION LAB.
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 3A

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 3A

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Reservoir Systems Optimization,
W82-06433 4A

CALIFORNIA UNIV., LOS ANGELES.
Incentives and Institutions for Water Conservation,
W82-05922 3D

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCE.
Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 6B

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 2G

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 2G

CALOCERINOS AND SPINA CO., LIVERPOOL, NY.
Urban Runoff and Combined Sewer Overflow,
W82-06914 5D

CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY, NJ.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 5D

CAMP, DRESSER AND MCKEE INC., BOSTON, MA.
Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 5E

CANADA CENTER FOR INLAND WATERS, BURLINGTON (ONTARIO).
Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 5A

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 5C

Suspended Sediment in a Wave Field,
W82-06527 2J

CANADA CENTRE FOR INLAND WATER, BURLINGTON (ONTARIO).
A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 5C

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 5B

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 5A

Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 5A

The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 5C

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 7C

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 5A

Steel Industry Wastes,
W82-06799 5D

CANADIAN DEPARTMENT OF SUPPLY AND SERVICES, OTTAWA, ONTARIO. BUREAU OF MANAGEMENT CONSULTING.
Statistical Cost Function for Water Mains,
W82-06252 6C

CANVIRO CONSULTANTS LIMITED, KITCHENER (ONTARIO).
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 5D

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. DEPT. OF MATHEMATICS.
Finite Element Approximations to Flow Problems,
W82-06730 8B

CASE WESTERN RESERVE UNIV., CLEVELAND, OH.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
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Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 2K

CENTRAL RICE RESEARCH INST., CUTTACK (INDIA).
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W82-03971 3F

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Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
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CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, GRENOBLE (FRANCE). INST. DE MECANIQUE.
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CENTRO STUDI TELECOMMUNICAZIONI SPAZIALI E POLITECNICO, MILAN (ITALY).
A Rain Attenuation Model for the Sirio-Shf Experiment,
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CH2M/HILL, ATLANTA, GA.
The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 5A

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Sediment Transport Study Along a Delta Shoreline,
W82-06553 2J

CH2M HILL, GAINESVILLE, FL.
Florida Style Water Supply and Treatment,
W82-06027 5F

CH2M/HILL INC., CORVALLIS, OR.
Effective Project Management,
W82-06328 5D

CH2M/HILL, PORTLAND, OR.
Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 6C

CH2M/HILL, REDDING, CA.
Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 3C

CHARLOTTE-MECKLENBURG UTILITY DEPT., NC.
Operating Collection Systems Under Fiscal Stress,
W82-06340 5D

CHICAGO UNIV., IL. DEPT. OF GEOPHYSICAL SCIENCES.
Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 2B

CINCINNATI UNIV., OH., DEPT. OF BIOLOGICAL SCIENCES.
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CLARKSON COLL. OF TECHNOLOGY, POTSDAM, NY. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Aquatic Sediments,
W82-06806 2J

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
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CLEMSON UNIV., COLUMBIA, SC. BELLE W. BARUCH INST. FOR MARINE BIOLOGY AND COASTAL RESEARCH.
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CLEMSON UNIV., SC. DEPT. OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY.
Economics,
W82-06998 5G

CLEMSON UNIV., SC. DEPT. OF CHEMISTRY AND GEOLOGY.
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W82-06309 4B

CLEMSON UNIV., SC. DEPT. OF ENVIRONMENTAL SYSTEMS ENGINEERING.
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W82-06046 5E

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 5D

Low-Cost Treatment of Wastewater,
W82-06506 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 5D

CLINTON-BOGERT ASSOCIATES, FORT LEE, NJ.
Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 5E

CLYDE, PRATT, GIBBS, AND CAHOON, SALT LAKE CITY, UT.
Allocation of Water for Resource Development,
W82-06839 6D

COASTAL WATER RESEARCH PROJECT, LONG BEACH, CA.
Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 5C

COBA-CONSULPRESA, LISBON (PORTUGAL).
Safety Aspects in the Design and Inspection of Dams,
W82-06203 8A

COCONINO NATIONAL FOREST, FLAGSTAFF, AZ.
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W82-06961 2G

COLORADO COOPERATIVE FISHERY RESEARCH UNIT, FORT COLLINS.
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W82-06402 6G

COLORADO DIV. OF WILDLIFE, FORT COLLINS.
The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 6G

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF BOTANY AND PLANT PATHOLOGY.
Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 3C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 2E

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 5C

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 4B

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 4A

Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 5D

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 5C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF EARTH RESOURCES.
Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 2J

COLORADO UNIV., LONGMONT.
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W82-06629 4C

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, MELBOURNE (AUSTRALIA).
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An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
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COMPAGNIE GENERALE DES EAUX, PARIS (FRANCE).
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CONAN/TEMPERLEY AND ASSOCIATES, JEDDAH (SAUDI ARABIA).
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 3A

CONCENTRATION SPECIALISTS, INC., ANDOVER, MA.
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W82-06125 3A

COOPERATIVE FISHERY RESEARCH UNIT, AMHERST, MASSACHUSETTS
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CORDOBA UNIV. (SPAIN). DEPT. OF ANALYTICAL CHEMISTRY.
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W82-06179 5A

CORNELL UNIV., ITHACA, NY.
Systems Analysis,
W82-06997 5G

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRICULTURAL ENGINERRING.
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W82-06772 5D

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRONOMY.
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W82-06756 5B

CORNELL UNIV., ITHACA, NY. DEPT OF ENVIRONMENTAL ENGINEERING.
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Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
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Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 5B

CORNELL UNIV., ITHACA, NY. SCHOOL OF CHEMICAL ENGINEERING.
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W82-05917 3A

Myths about Freeze Desalting,
W82-06114 3A

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 5D

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
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W82-06370 7C

CORNING GLASS WORKS, NY. RESEARCH AND DEVELOPMENT LABS.
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W82-06005 5D

CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
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CULLEN COLL. OF ENGINEERING, HOUSTON, TX.
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CULP/WESNER/CULP, DENVER, CO.
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Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
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The Energy Resources of Kenya,
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Policing Demand Through Pricing,
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Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits,
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W82-06495 5A

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Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
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Put Pressure on Sewage,
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W82-06016 5A

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Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
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W82-06099 5G

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Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
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A Dynamic System Model for Simulating Sediment Discharge,
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Spatial Coherence of Monthly Precipitation in the United States,
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Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
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Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
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Water Quality and Hydrology in a Coastal Region of the Netherlands,
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Turbidity Maximum and Mud Shoaling in the Weser Estuary,
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Anaerobic Processes,
W82-06923 5D

INSTITUTE OF GEOLOGICAL SCIENCE, LONDON (ENGLAND).
Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 2J

INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).
Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 4A

INSTITUTE OF OCEANOGRAPHIC AND FISHERIES RESEARCH, ATHENS (GREECE).
Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 5B

INSTITUTO NACIONAL DE TECHNOLOGIA INDUSTRIAL, MAR DEL PLATA (ARGENTINA).
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 5D

INSTITUTT FOR ENERGITEKNIKK, KJELLER (NORWAY).
Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 5A

INTERNATIONAL ENVIRONMENTAL CONSULTANTS LTD., ISLINGTON (ONTARIO).
Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 5D

INTERNATIONAL INST. FOR APPLIED SYSTEMS ANALYSIS, LAXENBURG (AUSTRIA).
Cost Allocation in Water Resources Development,
W82-06854 6C

IOWA DEPT. OF TRANSPORTATION, AMES.
The Challenge of Upgrading Roadside Rest Areas,
W82-06845 5G

IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 3G

ISCO, INC., LINCOLN, NE.
Right Place, Time and Technique: Right Sample,
W82-06642 5A

ISTITUTO DI RICERCA SULLE ACQUE, BARI (ITALY).
An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 5D

ISTITUTO DI RICERCA SULLE ACQUE, MILAN (ITALY).
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 5C

JAWAHARLAL NEHRU UNIV., NEW DELHI (INDIA). SCHOOL OF ENVIRONMENTAL SCIENCES.
Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 2J

JOHNSON (BERNARD), INC., HOUSTON, TX.
Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 5D

JYVASKYLA UNIV. (FINLAND). DEPT. OF CELL BIOLOGY.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 5B

KANSAI UNIV., OSAKA (JAPAN). DEPT. OF CHEMISTRY.
Studies on Syntheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 3A

KANSAS STATE UNIV. MANHATTAN. DEPT. OF GEOGRAPHY.
Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 7B

KANSAS WATER RESOURCES RESEARCH INST., MANHATTAN.
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 5B

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 5C

KARLSRUHE UNIV. (GERMANY, F.R.).
Experiments on Coaxial Heated Water Discharges,
W82-06422 5B

KARLSRUHE UNIV. (GERMANY, F. R.). INST. FUER HYDROMECHANICK.
Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen).
W82-06237 8B

KARLSRUHE UNIV. (GERMANY, F. R.). INST. WASSERBAU III.
Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 8B

KAROLINSKA INST. STOCKHOLM (SWEDEN). DEPT. OF PHYSIOLOGICAL CHEMISTRY.
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 5A

KARTOUM UNIV., (SUDAN). DEPT. OF AGRICULTURAL BOTANY.
Microbiological Examination of Sebeel Water,
W82-06882 5C

KENTUCKY UNIV., LEXINGTON. DEPT. OF AGRICULTURAL ENGINEERING.
A Comparison of Three Infiltration Models,
W82-05965 2G

KENTUCKY UNIV., LEXINGTON. DEPT. OF CIVIL ENGINEERING.
Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 2E

KENTUCKY WATER RESOURCES RESEARCH INST., LEXINGTON.
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 6A

KERNFORSCHUNGSANLAGE JUELICH G.M.B.H. (GERMANY, F.R.). DEPT OF CHEMISTRY.
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 5A

KHARTOUM UNIV. (SUDAN). DEPT. OF GEOLOGY.
Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 2E

KINNERT LIMNOLOGY LAB., TIBERIAS (ISRAEL).
Free Surface Oscillations in Lake Kinneret,
W82-06879 2H

KOMENSKEHO UNIV., BRATISLAVA (CZECHOSLOVAKIA).
A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 2F

KOREA ADVANCED INST. OF SCIENCE, SEOUL. DEPT. OF CHEMICAL ENGINEERING.
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 3A

KRAFT, INC., GLENVIEW, IL.
Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 5D

Dairy Wastes,
W82-06921 5D

KREBS (PAUL B.) AND ASSOCIATES, INC., BIRMINGHAM, AL.
Textile Wastes,
W82-06916 5D

KROFTA ENGINEERING CORP., LENOX, MA.
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 5F

KUMAUN UNIV., NAINITAL (INDIA). DEPT. OF ZOOLOGY.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 5C

KUPPER (CHARLES J.), INC., PISCATAWAY, NJ.
Overhauling a Water System,
W82-06224 5F

KURITA WATER INDUSTRIES LTD., YOKOHAMA (JAPAN).
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 5A

KYOTO UNIV. (JAPAN). DEPT. OF CHEMICAL ENGINEERING.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 5F

L'AQUILA UNIV. (ITALY). FACULTY OF ENGINEERING.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 3A

Analysis of Large Desalination Plants,
W82-06122 3A

LA TROBE UNIV., BUNDOORA (AUSTRALIA). DEPT. OF PHYSICAL CHEMISTRY.
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 5A

LAHMEYER INTERNATIONAL G.M.B.H., FRANKFURT AM MAIN (GERMANY, F. R.).
The Value of Inspection Galleries,
W82-06204 8D

LAKE MEAD LIMNOLOGICAL RESEARCH CENTER, LAS VEGAS.
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 6G

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 5C

LANCASTER UNIV., BAILRIGG (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 5B

LANCASTER UNIV. (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 5B

LANCASTER UNIVERSITY (UNITED KINGDOM), DEPARTMENT OF BIOLOGICAL SCIENCES.
Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 5C

LANCHESTER POLYTECHNIC, COVENTRY (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 5D

LEHIGH UNIV., BETHLEHEM, PA. DEPT. OF BIOLOGY.
A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 5B

LEICESTER POLYTECHNIC (ENGLAND). SCHOOL OF LIFE SCIENCES.
Circulation Patterns; Their Investigation and Prediction,
W82-06477 5F

LEICESTER UNIV. (ENGLAND). DEPT. OF ADULT EDUCATION.
Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 2H

Introduction - Rutland Water 1970-1981,
W82-06482 6B

LEICESTER UNIV. (ENGLAND). DEPT. OF ECONOMICS.
Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 6D

LEICESTERSHIRE AND RUTLAND TRUST FOR NATURE CONSERVATION (ENGLAND).
Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 6D

LENINGRAD POLYTECHNIC INST. (USSR).
Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 8B

LIMNOLOGICAL INST., OOSTERZEE (NETHERLANDS). TJEUKEMEER LAB.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 5A

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 5C

LIMNOS LIMITED, TORONTO, ONTARIO.
Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 5C

LINCOLN COLL. (NEW ZEALAND). DEPT OF AGRICULTURAL ENGINEERING.
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 2J

LIVERPOOL UNIV. (ENGLAND). DEPT. OF OCEANOGRAPHY.
Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 5B

LIVERPOOL UNIV. (ENGLAND). DEPT. OF ZOOLOGY.
Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 8I

LOMBARDO AND ASSOCIATES, BOSTON, MA.
Expanding Cptions for Greywater Treatment,
W82-06491 5D

LONDON COLL. (NEW ZEALAND). DEPT. OF AGRICULTURAL ENGINEERING.
Lower Flow Regime Bedforms: Rational Classification,
W82-06421 2E

LOS ANGELES COUNTY SANITATION DISTRICTS, WHITTIER, CA.
Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 5D

LOUGHBOROUGH UNIV. OF TECHNOLOGY (ENGLAND). WEDC GROUP.
They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 5F

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF CIVIL ENGINEERING.
Lag Time for Diverging Overland Flow,
W82-05944 2A

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 5B

LOUISIANA WATER RESOURCES RESEARCH INST., BATON ROUGE.
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 5B

LULEA UNIV. (SWEDEN). DIV. OF WATER RESOURCES ENGINEERING.
Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 2E

LULEAP UNIV. (SWEDEN). DIV. OF WATER RESOURCES ENGINEERING.
The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 2C

LUND UNIV. (SWEDEN). INST. OF LIMNOLOGY.
Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 5C

LUND UNIV. (SWEDEN). LIMNOLOGICAL INST.
Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 5B

MADHYA PRADESH STATE PLANNING BOARD, BHOPAL (INDIA).
Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 5F

MAGYAR TUDOMANYOS AKADEMIA, TIHANY. BIOLOGICAL RESEARCH INST.
Heavy Metals in Animals of Lake Balaton,
W82-06284 5C

MAINE COOPERATIVE FISHERY RESEARCH UNIT, ORONO.
Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 5C

MAINE OFFICE OF ENERGY RESOURCES, AUGUSTA.
Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 6B

MAINE UNIV. AT ORONO. DEPT. OF CIVIL ENGINEERING.
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 5D

MAINE UNIV. AT ORONO. DEPT. OF GEOLOGICAL SCIENCES.
Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 2H

MAINE UNIVERSITY AT ORONO, WALPOLE.
Retention of Riverine Iron in Estuaries,
W82-06191 5B

MAINZ UNIV. (GERMANY, F.R.). HYGIENE INST.
On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 5A

MALCOLM PIRNIE, INC., PARAMUS, NJ.
Selection of a Sludge Handling Disposal System,
W82-06346 5E

MANITOBA UNIV., WINNIPEG. DEPT. OF GEOGRAPHY.
China's Agro-Ecosystem,
W82-06019 3B

MARINE LAB., ABERDEEN (SCOTLAND).
Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 5C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CIVIL ENGINEERING.
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 5D

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 2A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF MICROBIOLOGY.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 5C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF ZOOLOGY.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 5C

MARYLAND UNIV., COLLEGE PARK. WATER RESOURCES RESEARCH CENTER.
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 5D

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 4A

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 2I

Dilution Analysis for Unidirectional Diffusers,
W82-06420 8B

Hydrothermal Analysis of Lakes and Reservoirs,
W82-06425 2H

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 2G

MASSACHUSETTS UNIV., AMHERST. DEPT OF CHEMISTRY.
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 5F

MASSACHUSETTS UNIV., BOSTON. DEPT. OF BIOLOGY.
Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 5B

MATHES (JOHN) AND ASSOCIATES, INC., COLUMBIA, IL.
Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 5G

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 5B

MCGRAW-EDISON CO., N.Y.
Design Considerations in Waterworks Pumps Selection,
W82-06343 8C

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF BIOLOGY.
Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 5C

MEMPHIS STATE UNIV., TN. DEPT. OF BIOLOGY.
Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 5C

MESA ENGINEERING AND SURVEYING CO., INC., MONTROSE, CO.
Packaged Plant Treats Turbidity,
W82-06026 5F

METCALF AND EDDY. INC., BOSTON, MA.
Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 5D

METEOROLOGICAL SATELLITE CENTER, TOKYO (JAPAN).
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 7B

METROPOLITAN COUNCIL, ST. PAUL, MN.
Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 2H

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, RESEARCH AND DEVELOPMENT DEPARTMENT.
Pretreatment Removal Credits: Fact or Fiction,
W82-06207 5G

METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENT, DC.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 6B

MIAMI UNIV., FL.
Malignant Melanoma and Drinking Water Contamination,
W82-05989 5C

MICHIGAN DEPT. OF PUBLIC HEALTH, LANSING.
Design of Heat Pump Return Wells,
W82-06294 8C

MICHIGAN STATE UNIV., HICKORY CORNERS, W. K. KELLOGG BIOLOGICAL STATION.
Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 2H

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 5C

MICHIGAN TECHNOLOGICAL UNIV. HOUGHTON, DEPT. OF CIVIL ENGINEERING.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 5C

MICHIGAN UNIV., ANN ARBOR. GREAT LAKES RESEARCH DIV.
Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 5C

MICHIGAN UNIV., ANN ARBOR. SCHOOL OF NATURAL RESOURCES.
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 5B

MICHIGAN UNIVERSITY, ANN ARBOR. GREAT LAKES RESEARCH DIVISION.
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 5A

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 5C

MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). DEPT. OF CHEMICAL ENGINEERING.
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 3A

MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). DEPT. OF CIVIL ENGINEERING.
Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 8B

MILAN UNIV. (ITALY). INST. OF GEOFISICA.
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 2F

MILITARY ENGINEERING SERVICES, HYDERABAD (INDIA).
Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 5C

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD, LOWESTOFT (ENGLAND). FISHERIES RADIOBIOLOGICAL LAB.
Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 5B

MINISTRY OF RECLAMATION AND WATER MANAGEMENT, MOSCOW (USSR).
Decontamination of Overland Runoff from Populated Areas,
W82-06980 5D

MINISTRY OF TRANSPORT AND PUBLIC WORK, MIDDELBURG (NETHERLANDS). ENVIRONMENTAL RESEARCH DIV.
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 5D

MINISTRY OF TRANSPORT AND PUBLIC WORKS, MIDDLEBURG (NETHERLANDS).
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 5D

MINISTRY OF WORKS AND DEVELOPMENT, HAMILTON (NEW ZEALAND). WATER AND SOIL DIV.
Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 5B

MINNEAPOLIS WATER WORKS, MN.
The Effect of Backwashing Rate on Filter Performance,
W82-06415 5F

MINNESOTA POLLUTION CONTROL AGENCY, ROSEVILLE.
Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 5B

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF ECOLOGY AND BEHAVIORAL BIOLOGY.
Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 5C

MISSISSIPPI UNIV., OXFORD. DEPT. OF CIVIL ENGINEERING.
Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 2F

MISSOURI UNIV.-COLUMBIA. DEPT. OF ATMOSPHERIC SCIENCES.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 2B

MISSOURI UNIV., COLUMBIA. DEPT. OF CIVIL ENGINEERING.
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 5A

MISSOURI UNIV., KANSAS CITY. DEPT. OF BIOLOGY.
The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 5B

MISSOURI UNIV., KANSAS CITY. DEPT. OF GEOSCIENCES.
Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 6A

MISSOURI WATER RESOURCES RESEARCH CENTER, COLUMBIA.
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 5F

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 6B

MOBIL OIL A.G., CELLE (GERMANY, F.R.).
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 3A

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF CHEMISTRY.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 5B

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 2A

Stochastic Generation of Monthly Streamflows,
W82-06427 4A

MONTANA STATE UNIV., BOZEMAN. COLL. OF ENGINEERING.
Dynamics of Biofilm Processes: Methods,
W82-06666 5D

MONTANA STATE UNIV., BOZEMAN. DEPT. OF MICROBIOLOGY.
Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 2E

MONTGOMERY (JAMES M) INC., PASADENA, CA.
How Much Air,
W82-06638 5D

MONTGOMERY (JAMES M.), SALT LAKE CITY, UT.
Land Application of Wastewater,
W82-06915 5E

MOSCOW COMBINED GEOLOGICAL AND GEOPHYSICAL EXPEDITION (USSR).
Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 2F

MOSCOW STATE UNIV. (USSR). INST. OF MECHANICS RESEARCH.
An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 4B

MUNICH UNIV. (GERMANY, F.R.). FACHBEREICH GEOWISSENSCHAFTEN.
Practicable Formulae for the Energy Exchange at the Boundary Layer Between Water Surface and Air (Brauchbare Energieumsatzformeln fur den Grenzbereich Gewasseroberflache/Luft),
W82-06824 2D

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., EDISON, NJ.
Status of Porous Pavement Research,
W82-06665 8G

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 5G

MURRAY STATE UNIV., KY. DEPT. OF BIOLOGICAL SCIENCES.
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 5C

Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 5A

NAIROBI UNIV. (KENYA). INST. FOR DEVELOPMENT STUDIES.
Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 6E

NATAL UNIV., DURBAN (SOUTH AFRICA).
Design and Operation of a Colorimetric Detector Controller,
W82-06656 5A

NATAL UNIV., PIETERMARITZBURG (SOUTH AFRICA).
Digitizing and Routine Analyses of Hydrological Data,
W82-06386 2E

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, CLEVELAND, OH. LEWIS RESEARCH CENTER.
The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 5B

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. GODDARD SPACE FLIGHT CENTER.
Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 2B

The Outlook for Precipitation Measurements from Space,
W82-06531 7B

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, HAMPTON, VA. LANGLEY RESEARCH CENTER.
Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 7C

Methane Flux in the Great Dismal Swamp,
W82-06840 2H

NATIONAL BOARD OF WATERS, HELSINKI (FINLAND).
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 5B

NATIONAL BUREAU OF STANDARDS, WASHINGTON, DC.
Water Rates and Residential Water Conservation,
W82-06276 3D

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.
Official and Folk Flood Warning Systems: An Assessment,
W82-06077 6F

Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 2B

NATIONAL CLIMATIC CENTER, ASHEVILLE, NC.
The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 2B

NATIONAL COLLEGE OF AGRICULTURAL ENGINEERING, SILSOE (ENGLAND).
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 2F

NATIONAL ENVIRONMENT PROTECTION BOARD, STUDSVIK (SWEDEN). BRACKISH WATER TOXICOLOGY LAB.
The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 5C

NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INST., NAGPUR (INDIA).
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 5F

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 5A

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 5A

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 5A

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 5D

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 5A

NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Freshwater Macroinvertebrates,
W82-06797 5C

NATIONAL PHYSICAL RESEARCH LAB., PRETORIA (SOUTH AFRICA). APPLIED SPECTROSCOPY DIV.
Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 5B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 2L

NATIONAL RESEARCH CENTER, CAIRO (EGYPT).
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 2J

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A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 5B

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). DIV. OF BIOLOGICAL SCIENCES.
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 5B

NATIONAL SEVERE STORMS LAB., NORMAN, OK.
On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 2B

NATIONAL WATER COUNCIL, LONDON (ENGLAND).
Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 5E

NATIONAL WATER WELL ASSOCIATION, WORTHINGTON, OH.
A Guide to Treatment for Bacterial Problems,
W82-06847 5F

NAVAL RESEARCH LAB., WASHINGTON, DC.
Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 5A

Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 5A

NAVAL RESEARCH LAB., WASHINGTON, DC. ENVIRONMENTAL SCIENCES DIV.
Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 5A

NEBRASKA UNIV. LINCOLN.
Who Owns Nebraska's Ground Water,
W82-06819 6E

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRONOMY.
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 5B

Aquaculture for Waste Management,
W82-06556 5D

NEBRASKA UNIV., LINCOLN. DEPT. OF CHEMISTRY.
Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 5D

NEBRASKA UNIV. PANHANDLE STATION AT SCOTTSBLUFF.
Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 3F

NEVADA UNIV. SYSTEM, LAS VEGAS. DESERT RESEARCH INST.
Secchi Disc Relationships,
W82-06627 2H

NEVADA UNIV. SYSTEM, RENO. DEPT. OF CIVIL ENGINEERING.
Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 8A

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 3D

NEW MEXICO BUREAU OF MINES AND MINERAL RESOURCES, SOCORRO.
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 5D

NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO. DEPT. OF GEOSCIENCE.
Vadose Zone Permeability Tests: Summary,
W82-06301 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 2G

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A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 3F

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF AGRICULTURAL ENGINEERING.
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 2G

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF ANIMAL, RANGE AND WILDLIFE SCIENCES.
Feed from Sewage: Prospects and Constraints,
W82-06409 5E

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A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 3C

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The Development of International Groundwater Law,
W82-03939 6E

NEW SOUTH WALES DEPT. OF AGRICULTURE, NARRABRI (AUSTRALIA). AGRICULTURAL RESEARCH STATION.
The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 3F

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). SCHOOL OF CIVIL ENGINEERING.
Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 5D

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). SCHOOL OF GEOGRAPHY.
Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 2A

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). LIMNOLOGY LAB.
Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 5B

NEW YORK CITY DEPT. OF ENVIRONMENTAL PROTECTION, BUREAU OF WATER SUPPLY.
Leak Location Enters Computer Age,
W82-06018 7A

NEW YORK STATE DEPARTMENT OF HEALTH, ALBANY. DIV. OF LABS. AND RESEARCH.
Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 5C

NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIV. OF LABS. AND RESEARCH.
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 5B

NEW YORK STATE ENERGY OFFICE, ALBANY.
Energy Conservation in Municipal Wastewater Plants,
W82-06070 5D

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Major Factors in Sewer Ventilation,
W82-06462 8A

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 2J

NORGES VETERINAERHOEGSKOLE, OSLO. DEPT. OF FOOD HYGIENE.
Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 5A

NORTH CAROLINA DEPT. OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, RALEIGH. DIV. OF ENVIRONMENTAL MANAGEMENT.
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 5C

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Subsurface Drainage Effects on Erosion,
W82-06795 4D

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF WOOD AND PAPER SCIENCE.
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 5D

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 5D

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 5F

NORTH CAROLINA UNIV., MOREHEAD CITY. INST. OF MARINE SCIENCES.
Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 5B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF BACTERIOLOGY.
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 5D

NORTH TEXAS STATE UNIV., DENTON. DEPT. OF BIOLOGICAL SCIENCES.
Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 2H

NORTH-WEST WATER AUTHORITY (ENGLAND).
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 5D

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 5D

NORTH WEST WATER AUTHORITY, WARRINGTON (ENGLAND).
Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 5B

NORTH YORKSHIRE COUNTY COUNCIL (ENGLAND).
A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 6B

NORTHEASTERN FOREST EXPERIMENT STATION, DURHAM, NH.
Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 2D

NORTHEASTERN FOREST EXPERIMENT STATION, PARSONS, WV. TIMBER AND WATERSHED LAB.
Acid Precipitation, A Review,
W82-06794 5C

NORTHERN GREAT PLAINS RESEARCH CENTER, MANDAN, ND.
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 2I

NORTHERN MICHIGN UNIV., MARQUETTE. DEPT. OF CHEMISTRY.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 5A

NORTHUMBRIAN WATER AUTHORITY (ENGLAND).
Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 5E

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Nitrification Kinetics and Its RBC Application,
W82-06356 5D

NORVILLE (RODNEY L.) AND CO., HOUSTON, TX.
Cost-Based Water Rate Design,
W82-06277 6C

NORWEGIAN ROAD RESEARCH LAB., OSLO.
Cold Regions Engineering in Norway,
W82-06000 8A

NORWEST HOLST CONSTRUCTION LTD., WATFORD (ENGLANDD).
Water Tanks in Reinforced Concrete,
W82-06604 8F

NOTRE DAME UNIV., IN., DEPT. OF CIVIL ENGINEERING.
Fermentation Industry,
W82-06917 5D

NOVOSIBIRSK STATE UNIV. (USSR).
Numerical Modeling of Unsteady Flows in Open Channels,
W82-06784 7C

O'BRIEN AND GERE ENGINEERS, INC., SYRACUSE, NY.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 5C

O'MELVENY AND MYERS, LOS ANGELES, CA.
Water Law and the Development of Geothermal Resources,
W82-06218 6E

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 5C

Radioactive Wastes,
W82-06920 5E

OBERSTE BAUBEHORDE IM BAYRISCHEN STAATSMINISTERIUM DES INNEREN, MUNICH (GERMANY, F.R.).
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 8A

OFFICE OF THE SECRETARY OF THE ARMY, WASHINGTON, DC.
Count on Uncle Sam Less,
W82-05998 6C

OHIO STATE UNIV., COLUMBUS. DEPT. OF CIVIL ENGINEERING.
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 7C

OHIO STATE UNIV., COLUMBUS. DEPT. OF MICROBIOLOGY.
Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 5C

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 5F

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 5B

OHIO STATE UNIV., COLUMBUS. WATER RESOURCES CENTER.
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 5D

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRICULTURAL ENGINEERING.
Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05989 3F

OKLAHOMA STATE UNIV., STILLWATER, DEPT. OF BOTANY.
UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 5C

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF CIVIL ENGINEERING.
Finite Element Modeling of Streamflow Routing,
W82-05918 2E

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF ZOOLOGY.
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 5C

OKLAHOMA STATE UNIV., STILLWATER. SCHOOL OF BIOLOGICAL SCIENCES.
Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 5G

OKLAHOMA STATE UNIV., STILLWATER. SCHOOL OF CIVIL ENGINEERING.
Rotating Biological Contactor Scale-Up and Design,
W82-06344 5D

Petroleum Processing Wastes,
W82-06801 5D

OKLAHOMA UNIV., NORMAN. BUREAU OF WATER AND ENVIRONMENTAL RESOURCES RESEARCH.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 5D

OKLAHOMA UNIV., NORMAN. DEPT. OF ZOOLOGY.
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 2J

ONTARIO MINISTRY OF THE ENVIRONMENT, REXALE, LIMNOLOGY AND TAXONOMY SECTION.
Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 5C

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE.
Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 5B

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 5C

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 5A

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 5C

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO.
Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 5G

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Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 5D

A Survey of Aerated Lagoon Performance,
W82-06391 5D

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Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 5B

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How to Set Up a Preventive Maintenance Program,
W82-06264 5D

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W82-06510 4D

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMIC.
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 6B

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL ENGINEERING.
Designing for Deficit Irrigation,
W82-06334 3F

OREGON STATE UNIV., CORVALLIS. DEPT. OF GEOGRAPHY.
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 6F

OREGON STATE UNIV., CORVALLIS. SCHOOL OF FORESTRY.
Carrying Capacity for the Illinois River,
W82-05927 6G

ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, PARIS (FRANCE).
Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 5C

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Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 5D

OSLO COMMISSION (NORWAY).
Disposal of Sludge to Sea,
W82-06595 5E

OXFORD UNIV. (ENGLAND). DEPT. OF AGRICULTURAL SCIENCE.
Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 5E

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION, CORVALLIS, OR.
A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 8I

Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 4C

PARSONS, BRINCKERHOFF, QUADE AND DOUGLAS, INC., NEW YORK.
Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 6B

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. COLL. OF AGRICULTURE.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 3D

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING.
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 5G

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 5C

Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 2A

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF GEOSCIENCES.
Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 2E

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF METEOROLOGY.
A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 2B

PENNSYLVANIA UNIV., PHILADELPHIA.
Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 3A

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Rotating Biological Contactor System Design,
W82-06355 5D

PITTSBURGH UNIV., PA. DEPT. OF MICROBIOLOGY.
Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 5C

PLAINVILLE WATER CO., CT.
Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 5G

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Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 5D

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The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 2L

POLICY SCIENCES ASSOCIATES, BOULDER, CO.
Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 3D

POPE SCIENTIFIC INC., MENOMONEE FALLS, WI.
Inorganics,
W82-06999 5A

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Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 5D

POST, BUCKLEY, SCHUH AND JERNIGAN, INC., ORLANDO, FL.
Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 5D

PREECE, CARDEW AND RIDER, BRIGHTON (ENGLAND).
Planning Sri Lanka's Victoria Scheme,
W82-05979 8A

PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
On the Relationship Between Kriging and State Estimation,
W82-06323 7C

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 5D

PROCTER AND GAMBLE CO., CINCINNATI, OH. ENVIRONMENTAL SAFETY DEPT.
A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 5D

PROMON ENGENHARIA, SAO PAULO (BRAZIL).
The Itaipu Hollow Gravity Dam,
W82-06205 8A

PROVINCIAL WATER AUTHORITY, ZWOLLE (THE NETHERLANDS). DEPARTMENT OF WATERSHED MANAGEMENT.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 5B

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF HYDROMECHANICS.
Antecedent Moisture Condition Probabilities,
W82-06451 2A

PURDUE UNIV., LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 6B

PUROPORE, INC., TUSTIN, CA.
The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 3A

QUEEN'S UNIV., KINGSTON (ONTARIO). DEPT. OF CHEMISTRY.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 5B

RESEARCH INST. ON THE ENVIRONMENTAL DEVELOPMENT, WARSAW (POLAND). WATER UTILIZATION DEPT.
The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 5A

REXNORD INC., MILWAUKEE, WI.
Thermal Effects,
W82-06809 5C

RHODE ISLAND UNIV., KINGSTON.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 5D

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CHEMISTRY.
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 2D

RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY.
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W82-06096 2L

RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). HYDROLOGICAL RESEARCH UNIT.
Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 4A

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Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 5G

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Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 5A

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W82-06912 5G

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Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 5E

ROBICON CORPORATION, PITTSBURGH, PA.
Variable Frequency Drives - Some Application Principles,
W82-06345 8C

ROORKEE UNIV., (INDIA).
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W82-06442 5D

ROSTOCK UNIV. (GERMANY, D.R.).
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W82-06763 5C

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN (ENGLAND).
Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 5D

RUHETALSPERRENVEREIN, ESSEN (GERMANY, F. R.).
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 8A

RUHRVERBAND, ESSEN (GERMANY, F.R.). CHEMISCHES UND BIOLOGISCHES LAB.
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 5A

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 5D

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 5G

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Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 5D

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. WATER RESOURCES RESEARCH INST.
Water Conservation Incentives and Strategy,
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New Problems with Upland Waters,
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Models of Annual Cycles in Lentic Water Bodies,
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Mathematical Model for Erodible Channels,
W82-06336 2J

SAN DIEGO STATE UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Accuracy Criteria in Diffusion Routing,
W82-06423 8B

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Tragedy of the San Francisco Bay Commons,
W82-06182 6E

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W82-06184 4C

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Dispersion in Mountainous Natural Streams,
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Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 5B

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W82-06273 2K

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W82-06899 5C

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Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 4A

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Effect of Water Management and Bed Height on Sugarcane Yield,
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W82-06959 8B

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Furrow Intake Rates and Water Management,
W82-05968 3F

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Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 3F

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Limits for Practical Level-Basin Design,
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Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
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On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 2B

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Sludge Tankering Economics - A Fresh Approach,
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The Control of Effluent and Water Quality in an Important Water Supply Catchment,
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Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 5D

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Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 2I

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Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121 3A

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Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 5B

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 5B

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Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 2L

SINGAPORE UNIV. DEPT. OF MICROBIOLOGY.
Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 5A

SMC-MARTIN, KING OF PRUSSIA, PA.
Ground Water,
W82-06807 5B

SOFIA UNIV. (BULGARIA). FACULTY OF CHEMISTRY.
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 5A

SOIL CONSERVATION SERVICE, BOISE, ID.
Habitat Recovery in the North Fork of the Teton River.
W82-06409 6G

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Erosion and Sediment,
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Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
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Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 5A

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On the Graphical Presentation of Raindrop Size Data,
W82-06529 2B

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Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 3C

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Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 5F

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Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 3F

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Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 5C

SOUTHEASTERN FOREST EXPERIMENT STATION, ASHEVILLE, NC.
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 5C

SOUTHERN CALIFORNIA METROPOLITAN WATER DISTRICT, LA VERNE.
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 5F

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Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 3A

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Municipal and Industrial Water Demands of Western U.S.,
W82-06463 6D

SOUTHERN WATER AUTHORITY, OTTERBOURNE (ENGLAND).
Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 5C

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Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 2F

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 5B

STANLEY CONSULTANTS, INC., MUSCATINE, IA.
Water Rate Studies and Rate Making Philosophy,
W82-06222 6C

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Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 5D

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Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 2B

STATE UNIV. OF NEW YORK AT SYRACUSE, COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY.
Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 5B

STATE UNIV. OF NEW YORK COLL. AT FREDONIA, DEPT. OF BIOLOGY.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 5C

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Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 2K

STATE UNIV. OF NEW YORK UPSTATE MEDICAL CENTER, SYRACUSE. DEPT. OF PEDIATRICS.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 5C

STORM- UND HAFENBAU, HAMBURG (GERMANY, F.R.). BEHORDE FUER WIRTSCHAFT, VERKEHR UND LANDWIRTSCHAFT.
Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 5E

STRATHCLYDE REGIONAL COUNCIL, GLASGOW (SCOTLAND).
Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 5E

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Drinking Water Disinfection,
W82-06341 5F

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W82-06635 5B

SUFFOLK COUNTY WATER AUTHORITY, OAKDALE, NY.
Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 5F

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The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
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The Moving Interface Problem with Finite Elements,
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TALLINN POLYTECHNIC INST. (USSR).
Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 8B

TALSPERRENABTEILUNG DES WUPPERVERBANDES (GERMANY, F. R.).
The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 8D

TAMPA WATER DEPT., FL.
Work Management Standards,
W82-06349 6F

TAYSIDE REGIONAL COUNCIL (ENGLAND).
Discharge to the North Sea,
W82-06248 5E

TECHNICAL UNIV. OF DENMARK, LYNGBY. DEPT. OF SANITARY ENGINEERING.
Immediate and Delayed Oxygen Depletion in Rivers,
W82-06269 5G

TECHNICON INSTRUMENTS CO. LTD. (ENGLAND).
Microprocessors and Computers in Analysis in the Water Industry,
W82-06259 5F

TECHNION - ISRAEL INST. OF TECH., HAIFA.
Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 3A

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 5C

TECHNION-ISRAEL INST. OF TECH., HAIFA (ISRAEL).
Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 5D

TECHNION-ISRAEL INST. OF TECH., HAIFA (ISRAEL). DEPT. OF CHEMICAL ENGINEERING.
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 3A

TECHNISCHE HOCHSCHULE, AACHEN (GERMANY, F. R.). INST. FUER WASSERBAU UND WASSERWIRTSCHAFT.
Aeration at Floor Offsets in Bottom Outlets (Belüftung an Sohlsprungen Von Grundablassen),
W82-06242 8C

TECHNISCHE HOGESCHOOL, DELFT (NETHERLANDS).
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 3A

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Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 5C

TECHNISCHE UNIV., BERLIN (GERMANY, F.R.). INST. FUER WASSERBAU UND WASSERWIRTSCHAFT.
Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen),
W82-06243 8B

TECHNISCHE UNIV., MUNICH (GERMANY, F.R.). INST. FUER HYDRAULIC UND GEWASSERKUNDE.
Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 4A

TECHNISCHE UNIV., MUNICH (GERMANY, F. R.). LEHRSTUHL FUER WASSERBAU.
Safety of Dams (Sicherheit Von Talsperren),
W82-06236 8A

TECHNISCHE UNIV., MUNICH (GERMANY, F. R.). VERSUCHSANSTALT FUER WASSERBAU.
Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 8B

TEKNEKRON, INC., BERKELEY, CA.
Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
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TEMPLE UNIV., PHILADELPHIA, PA. COLL. OF ENGINEERING TECHNOLOGY.
A Look at Co-Disposal,
W82-06354 5E

TENNESSEE UNIV., KNOXVILLE. DEPT. OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY.
Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 6F

TENNESSEE UNIV., KNOXVILLE. DEPT. OF MICROBIOLOGY.
Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 5C

TENNESSEE VALLEY AUTHORITY, CHATTANOOGA.
Coal and Coal Mine Drainage,
W82-06802 5B

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 5C

TENNESSEE VALLEY AUTHORITY, NORRIS.
TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 4A

TENNESSEE VALLEY AUTHORITY, NORRIS. WATER SYSTEMS DEVELOPMENT BRANCH.
TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 4A

TETRA TECH. INC., LAFAYETTE, CA.
Acid Rain Model: Hydrologic Module,
W82-06360 5B

TEXAS A AND M UNIV., COLLEGE STATION. REMOTE SENSING CENTER.
Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 7B

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Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 6A

TEXAS UNIV. AT HOUSTON. SCHOOL OF PUBLIC HEALTH.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 5B

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Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 5A

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Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 3F

THAMES WATER AUTHORITY (ENGLAND).
A Review of Industrial Effluent Control Experience,
W82-06648 5G

THAMES WATER AUTHORITY, LONDON (ENGLAND).
Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 5E

Sludge Disposal to Sea in U.K.,
W82-06292 5E

Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 8A

Crisis: Financing Water and Wastewater,
W82-06641 6C

THAMES WATER AUTHORITY, LONDON (LONDON).
Control of Toxic Metals at Sewage Treatment Works,
W82-06592 5E

THESSALONIKI UNIV., SALONIKA (GREECE). LAB. OF ANALYTICAL CHEMISTRY.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 5B

TIERAERZTLICHEN HOCHSCHULE, HANOVER (GERMANY, F.R.). CHEMICAL INST.
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 5A

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Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 5C

TOKYO METROPOLITAN UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 5A

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Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 5A

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Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 5B

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Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 5C

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Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 5A

TORONTO UNIV. (ONTARIO), DEPT. OF GEOGRAPHY.
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 2C

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The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 2B

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Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 5D

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Designing and Excavating Underground Powerplants,
W82-05982 8E

TRONDHEIM UNIV. (NORWAY). DIV. OF HYDRAULIC AND SANITARY ENGINEERING.
Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 5F
Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 5F

TURBITROL CO., ATLANTA, GA.
Maintenance of Analog Instrument systems,
W82-062[illegible]3 5D

TUSKEGEE INST., AL. DEPT. OF AGRICULTURAL SCIENCES.
Wastewater Irrigation of Fruit Trees,
W82-06008 3C

UMWELTBUNDESAMT, BERLIN (GERMANY, F.R.).
Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 5E

UNION CARBIDE CORP., SOUTH CHARLESTON, WV.
Chemicals and Allied Products,
W82-06805 5D

UNIVERITY OF WEST FLORIDA, PENSACOLA. DEPT. OF BIOLOGY.
Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 5C

UNIVERITY OF WESTERN ONTARIO, LONDON. DEPT. OF GEOGRAPHY.
Topologic Model for Drainage Networks with Lakes,
W82-05905 2A

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO. MEXICO CITY. CENTRO DE INVESTIGACIONES EN MATEMATICAS APLICADAS Y EN SISTEMAS.
Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 2F

UNIVERSIDAD NACIONAL DE EDUCATIONAL A DISTANCIA, MADRID (SPAIN).
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 5D

UNIVERSIDAD SIMON BOLIVAR, CARACAS (VENEQUELA)> GRADUATE PROGRAM IN HYDROLOGY AND WATER RESOURCES.
The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 2E

UNIVERSITY COLL. OF SWANSEA (WALES). DEPT. OF OCEANOGRAPHY.
Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 2H

UNIVERSITY COLL. OF WALES, ABERYSTWYTH. DEPT. OF ZOOLOGY.
The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 5C

UNIVERSITY OF MANCHESTER INST. OF SCIENCE AND TECHNOLOGY (ENGLAND). DEPT. OF ELECTRICAL ENGINEERING AND ELECTRONICS.
Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 5F

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES, DEPT. OF GEOLOGICAL SCIENCES.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 5C

UNIVERSITY OF SOUTHERN MISSISSIPPI, HATTIESBURG. DEPT. OF MICROBIOLOGY.
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 5D

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 8B

UNIVERSITY OF WEST FLORIDA, PENSACOLA. DEPT. OF BIOLOGY.
Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 5A

URS ENGINEERS, SEATTLE, WA.
County Provides a Rural Water Supply System,
W82-06843 3D

UTAH STATE UNIV., LOGAN. DEPT. OF BIOLOGY.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 5A
Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 5C

UTAH WATER RESEARCH LAB., LOGAN.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 2E

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). INST. VOOR METEOROLOGIE EN OCEANOGRAFIE.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 5B

VANDERBILT UNIV., NASHVILLE, TN.
Verification of a Model for Foam Flotation Column Operation,
W82-06001 5D

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 5D
Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 5D
The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 5D
Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 5D

VATTENBYGGNADSBYRAN LTD., STOCKHOLM (SWEDEN). DEPT. OF WATER, SOIL AND ENVIRONMENT DEVELOPMENT.
Salbukh Reverse Osmosis Plant on Stream,
W82-06127 3A

VERLAG CHEMIE, WEINHEIM (GERMANY, F.R.).
Recent Developments in the Field of Eutrophication Prevention,
W82-06299 5C

VERMONT UNIV., BURLINGTON.
Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 8I

VERMONT UNIV., BURLINGTON. DEPT. OF GEOLOGY.
Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 2K

VERMONT WATER RESOURCES RESEARCH CENTER, BURLINGTON.
Non-Point Source Pollution: Directions for Vermont,
W82-06372 5G

VETERANS ADMINISTRATION MEDICAL CENTER, PITTSBURGH, PA.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 5B

VICTORIA MINISTRY FOR CONSERVATION, MELBOURNE (AUSTRALIA). MARINE SCIENCE LABS.
Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 5B

VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 2L

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKBURG. DEPT. OF CIVIL ENGINEERING.
Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 5E

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. CENTER FOR ENVIRONMENTAL STUDIES.
Effects of Pollution on Freshwater Invertebrates,
W82-06804 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ECONOMICS.
Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 6E

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.
Electroplating and Cyanide Wastes,
W82-06798 5D

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 5A

VSESOYUZNYI NAUCHNO-ISSLEDOVATELSKII INST. VODOSNABZHENIYA, KANALIZATSII, GIDROTEKHNICHESKIKH SOORUZHENII I INZHENERNOI GIDROGEOLOGII, KHARKOV (USSR).
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 2J

VSESOYUZNYI NAUCHO-ISSLEDOVATELSKII INST. GIDROTEKHNIKI I MELIORATSII, MOSCOW (USSR).
Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 3F

WADE (R. M.) AND CO., PORTLAND, OR.
Sprinkler Leveler and Wind Compensating Device,
W82-06164 3F

WAHNBACHTALSPERENVERBAND, SIEGBURG (GERMANY, F.R.).
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 5F

WAKE FOREST UNIV., WINSTON-SALEM, NC, DEPT. OF BIOLOGY.
Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 5C

WAKE FOREST UNIVERSITY, WINSTON-SALEM, NORTH CAROLINA, DEPARTMENT OF BIOLOGY.
Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 5C

WARREN SPRING LAB., STEVENAGE (ENGLAND). POLLUTION DIV.
The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 5D

WARSAW UNIV. (POLAND). DEPT. OF CHEMISTRY.
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 5A

WASHINGTON STATE UNIV., PULLMAN.
Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 5D

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRICULTURAL ECONOMICS.
Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 6A

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 2H

WASHINGTON UNIV., SEATTLE. DEPT. OF GEOLOGICAL SCIENCES.
Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 4D

WASHINGTON UNIV., SEATTLE. DEPT. OF MICROBIOLOGY AND IMMUNOLOGY.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 5C

WASHINGTON UNIV., SEATTLE. FISHERIES RESEARCH INST.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 5C

WASHINGTON UNIV., SEATTLE. SCHOOL OF PUBLIC HEALTH AND COMMUNITY MEDICINE, DEPARTMENT OF ENVIRONMENTAL HEALTH.
Organics,
W82-06922 5A

WASTEWATER TREATMENT PLANT, APPLETON, WI.
How Appleton Reduced Phosphorus,
W82-06249 5D

WATER AND AIR RESEARCH, INC., GAINESVILLE, FL.
Low-Dosage High-Rate Direct Filtration,
W82-06416 5F

WATER AND POWER RESOURCES SERVICE, DENVER, COLORADO.
Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 8B

WATER RESEARCH CENTER (ENGLAND).
Sewerage: Priorities for Action,
W82-06260 8G

WATER RESEARCH CENTER, STEVENAGE (ENGLAND).
Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 5E

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 5D

WATER RESEARCH LAB., COLUMBUS, OH., DIV. OF WATER.
Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 5C

WATERLOO UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 5C

WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.
The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 2F

WATERLOOPKUNDIG LAB., DELFT (NETHERLANDS).
The V-Shaped Broad-Crested Weir,
W82-06450 8B

WESLEYAN UNIV., MIDDLETOWN, CT. DEPT. OF CHEMISTRY.
Oxidation Products and Rates of Reaction in the Ozonolysis of Dibenzofuran,
W82-06305 5B

WESSEX WATER AUTHORITY (ENGLAND).
The Use of Oxygen in Sewage Treatment,
W82-06262 5D

WEST VIRGINIA DEPT. OF NATURAL RESOURCES, CHARLESTON. WILDLIFE RESOURCES DIV.
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 5C

WEST VIRGINIA INST. OF TECH., MONTGOMERY. DEPT. OF CIVIL ENGINEERING.
Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 5F

WESTERN INDUSTRIAL LABS. LTD., EDMONTON (ALBERTA).
Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 5D

WESTINGHOUSE RESEARCH LAB., PITTSBURGH, PA.
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 3A

WHEATON SANITARY DISTRICT, IL.
New Bubble Diffusers Reduce Treatment Costs,
W82-06513 5D

WHITELEY-JACOBSEN AND ASSOCIATES, PORTLAND, OR.
Regional Detention Basins for Stormwater Control,
W82-06225 8A

WILLIAMSPORT SANITARY AUTHORITY, PA.
Water Conservation at Wastewater Treatment Plants,
W82-06512 3C

Components for a Treatment Plant Safety Program,
W82-06992 5G

WINDREM, FEENEY AND WILLIAMS, LAKEPORT, CA.
Environmental Problems and Geothermal Permitting,
W82-06217 6G

WINDSOR UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 5C

Physical Process and Eutrophication,
W82-06875 5C

WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON.
Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 4A

WISCONSIN UNIV., EAU CLAIRE. DEPT. OF BIOLOGY.
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 5A

WISCONSIN UNIV. EXTENSION, MADISON. DEPT. OF ENVIRONMENTAL SCIENCES.
Sampling Characteristics of Macrophyte Biomass,
W82-06779 5A

WISCONSIN UNIV. LA CROSSE, RIVER STUDIES CENTER.
Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 5B

WISCONSIN UNIV.-MADISON. DEPT. OF BACTERIOLOGY.
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 5B

WISCONSIN UNIV.- MADISON. DEPT. OF GEOGRAPHY.
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 4D

WISCONSIN UNIV.-MADISON. DEPT. OF SOIL SCIENCE.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 5B

WISCONSIN UNIV.-MADISON. WATER CHEMISTRY PROGRAM.
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 5B

WISCONSIN UNIV.-MILWAUKEE, DEPT. OF BOTANY.
Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 5C

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF CIVIL ENGINEERING.
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 5D

WISCONSIN UNIV., MILWAUKEE. DEPT. OF URBAN PLANNING.
Problems and Processes in Water Quality Management,
W82-06147 5G

WISCONSIN UNIV., STEVENS POINT. COLL. OF NATURAL RESOURCES.
Calibrating A Mountain Watershed in Wyoming,
W82-06583 2E

WISCONSIN UNIVERSITY, PLATTEVILLE.
Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 5C

WOLLONGONG UNIV. (AUSTRALIA). DEPT. OF CHEMISTRY.
Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 5D

WORCESTER POLYTECHNIC INST., MA. DEPT. OF CIVIL ENGINEERING.
Performance of Modified Chlorine Contact Chamber,
W82-06359 5D

WORCESTER POLYTECHNIC INST., MA. DEPT. OF MECHANICAL ENGINEERING.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1A

WORLD HEALTH ORGANIZATION, COPENHAGEN (DENMARK). REGIONAL OFFICE FOR EUROPE.
The Mediterranean Action Plan: Design and Implementation,
W82-06154 5B

WORLD HEALTH ORGANIZATION SCHISTOSOMIASIS CONTROL PROJECT, ACCRA (GHANA).
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 5C

WRIGHT MCLAUGHLIN ENGINEERS, DENVER, CO.
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 2I

WRIGHT-PIERCE, TOPSHAM, ME.
Locating Monitoring Wells,
W82-06848 8B

WRIGHT STATE UNIV., DAYTON, OH. DEPT. OF BIOLOGICAL SCIENCES.
Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 5B

WRIGHT WATER ENGINEERS, INC., DENVER, CO.
Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 6B

WYOMING UNIV., LARAMIE. WATER RESOURCES RESEARCH INST.
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 4D

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 7B

YORK UNIV. (ENGLAND). DEPT. OF BIOLOGY.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 5D

YORK UNIV., TORONTO (ONTARIO). DEPT. OF BIOLOGY.
A Model for the Design of Hypolimnetic Aerators,
W82-06610 5G

YORKSHIRE WATER AUTHORITY (ENGLAND). DIRECTORATE OF RESOURCE PLANNING.
The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 5G

YORKSHIRE WATER AUTHORITY (ENGLAND). WESTERN DIV.
Esholt--Past, Present and Future,
W82-06653 5D

YOUNGSTOWN STATE UNIV., OH DEPT. OF CIVIL ENGINEERING.
A Model for Managing Irrigated Agriculture,
W82-06584 5G

ZIMPRO, INC., ROTHSCHILD, WI.
PAC Process,
W82-06643 5D

ACCESSION NUMBER INDEX

W82-05901	2B
W82-05902	5D
W82-05903	2A
W82-05904	2F
W82-05905	2A
W82-05906	3D
W82-05907	5F
W82-05908	3A
W82-05909	6B
W82-05910	1A
W82-05911	5D
W82-05912	5C
W82-05913	5D
W82-05914	2H
W82-05915	6A
W82-05916	3A
W82-05917	3A
W82-05918	2E
W82-05919	5G
W82-05920	3C
W82-05921	5B
W82-05922	3D
W82-05923	6G
W82-05924	3F
W82-05925	4A
W82-05926	2E
W82-05927	6G
W82-05928	2G
W82-05929	7B
W82-05930	6F
W82-05931	4D
W82-05932	5F
W82-05933	5B
W82-05934	5C
W82-05935	5A
W82-05936	5B
W82-05937	5D
W82-05938	6E
W82-05939	6E
W82-05940	6E
W82-05941	2F
W82-05942	2C
W82-05943	2F
W82-05944	2A
W82-05945	2E
W82-05946	5B
W82-05947	5D
W82-05948	8A
W82-05949	2A
W82-05950	5D
W82-05951	5A
W82-05952	5D
W82-05953	5F
W82-05954	6B
W82-05955	5D
W82-05956	7B
W82-05957	2J
W82-05958	2J
W82-05959	2J
W82-05960	5D
W82-05961	5D
W82-05962	5D
W82-05963	3F
W82-05964	5D
W82-05965	2G
W82-05966	6B
W82-05967	2I
W82-05968	3F
W82-05969	3F
W82-05970	2J
W82-05971	3F
W82-05972	2I
W82-05973	5D
W82-05974	5D
W82-05975	5D
W82-05976	3A
W82-05977	3A
W82-05978	6D
W82-05979	8A
W82-05980	8E
W82-05981	8C
W82-05982	8E
W82-05983	5C
W82-05984	5B
W82-05985	5C
W82-05986	6E
W82-05987	6E
W82-05988	5C
W82-05989	5C
W82-05990	2F
W82-05991	5B
W82-05992	2H
W82-05993	5A
W82-05994	5C
W82-05995	5C
W82-05996	5C
W82-05997	2E
W82-05998	6C
W82-05999	8F
W82-06000	8A
W82-06001	5D
W82-06002	6E
W82-06003	5C
W82-06004	5A
W82-06005	5D
W82-06006	5F
W82-06007	5E
W82-06008	3C
W82-06009	5E
W82-06010	3F
W82-06011	8A
W82-06012	8A
W82-06013	5G
W82-06014	8A
W82-06015	5A
W82-06016	5A
W82-06017	3F
W82-06018	7A
W82-06019	3B
W82-06020	5B
W82-06021	5A
W82-06022	3E
W82-06023	5A
W82-06024	5D
W82-06025	5D
W82-06026	5F
W82-06027	5F
W82-06028	5A
W82-06029	5D
W82-06030	5A
W82-06031	5C
W82-06032	5A
W82-06033	5A
W82-06034	5C
W82-06035	5B
W82-06036	5C
W82-06037	5A
W82-06038	5B
W82-06039	5D
W82-06040	5A
W82-06041	5D
W82-06042	6C
W82-06043	5B
W82-06044	5D
W82-06045	5F
W82-06046	5E
W82-06047	5D
W82-06048	5D
W82-06049	5B
W82-06050	5B
W82-06051	5F
W82-06052	2K
W82-06053	5D
W82-06054	5B
W82-06055	5D
W82-06056	5F
W82-06057	5G
W82-06058	4B
W82-06059	4B
W82-06060	8B
W82-06061	2D
W82-06062	6A
W82-06063	6B
W82-06064	2C
W82-06065	2D
W82-06066	2F
W82-06067	5B
W82-06068	2A
W82-06069	6E
W82-06070	5D
W82-06071	5G
W82-06072	6B
W82-06073	6F
W82-06074	6C
W82-06075	5F
W82-06076	5E
W82-06077	6F
W82-06078	5D
W82-06079	5D
W82-06080	5B
W82-06081	5A
W82-06082	5A
W82-06083	2E
W82-06084	8I
W82-06085	2F
W82-06086	8H
W82-06087	6G
W82-06088	6E
W82-06089	6G
W82-06090	6G
W82-06091	6G
W82-06092	6G
W82-06093	2E
W82-06094	2J
W82-06095	8B
W82-06096	2L
W82-06097	4A
W82-06098	5F
W82-06099	5G
W82-06100	2J
W82-06101	3A
W82-06102	2J
W82-06103	5B
W82-06104	3A
W82-06105	3A
W82-06106	3A
W82-06107	3A
W82-06108	3A
W82-06109	3A
W82-06110	3A
W82-06111	3A
W82-06112	3A
W82-06113	3A
W82-06114	3A
W82-06115	3A
W82-06116	3A
W82-06117	5A
W82-06118	3A
W82-06119	3A
W82-06120	3A
W82-06121	3A
W82-06122	3A
W82-06123	5D
W82-06124	3A
W82-06125	3A
W82-06126	3A
W82-06127	3A
W82-06128	2E
W82-06129	7C
W82-06130	7A
W82-06131	7C
W82-06132	2A
W82-06133	7C
W82-06134	7C
W82-06135	7C
W82-06136	3B
W82-06137	5C
W82-06138	7C
W82-06139	2E
W82-06140	7C
W82-06141	2F
W82-06142	2E
W82-06143	7C
W82-06144	7C
W82-06145	5B
W82-06146	5A
W82-06147	5G
W82-06148	3F
W82-06149	6A
W82-06150	5D
W82-06151	7C
W82-06152	3A
W82-06153	5C
W82-06154	5B
W82-06155	3D
W82-06156	6A
W82-06157	5D
W82-06158	5F
W82-06159	5B
W82-06160	6D
W82-06161	2K
W82-06162	5D
W82-06163	2J
W82-06164	3F
W82-06165	5C
W82-06166	5D
W82-06167	3A
W82-06168	5C
W82-06169	5B
W82-06170	4D
W82-06171	5D
W82-06172	2G
W82-06173	5F
W82-06174	4B
W82-06175	4A
W82-06176	6B
W82-06177	5C
W82-06178	5D
W82-06179	5A
W82-06180	5B
W82-06181	6E
W82-06182	6E
W82-06183	8A
W82-06184	4C
W82-06185	5G
W82-06186	8A
W82-06187	5D
W82-06188	2K
W82-06189	2J
W82-06190	5B
W82-06191	5B
W82-06192	5A
W82-06193	5D
W82-06194	5B
W82-06195	5D
W82-06196	8B
W82-06197	2E
W82-06198	2E
W82-06199	2E
W82-06200	2E
W82-06201	2H
W82-06202	8C
W82-06203	8A
W82-06204	8D
W82-06205	8A
W82-06206	6A
W82-06207	5G
W82-06208	2B
W82-06209	2B
W82-06210	2B
W82-06211	2B
W82-06212	2B
W82-06213	2B
W82-06214	2B
W82-06215	2G
W82-06216	2D
W82-06217	6G
W82-06218	6E
W82-06219	2A
W82-06220	8A
W82-06221	5D
W82-06222	6C
W82-06223	5F
W82-06224	5F
W82-06225	8A
W82-06226	5D
W82-06227	4A
W82-06228	5E
W82-06229	2I
W82-06230	3F
W82-06231	2I
W82-06232	5B
W82-06233	7C
W82-06234	2F
W82-06235	5A
W82-06236	8A

ACCESSION NUMBER INDEX

W82-06237 8B
W82-06238 5B
W82-06239 8A
W82-06240 8D
W82-06241 8G
W82-06242 8C
W82-06243 8B
W82-06244 8B
W82-06245 5B
W82-06246 2K
W82-06247 5G
W82-06248 5E
W82-06249 5D
W82-06250 5D
W82-06251 5D
W82-06252 6C
W82-06253 5D
W82-06254 5G
W82-06255 5D
W82-06256 5G
W82-06257 5D
W82-06258 5D
W82-06259 5F
W82-06260 8G
W82-06261 6E
W82-06262 5D
W82-06263 5D
W82-06264 5D
W82-06265 5D
W82-06266 5D
W82-06267 5C
W82-06268 5D
W82-06269 5G
W82-06270 5D
W82-06271 5A
W82-06272 5A
W82-06273 2K
W82-06274 5A
W82-06275 6C
W82-06276 3D
W82-06277 6C
W82-06278 5F
W82-06279 5F
W82-06280 5F
W82-06281 5F
W82-06282 5D
W82-06283 5D
W82-06284 5C
W82-06285 5B
W82-06286 5B
W82-06287 5C
W82-06288 5B
W82-06289 5E
W82-06290 5C
W82-06291 5E
W82-06292 5E
W82-06293 5E
W82-06294 8C
W82-06295 6E
W82-06296 6E
W82-06297 6E
W82-06298 5D
W82-06299 5C
W82-06300 4A
W82-06301 2G
W82-06302 2G
W82-06303 2G
W82-06304 5C
W82-06305 5B
W82-06306 5D
W82-06307 5D
W82-06308 4D
W82-06309 4B
W82-06310 5B
W82-06311 5D
W82-06312 5D
W82-06313 5C
W82-06314 5A
W82-06315 5C
W82-06316 5C
W82-06317 2F
W82-06318 2G
W82-06319 2E
W82-06320 2D
W82-06321 2J
W82-06322 2J
W82-06323 7C
W82-06324 5D
W82-06325 2E
W82-06326 2E
W82-06327 2B
W82-06328 5D
W82-06329 6D
W82-06330 5C
W82-06331 5D
W82-06332 2G
W82-06333 3C
W82-06334 3F
W82-06335 2J
W82-06336 2J
W82-06337 2H
W82-06338 5D
W82-06339 2G
W82-06340 5D
W82-06341 5F
W82-06342 5F
W82-06343 8C
W82-06344 5D
W82-06345 8C
W82-06346 5E
W82-06347 5D
W82-06348 5C
W82-06349 6F
W82-06350 6C
W82-06351 6C
W82-06352 6D
W82-06353 5F
W82-06354 5E
W82-06355 5D
W82-06356 5D
W82-06357 2E
W82-06358 5D
W82-06359 5D
W82-06360 5B
W82-06361 6B
W82-06362 2K
W82-06363 5F
W82-06364 2J
W82-06365 6D
W82-06366 2A
W82-06367 6B
W82-06368 6B
W82-06369 3E
W82-06370 7C
W82-06371 5C
W82-06372 5G
W82-06373 8I
W82-06374 3F
W82-06375 3F
W82-06376 3F
W82-06377 5E
W82-06378 5D
W82-06379 5D
W82-06380 5D
W82-06381 5D
W82-06382 5D
W82-06383 5C
W82-06384 2A
W82-06385 5G
W82-06386 2E
W82-06387 5B
W82-06388 2L
W82-06389 5G
W82-06390 5D
W82-06391 5D
W82-06392 5D
W82-06393 8B
W82-06394 2L
W82-06395 8I
W82-06396 7B
W82-06397 8F
W82-06398 3A
W82-06399 6G
W82-06400 5G
W82-06401 6G
W82-06402 6G
W82-06403 2H
W82-06404 6G
W82-06405 5E
W82-06406 6G
W82-06407 6G
W82-06408 2G
W82-06409 6G
W82-06410 2L
W82-06411 6E
W82-06412 5F
W82-06413 5F
W82-06414 5F
W82-06415 5F
W82-06416 5F
W82-06417 5G
W82-06418 8B
W82-06419 8C
W82-06420 8B
W82-06421 2E
W82-06422 5B
W82-06423 8B
W82-06424 2J
W82-06425 2H
W82-06426 2J
W82-06427 4A
W82-06428 2E
W82-06429 6G
W82-06430 4A
W82-06431 4A
W82-06432 8A
W82-06433 4A
W82-06434 5B
W82-06435 5B
W82-06436 5C
W82-06437 5F
W82-06438 5D
W82-06439 5D
W82-06440 5F
W82-06441 5F
W82-06442 5D
W82-06443 2K
W82-06444 5F
W82-06445 5D
W82-06446 5F
W82-06447 2A
W82-06448 8A
W82-06449 8A
W82-06450 8B
W82-06451 2A
W82-06452 3F
W82-06453 5F
W82-06454 5D
W82-06455 5D
W82-06456 5D
W82-06457 5D
W82-06458 5D
W82-06459 5D
W82-06460 5B
W82-06461 5D
W82-06462 8A
W82-06463 6D
W82-06464 5A
W82-06465 2L
W82-06466 5A
W82-06467 5A
W82-06468 8B
W82-06469 5D
W82-06470 5C
W82-06471 6D
W82-06472 2H
W82-06473 2H
W82-06474 5F
W82-06475 5G
W82-06476 2H
W82-06477 5F
W82-06478 6G
W82-06479 6D
W82-06480 6B
W82-06481 6D
W82-06482 6B
W82-06483 5G
W82-06484 5C
W82-06485 5E
W82-06486 5D
W82-06487 5D
W82-06488 5E
W82-06489 5E
W82-06490 5E
W82-06491 5D
W82-06492 3F
W82-06493 5B
W82-06494 2J
W82-06495 5A
W82-06496 5C
W82-06497 2L
W82-06498 5F
W82-06499 5B
W82-06500 8A
W82-06501 8B
W82-06502 8A
W82-06503 8A
W82-06504 8A
W82-06505 5D
W82-06506 5D
W82-06507 3C
W82-06508 8A
W82-06509 5D
W82-06510 4D
W82-06511 5D
W82-06512 3C
W82-06513 5D
W82-06514 8C
W82-06515 5C
W82-06516 5D
W82-06517 3E
W82-06518 5B
W82-06519 8A
W82-06520 5D
W82-06521 3C
W82-06522 6B
W82-06523 2E
W82-06524 2F
W82-06525 4B
W82-06526 2B
W82-06527 2J
W82-06528 2D
W82-06529 2B
W82-06530 7B
W82-06531 7B
W82-06532 5D
W82-06533 2L
W82-06534 5C
W82-06535 2H
W82-06536 2L
W82-06537 5A
W82-06538 5C
W82-06539 5F
W82-06540 5C
W82-06541 2L
W82-06542 5A
W82-06543 5B
W82-06544 5B
W82-06545 5A
W82-06546 2L
W82-06547 2G
W82-06548 5A
W82-06549 5A
W82-06550 5E
W82-06551 2H
W82-06552 6A
W82-06553 2J
W82-06554 2J
W82-06555 6G
W82-06556 5D
W82-06557 5E
W82-06558 5C
W82-06559 5A
W82-06560 5A
W82-06561 5A
W82-06562 5A
W82-06563 5A
W82-06564 5A
W82-06565 9D
W82-06566 5A
W82-06567 7C
W82-06568 2E
W82-06569 5B
W82-06570 5A
W82-06571 5C
W82-06572 5B

ACCESSION NUMBER INDEX

W82-06573	5B
W82-06574	5B
W82-06575	5A
W82-06576	5A
W82-06577	5A
W82-06578	2C
W82-06579	5F
W82-06580	5B
W82-06581	2B
W82-06582	6E
W82-06583	2E
W82-06584	5G
W82-06585	6F
W82-06586	2A
W82-06587	5B
W82-06588	6E
W82-06589	4C
W82-06590	5E
W82-06591	7C
W82-06592	5E
W82-06593	5E
W82-06594	5E
W82-06595	5E
W82-06596	5E
W82-06597	5E
W82-06598	5E
W82-06599	5E
W82-06600	5E
W82-06601	8A
W82-06602	5G
W82-06603	8G
W82-06604	8F
W82-06605	3B
W82-06606	8C
W82-06607	5D
W82-06608	5F
W82-06609	5B
W82-06610	5G
W82-06611	5D
W82-06612	2H
W82-06613	2A
W82-06614	8B
W82-06615	2H
W82-06616	4B
W82-06617	2F
W82-06618	8B
W82-06619	8B
W82-06620	2J
W82-06621	8B
W82-06622	8B
W82-06623	5B
W82-06624	5G
W82-06625	2H
W82-06626	5B
W82-06627	2H
W82-06628	5A
W82-06629	4C
W82-06630	2K
W82-06631	2A
W82-06632	8D
W82-06633	8C
W82-06634	5D
W82-06635	5B
W82-06636	8E
W82-06637	5E
W82-06638	5D
W82-06639	5F
W82-06640	8G
W82-06641	6C
W82-06642	5A
W82-06643	5D
W82-06644	5G
W82-06645	5E
W82-06646	5E
W82-06647	5D
W82-06648	5G
W82-06649	5D
W82-06650	5D
W82-06651	5C
W82-06652	5G
W82-06653	5D
W82-06654	5A
W82-06655	5D
W82-06656	5A
W82-06657	5D
W82-06658	5D
W82-06659	5B
W82-06660	5G
W82-06661	5D
W82-06662	5D
W82-06663	2H
W82-06664	5D
W82-06665	8G
W82-06666	5D
W82-06667	5D
W82-06668	2L
W82-06669	3D
W82-06670	7C
W82-06671	7C
W82-06672	7C
W82-06673	7C
W82-06674	7C
W82-06675	2F
W82-06676	7C
W82-06677	2E
W82-06678	2H
W82-06679	2A
W82-06680	5B
W82-06681	5B
W82-06682	5A
W82-06683	2E
W82-06684	2A
W82-06685	2F
W82-06686	2F
W82-06687	2H
W82-06688	7C
W82-06689	5B
W82-06690	2H
W82-06691	5B
W82-06692	2G
W82-06693	3C
W82-06694	6B
W82-06695	3F
W82-06696	6B
W82-06697	5A
W82-06698	5G
W82-06699	5D
W82-06700	6B
W82-06701	5D
W82-06702	5B
W82-06703	7B
W82-06704	6B
W82-06705	3D
W82-06706	5C
W82-06707	5C
W82-06708	5D
W82-06709	5F
W82-06710	2J
W82-06711	3A
W82-06712	3C
W82-06713	8A
W82-06714	6F
W82-06715	5A
W82-06716	5G
W82-06717	2E
W82-06718	5A
W82-06719	5B
W82-06720	5B
W82-06721	5C
W82-06722	5C
W82-06723	5C
W82-06724	5D
W82-06725	5G
W82-06726	5F
W82-06727	5B
W82-06728	5B
W82-06729	2E
W82-06730	8B
W82-06731	5A
W82-06732	5D
W82-06733	5C
W82-06734	5A
W82-06735	5A
W82-06736	5C
W82-06737	5C
W82-06738	5B
W82-06739	5D
W82-06740	5F
W82-06741	5B
W82-06742	5C
W82-06743	5A
W82-06744	5A
W82-06745	5C
W82-06746	5C
W82-06747	5A
W82-06748	5C
W82-06749	5C
W82-06750	5D
W82-06751	5A
W82-06752	5D
W82-06753	5C
W82-06754	5A
W82-06755	5A
W82-06756	5B
W82-06757	5A
W82-06758	8A
W82-06759	8A
W82-06760	5B
W82-06761	2B
W82-06762	5B
W82-06763	5C
W82-06764	5C
W82-06765	5C
W82-06766	5B
W82-06767	5C
W82-06768	5D
W82-06769	5F
W82-06770	5C
W82-06771	5D
W82-06772	5D
W82-06773	5A
W82-06774	5B
W82-06775	5G
W82-06776	5G
W82-06777	5C
W82-06778	6B
W82-06779	5A
W82-06780	2D
W82-06781	3F
W82-06782	7C
W82-06783	8E
W82-06784	7C
W82-06785	8B
W82-06786	8B
W82-06787	2L
W82-06788	5D
W82-06789	5C
W82-06790	5B
W82-06791	5A
W82-06792	3A
W82-06793	2I
W82-06794	5C
W82-06795	4D
W82-06796	4D
W82-06797	5C
W82-06798	5D
W82-06799	5D
W82-06800	5D
W82-06801	5D
W82-06802	5B
W82-06803	5C
W82-06804	5C
W82-06805	5D
W82-06806	2J
W82-06807	5B
W82-06808	5C
W82-06809	5C
W82-06810	5A
W82-06811	5C
W82-06812	5C
W82-06813	8A
W82-06814	5F
W82-06815	3F
W82-06816	3F
W82-06817	3F
W82-06818	3F
W82-06819	6E
W82-06820	5D
W82-06821	5D
W82-06822	5D
W82-06823	2B
W82-06824	2D
W82-06825	8A
W82-06826	4A
W82-06827	5C
W82-06828	5A
W82-06829	5B
W82-06830	5D
W82-06831	5B
W82-06832	5D
W82-06833	5D
W82-06834	4D
W82-06835	4A
W82-06836	2K
W82-06837	2L
W82-06838	2B
W82-06839	6D
W82-06840	2H
W82-06841	5G
W82-06842	5G
W82-06843	3D
W82-06844	5G
W82-06845	5G
W82-06846	5G
W82-06847	5F
W82-06848	8B
W82-06849	4C
W82-06850	2D
W82-06851	2F
W82-06852	3F
W82-06853	6C
W82-06854	6C
W82-06855	4A
W82-06856	2G
W82-06857	2G
W82-06858	2F
W82-06859	2F
W82-06860	5C
W82-06861	2F
W82-06862	2K
W82-06863	2F
W82-06864	2F
W82-06865	5B
W82-06866	5B
W82-06867	2G
W82-06868	2H
W82-06869	6B
W82-06870	5D
W82-06871	5B
W82-06872	4D
W82-06873	2J
W82-06874	4A
W82-06875	5C
W82-06876	4D
W82-06877	5B
W82-06878	5C
W82-06879	2H
W82-06880	5C
W82-06881	5C
W82-06882	5C
W82-06883	5A
W82-06884	5A
W82-06885	5A
W82-06886	2H
W82-06887	5B
W82-06888	5C
W82-06889	5A
W82-06890	5A
W82-06891	5B
W82-06892	5C
W82-06893	5C
W82-06894	2B
W82-06895	5C
W82-06896	5C
W82-06897	5G
W82-06898	5C
W82-06899	5C
W82-06900	5C
W82-06901	5C
W82-06902	5A
W82-06903	5C
W82-06904	5B
W82-06905	5B
W82-06906	5C
W82-06907	5C
W82-06908	5B

ACCESSION NUMBER INDEX

W82-06909	5C
W82-06910	5C
W82-06911	5C
W82-06912	5G
W82-06913	5C
W82-06914	5D
W82-06915	5B
W82-06916	5D
W82-06917	5D
W82-06918	5D
W82-06919	5A
W82-06920	5B
W82-06921	5D
W82-06922	5A
W82-06923	5D
W82-06924	5B
W82-06925	5C
W82-06926	5D
W82-06927	5B
W82-06928	5C
W82-06929	5B
W82-06930	5C
W82-06931	5A
W82-06932	5C
W82-06933	5C
W82-06934	5C
W82-06935	5C
W82-06936	5C
W82-06937	5C
W82-06938	5C
W82-06939	5C
W82-06940	5C
W82-06941	5C
W82-06942	5C
W82-06943	5C
W82-06944	5C
W82-06945	4A
W82-06946	2E
W82-06947	4A
W82-06948	8B
W82-06949	2F
W82-06950	7A
W82-06951	7B
W82-06952	4B
W82-06953	7C
W82-06954	7C
W82-06955	7C
W82-06956	7C
W82-06957	7C
W82-06958	5D
W82-06959	8B
W82-06960	5D
W82-06961	2G
W82-06962	8A
W82-06963	2J
W82-06964	3F
W82-06965	5C
W82-06966	5C
W82-06967	6G
W82-06968	4D
W82-06969	7B
W82-06970	4D
W82-06971	4D
W82-06972	5C
W82-06973	5B
W82-06974	5A
W82-06975	5A
W82-06976	5C
W82-06977	5B
W82-06978	2H
W82-06979	5C
W82-06980	5D
W82-06981	5B
W82-06982	5C
W82-06983	4C
W82-06984	3F
W82-06985	6G
W82-06986	5C
W82-06987	5C
W82-06988	5D
W82-06589	5D
W82-06990	8B
W82-06991	5C
W82-06992	5G
W82-06993	5E
W82-06994	7B
W82-06995	7B
W82-06996	5D
W82-06997	5G
W82-06998	5G
W82-06999	5A
W82-07000	5D

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and montlhy updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Illinois State Water Survey.
- Metropolitan water resources planning and management at the Center for Urban and Regional Studies of University of North Carolina.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Center of the University of Wisconsin.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.
- Water-related aspects of nuclear radiation and safety at the Oak Ridge National Laboratory.
- Water resource aspects of the pulp and paper industry at the Institute of Paper Chemistry.

Supported by the Environmental Protection Agency in cooperation with WRSIC

- Effect on water quality of irrigation return flows at the Department of Agricultural Engineering of Colorado State University.
- Agricultural livestock waste at East Central State College, Oklahoma.
- Municipal wastewater treatment technology at the Franklin Institute Research Laboratories.

A NOTE ON THE INDEXES . . .

This cumulation is an index of AUTHORS, ORGANIZATIONS, AND ACCESSION NUMBERS appearing in the 1982 issue of SELECTED WATER RESOURCES ABSTRACTS. A table is provided below to facilitate the location of abstracts.

Inclusive Abstract Numbers will be found in **Issue Number and Date**

W82-00001—W82-00500	"	1	January 1, 1982
W82-00501—W82-01100	"	2	February 1, 1982
W82-01101—W82-01600	"	3	March 1, 1982
W82-01601—W82-02100	"	4	April 1, 1982
W82-02101—W82-02600	"	5	May 1, 1982
W82-02601—W82-03000	"	6	June 1, 1982
W82-03001—W82-03400	"	7	July 1, 1982
W82-03401—W82-03750	"	8	August 1, 1982
W82-03751—W82-04250	"	9	September 1, 1982
W82-04251—W82-04750	"	10	October 1, 1982
W82-04751—W82-05900	"	11	November 1, 1982
W82-05901—W82-07000	"	12	December 1, 1982

AUTHOR INDEX

AARSTAD, J. S.
Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 1501 2J

ABADZHYAN, K. A.
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 1507 8G

ABAL'YANTS, S. KH.
Canals in Sand Channels,
W82-06196 1512 8B

ABBAN, E. K.
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 1512 5C

ABBAS, M. N.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 1505 5A

ABBEY, D.
Water Related Planning and Design at Energy Firms,
W82-00042 1501 6D

Water Suppiy and Demand in an Energy Supply Model,
W82-00050 1501 6D

ABDALLA, C. W.
Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 1506 6B

ABDEL-HADI, O. N.
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 1506 2G

ABDEL-MALEK, S. A.
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

ABDEL-MALIK, W. E.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 1502 5B

ABDEL RAHMAN, M. E. S.
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 1507 6B

ABDOU, F. M.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 1502 5E

ABDULLAH, M.
Rural Power Schemes in Pakistan,
W82-04328 1510 8A

ABE, J. M.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

ABECASIS, F.
Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 1507 8A

ABEL, P. D.
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 1504 5C

ABELE, A. C.
Rainwater Gauge,
W82-00068 1501 2B

ABELIOVICH, A.
Biological Equilibrium in a Wastewater Reservoir,
W82-06282 1512 5D

ABELL, P. I.
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

ABERNATHY, A. R.
Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 1506 5B

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 1503 5B

ABIDI, S. L.
Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 1511 5B

ABOUZAID, H.
Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 1507 2H

ABRAHAM, C. H. M.
Automatic Flow Control in Combined Sewer Systems-Effectiveness and Implementation Problems,
W82-04049 1509 5D

ABRAHAM, M.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 1503 5A

ABSALON, J. R.
Improving the Reliability of Ground-Water Monitoring at Industrial Waste Disposal Facilities,
W82-03940 1509 5A

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 1503 5G

ABT, S. R.
Evaluating Scour at Culvert Outlets,
W82-01931 1504 4D

ABU-HILAL, A. H.
The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 1505 5A

ACAVIA, D.
Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 1511 2H

ACHARYA, H. S.
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 1511 8B

ACHER, A. J.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 1502 5B

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 1511 5B

ACHTEMEIER, G. L.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

ACOBAS, F.
Testing the Floccuiation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

ADAM, D. P.
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 1505 2K

ADAMOWSKI, K.
Multivariate Hydrologic Time Series Analysis,
W82-00647 1502 2A

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

ADAMS, B. J.
Capacity Expansion Planning Model for Waste Water Treatment and I/I Control,
W82-04239 1509 5D

Water Quality Evaluation of Regional Wastewater Management,
W82-00977 1502 5D

ADAMS, D. J.
Theory of the Dielectric Constant of Ice,
W82-03176 1507 2C

ADAMS, F. E.
Buoyant Surface Jets,
W82-03670 1508 8B

Dilution Analysis for Unidirectional Diffusers,
W82-06429 1512 8B

ADAMS, J. R.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

ADAMS, T. G.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 1502 5B

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

ADAMS, W.
Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

ADAMS, W. J.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 1502 5A

ADAMS, W. P.
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 1501 2C

ADAMS, W. R. JR.
Interstate Highways Versus Watershed Protection in New England,
W82-03431 1508 5D

ADAMSON, R. P.
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 1512 5F

ADDIEGO, J. C.
Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

ADDISON, R.
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 1503 5D

ADDISON, R. F.
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 1501 5B

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 1508 5C

ADEMA, C.
Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

ADLER, R. F.
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 1502 2B

Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 1512 2B

ADRIAN, D. D.
Development of Improved Stormwater Quality Models,
W82-04559 1510 5B

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 1511 5B

AFANAS'EV, A. A.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 1506 8B

AFOUDA, A. A.
Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 1505 2A

AGAMI, M.
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

AGARWAL, M. C.
Effect of Field Levelling Quality on Irrigation Efficiency and Crop Yield,
W82-03789 1509 3F

AGES, A.
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

AGG, A. R.
Disposal of Sewage Sludge to Sea–Research Needs,
W82-06293 1512 5E

AGGARWAL, P. K.
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

AGIRALIOGLU, N.
Diverging Overland Flow,
W82-03676 1508 2A

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

Overland Flow on a Diverging Surface,
W82-00986 1502 2A

Water Routing on Diverging-Converging Watersheds,
W82-02200 1505 2A

AGNEW, R. W.
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 1510 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 1510 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 1510 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 1510 5B

AGOSTINELLI, A.
Using Pumps as Small Turbines,
W82-05597 1511 8C

AGRAWAL, R. P.
The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

AGTHE, D. E.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 1502 6C

AGUADO, J.
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

AGYEI, F. O.
Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

AHIPO, Z. M.
A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

AHLERT, R. C.
Oil Slick Mechanics,
W82-05064 1511 5G

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 1511 2E

AHLQUIST, A. J.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 1503 5B

AHMAD, A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 1503 5B

AHMAD, I.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 1511 5A

AHMAD, S.
On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

Wastewater from a Sugar Refining Industry,
W82-05337 1511 5D

AHMADI, M. Z.
Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 1508 2G

AHMED, A. M.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 1505 3F

AHMED, Q. S.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 1504 5A

Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 1507 5B

AHMED, S.
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 1501 2D

AHO, M.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

AHUJA, L. R.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 1503 2G

AIBA, S.
Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 1505 5B

AIETA, E. M.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

AIKEN, G. R.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

AIKEN, H. V.
Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

AIKEN, J. D.
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 1503 6E

Nebraska Ground Water Law and Administration,
W82-01236 1503 6E

AILI, Z.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

AIREY, D.
Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 1512 5B

AJMAL, M.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 1503 5B

AKHAVI, M. S.
Water Resources Investigations in West Central Iran Using Landsat Data,
W82-03927 1509 7B

AKIELASZEK, J. J.
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 1503 5B

AKRAM, M.
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 1506 3F

AL-ANI, S.
Monitoring of Turbidity and Suspended Solids Concentration in Wastewater Treatment Plants,
W82-04054 1509 5D

AL-JEBOURI, M. M.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 1503 5A

AL-KHAFAJI, A. W. N.
Densification of Paper Mill Sludge Materials,
W82-06594 1510 5E

AL-KHATIB, H. H.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

AL-MASRI, N.
Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 1508 3C

AL-NASSRI, S. A.
Uncertainties in Water Distribution Systems,
W82-03668 1508 8A

AL-SAAD, H. A.
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 1506 5C

AL-SAADI, H. A.
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 1512 5C

ALARIE, R. L.
Simulation Modeling of Primary Clarifiers,
W82-01027 1502 6A

ALAWI, B. J.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

ALAWI, M. A.
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 1512 5A

ALBAGNAC, G.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 1510 5D

ALBANESE, A. S.
Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 1501 5D

ALBEN, K.
Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 1502 5B

ALBERTS, J. J.
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

Laboratory and Field Studies of The Relative Mobility of 239, 24OPU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

ALBIGNAT, J. P.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

ALBRECHT, S. L.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

ALBRIGHT, L. J.
Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 1512 5B

Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 1502 5C

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 1510 2L

ALBURY, W. W.
Safety Considerations in Handling Activated Carbon,
W82-054[illegible] 1511 5D

ALDOUS, K.
Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

ALDRED, M. I.
Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 1512 5C

ALDRICH, T. E.
Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

ALDRIDGE, B. N.
Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

ALEKPEROV, I. K.
Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 1511 2H

ALEKSANDROV, V. V.
Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 1511 5G

ALEKSEEV, V. S.
Methods of Restoring the Delivery of Drainage Wells,
W82-02385 1505 4A

ALESII, B. A.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5E

ALEXANDER, E. C. JR.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

ALEXANDER, H. J.
Radioactive Wastes,
W82-06920 1512 5E

ALEXANDER, M.
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 1502 5A

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 1512 5B

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 1502 2H

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 1512 5B

ALEXANDER, M. L.
Wastewater Treatment Plant Features New Technology,
W82-03591 1508 5D

ALEXANDER, S. M.
A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 1512 6A

ALEXANDER, S. S.
Research on Piezodialysis - Sixth Report,
W82-0[illegible]294 1511 3A

ALEXANDER, W. J.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 1504 5E

ALEXANDER, W. J. R.
Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 1512 2E

ALHONEN-HONGISTO, L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 1504 2G

ALI, E. M.
A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

ALI, S. H. M.
Prediction of the Circulation in Reservoirs,
W82-04682 1510 2H

ALIFEROV, A. N.
Shaft Spillways Combined with a Water Intake,
W82-05111 1511 8A

ALLAN, R. J.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

ALLANSON, B. R.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

ALLCOCK, R.
Determination of Marine Consent Conditions,
W82-00323 1501 5G

ALLEMAN, J. E.
Activated Sludge,
W82-01243 1503 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 1511 5D

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

ALLEN, C. F.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

ALLEN, D. A.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

ALLEN, D. C.
The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works,
W82-03850 1509 5D

ALLEN, D. W.
Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 1512 2B

ALLEN, E. T.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 1503 3C

ALLEN, G. H.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

ALLEN, H. E.
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

Effect of Water Treatment on Mutagenic Potential,
W82-03776 1509 5A

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 1502 5A

ALLEN, H. L.
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

ALLEN, J. L.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1502 5B

ALLEN, K. O.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01766 1503 6G

ALLEN, L. H. JR.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01773 1503 7B

ALLEN, M. B.
Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

ALLEN, M. J.
Microbiology of Ground Water,
W82-01286 1503 5B

Microbiology of Potable Water,
W82-01287 1503 5F

ALLEN, M. P.
Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

ALLEN, N. L.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

ALLEN, P. G.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 1511 6C

ALLEN, R.
Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 1507 5E

ALLEN, R. K.
A Case for Regional Sludge Management,
W82-06993 1512 5E

ALLENBY, K. G.
Some Analyses of Aquatic Plants and Their Waters,
W82-02293 1505 2H

ALLER, R. C.
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 1506 2K

ALLERUP, P.
Accuracy of Point Precipitation Measurements,
W82-02209 1505 2B

ALLEY, W. M.
Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 1510 5B

Estimation of Impervious-Area Washoff Parameters,
W82-01465 1503 4C

ALLISON, G. B.
Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648 1511 2D

The Relationship Between O18 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759 1511 2G

ALMBERG, L.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 1504 5D

ALONSO, C. V.
Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 1505 2J

Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 1503 2J

ALONSO, J. M.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 1502 5A

ALPINE, A. E.
Plankton Studies in San Francisco Bay. 1. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

ALQUIER, M.
Improvement of Swirl Concentrator,
W82-05821 1511 5D

ALSEN, C.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

ALSOP, G. M.
Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 1511 5E

ALTHER, G. R.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

ALTHOFF, W. F.
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

ALTINISIK, D.
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 1511 8B

ALTOBELLO, M. A.
An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 6B

ALTSHULER, E. E.
Large Rain Drops in the Bright Band,
W82-03065 1507 7B

ALTUNIN, V. S.
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 1511 2E

ALVAREZ, G.
Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 1511 5B

ALVAREZ, G. H.
Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 1511 5D

ALVAREZ, H. G.
Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 1511 5D

ALVAREZ, M. E.
Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 1510 5F

ALVAREZ, R. J.
Microbiological Quality of Selected Recreational Waters,
W82-03636 1508 5A

ALVAREZ, Z. W.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

ALVES, W. J.
Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 1512 2G

AMADI, P. U. M.
Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana,
W82-03810 1509 2F

AMADON, J. F.
Nitrogen Availability from Sewage Sludge,
W82-00158 1501 5E

AMANDES, C. B.
Stormwater Detention in Developing Watersheds,
W82-03363 1507 4A

AMAVIS, R.
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 1502 6D

AMBROSE, R. B. JR.
Dynamic Estuary Model Performance,
W82-05319 1511 2L

AMBROSINO, G.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

AMBRUS, A.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

AMEL, R. T.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1502 5B

AMIARD, J-C.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

AMIARD-TRIQUET, C.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

AMIN, M. I.
Two Bed-Load Formulas: An Evaluation,
W82-02375 1505 2J

AMIR, I.
Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 1507 3F

AMIRTHARAJAH, A.
Initial Degradation of Effluent Quality During Filtration,
W82-04134 1509 5F

AMMON, D. C.
Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

AMOOZEGAR-FARD, A.
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 1501 6A

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 1503 5B

AMOROS, C.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 1504 7B

AMUNDSEN, D. W.
Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

AMY, G. L.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

AMY, V. P.
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 1505 2F

ANAND REDDY, K.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

ANDERSEN, J. M.
Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

ANDERSEN, M. E.
Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 1512 2D

ANDERSEN, P. F.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

ANDERSLAND, O. B.
Densification of Paper Mill Sludge Materials,
W82-04694 1510 5E

ANDERSON, B. F.
Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 1506 6B

ANDERSON, C. A.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

ANDERSON, C. H.
Interim Method for Determining Asbestos in Water,
W82-00741 1502 5A

ANDERSON, D.
Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 1504 5D

ANDERSON, D. A.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

ANDERSON, D. E.
Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

ANDERSON, D. L.
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 1505 3D

ANDERSON, E. L.
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 1503 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 1503 5D

ANDERSON, F. E.
The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 1506 2L

ANDERSON, H. M.
A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

ANDERSON, H. W.
Sources of Sediment-Induced Reductions in Water Quality Appraised from Catchment Attributes and Land Use,
W82-05494 1511 2J

ANDERSON, J. A.
Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 1512 5D

Primary Sedimentation of Sewage,
W82-03429 1508 5D

Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

ANDERSON, J. J.
Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04405 1510 5D

ANDERSON, L. D.
The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 1508 6B

ANDERSON, L. H.
Highlights of the St. Mary's Redevelopment Project,
W82-03617 1508 8A

ANDERSON, L. J.
Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

ANDERSON, L. W. J.
Control of Aquatic Weeds with Hexazinone,
W82-02326 1505 4A

ANDERSON, M. A.
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 1512 5B

ANDERSON, M. L.
Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 1508 5B

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

ANDERSON, M. P.
Groundwater Quality Models - State of the Art,
W82-01061 1502 5G

Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 1505 2F

ANDERSON, P. T.
Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 1508 5F

ANDERSON, R.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

Regulating Corrosive Water,
W82-04335 1510 6B

ANDERSON, R. F.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 1511 5B

ANDERSON, R. L.
Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 1511 6E

Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 1503 5C

Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

ANDERSON, R. S. JR.
A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

ANDERSON, R. Y.
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 1502 2F

ANDERSON, S. J.
Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1508 1B

ANDERSON, T. J.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 1502 5A

ANDERSON, W.
Aerated Drip Irrigation,
W82-02186 1505 3F

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

ANDO, A.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1505 5A

ANDRADE, W. P.
Relaxation in Concrete,
W82-05511 1511 8F

ANDRASKI, B.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

ANDREAE, M. O.
Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 1501 5A

ANDREN, A. W.
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 1501 5B

ANDREWS, J.
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 1506 5D

ANDREWS, J. F.
Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants,
W82-04026 1509 5D

Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

ANDREWS, M. J.
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 1505 5G

ANDREWS, P. L.
Sewer Maintenance and Rehab Options,
W82-06253 1512 5D

ANDREWS, R. W.
Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 1505 5B

ANDREWS, W. H.
Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

ANEJA, V. P.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 1502 5B

ANGEL, S.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 1505 6A

ANGELO, C. G.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

ANGINO, E. E.
Effect of Leachate Solutions from Fly and Bottom Ash on Groundwater Quality,
W82-03798 1509 5B

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

ANGIOLETTI, A.
Floating Breakwater,
W82-00067 1501 8A

ANIKEENKO, A. M.
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 1512 2J

ANLIKER, R.
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04823 1511 5B

ANMA, S.
Slope Failures and Tailing Dam Damage in the 1978 Izu-Oshima-Kinkai Earthquake,
W82-02891 1506 8D

ANNANDALE, G. W.
Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 1501 8D

Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 1502 8D

ANSPAUGH, L.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

ANTHONY, R. M.
Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 1505 5A

ANTON, C.
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

ANTONINO, R. A.
Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 1507 8D

ANTONOFF, D. P.
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 1511 3A

ANTONOPOULOS, V. Z.
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 1510 4A

ANUFRIEVA, N. M.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents, 1507 5G
W82-03371

ANUGWELEM, U. A.
Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry, 1511 5A
W82-05019

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species, 1510 5C
W82-04342

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response, 1510 5C
W82-04341

ANYATA, B. U.
Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries, 1508 6D
W82-03507

AOKI, M.
Practice and Perspective on Computer Control in Sewage Process, 1509 5D
W82-03852

AOKI, T.
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite, 1512 7B
W82-06995

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide, 1512 5D
W82-06658

AOYAMA, M.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI), 1504 5A
W82-02007

APARTSIN, M. S.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method, 1506 5C
W82-02626

APLAND, J.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt, 1502 6A
W82-00522

APONASENKO, A. D.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal, 1504 2H
W82-02078

APPAN, S. G.
A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems, 1505 7A
W82-02167

APPLEBY, P.
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates, 1508 5B
W82-03480

APPLEBY, P. G.
Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation, 1507 2J
W82-03235

APPLER, H. N.
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees, 1506 2H
W82-02882

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth, 1506 2H
W82-02883

APPLETON, A. R. JR.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O, 1503 5F
W82-01799

APPLETON, T. P.
Rutland Water Nature Reserve: Concept, Design and Management, 1512 6D
W82-06471

ARAI, M.
Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant, 1509 5D
W82-03862

ARAI, T.
Attenuation of Incident Solar Radiation in Lake Water, 1509 2H
W82-04180

ARAI, Y.
Preliminary Studies on Control Parameters and Biological Community for the Activated Sludge Process, 1509 5D
W82-04008

ARAKEL, A. V.
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study, 1503 2L
W82-01746

ARAL, M. M.
Evaluation of a Chimney Drain Design in an Earthfill Dam, 1510 8D
W82-04675

ARBAB, M.
Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds, 1508 2A
W82-03513

ARBHABHIRAMA, A.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand, 1505 6A
W82-02408

Reservoir Sedimentation with Random Deposits, 1510 2J
W82-04443

ARCE, R. G.
Water Chemistry of Alabama Ponds, 1508 2K
W82-03534

ARCEMENT, G. J.
Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi, 1511 2E
W82-05216

ARCHER, B.
The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas, 1512 8A
W82-06449

ARCHER, D. R.
A Catchment Approach to Flood Estimation, 1503 2E
W82-01397

Seasonality of Flooding and the Assessment of Seasonal Flood Risk, 1510 2E
W82-04646

Severe Snowmelt Runoff in North-East England and Its Implications, 1510 2E
W82-04648

ARCHER, P. B. R.
Models of Annual Cycles in Lentic Water Bodies, 1512 5G
W82-06483

ARCHIBALD, E. M.
Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas, 1510 5C
W82-04278

ARCHIBALD, G. G.
The Seven-Trent Studies of Industrial Water Use, 1510 6D
W82-04686

ARDEN, R. S.
Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie, 1511 5C
W82-05637

ARENAS, V.
The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon, 1510 2L
W82-04299

ARENDARCHUK, V. V.
Indoles in the Decomposition Products of Certain Blue-Green Algae, 1511 2H
W82-05505

ARENS, H-J.
Structural Aspects of the Water Supply in the Federal Republic of Germany, 1504 6E
W82-02066

ARFA, H.
Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa, 1508 2A
W82-03718

ARFI, F.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models, 1512 2A
W82-06366

ARGAL, E. S.
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints, 1507 8G
W82-03158

ARGAMAN, Y.
Single Sludge Nitrogen Removal from Industrial Wastewater, 1511 5D
W82-05245

ARGO, D. G.
Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II, 1505 5D
W82-02457

ARIEL, P. D.
Conformal Mapping for Channel Junction Flow, 1510 2E
W82-04306

ARKIN, G. F.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses, 1501 2G
W82-00113

ARKLEY, R. J.
Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate, 1505 2I
W82-02558

ARMANTROUT, G.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology, 1511 5E
W82-05213

ARMITAGE, P. D.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates, 1501 7B
W82-00308

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines, 1504 5C
W82-02053

ARMSTRONG, C. A.
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota, 1506 4A
W82-02828

ARMSTRONG, D. E.
Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 1501 2H

ARMSTRONG, J. L.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

ARMSTRONG, N. E.
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecclogic Model,
W82-05187 1511 2H

ARMSTRONG, R. N.
The Computer: Water Management Tool,
W82-03290 1507 6A

Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

ARNOLD, C. L.
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

ARNOLD, D. E.
Effects of Acid Precipitation,
W82-05149 1511 5C

ARNOLD, H.
Digitizing and Routine Analyses of Hydrological Data,
W82-06386 1512 2E

ARNOLD, L. E.
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 1512 4C

Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 1503 4C

ARNOLD, M. D.
Floodplain Management: A Flood and Land Planning System,
W82-01872 1504 6F

ARNOLDY, P.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

ARNOTT, E.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

ARON, G.
Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 1512 2A

ARONSON, D. A.
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 1508 4B

ARONSON, G. L.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 1508 5D

ARONSON, GL.
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 1510 5D

ARORA, M. L.
How Much Air,
W82-06638 1512 5D

ARSLANOVA, T. F.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02073 1504 2H

ARTHER, R. G.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 1504 5B

ARTHUR, J. P.
The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 1510 5D

ARTHUR, L. M.
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 1512 6B

ARTIOLA-FORTUNY, J.
Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 1512 5B

ARTS, M. T.
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

ARULANANDAN, K.
Relationship of Electrical Dispersion to Soil Properties,
W82-02561 1505 8D

ARUMUGAM, P. T.
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-0[illegible]360 1503 2H

ASAHARA, T.
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 1511 5A

ASAY, K. H.
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 1511 3F

ASHENMACHER, T. G.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

ASHIKHMEN, V. A.
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 1507 8A

ASHKENAZI, V.
Measuring Reservoir Ground Movements,
W82-05773 1511 8G

ASHLEY, C. S.
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 1502 5A

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

ASHLEY, N. V.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 1512 5D

ASHTON, P. J.
Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 1501 2H

ASIKAINEN, M.
Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

ASKARI, F.
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

ASMAN, W. A. H.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 1506 2K

ASPILA, K. I.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 1504 5A

ASPINWALL, D. M. V.
A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 1508 5B

ASPLUND, R.
Composite Sampling of Highway Runoff,
W82-02230 1505 7B

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 1511 5B

ASSINDER, D. J.
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

ASTAFICHEV, V. I.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

ASTON, S. R.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 1504 5B

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 1512 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 1508 5B

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

The Role of Suspended Solids in the Estuarine Geochemistry of Mercury, 1512 5B
W82-06035

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium, 1511 5B
W82-05178

ATCHISON, G. J.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake, 1502 5C
W82-00925

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream, 1502 5B
W82-00886

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination, 1511 5A
W82-04948

ATHANAS, L. C.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay, 1505 6G
W82-02115

ATHAVALEY, A. S.
Deep Well Injection of Industrial Wastes, 1501 5E
W82-00475

ATHERTON, T. AND
Low Turbidity Water from Fast Processes, 1502 5F
W82-00946

ATKINSON, G.
Ion Hydration and Ion Interaction, 1511 2K
W82-05310

ATLAS, D.
The Corrosion of Copper by Chlorinated Drinking Waters, 1512 5F
W82-06051

The Outlook for Precipitation Measurements from Space, 1512 7B
W82-06531

ATTWELL, R. W.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms, 1512 5C
W82-06534

ATWATER, J. W.
Operational Performance of an RBC Unit in Conjunction with a Septic Tank, 1510 5D
W82-04355

AUBERT, J.
Sludge Disposal to Sea in France, 1512 5E
W82-06593

AUBERT, M.
Sludge Disposal to Sea in France, 1512 5E
W82-06593

AUBERT, R.
Hypolimnion Oxygenation Studies in Clark Hill Lake, 1511 5G
W82-05001

AUCLAIR, B.
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France), 1503 6F
W82-01351

AUER, M. T.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics, 1512 5C
W82-06939

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics, 1512 5C
W82-06940

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron, 1503 5C
W82-01149

AUFREITER, S.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace, 1511 5A
W82-05397

AUGIER, H.
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Qu.a: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique, 1507 5B
W82-03312

AUGUSTINE, J. A.
Satellite Rain Estimation in the U.S. High Plains, 1502 2B
W82-00808

AUGUSTINE, M.
Continuous Monitoring at Minworth Water Reclamation Works, 1505 7B
W82-02431

AUKERMAN, R.
Recreational Enhancement of High Country Water Supply Reservoirs, 1509 6A
W82-03923

AULENBACH, D. B.
Land Application of Secondary Effluent at Lake George, NY, 1511 5D
W82-05704

Land Application of Wastewaters: An Overview, 1506 3C
W82-02650

AULL, G. H. III.
Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution, 1506 5G
W82-02728

AURAND, T. A.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM), 1501 5A
W82-00256

AUS, H. C.
Measurement of Air in Flowing Water, 1510 7B
W82-04322

AUSTFORD, V. M.
Flood Control and Flow Regulation Problems on the Assiniboine River, 1511 4A
W82-05389

AUSTIN, B.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli, 1504 5A
W82-01911

AUSTIN, C. F.
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California, 1510 1A
W82-04743

AUSTIN, S.
Parallel Evaluation of Air- and Oxygen-Activated Sludge, 1510 5D
W82-04624

AVADHANULU, R. V.
An Aquifer Simulation Program for Micro-Based Processors, 1504 2F
W82-01879

AVCI, C. B.
Nitrogen Dynamics in Waste Stabilization Ponds, 1512 5D
W82-06456

AVERETT, R. C.
Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California, 1505 4C
W82-02484

AVERILL, D. W.
Data Base Development for the Design of a Radium-226 Removal Process, 1503 5D
W82-01188

AVNIMELECH, Y.
Decomposition of Chelates Leached from Waste Disposal Sites, 1511 5B
W82-04879

A Method for the Evaluation of Conditions in a Fish Pond Sediment, 1502 2H
W82-01019

Mutual Flocculation of Algae and Clay: Evidence and Implications, 1511 2H
W82-05460

AXBERG, C.
Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B, 1507 5D
W82-03319

AXLER, R. P.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake, 1501 2H
W82-00476

AYALA, L.
Viscosity-Controlled Sediment Transport in the Absence of Suspended Load, 1509 2J
W82-04210

AYERS, J. F.
Evaluation of the Groundwater Resources of the Agag Basin, Saipan, 1512 2F
W82-06524

AYERS, M. A.
Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota, 1512 2H
W82-06690

AYOADE, J. O.
On Water Availability and Demand in Nigeria, 1507 6D
W82-03062

AZARKOVICH, A. E.
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers, 1506 8H
W82-02783

Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station, 1511 8H
W82-05585

AZOV, Y.
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds, 1511 5D
W82-05373

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond, 1512 5C
W82-06538

Operation of High-Rate Oxidation Ponds: Theory and Experiments, 1512 5D
W82-06266

BAALSRUD, K.
The Rehabilitation of Norway's Largest Lake,
W82-05243 1511 5G

BAARD, J. H.
Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02374 1506 2K

BABA, K.
Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 1512 5D

BABA, M.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 1502 5A

BABALOLA, O.
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 1503 2I

Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 1502 2I

BABB, A. F.
Measurement of Air in Flowing Water,
W82-04322 1510 7B

BABCOCK, M.
Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

BABENKO, L. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

BABICH, H.
Acid Precipitation. 1. Causes and Consequences,
W82-04771 1511 5C

BABIN, F. G.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 1511 6C

BABITSKIY, V. A.
Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

BABUTSIDZE, M. G.
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 1508 4A

BACA, E.
Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

BACCINI, P.
Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 1511 5B

BACHMANN, R. W.
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 1501 2H

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 1511 2H

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

BACK, W.
Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 1511 4B

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

BACKER, R. R.
Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

BACON, M. P.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 1511 5B

BAETJER, K.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

BAGBY, J. C.
Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

BAGBY, M. M.
Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 1506 5D

BAGENSKI, G.
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 1507 5D

BAGG, J.
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 1505 5B

BAGNYUK, L. I.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

BAHNER, L. H.
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 1506 5C

BAHNICK, D. A.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

BAIGOROV, Y. U.
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 1511 8G

BAILEY, G. C.
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 1502 5F

BAILEY, R. H.
The Shubenacadie-Stewiacke River Basin Study,
W82-05385 1511 6B

BAILEY, Z. C.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

BAIN, C. A. R.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

BAIN, G. L.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

BAIN, W. S.
A New Look at Design of Raw Water Piping,
W82-01029 1502 8A

BAINES, M. J.
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 1510 2F

BAIR, E. S.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 1502 6A

BAIRD, W. F.
Canadian Wave Climate Study: Organization and Operation,
W82-06393 1512 8B

BAJARD, Y.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 1503 6A

BAJRAKTAREVIC-DOBRAN, H.
Dispersion in Mountainous Natural Streams,
W82-06357 1512 2E

BAKER, A. L.
Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

BAKER, B. L.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

BAKER, J. L.
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 1505 5B

BAKER, J. P.
Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 1506 5C

Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

BAKER, J. R.
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G

BAKER, K. H.
Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

BAKER, L. A.
Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

BAKER, M. B.
An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 1506 2K

BAKER, S. J.
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

BAKER, V. R.
Paleoflood Hydrology,
W82-03761 1509 2E

BAKHTIN, B. M.
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 1508 8D

BAKOS, L.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 1505 5A

BALACHANDRAN, W.
Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

BALAKRISHNA, S.
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

BALARAJU, M.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 1504 3F

BALBA, M. T.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

BALE, J. B.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

BALL, R. O.
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

BALLESTERO, T. P.
Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 1511 4A

BALLING, S. S.
Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

BALLINGER, D.
A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 1511 5A

BALLOU, S. W.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

BALLUKRAYA, P. N.
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 1508 7B

BALRAM, A.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

BALTZER, R. A.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

BALVAY, G.
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 1501 2H

BAMBA, E.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

BANAT, I. M.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

BANCROFT, K. C. C.
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 1512 5D

BANDLER, H.
Large Water and Hydroelectric Developments in Fiji,
W82-05614 1511 6D

BANDT, K. E.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 1503 7B

BANDY, J. T.
R-Factors for Soil Loss Impact Prediction,
W82-01963 1504 2J

BANERJI, S. K.
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

BANIN, A.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

BANIUKIEWICZ, A.
Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

BANKS, D. J.
The Kielder Transfer Works,
W82-06502 1512 8A

Riding Mill Pumping Station,
W82-04292 1510 8A

BANKS, H. O.
Management of Interstate Aquifer Systems,
W82-02578 1505 4B

BANKS, J. T.
Water Quality: What Should Be Done Today,
W82-03631 1508 6E

BANKS, N. B.
The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 1511 5D

BANKS, W.
Riding Mill Pumping Station,
W82-04292 1510 8A

BANNER, R.
Gerber Saves 465,000 Gallons of Water/Day,
W82-00187 1501 3E

BANNING, D.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

BANNINK, B. A.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

BANSAL, S. K.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

BAO, P.
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

BARACOS, P. C.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

BARAM, M. S.
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

BARANOS, E. S.
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 1507 8A

BARANOVA, V. V.
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

BARANSKI, J.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

BARATAN, R.
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 1508 7B

BARAZE, A.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

BARBA, D.
Analysis of Large Desalination Plants,
W82-06122 1512 3A

Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

BARBARICK, K. A.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

BARBEAU, C.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 1503 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 1503 5B

BARBER, L. K.
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 1501 5D

BARBER, S.
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03505 1508 5A

BARBIERI, J. L.
Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 1507 5B

BARCELONA, M. J.
Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 1508 5B

BARCLAY, L. A. JR.
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

BARCLAY, W. R.
The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 1505 2L

BARDSLEY, W. E.
Note on Random Raindrops and Sampling Error,
W82-02032 1504 2B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 1503 2J

BARFIELD, B. J.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

BARICA, J.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 1502 2H

BARILA, T. Y.
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 1501 2E

BARKER, J. A.
A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 1505 8E

BARKER, J. F.
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

Conteminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 1511 2K

BARKER, M.
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

BARKER, T. W.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

BARKLEY, J. J. JR.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

BARKO, J. W.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 1502 2H

BARLTROP, J.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 1502 5G

BARNARD, J. L.
The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 1511 5D

BARNBY, M. A.
Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

BARNER, U.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

BARNES, A. A. JR.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

BARNES, D.
Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 1507 5D

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 [illegible] 5D

BARNES, D. B.
Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

BARNES, G. D.
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

BARNES, I.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

BARNES, J. S.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

BARNES, J. W.
Obtaining Layout of Water Distribution Systems,
W82-04319 1510 8A

BARNES, K. A.
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

BARNES, M. J.
Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

Selection of a Sludge Handling Disposal System,
W82-06346 1512 5E

BARNES, V. C.
Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

BARNETT, B. B.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

BARNETT, S. M.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 1512 5D

BARNEY, T. W.
Remote Sensing Applications for Resource Management,
W82-03279 1507 7B

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 1506 5B

BARNHILL, C.
Forecasting Water Demand in the Pacific Northwest,
W82-04135 1509 6D

BARON, D. M.
Screened Auger Aids Investigation,
W82-02096 1504 7B

BARON, V. A.
Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 1506 2A

BARONE, K. A.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a

Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

BAROSS, J. A.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

BARQUET, A.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

BARR, D. I. H.
Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 1510 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 1512 8B

Uniform Flow Calculations for Pipes,
W82-03748 1508 8B

BARR, G. L.
Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

BARRACLOUGH, J. T.
Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

BARRANCO, G. S.
The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 1512 3F

BARRETT, H. B.
History of Human-Use Impacts on Long Point Bay,
W82-02580 1505 5B

BARRETT, P. R. F.
Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 1505 4A

BARRETT, R. K.
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 1505 8A

BARRETT, W. J.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 1511 5A

BARRICK, R. C.
Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

BARRIE, L. A.
The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 1506 5B

BARRON, G. M.
Work Management Standards,
W82-06349 1512 6F

BARRON, P. F.
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 1507 2H

BARROW, E. T.
Sources and Control of Organic Air Pollutants,
W82-00711 1502 5B

BARROW, G. I.
Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 1504 5C

BARROW, N. J.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 1503 5B

BARROWS, M. E.
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

BARRY, J. J.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

BARRY, J. J. III
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

BARTEL, H.
Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 1510 4B

BARTEL, R. L.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

BARTELL, S. M.
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 1502 2H

BARTELLS, J. H.
An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 1501 4A

BARTESZEWSKI, K.
Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 1511 5D

BARTH, E. F.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

To Inhibit or Not to Inhibit: That is The Question,
W82-02672 1506 5A

BARTHOLDY, J.
On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 1511 2J

BARTHOLOMEW, W. C.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

BARTLE, J. R.
Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

BARTLETT, D. S.
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

BARTLETT, W. P. JR.
Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 1512 8B

BARTON, N.
Shear Strength of Rockfill,
W82-00116 1501 8D

BASAK, P.
Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 1508 5G

BASCOM, W.
Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 1512 5C

BASHKIN, V. N.
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 1508 5B

BASIOUNY, F. M.
Wastewater Irrigation of Fruit Trees,
W82-06008 1512 3C

BASS, D.
Water Quality of a Southeast Texas Stream,
W82-02570 1505 2K

BASSELL, C. D.
Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 1506 5D

BASSETT, D. A.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 1501 5E

BASSETT, R. L.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

BASTIAN, R. K.
Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 1507 5D

BASTOS, J. T.
Relaxation in Concrete,
W82-05511 1511 8F

BATCHELDER, A. R.
Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 1507 5C

BATE, G. C.
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

BATES, J.
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 1507 5D

BATES, T.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 1502 5D

BATES, T. E.
Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 1512 5E

BATES, V. T.
Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05899 1511 5D

BATH, A. H.
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 1508 2K

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

BATHURST, E. T. J.
Bromide in Canterbury Ground Water,
W83-02096 1504 5B

BATHURST, J. C.
Resistance Equation for Large-Scale Roughness,
W82-04496 1510 2E

BATJER, K.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

BATLEY, G. E.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-07614 1502 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 1502 5A

BATTAGLIA, G.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

BATTAN, L. J.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 1504 2B

BATTARBEE, R. W.
Paleoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 1508 5B

BATTEN, C.
Recycling,
W82-02514 1505 6E

BATTEN, R.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-06406 1510 5D

BATTERMAN, A. R.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 1504 5C

BATTERSON, T. R.
Arsenic in Lake Lansing, Michigan,
W82-03522 1508 5B

BATY, R. J.
Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 1512 8A

BAUER, J.
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

BAUER, N. J.
A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

BAUER, S.
The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

BAUGHMAN, G. L.
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 1511 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 1511 2K

Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 1502 2K

BAUMGARDNER, M. F.
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 1511 2G

BAUMGARDNER, R. W.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

BAUR, R. J.
Polyculture of the Freshwater Prawn, Macrobrachium Rosenbergii, Chinese and Common Carps in Ponds Enriched with Swine Manure I. Initial Trials,
W82-03900 1509 3C

BAUSCH, W. C.
Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 1508 2G

BAUSUM, H. T.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

BAVEJA, A. K.
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 1507 5A

BAXENDALE, R. A.
Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 1507 2F

BAXTER, J. C.
Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 1510 5D

BAXTER, M. S.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

BAYAZIT, M.
Distribution of Joint Run-Lengths of Bivariate Markov Processes,
W82-02191 1505 2E

Three-State Markov Model for Differential Persistence,
W82-05654 1511 2E

BAYHA, K.
Overview of Freshwater Inflow Depletions,
W82-02152 1505 6D

BAYLEY, S. E.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

BAYS, J. S.
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

BAZARAA, A.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

BAZZA, M.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

BAZZAZ, F. A.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

BEALL, M. L. JR.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 1502 5B

BEAMS, J.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

BEAR, J.
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 1504 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 1504 2F

A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 1503 2F

BEARD, D. P.
Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 1512 6B

BEARD, H. R.
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

BEARD, J. D. II.
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 1506 5F

BEARD, L. R.
Reservoir Operation for Water Conservation,
W82-04165 1509 3B

BEASLEY, D. B.
Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 1511 4D

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 1511 4D

BEASLEY, T. W.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

BEATTIE, B. R.
Can Prices Tame the Inflationary Tiger,
W82-04142 1509 6D

BEATTIE, D. M.
Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 1503 2H

BEATTY, J. S.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

BEAUCHAMP, J. J.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

BEAUPRE, R. T.
Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

BEAVER, J. R.
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

BEAVIS, B.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

BEBAWI, F. F.
Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 1512 2I

BECHER, A. E.
Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 1511 2F

BECK, B.
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling.
W82-03243 1507 5B

BECK, B. F.
The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 1511 3B

BECK, M. B.
Operational Estimation and Prediction of Nitrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

BECK, W.
Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 1512 5C

BECK, W. W. JR.
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 1503 5G

BECKER, K.
Control of Sludge Bulking in the Brewing Industry,
W82-05260 1511 5D

BECKER, R. H.
User Reaction to Wild and Scenic River Designation,
W82-02278 1505 6G

BECKER, R. M.
Cation Chromatography With a Conductivity Detector,
W82-00582 1502 5A

BECKETT, P. H. T.
Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

BECKMANN, D. D.
Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

BEDARD, P.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 1503 2C

BEDFORD, B. L.
Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 1507 5C

BEDFORD, K. W.
A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

BEDIENT, P. B.
Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 1512 5G

Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

Revised Rainfall Frequency Analysis for Houston,
W82-05863 1511 2B

Stormwater Detention in Developing Watersheds,
W82-03363 1507 4A

Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

BEDNAR, G. A.
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 1511 5B

BEECH, J. A.
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 1502 5B

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

BEER, S.
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

BEER, T.
Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 1506 2L

BEG, S. A.
Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 1511 5C

BEGG, J. E.
Plant-Water Relations and Adaptation to Stress,
W82-00812 1502 2I

BEGIN, Z. B.
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 1511 2E

BEILOCK, R.
How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 1512 6C

BEITINGER, T. L.
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 1510 5C

BELANGER, T. V.
Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 1508 2H

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 1505 2H

Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 1510 5B

BELFORT, G.
Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 1507 3A

BELICHENCKO, Y. P.
Decontamination of Overland Runoff from Populated Areas,
W82-06980 1512 5D

BELL, C. R.
Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 1512 5B

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 1512 5B

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 1512 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 1512 5A

BELL, F. C.
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 1512 2A

BELL, H. E. III.
Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

BELL, J. B.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 1502 5A

BELL, J. N. B.
Acid Precipitation--A New Study from Norway,
W82-03341 1507 5C

BELL, R. G.
Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 1512 5A

BELL, S. E.
An Analysis of the Effects of Alternative Measures of Price on the Demand for Water by Self-Supplied Industries,
W82-03828 1509 6C

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

BELL, W. H.
Bacterial Utilization of Algal Extracellular Products. 1. The Kinetic Approach,
W82-03330 1507 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 1507 5C

BELLAN-SANTINI, D.
Relationship Between Populations of Amphipods and Pollution.
W82-02444 1505 5C

BELLES, R.
Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

BELLES, R. G.
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

BELLINGER, E. G.
A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 1511 5B

BELLUCK, D.
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 1502 5B

BELLUCK, D. A.
Pesticides in the Aquatic Environment,
W82-04727 1510 5C

BELOBABA, E. G.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

BELSER, L. W.
Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 1501 2L

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 1512 5A

BELT, P. B.
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

BELTAOS, S.
Dispersion in Tumbling Flow,
W82-05796 1511 8B

BELTRAMI, E. J.
Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

BELYAKOVA, O. V.
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 1502 2H

BEN-ASHER, J.
Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 1512 3C

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 1503 2D

BEN-ASHER, Y.
Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 1511 7B

BEN-YAAKOV, S.
Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 1511 7B

BEN[illegible]ICHA, M.
Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 1508 6C

BEND, J. R.
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 1501 5C

BENDER, M. E.
Kepone in the James River,
W82-00631 1502 5B

BENECKE, G.
Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 1511 5A

BENEDEK, P.
Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 1510 5D

A Large International River: The Danube,
W82-03369 1507 5G

New Trends in Water Quality Management,
W82-02429 1511 5G

BENEDICT, A. H.
Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 1501 5D

BENEFIELD, L.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

BENEFIELD, L. D.
The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

BENES, P.
Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

BENFIELD, E. F.
Effects of Pollution on Freshwater Invertebrates,
W82-01280 1503 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 1505 5C

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 1502 5A

BENGERT, G. A.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

BENGT[illegible]ON, R. L.
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 1503 2E

BENGTSSON, L.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 1504 2D

Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 1512 2E

The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 1512 2C

BENHAM, D. G.
A Portable System for Measuring Water Temperature, Conductivity. Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 1511 7B

BENJAMIN, K.
The Chertsey Automation Project at North Surrey,
W82-05805 1511 5F

BENJAMIN, M. M.
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 1510 5D

BENJAMIN, P. M.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

BENKE, A. C.
Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

BENNDORF, J.
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 1504 2H

BENNETT, C. R.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

BENNETT, E.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

BENNETT, J. C.
Planning Sri Lanka's Victoria Scheme,
W82-05979 1512 8A

BENNETT, J. M.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

BENNETT, J. T.
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

BENNETT, O. L.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 1503 5E

BENOIT, F. M.
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 1504 5A

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 1502 5A

BENSON, B. B.
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1507 1B

BENSON, C. R.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

BENSON, N. G.
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

BENSON, R. C.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 1503 5G

BENYAMINI, Y.
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 1511 2G

BENZ, L. C.
Watertable Management Saves Water and Energy,
W82-00943 1502 3F

BENZINGER, W. D.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 1503 5D

BERBEN, S. A.
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 1501 5A

BERESFORD, J. D.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 1511 4B

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

BERG, G.
Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 1502 5A

Method for Recovering Viruses from River Water Solids,
W82-00200 1501 5A

BERG, J. D.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

BERGAMIN, F. H.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 1508 5A

BERGATINO, R. N.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

BERGEN, L. J.
Reregulation on an International River--A Case Study,
W82-06429 1512 6G

BERGER, J.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

BERGERON, M. P.
Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 1502 7B

BERGERSEN, E. P.
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

BERGEY, E. A.
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C

BERGH-CHRISTENSEN, J.
Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 1512 8E

BERGLING, S.
Jonkoping's Water Supply,
W82-02419 1505 5F

BERGLUND, E. R.
Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05715 1511 6B

BERGLUND, S. H.
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 1503 4D

BERGMAN, D. L.
Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma,
W82-03999 1509 2E

BERGMAN, H. L.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

BERGMANN, M.
A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

BERGSENG, J.
Water Level Control for Small Hydro Plants,
W82-04173 1509 8C

BERKES, F.
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 1504 6G

BERMAN, D.
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 1501 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 1502 5A

BERMAN, J.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 1503 5B

BERMAN, S. S.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

BERMAN, T.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 1502 2H

BERNARD, R.
Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

BERNDT, C.
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

BERNHARDT, H.
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 1512 5F

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 1512 5C

Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminierung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

BERNHARDT, J. C.
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 1502 5D

BERRIE, T. W.
The Energy Resources of Kenya,
W82-05978 1512 6D

BERRY, D.
Regulating Corrosive Water,
W82-04333 1510 6B

BERRY, N. S. M.
The Kielder Transfer Works,
W82-06[illegible]02 1512 8A

BERSCHAUER, W. L.
County Provides a Rural Water Supply System,
W82-06843 1512 3D

BERSELL, P. O.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

BERTA, E.
Heavy Metals in Animals of Lake Balaton,
W82-06284 1512 5C

BERTHEL, R. O.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

BERTING, J. P.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00[illegible]40 1501 5D

BESCHTA, R. L.
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

Sediment Transport During a Controlled Reservoir Release,
W82-02196 1505 2J

BESEDA, N. I.
Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 1506 4B

BESHA, J. A.
Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

BESSIERE, J.
Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1506 1B

BEST, B. R.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 1502 5D

BESZEDITS, S.
Feeding Animals Activated Sludge,
W82-00523 1502 5D

BETTESS, R.
Mathematical Simulation of Sediment Movement in Streams,
W82-04650 1510 2J

BETTINGER, G. E.
Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 1512 5F

BEUKES, D. J.
Soil Water Studies on Small Lucerne Plots,
W82-01713 1503 2I

BEVEN, K.
Kinematic Subsurface Stormflow,
W82-03844 1509 2G

BEVERS, J.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

BEWERS, J. M.
Discharge of Metals from the St. Lawrence River,
W82-06190 1512 5B

BEYTH, M.
The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 1508 4B

Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03706 1508 2K

BEZDEK, J. C.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 1503 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 1503 3F

BHAGAT, S. K.
Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 1512 5D

BHAGAT, T.
Spiral Classifiers Help One Manufacturer Meet Environmental Standards More Easily,
W82-02602 1506 5D

BHALME, H. N.
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 1511 2A

BHAN, S.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 1504 3F

BHAT, RAMA S.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 1502 5A

BHAT, S. R.
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 1507 5A

BHATTACHARYA, R. N.
Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 1507 2F

BHATTACHARYA, S.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

BHATTACHARYYA, D.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 1511 5D

Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results,
W82-03878 1509 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

BHENDE, S. S. S.
Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 1512 5C

BHIMASANKARAM, V. L. S.
Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 1508 2F

BHOLE, A. G.
Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 1507 5F

Measuring the Velocity of Water in a Paddled Flocculator,
W82-04102 1509 5F

BHOWMIK, N. G.
Carrying Capacity of Flood Plains,
W82-06428 1512 2E

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

BIANCHI, W. C.
Artificial Basin Recharge,
W82-03745 1508 4B

Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

BIANCHINE, J. R.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

BIBBY, R.
Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 1503 5B

BICHLER, J.
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

BIDINGER, F.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

BIDWELL, R.
Effluent Charging Systems and Their Administrative Implications,
W82-02403 1505 6C

BIEHL, T. G.
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 1503 5D

BIENFANG, P.
Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 1506 5C

BIERIG, H. W.
Detroit - Fresh Clean Water,
W82-01506 1503 5D

BIERMAN, S. L.
Small Hydro Schemes for Private Developers,
W82-04327 1510 8A

BIERMAN, V. J.
Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 1511 5C

BIESINGER, M. G.
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 1501 5D

BIGELOW, S. M.
Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

BIGGAR, J. W.
Irrigation Tailwater Management,
W82-00392 1501 3C

BIGGS, A. I.
An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 1505 6G

BIGGS, D. C.
Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 1511 5F

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

BIGGS, R. B.
Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 1505 2L

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

BIHLER, S.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

BIKBULATOV, E. S.
Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1508 1A

BIKINEEV, M. G.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

BILBY, R. E.
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 1506 4D

BILLARD, T. C.
Solution of the Continuity Equation for the Karnak Area,
W82-03196 1507 2G

BILLET, M. L.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

BILLINGS, R. B.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 1502 6C

BILLINGSLEY, E.
Water Savings in the Orange Water and Sewer Authority,
W82-02519 1505 3D

BILYJ, B.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 1502 2H

BINGHAM, A.
Cave Water--Java's Hidden Resource,
W82-06605 1512 3B

Hydro Powers Mindanao Development Plans,
W82-05881 1511 8A

BINGHAM, A. E.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

BINGHAM, S. C.
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 1501 5B

BININI, A. P.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

BIRCH, P. B.
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

BIRCH, R. B.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

BIRD, J. W.
Development of Federal Reserve Rights,
W82-04446 1510 6E

BIRD, P. G.
The Effect of Nitrification in the BOD Test,
W82-02384 1505 5D

BIRGE, W. J.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

BISCHOF, R. B.
Morocco's Largest Multipurpose Scheme,
W82-01724 1503 8A

BISEMBAEVA, K. K.
Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 1506 2A

BISHOP, A. A.
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

BISHOP, C. S.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

Health Aspects of Urban Water Conservation,
W82-01047 1502 3C

BISHOP, C. T.
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 1505 5B

BISHOP, D. F.
Toxics in Municipal and Industrial Wastewaters,
W82-00712 1502 5A

BISHOP, R.
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 1505 5E

BISHOP, S.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

BISHOP, S. L.
Methods for Evaluating Performance of Filter Media,
W82-02684 1506 5D

Methods for Evaluating Performance of Filter Media,
W82-03661 1508 5F

BISOGNI, J. J. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

BISSON, B. T.
Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 1506 5D

BISTRICKI, T.
Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

BISWAS, A. K.
Clean Water for the Third World,
W82-04604 1510 6D

Integrated Water Management: Some International Dimensions,
W82-05493 1511 6D

Long Distance Mass Transfer of Water,
W82-00858 1502 6D

Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 1505 6A

BITONDO, M.
Cold Weather Waste Treatment,
W82-00636 1502 5D

BITTINGER, M. W.
Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

BITTON, G.
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 1505 5A

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 1512 5D

BJERVE, L.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 1504 7B

BJORNSEN, G.
Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Überwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

BLACHUT, S. P.
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

BLACK, A. L.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

BLACK, E.
Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

BLACK, J. A.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

BLACK, J. H.
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 1502 7B

BLACK, J. J.
Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 1511 5B

BLACK, P. E.
Search: A Gaged Watershed Inventory,
W82-04433 1510 10B

Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 1510 5B

BLACKARD, J.
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 1501 2J

BLACKBURN, T. R.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

BLACKWELL, C. D.
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 1501 10D

BLAHM, T. H.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

BLAIR, J. F.
2,500 Acres of Wastewater Irrigation,
W82-00769 1502 3C

BLAIR, W. R.
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 1511 5A

BLAKE, L. M.
Liming Acid Ponds in New York,
W82-02572 1505 5G

BLANC, F. C.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 1508 5D

BLANCHAR, R. W.
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 1503 2G

BLANCHARD, A. J.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

BLANCHARD, B. J.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

BLANCHARD, S. F.
Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998 1509 2L

BLANCHARD, W. A.
Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

BLANKENBAKER, G. G.
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

BLANKENSHIP, W.
Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 1507 5B

BLASING, T. J.
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

BLAVOUX, B.
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 1506 2F

BLAYLOCK, B. G.
Radioactive Wastes,
W82-01268 1503 5D

Radioactive Wastes,
W82-06920 1512 5E

BLEDSOE, B.
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

BLEIL, D. F.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapeapeake Bay,
W82-02115 1505 6G

BLENCH, T.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 1502 2J

BLENK, J. B.
Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

BLERY, P. F.
Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

BLEVINS, R. D.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

BLEVINS, W. T.
Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 1512 5D

BLIGHT, G. E.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 1502 8D

BLIND, H.
Safety of Dams (Sicherheit Von Talsperren),
W82-06236 1512 8A

BLINN, D. W.
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 1502 7B

BLINOV, I. F.
Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 1505 8A

Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 1511 8A

BLISS, P. J.
Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

BLOCK, J. C.
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 1502 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 1503 5A

BLODGETT, J. C.
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 1501 2E

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 1512 4A

Floodflow Characteristics of the Sacramento River in the Vicinity of Gianella Bridge, Hamilton City, California,
W82-03985 1509 2E

BLOESCH, J.
Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 1512 2J

BLOKHINA, N. P.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 1504 2H

BLOMMAERT, W.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

BLOMO, V. J.
Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 1505 6G

BLOMQUIST, G.
Water Quality and the Demand for Recreation,
W82-01942 1504 6D

BLOMQVIST, S.
A Review on Sediment Traps in Aquatic Environments,
W82-01020 1502 7B

BLOOD, E. R.
Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

BLOOMFIELD, C.
Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 1512 5D

BLOTNICK, J. R.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 1503 4A

BLOYD, R. M.
Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 1502 7C

BLUEMKE, C.
Problems and Processes in Water Quality Management,
W82-06147 1512 5G

BLUM, A.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 1502 2I

BLUM, J. L.
Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 1512 5C

BLUME, H. J. C.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

BLUME, H. P.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

BLUMM, M. C.
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 1504 6E

BLUNT, D. J.
Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

BLYTHE, M.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

BOALCH, R.
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

BOARDMAN, D. C.
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

BOBBA, A. G.
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 1503 5B

BOBEE, B.
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 1503 2E

A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 1510 6D

Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 1506 2K

BOBENRIETH, M. J.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

BOBROV, V. I.
New Jet-Gate Design,
W82-02691 1506 8C

BODECHTEL, J.
Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 1511 7C

BODEWIG, F. G.
Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry,
W82-05580 1511 5A

BOEGMAN, N.
Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

BOEHMKE, J. R.
Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

BOELHOUWER, C.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 1503 5D

BOELTER, D. H.
Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 1511 5D

BOENING, P. H.
Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

BOERSMA, J. R.
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 1501 2L

BOES, R.
An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

An Organics Detection System for the Ohio River,
W82-03436 1508 5A

BOESE, B. L.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

BOESEL, M. W.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 1502 5C

BOGARDI, I.
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8H

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03431 1508 5G

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 1511 5G

Reliability of Underground Flood Control System,
W82-00556 1502 8A

BOGARDUS, E. R.
Energy Conservation in Municipal Wastewater Plants,
W82-06070 1512 5D

BOGATOVA, I. B.
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 1511 5D

BOGAZZI, D.
Analysis of Large Desalination Plants,
W82-06122 1512 3A

BOGDAN, G. F.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

BOGERT, I. L.
Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 1512 5E

BOGGESS, D. H.
Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

BOGGESS, W. R.
A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

BOGNER, W. C.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

BOGOLYUBOV, K. S.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 1511 8C

BOHAC, C. E.
Dissolved Oxygen in Streams and Reservoirs,
W82-01272 1503 5G

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 1512 5C

BOHLING, R. A.
Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 1510 5D

BOHN, M.
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 1501 2L

BOIKOV, A. I.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 1506 8B

BOILLAT, J. L.
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1506 1B

BOISON, P. J.
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

BOISSELLE, E. B.
A Method for Wastewater Treatment System User Cost Allocation, Volume 1: Study Report,
W82-06382 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 1512 5D

BOITEN, W.
The V-Shaped Broad-Crested Weir,
W82-06450 1512 8B

BOKE, E.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

BOKHARI, S. M. H.
Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 1510 6A

BOKIL, S. D.
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 1501 5D

BOLAND, J. J.
How Much Water Supply Capacity Is Enough,
W82-04103 1509 6D

BOLDING, M. E.
An Alternative Solution to the THM Problem,
W82-00072 1501 5F

Piloting Mag-Carbonate Treatment,
W82-05794 1511 5F

BOLDUC, P. A.
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

BOLES, E. E.
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 1503 6A

BOLKE, E. L.
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

BOLLIGER, W.
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 1511 8A

BOLSENGA, S. J.
Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 1511 2C

BOLSTAD, W.
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

BOLTO, B. A.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

BOLTON, E. F.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 1503 2I

BOLTON, F. E.
Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 1511 3F

BOLZERN, P.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

BOM, C. M.
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

BOMBERGER, D. C. JR.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04317 1511 5B

BONACCI, O.
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 1504 2J

BONAZOUNTAS, M.
Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 1511 2E

BOND, W. J.
Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 1507 2G

Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 1507 2G

BONDARENKO, M. D.
Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 1511 8H

BONDELID, T. R.
Comparison of Detention Basin Planning and Design Models,
W82-02592 1505 6A

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 1512 2A

BONDEV, I. A.
The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Sebiratelnite Ezera v Mestnoustta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiekh),
W82-04476 1510 5C

BONDURANT, J. A.
Furrow Intake Rates and Water Management,
W82-05968 1512 3F

Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 1510 4D

BONELLI, J. E.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1503 1A

A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 1501 5A

BONHAM, E.
Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 1511 4A

BONNER, R. F.
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 1508 6A

BONNER, R. F. JR.
Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 1507 5D

BONNET, L.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 1502 5A

BONNIN, J.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

BONTOUX, J.
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

BOOKER, D. I. J.
Beddington Sewage-Treatment Works, Canyon: Some Operating Experiences 1969-79,
W82-02410 1505 5D

BOOMAN, G. L.
Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 1511 3A

BOON, A. G.
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 1510 5D

BOONE, D. R.
Formulating Alternatives for Environmental Studies,
W82-00997 1502 6G

Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 1510 5D

BOORAM, C. V.
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 1501 5D

BOORMAN, L. A.
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

BOOTH, J.
Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

BOOTH, M. G.
The Use of Oxygen in Sewage Treatment,
W82-06262 1512 5D

BOPP, R. F.
Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 1511 2J

BORDEAU, L. E.
Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 1512 5G

BORDESSA, R.
Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 1511 6E

BORDNER, R. H.
Microbiology: Methodology and Quality Assurance,
W82-01285 1503 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 1512 5A

BORDOVSKY, J. P.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 1504 3F

BOREMAN, J.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

BORENZSTAJN-ROTEM, Y.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 1502 5A

BORGHARD, W. G.
Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W22-05399 1511 5D

BORGMANN, U.
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 1504 5A

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 1502 5C

Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 1503 5C

BORGWARDT, R. H.
Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 1506 3E

BORJESON, H. B.
Field Report on a Nonpolluting Bleach Plant,
W82-02793 1506 5D

BORMAN, R. G.
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 1503 5B

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 1501 7C

BORNKAMM, R.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

BORRELLI, J.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

BORROWS, P.
Reviving the Rio Reconquista,
W82-02014 1504 5G

BORST, M.
Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 1511 5G

BORTKEVICH, S. V.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 1511 8A

BORTNIK, V. N.
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 1503 2H

BORTON, D. L.
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

BOSCH, J. M.
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 1511 4C

BOSIO, N. J.
Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

BOSMANS, F.
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 1506 2H

BOSSERMAN, R. W.
Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 1511 5C

BOST, J-F.
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 1503 6F

BOST, R. C.
Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

BOTHA, B. J. V.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

BOTHWELL, M. L.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

BOTHWELL, P. D.
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

BOTTCHER, A. B.
Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 1505 5B

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Subsurface Drainage and Sediment Transport Model,
W82-00894 1502 2G

BOUCHER, P.
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 1503 2E

A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 1510 6D

BOUDOU, A.
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 1508 5B

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 1507 5C

BOUGHTON, W. C.
Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 1511 4A

BOUCIE, R.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 1503 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 1503 5B

BOULDIN, D. R.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5B

BOULEGUE, J.
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

BOUMA, J.
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

Soil Morphology and Preferential Flow Along Macropores,
W82-03175 1507 2G

BOURBONNIERE, R. A.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 1504 2J

BOURGET, E.
Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 1511 2L

BOURQUE, H.
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

BOUSFIELD, K. H.
Information Management: A Role for Primacy Agencies in The PR,
W82-03891 1509 10B

BOUTIN, C.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

BOUTOT, W.
Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

BOUTRON, C.
Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 1505 5B

BOUVETTE, T. C.
Revised Rainfall Frequency Analysis for Houston,
W82-05863 1511 2B

BOUWER, H.
Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

BOUYER, Y.
Chemical and Hydrological Heterogeneity of Groundwaters in the Upper 'Jura Neuchatelois', Switzerland. (Heterogeneite Chimique et Hydrologique Des Eaux Souterraines D'un Karst Du Haut-Jura Neuchatelois, Suisse),
W82-03794 1509 2K

BOUZANNE, M.
Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 1510 5A

BOWEN, A. J.
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

BOWEN, G. E.
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 1505 10C

BOWEN, J. E.
Cutting Irrigation Costs,
W82-05081 1511 3F

BOWEN, R.
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 1502 5F

Down to Earth Leak Detection,
W82-03561 1508 5F

BOWEN, S. H.
A Study of Biotic Transport of Asbestiform Fibers in Lake Superior,
W82-03950 1509 5B

BOWER, C. E.
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 1501 5A

BOWER, D. E.
Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

BOWER, P. M.
Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 1510 2H

BOWER, R. F.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

BOWERS, A. E.
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 1506 5F

BOWERS, J.
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

BOWERS, J. A.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 1504 2H

BOWERS, S. A.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 1502 3F

BOWERSOX, V. C.
Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 1502 2K

BOWKER, R. P. G.
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

BOWLER, D. S.
Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

BOWMAN, C. F.
A New Look at Design of Raw Water Piping,
W82-01029 1502 8A

BOWMAN, D. D.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

BOWMAN, G.
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

BOWMAN, J. O.
Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 1511 5D

BOWMAN, K. O.
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 1503 2B

BOWYER-LOWE, J.
Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 1511 5F

BOX, J. E. JR.
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 1501 2J

BOXLEY, W. M.
Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

BOYCE, D. S.
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

BOYCE, F. M.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

BOYD, C. E.
Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 1502 2K

Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

Liming Fish Ponds,
W82-05866 1511 5G

Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 1505 5B

BOYD, D. W.
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 1505 6A

BOYLE, D. B.
Interagency Connections: Insurance Against Interruptions in Supply,
W82-04090 1509 5F

BOYLE, J. S.
Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 1512 2B

BOYLE, M. V.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5B

BOYLE, T. P.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 1504 5C

BOYLE, V. J.
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 1502 5C

BOYLE, W. C.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 1508 5D

A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 1505 3D

Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

BOYLE, W. H.
Sludge Blanket in Activated Final Clarifiers,
W82-00951 1502 5D

BOYLEN, C. W.
Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 1502 2H

BOYNTON, W. R.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

BOYUM, A.
Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

BOZEMAN, E. L. JR.
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

BRAAM, F.
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 1503 5C

BRADDOCK, R. D.
Optimization Principle for Air and Water Movement,
W82-05172 1511 2G

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 1504 2G

BRADE, C. E.
Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 1507 5D

Sludge Tankering Economics - A Fresh Approach,
W82-06076 1512 5E

BRADEN, J. B.
The Economics of Cooperation Over Collective Bads,
W82-01909 1504 6A

Some Emerging Rights in Agricultural Land,
W82-04890 1511 6E

BRADFIELD, G. E.
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

BRADFORD, G. R.
Are Sierra Lakes Becoming Acid,
W82-00231 1501 5C

BRADFORD, J. M.
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 1501 2J

BRADFORD, W. L.
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 1503 7C

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 1506 2F

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 1505 2F

BRADLEY, B.
A Survey of Aerated Lagoon Performance,
W82-06391 1512 5D

BRADLEY, G. A.
Aircraft Radar Responses to Soil Moisture,
W82-04187 1509 7B

BRADLEY, M. W.
Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

BRADNER, L. A.
Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 1511 7C

BRADSHAW, G.
Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 1510 5D

BRADSTREET, K. A.
Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 1511 5D

BRAIDS, O. C.
Ground Water,
W82-01273 1503 2F

BRAILEY, D.
Energy Management in the Water Works Industry,
W82-02608 1506 5F

BRAINERD, R. T.
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

BRAKENSIEK, D. L.
Estimating Soil Water Retention from Soil Properties,
W82-06332 1512 2G

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 1503 2G

BRAKKE, D. F.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

BRALTS, V. F.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 1504 3F

BRAMELLER, A.
An integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 1507 5F

Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 1512 5F

BRAND, J. G.
The Cape Flats Sewage Treatment Works,
W82-00957 1502 5D

BRAND, J. I.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

BRANDANI, V.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

BRANDE, J.
Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 1501 6B

BRANDES, D.
The Significance of Tropical Cyclone Rainfall in the Water Supply of South Florida,
W82-03821 1509 2B

BRANDL, J. S.
Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 1503 5D

BRANDT, L. W.
Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 1501 5D

BRANICA, M.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 1504 2H

BRANSON, D. R.
Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 1501 5C

BRAS, R. L.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 1504 3F

The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 1506 2D

Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 1512 4A

BRASHEAR, D. A.
Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 1512 5A

BRASS, H. J.
Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 1511 5A

BRATBY, J. R.
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 1503 5F

Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 1505 5F

BRAUD, H. J.
Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 1503 8C

BRAULT, J.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 1502 5A

BRAUN, H. E.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

BRAUN, R.
Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 1512 5D

BRAUN, T.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural

Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 1505 5A

BRAY, D. I.
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 1503 8B

BRAY, E. A.
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 1502 2I

BRAY, M. M.
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

BRECK, W. G.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 1512 5B

BREDEHOEFT, J. D.
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 1501 5E

BREEN, C. M.
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 1508 2H

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 1502 6G

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 1505 5C

BREIMBURST, L. H.
Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 1505 5A

BREKHOVSKIKH, V. F.
Effect of a Deep-Water Outfall from a Power-Plant Reservoir on Water Quality in the Lower Pool,
W82-03768 1509 5C

BREMMON, C. E.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00195 1501 5D

BRENNIMAN, G. R.
Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 1503 5D

Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 1502 5F

Recreational Water Quality and Health,
W82-02997 1506 5C

BRESLER, E.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 1507 2G

Transport of Salts in Soils and Subsoils,
W82-00930 1502 5B

A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 1512 2G

BRESLIN, M. K.
Performance Testing of Four Skimming Systems,
W82-05099 1511 5G

Performance Testing of the Diperna Sweeper,
W82-05058 1511 5G

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 1511 5G

Using Coherent Water Jets to Control Oil Spills,
W82-03031 1507 5G

BRETELER, R. J.
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 1508 5B

BRETH, H.
The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 1512 8E

BREUSERS, H. N. C.
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 1508 2L

BREVIK, E. M.
Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 1512 5A

BREW, J. S.
Reliability of Water Resources,
W82-02749 1506 6A

BREWER, P. G.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 1511 5B

BREWER, W. S.
Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

BREWSTER, M. R.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 1505 6A

BREZONIK, P. L.
A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 1506 5C

Chemistry of Precipitation at Gainesville, Florida,
W82-00185 1501 2K

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 1510 5C

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 1505 5B

BRIAND, F.
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 1506 2H

BRICKER, O. P.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

BRIDGER, J. S.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

BRIDGER, K. C.
Northwestern Ontario River Dimensions,
W82-05742 1511 6G

BRIDLE, T. R.
Biological Nitrogen Control of Industrial Wastewater,
W82-03131 1507 5D

BRIERLEY, C. L.
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

BRIERLEY, J. A.
Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

BRIGGS, R.
Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

Where Do We Go from Here.
W82-02086 1504 7A

BRIGHAM, A. R.
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

BRIGHAM, W. U.
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

BRIGHT, G. R.
Secondary Benthic Production in a Tropical Island Stream,
W82-06933 1512 5C

BRILL, E. D.
Optimization of Looped Water Distribution Systems,
W82-04045 1509 6A

BRILL, E. D. JR.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 1503 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 1503 6A

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 1510 5D

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

BRINCKMAN, F. E.
Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort

and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 1511 5A

Speciation of Trace Di- and Triorganotins in Water by Ion-Exchange HPLC-GFAA,
W82-04037 1509 5A

BRINDLEY, P.
A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

BRINGI, V. N.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

BRISBIN, T. D.
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 1502 5A

BRISTOW, K. L.
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 1501 2D

BRITO, R. A. L.
Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 1508 3C

BRITT, H. K.
The North Carolina Sedimentation Control Program--An Assessment,
W82-04160 1509 2J

BRITTER, R. E.
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 1511 2E

BRITTO, A. M.
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

BRITTON, A.
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

BRIZ-KISHORE, B. H.
Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 1508 2F

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 1504 2F

BROACH, G. T.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

BROADBENT, F. E.
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 1501 5E

BROADBENT, R. C.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

BROADHEAD, R.
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 1502 2F

BROCH, E.
Designing and Excavating Underground Powerplants,
W82-05982 1512 8E

BROCK, R. R.
Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 1512 2F

BROCK, R. W.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-05846 1512 5G

BROCK, T. D.
Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 1501 2H

Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 1508 2H

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 1504 2H

BROCKMANN, C.
The Tidal Stream in the German Bight,
W82-05190 1511 2L

BROCKSEN, R. W.
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 1503 6G

BROCKWAY, C. E.
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 1510 4D

BRODEUR, T. P.
Upgrading to Increase Treatment Capacity,
W82-03654 1508 5F

BRODOWSKI, D. F.
Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

BROEKER, H. W.
Automatic Flow Control in Combined Sewer Systems-Effectiveness and Implementation Problems,
W82-04049 1509 5D

BROMBACH, H.
Flow Control at Stormwater Overflows and Stormwater Tanks (Abflusssteuerung von Regenwasserbehandlungsanlagen),
W82-06633 1512 8C

BROMLEY, D. W.
The Economics of Cooperation Over Collective Bads,
W82-01909 1504 6A

BRONSTEIN, B.
Argentina's Hydroelectric-Based Energy Plan,
W82-02794 1505 8A

BROOKMAN, G. T.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 1508 5B

BROOKS, K. N.
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 1508 2A

Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 1511 6B

BROSSET, C.
The Mercury Cycle,
W82-01869 1504 5B

BROTHERSON, J. D.
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

BROUGHTON, R. S.
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 1508 2A

BROWDER, J. A.
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

BROWER, G. R.
Solid Wastes and Water Quality,
W82-01269 1503 5B

Solid Wastes and Water Quality,
W82-06929 1512 5B

BROWER, R. D.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

BROWER, W. W. II.
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 1503 5B

BROWN, A.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

BROWN, A. C.
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 1510 5C

BROWN, A. E.
An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

BROWN, B. E.
Effect of Ashfall on Snowmelt Rate at Paradise, Mount Rainier, Washington,
W82-05871 1511 2C

BROWN, D.
The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 1511 5C

BROWN, D. E.
Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

BROWN, D. J. A.
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 1508 5C

BROWN, E. J.
Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 1507 2H

BROWN, G.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

BROWN, G. A.
Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

BROWN, G. J.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 1501 5D

BROWN, H. S.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01633 1503 5E

BROWN, J. A. H.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 1504 2A

BROWN, J. H.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

BROWN, K. A.
Sulphur in the Environment: A Review,
W82-05179 1511 5B

BROWN, K. W.
Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 1508 6E

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 1511 5C

BROWN, L.
A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 1511 5B

Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 1512 5D

BROWN, L. C.
Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

BROWN, L. H.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

BROWN, M. J.
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 1510 4D

BROWN, M. P.
Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

BROWN, M. S.
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 1507 5C

BROWN, P.
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

BROWN, P. L.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

BROWN, S.
A Comparison of the Structure, Primary Productivity, and Transpiration of Cypress Ecosystems in Florida,
W82-03885 1509 2I

BROWN, S. W.
Water Quality and Off-Flavor Problems in Commercial Channel Catfish Culture in West-Central Alabama,
W82-04087 1509 5C

BROWNE, D. W.
Forecasting Water Demand in the Pacific Northwest,
W82-04135 1509 6D

BROWNE, F. X.
Non-Point Sources,
W82-01270 1503 5B

BROWNLEE, B.
A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 1512 5C

BROWNLEE, B. G.
Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 1506 2H

BROYD, T. W.
Dispersion Coefficients in Estuaries,
W82-04684 1510 5B

BROZKA, R. J.
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 1512 4C

Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 1503 4C

BRUBAKER, J. M.
Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 1508 2H

BRUCE, A. M.
New Approaches to Anaerobic Sludge Digestion,
W82-01398 1503 5D

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

BRUCE, R. R.
Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

BRUECK, T. M.
Computer-Based Implementation of Combined Sewer Control,
W82-04783 1511 5D

BRUEGGEMANN, G.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

BRUEHL, D. H.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

BRUGAM, R. B.
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 1502 2K

Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes,
W82-03960 1509 2J

BRUGGELLER, P.
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

BRUGGINK, T. H.
Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 1510 6C

BRUGMAN, M. M.
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

BRUHN, J. A.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 1503 2B

BRUN, G. L.
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 1501 5A

BRUNKOW, D. A.
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

BRUNO, S. F.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

BRUNSKILL, G. J.
Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

BRUSCHIN, J.
The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

BRUSENTSEVA, S. A.
Prospects of Using Radiation Water Treatment Methods,
W82-05026 1511 5D

BRUSH, G. S.
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 1502 2L

BRUSLETTO, R.
Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

BRUTSAERT, W. F.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

BRUVOLD, W. H.
Community Evalvation of Adopted Uses of Reclaimed Water,
W82-02551 1505 3C

Reclaiming and Reusing Wastewater,
W82-00402 1501 5D

BRYAN, K. A.
An Investigation of Some Factors Influencing the Performance of a Recreational Trout Fishery,
W82-06329 1512 6D

BRYANT, E. G.
Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 1511 6B

BRYANT, M. D.
Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
W82-04075 1509 8I

BRYANT, R.
Recording Unconfined Tension Tester,
W82-04238 1509 8D

BRYERS, J. D.
Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

BRYNSKIKH, M. N.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

BRYSON, A. W.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 1504 5D

BRYSON, H. C.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

BUAPENG, S.
A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

BUBECK, R. C.
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

BUBENZER, G. D.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

BUBENZER, G. G.
Splash Erosion Modeling: Physical Analysis,
W82-05970 1512 2J

BURMAN, I. S.
Progressive Solutions in the Design of Underground Structures for the Rogun Hydroelectric Plant,
W82-02950 1506 8A

BUCHAN, R. M.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

BUCHANAN, B.
Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 1503 5D

BUCHANAN, D. W.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

BUCHANAN, T. J.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

BUCHERT, H.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

BUCK, C. E.
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

BUCK, D. H.
Polyculture of the Freshwater Prawn, Macrobrachium Rosenbergii, Chinese and Common Carps in Ponds Enriched with Swine Manure I. Initial Trials,
W82-03900 1509 3C

BUCK, J. D.
Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 1511 2L

BUCKHOUSE, J. C.
Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 1511 2J

BUCKLER, W. R.
Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin,
W82-03817 1509 2J

BUCKS, D. A.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04350 1510 3F

BUCSH, R. O.
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

BUDAGOVSKII, A. I.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 1504 2D

BUDD, W. W.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

BUDDE, W. L.
Trace Analyses for Wastewaters,
W82-03639 1508 5A

BUDDEMEIER, R. W.
Atoll Island Hydrology,
W82-02617 1506 2F

BUDIANSKY, S.
Understanding Acid Rain,
W82-00479 1501 5B

BUDLEIGH, J.
Adopting Sewers,
W82-04655 1510 8A

BUDNIKOV, E. L.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 1511 8H

BUDWEG, F. M. G.
Irrigation for Brazil's Poligono Das Secas,
W82-01744 1503 3F

Reservoir Planning for Brazilian Dams,
W82-06206 1512 6A

BUELOW, R. W.
The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 1511 8G

Laboratory Technique for Measurement of pH for Corrosion Control Studies and Water Not in Equilibrium with the Atmosphere,
W82-04101 1509 5G

BUGENYI, F. W. B.
Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578 1511 5B

BUGG, S. F.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

BUGGIANI, S. S.
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

BUGGINS, M. E.
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 1510 5D

BUGROV, A. K.
Calculation of Earth Dams Being Undermined,
W82-03162 1507 8D

BUHR, H. O.
A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

BUIKEMA, A. L. JR.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 1511 5C

Effects of Pollution on Freshwater Invertebrates,
W82-01280 1503 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

BUISSON, R. A. JR.
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

BUKATA, R. P.
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 1503 5B

BULDINI, P. L.
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 1506 5A

BULICH, A. A.
A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 1512 5A

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 1511 5A

BULKLEY, R. V.
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 1508 5B

BULL, D. L.
Environmental Fate of Methyl Eugenol,
W82-02013 1504 5B

Fate of Diflubenzuron in Water,
W82-02216 1505 5B

BULL, M. A.
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 1508 5D

BULL, R. J.
Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 1510 5C

BULLER, J. R. JR.
An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-03307 1511 8B

BULUSU, K. R.
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

BUMGARDNER, W. H.
Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222 1509 6D

BUNGAY, H. R.
Shallow-Depth Sedimentation of Biological Materials,
W82-02336 1505 5D

BUNKER, T. J.
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 1502 5E

BUNSE, L.
Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

BURBANK, N. C.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

BURDAN, P.
Organic Contamination of Ground Water: Tell it All,
W82-01474 1503 5C

BURDGE, R. J.
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 1511 6D

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 1511 4C

BURESH, R. J.
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 1503 5B

BURGARINO, A. E.
A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 1506 5F

BURGE, W. D.
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 1511 5D

BURGENER, D. B.
Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 1512 5D

BURGER, J. S.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Health Aspects of Waters at Public Health Resorts,
W82-04348 1510 5A

BURGES, S. J.
Approximate Error Bounds for Simulated Hydrographs,
W82-02678 1506 2A

BURGESS, M. D.
Automatic Class-A Pan-Filling System,
W82-01326 1503 7B

BURGESS, R. A.
Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

BURGH, J.
Saving Water Sonically,
W82-05789 1511 5D

BURKE, C. D.
The Eighties--Implications for Water Management,
W82-03772 1511 6B

BURKE, J. B.
Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 1505 2L

BURKE, J. C.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

BURKE, S. H.
Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 1512 6E

BURKE, T.
Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 1511 5F

BURKETT, H. D.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

BURMAN, G. K.
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

BURMASTER, D. E.
The New Pollution--Groundwater Contamination,
W82-04938 1511 5C

BURNEY, C. M.
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 1507 2L

BURNHAM, J. C.
Bacterial Control of Aquatic Algal Populations--Phase II,
W82-04163 1509 5C

BURNHAM, L. N.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

BURNHAM, R. A.
Packaged Plant Treats Turbidity,
W82-06026 1512 5F

BURNS, A. W.
Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 1510 6G

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 1510 6A

BURNS, C. W.
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 1503 2H

BURNS, D. A.
Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

BURNS, E.
MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 1512 3A

BURNS, G.
Solution of the Continuity Equation for the Karnak Area,
W82-03196 1507 2G

BURNS, G. D.
Identification of Organic Compounds,
W82-00635 1502 5A

BURNS, G. P.
Solvent Extraction of Phenols,
W82-00138 1501 5D

BURNS, S.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 1502 3C

BUROS, O. K.
Florida Style Water Supply and Treatment,
W82-06027 1512 5F

BURRELL, V. G. JR.
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

BURRINI, D.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

BURRIS, B. E.
Innovative/Alternative Technology Program; Case Studies,
W82-03970 1509 5D

BURRIS, C. B.
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

BURROWS, R. L.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

BURSEY, B. W.
Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 1508 6G

BURSTEIN, D.
Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 1507 8G

BURSZTYNSKY, T. A.
Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

BURT, J. E.
A Parametric Crop Water Use Model,
W82-01310 1503 2I

BURTON, B. D.
Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

BURTON, D. T.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

BURTON, G. A. JR.
Substrate-Associated Microfauna,
W82-06925 1512 5C

BURTON, H. R.
Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 1511 2H

BUSCH, C. D.
Water Movement for Water Quality in Catfish Production,
W82-00866 1502 5G

BUSCH, D. E.
Metabolism of a Desert Stream,
W82-02349 1505 1A

BUSCH, J. R.
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

BUSCH, R. A.
Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

BUSCHECK, T.
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

BUSET, H.
Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

BUSH, P. B.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

BUSH, P. W.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

BUSHWAY, R. J.
High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 1508 5A

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5B

BUSO, D. C.
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

BUSS, D. F.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 1503 7B

BUSZKA, P. M.
Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

BUTAKOV, A. N.
Determination of the Optimal Height of the Bucket Lip of a Ski-Jump Spillway,
W82-05107 1511 8B

BUTH, D.
The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

BUTLER, D.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

BUTLER, J.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

BUTLER, J. B.
Treatment Works--The Designer's Problems,
W82-00312 1501 5F

BUTLER, J. S.
The Evaluation of the Elutriate Test as a Means of Predicting the Behavior of Selected Chlorinated Hydrocarbons in Dredged Sediment During Open-Water Disposal,
W82-03824 1509 5A

BUTLER, M.
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 1507 5D

BUTLER, T. J.
Recent Acidification of Precipitation in North America,
W82-01514 1503 5B

BUTTERWORTH, B. C.
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

BUTTERY, B. R.
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

BUTTERY, R. G.
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 1501 5E

BUTTON, D. K.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

BUTTS, E.
Water Hammer,
W82-05432 1511 8C

BUTTS, T. A.
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

BUTTY, M.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

BUTWELL, A. J.
The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 1511 5D

BUTZ, B. P.
A Look at Co-Disposal,
W82-06354 1512 5E

BUXTON, H. T.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

BUZBY, M. E.
A Comparison of Chlorine and Chlorine Dioxide Disinfection of Wastewater Effluents: The Generation of Selected Halohydrocarbons,
W82-03751 1509 5D

BUZUN, J.
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5D

BYCROFT, B. M.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

BYER, H. G.
Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 1507 5E

BYESEDA, J. J.
Oil-Water Separation by Induced Air Flotation,
W82-03719 1508 5D

BYINGTON, R. B.
Recreational Water Quality and Health,
W82-02997 1506 5C

BYKOVSKIY, V. I.
Effect of Water Turbulence on Illumination at Depth,
W82-05594 1511 1A

BYNOE, M. C.
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-0[illegible]6 1505 5B

BYRNE, C. J.
The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

BYRNE, G. F.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 1508 7B

BYRNE, R. P.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

BYROADE, J. D.
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 1511 5G

CABALLERO, R. C.
A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

CABELLI, V. J.
Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 1501 5A

Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 1510 5A

CABRERA, F.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 1512 5A

CACCHIONE, D. A.
Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

CADDY, D. E.
Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 1507 5A

CADOTTE, J. E.
Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

CAGINALP, O. A.
The Fifth Amendment Privilege Against Self-Incrimination and Compulsory Self-Disclosure Under the Clean Air and Clean Water Acts,
W82-03746 1508 6E

CAHET, G.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

CAHILL, T. H.
A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

CAIN, D.
Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southerstern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

CAIN, P.
Instrumentation for Aerated Flow on Spillways,
W82-02880 1506 7B

Measurements of Self-Aerated Flow on a Spillway,
W82-02715 1506 8B

CAIRE, R.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G

CAIRNS, J.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 1511 5A

CAIRNS, J. JR.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 1511 5A

Biological Monitoring. Part V - Preference and Avoidance Studies,
W82-05340 1511 5C

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 1511 5A

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 1502 5A

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 1502 5A

CAIRNS, J. K. JR.
Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 1511 5C

CAIRNS, J. R.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

CAIRNS JR, J.
Biological Monitoring Part VI - Future Needs,
W82-03230 1507 5C

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

CAIRO, P. R.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 1511 5F

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 1505 5F

CALABRESE, E. J.
Health Effects of Monochloramines in Drinking Water,
W82-01091 1502 5C

CALDERON, R. L.
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

CALHOUN, L. B.
A Look at Co-Disposal,
W82-06354 1512 5E

CALI, F. J.
Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

CALKINS, J.
Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 1510 2H

CALL, D. J.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

CALLAHAN, C. A.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-00639 1506 5C

CALMON, C.
Municipal Ion Exchange: Waiting to Take Off,
W82-03837 1509 5F

Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 1510 5F

CALOMIRIS, J. J.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

CALVERT, J. W.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

CALVO, C.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 1502 5A

CALZONETTI, F. J.
Bentonite Liners for Power Plant Lagoons,
W82-00617 1502 5E

CAMBOULIVES, J. M.
Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 1511 2E

CAMERON, A. J.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 1502 5A

CAMERON, D. R.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

CAMERON, J. M.
Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 1511 6E

CAMERON, S. C.
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 1510 5A

CAMP, C. R.
Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 1512 2I

CAMPANA, R. J.
The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

CAMPBELL, J. E.
Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods,
W82-03873 1509 5B

CAMPBELL, J. F.
Environmental Improvement at Port Alice, B. C.,
W82-06515 1512 5C

CAMPBELL, K. L.
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

CAMPBELL, R. S.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

CAMPBELL, S. G.
Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

CAMPBELL, W.
An Exercise in Sludge Consolidation,
W82-04848 1511 5D

CANADAY, J. T.
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

CANALE, R. P.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 1512 5C

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 1503 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

CANFIELD, D. E.
Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

CANFIELD, D. E. JR.
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 1501 2H

CANIPAROLI, D.
An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 1506 2K

CANO, C. J.
The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 1511 6E

CANTERAS, J. C.
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 1502 5B

CANTON, R. B.
Sources and Control of Organic Air Pollutants,
W82-00711 1502 5B

CANTON, S. P.
Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

CANUTI, P.
Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 1512 2E

CAPDEVILLE, B.
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 1508 5A

Studies of the Transformation of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 1508 5A

CAPLENAS, N. R.
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 1505 5B

CAPOBIANCO, J. A.
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 1501 2L

CAPRIO, J. M.
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

CARBON, B. A.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 1511 4B

CARBONNEL, J. P.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

CARDEILHAC, P. T.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

CARDILE, R.
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

CARDITO, J. M.
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

CARDY, W. F. G.
River Basins and Water Management in New Brunswick,
W82-05391 1511 6D

Water Management in the Maritimes,
W82-05776 1511 6B

CARE, R.
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 1512 5A

CAREY, G. F.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 1502 2I

CAREY, J. H.
Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) 1. Pathway of the Direct Photolysis in Solution,
W82-04032 1509 5B

A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 1512 5C

CAREY, V. P.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1502 1A

CAREY, W. P.
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

CARIC, D. M.
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

CARIGNAN, R.
Phosphorus Release by Submerged Macrophytes: Significance to Epiphytes and Phytoplankton,
W82-06977 1512 5B

Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 1501 2H

CARL, C. C.
Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

CARLE, F. L.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 1502 5A

CARLEO, D. J.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

CARLETON, A. M.
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 1501 2B

CARLINE, R.
Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

CARLSON, C. G.
Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

CARLSON, D. J.
Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 1508 2L

CARLSON, M. A.
Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes,
W82-03960 1509 2J

CARLSON, R. E.
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 1505 5A

CARLSON, T. W.
Contourites in Lake Superior,
W82-01935 1504 2H

CARLTON-SMITH, C. H.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

CARLYLE, R. M.
Use of Synthetic Adsorbents in Chemical Processes,
W82-03404 1511 5D

CARMACK, E.
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 1510 2H

CARMACK, E. C.
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02226 1505 2H

CARNEY, J. H.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

CARNS, K. E.
Hazardous Material Spills--Are You Ready,
W82-06417 1512 5G

CARON, R. P.
Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

CARPENTER, A. B.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 1503 5B

CARPENTER, C.
The Value of Exploratory Test Holes in Ground Water Development,
W82-03896 1509 2F

CARPENTER, P. J.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

CARPENTER, R.
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1506 5B

CARPENTER, R. A.
Using Ecological Knowledge for Development Planning,
W82-00671 1502 6A

CARPENTER, S. R.
Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 1511 2H

Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 1507 5C

CARPENTER, T. G.
Planning Sri Lanka's Victoria Scheme,
W82-05979 1512 8A

CARPENTER, T. J.
Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 1508 5D

CARR, J. D.
Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

CARR, R. S.
A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 1511 5A

CARR, W. E.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

CARRE, J.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00[illegible]39 1501 5A

CARREIRA, L. A.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

CARRICK, R. J.
Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

CARROLL, B. R.
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 1505 5B

CARROLL, J. D. JR.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

CARROLL, T. O.
Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

CARROLL, T. R.
Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 1508 2G

CARRONDO, J. J. T.
Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 1507 5D

CARRONDO, M. J. T.
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 1502 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 1512 5D

CARSWELL, L. D.
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

CARSWELL, W. J. JR.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 1510 2E

CARTER, D. C.
A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

CARTER, J. C.
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

CARTER, J. C. H.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

CARTER, J. L.
Water System Design Meets Modern Challenges,
W82-05170 1511 5F

CARTER, M. J.
Leach Characteristics of Coal-Gasification Char,
W82-01025 1502 5B

CARTER, M. V.
Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 1511 6B

CARTER, R. P.
Control of the Activated Sludge Process,
W82-03499 1508 5D

CARTWRIGHT, K.
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 1505 5E

Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

Selection of Waste disposal sites,
W82-06550 1512 5E

CARTY, A. J.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

CARVER, J. D.
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

CARVER, P. H.
How Much Water Supply Capacity Is Enough,
W82-04103 1509 6D

CARY, G. A.
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

CARY, J. S.
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 1511 8A

CARY, S. J.
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

CASELLAS-SALHA, C.
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

CASEY, H.
Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 1505 5C

The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 1505 5B

CASH, F. M.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

CASPARIUS, R. E.
Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

CASSANI, J. R.
Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 1505 4A

CASSELL, E. A.
Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

CASSIDY, R. M.
Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-01361 1511 5A

CASTANO, E.
Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

CASTEIGNAU, G.
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 1504 5D

CASTELNAU, G.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

CASTLE, R. O.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

CASTORINA, A. R.
Reservoir Improvements as a Key to Source Quality Control,
W82-04145 1509 5G

CASWELL, B.
Locating Monitoring Wells,
W82-06848 1512 8B

CATHEY, D. D.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

CAUVIN, D.
The Valuation of Recreational Fisheries,
W82-00348 1501 6C

CAVARI, B.
Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

CCHESNIN, L.
Aquaculture for Waste Management,
W82-06556 1512 5D

CEAZAN, M. L.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

CECH, I.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

CEDARHOLM, C. J.
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

CELSO DO AMARAL E SILVA, C.
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 1508 5G

CENGIZ, H. S.
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 1505 2I

CENTER, D. M.
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 1506 3F

CERCO, C. F.
Efficient Cooling Ponds: Design,
W82-03672 1508 8A

CERVANTES, J. E.
A Trigger Type Cluster Model for Flood Analysis,
W82-03818 1509 2A

CESARIO, A. L.
Computer Modeling Programs: Tools for Model Operations,
W82-04130 1509 6A

CETINKAYA, M.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

CHABRECK, R. H.
Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 1505 6G

CHACEY, K. A.
Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

CHACKO, V. T.
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

CHADDERTON, R. A.
Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

Discussion: A Multiobjective Model for Regional Water Quality Management, by B. N. Lohani and Pakhorn Adulbhan,
W82-03785 1509 5G

CHADWICK, D. J. JR.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

CHAIKA, A. M.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A

CHAIX, B.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

CHAKRABARTI, C.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 1504 2J

CHALAM, P. S.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

CHALIFOUR, M. J.
An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 1512 5A

CHALLAIAH,
Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 1512 3F

CHALMERS, D. J.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 2I

CHAM, V.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 1504 5A

CHAMBERLAIN, C.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

CHAMBERLIN, R. M.
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

CHAMBERS, R. L.
Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 1503 [illegible]

CHAMBERS, W.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

CHAMBLEE, J. A.
Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 1511 5D

CHAMEIDES, W. L.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

CHAMP, M. A.
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

CHAMPION, D, B.
A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 1511 6D

CHAMPNEY, R. U.
Five-Year Plan of the Water Resources Research Center,
W82-05526 1511 6B

CHAN, A. H.
Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 1508 6B

CHAN, C. H.
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 1512 5A

CHAN, K. Y.
Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 1511 5E

The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 1512 3F

CHAN, S.
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

CHAN, V. W. C.
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1510 1A

CHAN, W-Y.
Reevaluating Hunter's Model for Residential Water Demand,
W82-04131 1509 6D

CHAN, Y. K.
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 1505 2H

CHANDER, S.
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 1506 2F

CHANDLER, D. S.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 1502 5B

CHANDLER, I. M.
Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 1512 5A

CHANDRA, B.
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

CHANDRA, D.
Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 1512 3F

CHANDRA, S.
Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 1512 4D

Flow Under Weir on Scoured Bed,
W82-05800 1511 8B

CHANEY, R. C.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 1503 8D

CHANG, A. C.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

CHANG, C.
Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 1503 2G

CHANG, H. H.
Geometry of Gravel Streams,
W82-04113 1509 2E

Mathematical Model for Erodible Channels,
W82-06336 1512 2J

CHANG, H-M.
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 1502 5D

O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 1503 5D

CHANG, H. N.
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 1512 3A

CHANG, L. T.
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 1505 5A

CHANG, S.
Reservoir Operation for Water Conservation,
W82-04165 1509 3B

CHANG, S. S.
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 1501 5D

CHANG, S-Y.
Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 1503 6A

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

CHANG, T-P.
Watershed Model Study Using LANDSAT Image Data,
W82-03814 1509 2A

CHANG, W. Y. B.
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 1512 5C

CHANGNON JR, S. A.
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 1510 2B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

CHANGNON, S. A.
Hydrologic Applications of Weather and Climate Information,
W82-03871 1509 7C

CHANGNON, S. A. JR.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 1510 2B

Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 1505 7A

CHANUT, J. P.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

CHAO, A. C.
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 1510 5D

CHAPELLE, F.
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

CHAPMAN, B. M.
Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 1511 5B

CHAPMAN, D. E.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

CHAPMAN, D. J.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

CHAPMAN, G.
Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678 1508 5C

Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 1507 5G

CHAPMAN, M. A.
Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

CHAPMAN, P. M.
Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

CHAPPELL, C. F.
Disaster by Flood,
W82-04618 1510 2E

CHAPPELL, T. E.
A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 1511 5D

CHAPRA, S. C.
A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-050[illegible]8 1511 5B

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 1504 2H

CHARACKLIS, W. G.
Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

CHARBENEAU, R. J.
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 1502 5B

CHARBONNEAU, J. O. G.
Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

CHARBONNEAU, R.
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

CHARLTON, J. A.
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 1505 5E

CHASE, J. A.
Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 1512 3D

CHATALBASHEV, P. P.
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 1506 8H

CHATT, A.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 1502 5A

CHATTERJEE, S.
Wastewater Collection,
W82-01251 1503 5D

CHATTERTON, J. B.
Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

CHATTOPADHYAY, G. N.
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 1503 3C

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 1504 2H

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 1502 2H

CHATURVEDI, G. S.
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

CHATURVEDI, M. C.
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 1503 6A

CHATUVEDI, A. C.
Water Quality Monitoring,
W82-03897 1509 5G

CHAU, A. S. Y.
Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 1507 5A

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 1512 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 1512 5A

CHAU, H. N.
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 1508 5G

CHAU, Y. K.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

CHAUDHRY, T.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

CHAUDHURI, M.
Removal of Inorganic Mercury from Water by Bituminous Coal,
W82-06265 1512 5D

CHAUHAN, S.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

CHAWLA, R. C.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

CHEATHAM, G. W.
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 1506 6B

CHEATHAM, L. R.
Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

CHELNOKOV, V. L.
Problems of Lightening Underground Structures and Methods of Constructing Them Under Permafrost Conditions,
W82-03918 1509 8A

CHEMBARISOV, E. I.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

CHEN, B.
Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 1512 2F

CHEN, C.
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

8

CHEN, C. W.
Acid Rain Model: Hydrologic Module,
W82-06360 1512 5B

CHEN, R. L.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

CHEN, Y. H.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

Unsteady Water Quality Model for River Network,
W82-02873 1506 5G

CHENEY, M. C.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 1502 5A

CHENEY, R. W.
Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

CHENG, A. H. D.
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 1506 8B

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

CHENG, C-S.
Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 1511 5D

CHENG, C. Y.
A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

A Study of The Vacuum-Freezing High Pressure Ice-Melting Process,
W82-04166 1509 3A

CHENG, K. C.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 1503 2C

CHENYAPANICH, P.
Reservoir Sedimentation with Random Deposits,
W82-04443 1510 2J

CHEREMISINOFF, P. N.
From Screening to Filtration: Treating the Water Supply,
W82-03739 1508 3A

CHERKAUER, D. S.
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 1503 5B

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 1504 2F

CHERNILOV, A. G.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 1511 8A

CHERNITSKAYA, L. N.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 1504 2H

CHERNOCK, G.
Egypt Tackles Rural Supply Task,
W82-05754 1511 5F

CHERNYI, I. P.
Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 1506 8D

CHERRY, D. S.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

Biological Monitoring. Part V - Preference and Avoidance Studies,
W82-05340 1511 5C

Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

CHERRY, J. A.
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 1512 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 1512 5B

Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

CHERY, D. L. JR.
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 1512 8B

CHESNER, W. H.
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

CHESSMAN, G. R.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

CHESTER, A. J.
Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 1505 2L

CHESTERIKOFF, A.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

CHESTERS, G.
Pollution From Land Runoff,
W82-00253 1501 5B

CHEUNG, L. S.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 1504 5A

CHEW, D. L.
Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

CHHONKAR, P. K.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 1504 2I

CHIAN, E. S. K.
Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 1503 5D

Organics,
W82-01239 1503 5A

Organics,
W82-06922 1512 5A

CHIANG, W.-L.
Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

CHIARITO, V.
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

CHIAUDANI, G.
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 1512 5C

CHIBA, K.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

CHICHESTER, F. W.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 1511 5B

CHIESA, S. C.
Fermentation Industry,
W82-06917 1512 5D

CHIEUX, P.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

CHIGBO, F. E.
Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

CHILDERS, J. M.
Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

CHILDRESS, W. M.
Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 1505 2H

CHIN, C. T.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

CHIN, E. H.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

CHIN, H. K.
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

CHIN, K. K.
Palm Oil Refinery Wastes Treatment,
W82-03909 1509 5D

CHING, C. T. K.
Water Multipliers--Regional Impact Analysis,
W82-01138 1503 6A

CHIOCCHIO, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

CHIRLIN, G. R.
On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

CHISTYAKOV, A. M.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 1507 8B

CHITNIS, B. V.
Water for Industry,
W82-02767 1506 6D

CHITTENDEN, D. M. II.
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

CHIU, A. A.
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 1504 2L

CHIU, C-L.
Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 1501 2J

CHIU, S.
Water Quality Issues and Energy Assessments,
W82-00036 1501 6B

CHO, C. Y.
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

CHONG, S. K.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 1503 2G

CHOPRA, A. K.
Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 1511 8D

CHORLEY, D. W.
Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

CHOU, S. F. J.
Adsorption of PCBs by Cellulose Fiber Filter-aids and Carbonaceous Adsorbents Used for Water Treatment,
W82-03937 1509 5F

CHOUDHURY, B. J.
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 1503 7B

CHOW, B. M.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

CHOW, V. T.
Hydraulic Exponents,
W82-03669 1[illegible] 2E

Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 1510 6A

CHOW, W.
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 1503 6G

CHRISTENSEN, D. A.
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

CHRISTENSEN, E. R.
Removal of Heavy Metals from Electroplating Wastewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-[illegible]552 1503 5D

CHRISTENSEN, G. M.
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-0[illegible]62 1510 5C

Effects of Pollution on Freshwater Fish,
W82-06[illegible] 1512 5C

CHRISTENSEN, H. H.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00[illegible] 1501 5B

CHRISTENSEN, L. A.
Irrigating with Municipal Effluent: A Socioeconomic Study of Community Experiences,
W82-03967 1509 3C

CHRISTENSEN, S. W.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

CHRISTIANSEN, C.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 1502 7B

CHRISTIANSON, R.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

CHRISTMAN, R. F.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

CHRISTMAS, A. D.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 1503 7A

CHRISTOPHERSEN, N.
Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 1507 5B

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 1511 2K

CHRISTOVA, R.
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 1512 5A

CHRISTY, M. S.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 1503 2F

CHROSTOWSKI, P. C.
Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 1511 5F

CHRZANOWSKI, T. H.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 1502 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 1512 2L

CHU, [illegible] C. S.
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

CHU, R. L.
Cation Transport in Packed Bed Reactor of Soil,
W82-00[illegible] 1502 5D

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

CHU, S. T.
Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

CHU, S. Y.
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 1504 2F

CHU, T-Y. J.
Power Industry Wastes,
W82-01265 1503 5B

CHUBATYI, O. V.
Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

CHUDOBA, J.
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

CHUNG, A. K.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 1503 5D

CHUNG, N. K.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

CHURAKOV, A. I.
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 1508 8A

CHURCH, M.
On Hydrological Data Needs in Canada,
W82-03443 1508 7A

On Hydrological Data Needs in Canada,
W82-05764 1511 7B

CHURCH, R. L.
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

CHURCH, T. M.
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

CHURCHILL, J. W.
Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 1511 7B

CHURCHLAND, L. M.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 1512 2K

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

CHURCHWELL, R. L.
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

CHYNOWETH, D. P.
Anaerobic Processes,
W82-06923 1512 5D

Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 1501 2H

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 1504 2H

CHYONG, N. S.
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 1506 6A

CIARLINI, R. M.
Pumped-Storage Development in Brazil. Part III,
W82-03381 1507 8A

CIBIK, C.
Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

CIECKA, J.
Eutrophication Measures for Small Lake Water Quality Management,
W82-04243 1509 2H

CILLIE, G. G.
Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

CINCOTTA, D. A.
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

CIRELLO, J.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

CIRIELLO, S.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

CIVIT, E. M.
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

CLAASSEN, H. C.
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 1506 2F

CLAES, A. L.
Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 1507 8G

CLAIBORNE, M.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 1503 10C

CLAIR, T. A.
Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

CLANET, F.
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 1507 5A

CLAPP, C. E.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 1502 3C

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

CLAPPERTON, C. M.
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 1507 2C

CLARE, R. G.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

CLARIDGE, F. B.
Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 1506 2J

CLARK, B. D.
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 1504 6A

CLARK, C. K.
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

CLARK, C. S.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

CLARK, C. W.
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 1502 6A

CLARK, D. L.
Composite Sampling of Highway Runoff,
W82-02230 1505 7B

CLARK, D. R.
Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 1510 2A

CLARK, J. R.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

CLARK, L.
Groundwater Investigations in the Vale of Stathmore,
W82-01400 1503 2F

CLARK, L. J.
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

CLARK, M. M.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

CLARK, P. G.
The Cost of Quality,
W82-02881 1506 5F

CLARK, P. J.
Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

Concentration and Size of Asbestos in Water Supplies,
W82-00262 1501 5D

CLARK, R. E.
Ground Water Conflicts and Barriers,
W82-00028 1501 6E

CLARK, R. M.
Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

Cost of Small Water Supply Treatment Systems,
W82-02318 1505 5F

Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 1511 5C

The Costs of Compliance: An EPA Estimate for Organics Control,
W82-04132 1509 6C

Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

Granular Activated Carbon Installations,
W82-04391 1510 5F

Removing Trihalomethanes from Drinking Water,
W82-00933 1502 5F

Small Water Systems: Role of Technology,
W82-01542 1503 5F

A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

CLARK, R. N.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 1503 2C

CLARK, R. P.
The Agus II Scheme in the Philippines,
W82-05599 1511 8A

CLARK, R. R.
Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 1511 5A

CLARK, R. T.
Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 1510 6A

CLARKE, D. A.
Uncertainties in Water Distribution Systems,
W82-03668 1508 8A

CLARKE, E. A.
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

CLARKE, G. K. C.
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 1505 2C

CLARKE, K. F.
Reliability of Water Resources,
W82-02749 1506 6A

CLARKE, R. T.
Adaptive Hydrological Forecasting - A Review,
W82-00984 1502 2A

A Distribution Function Approach to Rainfall Runoff Modeling,
W82-03845 1509 2A

The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 1505 5B

CLARKE, W. B.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

CLARKE, W. G.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 1503 5G

CLAVEL, R. L.
New Bubble Diffusers Reduce Treatment Costs,
W82-06513 1512 5D

CLAY, D. M.
Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

CLAYTON, A. J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

CLAYTON, J. R. JR.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

CLEARY, R. W.
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

CLEASBY, J. L.
Declining-Rate Filtration,
W82-03656 1508 5F

CLEMENTS, E. V.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 1508 5D

CLEMMENS, A. J.
Depths of Flow in Level Basins,
W82-00900 1502 3F

Development of Solutions for Level-Basin Design,
W82-01976 1504 3F

Dimensionless Stream Advance in Sloping Borders,
W82-04308 1510 3F

Estimating Distribution Uniformity in Level Basins,
W82-03058 1507 3F

Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 1507 7B

Limits for Practical Level-Basin Design,
W82-06452 1512 3F

Measuring Flumes of Simplified Construction,
W82-00140 1501 7B

CLENNETT, C.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

CLESCERI, N. L.
Land Application of Secondary Effluent at Lake George, NY,
W82-05704 1511 5D

CLIFFORD, D.
Processes for Removal of Inorganic Contaminants from Water,
W82-06342 1512 5F

CLIFFORD, D. A.
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 1506 5F

CLIFFT, R. C.
Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants,
W82-04026 1509 5D

CLIFTON, D. G.
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

CLINE, G. C.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

CLINE, T. B.
Selecting Seasonal Streamflow Models,
W82-02502 1505 2E

CLINGER, R. C.
Safety Considerations in Handling Activated Carbon,
W82-05442 1511 5D

CLOERN, J. E.
Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

CLOTHIER, B. E.
Measurement of Sorptivity and Soil Water Diffusivity in the Field,
W82-03764 1509 2G

CLOUSER, R. L.
Household Water Use: Technological Shifts and Conservation Implications,
W82-03910 1509 3D

CLUFF, C. B.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 1511 3C

CLYDE, E. W.
Allocation of Water for Resource Development,
W82-06839 1512 6D

CLYMA, W.
Furrow Irrigation Practices in Northern Colorado,
W82-00139 1501 3F

Optimal Design of Border Irrigation Systems,
W82-01977 1504 3F

Optimal Design of Furrow Irrigation Systems,
W82-00138 1501 3F

COATES, K.
Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 1505 5A

COATS, D. J.
The Kielder Headworks,
W82-06504 1512 8A

The Kielder Transfer Works,
W82-06502 1512 8A

The Kielder Water Scheme,
W82-06503 1512 8A

COBET, A. B.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

COBLE, L. W. JR.
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 1503 5D

COCCI, A. A.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

COCHARD, D. D.
A Model for Solving Multiperiod Multireservoir Water Resources Problems with Stochastic Inflows,
W82-03830 1509 6A

COCHRAN, G. F.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

COCHRANE, A.
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

COCKBURN, A.
Discharge to the North Sea,
W82-06248 1512 5E

COCKBURN, A. G.
Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 1510 2L

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 1512 5E

CODNER, G. P.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 1504 2A

CODY, H. M.
New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 1502 5D

COE, C. J.
The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 1505 7C

COFFEY, A.
Stream Improvement: The Chicod Creek Episode,
W82-05717 1511 4D

COFFEY, W. A.
Deep Well Injection of Industrial Wastes,
W82-00475 1501 5E

COGLEY, D. R.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 1502 5G

COGO, N. P.
Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

COHEN, A.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

COHEN, H.
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02533 1505 5G

COHN, T.
Systems Analysis,
W82-06997 1512 5G

COILLET, D. W.
Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 1501 5F

COLACICCO, D.
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 1511 5D

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 1507 5E

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

COLBECK, S. C.
Configuration of Ice in Frozen Media,
W82-05615 1511 2C

A Simulation of the Enrichment of Atmospheric Pollutants in Snow Cover Runoff,
W82-03838 1509 5B

COLE, B. E.
Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

COLE, E. R.
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

COLE, G. B.
Leak Detection - Two Methods That Work,
W82-02521 1505 3D

COLE, J. J.
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

COLEE, C. D.
Plant Expansion Via High-Rate Pretreatment,
W82-05953 1512 5F

COLEMAN, D. J.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

COLEMAN, G. A.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

COLEMAN, G. C.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

COLEMAN, N. L.
Velocity Profiles with Suspended Sediment,
W82-02581 1505 2J

COLEMAN, W. E.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

COLEMAN, W. M. III.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

COLER, R. A.
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 1511 5C

COLES, D. G.
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 1511 5B

COLESC, T. F.
The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 1512 2E

COLEY, T. C.
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

COLLARD, V.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

COLLER, B. A. W.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

COLLETT, L. C.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

COLLIE, A.
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

COLLIER, K. R.
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

COLLIER, R. L.
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 1501 3F

COLLINS, A. J.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

COLLINS, B.
Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

COLLINS, D. R.
Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 1508 4B

COLLINS, J. N.
Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

COLLIS-GEORGE, N.
Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 1507 2G

Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 1507 2G

COLONELL, J. M.
Deep Water Renewal in Subarctic Fjord,
W82-03675 1508 2L

COLQUHOUN, J. R.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

COLT, J.
Concepts in Aquatic Treatment System Design,
W82-02593 1505 5D

COLTHURST, J. M.
Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 1511 5F

COLVIN, R. B.
Carrying Capacity for the Illinois River,
W82-05927 1512 6G

COLVIN, T. S.
Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 1505 2I

Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 1501 2J

COLWELL, R. R.
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 1503 5C

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 1503 5A

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

COLYER, P.
Money Down the Drain,
W82-04653 1510 4A

COLYER, R. S.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

COMBE, A. J. III.
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

COMBS, L. J.
Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

COMEAU, J. C.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

COMER, D.
How Rate Structures and Elasticities Affect Water Consumption.
W82-06351 1512 6C

COMER, D. A. D.
An Economic Analysis of Ground Water Management Alternatives,
W82-02740 1506 4B

COMFORT, E.
Group Treatment Evaluation for Metal Finishers,
W82-02995 1506 5D

CONARROE, K.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 1510 5D

CONDREN, A. J.
Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 1506 5D

CONEY, T. A.
The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

CONFORTI, P. M.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

CONLEY, C. D.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 1504 7B

CONNELL, D. W.
An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606 1511 5B

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

CONNELL, N.
Tracking Seasonal Load Variations,
W82-05787 1511 5D

CONNELLY, P. J.
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

CONNER, W. H.
Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 1505 2H

CONNERY, P. B.
Treatment Works--The Designer's Problems,
W82-00312 1501 5F

CONNICK, D. J.
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 1510 5D

CONNOR, J. N.
Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 1508 2H

CONNORS, S. D.
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 1503 7B

CONOVER, C. S.
Hydrologic Almanac of Florida,
W82-03974 1509 7C

CONQUEST, L. L.
On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 1506 5A

CONRAD, J. R.
Anaerobic Processes,
W82-01245 1503 5D

Anaerobic Processes,
W82-06923 1512 5D

CONROY, L. E.
Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 1501 5A

CONROY, N. I.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 1503 5B

CONSTANTINE, T. A.
Advanced Water Treatment for Color and Organics Removal,
W82-06279 1512 5F

CONSTRANCE, E.
Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-02948 1509 7B

CONTRACTOR, D. N.
A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 1503 7A

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 1512 4B

CONTRATTO, P. K.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

CONTRERAS, S.
Purification of Wastewater by Electrolysis,
W82-00847 1502 5D

CONWAY, R. A.
High-Solubility Gas Flotation,
W82-01184 1503 5D

Impact of Discharges as a Basis for Control Measures,
W82-05354 1511 5B

Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 1511 5E

COOK, B.
Right Velocity Keeps the Solids Up,
W82-05788 1511 5D

COOK, C. J.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

COOK, J.
Reclaiming and Reusing Wastewater,
W82-00402 1501 5D

COOK, J. R.
A Survey of Radioactive Effluent Releases from Byproduct Material Facilities,
W82-03963 1509 5B

COOK, N. G.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

COOK, P. M.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 1504 5C

COOK, R. B.
The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 1510 2H

COOK, S.
Estimation and Control Problems in Activated Sludge Processes,
W82-04612 1510 5D

COOKE, A. S.
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 1501 5A

COOKE, D.
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-FeOOH) in Freshwaters,
W82-05140 1511 2K

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

COOKE, G. D.
Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 1510 5G

Effectiveness of Dupont Typar Sheeting in Controlling Macrophyte Regrowth After Overwinter Drawdown,
W82-04246 1509 5G

Lake Level Drawdown as a Macrophyte Control Technique,
W82-04235 1509 4A

COOKE, R. C.
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

COOKE, S. F.
The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 1506 5F

COOKSEY, B. G.
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 1501 5A

COOLEY, K. R.
Erosivity 'R' for Individual Design Storms,
W82-01403 1503 2J

Erosivity Values for Individual Design Storms,
W82-05694 1511 4D

COOLEY, P.
Wedge-Block Tunnels in Water Supply,
W82-05603 1511 8F

COOLIDGE, P. S.
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

COOMBS, E. G.
High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 1511 5A

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

COOMBS, J.
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 1512 5F

COOPER, C.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

COOPER, C. L.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

COOPER, C. M.
Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

COOPER, J. J.
Secchi Disc Relationships,
W82-06627 1512 2H

COOPER, W. J.
Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 1508 5A

COOTE, D. R.
Pollution From Land Runoff,
W82-00253 1501 5B

COPAS, S. R.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

COPE, J.
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 1505 7C

A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 1510 7A

COPELAND, C.
Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

COPLAND, D.
The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

COPLEN, L. E.
The Aftermath at Longview,
W82-00073 1501 5C

CORAPCIOGLU, M. Y.
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 1504 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 1504 2F

CORBET, S. A.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

CORBETT, E. S.
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 1511 4C

CORCORAN, E. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 1504 5B

CORDIVIOLA, S.
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

CORDONNIER, M. J.
Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 1508 3C

CORDOVA, J. R.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 1504 3F

CORDOVA, R. M.
Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 1510 6D

CORDS, F.
The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 1512 8D

COREY, A. T.
Pumped Outlets for Drainage Systems,
W82-04364 1510 8A

COREY, J. E.
Trace Element Accumulation, Movement, an Distribution in the Soil Profile From Mas Applications of Sewage Sludge,
W82-00640 1502 5

CORLEW, P. M.
Development of a Rural Water District,
W82-00288 1501 6A

CORLISS, D. A.
The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 1511 5D

CORMACK, J. W.
Land Disposal of Sludge,
W82-04757 1511 5E

CORMIER, C. J.
Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

CORNEILLE, R. W.
Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

CORNELISSE, A.
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

CORNELIUS, G.
Sprinkler Leveler and Wind Compensating Device,
W82-06164 1512 3F

CORNELL, J. C.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

CORNELL, J. H.
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

CORNILLON, P.
Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 1506 3F

CORNWELL, D. A.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

Feasibility Studies on Liquid Ion Exchange for Alum Recovery from Water Treatment Plant Sludges,
W82-04107 1509 5E

CORRELL, D. L.
Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 1505 5C

Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 1510 2L

CORRY, M. L.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

CORSSMIT, C. W.
Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 1512 6C

CORY, D. C.
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 1510 6B

CORY, R. L.
Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

COSBY, R.
Sampling Ground Water for Organic Contaminants,
W82-00820 1502 5A

COSBY, R. L.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 1505 5B

COSKUNOGLU, O.
Optimal Stream-Aquifer Development,
W82-02575 1505 6A

COSTA, H. S.
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05648 1511 5B

COSTA, J. E.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 1503 2E

COSTELLO, R.
Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

COSTERTON, J. W.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

COTE, J-E.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 1503 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 1503 5B

COTE, P.
A Method for Wastewater Treatment System User Cost Allocation, Volume 1: Study Report,
W82-06382 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 1512 5D

COTE, R.
Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 1510 5C

COTTON, A. P.
The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 1507 2L

COTTON, P.
Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 1512 5D

COUBROUGH, P.
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

COUILLARD, D.
Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 1511 5B

COULOMBE, A. M.
Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 1503 2H

COULTER, J. B.
The Hazards of Hazardous Waste Management,
W82-01940 1504 6E

COURTNEY, C. M.
Meromixis in a Coastal Zone Excavation,
W82-02120 1505 2H

COURY, G. E.
A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

COUSINS, J. R.
Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 1501 5F

COUTANT, C. C.
Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 1511 2B

COVAY, K. J.
Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

COVE, R.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 1502 5C

COVER, E.
Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 1512 5G

COVERT, T. C.
Waste Discharge Monitoring Requirements Under the NPDES Permits Program,
W82-03969 1509 5D

COWAN, M. S.
Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

COWARDIN, L. M.
Wetlands and Deepwater Habitats: A New Classification,
W82-05716 1511 2L

COWART, J. B.
Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 1506 5A

COWELL, B. C.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

COWELL, D. W.
Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 1501 2K

COWING, D. J.
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

COWLEY, I. D.
Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 1510 5E

COWLING, E. B.
Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 1503 5C

Acid Precipitation in Historical Perspective,
W82-04807 1511 5B

COX, R. G.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1504 1B

The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1504 1B

COX, W. E.
Law,
W82-01302 1503 6E

COYLE, J. T.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 1511 5F

CRABTREE, R. J.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 1504 2I

CRAIG, K. S.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

CRAIG, R. W.
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

CRAMER, D.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 1502 5A

CRAMER, G. W.
Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 1505 2H

CRAMER, W. N.
Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 1511 5D

CRAMPTON, C. B.
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 1503 2G

CRANDALL, M. E.
Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 1505 4A

CRANE, D.
Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

CRANE, S. M.
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06199 1512 5B

CRANE, S. R.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

CRANOR, R. O.
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 1503 5D

CRANSTON, C. C.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

CRASSOUS, F.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

CRATE, J.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G

CRAUN, G. F.
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 1503 5C

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 5C

Disease Outbreaks Caused by Drinking Water,
W82-01289 1503 5C

Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 1508 5B

CRAVEN, H.
Treating Phenol Resin Plant Wastes,
W82-05128 1511 5D

CRAVEN, J. A.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 1502 5B

CRAVENS, J. B.
Thermal Effects,
W82-01275 1503 5C

Thermal Effects,
W82-06809 1512 5C

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 1510 5D

CRAWFORD, C.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

CRAWFORD, C. G.
Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

CRAWFORD, J. K.
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 1507 7B

CREASY, D. E. J.
A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

CREMA, R.
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

CRESON, C.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 1510 5D

CRESSER, M. S.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

CRESSWELL, C. F.
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

CREUTIN, J. D.
Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 1512 2B

CREWE, W.
The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476 1511 5B

CRIPE, C. R.
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 1504 2L

CRISMAN, T. L.
Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

CRISP, P. T.
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 1507 5A

CRISP, R.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 1503 6D

CRISTIANI, G.
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 1507 5B

CRITES, R. W.
Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 1511 5D

CRITTENDEN, J. C.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

CROCKET, J. H.
Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 1511 5B

CROLEY, T. E.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

CROLEY, T. E. I.
Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 1512 5G

CROMMELINCK, H.
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

CRONBERG, G.
Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 1512 5C

CRONHOLM, L. S.
Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 1503 5C

CRONIN, L. E.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

CROONENBERGHS, R. E.
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 1505 5B

CROSBY, J. W. III.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 1502 5B

CROSS, J. E.
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 1507 5B

CROSS, S. F.
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

CROSS, W. H.
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 1501 5D

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

Role of Surface Active Media in Anaerobic Filters,
W82-05816 1511 5D

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

CROSSER, M. L.
Industrial Wastewater Audit,
W82-03337 1507 5D

CROSSLEY, E. I.
Upgrading Water Treatment Plants in San Diego,
W82-03655 1508 5F

CROUSE, M. R.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 1506 5C

CROW, N.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

CROWE, A. S.
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 1502 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 1502 2A

CROWE, S.
The Landscape of Rutland Water,
W82-06478 1512 6G

CROWLEY, K. D.
Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

CROWLEY, P.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

CROWLEY, V.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

CROWTHER, J. M.
Monitoring of Turbidity and Suspended Solids Concentration in Wastewater Treatment Plants,
W82-04054 1509 5D

Theoretical Considerations for Control and Monitoring of Wastewater Treatment Systems,
W82-04060 1509 5D

CROZIER, M. J.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

CRUTCHER, A. J.
Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

CRUZ, E.
Bridging the Water Supply Gap,
W82-06508 1512 8A

CRUZ, R. B.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

CRUZ, R. R.
Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

CSANADY, G. T.
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 1502 2H

CSIZINSZKY, A. A.
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 1502 3F

CUKER, B. E.
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

CULLEN, A. J.
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 1501 5F

CULLEY, J. L.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

CULLEY, J. L. B.
Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 1511 2A

CULP, R. L.
Granular Activated Carbon Installations,
W82-04391 1510 5F

CULVER, C. F.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

CUMBUS, I. P.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

CUMMANS, J.
Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

CUMMANS, J. E.
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 1503 2E

CUNDAY, T. W.
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03569 1508 2A

CUNNINGHAM, A. J.
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

CUNNINGHAM, G. L.
A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 1512 3C

CUNNINGHAM, R.
Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 1505 2J

CUNNINGHAM, R. L.
The Occurrence of Flow Channels in Soils,
W82-04875 1511 3C

CURLEY, T.
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

CURRAN, C.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

CURRAN, D. J.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 1502 5A

CURRAN, H. M.
Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 1511 3A

CURRY, R. B.
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

CURRY, R. R.
Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 1505 2F

CURRY, R. W.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 1504 5B

CURSTEDT, T.
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 1512 5A

CURTIN, S. E.
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

CURTIS, C.
Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

CURTIS, C. R.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 1504 4A

CURTIS, D. L.
Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

CURTIS, L. L.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

CURTIS, W. F.
Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

CUSHING, C. E.
Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772 1509 2H

CUSHMAN, J. H.
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 1507 5E

CUSHMAN, R. M.
A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 1506 5C

CUSICK, W.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

CUTHBERT, D. R.
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

AUTHOR INDEX

CUTSHALL, N. H.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

CYR, R.
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04933 1510 5F

CZUBA, M.
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 1511 5C

D'ANGLEJAN, B.
On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 1505 2L

D'APPOLONIA, D. J.
Soil-Bentonite Supply Trench Cutoffs,
W82-01999 1503 8D

D'AURIA, J. M.
Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 1508 5A

D'ITRI, F. M.
Managing Vegetation in Wastewater Application,
W82-03401 1508 5D

DABROWSKA-ZIELINSKA, K.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 1508 7B

DABROWSKI, H.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 1504 6G

DACRE, J. C.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 1502 5G

DADDIO, E.
Surface Water Flow from a South Florida Wetland Area,
W82-02121 1505 2E

DADKHAH, M.
Influence of Vegetation, Rock Cover, and Trampling on Filtration Rates and Sediment Production,
W82-04153 1509 2G

DADSWELL, M. J.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

DAFFER JR, R. A.
Pump Systems: What Price Inefficiency,
W82-04093 1509 8C

DAGAN, G.
Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 1507 2F

DAGUE, R. E.
Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 1511 5D

DAGUE, R. R.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

DAHL, B. W.
How to Set Up a Preventive Maintenance Program,
W82-06264 1512 5D

DAHL, D.
On the Sampling Variance of Raingage Networks,
W82-05875 1511 7B

DAHLBERG, M. D.
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 1503 7A

DAHLING, D. R.
Method for Recovering Viruses from River Water Solids,
W82-00200 1501 5A

DAHM, C. N.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 1505 5B

DAIBER, F. C.
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

DAIGH, R. V.
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 1503 5D

DAKERS, J. L.
Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

The Sewerage Policy of Thames Water,
W82-02040 1504 6E

DAKSHANAMURTHY, V.
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 1502 2G

DAKSHINI, K. M. M.
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

DALE, L.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

DALELA, R. C.
Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 1511 5C

DALLAIRE, G.
Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 1508 5F

EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 1508 5D

Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 1507 6C

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 1508 5G

DALPRA, C.
Secondary Treatment Waivers Issued, Controversy Continues,
W82-02452 1506 6E

DALTROPHE, N. C.
Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 1512 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 1512 3A

DALY, C. J.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 1504 2F

DALY, E. L. JR.
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 1511 5A

DALY, P. G.
High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

DAMEZ, F.
Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

DAMHAUG, T.
Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

DAMIANI, V.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 1503 5B

DAMM, M. V.
Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 1510 2F

DAMPIER, B.
Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 1505 5C

DAN, J.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

DANCE, K. W.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

DANCHUK, W. J.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

DANDEKAR, M. M.
Conformal Mapping for Channel Junction Flow,
W82-04306 1510 2E

DANIEL, C. C. III
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 1507 7B

DANIEL, D. E. JR.
Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 1508 2G

DANIEL, J. R. K.
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 1503 2A

DANIEL, R. R.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 1502 5D

DANIEL, T. C.
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 1501 5B

Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

DANIELS, M. L.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

DANIELSON, R. E.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

DANIELSON, T. W.
Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

DANIELSSON, L. G.
On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012 1511 5A

DARA, S. S.
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 1507 5D

DARBY, W. P.
In-Home Conservation and Wastewater Management,
W82-02591 1505 3D

DARDEN, D.
Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 1512 7C

DARDIS, K. A.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 1504 5D

DARNELL, R. M.
Strategies for the Management of Estuaries,
W82-02166 1505 6F

DAROS, B.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

DARVES-BORNOZ, R.
Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 1511 4B

DARVILLE, R. G.
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 1502 5C

DARZI, M.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

DAS, D. K.
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

DAS GUPTA, A.
Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 1508 4B

DAS, M. M.
Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 1510 8B

DASHER, D. H.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

DATTA, B.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 1503 8A

DAUBERT, J.
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 1510 6B

DAUBERT, J. T.
Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

DAUCHY, J.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

DAUGHERTY, J. L.
'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 1511 5D

DAUKAS, P.
Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

DAUPLE, P.
Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 1506 3F

DAVANZO, A. C.
Detroit - Fresh Clean Water,
W82-01506 1503 5D

Detroit's WWTP: One of the World's Biggest,
W82-01865 1504 5D

DAVAR, K. S.
Management of Ice-Covered Rivers: Problems and Perspectives,
W82-03807 1509 2C

DAVE, M.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

DAVENPORT, D. C.
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 1510 3F

DAVENPORT, R. J.
Continuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 1508 5A

DAVEY, C. B.
Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 1503 5C

DAVEY, T.
Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 1508 5D

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 1508 5D

DAVID, L.
Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 1511 5G

DAVIDAR, D. J.
India: Every River Polluted, and Few Effective Controls,
W82-05033 1511 5B

DAVIDSON-ARNOTT, R. G. D.
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 1503 2J

DAVIDSON, P. J.
Reducing the Flush,
W82-04654 1510 3D

DAVIES, A. W.
Laboratory Services in Regional Water Authorities,
W82-06256 1512 5G

DAVIES, E.
Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 1502 2H

DAVIES, F. S.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

DAVIES, J. A.
Potential Evaporation in the Peace Region of British Columbia,
W82-06528 1512 2D

DAVIES, M.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 1512 5D

DAVIES, M. H.
The Search for Reservoir Sites in an Urban Environment,
W82-04867 1511 8A

DAVIES, R. W.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 1512 5C

DAVIES, S. H. R.
Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

DAVIES, T. R. H.
Lower Flow Regime Bedforms: Rational Classification,
W82-06421 1512 2E

DAVIES, T. T.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

DAVIES, W. D.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-0100[illegible] 1502 2H

DAVIES, W. J.
The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 1507 2D

DAVIS, A. L.
Flexible Outfall at Aldeburgh,
W82-02415 1505 8A

DAVIS, B.
Composting Results in Los Angeles,
W82-03400 1507 5E

DAVIS, C. B.
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 1502 2H

DAVIS, C. O.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

DAVIS, D. L.
Acid Precipitation. 1. Causes and Consequences,
W82-04771 1511 5C

DAVIS, E. I.
The Horse Creek Basin Project,
W82-00071 1501 5G

DAVIS, E. M.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 1510 5C

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 1510 5C

DAVIS, G. E.
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 1506 5G

DAVIS, J.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 1502 2H

DAVIS, J. A.
Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 1506 5F

DAVIS, J. J.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 1511 5F

DAVIS, J. R.
Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

DAVIS, M. J.
Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 1501 6A

Water Quality Issues and Energy Assessments,
W82-00036 1501 6B

DAVIS, P.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

DAVIS, R. A.
'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 1511 5D

DAVIS, R. B.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

DAVIS, R. D.
Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

DAVIS, R. L.
The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 1506 5C

Potential Evaporation in the Peace Region of British Columbia,
W82-06528 1512 2D

DAVISON, R. R.
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

DAVISON, W.
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 1506 2K

Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

DAVOREN, W. T.
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

Tragedy of the San Francisco Bay Commons,
W82-06182 1512 6E

DAWES, C. J.
The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 1508 2L

DAWSON, F. H.
The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02193 1505 1B

DAWSON, J. F.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

DAWSON, R.
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 1507 2L

DAWSON, V. K.
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 1512 5A

Residues of Isobornyl Thiocyanoacetate (Tha-ite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1302 5B

DAY, A. D.
Alfalfa Hay Grown with Municipal W
Water and Pump Water,
W82-04873 1511 3C

DAY, F. P.
Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

DAY, G. E.
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

DAY, H. J.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

DAY, J. C.
The Long Lake Diversion: An Environmental Evaluation,
W82-05568 1511 6G

Northwestern Ontario River Dimensions,
W82-05742 1511 6G

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

DAY, J. P.
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 1507 5B

A Case Study of Nutrients in the River Holme, West Yorkshire, England,
W82-05577 1511 5B

DAY, J. W. JR.
Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 1511 5C

Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 1501 2A

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 1505 2H

DAY JR, J. W.
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

DAY, W. J.
The Horse Creek Basin Project,
W82-00071 1501 5G

DAYANANDA, P. W. A.
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 1506 5B

DAZY, J.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

DDORE, M.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 1511 5F

DE ALMEIDA, M.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

DE ARAMBARRI, P.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 1512 5A

DE BOER, T.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

DE BORNE DE GRANDPRE, C.
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

DE CAPRARIIS, P.
A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 1508 2H

DE DECKER, P.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

DE GREEF, E.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

DE HAAN, H.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 1512 5C

DE HEER, H.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

DE JAGER, J. M.
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 1501 2D

DE JESUS, A. S. M.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

DE JESUS, S. J.
The Agus II Scheme in the Philippines,
W82-05599 1511 8A

DE JONG, T. M.
Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 1505 2I

DE JONGE, V. N.
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 1501 5A

DE LA LANZA, G.
The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 1510 2L

DE LA NOUE, J.
Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 1508 5D

DE LAAT, J.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 1511 5F

DE LAUNE, R. D.
Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

DE MAEYER-CLEEMPOEL, S.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

DE MEL, I. D. T.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

DE MORAES, J.
Turbines for Itaipu,
W82-04955 1511 8C

DE PENA, R. G.
Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 1502 2K

DE, R.
Consumptive Water Use by Opium Poppy,
W82-03356 1507 2I

DE, S. K.
Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834 1512 4D

DE S, N. L.
Aeration at High Velocity Flows,
W82-05602 1511 8A

DE SMET, W. H. O.
Observations on the Immature Chironomides of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

DE TURVILLE, C. M.
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 1505 5C

DE, U. K.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 1506 5C

DE VOS, C. P.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

DE VRIES, A.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

DE VRIES, R. T. P.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

DE WET, F. J.
Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

DE WULF, E.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

DEACON, G. B.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

DEACON, J. E.
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G

DEAN, C. H.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

DEAN, J. D.
Acid Rain Model: Hydrologic Module,
W82-06360 1512 5B

DEAN, J. M.
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 1512 2J

DEB, A. K.
Dual Distribution Systems Analysis,
W82-04123 1509 5F

DEBALAK, K. A.
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

DEBELAK, K. A.
Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 1506 5D

DEBETTENCOURT, J. S.
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 1510 6B

DEBO, T. N.
Detention Basins--An Urban Experience,
W82-04332 1510 4A

Storm Water Management: The Concept and Its Application,
W82-04240 1509 4A

DEBOL'SKAYA, E. I.
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

DEBROVOL'SKAYA, Z. N.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

DEBYLE, N. V.
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

DECK, B. L.
Radionuclides in Mono Lake, California,
W82-05461 1511 5B

DECKERS, H.
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 1506 2H

DECOTTE, D. C. W.
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

DECOSTA, J.
Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 1502 2H

DECOURSEY, D. G.
Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 1512 2F

Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

DEDRICK, A. R.
Development of Solutions for Level-Basin Design,
W82-01976 1504 3F

Estimating Distribution Uniformity in Level Basins,
W82-03058 1507 3F

Limits for Practical Level-Basin Design,
W82-06452 1512 3F

DEDYO, J.
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 1506 5D

Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 1507 5D

DEE, J.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

DEFFERDING, L. J.
State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 1501 5E

DEFOE, D. L.
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 1503 5C

DEFRIES, R. S.
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 1502 2L

DEGHI, G. S.
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

DEGOMA, E. S.
Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

DEGUCHI, T.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 1507 5A

DEHAAN, R. W.
The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 1507 6D

DEINFANTE, A.
Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 1512 5C

DEININGER, R. A
An Interactive Data Management System for River Water Quality Data,
W82-04659 1510 10B

DEKKER, L. W.
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

DEKKERS, Z. M. J.
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 1506 2K

DEL BRENNA, F.
Turbines for Itaipu,
W82-04955 1511 8C

DEL PRETE, A.
The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03803 1509 5C

DELAND, M. R.
Acid Rain: Legal and Political Fallout,
W82-05147 1511 6E

DELANEY, D. F.
Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 1511 7C

DELANEY, R. H.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

DELARCHE, A.
Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 1507 5C

DELAUNAY, J.
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 3C

DELAUNE, R. D.
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

DELFINO, J. J.
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 1505 5A

DELLEUR, J. W.
Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 1511 4A

A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 1503 2B

DELLEY, P.
The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

DELMAS, D.
Improvement of Swirl Concentrator,
W82-05821 1511 5D

DELONCLE, R.
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 1507 5A

DELONG, L. L.
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

DELPHEY, C. E.
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

DELPHIA, L. M.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 1503 5A

DELUISE, F. J.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 1512 5D

DELWICHE, J. T.
Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

DEMALACH, Y.
Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 1512 3C

DEMARD, H.
A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 1510 6D

DEMARRE, J.
Sampling and Analyzing Water,
W82-05263 1511 5A

DEMERS, S.
Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 1510 2L

DEMERY, P. M.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

DEMETRACOPOULOS, A. C.
Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 1510 7B

DEMIDOV, V. N.
Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

DEMISSIE, M.
Carrying Capacity of Flood Plains,
W82-06428 1512 2E

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

DEMONSABERT, S. M.
Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

DEMONTMOLLIN, F. A.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

DEMPSEY, P. S.
Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law,
W82-04803 1511 6E

DEMPSTER, W. S.
An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

DEN BLANKEN, J. G.
Microbial Activity in Activated Carbon Filters,
W82-05683 1511 5F

DENCE, C. W.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

DENDY, B. B.
Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

DENDY, F. E.
Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 1505 2J

DENHAM, S. J.
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 1501 5D

DENICH, K.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

DENISOVA, A. I.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 1504 2H

DENKHAUS, R.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

DENNEHY, K. F.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Piant Site, Southeastern New Mexico,
W82-04517 1510 5B

DENNIS, A. S.
A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

DENNIS, R. P.
Water Management in Ontario,
W82-04259 1510 6E

DENNIS, R. W.
A Stoichiometric Model of Bacterial Growth,
W82-03756 1509 5D

DENOYELLES, F.
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

DENTEL, S. K.
Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 1512 5D

DENTON, M. S.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

DEPARASIS, O. A.
Water Conservation at Wastewater Treatment Plants,
W82-06512 1512 3C

DEPINTO, J. V.
Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 1511 5B

Aquatic Sediments,
W82-01279 1503 5B

Aquatic Sediments,
W82-06806 1512 2J

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
W82-06829 1512 5B

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

DERECKI, J. A.
Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 1507 2D

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

DERENZO, D. R.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 1502 2B

DERMISIS, V.
Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

DESAI, J. B.
Water Requirements of Urban Plants,
W82-03972 1509 3D

DESAULINIERS, J. A. H.
Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

DESAULNIERS, D. E.
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

DESAULNIERS, J. A. H.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

DESCHENES, J. M.
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

DESHPANDE, C. M.
Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 1512 5C

DESMARAIS, D. J.
Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 1512 2H

DESORTOVA, B.
Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 1507 2H

DETAR, W. R.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

DETTINGER, M. D.
First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 1507 2F

DEUDNEY, D.
Hydropower--An Old Technology for a New Era,
W82-01593 1503 4A

DEVAUX, J.
Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 1507 2H

DEVEAUX, J.
Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplancton),
W82-03219 1507 2H

DEVENDER REDDY, M.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

DEVER, R. J. JR.
Discussion of 'Finite Element Method for Direct Runoff Flow',
W82-03782 1509 2A

DEVI, R.
Discussion of 'Turbulence Prediction in Open Channel Flow',
W82-03781 1509 8B

DEVINNY, J. S.
Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 1502 5C

DEVITT, D.
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

DEVOL, A. H.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 1511 5C

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 1511 5B

DEWALLE, D. R.
Acid Precipitation, A Review,
W82-06794 1512 5C

DEWALLE, F. B.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

Organics,
W82-01239 1503 5A

Organics,
W82-06922 1512 5A

Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

DEWLING, R. T.
New Directions in Water Pollution Control,
W82-06071 1512 5G

DEXTER, F.
Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 1502 5A

DEZELLAR, J.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 1510 3D

DHAMOTHARAN, S.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 1503 2J

DHARMASIRI, J. K.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

DHARMAWARDENA, K. G.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

DHAWAN, K. L.
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 1501 5B

DHILLON, B. S.
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

DHILLON, G. S.
A Suitable Lining Technique for Existing Distributaries,
W82-03063 1507 8G

DI BERNARDO, L.
The Use of a Perforated Baffle at the Inlet of Rectangular Settling Basins,
W82-04124 1509 8B

DI GIACOMO, G.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

DI PERNA, J.
System for Oil and Water Separation,
W82-00611 1502 5D

DI PIETRO, N. D.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1504 1B

DIACHENKO, G. W.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

DIACON, A.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 1503 6A

DIAMANT, B. Z.
Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 1505 6G

DIAZ ARRIVIALLAGA, A.
The El Cajon Hydro Project in Honduras, Part Two,
W82-03333 1507 8A

DIAZ, E.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 1512 5A

DIAZ, R.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

DIBBLE, W. E. JR.
Non-Equilibrium Water/Rock Interactions,
W82-01684 1503 1A

DICK, A. C.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

DICK, M. W.
Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 1505 2H

DICK, R. I.
Sludge Management Process Integration,
W82-03130 1507 5D

DICKER, H. J.
Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 1501 2L

DICKEY, E. C.
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 1502 5D

DICKINSON, H.
The Nile Waters: Sudan's Critical Resource, Part II,
W82-03601 1511 6D

DICKINSON, R. E.
Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 1512 6C

DICKSON, A. G.
An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1507 1B

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 1501 2K

DICKSON, G. W.
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H

DIDDENS, J. H.
Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 1508 6B

DIDERIKSEN, R. I.
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 1504 2J

DIDIER, P. P.
Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

DIERBERG, F. E.
The Effects of Secondary Sewage Effluent o the Water Quality, Nutrient Cycles and Mas Balances, and Accumulation of Soil Orga Matter in Cypress Domes,
W82-01687 1503 5G

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 1510 5C

DIERCKX, P.
A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

DIERICKX, W.
Effect of Perforation Shape and Pattern on the Performance of Drain Pipes,
W82-03792 1509 8B

DIESL, W. F.
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

DIETRICH, A. M.
Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 1511 5F

DIETRICH, C. C.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

DIETZ, F.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 1512 5A

DIGERFELDT, G.
Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 1508 5B

DIGGINS, M. R.
Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 1512 5C

DIGGS, R. E.
Apparatus for Desalinating Water,
W82-06711 1512 3A

DIJULIO, D. H.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 1502 5A

DIKMEN, S. U.
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 1503 8D

DILLAHA, T. A. III
Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 1511 4D

DILORETO, G. E.
Regional Detention Basins for Stormwater Control,
W82-06225 1512 8A

DILOUIE, J.
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 1507 2J

DIMMICK, J. F.
Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 1512 5C

DINCHAK, W. G.
Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 1511 8F

DINEHART, R. L.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01793 1503 7C

DINGESS, J. M.
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

DINGMAN, S. L.
Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 1506 6B

DINIA, N.
Morocco's Largest Multipurpose Scheme,
W82-01724 1503 8A

DINNEL, P. A.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 1502 5A

DINSMORE, S. R.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

DION, N. P.
Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

DIRAR, H. A.
Microbiological Examination of Sebeel Water,
W82-06882 1512 5C

DIRICKX, I. J.
A Century of Water for Antwerp,
W82-03355 1507 5F

DIRICKX, J.
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

DIRKS, V. A.
Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 1503 2I

DISHER, J. W.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

DISINGER, J. F.
Project Outcomes Correlate with Public Participation Variables,
W82-02663 1506 6B

DISSANAYAKE, C. B.
Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 1511 5C

DITARANTO, V. M. JR.
American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 1510 5D

DITWILER, C. D.
Water: A Low-Priced But High-Cost Resource,
W82-02061 1504 6C

DIVOKY, D.
Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

DIXON, K. R.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 1512 5C

DIXON, L. S.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

DMITRIEV, N. V.
Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 1507 8A

DOAN, R. JR.
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 1506 5D

DOBBS, S.
Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 1507 5B

DOBOSZ, J.
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

DOBROVOL'SKAYA, Z. N.
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W32-06612 1512 2H

DOBSON, H. F. H.
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 1504 2H

DOBSON, R.
The River Ouse Water Supply Scheme,
W82-01371 1503 5F

DODGE, K. A.
Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 1505 7C

DODGE, R. A.
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 1501 8A

DODSON, A. H.
Measuring Reservoir Ground Movements,
W82-05773 1511 8G

DOEHRING, D. O.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

DOGADINA, T. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

DOHANYOS, M.
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

DOLAN, D. M.
Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 1511 5C

DOLAN, F.
Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 1506 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

DOLAN, R.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 1503 2J

DOLAN, T. J.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

DOLARA, P.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

DOLD, P. L.
A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

DOLIN, P. I.
Prospects of Using Radiation Water Treatment Methods,
W82-05026 1511 5D

DOLLING, H.
The Challenge of Upgrading Roadside Rest Areas,
W82-06845 1512 5G

DOLSKE, D.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

DOLSKE, D. A.
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 1503 5B

DOMBROVSKII, V. N.
Bearing Capacity of Sand Bases (Discussion of Construction Specifications),
W82-05583 1511 8D

DOMENICO, P. A.
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 1512 2F

DOMINGUEZ, S. E.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 1506 5C

DOMINIK, J.
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods.
W82-03883 1509 2J

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

DOMINO, M. M.
Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

DONAHUE, J. R.
Comparison of Detention Basin Planning and Design Models,
W82-02592 1505 6A

DONEAUD, A. A.
A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

DONNADIEU, G.
Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 1508 2B

DONNAN, J.
Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 1506 5E

Who Wins in the Fight for Pollution Control,
W82-04554 1510 6B

DONNELLON, J. J.
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

DONNELLY, K. C.
Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 1511 5C

DONNERT, D.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

DONOGHUE, J. F.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

DONOVAN, E.
Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 1506 5D

DONOVAN, J.
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 1501 5E

DONOVAN, J. J.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

DOOLEY, C. J.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

DOORIS, G. M.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 1511 5C

DOORIS, P. M.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 1511 5C

DORAN, J. W.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

DORAN, T. M.
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 1510 5D

DORAS, N.
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 1503 2B

DORCEY, A. H. J.
The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 1511 6F

DORING, E. J.
Watertable Management Saves Water and Energy,
W82-00943 1502 3F

DORNSEIF, B.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

DORSEY, M. E.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

DORSEY, P.
The Costs of Compliance: An EPA Estimate for Organics Control,
W82-04132 1509 6C

DOSKEY, P. V.
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 1501 5B

DOSS, B. D.
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

DOTY, R. D.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

DOUGAL, M. D.
Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 1507 2F

Tapered Inlet Design Using Specific Energy Curves,
W82-04693 1510 8A

DOUGHTY, C.
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

DOUGLAS, A. V.
On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 1512 2B

DOUGLASS, A. R.
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 1503 2A

DOUGLASS, J. E.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

DOVER, V. L. JR.
Land Restoration Following Oil-Well Drilling,
W82-00057 1501 5D

DOWDY, R. H.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

DOWELL, J. C.
Sewage Pumping Station Split for Maintenance,
W82-05719 1511 5D

DOWIAK, N. J.
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 1503 5G

DOWNES, M. T.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

DOWNING, J. P. JR.
Particle Counter for Sediment Transport Studies,
W82-03666 1508 7B

DOWNING, R. H.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

DOWNS, C. E.
The Technology Transfer Process in Water Resources R&D Management,
W82-01694 1503 6A

DOYLE, J. T.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 1505 2A

DOYLE, T. J.
Surface Water Management at Hazardous Waste Sites,
W82-01429 1503 5G

DOYLE, W. H. JR.
The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

DOZIER, J.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-03311 1503 7B

Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 1507 7B

DRAEBE, J. A.
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 1503 7B

DRAGE, B. E.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

DRAKE, B. G.
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 1506 2L

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 1505 2I

DRAKE, C. M.
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 1502 7B

DRAKE, D. E.
Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

DRAKE, J. C.
Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 1512 2K

DRAKE, J. J.
The Effects of Surface Dust on Snowmelt Rates,
W82-00845 1502 2C

DRAKE, R. A. R.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 1504 5D

DRAKE, R. J.
Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 1503 5D

DRAKE, S. R.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

DRAKIDES, C.
The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 1506 5D

DRAPEAU, A. J.
Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

DRAPER, M.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 1503 6A

DRAPER, S. E.
Urban Rainfall-Runoff Modelling Using Remote Sensing Imagery,
W82-03820 1509 2A

DRATNAL, E.
The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 1506 5C

DREHWING, F. J.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

DRESLER, P. V.
Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

DRESSCHER, TH. G. N.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 1504 5A

DRESSEL, P.
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

DRISCOLL, C. T.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 1512 2K

DRISCOLL, C. T. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

DRNDARSKI, N.
Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

DROWN, D. B.
Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

DRUFUCA, G.
A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 1512 7B

DRUMMOND, C. J.
Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 1501 5D

DRUMMOND, D.
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

DRURY, D. D.
O & M Wastewater Collection and Treatment Facilities,
W82-01249 1503 5D

DRYNAN, R. G.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

DU PLESSIS, J.
An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

DUBA, G. A.
Storm-Sewer Input of Heavy Metals Into an Urban Lake Environment,
W82-04207 1509 5A

DUBETZ, S.
Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

DUBINCHUK, V. T.
Radon and Radium Discharge to Surface Streams,
W82-03881 1509 5B

DUBKO, N. V.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 1504 5B

DUBROWSKI, F.
Water Quality: What Should Be Done Today,
W82-03631 1508 6E

DUBUC, J. P.
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

DUCKLOW, H. W.
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 1512 5C

DUCKSTEIN, L.
Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8B

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 1511 5G

Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 1512 6A

Reliability of Underground Flood Control System,
W82-00556 1502 8A

DUCRET, G. L. JR.
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 1501 6E

DUDA, A. M.
Impact of Mining Activities on Water Quality in Western North Carolina,
W82-03926 1509 5B

DUDDRIDGE, J. A.
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

DUDDRIDGE, J. E.
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 1505 5B

DUDLEY, D. J.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

DUDLEY, L. M.
Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

DUERR, A. D.
Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482
1505 7C

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417
1501 5B

DUESZELN, J.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008
1504 5A

DUFF, E. J.
Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259
1507 5F

Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269
1507 5A

DUFFIELD, J. W.
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260
1510 6B

DUFFY, D.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170
1503 8D

DUFOUR, A. P.
Disease Outbreaks Caused by Drinking Water,
W82-06928
1512 5C

Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487
1501 5A

Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337
1505 5B

DUGAN, G. L.
Sewage Irrigation and Recharge Consequences, Oahu,
W82-04041
1509 3C

DUIGON, M. T.
Lineboro Quadrangle: Hydrogeology,
W82-04969
1511 7C

DUKE, D. T.
Control of Trihalomethanes in Drinking Water,
W82-04425
1510 5F

DUKE, K. M.
Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654
1512 5A

DUKE, M. L.
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838
1511 5D

DUKE, T. W.
Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378
1511 5C

DUKE, W.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764
1503 6D

DUMONT, H. J.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379
1503 2H

DUNAEVSKII, R. A.
Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116
1511 8E

DUNBAR, D. S.
Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572
1510 2H

DUNCAN, J. M.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954
1504 8D

DUNCAN, L. C.
Acid Precipitation in the Washington Cascades,
W82-05287
1511 5B

DUNCAN, M.
Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107
1501 6D

DUNCAN, S. W.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826
1502 7B

DUNFORD, W. E.
Attached Algae of the Lake Erie Shoreline Near Nanticoke Generating Station,
W82-04025
1509 5C

DUNIN, F. X.
Wheat Yield Estimation in Northwest Iran,
W82-03267
1507 2I

DUNKEL, B. W.
Industrial Wastewater Pretreatment Service,
W82-02253
1505 5E

DUNLAP, L. E.
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475
1505 7C

DUNLAP, R. M.
Fresh-Water Transport by Sea,
W82-04861
1511 6D

DUNLAP, W. J.
Sampling Ground Water for Organic Contaminants,
W82-00820
1502 5A

Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220
1505 5B

DUNLOP, S.
Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678
1508 5C

Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334
1507 5G

DUNN, B.
Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477
1505 4C

DUNN, D. L.
An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737
1511 6A

DUNN, I. J.
Kinetics of Biofilm Nitrification,
W82-05374
1511 5D

DUNN, J.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124
1505 6G

DUNN, S. J.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536
1511 5D

DUNNE, A.
Summary of Basin and Flood Characteristics fo
Unregulated Basins in New Mexico,
W82-06671
1512 7C

DUNNE, T.
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624
1506 2C

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970
1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971
1512 4D

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571
1503 2C

DUNNETTE, D. A.
Sampling Frequency Optimization Using a Water Quality Index,
W82-05268
1511 5A

DUNNING, C. M.
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102
1501 6B

DUPIES, D.
Problems and Processes in Water Quality Management,
W82-06147
1512 5G

DUPPERS, W.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616
1510 5D

DUPUY, A. E. JR.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883
1511 5A

DUPUY, G.
Sewers and Cities: France and the United States Compared,
W82-05684
1511 5D

DUPUY, J.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123
1511 2C

DURCHEVA, V. N.
On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773
1506 8A

DURHAM, J. L.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642
1502 5B

DURKIN, J. T.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139
1505 2L

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132
1505 2L

DURKIN, P.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632
1502 5C

DURVE, V. S.
Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 1505 5C

DUSEK, D. A.
Deep Tillage of Irrigated Pullman Clay Loam—A Long-Term Evaluation,
W82-04372 1510 2G

A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 1505 3F

Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 1506 3F

DUSSART, G.
A Pragmatic Approach to Water Quality Microbiology in a Clean River Area,
W82-05575 1511 5A

Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 1502 2K

DUSZELN, J. V.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

DUTHIE, H. C.
Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

DUTKA, B. J.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

DUTONG,
Cavitation and Wear on Hydraulic Machines,
W82-00331 1501 8C

DUVAL, R. L.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

DUVAL, W. S.
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 1501 5C

DUVICK, D. N.
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

DVORACEK, M. J.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

DVOSKIN, D.
Projected Effects of Energy Policies on Agricultural Water Use and Irrigation,
W82-03915 1509 6C

DWYER, D. F.
Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

DYCK, S.
Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 1510 4A

DYE, C. W.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

DYER, T. G. J.
On a Technique to Investigate the Covariation Between Streamflow and Rainfall in Afforested Catchments,
W82-03864 1509 4C

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 1502 2B

Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 1512 2B

Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 1511 2B

DYHOUSE, G. R.
Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

DYLLA, A. S.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01572 1503 5B

DZHAMALOV, R. G.
Groundwater Discharge to the Pacific Ocean,
W82-01647 1503 2F

DZHOGAN, L. YA.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 1504 2D

DZUBAN, N. A.
Hypania Invalida in the Volga Reservoirs and Hydrobiological Monitoring,
W82-05331 1511 2H

EADIE, B.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 1503 2H

EADIE, B. J.
Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 1511 2H

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 1503 2H

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

EADIE, R.
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 1510 6C

EAGLE, G. A.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

EAGLES, B. G.
Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 1512 5C

EAGLESON, K. W.
Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 1511 7B

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

EAGLESON, P. S.
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 1512 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 1512 2I

Identification of Independent Rainstorms,
W82-05708 1511 2B

Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation,
W82-00132 1501 2B

EARL, K. D.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 1511 3C

EARLEY, J. J.
Erosion Control at a Delicate Highway Construction Site,
W82-06510 1512 4D

EARNSHAW, J. C.
Surface Viscosity of Water,
W82-03501 1508 1A

EASLEY, R. S.
Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 1512 5D

EAST, J. W.
The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 1512 2E

EASTBURN, R. P.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 1502 5D

EATON, D.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 1502 5D

EATON, J. S.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

EATOUGH, D. J.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

EBE, S. C.
Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 1512 3C

EBERLE, M.
Water Use in Ohio, 1975,
W82-05226 1511 6D

EBERLE, S. H.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

EBERZ, P. G.
Ferric Chloride Takes Over,
W82-00954 1502 5F

ECCLES, P. G.
Salby Reservoir - Providing Water for the Isle of Man,
W82-02066 1504 8A

ECHERT, J. M.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 1502 5A

ECK, T. H.
The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

ECKEL, L. H.
Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 1508 6G

ECKENFELDER, W. W.
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

ECKENFELDER, W. W. JR.
Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 1511 5D

ECKERMAN, J.
The Outlook for Precipitation Measurements from Space,
W82-06531 1512 7B

ECKERSON, D.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 1501 5A

ECKERT, J. M.
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 1507 5A

ECKHOFF, P. A.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

ECKMANN, D. E.
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

ECONOMOU-AMILLI, A.
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 1503 5A

EDDS, J.
Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 1510 7C

EDEL, YU. U.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 1507 8B

EDELMANN, P.
Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

EDEN, G. E.
Disposal of Industrial Effluents - Some Future Problems,
W82-02405 1505 5D

EDGAR, R. K.
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

EDGEHILL, R. U.
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-049[illegible]7 1511 5G

EDGREN, M.
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C

EDIL, T. B.
Ground-Water Flow Systems and Stability of a Slope,
W82-04677 1510 2J

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

EDMOND, J. M.
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

EDMONDS, J. S.
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 1507 5B

EDMONDSON, W. T.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

EDMUNDS, R. C.
Practical Power-Saving Techniques in Pinellas County,
W82-04092 1509 5F

EDMUNDS, W. M.
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 1508 2K

EDWARDS, M. D.
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

EDWARDS, P.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 1501 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

EDWARDS, R. E.
The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 1505 2L

EDWARDS, R. V.
A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

EDWARDS, R. W.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

EDWARDS, S. J.
Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 1503 2H

EDZWALD, J. K.
Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 1505 5F

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

EFIMOV, A. S.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

EGANHOUSE, R. P.
Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 1511 5B

EGELAND, D. R.
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 1503 5D

EGESTAD, B.
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 1512 5A

EGGELESTON, G.
Problems and Processes in Water Quality Management,
W82-06147 1512 5G

EGGERT, K. G.
A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 1510 5B

EGOZY, Y.
Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 1512 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 1512 5A

EHEART, J. W.
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

EICHELBERGER, J. L.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 1503 5D

EICKMEIER, W. G.
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 1502 2I

EID, B.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

EIFERT, W. H.
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

EIGEL, J. D.
Infiltration into Two-Layered Soil Profiles,
W82-04536 1510 2G

EIGENHEER, L. P.
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

EIKENBERRY, S. E.
Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

EILERS, H. P.
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

EIMHJELLEN, K.
Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 1501 5D

EISEL, L. M.
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 1510 6C

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

EISENACHER, K.
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 1510 5D

EISENHAUER, D. E.
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

EISENHAUER, R. J.
Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

EISENMANN, J. L.
Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 1506 5D

EISENREICH, J. J.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

EISENREICH, S. J.
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

EISLER, L. A.
Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 1511 8D

EKAMA, G. A.
The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 1507 5D

EKERN, P. C.
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

EL-GAMAL, I.
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

EL-KOBBIA, T.
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

EL-NASHAR, ALI M.
Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 1512 5D

EL-NENNAH, M.
Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 1502 5E

Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

EL-RAYIS, O. A.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

EL-SABH, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

EL-SABH, M. I.
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

EL SABROUTI, M. A.
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

EL-SAYED, M. K.
Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 1511 5B

EL-SEBAE, A. H.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 1511 5B

EL-SHERBINI, A. A.
Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 1508 6F

EL-SHINAWY, R. M. K.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 1502 5B

ELAMAYEM, M. M. A.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 1511 5B

ELBERT, W. C.
Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 1506 5B

ELCHUK, S.
Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

ELDER, R. A.
Pump Sump Design Experience: Summary,
W82-06419 1512 8C

ELDER, V. A.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

ELEK, A.
Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 1505 5A

ELGERSHUIZEN, J. H. B. W.
Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 1505 6G

ELGMORK, K.
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

ELHADI, N. A.
Management of Ice-Covered Rivers: Problems and Perspectives,
W82-03807 1509 2C

ELKINS, J. W.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

ELLENDER, R. D.
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 1512 5D

ELLIOT, C.
An Investigation of Biologically Adjusted pH Changes in Domestic Sewage Effluent,
W82-03953 1509 5D

ELLIOT, G. E.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 1502 5A

ELLIOT, R. L.
Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 1512 3F

ELLIOT, W. M.
Energy Costs and Portland Water Supply System,
W82-02586 1505 5F

ELLIOTT, A. L.
Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

ELLIOTT, J. C.
A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

ELLIOTT, J. M.
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 1502 7B

ELLIOTT, L. P.
Enumerating Bacteria in River Water and Sewage Effluent,
W82-03446 1508 5A

ELLIOTT, R. A.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 1503 3C

ELLIS, B. G.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04656 1511 5B

ELLIS, B. K.
Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

ELLIS, D. D.
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

ELLIS, D. V.
Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 1505 5A

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

ELLIS, J.
Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 1512 5D

ELLIS, J. B.
Water Quality Indices: An Additional Management Tool,
W82-01994 1504 5G

ELLIS, K. V.
The Tertiary Treatment of Sewages. Conclusion,
W82-03228 1507 5D

ELLIS, M. J.
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 1511 7C

ELLIS, R. A.
Project Outcomes Correlate with Public Participation Variables,
W82-02663 1506 6B

ELLIS, R. M.
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

ELLIS, S. R.
Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

ELMAN, W.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

ELMORE, J. L.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

ELOFF, J. N.
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 1506 5C

ELORANTA, P.
Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 1502 5C

ELSAYED, E. F. M.
Thermocline Drawdown Above Cooling Water Intakes,
W82-05560 1511 8C

ELWOOD, J. W.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

ELZEFTAWY, A.
Modeling the Transport of Heat, Water, and Solute in Unsaturated Soil and Earth Materials,
W82-03958 1509 5B

ELZERMAN, A. W.
Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 1511 5A

EMANUEL, R. P.
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

EMBREY, S. S.
Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

EMERSON, D. G.
Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

EMMERMANN, D. K.
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 1512 3A

VTE/VC for Sea Water,
W82-04909 1511 3A

EMMERSON, W. D.
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 1510 5B

EMMETT, R. C.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 1504 5D

EMMETT, R. L.
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

EMMETT, W. W.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

EMRICH, G. H.
Ground Water,
W82-06807 1512 9B

PVC Cover Causes Leachate Retreat,
W82-02321 1505 5E

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 1503 5G

ENCK, E. D.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

ENFIELD, C. G.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 1505 5B

ENGBERG, R. A
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

ENGEL, P.
Bed Load Discharge Coefficient,
W82-0[illegible]36 1506 2J

Discussion of 'Visualization of Separation over Sand Waves',
W82-03783 1509 8B

ENGEL, S.
Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 1512 4A

ENGELBERT, E. A.
Incentives and Institutions for Water Conservation,
W82-05922 1512 3D

ENGELBRECHT, R. S.
Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 1503 5D

ENGELKE, M. J. JR.
Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

ENGELMANN, H. M.
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 1507 4A

ENGELS, C.
Ozone and Activated Carbon,
W82-05370 1511 5F

ENGLAND, E. C.
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

ENGLANDE, A. J.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

ENGLEHART, P. J.
On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 1512 2B

ENGLESSON, G. A.
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 1511 2D

ENGLISH, B. C.
Projected Effects of Energy Policies on Agricultural Water Use and Irrigation,
W82-03915 1509 6C

ENGLISH, M. J.
Designing for Deficit Irrigation,
W82-06334 1512 3F

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 1502 3F

ENGLUND, J-O.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 1503 2F

ENGMAN, E. T.
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 1501 2A

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

ENK, M. D.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

ENO, J. M.
Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 1512 5E

ENSLER, E. F.
Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

ENTZ, R. C.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

EPIFANOV, A. P.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A

EPIKHOV, G. P.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

EPP, D. J.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 1502 5D

EPPINGER, K. H.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

EPPLER, B.
Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 1510 2E

ERASMUS, D. A.
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 1504 2B

ERBISTE, P. C.
Hydraulic Gates: The State-of-the-Art,
W82-00332 1501 8C

EREMENKO, E. V.
Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 1502 6A

ERICKSON, A. E.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

ERICKSON, E. A.
Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

ERICKSON, R. E.
A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 1512 5A

ERICKSON, R. J.
Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

ERICKSON, S. J.
Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 1501 5C

ERICSSON, B.
Salbukh Reverse Osmosis Plant on Stream,
W82-06127 1512 3A

ERIE, L. J.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

ERIKSSON, L.
Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 1507 5D

ERIKSSON, M. O. G.
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

ERKENBRECHER, C. W. JR.
Sediment Bacterial Indicators in an Urban Shellfishing Subestuary of the Lower Chesapeake Bay,
W82-01661 1503 5A

ERMAK, D.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

ERMAN, D. C.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 1503 5C

Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 1508 5A

ERSHOVA, E. P.
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Opresnenii Vody),
W82-03698 1508 3A

ERSKINE, W. D.
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

ESCALONA, R. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

ESCHNER, T. R.
Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

ESCOBAR, L. A.
The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 1512 2E

ESCOFFIER, F. F.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 1503 2L

ESFANDI, A.
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 1507 5D

ESMAEIL-BEIK, S.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 1511 2E

ESOGBUE, A. O.
A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

ESPANA, C.
Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 1503 8D

ESSINGTON, E. H.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

ESTEP, M. F.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 1504 6G

ETHRIDGE, F. G.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

ETZOLD, D. J.
Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 1505 6B

EUSTACHE, H.
Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 1512 5A

EVANS, D. D.
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

EVANS, D. W.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 1502 5B

EVANS, G. T.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 1504 2H

EVANS, J. C. W.
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 1503 5D

EVANS, J. E.
Contourites in Lake Superior,
W82-01935 1504 2H

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04330 1510 2J

EVANS, L. S.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 1510 5B

EVANS, M. P.
Dual Distribution Systems Analysis,
W82-04123 1509 5F

EVANS, M. S.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

EVANS, N. A.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

EVANS, R. G.
Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 1511 5G

Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 1508 6B

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

EVANS, R. H.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

EVANS, R. L.
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

EVANS, T. M.
Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 1501 5A

Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

EVDOKIMOV, P. D.
Calculation of Foundations and Earth Dams,
W82-02689 1506 8D

Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 1506 8D

EVENSON, W. E.
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

EVERDELL, R. A.
Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 1507 8A

EVEREST, F. H.
Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 1512 5C

A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 1512 8I

EVERITT, D. A.
An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 1511 2H

EVES, E. G.
Hogsmill Valley Works: Twenty Years On,
W82-03834 1509 5D

EWEL, K. C.
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

Metabolism of a Florida Lake Ecosystem,
W82-02268 1505 2H

Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 1508 5D

EWERT, D. L.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 1502 5A

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 1501 5A

EZZAT, A. A.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

FABIAN, R.
Eutrophication Measures for Small Lake Water Quality Management,
W82-04243 1509 2H

FABRIS, H.
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06038 1512 4B

FACI, J. M.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 1504 3F

FACY, G.
Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 1511 5F

FAGAN, D. A.
Landspreading of sludge in New York State,
W82-06557 1512 5E

FAGAN, G. L. JR.
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 1506 2A

FAHRENTHOLD, P. D.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 1504 5B

FAHSELT, D.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 1503 2H

FAIRWEATHER, V.
Barrier Islands: Should Engineers Interfere with Nature,
W82-03377 1507 6F

CZ '80: Coastal Quandaries Persist,
W82-03383 1507 6E

Engineering U.S. Water Policy,
W82-03294 1507 6E

FAISON, J. H.
A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

FAISST, J. A.
Innovative/Alternative Technology Program; Case Studies,
W82-03970 1509 5D

FALBESANER, E.
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

FALK, W. H.
Water Conservation at Wastewater Treatment Plants,
W82-06512 1512 3C

FALKE, W.
Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 1511 5A

FALKENMARK, M.
International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 1505 5C

FALKLER, W. A. JR.
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

FALKOWSKI, P. G.
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 1501 5C

Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 1503 5A

FAN, C-Y.
Recycling Urban Stormwater for Profit,
W82-00524 1502 3C

FANCEY, L. L.
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 1511 5C

FANNIN, K. F.
Anaerobic Processes,
W82-01245 1503 5D

Anaerobic Processes,
W82-06923 1512 5D

FANNIN, T. E.
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

FAPOHUNDA, H. O.
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 1503 3F

FARKAS, E. J.
Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 1507 5E

FARKAS, P. A.
The Use of Respirography in Biological Treatment Plant Control,
W82-04011 1509 5D

FARLEY, D.
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 1502 5C

FARMER, D. M.
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 1510 2H

FARMER, J. G.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

FARNUM, P.
Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 1502 2I

FAROOQ, S.
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 1511 5A

FAROOQUI, R.
Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 1511 5C

FARQUHAR, G. J.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

Simulation Modeling of Primary Clarifiers,
W82-01027 1502 6A

FARR, J. L.
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

FARRAGUT, P. A.
Construction of Containment Facility for Dredged Materials Begins,
W82-03839 1509 5G

FARRAH, S. R.
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 1505 5A

FARRAR, C. D.
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

FARRELL, M. P.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 1502 5C

FARRELL, T. P.
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

FARRINGTON, P.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 1511 4B

FASEHUN, F. E.
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

FASOL, K. H.
Simulating and Improving Hydro Plant Control,
W82-06202 1512 8C

FASS, R.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 1501 5F

FATTARUSSO, L. R.
An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 6B

FAUP, G.
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

FAURE, H.
Will the Sahelian Drought End in 1985,
W82-03167 1507 2B

FAUSEY, N. R.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

Water Management Model Evaluation for North Central Ohio,
W82-01536 1503 4A

FAUST, C. R.
Computer Modeling and Ground-Water Protection,
W82-01336 1503 2F

Ground-Water Modeling: Recent Developments,
W82-00281 1501 2F

FAUST, W.
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

FAWUSI, M. O. A.
Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 1503 2I

FBERLE, S.
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

FEDER, G. L.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

FEDERER, C. A.
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

FEDERLE, T. W.
Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 1501 2H

FEDORAK, P. M.
A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

FEDORS, J. C.
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

FEDOSEEV, E. A.
Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

FEDULOV, A. K.
Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 1506 8A

FEE, E. J.
Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

FEELY, R. A.
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

FEIGENBAUM, S.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 1503 3C

FEIGIN, A.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 1503 3C

FEIN, J. S.
Report on the Summer MONEX Field Phase,
W82-00265 1501 2B

FELDMAN, C. L.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

FELICIANO, D. V.
Sludge: Back into the Ocean,
W82-02577 1505 5E

FELLER, M. C.
Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 1507 5C

FELLOWS, C. R.
Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

FELSOT, A.
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 1502 5B

FENDER, V. F.
A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

FENG, Y. J.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

FENNER, L. B.
The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 1512 3E

FENTON, G. G.
Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121 1512 3A

FERENTCHAK, J. A.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

FERERES, E.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01964 1504 3F

FERGUSON, A. J. D.
Circulation Patterns; Their Investigation and Prediction,
W82-06477 1512 5F

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 1512 2H

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 1512 2H

FERGUSON, B. K.
Erosion and Sedimentation Control in Regional and Site Planning,
W82-01553 1503 4D

FERGUSON, D. L.
Access to Water-Related Data in Texas,
W82-04000 1509 10B

FERGUSON, J.
Composite Sampling of Highway Runoff,
W82-02230 1505 7B

FERGUSON, J. A.
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybeans,
W82-06172 1512 2G

FERGUSON, J. F.
Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 1511 5B

Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 1510 5D

FERNANDEZ, M. JR.
Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

FERRADOU, C.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

FERRANTE, J. C.
A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

FERRARA, A. P.
Controlling Bed Losses of Granular Activated Carbon Through Proper Filter Operation,
W82-04089 1509 5F

FERRARA, R. A.
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 1503 5D

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 1504 5D

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 1512 5D

FERRARI, P.
Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

FERRE, R.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

FERRI, D.
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 1506 5A

FERRIERIA, R. F.
Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 1510 5C

FERRIS, C. R.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

FERRO, V. A.
Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 1512 5B

FERRONSKII, V. I.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

FETTER, C. W. JR.
Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 1502 6E

FEUILLADE, J.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

FEUILLADE, M.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

FEURER, J.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

FFOLLIOTT, P. F.
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

FICK, G. W.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 1503 2B

FICQUETTE, B. N.
Color Removal from Groundwater by Ion Exchange and Sludge Recycle Techniques,
W82-03956 1509 5F

FIDDES, D.
Britain's Sewers - Researching for the Future,
W82-02871 1506 5D

Sewerage: Priorities for Action,
W82-06260 1512 8G

FIDDLER, W.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

FIELD, R.
An Overview of Porous Pavement Research,
W82-05744 1511 5D

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 1512 5G

Recycling Urban Stormwater for Profit,
W82-00524 1502 3C

Status of Porous Pavement Research,
W82-06665 1512 8G

Storm and Combined Sewers: Part of The Treatment Process,
W82-04195 1509 5B

Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

FIELD, T. K.
Coagulation: Experiences in Organics Removal,
W82-04424 1510 5F

FIELD, W. G.
Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 1511 4A

FIELDER, P. W.
The Energy Resources of Kenya,
W82-05978 1512 6D

FIERING, M. B.
Alternative Indices of Resilience,
W82-05045 1511 6A

Estimates of Resilience Indices by Simulation,
W82-05046 1511 6A

Estimating Resilience by Canonical Analysis,
W82-05047 1511 6A

A Screening Model to Quantify Resilience,
W82-05044 1511 6A

FIFIELD, J. S.
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 1503 5B

FIGURA, P.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 1503 5A

FIKSDAL, L.
Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 1512 5F

FILATOV, N. N.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

FILATOVA, T. N.
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 1512 2H

FILBERT, J. W.
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 1508 5D

FINANCE, C.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

FINDEIS, J. L.
Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

FINDLAY, D. M.
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 1503 5D

FINE, L. O.
Phosphate in Water: I. Reduction Using Northern Lignite Fly Ash,
W82-03882 1509 5F

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 1510 3F

FINK, L. K.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

FINK, R. P.
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 1501 5C

FINLAYSON, B. J.
Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01822 1504 5C

FINLAYSON, C. M.
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

FINLAYSON, D.
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

FINLEY, R. J.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

FINN, J. T.
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 1501 2L

Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1502 1A

FINN, R. K.
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 1511 5G

FINNELL, L. M.
Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

FINNEY, B. A.
Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

Random Differential Equations in Water Quality Modeling,
W82-01688 1503 6A

FINNEY, V. L.
Acid Pond Drainage,
W82-05199 1511 5G

FINSTEIN, M. S.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

FIRESTONE, H. M.
Statistical Cost Function for Water Mains,
W82-06252 1512 6C

FISCHER, B.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

FISCHER, R. A.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 1511 3F

FISCHER, W. K.
A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 1510 5B

FISCUS, E. L.
Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 1510 2I

FISH, E. B.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

FISH, R. E.
Report of the River Master of the Delaware River for the Period December 1, 1979 -- November 30, 1980,
W82-03989 1509 4A

FISH, R. H.
Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

FISHELSON, G.
Water Quality and the Demand for Recreation,
W82-01942 1504 6D

FISHER, A.
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 1502 5E

FISHER, D.
Acid Snow in the Canadian High Arctic,
W82-04542 1510 2C

FISHER, F. W.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

FISHER, J. B.
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

FISHER, J. W.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

FISHER, N. S.
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02372 1505 5C

FISHER, S. G.
Metabolism of a Desert Stream,
W82-02349 1505 1A

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

FISK, M. J.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

FITCH, B.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

FITCH, J. H. JR.
A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 1511 5B

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967
1506 5D

FITZGERALD, C. M.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703
1506 5D

FITZGERALD, K. K.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832
1511 7C

FITZGERALD, P. R.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018
1504 5B

FITZGERALD, R. A.
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236
1501 5A

FITZGERALD, S. D.
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558
1510 8A

FITZGERALD, W. F.
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040
1502 5B

FITZGIBBON, J. E.
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624
1506 2C

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571
1503 2C

FITZNER, R. E.
Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772
1509 2H

FITZPATRICK, L. C.
Trophic Structure and Energy Flow in a Texas Pond,
W82-02397
1505 2H

FIX, G. J.
Finite Element Approximations to Flow Problems,
W82-06730
1512 8B

FLAATE, K.
Cold Regions Engineering in Norway,
W82-06000
1512 8A

FLACK, J. E.
Achieving Urban Water Conservation,
W82-04227
1509 3D

FLACK, T. R.
Sugar Beet Production as Influenced by Water Stress,
W82-04086
1509 3F

FLAKE, R. H.
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188
1511 6A

FLANAGAN, E. P.
Effect of Water Treatment on Mutagenic Potential,
W82-03776
1509 5A

FLANAGAN, M. J.
An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314
1512 5A

FLANIGAN, G. A.
An Analysis of Selected Classes of Organic Constituents in the Thames River Estuary,
W82-03819
1509 2L

FLAVIN, R. J.
Experiences with Borehole Recharge in The Lee Valley,
W82-03894
1509 4B

FLECKSEDER, H.
Multi-Objective Decision Making in Water Management,
W82-04010
1509 6A

Water Quality Management of Lake Neusiedler, Austria,
W82-02090
1504 5C

FLEIGE, H.
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410
1508 2I

FLEISSNER, J. T.
Indicator Bacteria Survival under Laboratory Conditions,
W82-05853
1511 5A

FLEMER, D. A.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118
1505 5B

FLEMING, G. H.
Water Quality Management in River Basins: US National Experience,
W82-00800
1502 6E

FLEROV, B. A.
The Use of Leeches to Identify Pesticides in Water,
W82-02075
1504 5A

FLETCHER, K.S. III.
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083
1502 5A

FLETCHER, R. A.
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196
1501 2D

FLETT, R. J.
Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474
1501 2H

FLIERMANS, C. B.
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356
1505 5C

Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06760
1512 5F

FLINT, E. A.
Limnology of Lake Rerewhakaaitu,
W82-01705
1503 2H

FLINT, R. W.
Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378
1511 5C

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135
1503 2L

FLOOD, C. A. JR.
Water Movement for Water Quality in Catfish Production,
W82-00866
1502 5G

FLOOD, R. D.
Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720
1503 2L

FLORA, C. J.
Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100
1502 5A

FLORA, M. D.
The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464
1511 5A

FLORESTANO, P. S.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642
1503 6B

FLORET, C.
Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876
1511 2D

FLOTRE, D. M.
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479
1508 2I

FLUEGGE, R. A.
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005
1507 5D

FLUG, M.
Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886
1511 3C

FLYNN, C. R.
How Much Water Supply Capacity Is Enough,
W82-04103
1509 6D

FLYNN, M. S.
Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006
1502 2B

FODA, M.
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955
1504 1B

FODOR-CSANYI, P.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886
1504 2G

FOERST, D. L.
Trace Analyses for Wastewaters,
W82-03639
1508 5A

FOERSTEL, H.
The Mackenzie River Basin Study,
W82-05778
1511 4A

FOERSTER, R. E.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461
1512 5D

FOGARASI, S.
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578
1512 2C

FOGELMAN, R. P.
Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502
1510 7C

FOGG, G. E.
Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202
1511 5B

FOGG, T. R.
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

FOGHT, J. M.
A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

FOK, Y. S.
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 1507 3B

FOLAND, D. L.
Ground-Level Versus Elevated Storage,
W82-03863 1509 5F

FOLEY, P. D.
Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant,
W82-04116 1509 5F

FOMCHENKOV, A. K.
Space-Time Variability of the Runoff of European Rivers,
W82-02848 1506 2E

FONG, M.
Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 1501 5D

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

FONTAINE, T. D. III
Metabolism of a Florida Lake Ecosystem,
W82-02268 1505 2H

FONTANE, D. G.
Optimal Control of Reservoir Discharge Quality Through Selective Withdrawal,
W82-04204 1509 5G

FONTVIEILLE, D.
A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 1512 5C

FOOSE, D. W.
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

FORBES, A. M.
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 1506 5C

FORBES, R. E.
Upgrading Water Treatment Plants: An Alternative to New Construction,
W82-04098 1509 5F

FORCELLA, L. S.
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 1510 2K

FORD, D.
Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 1511 4A

FORD, D. B.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

FORD, D. C.
Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 1501 2K

FORD, D. L.
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 1507 5D

FORD, D. T.
Interactive Nonstructural Flood-Control Planning,
W82-02320 1505 6F

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 1505 6A

Reservoir Systems Optimization,
W82-06433 1512 4A

FORDHAM, J. W.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 1512 3D

FORE, C. S.
Radioactive Wastes,
W82-01268 1503 5D

FORGE, P.
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 1503 2H

FORGIONE, R.
Nitrogen Removal in a Subsurface Disposal System,
W82-04001 1509 5D

FORIS, W. J.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

FORLIN, L.
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

FOROUD, N.
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 1508 2A

FORSBERG, C.
Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 1511 5D

FORSTER, R.
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 1503 5A

FORSYTH, D. J.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

Zooplankton of Lake Taupo,
W82-02888 1506 2H

FORSYTHE, P.
Engineering in Catfish Production,
W82-04367 1510 8I

FORTES, M.
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 1502 2F

FOSBERG, T. M.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

FOSCOLO, P. U.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

FOSTER, D. A.
Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 1505 5B

FOSTER, G. R.
Concentrated Flow Relationships,
W82-01409 1503 2J

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 1505 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 1503 2J

Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

FOSTER, H. S. JR.
Can Prices Tame the Inflationary Tiger,
W82-04142 1509 6D

FOSTER, I. D. L.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 1503 7A

FOSTER, K. E.
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

FOSTER, R. B.
Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 1512 5A

FOSTER, S. S. D.
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

FOURNIER, R. B.
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

FOURNIER, R. O.
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1510 1A

FOWLER, E. B.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172
1503 5B

FOWLER, L. C.
Urban Creekside Design Features Parallel Streets,
W82-06184
1512 4C

FOWLER, W. B.
A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435
1510 7B

FOX, G. T. J.
Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094
1509 5F

FOX, I. K.
Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-03564
1511 6A

FOX, J. C.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018
1504 5B

FOX, J. P.
Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445
1501 5D

FOX, K.
Getting Your Money's Worth from Filtration,
W82-06412
1512 5F

FOX, M. E.
Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) 1. Pathway of the Direct Photolysis in Solution,
W82-04032
1509 5B

A Review of Benzothiazoles in the Aquatic Environment,
W82-06571
1512 5C

FOY, R. H.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017
1511 5B

FRADKIN, L. J.
Identification of the Wairakei Geothermal System,
W82-01312
1503 2F

On Identification and Validation of Some Geothermal Models,
W82-01467
1503 6A

FRALISH, M. C.
Shock Load of Chromium (VI),
W82-05353
1511 5D

FRANCE, P. W.
Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645
1510 8B

An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05379
1511 8B

FRANCESCONI, K. A.
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-00183
1507 5B

FRANCIS, A. J.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302
1510 5B

Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261
1507 5B

FRANCKO, D. A.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833
1504 5F

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930
1512 5C

FRANCO, R. J.
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317
1510 3C

FRANK, A. B.
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793
1512 2I

FRANK, H. D.
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023
1512 5A

FRANK, N. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078
1504 2H

FRANK, R.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190
1503 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635
1511 5B

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155
1503 5B

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641
1511 5B

FRANK, U.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431
1503 5A

FRANKEL, R. J.
Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869
1511 5F

FRANKLIN, A. G.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953
1504 8D

FRANKLIN, C.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02953
1506 5D

FRANKLIN, J.
Making Your Way Through Murky Waters-A Manual for Public Participation Coordinators in Natural Resources Planning,
W82-04083
1509 6A

FRANKLIN, M.
Bacteria Under the Ice,
W82-06561
1512 5A

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544
1512 5B

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563
1512 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560
1512 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564
1512 5A

FRANKLIN, T.
Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350
1507 8G

FRANKLIN, W. T.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455
1505 6A

FRANKOS, N. H.
Trenching of Digested Sludge,
W82-00974
1502 5E

FRANKS, B. J.
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010
1501 5F

FRANZ, D. D.
Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986
1506 7B

FRANZIN, W. G.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016
1504 5A

FRAPE, S. K.
The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990
1512 2F

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304
1505 2A

FRASER, A. S.
Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126
1503 2H

Loading Estimates to Lake Erie, 1967-1976,
W82-01852
1504 5A

FRASER, D. J.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124
1503 5A

FRASER, JAMES H.
Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125
1512 3A

FRASER, W. B.
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210
1501 7B

FRAZAR, J. H.
Development of Oil-In-Water Monitor, Phase II,
W82-00300 1501 5A

FRAZIER, B. E.
Aerial Photography to Detect Rill Erosion,
W82-02232 1505 7B

FREA, J. I.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

FRECKLETON, J. R.
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

FREDERICK, V. R.
Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 1511 5C

FREDLUND, D. G.
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 1502 2G

FREEDMAN, S. D.
Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

FREELAND, H. J.
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

FREEMAN, D. H.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 1504 5A

FREEMAN, L.
The Day That the Rain Came Down,
W82-02064 1504 2E

FREESTONE, F. J.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 1503 5D

FREIBERG, G. R.
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 1510 5D

FREIBERG, J. E.
Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 1502 2K

Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 1503 2K

FREILING, K.
The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 1511 5D

FREMPONG, E.
Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04296 1510 5C

FRENCH, C. O.
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 1504 6B

FRENCH, J. A.
Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 1512 5E

FRENCH, O. F.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

Subsurface Trickle Irrigation Maagement with Multiple Cropping,
W82-04356 1510 3F

FRENCH, R. H.
Effectiveness of River Models,
W82-00961 1502 6A

Secchi Disc Relationships,
W82-06627 1512 2H

State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 1511 2H

FRENET, M.
The Distribution of Mercury, Cadmium and Lead Between Water and Suspended Matter in the Loire Estuary as a Function of the Hydrological Regime,
W82-03757 1509 2L

FRENKEL, H.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 1503 2G

Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

FRENKEL, R. E.
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

FRENZ, C. M.
Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 1508 5D

FRERE, M. H.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

FRESENIUS, W.
Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 1510 5F

FRETWELL, J. D.
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

FREUDBERG, S.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

FREUDENBURG, W. R.
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 1511 5B

FREVERT, T.
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 1504 2H

FREY, J. C.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

FREYTAG, J.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

FRIANT, S. L.
The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

FRICKE, A. H.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

FRIEDMAN, M.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

FRIEDMAN, M. M.
Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 1507 5D

FRIELING, J. L.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

FRIESEN, B. F.
Northwestern Ontario River Dimensions,
W82-05742 1511 6G

FRIH, A.
Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 1508 6C

FRILIGOS, M.
Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 1512 5B

FRIMPTER, M. H.
Probable High Ground-Water Levels in Massachusetts,
W82-02829 1506 2F

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 1510 7C

FRIND, E. O.
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 1503 2F

FRINK, C. R.
PCBs in the Housatonic River: Determination and Distribution,
W82-02255 1505 5A

FRISCH, J.
Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

FRISCHE, R.
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 1512 5B

FRISK, T.
Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

FRITTON, D. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5F

FRITZ, E. S.
Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 1503 8I

FRITZ, J. S.
Cation Chromatography With a Conductivity Detector,
W82-00582 1502 5A

FRITZ, P.
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 1512 2F

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 1511 2K

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

FRITZLER, E. A.
A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

FROBEL, R. K.
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 1506 8G

FROEHLICH, D. C.
Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

FROLOV, A. V.
Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 1508 2H

FROLOV, N. M.
Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 1512 7C

FRONCZAK, R.
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

FRONZA, G.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

FROOMER, N. L.
The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 1511 2J

FROST, F.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

FROST, R. C.
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

FRUGE, D. W.
Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

FRUH, E. G.
Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 1511 2H

FRY, D. L.
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 1503 2H

FRY, G. G.
SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 1508 6E

FRY, W. E.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 1503 2B

FRYE, P.
A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 1510 6D

FU, A. Y.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

FU-SHENG, W.
Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 1511 5A

FUCHS, D.
Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 1512 5E

FUGGLE, R. W.
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 1503 5D

FUHRIMAN, D. K.
Refinement of Lake Evaporation Measurements, Using an Ion-Balance Technique,
W82-03808 1509 2D

FUHRMANN, H.
Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Loesmittel in Luft und Wasser),
W82-04579 1510 5A

FUJIE, K.
Automatic Monitoring of Exhaust Gas Analysis in Activated Sludge Wastewater Treatment Process,
W82-04014 1509 5D

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 1511 5D

FUJIMOTO, E.
Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

Evaluation of the Resident Mass of Sludge in Final Sedimentation Tanks for Waste Sludge Control,
W82-04015 1509 5D

Preliminary Studies on Control Parameters and Biological Community for the Activated Sludge Process,
W82-04008 1509 5D

Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

FUJIMOTO, M.
Studies on Syntheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 1512 3A

FUJIMOTO, Y.
Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

FUJIOKA, R. S.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 1502 5C

FUJITA, T.
Underwater Aerator,
W82-00065 1501 5D

FUKSMAN, Y. L.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

FUKSMAN, YA. L.
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 1502 5B

FUKUI, Y.
Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Kokko Mountains, (In Japanese),
W82-04177 1509 2K

FUKUNAGA, M.
Problems and Solutions on Sludge Level Measurement,
W82-04055 1509 5D

FUKUO, Y.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

FULLER, R. H.
Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

FULLER, R. M.
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

FULLER, W. H.
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5E

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 1507 5G

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 1503 5B

Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 1512 5B

FULOP, A.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

FULTON, G. P.
Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 1512 5G

FULTON, J. L.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

FULTON, J. M.
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 1501 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 1503 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

FUNAZO, K.
Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

FUNDERBURG, S. W.
Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

FUNG, C.
The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 1512 2B

FUNGLADDA, N.
The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

FUNK, R. J.
Deep Well Injection of Industrial Wastes,
W82-00475 1501 5E

FUNKE, B. R.
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 1512 5D

FUNKE, J. W.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

FURLEY, R. J.
Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04991 1510 2L

FURNESS, C. D.
How Equitable Are Effluent Charges,
W82-06074 1512 6C

FURSE, M. T.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 1501 7B

FURTADO, J. I.
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 1503 2H

FURUSE, K.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1506 5A

FURUTANI, A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Mercury Methylation by Fish Intestinal Contents,
W82-01820 1504 5C

FUSCO, R. A.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

FUSILLO, T. V.
Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 1510 7C

FUSSELL, J.
Who Owns Nebraska's Ground Water,
W82-06819 1512 6E

FUSTE, L. A.
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

FYFE, W. S.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

FYNSK, A. W.
Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 1512 5F

GABEL, B.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

GABER, M. S.
Methane in Water Wells,
W82-05262 1511 5F

GABLE, R. C.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

GABRYSCH, R. K.
Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 1505 2F

GABUNIYA, L. S.
Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 1506 8A

GAC, J-Y.
Will the Sahelian Drought End in 1985,
W82-03167 1507 2B

GAGE, J.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 1504 6D

GAILLARD, J. M.
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 1512 4A

GAITHER, R. E.
Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 1511 2J

GAL'PERIN, L. R.
Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 1505 8A

GALAGAN, N. P.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

GALAT, D. L.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

GALE, W. F.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

GALITSYN, M. S.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

GALLAGHER, D.
Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 1511 6C

GALLICO, A.
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

GALLOWAY, A. K.
Water Quality and the EEC,
W82-03472 1508 6B

GALLOWAY, J. N.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 1502 2K

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

Effects of Acid Precipitation,
W82-05140 1511 5C

GALLUCCI, K. K.
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 1505 5A

GAMBHIR, S. P.
Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

GAMBRELL, R. P.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267
1505 5B

GAMES, L. M.
Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638
1508 5B

GAN, H. B.
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-06392
1510 5D

GANDER, G. A.
Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874
1512 4A

GANDZYUK, S. S.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585
1511 8H

GANGAWARE, T. R.
Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101
1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102
1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103
1505 10C

GANGNON, M.
Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306
1505 2L

GANNETT, M. W.
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06930
1512 7A

GANZEL, L. A.
Electroplating Wastes: History and Current Status,
W82-03588
1508 5D

GARBADE, J. M.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729
1502 7C

GARBER, W. F.
Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609
1510 5D

Sludge Disposal to Sea: North American Viewpoint,
W82-06598
1512 5E

GARBRECHT, M.
Corrosion Roundtable--Opportunities/Pitfalls for New Materials,
W82-03373
1507 8G

Rapid Sewer Analysis Saves Tourist Season,
W82-03494
1508 5G

GARCIA-BENGOCHEA, J. I.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442
1510 5E

GARCIA, O.
A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533
1508 7B

GARCIN, J. F.
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766
1511 5F

GARDNER, A. M.
Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832
1511 5D

GARDNER, L. R.
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175
1501 5B

Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150
1501 2L

Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716
1510 2L

GARDNER, R. H.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991
1502 7A

GARDNER, R. L.
Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898
1506 5B

GARDNER, W.
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104
1501 7B

GARDNER, W. D.
Field Assessment of Sediment Traps,
W82-00105
1501 7B

GARDNER, W. S.
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545
1512 5A

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882
1511 5A

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502
1503 2H

GARELICK, H.
Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712
1506 5A

GAREN, D. C.
Approximate Error Bounds for Simulated Hydrographs,
W82-02678
1506 2A

GARG, S. K.
Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732
1510 6A

GARIBALDI, J. A.
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156
1501 5E

GARKUN, L. M.
Concrete of the Dam of the Kiroveke Reservoir,
W82-03159
1507 8F

GARLAND, R.
Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02580
1505 6A

GARLAND, T. R.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481
1501 5B

GARLOCK, C.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434
1512 5B

GARNETT, P. H.
Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384
1503 6E

GAROFALO, F.
Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325
1511 4A

GAROFANO, J. S.
Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003
1512 5C

GARRETT, J. T. JR.
Evaluating a Plant's Potential for Upgrading,
W82-02895
1506 5F

GARRETT, M. R.
Water Management in the Metropolitan Toronto Region,
W82-05775
1511 6B

GARRISON, W. E.
Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347
1512 5D

Start-Up Problems of Sludge Dewatering Facility,
W82-05444
1511 5D

GARRITY, G. M.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891
1512 5B

GARRY, J. A.
Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833
1509 5A

GARSIDE, C.
Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286
1505 5C

GARTEN, C. T. JR.
Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323
1505 5B

GARTON, J. E.
Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526
1505 2H

Upflow Water Filtration Unit, Test Results,
W82-00407
1501 5F

GARTSIDE, P. S.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203
1511 5B

GARVER, J. L.
Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233
1507 5C

GARVEY, E. T.
Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

GARVINE, R. W.
Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 1502 8B

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 1512 2L

GARWOOD, P. E.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

GARY, G. W.
Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

GASCHO, G. J.
Water Requirement for Sugarcane Production,
W82-00899 1502 3F

GASET, A.
Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 1511 5D

GASS, T.
Applications of Aerial Photography,
W82-01988 1504 7B

Ground Water Monitoring: Part II,
W82-03484 1508 8A

Injection, Recharge and Return Wells,
W82-02920 1506 4B

Sampling and Analyzing Water,
W82-05263 1511 5A

GASS, T. E.
Ground Water Monitoring: Part II,
W82-03380 1507 5B

GASSEND, R.
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 1507 5B

GAT, J.
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 1508 2F

GATES, J. S.
Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

GATES, W. H.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

GATZ, D. F.
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 1502 2B

GAUDET, J. J.
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 1505 2K

Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

GAUDY, A. F. JR.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

GAUDY, E. T.
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

GAUNTLETT, R.
Biological Denitrification for Potable Water Treatment,
W82-05247 1511 5F

GAUTHIER, M. J.
Sludge Disposal to Sea in France,
W82-06593 1512 5E

GAVIN, J.
Summer Ice and Carbon Dioxide,
W82-01843 1504 2C

GAVRILOVA, V. A.
An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

GAVRISHOVA, N. A.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 1504 2H

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 1511 5A

GAY, F.
Water System Efficiencies,
W82-05281 1511 8C

GAY, F. G.
Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 1511 7C

GAYLE, G. A.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

GAYLORD, J. L.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

GEAR, D.
Can Hard-Rock Wells Solve Africa's Irrigation Problem,
W82-05503 1511 3B

GEARING, J. N.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

GEARING, P. J.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

GEATING, J.
Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

GEBHART, B.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1502 1A

Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

GEDDES, M. C.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

GEE, J. R.
Prediction of Leachate Accumulation in Sanitary Landfills,
W82-03934 1509 5B

GEEN, G. H.
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 1501 5C

GEESEY, G. G.
Marine and Estuarine Pollution,
W82-01274 1503 5C

Marine and Estuarine Pollution,
W82-06808 1512 5C

GEIGER, G.
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 1512 5D

GEINOPOLOS, A.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

GEIST, R. D.
Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

GELDREICH, E. E.
Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

Microbiology of Water,
W82-01284 1503 5B

Microbiology: Water,
W82-06924 1512 5B

Removing Trihalomethanes from Drinking Water,
W82-00953 1502 5F

GELLER, G. N.
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 1502 2D

GELMAN, S. R.
Treating Phenol Resin Plant Wastes,
W82-05128 1511 5D

GEMMELL, R. S.
Water Quality Evaluation of Regional Wastewater Management,
W82-00977 1502 5D

GENETELLI, E. J.
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 1512 5D

GENUNG, R. K.
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

GEORGAKAKOS, K. P.
Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855
1512 4A

GEORGE, A. B.
Devon Floods and the Waterways of Bridges,
W82-05948
1512 8A

GEORGE, D. B.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735
1512 5A

Lagoons and Oxidation Ponds,
W82-01244
1503 5D

GEORGE, D. G.
A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105
1511 7B

GEORGIANNA, T. D.
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805
1511 6D

GEORGIEV, A. A.
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028
1511 7B

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982
1512 5C

GERAGHTY, J. J.
Evaluation of Hydrogeologic Conditions,
W82-01420
1503 5G

GERARDI, M. B.
What Caused the Bad Odor in the Drinking Water,
W82-00527
1502 5F

GERARDI, M. H.
Colloidal Organics,
W82-04689
1510 5F

Components for a Treatment Plant Safety Program,
W82-06992
1512 5G

Sludge Settling Hampered by Industrial Discharge,
W82-00290
1501 5D

Water Conservation at Wastewater Treatment Plants,
W82-06512
1512 3C

Waterborne Giardiasis--An Overview,
W82-04186
1509 5C

What Caused the Bad Odor in the Drinking Water,
W82-00527
1502 5F

GERBA, C. P.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247
1501 5A

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885
1512 5A

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572
1502 5A

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199
1501 5A

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485
1511 5C

Movement of Endotoxin Through Soil Columns,
W82-00586
1502 5B

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810
1511 5B

Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757
1512 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574
1502 5A

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-[illegible]
1501 5D

Thermo[illegible] of Enteroviruses by Estuarine Se[illegible],
W82-0[illegible]3
1501 2L

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348
1512 5C

GERHART, J. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-0[illegible]780
1503 6A

GERHOLD, R.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928
1504 5B

GERIKE, P.
A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534
1510 5B

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477
1510 5D

GERLEK, S.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738
1511 6D

GERMAINE, J. E.
Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Gilbert/Commonwealth, Reading, PA,
W82-03475
1508 6A

GERMANA', A.
Analysis of Large Desalination Plants,
W82-06122
1512 3A

GERNERT, J. L.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535
1502 2H

GERODETTI, M.
Model Studies of an Overtopped Rockfill Dam,
W82-03694
1508 8E

GEROFI, J. P.
Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121
1512 3A

GERRARD, E. D.
Bioassays - Procedures and Results,
W82-01277
1503 5A

GERSHON, M.
Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062
1512 6A

GERTLER, A. W.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525
1503 7B

GERVIN, J. C.
Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440
1510 2H

GESSER, H. D.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516
1502 5A

GETCHES, D. H.
Water Rights on Indian Allotments,
W82-02363
1505 5E

GEVIRTS, G. A.
Problems of Lightening Underground Structures and Methods of Constructing Them Under Permafrost Conditions,
W82-03918
1509 8A

GEYH, M. A.
Methane in Groundwater and Its Effect on 14 C Groundwater Dating,
W82-03801
1509 7B

GHABOUSSI, J.
Liquefaction Analysis for Multidirectional Shaking,
W82-01169
1503 8D

GHASSEMI, M.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430
1503 5D

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068
1511 5G

GHERING, G. E.
A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233
1511 5B

GHERINI, S. A.
Acid Rain Model: Hydrologic Module,
W82-06360
1512 5B

Management Options for Ground Water in Urbanizing Areas,
W82-03961
1509 4B

GHILDYAL, B. P.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846
1504 2I

GHIRIN, A.
Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222
1509 6D

GHORBANZADEH, A.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024
1502 5B

GHOSH, M. M.
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932
1512 5F

Removal of Organics by Reactivated Carbon,
W32-04159
1509 5F

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976
1502 5D

GHOSH, R. K.
Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 1502 2G

GIABBAI, M.
Organics,
W82-01239 1503 5A

GIAM, C. S.
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

GIANELLI, W. R.
Coast on Uncle Sam Less,
W82-05998 1512 6C

Future Directions in Federal Water Resources,
W82-04196 1509 6D

GIANESSI, L. P.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 1503 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 1503 6A

The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 1502 6B

GIANQUINTA, A. R.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

GIAQUINTA, A. R.
Cooling Potential of Missouri River in Missouri,
W82-01654 1503 5B

Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 1512 5G

GIBB, J. P.
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

GIBBS, K. E.
The Aquatic Insects of The Narraguagus River, Hancock and Washington Counties, Maine,
W82-04167 1509 2E

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

GIBBS, P. J.
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

GIBBS, R. J.
Sites of River-Derived Sedimentation in the Ocean,
W82-01332 1503 7B

GIBS, J.
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 1512 5B

GIBSON, B. W.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

GIBSON, C. E.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

GIBSON, J.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

GIBSON, N. A.
A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 1502 5A

A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 1507 5A

GICHURU, M.
Effects of Water Quality on Forage Production,
W82-01002 1502 3C

GIESY, J. P.
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H

GIFFORD, G. F.
Influence of Vegetation, Rock Cover, and Trampling on Filtration Rates and Sediment Production,
W82-04153 1509 2G

GIGER, W.
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1506 1B

GIJBELS, R.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

GILBERT, B. K.
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

GILBERT, E.
Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 1510 5F

GILBERT, K. C.
TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 1512 4A

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 1512 4A

GILBERT, R.
Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario,
W82-04031 1509 2K

GILBERT, R. G.
Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 1501 5D

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

GILBERT, T. L.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 1505 2A

GILBERTSON, C. B.
Controlling Runoff for Livestock Feedlots: A State of the Art,
W82-01769 1503 5G

GILES, A. H.
Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 1502 4B

GILES, J. E.
Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 1505 6A

GILES, M.
Chemical Treatment Solves Tannery Waste Problems,
W82-00638 1502 5D

GILKESON, R. H.
Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

GILL, K. S.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03263 1507 2I

GILL, M. A.
Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 1507 4A

Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 1505 2F

GILLAM, A. H.
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 1507 2H

GILLEAN, J. I.
A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

GILLESPIE, R. G.
Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

GILLETTE, R. W.
Small and Low-Head Hydro in the USA,
W82-04176 1509 8A

GILLEY, J. R.
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

GILLIAM, J. W.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 1505 5B

GILLIES, D. C.
Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

GILLIGAN, D. S.
Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287
1501 5E

GILLILAND, E. J.
Crisis: Financing Water and Wastewater,
W82-06641
1512 6C

GILLILAND, M. W.
The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517
1512 3E

The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807
1504 6A

Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806
1511 6D

GILLOOLY, J. F.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901
1512 2B

Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900
1511 2B

GILMOUR, C. M.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001
1502 5E

GILMOUR, J. T.
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172
1512 2G

A Simulation Model for Sludge Decomposition in Soil,
W82-01001
1502 5E

GILPIN, R. R.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128
1503 2C

GINAVEN, M. E.
High Capacity Waste Water Treatment System,
W82-00066
1501 5D

GINGOLD, P. R.
The Optimum Size of Small Run-Of-River Plants,
W82-04175
1509 8A

GINNOCCHIO, J. C.
Metal Removal 'A La Carte',
W82-06606
1512 5F

GIORGETTI, M. F.
The Use of a Perforated Baffle at the Inlet of Rectangular Settling Basins,
W82-04124
1509 8B

GIRARDOT, P-L.
French Experience in Water Pollution Control,
W82-02765
1506 5G

GITLIN, H. M.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860
1504 3F

GIVENS, W. D.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320
1510 5D

GIVLER, C.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001
1511 5G

GJERDE, D. T.
Cation Chromatography With a Conductivity Detector,
W82-00582
1502 5A

GJESSING, E. T.
The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353
1505 9C

GLACCUM, R. A.
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422
1503 5G

GLADILIN, A. M.
Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692
1506 8D

GLADKOV, E. G.
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106
1511 2E

GLADYSHEV, M. T.
Numerical Modeling of Unsteady Flows in Open Channels,
W82-06784
1512 7C

GLANTZ, M. H.
Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082
1511 2E

GLASER, J. A.
Trace Analyses for Wastewaters,
W82-03639
1508 5A

GLASER, P. H.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300
1505 2H

GLASGOW, D.
Pressure Sewer Systems,
W82-00528
1502 5D

GLASS, C. E.
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436
1510 7D

GLASS, J. S.
Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887
1509 5F

Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096
1509 5A

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency,
W82-04095
1509 5A

GLASS, N. R.
Effects of Acid Precipitation,
W82-05149
1511 5C

GLASSMAN, D. L.
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814
1506 5B

GLATER, J.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188
1505 5D

GLAVISH, L. I.
Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987
1512 5C

GLAZE, W. H.
GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016
1511 5A

GLEDHILL, W. E.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615
1502 5A

GLEED, J.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892
1511 5A

GLIWICZ, Z. M.
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103
1511 2H

GLOOR, R.
Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940
1506 5F

GLOOSCHENKO, W. A.
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148
1501 2L

GLOVER, E. W. JR.
Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636
1503 5E

GLOVER, T. F.
Energy Siting in Utah: A Programming Model,
W82-05297
1511 6B

Floodplain Management Needs Peculiar to Arid Climates,
W82-03908
1509 2E

GLOWA, W.
PCBs in the Housatonic River: Determination and Distribution,
W82-02255
1505 5A

GLOYNA, E. F.
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675
1506 5D

GLYNN, J. E.
A Mechanism for the formation of Large Icebergs,
W82-04798
1511 2C

GOCKE, K.
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359
1507 2L

GODA, T.
Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760
1509 5D

GODDARD, M. R.
Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121
1507 5D

GODDEN, G. F.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685
1502 6D

GODDRICK, G. N.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682
1508 7B

GODFREY, K. A. JR.
Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453
1508 5D

GODFREY, P. J.
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Inhibiting the Green River, Massachusetts,
W83-04947 1511 5C

GODIN, G.
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

GODSY, E. M.
Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 1501 5A

GOEL, A. C.
Effect of Field Levelling Quality on Irrigation Efficiency and Crop Yield,
W82-03789 1509 3F

GOEL, P. K.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

GOETZ, C. L.
Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

GOFMAN, E.
Loop Equations with Unknown Pipe Characteristics,
W82-02258 1505 3F

GOGEL, T.
Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 1510 7C

GOGGINS, C.
Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 1503 6D

GOGISH, L. V.
Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 1512 8B

GOGUS, M.
Flow Characteristics Below Floating Covers with Application to Ice Jams,
W82-03011 1507 2C

Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 1505 2C

GOHIL, B. S.
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

GOICHON, J.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 1511 5F

GOLABI, K.
Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 1503 4B

GOLD, R. L.
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

GOLDBACH, J. C.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

GOLDBERG, D. E.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

GOLDEN, H. G.
Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

GOLDFARB, W.
Three Important Court Decisions,
W82-04349 1510 6E

What Is a Point Source,
W82-04158 1509 6E

GOLDING, B. L.
Flood Routing Program,
W82-03286 1507 4A

GOLDMAN, C. R.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 1501 2H

GOLDMAN, J.
Oxygenation of the Avon River,
W82-05730 1511 5G

GOLDROSEN, J. J.
Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

GOLDSCHMIDT, E. E.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

GOLDSCHMIDT, Y.
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 1511 6B

GOLDSMITH, F. B.
Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 1511 2H

GOLDSTEIN, F. J.
Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5D

GOLDSTEIN, N.
Current Policies on Land Application,
W82-02629 1506 5E

Ocean Dumping Battle Marches On,
W82-06490 1512 5E

GOLDSTEIN, R. A.
Acid Rain Model: Hydrologic Module,
W82-06360 1512 5D

GOLDSTEIN, R. M.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 1501 5C

GOLIBER, P.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

GOLOMBICK, T.
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 1510 5C

GOLTERMAN, H. L.
Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 1505 5A

Phosphate Models, a Gap to Bridge,
W82-00929 1502 2H

GOLUBEV, N. K.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A

GOMOLKO, L. N.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

Concrete for Surfaces of High-Head Spillways,
W82-05110 1511 8F

GONCHAROVA, J. S.
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

GONENG, E.
Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 1511 5E

GONG, B.
Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 1505 5F

GONSOULIN, F.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

GONZALES-VILLARREAL, F. J.
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 1503 6A

GONZALEZ, V. J. B.
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 1503 5G

GOODCHILD, M. F.
Topologic Model for Drainage Networks with Lakes,
W82-05905 1512 2A

GOODE, S. R.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01646 1503 5A

GOODIN, J. R.
Effects of Water Quality on Forage Production,
W82-01002 1502 3C

GOODISON, B. E.
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 1503 2C

GOODMAN, P.
A Successful Transfer,
W82-00309 1501 4A

GOODYEAR, C. P.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

GOPAL, B.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

GOPHEN, M.
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 1511 2H

GOPPERS, V. M.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

GORDON, D. M.
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

GORDON, J. A.
LARM Two-Dimensional Model: An Evaluation,
W82-02597 1505 4A

GORDON, J. D.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

GORDON, J. L.
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 1511 8A

The Expansion of Two Bolivian Plants,
W82-05598 1511 8A

GORDON, M.
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 1511 5A

GORDON, M. S.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

GORDON, W.
Pump Installations for reverse Osmosis Systems,
W82-05882 1511 8C

GORE, J. A.
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

GORELICK, S. M.
Numerical Management Models of Groundwater Pollution,
W82-04211 1509 5B

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 1511 5G

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 1511 5G

GORETTI, G.
Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

GORGENS, A. H. M.
An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 1511 2A

Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 1510 2A

Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 1512 4A

GORHAM, E.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

GORITSKII, A. B.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 1507 5G

GORMAN, M. E.
Effectiveness of Dupont Typar Sheeting in Controlling Macrophyte Regrowth After Overwinter Drawdown,
W82-04246 1509 5G

GORMAN, W. A.
A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

GORNSHTEIN, M. YU.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

GOROBETS, L. V.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 1504 2H

GORONSKY, M. C.
Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 1507 5D

GORONSZY, M. C.
Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 1512 5D

GOSH, S.
Anaerobic Processes,
W82-01245 1503 5D

GOSINK, J. P.
Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

GOSLING, L. M.
Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

GOSS, D. W.
Management of Recharge Basins on the Southern High Plains,
W82-00938 1502 4B

GOSS, J.
Low Turbidity Water from Fast Processes,
W82-00946 1502 5F

GOSSETT, J. M.
Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 1512 5D

GOSSOM, W. J.
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 1511 5D

GOSTIN, V. A.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 1501 2L

GOSZ, J. R.
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 1502 2K

GOTHAM, I. J.
The Effect of Environmental Factors on Phytoplankton Growth: Light and the Intersctions of Light with Nitrate Limitation,
W82-02331 1505 2H

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

GOTO, E.
Evaluation of the Resident Mass of Sludge in Final Sedimentation Tanks for Waste Sludge Control,
W82-04015 1509 5D

GOTO, S.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 1503 3A

GOTTLIEB, L.
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 1504 2C

GOTTSCHING, L.
New Developments in Papermaking in Western Europe,
W82-02947 1506 5D

GOULD, J. P.
Disinfection,
W82-01250 1503 5D

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 1512 5D

GOULD, M. S.
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 1512 5D

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 1503 6G

GOULDER, R.
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 1508 7B

GOVE, G. W.
Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 1511 5D

Pulp and Paper Industry Effluent Management,
W82-01260 1503 5D

GOWDA, N. M. MADE
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

GOYAL, S. K.
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 1506 2F

GOYAL, S. M.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 1501 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 1502 5B

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 1511 5B

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

GOZLAN, G.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 1502 2I

GRABOW, N. A.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

GRABOW, W. O. K.
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

GRACE, M. G.
United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 1512 6E

GRACZYK, D.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

GRADY JR, C. P. L.
Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 1507 5D

GRAESER, H. J.
Conservation Ethics for the 1980's,
W82-05009 1511 3D

GRAETZ, D. A.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

GRAF, D. L.
Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

GRAF, W. H.
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1506 1B

GRAF, W. L.
Channel Instability in a Braided, Sand Bed River,
W82-01316 1503 2J

GRAHAM, B. W.
Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

GRAHAM, D. S.
Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 1508 6E

GRAHAM, M. J.
Detroit-Style CSO Studies,
W82-06247 1512 5G

GRAHAM, M. S.
Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 1506 5C

GRAMANN, J. H.
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 1511 6D

GRANAT, M. A.
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 1501 2L

GRANDELL, J.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 1502 2B

GRANDT, A. F.
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 1501 5D

GRANGE, G. H.
Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

GRANGER, H. C.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

GRANLUND, C. P.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 1512 5A

GRANLUND, J. G.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 1512 5A

GRANT, D. L.
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 1505 6E

GRANT, D. M.
Right Place, Time and Technique: Right Sample,
W82-06642 1512 5A

GRANT, I. J.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

GRANT, M. A.
Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 1505 2F

A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

GRANTHAM, D.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

GRANTZ, A.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

GRASTY, R. L.
Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 1511 2C

GRATZ, J.
Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

GRAU, P.
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

GRAUPMANN, R. W.
Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

GRAVELAND, A.
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

GRAVELAND, I. A.
Water Softening by Crystallization,
W82-03750 1508 5F

GRAVES, J. B.
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 1505 5B

GRAVES, W. C.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

GRAY, A. V.
Phosphorus Reduction Studies,
W82-03426 1508 5D

Phosphorus Reduction Studies,
W82-05408 1511 5D

GRAY, D. D.
Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

GRAY, M. J.
Manganese Dioxide as an Adsorbent for Heavy Metals,
W82-00775 1502 5F

GRAY, N. F.
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 1504 5D

GREBENEVICH, E. V.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

GREBENNIKOV, V. T.
Methods of Restoring the Delivery of Drainage Wells,
W82-02385 1505 4A

GREELEY, D. S.
Leak Location Enters Computer Age,
W82-06018 1512 7A

GREEMAN, T. K.
Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 1512 2F

GREEN, A.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

GREEN, D. D.
Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 1512 6C

GREEN, G.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

GREEN, G. C.
Field Test of an Irrigation Scheduling Computer Model,
W82-00184 1501 3F

GREEN, J. C.
A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 1503 6E

GREEN, M.
Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 1511 5D

Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 1503 5D

GREEN, R. E.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 1503 2G

GREEN, S. L.
Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 1501 7C

GREEN, T.
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03593 1508 5B

GREENBERG, H. B.
Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

GREENBERG, M.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

GREENBERG, M. R.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01605 1503 5A

GREENE, D. J.
An Alternative Wastewater Disinfectant,
W82-00950 1502 5D

GREENE, G. M.
Simulation of Ice-Cover Growth and Thermal Decay on the Upper St. Lawrence River.
W82-03822 1509 2C

GREENE, L. A.
The Impact of Eutrophication on Water Treatment and Supplies in the Anglian Water Authority,
W82-03866 1509 5C

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 1502 5F

GREENE, M. C.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

GREENE, S.
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

GREENFIELD, J. H.
Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 1507 5D

GREENHALGH, R.
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 1501 5B

GREENLEE, J. K.
Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 1507 5C

GREENWOOD, E. A. N.
Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

GREENWOOD, P. J.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

GREER, J. D.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 1502 2J

Recording Raingage Modifications,
W82-05665 1511 7B

GREER, W. P.
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 1503 5D

Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 1512 5E

GREESON, P. E.
An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 1510 5C

Infectious Waterborne Diseases,
W82-01784 1503 5A

GREEY, G. W.
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 1506 [illegible]

GREGERSEN, H. M.
Economic Evaluation of Watershed Projects-An Overview Methodology and Application,
W82-05735 1511 6E

GREGORY, J. M.
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 1505 2I

GREGORY, R. W.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

GREIF, R.
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 1512 3A

Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 1512 3A

GREIS, N. P.
Regional Flood Frequency Estimation and Network Design,
W82-01294 1503 2E

GREMINGER, D. C.
Solvent Extraction of Phenols,
W82-00438 1501 5D

GRENNEY, W. J.
Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

GRESHAM, C. A.
Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 1512 6B

GREVE, P. A.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

GRIEVE, I. C.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 1503 7A

GRIFFIN, A. H.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 1503 6B

The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6B

GRIFFIN, J. S.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

GRIFFIN, R. A.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

Adsorption of PCBs by Cellulose Fiber Filter-aids and Carbonaceous Adsorbents Used for Water Treatment,
W82-03937 1509 5F

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

GRIFFIN, R. C.
Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 1508 5G

GRIFFINI, O.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

GRIFFITH, C.
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 1501 7C

GRIFFITH, C. G.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 1502 2B

GRIFFITH, F. P. JR.
Policing Demand Through Pricing,
W82-06352 1512 6D

GRIFFITH, M. J.
Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 1512 5D

GRIFFITHS, D. J.
Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

GRIFFITHS, G. A.
Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 1508 2J

Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 1511 2E

GRIFFITHS, I. W.
Sulphide Control in Rising Mains,
W82-05465 1511 5D

GRIFFITHS, J. F.
Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 1502 2B

GRIGG, N. S.
Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 1510 6A

Urgent Problems in the Transfer of Water Resources Knowledge,
W82-03802 1509 7C

Water Quality Management in River Basins: US National Experience,
W82-00800 1502 6B

GRIGOR'EV, V. M.
Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 1511 8C

GRIGORASH, V. A.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

GRIMES, D. J.
Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 1512 5B

GRIMESTAD, G.
Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 1508 2F

GRIMM, N. G.
Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

GRIMME, H.
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

GRINGARTEN, A. C.
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

GRISAK, G. E.
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 1503 2F

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 1504 2F

GRISSINGER, E. H.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 1501 2J

Gully Erosion,
W82-01407 1503 2J

GRITSCHKE, M.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

GRIZZARD, T.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 1503 2G

GRIZZARD, T. J.
Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

GRIZZLE, J. M.
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 1502 5C

GROBLER, D.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

GROBLER, D. C.
An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 1508 7B

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 1502 2H

GRODY, N. C.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

GRODZINSKA, K.
Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 1511 5B

GROENEWEG, J.
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 1507 5D

Mass Production of Freshwater Rotifers on Liquid Wastes II. Mass Production of Brachionus Rubens Ehrenberg 1838 in the Effluent of High-Rate Algal Ponds Used for the Treatment of Piggery Waste,
W82-03884 1509 3C

GROENEWOLD, G. H.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

GROENEWOLD, J. C.
Comparison of BOD Relationships for Typical Edible and Petroleum Oils,
W82-06458 1512 5D

Dairy Wastes,
W82-01258 1503 5D

Dairy Wastes,
W82-06921 1512 5D

GROHMANN, A.
Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 1510 5F

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

GROLIER, M. J.
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

GROSCH, C. E.
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 1511 2L

GROSCHEN, G. E.
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

GROSS, D. L.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

GROSSE, R. N.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

GROTERUD, O.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 1504 7B

GROVER, B.
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

GROVER, K.
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 1502 5A

GROVER, R.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 1503 4A

GRUBER, A.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

GRUBER, D.
Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 1510 5B

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 1511 5A

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00330 1502 5A

GRUBER, H.
Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 1508 6G

GRUBER, P.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

GRUDININ, M. P.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 1506 5C

GRUENFELD, M.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

GRUNDLER, H. C.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

GRUNINGER, R. M.
Chemical Coagulation of Surface Water,
W82-02623 1506 5F

GRUNWALD, G. K.
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

GRUSHKO, YA. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 1504 5C

GRUTSCH, J. F.
The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 1501 5D

Maximizing Effluent Quality from a Municipal Activated Sludge Plant Concurrent with a Major Reduction in Process Energy Requirements,
W82-03874 1509 5D

GSCHWEND, P. M.
Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 1511 5B

GUARD, H. E.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

GUARINO, C. F.
Ocean Disposal Legislation in the United States,
W82-06597 1512 5E

Treatment Plant Features Ultraviolet Disinfection,
W82-02644 1506 5D

GUARISO, G.
Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

GUDE, H.
Occurrence of Cytophages in Sewage Plants,
W82-00682 1502 5A

GUEDES, Q. M.
Relaxation in Concrete,
W82-05511 1511 8F

GUENTZEL, M. N.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

GUERRERA, A. A.
Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 1512 5F

GUERRERO-RUIZ, A.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

GUEVREMONT, R.
Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 1502 5A

GUILBAULT, G. G.
Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 1503 5A

GUITAR, J.
Effects of Decreased Watering on Crop Yields,
W82-04411 1510 2I

GUITRON, A.
Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 1503 6A

GUJER, W.
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1506 1B

GULARTE, R. C.
Erosion Resistance of Cohesive Soils,
W82-02676 1506 2J

GULLIVER, J.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

GULLIVER, J. S.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 1503 2J

GULVAS, J. A.
Power Plant Water Intake Assessment,
W82-00216 1501 6G

GUMBS, F.
Agriculture in the Wider Caribbean,
W82-03778 1509 6D

GUMMER, J. H.
Turbines for Itaipu,
W82-04955 1511 8C

GUMMER, W. D.
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

GUNN, M. J.
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

GUNNEBERG, F.
Automatic Collection and Transmission of Data for the Federal Waterway Authority.
W82-04596 1510 7A

GUNNER, H. B.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 1503 4A

GUNTHNER, W.
The BASF Toximeter - A Helpful Instrument to Control and Monitor Biological Waste Water Treatment Plants,
W82-04050 1509 5A

GUO, C-Y.
Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

GUPTA, A. D.
Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 1512 2F

GUPTA, A. K.
Bioassay Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

GUPTA, A. S.
M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 1512 5F

GUPTA, G. C.
Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 1501 2K

Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 1501 5B

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W82-02442 1505 5C

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

GUPTA, R. K.
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 1511 2I

GUPTA, R. P.
Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 1511 7C

GUPTA, S.
Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 1501 5F

GUPTA, S. C.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

GUPTA, S. K.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 1503 2F

GUPTA, V. K.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 1507 5A

A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 1502 2A

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 1507 2F

GUREGHIAN, A. B.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 1505 2F

GURNHAM, C. F.
Electroplating Wastes: History and Current Status,
W82-03588 1508 5D

GURTOVNIK, F. I.
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 1506 8A

GURTZ, M. E.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

GUSEVA, E. V.
An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 1512 4B

GUSWA, J. H.
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

GUSYNSKAYA, S. L.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

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Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

GUTER, K. J.
Ferric Chloride Takes Over,
W82-00954 1502 5F

GUTH, E.
Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

GUTHRIE, D. L.
NPDES Compliance Flow Measurement Manual,
W82-03965 1509 5D

GUTHRIE, R. K.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 1511 5A

Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 1510 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 1510 5C

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 1510 5C

GUTIERREZ, M.
Portable Water Elevation Measuring Gage,
W82-06396 1512 7B

GUTTMAN, J.
Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 1511 2F

GUYMON, G. L.
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 1507 6A

Subdomain Integration Model of Ground-Water Flow,
W82-02530 1505 2F

GVAZAVA, G. N.
Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06632 1512 8B

GWINN, W. R.
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 1501 8A

Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 1512 8B

GYSI, M.
The Cost of Peak Capacity Water,
W82-04065 1509 6B

Energy, Environmental, and Economic Implications of Some Recent Alberta Water Resources Projects,
W82-04226 1509 6B

A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 1511 6B

GYUNTER, L. I.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

HAACK, B. N.
A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 1505 2A

HAACK, T. K.
Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 1512 2E

HAAG, W. R.
The Chemistry of Saline Water Chlorination,
W82-04729 1510 3C

HAAN, C. T.
Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 1502 5G

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 1503 2J

HAAS, C. N.
Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 1512 5F

Disinfection,
W82-01250 1503 5D

HAAS, L. W.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

HABICHT, M. H.
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

HACKBARTH, D. A.
Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-05611
1508 2K

Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780
1511 4B

HADALA, P. F.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953
1504 8D

HADAS, A.
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327
1501 2A

HADLEY, R. F.
Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946
1512 2E

HADLEY, T. L.
Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851
1511 7C

HAFEZ, H.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290
1510 5B

HAFFIELD, N. D.
Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133
1512 7C

HAFFNER, G. D.
Physical Process and Eutrophication,
W82-06875
1512 5C

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336
1507 5C

HAGAN, R. E.
Sizing Rice Irrigation Canals,
W82-00895
1502 3F

HAGAN, R. M.
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251
1510 3F

Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360
1510 3F

HAGERHALL, B.
International Cooperation to Protect the Baltic,
W82-02087
1504 6E

HAGERTY, D.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066
1511 5E

HAGERTY, D. J.
Bank Failure and Erosion on the Ohio River,
W82-02343
1505 2J

Bank Failure and Erosion on the Ohio River,
W82-04473
1510 2J

HAGGAR, R. J.
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654
1502 2I

HAGLUND, F.
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006
1504 5D

HAGURA, L. M.
Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738
1510 6F

HAHL, D. C.
Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998
1509 2L

HAHN, H. H.
Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663
1510 2E

HAHN, M. G.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-02025
1507 1A

HAILS, J. R.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314
1501 2L

HAIMES, A. S.
Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144
1507 5D

HAIN, K. E.
Sewage Sludge Pathogen Transport Model Project,
W82-04403
1510 5A

HAINES, T. A.
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818
1504 5C

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459
1503 5B

HAIRSTON, J. E.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01590
1503 5B

HAITH, D. A.
Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504
1505 5B

HAITJEMA, H. M.
Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078
1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084
1507 2F

HAKANSON, L.
Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586
1510 2H

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-02837
1502 2H

A Review on Sediment Traps in Aquatic Environments,
W82-01020
1502 7B

HAKE, K. A.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739
1502 6D

HAKONSON, T. E.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109
1503 5B

HAKTANIR, T.
Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523
1508 6A

HAKULINEN, R.
Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226
1512 5D

HALE, D. R.
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483
1501 5A

HALE, E. J.
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159
1501 5B

HALE, J. M.
A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248
1511 7B

HALE, O. M.
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161
1501 5D

HALE, T. W.
Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979
1511 2E

HALL, B. J.
Chemical Flux in an Acid-Stressed Stream,
W82-03338
1507 5C

HALL, A. J.
The Mixing Layer of Loch Ness,
W82-02421
1505 2H

HALL, B. B.
Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323
1510 5D

Waste Treatment System Retrofitted Within Deadline,
W82-05947
1512 5D

HALL, C.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume I - Environment, Health and Socio-economics,
W82-05214
1511 6G

HALL, D. K.
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690
1503 2C

HALL, F. J.
Wastewater Technologies in South Africa: Research and Application,
W82-05350
1511 5D

HALL, G. H.
Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 1512 5C

HALL, J. D.
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 1501 5C

HALL, J. F.
Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 1511 8D

HALL, J. K.
Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 1512 2A

HALL, L. W. JR.
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

HALL, M. J.
A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 1510 2A

HALL, R. H.
Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 1502 5A

HALL, R. W.
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

HALL, W. A.
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

HALLERMEIER, R. J.
Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 1511 2J

HALLET, B.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

HALLETT, I. C.
Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 1505 2H

HALLEY, M. A.
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

HALMO, G.
Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 1501 5D

HALSE, S. A.
Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 1508 2H

HALVORSON, A. D.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

HAMA, T.
Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 1506 5A

HAMAKER, P.
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

HAMALA, J. A.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 1502 7B

HAMANN, C. L.
Reliability and Redundancy: Dual Protection for Water Treatment Plants,
W82-04148 1509 5F

HAMBLIN, A. P.
The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

HAMBRICK, G. A. III
Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

HAMDY, Y. S.
Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 1512 5C

HAMEED, H. A.
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 1512 5C

Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 1506 5C

HAMILTON, A. D.
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 1506 2L

HAMILTON, C. L.
Operating Collection Systems Under Fiscal Stress,
W82-06340 1512 5D

HAMILTON, E. I.
Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 1507 5A

HAMILTON, G. D.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

HAMILTON, J. R.
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 1512 3F

HAMILTON, R. N.
Variable Frequency Drives - Some Application Principles,
W82-06345 1512 8C

HAMMAD, Z. H.
Microbiological Examination of Sebeel Water,
W82-06882 1512 5C

HAMMAN, H.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

HAMMEL, H. T.
Superseparation: Soret Effect Reversed,
W82-00791 1502 3A

HAMMER, M. J.
An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 1505 6F

HAMMER, U. T.
Primary Production in Saline Lakes,
W82-04926 1511 2H

HAMMERTON, D.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 1502 6E

Determination of Marine Consent Conditions,
W82-00323 1501 5G

HAMMETT, K. M.
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

HAMMITT, F. G.
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

HAMMITT, W. E.
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 1503 6A

HAMMOND, D. E.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

HAMMOND, R. E.
Water Regulation in an Inflationary Environment,
W82-02701 1506 5F

HAMMONDS, A. F.
Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

HAMPSON, P. S.
Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 1511 7C

HAMPTON, N. F.
Water Constraints on Emerging Energy Production,
W82-04151 1509 6D

HAMRUD, M.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 1502 2B

HANAMI, L.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 1510 5A

HAND, J. M.
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

HANDA, B. K.
An Integrated Water-Quality Index for Irrigation Use,
W82-04723 1510 5C

HANDA, N.
Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 1506 5A

HANDLEY, L. L.
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

HANDMER, J. W.
Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 1511 7C

HANDY, M. F.
Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

HANEL, K.
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

HANG, Y. D.
Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 1501 5D

HANISAK, M. D.
Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 1506 5D

HANKE, S. H.
Crisis: Financing Water and Wastewater,
W82-06641 1512 6C

Crisis-Ridden Water Systems Should Go Private,
W82-05436 1511 6C

On the Marginal Cost of Wastewater Services,
W82-04376 1510 6C

On Water Tariff Equalization Policies,
W82-01175 1503 6C

Projective Evaluation During Inflation, Revisited: A Solution to Turvey's Relative Price Change Problem,
W82-04202 1509 6B

Water Metering and Conservation,
W82-03562 1508 3D

HANKS, R. J.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 1504 3F

HANLON JR, E. A.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

HANLON, R. D. G.
Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 1506 2H

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 1512 5C

HANNAY, F.
Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

HANNUKSELA, J. S.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

HANOUNE, N.
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 1501 5A

HANSEN, B. E.
Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

HANSEN, B. P.
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 1501 2F

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 1501 5C

HANSEN, E. C.
Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

HANSEN, E. M.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

HANSEN, L. D.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

HANSEN, P.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

HANSEN, P. D.
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 1502 5C

HANSEN, R. D.
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 1505 6D

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 1510 3D

HANSEN, S.
Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

HANSHAW, B. B.
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

HANSON, B. C.
Procedure for Evaluating the Geologic Integrity of Existing Hazardous Waste Sites in Louisiana: Case Histories,
W82-03932 1509 5A

HANSON, C. A.
Data Acquisition for River Management,
W82-04601 1510 7A

HANSON, C. L.
Automatic Class-A Pan-Filling System,
W82-01326 1503 7B

Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 1505 2A

HANSON, D. N.
Solvent Extraction of Phenols,
W82-00438 1501 5D

HANSON, D. W.
The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

HANSON, M. J.
Phosphorus Recycling in Five Shallow Lakes,
W82-04040 1509 2H

HANSON, R.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

HANSON, R. B.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

HANSON, R. J.
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 1507 6B

HANSSON, T.
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

HANUSOVA, J.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

HANYA, T.
Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 1501 5B

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 1502 2H

HAPPEY-WOOD, C. M.
Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 1511 2H

HAQUE, M. I.
Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

HARADA, H.
Combined Effects of Biological Solids Retention Time and Temperature on the Growth Parameters of Activated Sludge,
W82-04021 1509 5D

HARADA, K.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

HARAGUCHI, H.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

HARBISON, P.
The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 1508 5B

HARBOE, R.
Applications of Simulation to Specific Water Projects,
W82-05522 1511 6A

HARDIN, C.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 1512 3F

HARDING, J. P. C.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

HARDY, G. M.
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 1503 5A

HARDY, J. W.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 1503 6G

HARGETT, C. W. JR.
Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

HARGIS, D. R.
Hydrology and Mining in the Tucson Areas,
W82-03697 1508 2F

Results of Acidizing Water Wells in Arizona,
W82-01199 1503 4B

HARGITAI, E.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

HARGREAVES, G. H.
Simplified Method for Rainfall Intensities,
W82-01978 1504 2B

Water Requirements and Man-Induced Climate Change,
W82-01633 1503 2D

HARING, J. A.
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

HARKER, D.
Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 1507 2F

HARKER, D. B.
Projected Tile Effluent Effects on the Oldman River,
W82-00333 1501 5C

HARKER, R. J.
Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 1511 5B

HARKINS, J. R.
Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 1511 2E

HARKNESS, N.
Chemistry of Septicity,
W82-00325 1501 5D

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 1511 5C

HARLEMAN, D. R. F.
Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 1503 5D

Efficient Cooling Ponds: Design,
W82-03672 1508 8A

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 1504 5D

Hydrothermal Analysis of Lakes and Reservoirs,
W82-06425 1512 2H

HARLESS, R. L.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 1511 5A

HARLO, E. H.
Large Rubble-Mound Breakwater Failures,
W82-00862 1502 8D

HARLOW, B. D.
Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 1510 5D

HARMON, B.
Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 1511 8G

HARMON, W. C.
Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

HARMS, L. L.
The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

HARMS, W. R.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 1510 4C

HARNED, D. A.
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 1507 7B

HAROLDSEN, R. O.
Micro Hydropower in the USA,
W82-04316 1510 8A

HARP, J. F.
Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

HARPER, D. M.
Introduction - Rutland Water 1970-1981,
W82-06482 1512 6B

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 1512 2H

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 1512 2H

HARR, R. D.
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

HARREL, R. C.
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 1502 5C

Water Quality of a Southeast Texas Stream,
W82-02570 1505 2K

HARRELSON, M. E.
Use of Microscreens to Polish Lagoon Effluents,
W82-04709 1510 5D

HARREMOES, P.
Criteria for Nitrification in Fixed Film Reactors,
W82-05352 1511 5D

Immediate and Delayed Oxygen Depletion in Rivers,
W82-06269 1512 5G

HARRIMAN, R.
Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 1512 5C

HARRINGTON, D. W.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

HARRINGTON, W.
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 1504 6E

HARRIOTT, P.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

HARRIS, D. L.
Tides and Tidal Datums in the United States,
W82-02982 1506 2A

HARRIS, E. R.
Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 1512 6G

HARRIS, G. F.
Development of a Rural Water District,
W82-00288 1501 6A

HARRIS, G. P.
Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 1512 5C

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 1507 5C

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 1502 5G

HARRIS, G. R.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

HARRIS, H. C.
Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 1501 2I

HARRIS, H. J. JR.
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

HARRIS, J. C.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 1501 5A

HARRIS, K.
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

HARRIS, S. A.
Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 1505 2C

HARRIS, W. B.
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

HARRISON, A. D.
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

HARRISON, B.
Filter Criteria for Sub-Surface Drainage,
W82-03660 1508 8G

HARRISON, D.
Group Treatment Evaluation for Metal Finishers,
W82-02995 1506 5D

HARRISON, D. C.
Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 1507 6F

HARRISON, F. L.
Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 1501 2K

Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 1501 5B

HARRISON, H.
An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 1506 2K

HARRISON, P.
Wanted: Water for Development,
W82-02088 1504 6D

HARRISON, R. M.
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 1503 5B

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 1507 5F

HARRISON, W. D.
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 1510 7B

HARRISS, R. C.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 1511 2K

Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 1503 5B

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 1511 2L

HARSH, J. F.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

HARSHBARGER, J. W.
Hydrology and Mining in the Tucson Areas,
W82-03697 1508 2F

HARSHBARGER, T. J.
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

HART, B. T.
Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

HART, G. E.
Erosion from Mountain Snowpack Melt,
W82-05664 1511 2J

Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

HARTENSTEIN, R.
Potential Use of Earthworms as a Solution to Sludge Management,
W82-05478 1511 5E

HARTIG, J. H.
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

HARTIGAN, J. P.
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

HARTLEY, D. R.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

HARTLEY, E.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

HARTLEY, P. E.
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 1503 2B

HARTMAN, R.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

HARTMANN, L.
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

HARTMETZ, G.
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

HARVEY, A.
Promising Steps Toward a New Ottawa River Regulation,
W82-05394 1511 6B

HARVEY, B. L.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 1503 2I

HARVEY, R. W.
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 1501 2L

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 1512 5A

HARVEY, R. W. S.
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 1508 5C

HARVEY, W. T.
Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

HARWOOD, J. M.
Sludge Tankering Economics - A Fresh Approach,
W82-06076 1512 5E

HASAN, S. E.
Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 1512 6A

HASHIMOTO, T.
Cost Allocation in Water Resources Development,
W82-06854 1512 6C

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Robustness of Water Resources Systems,
W82-05077 1511 6A

Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 1506 6A

HASHIZUME, T.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 1508 5C

HASS, J. R.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

HASSAN, A. A.
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 1503 3A

HASSAN, F. A.
Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 1501 2E

HASSETT, A.
The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

HASSETT, J. M.
Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 1501 5A

HASSETT, J. P.
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 1512 5B

HASSINGER, J.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

HASTINGS, D.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

HATCHER, M. L.
Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 1511 5E

HATCHER, P. G.
Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

HATFIELD, D. L.
A Treatment System for an Organic Chemicals Plant,
W82-04353 1510 5D

HATHAWAY, R. M.
Water Use in Ohio, 1975,
W82-05226 1511 6D

HATLEN, J. B.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

HATLEN, M. B.
Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

HATTORI, A.
Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

HAUG, R. T.
Composting Results in Los Angeles,
W82-03400 1507 5E

HAUGAN, B.-E.
Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

HAUGH, R. S.
Reliability and Stability of Trickling Filter Processes,
W82-04784 1511 5D

HAUTH, L. D.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

HAVE, M. R.
Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

HAVERKAMP, R.
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 1501 2G

HAVLIK, B.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

HAWERMAN, B.
Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 1511 5D

HAWKES, D. L.
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 1501 5D

HAWKES, H. A.
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 1511 5D

HAWKINS, B. E.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

HAWKINS, C. E.
Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 1501 5C

HAWKINS, J. E.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

HAWLEY, M. E.
Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 1510 2A

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

Water Yield Estimation in Western United States,
W82-05689 1511 4D

HAWLEY, R. P.
Energy Costs and Portland Water Supply System,
W82-02586 1505 5F

HAWNT, R. J. E.
Experience with Borehole Recharge in The Lee Valley,
W82-03894 1509 4B

HAY, D.
Pump Sump Design Experience: Summary,
W82-06419 1512 8C

HAYASHIDA, S.
An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

HAYDEN, C. M.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

HAYDEN, T.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

HAYDOCK, I.
Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

HAYDU, K. J.
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 1511 2B

HAYES, C. R.
The Impact of Eutrophication on Water Treatment and Supplies in the Anglian Water Authority,
W82-03866 1509 5C

The use of Activated Carbon in Water Treatment,
W82-05182 1511 5F

HAYES, E. C.
Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05879 1511 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

HAYES, J. T.
A Parametric Crop Water Use Model,
W82-01310 1503 2I

HAYES, M. O.
General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 1502 2L

HAYNES, D. L.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 1511 5B

HAYNES, K. E.
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 1511 6D

HAYS, A. J. JR.
A Consistent Methodology for Wasteload Allocations,
W82-05702 1511 5G

HAYTON, R. D.
The Ground Water Legal Regime as Instrument of Policy Objectives and Management Requirements,
W82-05938 1512 6E

The Law of International Aquifers,
W82-05940 1512 6E

HAYWARD, D.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

HAZEN, R. E.
Cadmium in an Aquatic Ecosystem,
W82-03724 1508 5A

HEADWORTH, H. G.
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

HEADY, E. O.
Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows,
W82-03914 1509 3F

HEADY, E. O.
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

Projected Effects of Energy Policies on Agricultural Water Use and Irrigation,
W82-03915 1509 6C

HEANEY, J. P.
Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 1512 6C

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 1504 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 1504 2A

Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

HEANEY, S. I.
Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 1506 2K

HEARNE, G. A.
Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 1505 2F

HEATH, M.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 1504 5B

HEATH, M. S.
Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

HEATH, M. S. JR.
Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

HEATH, R. C.
Efficient Groundwater Utilization,
W82-02520 1505 6D

Hydrologic Almanac of Florida,
W82-03974 1509 7C

HEATH, R. T.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 1504 5F

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

HEATHCOTE, I. W.
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 1505 2H

HEATON, T. H. E.
Excess Air in Groundwater,
W82-02099 1504 2F

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

HEATWOLE, C. G.
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 1506 4B

HEBBERT, R. H. B.
A Comparison of Rainfall-Runoff Models,
W82-00911 1502 2A

HECKER, G. E.
Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

Model-Prototype Comparison of Free Surface Vortices,
W82-03667 1508 8B

HECKER, G. M.
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 1503 2L

HECKMAN, C. W.
Pesticide Effects on Aquatic Habitats,
W82-05146 1511 5C

HECKMANN, R. A.
Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 1503 5C

HECKY, P. E.
The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

HEDDEN, K. F.
Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 1501 5F

HEDGEPETH, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

HEDGES, J. E.
Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

HEDGES, J. I.
Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 1501 5B

HEEG, J.
The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 1502 6G

HEEKMANN, W.
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

HEERTJES, P. M.
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 1511 5D

HEESE, H. DE V.
An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

HEGARTY, T. W.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

HEGEMANN, W.
Investigation on Constant F/M Ratio by Adaption of Aeration Tank Volume,
W82-03860 1509 5D

HEGGEN, R. J.
Relative Runoff by Curve Number Nomograph,
W82-04307 1510 2A

Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 1510 5C

HEIDARI, M.
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 1505 5E

HEIDELL, P. A.
Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 1512 6E

HEIDINGER, R. C.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

HEIDMAN, J. A.
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

HEIDTKE, T. M.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-02143 1503 5G

HEIKAL, M. M.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 1505 3F

HEILMAN, J. L.
Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 1512 7B

HEIM, N. E.
Innovative/Alternative Technology Program: Case Studies,
W82-03970 1509 5D

HEIMLICH, R.
Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

HEINEMANN, H. G.
A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 1507 8A

A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 1503 2J

HEINEMANN, W. H.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 1511 8A

HEINKE, G. W.
Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

HEINRICH, D.
The Continuous Oxygen Uptake Rate Measurement and Its Applicability as an Activated Sludge Control Parameter,
W82-04020 1509 5D

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 1510 5D

HEISINGER, J. F.
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 1512 5C

HEIST, J. A.
Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 1507 5D

HEIT, M.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

HEITMANN, H.
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 1510 5A

HEJKAL, T. W.
Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 1512 5A

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

Water-To-Air Fractionation of Bacteria,
W82-00575 1502 5B

HEJL, H. R. JR.
Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

HELD, S.
Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 1512 5C

HELDER, W.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

HELGESEN, J. O.
Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

HELLBERG, T.
The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 1511 2H

HELLER, R.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

HELLICKSON, M. L.
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 1501 6A

HELLSTROM, G.
A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 1512 2F

HELMER, R.
Water-Quality Monitoring: A Global Approach,
W82-01339 1503 7A

HELSEL, D. R.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

HELVEY, J. D.
Acid Precipitation, A Review,
W82-06794 1512 5C

Effects of a North Central Washington Wildfire on Runoff and Sediment Production,
W82-04250 1509 2E

A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 1510 7B

HELWEG, O.
Managing Wells for Energy Efficiency,
W82-03734 1508 4B

HELWEG, O. J.
Reservoir Systems Optimization,
W82-06433 1512 4A

HELZ, G. R.
Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

HEM, J. D.
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

HEMOND, H. F.
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 1502 2K

A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076 1511 7B

HEMSLEY, J.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 1502 5D

HEMSLEY, W. T.
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

HEMYARI, P.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 1503 2G

HENDERSON, J. E.
GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 1511 5A

HENDERSON, K. W.
Plant Expansion Via High-Rate Pretreatment,
W82-05953 1512 5F

HENDERSON, R. J. A.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 1511 5D

HENDERSON-SELLERS, B.
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 1503 5G

Modelling Evaporation from Reservoirs,
W82-04722 1510 2D

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 1512 5G

A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 1508 3B

HENDREY, G. R.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 1510 5B

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

Effects of Acid Precipitation,
W82-05149 1511 5C

HENDRICKS, A. C.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

HENDRICKS, D. W.
Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 1512 5D

Fecal Coliform Densities in a Western Watershed,
W82-05618 1511 5B

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 1507 6D

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

Water Reuse Planning by Means of an Input-Output Table,
W82-04794 1511 6A

HENDRIX, J. P.
Reservoir Operation for Water Conservation,
W82-04165 1509 3B

HENDRIX, P. F.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

HENDRY, C. D.
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 1501 2K

HENDRY, G. S.
Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 1512 5C

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 1512 5B

HENEBRY, M. S.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

HENKEL, M.
Status and Problems of Process Water Supply in the Fruit- and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 1510 3E

HENNART, J. P.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 1504 2F

HENNES, R. W.
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

HENNESSY, R. R.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

HENNEY, R. C.
Shock Load of Chromium (VI),
W82-05253 1511 5D

HENNIG, H. F-K. O.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

HENNIGAN, R. D.
The Evolution of Water Quality Management,
W82-03476 1508 6E

Institutional Change - Water Quality Management,
W82-05401 1511 6E

HENNING, H. F-K. O.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

HENRICH, J.
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04178 1510 2H

HENRIKSEN, K.
Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 1502 5A

HENRIKSON, L.
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

HENRY, J. G.
Recent Developments in Water Pollution Control,
W82-00340 1501 5D

HENRY, J. K.
Agricultural Conservation Program: An Evaluation,
W82-02019 1504 3F

HENSCHKE, C. J.
Groundwater Systems Associated with Secondary Salinity in Western Australia,
W82-02770 1506 2F

HENSEL, R.
Pump Installations for reverse Osmosis Systems,
W82-05882 1511 8C

HENZEN, M. R.
Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

HERB, W. J.
Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

HERBAUTS, J.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 1504 2G

HERBERT, I.
The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 1503 5B

HERBERT, R.
Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 1506 2F

HERDENDORF, C. E.
Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 1512 5C

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

HERGENRADER, G. L.
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 1503 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 1507 5C

HERGERT, G. W.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5B

HERKELMANN, H.
Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 1512 5D

HERMANN, A. J.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

HERMANN, D. J.
Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

HERMANN, R.
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

HERON, R.
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 1502 2C

HERRERA, I.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 1504 2F

Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 1512 2F

HERPGESELL, P. L.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

HERRICKS, E. E.
Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 1511 5A

HERRINGTON, P. R.
Charging Policies for Water Services,
W82-01734 1503 6C

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 1512 6D

HERRMANN, R.
Transport of Polycyclic Aromatic Hydrocarbons through a Partly Urbanized River Basin,
W82-04191 1509 5B

HERSCH, P.
Readying Boston's Water and Sewer System for the Next Century,
W82-03870 1509 6B

HERSHAFT, A.
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 1502 5B

HERSHFIELD, D. M.
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 1501 2A

The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 1502 2B

HESS, A. F.
Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

Selection of a Sludge Handling Disposal System,
W82-06346 1512 5E

HESS, C. T.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

HESSE, C. S.
Recreational Water Quality and Health,
W82-02997 1506 5C

HESSELBERG, R. J.
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 1503 5C

HESTER, W. H.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

HESTON, J. F.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 3C

HEUER, T.
Wastewater Collection,
W82-01251 1503 5D

HEWETSON, J. P.
Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

HEWLETT, J. D.
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 1511 4C

HEY, D. L.
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

HICKEY, C. R. JR.
Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

HICKEY, J. J.
Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

HICKEY JR, C. R.
Power Plant Siting and Design: A Case Study of Minimal Entrainment and Impingement Impacts at Davis-Besse Nuclear Power Station,
W82-03964 1509 5C

HICKMAN, K.
Characterization of Properties of Water,
W82-05540 1511 1A

HICKMAN, M.
The Removal of a Heated Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 1512 5C

HICKMAN, R. E.
Engineering Responds to Ecology,
W82-02935 1506 5D

HICKS, O.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 1502 5A

HICKS, R.
Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 1511 6D

HIGGINS, A. J.
Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 1511 5E

HIGGINS, G.
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

HIGGINS, J. M.
Do Model for Discharges from Deep Impoundments,
W82-05316 1511 2H

HIGGINS, M. R.
Supreme Court Clarifies Water Act Requirement,
W82-02257 1505 6E

HIGNETT, K. C.
Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 1510 5D

HIJNEN, W. A. M.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 1502 5A

HIKUMA, M.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 1502 5A

HILBERG, S. D.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

HILDEBRAND, S. G.
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 1511 6D

HILDERBRAND, D. C.
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 1512 5F

HILEMAN, B.
Acid Precipitation,
W82-01607 1503 5C

HILER, E. A.
A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 1511 3F

HILL, A. J.
Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 1507 5D

HILL, A. R.
Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 1505 5B

HILL, D.
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 1512 5D

HILL, D. E.
Optimization Principle for Air and Water Movement,
W82-05172 1511 2G

Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 1503 5D

HILL, D. O.
Methods for Treatment of Color in Groundwater,
W82-02532 1505 5F

HILL, D. R.
Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 1511 5A

HILL, G.
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 1502 2H

Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 1503 2H

HILL, G. E.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 1503 7B

Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 1502 3B

HILL, R.
An Introduction to Industrial Water Treatment,
W82-03071 1507 5F

HILL, R. D.
Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

HILL, R. W.
Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 1510 5F

HILLARE-MARCEL, C.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 1503 2C

HILLEARY, J. T.
Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

HILLMAN, R. M.
Land and Stream Salinity in Western Australia,
W82-01374 1503 5B

HILNER, C. A.
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

HILSDON, C. W.
Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 1511 8C

HILTON, J.
The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 1512 5C

Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 1501 5D

HIMEBAUGH, R. R.
Microorganism Inventory in Activated Sludge Control,
W82-03483 1508 5D

HIMES, W.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

HIMMELBLAU, D. M.
Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 1505 5D

HINCKLEY, B. S.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

HINCKLEY, T. M.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

HINDE, R. C.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 1504 4A

HINDLE, R.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 1502 5B

HINES, A. L.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

HINES, D. C. M.
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

HINES, M. E.
Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 1511 2L

HINES, R.
The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 1510 5C

HINKINS, S. M.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

HINKS, R. W.
Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

Reservoir Systems Optimization,
W82-06433 1512 4A

HINRICHS, D. J.
Innovative/Alternative Technology Program; Case Studies,
W82-03970 1509 5D

HINRICHS, R.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

HINRICHS, R. L.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

HINRICHSEN, D.
Poland: Coming to Grips with Pollution,
W82-02092 1504 5G

HINTERLEITNER, S.
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

HINTON, G. C. F.
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

HIPEL, K. W.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

Operational Research Techniques in River Basin Management,
W82-05387 1511 6A

HIRAOKA, M.
An Approach to the Control of the Activated Sludge System by Use of a Succession Model,
W82-04057 1509 5D

Calculation of Sludge Reservoir Volume for MLSS Control,
W82-03856 1509 5D

A Control System for Smaller Wastewater Treatment Plants,
W82-04024 1509 5D

A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

HIRATA, T.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 1503 2C

HIRATSUKA, Y.
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

HIRAYAMA, K.
Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

Studies on Oxygen Transfer Models,
W82-05349 1511 1A

HIRO, S.
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

HIROSE, T.
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

HIROTSUJI, J.
A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

HIRSCH, J. H.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

HIRSCH, R. M.
Stochastic Hydrologic Model for Drought Management,
W82-02897 1506 2E

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

HIRSHFIELD, H. I.
Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 1512 5C

HIRTH, L. J.
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

HIRTLE, R. W. M.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-03548 1502 5C

HISTI, G.
Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 1512 5A

HITDLEBAUGH, J. A.
Nitrification Using the Rotating Biological Contactor,
W82-03132 1507 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

HITE, J. C.
Economics,
W82-01304 1503 5G

Economics,
W82-06998 1512 5G

HITES, R. A.
Aromatic Amines in and Near the Buffalo River,
W82-00622 1502 5B

Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 1511 5B

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

HITZ, H. R.
The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 1511 5C

HJELDNES, E. I.
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

HJELMFELT, A. T.
Time Distribution of Clock Hour Rainfall,
W82-01402 1503 2A

HJELMFELT, A. T. JR.
Empirical Investigation of Curve Number Technique,
W82-04112 1509 2A

HJORT, J.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

HLAVAY, J.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

HO, A. K. W.
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

HO, J.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 1504 5C

HO, K. W. A.
Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

HO, K.C.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

HO, M. H.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 1503 5A

HO, W. S.
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

HO, Y. B.
Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 1511 2H

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 1508 5B

HOANG, V. D.
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

HOBBA, W. A. JR.
Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 1511 2F

HOBBIE, J. E.
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

HOBBS, E. H.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

HOBBS, J. M.
Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 1506 3A

HOBO, T.
Ion . Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 1504 5A

HOCH, H. J.
Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen),
W82-06243 1512 8B

HOCUTT, C. H.
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 1510 6G

HODGDON, R. B.
Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

HODGES, E.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 1502 5D

HODGKISS, I. J.
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 1512 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 1504 5B

HODGSON, A. S.
The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 1512 3F

HODGSON, J. M.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

HODGSON, M. E.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

HODSON, R. E.
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 1512 2L

HODSON, R. G.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

HOEFLIN, J. R.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

HOEHN, R. C.
Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

HOEKS, J.
Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 1508 5B

HOESE, H. D.
Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

HOFFMAN, D.
Low Temperature Evaporation Plants,
W82-05118 1511 3A

HOFFMAN, G. J.
Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

HOFFMAN, M. R.
Trace Metal Catalysis in Aquatic Environments,
W82-00629 1502 5B

HOFFMANN, M. R.
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

HOFFMASTER, W. W.
Foam Control in Aeration Tanks,
W82-00171 1501 5D

HOFKES, E.
How Proper Prospecting Improves the Odds,
W82-05757 1511 3B

HOFSTEE, A. W. M.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

HOGGAN, D. H.
Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

HOGGATT, R. E.
Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

HOLBECHE, J. D.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 1504 5A

HOLBURT, M. B.
Colorado River Water Allocation,
W82-05888 1511 6C

International Problems on the Colorado River,
W82-05892 1511 5G

HOLDER-FRANKLIN, M. A.
Bacteria Under the Ice,
W82-06561 1512 5A

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 1512 5B

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 1512 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 1512 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 1512 5A

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 1512 5A

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 1512 5C

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

HOLDREN, G. C. JR.
Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 1501 2H

HOLDRINET, H.
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

HOLDRINET, M. V. H.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 1503 5B

HOLDSWORTH, G.
A Mechanism for the formation of Large Icebergs,
W82-04798 1511 2C

HOLFORD, I. C. R.
Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

HOLL, W.
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 1503 5F

HOLLAN, E.
Free Surface Oscillations in Lake Kinneret,
W82-06879 1512 2H

HOLLETT, K. J.
Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

HOLLEY, E. R.
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 1510 8A

HOLLIS, G. E.
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 1505 2E

HOLLOD, G. J.
Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 1511 5F

HOLLON, B. F.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B

HOLM-HANSEN, T.
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 1501 5A

HOLMAN, D.
Supplying Water to the Rural Community,
W82-06223 1512 5F

HOLMAN, R. C.
Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

HOLMAN, W. F.
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 1511 5D

HOLMBERG, A.
Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 1512 5D

HOLMES, B. H.
Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 1502 6E

HOLMES, J. W.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

HOLMES, K. T.
Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

HOLMES, N. T. H.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 1504 2K

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 1503 2E

HOLMES, P. R.
The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 1512 5G

HOLMSTROM, H.
Improved Operation of Municipal Wastewater Treatment Plants in Sweden by Use of Instrumentation and Automation,
W82-03846 1509 5D

HOLSAMBRE, D. G.
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 1511 8B

HOLT, J.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

HOLT, R. F.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

HOLT, S. M.
Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 1508 2F

HOLTSCHLAG, D. J.
Flow Model of Saginaw River Near Saginaw, Michigan,
W82-03996 1509 2E

HONDA, T.
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

HONEYCUTT, F. G. JR.
Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 1511 6B

HOOD, J. W.
Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

HOOD, M. A.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 1503 5C

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 1502 2L

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 1512 5A

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 1512 5C

HOOFTMAN, R. N.
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

HOOK, D. D.
Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 1512 6B

HOOK, L. A.
Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

HOOK, N. K. JR.
Billing Data Aids Utility Planning,
W82-05786 1511 6C

HOOVER, J. R.
Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

HOPCRAFT, J.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

HOPE, M.
Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 1511 6E

HOPKINS, G. D.
Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5B

HOPKINS, H. T.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

HOPKINS, L. D.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 1503 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 1503 6A

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

HOPKINS, T. S.
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 1501 5C

HOPKINSON, C. S. JR.
Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 1501 2A

HOPKINSON JR, C. S.
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

HOPP, W. J.
In-Home Conservation and Wastewater Management,
W82-02591 1505 3D

HOPPE, M.
Simulating and Improving Hydro Plant Control,
W82-06202 1512 8C

HOPPER, B. D.
Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833 1509 5A

HOPPING, W. D.
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 1511 5D

HORIE, S.
Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

HORN, H. F.
Water Level Control for Small Hydro Plants,
W82-04173 1509 8C

HORNBECK, J. W.
Acid Rain: Facts and Fallacies,
W82-00518 1502 5C

HORNBERGER, R. J.
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

HORNE, A.
Groundwater Policy: A Patchwork of Protection,
W82-06411 1512 6E

HORNE, M. W.
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 1505 5B

HORNEF, H.
New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

Water Pollution Control in the Federal Republic of Germany,
W82-02766 1506 6E

HORNER, G. L.
Irrigation Tailwater Management,
W82-00392 1501 3C

HORNER, R. W.
The Thames Barrier,
W82-04039 1509 4A

HORNICK, L. E.
Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 1505 5C

HORNING, W. B.
Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 1506 5C

HORNOR, S. G.
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 1505 5E

HORNSBY, A. G.
The Colorado River Salinity Problem,
W82-05889 1511 5G

HORSFALL, F. L. III.
Chemometric Modeling of Wastewater Treatment Processe,
W82-05858 1511 5D

HORSLEY, M. B.
Curbing the Distribution Energy Appetite,
W82-04136 1509 5F

HORSLEY, R. W.
Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 1511 5B

HORSNELL, G.
Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 1512 5C

HORSTER, M.
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 1512 8C

HORTON, J. H.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 1502 5B

HORTON, R.
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 1501 5D

HORVATH, D. J.
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

HORVATH, F. J.
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

HORVATH, G. L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 1504 2G

HOSKING, R. J.
Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

HOTCHKISS, W. R.
Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

HOUCK, D. H.
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 1510 5D

HOUCK, M. H.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 1503 8A

HOULE, E. H.
Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

HOUSDEN, A. J.
Operational Experiences in the Effective Treatment of Effluents from Synthetic Resin Manufacture,
W82-03835 1509 5D

HOUSE, L. B.
An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 1512 2E

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 1512 2H

HOUSE, M.
Water Quality Indices: An Additional Management Tool,
W82-01994 1504 5G

HOUSMAN, J.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

HOUSTON, J. F. T.
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 1511 4B

HOUSTON, K. L.
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 1503 8A

HOUSTON, M.
Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 1512 5C

HOUSTON, W. N.
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 1508 2F

HOWARD, A.
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 1503 2J

HOWARD, C. D. D.
Water Supply Reliability Theory,
W82-03432 1508 6A

HOWARD, P. M.
Impressions of Soil and Water Conservation in China,
W82-01730 1503 4D

HOWARD, W. F.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 1501 5A

HOWARD-WILLIAMS, C.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 1506 5B

HOWE, C. W.
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

HOWELL, J. A.
Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 1507 5D

HOWELL, J. N.
Beneficial Disposal of Pickle Liquor,
W82-06486 1512 5D

HOWELL, T. A.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

HOWELLS, D. H.
Comments on a National Ground-Water Protection Strategy,
W82-03740 1508 6F

The North Carolina Sedimentation Control Program--An Assessment,
W82-04160 1509 2J

HOWITT, R. E.
An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

HOWORTH, R.
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

HOXIT, L. R.
Disaster by Flood,
W82-04618 1510 2E

HOY, N. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 1503 10C

HOYE, W. W.
Controlling the Cost of System Maintenance,
W82-04139 1509 8G

HOYLE, M.
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 1510 6C

HROMADKA, T. V.
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 1507 6A

HROMADKA, T. V. II
Subdomain Integration Model of Ground-Water Flow,
W82-02550 1505 2F

HRUBOVACK, J. M.
Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

HRUDEV, S. E.
Water Reclamation and Reuse,
W82-01252 1503 3C

HRUSCHKA, H.
Investigation on Constant F/M Ratio by Adaption of Aeration Tank Volume,
W82-03860 1509 5D

HSIAO, S. I. C.
Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 1506 2C

HSIEH, S. A. K.
Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 1507 5A

HSIUNG, D. E.
Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 1501 2J

HSU, C. F.
Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

HSU, C. T.
Multivariate Hydrologic Time Series Analysis,
W82-00647 1502 2A

HSU, T-B.
Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 1508 3A

HU, M. C.
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports,
W82-05067 1511 2D

HUANG, C. -S.
Nitrification Kinetics and Its RBC Application,
W82-06356 1512 5D

HUANG, J-C.
Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05859 1511 5D

HUANG, J. C. K.
Simulation and Verification of Lake Ontario's Mean State,
W82-04570 1510 2H

HUANG, P. M.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 1502 2J

HUBBARD, R. K.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

HUBBELL, D. W.
Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 1510 7B

HUBBELL, J. W.
Detroit - Fresh Clean Water,
W82-01506 1503 5D

HUBER, D.
Oxygenation of the Avon River,
W82-05730 1511 5G

HUBER, J.
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 1502 5D

HUBER, W. C.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 1504 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 1504 2A

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 1505 5B

Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

HUBINGER, D. C.
Dupont's Wastewater Treatment Approach,
W82-02254 1505 5D

HUCK, P. M.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 1503 5D

HUCKABEE, A. J.
Evaluating a Plant's Potential for Upgrading,
W82-02895 1506 5F

HUCKINS, J. N.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 1504 5B

HUDGINS, J. S.
The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 1501 5D

HUDON, C.
Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 1511 2L

HUDSON, H. E. JR.
Low-Dosage High-Rate Direct Filtration,
W82-06416 1512 5F

HUDSON, H. H.
Ground Water Availability,
W82-00027 1501 4D

HUDSON, H. R.
A Field Technique to Directly Measure Rive
Bank Erosion,
W82-05410 1511 7B

HUDSON JR, H. E.
Upgrading Water Treatment Plants: An Altern
tive to New Construction,
W82-04098 1509 5F

HUDSON, M. C.
Factors Affecting the Fate of Heavy Metals i
the Activated Sludge Process,
W82-01547 1503 5D

HUEY, D. W.
Toxicity of Nitrite to Larvae of the Salamande
Ambystoma Texanum,
W82-04529 1510 5C

HUFF, F. A.
Rainfall Prediction-Measurement Systems an
Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Real-Time Rainfall Monitoring-Predictio
System and Urban Hydrologic Operations,
W82-02588 1505 7A

HUFF, J. E.
Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 1512 5G

Treatment of High-Strength Fatty Amine
Wastewater - A Case History,
W82-04712 1510 5D

HUFF, L. L.
Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 1512 5G

HUFFMAN, G. C.
Ground-Water Data for Michigan, 1979,
W82-00014 1501 2F

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

HUGGETT, R. J.
Kepone in the James River,
W82-00631 1502 5B

The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 1505 5B

HUGGINS, L. F.
Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 1511 4D

Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 1505 5B

Subsurface Drainage and Sediment Transport Model,
W82-00894 1502 2G

Using the Answers Model to Estimate Sedimen
Yields on Construction Sites,
W82-05865 1511 4D

HUGHES, C. H.
VTE/VC for Sea Water,
W82-04909 1511 3A

HUGHES, D. A.
An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 1511 2A

Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 1512 4A

HUGHES, G. H.
Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 1506 2E

HUGHES, J. P.
Data Requirements for Kriging: Estimation and Network Design,
W82-04200 1509 7A

HUGHES, M. C.
Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 1511 2K

HUGHES, P. E.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

HUGHES, T. C.
Peak Period Design Standards for Small Western U.S. Water Supply Systems,
W82-04249 1509 6D

HUGHES, W. C.
Floodplain Delineation: An Economic Approach,
W82-04236 1509 6F

HUGHEY, P. W.
Algorithm for Optimal Activated Sludge Operation,
W82-05682 1511 5D

HUGHTO, R. J.
Microcomputer Water Quality Simulation Model,
W82-05191 1511 7B

Multi-Constituent Simulation and Optimization Models for Water Quality Management,
W82-03815 1509 5G

HUISKES, A. H. L.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

HUKKERI, S. B.
Irrigation Requirements of Field-Pea for Grain,
W82-02395 1505 2I

HULSEY, C.
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 1510 2H

HULT, M. F.
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 1501 5B

HULTMAN, B.
Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 1511 5D

Improved Operation of Municipal Wastewater Treatment Plants in Sweden by Use of Instrumentation and Automation,
W82-03846 1509 5D

HULTMAN, C.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

HULTQUIST, N. B.
Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 1512 2H

HUM, K. S.
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 1508 5D

HUME, A. S.
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

HUMENICK, M. J.
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

HUMPHRIES, C.
Recording Underground,
W82-02036 1504 8A

HUNDAL, H. S.
From Screening to Filtration: Treating the Water Supply,
W82-03739 1508 3A

HUNDAL, S. S.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

HUNDLEY, N.
The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 1510 6E

HUNGERFORD, N.
Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 1508 6E

HUNKINS, K.
Salt Dispersion in the Hudson Estuary,
W82-01615 1503 2L

HUNSINGER, R. B.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 1502 5F

HUNT, B.
Asymptotic Solution for Dam-Break Problem,
W82-04313 1510 8B

Integral Equation Formulation for Ground-Water Flow,
W82-02716 1506 2F

Seepage from Free Water Above Impermeable Tailings,
W82-02714 1506 5B

HUNT, C. D. JR.
Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 1511 4B

HUNT, D.
Analytical Quality Control,
W82-04345 1510 5G

HUNT, F. L.
Performance of Modified Chlorine Contact Chamber,
W82-06359 1512 5D

HUNT, G. E.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

HUNT, J. M.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01[illegible]7 1503 5B

HUNT, L. L.
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 1511 5A

HUNT, T. P.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

HUNTER, E. J.
Traveling Sprinkler System and Method,
W82-00561 1502 3F

HUNTER, J. V.
Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 1511 5E

Settleability of Urban Runoff Pollution,
W82-05320 1511 5G

HUNTER, K.
Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment,
W82-03758 1509 5B

HUNTZINGER, T. L.
Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma,
W82-03999 1509 2E

HUPPERT, H. E.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 1503 2C

Icebergs: Technology for the Future,
W82-04778 1511 2C

HUQ, A.
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 1507 5B

HUQ, M. F.
Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 1506 5C

HURR, R. T.
Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

HURST, C. J.
Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 1501 5D

HURST, T. J.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 1512 5D

HUSEN, J. A.
Water Supply in Denmark,
W82-03274 1507 6D

HUSS, H. H.
Distribution of Clostridium Botulinum,
W82-00349 1501 5A

HUSS, J. B.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

HUSS, S.
Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 1512 5D

HUSSEIN, M. T.
Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 1512 2E

HUSSEINY, A.
A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 1512 3A

HUSSEINY, A. A.
MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 1512 3A

HUSSONG, D.
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 1503 5A

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

HUTCHINS, M. L.
Input/Output Models as Decision Aids for Lake Restoration,
W82-03734 1509 5G

HUTCHINS, S.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

HUTCHINSON, C. B.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

HUTCHINSON, I.
Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 1512 2L

Vertical Variation in Stemflow Generation,
W82-02959 1506 2I

HUTHMANN, G.
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 1511 2E

HUTKA, J.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

HUTTON, D. G.
Dupont's Wastewater Treatment Approach,
W82-02254 1505 5D

Removal of Priority Pollutants,
W82-00639 1502 5D

HUXSTEP, M. R.
Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 1506 5F

HVITVED-JACOBSEN, T.
The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 1512 5C

HWANG, C. J.
Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

HWANG, R. N.
Response of Buried Structures to Traveling Waves,
W82-03346 1507 8D

HWANG, S. T.
Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 1508 5B

Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 1507 5D

HYDE, C. S.
The Growing Business of Bacterial Cultures,
W82-03786 1509 5D

HYNES, H. B. N.
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

HYODO, M.
Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

IBANEZ, F.
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 1503 7A

IBARRA, M. J.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

IBRAHIM, M. M.
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

ICHIMURA, V. T.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 1502 5B

IDEL, K.-H.
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 1512 8A

IDELOVITCH, E.
Environmental Effects of Water Reuse Scheme,
W82-00973 1502 3C

IDIKE, F. I.
Modeling the Effects of Conservation Practices on Soil Moisture,
W82-03811 1509 2G

IDSO, S. B.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

Humidity Measurement by Infrared Thermometry,
W82-05611 1511 7B

IFUKU, M.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

IGNATIADES, L.
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 1506 5C

IIDA, S.
The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 1505 5A

IKATSU, H.
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 1505 5A

IKEDA, S.
Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 1511 2E

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 1511 2E

Incipient Motion of Sand Particles on Side Slopes,
W82-04368 1510 8D

IL'CHENKO, N. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

IL'IN, V. I.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 1506 8B

ILIAS, S.
Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 1511 5C

ILIEV, S.
Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 1511 8A

ILLANGASEKARE, T.
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 1511 2F

ILLANGASEKARE, T. H.
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

ILYUSHIN, V. F.
Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 1506 8A

Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 1511 8A

IMAMURA, T.
Advanced Supervisory Control Systems for Sludge Treatment,
W82-04841 1511 5D

IMBERGER, J.
The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 1506 4C

IMBRIGIOTTA, T. E.
Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

IMHOFF, K. R.
Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 1511 5D

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

INCZEDY, J.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

INGRAM, H. A. P.
Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 1512 2G

INGRAM, J. W.
Multi-Attribute Decision Analysis for the Protection of Groundwater Resources,
W82-03805 1509 6A

INGRAM, R.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 1502 2H

INKINA, G. A.
Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 1512 5C

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 1504 5B

INMAN, G. W. JR.
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02631 1506 5B

INNERFELD, H.
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 1511 5D

INNISS, W. E.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 1501 2K

INO, H.
Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 1512 5D

INO, R.
Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 1512 5D

INOUE, T.
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

INOUE, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 1504 5A

INOZEMTSEV, Y. P.
Cavitation Resistance of Concrete,
W82-03165 1507 8F

INVERSIN, A. R.
Rural Power Schemes in Pakistan,
W82-04328 1510 8A

IP, S. Y.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

IQBAL, M. M.
Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

IRELAND, M. P.
Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 1505 5A

IRVINE, R. B.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 1503 2I

IRVINE, R. L.
Fermentation Industry,
W82-01257 1503 5D

Fermentation Industry,
W82-06917 1512 5D

Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 1507 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 1511 5D

Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

A Stoichiometric Model of Bacterial Growth,
W82-03756 1509 5D

IRVING, W. M.
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

IRWIN, G. A.
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 1501 5F

IRWIN, J.
Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 1510 5D

IRWIN, R.
Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 1505 5D

ISAAC, P.
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 1511 5G

ISAACS, L. T.
Integral Equation Formulation for Ground-Water Flow,
W82-02716 1506 2F

Seepage from Free Water Above Impermeable Tailings,
W82-02714 1506 5B

ISAACSON, P. A.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 1504 5C

ISAKA, H.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

ISAKOVA, YE. F.
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 1504 5C

ISAKSEN, H. C.
Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

ISELY, R. B.
The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 1510 6D

ISENSEE, A. R.
Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 1501 5C

ISHAK, M. M.
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

ISHIBASHI, T.
Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 1510 5F

ISHIDA, K.
Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

ISHIDA, Y.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

ISHIO, S.
Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 1507 5C

ISHIWATARI, R.
Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

ISHIZUKA, T.
Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 1512 5A

The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 1512 5D

ISKANDAR, I. K.
Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 1507 2G

ISRAEL, D. H.
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 1502 6E

ISSAR, A.
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 1508 2F

The Rate of Flushing as a Major Factor in Determining the Chemistry of Water in Fossil Aquifers in Southern Israel,
W82-03799 1509 2K

ITO, T.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 1502 5A

ITOH, Y.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

IVAKHNENKO, A. G.
The Modeling of Aquatic Ecological Systems,
W82-01972 1504 5B

IVANOV, E. G.
Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 1506 2E

IVANOV, V. A.
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 1506 5A

IVANOVA, L. YU.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

IVANOVA, T. N.
Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 1511 4A

IVASHCHENKO, I. N.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

IVERSON, R. M.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

IVERSON, W. P.
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 1511 5A

IVIE, G. W.
Fate of Diflubenzuron in Water,
W82-02216 1505 5B

IWAHORI, K.
Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

IWAI, S.
Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 1511 5D

IWATSUBO, R. T.
Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

IWUGO, K. O.
The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

IYER, C. S. P.
A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 1507 5A

IZAGUIRRE, G.
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

IZAQUIRRE, G.
Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

IZUMI, N.
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

JACINTHO, A. O.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 1508 5A

JACK, W.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

JACKSON, D.
Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

JACKSON, D. C.
Why Bother with Historic Preservation,
W82-03384 1507 8A

JACKSON, D. L.
Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 1501 5D

JACKSON, F. H.
Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 1503 6A

JACKSON, J. A. A.
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 1511 5A

JACKSON, L. A.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

JACKSON, L. L.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

JACKSON, M. B.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 1512 5C

JACKSON, M. D.
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 1512 5A

JACKSON, P. J.
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 1510 5F

JACKSON, R.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

JACKSON, R. A.
Keeping a Century-Old Water System Young,
W82-04138 1509 8G

JACKSON, R. D.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

JACKSON, T.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

JACKSON, T. J.
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W82-01771 1503 7B

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 1505 2C

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 1512 2A

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

JACKSON, W. H.
Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

JACKSON, W. L.
Sediment Transport During a Controlled Reservoir Release,
W82-02196 1505 2J

JACOB, J. T.
Detoxification of Residual Quaternaries,
W82-00562 1502 5G

JACOBS, A.
Energy Management in the Water Works Industry,
W82-02608 1506 5F

Trends in Sludge Management,
W82-05435 1511 5E

JACOBS, R. R.
Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency,
W82-04095 1509 5A

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

JACOBS, S. F.
Liquid Level Interferometer,
W82-05929 1512 7B

JACOBSON, J. S.
Acid Rain and Environmental Policy,
W82-01987 1504 5B

JACOBSON, P.
Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 1501 4D

JACOBY, J. M.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

JACQUEZ, R. B.
Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

JAEGER, C.
Resonance in Hydropower Stations,
W82-04953 1511 8C

JAEGGI, M. N. R.
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 1512 2J

JAGGI, I. K.
Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 1511 2D

JAGIELO, T. H.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

JAHNKE, A.
Fine Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

JAHREN, N. G.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

JAIN, S. C.
Application of SCS Infiltration Model,
W82-06872 1512 4D

River Bed Aggradation Due to Overloading,
W82-01486 1503 2J

JAIN, T. C.
Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 1507 2I

JAISWAL, S.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

JAL, J. F.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

JALURIA, Y.
Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 1512 5C

JAMEEL, H.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

JAMES, A.
Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 1511 5D

JAMES, C. R.
Considering Sludge Production in the Selection of Coagulants,
W82-05675 1511 5F

JAMES, L. D.
Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 1511 6B

JAMES, R. H.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 1511 5A

JAMES, S. C.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

JAMES, W.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

JAMIESON, A.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 1504 5D

JANA, B. B.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 1506 5C

JANA, P. K.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 1504 2I

JANARDAN, K. G.
Abundance of Organic Compounds in Water,
W82-01162 1503 5A

Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 1502 5A

Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 1501 5G

JANES, D.
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

JANGI, M. S.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

JANHURST, S.
Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 1512 5C

JANISZEWSKI, M.
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 1503 6D

JANONIS, B. A.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

JANUS, L. L.
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 1512 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 1512 7C

JAQUES, W. B.
Stopping Water with Chemical Grout,
W82-03396 1507 8G

JAQUETTE, D. J.
Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 1511 4B

JARMAN, R.
Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 1505 5B

JARMAN, R. T.
Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 1505 5C

JARNIS, R. N.
High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

JARNIS, R. W.
Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 1506 5D

JAROSZYNSKI, L. O.
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 1501 7B

JARRELL, S. L.
Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 1512 5F

JARRELL, W. M.
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

JARRETT, A. R.
Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

JARRETT, R. D.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 1503 2E

JARVIS, R. S.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 1503 2A

JAYANGOUDAR, I.
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

JAYARAMAN, T. K.
Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 1508 9B

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 1510 3F

JEFFERSON, C. A.
Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

JEFFREE, R. A.
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

JEFFS, D. N.
Pollution From Land Runoff,
W82-00253 1501 5B

JEKEL, M. R.
Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 1501 5D

JEN, W. C.
Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 1512 5A

JENKINS, C. R.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

JENKINS, D.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 1503 5A

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 1511 5D

JENKINS, D. N.
Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

JENKINS, J. J.
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 1504 2F

JENKINS, S. H.
Disposing of Sewage Sludge at Sea,
W82-05127 1511 5E

JENKINS, T. F.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 1502 5D

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 1503 5E

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

JENKINS, W. J.
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

JENNETT, J. C.
Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 1501 5A

Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 1511 5D

JENNINGS, M.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

JENNINGS, M. E.
Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 1505 6G

JENSEN, A. L.
PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

JENSEN, K. H.
Application of Soil Water Flow Theory in Field Simulation,
W82-03589 1508 2G

JENSEN, P. K.
Practical Experiences in Plants Using Activated Carbon,
W82-02788 1506 5F

JENSEN, R. G.
Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

JENSEN, W. P.
Phosphate in Water: I. Reduction Using Northern Lignite Fly Ash,
W82-03882 1509 5F

JEPSEN, C. P.
Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 1505 5F

Effects of Salts on Activated Carbon Adsorption of Fulvic Acids,
W82-05667 1511 5F

JERGER, D. E.
Anaerobic Processes,
W82-01245 1503 5D

Anaerobic Processes,
W82-06923 1512 5D

JERVIS, R. E.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

JESSEN, S.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

JETHWAS, J. L.
Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 1507 8A

JEVONS, C.
Ultraviolet Systems in Water Treatment,
W82-06726 1512 5F

JEWELL, T. K.
Development of Improved Stormwater Quality Models,
W82-04559 1510 5B

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 1511 5B

JEWELL, W. J.
Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 1507 5D

Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 1512 5D

JEWETT, K. L.
Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

Speciation of Trace Di- and Triorganotins in Water by Ion-Exchange HPLC-GFAA,
W82-04037 1509 5A

JHA, K. P.
Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 1512 3F

JIRKA, G. H.
Buoyant Surface Jets,
W82-03670 1508 8B

Efficient Cooling Ponds: Design,
W82-03672 1508 8A

Vertical Round Buoyant Jet in Shallow Water,
W82-04365 1510 7C

JIWA, S. F. H.
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 1510 5A

JOB, S. V.
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 1504 2H

JOBES, J. A.
Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

JOBLING, M.
Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 1504 5C

JOBSON, H. E.
Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 1512 2D

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 1502 2E

JOERES, E. F.
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 1507 4A

JOFRE, J.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

JOHANNSEN, C. J.
Remote Sensing Applications for Resource Management,
W82-03279 1507 7B

JOHANSSON, N.
Perivitelline pH of Salmonide Eggs in Relation to Ambient pH,
W82-04064 1509 5C

JOHN, D. M.
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 1506 2H

JOHN, J.
Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

JOHN, P.
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 1511 5A

JOHNSEN, T. N.
Picloram Dissipation in a Small Southwestern Stream,
W82-00212 1501 5B

JOHNSON, A. H.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

JOHNSON, B. T.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 1504 5B

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 1503 5B

JOHNSON, C. C. JR.
The Safe Drinking Water Act on Review,
W82-05792 1511 5G

JOHNSON, D. A.
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 1511 3F

JOHNSON, D. E.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

JOHNSON, D. G.
A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 1501 5A

JOHNSON, D. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 1503 2B

JOHNSON, D. P.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

JOHNSON, D. R.
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

JOHNSON, D. W.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 1510 5B

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 1504 5B

JOHNSON, G.
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

JOHNSON, G. E.
Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 1501 5D

JOHNSON, H. P.
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 1505 5B

Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 1511 5B

JOHNSON, J. D.
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

JOHNSON, K. G.
Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

JOHNSON, K. L.
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

JOHNSON, K. M.
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 1507 2L

JOHNSON, K. S.
The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1508 1B

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

JOHNSON, L. D.
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 1501 5D

JOHNSON, L. S.
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

JOHNSON, M. G.
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 1502 6G

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

JOHNSON, M. S.
Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

JOHNSON, N. M.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

JOHNSON, P.
The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

JOHNSON, P. R.
Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

JOHNSON, R.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

JOHNSON, R. A.
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 1512 5D

JOHNSON, R. K.
Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

JOHNSON, R. S.
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

JOHNSON, R. W.
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

JOHNSON, S. M.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 1503 5A

JOHNSON, T. C.
Contourites in Lake Superior,
W82-01935 1504 2H

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

JOHNSON, T. M.
Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

JOHNSON, V. G.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

JOHNSON, W.
Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-027[illegible]8 1506 5C

JOHNSTON, C. D.
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 1506 2K

JOHNSTON, G. L.
Guidelines for Control of Septic Tank Systems,
W82-02599 1505 5B

JOHNSTON, J. B.
Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 1511 5A

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

JOHNSTON, R.
Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

JOHNSTON, R. A.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 1502 5D

JOHNSTON, R. H.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

JOHNSTON, S. A. JR.
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 1504 2L

JOKINEN, E. H.
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

JOLLER, T.
Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 1511 5B

JOLLEY, R. L.
Concentrating Organics in Water for Biological Testing,
W82-01591 1503 5A

JOLLY, V. H.
Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

JONAS, J.
Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

JONAS, T. D.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-0[illegible]399 1503 2A

JONASSON, R.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 1511 5A

JONE, C. M.
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06[illegible]71 1512 5D

JONES, A. J.
Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 1506 8I

JONES, C.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

JONES, C. A.
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

JONES, C. W.
Performance of Granular Soil Covers on Canals,
W82-00047 1501 8D

JONES, D. A.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

JONES, D. B.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

JONES, D. D.
Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 1511 5D

JONES, D. E. B.
Measuring Reservoir Ground Movements,
W82-05773 1511 8G

JONES, E. B.
Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

JONES, F.
Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 1512 5B

JONES, F. V.
Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 1506 5C

JONES, G. J.
Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 1505 5C

JONES, G. L.
Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 1511 5D

JONES, J. D.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

JONES, J. G.
The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 1504 2H

JONES, J. H.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 1501 5E

JONES, J. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 1504 5B

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 1506 5B

JONES, J. S.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

JONES, K.
Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 1512 5C

A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 1511 2B

JONES, M. J.
Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 1511 5B

JONES, M. L.
Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

JONES, O. R.
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 1502 3F

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 1502 3F

Management of Recharge Basins on the Southern High Plains,
W82-00938 1502 4B

JONES, P. D.
Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 1512 5B

JONES, P. H.
Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 1511 5D

JONES, R.
Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

JONES, R. A.
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 1512 5C

Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 1508 6E

JONES, R. D.
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 1503 5C

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 1502 2L

JONES, S. B.
Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 1512 4A

JONES, W. J.
Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 1501 2L

JOP, K.
Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 1506 5B

JORDAN, T. A.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

JORDAN, T. P.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

JORDAN, Y.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

JORDAO, W.
Pumped-Storage Development in Brazil. Part III,
W82-03381 1507 8A

JORET, J. C.
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 1503 5A

JORGENSEN, D. G.
Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

JORGENSEN, L. A.
Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

JORGENSEN, S. E.
Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

JORSTAD, K.
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

JOSBERGER, E. G.
A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 1511 2C

On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 1501 2C

JOSE, C.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

JOSEPH, E. S.
Municipal and Industrial Water Demands of Western U.S.,
W82-06463 1512 6D

JOSEPH, I.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 1502 8B

JOSEPH, J. B.
Artificial Groundwater Recharge,
W82-01110 1503 4B

Experience with Borehole Recharge in The Lee Valley,
W82-03894 1509 4B

JOSEPH, S. W.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

JOSEPHSON, J.
Groundwater Monitoring,
W82-04809 1511 6E

Groundwater Strategies,
W82-00620 1502 5G

Humic Substances,
W82-05148 1511 5B

Protecting Virginia's Waterways,
W82-01608 1503 5G

Water Regulations,
W82-00482 1501 6E

JOSHI, D. C.
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 1508 3B

JOSHI, M. G.
The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 1512 5D

JOSHI, S. R.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

JOSSELYN, M. N.
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 1502 2L

JOUBERT, P. J.
Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 1511 5D

JOURNET, J. -M.
The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 1510 5A

JOWITT, P. W.
Risk Analysis in the Planning, Design and Operational Control of Water Pollution Prevention Schemes- A Perspective,
W82-03857 1509 5G

JOYCE, T. W.
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

JOYNER, B. F.
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

JUDD, L. B.
Problems and Processes in Water Quality Management,
W82-06147 1512 5G

JUDE, D. J.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

JUDKINS, J. F. JR.
Textile Wastes,
W82-01259 1503 5D

Textile Wastes,
W82-06916 1512 5D

JUDKINS, J. R. JR.
Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 1511 5E

JUDY, R. D. JR.
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

JUMAWAN, A. B.
Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results,
W82-03878 1509 5D

JUNE, J. A.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 1511 5C

JUNGREIS, E.
A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 1510 5A

JUNOR, F. J. R.
The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 1511 2H

JUO, A. S. R.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 1503 2G

JURADO, A.
Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

JURGENSEN, M. F.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 1501 5D

JURINAK, J. J.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 1503 5B

Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

JURY, W. A.
Domestic Water Supplies for Power Plant Cooling,
W82-00180 1501 6D

Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 1502 5B

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 1512 2G

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 1512 2G

KABIR, A.
Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 1511 5B

KABRICK, R. M.
Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 1512 5D

KACHTICK, J. W.
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

KACZYNSKI, V. W.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

KADABA, P. K.
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 1512 5A

KADOTA, H.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

KAERGAARD, H.
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 1504 2F

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

KAHN, P. A.
Wind Aeration in Model Waste Treatment System,
W82-02944 1506 5D

KAINULAINEN, H.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 1512 5B

KAISER, D. L.
Coordinated Effort Stems Sediment and Erosion,
W82-00766 1502 4D

KAJAK, Z.
Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 1502 2H

KAKINUMA, T.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

KALCHEV, L.
Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 1511 8A

KALEY, R. G.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 1502 5A

KALFF, J.
The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 1511 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 1512 5B

Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 1503 5C

KALIL, E. K.
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

KALINSKE, A. A.
Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 1502 5D

KALKE, R. D.
Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 1511 5C

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

KALKHOFF, S. J.
Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 1511 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 1511 5B

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 1501 5B

KALMAN, D.
Organics,
W82-06922 1512 5A

KALMAR, D.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 1504 3F

KALMAZ, E. V.
Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 1507 5B

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 1501 5B

KALWEIT, H.
Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 1510 5G

KALYUZHNYI, I. L.
Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 1505 2A

KAMAL, I.
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 1512 3A

KAMIMURA, S.
A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 1505 5B

KAMP-NIELSEN, L.
Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

KAMPE, D.
Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 1512 6F

KAN, G.
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

KANAREK, M. S.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 1505 5B

KANE, D. L.
Physical Mechanics of Aufeis Growth,
W82-00836 1502 2C

KANE, J.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

KANEKO, T.
Bacteria Under the Ice,
W82-06561 1512 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 1512 5A

KANG, I. S.
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 1512 3A

KANG, S. W.
The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

KANNAN, V.
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 1504 2H

KANOWSKI, S.
New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

KANWAR, R. S.
Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 1511 5B

KAO, J-F.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

KAO, T. W.
Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1507 1A

KAPADIA, R. N.
Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 1506 3A

KAPLAN, A. M.
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

KAPLAN, D. L.
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

KAPLAN, I. R.
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 1511 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 1501 5B

KAPLOVSKY, A. J.
Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 1511 5E

KAPOOR, P. N.
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 1506 2F

KAPP, H.
The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 1510 5D

KAPULER, I.
A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 1503 2F

KARABAEV, E. I.
Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 1511 8A

KARADENIZ, H.
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 1511 8B

KARICKHOFF, S. W.
Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 1511 5B

KARIYAWASAM, H. C.
Evaluation of Hydropower Potential in a River Basin,
W82-04214 1509 6B

KARL, D. M.
RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 1507 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 1507 5A

KARL, T. R.
The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 1512 2B

KARMELI, D.
Solid Set Irrigation System Design Using Linear Programming,
W82-02273 1505 6A

KAROLY, E.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

KARTHEGISAN, J.
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 1507 2L

KARUBE, I.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 1502 5A

Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

KASAI, T.
Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems,
W82-03763 1509 5D

Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

KASAKURA, T.
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

Automatic Monitoring of Exhaust Gas Analysis in Activated Sludge Wastewater Treatment Process,
W82-04014 1509 5D

KASATKIN, Y. N.
Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 1511 8A

KASHEF, A-A. I.
The Nile - One River and Nine Countries,
W82-03545 1508 4A

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 1506 4A

KASHIWAGI, M.
Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

KASHKULI, H. A.
A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 1510 2F

KASIDA, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 1504 5A

KASPRZAK, K.
The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02731 1506 5C

KASSAKHIAN, G. H.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 1503 5D

KASSO, W. B.
A Survey of Trihalomethanes in the Drinking Water System of Murfreesboro, Tennessee,
W82-01817 1504 5B

KAST, F.
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

KATOH, S.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

KATOH, T.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

KATSAROS, K. B.
Convection Patterns in a Pond,
W82-04461 1510 2C

KATYAL, A. K.
Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 1505 2G

KATZ, A.
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 1508 2K

KATZ, B. G.
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

KATZ, D.
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

KATZ, G.
Environmental Control Technology Development for Geothermal Energy,
W82-02197 1505 5C

KATZ, H. M.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

KATZ, P. B.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 1508 5B

KATZ, P. G.
Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

KATZENELSON, E.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 1502 5A

KATZER, T.
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

KAUFMAN, J. R.
Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

KAUFMAN, P. B.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

KAVANAGH, B. V.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 1511 5D

KAVANAUGH, M.
Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

KAVVAS, M. L.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 1503 2B

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 1512 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 1512 2E

KAWABATA, N.
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 1501 5D

KAWAGUCHI, H.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 1502 5A

KAWAMURA, K.
The Effect of Particle Substrate on Mineralization Performance and the Formation of Excess Sludge in a Complete Mixing Aeration Tank,
W82-04012 1509 5D

KAWASAKI, L. Y.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

KAWAUCHI, S.
Underwater Aerator,
W82-00065 1501 5D

KAWECKA, B.
Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 1507 5C

KAY, C.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 1502 5A

KAY, D.
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 1501 5B

New Problems with Upland Waters,
W82-06602 1512 5G

KAY, G. P.
Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

KAY, R.
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 1502 2K

KAYS, W. B.
The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 1510 5G

KAYSER, W. V.
Characterization of Properties of Water,
W82-05540 1511 1A

KAYSNER, C. A.
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 1501 5A

KAZMANN, R.
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 1510 8B

KAZMANN, R. G.
A Closer Look at Deep Well Disposal of Wastes,
W82-03646 1508 5E

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 1511 8B

Will New Orleans Miss The Mississippi,
W82-04274 1510 4A

KEAN, W. F.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 1503 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

KEARNS, P. K.
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 1512 5B

KEATING, T.
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

KECK, R. G.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

KECK, R. T.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

KEDDIE, A. W. C.
The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 1512 5D

KEDMI, S.
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 1502 5A

KEECH, D. K.
Design of Heat Pump Return Wells,
W82-06294 1512 8C

Methane in Water Wells,
W82-05262 1511 5F

KEEFE, C. M.
Use of Longitudinal Conductance in Estimating Transmissivity of Granular Aquifers in Northern Missouri,
W82-03957 1509 2F

KEELEY, J. W.
Sampling Ground Water for Organic Contaminants,
W82-06820 1502 5A

KEENE, J.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

KEENE, K. M.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 1504 7B

KEINATH, T. M.
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 1510 5D

Solids Inventory Control in the Activated Sludge Process,
W82-04048 1509 5D

KEINKE, G. W.
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 1501 5E

KEITH, J. E.
Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

KEITH, L. H.
EPA's Priority Pollutants: Where They Come from--Where They're Going,
W82-03875 1509 6E

KELADA, N. P.
Fate of Priority Pollutants in Large Municipal Treatment Plants,
W82-03867 1509 5B

KELIN, J.
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 1510 5D

KELKAR, R. R.
Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 1510 2B

KELLEHER, D. L.
Investigation of Volatile Organics Removal,
W82-01490 1503 5F

KELLER, L. F.
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 1506 4B

KELLER, V. W.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 1504 2B

KELLER, W.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 1503 5B

Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

KELLERHALS, M.
On Hydrological Data Needs in Canada,
W82-03443 1508 7A

KELLERHALS, R.
On Hydrological Data Needs in Canada,
W82-05764 1511 7B

KELLO, D.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 1502 5C

KELLOGG, S. R.
Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

KELLY, C. A.
Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 1501 2H

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 1504 2H

KELLY, D. M.
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

KELLY, J. M.
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

KELLY, T.
Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

KELLY, W. E.
Erosion Resistance of Cohesive Soils,
W82-02676 1506 2J

Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

KELSH, D. J.
Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 1512 5D

KEMBER, P. N.
ISFETs-New Tools for Water Quality Monitoring,
W82-04059 1509 5A

KEMP, G. P.
Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 1511 5C

KEMP, P. R.
A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 1512 3C

KEMPA, E. S.
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

KEMPER, W. D.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 1511 8A

Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 1512 3F

Furrow Intake Rates and Water Management,
W82-05968 1512 3F

Water Levels and Losses and Cleaning in Watercourses,
W82-02747 1506 3F

KEMPF, T.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

KENARANGUI, R.
A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 1512 3A

KENDALL, B. M.
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

KENLAN, K. H.
Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

KENNEDY, A.
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

KENNEDY, C. W.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

KENNEDY, J. H.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

KENNEDY, R. H.
Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

KENNETT, G. A.
Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 1505 2F

KENNICUTT, M. C. II.
Particulate and Dissolved Lipids in Sea Water,
W82-02727 1506 5A

KENNY, A. W.
The Effect of EEC Directives on Water Supplies,
W82-02432 1505 6E

KENT, D.
Water Management on the Columbia River,
W82-02112 1505 6D

KENT, D. H.
Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 1505 6D

KENT, S. J.
Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

KENYON, G. F.
The Environmental Effects of Hydroelectric Projects,
W82-02632 1506 6G

KENYON, K. F.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

KEOHAN, P. W.
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

KEPKAY, P. E.
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

KERCHER, J.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

KERFOOT, W. B.
Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5B

KERKHOFF, M. A. T.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

KERNDORFF, H.
Effects of Pollution on Humic Substances,
W82-03253 1507 5C

KERNODLE, D. R.
Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

KERNODLE, J. M.
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

KERR, S. N.
Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 1511 5E

KERSTER, H. W.
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 1502 5A

Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 1501 5G

KESLER, D. H.
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 1502 2H

KESSLER, E.
On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 1512 2B

KESSLER, K. A.
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

KESTING, R. E.
The Development of Dry-RO Membranes from Cellulosic and Noncellulosic Polymers Bearing Quaternary Ammonium Groups,
W82-06152 1512 3A

KESWICK, B.
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

KESWICK, B. H.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

KETCHESON, J. W.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 1502 5B

KETCHUM, L. H. JR.
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

KETTLE, D.
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

KEUNE, H.
Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 1512 3E

KEYS, C. H.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 1503 3F

KFIR, R.
Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 1512 5D

KHABAKPHASHEVA, YE. M.
Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 1512 8B

KHALEEL, R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 1502 5B

Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 1501 5B

KHALID, R. A.
Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Kinetics of Nitrogen Loss in Simulated Wastewater Treatment in a Soil-Plant System,
W82-03869 1509 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 1510 5D

KHAN, I. A.
Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 1511 2F

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 1510 4B

Managing Salinity in Irrigated Agriculture,
W82-05691 1511 3C

A Model for Managing Irrigated Agriculture,
W82-06584 1512 3G

Waste Water Disposal Through a Coastal Aquifer,
W82-04231 1509 5E

KHAN, K. A.
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Role of Surface Active Media in Anaerobic Filters,
W82-05816 1511 5D

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

KHAN, M. A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 1510 2E

Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 1507 2H

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 1505 2H

KHAN, N. A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 1503 5B

KHANGAROT, B. S.
Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

KHANJANI, M. J.
Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 1508 3F

KHARE, S. T.
Water Supply and Sanitation Decade Programme,
W82-02757 1506 5F

KHARITONOVA, N. N.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 1504 2H

KHARLAMOV, YU. A.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-05163 1507 8B

KHERA, K. L.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

KHIND, C. S.
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

KHUDENKO, B. M.
Optimization of Automated Equalization Basin-Reactor Systems for Chemical Treatment of Wastewater,
W82-04052 1509 5D

KHULBE, R. D.
Occurrence, Distribution and Seasonal Periodicity of some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 1506 2H

KIBLER, D. F.
Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

KICHENS, W. M.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

KICEOX, D. H.
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

KIDWAI, A. L.
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

KIDWELL, C. C.
Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

KIEFER, J. E.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1502 1B

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

KIEFER, R. W.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

KIEHLING, B.
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 1503 5F

KIERSPE, G. H.
Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 1505 2L

KIESLER, J.
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

KIHANA, H.
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

KIHLSTROM, M.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 1512 5B

KIJNE, J. W.
Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 1505 2G

KIKICHEV, KH. A.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

KIKUCHI, E.
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

KILADZE, R. M.
Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 1512 3F

KILLILEA, W. R.
Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 1501 5D

KIM, B. M.
Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 1507 5D

KIM, B. R.
Do Model for Discharges from Deep Impoundments,
W82-05316 1511 2H

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 1510 5F

KIM, C. S.
Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

KIM, I. H.
Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 1512 3A

KIM, J. W.
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

KIM, S.
Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

KIMBALL, K. D.
Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

KIMMEL, B. L.
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

KIMMERER, W. J.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

KIMOTO, W. I.
Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

KIMURA, I.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyte Sea Urchin Eggs,
W82-03610 1508 5C

KINAE, N.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyte Sea Urchin Eggs,
W82-03610 1508 5C

KINCAID, D. C.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 1511 8A

Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 1512 3F

KINCAID, D. T.
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 1506 2I

KINCANNON, D. F.
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 1507 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 1512 5D

KING, B. D. III.
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

KING, C. J.
Solvent Extraction of Phenols,
W82-00438 1501 5D

KING, D.
Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

KING, F. R.
Vacuum Sewers--The Future for Sewage Collection,
W82-03394 1507 5G

KING, G. A.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 1502 2H

KING, G. M.
Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 1512 5C

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 1501 2H

KING, J. E.
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 1511 5D

KING, J. W.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 1504 5B

KING, L. D.
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 1501 6A

KING, N. J.
Implications for the Water Industry of the Notification Scheme for New Chemicals,
W82-06261 1512 6E

KING, P. H.
Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 1512 5F

KING, R. P.
Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

KING, R. S.
Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03963 1509 3A

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

KING, R. W.
Upgrading Water Treatment Plants in San Diego,
W82-03655 1508 5F

KINGSOLVER, J.
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 1502 2I

KINGVORSEN, K.
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

KINNELL, P. I. A.
Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 1501 2J

KINNERSLEY, D.
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 1503 6C

KINNEY, W. C.
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 1503 6A

KINNUNEN, K. A. I.
Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

KINSLEY, K. R.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

KINZEL, R.
Domes, Bubbles, and Paper Waste,
W82-06025 1512 5D

KIPNIS, T.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

KIPP, J. S.
A Legacy from Construction Grants,
W82-06251 1512 5D

KIPP, K. L. JR.
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 1502 7B

KIRBY, M. K.
Attached Algae of the Lake Erie Shoreline Near Nanticoke Generating Station,
W82-04033 1509 5C

KIRBY, R.
A Suspended Sediment Front in the Severn Estuary,
W82-04639 1510 2L

KIRCHER, J. E.
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

KIRCHMAN, D.
Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 1510 2H

KIRCHMAN, D. L.
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 1512 5C

KIRK, P. W. W.
The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 1512 5D

KIRK, T. K.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 1502 5D

KIRKHAM, D.
Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 1511 5B

KIRKHAM, M. B.
Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 1508 5B

KIRKLAND, D. W.
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 1502 2F

KIRKLAND, K. J.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 1503 3F

KIROUAC, C.
Utilization of the Algae Cocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 1508 5D

KIRSCH, E. J.
Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 1507 5D

KIRSCH, M.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

KIRSHEN, P. H.
Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 1512 6E

Small-Scale Hydro in New England: 1960-1976,
W82-00169 1501 6D

KISHI, Y.
Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

KISSEL, D. E.
Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

KISTLER, R. W.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

KITABATAKE, Y.
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

KITAGISHI, H.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

KITCHENS, J. F.
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

KITCHENS, W. M.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

KITCHING, R
Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 1506 2F

KITE, G. W.
Analysis of Lake Victoria Levels,
W82-06201 1512 2H

Recent Changes in Level of Lake Victoria,
W82-01711 1503 4A

KITITSYNA, L. A.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 1504 5C

KITTEL, J. H.
The Status of Nuclear Waste Management,
W82-02659 1506 5E

KITTREDGE, D.
Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 1510 5G

KJAERNSLI, B.
Shear Strength of Rockfill,
W82-00116 1501 8D

KJELBERG, R.
Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 1512 8E

KJELSON, M. A.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

KJELSTROM, L. C.
A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

KJENSMO, J.
Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

KJERFVE, B.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

KLAPPER, H.
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 1504 2H

KLAPWIJK, A.
Effect of Copper on Nitrification in Activated Sludge,
W82-01497 1503 5C

KLAR, L. R.
Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222 1509 6D

KLASSEN, M. J.
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00949 1502 8B

KLASSEN, V. I.
Prospects of Using Magnetic Wastewater Treatment,
W82-06989 1512 5D

KLAUDA, R. J.
Accumulation of Polychlorinated Biphenyls in Atlantic Tomcod (Microgadus Tomcod) Collected from the Hudson River Estuary, New York,
W82-03777 1509 5C

KLAUSNER, S. D.
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5D

KLAZURA, G. E.
Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 1510 2B

KLEEN, H.
Floc/Float System Cleans Desalter Effluent,
W82-00906 1502 5D

KLEI, H. E.
Metal Leaching from Sewage Sludge Ash,
W82-00770 1502 5B

KLEIN, C. J.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

KLEIN, H.
Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06425 1512 5B

KLEIN, J. A.
Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 1501 5D

KLEINAU, J. H.
Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 1510 5E

KLEINSTREUER, C.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 1504 5C

KLEMAS, V.
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

KLEMER, A. R.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

KLEMETSON, S. L.
Biological Filters,
W82-01242 1503 5D

KLEMPNER, R. A.
Small Hydro Schemes for Private Developers,
W82-04327 1510 8A

KLENUS, V. G.
Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1511 1A

KLEPACKA, B.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 1506 5D

KLEPPEL, G. S.
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 1502 2H

KLEPPER, R. P.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 1504 5D

KLETKE, D.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

KLEY, W.
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

KLIBANOV, A. M.
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 1502 5D

KLIEVE, J.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00135 1501 5D

KLIEVE, J. R.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

KLIMOWICZ, H.
The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 1512 5A

KLING, H.
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

KLING, H. J.
The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

KLINGEMAN, P. C.
Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 1511 2J

KLINGER, S. A.
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

KLINK, R. E.
Cost-Effectiveness Analysis for On-Site Wastewater Treatment Alternatives,
W82-04185 1509 5D

KLOECHNER, D. C.
Maximizing Effluent Quality from a Municipal Activated Sludge Plant Concurrent with a Major Reduction in Process Energy Requirements,
W82-03874 1509 5D

KLOOZ, D.
Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

Water Reuse Planning by Means of an Input-Output Table,
W82-04794 1511 6A

KLOPATEK, J. M.
Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 1511 6D

KLOPFFER, W.
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 1512 5B

KLOPP, R.
Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 1512 5D

KLOPPEL, H. B.
Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 1510 5A

Computerized Data Acquisition and Data Handling in Sewage Treatment Plants,
W82-04023 1509 5D

KLOSTERMAN, M. J.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

KLUG, M. J.
Comparadve Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 1512 5C

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 1501 2H

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 1501 2H

KLUSEK, C.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

KNAEBEL, K. S.
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 1503 3A

KNAP, A. H.
Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 1511 5B

KNAPP, H. V.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

KNAPP, K.
Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

KNAPP, V.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 1511 2E

KNAUER, G. A.
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 1511 5A

KNAUSS, J.
Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 1512 8B

KNAUTH, L. P.
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

KNECHT, W. A.
National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

KNEEBONE, W. R.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 1503 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 1503 5D

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 1506 3C

KNIGHT, A. W.
The Nutritional Significence of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 1505 2L

KNIGHT, D. W.
Boundary Shear in Smooth and Rough Channels,
W82-02711 1506 8B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel,
W82-02792 1506 2L

KNIGHT, J. H.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 1504 2F

KNIGHT, N. J.
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 1501 5C

KNIGHTON, A. D.
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 1506 2E

KNIGHTON, M. D.
A More Versatile Soil Water Sampler,
W82-00191 1501 7B

A More Versatile Soil Water Sampler,
W82-02523 1505 7B

KNIGHTS, E. A.
Rutland Water - From Conception to Operation,
W82-06481 1512 6D

KNITTEL, M. D.
A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

KNOCHEL, A.
Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 1507 5A

KNOCHENMUS, D. D.
A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

KNOCKE, W. R.
The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

Electroplating and Cyanide Wastes,
W82-01266 1503 5D

Electroplating and Cyanide Wastes,
W82-06798 1512 5D

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 1502 5D

KNOERR, K. R.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 1502 2I

KNOOP, K. D.
Sediment Transport During a Controlled Reservoir Release,
W82-02196 1505 2J

KNOPPERT, P. L.
The Biesbosch Water Storage Scheme,
W82-06014 1512 8A

KNORRE, H.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

KNOTT, J. M.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

KNOTT, R. K.
Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 1511 7C

KNOWLES, G.
The Removal of Organic Matter from Demineralised Water,
W82-00888 1502 5F

KNOWLES, R.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

Nitrous Oxide Concentrations in Lakes: Va ations with Depth and Time,
W82-02553 1505 2H

KNOX, J. C.
Climate Variation and the Mobility and Storag of Sediment in Watersheds,
W82-05931 1512 4D

KNUCKLES, M. E.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

KNUDSEN, D. L.
Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 1510 5E

Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

KNUDSON, M. K.
Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 1510 5D

KNUTH, S.
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 1512 5B

KOBAYASHI, H.
Microbial Removal of Hazardous Organic Compounds,
W82-05177 1511 5D

KOBAYASHI, K.
Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 1506 5D

KOBLANSKI, J. N.
Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 1501 5G

KOBRIGER, N. P.
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 1510 4C

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 1510 5B

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 1510 5B

KOCAN, R. M.
Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutaganic Chemicals,
W82-02979 1506 5C

KOCH, C. M.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

KOCH, R.
Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-03093 1511 5A

KOCHEL, R. C.
Paleoflood Hydrology,
W82-03761 1509 2E

KOCHERT, T. L.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 1501 6A

KODATE, H.
An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

KODUKA[illegible], P. S.
Biodegradation of Hazardous Organic Pollutants,
W82-04910 1511 5B

KOEHLER, J. H.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 1503 6B

KOENIG, L. R.
Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 1503 2B

KOERNER, R. M.
Acid Snow in the Canadian High Arctic,
W82-04542 1510 2C

KOERS, D. A.
Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

KOGAN, E. A.
Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 1506 8A

KOGIKU, K. C.
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 1502 6A

KOGURE, K.
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 1505 5A

KOHL, H. H.
New Antimicrobial Agents for Treatment of Water,
W82-02808 1506 5F

A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

KOHLER, A.
Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 1512 5C

KOHLER, G. K.
Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 1510 5F

KOHLHORST, D. W.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

KOHLI, B.
Physical Process and Eutrophication,
W82-06875 1512 5C

KOHONEN, T.
Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 1510 7B

KOIDA, K. N.
Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 1505 6A

KOIKE, I.
Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

KOIVUSAARI, U.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

KOJOLA, W. H.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 1502 5F

KOK, G. L.
Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 1501 2K

KOKERNAK, R. P.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

KOLLAR, K. L.
Water Requirements for Industrial Development,
W82-04117 1509 6D

KOLLE, W.
The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 1510 5F

KOMANOWSKY, M.
Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

KOMAROV, V. D.
Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 1502 2A

KOMINEK, E.
Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

KON'KO, V. V.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A

KONDO, K.
Extraction of Copper with Liquid Surfactant Membranes,
W82-0189[illegible] 1504 5D

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 1507 5C

KONDO, O.
Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 1511 5A

KONIKOW, L. F.
Discussion: Influence of Well Water Quality Variability on Sampling Decisions and Monitoring, By Harry I. Nightingale and William C. Bianchi,
W82-03779 1509 5G

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 1502 5B

KONOBEYEV, A. G.
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

KONOBEYEVA, V. K.
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

KONONOV, V. V.
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 1511 8C

KONOPLYANTSEV, A. A.
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 1511 2G

KONRAD, J. C.
Pollution From Land Runoff,
W82-00253 1501 5B

KONWINSKI, G. R.
Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

KOOL, H. J.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

KOOPMAN, B.
Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 1512 5D

KOOTTATEP, S.
Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 1512 5F

KOPFLER, F. C.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

KOPP, F. J.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

KOPPE, P.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

KOPPER, W.
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

KOPPULA, S. D.
An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 1503 6A

Predicting Lake Levels by Exponential Smoothing,
W82-00118 1501 2A

KOPSICK, D. A.
Effect of Leachate Solutions from Fly and Bottom Ash on Groundwater Quality,
W82-03798 1509 5B

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

KOPYSHEV, G. P.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

KORBITZ, W. E.
Energy Minimization at Metro Denver Sewage District,
W82-03142 1507 5D

KORCHITS, K. V.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

KORDIC, J. R.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

KORENAGA, T.
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 1505 5A

KORNATZKI, K. H.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

KORNGOLD, E.
Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 1512 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 1513 5A

KOROL, T.
Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00930 1501 8A

KOROLEV, V. M.
Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 1507 8G

KORSAK, N. B.
The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 1511 2H

KORTMANN, R. W.
Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-04[illegible] 1506 2H

KORVEN, H. C.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 1503 4A

KORYAVOF, P. P.
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 1512 2H

KORYAVOV, P. P.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

KOS, P.
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 1506 5D

KOSAREV, A. N.
Salinity and Biogenic Material in the North Caspian,
W82-03155 1507 4A

KOSHUT, R. A.
Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

KOSICHENKO, Y. M.
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 1511 8G

KOSINSKI, W. K.
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

KOSKINEN, J. R.
Chemometric Modeling of Wastewater Treatment Processes,
W82-05858 1511 5D

KOSTER, W. C.
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

KOSZALKA, E. J.
Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

KOTANI, A.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

KOTHANDARAMAN, V.
Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

KOTHARI, M. S.
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 1503 8B

KOUSSIS, A. D.
Nonlinear Sorption of Water in Soil,
W82-03686 1508 2G

KOUSSOURIS, T. S.
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 1506 2H

KOUTITAS, C.
Turbulence Model for Flow Over Dredged Channels,
W82-02201 1505 8B

KOUTSANDREAS, J. D.
Overview and Assessment of Biological Sensing,
W82-05156 1511 5C

KOUWEN, N.
Flow Resistance in Vegetated Waterways,
W82-00152 1501 2E

KOVAL'CHUK, A. A.
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 1504 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 1511 2H

KOVALEVSKII, V. S.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

KOVOOR, A.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

KOVRIZHNYKH, A. I.
Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 1512 5C

KOWAL, N. E.
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 1503 5C

KOWALCZEWSKI, A.
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 1511 2H

KOWARSKY, J.
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

KOYAMA-ITO, H.
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

KOYUMDJISKY, H.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

KOZAI, K.
Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

KOZAR, A. V.
New Methods of Designing Flood Control Measures,
W82-05030 1511 2E

KOZHEVNIKOVA, N. E.
Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

KOZHOVA, O. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 1504 5

KOZIARSKI, S.
Anaerobic Treatment in Novel Contact Digester,
W82-05681 1511 5D

KOZIN, V. N.
Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 1506 8A

KRAFT, K. J.
Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

KRAINOV, S. R.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

KRAKOVSKII, B. S.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 1511 8C

KRALJ, M.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

KRAMAR, O.
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

KRAMER, H. A.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

KRAMER, J. R.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 1511 5A

KRAMER, R. J. III.
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

KRAMLICH, C. L.
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

KRANENBURG, C.
Wind-Induced Mixing in Stratified Fluid,
W82-02371 1505 2H

KRASNER, S. W.
Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

KRASNIKOV, N. D.
Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 1511 8D

KRASNOZHON, G. F.
Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

KRASOVSKY, G. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 1504 6E

KRASS, M. S.
Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 1506 4B

KRATKY, B. A.
Cutting Irrigation Costs,
W82-05081 1511 3F

KRATZER, C. R.
A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 1506 5C

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

KRATZER, K.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

KRAUSE, D. JR.
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1507 1B

KRAUSE, R. E.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

KRAYBILL, H. F.
Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
W82-03433 1508 5C

KREFT, P.
Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

KREISSL, J. F.
Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 1510 5D

KREITLER, C. W.
Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 1511 5B

KREMER, J. G.
A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

KREMPIN, D. W.
Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

KRENKEL, P. A.
Effectiveness of River Models,
W82-00961 1502 6A

State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 1511 2H

KRESCH, D. L.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

KRESGE, P. O.
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

KREUL, B.
Solar Heat Pond System,
W82-02187 1505 3F

KREUTZBERGER, W.
Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 1510 5B

KREUTZWISER, R.
The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 1505 6B

KREUZER, H.
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 1507 8A

KRISCHAN, T. M.
Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 1510 5B

KRISHNA, J. H.
A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 1511 2E

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 1508 2A

KRISHNA MURTHY, I.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

KRISHNAMOORTHI, K. P.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

KRISHNAMURTI, T. N.
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 1511 2B

KRISHNAN, A.
Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 1511 2I

KRISHNAPPAN, B. G.
Ice Cover Effects on Stream Flows and Mixing,
W82-02698 1506 2C

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 1507 2E

Suspended Sediment in a Wave Field,
W82-06527 1512 2J

KRISHNASWAMI, S. K.
Protecting the Source,
W82-05785 1511 5F

KRISTIANSEN, R.
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 1507 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 1507 5D

KROFTA, M.
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 1512 5F

KROGMAN, K. K.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

KROLL, R.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

KROMM, D. E.
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

KRONBERG, B. I.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

KRONFELD, J.
Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 1511 2F

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 1503 2F

KRONIS, H.
Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

KROPOTKIN, M. A.
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 1506 5A

KROTHE, N. C.
Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 1502 7B

KROVACEK, K.
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 1510 5A

KRUER, S. A.
Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

KRUGER, D.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

KRUGER, D. M.
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

KRUGER, G. H. J.
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 1506 5C

KRUGER, L. -R.
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

KRUGLOVA, A. N.
The Importance of Lacustrine Zooplankton to the Feeding Capacity of the Lizhma Lake-River System (Basin of Lake Onega).
W82-05508 1511 2H

KRUIZE, R. R.
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 1502 5F

KRULIKAS, R. K.
Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

KRUMHARDT, A. P.
Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

KRUP, M.
Denitrification,
W82-01246 1503 5D

KRUPNICK, A. J.
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 1504 6E

KRUSE, E. G.
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 1502 3F

KRUSE, H.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

KRUTZSCH, W. C.
Design Considerations in Waterworks Pumps Selection,
W82-06343 1512 8C

KRYLOVA, E. V.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 1504 8A

KU, H. F. H.
Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

KU, Y.
Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 1511 5D

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 1511 5B

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 1511 5D

KUAN, S. S.
Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

KUBAREWICZ, J. W.
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

KUBLER, B.
Chemical and Hydrological Heterogeneity of Groundwaters in the Upper 'Jura Neuchatelois', Switzerland. (Heterogeneite Chimique et Hydrologique Des Eaux Souterraines D'un Karst Du Haut-Jura Neuchatelois, Suisse),
W82-03794 1509 2K

KUBO, T.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 1502 5A

KUBOTA, H.
Automatic Monitoring of Exhaust Gas Analysis in Activated Sludge Wastewater Treatment Process,
W82-04014 1509 5D

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 1511 5D

KUCHMA, S. R.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

KUCZERA, G.
Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 1512 2A

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05499 1511 2A

Robust Flood Frequency Models,
W82-06319 1512 2E

KUDEYAROV, V. N.
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 1508 5B

KUDEYAROVA, A. Y.
Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 1508 5B

KUDO, A.
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

KUDRYAVTSEV, V. M.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 1504 2H

KUE, C. Y.
Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 1512 7C

KUEBLER, B. W.
Computer Modeling of Los Angeles Water Resources,
W82-01168 1503 6A

KUEHL, D. W.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 1503 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 1511 5A

KUES, G. E.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

KUETTNER, J. P.
Report on the Summer MONEX Field Phase,
W82-00265 1501 2B

KUFS, C.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5G

KUGE, T.
A New Indicator of the Activated Sludge Process - Nitrous Oxide,
W82-04018 1509 5D

KUGIMOTO, M.
Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 1507 5A

KUIJVENHOVEN, L. J.
Fluid Flow Patterns in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 1511 5D

KUIPER, L. K.
A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 1503 2F

KUKLA, G.
Summer Ice and Carbon Dioxide,
W82-01843 1504 2C

KULATHILAKE, A. I.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 1502 5A

KULKARNI, V. N.
Ski-Jump Spillway for India's Ukai Dam,
W82-02430 1505 8A

KULP, K. P.
Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 1512 2H

KUMAR, A.
Discussion of 'Turbulence Prediction in Open Channel Flow',
W82-03781 1509 8B

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 1503 2I

KUMAR, D.
Flow Under Weir on Scoured Bed,
W82-05800 1511 8B

KUMAR, K. D.
Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 1511 5C

KUMAR, M. B.
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

KUMAR, M. S. M.
Parametric Study of Flood Wave Propagation,
W82-03425 1508 2E

KUMAR, P.
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 1507 5D

KUMAR, S.
Application of SCS Infiltration Model,
W82-06872 1512 4D

KUMAR, V.
Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 1507 3F

KUMMEL, M.
Computer Control of Nitrifying and Denitrifying Activated Sludge Process,
W82-04025 1509 5D

KUNII, H.
Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 1512 5C

KUNJUR, J.
Electroplating and Cyanide Wastes,
W82-06798 1512 5D

KUNKLE, S. H.
Acid Precipitation, A Review,
W82-06794 1512 5C

KUNKLER, J. L.
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 1501 5B

KUNOGI, R.
Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

KUNST, M.
Proton Mobility in Ice,
W82-03701 1508 2C

KUNTZ, K. W.
Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 1512 5A

KUNTZE, E.
Northern Elbe Culvert,
W82-05427 1511 8B

KUNZ, H.
Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 1511 5E

The Unterweser Automatic Water Quality Measurement System,
W82-04588 1510 5A

KUNZL, R.
Methane in Groundwater and Its Effect on 14 C Groundwater Dating,
W82-03801 1509 7B

KUO, C. Y.
Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 1512 5E

KUO, J-T.
The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 1507 2H

KUPERMAN, V. L.
Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 1506 8A

KURAMOTO, N.
Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

KURANZ, J. H.
Distribution System Liability,
W82-01028 1502 5F

KURATTI, L. G.
Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 1512 5D

KURIHARA, Y.
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

KURITA, H.
On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 1506 2H

KUROKAWA, Y.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

KURSTAK, E.
Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

KURTZ, J.
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 1503 5B

KURZWEG, D.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

KUSAKA, Y.
Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

KUSHNER, D. J.
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 1501 5A

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 1503 5C

KUSS, F. R.
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 1501 2J

KUTUNIN, D. N.
Salinity and Biogenic Material in the North Caspian,
W82-03155 1507 4A

KUTZNER, C.
The Value of Inspection Galleries,
W82-06204 1512 8D

KUUSISTO, E.
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 1503 2C

KUWAHARA, T.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

KUWATA, T.
A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

KUZ'MENKO, M. I.
Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1511 1A

KUZNETSOVA, L. P.
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

KUZNETSOVA, M. A.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 1504 2H

KVARATSKHELIYA, L. L.
Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 1512 8B

KVENVOLDEN, K. A.
Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

KVON, V. I.
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 1512 2H

KWAN, K. K.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

KWIATKOWSKI, R. E.
Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 1503 7A

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 1503 2H

KWOK, TT.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

KYLE, S. W.
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 1511 5B

KYNE, J. M.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

LA FRANCE, P.
Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

LA ROSE, H. R.
Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

LAAK, R.
Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

Mutlichamber Septic Tanks,
W82-00969 1502 5D

LAANE, R. W. P. M.
Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 1511 2L

LABADIE, J. W.
Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

Optimal Control of Reservoir Discharge Quality Through Selective Withdrawal,
W82-04204 1509 5G

Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 1510 8A

Recreational Enhancement of High Country Water Supply Reservoirs,
W82-03923 1509 6A

Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03079 1507 2A

LABANAUSKAS, C. K.
Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

LABAR, G. W.
Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 1512 8I

LABAUGH, J. W.
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 1502 5G

LABEL, G. L.
Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

LABELLE, R.
Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 1511 5C

LABELLE, R. L.
Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 1501 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

LABHSETWAR, V. K.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

LABIB, T. M.
Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 1506 2J

LABOUNTY, J. F.
Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

LABUTINA, T. M.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 1504 2H

LACEWELL, D.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 1512 3F

LACHANCE, M.
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 1506 2K

LACHER, M.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 1502 2H

LACINA, W. V.
Shock Load of Chromium (VI),
W82-05253 1511 5D

LACKEY, S. L.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

LACKINGTON, D. W.
The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

LACROIX, G.
Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 1505 2L

LACROIX, S. J.
Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 1510 5A

LACY, W.
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 1502 5B

LADD, T.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

LADOWSKI, J. A.
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

LAFFONT, C.
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 1508 5A

Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 1508 5A

LAFLEN, J. M.
Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 1505 2J

Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 1501 2J

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

LAGANA, A.
Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

LAGE, O. E.
BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

LAGER, J. A.
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

LAGREGA, M. D.
Managing Hazardous Wastes,
W82-02252 1505 5E

LAHAV, E.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 1504 3F

LAHIRI, A.
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 1510 2B

LAHL, U.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

LAING, A.
Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 1501 6D

LAIRD, A. D. K.
Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

Heat Transfer in a Rotating Disk Evaporator,
W82-06112 1512 3A

LAIRD, C. E.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01579 1503 5C

LAIRD, M. G.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

LAISHEY, R.
Tanzania's Master Water Plan Will Miss Decade Goal,
W82-04657 1510 5F

LAKE, P. S.
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 1507 5C

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

LAKHE, S. B.
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 1501 5D

LAKSHMINARAYANA, J. S. S.
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

LAL, D.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 1503 2F

LALIBERTE, P.
Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 1512 5B

LAM, C. S.
Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 1512 2J

LAM, C. W. Y.
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 1503 5C

LAMB, C. E.
Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 1511 7C

LAMB, D. S.
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 1502 5F

LAMB, J. D.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

LAMB, T. J.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 1503 8A

LAMBERT, J. L.
Revised Rainfall Frequency Analysis for Houston,
W82-05863 1511 2B

LAMBERT, L.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

LAMBERT, P. W.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

LAMBERT, T. W.
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

LAMBETH, V. N.
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

LAMBOU, V. W.
Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 1511 5A

LAMKA, K. G.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 1501 5A

LAMM, F. R.
The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 1505 2I

LAMOTTA, E. J.
Simplified Mathematical Models for a Fluidized Bed Biofilm Reactor,
W82-03877 1509 5D

LAN, B. Y.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

LANCASHIRE, P. D.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

LANCASTER, R. L.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 1503 3E

LANCE, J. C.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 1502 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 1502 5B

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 1501 5D

LAND, J.
Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 1512 5D

LAND, L. F.
Mathematical Simulations of The Toccoa Falls, Georgia Dam Break Flood,
W82-03920 1509 2E

LAND, L. S.
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

LANDEL, P. A.
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

LANDERS, D. H.
Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 1512 5C

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

LANDIM, P. M. B.
Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

LANDINE, R. C.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

LANDNER, L.
Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 1507 2H

LANDOLT, M. L.
Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 1506 5C

LANDRETH, R. E.
Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

LANDRUM, P. F.
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 1512 5A

LANDSBERGER, S.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

LANE, A. G.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 1504 5D

LANE, L. J.
Concentrated Flow Relationships,
W82-01409 1503 2J

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

LANFEAR, K. J.
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

LANG, D. S.
Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 1507 2H

LANG, G. E.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

LANG, H.
Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

LANG, J.
Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

LANGE, W.
The Tidal Stream in the German Bight,
W82-05190 1511 2L

LANGELAND, A.
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

LANGELAND, G.
Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 1512 5A

LANGER, G.
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 1503 7B

LANGNER, C. L.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

LANGOWSKA, I.
Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 1511 5G

LANGWORTHY, V. W.
Management Training is the Key to Good Operator Performance,
W82-00623 1502 5D

LANNON, J. M.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

LANTER, N. L.
A Treatment System for an Organic Chemicals Plant,
W82-04353 1510 5D

LANTOS, J.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

LANYON, R.
Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5G

LANZA, G. R.
Substrate Associated Microfauna,
W82-01283 1503 5C

LAOHAVIRANIT, L.
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

LAPEN, R. F.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

LAPHAM, W. W.
Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 1501 2A

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

LAPKINA, L. N.
The Use of Leeches to Identify Pesticides in Water,
W82-02075 1504 5A

LARDEAU, J.-P.
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

LARGE, J. M.
The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

LAROCHE, M.
Continuous Denitrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

LAROCK, P. A.
Water-To-Air Fractionation of Bacteria,
W82-00575 1502 5B

LARONNE, J. B.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 1511 3B

LARRANCE, J. D.
Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 1505 2L

LARSEN, C. E.
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 1502 6E

LARSEN, D. P.
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

LARSEN, I. L.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

LARSEN, P.
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 1505 4A

LARSON, C. L.
An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 1501 2G

LARSON, D. T.
Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

LARSON, D. W.
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 1505 2H

LARSON, G. L.
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 1502 6A

Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 1503 6A

LARSON, J. S.
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 1501 2I

LARSON, R. A.
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 1511 5A

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

LARSON, R. J.
Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 1508 5B

A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 1512 5D

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 1501 5A

LARSON, W. E.
Crop Residue Removal and Tillage Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 1502 3C

LARSSON, P.
Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

LASHCHENOV, S. YA.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

LASKOWSKI-HOKE, R. A.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 1504 5C

LASTOCHKINA, K. O.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

LASZLO, E.
Geothermal Energy: An Old Ally,
W82-02333 1505 2F

LASZLO, F.
A Large International River: The Danube,
W82-03369 1507 5G

LATHER, P.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

LATINOPOULOS, P.
Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 1510 8B

The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 1510 4B

LATTEN, A.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 1502 5D

LATTERELL, J. J.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

LAU, L. S.
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

Sewage Irrigation and Recharge Consequences, Oahu,
W82-04041 1509 3C

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 1502 5C

LAU, S. L.
Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

LAU, Y. L.
Bed Load Discharge Coefficient,
W82-02936 1506 2J

Discussion of 'Visualization of Separation over Sand Waves',
W82-03783 1509 8B

Ice Cover Effects on Stream Flows and Mixing,
W82-02698 1506 2C

Velocity Distributions Under Floating Covers,
W82-05562 1511 2E

LAUBE, V. M.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 1503 5C

LAUENROTH, W. K.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

LAUER, W. L.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

LAUGHLIN, D. H.
The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 1508 6B

LAUGHTON, P. J.
Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 1510 5D

LAULETTA, T.
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 1506 5E

LAURENT, E. L.
How Appleton Reduced Phosphorus,
W82-06249 1512 5D

LAVANIA, B. V. K.
Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

LAW, A.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

LAW, F. C. P.
Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 1508 5C

LAW, J. P. JR.
The Colorado River Salinity Problem,
W82-05889 1511 5G

LAW, R. J.
Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 1504 5B

LAWRENCE, D. F.
Salinity Forum: What. How. Why,
W82-02587 1505 6E

LAWRENCE, J.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 1502 5F

LAWRENCE, S. G.
An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

LAWS, E. A.
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 1503 2H

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 1512 5C

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 1512 5C

LAWSON, P.
A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 1512 6B

LAX, F.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

LAXEN, D. P. H.
Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 1512 5A

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 1503 5B

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 1507 5F

LAYLA, R. I.
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 1503 2F

LAYNE, R. E. C.
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 1501 2I

LAYTON, D. W.
Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

LAZARO, R. C.
Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 1512 2E

Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 1507 2A

LAZERTE, B. D.
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 1512 5C

LAZORCHAK, J. M.
Substrate-Associated Microfauna,
W82-06925 1512 5C

LE LIEVRE, S.
The Welsh Approach to Water Recreation,
W82-04658 1510 6D

LEACH, J. H.
Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 1504 5D

LEACH, L. E.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

LEADBETTER, M. R.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01806 1504 5B

LEAN, D. R. S.
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 1505 2H

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

LEANEY, F. W.
Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648 1511 2D

LEASK, S. M.
Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario,
W82-04031 1509 2K

LEATHEM, W. A.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

LEATHERLAND, T. M.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 1502 6E

LEAVENWORTH, S. W
Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 1510 6E

LEAVITT, J. R. C.
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 1512 5B

LEBEDEVA, T. V.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

LEBEL, G. L.
Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00675 1502 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 1502 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 1504 5B

LEBEL, J.
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 1502 7B

LEBERT, J. E. JR.
Year-Round Distribution System Maintenance,
W82-04699 1510 5F

LEBLANC, D. R.
Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

LEBOFF, J. P.
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 1511 5G

LECH, J. J.
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 1501 5C

LECHEVALIER, M. W.
Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

LECHEVALLIER, M. W.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 1501 5A

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 1501 5A

Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 1510 5A

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 1501 5B

LECKIE, J. O.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 1503 5F

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 1512 5A

LECLERC, H.
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 1501 5A

LECOLLE, P.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

LECOMTE, R.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

LECROY, S. R.
Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 1512 7C

LEDERMAN, P. B.
Managing Hazardous Wastes,
W82-02252 1505 5E

LEDERMAN, T. C.
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 1512 5B

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

LEDGER, D.
Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

LEE, D. R.
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

LEE, D. Y.
The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

LEE, E. G-H.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 1502 5C

LEE, F. N.
Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

LEE, G. B.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

LEE, G. F.
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 1510 5C

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 1512 5C

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 1508 6B

LEE, H-B.
Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychiorinated Biphenyl Quality Control Studies,
W82-03224 1507 5A

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 1512 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 1512 5A

LEE, J. H.
Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

LEE, J. H. W.
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 1510 7C

LEE, J. J.
Effects of Acid Precipitation,
W82-05149 1511 5C

Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 1511 5C

LEE, M. T.
Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 1510 2J

LEE, M. Y.
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 1503 3D

Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

LEE, R. F.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

LEE, T. L.
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 1508 5D

LEE, Y.-N.
Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 1511 2K

LEED, J. A.
Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 1510 5B

LEENHEER, J. A.
Migration Through Soil of Organic Solutes in An Oil-Shale Process Water,
W82-03640 1508 5B

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

LEENTVAAR, J.
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 1512 5D

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

LEFRANCOIS, P. R.
The Real Price of Urban Water,
W82-04797 1511 6C

LEFTWICH, D. B.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

LEGENDRE, L.
Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 1510 2L

LEGENDRE, P.
A Water Quality Index for Lake Beaches,
W82-06660 1512 5G

LEGERON, J. P.
Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 1512 5D

LEGGATT, E. A.
Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 1512 5B

LEGGE, G. H. H.
Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 1502 8D

LEGGE, W. C. S.
Design Technique Development for Dams in South Africa,
W82-06011 1512 8A

LEGGETT, D.
Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

LEGGETT, D. C.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 1502 5D

LEGRAND, H. E.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 1503 5E

Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 1505 2F

LEHMAN, J. T.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 1511 2H

LEHMAN, O. R.
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

LEHMAN, W. F.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

LEHMICKE, L. G.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

LEHOLM, A. G.
Potential Impact of Ground Water Policy Alternatives on Nebraska Agriculture, 1977-2020,
W82-03826 1509 6B

LEHR, J.
Sampling and Analyzing Water,
W82-05263 1511 5A

LEHRE, A. K.
Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

LEIGHTON, J. P.
Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 1511 4B

LEINSTER, P.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

LEITH, W.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

LEITNER, P.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

LEKAN, J. F.
The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

LEKKAS, T. D.
Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

LELAND, D. E.
A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

LELONG, F.
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

LEMBI, C. A.
Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 1510 2H

LEMERT, G. W.
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

LEMKE, A. E.
The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

LEMLIN, J. S.
The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 1504 5G

LEMLY, A. D.
Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 1512 5C

Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 1512 5C

LEMON, D.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 1504 2H

LEMON, E.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 1504 2H

LEMUNYON, R. M.
Feasibility Studies on Liquid Ion Exchange for Alum Recovery from Water Treatment Plant Sludges,
W82-04107 1509 5E

LENAT, D. R.
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06157 1512 5C

LENHART, T. E.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

LENNOX, L. J.
An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 1512 5A

LENOVA, L. I.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 1504 5C

LENTZ, J. J.
Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 1503 2G

LEO, J. N.
Fluoridation System,
W82-00061 1501 5F

LEONARD, E. N.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 1503 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

LEONARD, R. A.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 1503 5B

LEONARDSON, L.
Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 1505 2K

LEONI, V.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

LEPILOVA, YE. A.
An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

LEPPANEN, O. E.
Evapotranspiration from Forage Grass Replacing Native Vegetation in the Gila River Valley of Arizona,
W82-03994 1509 2D

LEPPARD, G. G.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

LEPRINCE, A.
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

LERDTHUSNEE, W.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

LERMAN, J. C.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

LESCHBER, R.
Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 1508 5E

Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 1510 7B

LESCHINE, T. M.
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 1501 2L

LESEMAN, W. G.
Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 1512 5D

LESEUR, L.
Groundwater Pollution from Industrial Waste Disposal, A Case Study.
W82-06434 1512 5B

LESLEY, D. E.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

LESLIE, J. K.
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 1502 6G

LESOUEF, A.
The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 1512 5G

LESSER, J. M.
Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 1511 4B

LESSIG, D. C.
Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

LESSING, P.
Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

LESTER, J. N.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 1512 5D

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 1511 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 1503 5E

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 1512 5D

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 1512 5D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 1502 5D

Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 1508 5D

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 1511 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 1507 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 1512 5D

LETOLLE, R.
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

LETTENMAIER, D. P.
Data Requirements for Kriging: Estimation and Network Design,
W82-04200 1509 7A

Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

LETTERMAN, R. D.
Economic Analysis of Granular-Bed Filtration,
W82-00975 1502 5F

Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

LEUNG, P. S. K.
Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

LEUNG, S.-Y. T.
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 1508 5B

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 1512 5B

LEUNG, T-S.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

LEUTHART, C. A.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

LEVESQUE-MADORE, C. S.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5B

LEVI, A.
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 1505 5D

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 1505 5D

LEVI-MINZI, R.
Humic Substances in Sewage Sludges,
W82-05576 1511 5E

LEVIN, A. I.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

LEVINE, P. R.
Industry Helps Conserve Municipal Water,
W82-05574 1511 3E

LEVINGS, G. W.
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 1503 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

LEVINGS, J. F.
Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 1505 7C

LEVNO, A.
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

LEWANDOWSKI, R.
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

LEWANDOWSKI, W.
A Survey of Aerated Lagoon Performance,
W82-06391 1512 5D

LEWANDOWSKI, Z.
Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 1510 5D

LEWIN, J.
Hydraulic Gates,
W82-02206 1505 8C

Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 1507 5C

LEWIS, B. D.
Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5B

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03934 1509 5B

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

LEWIS, B. J.
Safety Considerations in Handling Activated Carbon,
W82-05442 1511 5D

LEWIS, D. H.
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

LEWIS, D. W.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

LEWIS, N. M.
Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 1510 5B

LEWIS, R. F.
Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 1510 5D

LEWIS, R. G.
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 1512 5A

Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 1511 5A

LEWIS, W. J.
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

LEWIS, W. M.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

LEWIS, W. M. JR.
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

LEY, T. W.
Furrow Irrigation Practices in Northern Colorado,
W82-00139 1501 3F

LEYDEN, D. E.
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 1503 5A

LI, N. N.
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

LI, R-M.
Flow Resistance in Vegetated Waterways,
W82-00152 1501 2E

Modeling Rill Density,
W82-02604 1506 2J

Resistance Equation for Large-Scale Roughness,
W82-04696 1510 2E

LIAW, W. K.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 1502 2J

LIBARDI, P. L.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

LIBBY, A. E.
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

LIBBY, L. W.
Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 1506 6B

LIBERTI, L.
An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 1512 5D

LIBRACH, A. S.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

LICARI, G. R.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

LICHTE, H. W.
Performance Testing of Four Skimming Systems,
W82-05059 1511 5G

Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 1510 5G

LICK, W.
The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 1510 2H

LICK, W. J.
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

LIDER, E. L.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

LIEB, H. S.
Disaster by Flood,
W82-04618 1510 2E

LIEBEZEIT, G.
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 1507 2L

LIEBMAN, J. C.
Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 1510 5D

Optimization of Looped Water Distribution Systems,
W82-04045 1509 6A

LIECHTY, B.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

LIEDKE, P.
Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

LIEDY, R. B.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 1504 5B

LIEU, S. M.
Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 1506 7B

LIEW, P.-F.
Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 1501 2L

LIGGETT, J.
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 1506 8B

LIGGETT, J. A.
BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

LIIV, U. R.
Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 1512 8B

LIJKLEMA, L.
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 1502 2H

LIKENS, G. E.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 1502 2K

'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

Chemical Flux in an Acid-Stressed Stream,
W82-03338 1507 5C

Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 1512 2K

Phosphorus, Nitrogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

Recent Acidification of Precipitation in North America,
W82-01514 1503 5B

LILLEY, M. D.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

LIMA, V. M. S.
Relaxation in Concrete,
W82-05511 1511 8F

LIMONI, H.
Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 1503 3C

LIN, H.
Bacteria: Man's Allies in Water Pollution Control,
W82-01150 1503 5D

LIN, J. S.
Determination of Dissolved Organic Carbon in Water,
W82-02194 1505 5A

LIN, K-C.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 1501 5D

LIN, S.
Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

LINCER, J. L.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

LINDBERG, S.
Field Report on a Nonpolluting Bleach Plant,
W82-02793 1506 5D

LINDBERG, S. E.
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 1503 5B

LINDEN, D. R.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

LINDHOLM, G. F.
Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 1506 2F

Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

LINDNER, J. B.
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

LINDSAY, A. H.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

LINDSAY, B. E.
An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 1511 6A

LINDSEY, A. K.
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 1512 6C

LINDSEY, J. L.
Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 1505 4A

LINDSTROM, E. B.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

LINDSTROM, K. P.
Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

LINDSTROM, M. J.
Crop Residue Removal and Tillage: Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

LINDSTROM-SEPPA, P.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

LINES, G. C.
Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

LINGEMAN, R.
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 1510 2H

On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 1505 2H

Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 1508 2H

LINK, A. N.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 1503 6F

LINK, M. H.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

LINNIK, P. N.
Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 1502 5A

Procedure for Investigating Metallic Ion Complexing in Natural Waters,
W82-05595 1511 5A

LINSMITH, M. J.
A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

LINSTEDT, D.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

LINTHURST, R. A.
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

LINTON, T. L.
A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 1505 7A

LINZELL, L. E.
Hydropower: Inflation-Proof Energy from Water Supply Dams,
W82-04137 1509 6B

LION, L. W.
Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 1512 5A

LIONEL, T.
Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

LIONG, S.-Y.
Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 1512 2F

LIOR, N.
Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 1512 3A

LIOTTA, F. P.
Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

LIOU, J. K.
Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 1512 5C

LIPINSKI, P.
A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

LIPPERT, T. E.
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

LIPPIATT, B. C.
Water Rates and Residential Water Conservation,
W82-06276 1512 5D

LIPPMAN, M. J.
Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 1502 3E

LISAUSKAS, R.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

LISLE, I. G.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 1504 2G

LIST, R.
The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 1512 2B

LITCHFIELD, J. H.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 1503 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 1512 5D

LITMANEN, R.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

LITTEN, W.
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5B

LITTIN, G. R.
Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 1511 7C

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

LITTLE, L.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 1510 5D

LITTLE, L. W.
Bioassays - Procedures and Results,
W82-01277 1503 5A

Bioassays - Procedures and Results,
W82-06810 1512 5A

LITTLE, M. D.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

LITTLE, W. C.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 1501 2J

LITTLEWORTH, A.
New Legislation in California and Its Effects,
W82-03731 1508 6E

LITVIN, O. N.
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 1512 2J

LITVINOV, N. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 1504 6E

LITWIN, Y. J.
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

LIU, C. C. K.
Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 1511 5B

LIU, D.
Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 1506 5D

The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 1512 5C

LIU, C. L.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

LIU, P. L-F.
BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

Boundary Calculations of Sluice and Spillway Flows,
W82-02677 1506 8B

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

LIUM, B. W.
Effect of Filtration Pressure on Analyses for Chlorophyll,
W82-04247 1509 2H

LIVELY, R. S.
Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

LIVERMAN, D.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 1510 5D

LIVINGSTON, J. M.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

LIVINGSTON, R. K.
Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

LIVINGSTONE, D.
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

LLOYD, A.
A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 1511 5A

LLOYD, B. J.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 1502 5D

LLOYD, J. W.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 1505 2F

Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 1507 2F

LLOYD, O. B. JR.
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

LO, A.
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 1507 3B

LO, C.
Organics,
W82-06922 1512 5A

LO, M. P.
A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

LOBANSKAYA, N. P.
Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

LOCK, J.
Deep Shaft,
W82-05793 1511 5E

LOCK, M. A.
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 1511 5B

LOCKMAN, H.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

LOCKYEAR, C. F.
Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 1511 5E

LODER, T. C.
The Dynamics of Conservative Mixing in Estuaries,
W82-02345 1505 2L

LOEB, S. L.
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 1502 7B

LOESER, C. A.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

LOEW, R. K.
Densification of Paper Mill Sludge Materials,
W82-04694 1510 5E

LOFFLER, H.
Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 1508 2H

LOFFREDO, J. C.
A Solution to Spring Ice-Jam Flooding,
W82-02908 1506 2C

LOFTIS, J. C.
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

LOGAN, B. E.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 1504 5C

LOGAN, T. J.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

LOGANATHAN, G. V.
Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 1511 4A

LOGSDON, G. S.
Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

Getting Your Money's Worth from Filtration,
W82-06412 1512 5F

Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

LOH, I. C.
Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 1503 6A

LOH, P. C.
Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-03446 1511 5D

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 1502 5C

LOHANI, B. N.
Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

LOHMAN, L. C.
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

LOHMANN, J.
Control of Dissolved Oxygen in Activated Sludge Plants,
W82-04061 1509 5D

Measurement and Control of the MLSS Concentration in Activated Sludge Plants,
W82-03762 1509 5D

LOHRBERG, K.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

LOIJENS, H. S.
Stormwater Management in the Ottawa-Carleton Region,
W82-05563 1511 5G

LOITSYANSKII, L. G.
Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 1512 8B

LOMAX, K. M.
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 1512 5D

LOMAX, P.
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 1501 5A

LOMBARD, R. E.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

LOMBARDO, P.
Expanding Options for Greywater Treatment,
W82-06491 1512 5D

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

LOMEN, D. O.
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 1501 2I

LONDON, W. B.
Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 1511 6B

LONDQUIST, C. J.
Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 1501 4B

LONG, J. C. S.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

LONG, J. M.
Interim Method for Determining Asbestos in Water,
W82-00741 1502 5A

LONG, J. P.
High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

LONG, R. B.
Primary and Secondary Impacts of a Water Resource Development Project,
W82-03907 1509 6B

LONGLEY, K. E.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

Drinking Water Disinfection,
W82-06341 1512 5F

LONGLEY, W. L.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

LONGSINE, D. E.
Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods.
W82-03873 1509 5B

LONNQUIST, C. G.
A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

LOOMIS, S. A.
Erosion from Mountain Snowpack Melt,
W82-05664 1511 2J

LOONEY, B. B.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

LOOSE, V.
Water Supply and Demand in an Energy Supply Model,
W82-00050 1501 6D

LOOYENGA, R. W.
The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

LOPEZ-AVILA, V.
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

LOPEZ-GONZALES, J. DE D.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

LOPEZ, J. G.
Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

LORAH, W. L.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 1504 3C

LORD, C. J. III
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

LORD, W. B.
Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 1512 3D

Municipal Water Supply Restrictions as Urban Growth Constraints,
W82-05748 1511 3D

Objectives and Constraints in Federal Water Resources Planning,
W82-04288 1510 6E

LORDA, E.
A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 1505 5C

LORDI, D.
Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

LORDI, D. T.
Fate of Priority Pollutants in Large Municipal Treatment Plants,
W82-03867 1509 5B

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5G

LORENZ, R. C.
Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 1512 5C

LORING, D. H.
Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 1512 2K

LOTSPEICH, F. B.
A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 1512 8I

Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 1510 7C

LOU, W. C.
Mathematical Modeling of Earth Dam Breaches,
W82-03532 1508 8A

LOUCKS, D. P.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 1504 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Robustness of Water Resources Systems,
W82-05077 1511 6A

LOUCKS, O. L.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

LOUIS, C.
Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1506 1B

LOUTIT, M.
Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment,
W82-03758 1509 5B

LOVE, F. G.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

LOVE, O. T. JR.
Removing Trihalomethanes from Drinking Water,
W82-00952 1502 5F

LOVERIDGE, C.
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 1502 5C

LOVLEY, D. R.
Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

LOW, N. F.
Rutland Water Raw Water Quality - Problems and Management,
W82-06475 1512 5G

LOW, W. H.
Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

LOWE, D. R.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 1504 2J

LOWE, R. L.
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

LOWER, G. W.
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

LOWHAM, H. W.
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

LOWING, M. J.
Flood Event Modeling - A Study of Two Methods,
W82-02291 1505 2A

LOWRANCE, R. R.
Nutrient Cycling in an Agricultural Watershed: Waterborne Nutrient Input/Output Budgets for the Riparian Zone,
W82-03825 1509 5B

LOWRY, J. D.
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 1512 5D

LOWRY, J. H.
Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-03360 1511 5A

LOWTHION, D.
Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 1512 5C

LOZEJ, A.
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 1512 2F

LOZINSKAYA, E. A.
Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 1511 2D

LUBBERS, J. R.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

LUBON, P.
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

LUCAS, J.
Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

LUCAS, J. L.
Groundwater Quality in the Severn-Trent Region,
W82-02423 1505 5A

LUCAS, S.
The Roman Way,
W82-02744 1506 5F

LUCCHITTA, I.
Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 1505 2A

LUCENA, F.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

LUCERO, F.
Water Related Planning and Design at Energy Firms,
W82-00042 1501 6D

LUDINGTON, D. C.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 1502 5B

LUDOVICI, P. R.
Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 1506 3C

LUDWICK, J. C.
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 1501 2L

Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 1511 2L

LUDWIG, H. F.
Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 1511 6G

LUDWIG, K. L.
Foam Control in Aeration Tanks,
W82-00525 1502 5D

LUDWIG, K. R.
James Bay Spillways and Control Structures,
W82-04692 1510 8A

LUDWIG, R.
Concepts in Aquatic Treatment System Design,
W82-02593 1505 5D

LUDWIGS, R. S.
Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

LUE-HING, C.
Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

Fate of Priority Pollutants in Large Municipal Treatment Plants,
W82-03867 1509 5B

Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5G

LUECKE, R. H.
Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 1501 5D

LUIKEN, R. L.
Water Rate Studies and Rate Making Philosophy,
W82-06222 1512 6C

LUKASIK, E. D.
Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

LUKIN, I. N.
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 1511 8C

LUM, L. W. K.
Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 1511 2H

LUMBERS, J. P.
Risk Analysis in the Planning, Design and Operational Control of Water Pollution Prevention Schemes- A Perspective,
W82-03857 1509 5G

LUND, D. E.
Empire Controlled by Computer,
W82-00529 1502 5D

LUND, J. W. G.
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

LUND, L. J.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

Nitrogen Balances for an Efficient Irrigation Area,
W82-01478 1503 3C

LUND, Z. F.
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

LUNDBLAD, P. O.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

LUNDSTROM, K.
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 1512 5B

LUNSFORD, C. A.
Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 1505 5B

LUPIN, H. M.
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

LUTHIN, J. N.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

LUTHY, R.
Leach Characteristics of Coal-Gasification Char,
W82-01025 1502 5B

LUTHY, R. C.
Treatment of Coal Gasification Process Wastewaters,
W82-00434 1501 5D

LUTHY, R. G.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 1502 5D

Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 1503 5F

LUTZ, G. A.
Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 1510 7B

LUXMOORE, R. J.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 1503 2G

LUXON, E. G.
Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

LY, C. K.
The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 1512 2J

LYATKHER, V. M.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

Numerical Methods in Hydraulics,
W82-06614 1512 8B

LYLE, W. M.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01839 1504 3F

LYNCH, D. D.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 [illegible]

LYNCH, D. R.
Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 1511 5B

Models of Landfill Leaching: Organic Strength,
W82-05817 1511 5B

LYNCH, J. A.
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 1511 4C

LYNN, S.
Solvent Extraction of Phenols,
W82-00438 1501 5D

LYON, R. M.
Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 1510 6E

LYONS, E. E.
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 1506 2I

LYONS, W. B.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 1502 5B

LYSMER, J.
Response of Buried Structures to Traveling Waves,
W82-03346 1507 8D

LYSYJ, I.
Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 1510 5D

MA, T. S.
Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 1507 5A

MABEY, W. R.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

MABINI, T. P.
Water Resources Apparisals for Hydroelectric Licensing: St. Joseph - Kalamazoo River Basin, Indiana - Michigan,
W82-03044 1507 6D

MACALADY, D. L.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 1512 5A

MACAULEY, P.
Water Requirements for Industrial Development,
W82-04117 1509 6D

MACCHI, G.
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 1502 5A

MACCHIARELLA, G.
A Rain Attenuation Model for the Sirio-SHF Experiment,
W82-06530 1512 7B

MACCONNELL, W. P.
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 1501 2I

MACCUBBIN, A. E.
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 1512 2L

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 1503 5G

MACDONALD, R. D.
Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 1512 2J

MACDONALD, R. M.
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 1501 5A

MACDONALD, R. W.
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 1510 5A

MACDONELL, M. T.
Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 1512 5A

MACE, H. A. F.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

MACEINA, M. J.
The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 1511 4A

MACGREGOR, A. N.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 1511 3C

MACINTYRE, S.
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 1508 2H

MACIOROWSKI, A. F.
Bioassays - Procedures and Results,
W82-01277 1503 5A

Bioassays - Procedures and Results,
W82-06810 1512 5A

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 1502 5A

MACK, F. K.
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

MACK, S.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00331 1502 2F

MACKAY, D. C.
Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 1511 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

MACKAY, G. H.
Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 1511 4A

MACKENZIE, C. J. G.
Water Quality Management in British Columbia,
W82-05767 1511 5C

MACKENZIE, D.
An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

MACKIERNAN, G. B.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
W82-02115 1505 6G

MACKIN, J. E.
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 1508 2H

MACKINNON, M.
A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 1503 2H

MACKNIGHT, H.
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

MACKO, C. A.
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 1503 5F

MACLAY, R. W.
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

MACLEISH, J. H.
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

MACLEOD, D. A.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

MACLEOD, D. C.
Sludge Disposal to Sea in South Africa,
W82-06599 1512 5E

MACLOCK, B.
Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 1511 6D

MACPHERSON, J. M.
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 1503 4C

MACRAE, W. R.
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 1502 5A

MACTAVISH, D.
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 1502 5B

MACY, J.
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

MADDOCK, T. III.
An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 1511 2F

MADDOCKS, S. L.
Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 1512 2H

MADDY, K. T.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

MADES, D. M.
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 1503 4A

MADSEN, B. C.
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 1502 5B

MADSEN, H.
Accuracy of Point Precipitation Measurements,
W82-02209 1505 2B

MAEDA, H.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

MAEDA, K.
A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 1512 5C

MAEDA, M.
A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

MAEYER-CLEEMPOEL, S. DE
Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

MAGDOFF, F. R.
Nitrogen Availability from Sewage Sludge,
W82-00158 1501 5E

MAGGERT, J. E.
Superseparation: Soret Effect Reversed,
W82-00791 1502 3A

MAGILL, R. N.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

MAGILLIGAN, F. J.
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

MAGNUSON, J. J.
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 1506 5C

MAGNUSON, M. L.
Upflow Water Filtration Unit, Test Results,
W82-00407 1501 5F

MAGNUSSEN, M. H.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

MAGOUN, A. D.
Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

MAGUIRE, R. J.
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00139 1501 5B

MAH, R. A.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 1502 5A

MAHADEVAN, A.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 1504 5B

MAHAJAN, R. K.
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 1503 2B

MAHAN, M. O.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 1501 3F

MAHAR, L.
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 1510 4B

MAHER, M. D.
The Economics of Urban Stormwater Management,
W82-03508 1508 4A

MAHER, W. A.
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 1505 5B

MAHLER, A.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

MAHMOOD, K.
Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

MAHMOUD, T. A.
Wastewater from a Sugar Refining Industry,
W82-05337 1511 5D

MAIDA, M.
A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

MAIDMENT, D.
Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

MAIDMENT, D. R.
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 1510 6A

MAIER, W. J.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 1510 3D

Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 1501 5A

MAINI, T.
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 1501 5E

MAIOLIE, M.
Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

MAIOLO, J. R.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 1503 5C

MAITY, S. P.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 1504 2I

MAJERLES, R. J.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

MAJETI, V. A.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

MAJI, C. C.
Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows,
W82-03914 1509 3F

MAJIMA, T.
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

MAKI, J. S.
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 1501 5A

MAKITA, T.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 1508 5C

MAKONNEN, G. A.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 1504 2I

MALAIYANDI, M.
Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 1506 5D

MALCOLM, R. L.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

MALCYZK, J. M.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

MALE, L. M.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 1503 5B

MALECHA, S. R.
Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 1503 2H

Polyculture of the Freshwater Prawn, Macrobrachium Rosenbergii, Chinese and Common Carps in Ponds Enriched with Swine Manure I Initial Trials,
W82-03900 1509 3C

MALEVANCHIK, B. S.
Engineering Aspects of Fish Protection at Water Intakes,
W82-04759 1511 8I

MALEY, T. S.
Mineral Law Since Nepa,
W82-06582 1512 6E

MALHERBE, A.
The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 1512 5A

MALIBARI, A.
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

MALINA, J. F. JR.
Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 1511 5A

Chemicals Disinfect Sludge,
W82-01003 1502 5D

MALLER, R. A.
An Analysis of Areal Infiltration Considering Spctial Variability,
W82-02927 1506 2G

MALLORY, M. J.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 1503 6B

MALONE, P. G.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

MALONE, R. F.
Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

MALONE, T. C.
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

MALONEY, L. M.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 1504 2H

MALOY, B. F.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 1501 6A

MALUEG, K. W.
Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 1506 5C

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

MALY, E. J.
The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 1505 7B

The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

MAMARBACHI, G.
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 1508 5A

MAMONTOVA, L. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 1504 5C

MANAHAN, S. E.
Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 1511 5D

MANBECK, D. M.
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

MANCINELLI, G.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

MANCY, K. H.
Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

MANDAL, B. K.
Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 1507 2H

MANDAL, L. N.
Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 1503 3C

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 1504 2H

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 1502 2H

MANDEL, R. M.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

MANDELLI, E. F.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

MANDL, C. E.
A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 1503 6A

MANGINI, A.
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods.
W82-03883 1509 2J

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

MANHEIM, F. T.
Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

MANKA, J.
Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 1501 5A

MANKIN, J. B.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

MANN, D. C.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

MANN, H. S.
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 1507 2B

MANN, J. H.
Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

MANN, P. C.
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 1510 6C

The Real Price of Urban Water,
W82-04797 1511 6C

MANN, P. G.
Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

MANN, R.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 3C

MANNING, J. F. JR.
Fermentation Industry,
W82-06917 1512 5D

MANNING, P. J.
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 1503 6E

MANNING, R.
Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 1511 6C

MANNS, P. V.
Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

MANTAI, K. E.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

MANTELL, A.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

MAPP, H.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

MAR, B. W.
Composite Sampling of Highway Runoff,
W82-02230 1505 7B

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 1511 5B

MARA, D. D.
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 1507 5A

A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 1503 5A

MARAIS, G. V. R.
The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 1507 5D

A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

MARCHAND, J.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

MARCHANT, R.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

MARCUS, M. D.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 1503 5C

Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

MARCUSON, W. F. III
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 1504 8D

MARGARITZ, M.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

MARGLER, L. W.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 1502 5A

MARGREY, S. L.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

MARINER, R. H.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

MARINI, R. C.
Potential Political Influences Affecting the Water Industry,
W82-00861 1502 6C

MARINO, M. A.
Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 1507 6A

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 1507 6A

The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 1511 6A

MARINOS, A. T.
Young's Inequality for Three-Dimensional Flows,
W82-04267 1510 2A

MARK, D. M.
Topologic Model for Drainage Networks with Lakes,
W82-05905 1512 2A

MARKEE, T. P.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

MARKER, A. F. H.
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 1505 5B

MARKEVICH, V. F.
Calculation of Earth Dams Being Undermined,
W82-03162 1507 8D

MARKS, D. H.
Local Irrigation Agencies,
W82-04560 1510 4B

MARKWELL, D. D.
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 1510 5B

MARLIN, J. C.
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 1506 5A

MAROTTE, F. K.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

MAROTZ, G.
Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 1510 3A

MARR, G. L.
Environmental Problems and Geothermal Permitting,
W82-06217 1512 6G

MARRY, J. R.
Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

MARSH, D.
Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

MARSH, D. G.
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 1503 5A

MARSH, F.
Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

MARSH, L.
Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 1512 2H

MARSH, P.
Evaporation at a High Arctic Site,
W82-04899 1511 2D

Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 1505 2A

MARSH, P. B.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 1501 5E

MARSH, T. J.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

MARSHALL, B. E.
The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 1511 2H

MARSHALL, E. J. P.
The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 1507 4A

MARSHALL, G.
Numerical Solution of the Dam Failure Problem by the Random Choice Method,
W82-03872 1509 8A

MARSHALL, J. S.
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

MARSILI-LIBELLI, S.
Estimation and Control Problems in Activated Sludge Processes,
W82-04612 1510 5D

Microprocessor Architecture and Performance in Wastewater Process,
W82-04056 1509 5D

MARSON, H.
Floc/Float System Cleans Desalter Effluent,
W82-00906 1502 5D

MARSON, H. W.
The Successful Treatment of Tanker Ba
Water at a Mediterranean Site,
W82-03703 1508 5D

MARTEL, C. J.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 1502 5D

Vegetation Selection and Management for Overland Flow Systems,
W83-01300 1503 5E

MARTEN, G. C.
Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 1502 3C

MARTENS, C. S.
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 1507 2K

MARTI, O. G.
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 1501 5D

MARTI, V. C.
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 1501 5A

MARTI, YU. YU.
The Azov Sea Problem,
W82-00651 1502 6G

MARTIN, A. JR.
Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

MARTIN, B. B.
Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 1502 5G

MARTIN, C.
Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

MARTIN, C. S.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

MARTIN, C. W.
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

MARTIN, D. F.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 1511 5C

Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 1502 5G

MARTIN, D. J.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

MARTIN, D. K.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

MARTIN, D. L.
Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 1503 5B

MARTIN, G.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

MARTIN, J. D.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

MARTIN, J. H.
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 1511 5A

MARTIN, L. J.
Ground Water in Washington,
W82-02536 1505 2F

MARTIN, M. V.
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 1512 6B

MARTIN, Q. W.
Optimal Design of Water Conveyance Systems,
W82-00160 1501 6B

MARTIN, R. J.
The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

MARTIN, R. S.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

MARTIN, S.
A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 1511 2C

Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 1505 5B

MARTIN, S. B.
Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

MARTIN, S. C.
Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 1511 5B

Aquatic Sediments,
W82-01279 1503 5B

Aquatic Sediments,
W82-06806 1512 2J

MARTIN, W. E.
The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

MARTIN, W. J.
Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 1510 5D

A Retrospective Benefit-Cost Analysis of Water Resource Projects in The Cumberland River Basin,
W82-03917 1509 6B

MARTIN, W. R. B.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

MARTIN, W. W.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 1502 8B

MARTINCIC, A.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

MARTINEC, J.
Areal Distribution of Snow Water Equivalent Evaluated by Snow Cover Monitoring,
W82-03842 1509 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 1504 2C

MARTINEZ, J. D.
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

MARTINOLA, B.
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

MARTONE, C. H.
Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

MARTYNOVA, M. V.
Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 1508 5B

MARX, L. F.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

MASCARENHAS, A. C.
Remote Sensing in Development,
W82-01719 1503 7B

MASHIKO, K.
Biology of Brackish Water, (In Japanese),
W82-04179 1509 2L

MASHNI, C. I.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

MASLIA, M.
Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 1507 6D

MASLIA, M. L.
Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 1510 8D

MASLOVA, O. V.
Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507 1511 5C

MASON, J. M. JR.
On-Site Stormwater Detention: An Overview,
W82-04758 1511 4A

MASON, P. J.
The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 1512 8A

MASON, R. J.
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 1503 5G

MASON, S.
Effluent Charging Systems and Their Administrative Implications,
W82-02403 1505 6C

MASSEY, J. E.
Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 1506 2H

MASSING, H.
The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 1507 5G

MASSOTH, G. J.
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

MASTELLER, M. B.
Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

MASTEN, S. J.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

MASTERS, H.
An Overview of Porous Pavement Research,
W82-05744 1511 5D

Status of Porous Pavement Research,
W82-06665 1512 8G

MASUI, S.
Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

MATHER, J. R.
Using Computed Stream Flow in Watershed Analysis,
W82-01538 1503 2A

MATHES, G. A.
Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 1510 5E

MATHES, G. M.
Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 1512 5G

MATHEW, J.
Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 1511 5A

MATHEWS, W. H.
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 1505 2C

MATHIAS, J. A.
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 1502 2H

MATHIESON, A. C.
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 1502 2L

MATHIEU, G.
Radionuclides in Mono Lake, California,
W82-05461 1511 5B

MATHIS, B. J.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

MATHUR, B.
A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

MATHUR, D.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 1502 5C

MATHUR, R. P.
Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 1512 5D

MATIS, S.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

MATISOFF, G.
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

MATLAK, E. S.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

MATOUSEK, J. P.
Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 1502 5A

MATSCHE, N. F.
Control of Bulking Sludge--Practical Experiences in Austria,
W82-03423 1511 5D

MATSUDA, H.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 1503 3A

MATSUDA, Y.
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 1501 2J

MATSUI, E.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

MATSUI, T.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

MATSUMOTO, G.
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 1501 5B

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 1501 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 1512 5A

MATSUMOTO, J.
Combined Effects of Biological Solids Retention Time and Temperature on the Growth Parameters of Activated Sludge,
W82-04021 1509 5D

Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

MATSUNAGA, I.
Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

MATSUNAGA, T.
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

MATSUO, T.
An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 1505 5G

Studies on Oxygen Transfer Models,
W82-05349 1511 1A

MATSUOKA, AND Y.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

MATSUOKA, I.
Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 1511 7C

MATSUYAMA, M.
Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 1506 2H

MATTER-MULLER, C.
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1506 1B

MATTHEWS, D. W.
The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works,
W82-03850 1509 5D

MATTHEWS, G. A.
The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 1505 2L

MATTHEWS, J. E.
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

MATTHEWS, R. A.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

MATTHEWS, R. B.
Cost-Based Water Rate Design,
W82-06277 1512 6C

MATTHEWS, R. C. JR.
Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 1511 5C

MATTHEWS, R. J.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 1503 5A

MATTHEWS, S. B.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 1502 8I

MATTHIAS, J. A.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5B

MATTHIESSEN, P.
Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 1511 5C

MATTHIJSEN, A. J. C. M.
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

MATTRAW, H. C. JR.
Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 1512 5B

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

MATTSON, L.
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

MATUSHANSKII, M. V.
The Azov Sea Problem,
W82-00651 1502 6G

MATVEEVA, O. S.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

MATVIYENKO, A. M.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

MAUCK, W. L.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

MAUGHAN, O. E.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 1502 5A

MAULOOD, B. K.
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

MAUN, M. A.
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 1503 2H

MAURER, D.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

MAURER, D. K.
Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 1512 2F

MAVINIC, D. S.
Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

Temperature Effects on Biostabilization of Leachate,
W82-04044 1509 5D

MAVRIGIAN, G.
A Historical Jewelpiece--Discovery of the Millennium Hydrological Works of Karaji,
W82-04155 1509 2F

MAWDSLEY, J. A.
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 1512 4A

Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

MAXWELL, M. J.
Sludge Management in the Rocky Mountain State,
W82-05165 1511 5E

MAY, S. C.
Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

MAY, T. W.
Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 1503 5B

MAY, V. J.
Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

MAYACK, D. T.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

MAYBERRY, K. S.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

MAYER, E.
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

MAYER, F. L.
Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 1501 5A

MAYER, J.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 1502 2I

MAYER, L. M.
Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 1508 2L

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

Retention of Riverine Iron in Estuaries,
W82-06191 1512 5B

MAYEWSKI, P. A.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

MAYFIELD, C. I.
Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 1501 2K

MAYO, R. I.
Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 1512 8B

MAYS, E. L.
Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 1501 2L

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 1512 5A

MAYS, L. W.
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 1503 8B

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 1512 8A

Risk Models for Flood Levee Design,
W82-01307 1503 8A

Water Reuse Planning Models: Extensions and Applications,
W82-04565 1510 6A

MBAHINZIREKI, G. B.
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 1506 2H

MCAFEE, M. E.
Effects of Water Drawdown on the Fauna in Small Cold Water Reservoirs,
W82-04219 1509 6G

MCANALLY, W. H. JR.
Modeling: How and When to Use,
W82-04754 1511 2L

MCANIFF, R.
Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 1512 6A

MCARDLE, F. X.
Water Supply for New York City in the 1980s,
W82-05671 1511 6D

MCAULIFFE, K. W.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 1511 3C

MCBAIN, W.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 1511 5D

MCBEAN, E. A.
Issues in Simulation Model Design--A Case Study,
W82-05627 1511 4A

Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 1501 5F

Simulation Modeling of Primary Clarifiers,
W82-01027 1502 6A

Uncertainties in Water Distribution Systems,
W82-03668 1508 8A

MCBRIDE, G. B.
Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 1512 5B

MCBRIDE, J. L.
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

MCBRIDE, M. S.
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

MCCAHILL, M. P.
Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 1501 5A

MCCALL, P. L.
Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

MCCALLUM, D. D.
An Exercise in Sludge Consolidation,
W82-04848 1511 5D

MCCALLUM, I. D.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

Zooplankton of Lake Taupo,
W82-02888 1506 2H

MCCALLUM, R.
Water for New Zealand's Plains,
W82-02402 1505 3F

MCCAMBRIDGE, J.
Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 1501 2L

MCCANN, R. C.
The General Hydrologic System Model,
W82-04314 1510 2A

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 1505 2A

MCCANN, S. B.
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

MCCARL, B. A.
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 1502 6A

MCCARTHY, C. J.
Sediment Transport by Rainsplash,
W82-03709 1508 2J

MCCARTHY, J. A.
Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

MCCARTHY, R. L.
Control Systems for Return and Waste Sludge,
W82-00949 1502 5D

MCCARTY, P. L.
Organics in Water - An Engineering Challenge,
W82-01540 1503 5F

Substrate Flux into Biofilms of Any Thickness,
W82-01964 1504 5D

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 1502 5B

MCCAULEY, C. A.
Results of Acidizing Water Wells in Arizona,
W82-01199 1503 4B

MCCLENEGHAN, K.
Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

MCCLIMANS, T. A.
River Plume Studies in Distorted Froude Models,
W82-05864 1511 2E

MCCLOSKEY, C.
Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

MCCLUNG, E. M.
Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 1512 6B

MCCLURE, B.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

MCCLURE, J. R.
Aquatic Weed Cutting Apparatus,
W82-00624 1502 4A

MCCOLL, J. G.
Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 1507 5B

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 1508 5B

MCCOLLOUGH, N. D.
New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

MCCOMB, A. J.
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

MCCONNELL, J. B.
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-03229 1511 5C

MCCONNELL, R. J.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

MCCONNELL, R. K.
Economics,
W82-06998 1512 5G

MCCONVILLE, T. P.
Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

MCCOOL, D. K.
Aerial Photography to Detect Rill Erosion,
W82-02232 1505 7B

MCCOOL, S. F.
Preferences for Allocating River Recreation Use,
W82-01181 1503 6D

MCCORISON, F. M.
Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03843 1509 5B

MCCORMICK, A. M.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

MCCORMICK, R. F.
Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 1512 5F

MCCOY, E. W.
Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

MCCOY, G. C.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

MCCOY, P.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

MCCOY, T. G.
Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 1507 6A

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 1507 6A

MCCRAY, BY K.
The Federal Response to Ground Water Protection,
W82-06295 1512 6E

Ground Water and the States,
W82-06297 1512 6E

MCCRAY, S. B.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

MCCUEN, R. H.
Comparison of Detention Basin Planning and Design Models,
W82-02592 1505 6A

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 1510 2A

A Decision Theory Approach to Earth Dam Classification,
W82-04152 1509 8A

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 1510 4C

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 1511 2E

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 1512 2A

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 1503 2G

Water Quality Trap Efficiency of Storm Water Management Basins,
W82-04248 1509 5G

Water Yield Estimation in Western United States,
W82-05689 1511 4D

MCCURDY, K. L.
A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

MCCUTCHAN, J. W.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

MCCUTCHEON, S. C.
Vertical Velocity Profiles in Stratified Flows,
W82-01171 1503 8B

MCDANIEL, D. D.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 1511 5A

MCDERMOTT, G. N.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 1503 5A

MCDIFFETT, W. F.
Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 1510 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

MCDONALD, A.
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 1501 5D

Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

New Problems with Upland Waters,
W82-06622 1512 5G

MCDONALD, D. G.
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 1501 5D

MCDONALD, J. W. JR.
International Decade on Drinking Water and Sanitation,
W82-04230 1509 6E

MCDONALD, R. J.
Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

MCDONNELL, A. J.
Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 1512 5G

MCDONNELL, W. E.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

MCDONOUGH, P. M.
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 1507 5A

MCDOUGALL, W. J.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

MCDOWELL, L. L.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

MCDOWELL, T. R.
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 1503 5A

MCDOWELL, W. H.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

MCDUFF, R. E.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 1504 2K

MCDUFFIE, B.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 1503 5A

Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 1501 2K

MCELROY, M. B.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

MCFARLAND, J. W.
A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 1510 6D

MCFARLAND, M. J.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

MCFARLAND, V. A.
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna.
W82-00268 1501 5C

MCFARLANE, G. A.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 1504 5A

MCFARREN, E. F.
The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

MCFETERS, G. A.
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 1510 5A

Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 1512 2E

MCGARRY, R.
Rate Structures and Demand Reduction,
W82-02517 1505 6C

MCGEE, A. B.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

MCGEE, M.
Health Effects of Monochloramines in Drinking Water,
W82-01091 1502 5C

MCGINNIS, D. F. JR.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 1503 7B

MCGOVERN, H. E.
Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

MCGRATH, S. M.
Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 1507 5B

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

MCGRATH, S. P.
Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 1512 5D

MCGRIFF, E. C.
Fecultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 1501 5D

MCGUFFEY, V. C.
Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

MCGUIRE, M. J.
Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

MCGUIRE, P. E.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

MCHENRY, J. R.
Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

MCHUGH, J. O.
Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

MCINTOSH, A. W.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

MCINTOSH, G. E.
Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 1501 4C

MCINTOSH, R. P.
The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 1508 2L

MCINTYRE, A. D.
Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 1512 5C

MCINTYRE, A. E.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 1503 5E

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

MCINTYRE, G.
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

MCINTYRE, G. T.
Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

MCKAGUE, A. B.
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 1502 5C

MCKAMEY, M. I.
A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quicoline,
W82-02630 1505 5C

MCKAY, G.
Design Models for Adsoprtion Systems in Wastewater Treatment,
W82-04300 1510 5D

Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 1504 5D

MCKEE, G. D.
Trace Analyses for Wastewaters,
W82-03639 1508 5A

MCKEE, G. L.
Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 1508 5A

MCKEE, P.
Water Resources Appraisals for Hydroelectric Licensing: Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 1504 6D

MCKELLAR, H. N. JR.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 1504 2L

MCKENZIE, C. N.
Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 1503 5C

MCKENZIE, R. C.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

MCKEOGH, E. J.
Sedimentation Control in Indian Reservoirs,
W82-03693 1508 8A

MCKEOWN, J. J.
Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 1511 5D

Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

MCKIM, T. W.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

MCKINLEY, I. G.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

MCKINLEY, J. W.
Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 1503 5A

MCKINLEY, V. L.
Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 1512 5C

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

MCKINNEY, G. L.
Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 1503 5B

MCKNIGHT, C. A.
Design of a Leachate Collection System for a Sludge Filled Landfill,
W82-03935 1509 5E

MCKNIGHT, D.
Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 1505 5C

MCKNIGHT, D. M.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

MCLACHLAN, C. N. S.
U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 1503 5A

MCLAREN, J. W.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

MCLAREN, P.
River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 1506 2E

MCLAUGHLIN, D. B.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 1503 5G

MCLAUGHLIN, F. A.
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 1510 5A

MCLEAN, D. G.
Bedload and Size Distribution in Paved Gravel Bed Streams,
W82-05795 1511 2J

MCLEAN, R. A. N.
The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 1506 5C

Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 1503 5D

MCLELLAN, B.
Evaluating Irrigation Systems,
W82-00772 1502 6B

MCLEOD, A. I.
Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

MCLEOD, J. D.
Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 1510 3F

MCLOUGHLIN, T. F.
Massachusetts Water Supply Priorities,
W82-04698 1510 6D

MCMAHON, B. R.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 1502 5D

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

MCMAHON, G. C.
Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

MCMAHON, G. F.
Developing Dam-Break Flood Zone Ordinance,
W82-02585 1505 6F

MCMAHON, T. A.
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 1503 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 1503 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 1503 2E

Stochastic Generation of Monthly Streamflows,
W82-06427 1512 4A

MCMEEKIN, T. A.
Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 1501 2L

MCMILLAN, M.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

MCMILLAN, R. K.
Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

MCMILLIN, C. R.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

MCNABB, A.
On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

MCNAUGHTON, B.
Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 1511 5B

MCNAUGHTON, D. J.
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 1502 5B

MCNICOL, L. A.
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 1506 5B

MCNULTY, K. J.
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

MCPHERSON, B. F.
Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

MCPHERSON, M. B.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

MCQUAT, E. R.
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 1511 5A

MCQUEEN, A. D.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

MCQUEEN, D. J.
Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 1505 5G

A Model for the Design of Hypolimnetic Aerators,
W82-06610 1512 5G

MCQUIGG, J.
Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

MCVEY, J.
Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 1503 6E

MCWILLIAM, J. R.
Research and Development to Service a Sustainable Agriculture,
W82-00669 1502 3F

MEAD, G. C.
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

MEADE, R. H.
Size Distribution of Amazon River Bed Sediment,
W82-03481 1508 2J

MEADOWS, C. A.
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 1512 5A

MEALS, D. W. JR.
Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

MEAN, P.
An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

MEANS, E. G.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 1510 5A

MEANS, J. C.
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

MEANS, J. L.
Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1508 1B

MEARNS, A. J.
Marine and Estuarine Pollution,
W82-01274 1503 5C

Marine and Estuarine Pollution,
W82-06808 1512 5C

MECKES, M. C.
Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 1512 5D

MEDHIOUB, K.
The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

MEDINA, M. A.
Discussion: Water Quality Trap Efficiency of Storm Water Management Basins, by Richard H. McCuen,
W82-03784 1509 4A

MEDINA, M. A. JR.
Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5B

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 1504 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 1504 2A

MEDINE, A. J.
Eutrophication,
W82-01271 1503 2H

MEDLAR, S.
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 1502 5F

The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 1503 2A

MEEHAN, W. R.
Forest Management and Anadromous Fish Habitat Productivity,
W82-06946 1512 5C

MEHRAN, M.
An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

MEHRLE, P. M.
Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 1501 5A

MEHROTRA, I.
Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 1512 5D

MEHTA, A. J.
Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

MEHTA, B. M.
Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 1511 2E

MEHTA, G. D.
Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 1511 3A

MEIDL, J. A.
PAC Process,
W82-06643 1512 5D

MEIER, R.
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 1503 2G

MEIGS, J. W.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 5C

MEIJER, J. A. M.
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 1512 3A

MEIN, R. G.
Analysis of Detention Basin Systems,
W82-04444 1510 2A

Flood Event Modeling - A Study of Two Methods,
W82-02291 1505 2A

MEINHOLZ, T. L.
Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 1510 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 1510 5B

MEINZ, M.
Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

MEINZER, F. C.
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 1507 2I

MEIRI, D.
Two-Phase Flow Simulation of Air Storage in an Aquifer,
W82-03841 1509 2F

MEIRI, M.
Phosphorus Removal by Activated Alumina,
W82-02313 1505 5D

MEIS, J. F. G. M.
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 1502 2H

MEJER, H. F.
Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

MEKO, D. M.
A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

MEL'NICHENKO, K. I.
High-Head Vertical Lift Gates,
W82-02388 1505 8A

MEL'NIKOV, A. K.
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 1506 8A

MEL'NIKOV, I. I.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

MELACK, J. M.
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 1505 2K

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 1511 2H

MELAMUT, D. L.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A

MELBY, C. L.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

MELEAR, E. L.
Physical and Chemical Methods,
W82-01241 1503 5D

MELLINGER, D. L.
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

MELNICK, J. L.
Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

MELTON, R. G.
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

MELVILLE, J. G.
Nearfield Performance of River Diffusers,
W82-04561 1510 5B

MELVIN, W. W.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

MELVOLD, R. W.
Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 1506 5A

MENDIA, L.
Electrochemical Processes for Wastewater Treatment,
W82-05422 1511 5D

MENEGHINI, R.
The Outlook for Precipitation Measurements from Space,
W82-06531 1512 7B

MENENDEZ, A. N.
Numerical Solution of the Dam Failure Problem by the Random Choice Method,
W82-03872 1509 8A

MENGEL, L. J.
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C

MENJOZ, A.
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

MENJOZ, A. C.
Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

MENSAH, E. K.
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 1503 6A

MENSER, H. A.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 1503 5B

MENWEI, F.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

MENZEL, D. C.
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

MENZEL, R. G.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Enrichment Ratios for Water Quality Modeling,
W82-01410 1503 2J

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

MER, G. S.
Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 1506 2H

MERCER, B. W.
Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 1501 5D

MERCER, J. W.
Computer Modeling and Ground-Water Protection,
W82-01336 1503 2F

Ground-Water Modeling: Recent Developments,
W82-00281 1501 2F

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

MERCER, M. W.
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 1508 10B

MEREDITH, D. D.
Algorithm for Optimal Activated Sludge Operation,
W82-05682 1511 5D

MEREDITH, J. W.
Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

MEREDITH, T. S.
Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 1501 7C

MERILATT, D.
Eutrophication Measures for Small Lake Water Quality Management,
W82-04243 1509 2H

MERKEL, S. M.
Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

MERKUR'EVA, R. V.
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 1508 3A

MERLET, N.
Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 1511 5F

MERRIAM, R. A.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

MERRILL, D. T.
Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

MERRILL, R.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

MERRILL, S. D.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

MERRITT, L. B.
Refinement of Lake Evaporation Measurements Using an Ion-Balance Technique,
W82-03808 1509 2D

MERSEREAU, R.
Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

MESHCHERYAKOVA, R. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

MESINGER, S.
Groundwater Pollution from Industrial Waste Disposal. A Case Study,
W82-06434 1512 5B

MESSER, J.
Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 1511 6B

MESSING, R. A.
Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 1512 5D

METAYER, C.
Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

METCALF, T. G.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 1501 5A

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

METCALFE, A. V.
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

METLER, M.
Polish Water Management--Structure, Problems and Research,
W82-03633 1508 6D

METZGER, H.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

MEVERDEN, J.
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

MEVOLHON, M.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

MEYER-ARENDT, K.
Sediment--Asset or Liability,
W82-02150 1505 6B

MEYER, B. R.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

MEYER, C. R.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

MEYER, E. A.
Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

MEYER, E. R.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

MEYER, J.
Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 1503 5A

MEYER, J. L.
Phosphorus, Nitrogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

MEYER, K. F.
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 1503 2F

MEYER, L. D.
How Rain Intensity Affects Interrill Erosion,
W82-04537 1510 2J

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

MEYER, M. A.
Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 1512 5F

MEYER, P. A.
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

MEYER, R. A.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

MEYER, R. L.
Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 1512 5C

MEYER, W. J.
Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 1511 8G

MEYER, W. S.
Field Test of an Irrigation Scheduling Computer Model,
W82-00184 1501 3F

MEYERS, M.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

MEYERS, P. A.
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 1508 2H

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 1503 2H

Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 1504 2J

MEYERS, T. E.
Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

MEZEIX, J. F.
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 1503 2B

MICHAEL, P. R.
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 1502 5A

MICHAELI, A.
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 1511 2G

MICHAELSON, A. P.
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

MICHAILOV, G.
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 1512 5A

MICHALCZYK, B.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

MICHALENKO, G.
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 6B

MICHALSON, E. L.
Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 1503 4D

MICHAUD, M. C.
Numerical Simulation of Reservoirs,
W82-03504 1508 6A

MICHEL, E. F.
Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 1510 5D

MICHLER, G.
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

MICHNOWSKY, E.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 1512 2K

MICKLEY, M. C.
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 1505 5D

A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

MIDDLEBROOKS, C. H.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 1503 5D

MIDDLEBROOKS, E. J.
Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 1511 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 1503 5D

The Flowering of Wastewater Treatment,
W82-02015 1504 5D

MIDDLEDITCH, B. S.
Volatile Constituents of the Produced Water Effluent from the Buccaneer Gas and Oil Field,
W82-05874 1511 5A

MIDDLESWORTH, B. C.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

MIDDLETON, A. C.
Algorithm for Optimal Activated Sludge Operation,
W82-05682 1511 5D

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

MIDDLETON, J. E.
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 1501 3F

MIELKE, L. N.
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 1512 5B

MIEREMET, R. B.
Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 1505 6E

MIETTINEN, J. K.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 1504 2G

MIEURE, J. P.
Determining Volatile Organics in Water,
W82-00630 1502 5A

MIGNONE, N.
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 1506 5D

MIHURSKY, J. A.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

MIJARES, C. R.
Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 1511 5F

MIKHAILENKO, L. E.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

MIKHAILOV, I. E.
New Jet-Gate Design,
W82-02691 1506 8C

MIKHAILOV, L. P.
Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 1507 8B

MIKHAYLOVA, YE. E.
Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 1512 8B

MIKHEYEVA, T. M.
Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

MIKUCKI, W. J.
Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

MILANOWSKI, J.
Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

MILDNER, W. F.
Erosion and Sediment,
W82-06554 1512 2J

MILES, J. C.
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

MILES, M. B.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

MILES, M. L.
Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 1511 5B

MILITEEV, A. N.
Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 1512 5B

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 1512 8B

MILITELLO, P.
Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 1507 5D

MILL, R.
Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

MILLER, A. C.
Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

MILLER, B. A.
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 1501 5B

MILLER, D. E.
Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 1501 2J

MILLER, D. G. JR.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 1504 5E

MILLER, E. A.
Value Engineering Saves Dam Project,
W82-03287 1507 8A

MILLER, G. G.
Selective Overburden Placement,
W82-00053 1501 5D

MILLER, G. J.
Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

MILLER, G. S.
Winter Temperature Structure in Lake Huron,
W82-04381 1510 2H

MILLER, H. C.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 1511 5A

MILLER, J.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

MILLER, J. A.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

MILLER, J. L.
Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 1510 2L

MILLER, J. R.
Normalized Agricultural Prices and Water Resources Planning,
W82-03928 1509 6B

MILLER, J. W.
Stranglehold on the Skagit,
W82-03490 1508 6G

MILLER, K. J.
Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

MILLER, L. W.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

MILLER, M. R.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

MILLER, N.
County Provides a Rural Water Supply System,
W82-06843 1512 3D

MILLER, P. C.
Comparative Field Water Relations of Four Co-Occuring Chaperral Shrub Species,
W82-00762 1502 2I

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 1502 2D

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W32-00846 1502 2I

MILLER, R. A.
Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 1512 5B

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

MILLER, R. D.
Nitrification Using the Rotating Biological Contactor,
W82-03132 1507 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

Rotating Biodisks Recarbonate Alkaline Wastewater.
W82-05685 1511 5D

MILLER, R. J.
Irrigation Tailwater Management,
W82-00392 1501 3C

MILLER, R. L.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

MILLER, R. M.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 1510 3D

MILLER, S.
Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 1502 5F

Adsorption on Carbon: Theoretical Considerations,
W82-02658 1506 5D

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 1503 5F

Environmental Health Hazards,
W82-00625 1502 5F

Water-Treatment Chemicals,
W82-00618 1502 5F

MILLER, T. A.
Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

MILLER, T. D.
Effects of Water Quality on Forage Production,
W82-01002 1502 3C

MILLER, T. G.
Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

MILLER, T. S.
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 1503 7C

MILLER, T. Y. JR.
Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 1505 4A

MILLER, W. J. III
Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

MILLER, W. L.
Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-03909 1512 6B

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 1512 6F

Household Water Use: Technological Shifts and Conservation Implications,
W82-03910 1509 3D

Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 1502 6A

MILLERO, F. J.
The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1511 1B

The Ionization of Acids in Estuarine Waters,
W82-03769 1509 2K

MILLETTE, J. R.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 1502 5C

Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 5C

The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

Concentration and Size of Asbestos in Water Supplies,
W82-00262 1501 5B

MILLHAM, C. B.
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 1507 6B

Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

MILLIGAN, J. H.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

MILLIKEN, J. G.
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

MILLNER, G. C.
Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

MILLNER, P. D.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 1501 5E

MILLS, A.
Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 1512 5F

MILLS, A. L.
Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

MILLS, E. L.
Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

MILLS, J. L.
Ferric Chloride Takes Over,
W82-00954 1502 5F

MILLS, W. C.
Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 1505 2J

MILLWARD, G. E.
The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 1503 5B

MILLY, P. C. D.
Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 1512 2G

MILNE, J. A.
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 1512 2J

MILNER, R. S.
Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

MILSTEAD, C. E.
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

MINAEVA, E. N.
Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 1501 4A

MINCKLEY, W. L.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

MINDLER, A. B.
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

MINEAR, R. A.
Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

MINEMOTO, M.
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 1511 5A

MINEMURA, H.
On the Sampling Size of Zoobenthos Along a Lake Shore (In Japanese),
W82-02796 1506 2H

MING, C. O.
Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

MING-KO, W.
Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 1505 2A

MINGMIN, H.
Bed Load Fluctuation: Applications,
W82-05000 1511 2J

MINGO, T. M.
The Aquatic Insects of The Narraguagus River, Hancock and Washington Counties, Maine,
W82-04167 1509 2E

MINIER, A.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

MINK, J. F.
Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

MINNIGH, H. A.
Microbiology: Wastewater Treatment,
W82-06926 1512 5D

MINTON, G.
Forecasting Water Demand in the Pacific Northwest,
W82-04135 1509 6D

MINTON, G. R.
Institutional Analysis Criteria for Water Supply Planning,
W82-03930 1509 6D

MINTZER, O.
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06131 1512 7C

MIRAIDE, M.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01397 1502 5A

MIRZA, A. M.
Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 1506 2J

MIRZAK, E. M.
Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 1511 8A

MISHRA, B. B.
'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment,
W82-03848 1509 5D

MISHRA, G. C.
Flow Under Weir on Scoured Bed,
W82-05800 1511 8B

MISSIMER, T. M.
Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

MISTRY, P. D.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 1503 2G

MISZTAL, M.
Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 1506 2H

MITAMURA, O.
Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 1506 2H

MITCHELL, B.
Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

Unified River Basin Management,
W82-05769 1511 6B

MITCHELL, C. P.
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 1502 3B

MITCHELL, D. G.
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

MITCHELL, G. F.
Methods for Treatment of Color in Groundwater,
W82-02532 1505 5F

MITCHELL, J. K.
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 1506 2G

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 1512 4D

Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 1511 2A

Splash Erosion Modeling: Physical Analysis,
W82-05970 1512 2J

MITCHELL, K. R.
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 1512 5D

MITCHELL, M. J.
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 1505 5E

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

MITCHELL, P. D.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 2I

MITCHELL, R.
Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 1510 2H

MITCHELL, R. N.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

MITCHELL, S. F.
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 1503 2H

MITHAL, R. S.
Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhibro-Khodri Tunnel in India,
W82-03181 1507 8A

MITRA, R. I.
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 1511 5D

MITROFANOV, G. A.
Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

MITSCH, W. J.
Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 1511 5C

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

MITTAL, A. K.
Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 1512 5D

MITTELHAUSER, H.
Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

MITTELSTAEDT, E.
The Tidal Stream in the German Bight,
W82-05190 1511 2L

MITTERMEYER, F. C.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 1502 5A

MIURA, R.
An Approach to Full-Automatic Control of Activated Sludge Process,
W82-03855 1509 5D

MIXON, M. N.
Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 1510 5D

MIYAI, K.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

MIYAKE, Y.
Selenium Content and Its Chemical Form in River Waters of Japan,
W82-04181 1509 5A

MIYAMOTO, H.
An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

MIYARES, J. R.
Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

MIYATA, H.
Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 1511 5A

MIYAZAKI, T.
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

MIZRAHI, A.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 1501 5F

MIZUIKE, A.
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 1502 5A

MIZUMURA, K.
Prediction of Water Level in Tidal Inlet,
W82-05005 1511 4A

MOALEM-MARON, D.
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 1512 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 1512 3A

MODI, P. N.
Conformal Mapping for Channel Junction Flow,
W82-04306 1510 2E

MOE, P. G.
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

MOED, J. R.
Multiple Addition Bioassay of Tjeukemeer Water,
W82-04907 1512 5C

MOELLER, J. R.
Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

MOENCH, W. L. JR.
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

MOFFA, P. E.
Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

MOFFATT, R. L.
A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

MOFFETT, D.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 1503 5D

MOGIL, H. M.
Disaster by Flood,
W82-04618 1510 2E

MOHAMED, S. M.
Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 1512 2I

MOHAMMAD, M-B. M.
A Hydrobiological Survey of a Polluted Canal,
W82-01356 1503 5C

MOHN, N.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

MOHSENISARAVI, M.
Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 1507 2G

MOISEEV, N. N.
Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

MOISELLO, U.
Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 1512 2E

MOJIB, R. M.
Application of and Guidelines for Using Available Dam Break Models,
W82-05152 1511 8A

MOLENAAR, H. W.
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

MOLENKAMP, C. R.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

MOLINAS, A.
Sediment Transport and Unit Stream Power Function,
W82-06424 1512 2J

MOLINIER, J.
Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 1511 5D

MOLL, R. A.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

MOLLARET, H. H.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 1502 5A

MOLLENDORF, J. C.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1502 1A

Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

MOLLER, J. S.
Diversion of the River Neva,
W82-03304 1507 4A

MOLNAU, M.
Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

MOLODTSOV, V. A.
Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 1502 3C

MOLOF, A. H.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 1504 6B

MOLZ, F. J.
Models of Water Transport in the Soil-Plant System: A Review,
W82-03066 1507 2I

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

MONAGHAN, B. A.
Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 1510 5D

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

MONARO, S.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

MONDADA, G.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

MONKE, E. J.
Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 1511 4D

Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 1505 5B

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Subsurface Drainage and Sediment Transport Model,
W82-00894 1502 2G

MONNIG, E.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 1510 5D

MONROE, R. J.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

MONSELISE, S. P.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

MONTAGNA, P. A.
Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 1512 5A

MONTEITH, H. D.
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

MONTGOMERY, H. A. C.
Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

MONTGOMERY, J. R.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

MONTIEL, A.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

MOOD, E. W.
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

MOODIE, S. P.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 1511 5D

MOODY, D. W.
Water Use Data--Who Needs It,
W82-04198 1509 7C

MOODY, J. L.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

MOOK, W. G.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 1503 2J

MOOLEY, D. A.
Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 1511 2A

MOOMAW, R. L.
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 1510 6E

MOONEY, G. A.
Treating Phenol Resin Plant Wastes,
W82-05128 1511 5D

MOORE, A. S.
Energy Recovery System,
W82-00059 1501 5D

MOORE, B. E.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 3C

MOORE, C. B.
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 1512 5D

MOORE, C. J.
Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833 1509 5A

MOORE, D.
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

MOORE, D. A.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

MOORE, D. G.
Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 1512 7B

MOORE, G.
An Organics Detection System for the Ohio River,
W82-03436 1508 5A

MOORE, G. E.
An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

MOORE, G. S.
Health Effects of Monochloramines in Drinking Water,
W82-01091 1502 5C

MOORE, I. D.
Effect of Surface Sealing on Infiltration,
W82-04362 1510 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 1510 2G

MOORE, J. A.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 1507 3B

MOORE, J. E.
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 1502 6G

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 1508 5F

MOORE, J. F.
Polymer Plays Plant Improvement Role,
W82-06250 1512 5D

MOORE, J. S.
Illinois Groundwater Problems and Needs,
W82-01052 1502 4B

Maximizing Effluent Quality from a Municipal Activated Sludge Plant Concurrent with a Major Reduction in Process Energy Requirements,
W82-03874 1509 5D

MOORE, J. W.
Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 1501 5B

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 1511 5B

MOORE, L. L.
An Intangible Benefit of Water Pollution Control Programs,
W82-01092 1502 6B

MOORE, P. D.
Exploiting Papyrus,
W82-03202 1507 2H

MOORE, R. J.
A Distribution Function Approach to Rainfall Runoff Modeling,
W82-03845 1509 2A

MOORE, R. K.
The Outlook for Precipitation Measurements from Space,
W82-06531 1512 7B

MOORE, R. L.
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 1512 5C

MOORE, R. M.
The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

MOORE, R. S.
Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887 1509 5F

MOORE, R. V.
The Practical Handling of Water Quality Monitoring Data,
W82-06591 1512 7C

MOORE, S. F.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 1503 5G

MOORE, S. R.
Waste Discharge Monitoring Requirements Under the NPDES Permits Program,
W82-03969 1509 5D

MOORE, W. S.
Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 1507 2H

MOOSBURNER, G. J.
Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

MORAINE, R.
Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 1511 5D

MORAITOU-APOSTOLOPOULOU, M.
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 1506 5C

MORALES, E. C.
Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

MORALES, M.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

MORAND, J. M.
Cost of Small Water Supply Treatment Systems,
W82-02318 1505 5F

MORARIU, S.
Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 1511 6B

Computer-Aided Evaluation of Peru's Hydropower,
W82-05515 1511 6A

MORDOVINA, A. N.
Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 1506 8G

MOREAUD, H.
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

MOREL, F. M. M.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 1504 2K

MOREL-SEYTOUX, H. J.
Application of Infiltration Theory for the Determination of Excess Rainfall Hyetograph,
W82-03752 1509 2A

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 1504 2F

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 1511 2F

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

MORENO-CASTILLA, C.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

MOREY, E. F.
Maintenance of Analog Instrument systems,
W82-06263 1512 5D

MORFAUX, J. N.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 1510 5D

MORGADE, C.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

MORGAN, C. H.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

MORGAN, C. O.
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 1508 10B

MORGAN, E. L.
Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 1511 7B

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 1511 5C

MORGAN, J. J.
Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals,
W82-03771 1509 2K

Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 1506 2K

Kinetics for the Aquatic Environment,
W82-01631 1503 2K

Kinetics for the Aquatic Environment,
W82-01806 1504 2K

MORGAN, J. M.
History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 1511 6E

Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 1507 2I

MORGAN, J. M. III.
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 1501 2J

MORGAN, K. M.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

MORGAN, M. D.
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

MORGAN, S. L.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 1503 5A

MORGAN, W. D.
An Economist's View of Demand Projections Considering Conservation,
W82-04448 1510 6D

The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

MORGAN, W. L.
Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 1511 5B

MORGAN, W. S. G.
A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 1512 5A

MORI, S.
Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems,
W82-03763 1509 5D

Experiences of MLSS Control of the Activated Sludge Process,
W82-03849 1509 5D

MORIGAKI, T.
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 1501 5D

MORIN, J.
The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 1511 2G

MORIN, K. A.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

MORING, J. R.
Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 1512 5C

MORKOVKINA, I. K.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

MORLEY, B. M.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

MORLEY, P. J.
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 1505 7C

MORRELL, R. A.
Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

MORREY, M. J.
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 1511 4B

MORRIS, B.
A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

MORRIS, C. E.
Low-Cost Wastewater Treatment,
W82-00841 1502 5D

MORRIS, D. R.
Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

MORRIS, J.
Trends in State and Federal Policy on Water Supply Management,
W82-02516 1505 6E

MORRIS, J. C.
Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 1511 5D

MORRIS, K.
Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 1505 5B

MORRIS, M. L.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

MORRIS, R.
Environmental Virology and its Problems,
W82-00505 1502 5A

MORRIS, W. F.
Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

MORRIS, W. T.
Perseverance Produces County Park,
W82-01932 1504 6D

MORRISON, A.
The Booming Business in Wick Drains,
W82-05192 1511 8G

GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 1507 5D

If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 1508 5B

Municipal Sewage: Three Communities Try to Cope,
W82-03284 1507 5D

MORRISON, B. R. S.
Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 1512 5C

MORRISON, J. D.
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 1512 5A

MORRISON, R. D.
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

MORRISSON, N. J. III.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 1504 5C

MORROW, C. T.
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

MORROW, D. M.
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 1507 2A

MORSE, W. J.
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

MORTIMER, D. C.
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 1511 5C

MORTON, A. S.
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

MORTON, D. W.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

MOSELHY, M. M.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 1504 5A

MOSER, P.
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

MOSEY, F. E.
Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 1502 5D

MOSIER, J. W.
Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 1501 5B

MOSLEY, M. P.
Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 1506 2J

Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 1511 4C

MOSS, A. J.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

MOSS, B.
The Composition and Ecology of Periphyton Communities in Freshwaters. II. I[illegible]-Relationships Between Water Chemistry, [illegible]oplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 1507 2H

MOSS, D.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 1501 7B

MOSS, M. O.
Distribution of Chromobacteria in a Lowland River,
W82-02795 1506 5C

MOSSAAD, M. E.
A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

MOSTAGHIMI, S.
Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 1511 2A

MOSTKOV, V. M.
Driving Large Hydraulic Tunnels by the Stepped Face Method,
W82-05586 1511 8H

Problems of Lightening Underground Structures and Methods of Constructing Them Under Permafrost Conditions,
W82-03918 1509 8A

Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 1506 8A

MOTHES, G.
Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 1511 2H

MOTT, J. B.
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

MOTT, T. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5E

MOTTIER, J-L.
Pumped-Storage for Swiss Railways, Part One,
W82-03468 1508 8A

MOTTS, W. S.
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 1510 2A

MOTZ, L. H.
Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 1502 2F

MOUAT, D. A.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

MOULTON, E.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 1501 5A

MOUSTAKIS, V.
An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning,
W82-03942 1509 6B

MOWER, R. W.
Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

MOY, H. C.
Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

MOYA, T. B.
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 1510 2I

MOYER, J. L.
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

MOZLEY, S. C.
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

MROZED JR, E.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 1504 5B

MUCHA, I.
A Numerical Modal of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

MUCHMORE, C. B.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 1510 5D

MUCK, R. E.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 1502 5B

MUCKLESTON, K. W.
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

MUDROCH, A.
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 1503 2H

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

MUDRY, J.
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 1505 2F

MUDRY, N.
Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 1511 4A

MUEHLENBACHS, K.
Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

MUELLER, A. J.
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 1501 2I

MUELLER, D. L.
Calorific Value of Wastewater Plant Sludges,
W82-04997 1511 5E

MUELLER, G. R.
Removal of Organics by Reactivated Carbon,
W82-04159 1509 5F

MUELLER, W.
Laboratory Technique for Measurement of pH for Corrosion Control Studies and Water Not in Equilibrium with the Atmosphere,
W82-04101 1509 5G

MUENCH, R. D.
Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

MUHLBALER, J.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

MUILWIJK, C. J.
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

MUIR, D. C. G.
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 1502 5A

MUIR, L. R.
Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 1512 2L

MUKHERJEE, A. K.
A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 1510 2K

MUKHOPADHYAY, D.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

MULAMOOTTIL, G.
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

MULBARGER, M. C.
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

MULCAHY, L. T.
Simplified Mathematical Models for a Fluidized Bed Biofilm Reactor,
W82-03877 1509 5D

MULDER, J. H.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

MULHOLLAND, P. J.
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 1501 2J

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

MULJADI, S.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

MULL, D. S.
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

MULLEN, E. D.
Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

MULLER, A. B.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

MULLER, F.
Glaciers and Their Fluctuations,
W82-04777 1511 2C

MULLER, G.
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods.
W82-03883 1509 2J

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

MULVIHILL, J.
Water and Wastewater Reclamation: An Economical Answer to Industrial Wastes and Pollution,
W82-00188 1501 3E

MUMALLAH, N. A.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 1504 5D

MUMALLAH, N. A. K.
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 1503 5D

MUNAWAR, M.
Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

MUNEMORI, M.
Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 1512 5D

MUNOZ, E. F.
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 1502 2G

MUNRO, D. S.
On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 1511 2G

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

MUNTEANU, N.
The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 1505 7B

MUNTER, J. A.
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 1505 2F

MURARKA, I. P.
Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 1503 6G

MURDOCK, T.
Institutional Analysis Criteria for Water Supply Planning,
W82-03930 1509 6D

MURK, J. S.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

MURPHEY, J. B.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 1501 2J

MURPHREE, C. E.
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Sediment Yield from a Flatland Watershed,
W82-00941 1502 2J

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 1505 2J

MURPHY, C. B. JR.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 1503 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 1512 5C

MURPHY, C. B. JR.
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

MURPHY, J.
Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 1510 5G

MURPHY, K. L.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 1510 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

MURPHY, P. J.
Two Bed-Load Formulas: An Evaluation,
W82-02375 1505 2J

MURPHY, R. J.
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 1511 5B

MURPHY, T. P.
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 1506 2H

MURRAY, C. M.
Trenching of Digested Sludge,
W82-00974 1502 5E

MURRAY, D. L.
Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 1510 2A

MURRAY, H. E.
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 1510 5C

MURRAY, J. P.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 1503 5B

MURTAGH, G. J.
The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 1501 2A

MURTHY, C. R.
Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 1510 2H

MURTY, V. V. N.
Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03653 1508 5G

MUSAEV, Z. A.
Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A

MUSATOV, A. P.
Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 1511 8I

MUSICK, J. T.
Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 1510 2G

A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02536 1505 3F

Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 1506 3F

MUSIK, I.
Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 1501 6A

MUSQUERE, P.
Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 1511 5F

MUSSER, W. N.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

MUSTY, P. R.
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 1505 7C

MUTCH, R.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

MUTCHLER, C. K.
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 1502 2J

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Sediment Yield from a Flatland Watershed,
W82-00941 1502 2J

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 1505 2J

MUTHUKUMAR, G.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 1504 5B

MUTHURI, F. M.
Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

MUZAEV, I. D.
Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 1512 8B

MUZYLEV, S. V.
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 1502 2H

MYAKUSHKO, V. K.
The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 1511 2H

MYERS, A.
Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 1505 5B

MYERS, P.
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-066[illegible] 1512 5A

MYERS, B. M.
Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

MYERS, E. A.
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 1506 3C

MYERS, E. J.
Circulation Patterns; Their Investigation and Prediction,
W82-06477 1512 5F

MYERS, W. R. C.
Flow Resistance in Wide Rectangular Channels,
W82-05798 1511 8B

MYHRSTAD, J. A.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

MYKYTIUK, A. P.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 1502 5A

MYRICK, R. M.
Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

NABIVANETS, B. I.
Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 1502 5A

NABORS, M. W.
Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 1512 3C

NADLER, A.
Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 1503 2G

Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 1507 2G

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

NAFF, F.
Can We Model the Rainfall-Runoff Process Today,
W82-01609 1503 2A

NAGAI, H.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 1507 5A

NAGASE, H.
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

NAGASHIMA, M.
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 1511 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

NAGEL, C. A.
Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 1512 5D

NAGEL, W. H.
Making Chlorination Trustworthy,
W82-06639 1512 5F

NAGELS, G.
Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

NAGPAL, J. L.
Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

NAI-KUI, S.
Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 1511 5A

NAIR, G. B.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 1503 5A

NAIR, J.
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 1507 5A

NAKAHARA, T.
Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 1506 5A

NAKAHORI, I.
A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

NAKAJIMA, K.
The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 1512 5D

NAKAJIMA, R.
Underwater Aerator,
W82-00065 1501 5D

NAKAJIMA, T.
Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

NAKAMURA, M.
A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 1510 6A

A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 1512 6A

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 1510 5D

NAKAOKA, A.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

NAKARI, T.
Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 1511 5C

NAKASHIO, F.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 1504 5D

NAKATSUJI, M.
Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

NAKAYAMA, F. S.
Simplifying Neutron Moisture Meter Calibration,
W82-05173 1511 7B

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

NAKAYAMA, O.
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 1506 5E

NAKAYAMA, R.
An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

NAKONO, H.
Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

NALEPA, T.
Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

NALEPA, T. F.
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 1506 2H

NAM, S. H.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

NAMBIAR, K. R.
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 1501 5D

NAMEDA, Y.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

NANBO, K.
Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

NAND, K.
A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 1510 2K

NANSON, G. C.
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

New Evidence of Scroll-Bar Formation on The Beatton River,
W82-04188 1509 2J

NAPARAXAWONG, K.
Modified Standard Operation Rules for Reservoirs,
W82-03658 1511 4A

NAPIER, T. L.
Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 1511 6B

NAPIORKOWSKI, J. J.
The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 1511 2E

NAQVI, N. Z.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

NAQVI, S. M.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

NARANG, R.
Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

NARASIMHAN, T. N.
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 1508 2F

NARAYANA, V. V. D.
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 1510 3F

NARAYANAN, R.
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 1505 6D

NARDA, N. K.
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

NARKIS, N.
Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 1512 5C

Phosphorus Removal by Activated Alumina,
W82-02313 1505 5D

NASH, H. D.
Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

NASH, R. G.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00566 1502 5B

NASS, H. G.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 1503 2I

NASSEHZADEH-TABRIZI, A. A.
Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

NASU, Y.
Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 1507 5A

NATARAJAN, R.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 1503 5A

NATEN, R. W.
Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

NAUDASCHER, E.
Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen),
W82-06237 1512 8B

NAUSCH-STENGEL, M.
Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 1511 2L

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Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials),
W82-04762 1511 2L

NAVARRE, J-L.
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

NAVARRO, J. M.
Continuous Denitrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

NAVOY, A. S.
Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 1510 7C

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

NAVROT, J.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

NAWLAKHE, W. G.
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

NAYMIK, T. G.
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 1508 5B

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

NEALE, P. J.
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

NEAR, F. M.
Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 1507 8A

NEARY, D. G.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

NEBEL, C.
Ozone Treatment of Potable Water - Part I,
W82-00451 1501 5F

Ozone Treatment of Potable Water--Part 2,
W82-00452 1501 5F

Ozone Water Treatment Systems,
W82-03448 1508 5F

NEBRAT, A. A.
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 1504 2H

NEDRIGA, V. P.
Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 1506 8D

NEDWELL, D. B.
Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

NEELY, W. C.
Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 1512 5F

NEEMAN, I.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

NEFF, E. L.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 1505 2A

NEFF, J. M.
A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 1511 5A

NEGI, V.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

NEGRI, A. J.
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 1502 2B

NEIBLING, W. H.
Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 1505 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 1503 2J

NEIDERT, S. H.
Aeration at High Velocity Flows,
W82-05602 1511 8A

NEIHOF, R. A.
Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 1512 5A

NEIL, J. H.
Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

NEILL, C. R.
Forest Management for Increased Water Yield-How Useful in Southern Alberta,
W82-05760 1511 3B

NEILL, W. H.
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

NEILSEN, G. H.
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

NEILSON, H. R.
Disposal of Sludge to Sea,
W82-06595 1512 5E

NEIMAN, M.
Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 6B

NEIMAN, T. N.
Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

NEISSER, M. P.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 1502 5D

NEL, C. C.
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurrence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

NELLER, R. J.
Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 1511 4A

NELLIS, M. D.
Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 1512 7B

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 1506 7B

NELSON, C. H.
Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

NELSON, C. O.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 1503 3C

NELSON, C. R.
Aromatic Amines in and Near the Buffalo River,
W82-00622 1502 5B

NELSON, D. C.
A Legal-Economic Critique of Groundwater Law and Administration With Special Reference to Arizona and Nebraska,
W82-03827 1509 6E

NELSON, D. W.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

NELSON, G. H.
Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

NELSON, G. L.
Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 1511 2F

NELSON, J. D.
Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 1508 5G

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 1506 7A

NELSON, J. G.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

NELSON, L. M.
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

NELSON, P. F.
Groundwater Problems in North Carolina,
W82-01056 1502 4B

NELSON, P. O.
Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 1503 5D

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 1505 5D

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 1510 5D

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 1506 5B

NELSON, R. F.
High-Solubility Gas Flotation,
W82-01184 1503 5D

NELSON, S. G.
Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 1511 5G

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 1502 5D

NELSON, W. H.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 1501 5A

NELSON, W. R.
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-0144[illegible] 1503 6G

NEMETH, J. C.
The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

NEMICKAS, B.
Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

NEMINSKII, M. L.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

NESHYBA, S.
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 1501 2C

NESLER, T. P.
The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 1512 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 1512 6G

NESS, G. E.
Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 1512 5C

NESTEROVA, M. P.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 1507 5G

NESTMANN, E. R.
Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

NEU, H. J. A.
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 1510 6G

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 1511 4A

NEUBAUER, C. P.
The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 1511 5C

NEUFELD, R. D.
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 1507 5D

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

NEUKRUG, H. M.
Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 1511 5F

NEUMAN, S. P.
Delayed Drainage in a Stream-Aquifer System,
W82-04268 1510 2F

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

NEUMAN, W. E.
Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 1508 5F

NEUMANN, U.
Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 1510 5D

NEUZIL, C. E.
On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 1512 8B

NEVEUX, J.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

NEVISSI, A. E.
Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 1511 5B

NEWBERN, L. A.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

NEWBOLD, J. D.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 1503 5C

NEWBRY, B. W.
Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

Water Quality Management Using the Hazard Assessment Approach,
W82-03823 1509 5G

NEWELL, C. J.
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

NEWMAN, F. M.
Development of Oil-In-Water Monitor, Phase II,
W82-00100 1502 5A

NEWPORT, R.
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 1502 8A

NEWTON, A. J.
The Design and Interpretation of Marine Pollution Surveys,
W82-00700 1502 6E

Determination of Marine Consent Conditions,
W82-00323 1501 5G

NEWTON, J. G.
Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

Induced Sinkholes: An Engineering Problem,
W82-02559 1505 4B

NEWTON, R. J.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

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W82-05293 1511 3F

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W82-05312 1511 3F

NG, E.
Soil Moisture Relations in the Southern California Chaparral,
W82-01035 1502 2D

NGANA, J. O.
Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 1511 2A

NGO, Q-T.
An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 1506 6D

NGUEN, V. K.
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 1508 8D

NGUYEN, V-T-V.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

NIBLING, F. L. JR.
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W82-03024 1507 4A

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On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

NICHOLS, D. S.
Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 1511 5D

NICHOLS, L. D.
Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

NICHOLS, S. A.
Sampling Characteristics of Macrophyte Biomass,
W82-06779 1512 5A

NICHOLSON, K.
Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 1507 5F

Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 1507 5A

NICHOLSON, L. W.
Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 1503 5C

NICHOLSON, R. B.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

NICHOLSON, S. E.
Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 1512 2B

NICKERSON, G. L.
Upgrading Water Treatment Plants: An Alternative to New Construction,
W82-04098 1509 5F

NICKS, A. D.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

NICOL, S. M.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 1502 6D

NIEBER, J. L.
Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 1510 2A

NIEBOER, E.
Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 1502 5A

NIEDERLEHNER, B. R.
Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 1511 5C

Effects of Pollution on Freshwater Invertebrates,
W82-01280 1503 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

NIELSEN, M. K.
Computer Control of Nitrifying and Denitrifying Activated Sludge Process,
W82-04025 1509 5D

NIEMANN, E.
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 1511 7B

NIEMI, J. S.
Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

NIEMI, R. M.
Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 1512 5B

NIEMITZ, W.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

NIERSTEDT, R. J.
Wastewater Management in Coastal North Carolina,
W82-02311 1505 5D

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

NIGAM, J. P.
Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 1512 5F

NIGHTINGALE, H. I.
Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

NIGHTINGALE, H. L.
Artificial Basin Recharge,
W82-03745 1508 4B

NIIMI, A. J.
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

NIJU, S.
Reliability and Stability of Trickling Filter Processes,
W82-04784 1511 5D

NIKIFOROVSKAYA, V. S.
Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 1512 8B

NIKITINA, T. E.
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 1507 8F

NIKOLAEV, I. I.
Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 1502 6G

NIKOLAYEV, S. G.
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 1506 2H

NIKOLIN, V. I.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

NIKU, S.
Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 1503 5D

NINE, B. J.
Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 1507 5B

NISHIKAWA, S.
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

NISHIO, T.
Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

NITZBERG, K. A.
Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

NIXON, S. W.
The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 1512 2L

Freshwater Inputs and Estuarine Productivity,
W82-02110 1505 2L

NOAROV, YU. A.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

NOBEL, P. S.
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 1510 2D

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 1502 2I

NODA, H.
High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 1511 5A

NOEL, D. S.
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

NOEL, J. E.
Modeling the Economics of Ground Water Management,
W82-03733 1508 4B

NOFZIGER, D. L.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 1503 2G

NOGITA, S.
Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 1512 5D

Calculation of Sludge Reservoir Volume for MLSS Control,
W82-03856 1509 5D

Experiences of MLSS Control of the Activated Sludge Process,
W82-03849 1509 5D

A New Indicator of the Activated Sludge Process - Nitrous Oxide,
W82-04018 1509 5D

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

NOGUCHI, S.
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 1511 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Eliminating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

NOGUEIRA, V. P.
River-Basin Simulation in Systems with Large Response Time,
W82-05496 1511 2A

NOI, Y.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

NOKES, J. M.
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 1501 10D

NOLAN, M.
Ground Water Protection by Recharge Zone Management: Institutional Arrangements,
W82-03951 1509 5G

NOLTE, B. H.
Water Management Model Evaluation for North Central Ohio,
W82-01536 1503 4A

NOMANI, A. A.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 1503 5B

NOONE, G. P.
Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 1507 5D

NOORISHAD, J.
An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

NORBERG, T. J.
Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

NORDIN, C. F. JR.
Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

NORDIN, R. N.
Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 1511 5G

NORDMEYE, F. R.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

NORDSTROM, D. K.
The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-03581 1511 2K

NORIN, H.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

NORMAN, D.
Organics,
W82-01239 1503 5A

NORMAN, D. M.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

NORMAN, T. S.
The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

NORNBERG, P.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 1502 7B

NOROUZIAN, M.
Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 1508 5D

NORRIS, D. P.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

NORRIS, R. H.
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 1507 5C

NORTHEIMER, J.
Ground Water Problems in West Virginia,
W82-01060 1502 4B

NORTHROP, R. L.
Recreational Water Quality and Health,
W82-02997 1506 5C

NORTON, D.
Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

NORTON, S. A.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

NORWINE, J.
Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 1505 2L

NORWOOD, D. L.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

NOSS, C. I.
Nitrification Using the Rotating Biological Contactor,
W82-03132 1507 5D

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 1511 5D

NOVAK, J. T.
Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 1502 5D

NOVAK, P.
Coefficient of Friction in Conduits with Large Roughness,
W82-02901 1506 8B

NOVAK, R.
Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 1511 5D

NOVATOROV, S. V.
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

NOVIKOV, YU
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

NOVIKOVA, I. S.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

Concrete for Surfaces of High-Head Spillways,
W82-05110 1511 8F

NOVKIRISHKA, M.
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 1512 5A

NOVKOV, S. M.
Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

NOVOTNY, V.
Delivery of Suspended Sediment and Pollutants from Nonpoint Sources during Overland Flow,
W82-03902 1509 2J

NOWLIN, J. D.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

NOYCE, J. R.
Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 1511 5A

NUGENT, C. E.
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

NULSEN, R. A.
Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 1506 2F

NUPEN, E. M.
Health Aspects of Waters at Public Health Resorts,
W82-04348 1510 5A

NUR, A. M.
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 1508 2F

NURNBERG, H. W.
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 1507 5A

Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry,
W82-05580 1511 5A

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 1504 2H

NUSCH, E. A.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

NUSS, G. S.
Designing for Deficit Irrigation,
W82-06334 1512 3F

NWA, E. U.
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 1503 4A

NYBORG, M.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

NYDICK, S.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

NYE, J. A.
Computer-Based Implementation of Combined Sewer Control,
W82-04783 1511 5D

NYE, J. C.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

NYGAARD, D. D.
Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 1511 5A

NYMAN, H. G.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

NYSTROM, J. B.
Heated Discharge in an Estuary: Case Study,
W82-03374 1508 2L

NYSTROM, R. R.
Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 1511 5C

O'BANNON, C. E.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5E

O'BRIEN, A. L.
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 1510 2A

O'BRIEN, J. J.
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

O'BRIEN, R. P.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

O'BRIEN, R. T.
Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 1510 5F

O'BRIEN, W. J.
Use of Aquatic Macrophytes for Wastewater Treatment,
W82-04046 1509 5D

O'CONNELL, E.
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System – II. Water Quality Modelling,
W82-03243 1507 5B

O'CONNELL, P. E.
Adaptive Hydrological Forecasting - A Review,
W82-00984 1502 2A

O'CONNOR, B.
Turbulence Model for Flow Over Dredged Channels,
W82-02201 1505 8B

O'CONNOR, J. T.
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

O'CONNORS, H. B. JR.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

O'DEA, J.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

O'DONNELL, T. H.
Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

O'DOWD, J.
Northeastern New Jersey Grapples With a Drought,
W82-00289 1501 8A

O'GRADY, S. M.
Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 1502 7B

O'HEARN, M.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

O'KEEFE, P.
Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

O'LEARY, S. J.
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

O'LOUGHLIN, E. M.
A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 1506 7B

O'MELIA, C. R.
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1502 1B

Considering Sludge Production in the Selection of Coagulants,
W82-05675 1511 5F

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

O'NEAIL, T. M.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

O'NEILL, J.
Esholt--Past, Present and Future,
W82-06653 1512 5D

O'NEILL, K.
A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 1511 2F

O'NEILL, P.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 1503 7B

O'NEILL, P. E.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

O'NEILL, R. V.
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

O'NEILL, W. B.
Pollution Permits and Markets for Water Quality,
W82-01699 1503 6A

O'RIORDAN, J.
New Strategies for Water Resource Planning in British Columbia,
W82-05395 1511 6E

O'ROURKE, P. A.
A Parametric Crop Water Use Model,
W82-01310 1503 2I

O'SHEA, J.
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 1510 2F

O'TOOLE, J. C.
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 1510 2I

OAKLEY, S. M.
Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 1506 5B

OBAYASKI, A. W.
Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

OBENG-ASAMOA, E. K.
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 1506 2H

OBENG, L. A.
Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 1511 5C

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 1512 5D

OBERAUER, S.
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 1502 2I

OBERMAYER, A. S.
Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

OBEYSEKERA, J. T. B.
Identification of Streamflow Stochastic Models,
W82-00555 1502 2A

OBLED, C.
Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 1512 2B

Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

OBORNE, A. C.
The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 1506 5A

OBUKHOVA, L. V.
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 1511 2G

OCANAS, G.
Water Reuse Planning Models: Extensions and Applications,
W82-04565 1510 6A

OCANAS SANCHEZ, G.
Optimal Water Reuse Planning,
W82-02736 1506 6A

OCHIAI, M.
Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 1502 2H

OCHS, J. D.
Composting Is Working in Camden,
W82-00948 1502 5E

OCKERSHAUSEN, R. W.
History of a Water Chemical,
W82-00074 1501 5F

ODA, K.
The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 1505 5A

ODAI, S.
Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 1511 5D

ODAJIMA, K.
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

ODAWARA, Y.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

ODEGAARD, H.
Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 1512 5F

ODGAARD, A. J.
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 1510 2J

ODUM, E. P.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

OEHLER, K. E.
The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 1510 5F

OERLEMANS, J.
Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 1507 2C

OESCHGER, H.
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

OFER, Z.
A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 1501 8D

OFFICER, C. B.
Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 1505 2L

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

OGASAWARA, H.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 1507 8C

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

OGATA, S.
An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

OGG, C. W.
Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

OGIL'VI, N. A.
Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 1511 2F

OGILVIE, D. M.
Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

Weak Controls from Sea to Shining Sea,
W82-05035 1511 5B

OGURA, K.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

OHKURA, K.
Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

OHLE, W.
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 1503 2H

OHMURA, A.
Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 1512 2D

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 1512 2D

OHNO, M.
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 1506 5E

OHTAKE, H.
Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 1505 5B

OHTO, T.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 1507 8C

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

OIKARI, A. O. J.
Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 1511 5C

OKADA, N.
Cost Allocation in Water Resources Development,
W82-06854 1512 6C

OKALI, D. U. U.
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

OKIDI, C. O.
Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 1512 6E

OKLAND, J.
Acidification in 50 Norwegian Lakes,
W82-03344 1507 2H

OKOS, M. R.
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 1502 2F

OKSIYUK, O. P.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 1504 5C

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 1511 5B

OKUN, D. A.
Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

OKUSA, S.
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02691 1506 8D

OLAIZ, A.
Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 1511 6C

OLASZI, V.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

OLDFIELD, F.
Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 1507 2J

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 1508 5B

OLDHAM, R. S.
Circulation Patterns; Their Investigation and Prediction,
W82-06477 1512 5F

OLEA, R. A.
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

OLECKNO, W. A.
The National Interim Primary Drinking Water Regulations, Part I - Historical Development,
W82-05814 1511 5G

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 1511 5G

OLEM, H.
Coal and Coal Mine Drainage,
W82-01261 1503 5G

Coal and Coal Mine Drainage,
W82-06802 1512 5B

Power Industry Wastes,
W82-01265 1503 5B

Rotating Disc Biological Treatment of Acid Mine Drainage,
W82-03968 1509 5D

OLESZKIEWICZ, J. A.
Biofiltration Design Based on Volumetric Loading,
W82-05698 1511 5D

Biological Nitrification of Industrial Wastewater,
W82-05129 1511 5D

OLESZKIWICZ, J. A.
Anaerobic Treatment in Novel Contact Digester,
W82-05681 1511 5D

OLEYNIK, G. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

OLIVE, J. H.
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

OLIVE, P.
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 1506 2F

OLIVE, R. T.
James Bay Spillways and Control Structures,
W82-04692 1510 8A

OLIVIER, R. J.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

OLIVIERI, A. W.
Guidelines for Control of Septic Tank Systems,
W82-02599 1505 5B

OLOFFS, P. C.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 1502 5C

OLPIN, O.
Water Law and the Development of Geothermal Resources,
W82-06218 1512 6E

OLSEN, C. R.
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 1511 2J

OLSEN, F. J.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 1501 5E

OLSEN, R.
Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

OLSON, B. H.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 1510 5A

OLSON, F. W.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 1502 8I

OLSON, K. N.
Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 1507 4C

OLSON, K. W.
Economics of Controlling Natural Salt Sources in the Arkansas River Basin,
W82-04234 1509 6B

OLSON, R. D.
The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

OLSON, R. J.
Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 1506 2A

OLSSON, G.
Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 1510 5D

Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

OLSSON, M.
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C

OLTHOF, M.
Biological Nitrification of Industrial Wastewater,
W82-05129 1511 5D

OLUFEAGBA, B. J.
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 1511 6A

OMAN, G. J.
Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

OMANG, R. J.
Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

OMERNIK, J. M.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 1503 5B

OMORINBOLA, E. O.
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 1503 2F

ONGLEY, E. D.
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

ONISHI, Y.
Sediment-Contaminant Transport Model,
W82-01614 1503 5B

ONIZUKA, D. R.
Polyculture of the Freshwater Prawn, Macrobrachium Rosenbergii, Chinese and Common Carps in Ponds Enriched with Swine Manure I. Initial Trials,
W82-03900 1509 3C

ONSTAD, C. A.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

ONUSCHAK, E. JR.
Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 1511 2J

ORAGUI, J. I.
Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 1507 5A

A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 1503 5A

ORCUTT, J. D. JR.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

ORDAZ, C.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

ORE, E. L.
Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 1512 8F

ORELLI, J. V.
Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 1511 2H

OREMLAND, R. S.
Denitrification Associated With Periphyton Communities,
W82-01814 1504 5B

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 1512 2H

ORHON, D.
Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 1511 5B

ORLANDINI, K. A.
Laboratory and Field Studies of The Relative Mobility of 239, 24OPU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

ORLOB, G. T.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 1502 5B

ORLOV, N. YA.
Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 1512 8H

ORMEROD, R. J.
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

ORNDORFF, S. A.
Effect of Kepone on Estuarine Microbial Activity,
W82-01231 1503 5C

ORON, G.
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 1505 5D

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 1512 3C

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 1505 5D

Solid Set Irrigation System Design Using Linear Programming,
W82-02273 1505 6A

ORREN, M. J.
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

ORSZAG, S. A.
Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 1511 8B

ORTIZ, N. V.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

ORVILLE, H. D.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

OSADA, S.
A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

OSADCHII, L. G.
Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 1506 8A

OSADCHUK, V. A.
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 1511 8A

OSADCHYKH, V. F.
Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 1511 2E

OSAMOR, C. A.
Oil Slick Mechanics,
W82-05064 1511 5G

OSANTOWSKI, R.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

OSAWA, S.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1505 5A

OSBORN, C. T.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

OSBORNE, J. A.
Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 1503 2H

OSBORNE, L. L.
Metagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 1512 5C

OSBORNE, P. L.
Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 1507 5C

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00924 1502 2H

OSBORNE, R. H.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

OSCARSON, D. W.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 1502 2J

OSCARSON, H. G.
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

OSE, Y.
Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

OSGOOD, R. A.
Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 1512 2H

OSHEKA, J. W.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

OSHIDA, P. S.
Marine and Estuarine Pollution,
W82-01274 1503 5C

Marine and Estuarine Pollution,
W82-06808 1512 5C

OSOKIN, P. K.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A

OSONUBI, O.
The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 1507 2D

OSREDKAR, R.
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 1512 5A

OSTEEN, C.
Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

OSTERKAMP, T. E.
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 1510 7B

OSTERYOUNG, J.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

OSTERYOUNG, R. A.
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

OSTLUND, H. G.
The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 1511 2A

OSTROVERKH, B. N.
Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 1512 8E

OSTRY, R. C.
Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 1512 5B

OSWALD, E. O.
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 1511 5A

OTA, J. J.
Aeration at High Velocity Flows,
W82-05602 1511 8A

OTAJIMA, K.
Problems and Solutions on Sludge Level Measurement,
W82-04055 1509 5D

OTIS, R. J.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 1508 5D

Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

Pressure Distribution Design for Septic Tank Systems,
W82-05439 1511 5E

OTOSKI, R. M.
Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 1501 5E

OTSON, R.
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Headspace Chromatographic Determination of Water Pollutants,
W82-06016 1512 5A

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 1511 5F

OTSUKA, H.
Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 1506 5B

OTT, C. R.
Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

Vacuum Filtration of Septage,
W82-04710 1510 5D

OTTERBY, M. A.
An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 1511 5B

OTTMERS, D. D.
Intensive Survey of the Sabine-Neches Canal - Segment 0703,
W82-04078 1509 5A

OTTON, E. G.
The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 1505 2F

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

OUELLET, M.
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

GULMAN, C. S.
The Bed Depth Service Time Design Method for Deep Bed Filtration,
W82-04143 1509 5F

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

OURTH, D. D.
Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 1512 5C

OUSEY, J. R. JR.
Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 1508 2E

OUTCALT, S. I.
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

OUTEN, R. B.
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 1503 6B

OUTH, D. D.
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 1505 5C

OUVRARD, J.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

OVCHINNIKOVA, L. K.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

OVERBEEKE, K.
Highlights of the St. Mary's Redevelopment Project,
W82-03617 1508 8A

OVERCASH, M. R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 1502 5B

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 1511 5B

Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 1501 5B

Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 1501 5B

OVERMAN, A. R.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 1502 5D

Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 1512 5D

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

OVERTON, J. H.
Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 1502 5B

OWE, M.
The Distribution of Heavy Metals and Petroleum Residues in the Soil from Urban Surface Runoff,
W82-04216 1509 5B

OWEN, J. R.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B

OWEN, R. B.
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

OWEN, R. M.
A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 1508 2H

OWEN, R. R.
The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476 1511 5B

OWENS, E. L.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

OWENS, E. M.
Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

OWENS, L. B.
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 1502 5G

OWER, J.
The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

OZAKI, M.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

OZGEN, C.
Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 1512 3A

Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

PAASIVIRTA, J.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

PABST, M. E.
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

PACA, J.
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 1507 5D

PACE, M. L.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

PACHA, R. E.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

PACHUR, H. J.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

PACKER, D. M.
Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 1505 5A

PACKMAN, M. J.
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

PAEPCKE, B. H.
Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 1511 5D

PAERL, H. W.
Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

PAGE, A. L.
Are Sierra Lakes Becoming Acid,
W82-00231 1501 5C

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 1503 3C

PAGE, C.
Reliability of Water Resources,
W82-02749 1506 6A

PAGE, G. W.
Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 1505 5A

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 1503 5A

PAGE, G. W. III.
Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 1503 5A

PAGE, H. R. S.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 1504 5D

PAGE, L. M.
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

PAGE, P.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 1503 2C

PAGE, S. W.
Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 1511 5D

PAGEL, J. E.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 1503 5A

PAGGA, U.
The BASF Toximeter - A Helpful Instrument to Control and Monitor Biological Waste Water Treatment Plants,
W82-04050 1509 5A

PAGLIAI, A. M. B.
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

PAHREN, H. R.
Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 1503 5C

PAI, M.
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

PAIGE, S.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5G

PAIGE, S. F.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

PAIN, D. F. H.
Riding Mill Pumping Station,
W82-04292 1510 8A

PAJAK, A. P.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

PAKHOMOV, O. A.
Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 1507 8D

PAL, D.
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 1501 5E

PAL, N.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Scccobranchus Fossilis,
W82-06031 1512 5C

PALACIOS, E. V.
Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 1506 3F

PALAZZO, A. J.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 1503 5E

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

PALCIAUSKAS, V. V.
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 1512 2F

PALEN, G. M.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

PALIN, A. T.
New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 1505 5A

PALIWAL, K. V.
Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 1505 3C

PALL, R.
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

PALLER, M. H.
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

PALLER, M. S.
Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 1512 5F

PALM, J. C.
Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 1511 5D

PALMENBERG, R. E.
Calculator Program Aids Lagoon Design,
W82-03211 1507 6A

PALMER, F. E.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

PALMER, H. J.
Characterization of Properties of Water,
W82-05540 1511 1A

PALMER, M. A.
Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 1505 2L

PALMER, M. D.
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 1505 7B

PALMER, T.
Don't Damn the Stanislaus,
W82-03275 1507 6E

PALMER, W. L.
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

PALMERO, S.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

PALMQUIST, W. N.
Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

PALOMEQUE, B.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

PALUMBO, A. V.
Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 1508 2L

PAMATMAT, M. M.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

PANDE, J.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

PANDEY, M. P.
Removal of Inorganic Mercury from Water by Bitmuminous Coal,
W82-06265 1512 5D

PANDLEY, P. C.
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

PANDOZZI, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

PANDYA, V. P.
Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 1506 3A

PANE, G.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 1502 2H

PANEK, F. M.
The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 1505 7A

PANFILOV, D. F.
The Effect of Wind on Ice Pressure on River Structures,
W82-02668 1506 2C

PANICKER, P. V. R. C.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

PANKOW, J. F.
Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals,
W82-03771 1509 2K

Kinetics for the Aquatic Environment,
W82-01631 1503 2K

PANKOW, J. R.
Kinetics for the Aquatic Environment,
W82-01806 1504 2K

PANO, A.
Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 1511 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

PANSEGROUW, J. P.
Absolute Roughness of Concrete-Lined Channels,
W82-03397 1507 8B

PANSING, M. F.
Concentration and Size of Asbestos in Water Supplies,
W82-00262 1501 5B

PANT, M. C.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

PANZER, C. C.
Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

PAO, H-P.
Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1507 1A

PAOLINI, A. E.
Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 1511 5D

PAPEE, H. M.
Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

PAPST, M. H.
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-03545 1502 2H

PARADIS, P.
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

PARAMASIVAM, R.
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

PARDOEN, G. C.
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 1507 6A

PAREKH, B. S.
High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 1503 5D

PAREN, J. G.
Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 1508 2C

PAREKE, M. A.
Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

PARIN, M. A.
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

PARIS, D. F.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 1502 2K

PARISH, G. E.
History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 1511 6E

PARIZEK, R. R.
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 1502 6A

PARK, S. W.
A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 7A

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 1512 4D

Splash Erosion Modeling: Physical Analysis,
W82-05970 1512 2J

PARK, W.
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 1506 5G

PARK, W. M.
Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control,
W82-04063 1509 5G

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 1512 6F

PARKER, B. C.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

PARKER, C. D.
Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 1511 5D

PARKER, C. E.
Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 1510 5A

PARKER, D. S.
Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 1511 5D

PARKER, G.
Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 1511 2J

Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 1511 2E

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 1511 2E

PARKER, G. W.
Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

PARKER, J. G.
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 1504 5C

PARKER, J. L.
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

PARKER, R. D. R.
Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

PARKER, W. F.
A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 1503 5A

PARKER, W. R.
A Suspended Sediment Front in the Severn Estuary,
W82-04639 1510 2L

PARKIN, R. B.
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 1506 2H

PARKIN, T. B.
Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 1508 2H

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 1504 2H

PARKINSON, D. B.
Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

PARKS, B.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

PARKS, G. A.
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

PARLANGE, J. Y.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 1506 5B

PARLANGE, J. Y.

Optimization Principle for Air and Water Movement,
W82-05173 1511 2G

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01097 1504 2G

PARNICKY, P.
Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

PARR, A. D.
Multiport Diffuser Mixing Zones in Rivers,
W82-02594 1505 5B

Nearfield Performance of River Diffusers,
W82-04561 1510 5B

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

PARR, J. F.
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 1512 5E

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

PARRA, M. A.
On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,.
W82-03273 1507 3C

PARRA-MATA, J. J.
Process-Response Systems: A Practical Approach to Watershed Classification Considering Water and Sediment Yields,
W82-06217 1509 2A

PARRETT, C.
Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

PARRIS, G. E.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

PARRISH, F. K.
Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

PARRY, T. A.
Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 1512 5D

PARSONS, L. R.
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 1502 2I

PARSONS, W. A.
Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 1501 5D

PARTENHEIMER, E. J.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D

PARTHENAIDES, E.
Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

PARTHIOT, F.
Development of the River Seine Estuary: Case Study,
W82-02867 1506 2L

PARTON, W. J.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 1503 4A

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

PASCALE, C. A.
Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

PASCHETTO, J. E.
Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

PASING, M. F.
Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

PASKINS, A. R.
Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 1511 5D

PASSINO, D. R. M.
Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

PASSINO, R.
An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 1512 5D

PASSIOURA, J. B.
Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 1507 2I

PATALAS, K.
Comment on 'A Relation Between Lake Morphometry and Primary Productivity and Its Use in Interpreting Whole-Lake Eutrophication Experiments' (E.J. Fee),
W82-03780 1509 5C

PATE, P. P.
Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

PATEL, D.
Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

PATEL, G. N.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 1506 5C

PATEL, I. C.
Ski-Jump Spillway for India's Ukai Dam,
W82-02430 1505 8A

PATEL, K. R.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 1503 2G

PATEMAN, D.
Prediction of the Circulation in Reservoirs,
W82-04682 1510 2H

PATERA, A. T.
Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 1511 8B

PATERSON, J. J.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 1501 5E

PATHAK, B. N.
Settling Characteristics of Flocculant Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

PATI, S.
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 1503 2A

PATNAIK, D.
Normality of Hydrological Data,
W82-05752 1511 7B

PATRICK, H. D.
Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

PATRICK JR, W. H.
Kinetics of Nitrogen Loss in Simulated Wastewater Treatment in a Soil-Plant System,
W82-03869 1509 5D

PATRICK, L.
Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

PATRICK, P. H.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

PATRICK, R.
The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

PATRICK, R. W.
Practical Power-Saving Techniques in Pinellas County,
W82-04092 1509 5F

PATRICK, W. H. JR.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 1503 5B

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 1510 5D

PATRINOS, A. A. N.
Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 1503 2B

PATTEN, J. E.
Will Synfuel Development Drain the West Dry,
W82-03292 1507 6D

PATTERSON, G. G.
Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 1511 2A

PATTERSON, H. V.
Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 1508 5F

PATTERSON, J. L.
Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

PATTERSON, J. W.
Biodegradation of Hazardous Organic Pollutants,
W82-04910 1511 5B

PATTERSON, M. R.
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 1503 2G

PATTERSON, R. J.
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 1505 2A

A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

PATTISON, P. L.
Conducting a Regular Main Flushing Program,
W82-04118 1509 5F

PATTON, J. L.
Curbing the Distribution Energy Appetite,
W82-04136 1509 5F

PATTON, J. T.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 1501 5D

PATTON, P. C.
Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

PATWARDHAN, S. V.
M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 1512 5F

PAUL, C. K.
Remote Sensing in Development,
W82-01719 1503 7B

PAUL, J.
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 1510 2H

PAUL, J. H.
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 1512 5A

Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 1512 5A

PAULL, C. K.
Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

PAULSON, D. L.
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

PAULSON, L. J.
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G

PAVIA, R. A.
Water Supply and Distribution in Larger Communities,
W82-06413 1512 5F

PAVLENCO, G. F.
Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 1511 2D

PAVLIK, B. M.
Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 1507 2I

PAVLOVA, K. K.
Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 1505 2A

PAVONI, J. L.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 1501 6A

PAWLIKOWSKI, W.
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 1504 6D

PAWLOWSKI, L.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 1506 5D

PAYMENT, P.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 1503 5A

PAYNE, G.
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

PAYNE, G. A.
Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

PAYNE, J. F.
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 1511 5C

PAYNE, W. J.
The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria,
W82-03770 1509 5E

PAYNTER, M. J. B.
Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 1502 5A

Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 1501 2L

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 1501 5A

PAZWASH, H.
A Historical Jewelpiece--Discovery of the Millennium Hydrological Works of Karaji,
W82-04155 1509 2F

PEAK, J. E.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

PEARSON, C. C.
Pressurized Oxygenation System and Method,
W82-00064 1501 5D

PEARSON, D. E.
Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

PEARSON, F.
Fixed Endpoint Alkalinity Determination,
W82-01187 1503 7B

O & M Costs and Optimal Capacity Expansion,
W82-04042 1509 6B

PEARSON, F. J.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

PEARSON, W. D.
Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 1505 2H

PEART, D. B.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

PEAVY, H. S.
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 1501 6A

PECK, A. J.
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 1506 2K

PECK, J. C.
Legal Questions and Problems of Kansas Groundwater Management Districts,
W82-02802 1506 6E

PECK, J. W.
Bloomington Lake - Potomac River Water Resources Project,
W82-06103 1512 8A

PECK, T. W.
Accumulation of Polychlorinated Biphenyls in Atlantic Tomcod (Microgadus Tomcod) Collected from the Hudson River Estuary, New York,
W82-03777 1509 5C

PEDDER, W. M.
Water Tanks in Reinforced Concrete,
W82-06604 1512 8F

PEDDICORD, R. K.
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 1501 5C

PEDERSEN, D.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 1504 5C

PEDERSEN, F. B.
Diversion of the River Neva,
W82-03304 1507 4A

PEDERSON, D. C.
Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

PEDERSON, D. T.
Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

PEEBLES, R. W.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 1502 2E

PEEL, D. A.
On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 1507 2C

PEET, R. W.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

PEET, S. E.
The Long Lake Diversion: An Environmental Evaluation,
W82-05368 1511 6G

Northwestern Ontario River Dimensions,
W82-05742 1511 6G

PEGLOWSKI, L. E.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

PEI, D.
Systems Analysis,
W82-01303 1503 6A

Systems Analysis,
W82-06997 1512 5G

PEIRCE, J. J.
Strategies to Control Nonpoint Source Water Pollution,
W82-04261 1510 5G

PEIRCE, M.
Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

PEIXOTO, J. P.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

PELLEREJ, M.
Improvement of Swirl Concentrator,
W82-05821 1511 5D

PELLETIER, E.
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 1502 7B

PELLICCIA, A.
Economic Analysis of Water Main Breaks,
W82-05673 1511 8A

PELON, W.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

PELOSI, P.
The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

PENDLETON, E. C.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

PENG, T-H.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 1511 2J

PENICKA, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

PENNACCHIO, V. F.
Current Trends in Cost of Service Studies,
W82-05806 1511 6C

PENNING-ROWSELL, E. C.
Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

PENROSE, D. L.
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 1512 5C

Impact of Mining Activities on Water Quality in Western North Carolina,
W82-03926 1509 5B

PENROSE, J. D.
Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 1506 2L

PENSAERT, J.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

PENTECOST, A.
Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 1511 2H

PENTEK, D. T.
Oxidation Products and Rates of Reaction in the Ozonolysis of Dibenzofuran,
W82-06305 1512 5B

PENTLAND, R. L.
A Federal Perspective on River Basin Management,
W82-05388 1511 6E

PEOPLES, A. J.
Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

PEOPLES, S. A.
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

PEPPER, I. L.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 1503 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 1503 5D

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA
W82-02817 1506 3C

PERCIVAL, J. B.
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

PEREIRA, W. E.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 1503 5A

PEREKHREST, S. M.
Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 1512 4C

PEREKHREST, V. S.
Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 1512 4C

PEREZ GAVILAN, D.
A Perspective Study of Droughts in Mexico,
W82-03358 1507 2E

PEREZ, H.
Resonant Waterhammer: A Case Study,
W82-05921 1512 8C

PEREZ, R.
Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 1512 7C

PERFECT, H. G.
Airy Holm Dam - Kielder Water Scheme,
W82-03070 1507 8A

PERHAM, R. E.
Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 1510 2C

PERINEAU, F.
Surfactant Adsorption on the Wool Carbonising Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 1511 5D

PERKINS, H. F.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

PERKINS, M. A.
Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

PERKINS, S. G.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

PERKINS, W. S.
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

Use of Hydroxylpropylcellulose to Decrease Wastage of Disperse Dyes in the Continuous Dyeing of Polyester,
W82-04164 1509 5G

PERNA, R. K.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

PERRIN, R. M. S.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

PERROUX, K. M.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 1510 2G

PERRY, B. H.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

PERRY, E. G.
Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

PERRY, P. F.
Demand Forecasting in Water Supply Networks,
W82-02926 1506 6D

PERRY, R.
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 1512 5D

Detergent Builders and Water Quality - A Changing Scene,
W82-03093 1507 5C

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 1511 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 1503 5E

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 1512 5D

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 1512 5D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 1502 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 1507 5D

Type a Zeolite in the Activated Sludge Process - I: Treatment Parameters,
W82-06459 1512 5D

PERRY, R. L.
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 1501 5A

PERSSON, O.
Computer Control of Nitrifying and Denitrifying Activated Sludge Process,
W82-04025 1509 5D

PERSSON, T.
Small Hydro Stations in Sweden,
W82-04174 1509 8C

PERTHUISOT, J. P.
The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

PERTICA, M.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

PESANT, C.
Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 1511 7B

PESCOD, M. B.
Major Factors in Sewer Ventilation,
W82-06462 1512 8A

The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02434 1505 6A

PESCOD, W.
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 1511 5G

PESKIN, H. M.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 1503 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 1503 6A

The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 1502 6B

PETERS, H. G. SR.
Mixing Technology Reduces Energy Use,
W82-00634 1502 5D

PETERS, J. E.
Reregulation on an International River--A Case Study,
W82-06429 1512 6G

PETERS, J. G.
Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 1501 5C

PETERS, N. E.
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 1505 5B

PETERS, R. H.
A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 1510 2H

PETERS, R. W.
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

PETERSEN, G. W.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5E

PETERSEN, J. C.
Water-Quality Reconnaissance of Harding Creek, Lawrence County, Arkansas,
W82-03995 1509 7C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

PETERSEN, R. J.
Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

PETERSON, A. W.
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 1502 2J

PETERSON, C. M.
By-Product Recovery Finances Treatment,
W82-02756 1506 5D

Water Conservation in Cotton by Drought Induced Leaf Surface Wax Synthesis,
W82-03946 1509 3F

PETERSON, D. F.
Computer-Based Implementation of Combined Sewer Control,
W82-04785 1511 5D

PETERSON, D. L.
Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water,
W82-04127 1509 5F

PETERSON, F. L.
Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 1511 4B

PETERSON, G. L.
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04269 1510 6B

PETERSON, J. B.
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 1511 2G

PETERSON, M. E.
Soil Percolation Tests,
W82-01044 1502 2G

PETERSON, M. L.
Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

PETERSON, P. A.
Waste Treatment System Retrofitted Within Deadline,
W82-05947 1512 5D

PETERSON, S. A.
Lake Restoration by Sediment Removal,
W82-06776 1512 5G

PETERSON, W. A.
Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

PETRASHEN, R. N.
Uplift Pressure of Water on the Base of Hydraulic Structures in Limit Design States (Discussion of Construction Specifications),
W82-05582 1511 8A

PETRICK, D.
Intensive Survey of Hunting Bayou,
W82-04080 1509 5A

PETRICONI, G. L.
Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

PETROFF, R.
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

PETRONIO, B. M.
Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

PETROV, G. N.
Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 1511 4A

PETROVIC, G.
On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929 1511 2H

PETTIGREW, F.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 1511 5D

PETTINE, M.
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 1502 5A

PETTS, G. E.
Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

PETTY, J. A.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 1512 3F

PETTY, J. D.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

PETTYJOHN, W.
Sampling and Analyzing Water,
W82-05263 1511 5A

PETTYJOHN, W. A.
Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 1505 2F

Sampling Ground Water for Organic Contaminants,
W82-00820 1502 5A

PEUKERT, V.
Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermessstellen),
W82-04582 1510 7B

PEVERLY, J. H.
Stream Transport of Nutrients Through a Wetland,
W82-04857 1511 5B

PEW, W. D.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

PFAENDER, F. K.
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 1505 5A

PFAFF, C. L.
Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

PFAFF, T.
California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411 1511 4A

PFAFFENBERGER, C. D.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

PFEIFFER, E. H.
On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 1512 5A

PFEIFFER, M.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

PFISTER, R. M.
Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 1512 5F

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 1512 5C

PFOHL, E.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

PHARAOH, P. L. G.
pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 1505 5F

PHATARFOD, R. M.
Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 1511 6A

PHEIFFER, T. H.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

PHETHEAN, S. J.
Recent Inshore Sediments in Musandam, Oman,
W82-02857 1506 2J

PHIEN, H. N.
Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 1510 2E

Normality of Hydrological Data,
W82-05752 1511 7B

Reservoir Sedimentation with Random Deposits,
W82-04443 1510 2J

A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 1505 2E

PHILIPSON, W. R.
Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

PHILLIPS, G. L.
The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 1512 5C

PHILLIPS, G. R.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

PHILLIPS, J. F. V.
Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

PHILLIPS, K. J.
Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

PHILLIPS, L. A.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

PHILLIPS, P. A.
Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 1511 2A

PHILLIPS, R. B.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

PHILLIPS, R. E.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

PHILLIPS, W.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

PHOTIS, J. D.
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 1506 2H

PIALY, P. P.
Mixing Zone Analysis for River Plumes,
W82-01961 1504 5B

PICARD, G. A.
Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 1508 5D

PICCININ, B. B.
Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 1507 5C

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

PICK, F. R.
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

PICKENS, J. F.
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 1503 2F

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 1504 2F

PICKERING, Q. H.
The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

PICKFORD, J.
They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 1512 5F

PICKMERE, S.
Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

PICKS, F. R.
Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

PICO, R. F.
Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 1512 5D

PIEBER, M.
Purification of Wastewater by Electrolysis,
W82-00847 1502 5D

PIEPHO, R. F.
Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 1501 5D

PIERCE, J. L.
Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 1501 5E

PIERCE, M. L.
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 1512 5D

PIESSENS, R.
A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

PIEST, R. F.
Gully Erosion,
W82-01407 1503 2J

PIET, G. J.
Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

PIETILA, K. A.
Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 1511 5D

PIETTE, J. P.
Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 1508 5D

PIHLAR, B.
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

PIKE, E. B.
Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

PILL, W. G.
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

PILZER, J. E.
Leak Detection--Histories,
W82-04363 1510 3D

PINCKNEY, D. J.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

PINDER, G. F.
A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 1511 2F

PINTER, P. J. JR.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

PIONKE, H.
Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

PIONKE, H. B.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

PIPES, W. O.
Microbiology of Wastewater Treatment,
W82-01291 1503 5D

Microbiology: Wastewater Treatment,
W82-06926 1512 5D

PIRBAZARI, M.
Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 1501 5F

Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 1506 5D

PIRRUNG, D. F.
Cost-Effectiveness Analysis for On-Site Wastewater Treatment Alternatives,
W82-04185 1509 5D

PISANO, W. C.
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 1510 5D

Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 1508 5D

PITBLADO, J. R.
A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 1503 5B

PITKAT, C.
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

PITLO, R. H.
The V-Shaped Broad-Crested Weir,
W82-06450 1512 8B

PITMAN, R. M.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 1502 2D

PITT JR, W. W.
Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 1503 5A

PLAGGEMEYER, T. G.
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 1505 6A

PLAKIDA, M. E.
Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 1506 8B

PLAMER, C. J.
Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 1503 2G

PLAN, B.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

PLANCHET, R. J.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

PLANK, V. G.
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

PLANTZ, G. G.
Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

PLATE, E. J.
Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 1512 8B

PLATE, V.
Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 1510 7B

PLATTS, W. S.
Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

PLAUMANN, E. W.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 1503 5D

PLAYLE, R.
Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 1511 5A

PLEBAN, S.
Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 1507 3F

PLEYSIER, J. L.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 1503 2G

PLITMAN, S. I.
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

PLUMLEY, A.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

POCHOP, L. O.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

POCOCK, J. S.
The Traditional Approach to Water Loss,
W82-04656 1510 3D

PODDUBNYY, A. G.
The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

PODUSHKO, Y. N.
Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 1511 8I

POERTNER, H. G.
Better Ways to Finance Stormwater Management,
W82-03298 1507 6C

POGGE, E. C.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 1511 2E

POLAND, J.
Ground-Water Information: NWWA Provides the Resources,
W82-00301 1501 2F

POLAND, J. F.
The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 1508 4B

POLAND, R.
Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

POLCYN, D. S.
Inorganics,
W82-01238 1503 5A

Inorganics,
W82-06999 1512 5A

POLGAR, T. T.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

POLLARD, F.
Detroit - Fresh Clean Water,
W82-01506 1503 5D

POLLARD, N.
The Gezira Scheme--A Study in Failure,
W82-03393 1507 6B

POLLARD, W. H.
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 1503 2J

POLLER, M. H.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

POLLOCK, G. A.
Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 1511 5B

POLPRASERT, C.
Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 1512 5B

Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

Wind Aeration in Model Waste Treatment System,
W82-02944 1506 5D

POLZER, W. L.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

PONCE, V. M.
Accuracy Criteria in Diffusion Routing,
W82-06423 1512 8D

Modeling Circulation in Depth-Averaged Flow,
W82-02679 1506 2E

Modeling Gradual Dam Breaches,
W82-00554 1502 8D

Modeling Rill Density,
W82-02604 1506 2J

Nature of Wave Attenuation in Open Channel Flow,
W82-09003 1511 2E

PONDICK, J.
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

PONNAMPERUMA, F. N.
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

PONTANIER, R.
Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 1511 2D

PONZINI, G.
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 1512 2F

POOLE, G. J.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

POOLE, L. R.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 1511 2K

POON, C. P. C.
Upgrading with Rotating Biological Contactors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

POOTS, V. J. P.
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 1504 5D

POPA, R.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 1503 6A

POPE, D. H.
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 1502 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 1502 2H

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

POPE, P. R.
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 1501 5D

POPHAM, J. D.
Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 1508 5A

POPKIN, B. P.
Strategies for Reuse and Conservation,
W82-05790 1511 3C

POPOFF, G.
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Pre-

concentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 1507 5A

POPOV, Y. A.
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 1511 8D

POPOWCHAK, T.
Control of Sludge Bulking in the Brewing Industry,
W82-05260 1511 5D

POPPITI, J. A.
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

PORCELLA, D. B.
Eutrophication,
W82-01271 1503 2H

PORTER, C. S.
Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 1508 8A

PORTER, G. L.
Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

PORTER, K.
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5B

PORTER, K. S.
An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

PORTER, P. E.
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

PORTIER, K. M.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 1503 5B

POSEY, C. J.
How About Reverse Filters,
W82-03247 1507 4D

POSNER, A.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

POSSIDENTO, M.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

POST, A.
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

POST, G.
Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 1511 5C

POSTMA, L.
Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

POTAPOVA, N. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

POTGIETER, H. J.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 1503 5D

POTTER, K. W.
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 1507 2E

POTVIN, L.
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 1506 2K

POULOS, S. J.
The Steady State of Deformation,
W82-02235 1505 8D

POULSEN, E.
Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 1505 5C

POULTON, D. J.
Physical Process and Eutrophication,
W82-06875 1512 5C

POWELL, J. R.
River Basin Management in Ontario,
W82-05393 1511 6E

POWELL, K. E.
A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

POWELL, R. D.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

POWER, J. F.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

Topsoil Management of Mined Soils,
W82-04571 1510 4D

POWER, N. A.
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 1510 6D

POWERS, C. D.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

POWERS, C. F.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

POWERS, W. F.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

PRAHL, F. G.
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

PRAKASAM, B. S.
Denitrification,
W82-01246 1503 5D

PRAKASH, A.
Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
W82-05799 1511 5B

Statistical Determination of Design Low Flows,
W82-01858 1504 2E

PRAKASH, T. M.
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 1512 5F

PRANDLE, D.
Salinity Intrusion in Estuaries,
W82-04574 1510 2L

PRANGE, A.
Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 1507 5A

PRASAD, D.
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 1501 5E

PRASAD, S. D.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 1511 2I

PRASAD, S. N.
Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

PRASAD, U. K.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 1511 2I

PRASILOVA, J.
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

PRATER, B. L.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 1504 5C

PRATHER, B. V.
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 1511 5D

PRATT, G.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 1503 5A

PRATT, J. M.
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 1511 5C

PRATT, P. F.
Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 1502 5B

PRAVIDIVETS, Y. P.
Passing Floodwaters Over Embankment Dams,
W82-02204 1505 8A

PRENDIVILLE, P. W.
Tailoring Design of Treatment Plants to Local Conditions,
W82-03893 1509 5F

PRENTICE, J. K.
Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

PREPEJCHAL, W.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

PRESSER, T. S.
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

PRETORIUS, J. A.
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 1506 5C

PREUL, H. C.
Application of Fluidic Devices for Control of Wastewater Treatment Operations,
W82-04013 1509 5D

PREZBINDOWSKI, D. R.
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

PRICE, A. C.
Major Factors in Sewer Ventilation,
W82-06462 1512 8A

PRICE, D.
Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 1502 7C

PRICE, J. M.
Pump Systems: What Price Inefficiency,
W82-04093 1509 8C

PRICE, M.
A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

PRICE, M. T.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

PRICE, R. I.
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 1503 2G

PRICE, T. H.
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 1508 5C

PRICKETT, T. A.
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 1502 4B

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

PRIDDLE, J.
The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 1506 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 1506 2H

PRIEST, C. J.
Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03993 1508 5D

PRIEST, P.
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

PRIHAR, S.S.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

PRIIMACHENKO, A. D.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

PRIMUS, C.
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

PRIMUS, C. L.
River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 1511 6E

PRINCE, A. B.
Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

PRINCE, E. D.
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C

PRINCE, K. R.
Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

PRIOR, B. A.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 1503 5D

PRITCHETT, J. W.
Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W32-04732 1510 6A

PRIVAL'SKII, V. E.
The Azov Sea Problem,
W82-00651 1502 6G

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 1507 5G

PROCKO, A.
Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

PROCTOR, B. L.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

PROEBSTING, E. L. JR.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 1501 3F

PROEHL, J. A.
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

PROHASKA, P. G.
Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 1507 5A

PROKOPOVICH, N. P.
Discussion-Engineering Geology of Arid Areas,
W82-01568 1503 4B

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

Terminological Confusion--Lake VS. Reservoir,
W82-06551 1512 2H

PROSEKOV, A. M.
Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 1512 2F

PROSSER, D. W.
A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 1506 2F

PROZESKY, O. W.
Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 1512 5D

PRUELL, R. J.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

PRUETT, J.
Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 1512 6E

PRUITT, W. O.
Irrigation Tailwater Management,
W82-00392 1501 3C

PRZYBYLA, J. M.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

PSARIS, P. J.
Fecal Coliform Densities in a Western Watershed,
W82-05618 1511 5B

PSHENICHNAYA, L. I.
Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

PUCCETTI, G.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

PUCHKOVA, S. M.
On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 1506 8A

PUCKETT, L. J.
Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 1505 2B

PUGH, C. A.
Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 1512 8B

Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 1511 8B

Intakes and Outlets for Low-Head Hydropower,
W82-01979 1504 8C

PUKITE, A. H.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

PURDY, E. J. JR.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 1502 5C

PUSTINGER, J. V.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

PUTNAM, M. E.
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

PUTNAM, P. E.
Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 1510 2J

PYBUS, C.
Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 1507 5C

PYLE, R.
Coefficient of Friction in Conduits with Large Roughness,
W82-02901 1506 8B

PYMAR, C. F.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 1502 2D

PYRKIN, YU. G.
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

PYYSALO, H.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

QADAR, A.
The Vortex Scour Mechanism at Bridge Piers,
W82-04642 1510 8B

QAZI, M. A.
Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

QI-PING, Q.
Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 1511 5A

QISHUN, Z.
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 1507 2J

QIWEI, H.
Bed Load Fluctuation: Applications,
W82-05000 1511 2J

QUACKENBUSH, D. W.
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

QUAGHEBEUR, D.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

QUARRIE, S. A.
Cereal Yields and Drought Resistance,
W82-03195 1507 2I

QUAVE, S. A.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

Trace Analyses for Wastewaters,
W82-03639 1508 5A

QUAYLE, R. G.
The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 1512 2B

QUEIROZ, C.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 1508 5D

QUESENBERRY, K. H.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

QUIGLEY, M. A.
Freshwater Macroinvertebrates,
W82-01281 1503 5C

Freshwater Macroinvertebrates,
W82-06797 1512 5C

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

QUIGLEY, T. M.
Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 1505 2I

QUIJANO, D. D.
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

QUIMBY, B. D.
The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 1508 5A

QUIMBY, P. C. JR.
Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 1505 4A

QUINDRY, G. E.
Optimization of Looped Water Distribution Systems,
W82-04045 1509 6A

QUINLIVAN, S.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 1503 5D

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 1511 5G

QUINN, F. H.
Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 1510 2B

QUINN, J. E.
Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

QUINN, J. G.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

QUINN, J. P.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

QUINN, N. J.
Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 1508 2L

QUINN, R. M.
Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 1512 3A

QUINONES, F.
Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

QUON, T. K.
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

QURESHI, A. A.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

QURESHI, M.
A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 1511 5A

QURESHI, N.
Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 1508 5F

The Effect of Backwashing Rate on Filter Performance,
W82-06415 1512 5F

RAABE, J.
Optimization of Pump Turbines,
W82-00181 1501 8C

RAATS, P. A. C.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 1502 2G

RABALAIS, S. C.
Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 1505 2L

RABBEN, S.
Aeration at Floor Offsets in Bottom Outlets (Belueftung an Sohlsprungen Von Grundablassen),
W82-06242 1512 8C

RACHAMANIN, Y. A.
Health Aspects of Water Desalination,
W82-03116 1507 3A

RADA, E. A.
Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 1510 6E

RADCLIFFE, D.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

RADEMAKER, A. D.
Leachates from Solid Waste Recovery Operations,
W82-00167 1501, 5D

RADFORD, J.
Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 1511 6D

RADFORD, P. J.
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 1503 2L

RADKE, J. K.
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 1501 2G

RADOSEVICH, G. E.
Future Water Development Policies,
W82-05884 1511 5G

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

RADTKE, D. B.
A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

RAE, J. E.
Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 1508 5B

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 1512 5B

RAFFERTY, M. R.
Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

RAGHI-ATRI, F.
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

RAGONE, S. E.
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

RAHAL, C. M.
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 1511 5F

RAHI, G. S.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 1504 2G

RAI, D.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5D

Solution Species of Plutonium in the Environment,
W82-00163 1501 5A

RAI, H.
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00466 1502 2H

Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 1503 2H

RAI, S. D.
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 1503 2I

RAI, S. N.
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 1503 2F

RAJARATNAM, N.
Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

Erosion by Submerged Circular Jets,
W82-05002 1511 2J

RAJPUT, R. K.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

RAJU, A. P.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

RAKHMANIN, YU
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 1508 3A

RAKNESS, K. R.
Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment,
W82-03032 1507 5D

RALSTON, C. W.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 1510 4C

RAM, N. M.
Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 1511 5D

RAM, V.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 1504 3F

RAMAKRISHNAN, P. S.
Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 1511 4C

RAMAN, A.
Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

RAMANA RAO, B. V.
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 1507 2B

RAMANA, Y. V.
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

RAMANATHAN, M.
Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 1508 5D

RAMANUJAM, V. M. SADAGOPA
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

RAMASAMY, K.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

RAMBAL, S.
Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 1511 2D

RAMEY, B. A.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

RAMEY, D. S.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

RAMIA, S.
Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 1501 5A

RAMIREZ, A.
Chemicals Disinfect Sludge,
W82-01003 1502 5D

RAMKRISHNADAS, R.
Solid Wastes and Water Quality,
W82-01269 1503 5B

Solid Wastes and Water Quality,
W82-06929 1512 5B

RAMOS, L. S.
Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 1507 5A

RAMSDEN, I.
Automation of Grimsby Pumping Stations,
W82-04006 1509 5D

RAMSEY, W. L.
Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 1503 5E

RAMSPOTT, L. D.
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 1511 5B

RAND, M. C.
Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 1511 5D

RANDALL, C. W.
Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

RANDALL, G. W.
Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

RANDTKE, S. J.
Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 1505 5F

Effects of Salts on Activated Carbon Adsorption of Fulvic Acids,
W82-05667 1511 5F

RANGO, A.
Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 1510 2A

Microwave Measurements of Snowpack Properties,
W82-02646 1506 2C

Operational Applications of Satellite Snow Cover Observations,
W82-04150 1509 7B

RANI, S.
Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 1511 5C

RANKL, J. G.
An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 1512 2G

RANSFORD, R.
Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 1502 5A

RAO, A. V.
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 1503 2B

RAO, A. V. R. K.
Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

RAO, D. B.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

RAO, D. R. J.
Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 1512 5F

RAO, G. G. S. N.
Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 1507 2B

RAO, G. R.
A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

RAO, N. H.
Ground-Water Recharge from Rectangular Areas,
W82-02791 1506 2F

RAO, P. S. C.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 1503 5B

RAO, P. V.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 1503 5B

RAO, V. C.
Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 1512 5A

Virus Removal in Waste Stabilization Ponds in India,
W82-00121 1501 5D

RAPER, W. G. C.
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 1505 5F

RAPINAT, M.
Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 1511 5F

RAQUEL, P. F.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

RASHID, H. A-H.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 1503 6A

RASPOR, B.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 1504 2H

RASSOULZADEGAN, F.
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

RATHBUN, P. A.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 1503 6B

RATHBUN, R. E.
Volatilization of Ketones From Water,
W82-05782 1511 5C

RATHFELDER, E. L.
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 1503 2I

RATHOD, K. S.
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

RATHORE, H. S.
A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 1511 5A

RATHORE, T. R.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 1504 2I

RATKOVICH, D. YA.
The Azov Sea Problem,
W82-00651 1502 6G

The Caspian Sea Problem,
W82-00657 1502 4A

RATTRAY, M. JR.
Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-0[illegible] 1503 2L

RATUSHNAYA, M. YA.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 1504 5C

RATZLAFF, K. W.
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 1501 7C

RAUCHER, R. L.
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 1503 5G

RAUSCH, D. L.
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 1503 2J

RAUSCH, L. L.
Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 1508 5C

RAVEH, A.
Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04879 1511 5B

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 1502 2H

RAWITZ, E.
The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 1502 3C

RAWLINGS, G. D.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5D

RAWLS, W. J.
Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 1505 2C

Estimating Soil Water Retention from Soil Properties,
W82-06332 1512 2G

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 1510 4C

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 1511 2E

Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 1503 2G

RAY, D.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

RAY, L. E.
Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

RAYBURN, R.
Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 1505 6G

RAYNOR, L. F.
Bioassays - Procedures and Results,
W82-06810 1512 5A

RAZEM, A. C.
Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

RAZZORENOV, F. F.
Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 1506 7B

REA, D. K.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 1504 2J

READ, D. J.
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

READ, M.
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 1506 2L

READ, W. A.
Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 1512 2J

REALINI, P. A.
Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 1501 5A

REARDON, E. J.
Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 1506 5B

REASONER, D. J.
Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 1503 5B

REBHUN, M.
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 1512 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 1501 5A

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 1511 5D

Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 1512 3A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 1512 5A

REBUCK, E. C.
Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

RECHSTEINER, C. E.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 1501 5A

RECKHOW, K. H.
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 1502 5G

REDALJE, D. G.
Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 1512 5C

REDDELL, D. L.
Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

REDDI, G. H. S.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

REDDY, C. N.
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

REDDY, G. B.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

REDDY, G. R.
Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 1507 2I

REDDY, J. M.
Optimal Design of Border Irrigation Systems,
W82-01977 1504 3F

Optimal Design of Furrow Irrigation Systems,
W82-00138 1501 3F

REDDY, K. R.
Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 1502 5B

Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 1501 5B

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 1511 2H

Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

REDDY, M. R.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

REDDY, S. R.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

REDFIELD, G. W.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 1501 2H

REDHEAD, A. A.
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 1503 8F

REEBURGH, W. S.
A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 1512 5A

REECE, D. E.
Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

REED, G. D.
Drought-Related Water Conservation Efforts in Missouri,
W82-05672 1511 3D

Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 1505 5A

Trihalomethane Precursor Control by Adsorption,
W82-02598 1505 5F

REED, J. C. JR.
Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

REED, J. F.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

REED, L. W.
Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 1511 2H

REED, P.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

REED, R. H.
On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 1508 2L

REED, S. C.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 1503 5D

Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 1507 5D

The Flowering of Wastewater Treatment,
W82-02015 1504 5D

REEDER, J. W.
Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 1507 2A

REES, J. F.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 1504 5B

REES, W.
Mt. St. Helens and the Fish,
W82-02508 1505 2J

REEVES, M.
Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods,
W82-03873 1509 5B

REFLING, D. R.
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 1501 5D

REGINATO, R. J.
Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

Simplifying Neutron Moisture Meter Calibration,
W82-05173 1511 7B

REH, C. W.
Disposal and Handling of Water Treatment Plant Sludge,
W82-04126 1509 5E

REHM, B. W.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

REICE, S. R.
The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

REICH, P. B.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

REICHARD, R. P.
The Dynamics of Conservative Mixing in Estuaries,
W82-02345 1505 2L

REICHARDT, K.
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

REICHENBAUGH, R. C.
Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

REICHMAN, G. A.
Watertable Management Saves Water and Energy,
W82-00943 1502 3F

REICOSKY, D. C.
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 1501 2G

REID, G. W.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

REID, I. A.
Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

REID, J. D.
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 1501 2K

REID, J. M.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

REID, L. M.
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

REID, P. C.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

REID, R.
Environment and Public Health in the Caribbean,
W82-03787 1509 6D

REID, R. C.
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 1502 6G

REID, T. A.
Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 1506 8B

REIJNDERS, H. F. R.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

REIMERS, R. S.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

REINBOLD, M.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

REINIUS, E.
Statistical Flood Flow Estimation,
W82-05945 1512 2E

REINNARTH, G.
50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

REIS, B. F.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 1508 5A

REISH, D. J.
Marine and Estuarine Pollution,
W82-01274 1503 5C

Marine and Estuarine Pollution,
W82-06808 1512 5C

REISS, B.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 1502 5C

REITER, G. A.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

REITER, M.
New Flocculation Units with High Efficiency,
W82-04940 1511 5D

REKUBRATSKIY, V. A.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

REMENYAK, M. B.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 1504 8A

REMER, J. S.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

REMETA, D. P.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

REMFRY, J. E.
Centrifugal Dewatering,
W82-01912 1504 5E

REMIZOVA, S. S.
The Azov Sea Problem,
W82-00651 1502 6G

REMSEN, C. C.
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 1501 5A

REMSON, I.
Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-03345 1511 5G

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 1511 5G

RENARD, J. J.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

RENARD, K. G.
Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 1512 8B

RENAUD, M.
A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 1512 5C

RENBERG, I.
The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 1511 2H

RENBERG, L.
Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 1511 5A

RENDELL, P. S.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 1502 5A

RENEAU, R. B. JR.
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 1505 5B

RENSHAW, E. F.
Conserving Water Through Pricing,
W82-04272 1510 3D

REPA, E. W.
Rainfall Catch Errors Associated with Circumambient Obstructions,
W82-03021 1507 2B

REPLOGLE, J. A.
Measuring Flumes of Simplified Construction,
W82-00140 1501 7B

RESH, V. H.
Recent Trends in Environmental Impact Assessment,
W82-02523 1505 6G

RESTREPO-POSADA, P. J.
Identification of Independent Rainstorms,
W82-05708 1511 2B

RETTA, A.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 1504 3F

RETTMAN, P.
Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 1505 7C

REUTERGARDH, L.
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant,
W82-04836 1511 5C

REUTTER, J. M.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

REVEL, J. L.
Potato and Corn By-Products Used as Cattle Feed,
W82-06488 1512 5E

REVESZ, R. L.
Local Irrigation Agencies,
W82-04560 1510 4B

REYNOLDS, C. S.
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

REYNOLDS, D.
Municipal Needs,
W82-02513 1505 6E

REYNOLDS, J. H.
Land Application of Municipal Wastewater,
W82-01253 1503 5D

Land Application of Wastewater,
W82-06915 1512 5E

REYNOLDS, J. M.
Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 1508 2C

REYNOLDS, P. J.
Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

RHEAD, M. M.
Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 1512 5D

RHEE, G-Y.
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 1512 5B

The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 1505 2H

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

RHEE, J. J.
The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 1506 6A

RHENALS, A. E.
The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 1506 2D

RHO, J.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 1503 4A

RHOADES, J. W.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

RHODES, E. G.
Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 1512 2J

RHODES, I. A-L.
Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

RIBENY, F. M. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 1504 2A

RIBEYRE, F.
Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 1508 5B

RICCI, V.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

RICE, C. E.
Upflow Water Filtration Unit. Test Results,
W82-00407 1501 5F

RICE, C. P.
Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

RICE, G. K.
Accumulation of Polychlorinated Biphenyls in Atlantic Tomcod (Microgadus Tomcod) Collected from the Hudson River Estuary, New York,
W82-03777 1509 5C

RICE, I. M.
An Alternative Solution to the THM Problem,
W82-00072 1501 5F

RICE, R. C.
Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-03334 1511 5D

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 1501 5D

RICE, R. G.
Ozone for the Treatment of Hazardous Materials,
W82-03139 1507 5D

RICE, T. L.
Reservoir Sedimentation Modeling,
W82-03813 1509 2J

RICH, L. G.
A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 1512 5E

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 1512 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 1512 5D

A Low-Cost Secondary Treatment Alternative,
W82-05169 1511 5D

Low-Cost Treatment of Wastewater,
W82-06506 1512 5D

RICHARD, J. J.
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 1508 5B

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 1512 5B

RICHARD, M. G.
Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 1508 5D

RICHARD, Y.
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 1510 5F

RICHARDS, A.
Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

RICHARDS, G.
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 1505 2E

RICHARDS, J.
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 1507 2L

RICHARDS, R. A.
Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 1507 2I

RICHARDS, W. N.
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

RICHARDSON, B. J.
Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

RICHARDSON, C. A.
Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 1512 2F

RICHARDSON, C. W.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

RICHARDSON, H. H.
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

RICHARDSON, L. B.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

RICHARDSON, M. L.
Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 1510 5B

RICHARDSON, W. H.
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 1502 6E

RICHEY, D.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

RICHEY, J. E.
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

RICHEZ, M.
Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

RICHMAN, M. B.
Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 1512 2B

RICHMOND, A. C.
Chemical Treatment of Small Remote Water Sources,
W82-04005 1509 5F

RICHTER, D. D.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 1510 4C

RICHTER, M.
Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 1510 3E

RICKARD, W. H.
Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772 1509 2H

RIDDELL, M. D. R.
Land Disposal of Sludge,
W82-04757 1511 5E

Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

RIDDER, T. B.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

RIDGIK, T. A.
Florida Style Water Supply and Treatment,
W82-06027 1512 5F

RIDGWAY, H. F.
Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 1510 5A

RIDINGER, D. N.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

RIDKER, R. G.
Long-Run Effects of Environmental Regulation,
W82-01848 1504 6A

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 1510 6B

RIDLINGTON, J. W.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

RIEDEL, B.
Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 1510 5C

RIEDEL, J. T.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

RIEKERK, H.
How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 1511 5E

RIES, R. E.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

RIFFALDI, R.
Humic Substances in Sewage Sludges,
W82-05576 1511 5E

RIGAL, S.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

RIGGINS, R. E.
R-Factors for Soil Loss Impact Prediction,
W82-01963 1504 2J

RIGGLE, F. R.
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 1502 7B

RIGGLEMAN, J. D.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 1502 5A

RIGHTMIRE, C. T.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

RIHA, S. J.
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 1503 2G

RIISGARD, H. U.
Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 1505 5C

RIJSTENBIL, J. W.
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 1503 5F

RILEY, J. M.
A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 1510 6A

RILEY, J. P.
Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 1505 5A

RILEY, R. G.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

RILEY, R. L.
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

RILEY, S. J.
The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 1505 2E

RIMMER, T. T.
A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 1508 7B

RINALDI, S.
Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

RINGLER, R. W.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

RINNE, J. N.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

RIPP, J. A.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

RIPPEN, G.
Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 1512 5B

RIPPEY, B.
Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 1511 5B

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 1512 5B

Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 1511 2J

RIPPINGALE, R. J.
The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 1511 2L

RIPPON, J. W.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 1504 5B

RISHEL, G. B.
Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 1511 4C

RISIK, N. S.
Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 1506 2L

RISSER, D. W.
Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

RISSER, P. G.
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 1503 4A

RISSLER, P.
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 1512 8A

RITCHIE, J. C.
Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

RITCHIE, J. T.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 1511 5B

Soil Water Availability,
W82-05623 1511 2G

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 1502 2I

RITSCHARD, R. L.
Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 1510 3F

RITTENHOUSE, R. C.
Developments in Wastewater Handling at Power Plants,
W82-05517 1511 5D

RITTER, J. A.
Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

RITTER, J. R.
An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

Sediment Data for Streams Near Mount St. Helens, Washington–Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

RITTER, W. F.
Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 1502 5D

RITTMANN, B. E.
Microbial Removal of Hazardous Organic Compounds,
W82-03177 1511 5D

Substrate Flux into Biofilms of Any Thickness,
W82-01964 1504 5D

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 1502 5B

RIZET, M.
Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 1511 5A

RIZET, M. M.
Eutrophication, Accelerated by Pollution,
W82-03193 1507 5C

RJANZHIN, S. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

RJARATNAM, N.
Erosion by Plane Turbulent Jets,
W82-05277 1511 8B

ROACH, F.
Ground Water Alternatives and Solutions,
W82-00029 1501 6D

ROAKE, A F.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 1503 5G

ROBBIBARO, P. A.
Warming Up to Geothermal,
W82-03156 1507 8A

ROBBINS, C. W.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 1503 5B

ROBBINS, J. A.
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

ROBBINS, T. W.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 1502 5C

ROBERSON, C. E.
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

ROBERT, B.
Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

ROBERTS, B.
Drinking Water Disinfection,
W82-06341 1512 5F

ROBERTS, C. P. R.
Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 1512 2E

ROBERTS, E. B.
Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 1510 3F

ROBERTS, F. J.
Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 1511 4B

ROBERTS, J.
Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 1502 6G

Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 1502 2D

ROBERTS, J. R.
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 1512 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 1512 5B

ROBERTS, K. J.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 1502 5F

ROBERTS, M. C.
Vertical Variation in Stemflow Generation,
W82-02959 1506 2I

ROBERTS, M. H. JR.
Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 1506 5C

ROBERTS, P. V.
Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5B

Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 1511 5F

Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 1501 5D

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

ROBERTS, R. J.
Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 1511 5C

ROBERTS, S. A.
Protecting the Source,
W82-05785 1511 5F

ROBERTS, S. W.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 1502 2I

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 1502 2I

ROBERTS, T. J.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

ROBERTSON, A.
Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 1506 2H

A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

ROBERTSON, B. R.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

ROBERTSON, J. B.
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

ROBERTSON, S. R.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

ROBEYRE, F.
Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 1507 5C

ROBIE, R. B.
The Impact of Federal Water Policy on State Planning: A Cautionary Example,
W82-04120 1509 6E

ROBINSON, A. E. JR.
Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 1505 6G

ROBINSON, A. R.
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 1503 4D

ROBINSON, C.
Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 1510 6E

ROBINSON, D.
Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

ROBINSON, D. K.
Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 1510 8A

ROBINSON, F. E.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

ROBINSON, G. G. C.
Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 1503 2H

ROBINSON, L. W.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

ROBINSON, R.
The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

ROBINSON, W. D.
Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 1512 2B

ROBINSON-WILSON, E. F.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

ROBISON, H. W.
A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 1512 2K

ROBISON, J. H.
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

ROBL, T. L.
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 1510 2F

ROBSON, S. G.
Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 1502 5B

ROBSON, T. O.
Aquatic Weed Research in Britain,
W82-03187 1507 4A

ROBY, K. B.
Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 1503 5C

ROCHAT, J.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

ROCHAT, P.
Pumped-Storage for Swiss Railways, Part One,
W82-03468 1508 8A

ROCHE, R. J.
Guidelines for Control of Septic Tank Systems,
W82-02599 1505 5B

ROCHESTER, E. W.
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 1501 3F

ROCHETTE, B.
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 1503 5F

ROCHOW, J. J.
Power Plant Water Intake Assessment,
W82-00216 1501 6G

ROCKE, G.
The Kielder Headworks,
W82-06504 1512 8A

ROCKWELL, A. L.
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

RODDA, D. W. C.
The Practical Handling of Water Quality Monitoring Data,
W82-06591 1512 7C

RODEH, M.
Loop Equations with Unknown Pipe Characteristics,
W82-02258 1505 3F

RODGERS, E. B.
Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 1512 2B

RODGERS, J. H. JR.
Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

RODGERS, L. J.
Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 1505 2L

RODGERS, P.
Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

RODHE, A.
Spring Flood: Meltwater or Groundwater,
W82-00531 1502 7B

RODHE, H.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 1502 2B

RODI, W.
Experiments on Coaxial Heated Water Discharges,
W82-06422 1512 5B

RODRIGUEZ-ITURBE, I.
The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 1512 2E

RODRIGUEZ, J.
Turbines for Itaipu,
W82-04955 1511 8C

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

RODRIGUEZ, J. J.
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

RODRIGUEZ-REINOSO, F.
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

ROELFS, V. L.
Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 1501 5D

ROERSMA, R. E.
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

ROESCH, S. E.
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

Dynamic Estuary Model Performance,
W82-05319 1511 2L

ROFF, J. C.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

ROFFLER, S.
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 1508 5B

ROFFMAN, A.
Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 1507 2B

ROGAL, M. F.
Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 1507 8A

ROGERS, A. N.
Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

Work Potential: An Objective Basis for the Comparison of Desalination Processes,
W82-05977 1512 3A

ROGERS, G. L.
Biological Filters,
W82-01242 1503 5D

ROGERS, J. E.
Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 1505 7C

ROGERS, J. S.
The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 1502 2J

ROGERS, K. H.
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 1508 2H

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 1502 6G

ROGERS, L. B.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

ROGERS, L. K.
On the Sampling Variance of Raingage Networks,
W82-05875 1511 7B

ROGERS, P. P.
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 1506 6A

ROGERS, R. B.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 1503 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

ROGERS, W. F.
Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 1511 4A

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 1511 4A

ROGERSON, A.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

ROGOSHEWSKI, P. J.
Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

ROGOWSKI, A. S.
Modeling Water Flux on Strip-Mined Land,
W82-00944 1502 2G

ROHDE, F. G.
Modified Standard Operation Rules for Reservoirs,
W82-05658 1511 4A

ROHDE, W.
Reviving Acidified Lakes,
W82-00933 1502 2H

ROHLICH, G. A.
Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

ROHR, M-E.
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 1501 5A

ROIKO, N. F.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 1511 8A

ROLFE, G. L.
First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 1512 4C

Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 1503 4C

ROLFES, L.
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 1507 2F

ROLLAND, D.
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 1502 5A

ROLLINGER, G.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

ROLLINS, D. K.
Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

ROLLINS, H. C.
Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 1501 10C

ROLOFF, G.
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 1501 2J

ROMANENKO, V. D.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Thermal Power Stations,
W82-01998 1504 5C

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

ROMANOV, V. V.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

ROMANYUTINA, Z. D.
New Methods of Designing Flood Control Measures,
W82-05030 1511 2E

ROMATZICK, S.
UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 1512 5D

ROMERO, G. C.
On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 1507 3C

ROMERO, J. C.
Geologic Structure, Hydrology, and Water Quality of the Laramie-Fox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

RONNEAU, C.
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

ROOK, J. J.
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

ROOS, A.
An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 1511 5B

Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 1512 5B

ROOSE, E. J.
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

ROOT, S. I.
Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 1511 2F

ROPER, H. P.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

ROPER, R. E.
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 1511 4C

ROQUES, H.
Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 1508 5A

Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 1508 5A

ROSA, F.
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

ROSALES, M. T. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

ROSCOE, J. V.
Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 1511 5B

ROSE, B.
Managing Water at Helicopter Plant,
W82-01974 1504 5D

ROSE, C. W.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 1511 5B

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 1506 5B

ROSE, P. W.
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 1505 2E

ROSEBOOM, D.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

ROSEBOOM, E. H. JR.
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

ROSEN, R. A.
Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 1512 5A

ROSEN, R. D.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

ROSENAU, J. C.
Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

ROSENBAUM, K. L.
Avoyelles Sportsmen's League V. Alexander,
W82-01456 1503 6E

ROSENBERG, D. M.
Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 1502 2H

ROSENBERG, S. H.
Recreational Water Quality and Health,
W82-02997 1506 5C

ROSENBLATT, D. H.
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 1502 5G

ROSENDAHL, P. C.
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 1505 2E

The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 1511 5A

ROSENTHAL, E.
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 1503 2F

ROSENTHAL, W. D.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

ROSS, A. H.
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

ROSS, B. D.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

ROSS, H. A.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

ROSS, L. E.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

ROSS, L. T.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

ROSS, P. E.
Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

ROSS, S. M.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

ROSSER, P. A. E.
A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Streptococci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 1512 5D

ROSSI, S. S.
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

ROSSIN, A. C.
Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 1512 5D

ROSSMANN, R.
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 1504 2H

Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 1503 2H

ROSSMILLER, R. L.
Tapered Inlet Design Using Specific Energy Curves,
W82-04693 1510 8A

ROSSNAGEL, B. G.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 1503 2I

ROTATORI, M.
Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

ROTH, D. K.
Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

ROTH, J. A.
Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

ROTH, J. C.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 1508 5D

ROTHBERG, M. R.
Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

ROTTNER, D.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 1507 3B

ROULET, N. T.
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 1501 2C

ROUSE, J. E.
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 1507 5B

ROUSE, J. V.
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01225 1503 5B

ROUSE, M.
Engineering Research and the Water Industry,
W82-00313 1501 8A

ROUSE, M. J.
Renovation of Water Mains and Sewers,
W82-04237 1509 5F

Sewerage: Priorities for Action,
W82-06260 1512 8G

ROUSE, W. R.
Evaporation at a High Arctic Site,
W82-04899 1511 2D

ROUSH, T. H.
The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

ROUSSELLE, J.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

ROUVE, G.
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 1512 8C

ROUX, P. H.
Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

ROVERS, F. A.
Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

ROWE, E. L.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

ROWE, G. T.
Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 1512 5C

ROWE, K.
Recent Water Towers in Norfolk,
W82-03246 1507 8A

ROWE, L. W.
Basin Management in the San Bernardino Basin Area,
W82-00280 1501 6A

Basin Management in the San Bernardino Valley,
W82-00075 1501 4B

ROWE, P. G.
Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

ROWELL, W. F.
Obtaining Layout of Water Distribution Systems,
W82-04319 1510 8A

ROWLAND, R. G.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

ROWLEY, C. K.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

ROY, D.
Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 1503 5D

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 1503 5A

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

ROY, P. S.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

ROY, S. K.
Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 1506 5C

ROYER, M. D.
Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 1511 5G

ROYER, T. C.
Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870 1511 2A

ROYSTER, D. L.
Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 1505 8A

ROZENGURT, M.
Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

ROZHANSKAYA, L. I.
Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 1511 5B

RUARDIJ, P.
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 1505 2H

RUBIN, A. J.
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

RUBIN, H.
Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 1505 2F

RUBIN, H. E.
Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 1512 5B

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 1512 5B

RUBIN, R. J.
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

RUBITSCHUN, C.
Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 1510 2H

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

RUBY, H.
Detention Basins--An Urban Experience,
W82-04332 1510 4A

RUDD, J. W.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

RUDD, J. W. M.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

RUDIE, A. W.
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

RUEDIGER, R. A.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

RUFF, J. F.
Evaluating Scour at Culvert Outlets,
W82-01934 1504 4D

RUFF, W. T.
Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 1505 8A

RUFFER, H.
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 1510 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

RUFFING, B. J.
Furrow Intake Rates and Water Management,
W82-03968 1512 3F

RUFFLE, N. J.
The Kielder Water Scheme,
W82-06503 1512 8A

RUGGIERO, D.
Ultra High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 1511 5D

RUGGLES, R. W.
Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 1511 2C

RUKSASILP, W.
A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 1505 2E

RUMBAUGH, M. D.
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 1511 3F

RUNN, P.
Perivitelline pH of Salmonide Eggs in Relation to Ambient pH,
W82-04064 1509 5C

RUNNELLS, D. D.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 1504 5B

RUNNING, S. W.
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 1504 2D

RUPP, G. L.
Management Options for Ground Water in Urbanizing Areas,
W82-03961 1509 4B

RUSHBROOK, E. L. JR.
Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

RUSHFORTH, S. R.
The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

RUSHTON, H.
Domes, Bubbles, and Paper Waste,
W82-06025 1512 5D

RUSHTON, K. R.
Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 1508 2F

Operating Policies for a Surface/Ground Water System,
W82-01741 1503 4B

RUSSEL, H. A.
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 1512 5A

RUSSEL, L. C.
Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 1508 5C

RUSSEL, S. O.
Flood Probability Estimation,
W82-04318 1510 6B

RUSSELL, D. S.
Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 1502 5A

RUSSELL, F. L.
Replacing Large Water Meters: Why and How,
W82-03560 1508 5F

RUSSELL, K. D.
The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 1505 6A

RUSSELL, L. L.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 1510 5D

RUSSELL, R. B.
Learning from the Skipton Flood,
W82-02063 1504 2E

RUSSELL, S. O.
Evolution of Water Management Techniques,
W82-05565 1511 6A

RUSSO, D.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 1507 2G

A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 1512 2G

RUSSO, R. C.
The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

RUTALA, W. A.
Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency,
W82-04095 1509 5A

RUTGERS VAN DER LOEFF, M. M.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

RUTHERFORD, J. C.
Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 1511 4C

RUTHERFORD, M. C.
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 1502 2I

RYABOV, V. L.
Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 1511 2E

RYALL, C.
Distribution of Chromobacteria in a Lowland River,
W82-02795 1506 5C

RYALL, M.
The Cone Pump,
W82-02713 1506 8C

RYALS, G. N.
Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 1502 7C

RYAN, B. J.
Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 1511 2F

RYAN, B. Y. JR.
Water Constraints on Emerging Energy Production,
W82-04151 1509 6D

RYAN, G. L.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

RYBUS, M. H.
Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

RYCKBORST, H.
Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

RYDER, R. A.
The Costs of Internal Corosion in Water Systems,
W82-03809 1509 5F

RYDER, R. B.
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

RYDIN, S.
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 1504 5D

RYDLAND, L. N.
Put Pressure on Sewage,
W82-06732 1512 5D

RYDZEWSKI, J. R.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 1503 6A

RYE, R. O.
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

RYMAREVICH, V. I.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

RYTHER, J. H.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

RZOSKA, J.
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 1504 6G

SAAD, M. A. H.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 1511 5B

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

SAAR, R. A.
Ground Water,
W82-01273 1503 2F

SAATCI, A. M.
The Bed Depth Service Time Design Method for Deep Bed Filtration,
W82-04143 1509 5F

SAAVA, A. E.
Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 1511 5A

SABANNAVAR, H. A.
Presedimentation Tanks for High Turbid Raw Water,
W82-06444 1512 5F

SABEY, B. R.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

SABEY, J. D.
Water Levels and Losses and Cleaning in Watercourses,
W82-02747 1506 3F

SABOSKI, E. M.
An Investigation of Biologically Adjusted pH Changes in Domestic Sewage Effluent,
W82-03953 1509 5D

SABRI, Z.
A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 1512 3A

SACCO, P. D.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

SACHAN, R. C.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

SACHAN, R. S.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 1504 2I

SACHS, E. F.
Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 1511 5D

SADA, E.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

SADASIVAN, S.
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 1502 2B

SADIQ, M.
The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 1508 5E

SADLER, B. S.
The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 1506 4D

SADLER, K.
The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 1508 5C

SAEED, Y. A.
Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 1507 5B

SAEGER, V. W.
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 1502 5B

SAEGROV, S.
River Plume Studies in Distorted Froude Models,
W82-05864 1511 2B

SAFFERMAN, R. S.
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 1501 5A

SAGIK, B. P.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 [illegible]

SAIJO, Y.
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W82-02768 1506 2H

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W82-02357 1505 5C

SAITO, Y.
A New Indicator of the Activated Sludge Process - Nitrous Oxide,
W82-04018 1509 5D

SAITOU, S.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

SAKAI, S.
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

SAKATA, M.
A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 1511 5A

SAKKAS, J. G.
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 1510 4A

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Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 1507 5C

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Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 1506 5C

SAKTHIVADIVEL, R.
Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 1508 7B

SALA, O. E.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

SALAMA, M. S.
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 1512 2J

SALANKI, J.
Heavy Metals in Animals of Lake Balaton,
W82-06284 1512 5C

SALARZ, S. E.
Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

SALAS, J. D.
Identification of Streamflow Stochastic Models,
W82-00555 1502 2A

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

SALATI, E.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

SALBACH, S. E.
Water Management in Ontario,
W82-04259 1510 6E

SALBU, B.
Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

SALDADZE, K. M.
Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

SALEH, F. Y.
Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

SALIM, R.
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 1501 5A

SALISBURY, D.
Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

SALISBURY, H. B.
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

SALKINOJA-SALONEN, M.
Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 1512 5D

SALO, E. O.
Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

SALOMON, J. C.
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03366 1507 2L

SALOMONS, W.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 1503 2J

SALSTEIN, D. A.
Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

SALTZMAN, S.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 1502 5B

SALZMAN, G. S.
Value Engineering Saves Dam Project,
W82-03287 1507 8A

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W82-04544 1510 5D

SAMANI, Z. A.
Soil Hydraulic Stability in a Subsurface Drainage Sytem,
W82-00115 1501 2G

SAMANIEGO, F. J.
Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

SAMEDOV, R. I.
Calculation of Large Unlined Canals,
W82-05131 1511 8B

SAMELSON, K. S.
Non-Indian Federal Reserved Water Rights,
W82-04804 1511 6E

SAMEOTO, D. D.
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 1501 7B

SAMMAN, J.
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 1512 5C

SAMMAN, N.
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

SAMMEL, E. A.
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

SAMMIS, T.
Effects of Decreased Watering on Crop Yields,
W82-04411 1510 2I

SAMMIS, T. W.
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

SAMOILOFF, M. R.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

SAMOLUBOV, B. I.
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

SAMSON, N.
Measuring Reservoir Ground Movements,
W82-05773 1511 8G

SAMUELS, W. B.
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W82-00915 1502 2H

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A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 1511 8B

SANCHEZ, Y.
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

SANCHO, J.
A Perspective Study of Droughts in Mexico,
W82-03358 1507 2E

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

SAND, J. E.
Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

SANDER, G.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

SANDER, W. H. III.
An Ex Post Analysis of the Uncompahgre Project,
W82-04218 1509 6B

SANDERS, H. O.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

SANDERSON, W. C.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 1503 3E

SANDHU, B. S.
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

SANDOVAL, F. M.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

SANDRIK, R.
Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

SANEMASA, I.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 1507 5A

SANGAL, B. P.
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

SANGER, H. W.
Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

SANTO, L. T.
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

SANVILLE, W. D.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

SAPANDOWSKI, H. P.
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

SAPOZHNIKOV, V. V.
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 1511 7B

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 1512 5C

SARFERT, F.
Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 1511 5D

SARGENT, D. M.
The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 1510 7B

SARGENT, F. O.
Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

SARGENT, G. E.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 1501 2L

SARGENT, R. J.
A River Coding System for Water Quality Archives,
W82-05474 1511 7A

SARKISYAN, A. V.
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

SARKKA, J.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

SARMA, P. B. S.
Ground-Water Recharge from Rectangular Areas,
W82-02791 1506 2F

SARMA, V. V. J.
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 1508 6D

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 1512 2K

SARROT-REYNAULD, J.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

SARTORI, F.
Humic Substances in Sewage Sludges,
W82-05576 1511 5E

SARTORIS, J. J.
Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lake, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

SARTORY, D. P.
A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Streptococci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 1512 5D

SASAKI, K.
Determination of Ammonia in Estuary,
W82-02390 1505 5A

SASMAN, R. T.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

SASSEN, K.
An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 1505 7B

SASTRI, A. S. R. A. S.
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W82-05122 1511 2I

SASTRI, V. S.
Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 1506 5D

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 1502 5D

SATI, S. C.
Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 1506 2H

SATO, N.
Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

SATOH, Y.
Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 1511 2H

SATTAR, S. A.
Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 1501 5A

SAUL, G. E.
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W82-06868 1512 2H

SAULNIER JR, G. J.
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W82-00723 1502 5B

SAUNDERS, B. C.
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W82-02587 1505 6E

SAUNDERS, C. L.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 1502 5D

SAUNDERS, D. G.
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W82-00164 1501 5B

SAUTY, J. P.
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W82-06059 1512 4B

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

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The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 1506 2H

SAVAGE, J. C.
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W82-01951 1504 8E

SAVAGE, W. C.
Superfund: What a Mess,
W82-02184 1505 6E

SAVENKO, V. S.
Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 1511 2K

SAVIN, D. M.
Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 1506 8A

SAVITOVA, N. I.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

SAVVINA, O. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

SAWADA, Y.
Determination of Ammonia in Estuary,
W82-02390 1505 5A

SAWAI, K.
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W82-05085 1511 2E

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W82-05651 1511 2E

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W82-01753 1504 6D

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W82-02255 1505 5A

Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 1503 5D

SAWICKI, D. S.
Problems and Processes in Water Quality Management,
W82-06147 1512 5G

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Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

SAX, R. I.
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W82-01968 1504 2B

SAY, P. J.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 1506 5C

SAYERS, B.
Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 1510 5D

SAYLER, G. S.
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W82-06719 1512 5B

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 1512 5C

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 1504 5C

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 1503 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 1503 5A

SAYLOR, J. H.
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W82-04381 1510 2H

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W82-01960 1504 5B

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W82-02594 1505 5B

SCALISE, M. A.
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W82-06513 1512 5D

SCAVIA, D.
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W82-01460 1503 2H

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 1508 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

SCHAEFER, D. H.
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W82-06949 1512 2F

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W82-05235 1511 6B

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W82-03989 1509 4A

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W82-04825 1511 5C

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W82-01189 1503 5C

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W82-01162 1503 5A

Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 1502 5A

Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 1501 5G

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

SCHAEFFER, S. L.
A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 1512 5D

SCHAFER, J.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

SCHAFF, R. M.
Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

SCHAFFNER, C.
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

SCHAFFRANEK, R. W.
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

SCHALACHA, E. B.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

SCHALEKAMP, M.
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 1507 5F

New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 1505 5F

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 1504 5G

SCHANZ, F.
Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 1511 2H

SCHARCH, J. F.
Improved Analytical Methods for the Design of Leachate Collection Systems,
W82-03936 1509 5E

SCHAUB, S. A.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

SCHAUMBERG, G. D.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

SCHEFTER, J. E.
Water Use Data–Who Needs It,
W82-04198 1509 7C

SCHEIBLE, O. K.
Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 1506 5D

SCHEIDE, E. P.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 1503 5A

SCHEIDER, W. A.
An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 1503 5B

SCHEINER, B. J.
Dewatering of Industrial Clay Wastes,
W82-00041 1501 5D

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 1512 5D

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

SCHELL, H.
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 1512 5F

SCHELL, W. R.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

SCHELSKE, C. L.
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

SCHEPERS, J. S.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

SCHERER, C. R.
O & M Costs and Optimal Capacity Expansion,
W82-04042 1509 6B

SCHEUCH, L. E.
Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

SCHICHT, R. J.
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

SCHICK, L. L.
Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

SCHIEWER, U.
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 1512 5C

SCHILLER, E. J.
Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 1511 2A

SCHILLING, K. E.
Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 1508 5F

SCHIMAUCHI, S.
Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

SCHINDLER, D. W.
The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 1503 5C

SCHINER, G. R.
Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

SCHINK, B.
Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

SCHLAIS, J. F.
Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 1511 5D

SCHLAUCH, R. M.
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 1507 5D

SCHLEGEL, S.
Control of Dissolved Oxygen in Activated Sludge Plants,
W82-04061 1509 5D

Measurement and Control of the MLSS Concentration in Activated Sludge Plants,
W82-03762 1509 5D

SCHLEIFF, U.
Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 1507 3C

SCHLENGER, D. L.
Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 1510 6C

SCHLEPPENBACH, F. X.
Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water,
W82-04127 1509 5F

SCHLESINGER, H. A.
Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 1506 5E

SCHLEYPEN, P.
Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

SCHLICHTING, H. E. JR.
New In-Situ Techniques in Biomonitoring,
W82-05157 1511 5A

SCHLOTZHAUER, P. F.
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 1511 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 1511 2K

SCHLUNGBAUM, G.
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 1511 2L

SCHLUTER, M.
Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 1507 5D

Mass Production of Freshwater Rotifiers on Liquid Wastes II. Mass Production of Brachionus Rubens Ehrenberg 1838 in the Effluent of High-Rate Algal Ponds Used for the Treatment of Piggery Waste,
W82-03884 1509 3C

SCHMID, G.
Seepage Flow in Extremely Thin Aquifers,
W82-03594 1508 2F

SCHMIDT, C.
Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 1511 5A

SCHMIDT, C. J.
Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 1508 5D

SCHMIDT, H. E. JR.
Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

SCHMIDT, J. W.
Steel Industry Wastes,
W82-06799 1512 5D

SCHMIDT, K. D.
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 1502 2F

SCHMIDT, R. D.
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 1501 6A

SCHMIDTKE, N. W.
Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 1508 5E

Steel Industry Wastes,
W82-01264 1503 5D

Steel Industry Wastes,
W82-06799 1512 5D

SCHMIERBACH, M. R.
Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

SCHMITTGEN, M. C.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

SCHMUGGE, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

Aircraft Remote Sensing of Soil Moisture and Hydrolcgic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 1503 7B

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

SCHNEEBERGER, P. J.
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

SCHNEIDER, A. D.
Deep Tillage of Irrigated Pullman Clay Loam-A Long-Term Evaluation,
W82-04372 1510 2G

Management of Recharge Basins on the Southern High Plains,
W82-00938 1502 4B

SCHNEIDER, G.
The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 1511 5G

SCHNEIDER, G. R.
Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 1511 5G

SCHNEIDER, R.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

SCHNEIDER, S. R.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 1503 7B

SCHNEIDER, W.
Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 1510 5F

SCHNITZER, M.
Effects of Pollution on Humic Substances,
W82-03253 1507 5C

SCHNOBRICH, D.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

SCHOCK, M. R.
The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 1511 8G

Laboratory Technique for Measurement of pH for Corrosion Control Studies and Water Not in Equilibrium with the Atmosphere,
W82-04101 1509 5G

SCHOCKE, K.
Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 1511 2H

SCHOENBERG, M. E.
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 1501 5B

SCHOENBERGER, R. J.
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 1512 5B

SCHOENHOLTZ, S.
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

SCHOFIELD, C.
The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03903 1509 5C

SCHOFIELD, C. L.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

SCHOFIELD, R.
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

SCHOLL, J. E.
1980 Needs Survey: Combined Sewer Ssite Studies,
W82-05862 1511 5D

SCHOOF, R.
Environmental Impact of Channel Modification,
W82-04245 1509 4A

SCHOOF, R. R.
Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 1512 4A

Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

SCHOONBEE, H. J.
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 1506 2H

The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 1511 5C

SCHOONHEE, H. J.
The Phosphorus Cycle in Germinston Lake. I. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

SCHOTT, J. R.
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 1507 7B

SCHOTT, P.
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

SCHOWENGERDT, R. A.
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

SCHRADER, E. K.
World's First All-Rollcrete Dam,
W82-05999 1512 8F

SCHRAMEL, P.
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

SCHRAMM, G.
Input and Output Constraints Affecting Irrigation Development,
W82-01476 1503 6B

SCHREIBER, J. D.
Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

SCHREIBER, R. P.
Microcomputer Water Quality Simulation Model,
W82-05191 1511 7B

SCHREIER, H.
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 1504 5A

SCHREINER, J.
Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5B

SCHREINER, S. P.
Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 1511 5C

SCHROEDER, E. D.
Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

Reliability and Stability of Trickling Filter Processes,
W82-04784 1511 5D

Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 1503 5D

SCHROEDER, P. J.
Freezing Processes - The Standard of the Future - An Update,
W82-06115 1512 3A

SCHROEDER, R. A.
Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

SCHROEDER, S. H.
Pollution Control: Changing Approaches,
W82-01870 1504 6E

SCHROER, C. V.
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

SCHUBERT, G.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1502 1A

A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

SCHUBERT, J.
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

SCHUETZLE, D.
Chemometric Modeling of Wastewater Treatment Processe,
W82-05658 1511 5D

SCHULHOF, P.
Water Supply in the Paris Suburbs: Changing Treatment for Changing Demands,
W82-04125 1509 5F

SCHULLER, R. M.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

SCHULTINK, L. J.
Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

SCHULTS, D. W.
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

SCHULTZ, D. T.
Design of a Leachate Collection System for a Sludge Filled Landfill,
W82-03935 1509 5E

SCHULTZ, G. A.
Applications of Simulation to Specific Water Projects,
W82-05522 1511 6A

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

SCHULZ, R. K.
Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

SCHULZ, S.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

SCHULZE, R. E.
Digitizing and Routine Analyses of Hydrological Data,
W82-06386 1512 2E

SCHUMAN, G. E.
Topsoil Management of Mined Soils,
W82-04571 1510 4D

SCHUMANN, H.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

SCHUMM, S. A.
Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 1511 3B

SCHUURING, C.
Dutch Dumps,
W82-03738 1508 5B

SCHUYTEMA, G. S.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

SCHWAB, D. J.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

SCHWAB, G. O.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

SCHWARE, R.
Official and Folk Flood Warning Systems: An Assessment,
W82-06077 1512 6F

SCHWARTZ, F. W.
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 1512 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 1512 5B

Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 1508 2G

Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 1502 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 1502 2A

SCHWARTZ, H. G. JR.
Control of Sludge Bulking in the Brewing Industry,
W82-05260 1511 5D

SCHWARTZ, S. E.
Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 1511 2K

Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 1502 2K

Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 1503 2K

SCHWARTZ, S. S.
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

SCHWARTZBROD, L.
Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

SCHWARZ, F. K.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

SCHWARZ, F. P.
Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 1501 5A

SCHWARZENBACH, R. P.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 1504 5B

SCHWENDEMAN, T. G.
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

SCHWINTZER, C. R.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 1501 2I

SCHWITZGEBEL, K.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results,
W82-03878 1509 5D

SCOLES, F. G.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

SCOTT, B. C.
Sulfate Washout Ratios in Winter Storms,
W82-04898 1511 5B

SCOTT, D.
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

SCOTT, F. A.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 1503 6F

SCOTT, J. C.
Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

SCOTT, J. L.
Sediment Transport Study Along a Delta Shoreline,
W82-06553 1512 2J

SCOTT, J. T.
Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 1502 2H

SCOTT, K. M.
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

SCOTT, R. A. F.
Mixed Bed Technology for Polishing Make-up Water and Condensate Return: Conclusion,
W82-03774 1509 5D

Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 1508 5F

SCOTTER, D. R.
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 1511 3C

SCOULLOS, M. J.
Zinc in Seawater and Sediments,
W82-03166 1507 5B

SCRIVNER, A. E.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

SCRIVNER, C. L.
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 1501 2J

SCRUDATO, R. J.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

SCULLION, J.
The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

SCULLY, D. R.
Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

SCUTT, J. E.
Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 1506 5A

SEABURG, K. G.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

SEAGLE JR, H. H.
Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

SEBACHER, D. I.
Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 1511 2L

SEBESTA, F.
Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

SEDELL, J. R.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 1511 5C

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 1511 5B

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

SEDGLEY, R. H.
Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

SEDITA, S. J.
Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

SEDLACEK, J.
Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

SEDOVA, V. K.
Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 1511 2G

SEEGER, D. R.
Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

SEETHARAMA, N.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

SEGALL, B. A.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5E

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

Vacuum Filtration of Septage,
W82-04710 1510 5D

SEHGAL, R. C.
Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 1512 5C

SEIBERT, D. L. R.
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

SEIDER, R. J.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 1501 5A

SEIDLER, R. J.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 1501 5A

Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 1501 5B

SEILS, C. A.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

SEIM, W. K.
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 1505 7B

SEINWILL, G. D.
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 1510 6C

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

SEIP, H. M.
Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 1507 5B

SEITZ, H. R.
Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

SEITZ, W. D.
Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

SEKEL, D. J.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 1502 5D

SEKI, H.
Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

SEKINE, T.
Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

SEKLA, L.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 1502 5A

SEKOULOV, I.
The Continuous Oxygen Uptake Rate Measurement and Its Applicability as an Activated Sludge Control Parameter,
W82-04020 1509 5D

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 1510 5D

SELBY, K.
The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 1512 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 1504 5G

SELEZNEY, G. S.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

SELIGA, T. A.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

SELIM, H. M.
Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 1507 2G

SELIVANOVA, E. A.
Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

SELL, D. W.
Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

SELL, N. J.
Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

SELLARS, C. D.
A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 1511 2D

SELLECK, R. E.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

SELLERS, D. R.
Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 1511 5A

SELTZ-PETRASH, A.
The New Energy Boom: Small-Scale Hydropower,
W82-03462 1508 8A

SELYAMETOV, M. M.
Formation of a Stable Canal Channel,
W82-05584 1511 8B

SEMIAT, R.
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 1512 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 1512 3A

SEMMENS, M.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

SEMMENS, M. J.
Coagulation: Experiences in Organics Removal,
W82-04424 1510 5F

SEMONIN, R. G.
Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

SEN, H.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 1504 2I

SEN, L. N.
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

SENARATNE, A.
Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 1511 5C

SENDLEIN, L. V. A.
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 1506 5B

SENECA, E. D.
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

SENGER, J. A.
Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 1503 5G

SENGUPTA, J. P.
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 1508 8A

SENGUPTA, S.
A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

SENIOR, E.
Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

SENKER, K.
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

SENN, C. L.
Waterborne Disease Is Prevalent in Egypt,
W82-02435 1505 5C

SENSKE, G. E.
Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

SEPERS, A.B. J.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

SEPHTON, H. H.
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 1511 3A

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 1512 3E

SEPP, E.
Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

SERAFIM, J. L.
Safety Aspects in the Design and Inspection of Dams,
W82-06203 1512 8A

Safety of Dams Judged from Failures,
W82-05512 1511 8A

SEREBRYAKOV, V. A.
New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

SERGEEV, B. I.
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 1511 8G

SERKOV, V. S.
Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 1506 8A

SERNE, R. J.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

Solution Species of Plutonium in the Environment,
W82-00163 1501 5A

SERRUYA, S.
Free Surface Oscillations in Lake Kinneret,
W82-06879 1512 2H

SERUCA, E.
Sizing and Selecting Modern Water Meters,
W82-04194 1509 6D

SETEANU, I.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 1503 6A

SETHUNATHAN, N.
Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 1501 5A

SETO, W.
Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

SETZLER-HAMILTON, E. M.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

SEUS, G. J.
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 1507 4A

SEVERN, R. T.
Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 1511 8B

SEVUK, A. S.
Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 1512 8B

SEWELL, J. I.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B

SEYFRIED, P. L.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 1503 5A

SEZGIN, M.
Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 1510 5D

SHABAN, H. I.
Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 1505 5D

SHABMAN, L.
Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 1512 6E

Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 1506 5G

SHABMAN, L. A.
Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control,
W82-04063 1509 5G

SHAFER, J. M.
Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

Recreational Enhancement of High Country Water Supply Reservoirs,
W82-03923 1509 6A

SHAFER, L.
Using Pumps as Small Turbines,
W82-05597 1511 8C

SHAH, R.
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 1506 5E

SHAHANE, A. N.
Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 1512 5B

SHAHAR, A.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 1501 5F

SHAIKAN, Y. P.
Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 1511 8A

SHAIKH, A. U.
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 1501 5A

SHAIKIN, YU. P.
Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 1505 8A

SHALABY, A.
Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 1510 4C

SHALER, A. J.
Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 1512 5D

SHALHEVET, J.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

SHAM, C. H.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 1503 2A

SHAMBAUGH, R. L.
The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 1512 5D

SHAMIR, U.
Water Supply Reliability Theory,
W82-03432 1508 6A

SHANE, R. M.
TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 1512 4A

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 1512 4A

SHANNON, E. E.
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

SHAPIRO, H. M.
Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

SHAPIRO, J.
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 1505 5A

SHAPIRO, N. I.
Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

SHARAF, I. F.
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. I. Residues of Organochlorine Pesticides,
W82-05620 1511 5B

SHARKUNOV, S. V.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

Concrete for Surfaces of High-Head Spillways,
W82-05110 1511 8F

SHARMA, A.
Development of Hydro-Power in Nigeria,
W82-04475 1510 6B

SHARMA, A. K.
Irrigation Requirements of Field-Pea for Grain,
W82-02395 1505 2I

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

SHARMA, A. P.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

SHARMA, B. M.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

SHARMA, H. C.
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 1504 2I

SHARMA, K. D.
'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 1508 3B

SHARMA, K. P.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

SHARMA, M. L.
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 1506 2G

SHARMA, N. N.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 1511 2I

SHARMA, P.
An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 1503 2F

SHARMA, P. C.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

SHARMA, R. C.
Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721 1511 5A

SHARMA, R. G.
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

SHARMA, V. C.
Development of Hydro-Power in Nigeria,
W82-04475 1510 6B

SHARMA, Y. L. V.
A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 1508 3B

SHARP, J. M. JR.
Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 1512 6B

SHARP, K.
Advanced Sludge Treatment for Modern Waterworks,
W82-02889 1506 5D

SHARPE, W. E.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

Water Conservation Devices for New or Existing Dwellings,
W82-00401 1501 3D

SHARPLEY, A. N.
Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 1501 5B

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

SHASHUA, L.
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 1511 6B

SHAUGHNESSY, J. C.
Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 1508 5D

SHAVER, T. N.
Environmental Fate of Methyl Eugenol,
W82-02013 1504 5B

SHAW, L. C.
Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

SHAW, R.
Water Conservation Program of the City of Greensboro,
W82-02518 1505 3D

SHAW, T. L.
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01665 1503 5C

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05603 1511 4C

SHAY, D. E.
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

SHCHAVELEV, N. F.
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 1506 8A

Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 1506 8A

SHCHERBAN, E. P.
Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 1511 5C

SHCHUR, L. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 1504 2H

SHEA, G. B.
Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
W82-02115 1505 6G

SHEARMAN, E. D. R.
Radar Measurements of Estuarine Currents and Tides,
W82-03360 1507 2L

SHEEHAN, M.
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 1502 6A

SHEER, D. P.
Analyzing the Risk of Drought: The Occoquan Experience,
W82-04097 1509 2A

SHEETS, T. J.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

SHEFFER, S. M.
A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

SHEFFIELD, W. J.
Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 1505 4A

SHEHATA, A.
Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

SHEIHAM, I.
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 1510 5F

SHEIKH, K. H.
On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

SHEINDORF, C.
Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 1511 5D

SHEINTUCH, M.
Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 1511 5D

SHEKAR, M. S.
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 1501 5G

SHELADIA, V. L.
Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 1512 5D

SHELBY, B.
Carrying Capacity for the Illinois River,
W82-05927 1512 6G

SHELDON, L. H.
Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 1511 8C

SHELDON, S. P.
Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 1512 5C

SHELEF, G.
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 1505 5D

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 1511 5D

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 1512 5C

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 1505 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 1511 5D

Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 1512 5D

Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 1503 5D

SHELLEY, G. J.
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 1501 5F

SHELLITO, G. A.
Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

SHELTON, M. L.
Ground-Water Management in Basalts,
W82-04931 1511 4B

SHELTON, W. L.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

SHELYAG-SOSONKO, Y. R.
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

SHEN, C. Y.
The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 1511 8B

SHEN, H. T.
Surface Heat Loss and Frazil Ice Production in The St. Lawrence River,
W82-03925 1509 2C

Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 1511 2C

SHEN, H. W.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

SHEN, J.
Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 1506 8B

SHEN, T. T.
Estimation of Organic Compound Emissions from Waste Lagoons,
W82-05679 1511 5C

SHEN, W. C.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

SHEPARD, C. L.
Professional Development for Water Quality Control Personnel,
W82-03531 1508 9A

SHEPARD, T. L.
Waste Treatment System Retrofitted Within Deadline,
W82-05947 1512 5D

SHEPHERD, A. D.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

SHEPHERD, K. J.
South Australia's Approach to Salinity Management in the River Murray,
W82-02761 1506 5G

SHEPPARD, W. L.
Redesign Controls Manhole Leakage,
W82-01237 1503 8G

SHERE, S. M.
High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

SHERENKOV, I. A.
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 1512 2J

SHERES, D.
Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 1507 7B

SHERIDAN, R. E.
Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

SHERIF, N.
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 1507 5B

SHERMAN, B.
A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 1512 3F

SHERMAN, D.
Group Treatment Evaluation for Metal Finishers,
W82-02995 1506 5D

SHERMAN, J. W.
The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

SHERMAN, P. L.
Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

SHERNOFF, P. K.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

SHERR, B. F.
The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria,
W82-03770 1509 5E

SHERRAD, J. H.
Activated Sludge,
W82-01243 1503 5D

SHERRARD, J. H.
Activated Sludge Nickel Toxicity Studies,
W82-01895 1504 5D

Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 1506 5D

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

SHERRILL, T. W.
Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 1503 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 1503 5A

SHERRY, J. P.
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

SHERTON, C. C.
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 1504 6E

SHERWANI, J. K.
Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

SHERWIN, M. J.
A Pipeline for all Environments,
W82-04764 1511 8G

SHETTY, C. M.
Optimal Stream-Aquifer Development,
W82-02575 1505 6A

SHEVELEVA, T. YU.
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 1506 5A

SHIARIS, M. P.
Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 1512 5B

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 1512 5C

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 1503 5A

SHIBAHARA, K.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

SHIEH, W. K.
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 1506 5D

Simplified Mathematical Models for a Fluidized Bed Biofilm Reactor,
W82-03877 1509 5D

SHIELDS, R. R.
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

SHIFRIN, N. S.
Ground Water Protection by Recharge Zone Management: Institutional Arrangements,
W82-03951 1509 5G

SHIGARAKI, Y.
Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

SHIGENO, D. S.
Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

SHIH, C. S.
Multi-Attribute Decision Analysis for the Protection of Groundwater Resources,
W82-03805 1509 6A

SHIH, S. F.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 1504 2G

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

Upland Marsh for Water Quality Control,
W82-01962 1504 5B

Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 1510 2H

Water Requirement for Sugarcane Production,
W82-00899 1502 3F

SHIKLOMANOV, I. A.
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 1503 4C

SHIMAUCHI, S.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 1507 8C

SHIMIZU, N.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

SHIMIZU, O.
Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

SHIMIZU, T.
An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

SHIMMEN, T.
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

SHIMODA, O.
A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 1511 5A

SHIMOISHI, Y.
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 1501 5A

SHINKAR, G. G.
Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 1511 7B

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 1512 5C

SHIOSAKI, K.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

SHIOYA, M.
Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 1507 8C

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

SHIRAZI, M. A.
Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 1505 7B

SHIREMAN, J. V.
The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 1511 4A

SHIROKOV, V. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

SHIRTS, M. B.
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

SHISHOVA, O. N.
Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

SHKOL'NIKOV, S. Y.
Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 1512 8B

SHMAKOV, V. M.
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 1504 5B

SHOAF, W. T.
Effect of Filtration Pressure on Analyses for Chlorophyll,
W82-04247 1509 2H

SHOEMAKER, C. A.
Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 1511 4B

SHOEMYEN, J.
Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study,
W82-03919 1509 7A

SHOLKOVITZ, E. R.
The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

SHOMAKER, N. B.
Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

SHONO, T.
Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

SHORE, F. L.
Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

SHORT, R. A.
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

SHORT, T. E.
Application of the Area of Review Concept,
W82-04674 1510 6E

SHORTRIDGE, K. R.
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 1510 5B

SHOUPP, W. J.
Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

SHOUSE, P.
A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 1512 2G

Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

SHPIRT, E.
Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 1501 5D

SHRADER, M. L.
Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 1511 2E

SHUCKROW, A. J.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

SHUIFER, M. I.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 1511 8H

SHULL, K. E.
An Experimental Approach to Corrosion Control,
W82-04099 1509 5F

SHULSTAD, R. N.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

SHULTERS, M. V.
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

SHULTZ, B.
Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 1511 5F

SHURLOCK, S. H.
Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 1512 8A

SHUSTOV, YU. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

SHUTENKOV, S. V.
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 1506 8A

New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

SHUTER, L. M.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 1507 5G

SHUVAL, H. I.
Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 1511 5D

Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 1511 6D

SHVELIDZE, T. V.
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 1508 4A

SIBLEY, T. H.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

SIBONY, J.
Clarification with Microsand Seeding. A State of the Art,
W82-03880 1509 5F

Disinfection of Drinking Water in Developing Countries,
W82-02091 1504 5F

SID'KO, F. YA.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 1504 2H

SIDDIQI, R. H.
Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 1511 5C

SIDDIQUE, M.
Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 1508 4B

SIDDOWAY, F. H.
Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

SIDEMAN, S.
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 1512 3A

Tranzfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 1512 3A

SIDORENKI, G. I.
Health Aspects of Water Desalination,
W82-03116 1507 3A

SIDWICK, J. M.
Municipal Sewage Treatment - Some Recent Developments,
W82-04528 1510 5D

Rural Sanitation in Developing Countries,
W82-01392 1503 5D

SIEBURTH, J. M.
Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 1507 2L

SIEGENTHALER, U.
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

SIEGERSTETTER, L. A.
Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 1512 4A

SIEGRIST, R. L.
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 1505 3D

SIEGRIST, T. W.
Chemicals and Allied Products,
W82-01267 1503 5D

Chemicals and Allied Products,
W82-06805 1512 5D

SIEVERING, H.
Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01132 1503 5B

Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

SIFORA, L. J.
Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 1507 5E

SIGLEO, A. C.
Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

SIGNOR, D. C.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

SIKORA, E. J.
Load Factors and Non-Destructive Testing of Clay Pipe,
W82-05700 1511 8G

SIKORA, L. J.
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 1512 5E

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

Trenching of Digested Sludge,
W82-00974 1502 5E

SIKORA, V.
Law for Environmentalists,
W82-05813 1511 5G

SIKORA, V. A.
Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

Health Aspects of Urban Water Conservation,
W82-01047 1502 3C

SIL'NITSKII, V. I.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A

SILBERMANN, P. T.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

SILKA, L.
Application of the Area of Review Concept,
W82-04674 1510 6E

SILKA, L. R.
Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

Computer Modeling and Ground-Water Protection,
W82-01336 1503 2F

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 1503 5G

SILLS, J. B.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1502 5B

SILLS, M. A.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

SILVA, C.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

SILVA, M.
Liquid-Liquid Extraction Combined with Atomic-Absorption Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 1512 5A

SILVA, S. J.
EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 1507 6E

SILVERMAN, B. A.
On the Sampling Variance of Raingage Networks,
W82-05875 1511 7B

SILVERMAN, G.
Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

SILVERMAN, M. P.
Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 1502 2G

SILVUS, H. S. JR.
Development of Oil-In-Water Monitor, Phase II,
W82-00100 1501 5A

SIMARD, R. G.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

SIMEK, E. M. JR.
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

SIMEONOV, S. YA.
The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 1510 5C

SIMIDU, U.
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 1505 5A

SIMM, R. I. G.
Groundwater Quality in the Severn-Trent Region,
W82-02423 1505 5A

SIMMONS, D. L.
Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

SIMMONS, G. M. JR.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

SIMMONS, J. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 1503 10C

SIMONOV, A. I.
Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 1512 2H

SIMONOVIC, S. P.
Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 1507 6A

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 1507 6A

The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 1511 6A

SIMONS, D. B.
Flow Resistance in Vegetated Waterways,
W82-00152 1501 2E

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

Modeling Rill Density,
W82-02604 1506 2J

Resistance Equation for Large-Scale Roughness,
W82-04696 1510 2E

SIMPSON, A.
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

SIMPSON, C. A.
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 1502 5C

SIMPSON, C. F.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

SIMPSON, D. W.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

SIMPSON, F. B.
Micro Hydropower in the USA,
W82-04316 1510 8A

SIMPSON, G. D.
Facts Fix Fund Finding,
W82-00885 1502 9A

SIMPSON, G. M.
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 1508 2I

SIMPSON, H. J.
Radionuclides in Mono Lake, California,
W82-05461 1511 5B

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 1511 2J

SIMPSON, J. E.
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 1511 2E

SIMPSON, J. T.
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 1502 5B

SIMPSON, M. H.
Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

SIMPSON, R. J.
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 1508 8A

SIMPSON, R. W.
Optimization Principle for Air and Water Movement,
W82-05172 1511 2G

SIMPSON, T. W.
The Occurrence of Flow Channels in Soils,
W82-04875 1511 3C

SIMS, C. A.
Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 1506 5D

SIMS, J. D.
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 1505 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

SIMS, J. L.
Bioassays - Procedures and Results,
W82-01277 1503 5A

Bioassays - Procedures and Results,
W82-06810 1512 5A

SIMS, R. A.
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 1501 2C

SIMS, R. C.
Bioassays - Procedures and Results,
W82-06810 1512 5A

SINAI, G.
Domestic Water Supplies for Power Plant Cooling,
W82-00180 1501 6D

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

SINCHUMPASAK, O-A.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 1501 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

SINCLAIR, L. R.
Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

SINCLAIR, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

SINCLAIR, R. A.
Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

SINCLAIR, W. C.
Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 1512 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

SINGER, M.
An Overview of Porous Pavement Research,
W82-05744 1511 5D

Status of Porous Pavement Research,
W82-06665 1512 8G

SINGER, M. J.
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 1501 2J

SINGER, P. C.
Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 1511 5F

Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

SINGER, R. D.
Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

SINGH, B.
Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 1507 8A

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

SINGH, D. P.
Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 1511 2I

SINGH, G.
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 1506 5F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

SINGH, K. P.
Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 1507 3F

SINGH, N. T.
Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

SINGH, R.
Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

SINGH, R. K.
Consumptive Water Use by Opium Poppy,
W82-03356 1507 2I

SINGH, R. N.
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 1503 2F

SINGH, S.
Effect of Profile Soil Moisture and Phosphor Levels on the Growth and Yield of Anomtries Uptake by Chickpea,
W82-02042 1504 2I

SINGH, S. D.
Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 1511 2I

Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 1503 2I

SINGH, S. N.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

SINGH, S. R.
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

SINGH, T.
A Suitable Lining Technique for Existing Distributaries,
W82-03063 1507 8G

SINGH, U. P.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

SINGH, V. P.
Comparing Urban Runoff Models,
W82-06447 1512 2A

Diverging Overland Flow,
W82-03676 1508 2A

The General Hydrologic System Model,
W82-04314 1510 2A

A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 1512 3F

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 1505 2A

A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

Overland Flow on a Diverging Surface,
W82-00986 1502 2A

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 1505 2A

SINGHAL, A. E.
Tying Up TCE,
W82-01866 1504 5G

SINGHAL, A. K.
Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 1511 5D

SINGLETON, F. L.
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

SINGLETON, L.
An Assessment of the Trophic Status of Deer, Leon, and Diamond Lakes,
W82-01072 1502 2H

SINGLEY, J. E.
The Search for a Corrosion Index,
W82-04279 1510 5F

SINHA, B. K.
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

SINHA, D. S.
The Chambal Project: Problems and Solutions,
W82-01739 1503 4A

SINHA, S. B.
Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 1511 2D

SINHA, S. K.
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

SINK, C. H.
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

SINNOTT, C.
The Risk Business,
W82-03281 1507 6E

SINNOTT, C. S.
The Search for Reservoir Sites in an Urban Environment,
W82-04867 1511 8A

SINNOTT, W. B.
Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 1511 5D

SIPE, T. W.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

SIRENKO, L. A.
Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 1511 5G

SIRIA, J. W.
Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

SISSON, J. B.
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 1503 2G

SIUDAK, R. V.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities.
W82-06101 1512 3A

SIVAKUMAR, M. V. K.
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

SIVAKUMARAN, N. S.
Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

SIVALOGANATHAN, K.
Storm Sewer Flow Computations,
W82-04640 1510 7B

SJOVALL, J.
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 1512 5A

SKAAR, D. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 1504 5B

SKAFEL, M. G.
Suspended Sediment in a Wave Field,
W82-06527 1512 2J

SKAGGS, R. W.
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 1503 4A

Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 1505 5B

Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

Water Management Model Evaluation for North Central Ohio,
W82-01536 1503 4A

Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 1510 3F

SKARBORN, S.
Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 1501 8A

SKHUNDIN, B. M.
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 1511 8D

SKIMMER, M. M.
Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

SKINNER, S. M. JR.
Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5B

SKOGERBOE, G. V.
Colorado River Development,
W82-05887 1511 4A

Development Issues in the Colorado River Basin,
W82-05890 1511 6D

Future Water Development Policies,
W82-05884 1511 5G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 1511 3C

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 1511 5G

The Physical Environment of the Colorado River Basin,
W82-05891 1511 6D

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

SKOGERBOE, R. K.
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 1501 5A

SKOLD, M. D.
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

SKREBKOV, G. P.
Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 1511 8A

SKRINDE, J. R.
Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 1512 5D

SKRIVAN, J. A.
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

SLABBERS, P. J.
Practical Prediction of Actual Evapotranspiration,
W82-02308 1505 2D

Wheat Yield Estimation in Northwest Iran,
W82-03267 1507 2I

SLABBERT, J. L.
A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 1512 5A

SLACK, D. C.
A Comparison of Three Infiltration Models,
W82-05965 1512 2G

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 1502 7B

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 1501 2G

SLACK, J. R.
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

SLACK, R.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 1503 7B

SLACK, R. B.
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

SLADE, R. M. JR.
Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

SLANINA, J.
Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-00245 1512 5B

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 1506 2K

SLATER, M. J.
Continuous Ion Exchange: A Survey of Recent Applications,
W82-03391 1507 5D

Continuous Ion Exchange: Design Calculations,
W82-03623 1508 8C

SLAUGHTER, C. W.
Use of Pre-Fabricated Parshall Flumes to Measure Streamflow in Permafrost-Dominated Watersheds,
W82-04074 1509 7B

SLAVENS, D. R.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 1504 2H

SLEMROVA, J.
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

SLINGERLAND, R.
Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 1512 2E

SLINN, S. A.
Predictions for Particle Deposition on Natural Waters,
W82-00264 1501 5B

SLINN, W. G. N.
Predictions for Particle Deposition on Natural Waters,
W82-00264 1501 5B

SLISSKY, S. M.
Passing Floodwaters Over Embankment Dams,
W82-02204 1505 8A

SLOANE, J.
Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

SLOBODCHIKOV, N. B.
Hypania Invalida in the Volga Reservoirs and Hydrobiological Monitoring,
W82-05331 1511 2H

SLOCUM, C. J.
Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

SLOMKA, T.
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 1510 5D

SLOSS, P. W.
Simulation and Verification of Lake Ontario's Mean State,
W82-04570 1510 2H

SMALL, J. G.
Liquid Level Interferometer,
W82-05929 1512 7B

SMALL, M. J.
Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

SMALL, T. A.
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05318 1511 7C

SMALLEY, T. L.
Water Quality Assessment for Agana Springs,
W82-05304 1511 5A

SMART, M. M.
Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 1506 5B

SMART, N.
Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 1511 2H

SMART, R. M.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 1502 2H

SMEERS, Y.
Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 1506 5D

SMEETS, J.
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 1502 6D

SMELLEY, A. G.
Dewatering of Industrial Clay Wastes,
W82-00041 1501 5D

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 1512 5D

SMETHIE, W. M. JR.
Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 1505 2L

SMETS, E.
A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

SMIES, M.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

SMIL, V.
China's Agro-Ecosystem,
W82-06019 1512 3B

A New Era for China's Hydropower,
W82-00335 1501 8A

SMILES, D. E.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 1510 2G

SMILEY, V. N.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

SMILLIE, R. H.
Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment,
W82-03758 1509 5B

SMIRNOVA, N. N.
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 1503 5B

SMITH, A. E.
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 1503 4A

SMITH, B.
Cutting the Water Losses,
W82-00310 1501 5F

SMITH, B. D.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 1502 5D

SMITH, B. R.
The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 1510 6A

SMITH, C. D.
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 1502 8B

SMITH, C. J.
A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

SMITH, C. L.
Management Provoked Conflict in Fisheries,
W82-00780 1502 6A

SMITH, D. A.
Activated Sludge,
W82-01243 1503 5D

SMITH, D. D.
Long Term Performance of Horizontal Drains,
W82-02212 1505 8A

SMITH, D. G.
Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 1510 2J

SMITH, D. J. G.
Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 1511 6A

SMITH, D. L.
Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 1503 5D

SMITH, D. P.
Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

SMITH, D. R.
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

SMITH, D. W.
Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 1501 2L

SMITH, E. D.
Filterability of Activated Sludge in Response to Growth Conditions,
W82-05960 1511 5D

Nitrification Using the Rotating Biological Contactor,
W82-03132 1507 5D

Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 1511 5D

Rotating Biological Contactor System Design,
W82-06355 1512 5D

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

Water Characteristics,
W82-01305 1503 5B

SMITH, E. M.
Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 1512 5A

SMITH, E. P.
On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 1506 5A

SMITH, F. B.
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 1504 5B

SMITH, F. J.
New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

SMITH, G. F.
Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 1511 5G

Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 1511 5G

Performance Testing of Four Skimming Systems,
W82-05059 1511 5G

SMITH, G. S.
Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

SMITH, H.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

SMITH, J. A.
Point Process Models of Rainfall,
W82-02452 1505 2A

SMITH, J. D.
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 1505 5B

SMITH, J. E.
Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 1501 5A

SMITH, J. F.
On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 1512 5A

SMITH, J. H.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 1511 5B

SMITH, J. K.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

SMITH, K.
Watering Australia's Driest State,
W82-03767 1509 6D

SMITH, K. E.
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 1502 5D

SMITH, L.
Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 1508 2G

SMITH, L. P.
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 1510 2E

SMITH, M. G.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

SMITH, N. D.
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 1503 2H

SMITH, N. K. R.
Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 1508 5C

SMITH, P. E.
Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 1510 5B

SMITH, P. J.
A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 1502 2F

Reservoirs and the Triggering of Earthquakes,
W82-03766 1509 8A

SMITH, P. L.
On the Graphical Presentation of Raindrop Size Data,
W82-06525 1512 2B

A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

SMITH, R.
Contaminant Dispersion in Oscillatory Flows,
W82-05631 1511 5B

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 1508 5D

Where to Put a Steady Discharge in a River,
W82-05632 1511 5G

SMITH, R. A.
Aggregation-Disaggregation Techniques for the Operation of Multi-Reservoir Systems,
W82-03954 1509 6A

Identification of Streamflow Stochastic Models,
W82-00555 1502 2A

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

SMITH, R. C. G.
Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 1501 2I

SMITH, R. E.
A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 1502 2E

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 1512 8B

Wastewater Collection and Treatment in Wayne County,
W82-02554 1505 5D

SMITH, R. E. H.
The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 1511 5C

SMITH, R. J.
Acid Rain Agreement,
W82-01933 1504 5B

The Waterway That Cannot be Stopped,
W82-00510 1502 6E

SMITH, R. L.
Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00482 1501 2H

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 1508 2H

SMITH, R. V.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

SMITH, R. W.
Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

SMITH, S.
A Guide to Treatment for Bacterial Problems,
W82-06847 1512 5F

Ozone Water Treatment,
W82-02682 1506 5F

Sulfur Bacterial Problems Revisted,
W82-05264 1511 5B

SMITH, S. J.
Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

SMITH, S. K.
American Indian Water Rights and the Use of Colorado River Water,
W82-05885 1511 6E

SMITH, S. S.
Relationship of Electrical Dispersion to Soil Properties,
W82-02561 1505 8D

SMITH, S. V.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

SMITH, T. R.
A Pipeline for all Environments,
W82-04764 1511 8G

SMITH, V. L.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

SMITH, W. G.
Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

SMITH, W. K.
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 1502 2D

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 1502 2I

SMITH, W. L.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

SMOCK, L. A.
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

SMOLEN, M. D.
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 1503 5B

SMOOT, J. L.
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

SMULLEN, J. T.
Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

SMYKOWSKI, K.
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 1511 5A

SNADDON, X. M. V.
Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

SNAVELY, D. S.
Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

SNEDAKER, S. C.
Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 1507 5C

SNELL, L. J.
Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

SNIDER, E. H.
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 1512 5D

SNIPES, S.
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

SNOEYINK, V. L.
Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 1510 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 1510 5F

SNUDDEN, B. H.
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 1512 5A

SNYDER, B.
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

SNYDER, D. L.
Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

SNYDER, F. L.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

SNYDER, G. R.
Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

SNYDER, J. H.
Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

SNYDER, J. R.
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

SNYDER, R.
Making Your Way Through Murky Waters-A Manual for Public Participation Coordinators in Natural Resources Planning,
W82-04085 1509 6A

SNYDER, R. D.
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

SNYDER, W. M.
Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 1511 2B

SOARES, H. F.
Design of Filters for Clay Cores of Dams,
W82-04321 1510 8G

SOBSEY, M. D.
Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887 1509 5F

Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency,
W82-04095 1509 5A

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

SOCHA, W. M.
Practical Power-Saving Techniques in Pinellas County,
W82-04092 1509 5F

SODERGREN, A.
Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

SOEDER, C. J.
Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 1502 5D

SOETJE, K. C.
The Tidal Stream in the German Bight,
W82-05190 1511 2L

SOFONIOU, M. C.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

SOHN, M. L.
Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 1511 2K

SOHTELL, M.
Perivitelline pH of Salmonide Eggs in Relation to Ambient pH,
W82-04064 1509 5C

SOILEAU, C. W.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

SOJKA, R. E.
Wheat Response to Drought,
W82-02242 1505 2I

SOKKARY, A. A.
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

SOKOL, L. J.
Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 1512 5E

SOKOL, R. L.
Control Systems for Return and Waste Sludge,
W82-00949 1502 5D

SOKOL'SKIY, A. F.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

SOKOL, W.
Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 1507 5D

SOKOLOV, I. Y.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

SOKOLOV, Y. N.
Hydraulic Resistance of Floodplains,
W82-02850 1506 2E

SOKOLOVSKAYA, T. F.
Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

SOLANGI, M. A.
Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 1507 5C

SOLLINS, P.
Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03843 1509 5B

SOLOKHINA, T. A.
Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-0369[illegible] 1508 3A

SOLOMATINA, V. D.
Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 1511 5C

SOLOMON, K.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 1503 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 1503 3F

SOLOVE, R. A.
The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 1507 5G

SOMEAHSARAI, K.
Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 1512 3E

SOMER, T. G.
Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 1512 3A

Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

SOMIYA, I.
The Effect of Particle Substrate on Mineralization Performance and the Formation of Excess Sludge in a Complete Mixing Aeration Tank,
W82-04012 1509 5D

SOMMER, E. M.
Federal Common Law of Nuisance Expands,
W82-01337 1503 6E

SOMMERFELD, M. R.
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 1512 5F

SOMMERFELDT, T. G.
Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 1511 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 1503 2G

SONCINI-SESSA, R.
Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

SONDEREGGER, J. L.
Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

SONG, C. C. S.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

SONI, J. K.
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

SONNEN, M. B.
Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

SONTHEIMER, H.
Experience with Riverbank Filtration Along the Rhine River,
W82-04104 1509 5D

The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 1510 5F

SONZOGNI, W. C.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

Pollution From Land Runoff,
W82-00253 1501 5B

SOOHOO, J. B.
Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

SOOM, A. M.
Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 1503 8C

SOON, Y. K.
Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 1502 5B

Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 1512 5E

SOPHOCLEOUS, M.
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 1502 4B

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

SOPPER, W. E.
Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 1511 5E

SORBER, C. A.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 3C

SOREN, J.
Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

SORENSEN, E.M. B.
Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 1508 5C

SORENSEN, P. B.
By-Product Recovery Finances Treatment,
W82-02756 1506 5D

SORENSEN, P. E.
Method of Evaluating the Possible Energy Savings by Implementing Do-Control or Fine Bubble Diffusors,
W82-04007 1509 5D

SORENSON, S. K.
Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 1505 2K

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

SOREY, M. L.
On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

SORG, T. J.
Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

SORLIN, D. J.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 1501 5A

SOROOSHIAN, S.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 1503 2A

SOSTER, F. M.
Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

SOTNIKOV, V. N.
Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 1511 5B

SOUGHTY, C.
A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 1512 3F

SOULSBY, P. G.
Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06693 1512 5C

SOUTAR, I.
Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 1511 5A

SOWBY, S. E.
Leak Detection Programs Recover Revenues,
W82-04375 1510 3D

SOYUPAK, S.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

SPANGENBERG, N. E.
Calibrating A Mountain Watershed in Wyoming,
W82-06583 1512 2E

SPANGGORD, R. J.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

SPANOVSKAYA, V. D.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1503 2H

SPARE, D. P.
Sizing Rice Irrigation Canals,
W82-00895 1502 3F

SPECKER, B.
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

SPEECE, R. E.
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G

SPEED, H. D. M.
Renovation of Water Mains and Sewers,
W82-04237 1509 5F

SPEHAR, R. L.
The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

SPEIDEL, H. K.
Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 1510 5B

SPENCER, D. F.
Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 1510 2H

SPENCER, H. T.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

SPENDLOVE, R. S.
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

SPERRY, J. F.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 1501 5A

SPEYER, M. R.
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

SPIEGEL, S. J.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 1512 5C

Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05235 1511 5A

The Status of Groundwater Law in New York State,
W82-05400 1511 6E

SPIEGLER, K. S.
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

Water and Salt Transport in Membranes,
W82-05537 1511 3A

SPIGARELLI, S. A.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

SPIKER, E. C.
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 1501 5B

SPINAZOLA, J. M.
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

SPINO, D. F.
Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

SPIRA, W. M.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 1504 5A

Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 1507 5B

SPIRANDI, O. B.
Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 1511 5B

SPOONER, P.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5B

SPOOR, M. F.
Bank Failure and Erosion on the Ohio River,
W82-02343 1505 2J

Bank Failure and Erosion on the Ohio River,
W82-04473 1510 2J

SPOSITO, G.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 1507 2F

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 1504 2F

SPOTTISWOOD, D. J.
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

SPRAKER, P.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 1502 5D

SPRINKLE, C. L.
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

SPROUL, C. R.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

Florida Style Water Supply and Treatment,
W82-06027 1512 5F

SPROUL, O. J.
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

SPRULES, W. G.
The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

SPRUTE, R. H.
Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 1512 5D

SPURRIER, J. D.
Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 1512 2L

SPYRIDAKIS, D. E.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

SRICHAROENCHAIKIT, P.
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

SRIDHARAN, K.
Parametric Study of Flood Wave Propagation,
W82-03425 1508 2E

SRIKAMESWARAN, K.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 1502 5A

SRIKANTHAN, R.
Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 1511 6A

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 1503 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 1503 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 1503 2E

Stochastic Generation of Monthly Streamflows,
W82-06427 1512 4A

SRIVASTAVA, D. K.
Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 1503 6A

SRIVASTAVA, R. C.
Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 1512 2B

SRIVASTAVA, V.
Anaerobic Processes,
W82-01245 1503 5D

SRIVASTAVA, V. J.
Anaerobic Processes,
W82-06923 1512 5D

ST, N.
A Water Quality Index for Lake Beaches,
W82-06660 1512 5G

STACHEL, B.
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

STACKIW, W.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 1502 5A

STAFFORD, D. A.
Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 1501 5D

STAGGS, D. W.
Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas
W82-03008 1507 2B

STAHL, J. B.
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 1506 2H

STAHLBAUM, B. W.
Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

STAKER, R. D.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

STALEY, J. T.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 1511 5C

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 1512 5F

STALKER, M. J.
Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

STALL, J. B.
Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 1510 2J

STALLARD, R. F.
Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

STANAGE, C. E.
Embankment Construction: New Melones Dam,
W82-05822 1511 8D

STANDER, G. J.
Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

STANDRIDGE, J. H.
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 1505 5A

STANFORD, J. A.
Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

STANLEY, C. W.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 1503 5A

STANLEY, D. A.
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

STANLEY, D. W.
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

STANLEY, R. F.
Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 1502 5B

STANLEY, R. H.
Water Rate Studies and Rate Making Philosophy,
W82-06222 1512 6C

STANNERS, D. A.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 1504 5B

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 1512 5B

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 1511 5B

STANSBURY, M. R.
Will Synfuel Development Drain the West Dry,
W82-03292 1507 6D

STARA, J. F.
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 1502 5C

STARINSKY, A.
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 1508 2K

STARK, K. P.
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 1510 6D

STARK, N.
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

STARK, P. E.
The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

STARR, R. C.
Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 1503 5G

STARY, J.
Mercury Circulation in Aquatic Environment Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

STATHIS, T. C.
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 1502 5D

STATZNER, B.
The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 1506 5C

STAUBITZ, W. W.
Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 1510 7C

STAUFFER, J. R. JR.
Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 1510 6G

The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 1501 2E

STAUFFER, R. E.
Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 1511 2K

STAVSKAYA, S. S.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 1504 5C

STAY, F. S.
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

STEAD, P. A.
Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 1505 5D

STECKER, P. P.
A Successful Low Technology Wastewater Process,
W82-01178 1503 5D

STEDINGER, J.
Systems Analysis,
W82-06997 1512 5G

STEDINGER, J. R.
Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Robustness of Water Resources Systems,
W82-05077 1511 6A

Systems Analysis,
W82-01303 1503 6A

STEDNICK, J. D.
Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 1508 2K

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

STEEBY, J. A.
Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

STEELE, R. L.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 1503 7B

STEEN, W. C.
Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 1511 5B

Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 1502 2K

STEFAN, H. G.
Heat Loss from Rapid Infiltracion Basin in Winter,
W82-05317 1511 5D

Phosphorus Recycling in Five Shallow Lakes,
W82-04040 1509 2H

Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 1503 2J

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

STEFFEN, BY H.
Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 1512 8G

STEGMAN, C. E.
The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05660 1511 5G

STEGMAN, E. C.
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

STEGMANN, N. K.
How Do You Build When Sewers Are Inadequate,
W82-03592 1508 5D

STEIN, R.
Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

STEIN, R. B.
Ohio's Ground Water Resources and Problem Areas,
W82-01057 1502 4B

STEINBERG, C.
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

STEINHEIMER, T. R.
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 1503 5A

STEKETEE, C. H.
Why EPA's I/I Control Program Fails,
W82-00790 1502 8A

STENDAHL, K.
Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 1511 3D

STENHOUSE, M. J.
Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

STENSEL, H. D.
Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

Biological Nitrogen Removal System Design,
W82-03145 1507 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

STENSLAND, G. J.
Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 1510 5B

STENSON, J. A. E.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

STENSTROM, M. K.
Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 1501 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

STENSTROM, R. C.
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 1505 2A

STEPANOV, G. Y.
Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 1512 8B

STEPANOV, I. N.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

STEPHAN, D. G.
EPA's Approach to Regulating New Energy Technologies,
W82-03129 1507 6E

STEPHANOU, E.
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

STEPHENS, D. B.
Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

STEPHENS, F.
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

STEPHENS, J. A.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

STEPHENS, R. D.
The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5E

STEPHENSON, D.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

STEPHENSON, J. B.
Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

STEPHENSON, J. P.
Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 1510 5D

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 1510 5D

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

STEPHENSON, R. A.
The Development of a Village Water Supply System on Truk,
W82-02816 1506 5F

STERLING, J. D. E.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 1503 2I

STERLING, M. J. H.
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 1511 5F

STERN, D. H.
The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

STERN, M. S.
The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

STERRETT, R. J.
Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 1508 2J

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 1510 2J

STERRITT, R. M.
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 1508 5D

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 1511 5D

STETSON, C. B.
Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 1505 6E

STEVEN, G. P.
The Moving Interface Problem with Finite Elements,
W82-06546 1512 2L

STEVENS, A. A.
Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

Removing Trihalomethanes from Drinking Water,
W82-00953 1502 5F

STEVENS, C.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

STEVENS, D. E.
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

STEVENS, H. H. JR.
Collapsible-Bag Suspended-Sediment Sampler.
W82-04745 1510 7D

STEVENS, J. D.
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

STEVENS, K. L.
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

STEVENS, P. R.
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

STEVENS, R. J.
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

STEVENSON, B.
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 1501 2J

STEVENSON, D. S.
Irrigation Efficiency in Orchards,
W82-05768 1511 3F

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkle, to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

STEVENSON, L. H.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 1502 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 1512 2L

STEVENSON, R. J.
Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 1512 5C

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 1505 2H

STEVIE, P. G.
Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 1511 5C

STEWART, B. A.
A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 1505 3F

STEWART, C. A. JR.
Chlorinated Drinking Water,
W82-00467 1501 5F

STEWART, J.
State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

STEWART, J. M.
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 1501 2C

STEWART, J. W.
Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 1501 5B

STEWART, L. W.
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 1505 5B

STEWART, M. T.
Predictive Depositional Model for Glacial Aquifers,
W82-00828 1502 2F

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

STEWART, T.
Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 1510 5A

STIERWALT, L.
Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 1510 5D

STIFFLER, D. F.
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 1507 5A

STIGEBRANDT, A.
On The Rate of Ice Formation in Water Cooled by a More Saline Sublayer,
W82-04190 1509 2C

STILES, E. A.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

STILES, W. H.
Microwave Measurements of Snowpack Properties,
W82-02646 1506 2C

STIMSON, K. R.
An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 1507 5F

Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 1512 5F

STINSON, D. L.
Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

STINSON, K. B.
Hazardous Material Spills--Are You Ready,
W82-06417 1512 5G

STITES, D. L.
Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

STITT, S. C.
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

STOBER, Q. J.
Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00985 1502 5A

STOCKTON, C. W.
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-06340 1510 2E

A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

STOERMER, E. F.
Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 1512 5C

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 1505 2H

STOFFEL, D.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1513 5B

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

STOFFELSEN, G. H.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

STOKES, R. A.
Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 1503 6A

STOKES, R. L.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

STOL'BERG, F. B.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 1504 5C

STOL'BERG, F. V.
Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 1511 5B

STOL, P. T.
Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 1508 2B

Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 1508 2B

Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm,
W82-04864 1511 2B

STOLBUNOV, A. K.
Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

STOLLENWERK, K. G.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 1504 5B

STOLTE, W. J.
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 1501 6A

STOLTENBERG, D. H.
Midwestern Wastewater Characteristics,
W82-00534 1502 5D

STOLTZ, R. L.
Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 1511 5B

STOLZENBACH, K. D.
Buoyant Surface Jets,
W82-03670 1508 8B

STOLZY, L. H.
Domestic Water Supplies for Power Plant Cooling,
W82-00180 1501 6D

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 1512 2G

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Wheat Response to Drought,
W82-02242 1505 2I

STOM, D. I.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 1506 5C

STONE, P. B.
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 1501 5F

STONEBURNER, D. L.
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

STONER, J. D.
Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 1510 7C

STONES, T.
A Comparison of the Carbonaceous Oxygen Demands of a Domestic and Industrial Sewage,
W82-05467 1511 5D

A Compendium of Experimental Work on Chemical Precipitation of Sewage,
W82-02370 1505 5D

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 1511 5D

A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 1501 5D

A Resume of the Kinetics of the BOD Test,
W82-03832 1509 5A

STORK, T. H.
Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

STORTZ, K. R.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

STOTT, D. A.
Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

STOTZKY, G.
Acid Precipitation. 1. Causes and Consequences,
W82-04771 1511 5C

STOUGHTON, H. W.
Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 1508 2H

STOUT, D. G.
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 1508 2I

Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 1505 2D

STOUT, R. J.
How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 1506 7A

STOVER, E. L.
Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 1508 5D

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

Investigation of Volatile Organics Removal,
W82-01490 1503 5F

Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 1506 5D

Ozone for Municipal Wastewater Disinfection,
W82-03559 1508 5D

Petroleum Processing Wastes,
W82-01262 1503 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

Rotating Biological Contector Scale-Up and Design,
W82-06344 1512 5D

Synthetic Fuel Effluents,
W82-01263 1503 5B

Synthetic Fuel Effluents,
W82-06800 1512 5D

STOW, C. D.
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 1511 2B

STOWELL, R.
Concepts in Aquatic Treatment System Design,
W82-02593 1505 5D

STOZEK, A.
Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugagebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 1512 5D

STRACK, O. D. L.
Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 1507 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singulari-

tion 2. Solution for Inhomogeneous Permeabilities,
W82-03084 1507 2F

STRAIN, B. R.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 1502 2I

STRAIN, P. M.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 1502 2C

STRALEY, W. M.
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 1505 5D

STRATHMANN, H.
Membrane Separation Processes,
W82-06445 1512 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 1504 5D

STRAUB, C. P.
Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

STRAUB, W. A.
Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 1511 5B

Models of Landfill Leaching: Organic Strength,
W82-05817 1511 5B

STRAUGHAN, I. R.
Are Sierra Lakes Becoming Acid,
W82-00231 1501 5C

STRAUS, J. M.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1502 1A

A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

STRAUSS, E. J.
The Wisconsin Soil and Water Conservation District as an Institution to Undertake Subwatershed Planning to Control Non-Point Source Water Pollution,
W82-04212 1509 6A

STRAUSSMAN, Y.
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 1501 5F

STRAWN, K.
Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

STRAYER, D. L.
Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

STREBEL, O.
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

STREBLOW, D. E.
A More Versatile Soil Water Sampler,
W82-00191 1501 7B

A More Versatile Soil Water Sampler,
W82-02523 1505 7B

STREET, R. L.
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

STRELKOFF, T.
Development of Solutions for Level-Basin Design,
W82-01976 1504 3F

Dimensionless Stream Advance in Sloping Borders,
W82-04308 1510 3F

STREUTKER, A.
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 1508 3F

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

STRICKERT, R. G.
Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

STRICKLAND, E. R.
Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 1501 5A

STRIER, M. P.
Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 1501 6E

STRIJAK, E. K.
Health Aspects of Water Desalination,
W82-03116 1507 3A

STRINGER, C. E.
Piloting Mag-Carbonate Treatment,
W82-05794 1511 5F

STROBEL, C. J.
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 1505 5B

STROEHLEIN, J. L.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sudangrass Yields,
W82-00767 1502 3C

STROKA, J. G.
Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

STROM, P. F.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

STROMATT, S. C.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

STROMBERG, P. T.
Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 1506 5C

STROUP, A. D.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

STROUD, S. M.
Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 1512 3C

STRUBITSKIY, I. V.
Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

STRUDGEON, G. E.
Safety Considerations in Handling Activated Carbon,
W82-05442 1511 5D

STRUPCZEWSKI, W. G.
The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 1511 2E

STRUWE, H.
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

STRUZZIERY, J. J.
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

STRZEPEK, K.
River-Basin Simulation in Systems with Large Response Time,
W82-05496 1511 2A

STUBER, H. A.
Migration Through Soil of Organic Solutes in An Oil-Seale Process Water,
W82-03640 1508 5B

Selective Concentration and Isolation of Aromatic Amines from Water,
W82-03829 1509 5D

STUDNICKI, M.
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 1504 5A

STULLKEN, L. E.
Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

STUMM, W.
Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 1511 5B

STURGEON, R. E.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 1502 5A

STURGES, D. L.
Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 1505 3B

SU, P. K.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 1502 8B

SUAREZ, D. L.
Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 1508 2G

SUBBA RAO, K.
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

SUBBA-RAO, R. V.
Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 1512 5B

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 1512 5B

SUBLA, B. A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

SUBLETTE, K. L.
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 1512 5D

SUBRAMANIAM, A. R.
Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

SUBRAMANIAN, K. S.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 1502 5D

SUBRAMANIAN, V.
Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 1512 2J

SUCHER, J.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 1503 5A

SUDICKY, E. A.
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 1503 2F

SUEHIRO, S.
Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

SUFFERN, J. S.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 1506 5D

SUFFET, I. H.
Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 1511 5F

Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 1511 5F

An Evaluation of Activated Carbon for Drinking Water Treatment: A National Academy of Science Report,
W82-04146 1509 5F

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 1511 5F

A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 1512 5B

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 1505 5F

SUFFLING, R.
The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 6B

SUGDEN, D. E.
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 1507 2C

SUGIHARA, M.
Studies on Syntheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 1512 3A

SUGIMURA, Y.
Selenium Content and Its Chemical Form in River Waters of Japan,
W82-04181 1509 5A

SUHR, L. G.
Reliability and Redundancy. Dual Protection for Water Treatment Plants,
W82-04148 1509 5F

SUIDAN, M. T.
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 1501 5D

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

Role of Surface Active Media in Anaerobic Filters,
W82-05816 1511 5D

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

SUJARITTANONTA, S.
Activated Sludge Nickel Toxicity Studies,
W82-01895 1504 5D

SULAIMAN, A. M.
A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 1511 5A

SULER, D. J.
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

SULLAVAN, J. N.
Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 1506 2E

SULLIVAN, C.
Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 1505 6A

SULLIVAN, C. W.
Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 1507 5B

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

SULLIVAN, M.
Investigation of Volatile Organics Removal,
W82-01490 1503 5F

Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

SULLIVAN, M. J.
Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 1505 6G

SULLIVAN, P. F.
Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 1511 2H

SULLIVAN, P. J.
Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 1511 5B

SULOWAY, J. J.
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

SULOWAY, L. B.
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

SUMARAH, R.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

SUMMER, R. M.
Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

SUMMERS, J. K.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 1504 2L

SUMMERS, K. V.
Management Options for Ground Water in Urbanizing Areas,
W82-03961 1509 4B

SUMMERS, R. S.
Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 1511 5F

SUMSION, C. T.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

SUN, G.
Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results,
W82-03878 1509 5D

SUNADA, D. K.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

SUNAHARA, H.
The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 1512 5D

SUNCHINDAH, A.
Normality of Hydrological Data,
W82-05752 1511 7B

SUND-HAGELBERG, C.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results,
W82-03878 1509 5D

SUNDARAM, K. M. S.
The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 1511 5B

Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 1502 5B

SUNDARESAN, B. B.
Water Supply and Sanitation Decade Programme,
W82-02757 1506 5F

SUNDAY, G.
Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

SUNDSTROM, D.
Metal Leaching from Sewage Sludge Ash,
W82-00770 1502 5B

SUNESON, N.
Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 1505 2A

SUNG, F. J. M.
The Effect of Leaf Water Status on Stomatal Activity, Transpiration and Nitrate Reductase of Sweet Potato,
W82-03793 1509 2D

SUNG, J.
Organics,
W82-01239 1503 5A

Organics,
W82-06922 1512 5A

SUNG, J. F. C.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

SUNG, W.
Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 1506 2K

SUPER, M.
An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

SUREY-GENT, S. C.
Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 1507 2L

SURMA-AHO, K.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

SUSAN, J. A.
Chemical Coagulation of Surface Water,
W82-02623 1506 5F

SUTA, B. E.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

SUTCLIFFE, H. JR.
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

SUTCLIFFE, J. V.
The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

SUTHERLAND, J. C.
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 1506 3C

SUTTON, P. M.
Biological Nitrogen Control of Industrial Wastewater,
W82-03131 1507 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 1506 5D

SUZUKI, J.
Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 1512 5A

Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

SUZUKI, O.
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

SUZUKI, S.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 1502 5A

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 1512 5A

Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 1504 5A

Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 1506 5D

SUZUKI, T.
Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 1511 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

SUZUKI, Y.
Selenium Content and Its Chemical Form in River Waters of Japan,
W82-04181 1509 5A

SVANBERG, O.
The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 1512 5C

SVENSON, G.
Multimillion-Acre Tea Bag,
W82-03352 1507 3F

SVENSSON, J.
By-Product Recovery Finances Treatment,
W82-02756 1506 5D

SVENSSON, S. A.
Lake Vattern,
W82-02755 1506 2H

SWAIN, R.
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 1507 5C

SWALES, S.
Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 1512 8I

SWAMY, A. N.
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 1508 6D

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 1512 2K

SWAN, D. S.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

SWANEPOEL, J. H.
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 1506 2H

The Phosphorus Cycle in Germiston Lake. I. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 1511 5C

SWANK, W. T.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 1503 4C

SWANSON, F. J.
Fire and Geomorphic Processes,
W82-06963 1512 2J

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06966 1512 4D

SWANSON, J. L.
Solution Species of Plutonium in the Environment,
W82-00163 1501 5A

SWANSON, J. R.
Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 1508 5A

SWANSON, K.
An Investigation of Biologically Adjusted pH Changes in Domestic Sewage Effluent,
W82-03953 1509 5D

SWANSON, N. P.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

SWAYZE, L. J.
Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 1510 10C

SWEENEY, C.
Metal Leaching from Sewage Sludge Ash,
W82-00770 1502 5B

SWEENEY, C. E.
Pump Sump Design Experience: Summary,
W82-06419 1512 8C

SWEENEY, R. A.
Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

SWEENEY, R. E.
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 1501 5B

SWEENY, K. H.
The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 1507 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 1507 5D

SWEET, R. G.
Deep Well Injection of Industrial Wastes,
W82-00475 1501 5E

SWENSON, C. M.
Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

SWENSON, E. M.
Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 1510 7B

SWENSON, W. A.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 1503 5C

SWICK, A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

SWIFT, L. W. JR.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 1503 4C

SWIGER, W. F.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 1503 8A

SWINGLE, R. S.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 1511 3C

SWINNEY, L. D.
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

SWITZENBAUM, M. S.
A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

SYDOR, M.
Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

SYERS, J. K.
Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 1501 5B

SYKES, J. F.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

SYKES, R. M.
Hydraulic Regime and Activated Sludge Performance,
W82-05819 1511 5D

SYKORA, J. L.
Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

SYLVESTER, N. D.
A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 1512 5D

SYME, J. R.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

SYMONS, G. E.
Trends in Wastewater Collection Systems,
W82-02573 1505 8G

SYMONS, J. M.
The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

Removing Trihalomethanes from Drinking Water,
W82-00953 1502 5F

SYMULA, J.
Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

SYPNIEWSKI, R. H.
Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

SYVERTSEN, J. P.
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 1503 2I

SYVITSKI, J. P. M.
Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 1512 2J

SZABO, L.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

SZALADOS, J. E.
Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 1512 5C

SZE, P.
A Culture Model for Phytoplankton Succession in the Potomac River Near Washington, D.C. (U.S.A.),
W82-03765 1509 5B

Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 1505 5B

SZETO, S.
The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 1511 5B

Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 1502 5B

SZETO, S. Y.
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 1502 5C

SZIDAROVSZKY, F.
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

Reliability of Underground Flood Control System,
W82-00556 1502 8A

SZIKSZAY, M.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

SZLUHA, A. T.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 1506 5D

SZPILMAN, A.
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

TABAK, H. H.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

TABLER, R. D.
Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 1505 3B

TABOR, P. S.
Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 1512 5A

TABUCANON, M.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

TADMOR, J.
Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 1511 5D

TAGA, N.
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 1505 5A

TAGGART, C. T.
Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 1505 5G

A Model for the Design of Hypolimnetic Aerators,
W82-06610 1512 5G

TAGLIAFERRI, G.
Analysis of Large Desalination Plants,
W82-06122 1512 3A

TAI, D. Y.
Volatilization of Ketones From Water,
W82-05782 1511 5C

TAI, S.
Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760 1509 5D

TAILOR, A.
Role of the Microcomputer in Water Management,
W82-05771 1511 7B

TAITEL-GOLDMAN, N.
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 1508 2K

TAKAGI, E.
Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 1507 5A

TAKAGI, M.
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

TAKAHASHI, M.
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

TAKALA, S.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 1504 2G

TAKAMA, N.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 1504 6A

TAKASE, K.
Integrated Agricultural Development in the Philippines,
W82-01725 1503 6B

TAKEDA, K.
Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

TAKEI, Y.
Underwater Aerator,
W82-00065 1501 5D

TAKEUCHI, N.
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

TALBOT, J. W.
Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 1512 5B

TALLING, I. B.
Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 1511 5B

TALLMAN, D. E.
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 1501 5A

TALLON, J. T.
Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 1502 5D

TALMA, A. S.
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

TALSMA, T.
Transport of Salts in Catchments and Soils,
W82-01880 1504 2G

TAM, T.-Y.
Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 1501 2K

TAN, C. S.
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 1501 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 1503 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

TAN, F. C.
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 1502 2C

TAN, R. Y.
Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 1506 8A

TAN, Y.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

TAN, Y. L.
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

TANABE, K.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

TANADA, S.
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

TANAKA, H.
Kinetics of Biofilm Nitrification,
W82-05374 1511 5D

TANAKA, K.
Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 1512 5A

Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 1504 5A

TANAKA, M.
Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

TANAKA, N.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

TANAKA, S.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

TANJI, K. K.
Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

Irrigation Tailwater Management,
W82-00392 1501 3C

River Basin Hydrosalinity Modeling,
W82-01469 1503 2K

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

TANJI, N.
Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

TANKG, J. C. S.
Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

TANNER, J. W.
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

TANQUE, E.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

TANSEY, G.
Turks Press Forward With Ambitious Dam Programme,
W82-05758 1511 6B

TANTHAPANICHAKOON, W.
Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 1505 5D

TANTHIMAKABUT, S.
Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

TANUMA, M.
Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

TANUMA, R.
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

TAO, P.
Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 1512 6C

TAPP, J. S.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

TAPP, J. S. JR.
Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 1508 5D

TARAIMOVICH, I. I.
Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 1511 8B

TARAPCHAK, S. J.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 1504 2H

Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 1510 2H

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

TARAS, M. J.
Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

TARASEVICH, V. V.
Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 1511 8B

TARHANEN, J.
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

TARIFENO-SILVA, E.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

TARIFENO-SILVA, W.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

TARKPEA, M.
The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 1512 5C

TARR, J. A.
City Sewage and the American Farmer,
W82-03600 1508 3C

Sewers and Cities: France and the United States Compared,
W82-05684 1511 5D

TARVER, D. P.
Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 1511 4A

TATE, C. H.
Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

Recent Developments in Direct Filtration,
W82-04122 1509 5F

Trihalomethanes in Drinking Water,
W82-03447 1508 5F

TATE, R. L. III
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 1501 2G

TATE, S. L.
A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

TATINCLAUX, J-C.
Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 1505 2C

TAUXE, G. W.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

TAY, A. J.
Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

TAYAA, M.
Economic Evaluation of Watershed Projects-An Overview Methodology and Application,
W82-05735 1511 6B

TAYLOR, A. H.
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

TAYLOR, B. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 1504 5B

TAYLOR, D.
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

TAYLOR, E. W.
The Continuing Struggle of Waterborne Illness,
W82-05366 1511 5C

TAYLOR, F. J. R.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 1504 2H

TAYLOR, G. L. JR.
Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 1503 5D

TAYLOR, G. S.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

TAYLOR, H. E.
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 1501 5A

TAYLOR, J.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 1504 5A

TAYLOR, J. A.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 1502 2I

TAYLOR, J. M.
Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-05009 1512 5E

TAYLOR, L.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

TAYLOR, L. E.
Environmental Aspects of Water-Resources Planning in England and Wales,
W82-03806 1509 6E

TAYLOR, M. K.
Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 1512 5C

TAYLOR, R. E. JR.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 5C

TAYLOR, R. S.
The Computer: Water Management Tool,
W82-03290 1507 6A

TAYLOR, T. E.
Piloting Mag-Carbonate Treatment,
W82-05794 1511 5F

TAYLOR, T. T.
The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 1512 5D

TAYLOR, W. D.
Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

TCHOBANOGLOUS, G.
Concepts in Aquatic Treatment System Design,
W82-02593 1505 5D

Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

TEAL, J. M.
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 1508 5B

TEDROW, A. C.
Groundwater Problems and Needs in New York,
W82-01055 1502 4B

TEED, J. C.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

TEISSEDRE, J-M.
Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

TEITTINEN, E.
Shaking Down a Solids Handling System,
W82-04338 1510 5D

TELANG, S. A.
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

TELEPCHAK, M.
Foam Control and Degradation of Nonionic Detergents,
W82-00637 1502 5D

TELLER, J. P.
Common Facility Treatment of Industrial Wastewaters,
W82-05974 1512 5D

TELLERS, T. E.
Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 1512 2I

TELTSCH, B.
Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 1511 5D

Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 1502 5A

TEMMERMAN, M.
A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

TEMPERLEY, TOM G.
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 1512 3A

TEMPLE, D. M.
Tractive Force Design of Vegetated Channels,
W82-00901 1502 4D

TEMPLER, O. W.
Conjunctive Management of Water Resources in the Context of Texas Water Law,
W82-04223 1509 6E

The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 1507 6E

Problems of Public Access to Water in Texas Lakes and Streams,
W82-04220 1509 6E

TEMPLETON, M. E.
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

TENG, T-L.
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 1503 2F

TENNANT, D.
The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

TENORE, K.
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

TENORE, K. R.
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

TENT, L.
Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 1512 5E

TERASHIMA, M.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

TERJUNG, W. H.
A Parametric Crop Water Use Model,
W82-01310 1503 2I

TERNOVSKII, I. N.
Problems of Lightening Underground Structures and Methods of Constructing Them Under Permafrost Conditions,
W82-03918 1509 8A

TERRY, J. C.
Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

TERRY, R. E.
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 1501 2G

TERVET, D. J.
The Impact of Fish Farming on Water Quality,
W82-05471 1511 5B

TERWEY, L.
How Proper Prospecting Improves the Odds,
W82-05757 1511 3B

TERWINDT, J. H. J.
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 1501 2L

TESHIMA, H.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 1503 3A

TESKE, G.
Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 1512 5A

TESTER, D. J.
Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 1511 5B

TEWARI, S. K.
An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 1511 6B

TEZUKA, Y.
Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

THACKER, W. E.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

THACKRAY, J. E.
The Seven-Trent Studies of Industrial Water Use,
W82-04686 1510 6D

THACKSTON, E. L.
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

A Retrospective Benefit-Cost Analysis of Water Resource Projects in The Cumberland River Basin,
W82-03917 1509 6B

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

THAGARD, M. E.
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

THAKUR, D. K.
Characterization of Properties of Water,
W82-05540 1511 1A

THANH, N. C.
Palm Oil Waste Treatment Study in Malaysia,
W82-03632 1508 5D

Wind Aeration in Model Waste Treatment System,
W82-02944 1506 5D

THARP, T. M.
An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 1511 2F

THAYER, G. W.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

THEILER, D.
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

THEIS, S. W.
SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

THEMELIS, D. G.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

THERON, S.
The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

THEURER, F. D.
Accuracy Criteria in Diffusion Routing,
W82-06423 1512 8B

THIEL, D. A.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

THIELEN, J.
An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

THIERY, D.
Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

THINGVOLD, D. A.
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

THIRANAGAMA, P.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

THIRUMURTHI, D.
Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 1501 5D

Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

THOM, B. G.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

THOMAS, A. W.
Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

THOMAS, C. L.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

THOMAS, D. W.
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

THOMAS, G. L.
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

THOMAS, J. F.
Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

THOMAS, M. H.
Virginians Optimize Sludge Handling,
W82-05171 1511 5D

THOMAS, M. P.
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 1507 2L

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

THOMAS, P.
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 1511 5A

THOMAS, P. A.
Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

THOMAS, R. E.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

THOMAS, R. G.
Bottom-Entry Large-Diameter Wells,
W82-04919 1511 8A

Cavity Well,
W82-04920 1511 8A

THOMAS, R. L.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 1503 5B

THOMAS, R. P.
Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 1512 7C

THOMAS, W. H.
Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

THOMAS, W. O.
Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

THOMAS, W. O. JR.
An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 1512 2A

THOMMES, M. M.
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

THOMPSON, B. C.
Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

THOMPSON, B. H.
Water Law and the Development of Geothermal Resources,
W82-06218 1512 6E

THOMPSON, G. B.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 1504 5C

THOMPSON, G. S.
Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 1507 6A

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 1507 6A

THOMPSON, J. B.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

THOMPSON, J. L.
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

THOMPSON, J. M.
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1510 1A

THOMPSON, L. H.
Sludge Disposal to Sea in U.K.,
W82-06292 1512 5E

THOMPSON, M. E.
Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 1511 2K

THOMPSON, N.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

THOMPSON, P. L.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

THOMPSON, Q. E.
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 1502 5B

THOMPSON, R.
Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 1507 2J

THOMPSON, S. A.
Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-05629 1512 4C

THOMPSON, W. B.
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 1510 5D

THOMPSON, W. J.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

THOMSEN, A. G.
Spatial Simulation of Snow Processes,
W82-01887 1504 2C

THOMSEN, T.
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 1504 2J

THOMSON, A. M.
The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779 1511 6E

THOMSON, D. G.
Microprocessors and Computers in Analysis in the Water Industry,
W82-06259 1512 5F

THOMSON, L. J.
Bromide in Canterbury Ground Water,
W82-02056 1504 5B

THOMSON, P. A.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 1512 2K

THORNE, C. R.
Recording Unconfined Tension Tester,
W82-04238 1509 8D

THORNE, R. E.
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

THORNHILL, J. T.
Application of the Area of Review Concept,
W82-04674 1510 6E

THORNTON, J. C.
Groundwater Pollution in Kentucky: A Status Report,
W82-01053 1502 4B

THORNTON, J. D.
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

THORNTON, K. W.
Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

THORP, J. H.
Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 1512 5C

Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C

THORPE, S. A.
The Mixing Layer of Loch Ness,
W82-02421 1505 2H

THRAILKILL, J.
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 1510 2F

THRELFALL, D.
Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 1503 5G

THRELKELD, S. T.
The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 1505 2H

THROCKMORTON, C. K.
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 1505 2K

THROWER, L. B.
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 1512 5B

THRUN, K. E.
Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 1501 5A

THULLEN, J. S.
1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 1507 4A

THURMAN, E. M.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

THURSTON, R. V.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

TIBBALS, C. H.
Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 1511 2F

TIBBITTS, G. C. JR
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

TIKMON, A.
Development and Use of a Continuous Toc-Measurement Device in Wastewater Purification,
W82-04019 1509 5A

TIETJEN, W. L.
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

TIJERO, J.
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

TILDEN, R. L.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

TILFORD, N. R.
Power Plant Siting,
W82-06555 1512 6G

TILLERY, J. B.
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

TILLY, L. J.
Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 1505 5C

TIMERKAYEVA, A. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

TIMMONS, D. R.
Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 1503 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

TIMMONS, J. F.
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 1502 4D

Protecting Agriculture's Natural Resource Base,
W82-00176 1501 4D

TIMMONS, T. J.
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

TIMOSHCHUK, V. I.
Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 1506 2L

TINGSANCHALI, T.
Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

TINGYONG, B.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

TINKER, J.
Who Will Pay the World's Water Bill,
W82-03280 1507 6B

TINSMAN, J. C.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

TIPPIN, D.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

TIPPIN, D. L.
Work Management Standards,
W82-06349 1512 6F

TIPPING, E.
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 1511 2K

TIPPING, E.
Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

TISCHLER, L. F.
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 1506 5D

TISON, D. L.
Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 1502 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 1502 2H

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

TISUE, G. T.
Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

TISUE, T.
Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

TITOV, L. A.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 1511 8C

TITTLE, K.
The Removal of Organic Matter from Demineralised Water,
W82-00888 1502 5F

TITTLEBAUM, M.
Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 1503 5A

TITTLEBAUM, M. E.
Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

TITTLEBAUM, M. L.
The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 1501 6A

TITUS, J. A.
Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

TOBIASON, J. E.
Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

TOBIN, R. L.
Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

TOBIN, R. S.
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 1501 5A

Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

TOCA, C. G.
Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 1512 5A

TODHUNTER, P. E.
A Parametric Crop Water Use Model,
W82-01310 1503 2I

TOEI, K.
Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 1511 5A

Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 1501 5A

TOERIEN, D. F.
Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

TOETZ, D.
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

TOETZ, D. W.
Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 1505 5C

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 1506 5G

TOGGWEILER, J. R.
Radionuclides in Mono Lake, California,
W82-05461 1511 5B

TOHA, J.
Purification of Wastewater by Electrolysis,
W82-00847 1502 5D

TOKAR, E. M.
Environmental Improvement at Port Alice, B. C.,
W82-06515 1512 5C

TOKY, O. P.
Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 1511 4C

TOLIKAS, D. K.
Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 1510 8B

TOLKACHEV, G. S.
Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 1511 8D

TOLLEFSON, R.
Environmental Improvement at Port Alice, B. C.,
W82-06515 1512 5C

TOMA, S. A.
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 1512 2J

TOMAR, A. S.
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 1511 2I

TOMAR, S. S.
Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 1511 2I

TOMASI, C.
Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 1511 2B

TOMITA, I.
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 1508 5C

TOMLINSON, L. M.
Operating Policies for a Surface/Ground Water System,
W82-01741 1503 4B

TOMS, R. G.
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 1502 5D

The Use of Oxygen in Sewage Treatment,
W82-06262 1512 5D

TOMSON, M. B.
Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

TONELLATO, P. J.
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

TONELLI, F.
Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

TOOKOS, I.
Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 1510 5D

TOPPING, M.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

TORDIFFE, E. A. W.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

TORGERSEN, T.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

TORPEY, W.
Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 1506 5D

TORPY, M. F.
Petroleum Processing Wastes,
W82-01262 1503 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

Synthetic Fuel Effluents,
W82-01263 1503 5B

Synthetic Fuel Effluents,
W82-06800 1512 5D

TORRANCE, K. E.
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1510 1A

TORTORICI, L. D.
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

TOSTENGARD, S.
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

TOTH, L. G.
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 1506 7B

TOURBIER, J. T.
Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 1505 4D

TOUSSAINT, C. G.
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

TOUZEL, J. P.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 1510 5D

TOVEY, N. K.
Recording Unconfined Tension Tester,
W82-04238 1509 8D

TOWNS, D. R.
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 1503 5C

TOWNSEND, B. E.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

TOWNSEND, S.
Ocean Disposal Legislation in the United States,
W82-06597 1512 5E

TRAFFORD, B. D.
The Background to the Flood Defences of London and the Thames Estuary,
W82-03895 1509 4A

TRAHAN, J. C.
The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

TRAHERN, P. G.
The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

TRANUM, W. M.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

TRATTNER, R. B.
From Screening to Filtration: Treating the Water Supply,
W82-03739 1508 3A

TREADWELL, B. D.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

TREFRY, J. H.
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 1508 5A

TREMBOVEL'SKII, G. T.
Investigations of Catastrophic Maximum Discharges of the Araks River,
W82-05591 1511 2E

TREWEEK, G. P.
Refuse-To-Energy Wastewater Treatment,
W82-00168 1501 5D

TRICKER, T. D. A.
The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 1512 5G

TRIEFF, N. M.
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

TRIER, R. M.
Radionuclides in Mono Lake, California,
W82-05461 1511 5B

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 1511 2J

TRIMBLE, S. W.
Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 1503 2J

TRINEL, P. A.
Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 1501 5A

TRIPP, J. B.
Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 1505 6E

TRIPP, L. N.
Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

TRISKA, F. J.
Denitrification Associated With Periphyton Communities,
W82-01814 1504 5B

TRIVEDY, R. K.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

TRLICA, M. J.
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

TRNKA, W. C.
Packaged Plant Treats Turbidity,
W82-06026 1512 5F

TROEGER, B. W.
Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 1511 2H

TROFE, T. W.
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

TROJANOWICZ, M.
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

TROLINGER, W. D.
Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 1505 8A

TROLLOPE, D. R.
The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 1503 5A

TROMMER, J. T.
Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 1505 7C

TROTH, A.
Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

TROUBOUNIS, G.
Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 1510 2E

TROUT, T. J.
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 1502 3F

TROUTMAN, D. E.
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00599 1501 5B

TRUCCO, G.
The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

TRUDEL, M.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 1503 5A

TRUITT, R. E.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 1503 5F

TRUJI, H.
Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

TRUJILLO, L. F.
Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 1511 2J

TRUKHIN, YU. G.
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 1506 8B

TRULEAR, M. G.
Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

TRUSSELL, A.
Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

TRUSSELL, A. R.
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

Trihalomethanes in Drinking Water,
W82-03447 1508 5F

TRUSSELL, H. R.
Trihalomethanes in Drinking Water,
W82-03447 1508 5F

TRUSSELL, R.
Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03090 1509 5F

TRUSSELL, R. R.
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

Recent Developments in Direct Filtration,
W82-04122 1509 5F

TSANG, C. F.
Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 1512 2F

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 1502 3E

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

TSANG, G.
Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

TSAO, K.
Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 1510 3F

TSCHANTZ, B. A.
Application of and Guidelines for Using Available Dam Break Models,
W82-05152 1511 8A

TSCHETTER, P.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 1503 5C

TSEDROV, G. N.
Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

Concrete for Surfaces of High-Head Spillways,
W82-05110 1511 8F

TSEYEB, YA. YA.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 1504 5C

TSEZOS, M.
The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 1511 5D

TSIVOGLOU, A. J.
Modeling Gradual Dam Breaches,
W82-00554 1502 8D

TSUCHIYA, N.
Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems,
W82-03763 1509 5D

TSUGITA, R. A.
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

TSUMURA, K.
An Approach to the Control of the Activated Sludge System by Use of a Succession Model,
W82-04057 1509 5D

A Control System for Smaller Wastewater Treatment Plants,
W82-04024 1509 5D

A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

TSUNOGAI, S.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

TSUTSUI, R. N.
Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 1511 5G

TSVETKOV, A. I.
Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 1511 8H

TUBBS, L. J.
Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 1505 5B

TUCCI, C. E. M.
Unsteady Water Quality Model for River Network,
W82-02273 1506 5G

TUCHIYA, N.
Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

TUCKER, C. S.
Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 1505 5B

TUCKER, J. M.
The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

TUCKER, S. S.
Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 1508 2H

TUCKER, T. C.
Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 1511 3C

TUCKER, W. A.
Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 1511 2H

TUCKER, W. G.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 1504 5B

TUFFLEY, R. E.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 1504 5A

TUITE, C. H.
Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 1506 2H

TULEPOVA, G. B.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

TULLIS, J. P.
Modeling Cavitation for Closed Conduit Flow,
W82-02700 1506 8B

TUNG, Y. K.
Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 1503 8A

Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 1508 8A

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 1512 8A

Risk Models for Flood Levee Design,
W82-01307 1503 8A

TUNNICLIFF, B. M.
Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 1507 5A

TURBEVILLE, J. E.
Method and Apparatus for Pollutant Spill Control,
W82-00056 1501 5G

TURCOTTE, D. L.
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1510 1A

TURGEON, A.
A Decomposition Method For The Long-Term Scheduling Of Reservoirs in Series,
W82-04205 1509 6A

TURK, C. A.
Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

TURK, J.
Industrial Wastewater Audit,
W82-03337 1507 5D

TURK, J. T.
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 1505 5B

Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 1512 5G

TURK, T. R.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

TURKHEDE, B. B.
Consumptive Water Use by Opium Poppy,
W82-03356 1507 2I

TURNBULL, R. H.
Design and Operation of a Colorimetric Detector Controller,
W82-06656 1512 5A

TURNER, C. D.
Sequential Water Reuse Effect on Stream Salinity,
W82-05721 1511 3C

TURNER, D. R.
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00294 1501 2K

TURNER, J.
The Effects of Acid Rain on Forest Nutrient Status,
W82-06060 1512 5C

TURNER, J. S.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 1503 2C

TURNER JR, F.
Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sudangrass Yields,
W82-00767 1502 3C

TURNER, M. A.
Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

TURNER, M. F.
Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

TURNER, N. C.
Plant-Water Relations and Adaptation to Stress,
W82-00812 1502 2I

TURNER, R. S.
Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

TURNPENNY, A. W. H.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 1511 5C

TUSEL, G. F.
RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 1512 3A

TUTARASHVILI, B. A.
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 1508 4A

TUTTLE, J. R.
Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

TUTTLE, S. B.
Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

TUVEL, H. N.
Jersey Drought Hastens Water Supply Project,
W82-03385 1507 6D

TUZHIKHIN, G. G.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 1504 8A

TWEDELL, A. M.
Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 1511 5G

TWEDELL, D.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5G

TWEETON, D. R.
Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 1507 5D

TWIDWELL, S. R.
Intensive Survey of Armand Bayou,
W82-04079 1509 5A

TWINCH, A. J.
The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 1505 5C

TWYMAN, J. D.
Concentration and Size of Asbestos in Water Supplies,
W82-00262 1501 5B

TYAGI, A. K.
Bioassay Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

Finite Element Modeling of Streamflow Routing,
W82-05918 1512 2E

TYAGI, N. K.
Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 1510 3F

TYE, R. J.
Mutagens, Carcinogens and the Water Cycle,
W82-05468 1511 5A

TYREE, S. Y. JR.
Rainwater Acidity Measurement Problems,
W82-02627 1506 5A

TYTECA, D.
Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 1506 5D

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 1506 5D

TYVAND, P. A.
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 1506 2F

UCHIDA, H.
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00237 1501 5A

UEHARA, G.
Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

UEMATSU, M.
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

UHLMANN, D.
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 1504 5D

UIGA, A.
Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 1511 5D

UJJAINWALLA, S. H.
Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

ULABY, F. T.
Aircraft Radar Responses to Soil Moisture,
W82-04187 1509 7B

Microwave Measurements of Snowpack Properties,
W82-02646 1506 2C

ULKEN, A.
On Some Chytrids Found in Estuarine Habitats,
W82-02038 1504 2L

ULLMAN, W. J.
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 1506 2K

ULLRICH, C.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

ULLRICH, C. R.
Bank Failure and Erosion on the Ohio River,
W82-02343 1505 2J

Bank Failure and Erosion on the Ohio River,
W82-04473 1510 2J

UMPHRES, M. D.
Trihalomethanes in Drinking Water,
W82-03447 1508 5F

UNCLES, R. J.
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 1505 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 1503 2L

UNDERWOOD, J. K.
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

UNGER, P. W.
Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 1502 3F

UNIONE, A.
MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 1512 3A

UNITES, D.
Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

UNZ, R. F.
Rotating Disc Biological Treatment of Acid Mine Drainage,
W82-03968 1509 5D

UPTON, J.
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

URAGAMI, T.
Studies on Syntheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Mem-

branes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 1512 3A

URANO, K.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

URBAN, D. R.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

URBAN, L. V.
Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

URCHIN, C. G.
Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 1505 5B

URIARTE, J.
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

USRY, J. W.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 1511 2K

USTACH, J. F.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

UTTER, J.
Preferences for Allocating River Recreation Use,
W82-01181 1503 6D

UTTON, A. E.
The Development of International Groundwater Law,
W82-05939 1512 6E

UTTORMARK, P. D.
Input/Output Models as Decision Aids for Lake Restoration,
W82-03924 1509 5G

V, K.
Heavy Metals in Animals of Lake Balaton,
W82-06284 1512 5C

VAATANEN, P.
Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 1502 2L

Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 1502 5C

VACCARO, J. J.
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

VACHON, D. T.
Steel Industry Wastes,
W82-01264 1503 5D

Steel Industry Wastes,
W82-06799 1512 5D

VAGNER, V. N.
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A

VAISMAN, I.
Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

VALAMANESH, A.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 1502 2I

VALCARCEL, M.
Liquid-Liquid Extraction Combined with Atomic-Absorption Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 1512 5A

VALCOUR, H. C. JR.
Pumping Station Reliability: How and How Much,
W82-04110 1509 8C

VALDES, M.
Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 1510 2L

VALENTA, P.
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 1507 5A

Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry,
W82-05580 1511 5A

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 1504 2H

VALENTIN, F.
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 1507 7B

VALENTIN, P.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

VALENTINE, G.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

VALERI, P.
Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03341 1507 6D

VALIELA, I.
Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 1508 5B

VALLEJO, L. E.
Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 1502 2J

VALLIS, G. K.
A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 1512 2B

VALOCCHI, A. J.
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

VALSANGKAR, A. J.
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

VAN ASWEGEN, I. S.
Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 1506 2H

VAN BEEK, J. L.
Sediment--Asset or Liability,
W82-02150 1505 6B

VAN BREEMEN, N. V
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

VAN BRUNT, M. R.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

VAN DAM, D.
Economical and Efficient Phosphorus Control at a Domestic-Icdustrial Wastewater Plant,
W82-05324 1511 5D

VAN DE KREEKE, J.
Surface Water Flow from a South Florida Wetland Area,
W82-02121 1505 2E

Tide-Induced Residual Flow in Shallow Bays,
W82-02003 1504 2L

VAN DE VELDE, I.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

VAN DELFT, W.
Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

VAN DEN HEUVEL, J. C.
pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 1503 5D

VAN DER KAMP, G.
Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 1507 2F

VAN DER KOOIJ, D.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 1502 5A

VAN DER MARK, H.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 1504 5A

VAN DER MEER, R. R.
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 1511 5D

VAN DER MOLEN, W. H.
Effect of Perforation Shape and Pattern on the Performance of Drain Pipes,
W82-03792 1509 8B

VAN DER PIEPEN, H.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

VAN DER VALK, A. G.
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 1502 2H

VAN DER VEEN, C.
Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

Hygiene of Drinking Water in Developing Countries,
W82-00269 1501 5F

VAN DOESBURG, H.
Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 1507 5D

VAN DUIVEDIJK, J.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

VAN ENDE, C. N.
Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 1505 2H

VAN ES, F. B.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

VAN EVERDINGEN, R. O.
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 1504 2F

VAN EYBERGEN, G. C.
Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 1512 5C

VAN GALEN, G. C.
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 1503 5F

VAN GENUCHTEN, M. T.
Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 1512 2G

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 1512 2G

VAN GRIEKEN, R.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

VAN HAANDEL, A. C.
The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 1507 5D

VAN HAVEREN, B. P.
An Automated Recording System for Evaporation Pans,
W82-06780 1512 2D

VAN HEEK, L.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 2I

VAN HOOF, F.
Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 1502 5A

VAN HOORN, J. W.
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

Salt Movement, Leaching Efficiency, and Leaching Requirement,
W82-03791 1509 2K

VAN HOUSE, M. P.
A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 1506 5B

VAN KLUMP, J.
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 1507 2K

VAN KRANEN, H. J.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

VAN KREIJL, C. F.
Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

VAN LEEUWEN, J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

VAN LOON, J. C.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

VAN MUNSTER, J.
Effective Project Management,
W82-06328 1512 5D

VAN NULAND, G. J.
Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 1502 2H

VAN OS, A. G.
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 1508 2L

VAN OS, E.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

VAN OSS, C. J.
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 1502 5D

VAN OVERMEEREN, R. A.
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 1502 2F

VAN REES VELLINGA, E.
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

VAN RENSBURG, J. F. J.
The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 1503 5A

VAN ROBBROECK, T. P. C.
Sediment Surveys in the Department of Water Affairs,
W82-00680 1502 7B

VAN ROSMALEN, G. M.
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 1512 3A

VAN ROSSUM, P. G.
Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

VAN SCHILFGAARDE, J.
Dryland Management for Salinity Control,
W82-01018 1502 2G

The Wellton-Mohawk Dilemma,
W82-05883 1511 3F

VAN STADEN, J. F.
Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 1511 5A

VAN STEENDEREN, R. A.
Determination of Dissolved Organic Carbon in Water,
W82-02194 1505 5A

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 1512 5A

VAN'T WOUDT, B. D.
Local Flow Accelerations in Rivers,
W82-02758 1506 2E

VAN VLIET, B. M.
Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

VAN VLIET, N.
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water

Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

VAN VUUREN, L. R. J.
A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

VAN WEELE, B. J.
Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 1512 6B

VANBUCKENHOUT, L.
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 1502 5A

VANCE, H. A.
Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 1510 6A

VANCE, L. T.
Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603 1511 6E

VANCOTT, W.
Polymer Plays Plant Improvement Role,
W82-06250 1512 5D

VANDELANNOOTE, R.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

VANDERBROOK, S. G.
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

VANDERHOLM, D. H.
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 1502 5D

VANDERPLOEG, H. A.
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 1504 7B

Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 1501 2H

VANGENECHTEN, J. H. D.
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 1506 2H

VANHASSEL, J. H.
Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

VANHUMBEECK, J. B.
Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 1511 5A

VANLOON, G. W.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 1512 5B

VANMARCKE, E. H.
Probabilistic Stability Analysis of Earth Slopes,
W82-01932 1504 8D

VANNESS, R.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

VANNOTE, R. L.
The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 1505 6G

VANNUCCHI, C.
Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

VANWINKLE, J. R.
Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 1507 6A

VARADE, S. B.
A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

VARDIA, H. K.
The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 1505 5C

VARDIMAN, L.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 1507 3B

VARIALI, G.
Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 1511 5D

VARMA, M. M.
Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

VARNESS, K. J.
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

VASIL'EV, O. F.
Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 1502 6A

VASIL'EV, V. B.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

VASIL'YEVA, G. L.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 1504 2H

VASILIKIOTIS, G. S.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

VASIUKOVITCH, L. J.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 1504 6E

VASS, K. K.
On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 1505 5C

VASSILIOU, P.
Leach Characteristics of Coal-Gasification Char,
W82-01025 1502 5B

VAUCLIN, M.
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 1501 2G

Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

VAUGHAN, C. W.
Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 1505 5A

VAUGHAN, D. S.
Entrainment Mortality of Ichthyoplankton: Detectability and Precision of Estimates,
W82-05181 1511 5C

VAUGHN, P. R.
Design of Filters for Clay Cores of Dams,
W82-04321 1510 8D

VAUX, H. J.
Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 4B

VAUX, H. J. JR.
Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

VAUX JR, H. J.
Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

VAVILIN, V. A.
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

VEAL, D.
Oxygenation of the Avon River,
W82-05730 1511 5G

VECCHIA, A. V. JR.
A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 1512 2E

VEDULA, S.
Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 1506 6A

VEECH, J. A.
Fate of Diflubenzuron in Water,
W82-02216 1505 5B

VEEMAN, T.
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

VEENSTRA, J. N.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

VEIL, J. A.
Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

VEIRS JR, S. D.
Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

VEITH, G. D.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 1503 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

VELGA, A.
Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 1508 5D

VENKATACHARI, A.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

VENKATANARAYANA, B.
Geotechnical Investigations at the Kalvani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

VENKATESWARAN, M.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 1502 5A

VENN, A. C.
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 1502 6D

Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

VERA, F. L.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

VERA, I.
Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05509 1511 3A

VERACHTERT, H.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

VERDIN, K. L.
Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

VERDONSCHOT, P.F.M.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

VERDOUW, H.
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 1506 2K

VERGARA, I.
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

VERHEYDEN, J.
Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

VERHOFF, F. H.
Energy Recovery System,
W82-00039 1501 5D

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 1511 2J

VERLINSKAYA, R. M.
Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 1507 5G

VERMA, S. R.
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 1511 5C

VERMAAK, J. F.
The Phosphorus Cycle in Germinston Lake. I. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 1511 5C

VERMIJ, S.
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 1510 2H

VERNER, K.
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

VERSTEEG, J. H.
Erosion Control at a Delicate Highway Construction Site,
W82-06510 1512 4D

VERVACKE, S. L.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 1512 5A

VESILIND, P. A.
Sludge Management: A Research Update,
W82-06007 1512 5E

Sludge Treatment, Utilization, and Disposal,
W82-01247 1503 5E

VESTAL, J. R.
Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 1512 5C

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 1501 2H

VETTER, R. J.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 1502 5B

Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 1512 5B

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

VIARENGO, A.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

VICK, S. G.
Siting and Design of Tailings Impoundments,
W82-01588 1503 8A

VICK, W. H.
Breakthrough Characteristics of Selected Toxicants in Granular Activated Carbon Treatment of Combined Industrial Wastewaters,
W82-03812 1509 5D

VICKERS, R. M.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

VICORY, A. H. JR.
Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 1511 5A

VIDAL-MADJAR, D.
Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

VIENS, P.
Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 1503 6A

VIESSMAN, W.
Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

VIESSMAN, W. JR.
National Water Policy: The Need for Institutional Reform,
W82-05180 1511 6E

VIG, A. C.
Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

VIGFUSSON, N. V.
Sister Chromatid Exchange as an Indicator of Short Term Chemical Stress in Aquatic Systems,
W82-04161 1509 5A

VIGG, S.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

Secchi Disc Relationships,
W82-06627 1512 2H

VIGH, G.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

VIGHI, M.
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 1512 5C

VIGIL, F. R.
Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 1512 3F

VIJAN, P. N.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 1504 5A

VIK, E. A.
Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 1512 5F

VIKULOVA, L. I.
Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

VIL'VOVSKII, V. V.
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

VILAGINES, R.
Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

VILARET, M. R.
Florida Style Water Supply and Treatment,
W82-06027 1512 5F

VILJOEN, M. F.
Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 1511 6A

VILJOEN, N.
Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

VILLA, O.
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

VILLERIUS, L. A.
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 1501 5A

VIMMERSTEDT, J. P.
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

VINCENT, B.
Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 1510 2L

VINCENT, R. J.
Pilot-Scale Investigations with Granular Activated Carbon,
W82-02289 1505 5D

VINCENT, W. F.
Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 1507 2H

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 1506 2C

VINIKOUR, W. S.
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 1504 4A

VINK, G. J.
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

VINK, J. S. L.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

VINSON, T. S.
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 1510 4B

VINYARD, L.
Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 1502 10D

VIRARAGHAVAN, T.
Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

On-Site Wastewater Management--Recent Trends,
W82-06439 1512 5D

VIRTANEN, M. T.
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 1512 5B

VISI, E.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

VISOCKY, A. P.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

VISSER, A.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 1502 5A

VISWANADHAM, Y.
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 1507 2B

VITA-FINZI, C.
Recent Inshore Sediments in Musandam, Oman,
W82-02857 1506 2J

VITRAC, O.
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

VIVONA, M. A.
Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 1512 5D

VLAMIS, J.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

VLASICH, J. A.
Pueblo Indian Agriculture, Irrigation and Water Rights,
W82-04208 1509 6E

VLASSOFF, L. T.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

VOEGTLY, N. E.
Reconnaissance of the Hot Springs Mountain and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

VOERMAN, J.
Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

VOETS, P.
Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

VOEVODIN, A. F.
Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 1512 8B

VOGEL, J. C.
Excess Air in Groundwater,
W82-02099 1504 2F

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

VOGEL, J. L.
Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 1510 2B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 1505 7A

VOGEL, T. S.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

VOGIATZIS, Z.
Performance of Modified Chlorine Contact Chamber,
W82-06359 1512 5D

VOLESKY, B.
The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 1511 5D

VOLKER, R. E.
Deterministic Models for Predicting Residential Water Consumption,
W82-04352 1510 6D

VOLKOVA, G. V.
Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 1512 2H

VOLLENWEIDER, R. A.
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 1512 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 1512 7C

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 1512 5C

VON BERG, R. L.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

Myths about Freeze Desalting,
W82-06114 1512 3A

VON DER EMDE, W.
Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 1511 5D

VON OERTZEN, J. A.
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 1511 2L

VONNEGUT, B.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 1502 2B

VOORHEES, M. L.
An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

VOORHEES, W. B.
Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 1501 2G

VOROB'YEV, V. I.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

VORONIN, L. M.
Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Penneville, New Jersey, 1980,
W82-04515 1510 7C

VOROPAEV, G. V.
Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 1511 4A

VOROPAEV, S. V.
Numerical Methods in Hydraulics,
W82-06614 1512 8B

VOROTOVOVA, T. S.
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 1507 8F

VORST, P. C.
Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 1512 2A

VOSSOUGHI, M.
Continuous Denitrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

VOULOUVOUTIS, N. A.
Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

VREEDENBURGH, E. G. H.
The Biesbosch Water Storage Scheme,
W82-06014 1512 8A

VRHOVSEK, D.
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

VRIJMOED, L. L. P.
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 1512 5B

VUTSEL', V. I.
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 1511 8A

WACHS, P.
How Appleton Reduced Phosphorus,
W82-06249 1512 5D

WACINSKI, A.
Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

WADA, H.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

WADDELL, K. M.
Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

WADDINGTON, J. I.
The Mediterranean Action Plan: Design and Implementation,
W82-06154 1512 5B

WADE, J. C.
The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

WADE, T. L.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

WADOWSKY, R. M.
Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 1512 5C

WADSTROM, T.
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 1510 5A

WAGENET, R. J.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 1503 5B

Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

WAGGOTT, A.
Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 1510 5B

WAGHMARE, S. V.
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 1501 5D

WAGNER, B.
Development and Use of a Continuous Toc-Measurement Device in Wastewater Purification,
W82-04019 1509 5A

WAGNER, E. G.
Low-Dosage High-Rate Direct Filtration,
W82-06416 1512 5F

Upgrading Water Treatment Plants: An Alternative to New Construction,
W82-04098 1509 5F

WAGNER, J. R.
Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

WAGNER-MERNER, D. TES.
Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 1508 2L

WAGNER, P.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

WAGNER, R. E.
Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

WAHID, P. A.
Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 1501 5A

WAHLISS, W.
Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 1512 4A

WAID, J. S.
Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

WAINWRIGHT, M.
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 1505 5B

WAISEL, Y.
Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

WAITE, B. A.
Ground Water Monitoring of Underground Coal Mines,
W82-04750 1510 5B

WAITE, J.
Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 1508 6G

WAITE, S. W.
Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 1502 7B

WAITE, W. M.
Environmental Virology and its Problems,
W82-00505 1502 5A

Mutagens, Carcinogens and the Water Cycle,
W82-05468 1511 5A

WAKAMIYA, W.
Shale Oil Wastewater Treatment by Evaporation,
W82-04905 1511 5D

WALDEN, R. W.
Wastewater Treatment at an Electrical Generation Station,
W82-05975 1512 5D

WALDESTAM, S.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 1504 5D

WALKER, D. J.
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 1502 4D

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 1512 3F

WALKER, D. L.
Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 1512 5E

WALKER, D. R.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

WALKER, E. A.
Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 1501 5C

WALKER, H. A.
A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 1505 5C

WALKER, J. F.
A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 1507 2E

WALKER, J. M.
Trenching of Digested Sludge,
W82-00974 1502 5E

WALKER, P. H.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

WALKER, R. L.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 1502 5A

WALKER, R. P.
Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

WALKER, T.
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland.
W82-02878 1506 2L

WALKER, W. R.
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 1512 3F

Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 1511 3C

Law,
W82-01302 1503 6E

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 1511 5G

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

WALKER, W. W.
A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

WALL, D.
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 1506 2H

WALL, P. C.
Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

WALLACE, J. B.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

WALLACE, J. R.
The Analysis of Oil Shale Wastes: A Review,
W82-00388 1501 5A

WALLACE, J. S.
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 1502 2D

WALLACE, R. B.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 1511 8B

WALLACE, R. E.
A 201 Pollution Control Planning Tragedy,
W82-00285 1501 6E

WALLACE, R. R.
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 1511 5B

WALLBANK, T. E.
Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 1512 5D

WALLEN, D. G.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

WALLER, B. G.
Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 1512 5B

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

WALLER, W. T.
Substrate Associated Microfauna,
W82-01283 1503 5C

WALLICK, E. I.
Chemical Evolution of Groundwater in a Drainage Basin of Holocene Age, East-Central Alberta, Canada,
W82-03800 1509 2K

WALLIN, B. K.
Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 1506 5D

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 1506 5B

WALLINGFORD, E.
Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 1510 2H

WALLIS, C.
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

WALMSLEY, R. D.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

WALSH, D. F.
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

WALSH, G. E.
Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 1512 5A

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 1506 5C

WALSH, J. E.
Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 1512 2B

WALSH, J. J.
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 1501 5C

WALSH, S. J.
Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

WALSH, T. W.
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

WALSKI, T. M.
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 1512 6C

Economic Analysis of Water Main Breaks,
W82-05673 1511 8A

Maps--A Planning Tool for Corps of Engineers Regional Water Supply Studies,
W82-04228 1509 6A

WALTA, M. E.
Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 1510 6E

WALTEMEYER, S. D.
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

WALTER, M. F.
Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 1510 2A

WALTER, S. D.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 5C

WALTERS, J. G.
Designing for Coarse Sand Filtration Systems,
W82-03478 1508 5D

WALTON, J. R.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

WALTON, M. T.
Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 1505 4A

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

WALTON, N. R. G.
The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801 1511 2K

WALTON, T. L. JR.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 1503 2L

WANDERS, J. B. W.
Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 1512 5C

WANEK, P. L.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

WANG, C.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

WANG, C. J. K.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

WANG, C. S.
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 1512 3A

WANG, C. T.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 1502 2A

WANG, D-S.
Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 1502 5A

WANG, F. C.
Cation Transport in Packed Bed Reactor of Soil,
W82-00970 1502 5D

Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

WANG, J.
Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 1511 5A

WANG, J-K.
Sizing Rice Irrigation Canals,
W82-00895 1502 3F

WANG, J. R.
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 1503 7B

WANG, J. S. Y.
A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

WANG, L. K.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 1512 5F

Reevaluating Hunter's Model for Residential Water Demand,
W82-04131 1509 6D

WANGANEO, A.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

WANGEN, L. E.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

WANGSNESS, D. J.
Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

WANKOFF, W.
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 1506 5E

WARBURTON, J. A.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

WARD, A. D.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 1502 5G

A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 1503 2J

WARD, A. K.
Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

WARD, D. S.
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

WARD, G. H. JR.
Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

WARD, J. C.
Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

WARD, J. V.
Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

WARD, P. R. B.
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 1503 2J

WARD, R. C.
Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 1506 7A

WARD, R. L.
Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 1512 5A

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 1501 5E

Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 1502 5A

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 1512 5D

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

WARD, T. E.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

WARDEN, J. H.
Advanced Sludge Treatment for Modern Waterworks,
W82-02889 1506 5D

WARING, S. L.
Non-Indian Federal Reserved Water Rights,
W82-04804 1511 6E

WARKENTIN, B. P.
Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

WARMAN, J. M.
Proton Mobility in Ice,
W82-03701 1508 2C

WARN, A. E.
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 1512 5G

WARNER, D. L.
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 1507 2F

WARNER, L.
The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 1510 6E

WARNER, R. E.
Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

WARNER, T. T.
A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 1512 2B

WARNICK, C. C.
Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

WARREN, C. S.
Poisons in the Hudson,
W82-05705 1511 5G

WARREN, C. W.
Groundwater Strategy: Protecting a Vital Resource,
W82-05403 1511 5B

WARREN, J.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

WARREN, J. M.
Water Quality: What Should Be Done Today,
W82-03631 1508 6E

WARREN, R. D.
Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

WARRICK, A. W.
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 1501 6A

Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 1503 5B

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 1501 2I

WARRY, N. D.
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

WARSH, C. E.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

WARSKOW, W. L.
Picloram Dissipation in a Small Southwestern Stream,
W82-00812 1501 5B

WARVICK, C. E.
Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

WARWICK, W. F.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

WASE, D. A. J.
Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 1510 5E

WASHBURN, M. C.
Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

WASSON, B. E.
Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 1512 7C

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 1512 7C

WATANABE, I.
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1505 5A

WATANABE, S.
Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 1512 5D

Experiences of MLSS Control of the Activated Sludge Process,
W82-03849 1509 5D

WATANABE, Y.
The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 1506 5C

WATERS, R. C.
An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning,
W82-03942 1509 6B

Theory and Reality in Allocating Federal Resources to Water Resources Development,
W82-04224 1509 6E

WATLING, H. R.
Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 1511 2B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 1511 5B

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

WATLING, R. J.
Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 1511 2B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 1511 5B

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

A Preliminary Pollution Survey of the Papekuils River, Port Elizabeth,
W82-04346 1510 5B

WATSON, A. O.
Warming Up to Geothermal,
W82-03156 1507 8A

WATSON, K.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

WATSON, K. K.
Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 1511 5B

WATSON, K. S.
Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 1512 5D

WATSON, M. D.
Sizing of Urban Flood Control Ponds,
W82-03297 1507 2A

WATSON, S.
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 1503 5C

WATSON, V. J.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

WATSON, W. D.
Long-Run Effects of Environmental Regulation,
W82-01848 1504 6A

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 1510 6B

WATT, T. A.
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 1502 2I

WATTS, D. G.
Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 1503 5B

WAUCHOPE, R. D.
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 1503 5B

WAWRONOWICZ, L. J.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

WAYLEN, P.
Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 1506 2E

WAYMIRE, E.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 1502 2A

WEAVER, A. V. B.
An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 1508 7B

WEAVER, D. S.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 1502 8B

WEAVER, L.
An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

An Organics Detection System for the Ohio River,
W82-03436 1508 5A

WEAVER, S. C.
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

WEBB, A. H.
Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 1512 2K

WEBB, M. G.
Charging Policies for Water Services,
W82-01734 1503 6C

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

WEBB, R. M.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

WEBB, T. R.
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 1505 5G

WEBBER, E. E.
Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

WEBBER, R. T.
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 1503 5D

WEBER, D. E.
Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 1511 5C

WEBER, H. W.
Soil Water Studies on Small Lucerne Plots,
W82-01713 1503 2I

WEBER, J.
Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

WEBER, J. B.
Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 1511 5B

WEBER, J. C.
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

WEBER, J. H.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 1503 5F

WEBER, J. W.
Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 1506 4B

WEBER, S. F.
Water Rates and Residential Water Conservation,
W82-06276 1512 3D

WEBER, T. W. H.
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 1507 5C

WEBER, W.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

WEBER, W. J. JR.
Application of Adsorption to Wastewater Treatment,
W82-02622 1506 5D

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 1501 5F

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 1505 5B

WEBSTER, C. J. D.
Reducing the Flush,
W82-04654 1510 3D

WEBSTER, D. A.
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

WEBSTER, J. R.
Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 1505 5C

Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

WEBSTER, R. M.
Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 1510 5C

WEBSTER, S.
Cost-Based Water Rate Design,
W82-06277 1512 6C

WEDGWOOD, K. F.
The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 1511 6D

WEEKES, M. C.
Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

WEEKS, E. P.
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

WEEKS, W. D.
A Comparison of Rainfall-Runoff Models,
W82-00911 1502 2A

WEERTMAN, J.
On Antarctic Glaciology: Ice Sheets–And Ice Cores,
W82-03170 1507 2C

WEETE, J. D.
Water Conservation in Cotton by Drought Induced Leaf Surface Wax Synthesis,
W82-03946 1509 3F

WEETER, D. W.
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

WEFRING, D. R.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

WEGMAN, R. C. C.
Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

WEGSCHEIDER, W.
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 1503 5A

WEHBRING, K.
Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 1511 6B

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 1511 6B

WEHRMANN, H. A.
Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

WEIBEZAHN, F. H.
Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

WEIGLE, J. M.
Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

WEIGONG, C.
China's Potential for Hydro Development,
W82-00336 1501 8A

WEILAND, R. A.
Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 1502 6E

WEILER, R. R.
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

WEINBAUER, J. D.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

WEINBERGER, P.
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 1501 5B

WEINER, R. M.
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 1503 5A

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

WEINRICH, B. E.
Modeling Water Flux on Strip-Mined Land,
W82-00944 1502 2G

WEINS, J. H.
Agricultural Runoff and Water Pollution,
W82-05569 1511 5B

WEISS, A.
Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

WEISS, D. E.
Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 1505 5F

WEISS, K.
Experiments on Coaxial Heated Water Discharges,
W82-05422 1512 5B

WEISS, L. A.
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

WELBY, C. W.
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 1503 5B

WELCH, C. S.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

WELCH, E. B.
The Dilution/Flushing Technique in Lake Restoration,
W82-02270 1505 2H

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

WELCH, J. F.
A/C Pipe - Assessment or Advocacy,
W82-00070 1501 5F

WELCH, K.
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 1503 5A

WELCH, R.
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

WELDER, G. E.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

WELLERSHAUS, S.
Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 1512 5B

WELLS, B. R.
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

WELLS, J. R.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

WELLS, M. R.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 1504 5B

WELSH, F. W.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 1503 5D

WEN, C-G.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

WENDERS, J. T.
Price or Persuasion,
W82-05791 1511 6C

WENDT, R. C.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

WENTSEL, R. S.
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

WENTWORTH, R. W.
On the Marginal Cost of Wastewater Services,
W82-04376 1510 6C

Projective Evaluation During Inflation, Revisited: A Solution to Turvey's Relative Price Change Problem,
W82-04202 1509 6B

WENZEL, H. G. JR.
An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

WERNER, J.
Practicable Formulae for the Energy Exchange at the Boundary Layer Between Water Surface and Air (Brauchbare Energieumsatzformeln fur den Grenzbereich Gewasseroberflache/Luft),
W82-06824 1512 2D

WERSHAW, R. L.
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

WERTAM, J.
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5B

WESCHE, A.
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

WESCHE, T. A.
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

WEST, D. W.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 1502 2I

WEST, J. R.
Dispersion Coefficients in Estuaries,
W82-04684 1510 5B

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 1507 2L

WEST, R. H.
Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

WEST, T. R.
Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 1512 6A

WESTALL, J.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 1504 5B

WESTBROOK, E. J.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

WESTBURY, W.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 1503 3C

WESTERHOFF, G. P.
Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

Water Cost Encourages Reuse and Conservation,
W82-03295 1507 5D

WESTERMAN, A. G.
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

WESTERMAN, P. W.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 1501 5B

WESTLAKE, D. W. S.
Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 1511 5B

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

WESTMACOTT, R.
Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 1505 4D

WESTON, R. T.
Pennsylvania Ground Water Problems and Needs,
W82-01058 1502 4B

WESTPHAL, J. W.
The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 1511 4B

WETSTEIN, D. P.
Initial Degradation of Effluent Quality During Filtration,
W82-04134 1509 5F

WETZEL, K. G.
Effects on Global Supplies of Freshwater,
W82-06733 1512 5C

WETZEL, R.
Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5G

WETZEL, R. G.
A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

WEXLER, R.
Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

WHALEN, G. A.
Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 1512 5D

WHALEN, R. C.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

WHARTON, C. H.
The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

WHARTON, R. A. JR.
Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

WHEATCRAFT, S. W.
Atoll Island Hydrology,
W82-02617 1506 2F

WHEATER, H. S.
Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 1511 4C

WHEATLEY, A. D.
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 1501 5D

Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 1511 5D

WHEATLEY, W. B.
New Antimicrobial Agents for Treatment of Water,
W82-02808 1506 5F

A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

WHEATON, F. W.
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 1501 5D

Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 1512 5D

WHEELER, G. A.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

WHEELER, J. C.
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

WHEELER, R. M.
Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 1510 6C

WHEELER, R. M. JR.
Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

WHEELER, R. P.
Pollution from Farms,
W82-02039 1504 5D

WHEELER, W.
Bridging the Water Supply Gap,
W82-06508 1512 8A

Updating Antiquated City Water Systems,
W82-03293 1507 5F

WHELAN, B. R.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 1503 5B

WHELAN, J. K.
Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 1503 5B

WHIPPLE, W. JR.
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 1507 2J

An Economic Analysis of Water Conservation Policy,
W82-03090 1507 6B

Settleability of Urban Runoff Pollution,
W82-05320 1511 5G

Water Conservation Incentives and Strategy,
W82-05906 1512 3D

WHITCOMB, B. M.
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

WHITE, C. S.
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

WHITE, E.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 1502 2H

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

WHITE, E. L.
Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 1512 2A

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

WHITE, E. M.
Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 1505 2I

WHITE, F. C.
Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

WHITE, F. H.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

WHITE, G. B.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D

WHITE, G. C.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 1503 5B

WHITE, I.
Characterization of Properties of Water,
W82-05540 1511 1A

Measurement of Sorptivity and Soil Water Diffusivity in the Field,
W82-03764 1509 2G

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 1510 2G

WHITE, J. K.
Groundwater Control,
W82-04714 1510 4B

WHITE, K. E.
Hydrological Studies Possible with Radionuclides of Bomb-Test, Primordial and Natural Origin to Complement Investigations Using Manufactured Radiotracers,
W82-03836 1509 5B

WHITE, M. J. D.
Small is Environmentally Acceptable . . .,
W82-00311 1501 5D

WHITE, R. G.
Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

WHITE, S. E.
Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

WHITE, S. F.
Requirements and Application of Control and Automation Systems in Wastewater Treatment-A Critical View,
W82-03858 1509 5D

WHITE, S. T.
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem.
W82-05538 1511 5C

WHITE, W. R.
Mathematical Simulation of Sediment Movement in Streams,
W82-04650 1510 2J

WHITEBLOOM, S.
Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5G

WHITEHALL, K. V.
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 1501 5D

WHITEHEAD, D.
Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

WHITEHEAD, P.
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 1507 5B

WHITEHEAD, P. G.
Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 1507 5A

WHITEHURST, C. A.
Current Use and Technology of Landsat Mss Data for Lake Trophic Classification,
W82-03755 1509 7B

WHITFIELD, M.
An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1507 1B

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 1501 2K

WHITFIELD, M. S. SR.
Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

WHITFIELD, P. H.
Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 1512 2K

Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 1511 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 1511 5B

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 1503 5A

WHITFORD, C. J.
The use of Activated Carbon in Water Treatment,
W82-05182 1511 5F

WHITLEY, W. G.
Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 1511 5B

WHITLOCK, C. H.
Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06231 1512 7C

Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05809 1511 2K

WHITMYRE, G. K.
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 1505 5A

WHITSON, E.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 1512 3F

WHITTAKER, J. G.
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 1512 2J

WHITTINGTON, D.
Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

WHITTLE, P. J.
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 1505 5B

WHITTLESEY, N. K.
Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

WHITTON, B. A.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 1506 5C

On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 1504 2K

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 1503 2E

WHYE, M.
Supplying Water to the Rural Community,
W82-06223 1512 5F

WIANCKO, P. M.
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

WICHERS, D. L.
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

WICKERSHAM, G.
A Preliminary Survey of State Ground-Water Laws,
W82-02616 1506 6E

WICKLUND, A.
Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 1511 5F

WICKSTROM, K.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

WIEANDT, H. F.
Myths about Freeze Desalting,
W82-06114 1512 3A

WIEBE, W. J.
Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 1502 2H

WIECHERS, S. G.
Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 1508 5D

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

WIEDER, R. K.
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

WIEDERHOLM, T.
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 1507 2H

WIEGAND, C.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

WIEGAND, R. C.
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 1505 2H

WIEGANDT, H. F.
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

WIEGERT, R. E.
Process for Removing Alkalinity and Hardness From Waters,
W82-00063 1501 5F

WIENER, J. G.
Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 1502 5B

WIENS, A. P.
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 1502 2H

WIER, W.
Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

WIERENGA, P. J.
Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 1503 2G

WIERICH, P.
The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 1510 5D

WIESER, W.
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

WIESMANN, U.
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

WIEST, S. C.
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

WIJAYARATNE, R.
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

WIJESINGHE, M. W. P.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

WIKRAMARATNA, R. S.
A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00983 1502 2F

WILBER, W. G.
Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

WILCOX, D. P.
Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

WILCOX, R. P.
The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 1501 5D

WILD, J.
Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 1512 2A

WILD, P. A.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 1503 8A

WILDE, E. W.
Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 1505 5C

Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 1511 5F

WILDER, B.
Denmark's State of the Environment,
W82-02401 1505 5B

WILDERER, P.
A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-05147 1507 5C

WILDUNG, R. E.
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

WILES, C. C.
Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

WILHELMS, A.
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaeufen),
W82-04281 1510 5G

WILHM, J.
Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 1512 5G

WILKE, D. A.
Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

WILKE, K.
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 1511 2E

WILKEN, G.
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 1512 3A

WILKES, F. G.
Marine and Estuarine Pollution,
W82-01274 1503 5C

Marine and Estuarine Pollution,
W82-06808 1512 5C

WILKINSON, L. F.
Bromide in Canterbury Ground Water,
W82-02056 1504 5B

WILLARDSON, L. S.
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 1501 2G

WILLEKE, G. E.
Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

WILLER, D. C.
Determining Feasibility of Small-Scale Hydropower,
W82-04693 1510 6B

Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 1502 6B

WILLEY, J. D.
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 1501 5A

WILLIAMS, A. W.
The Expansion of Two Bolivian Plants,
W82-05558 1511 8A

WILLIAMS, B. J.
Expansion of Effluent Constrained Treatment Plants,
W82-01355 1503 5D

WILLIAMS, D. E.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

WILLIAMS, D. G.
Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

WILLIAMS, D. T.
Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 1504 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 1502 5A

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00902 1502 5A

Headspace Chromatographic Determination of Water Pollutants,
W82-06016 1512 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 1504 5B

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W52-05761 1511 5F

WILLIAMS, E. R.
Fundamental Concepts of Well Design,
W82-02614 1506 8A

WILLIAMS, E. G.
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

WILLIAMS, G. M.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 1502 5C

WILLIAMS, H. N.
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

WILLIAMS, J.
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 1504 2B

WILLIAMS, J. D. H.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

WILLIAMS, J. M.
Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

WILLIAMS, J. R.
Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 1511 5B

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

SPNM, A Model for Predicting Sediment, Phosphorus, and Nitrogen Yields from Agricultural Basins,
W82-04157 1509 6A

WILLIAMS, J. S.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

WILLIAMS, L. R.
Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 1511 5A

WILLIAMS, M. D.
A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 1511 6D

WILLIAMS, N. J.
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

WILLIAMS, O. O.
National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

WILLIAMS, P. J.
The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 1506 4D

WILLIAMS, P. J. LEB.
Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 1511 5B

WILLIAMS, R.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 1511 5C

Institutional Analysis Criteria for Water Supply Planning,
W82-03930 1509 6D

WILLIAMS, R. D.
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 1501 2E

WILLIAMS, R. J.
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 1505 2D

WILLIAMS, W. D.
The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 1511 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

WILLIAMSON, D. R.
Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 1506 2K

WILLIAMSON, J. C.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

WILLIAMSON, K. J.
A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 1501 5A

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 1505 5D

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 1510 5D

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 1506 5B

WILLIS, C. E.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 1511 6C

WILLIS, G. H.
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 1505 5B

WILLIS, W. O.
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

WILLSON, G. B.
Land Treatment of Industrial Wastes: Principles and Practices. Part II.
W82-06009 1512 5E

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

WILLSON, K. E.
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 1504 5A

WILLSON, W. G.
Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 1501 5D

WILSON, B. N.
A Comparison of Three Infiltration Models,
W82-05965 1512 2G

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 1501 2G

WILSON, C. A.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 1502 2L

WILSON, C. R.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

WILSON, D.
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1502 1B

WILSON, D. J.
Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 1504 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

WILSON, E. A.
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 1505 5C

WILSON, I.
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 1503 5A

WILSON, I. R.
Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

WILSON, J.
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 1503 5D

WILSON, J. L.
Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 1507 2G

Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 1510 5A

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 1507 2F

River-Basin Simulation in Systems with Large Response Time,
W82-05496 1511 2A

WILSON, J. R.
Canadian Wave Climate Study: Organization and Operation,
W82-06393 1512 8B

WILSON, J. T.
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 1505 5B

WILSON, L. G.
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 1508 5B

WILSON, M. A.
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 1507 2H

WILSON, R.
Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

Why Bother with Historic Preservation,
W82-03384 1507 8A

WILSON, R. E.
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 1506 2L

WILSON, R. W.
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

WILSON, T. E.
Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

WILSON, W. E.
Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

WIMMER, E.
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

WINANT, W. M.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 1503 5E

WINCHESTER, J. W.
Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

Water-To-Air Fractionation of Bacteria,
W82-00575 1502 5B

WINDHAM, M. P.
Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

WINDLE, M. R.
A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 1511 5D

WINDREM, P. F.
Environmental Problems and Geothermal Permitting,
W82-06217 1512 6G

WINDSHUTTEL, B. A.
Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

WINEK, D.
Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

WINFIELD, B. A.
Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 1512 5D

Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 1505 5D

WINN, C. D.
RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 1507 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 1507 5A

WINNER, J. M.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

WINNER, M. D. JR.
An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 1501 4B

Proposed Observation-Well Networks and Ground-Water Level Programs for North Carolina,
W82-00426 1501 4B

WINNER, R. W.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 1502 5C

WINSTON, A.
Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

WINTER, F. J.
Land Disposal of Sludge,
W82-04757 1511 5E

WINTER, S. J.
The Development of a Village Water Supply System on Truk,
W82-02816 1506 5F

WINTER, T. C.
Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 1505 2H

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

WINTERFIELD, L. A.
Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 1512 3D

WINTERINGHAM, F. P. W.
Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 1506 5B

WIPPLER, K. A.
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

WIRTH, J.
Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 1511 5D

WISE, H. E. JR.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 1504 5B

WISNER, P. E.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 1503 5G

WISNIEWSKI, J.
Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 1503 7B

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 1512 2K

WISNIEWSKI, R. L.
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 1511 5B

WISSELO, A. G.
Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 1505 5A

WISSMAR, R. C.
Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 1511 5C

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 1511 5B

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

WIT, K. E.
Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

WITHEROW, J. L.
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

WITHERSPOON, P. A.
Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

WITMER, A.
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 1505 2A

WITTE, C. H.
Overhauling a Water System,
W82-06224 1512 5F

WITTE, W. G.
Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 1511 2K

WITTLE, J. K.
Industrial Wastewater Pretreatment Service,
W82-02253 1505 5E

WITTMANN, J. W.
How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 1511 5D

WITZIG, A. S.
Current Use and Technology of Landsat Mss Data for Lake Trophic Classification,
W82-03755 1509 7B

WIUFF, R.
Distribution of Wastewater in Drain Field Pipes,
W82-02945 1506 8D

WOFFINDEN, D. S.
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 1503 7B

WOFSY, S. C.
Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

WOHLSCHLAG, D. E.
Metabolic Response of Fish to Stress,
W82-05159 1511 5C

WOJNER, W.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

WOLANSKI, E. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 1504 2A

WOLANSKY, R. M.
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

WOLCOTT, A. R.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

WOLCOTT, S. W.
A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 1512 2D

WOLDENBERG, M. J.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

WOLF, H. W.
Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

WOLF, P.
Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Untersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

WOLFE, N. L.
Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 1502 2K

WOLFE, S. N.
Urban Creekside Design Features Parallel Streets,
W82-06184 1512 4C

WOLFF, A. H.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 1502 5F

WOLFF, T. F.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

WOLMAN, A.
Water: Too Much, Too Little, Too Bad,
W82-03291 1507 6D

WONG, A.
Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 1504 5B

WONG, B.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 1503 6A

WONG, B. W. C.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

WONG, D. C. L.
RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 1507 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 1507 5A

WONG, D. R.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 1511 8B

WONG, K. K.
Palm Oil Refinery Wastes Treatment,
W82-03909 1509 5D

WONG, M-H.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

WONG, P. K. Y.
Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Mechanism of Enteroviral Inactivation by Ozone,
W82-01482 1503 5D

WONG, P. T. S.
Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

WONG, R. L. J.
Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

WOO, M.-K.
Evaporation at a High Arctic Site,
W82-04899 1511 2D

Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 1502 2C

Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 1506 2E

WOO, V.
Drought Management: Expecting the Unexpected,
W82-05640 1511 3D

WOOD, C. M.
Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 1506 5C

WOOD, C. R.
Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

WOOD, D. E.
Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 1510 6F

WOOD, E. F.
Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

Regional Flood Frequency Estimation and Network Design,
W82-01294 1503 2E

WOOD, H. B.
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

WOOD, I. R.
Instrumentation for Aerated Flow on Spillways,
W82-02880 1506 7B

Measurements of Self-Aerated Flow on a Spillway,
W82-02715 1506 8B

WOOD, J. D.
Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

WOOD, K. V.
Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

WOOD, P. C.
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 1503 6E

WOOD, S.
Sewage Pumping Station Split for Maintenance,
W82-05719 1511 5D

WOOD, W. W.
A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 1506 2F

WOODCOCK, A. H.
Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 1512 5C

WOODFIELD, R.
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

WOODHAM, W. M.
Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 1512 7B

Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

WOODHOUSE, R. A.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

WOODLEY, W. L.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

Satellite Rain Estimation in the U.S. High Plains,
W82-00908 1502 2B

WOODS, P. F.
Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

WOODWARD, D. F.
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

WOODWORTH, J.
A Citizen's View of Water Management in the Okanagan Valley,
W82-05781 1511 6G

WOOF, C.
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

WOOLDRIDGE, G. L.
Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

WOOLF, H. M.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

WOOLSTON, M. E.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 1512 5B

WOOMER, N.
Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 1512 5C

WOOTON, F. T.
Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 1502 5E

WOOTTON, R. J.
Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 1505 5A

WORDEN, D. J.
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

WORK, S. W.
Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

WORLEY, S. D.
New Antimicrobial Agents for Treatment of Water,
W82-02808 1506 5F

A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

WORONIECKA-STASIAK, A.
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 1502 2H

WORSTELL, R. V.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 1511 8A

WORTHINGTON, P. F.
Preparation of Friable Aquiferous Specimens,
W82-02955 1506 2F

WREN, W. C.
Treatment Plant Features Ultraviolet Disinfection,
W82-02644 1506 5D

WRENCH, J. J.
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 1501 5B

WRIGHT, A. F.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

WRIGHT, G. W.
Stormwater Management - One Developer's Experience,
W82-05777 1511 6B

WRIGHT, H. E. JR.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

WRIGHT, J.
Making Your Way Through Murky Waters-A Manual for Public Participation Coordinators in Natural Resources Planning,
W82-04085 1509 6A

WRIGHT, J. F.
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 1501 7B

WRIGHT, J. L.
New Evapotranspiration Crop Coefficients,
W82-05692 1511 3F

WRIGHT, K. R.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 1504 3C

WRIGHT, L. D.
Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

WRIGHT, L. H.
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 1512 5A

WRIGHT, R. F.
Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 1511 2K

WRIGHT, R. M.
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 1512 5G

WRIGHT, R. R.
Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

WRIGHT, S. G.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 1504 8D

WRIGHT, S. J.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 1511 8B

WROBLEWSKI, J. S.
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

WRONSKI, E. B.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

WU, H. -L.
Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

WU, I. P.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 1504 3F

WU, R. S. S.
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 1507 2L

WU, T. H.
A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

WU, T. L.
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

WU, Y. C.
Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 1511 5D

Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

Rotating Biological Contactor System Design,
W82-06355 1512 5D

WUERDEMAN, D.
Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 1510 5D

WUKASCH, R. F.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 1507 5D

WUNDERLICH, W. O.
Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 1505 6A

WURSTER, C. F.
Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

WYANT, T.
Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study,
W82-03919 1509 7A

WYANT, T.
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5D

WYCKOFF, J. B.
Federal Subsidy of Irrigation Development,
W82-04233 1509 6E

WYCOFF, R. L.
1980 Needs Survey: Combined Sewer Saite Studies,
W82-05862 1511 5D

WYETH, R. K.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

WYKOWSKI, J. C.
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 3C

WYNGAARD, G. A.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

WYNVEEN, R. A.
Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 1508 5A

WYVILL, C.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

XUE-ZHONG, L.
Guidevane Erosion at Mao Tiao He,
W82-05600 1511 8G

YABUSAKI, S. B.
Modeling Circulation in Depth-Averaged Flow,
W82-02679 1506 2E

YADAV, B. R.
Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 1505 3C

YADAV, J. S.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

YAHNKE, J. W.
Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

YAKE, W. E.
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 1502 5D

YAKOVENKO, P. I.
Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 1506 4B

YAKOWITZ, S. J.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 1502 2E

YAKSICH, S. M.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 1511 2J

YALYNSKAYA, N. S.
Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

YAMAGUCHI, T.
Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

YAMAMOTO, A.
Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

YAMAMOTO, M.
The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

YAMAMOTO, T.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 1503 3A

YAMAMOTO, Y.
Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 1507 2H

YAMAMURA, M.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

YAMANE, A. N.
Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760 1509 5D

YAMANISHI, K.
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

YAMASHITA, T.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

YAMAWAKI, S.
A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

YAMAZAKI, T.
Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

YANAGITA, T.
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

YANG, C. T.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

Sediment Transport and Unit Stream Power Function,
W82-06424 1512 2J

YANG, C. Y.
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

YANG, S-Y.
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 1501 5E

YANOSKY, T. M.
Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 1512 2E

YAPA, P. N. D. D.
Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 1512 2F

YAPIJAKIS, C.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 1504 6B

YARD, K. D.
Regulation of Utility Waste Disposal Practices,
W82-03691 1508 5E

YARECHEWSKI, A. L.
Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

YASKAWA, K.
Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

YASUDA, T.
Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 1502 5A

YATES, D. A.
Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 1512 5A

YATES, R.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 1504 2F

YAZDANI, G.
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

YAZICIGIL, H.
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 1506 5B

Optimal Operation of a Reservoir System Using Forecasts,
W82-04209 1509 4A

YDE, M.
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

YEAGER, J. G.
Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 1501 5E

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

YEATS, P. A.
Discharge of Metals from the St. Lawrence River,
W82-06190 1512 5B

YEE, R. B.
Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 1512 5C

YEH, G-T.
On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 1507 2F

YEH, W. W-G.
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 1501 2F

YELIGAR, M. B.
Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 1507 5D

YEN, B. C.
Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 1512 8B

YEO, R. K.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

YEROFEYEVA, Z. I.
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 1511 5D

YESHOV, YU. V.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 1504 2H

YEVJEVICH, V.
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

YEVTUSHENKO, N. YU.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 1504 5C

YIQIU, C.
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 1501 6D

YOBBI, D. K.
Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

YOCKIM, R. S.
Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 1501 5C

YODER, D.
Aquifer Management in Dade County,
W82-05784 1511 5G

YOHE, T. L.
Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 1505 5F

YOKOYAMA, T.
Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

YOKOYAMA, Y.
Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 1512 5A

YOKSAS, T.
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 1504 2B

YOLES, D.
Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

YOMTOVIAN, I.
Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 1511 4A

YONGUE, W. H.
A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

YONGUE, W. H. JR.
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

YONKER, S. A.
Sewer Maintenance and Rehab Options,
W82-06253 1512 5D

YOO, K. H.
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

YOON, Y. S.
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 1501 2F

YORDY, J. R.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 1502 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 1502 2H

YORTON, R. A.
Florida Style Water Supply and Treatment,
W82-06027 1512 5F

YOSHIDA, K.
Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

YOSHIDA, S.
Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

YOSHIKURA, T.
The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 1505 5A

YOSIE, T. F.
Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 1508 5D

YOST, E. C.
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

YOST, K. J.
Heavy Metal Sources and Flows in a Municipal Sewage System; Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

YOTSUKURA, N.
An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02456 1505 5G

YOU, L.
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

YOUNG, B. A.
High-Solubility Gas Flotation,
W82-01184 1503 5D

YOUNG, C. E.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 1502 5D

YOUNG, C. P.
The Distribution and Movement of Solutes Derived from Agricultural Land in The Principal Aquifers of The United Kingdom, with Particular Reference to Nitrate,
W82-03912 1509 5B

YOUNG, D. M.
Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

YOUNG, E.
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

YOUNG, G. J.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 1506 2C

Monitoring Glacier Outburst Floods,
W82-01558 1503 2C

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

YOUNG, G. P.
Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

YOUNG, H. P.
Cost Allocation in Water Resources Development,
W82-06854 1512 6C

YOUNG, J. C.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 1503 5A

Leachates from Solid Waste Recovery Operations,
W82-00167 1501 5D

Specific Oxygen Demand as an Operating Parameter for Activated Sludge Processes,
W82-04029 1509 5D

Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 1501 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 1501 5D

YOUNG, J. L.
Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 1510 5D

YOUNG, L. Y.
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 1501 2L

YOUNG, M. F.
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 1507 8A

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

YOUNG, R. A.
A Comparison of Three Infiltration Models,
W82-05965 1512 2G

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 1511 5B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

YOUNG, R. H. F.
Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

YOUNG, R. W.
Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

YOUNG, T. C.
Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 1511 5B

Aquatic Sediments,
W82-01279 1503 5B

Aquatic Sediments,
W82-06806 1512 2J

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

YOUNGS, E. G.
Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 1503 2G

YOW, M. G.
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 1507 2F

YOXALL, W. H.
The Water Balance in Newfoundland,
W82-03921 1509 7A

YU, D. P.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

YU, K.
Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 1503 5D

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 1511 5G

YU, K. Y.
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

YU, V. L.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower
W82-06891 1512 5B

YU, Y-S.
A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 1511 2E

YUEN, S.
Statistical Search for High Water at Boars Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

YUI, A. K.
Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

YUNIS, A. M.
The Effect of Reuse of Water for Agriculture on The Arab-Asian Society: A New Interdisciplinary Model for Understanding a Development Problem,
W82-04213 1509 3C

YUQIAN, L.
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 1507 2J

YUST, L. J.
Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 1510 5D

YUSUF, M.
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 1503 2I

YWEMA, T. S. J.
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

ZABEL, T. F.
Biological Denitrification for Potable Water Treatment,
W82-05247 1511 5F

Developments in Sedimentation and Flotation,
W82-01391 1503 5F

ZACCOR, J. V.
A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 1511 5G

ZAGATTO, E. A. G.
Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 1508 5A

ZAGHLOUL, N. A.
SWMM Model and Level of Discretization,
W82-03673 1508 6A

ZAGIROV, F. G.
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A

ZAHAVI, A.
Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 1508 2J

ZAHNOW, E. W.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 1502 5A

ZAIDI, T. H.
The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 1508 5E

ZAJAC, P. K.
Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 1511 5B

ZAJICEK, O. T.
The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 1512 5F

ZAK, F. J.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

ZAKAR, F.
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

ZALEWSKI, R.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 1506 5D

ZALKIND, D.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

ZALL, R. R.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 1503 5D

ZALOM, F. G.
Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 1505 6G

ZANELLA, E. F.
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 1501 5A

ZANICCHI, G.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

ZANKER, A.
Estimating Water Flow Under Gates,
W82-05514 1511 8B

ZANONI, A. E.
Calorific Value of Wastewater Plant Sludges,
W82-04997 1511 5E

Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 1511 5A

ZAPF-GILGE, R.
Temperature Effects on Biostabilization of Leachate,
W82-04044 1509 5D

ZARANDIYA, G. YA.
Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 1506 8A

ZARETSKII, YU. K.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

ZARTMAN, R. E.
Effects of Water Quality on Forage Production,
W82-01002 1502 3C

ZARZANA, A. L.
Oil and Grease in Stormwater Runoff,
W82-03557 1511 5C

ZASLAVSKII, YU. L.
Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

ZATEVAKHIN, A. L.
Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 1511 8C

ZATKO, J. R.
Dewatering of Industrial Cl[illegible] Wastes,
W82-00041 1501 5D

Preliminary Studies on the De[illegible]ing of Coal-Clay Waste Slurries Using a Flo[illegible]nt,
W82-06958 1512 5D

ZAUDTKE, T. M.
Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water,
W82-04127 1509 5F

ZAUKE, G. P.
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 1507 5B

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 1512 5B

ZAWISTOWSKI, S.
Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

ZAYCEV, L. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

ZEDLER, J. B.
The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 1511 2H

ZEGELIN, S. J.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

ZEHNDER, A. J. B.
Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 1501 2H

ZEIEN, C. T.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

ZEIKUS, J. G.
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

ZEISIG, T.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

ZEITOUN, I. H.
Power Plant Water Intake Assessment,
W82-00216 1501 6G

ZEKTSER, I. S.
Groundwater Discharge to the Pacific Ocean,
W82-01647 1503 2F

ZELENEVSKII, Z. L.
Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 1511 8C

ZELLER, E. J.
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

ZELVER, N.
Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

ZEMBRZUSKI, T. J. JR.
Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 1505 2E

ZENTENO, M.
The Expansion of Two Bolivian Plants,
W82-05598 1511 8A

ZENZ, D.
Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

ZENZ, D. R.
Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

ZEPP, R. G.
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 1511 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 1511 2K

ZERDA, K. S.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 1501 5A

ZEY, A. F.
Trihalomethane Precursor Control by Adsorption,
W82-02598 1505 5F

ZHDANOVA, G. A.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 1504 5C

ZHIRKOV, E. S.
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 1507 8F

ZHOKHOV, E. I.
Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 1506 8A

ZHOLDAKOVA, Z. I.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 1504 6E

ZHUK, G. P.
Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 1511 8A

ZHUKINSKIY, V. N.
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

ZIA, H. A.
Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 1511 4A

ZIDAN, M. A.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 1505 3F

ZIEGLER, J. A.
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

ZIEMER, R. R.
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 1503 4C

ZIKRI, B. S.
Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

ZIL'BERG, V. S.
Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 1506 4B

ZILLMAN, J. W.
The World Climate Programme,
W82-00317 1501 6A

ZIMBELMAN, D. D.
Computerized Control of an Open-Channel Water Distribution System,
W82-02732 1506 4A

ZIMMER, B. J.
Nitrogen Dynamics in the Surface Waters of the New Jersey Pine Barrens,
W82-03816 1509 2A

ZIMMERMAN, A. P.
Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 1505 2K

ZIMMERMAN, E. A.
Hydrology of Salt Wells Creek–A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

ZIMMERMAN, H. S.
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

ZIMMERMAN, K. E.
Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 1511 8B

ZIMMERMANN, C.
A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

ZIMNY, H.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 1504 5C

ZINI, Q.
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 1506 5A

ZIOBRO, R. J.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

ZIPF, K. A. JR.
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 1503 5F

ZITRIDES, T. G.
Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 1502 5D

ZLOBINA, V. L.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

ZNAMENSKAYA, N. S.
Investigation of Fluvial Processes Under Conditions of Natural Variability of the Runoff,
W82-03906 1509 2J

ZOETEMAN, B. C. J.
Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

ZOETEMEYER, R. J.
Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 1503 5D

ZOGORSKI, J. S.
Hydrologic Evaluation of a Hypothetical Co Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506

ZOLAN, W. J.
Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

Metal Concentrations in Guam Urban Runoff,
W82-05302 1511 5B

Water Quality Assessment for Agana Springs,
W82-05304 1511 5A

ZOLTEK, J. JR.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

Physical and Chemical Methods,
W82-01241 1503 5D

ZOOK, R. L.
Cost Effective Ground Water Monitoring,
W82-01113 1503 4B

ZOSKI, J. E.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 1503 3C

ZUEHLS, E. E.
Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

ZUKOVS, G.
Capacity Expansion Planning Model for Waste Water Treatment and I/I Control,
W82-04239 1509 5D

ZUKOWSKA-WIESZCZEK, D.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 1504 5C

ZULLIC [illegible]
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 1503 2H

ZUR, O.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 1502 2H

ZURAWSKI, A.
Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 1503 2F

ORGANIZATIONAL INDEX

A/C PIPE PRODUCERS ASSOCIATION, ARLINGTON, VA.
A/C Pipe - Assessment or Advocacy,
W82-00070 1501 5F

AALBORG UNIV. (DENMARK). DEPT. OF ENVIRONMENTAL ENGINEERING.
The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 1512 5C

AARHUS UNIV. (DENMARK). INST. OF ECOLOGY AND GENETICS.
Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 1502 5A

AARHUS UNIV. (DENMARK), LAB. OF PHYSICAL GEOGRAPHY.
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 1502 7B

ABCOR, INC., WILMINGTON, MA.
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

ABERDEEN UNIV. (SCOTLAND). DEPT. OF GEOGRAPHY.
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 1507 2C

ABERDEEN UNIV. (SCOTLAND). DEPT. OF SOIL SCIENCE.
Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

ACADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 1507 5G

ACADEMY OF MINING AND METALLURGY, KRACOW (POLAND). INST. OF ENVIRONMENTAL PROTECTION.
Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 1511 5B

ACADEMY OF MUNICIPAL ECONOMY, MOSCOW (USSR).
Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, AVONDALE, PA. STROUD WATER RESEARCH CENTER.
The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 1505 6G

Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, BENEDICT, MD. BENEDICT ESTUARINE RESEARCH LAB.
Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA. BENEDICT ESTUARINE RESEARCH LAB.
The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, PA. DIV. OF LIMNOLOGY AND ECOLOGY.
The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

ACADEMY OF NATURAL SCIFNCES OF PHILAELPHIA, PA.
The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

ACUREX CORP., MOUNTAIN VIEW, CA.
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

ADELAIDE UNIV. (AUSTRALIA). CENTRE FOR ENVIRONMENTAL STUDIES.
The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 1508 5B

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF GEOGRAPHY.
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 1501 2B

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF GEOLOGY.
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 1501 2L

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF ZOOLOGY.
On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 1511 2H

AEROSPACE CORP., GERMANTOWN, MD.
Water Constraints on Emerging Energy Production,
W82-04151 1509 6D

AEROSPACE CORP., LOS ANGELES, CA. SPACE SCIENCE LAB.
Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1502 1A

AES ENGINEERS, INC., WILLOW SPRINGS, IL.
Wastewater Collection,
W82-01251 1503 5D

AGENCE FINANCIERE DE BASSIN SEINE-NORMANDIE (FRANCE).
The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 1512 5G

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC.
Remote Sensing in Development,
W82-01719 1503 7B

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC. BUREAU FOR AFRICA.
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 1503 6G

AGRICULTURAL RESEARCH AND EDUCATION CENTER, BELLE GLADE, FL.
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 1501 2G

Water Requirement for Sugarcane Production,
W82-00899 1502 3F

AGRICULTURAL RESEARCH AND EDUCATION CENTER, BRADENTON.
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 1502 3F

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01545 1503 2I

Upland Marsh for Water Quality Control,
W82-01962 1504 5B

AGRICULTURAL RESEARCH AND EDUCATION CENTER, SANFORD, FL.
Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 1511 2H

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Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

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Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 1505 4A

Aquatic Weed Research in Britain,
W82-03187 1507 4A

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Cereal Yields and Drought Resistance,
W82-03195 1507 2I

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Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 1507 2G

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A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
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Optimal Salinity Control Program for the Upper Colorado River Basin,
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Agricultural Conservation Program: An Evaluation,
W82-02019 1504 3F

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Salt Movement, Leaching Efficiency, and Leaching Requirement,
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Effect of Copper on Nitrification in Activated Sludge,
W82-01497 1503 5C

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Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 1512 5D

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A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 1512 2G

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Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 1503 4A

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF CIVIL ENGINEERING.
Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 1505 2F

Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 1507 4A

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF ELECTRICAL ENGINEERING.
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 1511 6A

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W82-02719 1506 5B

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W82-04713 1510 5D

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W82-02375 1505 2J

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W82-00661 1502 5E

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Temperature Effects on Hydrazine Toxicity to Bluegills,
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An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 [illegible]B

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W82-03312 1507 5B

AKADEMIA ROLNICZA, LUBIN (POLAND), INST. GLEBOZNAWSTWA I CHEMII ROLNEJ.
Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 1506 2H

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W82-00675 1502 2H

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Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 1504 5C

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Effects on Global Supplies of Freshwater,
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Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 1506 2H

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Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 1511 2H

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Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 1504 2H

The Use of Leeches to Identify Pesticides in Water,
W82-02075 1504 5A

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 1508 5B

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 1508 2H

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Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

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Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 1511 5G

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W82-03556 1508 5B

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Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1508 1A

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. GEOGRAFII.
Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 1501 4A

AKADEMIYA NAUK SSSR, MOSCOW. INST. OF LIMNOLOGY.
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 1502 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. OF SOIL CHEMISTRY AND SOIL SCIENCE.
Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

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Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 1507 5G

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 1502 2H

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 1502 6G

The Azov Sea Problem,
W82-00651 1502 6G

The Caspian Sea Problem,
W82-00657 1502 4A

Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

Groundwater Discharge to the Pacific Ocean,
W82-01647 1503 2F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 1504 2D

Space-Time Variability of the Runoff of European Rivers,
W82-02848 1506 2E

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 1506 2E

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 1511 2D

Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 1511 2F

Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 1511 4A

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

AKADEMIYA NAUK SSSR, NOVOSIBIRSK. INST. FIZIKI.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 1504 2H

AKADEMIYA NAUK SSSR, NOVOSIBIRSK. INST. OF HYDRODYNAMICS.
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W82-06615 1512 2H

Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 1512 8B

AKADEMIYA NAUK SSSR, PETROZAVODSK. KARELSKII FILIAL.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

AKADEMIYA NAUK URSR, KIEV. INST. BOTANIKI.
Effect of Sodium Dodecylsulfate or Unicellular Green Algae of the Genus Chlorella,
W82-01920 1504 5C

AKADEMIYA NAUK URSR, KIEV. INST. HIDOBIOLOGII.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 1504 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 1502 5B

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 1502 5A

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 1504 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 1504 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 1504 5C

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 1504 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 1504 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 1504 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 1504 2H

Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

Heterotrophic Assimilation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1511 1A

Some Features of the Toxic Action of the Nonionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 1511 5C

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 1511 2H

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 1511 5A

Indoles in the Decomposition Products of Certain Blue-Green Algae,
W82-05505 1511 2H

Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 1511 5C

Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507 1511 5C

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 1511 5B

Effect of Water Turbulence on Illumination at Depth,
W82-05594 1511 1A

Procedure for Investigating Metallic Ion Complexing in Natural Waters,
W82-05595 1511 5A

AKADEMIYA NAUK URSR, KIEV. INST. HIDROLOGII.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 1504 5C

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Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 1504 5B

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The Modeling of Aquatic Ecological Systems,
W82-01972 1504 5B

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Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 1512 8E

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W82-05508 1511 2H

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W82-01099 1502 5A

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Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

ALABAMA AGRICULTURAL EXPERIMENT STATION, AUBURN.
Water Movement for Water Quality in Catfish Production,
W82-00866 1502 5G

Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

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Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

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Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

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Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 1511 5D

ALABAMA UNIV., UNIVERSITY. SCHOOL OF LAW.
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 1505 5G

ALABAMA WATER WORKS, BIRMINGHAM.
Plant Expansion Via High-Rate Pretreatment,
W82-05953 1512 5F

ALASKA UNIV., FAIRBANKS. GEOPHYSICAL INST.
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 1510 7B

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

ALASKA UNIV., FAIRBANKS. INST. OF MARINE SCIENCE.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870 1511 2A

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 1512 5A

ALASKA UNIV., FAIRBANKS. INST. OF WATER RESOURCES.
Physical Mechanics of Aufeis Growth,
W82-00836 1502 2C

Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 1507 2H

ALBERTA ENVIRONMENTAL CENTER, VEGREVILLE.
Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 1501 5B

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 1511 5A

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W82-05205 1511 5B

ALBERTA RESEARCH COUNCIL, EDMONTON.
A Field Technique to Directly Measure River Bank Erosion,
W82-05410 1511 7B

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Chemical Evolution of Groundwater in a Drainage Basin of Holocene Age, East-Central Alberta, Canada,
W82-03800 1509 2K

ALBERTA UNIV., EDMONTON.
Water Reclamation and Reuse,
W82-01252 1503 3C

Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

Erosion by Plane Turbulent Jets,
W82-05277 1511 8B

ALBERTA UNIV., EDMONTON. DEPT. OF BOTANY.
The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 1512 5C

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Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 1502 2J

Erosion by Submerged Circular Jets,
W82-05002 1511 2J

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Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 1502 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 1502 2A

Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 1512 5B

ALBERTA UNIV., EDMONTON. DEPT. OF MECHANICAL ENGINEERING.
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 1503 2C

ALBERTA UNIV., EDMONTON. DEPT. OF MICROBIOLOGY.
A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

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Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 1501 8A

ALCOA OF AUSTRALIA, PINJARRA.
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W82-05629 1511 4B

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W82-04290 1510 5B

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 1511 5B

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 1511 5B

ALIGARH MUSLIM UNIV. (INDIA). ENVIRONMENTAL RESEARCH LAB.
Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilizers, Soils and River Waters,
W82-01388 1503 5B

ALL-INDIA CO-ORDINATED RICE IMPROVEMENT PROJECT, HYDERABAD (INDIA).
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 1503 2B

ALL UNION DESIGNING, SURVEYING, AND SCIENTIFIC RESEARCH INST. HYDROPROJECT, MOSCOW (USSR).
Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 1512 5B

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Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 1512 8B

ALL-UNION SCIENTIFIC RESEARCH INST. OF HYDROGEOLOGY AND ENGINEERING GEOLOGY.
Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

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Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 1506 2A

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 1512 7C

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Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 1512 5C

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Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

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W82-06834 1512 4D

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A Treatment System for an Organic Chemicals Plant,
W82-04353 1510 5D

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Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

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Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 1511 3A

ALTEX SCIENTIFIC, BERKELEY, CA.
Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 1501 5A

ALVORD, BURDICK AND HOWSON, CHICAGO, IL.
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 1502 6E

Leak Detection--Histories,
W82-04363 1510 3D

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

AMERICAN HOECHST CORP., LEOMINISTER, MA.
American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 1510 5D

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Jersey Drought Hastens Water Supply Project,
W82-03385 1507 6D

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W82-02199 1505 5D

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A Survey of Quality Control Practices in Water Bacteriology Laboratories,
W82-04111 1509 5A

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Investigation of Volatile Organics Removal,
W82-01490 1503 5F

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Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 1508 5F

AMES LAB., IA.
Cation Chromatography With a Conductivity Detector,
W82-00582 1502 5A

AMF CUNO, MERIDAN, CT.
Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887 1509 5F

AMHERST COLL., MA. DEPT. OF PHYSICS.
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1507 1B

AMSTERDAM PUBLIC WORKS (NETHERLANDS).
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 1502 5F

AMSTERDAM UNIV. (NETHERLANDS).
Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

AMSTERDAM UNIV. (NETHERLANDS). DEPT. OF AQUATIC ECOLOGY.
Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 1510 2H

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF AQUATIC ECOLOGY.
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 1505 2H

Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 1508 2H

AMSTERDAM UNIV. (NETHERLANDS). LAB. OF CHEMICAL TECHNOLOGY.
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 1503 5D

Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

AMSTERDAM WATER WORKS (NETHERLANDS).
Hygiene of Drinking Water in Developing Countries,
W82-00269 1501 5F

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

AMSTERDAM WATERWORKS (NETHERLANDS).
Water Softening by Crystallization,
W82-03750 1508 5F

ANDERSON-NICHOLS AND CO., INC., BOSTON, MA
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

ANDERSON-NICHOLS AND CO., INC., CONCORD, NH.
Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

ANDERSON-NICHOLS AND CO., INC., PROVIDENCE, RI.
Industry Helps Conserve Municipal Water,
W82-05674 1511 3E

ANDHRA PRADESH AGRICULTURAL UNIV., HYDERABAD (INDIA). DEPT. OF AGRONOMY.
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

ANDHRA PRADESH AGRICULTURAL UNIV. HYDERAHAD (INDIA).
Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 1507 2I

ANDHRA PRADESH AGRICULTURAL UNIV. (INDIA). DEPT. OF AGRONOMY.
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

ANDHRA UNIV., WALTAIR (INDIA).
Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 1512 2K

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF GEOPHYSICS.
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 1508 6D

ANDHRA UNIV., WALTAIR (INDIA). DEPT. OF METEOROLOGY AND OCEANOGRAPHY.
Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

ANGLIAN WATER AUTHORITY (ENGLAND).
Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 1502 5F

Flexible Outfall at Aldeburgh,
W82-02415 1505 8A

ORGANIZATIONAL INDEX

ANGLIAN WATER AUTHORITY (ENGLAND).

Reliability of Water Resources,
W82-02749 1506 6A

Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 1507 5A

The use of Activated Carbon in Water Treatment,
W82-05182 1511 5F

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 1511 5B

The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 1512 2E

Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 1512 5D

ANGLIAN WATER AUTHORITY (ENGLAND). DEPT. OF OPERATIONAL PLANNING.
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 1512 5G

ANGLIAN WATER AUTHORITY (ENGLAND). SCIENTIFIC SERVICES.
Laboratory Services in Regional Water Authorities,
W82-06256 1512 5G

ANGLIAN WATER AUTHORITY, LEICESTERSHIRE (ENGLAND).
Rutland Water - From Conception to Operation,
W82-06481 1512 6D

ANGLIAN WATER AUTHORITY, LINCOLN (ENGLAND).
Automation of Grimsby Pumping Stations,
W82-04006 1509 5D

ANGLIAN WATER AUTHORITY, NORTHAMPTON (ENGLAND). PITSFORD LAB.
The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

ANGLIAN WATER AUTHORITY, NORWICH (ENGLAND). NORWICH SEWAGE DIV.
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 1502 5D

Recent Water Towers in Norfolk,
W82-03246 1507 8A

ANGLIAN WATER AUTHORITY, PETERBOROUGH (ENGLAND).
Rutland Water Raw Water Quality - Problems and Management,
W82-06475 1512 5G

ANGLIAN WATER AUTHORITY, PETERBOROUGH (ENGLAND), WELLAND AND NENE RIVER DIV.
Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 1512 2H

ANGLIAN WATER AUTHORITY, PETERSBOROUGH (ENGLAND). PETERSBOROUGH SEWAGE DIV.
The Effect of Nitrification in the BOD Test,
W82-02384 1505 5D

ANGLO AMERICAN RESEARCH LAB., JOHANNESBURG (SOUTH AFRICA).
A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 1510 5A

ANNE ARUNDEL COUNTY DEPT. OF PUBLIC WORKS, ANNAPOLIS, MD.
Coordinated Effort Stems Sediment and Erosion,
W82-00766 1502 4D

ANTWERP UNIV., WILRIJK (BELGIUM). DEPT. OF CHEMISTRY.
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

ANTWERP WATER WORKS (BELGIUM). DEPT. OF CIVIL ENGINEERING.
Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

ANTWERPSE WATERWERKEN (BELGIUM).
Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 1502 5A

A Century of Water for Antwerp,
W82-03355 1507 5F

APACHE SITGREAVES NATIONAL FORESTS, SPRINGERVILLE, AZ.
San Francisco River Wild and Scenic River Study Report; Greenlee County, Arizona.
W82-04076 1509 6G

APPLIED ENVIRONMENTAL SERVICES, MARCO ISLAND, FL.
Meromixis in a Coastal Zone Excavation,
W82-02120 1505 2H

ARAGO LAB., BANYULS-SUR-MER (FRANCE).
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

ARGONNE NATIONAL LAB., ARGONNE, IL.
Water Quality Issues and Energy Assessments,
W82-00036 1501 6B

Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 1501 6A

ARGONNE NATIONAL LAB., IL.
Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 1501 5C

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

Synthetic Fuel Effluents,
W82-01263 1503 5B

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 1504 4A

The Status of Nuclear Waste Management,
W82-02659 1506 5E

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

ARGONNE NATIONAL LAB., IL. DIV. OF ENVIRONMENTAL IMPACT STUDIES.
A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 1505 2F

ARGONNE NATIONAL LAB., IL. ENERGY AND ENVIRONMENTAL SYSTEMS DIV.
Synthetic Fuel Effluents,
W82-06800 1512 5D

ARGONNE NATIONAL LAB., IL. RADIOLOGICAL AND ENVIRONMENTAL RESEARCH DIV.
Laboratory and Field Studies of The Relative Mobility of 239, 24OPU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

ARHUS AMTSVANDVAESEN (DENMARK).
Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON.
Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 1507 5G

Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 1511 3C

ARIZONA STATE UNIV., TEMPE.
Computerized Control of an Open-Channel Water Distribution System,
W82-02732 1506 4A

ARIZONA STATE UNIV., TEMPE. DEPT. OF BOTANY AND MICROBIOLOGY.
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 1512 5F

ARIZONA STATE UNIV., TEMPE. DEPT. OF CHEMISTRY.
Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 1512 5D

ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOGRAPHY.
Channel Instability in a Braided, Sand Bed River,
W82-01316 1503 2J

ARIZONA STATE UNIV., TEMPE. DEPT. OF GEOLOGY.
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

ARIZONA STATE UNIV., TEMPE. DEPT. OF LEISURE STUDIES.
Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 1506 6B

ARIZONA STATE UNIV., TEMPE. DEPT. OF ZOOLOGY.
Metabolism of a Desert Stream,
W82-02349 1505 1A

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

ARIZONA STATE UNIV., TEMPE. FORESTRY SCIENCES LAB.
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

ARIZONA UNIV., TUCSON.
Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 1510 2H

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 1511 2F

ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL ECONOMICS.
The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 1510 6B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

ARIZONA UNIV., TUCSON. DEPT. OF ECONOMICS.
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 1502 6C

Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 1503 6A

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 1503 6B

Delayed Drainage in a Stream-Aquifer System,
W82-04268 1510 2F

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 1511 5G

ARIZONA UNIV., TUCSON. DEPT. OF MINING AND GEOLOGICAL ENGINEERING.
The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

ARIZONA UNIV., TUCSON. DEPT. OF POLITICAL SCIENCE.
Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER, AND ENGINEERING.
Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 1501 6A

Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 1501 2I

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5E

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 1503 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 1503 5D

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 1503 5B

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 1506 3C

Water Requirements of Urban Plants,
W82-03972 1509 3D

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 1512 5B

ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS AND INDUSTRIAL ENGINEERING.
Reliability of Underground Flood Control System,
W82-00556 1502 8A

Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8B

Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 1512 6A

ARIZONA UNIV., TUCSON. INST. OF ATMOSPHERIC PHYSICS.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 1504 2B

ARIZONA UNIV., TUCSON. LAB. OF TREE-RING RESEARCH.
A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 1510 2E

ARIZONA UNIV., TUCSON. LAW SCHOOL.
Ground Water Conflicts and Barriers,
W82-00028 1501 6E

ARIZONA UNIV., TUCSON. OFFICE OF ARID LANDS STUDIES.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

ARIZONA UNIV., TUCSON. OPTICAL SCIENCES CENTER.
Liquid Level Interferometer,
W82-05929 1512 7B

ARIZONA WATER RESOURCES RESEARCH CENTER, TUSCON.
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 1508 5B

ARKANSAS STATE UNIV., STATE UNIVERSITY. DEPT. OF AGRICULTURAL ENGINEERING.
Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants,
W82-04026 1509 5D

ARKANSAS UNIV., FAYETTEVILLE.
An Analysis of the Effects of Alternative Measures of Price on the Demand for Water by Self-Supplied Industries,
W82-03828 1509 6C

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY.
A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF AGRONOMY.
A Simulation Model for Sludge Decomposition in Soil,
W82-01001 1502 5E

ARKANSAS UNIV., FAYETTEVILLE. WATER RESOURCES RESEARCH CENTER.
A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 1512 2K

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 1512 5C

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

ARKANSAS WATER RESOURCES RESEARCH CENTER, FAYETTEVILLE.
Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

ARLINGTON COUNTY DEPT. OF PUBLIC WORKS, VA. PUBLIC WORKS PLANNING.
Billing Data Aids Utility Planning,
W82-05786 1511 6C

ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 1502 5D

ARMY CONSTRUCTION ENGINEERING RESEARCH LAB. (ARMY), CHAMPAIGN, IL.
Water Characteristics,
W82-01305 1503 5B

ARMY CORPS OF ENGINEERS, BELVOIR, VA.
Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 1508 5F

ARMY CORPS OF ENGINEERS, NEW YORK.
Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 1512 6G

ARMY ENGINEER DISTRICT, BALTIMORE, MD.
Bloomington Lake - Potomac River Water Resources Project,
W82-06183 1512 8A

ARMY ENGINEER DISTRICT, GALVESTON, TX. ENGINEERING DIV.
The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

ARMY ENGINEER DISTRICT, NEW ORLEANS, LA.
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

ARMY ENGINEER DISTRICT, NEW YORK.
Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 1501 4A

ARMY ENGINEER DISTRICT, ST. LOUIS, MO.
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

ARMY ENGINEER DISTRICT, WALLA WALLA, WA. NORTH PACIFIC DIV.
World's First All-Rollcrete Dam,
W82-05999 1512 8F

ARMY ENGINEER DIV. NORTH PACIFIC, PORTLAND, OR.
Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 1510 6F

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 1501 5C

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 1504 8D

Maps--A Planning Tool for Corps of Engineers Regional Water Supply Studies,
W82-04228 1509 6A

Modeling: How and When to Use,
W82-04754 1511 2L

Economic Analysis of Water Main Breaks,
W82-05673 1511 8A

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL LAB.
Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 1506 5B

ARMY ENGINEERS DISTRICT, SACRAMENTO, CA.
Embankment Construction: New Melones Dam,
W82-05822 1511 8D

ARMY ENGINEERS WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 1512 6C

ARMY ENVIRONMENTAL HYGIENE AGENCY, ABERDEEN PROVING GROUND, MD.
Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

Nitrification Using the Rotating Biological Contactor,
W82-03132 1507 5D

ARMY MEDICAL BIOENGINEERING RESEARCH AND DEVELOPMENT LAB., FORT DETRICK, MD.
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 1502 5G

Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 1511 5D

ARMY NATICK RESEARCH AND DEVELOPMENT LABS., MA.
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

ARMY WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 1502 2H

ARTOIS-PICARDIE AGENCE DE 1'EAU, DOUAI (FRANCE).
The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-046[illegible]2 1510 5A

ASIAN DEVELOPMENT BANK, MANILA (PHILIPPINES). AGRICULTURE AND RURAL DEVELOPMENT DEPT.
Integrated Agricultural Development in the Philippines,
W82-01725 1503 6B

ASIAN INST. OF TECH., BANGKOK (THAILAND).
A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 1505 2E

Palm Oil Waste Treatment Study in Malaysia,
W82-03632 1508 5D

Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 1510 2E

Reservoir Sedimentation with Random Deposits,
W82-04443 1510 2J

Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

Normality of Hydrological Data,
W82-05752 1511 7B

Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 1512 2F

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF AGRICULTURAL AND FOOD ENGINEERING.
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 1501 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF ENVIRONMENTAL ENGINEERING.
Wind Aeration in Model Waste Treatment System,
W82-02944 1506 5D

Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 1512 5D

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF INDUSTRIAL ENGINEERING AND MANAGEMENT.
Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

ASIAN INST. OF TECH., BANGKOK (THAILAND). DIV. OF WATER RESOURCES ENGINEERING.
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 1505 6A

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 1508 4B

ASPINWALL HYDROTECHNICAL SERVICES LTD. (ENGLAND), (UNITED KINGDOM).
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 1511 4B

ASSIUT UNIV. (EGYPT). DEPT. OF BOTANY.
Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 1505 3F

ASSOCIATED INDUSTRIAL CONSULTANTS, BOMBAY (INDIA).
Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 1512 5C

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

ASSOCIATION OF METROPLITAN SEWERAGE AGENCIES, WASHINGTON, DC.
Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 1510 5D

ASSOCIATION OF STATE AND INTERSTATE WATER POLLUTION CONTROL ADMINISTRATORS, WASHINGTON, DC.
Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 1505 6E

Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 1505 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 1505 6E

Compliance Strategy for Clean Water.
W82-02185 1505 6E

ATHENS UNIV. (GREECE). INORGANIC CHEMISTRY LAB.
Zinc in Seawater and Sediments,
W82-03166 1507 5B

ATHENS UNIV. (GREECE) INST. OF SYSTEMATIC BOTANY.
Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 1503 5A

ATHENS UNIV. (GREECE). ZOOLOGICAL LAB. AND MUSEUM.
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 1506 5C

ATLANTIC ENVIRONMENTAL ASSOCIATES, INC., WALTHAM, MA.
Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

ATLANTIC RESEARCH CORP., ALEXANDRIA, VA.
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 1503 2C

The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 1506 5B

ATOMIC ENERGY ESTABLISHMENT, CAIRO (EGYPT). RADIATION PROTECTION DEPT.
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 1502 5B

ATOMIC ENERGY OF CANADA LTD., CHALK RIVER (ONTARIO).
Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

AUBURN UNIV., AL.
Textile Wastes,
W82-01259 1503 5D

Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

Water Chemistry of Alabama Ponds,
W82-03534 1508 2K

Water Quality and Off-Flavor Problems in Commercial Channel Catfish Culture in West-Central Alabama,
W82-04087 1509 5C

Use of Hydroxylpropylcellulose to Decrease Wastage of Disperse Dyes in the Continuous Dyeing of Polyester,
W82-04164 1509 5G

AUBURN UNIV., AL. AGRICULTURAL EXPERIMENT STATION.
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 1501 3F

AUBURN UNIV., AL. DEPT. OF BOTANY, PLANT PATHOLOGY AND MICROBIOLOGY.
Water Conservation in Cotton by Drought Induced Leaf Surface Wax Synthesis,
W82-03946 1509 3F

Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 1512 5D

AUBURN UNIV., AL. DEPT. OF CHEMISTRY.
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 1505 5G

New Antimicrobial Agents for Treatment of Water,
W82-02808 1506 5F

A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 1512 5F

AUBURN UNIV., AL. DEPT. OF CIVIL ENGINEERING.
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
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Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 1511 5E

AUBURN UNIV., AL. DEPT. OF ECONOMICS.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 1503 6F

AUBURN UNIV., AL. DEPT. OF FISHERIES AND ALLIED AQUACULTURES.
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 1502 5C

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 1502 2K

Liming Fish Ponds,
W82-05866 1511 5G

AUBURN UNIV., AL. SCHOOL OF ENGINEERING.
Models of Water Transport in the Soil-Plant System: A Review,
W82-03066 1507 2I

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A Five-Year Plan of Water Resources Research.
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Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 1503 5C

AUCKLAND UNIV., (NEW ZEALAND). DEPT. OF BOTANY.
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 1503 5C

AUCKLAND UNIV., (NEW ZEALAND). DEPT. OF PHYSICS.
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 1511 2B

AUCKLAND UNIV., (NEW ZEALAND). DEPT. OF ZOOLOGY.
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 1503 5C

AUSLAM AND ASSOCIATES, INC., SACRAMENTO, CA.
Modeling the Economics of Ground Water Management,
W82-03733 1508 4B

AUSTRALIAN ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS.
Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 1502 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 1502 5A

Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 1503 2B

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

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Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
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AUSTRALIAN NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF EARTH SCIENCES.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

AUSTRALIAN NUMERICAL METEOROLOGY RESEARCH CENTER, MELBOURNE.
On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

AUSTRALIAN WATER RESOURCES COUNCIL, CANBERRA.
Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 1512 5G

AVANTI INTERNATIONAL, HOUSTON, TX.
Stopping Water with Chemical Grout,
W82-03396 1507 8G

AWARE CORP., NASHVILLE, TN.
Single Sludge Nitrogen Removal from Industrial Wastewater,
W82-05245 1511 5D

AWARE, INC., NASHVILLE, TN.
Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

AYRES, LEWIS, NORRIS AND MAY, INC., ANN ARBOR, MI.
Tying Up TCE,
W82-01866 1504 5G

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 1511 5D

BABTIE, SHAW AND MORTON, GLASGOW (SCOTLAND).
Airy Holm Dam - Kielder Water Scheme,
W82-03070 1507 8A

BADGER PAPER MILLS, INC., PESHTIGO, WI.
Domes, Bubbles, and Paper Waste,
W82-06025 1512 5D

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A Hydrobiological Survey of a Polluted Canal,
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Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

BALL STATE UNIV., MUNCIE, IN. DEPT. OF GEOGRAPHY.
A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 1505 2A

BALL STATE UNIV., MUNCIE, IN. DEPT. OF NATURAL RESOURCES.
Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 1511 5B

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Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 1503 2G

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Use of Microscreens to Polish Lagoon Effluents,
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Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
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BASF A. G., LUDWIGSHAFEN AM RHEIM (GERMANY, F.R.).
The BASF Toximeter - A Helpful Instrument to Control and Monitor Biological Waste Water Treatment Plants,
W82-04050 1509 5A

BATH UNIV. (ENGLAND). SCHOOL OF BIOLOGICAL SCIENCES.
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

BATTELLE COLUMBUS DIV., OH.
Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1508 1B

BATTELLE-COLUMBUS LAB., COLUMBUS, OH.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 1503 5D

BATTELLE COLUMBUS LAB., OH.
Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 1512 5D

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Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
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W82-05725 1511 5A

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Solution Species of Plutonium in the Environment,
W82-00163 1501 5A

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 1501 5D

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

Sediment-Contaminant Transport Model,
W82-01614 1503 5B

BATTELLE PACIFIC NORTHWEST LAB., RICHLAND, WA. ATMOSPHERIC SCIENCES DEPT.
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
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Predictions for Particle Deposition on Natural Waters,
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W82-00375 1501 5E

In-Home Conservation and Wastewater Management,
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Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772 1509 2H

Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

Sulfate Washout Ratios in Winter Storms,
W82-04898 1511 5B

Shale Oil Wastewater Treatment by Evaporation,
W82-04905 1511 5D

BAUER BROS. CO., SPRINGFIELD, OH. (ASSIGNEE).
High Capacity Waste Water Treatment System,
W82-00066 1501 5D

BAYER A.G., LEVERKUSEN (GERMANY , F.R.).
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

BAYERISCHES LANDESAMT FUER WASSERWIRTSCHAFT, MUINICH (GERMANY, F.R.),
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Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
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BAYLOR COLL. OF MEDICINE, HOUSTON, TX.
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W82-05446 1511 5D

BAYLOR COLL. OF MEDICINE, HOUSTON, TX. DEPT. OF VIROLOGY AND EPIDEMIOLOGY.
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 1501 5A

Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 1501 2L

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 1501 5D

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 1502 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 1502 5B

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 1511 5C

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 1511 5B

BAYLOR COLLEGE OF MEDICINE, HOUSTON, TX. DEPT. OF VIROLOGY AND EPIDEMIOLOGY.
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BAYREUTH UNIV. (GERMANY, F.R.).
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
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BAYREUTH UNIV. (GERMANY, F.R.). LEHRSTUHL FUER HYDROLOGIE.
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W82-00493 1501 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

BEARD (ARTHUR) INC., CHEVY CHASE, MD.
Upgrading Water Treatment Plants: An Alternative to New Construction,
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BECHTEL CORP., SAN FRANCISCO, CA.
Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

BECHTEL INC., NORWALK, CA.
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 1502 8B

BECHTEL, INC., SAN FRANCISCO, CA.
Statistical Determination of Design Low Flows,
W82-01858 1504 2E

BECHTEL NATIONAL, INC., SAN FRANCISCO, CA.
Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

BECKMAN INSTRUMENTS, INC., CARLSBAD, CA.
Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 1511 5A

A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 1512 5A

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Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
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Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 1512 2K

Discharge of Metals from the St. Lawrence River,
W82-06190 1512 5B

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA). MARINE ECOLOGY LAB.
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 1501 7B

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W82-00239 1501 5B

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W82-02528 1505 2A

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W82-06986 1512 5C

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W82-05751 1511 3B

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Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 1512 3A

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Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
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W82-05015 1511 7B

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W82-06117 1512 5A

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W82-02273 1505 6A

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W82-06333 1512 3C

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W82-02275 1505 5D

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W82-06282 1512 5D

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W82-02210 1505 2A

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W82-04475 1510 6B

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W82-06003 1512 5C

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Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 1511 5B

BERN UNIV. (SWITZERLAND). PHYSIKALISCHES INST.
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

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Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 1511 2H

BHABHA ATOMIC RESEARCH CENTRE, BOMBAY (INDIA). AIR MONITORING SECTION.
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W82-00676 1502 2B

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W82-02045 1504 2I

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W82-00785 1502 2G

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The Biesbosch Water Storage Scheme,
W82-06014 1512 8A

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Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 1505 5C

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W82-02793 1506 5D

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W82-01393 1503 7A

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W82-03219 1507 2H

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W82-04684 1510 5B

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W82-04347 1510 5E

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W82-01741 1503 4B

Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

Boundary Shear in Smooth and Rough Channels,
W82-02711 1506 8B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel,
W82-02792 1506 2L

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 1507 2L

Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 1508 2F

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

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W82-03360 1507 2L

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W82-02437 1505 2F

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W82-04604 1510 6D

BLACK AND VEATCH, DALLAS, TX.
Use of Aquatic Macrophytes for Wastewater Treatment,
W82-04046 1509 5D

Conservation Ethics for the 1980's,
W82-05009 1511 3D

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W82-05165 1511 5E

Fecal Coliform Densities in a Western Watershed,
W82-05618 1511 5B

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Curbing the Distribution Energy Appetite,
W82-04136 1509 5F

Detroit-Style CSO Studies,
W82-06247 1512 5G

BOCHUM UNIV. (GERMANY, F.R.). DEPT. OF MECHANICAL ENGINEERING.
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W82-06202 1512 8C

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W82-05522 1511 6A

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W82-06823 1512 2B

BOGERT (CLINTON) ASSOCIATES, FORT LEE, NJ.
Updating Antiquated City Water Systems,
W82-03293 1507 5F

Bridging the Water Supply Gap,
W82-06508 1512 8A

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Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 1510 5F

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Aerated Drip Irrigation,
W82-02186 1505 3F

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W82-03303 1507 5C

BOSTON COLL., CHESTNUT, MA.
Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 1512 6E

BOTANICAL RESEARCH INST., PRETORIA (SOUTH AFRICA).
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W82-00693 1502 2I

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Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

BOYLE ENGINEERING CORP., CORONA DEL MAR, CA.
Interagency Connections: Insurance Against Interruptions in Supply,
W82-04090 1509 5F

BRACKEN AND BARAM, BOSTON, MA.
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

BRADLEY UNIV., PEORIA, IL. DEPT. OF BIOLOGY.
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
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BRANDON UNIV. (MANITOBA). DEPT. OF CHEMISTRY.
Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 1502 5A

BRAZILIAN NATIONAL COMMITTEE ON LARGE DAMS; AND TECHNICAL COMMISSION ON DAMS AND THE ENVIRONMENT.
Reservoir Planning for Brazilian Dams,
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BREMEN UNIV. (GERMANY, F.R.).
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 1512 5B

BREMEN UNIV. (GERMANY, F.R.). DEPT. OF CHEMISTRY.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

BRICE, PETRIDES, AND ASSOCIATES, INC., WATERLOO, IA.
Leachates from Solid Waste Recovery Operations,
W82-00167 1501 5D

BRIDGEPORT HYDRAULIC CO., CT.
Reservoir Improvements as a Key to Source Quality Control,
W82-04145 1509 5G

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Biological Filters,
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The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
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The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

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Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
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Refinement of Lake Evaporation Measurements, Using an Ion-Balance Technique,
W82-03808 1509 2D

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On Hydrological Data Needs in Canada,
W82-03443 1508 7A

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

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Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF CIVIL ENGINEERIG.
Evolution of Water Management Techniques,
W82-05565 1511 6A

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF CIVIL ENGINEERING.
Flood Probability Estimation,
W82-04318 1510 6B

Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 1510 5D

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On Hydrological Data Needs in Canada,
W82-05764 1511 7B

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Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
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Phytoplankton Accumulation in Langmuir Cells,
W82-01946 1504 2H

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W82-03087 1507 5C

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Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
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Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
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Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
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Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 1511 2K

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Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 1501 5D

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Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 1507 5B

BROWN AND CALDWELL, EUGENE, OR.
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

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Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

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Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
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Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 1511 8G

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Composite Sampling of Highway Runoff,
W82-02230 1505 7B

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Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
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Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

BROWN UNIV., PROVIDENCE, RI. DIV. OF APPLIED MATHEMATICS.
Numerical Simulation of Reservoirs,
W82-03504 1508 6A

BROWNE (F. X.) ASSOCIATES, INC., LANSDALE, PA.
Non-Point Sources,
W82-01270 1503 5B

BROWNE (RICHARD) ASSOCIATES, WAYNE, NJ.
How Do You Build When Sewers Are Inadequate,
W82-03592 1508 5D

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Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 1510 2H

BUILDING RESEARCH ESTABLISHMENT, WATFORD (ENGLAND).
Reducing the Flush,
W82-04654 1510 3D

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W82-04476 1510 5C

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W82-03410 1508 2I

BUNDESANSTALT FUER GEWASSERKUNDE, COBLENZ (GERMANY, F.R.).
Automatic Collection and Transmission of Data for the Federal Waterway Authority.
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Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 1508 5E

Recent Developments in and Application of Automation and Monitoring in Water Management,
W82-04593 1510 7B

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 1510 5F

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

BURBANK, CA.
Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 1503 3C

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Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

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International Decade on Drinking Water and Sanitation,
W82-04230 1509 6E

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Mineral Law Since Nepa,
W82-06582 1512 6E

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An Automated Recording System for Evaporation Pans,
W82-06780 1512 2D

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Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

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The World Climate Programme,
W82-00317 1501 6A

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Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 1501 4C

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Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

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Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

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Selective Overburden Placement,
W82-00053 1501 5G

Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 1512 5D

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Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 1501 6A

Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 1507 5D

BUREAU OF MINES, UNIVERSITY, AL. TUSCALOOSA RESEARCH CENTER.
Dewatering of Industrial Clay Wastes,
W82-00041 1501 5D

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 1501 5D

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Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 1502 3C

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Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 1510 2B

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On the Sampling Variance of Raingage Networks,
W82-05875 1511 7B

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 1512 6G

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Performance of Granular Soil Covers on Canals,
W82-00047 1501 8D

Hydraulic Sediment Model Study for Proposed Bianco Diversion Dam Modification,
W82-00446 1501 8A

Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 1503 8A

Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

Intakes and Outlets for Low-Head Hydropower,
W82-01979 1504 8C

Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 1507 4A

Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 1507 8A

Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 1511 8B

Portable Water Elevation Measuring Gage,
W82-06396 1512 7B

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

Sediment Transport and Unit Stream Power Function,
W82-06424 1512 2J

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

BUREAU OF RECLAMATION, DENVER, CO. LOWER MISSOURI REGION.
Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

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W82-04068 1509 4A

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

BUREAU OF RECLAMATION, SACRAMENTO, CA. MID-PACIFIC REGION.
Terminological Confusion--Lake VS. Reservoir,
W82-06551 1512 2H

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W82-02974 1506 6B

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W82-02586 1505 5F

BURGESS AND NIPLE LTD., COLUMBUS, OH.
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W82-04137 1509 6B

BURK AND ASSOCIATES, INC., NEW ORLEANS, LA.
Role of Surface Active Media in Anaerobic Filters,
W82-05816 1511 5D

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Discussion of 'Visualization of Separation over Sand Waves',
W82-03783 1509 8B

BURLINGTON WATER DEPT., VT.
Low Turbidity Water from Fast Processes,
W82-00946 1502 5F

BURNS AND MCDONNELL, KANSAS CITY, MO.
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W82-04093 1509 8C

Sewer Maintenance and Rehab Options,
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Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
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W82-06268 1512 5D

C. M. ENGINEERING ASSOCIATES, VISTA, CA.
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W82-05272 1511 5D

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W82-01090 1502 5A

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Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 1506 2J

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W82-06770 1512 5C

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Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 1501 6A

The Cost of Peak Capacity Water,
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Energy, Environmental, and Economic Implications of Some Recent Alberta Water Resources Projects,
W82-04226 1509 6B

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A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
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Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
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Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 1505 5A

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W82-04396 1510 5A

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A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
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Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

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The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5B

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Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

The Impact of Federal Water Policy on State Planning: A Cautionary Example,
W82-04120 1509 6E

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Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 1511 8D

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Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals,
W82-03771 1509 2K

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

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W82-02923 1506 2K

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Trace Metal Catalysis in Aquatic Environments,
W82-00629 1502 5B

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Guidelines for Control of Septic Tank Systems,
W82-02599 1505 5B

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Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 1502 6F

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, SACRAMENTO.

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 1512 6B

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Status Report on Striped Bass Analyses,
W82-04386 1510 8I

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W82-01882 1504 5C

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W82-02141 1505 4C

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W82-01851 1504 6E

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W82-03111 1507 6D

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Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 1507 5A

CALIFORNIA STATE UNIV., FRESNO. DEPT. OF GEOLOGY.

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 1502 2F

CALIFORNIA STATE UNIV., FULLERTON. DEPT. OF CIVIL ENGINEERING.

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 1512 2F

CALIFORNIA STATE UNIV., LONG BEACH.

Marine and Estuarine Pollution,
W82-01274 1503 5C

Marine and Estuarine Pollution,
W82-06808 1512 5C

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, SACRAMENTO.

Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

CALIFORNIA UNIV., BERKELEY.

Reclaiming and Reusing Wastewater,
W82-00402 1501 5D

Solvent Extraction of Phenols,
W82-00438 1501 5D

A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 1503 6A

Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 1508 8A

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 1508 5D

Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 1511 6D

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 1511 5D

CALIFORNIA UNIV., BERKELEY. DEPT. OF CHEMICAL ENGINEERING.

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 1501 5D

CALIFORNIA UNIV., BERKELEY. DEPT. OF CIVIL ENGINEERING.

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 1504 8D

Response of Buried Structures to Traveling Waves,
W82-03346 1507 8D

CALIFORNIA UNIV., BERKELEY. DEPT. OF ENGINEERING.

Viscosity-Controlled Sediment Transport in the Absence of Suspended Load,
W82-04210 1509 2J

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND CONSERVATION.

Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 1503 5C

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND RESOURCES MANAGEMENT.

Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 1508 5A

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Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 1505 2I

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 1507 5B

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 1508 5B

CALIFORNIA UNIV., BERKELEY. DEPT. OF SOILS AND PLANT NUTRITION.
Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 1501 5D

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 1502 3E

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 1510 3F

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 1512 2F

CALIFORNIA UNIV., BERKELEY. NAVAL BIOSCIENCES LAB.
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

CALIFORNIA UNIV., BERKELEY, SANITARY ENGINEERING RESEARCH LAB.
Fixed Endpoint Alkalinity Determination,
W82-01187 1503 7B

CALIFORNIA UNIV., BERKELEY. SCHOOL OF PUBLIC HEALTH.
Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 1505 3C

CALIFORNIA UNIV., BERKELEY. SEA WATER CONVERSION LAB.
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 1512 3A

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

CALIFORNIA UNIV. DAVIS.
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 1503 6A

Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 1510 3F

CALIFORNIA UNIV., DAVIS. DEPT. OF AGRICULTURAL ECONOMICS.
An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

CALIFORNIA UNIV., DAVIS. DEPT. OF AGRONOMY AND RANGE SCIENCES.
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 1506 3F

CALIFORNIA UNIV., DAVIS. DEPT. OF BIOLOGY.
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

CALIFORNIA UNIV., DAVIS. DEPT. OF BOTANY.
Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 1507 2I

CALIFORNIA UNIV., DAVIS. DEPT. OF CIVIL ENGINEERING.
Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 1503 5D

Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 1507 6A

Managing Wells for Energy Efficiency,
W82-03734 1508 4B

Reservoir Systems Optimization,
W82-06433 1512 4A

CALIFORNIA UNIV., DAVIS. DEPT. OF GEOGRAAPHY.
Ground-Water Management in Basalts,
W82-04931 1511 4B

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR, AND WATER RESOURCES.
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 1501 5E

Irrigation Tailwater Management,
W82-00392 1501 3C

Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 1501 2J

Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

River Basin Hydrosalinity Modeling,
W82-01469 1503 2K

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 1504 3F

The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 1505 2L

Remote Sensing Applications for Resource Management,
W82-03279 1507 7B

A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 1510 3F

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 1501 2H

An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 1502 7B

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

CALIFORNIA UNIV., DAVIS. SCHOOL OF CIVIL ENGINEERING.
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 1502 5B

CALIFORNIA UNIV., DAVIS. WATER RESOURCES CENTER.
Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

CALIFORNIA UNIV., IRVINE. DEPT. OF CIVIL ENGINEERING.
Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 1507 6A

CALIFORNIA UNIV., IRVINE. SCHOOL OF ENGINEERING.
Subdomain Integration Model of Ground-Water Flow,
W82-02550 1505 2F

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Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

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Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 1507 6A

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04703 1510 5D

Incentives and Institutions for Water Conservation,
W82-05922 1512 3D

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF BIOLOGY.
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 1510 2D

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF CHEMICAL, NUCLEAR, AND THERMAL ENGINEERING.
The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

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Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 1511 5B

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A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

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Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

CALIFORNIA UNIV., LOS ANGELES. DEPT. OF GEOGRAPHY.
A Parametric Crop Water Use Model,
W82-01310 1503 2I

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 1503 2J

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The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 1510 6E

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Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 1501 5B

CALIFORNIA UNIV., LOS ANGELES. LAB. OF NUCLEAR MEDICINE AND RADIATION BIOLOGY.
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 1502 2I

CALIFORNIA UNIV., LOS ANGELES. OFFICE OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 1506 5C

CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF ENGINEERING AND APPLIED SCIENCE.
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 1501 2F

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 1501 5D

CALIFORNIA UNIV., LOS ANGELES. SCHOOL OF PUBLIC HEALTH.
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 1502 5A

CALIFORNIA UNIV., RICHMOND. SANITARY ENGINEERING RESEARCH LAB.
O & M Costs and Optimal Capacity Expansion,
W82-04042 1509 6B

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF BOTANY AND PLANT SCIENCES.
Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCE.
Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 1503 3C

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 6B

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Are Sierra Lakes Becoming Acid,
W82-00231 1501 5C

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 1502 5B

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 1504 2F

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 1512 2G

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 1512 2G

CALIFORNIA UNIV., SANTA BARBARA.
The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

CALIFORNIA UNIV., SANTA BARBARA. COMPUTER SYSTEMS LAB.
Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 1507 7B

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Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 1511 2H

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF ECONOMICS.
An Economist's View of Demand Projections Considering Conservation,
W82-04448 1510 6D

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF GEOGRAPHY.
Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 1503 7B

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF MECHANICAL AND ENVIRONMENTAL ENGINEERING.
The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

CALIFORNIA UNIV., SANTA BARBARA. MARINE SCIENCE INST.
The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1508 1B

CALOCERINOS AND SPINA CO., LIVERPOOL, NY.
Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

CALSCIENCE RESEARCH, INC., HUNTINGTON BEACH, CA.
Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

CAMBRIDGE UNIV. (ENGLAND).
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

Icebergs: Technology for the Future,
W82-04778 1511 2C

CAMBRIDGE UNIV. (ENGLAND). DEPT. OF APPLIED BIOLOGY.
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

CAMBRIDGE UNIV. (ENGLAND). DEPT. OF APPLIED MATHEMATICS AND THEORETICAL PHYSICS.
Ice Blocks Melting Into a Salinity Gradient,
W82-01530 1503 2C

Contaminant Dispersion in Oscillatory Flows,
W82-05631 1511 5B

Where to Put a Steady Discharge in a River,
W82-05632 1511 5G

CAMBRIDGE UNIV. (ENGLAND). DEPT. OF ENGINEERING.
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 1511 2E

CAMDEN COUNTY MUNICIPAL UTILITIES AUTHORITY, NJ.
Composting Is Working in Camden,
W82-00948 1502 5E

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

CAMP, DRESSER AND MCKEE, BOSTON, MA.
Tailoring Design of Treatment Plants to Local Conditions,
W82-03893 1509 5F

CAMP, DRESSER, AND MCKEE, INC., ALBUQUERQUE, NM.
Saving Water Scenically,
W82-05709 1511 5D

CAMP DRESSER AND MCKEE, INC., ANNANDALE, VA.
Discussion of 'Finite Element Method for Direct Runoff Flow',
W82-03782 1509 2A

CAMP, DRESSER AND MCKEE, INC., BOSTON, MA.
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 1501 5E

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 1501 5E

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 1512 5E

CAMP, DRESSER AND MCKEE, INC., CLEARWATER, FL.
Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

The Computer: Water Management Tool,
W82-03290 1507 6A

CAMP, DRESSER AND MCKEE, INC., MILWAUKEE, WI. ENVIRONMENTAL SCIENCES DIV.
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 1503 7B

CAMP, DRESSER AND MCKEE, INC., NEW YORK.
Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 1511 5D

CAMP DRESSER AND MCKEE, INC., WALNUT CREEK, CA. WATER RESOURCES DIV.
Management of Interstate Aquifer Systems,
W82-02578 1505 4B

CAMP, DRESSER AND MCKEE, INC., WALTHAM, MA.
Microcomputer Water Quality Simulation Model,
W82-05191 1511 7B

CANADA CENTER FOR INLAND WATERS, BURLINGTON (ONTARIO).
Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00993 1502 5C

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 1507 2E

Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) I. Pathway of the Direct Photolysis in Solution,
W82-04032 1509 5B

Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 1511 2K

Velocity Distributions Under Floating Covers,
W82-05562 1511 2E

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

Suspended Sediment in a Wave Field,
W82-06527 1512 2J

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Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 1507 5A

A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 1512 5C

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 1512 5B

National Interlaboratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 1512 5A

Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 1512 5A

The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 1512 5C

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).
Measurement of Particulates Entrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 1502 6G

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 1502 6G

Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 1503 5C

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 1503 2H

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 1503 7A

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 1503 5A

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 1503 5B

Ice Cover Effects on Stream Flows and Mixing,
W82-02698 1506 2C

Evaluation of Four Concentration/Extraction Procedures on Waters and Effluents Collected for Use with the Salmonella Typhimurium Screening Procedure for Mutagens,
W82-03775 1509 5A

Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 1510 2H

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

Dispersion in Tumbling Flow,
W82-05796 1511 8B

The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 1512 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 1512 7C

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

Steel Industry Wastes,
W82-06799 1512 5D

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, GREAT LAKES ENVIRONMENTAL LAB.
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 1504 5A

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). AQUATIC PHYSICS AND SYSTEMS DIV.
Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 1503 2H

CANADIAN APPLIED TECHNOLOGY, BUTTONVILLE, ONTARIO.
Role of the Microcomputer in Water Management,
W82-05771 1511 7B

CANADIAN DEPARTMENT OF SUPPLY AND SERVICES, OTTAWA, ONTARIO. BUREAU OF MANAGEMENT CONSULTING.
Statistical Cost Function for Water Mains,
W82-06252 1512 6C

CANMET, OTTAWA (ONTARIO). MINERAL SCIENCES LAB.
Separation of Selenium from Sulfide Leach Liquors,
W82-00905 1502 5D

CANTEBURY UNIV., CHRISTCHURCH (NEW ZEALAND).
Asymptotic Solution for Dam-Break Problem,
W82-04313 1510 8B

CANTERBURG UNIV., CHRISTCHURCH (NEW ZEALAND). DEPT. OF ECONOMICS.
Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 1511 6C

CANTERBURY UNIV., CHRISTCHURCH (NEW ZEALAND).
Integral Equation Formulation for Ground-Water Flow,
W82-02716 1506 2F

CANTERBURY UNIV. CHRISTCHURCH (NEW ZEALAND). DEPT. OF AGRICULTURAL ENGINEERING.
Local Flow Accelerations in Rivers,
W82-02758 1506 2E

CANTERBURY UNIV., CHRISTCHURCH (NEW ZEALAND). DEPT. OF GEOLOGY.
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

CANVIRO CONSULTANTS LIMITED, KITCHENER (ONTARIO).
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

CAPE TOWN UNIV., RONDEBOSCH (SOUTH AFRICA). DEPT. OF ZOOLOGY.
Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 1510 5C

CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF CIVIL ENGINEERING.
The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 1507 5D

A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

CAPITAL CONSULTANTS, INC., LANSING, MI. INDUSTRIAL AND ENVIRONMENTAL DIV.
Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

CAPRICORNIA INST. OF ADVANCED EDUCATION, ROCKHAMPTON (AUSTRALIA). DEPT. OF BIOLOGY.
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

CARNEGIE INSTITUTION OF WASHINGTON, DC. GEOPHYSICAL LAB.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 1504 6G

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
City Sewage and the American Farmer,
W82-03600 1508 3C

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. COLL. OF HUMANITIES AND SOCIAL SCIENCES.
Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 1508 5D

CARNEGIE - MELLON UNIV., PITTSBURGH, PA. DEPT. OF CIVIL ENGINEERING.
Treatment of Coal Gasification Process Wastewaters,
W82-00434 1501 5D

Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 1502 5D

Leach Characteristics of Coal-Gasification Char,
W82-01025 1502 5B

Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 1503 5F

CARNEGIE-MELLON UNIV., PITTSBURGH, PA. DEPT. OF MATHEMATICS.
Finite Element Approximations to Flow Problems,
W82-06730 1512 8B

CASE WESTERN RESERVE UNIV., CLEVELAND, OH.
Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
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Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

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Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
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W82-05576 1511 5E

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Wake Collapse in The Thermocline and Internal Solitary Waves,
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Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
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Electroplating Wastewater Sludge Characterization,
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Group Treatment Evaluation for Metal Finishers,
W82-02995 1506 5D

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Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 1508 5G

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Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
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Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
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W82-03413 1508 3B

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Ski-Jump Spillway for India's Ukai Dam,
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Sulphur in the Environment: A Review,
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W82-01363 1503 3C

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 1504 2H

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On the Trophic Status and Conservation of Kashmir Lakes,
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Variability of the DNEPR Runoff Under the Effect of Economic Activities,
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Relationship Between Populations of Amphipods and Pollution,
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Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
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Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
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Will the Sahelian Drought End in 1985,
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Improvement of Swirl Concentrator,
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Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
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An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
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A Rain Attenuation Model for the Sirio-Shf Experiment,
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Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

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Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

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Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
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CESKOSLOVENSKA AKADEMIE VED, PRAGUE. HYDROBIOLOGICKA LAB.
Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 1507 2H

CH2M/HILL, ATLANTA, GA.
The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

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Small and Low-Head Hydro in the USA,
W82-04176 1509 8A

Sediment Transport Study Along a Delta Shoreline,
W82-06553 1512 2J

CH2M/HILL, DENVER, CO.
Will Synfuel Development Drain the West Dry,
W82-03292 1507 6D

CH2M HILL, GAINESVILLE, FL.
Florida Style Water Supply and Treatment,
W82-06027 1512 5F

CH2M/HILL INC., CORVALLIS, OR.
Effective Project Management,
W82-06328 1512 5D

CH2M/HILL INC., GAINESVILLE, FL.
Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

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Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 1512 6C

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Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 1512 3C

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Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
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On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
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W82-02898 1506 5B

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Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 1504 3F

CHARLOTTE HARBOR WATER ASSOCIATION, INC., HARBOUR HEIGHTS, FL.
Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 1506 5F

CHARLOTTE-MECKLENBURG UTILITY DEPT., NC.
Operating Collection Systems Under Fiscal Stress,
W82-06340 1512 5D

CHELSEA INTERNATIONAL CORP., WASHINGTON, DC.
Superfund: What a Mess,
W82-02184 1505 6E

CHEM-CLEAR, INC., WAYNE, PA.
Industrial Wastewater Pretreatment Service,
W82-02253 1505 5E

CHEMED CORP., CINCINNATI, OH. (ASSIGNEE).
Detoxification of Residual Quaternaries,
W82-00562 1502 5G

CHEMICAL RECOVERY SYSTEMS, HANOVER, MA.
Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 1506 5D

CHEMIN DES VIGNES, PULLY LAUSANNE (SWITZERLAND).
Resonance in Hydropower Stations,
W82-04953 1511 8C

CHENGDU AGRICULTURAL MACHINERY COLL. (CHINA).
Cavitation and Wear on Hydraulic Machines,
W82-00331 1501 8C

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Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
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Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

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An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

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Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 1501 2H

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 1512 5C

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Application of Fluidic Devices for Control of Wastewater Treatment Operations,
W82-04013 1509 5D

CLARK UNIV., WORCESTER, MA. DEPT. OF GEOGRAPHY.
Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 1508 2J

CLARKSON COLL. OF TECHNOLOGY, POTSDAM, NY.
Aquatic Sediments,
W82-01279 1503 5B

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W82-03925 1509 2C

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 1511 5B

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 1511 2C

Aquatic Sediments,
W82-06806 1512 2J

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
W82-06829 1512 5B

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Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 1512 6B

CLEMSON UNIV., SC.
Economics,
W82-01304 1503 5G

Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 1511 5A

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User Reaction to Wild and Scenic River Designation,
W82-02278 1505 6G

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Economics,
W82-06998 1512 5G

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Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

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Solids Inventory Control in the Activated Sludge Process,
W82-04048 1509 5D

A Low-Cost Secondary Treatment Alternative,
W82-05169 1511 5D

A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 1512 5E

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 1512 5D

Low-Cost Treatment of Wastewater,
W82-06506 1512 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 1512 5D

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Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 1501 2L

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 1501 5A

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 1502 5A

CLEMSON UNIV., SC. DEPT. OF ZOOLOGY.
Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 1511 5C

CLINTON-BOGERT ASSOCIATES, FORT LEE, NJ.
Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 1512 5E

CLYDE, PRATT, GIBBS, AND CAHOON, SALT LAKE CITY, UT.
Allocation of Water for Resource Development,
W82-06839 1512 6D

CLYDE RIVER PURIFICATION BOARD (SCOTLAND).
Determination of Marine Consent Conditions,
W82-00323 1501 5G

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 1502 6E

COAST GUARD, HAMILTON AFB, CA. PACIFIC STRIKE TEAM.
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

COASTAL ENGINEERING RESEARCH CENTER, FORT BELVOIR, VA.
Linearized Solution to Inlet Equation with Inertia,
W82-01183 1503 2L

Tides and Tidal Datums in the United States,
W82-02982 1506 2A

Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 1511 2J

COASTAL ENVIRONMENTS, INC., BATON ROUGE, LA.
Sediment--Asset or Liability,
W82-02150 1505 6B

COASTAL WATER RESEARCH PROJECT, LONG BEACH, CA.
Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 1512 5C

COBA-CONSULPRESA, LISBON (PORTUGAL).
Safety Aspects in the Design and Inspection of Dams,
W82-06203 1512 8A

COBA INTERNATIONAL CONSULTANTS, LISBON (PORTUGAL).
Safety of Dams Judged from Failures,
W82-05512 1511 8A

COCONINO NATIONAL FOREST, FLAGSTAFF, AZ.
Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

COFFIN AND RICHARDSON, BOSTON, MA.
Current Trends in Cost of Service Studies,
W82-05806 1511 6C

COFFIN & RICHARDSON, INC., BOSTON, MA.
Water Conservation Under Conditions of Extreme Scarcity: The U.S. Virgin Islands.
W82-04170 1509 3A

COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 1504 2F

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 1507 5D

Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 1510 2C

A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 1511 2F

Configuration of Ice in Frozen Media,
W82-05615 1511 2C

COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, HANOVER, NH.
Vegetation Selection and Management for Overland Flow Systems,
W82-01500 1503 5E

A Simulation of the Enrichment of Atmospheric Pollutants in Snow Cover Runoff,
W82-03838 1509 5B

COLLEGE OF PETROLEUM AND MINERAL, DHAHRAN (SAUDI ARABIA).
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W82-05855 1511 5C

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W82-03553 1508 5E

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SWMM Model and Level of Discretization,
W82-03673 1508 6A

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Five-Year Plan of the Water Resources Research Center,
W82-03526 1511 6B

COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA. DEPT. OF MARINE SCIENCE.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 1503 5C

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 1503 5G

COLLINS, RYDER AND WATKINS, INC., TACOMA, WA.
The Costs of Internal Corosion in Water Systems,
W82-03809 1509 5F

COLORADO COOPERATIVE FISHERY RESEARCH UNIT, FORT COLLINS.
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

COLORADO DIV. OF WILDLIFE, FORT COLLINS.
Effects of Water Drawdown on the Fauna in Small Cold Water Reservoirs,
W82-04219 1509 6G

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 1512 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 1512 6G

COLORADO DIV. OF WILDLIFE, FORT COLLINS. RESEARCH CENTER.
Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

COLORADO E AGRICULTURAL EXPERIMENT STATION, FORT COLLINS.
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

COLORADO RIVER BOARD OF CALIFORNIA, LOS ANGELES.
Colorado River Water Allocation,
W82-05888 1511 6C

International Problems on the Colorado River,
W82-05892 1511 5G

COLORADO STATE UNIV., FORT COLLINS.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

Sugar Beet Production as Influenced by Water Stress,
W82-04086 1509 3F

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 1511 6E

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Optimal Design of Furrow Irrigation Systems,
W82-00138 1501 3F

Furrow Irrigation Practices in Northern Colorado,
W82-00139 1501 3F

Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 1502 3F

Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 1508 6B

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

Future Water Development Policies,
W82-05884 1511 5G

Colorado River Development,
W82-05887 1511 4A

Development Issues in the Colorado River Basin,
W82-05890 1511 6D

The Physical Environment of the Colorado River Basin,
W82-05891 1511 6D

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURE AND CHEMICAL ENGINEERING.
Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 1508 5G

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRONOMY.
Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF BOTANY AND PLANT PATHOLOGY.
Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 1512 3C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CHEMISTRY.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1503 1A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

Identification of Streamflow Stochastic Models,
W82-00555 1502 2A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 1503 2F

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

Optimal Design of Border Irrigation Systems,
W82-01977 1504 3F

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

Modeling Rill Density,
W82-02604 1506 2J

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 1507 6D

Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 1507 2A

Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 1508 6E

Mathematical Modeling of Earth Dam Breaches,
W82-03532 1508 8A

Application of Infiltration Theory for the Determination of Excess Rainfall Hyetograph,
W82-03752 1509 2A

Reservoir Sedimentation Modeling,
W82-03813 1509 2J

Watershed Model Study Using LANDSAT Image Data,
W82-03814 1509 2A

Water Quality Management Using the Hazard Assessment Approach,
W82-03823 1509 5G

Recreational Enhancement of High Country Water Supply Reservoirs,
W82-03923 1509 6A

Optimal Control of Reservoir Discharge Quality Through Selective Withdrawal,
W82-04204 1509 5G

Process-Response Systems: A Practical Approach to Watershed Classification Considering Water and Sediment Yields,
W82-04217 1509 2A

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 1510 2F

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 1510 5B

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 1511 4A

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 1512 2E

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 1512 5C

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 1512 5D

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF EARTH RESOURCES.

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ECONOMICS.

Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF FISHERY AND WILDLIFE BIOLOGY.

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 1511 5C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF FOREST AND WOOD SCIENCES.

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 1504 2D

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF ZOOLOGY AND ENTOMOLOGY.

Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.

Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

Evaluating Scour at Culvert Outlets,
W82-01934 1504 4D

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 1511 2F

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

COLORADO STATE UNIV., FORT COLLINS. NATURAL RESOURCE ECOLOGY LAB.

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

Impact of Management Practices on the Tallgrass Prairie,
W82-01580 1503 4A

COLORADO STATE UNIV., FORT COLLINS. WATER RESOURCES RESEARCH INST.

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

COLORADO UNIV. AT BOULDER.

Eutrophication,
W82-01271 1503 2H

COLORADO UNIV. AT BOULDER. DEPT. OF CHEMISTRY.

Selective Concentration and Isolation of Aromatic Amines from Water,
W82-03829 1509 5D

COLORADO UNIV AT BOULDER. DEPT. OF GEOLOGICAL SCIENCES.

Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 1504 5B

COLORADO UNIV. AT DENVER. DEPT. OF CIVIL AND URBAN ENGINEERING.

Floodplain Delineation: An Economic Approach,
W82-04236 1509 6F

COLORADO UNIV., BOULDER. DEPT. OF CIVIL, ENVIRONMENTAL AND ARCHITECTURAL ENGINEERING.

Achieving Urban Water Conservation,
W82-04227 1509 3D

COLORADO UNIV., BOULDER. DEPT. OF ENVIRONMENTAL, POPULATION, AND ORGANISMIC BIOLOGY.

Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

COLORADO UNIV., DENVER. GRADUATE SCHOOL OF PUBLIC AFFAIRS.

Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 1506 4B

COLORADO UNIV., LONGMONT.

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 1512 4C

COLORADO WATER RESOURCES RESEARCH INST., FORT COLLINS.

Aggregation-Disaggregation Techniques for the Operation of Multi-Reservoir Systems,
W82-03954 1509 6A

A Five-Year Plan for Water Research in Colorado,
W82-05531 1511 6B

COLQUHOUN (BRIAN) AND PARTNERS, LONDON (ENGLAND).

Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

COLUMBIA GAS SYSTEM SERVICE CORP., WILMINGTON, DE.

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 1511 2J

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MD.
Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 1503 5B

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 1501 5A

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 1503 5B

COLUMBIA NATIONAL FISHERY RESEARCH LAB., MO.
Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 1504 5C

COLUMBIA RIVER BASIN COMMISSION, PORTLAND, OR.
Water Management on the Columbia River,
W82-02112 1505 6D

COLUMBIA UNIV., NEW YORK.
Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 1506 8A

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 1508 5C

COLUMBIA UNIV., NEW YORK. DEPT OF GEOLOGICAL SCIENCES.
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

COMISION NACIONAL DE ENERGIA ATOMICA, BUENOS AIRES (ARGENTINA). CENTRO DE COMPUTOS.
Numerical Solution of the Dam Failure Problem by the Random Choice Method,
W82-03872 1509 8A

COMMISSION OF THE EUROPEAN COMMUNITIES, BRUSSELS (BELGIUM).
European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 1502 6D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION, WEMBLEY (AUSTRALIA). DIV. OF MATHEMATICS AND STATISTICS.
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 1506 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

Measurement of Sorptivity and Soil Water Diffusivity in the Field,
W82-03764 1509 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF FOREST RESEARCH.
Transport of Salts in Catchments and Soils,
W82-01880 1504 2G

A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 1506 7B

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF LAND RESEARCH.
Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 1508 7B

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF MATHEMATICS AND STATISTICS.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 1504 2F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF PLANT INDUSTRY.
Plant-Water Relations and Adaptation to Stress,
W82-00812 1502 2I

Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 1507 2I

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 1511 3F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF SOILS.
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). INST. OF EARTH RESOURCES.
Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 1501 2J

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA CITY (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 1510 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, GLEN OSMOND (AUSTRALIA). DIV. OF SOILS.
Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648 1511 2D

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05739 1511 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, MELBOURNE (AUSTRALIA).
Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, MELBOURNE (AUSTRALIA). DIV. OF CHEMICAL TECHNOLOGY.
An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, NORTH RYDE (AUSTRALIA). DIV. OF FOOD RESEARCH.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 1504 5D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ROCKHAMPTON (AUSTRALIA). MEAT RESEARCH LAB.
Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 1511 5D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, RYDE (AUSTRALIA). INST. OF EARTH RESOURCES.
Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 1511 5B

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, SOUTH MELBOURNE (AUSTRALIA). DIV. OF CHEMICAL TECHNOLOGY.
Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 1505 5F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, SYDNEY (AUSTRALIA). ANIMAL RESEARCH LABS.
Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, WEMBLEY (AUSTRALIA). DIV. OF LAND RESOURCES MANAGEMENT.
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 1503 5B

Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 1506 2K

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

COMMONWEALTH TECH, INC., LEXINGTON, KY.
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

COMMUNITY CONSULTANTS, INC., PROVO, UT.
Leak Detection Programs Recover Revenues,
W82-04375 1510 3D

COMPAGNIE GENERAL DES EAUX, PARIS (FRANCE).
Water Supply in the Paris Suburbs: Changing Treatment for Changing Demands,
W82-04123 1509 5F

COMPAGNIE GENERALE DES EAUX, PARIS (FRANCE).
French Experience in Water Pollution Control,
W82-02765 1506 5G

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

COMPLEXE SCIENTIFIQUE DES CEZEAUX, AUBIERE (FRANCE). LAB. ASSOCIE DE METEOROLOGIE PHYSIQUE.
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

CONAN/TEMPERLEY AND ASSOCIATES, JEDDAH (SAUDI ARABIA).
Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 1512 3A

CONCENTRATION SPECIALISTS, INC., ANDOVER, MA.
Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 1501 5D

Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 1510 3A

Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 1512 3A

CONCORDIA UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

CONFEDERATION OF BRITISH INDUSTRY, LONDON (ENGLAND).
An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 1505 6G

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN.
Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 1503 5D

PCBs in the Housatonic River: Determination and Distribution,
W82-02255 1505 5A

CONNECTICUT UNIV., NOANK.
Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 1511 2L

CONNECTICUT UNIV., STORRS.
An Analysis of Selected Classes of Organic Constituents in the Thames River Estuary,
W82-03819 1509 2L

Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

CONNECTICUT UNIV., STORRS. DEPT. OF BIOLOGICAL SCIENCES.
Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 1506 2H

CONNECTICUT UNIV., STORRS. DEPT. OF CHEMICAL ENGINEERING.
Metal Leaching from Sewage Sludge Ash,
W82-00770 1502 5B

CONNECTICUT UNIV., STORRS. DEPT. OF CIVIL ENGINEERING.
Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

How About Reverse Filters,
W82-03247 1507 4D

CONNECTICUT UNIV., STORRS. DEPT. OF GEOLOGY AND GEOPHYSICS.
Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 1505 5B

CONNECTICUT UNIV., STORRS. INST. OF WATER RESOURCES.
An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 6B

CONNECTICUT UNIV., STORRS. SCHOOL OF ENGINEERING.
Mutlichamber Septic Tanks,
W82-00969 1502 5D

CONNECTICUT WATER CO., CLINTON.
Year-Round Distribution System Maintenance,
W82-04699 1510 5F

CONSIGLIO NAZIONAL DELE RICERCHE, BOLOGNA (ITALY).
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 1506 5A

CONSIGLIO NAZIONALE DELLE RICERCHE, BOLOGNA (ITALY).
Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 1511 2B

CONSIGLIO NAZIONALE DELLE RICERCHE, MILAN (ITALY). CENTRO DI TEORIA DEI SISTEMI.
Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

CONSIGLIO NAZIONALE DELLE RICERCHE, ROME (ITALY). INST. FOR AEROSOL NUCLEATION.
Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

CONSOLIDATED PAPERS, INC., WISCONSIN RAPIDS, WI.
Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.
R-Factors for Soil Loss Impact Prediction,
W82-01963 1504 2J

CONSUMERS POWER CO., JACKSON, MI.
Power Plant Water Intake Assessment,
W82-00216 1501 6G

CONVERSE WARD DAVIS DIXON, INC., SAN FRANCISCO, CA.
Value Engineering Saves Dam Project,
W82-03287 1507 8A

COOK COLL., BRUNSWICK, NJ.
What Is a Point Source,
W82-04158 1509 6E

COOK COLL., NEW BRUNSWICK, NJ.
Three Important Court Decisions,
W82-04349 1510 6E

COOPERATIVE FISHERIES UNIT, COLUMBUS, OH.
Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

COOPERATIVE FISHERY RESEARCH UNIT, AMHERST, MASSACHUSETTS
Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 1512 5A

COPENHAGEN UNIV. (DENMARK). DEPT. OF GEOGRAPHY.
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 1504 2J

On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 1511 2J

COPENHAGEN WATER SUPPLY (DENMARK).
Water Supply in Denmark,
W82-03274 1507 6D

CORDOBA UNIV. (SPAIN). DEPT. OF ANALYTICAL CHEMISTRY.
Liquid-Liquid Extraction Combined with Atomic-Absortpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 1512 5A

CORLEW (M. B.) AND ASSOCIATES, INC., EDWARDSVILLE, IL.
Development of a Rural Water District,
W82-00288 1501 6A

CORNEL UNIV., ITHACA, NY.
The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 1507 2H

CORNELL UNIV., ITHACA, NY.
Systems Analysis,
W82-01303 1503 6A

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 1504 2H

Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 1506 6A

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

CORNELL UNIV., ITHACA, NY.

Sludge Management Process Integration,
W82-03130 1507 5D

Multi-Constituent Simulation and Optimization Models for Water Quality Management,
W82-03815 1509 5G

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

Systems Analysis,
W82-06997 1512 5G

CORNELL UNIV., ITHACA, NY. CENTER FOR ENVIRONMENTAL RESEARCH.
An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRICULTURAL ECONOMICS.
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRICULTURAL ENGINERRING.
Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 1512 5D

CORNELL UNIV., ITHACA, NY. DEPT. OF AGRONOMY.
Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 1502 5A

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5B

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B

Stream Transport of Nutrients Through a Wetland,
W82-04857 1511 5B

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 1512 5B

CORNELL UNIV., ITHACA, NY. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 1508 6D

CORNELL UNIV., ITHACA, NY., DEPT. OF ENVIRONMENTAL ENGINEERING.
Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 1511 4B

Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 1512 5D

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 1512 5A

CORNELL UNIV., ITHACA, NY. DEPT. OF FOOD SCIENCE.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 1503 5D

CORNELL UNIV., ITHACA, NY. DEPT. OF PLANT PATHOLOGY.
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 1503 2B

CORNELL UNIV., ITHACA, NY. DIV. OF BIOLOGICAL SCIENCES.
Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 1506 4D

CORNELL UNIV., ITHACA, NY. LAB. OF SOIL MICROBIOLOGY.
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 1512 5B

CORNELL UNIV., ITHACA, NY. SCHOOL OF CHEMICAL ENGINEERING.
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 1511 5G

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

Myths about Freeze Desalting,
W82-06114 1512 3A

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 1512 5D

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Boundary Calculations of Sluice and Spillway Flows,
W82-02677 1506 8B

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

Buoyant Surface Jets,
W82-03670 1508 8B

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

CORNELL UNIV., ITHACA, NY. SECTION OF ECOLOGY AND SYSTEMATICS.
Chemical Flux in an Acid-Stressed Stream,
W82-03338 1507 5C

CORNELL UNIV., ITHACA, NY. SOIL MICROBIOLOGY LAB.
Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 1502 2H

CORNELL UNIV., ITHACA. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Efficient Cooling Ponds: Design,
W82-03672 1508 8A

CORNELL UNIVERSITY, ITHACA, NY.
Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 1506 5C

CORNELL UNIVERSITY, ITHACA, NY. SECTION OF ECOLOGY AND SYSTEMATICS.
Recent Acidification of Precipitation in North America,
W82-01514 1503 5B

CORNING GLASS WORKS, NY. RESEARCH AND DEVELOPMENT LABS.
Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 1512 5D

CORPS OF ENGINEERS, BALTIMORE, MD. BALTIMORE DISTRICT.
Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 1505 6G

CORPS OF ENGINEERS, BUFFALO, NY.
A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

CORPS OF ENGINEERS, MOBILE, AL. MOBILE DISTRICT.
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 1501 6G

CORPS OF ENGINEERS, PORTLAND, OR.
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 1505 2H

CORPS OF ENGINEERS, SAVANNAH, GA.
Developing Dam-Break Flood Zone Ordinance,
W82-02585 1505 6F

CORVALLIS ENVIRONMENTAL PROTECTION AGENCY, OH.
Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

CORVALLIS ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR.
Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 1503 5B

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 1505 7B

Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 1506 5C

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 1506 5B

Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 1510 7C

Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 1511 5C

Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

Lake Restoration by Sediment Removal,
W82-06776 1512 5G

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, PRETORIA (SOUTH AFRICA).
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 1507 2F

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, PRETORIA (SOUTH AFRICA). NATURAL ISOTOPES DIV.
Excess Air in Groundwater,
W82-02099 1504 2F

COUNCIL OF ECONOMIC ADVISORS, WASHINGTON, DC.
Water Metering and Conservation,
W82-03562 1508 3D

COUNCIL ON ENVIRONMENTAL QUALITY, WASHINGTON, DC.
Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 1508 6E

COURY AND ASSOCIATES, INC., LAKEWOOD, CO.
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 1505 5D

A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

COWICONSULT, VIRUM (DENMARK).
Distribution of Wastewater in Drain Field Pipes,
W82-02945 1506 8B

CRANBROOK INST. OF SCIENCE, BLOOMFIELD HILLS, MI.
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

CREWE AND ALSAGAR COLL. OF HIGHER EDUCATION (ENGLAND).
Some Analyses of Aquatic Plants and Their Waters,
W82-02293 1505 2H

CREWE AND ALSAGER COLL., ALSAGER (ENGLAND).
The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 1506 2H

CULLEN COLL. OF ENGINEERING, HOUSTON, TX.
Processes for Removal of Inorganic Contaminants from Water,
W82-06342 1512 5F

CULLIGAN INC., NORTHBROOK, IL.
Water and Wastewater Reclamation: An Economical Answer to Industrial Wastes and Pollution,
W82-00188 1501 3E

CULP/WESNER/CULP, CAMERON PARK, CA.
Granular Activated Carbon Installations,
W82-04391 1510 5F

CULP/WESNER/CULP, DENVER, CO.
Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

CUSTOM ENGINEERING INC., ENGLEWOOD, CO.
'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment,
W82-03848 1509 5D

CUTTER LAB., SHAWNEE, KS. BAYVET DIV.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 1504 5B

D. A. V. COLL., MUZAFFARNAGAR (INDIA). DEPT. OF ZOOLOGY.
Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 1511 5C

Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

DADE COUNTY DEPT. OF ENVIRONMENTAL RESOURCES MANAGEMENT, MIAMI, FL. ENVIRONMENTAL PLANNING DIV.
Aquifer Management in Dade County,
W82-05784 1511 5G

DALHOUSIE UNIV., HALIFAX (NOVA SCOTIA). COLL. OF PHARMACY.
Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 1508 5C

DALHOUSIE UNIV., HALIFAX (NOVA SCOTIA). DEPT. OF OCEANOGRAPHY.
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

DALHOUSIE UNIVERSITY, HALIFAX (NOVA SCOTIA). DEPT. OF CHEMISTRY.
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 1502 5A

DALLAS CITY MANAGER'S OFFICE, TX.
An Alternative Solution to the THM Problem,
W82-00072 1501 5F

DALLAS CITY WATER UTILITIES DEPT., TX.
Piloting Mag-Carbonate Treatment,
W82-05794 1511 5F

DAMES AND MOORE, ATLANTA, GA.
Surface Water Management at Hazardous Waste Sites,
W82-01429 1503 5G

DAMES AND MOORE, GOLDEN, CO.
Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
W82-05799 1511 5B

DAMES AND MOORE, HOUSTON, TX.
Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

Strategies for Reuse and Conservation,
W82-05790 1511 3C

DANISH INST. OF APPLIED HYDRAULICS, HOERSHOLM.
Spatial Simulation of Snow Processes,
W82-01887 1504 2C

DANISH METEOROLOGICAL INST., COPENHAGEN.
Accuracy of Point Precipitation Measurements,
W82-02209 1505 2B

DARTMOUTH COLL., HANOVER, NH.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

DARTMOUTH COLL., HANOVER, NH. DEPT. OF EARTH SCIENCES.
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

DAVIS AND FLOYD ENGINEERS, INC., GREENWOOD, SC.
The Horse Creek Basin Project,
W82-00071 1501 5G

DAVIS, GRAHAM AND STUBBS, DENVER, CO.
Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

DE PAUL UNIV., CHICAGO, IL. DEPT. OF ECONOMICS.
Eutrophication Measures for Small Lake Water Quality Management,
W82-04243 1509 2H

DEARBORN ENVIRONMENTAL CONSULTING SERVICES, MISSISSAUGA (ONTARIO).
Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 1512 5D

DECHERT, PRICE AND RHOADS, DENVER, CO.
Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 1502 6E

DEDHAM WATER CO., MA.
Organic Contamination of Ground Water: Tell it All,
W82-01474 1503 5C

DEGREMONT INFILCO LTD., RUEIL-MALMAISON (FRANCE).
Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 1510 5F

DELAWARE UNIV., LEWES. COLL. OF MARINE STUDIES.
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.
Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 1501 2L

Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 1502 8B

Sites of River-Derived Sedimentation in the Ocean,
W82-01332 1503 7B

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 1506 5B

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 1512 2L

DELAWARE UNIV., NEWARK. DEPT. OF AGRICULTURAL ENGINEERING.
Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 1502 5D

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

DELAWARE UNIV., NEWARK. DEPT. OF CHEMICAL ENGINEERING.
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 1503 3A

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 1508 3A

DELAWARE UNIV., NEWARK. DEPT. OF CIVIL ENGINEERING.
Vertical Round Buoyant Jet in Shallow Water,
W82-04365 1510 7C

Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

DELAWARE UNIV., NEWARK. DEPT. OF GEOGRAPHY.
Using Computed Stream Flow in Watershed Analysis,
W82-01538 1503 2A

DELAWARE UNIV., NEWARK. DEPT. OF GEOLOGY.
Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 1505 2L

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Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 1505 4D

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 1512 6B

DELHI COLL. OF ENGINEERING (INDIA).
Discussion of 'Turbulence Prediction in Open Channel Flow',
W82-03781 1509 8B

DELHI UNIV., NEW DELHI (INDIA). DEPT. OF BOTANY.
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

DELTA EXPERIMENT STATION, STONEVILLE, MS.
Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 1505 5B

DELTA INST. FOR HYDROBIOLOGICAL RESEARCH, YERSEKE (NETHERLANDS).
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 1503 5F

DEMOCRITOS UNIV. OF THRAKI, XANTHI (GREECE). SCHOOL OF ENGINEERING.
Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 1510 4A

DENVER RESEARCH INST., CO.
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

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W82-04803 1511 6E

DENVER UNIV., CO. CHARLES H. PRIEN CENTER FOR SYNTHETIC FUEL STUDIES.
The Analysis of Oil Shale Wastes: A Review,
W82-00388 1501 5A

DENVER UNIV., CO. DEPT. OF CHEMISTRY.
Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 1503 5A

DENVER UNIV., CO. DEPT., OF GEOGRAPHY.
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 1503 2E

DENVER WATER DEPT.
Computer Modeling Programs: Tools for Model Operations,
W82-04130 1509 6A

DENVER WATER DEPT., CO
Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

DEPARTEMENT DE GENIE BIOCHIMIQUE, TOLOUSE (FRANCE).
Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

DEPARTMENT OF AGRICULTURE AND FISHERIES FOR SCOTLAND, EDINBURGH.
Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

DEPARTMENT OF AGRICULTURE AND FISHERIES, STELLENBOSCH (SOUTH AFRICA).
Soil Water Studies on Small Lucerne Plots,
W82-01713 1503 2I

DEPARTMENT OF AGRICULTURE, CHARLOTTETOWN (PRINCE EDWARD ISLAND). RESEARCH STATION.
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 1503 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO).
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 1501 2I

Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

DEPARTMENT OF AGRICULTURE, HARROW (ONTARIO). RESEARCH STATION.
Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 1503 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 1503 2D

DEPARTMENT OF AGRICULTURE, LACOMBE (ALBERTA). RESEARCH STATION.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA).
Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). IRRIGATION DIV.
Projected Tile Effluent Effects on the Oldman River,
W82-00333 1501 5C

Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). RESEARCH STATION.
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 1503 2G

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 1503 2G

Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 1511 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO).
Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 1511 2A

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). CHEMISTRY AND BIOLOGY RESEARCH INST.
Effects of Pollution on Humic Substances,
W82-03253 1507 5C

DEPARTMENT OF AGRICULTURE, PHOENIX, ARIZONA, WATER CONSERVATION LABORATORY.
Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

DEPARTMENT OF AGRICULTURE, SAINTE-FOY (QUEBEC).
Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

DEPARTMENT OF AGRICULTURE, SUMMERLAND (BRITISH COLUMBIA).
Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

DEPARTMENT OF AGRICULTURE, SUMMERLAND (BRITISH COLUMBIA). RESEARCH STATION.
Irrigation Efficiency in Orchards,
W82-05768 1511 3F

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

DEPARTMENT OF AGRICULTURE, SWIFT CURRENT (SASKATCHEWAN). EXPERIMENTAL FARM.
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 1503 3F

DEPARTMENT OF AGRICULTURE, SWIFT CURRENT (SASKATCHEWAN). RESEARCH STATION.
Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 1503 2I

DEPARTMENT OF COMMERCE, WASHINGTON, DC.
Water Requirements for Industrial Development,
W82-04117 1509 6D

DEPARTMENT OF ENERGY, ARGONNE, ILLINOIS, OPERATIONAL AND ENVIRONMENTAL SAFETY DIVISION.
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 1512 5B

DEPARTMENT OF ENERGY, GRAND FORKS, ND. GRAND FORKS ENERGY TECHNOLOGY CENTER.
Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 1501 5D

DEPARTMENT OF ENERGY, IDAHO FALLS, ID. IDAHO OPERATIONS OFFICE.
Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 1511 8C

DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO). POLAR CONTINENTAL SHELF PROJECT.
Acid Snow in the Canadian High Arctic,
W82-04542 1510 2C

DEPARTMENT OF ENERGY, NEW YORK. ENVIRONMENTAL MEASUREMENTS LAB.
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

DEPARTMENT OF ENERGY, NY. ENVIRONMENTAL MEASUREMENTS LAB.
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

DEPARTMENT OF ENERGY, OAKLAND, CA. GEOTHERMAL ENERGY DIV.
Environment Control Technology Development for Geothermal Energy,
W82-02197 1505 5C

DEPARTMENT OF ENERGY, PITTSBURGH, PA. PITTSBURGH ENERGY TECHNOLOGY CENTER.
Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 1501 5D

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 1503 7A

DEPARTMENT OF ENERGY, WASHINGTON, DC.
Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 1512 6G

Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
W82-06404 1512 6G

DEPARTMENT OF ENERGY, WASHINGTON, DC. (ASSIGNEE).
Energy Recovery System,
W82-00059 1501 5D

DEPARTMENT OF ENERGY, WASHINGTON, DC. DIV. OF GEOTHERMAL ENERGY.
Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 1512 6G

DEPARTMENT OF ENERGY, WASHINGTON, DC. OFFICE OF ENVIRONMENTAL ASSESSMENTS.
Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 1510 6B

DEPARTMENT OF ENVIRONMENTAL AFFAIRS (SOUTH AFRICA).
Design Technique Development for Dams in South Africa,
W82-06011 1512 8A

DEPARTMENT OF ENVIRONMENTAL PLANNING AND ENERGY (SOUTH AFRICA).
Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

DEPARTMENT OF FISHERIES AND MARINE SERVICE, STE ANNE DE BELLEVUE (QUEBEC). ARCTIC BIOLOGICAL STATION.
Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 1506 2C

DEPARTMENT OF FISHERIES AND OCEANS, WINNEPEG (MANITOBA). FRESHWATER INST.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 1504 5A

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA).
Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

The Valuation of Recreational Fisheries,
W82-00348 1501 6C

Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 1502 2H

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 1502 2H

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 1502 5A

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

Comment on 'A Relation Between Lake Morphometry and Primary Productivity and Its Use in Interpreting Whole-Lake Eutrophication Experiments' (E.J. Fee),
W82-03780 1509 5C

Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 1511 5B

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

DEPARTMENT OF NATIONAL HEALTH AND WELFARE, OTTAWA (ONTARIO).
Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

DEPARTMENT OF NATURAL RESOURCES, BATON ROUGE, LA.
Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 1505 4A

DEPARTMENT OF SCIENCE, MELBOURNE (AUSTRALIA).
An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 1511 2H

DEPARTMENT OF SCIENFITIC AND INDUSTRIAL RESEARCH, LOWER HUTT (NEW ZEALAND). PHYSICS AND ENGINEERING LAB.
On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, CHRISTCHURCH (NEW ZEALAND). CHEMISTRY DIV.
Bromide in Canterbury Ground Water,
W82-02056 1504 5B

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, LOWER HUTT (NEW ZEALAND). PHYSICS AND ENGINEERING LAB.
Identification of the Wairakei Geothermal System,
W82-01312 1503 2F

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). ECOLOGY DIV.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

Zooplankton of Lake Taupo,
W82-02888 1506 2H

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). FRESHWATER SECTION.
Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 1502 2H

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 1506 2C

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 1507 2H

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON (NEW ZEALAND). APPLIED MATHEMATICS DIV.
Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 1505 2F

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON (NEW ZEALAND). INDUSTRIAL PROCESSING DIV.
U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 1503 5A

DEPARTMENT OF THE AIR FORCE, WASHINGTON, DC.
Obtaining Layout of Water Distribution Systems,
W82-04319 1510 8A

DEPARTMENT OF THE ENVIRONMENT, BURLINGTON (ONTARIO). LANDS DIRECTORATE.
Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 1501 2K

DEPARTMENT OF THE ENVIRONMENT, DARTMOUTH (NOVA SCOTIA). INLAND WATERS DIRECTORATE.
Reregulation on an International River–A Case Study,
W82-06429 1512 6G

DEPARTMENT OF THE ENVIRONMENT (EDMONTON).
Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 1511 6D

DEPARTMENT OF THE ENVIRONMENT, EDMONTON. DIV. OF DESIGN AND CONSTRUCTION.
Predicting Lake Levels by Exponential Smoothing,
W82-00118 1501 2A

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 1503 6A

DEPARTMENT OF THE ENVIRONMENT, EDMONTON. DIV. OF EARTH SCIENCES.
A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 1506 2F

DEPARTMENT OF THE ENVIRONMENT, HALIFAX (NOVA SCOTIA).
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

The Shubenacadie-Stewiacke River Basin Study,
W82-05385 1511 6B

DEPARTMENT OF THE ENVIRONMENT, LONDON (ENGLAND).
Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 1503 6E

Implications for the Water Industry of the Notification Scheme for New Chemicals,
W82-06261 1512 6E

DEPARTMENT OF THE ENVIRONMENT, MONCTON (NEW BRUNSWICK). INLAND WATERS DIRECTORATE.
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 1501 5A

DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO).
Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 1507 7C

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W82-03097 1507 10C

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A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 1512 5D

Water Resources Research Support Program 1981 - 1982.
W82-06565 1512 9D

Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 1512 2C

DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO). COMPUTING AND APPLIED STATISTICS DIRECTORATE.
Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 1512 2J

DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO). INLAND WATERS DIRECTORATE.
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 1506 2C

DEPARTMENT OF THE ENVIRONMENT, READING (ENGLAND). CENTRAL WATER PLANNING UNIT.
Environmental Aspects of Water-Resources Planning in England and Wales,
W82-03806 1509 6E

DEPARTMENT OF THE ENVIRONMENT, READING (ENGLAND). WATER DATA UNIT.
The Practical Handling of Water Quality Monitoring Data,
W82-06591 1512 7C

DEPARTMENT OF THE ENVIRONMENT, SIDNEY (BRITISH COLUMBIA). INST. OF OCEAN SCIENCES.
The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 1510 5A

DEPARTMENT OF THE ENVIRONMENT, VANCOUVER (BRITISH COLUMBIA).
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

DEPARTMENT OF THE ENVIRONMENT, VANCOUVER (BRITISH COLUMBIA). INLAND WATER DIRECTORATE (PACIFIC REGION).
Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

DEPARTMENT OF THE ENVIRONMENT, VANCOUVER (BRITISH COLUMBIA). INLAND WATERS DIRECTORATE (PACIFIC REGION).
A Federal Perspective on River Basin Management,
W82-05388 1511 6E

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory, 1511 5B
W82-05741

Selecting a Method for Estimating Substance Loadings, 1511 5B
W82-05746

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments, 1512 2K
W82-06630

DEPARTMENT OF THE ENVIRONMENT, VICTORIA (BRITISH COLUMBIA).
New Strategies for Water Resource Planning in British Columbia, 1511 6E
W82-05395

Strategies for Maintaining Water Quality in Two British Columbia Lakes, 1511 5G
W82-05567

DEPARTMENT OF THE ENVIRONMENT, VICTORIA (BRITISH COLUMBIA). ASSESSMENT AND PLANNING DIV.
Agricultural Runoff and Water Pollution, 1511 5B
W82-05569

DEPARTMENT OF THE ENVIRONMENT, VICTORIA (BRITISH COLUMBIA). INST. OF OCEAN SCIENCES.
Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density, 1510 2H
W82-04573

DEPARTMENT OF TRANSPORT AND WORKS, DARWIN (AUSTRALIA).
Deterministic Models for Predicting Residential Water Consumption, 1510 6D
W82-04352

DEPARTMENT OF WATER AFFAIRS, FORESTRY AND ENVIRONMENT CONSERVATION, PRETORIA (SOUTH AFRICA).
Lessons Learned from the 1981 Laingsburg Flood, 1512 2E
W82-05997

DEPARTMENT OF WATER AFFAIRS, PRETORIA (SOUTH AFRICA).
Sediment Surveys in the Department of Water Affairs, 1502 7B
W82-00680

Absolute Roughness of Concrete-Lined Channels, 1507 8B
W82-03397

DEPARTMENT OF WATER AFFAIRS, PRETORIA (SOUTH AFRICA). HYDROLOGICAL RESEARCH INST.
Sediments as a Source of Phosphate: A Study of 38 Impoundments, 1502 2H
W82-00653

DEPT. ENVIRONMENTAL QUALITY ENGINEERING, MA.
Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects, 1508 5F
W82-03663

DEPT. OF AGRICULTURE, OTTAWA (GNTARIO).
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems, 1501 5B
W82-00157

DEPT. OF FISHERIES AND OCEANS, ST. JOHN'S (NEWFOUNDLAND).
Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring, 1511 5C
W82-04884

DETROIT DEPT. OF WATER SUPPLY, MI. WATER AND SEWER TREATMENT.
Detroit's WWTP: One of the World's Biggest, 1504 5D
W82-01865

DETROIT WATER AND SEWERAGE DEPT., MI.
Detroit - Fresh Clean Water, 1503 5D
W82-01506

DEUTSCHES HYDROGRAPHISCHES INST., HAMBURG (GERMANY, F.R.).
The Tidal Stream in the German Bight, 1511 2L
W82-05190

DEVELOPMENT CORP., ST. VINCENT (WEST INDIES).
The Optimum Size of Small Run-Of-River Plants, 1509 8A
W82-04175

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W82-02593

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W82-06279

DISTRICT OF COLUMBIA UNIV., WASHINGTON. DEPT. OF ENVIRONMENTAL SCIENCE.
Urban Aquaculture of the Rainbow Trout (Salmo gairdneri), 1506 8I
W82-02812

DOMTAR LTD. RESEARCH CENTER, SENNEVILLE (ONTARIO).
Removal of Elemental Mercury from Wastewaters Using Polysulfides, 1503 5D
W82-01800

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The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies, 1506 5C
W82-02913

DONOHUE AND ASSOCIATES, INC., SHEBOYGAN, WI.
Industrial Wastewater Audit, 1507 5D
W82-03337

Cost-Effectiveness Analysis for On-Site Wastewater Treatment Alternatives, 1509 5D
W82-04185

A Legacy from Construction Grants, 1512 5D
W82-06251

DONOHUE AND ASSOCIATES, INC., SHEBOYGAN, WI. ENVIRONMENTAL DIV.
A Successful Low Technology Wastewater Process, 1503 5D
W82-01178

DORCHESTER COUNTY HEALTH DEPARTMENT, CAMBRIDGE, MD.
Influence on Groundwater from the Bermed Infiltration Pond, 1503 5D
W82-01622

DORNBUSCH (DAVID M.) AND CO., INC., SAN FRANCISCO, CA.
Institutional Obstacles to Water Reuse in the Western United States, 1511 6B
W82-04958

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest, 1511 6B
W82-05554

DORNIER SYSTEM G.M.B.H., FRIEDRICHSHAFEN (GERMANY, F.R.).
Development and Use of a Continuous Toc-Measurement Device in Wastewater Purification, 1509 5A
W82-04019

DORR-OLIVER, INC., STAMFORD, CT.
Predicting Reactor Biomass Concentration in a Fluidized-Bed System, 1506 5D
W82-02932

Biological Nitrogen Control of Industrial Wastewater, 1507 5D
W82-03131

Sludge Disposal by Combustion Offers Potential Energy Source, 1510 5E
W82-04329

DOW CHEMICAL CO., MIDLAND, MI.
Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment, 1501 5C
W82-00300

DREXEL UNIV., PHILADELPHIA, PA.
Microbiology of Wastewater Treatment, 1503 5D
W82-01291

An Evaluation of Activated Carbon for Drinking Water Treatment: A National Academy of Science Report, 1509 5F
W82-04146

Hypolimnion Oxygenation Studies in Clark Hill Lake, 1511 5G
W82-05001

DREXEL UNIV., PHILADELPHIA, PA., DEPT. OF BIOLOGICAL SCIENCES.
Microbiology: Wastewater Treatment, 1512 5D
W82-06926

DREXEL UNIV., PHILADELPHIA, PA. ENVIRONMENTAL STUDIES INST.
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate, 1512 5D
W82-06038

DU PONT DE NEMOURS AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila, 1512 5F
W82-06769

DU PONT DE NEMOURS (E.I.) AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams, 1505 5C
W82-02399

Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors, 1511 5F
W82-05713

DU PONT DE NEMOURS (E. I.) AND CO., DEEPWATER, NJ.
Removal of Priority Pollutants, 1502 5D
W82-00639

DU PONT DE NEMOURS (E. I.) AND CO., WILMINGTON, DE. DEPT. OF BIOCHEMICALS.
Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 1502 5A

DUKE UNIV., DURHAM, NC.
Sludge Treatment, Utilization, and Disposal,
W82-01247 1503 5E

Sludge Management: A Research Update,
W82-06007 1512 5E

DUKE UNIV., DURHAM, NC. DEPT. OF BOTANY.
Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 1502 2I

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL ENGINEERING.
Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 1504 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 1504 2E

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5B

Discussion: Water Quality Trap Efficiency of Storm Water Management Basins, by Richard H. McCuen,
W82-03784 1509 4A

Strategies to Control Nonpoint Source Water Pollution,
W82-04261 1510 5G

DUKE UNIV., DURHAM, NC. DEPT. OF ZOOLOGY.
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 1508 2H

DUKE UNIV., DURHAM, NC. SCHOOL OF FORESTRY AND ENVIRONMENTAL STUDIES.
Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 1510 4C

DUNCAN, LAGNESE AND ASSOCIATES, INC., PITTSBURGH, PA.
Anaerobic Treatment in Novel Contact Digester,
W82-05681 1511 5D

DUNDEE UNIV. (SCOTLAND). DEPT. OF BIOLOGICAL SCIENCES.
Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 1511 2H

Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 1512 2G

DUNDEE UNIV. (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 1505 5E

DUPONT CO., WILMINGTON, DE.
Dupont's Wastewater Treatment Approach,
W82-02254 1505 5D

DUPONT DE NEMOURS (E. I.) AND CO., AIKEN, SC. SAVANNAH RIVER LAB.
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 1502 5A

DURHAM UNIV. (ENGLAND). DEPT. OF BOTANY.
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 1503 2E

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 1504 2K

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 1506 5C

DVIRKA AND BARTILUCCI, LONG ISLAND, NY.
Nitrogen Removal in a Subsurface Disposal System,
W82-04001 1509 5D

E. V. S. CONSULTANTS, INC. SEATTLE, WA.
Environmental Improvement at Port Alice, B. C.,
W82-06515 1512 5C

EARTHSCAN, LONDON (ENGLAND).
Who Will Pay the World's Water Bill,
W82-03280 1507 6B

EAST AFRICAN FRESHWATER FISHERIES RESEARCH ORGANIZATION, JINJA (UGANDA).
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 1506 2H

Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578 1511 5B

EAST BAY MUNICIPAL UTILITY DISTRICT, OAKLAND, CA. WATER QUALITY DIV.
Hazardous Material Spills--Are You Ready,
W82-06417 1512 5G

EAST CAROLINA UNIV., GREENVILLE, NC. DEPT. OF SOCIOLOGY AND ANTHROPOLOGY.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 1503 5C

EAST SAN BERNARDINO CITY WATER DISTRICT, CA.
Basin Management in the San Bernardino Valley,
W82-00075 1501 4B

EAST SURREY WATER CO. (ENGLAND).
Advanced Sludge Treatment for Modern Waterworks,
W82-02889 1506 5D

EAST TENNESSEE STATE UNIV., JOHNSON CITY. DEPT. OF ENVIRONMENTAL HEALTH.
Health Aspects of Urban Water Conservation,
W82-01047 1502 3C

Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

EAST TENNESSEE STATE UNIV., KINGSPORT. DEPT. OF CHEMISTRY.
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

EAST-WEST ENVIRONMENT AND POLICY INST., HONOLULU, HAWAII.
Using Ecological Knowledge for Development Planning,
W82-00671 1502 6A

EASTERN WASHINGTON UNIV., CHEMEY. DEPT. OF BIOLOGY.
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 1502 2H

EBASCO SERVICES, INC., GREENSBORO, NC.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

Power Plant Siting,
W82-06555 1512 6G

EBASCO SERVICES INC., NORCROSS, GA.
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

ECO-RECHERCHE LTD., POINTE-CLAIRE (QUEBEC).
A Water Quality Index for Lake Beaches,
W82-06660 1512 5G

ECO-RESEARCH LTD., INC., POINT-CLAIRE (QUEBEC).
High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

ECOLE NATIONALE DES PONTS ET CHAUSSEES, PARIS (FRANCE).
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 1512 4A

ECOLE NATIONALE SUPERIEURE DE CHIMIE, TOULOUSE (FRANCE), LABORATOIRE DE CHIMIE ORGANIQUE ET D'AGROCHIMIE.
Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 1511 5D

ECOLE NORMALE SUPERIEURE, ABIDJAN (IVORY COAST).
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 1503 2H

ECOLE POLYTECHNIQUE FEDERALE DE LAUSAGNE (SWITZERLAND).
The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (SWITZERLAND).
Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1506 1B

ECOLE POLYTECHNIQUE, LIMOGES (FRANCE).
Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

ECOLE POLYTECHNIQUE, MONTREAL (QUEBEC). DEPT. OF CIVIL ENGINEERING.
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

ECOLOGICAL ANALYSTS, INC., OAK RIDGE, TN.
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 1506 5D

ECOLOGICAL ANALYSTS, INC., SPARKS, MD.
Bioassays - Procedures and Results,
W82-01277 1503 5A

ECOLOGICAL ANALYSTS, INC., SPARKS, NV.
Bioassays - Procedures and Results,
W82-06810 1512 5A

ECOLOGICAL AND TOXICOLOGICAL ASSOCIATION, BASEL (SWITZERLAND).
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

ECOLOGY AND ENVIRONMENT, INCORPORATED, BUFFALO, NEW YORK.
Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

ECONOMIC RESEARCH SERVICE, WASHINGTON, DC.
Irrigating with Municipal Effluent: A Socioeconomic Study of Community Experiences,
W82-03967 1509 3C

ECONOMIC RESEARCH SERVICE, WASHINGTON, DC. NATURAL RESOURCE ECONOMICS DIV.
Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 1502 6E

ECONOMICS AND STATISTICS SERVICE, WASHINGTON, DC. NATURAL RESOURCE ECONOMICS DIV.
Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE, WASHINGTON, DC. NATURAL RESOURCES ECONOMICS DIV.
Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 1502 5D

EDECO, INC., TULSA, OK.
Designing Wastewater Treatment Systems to Save Energy,
W82-04906 1511 5D

EDINBURGH UNIV. (SCOTLAND).
Sedimentation Control in Indian Reservoirs,
W82-03693 1508 8A

EDINBURGH UNIV. (SCOTLAND). DEPT. OF ELECTRICAL ENGINEERING.
The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 1511 6D

EDINBURGH UNIV. (SCOTLAND). DEPT. OF GEOLOGY.
The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

EDINBURGH UNIV. (SCOTLAND). GRANT INST. OF GEOLOGY.
Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 1512 5A

EG AND G, BIONOMICS, WAREHAM, MA.
Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

EG AND G ENVIRONMENTAL CONSULTANTS, WALTHAM, MA.
Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 1511 6C

EG AND G IDAHO, INC., IDAHO FALLS.
Micro Hydropower in the USA,
W82-04316 1510 8A

EIDENOSSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWASSERSCHUTZ, ZURICH (SWITZERLAND).
Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 1512 2J

EIDGENOESSESCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). TECHNISCH-CHEMISCHES LAB.
Kinetics of Biofilm Nitrification,
W82-05374 1511 5D

EIDGENOESSESCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU, HYDROLOGIE UND GLAZIOLOGIE.
Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1506 1B

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 1506 5F

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHUTZ, ZURICH (SWITZERLAND).
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 1504 5B

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

EIDGENOESSISCHE ANSTALT FUER WASSERVORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHUTZ, KASTIENBAUM (SWITZERLAND). LAKE RESEARCH LAB.
Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 1511 5B

EIDGENOESSISCHE INST. FUER SCHNEE- UND LAWINENFORSCHUNG, DAVOS (SWITZERLAND).
Areal Distribution of Snow Water Equivalent Evaluated by Snow Cover Monitoring,
W82-03842 1509 2C

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND).
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W82-05353 1511 5B

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W82-00361 1501 5D

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Removing Trihalomethanes from Drinking Water,
W82-00953 1502 5F

Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 1503 5C

Microbiology of Water,
W82-01284 1503 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 1503 5A

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 1503 5B

EPA's Approach to Regulating New Energy Technologies,
W82-03129 1507 6E

Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

The Costs of Compliance: An EPA Estimate for Organics Control,
W82-04132 1509 6C

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 1510 5C

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 1511 5A

Getting Your Money's Worth from Filtration,
W82-06412 1512 5F

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
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W82-00580 1502 5A

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W82-05149 1511 5C

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W82-01286 1503 5B

Microbiology of Potable Water,
W82-01287 1503 5F

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W82-06071 1512 5G

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W82-03300 1507 5E

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W82-06925 1512 5C

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W82-00252 1501 6E

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W82-01419 1503 5G

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 1504 5B

Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 1507 5D

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 1508 5B

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W82-03965 1509 5D

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W82-04335 1510 6B

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W82-05861 1511 5D

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W82-03626 1508 5D

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W82-03627 1508 5B

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W82-03629 1508 5D

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W82-01076 1502 5D

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W82-01077 1502 5D

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W82-00741 1502 5A

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W82-04885 1511 5B

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W82-04914 1511 2K

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W82-04915 1511 2K

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W82-05319 1511 2L

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Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
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Pollution Control: Changing Approaches,
W82-01870 1504 6E

EXXON RESEARCH AND ENGINEERING CO., FLORHAM PARK, NJ.
A Stoichiometric Model of Bacterial Growth,
W82-03756 1509 5D

EXXON RESEARCH AND ENGINEERING CO., LINDEN, NJ. CORPORATED RESEARCH TECHNOLOGY FEASIBILITY CENTER.
Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

FAIRFAX COUNTY DIV. OF ENVIRONMENTAL HEALTH, VA.
Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 1511 5D

FAIRFAX COUNTY WATER AUTHORITY, MERRIFIELD, VA.
Policing Demand Through Pricing,
W82-06352 1512 6D

FEDERAL ENERGY REGULATORY COMMISSION, ATLANTA, GA. ATLANTA REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 1503 6D

FEDERAL ENERGY REGULATORY COMMISSION, CHICAGO, IL. CHICAGO REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 1504 6D

Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 1507 6D

FEDERAL ENERGY REGULATORY COMMISSION, FORT WORTH, TX. FORT WORTH REGIONAL OFFICE.
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 1504 6D

FEDERAL ENERGY REGULATORY COMMISSION, NEW YORK, NEW YORK REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 1504 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 1503 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 1507 6D

FEDERAL ENERGY REGULATORY COMMISSION, SAN FRANCISCO, CA. OFFICE OF ELECTRIC POWER REGULATION.
Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 1501 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 1501 6B

FEDERAL ENERGY REGULATORY COMMISSION, SAN FRANCISCO, CA. SAN FRANCISCO REGIONAL OFFICE.
Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 1506 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 1507 6D

Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 1507 6D

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 1510 6D

FEDERAL ENERGY REGULATORY COMMISSION, SAN FRANCISCO. OFFICE OF ELECTRIC POWER REGULATION.
Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 1501 6B

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, D.C. OFFICE OF ELECTRIC POWER REGULATION.
Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 1502 6D

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 1502 6G

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC.
Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 1503 7B

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC. OFFICE OF ELECTRIC POWER REGULATION.
Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 1501 6G

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 1501 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 1501 6G

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 1501 6G

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 1501 6B

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 1502 6G

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico.
W82-01439 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California.
W82-01441 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 1504 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 1503 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 1503 6D

Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 1507 6G

Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 1512 6E

FEDERAL HIGHWAY ADMINISTRATION, WASHINGTON, DC. OFFICE OF ENGINEERING.
The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

FEDERAL INST. FOR SNOW AND AVALANCHE RESEARCH, DAVOS/WEISSFLUHJOCH (SWITZERLAND).
Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 1504 2C

FEDERAL INST. OF HYDROLOGY, COBLENZ (GERMANY F.R.).
Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 1511 2E

FEDERAL INST. ON WATER RESOURCES RESEARCH (SWITZERLAND).
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 1504 5C

FEDERAL RESERVE BANK OF KANSAS CITY, MO.
Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 1501 6D

FILMTEC CORP., MINNEAPOLIS, MN.
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

FINLAND TECHNICAL RESEARCH CENTER, ESPOO.
Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

FINNISH HYDROLOGICAL OFFICE, HELSINKI.
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 1503 2C

FIRST CHEMICAL CORP., PASCAGOULA, MS.
The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 1512 5D

FISCHER AND PORTER CO., WARMINSTER, PA.
Making Chlorination Trustworthy,
W82-06639 1512 5F

FISH AND WILDLIFE SERVICE, COLUMBIA, MO.
Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

FISH AND WILDLIFE SERVICE, COOKIERVILLE, TN.
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

FISH AND WILDLIFE SERVICE, FORT COLLINS, CO.
Overview of Freshwater Inflow Depletions,
W82-02152 1505 6D

FISH AND WILDLIFE SERVICE, JAMESTOWN, ND. NORTHERN PRAIRIE WILDLIFE RESEARCH CENTER.
Wetlands and Deepwater Habitats: A New Classification,
W82-05716 1511 2L

FISH AND WILDLIFE SERVICE, LA CROSSE, WI.
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 1512 5A

FISH AND WILDLIFE SERVICE, LAFAYETTE, LA.
Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

FISH AND WILDLIFE SERVICE, PIERRE, SD. NORTH CENTRAL RESERVOIR INVESTIGATIONS.
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

FISH AND WILDLIFE SERVICE, SACRAMENTO, CA.
Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

FISH AND WILDLIFE SERVICE, SLIDELL, LA.
Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

FISH AND WILDLIFE SERVICE, STOCKTON, CA.
Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

FISH AND WILDLIFE SERVICE, VERO BEACH, FL. ECOLOGICAL SERVICES.
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

FISH AND WILDLIFE SERVICE, WASHINGTON, DC. OFFICE OF FISHERY ASSISTANCE.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 1503 6G

FISHERIES AND MARINE SERVICE, WINNIPEG (MANITOBA). FRESHWATER INST.
The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 1503 5C

FISHERIES AND WILDLIFE, COLUMBIA, MO.
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

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W82-02095 1504 5C

Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 1507 2L

FLINDERS UNIV. OF SOUTH AUSTRALIA, BEDFORD PARK. SCHOOL OF EARTH SCIENCES.
The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

FLOOD METEOROLOGICAL OFFICE (INDIA).
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W82-04670 1510 2B

FLORENCE UNIV. (ITALY).
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W82-06200 1512 2E

FLORENCE UNIV. (ITALY). INST. OF COMPUTER AND SYSTEM SCIENCE.
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W82-04056 1509 5D

FLORENCE UNIV. (ITALY). INST. OF PHARMACOLOGY.
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

FLORIDA DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE.
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

FLORIDA DEPT. OF NATURAL RESOURCES, TALLAHASSEE BUREAU OF AQUATIC PLANT RESEARCH AND CONTROL.
Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 1511 4A

FLORIDA INST. OF TECH., MELBOURNE.
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 1508 5A

FLORIDA INST. OF TECH., MELBOURNE. DEPT. OF ENVIRONMENTAL ENGINEERING AND SCIENCE.
Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 1505 2H

FLORIDA INST. OF TECH., MELBOURNE. DEPT. OF MECHANICAL ENGINEERING.
Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 1512 5D

FLORIDA INTERNATIONAL UNIV., MIAMI. SCHOOL OF TECHNOLOGY.
Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 1502 5B

FLORIDA INTERNATIONAL UNIVERSITY, MIAMI. DRINKING WATER QUALITY RESEARCH CENTER.
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W82-01835 1504 5A

FLORIDA STATE DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE.
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W82-01805 1504 2L

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF GEOLOGY.
Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 1506 5A

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF METEOROLOGY.
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 1511 2B

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF OCEANOGRAPHY.
Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 1501 5A

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

FLORIDA STATE UNIV., TALLAHASSEE. OCEANOGRAPHY DEPT.
Water-To-Air Fractionation of Bacteria,
W82-00575 1502 5B

FLORIDA UNIV., BELLE GLADE. AGRICULTURAL RESEARCH AND EDUCATION CENTER.
Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 1510 2H

FLORIDA UNIV., BELLE GLADE. DEPT. OF AGRICULTURAL ENGINEERING.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 1504 2G

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

FLORIDA UNIV., GAINESVILLE.
Physical and Chemical Methods,
W82-01241 1503 5D

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 1503 5G

FLORIDA UNIV., GAINESVILLE. CENTER FOR WETLANDS.
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

A Comparison of the Structure, Primary Productivity, and Transpiration of Cypress Ecosystems in Florida,
W82-03885 1509 2I

FLORIDA UNIV., GAINESVILLE. COLL. OF VETERINARY MEDICINE.
Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Subsurface Drainage and Sediment Transport Model,
W82-00894 1502 2G

Nutrient and Sediment Loadings from a Subsurface Drainage System.
W82-02266 1505 5B

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 1512 5D

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRONOMY.
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

FLORIDA UNIV., GAINESVILLE. DEPT. OF BOTANY.
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 1503 5B

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENGINEERING SCIENCES.
Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

FLORIDA UNIV., GAINESVILLE, DEPT. OF ENVIRONMENTAL ENGINEERING.
Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 1510 5C

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 1501 2K

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 1505 5B

Metabolism of a Florida Lake Ecosystem,
W82-02268 1505 2H

Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 1512 5D

Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 1512 6C

FLORIDA UNIV., GAINESVILLE. DEPT. OF FOOD AND RESOURCES ECONOMICS.
How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 1512 6C

FLORIDA UNIV., GAINESVILLE. DEPT. OF FOOD SCIENCE AND HUMAN NUTRITION.
Microbiological Quality of Selected Recreational Waters,
W82-03636 1508 5A

FLORIDA UNIV., GAINESVILLE. DEPT. OF FRUIT CROPS.
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

FLORIDA UNIV., GAINESVILLE. DEPT. OF GEOGRAPHY.
The Significance of Tropical Cyclone Rainfall in the Water Supply of South Florida,
W82-03821 1509 2B

FLORIDA UNIV., GAINESVILLE, DEPT. OF STATISTICS.
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 1503 5B

FLORIDA UNIV., GAINESVILLE. SCHOOL OF FOREST RESOURCES.
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W82-05371 1511 5E

FLORIDA UNIV., GAINESVILLE. SCHOOL OF FOREST RESOURCES AND CONSERVATION.
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W82-00499 1501 5E

The Utilization of Grass Carp, Ctenopharyngodon Ideila Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 1511 4A

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W82-02811 1506 5B

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W82-00179 1501 5B

Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

FLORIDA UNIV., STANFORD. INST. OF FOOD AND AGRICULTURAL SCIENCES.
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W82-00797 1502 5B

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W82-00970 1502 5D

FLORIDA UNIVERSITY, GAINESVILLE SCHOOL OF FOREST RESOURCES AND CONSERVATION.
Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

FLOW GENERAL INC., MCLEAN, VA.
The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 1512 2K

FMC CORP., SAN JOSE, CA. (ASSIGNEE).
Pressurized Oxygenation System and Method,
W82-00064 1501 5D

FMC CORPORATION, ENGLEWOOD, CO.
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W82-03032 1507 5D

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Bottom-Entry Large-Diameter Wells,
W82-04919 1511 8A

Cavity Well,
W82-04920 1511 8A

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W82-00646 1502 5A

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W82-00490 1501 5A

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W82-00873 1502 5B

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Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 1511 5B

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W82-04833 1511 5D

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W82-04832 1511 5D

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W82-06314 1512 5A

FORD MOTOR CO., DEARBORN, MI.
Chemometric Modeling of Wastewater Treatment Processe,
W82-05858 1511 5D

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W82-06868 1512 2H

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W82-00915 1502 2H

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Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 1502 5B

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 1511 5B

FOREST RESEARCH INST., CHRISTCHURCH (NEW ZEALAND).
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 1503 4C

Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 1506 2J

Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 1511 4C

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W82-06965 1512 5C

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

FORESTRY SCIENCES LAB., GRAND RAPIDS, MN.
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W82-04871 1511 5D

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W82-01900 1504 5D

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W82-06445 1512 5D

FORSCHUNGSZENTRUM WASSERTECHNIK (GERMAN,D.R.).
Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermessstellen),
W82-04582 1510 7B

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

FORT WAYNE WATER UTILITY, IN.
Ground-Level Versus Elevated Storage,
W82-03865 1509 5F

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A River Coding System for Water Quality Archives,
W82-05474 1511 7A

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River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

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W82-01083 1502 5A

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W82-02422 1505 2F

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W82-00744 1502 6E

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W82-00718 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 1502 6E

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 1502 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 1502 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 1502 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 1502 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 1502 6E

FRANKLIN PIERCE LAW CENTER, CONCORD, NH. ENERGY LAW INST.
Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 1501 6E

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 1501 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 1501 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 1502 6E

FRANKLIN PIERCE LAW CENTER, CONCORD, NY. ENERGY LAW INST.
Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 1501 6E

FRANKLIN PIERCE LAW INST. CENTER, CONCORD, NH.
The Financing of Private Small Scale Hydroelectric Projects.
W82-04633 1510 6B

FRANKLIN RESEARCH CENTER, PHILADELPHIA, PA.
Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

FRASER (J. KENNETH) AND ASSOCIATES, RENSSELAER, NY.
Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

FREASHWATER BIOLOGICAL ASSOCIATION, WINDMERE (ENGLAND).
The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 1512 5C

FREESE AND NICHOLS, FORT WORTH, TX.
Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 1506 8B

FREESE AND NICHOLS, INC., AUSTIN, TX.
Evaluating a Plant's Potential for Upgrading.
W82-02895 1506 5F

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 1510 5C

Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 1511 5B

Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 1512 5C

FRESHWATER BIOLOGICAL ASSOCIATION, CUMBRIA (ENGLAND).
The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 1511 2K

FRESHWATER BIOLOGICAL ASSOCIATION, CUMBRIA (ENGLAND). WINDERMERE LAB.
The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 1504 2H

FRESHWATEP BIOLOGICAL ASSOCIATION, EAST STOKE (ENGLAND). RIVER LAB.
The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1505 1B

FRESHWATER BIOLOGICAL ASSOCIATION, WAREHAM (ENGLAND).
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 1501 7B

FRESHWATER BIOLOGICAL ASSOCIATION, WAREHAM (ENGLAND). RIVER LAB.
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 1504 5C

Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 1505 5C

FRESHWATER BIOLOGICAL ASSOCIATION, WARHAM (ENGLAND).
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 1505 5B

FRESHWATER BIOLOGICAL ASSOCIATION, WINDERMERE (ENGLAND).
A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 1502 7B

Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 1506 2K

Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

FRESHWATER FISHERIES LAB.
Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 1512 5C

FRITO-LAY, INC., DALLAS, TX.
Potato and Corn By-Products Used as Cattle Feed,
W82-06488 1512 5E

FUJI ELECTRIC CO. LTD., TOKYO.
Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

FUJI ELECTRIC CO., LTD., TOKYO (JAPAN).
Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

FUJI ELECTRIC CORPORATE RESEARCH AND DEVELOPMENT LTD., KANAGAWA (JAPAN).
Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

FURNESS (C. D.) AND ASSOCIATES LTD. (ENGLAND).
How Equitable Are Effluent Charges,
W82-06074 1512 6C

GARLAND WASTEWATER TREATMENT DEPT., TX.
Right Velocity Keeps the Solids Up,
W82-05788 1511 5D

GENERAL BATTERY CORP., READING, PA.
Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 1510 5B

GENERAL DEVELOPMENT CORPORATION, MIAMI, FLORIDA, ENVIRONMENTAL PLANNING AND PROGRAMS DEPARTMENT.
Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 1512 5B

GENERAL ELECTRIC CO., SCHENECTADY, NY.
Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 1507 5D

GENERAL MOTORS CORP., SAGINAW. STEERING GEAR DIV.
Mixing Technology Reduces Energy Use,
W82-00634 1502 5D

GENOA UNIV. (ITALY). FISIOLOGIA GENERALE.
Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

GENTOFTE WATER SUPPLY (DENMARK).
Practical Experiences in Plants Using Activated Carbon,
W82-02788 1506 5F

GEOLOGICAL SURVEY, ALBANY, NY.
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 1505 5B

GEOLOGICAL SURVEY, ALBANY, NY. WATER RESOURCES DIV.
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

Water Resources Investigations in New York--1980.
W82-00011 1501 7C

Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 1503 7C

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 1505 4C

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 1505 2E

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

GEOLOGICAL SURVEY, ALBUQUERQUE, NM. WATER RESOURCES DIV.
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 1501 5B

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 1505 2F

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 1505 7C

Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 1512 7C

GEOLOGICAL SURVEY, ALEXANDRIA, LA. WATER RESOURCES DIV.
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 1502 7C

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 1505 7C

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

GEOLOGICAL SURVEY, ANCHORAGE, AK. WATER RESOURCES DIV.
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

Water Resources Data for Alaska, Water Year 1980.
W82-02845 1506 7C

Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 1511 2F

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

GEOLOGICAL SURVEY, ANNAPOLIS, MD. WATER RESOURCES DIV.

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

GEOLOGICAL SURVEY, ATLANTA, GA.

Effect of Filtration Pressure on Analyses for Chlorophyll,
W82-04247 1509 2H

GEOLOGICAL SURVEY, ATLANTA, GA. WATER RESOURCES DIV.

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

GEOLOGICAL SURVEY, AUGUSTA, ME. WATER RESOURCES DIV.

Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

GEOLOGICAL SURVEY, AUSTIN, TX. WATER RESOURCES DIV.

Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 1501 7C

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 1503 7C

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 1505 2F

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 1505 7C

Mathematical Simulations of The Toccoa Falls, Georgia Dam Break Flood,
W82-03920 1509 2E

Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 1512 7C

GEOLOGICAL SURVEY, BATON ROUGE, LA.

Procedure for Evaluating the Geologic Integrity of Existing Hazardous Waste Sites in Louisiana: Case Histories,
W82-03932 1509 5A

GEOLOGICAL SURVEY, BATON ROUGE, LA. WATER RESOURCES DIV.

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 1510 7C

Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 1511 7C

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 1512 7C

GEOLOGICAL SURVEY, BILLINGS, MT. WATER RESOURCES DIV.

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

GEOLOGICAL SURVEY, BISMARCK, ND. WATER RESOURCES DIV.

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 1505 7C

Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 1506 4A

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 1512 7C

GEOLOGICAL SURVEY, BOISE, ID. WATER RESOURCES DIV.

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

GEOLOGICAL SURVEY, BOSTON, MA. WATER RESOURCES DIV.

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 1501 5C

Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 1501 2F

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 1501 7C

Probable High Ground-Water Levels in Massachusetts,
W82-02829 1506 2F

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 1510 7C

Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 1511 7C

GEOLOGICAL SURVEY, CARSON CITY, NV. WATER RESOURCES DIV.

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 1511 6B

Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 1512 2F

GEOLOGICAL SURVEY, CHARLESTON, WV. WATER RESOURCES DIV.

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 1501 7C

GEOLOGICAL SURVEY, CHARLESTON, WV. WATER RESOURCES DIV.

Water Resources Data for West Virginia, Water Year 1979. Appendix - Coal Areas.
W82-03990 1509 7C

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 1510 7C

GEOLOGICAL SURVEY, CHEYENNE, WY. WATER RESOURCES DIV.

Water-Resources Investigctions of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 1501 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 1505 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 1506 7C

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 1512 2G

GEOLOGICAL SURVEY, CHEYENNE, WY. WATER RESOURCES DIV., AND GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

GEOLOGICAL SURVEY, COLUMBIA, SC. WATER RESOURCES DIV.

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 1503 7C

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 1511 2A

GEOLOGICAL SURVEY, COLUMBUS, OH. WATER RESOURCES DIV.

Water Use in Ohio, 1975,
W82-05226 1511 6D

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 1512 8B

GEOLOGICAL SURVEY, DENVER, CO.

A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 1501 5A

Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 1503 5A

Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 1505 2H

Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 1508 5B

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 1512 5G

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.

Ground Water Availability,
W82-00027 1501 6D

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 1510 6G

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 1512 2E

GEOLOGICAL SURVEY, DENVER, COLO. WATER RESOURCES DIVISION.

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

GEOLOGICAL SURVEY, DORAVILLE, CA. WATER RESOURCES DIV.

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia.
W82-05229 1511 5C

GEOLOGICAL SURVEY, DORAVILLE, GA.

Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 1510 8D

GEOLOGICAL SURVEY, DORAVILLE, GA. WATER RESOURCES DIV.

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 1511 2E

GEOLOGICAL SURVEY, EDGEWATER, MD. WATER RESOURCES DIV.

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

GEOLOGICAL SURVEY, FLAGSTAFF, AZ.

Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 1505 2A

GEOLOGICAL SURVEY, GARDEN CITY, KS. WATER RESOURCES DIV.

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

GEOLOGICAL SURVEY, HARRISBURG, PA. WATER RESOURCES DIV.

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 1503 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 1505 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 1510 7C

Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

GEOLOGICAL SURVEY, HARRISBURG, PA. WATER RESOURCES DIV., AND ESSO PROSPECCAO LIMITADA, RIO DE JANEIRO, BRAZIL.

Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 1511 2F

GEOLOGICAL SURVEY, HARTFORD, CT. WATER RESOURCES DIV.

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 1512 2H

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 1503 7C

Water Resources Data for Montana, Water Year 1980–Volume 2. Upper Columbia River Basin.
W82-01214 1503 7C

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 1503 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 1503 7C

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 1505 7C

Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 1510 5C

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

GEOLOGICAL SURVEY, HONOLULU, HI. WATER RESOURCES DIV.

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 1503 7C

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 1511 7C

GEOLOGICAL SURVEY, HOUSTON, TX. WATER RESOURCES DIV.

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

GEOLOGICAL SURVEY, HURON, SD. WATER RESOURCES DIV.

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 1503 2F

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 1503 7C

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 1505 2F

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 1506 2F

GEOLOGICAL SURVEY, IDAHO FALLS, ID. WATER RESOURCES DIV.

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5B

GEOLOGICAL SURVEY, INDIANAPOLIS, IN. WATER RESOURCES DIV.

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 1501 2A

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 1501 5C

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

Water Resources Data for Indiana, Water Year 1980.
W82-02492 1505 7C

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 1512 2F

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

GEOLOGICAL SURVEY, IOWA CITY, IA.

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 1505 2F

GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 1501 5B

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 1506 7C

Water Resources Investigations in Mississippi 1980-81.
W82-03988 1509 7C

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 1511 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 1511 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 1511 5B

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 1512 7C

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 1512 7C

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 1512 7C

GEOLOGICAL SURVEY, KNOXVILLE, TN. WATER RESOURCES DIV.

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

GEOLOGICAL SURVEY, LAGUNA NIGUEL, CA. WATER RESOURCES DIV.

Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 1511 7C

GEOLOGICAL SURVEY, LAKEWOOD, CO.

Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 1506 2F

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 1510 7B

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 1501 7C

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 1501 7C

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 1502 5B

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 1503 7C

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 1503 5B

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 1510 6A

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

San Juan River Basin,
W82-06144 1512 7C

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV., AND COLORADO DEPT. OF NATURAL RESOURCES, DENVER.
Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV., AND GEOLOGICAL SURVEY, IDAHO FALLS, ID. WATER RESOURCES DIV.
Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

GEOLOGICAL SURVEY, LANSING, MI. WATER RESOURCES DIV.
Ground-Water Data for Michigan, 1979,
W82-00014 1501 2F

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

Flow Model of Saginaw River Near Saginaw, Michigan,
W82-03996 1509 2E

GEOLOGICAL SURVEY, LAWRENCE, KS.
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 1502 4B

Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 1510 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 1510 2E

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

Hydrogeologic Reconneissance of the Republican River Basin in Nebraska,
W82-05828 1511 7C

GEOLOGICAL SURVEY, LITTLE ROCK, AR. WATER RESOURCES DIV.
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 1501 6E

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

Water-Quality Reconnaissance of Harding Creek, Lawrence County, Arkansas,
W82-03995 1509 7C

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 1510 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 1510 7C

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 1511 7C

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 1512 7C

GEOLOGICAL SURVEY, LOUISVILLE, KY. WATER RESOURCES DIV.
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 1505 7C

Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 1506 2E

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

GEOLOGICAL SURVEY, MADISON, WI. WATER RESOURCES DIV.
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

GEOLOGICAL SURVEY, MENLO PARK, CA.
Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 1501 5E

Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 1505 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1510 1A

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 1511 5G

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 1511 2K

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 1512 2H

Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.

Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 1501 2E

Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 1501 5A

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 1501 4B

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 1502 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 1503 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 1503 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 1503 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 1503 7C

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 1503 6B

Denitrification Associated With Periphyton Communities,
W82-01814 1504 5B

Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 1505 2K

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

Floodflow Characteristics of the Sacramento River in the Vicinity of Gianella Bridge, Hamilton City, California,
W82-03985 1509 2E

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 1511 2J

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

GEOLOGICAL SURVEY, MIAMI, FL. WATER RESOURCES DIV.

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 1501 7C

Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

GEOLOGICAL SURVEY, MONTGOMERY, AL. WATER RESOURCES DIV.

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

GEOLOGICAL SURVEY, MORGANTOWN, WV. WATER RESOURCES DIV.

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 1511 2F

GEOLOGICAL SURVEY, MS. WATER RESOURCES DIV.

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 1512 2E

GEOLOGICAL SURVEY, NASHVILLE, TN. WATER RESOURCES DIV.

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 1503 2F

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 1512 7C

GEOLOGICAL SURVEY, NORMAN, OK.

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

GEOLOGICAL SURVEY, NSTL STATION, MS. GULF COAST HYDROSCIENCE CENTER.

Vertical Velocity Profiles in Stratified Flows,
W82-01171 1503 8B

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 1505 6G

Volatilization of Ketones From Water,
W82-05782 1511 5C

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 1512 2D

GEOLOGICAL SURVEY, NSTL STATION, MS. WATER RESOURCES DIV.

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 1502 2E

Evapotranspiration from Forage Grass Replacing Native Vegetation in the Gila River Valley of Arizona,
W82-03994 1509 2D

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 1512 2H

GEOLOGICAL SURVEY OF CANADA, OTTAWA (ONTARIO).

Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 1511 2C

GEOLOGICAL SURVEY OF ISRAEL, JERUSALEM.

The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 1511 2E

GEOLOGICAL SURVEY OF NEW SOUTH WALES, SYDNEY (AUSTRALIA). DEPT. OF MINERAL RESOURCES AND DEVELOPMENT.

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

GEOLOGICAL SURVEY, OKLAHOMA CITY, OK. WATER RESOURCES DIV.

Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma,
W82-03999 1509 2E

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 1510 7C

GEOLOGICAL SURVEY, ORLANDO, FL.
Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 1512 5B

GEOLOGICAL SURVEY, ORLANDO, FL. WATER RESOURCES DIV.
Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 1510 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 1511 7C

GEOLOGICAL SURVEY, PASCO, WA. WATER RESOURCES DIV.
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

GEOLOGICAL SURVEY, PORTLAND, OR. WATER RESOURCES DIV.
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 1512 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 1512 7C

GEOLOGICAL SURVEY, PROVIDENCE, RI.
Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 1511 2F

GEOLOGICAL SURVEY, RALEIGH, NC.
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 1507 7B

GEOLOGICAL SURVEY, RALEIGH, NC. WATER RESOURCES DIV.
An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 1501 4B

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 1501 4B

GEOLOGICAL SURVEY, RESTON.
On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 1512 8B

GEOLOGICAL SURVEY, RESTON, VA.
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 1501 5B

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 1502 5B

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

Estimation of Impervious-Area Washoff Parameters,
W82-01465 1503 4C

Discussion: Influence of Well Water Quality Variability on Sampling Decisions and Monitoring, By Harry I. Nightingale and William C. Bianchi,
W82-03779 1509 5G

Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study,
W82-03919 1509 7A

Water Use Data--Who Needs It,
W82-04198 1509 7C

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 1510 5B

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 1510 6B

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 1511 4B

An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 1512 2A

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 1501 10D

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

Organic Substances in Water,
W82-01783 1503 5A

Infectious Waterborne Diseases,
W82-01784 1503 5A

Microbiology of the Aquatic Environment,
W82-01786 1503 5C

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 1503 3A

Biota and Biological Parameters as Environmental Indicators,
W82-01794 1503 5C

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 1505 2B

Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 1506 1B

Stochastic Hydrologic Model for Drought Management,
W82-02897 1506 2E

Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 1508 10B

Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998 1509 2L

Biota and Biological Principles of the Aquatic Environment.
W82-04499 1510 5C

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 1510 5C

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 1512 2E

GEOLOGICAL SURVEY, RESTON VA. WATER RESOURCES DIV.; AND GEOLOGICAL SURVEY, MILFORD, PA. WATER RESOURCES DIV.
Report of the River Master of the Delaware River for the Period December 1, 1979 - November 30, 1980,
W82-03989 1509 4A

GEOLOGICAL SURVEY, RICHMOND, VA. WATER RESOURCES DIV.
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

GEOLOGICAL SURVEY, ROLLA, MO. WATER RESOURCES DIV.
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 1505 7C

GEOLOGICAL SURVEY, SACRAMENTO, CA. WATER RESOURCES DIV.
Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 1510 7C

GEOLOGICAL SURVEY, SACRAMENTO, CALIF. WATER RESOURCES DIVISION.
Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 1512 4A

GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 1502 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 1502 7C

Water Resources Data for Utah, Water Year 1979.
W82-02474 1505 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 1510 6D

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

GEOLOGICAL SURVEY, SAN ANTONIO, TX. WATER RESOURCES DIV.

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79,
W82-04987 1511 7C

GEOLOGICAL SURVEY, SAN JUAN, PR. WATER RESOURCES DIV.

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

GEOLOGICAL SURVEY, ST. PAUL, MN. WATER RESOURCES DIV.

Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 1501 5B

Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 1505 7C

Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 1506 2F

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

GEOLOGICAL SURVEY, SYOSSET, NY. WATER RESOURCES DIV.

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 1508 4B

Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 1501 4A

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 1503 2E

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.

Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 1501 5F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 1501 5B

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 1501 10C

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 1503 7C

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 1503 10C

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 1505 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 1505 7C

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 1506 2E

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

Hydrologic Almanac of Florida,
W82-03974 1509 7C

Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 1510 10C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 1511 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 1511 2F

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 1512 7C

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 1512 5B

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 1512 7B

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 1512 7C

Water Resources Data for Florida, Water Year 1980--Volume 2B. South Florida Ground Water,
W82-06956 1512 7C

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIVISION.

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 1503 7C

GEOLOGICAL SURVEY, TAMPA, FL.

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

GEOLOGICAL SURVEY, TAMPA, FL. WATER RESOURCES DIV.

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

GEOLOGICAL SURVEY, TOWSON, MD.

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

GEOLOGICAL SURVEY, TOWSON, MD. WATER RESOURCES DIV.

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 1501 2F

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 1505 2F

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 1510 7C

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 1512 2F

GEOLOGICAL SURVEY, TRENTON, NJ. WATER RESOURCES DIV.

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

Water-Quality Data for the Potomac-Rarita Magothy Aquifer System, Trenton to Pe ville, New Jersey, 1980,
W82-04515 1510 7C

GEOLOGICAL SURVEY, TUCSON, AZ. WATER RESOURCES DIV.

Delineation of Flood Hazards in the Jayn Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 1511 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 1511 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

GEOLOGICAL SURVEY, TUSCALOOSA, AL. WATER RESOURCES DIV.

Induced Sinkholes: An Engineering Problem,
W82-02559 1505 4B

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 1511 2E

GEOLOGICAL SURVEY, UNIV., AL. WATER RESOURCES DIV.

Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 1512 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascaguoula, and Tennessee River Basins,
W82-06954 1512 7C

GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 1502 7C

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 1503 4A

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

GEOLOGISCHES LANDESAMT NORDRHEIM-WESTFALEN, KREFELD (GERMANY, F.R.).
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

GEORGE WASHINGTON UNIV., WASHINGTON, DC.
Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

GEORGE WASHINGTON UNIV., WASHINGTON, DC. DEPT. OF ENGINEERING ADMINISTRATION.
An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning,
W82-03942 1509 6B

Theory and Reality in Allocating Federal Resources to Water Resources Development,
W82-04224 1509 6E

GEORGE WASHINGTON UNIV., WASHINGTON, DC. PROGRAM OF POLICY STUDIES IN SCIENCE AND TECHNOLOGY.
Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 1512 6B

GEORGE WASHINGTON UNIV., WASHINGTON, DC. SCHOOL OF ENGINEERING AND APPLIED SCIENCE.
A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

GEORGETOWN UNIV., WASHINGTON, DC. DEPT. OF BIOLOGY.
Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 1505 5B

A Culture Model for Phytoplankton Succession in the Potomac River Near Washington, D.C. (U.S.A.),
W82-03765 1509 5B

GEORGIA INST. OF TECH., ATLANTA.
Disinfection,
W82-01250 1503 5D

Storm Water Management: The Concept and Its Application,
W82-04240 1509 4A

Detention Basins--An Urban Experience,
W82-04332 1510 4A

GEORGIA INST. OF TECH., ATLANTA. ENGINEERING EXPERIMENT STATION.
An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF BIOLOGY.
Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 1501 5D

Mixing Zone Analysis for River Plumes,
W82-01961 1504 5B

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Urban Rainfall-Runoff Modelling Using Remote Sensing Imagery,
W82-03820 1509 2A

Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 1510 5D

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 1512 5D

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF INDUSTRIAL AND SYSTEMS ENGINEERING.
A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

GEORGIA PACIFIC CORP., FORT BRAGG, CA.
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

GEORGIA SOUTHWESTERN COLL., AMERICUS. DEPT. OF BIOLOGY.
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

GEORGIA SOUTHWESTERN COLL., AMERICUS. DEPT. OF GEOLOGY AND PHYSICS.
The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 1511 3B

GEORGIA UNIV. AT ATHENS.
Nutrient Cycling in an Agricultural Watershed: Waterborne Nutrient Input/Output Budgets for the Riparian Zone,
W82-03825 1509 5B

GEORGIA UNIV., ATHENS.
New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

GEORGIA UNIV., ATHENS. DEPT. OF MICROBIOLOGY.
The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria,
W82-03770 1509 5E

Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 1512 2L

GEORGIA UNIV., ATHENS. DEPT. OF POULTRY SCIENCE.
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY.
Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

GEORGIA UNIV., ATHENS. INST. OF ECOLOGY.
Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

GEORGIAN SCIENTIFIC RESEARCH INST. OF POWER AND HYDRAULIC STRUCTURES (USSR).
Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 1512 8B

GEOTEAM A/S, OSLO (NORWAY).
Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 1512 8E

GEOTECHNICAL CONSULTANTS, INC., SAN FRANCISCO, CA.
Coupled Heat and Water Flows Around Buried Cables,
W82-02680 1506 2G

GEOTHECHNICAL ENGINEERS INC., WINCHESTER, MA.
The Steady State of Deformation,
W82-02235 1505 8D

GEOTRANS, INC., RESTON, VA.
Ground-Water Modeling: Recent Developments,
W82-00281 1501 2F

Computer Modeling and Ground-Water Protection,
W82-01336 1503 2F

Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

GERAGHTY AND MILLER, INC., ANNAPOLIS, MD.
Evaluation of Hydrogeologic Conditions,
W82-01420 1503 5G

GERAGHTY AND MILLER, INC., SYOSSET, NY.
Ground Water,
W82-01273 1503 2F

GERAGHTY AND MILLER, INC., WEST PALM BEACH, FL.
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 1505 2F

GESELLSCHAFT FUER BIOTECHNOLOGISCHE FORSCHUNG, M.B.H., STOCKHEIM (GERMANY, F.R.).
Occurrence of Cytophagas in Sewage Plants,
W82-00682 1502 5A

GHANA INST. OF AQUATIC BIOLOGY, ACHIMOTA.
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 1512 5C

GHANA UNIV., LEGON, DEPT OF GEOLOGY.
The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 1512 2J

GHENT RIJKSUNIVERSITEIT (BELGIUM). ZOOLOGY INST.
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

GIBBS AND HILL, INC., NEW YORK.
Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 1506 5E

GILBERT/COMMONWEALTH, JACKSON, MI.
Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

GINGERY ASSOCIATES, INC., ENGLEWOOD, CO.
Design of a Leachate Collection System for a Sludge Filled Landfill,
W82-03935 1509 5E

GLASGOW UNIV. (SCOTLAND). DEPT. OF CHEMISTRY.
Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

GLASGOW UNIVERSITY (SCOTLAND), DEPARTMENT OF CHEMISTRY.
Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

GLOBE LININGS INC., LONG BEACH, CA.
The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 1510 5G

GOETEBORG UNIV. (SWEDEN). DEPT. OF OCEANOGRAPHY.
On The Rate of Ice Formation in Water Cooled by a More Saline Sublayer,
W82-04190 1509 2C

GOETEBORG UNIV. (SWEDEN). DEPT. OF ZOOLOGY.
Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

GOETEBORG UNIV. (SWEDEN). DEPT. OF ZOOPHYSIOLOGY.
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

GORE AND STORRIE LTD., TORONTO (ONTARIO).
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 1505 7B

GORKII STATE UNIV. (USSR).
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 1504 2H

GOSUDARSTVENNYI GIDROLOGICHESKII INST., LENINGRAD (USSR).
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 1503 4C

Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

GOSUDARSTVENNYI NAUCHNO-ISSLEDOVATELSKII INST. GORNOKHIMICHESKOGO SYRYA, LYUBERTSII (USSR).
Prospects of Using Magnetic Wastewater Treatment,
W82-06989 1512 5D

GOSUDARSTVENNYI NAUCHNO-ISSLEDOVATELSKII INST. OZERNOGO I RECHNOGO RYBNOGO KHOZYAISTVA, LENINGRAD (USSR).
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

GOVERNMENT ENGINEERING COLL., TRICHUR (INDIA). DEPT. OF CIVIL ENGINEERING.
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 1501 5D

GOVERNMENT INDUSTRIAL RESEARCH INST., NAGOYA (JAPAN).
Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 1512 5A

The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 1512 5D

GOVERNORS STATE UNIV., PARK FOREST SOUTH, IL. COLL. OF ENVIRONMENTAL AND APPLIED SCIENCES.
Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 1503 5B

GOVIND BALLABH PANT UNIV. OF AGRICULTURE AND TECHNOLOGY, PANTNAGAR (INDIA).
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 1503 2I

GOVIND BALLABH PANT UNIV. OF AGRICULTURE AND TECHNOLOGY, PANTNAGAR (INDIA). DEPT. OF SOIL SCIENCE.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 1504 2I

GRAHAM ASSOCIATES, INC., DALLAS, TX.
Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 1511 6B

GRANADA UNIV. (SPAIN). DEPT. OF ECOLOGY.
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 1502 5B

GRANADA UNIV. (SPAIN). DEPT. OF MICROBIOLOGY.
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 1502 5A

GREAT LAKES BASIN COMMISSION, ANN ARBOR, MI.
Pollution From Land Runoff,
W82-00253 1501 5B

GREAT LAKES FORESTRY RESEARCH CENTER, SAULT STE. MARIE (ONTARIO).
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 1501 2C

GREAT LAKES STEEL, DETROIT, MI.
Beneficial Disposal of Pickle Liquor,
W82-06486 1512 5D

GREAT SMOKY MOUNTAINS NATIONAL PARK, GATLINBURG, TN.
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 1502 6A

GREAT SMOKY MOUNTAINS NATIONAL PARK, GATLINBURG, TN. UPLANDS FIELD RESEARCH LAB.
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 1503 6A

GREATER CHICAGO METROPOLITAN SANITARY DISTRICT, IL.
Dentrification,
W82-01246 1503 5D

GREATER LAWRENCE SANITARY DISTRICT, NORTH ANDOVER, MA.
Shaking Down a Solids Handling System,
W82-04338 1510 5D

GREELEY AND HANSEN, CHICAGO, IL.
Disposal and Handling of Water Treatment Plant Sludge,
W82-04126 1509 5E

Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

GREELEY DEPT. OF PUBLIC WORKS AND UTILITIES, CO.
Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

GREENHORNE AND O'MARA, INC., RIVERDALE, MD.
Put Pressure on Sewage,
W82-06732 1512 5D

GREENSBORO PUBLIC WORKS DEPT., NC WATER AND SEWER ADMINISTRATION.
Water Conservation Program of the City of Greensboro,
W82-02518 1505 3D

GRENOBLE-1 UNIV. (FRANCE). INST. DE MECANIQUE.
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

GRENOBLE UNIV. (FRANCE). UNITE DE GEOLOGIE ET DE PHARMACIE.
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

GRIFFITH UNIV., BRISBANE, QUEENSLAND (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution, 1503 2A
W82-01617

GRIFFITH UNIV., NATHAN (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity, 1504 2G
W82-01897

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement, 1506 5B
W82-02922

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland, 1508 4A
W82-03705

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils, 1511 5B
W82-04876

A Contribution to Simplified Models of Field Solute Transport, 1511 5B
W82-04877

Optimization Principle for Air and Water Movement, 1511 2G
W82-05172

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia, 1511 4A
W82-05572

GROUND WATER ASSOCIATES, INC., WESTERVILLE, OH.
Fundamental Concepts of Well Design, 1506 8A
W82-02614

GROUNDWATER SURVEY TNO, DELFT (NETHERLANDS).
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan, 1502 2F
W82-00852

GROUPEMENT NATIONAL D'ETUDES DES FLEAUX ATMOSPHERIQUES, GRENOBLE (FRANCE).
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment, 1503 2B
W82-01732

GUAM UNIV., AGANA. MARINE LAB.
Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L., 1502 5D
W82-00937

GUAM UNIV., AGANA. WATER AND ENERGY RESEARCH INST.
The Development of a Village Water Supply System on Truk, 1506 5F
W82-02816

Metal Concentrations in Guam Urban Runoff, 1511 5B
W82-05302

The Effects of Land-Clearing on a Small Watershed in Southern Guam, 1511 5C
W82-05303

Water Quality Assessment for Agana Springs, 1511 5A
W82-05304

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta), 1511 5G
W82-05311

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W82-05865

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W82-06146

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W82-06525

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W82-01452

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W82-02146

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Northern Elbe Culvert, 1511 8B
W82-05427

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Alternative Indices of Resilience,
W82-05045 1511 6A

Estimates of Resilience Indices by Simulation,
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Estimating Resilience by Canonical Analysis,
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Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 1502 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 1503 2I

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Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

IBADAN UNIV. (NIGERIA). DEPT. OF GEOGRAPHY.
On Water Availability and Demand in Nigeria,
W82-03062 1507 6D

IBM SCIENTIFIC CENTER, HAIFA (ISRAEL).
Loop Equations with Unknown Pipe Characteristics,
W82-02258 1505 3F

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Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 1507 2H

ICI AMERICAS, INC., WILMINGTON, DE.
Controlling Bed Losses of Granular Activated Carbon Through Proper Filter Operation,
W82-04089 1509 5F

IDAHO DIV. OF ENVIRONMENT, POCATELLO.
Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

IDAHO UNIV., MOSCOW.
The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 1512 3F

IDAHO UNIV., MOSCOW. COLL. OF ENGINEERING.
Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

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Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ECONOMICS.
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 1502 4D

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ECONOMICS AND APPLIED STATISTICS.
Primary and Secondary Impacts of a Water Resource Development Project,
W82-03907 1509 6B

IDAHO UNIV., MOSCOW. DEPT. OF AGRICULTURAL ENGINEERING.
Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 1508 3F

Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

IDAHO UNIV., MOSCOW. DEPT. OF ECONOMICS.
Price or Persuasion,
W82-05791 1511 6C

IDAHO UNIV., MOSCOW. DEPT. OF ELECTRICAL ENGINEERING.
Selecting Seasonal Streamflow Models,
W82-02502 1505 2E

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Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 1512 2H

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Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 1511 5B

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Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 1510 5C

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Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 1503 2F

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Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 1512 5F

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, SPRINGFIELD.
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
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Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
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Abundance of Organic Compounds in Water,
W82-01162 1503 5A

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY, SPRINGFIELD. DIV. OF LAND/NOISE POLLUTION CONTROL.
Illinois Groundwater Problems and Needs,
W82-01052 1502 4B

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Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

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A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 1506 5F

Biodegradation of Hazardous Organic Pollutants,
W82-04910 1511 5B

ILLINOIS INST. OF TECH., CHICAGO. PRITZER DEPT. OF ENVIRONMENTAL ENGINEERING.
Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

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Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 1502 5A

Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 1512 5F

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W82-04389 1510 5C

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Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 1502 5B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 1502 7B

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

ILLINOIS POWER COMPANY, DECATUR.
Wastewater Treatment at an Electrical Generation Station,
W82-05975 1512 5D

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Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

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Adsorption of PCBs by Cellulose Fiber Filteraids and Carbonaceous Adsorbents Used for Water Treatment,
W82-03937 1509 5F

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Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

Selection of Waste disposal sites,
W82-06550 1512 5E

ILLINOIS STATE GEOLOGICAL SURVEY, URBANA.
Modeling the Transport of Heat, Water, and Solute in Unsaturated Soil and Earth Materials,
W82-03958 1509 5B

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Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

ILLINOIS STATE UNIV., NORMAL. DEPT. OF ECONOMICS.
Water Quality and the Demand for Recreation,
W82-01942 1504 6D

ILLINOIS STATE WATER SURVEY, CHAMPAIGN.
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 1508 5B

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

ILLINOIS STATE WATER SURVEY DIV., CAMPAIGN; AND ILLINOIS STATE GEOLOGICAL SURVEY DIV., CHAMPAIGN.
Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

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Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

Hydrologic Applications of Weather and Climate Information,
W82-03871 1509 7C

Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

Carrying Capacity of Flood Plains,
W82-06428 1512 2E

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

ILLINOIS STATE WATER SURVEY DIV., CHAMPAIGN; AND ILLINOIS STATE GEOLOGICAL SURVEY DIV., CHAMPAIGN.
Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

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Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

ILLINOIS STATE WATER SURVEY, URBANA.
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 1502 2B

Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 1510 2B

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04358 1510 5G

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 1510 2J

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

ILLINOIS UNIV. AT CHICAGO CIRCLE, CHICAGO. DEPT. OF GEOLOGICAL SCIENCES.
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 1503 2H

ILLINOIS UNIV. AT CHICAGO CIRCLE. SCHOOL OF URBAN SCIENCES.
Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 1510 6B

ILLINOIS UNIV. AT THE MEDICAL CENTER, CHICAGO.
Recreational Water Quality and Health,
W82-02997 1506 5C

ILLINOIS UNIV. AT THE MEDICAL CENTER, CHICAGO, IL. SCHOOL OF PUBLIC HEALTH.
Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 1503 5D

ILLINOIS UNIV. AT THE MEDICAL CENTER, CHICAGO. SCHOOL OF PUBLIC HEALTH.
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 1502 5F

ILLINOIS UNIV. AT URBANA-CHAMPAIGN.
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 1506 5A

Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

Pesticides in the Aquatic Environment,
W82-04727 1510 5C

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ECONOMICS.
The Economics of Cooperation Over Collective Bads,
W82-01909 1504 6A

Some Emerging Rights in Agricultural Land,
W82-04890 1511 6E

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ENGINEERING.
Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 1511 2A

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 1512 4D

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF ATMOSPHERIC SCIENCES.
Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 1512 2B

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF BOTANY.
Photosynthesis and Growth in Populations of Populus Deltoides from Contrasting Habitats,
W82-00935 1502 2I

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 1503 8D

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 1503 6A

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Substrate Flux into Biofilms of Any Thickness,
W82-01964 1504 5D

Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 1505 5F

Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 1511 5A

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 1511 5A

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

Effects of Salts on Activated Carbon Adsorption of Fulvic Acids, 1511 5F
W82-05667

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF ENVIRONMENTAL ENGINEERING.
The Monochloramine-GAC Reaction in Adsorption Systems, 1510 5F
W52-04426

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF FORESTRY.
Water Quality from Two Small Forested Watersheds in Southern Illinois, 1503 4C
W82-01140

First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield, 1512 4C
W82-06589

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF GENERAL ENGINEERING.
Optimal Stream-Aquifer Development, 1505 6A
W82-02575

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF GEOLOGY.
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks, 1512 2F
W82-05904

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF LANDSCAPE ARCHITECTURE.
Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems, 1503 6A
W82-01450

ILLINOIS UNIV AT URBANA-CHAMPAIGN. INST. FOR ENVIRONMENTAL STUDIES.
Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters, 1511 5A
W82-04821

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir, 1511 4C
W82-04966

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. WATER RESOURCES CENTER.
Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes, 1509 2J
W82-03960

ILLINOIS UNIV., URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ENGINEERING.
Splash Erosion Modeling: Physical Analysis, 1512 2J
W82-05970

ILLINOIS UNIV., URBANA-CHAMPAIGN. DEPT. OF GEOLOGY.
Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water, 1509 2F
W82-03796

ILLINOIS UNIVERSITY AT URBANA-CHAMPAIGN. INST. FOR ENVIRONMENTAL STUDIES.
Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants, 1512 5D
W82-06178

ILLINOISS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL AND HYDROSYSTEMS ENGINEERING.
Hydraulic Exponents, 1508 2E
W82-03669

IMPERIAL CHEMICAL INDUSTRIES LTD., BRIXHAM (ENGLAND).
The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test, 1511 5C
W82-04825

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).
Sedimentation of Zeolite Type A in Water and Waste Water, 1502 5D
W82-02848

Design of Filters for Clay Cores of Dams, 1510 8G
W82-04321

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters, 1512 5D
W82-06459

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). CENTRE FOR ENVIRONMENTAL TECHNOLOGY.
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W82-03341

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Demand Forecasting in Water Supply Networks, 1506 6D
W82-02926

Detergent Builders and Water Quality - A Changing Scene, 1507 5C
W82-03093

Risk Analysis in the Planning, Design and Operational Control of Water Pollution Prevention Schemes- A Perspective, 1509 5G
W82-03857

Estimation and Control Problems in Activated Sludge Processes, 1510 5D
W82-04612

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England, 1512 5A
W82-06081

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal, 1512 5D
W82-06338

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The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges, 1503 5E
W82-01387

IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND). PUBLIC HEALTH ENGINEERING LAB.
Some Methods Available for Treatment of Waste Water in the Dairy Industry, 1508 5D
W82-03650

Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent, 1511 5A
W82-04815

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process, 1511 5C
W82-04829

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process, 1511 5D
W82-04937

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process, 1512 5D
W82-06193

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge, 1512 5D
W82-06667

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND).
Storm Runoff from Small Lowland Catchments in Southwest England, 1511 4C
W82-05653

INDIAN AGRICULTURAL RESEARCH INST., NEW DELHI.
Effect of Saline Irrigation Water on the Yield of Potato, 1505 3C
W82-02396

Consumptive Water Use by Opium Poppy, 1507 2I
W82-03356

Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley, 1512 2I
W82-05972

INDIAN AGRICULTURAL RESEARCH INST., NEW DELHI. DIV. OF AGRICULTURAL ECONOMICS.
Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows, 1509 3F
W82-03914

INDIAN AGRICULTURAL RESEARCH INST., NEW DELHI (INDIA). WATER TECHNOLOGY CENTER.
Ground-Water Recharge from Rectangular Areas, 1506 2F
W82-02791

INDIAN COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.
Irrigation Requirements of Field-Pea for Grain, 1505 2I
W82-02395

INDIAN HEALTH SERVICE, SEATTLE, WA. OFFICE OF ENVIRONMENTAL HEALTH.
Soil Percolation Tests, 1502 2G
W82-01044

INDIAN INST. OF SCIENCE, BANGALORE. DEPT. OF CIVIL ENGINEERING.
Multiobjective Analysis of Irrigation Planning in River Basin Development, 1506 6A
W82-02855

INDIAN INST. OF SCIENCE, BANGALORE (INDIA). DEPT. OF CIVIL ENGINEERING.
Parametric Study of Flood Wave Propagation, 1508 2E
W82-03425

INDIAN INST. OF TECH., BOMBAY. CENTRE OF STUDIES OF RESOURCES ENGINEERING.
Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India, 1511 7C
W82-05612

INDIAN INST. OF TECH., KANPUR. DEPT. OF CIVIL ENGINEERING.
Removal of Inorganic Mercury from Water by Bitmuminous Coal, 1512 5D
W82-06265

INDIAN INST. OF TECH., NEW DELHI.
Study of a Complex Water Resources System with Screening and Simulation Models, 1503 6A
W82-01309

INDIAN INST. OF TECH., NEW DELHI. DEPT. OF CIVIL ENGINEERING.
Analysis of Pumping Test Data Using Marquardt Algorithm, 1506 2F
W82-02721

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Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 1511 2A

INDIAN SPACE RESEARCH ORGANIZATION, AHMEDABAD. SPACE APPLICATIONS CENTRE.
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

INDIANA STATE BOARD OF HEALTH, INDIANAPOLIS.
Secondary Benthic Production in a Tropical Island Stream,
W82-06933 1512 5C

INDIANA STATE BUDGET AGENCY. INDIANAPOLIS.
Household Water Use: Technological Shifts and Conservation Implications,
W82-03910 1509 3D

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Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 1511 6D

INDIANA UNIV. AT BLOOMINGTON. DEPT. OF CHEMISTRY.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

INDIANA UNIV. AT BLOOMINGTON. DEPT. OF GEOLOGY.
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 1502 7B

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana,
W82-03810 1509 2F

INDIANA UNIV. AT BLOOMINGTON. SCHOOL OF PUBLIC AND ENVIRONMENTAL AFFAIRS.
Aromatic Amines in and Near the Buffalo River,
W82-00622 1502 5B

INDIANA UNIV., BLOOMINGTON. DEPT. OF BIOLOGY.
Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 1512 5C

INDIANA UNIV., BLOOMINGTON. SCHOOL OF PUBLIC AND ENVIRONMENTAL AFFAIRS.
Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 1511 5B

INDIANA UNIV.-PURDUE UNIV. AT INDIANAPOLIS. DEPT. OF GEOLOGY.
A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 1508 2H

INDIANAPOLIS POWER AND LIGHT CO., IN.
Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

INDO-BRITISH BETWA GROUNDWATER PROJECT, BHOPAL (INDIA).
Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

INDUSTRIE PIRELLI, S.P.A., MILAN (ITALY). (ASSIGNEE).
Floating Breakwater,
W82-00067 1501 8A

INGENIEURGESELLSCHAFT M.B.H., PFORZHEIM (GERMANY, F.R.).
Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

INGENIEURS A LA SOCIETE LYONNAISE DES EAUX ET DE L'ECLAIRAGE, PARIS (FRANCE).
Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 1503 6F

INLAND CONTAINER CORP., NEWPORT MILL, IN.
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W82-03593 1508 5D

INLAND WATERS DIRECTORATE, ENVIRONMENT CANADA, OTTAWA, ONTARIO.
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W82-06568 1512 2E

INLAND WATERS DIRECTORATE, OTTAWA (ONTARIO).
Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

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Water Quality Data, Mackenzie River Basin 1960-1979.
W82-02506 1505 7C

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Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

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Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

INSTITUT ARMAND-FRAPPIER, LAVAL (QUEBEC). CENTRE DE RECHERCHE EN VIROLOGIE.
A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 1503 5A

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Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

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W82-03491 1508 2L

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Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 1508 2B

INSTITUT FRESENIUS, CHEMISCHE UND BIOLOGISCHE LABORATORIEN GMBH, TAUNUSSTEIN-NEUHOF (GERMANY, F.R.).
Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 1510 5F

INSTITUT FUER ANORGANISCHE UND ANGEWANDTE CHEMIE. HAMBURG (GERMANY, F.R.).
Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 1507 5A

INSTITUT FUER MEERESFORSCHUNG, BREMERHAVEN (GERMANY, F.R.). DEPT. OF BOTANY.
On Some Chytrids Found in Estuarine Habitats,
W82-02038 1504 2L

INSTITUT FUER WASSERGUTE UND LANDSCHAFTSWASSERBAU, VIENNA (AUSTRIA).
Multi-Objective Decision Making in Water Management,
W82-04010 1509 6A

INSTITUT FUER WASSERWIRTSCHAFT, BERLIN (GERMAN D.R.).
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 1504 2H

INSTITUT JOZEF STEFAN, LJUBLJANA (YUGOSLAVIA).
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 1512 5A

INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE, PARIS (FRANCE).
Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 1506 3F

INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE, THONON-LES-BAINS (FRANCE).
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique), 1501 2H
W82-00305

INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE, VILLENEUVE-D' ASCQ (FRANCE). STATION DE TECHNOLOGIE ALIMENTAIRE.
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires), 1510 5D
W82-04544

INSTITUT NATIONAL DE LA RECHERCHE SCIENTIFIQUE, SAINTE-FOY (QUEBEC).
A Method for Estimating Peak Water Demand of Multifamily Residences, 1510 6D
W82-04734

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants, 1512 5A
W82-06577

INSTITUT NATIONAL DES SCIENCES APPLIQUEES, TOULOUSE (FRANCE). LAB. DE CHIMIE ET GENIE DE L'ENVIRONNEMENT.
Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French), 1508 5A
W82-03485

Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French), 1508 5A
W82-03486

INSTITUT NATIONALE DE LA RECHERCHE SCIENTIFIQUE, SAINTE FOY (QUEBEC).
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics, 1503 2E
W82-01317

INSTITUT ZA VODOPRIVREDU JAROSLAV CERNI, BELGRADE (YUGOSLAVIA).
Reliability Programming in Reservoir Management 2. Risk-Loss Functions, 1507 6A
W82-03245

The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming, 1511 6A
W82-05523

INSTITUTE FOR LAND AND WATER MANAGEMENT RESEARCH, WAGENINGEN (NETHERLANDS).
Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm, 1511 2B
W82-04864

Water Quality and Hydrology in a Coastal Region of the Netherlands, 1512 5B
W82-06103

INSTITUTE FOR MARINE ENVIRONMENTAL RESEARCH, PLYMOUTH (ENGLAND).
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada, 1502 6G
W82-00908

Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget, 1503 2A
W82-01399

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary, 1503 2L
W82-01749

A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data, 1505 2L
W82-02193

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary, 1507 5A
W82-03345

INSTITUTE FOR SOIL FERTILITY, GRONINGEN (NETHERLANDS). DELFT HYDRAULIC LAB.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries, 1503 2J
W82-01714

INSTITUTE FOR WATER RESEARCH LTD., DORTMUND (GERMANY, F. R.).
Use of Algal Fluorescence for an Automated Biological Monitoring System, 1511 5A
W82-05728

INSTITUTE FOR WATER RESOURCES (ARMY), FORT BELVOIR, VA.
Report of Survey of Corps of Engineers Construction Workforce, 1501 6B
W82-00102

INSTITUTE FUER MEERESFORSCHUNG (GERMANY, D.R.).
Turbidity Maximum and Mud Shoaling in the Weser Estuary, 1512 5B
W82-06766

INSTITUTE FUER WASSERWIRTSCHAFT, BERLIN (GERMAN D.R.).
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle), 1510 5A
W82-04580

INSTITUTE OF BIOLOGY OF THE SOUTHERN SEAS.
Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea, 1511 5B
W82-05458

INSTITUTE OF BIOLOGY OF THE SOUTHERN SEAS, SEVASTOPOL (USSR).
Fine Structure of Salinity in the Water Off the Danube Estuary, 1506 2L
W82-02892

INSTITUTE OF CIVIL AND CONSTRUCTION ENGINEERING, SPLIT (YUGOSLAVIA). FACULTY OF CIVIL ENGINEERING.
Accuracy of Suspended Sediment Measurements in Natural Streamflows, 1504 2J
W82-02002

INSTITUTE OF GAS TECHNOLOGY, CHICAGO, IL.
Anaerobic Processes, 1503 5D
W82-01245

INSTITUTE OF GAS TECHNOLOGY, CHICAGO, IL.
Anaerobic Processes, 1512 5D
W82-06923

INSTITUTE OF GENERAL AND MUNICIPAL HYGIENE, MOSCOW (USSR).
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring, 1504 6E
W82-01990

Health Aspects of Water Desalination, 1507 3A
W82-03116

Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody), 1508 3A
W82-03698

INSTITUTE OF GEOLOGICAL SCIENCE, LONDON (ENGLAND).
Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin, 1512 2J
W82-05959

INSTITUTE OF GEOLOGICAL SCIENCE, WALLINGFORD (ENGLAND).
Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests, 1506 2F
W82-02917

INSTITUTE OF GEOLOGICAL SCIENCES, HARWELL (ENGLAND). ENVIRONMENTAL PROTECTION UNIT.
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal, 1502 7B
W82-00603

INSTITUTE OF GEOLOGICAL SCIENCES, LONDON (ENGLAND).
The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon, 1511 2K
W82-05801

INSTITUTE OF GEOLOGICAL SCIENCES, LONDON (ENGLAND). GEOCHEMISTRY AND PETROLOGY DIV.
Major Evaporite Deposition from Groundwater Remobilized Salts, 1507 5B
W82-03339

INSTITUTE OF GEOLOGICAL SCIENCES, WALLINGFORD (ENGLAND).
A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data, 1505 8E
W82-02292

Identification of Connate Water in Interstitial Solution of Chalk Sediment, 1508 2K
W82-03642

A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing, 1509 2F
W82-03804

INSTITUTE OF GEOLOGICAL SCIENCES, WALLINGFORD (ENGLAND). (UNITED KINGDOM).
The Likelihood of Active Groundwater Recharge in the Botswana Kalahari, 1511 4B
W82-05657

INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).
Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy, 1502 2D
W82-00655

Adaptive Hydrological Forecasting - A Review, 1502 2A
W82-00984

INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 1502 2F

The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

Flood Event Modeling - A Study of Two Methods,
W82-02291 1505 2A

A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 1507 5B

A Distribution Function Approach to Rainfall Runoff Modeling,
W82-03845 1509 2A

Resistance Equation for Large-Scale Roughness,
W82-04696 1510 2E

Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 1512 4A

INSTITUTE OF LIMNOLOGY, NIEUWERSLUIS (NETHERLANDS).
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 1506 2K

INSTITUTE OF OCEAN SCIENCES, SIDNEY (BRITISH COLUMBIA).
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

INSTITUTE OF OCEANOGRAPHIC AND FISHERIES RESEARCH, ATHENS (GREECE).
Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 1512 5B

INSTITUTE OF OCEANOGRAPHIC AND FISHERIES RESEARCHES, ATHENS (GREECE).
Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 1506 2H

INSTITUTE OF OCEANOGRAPHIC SCIENCES, MERSEYSIDE (ENGLAND).
Salinity Intrusion in Estuaries,
W82-04574 1510 2L

INSTITUTE OF OCEANOGRAPHIC SCIENCES, TAUNTON (ENGLAND).
A Suspended Sediment Front in the Severn Estuary,
W82-04639 1510 2L

INSTITUTE OF OCEANOGRAPHIC SCIENCES, TAUNTON (UNITED KINGDOM).
Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 1503 2L

INSTITUTE OF OCEANOGRAPHIC SCIENCES, WORMLEY (ENGLAND).
The Mixing Layer of Loch Ness,
W82-02421 1505 2H

INSTITUTE OF OCEANOGRAPHY AND FISHERIES, CAIRO (EGYPT). INLAND WATERS AND FISH CULTURE DIV.
Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

INSTITUTE OF PAPER CHEMISTRY, APPLETON, WI.
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 1501 5A

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

INSTITUTE OF RADIATION PROTECTION, HELSINKI (FINLAND).
Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

INSTITUTE OF SOIL FERTILITY, GRONINGEN (NETHERLANDS).
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 1502 2G

INSTITUTE OF TERRESTRIAL ECOLOGY, HUNTINGDON (ENGLAND). MONKS WOOD EXPERIMENTAL STATION.
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

INSTITUTE OF WATER CONSERVANCY AND HYDROELECTRIC POWER RESEARCH, BEIJING (CHINA).
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 1507 2J

Bed Load Fluctuation: Applications,
W82-05600 1511 2J

INSTITUTO DE PESQUISAS ESPACIAIA, SAO PAULO (BRAZIL).
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 1507 2B

INSTITUTO DE PESQUISAS HYDRAULICAS, PORTO ALEGRE (BRAZIL).
Unsteady Water Quality Model for River Network,
W82-02873 1506 5G

INSTITUTO NACIONAL DE TECHNOLOGIA INDUSTRIAL, MAR DEL PLATA (ARGENTINA).
Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

INSTITUTT FOR ENERGITEKNIKK, KJELLER (NORWAY).
Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 1512 5A

INSTITUTUL POLITEHNIC DIN BUCURESTI (ROMANIA). POWER DIV.
Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 1503 6A

INSTITUUT VOOR CULTURRTECHNIEK EN WATERHUISHOUDING, WAGENINGEN (NETHERLANDS).
Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 1508 5B

INSTITUUT VOOR CULTUURTECHNIEK EN WATERHUISHOUDING, WAGENINGEN (NETHERLANDS).
Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 1508 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 1508 2B

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION, BOISE, ID.
Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

INTERNACIONAL DE ENGENHARIA, RIO DE JANEIRO (BRAZIL).
Hydraulic Gates: The State-of-the-Art,
W82-00332 1501 8C

INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES, PARIS (FRANCE).
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT, WASHINGTON, DC. POLICY PLANNING DIV.
Long-Run Effects of Environmental Regulation,
W82-01848 1504 6A

INTERNATIONAL CROPS RESEARCH INST. FOR THE SEMI-ARID TROPICS, PATACHERU (INDIA).
A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 1511 2E

INTERNATIONAL CROPS RESEARCH INST. FOR THE SEMI-ARID TROPICS, PATANCHERU (INDIA).
Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

INTERNATIONAL ENGINEERING CO., INCORP., SAN FRANCISCO, CA.
Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 1510 2F

INTERNATIONAL ENVIRONMENTAL CONSULTANTS LTD., ISLINGTON (ONTARIO).
Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

INTERNATIONAL ENVIRONMENTAL CONSULTANTS LTD., TORONTO (ONTARIO).
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT, ROME (ITALY).
Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 1508 6F

INTERNATIONAL INST. FOR APPLIED SYSTEMS ANALYSIS, LAXENBURG (AUSTRIA).
Operational Estimation and Prediction of Nitrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

Robustness of Water Resources Systems,
W82-05077 1511 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Cost Allocation in Water Resources Development,
W82-06854 1512 6C

INTERNATIONAL INST. FOR LAND RECLAMATION AND IMPROVEMENT, WAGENINGEN (NETHERLANDS).
Practical Prediction of Actual Evapotranspiration,
W82-02308 1505 2D

Wheat Yield Estimation in Northwest Iran,
W82-03267 1507 2I

INTERNATIONAL INST. OF TROPICAL AGRICULTURE, IBADAN (NIGERIA).
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 1503 2G

INTERNATIONAL JOINT COMMISSION-UNITED STATES AND CANADA, WINDSOR (ONTARIO).
Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 1502 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 1502 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 1502 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 1502 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 1502 5C

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W82-00707 1502 5C

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W82-00708 1502 5C

INTERNATIONAL JOINT COMMISSION-UNITED STATES AND CANADA, WINDSOR (ONTARIO). GREAT LAKES SCIENCE ADVISORY BOARD.
Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 1507 5G

INTERNATIONAL JOINT COMMISSION-UNITED STATES AND CANADA, WINDSOR (ONTARIO). GREAT LAKES WATER QUALITY BOARD.
Great Lakes International Surveillance Plan,
W82-00701 1502 6E

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 1507 5G

1981 Report on Great Lakes Water Quality.
W82-03102 1507 5G

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 1507 5G

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W82-03104 1507 5A

INTERNATIONAL LAB. OF MARINE RADIOACTIVITY, MONTE CARLO (MONACO). OCEANOGRAPHIC MUSEUM.
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

INTERNATIONAL NICKEL INC., STERLING FOREST, NY.
Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

INTERNATIONAL PAPER CO., TUXEDO PARK, NY.
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 1502 5C

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

INTERNATIONAL REFERENCE CENTER FOR THE COMMUNITY WATER SUPPLY, THE HAGUE (NETHERLANDS).
How Proper Prospecting Improves the Odds,
W82-05757 1511 3B

INTERNATIONAL RICE RESEARCH INST., LOS BANOS, LAGUNA (PHILIPPINES).
Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 1510 2I

INTERNATIONAL RICE RESEARCH INST., LOS BANOS, LAGUNA (PHILLIPPINES).
Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

INTERNATIONAL RICE RESEARCH INST. LOS BANOS (PHILIPPINES).
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

INTERNATIONAL SOCIETY OF ECOLOGICAL MODELLING, COPENHAGEN (DENMARK).
Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

INTERNATIONAL WATER RESOURCES ASSOCIATION, BUENOS AIRES (ARGENTINA).
The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 1511 6E

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN, ROCKVILLE, MD.
Analyzing the Risk of Drought: The Occoquan Experience,
W82-04097 1509 2A

INTERTECHNOLOGY/SOLAR CORP., WARRENTON, VA.
Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 1511 3A

INTERUNIVERSITAIR REACTOR INST., DELFT (NETHERLANDS).
Proton Mobility in Ice,
W82-03701 1508 2C

IONICS, INC., WATERTOWN, MA.
Pumping Station Reliability: How and How Much,
W82-04110 1509 8C

Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

IOWA DEPT. OF TRANSPORTATION, AMES.
The Challenge of Upgrading Roadside Rest Areas,
W82-06845 1512 5G

IOWA STATE UNIV., AMES.
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 1501 5D

Protecting Agriculture's Natural Resource Base,
W82-00176 1501 4D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 1501 5D

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 1503 6A

A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 1503 2A

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

IOWA STATE UNIV., AMES. CENTER FOR AGRICULTURAL AND RURAL DEVELOPMENT.
Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

Projected Effects of Energy Policies on Agricultural Water Use and Irrigation,
W82-03915 1509 6C

IOWA STATE UNIV., AMES. DEPT. OF AGRICULTURAL ENGINEERING.
Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 1505 5B

Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 1511 5B

IOWA STATE UNIV., AMES. DEPT. OF ANIMAL ECOLOGY.
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 1501 2H

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 1511 2H

IOWA STATE UNIV., AMES. DEPT. OF BOTANY AND PLANT PATHOLOGY.
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 1502 2H

IOWA STATE UNIV., AMES. DEPT. OF CIVIL ENGINEERING.
Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 1503 5A

Declining-Rate Filtration,
W82-03656 1508 5F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 1508 2A

Specific Oxygen Demand as an Operating Parameter for Activated Sludge Processes,
W82-04029 1509 5D

Tapered Inlet Design Using Specific Energy Curves,
W82-04695 1510 8A

IOWA STATE UNIV., AMES. DEPT. OF ECONOMICS.
The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 1506 6A

IOWA STATE UNIV., AMES. DEPT. OF SOCIOLOGY AND ANTHROPOLOGY.
Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 1503 3D

Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

IOWA STATE UNIV., AMES. ENGINEERING RESEARCH INST.
Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

IOWA STATE WATER RESOURCES RESEARCH INST., AMES.
Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 1507 2F

IOWA UNIV., IOWA CITY.
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

Flow Characteristics Below Floating Covers with Application to Ice Jams,
W82-03011 1507 2C

IOWA UNIV., IOWA CITY. COLL. OF ENGINEERING.
Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 1511 5D

IOWA UNIV., IOWA CITY. DEPT. OF CIVIL ENGINEERING.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

IOWA UNIV., IOWA CITY. DIV. OF ENERGY.
River Bed Aggradation Due to Overloading,
W82-01486 1503 2J

IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
Cooling Potential of Missouri River in Missouri,
W82-01654 1503 5B

Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 1505 2C

Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 1512 5G

IOWA UNIV., IOWA CITY. INST. OF HYDROLOGICAL RESEARCH.
Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 1510 2J

IOWA UNIV., IOWA CITY. INST. OF URBAN AND REGIONAL RESEARCH.
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 1502 6A

IRKUTSK UNIV. (USSR). BIOLOGICAL RESEARCH INST.
Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 1506 5C

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Ozone for the Treatment of Hazardous Materials,
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W82-04421 1510 5G

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W82-04362 1510 2G

Infiltration into Two-Layered Soil Profiles,
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A Comparison of Three Infiltration Models,
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Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
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W82-03884 1509 3C

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Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
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W82-04280 1510 5D

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 1510 5F

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Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
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The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
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Evaluation of Groundwater Resources in Tokar Delta, Sudan,
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Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
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The Bed Depth Service Time Design Method for Deep Bed Filtration,
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Exploiting Papyrus,
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Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
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Free Surface Oscillations in Lake Kinneret,
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An Assessment of Current Standards for Selenium in Drinking Water,
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W82-04177 1509 2K

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Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 1505 6G

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Mass Transfer in the U-Turn of an Electrodialyzer,
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A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

KRAFT, INC., GLENVIEW, IL.
Dairy Wastes,
W82-01258 1503 5D

Comparison of BOD Relationships for Typical Edible and Petroleum Oils,
W82-06458 1512 5D

Dairy Wastes,
W82-06921 1512 5D

KRAMER, CHIN, AND MAYO, PORTLAND, OR.
Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 1510 5D

KREBS (PAUL B.) AND ASSOCIATES, INC., BIRMINGHAM, AL.
Textile Wastes,
W82-06916 1512 5D

KROFTA ENGINEERING CORP., LENOX, MA.
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 1512 5F

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Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 1507 5A

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Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
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KUMAUN UNIV., NAINI TAL (INDIA). DEPT. OF ZOOLOGY.
Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

KUMAUN UNIV., NAINITAL (INDIA). DEPT. OF ZOOLOGY.
Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

KUPPER (CHARLES J.), INC., PISCATAWAY, NJ.
Overhauling a Water System,
W82-06224 1512 5F

KURITA WATER INDUSTRIES LTD., YOKOHAMA (JAPAN).
Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

KUWAIT UNIV. DEPT. OF CHEMICAL ENGINEERING.
Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 1505 5D

KYOTO INST. OF TECH. (JAPAN). DEPT. OF CHEMISTRY.
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 1501 5D

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Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 1511 5D

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Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

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Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

KYOTO UNIV. (JAPAN). DEPT. OF SANITARY ENGINEERING.
The Effect of Particle Substrate on Mineralization Performance and the Formation of Excess Sludge in a Complete Mixing Aeration Tank,
W82-04012 1509 5D

A Control System for Smaller Wastewater Treatment Plants,
W82-04024 1509 5D

A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

An Approach to the Control of the Activated Sludge System by Use of a Succession Model,
W82-04057 1509 5D

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Paleolimnology of Lake Kizaki,
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Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

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An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

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Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 1504 5D

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Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 1507 5C

L'AQUILA UNIV. (ITALY). FACULTY OF ENGINEERING.
Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

Analysis of Large Desalination Plants,
W82-06122 1512 3A

LA SOCIETE D'ENERGIE DE LA BAIE JAMES, MONTREAL (QUEBEC).
James Bay Spillways and Control Structures,
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On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
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LABORATOIRE DE CHIMIE INORGANIQUE ET NUCLEAIRE, LOUVAIN (BELGIUM).
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

LABORATORIO NACIONAL DE ENGENHARIA CIVIL LISBON (PORTUGAL). DEPT. OF HYDRAULICS.
Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 1507 8A

LABORATORIUM FUER ADSORPTIONSTECHNIK, G.M.B.H., FRANKFURT AM MAIN (GERMANY, F.R.).
Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 1511 5D

LAFAYETTE COLL., EASTON, PA.
Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 1510 6C

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Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

LAHMEYER INTERNATIONAL G.M.B.H., FRANKFURT AM MAIN (GERMANY, F. R.).
The Value of Inspection Galleries,
W82-06204 1512 8D

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The Decline of Salvinia Molesta on Lake Kariba,
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Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam, 1512 6G
W82-06090

Influence of Dredging and High Discharge on the Ecology of Black Canyon, 1512 6G
W82-06091

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam, 1512 6G
W82-06092

LAMAR UNIV., BEAUMONT, TX. DEPT. OF BIOLOGY.
Water Quality of a Southeast Texas Stream, 1505 2K
W82-02570

LAMAR UNIVERSITY, BEAUMONT, TX. DEPT. OF BIOLOGY.
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas, 1502 5C
W82-00924

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation, 1501 7B
W82-00104

Field Assessment of Sediment Traps, 1501 7B
W82-00105

Salt Dispersion in the Hudson Estuary, 1503 2L
W82-01615

Summer Ice and Carbon Dioxide, 1504 2C
W82-01843

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary, 1505 2L
W82-02117

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers, 1505 2L
W82-02576

Radionuclides in Mono Lake, California, 1511 5B
W82-05461

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments, 1511 2J
W82-05868

Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps, 1512 5C
W82-06736

LANCASTER UNIV., BAILRAGG (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River, 1503 5B
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The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique, 1510 7B
W82-04643

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The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity, 1507 2D
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Physiochemical Speciation of Lead in Drinking Water, 1507 5F
W82-03198

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Americium in Intertidal Sediments from the Coastal Environs of Windscale, 1504 5B
W82-02098

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea, 1508 5B
W82-03696

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium, 1511 5B
W82-05178

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary, 1512 5B
W82-05984

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The Role of Suspended Solids in the Estuarine Geochemistry of Mercury, 1512 5B
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Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune, 1512 5C
W82-06944

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The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions, 1503 7A
W82-01646

LANCHESTER POLYTECHNIC, COVENTRY (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Primary Sedimentation of Sewage, 1508 5D
W82-03429

Storm Sewer Flow Computations, 1510 7B
W82-04640

Microstrainer Theory and the Filtrability Index of Sewage Effluents, 1512 5D
W82-06647

LANDESAMT FUER GEWASSERKUNDE, MAINZ (GERMANY, F.R.).
Telemetric Water Control System of the Artificially Aerated Mosel River, 1510 5G
W82-04598

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Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development, 1505 4A
W82-02119

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Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode, 1502 5A
W82-01100

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A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation, 1503 5B
W82-01145

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W82-03464

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Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)), 1510 2L
W82-04331

Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy, 1511 2L
W82-05193

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Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model, 1505 2L
W82-02306

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Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord, 1503 5B
W82-01639

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay), 1503 2J
W82-01644

LAW ENGINEERING TESTING CO., ATLANTA, GA.
Practical Aspects of Ground Water Monitoring at Existing Disposal Sites, 1503 5G
W82-01421

LAW ENGINEERING TESTING CO., MARIETTA, GA.
Land Treatment Site Evaluation in Southeastern Mountainous Areas, 1503 5D
W82-01596

Geologic Aspects of Waste Disposal Site Evaluations, 1504 5E
W82-02011

A Retrospective Benefit-Cost Analysis of Water Resource Projects in The Cumberland River Basin, 1509 6B
W82-03917

LAW ENGINEERING TESTING CO., TAMPA, FL.
Well-Field Drawdowns Using Coupled Aquifer Model, 1502 2F
W82-00990

LAWRENCE LIVERMORE NATIONAL LAB., CA.
Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results, 1511 5B
W82-05008

LEE COUNTY HYACINTH CONTROL DISTRICT, FORT MYERS, FL.
Biological Control of Aquatic Weeds in Southwest Florida, 1505 4A
W82-02285

LEEDS UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration, 1503 5A
W82-01620

Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater, 1507 5A
W82-03122

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Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 1501 5B

Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

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A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

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Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 1511 2K

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Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
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Hereditary Phenomena in Turbulent Boundary Layers,
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W82-01455 1503 6E

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W82-05433 1511 6E

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Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
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Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
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Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 1501 5B

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Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 1512 5C

LIMNOS LIMITED, TORONTO, ONTARIO.
Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

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Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 1504 5D

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The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 1507 2H

LINCOLN COLL. (NEW ZEALAND). DEPT OF AGRICULTURAL ENGINEERING.
Origin of Step-Pool Systems in Mountain Streams,
W82-06335 1512 2J

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W82-05050 1511 2A

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Methods for Level 2 Analysis by Organic Compound Category,
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Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
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Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
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The Occurrence of Sewage-Borne Pathogens in the UK,
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Prediction of the Circulation in Reservoirs,
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The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
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Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
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Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
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Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

LOMBARDO AND ASSOCIATES, BOSTON, MA.
Expanding Options for Greywater Treatment,
W82-06491 1512 5D

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Lower Flow Regime Bedforms: Rational Classification,
W82-06421 1512 2E

LOS ALAMOS NATIONAL LAB., NM.
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 1503 5B

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Ground Water Alternatives and Solutions,
W82-00029 1501 6D

Water Related Planning and Design at Energy Firms,
W82-00042 1501 6D

Water Supply and Demand in an Energy Supply Model,
W82-00050 1501 6D

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

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Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 1510 5D

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Computer Modeling of Los Angeles Water Resources,
W82-01168 1503 6A

Controlling the Cost of System Maintenance,
W82-04139 1509 8G

LOS ANGELES COUNTY SANITATION DISTRICT, CA.
Pressure Sewer Systems,
W82-00528 1502 5D

LOS ANGELES COUNTY SANITATION DISTRICTS, CA.
Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

LOS ANGELES COUNTY SANITATION DISTRICTS, WHITTIER, CA.
Foam Control in Aeration Tanks,
W82-00171 1501 5D

A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
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Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 1512 5D

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Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

The Tertiary Treatment of Sewages. Conclusion,
W82-03228 1507 5D

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They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 1512 5F

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An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 1511 8B

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Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 1503 5A

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Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 1505 2J

Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 1510 7B

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 1510 5D

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Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 1511 5C

LOUISIANA STATE UNIV., BATON ROUGE. COASTAL ECOLOGY LAB.
Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 1501 2A

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 1505 2H

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Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 1503 8C

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Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 1507 2G

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Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

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The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 1501 6A

Mechanism of Enteroviral Inactivation by Ozone,
W82-01482 1503 5D

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 1508 5E

Will New Orleans Miss The Mississippi,
W82-04274 1510 4A

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

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Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 1504 2J

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Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

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Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

LOUISIANA STATE UNIV., BATON ROUGE. INST. OF ENVIRONMENTAL STUDIES.
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

LOUISIANA STATE UNIV., BATON ROUGE. LAB. FOR WETLAND SOILS AND SEDIMENTS.
Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 1503 5B

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Kinetics of Nitrogen Loss in Simulated Wastewater Treatment in a Soil-Plant System,
W82-03869 1509 5D

LOUISIANA STATE UNIV., BATON ROUGE. SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT.
Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 1505 6G

LOUISIANA STATE UNIV. MEDICAL CENTER, NEW ORLEANS. DEPT. OF MICROBIOLOGY.
Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

LOUISIANA TECHNICAL UNIV., RUSTON. DEPT. OF AGRICULTURAL ENGINEERING.
Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 1506 7A

LOUISIANA WATER RESOURCES RESEARCH INST., BATON ROUGE.
Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 1510 8B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 1511 8B

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

LOUISVILLE GAS AND ELECTRIC CO., KY.
Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

LOUISVILLE UNIV., KENTUCKY. DEPT. OF CIVIL ENGINEERING.
Bank Failure and Erosion on the Ohio River,
W82-02343 1505 2J

LOUISVILLE UNIV., KY. DEPT. OF BIOLOGY.
Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 1503 5C

LOUISVILLE UNIV., KY. DEPT. OF CHEMICAL AND ENVIRONMENTAL ENGINEERING.
Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 1510 5D

A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 1510 6A

LOUISVILLE UNIV., KY. DEPT. OF CIVIL ENGINEERING.
Bank Failure and Erosion on the Ohio River,
W82-04473 1510 2J

LOUISVILLE WATER CO., KY.
Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

LOUVAIN UNIV. (BELGIUM). APPLIED MATHEMATICS DIV.
A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

LOUVAIN UNIV. (BELGIUM). INST. D'ADMINISTRATION ET DE GESTION.
Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 1506 5D

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 1506 5D

LOUVAIN UNIV. (BELGIUM). LAB. OF INDUSTRIAL MICROBIOLOGY AND BIOCHEMISTRY.
Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

LOWELL UNIV., MA.
Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5E

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

LOWELL UNIV., MA. DEPT. OF CIVIL ENGINEERING.
Vacuum Filtration of Septage,
W82-04710 1510 5D

LOWELL UNIV., MA. DEPT. OF EARTH SCIENCES.
Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 1510 2A

LOXTON, HUNTING AND ASSOCIATES, GABERONE (BOTSWANA).
Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

LOZIER ENGINEERS, INC., ROCHESTER, NY.
Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

LULEA UNIV. (SWEDEN). DIV. OF WATER RESOURCES ENGINEERING.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01288 1504 2D

Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 1512 2E

LULEAP UNIV. (SWEDEN). DIV. OF WATER RESOURCES ENGINEERING.
The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 1512 2C

LUND INST. OF TECH. (SWEDEN). DIV. OF AUTOMATIC CONTROL.
Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

LUND UNIV. (SWEDEN). INST. OF LIMNOLOGY.
Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 1512 5C

LUND UNIV. (SWEDEN). LIMNOLOGICAL INST.
Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 1505 2K

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

LUXEMBOURG FOUNDATION UNIV., ARLON.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 1504 2G

LVOV UNIV., (USSR).
Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-03455 1511 2H

LWFW, INC., DALLAS, TX.
Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 1507 6A

Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 1507 6A

LYCOMING COUNTY PLANNING COMMISSION, WILLIAMSPORT, PA.
Don't Dams the Stanislaus,
W82-03275 1507 6E

LYNCHBURG REGIONAL WASTEWATER TREATMENT PLANT, VA.
Virginians Optimize Sludge Handling,
W82-05171 1511 5D

LYNE AND MARTIN PUBLIC ANALYSTS, READING (ENGLAND).
Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 1510 5C

LYON-1 UNIV., VILLEURBANNE (FRANCE). DEPT. DE BIOLOGIE ANIMAUX ET ZOOLOGIE.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 1504 7B

LYON-1 UNIV., VILLEURBANNE (FRANCE). LAB. DE PHYSIQUE DES MATERIAUX.
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

MACDONALD COLL, MONTREAL (QUEBEC).
Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

MACDONALD COLL., STE. ANNE DE BELLEVUE (QUEBEC). DEPT. OF AGRICULTURAL ENGINEERING.
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 1508 2A

MACLAREN (J. F.) LTD., WILLOWDALE (ONTARIO).
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

MACLAREN (JAMES F.) LTD., TORONTO (ONTARIO). WATER RESOURCES DIV.
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 1503 5G

MACLAREN (JAMES F.) LTD., WILLOWDALE (ONTARIO).
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 1505 5E

MACQUARIE UNIV., NORTH RYDE (AUSTRALIA). SCHOOL OF EARTH SCIENCES.
The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 1505 2E

MADHYA PRADESH IRRIGATION DEPT., BHOPAL (INDIA).
The Chambal Project: Problems and Solutions,
W82-01739 1503 4A

MADHYA PRADESH STATE PLANNING BOARD, BHOPAL (INDIA).
Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 1512 5F

MADRAS UNIV. (INDIA). CENTRE OF ADVANCED STUDY IN BOTANY.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 1504 5B

MADRID UNIV. (SPAIN). DEPT. OF GEOLOGY AND GEOCHEMISTRY.
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

MADURAI KAMARAJ UNIV. (INDIA). DEPT. OF BIOLOGICAL SCIENCES.
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

MAGYAR TUDOMANYOS AKADEMIA, TIHANY. BIOLOGICAL RESEARCH INST.
Heavy Metals in Animals of Lake Balaton,
W82-06284 1512 5C

MAHI-KADANA IRRIGATION PROJECT, AHMEDABAD (INDIA).
Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 1508 9B

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 1510 3F

MAIN ADMINISTRATION FOR CONSTRUCTION AND INSTALLATION OF HYDROELECTRIC POWER PLANTS IN THE EAST (USSR).
Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 1506 8A

MAINE COOPERATIVE FISHERY RESEARCH UNIT, ORONO.
Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 1512 5C

MAINE OFFICE OF ENERGY RESOURCES, AUGUSTA.
Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 1512 6E

MAINE UNIV. AT ORONO.
Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

MAINE UNIV. AT ORONO; AND COLUMBIA NATIONAL FISHERIES RESEARCH LAB.
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 1503 5B

MAINE UNIV. AT ORONO. DEPT. OF CIVIL ENGINEERING.
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 1511 5B

UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 1512 5D

MAINE UNIV., AT ORONO. DEPT. OF FOOD SCIENCE.
High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 1508 5A

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5B

MAINE UNIV. AT ORONO. DEPT. OF GEOLOGICAL SCIENCES.
The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

MAINE UNIV. AT ORONO. DEPT. OF OCEANOGRAPHY.
Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 1508 2L

MAINE UNIV. AT ORONO. DEPT. OF PHYSICS.
Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

MAINE UNIV. AT ORONO. DEPT. OF PHYSICS AND ASTRONOMY.
High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 1511 5A

MAINE UNIV. AT ORONO. DEPT. OF ZOOLOGY AND COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 1504 5C

MAINE UNIV. AT ORONO. LAND AND WATER RESOURCES CENTER.
Input/Output Models as Decision Aids for Lake Restoration,
W82-03924 1509 5G

The Aquatic Insects of The Narraguagus River, Hancock and Washington Counties, Maine,
W82-04167 1509 2E

The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 1510 5C

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

MAINE UNIV. AT ORONO. SCHOOL OF FOREST RESOURCES.
Effects of a Castleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

MAINE UNIVERSITY AT ORONO, WALPOLE.
Retention of Riverine Iron in Estuaries,
W82-06191 1512 5B

MAINZ UNIV. (GERMANY, F.R.). HYGIENE INST.
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 1512 5A

MAJOR HOLDINGS LTD., KITCHENER (ONTARIO).
Stormwater Management - One Developer's Experience,
W82-05777 1511 6B

MALAYA UNIV., KUALA LUMPUR (MALAYSIA). DEPT. OF ZOOLOGY.
Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 1503 2H

MALCOLM PIRNIE, INC., PARAMUS, NJ.
Selection of a Sludge Handling Disposal System,
W82-06346 1512 5E

MALVIYA REGIONAL ENGINEERING COLL. JAIPUR (INDIA), DEPT. OF CIVIL ENGINEERING.
Conformal Mapping for Channel Junction Flow,
W82-04306 1510 2E

MANCHESTER INST. OF SCIENCE AND TECHNOLOGY (ENGLAND).
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 1501 5D

MANCHESTER UNIV. (ENGLAND). DEPT. OF BACTERIOLOGY.
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 1507 2L

MANCHESTER UNIV. (ENGLAND). DEPT. OF CHEMISTRY.
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 1507 5B

MANCHESTER WATER WORKS, NH.
Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 1510 5G

MANITOBA DEPT. OF NATURAL RESOURCES, WINNIPEG.
Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 1511 4A

MANITOBA UNIV., WINNIPEG. DEPT. OF BOTANY.
Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 1503 2H

MANITOBA UNIV., WINNIPEG. DEPT. OF GEOGRAPHY.
A New Era for China's Hydropower,
W82-00335 1501 8A

China's Agro-Ecosystem,
W82-06019 1512 3B

MANITOBA UNIV., WINNIPEG. DEPT. OF ZOOLOGY.
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

MANKATO STATE UNIV., MN.
Shock Load of Chromium (VI),
W82-05253 1511 5D

MARATHWADA AGRICULTURAL UNIV., PARBHANI (INDIA).
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 1511 8B

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

MARIA-CURIE SKLODOWSKA UNIV., LUBLIN (POLAND). DEPT. OF CHEMICAL TECHNOLOGY.
A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 1506 5D

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM, PLYMOUTH (ENGLAND).
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 1501 2K

An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1507 1B

MARINE DEPT., ROTORUA (NEW ZEALAND). FISHERIES RESEARCH DIV.
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 1502 3B

MARINE LAB., ABERDEEN (SCOTLAND).
Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 1512 5C

MARQUETTE UNIV., MILWAKEE, WI. DEPT. OF CIVIL ENGINEERING.
Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 1511 5A

MARQUETTE UNIV., MILWAUKEE, WI.
Calorific Value of Wastewater Plant Sludges,
W82-04997 1511 5E

MARQUETTE UNIV., MILWAUKEE, WI. DEPT. OF CIVIL ENGINEERING.
Delivery of Suspended Sediment and Pollutants from Nonpoint Sources during Overland Flow,
W82-03902 1509 2J

MARTIKI COAL CORP., DENVER, CO.
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 1503 5D

MARYLAND DEPT. OF NATURAL RESOURCES, ANNAPOLIS.
Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

The Hazards of Hazardous Waste Management,
W82-01940 1504 6E

MARYLAND ENVIRONMENTAL SERVICE, ANNAPOLIS.
An Alternative Wastewater Disinfectant,
W82-00950 1502 5D

MARYLAND OFFICE OF ENVIRONMENTAL PROGRAMS, ANNAPOLIS.
Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 1503 5E

MARYLAND TECHNICAL ADVISORY SERVICE, COLLEGE PARK.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 1503 6B

MARYLAND UNIV., BALTIMORE. DEPT. OF MICROBIOLOGY.
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

MARYLAND UNIV., COLLEGE PARK.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 1503 2F

Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 1503 2C

MARYLAND UNIV., COLLEGE PARK. CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES.
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

MARYLAND UNIV., COLLEGE PARK. COLL. OF ENGINEERING.
Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CHEMISTRY.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 1504 5A

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

Ion Hydration and Ion Interaction,
W82-05310 1511 2K

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CIVIL ENGINEERING.
Comparison of Detention Basin Planning and Design Models,
W82-02592 1505 6A

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

A Decision Theory Approach to Earth Dam Classification,
W82-04152 1509 8A

Water Quality Trap Efficiency of Storm Water Management Basins,
W82-04248 1509 5G

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 1510 2A

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 1511 5D

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 1511 2E

Water Yield Estimation in Western United States,
W82-05689 1511 4D

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 1512 2A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF MICROBIOLOGY.
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

Effect of Kepone on Estuarine Microbial Activity,
W82-01231 1503 5C

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 1503 5A

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF RECREATION.
Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 1501 2J

MARYLAND UNIV., COLLEGE PARK. DEPT. OF ZOOLOGY.
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

MARYLAND UNIV., COLLEGE PARK. SCHOOL OF ENGINEERING.
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01137 1503 2G

MARYLAND UNIV., COLLEGE PARK. WATER RESOURCES RESEARCH CENTER.
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 1506 5B

Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 1512 5D

MARYLAND UNIV. EASTERN SHORE, PRINCESS ANNE. DEPT. OF NATURAL SCIENCES.
Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 1501 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 1501 2K

MARYLAND UNIV., FROSTBURG. APPALACHIAN ENVIRONMENTAL LAB.
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania, 1501 2E
W82-00109

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation, 1510 6G
W82-04735

MARYLAND UNIVERSITY, SOLOMONS. CHESAPEAKE BIOLOGICAL LAB.
Freshwater Influences on Striped Bass Population Dynamics, 1505 6G
W82-02116

MASON AND HANGER-SILAS MASON CO., INC., LEONARD, NJ.
Dispersant Application System for the U.S. Coast Guard 32-Foot WPB, 1511 5G
W82-05069

MASON AND HANGER-SILAS MASON CO., INC., LEONARDO, NJ.
Using Coherent Water Jets to Control Oil Spills, 1507 5G
W82-03031

Performance Testing of the Soviet Oil/Debris Skimmer, 1510 5G
W82-04621

Performance Testing of the Diperna Sweeper, 1511 5G
W82-05058

Performance Testing of Four Skimming Systems, 1511 5G
W82-05059

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms, 1511 5G
W82-05062

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials, 1511 5G
W82-05063

MASSACHUSETTS DEPT. OF ENVIRONMENTAL QUALITY ENGINEERING, BOSTON.
Massachusetts Water Supply Priorities, 1510 6D
W82-04698

MASSACHUSETTS DEPT. OF PUBLIC WORKS, TEWKSBURY, MA.
Conducting a Regular Main Flushing Program, 1509 5F
W82-04118

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation, 1501 2B
W82-00132

The Geochemical Control of Seawater (Sillen Revisited), 1504 2K
W82-01936

The Irrigation Scheduling Problem and Evapotranspiration Uncertainty, 1506 2D
W82-02900

Real-Time, Statistically Linearized, Adaptive Flood Routing, 1512 4A
W82-06855

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts, 1502 2K
W82-00887

Intraseasonal Water Allocation in Deficit Irrigation, 1504 3F
W82-01916

Probabilistic Stability Analysis of Earth Slopes, 1504 8D
W82-01952

Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method, 1507 2G
W82-03321

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development, 1507 2F
W82-03329

Local Irrigation Agencies, 1510 4B
W82-04560

A Low-Cost Multichannel Recording Piezometer System for Wetland Research, 1511 7B
W82-05076

River-Basin Simulation in Systems with Large Response Time, 1511 2A
W82-05496

Identification of Independent Rainstorms, 1511 2B
W82-05708

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis, 1512 2I
W82-06321

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications, 1512 2I
W82-06322

Dilution Analysis for Unidirectional Diffusers, 1512 8B
W82-06420

Hydrothermal Analysis of Lakes and Reservoirs, 1512 2H
W82-06425

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model, 1512 2G
W82-06857

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF MATHEMATICS.
Finite-Amplitude Stability of Axisymmetric Pipe Flow, 1511 8B
W82-05087

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. LAB. OF APPLIED BIOCHEMISTRY.
Application of Immobilized Hydrogenase for the Detritiation of Water, 1502 5D
W82-00768

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. OPERATIONS RESEARCH CENTER.
A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks, 1503 6A
W82-01296

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. RALPH M. PARSONS LAB. FOR WATER RESOURCES AND HYDRODYNAMICS.
Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts, 1505 5C
W82-02233

MASSACHUSETTS UNIV., AMHERST. DEPT OF CHEMISTRY.
The Corrosion of Copper by Chlorinated Drinking Waters, 1512 5F
W82-06051

MASSACHUSETTS UNIV., AMHERST. DEPT. OF ENVIRONMENTAL SCIENCES.
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts, 1511 5C
W82-04947

MASSACHUSETTS UNIV., AMHERST. DEPT. OF FORESTRY AND WILDLIFE MANAGEMENT.
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis, 1501 2L
W82-00259

A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain, 1501 2I
W82-00397

Flow Analysis of Models of the Hubbard Brook Ecosystem, 1502 1A
W82-01038

MASSACHUSETTS UNIV., AMHERST. DEPT. OF LANDSCAPE ARCHITECTURE AND REGIONAL PLANNING.
Drought Management: Expecting the Unexpected, 1511 3D
W82-05649

MASSACHUSETTS UNIV., AMHERST. DIV. OF PUBLIC HEALTH.
Health Effects of Monochloramines in Drinking Water, 1502 5C
W82-01091

MASSACHUSETTS UNIV., AMHURST. DEPT. OF CHEMISTRY.
The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters, 1508 5A
W82-03529

MASSACHUSETTS UNIV., BOSTON. DEPT. OF BIOLOGY.
Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms, 1512 5B
W82-06719

MASSACHUSETTS UNIV., WALTHAM. DEPARTMENT OF ENVIRONMENTAL SCIENCE.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum, 1503 4A
W82-01796

MASSEY UNIV., PALMERSTON NORTH (NEW ZEALAND). DEPT. OF SOIL SCIENCE.
Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed, 1501 5B
W82-00173

Casein Whey Wastewater Effects on Soil Permeability, 1511 3C
W82-04874

MATHEMATICAL SCIENCES NORTHWEST, INC., BELLEVUE, WA.
Institutional Analysis Criteria for Water Supply Planning, 1509 6D
W82-03930

MATHES (JOHN) AND ASSOCIATES, INC., COLUMBIA, IL.
Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer, 1512 5G
W82-06185

MATRECON, INC., OAKLAND, CA.
Lining of Waste Impoundment and Disposal Facilities. 1501 5E
W82-00099

MAX-PLANCK-INST. FUER LIMNOLOGIE ZU PLOEN (GERMANY, F.R.).
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 1503 2H

MAX PLANCK INST. FUER LIMNOLOGIE ZU PLOEN (GERMANY, F.R.). DEPT. OF TROPICAL ECOLOGY.
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 1502 2H

MAX PLANCK INST. FUER LIMNOLOGIE ZUR HOLSTEIN (GERMANY, F.R.).
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 1503 2H

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 1503 5C

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 1505 5G

Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 1510 2H

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 1511 5C

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 1512 5B

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF CHEMICAL ENGINEERING.
The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 1511 5D

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF CHEMISTRY.
Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 1502 7B

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF CIVIL ENGINEERING AND APPLIED MECHANICS.
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1504 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1504 1B

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF MICROBIOLOGY.
Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 1505 2H

MCGILL UNIV., MONTREAL (QUEBEC). INST. OF OCEANOGRAPHY.
On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 1505 2L

MCGILL UNIVERSITY, MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 1501 2H

MCGRAW-EDISON CO., MOUNTAINSIDE, NJ.
Using Pumps as Small Turbines,
W82-05597 1511 8C

MCGRAW-EDISON CO., N.Y.
Design Considerations in Waterworks Pumps Selection,
W82-06343 1512 8C

MCKEE (ARTHUR G.) AND CO., CLEVELAND, OH.
Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 1501 5D

MCKINSEY AND CO., AMSTERDAM, (NETHERLANDS).
Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 1507 5D

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF BIOLOGY.
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 1502 5G

Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 1506 5C

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 1507 5C

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 1512 5C

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF GEOGRAPHY.
Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 1502 2C

The Effects of Surface Dust on Snowmelt Rates,
W82-00845 1502 2C

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 1505 2A

Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 1506 2E

Evaporation at a High Arctic Site,
W82-04899 1511 2D

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF GEOLOGY.
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 1511 5A

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 1511 5B

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF MECHANICAL ENGINEERING.
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 1502 8B

MEDICAL COLL. OF WISCONSIN, MILWAUKEE. DEPT. OF PHARMACOLOGY AND TOXICOLOGY.
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 1501 5C

MEDICAL COLLEGE OF OHIO AT TOLEDO. DEPT. OF MICROBIOLOGY.
Bacterial Control of Aquatic Algal Populations-Phase II,
W82-04163 1509 5C

MEIDENSHA ELECTRIC CO., TOKYO (JAPAN).
Preliminary Studies on Control Parameters and Biological Community for the Activated Sludge Process,
W82-04008 1509 5D

Evaluation of the Resident Mass of Sludge in Final Sedimentation Tanks for Waste Sludge Control,
W82-04015 1509 5D

MEIDENSHA ELECTRIC MFG., CO., LTD., TOKYO (JAPAN).
Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

MEIDENSHA ELECTRIC MFG., CO., TOKYO (JAPAN).
Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

Advanced Supervisory Control System for Sludge Treatment,
W82-04841 1511 5D

MEIKEI HIGH SCHOOL, IBARAKI (JAPAN).
Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

MEIRING (P. G. J.) AND PARTNERS (SOUTH AFRICA).
The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 1511 5D

MELBOURNE UNIV., PARKVILLE (AUSTRALIA). DEPT. OF INDUSTRIAL SCIENCE.
Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 1505 5B

MEMORIAL UNIV. OF NEWFOUNDLAND, ST. JOHN'S. DEPT. OF GEOGRAPHY.
The Water Balance in Newfoundland,
W82-03921 1509 7A

MEMPHIS STATE UNIV., TN. DEPT. OF BIOLOGY.
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 1505 5C

Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 1512 5C

MENASHA CORP., OTSEGO, MI.
Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 1503 5D

MESA ENGINEERING AND SURVEYING CO., INC., MONTROSE, CO.
Packaged Plant Treats Turbidity,
W82-06026 1512 5F

METALLGESELLSCHAFT, A.G., FRANKFURT AM MAIN (GERMANY, F.R.). (ASSIGNEE).
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

METAMETRICS INC., WASHINGTON, DC.
Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 1505 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 1505 3A

METCALF AND EDDY, INC., BOSTON, MA.
High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

Energy Management in the Water Works Industry,
W82-02608 1506 5F

Methods for Evaluating Performance of Filter Media,
W82-02684 1506 5D

Methods for Evaluating Performance of Filter Media,
W82-03661 1508 5F

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

METCALF AND EDDY, INC., NY.
Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 1506 5D

METCALF AND EDDY, INC., PALO ALTO, CA.
Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 1511 5D

METEOROLOGICAL OFFICE, POONA (INDIA).
Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 1510 2B

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 1510 2K

METEOROLOGICAL SATELLITE CENTER, TOKYO (JAPAN).
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

METEROLOGICAL RESEARCH INST., TOKYO (JAPAN). GEOCHEMICAL RESEARCH DIV.
Selenium Content and Its Chemical Form in River Waters of Japan,
W82-04181 1509 5A

METROPOLITAN COUNCIL, ST. PAUL, MN.
Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 1512 2H

METROPOLITAN DENVER SEWAGE DISPOSAL DISTRICT NO. 1, CO.
Energy Minimization at Metro Denver Sewage District,
W82-03142 1507 5D

Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 1510 5D

METROPOLITAN POLLUTION CONTROL-THAMES WATER, LONDON (ENGLAND).
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 1505 5G

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, IL.
Control Systems for Return and Waste Sludge,
W82-00949 1502 5D

Fate of Priority Pollutants in Large Municipal Treatment Plants,
W82-03867 1509 5B

Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, RESEARCH AND DEVELOPMENT DEPARTMENT.
Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5G

METROPOLITAN TORONTO AND REGION CONSERVATION AUTHORITY, DOWNSVIEW (ONTARIO). WATER RESOURCE DIVISION.
Water Management in the Metropolitan Toronto Region,
W82-05775 1511 6B

METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENT, DC.
Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

MIAMI UNIV., FL.
Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

MIAMI UNIV., FL. DEPT. OF MECHANICAL ENGINEERING.
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 1511 5A

MIAMI UNIV., FL. SCHOOL OF MEDICINE.
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

MIAMI UNIV., OXFORD, OH. DEPT. OF ZOOLOGY.
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 1502 5C

MICHIGAN AGRICULTURAL EXPERIMENT STATION, EAST LANSING.
Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

MICHIGAN DEPT. OF NATURAL RESOURCES, LANSING.
A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

MICHIGAN DEPT. OF PUBLIC HEALTH, EAST LANSING.
A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

MICHIGAN DEPT. OF PUBLIC HEALTH, LANSING.
Methane in Water Wells,
W82-05262 1511 5F

Design of Heat Pump Return Wells,
W82-06294 1512 8C

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF AGRICULTURAL ECONOMICS.
Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 1506 6B

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF AGRICULTURAL ENGINEERING.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 1504 3F

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CIVIL AND SANITARY ENGINEERING.
Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 1502 2J

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CIVIL ENGINEERING.
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

Feasibility Studies on Liquid Ion Exchange for Alum Recovery from Water Treatment Plant Sludges,
W82-04107 1509 5E

Densification of Paper Mill Sludge Materials,
W82-04694 1510 5E

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCE.
Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 1508 2H

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 1508 3C

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCES.
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 1504 2H

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF FISHERIES AND WILDLIFE.
Arsenic in Lake Lansing, Michigan,
W82-03522 1508 5B

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF GEOGRAPHY.
Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin,
W82-03817 1509 2J

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF MICROBIOLOGY.
Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 1508 2H

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF RESOURCE DEVELOPMENT.
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 1502 5G

MICHIGAN STATE UNIV., EAST LANSING. INST. OF WATER RESEARCH.
Managing Vegetation in Wastewater Application,
W82-03401 1508 5D

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 1511 6B

MICHIGAN STATE UNIV., HICKORY CORNERS, KELLOGG BIOLOGICAL STATION.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 1504 5F

MICHIGAN STATE UNIV., HICKORY CORNERS. W. K. KELLOGG BIOLOGICAL STATION.
Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 1501 2H

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 1501 2H

Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 1502 2H

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 1512 5C

MICHIGAN STATE UNIVERSITY, DEPARTMENT OF AGRICULTURAL ENGINEERING.
Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 1506 5G

MICHIGAN TECHNOLOGICAL UNIV., HOUGHTON.
Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

MICHIGAN TECHNOLOGICAL UNIV., HOUGHTON. DEPT. OF BIOLOGICAL SCIENCES.
A Study of Biotic Transport of Asbestiform Fibers in Lake Superior,
W82-03950 1509 5B

Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

MICHIGAN TECHNOLOGICAL UNIV., HOUGHTON. DEPT. OF CHEMISTRY AND CHEMICAL ENGINEERING.
Water and Salt Transport in Membranes,
W82-05537 1511 3A

MICHIGAN TECHNOLOGICAL UNIV. HOUGHTON, DEPT. OF CIVIL ENGINEERING.
Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 1512 5C

MICHIGAN UNIV., ANN ARBOR.
Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 1501 5F

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 1503 5C

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 1508 2H

Simulation of Ice-Cover Growth and Thermal Decay on the Upper St. Lawrence River.
W82-03822 1509 2C

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 1511 2H

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ATMOSPHERIC AND OCEANIC SCIENCE.
Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 1503 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 1504 2J

A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 1508 2H

MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 1504 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 1504 2F

Application of Adsorption to Wastewater Treatment,
W82-02622 1506 5D

Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 1508 2H

Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 1511 8B

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND INDUSTRIAL HEALTH.
Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 1501 2H

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 1504 2H

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND WATER RESOURCES ENGINEERING.
Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 1508 5B

MICHIGAN UNIV., ANN ARBOR. DEPT. OF GEOGRAPHY.
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

MICHIGAN UNIV., ANN ARBOR. DIV. OF BIOLOGICAL SCIENCES.
How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 1506 7A

MICHIGAN UNIV., ANN ARBOR. GREAT LAKES AND MARINE WATERS CENTER.
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 1504 2H

MICHIGAN UNIV., ANN ARBOR. GREAT LAKES RESEARCH DIV.
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 1503 2H

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 1505 2H

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 1512 5C

MICHIGAN UNIV., ANN ARBOR. INST. OF SCIENCE AND TECHNOLOGY.
Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

MICHIGAN UNIV., ANN ARBOR. SCHOOL OF NATURAL RESOURCES.
Freshwater Macroinvertebrates,
W82-01281 1503 5C

Input and Output Constraints Affecting Irrigation Development,
W82-01476 1503 6B

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

MICHIGAN UNIV., ANN ARBOR. SCHOOL OF PUBLIC HEALTH.
Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

An Interactive Data Management System for River Water Quality Data,
W82-04659 1510 10B

MICHIGAN UNIV., PELLSTON. BIOLOGICAL STATION.
Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 1501 2I

MICHIGAN UNIVERSITY.
Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 1506 5D

MICHIGAN UNIVERSITY, ANN ARBOR. GREAT LAKES RESEARCH DIVISION.
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 1512 5C

MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). DEPT. OF CHEMICAL ENGINEERING.
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 1512 3A

MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). DEPT. OF CIVIL ENGINEERING.
Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 1512 8B

MIDDLE TENNESSEE STATE UNIV., MURFREESBORO.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 1504 5B

MIDDLEBURY COLL., VT. DEPT. OF BIOLOGY.
Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 1507 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 1507 5C

MIDDLESEX POLYTECHNIC, LONDON (ENGLAND).
Water Quality Indices: An Additional Management Tool,
W82-01994 1504 5G

MIDDLESEX WATER CO., WOODBRIDGE, NJ.
Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

MIDWEST RESEARCH INST., KANSAS CITY, MO.
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 1511 5A

MILAN UNIV. (ITALY). INST. OF GEOFISICA.
Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 1512 2F

MILITARY ENGINEERING SERVICES, HYDERABAD (INDIA).
Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 1512 5C

MILJOSTYRELSEN, CHARLOTTENLUND (DENMARK). MARINE POLLUTION LAB.
Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 1505 5C

MINING DEVELOPMENT INST., BUDAPEST (HUNGARY).
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

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Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

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Morocco's Largest Multipurpose Scheme,
W82-01724 1503 8A

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Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 1506 4B

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Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
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Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
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The Background to the Flood Defences of London and the Thames Estuary,
W82-03895 1509 4A

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The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 1503 6E

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Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 1512 5B

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Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

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International Cooperation to Protect the Baltic,
W82-02087 1504 6E

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Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 1511 8A

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Instrumentation for Aerated Flow on Spillways,
W82-02880 1506 7B

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Decontamination of Overland Runoff from Populated Areas,
W82-06980 1512 5D

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The Eighties--Implications for Water Management,
W82-05772 1511 6B

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New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

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Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 1512 5D

MINISTRY OF TRANSPORT AND PUBLIC WORKS, MIDDELBURG (NETHERLANDS). ENVIRONMENTAL RESEARCH DIV.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

MINISTRY OF TRANSPORT AND PUBLIC WORKS, MIDDLEBURG (NETHERLANDS).
Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

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Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 1510 6A

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Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 1511 2E

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Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 1508 2J

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Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 1512 5B

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Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 1508 5F

The Effect of Backwashing Rate on Filter Performance,
W82-06415 1512 5F

MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST. PAUL.
Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

MINNESOTA DEPT. OF WATER AND GAS, DULUTH.
Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water,
W82-04127 1509 5F

MINNESOTA POLLUTION CONTROL AGENCY, ROSEVILLE.
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 1508 5B

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 1512 5B

MINNESOTA UNIV.-DULUTH.
Modeling the Effects of Conservation Practices on Soil Moisture,
W82-03811 1509 2G

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Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

MINNESOTA UNIV., MINNEAPLIS. DEPT. OF CIVIL AND MINERAL ENGINEERING.
Coagulation: Experiences in Organics Removal,
W82-04424 1510 5F

MINNESOTA UNIV., MINNEAPOLIS.
Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 1507 5C

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CHEMISTRY.
Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 1501 5A

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINERAL ENGINEERING.
Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 1507 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 1507 2F

Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 1511 5D

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINING ENGINEERING.
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 1503 2J

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL ENGINEERING.
Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 1510 3D

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF ECOLOGY AND BEHAVIORAL BIOLOGY.
Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 1512 5C

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF GEOLOGY AND GEOPHYSICS.
Contourites in Lake Superior,
W82-01935 1504 2H

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

MINNESOTA UNIV., MINNEAPOLIS. LIMNOLOGICAL RESEARCH CENTER.
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

MINNESOTA UNIV., MINNEAPOLIS. SCHOOL OF PUBLIC HEALTH.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

MINNESOTA UNIV., MINNEAPOLIS. ST. ANTHONY FALLS HYDRAULIC LAB.
Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

Phosphorus Recycling in Five Shallow Lakes,
W82-04040 1509 2H

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 1511 2E

Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 1511 2J

MINNESOTA UNIV., ST. PAUL.
Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 1505 6G

MINNESOTA UNIV., ST. PAUL. COLL. OF FORESTRY.
Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 1511 6B

MINNESOTA UNIV., ST. PAUL. DEPT. OF AGRICULTURAL ENGINEERING.
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 1502 7B

MINNESOTA UNIV., ST. PAUL. DEPT. OF SOIL SCIENCE.
Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

MINNESOTA UNIV., ST. PAUL. LAB. OF PLANT HARDINESS.
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 1502 2I

MINOR IRRIGATION DEPT., LUCKNOW (INDIA).
Water Quality Monitoring,
W82-03897 1509 5G

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE.
Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 1505 2A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF BIOLOGICAL SCIENCES.
Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 1505 6G

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF CIVIL ENGINEERING.
Overland Flow on a Diverging Surface,
W82-00986 1502 2A

Methods for Treatment of Color in Groundwater,
W82-02532 1505 5F

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 1505 2A

Diverging Overland Flow,
W82-03676 1508 2A

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF MATHEMATICS.
The General Hydrologic System Model,
W82-04314 1510 2A

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DIV. OF BUSINESS RESEARCH.
Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. WATER RESOURCES RESEARCH INST.
Color Removal from Groundwater by Ion Exchange and Sludge Recycle Techniques,
W82-03956 1509 5F

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

MISSISSIPPI UNIV., OXFORD. DEPT. OF CIVIL ENGINEERING.
Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 1512 2F

MISSISSIPPI UNIV., UNIVERSITY. DEPT. OF CIVIL ENGINEERING.
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 1502 2A

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 1507 2F

MISSISSIPPI UNIVERSITY, UNIVERSITY DEPT. OF CIVIL ENGINEERING.
Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

MISSOURI UNIV., COLUMBIA.
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 1501 5D

Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 1501 2J

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

MISSOURI UNIV., COLUMBIA. DEPT. OF ATMOSPHERIC SCIENCE.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 1511 2B

MISSOURI UNIV.-COLUMBIA. DEPT. OF ATMOSPHERIC SCIENCES.
Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 1512 2B

MISSOURI UNIV., COLUMBIA. DEPT. OF CIVIL ENGINEERING.
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

MISSOURI UNIV.-COLUMBIA. DEPT. OF GEOLOGY.
Use of Longitudinal Conductance in Estimating Transmissivity of Granular Aquifers in Northern Missouri,
W82-03957 1509 2F

MISSOURI UNIV.-COLUMBIA. SCHOOL OF FORESTRY, FISHERIES AND WILDLIFE.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 1504 5B

MISSOURI UNIV., KANSAS CITY. DEPT. OF BIOLOGY.
The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

MISSOURI UNIV., KANSAS CITY. DEPT. OF GEOSCIENCES.
Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 1512 6A

MISSOURI UNIV.-ROLLA.
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 1507 2F

MISSOURI UNIV-ROLLA. DEPT. OF CIVIL ENGINEERING.
Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 1506 5F

Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05859 1511 5D

MISSOURI WATER RESOURCES RESEARCH CENTER, COLUMBIA.
Removal of Organics by Reactivated Carbon,
W82-04159 1509 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 1511 5D

Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 1512 5F

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 1512 6B

MITRE CORP., MCLEAN, VA.
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 1501 5D

Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 1503 7B

MITRE CORP., MCLEAN, VA. METREK DIV.
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 1502 5B

MITSUBISHI ELECTRIC CORP., HYOGO (JAPAN).
A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

MOBAY CHEMICAL CORP., KANSAS CITY, MO. DIV. OF AGRICULTURAL CHEMICALS.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 1503 5A

MOBIL OIL A.G., CELLE (GERMANY, F.R.).
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 1512 3A

MODENA UNIV. (ITALY). INST. OF ZOOLOGY.
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

MODO-CHEMETICS, A. B., ORNSKOLDSVIK (SWEDEN).
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 1504 5D

MOLECULON RESEARCH CORP., CAMBRIDGE, MA.
Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

MONASH UNIV., CLAYTON (AUSTRALIA).
Analysis of Detention Basin Systems,
W82-04444 1510 2A

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF CHEMISTRY.
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 1503 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 1503 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 1503 2E

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 1511 2A

Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 1512 2A

Stochastic Generation of Monthly Streamflows,
W82-06427 1512 4A

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Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 1511 6A

MONCTON UNIV., (NEW BRUNSWICK).
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

MONROE COUNTY WATER AUTHORITY, ROCHESTER, NY.
Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 1508 5D

MONSANTO CO., ST. LOUIS, MO.
Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 1502 5B

An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 1502 5A

MONSANTO INDUSTRIAL CHEMICALS CO., ST. LOUIS, MO.
Determining Volatile Organics in Water,
W82-00630 1502 5A

MONSANTO RESEARCH CORP., DAYTON, OH.
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

MONTANA BUREAU OF MINES AND GEOLOGY, BUTTE.
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W82-01022 1502 5B

MONTANA COOPERATIVE FISHERY RESEARCH UNIT, BOZEMAN.
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

MONTANA STATE UNIV., BOZEMAN. COLL. OF ENGINEERING.
Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

MONTANA STATE UNIV., BOZEMAN. DEPT. OF AGRICULTURAL ECONOMICS.
Can Prices Tame the Inflationary Tiger,
W82-04142 1509 6D

MONTANA STATE UNIV., BOZEMAN, DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 1501 6A

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

Initial Degradation of Effluent Quality During Filtration,
W82-04134 1509 5F

MONTANA STATE UNIV., BOZEMAN. DEPT. OF INDUSTRIAL AND MANAGEMENT ENGINEERING.
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 1505 6A

MONTANA STATE UNIV., BOZEMAN. DEPT. OF MICROBIOLOGY.
Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 1510 5A

Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 1512 2E

MONTANA STATE UNIV., BOZEMAN. DEPT. OF PLANT AND SOIL SCIENCE.
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

MONTANA STATE UNIV., BOZEMAN. FISHERIES BIOASSAY LAB.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01529 1503 5C

MONTANA UNIV., MISSOULA. DEPT. OF ECONOMICS.
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 1510 6B

MONTANA UNIV., MISSOULA. SCHOOL OF FORESTRY.
Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

Preferences for Allocating River Recreatio
Use,
W82-01181 1503 6D

MONTANA UNIV., MISSOULA. SCHOOL OF GEOLOGY.
Investigations of High Groundwater in Polso
Terminal Moraine,
W82-02538 1505 2F

MONTGOMERY COUNTY SANITARY DEPT., DAYTON, OH.
Microorganism Inventory in Activated Sludge Control,
W82-03483 1508 5D

MONTGOMERY (J. M.), WALNUT CREEK, CA.
Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 1505 5B

MONTGOMERY (JAMES), INC., WALNUT CREEK, CA.
Water Recycling/Reuse in the Food Processing Industry,
W82-04566 1510 5D

MONTGOMERY (JAMES M.), INC. PASADENA, CA.
Refuse-To-Energy Wastewater Treatment,
W82-00168 1501 5D

Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 1503 5D

Trihalomethanes in Drinking Water,
W82-03447 1508 5F

Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

Recent Developments in Direct Filtration,
W82-04122 1509 5F

How Much Air,
W82-06638 1512 5D

MONTGOMERY (JAMES M.), INC., RESTON, VA.
Considering Sludge Production in the Selection of Coagulants,
W82-05675 1511 5F

MONTGOMERY (JAMES M.) INC., WALNUT CREEK, VA.
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

MONTGOMERY (JAMES M.), PASADENA, CA.
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

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Land Application of Wastewater,
W82-06915 1512 5E

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W82-02960 1506 5D

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Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 1511 8A

MOODY AND ASSOCIATES INC., MEADVILLE, PA.
Ground Water Monitoring of Underground Coal Mines,
W82-04750 1510 5B

MORRIS FORMAN WASTEWATER TREATMENT PLANT, LOUISVILLE, KY.
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 1510 5D

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W82-06617 1512 2F

MOSCOW STATE UNIV. (USSR).
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 1504 5C

Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 1506 4B

Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 1511 7B

Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 1511 2K

MOSCOW STATE UNIV. (USSR). DEPT. OF ICHTHYOLOGY.
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

MOSCOW STATE UNIV. (USSR). INST. OF MECHANICS RESEARCH.
An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 1512 4B

MOSKOVSKII INZHENERNO-FIZICHESKII INST. (USSR). DYNAMICS LAB.
Passing Floodwaters Over Embankment Dams,
W82-02204 1505 8A

MOSS LANDING MARINE LAB., CA.
Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 1511 5A

MOSUL UNIV. (IRAQ).
Wastewater from a Sugar Refining Industry,
W82-05337 1511 5D

MOTOR-COLUMBUS CONSULTING ENGINEERS, INC., BADEN (SWITZERLAND).
Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

MOUCHEL (L.G.) AND PARTNERS, BATH (ENGLAND).
Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

MOULTON NIGUEL WATER DISTRICT, LAGUNA NIGUEL, CA.
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 1501 5D

MUNICH UNIV. (GERMANY, F.R.). FACHBEREICH GEOWISSENSCHAFTEN.
Practicable Formulae for the Energy Exchange at the Boundary Layer Between Water Surface and Air (Brauchbare Energieumsatzformeln fur den Grenzbereich Gewasseroberflache/Luft),
W82-06824 1512 2D

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Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayeriacher Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

MUNICIPAL ENVIRONMENT RESEARCH LAB., CINCINNATI, OH.
Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.
Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 1506 5B

Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 1510 5D

Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 1510 5B

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
Small Water Systems: Role of Technology,
W82-01542 1503 5F

Cost of Small Water Supply Treatment Systems,
W82-02318 1505 5F

Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH. WASTEWATER RESEARCH DIV.
Toxics in Municipal and Industrial Wastewaters,
W82-00712 1502 5A

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., EDISON, NJ.
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

Storm and Combined Sewers: Part of The Treatment Process,
W82-04195 1509 5B

Status of Porous Pavement Research,
W82-06665 1512 8G

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 1512 5G

MUNICIPAL ENVIRONMENTAL RESEARCH LAB., EDISON, NJ. STORM AND COMBINED SEWER SECTION.
An Overview of Porous Pavement Research,
W82-05744 1511 5D

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Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

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Water: A Low-Priced But High-Cost Resource,
W82-02061 1504 6C

MURRAY STATE UNIV., KY. DEPT. OF BIOLOGICAL SCIENCES.
Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 1512 5A

NAGASAKI UNIV. (JAPAN). FACULTY OF FISHERIES.
Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 1506 2H

NAGOYA UNIV. (JAPAN).
Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 1502 5A

NAGOYA UNIV. (JAPAN). DEPT. OF CHEMICAL ENGINEERING.
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 1503 3A

NAGOYA UNIV. (JAPAN). WATER RESEARCH INST.
Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 1506 5A

NAIROBI UNIV. (KENYA). DEPT. OF AGRICULTURAL ENGINEERING.
Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 1505 2G

NAIROBI UNIV. (KENYA). DEPT. OF BOTANY.
Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 1505 2K

Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

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Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
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Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

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A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

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Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
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Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-034[illegible] 1508 5B

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Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1506 1B

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Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 1503 5A

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Electrochemical Processes for Wastewater Treatment,
W82-05422 1511 5D

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Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

NASSAUX-HEMSLEY, INC., CHAMBERSBURG, PA.
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

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Design and Operation of a Colorimetric Detector Controller,
W82-06656 1512 5A

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W82-00684 1502 6G

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 1512 2E

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The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 1505 5C

Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 1508 2H

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Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 1507 6F

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An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 1511 6B

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The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

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Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 1502 2B

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 1503 7B

Operational Applications of Satellite Snow Cover Observations,
W82-04150 1509 7B

Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 1512 2B

The Outlook for Precipitation Measurements from Space,
W82-06531 1512 7B

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, HAMPTON, VA. LANGLEY RESEARCH CENTER.
Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 1511 2L

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 1512 7C

Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

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Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 1502 2G

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Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 1511 2K

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Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 1501 2H

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Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 1512 5B

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Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 1510 7B

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Speciation of Trace Di- and Triorganotins in Water by Ion-Exchange HPLC-GFAA,
W82-04037 1509 5A

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 1511 5A

Water Rates and Residential Water Conservation,
W82-06276 1512 3D

NATIONAL BUREAU OF STANDARDS, WASHINGTON, DC. NATIONAL MEASUREMENT LAB.
Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 1501 5A

Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 1511 5A

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Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
W82-03433 1508 5C

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Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 1511 2E

Official and Folk Flood Warning Systems: An Assessment,
W82-06077 1512 6F

Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 1512 2B

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A Preliminary Survey of State Ground-Water Laws,
W82-02616 1506 6E

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Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

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Load Factors and Non-Destructive Testing of Clay Pipe,
W82-05700 1511 8G

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The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 1512 2B

NATIONAL COAL BOARD, STOKE ORCHARD (ENGLAND). COAL RESEARCH ESTABLISHMENT.
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 1503 5D

NATIONAL COLLEGE OF AGRICULTURAL ENGINEERING, SILSOE (ENGLAND).
Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT, INC., MEDFORD, MA.
Pulp and Paper Industry Effluent Management,
W82-01260 1503 5D

Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

NATIONAL EARTH SATELLITE SERVICE, WASHINGTON, DC.
Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER, DENVER, CO.
Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 1511 5A

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The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 1512 5C

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Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INST., NAGPUR (INDIA).
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 1501 5D

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

Water Supply and Sanitation Decade Programme,
W82-02757 1506 5F

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

NATIONAL ENVIRONMENTAL SATELLITE SERVICE, WASHINGTON, DC.
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

NATIONAL FISHERY RESEARCH LAB., LA CROSSE, WI.
Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1502 5B

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 1511 5B

NATIONAL FOREST SERVICE, CHALLIS, ID.
Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

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A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 1503 2F

Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

NATIONAL HURRICANE AND EXPERIMENTAL METEOROLOGY LAB., CORAL GABLES, FL.
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 1504 2B

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W82-01904 1504 2F

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An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 1503 2F

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 1504 2F

Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 1507 2F

A Mechanism for the formation of Large Icebergs,
W82-04798 1511 2C

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Monitoring Glacier Outburst Floods,
W82-01558 1503 2C

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Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

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W82-03760 1509 5D

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Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 1501 2H

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 1503 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Determination of Dissolved Organic Carbon in Water,
W82-02194 1505 5A

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 1508 5D

Health Aspects of Waters at Public Health Resorts,
W82-04348 1510 5A

Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 1512 5A

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 1512 5A

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 1512 5D

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Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

NATIONAL INST. OF RADIOLOGICAL SCIENCES, CHIBA (JAPAN). DIV. OF ENVIRONMENTAL HEALTH.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 1504 5A

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A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

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W82-01079 1502 5C

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Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 1503 5C

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

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Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 1505 2L

NATIONAL MARINE FISHERIES SERVICE, BEAUFORT, NC. SOUTHEAST FISHERIES CENTER.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

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The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 1505 2L

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Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C

NATIONAL MARINE FISHERIES SERVICE, MIAMI, FL. SOUTHEAST FISHERIES CENTER.
A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

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An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 1507 5A

NATIONAL MUSEUM OF VICTORIA, MELBOURNE (AUSTRALIA).
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 1507 5C

NATIONAL OCEAN SURVEY, ROCKVILLE, MD. OCEAN DUMPING AND MONITORING DIV.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 1503 2H

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 1504 7B

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 1504 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 1504 2H

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 1506 2H

Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 1507 2D

Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 1510 2H

Winter Temperature Structure in Lake Huron,
W82-04381 1510 2H

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 1510 2H

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 1511 5B

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 1511 2H

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 1512 5A

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB. MI.
Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 1510 2B

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER, CO.
Satellite Rain Estimation in the U.S. High Plains,
W82-00808 1502 2B

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, BOULDER. ENVIRONMENTAL RESEARCH LABS.
Disaster by Flood,
W82-04618 1510 2E

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, MIAMI, FL. ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABS.
Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, SEATTLE, WA. PACIFIC MARINE ENVIRONMENTAL LAB.
Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Freshwater Macroinvertebrates,
W82-06797 1512 5C

NATIONAL OCEANOGRAPHIC AND ATMOSPHERIC ADMINISTRATION, WASHINGTON, DC. OFFICE OF COASTAL ZONE MANAGEMENT.
Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 1505 6E

NATIONAL OCEANOGRAPHIC ATMOSPHERIC AND ADMINISTRATION, ROCKVILLE, MD. OFFICE OF MARINE POLLUTION ASSESSMENT.
Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

NATIONAL PARK SERVICE, HOMESTEAD, FL.
Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 1505 2E

On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 1506 5G

The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 1511 5A

NATIONAL PHYSICAL RESEARCH LAB., PRETORIA (SOUTH AFRICA).
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 1511 5B

Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 1511 2B

NATIONAL PHYSICAL RESEARCH LAB., PRETORIA (SOUTH AFRICA). APPLIED SPECTROSCOPY DIV.
Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

NATIONAL POWER CORP., MANILA (PHILIPPINES).
The Agus II Scheme in the Philippines,
W82-05599 1511 8A

NATIONAL POWER PLANT TEAM, ANN ARBOR, MI.
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 1503 8I

NATIONAL PROVINCIAL CHUNG-HSING UNIV., TAICHUNG (TAIWAN). DEPT. OF AGRONOMY.
The Effect of Leaf Water Status on Stomatal Activity, Transpiration and Nitrate Reductase of Sweet Potato,
W82-03793 1509 2D

NATIONAL RESEARCH CENTER, CAIRO (EGYPT).
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 1512 2J

NATIONAL RESEARCH COUNCIL OF CANADA, HALIFAX (NOVA SCOTIA). ATLANTIC REGIONAL LAB.
Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 1502 5A

NATIONAL RESEARCH COUNCIL OF CANADA (ONTARIO). DIV. OF CHEMISTRY.
Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 1502 5A

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO).
A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 1512 5B

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). DIV. OF BIOLOGICAL SCIENCES.
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 1511 5C

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). DIV. OF CHEMISTRY.
Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

NATIONAL RESEARCH COUNCIL, WASHINGTON, DC. WATER RESOURCES RESEARCH REVIEW COMMITTEE.
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

NATIONAL RESEARCH INST. FOR OCEANOGRAPHY, STELLENBOSCH (SOUTH AFRICA).
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

NATIONAL RESEARCH INST. FOR OCEANOLOGY, STELLENBOSCH (SOUTH AFRICA).
Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02865 1506 8A

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

NATIONAL RESOURCES DEFENSE COUNCIL, INC., WASHINGTON, DC.
Water Quality: What Should Be Done Today,
W82-03631 1508 6E

NATIONAL SCHOOL OF BRIDGES AND ROADS, PARIS (FRANCE).
Sewers and Cities: France and the United States Compared,
W82-05684 1511 5D

NATIONAL SCIENCE FOUNDATION, WASHINGTON, DC.
Report on the Summer MONEX Field Phase,
W82-00265 1501 2B

NATIONAL SEVERE STORMS LAB., NORMAN, OK.
On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 1512 2B

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, STOCKHOLM.
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, UPPSALA (SWEDEN).
Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 1510 2H

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, UPPSALA (SWEDEN). WATER QUALITY LAB.
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 1507 2H

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, UPPSALA. WATER QUALITY LAB.
On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 1502 2H

NATIONAL TRUST FOR HISTORIC PRESERVATION, WASHINGTON, DC.
Why Bother with Historic Preservation,
W82-03384 1507 8A

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Charging for Water Supply in England and Wales in the 1980s,
W82-01722 1503 6C

Requirements and Application of Control and Automation Systems in Wastewater Treatment-A Critical View,
W82-03858 1509 5D

Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 1512 5E

NATIONAL WATER PLAN COMMISSION, MEXICO CITY.
Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 1503 6A

NATIONAL WATER PLANNING COMMISSION, MEXICO CITY.
A Perspective Study of Droughts in Mexico,
W82-03358 1507 2E

NATIONAL WATER QUALITY LAB., ARVADA, CO.
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 1501 5A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 1501 5B

Loading Estimates to Lake Erie, 1967-1976,
W82-01852 1504 5A

Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 1506 5D

Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). AQUATIC ECOLOGY DIV.
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 1506 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). ENVIRONMENTAL CONTAMINANTS DIV.
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 1503 2H

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). HYDRAULIC RESEARCH DIV.
Bed Load Discharge Coefficient,
W82-02936 1506 2J

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). PROCESS RESEARCH DIV.
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 1501 2L

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). WATER QUALITY BRANCH.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 1504 5A

NATIONAL WATER RESEARCH INST., BURLINGTON, (ONTARIO). WATER RESOURCES BRANCH.
Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

NATIONAL WATER RESEARCH INST., VANCOUVER (BRITISH COLUMBIA). PACIFIC AND YUKON REGION.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 1504 5A

Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 1505 2H

NATIONAL WATER RESEARCH INSTITUTE, WINNIPEG (MANITOBA). FRESHWATER INST.
Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

NATIONAL WATER WELL ASSOCIATION, WORTHINGTON, OH.
Ground-Water Information: NWWA Provides the Resources,
W82-00301 1501 2F

A Guide to Treatment for Bacterial Problems,
W82-06847 1512 5F

NATIONAL WEATHER SERVICE, MINNEAPOLIS, MN. NORTH CENTRAL RIVER FORECAST CENTER.
Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 1508 2G

NATIONAL WEATHER SERVICE, SILVER SPRING, MD.
The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980,
W82-04632 1510 2E

NATIONAL WEATHER SERVICE, SILVER SPRING, MD. OFFICE OF HYDROLOGY.
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

NATIONAL WEATHER SERVICE STONEVILLE, MS.
Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 1502 2B

NATIONAL WILDLIFE FEDERATION, WASHINGTON, DC.
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

NATURAL ENVIRONMENT RESEARCH COUNCIL, CAMBRIDGE (ENGLAND). BRITISH ANTARCTIC SURVEY.
The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 1506 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 1506 2H

NATURE CONSERVANCY, ABBOTTS RIPTON (ENGLAND). MONKS WOOD EXPERIMENTAL STATION.
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 1501 5A

NATURE CONSERVANCY, GRANGE-OVER-SANDS (ENGLAND). MERLEWOOD RESEARCH STATION.
A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 1511 7B

NAUCHNO-ISSLEDOVATELSKII INST. GIGIENY, MOSCOW (USSR).
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

NAVAL RESEARCH LAB., WASHINGTON, DC.
Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 1512 5A

Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 1512 5A

NAVAL RESEARCH LAB., WASHINGTON, DC. ENVIRONMENTAL SCIENCES DIV.
Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 1512 5A

NAVORSINGSINSTITUUT VIR GROND EN BESPROEIING, PRETORIA (SOUTH AFRICA).
Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 1508 3F

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

NAYLOR DANA INST. FOR DISEASE PREVENTION, VALHALLA, NY.
The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 1502 5C

NEBRASKA UNIV. AT OMAHA. DEPT. OF CIVIL ENGINEERING.
Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 1511 4A

NEBRASKA UNIV., LINCOLN.
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 1503 6E

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 1508 2A

Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 1508 6B

Potential Impact of Ground Water Policy Alternatives on Nebraska Agriculture, 1977-2020,
W82-03826 1509 6B

A Legal-Economic Critique of Groundwater Law and Administration: With Special Reference to Arizona and Nebraska,
W82-03827 1509 6E

Who Owns Nebraska's Ground Water,
W82-06819 1512 6E

NEBRASKA UNIV., LINCOLN. DEPT. OF AGRICULTURAL ECONOMICS.
An Economic Analysis of Ground Water Management Alternatives,
W82-02740 1506 4B

NEBRASKA UNIV. LINCOLN. DEPT. OF AGRICULTURAL ENGINEERING.
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 1502 5D

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 1503 5B

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRONOMY.
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 1512 5B

Aquaculture for Waste Management,
W82-06556 1512 5D

NEBRASKA UNIV., LINCOLN. DEPT. OF CHEMISTRY.
Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

NEBRASKA UNIV., LINCOLN. SCHOOL OF LIFE SCIENCES.
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 1503 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 1507 5C

NEBRASKA UNIV., OMAHA. DEPT. OF CIVIL ENGINEERING.
Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 1511 4A

NEBRASKA UNIV. PANHANDLE STATION AT SCOTTSBLUFF.
Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

NEDERLANDS INST. VOOR ONDERZOEK DER ZEE, TEXEL.
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 1501 5A

NEDERLANDS INST. VOOR ONDERZOEK DER ZEE, TEXEL. BIOLOGICAL RESEARCH EMS-DOLLART ESTUARY.
Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 1511 2L

NETHERLANDS WATERWORKS, RIJSWIJK. TESTING AND RESEARCH INST.
Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 1502 5A

NEUCHATEL UNIV. (SWITZERLAND). INST. DE GEOLOGIE.
Chemical and Hydrological Heterogeneity of Groundwaters in the Upper 'Jura Neuchatelois', Switzerland. (Heterogeneite Chimique et Hydrologique Des Eaux Souterraines D'un Karst Du Haut-Jura Neuchatelois, Suisse),
W82-03794 1509 2K

NEVADA UNIV. SYSTEM, LAS VEGAS. DESERT RESEARCH INST.
Effectiveness of River Models,
W82-00961 1502 6A

Secchi Disc Relationships,
W82-06627 1512 2H

NEVADA UNIV. SYSTEM, RENO. DEPT. OF CIVIL ENGINEERING.
Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 1503 8B

Development of Federal Reserve Rights,
W82-04446 1510 6E

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 1512 8A

NEVADA UNIV. SYSTEM, RENO. DESERT RESEARCH INST.
Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 1503 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 1512 3D

NEVADA UNIV. SYSTEM, RENO, NV. DESERT RESEARCH INST.
Atoll Island Hydrology,
W82-02617 1506 2F

NEVADA UNIV. SYSTEM, RENO. WATER RESOURCES CENTER.
State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 1511 2H

Nevada Water Resources Research 1982-1987,
W82-05533 1511 6B

NEVADA UNIV. SYSTEMS, RENO. DEPT. OF CIVIL ENGINEERING.
Risk Models for Flood Levee Design,
W82-01307 1503 8A

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Water Management in the Maritimes,
W82-05776 1511 6B

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River Basins and Water Management in New Brunswick,
W82-05391 1511 6D

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Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 1501 5D

Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 1503 8B

Management of Ice-Covered Rivers: Problems and Perspectives,
W82-03807 1509 2C

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W82-03953 1509 5D

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W82-00396 1501 3D

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Control of the Activated Sludge Process,
W82-03499 1508 5D

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Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

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Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 1503 5F

NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF EARTH SCIENCES.
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 1502 5B

NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF MICROBIOLOGY.
Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 1501 5A

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Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 1506 6B

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 1511 6A

NEW HAMPSHIRE UNIV., DURHAM. JACKSON ESTUARINE LAB.
Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 1502 2L

The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 1506 2L

NEW HAMPSHIRE UNIV., DURHAM. NORTHEASTERN FOREST EXPERIMENT STATION.
The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

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The Dynamics of Conservative Mixing in Estuaries,
W82-02345 1505 2L

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Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 1508 2H

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 1510 6E

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Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

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Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

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Northeastern New Jersey Grapples With a Drought,
W82-00289 1501 8A

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From Screening to Filtration: Treating the Water Supply,
W82-03739 1508 3A

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Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 1503 2G

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Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO. DEPT. OF GEOSCIENCE.
Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO. DEPT. OF MATHEMATICS.
A Kinematic Model for Surface Irrigation: An Extension,
W82-06832 1512 3F

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF AGRICULTURAL ENGINEERING.
Effects of Decreased Watering on Crop Yields,
W82-04411 1510 2I

Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF ANIMAL, RANGE AND WILDLIFE SCIENCES.
Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

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Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 1510 5F

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Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 1511 5A

NEW MEXICO STATE WATER RESOURCES RESEARCH INST., LAS CRUCES.
A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 1512 7C

NEW MEXICO UNIV., ALBUQUERQUE.
The Development of International Groundwater Law,
W82-05939 1512 6E

NEW MEXICO UNIV., ALBUQUERQUE. DEPT. OF BIOLOGY.
Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 1502 2K

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

NEW MEXICO UNIV., ALBUQUERQUE. DEPT. OF CHEMICAL AND NUCLEAR ENGINEERING.
A Study of The Vacuum-Freezing High Pressure Ice-Melting Process,
W82-04166 1509 3A

A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

NEW MEXICO UNIV., ALBUQUERQUE. DEPT. OF CIVIL ENGINEERING.
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 1510 6C

Relative Runoff by Curve Number Nomograph,
W82-04307 1510 2A

NEW MEXICO UNIV., ALBUQUERQUE. DEPT. OF GEOLOGY.
Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 1502 2F

NEW ORLEANS UNIV., LA. DEPT. OF CHEMISTRY.
Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 1503 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

NEW ORLEANS UNIV., LA. DEPT. OF GEOGRAPHY.
The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 1511 2J

NEW SOUTH WALES DEPT. OF AGRICULTURE, NARRABRI (AUSTRALIA). AGRICULTURAL RESEARCH STATION.
The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 1512 3F

NEW SOUTH WALES DEPT. OF AGRICULTURE, TAMWORTH. TAMWORTH AGRICULTURAL RESEARCH CENTER.
Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 1507 2I

NEW SOUTH WALES DEPT. OF AGRICULTURE, WOLLONGBAR (AUSTRALIA).
The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 1501 2A

NEW SOUTH WALES STATE FISHERIES, SIDNEY (AUSTRALIA).
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA).
Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 1507 5D

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). SCHOOL OF CIVIL ENGINEERING.
Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 1510 8A

Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 1511 5B

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). SCHOOL OF GEOGRAPHY.
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 1512 2A

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). LIMNOLOGY LAB.
Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 1511 2J

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 1512 5B

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). SCHOOL OF BIOLOGICAL AND ENVIRONMENTAL STUDIES.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). SCHOOL OF CIVIL ENGINEERING.
Flow Resistance in Wide Rectangular Channels,
W82-05798 1511 8B

NEW YORK CITY DEPT. OF ENVIRONMENTAL PROTECTION, BUREAU OF WATER SUPPLY.
Leak Location Enters Computer Age,
W82-06018 1512 7A

NEW YORK CITY ENVIRONMENTAL PROTECTION ADMINISTRATION.
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

NEW YORK OCEAN SCIENCE LAB., MONTAUK.
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA. DEPT. OF FOOD SCIENCE AND TECHNOLOGY.
Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 1501 5D

NEW YORK STATE DEPARTMENT OF HEALTH, ALBANY. DIV. OF LABS. AND RESEARCH.
Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

NEW YORK STATE DEPT. OF ENVIRONMENT CONSERVATION, WATERTOWN.
Liming Acid Ponds in New York,
W82-02572 1505 5G

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION, ALBANY.
Groundwater Problems and Needs in New York,
W82-01055 1502 4B

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

Estimation of Organic Compound Emissions from Waste Lagoons,
W82-05679 1511 5C

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION, WATERTOWN.
The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 1505 7A

NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIV. OF LAB. AND RESEARCH.
Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 1501 5D

Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 1502 5B

NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIV. OF LABS. AND RESEARCH.
Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 1512 5B

NEW YORK STATE DEPT. OF HEALTH, ALBANY. DIVISION OF LABS. AND RESEARCH.
The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 1505 2H

NEW YORK STATE DEPT. OF PUBLIC SERVICE, ALBANY. OFFICE OF ENVIRONMENTAL PLANNING.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 1504 5C

NEW YORK STATE ENERGY OFFICE, ALBANY.
Energy Conservation in Municipal Wastewater Plants,
W82-06070 1512 5D

NEW YORK UNIV., NY. DEPT. OF ENVIRONMENTAL MEDICINE.
Cadmium in an Aquatic Ecosystem,
W82-03724 1508 5A

NEWCASTLE AND GATESHEAD WATER CO. (ENGLAND).
New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 1505 5A

Renovation of Water Mains and Sewers,
W82-04237 1509 5F

NEWCASTLE UNIV. (AUSTRALIA). DEPT. OF CIVIL ENGINEERING AND SURVEYING.
Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 1511 4A

NEWCASTLE UNIV., NEW SOUTH WALES (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
Expansion of Effluent Constrained Treatment Plants,
W82-01355 1503 5D

NEWCASTLE UPON TYNE UNIV. (ENGLAND).
The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 1505 6A

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Water-Pollution Research and Its Application in Developing Countries,
W82-05246 1511 5G

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 1511 5D

Major Factors in Sewer Ventilation,
W82-06462 1512 8A

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF ECONOMICS.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

NEWCASTLE UPON TYNE UNIV., (ENGLAND). DEPT. OF ENGINEERING MATHEMATICS.
Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 1512 2J

NEWFOUNDLAND AND LABRADOR HYDRO, ST. JOHN'S.
Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 1508 6G

NEYA RIVER BASIN-WIDE SEWAGE WORKS ASSOCIATION (JAPAN).
Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

NGK INSULATORS, LTD, NAGOYA (JAPAN).
Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

NIAGARA FALLS WASTEWATER TREATMENT PLANT, NEW YORK.
Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

NIEDERSACHSISCHES LANDESAMT FUR BODENFORSCHUNG, HANNOVER (GERMANY, F.R.).
Methane in Groundwater and Its Effect on 14 C Groundwater Dating,
W82-03801 1509 7B

NIEDERSACHSISCHES WASSERUNTERSUCHUNGSAMT, HILDESHEIM (GERMANY, F.R.).
Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 1510 7B

NIELSON, MAXWELL AND WANGSGARD, SALT LAKE CITY, UT.
Land Application of Municipal Wastewater,
W82-01253 1503 5D

NIERSVERBAND, VIERSEN UND EMSCHERGENOSSENSCHAFT, ESSEN (GERMANY, F.R.).
Measurement and Control of the MLSS Concentration in Activated Sludge Plants,
W82-03762 1509 5D

NIJVERHEIDSORGANISATIE TNO, DELFT (NETHERLANDS).
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

NOAA DATA BUOY OFFICE, NSTL STATION, MS.
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

NORANDA RESEARCH CENTRE, POINTE CLAIRE (QUEBEC). PROCESS TECHNOLOGY DEPT.
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

NORDRHEIN-WESTFALEN LANDESAMT FUR WASSER UND ABFALL, DUSSELDORF (GERMANY, F.R.).
The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 1507 5G

NORFOLK STATE UNIV., VA.
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 1504 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK. DEPT. OF GEOLOGY.
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 1503 2F

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK. DEPT. OF MICROBIOLOGY.
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 1507 5D

NORGES VETERINAERHOEGSKOLE, OSLO. DEPT. OF FOOD HYGIENE.
Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 1512 5A

NORSK ELEKTRISK AND BRTOWN BOVERI A/S, OSLO (NORWAY).
Water Level Control for Small Hydro Plants,
W82-04173 1509 8C

NORSK INST. FOR VANNFORSKNING, OSLO.
The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 1505 5C

Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

The Rehabilitation of Norway's Largest Lake,
W82-05243 1511 5G

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIV., GREENSBORO. DEPT. OF PLANT SCIENCE AND TECHNOLOGY.
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, DIVISION OF ENVIRONMENTAL MANAGEMENT.
Recycling,
W82-02514 1505 6E

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, OFFICE OF INTERGOVERNMENTAL RELATIONS.
Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, OFFICE OF WATER RESOURCES.
Trends in State and Federal Policy on Water Supply Management,
W82-02516 1505 6E

NORTH CAROLINA DEPT. OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, RALEIGH.
Water Quality Management in River Basins: US National Experience,
W82-00800 1502 6E

Groundwater Problems in North Carolina,
W82-01056 1502 4B

NORTH CAROLINA DEPT. OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT, RALEIGH. DIV. OF ENVIRONMENTAL MANAGEMENT.
Impact of Mining Activities on Water Quality in Western North Carolina,
W82-03926 1509 5B

Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 1512 5C

NORTH CAROLINA LEAGUE OF MUNICIPALITIES, RALEIGH.
Municipal Needs,
W82-02513 1505 6E

NORTH CAROLINA OFFICE OF COASTAL MANAGEMENT, MOREHEAD CITY.
Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

NORTH CAROLINA STATE UNIV. AT RALEIGH.
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 1503 5C

Current Use and Technology of Landsat Mss Data for Lake Trophic Classification,
W82-03755 1509 7B

Making Your Way Through Murky Waters-A Manual for Public Participation Coordinators in Natural Resources Planning,
W82-04085 1509 6A

Acid Precipitation in Historical Perspective,
W82-04807 1511 5B

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BIOLOGICAL AND AGRICULTURAL ENGINEERING.
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 1501 5B

Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 1503 4A

Water Management Model Evaluation for North Central Ohio,
W82-01536 1503 4A

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 1505 5B

Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 1510 3F

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 1511 5B

Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BOTANY.
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF CIVIL ENGINEERING.
Destabilization of Biological Solids with Ferric Chloride,
W82-04373 1510 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF ECONOMICS AND BUSINESS.
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF MARINE EARTH, AND ATMOSPHERIC SCIENCES.
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 1503 5B

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 1503 5E

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF MARINE SCIENCE AND ENGINEERING.
Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 1508 2L

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF PSYCHOLOGY.
New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF PULP AND PAPER SCIENCE.
O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 1503 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF WOOD AND PAPER SCIENCE.
Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 1502 5D

Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF ZOOLOGY.
Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

NORTH CAROLINA STATE UNIV. AT RALEIGH. PESTICIDE RESIDUE RESEARCH LAB.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 1504 5B

NORTH CAROLINA STATE UNIV. AT RALEIGN. DEPT. OF ZOOLOGY.
Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF ZOOLOGY.
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

NORTH CAROLINA UNIV. AT CHAPEL HILL.
Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 1505 5A

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES.
Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 1505 5A

Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF GEOLOGY.
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 1507 2K

NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ZOOLOGY.
The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

NORTH CAROLINA UNIV. AT CHAPEL HILL. SCHOOL OF PUBLIC HEALTH.
Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency,
W82-04095 1509 5A

Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

NORTH CAROLINA UNIV. AT WILMINGTON. DEPARTMENT OF CHEMISTRY.
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 1501 5A

NORTH CAROLINA UNIV., MOREHEAD CITY. INST. OF MARINE SCIENCES.
Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

NORTH CAROLINA UTILITIES COMMISSION, RALEIGH.
Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 1511 5C

NORTH CAROLINA WATER RESOURCES RESEARCH INST.
Urgent Problems in the Transfer of Water Resources Knowledge,
W82-03802 1509 7C

NORTH CAROLINA WATER RESOURCES RESEARCH INST., CHAPEL HILL.
The North Carolina Sedimentation Control Program--An Assessment,
W82-04160 1509 2J

NORTH CAROLINA WATER RESOURCES RESEARCH INST., RALEIGH.
Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 1510 6A

NORTH CENTRAL FOREST EXPERIMENT STATION, GRAND RAPIDS, MN.
A More Versatile Soil Water Sampler,
W82-02523 1505 7B

NORTH CENTRAL FOREST EXPERIMENTAL STATION, GRAND RAPIDS, MN.
A More Versatile Soil Water Sampler,
W82-00191 1501 7B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF AGRICULTURAL ENGINEERING.
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF BACTERIOLOGY.
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 1512 5D

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CHEMISTRY.
Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 1501 5A

NORTH DAKOTA UNIV., GRAND FORKS. ENGINEERING EXPERIMENT STATION.
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

NORTH SURREY WATER CO. (ENGLAND).
Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 1511 5F

NORTH TEXAS STATE UNIV., DENTON. DEPT. OF BIOLOGICAL SCIENCES.
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 1510 5C

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

NORTH TEXAS STATE UNIV., DENTON. DEPT. OF CHEMISTRY.
GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 1511 5A

NORTH TEXAS STATE UNIV., DENTON. INST. OF APPLIED SCIENCES.
Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

NORTH-WEST WATER AUTHORITY (ENGLAND).
Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 1512 5D

NORTH WEST WATER AUTHORITY (ENGLAND), RIVERS DIV.
A Pragmatic Approach to Water Quality Microbiology in a Clean River Area,
W82-05575 1511 5A

NORTH WEST WATER AUTHORITY, WARRINGTON (ENGLAND).
Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 1505 5B

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 1512 5B

NORTH YORKSHIRE COUNTY COUNCIL (ENGLAND).
A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 1512 6B

NORTHEASTERN FOREST EXPERIMENT STATION, BROOMALL, PA.
Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

NORTHEASTERN FOREST EXPERIMENT STATION, DURHAM, NH.
Acid Rain: Facts and Fallacies,
W82-00518 1502 5C

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

NORTHEASTERN FOREST EXPERIMENT STATION, PARSONS, WV. TIMBER AND WATERSHED LAB.
A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 1510 7B

Acid Precipitation, A Review,
W82-06794 1512 5C

NORTHEASTERN HILL UNIV., SHILLONG (INDIA). DEPT. OF BOTANY.
Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 1511 4C

NORTHEASTERN UNIV., BOSTON, MA. DEPT. OF ECONOMICS.
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 1507 6B

NORTHERN ARIZONA UNIV., FLAGSTAFF. DEPT. OF BIOLOGICAL SCIENCES.
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 1502 7B

The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

NORTHERN ARIZONA UNIV., FLAGSTAFF. DEPT. OF MICROBIOLOGY.
Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 1510 5B

NORTHERN GREAT PLAINS RESEARCH CENTER, MANDAN, ND.
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 1512 2I

NORTHERN ILLINOIS UNIV., DEKALB. DEPT. OF BIOLOGICAL SCIENCE.
Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 1505 2H

NORTHERN ILLINOIS UNIV., DEKALB. DEPT. OF GEOLOGY.
Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 1511 4B

NORTHERN ILLINOIS UNIV., DEKALB. SCHOOL OF ALLIED HEALTH PROFESSIONS.
The National Interim Primary Drinking Water Regulations, Part I - Historical Development,
W82-05814 1511 5G

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 1511 5G

NORTHERN IRELAND DEPARTMENT OF AGRICULTURE, COLERAINE, FISHERIES RESEARCH LABORATORY.
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 1504 5C

NORTHERN MICHIGN UNIV., MARQUETTE. DEPT. OF CHEMISTRY.
On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 1512 5A

NORTHERN SCIENTIFIC RESEARCH INST. OF HYDRAULIC ENGINEERING AND RECLAMATION, KAZAN (USSR).
Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 1511 4A

NORTHROP SERVICES, INC., CORVALLIS, OR.
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04395 1511 5C

NORTHUMBRIAN WATER AUTHORITY (ENGLAND).
Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 1512 5E

NORTHUMBRIAN WATER AUTHORITY, GOSFORTH (ENGLAND).
Cutting the Water Losses,
W82-00310 1501 5F

A Catchment Approach to Flood Estimation,
W82-01397 1503 2E

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 1510 2E

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 1510 2E

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

NORTHWEST WATER AUTHORITY (ENGLAND).
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

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On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 1507 2C

The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 1508 6B

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Nitrification Kinetics and Its RBC Application,
W82-06356 1512 5D

NORVILLE (RODNEY L.) AND CO., HOUSTON, TX.
Cost-Based Water Rate Design,
W82-06277 1512 6C

NORWAY AGRICULTURAL RESEARCH COUNCIL, AAS.
Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 1507 5D

NORWEGIAN HYDRODYNAMICAL LABS., TRONDHEIM. RIVER AND HARBOUR LAB. DIV.
River Plume Studies in Distorted Froude Models,
W82-05864 1511 2E

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Cold Regions Engineering in Norway,
W82-06000 1512 8A

NORWEST HOLST CONSTRUCTION LTD., WATFORD (ENGLANDD).
Water Tanks in Reinforced Concrete,
W82-06604 1512 8F

NOTRE DAME UNIV., IN.
Fermentation Industry,
W82-01257 1503 5D

Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

NOTRE DAME UNIV., IN. DEPT. OF BIOLOGY.
Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 1507 5C

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 1511 2H

NOTRE DAME UNIV., IN., DEPT. OF CIVIL ENGINEERING.
Fermentation Industry,
W82-06917 1512 5D

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Measuring Reservoir Ground Movements,
W82-05773 1511 8G

NOVA SCOTIA TECHNICAL COLL., HALIFAX. DEPT. OF CIVIL ENGINEERING.
Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 1501 5D

NOVOSIBIRSK STATE UNIV. (USSR).
Numerical Modeling of Unsteady Flows in Open Channels,
W82-06784 1512 7C

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Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

Power Plant Siting and Design: A Case Study of Minimal Entrainment and Impingement Impacts at Davis-Besse Nuclear Power Station,
W82-03964 1509 5C

NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC. DIV. OF FUEL CYCLE AND MATERIAL SAFETY.
A Survey of Radioactive Effluent Releases from Byproduct Material Facilities,
W82-03963 1509 5B

NUS CORP., PITTSBURGH, PA., ANALYTICAL SERVICES LAB.
Identification of Organic Compounds,
W82-00635 1502 5A

NUS CORPORATION, ROCKVILLE, MD.
Two-Phase Flow Simulation of Air Storage in an Aquifer,
W82-03841 1509 2F

O'BRIEN AND GERE ENGINEERS, INC., SYRACUSE, NY.
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 1503 5C

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 1511 5A

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 1512 5C

O'MELVENY AND MYERS, LOS ANGELES, CA.
Water Law and the Development of Geothermal Resources,
W82-06218 1512 6E

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Hydraulic Properties of Fullerton Cherty Silt Loam,
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Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 1501 5D

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 1503 5A

Radioactive Wastes,
W82-01268 1503 5D

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

Concentrating Organics in Water for Biological Testing,
W82-01591 1503 5A

Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

Entrainment Mortality of Ichthyoplankton: Detectability and Precision of Estimates,
W82-05181 1511 5C

OAK RIDGE NATIONAL LAB., TN. CHEMICAL TECHNOLOGY DIV.
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

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Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 1503 2B

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Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 1505 5B

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Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 1501 2J

The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 1503 5B

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01667 1504 5B

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 1506 5C

On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 1507 2F

Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 1511 2B

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

Radioactive Wastes,
W82-06920 1512 5E

OBERSTE BAUBEHORDE IM BAYRISCHEN STAATSMINISTERIUM DES INNEREN, MUNICH (GERMANY, F.R.).
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

OCEAN ECOLOGY LTD., EDMONTON (ALBERTA). (ASSIGNEE).
Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 1501 5G

OCEANIC INST., WAIMANALO, HI.
Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 1506 5C

ODESSA STATE UNIV. (USSR).
Hydraulic Resistance of Floodplains,
W82-02850 1506 2E

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT (DI), WASHINGTON, DC.
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 1502 2E

OFFICE OF THE ASSISTANT SECRETARY FOR CIVIL WORKS, WASHINGTON, DC.
Future Directions in Federal Water Resources,
W82-04196 1509 6D

OFFICE OF THE CHIEF OF ENGINEERS (ARMY), WASHINGTON, D.C.
Digest of Water Resources Policies and Authorities,
W82-02973 1506 6E

OFFICE OF THE SECRETARY OF THE ARMY, WASHINGTON, DC.
Count on Uncle Sam Less,
W82-05998 1512 6C

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER.
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

OHIO ENVIRONMENTAL PROTECTION AGENCY, COLUMBUS. GROUNDWATER DIV.
Ohio's Ground Water Resources and Problem Areas,
W82-01057 1502 4B

OHIO RIVER VALLEY WATER SANITATION COMMISSION, CINCINNATI.
An Organics Detection System for the Ohio River,
W82-03436 1508 5A

An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 1511 5A

OHIO STATE UNIV., COLUMBUS.
The Development of Methods for Determining Aquifer Characteristics,
W82-00827 1502 2F

Professional Development for Water Quality Control Personnel,
W82-03531 1508 9A

OHIO STATE UNIV., COLUMBUS. DEPT. OF AGRONOMY.
Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

OHIO STATE UNIV., COLUMBUS. DEPT. OF CIVIL ENGINEERING.
A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

Hydraulic Regime and Activated Sludge Performance,
W82-05819 1511 5D

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

OHIO STATE UNIV., COLUMBUS. DEPT. OF DEVELOPMENT SOCIOLOGY.
Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 1511 6B

OHIO STATE UNIV. COLUMBUS. DEPT. OF ELECTRICAL ENGINEERING.
A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

OHIO STATE UNIV., COLUMBUS. DEPT. OF MICROBIOLOGY.
Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 1512 5C

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 1512 5F

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

OHIO STATE UNIV., COLUMBUS. DEPT. OF NATURAL RESOURCES.
Project Outcomes Correlate with Public Participation Variables.
W82-02663 1506 6B

OHIO STATE UNIV., COLUMBUS. DEPT. OF PHARMACOLOGY.
Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

OHIO STATE UNIV., COLUMBUS. WATER RESOURCES CENTER.
Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

OHIO STATE UNIV., PUT-IN-BAY. CENTER FOR LAKE ERIE AREA RESEARCH.
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

OHIO WESLEYAN UNIV., DELAWARE. DEPT. OF GEOGRAPHY AND GEOLOGY.
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

OKAYAMA UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 1501 5A

Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 1511 5A

OKAYAMA UNIV. (JAPAN). SCHOOL OF ENGINEERING.
Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 1505 5A

OKLAHOMA STATE DEPT. OF HEALTH, OKLAHOMA CITY.
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 1502 5C

OKLAHOMA STATE UNIV., STILLWATER.
Petroleum Processing Wastes,
W82-01262 1503 5D

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 1503 2E

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 1508 5G

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 1511 4B

OKLAHOMA STATE UNIV., STILLWATER. CENTER FOR APPLICATIONS OF REMOTE SENSING.
Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRICULTURAL ECONOMICS.
Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRICULTURAL ENGINEERING.
Upflow Water Filtration Unit, Test Results,
W82-00407 1501 5F

Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 1505 2H

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 1512 3F

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRONOMY.
Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 1503 2G

Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 1504 2I

Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 1508 5B

OKLAHOMA STATE UNIV., STILLWATER, DEPT. OF BOTANY.
UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material [illegible] ron in a Bog Lake,
W82-06930 1512 5C

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF CIVIL ENGINEERING.
Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 1506 5D

Finite Element Modeling of Streamflow Routing,
W82-05918 1512 2E

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF ECONOMICS.
Economics of Controlling Natural Salt Sources in the Arkansas River Basin,
W82-04234 1509 6B

The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 1510 6E

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF GEOLOGY.
Sampling Ground Water for Organic Contaminants,
W82-00820 1502 5A

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF ZOOLOGY.
Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

OKLAHOMA STATE UNIV., STILLWATER. SCHOOL OF BIOLOGICAL SCIENCES.
Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 1505 5C

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 1506 5G

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 1512 5G

OKLAHOMA STATE UNIV., STILLWATER. SCHOOL OF CIVIL ENGINEERING.
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 1507 5D

Ozone for Municipal Wastewater Disinfection,
W82-03559 1508 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 1512 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

OKLAHOMA UNIV. HEALTH SCIENCES CENTER, OKLAHOMA CITY.
Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 1508 5D

OKLAHOMA UNIV., KINGSTON. BIOLOGICAL STATION.
The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 1505 2H

OKLAHOMA UNIV., NORMAN.
Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 1508 5A

The Effect of Reuse of Water for Agriculture on The Arab-Asian Society: A New Interdisciplinary Model for Understanding a Development Problem,
W82-04213 1509 3C

OKLAHOMA UNIV., NORMAN. BUREAU OF WATER AND ENVIRONMENTAL RESOURCES RESEARCH.
Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

OKLAHOMA UNIV., NORMAN. DEPT. OF CIVIL ENGINEERING.
Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

OKLAHOMA UNIV., NORMAN. DEPT. OF ZOOLOGY.
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

OKLAHOMA WATER RESOURCES BOARD, OKLAHOMA CITY. WATER QUALITY DIV.
Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 1505 5B

OKLAHOMA WATER RESOURCES RESEARCH INST., STILLWATER.
Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 1511 6B

OLD DOMINION UNIV. NORFOLK, VA.
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 1503 2L

OLD DOMINION UNIV., NORFOLK, VA. DEPT. OF BIOLOGICAL SCIENCES.
Sediment Bacterial Indicators in an Urban Shellfishing Subestuary of the Lower Chesapeake Bay,
W82-01661 1503 5A

OLD DOMINION UNIV., NORFOLK, VA. DEPT. OF OCEANOGRAPHY.
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 1511 2L

OLDENBURG UNIV. (GERMANY, F.R.).
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 1507 5B

OLYMPIA AND YORK BATTERY PARK CO., NEW YORK.
Water Supply for New York City in the 1980s,
W82-05671 1511 6D

OMNIUM DE TRAITEMENT ET DE VALORISATION, COURBEVOIE (FRANCE).
Clarification with Microsand Seeding. A State of the Art,
W82-03880 1509 5F

OMNIUM DE TRAITMENT ET DE VALORISATION, COURBEVOIE (FRANCE). WATER DEPT.
Disinfection of Drinking Water in Developing Countries,
W82-02091 1504 5F

ONTARIO HYDRO, TORONTO. CENTRAL THERMAL SERVICES.
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

ONTARIO HYDRO, TORONTO. FLOW SYSTEMS LAB.
Thermocline Drawdown Above Cooling Water Intakes,
W82-05560 1511 8C

ONTARIO HYDRO, TORONTO. HYDRAULIC STUDIES AND DEVELOPMENT DEPT.
Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 1511 5C

ONTARIO MINISTRY OF AGRICULTURE AND FOOD, GUELPH (ONTARIO). PESTICIDE RESIDUE LAB.
PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 1503 5B

ONTARIO MINISTRY OF AGRICULTURE AND FOOD, GUELPH. PESTICIDE RESIDUE LAB.
Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 1511 5B

ONTARIO MINISTRY OF NATURAL RESOURCES, THUNDER BAY.
The Long Lake Diversion: An Environmental Evaluation,
W82-05568 1511 6G

ONTARIO MINISTRY OF NATURAL RESOURCES, TORONTO.
Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 1508 6G

ONTARIO MINISTRY OF NATURAL RESOURCES, WHEATLEY. LAKE ERIE FISHERIES RESEARCH STATION.
Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 1504 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, REXALE, LIMNOLOGY AND TAXONOMY SECTION.
Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 1512 5C

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE.
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 1503 5A

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 1512 5B

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 1512 5C

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 1512 5C

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE (ONTARIO). LAB. SERVICES BRANCH.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 1504 5A

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO.
Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 1502 5F

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 1503 5B

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant,
W82-04116 1509 5F

Capacity Expansion Planning Model for Waste Water Treatment and I/I Control,
W82-04239 1509 5D

Water Management in Ontario,
W82-04259 1510 6E

Oxygenation of the Avon River,
W82-05730 1511 5G

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO (ONTARIO).
Sources and Control of Organic Air Pollutants,
W82-00711 1502 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO. POLLUTION CONTROL BRANCH.
Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

A Survey of Aerated Lagoon Performance,
W82-06391 1512 5D

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO. WATER RESOURCES BRANCH.
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 1505 2H

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 1512 5B

OPEN UNIV., MILTON KEYNES (ENGLAND). DEPT. OF EARTH SCIENCES.
Reservoirs and the Triggering of Earthquakes,
W82-03766 1509 8A

OPERATION MANAGEMENT SERVICES, WILTON, CT.
How to Set Up a Preventive Maintenance Program,
W82-06264 1512 5D

ORANGE COUNTY WATER DISTRICT, FOUNTAIN VALLEY, CA.
Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 1505 5D

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Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 1511 6A

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF AGROMETEOROLOGY.
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 1501 2D

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF BOTANY.
Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 1506 5C

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF GEOLOGY.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF MICROBIOLOGY.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 1503 5D

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). INST. FOR ENVIRONMENTAL SCIENCES.
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

ORANGE WATER AND SEWER AUTHORITY, CARRBORO, NC.
Water Savings in the Orange Water and Sewer Authority,
W82-02519 1505 3D

OREGON DEPT. OF TRANSPORTATION, SALEM.
Erosion Control at a Delicate Highway Construction Site,
W82-06510 1512 4D

OREGON GRADUATE CENTER, BEAVERTON.
Kinetics for the Aquatic Environment,
W82-01631 1503 2K

Kinetics for the Aquatic Environment,
W82-01806 1504 2K

OREGON STATE DEPT. OF ENVIRONMENTAL QUALITY, SALEM.
Sampling Frequency Optimization Using a Water Quality Index,
W82-05268 1511 5A

OREGON STATE UNIV., CORVALLIS.
Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 1508 2H

Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 1510 4B

Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMIC.
Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 1512 6B

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMICS.
Federal Subsidy of Irrigation Development,
W82-04233 1509 6E

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL ENGINEERING.
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 1501 6A

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 1502 3F

Designing for Deficit Irrigation,
W82-06334 1512 3F

OREGON STATE UNIV., CORVALLIS. DEPT. OF ANTHROPOLOGY.
Management Provoked Conflict in Fisheries,
W82-00780 1502 6A

OREGON STATE UNIV., CORVALLIS. DEPT. OF CIVIL ENGINEERING.
A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 1501 5A

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 1503 5D

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 1505 5D

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 1506 5B

OREGON STATE UNIV., CORVALLIS. DEPT. OF CROP SCIENCE.
Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 1511 3F

OREGON STATE UNIV., CORVALLIS. DEPT. OF FISHERIES AND WILDLIFE.
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 1501 5C

OREGON STATE UNIV., CORVALLIS. DEPT. OF FOREST SCIENCE.
Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03643 1509 5B

OREGON STATE UNIV., CORVALLIS. DEPT. OF GEOGRAPHY.
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 1503 5A

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 1506 7B

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

OREGON STATE UNIV., CORVALLIS. DEPT. OF MICROBIOLOGY.
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 1501 5A

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 1501 5B

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 1501 5A

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 1502 2H

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

OREGON STATE UNIV., CORVALLIS. DEPT. OF RANGELAND RESOURCES.
Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 1511 2J

OREGON STATE UNIV., CORVALLIS. SCHOOL OF FORESTRY.
Sediment Transport During a Controlled Reservoir Release,
W82-02196 1505 2J

Carrying Capacity for the Illinois River,
W82-05927 1512 6G

OREGON STATE UNIV., CORVALLIS. SCHOOL OF OCEANOGRAPHY.
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 1501 2C

Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 1505 5B

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

OREGON UNIV. HEALTH SCIENCES CENTER, PORTLAND.
Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

OREGON WATER RESOURCES DEPT., SALEM.
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 1510 2K

ORGANISATION DE RECHERCHE SCIENTIFIQUE-TECHNIQUE D'OUTRE-MER, PARIS (FRANCE).
Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, PARIS (FRANCE).
Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 1512 5C

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Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 1505 5A

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

OSAKA KYOIKU UNIV. (JAPAN). LAB. OF ENVIRONMENTAL SCIENCE.
Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 1506 2H

OSAKA PREFECTURE UNIV. (JAPAN). COLL. OF ENGINEERING.
Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 1512 5D

OSAKA PREFECTURE UNIV. (JAPAN). DEPT. OF APPLIED CHEMISTRY.
Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 1506 5A

OSAKA UNIV. (JAPAN). DEPT. OF FERMENTATION TECHNOLOGY.
Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 1505 5B

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Disposal of Sludge to Sea,
W82-06595 1512 5E

OSLO UNIV. (NORWAY).
Acidification in 50 Norwegian Lakes,
W82-03344 1507 2H

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

OSLO UNIV. (NORWAY). DEPT. OF MECHANICS.
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 1506 2F

OSLO UNIV. (NORWAY). INST. OF LIMNOLOGY.
Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

OSLO UNIV. (NORWAY). INST. OF ZOOLOGY.
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

OSMANIA UNIV., HYDERABAD (INDIA). CENTRE OF EXPLORATION GEOPHYSICS.
An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 1504 2F

Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 1508 2F

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Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment,
W82-03758 1509 5B

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Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 1503 2H

OTAGO UNIV. (NEW ZEALAND).
Note on Random Raindrops and Sampling Error,
W82-02032 1504 2B

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Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 1503 5C

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Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 1506 2H

OTTAWA UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Multivariate Hydrologic Time Series Analysis,
W82-00647 1502 2A

Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 1511 2A

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Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 1501 5A

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On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

OUFRESNE AND HENRY ENGINEERS, INC., NORTH SPRINGFIELD, VT.
Fresh-Water Transport by Sea,
W82-04861 1511 6D

OXFORD UNIV. (ENGLAND). DEPT. OF AGRICULTURAL SCIENCE.
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 1502 2I

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

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River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
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A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
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Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

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Use of Pre-Fabricated Parshall Flumes to Measure Streamflow in Permafrost-Dominated Watersheds,
W82-04074 1509 7B

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Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
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Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
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Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

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W82-04250 1509 2E

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Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
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Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
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Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

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Water Levels and Losses and Cleaning in Watercourses,
W82-02747 1506 3F

PAN AMERICAN HEALTH ORGANIZATION, WASHINGTON, DC.
Environment and Public Health in the Caribbean,
W82-03787 1509 6D

PARAMOUNT ENGINEERING LTD., KITCHENER (ONTARIO).
Simulation Modeling of Primary Clarifiers,
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Aeration at High Velocity Flows,
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Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

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Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
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Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

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Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 1510 5A

PARSONS, BRINCKERHOFF, QUADE AND DOUGLAS, INC., NEW YORK.
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Fluidized Bed for Biological Wastewater Treatment,
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Ozone Water Treatment Systems,
W82-03448 1508 5F

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Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
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Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 1503 5G

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W82-01058 1502 4B

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W82-05065 1511 5E

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W82-03716 1508 2E

Rotating Disc Biological Treatment of Acid Mine Drainage,
W82-03968 1509 5D

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. COLL. OF AGRICULTURE.
The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

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Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING.
Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 1508 6A

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 1512 5G

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 1512 2A

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Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 1512 2E

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Seasonal Stream Temperature Changes Following Forest Harvesting,
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Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 1505 5F

An Experimental Approach to Corrosion Control,
W82-04099 1509 5F

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Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
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An Ex Post Analysis of the Uncompahgre Project,
W82-04218 1509 6B

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Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
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An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
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Floc/Float System Cleans Desalter Effluent,
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PIRNIE (MALCOLM), INC., PARAMUS, NJ.
Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
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Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 1507 5D

Water Cost Encourages Reuse and Conservation,
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Protecting the Source,
W82-05785 1511 5F

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Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

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W82-03785 1509 5G

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Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 1501 2J

Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 1507 5D

Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 1511 5D

Rotating Biological Contactor System Design,
W82-06355 1512 5D

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Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
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The Cost and Effectiveness of Public Notification of MCL Violations,
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Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 1507 2B

PLAINVILLE WATER CO., CT.
Purge Aquifer to Remove Volatile Organic Contamination,
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PLANO-EMPRESA DE PROJECTOS, LDA., LISBOA (PORTUGAL).
Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
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General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

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The Distribution of Mercury in the Sediments of the Plym Estuary,
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Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
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Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
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Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
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Inorganics,
W82-01238 1503 5A

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Inorganics,
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Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 1505 5D

PORTSMOUTH POLYTECHNIC (ENGLAND). DEPT. OF CHEMISTRY.
Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

PORTSMOUTH POLYTECHNIC (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 1512 5D

POST, BUCKLEY, SCHUH, AND JERNIGAN, INC., FORT MYERS, FL.
Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

POST, BUCKLEY, SCHUH AND JERNIGAN, INC., ORLANDO, FL.
Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

PRAGUE DEPT. OF WATER TECHNOLOGY AND ENVIRONMENTAL ENGINEERING (CZECHOSLOVAKIA).
Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

PREECE, CARDEW AND RIDER, BRIGHTON (ENGLAND).
Planning Sri Lanka's Victoria Scheme,
W82-05979 1512 8A

PRESIDENT'S COUNCIL OF ECONOMIC ADVISERS, WASHINGTON, DC.
On the Marginal Cost of Wastewater Services,
W82-04376 1510 6C

PRETORIA UNIV. (SOUTH AFRICA).
Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 1501 8D

PRETORIA UNIV., (SOUTH AFRICA). DEPT. OF CHEMISTRY.
Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 1511 5A

PRICKETT (THOMAS A.) AND ASSOCIATES, URBANA, IL.
Mathematical Modeling Techniques for Groundwater Management,
W82-01062 1502 4B

PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
Regional Flood Frequency Estimation and Network Design,
W82-01294 1503 2E

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 1503 5D

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 1504 5D

Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06436 1512 5D

PROCTER AND GAMBLE CO., CINCINNATI, OH.
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 1501 5A

Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 1508 5B

Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 1511 5D

PROCTER AND GAMBLE CO., CINCINNATI, OH. ENVIRONMENTAL SAFETY DEPT.
A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 1512 5D

PROMON ENGEHARIA SA, SAO PAULO (BRAZIL).
Relaxation in Concrete,
W82-05511 1511 8F

PROMON ENGENHARIA, SAO PAULO (BRAZIL).
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

PROVINCIAL INST. VOOR HYGIENE, ANTWERP (BELGIUM).
Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

PROVINCIAL WATER AUTHORITY, ZWOLLE (THE NETHERLANDS). DEPARTMENT OF WATERSHED MANAGEMENT.
The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

PUBLIC POWER CORP., ATHENS (GREECE). COMPUTING CENTER.
Young's Inequality for Three-Dimensional Flows,
W82-04267 1510 2A

PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA).
Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

PUNJAB AGRICULTURAL UNIV., LUDIANA (INDIA). DEPT. OF SOIL AND WATER ENGINEERING.
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

PUNJAB UNIV., LAHORE (PAKISTAN), DEPT. OF BOTANY.
On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

PURDUE UNIV., LAFATETTE IN. SCHOOL OF CIVIL ENGINEERING.
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 1503 8A

PURDUE UNIV., LAFAYETTA. IN.
Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

PURDUE UNIV., LAFAYETTE.
A Trigger Type Cluster Model for Flood Analysis,
W82-03818 1509 2A

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 1511 4D

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRONOMY.
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 1507 5E

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF BIONUCLEONICS.
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 1502 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF BOTANY AND PLANT PATHOLOGY.
Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 1510 2H

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF HYDROMECHANICS.
Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

PURDUE UNIV., LAFAYETTE, IN. LAB. OF RENEWABLE RESOURCES ENGINEERING.
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 1501 5D

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF CIVIL ENGINEERING.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 1503 2B

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 1507 5D

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF PHARMACY AND PHARMACAL SCIENCES.
The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

PURDUE UNIV. LAFAYETTE, IN. WATER RESOURCES RESEARCH CENTER.
Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 1511 2G

An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 1512 6B

PURDUE UNIV., LAFAYETTE, IND. WATER RESOURCES RESEARCH CENTER.
Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 1511 4A

PURDUE UNIV., SOUTH BEND, IN.
Optimal Operation of a Reservoir System Using Forecasts,
W82-04209 1509 4A

PUROPORE, INC., TUSTIN, CA.
The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 1512 3A

QUEBEC UNIV., CHICOUTIMI. DEPT. DES SCIENCES PURES.
Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 1510 5C

QUEBEC UNIV., MONTREAL. DEPT. OF EARTH SCIENCES.
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 1503 2C

QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

QUEBEC UNIV., RIMOUSKI. INST. NATIONAL DE LA RECHERCHE SCIENTIFIQUE.
Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 1511 5B

QUEBEC UNIV., SAINTE-FOY.
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W82-02662 1506 2K

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Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 1510 2L

QUEEN ELIZABETH COLL., LONDON (ENGLAND).
Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678 1508 5C

QUEEN ELIZABETH COLL., LONDON (ENGLAND). DEPT. OF BIOLOGY.
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W82-03334 1507 5G

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Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 1504 5D

Design Models for Adsoprtion Systems in Wastewater Treatment,
W82-04300 1510 5D

QUEEN'S UNIV., BELFAST (NORTHERN IRELAND). DEPT. OF PURE AND APPLIED PHYSICS.
Surface Viscosity of Water,
W82-03501 1508 1A

QUEEN'S UNIV., KINGSTON (ONTARIO). DEPT. OF CHEMISTRY.
A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 1512 5B

QUEEN'S UNIV., KINGSTON (ONTARIO). DEPT. OF GEOGRAPHY.
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 1501 7C

Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario,
W82-04031 1509 2K

QUEEN'S UNIV., KINGSTON (ONTARIO). DEPT. OF GEOLOGICAL SCIENCES.
A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

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Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

QUEENSLAND UNIV., BRISBANE (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
Seepage from Free Water Above Impermeable Tailings,
W82-02714 1506 5B

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Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 1508 2L

QUEST AUTOMATRON RESEARCH, LTD., DORSET (ENGLAND).
pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 1505 5F

RACINE WASTEWATER UTILITY, WI.
Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 1502 5E

RADIAN CORP., AUSTIN, TX.
Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

EPA's Priority Pollutants: Where They Come from--Where They're Going,
W82-03875 1509 6E

RADIATION MANAGEMENT CORP., DRUMORE, PA. MUDDY RUN ECOLOGICAL LAB.
Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 1502 5C

RAIN BIRD WESTERN SALES CORP., GLENDORA, CA.
Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 1503 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 1503 3F

RAJASTHAN UNIV. JAIPUR (INDIA). DEPT. OF BOTANY.
Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur),
W82-05102 1511 2H

RAJENDRA AGRICULTURAL UNIV., SAMASTIPUR (INDIA).
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W82-05120 1511 2I

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Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

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Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 1506 2H

The Phosphorus Cycle in Germiston Lake. I. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 1511 5C

RAND CORP., SANTA MONICA, CA.
Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 1503 2B

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 1511 4B

RAVENSHAW COLL., CUTTACK (INDIA). DEPT. OF ZOOLOGY.
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 1503 2A

RAVISHANKAR UNIV., RAIPUR (INDIA). DEPT. OF CHEMISTRY.
Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 1507 5A

RAY D. NIXON POWER PLANT WATER SUPPLY, COLORADO SPRINGS, CO.
Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

READING UNIV. (ENGLAND). DEPT. OF MATHEMATICS.
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 1510 2F

READING UNIV. (ENGLAND). PLANT SCIENCE LAB.
Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 1505 2H

REGINA RESEARCH STATION (SASKATCHEWAN).
A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 1503 4A

RENNES ECOLE NATIONALE SUPERIEURE DE CHIMIE (FRANCE).
Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

RENSSELAER POLYTECHNIC INST. DEPT. OF CHEMICAL AND ENVIRONMENTAL ENGINEERING.
Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 1507 3A

RENSSELAER POLYTECHNIC INST., TROY, NY.
Shallow-Depth Sedimentation of Biological Materials,
W82-02336 1505 5D

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

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Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 1502 5C

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Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 1504 5C

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W82-04454 1510 5D

RESEARCH INST. FOR ENVIRONMENTAL DEVELOPMENT, WROCLAW (POLAND).
Biofiltration Design Based on Volumetric Loading,
W82-05698 1511 5D

RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAPEST (HUNGARY).
The Use of Respirography in Biological Treatment Plant Control,
W82-04011 1509 5D

Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 1510 5D

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Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 1501 6D

RESEARCH INST. ON THE ENVIRONMENTAL DEVELOPMENT, WARSAW (POLAND). WATER UTILIZATION DEPT.
The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 1512 5A

RESEARCH TRIANGLE INST., RESEARCH TRIANGLE PARK, NC.
Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 1510 5D

RESIDUALS MANAGEMENT TECHNOLOGY, INC., MADISON, WI.
Improved Analytical Methods for the Design of Leachate Collection Systems,
W82-03936 1509 5E

RESOURCES CONSERVATION CO., SEATTLE, WA.
Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

RESOURCES FOR THE FUTURE, INC., WASHINGTON, DC.
Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 1503 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 1503 6A

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The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 1502 6B

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 1504 6E

RESOURCES MANAGEMENT ASSOCIATES, LAFAYETTE, CA.
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 1503 5G

REXNORD, INC., MILWAUKEE, WI.
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

Thermal Effects,
W82-01275 1503 5C

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

Thermal Effects,
W82-06809 1512 5C

RH2 ENGINEERING, SEATTLE, WA.
Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 1511 5B

RHODE ISLAND UNIV., KINGSTON.
Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 1512 5D

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CHEMISTRY.
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 1501 5A

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

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Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL ENGINEERING.
Erosion Resistance of Cohesive Soils,
W82-02676 1506 2J

RHODE ISLAND UNIV., KINGSTON. DEPT. OF ZOOLOGY.
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 1502 2H

RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY.
Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

Freshwater Inputs and Estuarine Productivity,
W82-02110 1505 2L

A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 1505 5C

Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 1507 2L

Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 1510 2L

The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 1512 2L

RHODE ISLAND UNIV., KINSTON. DEPT. OF MICROBIOLOGY.
Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 1510 5A

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Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 1510 2A

An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 1511 2A

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Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 1512 4A

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Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 1506 5B

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Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 1503 2J

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The Economics of Urban Stormwater Management,
W82-03508 1508 4A

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Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

Revised Rainfall Frequency Analysis for Houston,
W82-05863 1511 2B

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 1512 5G

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Stormwater Management in the Ottawa-Carleton Region,
W82-05563 1511 5G

RIJKSINSTITUUT VOOR DE VOLKSGEZONDHEID, BILTHOVEN (NETHERLANDS).
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

RIJKSINSTITUUT VOOR DRINKWATERVOORZIENING, LEIDSCHENDAM (NETHERLANDS).
Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

RIJKSINSTITUUT VOOR DRINKWATERVOORZIENING, LEIDSCHENDAM (NETHERLANDS). CHEMICAL BIOLOGICAL DIV.
The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

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Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

RIJKSINSTITUUT VOOR ZUIVERING VAN AFVALWATER, LELYSTAD (NETHERLANDS).
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 1504 5A

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Effect of Perforation Shape and Pattern on the Performance of Drain Pipes,
W82-03792 1509 8B

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Observations on the Immature Chironomides of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

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Attenuation of Incident Solar Radiation in Lake Water,
W82-04180 1509 2H

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Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

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Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

Application of the Area of Review Concept,
W82-04674 1510 6E

ROBICON CORPORATION, PITTSBURGH, PA.
Variable Frequency Drives - Some Application Principles,
W82-06345 1512 8C

ROCHESTER UNIV., NY. DEPT. OF GEOLOGICAL SCIENCES.
The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 1506 5C

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Characterization of Properties of Water,
W82-05540 1511 1A

ROCK VALLEY METROPOLITAN COUNCIL, ROCKFORD, IL.
Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

ROCKWELL INTERNATIONAL, ATLANTA, GA.
Replacing Large Water Meters: Why and How,
W82-03560 1508 5F

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Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 1506 5A

ROCKWELL INTERNATIONAL, NEWBURY PARK, CA.
Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 1510 5D

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 1511 5G

ROCKWELL INTERNATIONAL, PITTSBURGH, PA.
An Intangible Benefit of Water Pollution Control Programs,
W82-01092 1502 6B

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Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 1505 3B

RODBOURNE WATER POLLUTION CONTROL PLANT, SWINDON (ENGLAND).
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 1501 5D

ROHM AND HAAS LTD., CROYDON (ENGLAND).
Mixed Bed Technology for Polishing Make-up Water and Condensate Return: Conclusion,
W82-03774 1509 5D

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 1511 5D

ROME AIR DEVELOPMENT CENTER, HANSCOM AFB, MA. ELECTROMAGNETIC SCIENCES DIV.
Large Rain Drops in the Bright Band,
W82-03065 1507 7B

ROME UNIV. (ITALY). IST. D'IGIENE.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

ROME UNIV. (ITALY). IST. DI CHIMICA ANALITICA.
Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

ROME UNIV. (ITALY). IST. DI CHIMICA APPLICATA ED INDUSTRIALE.
Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 1511 5D

ROORKEE UNIV., (INDIA).
Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 1512 5D

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE, MIAMI, FL.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 1504 5B

Tide-Induced Residual Flow in Shallow Bays,
W82-02003 1504 2L

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 1505 2L

Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 1507 5C

The Ionization of Acids in Estuarine Waters,
W82-03769 1509 2K

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1511 1B

The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 1511 2A

ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCE, MIAMI, FL. DIV. OF OCEAN ENGINEERING.
Surface Water Flow from a South Florida Wetland Area,
W82-02121 1505 2E

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W82-06763 1512 5C

ROSWELL PARK MEMORIAL INST., BUFFALO, NY.
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W82-06079 1512 5D

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Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 1503 2G

ROYAL MANCHESTER CHILDREN'S HOSPITAL (ENGLAND). DEPT. OF CLINICAL GENETICS.
An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

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Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 1507 2C

RPC, INC., AUSTIN, TX.
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W82-01081 1502 5G

RUHETALSPERRENVEREIN, ESSEN (GERMANY, F. R.).
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W82-06239 1512 8A

RUHRVERBAND, ESSEN (GERMANY, F. R.).
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

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W82-05241 1511 5D

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W82-06469 1512 5D

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

RURAL DEPARTMENT FOR WATERS AND FORESTRY, PARIS (FRANCE).
Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 1511 4B

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W82-03538 1508 5D

RUTGERS - THE STATE UNIV., BRUNSWICK, NJ.
Oil Slick Mechanics,
W82-05064 1511 5G

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Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 1503 5A

An Economic Analysis of Water Conservation Policy,
W82-03090 1507 6B

Nitrogen Dynamics in the Surface Waters of the New Jersey Pine Barrens,
W82-03816 1509 2A

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

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W82-05854 1511 5E

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Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 1511 2E

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Movement of Cobalt in Freshwater Micro-Ecosystems, W82-03524 1508 2H
Microbial Ecosystems Responsible for Anaerobic Digestion and Composting, W82-05252 1511 5E

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Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges, W82-06270 1512 5D

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. GRADUATE PROGRAM IN ENVIRONMENTAL SCIENCE.
A Comparison of Chlorine and Chlorine Dioxide Disinfection of Wastewater Effluents: The Generation of Selected Halohydrocarbons, W82-03751 1509 5D

RUTGERS-THE STATE UNIV., NEW BRUNSWICK, NJ. WATER RESOURCES RESEARCH INST.
Coping with Increased Stream Erosion in Urbanizing Areas, W82-03067 1507 2J
Settleability of Urban Runoff Pollution, W82-05320 1511 5G
Water Conservation Incentives and Strategy, W82-05906 1512 3D

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Modeling Suspended Solids and Bacteria in Ford Lake, W82-02595 1505 5B

S & E IRRIGATED AGRICULTURE RESEARCH AND EXTENSION CENTER, PROSSER, WA.
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates, W82-00119 1501 3F

S KANSAS UNIV., LAWRENCE. SCHOOL OF ENGINEERING AND ARCHITECTURE.
Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas, W82-03525 1508 5D

SAINT DAVID'S UNIV. COLL., LAMPETER (WALES).
New Problems with Upland Waters, W82-06602 1512 5G

SAINT LAWRENCE UNIV., CANTON, NY.
Groundwater Pollution from Industrial Waste Disposal, A Case Study, W82-06434 1512 5B

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Incipient Motion of Sand Particles on Side Slopes, W82-04368 1510 8D
Bend Theory of River Meanders. Part 1. Linear Development, W82-05085 1511 2E

SALFORD UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Destratification and Reaeration as Tools for In-Lake Management, W82-01648 1503 5G
A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces, W82-03440 1508 3B
Modelling Evaporation from Reservoirs, W82-04722 1510 2D
Models of Annual Cycles in Lentic Water Bodies, W82-06483 1512 5G

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT, CA.
Basin Management in the San Bernardino Basin Area, W82-00280 1501 6A

SAN DIEGO STATE UNIV., CA.
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species, W82-00762 1502 2I
Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species, W82-00846 1502 2I
Geometry of Gravel Streams, W82-04113 1509 2E
Nature of Wave Attenuation in Open Channel Flow, W82-05003 1511 2E
Mathematical Model for Erodible Channels, W82-06336 1512 2J

SAN DIEGO STATE UNIV., CA. DEPT. OF BIOLOGY.
Soil Moisture Relations in the Southern California Chaparral, W82-01035 1502 2D
The Ecology of Southern California Coastal Salt Marshes: A Community Profile, W82-05215 1511 2H

SAN DIEGO STATE UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Modeling Gradual Dam Breaches, W82-00554 1502 8D
Modeling Circulation in Depth-Averaged Flow, W82-02679 1506 2E
Accuracy Criteria in Diffusion Routing, W82-06423 1512 8B

SAN DIEGO WATER UTILITIES DEPT., CA.
Upgrading Water Treatment Plants in San Diego, W82-03655 1508 5F

SAN FRANCISCO BAY INST., CA.
Tragedy of the San Francisco Bay Commons, W82-06182 1512 6E

SANDIA LABS., ALBUQUERQUE, NM.
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus, W82-00576 1502 5A

SANDIA NATIONAL LAB., ALBUQUERQUE, NM.
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Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies, W82-03073 1507 6B

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Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods, W82-03873 1509 5B

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Urban Creekside Design Features Parallel Streets, W82-06184 1512 4C

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The Use of a Perforated Baffle at the Inlet of Rectangular Settling Basins, W82-04124 1509 8B

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Dispersion in Mountainous Natural Streams, W82-06357 1512 2E

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The Mackenzie River Basin Study, W82-05778 1511 4A
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River, W82-06573 1512 5B

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF BIOLOGY.
Primary Production in Saline Lakes, W82-04926 1511 2H

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF CIVIL ENGINEERING.
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study, W82-00229 1501 6A
A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients, W82-00605 1502 2G
Hydraulic Design for the Two-Stage Stilling Basin, W82-00849 1502 8B

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF CROP SCIENCE.
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress, W82-03479 1508 2I

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF GEOGRAPHY.
Snowmelt Prediction in a Subarctic Drainage Area, W82-01571 1503 2C
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System, W82-02624 1506 2C

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF SOIL SCIENCE.
The Nature of Selected Prairie Lake and Stream Sediments, W82-00815 1502 2J

SAVANNAH RIVER ECOLOGY LAB., AIKEN, SC.
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 1502 5B

The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H

The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 1512 5C

SCHNEIDER ENGINEERS, BRIDGEVILLE, PA.
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W82-00287 1501 5E

SCHROEDER PROCESS CORP., SANTA ANA, CA.
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W82-02105 1505 3A

Freezing Processes - The Standard of the Future - An Update,
W82-06115 1512 3A

SCIENCE AND EDUCATION ADINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Sediment Yield from a Flatland Watershed,
W82-00941 1502 2J

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Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 1505 2I

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Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 1501 2J

SCIENCE AND EDUCATION ADMINISTRATION, ATHENS, GA.
Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

SCIENCE AND EDUCATION ADMINISTRATION, BATON ROUGE, LA.
Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 1505 5B

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD.
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 1501 5E

Trenching of Digested Sludge,
W82-00974 1502 5E

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 1507 8A

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 1510 4C

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 1511 5D

Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 1512 5E

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD. HYDROLOGY LAB.
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 1501 2A

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 1503 7B

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 1505 2C

Estimating Soil Water Retention from Soil Properties,
W82-06332 1512 2G

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD. PESTICIDE DEGRADATION LAB.
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 1502 5B

SCIENCE AND EDUCATION ADMINISTRATION, BELTSVILLE, MD. WATER DATA LAB.
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 1503 2A

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Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 1501 5E

SCIENCE AND EDUCATION ADMINISTRATION, BOISE, ID.
Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 1505 2A

SCIENCE AND EDUCATION ADMINISTRATION, BOISE, ID. NORTHWEST WATERSHED RESEARCH CENTER.
Automatic Class-A Pan-Filling System,
W82-01326 1503 7B

Erosivity Values for Individual Design Storms,
W82-05694 1511 4D

SCIENCE AND EDUCATION ADMINISTRATION, BUSHLAND, TX. CONSERVATION AND PRODUCTION RESEARCH LAB.
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 1502 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 1502 3F

Management of Recharge Basins on the Southern High Plains,
W82-00938 1502 4B

A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 1505 3F

Deep Tillage of Irrigated Pullman Clay Loam-A Long-Term Evaluation,
W82-04372 1510 2G

SCIENCE AND EDUCATION ADMINISTRATION, CHEYENNE, WY.
Topsoil Management of Mined Soils,
W82-04571 1510 4D

SCIENCE AND EDUCATION ADMINISTRATION, CHICKASHA, OK.
Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

Environmental Impact of Channel Modification,
W82-04245 1509 4A

SCIENCE AND EDUCATION ADMINISTRATION, CHICKASHA, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 1512 4A

SCIENCE AND EDUCATION ADMINISTRATION, COLLEGE STATION, TX. COTTON INSECTS RESEARCH LAB.
Environmental Fate of Methyl Eugenol,
W82-02013 1504 5B

SCIENCE AND EDUCATION ADMINISTRATION, COLLEGE STATION, TX. VETERINARY TOXICOLOGY AND ENTOMOLOGY RESEARCH LAB.
Fate of Diflubenzuron in Water,
W82-02216 1505 5B

SCIENCE AND EDUCATION ADMINISTRATION, COLUMBIA, MO.
Time Distribution of Clock Hour Rainfall,
W82-01402 1503 2A

Gully Erosion,
W82-01407 1503 2J

Empirical Investigation of Curve Number Technique,
W82-04112 1509 2A

Acid Pond Drainage,
W82-05199 1511 5G

SCIENCE AND EDUCATION ADMINISTRATION, COSHOCTON, OH. NORTH APPALACHIAN EXPERIMENTAL WATERSHED.
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 1502 5G

SCIENCE AND EDUCATION ADMINISTRATION, DAVIS, CA.
Control of Aquatic Weeds with Hexazinone,
W82-02326 1505 4A

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.
A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 1502 2H

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 1511 2H

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY MANAGEMENT LAB.
Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

SCIENCE AND EDUCATION ADMINISTRATION, DURANT, OK. WATER QUALITY MANAGEMENT LAB.
Enrichment Ratios for Water Quality Modeling,
W82-01410 1503 2J

SCIENCE AND EDUCATION ADMINISTRATION, FLORENCE, SC.
Wheat Response to Drought,
W82-02242 1505 2I

SCIENCE AND EDUCATION ADMINISTRATION, FLORENCE, SC. COASTAL PLAINS SOIL AND WATER CONSERVATION RESEARCH CENTER.
Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 1512 2I

SCIENCE AND EDUCATION ADMINISTRATION, FORT COLLINS, CO.
Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 1507 5C

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 1510 2I

Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 1512 8B

SCIENCE AND EDUCATION ADMINISTRATION, FORT COLLINS, CO; AND ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE, WASHINGTON, DC.
Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

SCIENCE AND EDUCATION ADMINISTRATION, FRESNO, CA.
Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

SCIENCE AND EDUCATION ADMINISTRATION, ITHACA, NY.
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 1502 5B

SCIENCE AND EDUCATION ADMINISTRATION, KIMBERLEY, ID. SNAKE RIVER RESEARCH CENTER.
A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 1503 5B

SCIENCE AND EDUCATION ADMINISTRATION, KIMBERLY, ID.
Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 1511 8A

SCIENCE AND EDUCATION ADMINISTRATION, KIMBERLY, ID. SNAKE RIVER CONSERVATION RESEARCH CENTER.
New Evapotranspiration Crop Coefficients,
W82-05692 1511 3F

Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 1512 3F

Furrow Intake Rates and Water Management,
W82-05968 1512 3F

SCIENCE AND EDUCATION ADMINISTRATION, LAFAYETTE, IN.
Sediment Transport Capacity of Overland Flow,
W82-01408 1503 2J

SCIENCE AND EDUCATION ADMINISTRATION, LEWIS, TN. DAIRY EXPERIMENTAL STATION.
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B

SCIENCE AND EDUCATION ADMINISTRATION, LINCOLN, NE.
Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 1510 6A

SCIENCE AND EDUCATION ADMINISTRATION, MANDAN, ND. NORTHERN GREAT PLAINS RESEARCH CENTER.
Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

Watertable Management Saves Water and Energy,
W82-00943 1502 3F

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

SCIENCE AND EDUCATION ADMINISTRATION, MORGANTOWN, WV.
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 1503 5E

SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN.
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 1501 2G

SCIENCE AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.
Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 1511 5B

SCIENCE AND EDUCATION ADMINISTRATION, NORTHEAST WATERSHED RESEARCH CENTER, UNIVERSITY PARK, PA.
Modeling Water Flux on Strip-Mined Land,
W82-00944 1502 2G

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS.
Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 1501 2J

Effect of Slope Length on Erosion from Low Slopes,
W82-00896 1502 2J

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 1503 2J

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 1505 2J

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 1505 2J

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 1505 2J

Velocity Profiles with Suspended Sediment,
W82-02581 1505 2J

Recording Unconfined Tension Tester,
W82-04238 1509 8D

SCIENCE AND EDUCATION ADMINISTRATION, OXFORD, MS. SEDIMENTATION LAB.

How Rain Intensity Affects Interrill Erosion,
W82-04537 1510 2J

Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

Recording Raingage Modifications,
W82-05665 1511 7B

SCIENCE AND EDUCATION ADMINISTRATION, PHILADELPHIA, PA. EASTERN REGIONAL RESEARCH CENTER.

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AR. WATER CONSERVATION LAB.

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. CONSERVATION LAB.

Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 1507 7B

Dimensionless Stream Advance in Sloping Borders,
W82-04308 1510 3F

SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB.

Measuring Flumes of Simplified Construction,
W82-00140 1501 7B

Depths of Flow in Level Basins,
W82-00900 1502 3F

Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

Erosivity 'R' for Individual Design Storms,
W82-01403 1503 2J

Development of Solutions for Level-Basin Design,
W82-01976 1504 3F

Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

Estimating Distribution Uniformity in Level Basins,
W82-03058 1507 3F

Simplifying Neutron Moisture Meter Calibration,
W82-05173 1511 7B

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

Humidity Measurement by Infrared Thermometry,
W82-05611 1511 7B

Limits for Practical Level-Basin Design,
W82-06452 1512 3F

SCIENCE AND EDUCATION ADMINISTRATION, PROSSER, WA.

Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 1501 2J

SCIENCE AND EDUCATION ADMINISTRATION, RIVERSIDE, CA. SALINITY LAB.

Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 1508 2G

Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

The Wellton-Mohawk Dilemma,
W82-05883 1511 3F

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 1512 2G

SCIENCE AND EDUCATION ADMINISTRATION, SIDNEY, MT.

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

SCIENCE AND EDUCATION ADMINISTRATION, ST. PAUL, MN.

Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 1502 3C

SCIENCE AND EDUCATION ADMINISTRATION, STILLWATER, OK. CONSERVATION STRUCTURES LAB.

Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 1501 8A

SCIENCE AND EDUCATION ADMINISTRATION, STILLWATER, OK. WATER CONSERVATION STRUCTURES LAB.

Tractive Force Design of Vegetated Channels,
W82-00901 1502 4D

SCIENCE AND EDUCATION ADMINISTRATION, STONEVILLE, MS. DELTA STATES AGRICULTURAL RESEARCH CENTER.

Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 1503 5B

SCIENCE AND EDUCATION ADMINISTRATION, STONEVILLE, MS. SOUTHERN WEED SCIENCE LAB.

Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 1505 4A

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. BLACKLAND CONSERVATION RESEARCH CENTER.

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. GRASSLAND, SOIL AND WATER RESEARCH.

Soil Water Availability,
W82-05623 1511 2G

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. GRASSLAND, SOIL AND WATER RESEARCH LAB.

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 1502 2I

SCIENCE AND EDUCATION ADMINISTRATION, TEMPLE, TX. GRASSLAND, SOIL, AND WATER, SOIL, AND WATER RESEARCH LAB.

SPNM, A Model for Predicting Sediment, Phosphorus, and Nitrogen Yields from Agricultural Basins,
W82-04157 1509 6A

SCIENCE AND EDUCATION ADMINISTRATION, TIFTON, GA. SOUTHEAST WATERSHED RESEARCH CENTER.

Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 1505 2J

SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ.

Picloram Dissipation in a Small Southwestern Stream,
W82-00212 1501 5B

SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ. SOUTHWEST RANGELAND WATERSHED RESEARCH CENTER.

Concentrated Flow Relationships,
W82-01409 1503 2J

SCIENCE AND EDUCATION ADMINISTRATION, WASHINGTON, DC.

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 1503 5B

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 1507 5E

SCIENCE AND EDUCATION, BELTSVILLE, MD. HYDROLOGY.

The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 1502 2B

SCIENCE APPLICATIONS, INC., AMES, IA.

A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 1512 3A

SCIENCE APPLICATIONS, INC., PALO ALTO, CA.

MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 1512 3A

SCIENTIFIC AND EDUCATION ADMINISTRATION, COLUMBIA, MO. WATERSHED RESEARCH UNIT.

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

SCIENTIFIC AND EDUCATION ADMINISTRATION, MORRIS, MN. NORTH CENTRAL SOIL CONSERVATION RESEARCH LAB.

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 1503 5B

SCIENTIFIC AND EDUCATIONAL ADMINISTRATION, DURANT, OK. SOUTHERN PLAINS WATERSHED AND WATER QUALITY LAB.

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). FRESHWATER SECTION.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

SCIENTIFIC RESEARCH INST. OF PLASTICS, (USSR).
Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

SCIENTIFIC SERVICE, INC., REDWOOD CITY, CA.
A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 1511 5G

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CA.
Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 1506 2A

Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 1507 7B

Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 1512 2B

A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 1512 2B

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CA. PHYSIOLOGICAL RESEARCH LAB.
Superseparation: Soret Effect Reversed,
W82-00791 1502 3A

SCS ENGINEERS, INC., LONG BEACH, CA.
Optimization of Looped Water Distribution Systems,
W82-04045 1509 6A

SEA RESEARCH FOUNDATION, WEST HARTFORD, CT. INST. FOR AQUARIUM STUDIES.
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 1501 5A

SEATEC INTERNATIONAL, BANGKOK (THAILAND).
Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 1511 5F

SECRETARIA DE AGRICULTURA Y RECUROSOS HIDRAULICOS, MEXICO CITY.
Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 1511 6C

SECRETARY FOR AGRICULTURE AND FORESTRY, CISKEI (SOUTH AFRICA).
Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 1502 6D

SECRETARY OF STATE FOR SCOTLAND, EDINBURGH. SCOTTISH DEVELOPMENT DEPT.
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 1511 5D

SEDWAY/COOKE, SAN FRANCISCO, CA.
Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 1501 6G

SERVICE CONTROLE DE QUALITE DES EAUX, RABAT (MOROCCO).
Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 1507 2H

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Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

SERVICE DE PROTECTION DE L'ENVIRONNEMENT, SAINTE-FOY (QUEBEC).
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 1508 5A

SERVICE HYDROLOGIQUE NATIONAL, BERN (SWITZERLAND).
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging).
W82-01892 1504 2B

SERVICO DE ENGENHARIA EMILIO BAUMGART LTD., BELO HORIZONTE (BRAZIL).
Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 1505 5F

SERVICOS DE ENGENHARIA EMILIO BAUMGART LTD., BELO HORIZONTE (BRAZIL).
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 1503 5F

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
Chemistry of Septicity,
W82-00325 1501 5D

Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 1503 8B

Waste Disposal--Choosing and Licensing Site,
W82-02035 1504 5G

Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 1505 7C

Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

The Seven-Trent Studies of Industrial Water Use,
W82-04686 1510 6D

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 1511 5C

Sludge Tankering Economics - A Fresh Approach,
W82-06076 1512 5E

SEVERN-TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND). DIRECTORATE OF SCIENTIFIC SERVICES.
Groundwater Quality in the Severn-Trent Region,
W82-02423 1505 5A

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An Investigation of Some Factors Influencing the Performance of a Recreational Trout Fishery,
W82-06329 1512 6D

SEVERN-TRENT WATER AUTHORITY, BURMINGHAM (ENGLAND).
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 1503 8F

SEVERN TRENT WATER AUTHORITY, COVENTRY (ENGLAND).
A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 1510 7A

SEVERN-TRENT WATER AUTHORITY (ENGLAND).
Environmental Virology and its Problems,
W82-00505 1502 5A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 1502 8A

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 1507 5D

Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

Sulphide Control in Rising Mains,
W82-05465 1511 5D

Mutagens, Carcinogens and the Water Cycle,
W82-05468 1511 5A

SEVERN-TRENT WATER AUTHORITY (ENGLAND). DERWENT DIV.
The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 1512 5G

SEWAGE RECLAMATION DEPT., TEL AVIV (ISRAEL).
Environmental Effects of Water Reuse Scheme,
W82-00973 1502 3C

SHALER (AMOS J.), INC., STATE COLLEGE, PA.
Wastewater Reuse Using Microgas Dispersion Stripping,
W82-05911 1512 5D

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Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 1512 2I

SHANGHAI INST. OF MECHANICAL AND ELECTRICAL ENGINEERING (CHINA).
Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

SHEFFIELD UNIV. (ENGLAND). DEPT. OF BOTANY.
Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

SHEFFIELD UNIV. (ENGLAND). DEPT. OF CONTROL ENGINEERING.
Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 1511 5F

SHEFFIELD UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 1506 2E

SHEFFIELD UNIVERSITY (ENGLAND) DEPT. OF MICROBIOLOGY.
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

SHEFIELD UNIV. (ENGLAND). DEPT. OF MICROBIOLOGY.
Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 1505 5B

SHELL INTERNATIONALE RESEARCH MAATSHCAPPIJ N.V., THE HAGUE (NETHERLANDS). GROUP TOXICOLOGY DIV.
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

SHIBUKAWA SENIOR GIRLS HIGH SCHOOL, GUNMA (JAPAN).
On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 1506 2H

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W82-03318 1507 5A

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W82-03610 1508 5C

SHORT-ELLIOTT-HENDRICKSON, INC., ST. PAUL, MN.
Empire Controlled by Computer,
W82-00529 1502 5D

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A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1510 1A

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Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121 1512 3A

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W82-04579 1510 5A

SIEMENS A.G., KARLSRUHE (GERMANY, F.R.).
Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 1510 5D

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Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 1511 5A

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W82-04044 1509 5D

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Northwestern Ontario River Dimensions,
W82-05742 1511 6G

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W82-04291 1510 2L

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 1512 5B

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 1512 5B

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Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 1508 5A

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Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 1503 2G

Vertical Variation in Stemflow Generation,
W82-02959 1506 2I

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W82-06497 1512 2L

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Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 1502 5C

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W82-03909 1509 5D

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W82-03236 1507 5A

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W82-06037 1512 5A

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W82-04683 1510 2A

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W82-02358 1505 5B

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W82-02583 1505 2L

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Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 1504 5B

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W82-01427 1503 5G

PVC Cover Causes Leachate Retreat,
W82-02321 1505 5E

Ground Water,
W82-06807 1512 5B

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Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

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W82-02165 1505 5C

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W82-02340 1505 2I

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W82-02937 1506 2L

SNAKE RIVER CONSERVATION RESEARCH CENTER, KIMBERLY, ID.
Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 1510 4D

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Ferric Chloride Takes Over,
W82-00954 1502 5F

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W82-01857 1504 2A

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W82-02867 1506 2L

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W82-03193 1507 5C

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W82-04763 1511 5A

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W82-05364 1511 5F

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W82-03456 1508 6C

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W82-06192 1512 5A

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W82-05177 1511 5D

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W82-00184 1501 3F

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W82-01636 1503 5E

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W82-02046 1504 2F

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W82-06409 1512 6G

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W82-05717 1511 4D

SOIL CONSERVATION SERVICE, LANHAM, MD.
Erosion and Sediment,
W82-06554 1512 2J

SOIL CONSERVATION SERVICE, WASHINGTON, DC.
Impressions of Soil and Water Conservation in China,
W82-01730 1503 4D

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 1504 2J

SOIL SURVEY INST., WAGENINGEN (NETHERLANDS).
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

Soil Morphology and Preferential Flow Along Macropores,
W82-03175 1507 2G

SOIL SURVEY INST., WAGENINGEN (NETHERLANDS). DEPT. OF SOIL PHYSICS.
A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

SOIL TESTING SERVICES OF WISCONSIN, INC., GREEN BAY.
Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 1503 5G

Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

SOLWAY RIVER PURIFICATION BOARD (SCOTLAND).
The Impact of Fish Farming on Water Quality,
W82-05471 1511 5B

SONNEN (M. B.) CO., INC., WALNUT CREEK, CA.
Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

SONOMA STATE UNIV., ROHNERT PARK, CA. DEPT. OF CHEMISTRY.
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

SOUTH AUSTRALIA ENGINEERING AND WATER SUPPLY DEPT., ADELAIDE.
South Australia's Approach to Salinity Management in the River Murray,
W82-02761 1506 5G

SOUTH CAROLINA UNIV., COLUMBIA. BELLE W. BARUCH INST. FOR MARINE BIOLOGY.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 1504 2L

SOUTH CAROLINA UNIV., COLUMBIA. BELLE W. BARUCH INST. FOR MARINE BIOLOGY AND COASTAL RESEARCH.
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00216 1502 7A

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 1505 2L

SOUTH CAROLINA UNIV., COLUMBIA. BELLE W. BARUCH INST. FOR MARINE SCIENCE AND COASTAL RESEARCH.
Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 1512 2L

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF BIOLOGY.
The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 1502 2L

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 1512 5A

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF CHEMISTRY.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 1503 5A

SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY.
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 1501 2L

Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 1501 5B

General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 1502 2L

Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 1507 2H

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY.
Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY. INST. OF ATMOSPHERIC SCIENCES.
A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

On the Graphical Presentation of Raindrop Size Data,
W82-06529 1512 2B

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF AGRICULTURAL ENGINEERING.
Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF CHEMISTRY.
Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 1512 5F

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF PLANT SCIENCE.
Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 1505 2I

Phosphate in Water: I. Reduction Using Northern Lignite Fly Ash,
W82-03882 1509 5F

Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 1512 3F

SOUTH DAKOTA STATE UNIV., BROOKINGS. WATER RESOURCES INST.
Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 1510 3F

SOUTH DAKOTA UNIV., VERMILLION. WATER RESOURCES INST.
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 1512 5C

SOUTHAMPTON UNIV. (ENGLAND).
Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF CHEMISTRY.
Theory of the Dielectric Constant of Ice,
W82-03176 1507 2C

SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF OCEANOGRAPHY.
Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 1507 2L

SOUTHAMPTON UNIV. (ENGLAND). INST. OF IRRIGATION STUDIES.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 1503 6A

SOUTHEASTERN FOREST EXPERIMENT STATION, ASHEVILLE, NC.
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

SOUTHEASTERN FOREST EXPERIMENT STATION, ASHEVILLE, NC. COWEETA HYDROLOGIC LAB.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 1503 4C

SOUTHEASTERN MASSACHUSETTS UNIV., NORTH DARTMOUTH.
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

SOUTHERN CALIFORNIA METROPOLITAN WATER DISTRICT, LA VERNE.
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

SOUTHERN CALIFORNIA METROPOLITAN WATER DISTRICT, LAVERNE.
Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 1510 5A

SOUTHERN CALIFORNIA METROPOLITAN WATER DISTRICT, LOS ANGELES.
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 1506 5F

SOUTHERN CALIFORNIA UNIV., LOS ANGELES. DEPT. OF GEOLOGICAL SCIENCES.
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 1503 2F

SOUTHERN FISHERIES RESEARCH CENTER, DECEPTION BAY (AUSTRALIA).
Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 1505 2L

SOUTHERN ILLINOIS UNIV. AT CARBONDALE.
Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. COAL EXTRACTION AND UTILIZATION RESEARCH CENTER.
Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 1506 5B

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF AGRICULTURAL INDUSTRIES.
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF PLANT AND SOIL SCIENCE.
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 1501 5E

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF THERMAL AND ENVIRONMENTAL ENGINEERING.
Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. DEPT. OF ZOOLOGY.
Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02630 1506 2H

SOUTHERN ILLINOIS UNIV. AT EDWARDSVILLE. DEPT. OF BIOLOGICAL SCIENCES.
Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 1502 2K

SOUTHERN ILLINOIS UNIV., CARBONDALE. DEPT. OF FORESTRY.
Water Resources Investigations in West Central Iran Using Landsat Data,
W82-03927 1509 7B

SOUTHERN PIEDMONT CONSERVATION RESEARCH CENTER, WATKINSVILLE, GA.
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 1501 2J

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

SOUTHERN RESEARCH INST., BIRMINGHAM, AL.
Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes,
W82-06167 1512 3A

SOUTHERN RESEARCH INST. BIRMINGHAM, AL. ANALYTICAL AND PHYSICAL CHEMISTRY DIV.
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 1511 5A

SOUTHERN UNIV., BATON ROUGE, LA. DEPT. OF BIOLOGICAL SCIENCES.
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

SOUTHERN UNIV., BATON ROUGE, LA. DEPT. OF CIVIL ENGINEERING.
Municipal and Industrial Water Demands of Western U.S.,
W82-06463 1512 6D

SOUTHERN UNIVERSITIES NUCLEAR INST., FAURE (SOUTH AFRICA). ATOMIC ENERGY BOARD ISOTOPE UNIT.
Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

SOUTHERN WATER AUTHORITY (ENGLAND).
Adopting Sewers,
W82-04655 1510 8A

A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 1511 5A

Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

SOUTHERN WATER AUTHORITY, OTTERBOURNE (ENGLAND).
Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 1512 5C

SOUTHERN WATER AUTHORITY, WORTHING (ENGLAND).
Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, BROOKSVILLE.
Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 1511 5C

SOUTHWEST RESEARCH INST., SAN ANTONIO, TX.
Development of Oil-In-Water Monitor, Phase II,
W82-00100 1501 5A

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

SOUTHWESTERN GREAT PLAINS RESEARCH CENTER, BUSHLAND, TX.
Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 1506 3F

SRI INTERNATIONAL, MENLO PARK, CA.
Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 1511 5B

Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

SRI LANKA UNIV., COLOMBO.
Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

SRI LANKA UNIV., PERADENIYA. DEPT. OF GEOLOGY.
Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 1511 5C

SRI PRATAP COLL., SRINAGAR (INDIA). HYDROBIOLOGY LAB.
Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

STAHLY ENGINEERING AND ASSOCIATES, KALISPELL, MT.
The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

STANDARD OIL CO., CHICAGO, IL.
The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 1501 5D

Maximizing Effluent Quality from a Municipal Activated Sludge Plant Concurrent with a Major Reduction in Process Energy Requirements,
W82-03874 1509 5D

STANFORD UNIV., CA.
Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 1507 2A

Numerical Management Models of Groundwater Pollution,
W82-04211 1509 5B

STANFORD UNIV., CA. DEPT. OF APPLIED EARTH SCIENCES.
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 1511 5G

STANFORD UNIV., CA. DEPT. OF BIOLOGICAL SCIENCES.
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 1502 2I

STANFORD UNIV., CA. DEPT. OF CIVIL ENGINEERING.
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 1501 2L

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 1502 5B

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 1503 6A

Effect of Reagent Mixing Rate on Adsorption Process for As-Fe2O3.H2O,
W82-01799 1503 5F

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 1511 5F

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5B

STANFORD UNIV., CA. DEPT. OF ENVIRONMENTAL ENGINEERING.
Organics in Water - An Engineering Challenge,
W82-01540 1503 5F

STANFORD UNIV., CA. DEPT. OF GEOLOGY.
Non-Equilibrium Water/Rock Interactions,
W82-01684 1503 1A

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 1508 4B

STANLEY ASSOCIATES ENGINEERING LTD., EDMONTON (ALBERTA).
Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 1508 2K

STANLEY CONSULTANTS, INC., MUSCATINE, IA.
Water Rate Studies and Rate Making Philosophy,
W82-06222 1512 6C

STANTON AND STAVELY, NOTTINGHAM (ENGLAND).
A Pipeline for all Environments,
W82-04764 1511 8G

STATE OCEANOGRAPHIC INST., MOSCOW (USSR).
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 1503 2H

STATE POLLUTION CONTROL COMMISSION, SYDNEY (AUSTRALIA).
Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 1512 5D

STATE POLLUTION CONTROL COMMISSIONS, LIDCOMBE (AUSTRALIA).
Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 1511 5E

STATE UNIV. OF NEW YORK AT ALBANY.
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 1502 2B

Conserving Water Through Pricing,
W82-04272 1510 3D

STATE UNIV. OF NEW YORK AT ALBANY. DEPT. OF ATMOSPHERIC SCIENCE.
Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 1512 2B

STATE UNIV. OF NEW YORK AT BINGHAMTON. DEPT. OF CHEMISTRY.
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 1501 2K

STATE UNIV. OF NEW YORK AT BINGHAMTON. LAB. FOR TRACE METHODS AND ENVIRONMENTAL ANALYSIS.
Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 1503 5A

STATE UNIV. OF NEW YORK AT BUFFALO, AMHERST. DEPT. OF MECHANICAL AND ENGINEERING AEROSPACE.
Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF GEOGRAPHY.
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 1503 2A

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF MECHANICAL ENGINEERING.
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1502 1A

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF MICROBIOLOGY.
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 1502 5D

STATE UNIV. OF NEW YORK AT STONY BROOK. INST. FOR ENERGY RESEARCH.
Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

STATE UNIV. OF NEW YORK AT STONY BROOK. MARINE SCIENCES RESEARCH CENTER.
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 1506 2L

An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606 1511 5B

STATE UNIV. OF NEW YORK AT SYRACUSE. COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY.
The Distribution of Heavy Metals and Petroleum Residues in the Soil from Urban Surface Runoff,
W82-04216 1509 5B

Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 1510 5B

Search: A Gaged Watershed Inventory,
W82-04433 1510 10B

Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 1512 5B

STATE UNIV., OF NEW YORK COLL. AT BUFFALO. GREAT LAKES LAB.
Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 1511 5C

STATE UNIV. OF NEW YORK COLL. AT FREDONIA. DEPT. OF BIOLOGY.
Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

STATE UNIV. OF NEW YORK COLL. AT FREDONIA. DEPT. OF ECONOMICS.
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 1502 5E

STATE UNIV. OF NEW YORK COLL. AT FREDONIA. DEPT. OF GEOLOGY.
Paleoflood Hydrology,
W82-03761 1509 2E

STATE UNIV. OF NEW YORK COLL. AT OSEWGO. DEPT. OF EARTH SCIENCES.
The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03903 1509 5C

STATE UNIV. OF NEW YORK COLL. AT OSWEGO.
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

STATE UNIV. OF NEW YORK COLL. AT PURCHASE.
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

STATE UNIV. OF NEW YORK COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY, SYRACUSE.
An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 1507 7B

Potential Use of Earthworms as a Solution to Sludge Management,
W82-05478 1511 5E

STATE UNIV. OF NEW YORK COLL. OF ENVIRONMENTAL SCIENCE AND FORESTRY, SYRACUSE. DEPT. OF ENVIRONMENTAL AND FORESTRY BIOLOGY.
Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

STATE UNIV. OF NEW YORK, SYRACUSE. DEPT. OF CIVIL ENGINEERING.
Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 1512 2K

STATE UNIV. OF NEW YORK UPSTATE MEDICAL CENTER, SYRACUSE. DEPT. OF PEDIATRICS.
The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

STATE WATER SURVEY DIV., CHAMPAIGN.
Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 1510 2B

STATION BIOLOGIQUE DE LA TOUR DU VALAT, ARLES (FRANCE).
Phosphate Models, a Gap to Bridge,
W82-00929 1502 2H

Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique),
W82-02562 1505 5A

STEARNS AND WHELER, CAZENOVIA, NY.
Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

STEVENS INST. OF TECH., HOBOKEN, NJ.
Reevaluating Hunter's Model for Residential Water Demand,
W82-04131 1509 6D

STOCKHOLM UNIV. (SWEDEN).
Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 1511 5A

STOCKHOLM UNIV. (SWEDEN). ARRHENIUS LAB.
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 1502 2B

STOCKHOLM UNIV. (SWEDEN). DEPT. OF GEOLOGY.
A Review on Sediment Traps in Aquatic Environments,
W82-01020 1502 7B

STONE AND WEBSTER ENGINEERING CORP., BOSTON, MA.
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 1503 8A

STONE AND WEBSTER ENGINEERING CORP., CHERRY HILL, NJ.
Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 1502 6A

STORA KOPPARBERG-BERGVIK, SKUTSKAR (SWEDEN).
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 1504 5D

STORM- UND HAFENBAU, HAMBURG (GERMANY, F.R.). BEHORDE FUER WIRTSCHAFT, VERKEHR UND LANDWIRTSCHAFT.
Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 1512 5E

STORMWATER CONSULTANTS, BOLINGBROOK, IL.
Better Ways to Finance Stormwater Management,
W82-03298 1507 6C

STRATHCLYDE REGIONAL COUNCIL, GLASGOW (SCOTLAND).
Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 1512 5E

STRATHCLYDE REGIONAL COUNCIL (SCOTLAND).
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 1503 5D

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

STRAUSS AND ROBERTS, INC., PORTERVILLE, CA.
Drinking Water Disinfection,
W82-06341 1512 5F

STRAUSS AND ROBERTS, PORTERVILLE, CA.
Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

STUTTGART UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERBAU, WASSERGUETEUND ABFALLWIRTSCHAFT.
The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 1510 5D

STUTTGART UNIV. (GERMANY, F.R.). INST. FUER SIEDLUNGSWASSERBAU, WASSERGUTE- UND ABFALLWIRTSCHAFT.
Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 1512 5B

SUFFOLK COUNTY WATER AUTHORITY, OAKDALE, NY.
Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 1512 5F

SULAIMANIYAH UNIV. (IRAQ). DEPT. OF BIOLOGY.
On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

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A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 1504 5C

SUNDERLAND POLYTECHNIC (ENGLAND). DEPT. OF CIVIL ENGINEERING.
The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
W82-06449 1512 8A

SURREY UNIV., GUILDFORD (ENGLAND). DEPT. OF MICROBIOLOGY.
Distribution of Chromobacteria in a Lowland River,
W82-02795 1506 5C

Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 1507 5D

SURREY UNIV., GUILFORD (ENGLAND). DEPT. OF MICROBIOLOGY.
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 1502 5D

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Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
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Multimillion-Acre Tea Bag,
W82-03352 1507 3F

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Control of Sludge Bulking in the Brewing Industry,
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Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
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Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 1507 5D

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International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 1505 5C

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Small Hydro Stations in Sweden,
W82-04174 1509 8C

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The Mercury Cycle,
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Improved Operation of Municipal Wastewater Treatment Plants in Sweden by Use of Instrumentation and Automation,
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Pumped-Storage for Swiss Railways, Part One,
W82-03468 1508 8A

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Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 1507 2G

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Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

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Microplate Technique for Determining Accumulation of Metals by Algae,
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Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
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Experimental Investigation of Accelerated Transitional Flow in Pipes,
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The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
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Work Management Standards,
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Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
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Water for Industry,
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Discharge to the North Sea,
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Application of Soil Water Flow Theory in Field Simulation,
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Diversion of the River Neva,
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Immediate and Delayed Oxygen Depletion in Rivers,
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W82-04767 1511 5A

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Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schusstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen),
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Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
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Safety of Dams (Sicherheit Von Talsperren),
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Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
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Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
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Coal and Coal Mine Drainage,
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W82-01272 1503 5G

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W82-05316 1511 2H

Coal and Coal Mine Drainage,
W82-06802 1512 5B

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 1512 5C

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W82-01265 1503 5B

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Foam Control in Aeration Tanks,
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Shear Strength of Rockfill,
W82-00116 1501 8D

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Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
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Particulate and Dissolved Lipids in Sea Water,
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Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

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Access to Water-Related Data in Texas,
W82-04000 1509 10B

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Optimal Design of Water Conveyance Systems,
W82-00160 1501 6B

Intensive Survey of the Sabine-Neches Canal - Segment 0703,
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Intensive Survey of Armand Bayou,
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Intensive Survey of Hunting Bayou,
W82-04080 1509 5A

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Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

TEXAS TECH UNIV., LUBBOCK. DEPT. OF GEOGRAPHY.
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 1507 6E

Problems of Public Access to Water in Texas Lakes and Streams,
W82-04220 1509 6E

Conjunctive Management of Water Resources in the Context of Texas Water Law,
W82-04223 1509 6E

TEXAS TECH UNIV., LUBBOCK. DEPT. OF GEOSCIENCE.
A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 1506 2F

TEXAS TECH UNIV., LUBBOCK. DEPT. OF PLANT AND SOIL SCIENCE.
Effects of Water Quality on Forage Production,
W82-01002 1502 3C

TEXAS UNIV. AT AUSTIN.
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

Optimal Water Reuse Planning,
W82-02736 1506 6A

Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 1508 8A

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 1508 2G

A Model for Solving Multiperiod Multireservoir Water Resources Problems with Stochastic Inflows,
W82-03830 1509 6A

Evaluation of Hydropower Potential in a River Basin,
W82-04214 1509 6B

TEXAS UNIV. AT AUSTIN. BUREAU OF ECONOMIC GEOLOGY.
Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 1511 5B

TEXAS UNIV. AT AUSTIN. CENTER FOR RESEARCH IN WATER RESOURCES.
Reservoir Operation for Water Conservation,
W82-04165 1509 3B

TEXAS UNIV. AT AUSTIN. DEPT. OF CIVIL ENGINEERING.
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 1502 5B

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 1505 5D

Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 1510 6A

Water Reuse Planning Models: Extensions and Applications,
W82-04565 1510 6A

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 1511 2H

Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

TEXAS UNIV. AT AUSTIN. DEPT. OF ECONOMICS.
Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 1510 6E

TEXAS UNIV. AT AUSTIN. DEPT. OF GEOLOGICAL SCIENCES.
The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

TEXAS UNIV. AT AUSTIN. DEPT. OF PHARMACOLOGY.
Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 1508 5C

TEXAS UNIV. AT AUSTIN. ENGINEERING DEPARTMENT. DEPT. OF ENGINEERING.
Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 1506 5D

TEXAS UNIV. AT AUSTIN, PORT ARANSAS. MARINE SCIENCE INST.
Metabolic Response of Fish to Stress,
W82-05159 1511 5C

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 1511 5C

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The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 1505 2L

TEXAS UNIV. AT AUSTIN. SCHOOL OF PUBLIC HEALTH.
Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 1510 5C

TEXAS UNIV. AT DALLAS, RICHARDSON.
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 1503 6B

Breakthrough Characteristics of Selected Toxicants in Granular Activated Carbon Treatment of Combined Industrial Wastewaters,
W82-03812 1509 5D

The Evaluation of the Elutriate Test as a Means of Predicting the Behavior of Selected Chlorinated Hydrocarbons in Dredged Sediment During Open-Water Disposal,
W82-03824 1509 5A

TEXAS UNIV. AT HOUSTON. SCHOOL OF PUBLIC HEALTH.
Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

TEXAS UNIV. AT SAN ANTONIO.
Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 3C

TEXAS UNIV. AT SAN ANTONIO. DIV. OF ENVIRONMENTAL STUDIES.
Multi-Attribute Decision Analysis for the Protection of Groundwater Resources,
W82-03805 1509 6A

TEXAS UNIV. CENTER FOR APPLIED RESEARCH AND TECHNOLOGY AT SAN ANTONIO.
Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

TEXAS UNIV., GALVESTON. MEDICAL BRANCH.
Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

TEXAS UNIV. HEALTH SCIENCE CENTER AT HOUSTON. SCHOOL OF PUBLIC HEALTH.
Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 1510 5C

TEXAS UNIV. HEALTH SCIENCE CENTER, HOUSTON. DEPT. OF ENVIRONMENTAL SCIENCES.
Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

TEXAS UNIV., HOUSTON. SCHOOL OF PUBLIC HEALTH.
Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 1511 5A

TEXAS UNIV. MEDICAL BRANCH AT GALVESTON. DEPT. OF MICROBIOLOGY.
Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 1512 5A

TEXAS UNIVERSITY AT DALLAS, RICHARDSON.
Substrate Associated Microfauna,
W82-01283 1503 5C

TEXAS WATER RESOURCES INST. COLLEGE STATION.
Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 1512 3F

THAMES WATER ADVISORY SERVICE (ENGLAND).
Reviving the Rio Reconquista,
W82-02014 1504 5G

THAMES WATER AUTHORITY, BERKSHIRE (ENGLAND).
Data Acquisition for River Management,
W82-04601 1510 7A

THAMES WATER AUTHORITY (ENGLAND).
The Sewerage Policy of Thames Water,
W82-02040 1504 6E

Pilot-Scale Investigations with Granular Activated Carbon,
W82-02289 1505 5D

The Risk Business,
W82-03281 1507 6E

Experience with Borehole Recharge in The Lee Valley,
W82-03894 1509 4B

The Traditional Approach to Water Loss,
W82-04656 1510 3D

A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

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Pollution from Farms,
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Beddington Sewage-Treatment Works, Canyon: Some Operating Experiences 1969-79,
W82-02410 1505 5D

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works,
W82-03850 1509 5D

Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 1510 5B

Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 1510 2L

The Search for Reservoir Sites in an Urban Environment,
W82-04867 1511 8A

Wedge-Block Tunnels in Water Supply,
W82-05803 1511 8F

THAMES WATER AUTHORITY, LONDON (ENGLAND).

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 1512 5E

Sludge Disposal to Sea in U.K.,
W82-06292 1512 5E

Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 1512 8A

Crisis: Financing Water and Wastewater,
W82-06641 1512 6C

THAMES WATER AUTHORITY, LONDON (ENGLAND). METROPOLITAN PUBLIC HEALTH DIV.

Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 1504 5D

THAMES WATER AUTHORITY, LONDON (LONDON).

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

THE HEBREW UNIV., REHOVOT (ISRAEL). DEPT. OF SOIL AND WATER SCIENCE.

The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 1502 3C

THE PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF GEOSCIENCES.

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

THEMAG ENGENHARIA LTDA., SAO PAOLO (BRAZIL).

Irrigation for Brazil's Poligono Das Secas,
W82-01744 1503 3F

THESSALONIKI UNIV., SALONIKA (GREECE). DEPT. OF HYDRAULICS.

Turbulence Model for Flow Over Dredged Channels,
W82-02201 1505 8B

Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 1510 8B

THESSALONIKI UNIV., SALONIKA (GREECE). LAB. OF ANALYTICAL CHEMISTRY.

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

THESSALONIKI UNIV., SALONIKA (GREECE). SCHOOL OF TECHNOLOGY.

The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 1510 4B

THOMPSON (BOYCE) INST., ITHACA, NY.

Acid Rain and Environmental Policy,
W82-01987 1504 5B

THORN CREEK BASIN SANITARY DISTRICT WATER, CHICAGO HEIGHTS, IL.

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 1511 5D

TIERAERZTLICHEN HOCHSCHULE, HANOVER (GERMANY, F.R.). CHEMICAL INST.

Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
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TOHOKU UNIV., SENDAI (JAPAN). BIOLOGICAL INST.

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
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Determination of Ammonia in Estuary,
W82-02390 1505 5A

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Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
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Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

TOKYO INST. OF TECH., (JAPAN).

Automatic Monitoring of Exhaust Gas Analysis in Activated Sludge Wastewater Treatment Process,
W82-04014 1509 5D

TOKYO INST. OF TECH., YOKOHAMA. RESEARCH LAB. OF RESOURCES UTILIZATION.

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 1511 5D

TOKYO METROPOLITAN UNIV. (JAPAN). DEPT. OF BIOLOGY.

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 1506 5C

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 1512 5C

TOKYO METROPOLITAN UNIV. (JAPAN). DEPT. OF CHEMISTRY.

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 1501 5B

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 1501 5A

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 1502 2H

Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 1512 5A

TOKYO METROPOLITAN UNIV (JAPAN). DEPT. OF INDUSTRIAL CHEMISTRY.

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 1504 5A

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Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

TOKYO SCIENCE UNIV. (JAPAN). FACULTY OF PHARMACEUTICAL SCIENCE.

Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 1506 5D

TOKYO SCIENCE UNIV. (JAPAN). FACULTY OF PHARMACEUTICAL SCIENCES.

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 1512 5A

TOKYO UNIV. (JAPAN).

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

TOKYO UNIV. (JAPAN). DEPT. OF BOTANY.

Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

TOKYO UNIV. (JAPAN). DEPT. OF CHEMISTRY.

Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

TOKYO UNIV. (JAPAN). DEPT. OF URBAN AND SANITARY ENGINEERING.

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 1505 5G

TOKYO UNIV. (JAPAN). DEPT. OF URBAN ENGINEERING.

Studies on Oxygen Transfer Models,
W82-05349 1511 1A

TOKYO UNIV. (JAPAN). FACULTY OF PHARMACEUTICAL SCIENCES.

Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

TOKYO UNIV. (JAPAN). OCEAN RESEARCH INST.

Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 1505 5A

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

TONGASS NATIONAL FOREST, KETCHIKAN, AK.

Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 1508 2K

TORO CO., SAN MARCOS, CA. (ASSIGNEE).
Traveling Sprinkler System and Method,
W82-00561 1502 3F

TORONTO UNIV. (ONTARIO).
Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

TORONTO UNIV. (ONTARIO). DEPT. OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY.
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

TORONTO UNIV. (ONTARIO). DEPT. OF CHEMISTRY.
Solution of the Continuity Equation for the Karnak Area,
W82-03196 1507 2G

TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 1501 5E

Recent Developments in Water Pollution Control,
W82-00340 1501 5D

Water Quality Evaluation of Regional Wastewater Management,
W82-00977 1502 5D

Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 1511 5D

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

TORONTO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 1503 5G

On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 1511 2G

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

TORONTO UNIV. (ONTARIO). DEPT. OF MICROBIOLOGY AND PARASITOLOGY.
Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 1503 5A

TORONTO UNIV. (ONTARIO). DEPT. OF PHYSICS.
The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 1512 2B

TORONTO UNIV. (ONTARIO). DEPT. OF ZOOLOGY.
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 1505 2K

TOSHIVA CORP., TOKYO (JAPAN). HEAVY APPARATUS ENGINEERING LAB.
An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

TOSHIVA MACHINE CO., TOKYO (JAPAN). INDUSTRIAL APPARATUS ENGINEERING DEPT.
An Approach to Full-Automatic Control of Activated Sludge Process,
W82-03855 1509 5D

TOUHILL, SHUCKROW AND ASSOCIATES, INC., PITTSBURGH, PA.
Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

TOURS UNIV. (FRANCE). LAB. DE CHIMIE MINERALE ET D'HYDROLOGIE.
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 1507 5A

TOWER SYSTEMS INC., TACOMA, WA.
Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 1503 3E

TOYAMA UNIV. (JAPAN).
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

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Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 1511 8B

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Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 1512 5D

TRC ENVIRONMENTAL CONSULTANTS, INC., WETHERSFIELD, CT.
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

TRENT UNIV., PETERBOROUGH (ONTARIO). DEPT. OF GEOGRAPHY.
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 1501 2C

TRINITY COLL., DUBLIN (IRELAND).
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 1504 5D

TROMSO UNIV. (NORWAY). INST. FOR FISKERIFAG.
Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 1504 5C

TRONDHEIM UNIV. (NORWAY).
Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 1501 5D

Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

TRONDHEIM UNIV. (NORWAY). DEPT. OF GEOLOGY.
Designing and Excavating Underground Powerplants,
W82-05982 1512 8E

TRONDHEIM UNIV. (NORWAY). DIV. OF HYDRAULIC AND SANITARY ENGINEERING.
Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 1512 5F

Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 1512 5F

TRW ENVIRONMENT ENGINEERING DIV., REDONDO BEACH, CA.
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W82-01430 1503 5D

TRW ENVIRONMENTAL ENGINEERING DIV., REDONDO BEACH, CA.
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W82-05068 1511 5G

TUBINGEN REGIERUNGSPRESIDIUM (GERMANY, F.R.).
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W82-04551 1510 4B

TUDOR ENGINEERING CO., RIVERTON, WY.
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 1502 6B

TUDOR ENGINEERING CO., SAN FRANCISCO, CA.
Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 1508 6E

Determining Feasibility of Small-Scale Hydropower,
W82-04693 1510 6B

TUFTS UNIV., MEDFORD, MA.
Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 1511 5D

TULANE UNIV., NEW ORLEANS, LA. DEPT. OF BIOLOGY.
Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 1508 5C

TULANE UNIV., NEW ORLEANS, LA. SCHOOL OF PUBLIC HEALTH AND TROPICAL MEDICINE.
Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

TULSA UNIV., OK.
Oil-Water Separation by Induced Air Flotation,
W82-03719 1508 5D

TURBITROL CO., ATLANTA, GA.
Maintenance of Analog Instrument systems,
W82-06263 1512 5D

TURNER, COLLIE AND BRADEN, INC., HOUSTON, TX.
Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 1510 8A

TUSKEGEE INST., AL. DEPT. OF AGRICULTURAL SCIENCES.
Wastewater Irrigation of Fruit Trees,
W82-06008 1512 3C

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The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 1505 5C

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

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W82-01716 1503 5B

ULM UNIV. (GERMANY, F. R.).
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W82-04828 1511 5A

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UMWELTBUNDESAMT, BERLIN (GERMANY, F.R.).
Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 1512 5E

UNDERWOOD MCLELLAND AND ASSOCIATES LTD., WINNIPEG (MANITOBA).
Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

UNION CARBIDE CORP., SOUTH CHARLESTON, WV.
Chemicals and Allied Products,
W82-01267 1503 5D

Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

Impact of Discharges as a Basis for Control Measures,
W82-05354 1511 5B

Chemicals and Allied Products,
W82-06805 1512 5D

UNION CARBIDE CORP., SOUTH CHARLESTON, WV. CHEMICALS AND PLASTICS.
High-Solubility Gas Flotation,
W82-01184 1503 5D

UNION CARBIDE CORP., SOUTH CHARLESTON, WV. RESEARCH AND DEVELOPMENT DEPT.
Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 1511 5E

UNION COLL., SCHENECTADY, NY. DEPT. OF CIVIL ENGINEERING.
Development of Improved Stormwater Quality Models,
W82-04559 1510 5B

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 1511 5B

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W82-06742 1512 5C

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W82-05905 1512 2A

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W82-01003 1502 5D

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W82-04299 1510 2L

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W82-00328 1501 2G

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W82-03480 1508 5B

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Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
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W82-02376 1505 2E

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W82-04934 1511 2H

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W82-01508 1503 5A

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Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 1507 5D

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W82-06476 1512 2H

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W82-02416 1505 5A

Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 1506 2H

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 1512 5C

UNIVERSITY HOSPITAL OF WALES, CARDIFF. REGIONAL PUBLIC HEALTH LAB.
Observations on Infections Associated with South Wales Natural Waters,
W82-03409 1508 5C

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W82-00533 1502 5B

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Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
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Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 1507 5C

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W82-03217 1507 2H

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Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 1512 5F

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Research and Development to Service a Sustainable Agriculture,
W82-00669 1502 3F

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High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 1511 5A

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W82-05871 1511 2C

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The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 1508 2L

Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 1508 2L

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Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 1502 5G

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Predictive Depositional Model for Glacial Aquifers,
W82-00828 1502 2F

Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 1510 5A

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Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 1502 5C

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Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 1507 5B

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES, DEPT. OF GEOLOGICAL SCIENCES.
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

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Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 1505 6B

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Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 1512 5D

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Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222 1509 6D

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Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

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Watering Australia's Driest State,
W82-03767 1509 6D

Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 1510 8B

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Monitoring of Turbidity and Suspended Solids Concentration in Wastewater Treatment Plants,
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Uniform Flow Calculations for Pipes,
W82-03748 1508 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
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Agriculture in the Wider Caribbean,
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A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 1501 8D

Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 1502 8D

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 1502 2B

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W82-02050 1504 5D

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Sizing of Urban Flood Control Ponds,
W82-03297 1507 2A

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On a Technique to Investigate the Covariation Between Streamflow and Rainfall in Afforested Catchments,
W82-03864 1509 4C

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Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 1510 8B

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The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 1506 5A

The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 1507 4A

Factors Affecting the Recovery of Fish Populations in an Industrial River,
W82-04812 1511 5C

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W82-05279 1511 8B

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Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 1504 2L

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W82-00910 1502 2L

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 1503 5C

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 1512 5A

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The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 1503 2I

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Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

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A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
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Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

Weak Controls from Sea to Shining Sea,
W82-05035 1511 5B

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Water for New Zealand's Plains,
W82-02402 1505 3F

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W82-02109 1505 3A

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Reviving Acidified Lakes,
W82-00933 1502 2H

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W82-05424 1511 5D

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Spring Flood: Meltwater or Groundwater,
W82-00531 1502 7B

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W82-04135 1509 6D

URS ENGINEERS, SEATTLE, WA.
County Provides a Rural Water Supply System,
W82-06843 1512 3D

UTAH DEPT. OF HEALTH, SALT LAKE CITY. BUREAU OF PUBLIC WATER SUPPLIES.
Information Management: A Role for Primacy Agencies in The 80S,
W82-03891 1509 10B

UTAH DIV. OF WATER RESOURCES, SALT LAKE CITY.
Salinity Forum: What. How. Why,
W82-02587 1505 6E

UTAH STATE UNIV., LOGAN.
Lagoons and Oxidation Ponds,
W82-01244 1503 5D

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 1503 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 1503 5B

Random Differential Equations in Water Quality Modeling,
W82-01688 1503 6A

Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 1508 2G

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 1510 3D

UTAH STATE UNIV., LOGAN. COLL. OF ENGINEERING.
Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 1503 5D

The Flowering of Wastewater Treatment,
W82-02015 1504 5D

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Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 1508 2A

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W82-05420 1511 5D

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W82-05610 1511 3F

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Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 1501 2G

Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

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Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

Water Requirements and Man-Induced Climate Change,
W82-01633 1503 2D

Simplified Method for Rainfall Intensities,
W82-01978 1504 2B

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Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

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Peak Period Design Standards for Small Western U.S. Water Supply Systems,
W82-04249 1509 6D

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W82-03502 1508 2A

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W82-03521 1508 3C

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Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

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Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 1504 3F

Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

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Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

UTAH STATE UNIV., LOGAN. WATER RESEARCH LAB.
Modeling Cavitation for Closed Conduit Flow,
W82-02700 1506 8B

UTAH STATE UNIV., LOGAN. WATERSHED SCIENCE UNIT.
Influence of Vegetation, Rock Cover, and Trampling on Filtration Rates and Sediment Production,
W82-04153 1509 2G

Erosion from Mountain Snowpack Melt,
W82-05664 1511 2J

UTAH UNIV., SALT LAKE CITY.
Biological Nitrogen Removal System Design,
W82-03145 1507 5D

UTAH UNIV., SALT LAKE CITY. DEPT. OF ECONOMICS.
Normalized Agricultural Prices and Water Resources Planning,
W82-03928 1509 6B

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Pueblo Indian Agriculture, Irrigation and Water Rights,
W82-04208 1509 6E

UTAH UNIV., SALT LAKE CITY. DEPT. OF METEOROLOGY.
An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 1505 7B

UTAH WATER RESEARCH LAB., LOGAN.
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 1502 3B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 1503 7B

Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 1511 5B

Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 1511 6B

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

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W82-00112 1501 2L

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Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 1506 2K

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

UTTAR PRADESH IRRIGATION RESEARCH INST., ROORKEE (INDIA). TEHI DAM DIV.
Flow Under Weir on Scoured Bed,
W82-05800 1511 8B

VALLEY SANITARY DISTRICT, CA.
O & M Wastewater Collection and Treatment Facilities,
W82-01249 1503 5D

VANDERBILT UNIV., NASHVILLE, TN.
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 1503 5D

Nonlinear Sorption of Water in Soil,
W82-03686 1508 2G

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 1511 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF CHEMICAL ENGINEERING.
Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 1506 5D

Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

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Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1502 1B

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 1504 5D

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

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Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

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W82-06822 1512 5D

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Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 1502 2I

VANDKVALITETSINSTITUTET, HOERSHOLM (DENMARK).
Method of Evaluating the Possible Energy Savings by Implementing Do-Control or Fine Bubble Diffusors,
W82-04007 1509 5D

VASSAR COLL., POUGHKEEPSIE, NY.
Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 1511 5F

VATTENBYGGNADSBYRAN LTD., STOCKHOLM (SWEDEN). DEPT. OF WATER, SOIL AND ENVIRONMENT DEVELOPMENT.
Salbukh Reverse Osmosis Plant on Stream,
W82-06127 1512 3A

VATTENBYGGNADSBYRAN LTD., STOCKHOLM (SWEDEN). WATER AND ENVIRONMENT ENGINEERING DEPT.
Jonkoping's Water Supply,
W82-02419 1505 5F

VELZY (CHARLES R.). ASSOCIATES, ARMONK, NY.
Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 1507 5D

VERBAND DER DEUTSCHEN GAS- UND WASSERWIRTSCHAFT E.V./DEUTSCHER VEREIN DES GAS UND WASSERFACHES E.V., BONN (GERMANY, F.R.).
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 1504 6E

VERLAG CHEMIE, WEINHEIM (GERMANY, F. R.).
Recent Developments in the Field of Eutrophication Prevention,
W82-06299 1512 5C

VERMONT HOUSE OF REPRESENTATIVES, MONTPELIER.
Floodplain Management: A Flood and Land Planning System,
W82-01872 1504 6F

VERMONT UNIV., BURLINGTON.
Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 1501 6B

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 1512 8I

VERMONT UNIV., BURLINGTON. DEPT. OF AGRICULTURAL AND RESOURCE ECONOMICS.
Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

VERMONT UNIV., BURLINGTON. DEPT. OF GEOLOGY.
Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 1512 2K

VERMONT UNIV., BURLINGTON. DEPT. OF PLANT AND SOIL SCIENCE.
Nitrogen Availability from Sewage Sludge,
W82-00158 1501 5E

VERMONT WATER RESOURCES RESEARCH CENTER, BURLINGTON.
Non-Point Source Pollution: Directions for Vermont,
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VESZPREMI VEGYIPARI EGYETEM (HUNGARY). INST. FOR ANALYTICAL CHEMISTRY.
Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

VETERANS ADMINISTRATION MEDICAL CENTER, PITTSBURGH, PA.
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

VICTORIA DEPT. OF AGRICULTURE (AUSTRALIA). ATTWOOD VETERINARY RESEARCH LAB.
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 1502 5B

VICTORIA DEPT. OF AGRICULTURE, TATURA (AUSTRALIA). IRRIGATION RESEARCH INST.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 2I

VICTORIA GENERAL HOSPITAL, HALIFAX (NOVA SCOTIA). DIV. OF LABORATORIES.
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

VICTORIA MINISTRY FOR CONSERVATION, MELBOURNE (AUSTRALIA). MARINE SCIENCE LABS.
Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
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Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 1505 5C

VICTORIA UNIV. (BRITISH COLUMBIA).
Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOLOGY.
Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 1505 5A

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

VICTORIA UNIV. OF MANCHESTER (ENGLAND). DEPT. OF CHILD DENTAL HEALTH.
Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 1507 5A

VICTORIA UNIV. OF MANCHESTER (ENGLAND). POLLUTION RESEARCH UNIT.
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 1511 5D

A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 1511 5B

VICTORIA UNIV. OF MANCHESTER (ENGLAND). POWER SYSTEMS LAB.
An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 1507 5F

VICTORIA UNIV., WELLINGTON (NEW ZEALAND).
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

VICTORIA UNIV., WELLINGTON (NEW ZEALAND). DEPT. OF INFORMATION SCIENCE.
The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 1510 6A

VICTORIAN DEPT. OF AGRICULTURE, FERNTREE GULLY (AUSTRALIA). SCORESBY HORTICULTURAL RESEARCH STATION.
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 1502 2I

VIENNA UNIV. (AUSTRIA). ZOOLOGISCHES INST.
Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 1508 2H

VILLANOVA UNIV., PA. DEPT. OF CIVIL ENGINEERING.
Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

VIRGINIA COMMONWEALTH UNIV., RICHMOND. DEPT. OF BIOLOGY.
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

VIRGINIA INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Biological Monitoring Part VI - Future Needs,
W82-03230 1507 5C

VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT.
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

VIRGINIA INST. OF MARINE SCIENCES, GLOUCESTER POINT.
Kepone in the James River,
W82-00631 1502 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKBURG. DEPT. OF CIVIL ENGINEERING.
Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 1512 5E

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
Activated Sludge,
W82-01243 1503 5D

Electroplating and Cyanide Wastes,
W82-01266 1503 5D

Effects of Pollution on Freshwater Invertebrates,
W82-01280 1503 5C

Law,
W82-01302 1503 6E

Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 1503 5A

Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 1505 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. CENTER FOR ENVIRONMENTAL STUDIES.
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 1502 5A

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 1511 5A

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. COLL. OF ARCHITECTURE AND URBAN STUDIES.
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ECONOMICS.
Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 1512 6E

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ENGINEERING.
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 1503 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 1502 5A

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 1505 5C

Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 1505 5E

Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 1511 5C

Biological Monitoring, Part V - Preference and Avoidance Studies,
W82-05340 1511 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF CIVIL ENGINEERING.
Small-Scale Hydro in New England: 1960-1976,
W82-00169 1501 6D

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 1502 5D

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

Electroplating and Cyanide Wastes,
W82-06798 1512 5D

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF ENTOMOLOGY.
Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 1502 5A

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. VIRGINIA WATER RESOURCES RESEARCH CENTER.
Virginia Water Resources Research Center Five-Year Plan.
W82-05529 1511 6B

VIRGINIA POLYTECNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 1511 5A

VIRGINIA STATE HEALTH DEPT., RICHMOND.
Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 1506 5D

VIRGINIA STATE WATER CONTROL BOARD, RICHMOND.
Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 1502 4B

VIRGINIA STATE WATER CONTROL BOARD, RICHMOND. DIV. OF ECOLOGICAL STUDIES.
Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 1505 5B

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF CIVIL ENGINEERING.
Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 1510 5A

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Acid Precipitation: The Importance of Nitric Acid,
W82-00643 1502 2K

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 1503 2J

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

Kinematic Subsurface Stormflow,
W82-03844 1509 2G

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

VISVA-BHARATI UNIV., SANTINIKETAN (INDIA). DEPT. OF ZOOLOGY.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

VISVESVARAYA REGIONAL COLL. OF ENGINEERING, NAGPUR (INDIA). DEPT. OF CHEMISTRY.
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 1507 5D

VISVESVARAYA REGIONAL COLL. OF ENGINEERING, NAGPUR (INDIA). DEPT. OF CIVIL ENGINEERING.
Measuring the Velocity of Water in a Paddled Flocculator,
W82-04102 1509 5F

VISVESVARAYA REGIONAL COLL. OF ENGINEERING, NAGPUR (INDIA). DEPT. OF PUBLIC HEALTH ENGINEERING.
Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 1507 5F

VIZGAZDALKODASI TUDOMANYOS KUTATO INTEZET, BUDAPEST (HUNGARY). INST. FOR WATER POLLUTION CONTROL.
A Large International River: The Danube,
W82-03369 1507 5G

New Trends in Water Quality Management,
W82-05429 1511 5G

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL).
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DEPT. OF SOIL PHYSICS.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF FIELD CROPS.
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 1502 2I

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Transport of Salts in Soils and Subsoils,
W82-00930 1502 5B

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 1503 2G

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DIV. OF SOIL RESIDUES CHEMISTRY.
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 1502 5B

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN ISRAEL). DIV. OF SUBTROPICAL HORTICULTURE.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 1504 3F

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). INST. OF SOIL AND WATER.
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

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Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 1503 3C

VOLTA LAKE RESEARCH AND DEVELOPMENT PROJECT, AKOSOMBO (GHANA).
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

VSESOYUZNYI NAUCHNO-ISSLEDOVATELSKII INST. PRODOVOGO RYNOGO KHOZIAISTVA RYBNOE (USSR).
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 1511 5D

VSESOYUZNYI NAUCHNO-ISSLEDOVATELSKII INST. VODOSNABZHENIYA, KANALIZATSII, GIDROTEKHNICHESKIKH SOORUZHENII I INZHENERNOI GIDROGEOLOGII, KHARKOV (USSR).
Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 1512 2J

VSESOYUZNYI NAUCHO-ISSLEDOVATELSKII INST. GIDROTEKHNIKI I MELIORATSII, MOSCOW (USSR).
Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 1512 3F

VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA, PRAGUE (CZECHOSLOVAKIA).
Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 1507 5D

WACKER-CHEMIE G.M.B.H., MUNICH (GERMANY, F. R.). (ASSIGNEE).
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

WADE (R. M.) AND CO., PORTLAND, OR.
Sprinkler Leveler and Wind Compensating Device,
W82-06164 1512 3F

WADE, TRIM AND ASSOCIATES, TAYLOR, MI.
Wastewater Treatment Plant Features New Technology,
W82-03591 1508 5D

WAHNBACHTALSPERENVERBAND, SIEGBURG (GERMANY, F.R.).
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 1512 5F

WAHNBACHTALSPERRENVERBAND, SIEGBURG (GERMANY, F.R.).
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

WAIKATO UNIV., HAMILTON (NEW ZEALAND). DEPT. OF EARTH SCIENCES.
Note on Two Limit Distributions of Bedload Movement,
W82-01643 1503 2J

WAIKATO UNIV., HAMILTON (NEW ZEALAND). SCHOOL OF SCIENCE.
Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

WAKE FOREST UNIV., WINSTON-SALEM, NC, DEPT. OF BIOLOGY.
Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 1512 5C

WAKE FOREST UNIVERSITY, WINSTON-SALEM, NORTH CAROLINA, DEPARTMENT OF BIOLOGY.
Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 1512 5C

WALK, HAYDEL AND ASSOCIATES, INC., NEW ORLEANS, LA.
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

WALKER (R. L.) AND PARTNERS LTD., OTTAWA (ONTARIO).
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 1508 6B

WARREN SPRING LAB., STEVENAGE (ENGLAND). POLLUTION DIV.
The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 1512 5D

WARSAW UNIV. (POLAND). CHAIR OF HYDROBIOLOGY.
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 1511 2H

WARSAW UNIV. (POLAND). DEPT. OF CHEMISTRY.
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

WASHINGTON STATE DEPT. OF ECOLOGY, OLYMPIA.
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 1502 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 1502 5D

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 1502 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 1502 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 1502 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 1502 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

WASHINGTON STATE DEPT. OF FISHERIES, OLYMPIA.
Mt. St. Helens and the Fish,
W82-02508 1505 2J

WASHINGTON STATE DEPT. OF SOCIAL AND HEALTH SERVICES, OLYMPIA. OFFICE OF ENVIRONMENTAL PROGRAMS.
Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

WASHINGTON STATE UNIV., PULLMAN.
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-03553 1511 5B

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 1512 5D

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRICULTURAL ECONOMICS.
Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRONOMY AND SOILS.
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 1503 2G

Aerial Photography to Detect Rill Erosion,
W82-02232 1505 7B

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF ANTHROPOLOGY.
Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 1501 2E

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Measurement of Air in Flowing Water,
W82-04322 1510 7B

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF ENVIRONMENTAL SCIENCE.
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

WASHINGTON STATE UNIV., PULLMAN. R. L. ALBROOK HYDRAULIC LAB.
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 1502 5B

WASHINGTON STATE UNIV., PULLMAN. WATER RESEARCH CENTER.
Ground Water in Washington,
W82-02536 1505 2F

WASHINGTON SUBURBAN SANITARY COMMISSION, HYATTSVILLE, MD.
Rate Structures and Demand Reduction,
W82-02517 1505 6C

WASHINGTON UNIV., SEATTLE.
Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

Organics,
W82-01239 1503 5A

On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 1506 5A

Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 1508 5A

Sediment Transport by Rainsplash,
W82-03709 1508 2J

WASHINGTON UNIV., SEATTLE. COLL. OF FISHERIES.
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 1502 8I

Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 1506 5C

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

WASHINGTON UNIV., SEATTLE. COLL. OF OCEAN AND FISHERIES SCIENCES.
Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

WASHINGTON UNIV., SEATTLE. DEPT. OF ATMOSPHERIC SCIENCES.
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 1504 2B

Convection Patterns in a Pond,
W82-04461 1510 2C

WASHINGTON UNIV., SEATTLE. DEPT. OF BOTANY.
Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 1507 2I

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

The Dilution/Flushing Technique in Lake Restoration,
W82-02270 1505 2H

Approximate Error Bounds for Simulated Hydrographs,
W82-02678 1506 2A

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 1506 2K

Data Requirements for Kriging: Estimation and Network Design,
W82-04200 1509 7A

Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 1510 5D

Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

WASHINGTON UNIV., SEATTLE. DEPT. OF ENVIRONMENTAL HEALTH.
Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

WASHINGTON UNIV., SEATTLE. DEPT. OF GEOLOGICAL SCIENCES.
Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

WASHINGTON UNIV., SEATTLE. DEPT. OF MICROBIOLOGY AND IMMUNOLOGY.
Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.
Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 1501 5B

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 1505 2L

Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 1507 5C

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

Particle Counter for Sediment Transport Studies,
W82-03666 1508 7B

The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 1511 8B

A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 1511 2C

WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY.
The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

WASHINGTON UNIV., SEATTLE. FISHERIES RESEARCH INST.
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 1502 5A

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 1511 5B

Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 1511 5C

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

WASHINGTON UNIV., SEATTLE. SCHOOL OF PUBLIC HEALTH AND COMMUNITY MEDICINE, DEPARTMENT OF ENVIRONMENTAL HEALTH.
Organics,
W82-06922 1512 5A

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Sister Chromatid Exchange as an Indicator of Short Term Chemical Stress in Aquatic Systems,
W82-04161 1509 5A

WASSERWIRTSCHAFTSAMT BRAKE (GERMANY, F. R.).
Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 1511 5E

WASTEWATER TREATMENT PLANT, APPLETON, WI.
How Appleton Reduced Phosphorus,
W32-06249 1512 5D

WATER AND AIR RESEARCH, INC., GAINESVILLE, FL.
Low-Dosage High-Rate Direct Filtration,
W82-06416 1512 5F

WATER AND POWER RESOURCES SERVICE, DENVER, CO.
Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 1507 3B

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Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 1512 8B

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A Monthly Time Series Model of Municipal Water Demand,
W82-02263 1505 6D

WATER AND POWER RESOURCES SERVICE, SACRAMENTO, CA.
Discussion-Engineering Geology of Arid Areas,
W82-01568 1503 4B

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Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02972 1506 8G

WATER AND SANITATION FOR HEALTH PROJECT, WASHINGTON, DC.
The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 1510 6D

WATER FUTURES, ALBUQUERQUE, NM.
Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

WATER MANAGEMENT RESEARCH LABORATORY, FRESNO, CALIFORNIA.
Artificial Basin Recharge,
W82-03745 1508 4B

WATER POLICY TASK FORCE, LITTLE ROCK, AR.
Arkansas Water Policy.
W82-00715 1502 6D

WATER POLLUTION CONTROL AUTHORITY, VERNON, CT.
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

WATER POLLUTION CONTROL BOARD, BARODA (INDIA). GUJARAT REGIONAL LAB.
Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 1506 3A

WATER POLLUTION CONTROL PLANTS, PHILADELPHIA, PA.
Evaluation of High- and Low- Speed Centrifuges,
W82-02931 1506 5E

WATER POLLUTION RESEARCH LAB., STEVENAGE (ENGLAND).
Small is Environmentally Acceptable . . .,
W82-00311 1501 5D

Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 1502 5D

New Approaches to Anaerobic Sludge Digestion,
W82-01398 1503 5D

WATER PURIFICATION ASSOCIATES, CAMBRIDGE, MA.
Municipal Ion Exchange: Waiting to Take Off,
W82-03837 1509 5F

Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 1510 5F

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Process for Removing Alkalinity and Hardness From Waters,
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Sewerage: Priorities for Action,
W82-06260 1512 8G

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Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 1511 5D

Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 1512 5E

WATER RESEARCH CENTRE ENGINEERING CENTRE, SWINDON (ENGLAND).
Britain's Sewers - Researching for the Future,
W82-02871 1506 5D

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Engineering Research and the Water Industry,
W82-00313 1501 8A

Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 1503 5B

Artificial Groundwater Recharge,
W82-01110 1503 4B

The Distribution and Movement of Solutes Derived from Agricultural Land in The Principal Aquifers of The United Kingdom, with Particular Reference to Nitrate,
W82-03912 1509 5B

The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 1511 5D

WATER RESEARCH CENTRE, STEVENAGE (ENGLAND).
Developments in Sedimentation and Flotation,
W82-01391 1503 5F

Groundwater Investigations in the Vale of Stathmore,
W82-01400 1503 2F

The Application of Mutagenicity Testing to Drinking Water,
W82-01487 1503 5A

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 1511 5E

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 1511 5F

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

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Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

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Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 1512 5C

WATER RESOURCE ENGINEERS, GAINESVILLE, FL.
1980 Needs Survey: Combined Sewer Saite Studies,
W82-05862 1511 5D

WATER RESOURCES COUNCIL, WASHINGTON, DC.
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Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 1510 6C

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Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
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New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 1505 5F

WATER TREATMENT PLANT, LONGVIEW, WA.
The Aftermath at Longview,
W82-00073 1501 5C

WATER TREATMENT PLANT, TRAVERSE CITY, MI.
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 1502 5F

Down to Earth Leak Detection,
W82-03561 1508 5F

WATERLOO UNIV., ONTARIO.
Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

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A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 1501 2K

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

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Flow Resistance in Vegetated Waterways,
W82-00152 1501 2E

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 1501 5F

Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

Issues in Simulation Model Design--A Case Study,
W82-05627 1511 4A

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Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 1503 2F

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 1505 2A

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 1506 5B

Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 1511 2K

The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 1512 2F

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Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

Unified River Basin Management,
W82-05769 1511 6B

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Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 1507 5E

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Operational Research Techniques in River Basin Management,
W82-05387 1511 6A

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The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 6B

WATERLOOPKUNDIG LAB., DELFT (NETHERLANDS).
The V-Shaped Broad-Crested Weir,
W82-06450 1512 8B

WATERLOOPKUNDIG LAB., DELFT (NETHERLANDS). BASIC RESEARCH DIV.
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 1508 2L

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Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 1501 2L

WATERWORKS, ZURICH (SWITZERLAND).
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 1507 5F

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Water System Design Meets Modern Challenges,
W82-05170 1511 5F

WAUKESHA WATER UTILITY, WI.
Distribution System Liability,
W82-01028 1502 5F

WAYNE COUNTY BOARD OF PUBLIC WORKS, MI.
The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 1503 5D

Wastewater Collection and Treatment in Wayne County,
W82-02554 1505 5D

WAYNE STATE UNIV., DETROIT, MI.
Optimization of Automated Equalization Basin-Reactor Systems for Chemical Treatment of Wastewater,
W82-04052 1509 5D

WAYNE STATE UNIVERSITY, DETROIT, MI.
A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

WEBER INDUSTRIES, INC., ST. LOUIS, MO.
Pump Installations for reverse Osmosis Systems,
W82-05882 1511 8C

WEIR PUMPS LTD., GLASGOW (SCOTLAND).
The Cone Pump,
W82-02713 1506 8C

WEIZMANN INST. OF SCIENCE, REHOVOT (ISRAEL). ISOTOPE DEPT.
The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

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A Successful Transfer,
W82-00309 1501 4A

WESLEYAN UNIV., MIDDLETOWN, CT. DEPT. OF CHEMISTRY.
Oxidation Products and Rates of Reaction in the Ozonolysis of Dibenzofuran,
W82-06305 1512 5B

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Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

WESSEX WATER AUTHORITY (ENGLAND).
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 1502 5D

The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

The Use of Oxygen in Sewage Treatment,
W82-06262 1512 5D

WEST KENT WATER CO. (ENGLAND).
Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 1502 5F

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Ground Water Problems in West Virginia,
W82-01060 1502 4B

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Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

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Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

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Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 1512 5F

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Bentonite Liners for Power Plant Lagoons,
W82-00617 1502 5E

Rainfall Catch Errors Associated with Circummambient Obstructions,
W82-03021 1507 2B

WEST VIRGINIA UNIV., MORGANTOWN. DEPT. OF BIOLOGY.
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 1502 2H

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 1502 5G

Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

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Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 1511 2J

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Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

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Marginal Cost and Seasonal Pricing of Water Service,
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The Real Price of Urban Water,
W82-04797 1511 6C

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Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

WESTECH ENGINEERING, INC., SALEM, OR.
Why EPA's I/I Control Program Fails,
W82-00790 1502 8A

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Groundwater Systems Associated with Secondary Salinity in Western Australia.
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The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 1511 2L

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A Comparison of Rainfall-Runoff Models,
W82-00911 1502 2A

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Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

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Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

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The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 1506 4C

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A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 1503 5A

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The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

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Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 1508 2H

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Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 1506 2L

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Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 1507 5B

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Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
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Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
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Enumerating Bacteria in River Water and Sewage Effluent,
W82-03446 1508 5A

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A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 1503 5G

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Storm-Sewer Input of Heavy Metals Into an Urban Lake Environment,
W82-04207 1509 5A

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A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 1510 6D

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Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

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Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 1508 5D

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Managing Hazardous Wastes,
W82-02252 1505 5E

Dual Distribution Systems Analysis,
W82-04123 1509 5F

Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
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Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

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Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 1502 2I

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New Bubble Diffusers Reduce Treatment Costs,
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Formulating Alternatives for Environmental Studies,
W82-00997 1502 6G

WHITELEY-JACOBSEN AND ASSOCIATES, PORTLAND, OR.
Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 1501 5D

Regional Detention Basins for Stormwater Control,
W82-06225 1512 8A

WHITMAN AND HOWARD, INC., WELLESLEY, MA.
Engineering Responds to Ecology,
W82-02935 1506 5D

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 1510 5G

WIGGINS TEAPE RESEARCH AND DEVELOPMENT, LTD. (ENGLAND).
The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 1510 5F

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An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

WILLIAM AND MARY COLL., GLOUCESTER POINT, VA. INST. OF MARINE SCIENCE.
The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 1505 5B

Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 1506 5C

WILLIAM AND MARY COLL., WILLIAMSBURG, VA. DEPT. OF CHEMISTRY.
Rainwater Acidity Measurement Problems,
W82-02627 1506 5A

WILLIAMS AND WORKS, GRAND RAPIDS, MI.
Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 1506 3C

WILLIAMSPORT SANITARY AUTHORITY, PA.
Sludge Settling Hampered by Industrial Discharge,
W82-00290 1501 5D

What Caused the Bad Odor in the Drinking Water,
W82-00527 1502 5F

Waterborne Giardiasis–An Overview,
W82-04186 1509 5C

Colloidal Organics,
W82-04689 1510 5F

Water Conservation at Wastewater Treatment Plants,
W82-06512 1512 3C

Components for a Treatment Plant Safety Program,
W82-06992 1512 5G

WILLIS, CUNLIFFE, TAIT AND DELCAN, NEW WESTMINISTER (BRITISH COLUMBIA).
Vacuum Sewers–The Future for Sewage Collection,
W82-03394 1507 5G

WILSON AND CO., WITCHITA, KS.
Sewage Pumping Station Split for Maintenance,
W82-05719 1511 5D

WINDREM, FEENEY AND WILLIAMS, LAKEPORT, CA.
Environmental Problems and Geothermal Permitting,
W82-06217 1512 6G

WINDSOR UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 1512 5C

Physical Process and Eutrophication,
W82-06875 1512 5C

WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON.
Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 1512 4A

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Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 1501 5A

WISCONSIN-MILWAUKEE UNIV. DEPT. OF GEOLOGICAL SCIENCES.
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 1503 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

WISCONSIN UNIV., EAU CLAIRE. DEPT. OF BIOLOGY.
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 1512 5A

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Sampling Characteristics of Macrophyte Biomass,
W82-06779 1512 5A

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Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

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Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
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Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 1512 5B

WISCONSIN UNIV.-MADISON.
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 1501 5B

Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 1502 2H

Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 1503 5G

Pollution Permits and Markets for Water Quality,
W82-01699 1503 6A

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 1506 6D

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 1507 5C

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 1508 2J

The Wisconsin Soil and Water Conservation District as an Institution to Undertake Subwatershed Planning to Control Non-Point Source Water Pollution,
W82-04212 1509 6A

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 1510 2A

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

WISCONSIN UNIV.-MADISON. DEPT. OF AGRICULTURAL ECONOMICS.
Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 1508 5G

WISCONSIN UNIV.-MADISON. DEPT. OF BACTERIOLOGY.
Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 1501 2H

Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

WISCONSIN UNIV.-MADISON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 1505 3D

A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 1507 2E

The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 1507 4A

Prediction of Leachate Accumulation in Sanitary Landfills,
W82-03934 1509 5B

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

Pressure Distribution Design for Septic Tank Systems,
W82-05439 1511 5E

WISCONSIN UNIV.-MADISON. DEPT. OF FORESTRY.
Comparing Two Measures of Water Based Recreation Participation,
W82-05733 1511 6D

WISCONSIN UNIV.- MADISON. DEPT. OF GEOGRAPHY.
Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

WISCONSIN UNIV.-MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
Groundwater Quality Models - State of the Art,
W82-01061 1502 5G

Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

WISCONSIN UNIV. MADISON. DEPT. OF PREVENTIVE MEDICINE.
Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

WISCONSIN UNIV.-MADISON. DEPT. OF SOIL SCIENCE.
Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

WISCONSIN UNIV.-MADISON. DEPT. OF VETERINARY SCIENCE.
Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 1505 5B

Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 1505 5A

WISCONSIN UNIV.-MADISON. INST. OF ENVIRONMENTAL STUDIES.
The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

WISCONSIN UNIV.-MADISON. LAB. OF HYGIENE.
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 1505 5A

WISCONSIN UNIV.-MADISON. LAB. OF LIMNOLOGY.
Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 1506 5C

WISCONSIN UNIV.-MADISON. MARINE STUDIES CENTER.
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 1508 5B

WISCONSIN UNIV.-MADISON. WATER CHEMISTRY LAB.
Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 1501 2H

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 1511 2K

WISCONSIN UNIV.-MADISON. WATER CHEMISTRY PROGRAM.
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 1512 5B

WISCONSIN UNIV.-MADISON. WATER RESOURCES CENTER.
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 1501 5B

WISCONSIN UNIV.-MILWAUKEE. CENTER FOR GREAT LAKES STUDIES.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 1504 2H

WISCONSIN UNIV.-MILWAUKEE, DEPT. OF BOTANY.
Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 1512 5C

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF CIVIL ENGINEERING.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 1503 5D

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF GEOLOGICAL SCIENCES.
The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 1503 5B

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 1504 2F

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF URBAN PLANNING.
Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 1505 5A

Problems and Processes in Water Quality Management,
W82-06147 1512 5G

WISCONSIN UNIV.-OSHKOSH. DEPT. OF GEOLOGY.
Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 1502 6E

WISCONSIN UNIV., STEVENS POINT. COLL. OF NATURAL RESOURCES.
Calibrating A Mountain Watershed in Wyoming,
W82-06583 1512 2E

WISCONSIN UNIV.-SUPERIOR.
Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

WISCONSIN UNIVERSITY, PLATTEVILLE.
Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

WOLLONGONG UNIV. (AUSTRALIA). DEPT. OF CHEMISTRY.
Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 1512 5D

WOLLONGONG UNIV. (AUSTRALIA). DEPT. OF GEOGRAPHY.
New Evidence of Scroll-Bar Formation on The Beatton River,
W82-04188 1509 2J

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 3C

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 1502 2H

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 1503 5B

Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 1508 5B

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA. DEPT. OF CHEMISTRY.
Elevated Concentrations of Actinides in Mono Lake,
W82-05520 1511 5B

WOODWARD-CLYDE CONSULTANTS, ANCHORAGE, AL.
Deep Water Renewal in Subarctic Fjord,
W82-03675 1508 2L

WOODWARD-CLYDE CONSULTANTS, HOUSTON, TX.
Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

WOODWARD-CLYDE CONSULTANTS, SAN FRANCISCO, CA.
Quarterly Progress Report, Nationwide Urban Runoff Program.
W82-00044 1501 5G

Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 1503 4B

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 1510 2J

WORCESTER COUNTY SANITARY DISTRICT, MD.
Tracking Seasonal Load Variations,
W82-05787 1511 5D

WORCESTER POLYTECHNIC INST., HOLDEN, MA. ALDEN RESEARCH LABS.
Model-Prototype Comparison of Free Surface Vortices,
W82-03667 1508 8B

Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

WORCESTER POLYTECHNIC INST., MA. DEPT. OF CIVIL ENGINEERING.
Performance of Modified Chlorine Contact Chamber,
W82-06359 1512 5D

WORCESTER POLYTECHNIC INST., MA. DEPT. OF MECHANICAL ENGINEERING.
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

WORLD HEALTH ORGANIZATION, COPENHAGEN (DENMARK). REGIONAL OFFICE FOR EUROPE.
The Mediterranean Action Plan: Design and Implementation,
W82-06154 1512 5B

WORLD HEALTH ORGANIZATION SCHISTOSOMIASIS CONTROL PROJECT, ACCRA (GHANA).
Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

WORLDWATCH INST., WASHINGTON, DC.
Hydropower--An Old Technology for a New Era,
W82-01593 1503 4A

WRIGHT MCLAUGHLIN ENGINEERS, DENVER, CO.
Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

WRIGHT-PIERCE ARCHITECTS/ ENGINEERS, PORTSMOUTH, NH.
Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

Models of Landfill Leaching: Organic Strength,
W82-05817 1511 5B

Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 1511 5B

WRIGHT-PIERCE, TOPSHAM, ME.
Locating Monitoring Wells,
W82-06848 1512 8B

WRIGHT STATE UNIV., DAYTON, OH. DEPT. OF BIOLOGICAL SCIENCES.
Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

WRIGHT STATE UNIV., DAYTON, OH. DEPT. OF GEOLOGY.
An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 1511 2F

WRIGHT WATER ENGINEERS, INC., DENVER, CO.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 1504 3C

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

WROCLAW TECHNICAL UNIV. (POLAND). INST. OF ENVIRONMENT PROTECTION ENGINEERING.
Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 1511 5D

WROCLAW TECHNICAL UNIV. (POLAND). INST. OF ENVIRONMENTAL PROTECTION ENGINEERING.
Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

WROCLAW TECHNICAL UNIV. (POLAND). INST. OF INORGANIC CHEMISTRY AND METALLURGY OF RARE ELEMENTS.
Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 1511 5G

WUIDART ENGINEERING LTD., SHEFFORD BEDS (ENGLAND).
Hydrogeological and Geophysical Logging,
W82-00511 1502 7B

WYOMING UNIV., LARAMIE.
Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

WYOMING UNIV., LARAMIE. DEPT. OF ATMOSPHERIC SCIENCE.
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 1504 2B

WYOMING UNIV., LARAMIE. DEPT. OF BOTANY.
Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 1502 2I

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 1502 2D

WYOMING UNIV., LARAMIE. DEPT. OF ZOOLOGY AND PHYSIOLOGY.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 1503 5C

Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

WYOMING UNIV., LARAMIE. WATER RESOURCES RESEARCH INST.
Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming,
W82-05528 1511 6B

Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

YALE UNIV., NEW HAVEN, CT.
Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 5C

YALE UNIV., NEW HAVEN, CT. DEPT. OF EPIDEMIOLOGY AND PUBLIC HEALTH.
Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

YAMAGATA UNIV. (JAPAN). DEPT. OF CHEMISTRY.
Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 1511 2H

YAMANASHI UNIV., KOFU (JAPAN). DEPT. OF ENVIRONMENTAL ENGINEERING.
Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 1506 5E

Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 1510 5F

YARMOUK UNIV., IRBID (JORDAN). DEPT. OF CIVIL ENGINEERING.
Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 1506 4A

YOKOHAMA NATIONAL UNIV. (JAPAN). DEPT. OF SAFETY AND ENVIRONMENTAL ENGINEERING.
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

YOKOHAMA SEWERAGE BUREAU, KAWASAKI (JAPAN).
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

YORK UNIV., DOWNSVIEW (ONTARIO). DEPT. OF GEOGRAPHY.
Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 1505 5B

YORK UNIV. (ENGLAND). DEPT. OF BIOLOGY.
The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 1512 5D

YORK UNIV., TORONTO (ONTARIO). DEPT. OF BIOLOGY.
A Model for the Design of Hypolimnetic Aerators,
W82-06610 1512 5G

YORK UNIVERSITY, HESLINGTON (ENGLAND). INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH.
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

YORK WATER CO., PA.
Perseverance Produces County Park,
W82-01932 1504 6D

YORKSHIRE WATER AUTHORITY (ENGLAND).
The River Ouse Water Supply Scheme,
W82-01371 1503 5F

Recording Underground,
W82-02036 1504 8A

The Cost of Quality,
W82-02881 1506 5F

A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 1508 7B

YORKSHIRE WATER AUTHORITY (ENGLAND). DIRECTORATE OF RESOURCE PLANNING.
The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 1512 5G

YORKSHIRE WATER AUTHORITY (ENGLAND). WESTERN DIV.
Esholt--Past, Present and Future,
W82-06653 1512 5D

YORKSHIRE WATER AUTHORITY, SHEFFIELDS (ENGLAND). SOUTHERN DIV.
A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 1508 5B

YOUNGSTOWN STATE UNIV., OH. DEPT. OF CIVIL ENGINEERING.
Waste Water Disposal Through a Coastal Aquifer,
W82-04231 1509 5E

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 1510 4B

Managing Salinity in Irrigated Agriculture,
W82-05691 1511 3C

Determination of Aquifer Parameters Using Regression Analy

ACCESSION NUMBER INDEX

W82-00001	1501	5C
W82-00002	1501	5B
W82-00003	1501	5B
W82-00004	1501	5B
W82-00005	1501	5C
W82-00006	1501	2H
W82-00007	1501	2C
W82-00008	1501	5B
W82-00009	1501	5B
W82-00010	1501	5F
W82-00011	1501	7C
W82-00012	1501	6E
W82-00013	1501	5C
W82-00014	1501	2F
W82-00015	1501	2J
W82-00016	1501	2F
W82-00017	1501	2F
W82-00018	1501	5B
W82-00019	1501	2E
W82-00020	1501	7C
W82-00021	1501	7C
W82-00022	1501	7B
W82-00023	1501	7A
W82-00024	1501	7C
W82-00025	1501	7C
W82-00026	1501	7C
W82-00027	1501	6D
W82-00028	1501	6E
W82-00029	1501	6D
W82-00030	1501	6D
W82-00031	1501	6E
W82-00032	1501	6B
W82-00033	1501	5B
W82-00034	1501	2J
W82-00035	1501	5B
W82-00036	1501	6B
W82-00037	1501	5D
W82-00038	1501	6A
W82-00039	1501	5B
W82-00040	1501	5D
W82-00041	1501	5D
W82-00042	1501	6D
W82-00043	1501	6A
W82-00044	1501	5G
W82-00045	1501	5G
W82-00046	1501	8A
W82-00047	1501	8D
W82-00048	1501	5D
W82-00049	1501	5D
W82-00050	1501	6D
W82-00051	1501	6G
W82-00052	1501	5C
W82-00053	1501	5G
W82-00054	1501	4C
W82-00055	1501	5F
W82-00056	1501	5G
W82-00057	1501	5D
W82-00058	1501	5D
W82-00059	1501	5D
W82-00060	1501	5D
W82-00061	1501	5F
W82-00062	1501	5G
W82-00063	1501	5F
W82-00064	1501	5D
W82-00065	1501	5D
W82-00066	1501	5D
W82-00067	1501	8A
W82-00068	1501	2B
W82-00069	1501	5D
W82-00070	1501	5F
W82-00071	1501	5G
W82-00072	1501	5F
W82-00073	1501	5C
W82-00074	1501	5F
W82-00075	1501	4B
W82-00076	1501	7C
W82-00077	1501	7C
W82-00078	1501	7C
W82-00079	1501	7C
W82-00080	1501	7C
W82-00081	1501	7C
W82-00082	1501	7C
W82-00083	1501	7C
W82-00084	1501	5B
W82-00085	1501	7C
W82-00086	1501	6D
W82-00087	1501	7C
W82-00088	1501	7C
W82-00089	1501	10D
W82-00090	1501	7C
W82-00091	1501	6A
W82-00092	1501	5D
W82-00093	1501	5D
W82-00094	1501	5B
W82-00095	1501	5E
W82-00096	1501	6A
W82-00097	1501	5E
W82-00098	1501	5D
W82-00099	1501	5E
W82-00100	1501	5A
W82-00101	1501	7B
W82-00102	1501	6B
W82-00103	1501	4A
W82-00104	1501	7B
W82-00105	1501	7B
W82-00106	1501	5C
W82-00107	1501	6D
W82-00108	1501	5E
W82-00109	1501	2E
W82-00110	1501	5A
W82-00111	1501	4C
W82-00112	1501	2L
W82-00113	1501	2G
W82-00114	1501	2I
W82-00115	1501	2G
W82-00116	1501	8D
W82-00117	1501	2J
W82-00118	1501	2A
W82-00119	1501	3F
W82-00120	1501	2I
W82-00121	1501	5D
W82-00122	1501	5C
W82-00123	1501	5A
W82-00124	1501	5A
W82-00125	1501	5D
W82-00126	1501	5A
W82-00127	1501	2H
W82-00128	1501	5F
W82-00129	1501	6D
W82-00130	1501	4C
W82-00131	1501	2F
W82-00132	1501	2B
W82-00133	1501	2G
W82-00134	1501	5B
W82-00135	1501	5B
W82-00136	1501	2J
W82-00137	1501	2G
W82-00138	1501	3F
W82-00139	1501	3F
W82-00140	1501	7B
W82-00141	1501	5B
W82-00142	1501	2A
W82-00143	1501	6A
W82-00144	1501	4D
W82-00145	1501	2J
W82-00146	1501	6G
W82-00147	1501	5B
W82-00148	1501	2L
W82-00149	1501	2L
W82-00150	1501	2L
W82-00151	1501	2J
W82-00152	1501	2E
W82-00153	1501	5B
W82-00154	1501	5A
W82-00155	1501	5D
W82-00156	1501	5E
W82-00157	1501	5B
W82-00158	1501	5E
W82-00159	1501	5B
W82-00160	1501	6B
W82-00161	1501	5D
W82-00162	1501	2I
W82-00163	1501	5A
W82-00164	1501	5B
W82-00165	1501	5E
W82-00166	1501	2C
W82-00167	1501	5D
W82-00168	1501	5D
W82-00169	1501	6D
W82-00170	1501	6E
W82-00171	1501	5D
W82-00172	1501	2K
W82-00173	1501	5B
W82-00174	1501	2K
W82-00175	1501	5B
W82-00176	1501	4D
W82-00177	1501	6B
W82-00178	1501	3F
W82-00179	1501	5B
W82-00180	1501	6D
W82-00181	1501	8C
W82-00182	1501	5D
W82-00183	1501	2D
W82-00184	1501	3F
W82-00185	1501	2K
W82-00186	1501	5C
W82-00187	1501	3E
W82-00188	1501	3E
W82-00189	1501	5A
W82-00190	1501	4A
W82-00191	1501	7B
W82-00192	1501	5E
W82-00193	1501	5B
W82-00194	1501	8D
W82-00195	1501	3C
W82-00196	1501	2D
W82-00197	1501	5D
W82-00198	1501	5A
W82-00199	1501	5A
W82-00200	1501	5A
W82-00201	1501	2L
W82-00202	1501	2L
W82-00203	1501	5A
W82-00204	1501	5D
W82-00205	1501	5A
W82-00206	1501	5A
W82-00207	1501	5A
W82-00208	1501	5A
W82-00209	1501	5A
W82-00210	1501	7B
W82-00211	1501	2C
W82-00212	1501	5B
W82-00213	1501	8C
W82-00214	1501	5G
W82-00215	1501	5C
W82-00216	1501	6G
W82-00217	1501	5D
W82-00218	1501	2H
W82-00219	1501	5A
W82-00220	1501	5B
W82-00221	1501	5A
W82-00222	1501	5A
W82-00223	1501	5B
W82-00224	1501	5C
W82-00225	1501	5A
W82-00226	1501	5D
W82-00227	1501	5C
W82-00228	1501	8B
W82-00229	1501	6A
W82-00230	1501	8A
W82-00231	1501	5C
W82-00232	1501	5A
W82-00233	1501	5C
W82-00234	1501	5D
W82-00235	1501	5B
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ACCESSION NUMBER INDEX

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ACCESSION NUMBER INDEX

W82-02689	1506	8D
W82-02690	1506	8A
W82-02691	1506	8C
W82-02692	1506	8D
W82-02693	1506	8A
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W82-05373	1511	5D
W82-05374	1511	5D
W82-05375	1511	5C
W82-05376	1511	5B

ACCESSION NUMBER INDEX

W82-05377	1511	5C
W82-05378	1511	5C
W82-05379	1511	2H
W82-05380	1511	5C
W82-05381	1511	5B
W82-05382	1511	5A
W82-05383	1511	5C
W82-05384	1511	5A
W82-05385	1511	6B
W82-05386	1511	6E
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W82-05389	1511	4A
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W82-05392	1511	6F
W82-05393	1511	6E
W82-05394	1511	6E
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W82-05397	1511	5A
W82-05398	1511	5A
W82-05399	1511	5D
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W82-05408	1511	5D
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W82-05484	1511	2H
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W82-06615	1512	2H
W82-06616	1512	4B
W82-06617	1512	2F
W82-06618	1512	8B
W82-06619	1512	8B
W82-06620	1512	2J
W82-06621	1512	8B
W82-06622	1512	8B
W82-06623	1512	5B
W82-06624	1512	5G
W82-06625	1512	2H
W82-06626	1512	5B
W82-06627	1512	2H
W82-06628	1512	5A
W82-06629	1512	4C
W82-06630	1512	2K
W82-06631	1512	2A
W82-06632	1512	8D
W82-06633	1512	8C
W82-06634	1512	5D
W82-06635	1512	5B
W82-06636	1512	8E
W82-06637	1512	5E
W82-06638	1512	5D
W82-06639	1512	5F
W82-06640	1512	8G
W82-06641	1512	6C
W82-06642	1512	5A
W82-06643	1512	5D
W82-06644	1512	5G
W82-06645	1512	5E
W82-06646	1512	5E
W82-06647	1512	5D
W82-06648	1512	5G
W82-06649	1512	5D
W82-06650	1512	5D
W82-06651	1512	5C
W82-06652	1512	5G
W82-06653	1512	5D
W82-06654	1512	5A
W82-06655	1512	5D
W82-06656	1512	5A
W82-06657	1512	5D
W82-06658	1512	5D
W82-06659	1512	5B
W82-06660	1512	5G
W82-06661	1512	5D
W82-06662	1512	5D
W82-06663	1512	2H
W82-06664	1512	5D
W82-06665	1512	8G
W82-06666	1512	5D
W82-06667	1512	5D
W82-06668	1512	2L
W82-06669	1512	3D
W82-06670	1512	7C
W82-06671	1512	7C
W82-06672	1512	7C
W82-06673	1512	7C
W82-06674	1512	7C
W82-06675	1512	2F
W82-06676	1512	7C
W82-06677	1512	2E
W82-06678	1512	2H
W82-06679	1512	2A
W82-06680	1512	5B
W82-06681	1512	5B
W82-06682	1512	5A
W82-06683	1512	2E
W82-06684	1512	2A
W82-06685	1512	2F
W82-06686	1512	2F
W82-06687	1512	2H
W82-06688	1512	7C
W82-06689	1512	5B
W82-06690	1512	2H
W82-06691	1512	5B
W82-06692	1512	2G
W82-06693	1512	3C
W82-06694	1512	6B
W82-06695	1512	3F
W82-06696	1512	6B
W82-06697	1512	5A
W82-06698	1512	5G
W82-06699	1512	5D
W82-06700	1512	6B
W82-06701	1512	5D
W82-06702	1512	5B
W82-06703	1512	7B
W82-06704	1512	6B
W82-06705	1512	3D
W82-06706	1512	5C
W82-06707	1512	5C
W82-06708	1512	5D
W82-06709	1512	5F
W82-06710	1512	2J
W82-06711	1512	3A
W82-06712	1512	3C
W82-06713	1512	8A
W82-06714	1512	6F
W82-06715	1512	5A
W82-06716	1512	5G
W82-06717	1512	2E
W82-06718	1512	5A
W82-06719	1512	5B
W82-06720	1512	5B

W82-06721	1512	5C
W82-06722	1512	5C
W82-06723	1512	5C
W82-06724	1512	5D
W82-06725	1512	5G
W82-06726	1512	5F
W82-06727	1512	5B
W82-06728	1512	5B
W82-06729	1512	2E
W82-06730	1512	8B
W82-06731	1512	5A
W82-06732	1512	5D
W82-06733	1512	5C
W82-06734	1512	5A
W82-06735	1512	5A
W82-06736	1512	5C
W82-06737	1512	5C
W82-06738	1512	5B
W82-06739	1512	5D
W82-06740	1512	5F
W82-06741	1512	5B
W82-06742	1512	5C
W82-06743	1512	5A
W82-06744	1512	5A
W82-06745	1512	5C
W82-06746	1512	5C
W82-06747	1512	5A
W82-06748	1512	5C
W82-06749	1512	5C
W82-06750	1512	5D
W82-06751	1512	5A
W82-06752	1512	5D
W82-06753	1512	5C
W82-06754	1512	5A
W82-06755	1512	5A
W82-06756	1512	5B
W82-06757	1512	5A
W82-06758	1512	8A
W82-06759	1512	8A
W82-06760	1512	5B
W82-06761	1512	2B
W82-06762	1512	5B
W82-06763	1512	5C
W82-06764	1512	5C
W82-06765	1512	5C
W82-06766	1512	5B
W82-06767	1512	5C
W82-06768	1512	5D
W82-06769	1512	5F
W82-06770	1512	5C
W82-06771	1512	5D
W82-06772	1512	5D
W82-06773	1512	5A
W82-06774	1512	5B
W82-06775	1512	5G
W82-06776	1512	5G
W82-06777	1512	5C
W82-06778	1512	6B
W82-06779	1512	5A
W82-06780	1512	2D
W82-06781	1512	3F
W82-06782	1512	7C
W82-06783	1512	8E
W82-06784	1512	7C
W82-06785	1512	8B
W82-06786	1512	8B
W82-06787	1512	2L
W82-06788	1512	5D
W82-06789	1512	5C
W82-06790	1512	5B
W82-06791	1512	5A
W82-06792	1512	3A
W82-06793	1512	2I
W82-06794	1512	5C
W82-06795	1512	4D
W82-06796	1512	4D
W82-06797	1512	5C
W82-06798	1512	5D
W82-06799	1512	5D
W82-06800	1512	5D
W82-06801	1512	5D
W82-06802	1512	5B
W82-06803	1512	5C
W82-06804	1512	5C
W82-06805	1512	5D
W82-06806	1512	2J
W82-06807	1512	5B
W82-06808	1512	5C
W82-06809	1512	5C
W82-06810	1512	5A
W82-06811	1512	5C
W82-06812	1512	5C
W82-06813	1512	8A
W82-06814	1512	5F
W82-06815	1512	3F
W82-06816	1512	3F
W82-06817	1512	3F
W82-06818	1512	3F
W82-06819	1512	6E
W82-06820	1512	5D
W82-06821	1512	5D
W82-06822	1512	5D
W82-06823	1512	2B
W82-06824	1512	2D
W82-06825	1512	8A
W82-06826	1512	4A
W82-06827	1512	5C
W82-06828	1512	5A
W82-06829	1512	5B
W82-06830	1512	5D
W82-06831	1512	5B
W82-06832	1512	5D
W82-06833	1512	5D
W82-06834	1512	4D
W82-06835	1512	4A
W82-06836	1512	2K
W82-06837	1512	2L
W82-06838	1512	2B
W82-06839	1512	6D
W82-06840	1512	2H
W82-06841	1512	5G
W82-06842	1512	5G
W82-06843	1512	3D
W82-06844	1512	5G
W82-06845	1512	5G
W82-06846	1512	5G
W82-06847	1512	5F
W82-06848	1512	8B
W82-06849	1512	4C
W82-06850	1512	2D
W82-06851	1512	2F
W82-06852	1512	3F
W82-06853	1512	6C
W82-06854	1512	6C
W82-06855	1512	4A
W82-06856	1512	2G
W82-06857	1512	2G
W82-06858	1512	2F
W82-06859	1512	2F
W82-06860	1512	5C
W82-06861	1512	2F
W82-06862	1512	2K
W82-06863	1512	2F
W82-06864	1512	2F
W82-06865	1512	5B
W82-06866	1512	5B
W82-06867	1512	2G
W82-06868	1512	2H
W82-06869	1512	6B
W82-06870	1512	5D
W82-06871	1512	5B
W82-06872	1512	4D
W82-06873	1512	2J
W82-06874	1512	4A
W82-06875	1512	5C
W82-06876	1512	4D
W82-06877	1512	5B
W82-06878	1512	5C
W82-06879	1512	2H
W82-06880	1512	5C
W82-06881	1512	5C
W82-06882	1512	5C
W82-06883	1512	5A
W82-06884	1512	5A
W82-06885	1512	5A
W82-06886	1512	2H
W82-06887	1512	5B
W82-06888	1512	5C
W82-06889	1512	5A
W82-06890	1512	5A
W82-06891	1512	5B
W82-06892	1512	5C
W82-06893	1512	5C
W82-06894	1512	2B
W82-06895	1512	5C
W82-06896	1512	5C
W82-06897	1512	5G
W82-06898	1512	5C
W82-06899	1512	5C
W82-06900	1512	5C
W82-06901	1512	5C
W82-06902	1512	5A
W82-06903	1512	5C
W82-06904	1512	5B
W82-06905	1512	5B
W82-06906	1512	5C
W82-06907	1512	5C
W82-06908	1512	5B
W82-06909	1512	5C
W82-06910	1512	5C
W82-06911	1512	5C
W82-06912	1512	5G
W82-06913	1512	5C
W82-06914	1512	5D
W82-06915	1512	5E
W82-06916	1512	5D
W82-06917	1512	5D
W82-06918	1512	5D
W82-06919	1512	5A
W82-06920	1512	5E
W82-06921	1512	5D
W82-06922	1512	5A
W82-06923	1512	5D
W82-06924	1512	5B
W82-06925	1512	5C
W82-06926	1512	5D
W82-06927	1512	5B
W82-06928	1512	5C
W82-06929	1512	5B
W82-06930	1512	5C
W82-06931	1512	5A
W82-06932	1512	5C
W82-06933	1512	5C
W82-06934	1512	5C
W82-06935	1512	5C
W82-06936	1512	5C
W82-06937	1512	5C
W82-06938	1512	5C
W82-06939	1512	5C
W82-06940	1512	5C
W82-06941	1512	5C
W82-06942	1512	5C
W82-06943	1512	5C
W82-06944	1512	5C
W82-06945	1512	4A
W82-06946	1512	2E
W82-06947	1512	4A
W82-06948	1512	8B
W82-06949	1512	2F
W82-06950	1512	7A
W82-06951	1512	7B
W82-06952	1512	4B
W82-06953	1512	7C
W82-06954	1512	7C
W82-06955	1512	7C
W82-06956	1512	7C
W82-06957	1512	7C
W82-06958	1512	5D
W82-06959	1512	8B
W82-06960	1512	5D
W82-06961	1512	2G
W82-06962	1512	8A
W82-06963	1512	2J
W82-06964	1512	3F
W82-06965	1512	5C
W82-06966	1512	5C
W82-06967	1512	6G
W82-06968	1512	4D
W82-06969	1512	7B
W82-06970	1512	4D
W82-06971	1512	4D
W82-06972	1512	5C
W82-06973	1512	5B
W82-06974	1512	5A
W82-06975	1512	5A
W82-06976	1512	5C
W82-06977	1512	5B
W82-06978	1512	2H
W82-06979	1512	5C
W82-06980	1512	5D
W82-06981	1512	5B
W82-06982	1512	5C
W82-06983	1512	4C
W82-06984	1512	3F
W82-06985	1512	6G
W82-06986	1512	5C
W82-06987	1512	5C
W82-06988	1512	5D
W82-06989	1512	5D
W82-06990	1512	8B
W82-06991	1512	5C
W82-06992	1512	5G
W82-06993	1512	5E
W82-06994	1512	7B
W82-06995	1512	7B
W82-06996	1512	5D
W82-06997	1512	5G
W82-06998	1512	5G

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SELECTED WATER RESOURCES ABSTRACTS

ANNUAL CUMULATED INDEXES TO VOLUME 15, 1982

MARCH 3, 1849

PART 2 SUBJECT

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SELECTED
WATER RESOURCES
ABSTRACTS

A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

ANNUAL CUMULATED INDEXES TO VOLUME 15, 1982

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE

- Ground and surface water hydrology at the Illinois State Water Survey.
- Metropolitan water resources planning and management at the Center for Urban and Regional Studies of University of North Carolina.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Center of the University of Wisconsin.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.
- Water-related aspects of nuclear radiation and safety at the Oak Ridge National Laboratory.
- Water resource aspects of the pulp and paper industry at the Institute of Paper Chemistry.

Supported by the Environmental Protection Agency in cooperation with WRSIC

- Effect on water quality of irrigation return flows at the Department of Agricultural Engineering of Colorado State University.
- Agricultural livestock waste at East Central State College, Oklahoma.
- Municipal wastewater treatment technology at the Franklin Institute Research Laboratories.

A NOTE ON THE INDEXES . . .

This cumulation is an index of SUBJECTS appearing in the 1982 issue of SELECTED WATER RESOURCES ABSTRACTS. A table is provided below to facilitate the location of abstracts.

Inclusive Abstract Numbers will be found in **Issue Number and Date**

W82-00001—W82-00500	"	**1**	January 1, 1982
W82-00501—W82-01100	"	**2**	February 1, 1982
W82-01101—W82-01600	"	**3**	March 1, 1982
W82-01601—W82-02100	"	**4**	April 1, 1982
W82-02101—W82-02600	"	**5**	May 1, 1982
W82-02601—W82-03000	"	**6**	June 1, 1982
W82-03001—W82-03400	"	**7**	July 1, 1982
W82-03401—W82-03750	"	**8**	August 1, 1982
W82-03751—W82-04250	"	**9**	September 1, 1982
W82-04251—W82-04750	"	**10**	October 1, 1982
W82-04751—W82-05900	"	**11**	November 1, 1982
W82-05901—W82-07000	"	**12**	December 1, 1982

SUBJECT INDEX

3- (TRIFLUOROMETHYL)-4-NITROPHENOL
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

ABANDONED COAL MINES
Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

ABATE
Further Observations on the Effect of Abate on Fish Catches,
W82-06722 1512 5C

ABIENOL
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 1502 5C

ABRASION
Cavitation and Wear on Hydraulic Machines,
W82-00331 1501 8C

ABSCISIC ACID
Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 1507 2I

ABSORPTION
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 1505 5A

Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 1510 3A

Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 1511 5D

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 1511 5G

Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 1511 5B

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 1511 5D

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

ACCIDENTS
Components for a Treatment Plant Safety Program,
W82-06992 1512 5G

ACCLIMATIZATION
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 1502 2I

ACCOUNTING
Crisis: Financing Water and Wastewater,
W82-06641 1512 6C

ACCUMULATION
The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 1502 2I

Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 1502 5C

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 1504 2H

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages).
W82-03491 1508 2L

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 1510 5B

Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 1512 5B

ACID MINE DRAINAGE
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 1501 5D

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 1501 5C

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

Acid Pond Drainage,
W82-05199 1511 5G

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

ACID MINE DRAINAGE. *BIOLOGICAL WASTEWATER TREATMENT
Rotating Disc Biological Treatment of Acid Mine Drainage,
W82-03968 1509 5D

ACID MINE WATER
Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 1502 5D

ACID PRECIPITATION
Water Characteristics,
W82-01305 1503 5B

Acid Precipitation, A Review,
W82-06794 1512 5C

ACID RAIN
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 1501 2K

Are Sierra Lakes Becoming Acid,
W82-00231 1501 5C

Understanding Acid Rain,
W82-00479 1501 5B

Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 1502 5B

Acid Rain: Facts and Fallacies,
W82-00518 1502 5C

Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 1502 5B

Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 1502 5B

Acid Precipitation: The Importance of Nitric Acid,
W82-00643 1502 2K

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 1502 2K

A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 1503 5B

Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

Water Characteristics,
W82-01305 1503 5B

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 1503 5B

Recent Acidification of Precipitation in North America,
W82-01514 1503 5B

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 1503 5C

Acid Precipitation,
W82-01607 1503 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 1504 5B

Acid Rain Agreement,
W82-01933 1504 5B

Acid Rain and Environmental Policy,
W82-01987 1504 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 1504 5C

International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 1505 5C

Rainwater Acidity Measurement Problems,
W82-02627 1506 5A

The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 1506 5B

Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 1506 5C

The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 1506 5C

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 1506 2K

Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 1507 5C

Chemical Flux in an Acid-Stressed Stream,
W82-03338 1507 5C

Acid Precipitation--A New Study from Norway,
W82-03341 1507 5C

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 1507 2B

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 1510 5B

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

Acid Precipitation. 1. Causes and Consequences,
W82-04771 1511 5C

Acid Precipitation in Historical Perspective,
W82-04807 1511 5B

Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 1511 5C

Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

Acid Rain: Legal and Political Fallout,
W82-05147 1511 6E

Effects of Acid Precipitation,
W82-05149 1511 5C

Acid Precipitation in the Washington Cascades,
W82-05287 1511 5B

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

Acid Rain Model: Hydrologic Module,
W82-06360 1512 5B

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 1512 5C

ACID STREAMS

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

ACID WATER

Acidification in 50 Norwegian Lakes,
W82-03344 1507 2H

ACIDIC SOILS

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 1503 2G

Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

ACIDIC WATER

Are Sierra Lakes Becoming Acid,
W82-00231 1501 5C

Reviving Acidified Lakes,
W82-00933 1502 2H

Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 1504 5B

Liming Acid Ponds in New York,
W82-02572 1505 5G

Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 1506 5C

Chemical Flux in an Acid-Stressed Stream,
W82-03338 1507 5C

The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 1508 5C

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03903 1509 5C

Perivitelline pH of Salmonide Eggs in Relation to Ambient pH,
W82-04064 1509 5C

ACIDITY

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 1502 2K

Fixed Endpoint Alkalinity Determination,
W82-01187 1503 7B

Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 1507 5C

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 1507 5B

Acid Snow in the Canadian High Arctic,
W82-04542 1510 2C

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 1512 2K

ACIDIZING

Results of Acidizing Water Wells in Arizona,
W82-01199 1503 4B

ACIDS

The Ionization of Acids in Estuarine Waters,
W82-03769 1509 2K

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 1512 2K

ACOUSTICS

Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 1506 2L

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

ACRYLAMIDE

Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 1512 5D

ACTIC

Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 1507 2C

ACTINOMYCES

Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 1507 5A

Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 1512 5B

ACTIVATED ALUMINA

The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 1506 5F

ACTIVATED CARBON

Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

Textile Effluents Lose Their Color.
W82-00342 1501 5D

Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 1501 5F

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 1501 5D

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

Chemicals and Allied Products,
W82-01267 1503 5D

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Investigation of Volatile Organics Removal,
W82-01490 1503 5F

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 1503 5D

Tying Up TCE,
W82-01866 1504 5G

Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 1505 5F

Dupont's Wastewater Treatment Approach,
W82-02254 1505 5D

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 1505 5F

Pilot-Scale Investigations with Granular Activated Carbon,
W82-02289 1505 5D

Trihalomethane Precursor Control by Adsorption,
W82-02598 1505 5F

Application of Adsorption to Wastewater Treatment,
W82-02622 1506 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 1506 5D

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

Practical Experiences in Plants Using Activated Carbon,
W82-02788 1506 5F

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 1508 5F

Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

Breakthrough Characteristics of Selected Toxicants in Granular Activated Carbon Treatment of Combined Industrial Wastewaters,
W82-03812 1509 5D

Adsorption of PCBs by Cellulose Fiber Filter-aids and Carbonaceous Adsorbents Used for Water Treatment,
W82-03937 1509 5F

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

Controlling Bed Losses of Granular Activated Carbon Through Proper Filter Operation,
W82-04089 1509 5F

Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

An Evaluation of Activated Carbon for Drinking Water Treatment: A National Academy of Science Report,
W82-04146 1509 5F

Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 1510 5D

Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 1510 5D

When a Water Supply Went Bad.
W82-04357 1510 5C

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

Granular Activated Carbon Installations,
W82-04391 1510 5F

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 1510 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 1510 5F

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 1511 5D

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 1511 5G

The use of Activated Carbon in Water Treatment,
W82-05182 1511 5F

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 1511 5D

Ozone and Activated Carbon,
W82-05370 1511 5F

Safety Considerations in Handling Activated Carbon,
W82-05442 1511 5D

Effects of Salts on Activated Carbon Adsorption of Fulvic Acids,
W82-05667 1511 5F

Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 1511 5F

Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 1511 5F

Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 1511 5F

Microbial Activity in Activated Carbon Filters,
W82-05683 1511 5F

A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 1512 5D

PAC Process,
W82-06643 1512 5D

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

ACTIVATED SLUDGE

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 1501 5A

The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 1501 5D

Feeding Animals Activated Sludge,
W82-00523 1502 5D

Sludge Blanket in Activated Final Clarifiers,
W82-00951 1502 5D

Activated Sludge,
W82-01243 1503 5D

Effect of Copper on Nitrification in Activated Sludge,
W82-01497 1503 5C

Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 1505 5E

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 1505 5D

The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 1506 5D

Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 1507 5D

Control of the Activated Sludge Process,
W82-03499 1508 5D

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 1508 5D

Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

Experiences of MLSS Control of the Activated Sludge Process,
W82-03849 1509 5D

Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

Investigation on Constant F/M Ratio by Adaption of Aeration Tank Volume,
W82-03860 1509 5D

Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

An Approach to the Control of the Activated Sludge System by Use of a Succession Model,
W82-04057 1509 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 1510 5D

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 1510 5D

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

Potential Use of Earthworms as a Solution to Sludge Management,
W82-05478 1511 5E

A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 1512 5E

Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 1512 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 1512 5D

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 1512 5D

ACTIVATED SLUDGE PROCES

How Much Air,
W82-06638 1512 5D

ACTIVATED SLUDGE PROCESS

Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 1501 5D

The Cape Flats Sewage Treatment Works,
W82-00957 1502 5D

Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 1502 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 1502 5D

Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 1503 5D

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 1503 5D

Activated Sludge Nickel Toxicity Studies,
W82-01895 1504 5D

Engineering Design Variables for the Activated Sludge Process.
W82-02199 1505 5D

Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 1505 5D

Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 1506 5D

Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 1506 5D

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme.
W82-02872 1506 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment,
W82-03032 1507 5D

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 1507 5D

Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 1507 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 1507 5D

The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 1507 5D

Microorganism Inventory in Activated Sludge Control,
W82-03483 1508 5D

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

Wastewater Treatment Plant Features New Technology,
W82-03591 1508 5D

A Stoichiometric Model of Bacterial Growth,
W82-03756 1509 5D

Operational Estimation and Prediction of NItrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

Measurement and Control of the MLSS Concentration in Activated Sludge Plants,
W82-03762 1509 5D

Hogsmill Valley Works: Twenty Years On,
W82-03834 1509 5D

'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment,
W82-03848 1509 5D

Experiences of MLSS Control of the Activated Sludge Process,
W82-03849 1509 5D

A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

An Approach to Full-Automatic Control of Activated Sludge Process,
W82-03855 1509 5D

Maximizing Effluent Quality from a Municipal Activated Sludge Plant Concurrent with a Major Reduction in Process Energy Requirements,
W82-03874 1509 5D

Method of Evaluating the Possible Energy Savings by Implementing Do-Control or Fine Bubble Diffusors,
W82-04007 1509 5D

Preliminary Studies on Control Parameters and Biological Community for the Activated Sludge Process,
W82-04008 1509 5D

An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

The Effect of Particle Substrate on Mineralization Performance and the Formation of Excess Sludge in a Complete Mixing Aeration Tank,
W82-04012 1509 5D

Automatic Monitoring of Exhaust Gas Analysis in Activated Sludge Wastewater Treatment Process,
W82-04014 1509 5D

Evaluation of the Resident Mass of Sludge in Final Sedimentation Tanks for Waste Sludge Control,
W82-04015 1509 5D

Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

A New Indicator of the Activated Sludge Process - Nitrous Oxide,
W82-04018 1509 5D

The Continuous Oxygen Uptake Rate Measurement and Its Applicability as an Activated Sludge Control Parameter,
W82-04020 1509 5D

Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

Computer Control of Nitrifying and Denitrifying Activated Sludge Process,
W82-04025 1509 5D

Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants,
W82-04026 1509 5D

A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

Specific Oxygen Demand as an Operating Parameter for Activated Sludge Processes,
W82-04029 1509 5D

Solids Inventory Control in the Activated Sludge Process,
W82-04048 1509 5D

The BASF Toximeter - A Helpful Instrument to Control and Monitor Biological Waste Water Treatment Plants,
W82-04050 1509 5A

Microprocessor Architecture and Performance in Wastewater Process,
W82-04056 1509 5D

Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 1510 5D

Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

Destabilization of Biological Solids with Ferric Chloride,
W82-04373 1510 5D

Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 1510 5D

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 1510 5D

Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 1510 5D

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 1510 5E

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 1510 5D

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 1510 5D

Estimation and Control Problems in Activated Sludge Processes,
W82-04612 1510 5D

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 1510 5D

Vacuum Filtration of Septage,
W82-04710 1510 5D

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 1511 5B

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 1511 5C

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 1511 5C

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 1511 5D

Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 1511 5D

Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 1511 5D

Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 1511 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 1511 5D

Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 1511 5D

Biological Nitrification of Industrial Wastewater,
W82-05129 1511 5D

Single Sludge Nitrogen Removal from Industrial Wastewater,
W82-05245 1511 5D

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

Shock Load of Chromium (VI),
W82-05253 1511 5D

Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 1511 5D

Control of Sludge Bulking in the Brewing Industry,
W82-05260 1511 5D

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 1511 5D

Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 1511 5D

Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 1511 5D

Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 1511 5D

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 1511 5D

Hydraulic Regime and Activated Sludge Performance,
W82-05819 1511 5D

Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 1511 5D

Nitrogen Removal in Continuous-Flow Sequentially Aereated Activated Sludge Systems,
W82-05950 1512 5D

A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 1512 5D

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 1512 5D

A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 1512 5D

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 1512 5D

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 1512 5D

PAC Process,
W82-06643 1512 5D

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 1512 5D

Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 1512 5D

ACTIVATED SLUDGE PROCESSES
Occurrence of Cytophagas in Sewage Plants,
W82-00682 1502 5A

Control of Dissolved Oxygen in Activated Sludge Plants,
W82-04061 1509 5D

Algorithm for Optimal Activated Sludge Operation,
W82-05682 1511 5D

ACTIVATRED SLUDGE PROCESS
Combined Effects of Biological Solids Retention Time and Temperature on the Growth Parameters of Activated Sludge,
W82-04021 1509 5D

ACTIVITY COEFFICIENT
Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 1511 2K

ACUTE TOXICITY
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 1504 5A

ADENOSINE TRIPHOSPHATE
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H

The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 1502 2L

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 1503 2H

Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

ADIRONDACK MOUNTAINS
Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 1506 5C

ADIRONDACK REGION
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

ADIRONDACKS
Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

ADJUDICATION PROCEDURE
The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 1507 6E

ADMINISTRATION
Effluent Charging Systems and Their Administrative Implications,
W82-02403 1505 6C

The Effect of EEC Directives on Water Supplies,
W82-02432 1505 6E

ADMINISTRATIVE DECISIONS
Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 1502 6F

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

Engineering U.S. Water Policy,
W82-03294 1507 6E

ADMINISTRATIVE REGULATIONS
Arkansas Water Policy.
W82-00715 1502 6D

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

Groundwater Problems and Needs in New York,
W82-01055 1502 4B

Ground Water Problems in West Virginia,
W82-01060 1502 4B

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

ADRIATIC SEA
Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 1512 5C

ADSOPRTION
Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 1512 5B

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

ADSORBENTS
Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

Granular Activated Carbon Installations,
W82-04391 1510 5F

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 1511 5D

ADSORPTION
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 1501 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 1501 2K

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 1501 5A

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 1501 5D

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 1501 5D

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 1502 5B

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 1502 5A

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 1502 5F

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 1502 5F

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1502 1B

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 1503 5D

Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 1503 5F

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 1503 5F

Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 1505 5B

Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 1505 5F

Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

Trihalomethane Precursor Control by Adsorption,
W82-02598 1505 5F

Application of Adsorption to Wastewater Treatment,
W82-02622 1506 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 1506 5D

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 1506 5B

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 1506 5F

The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 1506 5F

Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 1507 5B

The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 1508 5E

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 1508 5B

Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

Breakthrough Characteristics of Selected Toxicants in Granular Activated Carbon Treatment of Combined Industrial Wastewaters,
W82-03812 1509 5D

Adsorption of PCBs by Cellulose Fiber Filteraids and Carbonaceous Adsorbents Used for Water Treatment,
W82-03937 1509 5F

Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

An Evaluation of Activated Carbon for Drinking Water Treatment: A National Academy of Science Report,
W82-04146 1509 5F

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 1510 5F

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 1510 5D

Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 1510 5F

Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 1511 2H

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 1511 5D

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 1511 5B

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 1511 5C

Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 1511 5F

Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 1512 5D

Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 1512 5D

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

ADVANCED WASTEWATER TREATMENT
Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 1505 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

In-Stream Aeration: A Possible Alternative to AWT.
W82-03375 1507 5G

Tampa's Hookers Point Awt Plant Working Well.
W82-03455 1508 5D

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 1511 5D

Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 1511 5D

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 1511 5D

Phosphorus Reduction Studies,
W82-05408 1511 5D

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 1511 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 1512 5D

ADVECTION
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 1505 2D

AEGEAN SEA
Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 1506 5C

AERATED LAGOONS
Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 1501 5D

Avoiding an Environmental Hangover.
W82-00344 1501 5D

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 1508 5D

A Low-Cost Secondary Treatment Alternative,
W82-05169 1511 5D

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 1512 5D

A Survey of Aerated Lagoon Performance,
W82-06391 1512 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 1512 5D

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

AERATION

Underwater Aerator,
W82-00065 1501 5D

Foam Control in Aeration Tanks,
W82-00171 1501 5D

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 1501 5D

Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 1501 5D

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 1502 5G

Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 1503 5D

Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 1503 5G

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 1505 5G

Measurements of Self-Aerated Flow on a Spillway,
W82-02715 1506 8B

Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1506 1B

Wind Aeration in Model Waste Treatment System,
W82-02944 1506 5D

In-Stream Aeration: A Possible Alternative to AWT.
W82-03375 1507 5G

Control of the Activated Sludge Process,
W82-03499 1508 5D

Hypolimnetic Aerator Fights Eutrophication,
W82-03563 1508 5G

Wastewater Treatment Plant Features New Technology,
W82-03591 1508 5D

A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

Calculation of Sludge Reservoir Volume for MLSS Control,
W82-03856 1509 5D

Investigation on Constant F/M Ratio by Adaption of Aeration Tank Volume,
W82-03860 1509 5D

Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants,
W82-04026 1509 5D

Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 1510 5G

Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 1511 5D

Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 1511 5D

Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 1511 5G

Oxygenation of the Avon River,
W82-05730 1511 5G

Solving a Poor Oxygen Transfer Problem.
W82-05952 1512 5D

Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 1512 8C

Low-Cost Treatment of Wastewater,
W82-06506 1512 5D

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 1512 5D

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 1512 5D

A Model for the Design of Hypolimnetic Aerators,
W82-06610 1512 5G

How Much Air,
W82-06638 1512 5D

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 1512 5C

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

AERATION TANKS

An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

AERATION ZONE

Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 1511 2G

AERATORS

Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 1510 5D

A Model for the Design of Hypolimnetic Aerators,
W82-06610 1512 5G

AERIAL PHOTOGRAPHY

The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 1502 7B

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00934 1502 7B

Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 1503 7B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 1503 7B

Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 1507 4C

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

AEROBIC-ANAEROBIC LAGOONS

Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 1501 5D

AEROBIC BACTERIA

Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 1507 5D

Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 1511 5C

AEROBIC CONDITIONS

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

AEROBIC DIGESTION

Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 1507 5D

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 1510 5D

Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

AEROBIC POPULATIONS

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population

of the Saint John River Using Classical Systematics,
W82-06559 1512 5A

AEROBIC TREATMENT
Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 1508 5D

A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 1512 5E

AEROMONAS
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 1502 5A

AEROSOLS
Predictions for Particle Deposition on Natural Waters,
W82-00264 1501 5B

Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 1502 2B

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 1503 5B

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 1503 5C

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 1504 2B

Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 1505 5B

Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

AESCHYNOMENE
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

AESTHETICS
Saving Water Scenically,
W82-05789 1511 5D

AFRICA
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

Exploiting the Waters of Lake Chad.
W82-01726 1503 8A

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 1503 6G

Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 1506 2H

Will the Sahelian Drought End in 1985,
W82-03167 1507 2B

Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

AGARS
An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 1503 5A

AGGRADATION
River Bed Aggradation Due to Overloading,
W82-01486 1503 2J

Mathematical Model for Erodible Channels,
W82-06336 1512 2J

AGGREGATES
Cavitation Resistance of Concrete,
W82-03165 1507 8F

AGRICULTURAL
A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 1510 3F

AGRICULTURAL CHEMICALS
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 1501 5B

Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 1502 5B

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 1502 5A

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 1503 4A

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 1511 5B

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 1511 5B

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 1512 5B

AGRICULTURAL CONSERVATION PROGRAM
Agricultural Conservation Program: An Evaluation,
W82-02019 1504 3F

AGRICULTURAL ENGINEERING
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 1504 2I

The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 1505 2J

Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 1505 2I

Modeling Rill Density,
W82-02604 1506 2J

AGRICULTURAL HYDROLOGY
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 1502 6D

A Parametric Crop Water Use Model,
W82-01310 1503 2I

Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 1508 5A

Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 1511 4C

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1.
W82-06375 1512 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 1512 3F

AGRICULTURAL RESERVOIRS
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 1503 2J

AGRICULTURAL RUNOFF
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 1501 5B

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 1502 5B

Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 1503 6A

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 1503 6A

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 1503 5B

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 1503 2J

Concentrated Flow Relationships,
W82-01409 1503 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 1503 5B

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 1503 5B

Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01[illegible]2 1503 5B

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 1505 2J

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 1505 5B

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 1505 5B

Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 1506 5G

The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 1507 5G

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 1508 5B

SPNM, A Model for Predicting Sediment, Phosphorus, and Nitrogen Yields from Agricultural Basins,
W82-04157 1509 6A

Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 1510 4D

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04860 1511 2A

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 1511 2H

Agricultural Runoff and Water Pollution,
W82-05569 1511 5B

Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 1511 5C

Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 1512 5B

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

AGRICULTURAL WATERSHEDS
An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 1501 5B

Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 1501 5B

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 1502 5B

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 1503 2A

Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 1505 2A

A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 1507 8A

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 1508 2A

A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 1511 2E

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 1511 4D

Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

AGRICULTURE
Protecting Agriculture's Natural Resource Base,
W82-00176 1501 4D

Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 1502 2I

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

Water Requirements and Man-Induced Climate Change,
W82-01633 1503 2D

Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 1506 3C

Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 1507 2J

A Perspective Study of Droughts in Mexico,
W82-03358 1507 2E

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 1508 5G

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 1508 3C

The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 1508 6B

Potential Impact of Ground Water Policy Alternatives on Nebraska Agriculture, 1977-2020,
W82-03826 1509 6B

The Distribution and Movement of Solutes Derived from Agricultural Land in The Principal Aquifers of The United Kingdom, with Particular Reference to Nitrate,
W82-03912 1509 5B

Normalized Agricultural Prices and Water Resources Planning,
W82-03928 1509 6B

Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control,
W82-04063 1509 5G

Drainage of Agricultural Lands.
W82-04069 1509 4A

Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

Some Emerging Rights in Agricultural Land,
W82-04890 1511 6E

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field cf Land and Water Management,
W82-05278 1511 4B

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 1511 3F

China's Agro-Ecosystem,
W82-06019 1512 3B

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 1512 3E

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 1512 6F

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

AGRICULTURE WATERSHEDS
Nutrient Cycling in an Agricultural Watershed: Waterborne Nutrient Input/Output Budgets for the Riparian Zone,
W82-03825 1509 5B

AIR CIRCULATION
Major Factors in Sewer Ventilation,
W82-06462 1512 8A

On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 1512 2B

Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 1512 2B

AIR ENTRAINMENT
Excess Air in Groundwater,
W82-02099 1504 2F

Measurement of Air in Flowing Water,
W82-04322 1510 7B

Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 1512 8B

AIR MASSES
Two-Phase Flow Simulation of Air Storage in an Aquifer,
W82-03841 1509 2F

AIR POLLUTION
Are Sierra Lakes Becoming Acid,
W82-00231 1501 5C

Acid Rain: Facts and Fallacies,
W82-00518 1502 5C

Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

Sources and Control of Organic Air Pollutants,
W82-00711 1502 5B

A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 1503 5B

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 1503 5B

The Mercury Cycle,
W82-01869 1504 5B

The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 1504 5B

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 1507 2B

A Simulation of the Enrichment of Atmospheric Pollutants in Snow Cover Runoff,
W82-03838 1509 5B

Estimation of Organic Compound Emissions from Waste Lagoons,
W82-05679 1511 5C

Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 1511 5B

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

AIR POLLUTION EFFECTS
Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

Sources and Control of Organic Air Pollutants,
W82-00711 1502 5B

The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 1503 5B

Acid Precipitation,
W82-01607 1503 5C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 1507 5C

Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

Acid Snow in the Canadian High Arctic,
W82-04542 1510 2C

Acid Precipitation in the Washington Cascades,
W82-05287 1511 5B

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

AIR POLLUTION SOURCES
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

AIR STRIPPING
Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 1508 5B

AIR TEMPERATURE
Humidity Measurement by Infrared Thermometry,
W82-05611 1511 7B

AIR-WATER INTERFACES
Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 1501 5B

Predictions for Particle Deposition on Natural Waters,
W82-00264 1501 5B

Water-To-Air Fractionation of Bacteria,
W82-00575 1502 5B

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1502 1B

Two-Phase Flow Simulation of Air Storage in an Aquifer,
W82-03841 1509 2F

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 1511 2L

AIRPORTS
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

AIRY HOLM DAM
Airy Holm Dam - Kielder Water Scheme,
W82-03070 1507 8A

AJWA RESERVOIR
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

ALABAMA

Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 1503 6F

Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 1505 5G

Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

Water Chemistry of Alabama Ponds,
W82-03534 1508 2K

Water Quality and Off-Flavor Problems in Commercial Channel Catfish Culture in West-Central Alabama,
W82-04087 1509 5C

A Five-Year Plan of Water Resources Research.
W82-05527 1511 6B

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 1511 2E

Plant Expansion Via High-Rate Pretreatment,
W82-05953 1512 5F

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 1512 5A

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 1512 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascaguoula, and Tennessee River Basins,
W82-06954 1512 7C

ALAGAL HARVESTING

Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 1511 5G

ALASKA

Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 1501 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 1501 6G

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 1502 6G

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 1502 2I

Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 1503 2C

Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 1505 2L

Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

Water Resources Data for Alaska, Water Year 1980.
W82-02845 1506 7C

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 1506 6D

Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 1508 2K

Deep Water Renewal in Subarctic Fjord,
W82-03675 1508 2L

Institutional Analysis Criteria for Water Supply Planning,
W82-03930 1509 6D

Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

Use of Pre-Fabricated Parshall Flumes to Measure Streamflow in Permafrost-Dominated Watersheds,
W82-04074 1509 7B

Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
W82-04075 1509 8I

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 1511 2F

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 1512 5C

ALBEDO

Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 1503 7B

Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 1512 2C

ALBERTA

Predicting Lake Levels by Exponential Smoothing,
W82-00118 1501 2A

The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 1501 6A

Projected Tile Effluent Effects on the Oldman River,
W82-00333 1501 5C

Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 1501 6A

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 1503 2G

Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 1508 2K

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 1508 8A

Chemical Evolution of Groundwater in a Drainage Basin of Holocene Age, East-Central Alberta, Canada,
W82-03800 1509 2K

The Cost of Peak Capacity Water,
W82-04065 1509 6B

Energy, Environmental, and Economic Implications of Some Recent Alberta Water Resources Projects,
W82-04226 1509 6B

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 1511 6E

Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 1511 6D

Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05636 1511 4D

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 1511 6B

Biogeochemistry of Mountain Stream Waters: The Marmot System, 1512 5B
W82-06569

Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta, 1512 5C
W82-06770

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community, 1512 5C
W82-06898

ALDEBURGH
Flexible Outfall at Aldeburgh, 1505 8A
W82-02415

ALDICARB
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry, 1512 5A
W82-06549

ALFALFA
Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions, 1505 2D
W82-02295

Effects of Decreased Watering on Crop Yields, 1510 2I
W82-04411

Alfalfa Hay Grown with Municipal Waste Water and Pump Water, 1511 3C
W82-04873

Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers, 1512 3F
W82-06148

ALGAE
Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System, 1501 5D
W82-00307

Microplate Technique for Determining Accumulation of Metals by Algae, 1501 5A
W82-00492

An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems, 1502 7B
W82-00756

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae, 1502 5C
W82-00870

Massive Cultivation of Microalgae: Results and Prospects, 1502 5D
W82-00913

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia, 1502 2H
W82-00919

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron, 1503 5C
W82-01149

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O_2 Toxicity, and Cyanophages, 1503 2H
W82-01595

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga, 1503 5C
W82-01598

Relationships Between Nannoplankton and Lake Trophic Status, 1503 5C
W82-01640

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston, 1504 7B
W82-01823

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water, 1504 2H
W82-01824

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella, 1504 5C
W82-01920

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State, 1504 2H
W82-01924

Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding, 1505 5C
W82-02272

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan, 1505 2H
W82-02299

Periphyton Production in an Appalachian Mountain Trout Stream, 1505 5C
W82-02335

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou, 1505 6G
W82-02531

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns, 1505 5C
W82-02563

Algal Polymorphism in High Rate Wastewater Treatment Ponds, 1505 5D
W82-02564

Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method, 1506 5C
W82-02626

Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic, 1506 2C
W82-02649

Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems, 1506 5D
W82-02675

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes, 1506 5C
W82-02710

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water, 1506 5B
W82-02724

On the Algal Ecology of the Lowland Iraqi Marshes, 1506 6G
W82-02777

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies, 1506 2H
W82-02861

Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels, 1506 5C
W82-02906

Changes in Flora Down a Stream Showing a Zinc Gradient, 1506 5C
W82-02946

Response of Phytoplankton to Acidification in Experimental Streams, 1507 5C
W82-03036

Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga, 1507 2H
W82-03120

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'), 1507 2H
W82-03217

Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species, 1507 5C
W82-03233

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'), 1507 5C
W82-03303

Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities, 1507 5C
W82-03309

Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach, 1507 5C
W82-03330

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations, 1507 5C
W82-03331

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia, 1507 2L
W82-03398

On the Conspecificity of Marine and Freshwater Bangia in Britain, 1508 2L
W82-03408

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters, 1508 5B
W82-03417

Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French), 1508 5D
W82-03464

A Culture Model for Phytoplankton Succession in the Potomac River Near Washington, D.C. (U.S.A.), 1509 5B
W82-03765

Attached Algae of the Lake Erie Shoreline Near Nanticoke Generating Station, 1509 5C
W82-04035

Phosphorus Recycling in Five Shallow Lakes, 1509 2H
W82-04040

Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA, 1509 5F
W82-04114

Effect of Filtration Pressure on Analyses for Chlorophyll, 1509 2H
W82-04247

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution, 1511 5A
W82-04818

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries, 1511 5B
W82-04994

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 1511 5G

Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1511 1A

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 1511 5C

Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 1511 2H

Indoles in the Decomposition Products of Certain Blue-Green Algae,
W82-05505 1511 2H

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 1511 5B

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 1511 2H

Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 1511 5A

Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 1512 5B

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 1512 5B

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 1512 5C

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-05470 1512 5C

Circulation Patterns; Their Investigation and Prediction,
W82-06477 1512 5F

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 1512 5C

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 1512 5C

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 1512 5C

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 1512 5C

Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 1512 5C

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 1512 5C

ALGAE HARVESTING
Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 1505 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 1511 5D

ALGAL
Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 1510 5C

Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

ALGAL CONTROL
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 1505 5C

The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 1506 5F

Bacterial Control of Aquatic Algal Populations--Phase II,
W82-04163 1509 5C

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 1510 5D

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 1512 4A

ALGAL GROWTH
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 1502 5A

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 1502 2H

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 1502 2H

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 1502 5C

Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 1503 5C

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 1505 5C

Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 1506 2H

Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 1507 5C

Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 1507 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 1508 2L

Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 1508 5D

Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 1510 2H

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 1511 2H

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 1511 2H

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 1511 5C

Algal Growth in Primary Settled Sewage–The Effects of Five Key Variables,
W82-06055 1512 5D

Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 1512 5C

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 1512 5D

Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 1512 5C

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 1512 5C

Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 1512 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 1512 5C

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

ALGAL MATS
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

ALGICIDES
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 1512 5F

ALGORITHMS
Computerized Control of an Open-Channel Water Distribution System,
W82-02732 1506 4A

An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 1511 6B

A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 1512 6A

ALKALINE SOILS
Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 1510 3F

ALKALINE WATER
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

ALKALINITY
Process for Removing Alkalinity and Hardness From Waters,
W82-00063 1501 5F

Fixed Endpoint Alkalinity Determination,
W82-01187 1503 7B

ALKYLPYRIDINES
Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

ALLEGHENY COUNTY
Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 1501 5E

ALLEGHENY RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 1504 6D

ALLOCATION OF RESOURCES
Arkansas Water Policy.
W82-00715 1502 6D

ALLOTMENTS
Preferences for Allocating River Recreation Use,
W82-01181 1503 6D

Water Rights on Indian Allotments,
W82-02363 1505 6E

ALLUVIAL AQUIFER
Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 1512 7C

ALLUVIAL AQUIFERS
Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 1512 6B

ALLUVIAL CHANNELS
River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 1506 2E

Bend Theory of River Meanders. Part I. Linear Development,
W82-05085 1511 2E

Mathematical Model for Erodible Channels,
W82-06336 1512 2J

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

ALLUVIAL DEPOSITS
Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

ALLUVIAL FANS
Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 1510 6F

ALLUVIAL RIVERS
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 1504 2J

ALLUVIUM
Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 1511 3B

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 1512 6B

ALPINE REGIONS
Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 1506 2H

Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 1508 2K

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 1512 2E

ALPS
Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

ALTAMAHA RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 1503 6D

ALTERATION OF FLOW
Local Flow Accelerations in Rivers,
W82-02758 1506 2E

ALTERNATIVE PLANNING
Formulating Alternatives for Environmental Studies,
W82-00997 1502 6G

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 1503 6A

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 1504 6B

Interactive Nonstructural Flood-Control Planning,
W82-02320 1505 6F

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

ALTITUDE
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 1506 2I

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 1512 2D

ALUM
History of a Water Chemical,
W82-00074 1501 5F

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 1502 5F

Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 1504 5F

Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 1505 5F

Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

ALUMINUM
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 1502 2H

Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

Feasibility Studies on Liquid Ion Exchange for Alum Recovery from Water Treatment Plant Sludges,
W82-04107 1509 5E

Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 1511 5A

ALUMINUM COMPOUNDS
Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 1511 2K

ALUMINUM OXIDE
Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 1506 5F

ALUMINUM SULFATE
History of a Water Chemical,
W82-00074 1501 5F

Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 1510 5F

AMAZON LAKES
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 1502 2H

AMAZON RIVER
Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

AMERICAN RIVER
Water Resources Appraisals for Hydroelectric Licensing: American River Basin, California.
W82-01441 1503 6D

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

AMERICIUM
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 1504 5B

Laboratory and Field Studies of The Relative Mobility of 239, 240PU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

AMES TEST
On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 1512 5A

AMINO ACIDS
Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

AMINOCARB
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 1501 5A

Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 1508 5A

AMMONIA
An Alternative Solution to the THM Problem,
W82-00072 1501 5F

A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 1501 5A

Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 1501 5D

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 1502 5A

Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 1505 5C

Determination of Ammonia in Estuary,
W82-02390 1505 5A

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 1506 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 1508 5D

Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 1508 5B

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

Criteria for Nitrification in Fixed Film Reactors,
W82-05352 1511 5D

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 1511 5B

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

AMMONIUM

Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 1502 2L

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 1503 5C

Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 1508 5A

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 1511 5G

AMMONIUM COMPOUNDS

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

AMPHIPODS

Relationship Between Populations of Amphipods and Pollution,
W82-02444 1505 5C

Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 1506 2H

AMVRAKIA LAKE

Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 1506 2H

ANABAENA

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 1511 2H

ANACOSTIA RIVER

Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

ANADROMOUS FISH

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 1504 6E

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 1512 5C

ANAEROBIC BACTERIA

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 1508 5D

ANAEROBIC CONDITIONS

Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 1501 2H

Chemistry of Septicity,
W82-00325 1501 5D

A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 1502 5D

Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 1502 5C

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals,
W82-03771 1509 2K

Anaerobic Treatment in Novel Contact Digester,
W82-05681 1511 5D

Role of Surface Active Media in Anaerobic Filters,
W82-05816 1511 5D

Biological Equilibrium in a Wastewater Reservoir,
W82-06282 1512 5D

Anaerobic Processes,
W82-06923 1512 5D

ANAEROBIC DIGESTION

Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 1501 5D

Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 1501 5E

Anaerobic Processes,
W82-01245 1503 5D

New Approaches to Anaerobic Sludge Digestion,
W82-01398 1503 5D

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 1503 5D

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 1504 5D

Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 1506 5D

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 1506 5D

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 1507 5D

Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 1508 5D

Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 1510 5E

Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 1510 5D

Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 1510 5D

The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 1510 5D

Package Anaerobic Sludge Digestion.
W82-04850 1511 5D

Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 1512 5D

Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute).
W82-06024 1512 5D

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079
1512 5D

Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226
1512 5D

Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312
1512 5D

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405
1512 5E

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667
1512 5D

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832
1512 5D

ANAEROBIC FILTER
Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959
1509 5D

ANAEROBIC LAGOONS
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226
1501 5D

Elimination of Odor from Anaerobic Lagoons,
W82-06221
1512 5D

ANAEROBIC TREATMENT
Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419
1510 5D

ANALOG COMPUTERS
Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389
1505 6A

ANALYTICAL TECHNIQUES
Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485
1508 5A

Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879
1509 5A

Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887
1509 5F

Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015
1511 7B

ANCHORAGE
Institutional Analysis Criteria for Water Supply Planning,
W82-03930
1509 6D

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981
1511 5G

ANDROSCOGGIN RIVER
Origin and Chemical Composition of Androscoggin River Foam,
W82-02970
1506 5B

ANIMAL DISEASES
Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686
1502 5B

ANIMAL WASTES
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141
1501 5B

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686
1502 5B

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555
1503 5B

A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620
1503 5A

Pollution from Farms,
W82-02039
1504 5D

Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175
1505 5E

Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114
1507 5D

Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122
1507 5A

Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650
1508 5D

Mass Production of Freshwater Rotifiers on Liquid Wastes II. Mass Production of Brachionus Rubens Ehrenberg 1838 in the Effluent of High-Rate Algal Ponds Used for the Treatment of Piggery Waste,
W82-03884
1509 3C

Polyculture of the Freshwater Prawn, Macrobrachium Rosenbergii, Chinese and Common Carps in Ponds Enriched with Swine Manure I. Initial Trials,
W82-03900
1509 3C

Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454
1510 5D

Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860
1511 5B

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207
1511 5B

Agricultural Runoff and Water Pollution,
W82-05569
1511 5B

Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834
1512 4D

ANION EXCHANGE
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484
1503 5F

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697
1503 5F

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes,
W82-06167
1512 3A

ANISOTROPY
Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570
1503 5B

ANN ARBOR
Cold Weather Waste Treatment,
W82-00636
1502 5D

ANNE ARUNDEL COUNTY
Coordinated Effort Stems Sediment and Erosion,
W82-00766
1502 4D

ANNUAL DISTRIBUTION
Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854
1506 2E

ANNUAL FLOODS
Spring Flood: Meltwater or Groundwater,
W82-00531
1502 7B

ANODIC STRIPPING VOLTAMMETRY
Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811
1511 5A

ANTARCTIC
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572
1503 5A

A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686
1503 2A

Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378
1505 5B

The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860
1506 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861
1506 2H

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862
1506 2C

On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170
1507 2C

West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362
1507 2C

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638
1510 2H

ANTARCTIC OCEAN
On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166
1501 2C

ANTARCTICA
A Mechanism for the formation of Large Icebergs,
W82-04798
1511 2C

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

ANTECEDENT MOISTURE
Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

ANTECEDENT PRECIPITATION INDEX
Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 1508 2A

ANTIBIOTICS
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 1505 5C

ANTIBODIES
Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 1511 5A

ANTIMIGRANTS
Use of Hydroxylpropylcellulose to Decrease Wastage of Disperse Dyes in the Continuous Dyeing of Polyester,
W82-04164 1509 5G

ANTIMONY
The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates,
W82-02355 1505 5A

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 1511 5A

ANTWERP
A Century of Water for Antwerp,
W82-03355 1507 5F

Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

APPALACHIAN REGION
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

APPLES
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

APPLICATION EQUIPMENT
Traveling Sprinkler System and Method,
W82-00561 1502 3F

Sprinkler Leveler and Wind Compensating Device,
W82-06164 1512 3F

APPLICATION RATES
Land Disposal of Sewage Sludge. A Summary of Research Results, 1972-1980,
W82-06377 1512 5E

APPROPRIATION
Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 1510 6E

APPROXIMATION METHOD
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

AQUACULTURE
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 3C

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 1502 5D

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 1503 2H

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 1506 5D

PP and L Uses Discharge Water for Fish Farming,
W82-02645 1506 3C

Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 1506 5C

Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 1506 8I

Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 1507 5D

Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 1507 5D

Mass Production of Freshwater Rotifiers on Liquid Wastes II. Mass Production of Brachionus Rubens Ehrenberg 1838 in the Effluent of High-Rate Algal Ponds Used for the Treatment of Piggery Waste,
W82-03884 1509 3C

Polyculture of the Freshwater Prawn, Macrobrachium Rosenbergii, Chinese and Common Carps in Ponds Enriched with Swine Manure I. Initial Trials,
W82-03900 1509 3C

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Aquaculture for Waste Management,
W82-06556 1512 5D

AQUATIC ANIMALS
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 3C

Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 1503 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 1504 5C

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

Effects of Water Drawdown on the Fauna in Small Cold Water Reservoirs,
W82-04219 1509 6G

A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 1512 2K

AQUATIC BACTERIA
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 1501 5A

Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 1505 5A

Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 1511 5B

AQUATIC DRIFT
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

AQUATIC ENVIRONMENT
An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 1501 5C

Distribution of Clostridium Botulinum,
W82-00349 1501 5A

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

A Review on Sediment Traps in Aquatic Environments,
W82-01020 1502 7B

Kinetics for the Aquatic Environment,
W82-01631 1503 2K

Microbiology of the Aquatic Environment,
W82-01786 1503 5C

Kinetics for the Aquatic Environment,
W82-01806 1504 2K

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 1507 7C

Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 1507 5A

Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

Biota and Biological Principles of the Aquatic Environment.
W82-04499 1510 5C

Pesticides in the Aquatic Environment,
W82-04727 1510 5C

Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 1511 5A

Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 1511 5C

AQUATIC ENVIRONMENTS
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

AQUATIC FAUNA
The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

AQUATIC FOOD CHAINS
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

AQUATIC FUNGI
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 1504 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 1504 2L

Seasonal and Diurnal Fluctuations of Oomycete Propagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 1505 2H

Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 1508 2L

Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 1512 5B

AQUATIC HABITANTS
The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

AQUATIC HABITAT
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

AQUATIC HABITATS
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 1505 2H

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 1507 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 1507 5A

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

Pesticide Effects on Aquatic Habitats,
W82-05146 1511 5C

Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 1512 8I

A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 1512 8I

Habitat Recovery in the North Fork of the Teton River.
W82-06409 1512 6G

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 1512 5C

AQUATIC INSECTS
Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 1502 5F

How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 1506 7A

The Aquatic Insects of The Narraguagus River, Hancock and Washington Counties, Maine,
W82-04167 1509 2E

AQUATIC LIFE
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 1501 5C

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 1501 5A

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 1502 5A

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 1503 6G

A Hydrobiological Survey of a Polluted Canal,
W82-01356 1503 5C

Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 1503 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

Microbiology of the Aquatic Environment,
W82-01786 1503 5C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 1503 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 1504 5C

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

Metabolism of a Desert Stream,
W82-02349 1505 1A

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosyn-

thesis and Excretion of Chlorella and Natural Phytoplankton in a Lake, 1506 5C
W82-02918

Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature, 1508 5B
W82-03602

The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species, 1510 5C
W82-04389

Overview and Assessment of Biological Sensing, 1511 5C
W82-05156

New In-Situ Techniques in Biomonitoring, 1511 5A
W82-05157

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System, 1511 6G
W82-05329

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea, 1511 5B
W82-05458

Biological Responses on Lakes in the Mount St. Helens Blast Zone, 1511 5C
W82-05519

Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens). 1512 5B
W82-06904

AQUATIC MICROORGANISMS
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa, 1501 5A
W82-00346

AQUATIC ORGANISMS
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter, 1504 5A
W82-02016

AQUATIC PLANTS
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches, 1501 5D
W82-00093

Search for Linuron Residues in Tributaries of the Chesapeake Bay, 1502 5A
W82-00569

Control of Water Weeds by Grass Carp in Two Small Lakes, 1502 3B
W82-00609

Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary, 1502 2L
W82-00918

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh, 1502 2H
W82-01096

Ecological and Physiological Features of the Root System of Inshore Hydrophytes, 1503 5B
W82-01715

Formation of Water Quality in the Irtysh-Karaganda Canal, 1503 5B
W82-01716

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel, 1504 5B
W82-01813

The Flowering of Wastewater Treatment, 1504 5D
W82-02015

Metabolism of a Florida Lake Ecosystem, 1505 2H
W82-02268

Some Analyses of Aquatic Plants and Their Waters, 1505 2H
W82-02293

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana, 1505 2H
W82-02334

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh, 1505 2I
W82-02340

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity, 1505 4A
W82-02365

Concepts in Aquatic Treatment System Design, 1505 5D
W82-02593

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water, 1506 5B
W82-02724

Changes in Flora Down a Stream Showing a Zinc Gradient, 1506 5C
W82-02946

Exploiting Papyrus, 1507 2H
W82-03202

Growth and Reproduction of Potamogeton Crispus in a South African Lake, 1508 2H
W82-03406

Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners, 1508 2H
W82-03689

Use of Aquatic Macrophytes for Wastewater Treatment, 1509 5D
W82-04046

Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla), 1510 5B
W82-04479

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England, 1510 5C
W82-04688

On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern), 1511 7B
W82-05092

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems, 1511 2H
W82-05097

Water Fluctuation and the Aquatic Flora of Lake Miccosukee, 1511 4A
W82-05808

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water, 1512 5F
W82-06363

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut, 1512 2H
W82-06678

Community Photosynthesis and Respiration in Experimental Streams, 1512 5C
W82-06896

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan, 1512 5C
W82-06900

AQUATIC POPULATIONS
Report of the Aquatic Ecosystem Objectives Committee, 1502 5G
W82-00705

Relationship Between Populations of Amphipods and Pollution, 1505 5C
W82-02444

The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973, 1506 2H
W82-02696

AQUATIC PRODUCTIVITY
Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment, 1512 5G
W82-05919

AQUATIC SOILS
Aquatic Sediments, 1503 5B
W82-01279

Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments, 1512 5C
W82-05934

AQUATIC VEGETATION
The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978, 1506 2H
W82-02779

AQUATIC WEED CONTROL
Aquatic Weed Cutting Apparatus, 1502 4A
W82-00624

Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum, 1503 4A
W82-01796

Biological Control of Aquatic Weeds in Southwest Florida, 1505 4A
W82-02285

Control of Aquatic Weeds with Hexazinone, 1505 4A
W82-02326

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK, 1505 5B
W82-02327

Diquat and Sodium Alginate for Weed Control in Rivers, 1505 4A
W82-02328

Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds, 1505 4A
W82-02329

Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems, 1505 5B
W82-02330

The Clear Lake Example: An Ecological Approach to Pest Management, 1506 5F
W82-02660

1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals, 1507 4A
W82-03024

Aquatic Weed Research in Britain, 1507 4A
W82-03187

The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida, 1511 4A
W82-05274

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains, 1512 5C
W82-06304

AQUATIC WEEDS
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment, 1503 5B
W82-01678

1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 1507 4A

Exploiting Papyrus,
W82-03202 1507 2H

AQUEDUCTS
Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 1512 8A

AQUEOUS SOLUTIONS
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

AQUIA AQUIFER
Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

AQUIFER
Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

AQUIFER CHARACTERISTICS
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 1501 2F

Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 1501 2F

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 1501 2A

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 1502 2F

Groundwater Investigations in the Vale of Stathmore,
W82-01400 1503 2F

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 1503 2F

Ground Water in Washington,
W82-02536 1505 2F

Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 1506 2F

Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 1506 2F

Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 1506 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 1506 2F

A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 1506 2F

Preparation of Friable Aquiferous Specimens,
W82-02955 1506 2F

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 1507 2F

Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 1508 2F

The Rate of Flushing as a Major Factor in Determining the Chemistry of Water in Fossil Aquifers in Southern Israel,
W82-03799 1509 2K

A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana,
W82-03810 1509 2F

Two-Phase Flow Simulation of Air Storage in an Aquifer,
W82-03841 1509 2F

The Value of Exploratory Test Holes in Ground Water Development,
W82-03896 1509 2F

Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 1510 6D

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 1510 7C

Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 1511 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 1511 2F

The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 1511 4B

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 1511 7C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 1512 2F

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

AQUIFER CHARCTERISTICS
Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 1506 2F

AQUIFER MANAGEMENT
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 1502 6E

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 1503 7A

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

Management of Interstate Aquifer Systems,
W82-02578 1505 4B

Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

Remote Sensing from Space-II,
W82-03248 1507 7B

Aquifer Management in Dade County,
W82-05784 1511 5G

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 1512 4B

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

AQUIFER PROPERTIES
Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 1512 2F

AQUIFER SYSTEMS
A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 1504 2F

Atoll Island Hydrology,
W82-02617 1506 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 1507 2F

Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

Use of Longitudinal Conductance in Estimating Transmissivity of Granular Aquifers in Northern Missouri,
W82-03957 1509 2F

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

AQUIFER TESTING
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 1502 7B

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 1505 2F

A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 1506 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 1506 2F

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

AQUIFERS
Ground-Water Data for Michigan, 1979,
W82-00014 1501 2F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 1501 5A

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 1501 4B

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 1502 2F

Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 1503 5B

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 1503 2F

A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 1503 2F

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 1503 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 1503 5B

Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 1503 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 1503 7C

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 1504 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 1504 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 1504 2F

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 1504 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 1504 2F

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 1504 2F

Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 1505 2F

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 1505 2F

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 1505 2F

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 1505 7C

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

Management of Interstate Aquifer Systems,
W82-02578 1505 4B

Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 1506 2F

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 1506 2F

The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 1507 2F

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 1507 2F

Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 1507 2F

Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 1507 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 1507 2F

Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 1507 2F

Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 1508 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 1508 4B

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 1508 5E

Experience with Borehole Recharge in The Lee Valley,
W82-03894 1509 4B

Improving the Reliability of Ground-Water Monitoring at Industrial Waste Disposal Facilities,
W82-03940 1509 5A

Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 1510 4B

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 1510 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 1510 7C

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1510 1A

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79,
W82-04987 1511 7C

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 1511 2F

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 1511 5B

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 1511 4B

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 1511 2F

Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 1511 2F

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 1511 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 1511 7C

The Law of International Aquifers,
W82-05940 1512 6E

Florida Style Water Supply and Treatment,
W82-06027 1512 5F

Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 1512 2F

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 1512 7C

Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 1512 5G

Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 1512 2E

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 1512 2F

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 1512 4B

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 1512 7C

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 1512 2F

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 1512 2F

Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 1512 2F

Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 1512 2F

AQUITARDS

Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 1503 2F

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

ARAKAWA TREATMENT PLANT

Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

ARAL SEA
Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 1503 2H

ARANASAS PASS
Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

ARCATA
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

ARCH DAMS
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 1504 8A

Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 1505 8A

Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 1508 8A

Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 1511 8A

ARCHAEOLOGY
Why Bother with Historic Preservation,
W82-03384 1507 8A

ARCTIC
Physical Mechanics of Aufeis Growth,
W82-00836 1502 2C

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 1502 2I

Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 1504 2B

Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 1505 2A

Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

Evaporation at a High Arctic Site,
W82-04899 1511 2D

ARCTIC ZONE
Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 1501 2H

Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 1502 2C

The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 1502 2C

Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 1506 2C

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 1512 2D

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 1512 2D

AREAL HYDROGEOLOGY
Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

AREAL PRECIPITATION
Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

ARGENTINA
Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

Reviving the Rio Reconquista,
W82-02014 1504 5G

Argentina's Hydroelectric-Based Energy Plan,
W82-02794 1506 8A

Issues in Simulation Model Design--A Case Study,
W82-05627 1511 4A

ARGON
Excess Air in Groundwater,
W82-02099 1504 2F

ARID AREAS
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 1512 6B

ARID LANDS
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 1502 2I

Metabolism of a Desert Stream,
W82-02349 1505 1A

Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 1507 2B

Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

The Effect of Reuse of Water for Agriculture on The Arab-Asian Society: A New Interdisciplinary Model for Understanding a Development Problem,
W82-04213 1509 3C

ARID REGIONS
Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

ARID-ZONE HYDROLOGY
Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

Discussion-Engineering Geology of Arid Areas,
W82-01568 1503 4B

Development of Federal Reserve Rights,
W82-04446 1510 6E

ARIZONA
Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

Results of Acidizing Water Wells in Arizona,
W82-01199 1503 4B

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 1503 2D

Channel Instability in a Braided, Sand Bed River,
W82-01316 1503 2J

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 1503 2B

Metabolism of a Desert Stream,
W82-02349 1505 1A

Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 1505 2A

The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

Value Engineering Saves Dam Project,
W82-03287 1507 8A

Hydrology and Mining in the Tucson Areas,
W82-03697 1508 2F

A Legal-Economic Critique of Groundwater Law and Administration: With Special Reference to Arizona and Nebraska,
W82-03827 1509 6E

Water Requirements of Urban Plants,
W82-03972 1509 3D

Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

Evapotranspiration from Forage Grass Replacing Native Vegetation in the Gila River Valley of Arizona,
W82-03994 1509 2D

San Francisco River Wild and Scenic River Study Report; Greenlee County, Arizona,
W82-04076 1509 6G

The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 1510 2E

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980,
W82-04632 1510 2E

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 1511 7C

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 1511 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

ARKANSAS

Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 1501 6E

Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 1502 6D

Arkansas Water Policy.
W82-00715 1502 6D

Adjusting Government Role in Water Law.
W82-02256 1505 6E

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

Water-Quality Reconnaissance of Harding Creek, Lawrence County, Arkansas,
W82-03995 1509 7C

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 1510 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 1510 7C

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 1511 7C

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 1512 2K

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 1512 7C

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

ARKANSAS RIVER BASIN

Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 1501 6E

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 1501 7C

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 1503 6D

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

Economics of Controlling Natural Salt Sources in the Arkansas River Basin,
W82-04234 1509 6B

ARMAND BAYOU

Intensive Survey of Armand Bayou,
W82-04079 1509 5A

AROMATIC AMINES

Selective Concentration and Isolation of Aromatic Amines from Water,
W82-03829 1509 5D

AROMATIC COMPOUNDS

Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 1503 5A

Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 1505 5B

Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 1506 5B

Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 1511 5D

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 1511 5B

Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 1512 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aqratic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 1512 5A

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 1512 5A

AROMATIC HYDROCARBONS

Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

ARSENATES

Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 1512 5D

ARSENIC

Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 1501 5A

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 1503 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 1504 5A

Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 1506 5A

Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 1506 5A

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 1506 5F

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 1507 5B

Arsenic in Lake Lansing, Michigan,
W82-03522 1508 5B

Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 1508 5C

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation, 1511 5A
W82-05360

Trace Determination of As(III) and As(V) in Natural Waters by Differential Pulse Anodic Stripping Voltammetry, 1511 5A
W82-05580

Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide, 1512 5D
W82-06311

ARSENIC COMPOUNDS
Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta, 1501 5B
W82-00239

Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters, 1506 5A
W82-02903

ARTESIAN CAPACITY
Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits, 1512 2F
W82-06617

ARTESIAN PRESSURE
Ground-Water Flow Systems and Stability of a Slope, 1510 2J
W82-04677

ARTIFCIAL RECHARGE
Experience with Borehole Recharge in The Lee Valley, 1509 4B
W82-03894

ARTIFICIAL LAKES
Meromixis in a Coastal Zone Excavation, 1505 2H
W82-02120

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida, 1505 5B
W82-02122

Biological Colonization of an Industrial Pond: Status After Two Decades, 1509 2H
W82-03772

ARTIFICIAL PRECIPITATION
Seeding-Opportunity Recognition in Winter Orographic Clouds, 1502 3B
W82-01005

ARTIFICIAL RECHARGE
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas, 1501 7C
W82-00085

Artificial Groundwater Recharge, 1503 4B
W82-01110

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York, 1508 4B
W82-03630

Artificial Basin Recharge, 1508 4B
W82-03745

Experience with Riverbank Filtration Along the Rhine River, 1509 5D
W82-04104

The Response of Groundwater to Artificial Recharge Schemes, 1510 4B
W82-04337

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses, 1512 6B
W82-06694

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands, 1512 5B
W82-06831

ASBESTIFORM
A Study of Biotic Transport of Asbestiform Fibers in Lake Superior, 1509 5B
W82-03950

ASBESTOS
A/C Pipe - Assessment or Advocacy, 1501 5F
W82-00070

Concentration and Size of Asbestos in Water Supplies, 1501 5B
W82-00262

Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies, 1502 5F
W82-00613

Interim Method for Determining Asbestos in Water, 1502 5A
W82-00741

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity, 1502 5C
W82-01031

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe, 1503 5B
W82-01592

Determination of Mineral Fiber Concentrations in Fish Tissues, 1504 5C
W82-01822

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water, 1504 5A
W82-01853

Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media, 1506 5A
W82-02712

Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects, 1506 5B
W82-02898

Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects, 1508 5F
W82-03663

A Study of Biotic Transport of Asbestiform Fibers in Lake Superior, 1509 5B
W82-03950

Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water, 1509 5F
W82-04127

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water, 1512 5F
W82-06363

ASBESTOS CEMENT
A/C Pipe - Assessment or Advocacy, 1501 5F
W82-00070

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974, 1502 5C
W82-01094

The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report, 1509 8G
W82-04119

The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations, 1511 8G
W82-04791

ASHURST LAKE
The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona, 1505 5G
W82-02571

ASPHALT
Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe, 1511 5A
W82-05676

ASPHALT CONCRETE
Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams, 1511 8A
W82-05113

ASPHALTIC CONCRETE
Bituminous Concrete Antiseepage Curtain for Concrete Dams, 1506 8A
W82-02690

ASSAY
Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus, 1505 5A
W82-02176

Enumerating Bacteria in River Water and Sewage Effluent, 1508 5A
W82-03446

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency, 1509 5A
W82-04095

Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water, 1509 5A
W82-04096

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples, 1512 5A
W82-06548

ASSESSMENTS
Water Treatment Model for Pollutant Exposure Assessment, 1501 5F
W82-00500

Recent Trends in Environmental Impact Assessment, 1505 6G
W82-02525

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir, 1511 4C
W82-04966

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience, 1511 6B
W82-05315

ASSIMILATIVE CAPACITY
Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh, 1506 2L
W82-02937

Analysis of Waste Load Allocation Procedures, 1508 5G
W82-03550

A Consistent Methodology for Wasteload Allocations, 1511 5G
W82-05702

ASSINIBOINE RIVER
Flood Control and Flow Regulation Problems on the Assiniboine River, 1511 4A
W82-05389

ASWAN DAM
Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt), 1507 6B
W82-03009

ATCHAFALAYA BAY
Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

ATCHAFALAYA RIVER
Will New Orleans Miss The Mississippi,
W82-04274 1510 4A

ATHABASCA GLACIER
Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

ATLANTA
Detention Basins--An Urban Experience,
W82-04332 1510 4A

ATLANTIC OCEAN
The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

ATLANTIC OUTER-CONTINENTAL SHELF
Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

ATMOSPHERE
Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 1503 2K

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 1512 2I

ATMOSPHERIC ICE
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

ATMOSPHERIC LOADING
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 1504 5A

ATMOSPHERIC MOISTURE
Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

ATMOSPHERIC PRECIPITATION
Identification of Independent Rainstorms,
W82-05708 1511 2B

ATMOSPHERIC PRESSURE
The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1511 1B

ATMOSPHERIC WATER
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 1504 2B

The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 1507 2B

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 1511 2B

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

ATOLLS
Atoll Island Hydrology,
W82-02617 1506 2F

A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

ATOMIC ABSORPTION SPECTROMETRY
Liquid-Liquid Extraction Combined with Atomic-Absorption Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 1512 5A

ATOMIC ABSORPTION SPECTROSCOPY
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 1504 5A

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 1511 5A

ATRAZINE
Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

ATTITUDES
Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 1501 6B

Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 1505 3C

Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 1511 6B

Water Management in the Maritimes,
W82-05776 1511 6B

AUBURN DAM
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 1510 6B

AUFEIS
Physical Mechanics of Aufeis Growth,
W82-00836 1502 2C

AUFEIS FIELDS
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 1503 2C

AUGERS
Screened Auger Aids Investigation,
W82-02096 1504 7B

AUSTRALIA
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 1501 2L

Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 1501 2B

The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 1501 2A

Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 1501 5F

Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

Research and Development to Service a Sustainable Agriculture,
W82-00669 1502 3F

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 1502 5B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 1503 2B

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 1503 6A

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

Land and Stream Salinity in Western Australia,
W82-01374 1503 5B

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 1503 2E

Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 1503 2L

Transport of Salts in Catchments and Soils,
W82-01880 1504 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

Water: A Low-Priced But High-Cost Resource,
W82-02061 1504 6C

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 1504 5A

Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 1505 5C

The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 1505 2E

Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 1505 2L

Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 1505 5B

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

South Australia's Approach to Salinity Management in the River Murray,
W82-02761 1506 5G

The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 1506 4C

The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 1506 4D

Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 1506 2K

Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 1506 2F

Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 1506 2L

Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 1508 2L

Water Metering and Conservation,
W82-03562 1508 3D

Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 1508 7B

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 1508 2H

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

Watering Australia's Driest State,
W82-03767 1509 6D

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 1511 2L

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 1511 2H

Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 1511 4B

Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 1512 2J

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

AUSTRIA

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 1504 5C

Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 1511 5D

The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 1512 8E

AUTOMATIC SAMPLING

Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 1512 5A

AUTOMATION

Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 1502 5D

Automatic Class-A Pan-Filling System,
W82-01326 1503 7B

Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 1504 5D

Where Do We Go from Here.
W82-02086 1504 7A

How Computers Have Changed Water Works Operations,
W82-02276 1505 5F

Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 1506 7B

Measurement and Control of the MLSS Concentration in Activated Sludge Plants,
W82-03762 1509 5D

Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems,
W82-03763 1509 5D

Improved Operation of Municipal Wastewater Treatment Plants in Sweden by Use of Instrumentation and Automation,
W82-03846 1509 5D

An Approach to Full-Automatic Control of Activated Sludge Process,
W82-03855 1509 5D

Requirements and Application of Control and Automation Systems in Wastewater Treatment-A Critical View,
W82-03858 1509 5D

Automated Treatment Plant Keeps Rotterdam Drinking Water Flowing.
W82-04004 1509 5F

Automation of Grimsby Pumping Stations,
W82-04006 1509 5D

Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

Computerized Data Acquisition and Data Handling in Sewage Treatment Plants,
W82-04023 1509 5D

Computer Control of Nitrifying and Denitrifying Activated Sludge Process,
W82-04025 1509 5D

Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

Automatic Flow Control in Combined Sewer Systems-Effectiveness and Implementation Problems,
W82-04049 1509 5D

Optimization of Automated Equalization Basin-Reactor Systems for Chemical Treatment of Wastewater,
W82-04052 1509 5D

Problems and Solutions on Sludge Level Measurement,
W82-04055 1509 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 1510 5D

A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 1510 7B

Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 1510 5A

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 1510 7B

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 1510 7B

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

Automatic Collection and Transmission of Data for the Federal Waterway Authority.
W82-04596 1510 7A

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 1510 5D

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 1510 5D

Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 1510 5D

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 1510 5D

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

Package Anaerobic Sludge Digestion.
W82-04850 1511 5D

New Telemetry System for the Cambridge Water Company.
W82-04852 1511 5F

A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076 1511 7B

Lateral Move Irrigation Offers Advantages for Rectangular Fields.
W82-05080 1511 3F

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 1511 5A

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 1511 7B

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 1511 5F

A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 1511 5D

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 1511 5D

Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 1511 5F

The Chertsey Automation Project at North Surrey,
W82-05805 1511 5F

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

AVAILABLE WATER
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 1511 6B

Soil Water Availability,
W82-05623 1511 2G

The Physical Environment of the Colorado River Basin,
W82-05891 1511 6D

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

AWUIFERS
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 1503 7C

AXISYMMETRIC PIPE FLOW
Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 1511 8B

AYASE RIVER
Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

AZOV SEA
The Azov Sea Problem,
W82-00651 1502 6G

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 1507 5G

BACKFILL
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

Soil-Bentonite Supply Trench Cutoffs,
W82-01599 1503 8D

BACKWASH
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 1501 5D

Controlling Bed Losses of Granular Activated Carbon Through Proper Filter Operation,
W82-04089 1509 5F

Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 1510 5D

Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 1511 5F

The Effect of Backwashing Rate on Filter Performance,
W82-06415 1512 5F

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

BACTERIA
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 1501 5A

Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 1501 2L

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

Isolation of Methanobacterium Bryantii from a Deep Aquifer by Using a Novel Broth-Antibiotic Disk Method,
W82-00240 1501 5A

Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 1501 5A

Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 1501 2L

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 1501 5D

Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

Distribution of Clostridium Botulinum,
W82-00349 1501 5A

A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 1501 5A

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 1501 5A

Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 1501 5D

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 1502 2G

Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 1502 5A

Water-To-Air Fractionation of Bacteria,
W82-00575 1502 5D

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 1502 5B

Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 1502 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 1502 5A

Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 1502 5C

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 1502 5A

Movement of Endotoxin Through Soil Columns,
W82-00586 1502 5B

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 1502 2H

Cold Weather Waste Treatment,
W82-00636 1502 5D

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

Occurrence of Cytophagas in Sewage Plants,
W82-00682 1502 5A

Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 1502 5C

Purification of Wastewater by Electrolysis,
W82-00847 1502 5D

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 1502 5D

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 1503 5A

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 1503 5D

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 1503 5C

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 1503 5B

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 1503 5A

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 1503 5A

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 1503 5G

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 1503 5A

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 1504 5B

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 1504 2H

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

Substrate Flux into Biofilms of Any Thickness,
W82-01964 1504 5D

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 1504 2H

Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 1504 2H

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 1504 5A

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 1504 2H

Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 1505 5B

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 1505 5A

Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 1505 5A

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 1505 5C

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 1505 5B

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

Distribution of Chromobacteria in a Lowland River,
W82-02795 1506 5C

Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 1506 5E

Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 1506 5F

Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 1506 5B

The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 1506 7B

Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 1506 5C

Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 1507 2L

Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 1507 5C

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 1507 5D

Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 1508 7B

Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 1508 2L

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 1508 2H

A Stoichiometric Model of Bacterial Growth,
W82-03756 1509 5D

The Growing Business of Bacterial Cultures,
W82-03786 1509 5D

Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 1510 5C

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 1510 2L

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 1510 5B

Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 1510 5A

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 1510 2H

Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 1510 5A

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 1510 5C

Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 1511 5C

Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 1511 2A

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 1511 5B

Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 1511 2L

Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 1511 5A

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 1511 5G

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 1511 5A

Sulfur Bacterial Problems Revisted,
W82-05264 1511 5B

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 1511 5D

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1511 1A

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 1511 5D

Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 1511 5B

Fecal Coliform Densities in a Western Watershed,
W82-05618 1511 5B

Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 1511 5D

Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 1511 5A

Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 1512 5D

Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 1512 5F

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 1512 5B

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 1512 5B

Bacteria Solve Problems Created by Prisoners.
W82-06505 1512 5D

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

Sludge Disposal to Sea in France,
W82-06593 1512 5E

Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 1512 5A

Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 1512 5C

Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 1512 5B

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 1512 5C

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 1512 5A

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 1512 5D

Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 1512 5A

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 1512 5A

Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 1512 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 1512 5F

Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 1512 5C

Microbiological Examination of Sebeel Water,
W82-06882 1512 5C

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 1512 5A

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 1512 5B

Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 1512 5A

Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 1512 5C

BACTERIAL ANALYSIS
- Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
  W82-00225 1501 5A
- Membrane Filter Method for Enumerating Escherichia Coli,
  W82-00487 1501 5A
- Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
  W82-00494 1501 5A
- Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
  W82-00495 1501 5A
- New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
  W82-00662 1502 5A
- Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
  W82-01043 1502 5A
- Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
  W82-01564 1503 5A
- An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
  W82-01565 1503 5A
- A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
  W82-02339 1505 5A
- Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
  W82-02427 1505 5A
- Microbiological Quality of Selected Recreational Waters,
  W82-03636 1508 5A
- Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
  W82-04108 1509 5A
- A Survey of Quality Control Practices in Water Bacteriology Laboratories,
  W82-04111 1509 5A
- Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
  W82-04277 1510 5A
- Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
  W82-04341 1510 5C
- Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
  W82-04342 1510 5C
- Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
  W82-04453 1510 5A
- Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
  W82-04463 1510 5A
- Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
  W82-04544 1510 5D
- Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
  W82-04567 1510 5B
- Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
  W82-04763 1511 5A
- Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
  W82-05311 1511 5G
- Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
  W82-05934 1512 5C
- Identification of Atypical Coliforms from Public Water Supplies in Missouri,
  W82-05935 1512 5A
- Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
  W82-06037 1512 5A
- Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
  W82-06542 1512 5A
- Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
  W82-06544 1512 5B
- A Water Quality Index for Lake Beaches,
  W82-06660 1512 5G
- Microbiology: Methodology and Quality Assurance,
  W82-06919 1512 5A

BACTERIAL ENUMERATION
- Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
  W82-06363 1512 5A

BACTERIAL PHYSIOLOGY
- Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
  W82-02806 1506 5F
- Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
  W82-05162 1511 5A

BACTERIAL POPULATIONS
- Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
  W82-06558 1512 5C
- Bacteria Under the Ice,
  W82-06561 1512 5A

BACTERIAL STUDY
- An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
  W82-06560 1512 5A

BACTERICIDES
- Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
  W82-02717 1506 5D
- New Antimicrobial Agents for Treatment of Water,
  W82-02808 1506 5F

BACTERIOPHAGE
- New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
  W82-00662 1502 5A
- A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
  W82-01507 1503 5A

BACTERIOPLANKTON
- Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
  W82-05451 1511 2H

BAFFIN BAY
- The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
  W82-00966 1502 2C
- 018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
  W82-01590 1503 2C

BAFFLES
- Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
  W82-04075 1509 8I
- The Use of a Perforated Baffle at the Inlet of Rectangular Settling Basins,
  W82-04124 1509 8B

BALDERHEAD DAM
- Design of Filters for Clay Cores of Dams,
  W82-04321 1510 8G

BALDWIN LAKE
- Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
  W82-02620 1506 2H

BALLAST
- The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
  W82-03703 1508 5D
- Treatment Effectiveness: Oil Tanker Ballast Water Facility,
  W82-04625 1510 5D

BALTIC SEA
International Cooperation to Protect the Baltic,
W82-02087 1504 6E

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 1511 2L

Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 1511 2L

BALTIMORE
Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 1511 8G

BALTIMORE HARBOR
Construction of Containment Facility for Dredged Materials Begins,
W82-03839 1509 5G

BAMBOO
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 1503 4A

BANANAS
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 1504 3F

BANGIA
On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 1508 2L

BANK EROSION
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

Bank Failure and Erosion on the Ohio River,
W82-02343 1505 2J

Bank Failure and Erosion on the Ohio River,
W82-04473 1510 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 1511 2E

A Field Technique to Directly Measure River Bank Erosion,
W82-05410 1511 7B

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

BARIUM
Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

BARLEY
Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 1508 3C

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

BARNACLES
Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 1508 5A

BARRIER ISLANDS
The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

Barrier Islands: Should Engineers Interfere with Nature,
W82-03377 1507 6F

BARRIERS
Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 1505 6G

Eastern Scheldt Design Has Changed.
W82-03493 1508 8A

The Thames Barrier,
W82-04039 1509 4A

Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 1510 8B

BASALTS
Ground-Water Management in Basalts,
W82-04931 1511 4B

BASE FLOW
Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 1506 2E

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

BASELINE STUDIES
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 1503 5A

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 1504 5B

Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 1505 6G

Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 1508 5A

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 1512 5C

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

BASIN IRRIGATION
Depths of Flow in Level Basins,
W82-00900 1502 3F

The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 1503 4C

Development of Solutions for Level-Basin Design,
W82-01976 1504 3F

Limits for Practical Level-Basin Design,
W82-06452 1512 3F

BASINS
Depths of Flow in Level Basins,
W82-00900 1502 3F

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 1504 5A

Estimating Distribution Uniformity in Level Basins,
W82-03058 1507 3F

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 1512 2E

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 1512 7C

BASS
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

Status Report on Striped Bass Analyses,
W82-04386 1510 8I

BATHYMETRY
Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 1512 2H

BAVARIA
Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

BAY OF BENGAL
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 1503 2A

BAY OF FUNDY
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 1502 6G

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 1512 2K

BAYER 73
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 1512 5A

BAYOUS
Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 1505 6G

Intensive Survey of Armand Bayou,
W82-04079 1509 5A

Intensive Survey of Hunting Bayou,
W82-04080 1509 5A

BAYS
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 1501 2L

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 1511 5A

The Tidal Stream in the German Bight,
W82-05190 1511 2L

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 1511 5B

Tragedy of the San Francisco Bay Commons,
W82-06182 1512 6E

BDELLOVIBRIOS
Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

BEACH EROSION
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 1501 2J

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 1510 2J

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 1512 2J

BEACH WILDLIFE SANCTUARY
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

BEACHES
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 1505 5E

BEANS
Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 1510 2I

BEAR CREEK
Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 1511 5C

BEATTON RIVER
New Evidence of Scroll-Bar Formation on The Beatton River,
W82-04188 1509 2J

BEAUFORT SEA SHELF
A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 1510 7B

BED LOAD
Note on Two Limit Distributions of Bedload Movement,
W82-01643 1503 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 1504 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 1504 2J

Two Bed-Load Formulas: An Evaluation,
W82-02375 1505 2J

Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

Bed Load Discharge Coefficient,
W82-02936 1506 2J

Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 1508 2J

Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

Particle Counter for Sediment Transport Studies,
W82-03666 1508 7B

New Evidence of Scroll-Bar Formation on The Beatton River,
W82-04188 1509 2J

Bed Load Fluctuation: Applications,
W82-05000 1511 2J

Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 1511 2J

Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 1511 2J

BED SEDIMENT
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 1512 2J

BEDFORD OUSE RIVER
A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 1507 5B

BEDROCK
Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

BEET SUGAR INDUSTRY
Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 1511 5D

BEHAVIOR
Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-0[illegible]16 1502 5A

BELFAST LOUGH
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 1504 5C

BELGIUM
Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 1506 2H

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

BELIZE
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 1503 5G

BELLINGHAM BAY AREA
Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 1502 5B

BEMIDJI
Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 1501 5D

BENEFICIAL USE
Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 1512 6B

BENEFITS
Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 1510 6B

Who Wins in the Fight for Pollution Control,
W82-04354 1510 6B

A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 1511 6B

Doubts Remain About Bura Economics,
W82-06816 1512 3F

BENTHIC ENVIRONMENT
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 1502 7B

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 1505 2L

Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 1507 2L

A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 1512 5C

BENTHIC FAUNA
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 1502 5C

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 1504 5C

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 1504 5C

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 1505 2L

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 1505 2L

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 1506 5C

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 1507 2H

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 1510 2L

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 1511 2H

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 1511 5C

Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 1511 2E

Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 1512 5C

Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 1512 5C

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

BENTHIC FLORA
Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 1505 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 1506 2H

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 1512 5C

BENTHOS
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 1502 5A

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

Biota and Biological Parameters as Environmental Indicators,
W82-01794 1503 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 1504 5C

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 1504 2K

The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 1506 2H

The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 1506 5C

On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 1506 2H

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 1506 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

Secondary Benthic Production in a Tropical Island Stream,
W82-06933 1512 5C

BENTONITE
The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

Bentonite Liners for Power Plant Lagoons,
W82-00617 1502 5E

Soil-Bentonite Supply Trench Cutoffs,
W82-01599 1503 8D

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

BENZENES
Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

BENZOTHIAZOLES
A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 1512 5C

BERING SEA
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 1501 5A

BERLIN
Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 1510 5F

Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 1511 5D

BERMUDAGRASS
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

BETWA BASIN
The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

BHASKARA SATELLITE
Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

BIBLIOGRAPHICS
Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 1510 10C

BIBLIOGRAPHIES
Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 1501 10C

Anaerobic Processes,
W82-01245 1503 5D

Dentrification,
W82-01246 1503 5D

Sludge Treatment, Utilization, and Disposal,
W82-01247 1503 5E

Wastewater Collection,
W82-01251 1503 5D

Land Application of Municipal Wastewater,
W82-01253 1503 5D

Microbiology of Potable Water,
W82-01287 1503 5F

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W82-02103 1505 10C

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W82-03097 1507 10C

BICARBONATES
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 1503 5F

Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 1511 5C

BIELERSEE
Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 1511 2H

BIG CREEK MARSH
Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 1503 2H

BIG RUN BOG
Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

BIG SIOUX AQUIFER
Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 1506 2F

BIGHTS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 1504 2L

The Tidal Stream in the German Bight,
W82-05190 1511 2L

BIOACCULULATION
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 1512 5C

BIOACCUMULATION
Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 1501 5B

Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 1502 5B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 1503 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 1503 5C

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 1503 5B

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 1504 5C

Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 1505 5B

A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 1505 5B

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 1507 5C

Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 1508 5B

Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations,
W82-04885 1511 5B

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 1512 5B

BIOASSAY
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 1501 5A

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

A Bacterial Bioassay for Assessment of Wastewater Toxicity,
W82-00398 1501 5A

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 1502 5A

Bioassays - Procedures and Results,
W82-01277 1503 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 1504 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 1504 5A

Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
W82-03433 1508 5C

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 1511 2H

Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 1511 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

Overview and Assessment of Biological Sensing,
W82-05156 1511 5C

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 1511 5A

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 1511 2H

Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 1511 5A

A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 1512 5A

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 1512 5A

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 1512 5C

BIOASSAYS
A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

Bioassays - Procedures and Results,
W82-06810 1512 5A

BIOASSY
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

BIOCHEMICAL OXYGEN DEMAND
Sludge Settling Hampered by Industrial Discharge,
W82-00290 1501 5D

Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 1503 5A

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5B

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

To Inhibit or Not to Inhibit: That is The Question,
W82-02672 1506 5A

Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 1506 5D

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 1506 5B

Specific Oxygen Demand as an Operating Parameter for Activated Sludge Processes,
W82-04029 1509 5D

Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 1511 7B

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 1511 5D

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 1511 5D

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 1512 5C

Comparison of BOD Relationships for Typical Edible and Petroleum Oils,
W82-06458 1512 5D

BIOCHEMICAL TESTS
Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 1512 5F

BIOCHEMISTRY
Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 1501 5B

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 1502 2K

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 1504 6G

Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 1508 5A

The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 1510 2H

Humic Substances,
W82-05148 1511 5B

BIOCONTROL
Detoxification of Residual Quaternaries,
W82-00562 1502 5G

BIODEGRADATION
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 1501 5A

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 1501 5D

Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 1502 5B

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 1503 5D

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 1503 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 1503 5A

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 1503 5B

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 1503 5G

Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 1504 5B

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 1504 5B

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

Treatment Plant Features Ultraviolet Disinfection,
W82-02644 1506 5D

Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 1506 5D

Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 1507 5D

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1508 1B

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 1508 5B

Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 1508 5B

The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria,
W82-03770 1509 5E

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 1510 5B

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 1511 5C

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 1511 5D

Biodegradation of Hazardous Organic Pollutants,
W82-04910 1511 5B

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 1511 5G

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 1511 2H

Microbial Removal of Hazardous Organic Compounds,
W82-05177 1511 5D

Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 1511 5B

BIODEGRATION
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 1501 5E

BIODETECTION
Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 1511 5A

BIOFILMS
Kinetics of Biofilm Nitrification,
W82-05374 1511 5D

Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

BIOFILTERS
The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 1511 5D

Biofiltration Design Based on Volumetric Loading,
W82-05698 1511 5D

BIOFILTRATION
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 1502 5D

BIOGEOCHEMISTRY
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

BIOINDICATORS
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 1501 5A

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 1502 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 1502 5A

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 1502 5A

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 1502 5B

The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 1502 5B

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 1502 5A

Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium,
W82-00916 1502 5A

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 1503 5A

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 1503 5A

Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 1504 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 1504 5A

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 1507 5A

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 1508 5B

Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 1508 5A

Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 1508 5A

Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 1508 5A

Sister Chromatid Exchange as an Indicator of Short Term Chemical Stress in Aquatic Systems,
W82-04161 1509 5A

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 1511 5A

Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 1511 5A

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 1511 5A

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

New In-Situ Techniques in Biomonitoring,
W82-05157 1511 5A

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 1511 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 1511 5C

Biological Monitoring, Part V - Preference and Avoidance Studies,
W82-05340 1511 5C

Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 1512 5F

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06303 1512 5C

A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 1512 5B

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 1512 5A

Microbiology: Water,
W82-06924 1512 5B

BIOLOGICAL ACTIVATED FILTRATION
Advanced Water Treatment for Color and Organics Removal,
W82-06279 1512 5F

BIOLOGICAL COMMUNITIES
Biota and Biological Principles of the Aquatic Environment.
W82-04499 1510 5C

BIOLOGICAL FILTERS
Biological Filters,
W82-01242 1503 5D

Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 1511 5D

BIOLOGICAL OXIDATION
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Rotating Disc Biological Treatment of Acid Mine Drainage,
W82-03968 1509 5D

Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

BIOLOGICAL OXYGEN DEMAND
The Effect of Nitrification in the BOD Test,
W82-02384 1505 5D

A Resume of the Kinetics of the BOD Test,
W82-03832 1509 5A

Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 1511 5B

Chemometric Modeling of Wastewater Treatment Processes,
W82-05858 1511 5D

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 1512 5D

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

BIOLOGICAL PROCESSES
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

BIOLOGICAL PROPERTIES
Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

BIOLOGICAL SAMPLES
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 1501 6G

BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 1501 7B

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 1504 6G

Shallow-Depth Sedimentation of Biological Materials,
W82-02336 1505 5D

Biological Monitoring Part VI - Future Needs,
W82-03230 1507 5C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 1512 6G

BIOLOGICAL TREATMENT
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 1501 5E

Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 1506 5D

Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 1507 5D

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

The Use of Respirography in Biological Treatment Plant Control,
W82-04011 1509 5D

Temperature Effects on Biostabilization of Leachate,
W82-04044 1509 5D

Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologioque Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04755 1511 5F

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 1511 5D

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 1511 5F

High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 1512 5D

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

Simplified Clarifier Axes Treatment Stages,
W82-06820 1512 5D

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 1512 5D

BIOLOGICAL WASTEWATER TREATMENT
Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 1501 5D

Small is Environmentally Acceptable . . .,
W82-00311 1501 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 1501 5D

Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 1502 5D

Fluidized Bed for Biological Wastewater Treatment,
W82-00968 1502 5D

Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 1502 5D

Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 1504 5D

Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 1505 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 1507 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 507 5D

Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 1507 5D

Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 1507 5D

A Stoichiometric Model of Bacterial Growth,
W82-03756 1509 5D

Experiences of MLSS Control of the Activated Sludge Process,
W82-03849 1509 5D

A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

An Approach to Full-Automatic Control of Activated Sludge Process,
W82-03855 1509 5D

Investigation on Constant F/M Ratio by Adaption of Aeration Tank Volume,
W82-03860 1509 5D

Simplified Mathematical Models for a Fluidized Bed Biofilm Reactor,
W82-03877 1509 5D

Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

An Approach to the Control of the Activated Sludge System by Use of a Succession Model,
W82-04057 1509 5D

Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 1510 5D

Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 1510 5D

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 1511 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 1511 5D

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 1511 5D

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 1511 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 1511 5D

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05859 1511 5D

Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 1512 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 1512 5D

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 1512 5D

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 1512 5D

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

BIOMASS

Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 1501 2C

The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 1501 5D

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 1503 2H

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 1504 5C

On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 1506 2H

Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 1506 5D

Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 1507 2H

Preliminary Studies on Control Parameters and Biological Community for the Activated Sludge Process,
W82-04008 1509 5D

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 1511 2H

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 1511 2H

Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 1511 2E

The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 1511 5D

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Sampling Characteristics of Macrophyte Biomass,
W82-06779 1512 5A

BIOMONITORING

Overview and Assessment of Biological Sensing,
W82-05156 1511 5C

New In-Situ Techniques in Biomonitoring,
W82-05157 1511 5A

BIOTA

Biota and Biological Principles of the Aquatic Environment.
W82-04499 1510 5C

BIOTRANSFORMATION

Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 1501 5C

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 1512 5B

BLACK CANYON

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

BLACK EARTH CREEK

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

BLACK RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Black River Basin, New York.
W82-01758 1504 6D

BLACK SEA
Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 1511 5B

BLACK WARRIOR RIVER
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 1503 6F

BLANCO DIVERSION DAM
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 1501 8A

BLEACHING WASTES
Pulp Companies Face Billion Dollar Cleanup.
W82-00343 1501 5D

O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 1503 5D

Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 1504 5D

Field Report on a Nonpolluting Bleach Plant,
W82-02793 1506 5D

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 1506 5D

Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

BLOOD
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

BLOOMINGTON DAM
Bloomington Lake - Potomac River Water Resources Project,
W82-06183 1512 8A

BLOSSOM-END ROT
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

BLUEBERRIES
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5B

BLUEGILLS
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

BLUFF EROSION
Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 1508 2J

BLUFF RECESSION
Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin,
W82-03817 1509 2J

BOATING
The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 1512 5C

BOG LAKES
UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

BOGS
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 1501 2C

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00464 1501 2I

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 1502 2K

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 1505 2H

Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 1506 2H

Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 1512 2G

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

BOILER WATER
Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 1508 5F

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 1512 3A

BOISE
Boise Looks Underground for Heat.
W82-02636 1506 2F

BOISE RIVER
Selecting Seasonal Streamflow Models,
W82-02502 1505 2E

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

BOISE RIVER PROJECT
Primary and Secondary Impacts of a Water Resource Development Project,
W82-03907 1509 6B

BORDER IRRIGATION
Optimal Design of Border Irrigation Systems,
W82-01977 1504 3F

Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 1505 2G

Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 1507 7B

Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 1510 3F

Dimensionless Stream Advance in Sloping Borders,
W82-04308 1510 3F

BOREHOLE GEOPHYSICS
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 1502 7B

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

BOREHOLES
Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

BORON
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

BOSMINA LONGIROSTRIS
The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 1505 2H

BOSTON
Readying Boston's Water and Sewer System for the Next Century,
W82-03870 1509 6B

Drought Management: Expecting the Unexpected,
W82-05649 1511 3D

BOTSWANA
Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 1511 5C

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

BOTTOM CURRENTS
Contourites in Lake Superior,
W82-01935 1504 2H

Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

BOTTOM OUTLETS

Aeration at Floor Offsets in Bottom Outlets (Belufting an Sohlsprungen Von Grundablassen), W82-06242 1512 8C

Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schusstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen). W82-06243 1512 8B

Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen), W82-06244 1512 8B

BOTTOM SAMPLING

The Kyholm Corer--A Diver-Operated Sediment Corer, W82-00793 1502 7B

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area, W82-06702 1512 5B

BOTTOM SEDIMENT

Survival of Escherichia Coli in Lake Bottom Sediment, W82-06741 1512 5B

BOTTOM SEDIMENTS

Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments, W82-00553 1502 5B

On Lake Bottom Dynamics--The Energy-Topography Factor, W82-00837 1502 2H

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies, W82-00840 1502 7B

A Method for the Evaluation of Conditions in a Fish Pond Sediment, W82-01019 1502 2H

A Review on Sediment Traps in Aquatic Environments, W82-01020 1502 7B

Trace Metal Fluxes to Nearshore Long Island Sound Sediments, W82-01040 1502 5B

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton, W82-01706 1503 2H

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water, W82-01720 1503 2L

Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms, W82-02290 1505 5B

A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater, W82-02893 1506 2K

Size Distribution of Amazon River Bed Sediment, W82-03488 1508 2J

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments, W82-04466 1510 2H

Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II), W82-05136 1511 2K

Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States, W82-05138 1511 5B

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland, W82-05145 1511 5B

BOTTOMLAND

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile, W82-05054 1511 6G

BOUNDARIES

Boundary Calculations of Sluice and Spillway Flows, W82-02677 1506 8B

The Moving Interface Problem with Finite Elements, W82-06546 1512 2L

BOUNDARY LAYERS

Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes, W82-04572 1510 2H

Hereditary Phenomena in Turbulent Boundary Layers, W82-06618 1512 8B

BOUNDARY PROCESS

Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers, W82-01161 1503 8B

BOUNDRY LAYERS

A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water, W82-05084 1511 2C

BOW LAKE

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake, W82-01510 1503 2H

BRACKISH WATER

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels, W82-00920 1502 2H

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil, W82-02027 1504 2H

Biology of Brackish Water, (In Japanese), W82-04179 1509 2L

The Acute Toxicity of Motor Fuels to Brackish Water Organisms, W82-05985 1512 5C

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands, W82-06905 1512 5B

BRAIDED RIVERS

Channel Instability in a Braided, Sand Bed River, W82-01316 1503 2J

BRAIDED STREAMS

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada, W82-04531 1510 2J

BRAZIL

Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake', W82-01381 1503 2H

Irrigation for Brazil's Poligono Das Secas, W82-01744 1503 3F

Pumped-Storage Development in Brazil. Part III, W82-03381 1507 8A

Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil, W82-03744 1508 5G

Turbines for Itaipu, W82-04955 1511 8C

BRAZOS RIVER

Environmental Assessment: Geothermal Direct Heat Project; Marlin Texas. W82-06404 1512 6G

BRAZOS RIVER BASIN

Water Resources Appraisals for Hydroelectric Licensing: Brazos River Basin, Texas-New Mexico. W82-01439 1503 6D

BREAKWATERS

Floating Breakwater, W82-00067 1501 8A

Large Rubble-Mound Breakwater Failures, W82-00862 1502 8D

Canadian Wave Climate Study: Organization and Operation, W82-06393 1512 8B

BREWERY INDUSTRY

Avoiding an Environmental Hangover. W82-00344 1501 5D

BREWING INDUSTRY

Control of Sludge Bulking in the Brewing Industry, W82-05260 1511 5D

BRIDGE DESIGN

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan, W82-02477 1505 4C

Umfolozi Road Bridge Hydraulic Model Investigation, W82-02868 1506 8A

Methods for Assessment of Stream-Related Hazards to Highways and Bridges, W82-04626 1510 8A

The Design of Encroachments on Flood Plains Using Risk Analysis, W82-04631 1510 8A

Optimal Risk-Based Hydraulic Design of Bridges, W82-06432 1512 8A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio, W82-06948 1512 8B

BRIDGE PIERS

The Vortex Scour Mechanism at Bridge Piers, W82-04642 1510 8B

BRIDGES

Umfolozi Road Bridge Hydraulic Model Investigation, W82-02868 1506 8A

Floodflow Characteristics of the Sacramento River in the Vicinity of Gianella Bridge, Hamilton City, California,
W82-03985 1509 2E

Devon Floods and the Waterways of Bridges,
W82-05948 1512 8A

Statistical Search for High Water at Board Landing Bridge, Traro, Nova Scotia,
W82-06394 1512 2L

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 1512 4A

BRIISH COLUMBIA
Potential Evaporation in the Peace Region of British Columbia,
W82-06528 1512 2D

BRINE
Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

BRINE DISPOSAL
An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

BRINE WASTES
Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

BRINES
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 1501 5B

The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

BRISTOL CHANNEL
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 1505 2L

BRITISH COLUMBIA
Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 1503 2G

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 1505 2H

Galvanized Pipe Vies for Equal Alternative Status in Storm Sewer Projects.
W82-02601 1506 8G

Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 1506 2E

Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 1507 5C

Vacuum Sewers--The Future for Sewage Collection,
W82-03394 1507 5G

Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 1508 6G

New Evidence of Scroll-Bar Formation on The Beatton River,
W82-04188 1509 2J

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 1510 2L

Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 1510 5D

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 1510 2H

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 1511 6F

New Strategies for Water Resource Planning in British Columbia,
W82-05395 1511 6E

Water Quality Management in British Columbia,
W82-05767 1511 5C

Irrigation Efficiency in Orchards,
W82-05768 1511 3F

The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779 1511 6E

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 1512 2C

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 1512 2K

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 1512 5B

BROMACIL
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 1502 5B

BROMAMINES
New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 1505 5A

BROMIDES
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

Bromide in Canterbury Ground Water,
W82-02056 1504 5B

Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

BROMINE
New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters,
W82-02394 1505 5A

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

BROMINE CHLORIDE
An Alternative Wastewater Disinfectant,
W82-00950 1502 5D

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

BROWARD COUNTY
Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

BROWN SOILS
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 1504 2G

BUBBLE DIFFUSERS
New Bubble Diffusers Reduce Treatment Costs,
W82-06513 1512 5D

BUBBLES
Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1502 1B

Measurement of Air in Flowing Water,
W82-04322 1510 7B

The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 1510 7B

Domes, Bubbles, and Paper Waste,
W82-06025 1512 5D

BUCKLING
Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

BUDGETING
The Risk Business,
W82-03281 1507 6E

BUFFALO RIVER
Aromatic Amines in and Near the Buffalo River, 1502 5B
W82-00622

BUFFER CAPACITY
A Simplified Buffer Capacity Model for Sanitary Landfill Leachate, 1512 5B
W82-06038

BUFFERS
Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode, 1507 5A
W82-03269

BULKING SLUDGE
Sludge Settling Hampered by Industrial Discharge, 1501 5D
W82-00290

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process, 1511 5D
W82-05441

BULL RUN WATERSHED
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980, 1501 5B
W82-00002

BUMPING LAKE
An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington, 1501 4A
W82-00421

BUOYANCY
Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water, 1502 1A
W82-00981

BURLINGTON
Low Turbidity Water from Fast Processes, 1502 5F
W82-00946

Restoring an Antique Water System. 1506 5F
W82-02685

BUTTE BASIN
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California, 1501 2E
W82-00019

BUTTRESS DAMS
Concrete of the Dam of the Kirovskoe Reservoir, 1507 8F
W82-03159

BUTYL BENZYL PHTHALATE
An Environmental Safety Assessment of Butyl Benzyl Phthalate, 1502 5A
W82-00615

BYPRODUCTS
Composition of Fruit and Vegetable Processing Wastes, 1503 5D
W82-01601

Two-Stage Biological Treatment of Coke Plant Wastewater, 1507 5D
W82-03029

BYRAM LAKE
Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977, 1502 2H
W82-00915

CABLEGATION
Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System, 1512 3F
W82-05963

CACHE LA POUDRE RIVER
Recreational Enhancement of High Country Water Supply Reservoirs, 1509 6A
W82-03923

CACHE LA POUDRE RIVER BASIN
Water Reuse Planning by Means of an Input-Output Table, 1511 6A
W82-04794

CADDISFLIES
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne, 1502 5B
W82-00982

Pesticides in the Aquatic Environment, 1510 5C
W82-04727

CADILLAC
Phosphorus and Nitrogen Removal at Cadillac, Michigan, 1511 5D
W82-05270

CADMIUM
Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium, 1501 2K
W82-00174

Monitoring Trace Amounts of Cadmium in Natural Waters, 1502 5A
W82-00516

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream, 1502 5B
W82-00886

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium, 1502 5A
W82-00916

Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater, 1502 5A
W82-01085

Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters, 1503 5B
W82-01388

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River, 1503 5B
W82-01498

Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration, 1503 5F
W82-01632

Chemical Availability of Cadmium in Mississippi River Sediment, 1505 5B
W82-02267

The Effect of Aquatic Humus on the Biological Availability of Cadmium, 1505 5C
W82-02353

Combined Effects of Cadmium and Nickel on Activated Sludge Process, 1506 5D
W82-02704

Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium, 1507 5C
W82-03026

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments, 1507 5B
W82-03094

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario, 1508 5C
W82-03612

Movement of Cadmium and Water in Split-Root Wheat Plants, 1508 5B
W82-03662

Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness, 1508 5C
W82-03678

Cadmium in an Aquatic Ecosystem, 1508 5A
W82-03724

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community, 1510 5C
W82-04379

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis, 1510 5D
W82-04664

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination, 1511 5A
W82-04948

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry, 1511 5A
W82-05020

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition, 1511 5A
W82-05040

Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline, 1511 5A
W82-05041

Industrial Waste Pretreatment and EPA Cadmium Limitations, 1511 5E
W82-05443

Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments, 1512 5C
W82-05934

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus), 1512 5C
W82-06003

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia, 1512 5B
W82-06054

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment, 1512 5B
W82-06580

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables, 1512 5B
W82-06659

CAIMANERO LAGOON
The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon, 1510 2L
W82-04299

CALCIUM
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage, 1501 5E
W82-00192

Consecutive Amperometric Titrations for Calcium and Magnesium, 1501 5A
W82-00208

Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 1502 2G

Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistoyu Sistemu),
W82-03699 1508 5C

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 1512 5A

CALCIUM CARBONATE
The Search for a Corrosion Index,
W82-04279 1510 5F

Acid Pond Drainage,
W82-05199 1511 5G

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 1511 2H

CALCIUM CARBONATE PREVENTION
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 1512 3A

CALCIUM HYDROXIDE
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 1512 5D

CALCIUM SULFATE
Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 1506 2F

Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 1512 3A

CALCIUM SULFIDE
Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 1507 5D

CALGARY
The Cost of Peak Capacity Water,
W82-04065 1509 6B

CALIBRATIONS
Ground-Water Modeling: Recent Developments,
W82-00281 1501 2F

Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 1502 2B

Simplifying Neutron Moisture Meter Calibration,
W82-05173 1511 7B

Calibrating A Mountain Watershed in Wyoming,
W82-06583 1512 2E

CALIFORNIA
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 1501 2E

Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 1501 5D

Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 1501 6G

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 1501 6G

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 1501 4B

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 1502 7C

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 1502 6G

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 1502 5C

Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 1502 5B

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 1502 2D

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 1503 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 1503 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 1503 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 1503 7C

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 1503 4C

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 1503 6A

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 1503 6B

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 1504 6E

Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 1505 2K

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 1505 3C

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 1507 6D

Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 1507 2I

Don't Damn the Stanislaus,
W82-03275 1507 6E

Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 1508 6E

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 1508 4B

New Legislation in California and Its Effects,
W82-03731 1508 6E

SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 1508 6E

Floodflow Characteristics of the Sacramento River in the Vicinity of Gianella Bridge, Hamilton City, California,
W82-03985 1509 2E

Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

Interagency Connections: Insurance Against Interruptions in Supply,
W82-04090 1509 5F

The Impact of Federal Water Policy on State Planning: A Cautionary Example,
W82-04120 1509 6E

The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

Status Report on Striped Bass Analyses,
W82-04386 1510 8I

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 1510 7C

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 1510 2E

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 1510 3F

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1510 1A

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 1511 2H

California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411 1511 4A

Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 1511 4B

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 1511 7C

Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 1511 2J

Solving a Poor Oxygen Transfer Problem.
W82-05952 1512 5D

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

Environmental Problems and Geothermal Permitting,
W82-06217 1512 6G

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 6B

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5B

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 1512 4A

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

CALIFORNIA BIGHT
Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 1511 5B

CALIFORNIAGRASS
Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

CALLAHAN RESERVOIR
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

CALOOSAHATCHEE RIVER
Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

CALORIMETRY
Calorific Value of Wastewater Plant Sludges,
W82-04997 1511 5E

CAMBRIDGE WATER COMPANY
New Telemetry System for the Cambridge Water Company.
W82-04852 1511 5F

CAMDEN
Use of Microscreens to Polish Lagoon Effluents,
W82-04709 1510 5D

CAMDEN COUNTY
Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

CAMP SITES
Carrying Capacity for the Illinois River,
W82-05927 1512 6G

CAMPING
Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

CAMPSITES
Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

CANADA
A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

Geographic Information Systems and Environmental Impact Assessment,
W82-00338 1501 7C

Recent Developments in Water Pollution Control,
W82-00340 1501 5D

The Valuation of Recreational Fisheries,
W82-00348 1501 6C

Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 1502 2C

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 1502 2C

Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 1503 5G

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 1503 2H

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 1504 5B

Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 1505 2C

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 1507 7C

Canada Water Year Book 1979-1980, References.
W82-03097 1507 10C

Canada Water Year Book 1977-1978.
W82-03099 1507 7C

On Hydrological Data Needs in Canada,
W82-03443 1508 7A

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 1508 6B

Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 1510 2J

Who Wins in the Fight for Pollution Control,
W82-04554 1510 6B

Weak Controls from Sea to Shining Sea,
W82-05035 1511 5B

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 1511 5B

A Federal Perspective on River Basin Management,
W82-05368 1511 6E

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

Oxygenation of the Avon River,
W82-05730 1511 5G

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 1511 5B

Northwestern Ontario River Dimensions,
W82-05742 1511 6G

Selecting a Method for Estimating Substance Loadings,
W82-05746 1511 5B

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 1511 5B

On Hydrological Data Needs in Canada,
W82-05764 1511 7B

A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams,
W82-05766 1511 6B

Water Quality Management in British Columbia,
W82-05767 1511 5C

Irrigation Efficiency in Orchards,
W82-05768 1511 3F

The Mackenzie River Basin Study,
W82-05778 1511 4A

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 1512 2K

Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 1512 2J

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 1512 5B

Water Resources Research Support Program 1981 - 1982.
W82-06565 1512 9D

The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 1512 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 1512 7C

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

CANADA WATER ACT

The Canada Water Act, Annual Report 1980-1981.
W82-03098 1507 7C

CANAL CONSTRUCTION

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

Exploiting the Waters of Lake Chad.
W82-01726 1503 8A

Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 1506 8H

Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

CANAL DESIGN

Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 1511 2E

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 1511 8A

Calculation of Large Unlined Canals,
W82-05131 1511 8B

Formation of a Stable Canal Channel,
W82-05584 1511 8B

Canals in Sand Channels,
W82-06196 1512 8B

CANAL EMBANKMENTS

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

CANAL LININGS

Performance of Granular Soil Covers on Canals,
W82-00047 1501 8D

Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 1511 8G

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

Canal Tunnel Repair Options.
W82-06758 1512 8A

CANAL SEEPAGE

Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 1512 7B

CANALS

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 1504 5C

Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411 1511 4A

Quantitative Assessment of Filamentous Algae as a Source of Deteriorating Water Quality in Canals,
W82-05593 1511 5B

Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 1511 5B

$12.6 M Repairs Bill for Ruahihi Canal.
W82-05880 1511 8D

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

CANOPY

Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 1502 2D

Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

Vertical Variation in Stemflow Generation,
W82-02959 1506 2I

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 1512 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 1512 2I

CAPACITY

Capacity Expansion Planning Model for Waste Water Treatment and I/I Control,
W82-04239 1509 5D

CAPE COD

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 1510 7C

CAPE FEAR ESTUARY

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

CAPE FEAR RIVER BASIN

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 1507 6D

CAPE FEAR RIVER ESTUARY

Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

CAPE LOOKOUT BIGHT
Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 1507 2K

CAPE MAY
Rapid Sewer Analysis Saves Tourist Season,
W82-03494 1508 5G

CAPE PENINSULA
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 1504 2B

CAPE TOWN
Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 1503 8A

Water to the South-Western Cape Keeping Up with the Demand.
W82-04887 1511 3C

CAPILLARY WATER
Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 1508 5B

CAPITAL COSTS
Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 1502 6B

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

The Risk Business,
W82-03281 1507 6E

Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 1508 5D

The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 1510 6A

Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 1511 5D

CARBAMATE PESTICIDES
Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 1512 5A

CARBARYL
High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 1508 5A

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 1510 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 1510 5C

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 1511 5A

CARBOHYDRATES
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 1502 2H

Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Composition of Fruit and Vegetable Processing Wastes,
W82-01601 1503 5D

Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 1507 2L

Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Commaunaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 1511 5D

CARBON
Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 1501 5B

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 1502 5F

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 1502 5E

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 1503 5A

Determination of Dissolved Organic Carbon in Water,
W82-02194 1505 5A

Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 1506 5D

Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03843 1509 5B

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

CARBON CYCLE
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 1501 5B

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 1504 2L

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 1507 5B

Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 1508 2H

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 1510 2H

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

CARBON DIOXIDE
Water Requirements and Man-Induced Climate Change,
W82-01633 1503 2D

Summer Ice and Carbon Dioxide,
W82-01843 1504 2C

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 1504 2H

Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 1506 2L

Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 1510 2K

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 1511 2H

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 1511 5D

Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 1511 2B

Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 1512 5D

A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 1512 5C

Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 1512 5D

CARBON FILTERS
Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

CARBON ISOTOPES
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 1511 2K

CARBON RADIOISOTOPES
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 1501 5B

Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 1503 2F

Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 1508 5A

Methane in Groundwater and Its Effect on 14 C Groundwater Dating,
W82-03801 1509 7B

CARBON TETRACHLORIDE
An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

CARBONATE AQUIFERS
The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

CARBONATE ROCKS
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

Induced Sinkholes: An Engineering Problem,
W82-02559 1505 4B

CARBONATES
Health Implications of Non-NTA Detergent Builders,
W82-00703 1502 5G

Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

CARCINOGENS
Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 1501 5F

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

Chlorinated Drinking Water,
W82-00467 1501 5F

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 5C

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 1503 5A

Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 1506 5D

Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 1506 5B

Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
W82-03433 1508 5C

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 1511 5B

Mutagens, Carcinogens and the Water Cycle,
W82-05468 1511 5A

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 1512 5F

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 1512 5A

CARIBBEAN
Agriculture in the Wider Caribbean,
W82-03778 1509 6D

Environment and Public Health in the Caribbean,
W82-03787 1509 6D

CAROTENOIDS
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 1503 2H

CARP
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 1502 3B

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 1503 2H

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 1504 5C

CARPATHIAN MOUNTAINS
Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

CARROLL COUNTY
Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

CARRYING CAPACITY
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 1504 6A

Carrying Capacity for the Illinois River,
W82-05927 1512 6G

Carrying Capacity of Flood Plains,
W82-06428 1512 2E

CARSON CITY QUADRANGLE
Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

CASCADE MOUNTAINS
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 1510 2K

CASE STUDIES
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 1503 6B

Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 1505 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 1505 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 1505 8A

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 1511 8G

CASINGS
Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 1506 8G

CASPER CREEK
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 1503 4C

CASPIAN SEA
The Caspian Sea Problem,
W82-00657 1502 4A

The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 1503 4C

Salinity and Biogenic Material in the North Caspian,
W82-03155 1507 4A

Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A

CASTLE ROCK
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 1502 4D

CATALYSTS
Trace Metal Catalysis in Aquatic Environments,
W82-00629 1502 5B

Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 1502 5D

Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 1505 5G

Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

CATCHMENT AREAS
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 1501 5B

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

Land and Stream Salinity in Western Australia,
W82-01374 1503 5B

Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields, 1510 2A
W82-04303

New Problems with Upland Waters, 1512 5G
W82-06602

The Control of Effluent and Water Quality in an Important Water Supply Catchment, 1512 5G
W82-06652

CATCHMENT BASINS
A Catchment Approach to Flood Estimation, 1503 2E
W82-01397

'Nadis', The Vital Water Resources of the Indian Arid Zone, 1508 3B
W82-03413

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance, 1512 2A
W82-06384

CATCHMENTS
A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration, 1511 4C
W82-05647

CATFISH
Water Movement for Water Quality in Catfish Production, 1502 5G
W82-00866

Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi, 1505 5C
W82-02524

PP and L Uses Discharge Water for Fish Farming, 1506 3C
W82-02645

Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978, 1508 5B
W82-03590

Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish, 1508 5C
W82-03607

Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish, 1509 8I
W82-04083

Water Quality and Off-Flavor Problems in Commercial Channel Catfish Culture in West-Central Alabama, 1509 5C
W82-04087

Engineering in Catfish Production, 1510 8I
W82-04367

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus), 1512 5C
W82-06003

Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System, 1512 5C
W82-06707

CATFISH FARMING
Engineering in Catfish Production, 1510 8I
W82-04367

CATHODES
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions, 1504 5D
W82-02050

Underground and Offshore: When to Consider Cathodic Protection, 1507 8G
W82-03349

CATION EXCHANGE
Cation Chromatography With a Conductivity Detector, 1502 5A
W82-00582

Cation Transport in Packed Bed Reactor of Soil, 1502 5D
W82-00970

CATIONS
Cation Chromatography With a Conductivity Detector, 1502 5A
W82-00582

Lake Trophic State and Algal Growth as Influenced by Cation Concentrations, 1507 5C
W82-03038

CATTLE
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado, 1503 5B
W82-01790

Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming, 1506 3F
W82-02809

CAVES
Cave Water--Java's Hidden Resource, 1512 3B
W82-06605

CAVITATION
Cavitation and Wear on Hydraulic Machines, 1501 8C
W82-00331

Modeling Cavitation for Closed Conduit Flow, 1506 8B
W82-02700

Cavitation Resistance of Concrete, 1507 8F
W82-03165

Cavitation-Resistant Gunite Coatings for Hydraulic Structures, 1508 8G
W82-03677

Concrete for Surfaces of High-Head Spillways, 1511 8F
W82-05110

Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect), 1511 8B
W82-05280

Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen). 1512 8B
W82-06237

CAYUGA LAKE
Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York, 1503 7A
W82-01195

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York, 1512 5B
W82-06493

CAZENOVIA CREEK
A Solution to Spring Ice-Jam Flooding, 1506 2C
W82-02908

CELLULOSE ACETATE
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes, 1512 3A
W82-06792

CELLULOSE ACETATE MEMBRANES
Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers, 1506 3A
W82-02929

Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling, 1507 3A
W82-03288

The Development of Dry-RO Membranes from Cellulosic and Noncellulosic Polymers Bearing Quaternary Ammonium Groups, 1512 3A
W82-06152

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor, 1512 5D
W82-06657

CEMENT
Consider Soil-Cement for Erosion and Seepage Control, 1511 8F
W82-05039

CENTER HILL LAKE
LARM Two-Dimensional Model: An Evaluation, 1505 4A
W82-02597

CENTRAL ILLINOIS
Assessment of a Regional Aquifer in Central Illinois, 1511 2F
W82-05052

CENTRAL MONTANA
Selected Hydrogeologic Data from the Judith Basin, Central Montana, 1505 7C
W82-02490

CENTRAL VALLEY
Irrigation Tailwater Management, 1501 3C
W82-00392

CENTRIFUGATION
The Effect of Centrifugation on the Suspended Particles of River Waters, 1501 5A
W82-00124

Centrifugal Dewatering, 1504 5E
W82-01912

Evaluation of High- and Low- Speed Centrifuges, 1506 5E
W82-02931

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge, 1511 5E
W82-05185

CERAMIC CUP
A More Versatile Soil Water Sampler, 1505 7B
W82-02523

CEREAL CROPS
Cereal Yields and Drought Resistance, 1507 2I
W82-03195

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales), 1510 2I
W82-04470

CERIUM COMPOUNDS
Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a Discussion on the Precision of the Winkler Technique), 1505 5A
W82-02562

CESIUM-137
Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary, 1512 5B
W82-05984

CESIUM RADIOISOTOPES
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay), 1503 2J
W82-01644

Rates of Recent Sedimentation in Lake Pepin, 1509 2J
W82-03922

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

CHACO REGION
Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 1511 6D

CHALK AQUIFER
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

CHALK FORMATION
Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 1508 2K

CHALK RIVER
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 1505 2A

CHAMBAL PROJECT
The Chambal Project: Problems and Solutions,
W82-01739 1503 4A

CHANNEL CATFISH
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 1505 5C

CHANNEL EROSION
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 1510 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 1511 8A

Mathematical Model for Erodible Channels,
W82-06336 1512 2J

CHANNEL FLOW
Flow Resistance in Vegetated Waterways,
W82-00152 1501 2E

Tractive Force Design of Vegetated Channels,
W82-00901 1502 4D

Concentrated Flow Relationships,
W82-01409 1503 2J

Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 1505 2E

Boundary Shear in Smooth and Rough Channels,
W82-02711 1506 8B

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 1507 2E

Parametric Study of Flood Wave Propagation,
W82-03425 1508 2E

Numerical Solution of the Dam Failure Problem by the Random Choice Method,
W82-03872 1509 8A

Conformal Mapping for Channel Junction Flow,
W82-04306 1510 2E

Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 1510 8B

Resistance Equation for Large-Scale Roughness,
W82-04696 1510 2E

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

Canals in Sand Channels,
W82-06196 1512 8B

Accuracy Criteria in Diffusion Routing,
W82-06423 1512 8B

Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 1512 8B

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 1512 8B

CHANNEL IMPROVEMENT
Aquatic Weed Cutting Apparatus,
W82-00624 1502 4A

Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

A Suitable Lining Technique for Existing Distributaries,
W82-03063 1507 8G

Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

Environmental Impact of Channel Modification,
W82-04245 1509 4A

Stream Improvement: The Chicod Creek Episode,
W82-05717 1511 4D

Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 1511 4A

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 1512 6G

CHANNEL JUNCTION FLOW
Conformal Mapping for Channel Junction Flow,
W82-04306 1510 2E

CHANNEL MORPHOLOGY
Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

Channel Instability in a Braided, Sand Bed River,
W82-01316 1503 2J

Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

Investigation of Fluvial Processes Under Conditions of Natural Variability of the Runoff,
W82-03906 1509 2J

Floodflow Characteristics of the Sacramento River in the Vicinity of Gianella Bridge, Hamilton City, California,
W82-03985 1509 2E

Geometry of Gravel Streams,
W82-04113 1509 2E

Relative Runoff by Curve Number Nomograph,
W82-04307 1510 2A

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

Canals in Sand Channels,
W82-06196 1512 8B

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

CHANNEL SCOUR
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

Devon Floods and the Waterways of Bridges,
W82-05948 1512 8A

CHANNEL STABILITY
Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

CHANNELING
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 1502 2J

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

Habitat Recovery in the North Fork of the Teton River.
W82-06409 1512 6G

CHANNELS
Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 1502 2J

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

Turbulence Model for Flow Over Dredged Channels,
W82-02201 1505 8B

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

Absolute Roughness of Concrete-Lined Channels,
W82-03397 1507 8B

CHAPARRAL
Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 1502 2I

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 1502 2D

CHAR
Leach Characteristics of Coal-Gasification Char,
W82-01025 1502 5B

CHARTS
Recording Raingage Modifications,
W82-05665 1511 7B

CHATTAHOOCHEE NATIONAL FOREST
Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

CHELATING AGENTS
Metal Speciation. Effects on Aquatic Toxicity, W82-00610 1502 5A
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water, W82-01839 1504 2H
Decomposition of Chelates Leached from Waste Disposal Sites, W82-04879 1511 5B
Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes, W82-05284 1511 5D

CHELATION
Soluble Element Concentrations and Complexation in Southeastern Lake Michigan, W82-01147 1503 2H
The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River, W82-01498 1503 5B
Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux, W82-03379 1507 5A
Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment, W82-04275 1510 5F
Procedure for Investigating Metallic Ion Complexing in Natural Waters, W82-05595 1511 5A
Multiple Addition Bioassay of Tjeukemeer Water, W82-06907 1512 5C

CHEMICAL ANALYSIS
Chemistry of Precipitation at Gainesville, Florida, W82-00185 1501 2K
Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal, W82-00197 1501 5D
Methods for Level 2 Analysis by Organic Compound Category, W82-00384 1501 5A
The Analysis of Oil Shale Wastes: A Review, W82-00388 1501 5A
Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data, W82-00395 1501 2F
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish, W82-00567 1502 5A
Identification of Organic Compounds, W82-00635 1502 5A
The Nature of Selected Prairie Lake and Stream Sediments, W82-00815 1502 2J
Comparison of Methods for the Determination of Trace Elements in Seawater, W82-01086 1502 5A
Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment, W82-01573 1503 5A
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water, W82-01689 1503 5A
Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978, W82-02228 1505 2K
Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography, W82-02298 1505 5A
The Spectrophotometric Determination of Antimony in Water, Effluents, Marine Plants and Silicates, W82-02355 1505 5A
Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water, W82-02380 1505 2K
Characterization of Oil Spills on Inland and Estuarine Waters, W82-02393 1505 5B
Major Ion Chemistry in a Tropical African Lake Basin, W82-02440 1505 2K
Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California, W82-02470 1505 2K
Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional), W82-02662 1506 2K
An Analysis of the First Year of MAP3S Rain Chemistry Measurements, W82-02934 1506 2K
On Antarctic Glaciology: Ice Sheets--And Ice Cores, W82-03170 1507 2C
A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels, W82-03289 1507 5A
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms, W82-03359 1507 2L
The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters, W82-03529 1508 5A
Water Chemistry of Alabama Ponds, W82-03534 1508 2K
Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A., W82-03584 1508 2F
Flow-System Controls of the Chemical Evolution of Groundwater, W82-03795 1509 2K
The Rate of Flushing as a Major Factor in Determining the Chemistry of Water in Fossil Aquifers in Southern Israel, W82-03799 1509 2K
Chemical Evolution of Groundwater in a Drainage Basin of Holocene Age, East-Central Alberta, Canada, W82-03800 1509 2K
EPA's Priority Pollutants: Where They Come from--Where They're Going, W82-03875 1509 6E
Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems, W82-03886 1509 5F
Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant, W82-03890 1509 5F
Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies, W82-04081 1509 5B
Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese), W82-04177 1509 2K
Water Chemistry of the Illinois Waterway, W82-04390 1510 2K
Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States, W82-04437 1510 2J
A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water, W82-04457 1510 5A
Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure), W82-04458 1510 5A
Acid Snow in the Canadian High Arctic, W82-04542 1510 2C
Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Losemittel in Luft und Wasser), W82-04579 1510 5A
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle), W82-04580 1510 5A
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California, W82-04743 1510 1A
Boron Status of Berlin Waters (Bor-Status Berliner Gewasser), W82-04767 1511 5A
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples, W82-04789 1511 5A
Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector, W82-04808 1511 5A
Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry, W82-04993 1511 5A

Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 1511 5A

The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 1512 2F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 1512 5F

Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 1512 2K

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 1512 5A

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 1512 5A

CHEMICAL ANAYSIS
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

CHEMICAL COAGULATION
Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

Chemical Coagulation of Surface Water,
W82-02623 1506 5F

Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

CHEMICAL COMPOSITION
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 1501 2L

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 1501 2K

Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 1501 2K

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 1502 2K

Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 1504 5C

Some Analyses of Aquatic Plants and Their Waters,
W82-02293 1505 2H

Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 1505 5C

Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 1505 2K

Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in It's Catchment Area,
W82-02752 1506 2H

Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 1506 2H

Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 1507 2H

Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 1508 2K

Chemical and Hydrological Heterogeneity of Groundwaters in the Upper 'Jura Neuchatelois', Switzerland. (Heterogeneite Chimique et Hydrologique Des Eaux Souterraines D'un Karst Du Haut-Jura Neuchatelois, Suisse),
W82-03794 1509 2K

Laboratory and Field Studies of The Relative Mobility of 239, 24OPU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 1511 2H

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 1511 2K

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 1512 2K

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

CHEMICAL COMPOUNDS
Implications for the Water Industry of the Notification Scheme for New Chemicals,
W82-06261 1512 6E

CHEMICAL DEGRADATION
Sources and Control of Organic Air Pollutants,
W82-00711 1502 5B

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

CHEMICAL INDUSTRY
An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 1502 5A

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

CHEMICAL INTERFERENCE
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 1501 5A

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 1512 5C

CHEMICAL INTERFERENCES
Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 1508 5A

CHEMICAL OXYGEN DEMAND
Energy Recovery System,
W82-00059 1501 5D

A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 1501 5D

Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 1505 5A

Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a

Discussion on the Precision of the Winkler Technique), 1505 5A
W82-02562

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes, 1508 5D
W82-03570

Functional Relations Between General Characteristics of Organic Matter in Natural Waters, 1508 1A
W82-03573

Calorific Value of Wastewater Plant Sludges, 1511 5E
W82-04997

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process, 1511 5D
W82-05441

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss), 1512 5D
W82-06634

Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water, 1512 5A
W82-06773

CHEMICAL PRECIPITATION

Assessment of Airborne Inorganic Contaminants in the Great Lakes, 1502 5B
W82-00710

Sources and Control of Organic Air Pollutants, 1502 5B
W82-00711

Data Base Development for the Design of a Radium-226 Removal Process, 1503 5D
W82-01188

Trace Metal Mineral Equilibria in Lake Erie Sediments, 1503 2H
W82-01191

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate, 1504 5D
W82-01863

A Compendium of Experimental Work on Chemical Precipitation of Sewage, 1505 5D
W82-02370

Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results, 1509 5D
W82-03878

Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario, 1509 2K
W82-04031

Does Conventional Sewage Treatment Meet the Demands of the 1980's, 1511 5D
W82-05407

Phosphorus Reduction Studies, 1511 5D
W82-05408

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion, 1511 2K
W82-05416

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results, 1511 5D
W82-05424

Beneficial Disposal of Pickle Liquor, 1512 5D
W82-06486

Modern Lacustrine Stromatolites, Walker Lake, Nevada, 1512 5C
W82-06934

CHEMICAL PROPERTIES

Element Mass Balances for South Carolina Coastal Plain Watersheds, 1501 5B
W82-00175

Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario, 1501 2K
W82-00321

Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland), 1502 2H
W82-00675

Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca), 1502 2K
W82-00854

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream, 1502 2K
W82-01021

Groundwater Chemistry of Some Selected Areas in Southeaster Norway, 1504 2K
W82-02020

Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)), 1505 2F
W82-02422

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability, 1506 5B
W82-02750

Biological Monitoring Part VI - Future Needs, 1507 5C
W82-03230

Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa), 1508 2K
W82-03543

Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana, 1509 2F
W82-03810

Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America, 1510 2K
W82-04673

On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia, 1511 2H
W82-04929

On the Chemistry and Biota of Some Saline Lakes in Western Australia, 1511 2H
W82-04940

Chemistry, Physics and Evolution of Antarctic Saline Lakes, 1511 2H
W82-05100

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana, 1511 7C
W82-05228

CHEMICAL REACTION

Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment, 1509 5B
W82-03758

Humic Substances, 1511 5B
W82-05148

CHEMICAL REACTIONS

Water Pollution Potential of Coal-Slurry Pipelines, 1501 6A
W82-00096

Trace Metal Catalysis in Aquatic Environments, 1502 5B
W82-00629

Measurement of in situ Rates of Nitrification in Sediment, 1502 5A
W82-00798

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment, 1503 2K
W82-01322

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment, 1503 5B
W82-01625

Kinetics for the Aquatic Environment, 1503 2K
W82-01631

Kinetics for the Aquatic Environment, 1504 2K
W82-01806

The Geochemical Control of Seawater (Sillen Revisited), 1504 2K
W82-01936

Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power, 1506 2K
W82-02864

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration, 1506 5B
W82-02942

Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System, 1507 2K
W82-03136

Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes, 1507 2K
W82-03308

A Comparison of Chlorine and Chlorine Dioxide Disinfection of Wastewater Effluents: The Generation of Selected Halohydrocarbons, 1509 5D
W82-03751

Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals, 1509 2K
W82-03771

The Chemistry of Saline Water Chlorination, 1510 3C
W82-04729

Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized, 1511 2K
W82-04914

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations, 1511 2K
W82-04915

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers, 1511 5B
W82-05079

The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters, 1511 2K
W82-05140

Theoretical Analysis of Ionic Equilibria in Natural Water, 1511 2K
W82-05239

Ion Hydration and Ion Interaction, 1511 2K
W82-05310

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 1511 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 1512 5F

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 1512 5D

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

CHEMICAL RECOVERY
Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 1501 5D

CHEMICAL REDUCTION
The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 1507 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 1507 5D

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

CHEMICAL SPILLS
An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

CHEMICAL STRATIFICATION
Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 1508 2H

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 1512 2K

CHEMICAL TREATMENT
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 1501 5D

Water-Treatment Chemicals,
W82-00618 1502 5F

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 1504 5D

Chemical Treatment of Small Remote Water Sources,
W82-04005 1509 5F

Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 1510 5D

Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

Waste Treatment System Retrofitted Within Deadline,
W82-05947 1512 5D

CHEMICAL WASTES
Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 1502 5C

Removal of Priority Pollutants,
W82-00639 1502 5D

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 1502 6E

1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 1502 5C

Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 1503 5D

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 1504 5G

Screened Auger Aids Investigation,
W82-02096 1504 7B

Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 1505 5A

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 1507 5A

Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 1508 5B

Dutch Dumps,
W82-03738 1508 5B

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

When a Water Supply Went Bad.
W82-04357 1510 5C

Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 1512 5E

Oxidation Products and Rates of Reaction in the Ozonolysis of Diebenzofuran,
W82-06305 1512 5B

Hazardous Material Spills--Are You Ready,
W82-06417 1512 5G

CHEMICAL WASTEWATER
Chemicals and Allied Products,
W82-01267 1503 5D

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 1504 5B

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 1504 6A

Industrial Wastewater Pretreatment Service,
W82-02253 1505 5E

Dupont's Wastewater Treatment Approach,
W82-02254 1505 5D

Wastewater Treatment for Japan's Research Institute.
W82-03905 1509 5D

A Treatment System for an Organic Chemicals Plant,
W82-04353 1510 5D

Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

Chemicals and Allied Products,
W82-06805 1512 5D

CHEMISTRY OF PRECIPITATION
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 1502 2B

Analysis of Precipitation Chemistry at a Central Pennsylvania Site, ,
W82-00980 1502 2K

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 1505 5C

Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

CHEMOCLINE
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

Meromixis in a Coastal Zone Excavation,
W82-02120 1505 2H

CHEMUNG COUNTY
Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

CHESAPEAKE BAY
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 1501 2L

Search for Linuron Residues in Tributaries of the Chesapeake Bay, 1502 5A
W82-00569

Kepone in the James River, 1502 5B
W82-00631

Effect of Kepone on Estuarine Microbial Activity, 1503 5C
W82-01231

Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management, 1503 6B
W82-01642

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay, 1503 5A
W82-01661

Chesapeake Bay Low Freshwater Inflow Study, 1505 6G
W82-02114

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay, 1505 6G
W82-02115

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay, 1505 5B
W82-02118

Freshwater Inflow to Estuaries, Short and Long Term Perspectives, 1505 2L
W82-02158

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh, 1505 2I
W82-02340

Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites, 1506 5B
W82-02814

Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh, 1506 2L
W82-02937

Construction of Containment Facility for Dredged Materials Begins, 1509 5G
W82-03839

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector, 1511 5A
W82-04808

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay, 1511 2L
W82-04924

CHEYENNE
Final Environmental Impact Statement: Cheyenne Stage II Water Diversion, Medicine Bow National Forest. 1509 6D
W82-04073

CHEZY EQUATION
Resistance of Beauharnois Canal in Winter, 1511 2C
W82-04998

CHICAGO
Yield Verification of a Dolomite Aquifer in Northeast Illinois, 1503 2F
W82-01334

Parasite Ova in Anaerobically Digested Sludge, 1504 5B
W82-02018

Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations, 1505 7A
W82-02588

A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant, 1506 5F
W82-02731

Fate of Priority Pollutants in Large Municipal Treatment Plants, 1509 5B
W82-03867

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area, 1510 2B
W82-04741

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants, 1511 5B
W82-05428

CHICAGO AREA
Nitrogen Control at Three Related Plants, 1511 5D
W82-05434

CHILE
Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile, 1508 2F
W82-03651

CHILE IRRIGATION
Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils, 1511 5B
W82-04781

CHINA
Environmental Impact Assessment of China's Water Transfer Project, 1501 6D
W82-00129

Dam Construction in China. 1501 8A
W82-00334

A New Era for China's Hydropower, 1501 8A
W82-00335

China's Potential for Hydro Development, 1501 8A
W82-00336

Bacteria: Man's Allies in Water Pollution Control, 1503 5D
W82-01158

Hydropower--An Old Technology for a New Era, 1503 4A
W82-01593

Erosion and Sediment Control in China's Yellow River Basin, 1503 4D
W82-01729

Impressions of Soil and Water Conservation in China, 1503 4D
W82-01730

Sediment Regulation Problems in Sanmenxia Reservoir, 1507 2J
W82-03072

China's Agro-Ecosystem, 1512 3B
W82-06019

CHINOOK BELT
Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report, 1505 2C
W82-02539

CHIRONOMIDS
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems, 1502 5C
W82-00596

CHLORALKALI PLANTS
Removal of Elemental Mercury from Wastewaters Using Polysulfides, 1503 5D
W82-01800

CHLORAMINE
The Use of Chloramines to Prevent Trihalomethane Formation, 1509 5F
W82-04115

CHLORAMINES
A Novel Chloramine Compound for Water Disinfection, 1508 5F
W82-03551

CHLORATES
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water, 1504 5A
W82-01835

CHLORDANE
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane, 1502 5C
W82-00558

CHLORELLA
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens). 1512 5B
W82-06904

CHLORIDE
Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt, 1505 5B
W82-02262

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies, 1512 5F
W82-05907

CHLORIDES
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California, 1502 2F
W82-00831

The Ground Water Flow System in the Vicinity of Marco Island, Florida, 1505 2F
W82-02123

Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes, 1505 5D
W82-02382

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida, 1508 2H
W82-03546

Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle), 1510 5A
W82-04580

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn, 1512 2F
W82-06234

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters, 1512 5A
W82-06718

CHLORINATED COMPOUNDS
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish, 1511 5A
W82-04883

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry, 1511 5A
W82-04993

CHLORINATED HYDROCARBONS
Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton, 1501 5C
W82-00266

Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane, 1502 5C
W82-00558

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges, 1503 5E
W82-01387

Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 1505 5B

Trihalomethane Precursor Control by Adsorption,
W82-02598 1505 5F

Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 1507 5E

An Organics Detection System for the Ohio River,
W82-03436 1508 5A

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 1508 5C

The Evaluation of the Elutriate Test as a Means of Predicting the Behavior of Selected Chlorinated Hydrocarbons in Dredged Sediment During Open-Water Disposal,
W82-03824 1509 5A

An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

A Treatment System for an Organic Chemicals Plant,
W82-04353 1510 5D

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 1510 5C

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 1511 5A

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C

Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 1511 5F

Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 1511 5C

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 1511 5F

Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 1512 5A

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 1512 5A

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 1512 5A

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 1512 5G

CHLORINATIION

A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Streptococci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 1512 5D

CHLORINATION

Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 1501 5A

The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 1501 6A

Chlorinated Drinking Water,
W82-00467 1501 5F

Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

Health Effects of Monochloramines in Drinking Water,
W82-01091 1502 5C

Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 1503 5A

Disinfection,
W82-01250 1503 5D

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 1503 5D

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 1503 5C

Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 1508 5C

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 1508 5D

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

A Comparison of Chlorine and Chlorine Dioxide Disinfection of Wastewater Effluents: The Generation of Selected Halohydrocarbons,
W82-03751 1509 5D

Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 1510 5F

Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 1510 5F

The Chemistry of Saline Water Chlorination,
W82-04729 1510 3C

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 1511 5A

GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 1511 5A

Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 1511 5F

Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 1512 5F

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

Performance of Modified Chlorine Contact Chamber,
W82-06359 1512 5D

Making Chlorination Trustworthy,
W82-06639 1512 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 1512 5F

CHLORINE

Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 1501 5A

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 1506 5F

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 1512 5F

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

Performance of Modified Chlorine Contact Chamber,
W82-06359 1512 5D

Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 1512 5F

CHLORINE DIOXDE

Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

CHLORINE DIOXIDE

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

CHLOROFORM

Chlorinated Drinking Water,
W82-00467 1501 5F

Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

CHLOROPHENOLS

Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct-Acetylation in Aqueous Solution,
W82-05363 1511 5A

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

CHLOROPHYLL

Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 1503 5A

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 1504 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 1504 2H

Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 1505 5A

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

Effect of Filtration Pressure on Analyses for Chlorophyll,
W82-04247 1509 2H

Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 1510 5C

Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 1511 2H

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 1512 5C

CHLOROPHYLL A

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 1504 5C

Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 1506 5C

Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 1507 2H

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

CHOLESTEROL

Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 1512 5B

CHOPTANK RIVER

Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

CHOWAN RIVER

Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 1505 5A

Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

CHROMATES

A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 1506 5D

CHROMATOGRAPHY

Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 1501 5A

Cation Chromatography With a Conductivity Detector,
W82-00582 1502 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 1507 5A

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 1511 5A

Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 1511 5A

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 1511 5A

Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 1512 5A

Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 1512 5A

A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 1512 5A

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 1512 5A

Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 1512 5A

CHROMIUM

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 1502 5A

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 1503 5E

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 1504 5A

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment,
W82-03758 1509 5B

Shock Load of Chromium (VI),
W82-05253 1511 5D

Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 1511 5D

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 1512 5D

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 1512 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 1512 5D

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 1512 5D

CHURCHILL COUNTY

Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

CIRCULATION

Modeling Circulation in Depth-Averaged Flow,
W82-02679 1506 2E

CISTERNS

Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 1507 3B

CITRUS FRUITS

Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 1503 2I

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 1504 5D

CIVIL ENGINEERING

Irrigation for Brazil's Poligono Das Secas,
W82-01744 1503 3F

Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 1507 8A

CIVIL LAW

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 1512 6E

CLADOPHORA

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 1503 5C

Denitrification Associated With Periphyton Communities,
W82-01814 1504 5B

Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 1512 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 1512 5C

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 1512 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

CLAMS

The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H

A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 1505 5C

CLARIFICATION

History of a Water Chemical,
W82-00074 1501 5F

Low Turbidity Water from Fast Processes,
W82-00946 1502 5F

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 1504 5D

Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 1505 5F

Clarification with Microsand Seeding. A State of the Art,
W82-03880 1509 5F

Solids Inventory Control in the Activated Sludge Process,
W82-04048 1509 5D

Simplified Clarifier Axes Treatment Stages,
W82-06820 1512 5D

CLARIFIED WASTEWATER

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

CLARIFIERS

Sludge Blanket in Activated Final Clarifiers,
W82-00951 1502 5D

Simulation Modeling of Primary Clarifiers,
W82-01027 1502 6A

Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 1505 5D

A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

CLARK FORK-PEND OREILLE RIVER BASIN

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 1501 6B

CLASSIFICATION

An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 1501 7B

Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 1502 2H

Water Quality Indices: An Additional Management Tool,
W82-01994 1504 5G

A Decision Theory Approach to Earth Dam Classification,
W82-04152 1509 8A

Process-Response Systems: A Practical Approach to Watershed Classification Considering Water and Sediment Yields,
W82-04217 1509 2A

Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 1510 2A

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 1511 5A

Wetlands and Deepwater Habitats: A New Classification,
W82-05716 1511 2L

Lower Flow Regime Bedforms: Rational Classification,
W82-06421 1512 2E

CLAY BOSWELL GENERATING STATION
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

CLAYS
Dewatering of Industrial Clay Wastes,
W82-00041 1501 5D

Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 1501 5D

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 1502 5F

Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 1502 2J

Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 1506 8D

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 1507 2F

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 1511 2H

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

CLEANING
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

CLEANUP OPERATIONS
Using Coherent Water Jets to Control Oil Spills,
W82-03031 1507 5G

Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 1510 5G

Performance Testing of the Diperna Sweeper,
W82-05058 1511 5G

Performance Testing of Four Skimming Systems,
W82-05059 1511 5G

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 1511 5G

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 1511 5G

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 1511 5G

Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 1511 5G

A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 1511 5G

Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 1511 5G

CLEAR-CUTTING
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 1501 2C

Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 1503 4C

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 1507 5C

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03843 1509 5B

Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 1511 4C

First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 1512 4C

CLEARCUTTING
A Citizen's View of Water Management in the Okanagan Valley,
W82-05781 1511 6G

CLEVELAND BAY
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 1506 2L

CLIMATES
Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 1505 2L

A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 1512 2B

CLIMATIC
Glaciers and Their Fluctuations,
W82-04777 1511 2C

CLIMATIC DATA
A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 1512 2D

CLIMATIC ZONES
A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 1512 2B

CLIMATOLOGY
The World Climate Programme,
W82-00317 1501 6A

Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 1501 2E

Water Requirements and Man-Induced Climate Change,
W82-01633 1503 2D

Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 1505 2C

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 1505 2B

130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 1505 2K

Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 1507 2C

A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 1510 2A

Glaciers and Their Fluctuations,
W82-04777 1511 2C

Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 1511 2J

Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 1511 2B

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 1512 2B

CLINTON
Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 1501 5D

CLOGGING
Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 1507 5D

CLOSED BASINS
Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 1511 4D

CLOSED-CONDUIT FLOW
Modeling Cavitation for Closed Conduit Flow,
W82-02700 1506 8B

Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 1512 8B

CLOSED LAKES
Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 1502 2H

CLOSTRIDIUM BOTULINUM
Distribution of Clostridium Botulinum,
W82-00349 1501 5A

CLOUD PHYSICS
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 1504 2B

Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 1512 2B

CLOUD SEEDING
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 1502 3B

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 1502 2B

Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01322 1503 7B

An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 1505 7B

Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 1507 3B

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 1512 6G

CLOUDS
Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 1502 2B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 1503 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 1503 7B

CLYDE RIVER
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 1501 5A

CO-DISPOSAL
A Look at Co-Disposal,
W82-06354 1512 5E

COAGULANTS
Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 1506 5D

COAGULATION
Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 1502 2H

Ferric Chloride Takes Over,
W82-00954 1502 5F

Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 1503 5F

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 1503 5D

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 1503 5F

Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 1505 5F

Chemical Coagulation of Surface Water,
W82-02623 1506 5F

A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 1506 5F

Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 1508 5F

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 1508 5D

Destabilization of Biological Solids with Ferric Chloride,
W82-04373 1510 5D

Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 1510 5F

Coagulation: Experiences in Organics Removal,
W82-04424 1510 5F

Considering Sludge Production in the Selection of Coagulants,
W82-05675 1511 5F

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 1512 5D

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 1512 5D

COAGULATION *WASTEWATER TREATMENT
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 1512 5D

COAL
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 1501 6A

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 1501 5D

Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

Water Resources Data for West Virginia, Water Year 1979. Appendix - Coal Areas.
W82-03990 1509 7C

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 1510 7C

Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 1511 5D

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 1511 5D

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 1512 6D

Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

COAL GASIFICATION

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels,
W82-00431 1501 5D

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 1501 5D

Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 1501 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 1501 5D

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 1501 5D

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 1501 5D

Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 1501 5D

Solvent Extraction of Phenols,
W82-00438 1501 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 1501 5D

Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 1501 5D

Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Biological Treatment of Synthetic Fuel Wastewater,
W82-00971 1502 5D

Leach Characteristics of Coal-Gasification Char,
W82-01025 1502 5B

Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

Synthetic Fuel Effluents,
W82-01263 1503 5B

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 1506 5B

A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 1506 5C

Will Synfuel Development Drain the West Dry,
W82-03292 1507 6D

Synthetic Fuel Effluents,
W82-06800 1512 5D

COAL GASIFICATION PLANTS

Energy Recovery System,
W82-00059 1501 5D

COAL MINES

Selective Overburden Placement,
W82-00053 1501 5G

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 1501 4C

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 1510 5C

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

COAL MINING

Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 1501 5C

Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 1502 6E

Illinois Groundwater Problems and Needs,
W82-01052 1502 4B

Coal and Coal Mine Drainage,
W82-01261 1503 5G

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 1505 7C

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

Ground Water Monitoring of Underground Coal Mines,
W82-04750 1510 5B

Acid Pond Drainage,
W82-05199 1511 5G

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 1511 5C

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

Coal and Coal Mine Drainage,
W82-06802 1512 5B

COAL PILE RUNOFF

Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 1508 5B

COAL TAR COATINGS

Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 1502 5B

COAL-TAR DERIVATIVES

Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 1501 5B

COALESCENCE

The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 1512 2B

COASTAL AQUIFERS

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 1503 2F

A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 1503 7A

Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 1503 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 1504 2F

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 1505 5B

Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 1507 2F

Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

Waste Water Disposal Through a Coastal Aquifer,
W82-04231 1509 5E

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

COASTAL AREAS

Groundwater Control,
W82-04714 1510 4B

COASTAL ENGINEERING

Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 1507 8A

COASTAL LAKE MARSHES

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

COASTAL LOUISIANA

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 1510 7C

COASTAL MARSHES

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 1505 6G

Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 1511 2H

COASTAL PLAINS

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 1511 3B

Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 1512 2J

COASTAL STREAMS

Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

COASTAL WATERS

Large Rubble-Mound Breakwater Failures,
W82-00862 1502 8D

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 1502 2H

Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 1504 6B

Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

Relationship Between Populations of Amphipods and Pollution,
W82-02444 1505 5C

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 1506 6E

On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 1506 5G

Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 1507 5C

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 1507 5C

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 1508 5B

Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 1510 2H

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 1511 5C

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 1512 5C

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 1512 2L

Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 1512 5B

COASTAL ZONE MANAGEMENT

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 1503 5C

Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 1505 6E

Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 1505 6G

Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 1505 4A

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 1505 5G

On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 1506 5G

CZ '80: Coastal Quandaries Persist,
W82-03383 1507 6E

COASTAL ZONE MENAGEMENT

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

COASTS

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

COATINGS

Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 1502 5B

Advanced Coatings for the Water Industry.
W82-06603 1512 8G

COBALT

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 1508 2H

CODING SYSTEMS

A River Coding System for Water Quality Archives,
W82-05474 1511 7A

COFFERDAMS

Model Studies of an Overtopped Rockfill Dam,
W82-03694 1508 8E

COHESION
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 1501 2J

COHESIONLESS SOILS
Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 1507 8D

COHESIVE SOILS
Erosion Resistance of Cohesive Soils,
W82-02676 1506 2J

COKE PLANT WASTEWATER
Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

COLD REGIONS
Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 1501 5E

Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 1502 2I

Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 1505 2C

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

COLIFORMS
Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 1501 5A

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 1501 5B

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 1501 5A

R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 1502 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 1502 5A

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 1503 5C

Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 1505 5A

Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 1506 5D

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 1506 5D

The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 1507 2L

Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 1510 5B

Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 1510 5A

Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

Fecal Coliform Densities in a Western Watershed,
W82-05618 1511 5B

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 1512 5D

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

A Water Quality Index for Lake Beaches,
W82-06660 1512 5G

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

COLIPHAGE
Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

COLIPHAGES
Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1505 5A

Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 1511 5D

COLLIER COUNTY
Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 1510 10C

COLLOIDALS
Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

COLLOIDS
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

Colloidal Organics,
W82-04689 1510 5F

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

COLOGNE
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

COLOR REMOVAL
Textile Effluents Lose Their Color.
W82-00342 1501 5D

Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 1502 5D

Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 1504 5D

Methods for Treatment of Color in Groundwater,
W82-02532 1505 5F

Field Report on a Nonpolluting Bleach Plant,
W82-02793 1506 5D

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

Color Removal from Groundwater by Ion Exchange and Sludge Recycle Techniques,
W82-03956 1509 5F

Recent Developments in Direct Filtration,
W82-04122 1509 5F

COLORADO

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 1501 7C

Furrow Irrigation Practices in Northern Colorado,
W82-00139 1501 3F

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 1501 7C

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 1502 5B

Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 1503 7C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 1503 5B

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 1504 2D

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

Operation Reports--City of Pueblo, Colorado Department of Public Works.
W82-03348 1507 5D

Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 1508 5A

Recreational Enhancement of High Country Water Supply Reservoirs,
W82-03923 1509 6A

Geologic Structure, Hydrology, and Water Quality of the Laramie-Fox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

An Ex Post Analysis of the Uncompahgre Project,
W82-04218 1509 6B

Effects of Water Drawdown on the Fauna in Small Cold Water Reservoirs,
W82-04219 1509 6G

Peak Period Design Standards for Small Western U.S. Water Supply Systems,
W82-04249 1509 6D

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 1510 5D

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 1510 6E

Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 1510 6E

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 1510 6A

Water Reuse Planning by Means of an Input-Output Table,
W82-04794 1511 6A

Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 1511 6E

Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law,
W82-04803 1511 6E

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

Sludge Management in the Rocky Mountain State,
W82-05165 1511 5E

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

A Five-Year Plan for Water Research in Colorado,
W82-05531 1511 6B

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 1512 3F

Packaged Plant Treats Turbidity,
W82-06026 1512 5F

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

San Juan River Basin,
W82-06144 1512 7C

Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 1512 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 1512 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 1512 5G

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 1512 4C

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

COLORADO PLATEAU

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

COLORADO RIVER

Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 1503 2J

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 1505 4A

Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 1506 6B

Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 1507 5A

The Wellton-Mohawk Dilemma,
W82-05883 1511 3F

Future Water Development Policies, W82-05884 1511 5G

American Indian Water Rights and the Use of Colorado River Water, W82-05885 1511 6E

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin, W82-05886 1511 3C

Colorado River Development, W82-05887 1511 4A

Colorado River Water Allocation, W82-05888 1511 6C

The Colorado River Salinity Problem, W82-05889 1511 5G

Development Issues in the Colorado River Basin, W82-05890 1511 6D

The Physical Environment of the Colorado River Basin, W82-05891 1511 6D

International Problems on the Colorado River, W82-05892 1511 5G

Optimal Salinity Control Program for the Upper Colorado River Basin, W82-05893 1511 5G

Salinity Control Measures for Grand Valley, W82-05894 1511 3F

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses, W82-06694 1512 6B

COLORADO RIVER BASIN
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms, W82-01677 1503 6A

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas. W82-01752 1504 6D

Salinity Forum: What. How. Why, W82-02587 1505 6E

Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages, W82-03047 1507 2B

Optimizing Salinity Control Strategies for the Upper Colorado River Basin, W82-03518 1508 6B

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin, W82-06693 1512 3C

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact, W82-06967 1512 6G

COLORADO RIVER BASINS
Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program, W82-00717 1502 3C

COLORADO SPRINGS
Recycling Allows Zero Powerplant Wastewater Discharge, W82-04323 1510 5D

COLORIMETRY
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water, W82-00483 1501 5A

Determination of Ammonia in Estuary, W82-02390 1505 5A

New Supplementary DPD Procedures Using Sodium Nitrite for (a) Bromine-Bromamine Separation and (b) Correction of Chlorine Dioxide Readings for Any Bromine Derived from Natural Bromide in Waters, W82-02394 1505 5A

Automatic Monitoring of Copper in Waste Water from Plating Shops, W82-04845 1511 5A

Design and Operation of a Colorimetric Detector Controller, W82-06656 1512 5A

COLUMBIA RIVER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79, W82-01139 1503 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System, W82-01804 1504 6E

Water Management on the Columbia River, W82-02112 1505 6D

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue, W82-02155 1505 6D

COLUMBIA RIVER BASALTS
Ground-Water Management in Basalts, W82-04931 1511 4B

COLUMBIA RIVER BASIN
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies, W82-03073 1507 6B

COLUMBIA RIVER ESTUARY
An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition, W82-02132 1505 2L

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978, W82-02139 1505 2L

COLUMBUS
Hydropower: Inflation-Proof Energy from Water Supply Dams, W82-04137 1509 6B

COMBINED SEWER OVERFLOW
A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality, W82-03427 1508 5B

COMBINED SEWER OVERFLOWS
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada, W82-01200 1503 5G

Urban Runoff and Combined Sewer Overflow, W82-01254 1503 5B

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis, W82-03035 1507 5G

Evaluation of a Treatment Lagoon for Combined Sewer Overflow, W82-04623 1510 5D

Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows, W82-05266 1511 5D

The Performance of an Off-Sewer Storm-Sewage Tank, W82-05469 1511 5D

Stormwater Management in the Ottawa-Carleton Region, W82-05563 1511 5G

Improvement of Swirl Concentrator, W82-05821 1511 5D

Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12 W82-06099 1512 5G

Detroit-Style CSO Studies, W82-06247 1512 5G

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River, W82-06316 1512 5C

Urban Runoff and Combined Sewer Overflow, W82-06914 1512 5D

COMBINED SEWERS
Studies for Abatement of Pollution from Combined Sewer Overflows in Canada, W82-01200 1503 5G

Municipal Sewage: Three Communities Try to Cope, W82-03284 1507 5D

Automatic Flow Control in Combined Sewer Systems-Effectiveness and Implementation Problems, W82-04049 1509 5D

Storm and Combined Sewers: Part of The Treatment Process, W82-04195 1509 5B

Computer-Based Implementation of Combined Sewer Control, W82-04783 1511 5D

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research, W82-06775 1512 5G

Decontamination of Overland Runoff from Populated Areas, W82-06980 1512 5D

COMBINED TREATMENT
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion, W82-01468 1503 5D

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations, W82-01992 1504 5D

COMBINED WASTEWATER
A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual, W82-06381 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report, W82-06382 1512 5D

COMMERCIAL FARMING
Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir, W82-04966 1511 4C

COMMERCIAL FISH
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi, W82-02524 1505 5C

COMMERCIAL FISHING
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 1502 6A

COMMERCIAL WATER SUPPLY
Crisis-Ridden Water Systems Should Go Private,
W82-05436 1511 6C

COMMON LAW
Federal Common Law of Nuisance Expands,
W82-01337 1503 6E

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

COMMUNITY DEVELOPMENT
Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 1512 5B

Urban Creekside Design Features Parallel Streets,
W82-06184 1512 4C

COMPACTED SOILS
Furrow Intake Rates and Water Management,
W82-05968 1512 3F

COMPACTION
Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 1506 8B

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 1508 4B

Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 1511 8A

COMPARISON ANALYSIS
Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 1502 5A

COMPARISON STUDIES
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 1502 2B

A Comparison of Rainfall-Runoff Models,
W82-00911 1502 2A

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 1503 2H

Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

Theory of the Dielectric Constant of Ice,
W82-03176 1507 2C

Tailoring Design of Treatment Plants to Local Conditions,
W82-03893 1509 5F

Optimization of Automated Equalization Basin-Reactor Systems for Chemical Treatment of Wastewater,
W82-04052 1509 5D

Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

Reservoir Operation for Water Conservation,
W82-04165 1509 3B

Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 1510 2E

A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 1511 6D

Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 1511 5A

Evaporation at a High Arctic Site,
W82-04899 1511 2D

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

Application of and Guidelines for Using Available Dam Break Models,
W82-05152 1511 8A

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

COMPETING USE
Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 1502 6D

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 1502 6F

Water Management on the Columbia River,
W82-02112 1505 6D

Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 1511 6D

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 1511 6E

Truckee Meadows Water Use - Present and Future,
W82-06705 1512 3D

COMPLETE WASTEWATER TREATMENT
Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 1511 5D

COMPOSTING
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 1501 5E

Composting Is Working in Camden,
W82-00948 1502 5E

Composting Results in Los Angeles,
W82-03400 1507 5E

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 1511 5D

Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 1511 5E

Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 1512 5E

COMPREHENSIVE PLANNING
Great Lakes International Surveillance Plan,
W82-00701 1502 6E

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 1504 6E

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 1507 6D

The Wisconsin Soil and Water Conservation District as an Institution to Undertake Subwatershed Planning to Control Non-Point Source Water Pollution,
W82-04212 1509 6A

COMPRESSIBILITY
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 1504 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 1504 2F

Densification of Paper Mill Sludge Materials,
W82-04694 1510 5E

COMPRESSIBLE FLOW
Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

COMPUTER APPLICATIONS
Basin Management in the San Bernardino Basin Area,
W82-00280 1501 6A

COMPUTER MODELS
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 1501 6A

Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 1501 3F

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 1501 5F

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 1502 2E

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 1502 2B

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 1502 6E

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 1502 6A

Computer Modeling of Los Angeles Water Resources,
W82-01168 1503 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 1505 6A

Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 1505 6A

Optimal Stream-Aquifer Development,
W82-02575 1505 6A

Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 1506 7B

The Computer: Water Management Tool,
W82-03290 1507 6A

Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

Modeling the Transport of Heat, Water, and Solute in Unsaturated Soil and Earth Materials,
W82-03958 1509 5B

Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants,
W82-04026 1509 5D

A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 1510 5B

Application of the Area of Review Concept,
W82-04674 1510 6E

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 1511 2E

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 1511 5B

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 1511 6A

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 1512 2E

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 1512 2G

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 1512 5G

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 1512 2H

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 1512 6B

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 1512 5G

COMPUTER PROGRAMS

Ground-Water Modeling: Recent Developments,
W82-00281 1501 2F

Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 1502 3F

A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 1503 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 1504 2F

Loop Equations with Unknown Pipe Characteristics,
W82-02258 1505 3F

Interactive Nonstructural Flood-Control Planning,
W82-02320 1505 6F

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 1507 2F

Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 1508 2F

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 1508 2G

The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works,
W82-03850 1509 5D

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 1510 5B

Computer-Aided Evaluation of Peru's Hydropower,
W82-05515 1511 6A

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 1511 2A

Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 1512 2H

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 1512 5D

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 1512 2E

TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 1512 4A

Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 1512 5F

COMPUTERS

Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 1501 6A

Empire Controlled by Computer,
W82-00529 1502 5D

Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 1505 7C

How Computers Have Changed Water Works Operations,
W82-02276 1505 5F

Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 1505 6A

Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

Flood Routing Program,
W82-03286 1507 4A

Improving Treatment Works Efficiency,
W82-03500 1508 5D

Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works,
W82-03850 1509 5D

Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

Microprocessor Architecture and Performance in Wastewater Process,
W82-04056 1509 5D

Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 1510 5D

Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 1510 5D

Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 1511 5F

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 1511 5A

Microcomputer Water Quality Simulation Model,
W82-05191 1511 7B

A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 1511 5D

A River Coding System for Water Quality Archives,
W82-05474 1511 7A

Evolution of Water Management Techniques,
W82-05565 1511 6A

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 1511 5D

Role of the Microcomputer in Water Management,
W82-05771 1511 7B

Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 1512 5D

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

Computer-Guided Linear Irrigator Marches on,
W82-06817 1512 3F

CONCORD

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 1510 6E

CONCRETE

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 1506 8A

World's First All-Rollcrete Dam,
W82-05999 1512 8F

CONCRETE ADDITIVES

Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 1512 8F

CONCRETE CONSTRUCTION

Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 1502 5A

An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 1503 8F

Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 1506 8G

Water Tanks in Reinforced Concrete,
W82-06604 1512 8F

CONCRETE DAMS

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 1511 8A

Relaxation in Concrete,
W82-05511 1511 8F

CONCRETE MIXES

Cavitation Resistance of Concrete,
W82-03165 1507 8F

Concrete for Surfaces of High-Head Spillways,
W82-05110 1511 8F

Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 1512 8F

CONCRETE TECHNOLOGY

Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 1505 8A

Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 1506 8B

Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 1506 8A

Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 1507 8F

Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 1507 8A

Mix Design Parameters for Concrete Containing Chemical Admixtures,
W82-06397 1512 8F

CONCRETE TESTING

Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 1507 8G

Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 1511 8A

CONCRETES

Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

Absolute Roughness of Concrete-Lined Channels,
W82-03397 1507 8B

Site Investigation and Materials Save Money on Sallente,
W82-05878 1511 8A

CONDENSATES

Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 1501 5D

The Removal of Organic Matter from Demineralised Water,
W82-00888 1502 5F

Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 1508 5F

Mixed Bed Technology for Polishing Make-up Water and Condensate Return: Conclusion,
W82-03774 1505 5D

CONDENSATION

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 1512 2K

On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 1512 2B

CONDENSERS

Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

CONDUCTANCE

Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 1512 5B

CONDUCTION

Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 1506 2F

CONDUCTIVITY

Cation Chromatography With a Conductivity Detector,
W82-00582 1502 5A

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 1503 2G

Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 1504 5D

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 1504 7B

Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 1507 2G

On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 1507 3C

Intensive Survey of the Sabine-Neches Canal - Segment 0703,
W82-04078 1509 5A

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

CONDUITS

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 1505 8A

Coefficient of Friction in Conduits with Large Roughness,
W82-02901 1506 8B

Wedge-Block Tunnels in Water Supply,
W82-05603 1511 8F

CONFERENCES

International Conference on the Effects of Acid Rain Urges More Research in Critical Areas,
W82-02311 1505 5C

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 1511 3A

CONFINED AQUIFERS

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 1505 2F

Ground-Water Recharge from Rectangular Areas,
W82-02791 1506 2F

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 1511 2F

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

CONFINED GROUNDWATER

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 1501 4B

CONGRESSIONAL POLICY

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 1503 6B

CONJUNCTIVE USE

Operating Policies for a Surface/Ground Water System,
W82-01741 1503 4B

Food and Energy Production: Conjunctive Water Planning,
W82-01856 1504 3C

Local Irrigation Agencies,
W82-04560 1510 4B

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 1511 4B

CONNATE WATER

Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 1508 2K

CONNECTICUT

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

PCBs in the Housatonic River: Determination and Distribution,
W82-02255 1505 5A

Reservoir Improvements as a Key to Source Quality Control,
W82-04145 1509 5G

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

Year-Round Distribution System Maintenance,
W82-04699 1510 5F

Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 1511 5D

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 1512 2H

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 1512 5G

CONNECTICUT RIVER

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 1512 2L

CONSEQUENT STREAMS

Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 1505 2F

CONSERVATION

Health Aspects of Urban Water Conservation,
W82-01047 1502 3C

Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 1503 4B

Agricultural Conservation Program: An Evaluation,
W82-02019 1504 3F

Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 1512 6D

CONSERVATION TILLAGE

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

CONSTRUCTION

Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 1501 6B

Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 1501 6G

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 1501 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 1501 6G

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

The Waterway That Cannot be Stopped,
W82-00510 1502 6E

Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

Large Rubble-Mound Breakwater Failures,
W82-00862 1502 8D

The River Ouse Water Supply Scheme,
W82-01371 1503 5F

Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 1506 8A

Engineering Responds to Ecology,
W82-02935 1506 5D

Digest of Water Resources Policies and Authorities.
W82-02973 1506 6E

Why Bother with Historic Preservation,
W82-03384 1507 8A

How Do You Build When Sewers Are Inadequate,
W82-03592 1508 5D

Highlights of the St. Mary's Redevelopment Project,
W82-03617 1508 8A

A Surface Water Outfall Sewer for Bournemouth By-Pass.
W82-04003 1509 8A

Riding Mill Pumping Station,
W82-04292 1510 8A

Adopting Sewers,
W82-04655 1510 8A

The Expansion of Two Bolivian Plants,
W82-05598 1511 8A

The Agus II Scheme in the Philippines,
W82-05599 1511 8A

Large Water and Hydroelectric Developments in Fiji,
W82-05614 1511 6D

Embankment Construction: New Melones Dam,
W82-05822 1511 8D

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 1511 4D

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 1512 8A

CONSTRUCTION COSTS
Low-Cost Wastewater Treatment,
W82-00841 1502 5D

Value Engineering Saves Dam Project,
W82-03287 1507 8A

Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

Optimum Depth and Spacing of Subsurface Drains,
W82-05693 1511 8B

A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 1512 5E

CONSTRUCTION EQUIPMENT
Tunnelling Machine Saves Time and Money,
W82-05513 1511 8H

CONSTRUCTION JOINTS
Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 1506 8A

CONSTRUCTION MATERIALS
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 1502 5F

Trends in Wastewater Collection Systems,
W82-02573 1505 8G

Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 1511 8F

World's First All-Rollcrete Dam,
W82-05999 1512 8F

CONSTRUCTION METHODS
Redesign Controls Manhole Leakage,
W82-01237 1503 8G

Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 1508 3B

Groundwater Control,
W82-04714 1510 4B

CONSUMPTIVE USE
Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 1504 2D

Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 1505 6G

Consumptive Water Use by Opium Poppy,
W82-03356 1507 2I

Water Use in Manufacturing,
W82-04070 1509 6D

Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports,
W82-05067 1511 2D

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

CONTACT STABILIZATION
Operation and Performance of a New Activated Sludge Process: The Contact Stabilization Extended Aeration Hybrid,
W82-05417 1511 5D

CONTAMINANTS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 1502 5C

Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada,
W82-03107 1507 5A

CONTAMINATION
Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 1501 5B

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 1503 5B

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 1504 5A

Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 1510 5B

Contaminant Dispersion in Oscillatory Flows,
W82-05631 1511 5B

Hazardous Material Spills--Are You Ready,
W82-06417 1512 5G

CONTINUING EDUCATION
Professional Development for Water Quality Control Personnel,
W82-03531 1508 9A

CONTINUITY EQUATION
Solution of the Continuity Equation for the Karnak Area,
W82-03196 1507 2G

CONTOURS
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 1501 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 1502 7C

Contourites in Lake Superior,
W82-01935 1504 2H

CONTROL SYSTEMS
Control Systems for Return and Waste Sludge,
W82-00949 1502 5D

Automatic Class-A Pan-Filling System,
W82-01326 1503 7B

Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 1506 4B

A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 1506 7B

Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 1507 8C

Improving Treatment Works Efficiency,
W82-03500 1508 5D

Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 1508 5F

Requirements and Application of Control and Automation Systems in Wastewater Treatment-A Critical View,
W82-03858 1509 5D

Evaluation of the Resident Mass of Sludge in Final Sedimentation Tanks for Waste Sludge Control,
W82-04015 1509 5D

A Control System for Smaller Wastewater Treatment Plants,
W82-04024 1509 5D

A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

Problems and Solutions on Sludge Level Measurement,
W82-04055 1509 5D

Water Level Control for Small Hydro Plants,
W82-04173 1509 8C

Estimation and Control Problems in Activated Sludge Processes,
W82-04612 1510 5D

Computer-Based Implementation of Combined Sewer Control,
W82-04783 1511 5D

Advanced Supervisory Control System for Sludge Treatment,
W82-04841 1511 5D

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 1511 5F

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 1511 5D

Conversion of Rapid Gravity Filters to Fully Automatic Operation Using a Programmable Logic Controller,
W82-05802 1511 5F

The Chertsey Automation Project at North Surrey,
W82-05805 1511 5F

Simulating and Improving Hydro Plant Control,
W82-06202 1512 8C

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflusssteuerung von Regenwasserbehandlungsanlagen),
W82-06633 1512 8C

Making Chlorination Trustworthy,
W82-06639 1512 5F

CONVECTION

Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 1506 2F

Convection Patterns in a Pond,
W82-04461 1510 2C

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

CONVECTIVE PRECIPITATION

Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 1504 2B

A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

CONVEYANCE STRUCTURES

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 1501 6G

Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 1502 3F

Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 1507 3F

Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 1508 8A

Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 1511 8A

COOLING

Cooling Potential of Missouri River in Missouri,
W82-01654 1503 5B

COOLING PONDS

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 1502 5C

Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 1506 2H

Efficient Cooling Ponds: Design,
W82-03672 1508 8A

Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772 1509 2H

Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 1512 5C

COOLING TOWER

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 1511 2D

COOLING TOWERS

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 1503 3E

Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 1503 2B

Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 1503 2B

Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 1503 3C

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 1512 3E

Treatment of Cooling Systems Containing High Levels of Legionella Pneumophila,
W82-06769 1512 5F

COOLING WATER

Domestic Water Supplies for Power Plant Cooling,
W82-00180 1501 6D

Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 1501 8A

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 1502 3C

Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 1502 6G

Effects of Water Quality on Forage Production,
W82-01002 1502 3C

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 1502 3E

Power Industry Wastes,
W82-01265 1503 5B

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 1503 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 1503 8I

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 1503 5F

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 1504 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 1503 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 1503 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 1503 6D

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 1504 5C

Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 1506 3E

Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 1506 5C

An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 1507 7B

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 1507 5C

Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Mixed Bed Technology for Polishing Make-up Water and Condensate Return: Conclusion,
W82-03774 1509 5D

Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 3C

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 1510 5D

Vertical Round Buoyant Jet in Shallow Water,
W82-04365 1510 7C

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 1511 2D

Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 1511 5F

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 1512 6G

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 1512 5D

COON CREEK
Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 1503 2J

COOPER
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 1504 5A

COOPERATIVES
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

COPEPODS
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 1501 2H

Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 1502 5C

Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 1503 5C

Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 1504 5A

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 1505 2L

Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 1507 5A

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

COPPER
Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 1501 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 1501 2K

Effect of Copper on Nitrification in Activated Sludge,
W82-01497 1503 5C

Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 1503 5F

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 1504 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 1504 5C

A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 1505 5B

Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 1511 5A

Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 1511 5B

Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 1512 5F

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 1512 5D

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 1512 5B

Liquid-Liquid Extraction Combined with Atomic-Absortpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 1512 5A

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

COPPER SULFATE
Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 1505 5C

COPROSTANOL
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

CORE DRILLING
Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

CORE SAMPLING
Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

CORER
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 1502 7B

CORES
Design of Filters for Clay Cores of Dams,
W82-04321 1510 8G

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 1510 7C

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

CORN
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 1501 2D

Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 1502 3C

Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 1503 2I

Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 1505 2I

Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 1511 2I

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

CORN BELT
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 1502 6A

CORPS OF ENGINEERS
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 1501 6B

CORPUS CHRISTI BAY ESTUARY TEXAS
Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 1505 2L

CORRELATION ANALYSIS
Space-Time Variability of the Runoff of European Rivers,
W82-02848 1506 2E

Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm,
W82-04864 1511 2B

Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

CORRELATION FUNCTIONS
Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 1508 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 1508 2B

CORROSION
A New Look at Design of Raw Water Piping,
W82-01029 1502 8A

Treatment of Sewage Plant Effluent for Use as Makeup Water,
W82-01585 1503 3C

The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 1511 8G

Sulfur Bacterial Problems Revisted,
W82-05264 1511 5B

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 1511 8G

Guidevane Erosion at Mao Tiao He,
W82-05600 1511 8G

The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 1512 5F

Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 1512 5C

CORROSION CONTROL
Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 1507 8G

Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 1507 8G

Corrosion Roundtable–Opportunities/Pitfalls for New Materials,
W82-03373 1507 8G

The Costs of Internal Corosion in Water Systems,
W82-03809 1509 5F

An Experimental Approach to Corrosion Control,
W82-04099 1509 5F

Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

Laboratory Technique for Measurement of pH for Corrosion Control Studies and Water Not in Equilibrium with the Atmosphere,
W82-04101 1509 5G

The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 1510 5F

Regulating Corrosive Water,
W82-04335 1510 6B

The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 1511 8G

Advanced Coatings for the Water Industry.
W82-06603 1512 8G

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

CORROSION INDEX
The Search for a Corrosion Index,
W82-04279 1510 5F

CORROSION POTENTIAL
Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

COSMETIC INDUSTRY
Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 1510 5F

COST ALLOCATION
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 1502 6B

Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 1506 5G

Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 1510 6C

A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 1512 5D

Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 1512 6C

Cost Allocation in Water Resources Development,
W82-06854 1512 6C

COST ANALYSIS
Optimal Design of Water Conveyance Systems,
W82-00160 1501 6B

Optimization of Pump Turbines,
W82-00181 1501 8C

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 1502 6C

Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 1502 5D

Expansion of Effluent Constrained Treatment Plants,
W82-01355 1503 5D

Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 1503 4B

Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

Cost of Small Water Supply Treatment Systems,
W82-02318 1505 5F

Energy Management in the Water Works Industry,
W82-02608 1506 5F

Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 1506 8B

Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 1506 6C

Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 1506 5D

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 1506 5D

Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 1507 6B

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 1507 5D

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 1508 6B

'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment,
W82-03848 1509 5D

Investigation on Constant F/M Ratio by Adaption of Aeration Tank Volume,
W82-03860 1509 5D

Method of Evaluating the Possible Energy Savings by Implementing Do-Control or Fine Bubble Diffusors,
W82-04007 1509 5D

O & M Costs and Optimal Capacity Expansion,
W82-04042 1509 6B

Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control,
W82-04063 1509 5G

The Cost of Peak Capacity Water,
W82-04065 1509 6B

Cost-Effectiveness Analysis for On-Site Wastewater Treatment Alternatives,
W82-04185 1509 5D

Small Hydro Schemes for Private Developers,
W82-04327 1510 8A

Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 1510 3F

Granular Activated Carbon Installations,
W82-04391 1510 5F

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

Bottom-Entry Large-Diameter Wells,
W82-04919 1511 8A

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 1511 5G

Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

Robustness of Water Resources Systems,
W82-05077 1511 6A

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 1511 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 1511 6B

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 1511 5G

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 1511 5G

An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 1512 6B

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 1512 5F

A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 1512 3A

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

Statistical Cost Function for Water Mains,
W82-06252 1512 6C

Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

COST-BASED WATER RATES
Cost-Based Water Rate Design,
W82-06277 1512 6C

COST-BENEFIT ANALYSIS
Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 1501 4A

Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

Evaluating Irrigation Systems,
W82-00772 1502 6B

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 1502 6B

Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 1504 6B

Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 1505 3A

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 1505 6B

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 1505 6D

In-Home Conservation and Wastewater Management,
W82-02591 1505 3D

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

West Sacramento Canal Unit Reformulation.
W82-02974 1506 6B

Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 1507 6B

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 1508 6B

Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

Water Metering and Conservation,
W82-03562 1508 3D

Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 1508 8A

Upgrading to Increase Treatment Capacity,
W82-03654 1508 5F

The Costs of Internal Corosion in Water Systems,
W82-03809 1509 5F

Household Water Use: Technological Shifts and Conservation Implications,
W82-03910 1509 3D

A Retrospective Benefit-Cost Analysis of Water Resource Projects in The Cumberland River Basin,
W82-03917 1509 6B

Panoche Creek Flood Protection Works.
W82-04068 1509 4A

A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II, W82-04084 1509 3A

The Optimum Size of Small Run-Of-River Plants, W82-04175 1509 8A

Sizing and Selecting Modern Water Meters, W82-04194 1509 6D

Projective Evaluation During Inflation, Revisited: A Solution to Turvey's Relative Price Change Problem, W82-04202 1509 6B

An Ex Post Analysis of the Uncompahgre Project, W82-04218 1509 6B

Energy, Environmental, and Economic Implications of Some Recent Alberta Water Resources Projects, W82-04226 1509 6B

Auburn Dam: A Case Study of Water Policy and Economics, W82-04260 1510 6B

Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach, W82-04287 1510 6B

Regulating Corrosive Water, W82-04335 1510 6B

Soil and Water Regimes for Optimum and for Maximum Yields, W82-04415 1510 3F

Reversing Water Pollution Standards in an Uncertain World, W82-04540 1510 6B

Determining Feasibility of Small-Scale Hydropower, W82-04693 1510 6B

Input-Output and Benefit-Cost Analysis for Water Resource Development Projects, W82-04733 1510 6A

Virginians Optimize Sludge Handling, W82-05171 1511 5D

An Evaluation of Twin Wells for Use with Water Source Heat Pumps, W82-05307 1511 8B

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications, W82-05309 1511 3A

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana, W82-05535 1511 8B

Economic Evaluation of Watershed Projects--An Overview Methodology and Application, W82-05735 1511 6B

A Review of the Benefit-Cost Analyses of Two Southern Alberta Dams, W82-05766 1511 6B

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas, W82-06170 1512 4D

Economics, W82-06998 1512 5G

COST COMPARISONS

UV Disinfection for Onsite Sand Filter Effluent, W82-05937 1512 5D

COST EFFECTIVENESS

Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung), W82-04545 1510 5D

COST ESTIMATES

Maps--A Planning Tool for Corps of Engineers Regional Water Supply Studies, W82-04228 1509 6A

COST SHARING

Agricultural Conservation Program: An Evaluation, W82-02019 1504 3F

Trends in State and Federal Policy on Water Supply Management, W82-02516 1505 6E

Water Savings in the Orange Water and Sewer Authority, W82-02519 1505 3D

Theory and Reality in Allocating Federal Resources to Water Resources Development, W82-04224 1509 6E

Financing Federal Water Development Projects and Sharing the Costs, W82-04739 1510 6C

COSTA DE HERMOSILLO

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals, W82-02547 1505 5B

COSTA RICA

Corobici Completion Ensures Costa Rica's Power Output, W82-05755 1511 8C

COSTS

The Waterway That Cannot be Stopped, W82-00510 1502 6E

Treatability Manual; Volume IV. Cost Estimating, W82-01076 1502 5D

Cost Effective Ground Water Monitoring, W82-01113 1503 4B

Energy Requirement for Small Wastewater Treatment Systems, W82-01185 1503 5D

Economics, W82-01304 1503 5G

The Dilution/Flushing Technique in Lake Restoration, W82-02270 1505 2H

Effluent Charging Systems and Their Administrative Implications, W82-02403 1505 6C

Wastewater Collection and Treatment in Wayne County, W82-02554 1505 5D

Energy Costs and Portland Water Supply System, W82-02586 1505 5F

Reduced Energy Usage with Biological Phosphorus Removal, W82-02705 1506 5D

The Costs of Compliance: An EPA Estimate for Organics Control, W82-04132 1509 6C

Modeling A Sociological-Hydrologic Flood Control Decision System, W82-04221 1509 6A

Renovation of Water Mains and Sewers, W82-04237 1509 5F

Optimal Design of Urban Storm Water Drainage Systems, W82-04414 1510 8A

Development of Hydro-Power in Nigeria, W82-04475 1510 6B

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges, W82-04597 1510 5D

Costing Dar-Es-Salaam's Sanitation Plan, W82-04603 1510 6C

Clean Water for the Third World, W82-04604 1510 6D

Costs for Small Systems to Meet the National Interim Drinking Water Regulations, W82-04793 1511 5C

Cutting Irrigation Costs, W82-05081 1511 3F

Cost of Wash Houses and Comfort Stations at Recreation Areas, W82-06042 1512 6C

New Bubble Diffusers Reduce Treatment Costs, W82-06513 1512 5D

COTTON

Water Conservation in Cotton by Drought Induced Leaf Surface Wax Synthesis, W82-03946 1509 3F

Effects of Decreased Watering on Crop Yields, W82-04411 1510 2I

The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay, W82-06010 1512 3F

Effluent in Trickle Irrigation of Cotton in Arid Zones, W82-06333 1512 3C

COWPEA

Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab, W82-04178 1509 3F

CRABS

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus, W82-01679 1503 5C

Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant, W82-06306 1512 5D

CRACKS

An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs, W82-01396 1503 8F

CRAYFISH

Preference-Avoidance Reactions of Crayfish to Sublethal Concentrations of Cadmium, W82-00916 1502 5A

CREEP

Relaxation in Concrete, W82-05511 1511 8F

CREOSOTE

Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source, W82-05042 1511 5B

CRESOLS

Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

CREST GAGES

The V-Shaped Broad-Crested Weir,
W82-06450 1512 8B

CROFTON UNIT

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

CROP PRODUCTION

Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 1501 2J

Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 1501 2I

Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 1502 6A

Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 1502 2I

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 1502 2I

Water Requirement for Sugarcane Production,
W82-00899 1502 3F

Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 1503 4A

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 1503 2I

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 1504 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 1504 2I

Aerated Drip Irrigation,
W82-02186 1505 3F

Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 1507 2I

Modeling the Economics of Ground Water Management,
W82-03733 1508 4B

Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows,
W82-03914 1509 3F

Sugar Beet Production as Influenced by Water Stress,
W82-04086 1509 3F

Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 1510 3F

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 1510 3F

The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 1511 3F

Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 1511 3F

CROP RESPONSE

Effects of Decreased Watering on Crop Yields,
W82-04411 1510 2I

CROP YIELD

Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

Effect of Irrigation and Tree Density on Peach Production,
W82-00120 1501 2I

Nitrogen Availability from Sewage Sludge,
W82-00158 1501 5E

Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 1502 3C

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 1502 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 1502 3F

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 1503 2I

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 1503 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 1503 2D

The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 1503 3F

Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 1503 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 1503 2I

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 1503 3F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 1503 2G

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 2I

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 1504 3F

Optimal Design of Border Irrigation Systems,
W82-01977 1504 3F

Solar Heat Pond System,
W82-02187 1505 3F

Wheat Response to Drought,
W82-02242 1505 2I

Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

Irrigation Requirements of Field-Pea for Grain,
W82-02395 1505 2I

Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 1506 3F

Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 1506 3F

Cereal Yields and Drought Resistance,
W82-03195 1507 2I

Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 1507 2I

Wheat Yield Estimation in Northwest Iran,
W82-03267 1507 2I

Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 1507 2I

Consumptive Water Use by Opium Poppy,
W82-03356 1507 2I

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 1508 3C

An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

Effect of Field Levelling Quality on Irrigation Efficiency and Crop Yield,
W82-03789 1509 3F

Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 1510 2G

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 1511 2I

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 1511 3F

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

CROP YIELDS
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 1502 2I

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 1503 5E

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 1505 3C

CROPLAND
Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 1501 2G

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

Dryland Management for Salinity Control,
W82-01018 1502 2G

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 1504 2J

Drainage of Agricultural Lands.
W82-04069 1509 4A

CROPPING PATTERNS
The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

CROPS
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 1503 2I

Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 1505 3F

CROSS-SECTIONS
A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

CRUDE OIL
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

CRUISES CREEK RESERVOIR
Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

CRUSTACEANS
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 1506 5C

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 1507 5B

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

CRYSTAL GROWTH
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

Non-Equilibrium Water/Rock Interactions,
W82-01684 1503 1A

Configuration of Ice in Frozen Media,
W82-05615 1511 2C

CRYSTAL LAKE
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 1501 5D

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5B

CRYSTALLINE ROCKS
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 1501 5E

CRYSTALLIZATION
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 1504 2B

Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 1507 5D

Water Softening by Crystallization,
W82-03750 1508 5F

A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

CUBATURE
A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

CULTIVATED LANDS
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 1501 2J

CULTIVATION
Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 1502 3F

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

Deep Tillage of Irrigated Pullman Clay Loam--A Long-Term Evaluation,
W82-04372 1510 2G

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

CULTURE MEDIA
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 1503 5A

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 1503 5A

A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 1503 5A

Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W32-04277 1510 5A

Isolation and Characterization of Cellulolytic Bacteria from Activated Sludge,
W82-04854 1511 5D

CULTURES
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 1504 5C

A Culture Model for Phytoplankton Succession in the Potomac River Near Washington, D.C. (U.S.A.),
W82-03765 1509 5B

CULTURING TECHNIQUES
Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 1512 3C

CULVERTS
Legal Challenge of the Ungaged Watershed,
W82-0166[illegible] 1503 2E

Evaluating Scour at Culvert Outlets,
W82-01934 1504 4D

Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
W82-04075 1509 8I

Tapered Inlet Design Using Specific Energy Curves,
W82-04695 1510 8A

Northern Elbe Culvert,
W82-05427 1511 8B

CUMBERLAND COUNTY
Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 1511 2F

CUMBERLAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 1504 6D

A Retrospective Benefit-Cost Analysis of Water Resource Projects in The Cumberland River Basin,
W82-03917 1509 6B

CUMULATIVE RUNOFF
Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 1505 2A

CURRENT METERS
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 1503 2L

CURRENTS
The Tidal Stream in the German Bight,
W82-05190 1511 2L

Circulation Patterns; Their Investigation and Prediction,
W82-06477 1512 5F

CUTOFFS
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 1503 8D

CYANIDE
Electroplating and Cyanide Wastes,
W82-01266 1503 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 1512 5A

Electroplating and Cyanide Wastes,
W82-06798 1512 5D

CYANOPHYTA
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 1505 5A

Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

CYANURIC ACID
Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 1512 5F

CYCLING NUTRIENTS
Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 1501 5B

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 1503 5D

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

Nutrient Cycling in an Agricultural Watershed: Waterborne Nutrient Input/Output Budgets for the Riparian Zone,
W82-03825 1509 5B

Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 1510 6G

Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 1511 2H

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

CYCLONES
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 1501 2B

CYCLOPS
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

CYPRESS CREEK
Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

CYPRESS DOMES
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 1503 5G

CYPRESS SWAMPS
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

CYTOPHAGAS
Occurrence of Cytophagas in Sewage Plants,
W82-00682 1502 5A

CZECHOSLOVAKIA
Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

DABOB BAY
The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

DADE COUNTY
Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

DAILY HYDROGRAPHS
Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 1506 2C

DAIRY INDUSTRY
Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 1501 5E
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D
Dairy Wastes,
W82-01258 1503 5D
Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B
Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 1508 5D
Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B
Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 1511 3C
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C
Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 1511 5D
Dairy Wastes,
W82-06921 1512 5D

DAM CONSTRUCTION
Dam Construction in China.
W82-00334 1501 8A
A New Era for China's Hydropower,
W82-00335 1501 8A
A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 1501 8D
Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 1502 6G
Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 1503 8A
Northfield Mountain Pumped Storage Project: Performance,
W82-01517 1503 8A
Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 1503 5D
Morocco's Largest Multipurpose Scheme,
W82-01724 1503 8A
Passing Floodwaters Over Embankment Dams,
W82-02204 1505 8A
Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 1506 8A
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A
Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 1507 8F
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 1508 8A
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 1511 8D
Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 1511 8A
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A
Embankment Construction: New Melones Dam,
W82-05822 1511 8D
Design Technique Development for Dams in South Africa,
W82-06011 1512 8A
Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A
The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 1512 8D
The Kielder Headworks,
W82-06504 1512 8A
Brantas Dams Trigger New Javanese Development,
W82-06818 1512 3F

DAM DESIGN
Dam Construction in China.
W82-00334 1501 8A
Siting and Design of Tailings Impoundments,
W82-01588 1503 8A
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 1506 8A
Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 1506 8A
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 1507 8A
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 1508 8A
Design of Filters for Clay Cores of Dams,
W82-04321 1510 8G
Shaft Spillways Combined with a Water Intake,
W82-05111 1511 8A
Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 1511 8A
Application of and Guidelines for Using Available Dam Break Models,
W82-05152 1511 8A
Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 1511 8A
Planning Sri Lanka's Victoria Scheme,
W82-05979 1512 8A
Design Technique Development for Dams in South Africa,
W82-06011 1512 8A
The Value of Inspection Galleries,
W82-06204 1512 8D
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A
The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 1512 8A
Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Ueberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

DAM EFFECTS
Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 1501 6G
Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 1501 6G
Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 1501 6G
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G
Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 1507 6G
Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H
Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G
Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 1511 4A
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G
Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A
Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

DAM FAILURE
Modeling Gradual Dam Breaches,
W82-00554 1502 8D

Slope Failures and Tailing Dam Damage in the 1978 Izu-Oshima-Kinkai Earthquake,
W82-02831 1506 8D

Mathematical Modeling of Earth Dam Breaches,
W82-03532 1508 6A

Numerical Solution of the Dam Failure Problem by the Random Choice Method,
W82-03872 1509 8A

Mathematical Simulations of The Toccoa Falls, Georgia Dam Break Flood,
W82-03920 1509 2E

A Decision Theory Approach to Earth Dam Classification,
W82-04152 1509 8A

Asymptotic Solution for Dam-Break Problem,
W82-04313 1510 8B

Safety of Dams Judged from Failures,
W82-05512 1511 8A

Safety Aspects in the Design and Inspection of Dams,
W82-06203 1512 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 1512 8A

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 1512 8B

Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 1512 8B

DAM FAILURE; *FLOODS

Application of and Guidelines for Using Available Dam Break Models,
W82-05152 1511 8A

DAM FOUNDATIONS

Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 1504 8A

Uplift Pressure of Water on the Base of Hydraulic Structures in Limit Design States (Discussion of Construction Specifications),
W82-05582 1511 8A

Bearing Capacity of Sand Bases (Discussion of Construction Specifications),
W82-05583 1511 8D

DAM SAFETY

Application of and Guidelines for Using Available Dam Break Models,
W82-05152 1511 8A

DAM STABILITY

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 1504 8D

Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 1506 8D

Calculation of Foundations and Earth Dams,
W82-02689 1506 8D

Calculation of Earth Dams Being Undermined,
W82-03162 1507 8D

Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 1508 8D

Model Studies of an Overtopped Rockfill Dam,
W82-03694 1508 8E

A Decision Theory Approach to Earth Dam Classification,
W82-04152 1509 8A

Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 1511 8A

Measuring Reservoir Ground Movements,
W82-05773 1511 8G

Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 1511 8D

DAMAGE

Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00309 1502 4D

DAMS

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 1501 6E

Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 1502 8D

Sediment Surveys in the Department of Water Affairs,
W82-00680 1502 7B

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 1502 6G

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 1502 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 1502 6E

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 1502 6G

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

Hydropower--An Old Technology for a New Era,
W82-01593 1503 4A

Recent Changes in Level of Lake Victoria,
W82-01711 1503 4A

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 1503 4A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 1505 2E

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 1505 8A

Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 1506 4D

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 1506 8A

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 1506 4A

Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 1507 6B

Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

Airy Holm Dam - Kielder Water Scheme,
W82-03070 1507 8A

Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 1507 8A

Value Engineering Saves Dam Project,
W82-03287 1507 8A

Why Bother with Historic Preservation,
W82-03384 1507 8A

The New Energy Boom: Small-Scale Hydropower,
W82-03462 1508 8A

Small and Low-Head Hydro in the USA,
W82-04176 1509 8A

Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 1510 6B

Small Hydro Schemes for Private Developers,
W82-04327 1510 8A

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 1511 8B

Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 1511 6D

The Riviersonderend-Berg River-Jonkershoek Project Most Outstanding Civil Engineering Achievement of 1980.
W82-04886 1511 8A

The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

The Agus II Scheme in the Philippines,
W82-05599 1511 8A

World's First All-Rollcrete Dam,
W82-05999 1512 8F

Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 1512 8I

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 1512 2J

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 1512 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 1512 8A

Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen).
W82-06237 1512 8B

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 1512 8D

Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 1512 8G

Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 1512 8C

DAMS *FLOOD CONTROL
Olmos Dam Modification.
W82-06186 1512 8A

DANBURY
Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

DANUBE ESTUARY
Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 1506 2L

DANUBE RIVER
A Large International River: The Danube,
W82-03369 1507 5G

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

New Trends in Water Quality Management,
W82-05429 1511 5G

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 1511 5B

DANVERS
Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 1502 5F

DAPHNIA
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 1504 5C

Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 1511 3C

DARCY'S EQUATION
Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

DARCYS LAW
Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

DATA ACQUISITION
Where Do We Go from Here.
W82-02086 1504 7A

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 1505 7A

Automatic Collection and Transmission of Data for the Federal Waterway Authority.
W82-04596 1510 7A

Data Acquisition for River Management,
W82-04601 1510 7A

Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 1511 7B

DATA ACQUISTION
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 1511 7B

DATA ANALYSIS
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 1512 2C

DATA COLLECTION
Great Lakes International Surveillance Plan,
W82-00701 1502 6E

Remote Sensing Applications for Resource Management,
W82-03279 1507 7B

DATA COLLECTIONS
Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 1502 4B

Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 1503 5D

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 1503 7C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 1503 2E

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 1503 7C

Where Do We Go from Here.
W82-02086 1504 7A

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 1505 7C

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 1505 2F

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 1505 7C

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 1505 7C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 1505 7C

Water Quality Data, Mackenzie River Basin 1960-1979.
W82-02506 1505 7C

Canada Water Year Book 1977-1978.
W82-03099 1507 7C

Water Resources Investigations in Mississippi 1980-81.
W82-03988 1509 7C

Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma,
W82-03999 1509 2E

Water Use Data--Who Needs It,
W82-04198 1509 7C

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 1510 7C

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 1510 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 1510 7C

Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 1511 7C

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

On Hydrological Data Needs in Canada,
W82-05764 1511 7B

Role of the Microcomputer in Water Management,
W82-05771 1511 7B

The Mackenzie River Basin Study,
W82-05778 1511 4A

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 1511 7C

Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 1512 2A

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

Implications for the Water Industry of the Notification Scheme for New Chemicals,
W82-06261 1512 6E

Canadian Wave Climate Study: Organization and Operation,
W82-06393 1512 8B

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 1512 7C

A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981,
W82-06673 1512 7C

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

DATA COLLECTIONSS
Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 1508 10B

DATA INTERPRETATION
Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

DATA PROCESSING
Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 1505 7C

Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 1512 2H

Microprocessors and Computers in Analysis in the Water Industry,
W82-06259 1512 5F

DATA STORAGE AND RETRIEVAL
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 1501 10D

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

Access to Water-Related Data in Texas,
W82-04000 1509 10B

Water Use Data--Who Needs It,
W82-04198 1509 7C

TNRIS: A Source for Water-Related Data in Texas.
W82-04651 1510 10B

An Interactive Data Management System for River Water Quality Data,
W82-04659 1510 10B

Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 1512 2H

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

The Practical Handling of Water Quality Monitoring Data,
W82-06591 1512 7C

DATA TRANSMISSION
Where Do We Go from Here.
W82-02086 1504 7A

Microprocessor Architecture and Performance in Wastewater Process,
W82-04056 1509 5D

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 1510 7B

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 1510 7B

Automatic Collection and Transmission of Data for the Federal Waterway Authority.
W82-04596 1510 7A

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 1511 7B

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 1512 7B

DATING
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 1503 2F

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 1508 5B

Hydrological Studies Possible with Radionuclides of Bomb-Test, Primordial and Natural Origin to Complement Investigations Using Manufactured Radiotracers,
W82-03836 1509 5B

A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 1510 2E

DDE
Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 1502 5C

DDT
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 1503 5C

DEAD SEA
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 1508 2K

DEBRIS BASINS
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

DEBRIS CONE
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 1503 2E

DECHLORINATION
Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 1506 5C

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

DECIDUOUS FORESTS
The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 1503 5B

DECISION MAKING
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 1501 6D

The Consultant's Viewpoint on Alternative Disinfectants,
W82-00286 1501 6A

Using Ecological Knowledge for Development Planning,
W82-00671 1502 6A

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 1504 6A

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 1504 6B

Acid Rain and Environmental Policy,
W82-01987 1504 5B

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 1506 6B

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 1506 6B

Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

Multi-Attribute Decision Analysis for the Protection of Groundwater Resources,
W82-03805 1509 6A

Multi-Objective Decision Making in Water Management,
W82-04010 1509 6A

Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

Objectives and Constraints in Federal Water Resources Planning,
W82-04288 1510 6E

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 1510 6B

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

Operational Research Techniques in River Basin Management,
W82-05387 1511 6A

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 1511 6F

Evolution of Water Management Techniques,
W82-05565 1511 6A

Incentives and Institutions for Water Conservation,
W82-05922 1512 3D

Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 1512 6A

Power Plant Siting,
W82-06555 1512 6G

DECOMPOSING ORGANIC MATTER
Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 1502 5B

Effects of Pollution on Humic Substances,
W82-03253 1507 5C

Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 1511 2L

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

Humic Substances,
W82-05148 1511 5B

Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 1512 5C

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

DECOMPOSITION
Carbon Transformations in the Land Areas Receiving Organic Wastes in Relation to Nonpoint Source Pollution: A Conceptual Model,
W82-00179 1501 5B

Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 1502 2L

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 1502 5E

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 1503 3C

Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 1504 2H

Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 1505 5E

Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 1506 5C

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 1511 5B

Indoles in the Decomposition Products of Certain Blue-Green Algae,
W82-05505 1511 2H

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 1512 5C

DECONTAMINATION
New Jersey Community Decontaminates Well Water.
W82-02243 1505 5F

DEDHAM
Organic Contamination of Ground Water: Tell it All,
W82-01474 1503 5C

DEEP WELLS
Groundwater Problems in North Carolina,
W82-01056 1502 4B

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 1508 5E

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

Bottom-Entry Large-Diameter Wells,
W82-04919 1511 8A

DEFICIT IRRIGATION
Designing for Deficit Irrigation,
W82-06334 1512 3F

DEFLECTION
Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 1512 8I

DEFLUORIDATION
Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

DEFORMATION
The Steady State of Deformation,
W82-02235 1505 8D

Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 1507 8G

The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 1508 2F

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

DEGRADATION

Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 1501 5B

Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 1501 5B

Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 1501 5B

Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 1502 5B

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

Fate of Diflubenzuron in Water,
W82-02216 1505 5B

Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 1505 5B

Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 1508 5B

Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) 1. Pathway of the Direct Photolysis in Solution,
W82-04032 1509 5B

Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 1510 5B

Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 1512 2L

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

DEGREE-DAY FACTOR

On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 1503 2C

DEICERS

Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 1505 5B

DELAWARE

Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 1501 2L

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware,
W82-00755 1502 6E

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 1506 5B

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

DELAWARE ESTUARY

Dynamic Estuary Model Performance,
W82-05319 1511 2L

DELAWARE RIVER

Report of the River Master of the Delaware River for the Period December 1, 1979 -- November 30, 1980,
W82-03989 1509 4A

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 1511 2E

DELAWARE RIVER BASIN

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 1510 7C

DELMARVA PENINSULA

Using Computed Stream Flow in Watershed Analysis,
W82-01538 1503 2A

DELTAS

Sediment Yield from a Flatland Watershed,
W82-00941 1502 2J

Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 1505 2J

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 1506 6D

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 1512 2J

Sediment Transport Study Along a Delta Shoreline,
W82-06553 1512 2J

DEMINERALIZATION

Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 1506 5D

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 1506 5D

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

DENDROCHRONOLOGY

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 1505 2B

DENITRIFICATION

Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 1501 5D

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 1502 5F

Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

Denitrification Associated With Periphyton Communities,
W82-01814 1504 5B

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

Biological Nitrogen Control of Industrial Wastewater,
W82-03131 1507 5D

Biological Nitrogen Removal System Design,
W82-03145 1507 5D

The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 1507 5D

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria,
W82-03770 1509 5E

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 1510 5D

Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 1511 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Eliminating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

Biological Denitrification for Potable Water Treatment,
W82-05247 1511 5F

Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 1511 5B

Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 1512 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 1512 5D

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

DENMARK
Denmark's State of the Environment,
W82-02401 1505 5B

Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 1505 5C

Practical Experiences in Plants Using Activated Carbon,
W82-02788 1506 5F

Water Supply in Denmark,
W82-03274 1507 6D

Diversion of the River Neva,
W82-03304 1507 4A

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 1512 5C

DENSITY
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 1504 2G

Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

DENSITY CURRENTS
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 1511 2E

DENTRIFICATION
Dentrification,
W82-01246 1503 5D

DENUDATION
Drainage Density as an Index of Climatic Geomorphology,
W82-01324 1503 2A

Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 1506 2J

DENVER
Energy Minimization at Metro Denver Sewage District,
W82-03142 1507 5D

'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment,
W82-03848 1509 5D

Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

DEOXYRIBONUCLEIC ACID
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 1512 5A

DEPOSITION
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 1501 2J

Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 1502 2B

The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 1503 5B

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 1505 2F

Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 1507 5B

Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 1508 5D

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

DEPOSITION RATES
Predictions for Particle Deposition on Natural Waters,
W82-00264 1501 5B

DEPOSITION (SEDIMENTS)
Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

DEPRECIATION
Crisis: Financing Water and Wastewater,
W82-06641 1512 6C

DERBY
Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 1511 5D

DES ALLEMANDS
Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

DESALINATION
Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 1503 3A

Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 1503 3A

Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 1505 3A

Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 1505 3A

Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 1505 3A

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 1506 3A

Health Aspects of Water Desalination,
W82-03116 1507 3A

Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 1507 3A

Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 1508 3A

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 1508 3A

Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760 1509 5D

Municipal Ion Exchange: Waiting to Take Off,
W82-03837 1509 5F

Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

Water Conservation Under Conditions of Extreme Scarcity: The U.S. Virgin Islands.
W82-04170 1509 3A

Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 1510 3A

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

Low Temperature Evaporation Plants,
W82-05118 1511 3A

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 1511 3A

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 1511 3A

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05509 1511 3A

Water and Salt Transport in Membranes,
W82-05537 1511 3A

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 1511 3A

Seawater Ro Heads Japan's Water Reuse Research.
W82-05756 1511 3A

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 1511 5G

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

Desalination Directory 1981.
W82-05908 1512 3A

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 1512 3A

Work Potential: An Objective Basis for the Comparison of Desalination Processes,
W82-05977 1512 3A

Analysis of Large Desalination Plants,
W82-06122 1512 3A

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

DESALINATION APPARATUS
Superseparation: Soret Effect Reversed,
W82-00791 1502 3A

Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 1505 3A

Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 1511 3A

Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 1512 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 1512 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 1512 3A

Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 1512 3A

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

DESALINATION EQUIPMENT
Heat Transfer in a Rotating Disk Evaporator,
W82-06112 1512 3A

Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 1512 3A

DESALINATION PLANT
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 1510 3A

DESALINATION PLANTS
From Screening to Filtration: Treating the Water Supply,
W82-03739 1508 3A

Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

VTE/VC for Sea Water,
W82-04909 1511 3A

The Wellton-Mohwak Dilemma,
W82-05883 1511 3F

Freezing Processes - The Standard of the Future - An Update,
W82-06115 1512 3A

A Comprehensive Formal Approach to the Evaluation of Bids for Desalination Plants Using Verbal Judgement,
W82-06116 1512 3A

Analysis of Large Desalination Plants,
W82-06122 1512 3A

MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 1512 3A

Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 1512 3A

Salbukh Reverse Osmosis Plant on Stream,
W82-06127 1512 3A

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

DESALINATION PROCESSES
A Study of The Vacuum-Freezing High Pressure Ice-Melting Process,
W82-04166 1509 3A

A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 1512 3A

Myths about Freeze Desalting,
W82-06114 1512 3A

Analysis of Large Desalination Plants,
W82-06122 1512 3A

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 1512 3A

Apparatus for Desalinating Water,
W82-06711 1512 3A

DESALINATION WASTES
Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

DESALINTION
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 1511 3A

DESERT PLANTS
Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 1502 2D

Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 1502 2I

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 1502 2I

Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 1507 2I

Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 1510 2D

DESERTS
Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 1507 2I

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

DESIGN
GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 1507 5D

DESIGN CONSIDERATIONS
The Case for Specifying AWWA Butterfly Valves.
W82-00213 1501 8C

Tampa's Hookers Point Awt Plant Working Well.
W82-03455 1508 5D

How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme.
W82-05249 1511 5D

DESIGN CRITERIA
Optimal Design of Water Conveyance Systems,
W82-00160 1501 6B

Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 1501 5D

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems, W82-00291 1501 5D

Treatment Works–The Designer's Problems, W82-00312 1501 5F

Cavitation and Wear on Hydraulic Machines, W82-00331 1501 8C

Hydraulic Gates: The State-of-the-Art, W82-00332 1501 8C

Mathematical Efficiency Concerns in Water Distribution Network Considerations, W82-00339 1501 5F

Hydraulic Design for the Two-Stage Stilling Basin, W82-00849 1502 8B

Good Looks, Low Maintenance Guide Water Tank Choice, W82-00868 1502 5A

Sizing Rice Irrigation Canals, W82-00895 1502 3F

A New Look at Design of Raw Water Piping, W82-01029 1502 8A

Design and Construction of the Danvers, Massachusetts Water Processing Plant, W82-01088 1502 5F

Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water, W82-01193 1503 6A

Risk Models for Flood Levee Design, W82-01307 1503 8A

Optimal Risk-Based Design of Flood Levee Systems, W82-01313 1503 8B

Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow, W82-01385 1503 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites, W82-01435 1503 5G

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process, W82-01503 1503 3E

Northfield Mountain Pumped Storage Project: Performance, W82-01517 1503 8A

Survey of Treatment Plant Design and Operation Deficiencies, W82-01543 1503 5D

Intakes and Outlets for Low-Head Hydropower, W82-01979 1504 8C

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant, W82-02044 1504 5D

Engineering Design Variables for the Activated Sludge Process, W82-02199 1505 5D

Hydraulic Gates, W82-02206 1505 8C

Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario, W82-02240 1505 5E

Solid Set Irrigation System Design Using Linear Programming, W82-02273 1505 6A

High-Head Vertical Lift Gates, W82-02388 1505 8A

Optimal Stream-Aquifer Development, W82-02575 1505 6A

Fundamental Concepts of Well Design, W82-02614 1506 8A

The Cone Pump, W82-02713 1506 8C

Evaluating a Plant's Potential for Upgrading, W82-02895 1506 5F

Troubleshooting and Control of Nitrification Wastewater Treatment Systems, W82-03135 1507 5D

Warming Up to Geothermal, W82-03156 1507 8A

Power Characteristic Curve of Hydraulic Turbine Set, W82-03163 1507 8B

Calculator Program Aids Lagoon Design, W82-03211 1507 6A

Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al., W82-03347 1507 5E

Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981, W82-03453 1508 5D

Designing an Energy-Efficient Wastewater Treatment Plant, W82-03477 1508 5D

Designing for Coarse Sand Filtration Systems, W82-03478 1508 5D

Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas, W82-03525 1508 5D

Design Manual; Onsite Wastewater Treatment and Disposal Systems, W82-03538 1508 5D

Continuous Ion Exchange: Design Calculations, W82-03623 1508 8C

Uncertainties in Water Distribution Systems, W82-03668 1508 8A

Efficient Cooling Ponds: Design, W82-03672 1508 8A

Optimal Risk-Based Design of Hydraulic Structures, W82-03710 1508 8A

The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works, W82-03850 1509 5D

Tailoring Design of Treatment Plants to Local Conditions, W82-03893 1509 5F

Pumping Station Reliability: How and How Much, W82-04110 1509 8C

The Use of a Perforated Baffle at the Inlet of Rectangular Settling Basins, W82-04124 1509 8B

The Bed Depth Service Time Design Method for Deep Bed Filtration, W82-04143 1509 5F

Reliability and Redundancy: Dual Protection for Water Treatment Plants, W82-04148 1509 5F

Peak Period Design Standards for Small Western U.S. Water Supply Systems, W82-04249 1509 6D

Simple Equations for Hooghoudt Equivalent Depth, W82-04271 1510 4A

Design Models for Adsoprtion Systems in Wastewater Treatment, W82-04300 1510 5D

Optimal Design of Urban Storm Water Drainage Systems, W82-04414 1510 8A

Analysis of Detention Basin Systems, W82-04444 1510 2A

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants, W82-04562 1510 5D

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain, W82-04611 1510 5D

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination), W82-04615 1510 5F

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes, W82-04649 1510 8A

Money Down the Drain, W82-04653 1510 4A

Adopting Sewers, W82-04655 1510 8A

Tapered Inlet Design Using Specific Energy Curves, W82-04695 1510 8A

The Roofloat (Floating) Cover System for Liquid Storage, W82-04702 1510 5G

Treatment of High-Strength Fatty Amines Wastewater - A Case History, W82-04712 1510 5D

Reliability and Stability of Trickling Filter Processes, W82-04784 1511 5D

New Flocculation Units with High Efficiency, W82-04840 1511 5D

An Exercise in Sludge Consolidation, W82-04848 1511 5D

Resonance in Hydropower Stations, W82-04953 1511 8C

Turbines for Itaipu, W82-04955 1511 8C

Restructuration of the Water Tariff System for Irrigation Districts in Mexico, W82-04962 1511 6C

Estimates of Resilience Indices by Simulation, W82-05046 1511 6A

Determination of the Optimal Height of the Bucket Lip of a Ski-Jump Spillway, W82-05107 1511 8B

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method, W82-05108 1511 8A

Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 1511 8G

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 1511 5D

Pressure Distribution Design for Septic Tank Systems,
W82-05439 1511 5E

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 1511 8A

Where to Put a Steady Discharge in a River,
W82-05632 1511 5G

Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 1511 8C

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

Deep Shaft,
W82-05793 1511 5D

Designing and Excavating Underground Powerplants,
W82-05982 1512 8E

Design Technique Development for Dams in South Africa,
W82-06011 1512 8A

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 1512 8A

Safety Aspects in the Design and Inspection of Dams,
W82-06203 1512 8A

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 1512 8A

Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen).
W82-06237 1512 8B

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 1512 8B

Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 1512 8G

Design of Heat Pump Return Wells,
W82-06294 1512 8C

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 1512 5D

Variable Frequency Drives - Some Application Principles,
W82-06345 1512 8C

Selection of a Sludge Handling Disposal System,
W82-06346 1512 5E

Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 1512 5D

Rotating Biological Contactor System Design,
W82-06355 1512 5D

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 1512 5D

Canadian Wave Climate Study: Organization and Operation,
W82-06393 1512 8B

Pump Sump Design Experience: Summary,
W82-06419 1512 8C

The Landscape of Rutland Water,
W82-06478 1512 6G

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

A Model for the Design of Hypolimnetic Aerators,
W82-06610 1512 5G

Design and Operation of a Colorimetric Detector Controller,
W82-06656 1512 5A

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

DESIGN FLOODS
Flood Event Modeling - A Study of Two Methods,
W82-02291 1505 2A

Flood Probability Estimation,
W82-04318 1510 6B

DESIGN FLOW
Statistical Determination of Design Low Flows,
W82-01858 1504 2E

Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

DESIGN STANDARDS
Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 1511 8B

DESIGN STORMS
Erosivity 'R' for Individual Design Storms,
W82-01403 1503 2J

An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

DESTRATIFICATION
Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 1512 5G

DESTRATIFICATION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 1503 5G

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 1508 5G

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 1510 2H

York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 1512 5C

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 1512 5G

DETECTION LIMITS
Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 1506 5A

Trace Analyses for Wastewaters,
W82-03639 1508 5A

On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 1512 5A

DETENTION RESERVOIRS
Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

Comparison of Detention Basin Planning and Design Models,
W82-02592 1505 6A

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

Stormwater Detention in Developing Watersheds,
W82-03363 1507 4A

Detention Basins--An Urban Experience,
W82-04332 1510 4A

Analysis of Detention Basin Systems,
W82-04444 1510 2A

Settleability of Urban Runoff Pollution,
W82-05320 1511 5G

Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 1511 2J

Regional Detention Basins for Stormwater Control,
W82-06225 1512 8A

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 1512 5G

DETENTION TIME
Discussion: Water Quality Trap Efficiency of Storm Water Management Basins, by Richard H. McCuen,
W82-03784 1509 4A

DETENTION TIMES
Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

DETERGENTS
Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 1502 5A

Health Implications of Non-NTA Detergent Builders,
W82-00703 1502 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 1502 5G

Detergent Builders and Water Quality - A Changing Scene,
W82-03093 1507 5C

A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

Type a Zeolite in the Activated Sludge Process - I: Treatment Parameters,
W82-06459 1512 5D

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 1512 5C

DETERMINISTIC MODELS
Models of Annual Cycles in Lentic Water Bodies,
W82-06483 1512 5G

DETOXIFICATION
Detoxification of Residual Quaternaries,
W82-00562 1502 5G

Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 1507 5G

DETRITUS
Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

Seasonal Influx and Decomposition of Autochthonous Macrophyte Litter in a North Temperate Estuary,
W82-00918 1502 2L

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 1506 4D

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 1510 5C

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

DETROIT
Detroit - Fresh Clean Water,
W82-01506 1503 5D

A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

Detroit-Style CSO Studies,
W82-06247 1512 5G

DEUTERIUM
Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 1503 2B

Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 1504 5A

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759 1511 2G

DEVELOPING COUNTRIES
Hygiene of Drinking Water in Developing Countries,
W82-00269 1501 5F

Using Ecological Knowledge for Development Planning,
W82-00671 1502 6A

Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 1503 6A

Rural Sanitation in Developing Countries,
W82-01392 1503 5D

The Water Decade (1981-1990).
W82-01534 1503 6E

Hydropower--An Old Technology for a New Era,
W82-01593 1503 4A

Remote Sensing in Development,
W82-01719 1503 7B

Simplified Method for Rainfall Intensities,
W82-01978 1504 2B

Wanted: Water for Development,
W82-02088 1504 6D

Disinfection of Drinking Water in Developing Countries,
W82-02091 1504 5F

Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 1505 6G

Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 1505 6A

The Development of a Village Water Supply System on Truk,
W82-02816 1506 5F

Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 1507 5F

Who Will Pay the World's Water Bill,
W82-03280 1507 6B

Agriculture in the Wider Caribbean,
W82-03778 1509 6D

Environment and Public Health in the Caribbean,
W82-03787 1509 6D

Water Quality Monitoring,
W82-03897 1509 5G

Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

International Decade on Drinking Water and Sanitation,
W82-04230 1509 6E

Rural Power Schemes in Pakistan,
W82-04328 1510 8A

Development of Hydro-Power in Nigeria,
W82-04475 1510 6B

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 1510 6C

Clean Water for the Third World,
W82-04604 1510 6D

The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 1510 6D

Tanzania's Master Water Plan Will Miss Decade Goal,
W82-04657 1510 5F

Water-Pollution Research and Its Application in Developing Countries,
W82-05246 1511 5G

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 1511 5F

Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 1511 6G

Egypt Tackles Rural Supply Task,
W82-05754 1511 5F

Turks Press Forward With Ambitious Dam Programme,
W82-05758 1511 6B

They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 1512 5F

On-Site Wastewater Management--Recent Trends,
W82-06439 1512 5D

Cave Water--Java's Hidden Resource,
W82-06605 1512 3B

Zimbabwean Hand Pump Passes Village-Level Endurance Tests.
W82-06606 1512 8C

Doubts Remain About Bura Economics,
W82-06816 1512 3F

Brantas Dams Trigger New Javanese Development,
W82-06818 1512 3F

DEVILS RIVER
Paleoflood Hydrology,
W82-03761 1509 2E

DEW
Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 1512 2K

DEWATERING
Dewatering of Industrial Clay Wastes,
W82-00041 1501 5D

Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 1501 5D

Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5E

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

Evaluation of High- and Low- Speed Centrifuges,
W82-02931 1506 5E

Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

Lime Softening Sludge Treatment and Disposal.
W82-04276 1510 5E

Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 1510 5E

Densification of Paper Mill Sludge Materials,
W82-04694 1510 5E

Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 1511 5E

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 1511 8C

The Booming Business in Wick Drains,
W82-05192 1511 8G

Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 1511 5E

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 1511 8C

Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 1511 5D

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 1512 5D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibiliity Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 1512 5D

DEWPOINT
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 1507 2B

DIAGENESIS
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

DIATOMACEOUS EARTH
Getting Your Money's Worth from Filtration,
W82-06412 1512 5F

DIATOMS
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 1503 5C

Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 1505 5C

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 1505 6G

The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 1505 7B

The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 1506 2H

Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 1507 5C

The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03903 1509 5C

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 1511 2H

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 1511 2H

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 1511 5C

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 1512 5C

DIBENZOFURAN
Oxidation Products and Rates of Reaction in the Ozonolysis of Diebenzofuran,
W82-06305 1512 5B

DICHLOROMETHANE
Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 1502 5B

DICKSON DAM
Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 1508 8A

DIEL RHYTHM
On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 1512 5C

DIEL VARIATINS
Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 1511 2H

DIEL VARIATIONS
Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

DIELDRIN
Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 1508 5B

DIETS
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

DIFFUSERS
Multiport Diffuser Mixing Zones in Rivers,
W82-02594 1505 5B

Nearfield Performance of River Diffusers,
W82-04561 1510 5B

DIFFUSION COEFFICENT
Dilution Analysis for Unidirectional Diffusers,
W82-06420 1512 8B

DIFFUSION COEFFICIENT
Carbon 14 Dating of Groundwater in Confined Aquifers: Implications of Aquitard Diffusion,
W82-01464 1503 2F

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 1503 2L

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 1504 2G

Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 1507 2F

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 1507 2L

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 1508 5G

DIFFUSION COEFFICIENTS
The Calculation of Ion Pair Diffusion Coefficients: A Comment, W82-03487 1508 1B

DIFFUSION MODEL
Accuracy Criteria in Diffusion Routing, W82-06423 1512 8B

DIFFUSIVITY
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal, W82-00603 1502 7B
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon, W82-03601 1508 5F
Measurement of Sorptivity and Soil Water Diffusivity in the Field, W82-03764 1509 2G
An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities, W82-05073 1511 2G

DIFLUBENZURON
Fate of Diflubenzuron in Water, W82-02216 1505 5B

DIGESTED SLUDGE
Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges, W82-06270 1512 5D
Fate of Pathogens in Thermophilic Aerobic Sludge Digestion, W82-06772 1512 5D

DIGESTION
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance, W82-05272 1511 5D

DIGITAL COMPUTERS
Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems, W82-03763 1509 5D
'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment, W82-03848 1509 5D
Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant, W82-04047 1509 5D
Advanced Supervisory Control System for Sludge Treatment, W82-04841 1511 5D
Management System for Control of Process Losses and Spills in the Kraft Pulping Industry, W82-04846 1511 5D
Digitizing and Routine Analyses of Hydrological Data, W82-06386 1512 2E

DIKES
Reservoir Improvements as a Key to Source Quality Control, W82-04145 1509 5G

DILUTH
Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse. W82-03249 1507 5E

DIMENSIONAL ANALYSIS
Buoyant Surface Jets, W82-03670 1508 8B
Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis, W82-06066 1512 2F

DIMETHYLSULFOXIDE
Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions, W82-00205 1501 5A

DINKEY CREEK PROJECT
Final Environmental Impact Statement, Dinkey Creek Project No. 2890 - California. W82-00352 1501 6G

DINOFLAGELLATES
Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada, W82-00908 1502 6G

DIOXIN
Love Canal: Chemical Contamination and Migration, W82-01436 1503 5B

DIOXINS
Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish, W82-04883 1511 5A

DIPHENYLMETHANES
Biodegradability of Halogen-Substituted Diphenylmethanes, W82-00599 1502 5B

DIQUAT
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.), W82-00589 1502 5C
Diquat and Sodium Alginate for Weed Control in Rivers, W82-02328 1505 4A

DIRECT FILTRATION
Direct Filtration Studies at Traverse City Water Treatment Plant, W82-00945 1502 5F
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication, W82-06414 1512 5F
Low-Dosage High-Rate Direct Filtration, W82-06416 1512 5F
Factors That Affect Use of Direct Filtration in Treating Surface Waters, W82-06579 1512 5F

DIRTY DEVIL RIVER BASIN
Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone, W82-05220 1511 7C

DISASTERS
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland, W82-03221 1507 5F
Will New Orleans Miss The Mississippi, W82-04274 1510 4A

DISCHARGE
A New Method of Cubature Using Spline Functions, W82-05189 1511 2L

DISCHARGE CAPACITY
Discharge Capacity of Large Streams Under an Ice Cover, W82-05106 1511 2E

DISCHARGE COEFFICIENT
Bed Load Discharge Coefficient, W82-02936 1506 2J

DISCHARGE FREQUENCY
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979, W82-05225 1511 2E

DISCHARGE HYDROGRAPHS
Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves, W82-02925 1506 7B
Time and Frequency Domain Analyses of Hydrological Systems, W82-05655 1511 2E

DISCHARGE MEASUREMENT
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams, W82-01891 1504 7B
Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends, W82-03056 1507 7B
Relative Runoff by Curve Number Nomograph, W82-04307 1510 2A
Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year, W82-05841 1511 7C
The V-Shaped Broad-Crested Weir, W82-06450 1512 8B
A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie, W82-06720 1512 5B
Supercritical Flow Flumes for Measuring Sediment-Laden Flow, W82-06959 1512 8B

DISCHARGE MEASUREMENTS
A New Method of Cubature Using Spline Functions, W82-04939 1511 2L

DISCHARGE (WATER)
GAO Finds Massive Failure of Wastewater Treatment Plants, W82-03299 1507 5D

DISCOUNT RATES
Optimal Water Pricing and Storage: The Effect of Discounting, W82-05049 1511 6C

DISEASES
Disease Outbreaks Caused by Drinking Water, W82-01289 1503 5C
Infectious Waterborne Diseases, W82-01784 1503 5A
Waterborne Giardiasis--An Overview, W82-04186 1509 5C
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks, W82-04468 1510 5B

DISINFECTANTS
An Alternative Wastewater Disinfectant, W82-00950 1502 5D
Removing Trihalomethanes from Drinking Water, W82-00953 1502 5F
New Antimicrobial Agents for Treatment of Water, W82-02808 1506 5F

DISINFECTION
The Consultant's Viewpoint on Alternative Disinfectants, W82-00286 1501 6A

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

Ozone Treatment of Potable Water--Part 2,
W82-00452 1501 5F

Purification of Wastewater by Electrolysis,
W82-00847 1502 5D

Chemicals Disinfect Sludge,
W82-01003 1502 5D

Disinfection,
W82-01250 1503 5D

Disinfection of Drinking Water in Developing Countries,
W82-02091 1504 5F

Treatment Plant Features Ultraviolet Disinfection,
W82-02644 1506 5D

Ozone Water Treatment,
W82-02682 1506 5F

Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 1506 5D

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 1506 5D

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Trihalomethanes in Drinking Water,
W82-03447 1508 5F

A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

Ozone for Municipal Wastewater Disinfection,
W82-03559 1508 5D

A Comparison of Chlorine and Chlorine Dioxide Disinfection of Wastewater Effluents: The Generation of Selected Halohydrocarbons,
W82-03751 1509 5D

Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

Health Aspects of Waters at Public Health Resorts,
W82-04348 1510 5A

Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 1510 5C

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

The Hygienic Control of Swimming Baths.
W82-04853 1511 5F

Prospects of Using Radiation Water Treatment Methods,
W82-05026 1511 5D

Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 1511 5F

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 1511 5F

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 1512 5D

Drinking Water Disinfection,
W82-06341 1512 5F

Performance of Modified Chlorine Contact Chamber,
W82-06359 1512 5D

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 1512 5D

Ultraviolet Systems in Water Treatment,
W82-06726 1512 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 1512 5F

DISPERSANTS
Oil Slick Mechanics,
W82-05064 1511 5G

Dispersant Application System for the U.S. Coast Guard 32-Foot WPB,
W82-05069 1511 5G

DISPERSION
Dispersion in Mountainous Natural Streams,
W82-06357 1512 2E

DISPERSION COEFFICIENT
Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 1511 5B

DISPERSION COEFFICIENTS
Dispersion Coefficients in Estuaries,
W82-04684 1510 5B

DISPERSIVITY
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 1504 2F

DISPOSAL WELLS
Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 1511 5G

DISRIBUTION GRAPHS
Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 1512 2A

DISSOLUTION
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

DISSOLVED AIR FLOTATION
Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 1512 5F

DISSOLVED ORGANIC MATTER
Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

DISSOLVED OXYGEN
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 1501 2H

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 1502 5D

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 1503 5G

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 1504 2H

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5B

Ceriometry, A Combined Method for Chemical Oxygen Demand and Dissolved Oxygen (With a

Discussion on the Precision of the Winkler Technique),
W82-02562 1505 5A

On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 1505 2H

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 1505 5D

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 1506 5B

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1507 1B

Effect of a Deep-Water Outfall from a Power-Plant Reservoir on Water Quality in the Lower Pool,
W82-03768 1509 5C

Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants,
W82-04026 1509 5D

Control of Dissolved Oxygen in Activated Sludge Plants,
W82-04061 1509 5D

Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 1510 5D

Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G

Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 1511 7B

Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 1511 7B

Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 1511 6A

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 1511 7B

Do Model for Discharges from Deep Impoundments,
W82-05316 1511 2H

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 1511 5D

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 1511 5D

Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 1511 5B

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 1512 5C

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 1512 2H

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 1512 5C

DISSOLVED SOILDS
Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

DISSOLVED SOLIDS
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 1503 7A

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 1503 5B

Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 1506 2H

Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998 1509 2L

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 1510 7C

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 1511 7C

Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 1511 2K

DISTILLATION
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 1503 3A

Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 1506 3A

Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 1510 3A

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

VTE/VC for Sea Water,
W82-04909 1511 3A

Low Temperature Evaporation Plants,
W82-05118 1511 3A

Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 1512 3A

DISTILLATION PROCESSES
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 1505 3A

DISTILLERY WASTES
Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 1512 5D

DISTRIBUTION
Development of Solutions for Level-Basin Design,
W82-01976 1504 3F

The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

DISTRIBUTION COEFFICIENT
Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 1506 5B

DISTRIBUTION COEFFICIENTS
Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 1507 5D

DISTRIBUTION PATTERNS
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Distribution of Clostridium Botulinum,
W82-00349 1501 5A

The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 1503 5B

Characterizing Sprinkler Distribution Patter.. with a Clustering Algorithm,
W82-01575 1503 3F

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 1505 2H

The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 1505 7B

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

Estimating Distribution Uniformity in Level Basins,
W82-03058 1507 3F

Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 1508 2B

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

DISTRICT OF COLUMBIA
Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 1505 5B

Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 1506 5D

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 1512 6B

DISTRICT OF COLUMBIA AREA
Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 1507 5E

How Much Water Supply Capacity Is Enough,
W82-04103 1509 6D

DIURNAL CHANGES
Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

DIURNAL DISTRIBUTION
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 150[illegible] 2H

Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

DIURNAL VARIATIONS
Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 1512 5A

DIURON
Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 1501 2D

DIVERGING-CONVERGING WATERSHEDS
Water Routing on Diverging-Converging Watersheds,
W82-02200 1505 2A

DIVERSION
A Successful Transfer,
W82-00309 1501 4A

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 1503 4C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 1504 4A

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 1505 6B

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 1507 8A

Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 1508 4A

A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 1511 5G

Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 1512 2H

DIVERSION CHANNELS
The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 1505 4A

DIVERSION DAMS
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 1501 8A

Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 1508 4A

DIVERSION DITCHES
Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

DIVERSION LOSSES
Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

Diversion of the River Neva,
W82-03304 1507 4A

DIVERSION STRUCTURES
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 1503 4D

Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 1506 8A

The Long Lake Diversion: An Environmental Evaluation,
W82-05568 1511 6G

Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 1511 8A

Northwestern Ontario River Dimensions,
W82-05742 1511 6G

DIVERSITY INDICES
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 1501 2E

DNA
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 1512 5A

DNIEPER RIVER
The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

DOGWOOD
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 1502 2I

DOLOMITE
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

DOMESTIC ANIMALS
Feeding Animals Activated Sludge,
W82-00523 1502 5D

DOMESTIC WASTES
Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas,
W82-00355 1501 6G

Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 1508 5D

Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 1510 6C

Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

DOMESTIC WATER

In-Home Conservation and Wastewater Management,
W82-02591 1505 3D

Household Water Use: Technological Shifts and Conservation Implications,
W82-03910 1509 3D

Deterministic Models for Predicting Residential Water Consumption,
W82-04352 1510 6D

A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 1510 6D

Sampling and Analyzing Water,
W82-05263 1511 5A

Domestic Water Conservation Research Plan,
W82-05547 1511 6B

DOMINANT MINERALS

Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

DOMINICAN REPUBLIC

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 1503 5D

DONBAS CANAL

Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 1511 8A

DORCHESTER COUNTY

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 1503 2F

DOUGLAS FIR

Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 1507 2I

DOUGLAS FIR TREES

Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

DOUGLAS POINT NUCLEAR PLANT

An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

DRAG

Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1506 1B

DRAIN SPACING

Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 1505 8A

Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 1510 3F

Optimum Depth and Spacing of Subsurface Drains,
W82-05693 1511 8B

DRAINAGE

Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 1503 2G

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 1503 2G

The Chambal Project: Problems and Solutions,
W82-01739 1503 4A

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 1503 4A

Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 1505 8A

Long Term Performance of Horizontal Drains,
W82-02212 1505 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 1505 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 1505 8A

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 1505 2F

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 1505 5B

Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 1506 3C

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

Effect of Perforation Shape and Pattern on the Performance of Drain Pipes,
W82-03792 1509 8B

Drainage of Agricultural Lands.
W82-04069 1509 4A

Young's Inequality for Three-Dimensional Flows,
W82-04267 1510 2A

Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

The Booming Business in Wick Drains,
W82-05192 1511 8G

Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 1511 4D

Topologic Model for Drainage Networks with Lakes,
W82-05905 1512 2A

DRAINAGE AREA

Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 1506 2C

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

DRAINAGE AREAS

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 1508 2E

DRAINAGE BASINS

Basin Management in the San Bernardino Basin Area,
W82-00280 1501 6A

DRAINAGE CANALS

Parish Is Not Liable for Subsidence.
W82-01603 1503 6E

DRAINAGE DENSITY

Drainage Density as an Index of Climatic Geomorphology,
W82-01324 1503 2A

The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 1512 2E

DRAINAGE DISTRICTS

Drainage of Agricultural Lands.
W82-04069 1509 4A

DRAINAGE DITCHES

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 1507 4A

DRAINAGE EFFECTS

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 1508 2H

Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 1512 2I

Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 1512 4C

DRAINAGE ENGINEERING

Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 1505 8A

Long Term Performance of Horizontal Drains,
W82-02212 1505 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 1505 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 1505 8A

Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 1505 8A

Distribution of Wastewater in Drain Field Pipes,
W82-02945 1506 8B

Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 1507 8A

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 1511 4A

Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 1511 4A

Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 1512 8A

DRAINAGE PATTERNS

Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 1503 2A

Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

DRAINAGE SYSTEMS

A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 1503 4A

Methods of Restoring the Delivery of Drainage Wells,
W82-02385 1505 4A

Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 1507 8C

Aquatic Weed Research in Britain,
W82-03187 1507 4A

Filter Criteria for Sub-Surface Drainage,
W82-03660 1508 8G

Pumped Outlets for Drainage Systems,
W82-04364 1510 8A

Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 1510 3F

Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 1510 8D

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 1511 2A

Regional Detention Basins for Stormwater Control,
W82-06225 1512 8A

The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
W82-06449 1512 8A

DRAINAGE WATERS

Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 1502 3C

DRAINAGE WELLS

Methods of Restoring the Delivery of Drainage Wells,
W82-02385 1505 4A

Delayed Drainage in a Stream-Aquifer System,
W82-04268 1510 2F

DRAINS

Wastewater Collection and Treatment in Wayne County,
W82-02554 1505 5D

An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 1511 2F

DRAWDOWN

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 1502 2F

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 1502 2H

Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 1504 2F

Induced Sinkholes: An Engineering Problem,
W82-02559 1505 4B

A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 1507 2F

Effects of Water Drawdown on the Fauna in Small Cold Water Reservoirs,
W82-04219 1509 6G

Lake Level Drawdown as a Macrophyte Control Technique,
W82-04235 1509 4A

Effectiveness of Dupont Typar Sheeting in Controlling Macrophyte Regrowth After Overwinter Drawdown,
W82-04246 1509 5G

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

Thermocline Drawdown Above Cooling Water Intakes,
W82-05560 1511 8C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 1511 4B

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 1511 2F

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

DREDGING

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 1502 7B

Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 1502 5E

Parish Is Not Liable for Subsidence.
W82-01603 1503 6E

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 1503 6G

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 1504 2L

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 1504 5C

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

Construction of Containment Facility for Dredged Materials Begins,
W82-03839 1509 5G

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 1511 2J

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 1511 6E

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 1512 6G

Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe).
W82-06637 1512 5E

DRIFT
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

DRILLERS LOGS
Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

DRILLING
Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 1505 8A

Treated Pit Fluids Meet Water Specifications.
W82-02557 1505 5E

DRILLING EQUIPMENT
Screened Auger Aids Investigation,
W82-02096 1504 7B

Warming Up to Geothermal,
W82-03156 1507 8A

DRILLING FLUIDS
Land Restoration Following Oil-Well Drilling,
W82-00057 1501 5D

Treated Pit Fluids Meet Water Specifications.
W82-02557 1505 5E

DRINKING WATER
A/C Pipe - Assessment or Advocacy,
W82-00070 1501 5F

An Alternative Solution to the THM Problem,
W82-00072 1501 5F

Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 1501 5A

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 1501 5B

Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

Concentration and Size of Asbestos in Water Supplies,
W82-00262 1501 5B

Hygiene of Drinking Water in Developing Countries,
W82-00269 1501 5F

Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 1501 5A

A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

Chlorinated Drinking Water,
W82-00467 1501 5F

What Caused the Bad Odor in the Drinking Water,
W82-00527 1502 5F

Growth of Aeromonas Hydrophila at Low Concentrations of Substrates Added to Tap Water,
W82-00578 1502 5A

Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 1502 5F

Environmental Health Hazards,
W82-00625 1502 5F

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 1502 5A

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 1502 5C

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

Groundwater Problems and Needs in New York,
W82-01055 1502 4B

Health Effects of Monochloramines in Drinking Water,
W82-01091 1502 5C

The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 1503 5F

Disease Outbreaks Caused by Drinking Water,
W82-01289 1503 5C

The Application of Mutagenicity Testing to Drinking Water,
W82-01487 1503 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

Organics in Water - An Engineering Challenge,
W82-01540 1503 5F

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 1503 5A

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 1503 5C

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 1503 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 1503 5A

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 1503 5F

Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 1505 5A

An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 1505 6F

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 1506 5A

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 1506 5B

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 1507 5F

Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 1507 5F

Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 1508 5B

Carcinogenesis of Synthetic Organic Chemicals in Drinking Water,
W82-03433 1508 5C

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 1508 5C

Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887 1509 5F

Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

Removal of Organics by Reactivated Carbon,
W82-04159 1509 5F

International Decade on Drinking Water and Sanitation,
W82-04230 1509 6E

Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 1510 5A

The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 1510 5F

Granular Activated Carbon Installations,
W82-04391 1510 5F

Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

Influence of Diluents, Media, and Membrane Filters on Detection of Injured Waterborne Coliform Bacteria,
W82-04469 1510 5A

Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 1510 5F

Clean Water for the Third World,
W82-04604 1510 6D

The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 1510 6D

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 1511 5F

Potable Water Production in Holland.
W82-04851 1511 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

Water System Design Meets Modern Challenges,
W82-05170 1511 5F

The use of Activated Carbon in Water Treatment,
W82-05182 1511 5F

An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 1511 5A

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 1511 5F

The Safe Drinking Water Act on Review,
W82-05792 1511 5G

The National Interim Primary Drinking Water Regulations, Part I - Historical Development,
W82-05814 1511 5G

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 1511 5G

Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 1512 5F

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 1512 5F

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 1512 5F

Nonstandard Methods for Enumerating Bacteria in Drinking Water,
W82-06278 1512 5F

Advanced Water Treatment for Color and Organics Removal,
W82-06279 1512 5F

Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 1512 5F

Drinking Water Disinfection,
W82-06341 1512 5F

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 1512 5F

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 1512 5F

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 1512 5A

Effects on Global Supplies of Freshwater,
W82-06733 1512 5C

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

Microbiological Examination of Sebeel Water,
W82-06882 1512 5C

Disease Outbreaks Caused by Drinking Water,
W82-06928 1512 5C

DRIP IRRIGATION

Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 1504 3F

Aerated Drip Irrigation,
W82-02186 1505 3F

Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

DROUGHT

Northeastern New Jersey Grapples With a Drought,
W82-00289 1501 8A

The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 1502 2I

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 1502 2B

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 1502 2I

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

Distribution of Joint Run-Lengths of Bivariate Markov Processes,
W82-02191 1505 2E

Wheat Response to Drought,
W82-02242 1505 2I

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 1505 2B

Rate Structures and Demand Reduction,
W82-02517 1505 6C

Stochastic Hydrologic Model for Drought Management,
W82-02897 1506 2E

An Economic Analysis of Water Conservation Policy,
W82-03090 1507 6B

Will the Sahelian Drought End in 1985,
W82-03167 1507 2B

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 1507 6A

A Perspective Study of Droughts in Mexico,
W82-03358 1507 2E

Jersey Drought Hastens Water Supply Project,
W82-03385 1507 6D

Analyzing the Risk of Drought: The Occoquan Experience,
W82-04097 1509 2A

A Tree-Ring Reconstruction of Drought in Southern California,
W82-04229 1509 2B

Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 1510 6A

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 1510 3F

The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 1511 2E

Drought Management: Expecting the Unexpected,
W82-05649 1511 3D

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 1511 3D

Water Conservation Incentives and Strategy,
W82-05906 1512 3D

The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 1512 2B

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 1512 6D

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 1512 5C

DROUGHT CONTINGENCY PLANS
Water Conservation Incentives and Strategy,
W82-05906 1512 3D

DROUGHT RESISTANCE
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 1502 2I

Cereal Yields and Drought Resistance,
W82-03195 1507 2I

Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 1508 2I

Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 1511 3F

DRUGS
R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 1502 5A

Antibiotic-Resistant Bacteria in Drinking Water,
W82-00645 1502 5F

DRY FARMING
Research and Development to Service a Sustainable Agriculture,
W82-00669 1502 3F

DUCKS
Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 1510 5B

DUCKWEED
Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 1507 5A

Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

The Use of an Alga Chlorella Pyrenoidosa and a Duckweed Lemna Perpusilla as Test Organisms for Toxicity Bioassays of Spent Bleaching Liquors and Their Components,
W82-06721 1512 5C

DUCTILITY
A Pipeline for all Environments,
W82-04764 1511 8G

DULUTH
Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

DUNBAR RIVER
Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 1512 5C

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream,
W82-06563 1512 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 1512 5A

DUNES
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 1504 2J

DUPONT COMPANY
Dupont's Wastewater Treatment Approach,
W82-02254 1505 5D

DUPUIT-FORCHHEIMER THEORY
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 1504 2F

DURANCE RIVER BASIN
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

DUSSELDORF
Ozone and Activated Carbon,
W82-05370 1511 5F

DUSTS
The Effects of Surface Dust on Snowmelt Rates,
W82-00845 1502 2C

DYE INDUSTRY WASTES
Aromatic Amines in and Near the Buffalo River,
W82-00622 1502 5B

Textile Wastes,
W82-01259 1503 5D

Use of Hydroxylpropylcellulose to Decrease Wastage of Disperse Dyes in the Continuous Dyeing of Polyester,
W82-04164 1509 5G

Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 1511 5D

Esholt--Past, Present and Future,
W82-06653 1512 5D

DYE RELEASES
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

DYES
Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 1502 5B

Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 1504 5D

Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 1510 5B

Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 1511 5C

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 1511 5B

Textile Wastes,
W82-06916 1512 5D

DYNAMIC PROGRAMMING
Weekly Multipurpose Planning Model for TVA Reservoir System,
W82-02319 1505 6A

Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 1510 6A

A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 1511 2E

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

DYSTROPHIC LAKES
Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 1503 2H

EAGLE LAKE
The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 1502 2H

EARTH DAMS
A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 1501 8D

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 1504 8D

Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 1506 8D

Calculation of Foundations and Earth Dams,
W82-02689 1506 8D

Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

Calculation of Earth Dams Being Undermined,
W82-03162 1507 8D

Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 1508 8A

Mathematical Modeling of Earth Dam Breaches,
W82-03532 1508 8A

A Decision Theory Approach to Earth Dam Classification,
W82-04152 1509 8A

Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 1510 8D

Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 1511 8A

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 1512 8A

EARTH PRESSURE
Calculation of Foundations and Earth Dams,
W82-02689 1506 8D

EARTH-WATER INTERFACES
Optimization Principle for Air and Water Movement,
W82-05172 1511 2G

EARTHQUAKE ENGINEERING
Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 1506 8D

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 1511 8D

EARTHQUAKE PREDICTIONS
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 1503 2F

EARTHQUAKES
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 1503 2F

Liquefaction Analysis for Multidirectional Shaking,
W82-01169 1503 8D

Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 1506 8D

Reservoirs and the Triggering of Earthquakes,
W82-03766 1509 8A

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 1512 8E

EARTHWORKS
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 1506 8A

EARTHWORM FEEDING
Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 1501 5E

EARTHWORMS
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 1505 5E

EAST CHICAGO
Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 1510 5D

EASTERN COAL PROVINCE
Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 1510 7C

EASTERN UNITED STATES
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 1502 2B

ECHINODERMS
Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 1502 5A

ECOLOGICAL EFFECTS
Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Power Plant Water Intake Assessment,
W82-00216 1501 6G

Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 1502 6A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 1502 6G

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 1502 2H

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 1503 6G

Bioassays - Procedures and Results,
W82-01277 1503 5A

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 1503 2E

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 1503 5C

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 1504 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 1504 5G

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 1504 5C

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 1505 6G

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 1505 6G

Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 1506 2H

The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 1506 5F

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 1507 5C

A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 1507 5C

Chemical Flux in an Acid-Stressed Stream,
W82-03338 1507 5C

Acid Precipitation--A New Study from Norway,
W82-03341 1507 5C

On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Effects of Water Drawdown on the Fauna in Small Cold Water Reservoirs,
W82-04219 1509 6G

The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 1510 6G

Acid Precipitation. 1. Causes and Consequences,
W82-04771 1511 5C

Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 1511 5C

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 1511 4A

Pesticide Effects on Aquatic Habitats,
W82-05146 1511 5C

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 1511 5C

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

ECOLOGY
Using Ecological Knowledge for Development Planning,
W82-00671 1502 6A

Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 1511 2H

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 1511 2H

The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 1511 2H

The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 1512 2L

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

ECONOMIC ANALYSIS
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 1503 5G

Energy, Environmental, and Economic Implications of Some Recent Alberta Water Resources Projects,
W82-04226 1509 6B

Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 1510 6B

Economic Analysis of Water Main Breaks,
W82-05673 1511 8A

Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 1511 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

ECONOMIC ASPECT
The Wellton-Mohwak Dilemma,
W82-05883 1511 3F

ECONOMIC ASPECTS
Conflicts and Barriers Working Group Report.
W82-00031 1501 6E

Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 1501 6B

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 1501 6E

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 1501 6E

Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 1502 6A

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 1502 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 1502 6E

Economics,
W82-01304 1503 5G

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 1503 4D

Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 1504 6E

Long-Run Effects of Environmental Regulation,
W82-01848 1504 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 1504 6E

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 1504 6B

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 1505 6E

The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 1505 6B

Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Rate Structures and Demand Reduction,
W82-02517 1505 6C

The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 1506 6A

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 1506 6D

An Economic Analysis of Ground Water Management Alternatives,
W82-02740 1506 4B

Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

Group Treatment Evaluation for Metal Finishers,
W82-02995 1506 5D

Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 1507 6B

Sludge Management Process Integration,
W82-03130 1507 5D

The Deep-Shaft Process: Bright Future for Treating High-Strength Wastewaters,
W82-03376 1507 5D

Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 1508 4B

The Economics of Urban Stormwater Management,
W82-03508 1508 4A

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 1508 5G

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 1508 6A

The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 1508 6B

Replacing Large Water Meters: Why and How,
W82-03560 1508 5F

Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 1508 6B

An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

Modeling the Economics of Ground Water Management,
W82-03733 1508 4B

A Legal-Economic Critique of Groundwater Law and Administration: With Special Reference to Arizona and Nebraska,
W82-03827 1509 6E

Risk Analysis in the Planning, Design and Operational Control of Water Pollution Prevention Schemes- A Perspective,
W82-03857 1509 5G

Primary and Secondary Impacts of a Water Resource Development Project,
W82-03907 1509 6B

State and Local Acquisition of Floodplains and Wetlands; A Handbook on the Use of Acquisition in Floodplain Management.
W82-03966 1509 6F

Irrigating with Municipal Effluent: A Socioeconomic Study of Community Experiences,
W82-03967 1509 3C

The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

Economics of Controlling Natural Salt Sources in the Arkansas River Basin,
W82-04234 1509 6B

Floodplain Delineation: An Economic Approach,
W82-04236 1509 6F

An Economist's View of Demand Projections Considering Conservation,
W82-04448 1510 6D

A Manual for Development of Small Scale Hydroelectric Projects by Public Entities.
W82-04634 1510 6E

Money Down the Drain,
W82-04653 1510 4A

Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 1510 6A

A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 1510 6D

The Real Price of Urban Water,
W82-04797 1511 6C

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 1511 6C

Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 1511 6B

A Low-Cost Secondary Treatment Alternative,
W82-05169 1511 5D

Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

Crisis-Ridden Water Systems Should Go Private,
W82-05436 1511 6C

Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 1511 6A

Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

Incentives and Institutions for Water Conservation,
W82-05922 1512 3D

The Energy Resources of Kenya,
W82-05978 1512 6D

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

Sludge Tankering Economics - A Fresh Approach,
W82-06076 1512 5E

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 1512 6D

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 1512 6B

Rutland Water - From Conception to Operation,
W82-06481 1512 6D

Introduction - Rutland Water 1970-1981,
W82-06482 1512 6B

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 6B

Doubts Remain About Bura Economics,
W82-06816 1512 3F

Economics,
W82-06998 1512 5G

ECONOMIC DEVELOPMENT
Future Directions in Federal Water Resources,
W82-04196 1509 6D

ECONOMIC EFFECTS
The Effect of EEC Directives on Water Supplies,
W82-02432 1505 6E

ECONOMIC EFFICIENCY
Cold Weather Waste Treatment,
W82-00636 1502 5D

An Ex Post Analysis of the Uncompahgre Project,
W82-04218 1509 6B

Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 1511 6D

ECONOMIC EVALUATION

Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 1506 6A

An Economic Analysis of Water Conservation Policy,
W82-03090 1507 6B

Projective Evaluation During Inflation, Revisited: A Solution to Turvey's Relative Price Change Problem,
W82-04202 1509 6B

Micro Hydropower in the USA,
W82-04316 1510 8A

Robustness of Water Resources Systems,
W82-05077 1511 6A

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 1511 3A

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

ECONOMIC FEASIBILITY

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 1501 6D

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 1501 6B

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 1502 6C

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 1503 5G

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 1508 6B

An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 6B

Hydropower: Inflation-Proof Energy from Water Supply Dams,
W82-04137 1509 6B

The Financing of Private Small Scale Hydroelectric Projects.
W82-04633 1510 6B

ECONOMIC IMPACT

Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 1501 6B

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 1512 5F

Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 1512 5G

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

ECONOMIC JUSTIFICATION

Economic Analysis of Granular-Bed Filtration,
W82-00975 1502 5F

ECONOMIC PREDICTION

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 1511 2F

ECONOMIC YIELD

Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 1511 6B

ECONOMICS

Ground Water Alternatives and Solutions,
W82-00029 1501 6D

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 1503 6A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 1503 6B

Water Conservation Incentives and Strategy,
W82-05906 1512 3D

ECONOMIES OF SCALE

Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 1511 5C

ECOSYSTEMS

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 1501 5C

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 1502 2H

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 1502 6G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 1502 5G

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 1502 2H

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 1502 2K

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1502 1A

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 1503 5G

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 1504 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

The Modeling of Aquatic Ecological Systems,
W82-01972 1504 5B

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 1504 5A

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 1504 6G

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 1505 6G

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 1505 6G

Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

Strategies for the Management of Estuaries,
W82-02166 1505 6F

Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 1506 5B

An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 1507 7B

Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 1507 5G

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 1507 5G

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 1507 5C

Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 1508 2H

Cadmium in an Aquatic Ecosystem,
W82-03724 1508 5A

Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772 1509 2H

Biology of Brackish Water, (In Japanese),
W82-04179 1509 2L

Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 1510 7C

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 1510 6G

Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 1511 5C

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 1511 2H

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 1511 5A

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

Overview and Assessment of Biological Sensing,
W82-05156 1511 5C

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 1512 5C

ECUADOR

Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 1503 8A

EDDY DIFFUSION

On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

EDEN RIVER

Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 1505 4A

EDISTO RIVER BASIN

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 1503 6D

EDUCATION

Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 1505 6A

Professional Development for Water Quality Control Personnel,
W82-03531 1508 9A

EDWARDS AQUIFER

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79.
W82-04987 1511 7C

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

EFFLUENT

Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

NPDES Compliance Flow Measurement Manual,
W82-03965 1509 5D

EFFLUENT CHARGES

Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 1503 6F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

Effluent Charging Systems and Their Administrative Implications,
W82-02403 1505 6C

How Equitable Are Effluent Charges,
W82-06074 1512 6C

EFFLUENT LIMITATIONS

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 1505 5E

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

How Equitable Are Effluent Charges,
W82-06074 1512 6C

EFFLUENT REUSE

Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

EFFLUENT STANDARDS

Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 1501 5G

Determination of Marine Consent Conditions,
W82-00323 1501 5G

Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 1504 6E

Supreme Court Clarifies Water Act Requirement,
W82-02257 1505 6E

Three Important Court Decisions,
W82-04349 1510 6E

Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 1512 5G

EFFLUENTS

Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 1501 5A

Projected Tile Effluent Effects on the Oldman River,
W82-00333 1501 5C

Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 1501 5A

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 1502 5A

Utilization of Dichloromethane by Suspended and Fixed-Film Bacteria,
W82-00577 1502 5B

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

Mutlichamber Septic Tanks,
W82-00969 1502 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 1502 5D

Treatability Manual; Volume V. Summary.
W82-01077 1502 5D

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

Loading Estimates to Lake Erie, 1967-1976,
W82-01852 1504 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 1504 5A

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 1504 5C

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 1504 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

Multiport Diffuser Mixing Zones in Rivers,
W82-02594 1505 5B

Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 1506 5E

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 1506 5B

GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 1507 5D

A Survey of Radioactive Effluent Releases from Byproduct Material Facilities,
W82-03963 1509 5B

Waste Discharge Monitoring Requirements Under the NPDES Permits Program,
W82-03969 1509 5D

Intensive Survey of the Sabine-Neches Canal - Segment 0703,
W82-04078 1509 5A

Intensive Survey of Armand Bayou,
W82-04079 1509 5A

Intensive Survey of Hunting Bayou,
W82-04080 1509 5A

Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

Initial Degradation of Effluent Quality During Filtration,
W82-04134 1509 5F

Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 1510 5A

Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

EGGPLANTS

Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 1506 3F

EGGS

Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne,
W82-00982 1502 5B

Parasite Ova in Anaerobically Digested Sludge,
W82-02018 1504 5B

Pesticides in the Aquatic Environment,
W82-04727 1510 5C

EGYPT

Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 1504 6G

Waterborne Disease Is Prevalent in Egypt,
W82-02435 1505 5C

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

Solution of the Continuity Equation for the Karnak Area,
W82-03196 1507 2G

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

Egypt Tackles Rural Supply Task,
W82-05754 1511 5F

Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

Invironmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

ELASTICITY OF DEMAND

Municipal Water Supply Restrictions as Urban Growth Constraints,
W82-05748 1511 3D

ELBE RIVER

Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 1510 5A

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06915 1512 5C

ELCTRICAL CONDUCTIVITY

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 1503 2G

ELECTRIC CURRENTS

Relationship of Electrical Dispersion to Soil Properties,
W82-02561 1505 8D

Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 1512 5F

ELECTRIC FIELDS

Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 1511 5G

ELECTRIC POWER

Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

ELECTRIC POWER COSTS

Energy Management in the Water Works Industry,
W82-02608 1506 5F

Curbing the Distribution Energy Appetite,
W82-04136 1509 5F

ELECTRIC POWER INDUSTRY

Power Industry Wastes,
W82-01265 1503 5B

Stranglehold on the Skagit,
W82-03490 1508 6G

Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 1511 5C

ELECTRIC POWER PRODUCTION

Optimization of Pump Turbines,
W82-00181 1501 8C

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 1501 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 1501 6B

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 1502 6G

Severn Barrage Scheme Gets Favourable Response.
W82-02089 1504 6B

The New Energy Boom: Small-Scale Hydropower,
W82-03462 1508 8A

A Decomposition Method For The Long-Term Scheduling Of Reservoirs in Series,
W82-04205 1509 6A

Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 1510 6G

Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 1511 5B

Wastewater Treatment at an Electrical Generation Station,
W82-05975 1512 5D

Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

ELECTRIC POWERPLANTS

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 1502 3E

Cooling Potential of Missouri River in Missouri,
W82-01654 1503 5B

River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 1505 5C

Waste Treatment System Retrofitted Within Deadline,
W82-05947 1512 5D

Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

ELECTRICAL EQUIPMENT

Coupled Heat and Water Flows Around Buried Cables,
W82-02680 1506 2G

ELECTRICAL GROUNDING

Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 1512 5F

ELECTRICAL NETWORKS

Argentina's Hydroelectric-Based Energy Plan,
W82-02794 1506 8A

ELECTRICAL PROPERTIES

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 1503 2G

Theory of the Dielectric Constant of Ice,
W82-03176 1507 2C

Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 1508 2C

Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 1511 2K

ELECTRICAL RESISTIVITY

Use of Longitudinal Conductance in Estimating Transmissivity of Granular Aquifers in Northern Missouri,
W82-03957 1509 2F

ELECTRO-COAGULATION

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 1512 5D

ELECTRO-OSMOSIS

Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5E

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 1512 5D

ELECTROCHEMISTRY

Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1503 1A

Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1506 1B

Improved Microbe Detection in Water Samples.
W82-03258 1507 5A

Electrochemical Processes for Wastewater Treatment,
W82-05422 1511 5D

ELECTRODES

Use of Longitudinal Conductance in Estimating Transmissivity of Granular Aquifers in Northern Missouri,
W82-03957 1509 2F

ELECTRODIALYSIS

Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 1506 5D

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 1511 3A

Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 1512 3A

ELECTROLYSIS

Purification of Wastewater by Electrolysis,
W82-00847 1502 5D

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 1512 5D

ELECTROLYTES

The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1508 1B

ELECTRON MICROSCOPY

Interim Method for Determining Asbestos in Water,
W82-00741 1502 5A

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 1512 5F

ELECTROPHORESIS

The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 1511 2K

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 1512 5D

ELECTROPLATING

Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 1502 5B

Electroplating and Cyanide Wastes,
W82-01266 1503 5D

Electroplating Wastes: History and Current Status,
W82-03588 1508 5D

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

Electroplating and Cyanide Wastes,
W82-06798 1512 5D

ELEVATION

Tides and Tidal Datums in the United States,
W82-02982 1506 2A

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

ELGO DAM

Value Engineering Saves Dam Project,
W82-03287 1507 8A

ELLESMERE ISLAND

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

ELODEA

Biocleansing with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 1512 5F

ELUTION

Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 1512 5A

ELUTRIATE TEST

The Evaluation of the Elutriate Test as a Means of Predicting the Behavior of Selected Chlorinated Hydrocarbons in Dredged Sediment During Open-Water Disposal,
W82-03824 1509 5A

ELWHA RIVER BASIN

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 1501 6B

EMBANKMENTS
Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 1501 8D

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History,
W82-02214 1505 8A

Embankment Construction: New Melones Dam,
W82-05822 1511 8D

The Kielder Headworks,
W82-06504 1512 8A

EMBRYO-LARVAL TESTS
The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

EMBRYONIC GROWTH STAGE
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 1512 5C

EMERGENT FLORAL STEM
Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

EMISSION SPECTROSCOPY
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 1504 5A

EMPLOYMENT
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 1501 6B

Water Requirements for Industrial Development,
W82-04117 1509 6D

ENCINA WATER POLLUTION CONTROL FACILITY
Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

ENDANGERED SPECIES
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

ENDOTOXIN
Movement of Endotoxin Through Soil Columns,
W82-00586 1502 5B

ENDRIN
Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 1503 5C

ENERGY
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 1503 5D

Energy Costs and Portland Water Supply System,
W82-02586 1505 5F

Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 1507 7B

Projected Effects of Energy Policies on Agricultural Water Use and Irrigation,
W82-03915 1509 6C

Energy and Water Resources.
W82-04066 1509 6D

Curbing the Distribution Energy Appetite,
W82-04136 1509 5F

Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 1510 3F

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 1510 6B

Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

Designing Wastewater Treatment Systems to Save Energy,
W82-04906 1511 5D

Water System Efficiencies,
W82-05281 1511 8C

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

Work Potential: An Objective Basis for the Comparison of Desalination Processes,
W82-05977 1512 3A

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 1512 5D

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 1512 3E

Potential Evaporation in the Peace Region of British Columbia,
W82-06528 1512 2D

Allocation of Water for Resource Development,
W82-06839 1512 6D

ENERGY BALANCE
Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 1511 2L

ENERGY CONSERVATION
Mixing Technology Reduces Energy Use,
W82-00634 1502 5D

Processes--Not Products--Biggest Energy-Saving Factors.
W82-02218 1505 5D

Energy Minimization at Metro Denver Sewage District,
W82-03142 1507 5D

Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 1507 5D

Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 1507 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 1508 6A

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 1510 8B

Energy Conservation in Municipal Wastewater Plants,
W82-06070 1512 5D

ENERGY CONVERSION
Warming Up to Geothermal,
W82-03156 1507 8A

Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute).
W82-06024 1512 5D

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 1512 5C

ENERGY DISSIPATION
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

New Jet-Gate Design,
W82-02691 1506 8C

Sediment Transport and Unit Stream Power Function,
W82-06424 1512 2J

The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 1512 8A

ENERGY EQUATION
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 1504 2F

ENERGY LOSS
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 1506 8B

Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 1508 5G

ENERGY SOURCES
Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 1508 6B

Water Constraints on Emerging Energy Production,
W82-04151 1509 6D

Evaluation of Hydropower Potential in a River Basin,
W82-04214 1509 6B

Calorific Value of Wastewater Plant Sludges,
W82-04997 1511 5E

Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 1511 6B

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 1511 3C

ENERGY STORAGE
Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

ENERGY TECHNOLOGY
EPA's Approach to Regulating New Energy Technologies,
W82-03129 1507 6E

ENERGY TRANSFER
Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 1511 3A

ENGINEERING
Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 1505 6E

Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 1506 2J

Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 1508 5D

ENGINEERING PERSONNEL
Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 1501 6B

ENGINEERING STRUCTURES
Floating Breakwater,
W82-00067 1501 8A

ENGLAND
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

The River Ouse Water Supply Scheme,
W82-01371 1503 5F

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 1503 2E

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 1503 5B

An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 1503 8F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

Charging for Water Supply in England and Wales in the 1980s,
W82-01722 1503 6C

Slowhill Copse Sewage Treatment Works.
W82-01727 1503 5D

Operating Policies for a Surface/Ground Water System,
W82-01741 1503 4B

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 1504 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 1504 5C

Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 1505 4A

Beddington Sewage-Treatment Works, Canyon: Some Operating Experiences 1969-79,
W82-02410 1505 5D

Flexible Outfall at Aldeburgh,
W82-02415 1505 8A

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

Distribution of Chromobacteria in a Lowland River,
W82-02795 1506 5C

Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 1507 2F

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 1507 5C

Aquatic Weed Research in Britain,
W82-03187 1507 4A

Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 1508 7B

Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833 1509 5A

Hogsmill Valley Works: Twenty Years On,
W82-03834 1509 5D

The Background to the Flood Defences of London and the Thames Estuary,
W82-03895 1509 4A

A Surface Water Outfall Sewer for Bournemouth By-Pass.
W82-04003 1509 8A

Automation of Grimsby Pumping Stations,
W82-04006 1509 5D

The Thames Barrier,
W82-04039 1509 4A

Riding Mill Pumping Station,
W82-04292 1510 8A

Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 1510 5C

Design of Filters for Clay Cores of Dams,
W82-04321 1510 8G

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

A Suspended Sediment Front in the Severn Estuary,
W82-04639 1510 2L

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 1510 2E

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 1510 2E

The Seven-Trent Studies of Industrial Water Use,
W82-04686 1510 6D

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 1510 5C

New Telemetry System for the Cambridge Water Company.
W82-04852 1511 5F

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 1511 5C

Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 1511 4C

Measuring Reservoir Ground Movements,
W82-05773 1511 8G

Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 1512 5B

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 1512 5B

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 1512 5B

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 1512 6D

The Kielder Transfer Works,
W82-06502 1512 8A

The Kielder Water Scheme,
W82-06503 1512 8A

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

Out of Sight--Out of Mind.
W82-06713 1512 8A

Canal Tunnel Repair Options.
W82-06758 1512 8A

Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 1512 8A

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 1512 5C

Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 1512 5C

ENGLAND (HAMPSHIRE)
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

ENGLISH CHANNEL
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

ENTERIC BACTERIA
Enteric Bacterial Concentrations in Reservoir Feeder Streams: Baseflow Characteristics and Response to Hydrograph Events,
W82-00462 1501 5B

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 1501 5E

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 1507 5A

Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 1512 5D

ENTEROBACTER
Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 1512 5A

ENTEROVIRUSES
Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 1501 2L

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 1501 5D

Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 1502 5A

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 1502 5C

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 1503 5A

Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 1505 5A

Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 1511 5C

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

ENTRAINMENT
Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 1502 6G

An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 1503 8I

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 1511 5C

Aeration at High Velocity Flows,
W82-05602 1511 8A

ENTROPY
Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760 1509 5D

ENVIROMENTAL EFFECTS
Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 1511 4A

ENVIRONMENT
Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 1511 5A

ENVIRONMENTAL CONTROL
Environmental Control Technology Development for Geothermal Energy,
W82-02197 1505 5C

Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 1505 5B

Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 1505 5G

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

ENVIRONMENTAL EFFECTS
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

Conflicts and Barriers Working Group Report.
W82-00031 1501 6E

Water Quality Issues and Energy Assessments,
W82-00036 1501 6B

Domestic Water Supplies for Power Plant Cooling,
W82-00180 1501 6D

Power Plant Water Intake Assessment,
W82-00216 1501 6G

Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 1501 2L

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 1501 6G

Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 1501 5C

Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 1502 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 1502 2L

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 1502 6G

Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It.
W82-00813 1502 6G

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

Environmental Effects of Water Reuse Scheme,
W82-00973 1502 3C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 1503 5C

Water Characteristics,
W82-01305 1503 5B

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 1503 5D

Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 1503 6A

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 1503 6G

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 1503 6G

Biota and Biological Parameters as Environmental Indicators,
W82-01794 1503 5C

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 1504 6B

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 1504 6G

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 1504 5C

Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 1504 6G

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
W82-02115 1505 6G

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 1505 4A

The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 1505 6G

Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 1505 3A

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 1505 5C

Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 1505 6G

Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 1505 6G

The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 1505 7C

Sludge: Back into the Ocean,
W82-02577 1505 5E

History of Human-Use Impacts on Long Point Bay,
W82-02580 1505 5B

The Environmental Effects of Hydroelectric Projects,
W82-02632 1506 6G

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 1506 4A

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 1507 5C

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930. IDAHO.
W82-03046 1507 6G

Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 1507 8A

Salinity and Biogenic Material in the North Caspian,
W82-03155 1507 4A

Biological Monitoring Part VI - Future Needs,
W82-03230 1507 5C

Don't Damn the Stanislaus,
W82-03275 1507 6E

Will the World Face Up to Its Ever-Worsening Environmental Problems.
W82-03459 1508 4C

Stranglehold on the Skagit,
W82-03490 1508 6G

Eastern Scheldt Design Has Changed.
W82-03493 1508 8A

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 1508 5G

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 1508 3C

Water Chemistry of Alabama Ponds,
W82-03534 1508 2K

Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 1508 6E

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 1508 6G

Highlights of the St. Mary's Redevelopment Project,
W82-03617 1508 8A

Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 1508 6G

Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 1508 6G

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 1508 6B

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

Reservoirs and the Triggering of Earthquakes,
W82-03766 1509 8A

On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

Environmental Aspects of Water-Resources Planning in England and Wales,
W82-03806 1509 6E

Power Plant Siting and Design: A Case Study of Minimal Entrainment and Impingement Impacts at Davis-Besse Nuclear Power Station,
W82-03964 1509 5C

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

Final Environmental Impact Statement: Cheyenne Stage II Water Diversion, Medicine Bow National Forest.
W82-04073 1509 6D

Environmental Impact of Channel Modification,
W82-04245 1509 4A

Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 1510 5A

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 1510 2B

A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 1511 6D

Acid Precipitation. 1. Causes and Consequences,
W82-04771 1511 5C

The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 1511 2J

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 1511 4A

Effects of Acid Precipitation,
W82-05149 1511 5C

Metabolic Response of Fish to Stress,
W82-05159 1511 5C

Sulphur in the Environment: A Review,
W82-05179 1511 5B

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

Impact of Discharges as a Basis for Control Measures,
W82-05354 1511 5B

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

The Long Lake Diversion: An Environmental Evaluation,
W82-05568 1511 6G

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 1511 4A

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 1511 5D

Northwestern Ontario River Dimensions,
W82-05742 1511 6G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 1511 3C

The Colorado River Salinity Problem,
W82-05889 1511 5G

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 1512 5G

Incentives and Institutions for Water Conservation,
W82-05922 1512 3D

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

China's Agro-Ecosystem,
W82-06019 1512 3B

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 1512 6G

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G

The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 1512 2L

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 1512 5C

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 1512 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
W82-06404 1512 6G

Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 1512 6G

Habitat Recovery in the North Fork of the Teton River.
W82-06409 1512 6G

Reregulation on an International River--A Case Study,
W82-06429 1512 6G

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 1512 5B

Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 1512 5B

Freshwater Macroinvertebrates,
W82-06797 1512 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 1512 6G

ENVIRONMENTAL EFFECTS. *POLLUTANT IDENTIFICATION
Organic Substances in Water,
W82-01783 1503 5A

ENVIRONMENTAL GRADIENT
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

ENVIRONMENTAL IMPACT STATEMENT
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 1501 7C

Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 1501 6G

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 1501 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 1501 6G

Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 1501 6G

Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 1501 6G

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 1501 5D

Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 1501 5D

Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 1501 5D

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 1501 5E

Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 1501 5D

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 1501 6G

Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 1501 6G

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 1502 6G

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 1502 6G

Recent Trends in Environmental Impact Assessment,
W82-02525 1505 6G

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 1507 6G

Final Environmental Impact Statement: Cheyenne Stage II Water Diversion, Medicine Bow National Forest.
W82-04073 1509 6D

San Francisco River Wild and Scenic River Study Report; Greenlee County, Arizona.
W82-04076 1509 6G

Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 1511 6G

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 1512 6G

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 1512 6G

ENVIRONMENTAL POLICY
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 1502 6G

Strategies for the Management of Estuaries,
W82-02166 1505 6F

EPA's Approach to Regulating New Energy Technologies,
W82-03129 1507 6E

ENVIRONMENTAL PROTECTION
Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 1501 6G

An Environmental Safety Assessment of Butyl Benzyl Phthalate,
W82-00615 1502 5A

Formulating Alternatives for Environmental Studies,
W82-00997 1502 6G

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

International Cooperation to Protect the Baltic,
W82-02087 1504 6E

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

User Reaction to Wild and Scenic River Designation,
W82-02278 1505 6G

ICI Brixham - Environmental Research in the Private Sector.
W82-03153 1507 5D

Law for Environmentalists,
W82-05813 1511 5G

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 1512 6E

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys,
W82-06368 1512 6B

ENVIRONMENTAL PROTECTION AGENCY
New Directions in Water Pollution Control,
W82-06071 1512 5G

ENVIRONMENTAL QUALITY
Who Wins in the Fight for Pollution Control,
W82-04554 1510 6B

ENZYMES
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 1510 5C

Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 1511 5C

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 1511 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

EPHEMERAL LAKES
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 1503 2H

EPHEMERAL STREAMS
A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 1502 2E

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 1507 2A

EPIDEMIOLOGY
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 1502 5C

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 1503 5A

Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 1508 5A

An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

EPILIMNION
Comment on 'A Relation Between Lake Morphometry and Primary Productivity and Its Use in Interpreting Whole-Lake Eutrophication Experiments' (E.J. Fee),
W82-03780 1509 5C

EPIPHYTIC ALGAE
Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 1505 6G

EQUALIZING BASINS
Optimization of Automated Equalization Basin-Reactor Systems for Chemical Treatment of Wastewater,
W82-04052 1509 5D

EQUILIBRIUM
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 1503 5F

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

Kinetics for the Aquatic Environment,
W82-01806 1504 2K

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 1504 8D

Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 1511 2K

Ion Hydration and Ion Interaction,
W82-05310 1511 2K

EQUIPMENT
Aquatic Weed Cutting Apparatus,
W82-00624 1502 4A

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 1508 5F

Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermesstellen),
W82-04582 1510 7B

EROSION
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

Modeling Gradual Dam Breaches,
W82-00554 1502 8D

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 1502 2J

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems,
W82-01401 1503 5B

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 1503 2J

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 1504 2J

Evaluating Scour at Culvert Outlets,
W82-01934 1504 4D

Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 1505 4A

Aerial Photography to Detect Rill Erosion,
W82-02232 1505 7B

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 1505 2J

Erosion Resistance of Cohesive Soils,
W82-02676 1506 2J

Erosion Control Along Transportation Routes in Northern Climates,
W82-02933 1506 2J

Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 1507 2J

Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 1507 8A

Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin,
W82-03817 1509 2J

Bank Failure and Erosion on the Ohio River,
W82-04473 1510 2J

How Rain Intensity Affects Interrill Erosion,
W82-04537 1510 2J

The Vortex Scour Mechanism at Bridge Piers,
W82-04642 1510 8B

Erosion by Submerged Circular Jets,
W82-05002 1511 2J

Erosion by Plane Turbulent Jets,
W82-05277 1511 8B

A Field Technique to Directly Measure River Bank Erosion,
W82-05410 1511 7B

Erosion from Mountain Snowpack Melt,
W82-05664 1511 2J

Splash Erosion Modeling: Physical Analysis,
W82-05970 1512 2J

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 1512 2J

Erosion and Sediment,
W82-06554 1512 2J

The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 1512 8E

EROSION CONTROL
Performance of Granular Soil Covers on Canals,
W82-00047 1501 8D

Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 1501 4D

Protecting Agriculture's Natural Resource Base,
W82-00176 1501 4D

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 1501 2J

Coordinated Effort Stems Sediment and Erosion,
W82-00766 1502 4D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 1502 4D

Tractive Force Design of Vegetated Channels,
W82-00901 1502 4D

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D

Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 1503 4D

Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 1503 4D

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 1503 4D

Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 1503 4D

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 1503 4D

Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 1505 2I

Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 1505 4D

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 1506 4A

How About Reverse Filters,
W82-03247 1507 4D

The North Carolina Sedimentation Control Program--An Assessment,
W82-04160 1509 2J

Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 1511 8F

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

Erosivity Values for Individual Design Storms,
W82-05694 1511 4D

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Erosion Control at a Delicate Highway Construction Site,
W82-06510 1512 4D

Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

EROSION RATES

Effect of Slope Length on Erosion from Low Slopes,
W82-00896 1502 2J

Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 1505 2J

Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 1508 2J

Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin,
W82-03817 1509 2J

A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 1511 2J

Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

ERROR ANALYSIS

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

Approximate Error Bounds for Simulated Hydrographs,
W82-02678 1506 2A

A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 1507 2E

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 1508 2H

Erosivity Values for Individual Design Storms,
W82-05694 1511 4D

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

ERRORS

Note on Random Raindrops and Sampling Error,
W82-02032 1504 2B

Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 1512 8G

ESCHERICHIA COLI

Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 1501 5A

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 1503 5A

Improved Microbe Detection in Water Samples,
W82-03258 1507 5A

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 1507 5D

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 1511 5A

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 1512 5C

ESK ESTUARY

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 1507 5A

ESSEX COUNTY

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 1505 2E

ESTHWAITE WATER

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

ESTIMATED COSTS

Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

ESTIMATING

Data Requirements for Kriging: Estimation and Network Design,
W82-04200 1509 7A

Flood Probability Estimation,
W82-04318 1510 6B

Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 1512 4A

ESTIMATING EQUATION

An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

ESTIMATING EQUATIONS

Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 1502 2G

Transport of Salts in Soils and Subsoils,
W82-00930 1502 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 1502 2G

Linearized Solution to Inlet Equation with Inertia,
W82-01183 1503 2L

Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 1506 8A

Boundary Calculations of Sluice and Spillway Flows,
W82-02677 1506 8B

Integral Equation Formulation for Ground-Water Flow,
W82-02716 1506 2F

The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 1507 2B

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 1511 2E

On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

ESTIMATION

Robust Flood Frequency Models,
W82-06319 1512 2E

ESTONIA

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 1511 5A

ESTUARIES

Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 1501 2L

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 1501 5A

Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 1501 5C

The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 1502 7B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 1502 2L

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 1502 2L

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 1503 5B

Salt Dispersion in the Hudson Estuary,
W82-01615 1503 2L

Sediment Bacterial Indicators in an Urban Shellfishing Subestuary of the Lower Chesapeake Bay,
W82-01661 1503 5A

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 1503 4C

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 1503 2J

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 1503 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 1503 2L

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 1504 2L

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 1504 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

On Some Chytrids Found in Estuarine Habitats,
W82-02038 1504 2L

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 1504 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

Water Management on the Columbia River,
W82-02112 1505 6D

Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 1505 6E

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 1505 4A

Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 1505 2J

Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 1505 2L

Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 1505 2L

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 1505 4A

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

Sediment--Asset or Liability,
W82-02150 1505 6B

Overview of Freshwater Inflow Depletions,
W82-02152 1505 6D

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 1505 6D

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 1505 2L

Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 1505 2L

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 1505 6G

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 1505 7A

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 1505 2L

Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 1505 2L

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 1505 2L

The Dynamics of Conservative Mixing in Estuaries,
W82-02345 1505 2L

Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 1505 2L

Determination of Ammonia in Estuary,
W82-02390 1505 5A

Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 1505 5G

Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 1505 5C

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 1505 5B

Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 1505 2L

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 1505 2L

Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 1506 2K

Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 1506 2L

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel,
W82-02792 1506 2L

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

Development of the River Seine Estuary: Case Study,
W82-02867 1506 2L

Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 1506 2L

Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 1507 2L

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 1507 5A

Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 1507 2L

Radar Measurements of Estuarine Currents and Tides,
W82-03360 1507 2L

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 1507 2L

The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 1508 2L

Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 1508 2L

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 1508 2L

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 1508 2L

Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 1508 5B

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 1508 2L

The Distribution of Mercury, Cadmium and Lead Between Water and Suspended Matter in the Loire Estuary as a Function of the Hydrological Regime,
W82-03757 1509 2L

An Analysis of Selected Classes of Organic Constituents in the Thames River Estuary,
W82-03819 1509 2L

The Background to the Flood Defences of London and the Thames Estuary,
W82-03895 1509 4A

Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998 1509 2L

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 1510 2L

Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 1510 2L

Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 1510 2L

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

Salinity Intrusion in Estuaries,
W82-04574 1510 2L

Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 1510 2L

A Suspended Sediment Front in the Severn Estuary,
W82-04639 1510 2L

Dispersion Coefficients in Estuaries,
W82-04684 1510 5B

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 1511 2L

Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 1511 2L

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 1511 2L

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 1511 5B

The Tidal Stream in the German Bight,
W82-05190 1511 2L

Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 1511 2L

Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

Dynamic Estuary Model Performance,
W82-05319 1511 2L

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 1511 6F

Contaminant Dispersion in Oscillatory Flows,
W82-05631 1511 5B

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 1511 5B

Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 1511 2B

Retention of Riverine Iron in Estuaries,
W82-06191 1512 5B

Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 1512 2L

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 1512 5C

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 1512 5A

York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 1512 5C

ESTUARIES *HYDROGEN ION CONCENTRATION

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

ESTUARINE ENVIRONMENT

Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 1501 5A

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 1501 2L

Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 1501 5C

Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 1501 2L

Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 1502 6E

Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 1502 2L

Effect of Kepone on Estuarine Microbial Activity,
W82-01231 1503 5C

Marine and Estuarine Pollution,
W82-01274 1503 5C

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 1503 6E

An Estuarine Agar Medium for Enumeration of Aerobic Heterotrophic Bacteria Associated with Water, Sediment, and Shellfish,
W82-01565 1503 5A

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 1503 5C

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 1503 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 1504 5B

Freshwater Inputs and Estuarine Productivity,
W82-02110 1505 2L

Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 1505 6E

Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 1505 6G

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
W82-02115 1505 6G

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 1505 2L

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 1505 2L

Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 1505 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 1505 4A

Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 1505 2L

Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 1505 5C

Strategies for the Management of Estuaries,
W82-02166 1505 6F

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 1505 7A

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 1505 2L

Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 1505 2L

Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 1506 5C

Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 1506 2L

Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 1507 2L

Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 1507 2L

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

Accumulation of Polychlorinated Biphenyls in Atlantic Tomcod (Microgadus Tomcod) Collected from the Hudson River Estuary, New York,
W82-01777 1509 5C

Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 1510 7B

Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 1510 2L

Modeling: How and When to Use,
W82-04754 1511 2L

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 1511 2L

Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 1511 2L

Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 1511 6A

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 1511 5C

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 1511 2J

Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 1512 2J

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

Isolation and Characterization of Ultramicrobacteria from a Gulf Coast Estuary,
W82-06747 1512 5A

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 1512 5B

Marine and Estuarine Pollution,
W82-06808 1512 5C

Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 1512 5C

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 1512 5A

ESTUARINE ENVIRONMENTS
Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 1502 2L

ESTUARINE FISHERIES
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 1505 6G

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 1505 6B

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 1505 5C

Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 1506 5C

ESTUARY
The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 1512 5B

ETHIOPIA
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 1510 5A

ETHYL METHANESULFONATE
Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

ETHYLENE
Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 1505 2K

EUPHOTIC ZONE
Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

EUPHRATES DAM
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

EUPHRATES RIVER
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

EUROPE
The Effect of EEC Directives on Water Supplies,
W82-02432 1505 6E

Space-Time Variability of the Runoff of European Rivers,
W82-02848 1506 2E

New Developments in Papermaking in Western Europe,
W82-02947 1506 5D

EUROPEAN ECONOMIC COMMUNITY
Experiences with EEC Guideline 75/440 on the Quality of Surface Waters for Drinking Water Production in the Member States (Erfahrungen mit der EG Richtlinie 75/440 Uber die Qualitat von Oberflachenwasser fur die Trinkwassergewinnung in den Mitgliedstaaten).
W82-04547 1510 6E

EUTROPHIC LAKES
Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 1501 2H

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 1502 5F

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 1502 2H

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 1502 5C

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 1502 2H

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 1502 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 1504 5F

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 1504 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 1504 2H

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 1504 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 1508 2H

The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 1510 5C

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

The Rehabilitation of Norway's Largest Lake,
W82-05243 1511 5G

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 1511 2H

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

EUTROPHICATION

Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 1501 5B

Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 1501 2H

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 1503 7A

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

Eutrophication,
W82-01271 1503 2H

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 1503 2H

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 1503 5C

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 1503 2H

Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 1503 5C

Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 1503 5C

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 1503 2H

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 1504 5C

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 1504 2H

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 1504 5C

Freshwater Inputs and Estuarine Productivity,
W82-02110 1505 2L

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 1505 2H

On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 1505 5C

Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 1505 5C

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 1505 5C

Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 1506 2H

Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 1506 5C

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 1506 5C

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

Lake Trophic State and Algal Growth as Influenced by Cation Concentrations,
W82-03038 1507 5C

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 1507 5G

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 1507 2H

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 1507 5C

Eutrophication, Accelerated by Pollution,
W82-03193 1507 5C

Exploiting Papyrus,
W82-03202 1507 2H

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 1507 5C

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 1507 5C

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 1508 5B

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

Hypolimnetic Aerator Fights Eutrophication,
W82-03563 1508 5G

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 1508 2H

Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

The Impact of Eutrophication on Water Treatment and Supplies in the Anglian Water Authority,
W82-03866 1509 5C

Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

Eutrophication Measures for Small Lake Water Quality Management,
W82-04243 1509 2H

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 1510 5C

Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 1510 5C

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 1510 5G

Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 1510 2H

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 1511 2H

Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 1511 2H

Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 1511 5G

Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 1511 5D

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

Phosphorus Reduction Studies,
W82-05408 1511 5D

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 1511 2H

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 1512 5C

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 1512 5C

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 1512 5C

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 1512 5C

The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 1512 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 1512 7C

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

Physical Process and Eutrophication,
W82-06875 1512 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 1512 5C

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 1512 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 1512 5C

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 1512 5C

EUTROPHICATION *POPULATION DYNAMICS
Persistent Blooms of Surf Diatoms Along the Pacific Coast, U.S.A. I. Physical Characteristics of the Coastal Region in Relation to the Distribution and Abundance of the Species,
W82-03233 1507 5C

EUTROPHIED LAKES
Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 1512 5F

EUTROPIC LAKES
Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 1512 5C

EVALUATION
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

Evaluating Irrigation Systems,
W82-00772 1502 6B

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 1503 5D

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 1503 6B

Methods for Evaluating Performance of Filter Media,
W82-02684 1506 5D

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

Methods for Evaluating Performance of Filter Media,
W82-03661 1508 5F

ISFETs-New Tools for Water Quality Monitoring,
W82-04059 1509 5A

Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 1510 6B

Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 1511 6B

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 1511 8C

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

Sampling Frequency Optimization Using a Water Quality Index,
W82-05268 1511 5A

Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 1512 6D

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 1512 3D

EVAPORATION
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 1503 7B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 1504 2D

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 1504 2D

Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 1506 2L

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 1507 2D

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a

Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

Shale Oil Wastewater Treatment by Evaporation,
W82-04905 1511 5D

VTE/VC for Sea Water,
W82-04909 1511 3A

Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 1511 2H

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

Low Temperature Evaporation Plants,
W82-05118 1511 3A

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759 1511 2G

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 1512 2D

Potential Evaporation in the Peace Region of British Columbia,
W82-06528 1512 2D

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 1512 2D

EVAPORATION CONTROL
A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 1508 3B

EVAPORATION PANS
Automatic Class-A Pan-Filling System,
W82-01326 1503 7B

Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648 1511 2D

An Automated Recording System for Evaporation Pans,
W82-06780 1512 2D

EVAPORATION RATE
A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 1511 2D

Evaporation at a High Arctic Site,
W82-04899 1511 2D

Liquid Level Interferometer,
W82-05929 1512 7B

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 1512 2D

EVAPORATOR-CONDENSERS (HORIZONTAL)
Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 1512 3A

EVAPORATORS
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 1512 3A

Heat Transfer in a Rotating Disk Evaporator,
W82-06112 1512 3A

Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 1512 3A

Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 1512 3A

EVAPOTRANSIRATION
Evapotranspiration from Forage Grass Replacing Native Vegetation in the Gila River Valley of Arizona,
W82-03994 1509 2D

EVAPOTRANSPIRATION
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 1501 2D

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 1501 3F

Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 1503 2D

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 1503 2D

Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 1504 3F

Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 1505 2D

Practical Prediction of Actual Evapotranspiration,
W82-02308 1505 2D

The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 1506 2D

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 1508 2A

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 1508 2G

Modeling the Effects of Conservation Practices on Soil Moisture,
W82-03811 1509 2G

The Water Balance in Newfoundland,
W82-03921 1509 7A

A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 1510 3F

Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 1510 2H

Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 1510 2A

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 1511 2D

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 1511 2D

Soil Water Availability,
W82-05623 1511 2G

A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 1511 4C

New Evapotranspiration Crop Coefficients,
W82-05692 1511 3F

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

EVAPOTRANSPIRATION POTENTIAL
Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: De-

termining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

EVERGLADES
Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

EVOLUTION
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 1501 2L

EXCAVATION
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 1506 8H

Groundwater Control,
W82-04714 1510 4B

Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 1511 8C

Frogmen's Subterranean Swim Sites Source,
W82-05901 1511 8A

Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 1511 8H

Driving Large Hydraulic Tunnels by the Stepped Face Method,
W82-05586 1511 8H

Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 1512 8E

EXCESS RAINFALL
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

Application of Infiltration Theory for the Determination of Excess Rainfall Hyetograph,
W82-03752 1509 2A

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

EXPANSION
Capacity Expansion Planning Model for Waste Water Treatment and I/I Control,
W82-04239 1509 5D

EXPERIMENTAL DATA
Recording Unconfined Tension Tester,
W82-04238 1509 8D

EXPERIMENTAL DESIGN
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 1501 7B

Solar Heat Pond System,
W82-02187 1505 3F

Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

EXPERIMENTAL FARMS
Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 1501 2J

Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 1504 2I

EXPLORATION
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 1508 7B

The Value of Exploratory Test Holes in Ground Water Development,
W82-03896 1509 2F

Frogmen's Subterranean Swim Sites Source,
W82-05901 1511 8A

EXPLOSIVES
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 1506 8H

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 1511 8H

EXTENDED AERATION
Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

FABABEANS
Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

FABRICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

FACTOR ANALYSIS
Associations and Mesoscale Spatial Relationships Among Rainwater Constituents,
W82-00964 1502 2B

Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

FALLOUT
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 1501 5E

The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 1504 5B

Hydrological Studies Possible with Radionuclides of Bomb-Test, Primordial and Natural Origin to Complement Investigations Using Manufactured Radiotracers,
W82-03836 1509 5B

A Simulation of the Enrichment of Atmospheric Pollutants in Snow Cover Runoff,
W82-03838 1509 5B

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

FALLOWING
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

FARM MANAGEMENT
Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 1502 4D

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 1503 4D

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

FARM WASTES
The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 1503 5B

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 1503 5B

Pollution from Farms,
W82-02039 1504 5D

Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 1507 5D

Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 1510 5E

Package Anaerobic Sludge Digestion.
W82-04850 1511 5D

Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 1511 2A

FARMING
Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 1503 4D

Logistics of Farm Water Supply.
W82-02037 1504 6A

City Sewage and the American Farmer,
W82-03600 1508 3C

FARMS
Land and Stream Salinity in Western Australia,
W82-01374 1503 5B

FATE OF POLLUTANTS
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

Dye-Sensitized Photooxidation of Bromacil in Water, 1502 5B
W82-00514

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption, 1502 5B
W82-01032

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes, 1503 5B
W82-01132

Microbiology: Detection, Occurrence, and Removal of Viruses, 1503 5A
W82-01290

Chemical and Bacteriological Quality of Pasture Runoff, 1503 5B
W82-01555

Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet, 1504 5B
W82-01820

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta, 1504 5B
W82-01868

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge, 1504 5C
W82-01919

Geologic Aspects of Waste Disposal Site Evaluations, 1504 5E
W82-02011

Environmental Fate of Methyl Eugenol, 1504 5B
W82-02013

Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond, 1505 5B
W82-02323

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK, 1505 5B
W82-02327

Multiport Diffuser Mixing Zones in Rivers, 1505 5B
W82-02594

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese), 1506 5B
W82-02719

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability, 1506 5B
W82-02750

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement, 1506 5B
W82-02922

Zinc in Seawater and Sediments, 1507 5B
W82-03166

Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution, 1507 5B
W82-03171

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System, 1507 5D
W82-03364

Kinetics of Phenol Oxidation by Washed Cells, 1507 5D
W82-03399

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates, 1508 5B
W82-03480

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida, 1508 2H
W82-03546

Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments, 1508 1B
W82-03557

Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978, 1508 5B
W82-03590

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment, 1508 5B
W82-03599

Comparative Study of the Trophic Transfer of Two Mercury Compounds--HGCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature, 1508 5B
W82-03602

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem, 1508 5B
W82-03690

Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge, 1508 5B
W82-03695

The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies, 1508 5B
W82-03735

Laboratory and Field Studies of The Relative Mobility of 239, 240PU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions, 1509 5B
W82-03899

Bacterial Dynamics in a Water Supply Reservoir: A Case Study, 1509 5A
W82-04108

Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan, 1510 2H
W82-04377

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants, 1510 5D
W82-04477

A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions, 1510 5B
W82-04534

Role of Natural Colloids in the Transport of Hydrophobic Pollutants, 1510 5B
W82-04539

Development of Improved Stormwater Quality Models, 1510 5B
W82-04559

Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils, 1511 5B
W82-04781

Volatilization Rates of Intermediate and Low Volatility Chemicals from Water, 1511 5B
W82-04817

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution, 1511 5A
W82-04818

Photolysis of Polycyclic Aromatic Hydrocarbons in Water, 1511 5B
W82-04835

Biosorption of Hydrophobic Organic Pollutants by Mixed Microbial Populations, 1511 5B
W82-04885

Biodegradation of Hazardous Organic Pollutants, 1511 5B
W82-04910

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers, 1511 5B
W82-05079

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System, 1511 5B
W82-05144

Humic Substances, 1511 5B
W82-05148

Microcomputer Water Quality Simulation Model, 1511 7B
W82-05191

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions, 1511 5B
W82-05273

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment, 1511 5B
W82-05353

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine, 1511 5B
W82-05376

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate, 1511 5A
W82-05382

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers, 1511 5B
W82-05418

Radionuclides in Mono Lake, California, 1511 5B
W82-05461

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions, 1511 5B
W82-05479

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival, 1511 5C
W82-05485

Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada, 1511 5B
W82-05486

Elevated Concentrations of Actinides in Mono Lake, 1511 5B
W82-05520

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters, 1512 5A
W82-06033

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia, 1512 5B
W82-06054

Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles, 1512 5B
W82-06056

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges, 1512 5D
W82-06270

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay, 1512 5D
W82-06438

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

Selection of Waste disposal sites,
W82-06550 1512 5E

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 1512 5B

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

Aquatic Sediments,
W82-06806 1512 2J

Organics,
W82-06922 1512 5A

FATE OF POLLUTENTS
Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

FATHEAD MINNOWS
Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

FATTY ACIDS
Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 1501 5A

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01134 1503 2H

FATTY AMINES
Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 1510 5D

FAUNA
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 1501 5C

The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 1506 5D

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 1508 2H

FEASIBILITY STUDIES
West Sacramento Canal Unit Reformulation.
W82-02974 1506 6B

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

Hydropower: Inflation-Proof Energy from Water Supply Dams,
W82-04137 1509 6B

Determining Feasibility of Small-Scale Hydropower,
W82-04693 1510 6B

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 1511 5G

FECAL COLIFORM
Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

FECAL STREPTOCOCCUS
Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 1510 5B

FECES
Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

Occurrence of Rhodococcus Coprophilus and Associated Actinomycetes in Feces, Sewage, and Freshwater,
W82-03122 1507 5A

FEDERAL JURISDICTION
Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 1501 6E

Water Regulations,
W82-00482 1501 6E

The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 1502 6B

Review of Ectuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 1505 6G

Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 1505 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 1505 6E

Superfund: What a Mess,
W82-02184 1505 6E

Compliance Strategy for Clean Water.
W82-02185 1505 6E

Engineering U.S. Water Policy,
W82-03294 1507 6E

Clean Water Act.
W82-03687 1508 6E

Comments on a National Ground-Water Protection Strategy,
W82-03740 1508 6F

The Impact of Federal Water Policy on State Planning: A Cautionary Example,
W82-04120 1509 6E

Future Directions in Federal Water Resources,
W82-04196 1509 6D

Federal Subsidy of Irrigation Development,
W82-04233 1509 6E

Development of Federal Reserve Rights,
W82-04446 1510 6E

New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 1510 6C

A Federal Perspective on River Basin Management,
W82-05388 1511 6E

The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 1511 6E

Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 1512 6E

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 1512 6E

FEDERAL REPUBLIC OF GERMANY
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 1504 6E

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 1512 5A

Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 1512 5E

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 1512 5B

FEDERAL-STATE COOPERATION
The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

FEDERAL WATER POLLUTION CONTROL ACT
Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

FEDERAL WATER RESOURCES RESEARCH
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

FEEDING RATES
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

FEEDLOT RUNOFF
Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 1502 5D

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 1508 3C

Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 1511 5B

FEEDLOT WASTES
Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 1507 5D

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

FEEDLOTS
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 1503 5B

FEEDS
Feeding Animals Activated Sludge,
W82-00523 1502 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 1511 5D

Potato and Corn By-Products Used as Cattle Feed,
W82-06488 1512 5E

Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

FEEDWATER TREATMENT
Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 1511 3A

FENITROTHION
Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 1501 5B

Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 1501 5B

FENS
Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 1501 2I

The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

FERMENTATION
Fermentation Industry,
W82-01257 1503 5D

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

Control of Sludge Bulking in the Brewing Industry,
W82-05260 1511 5D

Fermentation Industry,
W82-06917 1512 5D

FERRIC CHLORIDE
Ferric Chloride Takes Over,
W82-00954 1502 5F

Destabilization of Biological Solids with Ferric Chloride,
W82-04373 1510 5D

FERTILITY
The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 1502 2H

FERTILIZERS
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 1501 2L

The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 1501 2A

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 1503 5B

Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 1503 5B

Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 1503 5B

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 1505 5B

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 1508 5B

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 1511 2I

Irrigation Efficiency in Orchards,
W82-05768 1511 3F

FIELD TESTS
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 1505 2E

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 1511 5C

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 1511 3A

FIJI ISLANDS
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

FILM COEFFICIENTS
Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 1512 3A

FILMS
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1504 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1504 1B

FILTER MEDIA
Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 1502 5F

Methods for Evaluating Performance of Filter Media,
W82-02684 1506 5D

Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 1506 5A

Methods for Evaluating Performance of Filter Media,
W82-03661 1508 5F

Controlling Bed Losses of Granular Activated Carbon Through Proper Filter Operation,
W82-04089 1509 5F

Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 1511 5D

Role of Surface Active Media in Anaerobic Filters,
W82-05816 1511 5D

Getting Your Money's Worth from Filtration,
W82-06412 1512 5F

Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 1512 5F

FILTER PERFORMANCE
Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

FILTERS
Concentration of Coliphages from Large Volumes of Water and Wastewater,
W82-00247 1501 5A

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 1501 5D

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

How About Reverse Filters,
W82-03247 1507 4D

Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 1508 5F

Filter Criteria for Sub-Surface Drainage,
W82-03660 1508 8G

Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887 1509 5F

The Bed Depth Service Time Design Method for Deep Bed Filtration,
W82-04143 1509 5F

Design of Filters for Clay Cores of Dams,
W82-04321 1510 8G

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 1512 5F

FILTRATION
Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 1501 5A

Upflow Water Filtration Unit, Test Results,
W82-00407 1501 5F

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 1502 5D

Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 1502 5F

Low Turbidity Water from Fast Processes,
W82-00946 1502 5F

Economic Analysis of Granular-Bed Filtration,
W82-00975 1502 5F

Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 1503 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 1503 5D

A Successful Low Technology Wastewater Process,
W82-01178 1503 5D

Investigation of Volatile Organics Removal,
W82-01490 1503 5F

Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 1504 5A

New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 1506 5F

Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

Improved Microbe Detection in Water Samples,
W82-03258 1507 5A

Designing for Coarse Sand Filtration Systems,
W82-03478 1508 5D

Upgrading to Increase Treatment Capacity,
W82-03654 1508 5F

Declining-Rate Filtration,
W82-03656 1508 5F

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

The Status of Direct Filtration.
W82-04105 1509 5F

Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant,
W82-04116 1509 5F

Recent Developments in Direct Filtration,
W82-04122 1509 5F

Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water,
W82-04127 1509 5F

Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

Initial Degradation of Effluent Quality During Filtration,
W82-04134 1509 5F

Waterborne Giardiasis--An Overview,
W82-04186 1509 5C

Effect of Filtration Pressure on Analyses for Chlorophyll,
W82-04247 1509 2H

Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 1510 5F

Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 1510 5D

Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 1511 5F

Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 1511 5D

On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012 1511 5A

Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 1511 5D

Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 1511 5D

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 1511 5D

Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 1511 5D

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

Advanced Water Treatment for Color and Organics Removal,
W82-06279 1512 5F

Getting Your Money's Worth from Filtration,
W82-06412 1512 5F

Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 1512 5F

The Effect of Backwashing Rate on Filter Performance,
W82-06415 1512 5F

Low-Dosage High-Rate Direct Filtration,
W82-06416 1512 5F

Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 1512 5F

Membrane Separation Processes,
W82-06445 1512 5D

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 1512 5F

Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 1512 5D

Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 1512 5A

FINANCIAL ASPECTS
Water Regulation in an Inflationary Environment,
W82-02701 1506 5F

Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 1508 5F

Operating Collection Systems Under Fiscal Stress,
W82-06340 1512 5D

FINANCIAL FEASIBILITY
Internal Rates of Return Derived from the Pay-Back Period,
W82-05542 1511 6B

FINANCING
A 201 Pollution Control Planning Tragedy,
W82-00285 1501 6E

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

Adjusting Government Role in Water Law.
W82-02256 1505 6E

Texas to Vote on Water Trust Fund.
W82-02302 1505 6C

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 1507 8A

The Financing of Private Small Scale Hydroelectric Projects.
W82-04633 1510 6B

Financing Federal Water Development Projects and Sharing the Costs,
W82-04739 1510 6C

Turks Press Forward With Ambitious Dam Programme,
W82-05758 1511 6B

Water Supply and Distribution in Larger Communities,
W82-06413 1512 5F

Crisis: Financing Water and Wastewater,
W82-06641 1512 6C

FINITE DIFFERENCE METHODS
A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 1511 8B

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 1512 2G

FINITE ELEMENT ANALYSIS
A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

FINITE ELEMENT METHOD
Subdomain Integration Model of Ground-Water Flow,
W82-02550 1505 2F

On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 1507 2F

Discussion of 'Finite Element Method for Direct Runoff Flow',
W82-03782 1509 2A

An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 1511 2F

The Moving Interface Problem with Finite Elements,
W82-06546 1512 2L

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 1512 2G

Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 1512 2J

Finite Element Approximations to Flow Problems,
W82-06730 1512 8B

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

FINITE ELEMENT MODELS
Finite Element Modeling of Streamflow Routing,
W82-05918 1512 2E

FINLAND
Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 1502 5C

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 1502 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 1502 2L

On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 1503 2C

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 1510 7B

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

FINNISS RIVER
Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

FIR TREES
Vertical Variation in Stemflow Generation,
W82-02959 1506 2I

FIRES
Fire and Geomorphic Processes,
W82-06963 1512 2J

FIRN
Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

FISH
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 1501 5C

Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 1501 5A

Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 1501 5A

Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1502 5B

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 1502 3B

Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 1502 5C

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 1502 5C

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 1503 5A

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 1503 5B

Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 1503 5C

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 1503 5A

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 1503 6G

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 1504 5C

Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 1504 5C

Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 1504 5C

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 1504 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 1504 5C

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 1504 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Thermal Power Stations,
W82-01998 1504 5C

Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 1505 5C

Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 1505 2L

Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 1506 5C

PP and L Uses Discharge Water for Fish Farming.
W82-02645 1506 3C

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 1506 5C

Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 1506 5C

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 1507 5C

Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 1507 5B

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 1508 5C

Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 1508 5C

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 1508 5C

A Study of Biotic Transport of Asbestiform Fibers in Lake Superior,
W82-03950 1509 5B

Power Plant Siting and Design: A Case Study of Minimal Entrainment and Impingement Impacts at Davis-Besse Nuclear Power Station,
W82-03964 1509 5C

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters–II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 1510 6G

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 1511 5A

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C

Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 1511 5A

Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 1511 5C

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 1511 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

Metabolic Response of Fish to Stress,
W82-05159 1511 5C

Entrainment Mortality of Ichthyoplankton: Detectability and Precision of Estimates,
W82-05181 1511 5C

The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 1511 4A

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 1511 5C

Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 1511 5C

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 1511 5B

Bioassay Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

Environmental Improvement at Port Alice, B. C.,
W82-06515 1512 5C

Organochlorine Residues in Fish from Lake Mjosa in Norway,
W82-06697 1512 5A

Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 1512 5C

Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 1512 5C

FISH BARRIERS

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 1504 5C

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

FISH BEHAVIOR

The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

Metabolic Response of Fish to Stress,
W82-05159 1511 5C

FISH CREEK
Two Bed-Load Formulas: An Evaluation,
W82-02375 1505 2J

FISH DIETS
Status Report on Striped Bass Analyses,
W82-04386 1510 8I

FISH DISEASES
Seasonal Variation in the Prevalence of 'Red Spot' Disease in Estuarine Fish with Particular Reference to the Sea Mullet, Mugil Cephalus L.,
W82-02426 1505 2L

Accumulation of Polychlorinated Biphenyls in Atlantic Tomcod (Microgadus Tomcod) Collected from the Hudson River Estuary, New York,
W82-03777 1509 5C

FISH EGGS
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 1505 7B

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

Perivitelline pH of Salmonide Eggs in Relation to Ambient pH,
W82-04064 1509 5C

FISH ESTABLISHMENT
Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

FISH FARMING
Thames Rears Carp in Sewage.
W82-00681 1502 3C

Water Movement for Water Quality in Catfish Production,
W82-00866 1502 5G

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

PP and L Uses Discharge Water for Fish Farming,
W82-02645 1506 3C

Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 1506 8I

Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

Water Quality and Off-Flavor Problems in Commercial Channel Catfish Culture in West-Central Alabama,
W82-04087 1509 5C

The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 1511 5D

The Impact of Fish Farming on Water Quality,
W82-05471 1511 5B

FISH FOOD
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

FISH FOOD ORGANISMS
Status Report on Striped Bass Analyses,
W82-04386 1510 8I

Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 1511 2H

FISH GUIDING
Engineering Aspects of Fish Protection at Water Intakes,
W82-04759 1511 8I

FISH HANDLING FACILITIES
Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 1503 5D

FISH LAKE
Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

FISH MANAGEMENT
Management Provoked Conflict in Fisheries,
W82-00780 1502 6A

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 1502 6G

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 1505 6G

Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

Notes on the Construction, Installation and Environmental Effects of Habitat Improvement Structures in a Small Lowland River in Shropshire,
W82-06084 1512 8I

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

FISH MIGRATION
Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

FISH PARASITES
Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 1506 2H

FISH PASSAGES
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
W82-04075 1509 8I

FISH PHYSIOLOGY
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 1506 5C

FISH PONDS
The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 1502 2H

A Method for the Evaluation of Conditions in a Fish Pond Sediment,
W82-01019 1502 2H

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 1503 3C

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 1504 2H

Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

FISH POPULATIONS
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 1501 2E

The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 1501 5C

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 1501 5C

Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

FISH POPULATIONS

Water Movement for Water Quality in Catfish Production,
W82-00866 1502 5G

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 1502 8I

Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 1503 5C

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 1503 7A

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 1504 5C

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

Liming Acid Ponds in New York,
W82-02572 1505 5G

Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C

Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 1508 2L

Status Report on Striped Bass Analyses,
W82-04386 1510 8I

The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 1510 5C

Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 1511 5C

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507 1511 5C

Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 1511 5C

Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide During Tsetse Fly Control Operations in Botswana,
W82-05630 1511 5C

Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

An Investigation of Some Factors Influencing the Performance of a Recreational Trout Fishery,
W82-06329 1512 6D

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 1512 8I

Further Observations on the Effect of Abate on Fish Catches,
W82-06722 1512 5C

Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

FISH TOXINS

Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 1502 5C

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 1502 5A

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 1512 5C

FISHERIES

The Valuation of Recreational Fisheries,
W82-00348 1501 6C

Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 1502 6A

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

Management Provoked Conflict in Fisheries,
W82-00780 1502 6A

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 1504 6E

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 1505 6G

Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 1508 5C

Eastern Scheldt Design Has Changed.
W82-03493 1508 8A

Engineering in Catfish Production,
W82-04367 1510 8I

Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 1511 8I

Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 1511 4A

FISHING INDUSTRY

Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

FISHKILL

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 1502 2H

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 1502 5A

Acid Precipitation,
W82-01607 1503 5C

Mt. St. Helens and the Fish,
W82-02508 1505 2J

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

FITZROY RIVER
Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

FIVE-YEAR PLAN
Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 1511 6B

FIVE-YEAR PLANS
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

FJORDS
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 1503 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 1503 2J

Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 1505 5C

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 1505 2L

Deep Water Renewal in Subarctic Fjord,
W82-03675 1508 2L

FLASH DISTILLATION
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 1512 3A

FLASH EVAPORATION
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

FLASH FLOODS
Learning from the Skipton Flood,
W82-02063 1504 2E

Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 1505 2A

Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 1506 2J

Disaster by Flood,
W82-04618 1510 2E

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 1510 2E

FLATWORMS
The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

FLEXIBILITY
Flexible Outfall at Aldeburgh,
W82-02415 1505 8A

Reliability and Redundancy: Dual Protection for Water Treatment Plants,
W82-04148 1509 5F

FLOATING ICE
A Mechanism for the formation of Large Icebergs,
W82-04798 1511 2C

Velocity Distributions Under Floating Covers,
W82-05562 1511 2E

FLOCCULATION
Dewatering of Industrial Clay Wastes,
W82-00041 1501 5D

A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 1501 5D

Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 1502 5F

Floc/Float System Cleans Desalter Effluent,
W82-00906 1502 5D

Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 1503 5F

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 1504 5D

Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 1505 5F

Upgrading to Increase Treatment Capacity,
W82-03654 1508 5F

Upgrading Water Treatment Plants in San Diego,
W82-03655 1508 5F

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 1508 5D

Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

Measuring the Velocity of Water in a Paddled Flocculator,
W82-04102 1509 5F

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 1510 5F

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

Mutual Flocculation of Algae and Clay: Evidence and Implications,
W82-05460 1511 2H

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

Metal Removal 'A La Carte',
W82-06608 1512 5F

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 1512 5D

FLOOD CONTROL
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 1501 4A

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 1501 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 1501 6B

Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

The Chambal Project: Problems and Solutions,
W82-01739 1503 4A

Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 1504 4A

The Day That the Rain Came Down,
W82-02064 1504 2E

Interactive Nonstructural Flood-Control Planning,
W82-02320 1505 6F

Methods of Restoring the Delivery of Drainage Wells,
W82-02385 1505 4A

Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 1505 6G

Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 1506 8A

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme.
W82-02872 1506 5D

A Solution to Spring Ice-Jam Flooding,
W82-02908 1506 2C

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

Flood Routing Program,
W82-03286 1507 4A

The Background to the Flood Defences of London and the Thames Estuary,
W82-03895 1509 4A

Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

The Thames Barrier,
W82-04039 1509 4A

Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

Storm Water Management: The Concept and Its Application,
W82-04240 1509 4A

Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

Environmental Impact of Channel Modification,
W82-04245 1509 4A

Detention Basins--An Urban Experience,
W82-04332 1510 4A

Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 1510 6A

Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 1510 6F

New Methods of Designing Flood Control Measures,
W82-05030 1511 2E

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 1511 4A

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 1511 6E

Resolving the Fish vs Flood Control Controversy on the Vedder River,
W82-05765 1511 4A

Flood Damage Assessment and Flood Control Planning as Part and Parcel of the Economics of Water Utilization (Vloedskadebepaling en Vloedskadebeheer as Onderdele Van Die Ekonomie Van Waterbenutting),
W82-05896 1511 6A

Urban Creekside Design Features Parallel Streets,
W82-06184 1512 4C

FLOOD-CONTROL STORAGE
Sizing of Urban Flood Control Ponds,
W82-03297 1507 2A

Analysis of Detention Basin Systems,
W82-04444 1510 2A

FLOOD DAMAGE
Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 1501 4A

Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Floodplain Management: A Flood and Land Planning System,
W82-01872 1504 6F

The Day That the Rain Came Down,
W82-02064 1504 2E

Bank Failure and Erosion on the Ohio River,
W82-02343 1505 2J

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 1507 8A

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 1507 6A

Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

Disaster by Flood,
W82-04618 1510 2E

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 1510 2E

The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 1511 2E

Devon Floods and the Waterways of Bridges,
W82-05948 1512 8A

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

Habitat Recovery in the North Fork of the Teton River,
W82-06409 1512 6G

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 1512 8A

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 1512 2E

FLOOD DATA
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 1501 2E

Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 1512 7C

FLOOD DISCHARGE
Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 1507 2E

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 1512 2E

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

FLOOD FLOW
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 1503 2E

How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 1506 7A

Hydraulic Resistance of Floodplains,
W82-02850 1506 2E

Floodflow Characteristics of the Sacramento River in the Vicinity of Gianella Bridge, Hamilton City, California,
W82-03985 1509 2E

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 1512 4A

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 1512 8B

FLOOD FORECASTING
Predicting Lake Levels by Exponential Smoothing,
W82-00118 1501 2A

Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 1501 6F

Regional Flood Frequency Estimation and Network Design,
W82-01294 1503 2E

A Catchment Approach to Flood Estimation,
W82-01397 1503 2E

Monitoring Glacier Outburst Floods,
W82-01558 1503 2C

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 1503 2E

Learning from the Skipton Flood,
W82-02063 1504 2E

Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 1505 2C

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

Developing Dam-Break Flood Zone Ordinance,
W82-02585 1505 6F

Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 1506 2E

Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

Flood Probability Estimation,
W82-04318 1510 6B

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 1510 2E

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 1510 2E

Statistical Forecasting of Heavy Rain and Floods in the River Tees,
W82-04670 1510 2B

Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 1511 2A

An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 1512 2A

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

FLOOD FREQUENCY
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

Regional Flood Frequency Estimation and Network Design,
W82-01294 1503 2E

Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 1503 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 1503 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 1503 2E

The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 1505 2E

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 1505 4C

Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 1510 2E

Investigations of Catastrophic Maximum Discharges of the Araks River,
W82-05591 1511 2E

Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 1512 2A

Statistical Flood Flow Estimation,
W82-05945 1512 2E

An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 1512 2A

Robust Flood Frequency Models,
W82-06319 1512 2E

FLOOD HYDROGRAPHS
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 1506 2A

Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 1511 2A

FLOOD INSURANCE
Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 1511 4A

FLOOD IRRIGATION
Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1502 4B

FLOOD PEAK
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 1503 2E

Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

A Trigger Type Cluster Model for Flood Analysis,
W82-03818 1509 2A

Mathematical Simulations of The Toccoa Falls, Georgia Dam Break Flood,
W82-03920 1509 2E

Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

Analysis of Detention Basin Systems,
W82-04444 1510 2A

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

Flood Peak Regionalization Using Mixed-Mode Estimation of the Parameters of the Log-Normal Distribution,
W82-05495 1511 2E

Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 1511 2A

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 1511 4C

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 1512 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 1512 2E

FLOOD PEAKS
Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 1511 2A

Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 1512 2A

FLOOD PLAIN MANAGEMENT
Floodplain Management: A Flood and Land Planning System,
W82-01872 1504 6F

Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

State and Local Acquisition of Floodplains and Wetlands; A Handbook on the Use of Acquisition in Floodplain Management.
W82-03966 1509 6F

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 1511 4A

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 1512 6F

FLOOD PLAIN ZONING

Developing Dam-Break Flood Zone Ordinance,
W82-02585 1505 6F

Floodplain Delineation: An Economic Approach,
W82-04236 1509 6F

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

FLOOD PLAINS

Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 1501 2J

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 1502 6G

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 1502 6E

Hydraulic Resistance of Floodplains,
W82-02850 1506 2E

Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 1507 4C

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 1507 5C

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

Flood Hazard Identification and Flood Plain Management on Alluvial Fans,
W82-04738 1510 6F

A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 1511 2D

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 1511 7C

Carrying Capacity of Flood Plains,
W82-06428 1512 2E

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 1512 2E

FLOOD PROCESSING INDUSTRY

Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 1506 5D

FLOOD PROFILES

Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 1501 2E

Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 1505 4C

Floodplain Analysis, Simplified vs. Complex Methods: A Case Study,
W82-05732 1511 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 1512 8B

FLOOD PROTECTION

Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 1501 6F

Reliability of Underground Flood Control System,
W82-00556 1502 8A

Risk Models for Flood Levee Design,
W82-01307 1503 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 1503 8B

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

Floodplain Management: A Flood and Land Planning System,
W82-01872 1504 6F

A Solution to Spring Ice-Jam Flooding,
W82-02908 1506 2C

Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

The Thames Barrier,
W82-04039 1509 4A

Panoche Creek Flood Protection Works.
W82-04068 1509 4A

Official and Folk Flood Warning Systems: An Assessment,
W82-06077 1512 6F

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 1512 8B

FLOOD RECURRENCE INTERVAL

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 1505 4C

Paleoflood Hydrology,
W82-03761 1509 2E

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

FLOOD ROUTING

Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 1507 4A

Flood Routing Program,
W82-03286 1507 4A

Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 1512 4A

Accuracy Criteria in Diffusion Routing,
W82-06423 1512 8B

Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 1512 4A

FLOOD STAGES

Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 1501 2E

FLOOD WAVES

Parametric Study of Flood Wave Propagation,
W82-03425 1508 2E

Asymptotic Solution for Dam-Break Problem,
W82-04313 1510 8B

FLOODING

Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 1501 2E

Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 1502 4D

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 1512 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 1512 2E

FLOODNG

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5B

FLOODS

Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Monitoring Glacier Outburst Floods,
W82-01558 1503 2C

Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 1505 2J

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 1505 2L

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 1505 2A

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 1505 2E

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8B

Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 1506 2J

The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 1506 2L

Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 1510 2E

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 1511 2E

Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 1512 2E

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

Robust Flood Frequency Models,
W82-06319 1512 2E

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 1512 6F

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 1512 7C

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

FLOODS FREQUENCY
Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

FLOODWATER
Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Passing Floodwaters Over Embankment Dams,
W82-02204 1505 8A

Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

Effect of the Spring Flood Regime on the Development of North Caspian Zoobenthos,
W82-05596 1511 2E

FLOODWAYS
Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

FLORENCE
Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

FLORIDA
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 1501 5F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Chemistry of Precipitation at Gainesville, Florida,
W82-00185 1501 2K

A 201 Pollution Control Planning Tragedy,
W82-00285 1501 6E

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 1501 7C

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 1501 5B

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 1501 10C

Hydrogeologic Data from Test Drilling near Vero Beach, Florida, 1978,
W82-00424 1501 2F

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 1502 5B

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 1502 2F

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 1503 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 1503 7C

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 1503 5G

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 1503 10C

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 1504 2B

Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 1505 4A

Surface Water Flow from a South Florida Wetland Area,
W82-02121 1505 2E

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 1505 5B

FLORIDA

The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 1505 2F

Metabolism of a Florida Lake Ecosystem,
W82-02268 1505 2H

Biological Control of Aquatic Weeds in Southwest Florida,
W82-02285 1505 4A

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 1505 2H

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 1505 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 1505 7C

Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 1505 2L

Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 1506 2E

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 1507 5G

The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 1508 2L

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 1508 2H

Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 1508 5A

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

Microbiological Quality of Selected Recreational Waters,
W82-03636 1508 5A

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

Upgrading to Increase Treatment Capacity,
W82-03654 1508 5F

Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

The Significance of Tropical Cyclone Rainfall in the Water Supply of South Florida,
W82-03821 1509 2B

A Comparison of the Structure, Primary Productivity, and Transpiration of Cypress Ecosystems in Florida,
W82-03885 1509 2I

Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study,
W82-03919 1509 7A

Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

Hydrologic Almanac of Florida,
W82-03974 1509 7C

Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

Practical Power-Saving Techniques in Pinellas County,
W82-04092 1509 5F

Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 1510 2H

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 1510 7C

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 1510 10C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 1510 5C

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 1510 2H

Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 1511 2H

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

The Utilization of Grass Carp, Ctenopharyngodon Idelia Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 1511 4A

Aquifer Management in Dade County,
W82-05784 1511 5G

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 1511 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 1511 2F

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 1511 7C

Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 1512 5D

Florida Style Water Supply and Treatment,
W82-06027 1512 5F

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 1512 7C

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 1512 2B

Work Management Standards,
W82-06349 1512 6F

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 1512 5B

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 1512 5C

Stormwater Management in a Sensitive Area.
W82-06841 1512 5G

Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 1512 5B

Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 1512 7B

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 1512 7C

Water Resources Data for Florida, Water Year 1980--Volume 2B. South Florida Ground Water,
W82-06956 1512 7C

FLORIDAN AQUIFER
Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

FLOTATION
Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 1501 5D

High-Solubility Gas Flotation,
W82-01184 1503 5D

Developments in Sedimentation and Flotation,
W82-01391 1503 5F

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 1504 5D

By-Product Recovery Finances Treatment,
W82-02756 1506 5D

Oil-Water Separation by Induced Air Flotation,
W82-03719 1508 5D

Palm Oil Refinery Wastes Treatment,
W82-03909 1509 5D

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 1511 3A

Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 1512 5D

Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 1512 5F

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

FLOW
Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 1501 2L

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 1505 2A

Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 1505 2F

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 1507 2F

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

Finite Element Approximations to Flow Problems,
W82-06730 1512 8B

FLOW AROUND OBJECTS
Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 1512 8B

FLOW AUGMENTATION
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 1508 5G

Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

FLOW CHANNELS
Lower Flow Regime Bedforms: Rational Classification,
W82-06421 1512 2E

Carrying Capacity of Flood Plains,
W82-06428 1512 2E

FLOW CHARACTERISTICS
Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 1501 2G

Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 1502 8B

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 1502 8B

Flow Analysis of Models of the Hubbard Brook Ecosystem,
W82-01038 1502 1A

Vertical Velocity Profiles in Stratified Flows,
W82-01171 1503 8B

Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5B

Turbulence Model for Flow Over Dredged Channels,
W82-02201 1505 8B

Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 1505 6A

Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 1506 2E

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

Flow Characteristics Below Floating Covers with Application to Ice Jams,
W82-03011 1507 2C

Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 1507 6A

Discussion of 'Turbulence Prediction in Open Channel Flow',
W82-03781 1509 8B

Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

Management of Ice-Covered Rivers: Problems and Perspectives,
W82-03807 1509 2C

Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

Flow Model of Saginaw River Near Saginaw, Michigan,
W82-03996 1509 2E

Empirical Investigation of Curve Number Technique,
W82-04112 1509 2A

Conformal Mapping for Channel Junction Flow,
W82-04306 1510 2E

Measurement of Air in Flowing Water,
W82-04322 1510 7B

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 1510 2E

Storm Sewer Flow Computations,
W82-04640 1510 7B

Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 1510 8B

Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 1510 8B

Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 1511 8B

Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 1511 8B

The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 1511 8B

The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 1511 2E

A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 1512 2E

Canals in Sand Channels,
W82-06196 1512 8B

Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 1512 8B

Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 1512 8B

Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 1512 8B

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 1512 4A

FLOW CONTROL

The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 1507 4A

Automatic Flow Control in Combined Sewer Systems-Effectiveness and Implementation Problems,
W82-04049 1509 5D

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

James Bay Spillways and Control Structures,
W82-04692 1510 8A

Water Hammer,
W82-05432 1511 8C

FLOW DEFLECTORS

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

FLOW DISCHARGE

Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 1501 6A

Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 1505 2E

Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 1505 2E

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 1506 2E

Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 1506 7B

Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 1507 7B

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 1511 2E

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

FLOW DISHCARGE

The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

FLOW DURATION

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

FLOW FRICTION

Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 1506 8B

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 1512 8B

FLOW MEASUREMENT

Modeling Water Flux on Strip-Mined Land,
W82-00944 1502 2G

Composite Sampling of Highway Runoff,
W82-02230 1505 7B

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

Leak Detection - Two Methods That Work,
W82-02521 1505 3D

Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 1506 8B

Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 1507 7B

Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 1507 7B

A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 1508 7B

NPDES Compliance Flow Measurement Manual,
W82-03965 1509 5D

Use of Pre-Fabricated Parshall Flumes to Measure Streamflow in Permafrost-Dominated Watersheds,
W82-04074 1509 7B

The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 1510 7B

Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 1511 5D

On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 1511 2J

FLOW NETS

A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 1503 5B

FLOW PATTERN

Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 1501 6A

Ice Cover Effects on Stream Flows and Mixing,
W82-02698 1506 2C

Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 1511 5D

Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 1512 5C

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 1512 8B

FLOW PATTERNS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 1504 2L

LARM Two-Dimensional Model: An Evaluation,
W82-02597 1505 4A

FLOW PROFILE
Contaminant Dispersion in Oscillatory Flows,
W82-05631 1511 5B

FLOW PROFILES
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

Hydraulic Exponents,
W82-03669 1508 2E

SWMM Model and Level of Discretization,
W82-03673 1508 6A

Young's Inequality for Three-Dimensional Flows,
W82-04267 1510 2A

Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

Dispersion in Tumbling Flow,
W82-05796 1511 8B

Flow Under Weir on Scoured Bed,
W82-05800 1511 8B

FLOW RATE
Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

FLOW RATES
Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5E

Depths of Flow in Level Basins,
W82-00900 1502 3F

Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 1505 2E

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

Local Flow Accelerations in Rivers,
W82-02758 1506 2E

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 1506 2E

A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 1507 2E

Estimating Water Flow Under Gates,
W82-05514 1511 8B

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 1511 7C

A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

FLOW REGULATION
The Kielder Water Scheme,
W82-06503 1512 8A

FLOW REGULATORS
New Jet-Gate Design,
W82-02691 1506 8C

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

FLOW RESISTANCE
Flow Resistance in Vegetated Waterways,
W82-00152 1501 2E

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

Resistance Equation for Large-Scale Roughness,
W82-04696 1510 2E

Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

Flow Resistance in Wide Rectangular Channels,
W82-05798 1511 8B

FLOW SEPARATION
Sediment--Asset or Liability,
W82-02150 1505 6B

Discussion of 'Visualization of Separation over Sand Waves',
W82-03783 1509 8B

Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 1512 8B

FLOW SYSTEM
Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 1510 7B

FLOW VELOCITY
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 1503 8B

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 1503 2F

Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 1506 2E

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 1511 2E

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 1511 8A

Formation of a Stable Canal Channel,
W82-05584 1511 8B

Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 1511 4C

Canals in Sand Channels,
W82-06196 1512 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 1512 8B

Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 1512 8B

FLOWMETERS
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 1507 7B

FLUCTUATIONS
Substrate Flux into Biofilms of Any Thickness,
W82-01964 1504 5D

An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 1506 2G

Bed Load Fluctuation: Applications,
W82-05000 1511 2J

FLUID DROPS
Large Rain Drops in the Bright Band,
W82-03065 1507 7B

On the Graphical Presentation of Raindrop Size Data,
W82-06529 1512 2B

The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 1512 2B

FLUID FLOW
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

Finite Element Approximations to Flow Problems,
W82-06730 1512 8B

FLUID MECHANICS
Surface Viscosity of Water,
W82-03501 1508 1A

Numerical Simulation of Reservoirs,
W82-03504 1508 6A

Buoyant Surface Jets,
W82-03670 1508 8B

Application of Fluidic Devices for Control of Wastewater Treatment Operations,
W82-04013 1509 5D

Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 1511 8B

The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 1511 8B

A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 1511 2C

Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 1511 8B

Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 1511 2E

Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

Numerical Methods in Hydraulics,
W82-06614 1512 8B

FLUIDIZED BED PROCESS
Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 1506 5D

Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse.
W82-03245 1507 5E

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 1512 5D

FLUIDIZED BEDS
Fluidized Bed for Biological Wastewater Treatment,
W82-00968 1502 5D

Simplified Mathematical Models for a Fluidized Bed Biofilm Reactor,
W82-03877 1509 5D

Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 1512 5D

The Effect of Backwashing Rate on Filter Performance,
W82-06415 1512 5F

FLUMES
Field Assessment of Sediment Traps,
W82-00105 1501 7B

Measuring Flumes of Simplified Construction,
W82-00140 1501 7B

Boundary Shear in Smooth and Rough Channels,
W82-02711 1506 8B

Use of Pre-Fabricated Parshall Flumes to Measure Streamflow in Permafrost-Dominated Watersheds,
W82-04074 1509 7B

Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 1512 8B

FLUORESCENCE
Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 1505 5A

Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 1511 2L

Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 1511 5A

Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 1511 5A

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

FLUORESCENCE SPECTROSCOPY
Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

FLUORIDATION
Fluoridation System,
W82-00061 1501 5F

FLUORIDE
The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 1506 5F

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02949 1506 5F

Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 1507 5F

Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 1510 5F

FLUORIDE OVERFEED
A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

FLUORIDES
Fluoride Determination in Water: An Optimum Buffer System for use with the Fluoride-Selective Electrode,
W82-03269 1507 5A

A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 1511 5C

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 1512 2K

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

FLUOROMETRY
Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 1512 5A

FLUSHING
Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 1503 3F

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

The Dilution/Flushing Technique in Lake Restoration,
W82-02270 1505 2H

Conducting a Regular Main Flushing Program,
W82-04118 1509 5F

Reducing the Flush,
W82-04654 1510 3D

FLUSHING MEADOWS PROJECT
Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

FLUTED TUBES
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 1512 3A

FLUVIAL SEDIMENTS
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 1503 2J

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 1503 4D

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 1512 2J

FLY ASH
Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 1503 5B

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 1503 5B

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

Effect of Leachate Solutions from Fly and Bottom Ash on Groundwater Quality,
W82-03798 1509 5B

Phosphate in Water: I. Reduction Using Northern Lignite Fly Ash,
W82-03882 1509 5F

FLYNN CREEK
Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

FOAM FLOTATION
Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

FOAM SEPARATION
Foam Control in Aeration Tanks, W82-00171 1501 5D
Foam Control in Aeration Tanks, W82-00525 1502 5D
Water Purification Studies with Activated Carbon and Foam Flotation, W82-01692 1503 5D
Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis, W82-05290 1511 3A
Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant, W82-05960 1512 5D
The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant, W82-06821 1512 5D
Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study, W82-06822 1512 5D

FOAMING
Foam Control in Aeration Tanks, W82-00171 1501 5D
Foam Control in Aeration Tanks, W82-00525 1502 5D
Origin and Chemical Composition of Androscoggin River Foam, W82-02970 1506 5B
Start-Up Problems of Sludge Dewatering Facility, W82-05444 1511 5D

FOG
The Potential Acidity Associated with Dews, Frosts, and Fogs, W82-06246 1512 2K

FOOD CHAIN
Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain, W82-01033 1502 5C

FOOD CHAINS
Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain, W82-01443 1503 5B
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet, W82-01820 1504 5B
Tracing Food Webs with Stable Hydrogen Isotopes, W82-02021 1504 6G
Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond, W82-02323 1505 5B
Stedy of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978), W82-03492 1508 5B
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains, W82-04369 1510 5D
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains, W82-04370 1510 5D
Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains, W82-04371 1510 5D
Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977, W82-05074 1511 2H

FOOD HABITS
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan, W82-00485 1501 2H

FOOD PROCESSING INDUSTRY
Gerber Saves 465,000 Gallons of Water/Day, W82-00187 1501 3E
Assimilation of Lemonade-Processing Wastewater by Yeasts, W82-00204 1501 5D
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System, W82-00226 1501 5D
Anaerobic Biological Treatment of Food Industry Wastewaters, W82-00698 1502 5D
Meat-, Fish-, and Poultry-Processing Wastes, W82-01256 1503 5D
Geothermally Powered Food-Processing Systems. W82-02543 1505 3E
Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires), W82-04544 1510 5D
Water Recycling/Reuse in the Food Processing Industry, W82-04566 1510 5D
Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie), W82-04584 1510 3E
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters, W82-06195 1512 5D

FOOD PROCESSING WASTES
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids, W82-00156 1501 5E
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers, W82-00406 1501 5D
Low-Cost Wastewater Treatment, W82-00841 1502 5D
Composition of Fruit and Vegetable Processing Wastes, W82-01601 1503 5D
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes, W82-01627 1503 5D
Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates, W82-02992 1506 5D
Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials, W82-03206 1507 5D
Anaerobic Fermentation - Filtration of Potato Processing Wastewater, W82-04713 1510 5D
Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters, W82-06195 1512 5D
Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant, W82-06306 1512 5D
Anaerobic Filter Treatment of Molasses Distillery Slops, W82-06312 1512 5D
Comparison of BOD Relationships for Typical Edible and Petroleum Oils. W82-06458 1512 5D
Potato and Corn By-Products Used as Cattle Feed, W82-06488 1512 5E
Recycled Food Processing Wastes Reduce Treatment Costs, W82-06507 1512 3C
Fruit, Vegetable, and Grain Processing Wastes, W82-06918 1512 5D
Dairy Wastes, W82-06921 1512 5D
Meat-, Fish-, and Poultry-Processing Wastes, W82-07000 1512 5D

FORAGES
Effects of Water Quality on Forage Production, W82-01002 1502 3C
Evapotranspiration from Forage Grass Replacing Native Vegetation in the Gila River Valley of Arizona, W82-03994 1509 2D
Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions, W82-05265 1511 3C

FORD LAKE
Modeling Suspended Solids and Bacteria in Ford Lake, W82-02595 1505 5B

FOREBAYS
Membrane Liner Seals 278-Acre Reservoir. W82-02361 1505 8G
Influence of Dredging and High Discharge on the Ecology of Black Canyon, W82-06091 1512 6G

FORECASTING
Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model, W82-00428 1501 2F
The Modeling of Aquatic Ecological Systems, W82-01972 1504 5B
Learning from the Skipton Flood, W82-02063 1504 2E
Demand Forecasting in Water Supply Networks, W82-02926 1506 6D

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 1511 6D

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 1511 2E

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 1512 2B

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 1512 2H

FOREIGN RESEARCH

A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

FOREST FIRES

Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 1510 4C

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

FOREST HYDROLOGY

Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

On a Technique to Investigate the Covariation Between Streamflow and Rainfall in Afforested Catchments,
W82-03864 1509 4C

A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 1511 4C

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 1511 2J

FOREST MANAGEMENT

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 1503 4C

The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 6B

Will the World Face Up to Its Ever-Worsening Environmental Problems.
W82-03459 1508 4C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 1510 4C

Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 1511 4C

Forest Management for Increased Water Yield--How Useful in Southern Alberta,
W82-05760 1511 3B

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 1512 5C

FOREST SOILS

Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 1505 2I

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 1508 5B

How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 1511 5E

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

FOREST WATERSHEDS

Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 1503 4C

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 1503 6A

Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 1506 4D

Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 1507 2G

Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03843 1509 5B

Effects of Sulfuric Acid Rain on Major Cation and Sulfate Concentrations of Water Percolating Through Two Model Hardwood Forests,
W82-04872 1511 5C

Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 1511 2K

Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 1512 4C

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 1512 5C

FORESTRY

Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 1503 6A

Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse),
W82-03460 1508 5A

New Problems with Upland Waters,
W82-06602 1512 5G

FORESTS

Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 1502 2D

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 1502 2I

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 1503 2G

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 1503 5B

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 1503 5C

Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 1512 2K

FORT COLLINS

Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

FORT PIERCE INLET

Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 1505 2L

FORT UNION COAL REGION

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 1510 5C

FORT WAYNE
Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

Ground-Level Versus Elevated Storage,
W82-03865 1509 5F

FORTRAN COMPUTER PROGRAMS
Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

FOS REFINERY
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 3C

FOULING
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 1503 5F

Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 1507 3A

Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 1512 3A

Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

FOUNDATION FAILURE
$12.6 M Repairs Bill for Ruahihi Canal.
W82-05880 1511 8D

FOUNDATION ROCKS
Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

Experience in Preparing the Rock Foundation of the Dnestr Hydroelectric Station,
W82-05585 1511 8H

FOUNDRY COVE
Cadmium in an Aquatic Ecosystem,
W82-03724 1508 5A

FOX RIVER
River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

FRACTURE PERMEABILITY
An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 1503 2F

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

FRACTURE TRACES
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

FRACTURE ZONES
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

FRACTURED POROUS MEDIA
An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

FRANCE
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 1501 2H

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 1503 6F

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

Sustaining the Growth of Provence.
W82-01738 1503 6D

Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 1505 2F

Relationship Between Populations of Amphipods and Pollution,
W82-02444 1505 5C

French Experience in Water Pollution Control,
W82-02765 1506 5G

Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 1506 2F

The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 1506 5D

Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 1507 2H

Limnologic Study of Lake Pavin (France) I: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) I: Facteurs Abiotiques et Phytoplancton),
W82-03219 1507 2H

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

Clarification with Microsand Seeding. A State of the Art,
W82-03880 1509 5F

Water Supply in the Paris Suburbs: Changing Treatment for Changing Demands,
W82-04125 1509 5F

Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 3C

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 1510 5A

Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 1511 5F

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 1511 5F

Generating Power from Compensating Flow.
W82-05624 1511 8C

The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 1512 5G

Sludge Disposal to Sea in France,
W82-06593 1512 5E

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 1512 5D

FRANKLIN COUNTY
Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

FRASER RIVER
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 1511 6F

FRASER RIVER CATCHMENT
Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 1506 2E

FRASER RIVER ESTUARY
Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

FRAZIL ICE
Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 1510 2C

Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 1511 2C

FREEZE DESALTING
Myths about Freeze Desalting,
W82-06114 1512 3A

Freezing Processes - The Standard of the Future - An Update,
W82-06115 1512 3A

FREEZE DRYING
Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

FREEZE PROCESS
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process,
W82-02105 1505 3A

FREEZING
Physical Mechanics of Aufeis Growth,
W82-00836 1502 2C

Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

A Study of The Vacuum-Freezing High Pressure Ice-Melting Process,
W82-04166 1509 3A

A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant,
W82-04724 1510 3A

Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 1511 2G

The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 1512 2C

Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 1512 3A

FRENCH ALPS
Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

FREQUENCY ANALYSIS
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 1502 2B

Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

Revised Rainfall Frequency Analysis for Houston,
W82-05863 1511 2B

Carrying Capacity for the Illinois River,
W82-05927 1512 6G

Statistical Flood Flow Estimation,
W82-05945 1512 2E

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

FREQUENCY DISTRIBUTION
An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 1506 2G

Empirical Investigation of Curve Number Technique,
W82-04112 1509 2A

Statistical Flood Flow Estimation,
W82-05945 1512 2E

FRESHWATER INFLOW
Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

FRESHWATER MARSHES
Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 1506 6B

FRICTION
Calculation of the Strength of Rigid Diaphragms in Earth Dams,
W82-02667 1506 8D

Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 1512 2E

FRICTION LOSS
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

Coefficient of Friction in Conduits with Large Roughness,
W82-02901 1506 8B

FROGS
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 1501 5A

FROST
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 1503 2C

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 1512 2K

FROST PROTECTION
Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

FROUDE NUMBER
Erosion by Submerged Circular Jets,
W82-05002 1511 2J

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

FROZEN GROUND
Configuration of Ice in Frozen Media,
W82-05615 1511 2C

FRUIT CROPS
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 1501 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 3F

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

Wastewater Irrigation of Fruit Trees,
W82-06008 1512 3C

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

FUEL
Water Quality Issues and Energy Assessments,
W82-00036 1501 6B

Refuse-To-Energy Wastewater Treatment,
W82-00168 1501 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 1501 5D

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 1510 6B

The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 1512 5C

FUEL REPROCESSING
The Status of Nuclear Waste Management,
W82-02659 1506 5E

241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 1507 5B

FULLER'S METHOD
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

FULLY PENETRATING WELLS
Cavity Well,
W82-04920 1511 8A

FULTON COUNTY
Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 1501 5E

FULVIC ACIDS
Effects of Salts on Activated Carbon Adsorption of Fulvic Acids,
W82-05667 1511 5F

FUNGI
Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 1501 5E

Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 1502 5D

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 1504 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 1504 2L

Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 1506 2H

Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 1511 5D

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 1512 2L

Actinomycetes and Fungi in Surface Waters and in Potable Water,
W82-06543 1512 5B

FUNKA BAY
A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

FURROW DRAINAGE
Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

FURROW IRRIGATION
Optimal Design of Furrow Irrigation Systems,
W82-00138 1501 3F

Furrow Irrigation Practices in Northern Colorado,
W82-00139 1501 3F

Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 1504 3F

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02536 1505 3F

Furrow Intake Rates and Water Management,
W82-05968 1512 3F

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 1512 3F

The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 1512 3F

FURROWS
Sediment Sizes Eroded from Crop Row Sidelopes,
W82-00903 1502 2J

FUTURE PLANNING
Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 1505 6G

Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

FUZZY SETS
A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

GABIONS
Model Studies of an Overtopped Rockfill Dam,
W82-03694 1508 8E

GAGING
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 1503 2C

GAGING STATIONS
A Catchment Approach to Flood Estimation,
W82-01397 1503 2E

Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 1508 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 1508 2B

Search: A Gaged Watershed Inventory,
W82-04433 1510 10B

GALT
Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

GALVANIZED STEEL
Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 1511 8G

GAMMA RADIATION
Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 1508 2G

Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 1511 2C

GAMMARUS
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 1506 2H

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 1512 5B

GAMO ESTUARY
Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

GAS CHROMATOGRAPHY
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 1501 5A

Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 1503 5A

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 1510 5A

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 1511 5A

Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

Headspace Chromatographic Determination of Water Pollutants,
W82-06016 1512 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

GAS CHROMATOGRPHY
Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

GAS LIQUID CHROMATOGRAPHY
Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 1501 5A

GASES
Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 1508 5D

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

GASTROENTERITIS
Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

GASTROPODS
Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

GATES
High-Head Vertical Lift Gates,
W82-02388 1505 8A

New Jet-Gate Design,
W82-02691 1506 8C

Estimating Water Flow Under Gates,
W82-05514 1511 8B

Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 1512 8C

Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 1512 8B

GEL CHROMATOGRAPHY
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods,
W82-06015 1512 5A

GENERA IDENTIFICATION
An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 1510 5C

GEOCHEMISTRY
Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 1502 5B

Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 1503 2L

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 1503 2F

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 1504 2K

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 1505 2F

Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 1506 2K

A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 1506 2F

Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 1508 2K

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

The Rate of Flushing as a Major Factor in Determining the Chemistry of Water in Fossil Aquifers in Southern Israel,
W82-03799 1509 2K

Chemical Evolution of Groundwater in a Drainage Basin of Holocene Age, East-Central Alberta, Canada,
W82-03800 1509 2K

Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana,
W82-03810 1509 2F

Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 1510 2F

Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 1511 2K

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 1511 4B

The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801 1511 2K

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

GEOCHRONOLOGY
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

GEODETIC LEVELLING
Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 1508 2H

GEOHYDROLOGIC UNITS
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 1504 5E

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

GEOHYDROLOGY
Supply Working Group Report.
W82-00030 1501 6D

Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 1501 4B

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 1501 5B

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

Hydrogeological and Geophysical Logging.
W82-00511 1502 7B

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 1502 2F

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 1502 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 1503 5E

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 1503 2F

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 1503 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 1503 2F

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 1505 7C

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 1505 2F

Induced Sinkholes: An Engineering Problem,
W82-02559 1505 4B

Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 1508 2F

Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

The Rate of Flushing as a Major Factor in Determining the Chemistry of Water in Fossil Aquifers in Southern Israel,
W82-03799 1509 2K

A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana,
W82-03810 1509 2F

Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 1510 4B

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 1511 5B

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 1511 2F

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 1511 2F

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 1511 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 1512 2F

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 1512 7C

GEOKCHAI RIVER
Calculation of Large Unlined Canals,
W82-05131 1511 8B

GEOLOGIC FISSURES
Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

GEOLOGIC FORMATIONS
Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 1508 5E

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

GEOLOGIC FRACTURES
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 1502 7B

Groundwater Investigations in the Vale of Stathmore,
W82-01400 1503 2F

A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 1505 8E

Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 1512 2F

GEOLOGIC HISTORY
Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 1502 2F

Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

GEOLOGICAL FRACTURES
Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 1512 2F

GEOLOGICAL SURVEY
Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 1512 2C

GEOLOGICAL SURVEY PROJECTS
Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 1501 10C

GEOLOGICAL SURVEYS
U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

Site Investigation and Materials Save Money on Sallente.
W82-05878 1511 8A

GEOLOGY
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 1503 7C

Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 1512 6A

GEOMORPHOLOGY
A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 1502 2A

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

Drainage Density as an Index of Climatic Geomorphology,
W82-01324 1503 2A

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 1503 2J

West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 1507 2C

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 1511 2A

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 1512 2A

Fire and Geomorphic Processes,
W82-06963 1512 2J

GEOPHYSICAL SURVEYS
Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 1510 5A

GEOPHYSICS
Hydrogeological and Geophysical Logging.
W82-00511 1502 7B

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 1502 2F

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

GEOPHYSIS
Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 1512 2F

GEORGIA
Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 1505 2K

The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

Nutrient Cycling in an Agricultural Watershed: Waterborne Nutrient Input/Output Budgets for the Riparian Zone,
W82-03825 1509 5B

Mathematical Simulations of The Toccoa Falls, Georgia Dam Break Flood,
W82-03920 1509 2E

Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 1511 5C

Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

GEORGIA BIGHT
Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

GEORGIA COAST
Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

GEOSTATIONARY METEOROLOGICAL SATELLITE
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

GEOTHERMAL POWER
Identification of the Wairakei Geothermal System,
W82-01312 1503 2F

Geothermal Energy: An Old Ally,
W82-02333 1505 2F

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 1510 6B

Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 1512 6G

GEOTHERMAL RESOURCES
State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 1501 5E

On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

Extraction Timing and Economic Incentives for Geothermal Reservoir Management,
W82-01504 1503 4B

Environmental Control Technology Development for Geothermal Energy,
W82-02197 1505 5C

Geothermally Powered Food-Processing Systems.
W82-02543 1505 3E

Boise Looks Underground for Heat.
W82-02636 1506 2F

Warming Up to Geothermal,
W82-03156 1507 8A

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

Environmental Problems and Geothermal Permitting,
W82-06217 1512 6G

Water Law and the Development of Geothermal Resources,
W82-06218 1512 6E

Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
W82-06404 1512 6G

GEOTHERMAL STUDIES
A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1502 1A

On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 1505 2F

Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1510 1A

A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1510 1A

A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Forous Medium,
W82-04888 1511 2F

Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 1511 2F

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 1511 2K

Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 1512 7C

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

GERMAN BIGHT

The Tidal Stream in the German Bight,
W82-05190 1511 2L

GERMAN DEMOCRATIC REPUBLIC

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 1504 2H

GERMANIUM

Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 1504 5A

GERMANY

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 1503 5F

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

Water Pollution Control in the Federal Republic of Germany,
W82-02766 1506 6E

The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 1506 5C

Computerized Data Acquisition and Data Handling in Sewage Treatment Plants,
W82-04023 1509 5D

Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 1510 4B

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 1510 7B

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 1510 5G

Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 1510 5D

Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 1511 5E

Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 1511 2H

Disposing of Sewage Sludge at Sea,
W82-05127 1511 5E

Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 1511 5D

Northern Elbe Culvert,
W82-05427 1511 8B

GERMINATION

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 1508 2I

GETTYSBURG FORMATION

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

GHANA

Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 1506 2H

Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 1512 2J

Further Observations on the Effect of Abate on Fish Catches,
W82-06722 1512 5C

GIARDIA

Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

GIARDIASIS

Waterborne Giardiasis--An Overview,
W82-04186 1509 5C

GILA RIVER

Channel Instability in a Braided, Sand Bed River,
W82-01316 1503 2J

GILA RIVER BASIN

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

GILBERT ISLANDS

A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

GILLETTE

42-Mile Water Pipeline for Coal Boom Town.
W82-02359 1505 6D

GLACIAL AQUIFERS

Predictive Depositional Model for Glacial Aquifers,
W82-00828 1502 2F

Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 1503 7C

Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

Glaciation and Ground Water.
W82-04002 1509 2C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

GLACIAL DRIFT

West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 1507 2C

GLACIAL LAKES

Monitoring Glacier Outburst Floods,
W82-01558 1503 2C

Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 1505 2C

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

Topologic Model for Drainage Networks with Lakes,
W82-05905 1512 2A

GLACIAL SEDIMENTS
The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 1503 2H

GLACIAL STREAMS
Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 1506 2E

GLACIER MASS BALANCE
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 1506 2C

GLACIERS
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

Shallow Core Snow Chemistry of Athabasca Glacier, Alberta,
W82-00320 1501 2C

Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 1504 2C

Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 1508 2C

Glaciers and Their Fluctuations,
W82-04777 1511 2C

Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 1512 2C

GLACIOHYDROLOGY
Monitoring Glacier Outburst Floods,
W82-01558 1503 2C

Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 1506 2C

Glaciation and Ground Water.
W82-04002 1509 2C

GLACIOLOGY
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

GLASGOW
Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

GLASGOW DRAINAGE AREA
Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 1503 5D

GLATT RIVER
Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

GLOBAL CLIMATE CHANGE
Water Requirements and Man-Induced Climate Change,
W82-01633 1503 2D

GLOBAL ENVIRONMENTAL MONITORING SYSTEM
Water-Quality Monitoring: A Global Approach,
W82-01339 1503 7A

GLUCOSE
Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 1507 2L

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

GLYCIDOL
Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

GOB
Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

GOCHEMISTRY
Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 1508 2K

GOLD
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

GOOSE CREEK
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 1504 4A

GOOSE RIVER
A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 1502 6E

GOUNDWATER
Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 1512 7C

GOVERNMENT FINANCE
Facts Fix Fund Finding,
W82-00885 1502 9A

Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 1505 6E

Count on Uncle Sam Less,
W82-05998 1512 6C

GOVERNMENT INTERRELATIONS
Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 1505 6E

GOVERNMENT SUPPORTS
Adjusting Government Role in Water Law.
W82-02256 1505 6E

Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 1508 5F

Federal Subsidy of Irrigation Development,
W82-04233 1509 6E

Count on Uncle Sam Less,
W82-05998 1512 6C

GOVERNMENTAL INTERRELATIONS
A 201 Pollution Control Planning Tragedy,
W82-00285 1501 6E

Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 1507 6F

CZ '80: Coastal Quandaries Persist,
W82-03383 1507 6E

GRAIN CROPS
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 1504 3F

Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 1507 3F

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

GRANADA
New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 1502 5A

GRAND CANYON
Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 1503 2J

Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 1507 5A

GRAND RIVER
Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

GRAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 1504 6D

GRAND VALLEY
Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 1502 3F

GRANITES
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

GRANTS
Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 1505 6E

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 1507 6C

EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 1508 5D

Innovative/Alternative Technology Program; Case Studies,
W82-03970 1509 5D

GRAPEVINES
Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

GRAPHICAL ANALYSIS
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 1503 5E

Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

Uniform Flow Calculations for Pipes,
W82-03748 1508 8B

Solids Inventory Control in the Activated Sludge Process,
W82-04048 1509 5D

Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 1511 8C

GRAPHICAL METHODS
Optimization of Automated Equalization Basin-Reactor Systems for Chemical Treatment of Wastewater,
W82-04052 1509 5D

Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

Relative Runoff by Curve Number Nomograph,
W82-04307 1510 2A

Statistical Flood Flow Estimation,
W82-05945 1512 2E

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 1512 8B

GRASSES
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 1502 2I

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 1512 3C

GRASSLANDS
Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 1512 3F

GRAVEL
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 1503 8B

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Geometry of Gravel Streams,
W82-04113 1509 2E

Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 1511 2E

Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 1511 2J

A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 1512 8I

GRAVITY DAMS
Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

Selecting the Optimum Cross-Section of a Concrete Gravity Dam,
W82-05510 1511 8A

The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 1512 8A

GRAVITY FILTERS
Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 1501 5D

GRAVITY FLOW
Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 1511 2F

GRAVITY STUDIES
A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 1511 2E

Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 1512 2F

GRAZING
Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming,
W82-02809 1506 3F

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 1511 3F

GREASE
Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

GREAT BASIN
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

GREAT BRITAIN
Cutting the Water Losses,
W82-00310 1501 5F

Engineering Research and the Water Industry,
W82-00313 1501 8A

Environmental Virology and its Problems,
W82-00505 1502 5A

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 1502 5F

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 1502 8A

Artificial Groundwater Recharge,
W82-01110 1503 4B

Developments in Sedimentation and Flotation,
W82-01391 1503 5F

Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 1503 8B

A Catchment Approach to Flood Estimation,
W82-01397 1503 2E

Waste Disposal--Choosing and Licensing Site,
W82-02035 1504 5G

Recording Underground,
W82-02036 1504 8A

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 1504 5D

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 1504 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

Learning from the Skipton Flood,
W82-02063 1504 2E

The Day That the Rain Came Down,
W82-02064 1504 2E

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 1504 2K

The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 1505 6A

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 1505 2F

Cereal Yields and Drought Resistance,
W82-03195 1507 2I

The Tertiary Treatment of Sewages. Conclusion,
W82-03228 1507 5D

Operational Estimation and Prediction of NItrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

Environmental Aspects of Water-Resources Planning in England and Wales,
W82-03806 1509 6E

The Search for Reservoir Sites in an Urban Environment,
W82-04867 1511 8A

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 1511 5B

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 1511 5B

New Problems with Upland Waters,
W82-06602 1512 5G

GREAT DISMAL SWAMP
Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

GREAT LAKES
Great Lakes International Surveillance Plan,
W82-00701 1502 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 1502 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 1502 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 1502 5C

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 1502 6G

Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 1503 5G

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 1503 7A

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 1504 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 1504 2H

Farm, Urban Drainage Polluting Great Lakes,
W82-02647 1506 5B

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 1506 2H

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 1507 5G

1981 Report on Great Lakes Water Quality.
W82-03102 1507 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 1507 5A

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 1507 5G

Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 1508 5B

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 1508 5D

Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 1508 2J

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 1510 2B

Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 1510 2H

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 1510 2J

A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 1511 2H

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 1512 5B

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

GREAT LAKES BASIN
Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 1502 6E

1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 1502 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 1507 5G

GREAT LAKES ECOSYSTEM
1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 1502 5C

GREAT LAKES TRIBUTARIES
Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 1503 6D

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 1511 5B

GREAT MARSH
Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

GREAT MAZURIAN LAKES
Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 1511 2H

GREAT OUSE RIVER BASIN
Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 1507 5A

GREAT PLAINS
Dryland Management for Salinity Control,
W82-01018 1502 2G

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 1510 3F

GREAT SALT LAKE DESERT
Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

GREAT SMOKY MOUNTAIN NATIONAL PARK
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 1503 6A

GREAT SMOKY MOUNTAINS NATIONAL PARK
Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 1511 5C

GREAT STAVROPOL CANAL
Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 1511 8G

GREECE
Greece Won't Be Letting Wastewater Problems Slide.
W82-00182 1501 5D

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 1503 5A

Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 1506 2H

Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 1512 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

GREEN BAY
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

GREEN LAKE
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 1501 5D

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

GREEN RIVER
Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 1511 5C

GREEN RIVER BASIN
Optimal Operation of a Reservoir System Using Forecasts,
W82-04209 1509 4A

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 1511 2E

GREENHOUSES
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

Solar Heat Pond System,
W82-02187 1505 3F

GREENSBORO
Water Conservation Program of the City of Greensboro,
W82-02518 1505 3D

GREYWATER
Expanding Options for Greywater Treatment,
W82-06491 1512 5D

GREYWATER TREATMENT
Expanding Options for Greywater Treatment,
W82-06491 1512 5D

GRIMSBY PUMPING STATIONS
Automation of Grimsby Pumping Stations,
W82-04006 1509 5D

GRINDING
The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

GROUND WATER
Selective Overburden Placement,
W82-00053 1501 5G

GROUNDNUTS
Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

GROUNDWATER
Water Resources Investigations in New York--1980.
W82-00011 1501 7C

January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 1501 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 1501 7C

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 1501 7C

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

Ground-Water Modeling: Recent Developments,
W82-00281 1501 2F

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 1501 2F

Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 1501 4B

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

Groundwater Strategies,
W82-00620 1502 5G

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 1502 5B

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 1502 7C

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 1502 7C

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 1502 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 1502 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 1502 7C

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 1502 2K

Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 1502 2F

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 1502 5B

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 1503 2F

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 1503 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from

Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 1503 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 1503 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 1503 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 1503 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 1503 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 1503 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 1503 7C

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 1503 5B

Ground Water,
W82-01273 1503 2F

Microbiology of Ground-Water,
W82-01286 1503 5B

Discussion-Engineering Geology of Arid Areas,
W82-01568 1503 4B

Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 1503 2C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 1503 5A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 1503 6B

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 1503 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 1503 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 1503 10C

Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

Applications of Aerial Photography,
W82-01988 1504 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

Groundwater Quality in the Severn-Trent Region,
W82-02423 1505 5A

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 1505 2F

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 1505 2F

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 1505 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 1505 2F

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 1505 2K

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

Water Resources Data for Utah, Water Year 1979.
W82-02474 1505 7C

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 1505 7C

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 1505 7C

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 1505 7C

Water Resources Data for Indiana, Water Year 1980.
W82-02492 1505 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 1505 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 1505 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 1505 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 1505 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 1505 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Methods for Treatment of Color in Groundwater,
W82-02532 1505 5F

Ground Water in Washington,
W82-02536 1505 2F

Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 1505 2F

Subdomain Integration Model of Ground-Water Flow,
W82-02550 1505 2F

The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 1506 5C

Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 1506 2F

Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 1506 2F

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 1506 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 1506 7C

Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 1506 5A

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

New Techniques to Remove Radon from Ground Water.
W82-03157 1507 5F

Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

Ground Water Monitoring: Part II,
W82-03380 1507 5B

Ground Water Monitoring: Part II,
W82-03484 1508 8A

Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 1508 2F

Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 1508 10B

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 1508 5G

Chemical and Hydrological Heterogeneity of Groundwaters in the Upper 'Jura Neuchatelois', Switzerland. (Heterogeneite Chimique et Hydrologique Des Eaux Sonterraines D'un Karst Du Haut-Jura Neuchatelois, Suisse),
W82-03794 1509 2K

Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

The Rate of Flushing as a Major Factor in Determining the Chemistry of Water in Fossil Aquifers in Southern Israel,
W82-03799 1509 2K

Chemical Evolution of Groundwater in a Drainage Basin of Holocene Age, East-Central Alberta, Canada,
W82-03800 1509 2K

Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

Hydrologic Almanac of Florida,
W82-03974 1509 7C

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

Water Resources Investigations in Mississippi 1980-81.
W82-03988 1509 7C

Water Resources Data for West Virginia, Water Year 1979. Appendix - Coal Areas.
W82-03990 1509 7C

Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

A Historical Jewelpiece--Discovery of the Millennium Hydrological Works of Karaji,
W82-04155 1509 2F

Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 1510 2F

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 1510 4B

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 1510 6D

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 1510 7C

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 1510 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 1510 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 1510 7C

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 1510 7C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 1510 7C

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 1510 7C

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 1510 7C

Manual Groundwater Sampling device (Vorrichtung Zu Manuellen Wasserprobenentnahme Aus Grundwassermessstellen),
W82-04582 1510 7B

Groundwater Monitoring,
W82-04809 1511 6E

Potable Water Production in Holland.
W82-04851 1511 5F

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 1511 2K

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 1511 7C

Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 1511 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 1511 2F

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79.
W82-04987 1511 7C

Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 1511 5B

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 1511 7C

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

The Status of Groundwater Law in New York State,
W82-05400 1511 6E

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 1511 5B

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
W82-05799 1511 5B

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 1511 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 1511 7C

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 1511 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

Ground-Water Reconnaissance of Part of the Lower Kenai Peninsula, Alaska,
W82-05837 1511 2F

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 1511 2F

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 1511 2F

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 1511 7C

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 1511 7C

The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 1512 2F

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 1512 7C

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 1512 7C

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 1512 7C

San Juan River Basin,
W82-06144 1512 7C

Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 1512 2E

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 1512 2F

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 1512 2K

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 1512 7C

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 1512 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 1512 7C

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 1512 5B

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 1512 2F

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5B

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

Ground Water,
W82-06807 1512 5B

Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 1512 2F

Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 1512 2F

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

Water Resources Data for Alabama, Water Year 1980–Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 1512 7C

Water Resources Data for Alabama, Water Year 1980–Volume 2. Tombigbee, Mobile, Dog, Pascagoula, and Tennessee River Basins,
W82-06954 1512 7C

Water Resources Data for Florida, Water Year 1980–Volume 2B. South Florida Ground Water,
W82-06956 1512 7C

Water Resources Data for Oregon, Water Year 1980–Volume 1. Eastern Oregon.
W82-06957 1512 7C

GROUNDWATER AVAILABILITY
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 1501 2F

Ground Water Availability,
W82-00027 1501 6D

Alternatives Working Group Report.
W82-00032 1501 6B

Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California,
W82-00415 1501 4B

Groundwater Problems and Needs in New York,
W82-01055 1502 4B

Groundwater Problems in North Carolina,
W82-01056 1502 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 1502 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 1502 4B

Groundwater Investigations in the Vale of Stathmore,
W82-01400 1503 2F

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California–Reconnaissance Study,
W82-01773 1503 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 1503 2F

Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 1505 3A

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 1505 2F

Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 1506 2F

Preparation of Friable Aquiferous Specimens,
W82-02955 1506 2F

Water Supply in Denmark,
W82-03274 1507 6D

Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 1508 7B

Glaciation and Ground Water.
W82-04002 1509 2C

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 1511 4B

Industry Helps Conserve Municipal Water,
W82-05674 1511 3E

Portable Water Elevation Measuring Gage,
W82-06396 1512 7B

Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 1512 2F

Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 1512 2F

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 1512 2F

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 1512 2F

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

GROUNDWATER BARRIERS
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

GROUNDWATER BASINS
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 1502 5B

Overland Flow on a Diverging Surface,
W82-00986 1502 2A

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California–Reconnaissance Study,
W82-01773 1503 6B

Hydrology and Mining in the Tucson Areas,
W82-03697 1508 2F

Ground-Water Management in Basalts,
W82-04931 1511 4B

Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 1512 2F

GROUNDWATER BUDGET
The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 1502 4B

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

Water Supply in Denmark,
W82-03274 1507 6D

GROUNDWATER CONTAMINATION
Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 1503 5G

Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

GROUNDWATER DATING
Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 1506 2F

The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

Identification of Connate Water in Interstitial Solution of Chalk Sediment,
W82-03642 1508 2K

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

Methane in Groundwater and Its Effect on 14 C Groundwater Dating,
W82-03801 1509 7B

GROUNDWATER DEPLETION
Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 1502 6E

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 1502 4B

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 1508 4B

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 1512 2F

GROUNDWATER DIVIDE
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

GROUNDWATER FLOW
Improving the Reliability of Ground-Water Monitoring at Industrial Waste Disposal Facilities,
W82-03940 1509 5A

GROUNDWATER HYDROLOGY

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 1504 5E

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

GROUNDWATER IRRIGATION

Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

GROUNDWATER *LEGAL ASPECTS

Who Owns Nebraska's Ground Water,
W82-06819 1512 6E

GROUNDWATER LEVEL

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 1504 2F

Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 1506 4A

Probable High Ground-Water Levels in Massachusetts,
W82-02829 1506 2F

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 1508 2K

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 1510 7C

Estimation of Moisture Exchange of Groundwater with Rocks of the Zone of Aeration in the Winter and Spring,
W82-05043 1511 2G

Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 1511 8C

Portable Water Elevation Measuring Gage,
W82-06396 1512 7B

GROUNDWATER MANAGEMENT

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 1501 4B

Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

Illinois Groundwater Problems and Needs,
W82-01052 1502 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 1502 4B

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

Groundwater Problems and Needs in New York,
W82-01055 1502 4B

Groundwater Problems in North Carolina,
W82-01056 1502 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 1502 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 1502 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 1502 4B

Ground Water Problems in West Virginia,
W82-01060 1502 4B

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 1502 4B

Cost Effective Ground Water Monitoring,
W82-01113 1503 4B

Results of Acidizing Water Wells in Arizona,
W82-01199 1503 4B

Nebraska Ground Water Law and Administration,
W82-01236 1503 6E

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

Operating Policies for a Surface/Ground Water System,
W82-01741 1503 4B

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 1505 6E

Efficient Groundwater Utilization,
W82-02520 1505 6D

Management of Interstate Aquifer Systems,
W82-02578 1505 4B

A Preliminary Survey of State Ground-Water Laws,
W82-02616 1506 6E

An Economic Analysis of Ground Water Management Alternatives,
W82-02740 1506 4B

Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 1506 4B

Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 1506 4B

Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 1506 4B

Injection, Recharge and Return Wells,
W82-02920 1506 4B

Subsidence--A Geological Problem with a Political Solution,
W82-03452 1508 4B

Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 1508 4B

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 1508 4B

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 1508 4B

New Legislation in California and Its Effects,
W82-03731 1508 6E

An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

Modeling the Economics of Ground Water Management,
W82-03733 1508 4B

Managing Wells for Energy Efficiency,
W82-03734 1508 4B

SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 1508 6E

Comments on a National Ground-Water Protection Strategy,
W82-03740 1508 6F

Artificial Basin Recharge,
W82-03745 1508 4B

Multi-Attribute Decision Analysis for the Protection of Groundwater Resources,
W82-03805 1509 6A

Potential Impact of Ground Water Policy Alternatives on Nebraska Agriculture, 1977-2020,
W82-03826 1509 6B

A Legal-Economic Critique of Groundwater Law and Administration: With Special Reference to Arizona and Nebraska,
W82-03827 1509 6E

Experience with Borehole Recharge in The Lee Valley,
W82-03894 1509 4B

Ground Water Protection by Recharge Zone Management: Institutional Arrangements,
W82-03951 1509 5G

Management Options for Ground Water in Urbanizing Areas,
W82-03961 1509 4B

The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 1510 4B

The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 1510 4B

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

Groundwater Control,
W82-04714 1510 4B

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Re-

charger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 1511 5D

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 1511 4B

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

Ground-Water Management in Basalts,
W82-04931 1511 4B

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 1511 4B

The Status of Groundwater Law in New York State,
W82-05400 1511 6E

Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs,
W82-05628 1511 4B

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 1511 4B

Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 1512 2F

The Ground Water Legal Regime as Instrument of Policy Objectives and Management Requirements,
W82-05938 1512 6E

The Development of International Groundwater Law,
W82-05939 1512 6E

Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 1512 3E

The Federal Response to Ground Water Protection,
W82-06295 1512 6E

Ground Water Law in Puerto Rico,
W82-06296 1512 6E

Ground Water and the States,
W82-06297 1512 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 1512 6E

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 6B

GROUNDWATER MINING

Predictive Depositional Model for Glacial Aquifers,
W82-00828 1502 2F

The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 1502 7B

Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 1506 4B

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

How Proper Prospecting Improves the Odds,
W82-05757 1511 3B

The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 1511 4B

The Physical Environment of the Colorado River Basin,
W82-05891 1511 6D

GROUNDWATER MOUNDS

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 1510 2F

GROUNDWATER MOVEMENT

Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 1501 6A

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 1501 2A

Spring Flood: Meltwater or Groundwater,
W82-00531 1502 7B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 1502 2F

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 1502 6A

Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 1503 2F

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 1503 2F

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 1503 2F

Computer Modeling and Ground-Water Protection,
W82-01336 1503 2F

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 1503 2F

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

Parameterization of Contaminant Transport Through an Anisotropic Unconfined Aquifer,
W82-01570 1503 5B

A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 1503 5B

Groundwater Discharge to the Pacific Ocean,
W82-01647 1503 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 1504 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 1504 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 1504 2F

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 1504 2F

The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 1505 2F

Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 1505 2F

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 1505 2A

Unsteady Free Flow to a Ditch from an Artesian Aquifer,
W82-02369 1505 2F

Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 1505 2F

Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 1505 2F

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 1505 2F

Integral Equation Formulation for Ground-Water Flow,
W82-02716 1506 2F

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 1506 2G

A Geochemical Method of Determining Dispersivity in Regional Groundwater Systems,
W82-02941 1506 2F

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 1507 2F

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 1507 2F

Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 1507 2F

Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 1507 2F

Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 1507 2F

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 1507 2F

Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 1507 5B

The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

Seepage Flow in Extremely Thin Aquifers,
W82-03594 1508 2F

Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

Chemical Evolution of Groundwater in a Drainage Basin of Holocene Age, East-Central Alberta, Canada,
W82-03800 1509 2K

Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana,
W82-03810 1509 2F

Use of Longitudinal Conductance in Estimating Transmissivity of Granular Aquifers in Northern Missouri,
W82-03957 1509 2F

Delayed Drainage in a Stream-Aquifer System,
W82-04268 1510 2F

The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 1510 2F

Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 1510 4B

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 1510 4B

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 1510 2J

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 1510 6A

Ground Water Monitoring of Underground Coal Mines,
W82-04750 1510 5B

A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 1511 2F

Possibility of Substantiating the Groundwater Flow Equation on the Basis of Thermodynamics of Irreversivble Processes,
W82-05032 1511 2F

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 1511 2F

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 1511 2F

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

GROUNDWATER POLLUTION

Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 1501 5E

Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 1501 5B

Movement of Endotoxin Through Soil Columns,
W82-00586 1502 5B

Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 1502 5B

Sampling Ground Water for Organic Contaminants,
W82-00820 1502 5A

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 1502 6E

Illinois Groundwater Problems and Needs,
W82-01052 1502 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 1502 4B

Groundwater Problems and Needs in New York,
W82-01055 1502 4B

Ohio's Ground Water Resources and Problem Areas,
W82-01057 1502 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 1502 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 1502 4B

Ground Water Problems in West Virginia,
W82-01060 1502 4B

Groundwater Quality Models - State of the Art,
W82-01061 1502 5G

Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 1503 5B

Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 1503 5B

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 1503 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 1503 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 1503 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 1503 5G

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 1503 5G

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 1503 5E

Organic Contamination of Ground Water: Tell it All,
W82-01474 1503 5C

Investigation of Volatile Organics Removal,
W82-01490 1503 5F

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 1503 5D

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 1503 5E

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 1503 5B

Tying Up TCE,
W82-01866 1504 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 1504 5G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 1504 2F

Bromide in Canterbury Ground Water,
W82-02056 1504 5B

Screened Auger Aids Investigation,
W82-02096 1504 7B

Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 1505 5B

PVC Cover Causes Leachate Retreat,
W82-02321 1505 5E

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 1505 5A

Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 1506 5B

Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 1506 5B

Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 1507 5D

Septic Sewage Systems Contaminate Ground Water.
W82-03378 1507 5B

If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 1508 5B

Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 1508 5B

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 1508 5G

Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 1508 5G

Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 1508 5B

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

Water Quality: What Should Be Done Today,
W82-03631 1508 6E

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 1508 5B

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 1508 5G

Effect of Leachate Solutions from Fly and Bottom Ash on Groundwater Quality,
W82-03798 1509 5B

The Distribution and Movement of Solutes Derived from Agricultural Land in The Principal Aquifers of The United Kingdom, with Particular Reference to Nitrate,
W82-03912 1509 5B

Procedure for Evaluating the Geologic Integrity of Existing Hazardous Waste Sites in Louisiana: Case Histories,
W82-03932 1509 5A

A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

Management Options for Ground Water in Urbanizing Areas,
W82-03961 1509 4B

Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

Groundwater Monitoring,
W82-04809 1511 6E

The Occurrence of Flow Channels in Soils,
W82-04875 1511 3C

The New Pollution--Groundwater Contamination,
W82-04938 1511 5C

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 1511 5B

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 1511 5G

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 1511 5B

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 1511 5G

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 1511 5B

Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 1512 5D

Groundwater Policy: A Patchwork of Protection,
W82-06411 1512 6E

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 1512 5C

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 1512 5B

GROUNDWATER POTENTIAL

Ground Water Conflicts and Barriers,
W82-00028 1501 6E

Ground Water Alternatives and Solutions,
W82-00029 1501 6D

Supply Working Group Report.
W82-00030 1501 6D

Conflicts and Barriers Working Group Report.
W82-00031 1501 6E

Alternatives Working Group Report.
W82-00032 1501 6B

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 1501 2A

A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 1502 2F

Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 1503 7C

Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, April 28-29, 1981. Cincinnati, Ohio.
W82-02106 1505 2F

Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 1506 4B

Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 1507 2F

A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 1510 2A

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

GROUNDWATER PROTECTION

Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 1510 4B

Ground Water Law in Puerto Rico.
W82-06296 1512 6E

GROUNDWATER RECHARGE

Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 1502 2F

Artificial Groundwater Recharge,
W82-01110 1503 4B

The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

Ground-Water Recharge from Rectangular Areas,
W82-02791 1506 2F

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 1506 3C

Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 1506 2A

Injection, Recharge and Return Wells,
W82-02920 1506 4B

Recharge Mechanisms and Groundwater Flow in the Chalk and Drift Deposits of Southern East Anglia,
W82-03182 1507 2F

Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 1508 2F

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 1508 4B

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 1508 2A

Ground Water Protection by Recharge Zone Management: Institutional Arrangements,
W82-03951 1509 5G

Sewage Irrigation and Recharge Consequences, Oahu,
W82-04041 1509 3C

The Response of Groundwater to Artificial Recharge Schemes,
W82-04337 1510 4B

Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 1510 2F

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 1510 2F

Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 1510 2F

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 1511 5D

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5B

GROUNDWATER RESERVOIRS

Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

GROUNDWATER RESOURCES

Ground-Water Data for Michigan, 1979,
W82-00014 1501 2F

GROUNDWATER RUNOFF

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 1503 2F

GROUNDWATER STORAGE

Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 1504 2F

Ground-Water Management in Basalts,
W82-04931 1511 4B

GROUTING

Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 1504 8A

Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 1506 8A

Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A

Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 1507 8G

Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 1507 8A

Stopping Water with Chemical Grout,
W82-03396 1507 8G

Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 1512 8A

GROWTH

SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 1504 5C

GROWTH KINETICS

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 1505 2H

Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 1507 2H

GROWTH RATES

Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 1502 2I

The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 1510 5C

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 1511 5C

GROWTH STAGES

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

GUADALUPE MOUNTAINS NATIONAL PARK

Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

GUAM

Metal Concentrations in Guam Urban Runoff,
W82-05302 1511 5B

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 1511 5C

Water Quality Assessment for Agana Springs,
W82-05304 1511 5A

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 1511 5G

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

GUILFORD-CHESTER DIVISION

Year-Round Distribution System Maintenance,
W82-04699 1510 5F

GULF OF ALASKA

Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

GULF OF MEXICO

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council,
W82-02146 1505 6G

Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

GULF OF MEXICO STATES

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 1504 6B

GULF OF SIRTE

Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 1507 5B

GULFS

Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

Zinc in Seawater and Sediments,
W82-03166 1507 5B

GULLY EROSION

Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 1501 2J

Gully Erosion,
W82-01407 1503 2J

GUNITE

Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

GYPSUM

Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 1503 5B

HABITATS

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

Wetlands and Deepwater Habitats: A New Classification,
W82-05716 1511 2L

HAIL

Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 1503 2B

Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

Calculations of Hailstone Growth in a Sloping Steady Updraft,
W82-06526 1512 2B

HALIFAC

Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

HALIFAX HARBOR

Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

HALL COUNTY

Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

HALOETHERS

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

HALOGENATED HYDROCARBONS

Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 1506 5B

HALOGENATED PESTICIDES

Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 1506 5B

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

HALOGENS

Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 1501 5D

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

HALOPHYTES

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 1504 2H

HAM'S LAKE
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 1508 5G

HAMBURG
Automatic Flow Control in Combined Sewer Systems-Effectiveness and Implementation Problems,
W82-04049 1509 5D

Northern Elbe Culvert,
W82-05427 1511 8B

HAMILTON CITY
Floodflow Characteristics of the Sacramento River in the Vicinity of Gianella Bridge, Hamilton City, California,
W82-03985 1509 2E

HAMILTON HARBOR
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 1505 7B

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

HAMMER CREEK FORMATION
Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

HANDBOOKS
Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 1505 4D

HANFORD SITE
Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772 1509 2H

HARBOR SPRINGS
A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

HARBORS
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 1505 7B

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

Physical Process and Eutrophication,
W82-06875 1512 5C

HARDING CREEK
Water-Quality Reconnaissance of Harding Creek, Lawrence County, Arkansas,
W82-03995 1509 7C

HARDNESS
Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 1502 5A

Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

Water Softening by Crystallization,
W82-03750 1508 5F

HARDNESS (WATER)
Process for Removing Alkalinity and Hardness From Waters,
W82-00063 1501 5F

HARTFORD AREA
Urban Rainfall-Runoff Modelling Using Remote Sensing Imagery,
W82-03820 1509 2A

HAWAII
Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 1502 5C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 1503 7C

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 1503 2H

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 1506 5C

Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 1506 2H

Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 1507 3B

Sewage Irrigation and Recharge Consequences, Oahu,
W82-04041 1509 3C

Waste Water Disposal Through a Coastal Aquifer,
W82-04231 1509 5E

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 1511 7C

Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 1512 5C

HAY
Soil Water Studies on Small Lucerne Plots,
W82-01713 1503 2I

HAZARDOUS MATERIAL
Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

HAZARDOUS MATERIALS
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 1502 5E

Environmental Health Hazards,
W82-00625 1502 5F

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 1502 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 1502 5C

Toxics in Municipal and Industrial Wastewaters,
W82-00712 1502 5A

Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 1502 5E

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 1502 5A

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 1503 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 1503 5G

Mapping Contaminated Soil Plumes by Kriging,
W82-01423 1503 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 1503 5G

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 1503 5D

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 1503 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 1503 5E

The Hazards of Hazardous Waste Management,
W82-01940 1504 6E

Superfund: What a Mess,
W82-02184 1505 6E

Managing Hazardous Wastes,
W82-02252 1505 5E

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 1507 5A

Ozone for the Treatment of Hazardous Materials,
W82-03139 1507 5D

Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

Procedure for Evaluating the Geologic Integrity of Existing Hazardous Waste Sites in Louisiana: Case Histories,
W82-03932 1509 5A

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 1510 5A

An Integrated Water-Quality Index for Irrigation Use,
W82-04723 1510 5C

Weak Controls from Sea to Shining Sea,
W82-05035 1511 5B

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 1511 5G

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 1511 5G

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 1511 5G

A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 1511 5G

Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 1511 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

Microbial Rembval of Hazardous Organic Compounds,
W82-05177 1511 5D

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 1511 4A

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

HAZARDOUS WASTE INVENTORY
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

HAZARDS
Water Quality Management Using the Hazard Assessment Approach,
W82-03823 1509 5G

Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

Safety Considerations in Handling Activated Carbon,
W82-05442 1511 5D

HEAD LOSS
Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 1507 8B

Declining-Rate Filtration,
W82-03656 1508 5F

HEAT BALANCE
The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

HEAT BUDGET
Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 1511 2C

HEAT EXCHANGER TUBE
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 1512 3A

HEAT EXCHANGERS
An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 1511 8B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 1511 8B

HEAT FLOW
On The Rate of Ice Formation in Water Cooled by a More Saline Sublayer,
W82-04190 1509 2C

Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 1511 5D

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 1512 7C

HEAT PUMPS
Design of Heat Pump Return Wells,
W82-06294 1512 8C

HEAT REUSE
A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

HEAT TRANSFER
Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 1503 2C

On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 1503 2C

Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 1506 2F

Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

Surface Heat Loss and Frazil Ice Production in The St. Lawrence River,
W82-03925 1509 2C

A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 1511 2F

Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 1511 2H

An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 1511 8B

Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 1511 8B

Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

Effect of Surface Configuration on Heat Transfer by the Condensation of Steam over Fluted Surfaces. Part II,
W82-06106 1512 3A

Enhanced Heat Transfer in Horizontal Evaporator-Condensers with Straight-Edged Grooved Tubes,
W82-06108 1512 3A

Heat Transfer in a Rotating Disk Evaporator,
W82-06112 1512 3A

Some Basic Observations on Heat Transfer and Evaporation in the Horizontal Flash Evaporator,
W82-06113 1512 3A

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 1512 3E

HEAT TRANSFER COEFFICIENTS
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

Transfer Characteristics of Convex and Concave Rivulet Flow on Inclined Surfaces with Straight-Edged Grooves,
W82-06107 1512 3A

HEAT TREATMENT

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 1506 5D

Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 1511 5E

HEATED WATER

Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 1504 5C

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 1504 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 1504 5C

Solar Heat Pond System,
W82-02187 1505 3F

Geothermally Powered Food-Processing Systems.
W82-02543 1505 3E

Effects of Hydrological and Biological Variables on the Survival, Growth, and Food Utilization of Estuarine Fishes Cage-Cultured in a Heated Water System,
W82-02730 1506 5C

Experiments on Coaxial Heated Water Discharges,
W82-06422 1512 5B

Thermal Effects,
W82-06809 1512 5C

Multiplication of Legionella Pneumophila in Unsterilized Tap Water,
W82-06881 1512 5C

HEATING

Boise Looks Underground for Heat.
W82-02636 1506 2F

HEAVY METAL

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

HEAVY METALS

Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 1501 5B

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 1501 5E

Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 1501 5A

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 1502 5C

Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 1502 5C

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 1502 5F

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 1502 5D

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 1502 5A

Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 1503 5A

Electroplating and Cyanide Wastes,
W82-01266 1503 5D

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-01278 1503 5C

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

The Role of Atmospheric Deposition in an Eastern U.S. Deciduous Forest,
W82-01491 1503 5B

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 1503 5B

Factors Affecting the Fate of Heavy Metals in the Activated Sludge Process,
W82-01547 1503 5D

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 1503 5B

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 1503 5C

Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 1503 5F

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 1503 5B

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 1503 5F

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 1504 5D

Pollution Solutions--The Wire Drawing Industry.
W82-02041 1504 5D

Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 1505 5C

Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 1505 5B

Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 1505 5A

Trace Metal Concentrations in Oxidation Ponds,
W82-02703 1506 5D

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 1506 5B

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 1507 5D

Ozone for the Treatment of Hazardous Materials,
W82-03139 1507 5D

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 1507 5F

Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 1507 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 1507 5D

Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 1507 5A

Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 1507 5A

Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 1507 5A

Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 1507 5G

Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 1507 5A

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 1508 5E

Study of the Transfer of Cd, Pb, Cu and Zn in Neritic and Estuarine Trophic Chains - II. Biological Accumulation in Planktonophage Fish. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes-II. Accumulation Biologique Chez les Poissons Planctonophages),
W82-03491 1508 2L

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 1508 5E

Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 1508 5A

The Distribution of Mercury, Cadmium and Lead Between Water and Suspended Matter in the Loire Estuary as a Function of the Hydrological Regime,
W82-03757 1509 2L

A Resume of the Kinetics of the BOD Test,
W82-03832 1509 5A

Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results,
W82-03878 1509 5D

Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

Experience with Riverbank Filtration Along the Rhine River,
W82-04104 1509 5D

Feasibility Studies on Liquid Ion Exchange for Alum Recovery from Water Treatment Plant Sludges,
W82-04107 1509 5E

A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

Storm-Sewer Input of Heavy Metals Into an Urban Lake Environment,
W82-04207 1509 5A

The Distribution of Heavy Metals and Petroleum Residues in the Soil from Urban Surface Runoff,
W82-04216 1509 5B

Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 1510 5D

A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 1510 5B

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 1510 5A

Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 1510 5C

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

Accumulation and Depuration of Metals by Duckweed (Lemna Perpusilla),
W82-04479 1510 5B

Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 1510 5C

Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 1511 5A

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 1511 5C

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 1511 5D

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 1511 5B

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 1511 5D

Metal Concentrations in Guam Urban Runoff,
W82-05302 1511 5B

Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 1511 5D

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 1511 5B

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 1511 5B

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 1511 5B

Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 1512 5C

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 1512 2K

Discharge of Metals from the St. Lawrence River,
W82-06190 1512 5B

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 1512 5D

Heavy Metals in Animals of Lake Balaton,
W82-06284 1512 5C

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 1512 5D

Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 1512 5C

Studies of BOD Inhibition in Presence of Inorganic Heavy Metals,
W82-06436 1512 5C

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 1512 5E

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 1512 5B

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 1512 5C

HEIDELSHEIM SEWAGE PLANT
Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

HELIUM
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

HENEY LAKE
Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 1506 2H

HERBICIDES
Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 1501 5B

Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 1501 2D

Picloram Dissipation in a Small Southwestern Stream,
W82-00212 1501 5B

Dye-Sensitized Photooxidation of Bromacil in Water,
W82-00514 1502 5B

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 1502 5A

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 1502 5A

Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 1503 5B

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 1504 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 1504 5C

The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 1505 5C

Control of Aquatic Weeds with Hexazinone,
W82-02326 1505 4A

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 1505 5B

Diquat and Sodium Alginate for Weed Control in Rivers,
W82-02328 1505 4A

Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 1505 4A

Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 1505 5B

Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 1507 5C

Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 1511 5A

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 1511 5B

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 1511 5C

Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 1512 5B

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

HERSEY RIVER
Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 1511 5B

HETEROGENEITY
Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 1503 7A

Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 1504 2F

HETEROTROPHIC BACTERIA
Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 1507 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 1507 5C

Availability of Dissolved Free Glucose to Heterotrophic Microorganisms,
W82-03359 1507 2L

Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 1508 7B

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 1512 5B

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change, W82-06558 1512 5C

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics, W82-06559 1512 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February, W82-06560 1512 5A

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River, W82-06562 1512 5A

Diurnal Variations of the Heterotrophic Bacteria in the Sediment and Water of a Small Woodland Stream, W82-06563 1512 5A

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies, W82-06887 1512 5B

HEXACHLOROBENZENE
Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials, W82-04620 1510 5B

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids, W82-05195 1511 5B

HEXACHLOROBIPHENYL
Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae, W82-05991 1512 5B

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture, W82-05994 1512 5C

HEXACHLOROCYCLOPENTADIENE
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water, W82-01819 1504 5A

HEXAZINONE
Control of Aquatic Weeds with Hexazinone, W82-02326 1505 4A

HIGH ASWAN DAM
Technical and Ecological Impacts of the High Aswan Dam, W82-02856 1506 4A

HIGH FALLS STATE PARK
A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia, W82-01078 1502 6E

HIGH-HEAD INSTALLATIONS
Cavitation Problems in High-Head Installations (Kavitationsprobleme In Grundablassen). W82-06237 1512 8B

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC, W82-06466 1512 5A

Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry, W82-06549 1512 5A

HIGH-VELOCITY JETS
Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen), W82-06242 1512 8C

HIGH WATER MARK
Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia, W82-06394 1512 2L

HIGHWAY EFFECTS
Are Metals from Highway Dustfall Hazardous in Swimming Pools, W82-01093 1502 5B

Use of Horizontal Drains: Case Histories from the Colorado Division of Highways, W82-02211 1505 8A

Long Term Performance of Horizontal Drains, W82-02212 1505 8A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil, W82-02213 1505 8A

Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History, W82-02214 1505 8A

Interstate Highways Versus Watershed Protection in New England, W82-03431 1508 5B

Constituents of Highway Runoff; Volume I, State-of-the-Art Report, W82-04627 1510 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff, W82-04628 1510 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff, W82-04629 1510 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report, W82-04637 1510 5B

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park, W82-04988 1511 5C

HIGHWAY RELOCATION
Erosion Control at a Delicate Highway Construction Site, W82-06510 1512 4D

HIGHWAYS
Composite Sampling of Highway Runoff, W82-02230 1505 7B

Methods for Assessment of Stream-Related Hazards to Highways and Bridges, W82-04626 1510 8A

Constituents of Highway Runoff; Volume I, State-of-the-Art Report, W82-04627 1510 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff, W82-04628 1510 5A

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual, W82-04630 1510 5B

The Design of Encroachments on Flood Plains Using Risk Analysis, W82-04631 1510 8A

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report, W82-04637 1510 5B

HILLSBOROUGH
Water Savings in the Orange Water and Sewer Authority, W82-02519 1505 3D

HIMALAYA MOUNTAINS
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir, W82-03314 1507 2H

HISTORIC FLOODS
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California, W82-00019 1501 2E

Paleoflood Hydrology, W82-03761 1509 2E

Investigations of Catastrophic Maximum Discharges of the Araks River, W82-05591 1511 2E

HISTORY
130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California, W82-02544 1505 2K

A Century of Water for Antwerp, W82-03355 1507 5F

Why Bother with Historic Preservation, W82-03384 1507 8A

Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959, W82-03721 1508 5D

Hogsmill Valley Works: Twenty Years On, W82-03834 1509 5D

A Historical Jewelpiece--Discovery of the Millennium Hydrological Works of Karaji, W82-04155 1509 2F

Pueblo Indian Agriculture, Irrigation and Water Rights, W82-04208 1509 6E

The Winters Decision and Indian Water Rights--A Mystery Reexamined, W82-04410 1510 6E

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland, W82-05145 1511 5B

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin, W82-05242 1511 5C

The Continuing Struggle of Waterborne Illness, W82-05366 1511 5C

Safety of Dams Judged from Failures, W82-05512 1511 8A

HOGSMILL VALLEY SEWAGE TREATMENT WORKS
The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works, W82-03850 1509 5D

HOGSMILL VALLEY WORKS
Hogsmill Valley Works: Twenty Years On,
W82-03834 1509 5D

HOLDING TANKS
Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

HOLLAND
Some Environmental Impacts of a Storm Surge Barrier,
W82-02417 1505 6G

Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 1508 2L

HOLLOW CONSTRUCTION DAMS
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

HOLSTON RIVER
Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

HOME-OPERATED FILTER SYSTEMS
Upflow Water Filtration Unit, Test Results,
W82-00407 1501 5F

HOME WATER HEATERS
What Caused the Bad Odor in the Drinking Water,
W82-00527 1502 5F

HOME WATER SOFTENERS
Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 1502 5F

HOMOCLINAL FLANKS
Regional Hydrogeologic Concepts of Homoclinal Flanks,
W82-02548 1505 2F

HOMOGENEITY
Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 1505 2F

HONDURAS
The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 1507 8A

Model Studies of an Overtopped Rockfill Dam,
W82-03694 1508 8E

HONG KONG
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 1504 5B

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 1504 5C

Mineral Element Content in Ulva Lactuca L. with Reference to Eutrophication in Hong Kong Coastal Waters,
W82-03417 1508 5B

A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 1508 3B

Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 1512 5B

HONG KONG ESTUARY
Variations in Benthic Community Structure in a Sub-Tropical Estuary,
W82-03169 1507 2L

HOOVER DAM
Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G

HOT SPRINGS
Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1510 1A

HOUSATONIC RIVER
PCBs in the Housatonic River: Determination and Distribution,
W82-02255 1505 5A

HOUSING
Adopting Sewers,
W82-04655 1510 8A

HOUSTON
Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

HUACCOTO DAM
Modeling Gradual Dam Breaches,
W82-00554 1502 8D

HUDSON RIVER
Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

Accumulation of Polychlorinated Biphenyls in Atlantic Tomcod (Microgadus Tomcod) Collected from the Hudson River Estuary, New York,
W82-03777 1509 5C

Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 1512 5C

HUDSON RIVER ESTUARY
Salt Dispersion in the Hudson Estuary,
W82-01615 1503 2L

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

HULL RIVER
Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 1508 7B

HUMAN DISEASE
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 1502 5D

Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

HUMAN DISEASES
Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 1502 5G

Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 1502 5C

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 1502 5A

Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 1502 5F

Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 1505 6G

Waterborne Disease Is Prevalent in Egypt,
W82-02435 1505 5C

Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 1507 5B

The Gezira Scheme--A Study in Failure,
W82-03393 1507 6B

Observations on Infections Associated with South Wales Natural Waters,
W82-03409 1508 5C

Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 1508 5B

Waterborne Disease in The United States and Canada.
W82-03892 1509 5C

Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 1511 5C

Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

Disease Outbreaks Caused by Drinking Water,
W82-06928 1512 5C

HUMAN PHYSIOLOGY
Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

HUMAN POPULATION
History of Human-Use Impacts on Long Point Bay,
W82-02580 1505 5B

HUMIC ACIDS
Reactions of Chlorine with Selected Aromatic Models of Aquatic Humic Material,
W82-00254 1501 5F

Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 1505 5A

The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 1505 5C

Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 1505 2K

Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 1507 2H

Effects of Pollution on Humic Substances,
W82-03253 1507 5C

Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 1511 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 1511 2K

Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 1511 2K

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 1512 5F

The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

HUMID AREAS
Combination Surface-Subsurface Drainage Systems for Humid Regions,
W82-01228 1503 4A

Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 1512 6B

HUMIDITY
Humidity Measurement by Infrared Thermometry,
W82-05611 1511 7B

Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 1512 2B

HUNGARY
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 1506 7B

Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 1510 5D

Heavy Metals in Animals of Lake Balaton,
W82-06284 1512 5C

Complex Sequence Treats Fluctuating Flows,
W82-06814 1512 5F

HUNTER VALLEY
Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

HUNTING BAYOU
Intensive Survey of Hunting Bayou,
W82-04080 1509 5A

HURON
The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

HURRICANES
Large Vertical Salinity Gradients in the Ft. Pierce Inlet Associated with Hurricane David,
W82-02569 1505 2L

HUSTON
Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

HYDRA
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

HYDRATION
Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 1508 5D

Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

Ion Hydration and Ion Interaction,
W82-05310 1511 2K

HYDRAULIC CAPACITY
Sludge Management in the Rocky Mountain State,
W82-05165 1511 5E

HYDRAULIC CONDUCTING
Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 1503 2I

HYDRAULIC CONDUCTIVITY
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 1503 2G

A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 1505 8E

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 1505 2F

A Method of Performing Response Tests on Highly Permeable Aquifers,
W82-02916 1506 2F

Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 1508 2G

A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

Kinematic Subsurface Stormflow,
W82-03844 1509 2G

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

HYDRAULIC DESIGN
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 1501 8A

Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 1502 8B

Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 1512 8B

Optimal Risk-Based Hydraulic Design of Bridges,
W82-06432 1512 8A

HYDRAULIC ENGINEERING
Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 1511 8B

Erosion by Plane Turbulent Jets,
W82-05277 1511 8B

Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 1512 8H

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

HYDRAULIC ENGINEERINGS
Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 1506 8A

HYDRAULIC EQUIPMENT
Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 1512 8H

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflussteuerung von Regenwasserbehandlungsanlagen),
W82-06633 1512 8C

HYDRAULIC FILL
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 1511 8D

Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A

HYDRAULIC FRACTURING
The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 1508 2F

HYDRAULIC GATES
Hydraulic Gates: The State-of-the-Art,
W82-00332 1501 8C

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 1502 8B

Hydraulic Gates,
W82-02206 1505 8C

New Jet-Gate Design,
W82-02691 1506 8C

Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 1506 8A

James Bay Spillways and Control Structures,
W82-04692 1510 8A

HYDRAULIC GEOMETRY
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 1512 2E

HYDRAULIC GRADIENT
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 1501 2G

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 1503 2G

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 1504 2F

HYDRAULIC JUMP
Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 1510 8B

An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279 1511 8B

Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 1512 8B

HYDRAULIC LOADING
Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

HYDRAULIC MACHINERY
Cavitation and Wear on Hydraulic Machines,
W82-00331 1501 8C

Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 1511 8C

HYDRAULIC MODELS
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 1501 8A

Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 1503 8A

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 1504 5D

Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 1507 8A

Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 1511 8B

Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 1512 8B

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

HYDRAULIC PERMEABILITY
Relationship of Electrical Dispersion to Soil Properties,
W82-02561 1505 8D

HYDRAULIC PROPERTIES
Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

Calculation of Large Unlined Canals,
W82-05131 1511 8B

On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 1512 8B

Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 1512 8H

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 1512 6B

HYDRAULIC ROUGHNESS
Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 1503 8B

Resistance Equation for Large-Scale Roughness,
W82-04696 1510 2E

HYDRAULIC STRUCTURES
Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 1506 8A

The Effect of Wind on Ice Pressure on River Structures,
W82-02668 1506 2C

Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 1506 8A

New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

Evaluation of the Mechanical Properties of the Mass of a Concrete Dam with Interblock Joints,
W82-03158 1507 8G

Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 1507 8D

Cavitation Resistance of Concrete,
W82-03165 1507 8F

Recent Water Towers in Norfolk,
W82-03246 1507 8A

Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 1508 8A

Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116 1511 8E

Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 1511 8D

Driving Large Hydraulic Tunnels by the Stepped Face Method,
W82-05586 1511 8H

Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 1511 8A

HYDRAULIC TURBINES
Turbines for Itaipu,
W82-04955 1511 8C

HYDRAULIC VALVES
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 1503 5F

HYDRAULICS
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 1503 8B

Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8B

Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 1506 8B

Hydraulic Exponents,
W82-03669 1508 2E

The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 1511 8B

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 1511 4B

Canals in Sand Channels,
W82-06196 1512 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 1512 8B

Numerical Methods in Hydraulics,
W82-06614 1512 8B

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 1512 8B

HYDRAZINE
Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

HYDROBIOLOGY
Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 1506 2H

HYDROCARBONS
Development of Oil-In-Water Monitor, Phase II,
W82-00100 1501 5A

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 1503 2H

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 1503 5B

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 1503 5A

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 1503 5B

Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 1504 5B

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 1507 5B

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 1507 5A

Transport of Polycyclic Aromatic Hydrocarbons through a Partly Urbanized River Basin,
W82-04191 1509 5B

The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 1511 5B

Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 1511 5B

Volatile Constituents of the Produced Water Effluent from the Buccaneer Gas and Oil Field,
W82-05874 1511 5A

Petroleum Processing Wastes,
W82-06801 1512 5D

HYDROCHLORIC ACID
Beneficial Disposal of Pickle Liquor,
W82-06486 1512 5D

HYDRODYNAMICS
Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 1501 5D

Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 1502 8B

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 1507 2H

Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 1507 4A

Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 1508 8A

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 1508 4B

Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

Hydrodynamic Effects in Earthquake Response of Embankment Dams,
W82-05823 1511 8D

Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

HYDROELECTRIC PLANTS
Final Environmental Impact Statement; Dinkey Creek Project No. 2890 - California.
W82-00352 1501 6G

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 1501 6G

Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 1501 6G

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 1501 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 1501 6B

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 1501 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 1501 6E

Small Hydro Installations Spur Unique Engineering Solutions,
W82-00538 1502 6B

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 1502 6E

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 1502 6C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 1502 6D

Final Environmental Impact Statement: Swan Lake Project No. 2911 - Alaska.
W82-00738 1502 6G

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 1502 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 1502 6E

Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 1503 8A

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California.
W82-01441 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 1504 6D

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 1504 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 1503 6D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 1504 6G

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 1504 5C

Intakes and Outlets for Low-Head Hydropower,
W82-01979 1504 8C

Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 1505 5C

Membrane Liner Seals 278-Acre Reservoir.
W82-02361 1505 8G

High-Head Vertical Lift Gates,
W82-02388 1505 8A

Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 1506 8A

Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 1506 8A

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 1506 8A

Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 1506 8A

Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 1506 8G

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 1506 8A

Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 1506 8A

Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

Experience in the Construction and First Years of Operation of the Zeya Dam,
W82-02952 1506 8A

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 1506 6D

Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 1507 6D

Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 1507 6D

Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 1507 6D

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 1507 6G

New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 1507 8A

TVA's Pumped-Storage Plant.
W82-03250 1507 8A

Don't Always Put Dam in Narrowest Part of Valley,
W82-03282 1507 8A

Pumped-Storage Development in Brazil. Part III,
W82-03381 1507 8A

Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 1508 6E

Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

Highlights of the St. Mary's Redevelopment Project,
W82-03617 1508 8A

Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 1508 6G

Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 1508 6G

Dickson Dam, Alberta - The 20 MW Power Facility,
W82-03621 1508 8A

Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

Problems of Lightening Underground Structures and Methods of Constructing Them Under Permafrost Conditions,
W82-03918 1509 8A

Water Level Control for Small Hydro Plants,
W82-04173 1509 8C

Small Hydro Stations in Sweden,
W82-04174 1509 8C

The Optimum Size of Small Run-Of-River Plants,
W82-04175 1509 8A

Small and Low-Head Hydro in the USA,
W82-04176 1509 8A

A Decomposition Method For The Long-Term Scheduling Of Reservoirs in Series,
W82-04205 1509 6A

Micro Hydropower in the USA,
W82-04316 1510 8A

Small Hydro Schemes for Private Developers,
W82-04327 1510 8A

Rural Power Schemes in Pakistan,
W82-04328 1510 8A

The Financing of Private Small Scale Hydroelectric Projects.
W82-04633 1510 6B

A Manual for Development of Small Scale Hydroelectric Projects by Public Entities.
W82-04634 1510 6E

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 1510 6D

Determining Feasibility of Small-Scale Hydropower,
W82-04693 1510 6B

Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 1511 6D

Resonance in Hydropower Stations,
W82-04953 1511 8C

Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 1511 6B

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 1511 8C

Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 1511 8A

Generating Power from Compensating Flow.
W82-05624 1511 8C

Site Investigation and Materials Save Money on Sallente.
W82-05878 1511 8A

Planning Sri Lanka's Victoria Scheme,
W82-05979 1512 8A

Resonant Waterhammer: A Case Study,
W82-05981 1512 8C

Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 1512 6E

Simulating and Improving Hydro Plant Control,
W82-06202 1512 8C

The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

Reregulation on an International River--A Case Study,
W82-06429 1512 6G

HYDROELECTRIC POWER

Small-Scale Hydro in New England: 1960-1976,
W82-00169 1501 6D

A New Era for China's Hydropower,
W82-00335 1501 8A

China's Potential for Hydro Development,
W82-00336 1501 8A

Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 1501 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 1501 6E

Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 1502 6G

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 1502 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 1502 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 1502 6E

Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 1503 8A

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico.
W82-01439 1503 6D

Hydropower--An Old Technology for a New Era,
W82-01593 1503 4A

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 1504 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 1504 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 1503 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 1503 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 1503 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 1504 6E

The Environmental Effects of Hydroelectric Projects,
W82-02632 1506 6G

Argentina's Hydroelectric-Based Energy Plan,
W82-02794 1506 8A

The New Energy Boom: Small-Scale Hydropower,
W82-03462 1508 8A

Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 1508 6G

Current Assessment of Prospects for Further Hydro Development in Canada,
W82-03620 1508 6B

Hydropower: Inflation-Proof Energy from Water Supply Dams,
W82-04137 1509 6B

Evaluation of Hydropower Potential in a River Basin,
W82-04214 1509 6B

The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 1510 6A

Development of Hydro-Power in Nigeria,
W82-04475 1510 6B

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 1510 6B

Computer-Aided Evaluation of Peru's Hydropower,
W82-05515 1511 6A

Generating Power from Compensating Flow.
W82-05624 1511 8C

Corobici Completion Ensures Costa Rica's Power Output.
W82-05755 1511 8C

Hydro Powers Mindanao Development Plans,
W82-05881 1511 8A

Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 1512 6B

The Energy Resources of Kenya,
W82-05978 1512 6D

Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 1512 6E

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 1512 6E

HYDROELECTRIC POWER PRODUCTION
Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 1508 4A

HYDROGEN ION CONCENTRATION
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 1502 7B

Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 1502 2K

Fixed Endpoint Alkalinity Determination,
W82-01187 1503 7B

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 1503 5D

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 1503 5C

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton.
W82-02398 1505 5C

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 1505 5F

The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 1506 5B

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 1507 5B

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 1507 2B

An Investigation of Biologically Adjusted pH Changes in Domestic Sewage Effluent,
W82-03953 1509 5D

Perivitelline pH of Salmonide Eggs in Relation to Ambient pH,
W82-04064 1509 5C

Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

Laboratory Technique for Measurement of pH for Corrosion Control Studies and Water Not in Equilibrium with the Atmosphere,
W82-04101 1509 5G

Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 1510 2K

Acid Precipitation. 1. Causes and Consequences,
W82-04771 1511 5C

Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 1511 2H

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 1511 2H

Acid Precipitation in the Washington Cascades,
W82-05287 1511 5B

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 1512 5C

Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 1512 2K

HYDROGEN PEROXIDE
Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 1501 2H

Rapid Growth Forecast for Peroxide.
W82-00345 1501 5D

Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 1501 2K

Preliminary Evaluation of Hydrogen Peroxide as a Potential Herbicide for Aquatic Weeds,
W82-02329 1505 4A

HYDROGEN SULFIDE
Chemistry of Septicity,
W82-00325 1501 5D

Rapid Growth Forecast for Peroxide.
W82-00345 1501 5D

Reviving the Rio Reconquista,
W82-02014 1504 5G

Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 1507 8G

Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment,
W82-03758 1509 5B

Sulfur Bacterial Problems Revisted,
W82-05264 1511 5B

Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 1512 5C

HYDROGENATION
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 1505 5G

HYDROGEOLOGY
A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

Ground-Water Modeling: Recent Developments,
W82-00281 1501 2F

The Importance of Drift Deposit Influences on the Hydrogeology of Major British Aquifers,
W82-02437 1505 2F

The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 1511 4B

HYDROGRAPH ANALYSIS
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 1506 2A

HYDROGRAPHS
Water Routing on Diverging-Converging Watersheds,
W82-02200 1505 2A

Approximate Error Bounds for Simulated Hydrographs,
W82-02678 1506 2A

SWMM Model and Level of Discretization,
W82-03673 1508 6A

A Trigger Type Cluster Model for Flood Analysis,
W82-03818 1509 2A

A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

The General Hydrologic System Model,
W82-04314 1510 2A

Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 1510 2A

A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 1510 2A

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

Comparing Urban Runoff Models,
W82-06447 1512 2A

HYDROLOGIC ASPECTS

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 1510 7B

The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 1511 3B

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1.
W82-06375 1512 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 1512 3F

HYDROLOGIC BALANCE

Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 1506 2A

HYDROLOGIC BUDGET

Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 1501 4A

Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 1502 2H

The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 1503 2H

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

Using Computed Stream Flow in Watershed Analysis,
W82-01538 1503 2A

The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 1503 4C

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 1505 5B

The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 1505 2F

The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 1506 2C

The Nile - One River and Nine Countries,
W82-03545 1508 4A

Refinement of Lake Evaporation Measurements, Using an Ion-Balance Technique,
W82-03808 1509 2D

Modeling the Effects of Conservation Practices on Soil Moisture,
W82-03811 1509 2G

The Water Balance in Newfoundland,
W82-03921 1509 7A

Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 1510 2H

Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 1510 2F

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 1512 2D

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

Truckee Meadows Water Use - Present and Future,
W82-06705 1512 3D

HYDROLOGIC BUDGETS

Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

HYDROLOGIC CYCLE

Supply Working Group Report.
W82-00030 1501 6D

Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 1503 2L

The Significance of Tropical Cyclone Rainfall in the Water Supply of South Florida,
W82-03821 1509 2B

Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

HYDROLOGIC DATA

Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 1501 6G

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 1501 4C

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 1501 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 1501 7C

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 1501 5B

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 1501 7C

Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 1501 10D

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 1501 2F

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 1502 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 1502 7C

The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River

Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 1503 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 1503 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 1503 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 1503 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 1503 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 1503 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 1503 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 1503 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 1503 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 1503 7C

Evaluation of Hydrogeologic Conditions,
W82-01420 1503 5G

Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 1503 2A

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 1503 7C

Water Resources Data for Utah, Water Year 1979.
W82-02474 1505 7C

Water Resources Data for Indiana, Water Year 1980.
W82-02492 1505 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 1505 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 1505 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 1505 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 1505 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 1505 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

Water Resources Data for Alaska, Water Year 1980.
W82-02845 1506 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 1506 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 1506 7C

Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 1506 7B

Canada Water Year Book 1977-1978.
W82-03099 1507 7C

Hydrologic Almanac of Florida,
W82-03974 1509 7C

Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

Water Resources Data for West Virginia, Water Year 1979. Appendix - Coal Areas.
W82-03990 1509 7C

Data Requirements for Kriging: Estimation and Network Design,
W82-04200 1509 7A

Ground-Water Levels in Arkansas, Spring 1981,
W82-04489 1510 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 1510 7C

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 1510 7C

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 1510 7C

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 1510 7C

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 1510 7C

Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 1511 7C

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79.
W82-04987 1511 7C

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 1511 2A

Normality of Hydrological Data,
W82-05752 1511 7B

On Hydrological Data Needs in Canada,
W82-05764 1511 7B

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 1512 7C

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 1512 7C

San Juan River Basin,
W82-06144 1512 7C

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 1512 7C

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 1512 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 1512 7C

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 1512 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascagoula, and Tennessee River Basins,
W82-06954 1512 7C

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 1512 7C

Water Resources Data for Florida, Water Year 1980--Volume 2B. South Florida Ground Water,
W82-06956 1512 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 1512 7C

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

HYDROLOGIC DATA COLLECTIONS
Hydrologic Applications of Weather and Climate Information,
W82-03871 1509 7C

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 1512 2E

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 1512 7B

HYDROLOGIC MAPS
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

HYDROLOGIC MODELS
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

Computer Modeling and Ground-Water Protection,
W82-01336 1503 2F

A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 1505 2A

On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 1506 7B

Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 1508 2A

Discussion of 'Finite Element Method for Direct Runoff Flow',
W82-03782 1509 2A

A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

Empirical Investigation of Curve Number Technique,
W82-04112 1509 2A

SPNM, A Model for Predicting Sediment, Phosphorus, and Nitrogen Yields from Agricultural Basins,
W82-04157 1509 6A

Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 1510 4A

Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

The General Hydrologic System Model,
W82-04314 1510 2A

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 1510 2A

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 1510 5B

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 1510 4C

Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 1511 2A

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 1511 2F

Numerical Simulation of a Thick Freshwater Lens: Pearl Harbor Groundwater Model,
W82-05621 1511 2F

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05455 1511 2E

Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 1512 2A

Topologic Model for Drainage Networks with Lakes,
W82-05905 1512 2A

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 1512 2A

HYDROLOGIC ROUGHNESS
Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 1505 2A

HYDROLOGICAL DATA COLLECTION
Hydrogeological and Geophysical Logging.
W82-00511 1502 7B

HYDROLOGICAL DATA COLLECTIONS
On Hydrological Data Needs in Canada,
W82-03443 1508 7A

HYDROLOGICAL REGIME
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 1504 2A

The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 1511 2E

HYDROLOGY
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 1501 2K

A Historical Jewelpiece--Discovery of the Millennium Hydrological Works of Karaji,
W82-04155 1509 2F

Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

Fire and Geomorphic Processes,
W82-06963 1512 2J

HYDROLOGY SURVEYS
Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 1512 2A

HYDROMETEOROLOGY
An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

HYDROPHYTES
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 1503 5B

1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 1507 4A

Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

HYDROSTATIC PRESSURE
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 1506 8G

Application of the Area of Review Concept,
W82-04674 1510 6E

HYDROTHERMAL STUDIES
A Model of Hydrothermal Convection in an Aquifer,
W82-04744 1510 1A

Hydrothermal Analysis of Lakes and Reservoirs,
W82-06425 1512 2H

HYDROXIDES
Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 1512 5D

HYDROXYBENZYLMETHANESULFONATE
The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 1506 5C

HYPANIA
Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 1511 2H

HYPERFILTRATION
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

HYPOCHLORITE
Chemical Treatment of Small Remote Water Sources,
W82-04005 1509 5F

HYPOLIMNION
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 1502 5C

Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

Hypolimnetic Aerator Fights Eutrophication,
W82-03563 1508 5G

Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G

Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 1512 5C

HYSTERESIS
Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

ICE
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 1501 8A

Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 1503 2C

Ice Nucleus Concentrations Measured During the 1975 Florida Area Cumulus Experiment (FACE),
W82-01522 1503 7B

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

Summer Ice and Carbon Dioxide,
W82-01843 1504 2C

On Antarctic Glaciology: Ice Sheets--And Ice Cores,
W82-03170 1507 2C

Theory of the Dielectric Constant of Ice,
W82-03176 1507 2C

Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 1507 2C

Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

Proton Mobility in Ice,
W82-03701 1508 2C

Convection Patterns in a Pond,
W82-04461 1510 2C

Acid Snow in the Canadian High Arctic,
W82-04542 1510 2C

A Laboratory and Theoretical Study of the Boundary Layer Adjacent to a Vertical Melting Ice Wall in Salt Water,
W82-05084 1511 2C

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 1511 2C

Cold Regions Engineering in Norway,
W82-06000 1512 8A

Bacteria Under the Ice,
W82-06561 1512 5A

ICE BREAKUP
A Solution to Spring Ice-Jam Flooding,
W82-02908 1506 2C

ICE BREAKUUP
A Mechanism for the formation of Large Icebergs,
W82-04798 1511 2C

ICE-BRINE SYSTEMS
Condensation of Butane Vapor in a Gravity-Drained Ice Bed,
W82-05917 1512 3A

ICE COVER
Ice Cover Effects on Stream Flows and Mixing,
W82-02698 1506 2C

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 1506 2C

Management of Ice-Covered Rivers: Problems and Perspctives,
W82-03807 1509 2C

Simulation of Ice-Cover Growth and Thermal Decay on the Upper St. Lawrence River.
W82-03822 1509 2C

Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 1510 2C

Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 1511 2E

The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions,
W82-05479 1511 5B

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 1511 2C

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

ICE FORMATION
Physical Mechanics of Aufeis Growth,
W82-00836 1502 2C

Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 1502 2C

Surface Heat Loss and Frazil Ice Production in The St. Lawrence River,
W82-03925 1509 2C

On The Rate of Ice Formation in Water Cooled by a More Saline Sublayer,
W82-04190 1509 2C

Tests of Frazil Collector Lines to Assist Ice Cover Formation,
W82-04460 1510 2C

Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

Configuration of Ice in Frozen Media,
W82-05615 1511 2C

Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 1511 2C

ICE JAMS

Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 1505 2C

A Solution to Spring Ice-Jam Flooding,
W82-02908 1506 2C

Flow Characteristics Below Floating Covers with Application to Ice Jams,
W82-03011 1507 2C

ICE PRESSURE

The Effect of Wind on Ice Pressure on River Structures,
W82-02668 1506 2C

ICE REMOVAL

Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 1505 2H

ICE-WATER INTERFACES

Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 1503 2C

Ice Blocks Melting Into a Salinity Gradient,
W82-01530 1503 2C

ICEBERGS

On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 1501 2C

Icebergs: Technology for the Future,
W82-04778 1511 2C

A Mechanism for the formation of Large Icebergs,
W82-04798 1511 2C

Fresh-Water Transport by Sea,
W82-04861 1511 6D

ICED LAKES

The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 1506 2H

ICELAND

Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

IDAHO

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

Preferences for Allocating River Recreation Use,
W82-01181 1503 6D

Aerated Drip Irrigation,
W82-02186 1505 3F

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 1505 2C

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 1507 2G

Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

Primary and Secondary Impacts of a Water Resource Development Project,
W82-03907 1509 6B

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 1512 3F

A Method of Estimating Flood-Frequency Parameters for Streams in Idaho,
W82-06142 1512 2E

Habitat Recovery in the North Fork of the Teton River.
W82-06409 1512 6G

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5B

IDAHO NATIONAL ENGINEERING LABORATORY

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

ILLINOIS

Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 1501 5D

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 1502 6E

Water Resources Data for Illinois, Water Year 1980–Volume 1. Illinois Except Illinois River Basin.
W82-00731 1502 7C

Water Resources Data for Illinois, Water Year 1980–Volume 2. Illinois River Basin.
W82-00732 1502 7C

Interstate Conflict Over Ground Water. Wisconsin-Illinois,
W82-00818 1502 6E

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 1502 5A

Illinois Groundwater Problems and Needs,
W82-01052 1502 4B

Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 1503 4C

Federal Common Law of Nuisance Expands,
W82-01337 1503 6E

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 1503 4A

Water Quality and the Demand for Recreation,
W82-01942 1504 6D

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes,
W82-03960 1509 2J

Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 1510 2B

Three Important Court Decisions,
W82-04349 1510 6E

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 1510 2J

Pesticides in the Aquatic Environment,
W82-04727 1510 5C

Land Disposal of Sludge,
W82-04757 1511 5E

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 1511 4C

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

Wastewater Treatment at an Electrical Generation Station,
W82-05975 1512 5D

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 1512 5G

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 1512 5D

First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 1512 4C

ILLINOIS RIVER BASIN
Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 1502 7C

ILLINOIS RIVER (OREGON)
Carrying Capacity for the Illinois River,
W82-05927 1512 6G

ILLINOIS WATERWAY
Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

ILLINOIS WATERWAY DAMS
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

IMMUNIZATION
Agglutination and Bactericidal Responses of the Channel Catfish to Salmonella Paratyphi,
W82-02524 1505 5C

IMPAIRED WATER QUALITY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

IMPAIRED WATER USE
Ground Water Alternatives and Solutions,
W82-00029 1501 6D

The Aftermath at Longview,
W82-00073 1501 5C

Irrigation Tailwater Management,
W82-00392 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 1502 3C

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 1505 3C

On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 1507 3C

Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 1512 3C

Water Conservation at Wastewater Treatment Plants,
W82-06512 1512 3C

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

IMPERIAL VALLEY
Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

IMPERVIOUS BEDS
Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 1507 2F

IMPERVIOUS SOILS
Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

IMPERVIOUS SURFACES
Estimation of Impervious-Area Washoff Parameters,
W82-01465 1503 4C

IMPOUNDMENTS
Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 1505 5E

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 1510 7B

Do Model for Discharges from Deep Impoundments,
W82-05316 1511 2H

INCINERATION
Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse.
W82-03249 1507 5E

Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 1510 5E

Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

A Look at Co-Disposal,
W82-06354 1512 5E

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

A Case for Regional Sludge Management,
W82-06993 1512 5E

INCUBATION
Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 1512 5A

INDEXING
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

INDIA
Virus Removal in Waste Stabilization Ponds in India,
W82-00121 1501 5D

Consumptive Use and Daily Evapotranspiration of Corn Under Different Levels of Nitrogen and Moisture Regimes,
W82-00660 1502 2D

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 1502 2B

Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 1503 6A

The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 1503 2B

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 1503 2G

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 1503 5A

The Chambal Project: Problems and Solutions,
W82-01739 1503 4A

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 1503 2I

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 1504 3F

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 1504 2H

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 1505 2H

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 1505 8A

Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

Water Supply and Sanitation Decade Programme,
W82-02757 1506 5F

Water for Industry,
W82-02767 1506 6D

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 1506 6A

Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 1506 2H

A Suitable Lining Technique for Existing Distributaries,
W82-03063 1507 8G

Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 1507 5F

Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 1507 8A

Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 1507 2H

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 1507 3F

Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 1507 2B

Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 1507 2I

Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 1508 7B

'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 1508 3B

Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 1508 9B

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 1508 2A

Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 1508 6D

Analysis of Ground-Water Hydrographs for Defining a Crystalline Hydrogeological Environment,
W82-03648 1508 2F

Sedimentation Control in Indian Reservoirs,
W82-03693 1508 8A

Effect of Field Levelling Quality on Irrigation Efficiency and Crop Yield,
W82-03789 1509 3F

Water Quality Monitoring,
W82-03897 1509 5G

Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows,
W82-03914 1509 3F

Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 1510 3F

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 1510 3F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 1510 2B

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 1510 2K

Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 1510 2B

Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 1511 2A

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

India: Every River Polluted, and Few Effective Controls,
W82-05033 1511 5B

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 1511 2I

Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 1511 2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 1511 2D

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 1511 2I

An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 1511 6B

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721 1511 5A

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 1512 3F

Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

Official and Folk Flood Warning Systems: An Assessment,
W82-06077 1512 6F

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 1512 5F

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834 1512 4D

INDIAN OCEAN
Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 1512 2J

INDIAN POINT NUCLEAR POWERPLANT
Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

INDIAN RESERVATIONS
Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 1510 6E

INDIAN RIVER
Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 1508 2K

INDIANA
Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 1501 2A

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 1501 5C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 1502 6E

A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 1503 2B

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

Water Resources Data for Indiana, Water Year 1980.
W82-02492 1505 7C

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

Ground Water Chemistry and Hydrochemical Facies Distribution as Related to Flow in the Mississippian Carbonates, Harrison County, Indiana,
W82-03810 1509 2F

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 1510 5D

Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 1511 5B

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 1511 5G

Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 1512 6A

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 1512 6F

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 1512 2F

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 1512 5C

INDIANS
Water Rights on Indian Allotments,
W82-02363 1505 6E

INDICATOR SPECIES
Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

INDICATORS
Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuaries,
W82-00033 1501 5B

Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 1501 5B

Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 1505 5A

Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 1510 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 1510 5C

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 1511 5A

Pixe Trace Element Analysis of an Aquatic Plant as Indicator of Heavy Metal Pollution,
W82-04818 1511 5A

Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 1511 5A

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 1511 5A

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

Microbiology: Water,
W82-06924 1512 5B

INDONESIA
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

The Development of Water Supply in Indonesia and All Its Challenges.
W82-03868 1509 6D

Aspects of Hydrology in the Province of North Sumatra, Indonesia,
W82-05949 1512 2A

Cave Water--Java's Hidden Resource,
W82-06605 1512 3B

Brantas Dams Trigger New Javanese Development,
W82-06818 1512 3F

INDOOR SWIMMING POOLS
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

INDUSRIAL WASTE
Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

INDUSTIRAL WATER
Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

INDUSTRIAL DEVELOPMENT
Disposal of Industrial Effluents - Some Future Problems,
W82-02405 1505 5D

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 1505 6G

An Analysis of the Effects of Alternative Measures of Price on the Demand for Water by Self-Supplied Industries,
W82-03828 1509 6C

Water Requirements for Industrial Development,
W82-04117 1509 6D

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

Hydro Powers Mindanao Development Plans,
W82-05881 1511 8A

INDUSTRIAL EFFLUENTS
Floc/Float System Cleans Desalter Effluent,
W82-00906 1502 5D

Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 1507 5A

INDUSTRIAL PLANTS
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

INDUSTRIAL WASTE
Sludge Settling Hampered by Industrial Discharge,
W82-00290 1501 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 1508 5B

INDUSTRIAL WASTE WATER
Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

INDUSTRIAL WASTES
Dewatering of Industrial Clay Wastes,
W82-00041 1501 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 1501 5D

Water and Wastewater Reclamation: An Economical Answer to Industrial Wastes and Pollution,
W82-00188 1501 3E

Determination of Marine Consent Conditions,
W82-00323 1501 5G

Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 1501 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 1501 5B

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 1502 5A

Mixing Technology Reduces Energy Use,
W82-00634 1502 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 1502 5D

Removal of Priority Pollutants,
W82-00639 1502 5D

Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 1502 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 1502 5D

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 1502 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 1502 5D

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 1502 6E

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

Abundance of Organic Compounds in Water,
W82-01162 1503 5A

Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 1503 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5B

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 1503 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 1503 5D

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 1503 6C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 1504 5B

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 1504 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 1504 5B

Bromide in Canterbury Ground Water,
W82-02056 1504 5B

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

Poland: Coming to Grips with Pollution,
W82-02092 1504 5G

New Jersey Community Decontaminates Well Water.
W82-02243 1505 5F

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 1505 5B

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 1506 5B

Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 1506 5E

Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 1506 5B

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 1507 5D

Zinc in Seawater and Sediments,
W82-03166 1507 5B

Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 1507 5D

River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 1507 6E

Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 1507 5E

Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 1507 5C

Industrial Wastewater Audit,
W82-03337 1507 5D

Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 1507 8G

The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 1507 5G

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 1508 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 1508 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 1508 5D

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 1508 5D

Palm Oil Waste Treatment Study in Malaysia,
W82-03632 1508 5D

The Distribution of Mercury, Cadmium and Lead Between Water and Suspended Matter in the Loire Estuary as a Function of the Hydrological Regime,
W82-03757 1509 2L

Biological Colonization of an Industrial Pond: Status After Two Decades,
W82-03772 1509 2H

On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

The Growing Business of Bacterial Cultures,
W82-03786 1509 5D

Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

Improving the Reliability of Ground-Water Monitoring at Industrial Waste Disposal Facilities,
W82-03940 1509 5A

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 1510 5D

Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 1510 5D

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 1510 5C

New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

Who Wins in the Fight for Pollution Control,
W82-04554 1510 6B

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 1511 5A

Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 1511 5D

Treating Phenol Resin Plant Wastes,
W82-05128 1511 5D

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 1511 5B

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 1511 5A

An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary–New York,
W82-05606 1511 5B

Common Facility Treatment of Industrial Wastewaters,
W82-05974 1512 5D

Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 1512 5B

How Equitable Are Effluent Charges,
W82-06074 1512 6C

Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 1512 5A

Enteric Bacteria in Sugarbeet Refinery Processing Waste Waters,
W82-06195 1512 5D

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 1512 5C

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 1512 5D

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 1512 5A

Steel Industry Wastes,
W82-06799 1512 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

INDUSTRIAL WASTEWATER

Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 1501 5D

Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

The Analysis of Oil Shale Wastes: A Review,
W82-00388 1501 5A

Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 1501 5D

Toxics in Municipal and Industrial Wastewaters,
W82-00712 1502 5A

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 1502 5D

The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 1502 5B

Treatability Manual; Volume I. Treatability Data.
W82-01073 1502 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 1502 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 1502 5D

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 1502 5D

Treatability Manual; Volume V. Summary.
W82-01077 1502 5D

Activated Sludge,
W82-01243 1503 5D

Fermentation Industry,
W82-01257 1503 5D

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 1503 5D

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 1504 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

Industrial Pretreatment Needs to Be Overhauled at the National Level.
W82-02198 1505 5D

Industrial Wastewater Pretreatment Service,
W82-02253 1505 5E

Disposal of Industrial Effluents - Some Future Problems,
W82-02405 1505 5D

Spiral Classifiers Help One Manufacturer Meet Environmental Standards More Easily,
W82-02602 1506 5D

By-Product Recovery Finances Treatment,
W82-02756 1506 5D

New Developments in Papermaking in Western Europe,
W82-02947 1506 5D

Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 1506 5D

Two-Stage Biological Treatment of Coke Plant Wastewater,
W82-03029 1507 5D

Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 1507 5D

Biological Nitrogen Control of Industrial Wastewater,
W82-03131 1507 5D

The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 1507 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 1507 5D

Water Policy at Inco Metals Company, Ontario Division Mills,
W82-03251 1507 3E

Republic Steel Recycling 80% of Steel-Mill Wastewater.
W82-03454 1508 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

Electroplating Wastes: History and Current Status,
W82-03588 1508 5D

Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 1508 5D

Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 1508 5C

Breakthrough Characteristics of Selected Toxicants in Granular Activated Carbon Treatment of Combined Industrial Wastewaters,
W82-03812 1509 5D

Operational Experiences in the Effective Treatment of Effluents from Synthetic Resin Manufacture,
W82-03835 1509 5D

A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 1510 5D

Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 3C

A Treatment System for an Organic Chemicals Plant,
W82-04353 1510 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 1511 5D

Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 1511 5D

Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

Shale Oil Wastewater Treatment by Evaporation,
W82-04905 1511 5D

Designing Wastewater Treatment Systems to Save Energy,
W82-04906 1511 5D

Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

Biodegradation of Hazardous Organic Pollutants,
W82-04910 1511 5B

Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 1511 5A

Single Sludge Nitrogen Removal from Industrial Wastewater,
W82-05245 1511 5D

Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 1511 5D

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 1511 5D

Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 1511 5D

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 1511 5D

Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 1512 5D

A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 1512 5A

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5G

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

Beneficial Disposal of Pickle Liquor,
W82-06486 1512 5D

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 1512 5G

A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

Esholt--Past, Present and Future,
W82-06653 1512 5D

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

Chemicals and Allied Products,
W82-06805 1512 5D

Textile Wastes,
W82-06916 1512 5D

Fermentation Industry,
W82-06917 1512 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

Dairy Wastes,
W82-06921 1512 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 1512 5D

INDUSTRIAL WASTEWATERS

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 1506 5D

INDUSTRIAL WATER

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

Water Supply and Demand in an Energy Supply Model,
W82-00050 1501 6D

Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 1501 5F

Detoxification of Residual Quaternaries,
W82-00562 1502 5G

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 1503 3E

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 1504 5C

Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

An Introduction to Industrial Water Treatment,
W82-03071 1507 5F

An Analysis of the Effects of Alternative Measures of Price on the Demand for Water by Self-Supplied Industries,
W82-03828 1509 6C

Water Use in Manufacturing,
W82-04070 1509 6D

Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 1510 5F

Water Recycling/Reuse in the Food Processing Industry,
W82-04566 1510 5D

Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 1510 3E

The Seven-Trent Studies of Industrial Water Use,
W82-04686 1510 6D

Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

The Role of Desalting Tehnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 1511 3A

Industry Helps Conserve Municipal Water,
W82-05674 1511 3E

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 1511 2F

Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 1512 3E

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 1512 5F

Complex Sequence Treats Fluctuating Flows,
W82-06814 1512 5F

INDUSTRIAL WATER USE

Municipal and Industrial Water Demands of Western U.S.,
W82-06463 1512 6D

INFANTS

An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

INFECTION

Infectious Waterborne Diseases,
W82-01784 1503 5A

Observations on Infections Associated with South Wales Natural Waters,
W82-03409 1508 5C

INFILTRATION

A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 1501 2G

Why EPA's I/I Control Program Fails,
W82-00790 1502 8A

Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 1503 2G

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Texture,
W82-01107 1503 2G

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 1503 2G

Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 1503 2G

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 1503 5D

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 1504 5B

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 1506 2G

Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 1507 2A

Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 1507 7B

Ponded Infiltration into Simple Soil Systems: I. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 1507 2G

Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 1508 2A

Application of Infiltration Theory for the Determination of Excess Rainfall Hyetograph,
W82-03752 1509 2A

Design of a Leachate Collection System for a Sludge Filled Landfill,
W82-03935 1509 5E

Improved Analytical Methods for the Design of Leachate Collection Systems,
W82-03936 1509 5E

Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

Dimensionless Stream Advance in Sloping Borders,
W82-04308 1510 3F

Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 1510 2A

Effect of Surface Sealing on Infiltration,
W82-04362 1510 2G

Deep Tillage of Irrigated Pullman Clay Loam-A Long-Term Evaluation,
W82-04372 1510 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 1510 2G

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 1510 2G

Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 1511 5D

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

A Comparison of Three Infiltration Models,
W82-05965 1512 2G

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 1512 3F

Development of Prediction Equations for a Phreatic Aquifer in Response to Infiltration: Dimensional Analysis,
W82-06066 1512 2F

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

Status of Porous Pavement Research,
W82-06665 1512 8G

Application of SCS Infiltration Model,
W82-06872 1512 4D

INFILTRATION CAPACITY

Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 1505 2A

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

INFILTRATION RATE

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 1503 2G

Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 1504 2G

Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 1507 2G

Influence of Vegetation, Rock Cover, and Trampling on Filtration Rates and Sediment Production,
W82-04153 1509 2G

The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 1511 2G

Furrow Intake Rates and Water Management,
W82-05968 1512 3F

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 1512 2G

INFILTRATION WATER

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 1511 5B

INFLOW

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 1507 4A

INFLOW FORECASTING

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

INFLUENT SEEPAGE

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

INFLUENT STREAMS

The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 1510 2F

INFLUENT WATER

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

INFLUENZA

Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 1510 5B

INFORMATION EXCHANGE

Ground-Water Information: NWWA Provides the Resources,
W82-00301 1501 2F

Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

Urgent Problems in the Transfer of Water Resources Knowledge,
W82-03802 1509 7C

Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

Desalination *Directory 1981*.
W82-05908 1512 3A

INFORMATION RETRIEVAL

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 1505 10C

Information Management: A Role for Primacy Agencies in The 80S,
W82-03891 1509 10B

Search: A Gaged Watershed Inventory,
W82-04433 1510 10B

INFORMATION SYSTEMS

Storage and Retrieval of Ground-Water Data at the U.S. Geological Survey,
W82-03649 1508 10B

Information Management: A Role for Primacy Agencies in The 80S,
W82-03891 1509 10B

Access to Water-Related Data in Texas,
W82-04000 1509 10B

Water Use Data--Who Needs It,
W82-04198 1509 7C

An Interactive Data Management System for River Water Quality Data,
W82-04659 1510 10B

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

INFRARED IMAGERY

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

INFRARED SPECTROSCOPY

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

INGLEWOOD

Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 1507 6A

INGURI DAM

Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 1504 8A

INGURI HYDROELECTRIC PLANT

Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 1507 8A

INGURI RIVER

Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 1506 8A

INHIBITION

Literature Study of the Biodegradability *of* Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 1511 5C

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 1512 5D

INJECTION

Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 1505 2F

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 2 - Environmental Control Technology,
W82-05213 1511 5E

INJECTION WELLS

Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 1501 6A

Deep Well Injection of Industrial Wastes,
W82-00475 1501 5E

A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 1502 3E

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 1505 5E

Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 1508 4B

Waste Water Disposal Through a Coastal Aquifer,
W82-04231 1509 5E

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 1510 8B

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

Application of the Area of Review Concept,
W82-04674 1510 6E

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

Environmental Assessmental, Geothermal Energy, Heber Geothermal Binary-Cycle Demonstration Project; Imperial County, California.
W82-06406 1512 6G

INLAND WATERWAYS

The Waterway That Cannot be Stopped,
W82-00510 1502 6E

Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 1512 6B

INLETS

General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 1502 2L

Linearized Solution to Inlet Equation with Inertia,
W82-01183 1503 2L

Tapered Inlet Design Using Specific Energy Curves,
W82-04695 1510 8A

Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 1512 8B

INORGANIC COMPOUNDS

Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

Inorganics,
W82-06999 1512 5A

INPUT-OUTPUT ANALYSIS

Water Multipliers--Regional Impact Analysis,
W82-01138 1503 6A

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 1507 6D

Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 1510 6A

Water Reuse Planning by Means of an Input-Output Table,
W82-04794 1511 6A

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 1511 2E

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

INSECT CONTROL

Fate of Diflubenzuron in Water,
W82-02216 1505 5B

INSECTICIDES

Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 1501 5B

Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 1501 5B

Residues of Isobornyl Thiocyanoacetate (Tha-ite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1502 5B

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 1503 5C

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

Effect of Kepone on Estuarine Microbial Activity,
W82-01231 1503 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 1503 5E

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

Fate of Diflubenzuron in Water,
W82-02216 1505 5B

Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 1505 5B

The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 1506 5F

Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 1508 5B

Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides,
W82-04257 1510 5C

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5D

Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 1511 5D

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 1512 5A

INSECTICIDES *ENDOSULFAN

Histopathological Changes in the Liver and Brain of Fish Exposed to Endosulfan Insecticide

During Tsetse Fly Control Operations in Botswana,
W82-05630 1511 5C

INSECTS
Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

INSPECTION
Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 1506 8A

INSPECTION GALLERIES
The Value of Inspection Galleries,
W82-06204 1512 8D

INSTITUTIONAL CONSTRAINTS
Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 1501 6E

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 1501 6E

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 1502 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 1502 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 1502 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 1502 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 1505 10C

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 1508 6G

Water Constraints on Emerging Energy Production,
W82-04151 1509 6D

The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 1510 6E

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 1511 6B

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 1511 6B

Incentives and Institutions for Water Conservation,
W82-05922 1512 3D

Problems and Processes in Water Quality Management,
W82-06147 1512 5G

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 6B

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 1512 6B

INSTREAM AERATION
In-Stream Aeration: A Possible Alternative to AWT.
W82-03375 1507 5G

Oxygenation of the Avon River,
W82-05730 1511 5G

INSTREAM FLOW
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 1504 6E

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 1511 6E

Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

INSTRUMENTATION
Rainwater Gauge,
W82-00068 1501 2B

A More Versatile Soil Water Sampler,
W82-02523 1505 7B

INSURANCE
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 1502 5E

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

INTAKE GATES
Prediction of Water Level in Tidal Inlet,
W82-05005 1511 4A

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A

INTAKES
Power Plant Water Intake Assessment,
W82-00216 1501 6G

Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 1501 8A

Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 1503 8B

Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 1503 8I

Intakes and Outlets for Low-Head Hydropower,
W82-01979 1504 8C

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

Model-Prototype Comparison of Free Surface Vortices,
W82-03667 1508 8B

Engineering Aspects of Fish Protection at Water Intakes,
W82-04759 1511 8I

Shaft Spillways Combined with a Water Intake,
W82-05111 1511 8A

Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 1511 5C

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

INTERAGENCY COOPERATION
Interagency Connections: Insurance Against Interruptions in Supply,
W82-04090 1509 5F

INTERBASIN TRANSFERS
Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 1512 6D

INTERCEPTION
Vertical Variation in Stemflow Generation,
W82-02959 1506 2I

INTERDISCIPLINARY STUDIES
Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 1503 6A

INTERFACES
Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

Surface Viscosity of Water,
W82-03501 1508 1A

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

The Moving Interface Problem with Finite Elements,
W82-06546 1512 2L

INTERFEROMETRY
Liquid Level Interferometer,
W82-05929 1512 7B

INTERMITTENT STREAMS
Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

INTERNATIONAL AGREEMENTS
Great Lakes International Surveillance Plan,
W82-00701 1502 6E

The Economics of Cooperation Over Collective Bads,
W82-01909 1504 6A

Acid Rain Agreement,
W82-01933 1504 5B

A Large Interational River: The Danube,
W82-03369 1507 5G

The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 1507 5G

Water Quality and the EEC,
W82-03472 1508 6E

Economical Use of Water Resources.
W82-03496 1508 6E

Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 1508 6E

International Problems on the Colorado River,
W82-05892 1511 5G

Disposal of Sludge to Sea,
W82-06595 1512 5E

INTERNATIONAL COMMISSIONS
International Cooperation to Protect the Baltic,
W82-02087 1504 6E

Desalination Directory 1981.
W82-05908 1512 3A

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 1512 5C

INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE
Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

INTERNATIONAL HYDROLOGICAL DECADE
They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 1512 5F

INTERNATIONAL JOINT COMMISSION
Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 1503 5G

INTERNATIONAL LAW
The Development of International Groundwater Law,
W82-05939 1512 6E

The Law of International Aquifers,
W82-05940 1512 6E

INTERNATIONAL WATERS
Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 1502 6G

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 1504 6B

INTERSTATE COMPACTS
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 1501 6E

Management of Interstate Aquifer Systems,
W82-02578 1505 4B

INTERSTATE RIVERS
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 1501 6E

INTERSTITIAL WATER
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 1502 2H

Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 1505 8A

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

INTERSTITIAL WATERS
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

INTERTIDAL AREAS
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 1501 2L

Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 1501 2L

Sediment Transport Study Along a Delta Shoreline,
W82-06553 1512 2J

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 1512 5C

INTERVENTION ANALYSIS
Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

INVERTEBRATES
Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

Effects of Pollution on Freshwater Invertebrates,
W82-01280 1503 5C

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 1503 5C

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 1504 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 1505 6G

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 1508 2H

Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

Impact of Hexazinone on Invertebrates After Application to Forested Watersheds,
W82-05206 1511 5C

Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 1512 5C

Freshwater Macroinvertebrates,
W82-06797 1512 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

Effects of Macroalgal Mats on the Ecology of Intertidal,
W82-06893 1512 5C

IODINE
Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 1506 2K

Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

ION EXCHANGE

Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 1501 5F

Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 1502 5A

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 1502 5B

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 1502 5F

The Removal of Organic Matter from Demineralized Water,
W82-00888 1502 5F

Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 1503 3A

Field Report on a Nonpolluting Bleach Plant,
W82-02793 1506 5D

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 1506 5D

Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 1507 5D

Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 1507 5B

Continuous Ion Exchange: A Survey of Recent Applications,
W82-03391 1507 5D

Continuous Ion Exchange: Design Calculations,
W82-03623 1508 8C

Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 1508 5A

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 1508 3A

Mixed Bed Technology for Polishing Make-up Water and Condensate Return: Conclusion,
W82-03774 1509 5D

Municipal Ion Exchange: Waiting to Take Off,
W82-03837 1509 5F

Color Removal from Groundwater by Ion Exchange and Sludge Recycle Techniques,
W82-03956 1509 5F

Feasibility Studies on Liquid Ion Exchange for Alum Recovery from Water Treatment Plant Sludges,
W82-04107 1509 5E

Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 1510 5F

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

Exchange of Marine Sodium for Calcium During Chemical Weathering in the Irle Aux Morts River Basin, Newfoundland,
W82-05414 1511 2K

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 1512 5A

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 1512 5A

Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 1512 3A

The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 1512 3A

An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 1512 5D

Complex Sequence Treats Fluctuating Flows,
W82-06814 1512 5F

ION EXCHANGE RESINS

Periodic Operation for Desalination with Thermally Regenerable Ion-Exchange Resin. Dynamic Studies,
W82-01341 1503 3A

Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 1507 5A

Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 1507 5A

An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

ION-SELECTIVE ELECTRODES

Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 1507 5F

ION TRANSPORT

Cation Transport in Packed Bed Reactor of Soil,
W82-00970 1502 5D

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 1503 5B

Ion Hydration and Ion Interaction,
W82-05310 1511 2K

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

Water and Salt Transport in Membranes,
W82-05537 1511 3A

IONIC INTERFERENCE

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 1502 2K

IONIZATION

The Ionization of Acids in Estuarine Waters,
W82-03769 1509 2K

IONS

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 1502 2K

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 1502 5A

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 1504 5D

An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1507 1B

The Calculation of Ion Pair Diffusion Coefficients: A Comment,
W82-03487 1508 1B

Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 1511 2K

IOWA

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 1503 3D

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 1503 6A

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 1508 2A

Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

The Challenge of Upgrading Roadside Rest Areas,
W82-06845 1512 5G

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 1512 5B

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

IRAN

Wheat Yield Estimation in Northwest Iran,
W82-03267 1507 2I

Water Resources Investigations in West Central Iran Using Landsat Data,
W82-03927 1509 7B

A Historical Jewelpiece--Discovery of the Millennium Hydrological Works of Karaji,
W82-04155 1509 2F

IRAQ

A Hydrobiological Survey of a Polluted Canal,
W82-01356 1503 5C

Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 1506 5C

On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

Wastewater from a Sugar Refining Industry,
W82-05337 1511 5D

Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 1512 5C

On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 1512 5C

IRELAND

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 1505 5B

Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 1507 5C

IRELAND (NORTHERN)

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 1512 5B

IRISH SEA

241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 1507 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 1508 5B

IRON

Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 1502 2H

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 1502 8A

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 1506 2K

Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 1506 2K

Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 1507 2H

Rotating Disc Biological Treatment of Acid Mine Drainage,
W82-03968 1509 5D

The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 1510 5F

A Pipeline for all Environments,
W82-04764 1511 8G

Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801 1511 2K

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

Retention of Riverine Iron in Estuaries,
W82-06191 1512 5B

On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 1512 5A

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 1512 5D

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 1512 5D

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

IRON COMPOUNDS

Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 1506 2K

Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals,
W82-03771 1509 2K

IRON EXCHANGE

Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 1508 5F

IRON HYDROXIDE

Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 1512 5D

IRON INDUSTRY

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 1508 5B

IRON OXIDES

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 1511 2K

IRRADIATION

On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 1505 2H

Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 1507 2I

Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 1508 2H

IRRIGABLE LAND

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1.
W82-06375 1512 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 1512 3F

IRRIGATION

January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 1501 6A

Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 1502 3C

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 1503 3C

A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 1503 6A

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 1503 6A

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 1504 7B

Agricultural Conservation Program: An Evaluation,
W82-02019 1504 3F

Aerated Drip Irrigation,
W82-02186 1505 3F

Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 1505 2G

Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

Ground Water in Washington,
W82-02536 1505 2F

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 1506 6D

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 1506 7B

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 1507 6D

Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 1507 8A

Evaluation of Infiltration Measurements for Border Irrigation,
W82-03264 1507 7B

The Gezira Scheme--A Study in Failure,
W82-03393 1507 6B

Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 1508 3C

Modeling the Economics of Ground Water Management,
W82-03733 1508 4B

Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

Salt Movement, Leaching Efficiency, and Leaching Requirement,
W82-03791 1509 2K

Primary and Secondary Impacts of a Water Resource Development Project,
W82-03907 1509 6B

Projected Effects of Energy Policies on Agricultural Water Use and Irrigation,
W82-03915 1509 6C

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

Pueblo Indian Agriculture, Irrigation and Water Rights,
W82-04208 1509 6E

The Effect of Reuse of Water for Agriculture on The Arab-Asian Society: A New Interdisciplinary Model for Understanding a Development Problem,
W82-04213 1509 3C

Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 1510 7C

Conservation Ethics for the 1980's,
W82-05009 1511 3D

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 1511 2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 1511 2D

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan,
W82-05122 1511 2I

An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 1511 6B

Rice Reigns Supreme as Indonesia Builds Up the Sawahs,
W82-05502 1511 3B

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

Conflict Over Water Sources Predicted by Global Study.
W82-05879 1511 6B

Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 1512 5B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

Field Evaluation of Furrow Infiltration and Advance Functions,
W82-05969 1512 3F

The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 1512 3F

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 1512 3F

China's Agro-Ecosystem,
W82-06019 1512 3B

Sprinkler Leveler and Wind Compensating Device,
W82-06164 1512 3F

Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 1512 3F

A Model for Managing Irrigated Agriculture,
W82-06584 1512 5G

Doubts Remain About Bura Economics,
W82-06816 1512 3F

Brantas Dams Trigger New Javanese Development,
W82-06818 1512 3F

IRRIGATION CANALS

Sizing Rice Irrigation Canals,
W82-00895 1502 3F

A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 1503 4A

1980 Progress Report on Baseline Aquatic Vegetation Studies to Determine the Efficacy of Hybrid Carp (Grass Carp Female X Bighead Carp Male) in Two California Irrigation Canals,
W82-03024 1507 4A

IRRIGATION DESIGN

A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 1503 6A

Input and Output Constraints Affecting Irrigation Development,
W82-01476 1503 6B

Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 1503 8C

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 1504 3F

Solid Set Irrigation System Design Using Linear Programming,
W82-02273 1505 6A

A Management System for the Conjunctive Use of Rainfall and Limited Irrigation of Graded Furrows,
W82-02556 1505 3F

Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 1507 3F

Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 1508 3F

Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 1510 3F

Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 1512 3F

Designing for Deficit Irrigation,
W82-06334 1512 3F

Limits for Practical Level-Basin Design,
W82-06452 1512 3F

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

Brantas Dams Trigger New Javanese Development,
W82-06818 1512 3F

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

IRRIGATION DISTRICTS

Local Irrigation Agencies,
W82-04560 1510 4B

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

IRRIGATION DITCHES

Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 1502 3F

Water Levels and Losses and Cleaning in Watercourses,
W82-02747 1506 3F

Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

IRRIGATION ECONOMICS

An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 1512 6B

IRRIGATION EFFECTS

Effect of Irrigation and Tree Density on Peach Production,
W82-00120 1501 2I

Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

Water Stress and Cold Hardiness in Field-Grown Citrus,
W82-00864 1502 2I

Effects of Water Quality on Forage Production,
W82-01002 1502 3C

Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 1503 5B

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 1503 5B

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 1503 2I

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 1506 3F

Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 1506 2A

Technical and Ecological Impacts of the High Aswan Dam,
W82-02856 1506 4A

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 1506 5B

Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 1507 2H

On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials,
W82-03273 1507 3C

Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 1508 2G

Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 1510 5C

The Wellton-Mohwak Dilemma,
W82-05883 1511 3F

International Problems on the Colorado River,
W82-05892 1511 5G

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

IRRIGATION EFFICIENCY

Optimal Design of Furrow Irrigation Systems,
W82-00138 1501 3F

Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 1502 3F

Research and Development to Service a Sustainable Agriculture,
W82-00669 1502 3F

Watertable Management Saves Water and Energy,
W82-00943 1502 3F

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 1503 3F

Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 1504 3F

Development of Solutions for Level-Basin Design,
W82-01976 1504 3F

Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 1504 2D

Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 1506 3F

Remote Sensing from Space-II.
W82-03248 1507 7B

Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization,
W82-03266 1507 3F

Multimillion-Acre Tea Bag,
W82-03352 1507 3F

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 1508 3F

Effect of Field Levelling Quality on Irrigation Efficiency and Crop Yield,
W82-03789 1509 3F

Water Requirements of Urban Plants,
W82-03972 1509 3D

Sugar Beet Production as Influenced by Water Stress,
W82-04086 1509 3F

Irrigation Practices for Reclaimed Alkali Soils,
W82-04269 1510 3F

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

Energy, Water, and Cost Trade-Offs in Irrigation System Selection and Management,
W82-04360 1510 3F

Deep Tillage of Irrigated Pullman Clay Loam—A Long-Term Evaluation,
W82-04372 1510 2G

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 1510 3F

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India,
W82-04608 1510 3F

Lateral Move Irrigation Offers Advantages for Rectangular Fields.
W82-05080 1511 3F

Cutting Irrigation Costs,
W82-05081 1511 3F

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 1511 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

Managing Salinity in Irrigated Agriculture,
W82-05691 1511 3C

New Evapotranspiration Crop Coefficients,
W82-05692 1511 3F

Irrigation Efficiency in Orchards,
W82-05768 1511 3F

The Wellton-Mohwak Dilemma,
W82-05883 1511 3F

Future Water Development Policies,
W82-05884 1511 5G

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 1512 3F

Computer-Guided Linear Irrigator Marches on,
W82-06817 1512 3F

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

IRRIGATION ENGINEERING
Laser Drip Irrigation.
W82-00771 1502 3F

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 1503 3F

Water for New Zealand's Plains,
W82-02402 1505 3F

Lateral Move Irrigation Offers Advantages for Rectangular Fields.
W82-05080 1511 3F

Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 1511 8A

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 1.
W82-06375 1512 3F

Manual of Engineering of Irrigated Lands (Manual de Ingenieria de Regadios), Vol. 2,
W82-06376 1512 3F

IRRIGATION OPERATION
Loop Equations with Unknown Pipe Characteristics,
W82-02258 1505 3F

Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

IRRIGATION PRACTICES
Furrow Irrigation Practices in Northern Colorado,
W82-00139 1501 3F

Saline Irrigation Water.
W82-00512 1502 3F

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 1502 3F

Lateral Sizes for Efficient Level-Basin Irrigation,
W82-00942 1502 3F

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 1503 4A

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 1504 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 2I

Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 1504 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 1504 3F

Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 1505 3C

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 1506 6A

The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 1506 2D

Estimating Distribution Uniformity in Level Basins,
W82-03058 1507 3F

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 1508 2G

Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows,
W82-03914 1509 3F

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 1510 3F

The 1977 Drought in Idaho: Economic Impacts and the Responses of Irrigators and Water Delivery Organizations.
W82-04959 1511 3F

Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

The Colorado River Salinity Problem,
W82-05889 1511 5G

Development Issues in the Colorado River Basin,
W82-05890 1511 6D

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

Furrow Intake Rates and Water Management,
W82-05968 1512 3F

The Effect of Electricity Prices, Lift, and Distance on Irrigation Development in Idaho,
W82-06017 1512 3F

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

Designing for Deficit Irrigation,
W82-06334 1512 3F

IRRIGATION PRACTICES SOIL WATER POTENTIAL
Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

IRRIGATION PROGRAMS
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

Integrated Agricultural Development in the Philippines,
W82-01725 1503 6B

Exploiting the Waters of Lake Chad.
W82-01726 1503 8A

Sustaining the Growth of Provence.
W82-01738 1503 6D

The Chambal Project: Problems and Solutions,
W82-01739 1503 4A

Irrigation for Brazil's Poligono Das Secas,
W82-01744 1503 3F

Environmental Repercussions of Irrigation Development in Hot Climates,
W82-02366 1505 6G

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Manage-

ment and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 1508 3F

Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 1508 6F

Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

Federal Subsidy of Irrigation Development,
W82-04233 1509 6E

Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 1510 6B

Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 1511 6C

IRRIGATION PROJECTS
Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 1508 9B

IRRIGATION REQUIREMENTS
Performance of Bearing Cherry and Prune Trees Under Very Low Irrigation Rates,
W82-00119 1501 3F

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 1501 3F

Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 1504 3F

Optimal Design of Border Irrigation Systems,
W82-01977 1504 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 1504 3F

Irrigation Requirements of Field-Pea for Grain,
W82-02395 1505 2I

Influence of Irrigation Rhythm and Water Supply on Growth, Water Status and Yield of Egg-Plant (Solanum Melongena L.),
W82-02746 1506 3F

Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 1508 3F

Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency,
W82-05120 1511 2I

Advance and Runoff-Surge Flow Furrow Irrigation,
W82-05690 1511 3F

New Evapotranspiration Crop Coefficients,
W82-05692 1511 3F

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 1512 3F

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

IRRIGATION-RETURN FLOW
Irrigation Tailwater Management,
W82-00392 1501 3C

Multimillion-Acre Tea Bag,
W82-03352 1507 3F

IRRIGATION-RETURNFLOW
Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

IRRIGATION SYSTEMS
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 1501 3F

Traveling Sprinkler System and Method,
W82-00561 1502 3F

Evaluating Irrigation Systems,
W82-00772 1502 6B

IRRIGATION WATER
Irrigation Tailwater Management,
W82-00392 1501 3C

Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 1502 5B

2,500 Acres of Wastewater Irrigation,
W82-00769 1502 3C

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Impressions of Soil and Water Conservation in China,
W82-01730 1503 4D

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 1507 3C

Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study,
W82-03919 1509 7A

Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

An Integrated Water-Quality Index for Irrigation Use,
W82-04723 1510 5C

Fecal Coliform Densities in a Western Watershed,
W82-05618 1511 5B

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721 1511 5A

Wastewater Irrigation of Fruit Trees,
W82-06008 1512 3C

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 1512 3C

Land Application of Wastewater,
W82-06915 1512 5E

IRRIGATION WELLS
Water for New Zealand's Plains,
W82-02402 1505 3F

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 1505 5B

Cavity Well,
W82-04920 1511 8A

The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 1511 3B

IRTYSH-KARAGANDA CANAL
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

ISLE AUX MORTS
Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 1511 2K

ISLE OF MAN
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 1504 8A

ISOHYETS
Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 1512 2B

ISOLATION
Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 1501 5A

New Waterborne Bacteriophages Active on Yersinia Enterocolitica,
W82-00662 1502 5A

ISOPOTIC TRACERS
Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 1508 2F

ISOTHERMS
Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 1511 5D

Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 1511 5F

ISOTOPE FRACTIONATION
Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1507 1B

ISOTOPE STUDIES
Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 1501 5B

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 1502 5A

Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 1503 2B

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 1503 2J

Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 1506 5A

Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 1508 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 1511 2F

Estimation of Isotopic Exchange Parameters, Using Constant-Feed Pans,
W82-05648 1511 2D

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation,
W82-05759 1511 2G

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

ISOTOPE TRACERS
Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 1503 2F

ISOTOPES STUDIES
Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

ISOTOPIC STUDIES
018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 1503 2C

ISOTOPIC TRACERS
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 1502 2C

The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

ISRAEL
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

Transport of Salts in Soils and Subsoils,
W82-00930 1502 5B

Environmental Effects of Water Reuse Scheme,
W82-00973 1502 3C

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 1503 2F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 1504 3F

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

Environmental Isotopes as a Tool in Hydrogeological Research in an Arid Basin,
W82-03415 1508 2F

The Rate of Flushing as a Major Factor in Determining the Chemistry of Water in Fossil Aquifers in Southern Israel,
W82-03799 1509 2K

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 1511 2H

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 1511 5D

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 1511 6D

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 1511 2F

Biological Equilibrium in a Wastewater Reservoir,
W82-06282 1512 5D

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 1512 3C

Free Surface Oscillations in Lake Kinneret,
W82-06879 1512 2H

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

ITALY
The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

IVAN'KOVO RESERVOIR
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

IVANKOVO RESERVOIR
Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

IVORY COAST
Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 1503 2H

JACKSON
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

JAMAICA BAY
Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 1511 6A

JAMES BAY
Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 1504 6G

JAMES RIVER
Kepone in the James River,
W82-00631 1502 5B

Protecting Virginia's Waterways,
W82-01608 1503 5G

Sediment-Contaminant Transport Model,
W82-01614 1503 5B

The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 1505 5B

Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 1505 5B

Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 1506 5C

JAPAN

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 1501 5B

Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1505 5A

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 1506 2H

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 1506 2H

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 1506 2H

Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 1506 8D

Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 1507 2H

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 1507 5C

Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

Wastewater Treatment for Japan's Research Institute.
W82-03905 1509 5D

Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

A Control System for Smaller Wastewater Treatment Plants,
W82-04024 1509 5D

Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

Selenium Content and Its Chemical Form in River Waters of Japan,
W82-04181 1509 5A

Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

Prediction of Water Level in Tidal Inlet,
W82-05005 1511 4A

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 1511 5D

Seawater Ro Heads Japan's Water Reuse Research.
W82-05756 1511 3A

Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 1512 5C

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 1512 5A

JAYNES QUADRANGLE

Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

JEFFERSON COUNTY

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 1511 2F

JETS

Using Coherent Water Jets to Control Oil Spills,
W82-03031 1507 5G

Buoyant Surface Jets,
W82-03670 1508 8B

Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 1510 8A

Circular Wall Jets in Coflowing Streams,
W82-04999 1511 8B

Erosion by Submerged Circular Jets,
W82-05002 1511 2J

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

Erosion by Plane Turbulent Jets,
W82-05277 1511 8B

An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279 1511 8B

Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 1512 8B

JETTIES

Large Rubble-Mound Breakwater Failures,
W82-00862 1502 8D

JOINT NEGATIVE RUN LENGTHS

Distribution of Joint Run-Lengths of Bivariate Markov Processes,
W82-02191 1505 2E

JORDAN

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 1503 6A

JUDICIAL DECISIONS

Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

Freedom from the Navigation Servitude Through Private Investment,
W82-01030 1502 6E

Federal Common Law of Nuisance Expands,
W82-01337 1503 6E

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 1503 6E

Avoyelles Sportsmen's League V. Alexander,
W82-01456 1503 6E

Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 1503 6E

Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

Supreme Court Clarifies Water Act Requirement,
W82-02257 1505 6E

Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 1508 6E

What Is a Point Source,
W82-04158 1509 6E

Three Important Court Decisions,
W82-04349 1510 6E

The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 1510 6E

Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603 1511 6E

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 1512 6E

JURA MOUNTAINS
Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 1505 2F

JURISDICTION
An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

JUVENILE FISH
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

KAKAKEE RIVER
Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

KALAHARI DESERT
Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

KALAMAZOO RIVER BASIN
Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 1507 6D

KALYANI DAM
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

KAMA RIVER
Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

KAMLOOPS LAKE
Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 1505 2H

KANEOHE BAY
Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 1512 5C

KANEV RESERVOIR
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 1504 2H

KANKAKEE RIVER
The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

KANSAS
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 1501 7C

Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 1502 4B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 1504 7B

Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

Legal Questions and Problems of Kansas Groundwater Management Districts,
W82-02802 1506 6E

Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 1508 4B

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 1510 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 1510 2E

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

KANSAS CITY
Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 1508 5D

KAOLIN
Effect of Kaolin Concentration on Distribution Coefficient of Copper,
W82-00153 1501 5B

Effect of Cations on Copper Adsorption by Kaolin,
W82-00172 1501 2K

KAOLINITE
Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 1501 5C

KARA-BOGAZ-GOL GULF
Damming of the Kara-Bogaz-Gol Strait without Side Diversion of the Flow,
W82-05114 1511 8A

KARST
Hydrochemistry of a Dolomite Karst: The Bruce Peninsula of Ontario,
W82-00321 1501 2K

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

KARST HYDROLOGY
Reliability of Underground Flood Control System,
W82-00556 1502 8A

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 1504 2F

Origin of Isotopic and Geochemical Ratio Gradients in Karst Water of the Jura Mountains. (Sur L'Origine des Gradients de Teneurs Isotopiques et Geochimiques dans les eaux Karstiques du Jura (France)),
W82-02422 1505 2F

The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 1506 5C

Chemical and Hydrological Heterogeneity of Groundwaters in the Upper 'Jura Neuchatelois', Switzerland. (Heterogeneite Chimique et Hydrologique Des Eaux Souterraines D'un Karst Du Haut-Jura Neuchatelois, Suisse),
W82-03794 1509 2K

Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 1510 4B

KASHMIR
Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 1505 2H

Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 1507 2H

KASHMIR VALLEY
On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 1505 5C

KASKASKIA RIVER
Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

KAWASAKI
Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

KELPS
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 1507 5B

KENAI RIVER
Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

KENNEBEC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Kennebec River Basin, Maine.
W82-01755 1504 6D

KENNEDY SPACE CENTER
Acid Rain at Kennedy Space Center, Florida: Recent Observations,
W82-00533 1502 5B

KENNET RIVER
Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 1510 5C

KENTON COUNTY
A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

KENTUCKY
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 1501 6E

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 1502 5G

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 1502 4B

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 1505 7C

Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 1506 2E

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 1511 2E

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

KENYA
Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 1505 2K

Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 1508 2H

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 1511 2H

The Energy Resources of Kenya,
W82-05978 1512 6D

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

Doubts Remain About Bura Economics,
W82-06816 1512 3F

KEPONE
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

Kepone in the James River,
W82-00631 1502 5B

Effect of Kepone on Estuarine Microbial Activity,
W82-01231 1503 5C

Protecting Virginia's Waterways,
W82-01608 1503 5G

Sediment-Contaminant Transport Model,
W82-01614 1503 5B

Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 1504 5B

The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 1505 5B

Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 1505 5B

KETONES
Volatilization of Ketones From Water,
W82-05782 1511 5C

KEWEENAW WATERWAY
Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

KHARKOV
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

KICKAPOO RIVER
Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

KIEV RESERVOIR
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 1504 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 1504 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 1511 2H

KIEV RESERVOIRS
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 1504 5C

KINCARDINE HARBOR
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

KINEMATIC WAVE THEORY
Water Routing on Diverging-Converging Watersheds,
W82-02200 1505 2A

Diverging Overland Flow,
W82-03676 1508 2A

Asymptotic Solution for Dam-Break Problem,
W82-04313 1510 8B

Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 1511 4A

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

KINEMATIC WAVES
Nature of Wave Attenuation in Open Channel Flow,
W82-05003 1511 2E

KINETIC ENERGY
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 1503 2B

KINETICS
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 1501 5B

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 1502 5D

Kinetics for the Aquatic Environment,
W82-01631 1503 2K

Kinetics for the Aquatic Environment,
W82-01806 1504 2K

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 1506 2K

Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 1507 5C

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 1507 5C

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 1508 5B

Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 1508 5B

A Resume of the Kinetics of the BOD Test,
W82-03832 1509 5A

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 1510 5D

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 1510 5D

Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 1511 5D

Kinetics of Biofilm Nitrification,
W82-05374 1511 5D

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 1511 5D

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

The Dependence of Drainage Density on Climate and Geomorphology,
W82-06199 1512 2E

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 1512 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 1512 5B

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 1512 5D

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
W82-06829 1512 5B

KIROVSKOE RESERVOIR
Concrete of the Dam of the Kirovskoe Reservoir,
W82-03159 1507 8F

KISSISSIMMEE RIVER BASIN
Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

KJELDAHL PROCEDURE
Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 1511 5D

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems.
W82-05437 1511 5A

An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 1512 5A

KNIGHT INLET
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

KNOWLTON LAKE
Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario,
W82-04031 1509 2K

KOHL SPRING
Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 1503 5B

KRAFT MILL WASTES
Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 1508 5D

KRAFT MILLS
New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

KRALINGEN
Automated Treatment Plant Keeps Rotterdam Drinking Water Flowing.
W82-04004 1509 5F

KREMENCHUG RESERVOIR
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 1504 2H

Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

KRIGING
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

Data Requirements for Kriging: Estimation and Network Design,
W82-04200 1509 7A

On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

LA GRANDE COMPLEX
James Bay Spillways and Control Structures,
W82-04692 1510 8A

LABORATORIES
A Survey of Quality Control Practices in Water Bacteriology Laboratories,
W82-04111 1509 5A

Laboratory Services in Regional Water Authorities,
W82-06256 1512 5G

LABORATORY EQUIPMENT
Sampling Ground Water for Organic Contaminants,
W82-00820 1502 5A

Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 1504 2L

A Survey of Quality Control Practices in Water Bacteriology Laboratories,
W82-04111 1509 5A

Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 1511 5A

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems.
W82-05437 1511 5A

LABORATORY STUDIES
Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 1511 5C

LABRADOR
Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 1508 6G

LAC LAFLAMME
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

LADBROKE SERVICE RESERVOIR
An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 1503 8F

LADOGA LAKE
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

LAGOONS
Bentonite Liners for Power Plant Lagoons,
W82-00617 1502 5E

Lagoons and Oxidation Ponds,
W82-01244 1503 5D

Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 1503 2L

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 1504 5D

Calculator Program Aids Lagoon Design,
W82-03211 1507 6A

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 1510 2L

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 1510 5D

Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 1511 5D

Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

LAGUNA PUEBLO
Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 1505 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 1505 3A

LAKE ALENASHALAN
On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012 1511 5A

LAKE APOPKA
Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 1505 2H

Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 1511 2H

LAKE BAIKAL
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 1504 2H

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 1504 2H

LAKE BALATON
The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 1506 7B

LAKE BASINS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 1502 5C

Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 1505 2K

Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 1512 4A

LAKE BEDS
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 1504 2F

Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 1505 2H

Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

LAKE BIWA
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

LAKE BLANKVATN
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

LAKE CARL BLACKWELL
Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 1505 5C

LAKE CHAD
Exploiting the Waters of Lake Chad.
W82-01726 1503 8A

LAKE CLASSIFICATION
Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 1502 2H

A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 1503 5B

On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 1505 5C

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 1505 2H

Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 1507 2H

Current Use and Technology of Landsat Mss Data for Lake Trophic Classification,
W82-03755 1509 7B

Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

Terminological Confusion--Lake VS. Reservoir,
W82-06551 1512 2H

LAKE CONSTANCE
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods.
W82-03883 1509 2J

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

LAKE CONWAY
Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

LAKE COUNTY
Land Disposal of Sludge,
W82-04757 1511 5E

LAKE CRETEIL
Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

LAKE DECATUR WATERSHED
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 1506 5A

LAKE DONJEK
Estimates of the Magnitude of Glacier Outburst Floods from Lake Donjek, Yukon Territory, Canada,
W82-02241 1505 2C

LAKE EDKU
Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

LAKE ERIE
Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 1503 2H

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

Loading Estimates to Lake Erie, 1967-1976,
W82-01852 1504 5A

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 1504 5B

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 1505 6B

Power Plant Siting and Design: A Case Study of Minimal Entrainment and Impingement Impacts at Davis-Besse Nuclear Power Station,
W82-03964 1509 5C

The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

Attached Algae of the Lake Erie Shoreline Near Nanticoke Generating Station,
W82-04035 1509 5C

Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 1510 2H

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 1511 2J

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 1511 5C

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 1511 5C

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 1512 5C

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 1512 2J

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 1512 5C

Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

LAKE ERIE BASIN

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

LAKE EVAPORATION

Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 1507 2D

Refinement of Lake Evaporation Measurements, Using an Ion-Balance Technique,
W82-03808 1509 2D

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

Paleoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 1512 2D

LAKE FISHERIES

Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 1506 2H

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 1512 6G

LAKE FRYXELL

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

LAKE GEORGE

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 1502 2H

LAKE HANCOCK

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

LAKE HARUNA

On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 1506 2H

LAKE HEFNER

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

LAKE HOUSTON

Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

LAKE HURON

Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 1503 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant,
W82-04116 1509 5F

Winter Temperature Structure in Lake Huron,
W82-04381 1510 2H

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 1511 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 1512 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 1512 5C

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 1. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 1512 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

LAKE ICE

Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 1501 2C

LAKE ISTOKPOGA

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 1510 2H

LAKE JACKSON

The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

LAKE KAIIKE

Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 1506 2H

LAKE KARIBA

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 1511 2H

LAKE KASUMIGAURA

Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 1507 2H

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

LAKE KEYSTONE

Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 1508 5A

LAKE KINNERET

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 1511 2H

LAKE KISSIMMEE

Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

LAKE KIZAKI
Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

LAKE KNAACK
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 1504 2H

LAKE LANSING
Arsenic in Lake Lansing, Michigan,
W82-03522 1508 5B

LAKE LENORE
Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 1507 2H

LAKE LILLINONAH
Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

LAKE LINNEVATN
Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

LAKE LUCERNE
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 1503 4D

LAKE MALINOVOYE
Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

LAKE MARCO
Meromixis in a Coastal Zone Excavation,
W82-02120 1505 2H

LAKE MARIUT
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

LAKE MATAMEC
Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

LAKE MEAD
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G

LAKE MEMPHREMAGOG
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 1503 5C

Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 1510 2H

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

LAKE MENDOTA
Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

LAKE MICHIGAN
Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 1501 2H

Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 1502 5C

Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 1503 2H

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 1503 5B

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 1503 2H

Organochlorine Insecticides and PCB in Surficial Sediments of Lake Michigan (1975),
W82-01190 1503 5A

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 1503 5C

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 1503 2H

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 1504 7B

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 1504 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 1504 2J

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 1504 2H

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 1504 5C

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 1504 2F

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

Quantitative Differences Between Benthic Algal Communities Along a Depth Gradient in Lake Michigan,
W82-02299 1505 2H

A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 1508 2H

Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 1508 5B

Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin,
W82-03817 1509 2J

Laboratory and Field Studies of The Relative Mobility of 239, 24OPU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 1510 2H

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 1512 5C

LAKE MJOSA
The Rehabilitation of Norway's Largest Lake,
W82-05243 1511 5G

LAKE MOHAVE
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G

LAKE MORPHOLOGY

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 1505 2H

LAKE MORPHOMETRY

Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

Comment on 'A Relation Between Lake Morphometry and Primary Productivity and Its Use in Interpreting Whole-Lake Eutrophication Experiments' (E.J. Fee),
W82-03780 1509 5C

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

LAKE NAINI TAL

Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

LAKE NAIVASHA

Major Ion Chemistry in a Tropical African Lake Basin,
W82-02440 1505 2K

Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

LAKE NASSER

Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 1504 6G

LAKE NEUSIEDLER

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 1504 5C

LAKE OGLETHROPE

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

LAKE OHRID

The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

LAKE OKEECHOBEE

Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 1510 2H

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

LAKE ONTARIO

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 1502 2H

A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 1503 2H

Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 1503 2H

Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

A Survey of ATP Concentrations in Lake Ontario, 1975-1976,
W82-01144 1503 2H

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 1503 5B

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 1504 2H

The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 1505 7A

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 1507 5C

Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 1508 2H

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 1510 2H

Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 1511 2H

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

Physical Process and Eutrophication,
W82-06875 1512 5C

LAKE ONTARIO TRIBUTARIES

Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) 1. Pathway of the Direct Photolysis in Solution,
W82-04032 1509 5B

LAKE PAIJANNE

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

LAKE PAVIN

Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 1507 2H

Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplancton),
W82-03219 1507 2H

LAKE PEPIN

Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

LAKE PONTCHARTRAIN

Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

LAKE QARUN

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

LAKE RAY HUBBARD

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 1510 5C

LAKE REHABILITATION

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 1502 5C

LAKE REREWHAKAAITU

Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

LAKE RESTORATION

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 1502 2H

Reviving Acidified Lakes,
W82-00933 1502 2H

Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 1503 5G

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 1504 2H

The Dilution/Flushing Technique in Lake Restoration,
W82-02270 1505 2H

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 1505 5G

The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

Hypolimnetic Aerator Fights Eutrophication,
W82-03563 1508 5G

Input/Output Models as Decision Aids for Lake Restoration,
W82-03924 1509 5G

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnaite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 1510 5C

The Rehabilitation of Norway's Largest Lake,
W82-05243 1511 5G

Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 1511 5G

Lake Restoration by Sediment Removal,
W82-06776 1512 5G

LAKE SEDIMENTS

Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 1501 5B

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 1501 2H

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 1501 2H

Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 1501 2H

Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 1501 2H

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 1501 2H

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 1502 2H

Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

Fatty Acid and Hydrocarbon Content of Settling Sediments in Lake Michigan,
W82-01154 1503 2H

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 1503 5B

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 1503 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 1504 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 1504 2J

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 1504 2H

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 1505 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 1507 5A

Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 1507 2H

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 1508 5B

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 1508 5B

Laboratory and Field Studies of The Relative Mobility of 239, 24OPU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03903 1509 5C

Phosphorus Recycling in Five Shallow Lakes,
W82-04040 1509 2H

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 1510 2H

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 1511 2H

Metal Icn Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 1511 2K

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 1511 2H

Radionuclides in Mono Lake, California,
W82-05461 1511 5B

Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 1511 2J

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 1511 5C

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 1511 5B

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 1512 2J

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 1512 5B

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

Lake Restoration by Sediment Removal,
W82-06776 1512 5G

Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 1512 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 1512 5C

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

LAKE SEMINOLE
Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 1501 6G

LAKE SEVAN
Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 1506 2H

LAKE SHORELINES
Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 1512 5C

LAKE SHORES
Rates and Implications of Bluff Recession Along the Lake Michigan Shorezone of Michigan and Wisconsin,
W82-03817 1509 2J

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5B

LAKE SJAELSOE

Practical Experiences in Plants Using Activated Carbon,
W82-02788 1506 5F

LAKE ST. CLAIR

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

LAKE SUPERIOR

Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 1503 5C

Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

Contourites in Lake Superior,
W82-01935 1504 2H

Operational Estimates of Lake Superior Evaporation Based on IFYGL Findings,
W82-03074 1507 2D

Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water,
W82-04127 1509 5F

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

LAKE TAHOE

Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 1501 5D

Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 1501 6G

An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 1502 7B

The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 1504 6A

Lake Tahoe Preservation Bill Enacted.
W82-02244 1505 6E

The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 1505 2H

Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 1508 2H

LAKE TANGANYIKA

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

LAKE TAUPO

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

Zooplankton of Lake Taupo,
W82-02888 1506 2H

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 1507 2H

LAKE TEXOMA

Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 1505 2H

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

LAKE VALENCIA

Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

LAKE VATTERN

Jonkoping's Water Supply,
W82-02419 1505 5F

Lake Vattern,
W82-02755 1506 2H

LAKE VECHTEN

Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 1506 2K

LAKE VICTORA

Analysis of Lake Victoria Levels,
W82-06201 1512 2H

LAKE VICTORIA

Recent Changes in Level of Lake Victoria,
W82-01711 1503 4A

Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 1506 2H

Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 1512 6E

LAKE WASHINGTON

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 1508 5A

LAKE-WATERSHED SYSTEMS

Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 1502 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 1502 2A

LAKE WINGRA

The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

LAKES

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

Predicting Lake Levels by Exponential Smoothing,
W82-00118 1501 2A

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 1501 2H

Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 1501 2H

Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 1502 2H

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 1502 5G

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 1502 2H

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 1502 2H

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 1502 2H

Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 1502 2H

Organochlorine Residues in Kenya's Rift Valley Lakes,
W82-00690 1502 5A

Great Lakes International Surveillance Plan,
W82-00701 1502 6E

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 1502 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 1502 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 1502 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 1502 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 1502 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 1502 5A

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 1502 2K

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 1502 2H

Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 1502 2H

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 1502 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 1503 6A

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

The Use of the Equilibrium Temperature to Establish the Heat Balance of a Water Surface (Sur l'Utilization de la Temperature d'Equilibre pour l'Etablissement du Bilan Thermique d'Un Plan d'Eau),
W82-01353 1503 2H

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 1503 2H

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 1503 2H

The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 1503 5C

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 1503 5B

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 1503 4D

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 1503 2H

Recent Changes in Level of Lake Victoria,
W82-01711 1503 4A

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

The Mercury Cycle,
W82-01869 1504 5B

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 1504 2H

Contourites in Lake Superior,
W82-01935 1504 2H

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 1504 2H

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 1504 5B

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 1504 2H

Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

Dissolved Humic Substances: A Major Source of Error in Fluorometric Analyses Involving Lake Waters,
W82-02223 1505 5A

Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 1505 2H

Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 1505 2H

Seasonal and Diurnal Fluctuations of Oomycete Proagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 1505 2H

Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 1505 2H

The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 1505 7A

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 1505 2A

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 1505 2K

Jonkoping's Water Supply,
W82-02419 1505 5F

The Mixing Layer of Loch Ness,
W82-02421 1505 2H

On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 1505 2H

Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 1505 2H

Liming Acid Ponds in New York,
W82-02572 1505 5G

Farm, Urban Drainage Polluting Great Lakes.
W82-02647 1506 5B

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 1506 5B

Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 1506 5A

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 1506 5B

Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 1506 2H

Some Hydrobiological Characteristics in Amvrakia Lake, Western Greece,
W82-02753 1506 2H

Lake Vattern,
W82-02755 1506 2H

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 1506 2H

Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 1506 2H

On the Sampling Size of Zoobenthos Along a Lake Shore (In Janpanese),
W82-02796 1506 2H

Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 1506 2H

Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 1506 2H

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 1506 5G

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

The Production Ecology of Benthic Plants in Some Antarctic Lakes. I. In Situ Production Studies,
W82-02860 1506 2H

Zooplankton of Lake Taupo,
W82-02888 1506 2H

Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 1506 2H

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 1506 5C

Screen Mesh Size Affects Estimates of Macro- and Meio-Benthos Abundance and Biomass in the Great Lakes,
W82-02912 1506 2H

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 1506 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 1506 2H

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 1506 5F

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 1507 2H

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 1507 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 1507 5A

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 1507 5G

Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 1507 5C

Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 1507 5C

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 1507 5C

Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 1507 2H

Exploiting Papyrus,
W82-03202 1507 2H

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 1507 2H

Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplancton),
W82-03219 1507 2H

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 1507 2J

Acid Precipitation--A New Study from Norway,
W82-03341 1507 5C

Acidification in 50 Norwegian Lakes,
W82-03344 1507 2H

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 1507 2B

Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 1508 2H

The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 1508 5C

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 1508 5G

Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 1508 2H

Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 1508 2H

Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 1508 2H

Arsenic in Lake Lansing, Michigan,
W82-03522 1508 5B

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 1508 2H

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 1508 2H

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 1508 2H

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 1508 2H

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

Phosphate in Water: I. Reduction Using Northern Lignite Fly Ash,
W82-03882 1509 5F

Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes,
W82-03960 1509 2J

Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

Attenuation of Incident Solar Radiation in Lake Water,
W82-04180 1509 2H

Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

Storm-Sewer Input of Heavy Metals Into an Urban Lake Environment,
W82-04207 1509 5A

The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

Lake Level Drawdown as a Macrophyte Control Technique,
W82-04235 1509 4A

Eutrophication Measures for Small Lake Water Quality Management,
W82-04243 1509 2H

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 1510 5C

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt. II. Heavy Metals,
W82-04290 1510 5B

Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 1510 5C

Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 1510 2H

Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 1510 2H

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 1510 5G

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnostta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 1510 5C

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 1510 2H

Structure of the Flow Within the Coastal Boundary Layer of the Great Lakes,
W82-04572 1510 2H

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 1510 2H

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 1510 2H

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 1510 2H

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 1510 2B

Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 1511 2H

Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 1511 2H

An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 1511 2H

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

Prediction of Water Level in Tidal Inlet,
W82-05005 1511 4A

Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 1511 2H

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 1511 5B

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 1511 2H

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 1511 2H

Nutrient Distribution in North German Lake Sediments and Remarks on Sediment-Pelagic Exchange (Die Nahrstoffverteilung in Sedimenten Norddeutscher Seen und Hinweise Auf Den Austausch Sediment-Pelagial),
W82-05091 1511 2H

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 1511 2H

Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 1511 2H

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 1511 2H

Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 1511 2H

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 1511 5G

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 1511 5D

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 1511 2H

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 1511 5B

The Importance of Lacustrine Zooplankton to the Feeding Capacity of the Lizhma Lake-River System (Basin of Lake Onega).
W82-05508 1511 2H

Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 1511 5B

Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 1511 5C

Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578 1511 5B

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 1511 2H

Stability Effects on Great Lakes Evaporation,
W82-05634 1511 2D

Electrical Interaction Between Polarized Water Masses and Zooplankton in Water Bodies,
W82-05707 1511 5G

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 1511 5G

Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 1511 2H

Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 1512 2H

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 1512 5C

Analysis of Lake Victoria Levels,
W82-06201 1512 2H

Heavy Metals in Animals of Lake Balaton,
W82-06284 1512 5C

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 1512 5G

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

Terminological Confusion--Lake VS. Reservoir,
W82-06551 1512 2H

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 1512 2H

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

Organochlorine Residues in Fish from Lake Mjoss in Norway,
W82-06697 1512 5A

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

Effects of Acid on Plant Litter Decompostion in an Arctic,
W82-06737 1512 5C

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 1512 5B

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 1512 5C

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

Free Surface Oscillations in Lake Kinneret,
W82-06879 1512 2H

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 1512 5G

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 1512 5C

Growth Dynamics of Cladophora Glomerata in Western Lake Erie in Relation to Some Environmental Factors,
W82-06932 1512 5C

Environmental Factors Controlling Physiological Changes in Cladophora in Lake Erie,
W82-06935 1512 5C

Projected Cladophora Growth in Southern Georgian Bay in Response to Proposed Municipal Sewage Treatment Plant Discharges to the Mary Ward Shoals,
W82-06936 1512 5C

Abundance Patterns of Diatoms on Cladophora in Lake Huron with Respect to a Point Source of Wastewater Treatment Plant Effluent,
W82-06937 1512 5C

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 1512 5C

Biomass and Distribution of Cladophora Glomerata in Relation to Some Physical-Chemical Variables at two Sites in Lake Erie,
W82-06941 1512 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

Colonization and Growth of Attached Algae at the Lake Michigan Water Line,
W82-06976 1512 5C

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

LAMINAR FLOW

Modeling Rill Density,
W82-02604 1506 2J

Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 1510 2L

LAMPRICIDES

Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) 1. Pathway of the Direct Photolysis in Solution,
W82-04032 1509 5B

A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 1512 5A

LAND ACQUISITION

State and Local Acquisition of Floodplains and Wetlands; A Handbook on the Use of Acquisition in Floodplain Management.
W82-03966 1509 6F

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 1511 4C

LAND APPLICATION

Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 1501 5B

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

Current Policies on Land Application,
W82-02629 1506 5E

A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 1507 5E

The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 1508 5E

Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 1511 5D

How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 1511 5E

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 1511 5D

Land Application of Secondary Effluent at Lake George, NY,
W82-05704 1511 5D

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 1511 5B

Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 1512 5D

Land Treatment of Industrial Wastes: Principles and Practices. Part II,
W82-06009 1512 5E

Recycled Food Processing Wastes Reduce Treatment Costs,
W82-06507 1512 3C

LAND APPRAISALS

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

LAND CLEARING

Avoyelles Sportsmen's League V. Alexander,
W82-01456 1503 6E

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 1511 5C

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 1511 5C

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

LAND DEVELOPMENT

Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 1505 4A

Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

LAND DISPOSAL

Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

Nitrogen Availability from Sewage Sludge,
W82-00158 1501 5E

Soil as a Medium for Dairy Liquid Waste Disposal,
W82-00165 1501 5E

Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 1501 5E

Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 1501 5E

Survival of Enteroviruses in Rapid-Infiltration Basins During the Land Application of Wastewater,
W82-00496 1501 5D

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

Movement of Endotoxin Through Soil Columns,
W82-00586 1502 5B

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 1502 5D

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

Persistence and Distribution of Erysipelothrix Rhusiopathiae and Bacterial Indicator Organisms on Land Used for Disposal of Piggery Effluent,
W82-00686 1502 5B

Vegetative Filter Treatment of Livestock Feedlot Runoff,
W82-00794 1502 5D

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 1502 5D

Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 1502 5B

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 1502 5D

Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 1503 5B

Artificial Groundwater Recharge,
W82-01110 1503 4B

Land Application of Municipal Wastewater,
W82-01253 1503 5D

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5G

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 1503 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 1503 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 1503 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 1503 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 1503 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 1503 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 1503 5E

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 1503 3C

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 1503 5E

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 1503 3C

Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 1503 5D

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5E

Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

Land Application of Wastewaters: An Overview.
W82-02650 1506 3C

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA.
W82-02817 1506 3C

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

Managing Vegetation in Wastewater Application,
W82-03401 1508 5D

Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 1508 5E

City Sewage and the American Farmer,
W82-03600 1508 3C

Kinetics of Nitrogen Loss in Simulated Wastewater Treatment in a Soil-Plant System,
W82-03869 1509 5D

Prediction of Leachate Accumulation in Sanitary Landfills,
W82-03934 1509 5B

Irrigating with Municipal Effluent: A Socioeconomic Study of Community Experiences,
W82-03967 1509 3C

Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 1510 5B

Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 1510 5D

Land Disposal of Sludge,
W82-04757 1511 5E

Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 1511 3C

Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 1511 5E

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 1511 5D

Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 1512 5E

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

Landspreading of sludge in New York State,
W82-06557 1512 5E

Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 1512 5E

Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 1512 5E

Land Application of Wastewater,
W82-06915 1512 5E

LAND FORMING

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 1502 3F

LAND MANAGEMENT

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 1511 4B

A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 1511 2E

The Landscape of Rutland Water,
W82-06478 1512 6G

Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 1512 4C

LAND RECLAMATION

Land Restoration Following Oil-Well Drilling,
W82-00057 1501 5D

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 1501 5E

Modeling Water Flux on Strip-Mined Land
W82-00944 1502 2G

Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

Topsoil Management of Mined Soils,
W82-04571 1510 4D

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

LAND SUBSIDENCE

Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

LAND TENURE

Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 1510 6E

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

LAND USE

Geographic Information Systems and Environmental Impact Assessment,
W82-00338 1501 7C

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 1502 5G

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 1502 6E

Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 1503 5G

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 1503 6A

Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 1505 5B

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 1506 5B

Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 1507 4C

Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 1510 2A

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 1510 4C

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 1511 4A

Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 1511 6E

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

Aquifer Management in Dade County,
W82-05784 1511 5G

Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 1512 5B

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 1512 5B

Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

LAND USE PLANNING

Urban Creekside Design Features Parallel Streets,
W82-06184 1512 4C

Development of an Environmental Geology Data Base for Land Use Planning,
W82-06552 1512 6A

LANDFILLS

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 1501 5C

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 1501 5E

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 1501 5B

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 1503 5B

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 1503 5B

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 1503 2G

Top-Sealing to Minimize Leac[illegible] Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 1503 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 1503 5G

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 1504 5B

Managing Hazardous Wastes,
W82-02252 1505 5E

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 1507 5G

Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

Design of a Leachate Collection System for a Sludge Filled Landfill,
W82-03935 1509 5E

Improved Analytical Methods for the Design of Leachate Collection Systems,
W82-03936 1509 5E

Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

Temperature Effects on Biostabilization of Leachate,
W82-04044 1509 5D

Three Important Court Decisions,
W82-04349 1510 6E

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

Land Disposal of Sludge,
W82-04757 1511 5E

Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04879 1511 5B

Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 1511 5B

Models of Landfill Leaching: Organic Strength,
W82-05817 1511 5B

A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 1512 5B

LANDIFLLS

Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 1503 5B

LANDSAT
Current Use and Technology of Landsat Mss Data for Lake Trophic Classification,
W82-03755 1509 7B

Watershed Model Study Using LANDSAT Image Data,
W82-03814 1509 2A

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

LANDSLIDES
Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

Mississippi's Experience with Horizontally Drilled Drains and Conduits in Soil,
W82-02213 1505 8A

Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 1511 8B

LANDUSE
New Problems with Upland Waters,
W82-06602 1512 5G

LANGBEIN'S METHOD
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

LANGMUIR CELLS
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 1504 2H

LANGSTONE HARBOR
Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

LAPLACE EQUATION
Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

LARAMIE-FOX HILLS AQUIFER
Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

LARVAE
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

LARVAL GROWTH STAGE
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

LARVICIDES
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 1503 5B

Further Observations on the Effect of Abate on Fish Catches,
W82-06722 1512 5C

LAS VEGAS SE QUADRANGLE
Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

LASERS
Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

Laser Drip Irrigation.
W82-00771 1502 3F

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 1503 7B

LATIN AMERICA
Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 1511 5F

LAUROX-9
Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 1511 5C

LAWN WATERING RESTRICTIONS
Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

LAWNS
Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

Deterministic Models for Predicting Residential Water Consumption,
W82-04352 1510 6D

LEACHAGES
Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 1503 5E

A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

LEACHATES
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 1501 5C

Lining of Waste Impoundment and Disposal Facilities.
W82-00099 1501 5E

Leachates from Solid Waste Recovery Operations,
W82-00167 1501 5D

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 1501 5B

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5E

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 1502 5B

Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 1503 2G

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 1503 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 1503 5G

Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 1504 5B

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 1504 5D

Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 1507 5G

Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 1507 5B

Migration Through Soil of Organic Solutes in AIJ Oil-Scale Process Water,
W82-03640 1508 5B

Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

Effect of Leachate Solutions from Fly and Bottom Ash on Groundwater Quality,
W82-03798 1509 5B

Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

Prediction of Leachate Accumulation in Sanitary Landfills,
W82-03934 1509 5B

Design of a Leachate Collection System for a Sludge Filled Landfill,
W82-03935 1509 5E

Improved Analytical Methods for the Design of Leachate Collection Systems,
W82-03936 1509 5E

Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

Temperature Effects on Biostabilization of Leachate,
W82-04044 1509 5D

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04879 1511 5B

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 1511 5C

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5B

Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 1511 5E

Dilution of Municipal Landfill Leachate, Franklin County, Indiana,
W82-05811 1511 5B

Models of Landfill Leaching: Organic Strength,
W82-05817 1511 5B

Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 1511 5B

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

A Simplified Buffer Capacity Model for Sanitary Landfill Leachate,
W82-06038 1512 5B

Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 1512 5B

Selection of Waste disposal sites,
W82-06550 1512 5E

LEACHING

Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 1501 6A

Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 1501 5E

The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 1502 5B

Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 1502 5B

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

Metal Leaching from Sewage Sludge Ash,
W82-00770 1502 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 1502 5D

Trenching of Digested Sludge,
W82-00974 1502 5E

Leach Characteristics of Coal-Gasification Char,
W82-01025 1502 5B

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 1502 5G

Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 1503 5B

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 1503 5B

Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 1503 2G

Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 1504 2G

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 1506 5B

Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges,
W82-02990 1506 5B

Restoring Ground Water Quality Following in Situ Leaching,
W83-03050 1507 5D

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 1508 3C

Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

Salt Movement, Leaching Efficiency, and Leaching Requirement,
W82-03791 1509 2K

Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 1510 5B

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 1511 5D

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

LEAD

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 1507 5F

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 1508 5B

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 1510 5F

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 1511 5A

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 1512 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

LEAD-210
Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes,
W82-03960 1509 2J

LEAD RADIOISOTOPES
Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods.
W82-03883 1509 2J

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

LEAF SURFACE WAX
Water Conservation in Cotton by Drought Induced Leaf Surface Wax Synthesis,
W82-03946 1509 3F

LEAKAGE
Cutting the Water Losses,
W82-00310 1501 5F

Leak Detection - Two Methods That Work,
W82-02521 1505 3D

Down to Earth Leak Detection,
W82-03561 1508 5F

Leak Detection--Histories,
W82-04363 1510 3D

Leak Detection Programs Recover Revenues,
W82-04375 1510 3D

Leak Location Enters Computer Age,
W82-06018 1512 7A

Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 1512 2F

Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 1512 7B

LEAKY AQUIFERS
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 1504 2F

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

Numerical Treatment of Leaky Aquifers in the Short Time Range,
W82-06863 1512 2F

LEATHER INDUSTRY
Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 1512 5A

LEAVES
Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 1502 2D

Seasonal Patterns of Leaf Water Relations in Four Co-Occurring Forest Tree Species: Parameters from Pressure-Volume Curves,
W82-01011 1502 2I

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 1505 2I

Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 1506 5C

The Effect of Leaf Water Status on Stomatal Activity, Transpiration and Nitrate Reductase of Sweet Potato,
W82-03793 1509 2D

Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 1510 2I

LEE COUNTY
Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

LEECHES
The Use of Leeches to Identify Pesticides in Water,
W82-02075 1504 5A

LEGAL ASPECTS
Conflicts and Barriers Working Group Report.
W82-00031 1501 6E

Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 1501 6E

Summary of the Midwest Conference on Small-Scale Hydropower in the Midwest: An Old Technology Whose Time Has Come.
W82-00449 1501 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 1501 6E

The Waterway That Cannot be Stopped,
W82-00510 1502 6E

Groundwater Strategies,
W82-00620 1502 5G

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 1502 6E

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia.
W82-00744 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 1502 6E

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 1502 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Development of the Hydroelectric Potential at Goose River, Maine.
W82-00751 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 1502 6E

Western Coal Mining in the 1980s: A Study in Federal/State Conflicts,
W82-00972 1502 6E

Experience Gained with the U.S. Pollution Control Policies,
W82-00996 1502 6E

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 1502 6E

Distribution System Liability,
W82-01028 1502 5F

Freedom from the Navigation Servitude Through Private Investment,
W82-01030 1502 6E

A Case Study Analysis of Legal and Institutional Obstacles and Incentives to the Potential Hydroelectric Development at High Falls State Park, Georgia.
W82-01078 1502 6E

Law,
W82-01302 1503 6E

The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 1503 6E

Parish Is Not Liable for Subsidence.
W82-01603 1503 6E

The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 1503 6E

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 1504 6E

Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 1504 6E

Perseverance Produces County Park,
W82-01932 1504 6D

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 1505 6E

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 1505 6E

Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 1505 6E

Sludge: Back into the Ocean,
W82-02577 1505 5E

Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 1506 6E

Water Pollution Control in the Federal Republic of Germany,
W82-02766 1506 6E

Digest of Water Resources Policies and Authorities.
W82-02973 1506 6E

Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 1508 6E

Clean Water Act.
W82-03687 1508 6E

Clean Water Act.
W82-03666 1508 6E

The Fifth Amendment Privilege Against Self-Incrimination and Compulsory Self-Disclosure Under the Clean Air and Clean Water Acts,
W82-03746 1508 6E

A Legal-Economic Critique of Groundwater Law and Administration: With Special Reference to Arizona and Nebraska,
W82-03827 1509 6E

The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

Pueblo Indian Agriculture, Irrigation and Water Rights,
W82-04208 1509 6E

The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 1510 6E

Experiences with EEC Guideline 75/440 on the Quality of Surface Waters for Drinking Water Production in the Member States (Erfahrungen mit der EG Richtlinie 75/440 Uber die Qualitat von Oberflachenwasser fur die Trinkwassergewinnung in den Mitgliedstaaten).
W82-04547 1510 6E

A Manual for Development of Small Scale Hydroelectric Projects by Public Entities.
W82-04634 1510 6E

Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 1510 6E

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 1510 6E

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 1510 6E

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law,
W82-04803 1511 6E

Some Emerging Rights in Agricultural Land,
W82-04890 1511 6E

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 1511 6B

India: Every River Polluted, and Few Effective Controls,
W82-05033 1511 5B

Weak Controls from Sea to Shining Sea,
W82-05035 1511 5B

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 1511 2E

Acid Rain: Legal and Political Fallout,
W82-05147 1511 6E

Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

The Status of Groundwater Law in New York State,
W82-05400 1511 6E

Institutional Change - Water Quality Management,
W82-05401 1511 6E

The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 1511 6E

Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603 1511 6E

Stream Improvement: The Chicod Creek Episode,
W82-05717 1511 4D

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 1511 6E

The Safe Drinking Water Act on Review,
W82-05792 1511 5G

The Development of International Groundwater Law,
W82-05939 1512 6E

The Law of International Aquifers,
W82-05940 1512 6E

Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 1512 6E

Small Scale Hydroelectric Development and Federal Environmental Law: A Guide for the Private Developer,
W82-06002 1512 6E

Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 1512 6E

Environmental Problems and Geothermal Permitting,
W82-06217 1512 6G

Water Law and the Development of Geothermal Resources,
W82-06218 1512 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 1512 6E

LEGISLATION

Ground Water Conflicts and Barriers,
W82-00028 1501 6E

Alternatives Working Group Report.
W82-00032 1501 6B

WQM Five Year Strategy (FY 81-Baseline).
W82-00045 1501 5G

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 1501 6E

Groundwater Problems in North Carolina,
W82-01056 1502 4B

Pennsylvania Ground Water Problems and Needs,
W82-01058 1502 4B

Ground Water Problems in West Virginia,
W82-01060 1502 4B

Pollution Control: Changing Approaches,
W82-01870 1504 6E

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

Superfund: What a Mess,
W82-02184 1505 6E

Compliance Strategy for Clean Water.
W82-02185 1505 6E

Lake Tahoe Preservation Bill Enacted.
W82-02244 1505 6E

Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 1508 6E

Water Quality: What Should Be Done Today,
W82-03631 1508 6E

New Legislation in California and Its Effects,
W82-03731 1508 6E

Groundwater Monitoring,
W82-04809 1511 6E

River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 1511 6E

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 1511 5B

The Federal Response to Ground Water Protection,
W82-06295 1512 6E

Ground Water Law in Puerto Rico.
W82-06296 1512 6E

Ground Water and the States,
W82-06297 1512 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 1512 6E

Mineral Law Since Nepa,
W82-06582 1512 6E

Ocean Disposal Legislation in the United States,
W82-06597 1512 5E

LEGUMES
Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 1505 3F

LEICESTER
Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

LENTIC ENVIRONMENT
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 1502 7B

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 1512 5G

LERDERDERG RIVER
Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

LESSER SLAVE LAKE
Predicting Lake Levels by Exponential Smoothing,
W82-00118 1501 2A

LEVEES
Risk Models for Flood Levee Design,
W82-01307 1503 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 1503 8B

LEWIS RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 1501 6B

LIABILITY
Superfund: What a Mess,
W82-02184 1505 6E

LIBRARIES
Ground-Water Information: NWWA Provides the Resources,
W82-00301 1501 2F

LIBYA
Major Evaporite Deposition from Groundwater Remobilized Salts,
W82-03339 1507 5B

LICENSING
Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 1512 6E

LIFE CYCLES
Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

LIFE HISTORY STUDIES
Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 1511 3C

LIGHT INTENSITY
The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 1505 2H

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 1506 5C

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 1512 5C

LIGHT PENETRATION
Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 1503 2H

Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 1503 5C

Attenuation of Incident Solar Radiation in Lake Water,
W82-04180 1509 2H

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

Effect of Water Turbulence on Illumination at Depth,
W82-05594 1511 1A

LIGNOCELLULOSES
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 1512 2L

LIGNOSULFONIC ACIDS
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

LIMA
Computer-Based Implementation of Combined Sewer Control,
W82-04783 1511 5D

LIME
Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 1501 5D

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 1501 5E

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 1504 2H

Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 1505 5D

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 1505 5F

Liming Acid Ponds in New York,
W82-02572 1505 5G

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 1508 5D

Lime Softening Sludge Treatment and Disposal.
W82-04276 1510 5E

Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

Piloting Mag-Carbonate Treatment,
W82-05794 1511 5F

Liming Fish Ponds,
W82-05866 1511 5G

Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 1512 5D

LIMESTONE
Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

LIMESTONE AQUIFERS
Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 1510 2F

LIMITING FACTORS
Cyanobacterial Blooms: Carbon and Nitrogen Limitation have Opposite Effects on the Buoyance of Oscillatori,
W82-05175 1511 5C

LIMITING NUTRIENTS
Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 1511 5C

Bioassays and the Algal Populations of Hastings Lake, Alberta, Canada,
W82-05484 1511 2H

LIMNOLOGY
Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 1501 5B

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 1502 6G

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

On Lake Bottom Dynamics--The Energy-Topography Factor,
W82-00837 1502 2H

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalayas,
W82-01361 1503 2H

Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 1503 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 1504 5B

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 1504 5D

Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 1505 2H

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

Functional Relationships Between Nutrient Dynamics. Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 1506 2H

Hydrologic Description of Lake Hancock, Polk County, Florida,
W82-02843 1506 2H

Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 1507 2H

The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 1510 2H

Limnological Characteristics of Eutrophic Lake Istokpoga, Florida,
W82-04719 1510 2H

Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 1511 2H

Hydrologic Description of Lake Jackson, Sebring, Florida,
W82-04975 1511 7C

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 1511 2H

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 1511 5C

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

LINDANE

Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 1501 5A

Uptake and Transfer of the Chlorinated Hydrocarbon Lindane (Gamma-BHC) in a Laboratory Freshwater Food Chain,
W82-01033 1502 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 1504 5C

LINEAMENTS

Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

LINEAR PROGRAMMING

Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 1503 6A

Solid Set Irrigation System Design Using Linear Programming,
W82-02273 1505 6A

Method of Constructing a System for Controlling Regional Exploitable Groundwater Resources,
W82-02849 1506 4B

Numerical Management Models of Groundwater Pollution,
W82-04211 1509 5B

Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

LINEARITY

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 1511 4A

Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 1511 4A

LINERS

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 1511 8G

LINING

Lining of Waste Impoundment and Disposal Facilities.
W82-00099 1501 5E

LININGS

Succeeding with Liner Installation,
W82-00909 1502 8G

Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 1506 5B

Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 1506 8G

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 1507 5G

A Suitable Lining Technique for Existing Distributaries,
W82-03063 1507 8G

Absolute Roughness of Concrete-Lined Channels,
W82-03397 1507 8B

Improved Analytical Methods for the Design of Leachate Collection Systems,
W82-03936 1509 5E

Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 1510 5G

Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 1511 8F

Sewer Renewal by Pipe Insertion.
W82-06759 1512 8A

LINURON

Search for Linuron Residues in Tributaries of the Chesapeake Bay,
W82-00569 1502 5A

LIPIDS

Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 1501 5B

Particulate and Dissolved Lipids in Sea Water,
W82-02727 1506 5A

Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 1510 5C

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

LIQUEFACTION

Liquefaction Analysis for Multidirectional Shaking,
W82-01169 1503 8D

Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 1503 8D

LIQUID CHROMATOGRAPHY

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

LIQUID FILMS
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

LIQUID WASTES
State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 1501 5E

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

LITERATURE REVIEW
Ground-Water Information: NWWA Provides the Resources,
W82-00301 1501 2F

Lagoons and Oxidation Ponds,
W82-01244 1503 5D

Anaerobic Processes,
W82-01245 1503 5D

Dentrification,
W82-01246 1503 5D

Sludge Treatment, Utilization, and Disposal,
W82-01247 1503 5E

Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

O & M Wastewater Collection and Treatment Facilities,
W82-01249 1503 5D

Disinfection,
W82-01250 1503 5D

Wastewater Collection,
W82-01251 1503 5D

Water Reclamation and Reuse,
W82-01252 1503 3C

Land Application of Municipal Wastewater,
W82-01253 1503 5D

Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Eutrophication,
W82-01271 1503 2H

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 1503 5G

Ground Water,
W82-01273 1503 2F

Marine and Estuarine Pollution,
W82-01274 1503 5C

Thermal Effects,
W82-01275 1503 5C

Aquatic Sediments,
W82-01279 1503 5B

Effects of Pollution on Freshwater Invertebrates,
W82-01280 1503 5C

Freshwater Macroinvertebrates,
W82-01281 1503 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

Substrate Associated Microfauna,
W82-01283 1503 5C

Microbiology of Water,
W82-01284 1503 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 1503 5A

Microbiology of Ground Water,
W82-01286 1503 5B

Microbiology of Potable Water,
W82-01287 1503 5F

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 1503 5B

Law,
W82-01302 1503 6E

Systems Analysis,
W82-01303 1503 6A

Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 1503 5A

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 1503 6G

Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning,
W82-03942 1509 6B

Water Research in Action.
W82-05292 1511 6B

Coal and Coal Mine Drainage,
W82-06802 1512 5B

LITERATURE REVIEWS
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 1502 5G

Non-Point Sources,
W82-01270 1503 5B

Acid Precipitation, A Review,
W82-06794 1512 5C

Freshwater Macroinvertebrates,
W82-06797 1512 5C

Steel Industry Wastes,
W82-06799 1512 5D

Synthetic Fuel Effluents,
W82-06800 1512 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

Chemicals and Allied Products,
W82-06805 1512 5D

Aquatic Sediments,
W82-06806 1512 2J

Ground Water,
W82-06807 1512 5B

Marine and Estuarine Pollution,
W82-06808 1512 5C

Thermal Effects,
W82-06809 1512 5C

Bioassays - Procedures and Results,
W82-06810 1512 5A

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 1512 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 1512 5C

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

Land Application of Wastewater,
W82-06915 1512 5E

Textile Wastes,
W82-06916 1512 5D

Fermentation Industry,
W82-06917 1512 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

Microbiology: Methodology and Quality Assurance,
W82-06919 1512 5A

Radioactive Wastes,
W82-06920 1512 5E

Dairy Wastes,
W82-06921 1512 5D

Organics,
W82-06922 1512 5A

Anaerobic Processes,
W82-06923 1512 5D

Microbiology: Water,
W82-06924 1512 5B

Substrate-Associated Microfauna,
W82-06925 1512 5C

Microbiology: Wastewater Treatment,
W82-06926 1512 5D

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

Disease Outbreaks Caused by Drinking Water,
W82-06928 1512 5C

Solid Wastes and Water Quality,
W82-06929 1512 5B

Systems Analysis,
W82-06997 1512 5G

Economics,
W82-06998 1512 5G

Inorganics,
W82-06999 1512 5A

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 1512 5D

LITERATUURE REVIEWS
Electroplating and Cyanide Wastes,
W82-06798 1512 5D

LITTER
Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 1506 2H

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06895 1512 5C

LITTLE LAKE CONWAY
Metabolism of a Florida Lake Ecosystem,
W82-02268 1505 2H

LITTLE RIVER BASIN
Nutrient Cycling in an Agricultural Watershed: Waterborne Nutrient Input/Output Budgets for the Riparian Zone,
W82-03825 1509 5B

LITTLE TENNESSEE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 1501 6B

LITTLE TURTLE BASIN
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 1505 2A

LITTLE WABASH BASIN
Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

LITTORAL ENVIRONMENT
Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

LITTORAL ZONE
Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 1502 2H

The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 1512 5C

LIVER
Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 1512 5C

LIVESTOCK
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

LLYN FRONGOCH
Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 1506 2H

LOAD DISTRIBUTION
Bearing Capacity of Sand Bases (Discussion of Construction Specifications),
W82-05583 1511 8D

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

LOAD FACTORS
Load Factors and Non-Destructive Testing of Clay Pipe,
W82-05700 1511 8G

LOADING ESTIMATES
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Repon,
W82-06566 1512 5A

LOAM
Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 1503 2G

LOANS
The Financing of Private Small Scale Hydroelectric Projects.
W82-04633 1510 6B

LOBSTERS
Arseno-Sugars from Brown Kelp (Ecklonia Radiata) as Intermediates in Cycling of Arsenic in a Marine Ecosystem,
W82-03183 1507 5B

LOCAL GIVERNMENTS
A Manual for Development of Small Scale Hydroelectric Projects by Public Entities.
W82-04634 1510 6E

LOCAL GOVERNMENTS
Texas to Vote on Water Trust Fund.
W82-02302 1505 6C

River Basin Management in Ontario,
W82-05393 1511 6E

Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 1512 6E

LOCH NESS
The Mixing Layer of Loch Ness,
W82-02421 1505 2H

LOCKS
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

LOESS
Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 1501 2J

LOG PEARSON DISTRIBUTION
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 1503 2E

LOGGING
Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 1503 5C

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 1503 4C

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 1503 4C

Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 1507 5C

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 1512 5C

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 1512 5C

LOGGING (RECORDING)
Hydrogeological and Geophysical Logging.
W82-00511 1502 7B

LOIRE ESTUARY
The Distribution of Mercury, Cadmium and Lead Between Water and Suspended Matter in the Loire Estuary as a Function of the Hydrological Regime,
W82-03757 1509 2L

LONG ISLAND
Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 1508 4B

Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

LONG ISLAND SOUND
Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 1502 5B

Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 1511 2L

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 1512 2L

LONG LAKE
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 1502 2H

LONG POINT BAY
Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 1505 2H

History of Human-Use Impacts on Long Point Bay,
W82-02580 1505 5B

LONG POINT MARSH
The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 1505 6B

LONG-TERM PLANNING
WQM Five Year Strategy (FY 81-Baseline).
W82-00045 1501 5G

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 1502 6F

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

Pennsylvania Ground Water Problems and Needs,
W82-01058 1502 4B

State of Washington Water Quality Assessment Report 1980.
W82-01067 1502 6E

Long-Run Effects of Environmental Regulation,
W82-01848 1504 6A

Municipal Needs,
W82-02513 1505 6E

Efficient Groundwater Utilization,
W82-02520 1505 6D

Reliability of Water Resources,
W82-02749 1506 6A

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 1507 6D

LORRAINE
Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 1506 2F

LOS ANGELES
Computer Modeling of Los Angeles Water Resources,
W82-01168 1503 6A

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 1507 5B

Composting Results in Los Angeles,
W82-03400 1507 5E

Controlling the Cost of System Maintenance,
W82-04139 1509 8G

Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 1510 5D

LOS ANGELES COUNTY
A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

LOS ANGELES HARBOR
Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

LOTIC ENVIRONMENT
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 1502 5C

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

LOTIC PERIPHYTON
A Portable Pump Sampler for Lotic Periphyton,
W82-00826 1502 7B

LOUGH NEAGH
Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

Phosphorus Reduction Studies,
W82-05408 1511 5D

LOUISIANA
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 1502 7C

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Avoyelles Sportsmen's League V. Alexander,
W82-01456 1503 6E

Parish Is Not Liable for Subsidence.
W82-01603 1503 6E

Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 1505 2H

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 1505 7C

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

Procedure for Evaluating the Geologic Integrity of Existing Hazardous Waste Sites in Louisiana: Case Histories,
W82-03932 1509 5A

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 1510 8B

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 1510 7C

Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 1511 7C

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 1511 5C

Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 1512 2I

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 1512 7C

LOUISVILLE
Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 1510 5D

LOVE CANAL
Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

LOW CONTROL
Reservoir Operation for Water Conservation,
W82-04165 1509 3B

LOW FLOW
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 1502 5B

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 1503 2E

Statistical Determination of Design Low Flows,
W82-01858 1504 2E

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
W82-02115 1505 6G

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 1505 5C

Point Process Models of Rainfall,
W82-02452 1505 2A

Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 1506 2E

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 1506 2E

Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 1508 2E

Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 1512 2E

LUMINESCENCE
Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 1511 5A

LYCOMING COUNTY
Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

LYNCHBURG
Virginians Optimize Sludge Handling,
W82-05171 1511 5D

LYSIMETERS
Evaporation at a High Arctic Site,
W82-04899 1511 2D

MACKENZIE RIVER
The Mackenzie River Basin Study,
W82-05778 1511 4A

MACKENZIE RIVER BASIN
Water Quality Data, Mackenzie River Basin 1960-1979,
W82-02506 1505 7C

MACROINVERTEBRATEES
Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

MACROINVERTEBRATES
An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates,
W82-00308 1501 7B

Leaf Litter Processing in a Regulated Rocky Mountain Stream,
W82-00542 1502 6G

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 1502 7B

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 1503 5C

Freshwater Macroinvertebrates,
W82-01281 1503 5C

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 1504 4A

Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 1506 5C

The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 1506 5C

Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 1508 5A

Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

MACROPHYTES
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 1502 2H

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 1502 5B

Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 1504 2H

The Response of Macroinvertebrates to Aquatic Macrophyte Decomposition,
W82-02664 1506 2H

Use of Aquatic Macrophytes for Wastewater Treatment,
W82-04046 1509 5D

Lake Level Drawdown as a Macrophyte Control Technique,
W82-04235 1509 4A

Effectiveness of Dupont Typar Sheeting in Controlling Macrophyte Regrowth After Overwinter Drawdown,
W82-04246 1509 5G

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 1510 5C

The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 1511 5C

Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 1512 4A

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 1512 5C

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 1512 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 1512 5B

MACROPOROUS RESINS
Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 1510 5D

MADISON COUNTY
Development of a Rural Water District,
W82-00288 1501 6A

MADRID BASIN AQUIFER
The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

MAGNANESE
Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

MAGNESIUM
Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 1501 5E

Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 1502 2G

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 1502 5A

Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06345 1512 5A

MAGNESIUM CARBONATE
Piloting Mag-Carbonate Treatment,
W82-05794 1511 5F

MAGNESIUM HYDROXIDE
Effect of Magnesium and Calcium Precipitation on Coagulation-Flocculation with Lime,
W82-06053 1512 5D

MAGNESIUM OXIDE
Magnesium Oxide Production from Concentrated Brines,
W82-06111 1512 3A

MAGNETIC WASTEWATER TREATMENT
Prospects of Using Magnetic Wastewater Treatment,
W82-06989 1512 5D

MAGOTHY AQUIFER

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

MAIN SEWERS

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

Hydrogen Sulfide Corrosion of the Baghdad Trunk Sewerage System,
W82-06651 1512 5C

MAINE

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 1501 5C

Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 1501 2F

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine,
W82-00750 1502 6E

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 1503 5B

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 1508 2L

Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 1510 5C

A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine,
W82-05376 1511 5B

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

MAINTENANCE

Cutting the Water Losses,
W82-00310 1501 5F

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 1503 6F

Operation Reports: East Bay Municipal District (SD No 1), California.
W82-02707 1506 5D

Britain's Sewers - Researching for the Future,
W82-02871 1506 5D

Replacing Large Water Meters: Why and How,
W82-03560 1508 5F

Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

Conducting a Regular Main Flushing Program,
W82-04118 1509 5F

Keeping a Century-Old Water System Young,
W82-04138 1509 8G

Renovation of Water Mains and Sewers,
W82-04237 1509 5F

Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 1510 5D

Year-Round Distribution System Maintenance,
W82-04699 1510 5F

Sewage Pumping Station Split for Maintenance,
W82-05719 1511 5D

Resonant Waterhammer: A Case Study,
W82-05981 1512 8C

A Legacy from Construction Grants,
W82-06251 1512 5D

Sewer Maintenance and Rehab Options,
W82-06253 1512 5D

Maintenance of Analog Instrument systems,
W82-06263 1512 5D

How to Set Up a Preventive Maintenance Program,
W82-06264 1512 5D

MAINTENANCE COSTS

Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 1502 5A

MAINTENANCE, *WATER COSTS

Controlling the Cost of System Maintenance,
W82-04139 1509 8G

MALAWI

Malawi: A Community Approach.
W82-01365 1503 5F

MALAYSIA

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 1503 2H

By-Product Recovery Finances Treatment,
W82-02756 1506 5D

Palm Oil Waste Treatment Study in Malaysia,
W82-03632 1508 5D

MALI

The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

MANAGEMENT

Management Provoked Conflict in Fisheries,
W82-00780 1502 6A

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 1505 6B

Training Programmes for Better Water Management in Surface Irrigation Projects in India,
W82-03434 1508 9B

Effective Project Management,
W82-06328 1512 5D

Operating Collection Systems Under Fiscal Stress,
W82-06340 1512 5D

MANAGEMENT PLANNING

WQM Five Year Strategy (FY 81-Baseline).
W82-00045 1501 5G

Basin Management in the San Bernardino Basin Area,
W82-00280 1501 6A

Management Training is the Key to Good Operator Performance,
W82-00623 1502 5D

Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

Strategies for the Management of Estuaries,
W82-02166 1505 6F

Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 1505 6A

Reliability of Water Resources,
W82-02749 1506 6A

On Water Availability and Demand in Nigeria,
W82-03062 1507 6D

Energy Minimization at Metro Denver Sewage District,
W82-03142 1507 5D

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 1507 6A

Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 1507 6A

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 1508 5D

Multi-Attribute Decision Analysis for the Protection of Groundwater Resources,
W82-03805 1509 6A

Readying Boston's Water and Sewer System for the Next Century,
W82-03870 1509 6B

The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 1510 6B

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 1511 5C

Dual Objective Control of Nutrient Loading into a Lake,
W82-05730 1511 5G

Protecting the Source,
W82-05785 1511 5F

Billing Data Aids Utility Planning,
W82-05786 1511 6C

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 1512 2E

Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 1512 6A

A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 1512 6A

Work Management Standards,
W82-06349 1512 6F

A Model for Managing Irrigated Agriculture,
W82-06584 1512 5G

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 1512 6B

MANCHESTER
Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 1510 5G

MANGANESE
Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 1506 2K

Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 1507 2H

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

MANGANESE DIOXIDE
Manganese Dioxide as an Adsorbent for Heavy Metals,
W82-00775 1502 5F

MANGANESE OXIDES
Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

MANGANESE RADIOISOTOPES
Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens),
W82-06904 1512 5B

MANGROVE SWAMPS
Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 1505 4A

Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 1507 5C

The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 1508 5B

MANILA
Development of Water Supply to Metro-Manila,
W82-03742 1508 5F

MANITOBA
Enteric Viruses in Renovated Water in Manitoba,
W82-01090 1502 5A

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 1506 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 1511 4A

MANNINGS EQUATION
Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels'.
W82-03382 1507 2E

Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

MANTARO DAM
Mathematical Modeling of Earth Dam Breaches,
W82-03532 1508 8A

MANURE
Coastal Bermudagrass Yield and Soil Properties as Affected by Surface-Applied Dairy Manure and Its Residue,
W82-00195 1501 3C

The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 1502 5B

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes,
W82-01132 1503 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5B

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 1503 3C

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B

Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

Bacteriological Quality of Surface and Subsurface Runoff from Manured Sandy Clay Loam Soil,
W82-04880 1511 2A

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834 1512 4D

MAPPING
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

The Use of Geologic, Hydrologic, and Geochemical Mapping Techniques in Environmental Assessment,
W82-02546 1505 7C

Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 1506 2J

Floodplain Delineation: An Economic Approach,
W82-04236 1509 6F

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 1510 2B

Graphic Retrieval, Analysis and Spatial Portrayal: An Information System for Idaho's Freshwater Lakes,
W82-05914 1512 2H

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 1512 2B

MAPS
Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980,
W82-00409 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979,
W82-00410 1501 7C

Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979,
W82-00411 1501 7C

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 1502 7C

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 1502 7C

Generalized Thickness of the Floridan Aquifer, Southwest Florida Water Management District,
W82-00729 1502 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California,
W82-00734 1502 7C

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

Recording Underground,
W82-02036 1504 8A

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 1505 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

Delineation of Flood Hazards in the Jaynes Quadrangle, Pima County, Arizona,
W82-03976 1509 7C

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 1510 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 1510 7C

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 1511 7C

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 1511 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980,
W82-05826 1511 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 1511 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 1511 7C

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 1511 7C

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 1512 7C

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 1512 7C

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 1512 7C

Bathymetry and Aquatic Plants of Lake Waramaug, Connecticut,
W82-06678 1512 2H

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 1512 7C

MARGINAL COSTS
Charging Policies for Water Services,
W82-01734 1503 6C

Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 1510 6C

On the Marginal Cost of Wastewater Services,
W82-04376 1510 6C

MARINE
Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

MARINE ANIMALS
A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 1501 5A

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

MARINE BACTERIA
Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Commaunaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

MARINE BIOLOGY
Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 1506 2A

MARINE ENVIRONMENT
Marine and Estuarine Pollution,
W82-01274 1503 5C

Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 1503 7A

Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 1506 2K

Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

Marine and Estuarine Pollution,
W82-06808 1512 5C

MARINE FLORA
Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 1507 5B

MARINE FUNGI
Factors Affecting the Distribution of Lignicolous Marine Fungi in Hong Kong,
W82-06908 1512 5B

MARINE SEDIMENTS
Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sedi-

ments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 1501 2L

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 1501 5B

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 1502 5A

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 1502 5B

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 1503 5B

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

Sephadex LH-20 Chromatography of Extracts of Marine Sediment and Biological Samples for the Isolation of Polynuclear Aromatic Hydrocarbons,
W82-03370 1507 5A

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

Distribution of Methanogenic and Sulfate-Reducing Bacteria in Near-Shore Marine Sediments,
W82-04894 1511 2L

Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 1511 2K

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 1511 5C

MARION COUNTY LAKE
Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 1501 6G

MARKET VALUE
Normalized Agricultural Prices and Water Resources Planning,
W82-03928 1509 6B

MARKETING
Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

MARKOV PROCESSES
Three-State Markov Model for Differential Persistence,
W82-05654 1511 2E

MARL
Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario,
W82-04031 1509 2K

MARMOT
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

MARQUARDT ALGORITHM
Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 1506 2F

MARROW POINT DAM
Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 1511 8B

MARSEILLES
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 1511 5F

MARSH MANAGEMENT
The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 1511 2H

MARSH PLANTS
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 1512 2L

MARSHALL BROOK
Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 1501 5C

MARSHALL ISLANDS
Atoll Island Hydrology,
W82-02617 1506 2F

MARSHES
Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

The Impact of a Natural Drawdown on the Growth of Four Emergent Species in a Prairie Glacial Marsh,
W82-01096 1502 2H

A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 1503 2H

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 1503 2H

Upland Marsh for Water Quality Control,
W82-01962 1504 5B

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 1505 2H

The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

On the Algal Ecology of the Lowland Iraqi Marshes,
W82-02777 1506 6G

Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 1508 7B

Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 1510 2H

MARYLAND
Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 1501 2F

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 1502 6E

Coordinated Effort Stems Sediment and Erosion,
W82-00766 1502 4D

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 1505 2F

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

Littletown Quadrangle: Hydrogeology,
W82-04984 1511 7C

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Ground Water in the Piedmont Upland of Central Maryland,
W82-06686 1512 2F

MASS SPECTROMETRY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 1502 5A

GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 1511 5A

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 1512 5A

MASS SPECTROSCOPY
Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

MASS TRANSFER
Non-Equilibrium Water/Rock Interactions,
W82-01684 1503 1A

Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1506 1D

Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 1508 2G

Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 1511 5B

Volatilization of Ketones From Water,
W82-05782 1511 5C

Mass Transfer in the U-Turn of an Electrodialyzer,
W82-06119 1512 3A

MASS TRANSPORT
Non-Equilibrium Water/Rock Interactions,
W82-01684 1503 1A

MASSACHUSETTS
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 1501 2I

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 1503 8A

The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

Probable High Ground-Water Levels in Massachusetts,
W82-02829 1506 2F

Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 1508 6E

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

Massachusetts Water Supply Priorities,
W82-04698 1510 6D

Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 1511 5C

Hydrologic Data of the Shawsheen River Basin, Massachusetts,
W82-04970 1511 7C

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 1511 2F

Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 1512 5A

A Case for Regional Sludge Management,
W82-06993 1512 5E

MATACIL
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 1503 5A

MATAGORDA BAY
Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

MATERIALS ENGINEERING
Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 1506 8A

Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 1506 8G

Corrosion Roundtable--Opportunities/Pitfalls for New Materials,
W82-03373 1507 8G

Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

A Pipeline for all Environments,
W82-04764 1511 8G

Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 1512 3A

MATERIALS TESTINGS
Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 1506 8G

MATHEMATICAL ANALYSIS
Hydrologic Maps of Ogallala Aquifer, West-Central Kansas,
W82-02475 1505 7C

Water Supply Reliability Theory,
W82-03432 1508 6A

Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 1512 8H

MATHEMATICAL EQUATIONS
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 1501 2D

A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 1501 2G

Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 1501 2J

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5E

Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 1506 5D

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 1506 5D

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 1508 5G

Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

Numerical Solution of the Dam Failure Problem by the Random Choice Method,
W82-03872 1509 8A

Empirical Investigation of Curve Number Technique,
W82-04112 1509 2A

Young's Inequality for Three-Dimensional Flows,
W82-04267 1510 2A

Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 1510 4A

Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 1511 8B

Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 1511 8B

A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 1511 8B

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 1511 2E

Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 1511 8B

Optimization Principle for Air and Water Movement,
W82-05172 1511 2G

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 1511 5D

Estimating Water Flow Under Gates,
W82-05514 1511 8B

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 1511 2E

Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 1511 8B

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

Secchi Disc Relationships,
W82-06627 1512 2H

Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 1512 5D

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

MATHEMATICAL MODELS
Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 1501 5B

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 1501 2G

Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 1501 5B

Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 1501 5D

Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 1502 6C

Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 1502 2H

Modeling of Processes of Decomposition of Organic Matter in Bottom Sediments,
W82-00553 1502 5B

Estimation of the Salt Burden of Irrigation Drainage Waters,
W82-00563 1502 5B

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 1502 6A

A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 1502 5B

Multivariate Hydrologic Time Series Analysis,
W82-00647 1502 2A

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 1502 2I

Frontal Jump Conditions for Models of Shallow, Buoyant Surface Layer Hydrodynamics,
W82-00804 1502 8B

Predictive Depositional Model for Glacial Aquifers,
W82-00828 1502 2F

Subsurface Drainage and Sediment Transport Model,
W82-00894 1502 2G

Adaptive Hydrological Forecasting - A Review,
W82-00984 1502 2A

Overland Flow on a Diverging Surface,
W82-00986 1502 2A

Mathematical Modeling Techniques for Groundwater Management,
W82-01062 1502 4B

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 1502 8B

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 1503 6A

Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil,
W82-01224 1503 2G

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

Impact of Management Practices on the Tallgrass Prairie,
W82-01580 1503 4A

Random Differential Equations in Water Quality Modeling,
W82-01688 1503 6A

A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 1504 2A

Mixing Zone Analysis for River Plumes,
W82-01961 1504 5B

The Modeling of Aquatic Ecological Systems,
W82-01972 1504 5B

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 1504 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 1504 2E

Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 1504 2J

A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 1505 2L

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 1505 2A

Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 1505 2A

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5B

Flood Event Modeling - A Study of Two Methods,
W82-02291 1505 2A

The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 1505 6A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 1505 2A

Seepage from Free Water Above Impermeable Tailings,
W82-02714 1506 5B

Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 1506 5D

Optimal Water Reuse Planning,
W82-02736 1506 6A

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 1506 5D

Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 1506 5D

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 1506 5D

Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 1507 2A

The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 1507 5G

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

BIEM Solutions to Combinations of Leaky, Layered, Confined, Unconfined, Nonisotropic Aquifers,
W82-03079 1507 2F

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 1507 2E

Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 1507 6A

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species

Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 1507 5B

Control of the Activated Sludge Process,
W82-03499 1508 5D

Numerical Simulation of Reservoirs,
W82-03504 1508 6A

Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 1508 6D

Hydrodynamic Effects in Dynamic Response of Arch Dams,
W82-03509 1508 8A

Mathematical Modeling of Earth Dam Breaches,
W82-03532 1508 8A

A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 1508 2H

Diverging Overland Flow,
W82-03676 1508 2A

Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems,
W82-03679 1508 5D

Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 1508 2H

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 1508 2G

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 1508 2A

Multi-Constituent Simulation and Optimization Models for Water Quality Management,
W82-03815 1509 5G

A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

An Approach to Full-Automatic Control of Activated Sludge Process,
W82-03855 1509 5D

Calculation of Sludge Reservoir Volume for MLSS Control,
W82-03856 1509 5D

Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods,
W82-03873 1509 5B

Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

An Approach to the Control of the Activated Sludge System by Use of a Succession Model,
W82-04057 1509 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

Optimal Operation of a Reservoir System Using Forecasts,
W82-04209 1509 4A

Numerical Management Models of Groundwater Pollution,
W82-04211 1509 5B

Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

Delayed Drainage in a Stream-Aquifer System,
W82-04268 1510 2F

The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 1510 2F

Relative Runoff by Curve Number Nomograph,
W82-04307 1510 2A

Dimensionless Stream Advance in Sloping Borders,
W82-04308 1510 3F

Reservoir Sedimentation with Random Deposits,
W82-04443 1510 2J

Analysis of Detention Basin Systems,
W82-04444 1510 2A

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 1510 2F

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 1510 5D

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 1510 5B

Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 1510 8D

Modelling Evaporation from Reservoirs,
W82-04722 1510 2D

A Finite-Difference Method to Evaluate Water Hammer Phenomena,
W82-04799 1511 8B

Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm,
W82-04864 1511 2B

Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 1511 6A

Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 1511 6A

The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 1511 2E

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 1511 5B

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 1511 3C

Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 1512 5G

The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 1512 2C

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 1512 6A

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 1512 2F

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 1512 2G

Robust Flood Frequency Models,
W82-06319 1512 2E

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 1512 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 1512 2E

Mathematical Model for Erodible Channels,
W82-06336 1512 2J

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 1512 2G

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

MATHEMATICAL MODELS

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 1512 2G

Stochastic Generation of Monthly Streamflows,
W82-06427 1512 4A

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 1512 5G

A Model for Managing Irrigated Agriculture,
W82-06584 1512 5G

Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 1512 2A

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 1512 5G

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 1512 3D

MATHEMATICAL STUDIES

Optimization of Pump Turbines,
W82-00181 1501 8C

Probability-Theoretical Analysis of Fluctuations in the Level of a Closed Water Body,
W82-00571 1502 2H

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 1502 2F

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 1503 2J

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 1503 2B

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 1503 3F

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

Kinetics for the Aquatic Environment,
W82-01631 1503 2K

Note on Two Limit Distributions of Bedload Movement,
W82-01643 1503 2J

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 1503 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 1503 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 1503 2E

Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 1505 2A

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

Subdomain Integration Model of Ground-Water Flow,
W82-02550 1505 2F

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 1506 2E

Unsteady Water Quality Model for River Network,
W82-02873 1506 5G

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 1506 2K

Regionalization and Prediction of Annual Floods in the Fraser River Catchment, British Columbia,
W82-02910 1506 2E

Numerical Stability and Accuracy of Implicit Integration of Free Surface Groundwater Equations,
W82-03060 1507 2F

Translatory Characteristics of the Muskingum Method of Flood Routing--Reply,
W82-03204 1507 4A

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 1507 2F

Numerical Simulation of Reservoirs,
W82-03504 1508 6A

Hydraulic Exponents,
W82-03669 1508 2E

Uniform Flow Calculations for Pipes,
W82-03748 1508 8B

Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

Specific Oxygen Demand as an Operating Parameter for Activated Sludge Processes,
W82-04029 1509 5D

Dimensionless Stream Advance in Sloping Borders,
W82-04308 1510 3F

The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 1510 5D

Application of the Area of Review Concept,
W82-04674 1510 6E

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

Bed Load Fluctuation: Applications,
W82-05000 1511 2J

Erosion by Submerged Circular Jets,
W82-05002 1511 2J

Nature of Wave Attenuation in Open Channel Flow,
W82-05003 1511 2E

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

Estimating Resilience by Canonical Analysis,
W82-05047 1511 6A

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 1511 2H

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

The Role of Unconditioned and Conditional Cumulative Distribution Functions in Reservoir Reliability Programming,
W82-05523 1511 6A

New Evapotranspiration Crop Coefficients,
W82-05692 1511 3F

Optimum Depth and Spacing of Subsurface Drains,
W82-05693 1511 8B

Erosivity Values for Individual Design Storms,
W82-05694 1511 4D

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

How Equitable Are Effluent Charges,
W82-06074 1512 6C

Canals in Sand Channels,
W82-06196 1512 8B

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5D

Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 1512 3G

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

Hydrothermal Analysis of Lakes and Reservoirs,
W82-06425 1512 2H

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 1512 4A

TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 1512 4A

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 1512 8B

Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 1512 2E

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06458 1512 2F

MATRIC POTENTIAL
Estimating Soil Water Retention from Soil Properties,
W82-06332 1512 2G

MAUMEE RIVER
Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

MAUMEE RIVER BASIN
Floods of March 1978 in the Maumee River Basin, Northeastern Indiana,
W82-02485 1505 2E

MAYURAKSHI IRRIGATION PROJECT
Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows,
W82-03914 1509 3F

MCNAUGHTON LAKE AREA
Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

MEADOWS
Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

MEAN DAILY FLOWS
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

MEANDERS
Bend Theory of River Meanders. Part 1. Linear Development,
W82-05085 1511 2E

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 1511 2E

MEASUREMENT TECHNIQUES
Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 1501 5A

Microplate Technique for Determining Accumulation of Metals by Algae,
W82-00492 1501 5A

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 1502 5A

Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 1507 2G

Measurement of Sorptivity and Soil Water Diffusivity in the Field,
W82-03764 1509 2G

Discussion of 'Visualization of Separation over Sand Waves',
W82-03783 1509 8B

Refinement of Lake Evaporation Measurements, Using an Ion-Balance Technique,
W82-03808 1509 2D

A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 1511 5A

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 1512 2K

MEASURING INSRUMENTS
Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Losemittel in Luft und Wasser),
W82-04579 1510 5A

MEASURING INSTRUMENTS
A Proposed Technique to Measure Evapotranspiration Using Micrometeorological Methods,
W82-00183 1501 2D

A More Versatile Soil Water Sampler,
W82-00191 1501 7B

BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 1501 7B

Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 1501 5A

Hydrogeological and Geophysical Logging,
W82-00511 1502 7B

Measurement of PH in the Estuarine Environment on the NBS Scale. (LA Mesure Du PH En Milieu Estuarien Sur L'Echelle NBS),
W82-00521 1502 7B

Identification of Organic Compounds,
W82-00635 1502 5A

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 1502 7B

Electronic Measurement and Recording of Evaporation Loss,
W82-01602 1503 7B

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 1505 2H

Leak Detection - Two Methods That Work,
W82-02521 1505 3D

Rainwater Acidity Measurement Problems,
W82-02627 1506 5A

Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 1506 5A

Instrumentation for Aerated Flow on Spillways,
W82-02880 1506 7B

Large Rain Drops in the Bright Band,
W82-03065 1507 7B

A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 1508 7B

An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 1508 7B

Particle Counter for Sediment Transport Studies,
W82-03666 1508 7B

A Study of Intergranular and Fissure Permeability in Chalk and Permian Aquifers, Using Double-Packer Injection Testing,
W82-03804 1509 2F

Improved Operation of Municipal Wastewater Treatment Plants in Sweden by Use of Instrumentation and Automation,
W82-03846 1509 5D

Monitoring of Turbidity and Suspended Solids Concentration in Wastewater Treatment Plants,
W82-04054 1509 5D

Problems and Solutions on Sludge Level Measurement,
W82-04055 1509 5D

ISFETs-New Tools for Water Quality Monitoring,
W82-04059 1509 5A

Theoretical Considerations for Control and Monitoring of Wastewater Treatment Systems,
W82-04060 1509 5D

Measuring the Velocity of Water in a Paddled Flocculator,
W82-04102 1509 5F

Attenuation of Incident Solar Radiation in Lake Water,
W82-04180 1509 2H

Sizing and Selecting Modern Water Meters,
W82-04194 1509 6D

Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 1510 7B

Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 1510 7B

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 1511 2B

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

Continuous Measurements of Dissolved Oxygen in Water Culture by a Self-Calibrating Monitor,
W82-05015 1511 7B

A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 1511 7B

Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 1511 7B

A Field Technique to Directly Measure River Bank Erosion,
W82-05410 1511 7B

MEASURING INSTRUMENTS

Recording Raingage Modifications,
W82-05665 1511 7B

How Proper Prospecting Improves the Odds,
W82-05757 1511 3B

On the Sampling Variance of Raingage Networks,
W82-05875 1511 7B

Liquid Level Interferometer,
W82-05929 1512 7B

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 1512 8D

Maintenance of Analog Instrument systems,
W82-06263 1512 5D

Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 1512 6C

The Outlook for Precipitation Measurements from Space,
W82-06531 1512 7B

Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 1512 5A

An Automated Recording System for Evaporation Pans,
W82-06780 1512 2D

MEAT PROCESSING INDUSTRY

Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 1501 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 1503 5D

Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 1510 5D

Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 1512 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 1512 5D

MECHANICAL EQUIPMENT

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

MECHANICAL FAILURE

Bank Failure and Erosion on the Ohio River,
W82-04473 1510 2J

MECHNICAL ENGINEERING

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 1511 3A

MEDFIELD

Vacuum Filtration of Septage,
W82-04710 1510 5D

MEDITERRANEAN

Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 1501 2I

MEDITERRANEAN SEA

Relationship Between Populations of Amphipods and Pollution,
W82-02444 1505 5C

The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 1508 5D

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

The Mediterranean Action Plan: Design and Implementation,
W82-06154 1512 5B

MEDUXNEKEAG RIVER

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 1512 5C

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 1512 5A

MEEWASIN VALLEY AUTHORITY

A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

MELT WATER

Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

MELTING

On the Estimation of Antarctic Iceberg Melt Rate,
W82-00166 1501 2C

Ice Blocks Melting Into a Salinity Gradient,
W82-01530 1503 2C

MEMBRANE FILTERS

Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 1501 5A

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

Membrane Filter Method for Enumerating Escherichia Coli,
W82-00487 1501 5A

Impact of Verification Media and Resuscitation on Accuracy of the Membrane Filter Total Coliform Enumeration Technique,
W82-00494 1501 5A

Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 1502 5D

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 1503 5A

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 1503 5D

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 1504 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 1504 5D

Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 1505 5A

Artificial Particulate Fouling of Hyperfiltration Membranes IV. Dynamic Protection from Fouling,
W82-03288 1507 3A

Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 1512 5F

MEMBRANE PROCESSES

Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 1506 3A

Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

Membrane Filter Method for Enumeration of Acinetobacter Calcoaceticus from Environmental Waters,
W82-04453 1510 5A

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 1511 5D

Water and Salt Transport in Membranes,
W82-05537 1511 3A

Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 1511 3A

Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 1512 5F

Studies on Synetheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 1512 3A

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 1512 3A

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

Membrane Separation Processes,
W82-06445 1512 5D

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 1512 5D

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 1512 5A

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

MEMBRANES
Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 1505 5D

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 1506 5D

Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 1506 8G

Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 1508 3A

Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 1511 3A

Water and Salt Transport in Membranes,
W82-05537 1511 3A

Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 1511 3A

Studies on Synetheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 1512 3A

Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 1512 5D

The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 1512 3A

Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 1512 3A

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 1512 5D

MENARD CREEK
Water Quality of a Southeast Texas Stream,
W82-02570 1505 2K

MENOMINEE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 1504 6D

MERAMEC PARK LAKE
Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

MERCURIC CHLORIDE
Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

MERCURY
Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 1503 5B

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 1503 5B

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 1503 5A

Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 1503 5D

Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

The Mercury Cycle,
W82-01869 1504 5B

Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 1505 5A

Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry,
W82-03268 1507 5A

Methylmercury Contamination of an Experimental Trophic Chain: Importance of the Primary Producer-Consumer System. (Contamination D'une Chaine Trophique Experimentale par le Methylmercure: Importance du Systeme 'Producteur-Consommateur Primaire'),
W82-03303 1507 5C

Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 1507 5B

Comparative Study of the Trophic Transfer of Two Mercury Compounds--HOCL2 and CH3HGCL--Between Chlorella Vulgaris and Daphnia Magna. Influence of Temperature,
W82-03602 1508 5B

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 1508 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 1508 5B

Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 1512 5B

Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 1512 5B

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

Removal of Inorganic Mercury from Water by Bitmuminous Coal,
W82-06265 1512 5D

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

MEROMICTIC LAKES
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 1504 2H

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

Meromixis in a Coastal Zone Excavation,
W82-02120 1505 2H

Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 1508 2H

MERRIMACK RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 1507 6D

MERSEY ESTUARY
The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 1507 2L

MESOCYCLOPS EDAX
Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

MESOTROPHIC LAKES
The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979,
W82-01070 1502 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 1503 4A

METABOLISM
Comparison of Two Direct-Count Methods for Determining Metabolizing Bacteria in Freshwater,
W82-00495 1501 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 1502 2H

Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 1506 2A

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 1511 2H

Metabolic Response of Fish to Stress,
W82-05159 1511 5C

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

METAL *ANALYTICAL TECHNIQUES
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1503 1A

METAL COMPLEXES
Metal Ion Complex Formation Constants of Some Sedimentary Humic Acids with Zn(II), Cu(II) and Cd(II),
W82-05136 1511 2K

METAL-FINISHING WASTES
The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 1502 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

Steel Industry Wastes,
W82-01264 1503 5D

Electroplating and Cyanide Wastes,
W82-01266 1503 5D

Managing Water at Helicopter Plant,
W82-01974 1504 5D

A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 1504 5D

Group Treatment Evaluation for Metal Finishers,
W82-02995 1506 5D

Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 1506 5D

Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 1507 5D

Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 1507 5D

Electroplating Wastes: History and Current Status,
W82-03588 1508 5D

A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 1510 5D

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 1510 5D

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 1512 5D

Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

Electroplating and Cyanide Wastes,
W82-06798 1512 5D

Steel Industry Wastes,
W82-06799 1512 5D

METAL IONS
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

METALS
Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 1501 5A

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5B

Metal Speciation. Effects on Aquatic Toxicity,
W82-00610 1502 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 1502 5A

Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 1502 5B

Metal Leaching from Sewage Sludge Ash,
W82-00770 1502 5B

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 1502 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 1503 5C

The Effect of Flyash Disposal on a Shallow Ground-Water System,
W82-01220 1503 5B

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 1504 5A

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 1504 5D

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 1504 5A

Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 1505 5G

The Status of Nuclear Waste Management,
W82-02659 1506 5E

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 1506 5B

Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 1507 5A

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 1508 5D

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 1508 5B

Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 1510 5F

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

Procedure for Investigating Metallic Ion Complexing in Natural Waters,
W82-05595 1511 5A

Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 1511 5B

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

A Sampling Study of the Brown Seaweed, Ascophyllum Nodosum as a Marine Monitor for Trace Metals,
W82-06050 1512 5B

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 1512 5A

Metal Removal 'A La Carte',
W82-06608 1512 5F

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments,
W82-06630 1512 2K

Aquatic Sediments,
W82-06806 1512 2J

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments, and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 1512 5G

METAMORPHIC ROCKS
Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

METEOROLOGICAL DATA
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 1503 2C

METEOROLOGICAL DATA COLLECTION
Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

METEOROLOGY
Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

METHANE
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 1501 5D

Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 1501 2H

Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 1501 2H

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 1501 2K

Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 1502 2H

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 1504 2H

Carbon Isotope Fractionation During Microbial Methane Oxidation,
W82-03188 1507 5A

Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 1507 2K

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 1508 5D

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Methane in Groundwater and Its Effect on 14 C Groundwater Dating,
W82-03801 1509 7B

Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 1510 5E

Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

The Occurrence and Origin of Methane in Some Groundwater Flow Systems,
W82-04925 1511 2K

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 1511 2L

Methane in Water Wells,
W82-05262 1511 5F

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 1512 2H

Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

METHANE BACTERIA
Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 1501 2L

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 1504 5C

Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 1512 5D

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

METHANOGENESIS
Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 1512 2H

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

METHANOL
A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

METHEMOGLOBINEMIA
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 1503 5C

METHOMYL
Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 1512 5A

METHOXYCHLOR
Methoxychlor Residues in Treated Irrigation Canal Water in Southcentral Idaho,
W82-05726 1511 5B

METHYL BROMIDE
Methyl Bromide and Bromide-Ion in Drainage Water After Leaching of Glasshouse Soils,
W82-01492 1503 5B

METHYL CHLOROFORM
Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

METHYL EUGENOL
Environmental Fate of Methyl Eugenol,
W82-02013 1504 5B

METHYLATION
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

METHYLENE BLUE
Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

METHYLMERCURY
Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 1502 5A

Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

METROPOLITAN WATER MANAGEMENT
Distribution System Liability,
W82-01028 1502 5F

Development of Water Supply to Metro-Manila.
W82-03742 1508 5F

Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

Can Prices Tame the Inflationary Tiger,
W82-04142 1509 6D

Domestic Water Conservation Research Plan,
W82-05547 1511 6B

Water Management in the Metropolitan Toronto Region,
W82-05775 1511 6B

METROSTAT
Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

MEXICO
Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 1503 6A

Input and Output Constraints Affecting Irrigation Development,
W82-01476 1503 6B

A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 1503 6A

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

Wheat Response to Drought,
W82-02242 1505 2I

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 1505 5B

A Perspective Study of Droughts in Mexico,
W82-03358 1507 2E

The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 1510 2L

Restructuration of the Water Tariff System for Irrigation Districts in Mexico.
W82-04962 1511 6C

MEXICO (YUCATAN PENINSULA)
Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 1511 4B

MIAMI
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

MICHIGAN
Ground-Water Data for Michigan, 1979,
W82-00014 1501 2F

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 1501 2H

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 1501 2I

A Case Study Analysis of the Legal and Institutional Obstacles and Incentives to the Development of the Hydrolelectric Power of the Boardman River at Traverse City, Michigan.
W82-00747 1502 6E

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

Ferric Chloride Takes Over,
W82-00954 1502 5F

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 1503 5D

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 1505 5B

Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 1506 5G

Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 1506 6B

Arsenic in Lake Lansing, Michigan,
W82-03522 1508 5B

Down to Earth Leak Detection,
W82-03561 1508 5F

Wastewater Treatment Plant Features New Technology,
W82-03591 1508 5D

Flow Model of Saginaw River Near Saginaw, Michigan,
W82-03996 1509 2E

A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

Storm-Sewer Input of Heavy Metals Into an Urban Lake Environment,
W82-04207 1509 5A

A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 1511 5A

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 1511 5B

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5D

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 1511 5D

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 1511 6B

Intermediary Metabolism of Organic Matter in the Sediments of a Eutrophic Lake,
W82-06745 1512 5C

Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 1512 5C

MICROBIAL DEGRADATION

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 1501 2G

Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 1502 2K

Phenanthrene Biodegradation in Freshwater Environments,
W82-01234 1503 5B

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 1503 5G

Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 1504 5B

Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 1505 5B

Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

Observation on the Occurrence of Microbial Agents Which Cause Lysis of Blue-Green Algae in Lake Kasumigaura,
W82-03177 1507 2H

Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 1508 5B

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 1511 5B

Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 1512 5F

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 1512 5B

MICROBIAL STUDIES

Factor Analysis of the Impact of the Environment on Microbial Communities in the Tvarminne Area, Southern Coast of Finland,
W82-00672 1502 5C

Effects of Environmental Factors on Microbial Populations in Brackish Waters off the Southern Coast of Finland,
W82-00683 1502 2L

MICROBIAL TREATMENT

Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 1511 5G

MICROBIOLOGICAL STUDIES

Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 1502 2H

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay, Canada. I: Bacteriological Aspects,
W82-00921 1502 2L

Microbiological Studies of a 'Virgin' Salt-Fresh Water Transect at North Point, James Bay II. Mycological Aspects,
W82-00922 1502 2L

Effect of Kepone on Estuarine Microbial Activity,
W82-01231 1503 5C

Microbiology of Water,
W82-01284 1503 5B

Microbiology: Methodology and Quality Assurance,
W82-01285 1503 5A

Microbiology of Ground Water,
W82-01286 1503 5B

Microbiology of Potable Water,
W82-01287 1503 5F

Microbiology of Wastewater Treatment,
W82-01291 1503 5D

Microbiology of the Aquatic Environment,
W82-01786 1503 5C

A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 1507 5C

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. II. Field Applications,
W82-03191 1507 5A

RNA Synthesis as a Measure of Microbial Growth in Aquatic Environments. I. Evaluation, Verification and Optimization of Methods,
W82-03192 1507 5A

Improved Microbe Detection in Water Samples.
W82-03258 1507 5A

Microbiological Quality of Selected Recreational Waters,
W82-03636 1508 5A

The Use of Respirography in Biological Treatment Plant Control,
W82-04011 1509 5D

Health Aspects of Waters at Public Health Resorts,
W82-04348 1510 5A

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 1510 5C

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

Factors Affecting Floc Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 1512 5D

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

Microbial Dynamics of an Epilithic Mat Community in a High Alpine Stream,
W82-06729 1512 2E

Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 1512 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 1512 5A

Microbiology: Water,
W82-06924 1512 5B

Microbiology: Wastewater Treatment,
W82-06926 1512 5D

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

MICROCOSMS

Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

MICROENVIRONMENT

Substrate-Associated Microfauna,
W82-06925 1512 5C

MICROGAS DISPERSIONS

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 1512 5D

MICROINVERTEBRATES

A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 1512 2K

MICROORGANISMS

Substrate Associated Microfauna,
W82-01283 1503 5C

Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 1504 2H

Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

MICROORGANISMS

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic.
W82-02649 1506 2C

The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage.
W82-02960 1506 5D

Improved Microbe Detection in Water Samples.
W82-03258 1507 5A

Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 1507 5B

Microorganism Inventory in Activated Sludge Control,
W82-03483 1508 5D

Control of the Activated Sludge Process,
W82-03499 1508 5D

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 1508 2H

The Growing Business of Bacterial Cultures,
W82-03786 1509 5D

Specific Oxygen Demand as an Operating Parameter for Activated Sludge Processes,
W82-04029 1509 5D

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 1511 5G

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 1512 2L

Ultraviolet Systems in Water Treatment,
W82-06726 1512 5F

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 1512 5A

MICROORGANSIMS

Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 1510 5D

MICROPROCESSORS

Microprocessors and Computers in Analysis in the Water Industry,
W82-06259 1512 5F

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 1512 5D

MICROPTERUS DOLOMIEUI

Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

MICROSCOPIC ANALYSIS

Interim Method for Determining Asbestos in Water,
W82-00741 1502 5A

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

MICROSCOPY

Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 1512 5A

MICROWAVES

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 1503 7B

Microwave Measurements of Snowpack Properties,
W82-02646 1506 2C

Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

MID-ATLANTIC STATES

Summary of the Mid-Atlantic Conference on Small-Scale Hydro-Power in the Mid-Atlantic States: Resolution of the Barriers Impeding Its Development.
W82-00743 1502 6E

MIDDLE LOUP RIVER

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 1510 2J

MIDGES

Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 1502 2H

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 1502 2H

Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 1503 2H

Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 1506 2H

A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 1506 5C

The Clear Lake Example: An Ecological Approach to Pest Management,
W82-02660 1506 5F

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

Observations on the Immature Chironomids of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

MIDMAR DAM

The Study of Phosphorus and Nitrogen Flows in Enriched Isolation Columns,
W82-02563 1505 5C

MIDWESTERN STATES

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 1502 6E

MIGRATION

Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 1501 2H

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5E

Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

MILFORD HAVEN ESTUARY

Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 1505 5C

MILLIGAN CANYON

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

MILWAUKEE

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

MINE DRAINAGE

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 1502 5B

Mining Pollution and the Diet of the Purple-Striped Gudgeon Mogurnda Mogurnda Richardson (Eleotridae) in the Finniss River, Northern Territory, Australia,
W82-01366 1503 5C

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 1504 5C

Character of Brines from the Belle Isle and Weeks Island Salt Mines, Louisiana, U.S.A.,
W82-03584 1508 2F

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

What Is a Point Source,
W82-04158 1509 6E

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 1510 5D

A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 1510 5A

Acid Pond Drainage,
W82-05199 1511 5G

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 1512 5G

Coal and Coal Mine Drainage,
W82-06802 1512 5B

MINE WASTES
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

Distribution and Transport of Heavy Metals in the Sediments of a Small Northern Eutrophic Lake,
W82-00235 1501 5B

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

Coal and Coal Mine Drainage,
W82-01261 1503 5G

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 1503 5D

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 1504 5D

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 1506 5D

Seepage from Free Water Above Impermeable Tailings,
W82-02714 1506 5B

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 1506 5C

Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

Impact of Mining Activities on Water Quality in Western North Carolina,
W82-03926 1509 5B

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 1511 5B

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

Mercury Contamination of the Lerderderg River, Victoria, Australia, from an Abandoned Gold Field,
W82-06194 1512 5B

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

Coal and Coal Mine Drainage,
W82-06802 1512 5B

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 1512 5D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts). 1. Laboratory and Field Tests,
W82-06960 1512 5D

MINERAL INDUSTRY
Dewatering Florida Phosphatic Clay Wastes With Moving Screens,
W82-00049 1501 5D

The Nonfuel Minerals Industry: Regulatory Impacts,
W82-00612 1502 5B

A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 1503 6E

Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 1504 5C

Impact of Mining Activities on Water Quality in Western North Carolina,
W82-03926 1509 5B

MINERAL SPRINGS
Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 1510 2K

MINERAL WATER
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

MINERAL WATER REACTIONS
Non-Equilibrium Water/Rock Interactions,
W82-01684 1503 1A

MINERALIZATION
Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 1501 2H

Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

The Effect of Particle Substrate on Mineralization Performance and the Formation of Excess Sludge in a Complete Mixing Aeration Tank,
W82-04012 1509 5D

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 1512 5B

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 1512 5B

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 1512 5C

MINERALOGY
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

MINERALS
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 1504 5A

Some Analyses of Aquatic Plants and Their Waters,
W82-02293 1505 2H

Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1511 1B

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 1511 3B

Mineral Law Since Nepa,
W82-06582 1512 6E

MINIMUM FLOW
Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 1508 5G

MINING ENGINEERING
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

Reliability of Underground Flood Control System,
W82-00556 1502 8A

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 1502 6A

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 1507 5B

MINING WASTES
Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 1508 5A

MINNEAPOLIS
Coagulation: Experiences in Organics Removal,
W82-04424 1510 5F

MINNESOTA
Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 1501 5B

Empire Controlled by Computer,
W82-00529 1502 5D

Chemistry of Lake Water and Groundwater in Areas of Contrasting Glacial Drifts in Eastern Minnesota,
W82-00821 1502 2K

The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 1505 7C

Ground-Water Appraisal of Sand Plains in Benton, Sherburne, Stearns, and Wright Counties, Central Minnesota,
W82-02838 1506 2F

Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

Waste Treatment System Retrofitted Within Deadline,
W82-05947 1512 5D

Supplying Water to the Rural Community,
W82-06223 1512 5F

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

Survival of Escherichia Coli in Lake Bottom Sediment,
W82-06741 1512 5B

MIREX

Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 1504 5B

MIRROW LAKE

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

MISSISSIPPI

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 1501 5B

Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 1501 5D

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 1505 6G

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 1505 2A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 1506 7C

Water Resources Investigations in Mississippi 1980-81.
W82-03988 1509 7C

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 1511 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 1511 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 1511 5B

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 1512 7C

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 1512 7C

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 1512 7C

MISSISSIPPI DELTA

Sediment Yield from a Flatland Watershed,
W82-00941 1502 2J

MISSISSIPPI LAKE

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

MISSISSIPPI RIVER

Sediment Yield from a Flatland Watershed,
W82-00941 1502 2J

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 1503 5F

Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

Will New Orleans Miss The Mississippi,
W82-04274 1510 4A

Coagulation: Experiences in Organics Removal,
W82-04424 1510 5F

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 1510 7B

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

MISSISSIPPI RIVER DELTA

The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 1511 2J

MISSOURI

Gully Development in the Deep Loess Hills Region of Central Missouri,
W82-00472 1501 2J

Floods in Kansas City, Missouri and Kansas, September 12-13,
W82-00724 1502 2E

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 1505 7C

Acid Pond Drainage,
W82-05199 1511 5G

Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 1511 3D

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

Geochemistry of Leachates from Selected Coal Mining and Combustion Wastes,
W82-05936 1512 5B

Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

Simplified Clarifier Axes Treatment Stages,
W82-06820 1512 5D

MISSOURI RIVER

River Bed Aggradation Due to Overloading,
W82-01486 1503 2J

Cooling Potential of Missouri River in Missouri,
W82-01654 1503 5B

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium, W82-06696 1512 6B

MISSOURI RIVER BASIN
Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin. W82-00078 1501 7C
Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin. W82-02846 1506 7C
Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study, W82-03549 1508 2A

MITA HILLS DAM
Settlement of a Compacted Unsaturated Earth Embankment, W82-00678 1502 8D

MITES
Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms, W82-02963 1506 5C

MIXED LIQUOR SOLIDS
Experiences of MLSS Control of the Activated Sludge Process, W82-03849 1509 5D
A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management, W82-03853 1509 5D
A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process, W82-03854 1509 5D
Calculation of Sludge Reservoir Volume for MLSS Control, W82-03856 1509 5D
Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process, W82-04829 1511 5C

MIXING
Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems, W82-01166 1503 5F
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O, W82-01799 1503 5F
The Dynamics of Conservative Mixing in Estuaries, W82-02345 1505 2L
Wind-Induced Mixing in Stratified Fluid, W82-02371 1505 2H
The Mixing Layer of Loch Ness, W82-02421 1505 2H
Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers, W82-02576 1505 2L
Multiport Diffuser Mixing Zones in Rivers, W82-02594 1505 5B
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary, W82-02657 1506 2L
Wind Aeration in Model Waste Treatment System, W82-02944 1506 5D
The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma, W82-03510 1508 5G
Stratification and Mixing in Shallow Tropical African Lakes, W82-03514 1508 2H
Vertical Round Buoyant Jet in Shallow Water, W82-04365 1510 7C
Winter Temperature Structure in Lake Huron, W82-04381 1510 2H
Jet Injections for Optimum Mixing in Pipe Flow, W82-04558 1510 8A
Nearfield Performance of River Diffusers, W82-04561 1510 5B
Salinity Intrusion in Estuaries, W82-04574 1510 2L
Dispersion Coefficients in Estuaries, W82-04684 1510 5B
Circular Wall Jets in Coflowing Streams, W82-04999 1511 5B
Mechanisms and Methods for Polymer Conditioning of Activated Sludge, W82-05445 1511 5D
Destratification of Lakes and Reservoirs to Improve Water Quality, W82-06385 1512 5G
Experiments on Coaxial Heated Water Discharges, W82-06422 1512 5B
Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence, W82-06533 1512 2L

MIXING *WATER EXCHANGE
Deep Water Renewal in Subarctic Fjord, W82-03675 1508 2L

MIXOLIMNION
Meromixis in a Coastal Zone Excavation, W82-02120 1505 2H

MMBRANE PROCESSES
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona, W82-04983 1511 3A

MOBILE
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line, W82-01007 1502 5D

MODEL STUDIES
Conceptual Design of a Regional Water Quality Screening Model, W82-00038 1501 6A
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin, W82-00046 1501 8A
Water Supply and Demand in an Energy Supply Model, W82-00050 1501 6D
Ground-Water Modeling: Recent Developments, W82-00281 1501 2F
Ground-Water Resources of the White River Basin, Madison County, Indiana, W82-00412 1501 2A
Digital Model of the Unconsolidated Aquifer System in the Modesto Area, Stanislaus and San Joaquin Counties, California, W82-00415 1501 4B
Water Treatment Model for Pollutant Exposure Assessment, W82-00500 1501 5F
A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information, W82-00546 1502 5G
Circulation and Energetics of a Deep, Strongly Stratified Inlet, W82-00547 1502 2L
Towards a Predictive Model for the Economic Regulation of Commercial Fisheries, W82-00549 1502 6A
Identification of Streamflow Stochastic Models, W82-00555 1502 2A
Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management, W82-00594 1502 5G
A Leaky Reservoir Model for Ephemeral Flow Recession, W82-00600 1502 2E
A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media, W82-00697 1502 2F
A Comparison of Rainfall-Runoff Models, W82-00911 1502 2A
Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model, W82-00926 1502 2A
Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada, W82-00927 1502 2A
Phosphate Models, a Gap to Bridge, W82-00929 1502 2H
The Uncertainty of Crop Models in Irrigation Optimization, W82-00940 1502 3F
Modeling Water Flux on Strip-Mined Land, W82-00944 1502 2G
Effectiveness of River Models, W82-00961 1502 6A
A Simulation Model for Sludge Decomposition in Soil, W82-01001 1502 5E
Dissolution of Salt Deposits by Brine Density Flow, W82-01016 1502 2F
Simulation Modeling of Primary Clarifiers, W82-01027 1502 6A
Groundwater Quality Models - State of the Art, W82-01061 1502 5G
Mathematical Modeling Techniques for Groundwater Management, W82-01062 1502 4B
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River, W82-01064 1502 5D
An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries, W82-01173 1503 6G

Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 1503 5G

A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Cypsiferous Soils,
W82-01230 1503 5B

A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 1503 6A

Identification of the Wairakei Geothermal System,
W82-01312 1503 2F

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 1503 2F

A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 1503 2F

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 1503 6A

Computer Modeling and Ground-Water Protection,
W82-01336 1503 2F

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 1503 5B

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Concentrated Flow Relationships,
W82-01409 1503 2J

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 1503 5B

Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 1503 8A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 1503 6A

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 1503 6A

A One-Dimensional, Finite Element Salt Water Intrusion Model,
W82-01452 1503 7A

Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 1503 8A

On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

River Basin Hydrosalinity Modeling,
W82-01469 1503 2K

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 1503 2H

Water Management Model Evaluation for North Central Ohio,
W82-01536 1503 4A

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 1503 2C

Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 1503 2G

Can We Model the Rainfall-Runoff Process Today,
W82-01609 1503 2A

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

Kinetics for the Aquatic Environment,
W82-01631 1503 2K

Note on Two Limit Distributions of Bedload Movement,
W82-01643 1503 2J

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 1503 2A

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 1503 2G

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 1503 3F

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 1503 2E

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques.
W82-01676 1503 5B

Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 1503 6A

Random Differential Equations in Water Quality Modeling,
W82-01688 1503 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 1503 6A

Pollution Permits and Markets for Water Quality,
W82-01699 1503 6A

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 1504 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 1504 5A

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 1504 2L

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 1504 2C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 1504 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 1504 2F

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 1505 6G

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 1505 2J

Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 1505 5D

A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 1505 2E

Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 1505 6A

Point Process Models of Rainfall,
W82-02452 1505 2A

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 1505 5G

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 1505 2F

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

Selecting Seasonal Streamflow Models,
W82-02502 1505 2E

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 1505 5B

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 1505 2F

Influence of Dissolved Oxygen on Activated Sludge Viability,
W82-02582 1505 5D

Developing Dam-Break Flood Zone Ordinance,
W82-02585 1505 6F

Modeling Circulation in Depth-Averaged Flow,
W82-02679 1506 2E

Modeling Cavitation for Closed Conduit Flow,
W82-02700 1506 8B

Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 1506 5D

The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 1506 6A

An Economic Analysis of Ground Water Management Alternatives,
W82-02740 1506 4B

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 1506 4A

Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 1506 6A

Development of the River Seine Estuary: Case Study,
W82-02867 1506 2L

Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 1506 8A

Unsteady Water Quality Model for River Network,
W82-02873 1506 5G

The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 1506 5A

The Irrigation Scheduling Problem and Evapotranspiration Uncertainty,
W82-02900 1506 2D

Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 1507 5C

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

Alternative Costs and Total Economic Benefits: An Input-Output Study of the Aswan Dam (Egypt),
W82-03009 1507 6B

Experimental Studies of the Effects of Ephemeral Streamflow Depths on Infiltration,
W82-03013 1507 2A

Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 1507 2G

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 1507 2H

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 1507 6D

The Madrid Basin Aquifer: Preliminary Isotopic Reconnaissance,
W82-03059 1507 2F

Models of Water Transport in the Soil-Plant System: A Review,
W82-03066 1507 2I

Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 1507 6B

Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 1507 2A

A Model of Discontinuous Measurement Error and Its Effects on the Probability Distribution of Flood Discharge Measurements,
W82-03076 1507 2E

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 1507 2F

Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 1507 6A

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

On the Computation of Darcian Velocity and Mass Balance in the Finite Element Modeling of Groundwater Flow,
W82-03083 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 1507 2F

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis,
W82-03113 1507 5C

Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 1507 5D

A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 1507 5C

Theory of the Dielectric Constant of Ice,
W82-03176 1507 2C

An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1507 1B

Some Basic Experiments with a Vertically-Integrated Ice Sheet Model,
W82-03209 1507 2C

The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development,
W82-03237 1507 4A

Sizing of Urban Flood Control Ponds,
W82-03297 1507 2A

Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 1507 5E

First Order Analysis of Uncertainty in Numerical Models of Groundwater Flow. Part I. Mathematical Development,
W82-03329 1507 2F

Bacterial Utilization of Algal Extracellular Products. I. The Kinetic Approach,
W82-03330 1507 5C

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 1508 5B

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 1508 2A

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 1508 2A

Mathematical Modeling of Earth Dam Breaches,
W82-03532 1508 8A

The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 1508 2H

Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 1508 2G

Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 1508 2G

Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 1508 2F

Model-Prototype Comparison of Free Surface Vortices,
W82-03667 1508 8B

Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 1508 2L

SWMM Model and Level of Discretization,
W82-03673 1508 6A

Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

Nonlinear Sorption of Water in Soil,
W82-03686 1508 2G

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 1508 5B

Model Studies of an Overtopped Rockfill Dam,
W82-03694 1508 8E

Sediment Transport by Rainsplash,
W82-03709 1508 2J

Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 1508 8A

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 1508 2G

Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 1508 2G

Modeling the Economics of Ground Water Management,
W82-03733 1508 4B

Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

A Stoichiometric Model of Bacterial Growth,
W82-03756 1509 5D

Operational Estimation and Prediction of NItrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

Discussion: A Multiobjective Model for Regional Water Quality Management, by B. N. Lohani and Pakhorn Adulbhan,
W82-03785 1509 5G

Geochemical Inputs for Hydrological Models of Deep-Lying Sedimentary Units: Loss of Mineral Hydration Water,
W82-03796 1509 2F

Modeling the Effects of Conservation Practices on Soil Moisture,
W82-03811 1509 2G

Reservoir Sedimentation Modeling,
W82-03813 1509 2J

Watershed Model Study Using LANDSAT Image Data,
W82-03814 1509 2A

Multi-Constituent Simulation and Optimization Models for Water Quality Management,
W82-03815 1509 5G

A Trigger Type Cluster Model for Flood Analysis,
W82-03818 1509 2A

Urban Rainfall-Runoff Modelling Using Remote Sensing Imagery,
W82-03820 1509 2A

Simulation of Ice-Cover Growth and Thermal Decay on the Upper St. Lawrence River,
W82-03822 1509 2C

A Model for Solving Multiperiod Multireservoir Water Resources Problems with Stochastic Inflows,
W82-03830 1509 6A

Kinematic Subsurface Stormflow,
W82-03844 1509 2G

A Distribution Function Approach to Rainfall Runoff Modeling,
W82-03845 1509 2A

Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

Input/Output Models as Decision Aids for Lake Restoration,
W82-03924 1509 5G

Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 6B

Flow Model of Saginaw River Near Saginaw, Michigan,
W82-03996 1509 2E

An Algorithm on Optimal Operations of Activated Sludge Systems,
W82-04009 1509 5D

The Effect of Particle Substrate on Mineralization Performance and the Formation of Excess Sludge in a Complete Mixing Aeration Tank,
W82-04012 1509 5D

Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

Analyzing the Risk of Drought: The Occoquan Experience,
W82-04097 1509 2A

How Much Water Supply Capacity Is Enough,
W82-04103 1509 6D

Computer Modeling Programs: Tools for Model Operations,
W82-04130 1509 6A

Reevaluating Hunter's Model for Residential Water Demand,
W82-04131 1509 6D

Reservoir Operation for Water Conservation,
W82-04165 1509 3B

Optimal Operation of a Reservoir System Using Forecasts,
W82-04209 1509 4A

Evaluation of Hydropower Potential in a River Basin,
W82-04214 1509 6B

Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

Maps--A Planning Tool for Corps of Engineers Regional Water Supply Studies,
W82-04228 1509 6A

Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 1510 6C

Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 1510 2H

Obtaining Layout of Water Distribution Systems,
W82-04319 1510 8A

Deterministic Models for Predicting Residential Water Consumption,
W82-04352 1510 6D

Effect of Surface Sealing on Infiltration,
W82-04362 1510 2G

Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 1510 2J

Temperatures and Currents in a Stratified Lake A Two-Dimensional Analysis,
W82-04378 1510 2H

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 1510 5B

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part I: Theory,
W82-04434 1510 5B

Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

A Lumped Approach to the Inverse Problem in Ground Water Hydrology,
W82-04451 1510 4B

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 1510 2A

The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 1510 6A

A Numerical Linked Model for the Prediction of the Decline of Groundwater Mounds Developed Under Recharge,
W82-04481 1510 2F

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 1510 7B

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 1510 5D

Water Reuse Planning Models: Extensions and Applications,
W82-04565 1510 6A

Simulation and Verification of Lake Ontario's Mean State,
W82-04570 1510 2H

Estimation and Control Problems in Activated Sludge Processes,
W82-04612 1510 5D

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 1510 2J

Prediction of the Circulation in Reservoirs,
W82-04682 1510 2H

Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 1510 6A

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 1510 3D

The Chemistry of Saline Water Chlorination,
W82-04729 1510 3C

Modeling: How and When to Use,
W82-04754 1511 2L

Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 1511 5F

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 1511 5B

Evaporation at a High Arctic Site,
W82-04899 1511 2D

Barriers to Effective Ground-Water Management: The California Case,
W82-04917 1511 4B

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

Ground-Water Management in Basalts,
W82-04931 1511 4B

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 1511 4B

Prediction of Water Level in Tidal Inlet,
W82-05003 1511 4A

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 1511 5B

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

A Screening Model to Quantify Resilience,
W82-05044 1511 6A

Estimates of Resilience Indices by Simulation,
W82-05046 1511 6A

Estimating Resilience by Canonical Analysis,
W82-05047 1511 6A

Surface Heat Fluxes from Lake Ontario: Further Verification of Lake Thermal Model,
W82-05048 1511 2H

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 1511 2D

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 1511 5B

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 1511 2E

Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 1511 8B

Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

Do Model for Discharges from Deep Impoundments,
W82-05316 1511 2H

Dynamic Estuary Model Performance,
W82-05319 1511 2L

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 1511 2H

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 1511 5D

An Evaluation of the Effectiveness of Combining Economic and Physical Ground-Water Models,
W82-05545 1511 2F

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 1511 5C

Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

Soil Water Availability,
W82-05623 1511 2G

Issues in Simulation Model Design--A Case Study,
W82-05627 1511 4A

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

Managing Salinity in Irrigated Agriculture,
W82-05691 1511 3C

New Evapotranspiration Crop Coefficients,
W82-05692 1511 3F

Models of Landfill Leaching: Moisture Flow and Inorganic Strength,
W82-05818 1511 5B

Hydraulic Regime and Activated Sludge Performance,
W82-05819 1511 5D

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 1511 5G

Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

Finite Element Modeling of Streamflow Routing,
W82-05918 1512 2E

Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 1512 5B

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 1512 5C

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 1512 2E

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 1512 2G

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A

Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 1512 4A

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 1512 5D

Acid Rain Model: Hydrologic Module,
W82-06360 1512 5B

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 1512 2A

Reservoir Systems Optimization,
W82-06433 1512 4A

Comparing Urban Runoff Models,
W82-06447 1512 2A

Circulation Patterns; Their Investigation and Prediction,
W82-06477 1512 5F

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 1512 2J

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 1512 4B

Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

Institutional Aspects Affecting Management of Groundwater in California,
W82-06700 1512 6B

Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 1512 5C

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

Light Adaptation and Inhibition: Processes Important in Modelling the Growth of Algae in Drinking Water Basins,
W82-06827 1512 5C

A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 1512 2B

Comparison of Techniques for Estimating Annual Lake Evaporation Using Climatological Data,
W82-06850 1512 2D

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 1512 3F

Real-Time, Statistically Linearized, Adaptive Flood Routing,
W82-06855 1512 4A

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 1512 2G

Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 1512 2F

Application of SCS Infiltration Model,
W82-06872 1512 4D

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 1512 4D

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: 2. Phosphorus Uptake Kinetics,
W82-06940 1512 5C

Systems Analysis,
W82-06997 1512 5G

MODEL TESTING
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 1503 8B

Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

Finite Element Modeling of Streamflow Routing,
W82-05918 1512 2E

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

MOISTURE
Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 1501 2I

Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 1512 2B

A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 1512 2B

MOISTURE AVAILABILITY
Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 1502 2I

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 1503 2I

Irrigation Requirements of Field-Pea for Grain,
W82-02395 1505 2I

Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 1505 2I

Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 1507 2I

MOISTURE CONTENT
Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 1501 5E

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 1507 2G

MOISTURE EQUIVALENT
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 1503 2C

MOISTURE METERS
Simplifying Neutron Moisture Meter Calibration,
W82-05173 1511 7B

MOISTURE PROBE
Soil Percolation Rates from Neutron Probe Measurements,
W82-04309 1510 4B

MOISTURE PROFILES
Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 1511 2B

MOISTURE STRESS
Comparison of Tests Characterizing Varieties of Barley and Wheat for Moisture Stress Resistance,
W82-01114 1503 2I

Yield and Phenotypic Traits of Semidwarf and Normal-Statured Barley (Hordeum Vulgare L.) Genotypes Grown Under Differing Levels of Moisture Stress,
W82-01121 1503 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 1503 2I

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

MOISTURE UPTAKE
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

MOLECULAR BACKWASH
Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

MOLECULAR STRUCTURE
Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 1501 6E

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

MOLLUSKS
Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 1502 2K

Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

MOLYBDENUM
Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 1502 5A

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

MONETARY BENEFITS
Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

MONGOMERY COUNTY
Water Quality Trap Efficiency of Storm Water Management Basins,
W82-04248 1509 5G

MONIMOLIMNION
Meromixis in a Coastal Zone Excavation,
W82-02120 1505 2H

MONITORING
Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

Basin Management in the San Bernardino Valley,
W82-00075 1501 4B

Development of Oil-In-Water Monitor, Phase II,
W82-00100 1501 5A

Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 1501 5A

Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 1501 4B

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 1501 4B

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 1502 7B

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 1502 5A

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 1502 5G

Cost Effective Ground Water Monitoring,
W82-01113 1503 4B

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 1503 7A

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 1503 5A

Water-Quality Monitoring: A Global Approach,
W82-01339 1503 7A

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 1503 5G

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 1503 5D

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

Monitoring Glacier Outburst Floods,
W82-01558 1503 2C

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 1504 5G

Where Do We Go from Here.
W82-02086 1504 7A

Groundwater Quality in the Severn-Trent Region,
W82-02423 1505 5A

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 1506 7A

Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 1506 5A

Biological Monitoring Part VI - Future Needs,
W82-03230 1507 5C

Ground Water Monitoring: Part II,
W82-03380 1507 5B

Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 1507 5A

An Organics Detection System for the Ohio River,
W82-03436 1508 5A

Microorganism Inventory in Activated Sludge Control,
W82-03483 1508 5D

Ground Water Monitoring: Part II,
W82-03484 1508 8A

Improving Treatment Works Efficiency.
W82-03500 1508 5D

Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 1508 5A

The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 1508 5B

Effect of Water Treatment on Mutagenic Potential,
W82-03776 1509 5A

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

Limitations of Standard Coliform Enumeration Techniques,
W82-03889 1509 5A

Water Quality Monitoring,
W82-03897 1509 5G

Improving the Reliability of Ground-Water Monitoring at Industrial Waste Disposal Facilities,
W82-03940 1509 5A

NPDES Compliance Flow Measurement Manual,
W82-03965 1509 5D

Waste Discharge Monitoring Requirements Under the NPDES Permits Program,
W82-03969 1509 5D

Automatic Monitoring of Exhaust Gas Analysis in Activated Sludge Wastewater Treatment Process,
W82-04014 1509 5D

The Continuous Oxygen Uptake Rate Measurement and Its Applicability as an Activated Sludge Control Parameter,
W82-04020 1509 5D

The BASF Toximeter - A Helpful Instrument to Control and Monitor Biological Waste Water Treatment Plants,
W82-04050 1509 5A

ISFETs-New Tools for Water Quality Monitoring,
W82-04059 1509 5A

Theoretical Considerations for Control and Monitoring of Wastewater Treatment Systems,
W82-04060 1509 5D

Control of Dissolved Oxygen in Activated Sludge Plants,
W82-04061 1509 5D

Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant,
W82-04344 1510 5D

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 1510 5A

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 1510 7B

Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 1510 5A

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 1510 7B

The Unterweser Automatic Water Quality Measurement System,
W82-04588 1510 5A

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 1510 7A

Recent Developments in and Application of Automation and Monitoring in Water Management,
W82-04593 1510 7B

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 1510 5A

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 1510 5A

Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 1510 2E

Ground Water Monitoring of Underground Coal Mines,
W82-04750 1510 5B

Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 1511 5A

Groundwater Monitoring,
W82-04809 1511 6E

Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 1511 5E

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 1511 5A

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 1511 5A

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 1511 5A

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 1511 5A

Biological Monitoring of Hazardous Wastes in Aquatic Systems,
W82-05154 1511 5A

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 1511 5A

Metabolic Response of Fish to Stress,
W82-05159 1511 5C

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

Sampling Frequency Optimization Using a Water Quality Index,
W82-05268 1511 5A

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

The Response of Specific Conductance to Environmental Conditions in the Everglades National Park, Florida,
W82-05464 1511 5A

A Pragmatic Approach to Water Quality Microbiology in a Clean River Area,
W82-05575 1511 5A

Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 1511 7C

Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 1512 5C

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 1512 5A

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

Portable Water Elevation Measuring Gage,
W82-06396 1512 7B

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

The Practical Handling of Water Quality Monitoring Data,
W82-06591 1512 7C

Making Chlorination Trustworthy,
W82-06639 1512 5F

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

Locating Monitoring Wells,
W82-06848 1512 8B

Ecological Studies and Mathematical Modeling of Cladophora in Lake Huron: I. Program Description and Field Monitoring of Growth Dynamics,
W82-06939 1512 5C

MONOCHLORAMINE
Kinetics of Monochloramine Decomposition in the Presence of Bromide,
W82-02651 1506 5B

The Monochloramine-GAC Reaction in Adsorption Systems,
W82-04426 1510 5F

MONOCHLORAMINES
Health Effects of Monochloramines in Drinking Water,
W82-01091 1502 5C

MONOMOLECULAR FILMS
Oriented Monolayer Assemblies to Modify Fouling Propensities of Membranes.
W82-06167 1512 3A

MONOSACCHARIDES
Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 1502 2H

MONROE COUNTY
Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 1508 5D

MONSOONS
Report on the Summer MONEX Field Phase,
W82-00265 1501 2B

Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 1503 2A

Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

MONTANA
The Relationship Between Fracture Traces and Joints in a Tertiary Basin, Southwest Montana,
W82-00829 1502 7B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 1503 7C

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 1503 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 1503 7C

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 1505 2F

Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

Revised Techniques for Estimating Magnitude and Frequency of Floods in Montana,
W82-03987 1509 2E

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 1510 5C

Non-Indian Federal Reserved Water Rights,
W82-04804 1511 6E

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

MONTANA WATER PLANNING MODEL
Development of a Prototype Method for Training Users of Water Resources Planning Models: Phase I,
W82-02540 1505 6A

MONTE CARLO METHOD
Comparison of First-Order Error Analysis and Monte Carlo Simulation in Time-Dependent Lake Eutrophication Models,
W82-01460 1503 2H

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 1503 2E

Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 1512 5G

MONTGOMERY COUNTY
The Availability of Ground Water in Western Montgomery County, Maryland,
W82-02481 1505 2F

MONTREAL
The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

MORAINES
Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 1505 2F

MOROCCO
Morocco's Largest Multipurpose Scheme,
W82-01724 1503 8A

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 1507 2H

MORPHOLOGY
Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 1505 5D

Morphological Changes in Toxic and Non-Toxic Microcystis Isolates at Different Irradiance Levels,
W82-02906 1506 5C

Soil Morphology and Preferential Flow Along Macropores,
W82-03175 1507 2G

MORTALITY
Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 1502 5C

Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

MOSCOW RIVER
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 1504 5C

MOSEL RIVER
Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 1510 5G

MOSSES
Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 1506 2H

MOST PROBABLE NUMBER TEST
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

MOST PROBABLE NUMBER TESTS
A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 1505 5A

MOTORS
Pump Systems: What Price Inefficiency,
W82-04093 1509 8C

MOTZ
Generating Power from Compensating Flow.
W82-05624 1511 8C

MOUNT MONADNOCK
Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 1506 2I

MOUNT ST. HELENS
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

MOUNTAIN BASINS
Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

MOUNTAIN LAKES
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 1507 2H

MOUNTAINS
Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 1507 5C

Dispersion in Mountainous Natural Streams,
W82-06357 1512 2E

Calibrating A Mountain Watershed in Wyoming,
W82-06583 1512 2E

MOZHAYSK RESERVOIR
On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

MT. ST. HELENS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 1502 4D

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

MUD FLATS
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

MUDFLOWS

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 1502 4D

Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 1502 2J

The Disastrous Southern California and Central Arizona Floods, Flash Floods, and Mudslides of February 1980.
W82-04632 1510 2E

MUDMINNOW

Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

MULCHING

Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 1501 2J

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 1502 3F

MULTI-FLASH DISTILLATION

Analysis of Large Desalination Plants,
W82-06122 1512 3A

MULTI-OBJECTIVE PLANNING

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 1502 6F

MULTIEFFECT DISTILLATION

Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

MULTIOBJECTIVE PLANNING

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 1503 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 1504 6E

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 1504 6A

Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 1506 6A

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 1506 6B

Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

Multi-Objective Decision Making in Water Management,
W82-04010 1509 6A

Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 1510 6A

A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 1512 6A

MULTIPHASE FLOW

A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

MULTIPLE FREQUENCY RESPONSE ANALYSIS

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 1511 2E

MULTIPURPOSE PROJECTS

Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 1511 4A

Reservoir Planning for Brazilian Dams,
W82-06206 1512 6A

MULTIPURPOSE RESERVOIRS

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico.
W82-01439 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California.
W82-01441 1503 6D

A Model for Solving Multiperiod Multireservoir Water Resources Problems with Stochastic Inflows,
W82-03830 1509 6A

Aggregation-Disaggregation Techniques for the Operation of Multi-Reservoir Systems,
W82-03954 1509 6A

Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 1510 6C

Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 1510 6A

Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 1511 6G

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

MULTIRESERVOIR NETWORKS

TVA Hydro Scheduling Model: Theoretical Aspects,
W82-06430 1512 4A

TVA Hydro Scheduling Model: Practical Aspects,
W82-06431 1512 4A

MULTISTAGE FLASH DISTILLATION

A Study of The MSF Desalination Process Utilizing The Controlled Two-Phase Flow Concept--Phase II,
W82-04084 1509 3A

RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 1512 3A

MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 1512 3A

MULTIVARIATE ANALYSIS

Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 1503 7A

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 1510 3D

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 1512 4A

MUNICIPAL WASTES

Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 1501 5D

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 1501 5E

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

How Do You Build When Sewers Are Inadequate,
W82-03592 1508 5D

Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

Water Quality Assessment for Agana Springs,
W82-05304 1511 5A

MUNICIPAL WASTEWATER

Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches,
W82-00093 1501 5D

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 1501 5D

Midwestern Wastewater Characteristics,
W82-00534 1502 5D

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 1502 5D

Toxics in Municipal and Industrial Wastewaters,
W82-00712 1502 5A

Land Application of Municipal Wastewater,
W82-01253 1503 5D

Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 1503 5D

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

Municipal Sewage: Three Communities Try to Cope,
W82-03284 1507 5D

Innovative/Alternative Technology Program; Case Studies,
W82-03970 1509 5D

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

Municipal Sewage Treatment - Some Recent Developments,
W82-04528 1510 5D

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 1510 5D

Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 1511 3C

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Temporal Variations and Mass Emission Rates to the Ocean,
W82-05142 1511 5B

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 1511 5D

Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 1511 5D

The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476 1511 5B

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 1511 5D

Energy Conservation in Municipal Wastewater Plants,
W82-06070 1512 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 1512 5D

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 1512 5D

MUNICIPAL WATER
Distribution System Liability,
W82-01028 1502 5F

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

Municipal Needs,
W82-02513 1505 6E

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 1508 6B

Urban Water Systems: Problems and Alternative Approaches to Solutions,
W82-03580 1508 5F

Ground-Level Versus Elevated Storage,
W82-03865 1509 5F

Readying Boston's Water and Sewer System for the Next Century,
W82-03870 1509 6B

Achieving Urban Water Conservation,
W82-04227 1509 3D

The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 1510 6E

When a Water Supply Went Bad.
W82-04357 1510 5C

The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 1510 5F

The Seven-Trent Studies of Industrial Water Use,
W82-04686 1510 6D

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 1510 3D

The Real Price of Urban Water,
W82-04797 1511 6C

Conservation Ethics for the 1980's,
W82-05009 1511 3D

Crisis-Ridden Water Systems Should Go Private,
W82-05436 1511 6C

Municipal and Industrial Water Demands of Western U.S.,
W82-06463 1512 6D

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 1512 3D

MUNITIONS WASTES
Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 1502 5A

MURDERKILL RIVER ESTUARY
Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

MURFREESBORO
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 1504 5B

MUSANDAM PENINSULA
Recent Inshore Sediments in Musandam, Gman,
W82-02857 1506 2J

MUSKINGUM-CUNGE MODEL
Choice of Space and Time Steps in the Muskingum-Cunge Flood Routing Method,
W82-06227 1512 4A

MUSSELS
Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 1503 5F

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 1503 5A

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

Growth of Mytilus Edulis in Net Bags Transferred to Different Localities in a Eutrophicated Danish Fjord,
W82-02428 1505 5C

Statistical Models for Estimating Seawater Metal Concentrations from Metal Concentrations in Mussels (Mytilus Edulis),
W82-03608 1508 5A

Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

MUTAGENESIS
Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 1502 5C

MUTAGENIC ACTIVITY
Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta,
W82-06770 1512 5C

MUTAGENS
The Application of Mutagenicity Testing to Drinking Water,
W82-01487 1503 5A

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens

in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 1506 5C

Evaluation of Four Concentration/Extraction Procedures on Waters and Effluents Collected for Use with the Salmonella Typhimurium Screening Procedure for Mutagens.
W82-03775 1509 5A

Effect of Water Treatment on Mutagenic Potential,
W82-03776 1509 5A

Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 1511 5A

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Mutagens, Carcinogens and the Water Cycle,
W82-05468 1511 5A

Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond,
W82-05727 1511 5C

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 1512 5A

MYRIOPHYLLUM

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 1512 5B

MYRIOPHYLLUM HETEROPHYLLUM

Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

MYTILUS

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 1503 5A

NAJAS MARINA

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

NALGONDA TECHNIQUE

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

NANNOPLANKTON

Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 1503 5C

NANTICOKE

Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

NANTICOKE THERMAL GENERATING STATION

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

NARMADA RIVER

Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 1503 6A

NARRAGUAGUS RIVER

The Aquatic Insects of The Narraguagus River, Hancock and Washington Counties, Maine,
W82-04167 1509 2E

NASSAU COUNTY

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

Fluidized Bed for Biological Wastewater Treatment,
W82-00968 1502 5D

Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

NATIONAL FLOOD INSURANCE PROGRAM

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

NATIONAL PARKS

Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 1501 6B

Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 1502 6A

NATURAL FLOW

Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1502 1A

NATURAL GAS

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

NATURAL RECHARGE

Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

Chloride Ion Concentrations as an Aid to Estimating Recharge to the Woburn,
W82-06234 1512 2F

NATURAL RECHARGE RAINFALL

Geohydrologic Appraisal of Water Resources of the South Fork, Long Island, New York,
W82-04206 1509 7C

NATURAL RESOURCES

Surficial Geology of Dugway Quadraegle, Oswego County, New York,
W82-01775 1503 7C

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 1510 10C

NATURAL STREAMS

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 1504 5B

The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1505 1B

Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 1505 2I

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 1505 5G

NATURAL WATERS

Hydrolysis of Fenitrothion in Model and Natural Aquatic Systems,
W82-00157 1501 5B

Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 1502 2K

Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 1502 5A

Effects of Ion-Pairing on Calculations of Ionic Activities of Major Ions in Freshwater,
W82-00823 1502 2K

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 1502 5A

The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 1503 7A

Preconcentration of Phenylmercury, Methylmercury and Inorganic Mercury from Natural Waters with Diethylammonium Diethyldithiocarbamate-Loaded Polyurethane Foam,
W82-02297 1505 5A

The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 1507 2H

Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1508 1A

On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters,
W82-05012 1511 5A

The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 1511 2A

Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 1512 5A

Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 1512 5C

NAVAJO GENERATING STATION
Development of Makeup-Line Safe-Operating Criteria,
W82-01095 1502 8B

NAVIER-STOKES EQUATION
Hydrodynamics of Condensate Films on Fluted Tube Surfaces. Part I,
W82-06105 1512 3A

NAVIGATION
Freedom from the Navigation Servitude Through Private Investment,
W82-01030 1502 6E

Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

Sediment--Asset or Liability,
W82-02150 1505 6B

Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 1512 6B

NAVIGATION CANALS
Intensive Survey of the Sabine-Neches Canal - Segment 0703,
W82-04078 1509 5A

Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

NAWDEX (NATIONAL WATER DATA EXCHANGE)
Directory of Member Organizations of the National Water Data Exchange (NAWDEX),
W82-00089 1501 10D

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

NEBRAKA
Hydrogeologic Reconnaissance of the Republican River Basin in Nebraska,
W82-05828 1511 7C

NEBRASKA
Nebraska Ground Water Law and Administration,
W82-01236 1503 6E

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 1503 5C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

An Economic Analysis of Ground Water Management Alternatives,
W82-02740 1506 4B

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 1507 5C

Potential Impact of Ground Water Policy Alternatives on Nebraska Agriculture, 1977-2020,
W82-03826 1509 6B

A Legal-Economic Critique of Groundwater Law and Administration: With Special Reference to Arizona and Nebraska,
W82-03827 1509 6E

Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

Evaluating Direct Benefit Estimation Procedures for Irrigation Projects: A Simplified Approach,
W82-04287 1510 6B

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 1510 6G

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 1510 2J

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 1512 2E

Who Owns Nebraska's Ground Water,
W82-06819 1512 6E

NEGEV DESERT
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

NEGOTIATIONS
Game Theory Analyses Applied to Water Resource Problems,
W82-00802 1502 6A

NEMATODES
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 1501 5D

A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 1507 2L

NENT RIVER
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 1504 5C

NEPHELOID LAYER
Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 1503 2H

NET RADIATION
An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

Potential Evaporation in the Peace Region of British Columbia,
W82-06528 1512 2D

NETHERLANDS
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 1501 2L

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 1502 2G

Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

Holland's Eastern Scheldt Estuary Barrier Scheme: Some Ecological Considerations,
W82-01375 1503 2L

Investigations into the Occurrence of Midge Plagues in the Vicinity of Harderwijk (Netherlands),
W82-01378 1503 2H

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

Iron and Manganese in Lake Vechten (The Netherlands): Dynamics and Role in the Cycle of Reducing Power,
W82-02864 1506 2K

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 1506 2K

Eastern Scheldt Design Has Changed.
W82-03493 1508 8A

Dutch Dumps,
W82-03738 1508 5B

Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

NETHERLANDS

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

Composition and Distribution of Dissolved Fluorescent Substances in the Ems-Dollart Estuary,
W82-04752 1511 2L

Potable Water Production in Holland.
W82-04851 1511 5F

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

NETWORK DESIGN

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 1501 5F

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 1501 4B

Regional Flood Frequency Estimation and Network Design,
W82-01294 1503 2E

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

Data Requirements for Kriging: Estimation and Network Design,
W82-04200 1509 7A

Obtaining Layout of Water Distribution Systems,
W82-04319 1510 8A

A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 1510 6A

Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 1512 5F

NETWORKS

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 1501 4B

A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 1511 5F

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

Topologic Model for Drainage Networks with Lakes,
W82-05905 1512 2A

NEUSIEDLERSEE

Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 1508 2H

NEUTRALIZATION

Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 1501 5D

Reviving Acidified Lakes,
W82-00933 1502 2H

Acid Pond Drainage,
W82-05199 1511 5G

Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 1512 5D

NEUTRON ACTIVATION ANALYSIS

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 1511 4B

NEVADA

Water Multipliers--Regional Impact Analysis,
W82-01138 1503 6A

Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

Flood and Related Debris Flow Hazards Map, Las Vegas SE Quadrangle,
W82-04490 1510 7C

Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

Flood and Debris Flood Hazards Map, Carson City Quadrangle,
W82-05217 1511 7C

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 1511 6B

Nevada Water Resources Research 1982-1987,
W82-05533 1511 6B

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake;
W82-06535 1512 2H

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

Truckee Meadows Water Use - Present and Future,
W82-06705 1512 3D

Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

Geophysical Reconnaissance of Lemmon Valley, Washoe County, Nevada,
W82-06949 1512 2F

NEVADA TEST SITE

Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 1511 5B

NEW BRUNSWICK

River Basins and Water Management in New Brunswick,
W82-05391 1511 6D

Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 1512 5C

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 1512 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 1512 5A

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 1512 5A

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

NEW ENGLAND

Small-Scale Hydro in New England: 1960-1976,
W82-00169 1501 6D

Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 1501 6E

The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 1503 2A

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

Report of Committee on Conservation, Development and Utilization of Water Resources.
W82-03374 1507 3D

Interstate Highways Versus Watershed Protection in New England,
W82-03431 1508 5B

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 1510 5G

Rare and Endangered Species: Freshwater Gastropods of Southern New England,
W82-04968 1511 5C

NEW ENGLAND RIVER BASINS COMMISSION

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 1501 3D

NEW HAMPSHIRE

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 1501 7C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 1502 6E

Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 1506 2I

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 1506 6B

The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 1506 2L

Chemical Flux in an Acid-Stressed Stream,
W82-03338 1507 5C

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 1510 6E

Biomass and Annual Production of the Freshwater Mussel Elliptio Complanata in an Oligotrophic Softwater Lake,
W82-05104 1511 2H

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

Hydrogen Ion Budget of an Aggrading Forested Ecosystem,
W82-06836 1512 2K

NEW JERSEY

Northeastern New Jersey Grapples With a Drought,
W82-00289 1501 8A

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 1502 6E

Composting Is Working in Camden,
W82-00948 1502 5E

Aluminum in Precipitation, Streams, and Shallow Groundwater in the New Jersey Pine Barrens,
W82-01297 1503 5B

Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 1503 4D

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 1503 5A

New Jersey Community Decontaminates Well Water.
W82-02243 1505 5F

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

Restoring an Antique Water System.
W82-02685 1506 5F

Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 1506 2A

Jersey Drought Hastens Water Supply Project,
W82-03385 1507 6D

If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 1508 5B

Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 1508 5F

How Do You Build When Sewers Are Inadequate,
W82-03592 1508 5D

Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

When a Water Supply Went Bad.
W82-04357 1510 5C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 1510 7C

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

Overhauling a Water System,
W82-06224 1512 5F

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 1512 5D

NEW JERSEY PINE BARRENS

Nitrogen Dynamics in the Surface Waters of the New Jersey Pine Barrens,
W82-03816 1509 2A

NEW MEXICO

Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 1501 5B

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 1502 2K

Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 1505 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 1505 3A

Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 1505 6E

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 1505 2F

Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 1505 7C

Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 1506 2F

Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

Pueblo Indian Agriculture, Irrigation and Water Rights,
W82-04208 1509 6E

Effects of Decreased Watering on Crop Yields,
W82-04411 1510 2I

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 1511 6D

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 1512 3E

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 1512 7C

NEW ORLEANS

Will New Orleans Miss The Mississippi,
W82-04274 1510 4A

NEW RIVER

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

NEW SOUTH WALES

Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 1501 2J

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

NEW YORK

Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

Water Resources Investigations in New York--1980.
W82-00011 1501 7C

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 1502 6E

Groundwater Problems and Needs in New York,
W82-01055 1502 4B

Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 1503 7A

Preliminary Report of Stream Sampling for Acidification Studies 1980,
W82-01453 1503 5A

Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 1503 7C

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

Two Bed-Load Formulas: An Evaluation,
W82-02375 1505 2J

Hydraulic Analysis of Chenango River, Broome County, New York, in Relation to State Highway Plan,
W82-02477 1505 4C

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 1505 2E

Liming Acid Ponds in New York,
W82-02572 1505 5G

If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 1508 5B

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

Cadmium in an Aquatic Ecosystem,
W82-03724 1508 5A

The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03903 1509 5C

Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

Search: A Gaged Watershed Inventory,
W82-04433 1510 10B

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 1511 4B

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

Modelling and Control of Dissolved Oxygen in an Estuary,
W82-05188 1511 6A

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 1511 5A

Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 1511 5D

The Status of Groundwater Law in New York State,
W82-05400 1511 6E

Institutional Change - Water Quality Management,
W82-05401 1511 6E

Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 1512 6G

Landspreading of sludge in New York State,
W82-06557 1512 5E

Rates of Mineralization of Trace Concentrations of Aromatic Compounds in Lake Water and Sewage Samples,
W82-06738 1512 5B

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

NEW YORK BIGHT

An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 1501 5C

Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 1505 5C

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 1512 5C

NEW YORK CITY

Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 1511 5D

Water Supply for New York City in the 1980s,
W82-05571 1511 6D

Leak Location Enters Computer Age,
W82-06018 1512 7A

NEW ZEALAND

Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 1502 3B

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 1502 2H

Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

Identification of the Wairakei Geothermal System,
W82-01312 1503 2F

On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 1503 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 1503 2H

Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 1503 5C

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 1503 4C

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 1503 5C

Limnology of Lake Rerewhakaaitu,
W82-01705 1503 2H

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

Logistics of Farm Water Supply.
W82-02037 1504 6A

Bromide in Canterbury Ground Water,
W82-02056 1504 5B

Water for New Zealand's Plains,
W82-02402 1505 3F

Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

Local Flow Accelerations in Rivers,
W82-02758 1506 2E

Zooplankton of Lake Taupo,
W82-02888 1506 2H

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 1507 2H

Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 1508 2J

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

The Representation of Variable Hydro Potential in Long-Range Electricity Planning Models,
W82-04474 1510 6A

Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 1511 4C

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

NEWFOUNDLAND
Three Case Studies of Small Scale Hydro in Newfoundland and Labrador,
W82-03619 1508 6G

The Water Balance in Newfoundland,
W82-03921 1509 7A

Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 1511 2K

NEWPORT RIVER ESTUARY
Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 1508 2L

NEWTON CREEK WATER POLLUTION CONTROL PLANT
Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 1511 5D

NIAGARA RIVER
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

NICKEL
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 1502 5A

Activated Sludge Nickel Toxicity Studies,
W82-01895 1504 5D

Combined Effects of Cadmium and Nickel on Activated Sludge Process,
W82-02704 1506 5D

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 1512 5D

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 1512 5D

NIGERIA
Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 1502 2I

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 1503 3F

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 1503 2F

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 1503 4A

Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

On Water Availability and Demand in Nigeria,
W82-03062 1507 6D

Development of Hydro-Power in Nigeria,
W82-04475 1510 6B

The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 1510 5D

A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 1511 2D

NILE BASIN
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 1504 2A

NILE DELTA
Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 1512 2J

NILE FLOODS
Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 1501 2E

NILE RIVER
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 1504 6G

Technical and Ecological Impacts of the High Aswan Dam.
W82-02856 1506 4A

Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 1506 2J

The Nile - One River and Nine Countries,
W82-03545 1508 4A

Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 1512 6E

NILNAG LAKE
Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 1507 2H

NITRAPYRIN
Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 1502 5G

NITRATE
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 1503 2G

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 1506 5F

Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

NITRATE REMOVAL
Tackling the Nitrate Problem.
W82-01874 1504 5F

NITRATES
Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 1502 5B

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 1502 5F

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 1502 5G

Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

Effects of Water and Nitrogen Management on Nitrate Leaching Loss from Sands,
W82-01581 1503 5B

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 1503 5C

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

Tackling the Nitrate Problem.
W82-01874 1504 5F

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 1505 5B

Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 1505 5C

Effect of Drainage System Design and Operation on Nitrate Transport,
W82-02505 1505 5B

Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 1506 5D

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 1508 5G

Seepage Flow in Extremely Thin Aquifers,
W82-03594 1508 2F

An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

The Distribution and Movement of Solutes Derived from Agricultural Land in The Principal Aquifers of The United Kingdom, with Particular Reference to Nitrate,
W82-03912 1509 5B

Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

Biological Denitrification for Potable Water Treatment,
W82-05247 1511 5F

Nitrate Reduction by Pseudomonas SPP.: Antagonism by Fermentative Bacteria,
W82-05499 1511 5B

Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 1511 5B

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

NITRIC ACID

Influence of Gaseous Nitric Acid on Sulfate Production and Acidity in Rain,
W82-00642 1502 5B

Acid Precipitation: The Importance of Nitric Acid,
W82-00643 1502 2K

The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 1506 5C

NITRIFICATION

Specific Inhibition of Nitrite Oxidation by Chlorate and Its Use in Assessing Nitrification in Soils and Sediments,
W82-00242 1501 2L

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 1502 5A

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 1502 2L

Activated Sludge,
W82-01243 1503 5D

Effect of Copper on Nitrification in Activated Sludge,
W82-01497 1503 5C

Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

The Effect of Nitrification in the BOD Test,
W82-02384 1505 5D

To Inhibit or Not to Inhibit: That is The Question,
W82-02672 1506 5A

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

Nitrification Using the Rotating Biological Contactor,
W82-03132 1507 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 1507 5D

Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 1507 5D

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 1508 5D

Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 1508 5D

Operational Estimation and Prediction of NItrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 1510 5D

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 1510 5C

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 1510 5D

Biological Nitrification of Industrial Wastewater,
W82-05129 1511 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 1511 5D

Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

Studies of Nitrification in a Coke-Waste Activated Sludge Process,
W82-05295 1511 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 1511 5D

Criteria for Nitrification in Fixed Film Reactors,
W82-05352 1511 5D

Kinetics of Biofilm Nitrification,
W82-05374 1511 5D

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 1511 5B

Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 1511 5D

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 1511 5D

Inhibition of Nitrification by Arsenic, Chromium, and Fluoride,
W82-05855 1511 5C

Nitrogen Removal in Continuous-Flow Sequentially Aereated Activated Sludge Systems,
W82-05950 1512 5D

Nitrification Kinetics and Its RBC Application,
W82-06356 1512 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

Apparent and Measured Rate of Nitrification in the Hypolimnion of a Mesotrophic Lake,
W82-06749 1512 5C

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 1512 5C

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 1512 5A

NITRILOTRIACETIC ACID

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

Effect of Mixed Liquor Suspended Solids Concentration on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-04829 1511 5C

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 1512 5D

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 1512 5D

NITRITES

Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 1507 5A

Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 1510 5C

High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 1511 5A

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 1511 5B

NITROGEN

Nitrogen Availability from Sewage Sludge,
W82-00158 1501 5E

Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 1501 5B

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 1501 5B

The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 1501 2H

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

Kinetics of Nitrate and Ammonium Uptake by the Tropical Freshwater Macrophyte Pistia Stratiotes L.,
W82-00937 1502 5D

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

Nitrogen Leaching as Influenced by Nitrogen Management and Supplement Irrigation Level,
W82-01472 1503 5B

Nitrogen Balances for an Effluent Irrigation Area,
W82-01478 1503 3C

Gaseous Nitrogen as Evidence for Denitrification in Groundwater,
W82-01485 1503 2K

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 1503 3C

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 1503 5B

Excess Air in Groundwater,
W82-02099 1504 2F

Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 1505 5C

Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

A Carlson-Type Trophic State Index for Nitrogen in Florida Lakes,
W82-02911 1506 5C

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 1507 5D

Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 1507 2G

A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03843 1509 5B

SPNM, A Model for Predicting Sediment, Phosphorus, and Nitrogen Yields from Agricultural Basins,
W82-04157 1509 6A

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems,
W82-05437 1511 5A

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 1511 3F

Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 1511 3F

Filterability of Activated Sludge in Response to Growth Conditions,
W82-05860 1511 5D

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 1512 5F

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 1512 5A

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

NITROGEN COMPOUNDS

Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis,
W82-00259 1501 2L

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 1502 2H

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 1502 6A

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 1502 2H

Nonpoint N Runoff from Agricultural Watersheds into the Great Lakes,
W82-01148 1503 5B

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 1503 5A

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 1512 5D

NITROGEN CYCLE

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 1503 2G

Studies of Biological Nitrogen Cycle Processes in the Upper Waters of the Ocean, with Special Reference to the Primary Nitrite Maximum,
W82-02742 1506 2A

Nitrogen Dynamics in the Surface Waters of the New Jersey Pine Barrens,
W82-03816 1509 2A

Irrigation of Californiagrass with Domestic Sewage Effluent: Water and Nitrogen Budgets and Crop Productivity,
W82-05153 1511 3C

NITROGEN DIOXIDE

Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 1511 2K

NITROGEN FIXATION

Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 1501 2H

Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 1501 2L

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 1501 2K

Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

Nitrogen Fixation in the Temperate Estuarine Intertidal Sediments of the River Lune,
W82-06944 1512 5C

NITROGEN FIXING BACTERIA

Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 1503 4A

Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 1505 5A

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

NITROGEN REMOVAL

Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 1501 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Biological Nitrogen Removal System Design,
W82-03145 1507 5D

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 1508 5B

Kinetics of Nitrogen Loss in Simulated Wastewater Treatment in a Soil-Plant System,
W82-03869 1509 5D

Nitrogen Removal in a Subsurface Disposal System,
W82-04001 1509 5D

Computer Control of Nitrifying and Denitrifying Activated Sludge Process,
W82-04025 1509 5D

Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 1511 5D

Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 1511 5D

Single Sludge Nitrogen Removal from Industrial Wastewater,
W82-05245 1511 5D

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 1511 5D

Ammonium Uptake by Micronesian Species of Gracilaria (Rhodophyta),
W82-05311 1511 5G

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 1511 5D

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 1511 5D

NITROPHENOLS

Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 1511 5A

NITROSAMINES

Photolysis of N-Nitrosodi-n-Propylamine in Water,
W82-00164 1501 5B

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

NITROSAMINES *DIETHANOLAMINE

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 1502 5A

NITROUS OXIDE

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 1504 2H

Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 1505 2H

A New Indicator of the Activated Sludge Process - Nitrous Oxide,
W82-04018 1509 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

NIZHNEKAMSK

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

NODULES

Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

NOMENCLATURE

Terminological Confusion--Lake VS. Reservoir,
W82-06551 1512 2H

NOMOGRAPHS

Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 1512 5B

NON-POINT POLLUTION SOURCES

Water Quality: What Should Be Done Today,
W82-03631 1508 6E

NON-POINT SOURCES

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 1511 5B

NONBIODEGRADABLE WASTES

Potential for Land Disposal of Two Nonbiodegradable Wastes,
W82-00939 1502 5D

NONHOMOGENEOUS AQUIFERS

Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 1505 2F

NONLINEAR PROGRAMMING

A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 1502 2A

NONPOINT POLLUTION CONTROL
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 1506 5G

NONPOINT POLLUTION SOURCES
Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 1501 5B

Pollution From Land Runoff,
W82-00253 1501 5B

Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 1501 5C

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

Water Quality Management in River Basins: US National Experience,
W82-00800 1502 6E

Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Non-Point Sources,
W82-01270 1503 5B

CREAMS: A Field-Scale Model for Chemicals, Runoff, and Erosion from Agricultural Management Systems.
W82-01401 1503 5B

Erosivity 'R' for Individual Design Storms,
W82-01403 1503 2J

Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula,
W82-01414 1503 5B

Relationship Between Increased Crop Acreage and Nonpoint-Source Pollution: A Georgia Case Study,
W82-01550 1503 5B

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 1505 2A

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 1505 5B

Farm, Urban Drainage Polluting Great Lakes.
W82-02647 1506 5B

Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 1506 5G

Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 1506 5G

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 1506 5B

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

Delivery of Suspended Sediment and Pollutants from Nonpoint Sources during Overland Flow,
W82-03902 1509 2J

Impact of Mining Activities on Water Quality in Western North Carolina,
W82-03926 1509 5B

Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control,
W82-04063 1509 5G

Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

What Is a Point Source,
W82-04158 1509 6E

The Wisconsin Soil and Water Conservation District as an Institution to Undertake Subwatershed Planning to Control Non-Point Source Water Pollution,
W82-04212 1509 6A

Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 1510 5B

Strategies to Control Nonpoint Source Water Pollution,
W82-04261 1510 5G

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 1510 5B

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

Agricultural Runoff and Water Pollution,
W82-05569 1511 5B

Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 1512 5B

Problems and Processes in Water Quality Management,
W82-06147 1512 5G

Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

NONSTRUCTURAL ALTERNATIVES
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

Flood Area Modelling from an Elementary Data Base,
W82-03581 1508 2E

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

NONTIDAL CURRENTS
Nontidal Circulation and Mixing Processes in the Lower Potomac Estuary,
W82-02657 1506 2L

NORDEN RESERVOIR
Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

NORTH AMERICA
Recent Acidification of Precipitation in North America,
W82-01514 1503 5B

NORTH CAROLINA
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 1501 4B

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 1501 4B

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

Groundwater Problems in North Carolina,
W82-01056 1502 4B

Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 1503 5C

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 1503 2L

Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Municipal Needs,
W82-02513 1505 6E

Recycling,
W82-02514 1505 6E

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

Trends in State and Federal Policy on Water Supply Management,
W82-02516 1505 6E

Efficient Groundwater Utilization,
W82-02520 1505 6D

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 1508 2L

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 1512 5C

Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 1512 5C

Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 1512 5C

NORTH CREEK
Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

NORTH DAKOTA
Watertable Management Saves Water and Energy,
W82-00943 1502 3F

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 1505 7C

Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 1506 4A

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 1512 7C

NORTH FORK PAYETTE RIVER PROJECT
Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 1507 6G

NORTH FORK STANISLAUS RIVER
Final Environmental Impact Statement: North Fork Stanislaus River Project No. 2409 - California.
W82-00737 1502 6G

NORTH INLET
Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

NORTH INLET ESTUARY
The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

NORTH PLATTE RIVER
Aggregation-Disaggregation Techniques for the Operation of Multi-Reservoir Systems,
W82-03954 1509 6A

Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

NORTH SEA
Discharge to the North Sea,
W82-06248 1512 5E

NORTHEASTERN UNITED STATES
Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 1508 6A

NORTHERN GREAT PLAINS
Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 1512 2I

NORTHERN IRELAND
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 1504 5C

Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 1511 5B

Phosphorus Reduction Studies,
W82-05408 1511 5D

NORTHUMBRIAN WATER AUTHORITY
A Catchment Approach to Flood Estimation,
W82-01397 1503 2E

NORTHWEST FLORIDA
Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 1505 7C

NORTHWEST HILLSBOROUGH COUNTY
A 201 Pollution Control Planning Tragedy,
W82-00285 1501 6E

NORTHWEST TERRITORIES
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 1504 2F

River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 1506 2E

NORWALK AGENT
Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

NORWAY
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 1503 2F

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 1506 2E

Cyclops Scutifer Sars - One and Two-Year Life Cycles with Diapause in the Meromictic Lake Blankvatn,
W82-02865 1506 2H

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 1507 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 1507 5D

Bacterial Utilization of Algal Extracellular Products. 2. A Kinetic Study of Natural Populations,
W82-03331 1507 5C

Acid Precipitation--A New Study from Norway,
W82-03341 1507 5C

Acidification in 50 Norwegian Lakes,
W82-03344 1507 2H

The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 1508 5C

Water Level Control for Small Hydro Plants,
W82-04173 1509 8C

The Rehabilitation of Norway's Largest Lake,
W82-05243 1511 5G

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 1511 2K

Investigations for Norway's Longest Unlined Pressure Shaft,
W82-05980 1512 8E

Designing and Excavating Underground Powerplants,
W82-05982 1512 8E

Cold Regions Engineering in Norway,
W82-06000 1512 8A

Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 1512 5F

Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 1512 2K

Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 1512 5A

NORWICH
Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 1502 5D

Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 1512 5D

NORWICH SEWAGE WORKS
Operational Estimation and Prediction of Nitrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

NOTTAWASAGA BAY
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 1503 2J

NOVA SCOTIA
Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C
Ice Problems at a Cooling Water Intake in a Tidal Estuary at Lingan, N.S.,
W82-00230 1501 8A
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C
Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 1502 8B
Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J
Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F
The Shubenacadie-Stewiacke River Basin Study,
W82-05385 1511 6B

NOZZLES
Erosion by Submerged Circular Jets,
W82-05002 1511 2J

NUCLEAR ENERGY
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 1504 5B

NUCLEAR ENGINEERING
The Status of Nuclear Waste Management,
W82-02659 1506 5E

NUCLEAR EXPLOSIONS
Hydrological Studies Possible with Radionuclides of Bomb-Test, Primordial and Natural Origin to Complement Investigations Using Manufactured Radiotracers,
W82-03836 1509 5B
Effects on Global Supplies of Freshwater,
W82-06733 1512 5C

NUCLEAR MAGNETIC RESONANCE
The Structure of Freshwater Humic Substances as Revealed by 13C-NMR Spectroscopy,
W82-03095 1507 2H
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 1512 5A

NUCLEAR POWERPLANTS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H
Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 1502 5A
A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 1503 2H
Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 1506 5D
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C
Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B
241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 1507 5B
Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 1508 5B
Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L
Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C
Power Plant Siting and Design: A Case Study of Minimal Entrainment and Impingement Impacts at Davis-Besse Nuclear Power Station,
W82-03964 1509 5C
The Unterweser Automatic Water Quality Measurement System,
W82-04588 1510 5A
A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C
Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 1511 5E
Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 1511 5B
Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 1512 5C

NUCLEAR REACTORS
Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

NUCLEAR WASTES
Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods,
W82-03873 1509 5B
The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 1511 5B
Radioactive Wastes,
W82-06920 1512 5E

NUCLEATION
Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

NUISANCE
Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

NUMERICAL ANALYSIS
A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 1502 2B
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 1503 2F
A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 1507 2F
The Seepage Flow Through a Free Boundary Aquifer into a River,
W82-04305 1510 2F
Modelling Evaporation from Reservoirs,
W82-04722 1510 2D
Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 1510 6A
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 1511 7B
Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G
A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 1512 2G
Bacteria Under the Ice,
W82-06561 1512 5A
Numerical Methods in Hydraulics,
W82-06614 1512 8B
Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 1512 3F

NUREK HYDROELECTRIC PLANT
Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

NUREK RESERVOIR
Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

NUTRIENT
Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

NUTRIENT CYCLING
The Effects of Acid Rain on Forest Nutrient Status,
W82-06860 1512 5C

NUTRIENT DYNAMICS
Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 1511 5C

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 1511 5C

NUTRIENT LOADING CONTROL
A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

NUTRIENT REDUCTION
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 1512 5A

NUTRIENT RELEASE
Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

NUTRIENT REMOVAL
Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 1503 4C

Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 1503 5B

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

Concepts in Aquatic Treatment System Design,
W82-02593 1505 5D

Studies on the Ability of a Potamogeton Pectinatus Community to Remove Dissolved Nitrogen and Phosphorus Compounds from Lake Water,
W82-02724 1506 5B

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 1508 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Stream Transport of Nutrients Through a Wetland,
W82-04857 1511 5B

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

An Ion Exchange Process to Recover Nutrients from Sewage,
W82-06516 1512 5D

NUTRIENT REQUIREMENTS
The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 1505 2H

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

NUTRIENT TRANSFORMATIONS
Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 1512 5A

NUTRIENT TRANSPORT
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 1507 5E

NUTRIENTS
Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 1501 5B

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 1501 2A

Lignocellulose Mineralization by Arctic Lake Sediments in Response to Nutrient Manipulation,
W82-00270 1501 2H

Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 1501 5A

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 1501 2I

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 1502 2H

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 1502 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 1502 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 1502 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 1502 2K

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 1502 5G

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

Nutrient Loading of Southern Lake Michigan by Dry Deposition of Atmospheric Aerosol,
W82-01152 1503 5B

Physico-Chemistry, Destratification and Nutrient Budget of a Lowland Eutrophicated Malaysian Reservoir and Its Limnological Implications,
W82-01360 1503 2H

Enrichment Ratios for Water Quality Modeling,
W82-01410 1503 2J

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 1503 5C

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

Application of Nutrient-Saturated Growth Model to Phytoplankton Management in Freshwater Prawn (Macrobrachium Rosenbergii) Ponds in Hawaii,
W82-01483 1503 2H

Stream Nutrient Levels and Proximity of Agricultural and Forest Land to Streams: Some Relationships,
W82-01554 1503 5B

Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 1503 5C

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 1503 5G

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 1503 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

Freshwater Inputs and Estuarine Productivity,
W82-02110 1505 2L

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 1505 5B

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 1505 2L

The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 1505 2L

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 1505 5C

Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 1505 5B

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 1505 5A

Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 1505 5B

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

Simulation Model for Agricultural Non-Point-Source Pollution,
W82-02504 1505 5B

Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 1505 5B

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 1505 5C

Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 1505 2I

Benthic Enrichment in the Georgia Bight Related to Gulf Stream Intrusions and Estuarine Outwelling,
W82-02583 1505 2L

Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

Functional Relationships Between Nutrient Dynamics, Oxidation-Reduction Capacity, and Eutrophication in a Soft-Water Lake,
W82-02810 1506 2H

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

The Canada Water Act, Annual Report 1980-1981,
W82-03098 1507 7C

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 1507 2H

Salinity and Biogenic Material in the North Caspian,
W82-03155 1507 4A

Phosphorus and Nitrogen Budgets of Barton Broad and Predicted Effects of a Reduction in Nutrient Loading on Phytoplankton Biomass in Barton, Sutton and Stalham Broads, Norfolk, United Kingdom,
W82-03184 1507 5C

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 1507 5C

Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

Nutrient Relationships in Shallow Water in an African Lake, Lake Naivasha,
W82-03404 1508 2H

Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 1508 2H

Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 1508 5D

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 1508 5B

Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 1508 5B

Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 1508 2H

Nitrogen Dynamics in the Surface Waters of the New Jersey Pine Barrens,
W82-03816 1509 2A

Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

A Comparison of the Structure, Primary Productivity, and Transpiration of Cypress Ecosystems in Florida,
W82-03885 1509 2I

Input/Output Models as Decision Aids for Lake Restoration,
W82-03924 1509 5G

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 1510 2L

Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 1510 2L

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

Factors Regulating the Spatial Distribution of the Filamentous Alga Pithophora Oedogonia (Chlorophyceae) in an Indiana Lake,
W82-04382 1510 2H

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 1510 5A

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

Boron Status of Berlin Waters (Bor-Status Berliner Gewasser),
W82-04767 1511 5A

Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 1511 2H

Stream Transport of Nutrients Through a Wetland,
W82-04857 1511 5B

The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 1511 2H

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 1511 2H

Kinetics of Nutrient and Metal Release from Decomposing Lake Sediments,
W82-05139 1511 2H

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

Strategies for Maintaining Water Quality in Two British Columbia Lakes,
W82-05567 1511 5G

Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 1511 4C

A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 1511 5B

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 1511 2H

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 1511 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 1511 5B

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 1511 5G

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

Multistep Approach to Identification of Limiting Nutrients in Northern Adriatic Eutrophied Coastal Waters,
W82-06267 1512 5C

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 1512 5B

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 1512 5C

Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 1512 5C

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 1512 5C

Effects of Naturally Senescing Aquatic Macrophytes on Nutrient Chemistry and Chlorophyll A of Surrounding Waters,
W82-06943 1512 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 1512 5B

OAHU
Sewage Irrigation and Recharge Consequences, Oahu,
W82-04041 1509 3C

Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

OAK RIDGE NATIONAL LABORATORY
Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

OB RIVER
Investigation of Fluvial Processes Under Conditions of Natural Variability of the Runoff,
W82-03906 1509 2J

OBSERVATION WELLS
January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

An Observation-Well Network Concept as Applied to North Carolina,
W82-00414 1501 4B

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

Proposed Observation-Well Networks and Ground-Water Level Program for North Carolina,
W82-00426 1501 4B

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 1503 7C

Probable High Ground-Water Levels in Massachusetts,
W82-02829 1506 2F

Ground Water Monitoring: Part II,
W82-03380 1507 5B

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 1510 7C

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 1512 7C

OBSERVATIONS
Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

OCCOQUAN BASIN
Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 1506 5G

OCCOQUAN RESERVOIR
Analyzing the Risk of Drought: The Occoquan Experience,
W82-04097 1509 2A

OCCOQUAN WATERSHED
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

OCEAN CIRCULATION
Groundwater Discharge to the Pacific Ocean,
W82-01647 1503 2F

On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

The Residence Time of the Freshwater Component in the Artic Ocean,
W82-05872 1511 2A

OCEAN DUMPING
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

Sludge: Back into the Ocean,
W82-02577 1505 5E

Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 1506 5E

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

Disposing of Sewage Sludge at Sea,
W82-05127 1511 5E

Extractable Organic Matter in Municipal Wastewaters. I. Petroleum Hydrocarbons: Tem-

poral Variations and Mass Emission Rates to the Ocean,
W82-05142 1511 5B

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 1512 5E

Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 1512 5C

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 1512 5B

Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 1512 5E

Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 1512 5C

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 1512 5E

Sludge Disposal to Sea in U.K.,
W82-06292 1512 5E

Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 1512 5E

Ocean Dumping Battle Marches On,
W82-06490 1512 5E

Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 1512 5E

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

Sludge Disposal to Sea in France,
W82-06593 1512 5E

Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 1512 5E

Disposal of Sludge to Sea,
W82-06595 1512 5E

Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 1512 5E

Ocean Disposal Legislation in the United States,
W82-06597 1512 5E

Sludge Disposal to Sea: North American Viewpoint,
W82-06598 1512 5E

Sludge Disposal to Sea in South Africa,
W82-06599 1512 5E

Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 1512 5E

Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 1512 5E

OCULAR SURVEY

Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

ODEN CURVE

Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 1512 2J

ODOR CONTROL

Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 1501 5E

Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 1510 5F

How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme.
W82-05249 1511 5D

Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 1512 5D

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 1512 5D

ODOR REMOVAL

What Caused the Bad Odor in the Drinking Water,
W82-00527 1502 5F

ODORS

Chemistry of Septicity,
W82-00325 1501 5D

What Caused the Bad Odor in the Drinking Water,
W82-00527 1502 5F

Reviving the Rio Reconquista,
W82-02014 1504 5G

OFF-ROAD VEHICLE EFFECTS

Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

OFFICE OF WATER RESEARCH AND TECHNOLOGY

Water Research in Action.
W82-05292 1511 6B

OFFSHORE PLATFORMS

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

OGALLALA AQUIFER

Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

Managing Crisis: The Effectiveness of Local Districts for Control of Ground Water Mining,
W82-02819 1506 4B

Economics of Declining Water Supplies in the Ogallala Aquifer,
W82-04922 1511 4B

OGALLALA FORMATION

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 1501 7C

OHIO

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 1501 4C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 1502 6E

Ohio's Ground Water Resources and Problem Areas,
W82-01057 1502 4B

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

Water Management Model Evaluation for North Central Ohio,
W82-01536 1503 4A

Microorganism Inventory in Activated Sludge Control,
W82-03483 1508 5D

Computer-Based Implementation of Combined Sewer Control,
W82-04783 1511 5D

Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

Water Use in Ohio, 1975,
W82-05226 1511 6D

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

Polymer Plays Plant Improvement Role,
W82-06250 1512 5D

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

Flood of August 20, 1979, on a Tributary of Chickamauga Creek, Near Gallipolis, Ohio,
W82-06947 1512 4A

Hydraulic Analysis, Paint Creek at State Route 772, Chillicothe, Ohio,
W82-06948 1512 8B

OHIO RIVER

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

Bank Failure and Erosion on the Ohio River,
W82-02343 1505 2J

An Organics Detection System for the Ohio River,
W82-03436 1508 5A

An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

Bank Failure and Erosion on the Ohio River,
W82-04473 1510 2J

OHIO RIVER BASIN
Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 1502 4B

Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, April 28-29, 1981. Cincinnati, Ohio.
W82-02106 1505 2F

A Trigger Type Cluster Model for Flood Analysis,
W82-03818 1509 2A

An Interactive Data Management System for River Water Quality Data,
W82-04659 1510 10B

OIL
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 1506 5A

Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 1511 5A

Biodegradation of Synthetic Crude Oil in Two Rivers of Northern Alberta, Canada,
W82-05486 1511 5B

OIL AND GAS PRODUCTION
Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 1505 5G

OIL FIELDS
Land Restoration Following Oil-Well Drilling,
W82-00057 1501 5D

OIL INDUSTRY
Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

Deep Well Injection of Industrial Wastes,
W82-00475 1501 5E

Mixing Technology Reduces Energy Use,
W82-00634 1502 5D

Floc/Float System Cleans Desalter Effluent,
W82-00906 1502 5D

Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 1510 6E

Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

Shale Oil Wastewater Treatment by Evaporation,
W82-04905 1511 5D

Experimental Studies to Determine the Fate of Petroleum Hydrocarbons from Refinery Effluent on an Estuarine System,
W82-05144 1511 5B

OIL POLLUTION
Method and Apparatus for Pollutant Spill Control,
W82-00056 1501 5G

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 1501 5G

Development of Oil-In-Water Monitor, Phase II,
W82-00100 1501 5A

Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

System for Oil and Water Separation,
W82-00611 1502 5D

Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 1503 5G

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 1504 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 1504 5B

Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 1505 5B

Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 1506 5A

Development of a Multidetector Petroleum Oil-In-Water Monitor,
W82-02964 1506 5A

Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 1507 5C

Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 1508 5C

An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606 1511 5B

Spilled Petroleum Recovered from Atop Water Table of Mississippi Aquifer,
W82-06185 1512 5G

OIL RECOVERY
Petroleum Processing Wastes,
W82-01262 1503 5D

Performance Testing of the Diperna Sweeper,
W82-05058 1511 5G

Performance Testing of Four Skimming Systems,
W82-05059 1511 5G

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 1511 5G

OIL REFINERIES
Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 3C

Designing Wastewater Treatment Systems to Save Energy,
W82-04906 1511 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

OIL SEALANTS
Stopping Water with Chemical Grout,
W82-03396 1507 8G

OIL SHALE
The Analysis of Oil Shale Wastes: A Review,
W82-00388 1501 5A

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 1501 5D

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 1501 5D

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 1501 5D

Alkylpyridines in Surface Waters, Groundwaters, and Subsoils of a Drainage Located Adjacent to an Oil Shale Facility,
W82-00481 1501 5B

Groundwater Leaching of Organic Pollutants From in Situ Retorted Oil Shale. A Mass Transfer Analysis,
W82-00626 1502 5B

Hydrogeochemistry and Simulated Solute Transport, Piceance Basin, Northwestern Colorado,
W82-00723 1502 5B

Synthetic Fuel Effluents,
W82-01263 1503 5B

Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 1504 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

Will Synfuel Development Drain the West Dry,
W82-03292 1507 6D

Stream Macroinvertebrate Baseline Surveys: A Comparative Analysis from the Oil-Shale Regions of Colorado, USA,
W82-03635 1508 5A

Migration Through Soil of Organic Solutes in An Oil-Shale Process Water, W82-03640 1508 5B

Note, Water for Oil Shale: Framework for the Legal Issues, W82-04681 1510 6E

Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law, W82-04803 1511 6E

Shale Oil Wastewater Treatment by Evaporation, W82-04905 1511 5D

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector, W82-05151 1511 5A

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals, W82-05375 1511 5C

Cold Lake-Beaver River Regional Water Resources Study, W82-05396 1511 6D

Synthetic Fuel Effluents, W82-06800 1512 5D

OIL SHALE MINING

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals, W82-05375 1511 5C

OIL SKIMMERS

Performance Testing of the Soviet Oil/Debris Skimmer, W82-04621 1510 5G

Performance Testing of the Diperna Sweeper, W82-05058 1511 5G

Performance Testing of Four Skimming Systems, W82-05059 1511 5G

OIL SLICKS

Oil Slick Mechanics, W82-05064 1511 5G

OIL SPILLS

Method and Apparatus for Pollutant Spill Control, W82-00056 1501 5G

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy, W82-00062 1501 5G

Compelled Self-Incrimination and the Federal Water Pollution Control Act, W82-01600 1503 6E

Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh, W82-02358 1505 5B

Characterization of Oil Spills on Inland and Estuarine Waters, W82-02393 1505 5B

Using Coherent Water Jets to Control Oil Spills, W82-03031 1507 5G

Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents, W82-03371 1507 5G

The Growing Business of Bacterial Cultures, W82-03786 1509 5D

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill, W82-04548 1510 5C

Performance Testing of the Soviet Oil/Debris Skimmer, W82-04621 1510 5G

Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring, W82-04884 1511 5C

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms, W82-05062 1511 5G

Oil Slick Mechanics, W82-05064 1511 5G

Dispersant Application System for the U.S. Coast Guard 32-Foot WPB, W82-05069 1511 5G

Handbook for Oil Spill Protection and Cleanup Priorities, W82-05210 1511 5G

The Oilspill Risk Analysis Model of the U.S. Geological Survey, W82-06145 1512 5B

OIL TANKERS

The Successful Treatment of Tanker Ballast Water at a Mediterranean Site, W82-03703 1508 5D

Treatment Effectiveness: Oil Tanker Ballast Water Facility, W82-04625 1510 5D

OIL WASTES

By-Product Recovery Finances Treatment, W82-02756 1506 5D

Palm Oil Refinery Wastes Treatment, W82-03909 1509 5D

Mutagenic Potential of Water Concentrates from the Effluent of a Waste Oil Storage Pond, W82-03727 1511 5C

OIL-WATER INTERFACES

The Spreading of Thin Liquid Films on a Water-Air Interface, W82-01955 1504 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream, W82-01956 1504 1B

Characterization of Oil Spills on Inland and Estuarine Waters, W82-02393 1505 5B

Oil Slick Mechanics, W82-05064 1511 5G

OIL WELLS

Application of the Area of Review Concept, W82-04674 1510 6E

OILS

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature, W82-06655 1512 5D

OILY WATER

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters, W82-00060 1501 5D

Development of Oil-In-Water Monitor, Phase II, W82-00100 1501 5A

The Successful Treatment of Tanker Ballast Water at a Mediterranean Site, W82-03703 1508 5D

Oil-Water Separation by Induced Air Flotation, W82-03719 1508 5D

Chrysler Upgrades Oily Wastes Treatment in Kokomo, W82-04283 1510 5D

Treatment Effectiveness: Oil Tanker Ballast Water Facility, W82-04625 1510 5D

Oil and Grease in Stormwater Runoff, W82-05557 1511 5C

OKA VALLEY

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley, W82-03556 1508 5B

OKEFENOKEE SWAMP

Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia, W82-00936 1502 2H

Environmental Impact of Upland Streams on the Okefenokee Swamp, W82-05933 1512 5B

OKLAHOMA

Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year, W82-00012 1501 6E

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model, W82-01672 1503 2E

Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton, W82-02398 1505 5C

Effects of Whole Lake Mixing on Water Quality and Phytoplankton, W82-0[illegible]33 1506 5G

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma, W82-03510 1508 5G

Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality, W82-03948 1509 7B

Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma, W82-03999 1509 2E

Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma, W82-04225 1509 4A

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978, W82-04518 1510 7C

Economics of Declining Water Supplies in the Ogallala Aquifer, W82-04922 1511 4B

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute. W82-05301 1511 6B

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir, W82-05912 1512 5C

Real-Time, Statistically Linearized, Adaptive Flood Routing, W82-06855 1512 4A

Effect of Artificial Destratification on Iron, Manganese, and Zinc in the Water, Sediments,

and two Species of Benthic Macroinvertebrates in an Oklahoma Lake,
W82-06897 1512 5G

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

OLATHE
Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 1501 5D

OLDMAN RIVER
Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

OLIGOCHAETES
Effect of the Earthworm, Eisenia Foetida (Oligochaeta), on Fluxes of Volatile Carbon and Sulfur Compounds from Sewage Sludge,
W82-02362 1505 5E

Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 1505 5A

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

OLIGOTROPHIC LAKES
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 1504 2H

Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 1505 2H

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 1506 2H

Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 1507 2H

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

OLIGOTROPHY
Distribution of Obligately Oligotrophic Bacteria in Lake Biwa,
W82-00346 1501 5A

OLIOGOTROPHIC LAKES
The OECD Cooperative Programme on Eutrophication; Canadian Contribution, Summary Report,
W82-06566 1512 5A

ON-SITE DATA COLLECTIONS
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 1512 7C

ON-SITE SYSTEMS
Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

ONEIDA LAKE
Iron-Manganese Banding in Oneida Lake Ferromanganese Nodules,
W82-03342 1507 2H

ONONDAGA
Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC,
W82-05255 1511 5A

ONTARIO
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 1501 2L

Recent Developments in Water Pollution Control,
W82-00340 1501 5D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 1503 2I

Estimating Evapotranspiration from Irrigated Crops in Southwestern Ontario,
W82-01116 1503 2D

A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 1503 2H

A Classification and Description of Some Northeastern Ontario Lakes Influenced by Acid Precipitation,
W82-01145 1503 5B

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 1503 2C

An Analysis of Acidic Precipitation in South-Central Ontario Using Air Parcel Trajectories,
W82-01513 1503 5B

The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 1505 6B

Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 1505 5E

Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 1505 5B

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 1505 5G

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 1505 2H

History of Human-Use Impacts on Long Point Bay,
W82-02580 1505 5B

The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 4B

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 1507 8A

Hypolimnetic Aerator Fights Eutrophication,
W82-03563 1508 5G

Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 1508 5D

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

Hydroelectric Power Development Conflicts and Approvals: The Ontario Scene,
W82-03616 1508 6G

Highlights of the St. Mary's Redevelopment Project,
W82-03617 1508 8A

Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario,
W82-04031 1509 2K

Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant,
W82-04116 1509 5F

Water Management in Ontario,
W82-04259 1510 6E

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 1511 5B

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

River Basin Management in Ontario,
W82-05393 1511 6E

Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 1511 2C

The Chemistry and Isotopic Composition of Saline Groundwaters from the Sudbury Basin, Ontario,
W82-05990 1512 2F

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 1512 5B

Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 1512 5B

OPEN-CHANNEL DRAINAGE
Topologic Model for Drainage Networks with Lakes,
W82-05905 1512 2A

OPEN CHANNEL FLOW
Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 1501 2J

Possibility of Investigating Open-Channel Flows on an Analog Computer,
W82-02389 1505 6A

Velocity Profiles with Suspended Sediment,
W82-02581 1505 2J

Computerized Control of an Open-Channel Water Distribution System,
W82-02732 1506 4A

Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels'.
W82-03382 1507 2E

Hydraulic Exponents,
W82-03669 1508 2E

Resistance of Beauharnois Canal in Winter,
W82-04998 1511 2C

Nature of Wave Attenuation in Open Channel Flow,
W82-05003 1511 2E

The Rotating Hydraulics of the Open-Channel Flow Between Two Basins,
W82-05083 1511 8B

OPEN CHANNELS
Modeling Circulation in Depth-Averaged Flow,
W82-02679 1506 2E

Discussion of 'Turbulence Prediction in Open Channel Flow',
W82-03781 1509 8B

Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

On Measuring Time-Averaged Velocities in Open Channel Flow,
W82-05462 1511 2J

The Properties of the Kernels of the Volterra Series Describing Flow Deviations from a Steady State in an Open Channel,
W82-05525 1511 2E

Flow Resistance in Wide Rectangular Channels,
W82-05798 1511 8B

OPEN WELLS
Bottom-Entry Large-Diameter Wells,
W82-04919 1511 8A

OPERATING COSTS
Operation Reports: East Bay Municipal District (SD No 1), California.
W82-02707 1506 5D

Operation Reports--City of Pueblo, Colorado Department of Public Works.
W82-03348 1507 5D

Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

Practical Power-Saving Techniques in Pinellas County,
W82-04092 1509 5F

Pump Systems: What Price Inefficiency,
W82-04093 1509 8C

Leak Detection Programs Recover Revenues,
W82-04375 1510 3D

On the Marginal Cost of Wastewater Services,
W82-04376 1510 6C

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 1510 5D

OPERATING POLICIES
The Effect of EEC Directives on Water Supplies,
W82-02432 1505 6E

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 1505 6A

Reliability and Redundancy: Dual Protection for Water Treatment Plants,
W82-04148 1509 5F

Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis,
W82-04430 1510 6A

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 1511 4A

Modified Standard Operation Rules for Reservoirs,
W82-05658 1511 4A

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 1512 2E

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

OPERATION AND MAINTENANCE
Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 1506 6C

OPERATIONS RESEARCH
Operational Research Techniques in River Basin Management,
W82-05387 1511 6A

OPIUM POPPY
Consumptive Water Use by Opium Poppy,
W82-03356 1507 2I

OPOSSUM SHRIMP
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

OPTICAL PROPERTIES
Detection of Oil Pollutants on the Surface of Inland Waters by a Projector-Based Optical Detector,
W82-02853 1506 5A

OPTIMAL YIELD
Managing Wells for Energy Efficiency,
W82-03734 1508 4B

OPTIMIZATION
Optimal Design of Furrow Irrigation Systems,
W82-00138 1501 3F

The Uncertainty of Crop Models in Irrigation Optimization,
W82-00940 1502 3F

Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 1503 6A

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 1503 6A

O & M Costs and Optimal Capacity Expansion,
W82-04042 1509 6B

Optimization of Looped Water Distribution Systems,
W82-04045 1509 6A

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

Modified Standard Operation Rules for Reservoirs,
W82-05658 1511 4A

Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 1511 2E

Algorithm for Optimal Activated Sludge Operation,
W82-05682 1511 5D

An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 1511 6A

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 1511 5G

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 1512 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 1512 2I

Reservoir Systems Optimization,
W82-06433 1512 4A

Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 1512 3F

OPTIMIZATION SYSTEM ANALYSIS
Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

OPTIMUM DEVELOPMENT PLANS
Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 1511 2E

Optimal Salinity Control Program for the Upper Colorado River Basin,
W82-05893 1511 5G

OPTIMUM DEVELOPMENT PLANS
Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

ORANGE COUNTY
Interagency Connections: Insurance Against Interruptions in Supply,
W82-04090 1509 5F

ORANGE COUNTY WATER DISTRICT
Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 1505 5D

ORCHARDS
Irrigation Efficiency in Orchards,
W82-05768 1511 3F

Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream,
W82-06177 1512 5C

ORDINANCES
Developing Dam-Break Flood Zone Ordinance,
W82-02585 1505 6F

OREGON
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 1503 5A

Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 1504 6E

Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 1505 2H

Energy Costs and Portland Water Supply System,
W82-02586 1505 5F

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 1505 7B

Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

Bedload and Size Distribution in Paved Gravel-Bed Streams,
W82-05795 1511 2J

Carrying Capacity for the Illinois River,
W82-05927 1512 6G

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 1512 7C

Regional Detention Basins for Stormwater Control,
W82-06225 1512 8A

Erosion Control at a Delicate Highway Construction Site,
W82-06510 1512 4D

Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

Evaluating Inland Waterway Navigation Improvement Projects: The Case of the Bonneville Lock,
W82-06869 1512 6B

Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 1512 5C

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 1512 7C

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 1512 7B

ORGANIC ACIDS
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 1501 5E

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 1504 5B

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 1504 5D

Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

ORGANIC CARBON
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 1501 2J

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 1501 5D

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 1503 2J

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 1504 5A

Determination of Dissolved Organic Carbon in Water,
W82-02194 1505 5A

Pathways and Mechanisms for Removal of Dissolved Organic Carbon from Leaf Leachate in Streams,
W82-02222 1505 5B

Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 1506 5D

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 1506 2H

Recent Inshore Sediments in Musandam, Oman,
W82-02857 1506 2J

Development and Use of a Continuous Toc-Measurement Device in Wastewater Purification,
W82-04019 1509 5A

Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

Removal of Organics by Reactivated Carbon,
W82-04159 1509 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 1510 5D

Performance of Granular Activated Carbon for Total Organic Carbon Removal,
W82-05677 1511 5F

Industrial Wastes as Carbon Sources in Biological Denitrification,
W82-06457 1512 5D

Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 1512 5A

ORGANIC CHEMICALS
Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

ORGANIC COMPOUNDS
Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 1501 5A

Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal,
W82-00197 1501 5D

Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 1501 5A

Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 1501 5C

Methods for Level 2 Analysis by Organic Compound Category,
W82-00384 1501 5A

Ozone Treatment of Potable Water--Part 2,
W82-00452 1501 5F

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 1501 5B

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 1501 5B

Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 1501 5F

A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 1502 5B

Biodegradability of Halogen-Substituted Diphenylmethanes,
W82-00599 1502 5B

Correlation of Microbial Degradation Rates With Chemical Structure,
W82-00621 1502 2K

Determining Volatile Organics in Water,
W82-00630 1502 5A

Identification of Organic Compounds,
W82-00635 1502 5A

Removal of Priority Pollutants,
W82-00639 1502 5D

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 1502 5A

Abundance of Organic Compounds in Water,
W82-01162 1503 5A

Organics,
W82-01239 1503 5A

Chemicals and Allied Products,
W82-01267 1503 5D

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 1503 5B

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

Modeling of Activated Carbon and Coal Gasification Char Adsorbents in Single-Solute and Bisolute Systems,
W82-01447 1503 1B

Investigation of Volatile Organics Removal,
W82-01490 1503 5F

Relationship of the Raw Water Quality to Mutagens Detectable by the Ames Salmonella/Microsome Assay in a Drinking-Water Supply,
W82-01493 1503 5A

Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 1503 5A

Concentrating Organics in Water for Biological Testing,
W82-01591 1503 5A

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 1503 5D

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 1503 5A

Organic Substances in Water,
W82-01783 1503 5A

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 1504 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 1504 5B

Tying Up TCE,
W82-01866 1504 5G

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 1504 5B

Transport and Fate of Selected Organic Pollutants in a Sandy Soil,
W82-02220 1505 5B

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 1505 5F

Application of Adsorption to Wastewater Treatment,
W82-02622 1506 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

Transfer of Volatile Substances from Water to the Atmosphere,
W82-02902 1506 1B

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 1506 5F

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 1507 5D

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 1507 5D

Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 1507 2K

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 1508 5B

Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 1508 5F

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 1508 5D

The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 1508 5A

Comparison of Five Different Methods for Measuring Biodegradability in Aqueous Environments,
W82-03557 1508 1B

Continuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 1508 5A

EPA's Priority Pollutants: Where They Come from–Where They're Going,
W82-03875 1509 6E

An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

An Evaluation of Activated Carbon for Drinking Water Treatment: A National Academy of Science Report,
W82-04146 1509 5F

Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

A Treatment System for an Organic Chemicals Plant,
W82-04353 1510 5D

Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 1510 5A

Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 1510 5B

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 1510 5D

ORGANIC COMPOUNDS

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 1510 5F

Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 1511 5B

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 1511 5A

Biodegradation of Hazardous Organic Pollutants,
W82-04910 1511 5B

Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 1511 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 1511 2K

The New Pollution--Groundwater Contamination,
W82-04938 1511 5C

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 1511 5B

GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 1511 5A

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 1511 5G

Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 1511 5A

Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 1511 5D

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

Microbial Removal of Hazardous Organic Compounds,
W82-05177 1511 5D

The use of Activated Carbon in Water Treatment,
W82-05182 1511 5F

Containment and Treatment of the Love Canal Landfill Leachate,
W82-05250 1511 5D

The Dissipation of Nonylphenol in Stream and Pond Water Under Simulated Field Conditions,
W82-05273 1511 5B

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 1511 5D

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 1511 5D

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 1511 5A

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 1511 5A

Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 1511 5C

Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 1511 5F

Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 1511 5F

Volatilization of Ketones From Water,
W82-05782 1511 5C

Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 1512 5A

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 1512 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 1512 5A

Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 1512 5D

Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 1512 5B

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

Monitoring of Selected Trace Organics During Biological Wastewater Treatment,
W82-06392 1512 5D

Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

A Survey of Discharges from a Natural Gas Drilling Operation in Lake Erie,
W82-06720 1512 5B

Physicochemical Properties as Useful Tools for Predicting the Environmental Fate of Organic Chemicals,
W82-06727 1512 5B

Kinetics and Extent of Mineralization of Organic Chemicals at Trace Levels in Freshwater and Sewage,
W82-06756 1512 5B

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 1512 5A

Chemicals and Allied Products,
W82-06805 1512 5D

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5D

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 1512 5G

Organics,
W82-06922 1512 5A

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 1512 5A

ORGANIC LOADING

An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 1501 5C

Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 1507 5D

Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 1511 5D

Biofiltration Design Based on Volumetric Loading,
W82-05698 1511 5D

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

A Survey of Aerated Lagoon Performance,
W82-06391 1512 5D

Bacteria Solve Problems Created by Prisoners.
W82-06505 1512 5D

ORGANIC LOADINGS

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

ORGANIC MATTER

Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 1501 5B

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 1501 2J

The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 1502 3C

Vertical Distribution of Monosaccharides in Lake Water,
W82-00665 1502 2H

The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 1502 5B

The Removal of Organic Matter from Demineralised Water,
W82-00888 1502 5F

Chemical Composition of Labile Fractions in DOM,
W82-00917 1502 2H

Organics in Water - An Engineering Challenge,
W82-01540 1503 5F

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 1503 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 1503 5F

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 1504 2H

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 1504 2H

Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 1504 2G

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 1504 2H

The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1505 1B

Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 1505 5F

Composition and Vertical Flux of Organic Matter in a Large Alaskan Estuary,
W82-02347 1505 2L

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 1506 5B

Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 1506 2H

Impact of Nutrient Enrichment in a Waterchestnut Ecosystem at Takahama-IRI Bay of Lake Kasumigaura, Japan. V. Dynamics of Organic Debris,
W82-03231 1507 2H

Dynamics of Bacterioplankton in the Newport River Estuary,
W82-03520 1508 2L

Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1508 1A

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

An Analysis of Selected Classes of Organic Constituents in the Thames River Estuary,
W82-03819 1509 2L

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

Colloidal Organics,
W82-04689 1510 5F

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

Modeling of Leachate Organic Migration and Attenuation in Groundwaters Below Sanitary Landfills,
W82-05075 1511 5B

The Effects of Adsorbed Humic Substances on the Surface Charge of Goethite (Alpha-Fe00H) in Freshwaters,
W82-05140 1511 2K

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 1511 5E

Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 1512 5D

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

ORGANIC MATTER *ULTRAVIOLET RADIATION

U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 1503 5A

ORGANIC PESTICIDES

Kepone Distribution in the Water Column of the James River Estuary - 1976-78,
W82-02360 1505 5B

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 1511 5A

ORGANIC POLLUTION

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 1511 2H

ORGANIC PRECURSORS

Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 1506 5F

ORGANIC SOILS

Nitrate Reduction in an Organic Soil-Water System,
W82-01129 1503 5B

Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 1504 2G

ORGANIC SOLVENTS

Solvent Extraction of Phenols,
W82-00438 1501 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 1501 5D

A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 1503 5B

If Your City's Well Water Has Chemical Pollutants, Then What,
W82-03451 1508 5B

ORGANIC WASTES

Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 1501 5D

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 1502 5D

The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 1506 5C

Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 1510 5D

Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

ORGANIZATION IDENTIFICATION CODE

Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

ORGANIZATIONS
Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 1502 10D

Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

ORGANOCHLORINE
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

ORGANOCHLORINES
Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

ORGANOLEPTIC PROPERTIES
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

ORGANOPHOSPHORUS COMPOUNDS
Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 1502 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 1504 5B

ORGANOPHOSPHORUS PESTICIDES
Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers,
W82-01567 1503 5C

Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 1504 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

ORGEON
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

OROGRAPHIC PRECIPITATION
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 1504 2B

ORTHOKINETIC FLOCCULATION
Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

ORTHOPHOSPHATES
Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

OSAKA
Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

OSCILLATORY WAVES
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 1512 8E

Free Surface Oscillations in Lake Kinneret,
W82-06879 1512 2H

OSMOSIS
Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 1511 3A

Molecular (Osmotic and Electro-Osmotic) Backwash of Cellulose Acetate Hyperfiltration Membranes,
W82-06792 1512 3A

OSMOTIC PRESSURE
Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 1508 2I

OSWEGO COUNTY
Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

OTTAWA RIVER
Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

OTTER TAIL COUNTY
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 1501 5D

OUTER CONTINENTAL SHELF
The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

OUTFALL SEWERS
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 1505 5G

Flexible Outfall at Aldeburgh,
W82-02415 1505 8A

Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 1507 5E

A Surface Water Outfall Sewer for Bournemouth By-Pass.
W82-04003 1509 8A

Discharge to the North Sea,
W82-06248 1512 5E

Design and Operational Aspects of Screening Installations at Sea Outfalls on the Northumbrian Coast,
W82-06645 1512 5E

OUTFALLS
The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 1505 5E

Sludge Disposal to Sea in South Africa,
W82-06599 1512 5E

OUTLETS
Hydraulic Model Study of Daule-Peripa Spillway and Outlet Works,
W82-01446 1503 8A

Intakes and Outlets for Low-Head Hydropower,
W82-01979 1504 8C

The Choice of Hydraulic Energy Dissipator for Dam Outlet Works Based on a Survey of Prototype Usage,
W82-06500 1512 8A

OVERDRAFT
Subsidence--A Geological Problem with a Political Solution.
W82-03452 1508 4B

OVERFLOW
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 1507 8A

Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 1508 5D

Detroit-Style CSO Studies,
W82-06247 1512 5G

OVERLAND FLOW
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

Overland Flow on a Diverging Surface,
W82-00986 1502 2A

Sediment Transport Capacity of Overland Flow,
W82-01408 1503 2J

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 1503 5E

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

Water Routing on Diverging-Converging Watersheds,
W82-02200 1505 2A

Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Diverging Overland Flow,
W82-03676 1508 2A

Delivery of Suspended Sediment and Pollutants from Nonpoint Sources during Overland Flow,
W82-03902 1509 2J

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

OWLS HEAD TREATMENT PLANT
Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

OWNERSHIP
Who Owns Nebraska's Ground Water,
W82-06819 1512 6E

OXIDATION

Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 1501 2H

Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 1501 2K

Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 1502 2L

Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 1502 2K

Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 1503 2K

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 1503 2H

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

Kinetics and Product of Ferrous Iron Oxygenation in Aqueous Systems,
W82-02923 1506 2K

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 1507 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

Functional Relations Between General Characteristics of Organic Matter in Natural Waters,
W82-03573 1508 1A

Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals,
W82-03771 1509 2K

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 1510 5F

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 1511 5A

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 1511 5D

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment,
W82-06380 1512 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

OXIDATION DITCHES

Simplified Clarifier Axes Treatment Stages,
W82-06820 1512 5D

OXIDATION LAGOONS

Lagoons and Oxidation Ponds,
W82-01244 1503 5D

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 1510 5D

Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 1512 5D

OXIDATION PONDS

Lagoons and Oxidation Ponds,
W82-01244 1503 5D

Trace Metal Concentrations in Oxidation Ponds,
W82-02703 1506 5D

Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 1512 5D

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 1512 5C

OXIDATION-REDUCTION POTENTIAL

Effect of pH and Redox Potential on Concentration of Dissolved Nutrients in an Estuarine Sediment,
W82-00795 1502 2L

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Electron Intensity, the Role of Humic Acids in Extracellular Electron Transport and Chemical Determination of pE in Natural Waters,
W82-02566 1505 2K

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

Stability of Beta-MnOOH and Manganese Oxide Deposition from Springwater,
W82-06862 1512 2K

OXIDIZING ENZYMES

Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

OXNARD

The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

OXYGEN

An Analysis of Factors Affecting Oxygen Depletion in the New York Bight,
W82-00106 1501 5C

O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 1503 5D

Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 1504 5D

Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 1507 4A

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters,
W82-04162 1509 5C

Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 1510 2H

Saving Energy by Catalytic Reduction of Oxygen in Feedwater,
W82-05183 1511 5F

Criteria for Nitrification in Fixed Film Reactors,
W82-05352 1511 5D

Influence of High Partial Pressure of Carbon Dioxide and/or Oxygen on Nitrification,
W82-05498 1511 5D

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

The Use of Oxygen in Sewage Treatment,
W82-06262 1512 5D

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 1512 5C

OXYGEN DEMAND

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

Studies of the Transformations of Forms of Carbon, Nitrogen, Phosphorus, Sulfur and Some Principal Mineral Elements During the Measurement of the Total Oxygen Demand - II. Transformation of Forms of Nitrogen (In French),
W82-03485 1508 5A

Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French).
W82-03486 1508 5A

Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833 1509 5A

Aeration Control for Reducing Energy Consumption in Small Activated Sludge Plants, W82-04026 1509 5D

Specific Oxygen Demand as an Operating Parameter for Activated Sludge Processes, W82-04029 1509 5D

Characterization of Industrial Wastes by Evaluating BOD, COD, and TOC, W82-05255 1511 5A

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration, W82-05466 1511 5D

A Comparison of the Carbonaceous Oxygen Demands of a Domestic and Industrial Sewage, W82-05467 1511 5D

The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants, W82-06611 1512 5D

OXYGEN DEPLETION

An Analysis of Factors Affecting Oxygen Depletion in the New York Bight, W82-00106 1501 5C

Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake, W82-00545 1502 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes, W82-02004 1504 2H

Lake Deoxygenation After Herbicide Use: A Simulation Model Analysis, W82-03113 1507 5C

Immediate and Delayed Oxygen Depletion in Rivers, W82-06269 1512 5G

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem). W82-06913 1512 5C

OXYGEN FLORAL STEM

Mineral Dynamics of The Submersed Macrophyte, Myriophyllum Heterophyllum, and The Competitive Interactions for Nutrients Between M. Heterophyllum, Phytoplankton and The Sediments in Littoral Waters, W82-04162 1509 5C

OXYGEN ISOTOPES

018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters, W82-01590 1503 2C

The Relationship Between 018 and Deuterium in Water in Sand Columns Undergoing Evaporation, W82-05759 1511 2G

OXYGEN LEVELS

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick, W82-06572 1512 5B

OXYGEN TRANSFER

Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows) W82-01153 1503 2H

Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment, W82-04395 1510 5D

Studies on Oxygen Transfer Models, W82-05349 1511 1A

Solving a Poor Oxygen Transfer Problem. W82-05952 1512 5D

How Much Air, W82-06638 1512 5D

OXYGEN UPTAKE

The Continuous Oxygen Uptake Rate Measurement and Its Applicability as an Activated Sludge Control Parameter, W82-04020 1509 5D

Metabolic Responses of Aquatic Bacterial Populations to Selected Insecticides, W82-04257 1510 5C

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary, W82-04751 1511 2L

Heterotrophic Assimilation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters, W82-05326 1511 1A

Biofiltration Design Based on Volumetric Loading, W82-05698 1511 5D

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water, W82-06032 1512 5A

OXYGENATION

Pressurized Oxygenation System and Method, W82-00064 1501 5D

Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System, W82-01594 1503 5D

Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment, W82-03032 1507 5D

Dissolved Oxygen Content Monitoring Using Gas Phase Oxygen Analysis in a High Purity Oxygen Activated Sludge Plant, W82-04344 1510 5D

Hypolimnion Oxygenation Studies in Clark Hill Lake, W82-05001 1511 5G

Oxygenation of the Avon River, W82-05730 1511 5G

The Use of Oxygen in Sewage Treatment, W82-06262 1512 5D

OYSTERS

Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers, W82-00406 1501 5D

OZONATION

High-Level Ozone Disinfection of Municipal Wastewater Effluents, W82-00379 1501 5D

Assessment of Environmental Control Technology for Coal Conversion Processes, W82-00432 1501 5D

Ozone Treatment of Potable Water - Part I, W82-00451 1501 5F

Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water, W82-00649 1502 5A

Disinfection, W82-01250 1503 5D

Ozone Water Treatment, W82-02682 1506 5F

Obtaining High-Level Wastewater Disinfection with Ozone, W82-02706 1506 5D

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light, W82-03005 1507 5D

Ozone for the Treatment of Hazardous Materials, W82-03139 1507 5D

Ozone Water Treatment Systems, W82-03448 1508 5F

Ozone for Municipal Wastewater Disinfection, W82-03559 1508 5D

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution, W82-04731 1510 5F

Kinetic Modeling of the Ozonation of Phenol in Water, W82-04780 1511 5C

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations, W82-04795 1511 5F

Ozone and Activated Carbon, W82-05370 1511 5F

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies, W82-05907 1512 5F

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances, W82-06173 1512 5F

Experimental Data About Waste-Water Tertiary Treatment with Ozone, W82-06257 1512 5D

Generation and Utilization of Ozone in Waste Water Treatment, W82-06442 1512 5D

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions, W82-06661 1512 5D

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling, W82-06709 1512 5F

OZONE

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water, W82-00292 1501 5F

Ozone Treatment of Potable Water--Part 2, W82-00452 1501 5F

Mechanism of Enteroviral Inactivation by Ozone. W82-01482 1503 5D

Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies, W82-03001 1507 5D

Inactivation of Enteroviruses by Ozone, W82-03208 1507 5F

Treating Taste and Odour Problems Using Ozone and Activated Carbon, W82-04553 1510 5

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 1510 5F

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 1511 5F

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 1512 5F

Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 1512 5D

Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 1512 5D

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 1512 5D

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 1512 5D

OZONOLYSIS
Oxidation Products and Rates of Reaction in the Ozonolysis of Diebenzofuran,
W82-06305 1512 5B

P-CHLOROPHENOL
Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

P-TOLUENE SULFONATE
Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

PACIFIC NORTHWEST
Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 1501 6A

Aerial Photography to Detect Rill Erosion,
W82-02232 1505 7B

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 1507 2I

Forecasting Water Demand in the Pacific Northwest,
W82-04135 1509 6D

PACIFIC NORTHWEST U.S
Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

Forest Management and Anadromous Fish Habitat Productivity,
W82-06965 1512 5C

PACIFIC OCEAN
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

PACKED-BED REACTOR
Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

PACKED BEDS
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 1504 5D

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

PAINT INDUSTRY
Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

PAKISTAN
Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 1502 3F

On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

Rural Power Schemes in Pakistan,
W82-04328 1510 8A

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 1510 6A

PALAGNEDRA DAM
The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

PALAN ISLANDS
Secondary Benthic Production in a Tropical Island Stream,
W82-06933 1512 5C

PALEOCLIMATOLOGY
Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

PALEOENVIRONMENT
Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

PALEOHYDROLOGY
Paleoflood Hydrology,
W82-03761 1509 2E

PALEOLIMNOLOGY
Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

Paleolimnological Evidence of Early Eutrophication in Lake Erie,
W82-05995 1512 5C

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

PALESTINE LAKE
The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

PALM OIL
By-Product Recovery Finances Treatment,
W82-02756 1506 5D

PALM OIL WASTES
Palm Oil Refinery Wastes Treatment,
W82-03909 1509 5D

PALM OIL WASTEWATER
Palm Oil Waste Treatment Study in Malaysia.
W82-03632 1508 5D

PALO ALTO AREA
Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

PANNONIAN PLAIN
On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929 1511 2H

PANOCHE CREEK
Panoche Creek Flood Protection Works.
W82-04068 1509 4A

PAPAGO INDIAN RESERVATION
Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

PAPENKUILS RIVER
A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 1510 5B

PARAGUAY
Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

PARAMETER ESTIMATION
Parameter Estimation in Eutrophication Modelling,
W82-03863 1509 2H

PARAMETRIC HYDROLOGY
Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 1501 2F

A Parametric Crop Water Use Model,
W82-01310 1503 2I

Geomorphic Parameters of Representative Basins and Their Hydrologic Significance,
W82-06384 1512 2A

PARANA RIVER
The Itaipu Hollow Gravity Dam,
W82-06205 1512 8A

PARAQUAT
Toxicities of Paraquat and Diquat Herbicides to Freshwater Copepods (Diaptomus Sp. and Eucyclops Sp.),
W82-00589 1502 5C

PARASITE
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 1504 5B

PARASITES
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

Observations on Some Common Parasites of Bagrus Docmac Forskahl (Pisces: Siluroidea) of Lake Victoria,
W82-02887 1506 2H

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

PARASITES

The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476 1511 5B

Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

PARIS
Water Supply in the Paris Suburbs: Changing Treatment for Changing Demands,
W82-04125 1509 5F

Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 1510 5F

PARKS
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 1502 6A

Perseverance Produces County Park,
W82-01932 1504 6D

Water Quality and the Demand for Recreation,
W82-01942 1504 6D

On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 1506 5G

PARTIAL DIVERSION
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

PARTIALLY PENETRATING WELLS
Bottom-Entry Large-Diameter Wells,
W82-04919 1511 8A

PARTICLE SIZE
Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 1501 7B

Field Assessment of Sediment Traps,
W82-00105 1501 7B

The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 1501 5A

Seasonal Particle-Size Selection by Diaptomus Sicilis in Offshore Lake Michigan,
W82-00485 1501 2H

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 1504 7B

Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1506 1B

An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 1508 7B

Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

Bed Load Fluctuation: Applications,
W82-05000 1511 2J

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 1512 2J

Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 1512 2J

PARTICLE SIZE DISTRIBUTION
On the Graphical Presentation of Raindrop Size Data,
W82-06529 1512 2B

PARTICULATE MATTER
Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 1501 2L

Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1502 1B

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 1504 2H

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 1511 5B

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 1512 5B

Effects of Dissolved Organic Matter on Adsorption of Hydrophobic Organic Compounds by River- and Sewage-Borne Particles,
W82-06056 1512 5B

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

Attached and Free-Floating Bacteria in a Diverse Selection of Water Bodies,
W82-06887 1512 5B

PARTITION COEFFICIENTS
Use of the Partition Coefficient as an Indicator of Bioaccumulation Tendency of Dyestuffs in Fish,
W82-04820 1511 5B

PASSAIC
Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 1508 5F

PASTURES
The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 1501 2A

Chemical and Bacteriological Quality of Pasture Runoff,
W82-01555 1503 5B

PATENTS
Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 1501 5F

Method and Apparatus for Pollutant Spill Control,
W82-00056 1501 5G

Land Restoration Following Oil-Well Drilling,
W82-00057 1501 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

Energy Recovery System,
W82-00059 1501 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 1501 5D

Fluoridation System,
W82-00061 1501 5F

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 1501 5G

Process for Removing Alkalinity and Hardness From Waters,
W82-00063 1501 5F

Pressurized Oxygenation System and Method,
W82-00064 1501 5D

Underwater Aerator,
W82-00065 1501 5D

High Capacity Waste Water Treatment System,
W82-00066 1501 5D

Floating Breakwater,
W82-00067 1501 8A

Rainwater Gauge,
W82-00068 1501 2B

Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 1501 5D

Traveling Sprinkler System and Method,
W82-00561 1502 3F

Detoxification of Residual Quaternaries,
W82-00562 1502 5G

System for Oil and Water Separation,
W82-00611 1502 5D

Aquatic Weed Cutting Apparatus,
W82-00624 1502 4A

Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

Sprinkler Leveler and Wind Compensating Device,
W82-06164 1512 3F

Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 1512 5D

Apparatus for Desalinating Water,
W82-06711 1512 3A

PATH OF POLLUTANTS
Distribution of Silvex, 2,4-D, and TCDD Applied to Turf in Chambers and Field Plots,
W82-00568 1502 5B

Water-To-Air Fractionation of Bacteria,
W82-00575 1502 5B

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 1503 5B

Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 1503 2F

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

Synthetic Fuel Effluents,
W82-01263 1503 5B

Radioactive Wastes,
W82-01268 1503 5D

Solid Wastes and Water Quality,
W82-01269 1503 5B

Aquatic Sediments,
W82-01279 1503 5B

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 1503 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 1503 6A

Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

Sediment-Contaminant Transport Model,
W82-01614 1503 5B

A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 1503 5B

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 1504 5B

The Mercury Cycle,
W82-01869 1504 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 1504 5B

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 3C

Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 1505 5B

The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 1505 5B

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 1505 2L

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 1506 5B

Study of the Experimental Contamination of the Marine Phanerogam Posidonia Oceanica (L.) Delile by Mercury Compounds I. Modalities of the Contamination by Mercury Chloride. (Etude De La Contamination Experimentale De La Phanerogame Marine Posidonia Oceanica (L.) Delile Par Les Composes Mercuri Ques: Partie I-Modalites De La Contamination Par Le Chlorure Mercurique,
W82-03312 1507 5B

Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 1507 5B

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 1507 5B

Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 1508 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 1508 5B

Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods,
W82-03873 1509 5B

Radon and Radium Discharge to Surface Streams,
W82-03881 1509 5B

Delivery of Suspended Sediment and Pollutants from Nonpoint Sources during Overland Flow,
W82-03902 1509 2J

Modeling the Transport of Heat, Water, and Solute in Unsaturated Soil and Earth Materials,
W82-03958 1509 5B

Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) 1. Pathway of the Direct Photolysis in Solution,
W82-04032 1509 5B

Distribution and Origin of N-Alkanoic Acids, N-Alkanols and N-Alkanes in Environmental Samples (In Japanese),
W82-04171 1509 5B

Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 1510 2H

Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B

Decomposition of Chelates Leached from Waste Disposal Sites,
W82-04879 1511 5B

Sulfate Washout Ratios in Winter Storms,
W82-04898 1511 5B

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 1511 5B

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 1511 5B

Fluxes of Polycyclic Aromatic Hydrocarbons to Marine and Lacustrine Sediments in the Northeastern United States,
W82-05138 1511 5B

Sulphur in the Environment: A Review,
W82-05179 1511 5B

Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada),
W82-05205 1511 5B

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

Manganese, Zinc and Copper in Hydrobionts in the Danube and the Northwestern Black Sea,
W82-05458 1511 5B

Contaminant Dispersion in Oscillatory Flows,
W82-05631 1511 5B

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

Geochemical Pathway Studies of Heavy Metals in Lake Sediments from the Sudbury-Temagami Area, Ontario,
W82-05640 1511 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 1511 5B

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 1511 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 1511 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 1511 5B

Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 1512 5B

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 1512 5B

Mercury in the River Mersey, Its Estuary and Tributaries During 1973 and 1974,
W82-06049 1512 5B

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 1512 2K

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

Dispersion in Mountainous Natural Streams,
W82-06357 1512 2E

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 1512 5B

Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 1512 2L

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 1512 2L

Biogeochemistry of Mountain Stream Waters: The Marmot System,
W82-06569 1512 5B

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 1512 5B

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 1512 5B

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5B

Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 1512 5B

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

Locating Monitoring Wells,
W82-06848 1512 8B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 1512 5B

PATH OFF POLLUTANTS
Circular Wall Jets in Coflowing Streams,
W82-04999 1511 5B

PATHOGENIC BACTERIA
Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 1510 5A

PATHOGENS
Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 1502 5A

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 1502 5B

Microbiology: Detection of Bacterial Pathogens and Their Occurrence,
W82-01288 1503 5B

Disease Outbreaks Caused by Drinking Water,
W82-01289 1503 5C

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

The Continuing Struggle of Waterborne Illness,
W82-05366 1511 5C

The Occurrence of Sewage-Borne Pathogens in the UK,
W82-05476 1511 5B

Criteria for Achieving Pathogen Destruction During Composting,
W82-05697 1511 5D

Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 1512 5D

PATHOLOGY
Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 1507 5C

PATUXENT RIVER
Role of Natural Colloids in the Transport of Hydrophobic Pollutants,
W82-04539 1510 5B

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

Composition of Estuarine Colloidal Material: Major and Trace Elements,
W82-05137 1511 2L

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 1511 2J

PAVEMENT
Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

PAVING
An Overview of Porous Pavement Research,
W82-05744 1511 5D

Status of Porous Pavement Research,
W82-06665 1512 8G

PAWTUXET RIVER
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

PAYETTE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 1507 6D

PEABODY LAKE
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

PEACE RIVER
Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 1508 6G

PEACH
Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

PEACHES
Effect of Irrigation and Tree Density on Peach Production,
W82-00120 1501 2I

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 1504 2I

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

PEAK DEMAND
Peak Period Design Standards for Small Western U.S. Water Supply Systems,
W82-04249 1509 6D

A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 1510 6D

Water Rate Studies and Rate Making Philosophy,
W82-06222 1512 6C

PEAK DEMANDS
The Cost of Peak Capacity Water,
W82-04065 1509 6B

PEAK DISCHARGE
Investigations of Catastrophic Maximum Discharges of the Araks River,
W82-05591 1511 2E

PEAK FLOW
A Practical Method of Estimating Peak from Mean Daily Flows With Application to Streams in Ontario,
W82-06568 1512 2E

PEAK LOADS
Pumped-Storage Development in Brazil. Part III,
W82-03381 1507 8A

PEANUTS
Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol 2: Response of Peanuts to Irrigation Management at Different Crop Growth Stages,
W82-05293 1511 3F

PEARL RIVER
The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

Hydrologic Analysis of Pearl River Floods, April 1979 and April 1980, in Louisiana and Mississippi,
W82-05216 1511 2E

PEAT BOGS
The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

Size and Shape in Raised Mire Ecosystems: A Geophysical Model,
W82-06215 1512 2G

PECONIC BAY ESTUARY
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

PECOS RIVER
Paleoflood Hydrology,
W82-03761 1509 2E

PECOS RIVER BASINS
Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

PEE DEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

PEEL-HARVEY ESTUARY
Nitrogen and Phosphorus Nutrition of Cladophora in the Peel-Harvey Estuarine System, Western Australia,
W82-03398 1507 2L

PEFORMANCE EVALUATION
Comparative Performance of Rotating Biological Contractors Using Air and Pure Oxygen,
W82-05859 1511 5D

PELICAN BAY
Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

PENFIELD
The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 1506 5C

PENIKESE ISLAND
The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

PENNSYLVANIA
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 1501 2E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 1503 6E

Pennsylvania Ground Water Problems and Needs,
W82-01058 1502 4B

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 1503 7C

Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 1505 7C

Delineation of Acid Mine Drainage Potential of Coal-Bearing Strata of the Pottsville and Allegheny Groups in Western Pennsylvania,
W82-02534 1505 6A

Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 1510 7C

Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

Groundwater and Geology of the Cumberland Valley, Cumberland County, Pennsylvania,
W82-04972 1511 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 1512 6E

Components for a Treatment Plant Safety Program,
W82-06992 1512 5G

PENOBSCOT RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 1503 6D

PENSTOCKS
Comparison of Isostatic and Hyperstatic Penstocks at Santa Isabel, Bolivia,
W82-05561 1511 8A

PENTACHLOROPHENOL
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 1511 5G

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 1511 5A

PENTICTON
Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

PEOPLE'S REPUBLIC OF CHINA
A New Era for China's Hydropower,
W82-00335 1501 8A

China's Potential for Hydro Development,
W82-00336 1501 8A

Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 1503 8A

PEOPLES REPUBLIC OF CHINA
Dam Construction in China.
W82-00334 1501 8A

PERCH
Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 1505 5C

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

The Ecological Significance of a Stunted White Perch Population in an Eutrophic Maine Pond,
W82-04418 1510 5C

Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 1512 5B

PERCH LAKE
Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 1505 2A

PERCHED GROUNDWATER
Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 1512 2F

PERCOLATING FILTERS
A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 1502 5D

Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 1510 5D

PERCOLATION
Soil Percolation Tests,
W82-01044 1502 2G

Simulation of Flow Patterns and Ion-Exchange in Soil Percolation Experiments. Part II. Ion-Exchange Processes,
W82-03335 1507 5B

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 1508 2A

Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

PERFORATED DRAIN PIPES
Effect of Perforation Shape and Pattern on the Performance of Drain Pipes,
W82-03792 1509 8B

PERFORMANCE EVALUATION

Furrow Irrigation Practices in Northern Colorado,
W82-00139 1501 3F

Water Conservation Devices for New or Existing Dwellings,
W82-00401 1501 3D

Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 1503 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 1503 5D

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 1505 8A

Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 1506 8A

Methods for Evaluating Performance of Filter Media,
W82-02684 1506 5D

Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 1508 5F

Effect of Perforation Shape and Pattern on the Performance of Drain Pipes,
W82-03792 1509 8B

A Retrospective Benefit-Cost Analysis of Water Resource Projects in The Cumberland River Basin,
W82-03917 1509 6B

Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 1510 8D

Strategies for the Control of Activated Sludge Plants Treating Industrial Wastewaters,
W82-04838 1511 5D

A Screening Model to Quantify Resilience,
W82-05044 1511 6A

Alternative Indices of Resilience,
W82-05045 1511 6A

Robustness of Water Resources Systems,
W82-05077 1511 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 1511 5E

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 1511 5D

MSF Desalination Plants, Availability, Reliability and Safety Analysis,
W82-06124 1512 3A

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

PERIPHYTON

Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 1503 5A

Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 1505 5C

Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 1506 2H

PERMAFROST

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 1504 2H

Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 1505 2C

Problems of Lightening Underground Structures and Methods of Constructing Them Under Permafrost Conditions,
W82-03918 1509 8A

Use of Pre-Fabricated Parshall Flumes to Measure Streamflow in Permafrost-Dominated Watersheds,
W82-04074 1509 7B

PERMEABILITY

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 1505 7C

A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 1. Solution for Homogeneous Permeability,
W82-03078 1507 2F

Modeling Double Aquifer Flow Using a Comprehensive Potential and Distributed Singularities 2. Solution for Inhomogeneous Permeabilities,
W82-03084 1507 2F

A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

Evidence for a Shallow Highly-Permeable Zone in the Chalk of Hampshire, U.K.,
W82-05645 1511 2F

Steady State Perched Groundwater Mounds on Thick Sublayers,
W82-06317 1512 2F

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 1512 5C

PERMEABILITY COEFFICIENT

Hydraulic Conductivity of Four Commercial Citrus Rootstocks,
W82-01546 1503 2I

Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 1503 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 1505 8E

Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 1507 2G

Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

PERMETHRIN

Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 1505 5B

PERMIAN BASIN

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

PERMITS

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 1507 6E

Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 1508 6E

Waste Discharge Monitoring Requirements Under the NPDES Permits Program,
W82-03969 1509 5D

History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 1511 6E

Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits.
W82-06088 1512 6E

PERSELECTIVE MEMBRANES

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

PERSONNEL

Components for a Treatment Plant Safety Program,
W82-06992 1512 5D

PERTH

Water Metering and Conservation,
W82-03562 1508 3D

PERU
Modeling Gradual Dam Breaches, W82-00554 1502 8D
Computer-Aided Evaluation of Peru's Hydropower, W82-04954 1511 6B

PERVAPORATION
Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer, W82-06791 1512 5A

PESTICIDE
Pesticide Accumulation in a New Impoundment in Iowa, W82-06871 1512 5B

PESTICIDE KINETICS
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula, W82-01414 1503 5B
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System, W82-01930 1504 2L
The Fate of Organic Pollutants in Frozen Waters: Sunlight Photodecomposition of Uracil Herbicides in Frozen Aqueous Solutions, W82-05479 1511 5B

PESTICIDE RESIDUES
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region, W82-00094 1501 5B
Determination of Aminocarb in Water by High Performance Liquid Chromatography, W82-00232 1501 5A
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions, W82-00382 1501 5B
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues, W82-00532 1502 5A
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application, W82-00559 1502 5B
Organochlorine Residues in Kenya's Rift Valley Lakes, W82-00690 1502 5A
Protecting Virginia's Waterways, W82-01608 1503 5G
Matacil Residue Determination in Foliage, Fish, Soil and Water, W82-01621 1503 5A
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation, W82-03215 1507 5A
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination, W82-03216 1507 5A
High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment, W82-03444 1508 5A
Organochlorine Residues in Fish from Lake Mjosa in Norway, W82-06697 1512 5A
Environmental Significance of Pesticide Residues Associated with Aquatic Sediments, W82-06789 1512 5C
Pesticide Accumulation in a New Impoundment in Iowa, W82-06871 1512 5B

PESTICIDE TOXICITY
Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments, W82-05921 1512 5B

PESTICIDES
Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils, W82-00189 1501 5A
Behavior of Trifluralin in Aquatic Model Ecosystems, W82-00233 1501 5C
Kepone in the James River, W82-00631 1502 5B
Absorption of Fenitrothion by Plankton and Benthic Algae, W82-00874 1502 5B
Bioconcentration of Pesticides by Egg Masses of the Caddisfly, Triaenodes Tardus Milne, W82-00982 1502 5B
Pesticide Concentrations in Agricultural Runoff: Available Data and an Approximation Formula, W82-01414 1503 5B
The Effects of Organophosphorus Pesticides on Estuarine Ammonium Oxidizers, W82-01567 1503 5C
Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978, W82-01583 1503 5A
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis), W82-01818 1504 5C
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals, W82-01993 1504 5C
Environmental Fate of Methyl Eugenol, W82-02013 1504 5B
The Use of Leeches to Identify Pesticides in Water, W82-02075 1504 5A
Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed, W82-02741 1506 5A
Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographie en Phase Gazeuse), W82-03460 1508 5A
Photodegradation of the Lampricide 3-Trifluoromethyl-4-Nitrophenol (TFM) 1. Pathway of the Direct Photolysis in Solution, W82-04032 1509 5B
Treatability Studies of Pesticide Manufacturing Wastewaters, W82-04406 1510 5D
Pesticides in the Aquatic Environment, W82-04727 1510 5C
Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment, W82-04822 1511 5A
Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography, W82-04828 1511 5A
Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff, W82-04967 1511 5G
Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use, W82-05143 1511 5B
Pesticide Effects on Aquatic Habitats, W82-05146 1511 5C
Enzymes and Antibodies as Sensors of Toxic Substances, W82-05160 1511 5A
A Survey of Azinphos Methyl and Azinphos Methyl Oxon in Water and Blueberry Samples from Hancock and Washington Counties of Maine, W82-05376 1511 5B
Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides, W82-05620 1511 5B
Pesticides and PCB in the Grand and Saugeen River Basins, W82-05641 1511 5B
Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations, W82-06004 1512 5A
Simple Procedures for Enrichment of Chlorinated Aromatic Pollutants from Fat, Water and Milk for Subsequent Analysis by High-Resolution Methods, W82-06015 1512 5A
Bioassy Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis, W82-06031 1512 5C
Effects of Apple Orchard Runoff on the Aquatic Macrofauna of a Mountain Stream, W82-06177 1512 5C
Model Ecosystem for Environmental Transport of Xenobiotics, W82-06760 1512 5B
Environmental Significance of Pesticide Residues Associated with Aquatic Sediments, W82-06789 1512 5C
Effects of Pollution on Freshwater Fish, W82-06803 1512 5C
Marine and Estuarine Pollution, W82-06808 1512 5C

PETROLEUM PRODUCTS
Predicting Priority Pollutants from Petrochemical Processes, W82-01809 1504 5B
Development of a Multidetector Petroleum Oil-In-Water Monitor, W82-02964 1506 5A
Comparison of BOD Relationships for Typical Edible and Petroleum Oils, W82-06458 1512 5D

PEYTO GLACIER
The Mass Balance of Peyto Glacier, Alberta, Canada, 1965 to 1978,
W82-02638 1506 2C

PHALLUS PROCESS
Observations on the Immature Chironomides of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

PHARMACEUTICAL INDUSTRY
Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 1503 5D

Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 1510 5F

PHARMACEUTICAL WASTES
On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

PHASE ISOLATION PONDS
Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 1501 5D

PHENOL
Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 1507 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

Removal of Water Soluble Hazardous Materials Spills from Waterways by Activated Carbon,
W82-05060 1511 5G

PHENOLIC PESTICIDES
Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 1502 5B

PHENOLS
Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 1501 5A

Solvent Extraction of Phenols,
W82-00438 1501 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 1501 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 1502 5D

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 1502 5A

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 1504 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 1504 5B

Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 1506 5C

Degradation of Pentachlorophenol in Simulated Lentic Environment,
W82-03489 1508 5B

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 1508 2L

Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 1510 5C

Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 1511 5A

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

Treating Phenol Resin Plant Wastes,
W82-05128 1511 5D

Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 1511 5A

Effect of Phenol on In Vivo Activity of Tissue Transaminases in the Fish Notopterus Notopterus,
W82-05571 1511 5C

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 1511 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 1512 5A

Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 1512 5D

Phenols in Municipal Solid Waste Leachates and Their Attenuation by Clay Soils,
W82-06518 1512 5B

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 1512 5D

PHILADELPHIA
An Experimental Approach to Corrosion Control,
W82-04099 1509 5F

PHILIPPINES
Integrated Agricultural Development in the Philippines,
W82-01725 1503 6B

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 1508 5F

PHOSHORUS REMOVAL
The Influence of Nitrogen on Phosphorus Removal in Activated Sludge Plants,
W82-05504 1511 5D

PHOSPHATE MINING
Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

PHOSPHATE REMOVAL
Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfernung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 1510 5F

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 1510 5F

Electrochemical Processes for Wastewater Treatment,
W82-05422 1511 5D

Polymer Plays Plant Improvement Role,
W82-06250 1512 5D

PHOSPHATES
Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 1501 5A

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 1502 2H

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 1502 6E

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 1502 5G

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 1502 2H

Phosphate Models, a Gap to Bridge,
W82-00929 1502 2H

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 1511 5D

Utilization of Organic Phosphates by Selected Bacteria and Algae,
W82-05024 1511 5G

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 1511 2K

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 1512 5A

Effect of Nitrate Concentration in Lake Water on Phosphate Release from the Sediment,
W82-06313 1512 5C

PHOSPHATES *LAKES

Interaction of Orthophosphate with Iron (III) and Aluminum Hydroxides,
W82-00783 1502 2H

PHOSPHORIC ACID

Water-Phosphoric Acid Media: Electrochemical Properties,
W82-02943 1506 1B

PHOSPHOROUS

Phosphorus Availability in Lake Memphremagog and Its Tributaries,
W82-04324 1510 2H

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 1512 5F

PHOSPHOROUS ABSORPTION

Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 1506 2H

PHOSPHOROUS REMOVAL

Health Implications of Non-NTA Detergent Builders,
W82-00703 1502 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 1502 5G

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

PHOSPHORUS

Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients.
W82-00039 1501 5B

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 1501 2H

Postdepositional Mobility of Phosphorus in Lake Sediments,
W82-00474 1501 2H

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 1502 5G

Distribution and Biological Availability of Reactive High Molecular Weight Phosphorus in Natural Waters in New Zealand,
W82-00659 1502 2H

Nitrogen and Phosphorus Recycling in Lake Sammamish, A Temperate Mesotrophic Lake,
W82-00824 1502 2H

Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 1502 2H

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 1502 2H

The Effect of Changes in the Nutrient Income on the Condition of Lake Washington,
W82-00987 1502 2H

Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 1503 2H

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

Phosphorus Uptake Dynamics as Related to Mathematical Modeling of Cladophora at a Site on Lake Huron,
W82-01149 1503 5C

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B

Release of Phosphorus by Certain Benthic Invertebrates,
W82-01502 1503 2H

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 1504 2H

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 1505 5B

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota,
W82-02332 1505 5B

Absorption by Chlorella Vulgaris Beijer. of Phosphorus Compounds Released by the Submerged Macrophyte Potamogeton Pectinatus L.,
W82-02780 1506 2H

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

Phosphorus-Limited Growth of a Green Alga and a Blue-Green Alga,
W82-03120 1507 2H

The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

Phosphorus Recycling in Five Shallow Lakes,
W82-04040 1509 2H

Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

SPNM, A Model for Predicting Sediment, Phosphorus, and Nitrogen Yields from Agricultural Basins,
W82-04157 1509 6A

Nitrogen and Phosphorus Content of Flow from Drains Fertilized with Cow Manure Slurry,
W82-04183 1509 5B

Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 1510 5C

The Effect of Dried and Cracked Sediment on the Availability of Phosphorus in a Coastal Lagoon,
W82-04299 1510 2L

Comparisons of Soluble Reactive Phosphorus and Orthophosphorus Concentrations at an Offshore Station in Southern Lake Michigan,
W82-04377 1510 2H

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 1511 5B

A Budget Model Accounting for the Positional Availability of Phosphorus in Lakes,
W82-05018 1511 5B

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 1511 5B

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

Nonpoint Source Pollution from Agricultural Watersheds on Coastal Plain Soils,
W82-05291 1511 5B

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

The Effect of Phosphorus Limitation on Algal Growth Rates: Evidence from Alkaline Phosphatase,
W82-05380 1511 5C

Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

Relationship Between the Distribution of Phosphorus Compounds in the Tissues of the Bivalve Anodonta Cygnea and Environmental Phosphorus Level,
W82-05506 1511 5C

Water Quality Modeling of Lake Michigan and Consideration of the Anomalous Ice Cover of 1976-1977,
W82-05638 1511 5B

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

The Phosphorus Cycle in Germiston Lake. II. The in vitro and in situ Absorption of 32-P by Potamogeton Pectinatus L,
W82-05895 1511 5C

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

Recent Advances in Assessing Impact of Phosphorus Loads on Eutrophication-Related Water Quality,
W82-06034 1512 5C

Hypolimnetic Redox and Phosphorus Cycling in Hypereutrophic Lake Sebasticook, Maine,
W82-06337 1512 2H

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 1512 5A

An Experimental Apparatus for Evaluating Kinetics of Available Phosphorus Release from Aquatic Particulates,
W82-06829 1512 5B

UV-Sensitive Complex Phosphorus: Association with Dissolved Humic Material and Iron in a Bog Lake,
W82-06930 1512 5C

Monitoring Cladophora Growth Conditions and the Effect of Phosphorus Additions at a Shoreline Site in Northeastern Lake Erie,
W82-06942 1512 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 1512 5B

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

PHOSPHORUS COMPOUNDS

Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

An Empirical Equation for Predicting Soluble Phosphorus Loads from Agricultural Watersheds,
W82-00134 1501 5B

Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 1501 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 1502 2H

Prediction of Phosphorus and Nitrogen Concentrations in Lakes from Both Internal and External Loading Rates,
W82-00928 1502 2H

Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 1504 5F

PHOSPHORUS RECYCLING

Phosphorus Recycling in Five Shallow Lakes,
W82-04040 1509 2H

PHOSPHORUS REMOVAL

Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 1502 6E

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 1502 5C

Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 1503 5D

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 1504 2H

Phosphorus Removal by Activated Alumina,
W82-02313 1505 5D

Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs,
W82-02526 1505 2H

Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 1506 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 1507 5D

Phosphorus Reduction Studies,
W82-03426 1508 5D

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 1508 5D

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 1508 5B

Phosphate in Water: I. Reduction Using Northern Lignite Fly Ash,
W82-03882 1509 5F

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 1510 4D

Phosphorus Removal Processes from Overland Flow Treatment of Simulated Wastewater,
W82-04706 1510 5D

Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 1511 5D

The Rehabilitation of Norway's Largest Lake,
W82-05243 1511 5G

A Survey of Phosphorus Removal in Lower Great Lakes Municipal Treatment Plants,
W82-05256 1511 5D

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 1511 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 1511 5D

Does Conventional Sewage Treatment Meet the Demands of the 1980's,
W82-05407 1511 5D

Phosphorus Reduction Studies,
W82-05408 1511 5D

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 1511 5D

Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 1512 5G

How Appleton Reduced Phosphorus,
W82-06249 1512 5D

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 1512 5C

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 1512 5C

Energy-Input-Controlled Direct Filtration to Control Progressive Eutrophication,
W82-06414 1512 5F

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 1512 5D

Beneficial Disposal of Pickle Liquor,
W82-06486 1512 5D

Sedimentary Losses of Phosphorus in some Natural and Artificial Iowa Lakes,
W82-06901 1512 5C

PHOSPHORUS RUNOFF
Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

PHOSPHORUS UPTAKE AND RELEASE
Radiotracer Experiments on Phosphorus Uptake and Release by Limnetic Microzooplankton,
W82-05381 1511 5B

PHOTOCHEMICAL REACTIONS
Comparison of Photochemical Behavior of Various Humic Substances in Water: I. Sunlight Induced Reactions of Aquatic Pollutants Photosensitized,
W82-04914 1511 2K

Comparison of Photochemical Behavior of Various Humic Substances in Water: II. Photosensitized Oxygenations,
W82-04915 1511 2K

PHOTOGRAPHY
Aluminum Shadowing-Direct Projection Photomicroscopy of Diatom Frustules,
W82-00884 1502 5A

PHOTOLYSIS
Comparison of Metals as Catalysts for the Photolysis of Water,
W82-02527 1505 5G

PHOTOMETRY
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 1504 2B

PHOTOPLANKTON
Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 1505 5B

PHOTOSYNTHESIS
Photosynthetic Recovery of Resurrection Spikemosses from Different Hydration Regimes,
W82-01010 1502 2I

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 1503 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 1504 2H

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 1506 2H

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 1507 2H

Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 1507 2I

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 1507 5C

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 1511 2H

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 1512 5C

PHOTOSYNTHETIC BACTERIA
Photosynthetic Bacterial Production and Carbon Mineralization in a Meromictic Lake,
W82-03403 1508 2H

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

PHOTOSYNTHETIC INHIBITORS
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

PHTHALATES
Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

PHYSICAL PROPERTIES
Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1502 1B

The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1504 1B

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 1505 2H

Surface Viscosity of Water,
W82-03501 1508 1A

Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 1510 2H

PHYSICOCHEMICAL PROPERTIES
Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

Classification of Central Amazon Lakes on the Basis of their Microbiological and Physico-Chemical Characteristics,
W82-00666 1502 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

Physical and Chemical Studies of Lago Tupe; A Central Amazonian Black Water 'Ria Lake',
W82-01381 1503 2H

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 1511 2H

Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 1511 5B

Correlations Between Predominant Heterotrophic Bacteria and Physicochemical Water Quality Parameters in Two Canadian Rivers,
W82-06544 1512 5B

PHYSICOCHEMICAL TREATMENT
Physical and Chemical Methods,
W82-01241 1503 5D

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 1505 5A

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 1510 5D

Selected Organic Pesticides, Behavior and Removal from Domestic Wastewater by Chemical and Physical Processes,
W82-05481 1511 5D

PHYSIOCHEMICAL TREATMENT
Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

PHYSIOLOGICAL ECOLOGY
Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 1507 5A

PHYSIOLOGY
Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 1508 5C

PHYTOPLANKTON

Reduction, Methylation, and Incorporation of Arsenic into Lipids by the Marine Phytoplankton Dunaliella Tertiolecta,
W82-00239 1501 5B

Effects of Halogenated Organic Compounds on Photosynthesis in Estuarine Phytoplankton,
W82-00266 1501 5C

The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 1501 5D

The Importance of Regenerated Nitrogen to Phytoplankton Productivity in a Subalpine Lake,
W82-00476 1501 2H

Temporal and Spatial Scales in Phytoplankton Ecology. Mechanisms, Methods, Models and Management,
W82-00594 1502 5G

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 1502 5C

Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 1502 6G

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 1502 2H

Phosphate Models, a Gap to Bridge,
W82-00929 1502 2H

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 1503 2E

The Effect of Fertilization with Phosphorus and Nitrogen Versus Phosphorus Alone on Eutrophication of Experimental Lakes,
W82-01457 1503 5C

Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 1503 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 1503 2H

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 1503 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 1504 2H

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 1504 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 1504 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 1504 2H

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 1504 2K

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 1504 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 1504 2H

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 1504 5C

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 1505 7B

Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 1505 5C

Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

The Effect of Environmental Factors on Phytoplankton Growth: Light and the Interactions of Light with Nitrate Limitation,
W82-02331 1505 2H

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 1505 2K

Effects of pH, Phosphate, and Ammonia on the Rate of Uptake of Nitrate and Ammonia by Freshwater Phytoplankton,
W82-02398 1505 5C

Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 1506 2H

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 1506 5C

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 1506 5G

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

Production Strategies in Antarctic Inland Waters: Phytoplankton Eco-Physiology in a Permanently Ice-Covered Lake,
W82-02862 1506 2C

The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 1506 7B

The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 1506 5C

Physicochemical Influences on Phytoplankton Production in a Tropical Alpine Lake,
W82-02921 1506 2H

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 1507 2H

Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 1507 5C

Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 1507 5C

Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 1507 2H

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 1507 2H

Limnologic Study of Lake Pavin (France) 1: Abiotic Factors and Phytoplankton (Contribution a L'etude Limnologique Du Lac Pavin (France) 1: Facteurs Abiotiques et Phytoplancton),
W82-03219 1507 2H

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

Mechanisms of Rapid Photosynthetic Adaptation in Natural Photoplankton Communities. II. Changes in Photochemical Capacity as Measured by DCMU-Induced Chlorophyll Fluorescence,
W82-03244 1507 2H

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 1507 5C

Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

A Culture Model for Phytoplankton Succession in the Potomac River Near Washington, D.C. (U.S.A.),
W82-03765 1509 5B

Diel Variation in the Abundance, Vertical Distribution, and Species Composition of Phytoplankton in a Eutrophic English Lake,
W82-04294 1510 5C

Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 1510 2L

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 1510 5C

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 1510 2H

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 1511 2L

Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 1511 2H

Primary Production in Saline Lakes,
W82-04926 1511 2H

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 1511 2H

Heterotrophic Assimulation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1511 1A

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 1511 2H

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 1511 5C

Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 1511 5C

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 1512 5A

Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 1512 2H

On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 1512 5C

Phytoplankton Community Analysis in Lakes of Kumaun Himalaya,
W82-06764 1512 5C

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 1512 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 1512 5C

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 1512 5C

PICLORAM
Picloram Dissipation in a Small Southwestern Stream,
W82-00212 1501 5B

PIERS
The Vortex Scour Mechanism at Bridge Piers,
W82-04642 1510 8B

PIEZOMETRIC HEAD
Subdomain Integration Model of Ground-Water Flow,
W82-02550 1505 2F

PIEZOMETRY
A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076 1511 7B

PIGEON RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 1507 6D

PIKE
Recent Trends of Biocides in Pikes of the Lake Paijanne,
W82-04819 1511 5A

PILOT PLANTS
An Alternative Solution to the THM Problem,
W82-00072 1501 5F

Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

The Microfauna of Activated Sludges. Study of an Observation Method and Application to Monitor a Pilot Plant During the Start-Up Phase. (La Microfauna Des Boues Activees. Etude D'une Methode D'Observation Et Application Au Suivi D'un Pilote En Phase De Demarrage,
W82-02960 1506 5D

Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 1508 5F

Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 1510 5D

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility.
W82-05555 1511 3A

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 1512 5D

PINE BARRENS
Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

PINE ISLAND
Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 1502 5C

PINE TREES
Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora,
W82-06410 1512 2L

PINELLAS COUNTY
Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

Practical Power-Saving Techniques in Pinellas County,
W82-04092 1509 5F

PINUS RADIATA
Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

PIPE FAILURE
Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 1502 8A

PIPE FAILURE

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

PIPE FLOW

Uniform Flow Calculations for Pipes,
W82-03748 1508 8B

Jet Injections for Optimum Mixing in Pipe Flow,
W82-04558 1510 8A

Storm Sewer Flow Computations,
W82-04640 1510 7B

Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 1510 8B

Maximum Pressure During Water Hammer Accompanied by Discontinuity of the Flow,
W82-04772 1511 8B

Finite-Amplitude Stability of Axisymmetric Pipe Flow,
W82-05087 1511 8B

Water Hammer,
W82-05432 1511 8C

Cablegation: II. Simulation and Design of the Moving-Plug Gated Pipe Irrigation System,
W82-05963 1512 3F

Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 1512 8B

PIPE JACKING

Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 1512 8A

PIPELINES

A/C Pipe - Assessment or Advocacy,
W82-00070 1501 5F

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 1501 6A

Northeastern New Jersey Grapples With a Drought,
W82-00289 1501 8A

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

A New Look at Design of Raw Water Piping,
W82-01029 1502 8A

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 1502 8B

Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

42-Mile Water Pipeline for Coal Boom Town.
W82-02359 1505 6D

The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

Selecting Pipelines to Achieve Effective Energy Conservation,
W82-02609 1506 8B

Response of Buried Structures to Traveling Waves,
W82-03346 1507 8D

Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 1507 8G

Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

Keeping a Century-Old Water System Young,
W82-04138 1509 8G

The Traditional Approach to Water Loss,
W82-04656 1510 3D

The Behavior of Asbestos-Cement Pipe under Various Water Quality Conditions: Part 2, Theoretical Considerations,
W82-04791 1511 8G

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 1511 2J

Alternative Tunnelling Method for Relief Sewer.
W82-05774 1511 8F

Grounding of Electric Circuits to Water Services: One Utility's Experience,
W82-06281 1512 5F

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 1512 6D

The Kielder Transfer Works,
W82-06502 1512 8A

Bridging the Water Supply Gap,
W82-06508 1512 8A

Texas Gulf Coast Project Answers Vital Water Need,
W82-06519 1512 8A

Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers--ASTM F585-78.
W82-06601 1512 8A

Cross-Country Force Main.
W82-06640 1512 8G

PIPES

Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 1502 8A

Asbestos Cement Pipe and Cancer in Connecticut 1955-1974,
W82-01094 1502 5C

Long Term Performance of Horizontal Drains,
W82-02212 1505 8A

Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 1505 8A

Flexible Outfall at Aldeburgh,
W82-02415 1505 8A

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

Galvanized Pipe Vies for Equal Alternative Status in Storm Sewer Projects.
W82-02601 1506 8G

The Cost of Quality,
W82-02881 1506 5F

Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 1506 5B

Vinyl Lined Asbestos Cement Pipe Problems, Health Aspects,
W82-03663 1508 5F

Uncertainties in Water Distribution Systems,
W82-03668 1508 8A

Effect of Perforation Shape and Pattern on the Performance of Drain Pipes,
W82-03792 1509 8B

The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 1510 5F

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

A Pipeline for all Environments,
W82-04764 1511 8G

Economic Analysis of Water Main Breaks,
W82-05673 1511 8A

Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 1511 5A

Load Factors and Non-Destructive Testing of Clay Pipe,
W82-05700 1511 8G

The Corrosion of Copper by Chlorinated Drinking Waters,
W82-06051 1512 5F

The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas,
W82-06449 1512 8A

PIT RECHARGE

Treated Pit Fluids Meet Water Specifications
W82-02557 1505 5E

PIT RIVER BASIN

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 1501 6B

PITCHER PLANT

The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 1502 2I

PITTSBURGH

Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

PITTSBURGH PNEUMONIA AGENT

Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

PLANE FLOW

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

PLANKTON

Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 1501 2H

Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 1502 2H

Enrichment of the Agricultural Herbicide Atrazine in the Microsurface Water of an Estuary,
W82-00877 1502 5B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 1502 7B

Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 1503 2A

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 1504 2H

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 1504 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 1504 2H

Metabolism of a Florida Lake Ecosystem,
W82-02268 1505 2H

Infrared Absorption Study of Humic Substances from Lake Apopka Sediment, Plankton and the Surrounding Drainage Basin,
W82-02348 1505 2H

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

Acoustic Reflection from Estuarine Pycnoclines,
W82-02722 1506 2L

Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 1506 5C

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt, Part II. Production of Plankton and Benthic Organisms,
W82-03052 1507 2H

Orthophosphate Uptake by Phytoplankton and Bacterioplankton from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03172 1507 5B

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 1507 5B

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 1510 2H

Synthesis and Degradation of Carbohydrates in the Marine Planktonic Community of Eutrophic Waters (Synthese et Degradation des Composes Glucidiques au sein de la Communaute Planctonique en Zone Marine Eutrophe),
W82-04672 1510 5B

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 1511 2L

Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 1511 2H

Photosynthetic Activity of Phytoplankton in Tropical African Soda Lakes,
W82-05101 1511 2H

Plankton Metabolism and Carbon Processes in the Amazon River, Its Tributaries, and Floodplain Waters, Peru-Brazil, May-June 1977,
W82-05197 1511 2K

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 1511 2H

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 1512 2H

PLANKTON NETS

BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 1501 7B

PLANNING

Water Related Planning and Design at Energy Firms,
W82-00042 1501 6D

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

Water, Energy and Labor Requirements for Future Pacific Northwest Irrigation,
W82-00143 1501 6A

Treatment Works--The Designer's Problems,
W82-00312 1501 5F

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan,
W82-00396 1501 3D

Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 1502 6D

Systems Analysis,
W82-01303 1503 6A

Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 1503 6A

Input and Output Constraints Affecting Irrigation Development,
W82-01476 1503 6B

Interdisciplinary Environmental Analysis for Timber Sale Planning,
W82-01539 1503 6A

Reviving the Rio Reconquista,
W82-02014 1504 5G

Values of Ecological Characterization Studies to Assess Effects of Freshwater Inflow to Estuaries,
W82-02147 1505 6G

Management, Planning, and Organization in Initiating, Supporting and Coordinating an Ongoing Freshwater Diversion Project,
W82-02153 1505 6B

Water Regulation in an Inflationary Environment,
W82-02701 1506 5F

Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 1506 6A

French Experience in Water Pollution Control,
W82-02765 1506 5G

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 1506 6B

The Computer: Water Management Tool,
W82-03290 1507 6A

Water: Too Much, Too Little, Too Bad,
W82-03291 1507 6D

Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 1508 6F

Polish Water Management--Structure, Problems and Research,
W82-03633 1508 6D

Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 1508 6B

Artificial Basin Recharge,
W82-03745 1508 4B

Environmental Aspects of Water-Resources Planning in England and Wales,
W82-03806 1509 6E

The Development of Water Supply in Indonesia and All Its Challenges,
W82-03868 1509 6D

Institutional Analysis Criteria for Water Supply Planning,
W82-03930 1509 6D

Making Your Way Through Murky Waters-A Manual for Public Participation Coordinators in Natural Resources Planning,
W82-04085 1509 6A

Objectives and Constraints in Federal Water Resources Planning,
W82-04288 1510 6E

Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 1510 4A

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 1510 6A

Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 1510 6A

Estimating Resilience by Canonical Analysis,
W82-05047 1511 6A

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 1511 6B

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

River Basin Planning in Alberta, Current Status--Future Issues,
W82-05390 1511 6E

River Basins and Water Management in New Brunswick,
W82-05391 1511 6D

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 1511 6F

New Strategies for Water Resource Planning in British Columbia,
W82-05395 1511 6E

Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 1511 6D

Five-Year Plan of the Water Resources Research Center,
W82-05526 1511 6B

A Five-Year Plan of Water Resources Research.
W82-05527 1511 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 1511 6B

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 1511 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 1511 6B

A Five-Year Plan for Water Research in Colorado,
W82-05531 1511 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

Nevada Water Resources Research 1982-1987,
W82-05533 1511 6B

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 1511 4A

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 1511 6B

The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 1511 6D

The Eighties--Implications for Water Management,
W82-05772 1511 6B

1980 Needs Survey: Combined Sewer Ssite Studies,
W82-05862 1511 5D

Count on Uncle Sam Less,
W82-05998 1512 6C

The Mediterranean Action Plan: Design and Implementation,
W82-06154 1512 5B

How to Set Up a Preventive Maintenance Program,
W82-06264 1512 5D

Effective Project Management,
W82-06328 1512 5D

Water Supply Development in Thailand.
W82-06367 1512 6B

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

PLANT GROWTH

The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 1502 2I

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 1502 2I

Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 1502 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 1502 2I

Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estuary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

Growth and Photosynthesis of Najas Marina L. as Affected by Light Intensity,
W82-02365 1505 4A

Water Requirements of Urban Plants,
W82-03972 1509 3D

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 1510 2I

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

PLANT GROWTH SUBSTANCES

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

PLANT MORPHOLOGY

The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 1502 2I

PLANT NUTRIENT UPTAKE

Upland Marsh for Water Quality Control,
W82-01962 1504 5B

PLANT PATHOLOGY

Structural Damage to Leaf Chloroplasts of Elodea Densa Caused by Methylmercury Accumulated from Water,
W82-05570 1511 5C

PLANT PHYSIOLOGY

Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

PLANT POPULATIONS

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

PLANT TISSUES

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 1510 2D

PLANT TOXINS

An Integrated Water-Quality Index for Irrigation Use,
W82-04723 1510 5C

PLANT WATER POTENTIAL

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 1502 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

Patterns of Water Potential and Photosynthesis of Desert Sand Dune Plants, Eureka Valley, California,
W82-03271 1507 2I

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 1510 2I

PLANT-WATER POTENTIALS

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 1512 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 1512 2I

PLANTING MANAGEMENT

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 1510 2B

The Landscape of Rutland Water,
W82-06478 1512 6G

PLANTS
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

PLASMIDS
Physical Characterization of Extra-Chromosomal DNA in Chesapeake Bay Bacteria from Polluted and Non-Polluted Sites,
W82-02814 1506 5B

PLASTICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 1503 8G

Membrane Liner Seals 278-Acre Reservoir.
W82-02361 1505 8G

Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

Cross-Country Force Main.
W82-06640 1512 8G

PLATINUM
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 1502 5D

PLATTE RIVER
Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 1510 6G

PLAYAS
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 1503 2L

PLUG FLOW
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 1503 5D

Cablegation: I. Cable Controlled Plugs in Perforated Supply Pipes for Automatic Furrow Irrigation,
W82-05617 1511 8A

PLUGGING FACTOR
A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

PLUMBING
Water Conservation Devices for New or Existing Dwellings,
W82-00401 1501 3D

The Costs of Internal Corosion in Water Systems,
W82-03809 1509 5F

PLUMES
Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

Mapping Contaminated Soil Plumes by Kriging,
W82-01423 1503 5G

Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 1508 5B

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 1508 5B

Survival and Heterotrophic Activities of Fraser River and Strait of Georgia Bacterioplankton Within the Fraser River Plume,
W82-04291 1510 2L

Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

River Plume Studies in Distorted Froude Models,
W82-05864 1511 2E

Production and Vertical Flux of Attached Bacteria in the Hudson River of the New York Bight as Studied with Floating Sediment Traps,
W82-06736 1512 5C

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 1512 2L

PLUTONIUM
Solution Species of Plutonium in the Environment,
W82-00163 1501 5A

Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

Laboratory and Field Studies of The Relative Mobility of 239, 24OPU and 241AM from Lake Sediments Under Oxic and Anoxic Conditions,
W82-03899 1509 5B

PLUTONIUM RADIOISOTOPES
Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 1503 5B

POINT MACKENZIE
Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

POLAND
Chemical Composition of Interstitial Waters in Bottom Sediments of Some Polish Lakes of the Wigry Group (Northern Poland),
W82-00675 1502 2H

Poland: Coming to Grips with Pollution,
W82-02092 1504 5G

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 1506 5B

The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 1506 5C

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 1506 2H

Polish Water Management–Structure, Problems and Research,
W82-03633 1508 6D

Epilimnetic and Hypolimnetic Symptoms of Eutrophication in Great Mazurian Lakes, Poland,
W82-05103 1511 2H

Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 1511 5B

The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 1512 5A

POLAR REGIONS
The Behavior of a Polar Ice-Dammed Lake, Ellesmere Island, N.W.T., Canada,
W82-01511 1503 2C

Biogenic Calcite Structures Forming in Lake Fryxell, Antarctica,
W82-04638 1510 2H

An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifera,
W82-04950 1511 2H

Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 1511 2H

POLAROGRAPHIC ANALYSIS
Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 1506 5A

POLICY MAKING
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 1502 6E

On Water Tariff Equalization Policies,
W82-01175 1503 6C

Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 1503 6B

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

Disposal of Industrial Effluents - Some Future Problems,
W82-02405 1505 5D

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 1505 6G

New Thrust in the 1980s for U.S. Water-Quality Programs,
W82-03252 1507 5G

POLITICAL ASPECTS
A 201 Pollution Control Planning Tragedy,
W82-00285 1501 6E

Potential Political Influences Affecting the Water Industry,
W82-00861 1502 6C

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 1504 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 1505 6E

The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 6B

Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 1508 6F

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 1511 6B

POLITICAL ASPECTS

Acid Rain: Legal and Political Fallout,
W82-05147 1511 6E

Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 1511 6E

Count on Uncle Sam Less,
W82-05998 1512 6C

Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 1512 6E

Organizational and Political Considerations in the Municipal Development of Small Hydropower,
W82-06588 1512 6E

County Provides a Rural Water Supply System,
W82-06843 1512 3D

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

POLITICAL CONSTRAINTS

Acid Rain Agreement,
W82-01933 1504 5B

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

Current Policies on Land Application,
W82-02629 1506 5E

Economical Use of Water Resources.
W82-03496 1508 6E

Objectives and Constraints in Federal Water Resources Planning,
W82-04288 1510 6E

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

River Basin Management in Ontario,
W82-05393 1511 6E

Stormwater Management - One Developer's Experience,
W82-05777 1511 6B

POLK COUNTY

Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

POLLEN

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 1502 2L

130,000-Yr Continuous Pollen Record from Clear Lake, Lake County, California,
W82-02544 1505 2K

Geochemistry of Amino Acids in Sediments from Clear Lake, California,
W82-02545 1505 2K

POLLUTANT IDENTIFICAION

On the Detection of Mutagenic/Carcinogenic Activities in Water with the Salmonella/Microsome Test (Ames Test)(Zum Nachweis Mutagener/Kanzerogener Aktivitaten in Wassern mit dem Salmonella/Mikrosomen-Test (Ames-Test)),
W82-06715 1512 5A

POLLUTANT IDENTIFICATION

Development of Oil-In-Water Monitor, Phase II,
W82-00100 1501 5A

A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 1501 5A

Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 1501 5A

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

Understanding Acid Rain,
W82-00479 1501 5B

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 1502 5A

Thin Layer Chromatographic and Atomic Absorption Spectrophotometric Determination of Methyl Mercury,
W82-00503 1502 5A

Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 1502 5A

Industrial Effluent Monitoring Incorporating a Recent Automated Fish Biomonitoring System,
W82-00530 1502 5A

Determining Volatile Organics in Water,
W82-00630 1502 5A

Identification of Organic Compounds,
W82-00635 1502 5A

Toxics in Municipal and Industrial Wastewaters,
W82-00712 1502 5A

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 1502 5A

Determination of Picogram Amounts of Technetium-99 by Resin Bead Mass Spectrometric Isotope Dilution,
W82-00999 1502 5A

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

Inorganics,
W82-01238 1503 5A

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 1503 5A

Faecal Pollution of Belgian Coastal Water,
W82-01373 1503 5A

A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 1503 5A

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract,
W82-01508 1503 5A

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 1503 5A

Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 1503 5A

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 1503 5A

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 1503 5A

Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 1503 5A

Infectious Waterborne Diseases,
W82-01784 1503 5A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 1504 5A

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 1504 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 1504 5A

The Use of Leeches to Identify Pesticides in Water,
W82-02075 1504 5A

Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 1505 5A

Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 1505 5A

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 1505 5A

A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 1505 5A

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 1506 5A

Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 1506 5A

Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 1506 5A

Differential Pulse Polarographic Determination of Inorganic and Organic Arsenic in Natural Waters,
W82-02903 1506 5A

Determination of Phthalates in Industrial and Municipal Wastewaters,
W82-02999 1506 5A

Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 1507 5A

Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 1507 5A

Fossil Carbon in Coastal Sediments,
W82-03201 1507 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 1507 5A

Chelating Resin Catcher for Capture, Preconcentration and Determination of Toxic Metal Traces (Zn, Cd, Hg, Pb) in Waters (Capteur de Resine Chelatante Pour le Prelevement la Preconcentration et la Determination de Metaux Traces Toxiques (Zn, Cd, Hg, Pb) dans les Eaux,
W82-03379 1507 5A

Identification and Determination of Aminocarb in Natural Water and Balsam Fir Foliage. (Recherche et Dosage De L'Aminocarb Dans Les eaux Naturelles et le Feuillage Du Sapin Baumier Par Chromatographic en Phase Gazeuse),
W82-03460 1508 5A

Speciation of Environmental Pollutants by GC-AA and by ESCA. Perification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 1508 5A

Balanus Eburneus: A Sensitive Indicator of Copper and Zinc Pollution in the Coastal Zone,
W82-03605 1508 5A

Trace Analyses for Wastewaters,
W82-03639 1508 5A

Evaluation of Four Concentration/Extraction Procedures on Waters and Effluents Collected for Use with the Salmonella Typhimurium Screening Procedure for Mutagens.
W82-03775 1509 5A

The Evaluation of the Elutriate Test as a Means of Predicting the Behavior of Selected Chlorinated Hydrocarbons in Dredged Sediment During Open-Water Disposal,
W82-03824 1509 5A

Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833 1509 5A

EPA's Priority Pollutants: Where They Come from--Where They're Going,
W82-03875 1509 6E

Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

Speciation of Trace Di- and Triorganotins in Water by Ion-Exchange HPLC-GFAA,
W82-04037 1509 5A

Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency,
W82-04095 1509 5A

Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

Evaluating Mediums and Plating Techniques for Enumerating Bacteria in Water Distribution Systems,
W82-04277 1510 5A

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

Responses of Bacteria to the Presence of Carbaryl in Water. II. Pure Culture vs. Mixed Culture Response,
W82-04341 1510 5C

Response of Bacteria to the Presence of Carbaryl in Water. I. Response of Bacterial Indicators Vs. Response of Pathogenic Bacterial Species,
W82-04342 1510 5C

Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 1510 5B

Enterotoxigenic Bacteria in Food and Water from an Ethiopian Community,
W82-04463 1510 5A

Occurrence and Fate of Certain Triphenylmethane Blue Dyestuffs in the Aquatic Environment,
W82-04478 1510 5B

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 1511 5A

Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 1511 5A

Apperatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 1511 5A

Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 1511 5A

Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 1511 5A

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 1511 5A

Unusual Polyhalogenated Chemical Residues Identified in Fish Tissue from the Environment,
W82-04822 1511 5A

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

Contents of Chlordane-, PCB- and DDT-Compounds and the Biotransformation Capacity of Fishes in the Lake Area of Eastern Finland,
W82-04827 1511 5A

Organochlorine Pollutant Analysis of Contaminated and Uncontaminated Lake Sediments by High Resolution Gas Chromatography,
W82-04828 1511 5A

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

Determination of 2,3,7,8-Tetrachlorodibenzo-P-Dioxin in Fresh Water Fish,
W82-04883 1511 5A

Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 1511 5A

Comparison of Atomic Absorption Spectrometric, Spectrophotometric, and Fluorimetric Methods for Determination of Aluminum in Water,
W82-04892 1511 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

POLLUTANT IDENTIFICATION

Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 1511 5A

Quantification of Octachlorostyrene and Related Compounds in Great Lakes Fish by Gas Chromatography-Mass Spectrometry,
W82-04993 1511 5A

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 1511 5A

Biological Monitoring, Part III.- Receiving System Methodology Based on Community Structure,
W82-05023 1511 5A

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

Fluorescence Cell Design and Use to Determine Crude Oil in Water,
W82-05358 1511 5A

Determination of Ultratrace Levels of Fluorine in Water and Urine Samples by a Gas Chromatographic/Atmospheric Pressure Helium Microwave Induced Plasma Emission Spectrometric System,
W82-05359 1511 5A

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 1511 5A

Determination of Metals in Groundwaters by Trace Enrichment and Liquid Chromatography,
W82-05361 1511 5A

Trace Enrichment of Difenzoquat in Water and Its Determination by Reversed Phase High Performance Liquid Chromatography,
W82-05362 1511 5A

Gas-Liquid Chromatographic Determination of Some Chloro- and Nitrophenols by Direct Acetylation in Aqueous Solution,
W82-05363 1511 5A

Determination of Mutagenic Potential and Organic Contaminants of Great Lakes Drinking Water,
W82-05398 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 1511 5A

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 1511 5A

High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 1511 5A

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 1511 5A

Use of Algal Fluorescence for an Automated Biological Monitoring System,
W82-05728 1511 5A

Volatile Constituents of the Produced Water Effluent from the Buccaneer Gas and Oil Field,
W82-05874 1511 5A

A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 1512 5A

Application of X-Ray Microanalysis for the Detection of Heavy Metal in Great Lakes Algae,
W82-05993 1512 5A

Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 1512 5A

Headspace Chromatographic Determination of Water Pollutants,
W82-06016 1512 5A

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 1512 5A

On the Limits of Detection of Traces of Volatile Organics in Water, Using Amberlite XAD-2 Resin,
W82-06028 1512 5A

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 1512 5A

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 1512 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 1512 5A

Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 1512 5A

Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 1512 5A

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

Liquid-Liquid Extraction Combined with Atomic-Absortpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 1512 5A

Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 1512 5A

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 1512 7C

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

The Potential Acidity Associated with Dews, Frosts, and Fogs,
W82-06246 1512 2K

A Method for Monitoring Mineralization of 14C-Labeled Compounds in Aqueous Samples,
W82-06272 1512 5A

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 1512 5A

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 1512 2K

Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

Determination of Methomyl and Methomyl-Oxime in Fruit Crops and Water by HPLC,
W82-06466 1512 5A

New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 1512 5A

Evaluation of Coliphage Detection as a Rapid Indicator of Water Quality,
W82-06537 1512 5A

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Io-

dophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

Fractionation of Metal Forms in Natural Waters by Size Exclusion Chromatography with Inductively Coupled Argon Plasma Detection,
W82-06545 1512 5A

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

Determination of Aldicarb Residues in Water by Combined High Performance Liquid Chromatography Mass Spectrometry,
W82-06549 1512 5A

Bacteria Under the Ice,
W82-06561 1512 5A

The OECD Cooperative Programme on Eutrophication Canadian Contribution, Summary Report, (Supplement),
W82-06567 1512 7C

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 1512 5C

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 1512 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 1512 5A

Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 1512 5A

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

Proportion of Methylmercury to the Total Amount of Mercury in River Waters in Canada and Japan,
W82-06609 1512 5B

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 1512 5B

Right Place, Time and Technique: Right Sample,
W82-06642 1512 5A

Algae and Crustaceans as Indicators of Bioactivity of Industrial Wastes,
W82-06654 1512 5A

Design and Operation of a Colorimetric Detector Controller,
W82-06656 1512 5A

A Water Quality Index for Lake Beaches,
W82-06660 1512 5G

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

Comparison of Filtration Techniques for Size Distribution in Freshwaters,
W82-06731 1512 5A

Salmonella SPP. in the Working Environment of Sewage Treatment Plants in Oslo, Norway,
W82-06734 1512 5A

Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

Dye-Coupled Electrode System for the Rapid Determination of Cell Populations in Polluted Water,
W82-06743 1512 5A

Comparison of Four Membrane Filter Methods for Fecal Coliform Enumeration,
W82-06744 1512 5A

Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 1512 5D

Use of Hoechst Dyes 33258 and 33342 for Enumeration of Attached and Planktonic Bacteria,
W82-06754 1512 5A

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 1512 5A

Applicability of Light Absorbance as a Measure of Oganic Carbon in Humic Lake Water,
W82-06773 1512 5A

Sampling Characteristics of Macrophyte Biomass,
W82-06779 1512 5A

Separation of Aqueous Organic Mixtures by Pervaporation and Analysis by Mass Spectrometry or a Coupled Gas Chromatograph-Mass Spectrometer,
W82-06791 1512 5A

Bioassays - Procedures and Results,
W82-06810 1512 5A

Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 1512 5A

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 1512 5A

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 1512 5A

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 1512 5A

Fluorometric Determination of DNA in Aquatic Microorganisms by Use of Hoechst 33258,
W82-06889 1512 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 1512 5A

Organics,
W82-06922 1512 5A

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 1512 5A

Inorganics,
W82-06999 1512 5A

POLLUTANTS

Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5E

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

Rapid Methods of Chemical Analysis Used in Emergency Response Mobile Laboratory Activities,
W82-01431 1503 5A

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

Laboratory Procedure for Estimating Residue Dynamics of Xenobiotic Contaminants in a Freshwater Food Chain,
W82-01443 1503 5B

The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 1504 5B

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 1505 5A

Fate of Priority Pollutants in Large Municipal Treatment Plants,
W82-03867 1509 5B

Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 1510 5C

Mutagens, Carcinogens and the Water Cycle,
W82-05468 1511 5A

A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 1511 5A

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

POLLUTION ABATEMENT

Pollution Permits and Markets for Water Quality,
W82-01699 1503 6A

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

POLLUTION CONTROL

Groundwater Strategies,
W82-00620 1502 5G

The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 1502 5D

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 1502 6E

The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 1503 6E

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 1503 6E

Some Emerging Rights in Agricultural Land,
W82-04890 1511 6E

POLLUTION EFFECTS

State of Washington Water Quality Assessment Report 1980.
W82-01067 1502 6E

POLLUTION IDENTIFICATION

Gas-Chromatographic Speciation of Methylstannanes in the Chesapeake Bay Using Purge Trap Sampling with a Tin-Selective Dector,
W82-04808 1511 5A

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

POLLUTION INDEX

EPA's Priority Pollutants: Where They Come from--Where They're Going,
W82-03875 1509 6E

POLLUTION LOAD

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 1501 5D

Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 1504 5C

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 1511 5B

Estimation of Pre- and Post-Development Nonpoint Water Quality Loadings,
W82-06043 1512 5B

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 1512 5B

Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

POLLUTION TAXES

The Economics of Cooperation Over Collective Bads,
W82-01909 1504 6A

POLSON MORAINE

Investigations of High Groundwater in Polson Terminal Moraine,
W82-02538 1505 2F

POLUTANT IDENTIFICATION

Solution Species of Plutonium in the Environment,
W82-00163 1501 5A

POLYAROMATIC HYDROCARBONS

Polycyclic Aromatic Hydrocarbons in Sediments and Associated Benthos in Lake Erie,
W82-04882 1511 5A

Investigating Potential Water Contamination by Petroleum-Asphalt Coatings in Ductile-Iron Pipe,
W82-05676 1511 5A

POLYBROMINATED BIPHENYLS

Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 1510 5B

POLYCHAETES

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina from Sediments Around the Coast of Wales,
W82-02416 1505 5A

POLYCHLORINATED BIPHENOLS

Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

POLYCHLORINATED BIPHENYLS

Modeling the Flux of Atmospheric Polychlorinated Biphenyls Across the Air/Water Interface,
W82-00193 1501 5B

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

Determination of Low NG/L Levels of Polychlorinated Biphenyls in Drinking Water by Extraction with Macroreticular Resin and Analysis Using a Capillary Column,
W82-00875 1502 5A

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan,
W82-01079 1502 5C

PCB Residues in Bottom Sediments Collected From the Bay of Quinte, Lake Ontario 1972-1973,
W82-01155 1503 5B

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 1503 5C

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 1503 5E

Polychlorinated Biphenyls and Other Organic Chemical Residues in Fish from Major United States Watersheds Near the Great Lakes, 1978,
W82-01583 1503 5A

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 1504 5B

PCBs in the Housatonic River: Determination and Distribution,
W82-02255 1505 5A

Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 1506 5D

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 1507 5A

Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies,
W82-03224 1507 5A

Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 1508 5B

Accumulation of Polychlorinated Biphenyls in Atlantic Tomcod (Microgadus Tomcod) Collected from the Hudson River Estuary, New York,
W82-03777 1509 5C

Adsorption of PCBs by Cellulose Fiber Filter-aids and Carbonaceous Adsorbents Used for Water Treatment,
W82-03937 1509 5F

Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

Pesticides and PCB in the Grand and Saugeen River Basins,
W82-05641 1511 5B

Poisons in the Hudson,
W82-05705 1511 5G

Bioconcentration of a Hexachlorobiphenyl in Great Lakes Planktonic Algae,
W82-05991 1512 5B

Influence of a Hexachlorobiphenyl in Great Lakes Phytoplankton in Continuous Culture,
W82-05994 1512 5C

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 1512 5B

National Interlabratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 1512 5A

Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 1512 5B

Effects of Polychlorinated Biphenyls and Environmental Bio-Transformation Products on Aquatic Nitrification,
W82-06753 1512 5C

A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 1512 5B

A Case Study of a Chemical Spill: Polychlorinated Biphenyls (PCBS). 2. Hydrogeological Conditions and Contaminant Migration,
W82-06866 1512 5B

Residues of PCB in a Cladophora Community Along the Lake Huron Shoreline,
W82-06938 1512 5C

POLYCHLORINATED BYPHENYLS
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 1502 5C

POLYELECTROLYTES
Research on Piezodialysis - Sixth Report,
W82-05294 1511 3A

POLYMER MEMBRANES
Studies on Synetheses and Permeabilities of Special Polymer Membranes.28. Permeation Characteristics and Structure of Interpolymer Membranes from Poly(Vinylidene Fluoride) and Poly(Styrene Sulfonic Acid),
W82-06109 1512 3A

POLYMERS
Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 1502 5F

Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 1510 5F

A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 1510 5A

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 1511 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

POLYPROPYLENE SHEETING
Effectiveness of Dupont Typar Sheeting in Controlling Macrophyte Regrowth After Overwinter Drawdown,
W82-04246 1509 5G

PONDING
An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 1501 2G

Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 1507 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 1510 2G

PONDS
Fenitrothion Sprayed on a Pond: Kinetics of Its Distribution and Transformation in Water and Sediment,
W82-00159 1501 5B

Residues of Isobornyl Thiocyanoacetate (Thanite) and a Metabolite in Fish and Treated Ponds,
W82-00570 1502 5B

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 1503 2H

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 1503 5D

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 1503 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 1504 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 1504 7B

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 1504 2H

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 1504 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 1504 2H

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 1505 2H

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

The Freshwater and Brackish-Water Diatoms of Penikese Island, Massachusetts: 1923-1973,
W82-02696 1506 2H

Limnological Studies of a Freshwater Fish Pond at Burdwan, West Bengal, India,
W82-03186 1507 2H

Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 1508 2H

Water Chemistry of Alabama Ponds,
W82-03534 1508 2K

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

Frequency of Low Dissolved Oxygen Concentrations in Ponds for Commercial Culture of Channel Catfish,
W82-04083 1509 8I

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

Convection Patterns in a Pond,
W82-04461 1510 2C

Contribution of Particle-Bound Bacteria to Total Microheterotrophic Activity in Five Ponds and Two Marshes,
W82-04467 1510 2H

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

Liming Fish Ponds,
W82-05866 1511 5G

Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 1512 4A

Observations on the Immature Chironomidea of Polluted Lowland Brook-Pond System (Antwerp, Belgium), Aerated by the Phallus Process,
W82-06912 1512 5G

POOLS
Effects of Short-Term Changes in Rain Water Supply on the Ionic Composition of Acid Moorland Pools in the Campine of Antwerp (Belgium),
W82-02775 1506 2H

POPULATION DENSITY
Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba,
W82-00520 1502 2H

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 1503 5C

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 1505 2L

Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 1508 7B

Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

POPULATION DYNAMICS

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 1503 5C

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 1504 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 1504 2H

Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 1505 2H

Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 1505 6G

How Abiotic Factors Affect the Distribution of Two Species of Tropical Predaceous Aquatic Bugs (Family: Naucoridae),
W82-02633 1506 7A

Production of Gammarus Lacustris (Amphipoda, Gammaridae) in Lake Sevan,
W82-02781 1506 2H

The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 1506 5C

Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 1506 2H

Pollution Effects on the Phytoplankton-Zooplankton Relationships in an Inshore Environment,
W82-02886 1506 5C

Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 1506 5C

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 1507 2H

Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 1511 2L

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

Microscale Patchiness of Nutrients in Plankton Communities,
W82-05613 1511 2H

Conflict Over Water Sources Predicted by Global Study.
W82-05879 1511 6B

Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 1512 5C

Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

POPULATION SHIFTS

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

Interactions of Heterotrophic Bacteria in the Sediment Water Phases of Two Contrasting Rivers,
W82-06564 1512 5A

POPULUS DELTOIDES

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

PORE PRESSURE

Estimating End-Of-Construction Pore-Pressures in Unsaturated Earth Embankments,
W82-00194 1501 8D

A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 1502 2G

The Role of Pore Pressure in Deformation in Geologic Processes,
W82-03706 1508 2F

PORE SIZE

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 1511 3A

PORE WATER

Origin, Age and Movement of Pore Water in Agrillaceous Quaternary Deposits at Four Sites in Southwestern Ontario,
W82-01321 1503 2F

A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

PORES

Soil Morphology and Preferential Flow Along Macropores,
W82-03175 1507 2G

POROSITY

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

Young's Inequality for Three-Dimensional Flows,
W82-04267 1510 2A

On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 1511 2G

Status of Porous Pavement Research,
W82-06665 1512 8G

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 1512 2G

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

POROUS CUP

A More Versatile Soil Water Sampler,
W82-02523 1505 7B

POROUS MEDIA

A Non-Equilibrium Thermodynamics Approach to Transport Phenomena in Capillary Porous Media,
W82-00697 1502 2F

Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 1503 5B

Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 1503 2G

A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 1503 5B

Integral Equation Formulation for Ground-Water Flow,
W82-02716 1506 2F

Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 1506 2F

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 1507 2F

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

A Derivation of the Equations for Transport of Liquid and Heat in Three Dimensions in a Fractured Porous Medium,
W82-04888 1511 2F

An Overview of Porous Pavement Research,
W82-05744 1511 5D

Immobilized Microbes and a High-Rate, Continuous Waste Processor for the Production of High Btu Gas and the Reduction of Pollutants,
W82-06005 1512 5D

Porous Media Equivalents for Networks of Discontinuous Fractures,
W82-06851 1512 2F

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 1512 2G

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

PORT VALDEZ
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

Deep Water Renewal in Subarctic Fjord,
W82-03675 1508 2L

PORTAGE
Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 1501 6G

PORTAGE LAKES
Algal Bioassay of the Portage Lakes, Summit County, Ohio,
W82-04813 1511 2H

PORTLAND
Energy Costs and Portland Water Supply System,
W82-02586 1505 5F

POSTIMPOUNDMENT
An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 1512 2E

POTABLE WATER
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 1501 5F

Ozone Treatment of Potable Water - Part I,
W82-00451 1501 5F

European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 1502 6D

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

Microbiology of Potable Water,
W82-01287 1503 5F

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 1504 5B

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 1504 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 1504 5B

Disinfection of Drinking Water in Developing Countries,
W82-02091 1504 5F

Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 1506 6C

Health Aspects of Water Desalination,
W82-03116 1507 3A

New Techniques to Remove Radon from Ground Water.
W82-03157 1507 5F

Ozone Water Treatment Systems,
W82-03448 1508 5F

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 1508 5G

Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Chemical Treatment of Small Remote Water Sources,
W82-04005 1509 5F

Water Supply in the USSR.
W82-04849 1511 6D

Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply,
W82-04961 1511 5A

Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 1512 5F

POTAMOGETON
Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 1508 2H

POTASSIUM
Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

Effect of Irrigation Frequency and Nitrogen on Groundnut Yield and Nutrient Uptake,
W82-06230 1512 3F

POTATO WASTES
Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 1501 5D

POTATOES
Odorous Compounds from Potato Processing Waste Effluent Irrigation Fields: Volatile Acids,
W82-00156 1501 5E

Aerated Drip Irrigation,
W82-02186 1505 3F

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 1505 3C

Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

POTENTIAL WATER SUPPLY
Verification of the Potential Yield and Chemical Quality of the Shallow Dolomite Aquifer in Dupage County, Illinois,
W82-03100 1507 2F

POTENTIOMETERS
Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

POTENTIOMETRIC HEAD
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 1504 2F

POTENTIOMETRIC LEVEL
Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisana,
W82-00728 1502 7C

Numerical Simulation of Potentiometric Surface Changes Caused by a Proposed Open-Pit Anthracite Mine,
W82-00819 1502 6A

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 1505 2F

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, May 1981,
W82-02464 1505 7C

Potentiometric Surface of the Floridan Aquifer, St. John's River Water Management District and Vicinity, Florida, May 1981,
W82-02479 1505 7C

Potentiometric Surface Maps of the Sparta Sand: Northern Louisiana and Southern Arkansas, 1900, 1965, 1975, and 1980,
W82-02839 1506 2F

Map Showing the Potentiometric Surface of the Magothy Aquifer in Southern Maryland, August 1980,
W82-03981 1509 7C

Map Showing How the Potentiometric Surface of the Magothy Aquifer of September 1979 Differed from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-03983 1509 7C

Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, May 1981,
W82-04507 1510 7C

Map Showing the Potentiometric Surface of the Aquia Aquifer, May 19-23, 1980,
W82-04978 1511 7C

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 1511 7C

Map Showing how the Potentiometric Surface of the Magothy Aquifer of August 1980 Differed

from the Potentiometric Surface of September 1977, in Southern Maryland,
W82-05838 1511 7C

Potentiometric Surface of the Floridan Aquifer, Southwest Florida Water Management District, September 1981,
W82-05840 1511 7C

Potentiometric Surface of the Floridan Aquifer in the St. Johns River Water Management District and Vicinity, Florida, September 1981,
W82-05849 1511 7C

Potentiometric Surface of the Floridan Aquifer in Central Sumter County, Florida, September 1981,
W82-05850 1511 7C

Potentiometric Map of the Sparta Aquifer System in Mississippi, Fall 1980,
W82-06135 1512 7C

Potentiometric Map of the Cockfield Aquifer in Mississippi, Fall 1980,
W82-06676 1512 7C

POTOMAC ESTUARY
Dynamic Estuary Model Performance,
W82-05319 1511 2L

POTOMAC RIVER
Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 1502 2L

Transformations of Nitrogen in a Polluted Estuary: Nonlinearities in the Demand for Oxygen at Low Flow,
W82-00777 1502 5B

Photosynthetic Pigments as Indicators of Algal Activity in the Upper Potomac Estuary,
W82-02529 1505 5B

Stochastic Hydrologic Model for Drought Management,
W82-02897 1506 2E

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

A Culture Model for Phytoplankton Succession in the Potomac River Near Washington, D.C. (U.S.A.),
W82-03765 1509 5B

Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998 1509 2L

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

Bloomington Lake - Potomac River Water Resources Project,
W82-06183 1512 8A

Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 1512 2E

POTOMAC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 1503 6D

Point Process Models of Rainfall,
W82-02452 1505 2A

POTOMAC RIVER ESTUARY
Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

Freshwater Influences on Striped Bass Population Dynamics,
W82-02116 1505 6G

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

POTTER CREEK AREA
Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

POULTRY
The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 1502 5B

Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 1503 5D

Detection of Chloroform in the Tissues of Freshly Eviscerated Poultry Carcasses Exposed to Water Containing Added Chlorine or Chlorine Dioxide,
W82-02374 1505 5A

POWDERED ACTIVATED CARBON
PAC Process,
W82-06643 1512 5D

POWER PLANTS
Power Plant Water Intake Assessment,
W82-00216 1501 6G

Effect of Leachate Solutions from Fly and Bottom Ash on Groundwater Quality,
W82-03798 1509 5B

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 1512 3E

POWERPLANTS
Water Related Planning and Design at Energy Firms,
W82-00042 1501 6D

Domestic Water Supplies for Power Plant Cooling,
W82-00180 1501 6D

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 1502 5B

Bentonite Liners for Power Plant Lagoons,
W82-00617 1502 5E

Measurement of Particulates Extrained in Some Great Lakes Power Plant Cooling Water: An Exercise in Futility,
W82-00782 1502 6G

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 1502 5C

The Removal of Organic Matter from Demineralised Water,
W82-00888 1502 5F

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

Development of Makeup-Line Safe-Operating Criteria,
W82-01095 1502 8B

An Empirical Methodology for Estimating Entrainment Losses at Power Plants Sited on Estuaries,
W82-01173 1503 6G

Entrainment and Impingement in Power Plant Cooling Systems,
W82-01276 1503 6G

Daily Optimization of Power Generation in Cascade Hydrosystems (A Stochastic Approach),
W82-01320 1503 6A

Northfield Mountain Pumped Storage Project: Performance,
W82-01517 1503 8A

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 1503 6B

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 1504 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 1504 5C

Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 1506 3E

PP and L Uses Discharge Water for Fish Farming,
W82-02645 1506 3C

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 1506 5C

Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

Efficient Cooling Ponds: Design,
W82-03672 1508 8A

Effect of a Deep-Water Outfall from a Power-Plant Reservoir on Water Quality in the Lower Pool,
W82-03768 1509 5C

Attached Algae of the Lake Erie Shoreline Near Nanticoke Generating Station,
W82-04035 1509 5C

Micro Hydropower in the USA,
W82-04316 1510 8A

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 1510 5D

Small Hydro Schemes for Private Developers,
W82-04327 1510 8A

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 1510 3A

A New Look at Small Power Plants. 2. The Environmental Effects,
W82-04769 1511 6D

Net Energy: Results for Small-Scale Hydroelectric Power and Summary of Existing Analyses,
W82-04806 1511 6D

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

Executive Summary for Power Plant Cooling System Water Consumption and Nonwater Impact Reports.
W82-05067 1511 2D

Entrainment Mortality of Ichthyoplankon: Detectability and Precision of Estimates,
W82-05181 1511 5C

Developments in Wastewater Handling at Power Plants,
W82-05517 1511 5D

The Expansion of Two Bolivian Plants,
W82-05598 1511 8A

Guidevane Erosion at Mao Tiao He,
W82-05600 1511 8G

Designing and Excavating Underground Powerplants,
W82-05982 1512 8E

Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 1512 5G

Power Plant Siting,
W82-06555 1512 6G

The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 1512 8E

Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 1512 5B

PRAIRIES
Impact of Management Practices on the Tallgrass Prairie,
W82-01580 1503 4A

PRECIPITABLE WATER
Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

PRECIPITAION
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 1503 2A

PRECIPITATION
Chemistry of Precipitation at Gainesville, Florida,
W82-00185 1501 2K

Report on the Summer MONEX Field Phase,
W82-00265 1501 2B

Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 1501 2B

Acid Rain: Facts and Fallacies,
W82-00518 1502 5C

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

Sources and Control of Organic Air Pollutants,
W82-00711 1502 5B

A Numerical Comparison Between Lagrangian and Eulerian Rainfall Statistics,
W82-00803 1502 2B

Effects of Atmospheric Precipitation Additions on Phytoplankton Photosynthesis in Lake Michigan Water Samples,
W82-01196 1503 2H

A Dendroclimatic Reconstruction of Annual Precipitation Amounts in Iowa Since 1680,
W82-01314 1503 2B

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 1504 5B

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 1504 2F

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 1504 2B

Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 1504 2B

Simplified Method for Rainfall Intensities,
W82-01978 1504 2B

Accuracy of Point Precipitation Measurements,
W82-02209 1505 2B

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 1505 2B

Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

Acid Precipitation--A New Study from Norway,
W82-03341 1507 5C

Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 1508 2J

Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 1510 2B

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 1510 2E

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 1510 2B

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 1511 2B

Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870 1511 2A

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 1512 2D

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 1512 2D

Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 1512 2B

PRECIPITATION INTENSITY
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 1504 2B

Young's Inequality for Three-Dimensional Flows,
W82-04267 1510 2A

PRECISION
Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 1511 5A

PREDATION
Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 1502 2H

Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 1505 6G

The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

Predator-Prey Relationships Among Water-Mites (Hydracarina) and Other Freshwater Organisms,
W82-02963 1506 5C

PREDICTION
Prediction of Total Phosphorus Concentrations, Chlorophyll a, and Secchi Depths in Natural and Artificial Lakes,
W82-00400 1501 2H

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 1502 6G

R-Factors for Soil Loss Impact Prediction,
W82-01963 1504 2J

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 1505 7A

Mathematical Models of Water Yield with Particular Reference to Missisippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 1508 2A

Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

Estimation of Flood Peaks with Limited Hydrologic Data,
W82-05521 1511 2A

Chemometric Modeling of Wastewater Treatment Processe,
W82-05858 1511 5D

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 1512 2B

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 1512 6B

PREDICTIONS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 1503 6A

PREIMPOUNDMENT
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota,
W82-02828 1506 4A

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 1510 6A

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 1512 2E

PRESSURE DISTRIBUTION
Uncertainties in Water Distribution Systems,
W82-03668 1508 8A

Pressure Distribution Design for Septic Tank Systems,
W82-05439 1511 5E

PRESSURE HEAD
Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 1507 2F

PRESSURE-MEASURING INSTRUMENTS
Determination of Hydrogeological Parameters Using Sinusoidal Pressure Tests: A Theoretical Appraisal,
W82-00603 1502 7B

Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 1507 7B

PRETREATMENT
Plant Expansion Via High-Rate Pretreatment,
W82-05953 1512 5F

PRETREATMENT OF WATER
Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 1501 5F

Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

The Status of Direct Filtration.
W82-04105 1509 5F

Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 1511 3A

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

PRICE DISCRIMINATION
Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 1510 6C

PRICES
Projected Effects of Energy Policies on Agricultural Water Use and Irrigation,
W82-03915 1509 6C

Normalized Agricultural Prices and Water Resources Planning,
W82-03928 1509 6B

Projective Evaluation During Inflation, Revisited: A Solution to Turvey's Relative Price Change Problem,
W82-04202 1509 6B

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 1510 6B

Current Trends in Cost of Service Studies,
W82-05806 1511 6C

PRICING
Potential Political Influences Affecting the Water Industry,
W82-00861 1502 6C

Water: A Low-Priced But High-Cost Resource,
W82-02061 1504 6C

An Analysis of the Effects of Alternative Measures of Price on the Demand for Water by Self-Supplied Industries,
W82-03828 1509 6C

Achieving Urban Water Conservation,
W82-04227 1509 3D

Conserving Water Through Pricing,
W82-04272 1510 3D

The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 1510 6E

On the Marginal Cost of Wastewater Services,
W82-04376 1510 6C

Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 1510 6C

The Real Price of Urban Water,
W82-04797 1511 6C

Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 1511 6C

Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 1511 6C

Price or Persuasion,
W82-05791 1511 6C

Water Utility Costs and Rate Design for Fire Protection Services,
W82-06275 1512 6C

Water Rates and Residential Water Conservation,
W82-06276 1512 3D

Cost-Based Water Rate Design,
W82-06277 1512 6C

How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 1512 6C

Policing Demand Through Pricing,
W82-06352 1512 6D

Methods for Apportioning the Cost of a Water Resource Project,
W82-06853 1512 6C

PRIMARY PRODUCTION
Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 1503 2H

Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 1510 5C

PRIMARY PRODUCTIVITY
An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 1502 7B

Ammonia and Nitrate Uptake in the Lower Great Lakes,
W82-00882 1502 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 1502 2H

Freshwater Inputs and Estuarine Productivity,
W82-02110 1505 2L

Productivity of Four Marsh Sites Surrounding Lake Pontchartrain, Louisiana,
W82-02334 1505 2H

Periphyton Production in an Appalachian Mountain Trout Stream,
W82-02335 1505 5C

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 1505 2H

Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 1507 2H

Primary Production and Rates of Algal Growth in Lake Tanganyika,
W82-03420 1508 2H

Signal Analysis of Irradiation, Temperature and Primary Production in a Small Artificial Pond, II. The Residual Spectra,
W82-03465 1508 2H

Environmental Factors Affecting the Growth of Photosynthetic Bacteria in Lakes,
W82-03712 1508 2H

A Comparison of the Structure, Primary Productivity, and Transpiration of Cypress Ecosystems in Florida,
W82-03885 1509 2I

Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 1510 2H

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 1510 2H

Primary Production in Saline Lakes,
W82-04926 1511 2H

Horizontal Distribution of Chlorophyll in the Bielersee (Die Horizontale Verteilung von Chlorophyll Im Bielersee),
W82-05007 1511 2H

Device for Continuous Measurement of Primary Production of Water Bodies and Biochemical Oxygen Demand,
W82-05028 1511 7B

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 1512 5C

PRIMARY TREATMENT
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 1511 5D

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

PRIMARY WASTEWATER TREATMENT
Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 1510 5D

Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 1512 5G

PRINCE WILLIAM FOREST PARK
Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

PRIORITIES
Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 1501 5C

The Sewerage Policy of Thames Water,
W82-02040 1504 6E

Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 1511 5G

PRIORITY POLLUTANTS
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 1504 5B

PRIVATE RIGHTS
Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 1503 6E

PROBABILISTIC PROCESS
The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 1501 6A

Channel Instability in a Braided, Sand Bed River,
W82-01316 1503 2J

Probabilistic Stability Analysis of Earth Slopes,
W82-01952 1504 8D

Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8B

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 1511 4A

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 1511 5C

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

PROBABILITY DISTRIBUTION
Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 1503 2B

Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 1503 2B

Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 1505 2J

Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 1506 7B

Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 1512 2A

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 1512 2G

Antecedent Moisture Condition Probabilities,
W82-06451 1512 2A

PROBABILITY DISTRIBUTIONS
On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

PROBABLE MAXIMUM PRECIPITATION
The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 1502 2B

Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 1511 2B

PROCESS CONTROL
Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 1503 5D

Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems,
W82-03763 1509 5D

Improved Operation of Municipal Wastewater Treatment Plants in Sweden by Use of Instrumentation and Automation,
W82-03846 1509 5D

Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment,
W82-03848 1509 5D

Experiences of MLSS Control of the Activated Sludge Process,
W82-03849 1509 5D

Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

A Method for the Evaluation of the Effectiveness of a Quality Control Operation in Activated Sludge Process,
W82-03854 1509 5D

PROCESS CONTROL

Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

Microprocessor Architecture and Performance in Wastewater Process,
W82-04056 1509 5D

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 1510 5D

Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

Advanced Supervisory Control System for Sludge Treatment.
W82-04841 1511 5D

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

A Dynamic Model Identification of the Sludge Dewatering Process,
W82-04844 1511 5D

Automatic Monitoring of Copper in Waste Water from Plating Shops,
W82-04845 1511 5A

Control of Sludge Bulking in the Brewing Industry,
W82-05260 1511 5D

PROCESS WATER

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 1501 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 1501 5D

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 1501 5D

Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 1501 5D

PRODUCTIVITY

Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 1503 2H

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 1504 2H

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 1504 2H

Metabolism of a Florida Lake Ecosystem,
W82-02268 1505 2H

Nitrate and Ammonia Uptake in the Apex of the New York Bight,
W82-02286 1505 5C

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 1506 5C

The Use of Dialyzing Sacks in Estimation of Production of Bacterioplankton and Phytoplankton,
W82-02866 1506 7B

Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 1507 6A

Comment on 'A Relation Between Lake Morphometry and Primary Productivity and Its Use in Interpreting Whole-Lake Eutrophication Experiments' (E.J. Fee),
W82-03780 1509 5C

Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 1511 2L

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

PROFESSIONAL PERSONNEL

Professional Development for Water Quality Control Personnel,
W82-03531 1508 9A

PROJECT PLANNING

Northeastern New Jersey Grapples With a Drought,
W82-00289 1501 8A

Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

Project Outcomes Correlate with Public Participation Variables,
W82-02663 1506 6B

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 1507 6D

Projective Evaluation During Inflation, Revisited: A Solution to Turvey's Relative Price Change Problem,
W82-04202 1509 6B

Water Reuse Planning by Means of an Input-Output Table,
W82-04794 1511 6A

A Screening Model to Quantify Resilience,
W82-05044 1511 6A

Alternative Indices of Resilience,
W82-05045 1511 6A

Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-05564 1511 6A

Water Yield Estimation in Western United States,
W82-05689 1511 4D

Colorado River Development,
W82-05887 1511 4A

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

Rutland Water - From Conception to Operation,
W82-06481 1512 6D

Introduction - Rutland Water 1970-1981,
W82-06482 1512 6B

PROJECTIONS

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 1508 6A

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Gilbert/Commonwealth, Reading, PA,
W82-03475 1508 6A

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

Truckee Meadows Water Use - Present and Future,
W82-06705 1512 3D

PROJECTS

Water Resources Investigations in New York-1980.
W82-00011 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

PROPERTY RIGHTS
Some Emerging Rights in Agricultural Land,
W82-04890 1511 6E

PROPERTY VALUE
Impact of Flood Hazard on Residential Property Values in Galt (Cambridge), Ontario,
W82-03929 1509 6B

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

PROTECTION
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 1507 5F

Barrier Islands: Should Engineers Interfere with Nature,
W82-03377 1507 6F

Engineering Aspects of Fish Protection at Water Intakes,
W82-04759 1511 8I

PROTEIN RECOVERY
Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

PROTEINS
Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 1511 5D

Protein Recovery from Dairy Industry Wastes with Aerobic Biofiltration,
W82-05497 1511 5D

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

PROTONS
Proton Mobility in Ice,
W82-03701 1508 2C

PROTOTYPE TESTS
Model-Prototype Comparison of Free Surface Vortices,
W82-03667 1508 8B

PROTOZOA
Effect of Crude Oil and Petroleum-Degrading Microorganisms on the Growth of Freshwater and Soil Protozoa,
W82-00517 1502 5C

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 1504 2H

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

Detoxification of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyriformis. II. Growth Experiments and Ultrastructural Studies on Sequestration of Heavy Metals,
W82-03334 1507 5G

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

PSEUDOMONAS
Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

PUBLIC ACCESS, RECREATION
Problems of Public Access to Water in Texas Lakes and Streams,
W82-04220 1509 6E

PUBLIC HEALTH
A/C Pipe - Assessment or Advocacy,
W82-00070 1501 5F

Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

Environmental Virology and its Problems,
W82-00505 1502 5A

Environmental Health Hazards,
W82-00625 1502 5F

Health Aspects of Urban Water Conservation,
W82-01047 1502 3C

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 1502 6B

Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 1503 5C

Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 1503 5D

The Water Decade (1981-1990),
W82-01534 1503 6E

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 1503 5A

Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

Thermophilic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 1504 5B

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 1504 5C

Wanted: Water for Development,
W82-02088 1504 6D

Recreational Water Quality and Health,
W82-02997 1506 5C

Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

Health Aspects of Water Desalination,
W82-03116 1507 3A

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 1508 5G

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 1508 5C

Microbiological Quality of Selected Recreational Waters,
W82-03636 1508 5A

Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 1508 5A

Environment and Public Health in the Caribbean,
W82-03787 1509 6D

Waterborne Disease in The United States and Canada,
W82-03892 1509 5C

Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

International Decade on Drinking Water and Sanitation,
W82-04230 1509 6E

Regulating Corrosive Water,
W82-04335 1510 6B

Clean Water for the Third World,
W82-04604 1510 6D

The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 1510 6D

The New Pollution--Groundwater Contamination,
W82-04938 1511 5C

The Continuing Struggle of Waterborne Illness,
W82-05366 1511 5C

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 1512 5A

Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 1512 5B

Disease Outbreaks Caused by Drinking Water,
W82-06928 1512 5C

PUBLIC HEARINGS
Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 1512 6B

PUBLIC INVESTMENT
Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

PUBLIC OPINION
Reclaiming and Reusing Wastewater,
W82-00402 1501 5D

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

San Francisco River Wild and Scenic River Study Report; Greenlee County, Arizona.
W82-04076 1509 6G

Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222 1509 6D

A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 1511 5B

Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

Rutland Water - From Conception to Operation,
W82-06481 1512 6D

PUBLIC PARTICIPATION
Potential Political Influences Affecting the Water Industry,
W82-00861 1502 6C

Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 1503 5

Malawi: A Community Approach.
W82-01365 1503 5F

Project Outcomes Correlate with Public Participation Variables,
W82-02663 1506 6B

Cascaded Tradeoffs: A Multiple-Objective, Multiple-Publics Method for Alternatives Evaluation in Water Resources Planning,
W82-02980 1506 6B

River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

Making Your Way Through Murky Waters-A Manual for Public Participation Coordinators in Natural Resources Planning,
W82-04085 1509 6A

Comparing Two Measures of Water Based Recreation Participation,
W82-05733 1511 6D

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 1512 6B

Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

PUBLIC POLICY
The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 1502 6B

Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 1503 6B

Digest of Water Resources Policies and Authorities.
W82-02973 1506 6E

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 1512 6B

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 1512 6D

PUBLIC RELATIONS
Organic Contamination of Ground Water: Tell it All,
W82-01474 1503 5C

The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 1511 5G

Flood Hazard Maps as Public Information: An Assessment Within the Context of the Canadian Flood Damage Reduction Program,
W82-05729 1511 7C

PUBLIC UTILITY DISTRICTS
The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 1511 5B

Water Supply and Distribution in Larger Communities,
W82-06413 1512 5F

County Provides a Rural Water Supply System,
W82-06843 1512 3D

PUBLIC WATERS
Carrying Capacity for the Illinois River,
W82-05927 1512 6G

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys.
W82-06368 1512 6B

PUBLICATIONS
Ground-Water Information: NWWA Provides the Resources,
W82-00301 1501 2F

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 1501 10C

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 1508 5D

Annotated Selected References on Natural Resources Investigations, Collier County, Florida,
W82-04508 1510 10C

PUDDLING
Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

PUEBLO
Operation Reports–City of Pueblo, Colorado Department of Public Works.
W82-03348 1507 5D

PUEBLO INDIANS
Pueblo Indian Agriculture, Irrigation and Water Rights,
W82-04208 1509 6E

PUERTO RICO
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

Ground Water Law in Puerto Rico.
W82-06296 1512 6E

PUGET SOUND
Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 1502 8I

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 1502 5D

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 1508 5A

PULLMAN-MOSCOW BASIN
Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 1502 5B

PULP AND PAPER INDUSTRY
Evaluation of Methodologies for the Determination of Acute Toxicity in Pulp and Paper Effluents,
W82-00297 1501 5A

The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 1501 5D

Pulp Companies Face Billion Dollar Cleanup.
W82-00343 1501 5D

Bacterial DNA Repair Assay of Selected Compounds in Pulp and Paper Mill Effluents,
W82-00687 1502 5C

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

Fungal Decolorization of Kraft Bleach Plant Effluents,
W82-00689 1502 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 1502 5D

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 1502 5B

Pulp and Paper Industry Effluent Management,
W82-01260 1503 5D

Environmental Recovery in a Marine Ecosystem Impacted by a Sulfite Process Pulp Mill,
W82-01548 1503 5B

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

O2 Bleaching Shows Potential for Reducing Costs and Effluent Problems,
W82-01578 1503 5D

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 1503 5D

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 1503 5G

Acid Precipitation: Basic Principles and Ecological Consequences,
W82-01586 1503 5C

Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 1503 5D

Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 1503 5D

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 1504 5B

Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 1504 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 1504 5D

Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 1505 5B

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 6B

Field Report on a Nonpolluting Bleach Plant,
W82-02793 1506 5D

New Developments in Papermaking in Western Europe,
W82-02947 1506 5D

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 1506 5D

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 1506 5D

Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 1508 5D

Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 1508 5D

Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 1508 5C

Densification of Paper Mill Sludge Materials,
W82-04694 1510 5E

Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 1511 5C

Hydroelectric Power Offers Stable, Cheap Energy Source for Industry,
W82-05954 1512 6B

High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

Domes, Bubbles, and Paper Waste,
W82-06025 1512 5D

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 1512 5D

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 1512 5C

Environmental Improvement at Port Alice, B. C.,
W82-06515 1512 5C

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

PULP WASHING
Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

PULP WASTES
Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 1501 5D

Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 1502 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 1502 5D

The Interaction of Treated Bleached Kraft Mill Effluent and Dissolved Oxygen Concentration on the Survival of the Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W82-01494 1503 5C

U.V.-DOC Characterization of Pulp and Paper Bleach Effluents,
W82-01495 1503 5A

Main Compounds Behavior in Kraft Wastes Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

Enchytraeid Oligochaetes as Marine Pollution Indicators,
W82-02445 1505 5A

Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 1508 5D

Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 1511 5D

Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

The Benefits of Pre-Operational Baseline Aquatic Biology Studies,
W82-06235 1512 5A

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

PUMP TURBINES
Optimization of Pump Turbines,
W82-00181 1501 8C

PUMP WELLS
Managing Wells for Energy Efficiency,
W82-03734 1508 4B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 1510 8B

Theory for Aquifer Test Analysis in Fractured Rock Under Linear (Nonradial) Flow Conditions,
W82-04676 1510 2F

Cavity Well,
W82-04920 1511 8A

An Evaluation of Twin Wells for Use with Water Source Heat Pumps,
W82-05307 1511 8B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 1511 8B

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 1511 4B

PUMPAGE
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

Northeastern New Jersey Grapples With a Drought,
W82-00289 1501 8A

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

Assessment of Eighteen Public Groundwater Supplies in Illinois,
W82-02510 1505 2F

SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 1508 6E

Hydrologic Effects from Changes in Ground Water Pumpage,
W82-04428 1510 2F

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980,
W82-05826 1511 4B

PUMPED STORAGE
Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

TVA's Pumped-Storage Plant.
W82-03250 1507 8A

Pumped-Storage Development in Brazil. Part III,
W82-03381 1507 8A

Pumped-Storage for Swiss Railways, Part One,
W82-03468 1508 8A

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 1512 6G

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 1512 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

PUMPING
Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 1505 6E

Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

Curbing the Distribution Energy Appetite,
W82-04136 1509 5F

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska,
W82-05846 1511 2F

A Numerical Model of Aquifer Tests in Multi-Layered Aquifer/Aquitard Systems,
W82-05943 1512 2F

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 1512 2H

PUMPING PLANTS
Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

Pumping Station Reliability: How and How Much,
W82-04110 1509 8C

Sewage Pumping Station Split for Maintenance,
W82-05719 1511 5D

Swift Action by State Officials Prepares for Water Supply Crisis,
W82-06514 1512 8C

PUMPING STATIONS
Demand Forecasting in Water Supply Networks,
W82-02926 1506 6D

PUMPING TESTS
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 1504 2F

Analysis of Pumping Test Data Using Marquardt Algorithm,
W82-02721 1506 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 1506 2F

PUMPS
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 1503 7B

The Cone Pump,
W82-02713 1506 8C

Designing an Energy-Efficient Wastewater Treatment Plant,
W82-03477 1508 5D

Practical Power-Saving Techniques in Pinellas County,
W82-04092 1509 5F

Pump Systems: What Price Inefficiency,
W82-04093 1509 8C

Pumped Outlets for Drainage Systems,
W82-04364 1510 8A

Cutting Irrigation Costs,
W82-05081 1511 3F

Water System Efficiencies,
W82-05281 1511 8C

Use and Design Features of the Pump Unit of the UVV-3-6KM Vacuum Groundwater Lowering Installation,
W82-05587 1511 8C

Use and Investigation of Water-Jet Pumps (Ejectors) at the Chirkey Hydroelectric Station,
W82-05592 1511 8C

Using Pumps as Small Turbines,
W82-05597 1511 8C

Using Pump Curves and Valving Techniques for Efficient Pumping,
W82-05666 1511 8C

Pump Installations for reverse Osmosis Systems,
W82-05882 1511 8C

Design Considerations in Waterworks Pumps Selection,
W82-06343 1512 8C

Pump Sump Design Experience: Summary,
W82-06419 1512 8C

Zimbabwean Hand Pump Passes Village-Level Endurance Tests,
W82-06606 1512 8C

PURE WATER
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

PURIFICATION
Development and Use of a Continuous Toc-Measurement Device in Wastewater Purification,
W82-04019 1509 5A

A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

PYGMY OAKS
Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

PYRAMID LAKE
Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

QANAT AL-JAISH CANAL
A Hydrobiological Survey of a Polluted Canal,
W82-01356 1503 5C

QUABBIN RESERVATION
Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222 1509 6D

QUALITY CONTROL
Microbiology: Methodology and Quality Assurance,
W82-01285 1503 5A

New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 1505 5F

Effect of Water Treatment on Mutagenic Potential,
W82-03776 1509 5A

The Use of Respirography in Biological Treatment Plant Control,
W82-04011 1509 5D

Application of Fluidic Devices for Control of Wastewater Treatment Operations,
W82-04013 1509 5D

A Survey of Quality Control Practices in Water Bacteriology Laboratories,
W82-04111 1509 5A

Analytical Quality Control,
W82-04345 1510 5G

Controlling the Quality of Compaction of Earth Fill in the Construction of High Dams,
W82-05109 1511 8A

QUANTITATIVE ANALYSIS
Subdomain Integration Model of Ground-Water Flow,
W82-02550 1505 2F

QUEBEC
Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

Spatial and Temporal Overlap in Lake Phytoplankton Communities,
W82-02610 1506 2H

Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 1506 2K

Susceptibility of Aquatic Ecosystems to the Effects of Atmospheric Pollutant Fallout in Quebec.
W82-03106 1507 5C

Ultraplankton Biomass, Productivity and Efficiency in Lac Matamec, A Precambrian Shield Lake,
W82-04383 1510 2H

Prediction of Water Inflow to Lake Memphremagog (Prevision des Apports Hydriques au lac Memphremagog),
W82-04459 1510 2A

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

James Bay Spillways and Control Structures,
W82-04692 1510 8A

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 1511 6E

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

Stable Carbon Isotope Ratio of Submerged Freshwater Macrophytes,
W82-06972 1512 5C

Phosphorus Release by Submerged Macrophytes: Significance to Epiphyton and Phytoplankton,
W82-06977 1512 5B

RADAR

Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 1502 2B

Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 1503 2G

Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 1504 2B

Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Radar Measurements of Estuarine Currents and Tides,
W82-03360 1507 2L

Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 1508 2B

Aircraft Radar Responses to Soil Moisture,
W82-04187 1509 7B

A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 1510 2B

RADIAL GATES

Hydraulic Gates,
W82-02206 1505 8C

Prospects of Using Radial Gates on Overflow Dams of Large Hydroelectric Stations,
W82-02693 1506 8A

RADIATION

Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

RADIOACTIVE DATING

Radiocarbon Dating of Groundwater of the Aquifer Confined in the Lower Triassic Sandstones of the Lorraine Region, France,
W82-02877 1506 2F

The Waters of Merom: A Study of Lake Huleh 7. Diatom Stratigraphy of the 54-M Core,
W82-06880 1512 5C

RADIOACTIVE TECHNIQUES

Algal-Bacterial Symbiosis in the Chowan River, NC,
W82-02177 1505 5A

RADIOACTIVE TRACERS

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 1503 2F

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 1504 2J

Orthophosphate and Its Flux in Lake Waters,
W82-03613 1508 2H

Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

RADIOACTIVE TRACES

Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

RADIOACTIVE WASTE DISPOSAL

Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 1501 5E

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

Dissolution of Salt Deposits by Brine Density Flow,
W82-01016 1502 2F

Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 1503 5B

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 1512 2F

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 1512 6G

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5B

Radioactive Wastes,
W82-06920 1512 5E

RADIOACTIVE WASTES

Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 1502 5D

Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 1502 5B

Radioactive Wastes,
W82-01268 1503 5D

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

Surface Water Hydrologic Criteria for Uranium Mine Tailings Impoundments in Ontario,
W82-02240 1505 5E

Comparative Uptake of Actinides by Plants and Rats from the Shoreline of a Radioactive Pond,
W82-02323 1505 5B

Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 1506 5D

The Status of Nuclear Waste Management,
W82-02659 1506 5E

241Am from the Decay of 241Pu in the Irish Sea,
W82-03199 1507 5B

Microbial Activity of Trench Leachates from Shallow-Land, Low-Level Radioactive Waste Disposal Sites,
W82-03261 1507 5B

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 1507 5A

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 1507 5B

Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

RADIOACTIVE WASTES

A Survey of Radioactive Effluent Releases from Byproduct Material Facilities,
W82-03963 1509 5B

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 1511 5E

Migration of Ruthenium-106 in a Nevada Test Site Aquifer: Discrepancy between Field and Laboratory Results,
W82-05008 1511 5B

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 1511 5B

Elevated Concentrations of Actinides in Mono Lake,
W82-05520 1511 5B

Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary,
W82-05984 1512 5B

Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

RADIOACTIVITY
Retention of Radionuclides by Some Aquatic Fresh Water Plants,
W82-00853 1502 5B

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

Prospects of Using Radiation Water Treatment Methods,
W82-05026 1511 5D

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

RADIOACTIVITY TECHNIQUES
High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 1511 5A

Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 1511 2C

RADIOCHEMICAL ANALYSIS
Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 1511 5A

RADIOISOTOPES
Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 1504 5B

Hydrological Studies Possible with Radionuclides of Bomb-Test, Primordial and Natural Origin to Complement Investigations Using Manufactured Radiotracers,
W82-03836 1509 5B

Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods.
W82-03883 1509 2J

A Survey of Radioactive Effluent Releases from Byproduct Material Facilities,
W82-03963 1509 5B

Radionuclides in Mono Lake, California,
W82-05461 1511 5B

Elevated Concentrations of Actinides in Mono Lake,
W82-05520 1511 5B

Determination of Recent Desposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

Effects on Global Supplies of Freshwater,
W82-06733 1512 5C

Manganese-54 Accumulation by Chlorella SPP., Daphnia Magna and Yellow Perch (Perca Flavescens).
W82-06904 1512 5B

RADIOMETERY
Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 1503 7B

RADIOMETRY
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

RADIONUCLIDES
Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

RADIUM
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

Uranium Isotopes and 226Ra Content in the Deep Groundwaters of the Tri-State Region, U.S.A.,
W82-02939 1506 5A

Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

Radon and Radium Discharge to Surface Streams,
W82-03881 1509 5B

Radium Content and the 226Ra/228Ra Activity Ratio in Groundwater from Bedrock,
W82-05450 1511 2K

RADIUM-226
Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 1503 5D

RADIUM RADIOISOTOPES
Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 1511 5A

High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 1511 5A

RADON
Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 1503 2F

Radon-222, In Potable Water Supplies of New England,
W82-01221 1503 5B

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 1505 2L

Radon and Radium Discharge to Surface Streams,
W82-03881 1509 5B

RADON REMOVAL
New Techniques to Remove Radon from Ground Water.
W82-03157 1507 5F

RAFT RIVER
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

RAILROAD YARDS
Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

RAILROADS
Pumped-Storage for Swiss Railways, Part One,
W82-03468 1508 8A

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

RAIN
Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 1501 2J

Measurements of Hydrogen Peroxide in Rainwater,
W82-00497 1501 2K

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 1502 2B

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 1506 2K

Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 1508 2B

Chemical Composition of Monsoon Rainwater Over Bhopal, Madhya Pradesh (India) During 1977 and 1978,
W82-04666 1510 2B

A Physical Reason for Higher pH of Tropical Rainwater,
W82-04669 1510 2K

A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 1511 2B

Splash Erosion Modeling: Physical Analysis,
W82-05970 1512 2J

Influence and Prevention of Bird-Droppings in Precipitation Chemistry Experiments,
W82-06245 1512 5B

On the Graphical Presentation of Raindrop Size Data,
W82-06529 1512 2B

The Effect of Pressure on the Breakup of One Pair of Raindrops,
W82-06761 1512 2B

RAIN-DROP SIZE ANALYSIS
Large Rain Drops in the Bright Band,
W82-03065 1507 7B

RAIN GAGES
Rainwater Gauge,
W82-00068 1501 2B

Note on Random Raindrops and Sampling Error,
W82-02032 1504 2B

Rainfall Catch Errors Associated with Circumambient Obstructions,
W82-03021 1507 2B

Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 1510 2B

Recording Raingage Modifications,
W82-05665 1511 7B

RAIN INTENSITY
How Rain Intensity Affects Interrill Erosion,
W82-04537 1510 2J

RAINBOW TROUT (SALMO GAIRDNERI)
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 1504 5A

RAINDROP SIZE
A Self-Evaluating Disdrometer for the Measurement of Raindrop Size and Charge at the Ground,
W82-04897 1511 2B

RAINFALL
Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation,
W82-00132 1501 2B

Report on the Summer MONEX Field Phase,
W82-00265 1501 2B

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 1502 2B

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

The Magnitude of the Hydrological Frequency Factor in Maximum Rainfall Estimation,
W82-00983 1502 2B

Adaptive Hydrological Forecasting - A Review,
W82-00984 1502 2A

Note on Probability Approach to Study the Occurrence of Rainfall at Hyderabad,
W82-01380 1503 2B

Time Distribution of Clock Hour Rainfall,
W82-01402 1503 2A

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 1503 2B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 1503 7B

A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 1503 2B

Note on Random Raindrops and Sampling Error,
W82-02032 1504 2B

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 1505 2L

Rainfall-Related Trends in the Structure of a Fish-Crustacean Community in Texas' Galveston Bay System,
W82-02160 1505 2L

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 1505 2A

The Relative Influence of Dams and Secular Climatic Change on Downstream Flooding, Australia,
W82-02425 1505 2E

Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 1505 2I

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 1506 2K

Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Rainfall Catch Errors Associated with Circumambient Obstructions,
W82-03021 1507 2B

Will the Sahelian Drought End in 1985,
W82-03167 1507 2B

Acid Precipitation in The Pittsburgh, Pennsylvania Area,
W82-03368 1507 2B

Rainfall Interstation Correlation Functions. II. Application to Three Storm Models with the Percentage of Dry Days as a New Parameter,
W82-03422 1508 2B

Rainfall Interstation Correlation Functions. I. An Analytic Approach,
W82-03467 1508 2B

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 1508 2A

A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 1510 2B

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 1510 2B

Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

Revised Rainfall Frequency Analysis for Houston,
W82-05863 1511 2B

An Analysis of Medium and Long Duration Extreme Rainfalls in the Southern Cape Coastal Lakes Region for the Purposes of Flood Hydrograph Generation,
W82-05899 1511 2A

Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 1511 2B

Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 1512 2B

Flood of May 5 and 6, 1981, Mobile, Alabama,
W82-06128 1512 2E

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 1512 2B

Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 1512 2B

A Moisture Analysis Procedure Utilizing Surface and Satellite Data,
W82-06212 1512 2B

The Outlook for Precipitation Measurements from Space,
W82-06531 1512 7B

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

RAINFALL DISTRIBUTION
Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 1501 2A

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 1502 2B

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

RAINFALL DISTRIBUTION

The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 1505 2L

Accuracy of Point Precipitation Measurements,
W82-02209 1505 2B

Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

Usefulness of Monthly Rainfall Normals in Agroclimatic Mapping,
W82-04668 1510 2B

Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 1510 2B

On the Sampling Variance of Raingage Networks,
W82-05875 1511 7B

Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 1512 2B

Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 1512 2B

RAINFALL FORECASTING

Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 1507 2A

RAINFALL IMPACT

Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 1501 2I

The Breakdown of Poultry Manure Aggregates by Rainfall Impact,
W82-00513 1502 5B

R-Factors for Soil Loss Impact Prediction,
W82-01963 1504 2J

Sediment Transport by Rainsplash,
W82-03709 1508 2J

RAINFALL INFILTRATION

Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 1501 2G

The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 1511 2G

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

RAINFALL INTENSITY

Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 1501 2J

Deuterium/Hydrogen Ratios in Australian Rainfall,
W82-01325 1503 2B

Erosivity 'R' for Individual Design Storms,
W82-01403 1503 2J

Simplified Method for Rainfall Intensities,
W82-01978 1504 2B

Application of Infiltration Theory for the Determination of Excess Rainfall Hyetograph,
W82-03752 1509 2A

Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 1510 2B

A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 1512 7B

RAINFALL RATE

Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 1502 2I

Accuracy of Point Precipitation Measurements,
W82-02209 1505 2B

A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 1512 7B

RAINFALL-RUNOFF RELATIONSHIPS

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

The Conservative Effect of Rainfall Variation on Fertiliser Response in a Humid Environment,
W82-00316 1501 2A

Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

A Comparison of Rainfall-Runoff Models,
W82-00911 1502 2A

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Can We Model the Rainfall-Runoff Process Today,
W82-01609 1503 2A

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 1503 2A

Surface Water Flow from a South Florida Wetland Area,
W82-02121 1505 2E

Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 1505 2A

Point Process Models of Rainfall,
W82-02452 1505 2A

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 1505 2A

Approximate Error Bounds for Simulated Hydrographs,
W82-02678 1506 2A

Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 1508 2A

Diverging Overland Flow,
W82-03676 1508 2A

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

Application of Infiltration Theory for the Determination of Excess Rainfall Hyetograph,
W82-03752 1509 2A

Discussion of 'Finite Element Method for Direct Runoff Flow',
W82-03782 1509 2A

A Distribution Function Approach to Rainfall Runoff Modeling,
W82-03845 1509 2A

On a Technique to Investigate the Covariation Between Streamflow and Rainfall in Afforested Catchments,
W82-03864 1509 4C

Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma,
W82-03999 1509 2E

A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

Empirical Investigation of Curve Number Technique,
W82-04112 1509 2A

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 1511 4A

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 1511 5B

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

An Evaluation of Flood Frequency Estimates Based on Rainfall/Runoff Modeling,
W82-06068 1512 2A

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 1512 2E

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen), W82-06635 1512 5B

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978, W82-06672 1512 7C

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming, W82-06692 1512 2G

RAINFALL-RUNOFF RELATIONSHIPS. TRACERS
- Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer, W82-05941 1512 2F

RAINFALL SIMULATORS
- Apparatus for the Simulation of Rain in the Laboratory, W82-00807 1502 2B

RAINSTORMS
- Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages, W82-03047 1507 2B
- Storm Runoff Analyses on Three Semi-Arid Catchments, W82-04339 1510 2A
- Rainfall Interstation Correlation Functions: III. Approximations to the Analytically Derived Equation of the Correlation Function for an Exponential Storm Model Compared to Those for a Rectangular and a Triangular Storm, W82-04864 1511 2B
- Identification of Independent Rainstorms, W82-05708 1511 2B

RAINWATER
- Measurements of Hydrogen Peroxide in Rainwater, W82-00497 1501 2K
- Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region, W82-02033 1504 5C
- Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia, W82-02069 1504 5A

RAJASTHAN
- Quantification of Rainfall and Its Utilization Efficiency in Rajasthan, W82-03276 1507 2B

RANGE MANAGEMENT
- Impact of Management Practices on the Tallgrass Prairie, W82-01580 1503 4A
- Runoff Curve Numbers for Northern Plains Rangelands, W82-02245 1505 2A
- Management of Blowing Snow on Sagebrush Rangelands, W82-02247 1505 3B
- Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds, W82-02555 1505 2C
- Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming, W82-02809 1506 3F
- Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation, W82-05610 1511 3F
- Forest Management and Anadromous Fish Habitat Productivity, W82-06965 1512 5C

RANGES
- Resource Allocation in a Sierra-Nevada Foothill Beef Cow-Calf Operation Through Linear Programming, W82-02809 1506 3F

RANKING
- Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph, W82-02803 1506 2A

RAPESEED
- Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System, W82-02031 1504 3F

RAPID INFILTRATION
- Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site, W82-01496 1503 5B

RAQUETTE RIVER
- Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration, W82-03657 1508 5F

RATE OF RETURN
- Internal Rates of Return Derived from the Pay-Back Period, W82-05542 1511 6B

RAVENGLASS ESTUARY
- Americium in Intertidal Sediments from the Coastal Environs of Windscale, W82-02098 1504 5B
- The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium, W82-05178 1511 5B
- Gamma Emitting Fission Products in Surface Sediments of the Ravenglass Estuary, W82-05984 1512 5B

RAW WASTEWATER
- Wastewater Treatment by Rooted Aquatic Plants in Sand and Gravel Trenches, W82-00093 1501 5D
- Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges, W82-03121 1507 5D

RAW WATER
- Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana, W82-00215 1501 5C
- Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters, W82-04821 1511 5A
- Rutland Water Raw Water Quality - Problems and Management, W82-06475 1512 5G

REAERATION
- Summer Reaeration and Winter Ice Removal from Lakes and Reservoirs, W82-02526 1505 2H

RECESSION
- A Leaky Reservoir Model for Ephemeral Flow Recession, W82-00600 1502 2E

RECHARGE
- Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters, W82-00302 1501 7B
- A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge, W82-01319 1503 2F
- Excess Air in Groundwater, W82-02099 1504 2F
- Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment, W82-05629 1511 4B
- Evaluation of the Groundwater Resources of the Agag Basin, Saipan, W82-06524 1512 2F

RECHARGE BASINS
- Management of Recharge Basins on the Southern High Plains, W82-00938 1502 4B
- Artificial Basin Recharge, W82-03745 1508 4B

RECIRCULATED WATER
- Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System, W82-06707 1512 5C

RECLAIMED WATER
- Water and Wastewater Reclamation: An Economical Answer to Industrial Wastes and Pollution, W82-00188 1501 3E
- Total Organic Halogen as a Parameter for the Characterization of Reclaimed Waters: Measurement, Occurrence, Formation, and Removal, W82-00197 1501 5D
- Reclaiming and Reusing Wastewater, W82-00402 1501 5D
- Recycling Urban Stormwater for Profit, W82-00524 1502 3C
- Managing Water at Helicopter Plant, W82-01974 1504 5D
- Microbial Purification of Recycled Wastewater in a Closed System, W82-02172 1505 5D
- A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications, W82-02180 1505 3D
- Continuous Monitoring at Minworth Water Reclamation Works, W82-02431 1505 7B
- Community Evaluation of Adopted Uses of Reclaimed Water, W82-02551 1505 3C
- Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA, W82-02817 1506 3C
- Water Cost Encourages Reuse and Conservation, W82-03295 1507 5D
- Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater, W82-03517 1508 5D

The Meadowbrook Artificial-Recharge Project in Nassau County, Long Island, New York,
W82-03630 1508 4B

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

Colorado River Development,
W82-05887 1511 4A

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 1512 5D

Land Application of Wastewater,
W82-06915 1512 5E

RECREATION

Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 1506 6B

Recreational Water Quality and Health,
W82-02997 1506 5C

Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 1507 5A

Final Environmental Impact Statement; North Fork Payette River Project FERC No. 2930-IDAHO.
W82-03046 1507 6G

Don't Damn the Stanislaus,
W82-03275 1507 6E

Recreational Enhancement of High Country Water Supply Reservoirs,
W82-03923 1509 6A

Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222 1509 6D

Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 1510 6B

The Welsh Approach to Water Recreation,
W82-04658 1510 6D

Comparing Two Measures of Water Based Recreation Participation,
W82-05733 1511 6D

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

The Challenge of Upgrading Roadside Rest Areas,
W82-06845 1512 5G

RECREATION DEMAND

The Valuation of Recreational Fisheries,
W82-00348 1501 6C

Preferences for Allocating River Recreation Use,
W82-01181 1503 6D

Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 1503 6A

Water Quality and the Demand for Recreation,
W82-01942 1504 6D

User Reaction to Wild and Scenic River Designation,
W82-02278 1505 6G

Summary; Lower Colorado River Recreation Research, 1974-1980,
W82-02976 1506 6B

RECREATION FACILITIES

Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 1501 2J

Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 1503 4D

Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning,
W82-03942 1509 6B

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 1510 6B

An Investigation of Some Factors Influencing the Performance of a Recreational Trout Fishery,
W82-06329 1512 6D

RECREATION WASTES

Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 1512 6C

RECREATIONAL BENEFITS

An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning,
W82-03942 1509 6B

RECREATIONAL USE

An Evaluation of Recreational Benefits and Use Estimating Models for Water Resource Planning,
W82-03942 1509 6B

RECYCLING

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 3C

Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 1503 5D

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

Recycling,
W82-02514 1505 6E

Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 1506 8I

Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Waste Water Recycling by Ion Exchange: II. Partial Desalination,
W82-06117 1512 5A

Waste Water Recycling by Ion-Exchange: I. Complete Desalination,
W82-06118 1512 3A

Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 1512 5D

Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

RED DRUM

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

RED LAKE

The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

RED RIVER

The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 1508 6B

RED RIVER BASIN

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 1504 6D

RED RIVER (OF THE NORTH)

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

RED RIVER VALLEY

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

RED SEA

Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 1510 3A

RED TIDE

Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 1502 5G

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 1504 2H

Observations on a Gyrodinium Aureolum (Dinophyta) Bloom Off the South Coast of Ireland,
W82-03053 1507 5C

Study on the Scarcity of Red Tide in the Eutrophicated Waters of Ariake Bay I. Dissolution of Phosphate Ion from Bottom Mud by Hydrogen Sulfide,
W82-03240 1507 5C

REDOX POTENTIAL
Behavior of DDT, Kepone, and Permethrin in Sediment-Water Systems Under Different Oxidation-Reduction and PH Conditions,
W82-00382 1501 5B

REEDSWAMP
The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

REFLECTANCE
Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 1503 2C

Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 1511 2G

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

REGENERATION
Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 1503 5F

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 1505 2L

Carbon Treatment of Drinking Water: N.J. Plant Trying to Get Out the Bugs,
W82-03461 1508 5F

Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05670 1511 5F

Addendum to: Evaluating Regenerated Activated Carbon Through Laboratory and Pilot-Column Studies,
W82-05680 1511 5F

REGIONAL ANALYSIS
Geographic Information Systems and Environmental Impact Assessment,
W82-00338 1501 7C

Regionalization of the Upper Great Lakes with Respect to Surveillance Eutrophication Data,
W82-01150 1503 7A

Regional Flood Frequency Estimation and Network Design,
W82-01294 1503 2E

REGIONAL ANALYSIS *GEOHYDROLOGY
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

REGIONAL DEVELOPMENT
Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 1503 4D

An Ex Post Analysis of the Uncompahgre Project,
W82-04218 1509 6B

Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 1511 6B

REGIONAL PLANNING
The Horse Creek Basin Project,
W82-00071 1501 5G

Water Multipliers--Regional Impact Analysis,
W82-01138 1503 6A

Municipal Needs,
W82-02513 1505 6E

Trends in State and Federal Policy on Water Supply Management,
W82-02516 1505 6E

Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

Report of Committee on Conservation, Development and Utilization of Water Resources.
W82-03374 1507 3D

Jersey Drought Hastens Water Supply Project,
W82-03385 1507 6D

Maps--A Planning Tool for Corps of Engineers Regional Water Supply Studies,
W82-04228 1509 6A

Strategies to Control Nonpoint Source Water Pollution,
W82-04261 1510 5G

An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 1511 6A

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 1512 6B

REGRESSION ANALYSIS
Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods,
W82-03873 1509 5B

Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

Prediction of Water Level in Tidal Inlet,
W82-05005 1511 4A

Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 1511 2F

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 1512 7C

Effect of Temperature on Heavy Metal Binding by Anaerobically Digested Sludges,
W82-06270 1512 5D

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 1512 4A

REGULATED FLOW
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 1503 4A

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 1511 4A

Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

REGULATIONS
Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation,
W82-00261 1501 5G

Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 1501 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 1501 6E

Towards a Predictive Model for the Economic Regulation of Commercial Fisheries,
W82-00549 1502 6A

Fundamental Economic Issues in the Development of Small Scale Hydro.
W82-00722 1502 6C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Jersey.
W82-00742 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Maryland.
W82-00745 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 1502 6E

Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in Maine.
W82-00750 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New York.
W82-00754 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Delaware.
W82-00755 1502 6E

Water Quality Management in River Basins: US National Experience,
W82-00800 1502 6E

Enforcement Under the Resource Conservation and Recovery Act of 1976,
W82-01013 1502 6E

Surface Water Management at Hazardous Waste Sites,
W82-01429 1503 5G

Background Document for Modification of pH Effluent Limitations Guidelines and Standards for Point Sources Required by NPDES Permit to Monitor Continuously Effluent pH.
W82-01438 1503 5D

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 1504 6E

Long-Run Effects of Environmental Regulation,
W82-01848 1504 6A

Pollution Control: Changing Approaches,
W82-01870 1504 6E

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 1504 6E

Disposal of Industrial Effluents - Some Future Problems,
W82-02405 1505 5D

EPA's Approach to Regulating New Energy Technologies,
W82-03129 1507 6E

Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 1508 6E

The Evolution of Water Quality Management,
W82-03476 1508 6E

Environmental Regulation and Constraints Upon Small Hydro Development in California, U.S.A.,
W82-03614 1508 6E

Clean Water Act.
W82-03688 1508 6E

Regulation of Utility Waste Disposal Practices,
W82-03691 1508 5E

NPDES Compliance Flow Measurement Manual,
W82-03965 1509 5D

Waste Discharge Monitoring Requirements Under the NPDES Permits Program,
W82-03969 1509 5D

Future Directions in Federal Water Resources,
W82-04196 1509 6D

Water Management in Ontario,
W82-04259 1510 6E

New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 1510 6E

Ground Water Monitoring of Underground Coal Mines,
W82-04750 1510 5B

Weak Controls from Sea to Shining Sea,
W82-05035 1511 5B

Disposing of Sewage Sludge at Sea,
W82-05127 1511 5E

The National Interim Primary Drinking Water Regulations, Part I - Historical Development,
W82-05814 1511 5G

Floodplain Regulations and Residential Land Values in Oregon,
W82-05930 1512 6F

The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 1512 5G

REHABILITATION
Why EPA's I/I Control Program Fails,
W82-00790 1502 8A

Rapid Sewer Analysis Saves Tourist Season,
W82-03494 1508 5G

Economic Analysis of Water Main Breaks,
W82-05673 1511 8A

Overhauling a Water System,
W82-06224 1512 5F

Sewer Maintenance and Rehab Options,
W82-06253 1512 5D

Sewerage: Priorities for Action,
W82-06260 1512 8G

Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers--ASTM F585-78.
W82-06601 1512 8A

Out of Sight--Out of Mind.
W82-06713 1512 8A

Canal Tunnel Repair Options.
W82-06758 1512 8A

Sewer Renewal by Pipe Insertion.
W82-06759 1512 8A

Watertight Manholes Cut Inflow.
W82-06844 1512 5G

The Challenge of Upgrading Roadside Rest Areas,
W82-06845 1512 5G

RELIABILITY
Water Supply Reliability Theory,
W82-03432 1508 6A

Reliability and Stability of Trickling Filter Processes,
W82-04784 1511 5D

REMOTE COMMUNITIES
Provision of Energy Requirements for Remote Communities by Small-Scale Hydro Development,
W82-03151 1507 8A

REMOTE CONTROL
Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 1511 5F

REMOTE SENSING
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

Sites of River-Derived Sedimentation in the Ocean,
W82-01332 1503 7B

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 1503 7B

Water Frost and Ice: The Near-Infrared Spectral Reflectance 0.65-2.5 Microns,
W82-01346 1503 2C

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 1503 5G

The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 1503 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 1503 7B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 1503 7B

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 1503 2G

Remote Sensing in Development,
W82-01719 1503 7B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 1503 7B

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 1504 7B

Applicatious of Aerial Photography,
W82-01988 1504 7B

Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

Freshwater Flow Rates and Distribution Within the Everglades Marsh,
W82-02163 1505 2E

An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 1505 7B

Aerial Photography to Detect Rill Erosion,
W82-02232 1505 7B

Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 1506 7B

Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 1506 7B

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 1507 7B

An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 1507 7B

Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 1507 7B

Remote Sensing from Space-II.
W82-03248 1507 7B

Remote Sensing Applications for Resource Management,
W82-03279 1507 7B

Radar Measurements of Estuarine Currents and Tides,
W82-03360 1507 2L

Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 1508 7B

Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 1508 2G

Comparison of Results Obtained with the VIDIAZ Spectropluviometer and the Joss-Waldvogel Rainfall Disdrometer in a 'Rain of a Thundery Type',
W82-03707 1508 2B

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 1508 2G

Current Use and Technology of Landsat Mss Data for Lake Trophic Classification,
W82-03755 1509 7B

Watershed Model Study Using LANDSAT Image Data,
W82-03814 1509 2A

Areal Distribution of Snow Water Equivalent Evaluated by Snow Cover Monitoring,
W82-03842 1509 2C

Water Resources Investigations in West Central Iran Using Landsat Data,
W82-03927 1509 7B

Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

Aircraft Radar Responses to Soil Moisture,
W82-04187 1509 7B

Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

A Simple Method for Estimating Convective Rain Volume Over an Area,
W82-04201 1509 7B

A Preliminary Study of Comparative Measurements of Rainfall Rate Using The Differential Reflectivity Radar Technique and A Raingage Network,
W82-04263 1510 2B

Differences Between Some Radar Rainfall Estimation Procedures in a High Rain Rate Gradient Storm,
W82-04265 1510 2B

Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers.
W82-04412 1510 5A

The Use of Landsat Imagery in Ground Water Exploration,
W82-04436 1510 7B

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

Remote Sensing of Atmospheric Water Content from Satellite Microwave Radiometer (SAMIR) on Bhaskara,
W82-04647 1510 7B

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 1511 7B

Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 1511 2B

Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 1511 2G

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 1511 7B

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 1511 2C

Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 1511 7C

Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 1511 2C

Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 1511 7B

Influence of Dissolved Organic Materials on Turbid Water Optical Properties and Remote-Sensing Reflectance,
W82-05869 1511 2K

Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 1512 7B

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 1512 7C

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 1512 8I

A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 1512 7B

The Outlook for Precipitation Measurements from Space,
W82-06531 1512 7B

Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 1512 5E

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 1512 7B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

The Use of Remote Sensing to Map the Areal Distribution of Cladophora Glomerata at a Site in Lake Huron,
W82-06973 1512 5B

Application of Thermal Infrared Imagery to Canal Leakage Detection,
W82-06994 1512 7B

Estimation of the Precipitable Water from the IR Channel of the Geostationary Satellite,
W82-06995 1512 7B

RENEWABLE RESOURCES
Water Conservation Incentives and Strategy,
W82-05906 1512 3D

RENOVATIONS
Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 1512 8A

REOVIRUSES
Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

REPRESENTATIVE BASINS

Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 1502 2A

RESEARCH

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 1507 7C

WPCF Presentations Attuned to the Times.
W82-03904 1509 5D

RESEARCH FACILITIES

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 1504 9A

ICI Brixham - Environmental Research in the Private Sector.
W82-03153 1507 5D

Wastewater Treatment for Japan's Research Institute.
W82-03905 1509 5D

RESEARCH NEEDS

Water Research in Action.
W82-05292 1511 6B

RESEARCH PRIORITIES

Engineering Research and the Water Industry,
W82-00313 1501 8A

Research and Development to Service a Sustainable Agriculture,
W82-00669 1502 3F

Federal Water Resources Research: A Review of the Proposed Five-Year Program Plan.
W82-01051 1502 6E

Britain's Sewers - Researching for the Future,
W82-02871 1506 5D

Research Needs: Hydraulics, Coastal Engineering and Irrigation,
W82-03254 1507 8A

Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 1508 5E

Water-Pollution Research and Its Application in Developing Countries,
W82-05246 1511 5G

Water Research in Action.
W82-05292 1511 6B

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 1511 6B

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 1511 3F

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

Some Perspectives in the Modelling of Biological Treatment of Wastewaters,
W82-05430 1511 5D

Five-Year Plan of the Water Resources Research Center,
W82-05526 1511 6B

A Five-Year Plan of Water Resources Research.
W82-05527 1511 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 1511 6B

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 1511 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 1511 6B

A Five-Year Plan for Water Research in Colorado,
W82-05531 1511 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

Nevada Water Resources Research 1982-1987,
W82-05533 1511 6B

Domestic Water Conservation Research Plan,
W82-05547 1511 6B

Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-05564 1511 6A

Foreseeable Effects of CO2-Induced Climatic Change: Freshwater Concerns,
W82-05574 1511 2B

Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 1511 6B

Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 1512 5E

New Problems with Upland Waters,
W82-06602 1512 5G

RESEARCH PROJECTS

Water Resources Research Support Program 1981 - 1982.
W82-06565 1512 9D

RESERVATION DOCTRINE

Development of Federal Reserve Rights,
W82-04446 1510 6E

Non-Indian Federal Reserved Water Rights,
W82-04804 1511 6E

RESERVIOURS

Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 1512 8E

RESERVOIR

Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 1503 5C

The Landscape of Rutland Water,
W82-06478 1512 6G

RESERVOIR CAPACITY

Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 1508 2E

RESERVOIR CONSTRUCTION

Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 1502 6G

An Investigation Into the Effects of Thermal Movement in the Walls of Service Reservoirs,
W82-01396 1503 8F

Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 1504 2A

Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 1507 6A

Design Technique Development for Dams in South Africa,
W82-06011 1512 8A

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

The Biesbosch Water Storage Scheme,
W82-06014 1512 8A

RESERVOIR COVERS

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 1510 5G

RESERVOIR DESIGN

The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 1501 6A

Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria,
W82-01462 1503 8A

Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 1511 2E

The Biesbosch Water Storage Scheme,
W82-06014 1512 8A

RESERVOIR EVAPORATION

Reservoir Operation for Water Conservation,
W82-04165 1509 3B

Modelling Evaporation from Reservoirs,
W82-04722 1510 2D

RESERVOIR FILLING

Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

RESERVOIR FISHERIES

Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

RESERVOIR LININGS
Succeeding with Liner Installation, W82-00909 1502 8G
Membrane Liner Seals 278-Acre Reservoir. W82-02361 1505 8G

RESERVOIR MANAGEMENT
LARM Two-Dimensional Model: An Evaluation, W82-02597 1505 4A
A Decomposition Method For The Long-Term Scheduling Of Reservoirs in Series, W82-04205 1509 6A
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis, W82-04430 1510 6A

RESERVOIR OPERATIN
Modified Standard Operation Rules for Reservoirs, W82-05658 1511 4A

RESERVOIR OPERATION
Northeastern New Jersey Grapples With a Drought, W82-00289 1501 8A
An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington, W82-00421 1501 4A
Performance Evaluation of a Stochastic Optimization Model for Reservoir Design and Management with Explicit Reliability Criteria, W82-01462 1503 8A
Operating Policies for a Surface/Ground Water System, W82-01741 1503 4B
Weekly Multipurpose Planning Model for TVA Reservoir System, W82-02319 1505 6A
Analysis of Firm Water Supply Under Complex Institutional Constraints, W82-02501 1505 6A
Operation Policy Analysis: Sam Rayburn Reservoir, W82-02589 1505 6A
Application of a Single Reservoir Operation Policy to a Rain Water Cistern System, W82-03088 1507 3B
Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir, W82-03148 1507 6A
Reliability Programming in Reservoir Management 2. Risk-Loss Functions, W82-03245 1507 6A
Optimal Reservoir Management and Crop Planning Under Deterministic and Stochastic Inflows, W82-03914 1509 3F
Recreational Enhancement of High Country Water Supply Reservoirs, W82-03923 1509 6A
Aggregation-Disaggregation Techniques for the Operation of Multi-Reservoir Systems, W82-03954 1509 6A
Report of the River Master of the Delaware River for the Period December 1, 1979 – November 30, 1980, W82-03989 1509 4A
Limnology of the Upper North Platte Reservoir System, Wyoming, W82-04067 1509 2H
Reservoir Operation for Water Conservation, W82-04165 1509 3B
Optimal Control of Reservoir Discharge Quality Through Selective Withdrawal, W82-04204 1509 5G
A Decomposition Method For The Long-Term Scheduling Of Reservoirs in Series, W82-04205 1509 6A
Optimal Operation of a Reservoir System Using Forecasts, W82-04209 1509 4A
Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung), W82-04576 1510 4A
Seasonal Risk-Based Reservoir Operating Rules, W82-05299 1511 4A
Integrated Management of Water Deficits and Floods in a Reservoir System, W82-05325 1511 4A
Promising Steps Toward a New Ottawa River Regulation, W82-05394 1511 6E
The Role of Unconditioned and Conditioned Cumulative Distribution Functions in Reservoir Reliability Programming, W82-05523 1511 6A
Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam, W82-06092 1512 6G
Investigation of Objective Functions and Operation Rules for Storage Reservoirs, W82-06175 1512 4A
Reregulation on an International River--A Case Study, W82-06429 1512 6G
TVA Hydro Scheduling Model: Theoretical Aspects, W82-06430 1512 4A
TVA Hydro Scheduling Model: Practical Aspects, W82-06431 1512 4A
Reservoir Systems Optimization, W82-06433 1512 4A
Zooplankton and Their Relationships with Water Quality and Fisheries, W82-06472 1512 2H
Rutland Water - From Conception to Operation, W82-06481 1512 6D
Introduction - Rutland Water 1970-1981, W82-06482 1512 6B

RESERVOIR PROTECTION
Automated Stream Diversion for Reservoir Protection, W82-02600 1505 5G

RESERVOIR RELEASES
Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir, W82-00805 1502 5C
Glen Canyon Dam Is Killing the Grand Canyon and Your Tax Dollars Are Paying for It. W82-00813 1502 6G
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge, W82-01658 1503 5C
Sediment Transport During a Controlled Reservoir Release, W82-02196 1505 2J
Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant, W82-02771 1506 8A
The Linear Decision Rule (LDR) Reservoir Problem with Correlated Inflows. I. Model Development, W82-03237 1507 4A
Effect of a Deep-Water Outfall from a Power-Plant Reservoir on Water Quality in the Lower Pool, W82-03768 1509 5C
Aggregation-Disaggregation Techniques for the Operation of Multi-Reservoir Systems, W82-03954 1509 6A
Report of the River Master of the Delaware River for the Period December 1, 1979 – November 30, 1980, W82-03989 1509 4A
Limnology of the Upper North Platte Reservoir System, Wyoming, W82-04067 1509 2H
Optimal Control of Reservoir Discharge Quality Through Selective Withdrawal, W82-04204 1509 5G
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams, W82-04388 1510 5G
Stochastic State Variable Dynamic Programming for Reservoir Systems Analysis, W82-04430 1510 6A
New Methods of Designing Flood Control Measures, W82-05030 1511 2E
Modified Standard Operation Rules for Reservoirs, W82-05658 1511 4A
Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave, W82-06089 1512 6G
The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam, W82-06090 1512 6G
Influence of Dredging and High Discharge on the Ecology of Black Canyon, W82-06091 1512 6G

RESERVOIR SILTING
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia, W82-01736 1503 2J
A New Sediment Trap Efficiency Curve for Small Reservoirs, W82-03086 1507 8A
Reservoir Sedimentation Modeling, W82-03813 1509 2J

RESERVOIR SITES
Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water Levels and Discharge, Southeastern North Dakota, W82-02828 1506 4A
The Search for Reservoir Sites in an Urban Environment, W82-04867 1511 8A

RESERVOIR STAGES

Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 1504 8A

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

RESERVOIR STORAGE

Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 1501 6A

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 1501 4A

Report of the River Master of the Delaware River for the Period December 1, 1979 -- November 30, 1980,
W82-03989 1509 4A

Analyzing the Risk of Drought: The Occoquan Experience,
W82-04097 1509 2A

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part II. Economic Analysis,
W82-05966 1512 6B

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

The Biesbosch Water Storage Scheme,
W82-06014 1512 8A

Investigation of Objective Functions and Operation Rules for Storage Reservoirs,
W82-06175 1512 4A

RESERVOIRS

Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 1501 6G

Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 1501 2H

Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

Factors Influencing Fish Distribution in Two Desert Reservoirs, Central Arizona,
W82-00814 1502 2H

Hydraulic Model Study for the Design of the Wreck Cove Control Gates,
W82-00880 1502 8B

Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 1503 5G

Hydroelectrical Model for Optimal Operation of a Single Multipurpose Reservoir,
W82-01329 1503 6A

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

Water Resources Appraisals for Hydroelectric Licensing: Brazos River Basin, Texas-New Mexico.
W82-01439 1503 6D

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 1503 8A

Water Resources Appraisal for Hydroelectric Licensing: Kennebec River Basin, Maine.
W82-01755 1504 6D

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 1503 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 1504 2H

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 1504 5C

Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 1504 6E

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 1504 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 1504 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 1504 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 1504 2H

Chemical and Biological Processes Controlling the Response of a Freshwater Ecosystem to Copper Stress: A Field Study of the CuSO4 Treatment of Mill Pond Reservoir, Burlington, Massachusetts,
W82-02233 1505 5C

On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 1506 4C

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 1506 6B

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 1507 2J

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 1507 5B

Eutrophication of the Lake-Reservoir Sidi Mohamed Ben Abdellah, Rabat, Morocco (L'Eutrophisation du Lac-Reservoir Sidi Mohamed Ben Abdellah Pres de Rabat, Maroco),
W82-03118 1507 2H

Reliability Programing in Reservoir Management I. Single Multipurpose Reservoir,
W82-03148 1507 6A

Relationship Between Chlorophyll-a Concentration and Phytoplankton Biomass in Several Reservoirs in Czechoslovakia,
W82-03185 1507 2H

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication,
W82-03214 1507 5C

Don't Damn the Stanislaus,
W82-03275 1507 6E

Numerical Simulation of Reservoirs,
W82-03504 1508 6A

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 1508 6A

Sedimentation Control in Indian Reservoirs,
W82-03693 1508 8A

Reservoirs and the Triggering of Earthquakes,
W82-03766 1509 8A

A Retrospective Benefit-Cost Analysis of Water Resource Projects in The Cumberland River Basin,
W82-03917 1509 6B

A Nonlinear Hydrologic Cascade,
W82-04051 1509 2A

Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

Reservoir Improvements as a Key to Source Quality Control,
W82-04145 1509 5G

Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

Effects of Water Drawdown on the Fauna in Small Cold Water Reservoirs,
W82-04219 1509 6G

Public Attitudes in Massachusetts Toward the Recreational Use of Domestic Water Supply Reservoirs,
W82-04222 1509 6D

Hydrologic Effects of the Flood Abatement Program in Southwestern Oklahoma,
W82-04225 1509 4A

Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

Reservoir Sedimentation with Random Deposits,
W82-04443 1510 2J

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 1510 2J

Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 1510 4A

Prediction of the Circulation in Reservoirs,
W82-04682 1510 2H

James Bay Spillways and Control Structures,
W82-04692 1510 8A

Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 1510 5G

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 1510 6E

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 1510 5G

The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 1510 5G

Modelling Evaporation from Reservoirs,
W82-04722 1510 2D

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 1510 6A

Abiogenic Elimination of Nutrients in a Newly Built Reservoir (Twistetalsperre, Nordhessen) (Abiogene Nahrstoffeliminierung in einer Neuentstandenen Talsperre (Twistetalspherre, Nordhessen),
W82-04768 1511 2H

Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 1511 7B

The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 1511 4C

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 1511 2E

Estimates of Resilience Indices by Simulation,
W82-05046 1511 6A

Estimating Resilience by Canonical Analysis,
W82-05047 1511 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 1511 2H

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 1511 2H

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 1511 4A

Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 1511 2H

State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 1511 2H

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 1511 2H

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 1511 2H

Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 1511 4A

Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 1511 6A

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 1511 2H

Geotechnical Applications of Landsat Image Analysis of Bhakra Dam Reservoir, India,
W82-05612 1511 7C

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

Northwestern Ontario River Dimensions,
W82-05742 1511 6G

Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 1511 6B

Measuring Reservoir Ground Movements,
W82-05773 1511 8G

Nutrient Control of Blue-Green Algae in a Southwestern Reservoir,
W82-05912 1512 5C

Reservoir Planning for Brazilian Dams,
W82-06206 1512 6A

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 1512 8B

Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 1512 4A

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 1512 5G

Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 1512 2H

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 1512 2H

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

Rutland Water Raw Water Quality - Problems and Management,
W82-06475 1512 5G

Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 1512 2H

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 1512 6D

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 1512 6B

Rutland Water - From Conception to Operation,
W82-06481 1512 6D

Introduction - Rutland Water 1970-1981,
W82-06482 1512 6B

The Kielder Headworks,
W82-06504 1512 8A

Texas Gulf Coast Project Answers Vital Water Need,
W82-06519 1512 8A

Terminological Confusion--Lake VS. Reservoir,
W82-06551 1512 2H

Secchi Disc Relationships,
W82-06627 1512 2H

Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

Pesticide Accumulation in a New Impoundment in Iowa,
W82-06871 1512 5B

RESERVOIRS
Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 1512 5B

RESIDENCE TIME
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 1504 2H

RESIDENTIAL WATER
Deterministic Models for Predicting Residential Water Consumption,
W82-04332 1510 6D

RESIDUAL CHLORINE
Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 1502 5C

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 1503 5D

Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

RESILIENCE
Alternative Indices of Resilience,
W82-05045 1511 6A

Estimates of Resilience Indices by Simulation,
W82-05046 1511 6A

Estimating Resilience by Canonical Analysis,
W82-05047 1511 6A

RESINS
Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 1501 5D

Corrosion Roundtable--Opportunities/Pitfalls for New Materials,
W82-03373 1507 8G

Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 1508 5F

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 1508 3A

Operational Experiences in the Effective Treatment of Effluents from Synthetic Resin Manufacture,
W82-03835 1509 5D

Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktiv[illegible]e zur Weitergehenden Abwasserreinigung),
W82-04284 1510 5D

Treating Phenol Resin Plant Wastes,
W82-05128 1511 5D

Selective Passage of Hydrophilic Nitrogenous Organic Materials Through Macroreticular Resins,
W82-05150 1511 5D

An Ion-Exchange Process with Thermal Regeneration XIV Thermally Regenerable Resin Systems with High Capacities,
W82-06101 1512 3A

RESISTIVITY
Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

Monitoring Ground-Water Contamination at a Fly Ash Disposal Site Using Surface Electrical Resistivity Methods,
W82-01218 1503 5B

Monitoring Leachate in Ground Water by Corrected Resistivity Methods,
W82-01219 1503 5A

Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

Inadequacies in the Technique of Resistivity Method for Location of Waterwell Sites in Hard Rock Areas,
W82-03412 1508 7B

Recrystallisation and Electrical Behaviour of Glacier Ice,
W82-03702 1508 2C

A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

How Proper Prospecting Improves the Odds,
W82-05757 1511 3B

RESONANCE
Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 1504 2H

Flow Resonance in Rigid Pipes with Regular Longitudinal Corrugations,
W82-04644 1510 8B

Theoretical and Experimental Studies on Dynamic Structure-Fluid Coupling,
W82-04755 1511 8B

Resonance in Hydropower Stations,
W82-04953 1511 8C

RESOURCE DEVELOPMENT
Water Supply and Demand in an Energy Supply Model,
W82-00050 1501 6D

The Physical Environment of the Colorado River Basin,
W82-05891 1511 6D

RESOURCES ALLOCATION
The Valuation of Recreational Fisheries,
W82-00348 1501 6C

RESOURCES DEVELOPMENT
Ground Water Availability,
W82-00027 1501 6D

State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 1501 5E

Integrated Agricultural Development in the Philippines,
W82-01725 1503 6B

Effect of Cold Water Entry into a Liquid-Dominated Two-Phase Geothermal Reservoir,
W82-02314 1509 2F

Trends in State and Federal Policy on Water Supply Management,
W82-02516 1508 6E

National Water Policy: The Need for Institutional Reform,
W82-05180 1511 6E

Colorado River Development,
W82-05887 1511 4A

The Colorado River Salinity Problem,
W82-05889 1511 5G

RESOURCES MANAGEMENT
The Caspian Sea Problem,
W82-00657 1502 4A

Management of Recharge Basins on the Southern High Plains,
W82-00938 1502 4B

Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 1503 6E

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 1503 6A

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 1507 6D

Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 1508 6E

Topsoil Management of Mined Soils,
W82-04571 1510 4D

Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 1512 6F

RESPIRATION
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 1501 5C

Relationships Between Water Chemistry and Respiration Rate in Several Populations of Lymnaea Peregra Muller (Gastropoda:Mollusca),
W82-00854 1502 2K

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 1504 2H

Biological Nitrogen Removal System Design,
W82-03145 1507 5D

Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

A Method for Estimating the Respiration of Mud Communities in Shallow Running Water,
W82-06036 1512 5C

Improved Method for Determination of Respiring Individual Microorganisms in Natural Waters,
W82-06883 1512 5A

Community Photosynthesis and Respiration in Experimental Streams,
W82-06896 1512 5C

RESPIROMETER
Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 1501 5A

RETAINING WALLS
Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 1506 8B

Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 1508 8D

RETENTION BASINS
Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

RETENTION TIME
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 1504 5D

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

RETURN FLOW
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 1503 5F

REVEGETATION
Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 1511 5E

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 1512 2E

REVERSE FILTERS
How About Reverse Filters,
W82-03247 1507 4D

REVERSE OSMOSIS
Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 1503 5D

Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 1505 5D

An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 1505 5D

Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 1506 5D

Scanning Electron Microscopy Study on Reverse Osmosis Membranes Prepared from Indian Cellulosic Polymers,
W82-02929 1506 3A

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 1506 5F

Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 1508 3A

From Screening to Filtration: Treating the Water Supply,
W82-03739 1508 3A

Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760 1509 5D

Improved Porous Supports for Thin-Film Composite Reverse Osmosis Membranes,
W82-03943 1509 3A

Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

Foam Fractionation-Flotation as Partial Pretreatment for Reverse Osmosis,
W82-05290 1511 3A

Parametric Analysis of Direct-Contact (Pistonless) Work Exchanger for Reverse Osmosis Applications,
W82-05309 1511 3A

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05509 1511 3A

Field Test Evaluation Research and Development and Operation and Maintenance of Reverse Osmosis Systems and Electrodialysis Pilot Plants at Roswell Test Facility,
W82-05555 1511 3A

Further Results on the Performace of Present-Day Osmotic Membranes in Various Osmotic Regions,
W82-05660 1511 3A

Seawater Ro Heads Japan's Water Reuse Research,
W82-05736 1511 3A

Pump Installations for reverse Osmosis Systems,
W82-05882 1511 8C

Operating Experiences on a Reverse Osmosis Plant Which Converts Sea Water into Boiler Feed Water,
W82-05976 1512 3A

Removal of Humic Substances from Natural Waters by Reverse Osmosis,
W82-06045 1512 5F

RO, MSF and VTE/VC Desalination: A Comparative Evaluation,
W82-06110 1512 3A

Salbukh Reverse Osmosis Plant on Stream,
W82-06127 1512 3A

The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 1512 3A

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 1512 5D

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

REVERSE OSMSOSIS
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

REVIEWS
Small-Scale Hydro in New England: 1960-1976,
W82-00169 1501 6D

Inorganics,
W82-01238 1503 5A

Biological Filters,
W82-01242 1503 5D

Pulp and Paper Industry Effluent Management,
W82-01260 1503 5D

Bioassays - Procedures and Results,
W82-01277 1503 5A

Economics,
W82-01304 1503 5G

Water Characteristics,
W82-01305 1503 5B

Small Water Systems: Role of Technology,
W82-01542 1503 5F

Geothermal Energy: An Old Ally,
W82-02333 1505 2F

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 1505 5B

Trends in Wastewater Collection Systems,
W82-02573 1505 8G

Recent Developments in and Application of Automation and Monitoring in Water Management,
W82-04593 1510 7B

Acid Precipitation in Historical Perspective,
W82-04807 1511 5B

REVIEWS

Biological Monitoring, Part IIA - Receiving System Functional Methods, Relationships and Indices,
W82-05013 1511 5A

Biological Monitoring, Part III- Receiving System Methodology Based on Community Structure,
W82-05023 1511 5A

Biological Monitoring, Part V - Preference and Avoidance Studies,
W82-05340 1511 5C

A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 1511 4C

New Directions in Water Pollution Control,
W82-06071 1512 5G

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

The Use of Oxygen in Sewage Treatment,
W82-06262 1512 5D

A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 1512 5D

Aquaculture for Waste Management,
W82-06556 1512 5D

A Review of Benzothiazoles in the Aquatic Environment,
W82-06571 1512 5C

A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 1512 5G

Acid Precipitation, A Review,
W82-06794 1512 5C

Freshwater Macroinvertebrates,
W82-06797 1512 5C

Electroplating and Cyanide Wastes,
W82-06798 1512 5D

Steel Industry Wastes,
W82-06799 1512 5D

Synthetic Fuel Effluents,
W82-06800 1512 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

Coal and Coal Mine Drainage,
W82-06802 1512 5B

Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

Chemicals and Allied Products,
W82-06805 1512 5D

Aquatic Sediments,
W82-06806 1512 2J

Ground Water,
W82-06807 1512 5B

Marine and Estuarine Pollution,
W82-06808 1512 5C

Thermal Effects,
W82-06809 1512 5C

Bioassays - Procedures and Results,
W82-06810 1512 5A

Dissolved Oxygen in Streams and Reservoirs,
W82-06811 1512 5C

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,
W82-06812 1512 5C

The Effects of Acid Rain on Forest Nutrient Status,
W82-06900 1512 5C

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

Land Application of Wastewater,
W82-06915 1512 5E

Textile Wastes,
W82-06916 1512 5D

Fermentation Industry,
W82-06917 1512 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

Microbiology: Methodology and Quality Assurance,
W82-06919 1512 5A

Radioactive Wastes,
W82-06920 1512 5E

Dairy Wastes,
W82-06921 1512 5D

Organics,
W82-06922 1512 5A

Anaerobic Processes,
W82-06923 1512 5D

Microbiology: Water,
W82-06924 1512 5B

Substrate-Associated Microfauna,
W82-06925 1512 5C

Microbiology: Wastewater Treatment,
W82-06926 1512 5D

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

Disease Outbreaks Caused by Drinking Water,
W82-06928 1512 5C

Solid Wastes and Water Quality,
W82-06929 1512 5B

Systems Analysis,
W82-06997 1512 5G

Economics,
W82-06998 1512 5G

Inorganics,
W82-06999 1512 5A

REYNOLDS NUMBER

Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 1512 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 1512 8B

RHINE RIVER

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 1504 5G

The River Rhine--Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 1507 5D

Experience with Riverbank Filtration Along the Rhine River,
W82-04104 1509 5D

Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

Analysis of PCBs in Sediment by Glass Capillary Gas Chromatography,
W82-04916 1511 5A

Ozone and Activated Carbon,
W82-05370 1511 5F

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 1511 2E

Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

RHIZOPUS

The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 1511 5D

RHIZOSPHERE

Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 1503 4A

Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

RHODE ISLAND

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 1502 6E

Grazing Rate Determination of Corynoneura Scutellata Winnertz (Chironomidae:Diptera),
W82-00822 1502 2H

Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 1508 5F

A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 1510 6D

RHODE RIVER

Endangered Estuarine Receiving Waters: The Effects of Low-Flow Land Runoff on Headwaters Biota,
W82-02165 1505 5C

RHODE RIVER ESTUARY

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

Nutrient Mass Balances for the Watershed, Headwaters Intertidal Zone, and Basin of the Rhode River Estuary,
W82-04330 1510 2L

RHODESIA

Sediment Transport and a Reservoir Simulation Formula for Zimbabwe-Rhodesia,
W82-01736 1503 2J

RHONE RIVER
Generating Power from Compensating Flow.
W82-05624 1511 8C

RICE
Effect of Microcrustaceans on Blue-Green Algae in Flooded Soil,
W82-00146 1501 6G

Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

Sizing Rice Irrigation Canals,
W82-00895 1502 3F

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 1510 2I

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table,
W82-05971 1512 3F

Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 1512 6B

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

RICE FARMING
Interactions Potentially Affecting the Seasonal Abundance of Selected Aquatic Invertebrates in a Rice Field Habitat,
W82-02568 1505 6G

RICHARDS BAY
Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

RICHFIELD QUADRANGLE
Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

RICHMOND
Keeping a Century-Old Water System Young,
W82-04138 1509 8G

RIDGING
Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 1512 2J

RIFFLES
Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 1512 2J

RILL EROSION
Aerial Photography to Detect Rill Erosion,
W82-02232 1505 7B

How Rain Intensity Affects Interrill Erosion,
W82-04537 1510 2J

RILLS
Modeling Rill Density,
W82-02604 1506 2J

RIPARIAN RIGHTS
Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States,
W82-00718 1502 6E

The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 1507 6E

The Nile - One River and Nine Countries,
W82-03545 1508 4A

Problems of Public Access to Water in Texas Lakes and Streams,
W82-04220 1509 6E

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 1511 6E

RIPRAP
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 1501 8A

RISK-BASED DESIGN
Optimal Risk-Based Design of Hydraulic Structures,
W82-03710 1508 8A

RISKS
Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 1501 5F

Risk Models for Flood Levee Design,
W82-01307 1503 8A

Optimal Risk-Based Design of Flood Levee Systems,
W82-01313 1503 8B

Reliability Programming in Reservoir Management 2. Risk-Loss Functions,
W82-03245 1507 6A

Risk Analysis in the Planning, Design and Operational Control of Water Pollution Prevention Schemes- A Perspective,
W82-03857 1509 5G

A Decision Theory Approach to Earth Dam Classification,
W82-04152 1509 8A

The Design of Encroachments on Flood Plains Using Risk Analysis,
W82-04631 1510 8A

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

A Screening Model to Quantify Resilience,
W82-05044 1511 6A

Alternative Indices of Resilience,
W82-05045 1511 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 1511 5D

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 1511 4A

Impact of Discharges as a Basis for Control Measures,
W82-05354 1511 5B

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

Managing Flood Risk: Technical Uncertainty in the National Flood Insurance Program,
W82-06073 1512 6F

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

Flood Risk Perceptions and Overdevelopment in the Floodplain,
W82-06585 1512 6F

RIVER BASIN
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 1502 5B

RIVER BASIN DEVELOPMENT
Basin Management in the San Bernardino Valley,
W82-00075 1501 4B

Basin Landscape-Halogeochemical Method of Evaluating the Natural and Reclamation Conditions of Irrigated Territories,
W82-00303 1501 2K

Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 1502 6D

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 1503 6G

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 1504 6B

Multiobjective Analysis of Irrigation Planning in River Basin Development,
W82-02855 1506 6A

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 1506 6D

Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 1507 6D

Water Resources Apparisals for Hydroelectric Licensing; St.'Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 1507 6D

Water Resources Appraisal for Hydroelectric Licensing: Yampa River Basin; Colorado, Wyoming.
W82-03045 1507 6D

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 1510 6D

Multi-Decision Analysis for Large-Scale River-Basin Reservoir Systems,
W82-05659 1511 2E

Future Water Development Policies,
W82-05884 1511 5G

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 1511 6E

Colorado River Water Allocation,
W82-05888 1511 6C

Multiobjective River Basin Planning with Qualitative Criteria,
W82-06062 1512 6A

RIVER BASINS
Water Quality Management in River Basins: US National Experience,
W82-00800 1502 6E

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 1503 2A

River Basin Hydrosalinity Modeling,
W82-01469 1503 2K

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 1503 3F

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

A Large Interational River: The Danube,
W82-03369 1507 5G

Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 1508 5G

Multi-Constituent Simulation and Optimization Models for Water Quality Management,
W82-03815 1509 5G

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

Forecasting Changes of Water Resources in Large Rivers Following Land Drainage,
W82-04721 1510 2A

The Shubenacadie-Stewiacke River Basin Study,
W82-05385 1511 6B

Operational Research Techniques in River Basin Management,
W82-05387 1511 6A

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 1511 6E

River-Basin Simulation in Systems with Large Response Time,
W82-05496 1511 2A

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

Combining Site-Specific and Regional Information: An Empirical Bayes Approach,
W82-05903 1512 2A

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

RIVER BEDS
Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

Evaluation of Effective Boundary Roughness for Gravel-Bed Rivers,
W82-01161 1503 8B

River Bed Aggradation Due to Overloading,
W82-01486 1503 2J

Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

New Evidence of Scroll-Bar Formation on The Beatton River,
W82-04188 1509 2J

Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 1510 2J

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 1510 2J

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 1510 2J

Resistance Equation for Large-Scale Roughness,
W82-04696 1510 2E

Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 1511 2E

New Trends in Water Quality Management,
W82-05429 1511 5G

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 1512 5F

RIVER CAM
Operational Experiences in the Effective Treatment of Effluents from Synthetic Resin Manufacture,
W82-03835 1509 5D

RIVER FLOW
Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

Some Effects of Fresh Water on the Atchafalaya Bay System,
W82-02143 1505 6G

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 1505 6D

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 1505 2L

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 1505 6G

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

Mean Characteristics of Asymmetric Flows: Application to Flow Below Ice Jams,
W82-02237 1505 2C

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

Management of Ice-Covered Rivers: Problems and Perspctives,
W82-03807 1509 2C

The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 1511 5B

River Plume Studies in Distorted Froude Models,
W82-05864 1511 2E

Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 1512 4C

RIVER MECHANICS
Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 1511 2E

RIVER MURRAY
South Australia's Approach to Salinity Management in the River Murray,
W82-02761 1506 5G

RIVER REGULATIONS
Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 1512 5G

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

RIVER RUNOFF
Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

RIVER RUNOFF *SALINITY
Observations on the Hydrography and Inshore Plankton of the Bay of Bengal off Balasore,
W82-01362 1503 2A

RIVER SYSTEMS
Unsteady Water Quality Model for River Network,
W82-02873 1506 5G

Data Acquisition for River Management,
W82-04601 1510 7A

A River Coding System for Water Quality Archives,
W82-05474 1511 7A

RIVER WATER
The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 1510 5F

RIVERS
Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 1501 5B

Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 1501 4A

Method for Recovering Viruses from River Water Solids,
W82-00200 1501 5A

Isolation, Enumeration, and Characterization of Aeromonas from Polluted Waters Encountered in Diving Operations,
W82-00224 1501 5C

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 1501 5C

Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

Kepone in the James River,
W82-00631 1502 5B

The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 1502 5B

Graphed Equilibrium Parameters of Channels Formed in Sediment,
W82-00881 1502 2J

A Comparison of Rainfall-Runoff Models,
W82-00911 1502 2A

Effectiveness of River Models,
W82-00961 1502 6A

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

Sites of River-Derived Sedimentation in the Ocean,
W82-01332 1503 7B

Phytoplankton of Four Rivers, the Tyne, Wear, Tees and Swale,
W82-01376 1503 2E

Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

Cooling Potential of Missouri River in Missouri,
W82-01654 1503 5B

Flood Control on the Parana and Paraguay Rivers,
W82-01707 1503 2E

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 1504 5B

The River Continuum: A Theoretical Construct for Analysis of River Ecosystems,
W82-02157 1505 6G

Bank Failure and Erosion on the Ohio River,
W82-02343 1505 2J

Enumeration of Heterotrophic Bacteria in River Waters by Using a Low Nutrient Medium (In Japanese),
W82-02352 1505 5A

Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 1505 2E

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 1506 2K

Hydrochemical Characteristics of the Stream Drwinka and Estimate of Its Self-Purification Ability,
W82-02750 1506 5B

Local Flow Accelerations in Rivers,
W82-02758 1506 2E

Studies on the Primary Production of the River Shatt Al-Arab at Basrah, Iraq,
W82-02776 1506 5C

Distribution of Chromobacteria in a Lowland River,
W82-02795 1506 5C

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

Space-Time Variability of the Runoff of European Rivers,
W82-02848 1506 2E

The Cost of Quality,
W82-02881 1506 5F

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 1506 6D

Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

Diversion of the River Neva,
W82-03304 1507 4A

Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 1507 5C

A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 1508 2H

Simulation of Ice-Cover Growth and Thermal Decay on the Upper St. Lawrence River.
W82-03822 1509 2C

Surface Heat Loss and Frazil Ice Production in The St. Lawrence River,
W82-03925 1509 2C

Evaluation of River Load Estimation Methods for Total Phosphorus,
W82-04034 1509 5B

The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

The Optimum Size of Small Run-Of-River Plants,
W82-04175 1509 8A

Selenium Content and Its Chemical Form in River Waters of Japan,
W82-04181 1509 5A

A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 1510 7A

Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 1510 5B

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

Organic Matter Transport in an Appalachian Mountain River in Virginia, U.S.A.,
W82-04949 1511 5B

Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 1511 5B

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 1511 5B

Microcomputer Water Quality Simulation Model,
W82-05191 1511 7B

Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

A Field Technique to Directly Measure River Bank Erosion,
W82-05410 1511 7B

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

A Case Study of Nutrients in the River Holem, West Yorkshire, England,
W82-05577 1511 5B

Bend Theory of River Meanders. Part 2, Nonlinear Deformation of Finite-Amplitude Bends,
W82-05651 1511 2E

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 1512 2J

Discharge of Metals from the St. Lawrence River,
W82-06190 1512 5B

Immediate and Delayed Oxygen Depletion in Rivers,
W82-06269 1512 5G

Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 1512 5B

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 1512 6B

ROACH
Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

ROAD CONSTRUCTION
Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 1503 4C

Interstate Highways Versus Watershed Protection in New England,
W82-03431 1508 5B

Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 1510 4B

Cold Regions Engineering in Norway,
W82-06000 1512 8A

ROADS
Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 1510 4C

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 1512 5B

The Challenge of Upgrading Roadside Rest Areas,
W82-06845 1512 5G

ROCHESTER
Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

ROCK EXCAVATION
Use of Combined Cyclic-Continuous Technology in Earth-Dam Construction,
W82-03498 1508 8A

Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 1511 8H

Practical Calculations and Recommendations on the Use of Gunpowder Rock Breakers in Hydrotechnical Construction,
W82-06086 1512 8H

ROCK FILL
Shear Strength of Rockfill,
W82-00116 1501 8D

ROCK MECHANICS
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-05904 1512 2F

On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 1512 8B

ROCK PROPERTIES
Geotechnical Investigations at the Kalyani Dam Site, Chittoor District, Andhra-Pradesh India,
W82-02890 1506 8E

ROCKAWAY TOWNSHIP
New Jersey Community Decontaminates Well Water.
W82-02243 1505 5F

ROCKFILL DAMS
Shear Strength of Rockfill,
W82-00116 1501 8D

A Laboratory Model for Under-Water Construction of a Dam,
W82-00347 1501 8D

Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 1504 8A

Cracking, Leakage, and Erosion of Earth Dam Materials,
W82-03149 1507 8D

TVA's Pumped-Storage Plant.
W82-03250 1507 8A

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 1512 8D

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

ROCKS
Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 1501 2K

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

ROCKSLIDES
Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

ROCKY MOUNTAIN ARSENAL
Rocky Mountain Arsenal: Landmark Case of Groundwater Polluted by Organic Chemicals, and Being Cleaned Up.
W82-03458 1508 5B

ROCKY MOUNTAIN PIPELINE PROJECT
Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

ROME
The Roman Way,
W82-02744 1506 5F

ROOT DEVELOPMENT
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 1503 2I

ROOT SYSTEMS
Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 1507 5E

ROOT ZONE
Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 1502 2G

Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 1507 3C

Soil Water Availability,
W82-05623 1511 2G

Comparison of Methods ot Estimate Deep Percolation Rates,
W82-06867 1512 2G

ROOTED AQUATIC PLANTS
Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 1502 2H

ROOTS
Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 1510 2D

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 1510 2I

ROSTHERNE MERE
Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

ROSWELL
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

ROTARY DRILLING
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

ROTATING BIOLOGICAL CONTACTOR
Prediction of RBC Performance for Nitrification,
W82-04043 1509 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 1512 5D

Rotating Biological Contactor System Design,
W82-06355 1512 5D

Nitrification Kinetics and Its RBC Application,
W82-06356 1512 5D

ROTATING BIOLOGICAL CONTACTORS
Biological Filters,
W82-01242 1503 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

ROTATING DISK EVAPORATORS
Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

ROTATION SPEED
Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 1511 5D

ROTIFERS
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 1504 2H

Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 1507 5D

Mass Production of Freshwater Rotifiers on Liquid Wastes II. Mass Production of Brachionus Rubens Ehrenberg 1838 in the Effluent of High-Rate Algal Ponds Used for the Treatment of Piggery Waste,
W82-03884 1509 3C

An Ecological Study of an Antarctic Freshwater Pool with Particular Reference to Tardigrada and Rotifers,
W82-04950 1511 2H

ROTTERDAM
Automated Treatment Plant Keeps Rotterdam Drinking Water Flowing.
W82-04004 1509 5F

ROTTERDAMSE WATERWEG ESTUARY
Physical Modeling of Rotterdamse Waterweg Estuary,
W82-03671 1508 2L

ROUGHNESS COEFFICIENT
Hydraulic Resistance of Floodplains,
W82-02850 1506 2E

Coefficient of Friction in Conduits with Large Roughness,
W82-02901 1506 8B

Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels'.
W82-03382 1507 2E

Absolute Roughness of Concrete-Lined Channels,
W82-03397 1507 8B

Numerical Method of Solving Certain Inverse Problems of Hydraulics,
W82-06619 1512 8B

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 1512 8B

ROUGHNESS COEFFICIENTS
Relationship of the Roughness Coefficient Manning's N and Discharge in an Urban River,
W82-02376 1505 2E

ROUTING
Water Routing on Diverging-Converging Watersheds,
W82-02200 1505 2A

Finite Element Modeling of Streamflow Routing,
W82-05918 1512 2E

Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 1512 8B

ROUTT COUNTY
Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

RUHR RIVER
The Fate of Heavy Metals in the Ruhr System and Their Influence on Drinking Water Quality,
W82-00962 1502 5B

Continuous Monitoring of Cyanide Concentration in Surface Water (Kontinuierliche Uberwachung Der Cyanid-Konzentration in Oberflachenwasser),
W82-06023 1512 5A

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Answirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 1512 5D

RUHR VALLEY
Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 1511 5D

RUNNING WATERS
The Relation Between 'Hydraulic Stress' and Microdistribution of Benthic Macroinvertebrates in a Lowland Running Water System, the Schierenseebroks (North Germany),
W82-02790 1506 5C

On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 1511 7B

RUNOFF
Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 1501 4D

Amounts and Relative Significance of Runoff Types in the Transport of Nitrogen into a Stream Draining an Agricultural Watershed,
W82-00173 1501 5B

Pollution From Land Runoff,
W82-00253 1501 5B

Multivariate Hydrologic Time Series Analysis,
W82-00647 1502 2A

Effects of Recent Increases in Rainfall on Floods and Runoff in the Upper Hunter Valley,
W82-00668 1502 2E

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Time Distribution of Clock Hour Rainfall,
W82-01402 1503 2A

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 1503 2A

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 1503 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 1504 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 1504 2C

Analysis of the Rainfall-Runoff Transformation Process,
W82-02210 1505 2A

Effect of Corn and Soybean Row Spacing on Plant Canopy, Erosion, and Runoff,
W82-02264 1505 2I

Permethrin Concentration on Cotton Plants, Persistence in Soil, and Loss in Runoff,
W82-02322 1505 5B

A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 1505 2A

Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

Space-Time Variability of the Runoff of European Rivers,
W82-02848 1506 2E

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 1508 2A

Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 1508 2A

SWMM Model and Level of Discretization,
W82-03673 1508 6A

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 1508 5B

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 1508 5D

Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

Effects of a North Central Washington Wildfire on Runoff and Sediment Production,
W82-04250 1509 2E

Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 1510 5B

Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 1510 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 1510 5B

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 1510 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 1510 5B

On-Site Stormwater Detention: An Overview,
W82-04758 1511 4A

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

Run-Off and Infiltration Losses Related to Shifting Agriculture (JHUM) in Northeastern India,
W82-05573 1511 4C

Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 1511 4A

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 1511 5B

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 1511 2E

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

Computation of Runoff Reduction Caused by Farm Ponds,
W82-06874 1512 4A

Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 1512 5B

RUNOFF COEFFICIENT
Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 1512 2A

RUNOFF COEFFICIENTS
A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

RUNOFF CYCLE
Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 1510 6G

RUNOFF FORECASTING
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Characterizing Short Duration Rainfall Intensities for Runoff Calculation,
W82-00142 1501 2A

Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 1502 2A

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

Adaptive Hydrological Forecasting - A Review,
W82-00984 1502 2A

Legal Challenge of the Ungaged Watershed,
W82-01664 1503 2E

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 1503 2E

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 1504 2C

Flood Event Modeling - A Study of Two Methods,
W82-02291 1505 2A

Discussion of 'Finite Element Method for Direct Runoff Flow',
W82-03782 1509 2A

Operational Applications of Satellite Snow Cover Observations,
W82-04150 1509 7B

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 1510 2A

Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

RUNOFF RATES
Residue and Tillage Effects on SCS Runoff Curve Numbers,
W82-01404 1503 4D

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 1510 2E

Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 1511 2A

RUNOFF VALUE
Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 1512 2D

RUNOFF VOLUME
Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 1506 2L

Investigation of Fluvial Processes Under Conditions of Natural Variability of the Runoff,
W82-03906 1509 2J

Some Characteristics and Implications of Drainage Basin Linearity and Non-Linearity,
W82-05710 1511 4A

Linear and Nonlinear Runoff from Large Drainage Basins,
W82-05711 1511 4A

Nonpoint Source Loading Rates from Selected Land Uses,
W82-06626 1512 5B

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 1512 4C

RURAL AREAS
Bacterial Contamination of Drinking Water Supplies in a Modern Rural Neighborhood,
W82-00198 1501 5A

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 1501 5B

Hygiene of Drinking Water in Developing Countries,
W82-00269 1501 5F

Development of a Rural Water District,
W82-00288 1501 6A

Upflow Water Filtration Unit, Test Results,
W82-00407 1501 5F

Wastewater Collection and Treatment in Wayne County,
W82-02554 1505 5D

Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 1507 5F

Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

Rural Power Schemes in Pakistan,
W82-04328 1510 6A

Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 1511 4C

A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

Egypt Tackles Rural Supply Task,
W82-05754 1511 5F

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

Supplying Water to the Rural Community,
W82-06223 1512 5F

RUSSIA
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 1506 8A

Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 1506 8A

Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

RUTLAND WATER
Introduction - Rutland Water 1970-1981,
W82-06482 1512 6B

SABINE-NECHES CANAL
Intensive Survey of the Sabine-Neches Canal - Segment 0703,
W82-04078 1509 5A

SACRAMENTO
Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 1510 6B

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 1511 8G

SACRAMENTO RIVER
Flood Data for the Sacramento River and Butte Basin 1875 to 1978, Sacramento Valley, California,
W82-00019 1501 2E

California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411 1511 4A

SACRAMENTO-SAN JOAQUIN ESTUARY
Effects of Freshwater Flow on Fishery Resources in the Sacramento-San Joaquin Estuary,
W82-02141 1505 4C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

SACRAMENTO VALLEY
Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 1510 7C

SAFE DRINKING WATER ACT
Information Management: A Role for Primacy Agencies in The 80S,
W82-03891 1509 10B

SAFE YIELD
Operating Policies for a Surface/Ground Water System,
W82-01741 1503 4B

An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 1512 4B

SAFETY
Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 1508 5D

Safety Analysis of High Hazard Deteriorating Concrete Gravity Dam-Reservoir Systems Including Corrective Measure - Earthquake and Dynamic Study,
W82-05296 1511 8A

Safety Considerations in Handling Activated Carbon,
W82-05442 1511 5D

Safety Aspects in the Design and Inspection of Dams,
W82-06203 1512 8A

Safety of Dams (Sicherheit Von Talsperren),
W82-06236 1512 8A

Components for a Treatment Plant Safety Program,
W82-06992 1512 5G

SAFFLOWER
Effect of Water, Nitrogen and Row Spacing on the Yield and Oil Content of Safflower,
W82-01112 1503 2I

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 1504 3F

SAGAMORE LAKE
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

SAGINAW BAY
Heavy Metal Contents in Some Macrophytes from Saginaw Bay (Lake Huron, U.S.A.),
W82-01000 1502 5B

Petroleum Hydrocarbons in Sediments of Saginaw Bay, Lake Huron,
W82-01141 1503 5A

Phytoplankton Productivity and Standing Crop in the Vicinity of the Lake Huron-Saginaw Bay Front,
W82-01164 1503 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

Modeling of Phytoplankton-Nutrient Dynamics in Saginaw Bay, Lake Huron,
W82-05639 1511 5C

SAGINAW BAY MODEL
Uncertainty Analysis of a Lake Eutrophication Model,
W82-03711 1508 2H

SAGINAW RIVER
Flow Model of Saginaw River Near Saginaw, Michigan,
W82-03996 1509 2E

SAGINAW RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 1503 6D

SAGUENAY FJORD
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 1503 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 1503 2J

SAHEL REGION
Will the Sahelian Drought End in 1985,
W82-03167 1507 2B

SAINT JOHN RIVER
Methods of Studying Population Shifts in Aquatic Bacteria in Response to Environmental Change,
W82-06558 1512 5C

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 1512 5A

An Ecological Approach to the Study of Bacteria at the Florenceville Site in September and February,
W82-06560 1512 5A

SALAMANDERS
Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 1510 5C

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 1511 5C

SALINE-FRESHWATER INTERFACES
Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

Resistivity Study of a Coastal Karst Terrain, Florida,
W82-00817 1502 2F

Ice Blocks Melting Into a Salinity Gradient,
W82-01530 1503 2C

018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 1503 2C

Studies on the Salinization of Coastal Ground Water. I. Confined Ground Water in the Naka River Estuary (In Japanese),
W82-03326 1507 2L

Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

Evaluation of Electromagnetic Terrain Conductivity Measurements for Detection and Mapping of Salt-water interfaces in Coastal Aquifers,
W82-04412 1510 5A

A Note on the Structure of the Head of an Intrusive Gravity Current,
W82-05089 1511 2E

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 1512 4B

SALINE LAKES
Standing Crop Densities and Distribution of Spirulina and Benthic Diatoms in East African Alkaline Saline Lakes,
W82-02759 1506 2H

The Gammaridae and Corixidae of an Inland Saline Lake from 1975 to 1978,
W82-02779 1506 2H

Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 1507 2H

Neusiedlersee: A Puzzle for Scientists, A Challenge for Planners,
W82-03689 1508 2H

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia,
W82-03704 1508 2H

Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 1508 2K

Water Resources Investigations in West Central Iran Using Landsat Data,
W82-03927 1509 7B

Primary Production in Saline Lakes,
W82-04926 1511 2H

Limnology of a Large, Deep, North American Terminal Lake, Pyramid Lake, Nevada, U.S.A.,
W82-04928 1511 2H

On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929 1511 2H

On the Chemistry and Biota of Some Saline Lakes in Western Australia,
W82-04940 1511 2H

The Limnology of Saline Lakes in Western Victoria, A Review of Some Recent Studies,
W82-04942 1511 2H

Chemistry, Physics and Evolution of Antarctic Saline Lakes,
W82-05100 1511 2H

Elevated Concentrations of Actinides in Mono Lake,
W82-05520 1511 5B

Methanogenesis in Big Soda Lake, Nevada: An Alkaline, Moderately Hypersaline Desert Lake,
W82-06535 1512 2H

SALINE SOILS

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 1503 2G

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils,
W82-01230 1503 5B

Transport of Salts in Catchments and Soils,
W82-01880 1504 2G

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

Effects of Salinization Treatments on Growth and Some Related Physiological Activities of Some Leguminous Plants,
W82-02381 1505 3F

Solution of the Continuity Equation for the Karnak Area,
W82-03196 1507 2G

Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 1508 2G

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

Salt Movement, Leaching Efficiency, and Leaching Requirement,
W82-03791 1509 2K

Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

Dryland Salinity in a Closed Drainage Basin in Nobleford, Alberta,
W82-05656 1511 4D

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 1512 3C

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

SALINE WATER

Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

Saline Irrigation Water.
W82-00512 1502 3F

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 1502 3C

Land and Stream Salinity in Western Australia,
W82-01374 1503 5B

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 1505 2F

Effect of Saline Irrigation Water on the Yield of Potato,
W82-02396 1505 3C

Salinity Forum: What. How. Why,
W82-02587 1505 6E

Relation Between PHC and Sodium Adsorption Ratio (SAR) and an Alternative Method of Estimating SAR of Soil or Drainage Waters,
W82-03445 1508 2G

Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 1508 3C

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 1508 5E

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 1508 6B

The Ionization of Acids in Estuarine Waters,
W82-03769 1509 2K

On The Rate of Ice Formation in Water Cooled by a More Saline Sublayer,
W82-04190 1509 2C

The Chemistry of Saline Water Chlorination,
W82-04729 1510 3C

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 1511 2L

Theoretical Analysis of Ionic Equilibria in Natural Water,
W82-05239 1511 2K

Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 1511 2F

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721 1511 5A

Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 1512 3C

Feasibility of Financial Incentives to Reuse Low Quality Waters in the Colorado River Basin,
W82-06693 1512 3C

SALINE WATER BARRIERS

Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 1505 6G

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

SALINE WATER CONTROL

The Agricultural Benefits of Salinity Control on the Red River of Texas and Oklahoma,
W82-03729 1508 6B

SALINE WATER INTRUSION

A Numerical Solution for the Movement of an Interface in a Layered Coastal Aquifer,
W82-01327 1503 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 1503 2F

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

Freshwater Inflow and Salt Water Barriers for Management of Coastal Wildlife and Plants in Louisiana,
W82-02144 1505 6G

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 1505 2L

Methods of Computation and Ecological Regulation of the Salinity Regime in Estuaries and Shallow Seas in Connection with Water Regulation for Human Requirements,
W82-02169 1505 5G

The Dynamics of Conservative Mixing in Estuaries,
W82-02345 1505 2L

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 1505 5D

South Australia's Approach to Salinity Management in the River Murray,
W82-02761 1506 5G

The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 1506 4C

Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 1507 2F

Graphs for Saline Wedges in Estuaries,
W82-03351 1507 2L

Boundary Integral Equation Solutions to Moving Interface Between Two Fluids in Porous Media,
W82-03577 1508 2F

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

Will New Orleans Miss The Mississippi,
W82-04274 1510 4A

Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

Salinity Intrusion in Estuaries,
W82-04574 1510 2L

Dispersion Coefficients in Estuaries,
W82-04684 1510 5B

Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

A Two-Dimensional, Finite Element Model of Salt Water Intrusion in Groundwater Systems,
W82-06525 1512 4B

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 1512 5B

Stormwater Management in a Sensitive Area.
W82-06841 1512 5G

Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 1512 2F

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

SALINITY

Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 1501 5B

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 1502 2I

The Azov Sea Problem,
W82-00651 1502 6G

Inorganic Transformation of Applied Phosphorus in Brackish Water Fish Pond Soil Under Different Water Salinity Levels,
W82-00920 1502 2H

Role of Solute-Transport Models in the Analysis of Groundwater Salinity Problems in Agricultural Areas,
W82-00993 1502 5B

Dryland Management for Salinity Control,
W82-01018 1502 2G

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 1503 6A

Effect of Different Levels of Water Salinity on the Decomposition of Organic Manures in a Brackish Water Fish Pond Soil,
W82-01363 1503 3C

Land and Stream Salinity in Western Australia,
W82-01374 1503 5B

Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 1503 2G

River Basin Hydrosalinity Modeling,
W82-01469 1503 2K

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 1503 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 1503 5B

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 1503 2L

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 1503 3A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 1504 2H

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 1504 2F

Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 1505 6G

Aspects of Impacts Assessment of Low Freshwater Inflows to Chesapapeake Bay,
W82-02115 1505 6G

Effects of Freshwater Flow on Salinity and Phytoplankton Biomass in the Lower Hudson Estuary,
W82-02117 1505 2L

Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 1505 6G

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

Estuarine Benthic Community Dynamics Related to Freshwater Inflow to the Corpus Christi Bay Estuary,
W82-02135 1505 2L

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 1505 2L

The Influence of Salinity Transition on Benthic Nutrient Regeneration in Estuaries,
W82-02137 1505 2L

Freshwater Inflow to Estuaries, Short and Long Term Perspectives,
W82-02158 1505 2L

Precipitation Trends and Variability in the Vicinity of Northwest Gulf Coast: 1900-1980,
W82-02159 1505 2L

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

Vertical Mixing Rates in Fjords Determined Using Radon and Salinity as Tracers,
W82-02576 1505 2L

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

South Australia's Approach to Salinity Management in the River Murray,
W82-02761 1506 5G

The Influence of Stream Salinity on Reservoir Water Quality,
W82-02762 1506 4C

The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 1506 4D

Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 1506 2K

Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 1506 2F

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 1506 2L

Fine Structure of Salinity in the Water Off the Danube Estuary,
W82-02892 1506 2L

Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 1507 2F

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 1507 5G

Salinity and Biogenic Material in the North Caspian,
W82-03155 1507 4A

Diversion of the River Neva,
W82-03304 1507 4A

The Measurement of Diffusion Coefficients in the Conwy Estuary,
W82-03388 1507 2L

The Effect of Organic Material and Inorganic Ions on the Photosynthetic Rate of Red Alga Bostrychia Binderi from a Florida Estuary,
W82-03423 1508 2L

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

Leaching Requirements for Salinity Control. II. Oat, Tomato, and Cauliflower,
W82-03790 1509 2I

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 1511 2J

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

Managing Salinity in Irrigated Agriculture,
W82-05691 1511 3C

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 1511 3B

The Wellton-Mohwak Dilemma,
W82-05883 1511 3F

Future Water Development Policies,
W82-05884 1511 5G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 1511 3C

Colorado River Water Allocation,
W82-05888 1511 6C

The Colorado River Salinity Problem,
W82-05889 1511 5G

International Problems on the Colorado River,
W82-05892 1511 5G

Salinity Control Measures for Grand Valley,
W82-05894 1511 3F

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 1512 2L

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata,
W82-06521 1512 3C

Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 1512 2L

A Model for Managing Irrigated Agriculture,
W82-06584 1512 5G

York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

SALINITY CONTROL
Economics of Controlling Natural Salt Sources in the Arkansas River Basin,
W82-04234 1509 6B

SALINITY CURRENTS
Salt Dispersion in the Hudson Estuary,
W82-01615 1503 2L

SALMON
Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 1501 5C

Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 1502 8I

Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

Influences of Freshwater Inflow on Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento-San Joaquin Estuary,
W82-02142 1505 6G

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

Mt. St. Helens and the Fish,
W82-02508 1505 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 1506 5C

Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
W82-04075 1509 8I

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

SALMON RIVER
Preferences for Allocating River Recreation Use,
W82-01181 1503 6D

SALMONELLA
Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 1502 5A

Dispersal of Salmonella from a Polluted Stream to Neighboring Terrestrial Habitats,
W82-01043 1502 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Effect of Water Treatment on Mutagenic Potential,
W82-03776 1509 5A

SALT BALANCE
Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 1502 5B

Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 1507 5A

Managing Salinity in Irrigated Agriculture,
W82-05691 1511 3C

A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

SALT DOMES
Isotope Geochemistry of Water in Gulf Coast Salt Domes,
W82-04742 1510 2K

Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 1511 5B

SALT LAKE CITY
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 1505 6D

SALT LOADING
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 1503 5B

SALT MARSHES
Geochemistry of a Subarctic Salt Marsh Environment,
W82-00148 1501 2L

Enrichment and Association of Bacteria and Particulates in Salt Marsh Surface Water,
W82-00201 1501 2L

Populations of Methane-Producing Bacteria and In Vitro Methanogenesis in Salt Marsh and Estuarine Sediments,
W82-00202 1501 2L

Enumeration and Relative Importance of Acetylene-Reducing (Nitrogen-Fixing) Bacteria in a Delaware Salt Marsh,
W82-00248 1501 2L

The Assay of Adenosine 5'Triphosphate Extracted from Salt-Marsh Microbiota,
W82-00838 1502 2L

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 1504 2L

Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

Carbon Dioxide Assimilation, Photosynthetic Efficiency, and Respiration of a Chesapeake Bay Salt Marsh,
W82-02937 1506 2L

Diel Flux of Dissolved Carbohydrate in a Salt Marsh and a Simulated Estuarine Ecosystem,
W82-03168 1507 2L

Retention and Fate of Experimentally Added Mercury in a Massachusetts Salt Marsh Treated with Sewage Sludge,
W82-03695 1508 5B

The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria, W82-03770 1509 5E

Oregon Coastal Salt Marsh Upper Limits and Tidal Datums, W82-04312 1510 2L

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment, W82-04464 1510 2L

Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina, W82-04716 1510 2L

The Influence of Water Salinity on Paludal Erosion Processes, W82-04995 1511 2J

The Ecology of Southern California Coastal Salt Marshes: A Community Profile, W82-05215 1511 2H

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware, W82-05415 1511 2K

The Ecology of New England High Salt Marshes: A Community Profile, W82-06096 1512 2L

Mineralization of Detrital Lignocelluloses by Salt Marsh Sediment Microflora, W82-06410 1512 2L

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh, W82-06536 1512 2L

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom, W82-06541 1512 2L

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh, W82-06975 1512 5A

SALT RIVER

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay, W82-03367 1507 5B

Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data, W82-04340 1510 2E

SALT RIVER BASIN

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah, W82-06093 1512 2E

SALT TOLERANCE

On the Dependence of Salt Tolerance of Beans (Phaseolus Vulgaris L.) on Soil Water Matric Potentials, W82-03273 1507 3C

On the Conspecificity of Marine and Freshwater Bangia in Britain, W82-03408 1508 2L

Faunal Assemblages of Some Saline Lakes near Marchagee, Western Australia, W82-03704 1508 2H

Salt- and Drought-Tolerant Crop Plants for Water Conservation, W82-05920 1512 3C

A Comparison of the Effects of Salinity on Photosynthetic Physiology of a Salt Sensitive Grass, Panicum Obtusum, and a Salt Tolerant Grass, Distichlis Spicata, W82-06521 1512 3C

SALT UPTAKE

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah, W82-06093 1512 2E

SALT VALLEY

Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton, W82-01653 1503 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication, W82-01797 1503 5C

Eutrophication of the Salt Valley Reservoirs, 1968-1973. II. Changes in Physical and Chemical Parameters of Eutrophication, W82-03214 1507 5C

SALTS

Areal Predictions of Water and Solute Flux in the Unsaturated Zone, W82-00381 1501 6A

Estimation of the Salt Burden of Irrigation Drainage Waters, W82-00563 1502 5B

Transport of Salts in Soils and Subsoils, W82-00930 1502 5B

Dissolution of Salt Deposits by Brine Density Flow, W82-01016 1502 2F

The Movement of Salts from Soils Following Heavy Application of Feedlot Wastes, W82-01132 1503 5B

Prediction of Diffusion Coefficients from the Electrical Conductance of Soil, W82-01224 1503 2G

A Combined Salt Transport-Chemical Equilibrium Model for Calcareous and Gypsiferous Soils, W82-01230 1503 5B

Transport of Salts in Catchments and Soils, W82-01880 1504 2G

Major Evaporite Deposition from Groundwater Remobilized Salts, W82-03339 1507 5B

Multimillion-Acre Tea Bag, W82-03352 1507 3F

Salt Movement, Leaching Efficiency, and Leaching Requirement, W82-03791 1509 2K

Ion Hydration and Ion Interaction, W82-05310 1511 2K

Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland, W82-05414 1511 2K

Effects of Salts on Activated Carbon Adsorption of Fulvic Acids, W82-05667 1511 5F

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale, W82-05751 1511 3B

SAM RAYBURN RESERVOIR

Operation Policy Analysis: Sam Rayburn Reservoir, W82-02589 1505 6A

SAMPLE PREPARATION

Preconcentration for Trace Element Determination in Aqueous Samples, W82-01574 1503 5A

Preparation of Friable Aquiferous Specimens, W82-02935 1506 2F

Analytical Reference Materials. III. Preparation and Homogeneity Test of Large Quantities of Wet and Dry Sediment Reference Materials for Long Term Polychlorinated Biphenyl Quality Control Studies, W82-03224 1507 5A

Preconcentration of Inorganic Mercury with an Anion-Exchange Resin and Direct Reduction-Aeration Measurements by Cold-Vapour Atomic Absorption Spectrometry, W82-03268 1507 5A

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction, W82-06902 1512 5A

SAMPLE PRESERVATION

Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution, W82-00206 1501 5A

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water, W82-01532 1503 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal), W82-01637 1503 5A

The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters, W82-04660 1510 5A

Changes in Extractable Metal Concentrations During Storage of Surface Water Samples Containing Sediments, W82-06630 1512 2K

Right Place, Time and Technique: Right Sample, W82-06642 1512 5A

SAMPLING

A More Versatile Soil Water Sampler, W82-00191 1501 7B

Graphical Effluent Quality Control for Compliance Monitoring: What Is a Violation, W82-00261 1501 5G

An Appraisal of Pond-Net Samples for Biological Monitoring of Lotic Macroinvertebrates, W82-00308 1501 7B

Understanding Acid Rain, W82-00479 1501 5B

Sampling Emerging Chironomidae (Diptera) With Submerged Funnel Traps in a New Northern Canadian Reservoir, Southern Indian Lake, Manitoba, W82-00520 1502 2H

Evaluation of Various Soil Water Samplers for Virological Sampling, W82-00572 1502 5A

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques, W82-00633 1502 5A

Sample Intake Position and Loading Rates from Nonpoint Source Pollution,
W82-00778 1502 5A

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

A Comparative Study of Four Dredges Used for Sampling Benthic Macroinvertebrates in Rivers,
W82-00833 1502 7B

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 1502 7B

A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 1503 5A

Cyclic Strengths Compared for Two Sampling Techniques,
W82-01170 1503 8D

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 1503 5A

Immediate Detection of Heterogeneities in Continuous Multivariate, Oceanographic Recordings. Application to Time Series Analysis of Changes in the Bay of Villefranche sur Mer,
W82-01393 1503 7A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 1504 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 1504 7B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 1504 2F

Note on Random Raindrops and Sampling Error,
W82-02032 1504 2B

A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

A More Versatile Soil Water Sampler,
W82-02523 1505 7B

Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 1506 7A

A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 1506 7B

The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 1508 5B

Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833 1509 5A

Gage Density and Location fpr Estimating Mean Annual Precipitation in Mountainous Areas,
W82-03901 1509 2B

Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study,
W82-03919 1509 7A

Ichthyoplankton Samplers for Simultaneous Replicate Samples at Surface and Bottom,
W82-04297 1510 7B

A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 1510 7B

Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermessstellen),
W82-04582 1510 7B

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

Sampling and Analyzing Water,
W82-05263 1511 5A

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 1512 6G

Evaluation of a System to Automatically Sample Zooplankton from the Discharge of Dams,
W82-06628 1512 5A

Right Place, Time and Technique: Right Sample,
W82-06642 1512 5A

Sampling Characteristics of Macrophyte Biomass,
W82-06779 1512 5A

Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 1512 5A

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 1512 5A

SAN ANTONIO

Multi-Attribute Decision Analysis for the Protection of Groundwater Resources,
W82-03805 1509 6A

SAN ANTONIO AREA

Compilation of Hydrologic Data for the Edwards Aquifer, San Antonio Area, Texas, 1934-79.
W82-04987 1511 7C

SAN ANTONIO BAY

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 1505 2L

SAN ANTONIO RIVER BASIN

Evaluation of Hydropower Potential in a River Basin,
W82-04214 1509 6B

SAN BERNARDINO MOUNTAINS

Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 1505 2I

SAN BERNARDINO VALLEY

Basin Management in the San Bernardino Valley,
W82-00075 1501 4B

Basin Management in the San Bernardino Basin Area,
W82-00280 1501 6A

SAN DIEGO

Upgrading Water Treatment Plants in Sa Diego,
W82-03655 1508 5F

SAN FRACISCO BAY

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 1505 2L

SAN FRANCISCO

Drought Management: Expecting the Unexpected,
W82-05649 1511 3D

SAN FRANCISCO BAY

The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 1505 2L

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

Plankton Studies in San Francisco Bay. I. Chlorophyll Distributions and Hydrographic Properties of the San Francisco Bay Estuary, July 1977 - December 1979,
W82-02831 1506 2L

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

SAN FRANCISCO BAY AREA

Chrysotile Asbestos Fibers in Drinking Water from Asbestos-Cement Pipe,
W82-01592 1503 5B

Increasing Hydrogen Ion Activity of Water in Two Reservoirs Supplying the San Francisco Bay Area, California,
W82-03081 1507 5B

SAN JOAQUIN RIVER

Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 1502 5B

SAN JUAN BASIN

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

SAN JUAN-CHAMA PROJECT

Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 1501 8A

SAN LUIS PASS

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

SAN LUIS VALLEY

Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

SAN PEDRO

Characterisation of Domestic and Industrial Sewage in Southern California Coastal Sediments Using Nitrogen, Carbon, Sulphur, and Uranium Tracers,
W82-00147 1501 5B

SAND

Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

Two Bed-Load Formulas: An Evaluation,
W82-02375 1505 2J

Clarification with Microsand Seeding. A State of the Art,
W82-03880 1509 5F

Bearing Capacity of Sand Bases (Discussion of Construction Specifications),
W82-05583 1511 8D

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

SAND AQUIFERS

Contaminant Occurrence in an Unconfined Sand Aquifer at a Municipal Landfill,
W82-03933 1509 5B

SAND FILTERS

A Successful Low Technology Wastewater Process,
W82-01178 1503 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 1507 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 1507 5D

Designing for Coarse Sand Filtration Systems,
W82-03478 1508 5D

Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

Biological Denitrification for Potable Water Treatment,
W82-05247 1511 5F

Land Application of Secondary Effluent at Lake George, NY,
W82-05704 1511 5D

UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 1512 5D

SAND MOUNDS

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5E

SAND WAVES

Discussion of 'Visualization of Separation over Sand Waves',
W82-03783 1509 8B

SANDS

The Likelihood of Active Groundwater Recharge in the Botswana Kalahari,
W82-05657 1511 4B

SANDSTONES

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Ueberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

SANDUSKY RIVER

Limnetic Larval Fish of the Maumee and Sandusky River Estuaries,
W82-01197 1503 7A

SANGAMON RIVER

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

SANITARY ENGINEERING

Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 1505 6E

Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 1508 5D

Cost of Wash Houses and Comfort Stations at Recreation Areas,
W82-06042 1512 6C

SANITARY ENGINEERING *COST ANALYSIS

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

SANITARY LANDFILLS

Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 1503 5E

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

Prediction of Leachate Accumulation in Sanitary Landfills,
W82-03934 1509 5B

SANITATION

Rural Sanitation in Developing Countries,
W82-01392 1503 5D

Wanted: Water for Development,
W82-02088 1504 6D

Water Supply and Sanitation Decade Programme,
W82-02757 1506 5F

Integrated Planning of Rural Water Supply and Sanitation,
W82-03916 1509 5G

International Decade on Drinking Water and Sanitation,
W82-04230 1509 6E

They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 1512 5F

SANMENXIA RESERVOIR

Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 1507 2J

SANTA BARBARA BASIN

Natural Abundances of 15N as a Source Indicator for Near-Shore Marine Sedimentary and Dissolved Nitrogen,
W82-00283 1501 5B

SANTA CRUZ COUNTY

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

SANTEE RIVER

Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

SANTEE RIVER BASIN

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 1503 6D

SANTIAGO

Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

SAPROBIC INDEX

Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 1502 2H

SAPROBITY

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 1504 5A

SASKATCHEWAN

The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 1502 2J

The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 1503 3F

A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

Operational Research Techniques in River Basin Management,
W82-05387 1511 6A

Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) 1. History, Distribution, and Surface Translocation,
W82-06865 1512 5B

SASKATCHEWAN GLACIER

Glacier Surveys in Alberta - 1979,
W82-01855 1504 2C

SATELLITE TECHNOLOGY

SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 1502 2B

Satellite Rain Estimation in the U.S. High Plains,
W82-00808 1502 2B

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 1503 7B

The Inference of Gate Convective Rainfall from SMS-1 Imagery,
W82-01519 1503 7B

A Comparison of Two Satellite Rainfall Estimates for GATE,
W82-01533 1503 7B

Determination of Moisture from NOAA Polar Orbiting Satellite Sounding Radiances,
W82-01535 1503 2B

Remote Sensing in Development,
W82-01719 1503 7B

Spatial Simulation of Snow Processes,
W82-01887 1504 2C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 1504 7B

Monitoring Freshwater Inflow to Estuaries by Remote Sensing,
W82-02138 1505 7A

Evaluation of Remote Sensing Data for Input into Hydrological Simulation Program-Fortran (HSPF),
W82-02986 1506 7B

Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 1507 7B

Remote Sensing from Space-II.
W82-03248 1507 7B

Remote Sensing Applications for Resource Management,
W82-03279 1507 7B

Use of Visible and Thermal Satellite Data to Monitor an Intermittently Flooding Marshland,
W82-03682 1508 7B

Watershed Model Study Using LANDSAT Image Data,
W82-03814 1509 2A

Areal Distribution of Snow Water Equivalent Evaluated by Snow Cover Monitoring,
W82-03842 1509 2C

Water Resources Investigations in West Central Iran Using Landsat Data,
W82-03927 1509 7B

Operational Applications of Satellite Snow Cover Observations,
W82-04150 1509 7B

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 1511 7B

Tropical Cyclone Rainfall Characteristics as Determined from a Satellite Passive Microwave Radiometer,
W82-06214 1512 2B

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

SATHIAR RESERVOIR
Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

SATURATED FLOW
A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 1503 5B

SATURATED SOILS
On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 1511 2G

SATURATION
Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 1508 2K

SATURATION INDEX
Factors Affecting Marl Deposition in Knowlton Lake, Southeastern Ontario,
W82-04031 1509 2K

SATURATION ZONE
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 1503 2F

SAUDI ARABIA
Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 1507 3C

Jeddah IV Seawater Desalination and Power Plant in Operation in Saudi Arabia (Meerwasserentsalzungs und Kraftanlage Jeddah IV in Saudi - Arabien in Betrieb),
W82-04581 1510 3A

Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 1512 3A

SAVANNAH RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 1503 6D

SAVANNAH RIVER IMPOUNDMENTS
The Effect of Season and Location on Phosphoadenylate Concentrations and Adenylate Energy Charge in Two Species of Freshwater Clams,
W82-00810 1502 2H

SAVANNAH RIVER PLANT
Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 1512 6G

SAVINJA RIVER
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

SAW MILLS
Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

SCALE FORMATION
Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 1512 3A

SCALE INHIBITION
Scale Inhibition of Calcium Sulfate by a Fluidized Bed,
W82-06104 1512 3A

SCALE PREVENTION
Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

SCALING
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 1505 5D

Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

The Siderite Model of The Formation of Corrosion-Resistant Scales,
W82-04270 1510 5F

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

Morphology of Inhibitor-Treated CaCo3 Precipitate,
W82-06120 1512 3A

SCALLOP
A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring. (In Japanese),
W82-02379 1505 5B

SCALLOPS
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 3C

SCHELDE BASIN
A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

SCHELDT ESTUARY
Coprostanol and Bacterial Indicators of Faecal Pollution in the Scheldt Estuary,
W82-04923 1511 5A

SCIENTIFIC PERSONNEL
Laboratory Services in Regional Water Authorities,
W82-06256 1512 5G

SCOTLAND
The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 1501 5A

The Design and Interpretation of Marine Pollution Surveys,
W82-00700 1502 6E

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

Airy Holm Dam - Kielder Water Scheme,
W82-03070 1507 8A

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 1511 2H

Bed-Material Size and the Riffle-Pool Sequence,
W82-05958 1512 2J

Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 1512 2J

Discharge to the North Sea,
W82-06248 1512 5E

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 1512 5C

SCOUR
Evaluating Scour at Culvert Outlets,
W82-01934 1504 4D

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

The Vortex Scour Mechanism at Bridge Piers,
W82-04642 1510 8B

Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 1511 8B

Calculation of Large Unlined Canals,
W82-05131 1511 8B

SCREENS
Cooling Water Intake Screening Devices Used to Reduce Entrainment and Impingement,
W82-01442 1503 8I

Use of Fish Larva Morphometry to Predict Exclusion Capabilities of Small-Mesh Screens at Cooling-Water Intakes,
W82-02687 1506 8I

How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 1511 5D

SEA ICE
The Distribution of Sea Ice Meltwater in the Eastern Canadian Arctic,
W82-00966 1502 2C

018 Modelling of Freshwater Inputs in Baffin Bay and Canadian Arctic Coastal Waters,
W82-01590 1503 2C

Quantitative Composition, Distribution, Community Structure and Standing Stock of Sea Ice Microalgae in the Canadian Arctic,
W82-02649 1506 2C

SEA LEVEL
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 1503 4C

Tides and Tidal Datums in the United States,
W82-02982 1506 2A

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

SEA URCHINS
Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 1508 5C

SEA WALLS
Large Rubble-Mound Breakwater Failures,
W82-00862 1502 8D

SEA WATER
Model Experiments on the Growth of Enteric Bacteria in Fresh and Sea Water,
W82-02377 1505 5A

Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 1510 5C

SEALANTS
Post-Treatment Process for Reverse Osmosis Membranes,
W82-02454 1505 3A

Improvement of the Seals of Expansion Joints of Hydraulic Structures,
W82-02669 1506 8A

Security Aspects at the Design and Construction of Sealing for Dams (Sicherheitsaspekte Bei Konstruktion Und Ausfuhrung Von Dammidichtungen),
W82-06241 1512 8G

SEALING
Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Ueberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

SEASONAL DISTRIBUTION
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 1502 2B

Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

SEASONAL EFFECTS
Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 1510 5C

SEASONAL RATIOS
Seasonal Variation of Nitrogen and Phosphorus Species in the Red River,
W82-06573 1512 5B

SEASONAL VARIATION
Model of the Seasonal Dynamics of an Ecosystem of a Shallow Lake,
W82-00552 1502 2H

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 1502 5C

Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 1503 2G

Changes in Lake Ontario Total Phosphorus Concentrations, 1976-1978,
W82-01126 1503 2H

A Successful Low Technology Wastewater Process,
W82-01178 1503 5D

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

Year-to-Year Changes in the Salinity of the Eastern English Channel, 1948-1973: A Budget,
W82-01399 1503 2A

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 1503 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 1503 2H

Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 1505 5F

Seasonal and Diurnal Fluctuations of Oomycete Proagule Numbers in the Free Water of a Freshwater Lake,
W82-02274 1505 2H

Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

Studies on the Seasonal Changes of Dissolved Organic Carbon, Nitrogen, Phosphorus and Urea Concentrations in Lake Biwa,
W82-02768 1506 2H

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

Seasonal Salinity Variations in Cleveland Bay, Northern Queensland,
W82-02878 1506 2L

Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 1506 2H

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

Seasonal Variation in Heterotrophic Activity and Population Density of Planktonic Bacteria in a Clean River,
W82-03405 1508 7B

Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 1508 2L

Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 1508 2K

Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 1510 6C

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 1510 2B

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 1510 2A

Seasonality of Flooding and the Assessment of Seasonal Flood Risk,
W82-04646 1510 2E

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

Effects of Use Pattern, Cover, Soil Drainage Class, and Overwinter Changes on Rain Infiltration on Campsites,
W82-04858 1511 2G

Seasonal Distribution of Bdellovibrios at the Mouth of the Patuxent River in the Chesapeake Bay,
W82-04924 1511 2L

Diel Variations of Certain Physico-Chemical Parameters of Water in Selected Aquatic Systems,
W82-05097 1511 2H

Mineral Composition of Phragmites Australis in Scottish Lochs as Related to Eutrophication. I. Seasonal Changes in Organs,
W82-05099 1511 2H

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 1511 4A

Seasonal Risk-Based Reservoir Operating Rules,
W82-05299 1511 4A

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

Weak Acid Concentrations and River Chemistry in the Tovdal River, Southern Norway,
W82-06052 1512 2K

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 1512 2E

Seasonal Variability and Transport of Suspended Microfungi in a Southeastern Salt Marsh,
W82-06536 1512 2L

Seasonal and Long-Term Changes in Surface Cover of Aquatic Plants in a Shallow Pond, Ojaga-Ike, Chiba, Japan,
W82-06900 1512 5C

Dynamics of a Subtropical Plankton Community, with Emphasis on the Copepod Mesocyclops Edax,
W82-06906 1512 5C

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

SEASONAL VARIATIONS

Climatic Factors Contributing to Year-To-Year Variation in Grain Yield of Corn on Brookston Clay,
W82-01115 1503 2I

Occurrence, Distribution and Seasonal Periodicity of Some Aquatic Fungi of Sat-Tal (Nainital), India,
W82-02894 1506 2H

Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 1511 4C

Tracking Seasonal Load Variations,
W82-05787 1511 5D

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser-II. Seasonal Variation and Correlation to Temperature and Other Environmental Variables,
W82-06659 1512 5B

Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 1512 5C

SEATTLE

Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 1502 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 1502 5D

Stranglehold on the Skagit,
W82-03490 1508 6G

The Costs of Internal Corosion in Water Systems,
W82-03809 1509 5F

SEAWATER

A Salicylate-Hypochlorite Method for Determining Ammonia in Seawater,
W82-00238 1501 5A

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 1501 2K

Survival of Human Enteroviruses in the Hawaiian Ocean Environment: Evidence for Virus-Inactivating Microorganisms,
W82-00587 1502 5C

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 1502 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 1502 5A

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 1502 5A

Organic Matrix Modifiers for Direct Graphite Furnace Atomic Absorption Determination of Cadmium in Seawater,
W82-01085 1502 5A

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 1504 5B

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 1504 2K

Non-Acid Pretreatment and Management of Microorganisms in Seawater Desalination by Reverse Osmosis,
W82-02108 1505 3A

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 1505 5E

Particulate and Dissolved Lipids in Sea Water,
W82-02727 1506 5A

Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 1506 3A

An Ion-Association Model for Estimating Acidity Constants (At 25 C and 1 ATM Pressure) in Electrolyte Mixtures Related to Seawater (Ionic Strength < 1 MOL/KG H20),
W82-03194 1507 1B

Community Metabolism of Adenylates by Microheterotrophs from the Los Angeles Harbor and Southern California Coastal Waters,
W82-03301 1507 5B

Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 1507 5A

From Screening to Filtration: Treating the Water Supply,
W82-03739 1508 3A

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

VTE/VC for Sea Water,
W82-04909 1511 3A

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1511 1B

SEBASTICOOK RIVER BASIN

Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

SECCHI DISKS

Secchi Disc Relationships,
W82-06627 1512 2H

SECONDARY PRODUCTIVITY

Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 1501 5D

Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

SECONDARY WASTEWATER

Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 1512 5D

SECONDARY WASTEWATER TREATMENT

Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 1501 6G

An Alternative Wastewater Disinfectant,
W82-00950 1502 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 1502 5D

Detroit's WWTP: One of the World's Biggest,
W82-01865 1504 5D

Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 1506 6E

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 1506 3C

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 1508 5D

An Investigation of Biologically Adjusted pH Changes in Domestic Sewage Effluent,
W82-03953 1509 5D

Relative Effects on Stream Biota of Chlorine and Ammonia Occurring in Secondary Sewage,
W82-04409 1510 5C

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 1510 5D

A Low-Cost Secondary Treatment Alternative,
W82-05169 1511 5D

Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 1512 5G

SEDIMENT
Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 1512 5C

SEDIMENT-CARRYING CAPACITY
Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 1503 2J

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 1505 2J

SEDIMENT CONCENTRATION
Mt. St. Helens and the Fish,
W82-02508 1505 2J

Effects of Fine Sediments on Growth of Juvenile Coho Salmon in Laboratory Streams,
W82-02639 1506 5C

SEDIMENT CONTROL
Hydraulic Sediment Model Study for Proposed Blanco Diversion Dam Modification,
W82-00446 1501 8A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 1503 6A

Erosion and Sedimentation Control in Regional and Site Planning,
W82-01552 1503 4D

Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 1506 2J

Sedimentation Control in Indian Reservoirs,
W82-03693 1508 8A

Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

Evaluating Sediment Blankets and a Screen for Macrophyte Control in Lakes,
W82-06097 1512 4A

Lake Restoration by Sediment Removal,
W82-06776 1512 5G

SEDIMENT COVERS
Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 1510 5G

SEDIMENT DEPOSITION
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00112 1501 2L

Sites of River-Derived Sedimentation in the Ocean,
W82-01332 1503 7B

Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 1503 2J

Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 1504 2J

SEDIMENT DEPOSITION. *RESERVOIR SILTING
A Verification Study on a Reservoir Sediment Deposition Model,
W82-01176 1503 2J

SEDIMENT DISCHARGE
Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

Reservoir Sedimentation with Random Deposits,
W82-04443 1510 2J

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 1512 4D

SEDIMENT DISTRIBUTION
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 1501 2J

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 1503 2H

The Effect of Changing Sediment Supply on Sedimentation in a Glacier-Fed Lake,
W82-01510 1503 2H

Size Distribution of Amazon River Bed Sediment,
W82-03488 1508 2J

The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 1511 2L

Sediment Mixing and Accumulation Rate Effects on Radionuclide Depth Profiles in Hudson Estuary Sediments,
W82-05868 1511 2J

SEDIMENT EROSION
Gully Erosion,
W82-01407 1503 2J

An Evaluation of Aquatic Life Found at Hydraulic Scour Sites in the Columbia River Estuary Selected for Potential Sediment Deposition,
W82-02132 1505 2L

Bed Load Fluctuation: Applications,
W82-05000 1511 2J

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

SEDIMENT LOAD
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

Flow Regime and Sediment Load Affected by Alterations of the Mississippi River,
W82-02125 1505 4C

Panoche Creek Flood Protection Works.
W82-04068 1509 4A

Sources of Sediment-Induced Reductions in Water Quality Appraised from Catchment Attributes and Land Use,
W82-05494 1511 2J

Supercritical Flow Flumes for Measuring Sediment-Laden Flow,
W82-06959 1512 8B

SEDIMENT SAMPLER
The Kyholm Corer--A Diver-Operated Sediment Corer,
W82-00793 1502 7B

Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 1510 7B

Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 1510 7B

A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 1512 8I

SEDIMENT TRANSPORT
Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

Secondary Flow, Shear Stress and Sediment Transport,
W82-00117 1501 2J

Sediment and Nutrient Movement from the Black Creek Watershed,
W82-00135 1501 5B

Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

Movement of Loose, Sandy Detritus by Shallow Water Flows: An Experimental Study,
W82-00776 1502 2J

Subsurface Drainage and Sediment Transport Model,
W82-00894 1502 2G

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 1503 2J

Selecting a Formula to Estimate Sediment Transport Capacity in Nonvegetated Channels,
W82-01405 1503 2J

Sediment Transport Capacity of Overland Flow,
W82-01408 1503 2J

Concentrated Flow Relationships,
W82-01409 1503 2J

River Bed Aggradation Due to Overloading,
W82-01486 1503 2J

Sediment-Contaminant Transport Model,
W82-01614 1503 5B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 1503 2J

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 1503 2J

Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 1503 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 1504 2J

Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 1504 2J

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 1504 2J

A New Approach to Determining the Quantitative Relationship Between Fishery Production and the Flow of Fresh Water to Estuaries,
W82-02130 1505 4C

Sediment Transport During a Controlled Reservoir Release,
W82-02196 1505 2J

Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

Estimating Sediment Transport Capacity in Watershed Modeling,
W82-02265 1505 2J

Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 1505 5B

Flash Flood in Arizona - Observations and Their Application to the Identification of Flash-Flood Deposits in the Geologic Record,
W82-02350 1505 2A

Two Bed-Load Formulas: An Evaluation,
W82-02375 1505 2J

Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

Hydraulics of Flow and Sediment Transport in the Kankakee River in Illinois,
W82-02512 1505 2J

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 1505 5B

River and Suspended Sediment Discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada,
W82-02637 1506 2E

Flow Resistance in Coarse Gravel Bed Rivers,
W82-02879 1506 2J

The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 1506 2L

Bed Load Discharge Coefficient,
W82-02936 1506 2J

Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 1507 2J

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 1507 2E

Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 1508 2J

Bedload Transport in an Oregon Coast Range Stream,
W82-03548 1508 2J

Particle Counter for Sediment Transport Studies,
W82-03666 1508 7B

Sediment Transport by Rainsplash,
W82-03709 1508 2J

Delivery of Suspended Sediment and Pollutants from Nonpoint Sources during Overland Flow,
W82-03902 1509 2J

Impact of Mining Activities on Water Quality in Western North Carolina,
W82-03926 1509 5B

The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

Geometry of Gravel Streams,
W82-04113 1509 2E

Viscosity-Controlled Sediment Transport in the Absence of Suspended Load,
W82-04210 1509 2J

Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 1510 2J

Incipient Motion of Sand Particles on Side Slopes,
W82-04368 1510 8D

Nutrient and Heavy Metal Transport Capabilities of Sediment in the Southwestern United States,
W82-04437 1510 2J

How Rain Intensity Affects Interrill Erosion,
W82-04537 1510 2J

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

Mathematical Simulation of Sediment Movement in Streams,
W82-04650 1510 2J

Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 1511 2L

Modeling: How and When to Use,
W82-04754 1511 2L

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 1511 2J

Bed Load Fluctuation: Applications,
W82-05000 1511 2J

Hydraulic Calculations of Stable Unlined Canals by the Vertical Velocity Distribution Method,
W82-05108 1511 8A

The Transport to and Deposition of Americium in Intertidal Sediments of the Ravenglass Estuary and its Relationship to Plutonium,
W82-05178 1511 5B

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 1511 2J

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

New Trends in Water Quality Management,
W82-05429 1511 5G

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 1511 2J

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

Mineralogical Input of Suspended Matter by Indian Rivers into the Adjacent Areas of the Indian Ocean,
W82-06102 1512 2J

Origin of Step-Pool Systems in Mountain Streams,
W82-06335 1512 2J

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

Sediment Transport and Unit Stream Power Function,
W82-06424 1512 2J

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 1512 2J

Suspended Sediment in a Wave Field,
W82-06527 1512 2J

Sediment Transport Study Along a Delta Shoreline,
W82-06553 1512 2J

Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 1512 2J

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 1512 4D

Laboratory Investigation of Deformations of Canals in Sand,
W82-06990 1512 8B

SEDIMENT-WATER INTERFACES

Dissolved Iodine Flux from Estuarine Sediments and Implications for the Enrichment of Iodine at the Sediment Water Interface,
W82-02656 1506 2K

Biogeochemical Cycling in an Organic-Rich Coastal Marine Basin - I. Methane Sediment-Water Exchange Processes,
W82-03308 1507 2K

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 1512 5B

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 1512 2K

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

SEDIMENT YIELD

Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 1503 2J

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 1504 2J

Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 1505 2J

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 1505 2J

Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 1508 2J

Influence of Vegetation, Rock Cover, and Trampling on Filtration Rates and Sediment Production,
W82-04153 1509 2G

SPNM, A Model for Predicting Sediment, Phosphorus, and Nitrogen Yields from Agricultural Basins,
W82-04157 1509 6A

Effects of a North Central Washington Wildfire on Runoff and Sediment Production,
W82-04250 1509 2E

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 1511 4D

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 1511 4D

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 1511 2J

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

Fire and Geomorphic Processes,
W82-06963 1512 2J

SEDIMENTARY BASINS

The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 1512 2J

SEDIMENTARY PETROLOGY

The Origin and Evolution of Saline Formation Water, Lower Cretaceous Carbonates, South-Central Texas, U.S.A.,
W82-03540 1508 2F

SEDIMENTATION

Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

Sediment Surveys in the Department of Water Affairs,
W82-00680 1502 7B

Holocene Sequences on an Embayed High-Energy Coast: An Evolutionary Model,
W82-00695 1502 2J

Coordinated Effort Stems Sediment and Erosion,
W82-00766 1502 4D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 1502 5D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 1502 4D

Sediment Yield from a Flatland Watershed,
W82-00941 1502 2J

Channel Instability in a Braided, Sand Bed River,
W82-01316 1503 2J

Geomorphology of the Colorado River in the Grand Canyon,
W82-01338 1503 2J

Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 1503 2H

Developments in Sedimentation and Flotation,
W82-01391 1503 5F

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

Sediment--Asset or Liability,
W82-02150 1505 6B

Shallow-Depth Sedimentation of Biological Materials,
W82-02336 1505 5D

A Close-Interval Sampler for Collection of Sediment Pore Waters for Nutrient Analyses,
W82-02346 1505 5A

Forms of Heavy Metals in the Settling Matter from a Man Made Lake (In Japanese),
W82-02719 1506 5B

Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 1507 2J

A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 1507 8A

Palaeoecological Studies of Lakes in the Highlands of Papua New Guinea. I. The Chronology of Sedimentation,
W82-03235 1507 2J

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 1507 5D

Algal Sedimentation in Relation to Phytoplankton Periodicity in Rostherne Mere,
W82-03414 1508 2H

Primary Sedimentation of Sewage,
W82-03429 1508 5D

Palaeoecological Studies of the Recent Development of Lake Vaxjosjon. III. Reassessment of Recent Chronology on the Basis of Modified Pb210 Dates,
W82-03480 1508 5B

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

Sedimentation Control in Indian Reservoirs,
W82-03693 1508 8A

A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

The North Carolina Sedimentation Control Program--An Assessment,
W82-04160 1509 2J

New Evidence of Scroll-Bar Formation on The Beatton River,
W82-04188 1509 2J

The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

Reservoir Sedimentation with Random Deposits,
W82-04443 1510 2J

Reservoir Sedimentation and Its Causes in Illinois,
W82-04450 1510 2J

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 1510 2J

Addition of Radiocarbon to the Mixed-Layers of Two Small Lakes: Primary Production, Gas Exchange, Sedimentation and Carbon Budget,
W82-04730 1510 2H

Modeling: How and When to Use,
W82-04754 1511 2L

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-

Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 1511 2L

Investigations on the Sedimentation in the Darss-Zingst Bodden Waters - A Contribution to the Establishment of an Energy and Matter Balance in the Ecosystem. Part 1: The Determination of the Rate of Sedimentation and Productivity Factors of Sedimented Material (Untersuchungen zur Sedimentation in den Darss-Zingster Boddengewassern - Ein Beitrag zur Aufstellung Einer Energie- und Stoffbilanz im Okosystem. Teil 1: Die Bestimmung der Sedimentationsrate und Die Erfassung Produktionsbiologisch Wichtiger Parameter des Sedimentierten Materials).
W82-04762 1511 2L

Surface Chemical Theory as an Aid to Predict the Distribution and the Fate of Trace Constituents and Pollutants in the Aquatic Environment,
W82-05353 1511 5B

Depositional Model for a Chenier Plain, Gulf of Carpentaria, Australia,
W82-05957 1512 2J

Sediment Character and Provenance in a Complex Fjord; Howe Sound, British Columbia,
W82-06189 1512 2J

Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 1512 5E

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

Erosion and Sediment,
W82-06554 1512 2J

Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 1512 2J

SEDIMENTATION BASINS

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 1502 5G

Approximate Sizing of Reservoirs for Detention Time,
W82-04315 1510 8A

Ponding Surface Drainage Water for Sediment and Phosphorus Removal,
W82-04358 1510 4D

SEDIMENTATION RATES

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 1503 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 1503 2J

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 1504 2J

Reservoir Sedimentation Modeling,
W82-03813 1509 2J

Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods.
W82-03883 1509 2J

Rates of Recent Sedimentation in Lake Pepin,
W82-03922 1509 2J

Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes,
W82-03960 1509 2J

The Entrainment and Deposition of Fine-Grained Sediments in Lake Erie,
W82-04033 1509 2J

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

Settleability of Urban Runoff Pollution,
W82-05320 1511 5G

Determination of Recent Deposition Rates in Lake Constance with Radioisotopic Methods,
W82-05625 1511 5B

Inshore-Offshore Sedimentation Differences Resulting from Resuspension in the Eastern Basin of Lake Erie,
W82-06494 1512 2J

Sedimentary Losses of Phosphorus in some Netural and Artificial Iowa Lakes,
W82-06901 1512 5C

SEDIMENTOLOGY

General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 1502 2L

Paleolimnology of Lake Kizaki,
W82-02863 1506 2J

Post-Glacial Sediments in Lake Linnevatn, Spitsbergen,
W82-02869 1506 2H

Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 1506 2J

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

Paleoflood Hydrology,
W82-03761 1509 2E

Sedimentary Record of Rainfall Variations on a Sub-Humic Lake,
W82-05516 1511 2J

Palaeoclimates at Lake Turkana, Kenya, from Oxygen Isotope Ratios of Gastropod Shells,
W82-06216 1512 2D

SEDIMENTS

Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 1501 6G

Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 1501 7B

Field Assessment of Sediment Traps,
W82-00105 1501 7B

Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 1501 2K

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 1501 5A

Anaerobic Methane Oxidation: Occurrence and Ecology,
W82-00218 1501 2H

Effect of Estuarine Sediment pH and Oxidation-Reduction Potential on Microbial Hydrocarbon Degradation,
W82-00243 1501 2L

Comparison of In Situ and In Vitro Rates of Methane Release in Freshwater Sediments,
W82-00245 1501 2H

Factors Affecting Phosphorus Release from Intact Lake Sediment Cores,
W82-00251 1501 2H

Thermostabilization of Enteroviruses by Estuarine Sediment,
W82-00263 1501 2L

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

Nitrogen Fixation and Methane Metabolism in a Stream Sediment-Water System Amended with Leaf Material,
W82-00486 1501 2K

Anthropogenic Trace Elements and Polycyclic Aromatic Hydrocarbon Levels in Sediment Cores From Two Lakes in the Adirondack Acid Lake Region,
W82-00501 1502 5B

Partitioning of No. 2 Fuel Oil in Controlled Estuarine Ecosystems. Sediments and Suspended Particulate Matter,
W82-00541 1502 2L

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 1502 5A

Debris Flow Deposits of Early Miocene Age, Deadman Stream, Marlborough, New Zealand,
W82-00694 1502 2J

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 1502 2L

Measurement of in situ Rates of Nitrification in Sediment,
W82-00798 1502 5A

Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

The Nature of Selected Prairie Lake and Stream Sediments,
W82-00815 1502 2J

Evidence of the Unsuitability of Gravity Coring for Collecting Sediment in Pollution and Sedimentation Rate Studies,
W82-00840 1502 7B

Sediment-Based Nutrition of Submersed Macrophytes,
W82-00843 1502 2H

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

Degradation of Hydrocarbons in Oxidized and Reduced Sediments,
W82-00907 1502 5B

The Effects of Heavy Metals on Microbial Biomass in Sediments of Palestine Lake,
W82-00925 1502 5C

A Review on Sediment Traps in Aquatic Environments,
W82-01020 1502 7B

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 1503 2H

Sediment Distribution of Methanogenic Bacteria in Lake Erie and Cleveland Harbor,
W82-01233 1503 2H

Aquatic Sediments,
W82-01279 1503 5B

Metal Ion Concentrations Associated with Late Summer Sediments of the Ohio River,
W82-01300 1503 5A

The Distribution of Mercury in the Sediments of the Plym Estuary,
W82-01390 1503 5B

Sediment Oxygen Demand and Its Effect on Dissolved Oxygen in a Cutoff Meander of the Kaskaskia River,
W82-01448 1503 4A

Application of Capillary Gas Chromatography Mass Spectrometry/Computer Techniques to Synoptic Survey of Organic Material in Bed Sediment,
W82-01573 1503 5A

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 1503 5A

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 1503 2L

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 1504 5C

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 1504 5A

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 1504 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

Sediment--Asset or Liability,
W82-02150 1505 6B

PCBs in the Housatonic River: Determination and Distribution,
W82-02255 1505 5A

Chemical Availability of Cadmium in Mississippi River Sediment,
W82-02267 1505 5B

Heavy Metals in River Sediments - Calculation of Metal Adsorption Maxima Using Langmuir and Freundlich Isotherms,
W82-02290 1505 5B

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

Distribution of Polycyclic Aromatic Hydrocarbons in Sediments from Estuaries of Southeastern Australia,
W82-02438 1505 5B

Chemistry of a 7.5-M Sediment Core from Lake Valencia, Venezuela,
W82-02745 1506 2H

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 1506 5B

Recent Inshore Sediments in Musandam, Oman,
W82-02857 1506 2J

Growth Characteristics of the Heterotrophic Bacterial Population of Water and Bottom Sediments in Tanks Under Different Trophic Conditions,
W82-02953 1506 5C

Preparation of Friable Aquiferous Specimens,
W82-02955 1506 2F

Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1506 1B

Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 1507 5B

Survey of Polychlorinated Biphenyls in Industrial Effluents in Canada.
W82-03107 1507 5A

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

Distribution of Anoplostoma Viviparum (Nematoda) in Southampton Water Sediments,
W82-03343 1507 2L

Alpha-Particle Radioactivity of Hot Particles from the Esk Estuary,
W82-03345 1507 5A

An Evaluation of the Sedigraph as a Standard Method of Sediment Particle Size Analysis,
W82-03437 1508 7B

Movement of Cobalt in Freshwater Micro-Ecosystems,
W82-03524 1508 2H

Methanogenesis in Marine Sediments of the Mississippi River Delta,
W82-03533 1508 5B

Degradation of Polychlorinated Biphenyls in Sediments of the Great Lakes,
W82-03536 1508 5B

Bottom Sediments as a Source of Nitrogen and Phosphorus in Water,
W82-03571 1508 5B

Removal of Hexavalent Chromium from Estuarine Waters by Model Substrates and Natural Sediments,
W82-03637 1508 5G

The Case for the Protection of Mangrove Swamps: Geochemical Considerations,
W82-03683 1508 5B

Mercury in Coastal and Estuarine Sediments of the Northeastern Irish Sea,
W82-03696 1508 5B

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 1508 2H

Cadmium in an Aquatic Ecosystem,
W82-03724 1508 5A

Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 1510 5G

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

Anastomosed River Deposits: Modern and Ancient Examples in Alberta, Canada,
W82-04531 1510 2J

Heavy Metal Content in Sediments of Lakes in Southern Bavaria as a Sign of Long-Term Environmental Impact (Schwermetallgehalte in Sedimenten Sudbayerischer Seen als Indikatoren Langfristiger Umweltbelastung),
W82-04550 1510 5B

Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 1510 2H

Seasonal Changes in the Depth Distributions of Interstitial Salinities in the Fraser River Estuary, British Columbia,
W82-04717 1510 2L

Distribution of Clay Minerals and Their Diagenesis in the Sediments of Lake Edku,
W82-04748 1510 2J

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

Algal-Available Phosphorus in Suspended Sediments from Lower Great Lakes Tributaries,
W82-04994 1511 5B

A Simple and Rapid Method for the Determination of Lead and Cadmium in Sediment by Graphite Furnace Atomic Absorption Spectrometry,
W82-05020 1511 5A

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 1511 2H

Movement and Identification of a Creosote-Derived PAH Complex Below a River Pollution Point Source,
W82-05042 1511 5B

Mercury Circulation in Aquatic Environment. Part 3. Mercury Transformations in Sediments,
W82-05094 1511 5B

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

Enzyme Activity and Kinetics in Substrate-Amended River Sediments,
W82-05336 1511 5C

Benthoc Investigations: Sediment Boxes or Natural Bottom,
W82-05378 1511 5C

The Role of Agricultural Sediments and Chemicals in Eutrophication,
W82-05447 1511 2H

Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 1511 5B

An Approximate Petroleum Hydrocarbon Budget for the Hudson Raritan Estuary--New York,
W82-05606 1511 5B

Preliminary Investigation of the Algal Flora in the Sediments of Lake Erie,
W82-05633 1511 5C

Poisons in the Hudson,
W82-05705 1511 5G

Effects of Selected Organic Compounds on Radionuclide Adsorption to Sediments in Freshwater Systems,
W82-05724 1511 5C

Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 1511 2J

Geochemical Factors Controlling the Accumulation and Dispersal of Heavy Metals in the Bay of Fundy Sediments,
W82-06188 1512 2K

Criteria for the Use of Regression Analysis for Remote Sensing of Sediment and Pollutants,
W82-06233 1512 7C

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 1512 2K

Effect of Sulfide on Nitrogen Fixation in a Stream Sediment-Water System,
W82-06540 1512 5C

National Interlaboratory Quality Control Study No 27, PCBs, in Naturally Contaminated Dry Sediments,
W82-06574 1512 5B

National Interlaboratory Quality Control Study No 25, PCBs in Wet Sediments,
W82-06575 1512 5A

Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

Effects of pH, Temperature, and eH on the Uptake of Cadmium by Bacteria and an Artificial Sediment,
W82-06580 1512 5B

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

Denitrification, Nitrate Reduction, and Oxygen Consumption in Coastal and Estuarine Sediments,
W82-06748 1512 5C

Use of Nitrifier Activity Measurements to Estimate the Efficiency of Viable Nitrifier Counts in Soils and Sediments,
W82-06755 1512 5A

Mutagenic Activity of Fish and Sediments in the Sheep River, Alberta.
W82-06770 1512 5C

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

Aquatic Sediments,
W82-06806 1512 2J

Sampling Design and Enumeration Statistics for Bacteria Extracted from Marine Sediments,
W82-06884 1512 5A

A 'Dipstick' Sampler for Rapid, Continuous Chemical Profiles in Sediments,
W82-06931 1512 5A

Change in Composition of Organic Matter in the Tama and The Ara River Sediments by Pollution, (In Japanese),
W82-06974 1512 5A

SEDIPAC CLARIFIER

Pollution Solutions--The Wire Drawing Industry.
W82-02041 1504 5D

SEEDS

Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 1507 2I

SEEPAGE

Saline Seep Development and Control in the North American Great Plains - Hydrogeological Aspects,
W82-01022 1502 5B

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 1504 2H

Effects of Water-Table Configuration on Seepage Through Lakebeds,
W82-02281 1505 2H

Chemistry of Interstitial Water and Bottom Sediments as Indicators of Seepage Patterns in Perch Lake, Chalk River, Ontario,
W82-02304 1505 2A

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

The Use of Ground-Water Flow Models for Estimating Lake Seepage Rates,
W82-02549 1505 2F

Rational Dimensions of an Earth Blanket and Its Seepage Calculation,
W82-02666 1506 8A

Seepage from Free Water Above Impermeable Tailings,
W82-02714 1506 5B

Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 1507 8A

Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

Ground Water Seepage in Lake Washington and the Upper St. Johns River Basin, Florida,
W82-03546 1508 2H

Seepage Flow Into Florida Lakes,
W82-04241 1509 2H

Potential for Groundwater Recharge Seepage from Flood-Retarding Reservoirs in South Central Nebraska,
W82-05663 1511 4B

Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 1512 2F

SEEPAGE CONTROL

Performance of Granular Soil Covers on Canals,
W82-00047 1501 8D

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

Soil-Bentonite Supply Trench Cutoffs,
W82-01599 1503 8D

Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 1506 8A

Computing the Settlement of Thin Antiseepage Walls Formed from Clayey Soils,
W82-02692 1506 8D

A Suitable Lining Technique for Existing Distributaries,
W82-03063 1507 8G

Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 1507 8D

Value Engineering Saves Dam Project,
W82-03287 1507 8A

Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 1511 8C

Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 1511 8F

Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 1511 8G

Quantitative Relationship of Grouting to the Reduction of Groundwater Flow Through Rock Foundations,
W82-05201 1511 8E

The Value of Inspection Galleries,
W82-06204 1512 8D

SEICHES
Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 1512 2H

Free Surface Oscillations in Lake Kinneret,
W82-06879 1512 2H

SEINE RIVER
Development of the River Seine Estuary: Case Study,
W82-02867 1506 2L

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 1511 5A

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 1511 5F

SEISMIC PROPERTIES
Determining of Seismic Earth Pressure on a Rigid Retaining Wall,
W82-03497 1508 8D

Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 1511 8D

SEISMIC WAVES
Liquefaction Analysis for Multidirectional Shaking,
W82-01169 1503 8D

Response of Buried Structures to Traveling Waves,
W82-03346 1507 8D

SEISMICITY
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

SEISMOLOGY
Reservoirs and the Triggering of Earthquakes,
W82-03766 1509 8A

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

Seismicity in the Mica Reservoir (McNaughton Lake) Area: 1973-1978,
W82-05196 1511 8E

SELENIUM
Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 1501 5A

Dynamics of Selenium in Mercury-Contaminated Experimental Freshwater Ecosystems,
W82-00595 1502 5B

Mercury and Selenium Concentrations in Fish, Sediments, and Water of Two Northwestern Quebec Lakes,
W82-00876 1502 5B

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 1502 5D

Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 1504 5B

An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 1505 6F

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 1507 5G

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 1511 5A

Antagonism of Selenium and Cadmium Pretreatments to Subsequent Embryotoxic Doses of Mercury and Cadmium in Fish Embryos,
W82-06371 1512 5C

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

SELF-PURIFICATION
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 1503 5B

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 1504 5B

Effect of a Deep-Water Outfall from a Power-Plant Reservoir on Water Quality in the Lower Pool,
W82-03768 1509 5C

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 1511 5A

Heterotrophic Assimilation of Phytoplankton as an Integral Part of the Self Purification of Natural Waters,
W82-05326 1511 1A

Studies on Oxygen Transfer Models,
W82-05349 1511 1A

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 1512 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 1512 5C

SEMIARID CLIMATES
Dew Fall in the Dry Climatic Zones of India,
W82-03278 1507 2B

SEMIARID LANDS
Annual Plant Production-Precipitation Relations in Arid and Semi-Arid Regions,
W82-00693 1502 2I

Irrigation for Brazil's Poligono Das Secas,
W82-01744 1503 3F

Food and Energy Production: Conjunctive Water Planning,
W82-01856 1504 3C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 1504 7B

Yield and Water Expense of Cowpea, Clusterbean and Sesbania as Summer Green Manures in Semi-Arid Regions of Punjab,
W82-04178 1509 3F

Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 1510 2A

Limnological Study of a Freshwater Reservoir, Jamwa Ramgarh (Jaipur).
W82-05102 1511 2H

Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 1511 3F

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 1512 2I

Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 1512 4A

SENECA LAKE
Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

SENEGAL RIVER
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 1503 6G

SENELIUM
Selenium Content and Its Chemical Form in River Waters of Japan,
W82-04181 1509 5A

SENSITIVITY ANALYSIS
A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

Sensitivity of SCS Models to Curve Number Variation,
W82-06631 1512 2A

SENSORS
Requirements and Application of Control and Automation Systems in Wastewater Treatment-A Critical View,
W82-03858 1509 5D

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

SEPARATION TECHNIQUES
Land Restoration Following Oil-Well Drilling,
W82-00057 1501 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 1501 5D

High Capacity Waste Water Treatment System,
W82-00066 1501 5D

Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 1501 5D

System for Oil and Water Separation,
W82-00611 1502 5D

Superseparation: Soret Effect Reversed,
W82-00791 1502 3A

A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid,
W82-01131 1503 5B

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 1503 5A

Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 1503 5D

Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 1503 3A

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

Oil-Water Separation by Induced Air Flotation,
W82-03719 1508 5D

Salt Removal from Brackish Water by Continuous Processes with Amphoteric, Thermally Regenerable Ion-Exchange Resins,
W82-03726 1508 3A

Selective Concentration and Isolation of Aromatic Amines from Water,
W82-03829 1509 5D

Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

A Study of The Vacuum-Freezing High Pressure Ice-Melting Process,
W82-04166 1509 3A

A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 1510 5D

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

An Exercise in Sludge Consolidation,
W82-04848 1511 5D

How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 1511 5D

Extended Dechlorination Studies with Granular Activated Carbon Filters,
W82-05257 1511 5F

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 1511 5D

Overestimation of Orthophosphorus Concentrations in Surface Waters of Southern Lake Michigan: Effects of Acid and Ammonium Molybdate,
W82-05382 1511 5A

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

Membrane Separation Processes,
W82-06445 1512 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 1512 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 1512 5D

SEPTIC SLUDGE

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

SEPTIC TANKS

Mutlichamber Septic Tanks,
W82-00969 1502 5D

Application of Aerial Photographs and Surficial Geologic Maps to the Determination of Suitability of Land for Septic Tank Systems,
W82-01569 1503 7B

Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 1505 5B

Guidelines for Control of Septic Tank Systems,
W82-02599 1505 5B

Distribution of Wastewater in Drain Field Pipes,
W82-02945 1506 8B

Septic Sewage Systems Contaminate Ground Water.
W82-03378 1507 5B

Nitrogen Removal in a Subsurface Disposal System,
W82-04001 1509 5D

Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

Cost-Effectiveness Analysis for On-Site Wastewater Treatment Alternatives,
W82-04185 1509 5D

Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 1510 5D

Pressure Distribution Design for Septic Tank Systems,
W82-05439 1511 5E

Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 1511 5D

Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 1511 5D

Put Pressure on Sewage,
W82-06732 1512 5D

SEPTIC WASTEWATER

Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 1507 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 1507 5D

Vacuum Filtration of Septage,
W82-04710 1510 5D

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5B

SEPTICITY

Chemistry of Septicity,
W82-00325 1501 5D

SESTON

Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 1504 7B

Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

A Comparison of Different Phosphorus Fractions as Predictors of Particulate Pigment Levels in Lake Memphremagog and Its Tributaries,
W82-06496 1512 5C

SETTLEABLE SOLIDS

The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 1501 5D

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 1508 5D

SETTLING BASINS

Reassessment of the Effects of Construction Dewatering on Ground-Water Levels in the Cowles Unit, Indiana Dunes National Lakeshore, Indiana. Supplement to Geological Survey Water-Resources Investigations 78-138,
W82-02478 1505 4A

The Use of a Perforated Baffle at the Inlet of Rectangular Settling Basins,
W82-04124 1509 8B

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 1512 5C

SETTLING TANKS
Primary Sedimentation of Sewage,
W82-03429 1508 5D

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

Plant Expansion Via High-Rate Pretreatment,
W82-05953 1512 5F

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 1512 5F

M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 1512 5F

SETTLING VELOCITY
Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 1503 2J

Settling Velocity of Spherical Particles in Calm Water,
W82-02958 1506 1B

Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 1510 5D

SEVERN ESTUARY
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 1503 2L

A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 1505 2L

A Suspended Sediment Front in the Severn Estuary,
W82-04639 1510 2L

SEVERN RIVER
Development of Upton Intake Works, River Severn Supply Scheme, With the Aid of a Model,
W82-01395 1503 8B

Severn Barrage Scheme Gets Favourable Response.
W82-02089 1504 6B

Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

SEVERN-TRENT WATER AUTHORITY
A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 1510 7A

The Seven-Trent Studies of Industrial Water Use,
W82-04686 1510 6D

SEVIER LAKE BASIN
Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 1510 6D

SEWAGE
Industrial Pretreatment Needs to Be Overhauled at the National Level.
W82-02198 1505 5D

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

Diatom Distribution and Status of Organic Pollution in Sewage Drains,
W82-06484 1512 5C

Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

SEWAGE BACTERIA
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 1501 5A

Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 1501 2L

R Factors in Coliform-Fecal Coliform Sewage Flora of the Prairies and Northwest Territories of Canada,
W82-00508 1502 5A

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

Enumerating Bacteria in River Water and Sewage Effluent,
W82-03446 1508 5A

A Note on the Effect of Chlorination of Sewage Effluents on Faecal Coliform to Faecal Streptococci Ratios in the Differentiation of Faecal Pollution Sources,
W82-05902 1512 5D

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

SEWAGE DISPOSAL
A Comparison of the Structure, Primary Productivity, and Transpiration of Cypress Ecosystems in Florida,
W82-03885 1509 2I

SEWAGE EFFLUENT
Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

SEWAGE SLUDGE
Disposing of Sewage Sludge at Sea,
W82-05127 1511 5E

SEWAGE TREATMENT
High Capacity Waste Water Treatment System,
W82-00066 1501 5D

The Tertiary Treatment of Sewages. Conclusion,
W82-03228 1507 5D

SEWAR SYSTEMS
Put Pressure on Sewage,
W82-06732 1512 5D

SEWER HYDRAULICS
Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 1507 7B

Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 1512 8B

SEWER INFILTRATION
Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

Rapid Sewer Analysis Saves Tourist Season,
W82-03494 1508 5G

Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 1508 5D

Capacity Expansion Planning Model for Waste Water Treatment and I/I Control,
W82-04239 1509 5D

Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 1511 5D

Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

SEWER OVERFLOW CONTROL
Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 1507 2A

SEWER SYSTEMS
Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 1501 6G

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 1501 5D

Pressure Sewer Systems,
W82-00528 1502 5D

Why EPA's I/I Control Program Fails,
W82-00790 1502 8A

Wastewater Collection,
W82-01251 1503 5D

Trends in Wastewater Collection Systems,
W82-02573 1505 8G

Infiltration/Inflow Source Identification by Comprehensive Flow Monitoring,
W82-02674 1506 5D

The Roman Way,
W82-02744 1506 5F

Britain's Sewers - Researching for the Future,
W82-02871 1506 5D

Engineering Responds to Ecology,
W82-02935 1506 5D

Continuous Discharge Measurement for the Transition Between Partly Filled and Pressurized Conduit Flow in Sewerage Systems,
W82-03152 1507 7B

Modern Management Techniques, Part II A: Case History of Production Improvement, W82-03310 1507 6A

Rapid Sewer Analysis Saves Tourist Season, W82-03494 1508 5G

How Do You Build When Sewers Are Inadequate, W82-03592 1508, 5D

Procedures for Estimating Dry Weather Pollutant Deposition in Sewer Systems, W82-03679 1508 5D

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality, W82-03859 1509 5D

Readying Boston's Water and Sewer System for the Next Century, W82-03870 1509 6B

Cost-Effectiveness Analysis for On-Site Wastewater Treatment Alternatives, W82-04185 1509 5D

Storm and Combined Sewers: Part of The Treatment Process, W82-04195 1509 5B

Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities, W82-04402 1510 5D

Storm Sewer Flow Computations, W82-04640 1510 7B

Adopting Sewers, W82-04655 1510 8A

On-Site Stormwater Detention: An Overview, W82-04758 1511 4A

Computer-Based Implementation of Combined Sewer Control, W82-04783 1511 5D

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y., W82-04956 1511 4B

Infiltration Inflow Analysis: Finding the Source, W82-05038 1511 5B

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers, W82-05267 1511 8G

Northern Elbe Culvert, W82-05427 1511 8B

Sewers and Cities: France and the United States Compared, W82-05684 1511 5D

Treatability of Type A Zeolite in Wastewater--Part I, W82-05687 1511 5D

Load Factors and Non-Destructive Testing of Clay Pipe, W82-05700 1511 8G

A Legacy from Construction Grants, W82-06251 1512 5D

Sewer Maintenance and Rehab Options, W82-06253 1512 5D

Sewerage: Priorities for Action, W82-06260 1512 8G

The Application of Microcomputers to the Design of Storm Sewer Systems for Small Areas, W82-06449 1512 8A

Major Factors in Sewer Ventilation, W82-06462 1512 8A

Standard Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers--ASTM F585-78. W82-06601 1512 8A

Out of Sight--Out of Mind. W82-06713 1512 8A

Sewer Renewal by Pipe Insertion. W82-06759 1512 8A

Watertight Manholes Cut Inflow. W82-06844 1512 5G

SEWERAGE

The Sewerage Policy of Thames Water, W82-02040 1504 6E

SEWERS

Engineering Research and the Water Industry, W82-00313 1501 8A

Redesign Controls Manhole Leakage, W82-01237 1503 8G

Recording Underground, W82-02036 1504 8A

The Cost of Quality, W82-02881 1506 5F

Group Treatment Evaluation for Metal Finishers, W82-02995 1506 5D

Vacuum Sewers--The Future for Sewage Collection, W82-03394 1507 5G

How Do You Build When Sewers Are Inadequate, W82-03592 1508 5D

Renovation of Water Mains and Sewers, W82-04237 1509 5F

SHAGAWA LAKE

Summer Internal Phosphorus Supplies in Shagawa Lake, Minnesota, W82-02332 1505 5B

SHALES

Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale, W82-05751 1511 3B

SHALLOW LAKES

Phosphorus Recycling in Five Shallow Lakes, W82-04040 1509 2H

Eutrophication Measures for Small Lake Water Quality Management, W82-04243 1509 2H

SHALLOW WATER

Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida, W82-00535 1502 2H

The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds, W82-02655 1506 2H

SHALLOW WELLS

The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia, W82-05548 1511 3B

SHARK RIVER SLOUGH

Freshwater Flow Rates and Distribution Within the Everglades Marsh, W82-02163 1505 2E

SHARPTOWN

The Hazards of Hazardous Waste Management, W82-01940 1504 6E

SHAWSHEEN RIVER BASIN

Hydrologic Data of the Shawsheen River Basin, Massachusetts, W82-04970 1511 7C

SHEAR STRESS

Secondary Flow, Shear Stress and Sediment Transport, W82-00117 1501 2J

Concentrated Flow Relationships, W82-01409 1503 2J

Boundary Shear in Smooth and Rough Channels, W82-02711 1506 8B

Some Field Measurements Concerned with the Behavior of Resistance Coefficients in a Tidal Channel, W82-02792 1506 2L

The Relationship Between Flow-Shear Stress and Stream Pattern, W82-04866 1511 2E

SHELLFISH

An Analysis of Factors Affecting Oxygen Depletion in the New York Bight, W82-00106 1501 5C

Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish, W82-00219 1501 5A

Does Salt Marsh Fertilization Enhance Shellfish Production. An Application of Flow Analysis, W82-00259 1501 2L

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada, W82-00908 1502 6G

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972, W82-01455 1503 6E

The Escherichia Coli Content of Mytilus Edulis from Analysis of Whole Tissue or Digestive Tract, W82-01508 1503 5A

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina, W82-01641 1503 5C

Review of Estuarine-Related Projects by the Gulf of Mexico Fishery Management Council, W82-02146 1505 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration, W82-02151 1505 4A

Polyculture of the Freshwater Prawn, Macrobrachium Rosenbergii, Chinese and Common Carps in Ponds Enriched with Swine Manure I. Initial Trials, W82-03900 1509 3C

Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn), W82-04262 1510 5C

SHENANGO RIVER

Federal Water Pollution Control Act's Notice Requirement Liberally Construed, W82-05986 1512 6E

SHEYENNE RIVER

Supplement to Predictive Modeling of Effects of the Planned Kindred Lake on Ground-Water

Levels and Discharge, Southeastern North Dakota,
W82-02828 1506 4A

SHINER
Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C

SHIPS
Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

Fresh-Water Transport by Sea,
W82-04861 1511 6D

SHOALS
Sediment Transport and Shoaling in Estuarine and Other Shallow-Water Areas,
W82-04753 1511 2L

SHOCK LOADS
Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 1507 5D

Bacteria Solve Problems Created by Prisoners,
W82-06505 1512 5D

SHORE PROTECTION
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 1501 2L

Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 1506 8B

SHORELINE COVER
On the Determination of the Degree of Weedage in Flowing Waters (Zur Ansprache Des 'Verkrautungszustandes' in Fliess-Gewassern),
W82-05092 1511 7B

SHORES
Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 1503 2J

Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 1508 2J

SHRIMP
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 1503 5C

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 1505 6G

Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina,
W82-02164 1505 2L

The Relative Abundance of Opossum Shrimp, Mysis Relicta, in Twin Lakes, Colorado Using a Benthic Trawl,
W82-06399 1512 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

SHUBENACADIE-STEWIACKE RIVER
The Shubenacadie-Stewiacke River Basin Study,
W82-05385 1511 6B

SIBERIA
Applicability and Design Criteria of a Blasting Method for Constructing Deep-Cut Sections of a Canal for Transferring Part of the Flow of Siberian Rivers,
W82-02783 1506 8H

Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 1511 8D

SIERRA NEVADA
Hydrogeology of the Sierra Nevada Foothill Lineament Near Oakhurst, California,
W82-00831 1502 2F

SILENIUM
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 1504 5A

SILICA
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 1505 5D

A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 1507 5A

SILICA SCALING
An Experimental Project to Determine the Parameters of Silica Scaling in Reverse Osmosis Systems,
W82-02451 1505 5D

SILICATES
Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 1501 5F

SILICON
The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 1505 5B

SILTING
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

Sediment Surveys in the Department of Water Affairs,
W82-00680 1502 7B

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 1504 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

Investigation of Fluvial Processes Under Conditions of Natural Variability of the Runoff,
W82-03906 1509 2J

Modification of Benthic Insect Communities in Polluted Streams: Combined Effects of Sedimentation and Nutrient Enrichment,
W82-06903 1512 5C

SIMAZINE
Relationships Between Pond Sediments and Simazine Loss from Waters of Laboratory Systems,
W82-02330 1505 5B

SIMULATED RAINFALL
Apparatus for the Simulation of Rain in the Laboratory,
W82-00807 1502 2B

Prediction of Leachate Accumulation in Sanitary Landfills,
W82-03934 1509 5B

SIMULATION
Time Distribution of Clock Hour Rainfall,
W82-01402 1503 2A

Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

Simulation of Nutrient Balances in a Shallow and Polluted River: A Strategy for Environmental Control,
W82-02354 1505 5B

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 1505 2F

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 1510 6A

Robust Flood Frequency Models,
W82-06319 1512 2E

SIMULATION ANALYSES
Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

SIMULATION ANALYSIS
Simulation Modeling of Primary Clarifiers,
W82-01027 1502 6A

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 1503 3F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 1503 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 1504 2F

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

Solution of the Continuity Equation for the Karnak Area,
W82-03196 1507 2G

A New Approach to Computerized Control System for the Activated Sludge Process in Transient States,
W82-04027 1509 5D

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

Reservoir Operation for Water Conservation,
W82-04165 1509 3B

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 1511 5D

Incorporation of Chemical Equilibrium, Physico-Chemical Reactions and the Simulation of Inorganic Qualities in a Reservoir Ecologic Model,
W82-05187 1511 2H

River-Basin Simulation in Systems with Large Response Time,
W82-05496 1511 2A

Applications of Simulation to Specific Water Projects,
W82-05522 1511 6A

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05530 1511 4A

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

Issues in Simulation Model Design--A Case Study,
W82-05627 1511 4A

Modified Standard Operation Rules for Reservoirs,
W82-05658 1511 4A

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

Computer Simulation of the Steady-State Flow System of the Tertiary Limestone (Floridan) Aquifer System in East-Central Florida,
W82-05844 1511 2F

A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 1512 2E

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Simulating and Improving Hydro Plant Control,
W82-06232 1512 8C

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 1512 2G

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

Computer Simulation of Surface Irrigation by Means of Numerical Methods for Finding Optimal Parameters,
W82-06781 1512 3F

SIMULATION MODEL
An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

SIMULATIONS
Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

SINAI
Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

SINKS
Two-Dimensional Linearized Moisture Flow with Water Extraction,
W82-00405 1501 2I

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 1504 2H

Nitrous Oxide Concentrations in Lakes: Variations with Depth and Time,
W82-02553 1505 2H

Induced Sinkholes: An Engineering Problem,
W82-02559 1505 4B

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

SIOUX CITY
Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

SIRIO-SHF EXPERIMENT
A Rain Attenuation Model for the Sirio-Shf Experiment,
W82-06530 1512 7B

SISTER CHROMATID EXCHANGE
Sister Chromatid Exchange as an Indicator of Short Term Chemical Stress in Aquatic Systems,
W82-04161 1509 5A

SITE SELECTION
Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 1503 5D

Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 1503 5E

Environmental Threshold Functions for User Oriented Resource Planning and Management,
W82-04289 1510 6B

The Search for Reservoir Sites in an Urban Environment,
W82-04867 1511 8A

Selection of Waste disposal sites,
W82-06550 1512 5E

Power Plant Siting,
W82-06555 1512 6G

SITES
Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 1503 7C

SKAGIT RIVER
Stranglehold on the Skagit,
W82-03490 1508 6G

SKAGIT RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 1501 6D

SKANE
Robustness of Water Resources Systems,
W82-05077 1511 6A

SLATE BELT
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 1501 2J

SLAVE RIVER
Investigating Whether a Large Hydro Development Can Be Environmentally Compatible: The Slave River Hydro Feasibility Study,
W82-03615 1508 6A

SLIME
Effect of Slime Stuck Inside Sampling Pipings on Water Quality and How to Remove It,
W82-03585 1508 5D

SLOPE DEGRADATION
Effect of Slope Length on Erosion from Low Slopes,
W82-00896 1502 2J

Transverse Bed Slope in Alluvial Channel Bends,
W82-04366 1510 2J

SLOPE STABILITY
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 1504 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 1504 8D

Slope Failures and Tailing Dam Damage in the 1978 Izu-Ohshima-Kinkai Earthquake,
W82-02891 1506 8D

Incipient Motion of Sand Particles on Side Slopes,
W82-04368 1510 8D

Ground-Water Flow Systems and Stability of a Slope,
W82-04677 1510 2J

SLOPE STABILIZATION
Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5E

Impulse Technology for Surface Compaction of Concrete Mixes in Construction of Slope Revetments,
W82-02695 1506 8B

Formation of a Stable Canal Channel,
W82-05584 1511 8B

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 1511 5D

SLOPES
Modeling Erosion and Sediment Yield from Flatland Watersheds,
W82-01406 1503 2J

Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 1503 8C

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 1505 2J

A Method for Obtaining Slope Information for Hydrologic Models,
W82-02364 1505 2A

Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 1510 2A

SLUDGE
Electroplating Wastewater Sludge Characterization,
W82-00095 1501 5E

Nitrogen Availability from Sewage Sludge,
W82-00158 1501 5E

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

Dispersal of Aspergillus Fumigatus from Sewage Sludge Compost Piles Subjected to Mechanical Agitation in Open Air,
W82-00273 1501 5E

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 1501 5E

Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 1502 5A

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 1502 5D

Control Systems for Return and Waste Sludge,
W82-00949 1502 5D

Evaluation of Winter Application of Liquid Sludge to Farmland,
W82-00952 1502 5B

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 1502 5D

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

Polychlorinated Biphenyls in Sewage Sludge and Sediments of the New York Bight,
W82-02904 1506 5A

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 1506 5D

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 1506 5D

Composting Results in Los Angeles,
W82-03400 1507 5E

Wastewater Treatment Plant Features New Technology,
W82-03591 1508 5D

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

Sludge Management in the Rocky Mountain State,
W82-05165 1511 5E

Virginians Optimize Sludge Handling,
W82-05171 1511 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 1511 5D

Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

Industrial Waste Pretreatment and EPA Cadmium Limitations,
W82-05443 1511 5E

Polychlorinated Biphenyl and Organochlorine Insecticide Concentrations in Forty Sewage Sludges in England,
W82-06081 1512 5A

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

Environmental Residuals and Capital Costs of Energy Recovery from Municipal Sludge and Feedlot Manure,
W82-06405 1512 5E

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibililty Study, (In Two Parts), I. Laboratory and Field Tests,
W82-06960 1512 5D

SLUDGE ANALYSIS
Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 1512 5A

SLUDGE ASH
Metal Leaching from Sewage Sludge Ash,
W82-00770 1502 5B

SLUDGE BULKING
Control of Sludge Bulking in the Brewing Industry,
W82-05260 1511 5D

Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 1511 5D

SLUDGE CAKE
Virginians Optimize Sludge Handling,
W82-05171 1511 5D

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

SLUDGE CONDITIONING
Sludge Settling Hampered by Industrial Discharge,
W82-00290 1501 5D

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 1501 5E

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 1502 5D

Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

The Influence of Chemical Conditioning and Dewatering on the Distribution of Polychlorinated Biphenyls and Organochlorine Insecticides in Sewage Sludges,
W82-01387 1503 5E

Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 1510 5E

Improved Thermal Sludge Conditioning by Treatment with Acids and Bases,
W82-04785 1511 5E

Production and Conditioning of Sludges from a High-Rate Biological Filter,
W82-05473 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05685 1511 5D

SLUDGE DIGESTION
Sludge Settling Hampered by Industrial Discharge,
W82-00290 1501 5D

Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

New Approaches to Anaerobic Sludge Digestion,
W82-01398 1503 5D

Evaluation of the Full-Scale Application of Anaerobic Sludge Digestion at the Blue Plains Wastewater Treatment Facility - Washington, D.C.,
W82-02965 1506 5D

Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 1507 5D

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 1507 5D

Advanced Supervisory Control System for Sludge Treatment,
W82-04841 1511 5D

Package Anaerobic Sludge Digestion.
W82-04850 1511 5D

Engineering and Economic Assessment of Autoheated Thermophilic Aerobic Digestion with Air Aeration,
W82-05071 1511 5D

Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 1511 5E

Uprating Sludge Digesters by Improving the Heat Transfer of Heatamix Units,
W82-05405 1511 5D

Organic Composition of Aerobic, Anaerobic, and Compost-Stabilized Sludges,
W82-05854 1511 5E

Sludge Management: A Research Update,
W82-06007 1512 5E

Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute).
W82-06024 1512 5D

Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 1512 5D

Design and Operation of Anaerobic Sludge Digestion Systems,
W82-06347 1512 5D

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

Fate of Pathogens in Thermophilic Aerobic Sludge Digestion,
W82-06772 1512 5D

SLUDGE DISPOSAL
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

Comparative Analysis of Sludge and Refuse Leachate: A Preliminary Report,
W82-00287 1501 5E

Final Environmental Impact Statement; Sludge Disposal and Land Reclamation in Fulton County, Illinois.
W82-00360 1501 5E

Engineering Assessment of Vermicomposting Municipal Wastewater Sludges,
W82-00385 1501 5E

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 1501 5E

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 1502 5D

Composting Is Working in Camden,
W82-00948 1502 5E

Trenching of Digested Sludge,
W82-00974 1502 5E

A Simulation Model for Sludge Decomposition in Soil,
W82-01001 1502 5E

Chemicals Disinfect Sludge,
W82-01003 1502 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 1502 5D

Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

Sludge Treatment, Utilization, and Disposal,
W82-01247 1503 5E

Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 1503 5C

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 1503 5E

Detroit's WWTP: One of the World's Biggest,
W82-01865 1504 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 1504 5E

Centrifugal Dewatering,
W82-01912 1504 5E

Sludge: Back into the Ocean,
W82-02577 1505 5E

Current Policies on Land Application,
W82-02629 1506 5E

Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 1506 5E

Field Investigation of Contaminant Loss from Chemically Stabilized Industrial Sludges.
W82-02990 1506 5B

Sludge Management Process Integration,
W82-03130 1507 5D

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 1507 5E

Composting Results in Los Angeles,
W82-03400 1507 5E

Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 1508 5E

Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York,
W82-03664 1508 5D

The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria,
W82-03770 1509 5E

Disposal and Handling of Water Treatment Plant Sludge,
W82-04126 1509 5E

Lime Softening Sludge Treatment and Disposal.
W82-04276 1510 5E

Sludge Disposal by Combustion Offers Potential Energy Source,
W82-04329 1510 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 1510 5E

Densification of Paper Mill Sludge Materials,
W82-04694 1510 5E

Land Disposal of Sludge,
W82-04757 1511 5E

Designing Wastewater Treatment Systems to Save Energy,
W82-04906 1511 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 1511 5E

Disposing of Sewage Sludge at Sea,
W82-05127 1511 5E

Sludge Management in the Rocky Mountain State,
W82-05165 1511 5E

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 1511 5E

Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 1511 5E

Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 1511 5D

How Much Sewage Nitrogen on Forest Soils. A Case History,
W82-05371 1511 5E

Potential Use of Earthworms as a Solution to Sludge Management,
W82-05478 1511 5E

Sludge Management: A Research Update,
W82-06007 1512 5E

A Cost-Effective System for the Aerobic Stabilization and Disposal of Waste Activated Sludge Solids,
W82-06046 1512 5E

Sludge Tankering Economics - A Fresh Approach,
W82-06076 1512 5E

Disposal of Sewage Sludge to Sea--Engineering Aspects,
W82-06286 1512 5E

Effects on the Ecosystem of Sewage Sludge Disposal by Dumping from Ships,
W82-06287 1512 5C

Bacterial Pollution of Marine Waters from the Disposal of Sewage and Sewage Sludge to Sea,
W82-06288 1512 5B

Effects of Turbulent Suspension on Trajectories of Settling Particles,
W82-06289 1512 5E

Effects on the Ecosystem of Sewage Sludge Disposal from a Pipeline,
W82-06290 1512 5C

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 1512 5E

Sludge Disposal to Sea in U.K.,
W82-06292 1512 5E

Disposal of Sewage Sludge to Sea--Research Needs,
W82-06293 1512 5E

Selection of a Sludge Handling Disposal System,
W82-06346 1512 5E

A Look at Co-Disposal,
W82-06354 1512 5E

Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 1512 5E

Potato and Corn By-Products Used as Cattle Feed,
W82-06488 1512 5E

Ocean Dumping Battle Marches On,
W82-06490 1512 5E

Landspreading of sludge in New York State,
W82-06557 1512 5E

Ocean Dumping of Sludge Vs. the Alternatives,
W82-06590 1512 5E

Control of Toxic Metals at Sewage Treatment Works,
W82-06592 1512 5E

Sludge Disposal to Sea in France,
W82-06593 1512 5E

Mathematical Model Investigation of Far-Field Transport of Ocean-Dumped Sewage Sludge Related to Remote Sensing,
W82-06594 1512 5E

Disposal of Sludge to Sea,
W82-06595 1512 5E

Sludge Disposal Strategy: A UK Viewpoint,
W82-06596 1512 5E

Ocean Disposal Legislation in the United States,
W82-06597 1512 5E

Sludge Disposal to Sea: North American Viewpoint,
W82-06598 1512 5E

Sludge Disposal to Sea in South Africa,
W82-06599 1512 5E

Sludge Disposal to Sea in the Federal Republic of Germany,
W82-06600 1512 5E

The Effect of Sewage Sludge Land Disposal on the Microbiological Quality of Groundwater,
W82-06767 1512 5C

A Case for Regional Sludge Management,
W82-06993 1512 5E

SLUDGE DRYING

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 1501 5E

Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 1502 5E

Centrifugal Dewatering,
W82-01912 1504 5E

Evaluation of High- and Low- Speed Centrifuges,
W82-02931 1506 5E

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 1510 5D

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 1510 5D

Application of Electro-Osmosis to Dewatering Sludges,
W82-04843 1511 5D

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

Mechanisms and Methods for Polymer Conditioning of Activated Sludge,
W82-05445 1511 5D

SLUDGE EXCESS

Calculation of Sludge Reservoir Volume for MLSS Control,
W82-03856 1509 5D

Considering Sludge Production in the Selection of Coagulants,
W82-05675 1511 5F

SLUDGE FILTERS

Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 1511 5D

SLUDGE LAGOONS

Parasite Ova in Anaerobically Digested Sludge,
W82-02018 1504 5B

Low-Cost Treatment of Wastewater,
W82-06506 1512 5D

SLUDGE RECONDITIONING

Sludge Management in the Rocky Mountain State,
W82-05165 1511 5E

SLUDGE SOLIDS

Problems and Solutions on Sludge Level Measurement,
W82-04055 1509 5D

SLUDGE THICKENING

High-Solubility Gas Flotation,
W82-01184 1503 5D

Advanced Sludge Treatment for Modern Waterworks,
W82-02889 1506 5D

Solids Inventory Control in the Activated Sludge Process,
W82-04048 1509 5D

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

An Exercise in Sludge Consolidation,
W82-04848 1511 5D

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 1511 5E

SLUDGE TREATMENT

Identification and Reclamation of Chromium Sludge Disposal Sites,
W82-01437 1503 5E

Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 1506 5E

Advanced Supervisory Control System for Sludge Treatment,
W82-04841 1511 5D

Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

SLUDGE UTILIZATION

Heavy Metals in Sewage Sludge--A Major Topic of Joint European Research,
W82-03435 1508 5E

Energy Crisis Redirects Sludge Disposal Perspectives: Part II,
W82-03482 1508 5E

Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 1510 5D

Calorific Value of Wastewater Plant Sludges,
W82-04997 1511 5E

SLUDGE VOLUME INDEX

Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 1510 5D

Control of Activated Sludge Filamentous Bulking--IV. Effect of Sludge Regeneration,
W82-05491 1511 5D

Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 1512 5D

SLUDGES

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 1502 5A

SLUG FLOW

Hydraulic Jump, Air Entrainment and Slug Flow in Bottom Outlets (Wechselsprung, Lufteintrag Und Schwallformiger Abfluss in Grundablassen),
W82-06244 1512 8B

SLUICE GATES

Construction of a Basic-Gate Unit for the Deep Catastrophic Sluice at the Nurek Hydroelectric Plant,
W82-02771 1506 8A

SLUICES

Boundary Calculations of Sluice and Spillway Flows,
W82-02677 1506 8B

SLUICWAYS

Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

SLURRIES

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 1501 6A

Soil-Bentonite Supply Trench Cutoffs,
W82-01599 1503 8D

Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 1507 8D

Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 1511 5D

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 1512 5D

SLUSH

Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 1501 2C

Convection Patterns in a Pond,
W82-04461 1510 2C

SMALL WATER SYSTEMS

Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 1511 5C

SMALL WATERSHEDS

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 1503 2D

Runoff Curve Numbers for Northern Plains Rangelands,
W82-02245 1505 2A

Rainfall-Runoff Modeling and Preliminary Regional Flood Characteristics of Small Rural Watersheds in the Arkansas River Basin in Colorado,
W82-02462 1505 2A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: Interim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

Runoff Prediction and Rainfall Utilization in the Semi-Arid Tropics,
W82-03502 1508 2A

Topographic Map of Golden Gate Estates, Collier County, Florida,
W82-03973 1509 7C

Rainfall-Runoff Hydrograph and Basin Characteristics Data for Small Streams in Oklahoma,
W82-03999 1509 2E

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

The Effects of Land-Clearing on a Small Watershed in Southern Guam,
W82-05303 1511 5C

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 1511 2A

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

SMALLMOUTH BASS
Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

SMITH MOUNTAIN LAKE
Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

SNAILS
Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

SNAKE LAKE
Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

SNAKE RIVER
Hydropower Losses from Navigation in the Snake-Columbia Rivers: 1978-79,
W82-01139 1503 6D

SNAKE RIVER BASIN
Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 1507 6B

SNAKE RIVER PLAIN
Plan of Study for the Regional Aquifer-System Analysis of the Snake River Plain, Idaho and Eastern Oregon,
W82-00730 1502 6A

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

SNOW
Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

Anomalous Snowfall Caused by Natural-Draft Cooling Towers,
W82-01512 1503 2B

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 1505 5B

Acid Snow in the Canadian High Arctic,
W82-04542 1510 2C

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 1511 2C

Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 1511 5B

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

SNOW ACCUMULATION
Spatial Simulation of Snow Processes,
W82-01887 1504 2C

SNOW COVER
Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 1501 2C

Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 1503 7B

Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 1503 2C

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 1504 2D

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 1504 2C

Climatic Relationships of Permafrost Zones in Areas of Low Winter Snow-Cover,
W82-02239 1505 2C

Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

Areal Distribution of Snow Water Equivalent Evaluated by Snow Cover Monitoring,
W82-03842 1509 2C

Operational Applications of Satellite Snow Cover Observations,
W82-04150 1509 7B

SNOW DEPTH
The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 1503 2A

SNOW MANAGEMENT
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

Management of Blowing Snow on Sagebrush Rangelands,
W82-02247 1505 3B

SNOW PACK
The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 1512 2C

SNOW SURVEYS
Compatibility of Canadian Snowfall and Snow Cover Data,
W82-01466 1503 2C

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 1505 2C

SNOW TRAPS
The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 1503 3F

Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

SNOW WATER EQUIVALENT
Microwave Measurements of Snowpack Properties,
W82-02646 1506 2C

Direct Snow-Water Equivalent Measurements by Air-Borne Gamma-Ray Spectrometry,
W82-05643 1511 2C

SNOWMELT
Economics of Snow Management for Agriculture in the Great Plains,
W82-00178 1501 3F

Spring Flood: Meltwater or Groundwater,
W82-00531 1502 7B

Study of the Factors and Regularities of River Runoff on the Basis of Data of Observations on Representative Basins,
W82-00652 1502 2A

The Effects of Surface Dust on Snowmelt Rates,
W82-00845 1502 2C

Effect of Grain Size and Snowpack Water Equivalence on Visible and Near-Infrared Satellite Observations of Snow,
W82-01311 1503 7B

The Significance of Snowmelt on Water Supplies in the Northeast,
W82-01488 1503 2A

Snowmelt Prediction in a Subarctic Drainage Area,
W82-01571 1503 2C

On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 1503 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 1504 2C

Spatial Simulation of Snow Processes,
W82-01887 1504 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 1504 2C

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 1504 2F

Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 1505 2A

Methods of Calculating Infiltration of Meltwaters into Frozen Soil,
W82-02386 1505 2A

Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 1506 2C

Use of Environmental Satellite Data for Input to Energy Balance Snowmelt Models,
W82-03048 1507 7B

A Simulation of the Enrichment of Atmospheric Pollutants in Snow Cover Runoff,
W82-03838 1509 5B

Areal Distribution of Snow Water Equivalent Evaluated by Snow Cover Monitoring,
W82-03842 1509 2C

Problems of Modelling a High Mountainous Drainage Basin with Predominant Snow Yields,
W82-04303 1510 2A

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

A New Method for Sampling Snow Melt and Rainfall in Forests,
W82-04435 1510 7B

Comparison of Models for Forecasting Snowmelt Runoff Volumes,
W82-04452 1510 2A

Severe Snowmelt Runoff in North-East England and Its Implications,
W82-04648 1510 2E

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

Evaluation of Snowmelt Forecasting Methods,
W82-05552 1511 4A

Erosion from Mountain Snowpack Melt,
W82-05664 1511 2J

Effect of Ashfall on Snowmelt Rate at Paradise, Mount Rainier, Washington,
W82-05871 1511 2C

The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 1512 2C

An Operational Net Shortwave Radiation Model for Glacial Basins,
W82-06064 1512 2C

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 1512 2D

Groundwater and Meltwater in the Snowmelt Induced Runoff,
W82-06198 1512 2E

SNOWPACK

Occurrence of Ice Layers at the Base of High Arctic Snowpacks,
W82-00844 1502 2C

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 1512 6G

SOCIAL ASPECTS

Report of Survey of Corps of Engineers Construction Workforce,
W82-00102 1501 6B

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

Management Provoked Conflict in Fisheries,
W82-00780 1502 6A

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 1504 6B

Water: A Low-Priced But High-Cost Resource,
W82-02061 1504 6C

The Reed Affair: A Canadian Logging and Pollution Controversy,
W82-02605 1506 6B

Modeling A Sociological-Hydrologic Flood Control Decision System,
W82-04221 1509 6A

The Relationship of Accessible Safe Water and Adequate Sanitation to Maternal and Child Health--Looking Forward to the Drinking Water and Sanitation Decade,
W82-04606 1510 6D

SOCIAL IMPACT

The Gezira Scheme--A Study in Failure,
W82-03393 1507 6B

Peace River Site C Project: Environmental Studies; Development of a Mitigation and Compensation Program; and Project Licensing,
W82-03618 1508 6G

Family Life Cycle Disruption in Rural Communities: The Case of the Lake Shelbyville Reservoir,
W82-04966 1511 4C

An Assessment of Geothermal Development in the Imperial Valley of California; Volume 1 - Environment, Health and Socio-economics,
W82-05214 1511 6G

SODIUM

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 1502 3C

Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02362 1505 5B

Sodium Regulation in the Tidepool Copepod Tigriopus Californicus,
W82-03262 1507 5A

SODIUM CHLORIDE

Dissolution of Salt on the East Flank of the Permian Basin in the Southwestern U.S.A.,
W82-03586 1508 2F

SODIUM POLYSULFIDE

Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 1503 5D

SOIL ABSORPTION CAPACITY

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5E

Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 1505 5B

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

SOIL ADSORPTION CAPACITY

The Depth of Rainfall-Runoff-Soil Interaction as Determined by P32,
W82-01318 1503 5B

Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 1508 5B

SOIL AERATION

Aeration Status of a Stratified Soil with a Falling Water Table,
W82-03717 1508 2G

SOIL ANALYSIS

Recording Unconfined Tension Tester,
W82-04238 1509 8D

SOIL CEMENT

Consider Soil-Cement for Erosion and Seepage Control,
W82-05039 1511 8F

SOIL CHEMISTRY

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

Enrichment Ratios for Water Quality Modeling,
W82-01410 1503 2J

Nitrate Production, Uptake, and Leaching,
W82-01411 1503 5B

Estimating Soluble (PO4-P) and Labile Phosphorus in Runoff from Croplands,
W82-01412 1503 5B

Effects of Sanitary Landfill Leachage on Some Soil Chemical Properties,
W82-01480 1503 5E

Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

Leaching Fractions and Salt Status of Two Irrigated Gypsum-Rich Soils in Southern Alberta,
W82-05762 1511 2G

SOIL COLUMNS

Leaching of Calcium and Magnesium from Soil Columns as Affected by Form of Nitrogen in Applied Sewage,
W82-00192 1501 5E

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 1502 5G

Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 1503 2G

SOIL COMPACTION

Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 1501 2G

Settlement of a Compacted Unsaturated Earth Embankment,
W82-00678 1502 8D

Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

Influence of Vegetation, Rock Cover, and Trampling on Filtration Rates and Sediment Production,
W82-04153 1509 2G

Long-Term Tillage Effects on Interrow Runoff and Infiltration,
W82-04189 1509 2G

SOIL CONSERVATION

Protecting Agriculture's Natural Resource Base,
W82-00176 1501 4D

Coordinated Effort Stems Sediment and Erosion,
W82-00766 1502 4D

Costs of Alternative Policies for Controlling Agricultural Soil Loss and Associated Stream Sedimentation,
W82-00869 1502 4D

Economic Impacts of Erosion and Sedimentation Control Plans: Case Studies of Pennsylvania Dairy Farms,
W82-01134 1503 4D

Impressions of Soil and Water Conservation in China,
W82-01730 1503 4D

Agricultural Conservation Program: An Evaluation,
W82-02019 1504 3F

Efficiently Reducing Nonpoint Phosphorus Loads to Lakes and Reservoirs,
W82-04154 1509 5B

Erosivity Values for Individual Design Storms,
W82-05694 1511 4D

SOIL CONTAMINATION

Deposition of Heavy Elements on Belgian Agricultural Soils,
W82-00306 1501 5B

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5B

Mapping Contaminated Soil Plumes by Kriging,
W82-01423 1503 5G

An Integrated Water-Quality Index for Irrigation Use,
W82-04723 1510 5C

Enhanced Biodegradation of Pesticides in Soil to Alleviate Contaminated Runoff,
W82-04967 1511 5G

SOIL DENSITY

An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

SOIL DISPOSAL FIELDS

Cation Transport in Packed Bed Reactor of Soil,
W82-00970 1502 5D

SOIL DYNAMICS

Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 1511 8D

SOIL ENGINEERING

Effect of Field Levelling Quality on Irrigation Efficiency and Crop Yield,
W82-03789 1509 3F

SOIL ENVIRONMENT

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 1512 2I

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 2. Tests and Applications,
W82-06322 1512 2I

SOIL EROSION

Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

Erodibility of Streambank Materials of Low Cohesion,
W82-00136 1501 2J

Effect of Crop Residue on Soil Loss from Continuous Row Cropping,
W82-00145 1501 2J

Rainfall Intensity-Kinetic Energy Relationships for Soil Loss Prediction,
W82-00466 1501 2J

Effect of Mulch Rate on Soil Loss by Raindrop Splash,
W82-00468 1501 2J

Effects of Small Amounts of Residue on Furrow Erosion,
W82-00470 1501 2J

The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 1501 2J

Effect of Slope Length on Erosion from Low Slopes,
W82-00896 1502 2J

Aerial Photography as an Aid to Cropland Erosion Analysis,
W82-00902 1502 2J

Sediment Sizes Eroded from Crop Row Sideslopes,
W82-00903 1502 2J

Erosivity 'R' for Individual Design Storms,
W82-01403 1503 2J

Enrichment Ratios for Water Quality Modeling,
W82-01410 1503 2J

Soil Conservation Problems and Practices: A Farmer View.
W82-01551 1503 4D

Soil Erosion Control in Idaho's Cow Creek Watershed: An Economic Analysis,
W82-01556 1503 4D

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 1503 2J

Impressions of Soil and Water Conservation in China,
W82-01730 1503 4D

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 1503 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 1504 2J

Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 1505 2J

Verification of the Slope Factor in the Universal Soil Loss Equation for Low Slopes,
W82-02246 1505 2J

Sediment Yield from a Mississippi Delta Cotton Field,
W82-02324 1505 2J

Soil Erosion and Total Denudation Due to Flash Floods in the Egyptian Eastern Desert,
W82-02875 1506 2J

Will the World Face Up to Its Ever-Worsening Environmental Problems.
W82-03459 1508 4C

Effects of a North Central Washington Wildfire on Runoff and Sediment Production,
W82-04250 1509 2E

Movement of Diffuse Source Pollutants in Small Agricultural Watersheds of the Great Lakes Basin,
W82-04856 1511 5B

The Influence of Water Salinity on Paludal Erosion Processes,
W82-04995 1511 2J

Erodibility of Selected Soils and Estimates of Sediment Yields in the San Juan Basin, New Mexico,
W82-05223 1511 2J

A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Erosion Control at a Delicate Highway Construction Site,
W82-06510 1512 4D

Efffect of Cattle Manure on Soil Erosion by Water,
W82-06834 1512 4D

Fire and Geomorphic Processes,
W82-06963 1512 2J

SOIL FILTERS

Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 1503 5D

SOIL GASES

Excess Air in Groundwater,
W82-02099 1504 2F

SOIL LOSS

Controlling Agricultural Soil Loss in Arkansas' North Lake Chicot Watershed: A Cost Analysis,
W82-06796 1512 4D

SOIL MANAGEMENT

Estimating the Physical Carrying Capacity of Recreation Areas: A Rationale for Application of the Universal Soil Loss Equation,
W82-00274 1501 2J

Deriving Sediment Yield Probabilities for Evaluating Conservation Practices,
W82-02225 1505 2J

Optimizing the Use of Water and Nitrogen Through Soil and Crop Management,
W82-05609 1511 3F

SOIL MECHANICS

Mechanics of Mudflow Mobilization in Low-Angled Clay Slopes,
W82-00989 1502 2J

Calculation of Earth Dams Being Undermined,
W82-03162 1507 8D

Large-Scale Experimental Investigations of Failure of an Embankment Slope under Dynamic Loads,
W82-04774 1511 8D

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Bunt-

sandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

SOIL MOISTURE

Variation in Microbial Activity in Histosols and Its Relationship to Soil Moisture,
W82-00244 1501 2G

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 1502 2D

The Effect of Snow Trapping and Cropping Sequence on Moisture Conservation and Utilization in West-Central Saskatchewan,
W82-01117 1503 3F

Remote Sensing of Soil Moisture Content Over Bare Field at 1.4 GHz Frequency,
W82-01345 1503 7B

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 1503 2G

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 1503 2G

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 1503 2F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 1503 2G

Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

Wheat Yield Estimation in Northwest Iran,
W82-03267 1507 2I

Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 1507 2G

Water Loss Equations and Coefficients to Estimate Runoff from Rainfall,
W82-03441 1508 2A

Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 1511 2G

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

SOIL MOISTURE DEFICIENCY

Response Functions of Crops Yield to Soil Moisture Stress,
W82-02725 1506 3F

Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 1512 3F

Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 1512 2I

SOIL MOISTURE METERS

Simplifying Neutron Moisture Meter Calibration,
W82-05173 1511 7B

SOIL MOISTURE MOVEMENT

Improved Water and Nutrient Management Through High-Frequency Irrigation - Vol I: Comparison of Methods for Determining Soil Hydraulic Characteristics,
W82-04169 1509 3F

SOIL MOISTURE RETENTIION

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

SOIL MOISTURE RETENTION

The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 1502 3C

Estimating Soil Water Retention from Soil Properties,
W82-06332 1512 2G

SOIL ORGANIC MATTER

Seasonal Variation of Infiltration Capacities of Soils in Western Oregon,
W82-06961 1512 2G

SOIL PHYSICAL PROPERTIES

Unsaturated Water Flow Through a Simulated Wheel Track,
W82-00473 1501 2G

Method of Determining Mechanical Characteristics of Coarse Soils,
W82-03160 1507 8D

Recording Unconfined Tension Tester,
W82-04238 1509 8D

Calculation of Large Unlined Canals,
W82-05131 1511 8B

SOIL PHYSICS

Scaling of Infiltration Behavior in Dissimilar Porous Materials,
W82-01105 1503 2G

SOIL POROSITY

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

Design of the Composition of Transition Layers of Asphaltic Concrete Membranes in Earth Dams,
W82-05113 1511 8A

Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 1511 5E

Moisture and Heat Transport in Hysteretic, Inhomogeneous Porous Media: A Matric Head-Based Formulation and a Numerical Model,
W82-06857 1512 2G

SOIL PROFILES

Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 1507 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 1510 2G

SOIL PROPERTIES

The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 1501 2J

A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 1502 2G

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 1502 2G

Behavior and Transport of Microbial Pathogens and Indicator Organisms in Soils Treated with Organic Wastes,
W82-00797 1502 5B

Soil Percolation Tests,
W82-01044 1502 2G

Variations of pH with Annual Cumulative Precipitation in Acid Forest Soils,
W82-01118 1503 2G

Water and Salt Movement in a Saline-Sodic Soil in Southern Alberta,
W82-01119 1503 2G

Gully Erosion,
W82-01407 1503 2J

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 1503 2G

Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 1503 2G

Transport of Salts in Catchments and Soils,
W82-01880 1504 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 1504 2F

The Steady State of Deformation,
W82-02235 1505 8D

Relationship of Electrical Dispersion to Soil Properties,
W82-02561 1505 8D

Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 1507 2G

Kinematic Subsurface Stormflow,
W82-03844 1509 2G

The Distribution of Heavy Metals and Petroleum Residues in the Soil from Urban Surface Runoff,
W82-04216 1509 5B

Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

Effect of Surface Sealing on Infiltration,
W82-04362 1510 2G

Estimating Soil Water Retention from Soil Properties,
W82-06332 1512 2G

SOIL RECLAMATION

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 1504 3C

SOIL SATURATION
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 1501 2G

SOIL SOLUTION
A Study of a Method for Displacing Soil Solution by Centrifuging with an Immiscible Liquid.
W82-01131 1503 5B

Field Application of the Four-Electrode Technique for Determining Soil Solution Conductivity,
W82-03260 1507 2G

SOIL STABILITY
Soil Hydraulic Stability in a Subsurface Drainage System,
W82-00115 1501 2G

Erosion Resistance of Cohesive Soils,
W82-02676 1506 2J

$12.6 M Repairs Bill for Ruahihi Canal.
W82-05880 1511 8D

SOIL STABILIZATION
Performance of Granular Soil Covers on Canals,
W82-00047 1501 8D

Effect of Cattle Manure on Soil Erosion by Water,
W82-06834 1512 4D

SOIL STRENGTH
Effects of Tillage and Gypsum Incorporation on Rain Runoff and Crust Strength in Field Soils Irrigated With Saline-Sodic Water,
W82-00327 1501 2A

Recording Unconfined Tension Tester,
W82-04238 1509 8D

SOIL STRUCTURE
Soil Morphology and Preferential Flow Along Macropores,
W82-03175 1507 2G

SOIL TEMPERATURE
Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 1511 8D

Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 1512 7B

SOIL TEXTURE
Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 1503 2G

SOIL-TURF FILTER
Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 1503 5D

SOIL TYPES
Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 1506 3C

Measurement of Sorptivity and Soil Water Diffusivity in the Field,
W82-03764 1509 2G

Modeling the Transport of Heat, Water, and Solute in Unsaturated Soil and Earth Materials,
W82-03958 1509 5B

Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 1511 2G

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

SOIL WATER
SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

An Infiltration Model: Development and Evaluation of Its Parameters,
W82-00137 1501 2G

A More Versatile Soil Water Sampler,
W82-00191 1501 7B

A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 1501 2G

Environmental Resources and Restraints to Agricultural Production in a Mediterranean-Type Environment,
W82-00329 1501 2I

Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 1501 6A

Effects of Topsoil and Subsoil Thickness on Soil Water Content and Crop Production on a Disturbed Soil,
W82-00465 1501 2G

Microbial Mobilization of Calcium and Magnesium in Waterlogged Soils,
W82-00560 1502 2G

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 1502 5A

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 1502 2I

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 1502 3F

Estimation of Soil-Moisture Characteristics from Mechanical Properties of Soils,
W82-00785 1502 2G

Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 1502 7B

Transport of Salts in Soils and Subsoils,
W82-00930 1502 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 1502 2G

Modeling Water Flux on Strip-Mined Land,
W82-00944 1502 2G

Soil Percolation Tests,
W82-01044 1502 2G

Infrared Spectroscopic Study of the Water-Soluble Fraction of Sewage Sludge-Soil Mixtures During Incubation,
W82-01130 1503 5E

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

Apportionment of Net Recharge in Landfill Covering Layer into Separate Components of Vertical Leakage and Horizontal Seepage,
W82-01298 1503 2G

The Water Balance of the Betwa Basin, India,
W82-01354 1503 2A

Determination of Solution Electrical Conductivity from Bulk Soil Electrical Conductivity Measurements by the Four-Electrode Method,
W82-01458 1503 2G

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 1503 2G

Hydraulic Properties of Fullerton Cherty Silt Loam,
W82-01561 1503 2G

Super Slurper Effects on Crust Strength, Water Retention, and Water Infiltration of Soils,
W82-01562 1503 2G

Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 1503 2G

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 1503 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 1503 2I

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 1503 2I

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 1503 7B

Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 1504 2G

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 1504 2G

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 1504 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 1504 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 1504 2I

Wheat Response to Drought,
W82-02242 1505 2I

A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils,
W82-02283 1505 2F

Prediction of the Advancing Wetting Front in Border Strip Irrigation,
W82-02309 1505 2G

A More Versatile Soil Water Sampler,
W82-02523 1505 7B

Coupled Heat and Water Flows Around Buried Cables,
W82-02680 1506 2G

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

Nodal Domain Integration Model of Unsaturated Two-Dimensional Soil-Water Flow: Development,
W82-03080 1507 6A

Soil Morphology and Preferential Flow Along Macropores,
W82-03175 1507 2G

Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 1507 2G

Ponded Infiltration into Simple Soil Systems: 1. The Saturation and Transition Zones in the Moisture Content Profiles,
W82-03323 1507 2G

Modeling Nitrogen Transport and Transformations in Soils: 1. Theoretical Considerations,
W82-03324 1507 2G

Performance of Different Crops with Residual Moisture in Vertisols,
W82-03357 1507 2I

A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

Simulation of Soil Moisture, Evapotranspiration and Deep Percolation in Agricultural Watersheds,
W82-03513 1508 2A

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 1508 2G

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

Airborne Soil Moisture Measurement Using Natural Terrestrial Gamma Radiation,
W82-03685 1508 2G

Nonlinear Sorption of Water in Soil,
W82-03686 1508 2G

Trace Elements in the Hydrologic Cycle of a Forest Ecosytem,
W82-03690 1508 5B

Development of a Soil Moisture Model for Use with Passive Microwave Remote Sensors,
W82-03715 1508 2G

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 1508 2G

Measurement of Sorptivity and Soil Water Diffusivity in the Field,
W82-03764 1509 2G

Modeling the Effects of Conservation Practices on Soil Moisture,
W82-03811 1509 2G

Modeling the Transport of Heat, Water, and Solute in Unsaturated Soil and Earth Materials,
W82-03958 1509 5B

Evapotranspiration from Forage Grass Replacing Native Vegetation in the Gila River Valley of Arizona,
W82-03994 1509 2D

Aircraft Radar Responses to Soil Moisture,
W82-04187 1509 7B

A Probe Method for Soil Water Sampling and Subsurface Measurements,
W82-04325 1510 7B

Two-Dimensional Soil Moisture Flow in a Sloping Rectangular Region: Experimental and Numerical Studies,
W82-04333 1510 2A

Effect of Surface Sealing on Infiltration,
W82-04362 1510 2G

Infiltration into Two-Layered Soil Profiles,
W82-04536 1510 2G

Note on Puddling Effects on Water Flow Through Soils,
W82-04671 1510 2G

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 1510 2G

Use of Spectral Data to Estimate the Relationship between Soil Moisture Tensions and Their Corresponding Reflectances,
W82-04963 1511 2G

An Approximate Method of Estimating Soil Water Diffusivity for Different Soil Bulk Densities,
W82-05073 1511 2G

Optimization Principle for Air and Water Movement,
W82-05172 1511 2G

Flexcrop: A Dryland Cropping Systems Model,
W82-05208 1511 3F

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

On Determining Volumetric Soil Moisture Variations in Peat by the Gravimetric Method,
W82-05616 1511 2G

Soil Water Availability,
W82-05623 1511 2G

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

Evaluating Near-Surface Soil Moisture Using Heat Capacity Mapping Mission Data,
W82-05956 1512 7B

A Comparison of Three Infiltration Models,
W82-05965 1512 2G

Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 1512 2G

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 1512 2G

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 1512 2G

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 1512 2G

Infiltration Capacity Curves for Sodium Affected Soils,
W82-06712 1512 3C

Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Chickasha, Okla., 1980 Report,
W82-06969 1512 7B

SOIL WATER MOVEMENT
Transient Soil Moisture Movement Through Layered Soils Using a Finite Element Approach,
W82-00133 1501 2G

Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

Modeling the Transport of Heat, Water, and Solute in Unsaturated Soil and Earth Materials,
W82-03958 1509 5B

Possible Use of Active Microwave Remote Sensing Data for Prediction of Regional Evaporation by Numerical Simulation of Soil Water Movement in the Unsaturated Zone,
W82-04199 1509 2G

Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 1510 3F

Water Movement in Uniform Soils During Constant-Flux Infiltration,
W82-04691 1510 2G

SOIL-WATER-PLANT RELATIONSHIP
Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 1507 2I

SOIL-WATER-PLANT RELATIONSHIPS
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 1502 2I

The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne,
W82-00654 1502 2I

Water Dynamics in the Soil-Plant-Atmosphere System,
W82-00759 1502 2I

Plant Water Relations and Adaptation to Stress,
W82-00812 1502 2I

Photosynthesis and Growth in Populations of Populus Deltoides from Constrating Habitats,
W82-00935 1502 2I

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

Soil Moisture Relations in the Southern California Chaparral,
W82-01035 1502 2D

Water Vapor Conductance and CO2 Uptake for Leaves of a C4 Desert Grass, Hilaria Rigida,
W82-01039 1502 2I

Response of Fababean Yield, Protein Production and Water Use to Irrigation,
W82-01089 1502 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 1503 2I

Irrigation Needs and Yield of Rice on a Sandy-Loam Soil as Affected by Continuous and Intermittent Submergence,
W82-01382 1503 3F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 1503 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 1503 2I

The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 1503 2I

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 1504 2D

Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 1504 2G

Practical Prediction of Actual Evapotranspiration,
W82-02308 1505 2D

Irrigation Requirements of Field-Pea for Grain,
W82-02395 1505 2I

Soil Moisture Use by Mixed Conifer Forest in a summer-Dry Climate,
W82-02558 1505 2I

Nutrient Contents of Precipitation and Canopy Throughfall Under Corn, Soybeans, and Oats,
W82-02574 1505 2I

Models of Water Transport in the Soil-Plant System: A Review,
W82-03066 1507 2I

Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 1507 2D

Completion of the List of Analytical Solutions for Nutrient Transport to Roots 1. Exact Linear Models,
W82-03327 1507 5E

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

Application of Soil Water Flow Theory in Field Simulation,
W82-03589 1508 2G

Daily Partitioning of Rainfall to Surface Runoff and Soil Water on Complex Landscapes,
W82-03681 1508 2A

Effects of Decreased Watering on Crop Yields,
W82-04411 1510 2I

Soil and Water Regimes for Optimum and for Maximum Yields,
W82-04415 1510 3F

Effects of Soil Moisture, Planting Date, and Weeds on Cereal Yields (Effets de l'Humidite du Sol, des Dates de Semis et des Mauvaises Herbes sur le Rendement des Cereales),
W82-04470 1510 2I

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 1511 2D

Soil Water Availability,
W82-05623 1511 2G

Deep Drainage and Water Use of Forests and Pastures Grown on Deep Sands in a Mediterranean Environment,
W82-05629 1511 4B

Effects of Irrigation Frequency on Germination and on Root and Shoot Yields of Acacia Species,
W82-06229 1512 2I

SOIL WATER POTENTIAL
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 1502 7B

SOIL WATER TABLE
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 1508 5B

Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 1512 2I

SOILS
Ponded Infiltration Into Simple Soil Systems: 3. The Behavior of Infiltration Rate With Time,
W82-03366 1507 2G

SOLAR ASSISTED DESALINATION
Critical Analysis of a Proposed Solar Assisted HTE Desalination System,
W82-06121 1512 3A

SOLAR ENERGY
Solar Heat Pond System,
W82-02187 1505 3F

Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

SOLAR RADIATION
Effect of Solar Radiation and Predacious Microorganisms on Survival of Fecal and Other Bacteria,
W82-00491 1501 2L

Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 1505 2I

Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 1510 2H

Photolysis of Polycyclic Aromatic Hydrocarbons in Water,
W82-04835 1511 5B

SOLAR RAIDATION
Attenuation of Incident Solar Radiation in Lake Water,
W82-04180 1509 2H

SOLID WASTE DISPOSAL
Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

Automatic Control of the Sewage Sludge Pyrolysis Process in Multiple Hearth Furnace,
W82-04587 1510 5E

Sludge Tankering Economics - A Fresh Approach,
W82-06076 1512 5E

SOLID WASTES
Solid Wastes and Water Quality,
W82-01269 1503 5B

Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse.
W82-03249 1507 5E

Reliability of Analytical Methods for Anaerobic Municipal Solid Waste Samples,
W82-04789 1511 5A

Solid Wastes and Water Quality,
W82-06929 1512 5B

SOLIDS
Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

SOLIDS CONTACT PROCESSES
Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

Operational Performance of an RBC Unit in Conjunction with a Septic Tank,
W82-04355 1510 5D

SOLUBILITY
Measurement of the Solubilities of Slightly Soluble Organic Liquids in Water by Elution Chromatography,
W82-00207 1501 5A

Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 1503 2H

High-Solubility Gas Flotation,
W82-01184 1503 5D

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

Estimation of Calcium Sulfate Solution Rate and Effective Aquifer Surface Area in a Ground-Water System near Carlsbad, New Mexico,
W82-02612 1506 2F

Solubilities of Gypsum and Halite in the Dead Sea and in Its Mixtures with Seawater,
W82-03708 1508 2K

Attenuation of Polybrominated Biphenyls and Hexachlorobenzene by Earth Materials,
W82-04620 1510 5B

Influence of an Americium Solid Phase on Americium Concentrations in Solutions,
W82-04720 1510 5B

Oil Slick Mechanics,
W82-05064 1511 5G

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1511 1B

Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 1511 2K

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 1511 2K

SOLUBILITY COEFFICIENT
The Concentration and Isotopic Fractionation of Gases Dissolved in Freshwater in Equilibrium with the Atmosphere. 1. Oxygen,
W82-03325 1507 1B

SOLUTE TRANSPORT
Groundwater Contaminant Transport with Adsorption and Ion Exchange Chemistry: Method of Characteristics for the Case Without Dispersion,
W82-00551 1502 5B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 1502 2E

Transport of Salts in Soils and Subsoils,
W82-00930 1502 5B

Residence Times of Water and Solutes Within and Below the Root Zone,
W82-00932 1502 2G

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

Mass Transport of Solutes in Dual-Porosity Media,
W82-01104 1503 5B

An Analytical Solution for Solute Transport Through Fractured Media with Matrix Diffusion,
W82-01179 1503 2F

A Stochastic Approach for Describing Convective-Dispersive Solute Transport in Saturated Porous Media,
W82-01461 1503 5B

Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 1504 5B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 1504 2F

Analyses of Solute Distributions in Deeply Weathered Soils,
W82-02764 1506 2K

Leaching of a Sorbed Solute: A Model for Peak Concentration Displacement,
W82-02922 1506 5B

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 1506 5B

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 1507 7B

Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

Transport of Ion-Exchanging Solutes in Groundwater: Chromatographic Theory and Field Simulation,
W82-03082 1507 5B

Molecular Approach to the Foundations of the Theory of Solute Transport in Porous Media. I. Conservative Solutes in Homogeneous Isotropic Saturated Media,
W82-03316 1507 2F

Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 1507 2G

Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 1508 5B

Mass Transport. 3. Role of Hydraulic Conductivity Data in Prediction,
W82-03578 1508 2G

Seepage Flow in Extremely Thin Aquifers,
W82-03594 1508 2F

Migration Through Soil of Organic Solutes in AIJ Oil-Seale Process Water,
W82-03640 1508 5B

Characterization of a Contaminant Plume in Ground Water, Meredosia, Illinois,
W82-03645 1508 5B

Flow-System Controls of the Chemical Evolution of Groundwater,
W82-03795 1509 2K

Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

Distributed Method of Solving the Convective-Dispersion Equation: 2. Error Analysis and Comparison with Other Methods,
W82-03873 1509 5B

The Distribution and Movement of Solutes Derived from Agricultural Land in The Principal Aquifers of The United Kingdom, with Particular Reference to Nitrate,
W82-03912 1509 5B

Dispersion Coefficients in Estuaries,
W82-04684 1510 5B

Application of an Approximate Analytic Method of Computing Solute Profiles with Dispersion in Soils,
W82-04876 1511 5B

A Contribution to Simplified Models of Field Solute Transport,
W82-04877 1511 5B

Numerical Simulation of the Transport and Speciation of Nonconservative Chemical Reactants in Rivers,
W82-05079 1511 5B

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 1511 5G

Hydrodynamic Dispersion During Absorption in a Fine Sand 1. The Constant Concentration Case,
W82-05347 1511 5B

Role of Sediment in Non-Point Source Salt Loading within the Upper Colorado River Basin,
W82-05551 1511 5B

Transport of Nitrate and Gaseous Denitrification in Soil Columns During Leaching,
W82-05709 1511 5B

Indications of Ground Water Influences on Nutrient Transport Through Schwatka Lake, Yukon Territory,
W82-05741 1511 5B

Selecting a Method for Estimating Substance Loadings,
W82-05746 1511 5B

Diffusive and Hydraulic Transfer of Solutes Through Homogeneous Membranes,
W82-06006 1512 5F

Analytical Solutions of the One-Dimensional Convective-Dispersive Solute Transport Equation,
W82-06408 1512 2G

A Comparison of Numerical Solutions of the One-Dimensional Unsaturated Flow and Mass Transport Equations,
W82-06547 1512 2G

An Upstream Finite Element Method for Solution of Transient Transport Equation in Fractured Porous Media,
W82-06858 1512 2F

SOLUTES
Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 1507 2G

Simulation of Solute Transport Using a Transfer Function Model,
W82-06318 1512 2G

A Field Test of the Transfer Function Model for Predicting Solute Transport,
W82-06339 1512 2G

SOLVENT EXTRACTION

Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 1507 5D

SOLVENTS

Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 1501 5A

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 1502 5F

Continuous Measurement of Organic Solvents in Air and Water (Kontinuierliche Messung Organischer Losemittel in Luft und Wasser),
W82-04579 1510 5A

SONAR

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 1512 8I

SONIFICATION

The Influence of Phytoplankton Composition on the Relative Effectiveness of Grinding and Sonification for Chlorophyll Extraction,
W82-06902 1512 5A

SONOITA CREEK

Estimating Evapotranspiration from the Sonoita Creek Watershed near Patagonia, Arizona,
W82-01306 1503 2D

SONORAN DESERT

Wheat Response to Drought,
W82-02242 1505 2I

SORBENT MATERIALS

Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 1511 5G

SORGHUM

Modeling Grain Sorghum Ratoon Cropping and Associated Runoff and Sediment Losses,
W82-00113 1501 2G

Land Forming Effects on Dryland Sorghum Production in the Southern Great Plains,
W82-00764 1502 3F

Effect of Soil Water Content and a Growing Season Straw Mulch on Grain Sorghum,
W82-00765 1502 3F

Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 1504 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 1504 3F

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

Drought Resistance of Sorghum Bicolor L. Moench. 3. Seed Germination Under Osmotic Stress,
W82-03479 1508 2I

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer,
W82-04471 1510 2I

SORPTION

Sorption of Trace Cadmium on Clay Minerals and River Sediments: Effects of pH AND CD(II) Concentrations in a Synthetic River Water Medium,
W82-00174 1501 2K

Sorption-Desorption of Lindane by Anaerobic and Aerobic Soils,
W82-00189 1501 5A

Uptake of Polychlorinated Biphenyls by Natural Phytoplankton Assemblages: Field and Laboratory Determination of C14-PCB Particle-Water Index of Sorption,
W82-01032 1502 5B

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 1504 5B

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 1504 2G

PCBs in the Housatonic River: Determination and Distribution,
W82-02235 1505 5A

Kd's--Can They Be Used to Describe Reversible Ion Sorption Reactions in Contaminant Migration,
W82-02942 1506 5B

Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 1507 5G

Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 1511 5D

Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 1512 5D

SOUND WAVES

Leak Detection - Two Methods That Work,
W82-02521 1505 3D

Kinetics of Compressibility in Two-Phase Fluid Flows,
W82-05910 1512 1A

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 1512 8I

SOUNDS

Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

SOUTH AFRICA

Nitrogen Fixation and the Nitrogen Budget of a Eutrophic Impoundment,
W82-00127 1501 2H

Field Test of an Irrigation Scheduling Computer Model,
W82-00184 1501 3F

Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

Sediments as a Source of Phosphate: A Study of 38 Impoundments,
W82-00653 1502 2H

Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

The Pongolo Floodplain: A Unique Ecosystem Threatened,
W82-00684 1502 6G

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 1502 6D

On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 1502 2B

The Cape Flats Sewage Treatment Works,
W82-00957 1502 5D

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

Volatile C1-C7 Organic Compounds in Surface Sediments from Walvis Bay,
W82-01367 1503 5B

Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 1503 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 1503 5A

Soil Water Studies on Small Lucerne Plots,
W82-01713 1503 2I

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 1504 5A

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 1504 2B

The Study of Phosphorus and Nitrogen Fluxes in Enriched Isolation Columns,
W82-02563 1505 5C

Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 1506 8A

Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

The Phosphorus Cycle in Germinston Lake. 1. Investigational Objectives and Aspects of the Limnology of the Lake,
W82-03234 1507 2H

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

Absolute Roughness of Concrete-Lined Channels,
W82-03397 1507 8B

Growth and Reproduction of Potamogeton Crispus in a South African Lake,
W82-03406 1508 2H

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribu-

tion of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1: Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versnipping),
W82-03438 1508 3F

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

On a Technique to Investigate the Covariation Between Streamflow and Rainfall in Afforested Catchments,
W82-03864 1509 4C

Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 1510 5C

Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 1510 2A

A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 1510 5B

Health Aspects of Waters at Public Health Resorts,
W82-04348 1510 5A

Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

The Riviersonderend-Berg River-Jonkershoek Project Most Outstanding Civil Engineering Achievement of 1980.
W82-04886 1511 8A

Water to the South-Western Cape Keeping Up with the Demand.
W82-04887 1511 3C

Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 1512 2E

Design Technique Development for Dams in South Africa,
W82-06011 1512 8A

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

Sludge Disposal to Sea in South Africa,
W82-06595 1512 5E

Syethesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 1512 4A

SOUTH CAROLINA
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 1501 5B

The Abundance of Estuarine Larval and Juvenile Fish in a South Carolina Intertidal Creek,
W82-00276 1501 2L

Estimation of Material Fluxes in an Estuarine Cross Section: A Critical Analysis of Spatial Measurement Density and Errors,
W82-00816 1502 7A

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 1503 7C

Variation in Life-History Patterns Between Intertidal and Subtidal Populations of the Meiobenthic Copepod Microarthridion Littorale,
W82-02560 1505 2L

Sheet Flow in a Salt-Marsh Basin, North Inlet, South Carolina,
W82-04716 1510 2L

Quantitative Geomorphology of Drainage Basins in Sumter National Forest, South Carolina,
W82-05839 1511 2A

Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 1512 6B

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 1512 6G

Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina,
W82-06309 1512 4B

Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 1512 5C

SOUTH DAKOTA
Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 1503 7C

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 1505 2F

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 1506 2F

The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

SOUTH FORK AMERICAN RIVER PROJECT
Final Environmental Impact Statement; South Fork American River Development, Upper Mountain Project No. 2761 - California.
W82-00367 1501 6G

SOUTH PLATTE RIVER
Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 1510 6A

SOUTH POLE
Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

SOUTH WEST AFRICA
An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

SOUTHAMPTON
Slowhill Copse Sewage Treatment Works.
W82-01727 1503 5D

SOUTHEAST ASIA
Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 1511 5F

SOUTHEASTERN UNITED STATES
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 1506 5G

SOUTHERN CALIFORNIA
New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 1506 5F

SOUTHERN HEMISPHERE
The Relationship Between Total Precipitable Water and Surface Dew Point,
W82-03257 1507 2B

SOUTHERN PIEDMONT
The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 1501 2J

SOUTHWEST U.S
Consumptive Use of Water by Major Crops in the Southwestern United States,
W82-06964 1512 3F

SOUTHWESTERN CONNECTICUT
An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 6B

SOYBEAN
A Salt and Water Balance Model for Silt Loam Soil Cropped to Rice and Soybean,
W82-06172 1512 2G

SOYBEANS
SOYROOT - A Dynamic Model of Soybean Root Growth and Water Uptake,
W82-00114 1501 2I

Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 1504 2I

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 1508 3C

SPAIN
The Organic Pollution of River Cubillas (Granada, South Spain),
W82-00674 1502 5B

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

SPARTINA
Dieback of Salt-Water Cordgrass (Spartina Alterniflora Loisel.) in the Lower Cape Fear Estu-

ary of North Carolina: An Experimental Approach to Re-Establishment,
W82-00889 1502 2L

SPATIAL DISTRIBUTION

Illustration of the Roles of Snow in the Evolution of the Winter Cover of a Lake,
W82-00267 1501 2C

Spatial Distributions of Pollen in Surface Sediments of the Potomac Estuary,
W82-00757 1502 2L

Nearshore Spatial Distribution of Fishes in Gill Net Samples, Cayuga Lake, New York,
W82-01195 1503 7A

Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 1503 5A

Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 1510 2L

Variations in Moisture Deficits over the Maize-Growing Region of South Africa I. Spatial Aspects,
W82-05901 1512 2B

On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 1512 2B

SPAWNING

Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

Cumulative Effects of Logging Road Sediment on Salmonid Populations in the Clearwater River, Jefferson County, Washington,
W82-02507 1505 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 1505 7B

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

SPAWNING GRAVEL

A New Method for Reporting and Interpreting Textural Composition of Spawning Gravel,
W82-06395 1512 8I

SPECIATION

The Physicochemical Speciation of Cd, Pb, Cu, Fe, and Mn in the Final Effluent of a Sewage Treatment Works and Its Impact on Speciation in the Receiving River,
W82-01498 1503 5B

Physiochemical Speciation of Lead in Drinking Water,
W82-03198 1507 5F

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

SPECIES COMPOSITION

Experimental Manipulation of Algal Bloom Composition by Nitrogen Addition,
W82-00998 1502 5C

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 1504 5C

Factors Influencing the Composition, Structure and Density of a Population of Benthic Invertebrates,
W82-02909 1506 2H

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 1510 2L

The Microfauna of Algal Mats and Artificial Substrates in Southern Victoria Land Lakes of Antarctica,
W82-05096 1511 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 1511 2H

Benthos Investigations: Sediment Boxes or Natural Bottom,
W82-05378 1511 5C

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

Structure and Dynamics of Zooplankton Communities in the Littoral Zone of Some North Carolina Lakes,
W82-06911 1512 5C

SPECIES DIVERSITY

The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

Accurate and Efficient Estimation of Benthic Populations: A Comparison Between Removal Estimation and Conventional Sampling Techniques,
W82-00633 1502 5A

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

Analysis of Temporal Changes in Fish Assemblages in Serpentine Creek, Queensland,
W82-03407 1508 2L

Phytoplankton Responses to Ground Water Addition in Central Florida Lakes,
W82-05747 1511 5C

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 1512 2L

SPECIFIC CAPACITY

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 1505 7C

SPECIFIC CONDUCTIVITY

The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 1503 7A

A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 1511 7B

SPECIFIC HUMIDITY

Evaluation of the Effect of Linearization of the Magnus Equation on the Accuracy of Calculating Evaporation from the Surface of Moist Soil and Transpiration,
W82-05031 1511 2D

Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 1512 2B

SPECIFICATIONS

Material Specification and the Availability and Life of Desalination Equipment in Both Saudia Arabia and the Arabian Gulf,
W82-06126 1512 3A

SPECTRAL ANALYSIS

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 1505 5G

A Remote Sensing Technique for Estimating Watershed Runoff,
W82-06151 1512 7C

SPECTRAL REFLECTANCE

Spectral Reflectances of Freshwater Ice and Snow from 340 Through 1100 NM,
W82-05556 1511 2C

SPECTROMETERS

Moisture Analysis from Radiosonde and Microwave Spectrometer Data,
W82-04900 1511 2B

SPECTROPHOTOMETRY

Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 1501 5A

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 1502 5A

Evaluation of Ultraviolet Spectrophotometric Determination of Nitrate-Nitrogen in Glacial Snow, Firn and Ice,
W82-01572 1503 5A

A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 1507 5A

Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 1511 5A

The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

SPECTROSCOPY
A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 1501 5A

High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 1511 5A

Inorganics,
W82-06999 1512 5A

SPENCER GULF
The Significance of the Submarine Geology of Upper Spencer Gulf, South Australia, to Environmental Decision-Making,
W82-00314 1501 2L

SPILLS
Use of Selected Sorbents and an Aqueous Film Foam on Floating Hazardous Materials,
W82-05063 1511 5G

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 1511 5G

SPILLWAY CAPACITY
The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

SPILLWAY CRESTS
Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

SPILLWAY GATES
Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

SPILLWAYS
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 1501 8A

Hydraulic Model Study of Daule-Perips Spillway and Outlet Works,
W82-01446 1503 8A

Passing Floodwaters Over Embankment Dams,
W82-02204 1505 8A

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 1505 8A

Boundary Calculations of Sluice and Spillway Flows,
W82-02677 1506 8B

Measurements of Self-Aerated Flow on a Spillway,
W82-02715 1506 8B

Instrumentation for Aerated Flow on Spillways,
W82-02880 1506 7B

Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 1507 8A

The El Cajon Hydro Project in Honduras, Part Two,
W82-03332 1507 8A

Analysis of the Hydraulic Jump Within a Diverging Rectangular Channel,
W82-04645 1510 8B

James Bay Spillways and Control Structures,
W82-04692 1510 8A

Calculation of Local Scour of Rock Foundations by High-Velocity Flows,
W82-04775 1511 8B

Steady Shallow Flow Over a Spillway,
W82-05086 1511 8B

Determination of the Optimal Height of the Bucket Lip of a Ski-Jump Spillway,
W82-05107 1511 8B

Concrete for Surfaces of High-Head Spillways,
W82-05110 1511 8F

Shaft Spillways Combined with a Water Intake,
W82-05111 1511 8A

An Investigation of a Jet-Assisted Hydraulic Jump,
W82-05279 1511 8B

Aeration at High Velocity Flows,
W82-05602 1511 8A

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A

Design Flood and Hydrological Risk for Spillways or Reservoirs and Flood Protection Basins (Bemessungshochwasser Und Hydrologisches Versagensrisiko Fur Talsperren Und Hochwasserruckhaltebecken),
W82-06238 1512 8B

SPIRAL-WOUND ELEMENTS
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

SPLASH EROSION
Splash Erosion Modeling: Physical Analysis,
W82-05970 1512 2J

SPLIT TREATMENT
Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 1503 5F

SPOIL BANKS
Vertical Migration and Mortality of Benthos in Dredged Material. Part I: Mollusca,
W82-03317 1507 6G

The Evaluation of the Elutriate Test as a Means of Predicting the Behavior of Selected Chlorinated Hydrocarbons in Dredged Sediment During Open-Water Disposal,
W82-03824 1509 5A

Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 1512 5E

SPOIL DISPOSAL
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 1504 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 1504 5C

Construction of Containment Facility for Dredged Materials Begins,
W82-03839 1509 5G

Distribution of Suspended Sediment in the Patuxent River, Maryland During Dredging Operations for Construction of a Pipeline,
W82-05198 1511 2J

SPORT FISHING
The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

The Warmwater Sport Fishery of Eastern Lake Ontario,
W82-02296 1505 7A

Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

SPRAY IRRIGATION
Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

Managing Vegetation in Wastewater Application,
W82-03401 1508 5D

SPRING BROOK BASIN
Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 1505 2A

SPRING WATER
Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

Geochemical and Isotopic Characteristics of Spring and Groundwater in the State of Sao Paulo, Brazil,
W82-03542 1508 2F

SPRINGFIELD
Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

SPRINGS
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 1503 2F

Geochemical Evidence on the Nature of the Basement Rocks of the Sierra Nevada, California,
W82-02460 1505 2K

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

A Faunal Analysis of the Springs off the Ouachita Mountains, Arkansas,
W82-06161 1512 2K

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

SPRINGVALE - BEAR CREEK
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 1501 5D

SPRINKLE IRRIGATION
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

SPRINKLER IRRIGATION
Water Application Uniformity of Hose Towed Traveler Irrigators,
W82-00296 1501 3F

Saline Irrigation Water.
W82-00512 1502 3F

Traveling Sprinkler System and Method,
W82-00561 1502 3F

Irrigation Management of Colorado River Water with Increase in Salinity,
W82-01226 1503 3C

Solid Set Irrigation System Design Using Linear Programming,
W82-02273 1505 6A

Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

Design Procedure of Sprinkling Laterals: The Mathematical Background of a Computerized Aid,
W82-03174 1507 3F

Response of Sorghum to Moisture Stress Using Line Source Sprinkler Irrigation I. Plant-Water Relations,
W82-03265 1507 2I

Managing Sprinkle Irrigation with Saline Water for Zero Leaching,
W82-03521 1508 3C

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 1508 3C

Sprinkler Leveler and Wind Compensating Device,
W82-06164 1512 3F

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

SPRINKLERS

Characterizing Sprinkler Distribution Patterns with a Clustering Algorithm,
W82-01575 1503 3F

SPRUCE KNOB LAKE

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 1502 5G

SPRUCE TREES

Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 1506 2I

SRI LANKA

Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

Planning Sri Lanka's Victoria Scheme,
W82-05979 1512 8A

Confluence of Two Jets Created by Two Parallel Segment Gates of a Bottom Outlet (Schussstrahl-Zusammenfuhrung Bei Einem Grundablass Mit Nebeneinyanderliegenden Segmentschutzen).
W82-06243 1512 8B

SRICSI METHODOLOGY

Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

ST. CLAIR RIVER

Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

ST. CROIX RIVER

Dissolved Oxygen Modelling of the St. Croix River, Maine - New Brunswick,
W82-06572 1512 5B

ST JOHNS RIVER

Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 1510 5B

ST. JOSEPH RIVER BASIN

Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 1507 6D

ST. LAWRENCE ESTUARY

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 1505 2L

A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

Vertical Mixing and Photosynthetic Capacity of Estuarine Phytoplankton (Melange Vertical et Capacite Photosynthetique du Phytoplancton Estuarien (Estuaire du Saint-Laurent)),
W82-04331 1510 2L

Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 1511 2L

Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 1511 5B

Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 1512 2L

ST. LAWRENCE RIVER

Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 1505 2L

Simulation of Ice-Cover Growth and Thermal Decay on the Upper St. Lawrence River.
W82-03822 1509 2C

Surface Heat Loss and Frazil Ice Production in The St. Lawrence River,
W82-03925 1509 2C

Depth, Silt and Current: Factors in the Transverse Microdistribution of the Benthos in the Freshwater Estuary of the St. Lawrence (Profondeur, Vase et Courant, Facteurs de Microrepartition Transversale du Benthos dans l'Estuaire d'eau Douce du Saint-Laurent (Quebec),
W82-04472 1510 2L

Winter Heat Budget and Frazil Ice Production in the Upper St. Lawrence River,
W82-05736 1511 2C

Discharge of Metals from the St. Lawrence River,
W82-06190 1512 5B

ST LUCIE ESTUARY

The Effects of Freshwater Discharges on Sportfishing Catch Rates in the St. Lucie Estuary, Martin County, Florida,
W82-02124 1505 6G

ST. THOMAS

Water Conservation Under Conditions of Extreme Scarcity: The U.S. Virgin Islands.
W82-04170 1509 3A

STABILITY ANALYSIS

Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems,
W82-00963 1502 1A

Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 1503 5D

Probabilistic Stability Analysis of Earth Slopes,
W82-01952 1504 8D

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 1504 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 1504 8D

Reliability and Stability of Trickling Filter Processes,
W82-04784 1511 5D

Dynamic Elastic and Absorbing Properties of Soils,
W82-05132 1511 8D

STABILIZATION LAGOONS

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 1502 5D

Lagoons and Oxidation Ponds,
W82-01244 1503 5D

STABILIZATION PONDS

Virus Removal in Waste Stabilization Ponds in India,
W82-00121 1501 5D

The Harvest of Microalgae from the Effluent of a Sewege Fed High Rate Stabilization Pond by Tilapia Nilotica. Part I: Description of the System and the Study of the High Rate Pond,
W82-00455 1501 5D

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 1503 5D

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 1504 5D

Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 1506 5D

The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 1510 5D

A Survey of Aerated Lagoon Performance,
W82-06391 1512 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 1512 5D

Low-Cost Treatment of Wastewater,
W82-06506 1512 5D

STABLE CHANNEL

Origin of Step-Pool Systems in Mountain Streams,
W82-06335 1512 2J

STABLE CHANNELS

Stable-Channel Design in Gravel-Bed Rivers,
W82-04865 1511 2E

STAGE-DISCHARGE RELATIONS

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 1503 4A

STAGNANT WATER

Data on the Stagnant Ponds of the Savannah of Lamto (Ivory Coast) (Donnees sur les Milieux Limniques Stagnants des Savanes de Lamto (Cote d'Ivoire)),
W82-01357 1503 2H

STANDARD PLATE COUNT

Analytical Note: Evaluation of the m-SPC Method as a Substitute for the Standard Plate Count in Water Microbiology,
W82-06280 1512 5F

STANDARDS

European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 1502 6D

Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 1503 5A

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

The National Interim Primary Drinking Water Standards. Part II. Impact on Community Water Systems. The Indiana Experience,
W82-05815 1511 5G

Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 1512 5G

STANDING CROPS

An In Situ Method for Measuring the Primary Productivity and Standing Crop of the Epilithic Periphyton Community in Lentic Systems,
W82-00756 1502 7B

Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 1503 5C

Moisture Conservation of Interseeded Grasslands Through the Use of Annual and Perennial Crop Barriers,
W82-06148 1512 3F

Determination of the Number of Respiring Thiobacillus Ferrooxidans Cells in Water Samples by Using Combined Fluorescent Antibody-2-(p-Iodophenyl)-3-(p-Nitrophenyl)-5-Phenyltetrazolium Chloride Staining,
W82-06542 1512 5A

STANISLAUS RIVER

Don't Damn the Stanislaus,
W82-03275 1507 6E

STAPHYLOCOCCUS AUREUS

Staphylococcus Aureus in Rural Drinking Water,
W82-00223 1501 5B

STATE ESTIMATION

On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 1512 5D

STATE JURISDICTION

Summary of the New England Conference on Legal and Institutional Incentives to Small-Scale Hydroelectric Development, January 30-31, 1979, Boston, Massachusetts.
W82-00447 1501 6E

Executive Summary, Legal Obstacles and Incentives to Small-Scale Hydroelectric Development in the Six Middle Atlantic States.
W82-00448 1501 6E

Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 1502 6D

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 1502 4B

Federal Common Law of Nuisance Expands,
W82-01337 1503 6E

Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 1505 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 1505 6E

Superfund: What a Mess,
W82-02184 1505 6E

Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 1505 6E

Appalachian Regional Commission and the Coastal Plains Regional Commission,
W82-02515 1505 6E

A Preliminary Survey of State Ground-Water Laws,
W82-02616 1506 6E

Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

The Impact of Federal Water Policy on State Planning: A Cautionary Example,
W82-04120 1509 6E

Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 1510 6E

Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 1511 6E

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

Ground Water and the States,
W82-06297 1512 6E

STATISTICAL ANALYSIS

Water-Rock Partition Coefficients and the Composition of Natural Waters - A Reassessment,
W82-00284 1501 2K

Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 1502 5C

Statistical Analysis of the Brooks-Corey and the Green-Ampt Parameters Across Soil Textures,
W82-01107 1503 2G

Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 1503 2E

Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 1503 5D

Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 1503 2B

Multivariate Analysis and Geochemical Interpretation of Spatial Variability of the Water Quality of Southern Quebec Rivers. (Analyse Multivariee et Interpretation Geochimique de la Variabilite Spatiale de la Qualite de l'Eau Des Rivieres Du Quebec Meridional),
W82-02662 1506 2K

On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 1506 5A

Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8B

Reliability Programing in Reservoir Management 1. Single Multipurpose Reservoir,
W82-03148 1507 6A

Reanalysis of 'Generalized Criteria for Seeding Winter Orographic Clouds',
W82-03173 1507 3B

Decisions Under Violation of Regression Normality,
W82-04264 1510 7C

Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 1510 6D

Water Yield Estimation in Western United States,
W82-05689 1511 4D

Identification of Independent Rainstorms,
W82-05708 1511 2B

Selecting a Method for Estimating Substance Loadings,
W82-05746 1511 5B

Normality of Hydrological Data,
W82-05752 1511 7B

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

On the Relationship Between Kriging and State Estimation,
W82-06323 1512 7C

Stochastic Trigger Model for Flood Peaks 1. Development of the Model,
W82-06325 1512 2E

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 1512 2E

Objective Analyses and Mapping Techniques for Rainfall Fields: An Objective Comparison,
W82-06327 1512 2B

STATISTICAL MEASURES

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: In-

terim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

STATISTICAL MECHANICS
The Statistical Mechanical Theory of Ground-water Flow,
W82-01982 1504 2F

STATISTICAL METHODS
Statistical Determination of Design Low Flows,
W82-01858 1504 2E

Statistical Considerations and Sampling Techniques for Ground-Water Quality Monitoring,
W82-02618 1506 7A

An Analysis of Areal Infiltration Considering Spatial Variability,
W82-02927 1506 2G

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

Integrated Management of Water Deficits and Floods in a Reservoir System,
W82-05325 1511 4A

Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 1512 6C

STATISTICAL MODELS
A Monthly Time Series Model of Municipal Water Demand,
W82-02263 1505 6D

The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

Analysis of Flow Through Heterogeneous Random Aquifers by the Method of Embedding Matrix. 1. Steady Flow,
W82-03320 1507 2F

STATISTICAL STUDIES
A Statistical-Dynamical Climate Model with a Simple Hydrology Cycle,
W82-06838 1512 2B

STATISTICS
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 1504 2J

Municipal Pollution Abatement Report card: Significant Progress,
W82-05861 1511 5D

Albedo Survey on Andrei Glacier, Iskut River Basin, B. C., Midsummer, 1980,
W82-06578 1512 2C

STATSTICAL ANALYSIS
Chemometric Modeling of Wastewater Treatment Processes,
W82-05858 1511 5D

STATUTES
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

STEADY FLOW
Flow in Aquifers with Clay Laminae 2. Exact Solutions,
W82-03232 1507 2F

Flow in Aquifers with Clay Laminae 1. The Comprehensive Potential,
W82-03242 1507 2F

A Steady State Model for Buoyant Surface Plume Hydrodynamics in Coastal Waters,
W82-06837 1512 2L

STEAM
A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

STEAM STRIPPING
Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

STEAMBOAT SPRINGS
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

STEEL INDUSTRY
Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

Steel Industry Wastes,
W82-01264 1503 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 1507 5D

Industrial Wastewater Audit,
W82-03337 1507 5D

Republic Steel Recycling 80% of Steel-Mill Wastewater.
W82-03454 1508 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 1508 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 1508 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 1508 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 1508 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

Snow Contamination by Heavy Metals and Sulphur in Cracow Agglomeration (Southern Poland),
W82-05783 1511 5B

Beneficial Disposal of Pickle Liquor,
W82-06486 1512 5D

Steel Industry Wastes,
W82-06799 1512 5D

STEEL PIPES
42-Mile Water Pipeline for Coal Boom Town.
W82-02359 1505 6D

STEMFLOW
Vertical Variation in Stemflow Generation,
W82-02959 1506 2I

STEPPES
Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe,
W82-05876 1511 2D

STEUBEN LAKES
Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 1501 5D

STILLING BASIN
Model Study of a Box-Inlet Chute Spillway and SAF Stilling Basin,
W82-00046 1501 8A

STILLING BASINS
Hydraulic Design for the Two-Stage Stilling Basin,
W82-00849 1502 8B

STILLWATER CREEK WATERSHED
Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

STOCHASTIC HYDROLOGY
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 1503 2B

Soil Hydraulic Properties as Stochastic Processes: I. An Analysis of Field Spatial Variability,
W82-03315 1507 2G

Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 1510 2E

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

STOCHASTIC MODELS
Models of Annual Cycles in Lentic Water Bodies,
W82-06483 1512 5G

STOCHASTIC PROCESS
Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 1501 6A

A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 1503 2B

Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 1506 5D

Stochastic Hydrologic Model for Drought Management,
W82-02897 1506 2E

Stochastic Analyses and Transfer Functions for Flows of the Upper Delaware River,
W82-05186 1511 2E

A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

Discretization in Stochastic Reservoir Theory with Markovian Inflows,
W82-05524 1511 6A

Normality of Hydrological Data,
W82-05752 1511 7B

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 1512 2E

Stochastic Generation of Monthly Streamflows,
W82-06427 1512 4A

A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 1512 2G

STOCHASTIC PROCESSES

Identification of Streamflow Stochastic Models,
W82-00555 1502 2A

Spatial Variability of Steady-State Infiltration Rates as a Stochastic Process,
W82-01560 1503 2G

A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 1507 5B

Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

STOCHASTIC PROGRESS

A Model for Solving Multiperiod Multireservoir Water Resources Problems with Stochastic Inflows,
W82-03830 1509 6A

STOMATAL TRANSPIRATION

Seasonal Changes in Leaf Area, Stomatal and Canopy Conductances and Transpiration From Bracken Below a Forest Canopy,
W82-00655 1502 2D

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 1504 2D

Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 1507 2D

STORAGE

Reliability of Water Resources,
W82-02749 1506 6A

Design and Economics of a Solar Heater Aquifer Storage System,
W82-03143 1507 4B

The Effect of Storage by Freezing on Dissolved Inorganic Phosphate, Nitrate and Reactive Silicate for Samples from Coastal and Estuarine Waters,
W82-04660 1510 5A

Kinematic Wave Theory of Catchment Response with Storage,
W82-05714 1511 4A

STORAGE CAPACITY

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 1501 4A

Water Budget Computations for a Shallow--Lake Okeechobee, Florida,
W82-04258 1510 2H

Pumped Outlets for Drainage Systems,
W82-04364 1510 8A

STORAGE COEFFICIENT

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 1502 2F

STORAGE COEFFICIENTS

Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

STORAGE EQUATION

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

STORAGE REQUIREMENTS

Analysis of Capacity Requirements for Storage Reservoirs: A Case Study,
W82-00341 1501 6A

STORAGE RESERVOIRS

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 1508 6A

Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 1508 3F

Some Geotechnical Aspects of the Construction of the 'Safety Reservoir Broechem',
W82-06012 1512 8A

STORAGE TANKS

Coal Tar Coatings of Storage Tanks. A Source of Contamination of the Potable Water Supply,
W82-00616 1502 5B

Recent Water Towers in Norfolk,
W82-03246 1507 8A

The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 1511 5D

STORM DRAINS

Bicycle-Safe Grate Inlets Study; Volume 5 - Hydraulic Design of General Slotted Drain Inlets,
W82-06095 1512 8B

STORM-OVERFLOW SEWERS

Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

Worth of Short-Term Rainfall Forecasting for Combined Sewer Overflow Control,
W82-03075 1507 2A

A Wet-Weather Model for Evaluating the Combined Effects of Storm-Sewage Overflows and Sewage-Works' Effluents Upon River Quality,
W82-03427 1508 5B

Detroit-Style CSO Studies,
W82-06247 1512 5G

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 1512 5C

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflussteuerung von Regenwasserbehandlungsanlagen),
W82-06633 1512 8C

An Overview of the U.S. Environmental Protection Agency's Storm and Combined Sewer Program Collection System Research,
W82-06775 1512 5G

STORM RUNOFF

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

Recycling Urban Stormwater for Profit,
W82-00524 1502 3C

Storm Flow Response to Road Building and Partial Cutting in Small Streams of Northern California,
W82-01295 1503 4C

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 1503 2E

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 1503 2F

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 1504 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 1504 2E

Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 1505 2E

Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

Computer Modeling of Flood Alleviation Benefits,
W82-02957 1506 6B

A Planning Method for Evaluating Downstream Effects of Detention Basins,
W82-03089 1507 4A

The Economics of Urban Stormwater Management,
W82-03508 1508 4A

Panoche Creek Flood Protection Works.
W82-04068 1509 4A

The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

Relative Runoff by Curve Number Nomograph,
W82-04307 1510 2A

The General Hydrologic System Model,
W82-04314 1510 2A

Storm Runoff Analyses on Three Semi-Arid Catchments,
W82-04339 1510 2A

Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 1510 4C

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 1510 5B

Sulfate Washout Ratios in Winter Storms,
W82-04898 1511 5B

Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 1511 5C

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 1511 4C

Erosivity Values for Individual Design Storms,
W82-05694 1511 4D

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 1512 4C

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 1512 5B

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 1512 7C

STORM SEEPAGE
Treating Infiltration at Its Source Reduces Capital Costs.
W82-03564 1508 5D

Kinematic Subsurface Stormflow,
W82-03844 1509 2G

STORM SEWERS
Galvanized Pipe Vies for Equal Alternative Status in Storm Sewer Projects.
W82-02601 1506 8G

Inflow Prediction and Cooperative Operation of Pumps, Valves and Gates in Storm Water Drainage System,
W82-03068 1507 8C

Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 1510 8A

Storm Sewer Flow Computations,
W82-04640 1510 7B

An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 1511 5D

STORM SURGES
Eastern Scheldt Design Has Changed.
W82-03493 1508 8A

STORM WASTEWATER
The Performance of an Off-Sewer Storm-Sewage Tank,
W82-05469 1511 5D

Stormwater Management in the Ottawa-Carleton Region,
W82-05563 1511 5G

Detroit-Style CSO Studies,
W82-06247 1512 5G

Flow Control at Stormwater Overflows and Stormwater Tanks (Abflussteuerung von Regenwasserbehandlungsanlagen),
W82-06633 1512 8C

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

Decontamination of Overland Runoff from Populated Areas,
W82-06980 1512 5D

STORM WATER
Modeling the Relationship Between Development and Storm Watrr and Nutrient Runoff,
W82-00260 1501 2A

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 1504 4A

Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 1505 7A

Comparison of Detention Basin Planning and Design Models,
W82-02592 1505 6A

Automated Stream Diversion for Reservoir Protection,
W82-02600 1505 5G

Better Ways to Finance Stormwater Management,
W82-03298 1507 6C

Discussion: Water Quality Trap Efficiency of Storm Water Management Basins, by Richard H. McCuen,
W82-03784 1509 4A

Storm Water Management: The Concept and Its Application,
W82-04240 1509 4A

Water Quality Trap Efficiency of Storm Water Management Basins,
W82-04248 1509 5G

Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

Development of Improved Stormwater Quality Models,
W82-04559 1510 5B

On-Site Stormwater Detention: An Overview,
W82-04758 1511 4A

An Overview of Porous Pavement Research,
W82-05744 1511 5D

Water Management in the Metropolitan Toronto Region,
W82-05775 1511 6B

Stormwater Management - One Developer's Experience,
W82-05777 1511 6B

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 1511 5B

Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 1512 5B

Regional Detention Basins for Stormwater Control,
W82-06225 1512 8A

The Impact of Combined Sewer Overflows on the Dissolved Oxygen Concentration of a River,
W82-06316 1512 5C

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 1512 5G

Stormwater Management in a Sensitive Area.
W82-06841 1512 5G

Storm Water Runoff Quality From Three Land-Use Areas in South Florida,
W82-06877 1512 5B

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

STORMS
Some Limiting Forms of the Poisson Distribution of Annual Station Precipitation,
W82-00132 1501 2B

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 1510 2B

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 1511 2J

Flood of April 12-13, 1979 in Tuscaloosa and Northport, Alabama,
W82-05824 1511 2E

On Accumulation of Water Substance in a Column of Rising Air,
W82-06581 1512 2B

STORMWATER
The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

STRATIFICATION
Formation of a Bottom Flow in a Natural Water Body with Various Types of Density Stratification,
W82-02205 1505 2J

Wind-Induced Mixing in Stratified Fluid,
W82-02371 1505 2H

Three Coastal Lakes on Kamikoshiki Island, Kagoshima Prefecture,
W82-02798 1506 2H

Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 1508 2H

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 1510 2H

Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 1512 2H

STRATIFIED FLOW
Vertical Velocity Profiles in Stratified Flows,
W82-01171 1503 8B

STRATIGRAPHIC DISTRIBUTION
Some Paleolimnological Aspects of the Most Recent Sediments of Lac Laflamme (Laurentides Provincial Park, Quebec) in Relation to Atmospheric Transportation of Pollutants,
W82-06577 1512 5A

STRATIGRAPHY
Reconnaissance of the Hot Springs Mountains and Adjacent Areas, Churchill County, Nevada,
W82-02830 1506 1A

The Applicability of Large-Diameter, Shallow Wells to a Coastal Plain Hydrogeologic Environment, Georgia,
W82-05548 1511 3B

STREAM BANKS
Erodibility of Streambank Materials of Low Cohesion,
W82-00136 1501 2J

Incipient Motion of Sand Particles on Side Slopes,
W82-04368 1510 8D

STREAM BIOTA
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 1504 4A

Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

STREAM CLASSIFICATION
Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 1510 7C

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 1510 6G

STREAM DEGRADATION
The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 1502 5B

Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 1507 5C

Sessile Algae in European Mountain Streams. I. The Ecological Characteristics of Communities,
W82-03309 1507 5C

Mathematical Model for Erodible Channels,
W82-06336 1512 2J

STREAM DISCHARGE
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 1503 4C

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 1504 7B

Ice Cover Effects on Stream Flows and Mixing,
W82-02698 1506 2C

Movement of Bed Material in a Small Reach of a Perennial Stream,
W82-03516 1508 2J

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

Dynamic Estuary Model Performance,
W82-05319 1511 2L

Effects of Reduced Stream Discharge on Fish and Aquatic Macroinvertebrate Populations,
W82-05923 1512 6G

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 1512 4A

STREAM EROSION
Debris Flows in Small Mountain Stream Channels of Colorado and Their Hydrologic Implications,
W82-01597 1503 2E

Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 1507 2J

Methods for Assessment of Stream-Related Hazards to Highways and Bridges,
W82-04626 1510 8A

Mathematical Model for Erodible Channels,
W82-06336 1512 2J

STREAM FISHERIES
Mt. St. Helens and the Fish,
W82-02508 1505 2J

Characterization of Spawning Gravel and Stream System Evaluation,
W82-02509 1505 2J

Predictive Models of Benthic Macroinvertebrate Density for Use in Instream Flow Studies and Regulated Flow Management,
W82-05194 1511 8I

STREAM FLOW
Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

STREAM IMPROVEMENT
Microhabitat Selection by Fish: A Rationale for Developing Design Criteria for Mitigation Devices in Channelized Streams,
W82-03955 1509 8I

Stream Rehabilitation Following Treatment for Phosphorus Removal: Pre-Treatment Assessment,
W82-05919 1512 5G

STREAM ORDER
The Influence of Stream Order and Selected Stream Bed Parameters on Fish Diversity in Raystown Branch, Susquehanna River Drainage, Pennsylvania,
W82-00109 1501 2E

STREAM POLLUTION
The Horse Creek Basin Project,
W82-00071 1501 5G

Residues of Nonylphenol in Spruce Foliage, Forest Soil, Stream Water and Sediment After its Aerial Application,
W82-00559 1502 5B

Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 1502 5D

Response of Phytoplankton to Acidification in Experimental Streams,
W82-03036 1507 5C

A Mobile Stream Diversion System for Hazardous Materials Spills Isolation,
W82-05070 1511 5G

STREAM POLLUTION INDEX
Insect Community Structure as an Index of Heavy-Metal Pollution in Lotic Ecosystems,
W82-00596 1502 5C

STREAM PROFILES
The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 1511 2E

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

STREAM STABILIZATION
Habitat Recovery in the North Fork of the Teton River.
W82-06409 1512 6G

STREAM UPFLOW
Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

STREAMBEDS
Stream System Evaluation with Emphasis on Spawning Habitat for Salmonids,
W82-02552 1505 7B

Origin of Step-Pool Systems in Mountain Streams,
W82-06335 1512 2J

Lower Flow Regime Bedforms: Rational Classification,
W82-06421 1512 2E

Decrease in Stream Gravel Permeability After Clear-Cut Logging: An Indication of Intragravel Conditions for Developing Salmonid Eggs and Alevins,
W82-06910 1512 5C

STREAMFLOW
Report of the Annual Yield of the Arkansas River Basin for the Arkansas River Basin Compact, Arkansas--Oklahoma, 1980 Water Year,
W82-00012 1501 6E

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 1501 5B

Picloram Dissipation in a Small Southwestern Stream,
W82-00212 1501 5B

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

Spring Flood: Meltwater or Groundwater,
W82-00531 1502 7B

Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 1502 2E

Factors Affecting Puget Sound Coho Salmon (Oncorhynchus Kisutch) Runs,
W82-00883 1502 8I

Using Computed Stream Flow in Watershed Analysis,
W82-01538 1503 2A

Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 1503 2E

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 1503 4A

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 1504 2J

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

Distribution of Joint Run-Lengths of Bivariate Markov Processes,
W82-02191 1505 2E

Snowmelt, Glacier Melt, and High Arctic Streamflow Regimes,
W82-02249 1505 2A

A Review of Single-Site Models for Monthly Streamflow Generation,
W82-02368 1505 2E

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed,
W82-02653 1506 4D

Channel Form and Flow Characteristics of Supraglacial Streams, Austre Okstindbreen, Norway,
W82-02787 1506 2E

Low-Flow Characteristics of Kentucky Streams, 1980,
W82-02826 1506 2E

Low-Flow Frequency Data for Selected Stream-Gaging Stations in Florida,
W82-02834 1506 2E

Flow Duration at Selected Stream-Sites in Kentucky,
W82-02837 1506 2E

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 1506 2E

Communication on 'Variation of Manning's n Roughness Coefficient with Flow in Open River Channels'.
W82-03382 1507 2E

Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 1508 2E

Application of Infiltration Theory for the Determination of Excess Rainfall Hyetograph,
W82-03752 1509 2A

Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

Flow Model of Saginaw River Near Saginaw, Michigan,
W82-03996 1509 2E

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

Use of Pre-Fabricated Parshall Flumes to Measure Streamflow in Permafrost-Dominated Watersheds,
W82-04074 1509 7B

Elevation: A Major Influence on the Hydrology of New Hampshire and Vermont, USA,
W82-04304 1510 2E

Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 1510 2E

Comparison of Two Autoregressive Models for Monthly Stream Flow Generation,
W82-04351 1510 2E

Search: A Gaged Watershed Inventory,
W82-04433 1510 10B

Mean Annual Streamflow of Selected Drainage Basins in the Coal Area of Southeastern Montana,
W82-04506 1510 5C

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 1510 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 1510 2E

The Development of a Viable Method of Stream Flow Measurement Using the Integrating Float Technique,
W82-04643 1510 7B

A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 1511 2E

Base Flow of Streams in Nassau County Sewer Districts 2 and 3, Long Island, New York, 1978-79,
W82-04980 1511 2E

Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 1511 2A

Velocity Distributions Under Floating Covers,
W82-05562 1511 2E

On Hydrological Data Needs in Canada,
W82-05764 1511 7B

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 1511 7C

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 1511 7C

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 1511 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 1511 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 1511 5B

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

A Stochastic Streamflow Model of the Platte River at Overton, Odessa, and Grand Island, Nebraska,
W82-06139 1512 2E

Dispersion in Mountainous Natural Streams,
W82-06357 1512 2E

Digitizing and Routine Analyses of Hydrological Data,
W82-06386 1512 2E

Stochastic Generation of Monthly Streamflows,
W82-06427 1512 4A

Summary of Basin and Flood Characteristics for Unregulated Basins in New Mexico,
W82-06671 1512 7C

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 1512 2E

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

Synthesis of Streamflow Information Relating to the Semi-Arid Karoo Biome of South Africa,
W82-06835 1512 4A

Floodflow Characteristics of Honcut Creek at State Highway 70 Bridges Near Live Oak, California,
W82-06945 1512 4A

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

STREAMFLOW DEPLETION

A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 1502 2E

Overview of Freshwater Inflow Depletions,
W82-02152 1505 6D

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

STREAMFLOW FORECASTING

The Limitations and Usefulness of Streamflow Generation Methods: A Case Study,
W82-00229 1501 6A

Identification of Streamflow Stochastic Models,
W82-00555 1502 2A

A Leaky Reservoir Model for Ephemeral Flow Recession,
W82-00600 1502 2E

Multivariate Hydrologic Time Series Analysis,
W82-00647 1502 2A

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 1503 2E

Point Process Models of Rainfall,
W82-02452 1505 2A

Selecting Seasonal Streamflow Models,
W82-02502 1505 2E

Stochastic Hydrologic Model for Drought Management,
W82-02897 1506 2E

Construction of a Gamma-Distribution Probability Paper for Straightening Discharge Probability Curves,
W82-02925 1506 7B

Calibrating and Verifying the SSARR Model--Missouri River Watersheds Study,
W82-03549 1508 2A

Safe-Yield Estimates of a Water Supply Reservoir on an Ungaged Stream,
W82-03716 1508 2E

Mathematical Simulations of The Toccoa Falls, Georgia Dam Break Flood,
W82-03920 1509 2E

Operational Applications of Satellite Snow Cover Observations,
W82-04150 1509 7B

A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 1510 2A

Derivation of Homogeneous Streamflow Records for the Green River Basin, Kentucky,
W82-04979 1511 2E

New Methods of Designing Flood Control Measures,
W82-05030 1511 2E

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 1511 2F

Three-State Markov Model for Differential Persistence,
W82-05654 1511 2E

Time and Frequency Domain Analyses of Hydrological Systems,
W82-05655 1511 2E

Finite Element Modeling of Streamflow Routing,
W82-05918 1512 2E

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning,
W82-05926 1512 2E

The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 1512 2E

STREAMFLOW-WATER QUALITY RELATIONS

Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 1507 7B

Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

STREAMS

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

Erosion and Sedimentation in the Kenai River, Alaska,
W82-00015 1501 2J

A Comparison of Nitrogen in Shallow Ground Water from Sewered and Unsewered Areas, Nassau County, New York, from 1952 Through 1976,
W82-00277 1501 5B

An Evaluation of Sources of Nitrogen as Causes of Ground-Water Contamination in Nassau County, Long Island,
W82-00279 1501 5B

Seston Dynamics in Southern Appalachian Streams: Effects of Clear-Cutting,
W82-00543 1502 4C

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 1502 5C

A Comparison of Sensitivity Analysis and Error Analysis Based on a Stream Ecosystem Model,
W82-00991 1502 7A

Phosphorus, Nirogen, and Organic Carbon Flux in a Headwater Stream,
W82-01021 1502 2K

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

Morphological Changes of River Channels Consequent Upon Headwater Impoundment,
W82-01087 1502 6G

Dissolved Oxygen in Streams and Reservoirs,
W82-01272 1503 5G

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 1504 5A

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 1505 5C

Discharge and Chemical Changes in a Chalk Stream Headwater Affected by the Outflow of a Commercial Watercress-Bed,
W82-02429 1505 5C

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

The Seasonal Variation in Silicon Concentration in Chalk-Streams in Relation to Diatom Growth,
W82-02439 1505 5B

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

Water Quality of a Southeast Texas Stream,
W82-02570 1505 2K

Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

Chemical Flux in an Acid-Stressed Stream,
W82-03338 1507 5C

Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

Acidification of Surface Waters in Two Areas of the Eastern United States,
W82-03554 1508 5B

Radon and Radium Discharge to Surface Streams,
W82-03881 1509 5B

Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

Geometry of Gravel Streams,
W82-04113 1509 2E

Erosion and Sedimentation in the Kenai River, Alaska,
W82-04495 1510 2J

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

The Relationship Between Flow-Shear Stress and Stream Pattern,
W82-04866 1511 2E

Nitrogen and Phosphorus Dynamics in Hot Desert Streams of Southwestern U.S.A.,
W82-04930 1511 2K

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 1511 2K

Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 1511 5B

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

A Conceptual Model of Primary Productivity in Shallow Streams Using Biomass Simulation,
W82-06153 1512 5C

Reliability Analysis of BOD Kinetics in a Southern Stream Governed by the Discharge of an Oxidation Pond,
W82-06159 1512 5B

The White Clay Creek Project: A Prototype Strategy for Protecting Small Stream Valleys,
W82-06368 1512 6B

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 1512 6B

Ecology of Streams Draining Forested and Non-Forested Catchments in an Area of Central Scotland Subject to Acid Precipitation,
W82-06909 1512 5C

STREATOR
Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 1501 5D

STREETER-PHELPS EQUATION
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 1502 5D

STREETER-PHELPS EQUATIONS
Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 1512 5B

STRENGTH
Shear Strength of Rockfill,
W82-00116 1501 8D

STREPTOCOCCI
A Water Quality Index for Lake Beaches,
W82-06660 1512 5G

STREPTOCOCCUS
Comparison of Selective Media for the Enumeration and Identification of Fecal Streptococci from Natural Sources,
W82-01564 1503 5A

STREPTOCOCCUS BOVIS
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 1503 5A

STRESS
A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

Application of the Southwell Plot Method to the Inspection and Testing of Buried Flexible Pipes,
W82-04649 1510 8A

Inertia and Recovery: An Approach to Stream Classification and Stress Evaluation,
W82-04735 1510 6G

STRESS ANALYSIS
Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 1505 5E

Calculation of Earth Dams Being Undermined,
W82-03162 1507 8D

Stress-Strain State of an Arch Dam Based on Data of Long-Term On-Site Observations,
W82-05112 1511 8A

Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116 1511 8E

STRESS RELAXATION COEFFICIENT
Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 1506 8A

STRESS-STRAIN CURVES
Relaxation in Concrete,
W82-05511 1511 8F

STRINGFELLOW QUARRY
Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

STRIP MINE WASTES
Hydraulic Properties of Coal and Related Materials, Northern Great Plains,
W82-00278 1501 2F

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 1502 5G

Lead-210 Analyses of Sediment Accumulation Rates in Five Southern Illinois Surface Mine Lakes,
W82-03960 1509 2J

Topsoil Management of Mined Soils,
W82-04571 1510 4D

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

STRIP MINES
Selective Overburden Placement,
W82-00053 1501 5G

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 1501 4C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 1510 7C

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

Topsoil Management of Mined Soils,
W82-04571 1510 4D

Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 1511 6D

Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 1511 5E

Ground-Water Hydrology of Strip-Mine Areas in Eastern Ohio (Conditions During Mining of Two Watersheds in Coshocton and Muskingum Counties),
W82-06141 1512 2F

STRIP MINING
Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

STROMATOLITES
Modern Lacustrine Stromatolites, Walker Lake, Nevada,
W82-06934 1512 5C

STRONG BASE ION EXCHANGERS
Color Removal from Groundwater by Ion Exchange and Sludge Recycle Techniques,
W82-03956 1509 5F

STRONTIUM RADIOISOTOPES
Radionuclides in Dardanelle Lake in the Area of the Nuclear I Facility: 1979-1981,
W82-06169 1512 5B

STRUCTURAL ENGINEERING
Soil-Bentonite Supply Trench Cutoffs,
W82-01599 1503 8D

STRUCTURAL GEOLOGY
Preliminary Data from Arbuckle Test Wells, Miami, Douglas, Saline, and Labette Counties, Kansas,
W82-04512 1510 7C

STRYI RIVER
New Methods of Designing Flood Control Measures,
W82-05030 1511 2E

STUTTGART
The Neckar as a Source of Process and Reserve Water (Der Neckar als Lifeferant von Betriebs- und Reservewasser),
W82-04546 1510 5F

SUBARCTIC ZONE
Aerial Biomass Distribution in an Undisturbed and Disturbed Subarctic Bog,
W82-00211 1501 2C

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 1504 6G

Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 1506 2C

SUBIRRIGATION
Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 1511 4A

SUBLETHAL EFFECTS
An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 1501 5C

Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 1502 5C

Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 1507 5C

A Method for Determining Stress in Wetland Plant Communities Following an Oil Spill,
W82-04548 1510 5C

Metabolic Response of Fish to Stress,
W82-05159 1511 5C

SUBMARINE SPRINGS
Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

SUBMERGENCE
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 1501 2L

SUBMERSIBLE PUMPS
Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 1502 4D

Description of a New Submersible Filter-Pump Apparatus for Sampling Plankton,
W82-01012 1502 7B

SUBSIDENCE
Legal Aspects of Subsidence Due to Well Pumping,
W82-00170 1501 6E

A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 1504 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 1504 2F

Calculation of Earth Dams Being Undermined,
W82-03162 1507 8D

Subsidence--A Geological Problem with a Political Solution.
W82-03452 1508 4B

The Occurrence and Control of Land Subsidence Due to Ground-Water Withdrawal with Special Reference to the San Joaquin and Santa Clara Valleys, California,
W82-03714 1508 4B

Quantitative Relationships Between Numbers of Fluvial Cycles, Bulk Lithological Composition and Net Subsidence in a Scottish Namurian Basin,
W82-05959 1512 2J

SUBSIDIES
An Economic Comparison of the Irrigation of Corn in Humid and Arid Regions of the United States,
W82-05909 1512 6B

SUBSOIL
The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 1512 8E

SUBSTRATES
Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 1501 2L

Monitoring River Periphyton With Artificial Benthic Substrates,
W82-00581 1502 5A

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 1502 7B

The Role of Substratum in Benthic Macroinvertebrate Microdistribution and Litter Decomposition in a Woodland Stream,
W82-01037 1502 2E

Substrate Flux into Biofilms of Any Thickness,
W82-01964 1504 5D

Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

The Effects of Sedimentation on Aquatic Life of the Kankakee River, Phase II: Quantitative Studies and Threatened, Endangered, and Rare Species,
W82-04389 1510 5C

Initial Colonization of Artificial Substrate: Community Development and Structure Studied by Scanning Electron Microscopy,
W82-05193 1511 2L

Chemical and Biochemical Oxygen Demand as Indicators of Biodegradable Substrate Concentration,
W82-05466 1511 5D

SUBSURFACE DRAINAGE
Backfill Alteration Effects on Pipe Drainage of a Clay Soil,
W82-00763 1502 4A

Subsurface Drainage and Sediment Transport Model,
W82-00894 1502 2G

Use of Horizontal Drains: Case Histories from the Colorado Division of Highways,
W82-02211 1505 8A

Horizontal Drains and Horizontal Drilling: An Overview,
W82-02215 1505 8A

Nutrient and Sediment Loadings from a Subsurface Drainage System,
W82-02266 1505 5B

Delayed Drainage in a Stream-Aquifer System,
W82-04268 1510 2F

Subsurface Drainage Effects on Erosion,
W82-06795 1512 4D

SUBSURFACE DRAINS
Optimum Depth and Spacing of Subsurface Drains,
W82-05693 1511 8B

SUBSURFACE FILTERS
Filter Criteria for Sub-Surface Drainage,
W82-03660 1508 8G

SUBSURFACE FLOW
Subsurface Flow Velocities Through Selected Forest Soils, South Island, New Zealand,
W82-05712 1511 4C

SUBSURFACE IRRIGATION
Water Movement Factors Important to the Design and Operation of Subirrigation Systems,
W82-04538 1510 3F

SUBSURFACE MAPPING
Mapping Contaminated Soil Plumes by Kriging,
W82-01423 1503 5G

SUBSURFACE WATER
Possibilities of Using Helium and Tritium Surveys for Studying Recharge Conditions of Subsurface Waters,
W82-00302 1501 7B

SUCCESSION
A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 1501 2I

A Culture Model for Phytoplankton Succession in the Potomac River Near Washington, D.C. (U.S.A.),
W82-03765 1509 5B

An Approach to the Control of the Activated Sludge System by Use of a Succession Model,
W82-04057 1509 5D

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

Rutland Water Phytoplankton: The Development of an Asset or a Nuisance,
W82-06473 1512 2H

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 1512 2L

SUDAN
A Combination of Electrical Resistivity, Seismic Refraction, and Gravity Measurements for Groundwater Exploration in Sudan,
W82-00852 1502 2F

The Gezira Scheme--A Study in Failure,
W82-03393 1507 6B

Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 1512 2E

Microbiological Examination of Sebeel Water,
W82-06882 1512 5C

SUFFOLK COUNTY
Nitrogen Removal in a Subsurface Disposal System,
W82-04001 1509 5D

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 1511 4B

SUGAR BEETS
Sugar Beet Production as Influenced by Water Stress,
W82-04086 1509 3F

SUGAR CROPS
Wastewater from a Sugar Refining Industry,
W82-05337 1511 5D

SUGARCANE
Water Requirement for Sugarcane Production,
W82-00899 1502 3F

Remote Detection of Nutrient and Water Deficiencies in Sugarcane Under Variable Cloudiness,
W82-02709 1506 7B

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 1512 2I

SULFATE
Isotopic and Geologic Studies to Identify the Sources of Sulfate in Groundwater Containing High Barium Concentrations,
W82-03931 1509 2K

SULFATE-REDUCING BACTERIA
Kinetic Analysis of Competition Between Sulfate Reducers and Methanogens for Hydrogen in Sediments,
W82-06886 1512 2H

SULFATE REDUCTION

Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 1508 2H

Sulfate Reduction and Methanogenesis in the Sediment of a Saltmarsh on the East Coast of the United Kingdom,
W82-06541 1512 2L

SULFATES

Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 1501 2H

Relationships Between Sulfate and Nitrate Ion Concentrations and Rainfall PH for Use in Modeling Applications,
W82-00507 1502 5B

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 1502 5A

Analysis of Precipitation Chemistry at a Central Pennsylvania Site,
W82-00980 1502 2K

Molecular Diffusion and the Sedimentary Environment: Results from the In Situ Determination of Whole Sediment Diffusion Coefficients,
W82-03091 1507 2J

Dynamics of Bacterial Sulfate Reduction in a Eutrophic Lake,
W82-03119 1507 2H

Sulfate Reduction in the Sediments of a Eutrophic Lake,
W82-03722 1508 2H

Evidence for Coexistence of Two Distinct Functional Groups of Sulfate-Reducing Bacteria in Salt Marsh Sediment,
W82-04464 1510 2L

Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 1511 5A

Sulfate Washout Ratios in Winter Storms,
W82-04898 1511 5B

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 1511 5A

Sulfate Budget and Model for Sulfate Concentrations in Stream Water at Birkenes, a Small Forested Catchment in Southernmost Norway,
W82-05288 1511 2K

The Effect of Sulfate on Aluminum Concentrations in Natural Waters: Some Stability Relations in the System Al2O3-SO3-H2O at 298 K,
W82-05581 1511 2K

SULFIDE PRECIPITATION

Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 1507 5D

SULFIDES

Interference of Sulphide in Inorganic Phosphate Determination in Natural Waters,
W82-00154 1501 5A

Determination of the Solubility of Ferrous Sulfide in a Seasonally Anoxic Marine Basin,
W82-02665 1506 2K

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

Dissolution of Tetragonal Ferrous Sulfide (Mackinawite) in Anoxic Aqueous Systems. 2. Implications for the Cycling of Iron, Sulfur, and Trace Metals,
W82-03771 1509 2K

Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

Handling and Measurement Techniques for Anoxic Interstitial Waters,
W82-05176 1511 7B

Case Study of Prediction of Sulfide Generation and Corrosion in Sewers,
W82-05267 1511 8G

Sulphide Control in Rising Mains,
W82-05465 1511 5D

A Method for the Determination of Sulphides in Water, Sewage and Effluents,
W82-05477 1511 5A

Determination of Sulphide in Industrial Waste Waters and Sewage Waters with an Iodide-Selective Electrode,
W82-06192 1512 5A

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 1512 5D

SULFUR

Chloramine-T as A Potential Scrubbing Agent: Removal of Odorous Sulfur-Containing Environmental Pollutants,
W82-00871 1502 5D

Sulfur and Associated Elements and Acidity in Continental and Marine Rain from North Florida,
W82-00965 1502 2B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

The Biogeochemistry of Sulfur in Two Small Lakes,
W82-04726 1510 2H

Sulphur in the Environment: A Review,
W82-05179 1511 5B

Sulfur Bacterial Problems Revisted,
W82-05264 1511 5B

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 1512 5F

Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

SULFUR COMPOUNDS

Reduction of Sulfur Compounds in the Sediments of a Eutrophic Lake Basin,
W82-00488 1501 2H

Mass-Transport Limitation to the Rate of Reaction of Gases in Liquid Droplets: Application to Oxidation of SO2 in Aqueous Solutions,
W82-00994 1502 2K

Oxidation of SO2 in Aqueous Droplets: Mass Transport Limitation in Laboratory Studies and the Ambient Atmosphere,
W82-01470 1503 2K

The Prediction of Rain Acidity and SO2 Scavenging in Eastern North America,
W82-02628 1506 5B

Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 1508 5A

Sulfur Contituents of Sediments and Their Relationship to Lake Acidification,
W82-03558 1508 5B

Sulfur Speciation and Associated Trace Metals (FE, CU) in the Pore Waters of Great Marsh, Delaware,
W82-05415 1511 2K

SULFUR CYCLE

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 1504 2H

Comparative Aspects of Sulfur Mineralization in Sediments of a Eutrophic Lake Basin,
W82-06888 1512 5C

SULFUR DIOXIDE

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

SULFUR EMISSIONS

The Chemistry and Fishery Status of Acid Lakes in Norway and Their Relationship to European Sulphur Emissions,
W82-03418 1508 5C

SULFURIC ACID

Acid Precipitation: The Importance of Nitric Acid,
W82-00643 1502 2K

Acidity Fluctuations at a Broadland Site in Norfolk,
W82-00656 1502 2K

Quality of Irrigation Water and Effects of Sulfuric Acid and Gypsum on Soil Properties and Sundangrass Yields,
W82-00767 1502 3C

The Relative Contributions of Sulfuric and Nitric Acids in Acid Rain to the Acidification of the Ecosystem. Implications for Control Strategies,
W82-02913 1506 5C

Acid Precipitation in the Washington Cascades,
W82-05287 1511 5B

SUMAS RIVER BASIN

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 1504 5A

SUMMER RAINFALL

An Index of Arizona Summer Rainfall Developed Through Eigenvector Analysis,
W82-01528 1503 2B

SUMPS

Pumped Outlets for Drainage Systems,
W82-04364 1510 8A

Pump Sump Design Experience: Summary,
W82-06419 1512 8C

SUNFLOWER
Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

SUNSPOTS
Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 1501 2J

Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 1511 2A

SUPERCOOLING
A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 1503 7B

SUPERSATUATION
Hydraulic Model Studies - Yellowtail Afterbay Dam Sluiceway,
W82-06962 1512 8A

SUPPLEMENTAL IRRIGATION
Risk and the Demand for Supplemental Irrigation: A Case Study in the Corn Belt,
W82-00522 1502 6A

Sizing Farm Reservoirs for Supplemental Irrigation of Corn. Part I: Modeling Reservoir Size Yield Relationships,
W82-05967 1512 2I

SURFACE DRAINAGE
Preliminary Appraisal of Ephemeral-Streamflow Characteristics as Related to Drainage Area, Active-Channel Width, and Soils in Northwestern New Mexico,
W82-02476 1505 2E

SURFACE FLOW
Surface Water Flow from a South Florida Wetland Area,
W82-02121 1505 2E

SURFACE-GROUNDWATER RELATIONS
Spring Flood: Meltwater or Groundwater,
W82-00531 1502 7B

Ground Water in the Ohio River Basin Portion of Maryland: Problems and Needs,
W82-01054 1502 4B

Design and Merit of a River-Aquifer Model for Optimal Use of Agricultural Water,
W82-01193 1503 6A

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 1504 2F

Proceedings and Recommendations of the Workshop on Groundwater Problems in the Ohio River Basin, April 28-29, 1981. Cincinnati, Ohio.
W82-02106 1505 2F

Aquifer Response Due to Zones of Higher Permeability and Storage Coefficient,
W82-02190 1505 2F

Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 1505 5A

Groundwater Systems Associated with Secondary Salinity in Western Australia.
W82-02770 1506 2F

A 'Random Walk' Solute Transport Model for Selected Groundwater Quality Evaluations,
W82-03007 1507 6A

Isotope Hydrology of Groundwaters in the Pampa Del Tamarugal, Chile,
W82-03651 1508 2F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 1508 2A

Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

Radon and Radium Discharge to Surface Streams,
W82-03881 1509 5B

Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

Effect of Irrigation Pumping on the Ground-Water System in Newton and Jasper Counties, Indiana,
W82-04497 1510 4B

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 1510 6G

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado,
W82-04725 1510 6A

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 1511 2F

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

Hydrology and Model of North Fork Solomon River Valley, Kirwin Dam to Waconda Lake, North-Central Kansas,
W82-06684 1512 2A

SURFACE-GROUNDWATER RELATIONSHIPS
Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

SURFACE IRRIGATION
Soil Water Intake Rates and Surface Irrigation System Characteristics by Soil Series in Southeastern Idaho,
W82-05539 1511 3F

A Kinematic Model for Surface Irrigation: An Extension,
W82-06852 1512 3F

SURFACE RUNOFF
Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Physical Effects of Vehicular Disturbances on Arid Landscapes,
W82-00111 1501 4C

The Effects of Surface Slaty Fragments on Soil Erosion by Water,
W82-00471 1501 2J

A Geomorphologic Synthesis of Nonlinearity in Surface Runoff,
W82-00604 1502 2A

Soluble N and P Concentrations in Surface Runoff Water,
W82-01413 1503 5B

The Release of Soil Phosphorous to Runoff in Relation to the Kinetics of Desorption,
W82-01477 1503 5B

Land Surface and Lake Storage During Snowmelt Runoff in a Subarctic Drainage System,
W82-02624 1506 2C

Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 1508 2H

The Distribution of Heavy Metals and Petroleum Residues in the Soil from Urban Surface Runoff,
W82-04216 1509 5B

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

Reduced Runoff and Nonpoint Source Pollution Through Increased Infiltration,
W82-05300 1511 2G

A Parametric Model to Estimate Runoff from Small Agricultural Watersheds in the Semi-Arid Tropics,
W82-05646 1511 2E

Erosion from Mountain Snowpack Melt,
W82-05664 1511 2J

Herbicide Loss in Runoff Water and Sediment as Affected by Center Pivot Irrigation and Tillage Treatments,
W82-05921 1512 5B

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

Advanced Calibration Methodology for Hydrologic Rainfall - Runoff Simulation Models,
W82-06366 1512 2A

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 1512 2G

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

SURFACE SEALING
Effect of Surface Sealing on Infiltration,
W82-04362 1510 2G

The Effect of Raindrop Impact on the Dynamics of Soil Surface Crusting and Water Movement in the Profile,
W82-04868 1511 2G

A Comparison of Three Infiltration Models,
W82-05965 1512 2G

SURFACE TENSION

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1504 1B

Surface Viscosity of Water,
W82-03501 1508 1A

Characterization of Properties of Water,
W82-05540 1511 1A

SURFACE WATER

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Water Resources Investigations in New York--1980.
W82-00011 1501 7C

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 1501 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 1501 7C

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 1501 5B

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 1501 7C

Areal Predictions of Water and Solute Flux in the Unsaturated Zone,
W82-00381 1501 6A

Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

Index to Active Hydrologic Data Collection Sites in Florida, 1980-81,
W82-00425 1501 7C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

Simultaneous Concentration of Salmonella and Enterovirus From Surface Water by Using Micro-Fiber Glass Filters,
W82-00573 1502 5A

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 1502 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 1502 7C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 1502 5A

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 1503 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 1503 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 1503 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 1503 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 1503 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 1503 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 1503 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 1503 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 1503 7C

Tenax-GC Extraction Technique for Residual Polychlorinated Biphenyl and Polyaromatic Hydrocarbon Analysis in Biodegradation Assays,
W82-01235 1503 5A

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 1503 10C

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 1505 7C

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

Water Resources Data for Utah, Water Year 1979.
W82-02474 1505 7C

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 1505 7C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

Water Resources Data for Indiana, Water Year 1980.
W82-02492 1505 7C

Water Resources Data for Florida, Water Year 1980–Volume 4. Northwest Florida.
W82-02493 1505 7C

Water Resources Data for Pennsylvania, Water Year 1980–Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 1505 7C

Water Resources Data for Wyoming, Water Year 1980–Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 1505 7C

Water Resources Data for Minnesota, Water Year 1980–Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 1505 7C

Water Resources Data for Minnesota, Water Year 1980–Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 1505 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 1505 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 1505 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Chemical Coagulation of Surface Water,
W82-02623 1506 5F

Miscellaneous Surface-Water Data, Pecos River Basin, New Mexico,
W82-02827 1506 7C

Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

Drainage Areas of Streams at Selected Locations in Kentucky,
W82-02835 1506 7C

Hydrologic Evaluation of a Hypothetical Coal-Mining Site Near Chrisney, Spencer County, Indiana,
W82-02840 1506 6B

Water Resources Data for Alaska, Water Year 1980.
W82-02845 1506 7C

Water Resources Data for Wyoming, Water Year 1980–Volume 1. Missouri River Basin.
W82-02846 1506 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 1506 7C

Remote Synoptic Surface Flow Measurements in Small Bodies of Water,
W82-03012 1507 7B

Observations on Infections Associated with South Wales Natural Waters,
W82-03409 1508 5C

The Characterization and Analysis of Chlorinated Organic Compounds Derived from Chlorination of Humic Substances in Surface Waters,
W82-03529 1508 5A

Enrichment of Dissolved Phenolic Material in the Surface Microlayer of Coastal Waters,
W82-03749 1508 2L

Nitrogen Dynamics in the Surface Waters of the New Jersey Pine Barrens,
W82-03816 1509 2A

Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

Hydrologic Almanac of Florida,
W82-03974 1509 7C

Progress Report on the Effects of Surface Mining on the Surface-Water Hydrology of Selected Basins in the Fort Union Coal Region, North Dakota and Montana,
W82-03975 1509 4C

Water Resources Investigations in Mississippi 1980-81.
W82-03988 1509 7C

Water Resources Data for West Virginia, Water Year 1979. Appendix - Coal Areas.
W82-03990 1509 7C

Water-Quality Reconnaissance of Harding Creek, Lawrence County, Arkansas,
W82-03995 1509 7C

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 1510 7C

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

Water-Resources Investigations of the U.S. Geological Survey in Kansas–Fiscal Year 1979 and 1980,
W82-04510 1510 7C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 1510 7C

Water Resources Data for Pennsylvania, Water Year 1980–Volume 1. Delaware River Basin.
W82-04521 1510 7C

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 1510 7C

Water Resources Data for Louisiana, Water Year 1981–Volume 3. Coastal Louisiana.
W82-04523 1510 7C

Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 1511 5F

Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 1511 7C

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

The Effect of Pressure on the Solubility of Minerals in Water and Seawater,
W82-05135 1511 1B

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 1511 7C

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 1511 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 1511 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 1511 5B

Hydrologic Reconnaissance of the Noatak River Basin, Alaska, 1978,
W82-05848 1511 4A

Evaluation of the Rate of Uptake of Nitrogen Dioxide by Atmospheric and Surface Liquid Water,
W82-05873 1511 2K

Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 1512 7C

Water Resources Data for Oregon, Water Year 1980–Volume 2. Western Oregon.
W82-06143 1512 7C

San Juan River Basin,
W82-06144 1512 7C

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 1512 7C

Water-Resources Investigations of the U. S. Geological Survey in Arkansas–Fiscal year 1981.
W82-06673 1512 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 1512 7C

Hydrologic and Morphologic Changes in Channels of the Platte River Basin: A Historical Perspective,
W82-06946 1512 2E

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 1512 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascaguoula, and Tennessee River Basins,
W82-06954 1512 7C

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 1512 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 1512 7C

SURFACE WATERS

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 1503 5A

Hydrology of Area 25, Eastern Region, Interior Coal Province, Illinois,
W82-05832 1511 7C

SURFACTANTS

Use of the Electrolytic Respirometer to Measure Biodegradation in Natural Waters,
W82-00126 1501 5A

Removal and Recovery of Organic Pollutants from the Aquatic Enviroment. 2. Removal and Recovery of Dodecylbenzenesulfonate from Aqueous Solution by Cross-Linked Poly(N-Benzyl-4-Vinylpyridinium Halide),
W82-00217 1501 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 1502 5D

Electrical Aspects of Adsorbing Colloid Flotation. XI. Surfactant Adsorption Isotherms, Particle Displacement, and Differential Capacitance,
W82-00788 1502 1B

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 1504 5D

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 1504 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 1504 5B

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 1506 5B

A Spectrophotometric Method for the Determination of Anionic Surfactants at Microg/Liter Levels,
W82-03289 1507 5A

Biodegradation of Linear Alcohol Ethoxylates in Natural Waters,
W82-03638 1508 5B

Persistent Organic Chemicals in Sewage Effluents: I. Identifications of Nonylphenols and Nonylphenolethoxylates by Glass Capillary Gas Chromatography/Mass Spectrometry,
W82-04834 1511 5A

Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 1511 5D

Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 1511 5C

Characterization of Properties of Water,
W82-05540 1511 1A

SURGES

Furrow Advance Rates Under Surge Flow Systems,
W82-01612 1503 3F

Simulation of Surges After Removal of a Separating Barrier Between Shallower and Deeper Bodies of Water,
W82-04685 1510 8B

SURVEYING INSTRUMENTS

Measuring Reservoir Ground Movements,
W82-05773 1511 8G

SURVEYS

Hydraulic Gates: The State-of-the-Art,
W82-00332 1501 8C

Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

Mapping Sediment Sources in a New Zealand Mountain Watershed,
W82-02885 1506 2J

Water Use in Manufacturing.
W82-04070 1509 6D

The Status of Direct Filtration.
W82-04105 1509 5F

The Socio-Environmental Impacts of Energy Development on Local User Groups and Water Resource Planning,
W82-05553 1511 5B

Comparing Two Measures of Water Based Recreation Participation,
W82-05733 1511 6D

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

SURVIVAL

Indicator Bacteria Survival under Laboratory Conditions,
W82-05853 1511 5A

SUSPENDED LOAD

Developments in Sedimentation and Flotation,
W82-01391 1503 5F

Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

Viscosity-Controlled Sediment Transport in the Absence of Suspended Load,
W82-04210 1509 2J

SUSPENDED SEDIMENT

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 1503 4C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

Storm Sediment Concentrations as Affected by Land Use, Hydrology, and Weather,
W82-04878 1511 2J

SUSPENDED SEDIMENTS

Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

Unsteady One-Dimensional Settling of Suspended Sediment,
W82-01463 1503 2J

Nepheloid and Suspended Particulate Matter in South-Eastern Lake Michigan,
W82-01499 1503 2H

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 1504 2J

The Suspended Sediment-Water Partitioning Coefficient for Kepone in the James River, Virginia,
W82-02284 1505 5B

Velocity Profiles with Suspended Sediment,
W82-02581 1505 2J

Modeling Suspended Solids and Bacteria in Ford Lake,
W82-02595 1505 5B

A Sediment Trap Experiment in Funka Bay, Japan: 'Upward Flux' of Particulate Matter in Seawater,
W82-02893 1506 2K

Some Suspended Sediment Yields from South Island Catchments, New Zealand,
W82-03411 1508 2J

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

A Suspended Sediment Front in the Severn Estuary,
W82-04639 1510 2L

Collapsible-Bag Suspended-Sediment Sampler,
W82-04745 1510 7B

Sources of Sediment-Induced Reductions in Water Quality Appraised from Catchment Attributes and Land Use,
W82-05494 1511 2J

Organic Contaminants in the Suspended Sediments of the Niagara River,
W82-05636 1511 5B

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Suspended Sediment in a Wave Field,
W82-06527 1512 2J

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 1512 5B

Calculation of Cumulative Percentage at Selected Particle Sizes from Bottom Withdrawal Tube Analysis,
W82-06873 1512 2J

SUSPENDED SOLIDS

Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

The Effect of Centrifugation on the Suspended Particles of River Waters,
W82-00124 1501 5A

Method for Recovering Viruses from River Water Solids,
W82-00200 1501 5A

Lethality of a Suspended Clay to a Diverse Selection of Marine and Estuarine Macrofauna,
W82-00268 1501 5C

Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 1501 5F

Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

A Review on Sediment Traps in Aquatic Environments,
W82-01020 1502 7B

The Nutritional Significance of the Distribution of Suspended Particulate Material in the Upper San-Francisco Bay-Estuary,
W82-02140 1505 2L

The Downstream Transport of Fine Material and the Organic Matter Balance for a Section of a Small Chalk Stream in Southern England,
W82-02192 1505 1B

Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 1505 5A

A Compendium of Experimental Work on Chemical Precipitation of Sewage,
W82-02370 1505 5D

Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 1507 2H

Primary Sedimentation of Sewage,
W82-03429 1508 5D

Predicting Suspended Solids Removal in Pilot Scale Sediment Ponds Utilizing Chemical Flocculation,
W82-03725 1508 5D

Monitoring of Turbidity and Suspended Solids Concentration in Wastewater Treatment Plants,
W82-04054 1509 5D

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 1511 5D

Virginians Optimize Sludge Handling,
W82-05171 1511 5D

Fate of Suspended Biological Solids Discharged to Receiving Waters,
W82-05448 1511 5B

Organochlorine Residues in Suspended Solids Collected from the Mouths of Canadian Streams Flowing into the Great Lakes 1974-1977,
W82-05635 1511 5B

Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 1511 5D

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 1511 5B

The Role of Suspended Solids in the Estuarine Geochemistry of Mercury,
W82-06035 1512 5B

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 1512 5F

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 1512 5D

Land Water Interactions: Effects of Introduced Nutrients and Soil Particles on Reservoir Productivity,
W82-06710 1512 2J

SUSQUEHANNA RIVER

Reactor-Released Radionuclides in Susquehanna River Sediments,
W82-03189 1507 5B

SUSQUEHANNA RIVER BASIN

Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 1501 6F

SUWANNEE RIVER WATER MANAGEMENT DISTRICT

Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study,
W82-03919 1509 7A

SWAMP FOREST

Floodwater Nutrient Processing in a Louisiana Swamp Forest Receiving Agricultural Runoff,
W82-05622 1511 5C

SWAMPS

Vegetation and Nutrient Status of Northern Michigan Bogs and Conifer Swamps with a Comparison to Fens,
W82-00484 1501 2I

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

Modeling Hydrology and Eutrophication in a Louisiana Swamp Forest Ecosystem,
W82-00890 1502 4A

Methane Formation in the Acid Peats of Okefenokee Swamp, Georgia,
W82-00936 1502 2H

Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 1503 5B

Organic Carbon Flow in a Swamp-Stream Ecosystem,
W82-04564 1510 5B

The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile,
W82-05054 1511 6G

Retention of Urban Derived Phosphorus by an Alluvial Swamp of the Coastal Plain of Georgia,
W82-05286 1511 5B

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

SWAN-AVON RIVER SYSTEM

The Ecology of Plankton Fauna in Saline River Pools,
W82-04941 1511 2L

SWARTVLEI LAKE

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 1504 2H

SWEDEN

Spring Flood: Meltwater or Groundwater,
W82-00531 1502 7B

Reviving Acidified Lakes,
W82-00933 1502 2H

The Mercury Cycle,
W82-01869 1504 5B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 1504 2D

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

Interactions Between Lugol's Fixative and Ethylene in the Acetylene-Reduction Assay for Nitrogenase Activity in Lake Water,
W82-02380 1505 2K

Jonkoping's Water Supply,
W82-02419 1505 5F

Lake Vattern,
W82-02755 1506 2H

Small Hydro Stations in Sweden,
W82-04174 1509 8C

Determination of Characteristic Values for Physical and Chemical Lake Sediment Parameters,
W82-04586 1510 2H

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C

The pH History of Lakes in Southwestern Sweden as Calculated from the Subsoil Diatom Flora of the Sediments,
W82-05034 1511 2H

Robustness of Water Resources Systems,
W82-05077 1511 6A

Experience from 10 Years Advanced Wastewater Treatment--Technology and Results,
W82-05424 1511 5D

The Importance of Refreezing on the Diurnal Snowmelt Cycle with Application to a Northern Swedish Catchment,
W82-05942 1512 2C

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

Pediastrum and Scenedesmus (Chlorococcales) in Sediments from Lake Vaxjosjon, Sweden,
W82-06878 1512 5C

SWEET POTATOES
The Effect of Leaf Water Status on Stomatal Activity, Transpiration and Nitrate Reductase of Sweet Potato,
W82-03793 1509 2D

SWIMMING
Recreational Water Quality and Health,
W82-02997 1506 5C

Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

SWIMMING POOLS
Distribution and Balance of Volatile Halogenated Hydrocarbons in the Water and Air of Covered Swimming Pools Using Chlorine for Water Disinfection,
W82-00128 1501 5F

Are Metals from Highway Dustfall Hazardous in Swimming Pools,
W82-01093 1502 5B

Persistence of Pseudomonas Aeruginosa in Chlorinated Swimming Pools,
W82-01124 1503 5A

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

Health Aspects of Waters at Public Health Resorts,
W82-04348 1510 5A

The Hygienic Control of Swimming Baths.
W82-04853 1511 5F

SWINE WASTE
Economic and Technical Evaluations of Swine Manure Management Systems Which Use Land Applications,
W82-02175 1505 5E

SWITZERLAND
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 1503 2H

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 1504 2C

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 1504 2B

New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 1505 5F

Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland,
W82-03221 1507 5F

Pumped-Storage for Swiss Railways, Part One,
W82-03468 1508 8A

Chemical and Hydrological Heterogeneity of Groundwaters in the Upper 'Jura Neuchatelois', Switzerland. (Heterogeneite Chimique et Hydrologique Des Eaux Souterraines D'un Karst Du Haut-Jura Neuchatelois, Suisse),
W82-03794 1509 2K

The Overtopping of the Palagnedra Dam,
W82-04952 1511 8A

SYMBIOSIS
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 1504 2I

SYMPOSIUM
The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 1511 4B

Numerical Methods in Hydraulics,
W82-06614 1512 8B

SYNOPTIC ANALYSIS
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 1510 2B

SYNTHESIS
Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

The Development of Dry-RO Membranes from Cellulosis and Noncellulosis Polymers Bearing Quaternary Ammonium Groups,
W82-06152 1512 3A

SYNTHETIC FUELS
Synthetic Fuel Effluents,
W82-01263 1503 5B

A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 1506 5C

Will Synfuel Development Drain the West Dry,
W82-03292 1507 6D

Synthetic Fuel Effluents,
W82-06800 1512 5D

SYNTHETIC ORGANICS
Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

SYRIA
Cost-Benefit Analysis of the Euphrates Dam,
W82-03054 1507 6B

SYSTEMATICS
The Aquatic Insects of The Narraguagus River, Hancock and Washington Counties, Maine,
W82-04167 1509 2E

An Introductory Study of Seasonal Variation in the Aerobic Heterotrophic Bacterial Population of the Saint John River Using Classical Systematics,
W82-06559 1512 5A

SYSTEMS ANALYSIS
Systems Analysis,
W82-01303 1503 6A

Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 1503 6A

The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 1504 6A

Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 1505 6A

Application of Reliability Theory to Hydraulic Engineering Design,
W82-02699 1506 8B

An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 1507 5F

Computerized Data Acquisition and Data Handling in Sewage Treatment Plants,
W82-04023 1509 5D

Optimization of Looped Water Distribution Systems,
W82-04045 1509 6A

Alternative Indices of Resilience,
W82-05045 1511 6A

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 1511 3F

Qualitative Stability Analysis of Geologic Systems, with an Example from River Hydraulic Geometry,
W82-06717 1512 2E

Systems Analysis,
W82-06997 1512 5G

SYSTEMS ENGINEERING
Computer Modeling Programs: Tools for Model Operations,
W82-04130 1509 6A

TACOMA AREA
Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

TADPOLES
Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 1501 5A

TAILINGS
Siting and Design of Tailings Impoundments,
W82-01588 1503 8A

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation.
W82-01589 1503 5D

TAILWATER
Irrigation Tailwater Management,
W82-00392 1501 3C

TAIWAN
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

TALLABOA VALLEY
Floods of September 16, 1975 in Tallaboa Valley, Puerto Rico,
W82-05230 1511 6F

TAMA RIVER
Distribution of Mutagens in Tama and Ayase River Sediments,
W82-04182 1509 5A

TAMAGAWA RIVER
Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

TAMARISK
Age, Spacing and Growth Rate of Tamarix as an Indication of Lake Boundary Fluctuations at Sebkhet Kelbia, Tunisia,
W82-05877 1511 2H

TAME RIVER
The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 1511 5C

TAMPA
Demonstration Testing of Alum Recovery by Liquid Ion Exchange,
W82-01167 1503 5D

Tampa's Hookers Point Awt Plant Working Well.
W82-03455 1508 5D

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

Water System Design Meets Modern Challenges,
W82-05170 1511 5F

TAMPA BAY
Estuarine Distribution of Saprolegniaceae in the Tampa Bay Area: I,
W82-03469 1508 2L

TAMPA BAY REGION
Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

TANANA RIVER
Sediment Transport in the Tanana River Near Fairbanks, Alaska, 1977-79,
W82-02472 1505 2J

TANNERY WASTES
Advanced Biological Treatment of Tannery Wastewater,
W82-00337 1501 5D

Chemical Treatment Solves Tannery Waste Problems,
W82-00638 1502 5D

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 1504 5B

Improved Performance in Combined Nitrification/Denitrification of Tannery Waste,
W82-03277 1507 5D

Reduction of Chromium(VI) by Bacterially Produced Hydrogen Sulphide in a Marine Environment,
W82-03758 1509 5B

TANNIC ACIDS
The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

TANNINS
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 1504 5B

TANZANIA
Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 1510 6C

Tanzania's Master Water Plan Will Miss Decade Goal,
W82-04657 1510 5F

TARAWA
A Ground Water Resources Study Of A Pacific Ocean Atoll--Tarawa, Gilbert Islands,
W82-04254 1510 2F

TASMANIA
Ecological Effects of Mine Effluents on the South ESK River, North-Eastern Tasmania. I. Study Area and Basic Water Characteristics,
W82-03322 1507 5C

TASTE
Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

Treating Taste and Odour Problems Using Ozone and Activated Carbon,
W82-04553 1510 5F

TATLOCKIA
Isolation of Pittsburgh Pneumonia Agent from a Hospital Shower,
W82-06891 1512 5B

TAXONOMY
The Prediction of Lacustrine Phytoplankton Diversity,
W82-00319 1501 2H

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 1504 5A

Plankton Studies in San Francisco Bay. II. Phytoplankton Abundance and Species Composition, July 1977 - December 1979,
W82-02832 1506 2L

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 1510 5C

Bacteria Under the Ice,
W82-06561 1512 5A

Seasonal and Diurnal Changes in the Predominant Heterotrophic Bacterial Species of the Meduxnekeag River,
W82-06562 1512 5A

TECHNICAL SOCIETIES
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 1504 6G

TECHNOLOGY
Dredging and Disposal of Toxic Material Using Japanese Technology Suggested for United States,
W82-01026 1502 5E

EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 1508 5D

Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 1511 5F

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 1511 5A

TECHNOLOGY TRANSFER
A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

Urgent Problems in the Transfer of Water Resources Knowledge,
W82-03802 1509 7C

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 1511 3A

Desalination Directory 1981.
W82-05908 1512 3A

TECTONICS
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 1504 8E

Disequilibrium Profile of the Potomac River Near Washington, D.C. - A Result of Lowered Base Level or Quaternary Tectonics Along the Fall Line,
W82-05134 1511 2E

TEES RIVER
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 1504 2K

TEESTA RIVER
Statistical Forecasting of Heavy Rain and Floods in the River Teesta,
W82-04670 1510 2B

TEHAMA-COLUSA CANAL
West Sacramento Canal Unit Reformulation.
W82-02974 1506 6B

TELEMETRY
Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 1510 5G

Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 1511 7B

New Telemetry System for the Cambridge Water Company.
W82-04852 1511 5F

Telemetry and Real Time Environmental Data Acquisition (la Telemetrie et l'Acquisition en Temps Reel des Donnees sur l'Environnement),
W82-05770 1511 7B

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

Comparison of Automated Satellite Systems with Conventional Systems for Hydrologic Data Collection in West-Central Florida,
W82-06951 1512 7B

TELTOW CANAL
Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

TEMPERATURE
Temperature and Solute-Transport Simulation in Streamflow Using a Lagrangian Reference Frame,
W82-00726 1502 2E

Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

The Effect of Environmental Factors on Phytoplankton Growth: Temperature and the Interactions of Temperature with Nutrient Limitation,
W82-02221 1505 2H

Correlation of Oxygen 18 in Precipitation with Temperature and Altitude,
W82-03203 1507 2A

Physical Variability and Phytoplankton Communities: II. Primary Productivity by Phytoplankton in a Physically Variable Environment,
W82-03336 1507 5C

Estimation of Primary Productivity in Aquatic Systems Using Free Oxygen Measurements,
W82-04256 1510 2H

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 1510 5D

Calculation of the Temperature Regime of Hydraulic Fill Dams During Their Construction,
W82-04760 1511 8D

A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 1511 7B

Variability of Temperature, Salinity and Tidally-Averaged Density in the Middle Estuary of the St. Lawrence,
W82-06533 1512 2L

TEMPERATURE CONTROL
On August Mean Temperature and the Succeeding Season's Rainfall Over South Africa,
W82-00692 1502 2B

TEMPERATURE EFFECT
Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

TEMPERATURE EFFECTS
Relationship Between Thermal Stability and Summer Oxygen Depletion in a Prairie Pothole Lake,
W82-00545 1502 2H

Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 1502 5C

Influence of Seasonal Temperature on the Temperature Optima of Bacteria in Sediments of Lake George, New York,
W82-00606 1502 2H

The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 1502 2I

Annual Succession of Phytoplankton in One Heated Pond in Central Finland,
W82-00673 1502 5C

Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 1502 2I

Buoyancy Force Reversals in Vertical Natural Convection Flows in Cold Water,
W82-00981 1502 1A

Numerical Simulation of the Effects of Cooling Tower Complexes on Clouds and Severe Storms,
W82-00995 1502 2B

River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 1504 2H

Mixing Zone Analysis for River Plumes,
W82-01961 1504 5B

Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 1505 2H

Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 1505 2H

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

Field Studies of the Temperature Regime and Stress State of the Concrete in Arch Dams Subjected to Various Methods of Cooling,
W82-02387 1505 8A

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 1505 5C

Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 1505 5C

Chironomidae (Diptera) of Baldwin Lake, Illinois, a Cooling Reservoir,
W82-02620 1506 2H

Coupled Heat and Water Flows Around Buried Cables,
W82-02680 1506 2G

On-Site Investigations of the Contact Zone of the Upstream Face of the Concrete Dam on the Ust-Ilim Hydroelectric Station,
W82-02773 1506 8A

An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 1507 7B

Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 1507 5D

Combined Effects of Biological Solids Retention Time and Temperature on the Growth Parameters of Activated Sludge,
W82-04021 1509 5D

Temperature Effects on Biostabilization of Leachate,
W82-04044 1509 5D

Effect of Temperature on Heterotrophic Glucose Uptake, Mineralization, and Turnover Rates in Lake Sediments,
W82-04466 1510 2H

Several Plume Flows in Pure and Saline Water at Its Density Extremum,
W82-05088 1511 2E

Controlled Nucleation and Quasi-Ordered Growth of Ice Crystals From Low Temperature Electrolyte Solutions,
W82-05123 1511 2C

Influence of Temperature on the Anaerobic Acidification of Glucose in a Mixed Culture Forming Part of a Two-Stage Digestion Process,
W82-05240 1511 5D

Biological Monitoring. Part V - Preference and Avoidance Studies,
W82-05340 1511 5C

Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 1511 5D

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

Influence of Temperature and Time of Incubation on the Estimation of Bacterial Numbers in Tropical Surface Waters,
W82-06037 1512 5A

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 1512 5D

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

TEMPERATURE GRADIENT
The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 1508 2H

TEMPORAL DISTRIBUTION
Time Distribution of Clock Hour Rainfall,
W82-01402 1503 2A

Recent Acidification of Precipitation in North America,
W82-01514 1503 5B

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 1503 2H

Physical Variability and Phytoplankton Communities IV. Temporal Changes in the Phytoplankton Community of a Physically Variable Lake,
W82-03229 1507 2H

Downcore Variation in Sediment Organic Nitrogen,
W82-05124 1511 2H

Variations in Moisture Deficits over the Maize-Growing Region of South Africa II: Temporal Aspects,
W82-05900 1511 2B

TENNESSEE

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

The U.S. Geological Survey Coal Hydrology Program and the Potential of Hydrologic Models for Impact Assessments,
W82-00429 1501 6E

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 1503 2E

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 1503 2F

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 1504 5B

LARM Two-Dimensional Model: An Evaluation,
W82-02597 1505 4A

An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 1512 7C

Biotransformation of PCB by Natural Assemblages of Freshwater Microorganisms,
W82-06719 1512 5B

TENNESSEE RIVER BASIN

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 1503 6D

TENNESSEE-TOMBIGBEE WATERWAY

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

The Waterway That Cannot be Stopped,
W82-00510 1502 6E

TENNESSEE VALLEY AUTHORITY

TVA's Pumped-Storage Plant.
W82-03250 1507 8A

TERBUTRYN

Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 1502 5A

Degradation of Terbutryn in Sediments and Water Under Various Redox Conditions,
W82-06790 1512 5B

TERRACING

Terrace Planning Criteria for Runoff Control for Deep Loess Soil,
W82-00144 1501 4D

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 1503 4D

TERRAIN ANALYSIS

Hydraulic Resistance of Floodplains,
W82-02850 1506 2E

A Stochastic Model of Soil Erosion,
W82-05298 1511 2J

TERROR LAKE

Final Environmental Impact Statement; Terror Lake Project No. 2743 - Alaska.
W82-00353 1501 6G

TERTIARY TREATMENT

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catecinol,
W82-00408 1501 5D

The Tertiary Treatment of Sewages. Conclusion,
W82-03228 1507 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--II. Biological Productivity of Artificial Food Chains,
W82-04197 1509 5D

TERTIARY WASTEWATER TREATMENT

Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

Estimation of Primary Productivity from Diel Nitrate Uptake Measurements of the Water Hyacinth Eichhornia Crassipes in an Aquaculture System,
W82-02635 1506 5D

Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewater--IV. Conclusions, Design and Operational Considerations for Artificial Food Chains,
W82-04369 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--III. Uptake of Dissolved Heavy Metals by Artificial Food Chains,
W82-04370 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Experiences with Purification Lakes and Polishing Lagoons,
W82-05241 1511 5D

Use of Synthetic Adsorbents in Chemical Processes,
W82-05404 1511 5D

Electrochemical Processes for Wastewater Treatment,
W82-05422 1511 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

Land Application of Secondary Effluent at Lake George, NY,
W82-05704 1511 5D

Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 1512 5D

Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

Application of Ozone to Eliminate Tertiary Treatment of Wastewater Used for Industrial Cooling,
W82-06709 1512 5F

TEST HOLES

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

TEST WELLS

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 1503 7C

The Value of Exploratory Test Holes in Ground Water Development,
W82-03896 1509 2F

Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico,
W82-04517 1510 5B

On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 1512 8B

Summary of Hydrologic Testing in Tertiary Limestone Aquifer, Tenneco Offshore Exploratory Well--Atlantic OCS, Lease-Block 427 (Jacksonville NH 17-5),
W82-06685 1512 2F

Data from Geothermal Test Wells Near Mount Hood, Oregon,
W82-06950 1512 7A

TESTING PROCEDURES

Design and Development of an Automated Hydrostatic Flexible Membrane Test Facility,
W82-02978 1506 8G

Recording Unconfined Tension Tester,
W82-04238 1509 8D

Turbines for Itaipu,
W82-04955 1511 8C

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 1511 8C

Infiltration Inflow Analysis: Finding the Source,
W82-05038 1511 5B

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 1511 5A

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 1511 5C

Ames Salmonella Mutagenicity Assays on Water: Dichloromethane Extracts Versus Preparation of Growth Media with Test Samples,
W82-06548 1512 5A

TETON DAM
Mathematical Modeling of Earth Dam Breaches,
W82-03533 1508 8A

TETRAALKYLEAD COMPOUNDS
Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

TETRAETHYL LEAD (TET)
Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

TETRAZOLIUM
Tetrazolium Reduction-Malachite Green Method for Assessing the Viability of Filamentous Bacteria in Activated Sludge,
W82-06752 1512 5D

TEXAS
Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 1501 7C

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

Preliminary Data From a Series of Artificial Recharge Experiments at Stanton, Texas,
W82-00085 1501 7C

Optimal Design of Water Conveyance Systems,
W82-00160 1501 6B

Interpretation of Surface-Water Circulation, Aransas Pass, Texas, Using Landsat Imagery,
W82-00904 1502 7B

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 1502 5C

Effects of Water Quality on Forage Production,
W82-01002 1502 3C

Variations in Precipitation Parameters Between Drought and Non-Drought Periods in Texas and Some Implications for Cloud Seeding,
W82-01006 1502 2B

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 1503 7C

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 1505 6G

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

The Mouth of the Colorado River Project; An Economic Development Environmental Enhancement Project,
W82-02148 1505 4A

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

Loss of Colorado River Inflows to Matagorda Bay, Texas, and Efforts for Restoration,
W82-02151 1505 4A

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

Texas to Vote on Water Trust Fund.
W82-02302 1505 6C

Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 1505 2H

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 1505 2F

Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980,
W82-02491 1505 7C

Water Quality of a Southeast Texas Stream,
W82-02570 1505 2K

Operation Policy Analysis: Sam Rayburn Reservoir,
W82-02589 1505 6A

Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 1507 6E

The Origin and Isotopic Composition of Dissolved Sulfide in Groundwater from Carbonate Aquifers in Florida and Texas,
W82-03644 1508 2K

Paleoflood Hydrology,
W82-03761 1509 2E

Hydrologic Data for North Creek Trinity River Basin, Texas, 1979,
W82-03979 1509 2E

Access to Water-Related Data in Texas,
W82-04000 1509 10B

Evaluation of Hydropower Potential in a River Basin,
W82-04214 1509 6B

Problems of Public Access to Water in Texas Lakes and Streams,
W82-04220 1509 6E

Conjunctive Management of Water Resources in the Context of Texas Water Law,
W82-04223 1509 6E

Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 1510 5C

TNRIS: A Source for Water-Related Data in Texas.
W82-04651 1510 10B

Analysis of Marine Sediment, Water and Biota for Selected Organic Pollutants,
W82-04823 1511 5A

Ground-Water Hydrology Around Salt Domes in the East Texas Basin: A Practical Approach to the Contaminant Transport Problem,
W82-05202 1511 5B

Test-Hole Data for the Edwards Aquifer in the San Antonio Area, Texas,
W82-05218 1511 7C

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

Improved Water and Nutrient Management Through High Frequency Irrigation,
W82-05313 1511 3F

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

Common Facility Treatment of Industrial Wastewaters,
W82-05974 1512 5D

Olmos Dam Modification.
W82-06186 1512 8A

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 1512 7C

Watertight Manholes Cut Inflow.
W82-06844 1512 5G

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 1512 5A

Comparative Photoheterotrophy, Chemoheterotrophy, and Photolithotrophy in a Eutrophic Reservoir and an Oligotrophic Lake,
W82-06978 1512 2H

TEXAS HIGH PLAINS
Conservation Ethics for the 1980's,
W82-05009 1511 3D

Economic Effect of Energy Price and Economic Feasibility and Potential of New Technology and Improved Management for Irrigation in Texas,
W82-06374 1512 3F

TEXAS NATURAL RESOURCES INFORMATION SYSTEM
Access to Water-Related Data in Texas,
W82-04000 1509 10B

TEXTILE MILL WASTES
Textile Effluents Lose Their Color.
W82-00342 1501 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 1502 5D

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

Textile Wastes,
W82-01259 1503 5D

Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 1504 5D

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 1506 5C

Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

Drainability of Aerobically Digested Biological Sludge from Textile Waste,
W82-05261 1511 5E

Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 1512 5D

Esholt–Past, Present and Future,
W82-06653 1512 5D

Textile Wastes,
W82-06916 1512 5D

TFM
A Rapid High-Performance Liquid-Chromatographic Method for Simultaneously Determining the Concentrations of TFM and Bayer 73 in Water During Lampricide Treatments,
W82-06495 1512 5A

THAILAND
Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 1505 6A

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 1506 6D

Economic Appraisal of a Groundwater Development Project,
W82-03077 1507 6B

Hydrodynamic Response of Nakhon Luang Aquifer, Bangkok, Thailand,
W82-03576 1508 4B

Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 1511 6G

Water Supply Development in Thailand.
W82-06367 1512 6B

Heavy Metal Pollution in the Chao Phraya River Estuary, Thailand,
W82-06774 1512 5B

Saltwater Encroachment in an Aquifer: A Case Study,
W82-06864 1512 2F

THALLIUM
A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 1501 5A

THAMES ESTUARY
Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 1505 5G

The Background to the Flood Defences of London and the Thames Estuary,
W82-03895 1509 4A

Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 1512 5B

THAMES RIVER
Bioassays of Waters from the Severn and Thames River Systems,
W82-02448 1505 5A

The Thames Barrier,
W82-04039 1509 4A

Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 1510 2L

Data Acquisition for River Management,
W82-04601 1510 7A

Microbial Ecology of River Deposits in the Rivers Kennet and Thames at Reading, England,
W82-04688 1510 5C

THAMES RIVER ESTUARY (USA)
An Analysis of Selected Classes of Organic Constituents in the Thames River Estuary,
W82-03819 1509 2L

THAMES WATER AUTHORITY
The Sewerage Policy of Thames Water,
W82-02040 1504 6E

The Risk Business,
W82-03281 1507 6E

THE GEYSERS
Helium Isotopes in Geothermal Systems: Iceland, The Geysers, Raft River and Steamboat Springs,
W82-06085 1512 2F

THE NETHERLANDS
Applicability of Light Absorbance as a Measure of Organic Carbon in Humic Lake Water,
W82-06773 1512 5A

The Distribution of Aquatic Oligochaetes in Brackish Inland Waters in the SW Netherlands,
W82-06905 1512 5B

Multiple Addition Bioassay of Tjeukemeer Water,
W82-06907 1512 5C

THEIS EQUATION
Inverse Solutions of the Theis Equation Determined with Programmable Calculators. II. Determination of Aquifer Hydraulic Constants from Numerical Test Data,
W82-03481 1508 2F

THEODORE ROOSEVELT DAM
Hydraulic Model Studies of Theodore Roosevelt Dam - South Spillway,
W82-03051 1507 8A

THEORETICAL ANALYSES
The Economics of Cooperation Over Collective Bads,
W82-01909 1504 6A

Numerical Solution of the Dam Failure Problem by the Random Choice Method,
W82-03872 1509 8A

Water and Salt Transport in Membranes,
W82-05537 1511 3A

THERMAL CONDUCTIVITY
Influence of Heat Dispersion on Steady Convection in Anisotropic Porous Media,
W82-02924 1506 2F

THERMAL DISCHARGES
Impact of Thermal Standards on Power Plant Water Consumption,
W82-06057 1512 5G

THERMAL POLLUTIHON
Characterization of Drained and Undrained Response of Thermally Loaded Repository Rocks,
W82-03904 1512 2F

THERMAL POLLUTION
Domestic Water Supplies for Power Plant Cooling,
W82-00180 1501 6D

Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C

Effect of Temperature on Mineralization by Heterotrophic Bacteria,
W82-00583 1502 5C

Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 1502 5C

Effects of Hypolimnetic Discharge on Fish Health Below a Reservoir,
W82-00805 1502 5C

Effects of Thermal Effluents on Communities of Benthic Marine Macroalgae,
W82-00870 1502 5C

A Quantitative Study of Shoreline Marsh Communities Along Lake Huron in Ontario,
W82-01122 1503 2H

Power Industry Wastes,
W82-01265 1503 5B

Thermal Effects,
W82-01275 1503 5C

River Thermal Standards Costs in the Upper Midwest,
W82-01655 1503 6B

Mixing Zone Analysis for River Plumes,
W82-01961 1504 5B

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 1504 5C

Productivity and Species Composition of Algal Mat Communities Exposed to a Fluctuating Thermal Regime,
W82-02356 1505 5C

Structural Characteristics of Algal Communities in Thermal Altered Artificial Streams,
W82-02399 1505 5C

Multiport Diffuser Mixing Zones in Rivers,
W82-02594 1505 5B

Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 1507 5C

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

The Structure of Benthic Communities in an Area of Thermal Discharge from a Coastal Power Station,
W82-03205 1507 5C

Reciprocating Hail Processes in the Alps,
W82-03227 1507 2B

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

Heated Discharge in an Estuary: Case Study,
W82-03674 1508 2L

Attached Algae of the Lake Erie Shoreline Near Nanticoke Generating Station,
W82-04035 1509 5C

Vertical Round Buoyant Jet in Shallow Water,
W82-04365 1510 7C

Nearfield Performance of River Diffusers,
W82-04561 1510 5B

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant,
W82-04836 1511 5C

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

Fish Abundance and Distribution Near Three Heated Effluents to Lake Michigan,
W82-05383 1511 5C

Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 1511 5C

Experiments on Coaxial Heated Water Discharges,
W82-06422 1512 5B

Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 1512 5C

Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

Thermal Effects,
W82-06809 1512 5C

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 1512 2F

The Removal of a Headed Discharge From a Lake and the Effect Upon an Epiphytic Algal Community,
W82-06898 1512 5C

Factors Affecting Depth Distribution of Dragonflies and Other Benthic Insects in a Thermally Destabilized Reservoir,
W82-06899 1512 5C

Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 1512 5B

THERMAL POWERPLANTS

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 1504 5D

Geothermal Energy: An Old Ally,
W82-02333 1505 2F

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

THERMAL PROPERTIES

Cooling Potential of Missouri River in Missouri,
W82-01654 1503 5B

Thermal Convection in a Nonhomogeneous Aquifer,
W82-02288 1505 2F

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 1510 2K

Thermal Regimes of Florida Lakes, A Comparison with Biotic and Climatic Transitions,
W82-04943 1511 2H

THERMAL SPRINGS

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Geochemistry of Thermal and Mineral Waters in the Cascade Mountains of Western North America,
W82-04673 1510 2K

THERMAL STRATIFICATION

Some Types of Temperature Inversion Encountered in a Freshwater Lake with Short Residence Time,
W82-02224 1505 2H

Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

Winter Temperature Structure in Lake Huron,
W82-04381 1510 2H

Convection Patterns in a Pond,
W82-04461 1510 2C

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 1510 2H

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 1512 5G

Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 1512 2H

THERMAL STRATIFICATION PREVENTION

Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 1503 5G

THERMAL STRESS

Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C

Postspawning Mortality of Rainbow Smelt in Western Lake Superior,
W82-01189 1503 5C

Response of Subtropical Phytoplankton to Power Plant Entrainment,
W82-02708 1506 5C

Seasonal Temperature and Power Plant Chlorination Effects on Estuarine Invertebrates,
W82-05204 1511 5C

Thermal Effects,
W82-06809 1512 5C

THERMAL WATER

A Mathematical Model for Consolidation in a Thermoelastic Aquifer Due to Hot Water Injection or Pumping,
W82-00602 1502 2F

Thermal Energy Storage in a Confined Aquifer: Second Cycle,
W82-01473 1503 4B

Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 1504 5B

Aquifer Thermal Energy Storage: A Numerical Simulation of Auburn University Field Experiments,
W82-02919 1506 4B

A Problem Posed by Vapour-Dominated Geothermal Systems,
W82-03200 1507 1A

Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

Field Observations of Fronts and High-Frequency Temperature Fluctuations in a Thermal Plume,
W82-03595 1508 5B

The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

Thermal Front Formation from Buoyant Surface Jets,
W82-05004 1511 5C

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82-06058 1512 4B

Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

Horizontal Recirculation in Water Bodies Due to Thermal Discharge,
W82-06723 1512 5C

Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

A Dimensionless Parameter Approach to the Thermal Behavior of an Aquifer Thermal Energy Storage System,
W82-06861 1512 2F

THERMOCLINE

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 1504 2H

Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1507 1A

Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 1508 2H

A Note on the Development of the Thermocline in Temperate Lakes,
W82-03622 1508 2H

Thermocline Drawdown Above Cooling Water Intakes,
W82-05560 1511 8C

Vertical Movements of the Surface Water and Thermal Stratification in Rutland Water,
W82-06476 1512 2H

THERMOCOUPLES
Effects of Joule Heating on Thermocouple Psychrometer Water Potential Determinations,
W82-00892 1502 7B

THERMODYNAMICS
Solution Species of Plutonium in the Environment,
W82-00163 1501 5A

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

Survey of Present Knowledge on Cavitation in Liquids Other Than Cold Water (Thermodynamic Effect),
W82-05280 1511 8B

Ion Hydration and Ion Interaction,
W82-05310 1511 2K

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 1512 5G

THERMOMECHANICAL PULPING PROCESS
High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

THERMOSIPHONING
Two-Phase Flow Thermosiphoning for Evaporator Application,
W82-05916 1512 3A

THIN LAYER CHROMATOGRAPHY
General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

THIOCYANATES
Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

THOREU'S BOG
Biogeochemistry of Thoreau's Bog, Concord, Massachusetts,
W82-00887 1502 2K

THORIUM
Absorption of Radium and Thorium From New Mexico Uranium Mill Tailing Solutions,
W82-00040 1501 5D

THREE MILE ISLAND
Submerged Demineralization System to Be Used to Process TMI Wastewater,
W82-02621 1506 5D

THREE MILE ISLAND NUCLEAR STATION
Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

THUNDERSTORMS
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 1502 2B

Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 1504 2B

Disaster by Flood,
W82-04618 1510 2E

THUNERSTORMS
Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

TIBBS RUN LAKE
Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

TIBER RIVER
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 1504 2L

TIDAL BASINS
A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

TIDAL CURRENTS
A Numerical Simulation of the Vertical and Horizontal M2 Tide in the Bristol Channel and Comparisons with Observed Data,
W82-02193 1505 2L

TIDAL EFFECTS
Neap-Spring Tide Sequences of Intertidal Shoal Deposits in a Mesotidal Estuary,
W82-00[illegible]12 1501 2L

Circulation and Energetics of a Deep, Strongly Stratified Inlet,
W82-00547 1502 2L

General Morphology and Sediment Patterns in Tidal Inlets,
W82-00792 1502 2L

Salt Dispersion in the Hudson Estuary,
W82-01615 1503 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W8[illegible]-01749 1503 2L

Tide-Induced Residual Flow in Shallow Bays,
W82-02003 1504 2L

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 1505 2L

Atoll Island Hydrology,
W82-02617 1506 2F

The Effect of Tidal Heights on the Distribution and Abundance of Coliform Bacteria in the Sediments of Two Sites in the Mersey Estuary,
W82-03180 1507 2L

Deep Water Renewal in Subarctic Fjord,
W82-03675 1508 2L

Salinity Intrusion in Estuaries,
W82-04574 1510 2L

The Unterweser Automatic Water Quality Measurement System,
W82-04588 1510 5A

Dynamic Estuary Model Performance,
W82-05319 1511 2L

Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 1511 4B

On the Diel Rhythm for Phytoplankton Productivity in Shatt Al-Arab at Basrah, Iraq,
W82-06763 1512 5C

TIDAL FLATS
The Variation in Suspended Sediment and Water Properties in the Flood-Water Front Traversing the Tidal Flat,
W82-02928 1506 2L

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

Sediment Water Exchanges of Nutrients and Oxygen on Tidal Flats in the Ems-Dollart Estuary,
W82-04751 1511 2L

TIDAL FLOODS
The Background to the Flood Defences of London and the Thames Estuary,
W82-03895 1509 4A

TIDAL MARSHES
Geomorphic and Hydraulic Evolution of Tidal Creeks on a Subsiding Beach Ridge Plain, North Inlet, S.C.,
W82-00150 1501 2L

Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

Nutrient Flux Between the Nueces Deltaic Marsh and the Nueces Estuary on the Texas Gulf Coast,
W82-02134 1505 2L

Phytoplankton Production and Community Composition in a Marsh-Dominated Estuary Which Receives Sewage Waste,
W82-02179 1505 5C

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 1505 2I

Oregon Coastal Salt Marsh Upper Limits and Tidal Datums,
W82-04312 1510 2L

The Ecology of New England High Salt Marshes: A Community Profile,
W82-06096 1512 2L

Vegetation Structure and Diversity Components of a Fraser Estuary Tidal Marsh,
W82-06465 1512 2L

Vegetation-Environment Relations in a Brackish Marsh, Lulu Island, Richmond, B.C.,
W82-06497 1512 2L

TIDAL POWERPLANTS
Sedimentological and Biological Changes in the Windsor Mudflat, an Area of Induced Siltation,
W82-00548 1502 5C

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 1502 6G

Severn Barrage Scheme Gets Favourable Response.
W82-02089 1504 6B

TIDAL RANGE
Tides and Tidal Datums in the United States,
W82-02982 1506 2A

Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 1510 7B

TIDAL RIVERS
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 1506 5B

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998 1509 2L

Electromagnetic Measurements of Tidal Transports in Estuaries,
W82-04296 1510 7B

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

TIDAL WATERS
Modeling the Environmental Effects of a Navigation Channel in a Tidal Bay,
W82-04449 1510 6G

TIDE LANDS
Effect of Agricultural Land Development on Drainage Waters in the North Carolina Tidewater Region,
W82-00094 1501 5B

A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 1511 2L

TIDES
Linearized Solution to Inlet Equation with Inertia,
W82-01183 1503 2L

Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 1504 2L

Concentration, Extent, and Duration of Salinity Intrusion into the Columbia River Estuary, September-October, 1977-1978,
W82-02139 1505 2L

Tides and Tidal Datums in the United States,
W82-02982 1506 2A

Radar Measurements of Estuarine Currents and Tides,
W82-03360 1507 2L

A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

Prediction of Water Level in Tidal Inlet,
W82-05005 1511 4A

A New Method of Cubature Using Spline Functions,
W82-05189 1511 2L

Statistical Search for High Water at Board Landing Bridge, Truro, Nova Scotia,
W82-06394 1512 2L

TIDEWATER
The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 1503 6E

TILAPIA
Trace Metal Concentrations in Oxidation Ponds,
W82-02703 1506 5D

TILE DRAINAGE
Projected Tile Effluent Effects on the Oldman River,
W82-00333 1501 5C

Impact of Water Resource Development on Salinization of Semi-Arid Lands,
W82-01024 1502 5B

Phosphorus Concentration-Water Flow Interactions in Tile Effluent from Manured Land,
W82-01340 1503 5B

Effects of Dairy Manure on Phosphorus Concentrations and Losses in Tile Effluent,
W82-01479 1503 5B

Nitrate-Nitrogen in Tile Drainage as Affected by Fertilization,
W82-02269 1505 5B

Analysis of Three-Dimensional Flows into Draintile,
W82-03803 1509 2G

Simple Equations for Hooghoudt Equivalent Depth,
W82-04271 1510 4A

Pumped Outlets for Drainage Systems,
W82-04364 1510 8A

TILE DRAINS
Measuring the Hydraulic Conductivity of Soil Adjacent to Tile Drains in a Heavy Clay Soil in the Netherlands,
W82-01323 1503 2G

TILLATOBA CREEK BASIN
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

TIME OF TRAVEL
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

TIME SERIES ANALYSIS
Small-Scale Hydro in New England: 1960-1976,
W82-00169 1501 6D

Modeling Hydrologic Time Series from the Arctic,
W82-01198 1503 2A

Upland Marsh for Water Quality Control,
W82-01962 1504 5B

A Monthly Time Series Model of Municipal Water Demand,
W82-02263 1505 6D

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 1505 5G

A Study of Low-Flow Operation of Milford and Elk City Lakes in Kansas,
W82-04964 1511 2E

The Tidal Stream in the German Bight,
W82-05190 1511 2L

On the Relationship Between the Reliability of Parameter Estimates and Hydrologic Time Series Data Used in Calibration,
W82-05490 1511 2A

Analyzing and Predicting Irrigation Diversions in Southeastern Idaho,
W82-05924 1512 3F

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologiaches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 1512 4A

TIN
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 1502 5A

TIN COMPOUNDS
Methylation of Trimethyltin Compounds by Estuarine Sediments,
W82-00801 1502 5B

TISSUE ANALYSIS
Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

TITANIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 1504 5A

TITRATION
Chloride Determination in Automated Water Composition Monitoring (Chloridbestimmung in der Automatisierten Wasserbeschaffenheitskontrolle),
W82-04580 1510 5A

TOCCOA FALLS
Mathematical Simulations of The Toccoa Falls, Georgia Dam Break Flood,
W82-03920 1509 2E

TOILETS
Reducing the Flush,
W82-04654 1510 3D

TOKYO
Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments--III. Phenols and Aromatic Acids in Polluted and Unpolluted Waters,
W82-06033 1512 5A

TOKYO BAY
Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 1505 5A

TOLO HARBOUR
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

TOMATOES
Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

The Effect of Temperature on Salt Uptake by Tomato Plants With Diurnal and Nocturnal Waterlogging of Salinized Rootzones,
W82-00608 1502 2I

Drought Susceptibility of Two Tomato (Lycopersicum Esculentum) Varieties,
W82-01369 1503 2I

Environmental Fate of Methyl Eugenol,
W82-02013 1504 5B

TOMBIGBEE-WARRIOR RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 1504 6D

TONGUE RIVER BASIN
Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

TONGUE RIVER RESERVOIR
Relation Between Trophic Position and Mercury Accumulation Among Fishes from the Tongue River Reservoir, Montana,
W82-01041 1502 5A

TOOLIK LAKE
Summer Population Fluctuations, Feeding, and Growth of Hydra in an Arctic Lake,
W82-02287 1505 2H

Effects of Petroleum Hydrocarbons on Plant Litter Microbiota in an Arctic Lake,
W82-04455 1510 5C

TOPOGRAPHY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 1503 2F

Effect of Soil Slope and Rainfall Characteristics on Phosphorus in Runoff,
W82-04859 1511 5B

Changes in Bottom Topography of the Western Shelf on the Nile Delta Since 1922,
W82-06094 1512 2J

TOPSOIL
Topsoil Management of Mined Soils,
W82-04571 1510 4D

TORONTO
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 1504 4A

Water Management in the Metropolitan Toronto Region,
W82-05775 1511 6B

TORONTO HARBOR
Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 1505 7B

TOTAL ORGANIC CARBON
Organics,
W82-01239 1503 5A

TOXICITY
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Biological Consequences of Treating a Lake with Hydrogen Peroxide on the Plankton Biocenosis (Biologiques Du Traitement D'Un Lac Avec Du Peroxyde D'Hydrogene Sur La Biocenose Planctonique),
W82-00305 1501 2H

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

Clinical Tests in Aquatic Toxicology: State of the Art,
W82-00464 1501 5A

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 1501 5B

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 1502 5C

Effect of Ozonation and Chlorination on the Mutagenic Potential of Drinking Water,
W82-00649 1502 5A

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 1502 5F

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 1502 5C

Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 1502 5A

Serum Enzymes in Rainbow Trout as Tools in the Diagnosis of Water Quality,
W82-00857 1502 5A

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

Toxic Dinoflagellates and Tidal Power Generation in the Bay of Fundy, Canada,
W82-00908 1502 6G

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 1502 5D

The Activity of Environmental Samples in a Cell Culture Test for Asbestos Toxicity,
W82-01031 1502 5C

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 1502 5C

Acute Toxicity of Leachates from Coal Gasification and Liquefaction Solid Wastes to the Fathead Minnow, Pimephales Promelas,
W82-01108 1503 5C

Interactive Effects of Metals in Mixtures on Biomass Production Kinetics of Freshwater Copepods,
W82-01125 1503 5C

Toxicity and Bioaccumulation of Endrin and Methoxychlor in Aquatic Invertebrates and Fish,
W82-01160 1503 5C

Abundance of Organic Compounds in Water,
W82-01162 1503 5A

Substrate Associated Microfauna,
W82-01283 1503 5C

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

Abate: Effects of the Organophosphate Insecticide on Bluegills and Invertebrates in Ponds,
W82-01445 1503 5C

Collapsing Aphanizomenon Flos-Aquae Blooms: Possible Contributions of Photo-Oxidation, O2 Toxicity, and Cyanophages,
W82-01595 1503 2H

Strategies of Response to Copper, Cadmium, and Lead by a Blue-Green and a Green Alga,
W82-01598 1503 5C

Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 1503 5C

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 1503 5C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 1503 5A

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 1504 5C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 1504 5B

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 1504 5A

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 1504 5C

Activated Sludge Nickel Toxicity Studies,
W82-01895 1504 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 1504 5C

Heavy Metals and Marine Phytoplankton: Correlation of Toxicity and Sulfhydryl-Binding,
W82-02272 1505 5C

The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 1505 5C

The Effect of Aquatic Humus on the Biological Availability of Cadmium,
W82-02353 1505 5C

A Chironomus Tentans Bioassay for Testing Synthetic Fuel Products and Effluents, with Data on Acridine and Quinoline,
W82-02630 1506 5C

The Status of Nuclear Waste Management,
W82-02659 1506 5E

Toxicity of Textile Mill Effluents to Freshwater and Estuarine Algae, Crustaceans and Fishes,
W82-02710 1506 5C

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

Reduction of Toxicity to Aquatic Organisms by Industrial Wastewater Treatment,
W82-02971 1506 5C

Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 1506 5C

Microcosms as Test Systems for the Ecological Effects of Toxic Substances: An Appraisal with Cadmium,
W82-03026 1507 5C

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 1507 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 1507 5A

Biological Monitoring Part VI - Future Needs,
W82-03230 1507 5C

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 1508 5D

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 1508 5C

Temperature Effects on Hydrazine Toxicity to Bluegills,
W82-03603 1508 5C

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

Evidence for Metal Poisoning in Acute Deaths of Large Red Drum (Sciaenops Ocellata),
W82-03606 1508 5C

Hemosiderin Granules: Cytotoxic Response to Arsenic Exposure in Channel Catfish,
W82-03607 1508 5C

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 1508 5C

Kraft Pulp Mill Effluent and Sediment Can Retard Development and Lyse Sea Urchin Eggs,
W82-03610 1508 5C

Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678 1508 5C

Dutch Dumps,
W82-03738 1508 5B

Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

Sister Chromatid Exchange as an Indicator of Short Term Chemical Stress in Aquatic Systems,
W82-04161 1509 5A

Effects of Phenol on Oxygen Consumption in The Whelk, Bullia Digitalis (Dillwyn),
W82-04262 1510 5C

Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 1510 5C

Toxicity of Nitrite to Larvae of the Salamander Ambystoma Texanum,
W82-04529 1510 5C

A Correlation Study of Biodegradability Determinations with Various Chemicals in Various Tests II. Additional Results and Conclusions,
W82-04534 1510 5B

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

Biodegradation of 14C-Tris(2,3-Dibromopropyl) Phosphate in a Laboratory Activated Sludge System,
W82-04833 1511 5D

Toxicity of Anakeesta Formation Leachates to Shovel-Nosed Salamander, Great Smoky Mountains National Park,
W82-04988 1511 5C

Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

The Aquatic Toxicity of Organic Compounds to Embryo-Larval Stages of Fish and Amphibians,
W82-05283 1511 5C

Some Features of the Toxic Action of the Non-Ionic Surfactant Laurox-9 on Daphnia Magna,
W82-05328 1511 5C

Biological Monitoring, Part IV - Toxicity Testing,
W82-05339 1511 5C

Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 1511 5C

Evaluation of Bacterial Binding and Release of Cadmium from Aquatic Sediments,
W82-05934 1512 5C

A Practical and Reliable Method for Monitoring the Toxicity of Aquatic Samples,
W82-05951 1512 5A

High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

The Acute Toxicity of Motor Fuels to Brackish Water Organisms,
W82-05985 1512 5C

Physiological and Biochemical Responses of Several Freshwater Algae to a Mixture of Metals,
W82-05996 1512 5C

Bioassay Trials with Twenty Three Pesticides to a Fresh Water Teleost, Saccobranchus Fossilis,
W82-06031 1512 5C

A Bioassay Technique Using Tetrahymena Pyriformis for the Rapid Assessment of Toxicants in Water,
W82-06032 1512 5A

Qualitative and Quantitative Studies on the In Situ Adsorption, Degradation and Toxicity of Acrylamide by the Spiking of the Waters of Two Sewage Works and a River,
W82-06044 1512 5D

A Rapid Method for Determining the Toxicity of Chemicals to Activated Sludge,
W82-06048 1512 5D

Environmental Improvement at Port Alice, B. C.,
W82-06515 1512 5C

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

Freshwater Macroinvertebrates,
W82-06797 1512 5C

Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

TOXINS

An Aquatic Respirometer for Use in Sublethal Studies,
W82-00122 1501 5C

Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 1501 5F

Toxics in Municipal and Industrial Wastewaters,
W82-00712 1502 5A

Bioassays - Procedures and Results,
W82-01277 1503 5A

Comparison of Groundwater and Surface Water for Patterns and Levels of Contamination by Toxic Substances,
W82-02541 1505 5A

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 1507 5G

1981 Report on Great Lakes Water Quality.
W82-03102 1507 5G

Water Quality: What Should Be Done Today,
W82-03631 1508 6E

Breakthrough Characteristics of Selected Toxicants in Granular Activated Carbon Treatment of Combined Industrial Wastewaters,
W82-03812 1509 5D

The BASF Toximeter - A Helpful Instrument to Control and Monitor Biological Waste Water Treatment Plants,
W82-04050 1509 5A

Surrogate Parameter Analysis for Organic Priority Pollutants,
W82-04704 1510 5A

Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 1511 5A

Fingerprinting Inorganic Arsenic and Organoarsenic Compounds in the Situ Oil Shale Retort and Process Waters Using a Liquid Chromatograph Coupled with an Atomic Absorption Spectrometer as a Detector,
W82-05151 1511 5A

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 1511 5A

A New Sensitive and Simple Spot Test for the Detection of Tertiary Amine Pollutants in Water,
W82-05483 1511 5A

Occurrence of Endotoxins in Groundwater During the Land Application of Wastewater,
W82-05810 1511 5B

Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 1512 5C

TRACE ELEMENTS
Trace Metal Geochemistry in Sediments from the Miramichi Estuary, New Brunswick,
W82-00236 1501 5A

Trace Element Concentrations Over Midlake Michigan as a Function of Meteorology and Source Region,
W82-00550 1502 5B

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 1502 5B

Effect of Leachate Flow Rate on Metal Migration Through Soil,
W82-00565 1502 5E

Trace Element Accumulation, Movement, and Distribution in the Soil Profile From Massive Applications of Sewage Sludge,
W82-00640 1502 5E

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 1502 5A

Comparison of Methods for the Determination of Trace Elements in Seawater,
W82-01086 1502 5A

Ferromanganese Nodules from Lake Ontario (Bay of Quinte): Minor Element Geochemistry,
W82-01143 1503 2H

Soluble Element Concentrations and Complexation in Southeastern Lake Michigan,
W82-01147 1503 2H

Preconcentration for Trace Element Determination in Aqueous Samples,
W82-01574 1503 5A

Model of Trace-Metal Partitioning in Marine Sediments,
W82-02824 1506 5B

Minor - Element Distribution in Mineral and Thermal Waters (Repartition des Elements Traces dans les Eaux Thermo-Minerals),
W82-03541 1508 2F

Trace Elements in the Hydrologic Cycle of a Forest Ecosystem,
W82-03690 1508 5B

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

Analysis of Geothermal Waters by Spark Source Mass Spectrometry,
W82-06464 1512 5A

A Study of Selected Great Lakes Coastal Marshes,
W82-06570 1512 5A

TRACE LEVELS
Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

Trace Constituents in Cloud Water, Rainwater and Aerosol Samples Collected near the West Coast of India During the Southwest Monsoon,
W82-00676 1502 2B

Extraction-Spectrophotometric Determination of Sub-Microgram Amounts of Nitrite Using 4-Nitroaniline and Naphth-1-Ol,
W82-03123 1507 5A

Trace Analyses for Wastewaters,
W82-03639 1508 5A

TRACE METALS
Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 1501 5B

Monitoring Trace Amounts of Cadmium in Natural Waters,
W82-00516 1502 5A

Trace Metal Catalysis in Aquatic Environments,
W82-00629 1502 5B

Trace Metal Fluxes to Nearshore Long Island Sound Sediments,
W82-01040 1502 5B

Trace Metal Mineral Equilibria in Lake Erie Sediments,
W82-01191 1503 2H

Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 1503 5A

Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 1504 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 1504 5A

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 1504 2H

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 1504 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 1504 5A

Seasonal Variation in the Trace Metal Content of Mytilus Edulis,
W82-02312 1505 5C

Sources of Twelve Trace Metals in Antarctic Snows Determined by Principal Component Analysis,
W82-02378 1505 5B

Discussion of Trace Metals in the Waters of a Partially-Mixed Estuary,
W82-02542 1505 2L

Kinetics of Trace Metal Partitioning in Model Anoxic Marine Sediments,
W82-02820 1506 5B

Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

Study of the Transfer of Cd, Pb, Cu, and Zn in Neritic and Estuarine Trophic Chains - I. State in the Internal Estuary of the Loire (France) During the Summer of 1978. (Etude du Transfert de Cd, Pb, Cu et Zn dans les Chaines Trophiques Neritiques et Estuariennes - I. Etat dans l'Estuaire Interne de la Loire (France) au Cours de l'Ete 1978),
W82-03492 1508 5B

Speciation of Trace Di- and Triorganotins in Water by Ion-Exchange HPLC-GFAA,
W82-04037 1509 5A

Sedimentation Rates and Depositional Processes in Lake Superior from Pb210 Geochronology,
W82-04380 1510 2J

Selected Trace Metals in the Upper St. Johns River and Their Land Use Relationships,
W82-04718 1510 5B

Mytilus Californianus as a Bioindicator of Trace Metal Pollution: Variability and Statistical Considerations,
W82-04776 1511 5A

Determination of Trace Metals in Estuarine Sediments by Graphite-Furnace Atomic Absorption Spectrometry,
W82-04893 1511 5A

Anthropogenically Derived Changes in the Sedimentary Flux of Mg, Ni, Cu, Zn, Hg, Pb, and P in Lough Neagh, Northern Ireland,
W82-05145 1511 5B

Metal Surveys in South African Estuaries. II. Knysna River,
W82-05897 1511 5B

Metal Surveys in South African Estuaries. I. Swartkops River,
W82-05898 1511 2B

Trace Metal Relationships at the Sediment-Water Interface,
W82-06362 1512 2K

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

Mechanisms for Trace Metal Enrichment at the Surface Microlayer in an Estuarine Salt Marsh,
W82-06975 1512 5A

TRACERS

Carbon Isotopes as Indicators of the Source and Fate of Carbon in Rivers and Estuairies,
W82-00033 1501 5B

Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 1501 5B

The Use of Na/Cl Ratios to Trace Solute Sources in a Semiarid Zone,
W82-00601 1502 7B

Groundwater Contamination by Sanitary Landfill Leachate and Domestic Wastewater in Carbonate Terrain: Principal Source Diagnosis, Chemical Transport Characteristics and Design Implications,
W82-01223 1503 5B

An Approach to Determining Pathways and Residence Time of Groundwaters: Dual Radiotracer Dating,
W82-01348 1503 2F

Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 1504 5D

Characterization of Oil Spills on Inland and Estuarine Waters,
W82-02393 1505 5B

Radiotracer Evaluation of Groundwater Dispersion in a Multi-Layered Aquifer,
W82-02870 1506 2F

A Portable Apparatus for the Measurement of Rate of Flow by the Lithium-Tracer Method,
W82-03428 1508 7B

Hydrological Studies Possible with Radionuclides of Bomb-Test, Primordial and Natural Origin to Complement Investigations Using Manufactured Radiotracers,
W82-03836 1509 5B

Detection of Diethylnitrosamine in Nitrite-Rich Water Following Treatment with Rhodamine Flow Tracers,
W82-05022 1511 5B

TRACKING TECHNIQUES

Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

TRACTIVE FORCES

Tractive Force Design of Vegetated Channels,
W82-00901 1502 4D

Incipient Motion of Sand Particles on Side Slopes,
W82-04368 1510 8D

TRAINING

National Water Data Exchange (NAWDEX) System 2000 Data Retrieval Manual,
W82-00420 1501 10B

Management Training is the Key to Good Operator Performance,
W82-00623 1502 5D

A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

TRANSITION FLOW

Experimental Investigation of Accelerated Transitional Flow in Pipes,
W82-06786 1512 8B

TRANSLOCATION

A Case Study of a Chemical Soil: Polychlorinated Biphenyls (PCBS) I. History, Distribution, and Surface Translocation,
W82-06865 1512 5B

TRANSMISSIVITY

Aquifer Parameter Identification with Optimum Dimension in Parameterization,
W82-00131 1501 2F

The Development of Methods for Determining Aquifer Characteristics,
W82-00827 1502 2F

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 1502 2F

A Comparison of the Incomplete Cholesky-Conjugate Gradient Method with the Strongly Implicit Method as Applied to the Solution of Two-Dimensional Groundwater Flow Equations,
W82-01315 1503 2F

A Formula for Estimating Fissure Transmissivities from Steady-State Injection-Test Data,
W82-02292 1505 8E

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana,
W82-02480 1505 7C

Geoelectric Soundings for Predicting Aquifer Properties,
W82-02619 1506 2F

Determination of Aquifer Parameters from Large-Diameter Dug Well Pumping Tests,
W82-02917 1506 2F

Use of Longitudinal Conductance in Estimating Transmissivity of Granular Aquifers in Northern Missouri,
W82-03957 1509 2F

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

Results of Deep-Well Injection Testing at Mulberry, Florida,
W82-05224 1511 5B

Determination of Aquifer Parameters Using Regression Analysis,
W82-05734 1511 2F

Identification of Aquifer Transmissivities: The Comparison Model Method,
W82-06859 1512 2F

TRANSPARENCY

Prediction Model by Grouping Method of Data Handling (GMDH) for Effluent Quality from Sewage Treatment Plant - Prediction Model of Transparency of Effluent for Automatic Control,
W82-04058 1509 5D

Primary Productivity and Nutrients in the Sediment Retention Basin of Lake Monroe,
W82-06470 1512 5C

TRANSPIRATION

Transpiration, Stomatal Conductance, and Photosynthesis of Tomato Plants With Various Proportions of Root System Supplied With Water,
W82-00504 1502 2I

Leaf and Environmental Parameters Influencing Transpiration: Theory and Field Measurements,
W82-00979 1502 2D

The Effect of Leaf Water Status on Stomatal Activity, Transpiration and Nitrate Reductase of Sweet Potato,
W82-03793 1509 2D

A Comparison of the Structure, Primary Productivity, and Transpiration of Cypress Ecosystems in Florida,
W82-03885 1509 2I

Spacing and Transpiration of Various Sized Clumps of a Desert Grass, Hilaria Rigida,
W82-04295 1510 2D

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

Transpirational Supply and Demand: Plant, Soil, and Atmospheric Effects Evaluated by Simulation,
W82-06320 1512 2D

Ecological Optimality in Water-Limited Natural Soil-Vegetation Systems 1. Theory and Hypothesis,
W82-06321 1512 2I

TRANSPIRATION CONTROL

Reduced Transpiration and Increased Water Efficiency by Diuron in Corn (Zea Mays),
W82-00196 1501 2D

TRANSPORTATION

Fresh-Water Transport by Sea,
W82-04861 1511 6D

A Case for Regional Sludge Management,
W82-06993 1512 5E

TRAP EFFICIENCY

Sediment Trap Dynamics and Calibration: A Laboratory Evaluation,
W82-00104 1501 7B

Field Assessment of Sediment Traps,
W82-00105 1501 7B

A Review on Sediment Traps in Aquatic Environments,
W82-01020 1502 7B

Sediment and Nutrient Trap Efficiency of a Small Flood-Detention Reservoir,
W82-01471 1503 4A

A New Sediment Trap Efficiency Curve for Small Reservoirs,
W82-03086 1507 8A

Trap Efficiency Study, Highland Creek Flood Retarding Reservoir Near Kelseyville, California, Water Years 1966-77,
W82-05852 1511 2J

TRAVERSE CITY

Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 1502 5F

Down to Earth Leak Detection,
W82-03561 1508 5F

TRAWLING
Effect of Otter Prawn Trawling on the Macrobenthos of a Sandy Substratum in a New South Wales Estuary,
W82-00677 1502 5C

Hydroacoustic Assessment of Pelagic Fish Stocks: A Potential New Management Tool,
W82-06373 1512 8I

TREATED MUNICIPAL WASTEWATER
Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

TREATIES
Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 1512 6E

TREATMENT PLANTS
Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

Operation Reports: East Bay Municipal District (SD No 1), California.
W82-02707 1506 5D

Water Conservation at Wastewater Treatment Plants,
W82-06512 1512 3C

TREES
Clonal Variations in the Water Relations of Red Osier Dogwood During Cold Acclimation,
W82-00839 1502 2I

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 1504 2D

Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables,
W82-03019 1507 2I

Evaporation from Vegetation in Landscapes Developing Secondary Salinity Using the Ventilated Chamber Technique, III. Evaporation from a Pinus Radiata Tree and the Surrounding Pasture in an Agroforestry Plantation,
W82-03213 1507 2D

Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 1512 2I

TRENCHES
Trenching of Digested Sludge,
W82-00974 1502 5E

Earth-Filled Slurry Walls Provide Economical Seepage Control,
W82-03256 1507 8D

Entrenchment of Sewage Sludge--A Disposal-Use Alternative,
W82-03353 1507 5E

TRIAZINE HERBICIDES
Herbicides in Kansas Waters--Evaluations of the Effects of Agricultural Runoff and Aquatic Weed Control on Aquatic Food Chains,
W82-06304 1512 5C

TRIBUTARIES
Drainage Network Structure and the Diameter-Magnitude Relation,
W82-01308 1503 2A

TRICHLOROETHYLENE
Tying Up TCE,
W82-01866 1504 5G

TRICKLE IRRIGATION
Laser Drip Irrigation.
W82-00771 1502 3F

Trickle Irrigation Lateral Design on Sloping Fields,
W82-01537 1503 8C

Significant Features of Emitter Flushing Mode Characteristics,
W82-01576 1503 3F

Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 1504 3F

Subsurface Trickle Irrigation Mangement with Multiple Cropping,
W82-04356 1510 3F

Improved Water and Nutrient Management Through High-Frequency Irrigation, Vol. 3: Determining the Transpiration Rate of Peach Trees Under Two Trickle Irrigation Regimes,
W82-05312 1511 3F

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 1512 3C

Responses of 6-Year-Old Diamond Grapevines to the Change from Sprinkler to Trickle Irrigation and to the Time and Method of Applying Nitrogen,
W82-06492 1512 3F

TRICKLING FILTERS
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 1504 5D

Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

Efficiencies of Advanced Waste Treatment Obtained with Upgraded Trickling Filters,
W82-03285 1507 5D

Reliability and Stability of Trickling Filter Processes,
W82-04784 1511 5D

TRIHALOMETHANE
Trihalomethane Formation in Water Treatment Plants in North Carolina,
W82-06158 1512 5F

TRIHALOMETHANE (THM)
Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 1508 5D

TRIHALOMETHANES
An Alternative Solution to the THM Problem,
W82-00072 1501 5F

Temporal Variations in Trihalomethane Content of Drinking Water,
W82-00255 1501 5A

Ozone Treatment of Potable Water--Part 2,
W82-00452 1501 5F

A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 1504 5B

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 1504 5A

Trihalomethane Formation in North Carolina Drinking Waters,
W82-02195 1505 5B

Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 1506 5F

Removing Trace Organics from Drinking Water Using Activated Carbon and Polymeric Adsorbents,
W82-02987 1506 5F

Trihalomethanes in Drinking Water,
W82-03447 1508 5F

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

Algae as Sources of Trihalomethane Precursors,
W82-04149 1509 5B

Removal of Organics by Reactivated Carbon,
W82-04159 1509 5F

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

Reactivity of Halogens with Aqueous Micropollutants: A Mechanism for the Formation of Trihalomethanes,
W82-05678 1511 5F

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 1512 5F

TRIHALOMETHANES *CHLORINATION
Removing Trihalomethanes from Drinking Water,
W82-00953 1502 5F

TRINITROTOLUENE
Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

TRITICALE
Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

TRITIUM
Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 1502 5D

Possibility of Using Tritium for Studying Global Circulation of Atmospheric Moisture,
W82-00863 1502 2A

Studies on Unsaturated Zone Hydrology and Radionuclide Migration at a Shallow-Land Burial Site,
W82-01172 1503 5B

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 1504 2G

Infiltration Rates of Rainwaters in Sri Lanka Measured by Using Tritium Tracer,
W82-05941 1512 2F

TROPHIC LEVEL

Occurrence of Aphanomyces Ovidestruens, a Fungus Parasitic on Copepods, in Two Eutrophic Lakes,
W82-00304 1501 2H

Comparison of a Few Systems for the Determination of Saprobic and Trophic Degree on the Basis of Plankton Data,
W82-00664 1502 2H

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 1502 2H

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 1503 5C

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 1504 2H

Trophic Structure and Energy Flow in a Texas Pond,
W82-02397 1505 2H

On the Trophic Status and Conservation of Kashmir Lakes,
W82-02412 1505 5C

Primary Productivity and Trophic Status of a Kashmir Himalayan Lake,
W82-02414 1505 2H

Nutrient Loading - Trophic State Relationships in Florida Lakes,
W82-02811 1506 5B

Blue-Green Algal Ammonia Uptake in Hypertrophic Prairie Lakes,
W82-02914 1506 2H

Ammonia Volatilization in a Hypertrophic Prairie Lake,
W82-02915 1506 2H

Current Use and Technology of Landsat Mss Data for Lake Trophic Classification,
W82-03755 1509 7B

Input/Output Models as Decision Aids for Lake Restoration,
W82-03924 1509 5G

Seston of the Kremenchug Reservoir and Quantitative Proportions of Its Components,
W82-05029 1511 2H

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

Evaluation of Fourteen Trophic State Indices for Phytoplankton of Indiana Lakes and Reservoirs,
W82-05579 1511 2H

Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 1512 2H

TROPIC ZONE

Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

TROPICAL CYCLONES

Effects of Tropical Cyclone Wally in Southeast Viti Levu, Fiji, Easter 1980,
W82-00670 1502 2A

Meteorology of Important Rainstorms in the Colorado River and Great Basin Drainages,
W82-03047 1507 2B

The Significance of Tropical Cyclone Rainfall in the Water Supply of South Florida,
W82-03821 1509 2B

TROPICAL REGIONS

Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

Atmospheric Water Content Over the Tropical Pacific Derived from the Nimbus-6 Scanning Microwave Spectrometer,
W82-01004 1502 7B

Studies of the Hydrobiology of a Tropical Lake in Northwestern Queensland. II. Seasonal Changes in Thermal and Dissolved Oxygen Characteristics,
W82-03218 1507 2H

Secondary Benthic Production in a Tropical Island Stream,
W82-06933 1512 5C

TROUT

Residues in Cutthroat Trout (Salmo Clarki) and California Newts (Tarichia Torosa) From a Lake Treated With Technical Chlordane,
W82-00558 1502 5C

Toxicity of Five Forest Insecticides to Cutthroat Trout and Two Species of Aquatic Invertebrates,
W82-00590 1502 5C

Evaluation of an Automatic System for Detection of Toxic Substances in Surface Water Using Trout,
W82-00855 1502 5A

Chlorinated Hydrocarbons as a Factor in the Reproduction and Survival of Lake Trout (Salvelinus Namaycush) in Lake Michigan.
W82-01079 1502 5C

Evidence of Natural Reproduction by Planted Lake Trout in Lake Michigan,
W82-01194 1503 8I

Influence of PCBs in Water on Uptake and Elimination of DDT and DDE by Lake Trout,
W82-01342 1503 5C

Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 1503 5B

Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 1503 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 1504 5C

Urban Aquaculture of the Rainbow Trout (Salmo gairdneri),
W82-02812 1506 8I

Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

Response of Trout Hepatic Mixed-Function Oxidases to Experimental Feeding of Ten Known or Possible Chlorinated Environmental Contaminants,
W82-03609 1508 5C

Evaluation of a Small Diameter Baffled Culvert for Passing Juvenile Salmonids,
W82-04075 1509 8I

Elimination of Hexachlorobenzene (HCB) by Rainbow Trout (Salmo Gairdneri), and an Examination of Its Kinetics in Lake Ontario Salmonids,
W82-05195 1511 5B

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 1511 5C

Kraft Pulp Mill Effluent Components Cause Liver Dysfunction in Trout,
W82-05377 1511 5C

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

The Impact of Managed Streamside Timber Removal on Cutthroat Trout and the Stream Ecosystem,
W82-05538 1511 5C

The Use of River Flow Data to Predict Low Flows as an Aid to Trout Farm Management,
W82-06083 1512 2E

Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

Twin Lakes Studies: A Characterization of the Twin Lakes Fishery via Creel Census with an Evaluation of Potential Effects of Pumped-Storage Power Generation,
W82-06401 1512 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Two Techniques for Locating and Sampling Brown Trout Microhabitat Under Complete Ice Cover,
W82-06703 1512 7B

TRUK

The Development of a Village Water Supply System on Truk,
W82-02816 1506 5F

TUBIFICIDS

Transport of PCBs in Aquatic Laboratory Model Ecosystems from Sediment to the Atmosphere Via the Surface Microlayer,
W82-06180 1512 5B

TUCSON

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 1503 6B

TUCSON AREA

Hydrology and Mining in the Tucson Areas,
W82-03697 1508 2F

TUNDRA

Some Aspects of Plant Water Relations in Alaskan Arctic Tundra Species,
W82-00846 1502 2I

Regional Water Balance on the Arctic Tundra in Summer,
W82-06061 1512 2D

Evaporation from the Surface of the Arctic Tundra on Axel Heiberg Island,
W82-06065 1512 2D

TUNISIA

Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 1508 6C

The Influence of Peripheral Sabkhas on the Geochemistry and Sedimentology of a Tunisian Lagoon: Bahiret El Biban,
W82-03684 1508 2K

TUNNEL CONSTRUCTION

Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 1506 8A

Outflow of Volcanic Rock and Gas During Opening of the Arpa-Sevan Tunnel,
W82-02772 1506 2A

Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 1506 8A

Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 1506 8A

Grouting Works in the Diversion Tunnel of the Inguri Hydroelectric Station,
W82-03164 1507 8A

Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 1507 8A

A Surface Water Outfall Sewer for Bournemouth By-Pass.
W82-04003 1509 8A

Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 1511 8A

Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 1511 8H

The Kielder Transfer Works,
W82-06502 1512 8A

Redevelopment of Aqueduct Crossing of Manchester Ship Canal and River Mersey,
W82-06813 1512 8A

TUNNEL FAILURE

Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 1507 8A

Problems in Tunnelling by Pipe Jacking at Tilehurst,
W82-06448 1512 8A

TUNNEL HYDRAULICS

Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 1506 8A

TUNNEL LININGS

Use of Crack-Resistant Linings of Hydraulic Tunnels with Consolidation Grouting of the Rock,
W82-02670 1506 8A

Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 1506 8A

New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

Influence of Geology on Tunnelling Conditions and Deformational Behavior of Supports in Faulted Zones a Case History of the Chhobro-Khodri Tunnel in India,
W82-03181 1507 8A

Problems of Lightening Underground Structures and Methods of Constructing Them Under Permafrost Conditions,
W82-03918 1509 8A

Wedge-Block Tunnels in Water Supply,
W82-05803 1511 8F

Out of Sight--Out of Mind.
W82-06713 1512 8A

Canal Tunnel Repair Options.
W82-06758 1512 8A

TUNNELING

Tunnelling Machine Saves Time and Money,
W82-05513 1511 8H

Driving Large Hydraulic Tunnels by the Stepped Face Method,
W82-05586 1511 8H

Alternative Tunnelling Method for Relief Sewer.
W82-05774 1511 8F

TUNNELS

Stress State of a Rock Mass with Two Parallel Tunnels with Loading of One of them by a Uniform Internal Pressure,
W82-05116 1511 8E

Selection of Temporary Diversion Tunnels and Tunnel Schemes for Discharge of Water,
W82-05588 1511 8A

Corobici Completion Ensures Costa Rica's Power Output.
W82-05755 1511 8C

Aeration at Floor Offsets in Bottom Outlets (Beluftung an Sohlsprungen Von Grundablassen),
W82-06242 1512 8C

TURBIDITY

Light Penetration and the Interrelationships Between Optical Parameters in a Turbid Subtropical Impoundment,
W82-00667 1502 2H

Effect of Turbidity on Chlorination Efficiency and Bacterial Persistence in Drinking Water,
W82-00865 1502 5A

Direct Filtration Studies at Traverse City Water Treatment Plant,
W82-00945 1502 5F

Low Turbidity Water from Fast Processes,
W82-00946 1502 5F

Ferric Chloride Takes Over,
W82-00954 1502 5F

Mineral Impact of Lakes as Background for Their Biogenic Dynamics,
W82-01359 1503 2H

On the Advection of Turbidity in the Saint Lawrence Middle Estuary,
W82-02344 1505 2L

The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 1507 2H

Monitoring of Turbidity and Suspended Solids Concentration in Wastewater Treatment Plants,
W82-04054 1509 5D

Upgrading Water Treatment Plants: An Alternative to New Construction,
W82-04098 1509 5F

Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant,
W82-04116 1509 5F

Recent Developments in Direct Filtration,
W82-04122 1509 5F

Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 1510 5F

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

Continuous Monitoring of the Effluent Quality of an Activated Sludge Plant by Turbidity Measurement (Kontinuierliche Kontrolle Der Ablaufgute Einer Belebtschlammanlage Mittels Trubungsmessung),
W82-04583 1510 5A

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 1511 5A

Plant Expansion Via High-Rate Pretreatment,
W82-05933 1512 5F

Packaged Plant Treats Turbidity,
W82-06026 1512 5F

The Effect of Boat Activity on Turbidity in a Shallow Broadland River,
W82-06330 1512 5C

Getting Your Money's Worth from Filtration,
W82-06412 1512 5F

Low-Dosage High-Rate Direct Filtration,
W82-06416 1512 5F

M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 1512 5F

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 1512 5F

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 1512 5B

TURBIDITY CURRENTS

Plume Development Using Lagrangian Marker Method,
W82-01182 1503 5B

TURBINES

Power Characteristic Curve of Hydraulic Turbine Set,
W82-03163 1507 8B

Computer-Aided Evaluation of Peru's Hydropower,
W82-04954 1511 6B

Turbines for Itaipu,
W82-04955 1511 8C

Field Testing and Optimizing Efficiency of Hydro Turbines,
W82-05010 1511 8C

Using Pumps as Small Turbines,
W82-05597 1511 8C

TURBULENT FLOW

Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 1503 2C

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 1504 2L

Turbulence Model for Flow Over Dredged Channels,
W82-02201 1505 8B

Some Measurements on Near Surface Turbulence in the Depth Direction and Some Phytoplankton Distribution Implications,
W82-02227 1505 7B

The Mixing Layer of Loch Ness,
W82-02421 1505 2H

Modeling Rill Density,
W82-02604 1506 2J

On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

Discussion of 'Turbulence Prediction in Open Channel Flow',
W82-03781 1509 8B

A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

Studies on Oxygen Transfer Models,
W82-05349 1511 1A

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 1511 5B

Effect of Water Turbulence on Illumination at Depth,
W82-05594 1511 1A

Dispersion in Tumbling Flow,
W82-05796 1511 8B

Dispersion in Mountainous Natural Streams,
W82-06357 1512 2E

Sediment Transport and Unit Stream Power Function,
W82-06424 1512 2J

Turbulent Friction in a Viscous Sublayer and in the Transition Region of the Flow of Water in a Flat Duct,
W82-06468 1512 8B

Solutions of the Colebrook-White Function for Resistance to Uniform Turbulent Flow,
W82-06501 1512 8B

Hereditary Phenomena in Turbulent Boundary Layers,
W82-06618 1512 8B

Use of the Finite-Element Method for Solving the Transfer Equation,
W82-06620 1512 2J

Turbulent Two-Dimensional Flow of an Incompressible Fluid Around Obstacles with Separation,
W82-06621 1512 8B

TURF GRASSES

Blaney-Criddle Coefficients for Western Turf Grasses,
W82-04310 1510 2D

TURFGRASSES

Water Reclamation by the Use of Soil-Turfgrass Systems in the Southwest USA,
W82-02817 1506 3C

TURKEY

Effect of Turbulent Dispersion on the Rate of Ammonia Nitrogen in Rivers,
W82-05418 1511 5B

Turks Press Forward With Ambitious Dam Programme,
W82-05758 1511 6B

Stochastic Trigger Model for Flood Peaks 2. Application of the Model to the Flood Peaks of Goksu-Karahacili,
W82-06326 1512 2E

TURNOVER TIME

Factors Influencing Orthophospate Turnover Times: A Comparision of Canadian and New Zealand Lakes,
W82-05992 1512 2H

TUSCAN COASTS

Mercury and Lead Concentrations in Some Species of Fish From the Tuscan Coasts (Italy),
W82-01368 1503 5B

TUSCANY

Relationship Between the Yearly Maxima of Peak and Daily Discharge for Some Basins in Tuscany,
W82-06200 1512 2E

TWIN LAKES

Hydroacoustic Surveys of Fish Abundance and Distribution in Twin Lakes, Colorado,
W82-02977 1506 6G

Results of Fisheries Investigations at Twin Lakes, Colorado; 1973-76,
W82-02984 1506 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Studies of the Effects of Operating the Mt. Elbert Pumped-Storage Powerplant on Twin Lakes, Colorado: 1980 Report of Findings,
W82-06403 1512 2H

TYEE LAKE PROJECT

Final Environmental Impact Statement; Tyee Lake Project FERC No. 3015 - Alaska.
W82-00354 1501 6G

TYNE RIVER

How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme.
W82-05249 1511 5D

U.S. GEOLOGICAL SURVEY

Identification Codes for Organizations Listed in Computerized Data Systems of the U.S. Geological Survey,
W82-02486 1505 10D

UKAI DAM

Ski-Jump Spillway for India's Ukai Dam,
W82-02430 1505 8A

UKRAINE

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 1504 5B

ULOTHRIX ZONATA

Effects of Phosphorus Enrichment and Wave Simulation of Populations of Ulothrix Zonata from Northern Lake Superior,
W82-06979 1512 5C

ULTRAFILTRATION

Characterization of Soluble and Colloidal-Phase Metal Complexes in River Water by Ultrafiltration. A Mass-Balance Approach,
W82-00480 1501 5A

Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 1502 5D

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 1503 5D

Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 1503 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 1504 5D

Color Removal from Groundwater by Ion Exchange and Sludge Recycle Techniques,
W82-03956 1509 5F

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 1511 5D

Organic Groups and Molecular Weight Distribution in Tertiary Effluents and Renovated Waters,
W82-05480 1511 5D

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

ULTRAVIOLET DISINFECTION

UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 1512 5D

ULTRAVIOLET RADIATION

Treatment Plant Features Ultraviolet Disinfection,
W82-02644 1506 5D

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 1506 5D

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

Sunlight Induced Movement of Planktonic Organisms and Their Relationships to Water Movements,
W82-04417 1510 2H

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 1512 5D

Ultraviolet Systems in Water Treatment,
W82-06726 1512 5F

ULTRAVIOLET RADIATION
Application of Ultraviolet Disinfection in a Tertiary Wastewater Treatment Plant,
W82-06390 1512 5D

UMFOLOZI RIVER
Umfolozi Road Bridge Hydraulic Model Investigation,
W82-02868 1506 8A

UNCONFINED AQUIFERS
The Ground Water Flow System in the Vicinity of Marco Island, Florida,
W82-02123 1505 2F

A Numerical Method for the Calculation of the Average Drawdown in a Fully Penetrating Observation Well in an Unconfined Aquifer,
W82-03061 1507 2F

Delayed Drainage in a Stream-Aquifer System,
W82-04268 1510 2F

Digital Models of Ground-Water Flow in the Cape Cod Aquifer System, Massachusetts,
W82-04487 1510 2F

UNDERGROUND STRUCTURES
Progressive Solutions in the Design of Under-Ground Structures for the Rogun Hydroelectric Plant,
W82-02950 1506 8A

New Technical Solutions Used for Concreting Tunnels of the Nurek Hydroelectric Plant,
W82-03150 1507 8F

Response of Buried Structures to Traveling Waves,
W82-03346 1507 8D

Underground and Offshore: When to Consider Cathodic Protection,
W82-03349 1507 8G

Prospective Engineering Designs for Underground Hydraulic Structures,
W82-05589 1511 8A

Quality of Contouring Workings When Driving Underground Structures at the Nurek Hydrostation,
W82-05590 1511 8H

Designing and Excavating Underground Powerplants,
W82-05982 1512 8E

UNDERGROUND WASTE DISPOSAL
Strategy for Radioactive Waste Disposal in Crystalline Rocks,
W82-00299 1501 5E

Deep Well Injection of Industrial Wastes,
W82-00475 1501 5E

Artificial Groundwater Recharge,
W82-01110 1503 4B

Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

Analysis of Rock Stress Around a Liquid Waste Injection System in Illinois,
W82-02280 1505 5E

Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

Final Environmental Impact Statement; Defense Waste Processing Facility, Savannah River Plant, Aiken, S.C.
W82-06087 1512 6G

UNDERWATER
On the Role of Underwater Parks and Sanctuaries in the Management of Coastal Resources in the Southeastern United States,
W82-02905 1506 5G

UNIFORM FLOW
Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 1507 2E

UNIT HYDROGRAPHS
Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 1506 2A

A Discrete System Storage Model for Analyzing Rainfall-Runoff Relationships,
W82-06219 1512 2A

Fitting a Gamma Distribution Over a Synthetic Unit Hydrograph,
W82-06586 1512 2A

UNITED KINGDOM
The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 1502 5D

The Workings of the Control of Pollution Act in Tidal Waters: A View of the Ministry of Agriculture, Fisheries and Food,
W82-01383 1503 6E

Thoughts on the Need to Control Discharges to Estuarial and Coastal Waters,
W82-01384 1503 6E

Groundwater Investigations in the Vale of Stathmore,
W82-01400 1503 2F

Charging Policies for Water Services,
W82-01734 1503 6C

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 1503 2L

Centrifugal Dewatering,
W82-01912 1504 5E

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 1504 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 1504 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 1504 5B

Disposal of Industrial Effluents - Some Future Problems,
W82-02405 1505 5D

An Industrial View. Treatment Vis-A-Vis Discharge to Sewers,
W82-02407 1505 6G

Groundwater Quality in the Severn-Trent Region,
W82-02423 1505 5A

The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

Reliability of Water Resources,
W82-02749 1506 6A

Britain's Sewers - Researching for the Future,
W82-02871 1506 5D

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme,
W82-02872 1506 5D

Demand Forecasting in Water Supply Networks,
W82-02926 1506 6D

Control of a Pumping Station by Mini Computer - A Progress Report,
W82-02956 1506 6B

A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling,
W82-03243 1507 5B

Recent Water Towers in Norfolk,
W82-03246 1507 8A

On the Conspecificity of Marine and Freshwater Bangia in Britain,
W82-03408 1508 2L

Improving Treatment Works Efficiency.
W82-03500 1508 5D

Iron Oxide from a Seasonally Anoxic Lake,
W82-03643 1508 2H

The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works,
W82-03850 1509 5D

The Impact of Eutrophication on Water Treatment and Supplies in the Anglian Water Authority,
W82-03866 1509 5C

Experience with Borehole Recharge in The Lee Valley,
W82-03894 1509 4B

The Distribution and Movement of Solutes Derived from Agricultural Land in The Principal Aquifers of The United Kingdom, with Particular Reference to Nitrate,
W82-03912 1509 5B

The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

Estimation of Extreme Low Flows for Pumped Storage Reservoir Design,
W82-04334 1510 2E

The Future of Flood Estimation and the Flood Studies Report,
W82-04687 1510 2E

The Chemistry of Suspended Matter in Esthwaite Water, A Biologically Production Lake with Seasonally Anoxic Hypolimnion,
W82-05416 1511 2K

Sludge Disposal to Sea in U.K.,
W82-06292 1512 5E

The Practical Handling of Water Quality Monitoring Data,
W82-06591 1512 7C

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 1512 5G

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 1512 5D

The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 1512 5G

Esholt–Past, Present and Future,
W82-06633 1512 5D

UNITED NATIONS
International Decade on Drinking Water and Sanitation,
W82-04230 1509 6E

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

UNITED STATES
Experience Gained with the U.S. Pollution Control Policies,
W82-00996 1502 6E

Disaster by Flood,
W82-04618 1510 2E

National Water Policy: The Need for Institutional Reform,
W82-05180 1511 6E

UNOX PROCESS
Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 1503 5D

UNSATURATED FLOW
A Comparative Study of Three Forms of the Richard Equation Used for Predicting One-Dimensional Infiltration in Unsaturated Soil,
W82-00328 1501 2G

A Mathematical Model for Predicting Moisture Flow in an Unsaturated Soil Under Hydraulic and Temperature Gradients,
W82-00605 1502 2G

Hydrodynamic Dispersion During Constant Rate Absorption of Water by Soil,
W82-01174 1503 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 1504 2G

Analysis of Longitudinal Dispersion in Unsaturated Flow I. The Analytical Method,
W82-03321 1507 2G

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 1508 2G

A Field Method for Measuring Short-Circuiting in Clay Soils,
W82-05626 1511 2G

A Univariate Versus a Multivariate Parameter Distribution in a Stochastic-Conceptual Analysis of Unsaturated Flow,
W82-06856 1512 2G

UNSTEADY FLOW
A Model for Simulation of Flow in Singular and Interconnected Channels,
W82-01210 1503 2E

Programming Manual for MOBED - An Unsteady, Nonuniform, Mobile Boundary Flow Model,
W82-03109 1507 2E

UPPER COLORADO RIVER
Soluble Mineral Content in Surficial Alluvium and Associated Mancos Shale,
W82-05751 1511 3B

UPPER COLUMBIA RIVER BASIN
Streamflow Characteristics of the Upper Columbia River Basin, Montana, Through 1979,
W82-05225 1511 2E

UPPER CONNECTICUT RIVER BASIN
Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

UPPER MISSISSIPPI RIVER
Assessment of Upper Mississippi River Floodplain Changes with Sequential Aerial Photography,
W82-03015 1507 4C

UPPER NIAGARA RIVER
Water Quality of the Upper Niagara River, 1975 and 1979,
W82-06576 1512 5A

UPPER SNAKE RIVER
Evaluation of Models and Procedures Used for River Operations and Planning in the Upper Snake and Boise Rivers in Idaho,
W82-05925 1512 4A

UPPER YOBE RIVER
A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 1511 2D

UPTAKE
Absorption of Fenitrothion by Plankton and Benthic Algae,
W82-00874 1502 5B

A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

PCB Uptake by Five Species of Fish in Lake Michigan, Green Bay of Lake Michigan, and Cayuga Lake, New York,
W82-06493 1512 5B

UPWELLING
On Modeling the Turbulent Transport of Passive Biological Variables in Aquatic Ecosystems,
W82-02661 1506 2L

URAL RIVER
Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 1511 8I

URAN AREAS
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 1507 2J

URANIUM
Computer Modeling of Fluid Flow During Production and Environmental Restoration Phases of In Situ Uranium Leaching,
W82-00043 1501 6A

Ground-Water Flow and Uranium in Colorado Plateau,
W82-00282 1501 2F

Uranium Concentration in the Ground Waters of the Pullman-Moscow Basin, Whitman County, Washington, and Latah County, Idaho,
W82-00809 1502 5B

Uranium Isotopes as a Natural Tracer in the Waters of the Bet Shean-Harod Valleys, Israel,
W82-01328 1503 2F

Mathematical Modeling and Computer Simulation of Radioactive and Toxic Chemical Species Dispersion in Porous Media in the Vicinity of Uranium Recovery Operations,
W82-03392 1507 5B

The Mechanism of Uranium Biosorption by Rhizopus Arrhizus,
W82-05723 1511 5D

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

URANIUM RADIOISOTOPES
Tracing Interaquifer Connections in the Kefar Uriyya-Agur Region (Israel), Using Natural Uranium Isotopes,
W82-05644 1511 2F

URANIZATION
Coping with Increased Stream Erosion in Urbanizing Areas,
W82-03067 1507 2J

URBAN AREAS
Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

SWMM Model and Level of Discretization,
W82-03673 1508 6A

Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control,
W82-04063 1509 5G

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 1510 6C

Evidence of Urban and Lake Influences on Precipitation in the Chicago Area,
W82-04741 1510 2B

The Search for Reservoir Sites in an Urban Environment,
W82-04867 1511 8A

Application of a Two-Dimensional Model of Formation of Storm Runoff to Calculation of the Rainwater Collector-Drain Discharge from an Urbanized Territory,
W82-05027 1511 2A

The Determination of Heavy Metals (Al, Mn, Fe, Ni, Cu, Zn, Cd, and Pb) in Urban Snow Using an Atomic Absorption Graphite Furnace,
W82-05397 1511 5A

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

Water Supply for New York City in the 1980s,
W82-05671 1511 6D

Lessons Learned from the 1981 Laingsburg Flood,
W82-05997 1512 2E

Water Supply and Distribution in Larger Communities,
W82-06413 1512 5F

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 1512 5G

URBAN DEVELOPMENT
Servicing Growth in the Metropolitan Toronto Region During the Early Years of the Ontario Water Resources Commission: 1956-1968,
W82-05566 1511 6E

URBAN DRAINAGE
Comparison of Detention Basin Planning and Design Models,
W82-02592 1505 6A

The Distribution of Mercury, Cadmium and Lead Between Water and Suspended Matter in the Loire Estuary as a Function of the Hydrological Regime,
W82-03757 1509 2L

Detention Basins--An Urban Experience,
W82-04332 1510 4A

Optimal Design of Urban Storm Water Drainage Systems,
W82-04414 1510 8A

Money Down the Drain,
W82-04653 1510 4A

Demand Signals for Urban Drainage and Flood Control Projects,
W82-04737 1510 6A

An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

Urban Impacts of Water Supply Reservoir,
W82-05318 1511 5G

Stormwater Management - One Developer's Experience,
W82-05777 1511 6B

URBAN EFFECTS

Downstream Reduction of Rural Channel Size with Contrasting Urban Effects in Small Coastal Streams of Southeastern Australia,
W82-04862 1511 2E

URBAN HYDROLOGY

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

Evaluation of Areal Versus Point Rainfall with Sparse Data,
W82-00835 1502 2B

Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 1505 7A

Development of Improved Stormwater Quality Models,
W82-04559 1510 5B

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 1512 7C

URBAN PLANNING

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 1505 6E

Storm Water Management: The Concept and Its Application,
W82-04240 1509 4A

Problems and Processes in Water Quality Management,
W82-06147 1512 5G

Urban Creekside Design Features Parallel Streets,
W82-06184 1512 4C

URBAN PLANTS

Water Requirements of Urban Plants,
W82-03972 1509 3D

URBAN RUNOFF

Quarterly Progress Report, Nationwide Urban Runoff Program,
W82-00044 1501 5G

Hydrologic Data for Urban Studies in the Austin, Texas Metropolitan Area, 1979,
W82-00083 1501 7C

Modeling the Relationship Between Development and Storm Water and Nutrient Runoff,
W82-00260 1501 2A

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

Recycling Urban Stormwater for Profit,
W82-00524 1502 3C

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979,
W82-01069 1502 5B

Studies for Abatement of Pollution from Combined Sewer Overflows in Canada,
W82-01200 1503 5G

Urban Runoff and Combined Sewer Overflow,
W82-01254 1503 5B

Estimation of Impervious-Area Washoff Parameters,
W82-01465 1503 4C

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5B

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

Urban Catchment Models: A Brief Examination,
W82-02813 1506 4C

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 1506 5B

Better Ways to Finance Stormwater Management,
W82-03298 1507 6C

Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 1508 6E

The Economics of Urban Stormwater Management,
W82-03508 1508 4A

Urban Rainfall-Runoff Modelling Using Remote Sensing Imagery,
W82-03820 1509 2A

Transport of Polycyclic Aromatic Hydrocarbons through a Partly Urbanized River Basin,
W82-04191 1509 5B

Storm-Sewer Input of Heavy Metals Into an Urban Lake Environment,
W82-04207 1509 5A

The Distribution of Heavy Metals and Petroleum Residues in the Soil from Urban Surface Runoff,
W82-04216 1509 5B

Water Quality Patterns During A Storm On A Mall Parking Lot,
W82-04252 1510 5B

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 1510 5B

Evaluation of Methods for Determining Urban Runoff Curve Numbers,
W82-04535 1510 4C

Development of Improved Stormwater Quality Models,
W82-04559 1510 5B

Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 1510 4C

Money Down the Drain,
W82-04653 1510 4A

A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 1510 2A

On-Site Stormwater Detention: An Overview,
W82-04758 1511 4A

Ecological Effects of Urban Stormwater Runoff on Benthic Macroinvertebrates Ihibiting the Green River, Massachusetts,
W82-04947 1511 5C

An Evaluation of the Urban Design Storm Concept,
W82-04960 1511 6A

Metal Concentrations in Guam Urban Runoff,
W82-05302 1511 5B

Settleability of Urban Runoff Pollution,
W82-05320 1511 5G

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 1511 4A

Oil and Grease in Stormwater Runoff,
W82-05557 1511 5C

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 1511 4A

An Overview of Porous Pavement Research,
W82-05744 1511 5D

Water Management in the Metropolitan Toronto Region,
W82-05775 1511 6B

Storm Related Dilution of Conductance in Three Hydrologically Different Water Bodies,
W82-06067 1512 5B

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

Comparing Urban Runoff Models,
W82-06447 1512 2A

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 1512 4C

Hydrologic Data for Urban Studies in the San Antonio, Texas Metropolitan Area, 1978,
W82-06672 1512 7C

Urban Runoff and Combined Sewer Overflow,
W82-06914 1512 5D

Decontamination of Overland Runoff from Populated Areas,
W82-06980 1512 5D

URBAN WATERSHEDS

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

Comparison of Behavior of Two Sub-Basins in the Turtle Creek Drainage System,
W82-02528 1505 2A

Urban Rainfall-Runoff Modelling Using Remote Sensing Imagery,
W82-03820 1509 2A

Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

Preliminary Model of an Urban Floodplain Under Changing Land Use,
W82-05642 1511 4C

Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

URBANIZATION

Use of Flow-Duration Curves to Evaluate Effects of Urbanization on Streamflow Patterns on Long Island, New York,
W82-00416 1501 4C

The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 1505 4D

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 1506 5C

Management Options for Ground Water in Urbanizing Areas,
W82-03961 1509 4B

Effect of Urbanization on Alternative Flood Control Strategies,
W82-04244 1509 4C

A Dimensionless Unit Hydrograph for Urbanizing Catchment Areas,
W82-04683 1510 2A

Sawmill Brook: An Example of Rapid Geomorphic Change Related to Urbanization,
W82-05276 1511 4C

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 1511 6B

Storm Runoff from Small Lowland Catchments in Southwest England,
W82-05653 1511 4C

Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

Sediment Analyses for Urbanizing Watersheds,
W82-06426 1512 2J

Reduction of Urban Runoff Through Economic Incentives: Boulder, Colorado,
W82-06629 1512 4C

URBINES

Small Hydro Stations in Sweden,
W82-04174 1509 8C

UREA

Decomposition of Urea by Size-Fractionated Planktonic Community in a Eutrophic Reservoir in Japan,
W82-05095 1511 2H

USER CHARGES

On Water Tariff Equalization Policies,
W82-01175 1503 6C

Charging Policies for Water Services,
W82-01734 1503 6C

Better Ways to Finance Stormwater Management,
W82-03298 1507 6C

Can Prices Tame the Inflationary Tiger,
W82-04142 1509 6D

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 1512 5D

USSR

Use of River Waters That Did Not Reach the Aral Sea as a Consequence of Economic Activity During 1961-1975,
W82-00190 1501 4A

Theory of Ecological Prediction of Limnetic Ecosystems,
W82-00597 1502 6G

Irrigation and Drainage Waters of a New Irrigation Zone in the Hungry Steppe and Possibilities of their Use,
W82-00658 1502 3C

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another
W82-019[illegible] 1504 5C

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 1504 2H

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 1504 5B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 1504 7A

On the Dynamics of Feeding of Young Fish from Mozhaysk Reservoir in Various Years,
W82-02434 1505 2H

Bituminous Concrete Antiseepage Curtain for Concrete Dams,
W82-02690 1506 8A

Study of the Experience in Operating Hydraulic Tunnels,
W82-02782 1506 8A

Scroll Casings of Steel and Reinforced-Concrete Construction,
W82-02784 1506 8G

Calculation of Diversion Tunnels of Special Profiles Operating Under Conditions of a Free Uniform Flow,
W82-02785 1506 8A

Stress Relaxation in Concrete of Massive Hydraulic Structures,
W82-02786 1506 8A

Effect of Irrigation on Groundwater Resources with Special Reference to the Vakhsh Valley,
W82-02851 1506 2A

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 1506 2E

Stages of Progress in the Organization of Hydraulic Construction,
W82-02858 1506 8A

Experience with and the Effectiveness of Automatic Systems for Control of Loading-Hauling Operations During Construction of the Dam for Nurek Hydroelectric Plant,
W82-02948 1506 8A

Construction of the Diversion Pressure Tunnel of the Inguri Hydroelectric Station,
W82-02949 1506 8A

Closure of the Kama River at the Site of the Lower Kama Hydroelectric Plant,
W82-02951 1506 8A

The Schooling Mechanism of Young Perch (Perca Fluviatilis) in the Open Part of Lake-Type Reservoirs (As Exemplified by Rybinsk Reservoir),
W82-02954 1506 2H

Asynchronism and Uncorrelated Phases of Streamflow in the Case of Its Interbasin Transfer with Special Reference to the Georgian SSR,
W82-03457 1508 4A

Losses of Nitrogen, Phosphorus and Potassium from Agricultural Watersheds of Minor Rivers in the Oka Valley,
W82-03556 1508 5B

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 1508 2H

Effect of Felling Forests on Flood Runoff in the Carpathian Mountains with Special Reference to Beech Forests,
W82-03574 1508 4C

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

Cavitation-Resistant Gunite Coatings for Hydraulic Structures,
W82-03677 1508 8G

Reservoirs and the Triggering of Earthquakes,
W82-03766 1509 8A

Investigation of Fluvial Processes Under Conditions of Natural Variability of the Runoff,
W82-03906 1509 2J

Performance Testing of the Soviet Oil/Debris Skimmer,
W82-04621 1510 5G

Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 1511 8A

Water Supply in the USSR.
W82-04849 1511 6D

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

New Methods of Designing Flood Control Measures,
W82-05030 1511 2E

Discharge Capacity of Large Streams Under an Ice Cover,
W82-05106 1511 2E

Use of Watertight Film Facings for Repair Works on the Great Stavropol Canal,
W82-05117 1511 8G

Calculation of Large Unlined Canals,
W82-05131 1511 8B

Structure and Permeability: Geologic Controls on Induced Seismicity at Nurek Reservoir, Tadjikistan, USSR,
W82-05133 1511 2F

Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 1511 4A

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

Hypania Invalida in the Volga Resevoirs and Hydrobiological Monitoring,
W82-05331 1511 2H

Some Data on the Fauna and Ecology of Metopidae (Infusoria) in Kiev Reservoir,
W82-05332 1511 2H

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 1511 8I

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

An Electron Microscopic Study of the Forms of Bacteria in the Surface Film of the Water,
W82-05452 1511 2H

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 1511 2H

Salt and Trace Element Composition of the Water of Lake Malinovoye (Altai Territory); as a Habitat of Artemia Salina,
W82-05455 1511 2H

Forms of the Migration of Metallic Ions in Fresh Water,
W82-05456 1511 2K

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 1511 5A

Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 1512 2H

Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 1512 2H

An Optimization Algorithm in a System for Management of the Regional Safe Groundwater Yield,
W82-06616 1512 4B

Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 1512 2F

Hydrogeothermal Mapping of the Active Water-Exchange zone in the USSR,
W82-06782 1512 7C

Numerical Investigations of Plans of Flow in Channels with a Complex Bottom Relief,
W82-06785 1512 8B

Decontamination of Overland Runoff from Populated Areas,
W82-06980 1512 5D

Investigation of the Distribution of Warm Water Discharge into Shallow Water Bodies,
W82-06981 1512 5B

Investigation of Eutrophication Processes by Continuous Recording of Production and Destruction,
W82-06982 1512 5C

Variability of the DNEPR Runoff Under the Effect of Economic Activities,
W82-06983 1512 4C

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 1512 5C

Effect of Phytoplankton on Water Quality in the Northern Donets-Donbas Canal,
W82-06987 1512 5C

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

Prospects of Using Magnetic Wastewater Treatment,
W82-06989 1512 5D

UTAH

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 1502 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 1502 7C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 1502 6D

The Effects of a New Reservoir on the Attached Diatom Communities in Huntington Creek, Utah, U.S.A.,
W82-01521 1503 2H

Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 1504 3F

An Initial Application of Polarization Lidar for Orographic Cloud Seeding Operations,
W82-02217 1505 7B

Water Resources Data for Utah, Water Year 1979.
W82-02474 1505 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Description of Soil Chemistry During Transient Solute Transport,
W82-03840 1509 2K

The Value of Exploratory Test Holes in Ground Water Development,
W82-03896 1509 2F

Floodplain Management Needs Peculiar to Arid Climates,
W82-03908 1509 2E

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Peak Period Design Standards for Small Western U.S. Water Supply Systems,
W82-04249 1509 6D

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 1510 6D

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 1510 6D

A Multivariate Analysis of Municipal Water Use in Utah,
W82-04728 1510 3D

The Effects of Dissolved Heavy Metals on Attached Diatoms in the Uintah Basin of Utah, U.S.A.,
W82-04951 1511 5A

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

Bedrock Aquifers in the Lower Dirty Devil River Basin Area, Utah, with Special Emphasis on the Navajo Sandstone,
W82-05220 1511 7C

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

Energy Siting in Utah: A Programming Model,
W82-05297 1511 6B

Erosion from Mountain Snowpack Melt,
W82-05664 1511 2J

The Limnological Status of Lake Mead and Lake Mohave Under Present and Future Powerplant Operations of Hoover Dam,
W82-06090 1512 6G

Influence of Dredging and High Discharge on the Ecology of Black Canyon,
W82-06091 1512 6G

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G

Salt Uptake in Natural Channels Traversing Mancos Shales in the Price Basin, Utah,
W82-06093 1512 2E

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

UTAH LAKE
Refinement of Lake Evaporation Measurements, Using an Ion-Balance Technique,
W82-03808 1509 2D

UTILITIES
Potential Political Influences Affecting the Water Industry,
W82-00861 1502 6C

Distribution System Liability,
W82-01028 1502 5F

A Century of Water for Antwerp,
W82-03355 1507 5F

Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 1508 6C

Regulation of Utility Waste Disposal Practices,
W82-03691 1508 5E

Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

Billing Data Aids Utility Planning,
W82-05786 1511 6C

UTILITY EXTENSION
Updating Antiquated City Water Systems,
W82-03293 1507 5F

VAALHARTS IRRIGATION PROJECT
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

VACUUM
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 1510 3A

VACUUM FILTRATION
Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 1502 5D

Automatic Control of Sludge Conditioning and Vacuum Filtration,
W82-04589 1510 5E

Vacuum Filtration of Septage,
W82-04710 1510 5D

VACUUM SEWERS
Vacuum Sewers--The Future for Sewage Collection,
W82-03394 1507 5G

VADOSE WATER
The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 1508 5B

Carbonate Geochemistry of Vadose Water Recharging Limestone Aquifers,
W82-04526 1510 2F

Vadose Zone Permeability Tests: Summary,
W82-06301 1512 2G

Vadose Zone Permeability Tests: Steady State Results,
W82-06302 1512 2G

Vadose Zone Permeability Tests: Unsteady Flow,
W82-06303 1512 2G

VALVES
The Case for Specifying AWWA Butterfly Valves.
W82-00213 1501 8C

VANADIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 1504 5A

VAPOR COMPRESSION
Absorption Freezing Vapor Compression - Process Selection, Pilot Plant Design, Process Economics,
W82-06125 1512 3A

VAPOR COMPRESSION DISTILLATION
Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

VAPOR COMPRESSION EVAPORATION
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 1505 3A

VAPOR PRESSURE
Humidity Measurement by Infrared Thermometry,
W82-05611 1511 7B

VARIABILITY
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 1504 5C

A Dynamic Methodology for Characterizing and Monitoring Estuarine Ecosystems,
W82-02167 1505 7A

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

Variation in Fecal Pollution Indicators Through Tidal Cycles in the Fraser River Estuary,
W82-05384 1511 5A

Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 1512 2B

VARIATION COEFFICIENTS
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 1504 2H

VEGETABLE CROPS
Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems,
W82-00544 1502 3F

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

Factors Affecting Radionuclide Availability to Vegetables Grown at Los Alamos,
W82-01109 1503 5B

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

VEGETATION
SEASAT SAR Response from Water Resources Parameters,
W82-00101 1501 7B

A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 1501 2I

The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

Water Status of Soil and Vegetation in a Shortgrass Steppe,
W82-00761 1502 2I

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

Vegetation Selection and Management for Overland Flow Systems,
W82-01500 1503 5E

The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 1511 4A

Fire and Geomorphic Processes,
W82-06963 1512 2J

VEGETATION EFFECTS
Flow Resistance in Vegetated Waterways,
W82-00152 1501 2E

Tractive Force Design of Vegetated Channels,
W82-00901 1502 4D

The Influence of Plant Communities Upon the Hydrology of Catchments,
W82-00931 1502 2D

Ratio Between Evapotranspiration of Irrigated Crops from Floating Lysimeters and Class A Pan Evaporation,
W82-01050 1502 2D

Estimating Contribution of Overstory Vegetation to Stream Surface Shade,
W82-02301 1505 2I

Water Levels and Losses and Cleaning in Watercourses,
W82-02747 1506 3F

Influence of Vegetation, Rock Cover, and Trampling on Filtration Rates and Sediment Production,
W82-04153 1509 2G

A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 1511 4C

Forest Management for Increased Water Yield--How Useful in Southern Alberta,
W82-05760 1511 3B

Potential Sediment Production Within Vegetative Communities in Oregon's Blue Mountains,
W82-05867 1511 2J

VEGETATION REGROWTH
Plant Improvement for Semi-Arid Rangelands: Possibilities for Drought Resistance and Nitrogen Fixation,
W82-05610 1511 3F

Effects of Flooding Upon Woody Vegetation Along Parts of the Potomac River Flood Plain,
W82-06683 1512 2E

VELOCITY
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 1504 2F

Measuring the Velocity of Water in a Paddled Flocculator,
W82-04102 1509 5F

Velocity Dependence of Phosphorus Transport in a Packed-Bed Reactor,
W82-05335 1511 5D

VELOCITY COEFFICIENTS
Velocity Profiles with Suspended Sediment,
W82-02581 1505 2J

VELOCITY DISTRIBUTION
Vertical Velocity Profiles in Stratified Flows,
W82-01171 1503 8B

Velocity Distributions Under Floating Covers,
W82-05562 1511 2E

VENEZUELA
Annual Variations in Abundance of Zooplankton in Lake Valencia (Venezuela),
W82-06765 1512 5C

VENTILATION
Methane in Water Wells,
W82-05252 1511 5F

Major Factors in Sewer Ventilation,
W82-06462 1512 8A

VERDE RIVER
Reconstructed Stream Flow for the Salt and Verde Rivers from Tree-Ring Data,
W82-04340 1510 2E

VERMONT
Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 1501 7C

Vinyl Lined Asbestos Cement Pipe Problems, Operator Aspects,
W82-02898 1506 5B

Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

A Sensitivity and Error Analysis Framework for Lake Eutrophication Modeling,
W82-05739 1511 5C

VERNA
Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

VERTICAL DISTRIBUTION
A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

VERTICAL TUBE EVAPORATION
Operating Characteristics of Various Combinations of Working Substances and Feeds in the Schroeder Desalting Process.
W82-02105 1505 3A

VIBRATIONS
A Mechanism for the formation of Large Icebergs,
W82-04798 1511 2C

VIBRIO
Incidence of Vibrio Alginolyticus and Bacteria of Sanitary Significance in the Bering Sea,
W82-00490 1501 5A

A Note on the Fate of El Tor Cholera and Other Vibrios in Percolating Filters,
W82-00566 1502 5D

Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 1504 5A

Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 1507 5B

VIBRIO CHOLERAE
Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

Survival of Vibrio Cholerae and Escherichia Coli in Estuarine Waters and Sediments,
W82-06742 1512 5C

VIBRIO PARAHAEMOLYTICUS
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 1503 5A

VICTORIA
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 1504 2F

VIENNA
Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 1511 5D

VILYUY RESERVOIR
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 1504 2H

VIRGIN ISLANDS
Five-Year Plan of the Water Resources Research Center,
W82-05526 1511 6B

VIRGINA
Potentiometric-Surface Map for the Cretaceous Aquifer, Virginia Coastal Plain, 1978,
W82-00727 1502 7C

VIRGINIA
Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

Kepone in the James River,
W82-00631 1502 5B

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Virginia,
W82-00744 1502 6E

Ground Water Problems Virginia Portion Ohio River Basin,
W82-01059 1502 4B

Dendroclimatic Estimates of a Drought Index for Northern Virginia,
W82-02468 1505 2B

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 1511 6B

Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 1511 5D

Policing Demand Through Pricing,
W82-06352 1512 6D

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 1512 5F

York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

Methane Flux in the Great Dismal Swamp,
W82-06840 1512 2H

VIRUS
Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 1505 5A

VIRUSES
Virus Removal in Waste Stabilization Fonds in India,
W82-00121 1501 5D

Influence of Estuarine Sediment on Virus Survival Under Field Conditions,
W82-00199 1501 5A

Method for Recovering Viruses from River Water Solids,
W82-00200 1501 5A

Improved Method and Test Strategy for Recovery of Enteric Viruses from Shellfish,
W82-00219 1501 5A

Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 1501 5A

Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 1501 5A

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

The Effect of Bentonite Clay on Ozone Disinfection of Bacteria and Viruses in Water,
W82-00292 1501 5F

Viral Transport Through Soil Columns Under Conditions of Saturated Flow,
W82-00295 1501 5B

Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 1501 5F

Application of a Multiple Alginate Filter Method for the Determination of Water Viruses Concentration (Conception D'Une Membrane Filtrante a Base D'Alginate Pour La Concentration Des Virus Hydriques),
W82-00458 1501 5A

Environmental Virology and its Problems,
W82-00505 1502 5A

Evaluation of Various Soil Water Samplers for Virological Sampling,
W82-00572 1502 5A

Relationships Between Environmental Factors, Bacterial Indicators, and the Occurrence of Enteric Viruses in Estuarine Sediments,
W82-00574 1502 5A

Effects of Wastewater Sludge and Its Detergents on the Stability of Rotavirus,
W82-00576 1502 5A

Destruction by Anaerobic Mesophilic and Thermophilic Digestion of Viruses and Indicator Bacteria Indigenous to Domestic Sludges,
W82-00580 1502 5A

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 1502 5C

Enteric Viruses in Renovated Water in Manitoba,
W82-01090 1502 5A

A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 1503 5A

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 1503 5A

Microbiology of Wastewater Treatment,
W82-01291 1503 5D

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 1503 5D

A Note on the Use of Membrane Faecal Coliform Medium for Enhancing Resolution and Accuracy When Enumerating a Small Plaquing Coliphage,
W82-01507 1503 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 1503 5A

Development of Immunoenzymatic Methods for Detection and Quantitation of Poliovirus,
W82-02176 1505 3A

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 3C

Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1505 5A

Concentration of Virus from Tap Water at Ambient Salt and pH Levels Using Positively Charged Filter Media,
W82-02712 1506 5A

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

Recovery of Indigenous Enteroviruses from Raw and Digested Sewage Sludges,
W82-03121 1507 5D

Inactivation of Enteroviruses by Ozone,
W82-03208 1507 5F

Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887 1509 5F

Waterborne Gastroenteritis Due to The Norwalk Agent: Clinical and Epidemiologic Investigation,
W82-03898 1509 5C

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency.
W82-04095 1509 5A

Evaluation of the Tentative Standard Method for Enteric Virus Concentration from Large Volumes of Tap Water,
W82-04096 1509 5A

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

Sewage Sludge Pathogen Transport Model Project,
W82-04403 1510 5A

Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 1510 5B

Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 1510 5F

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 1512 5D

Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 1512 5D

Reduction of Cytotoxicity in Virus Concentrates from Environmental Samples,
W82-06757 1512 5A

Comparison of Methods for Recovering Indigenous Viruses from Raw Wastewater Sludge,
W82-06890 1512 5A

Microbiology: Detection, Occurrence and Removal of Viruses,
W82-06927 1512 5B

VISAKHAPATNAM BASIN
Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 1508 6D

VISCOSITY
Surface Viscosity of Water,
W82-03501 1508 1A

Viscosity-Controlled Sediment Transport in the Absence of Suspended Load,
W82-04210 1509 2J

VISTULA RIVER
The Plankton of the River Vistula in the Region of Warsaw in the Years 1977-1979,
W82-06021 1512 5A

VITAMINS
Seasonal Variation of Vitamin B12, B12 Analogs, and Phytoplankton in a Long Island Estuary,
W82-02282 1505 2L

VITRIFIED WATER
Complete Vitrification in Pure Liquid Water and Dilute Aqueous Solutions,
W82-03361 1507 1A

VOLATILE ACIDS
Volatile Organic Acids in Lake Water; Their Gas Chromatographic Determination and Ecological Significance,
W82-02720 1506 5A

VOLATILE COMPOUNDS
Analysis of Volatile Organic Compounds in Water, Waste Water and an Industrial Effluent,
W82-04815 1511 5A

VOLATILE ORGANIC COMPOUNDS
Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 1510 5A

VOLATILE SOLIDS
Calorific Value of Wastewater Plant Sludges,
W82-04997 1511 5E

VOLATILITY
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

Volatilization Rates of Intermediate and Low Volatility Chemicals from Water,
W82-04817 1511 5B

Volatilization of Ketones From Water,
W82-05782 1511 5C

VOLCANIC ASH
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

VOLCANOES
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

The Aftermath at Longview,
W82-00073 1501 5C

Submersible Pumps Help Quell Damage From Mount St. Helens Mudflow.
W82-00509 1502 4D

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

Mt. St. Helens and the Fish,
W82-02508 1505 2J

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05123 1511 2H

Chemical Changes of Lakes Within the Mount St Helens Blast Zone,
W82-05459 1511 5B

Biological Responses on Lakes in the Mount St. Helens Blast Zone,
W82-05519 1511 5C

Effect of Ashfall on Snowmelt Rate at Paradise, Mount Rainier, Washington,
W82-05871 1511 2C

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

Impact of Mount St. Helens Eruption on Bacteriology of Lakes in the Blast Zone,
W82-06746 1512 5C

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

VOLGA DELTA
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 1504 2H

VOLGA RIVER
Salinity and Biogenic Material in the North Caspian,
W82-03155 1507 4A

Hypania Invalida in the Volga Reservoirs and Hydrobiological Monitoring,
W82-05331 1511 2H

VOLTA LAKE
Periphyton in the Volta Lake. I. Seasonal Changes on the Trunks of Flooded Trees,
W82-02882 1506 2H

Periphyton in the Volta Lake. II. Seasonal Changes on Wooden Blocks with Depth,
W82-02883 1506 2H

Epidemiology of Human Schistosoma Haematobium Infection Around Volta Lake, Ghana, 1973-75,
W82-05988 1512 5C

VOLTA RIVER
The Role of the Akosombo Dam on the Volta River in Causing Coastal Erosion in Central and Eastern Ghana (West Africa),
W82-06100 1512 2J

VOLTAMMETRY
New High-Performance Analytical Procedure for the Voltammetric Determination of Nickel in Routine Analysis of Water, Biological Materials and Food,
W82-06467 1512 5A

VOLUMETRIC ANALYSIS
Voltammetric Characterization and Chemical Behavior of Inorganic Tin in Natural Waters,
W82-00627 1502 5A

Trace Analysis of Toxic Metals. I. Determination of Lead, Mercury, Cadmium and Thallium by Amperometric Titration,
W82-03236 1507 5A

VORTICES
Model-Prototype Comparison of Free Surface Vortices,
W82-03667 1508 8B

The Vortex Scour Mechanism at Bridge Piers,
W82-04662 1510 8B

WABIGOON RIVER BASIN
Mercury Methylation by Fish Intestinal Contents,
W82-01830 1504 5C

WAKEBY DISTRIBUTION
Determination of the Confidence Intervals of the Wakeby Distribution Using Order Statistics,
W82-01317 1503 2E

WALES
A Successful Transfer,
W82-00309 1501 4A

The Effect of Pollutants from the Coal Industry on the Fish Fauna of a Small River in the South Wales Coalfield,
W82-01389 1503 5C

Charging for Water Supply in England and Wales in the 1980s,
W82-01722 1503 6C

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 1504 5C

Effect of Pembroke Power Station on the Temperatures in Milford Haven, Wales,
W82-02406 1505 5C

Cadmium, Copper, Lead, Zinc and Manganese in the Polychaete Arenicola Marina fro . Sediments Around the Coast of Wales,
W82-02416 1505 5A

Allochthonous Plant Litter as a Source of Organic Material in an Oligotrophic Lake (Llyn Frongoch),
W82-02778 1506 2H

The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 1506 5A

The Welsh Approach to Water Recreation,
W82-04658 1510 6D

Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 1511 5C

Algal Bioassay of the Water from Two Linked but Contrasting Welsh Lakes,
W82-04934 1511 2H

The Breakdown and Decomposition of Allochthonous and Autochthonous Plant Litter in an Oligotrophic Lake (Llyn Frongoch),
W82-06095 1512 5C

WALKER RIVER INDIAN RESERVATION
Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 1511 6B

WALLACE DAM
Evaluation of a Chimney Drain Design in an Earthfill Dam,
W82-04675 1510 8D

WALLOWA LAKE
Factors Contributing to the Maintenance of Oligotrophy in an Alpine Glacial Moraine Lake (Wallowa Lake) in Northeast Oregon,
W82-02250 1505 2H

WARNER VALLEY
The Geothermal Hydrology of Warner Valley, Oregon: A Reconnaissance Study,
W82-04496 1510 1A

WARNING SYSTEMS
Flood Forecast and Warning System Evaluation, Susquehanna River Basin, New York, Pennsylvania and Maryland.
W82-00351 1501 6F

The Day That the Rain Came Down,
W82-02064 1504 2E

An Early Warning Organics Detection System for the Ohio River,
W82-04091 1509 5A

Official and Folk Flood Warning Systems: An Assessment,
W82-06077 1512 6F

WASHINGTON
Toxicity of Mount St. Helens Ash Leachate to a Blue-Green Alga,
W82-00001 1501 5C

Mudflows Resulting From the May 18, 1980, Eruption of Mount St. Helens, Washington,
W82-00003 1501 5B

Channel Conditions in the Lower Toutle and Cowlitz Rivers Resulting From the Mudflows of May 18, 1980,
W82-00004 1501 5B

Effects of the Mount St. Helens Eruption on the Benthic Fauna of the Toutle River, Muddy River, and Pine Creek Drainage Basins, Washington,
W82-00005 1501 5C

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

Effects of Volcanism on the Glaciers of Mount St. Helens,
W82-00007 1501 2C

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 1501 4A

An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 1502 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 1502 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 1502 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 1502 2H

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 1502 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 1503 2E

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 1503 7C

The Dilution/Flushing Technique in Lake Restoration,
W82-02270 1505 2H

The Early Diagenesis of Aliphatic Hydrocarbons and Organic Matter in Sedimentary Particulates from Dabob Bay, Washington,
W82-02310 1505 5B

Ground Water in Washington,
W82-02536 1505 2F

Digital-Model Simulation of the Hydrologic Flow System, with Emphasis on Ground Water, in the Spokane Valley, Washington and Idaho,
W82-02836 1506 2F

Effects of Dilution on the Benthos of an Alkaline Lake,
W82-03064 1507 2H

Hydrocarbon Geochemistry of the Puget Sound Region-I. Sedimentary Acyclic Hydrocarbons,
W82-03241 1507 5B

Effects of a North Central Washington Wildfire on Runoff and Sediment Production,
W82-04250 1509 2E

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 1511 2E

Life History and Habitat Utilization of Cutthroat Trout (Salmo Clarki) in a Headwater Stream on the Olympic Peninsula, Washington,
W82-05306 1511 5C

Total Suspended Solids in Highway Runoff in Washington State,
W82-05820 1511 5B

Competition Between Irrigation and Hydropower Water Use in Washington State,
W82-06156 1512 6A

Sediment Transport Study Along a Delta Shoreline,
W82-06553 1512 2J

Internal Phosphorus Loading in a Shallow Eutrophic Lake,
W82-06663 1512 2H

Effects of Suspended Volcanic Sediment on Coho and Chinook Salmon in the Toutle and Cowlitz Rivers,
W82-06706 1512 5C

County Provides a Rural Water Supply System,
W82-06843 1512 3D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibility Study, (In Two Parts), 1. Laboratory and Field Tests,
W82-06960 1512 5D

Preliminary Post-Eruption Sediment Budget for the North Fork Toutle River Drainage, June 1980-May 1981,
W82-06970 1512 4D

Sediment Influx to the Toutle River from Erosion of Tephra, May 1980-May 1981,
W82-06971 1512 4D

WASHINGTON CASCADES

Acid Precipitation in the Washington Cascades,
W82-05287 1511 5B

WASHINGTON SUBURBAN SANITARY COMMISSION

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

WASHOUTS

Flood of November 26-27, 1979, in Essex County, New York,
W82-02483 1505 2E

WASTE ASSIMILATIVE CAPACITY

The Effect of Sewage Sludge on Salt-Marsh Denitrifying Bacteria,
W82-03770 1509 5E

A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

Differential Phosphorus Assimilation in Attached vs. Unattached Microorganisms,
W82-06762 1512 5B

WASTE CHARACTERISTICS

Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 1501 5D

Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 1502 5A

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 1502 5D

WASTE DISPOSAL

Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 1501 5D

Lining of Waste Impoundment and Disposal Facilities.
W82-00099 1501 5E

Slash Treatment After Clearcutting Lodgepole Pine Affects Nutrients in Soil Water,
W82-00130 1501 4C

Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 1501 5E

The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 1502 5E

Bentonite Liners for Power Plant Lagoons,
W82-00617 1502 5E

Illinois Groundwater Problems and Needs,
W82-01052 1502 4B

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 1502 4B

Solid Wastes and Water Quality,
W82-01269 1503 5B

A Study of Regional Temperature and Thermohydrologic Effects of an Underground Repository for Nuclear Wastes in Hard Rock,
W82-01347 1503 5E

Rural Sanitation in Developing Countries,
W82-01392 1503 5D

The Stringfellow Industrial Waste Disposal Site: A Technical Assessment of Environmental Impact,
W82-01415 1503 5B

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

Rating the Hazard Potential of Waste Disposal Facilities,
W82-01418 1503 5G

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 1503 5G

Evaluation of Hydrogeologic Conditions,
W82-01420 1503 5G

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 1503 5G

Site Assessment: Improving Confidence Levels with Surface Remote Sensing,
W82-01422 1503 5G

Case Studies on the Migration of Pollutants in Ground Water,
W82-01424 1503 5B

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 1503 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 1503 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

Electro-Osmosis Chemistry and Water Quality,
W82-01518 1503 5E

A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 1503 5B

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 1503 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 1503 5E

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 1504 5E

Waste Disposal--Choosing and Licensing Site,
W82-02035 1504 5G

Managing Hazardous Wastes,
W82-02252 1505 5E

Treated Pit Fluids Meet Water Specifications.
W82-02557 1505 5E

Bactericidal Effect of Seawater Containing Digested Night Soil and Marine Plankton Against Intestinal Bacteria, (In Japanese),
W82-02799 1506 5E

Flue Gas Desulfurization Sludge Disposal Practices for Coal-Fired Steam and Power Plants,
W82-02907 1506 5E

Duluth Sanitary District First in U.S. to Take Charge of Both Sewage and Refuse.
W82-03249 1507 5E

Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 1507 5E

Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 1508 5G

Analytical Solutions for Transpot of Conservative and Nonconservative Contaminants in Groundwater Systems,
W82-03555 1508 5B

Patterns of Groundwater Salinity Changes in a Deep Continental-Oceanic Transect Off the Southeastern Atlantic Coast of the U.S.A.,
W82-03582 1508 2F

City Sewage and the American Farmer,
W82-03600 1508 3C

A Closer Look at Deep Well Disposal of Wastes,
W82-03646 1508 5E

Regulation of Utility Waste Disposal Practices,
W82-03691 1508 5E

Moisture Movement in Soils in the Vicinity of Waste Disposal Sites,
W82-03728 1508 2G

On the Quality and Some Ecological Effects of Wastewater Effluents from Two Chemical Industrial Plants in Pakistan,
W82-03773 1509 5C

Geological Considerations in Hazardous-Waste Disposal,
W82-03797 1509 5B

The Evaluation of the Elutriate Test as a Means of Predicting the Behavior of Selected Chlorinated Hydrocarbons in Dredged Sediment During Open-Water Disposal,
W82-03824 1509 5A

Procedure for Evaluating the Geologic Integrity of Existing Hazardous Waste Sites in Louisiana: Case Histories,
W82-03932 1509 5A

Performance Studies of Various Landfill and Impoundment Liners,
W82-03938 1509 5E

Application of Computer Modeling for the Investigation of Ground-Water Contamination,
W82-03939 1509 5E

A Hydrogeochemical Study of Contaminant Attenuation and Remobilization in the Big Swamp Overburden Near Picton, Ontario,
W82-03945 1509 5B

Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 1510 5D

Anaerobic Digestion of Farm Wastes: A Review - Part 2,
W82-04347 1510 5E

Wet Disposal of Fossil Plant Waste: Case History,
W82-04385 1510 5E

Costing Dar-Es-Salaam's Sanitation Plan,
W82-04603 1510 6C

Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

Weak Controls from Sea to Shining Sea,
W82-05035 1511 5B

Pilot Field Studies of FGD Waste Disposal at Louisville Gas and Electric,
W82-05066 1511 5E

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

Estimation of Organic Compound Emissions from Waste Lagoons,
W82-05679 1511 5C

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 1511 5D

Optimal Location and Management of Waste Disposal Facilities Affecting Ground Water Quality,
W82-05740 1511 5G

Law for Environmentalists,
W82-05813 1511 5G

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

A Look at Co-Disposal,
W82-06354 1512 5E

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

Feed from Sewage: Prospects and Constraints,
W82-06489 1512 5E

Selection of Waste disposal sites,
W82-06550 1512 5E

Radioactive Wastes,
W82-06920 1512 5E

WASTE DUMPS
The Toxic Waste Dump Problem and a Suggested Insurance Program,
W82-00591 1502 5E

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

Love Canal: Chemical Contamination and Migration,
W82-01436 1503 5B

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

Dutch Dumps,
W82-03738 1508 5B

Effect of Leachate Solutions from Fly and Bottom Ash on Groundwater Quality,
W82-03798 1509 5B

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

An Environmental Health Survey of Drinking Water Contamination by Leachate from a Pesticide Waste Dump in Hardeman County, Tennessee,
W82-05203 1511 5B

WASTE HEAT
Waste Heat Balance in Aquifers Calculated by a Computer Programme,
W82-00830 1502 7B

Municipal Wastewater Treatment Plant Pioneers in Conservation Approach,
W82-03255 1507 5D

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 1512 3E

WASTE IDENTIFICATION
Biological Testing Methods - Compliance with Hazardous Waste Regulation Chapter 173-302 WAC.
W82-01071 1502 5A

Abundance of Organic Compounds in Water,
W82-01162 1503 5A

WASTE LOAD
Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

A Consistent Methodology for Wasteload Allocations,
W82-05702 1511 5G

WASTE LOAD ALLOCATIONS
Discussion: A Multiobjective Model for Regional Water Quality Management, by B. N. Lohani and Pakhorn Adulbhan,
W82-03785 1509 5G

WASTE MANAGEMENT
An Industrial and Hazardous Waste Inventory of Washington's Manufacturing Industries (1980),
W82-01065 1502 5B

Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

The Hazards of Hazardous Waste Management,
W82-01940 1504 6E

Managing Hazardous Wastes,
W82-02252 1505 5E

The Status of Nuclear Waste Management,
W82-02659 1506 5E

Leachate Collection Design for Containment Landfills,
W82-04996 1511 5E

Impact of American Regulations on Industrial Sludge Management,
W82-05184 1511 6E

WASTE POLLUTION PREVENTION
Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 1511 5B

WASTE RECOVERY
Survival of Eggs and Larvae of Swine Nematode Parasites in Aerobic and Anaerobic Waste Treatment Systems,
W82-00161 1501 5D

Leachates from Solid Waste Recovery Operations,
W82-00167 1501 5D

Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 1503 5D

A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 1506 5D

Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 1507 5D

Potato and Corn By-Products Used as Cattle Feed,
W82-06488 1512 5E

WASTE STORAGE
Lining of Waste Impoundment and Disposal Facilities,
W82-00099 1501 5E

Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 1503 5E

Four Options for Hazardous Waste Disposal,
W82-03416 1508 5E

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

WASTE TREATMENT
Land Restoration Following Oil-Well Drilling,
W82-00057 1501 5D

Methane Production from Ozonated Pulp Mill Effluent,
W82-00155 1501 5D

Anaerobic Treatment of Human Waste in Northern Communities,
W82-00249 1501 5E

Pollution from Farms,
W82-02039 1504 5D

Bioengineering Aspects of Aerobic Microbial Piggery Waste Treatment, Part II. Effect of Controlled Conditions on Growth of Microflora and Efficiency of Biodegradation,
W82-03212 1507 5D

Lime Softening Sludge Treatment and Disposal,
W82-04276 1510 5E

The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 1510 5D

WASTE WATER
Detection of Volatile Nitrosamines in Waste Water from Chemical Plants by Combined Capillary Gas Chromatography-Mass Spectrometry,
W82-00856 1502 5A

WASTE WATER DISPOSAL
1980 Annual Report - A Perspective on the Problem of Hazardous Substances in the Great Lakes Basin Ecosystem,
W82-00707 1502 5C

Saline Water Use and Disposal Opportunities; Colorado River Water Quality Improvement Program,
W82-00717 1502 3C

WASTE WATER TREATMENT
Design, Evaluation and Effluent Water Quality Analysis of Three Oyster Shellstock Washers,
W82-00406 1501 5D

Continuous Bioregeneration of Granular Activated Carbon During the Anaerobic Degradation of Catechol,
W82-00408 1501 5D

High Temperature Ultrafiltration with Kynar Poly(Vinylidene Fluoride) Membranes,
W82-01566 1503 5D

Rosario Dominicana's Cyanide Tailings Dam Construction and Operation,
W82-01589 1503 5D

Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 1512 5D

WASTES
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 1504 5A

WASTEWATER
Evaluation of the Overland Runoff Mode of Land Wastewater Treatment for Virus Removal,
W82-00220 1501 5B

Enumeration of Potentially Pathogenic Bacteria from Sewage Sludges,
W82-00221 1501 5A

Technique for Determining Total Bacterial Virus Counts in Complex Aqueous Systems,
W82-00222 1501 5A

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 1502 5A

Microbial Metabolism of N-Nitrosodiethanolamine in Lake Water and Sewage,
W82-00585 1502 2H

Thames Rears Carp in Sewage,
W82-00681 1502 3C

Formation of N-Nitrosodiethanolamine from Diethanolamine in Lake Water and Sewage,
W82-00796 1502 5A

Waterborne Methylene Bis(2-Chloroaniline) and 2-Chloroaniline Contamination Around Adrian, Michigan,
W82-00873 1502 5B

Sea Urchin Sperm Bioassay for Sewage and Chlorinated Seawater and Its Relation to Fish Bioassays,
W82-00988 1502 5A

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 1504 5A

Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 1505 5A

Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 1505 5A

Distribution of Ribonucleic Acid Coliphages in Raw Sewage from Treatment Plants in Japan,
W82-02443 1505 5A

Method of Selective Dissolution for Characterization of Particulate Forms of Radium and Barium in Natural and Waste Waters,
W82-03879 1509 5A

Speciation of Trace Di- and Triorganotins in Water by Ion-Exchange HPLC-GFAA,
W82-04037 1509 5A

Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

The Unterweser Automatic Water Quality Measurement System,
W82-04588 1510 5A

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

Effects of Treated Municipal Wastewater on the Hepatic, Xenobiotic, and Steroid Metabolism in Trout,
W82-05406 1511 5C

Re-Examining the Kinetics of the Biochemical Oxidation of Sewage,
W82-05409 1511 5D

Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 1512 5E

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment,
W82-06380 1512 5D

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

Evaluation of Cell Lines and Immunofluorescence and Plaque Assay Procedures for Quantifying Reoviruses in Sewage,
W82-06735 1512 5A

WASTEWATER ANALYSIS
The Analysis of Oil Shale Wastes: A Review,
W82-00388 1501 5A

Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 1502 5A

Ammonia Electrode with Immobilized Nitrifying Bacteria,
W82-01099 1502 5A

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 1503 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 1503 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively

Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 1504 5A

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 1505 5A

Source and Extent of Klebsiella Pneumoniae in the Paper Industry,
W82-02337 1505 5B

Positively Charged Filters for Virus Recovery from Wastewater Treatment Plant Effluents,
W82-02338 1505 5A

A-1 Medium: Alternative Technique for Fecal Coliform Organism Enumeration in Chlorinated Wastewaters,
W82-02339 1505 5A

Studies of the Transformation of Carbon, Nitrogen, Phosphorus, Sulphur and the Principal Mineral Elements in the Course of Measuring Total Oxygen Demand--III. Transformation of Sulfur (In French),
W82-03486 1508 5A

Trace Analyses for Wastewaters,
W82-03639 1508 5A

A Resume of the Kinetics of the BOD Test,
W82-03832 1509 5A

Waste Discharge Monitoring Requirements Under the NPDES Permits Program,
W82-03969 1509 5D

Determination of Volatile Organics in Industrial and Municipal Wastewaters,
W82-04396 1510 5A

Determination of Haloethers in Industrial and Municipal Wastewaters,
W82-04398 1510 5A

A Simple Microdetermination of Polymer Flocculants (Polyacrylamides and Guar) in Mine Water,
W82-04457 1510 5A

Gas Chromatographic Determination of Phenolic Compounds in Water, as their Pentafluorobenzoyl Derivatives,
W82-04816 1511 5A

Occurrence and Determination of Organic Oxidants in Rivers and Wastewaters,
W82-04821 1511 5A

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 1511 7B

Sample Digestion Procedures for Simultaneous Determination of Arsenic, Antimony, and Selenium by Inductively Coupled Argon Plasma Emission Spectrometry with Hydride Generation,
W82-05360 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene, 2. Determination of a Representative Discharge of Ether-Extractable Components,
W82-05412 1511 5A

Effluent Analysis of Wastewater Generated in the Manufacture of 2,4,6-Trinitrotoluene. 1. Characterization Study,
W82-05413 1511 5A

Portable Water-Wastes Laboratory Highlights Benefits of Nitrogen Analyzing Systems.
W82-05437 1511 5A

Application of Nuclear Double Resonance Technique for Detection of Pesticides in Water at Low Concentrations,
W82-06004 1512 5A

The Molecular Mass Distribution of Organic Compounds in Activated Sludge Plant Effluent Determined by Means of Gel Permeation Chromatography,
W82-06030 1512 5A

Determination of Phosphate in Wastewater by Ion-Exclusion Chromatography with Flow Coulometric Detection,
W82-06040 1512 5A

Development of a Method for Detection of Human Rotavirus in Water and Sewage,
W82-06885 1512 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 1512 5A

Organics,
W82-06922 1512 5A

WASTEWATER COLLECTION
Pressure Sewer Systems,
W82-00528 1502 5D

O & M Wastewater Collection and Treatment Facilities,
W82-01249 1503 5D

Wastewater Collection,
W82-01251 1503 5D

The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 1503 5D

Vacuum Sewers--The Future for Sewage Collection,
W82-03394 1507 5G

Put Pressure on Sewage,
W82-06732 1512 5D

WASTEWATER COLLECTIONS
Northern Elbe Culvert,
W82-05427 1511 8B

WASTEWATER COMPOSITION
Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

Midwestern Wastewater Characteristics,
W82-00534 1502 5D

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

WASTEWATER DILUTION
Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 1502 5D

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

WASTEWATER DISPOSAL
Cropping Systems for Treatment and Utilization of Municipal Wastewater and Sludge,
W82-00097 1501 5E

Phosphorus Dynamics of a Florida Freshwater Marsh Receiving Treated Wastewater,
W82-00108 1501 5E

Experimental Studies on the Effect of Arsenic on Microbial Degradation of Organic Matter and Algal Growth,
W82-00237 1501 2H

Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 1501 6G

State-of-the-Art of Liquid Waste Disposal for Geothermal Energy Systems: 1979,
W82-00375 1501 5E

Sodium-Potassium Ratios in Soil Solution and Plant Response Under Saline Conditions,
W82-00469 1501 3C

The Control of Bacterial Pollution Caused by Sea Discharges of Sewage,
W82-00699 1502 5D

Dairy Liquid Waste Distribution in an Overland Flow Vegetative-Soil Filter System,
W82-00897 1502 5D

Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 1503 5C

A Hydrobiological Survey of a Polluted Canal,
W82-01356 1503 5C

Groundwater Contamination by Trace Level Organics from a Rapid Infiltration Site,
W82-01496 1503 5B

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 1503 5D

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 1503 5E

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 1504 5C

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

Industrial Wastewater Pretreatment Service,
W82-02253 1505 5E

An Investigation of the Influence of Bacteriophages on the Bacterial Flora and Purification Powers of Activated Sludge,
W82-02433 1505 5E

Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Guidelines for Control of Septic Tank Systems,
W82-02599 1505 5B

Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 1506 5E

Land Application of Wastewaters: An Overview.
W82-02650 1506 3C

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 1506 5B

Distribution of Wastewater in Drain Field Pipes,
W82-02945 1506 8B

Wastewater Treatment by a Prototype Slow Rate Land Treatment System,
W82-02981 1506 5D

Simulation of the Transport of Ion-Exchanging Solutes Using Laboratory-Determined Chemical Parameter Values,
W82-03057 1507 5B

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 1507 6E

Note on Design of Diffusers for Sewage Outfalls Based on the Work of Rawn Et Al.,
W82-03347 1507 5E

Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 1508 5D

The Adsorption Characteristics of Soils and Removal of Cadmium and Nickel from Wastewaters,
W82-03553 1508 5E

Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 1508 5D

Nitrogen Removal in a Subsurface Disposal System,
W82-04001 1509 5D

Experience with Riverbank Filtration Along the Rhine River,
W82-04104 1509 5D

Disposal and Handling of Water Treatment Plant Sludge,
W82-04126 1509 5E

Waste Water Disposal Through a Coastal Aquifer,
W82-04231 1509 5E

Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Deep Well Disposal of Secondary Effluent in Dade County Florida,
W82-04442 1510 5E

New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

Nitrifying Population Densities and Inhibition of Ammonium Oxidation in Natural and Sewage-Enriched Cypress Swamps,
W82-04556 1510 5C

Casein Whey-Wastewater Effects on Soil Permeability,
W82-04874 1511 3C

Relative Health Risks of Activated Sludge Treatment and Slow-Rate Land Treatment,
W82-05258 1511 5D

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 1511 5G

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 1511 5D

Effect of Sewage Effluent on the Sediments of Nordasvatnet (A Landlocked Fjord), Norway,
W82-05605 1511 5B

Die-Away Kinetics of Aerosolized Bacteria from Sprinkler Application of Wastewater,
W82-05706 1511 5D

Reliability of On-Site Sewage Disposal Systems in Fairfax County, Virginia,
W82-05812 1511 5D

Investigations of Dispersal in an Area of Complex Circulation - The Outer Thames Estuary,
W82-05946 1512 5B

Effect of Irrigation Loamy Sand Soil by Sewage Effluents on Its Content of Some Nutrients and Heavy Metals,
W82-06228 1512 5E

Discharge to the North Sea,
W82-06248 1512 5E

Environmental Assessment; Geothermal Direct Heat Project; Marlin Texas.
W82-06404 1512 6G

Dilution Analysis for Unidirectional Diffusers,
W82-06420 1512 8B

On-Site Wastewater Management--Recent Trends,
W82-06439 1512 5D

Cross-Country Force Main.
W82-06640 1512 8G

Preliminary Study of Thessaloniki Bay for Contamination by Mercury and Lead,
W82-06728 1512 5B

WASTEWATER FACILITES

Nonlinear Programming Model of Wastewater Treatment Plant,
W82-02962 1506 5D

Heat Loss from Rapid Infiltration Basin in Winter,
W82-05317 1511 5D

WASTEWATER FACILITIES

The Horse Creek Basin Project,
W82-00071 1501 5G

Greece Won't Be Letting Wastewater Problems Slide.
W82-00182 1501 5D

Final Environmental Impact Statement for Proposed Sewerage Facilities in the Marion County Lake Improvement District, Marion County, Kansas.
W82-00355 1501 6G

Final Environmental Impact Statement, City of Portage Wastewater System, Columbia County, Wisconsin.
W82-00356 1501 6G

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 1501 5D

Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 1501 5D

Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 1501 5D

Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 1501 5D

Final Environmental Impact Statement; South Tahoe Public Utility District and Douglas County Sewer Improvement District No. 1, Appendix B: Mitigation Program.
W82-00369 1501 6G

Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 1501 5D

Management Training is the Key to Good Operator Performance,
W82-00623 1502 5D

Low-Cost Wastewater Treatment,
W82-00841 1502 5D

The Cape Flats Sewage Treatment Works,
W82-00957 1502 5D

Effects of Renton Wastewater Treatment Plant Effluent on Water Quality of the Lower Green/Duwamish River,
W82-01063 1502 5D

O & M Wastewater Collection and Treatment Facilities,
W82-01249 1503 5D

A Survey of Mathematical Optimization Models and Algorithms for Designing and Extending Irrigation and Wastewater Networks,
W82-01296 1503 6A

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 1503 5D

Stability of Activated Sludge Processes Based on Statistical Measures,
W82-01489 1503 5D

Slowhill Copse Sewage Treatment Works.
W82-01727 1503 5D

Detroit's WWTP: One of the World's Biggest,
W82-01865 1504 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 1504 5D

Beddington Sewage-Treatment Works, Canyon: Some Operating Experiences 1969-79,
W82-02410 1505 5D

Wastewater Collection and Treatment in Wayne County,
W82-02554 1505 5D

Treatment Plant Features Ultraviolet Disinfection,
W82-02644 1506 5D

Secondary Treatment Waivers Issued, Controversy Continues,
W82-02652 1506 6E

Totnes Sewage Treatment, Resewerage and Flood Prevention Scheme.
W82-02872 1506 5D

Advanced Sludge Treatment for Modern Waterworks,
W82-02889 1506 5D

Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 1506 5D

Municipal Sewage: Three Communities Try to Cope,
W82-03284 1507 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 1508 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Gilbert/Commonwealth, Reading, PA,
W82-03475 1508 6A

Improving Treatment Works Efficiency.
W82-03500 1508 5D

Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 1508 5D

How Do You Build When Sewers Are Inadequate,
W82-03592 1508 5D

A Resume of the Kinetics of the BOD Test,
W82-03832 1509 5A

Sewage-Treatment Works' Effluent Sampling--Have Our Means Any Meaning,
W82-03833 1509 5A

Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

Automation of Grimsby Pumping Stations,
W82-04006 1509 5D

Method of Evaluating the Possible Energy Savings by Implementing Do-Control or Fine Bubble Diffusors,
W82-04007 1509 5D

A Control System for Smaller Wastewater Treatment Plants,
W82-04024 1509 5D

O & M Costs and Optimal Capacity Expansion,
W82-04042 1509 6B

Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

Automatic Flow Control in Combined Sewer Systems-Effectiveness and Implementation Problems,
W82-04049 1509 5D

The BASF Toximeter - A Helpful Instrument to Control and Monitor Biological Waste Water Treatment Plants,
W82-04050 1509 5A

Storm and Combined Sewers: Part of The Treatment Process,
W82-04195 1509 5B

Capacity Expansion Planning Model for Waste Water Treatment and I/I Control,
W82-04239 1509 5D

Hourly Diurnal Flow Variations in Publicly-Owned Wastewater Treatment Facilities,
W82-04402 1510 5D

Variation of Sludge Volume Index with Activated Sludge Characteristics,
W82-04555 1510 5D

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 1510 5D

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 1510 5D

Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

An Exercise in Sludge Consolidation,
W82-04848 1511 5D

Regional Management of Groundwater Recharge and Pollution in a Rapidly Urbanizing Area: Long Island, N.Y.,
W82-04956 15[illegible] 4B

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

Galvanized Steel Stalls Treatment Plant Corrosion,
W82-05167 1511 8G

A Low-Cost Secondary Treatment Alternative,
W82-05169 1511 5D

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

Inhibition of Nitrogenous BOD and Treatment Plant Performance Evaluation,
W82-05323 1511 5D

Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 1511 5D

Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

Start-Up Problems of Sludge Dewatering Facility,
W82-05444 1511 5D

The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 1511 5D

A Computer-Based Centralized Control and Supervisory System for the Davyhulme Sewage Treatment Works,
W82-05472 1511 5D

Automation at Norwich Sewage-Treatment Work: Five Years' Experience,
W82-06157 1512 5D

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

How to Set Up a Preventive Maintenance Program,
W82-06264 1512 5D

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

Pilot-Scale Advanced Waste-Water Treatment at Davyhulme,
W82-06649 1512 5D

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

WASTEWATER FACILITIES *SLUDGE SOLIDS

Shaking Down a Solids Handling System,
W82-04338 1510 5D

WASTEWATER FARMING

Effects of Municipal Waste Water Effluent on Performance and Feed Quality of Maize Vs. Reed Canarygrass,
W82-00564 1502 3C

City Sewage and the American Farmer,
W82-03600 1508 3C

Land Disposal of Sewage Sludge, A Summary of Research Results, 1972-1980,
W82-06377 1512 5E

WASTEWATER IRRGATION

Effluent in Trickle Irrigation of Cotton in Arid Zones,
W82-06333 1512 3C

WASTEWATER IRRIGATION

Isolation and Identification of Pathogenic Microorganisms at Wastewater-Irrigated Fields: Ratios in Air and Wastewater,
W82-00579 1502 5A

Effect of Irrigating Loamy Sand Soil by Liquid Sewage Sludge on its Content of some Micronutrients,
W82-00661 1502 5E

The Effects of Sodium and Organic Matter In Sewage Effluent on Water Retention Properties of Soils,
W82-00663 1502 3C

2,500 Acres of Wastewater Irrigation,
W82-00769 1502 3C

A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 1505 3D

Effects of Scheduling Municipal Waste-Water Effluent Irrigation of Reed Canarygrass on Nitrogen Renovation and Grass Production,
W82-02219 1505 3C

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 3C

Reducing Ground-Water Pollution from Municipal Waste-Water Irrigation of Rhodes Grass Grown on Sand Dunes,
W82-02391 1505 3C

Accumulation of Heavy Metals in Arid-Zone Soils Irrigated with Treated Sewage Effluents and Their Uptake by Rhodes Grass,
W82-02392 1505 5B

Selection of Irrigation Systems for Land Application of Municipal Wastewater,
W82-02643 1506 3C

Land Application of Wastewaters: An Overview.
W82-02650 1506 3C

Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 1508 3C

Yield and Development of Soybeans (Glycine Max L.) as Affected by Irrigation with Municipal Wastewater and Well Water,
W82-03723 1508 3C

Irrigating with Municipal Effluent: A Socioeconomic Study of Community Experiences,
W82-03967 1509 3C

Sewage Irrigation and Recharge Consequences, Oahu,
W82-04041 1509 3C

Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

Chemical Fractionation of Heavy Metals in Wastewater-Affected Soils,
W82-04781 1511 5B

Comparison of Coliphage and Bacterial Aerosols at a Wastewater Spray Irrigation Site,
W82-04830 1511 3C

Alfalfa Hay Grown with Municipal Waste Water and Pump Water,
W82-04873 1511 3C

Casein Whey Wastewater Effects on Soil Permeability,
W82-04874 1511 3C

The Occurrence of Flow Channels in Soils,
W82-04875 1511 3C

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

Forage Production Utilizing Cheese Plant Effluent Under High-Altitude Conditions,
W82-05265 1511 3C

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 1511 5D

Changes to a Soil on Irrigation with a Sanitary Landfill Leachate,
W82-05619 1511 5E

Soil and Groundwater Changes Under Land Treatment of Wastewater,
W82-05964 1512 5D

Wastewater Irrigation of Fruit Trees,
W82-06008 1512 3C

WASTEWATER LAGOONS

Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 1501 5D

The National Assessment of the Ground-Water Contamination Potential of Wastewater Impoundments,
W82-01419 1503 5G

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 1504 5D

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 1505 3A

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

Algal Polymorphism in High Rate Wastewater Treatment Ponds,
W82-02564 1505 5D

Sealing of Lagoons and Ponds: Proposed Quality Requirements for Soil Liners,
W82-03941 1509 5G

Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 1510 5D

Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 1511 5D

Consider Soil-Cement for Erosion and Seepage Control
W82-05039 1511 8F

Bactericidal Agents in Wastewater Lagoons and Lagoon Design,
W82-05333 1511 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 1511 5D

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 1511 5D

Ammonia and Total Kjeldahl Nitrogen Removal in Aerated Lagoons,
W82-05420 1511 5D

Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

Biological Equilibrium in a Wastewater Reservoir,
W82-06282 1512 5D

WASTEWATER MANAGEMENT

Water Quality Evaluation of Regional Wastewater Management,
W82-00977 1502 5D

The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force,
W82-01142 1503 5F

Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Trends in Wastewater Collection Systems,
W82-02573 1505 8G

In-Home Conservation and Wastewater Management,
W82-02591 1505 3D

Project Outcomes Correlate with Public Participation Variables,
W82-02663 1506 6B

Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 1508 5G

Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 1508 5D

Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems,
W82-03763 1509 5D

Practice and Perspective on Computer Control in Sewage Process,
W82-03852 1509 5D

A New Mixed Liquor Suspended Solids Method of Control with Total Sludge Management,
W82-03853 1509 5D

Requirements and Application of Control and Automation Systems in Wastewater Treatment-A Critical View,
W82-03858 1509 5D

Role of Sensors in Trunk Sewers in the Control of Flow and Wastewater Quality,
W82-03859 1509 5D

Study of Necessary Factors for Adaptive Control of Activated Sludge System,
W82-03861 1509 5D

Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

Organic Load Control of the Activated Sludge Process Based on Predicted Daily Variation of Influent Load,
W82-04028 1509 5D

A Computer-Based Strategy for the Control of Equalization Tanks,
W82-04053 1509 5D

Microprocessor Architecture and Performance in Wastewater Process,
W82-04056 1509 5D

Experience with Riverbank Filtration Along the Rhine River,
W82-04104 1509 5D

Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Municipal Sewage Treatment - Some Recent Developments,
W82-04528 1510 5D

Optimization of Areawide Wastewater Management,
W82-04703 1510 5D

Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 1510 5D

Computer-Based Implementation of Combined Sewer Control,
W82-04783 1511 5D

Sludge Management in the Rocky Mountain State,
W82-05165 1511 5E

Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 1511 6B

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

Septage and Wastewater Treatment in the Activated Sludge Process,
W82-05699 1511 5D

A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 1512 6A

On-Site Wastewater Management--Recent Trends,
W82-06439 1512 5D

WASTEWATER OUTFALL
Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

Where to Put a Steady Discharge in a River,
W82-05632 1511 5G

Outfall Diffuser Behavior in Stratified Ambient Fluid,
W82-05797 1511 8B

WASTEWATER OXIDATION
Ultimate BOD Estimation in Receiving Water Quality Modeling,
W82-04016 1509 5D

A Comparison of the Carbonaceous Oxygen Demands of a Domestic and Industrial Sewage,
W82-05467 1511 5D

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 1512 5D

WASTEWATER PLANT OPERATORS
The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 1502 5C

WASTEWATER POLLUTION
The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 1502 5D

Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

Preliminary Pollution Surveys Around the South-Western Cape Coast. Part 4: Salt River Mouth, Table Bay,
W82-03367 1507 5B

Effect of River Discharge on the Distribution Pattern of Dissolved Constituents in the Gamo Estuary, Miyagi Prefecture,
W82-04543 1510 2L

Dynamics of the Number of Bacteria and Conversion of Readily Oxidizable Substances in Small Rivers,
W82-05237 1511 5A

Enrichment of Inorganic Nutrients in the Inner Saronikos Gulf (1973-1976),
W82-06499 1512 5B

Kaneohe Bay Sewage Diversion Experiment: Perspectives on Ecosystem Responses to Nutritional Perturbation,
W82-06846 1512 5G

Sewage Diversion Effects on the Water Column of a Subtropical Estuary,
W82-06892 1512 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

Comparative Characteristics of the Bacterioplankton of Rivers,
W82-06986 1512 5C

WASTEWATER RENOVATION
Leachates from Solid Waste Recovery Operations,
W82-00167 1501 5D

Refuse-To-Energy Wastewater Treatment,
W82-00168 1501 5D

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 1501 5D

Environmental Effects of Water Reuse Scheme,
W82-00973 1502 3C

Enteric Viruses in Renovated Water in Manitoba,
W82-01090 1502 5A

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 1504 3C

Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 1505 5D

Recycling,
W82-02514 1505 6E

Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

Managing Vegetation in Wastewater Application,
W82-03401 1508 5D

The Effect of Reuse of Water for Agriculture on The Arab-Asian Society: A New Interdisciplinary Model for Understanding a Development Problem,
W82-04213 1509 3C

Water Recycling/Reuse in the Food Processing Industry,
W82-04566 1510 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

Characterization, Renovation, and Utilization of Water from Slurry Transport Systems,
W82-05289 1511 5D

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 1512 5D

WASTEWATER TREATMENT
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 1501 5D

Treatment of Florida Surface Waters for Use in Phosphate Beneficiation,
W82-00048 1501 5D

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

Energy Recovery System,
W82-00059 1501 5D

Apparatus for the Purification of Oily Emulsions, Solutions, and Industrial Waste Waters,
W82-00060 1501 5D

Pressurized Oxygenation System and Method,
W82-00064 1501 5D

Underwater Aerator,
W82-00065 1501 5D

High Capacity Waste Water Treatment System,
W82-00066 1501 5D

Apparatuses for the Anaerobic Digestion of Natural Organic Waste,
W82-00069 1501 5D

Facultative Lagoon Effluent Polishing Using Phase Isolation Ponds,
W82-00092 1501 5D

Evaluation of the Effectiveness of Granular Activated Carbon Adsorption and Aquaculture for Removing Toxic Compounds From Treated Petroleum Refinery Effluents,
W82-00098 1501 5D

Virus Removal in Waste Stabilization Ponds in India,
W82-00121 1501 5D

Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 1501 5A

Modeling Ammonium Exchange and Regeneration on Clinoptilolite,
W82-00125 1501 5D

Leachates from Solid Waste Recovery Operations,
W82-00167 1501 5D

Refuse-To-Energy Wastewater Treatment,
W82-00168 1501 5D

Foam Control in Aeration Tanks,
W82-00171 1501 5D

Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 1501 5D

Treatment of Potato-Processing Waste Water by an Anaerobic Lagoon-Filter System,
W82-00226 1501 5D

Concentration of Poliovirus in Water by Molecular Filtration,
W82-00246 1501 5A

Design Guidelines for Incompletely Mixed or Aerobic-Anaerobic Aerated Lagoons,
W82-00250 1501 5D

Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 1501 6E

Recovery of Indigenous Viruses from Wastewater Sludges, Using a Bentonite Concentration Procedure,
W82-00271 1501 5D

The Alpha-Beta-Gamma's of Wastewater Treatment,
W82-00275 1501 5D

Effects of Alpha, Beta and Theta Factor Upon the Design, Specification and Operation of Aeration Systems,
W82-00291 1501 5D

Role of Hydrodynamic Factors in Ammonia Desorption by Diffused Aeration,
W82-00293 1501 5D

The Operation of a Waste Treatment Plant. Process Dynamic Considerations,
W82-00298 1501 5D

Luxury Uptake of Nitrogen in Flocculating Algal-Bacterial System,
W82-00307 1501 5D

Small is Environmentally Acceptable . . .,
W82-00311 1501 5D

Pilot Scales Tests on the Flotation of Abattoir Wastes by Deep U Tubes,
W82-00322 1501 5D

A Realistic Assessment of the Effect of Settlement on Sewage,
W82-00324 1501 5D

Advanced Biological Treatment of Tannery Wastewater,
W82-00337 1501 5D

Recent Developments in Water Pollution Control,
W82-00340 1501 5D

Textile Effluents Lose Their Color.
W82-00342 1501 5D

Pulp Companies Face Billion Dollar Cleanup.
W82-00343 1501 5D

Avoiding an Environmental Hangover.
W82-00344 1501 5D

Rapid Growth Forecast for Peroxide.
W82-00345 1501 5D

Final Environmental Impact Statement for Wastewater Treatment Facilities; City of Olathe, Johnson County, Kansas.
W82-00357 1501 5D

Final Environmental Impact Statement; Bemidji Wastewater Treatment System, Beltrami County, Minnesota.
W82-00358 1501 5D

Final Environmental Impact Statement; Wastewater Treatment Facilities, South Shore Lake Tahoe Basin.
W82-00359 1501 5D

Final Environmental Impact Statement; Rehabilitation of Wastewater Facilities, Streator, Illinois.
W82-00361 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 2: The Green Lake Sanitary Sewer and Waste District, Kandiyohi County, Minnesota.
W82-00363 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 3: Springvale-Bear Creek Sewage Disposal Authority, Emmet County, Michigan.
W82-00364 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 4: Steuben Lakes Regional Waste District, Steuben County, Indiana.
W82-00365 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 5: Otter Tail County Board of Commissioners, Otter Tail County, Minnesota.
W82-00366 1501 5D

Limestone-Lime Treatment of Acid Mine Drainage - Full Scale,
W82-00377 1501 5D

Physical/Chemical Treatment of Blast Furnace Wastewaters Using Mobile Pilot Units,
W82-00378 1501 5D

High-Level Ozone Disinfection of Municipal Wastewater Effluents,
W82-00379 1501 5D

Lime Stabilization and Ultimate Disposal of Municipal Wastewater Sludges,
W82-00386 1501 5E

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

Joint Dry/Wet Weather Treatment of Municipal Wastewater at Clatskanie, Oregon,
W82-00391 1501 5D

High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

Processing Needs and Methodology for Wastewaters from the Conversion of Coal, Oil Shale and Biomass to Synfuels.
W82-00431 1501 5D

Assessment of Environmental Control Technology for Coal Conversion Processes,
W82-00432 1501 5D

Slagging Fixed-Bed Gasifier (SFBG) Wastewater Pretreatment,
W82-00433 1501 5D

Treatment of Coal Gasification Process Wastewaters,
W82-00434 1501 5D

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 1501 5D

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 1501 5D

Improved Water Management of Coal Conversion Processes by Preliminary Absorption of Halides,
W82-00437 1501 5D

Solvent Extraction of Phenols,
W82-00438 1501 5D

Assessment of Solvent Extraction for Treatment of Coal Gasifier Wastewater,
W82-00439 1501 5D

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

Characterization and Processing of Coal Conversion Process Wastewaters,
W82-00441 1501 5D

Biological Oxidation of Aqueous Thiocyanate,
W82-00442 1501 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 1501 5D

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 1501 5D

Potential Uses of Spent Shale in the Treatment of Oil Shale Retort Waters,
W82-00445 1501 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 1: Description of the System and the Study of the High Rate Pond,
W82-00455 1501 5D

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 2: Studies of the Fish Ponds,
W82-00456 1501 3C

The Harvest of Microalgae from the Effluent of a Sewage Fed High Rate Stabilization Pond by Tilapia Nilotica. Part 3: Maize Cultivation Experiment, Bacteriological Studies, and Economic Assessment,
W82-00457 1501 3C

Management and Design Implications of a Mathematical Model of a Rapid Gravity Sand Filter Backwash,
W82-00460 1501 5D

Low Temperature Removal of Nitrate by Bacterial Denitrification,
W82-00461 1501 5D

Testing the Flocculation/Coagulation of Wastewater by Granulometric Analysis of Suspended Solids in the Water Using a Laser Diffraction Meter,
W82-00463 1501 5D

Response of Bacteria in Wastewater Sludge to Moisture Loss by Evaporation and Effect of Moisture Content on Bacterial Inactivation by Ionizing Radiation,
W82-00489 1501 5D

Effects of Moisture Content on Long-Term Survival and Regrowth of Bacteria in Wastewater Sludge,
W82-00493 1501 5E

Better Dewatering Improves Sludge Recycling and Gives Significant Energy Savings,
W82-00526 1502 5E

Empire Controlled by Computer,
W82-00529 1502 5D

Enumeration of Bacteriophages and Host Bacteria in Sewage and the Activated-Sludge Treatment Process,
W82-00584 1502 5A

Land Treatment of Municipal Wastewater in Small Communities,
W82-00588 1502 5D

Cold Weather Waste Treatment,
W82-00636 1502 5D

Foam Control and Degradation of Nonionic Detergents,
W82-00637 1502 5D

Chemical Treatment Solves Tannery Waste Problems,
W82-00638 1502 5D

Removal of Priority Pollutants,
W82-00639 1502 5D

Mechanism of Charged Membrane Ultrafiltration of Salt Solutions,
W82-00641 1502 5D

Anaerobic Biological Treatment of Food Industry Wastewaters,
W82-00698 1502 5D

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 1502 5G

Application of Immobilized Hydrogenase for the Detritiation of Water,
W82-00768 1502 5D

Manganese Dioxide as an Adsorbant for Heavy Metals,
W82-00775 1502 5F

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 1502 5C

Purification of Wastewater by Electrolysis,
W82-00847 1502 5D

Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 1502 5D

Pilot Plant Performances in Municipal Wastewater Treatment by Activated Carbon Adsorption,
W82-00851 1502 5D

Facts Fix Fund Finding,
W82-00885 1502 9A

Separation of Selenium from Sulfide Leach Liquors,
W82-00905 1502 5D

Floc/Float System Cleans Desalter Effluent,
W82-00906 1502 5D

Extracting Heavy Metals and Toxic Organics from Sludge,
W82-00947 1502 5D

Control Systems for Return and Waste Sludge,
W82-00949 1502 5D

Sludge Blanket in Activated Final Clarifiers,
W82-00951 1502 5D

Automation of Norwich Sewage-Treatment Works: Early Cost Considerations,
W82-00955 1502 5D

Guideline Tables to Industrial Wastes Problems.
W82-00956 1502 5D

Vacuum Filtration of Metal Hydroxide Sludges,
W82-00976 1502 5D

Chemicals Disinfect Sludge,
W82-01003 1502 5D

Mutant Bacteria Control Filamentous Growth in Mill Wastewater Treatment,
W82-01008 1502 5D

New Secondary Treatment System Brought On-Line at Georgia-Pacific,
W82-01009 1502 5D

Simulation Modeling of Primary Clarifiers,
W82-01027 1502 6A

Removal of Volatile Trace Organics from Wastewater by Overland Flow Land Treatment,
W82-01042 1502 5D

The Impact of Effluent from the Renton Wastewater Treatment Plant on the Dissolved Oxygen Regimen of the Lower Green/Duwamish River,
W82-01064 1502 5D

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 1502 5B

The Effect of Continuous Advanced Wastewater Treatment by the City of Spokane on the Trophic Status of Long Lake, WA During 1979.
W82-01070 1502 2H

Treatability Manual; Volume I. Treatability Data.
W82-01073 1502 5D

Treatability Manual: Volume II. Industrial Descriptions.
W82-01074 1502 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 1502 5D

Treatability Manual; Volume IV. Cost Estimating.
W82-01076 1502 5D

Treatability Manual; Volume V. Summary.
W82-01077 1502 5D

Reclamation of Wastewater with a Soil-Turf Filter: I: Removal of Nitrogen,
W82-01101 1503 5D

Reclamation of Wastewater with a Soil-Turf Filter: II: Removal of Phosphorus, Boron, Sodium and Chlorine,
W82-01102 1503 5D

Pharmaceutical Company's Aeration System Saves Energy,
W82-01180 1503 5D

High-Solubility Gas Flotation,
W82-01184 1503 5D

Energy Requirement for Small Wastewater Treatment Systems,
W82-01185 1503 5D

Data Base Development for the Design of a Radium-226 Removal Process,
W82-01188 1503 5D

Denitrification of Blackwater with Greywater,
W82-01225 1503 5D

Potential Health Hazards from Microbial Aerosols in Densely Populated Urban Regions,
W82-01232 1503 5C

Physical and Chemical Methods,
W82-01241 1503 5D

Biological Filters,
W82-01242 1503 5D

Activated Sludge,
W82-01243 1503 5D

Dentrification,
W82-01246 1503 5D

Onsite Alternatives for Treatment and Disposal,
W82-01248 1503 5D

Disinfection,
W82-01250 1503 5D

Health Effects Associated with Wastewater Treatment and Disposal,
W82-01255 1503 5C

Meat-, Fish-, and Poultry-Processing Wastes,
W82-01256 1503 5D

Fermentation Industry,
W82-01257 1503 5D

Dairy Wastes,
W82-01258 1503 5D

Textile Wastes,
W82-01259 1503 5D

Petroleum Processing Wastes,
W82-01262 1503 5D

Steel Industry Wastes,
W82-01264 1503 5D

Chemicals and Allied Products,
W82-01267 1503 5D

Microbiology of Wastewater Treatment,
W82-01291 1503 5D

Formation of N-Nitrosodimethylamine During Treatment of Municipal Waste Water by Simulated Land Application,
W82-01343 1503 5D

Removal of Phosphorus from Waste Water by Soil Under Aerobic and Anaerobic Conditions,
W82-01344 1503 5D

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 1503 6F

Design and Construction of Shieldhall Sewage-Treatment Works, Glasgow,
W82-01385 1503 5D

Scaynes Hill STW Extensions Include Plastic Media Filtration.
W82-01386 1503 5D

Rural Sanitation in Developing Countries,
W82-01392 1503 5D

New Approaches to Anaerobic Sludge Digestion,
W82-01398 1503 5D

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

Comparative Evaluation of Processes for the Treatment of Concentrated Wastewaters at Uncontrolled Hazardous Waste Sites,
W82-01430 1503 5D

Environmental Impact and Health Effects of Wastewater Chlorination,
W82-01451 1503 5D

Anaerobic Carbon Filter for Degradation of Phenols,
W82-01454 1503 5D

Purification of Municipal Wastewater by Subsequent Reverse Osmosis and Anaerobic Digestion,
W82-01468 1503 5D

Mechanism of Enteroviral Inactivation by Ozone.
W82-01482 1503 5D

The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 1503 5D

Detroit - Fresh Clean Water,
W82-01506 1503 5D

Utilization Efficiency of Nitrogen from Sewage Effluent and Fertilizer Applied to Corn Plants Growing in a Clay Soil,
W82-01515 1503 3C

Dynamic Nutrient Cycle Model for Waste Stabilization Ponds,
W82-01541 1503 5D

Design and Cost Comparison of Biological Nitrogen Removal Processes,
W82-01544 1503 5D

Pipeline Friction Losses for Wastewater Sludges,
W82-01545 1503 5D

Operational Problems with Rotating Biological Contactors,
W82-01549 1503 5D

Open-Pore Polyurethane as a Medium for Coal Conversion Process Aqueous Effluent Cleanup,
W82-01577 1503 5D

Siting and Design of Tailings Impoundments,
W82-01588 1503 8A

Treatment of Pulp and Papermill Wastewaters and the Use of the Oxygen Activated Sludge System,
W82-01594 1503 5D

Land Treatment Site Evaluation in Southeastern Mountainous Areas,
W82-01596 1503 5D

Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 1503 5D

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 1503 5D

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 1503 5D

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 1503 5D

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 1503 5D

Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 1503 5D

Slowhill Copse Sewage Treatment Works.
W82-01727 1503 5D

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 1503 5D

Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 1503 5D

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 1504 5D

Simulating Effects of Combined Sewer Overflows,
W82-01864 1504 6A

Detroit's WWTP: One of the World's Biggest,
W82-01865 1504 5D

Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 1504 5D

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 1504 6A

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 1504 5D

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 1504 5D

Substrate Flux into Biofilms of Any Thickness,
W82-01964 1504 5D

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 1504 5D

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 1504 2A

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 1504 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 1504 5D

The Flowering of Wastewater Treatment,
W82-02015 1504 5D

Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 1504 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 1504 5D

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 1504 5D

Microbial Purification of Recycled Wastewater in a Closed System,
W82-02172 1505 5D

Assessment of the National Water Quality Management Program, Volume 2: Construction Grants.
W82-02182 1505 6E

Assessment of the National Water Quality Management Program, Volume 3: Industrial and Municipal Control.
W82-02183 1505 6E

The Effect of pH and Halogens on the Stability of Reverse Osmosis Membranes,
W82-02188 1505 5D

Industrial Pretreatment Needs to Be Overhauled at the National Level.
W82-02198 1505 5D

Engineering Design Variables for the Activated Sludge Process.
W82-02199 1505 5D

Processes--Not Products--Biggest Energy-Saving Factors.
W82-02218 1505 5D

Biodegradability Studies with Organic Priority Pollutant Compounds,
W82-02231 1505 5D

Dupont's Wastewater Treatment Approach,
W82-02254 1505 5D

Environmental Phenotypic Variation of Scenedesmus Dimorphus in High-Rate Algae Ponds and Its Relationship to Wastewater Treatment and Biomass Production,
W82-02275 1505 5D

Pilot-Scale Investigations with Granular Activated Carbon,
W82-02289 1505 5D

Simulation of a Time Dependent Activated Sludge Wastewater Treatment Plant,
W82-02303 1505 5D

Phosphorus Removal by Activated Alumina,
W82-02313 1505 5D

Coupled Trickling Filter-Rotating Biological Contactor Nitrification Process,
W82-02315 1505 5D

A Compendium of Experimental Work on Chemical Precipitation of Sewage,
W82-02370 1505 5D

Treatment of Effluent Waters Containing Chlorides by Reverse Osmosis Dynamically Formed Membranes,
W82-02382 1505 5D

Main Compounds Behavior in Kraft Waste Cleaning by Acid Coagulation and Carbon Adsorption,
W82-02383 1505 5D

Disposal of Industrial Effluents - Some Future Problems,
W82-02405 1505 5D

Upward Flow Clarification of Secondary Sewage Effluent Using Lime,
W82-02413 1505 5D

Application of the Expanded Bed Technique for the Denitrification of a Sewage Effluent,
W82-02436 1505 5D

Wastewater Management in Coastal North Carolina,
W82-02511 1505 5D

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

Concepts in Aquatic Treatment System Design,
W82-02593 1505 5D

Thiocyanate Bio-Oxidation Kinetics,
W82-02596 1505 5D

Spiral Classifiers Help One Manufacturer Meet Environmental Standards More Easily,
W82-02602 1506 5D

Ontario's Seven-Point Plan for the Treatment and Disposal of Industrial Waste Liquids and Sludges,
W82-02603 1506 5E

Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 1506 3E

Submerged Demineralization System to Be Used to Process TMI Wastewater.
W82-02621 1506 5D

Application of Adsorption to Wastewater Treatment,
W82-02622 1506 5D

Reverse Osmosis Separation of Sulfate, Nitrate, and Ammonia from Mining Effluents,
W82-02640 1506 5D

Separation of Toxic Organotin Compounds from Aqueous Solution by Adsorption,
W82-02641 1506 5D

Wastewater Treatment with Powdered Activated Carbon,
W82-02642 1506 5D

Treatment Plant Features Ultraviolet Disinfection,
W82-02644 1506 5D

Adsorption on Carbon: Theoretical Considerations,
W82-02658 1506 5D

Upgrading with Rotating Biological Contractors for Ammonia Nitrogen Removal,
W82-02673 1506 5D

Recommendations for Regulatory Modifications: The Use of Waste Stabilization Pond Systems,
W82-02675 1506 5D

Stochastic Modeling of an Industrial Activated Sludge Process,
W82-02683 1506 5D

Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 1506 5C

Comparative Performance of Synthetic Adsorbents and Activated Carbon for Specific Compound Removal from Wastewaters,
W82-02702 1506 5D

Reduced Energy Usage with Biological Phosphorus Removal,
W82-02705 1506 5D

Obtaining High-Level Wastewater Disinfection with Ozone,
W82-02706 1506 5D

Prevention of Putrefaction in Organic Sludge by Co-Precipitation of Bactericide and Coagulant,
W82-02717 1506 5D

A New Method of Regeneration of Anion Exchangers Used For Recovering Chromates from Wastewater,
W82-02723 1506 5D

Optimal Water Reuse Planning,
W82-02736 1506 6A

A Multimedia Information Package Regarding Land Application of Wastewater and Sludge: A Study of Training Dissemination Specialists, Evaluation Methods, and Cost-Effectiveness,
W82-02815 1506 5D

Advanced Sludge Treatment for Modern Waterworks,
W82-02889 1506 5D

Biodegradation of Aroclor 1221 Type PCBs in Sewage Wastewater,
W82-02899 1506 5D

Predicting Reactor Biomass Concentration in a Fluidized-Bed System,
W82-02932 1506 5D

Wind Aeration in Model Waste Treatment System,
W82-02944 1506 5D

Nonlinear Programming Design of Wastewater Treatment Plant,
W82-02961 1506 5D

Evaluation of Ion Exchange Technology for Toxic and Non-Conventional Pollutant Reduction in Bleach Plant Effluents,
W82-02967 1506 5D

Pilot-Scale Anaerobic Filter Treatment of Heat Treatment Liquor,
W82-02972 1506 5D

Ultraviolet Disinfection of a Secondary Wastewater Treatment Plant Effluent,
W82-02985 1506 5D

Characterization of Boliden's Sulfide-Lime Precipitation System,
W82-02988 1506 5D

Chlorine Dioxide for Wastewater Disinfection: A Feasibility Evaluation,
W82-02989 1506 5D

Overland Flow Treatment of Poultry Processing Wastewater in Cold Climates,
W82-02992 1506 5D

Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

Protein Recovery from Beef Packing Effluent,
W82-02994 1506 5D

Group Treatment Evaluation for Metal Finishers,
W82-02995 1506 5D

Nitrogen and Phosphorus Reactions in Overland Flow of Wastewater,
W82-02996 1506 5D

Fate of Toxic and Nonconventional Pollutants in Wastewater Treatment Systems Within the Pulp, Paper, and Paperboard Industry,
W82-02998 1506 5D

Nickel Recovery from Electroplating Rinsewaters by Electrodialysis,
W82-03000 1506 5D

Assessment of Emerging Technologies for Metal Finishing Pollution Control: Three Case Studies,
W82-03001 1507 5D

Treatment of Metal Finishing Wastes by Use of Ferrous Sulfide,
W82-03002 1507 5D

Virus Inactivation in Wastewater Effluents by Chlorine, Ozone, and Ultraviolet Light,
W82-03005 1507 5D

Laboratory Studies of Priority Pollutant Treatability,
W82-03030 1507 5D

Feasibility Study of Open Tank Oxygen Activated Sludge Wastewater Treatment,
W82-03032 1507 5D

Physical/Chemical Treatment of Coke Plant Wastewater,
W82-03033 1507 5D

Removal of Heavy Metals and Suspended Solids from Battery Wastewaters: Application of Hydroperm Cross-Flow Microfiltration,
W82-03037 1507 5D

Fine Coal-Refuse Slurry Dewatering,
W82-03049 1507 5D

Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 1507 5D

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

Mass Production of Freshwater Rotifers on Liquid Wastes I. The Influence of Some Environmental Factors on Population Growth of Brachionus Rubens Ehrenberg 1838,
W82-03114 1507 5D

Use of a Fractional Design to Evaluate Interactions of Environmental Factors Affecting Biodegradation Rates,
W82-03117 1507 5D

The Effect of Ni(II) on Nitrification in the Activated Sludge Process,
W82-03124 1507 5D

Treatment of Metal Containing Wastewater with Calcium Sulfide,
W82-03125 1507 5D

Treatment of Cooling Tower Blowdown,
W82-03126 1507 5D

Treatability of Toxic Wastewater Pollutants by Solvent Extraction,
W82-03127 1507 5D

Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 1507 5D

Sludge Management Process Integration,
W82-03130 1507 5D

Biological Nitrogen Control of Industrial Wastewater,
W82-03131 1507 5D

Nitrification Using the Rotating Biological Contactor,
W82-03132 1507 5D

Prediction of the Fate of Organic Compounds in Biological Wastewater Treatment Systems,
W82-03133 1507 5D

Factors Influencing Biological Nitrification of Steel Industry Wastewaters,
W82-03134 1507 5D

Troubleshooting and Control of Nitrification Wastewater Treatment Systems,
W82-03135 1507 5D

The Reductive Treatment of Industrial Wastewaters. I. Process Description,
W82-03137 1507 5D

The Reductive Treatment of Industrial Wastewaters. II. Process Applications,
W82-03138 1507 5D

Evaluation of Temperature Effects in Aerated Biotreaters,
W82-03140 1507 5D

Intermittent Biological Waste Treatment Systems-Process Considerations,
W82-03141 1507 5D

Energy Minimization at Metro Denver Sewage District,
W82-03142 1507 5D

Retrofit Conserves Energy at a Water Pollution Control Facility,
W82-03144 1507 5D

Biological Nitrogen Removal System Design,
W82-03145 1507 5D

Inhibition of Nitrifying Activated Sludge Systems by Organic Shock Loads,
W82-03146 1507 5D

ICI Brixham - Environmental Research in the Private Sector.
W82-03153 1507 5D

Removal of Toxic Heavy Metal Ions from Wastewaters Using Modified Agricultural Waste Materials,
W82-03206 1507 5D

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 1507 5D

The Activated Sludge Process--3. Single Sludge Denitrification,
W82-03223 1507 5D

Demonstration of Anaerobic Biogas Digesters in Developing Countries. Part III: The Philippines,
W82-03226 1507 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: I. Clogging Mechanism and Soil Physical Environment,
W82-03238 1507 5D

Sand-Filter Trenches for Purification of Septic Tank Effluent: II. The Fate of Nitrogen,
W82-03239 1507 5D

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 1507 6E

Use of Adenosine Triphosphate in Biological Purification Systems (In French),
W82-03302 1507 5D

Direct Influence of Wastewater Pollutants on Flocculation and Sedimentation Behavior in Biological Wastewater Treatment-I. Model System E. Coli B,
W82-03319 1507 5D

Industrial Wastewater Audit,
W82-03337 1507 5D

Operation Reports--City of Pueblo, Colorado Department of Public Works.
W82-03348 1507 5D

Engineers Assess Aquaculture Systems for Wastewater Treatment,
W82-03354 1507 5D

The Deep-Shaft Process: Bright Future for Treating High-Strength Wastewaters.
W82-03376 1507 5D

Anaerobic Sludge Digestion--Need It Be Expensive,
W82-03389 1507 5D

Continuous Ion Exchange: A Survey of Recent Applications,
W82-03391 1507 5D

Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 1507 6C

Kinetics of Phenol Oxidation by Washed Cells,
W82-03399 1507 5D

Composting Results in Los Angeles,
W82-03400 1507 5E

Managing Vegetation in Wastewater Application,
W82-03401 1508 5D

Phosphorus Reduction Studies,
W82-03426 1508 5D

Primary Sedimentation of Sewage,
W82-03429 1508 5D

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 1508 5D

Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 1508 5D

Republic Steel Recycling 80% of Steel-Mill Wastewater.
W82-03454 1508 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from CH2M Hill, Corvallis, OR,
W82-03463 1508 5D

Utilization of the Algae Oocystis SP. for Tertiary Treatment of Wastewaters - II. Effect of Preliminary Conditioning of the Cells in a Cyclostat on Their Nitrogen Uptake Rate During Prolonged Incubations (In French),
W82-03464 1508 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 1508 5F

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Malcolm Pirnie, Inc., White Plains, NY,
W82-03474 1508 6A

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Gilbert/Commonwealth, Reading, PA,
W82-03475 1508 6A

Designing for Coarse Sand Filtration Systems,
W82-03478 1508 5D

Control of the Activated Sludge Process,
W82-03499 1508 5D

Trihalomethane Formation from Humic Materials in Chlorinated Reclaimed Wastewater,
W82-03517 1508 5D

Health and Safety of Wastewater Treatment Plant Personnel,
W82-03535 1508 5D

Design Manual; Onsite Wastewater Treatment and Disposal Systems,
W82-03538 1508 5D

Unslaked Lime - Its Direct Use in Phosphorus Removal Processes.
W82-03539 1508 5D

Ozone for Municipal Wastewater Disinfection,
W82-03559 1508 5D

Texans Claim Breakthrough in Anaerobic Waste Treatment,
W82-03565 1508 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--I. Analysis of Bacterial Growth and Substrate Removal Kinetics by a Statistical Method,
W82-03567 1508 5D

A Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--III. Treatment System Design,
W82-03568 1508 5D

Comprehensive Study on the Biological Treatabilities of Phenol and Methanol--II. The Effects of Temperature, pH, Salinity and Nutrients,
W82-03569 1508 5D

Coliform and Chemical Oxygen Demand Removal from Meatworks Effluents by Different Treatment Processes,
W82-03570 1508 5D

Tertiary Wastewater Treatment to Remove Nitrogen Compounds in Aerated Oxidation Ponds,
W82-03587 1508 5D

Electroplating Wastes: History and Current Status,
W82-03588 1508 5D

Wastewater Treatment Plant Features New Technology,
W82-03591 1508 5D

Inland Container Saves Money with Anaerobic-Aerobic Treatment Plant,
W82-03593 1508 5D

Biological Kinetic Design for Nitrification in High-Strength Industrial Wastewaters,
W82-03597 1508 5D

Production of Ammonia in a Packed-Bed Anaerobic Upflow (ANFLOW) Bioreactor,
W82-03598 1508 5D

Treatability and Pathways of Priority Pollutants in the Biological Wastewater Treatment,
W82-03599 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 1508 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 1508 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 1508 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 1508 5D

Palm Oil Waste Treatment Study in Malaysia,
W82-03632 1508 5D

Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 1508 5D

Some Methods Available for Treatment of Waste Water in the Dairy Industry,
W82-03650 1508 5D

Sludge Handling and Disposal at the Central Processing Facility, Monroe County, New York.
W82-03664 1508 5D

Anaerobic Activated Carbon Filter for the Treatment of Phenol-Bearing Waste Water,
W82-03680 1508 5D

The Successful Treatment of Tanker Ballast Water at a Mediterranean Site,
W82-03703 1508 5D

Oil-Water Separation by Induced Air Flotation,
W82-03719 1508 5D

Characteristics of an Aerated Lagoon for Municipal Wastewater Treatment,
W82-03727 1508 5D

EPA's I/A Program Speeds Use of New Wastewater Treatment Methods,
W82-03737 1508 5D

A Comparison of Chlorine and Chlorine Dioxide Disinfection of Wastewater Effluents: The Generation of Selected Halohydrocarbons,
W82-03751 1509 5D

Operational Estimation and Prediction of Nitrification Dynamics in the Activated Sludge Process,
W82-03759 1509 5D

Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760 1509 5D

Measurement and Control of the MLSS Concentration in Activated Sludge Plants,
W82-03762 1509 5D

Distributed Control System 'Aquamax-80' Series for Managing Wastewater Systems,
W82-03763 1509 5D

The Growing Business of Bacterial Cultures,
W82-03786 1509 5D

Environment and Public Health in the Caribbean,
W82-03787 1509 6D

Breakthrough Characteristics of Selected Toxicants in Granular Activated Carbon Treatment of Combined Industrial Wastewaters,
W82-03812 1509 5D

Selective Concentration and Isolation of Aromatic Amines from Water,
W82-03829 1509 5D

Operational Experiences in the Effective Treatment of Effluents from Synthetic Resin Manufacture,
W82-03835 1509 5D

Improved Operation of Municipal Wastewater Treatment Plants in Sweden by Use of Instrumentation and Automation,
W82-03846 1509 5D

Total Sludge Quantity Control for Activated Sludge Process,
W82-03847 1509 5D

'In-Situ' Operational Experiences of Computer Control in Wastewater Treatment,
W82-03848 1509 5D

The Development of the Design Philosophy for the Automation of Hogsmill Valley Sewage Treatment Works,
W82-03850 1509 5D

Optimal Coding of Energy Consumption on a Sewage Plant at Heidelsheim,
W82-03851 1509 5D

Calculation of Sludge Reservoir Volume for MLSS Control,
W82-03856 1509 5D

Supervisory Computer Control System for Arakawa Left Basin-Wide Sewage Treatment Plant,
W82-03862 1509 5D

Fate of Priority Pollutants in Large Municipal Treatment Plants,
W82-03867 1509 5B

Kinetics of Nitrogen Loss in Simulated Wastewater Treatment in a Soil-Plant System,
W82-03[illegible] 1509 5D

Maximizing Effluent Quality from a Municipal Activated Sludge Plant Concurrent with a Major Reduction in Process Energy Requirements,
W82-03874 1509 5D

A Finite Differencing Scheme for the Dynamic Simulation of Continuous Sedimentation,
W82-03876 1509 5D

Simplified Mathematical Models for a Fluidized Bed Biofilm Reactor,
W82-03877 1509 5D

Precipitation of Heavy Metals with Sodium Sulfide: Bench-Scale and Full-Scale Experimental Results,
W82-03878 1509 5D

WPCF Presentations Attuned to the Times.
W82-03904 1509 5D

Wastewater Treatment for Japan's Research Institute.
W82-03905 1509 5D

Treatment of Phenol and Substituted Phenols with an Anaerobic Activated Carbon Filter,
W82-03959 1509 5D

Irrigating with Municipal Effluent: A Socioeconomic Study of Community Experiences,
W82-03967 1509 3C

Innovative/Alternative Technology Program; Case Studies,
W82-03970 1509 5D

Water-Quality Data from a Landfill-Leachate Treatment and Disposal Site, Pinellas County, Florida, January 1979-August 1980,
W82-03997 1509 5B

Method of Evaluating the Possible Energy Savings by Implementing Do-Control or Fine Bubble Diffusors,
W82-04007 1509 5D

Preliminary Studies on Control Parameters and Biological Community for the Activated Sludge Process,
W82-04008 1509 5D

The Use of Respirography in Biological Treatment Plant Control,
W82-04011 1509 5D

The Effect of Particle Substrate on Mineralization Performance and the Formation of Excess Sludge in a Complete Mixing Aeration Tank,
W82-04012 1509 5D

Application of Fluidic Devices for Control of Wastewater Treatment Operations,
W82-04013 1509 5D

Automatic Monitoring of Exhaust Gas Analysis in Activated Sludge Wastewater Treatment Process,
W82-04014 1509 5D

Evaluation of the Resident Mass of Sludge in Final Sedimentation Tanks for Waste Sludge Control,
W82-04015 1509 5D

Dissolved Oxygen Control in the Activated Sludge Process,
W82-04017 1509 5D

A New Indicator of the Activated Sludge Process - Nitrous Oxide,
W82-04018 1509 5D

Development and Use of a Continuous Toc-Measurement Device in Wastewater Purification,
W82-04019 1509 5A

The Continuous Oxygen Uptake Rate Measurement and Its Applicability as an Activated Sludge Control Parameter,
W82-04020 1509 5D

Combined Effects of Biological Solids Retention Time and Temperature on the Growth Parameters of Activated Sludge,
W82-04021 1509 5D

Automatic Measurement Device of the Respiration Rate and Experimental Investigation on the Constant DO Control by Using the Device for the Activated Sludge Process,
W82-04022 1509 5D

Computerized Data Acquisition and Data Handling in Sewage Treatment Plants,
W82-04023 1509 5D

Computer Control of Nitrifying and Denitrifying Activated Sludge Process,
W82-04025 1509 5D

Use of Aquatic Macrophytes for Wastewater Treatment,
W82-04046 1509 5D

Start-Up and Operating Experience with Computerized Control System in a 1.3 CU M/S (30 MGD) Wastewater Treatment Plant,
W82-04047 1509 5D

Solids Inventory Control in the Activated Sludge Process,
W82-04048 1509 5D

Optimization of Automated Equalization Basin-Reactor Systems for Chemical Treatment of Wastewater,
W82-04052 1509 5D

Monitoring of Turbidity and Suspended Solids Concentration in Wastewater Treatment Plants,
W82-04054 1509 5D

Theoretical Considerations for Control and Monitoring of Wastewater Treatment Systems,
W82-04060 1509 5D

Control of Dissolved Oxygen in Activated Sludge Plants,
W82-04061 1509 5D

Dissolved Oxygen Control Using Aeration Exhaust Gas,
W82-04062 1509 5D

Intensive Survey of Armand Bayou,
W82-04079 1509 5A

Intensive Survey of Hunting Bayou,
W82-04080 1509 5A

Post-Secondary Treatment of Effluent for Drip Irrigation: July 1977 to March 1980, Phase II-B,
W82-04082 1509 3C

The Use of a Perforated Baffle at the Inlet of Rectangular Settling Basins,
W82-04124 1509 8B

Disposal and Handling of Water Treatment Plant Sludge,
W82-04126 1509 5E

Initial Degradation of Effluent Quality During Filtration,
W82-04134 1509 5F

A Study of the In-Situ Indirect Freezing Process,
W82-04168 1509 3A

A Local Source Control Program for Metal Finishing Plants,
W82-04172 1509 5D

Cost-Effectiveness Analysis for On-Site Wastewater Treatment Alternatives,
W82-04185 1509 5D

Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 1510 5F

Experiences with a Pilot Scale Research Plant for Phosphate Removal from Wastewater with Activated Alumina (Erfahrungen mit Einer Halbtechnischen Versuchsanlage zur Abtrennung von Phosphat Aus Abwasser mit Aktivtonerde),
W82-04280 1510 5D

Use of Stormwater Detention Basins for Neutralization and Special Treatment of Toxicants (Einsatz von Regenklarbecken zum Ausgleich und zur Sonderbehandlung Toxischer Abwasserstosse),
W82-04282 1510 5D

Wastewater Treatment with Activated Carbon Addition at the Aeration Stage and Spent Carbon Regeneration. (Abwasserreinigung Unter Zugabe von Aktivkohle in die Belebungsstufe und Regenerierung der Aktivkohle),
W82-04283 1510 5D

Combination of Macroporous Resins and Activated Carbon in Advanced Wastewater Treatment. (Kombination von Makroporosen Adsorberharzen mit Aktivkohle zur Weitergehenden Abwasserreinigung),
W82-04284 1510 5D

Chrysler Upgrades Oily Wastes Treatment in Kokomo,
W82-04285 1510 5D

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 1510 5D

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 1510 5D

A Treatment System for en Organic Chemicals Plant,
W82-04353 1510 5D

American Hoechst Upgrades a Treatment System Through Automation,
W82-04354 1510 5D

On the Marginal Cost of Wastewater Services,
W82-04376 1510 6C

Wastewater Dechlorination State-Of-The-Art Field Survey and Pilot Studies,
W82-04392 1510 5D

Performance of Activated Sludge Processes: Reliability, Stability and Variability,
W82-04394 1510 5D

Survey and Evaluation of Fine Bubble Dome Diffuser Aeration Equipment,
W82-04395 1510 5D

Demonstration Physical Chemical Sewage Treatment Plant Utilizing Biological Nitrification,
W82-04397 1510 5D

Design Optimization of the Chlorination Process: Volume 1. Comparison of Optimized Pilot System with Existing Full-Scale Systems,
W82-04399 1510 5D

Density Levels of Pathogenic Organisms in Municipal Wastewater Sludge - A Literature Review,
W82-04400 1510 5E

Evaluation of On-Site Wastewater Treatment and Disposal Options,
W82-04404 1510 5D

Production Engineering and Marketing Analysis of the Rotating Disk Evaporator,
W82-04405 1510 5D

Treatability Studies of Pesticide Manufacturing Wastewaters,
W82-04406 1510 5D

Parasites in Southern Sludges and Disinfection by Standard Sludge Treatment,
W82-04408 1510 5B

Treatment of Sulfite Evaporation Condensate with an Anaerobic Reactor,
W82-04419 1510 5D

Terminal Reactions in the Anaerobic Digestion of Animal Waste,
W82-04454 1510 5D

Biodegradation of Glycidol and Glycidyl Nitrate,
W82-04456 1510 5D

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

The Fate of Soluble, Recalcitrant, and Adsorbing Compounds in Activated Sludge Plants,
W82-04477 1510 5D

Municipal Sewage Treatment - Some Recent Developments,
W82-04528 1510 5D

Laboratory Experiments on the Physico-Chemical Treatment of Meat Processing Effluents,
W82-04532 1510 5D

Microbiology of Anaerobic Digestors for Wastewater Purification. (Microbiologie des Digesteurs Anaerobies de l'Epuration des eaux Residuaires),
W82-04544 1510 5D

Increasing Wastewater Treatment Efficiency (Uber die Erhohung des Wirkungsgrades der Abwasserreinigung),
W82-04545 1510 5D

The Importance of the Solids Content of the Sludge in Anaerobic Alkaline Digestion (Die Bedeutung des Feststoffgehalts bei der Schlammfaulung),
W82-04549 1510 5D

Multiperiod Design of Regional Wastewater Systems: Generating and Evaluating Alternative Plants,
W82-04562 1510 5D

The Effects of pH and Suspended Solids in the Removal of Organics from Water and Wastewaters by the Activated Carbon Adsorption Process,
W82-04568 1510 5D

Evaluation of Instruments for Continuous Activated Sludge Monitoring,
W82-04594 1510 5D

Dynamic Step Feed Control for Organic Carbon Removal in a Suspended Growth System,
W82-04595 1510 5D

Control and Automation in Wastewater Treatment - Advances, Unsolved Problems and Challenges,
W82-04597 1510 5D

Automatic Operation of a Freeze-Thawing and Dewatering Plant for Sewage Sludges,
W82-04599 1510 5D

Application Examples of and Operating Experiences with the Use of Process Computers in Sewage Treatment Plants,
W82-04600 1510 5D

Experience with Computer Control of Wastewater Treatment Processes at Los Angeles and Other Communities,
W82-04609 1510 5D

Automatic Control of Solids Retention Time and Dissolved Oxygen in the Activated Sludge Process,
W82-04610 1510 5D

Waste Water Treatment Plant Reliability - Engineering Design for Failure and Economic Gain,
W82-04611 1510 5D

Pulsed-Bed Technique Can Cut Treatment Stages,
W82-04613 1510 5D

Detoxification of Waste Water Containing Cyanides from the Wet-Scrubbing Systems of Steel Mills (Entgiftung Cyanidhaltigen Gichtgaswaschwasser von Hochofen),
W82-04616 1510 5D

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

Evaluation of a Treatment Lagoon for Combined Sewer Overflow,
W82-04623 1510 5D

Parallel Evaluation of Air- and Oxygen-Activated Sludge,
W82-04624 1510 5D

Treatment Effectiveness: Oil Tanker Ballast Water Facility,
W82-04625 1510 5D

The Development of Design Equations for Facultative Waste Stabilization Ponds in Semiarid Areas,
W82-04641 1510 5D

Pilot Studies of the Nitrification Process in Fixed Film Reactors (Pilotversuche zur Nitrifikation in Festbettreaktoren),
W82-04652 1510 5D

Comparative Disinfection of Poliovirus by Bromine Chloride and Chlorine in a Model Contact Chamber,
W82-04661 1510 5D

Temperature Dependency of Biological Denitrification with Organic Materials Addition,
W82-04662 1510 5D

Treatment of Noncyanide Electroplating Cadmium Wastewater by Reverse Osmosis,
W82-04664 1510 5D

On Line Control of Pharmaceutical Influent Loads to a Biological Wastewater Treatment Plant,
W82-04665 1510 5D

Application of the Wastewater Effluent of a Rural Community to a Mountain Meadow,
W82-04705 1510 5E

Influence of Dissolved Oxygen on Substrate Utilization Kinetics of Activated Sludge,
W82-04707 1510 5D

Municipal Wastewater Reclamation by Reverse Osmosis - A 3-Year Case Study,
W82-04708 1510 5D

Vacuum Filtration of Septage,
W82-04710 1510 5D

Air Drying Liquid Anaerobically Digested Sludge in Earthen Drying Basins,
W82-04711 1510 5D

Treatment of High-Strength Fatty Amines Wastewater - A Case History,
W82-04712 1510 5D

Anaerobic Fermentation - Filtration of Potato Processing Wastewater,
W82-04713 1510 5D

Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 1511 5D

Kinetic Modeling of the Ozonation of Phenol in Water,
W82-04780 1511 5C

Disinfection Efficiencies of Chlorine Dioxide in a Gravity Flow Contractor,
W82-04782 1511 5D

Reliability and Stability of Trickling Filter Processes,
W82-04784 1511 5D

Treatment of Cyanide Waste by the Extended Aeration Process,
W82-04787 1511 5D

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 1511 5B

Advanced Wastewater Treatment for Groundwater Recharge--Berlin Recharge Project (Recyclage et Traitement D'Eaux usees pour Recharger une nappe Souterraine: L'Installation Pilote de Berlin),
W82-04831 1511 5D

Microbial Degradation of 14C-Diphenylamine in a Laboratory Model Sewage Sludge System,
W82-04832 1511 5D

Control of Alum Addition in Wastewater Treatment,
W82-04837 1511 5D

New Flocculation Units with High Efficiency,
W82-04840 1511 5D

Ultrasonic Sensors for Monitoring Flows and Sludge Solids Concentrations in Water and Waste-Water Treatment,
W82-04842 1511 5D

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 1511 5D

Package Anaerobic Sludge Digestion.
W82-04850 1511 5D

Treatment of Secondary Sewage Effluent with a Peat-Sand Filter Bed,
W82-04871 1511 5D

Purification of Dye Works Effluents with Active Carbon (Reinigung von Farbereiabwassern mit Aktivkohle),
W82-04903 1511 5D

Selecting Energy-Efficient Wastewater Treatment Systems,
W82-04904 1511 5D

Shale Oil Wastewater Treatment by Evaporation,
W82-04905 1511 5D

Anaerobic Treatment of High-Strength Wastes,
W82-04907 1511 5D

Treatment of Cooling Tower Blowdown,
W82-04908 1511 5D

Biodegradation of Hazardous Organic Pollutants,
W82-04910 1511 5B

Speciation of Copper and Manganese in Effluents from the Activated Sludge Process,
W82-04937 1511 5D

Acclimation of Sludge for Efficient Removal of Nitrogen from Fermentation Wastewater,
W82-04990 1511 5D

Studies on Biological Nutrients Removal from Fermentation Wastewater (III). Operational Conditions Elimiating the Evolution of Nitrous Oxide in a Denitrification Process,
W82-04991 1511 5D

Effect of Rotation Speed on Reaction Rate on a Rotating Biological Contactor,
W82-04992 1511 5D

Kinetic Considerations on the Performance of Activated Sludge Reactors and Rotating Biological Contactors,
W82-05011 1511 5D

GC/MS Analysis of XAD-2 Extracts of Superchlorinated Septage,
W82-05016 1511 5A

Surfactant Adsorption on the Wool Carbonizing Waste (Adsorption De Surfactants Sur Le Dechet Lainier De Carbonisage),
W82-05021 1511 5D

Prospects of Using Radiation Water Treatment Methods,
W82-05026 1511 5D

Try Chemical Tests If Industrial Wastes Are Strong,
W82-05037 1511 5D

Literature Study of the Biodegradability of Chemicals in Water: Volumes 1 and 2,
W82-05055 1511 5D

Data Base for Influent Heavy Metals in Publicly Owned Treatment Works,
W82-05056 1511 5D

Heavy Metal Sources and Flows in a Municipal Sewage System: Literature Survey and Field Investigation of the Kokomo, Indiana, Sewage System,
W82-05061 1511 5D

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills,
W82-05068 1511 5G

Carbohydrates and Proteins Removals in Activated-Sludge Procedure,
W82-05090 1511 5D

Treating Phenol Resin Plant Wastes,
W82-05128 1511 5D

Biological Nitrification of Industrial Wastewater,
W82-05129 1511 5D

Railroad's Shops Correct an Oily Wastes Problem,
W82-05130 1511 5D

How Screen Mounting Affects Microscreening Hydraulics,
W82-05168 1511 5D

Virginians Optimize Sludge Handling,
W82-05171 1511 5D

Microbial Removal of Hazardous Organic Compounds,
W82-05177 1511 5D

Predicting Full-Scale Batch Thickener Performance Using the Frozen-Image Centrifuge,
W82-05185 1511 5E

A Reliable Dissolved Oxygen Probe for Waste Water Treatment Plants,
W82-05248 1511 7B

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

Microbial Ecosystems Responsible for Anaerobic Digestion and Composting,
W82-05252 1511 5E

Shock Load of Chromium (VI),
W82-05253 1511 5D

Nitrification in the Sequencing Batch Biological Reactor,
W82-05254 1511 5D

Ion-Precipitate Flotation of Iron-Cyanide Complexes,
W82-05259 1511 5D

Ultra-High-Rate Filtration of Raw and Combined Sewer Overflows,
W82-05266 1511 5D

Mathematical Model of Sequential Loading in Fixed-Bed Adsorbers,
W82-05269 1511 5D

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 1511 5D

Comprehensive Analysis of Nitrification of Chemical Processing Wastewaters,
W82-05271 1511 5D

Use of Bench-Scale Digesters to Evaluate Full-Scale Digester Performance,
W82-05272 1511 5D

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

Low Pressure Membrane Separation Process to Remove Heavy Metal Complexes,
W82-05284 1511 5D

Filtration Performance in Water and Wastewater Treatment: Theory and Measurement,
W82-05285 1511 5D

International Nutrient Control Technology for Municipal Effluents,
W82-05321 1511 5D

Economical and Efficient Phosphorus Control at a Domestic-Industrial Wastewater Plant,
W82-05324 1511 5D

Rapid-Infiltration Research at Flushing Meadows Project, Arizona,
W82-05334 1511 5D

Wastewater from a Sugar Refining Industry,
W82-05337 1511 5D

Organic Pollutants Adsorption from Multicomponent Systems Modeled by Freundlich Type Isotherm,
W82-05338 1511 5D

pH Influence on Acidogenic Dissimilation of Glucose in an Anaerobic Digestor,
W82-05341 1511 5D

Industrial Wastewater Treatment Technology--Recent Developments,
W82-05348 1511 5D

Criteria for Nitrification in Fixed Film Reactors,
W82-05352 1511 5D

High-Rate Algae Ponds for Wastewater Treatment and Protein Production,
W82-05355 1511 5D

Design and Operation Interaction--An Example: Main Treatment Plant Vienna,
W82-05356 1511 5D

Fluid Flow Pattern in Upflow Reactors for Anaerobic Treatment of Beet Sugar Factory Wastewater,
W82-05372 1511 5D

Carbon Limitation of Biomass Production in High-Rate Oxidation Ponds,
W82-05373 1511 5D

Kinetics of Biofilm Nitrification,
W82-05374 1511 5D

Land Extensive Processes for Wastewater Treatment and Disposal--A Perspective,
W82-05419 1511 5D

Electrochemical Processes for Wastewater Treatment,
W82-05422 1511 5D

Control of Bulking Sludge--Practical Experiences in Austria,
W82-05423 1511 5D

Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 1511 5F

Environmental Impact of the Microbial Aerosol Emissions from Wastewater Treatment Plants,
W82-05428 1511 5B

The Effects of Temperature on the Biochemical Reaction Rates of the Activated Sludge Process,
W82-05431 1511 5D

Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

Nitrogen Control at Three Related Plants,
W82-05434 1511 5D

Energy Conservation and Alternative Energy Sources in Wastewater Treatment,
W82-05440 1511 5D

Relationship Between Organic Loading, Dissolved Oxygen Concentration and Sludge Settleability in the Completely-Mixed Activated Sludge Process,
W82-05441 1511 5D

Safety Considerations in Handling Activated Carbon,
W82-05442 1511 5D

Comparative Disinfection by Bromine Chloride and Chlorine of Viruses and Bacteria in Wastewater,
W82-05446 1511 5D

The Coleshill Advanced Waste-Water Treatment Plant,
W82-05470 1511 5D

Wastewater Management in Coastal North Carolina,
W82-05559 1511 5E

Anaerobic Treatment in Novel Contact Digester,
W82-05681 1511 5D

Sewers and Cities: France and the United States Compared,
W82-05684 1511 5D

Rotating Biodisks Recarbonate Alkaline Wastewater,
W82-05685 1511 5D

Pharmaceutical Waste Treatment by Anaerobic Filter,
W82-05686 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 1511 5D

Examination of Process Parameters Affecting Sludge Dewatering with a Diaphragm Filter Press,
W82-05695 1511 5D

Materials Balance in Aerated Static Pile Composting,
W82-05696 1511 5D

Biofiltration Design Based on Volumetric Loading,
W82-05698 1511 5D

Effects of Chemical Addition on the Performance of Settling Tanks,
W82-05701 1511 5D

The XIII Olympic Games and Environmental Quality Perspective,
W82-05703 1511 5D

'Computerized' Means Cost-Effective for Sewage Treatment,
W82-05720 1511 5D

Tracking Seasonal Load Variations,
W82-05787 1511 5D

Right Velocity Keeps the Solids Up,
W82-05788 1511 5D

Saving Water Scenically,
W82-05789 1511 5D

Deep Shaft,
W82-05793 1511 5D

1980 Needs Survey: Combined Sewer Seite Studies,
W82-05862 1511 5D

Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 1512 5D

Environmental Aspects of Some Alternative Pulp Bleaching Techiques,
W82-05913 1512 5D

UV Disinfection for Onsite Sand Filter Effluent,
W82-05937 1512 5D

Waste Treatment System Retrofitted Within Deadline,
W82-05947 1512 5D

Nitrogen Removal in Continuous-Flow Sequentially Aerated Activated Sludge Systems,
W82-05950 1512 5D

Solving a Poor Oxygen Transfer Problem.
W82-05952 1512 5D

High Rate Biological Treatment of TMP Effluent,
W82-05955 1512 5D

Copper Removal by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-05960 1512 5D

Recovery of Fine-Particle Coal by Colloid Flotation,
W82-05961 1512 5D

Removal of Heavy Metals from Aqueous Solutions Using Microgas Dispersions,
W82-05962 1512 5D

Carbon-Dioxide Neutralization of an Alkaline Effluent,
W82-05973 1512 5D

Common Facility Treatment of Industrial Wastewaters,
W82-05974 1512 5D

Wastewater Treatment at an Electrical Generation Station,
W82-05975 1512 5D

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

Modified Sludge Digestion with Improved Gas Yield (Modifizierte Schlammfaulung Mit Verbesserter Gasausbeute).
W82-06024 1512 5D

Domes, Bubbles, and Paper Waste,
W82-06025 1512 5D

Removal of Heavy Metals from Electroplating Rinsewaters by Precipitation, Flocculation and Ultrafiltration,
W82-06029 1512 5D

Effect of Chemical Coagulation on Anaerobic Digestibility of Organic Materials,
W82-06039 1512 5D

Product Inhibition in the Acid Forming Stage of the Anaerobic Digestion Process,
W82-06041 1512 5D

Scanning Electron Microscope Evaluation of Rotating Biological Contactor Biofilm,
W82-06047 1512 5D

Algal Growth in Primary Settled Sewage--The Effects of Five Key Variables,
W82-06055 1512 5D

Energy and Water Conservation Through Recycle of Dyeing Wastewater Using Dynamic Zr(IV)-PAA Membranes,
W82-06123 1512 5D

Survival and Fate of Enteric Viruses in Soil Treatment Systems for Wastewater,
W82-06150 1512 5D

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

Factors Affecting Flog Formation and Bulking in the Activated Sludge Process for Treatment of Textile Waste Waters,
W82-06171 1512 5D

Organic Constituents of Mutagenic Secondary Effluents from Wastewater Treatment Plants,
W82-06178 1512 5D

The Influence of Transient Temperature Changes on the Biodegradation of Nitrilotriacetic Acid in the Activated Sludge Process,
W82-06193 1512 5D

Elimination of Odor from Anaerobic Lagoons,
W82-06221 1512 5D

Treatment of Pulp and Paper Industry Wastewaters in an Anaerobic Fluidized Bed Reactor,
W82-06226 1512 5D

How Appleton Reduced Phosphorus,
W82-06249 1512 5D

Polymer Plays Plant Improvement Role,
W82-06250 1512 5D

The Quantification of the Emissions and Dispersion of Odours from Sewage-Treatment Works,
W82-06255 1512 5D

Experimental Data About Waste-Water Tertiary Treatment with Ozone,
W82-06257 1512 5D

Sewage Sludge Pumping - Recent Research and Application,
W82-06258 1512 5D

The Use of Oxygen in Sewage Treatment,
W82-06262 1512 5D

Removal of Inorganic Mercury from Water by Bitmuminous Coal,
W82-06265 1512 5D

Operation of High-Rate Oxidation Ponds: Theory and Experiments,
W82-06266 1512 5D

A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment,
W82-06268 1512 5D

Oxidation of Aqueous Phenol Solutions in the Presence of Polyelectrolytes,
W82-06283 1512 5D

Design Criteria for a Coagulation-Flocculation Plant for Sewage,
W82-06298 1512 5D

Recent Developments in the Field of Eutrophication Prevention,
W82-06299 1512 5C

Wastewater Characterization and Treatment System Development for a Blue Crab Processing Plant,
W82-06306 1512 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 1512 5D

Adsorption of Arsenite and Arsenate on Amorphous Iron Hydroxide,
W82-06311 1512 5D

Anaerobic Filter Treatment of Molasses Distillery Slops,
W82-06312 1512 5D

Modelling of the Activated Sludge Process for Microprocessor-Based State Estimation and Control,
W82-06324 1512 5D

Extraction of Phenolic Compounds and Organic Acids by Liquid Membranes,
W82-06331 1512 5D

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 1512 5D

Rotating Biological Contactor Scale-Up and Design,
W82-06344 1512 5D

Rotating Biological Contactor System Design,
W82-06355 1512 5D

Nitrification Kinetics and Its RBC Application,
W82-06356 1512 5D

Design Approach to Dual-Power Aerated Lagoons,
W82-06358 1512 5D

Performance of Modified Chlorine Contact Chamber,
W82-06359 1512 5D

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 1512 5D

Evaluation of Biological Nitrification - Denitrification at Penticton, British Columbia,
W82-06379 1512 5D

Pilot Scale Assessment of the Biological Fluidized Bed Process for Municipal Wastewater Treatment.
W82-06380 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume 2: User's Manual,
W82-06381 1512 5D

A Method for Wastewater Treatment System User Cost Allocation, Volume I: Study Report,
W82-06382 1512 5D

A Survey of Aerated Lagoon Performance,
W82-06391 1512 5D

Determination of Reaction Rate Constant and Temperature Coefficient Constant for Dadar Sewage, Bombay,
W82-06438 1512 5D

Generation and Utilization of Ozone in Waste Water Treatment,
W82-06442 1512 5D

Ammonia Nitrogen Removal in Facultative Wastewater Stabilization Ponds,
W82-06454 1512 5D

Fate of Nitrogen in Aerobic Sludge Digestion,
W82-06455 1512 5D

Nitrogen Dynamics in Waste Stabilization Ponds,
W82-06456 1512 5D

Comparison of BOD Relationships for Typical Edible and Petroleum Oils.
W82-06458 1512 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 1512 5D

Impact of Pretreatment on Sludge Content of Heavy Metals,
W82-06461 1512 5D

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebziger Jahren),
W82-06469 1512 5D

Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

Beneficial Disposal of Pickle Liquor,
W82-06486 1512 5D

Expanded Wastewater Treatment at a Metal Working Plant,
W82-06487 1512 5D

Expanding Options for Greywater Treatment,
W82-06491 1512 5D

Bacteria Solve Problems Created by Prisoners.
W82-06505 1512 5D

Low-Cost Treatment of Wastewater,
W82-06506 1512 5D

Controlling Sulfides and Odors in Sewers, Part One,
W82-06509 1512 5D

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

New Bubble Diffusers Reduce Treatment Costs,
W82-06513 1512 5D

Biological Processes for Concentrating Trace Elements from Uranium Mine Waters,
W82-06520 1512 5D

Effect of UV Light Disinfection on Antibiotic-Resistant Coliforms in Wastewater Effluents,
W82-06532 1512 5D

Effect of Hard Detergents on Algae in a High-Rate-Oxidation Pond,
W82-06538 1512 5C

Aquaculture for Waste Management,
W82-06556 1512 5D

French Premiere for Wastewater Disinfection Using Ozone.
W82-06607 1512 5D

Metal Removal 'A La Carte',
W82-06608 1512 5F

A Model for the Design of Hypolimnetic Aerators,
W82-06610 1512 5G

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

How Much Air,
W82-06638 1512 5D

Crisis: Financing Water and Wastewater,
W82-06641 1512 6C

PAC Process,
W82-06643 1512 5D

Microstrainer Theory and the Filtrability Index of Sewage Effluents,
W82-06647 1512 5D

Performance of Rotating Biological Contactors Under Field Conditions,
W82-06650 1512 5D

Esholt--Past, Present and Future,
W82-06653 1512 5D

Recovery of Protein and Oil from Fishery Bloodwater Waste, Effect of pH and Temperature,
W82-06655 1512 5D

Cellulose Acetate Membranes for the Reverse Osmosis Treatment of Sewage Effluents. Is Long term Performance a Limiting Factor,
W82-06657 1512 5D

Recovery of Chromium(VI) from Wastewaters with Iron(III) Hydroxide-I. Adsorption Mechanism of Chromium(VI) on Iron(III) Hydroxide,
W82-06658 1512 5D

The Kinetics of Ozone-Phenol Reaction in Aqueous Solutions,
W82-06661 1512 5D

Influence of Multicellular Configurations on Algal Growth in Aerated Lagoons,
W82-06662 1512 5D

Derivation of an Empirical Sorption Rate Equation by Analysis of Experimental Data,
W82-06664 1512 5D

Dynamics of Biofilm Processes: Methods,
W82-06666 1512 5D

The Behaviour of Nitrilotriacetic Acid During the Anaerobic Digestion of Sewage Sludge,
W82-06667 1512 5D

Ferrate Ion: Potential Uses in Advanced Wastewater Treatment,
W82-06701 1512 5D

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

Investigations into the Nitrification of Sydney's Wastewaters,
W82-06724 1512 5D

Put Pressure on Sewage,
W82-06732 1512 5D

Evidence That Microorganisms Cause Inactivation of Viruses in Activated Sludge,
W82-06739 1512 5D

Isolation of Enteroviruses from Oxidation Pond Waters,
W82-06750 1512 5D

The Kinetics of Hexavalent Chromium Reduction by Metallic Iron,
W82-06771 1512 5D

Effect of Carbon-Oxygen and Carbon-Sulfur Surface Complexes on the Adsorption of Mercuric Chloride in Aqueous Solutions by Activated Carbons,
W82-06788 1512 5D

Electroplating and Cyanide Wastes,
W82-06798 1512 5D

Steel Industry Wastes,
W82-06799 1512 5D

Synthetic Fuel Effluents,
W82-06800 1512 5D

Petroleum Processing Wastes,
W82-06801 1512 5D

Simplified Clarifier Axes Treatment Stages,
W82-06820 1512 5D

The Removal of Mixtures of Metals by an Adsorbing Colloid Foam Flotation Pilot Plant,
W82-06821 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

Continuous Dentrification by Immobilized Cells (Denitrification en Continu a l'Aide de Microorganismes Immobilises sur des Supports Solides),
W82-06830 1512 5D

The Effect of Increased Nickel Ion Concentrations on Microbial Populations in the Anaerobic Digestion of Sewage Sludge,
W82-06832 1512 5D

Basic Studies on Carbon Dioxide/Air Control System for Activated Sludge Processes,
W82-06833 1512 5D

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

Textile Wastes,
W82-06916 1512 5D

Fermentation Industry,
W82-06917 1512 5D

Fruit, Vegetable, and Grain Processing Wastes,
W82-06918 1512 5D

Anaerobic Processes,
W82-06923 1512 5D

Microbiology: Wastewater Treatment,
W82-06926 1512 5D

Preliminary Studies on the Dewatering of Coal-Clay Waste Slurries Using a Flocculant,
W82-06958 1512 5D

Electrokinetic Densification of Solids in a Coal Mine Sediment Pond- A Feasibilility Study, (In Two Parts), I. Laboratory and Field Tests,
W82-06960 1512 5D

Decontamination of Overland Runoff from Populated Areas,
W82-06980 1512 5D

Treatment of Wastewaters and Demineralization of Saline Waters by Reverse Osmosis and Ultrafiltration,
W82-06988 1512 5D

Prospects of Using Magnetic Wastewater Treatment,
W82-06989 1512 5D

The Electrolytic Process for Chromate Removal in Cooling Towers,
W82-06996 1512 5D

Meat-, Fish-, and Poultry-Processing Wastes,
W82-07000 1512 5D

WASTEWATER TREATMENT FACILITIES
Scott Brings Unique $25-Million Waste Treatment Facilities On-Line,
W82-01007 1502 5D

Advanced Wastewater Plant is Energy Saver,
W82-01177 1503 5D

Survey of Treatment Plant Design and Operation Deficiencies,
W82-01543 1503 5D

GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 1507 5D

Wastewater Treatment: Corrosion Solution are as Varied as Problems,
W82-03350 1507 8G

Project Report, Planning and Design Development Kaw Point Wastewater Treatment Plant, Kansas City, Kansas,
W82-03525 1508 5D

Hogsmill Valley Works: Twenty Years On,
W82-03834 1509 5D

Developing an Effective Maintenance Program Part A: Evaluation,
W82-04447 1510 5D

How the Tyne Was Saved. Duke of Edinburgh Opens 120 Million Pound Sterling Scheme,
W82-05249 1511 5D

WATER
Determination of Terbutryn and its Degradation Products in Water, Sediments, Aquatic Plants, and Fish,
W82-00567 1502 5A

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 1503 2H

Determination of 2,4-Dichlorophenoxyacetic Acid and Silvex in Water with High-Performance Liquid Chromatography,
W82-02298 1505 5A

WATER ALLOCATION
Water Related Planning and Design at Energy Firms,
W82-00042 1501 6D

Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 1501 6D

The Azov Sea Problem,
W82-00651 1502 6G

Game Theory Analyses Applied to Water Resource Problems,
W82-00802 1502 6A

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 1503 6A

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 1504 3F

Groundwater Allocation Mechanisms: The Case of Western Kansas,
W82-03503 1508 4B

Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 1511 2B

Development Issues in the Colorado River Basin,
W82-05890 1511 6D

Allocation of Water for Resource Development,
W82-06839 1512 6D

WATER ANALYSES
Water Quality Data, Mackenzie River Basin 1960-1979.
W82-02506 1505 7C

WATER ANALYSIS
Determination of Priority Pollutant Phenols in Water by HPLC,
W82-00110 1501 5A

Organic Micropollution Indices of Effluents and Renovated Waters,
W82-00123 1501 5A

Determination of Trace Quantities of Dimethylsulfoxide in Aqueous Solutions,
W82-00205 1501 5A

Redox Stability of Inorganic Arsenic(III) and Arsenic(V) in Aqueous Solution,
W82-00206 1501 5A

Consecutive Amperometric Titrations for Calcium and Magnesium,
W82-00208 1501 5A

A Direct Differential Pulse Anodic Stripping Voltammetric Method for the Determination of Thallium in Natural Waters,
W82-00209 1501 5A

Determination of Aminocarb in Water by High Performance Liquid Chromatography,
W82-00232 1501 5A

Identification of Organic Compounds in a Mutagenic Extract of a Surface Drinking Water by a Computerized Gas Chromatography/Mass Spectrometry System (GC/MS/COM),
W82-00256 1501 5A

Gas Chromatographic Determination of Selenium (-II, O), -(IV), and -(VI) in Natural Waters,
W82-00257 1501 5A

Determination of Organically Combined Chlorine in High Molecular Weight Aquatic Organics,
W82-00258 1501 5A

Analytical Methods Evaluation for Applicability in Leachate Analysis,
W82-00380 1501 5A

A Resonance Raman Method for the Rapid Detection and Identification of Bacteria in Water,
W82-00404 1501 5A

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments. II. Features of Fatty Acids for Polluted and Unpolluted Waters,
W82-00454 1501 5A

Nitrosamines in Tap Water After Concentration by a Carbonaceous Adsorbent,
W82-00459 1501 5A

Comparison of Automated Segmented-Flow and Discrete Analyzers for the Determination of Nutrients in Water,
W82-00483 1501 5A

Gas Chromatographic Determination of Trialkyl/Aryl Phosphates in Drinking Water, Following Isolation Using Macroreticular Resin,
W82-00502 1502 5A

Adsorption as a Control of Metal Concentrations in Sediment Extracts,
W82-00614 1502 5A

Evaluation of Standard and Modified M-FC, Macconkey, and Teepol Media for Membrane Filtration Counting of Fecal Coliforms in Water,
W82-00644 1502 5A

Modification of the Standard Most-Probable-Number Procedure for Fecal Coliform Bacteria in Seawater and Shellfish,
W82-00646 1502 5A

New Liquid Chromatographic Detection System for Environmental Pollutants,
W82-00740 1502 5A

Interim Method for Determining Asbestos in Water,
W82-00741 1502 5A

Simultaneous Determination of Iron, Cadmium, Zinc, Copper, Nickel, Lead, and Uranium in Seawater by Stable Isotope Dilution Spark Source Mass Spectrometry,
W82-00786 1502 5A

A Reduction-Spectrophotometric Method for the Determination of Sulphate in Waters,
W82-00850 1502 5A

Methods of Investigating the State of Metal Ions in Natural Waters,
W82-00859 1502 5A

Heavy Metal Concentrations in the Holston River Basin (Tennessee),
W82-00959 1502 5A

Determination of Alkaline Earth and Divalent Transition Metal Cations by Ion Chromatography with Sulfate-Suppressed Barium and Lead Eluents,
W82-01082 1502 5A

Water Hardness Determination by the Catalytic Polarographic Wave of Magnesium Ion,
W82-01083 1502 5A

Determination of Chromium Speciation in Natural Waters by Electrodeposition on Graphite Tubes for Electrothermal Atomization,
W82-01084 1502 5A

Multielement Preconcentration of Trace Heavy Metals in Water by Coprecipitation and Flotation with Indium Hydroxide for Inductively Coupled Plasma-Atomic Emission Spectrometry,
W82-01097 1502 5A

Determination of Molybdenum in Sea and Estuarine Water with Beta-Naphthoin Oxime and Neutron Activation,
W82-01098 1502 5A

Determination of Nickel by Differential Pulse Polarography at a Dropping Mercury Electrode,
W82-01100 1502 5A

A Simple Low Cost Apparatus for Conditioning Large Volumes of Water for Virological Analysis,
W82-01123 1503 5A

Some Recent Studies on Groundwater Radon Content as an Earthquake Precursor,
W82-01127 1503 2F

Use of Excised Root Cultures as Bioindicators of Water Pollution (Utilisation Des Cultures de Racines Isolees Comme Test Biologique de Pollution des Eaux),
W82-01133 1503 5A

Fixed Endpoint Alkalinity Determination,
W82-01187 1503 7B

Determination of Labilities of Soluble Trace Metal Species in Aqueous Environmental Samples by Anodic Stripping Voltammetry and Chelex Column and Batch Methods,
W82-01229 1503 5A

Inorganics,
W82-01238 1503 5A

Organics,
W82-01239 1503 5A

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 1503 5A

Water-Quality Monitoring: A Global Approach,
W82-01339 1503 7A

The Application of Mutagenicity Testing to Drinking Water,
W82-01487 1503 5A

Determination of Nanogram Quantities of Mercury in Water with a Gold-Plated Piezoelectric Crystal Detector,
W82-01509 1503 5A

Concentrating Organics in Water for Biological Testing,
W82-01591 1503 5A

Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 1503 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 1503 5A

Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 1503 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 1504 5A

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 1504 5A

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 1504 5B

The Use of Leeches to Identify Pesticides in Water,
W82-02073 1504 5A

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 1504 5B

Determination of Dissolved Organic Carbon in Water,
W82-02194 1505 5A

Continuous-Flow Injection Analysis of Aqueous Environmental Samples for Chemical Oxygen Demand,
W82-02203 1505 5A

Automatic Capture and Processing of Analytical Data in a Water Industry Laboratory,
W82-02207 1505 7C

Lake Erie Nearshore Water Chemistry at Nanticoke, Ontario, 1969-1978,
W82-02228 1505 2K

Distribution on Viable Marine Bacteria in Neritic Seawater Around Japan,
W82-02427 1505 5A

To Inhibit or Not to Inhibit: That is The Question,
W82-02672 1506 5A

Application of Hydride Generation to the Determination of Trace Concentrations of Arsenic by Inductively-Coupled Plasma Atomic Emission Spectrometry,
W82-02718 1506 5A

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02752 1506 2H

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. III. Gas Chromatographic Analysis and Confirmation,
W82-03215 1507 5A

General Method for Determination of Pesticide Residues in Samples of Plant Origin, Soil, and Water. II. Thin Layer Chromatographic Determination,
W82-03216 1507 5A

Fluoride Determination in Water: An Optimum Buffer System for Use with the Fluoride-Selective Electrode,
W82-03259 1507 5F

A New Voltammetric Method for the Determination of Silica Traces in Water,
W82-03270 1507 5A

Acidification in 90 Norwegian Lakes,
W82-03344 1507 2H

A Factor Analysis of Elemental Associations in the Surface Microlayer of Lake Michigan and Its Fluvial Inputs,
W82-03442 1508 2H

High Performance Liquid Chromatographic Determination of Carbaryl and 1-Naphthol at Residue Levels in Various Water Sources by Direct Injection and Trace Enrichment,
W82-03444 1508 5A

Water Chemistry of Alabama Ponds,
W82-03534 1508 2K

Ion Exchange in Flow Injection Analysis Determination of Ammonium Ions at the Microgram per Liter Level in Natural Waters with Pulsed Nessler Reagent,
W82-03700 1508 5A

The Fate of Pollutants in the Vadose Zone, Monitoring Methods and Case Studies,
W82-03735 1508 5B

Electron-Capture Gas Chromatographic Determination of Sulphide as a New Pentafluorobenzyl Derivative,
W82-04036 1509 5A

Speciation of Trace Di- and Triorganotins in Water by Ion-Exchange HPLC-GFAA,
W82-04037 1509 5A

Concentration and Isolation of Organic Acids on Graphitized Carbon Black,
W82-04038 1509 5A

Effect of Filtration Pressure on Analyses for Chlorophyll,
W82-04247 1509 2H

Analytical Quality Control,
W82-04345 1510 5G

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 1510 7C

Determination of Trace Elements in Seawater by Neutron Activation Analysis and Electrochemical Separation,
W82-04530 1510 5A

Interpretation of Chemical Analyses of Water Collected from Two Geothermal Wells at Coso, California,
W82-04743 1510 1A

Apparatus Needs and Costs for Monitoring Priority Pollutants,
W82-04779 1511 5A

Anodic Stripping Voltammetry as an Analytical Tool,
W82-04811 1511 5A

High-Performance Liquid Chromatographic Determination of Nitrite in Environmental Samples by the Use of Hydralazine,
W82-04855 1511 5A

Determination of Sulfate in River Water by Flow Injection Analysis,
W82-04891 1511 5A

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

Use of XAD-Resins for the Detection of Mutagenic Activity in Water. I. Studies with Surface Water,
W82-04913 1511 5A

Automated Turbidimetric Determination of Sulphate in Surface, Ground and Domestic Water by Flow-Injection Analysis,
W82-04935 1511 5A

Determination of Cadmium in Lake Michigan by Mass Spectrometric Isotope Dilution Analysis or Atomic Absorption Spectrometry Following Electrodeposition,
W82-05040 1511 5A

Extraction and Spectrophotometric Determination of Cadmium Based on the Formation of a Ternary Complex with Cadion and 1,10-Phenanthroline,
W82-05041 1511 5A

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

Determination of Arsenic and Antimony in Water and Soil by Hydride Generation and Atomic Absorption Spectroscopy,
W82-05141 1511 5A

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 1511 5A

Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

Evaluation of Methods for the Assay of Radium-228 in Water,
W82-05212 1511 5A

Sampling and Analyzing Water,
W82-05263 1511 5A

Acid Precipitation in the Washington Cascades,
W82-05287 1511 5B

Metal Concentrations in Guam Urban Runoff,
W82-05302 1511 5B

Water Quality Assessment for Agana Springs,
W82-05304 1511 5A

Procedures for Analyzing Contaminants in Drinking Water,
W82-05438 1511 5A

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 1511 5A

High Resolution Alpha Spectroscopy by Liquid Scintillation Techniques,
W82-05541 1511 5A

Occurrence and Distribution of Chemical Pollutants in Lake Mariut, Egypt, I. Residues of Organochlorine Pesticides,
W82-05620 1511 5B

A Simple Spectrophotometric Technique for the Determination of Pentachlorophenol in Water,
W82-05725 1511 5A

Environmental Impact of Upland Streams on the Okefenokee Swamp,
W82-05933 1512 5B

Verification of a Model for Foam Flotation Column Operation,
W82-06001 1512 5D

Headspace Chromatographic Determination of Water Pollutants,
W82-06016 1512 5A

Diatom Assemblages as Indicators of Water Quality in Freshwater Habitats of Guam,
W82-06146 1512 5A

Effects of Urbanization on Stream Ecosystems,
W82-06163 1512 5C

Application of a New Method for Quantitative Evaluation of Stream Benthic Algal Populations,
W82-06168 1512 5C

Liquid-Liquid Extraction Combined with Atomic-Absortpion Spectrometry for Determination of Copper in Waters, Foods and Analytical Reagents Using 1,2-Naphthoquinone Thiosemicarbazone,
W82-06179 1512 5A

Laboratory Services in Regional Water Authorities,
W82-06256 1512 5G

On the Presence of Iron(II) in Oxygenated Surface Waters: Analytical Implications,
W82-06271 1512 5A

The Effect of Metal Ions on the Ultraviolet Spectra of Humic Acid, Tannic Acid and Lignosulfonic Acid,
W82-06273 1512 2K

Determination of Organochlorines in River Sediment by Capillary Gas Chromatography, Application to Dutch River Sediment,
W82-06274 1512 5A

An Automated Procedure for the Determination of Total Kjeldahl Nitrogen,
W82-06314 1512 5A

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

Multiple Potentiometric System for Continuous Determination of Chloride, Fluoride, Nitrate, and Ammonia in Natural Waters,
W82-06718 1512 5A

Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 1512 5A

Modification of the Hydrogen Peroxide Method of Determination of Total Phosphorus in Natural Waters,
W82-06828 1512 5A

Microbiology: Methodology and Quality Assurance,
W82-06919 1512 5A

Inorganics,
W82-06999 1512 5A

WATER ANAYLSIS

Organics,
W82-06922 1512 5A

WATER BALANCE

A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 1503 2A

Atmospheric Moisture Transport and the Water Balance of the Mediterranean Sea,
W82-05050 1511 2A

WATER BASIN DEVELOPMENT

Unified River Basin Management,
W82-05769 1511 6D

WATER CHEMISTRY

Particulate and Dissolved Lipids in Sea Water,
W82-02727 1506 5A

Nitrogen Recycling in a North Carolina Coastal River,
W82-02822 1506 5B

The Composition and Ecology of Periphyton Communities in Freshwaters. II. Inter-Relationships Between Water Chemistry, Phytoplankton Populations and Periphyton Populations in a Shallow Lake and Associated Experimental Reservoirs ('Lund Tubes'),
W82-03217 1507 2H

Hysteresis in Relationships Between Discharge and Water Chemistry in the Fraser River Basin, British Columbia,
W82-04326 1510 2K

WATER CIRCULATION

Water Movement for Water Quality in Catfish Production,
W82-00866 1502 5G

Mean Summer Circulation in Lake Ontario Within the Coastal Zone,
W82-00967 1502 2H

Hypolimnion Flow Between the Central and Eastern Basins of Lake Erie During 1977 (Interbasin Hypolimnion Flows)
W82-01153 1503 2H

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 1504 2H

Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 1504 2H

Chesapeake Bay Low Freshwater Inflow Study,
W82-02114 1505 6G

The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

Stratification and Mixing in Shallow Tropical African Lakes,
W82-03514 1508 2H

Prediction of the Circulation in Reservoirs,
W82-04682 1510 2H

Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 1512 2H

WATER CONSERVATION

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 1501 3D

Water Conservation Devices for New or Existing Dwellings,
W82-00401 1501 3D

The Declining Ground-Water Resources of Alluvial Valleys: A Case Study,
W82-00832 1502 4B

Ground-Water Use for Cooling: Associated Aquifer Temperature Changes,
W82-01014 1502 3E

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

Organic Contamination of Ground Water: Tell it All.
W82-01474 1503 5C

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 1503 3D

Case Studies of Agricultural Water Conservation,
W82-01667 1503 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 1504 3F

A Field Evaluation of Selected Water Conservation and Wastewater Reduction Systems for Residential Applications,
W82-02180 1505 3D

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

Rate Structures and Demand Reduction,
W82-02517 1505 6C

Water Conservation Program of the City of Greensboro,
W82-02518 1505 3D

Water Savings in the Orange Water and Sewer Authority,
W82-02519 1505 3D

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

In-Home Conservation and Wastewater Management,
W82-02591 1505 3D

Reliability of Water Resources,
W82-02749 1506 6A

Management of Soil Water Budgets of Recharge Areas for Control of Salinity in South-Western Australia,
W82-02754 1506 3F

Scientific and Technical Aspects of the Rational Use and Conservation of Groundwaters in the Ukrainian SSR,
W82-02852 1506 4B

An Economic Analysis of Water Conservation Policy,
W82-03090 1507 6B

Report of Committee on Conservation, Development and Utilization of Water Resources.
W82-03374 1507 3D

Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

Modeling the Effects of Conservation Practices on Soil Moisture,
W82-03811 1509 2G

Household Water Use: Technological Shifts and Conservation Implications,
W82-03910 1509 3D

Final Environmental Impact Statement: Cheyenne Stage II Water Diversion, Medicine Bow National Forest.
W82-04073 1509 6D

The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

Reservoir Operation for Water Conservation,
W82-04165 1509 3B

Water Conservation Under Conditions of Extreme Scarcity: The U.S. Virgin Islands.
W82-04170 1509 3A

Achieving Urban Water Conservation,
W82-04227 1509 3D

Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado,
W82-04232 1509 3D

A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 1510 3F

Conserving Water Through Pricing,
W82-04272 1510 3D

The Adoption of Municipal Water Conservation: An Unlikely Event,
W82-04343 1510 6E

An Economist's View of Demand Projections Considering Conservation,
W82-04448 1510 6D

Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 1510 3D

Reducing the Flush,
W82-04654 1510 3D

The Traditional Approach to Water Loss,
W82-04656 1510 3D

Energy and Water Conservation Strategies in Irrigated Agriculture,
W82-04736 1510 3F

A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 1510 6D

Conservation Ethics for the 1980's,
W82-05009 1511 3D

Cutting Irrigation Costs,
W82-05081 1511 3F

Water Research in Action.
W82-05292 1511 6B

A Report on: Research Needs....Water Conservation in Agriculture,
W82-05308 1511 3F

Domestic Water Conservation Research Plan,
W82-05547 1511 6B

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 1511 3D

Industry Helps Conserve Municipal Water,
W82-05674 1511 3E

Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

Municipal Water Supply Restrictions as Urban Growth Constraints,
W82-05748 1511 3D

Saving Water Scenically,
W82-05789 1511 5D

Strategies for Reuse and Conservation,
W82-05790 1511 3C

Water Conservation Incentives and Strategy,
W82-05906 1512 3D

Incentives and Institutions for Water Conservation,
W82-05922 1512 3D

Leak Location Enters Computer Age,
W82-06018 1512 7A

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 1512 6E

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

Water Rates and Residential Water Conservation,
W82-06276 1512 3D

How Rate Structures and Elasticities Affect Water Consumption,
W82-06351 1512 6C

Water Conservation at Wastewater Treatment Plants,
W82-06512 1512 3C

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 1512 3E

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 1512 3D

WATER CONSUMPTION

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 1507 5G

Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

Household Water Use: Technological Shifts and Conservation Implications,
W82-03910 1509 3D

The Effects of Water Conservation Kits on Water Use,
W82-04121 1509 3D

Deterministic Models for Predicting Residential Water Consumption,
W82-04352 1510 6D

WATER CONTENT

An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data,
W82-01523 1503 7B

A Balloonborne Instrument for the Measurement of Vertical Profiles of Supercooled Liquid Water Concentration,
W82-01524 1503 7B

Experimental Verification of the Linear Relationship Between IR Extinction and Liquid Water Content of Clouds,
W82-01525 1503 7B

Lidar Determinations of Atmospheric Ice Crystal Layers at South Pole During Clear-Sky Precipitation,
W82-01529 1503 2C

WATER CONVEYANCE

Optimal Design of Water Conveyance Systems,
W82-00160 1501 6B

Cutting the Water Losses,
W82-00310 1501 5F

Logistics of Farm Water Supply.
W82-02037 1504 6A

Restoring an Antique Water System.
W82-02685 1506 5F

Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 1506 8A

Modern Management Techniques, Part II A: Case History of Production Improvement,
W82-03310 1507 6A

Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 1508 5F

Final Environmental Impact Statement: Cheyenne Stage II Water Diversion, Medicine Bow National Forest.
W82-04073 1509 6D

Riding Mill Pumping Station,
W82-04292 1510 8A

Year-Round Distribution System Maintenance,
W82-04699 1510 5F

Reconstruction of the Northern Donets-Donbas Canal,
W82-04773 1511 8A

Tunnelling Machine Saves Time and Money,
W82-05513 1511 8H

WATER COOLING

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 1503 6B

WATER COST

Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

WATER COSTS

Managing Water at Helicopter Plant,
W82-01974 1504 5D

Cost of Small Water Supply Treatment Systems,
W82-02318 1505 5F

Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

Water Cost Encourages Reuse and Conservation,
W82-03295 1507 5D

Keeping a Century-Old Water System Young,
W82-04138 1509 8G

Can Prices Tame the Inflationary Tiger,
W82-04142 1509 6D

Domestic Water Conservation Research Plan,
W82-05547 1511 6B

Current Trends in Cost of Service Studies,
W82-05806 1511 6C

A Multiobjective Branch-and-Bound Method for Planning Wastewater and Residual Management Systems,
W82-06149 1512 6A

Water Rate Studies and Rate Making Philosophy,
W82-06222 1512 6C

WATER CURRENTS

Perpetual Shoals at the Entrance to Chesapeake Bay: Flow-Substrate Interactions and Mutually Evasive Net Currents,
W82-00149 1501 2L

Salt Dispersion in the Hudson Estuary,
W82-01615 1503 2L

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 1503 2L

The Effect of Current on the Distribution of Diatoms Settling on Submerged Glass Slides,
W82-02567 1505 7B

Radar Measurements of Estuarine Currents and Tides,
W82-03360 1507 2L

A Two-Dimensional Numerical Model of the Vertical Circulation of Tides in the St. Lawrence Estuary,
W82-03386 1507 2L

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 1510 2H

Coastal Fresh Water Discharge in the Northeast Pacific,
W82-05870 1511 2A

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 1512 2H

Numerical Modeling of Wind-Driven Currents in Lake Chudskoe,
W82-06615 1512 2H

WATER DAMAND

Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 1507 6D

WATER DEFICIT

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 1503 6A

Rate Structures and Demand Reduction,
W82-02517 1505 6C

WATER DEMAND

Ground Water Availability,
W82-00027 1501 6D

Ground Water Alternatives and Solutions,
W82-00029 1501 6D

Supply Working Group Report.
W82-00030 1501 6D

Water Related Planning and Design at Energy Firms,
W82-00042 1501 6D

Water Supply and Demand in an Energy Supply Model,
W82-00050 1501 6D

Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 1502 6C

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 1502 6D

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

Health Aspects of Urban Water Conservation,
W82-01047 1502 3C

Water Multipliers--Regional Impact Analysis,
W82-01135 1503 6A

Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 1503 6D

Water Management on the Columbia River,
W82-02112 1505 6D

Overview of Freshwater Inflow Depletions,
W82-02152 1505 6D

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 1505 6D

A Monthly Time Series Model of Municipal Water Demand,
W82-02263 1505 6D

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 1505 7C

Efficient Groundwater Utilization,
W82-02520 1505 6D

Water for Industry,
W82-02767 1506 6D

Demand Forecasting in Water Supply Networks,
W82-02926 1506 6D

Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 1507 6D

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 1507 6D

Potential Water Use and Agricultural Production Patterns Under Alternative Water Prices,
W82-03092 1507 6B

Potential Impact of Irrigation on Water Resources in the Little Wabash Basin of Illinois,
W82-03547 1508 6D

Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 1508 5F

Agriculture in the Wider Caribbean,
W82-03778 1509 6D

Environment and Public Health in the Caribbean,
W82-03787 1509 6D

An Analysis of the Effects of Alternative Measures of Price on the Demand for Water by Self-Supplied Industries,
W82-03828 1509 6C

Institutional Analysis Criteria for Water Supply Planning,
W82-03930 1509 6D

An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 6B

Final Environmental Impact Statement: Cheyenne Stage II Water Diversion, Medicine Bow National Forest.
W82-04073 1509 6D

How Much Water Supply Capacity Is Enough,
W82-04103 1509 6D

Water Requirements for Industrial Development,
W82-04117 1509 6D

Water Supply in the Paris Suburbs: Changing Treatment for Changing Demands,
W82-04125 1509 5F

Reevaluating Hunter's Model for Residential Water Demand,
W82-04131 1509 6D

The Costs of Compliance: An EPA Estimate for Organics Control,
W82-04132 1509 6C

Forecasting Water Demand in the Pacific Northwest,
W82-04135 1509 6D

Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

Can Prices Tame the Inflationary Tiger,
W82-04142 1509 6D

Water Constraints on Emerging Energy Production,
W82-04151 1509 6D

Achieving Urban Water Conservation,
W82-04227 1509 3D

Peak Period Design Standards for Small Western U.S. Water Supply Systems,
W82-04249 1509 6D

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

An Economist's View of Demand Projections Considering Conservation,
W82-04448 1510 6D

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 1510 6D

The Welsh Approach to Water Recreation,
W82-04658 1510 6D

The Seven-Trent Studies of Industrial Water Use,
W82-04686 1510 6D

Massachusetts Water Supply Priorities,
W82-04698 1510 6D

A Method for Estimating Peak Water Demand of Multifamily Residences,
W82-04734 1510 6D

A Municipal Water Supply Investment Problem in Rhode-Island,
W82-04740 1510 6D

Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 1511 6D

Water Supply in the USSR.
W82-04849 1511 6D

Water to the South-Western Cape Keeping Up with the Demand.
W82-04887 1511 3C

Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 1511 6C

Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 1511 6D

Cold Lake-Beaver River Regional Water Resources Study,
W82-05396 1511 6D

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 1511 6D

Costa Rica Stays Top of Water League,
W82-05500 1511 6D

Rice Reigns Supreme as Indonesia Builds Up the Sawahs,
W82-05502 1511 3B

Hydro-Economic Analysis and Projection of Irrigation Water Demands in Pennsylvania,
W82-05558 1511 6C

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

The Eighties--Implications for Water Management,
W82-05772 1511 6B

Billing Data Aids Utility Planning,
W82-05786 1511 6C

Price or Persuasion,
W82-05791 1511 6C

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 1511 6E

Development of Models for the Planning of Large-Scale Water-Energy Systems,
W82-05915 1512 6A

Estimating Water Demand Schedules for Selected Industries in Arkansas,
W82-06160 1512 6D

Policing Demand Through Pricing,
W82-06352 1512 6D

Escaping from Prison: An Economic Reassessment of Rutland Water,
W82-06479 1512 6D

A 'Regrettable Necessity' - The Decision to Construct,
W82-06480 1512 6B

Evaluation of Demand Management Policies for Conserving Water in Urban Outdoor Residential Uses,
W82-06669 1512 3D

Lineaments and Fracture Traces, Jennings County and Jefferson Proving Ground, Indiana,
W82-06675 1512 2F

WATER DEPTH

Depths of Flow in Level Basins,
W82-00900 1502 3F

Factors Controlling Phytoplankton Primary Productivity in Byram Lake, Mt. Kisco, N.Y., Summer, 1977,
W82-00915 1502 2H

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

WATER DISTRIBUTION

Development of a Rural Water District,
W82-00288 1501 6A

Mathematical Efficiency Concerns in Water Distribution Network Considerations,
W82-00339 1501 5F

Malawi: A Community Approach.
W82-01365 1503 5F

Loop Equations with Unknown Pipe Characteristics,
W82-02258 1505 3F

How Computers Have Changed Water Works Operations,
W82-02276 1505 5F

Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 1505 6A

Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

Energy Costs and Portland Water Supply System,
W82-02586 1505 5F

Restoring an Antique Water System.
W82-02685 1506 5F

Computerized Control of an Open-Channel Water Distribution System,
W82-02732 1506 4A

Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 1506 8A

Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 1507 6A

An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis,
W82-03305 1507 5F

A Century of Water for Antwerp,
W82-03355 1507 5F

Outbreaks of Waterborne Disease in the United States: 1971-1978,
W82-03430 1508 5B

Uncertainties in Water Distribution Systems,
W82-03668 1508 8A

Ground-Level Versus Elevated Storage,
W82-03865 1509 5F

Optimization of Looped Water Distribution Systems,
W82-04045 1509 6A

Laboratory Technique for Measurement of pH for Corrosion Control Studies and Water Not in Equilibrium with the Atmosphere,
W82-04101 1509 5G

Pumping Station Reliability: How and How Much,
W82-04110 1509 8C

The Behavior of Asbestos-Cement Pipe Under Various Water Quality Conditions: A Progress Report,
W82-04119 1509 8G

Dual Distribution Systems Analysis,
W82-04123 1509 5F

Computer Modeling Programs: Tools for Model Operations,
W82-04130 1509 6A

Curbing the Distribution Energy Appetite,
W82-04136 1509 5F

Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

Obtaining Layout of Water Distribution Systems,
W82-04319 1510 8A

Leak Detection--Histories,
W82-04363 1510 3D

Leak Detection Programs Recover Revenues,
W82-04375 1510 3D

Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 1511 5F

Centralized Control of the Water Supply Complex for the Marseilles Urban Area (Controle Centralise du Complexe D'Alimentation en Eau De L'Agglomeration de Marseille),
W82-04766 1511 5F

A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

Overhauling a Water System,
W82-06224 1512 5F

Water Supply and Distribution in Larger Communities,
W82-06413 1512 5F

Water Distribution Network Analysis Using Interactive Graphics,
W82-06453 1512 5F

WATER DISTRICTS

Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 1512 3E

WATER DIVERSION

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

WATER DUMPS

Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

WATER EXCHANGE

Interagency Connections: Insurance Against Interruptions in Supply,
W82-04090 1509 5F

Evaluation of the Water Resources Potential of the Lower Missouri River Valley Alluvium,
W82-06696 1512 6B

WATER HAMMER

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

Water Hammer,
W82-05432 1511 8C

WATER HARDNESS

Toxicity of Environmental Acid to the Rainbow Trout: Interactions of Water Hardness, Acid Type, and Exercise,
W82-02631 1506 5C

WATER HARVESTING

Snow Barrier Potential for Harvesting Moisture in Transects Across Chinook Areas in Montana--Summary Report,
W82-02539 1505 2C

WATER HYACINTH

The Flowering of Wastewater Treatment,
W82-02015 1504 5D

Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes),
W82-03179 1507 5B

Wastewater Effects on a Waterhyacinth Marsh and Adjacent Impoundment,
W82-03634 1508 5D

Pollution: Cleaning Up with the Water Hyacinth,
W82-04770 1511 5D

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

The Effects of Varying Culture Nitrogen and Phosphorus Levels of Nutrient Uptake and Storage by the Waterhyacinth Eichhornia Crassipes (Mart) Solms,
W82-05098 1511 5G

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 1511 5C

WATER LAW

Ground Water Conflicts and Barriers,
W82-00028 1501 6E

Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 1501 6D

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Illinois.
W82-00719 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Rhode Island.
W82-00720 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire.
W82-00721 1502 6E

Nebraska Ground Water Law and Administration,
W82-01236 1503 6E

Law,
W82-01302 1503 6E

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the

Federal Water Pollution Control Act Amendments of 1972,
W82-01455 1503 6E

A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 1503 6E

Compelled Self-Incrimination and the Federal Water Pollution Control Act,
W82-01600 1503 6E

Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 1505 5G

Management of Interstate Aquifer Systems,
W82-02578 1505 4B

A Preliminary Survey of State Ground-Water Laws,
W82-02616 1506 6E

Legal Questions and Problems of Kansas Groundwater Management Districts,
W82-02802 1506 6E

New Developments in Papermaking in Western Europe,
W82-02947 1506 5D

The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 1507 6E

Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 1508 6E

New Legislation in California and Its Effects,
W82-03731 1508 6E

SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 1508 6E

The Impact of Federal Water Policy on State Planning: A Cautionary Example,
W82-04120 1509 6E

Problems of Public Access to Water in Texas Lakes and Streams,
W82-04220 1509 6E

Conjunctive Management of Water Resources in the Context of Texas Water Law,
W82-04223 1509 6E

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

Development of Federal Reserve Rights,
W82-04446 1510 6E

Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 1511 6E

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

Federal Water Pollution Remedies: Non-Statutory Remedies are Eliminated,
W82-05603 1511 6E

History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 1511 6E

American Indian Water Rights and the Use of Colorado River Water,
W82-05885 1511 6E

Colorado River Water Allocation,
W82-05888 1511 6C

Reorganization of Groundwater Utilization Sought (Neuordnung Der Grundwasserverwendung Angestrebt),
W82-06022 1512 3E

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 1512 6E

WATER LEVEL

January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 1501 7C

Water Level Data for Wells in and Near Burial Ground 3, Oak Ridge National Laboratory, Tennessee, 1975-1979,
W82-00423 1501 7C

Approximate Ground-Water-Level Contours, April 1981, for the Soquel-Aptos Area, Santa Cruz County, California.
W82-00734 1502 7C

A Method for Estimating Recharge and Boundary Flux from Groundwater Level Observations,
W82-00985 1502 2F

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

Geohydrologic Models of the Houston District, Texas,
W82-01335 1503 2F

Balance of Biogenic Elements in the Aral Sea Upon a Drop of Its Level,
W82-01370 1503 2H

Recent Changes in Level of Lake Victoria,
W82-01711 1503 4A

Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 1503 7C

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 1505 2F

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 1505 2F

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

Fish Movement Upstream Through a Central Queensland (Fitzroy River) Coastal Fishway,
W82-02800 1506 8I

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota.
W82-02844 1506 2F

Investigation of the Accuracy of Water Level Transfer to Determine Geodetic Elevation in Lake Ontario,
W82-03515 1508 2H

Lake Level Drawdown as a Macrophyte Control Technique,
W82-04235 1509 4A

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 1511 7C

Annual Summary of Ground-Water Conditions in Arizona, Spring 1979 to Spring 1980.
W82-05826 1511 4B

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

Water-Level Map of the Mississippi Delta Alluvium in Northwestern Mississippi, April 1981,
W82-06138 1512 7C

Analysis of Lake Victoria Levels,
W82-06201 1512 2H

WATER LEVEL FLUCTUATIONS

January 1980 Water Levels, and Data Related to Water-level Changes, Western and South-Central Kansas,
W82-00016 1501 2F

Predicting Lake Levels by Exponential Smoothing.
W82-00118 1501 2A

Computer Modeling of Los Angeles Water Resources,
W82-01168 1503 6A

Ecology of Larval Fishes in Lake Oahe, South Dakota,
W82-01444 1503 6G

The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 1503 4C

Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

The Environmental Effects of Hydroelectric Projects,
W82-02632 1506 6G

Space-Time Variability of the Runoff of European Rivers,
W82-02848 1506 2E

Calculation of the Annual Distribution of River Runoff When Observation Data Are Available,
W82-02854 1506 2E

Temporary Hydrologic Changes After Deforestation for Pioneer Homesteading,
W82-03544 1508 4C

Probabilistic Model of Long-Term Fluctuations on the Level of an Open Lake,
W82-03572 1508 2H

Declining-Rate Filtration,
W82-03656 1508 5F

Surface Water and Groundwater Interactions in a Surficial Aquifer in Northwest Iowa,
W82-03718 1508 2A

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 1510 2B

Probable High Ground-Water Levels on Cape Cod, Massachusetts,
W82-04511 1510 7C

A New Method of Cubature Using Spline Functions,
W82-04939 1511 2L

Prediction of Water Level in Tidal Inlet,
W82-05005 1511 4A

Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 1511 4B

Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 1511 4B

Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 1511 4A

Liquid Level Interferometer,
W82-05929 1512 7B

Evaluation of Impacts Associated with Reregulation of Water Levels in Lake Mohave,
W82-06089 1512 6G

Colorado Cooperative Fishery Research Unit Studies at Twin Lakes, Colorado: 1980 Report of Findings,
W82-06402 1512 6G

Hypereutrophication of an Hawaiian Alpine Lake,
W82-06991 1512 5C

WATER LEVEL RECORDERS

Water Level Control for Small Hydro Plants,
W82-04173 1509 8C

Liquid Level Interferometer,
W82-05929 1512 7B

WATER LEVELS

Ground-Water Data for Michigan, 1979,
W82-00014 1501 2F

An Example of the Application of Statistical Techniques to Predict Lake Level Elevations,
W82-01111 1503 6A

Salt-Water Intrusion in a Layered Coastal Aquifer at York Point, Prince Edward Island,
W82-03108 1507 2F

Towards Digital Technology in the Measurement and Control of Water Levels,
W82-04847 1511 7B

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

WATER LOGGING

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 1. The Contribution of Farm Water Usage, Irrigation Management and Leakage from the Canal System to Waterlogging. (Besproeiing, Gewasopbrengs en Dreinering Op Die Vaalharts-Besproeiingskema: 1. Die Bydrae Van Plaaswaterverbruik, Besproeiingsbestuur en Kanaalwaterverliese tot Versuiping),
W82-03438 1508 3F

WATER LOSS

Operational Evaluation of Village Level Irrigation Conveyance Systems,
W82-00696 1502 3F

Water Conservation Program of the City of Greensboro,
W82-02518 1505 3D

Leak Detection - Two Methods That Work,
W82-02521 1505 3D

Water Levels and Losses and Cleaning in Watercourses,
W82-02747 1506 3F

Leak Detection--Histories,
W82-04363 1510 3D

The Traditional Approach to Water Loss,
W82-04656 1510 3D

WATER LOSSES

A Conceptual Framework for Evaluating Agricultural Water Conservation Potentials,
W82-04251 1510 3F

WATER MAINS

Engineering Research and the Water Industry,
W82-00313 1501 8A

Factors Influencing the Occurrence of Bursts in Iron Water Mains,
W82-00960 1502 8A

Recording Underground,
W82-02036 1504 8A

Estimation and Optimization of the Serviceability of Underground Water Transmission Network Systems Under Seismic Risk,
W82-02743 1506 8A

Conducting a Regular Main Flushing Program,
W82-04118 1509 5F

Renovation of Water Mains and Sewers,
W82-04237 1509 5F

The Search for a Corrosion Index,
W82-04279 1510 5F

Year-Round Distribution System Maintenance,
W82-04699 1510 5F

Sulphide Control in Rising Mains,
W82-05465 1511 5D

Statistical Cost Function for Water Mains,
W82-06252 1512 6C

WATER MANAGEMENT

Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 1501 6D

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 1501 3D

Summary of U.S. Geological Survey Investigations and Hydrologic Conditions in Southwest Florida for 1979,
W82-00419 1501 10C

The Azov Sea Problem,
W82-00651 1502 6G

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 1502 6F

The U.S. Geological Survey Federal-State Cooperative Water Resources Program,
W82-00735 1502 6B

Potential Eutrophication of the Rideau River by an Urban Drainage Waterway,
W82-00834 1502 5C

Management of Recharge Basins on the Southern High Plains,
W82-00938 1502 4B

Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado,
W82-01301 1503 6A

Systems Analysis,
W82-01303 1503 6A

Generating Alternative Solutions for Dynamic Programming Models of Water Resources Problems,
W82-01450 1503 6A

Water Management Model Evaluation for North Central Ohio,
W82-01536 1503 4A

Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 1503 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 1503 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 1504 6E

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 1504 6E

Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 1505 6E

Water Management on the Columbia River,
W82-02112 1505 6D

Federal and State Coastal Zone Management Efforts Directed at Estuaries and Freshwater Inflow,
W82-02113 1505 6E

Texas Shrimp Fisheries and Freshwater Inflow,
W82-02131 1505 6G

Colorado River Simulation System; An Executive Summary,
W82-02170 1505 6A

Public Perception of Groundwater Depletion in Southwestern Kansas,
W82-02174 1505 3F

How Computers Have Changed Water Works Operations,
W82-02276 1505 5F

Systems Analysis Applied to Water Management in Developing Countries: Problems and Prospects,
W82-02441 1505 6A

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 1505 7C

Trends in State and Federal Policy on Water Supply Management,
W82-02516 1505 6E

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

Salt-Water Intrusion in the Costa De Hermosillo, Mexico: A Numerical Analysis of Water Management Proposals,
W82-02547 1505 5B

Optimal Stream-Aquifer Development,
W82-02575 1505 6A

Energy Costs and Portland Water Supply System,
W82-02586 1505 5F

Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

Water Management in the North Deschutes Unit Irrigation District: Geographic Perspectives and Remote Sensing Applications,
W82-02739 1506 7B

Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 1507 6A

Estimating the Costs in Lost Power of Alternative Snake-Columbia Basin Management Policies,
W82-03073 1507 6B

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 1507 7C

Canada Water Year Book 1977-1978.
W82-03099 1507 7C

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 1507 6D

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 1507 5G

A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System – II. Water Quality Modelling,
W82-03243 1507 5B

Remote Sensing Applications for Resource Management,
W82-03279 1507 7B

The Computer: Water Management Tool,
W82-03290 1507 6A

Water: Too Much, Too Little, Too Bad,
W82-03291 1507 6D

On Hydrological Data Needs in Canada,
W82-03443 1508 7A

Economical Use of Water Resources.
W82-03496 1508 6E

Polish Water Management–Structure, Problems and Research,
W82-03633 1508 6D

Hydrology and Mining in the Tucson Areas,
W82-03697 1508 2F

Discussion: Water Quality Trap Efficiency of Storm Water Management Basins, by Richard H. McCuen,
W82-03784 1509 4A

The Impact of Eutrophication on Water Treatment and Supplies in the Anglian Water Authority,
W82-03866 1509 5C

Hydrologic Applications of Weather and Climate Information,
W82-03871 1509 7C

Recreational Enhancement of High Country Water Supply Reservoirs,
W82-03923 1509 6A

Utilization, Planning and Problem Evaluation of Urban Arterial Waterways and Corridors as an Urban Resource,
W82-03952 1509 6A

Report of the River Master of the Delaware River for the Period December 1, 1979 – November 30, 1980,
W82-03989 1509 4A

Multi-Objective Decision Making in Water Management,
W82-04010 1509 6A

Energy and Water Resources.
W82-04066 1509 6D

Forecasting Water Demand in the Pacific Northwest,
W82-04135 1509 6D

Water Conservation Under Conditions of Extreme Scarcity: The U.S. Virgin Islands.
W82-04170 1509 3A

Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

Optimal Operation of a Reservoir System Using Forecasts,
W82-04209 1509 4A

Conjunctive Management of Water Resources in the Context of Texas Water Law,
W82-04223 1509 6E

Water Management in Ontario,
W82-04259 1510 6E

Three Important Court Decisions,
W82-04349 1510 6E

Secular Changes in Annual and Seasonal Great Lakes Precipitation, 1854-1979, and Their Implications for Great Lakes Water Resource Studies,
W82-04431 1510 2B

Two-Dimensional Ground-Water Flow Model of the Cretaceous Aquifer System of Lee County and Vicinity, Mississippi,
W82-04492 1510 2F

Borehole Data-Collection Methods Applicable for the Regional Observation and Monitor Well Program, Southwest Florida Water Management District,
W82-04493 1510 4B

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 1510 6G

Local Irrigation Agencies,
W82-04560 1510 4B

Status and Problems of Process Water Supply in the Fruit and Vegetable Processing Industry (Situation und Aufgaben Der Betriebswasserwirtschaft in Der Obst- Und Gemuseverarbeitenden Industrie),
W82-04584 1510 3E

Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 1510 7B

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 1510 5G

Data Acquisition for River Management,
W82-04601 1510 7A

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 1510 6A

Ground-Water Management in Basalts,
W82-04931 1511 4B

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

Water and Wastewater Managers Face the Financially Troubled 1980s,
W82-05166 1511 6B

Reflections of the Choice of Some Priority Axes of Hydraulic Research in the Field of Land and Water Management,
W82-05278 1511 4B

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 1511 6B

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 1511 8I

Stream-Aquifer Influence Coefficients as Tools for Simulation and Management,
W82-05346 1511 2F

The Shubenacadie-Stewiacke River Basin Study,
W82-05385 1511 6B

A Case Study of Rural Opposition Toward River Valley Planning,
W82-05386 1511 6E

Operational Research Techniques in River Basin Management,
W82-05387 1511 6A

A Federal Perspective on River Basin Management,
W82-05388 1511 6E

Flood Control and Flow Regulation Problems on the Assiniboine River,
W82-05389 1511 4A

River Basin Planning in Alberta, Current Status–Future Issues,
W82-05390 1511 6E

River Basins and Water Management in New Brunswick,
W82-05391 1511 6D

The Uncertain Quest for a Management Strategy in the Fraser Estuary,
W82-05392 1511 6F

River Basin Management in Ontario,
W82-05393 1511 6E

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 1511 6E

New Strategies for Water Resource Planning in British Columbia,
W82-05395 1511 6E

Coid Lake-Beaver River Regional Water Resources Study,
W82-05396 1511 6D

Institutional Change - Water Quality Management,
W82-05401 1511 6E

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 1511 6D

Problems of the Multipurpose Use of Water Resources of the Volga-Akhtuba Floodplain and Volga Delta,
W82-05487 1511 4A

The Recommendations of the United Nations Water Conference (Mar Del Plata, 1977) and Related Meetings, on National Water Laws,
W82-05492 1511 6E

Integrated Water Management: Some International Dimensions,
W82-05493 1511 6D

Optimality, Information Generation Strategies, and Water Resources Management in the Yukon Territory,
W82-05564 1511 6A

Evolution of Water Management Techniques,
W82-05565 1511 6A

Modifications to Steam Channels in the Brisbane Metropolitan Area, Australia,
W82-05572 1511 4A

Water Supply for New York City in the 1980s,
W82-05671 1511 6D

Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

Role of the Microcomputer in Water Management,
W82-05771 1511 7B

The Eighties--Implications for Water Management,
W82-05772 1511 6B

Water Management in the Metropolitan Toronto Region,
W82-05775 1511 6B

Water Management in the Maritimes,
W82-05776 1511 6B

The Mackenzie River Basin Study,
W82-05778 1511 4A

The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779 1511 6E

A Citizen's View of Water Management in the Okanagan Valley,
W82-05781 1511 6G

Daily Operational Tool for Maximum Beneficial Use Management of Surface and Ground Waters in a Basin,
W82-06174 1512 4B

Evaluation of the Groundwater Resources of the Agag Basin, Saipan,
W82-06524 1512 2F

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 1512 6F

Farm Water Management Gets Fao Boost,
W82-06815 1512 3F

Stormwater Management in a Sensitive Area.
W82-06841 1512 5G

Ecological Principles of the Creation of an Optimal Water Regime in the Volga Delta and North Caspian Sea,
W82-06985 1512 6G

WATER MANAGEMENT (APPLIED)
Five-Year Plan of the Water Resources Research Center,
W82-05526 1511 6B

A Five-Year Plan of Water Resources Research.
W82-05527 1511 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 1511 6B

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 1511 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 1511 6B

A Five-Year Plan for Water Research in Colorado,
W82-05531 1511 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

Nevada Water Resources Research 1982-1987,
W82-05533 1511 6B

Chemical Constraints of Groundwater Management in the Yucatan Peninsula, Mexico,
W82-05650 1511 4B

The Benefits of Water Management in Energy and Agricultural Development in the San Juan River Basin of New Mexico,
W82-06517 1512 3E

WATER MANAGMENT
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 1504 4A

WATER MEASUREMENT
Portable Water Elevation Measuring Gage,
W82-06396 1512 7B

WATER METERING
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 1503 6C

Water Savings in the Orange Water and Sewer Authority,
W82-02519 1505 3D

Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 1508 6C

Replacing Large Water Meters: Why and How,
W82-03560 1508 5F

Water Metering and Conservation,
W82-03562 1508 3D

The Cost of Peak Capacity Water,
W82-04065 1509 6B

Sizing and Selecting Modern Water Meters,
W82-04194 1509 6D

Leak Detection Programs Recover Revenues,
W82-04375 1510 3D

Statistical Sampling Technique for Controlling the Accuracy of Small Water Meters,
W82-06350 1512 6C

WATER PERMITS
SB 1391--Towards a Permit System for Ground Water. Towards a New Definition of Ownership of Ground Water,
W82-03736 1508 6E

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 1512 6B

WATER POLICY
Western Water Resources: Coming Problems and Policy Alternatives,
W82-00107 1501 6D

Arkansas Water Policy.
W82-00715 1502 6D

Potential Political Influences Affecting the Water Industry,
W82-00861 1502 6C

On Water Tariff Equalization Policies,
W82-01175 1503 6C

The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 1503 6E

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 1503 6B

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 1503 6A

Charging Policies for Water Services,
W82-01734 1503 6C

The Sewerage Policy of Thames Water,
W82-02040 1504 6E

Water: A Low-Priced But High-Cost Resource,
W82-02061 1504 6C

Adjusting Government Role in Water Law.
W82-02256 1505 6E

Texas to Vote on Water Trust Fund.
W82-02302 1505 6C

Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 1505 6A

Trends in State and Federal Policy on Water Supply Management,
W82-02516 1505 6E

Salinity Forum: What. How. Why,
W82-02587 1505 6E

Policies and Goals for California Water Management: The Next 20 Years.
W82-03111 1507 6D

Water Policy at Inco Metals Company, Ontario Division Mills,
W82-03251 1507 3E

The Risk Business,
W82-03281 1507 6E

Engineering U.S. Water Policy,
W82-03294 1507 6E

Do We Need a National Water Policy Process. Preliminary Criteria for Designing a Constituency-Based Water Policy Structure,
W82-03340 1507 6F

Report of Committee on Conservation, Development and Utilization of Water Resources.
W82-03374 1507 3D

Use of a Predictive Model in Evaluating Water Consumption Conservation,
W82-03754 1509 3D

Potential Impact of Ground Water Policy Alternatives on Nebraska Agriculture, 1977-2020,
W82-03826 1509 6B

The Impact of Federal Water Policy on State Planning: A Cautionary Example,
W82-04120 1509 6E

Theory and Reality in Allocating Federal Resources to Water Resources Development,
W82-04224 1509 6E

Water Management in Ontario,
W82-04259 1510 6E

Auburn Dam: A Case Study of Water Policy and Economics,
W82-04260 1510 6B

Objectives and Constraints in Federal Water Resources Planning,
W82-04288 1510 6E

Transglobal Variations in the Planning Objectives and Critiques,
W82-04605 1510 6A

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 1511 4B

Arizona Ground-Water Reform: Innovations in State Water Policy,
W82-04933 1511 6E

National Water Policy: The Need for Institutional Reform,
W82-05180 1511 6E

A Federal Perspective on River Basin Management,
W82-05388 1511 6E

River Basins and Water Management in New Brunswick,
W82-05391 1511 6D

Promising Steps Toward a New Ottawa River Regulation,
W82-05394 1511 6E

New Strategies for Water Resource Planning in British Columbia,
W82-05395 1511 6E

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 1511 6D

Effects of Potential Water Conservation Efforts in East Tennessee,
W82-05745 1511 3D

Water Quality Management in British Columbia,
W82-05767 1511 5C

Unified River Basin Management,
W82-05769 1511 6B

Water Management in the Maritimes,
W82-05776 1511 6B

The Okanagan Basin Agreements--An Example of Integrated Water Resource Planning in British Columbia,
W82-05779 1511 6E

A Citizen's View of Water Management in the Okanagan Valley,
W82-05781 1511 6G

Future Water Development Policies,
W82-05884 1511 5G

Water Conservation Incentives and Strategy,
W82-05906 1512 3D

Discussion on an Economic Analysis of Water Conservation Policy, by William Whipple,
W82-06069 1512 6E

Groundwater Policy: A Patchwork of Protection,
W82-06411 1512 6E

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 1512 6F

WATER POLLUTION

Transformation of the Mouse Clonal Cell Line R846-DP8 by Mississippi River, Raw, and Finished Water Samples from Southeastern Louisiana,
W82-00215 1501 5C

Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 1501 5C

Toxicity and Ecological Significance of Trace Elements in Aquatic Environments,
W82-00498 1501 5B

Aquasols: The Behavior of Small Particles in Aquatic Systems,
W82-00540 1502 1B

Trace Element Inputs From a Coal Burning Power Plant to Adjacent Terrestrial and Aquatic Environments,
W82-00557 1502 5B

Human Health Hazards Associated With Chemical Contamination of Aquatic Environment,
W82-00632 1502 5C

Effects of a Cattleskin Tannery of Stream Quality and Benthic Macroinvertebrates in Central Maine,
W82-00872 1502 5C

Occurrence of Tetraalkylead Compounds in the Aquatic Environment,
W82-00878 1502 5A

Abundance of Organic Compounds in Water,
W82-01162 1503 5A

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 1503 5C

Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 1503 5A

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 1503 5A

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 1503 5F

The Mercury Cycle,
W82-01869 1504 5B

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 1504 6B

The Effect of EEC Directives on Water Supplies,
W82-02432 1505 6E

The Design of Sea Outfalls with Reference to EEC Amenity Water Pollution Criteria,
W82-02449 1505 5E

Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 1506 5A

Sources of Halogenated Hydrocarbons in an Urban Water Supply,
W82-02991 1506 5B

GAO Finds Massive Failure of Wastewater Treatment Plants,
W82-03299 1507 5D

Carbon Isotope Analysis of Carbonaceous Compounds in Puget Sound and Lake Washington,
W82-03505 1508 5A

Arsenic in Lake Lansing, Michigan,
W82-03522 1508 5B

Speciation of Environmental Pollutants by GC-AA and by ESCA. Purification of Water at Ultratrace Levels of Heavy Metals and Complexation Studies by Electrochemical Methods,
W82-03526 1508 5A

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 8. Effects of Mining,
W82-04071 1509 5C

Storm-Sewer Input of Heavy Metals Into an Urban Lake Environment,
W82-04207 1509 5A

Areawide Stormwater Pollution Analysis with the Macroscopic Planning (ABMAC) Model,
W82-04393 1510 5B

The Identification and Treatment of Bromides and Trihalomethanes in Potable Water from the Pearl River at Jackson, MS: Evaluation of Toxicity on Species Diversity,
W82-04413 1510 5A

Development of the Fecal Streptococcus Group and Its Individual Species as Water Quality Indicators,
W82-04416 1510 5B

Biota and Biological Principles of the Aquatic Environment.
W82-04499 1510 5C

Thunderstorm in Agriculture and in Forest Management,
W82-04617 1510 2B

Detection and Mapping of Insoluble Sinking Pollutants,
W82-04619 1510 5A

Enzymes and Other Biochemical Indicators of Toxicant Effects in Fishes,
W82-05155 1511 5C

Computer Interfaced Systems for Biological Monitoring of Water Quality,
W82-05158 1511 5A

Enzymes and Antibodies as Sensors of Toxic Substances,
W82-05160 1511 5A

Bioprobes for the Monitoring of Toxic Compounds and Hazardous Materials in Water,
W82-05161 1511 5A

Utility of the Microtox Luminescent Bacterial Assay for the Rapid Assessment of Aquatic Pollution,
W82-05162 1511 5A

The Use of Algae as Biological Accumulators for Monitoring Aquatic Pollutants,
W82-05163 1511 5A

A Computer Model for Heavy Metal Transport within the Penobscot River,
W82-05544 1511 5B

WATER POLLUTION CONTROL

Quarterly Progress Report, Nationwide Urban Runoff Program.
W82-00044 1501 5G

Selective Overburden Placement,
W82-00053 1501 5G

Method and Apparatus for Pollutant Spill Control,
W82-00056 1501 5G

Predicting Runoff Pollutant Reduction in Buffer Zones Adjacent to Land Treatment Sites,
W82-00141 1501 5B

Environmental Planning for Coal Strip Mining,
W82-00214 1501 5G

Pollutant Treatability: A Molecular Engineering Approach,
W82-00252 1501 6E

Concentration of Seeded Simian Rotavirus SA-11 from Potable Waters by Using Talc-Celite Layers and Hydroextraction,
W82-00272 1501 5A

Determination of Marine Consent Conditions,
W82-00323 1501 5G

Recent Developments in Water Pollution Control,
W82-00340 1501 5D

Final Environmental Impact Statement; Alternative Wastewater Treatment Systems for Rural Lake Projects; Case Study No. 1: Crystal Lake Area Sewage Disposal Authority, Benzie County, Michigan.
W82-00362 1501 5D

Control Technology Strategies for Coal Preparation Waste Drainages,
W82-00440 1501 5D

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 1501 5D

Environmental Control Technology for Shale Oil Wastewaters,
W82-00444 1501 5D

Water Regulations,
W82-00482 1501 6E

The Distribution of the Costs of Federal Water Pollution Control Policy,
W82-00537 1502 6B

Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 1502 5G

Trace Metal Catalysis in Aquatic Environments,
W82-00629 1502 5B

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

Evaluation of Stripmine Sediment Detention Basins in Kentucky,
W82-00893 1502 5G

Experience Gained with the U.S. Pollution Control Policies,
W82-00996 1502 6E

Effects of Nitrapyrin on Nitrate Movement in Soil Columns,
W82-01048 1502 5G

Groundwater Pollution in Kentucky: A Status Report,
W82-01053 1502 4B

Treatability Manual; Volume I. Treatability Data.
W82-01073 1502 5D

Treatability Manual; Volume III. Technologies for Control/Removal of Pollutants.
W82-01075 1502 5D

Treatability Manual; Volume V. Summary.
W82-01077 1502 5D

Public Concerns and PLUARG: Selected findings and Discussion,
W82-01137 1503 5G

Modelling Effects of Remedial Programs to Aid Great Lakes Environmental Management,
W82-01146 1503 5G

Bacteria: Man's Allies in Water Pollution Control,
W82-01158 1503 5D

Coal and Coal Mine Drainage,
W82-01261 1503 5G

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 1503 6A

Analysis of National Water Pollution Control Policies 2. Agricultural Sediment Control,
W82-01293 1503 6A

Law,
W82-01302 1503 6E

Systems Analysis,
W82-01303 1503 6A

Economics,
W82-01304 1503 5G

Federal Common Law of Nuisance Expands,
W82-01337 1503 6E

Sanitation Service Management in France (La Gestion des Services d'Assainissement en France),
W82-01351 1503 6F

Use of the Contingency Fund at Stringfellow Hazardous Waste Disposal Site,
W82-01416 1503 5G

Geological Studies of Industrially-Related Contamination: Soil and Ground Water Investigations,
W82-01425 1503 5B

Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 1503 5G

Remedial Technique of Controlling and Treating Low Volume Leachate Discharge,
W82-01428 1503 5G

Evaluation of Remedial Treatment, Detoxification and Stabilization Alternatives,
W82-01434 1503 5D

Preliminary Design and Cost Estimates for Remedial Actions at Hazardous Waste Disposal Sites,
W82-01435 1503 5G

Middlesex County Sewerage Authority V. National Sea Clammers Association: Implied Private Rights of Action for Damages under the Federal Water Pollution Control Act Amendments of 1972,
W82-01455 1503 6E

New Opportunities for In-Plant Reduction of Pollutants Through Process Changes,
W82-01559 1503 5G

Pollution Permits and Markets for Water Quality,
W82-01699 1503 6A

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 1503 5G

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 1504 6E

Long-Run Effects of Environmental Regulation,
W82-01848 1504 6A

Pollution Control: Changing Approaches,
W82-01870 1504 6E

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 1504 5A

Reviving the Rio Reconquista,
W82-02014 1504 5G

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 1504 2L

Poland: Coming to Grips with Pollution,
W82-02092 1504 5G

Supreme Court Clarifies Water Act Requirement,
W82-02257 1505 6E

PVC Cover Causes Leachate Retreat,
W82-02321 1505 5E

Denmark's State of the Environment,
W82-02401 1505 5B

Effluent Charging Systems and Their Administrative Implications,
W82-02403 1505 6C

Some Economic Impacts of Freshwater Stream Effluent Discharge Limits on Selected Small Communities in Mississippi,
W82-02530 1505 5D

Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 1506 5G

Lake Vattern,
W82-02755 1506 2H

The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 1506 4D

French Experience in Water Pollution Control,
W82-02765 1506 5G

Water Pollution Control in the Federal Republic of Germany,
W82-02766 1506 6E

Runoff and Pollution Abatement Characteristics of Concrete Grid Pavements,
W82-02801 1506 5B

Securing Support for Nonpoint Pollution Control with Local Compensation,
W82-02807 1506 5G

New Developments in Papermaking in Western Europe,
W82-02947 1506 5D

Using Coherent Water Jets to Control Oil Spills,
W82-03031 1507 5G

Textile Warp Size Reclamation Using Thermal Precipitation,
W82-03034 1507 5D

Combined Sewer Overflow Abatement Program, Rochester, N.Y. - Volume I. Abatement Analysis,
W82-03035 1507 5G

Restoring Ground Water Quality Following in Situ Leaching,
W82-03050 1507 5D

Final Report, Ground Water Study, Ames-Cambridge Reach of the Skunk River, Story County, Iowa,
W82-03112 1507 2F

Eutrophication, Accelerated by Pollution,
W82-03193 1507 5C

New Thrust in the 1980s for U.S. Water-Quality Programs,
W82-03252 1507 5G

EPA Moving to Control Industrial Toxic Pollutants with New NPDES Permits,
W82-03296 1507 6E

Groundwater Contamination by Chlorinated Hydrocarbons: Causes and Prevention,
W82-03300 1507 5E

Removal of Oil Pollutants from Water Bodies by Means of Hydrophobic Sorbents,
W82-03371 1507 5G

Major Changes Ahead in the Nation's Water Clean-Up Program,
W82-03395 1507 6C

The Evolution of Water Quality Management,
W82-03476 1508 6E

Rapid Sewer Analysis Saves Tourist Season,
W82-03494 1508 5G

Irrigated Agriculture and Nitrate Pollution of Rural Water Supplies: Economics for Policy in Central Wisconsin,
W82-03512 1508 5G

Closed Cycle System a Boon to Pulp and Paper Industry,
W82-03566 1508 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 1508 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 1508 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 1508 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 1508 5B

The Fifth Amendment Privilege Against Self-Incrimination and Compulsory Self-Disclosure Under the Clean Air and Clean Water Acts,
W82-03746 1508 6E

Evaluation of Four Concentration/Extraction Procedures on Waters and Effluents Collected for Use with the Salmonella Typhimurium Screening Procedure for Mutagens.
W82-03775 1509 5A

Water Quality Monitoring,
W82-03897 1509 5G

Management Model for Controlling Nitrate Contamination in The New Jersey Pine Barrens Aquifer,
W82-03913 1509 5G

A New Indicator of the Activated Sludge Process - Nitrous Oxide,
W82-04018 1509 5D

Combined Effects of Biological Solids Retention Time and Temperature on the Growth Parameters of Activated Sludge,
W82-04021 1509 5D

Considerations in Choosing the Appropriate Mix of Urban and Agricultural Nonpoint Pollution Control,
W82-04063 1509 5G

Intensive Survey of the Sabine-Neches Canal - Segment 0703,
W82-04078 1509 5A

The Control of Pollution Act 1974. 1. Implications for River Quality Management,
W82-04088 1509 6E

Strategies to Control Nonpoint Source Water Pollution,
W82-04261 1510 5G

Application of the OECD Eutrophication Modeling Approach to Lake Ray Hubbard, Texas,
W82-04278 1510 5C

New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 1510 6B

Who Wins in the Fight for Pollution Control,
W82-04554 1510 6B

Telemetric Water Control System of the Artificially Aerated Mosel River,
W82-04598 1510 5G

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 1510 5F

Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives,
W82-04701 1510 5G

The Roofloat (Floating) Cover System for Liquid Storage,
W82-04702 1510 5G

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 1510 6E

On-Site Stormwater Detention: An Overview,
W82-04758 1511 4A

Oil Shale and Water Quality: The Colorado Phospectus under Federal, State, and International Law,
W82-04803 1511 6E

Factors Affecting the Recovery of ish Populations in an Industrial River,
W82-04812 1511 5C

India: Every River Polluted, and Few Effective Controls,
W82-05033 1511 5B

Performance Testing of Four Skimming Systems,
W82-05059 1511 5G

Deployment Configurations for Improved Oil Containment with Selected Sorbent Booms,
W82-05062 1511 5G

Revegetating Strip-Mined Land with Municipal Sewage Sludge,
W82-05065 1511 5E

Handbook for Oil Spill Protection and Cleanup Priorities,
W82-05210 1511 5G

The River Tame--A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 1511 5C

Water-Pollution Research and Its Application in Developing Countries,
W82-05246 1511 5G

Phosphorus and Nitrogen Removal at Cadillac, Michigan,
W82-05270 1511 5D

The Utilization of Grass Carp, Ctenopharyngodon Idella Val., for Hydrilla Control in Lake Baldwin, Florida,
W82-05274 1511 4A

Impact of Discharges as a Basis for Control Measures,
W82-05354 1511 5B

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 1511 5B

Erosion Control Potential with Conservation Tillage in the Lake Erie Basin: Estimates Using the Universal Soil Loss Equation and the Land Resource Information System (LRIS),
W82-05661 1511 4D

Dual Objective Control of Nutrient Loading into a Lake,
W82-05750 1511 5G

Federal Water Pollution Control Act's Notice Requirement Liberally Construed,
W82-05986 1512 6E

New Directions in Water Pollution Control,
W82-06071 1512 5G

The Mediterranean Action Plan: Design and Implementation,
W82-06154 1512 5B

Water Pollution Control Plant Upgraded to Meet EPA Regs.
W82-06187 1512 5D

Non-Point Source Pollution: Directions for Vermont,
W82-06372 1512 5G

Groundwater Policy: A Patchwork of Protection,
W82-06411 1512 6E

WATER POLLUTION CONTROL

A Review of Industrial Effluent Control Experience,
W82-06648 1512 5G

WATER POLLUTION EFFECTS

Water Quality Issues and Energy Assessments,
W82-00036 1501 6B

Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 1501 6A

Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

The Aftermath at Longview,
W82-00073 1501 5C

Behavior of Trifluralin in Aquatic Model Ecosystems,
W82-00233 1501 5C

Prioritization of Chemicals According to the Degree of Hazard in the Aquatic Environment,
W82-00300 1501 5C

Natural Variation in Abundance of Salmonid Populations in Streams and its Implications for Design of Impact Studies,
W82-00389 1501 5C

Longitudinal Succession in Impact Assessment of River System Fish Communities,
W82-00399 1501 5C

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 1501 5C

Field Experiments on Responses of a Freshwater, Benthic Macroinvertebrate Community to Vertebrate Predators,
W82-00477 1501 5C

Tadpoles as Indicators of Harmful Levels of Pollution in the Field,
W82-00478 1501 5A

Effect of Metals on the Biomass Production Kinetics of Freshwater Copepods,
W82-00593 1502 5C

Receiving Stream Fisheries Studies Relative to Secondary Treated Pulp and Paper Mill Effluents,
W82-00688 1502 5C

The Relationship of Environmental Epidemiology to Water and Wastewater Plant Operators,
W82-00789 1502 5C

A Rapid Simple Long-Term Toxicity Assay for Aquatic Contaminants Using the Nematode Panagrellus Redivivus,
W82-01017 1502 5A

An Assessment of the Trophic Status of Deer, Loon, and Diamond Lakes,
W82-01072 1502 2H

Effects of Logging on Macroinvertebrates in Streams with and Without Buffer Strips,
W82-01227 1503 5C

Pulp and Paper Industry Effluent Management,
W82-01260 1503 5D

Coal and Coal Mine Drainage,
W82-01261 1503 5G

Effects of Pollution on Freshwater Invertebrates,
W82-01280 1503 5C

Freshwater Macroinvertebrates,
W82-01281 1503 5C

The Effects of Pollution on Freshwater Fish,
W82-01282 1503 5C

A Hydrobiological Survey of a Polluted Canal,
W82-01356 1503 5C

Historical Changes and Relationship to Internal Loading of Sediment Phosphorus Forms in Hypertrophic Prairie Lakes,
W82-01516 1503 2H

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 1503 5A

Acid Precipitation,
W82-01607 1503 5C

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 1503 5C

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 1503 5C

Infectious Waterborne Diseases,
W82-01784 1503 5A

Microbiology of the Aquatic Environment,
W82-01786 1503 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 1504 5C

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 1504 5C

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 1504 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 1504 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 1504 5C

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 1504 5B

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 1504 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 1504 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 1504 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 1504 5C

Environmental Control Technology Development for Geothermal Energy,
W82-02197 1505 5C

A Comparison of the Incidence of Five Pathological Conditions in Soft-Shell Clams, Mya Arenaria, from Environments with Various Pollution Histories,
W82-02357 1505 5C

Fate and Effects of a Heavy Fuel Oil Spill on a Georgia Salt Marsh,
W82-02358 1505 5B

Aspects of Water Pollution in Lake Naini Tal, U.P., India,
W82-02442 1505 5C

Relationship Between Populations of Amphipods and Pollution,
W82-02444 1505 5C

Effect of N-Benzoquinone and of Some Polyphenols on the Membrane Potential of Nitella Sp. Measured by the Open-Vacuole Method,
W82-02626 1506 5C

Decomposition and Microbial Colonization of Leaves in a Stream Modified by Coal Ash Effluent,
W82-02654 1506 5C

On the Van Belle-Fisher Statistic for Water Pollution Monitoring Via Ecological Change,
W82-02671 1506 5A

Aggregation of Spottail Shiners in the Heated Discharge of a Nuclear Power Station,
W82-02686 1506 5C

Detoxification of Chlorinated Sewage Effluent by Dechlorination in Estuarine Waters,
W82-02688 1506 5C

Aluminum Toxicity to Fish as Related to Acid Precipitation and Adirondack Surface Water Quality,
W82-02726 1506 5C

The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 1506 5C

The Response of the Invertebrate Fauna to Organic Pollution in a Well Oxygenated Karst Stream Exemplified by the Pradnik Stream (South Poland),
W82-02751 1506 5C

The Distribution and Seasonal Fluctuations of Heterotrophic Bacteria and Coliform Bacteria in the Rivers and Estuaries in Osaka City, Japan (In Japanese),
W82-02774 1506 5A

Studies on the Acute Toxicity of Some Heavy Metals to an Indian Freshwater Pond Snail Viviparus Bengalensis L.,
W82-02789 1506 5C

Seasonal Change in Ciliate Populations in the Bottom Sediment of a Polluted River,
W82-02797 1506 5C

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 1506 5B

The Effect of Alpha-Hydroxybenzylmethanesulfonate on Photosynthesis and Excretion of Chlorella and Natural Phytoplankton in a Lake,
W82-02918 1506 5C

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 1506 5C

Origin and Chemical Composition of Androscoggin River Foam,
W82-02970 1506 5B

Alterations in the Frequency of Sister Chromatid Exchanges in Flatfish from Puget Sound, Washington, Following Experimental and Natural Exposure to Mutagenic Chemicals,
W82-02979 1506 5C

Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 1507 5C

Histopathological Changes in Two Estuarine Fishes Exposed to Crude Oil and Its Water-Soluble Fractions,
W82-03020 1507 5C

Detergent Builders and Water Quality - A Changing Scene,
W82-03093 1507 5C

A Model River Test to Describe the Various Impacts of Chemical Substances on Microbial Biocommunities,
W82-03147 1507 5C

Effects of Eutrophication on the Intertidal Ecology of Langstone Harbour, U.K. and Proposed Control Measures,
W82-03207 1507 5C

Effects of Pollution on Humic Substances,
W82-03253 1507 5C

Lemna (Duckweed) as an Indicator of Water Pollution. I. The Sensitivity of Lemna Paucicostata to Heavy Metals,
W82-03318 1507 5A

Effects of Some Representative Petroleum Refinery Effluent Compounds on Photosynthesis and Growth of Natural Marine Phytoplankton Assemblages: Part I--Cresols,
W82-03470 1508 5C

Neurochemical and Physiological Changes in a Teleost Fish Induced by Exposure to the Water Soluble Fraction of South Louisiana Crude Oil or Its Toxic Aromatic Components,
W82-03511 1508 5C

Production and Decomposition of Organic Matter and Bacterioplankton under Eutrophication Conditions,
W82-03575 1508 5C

Persistence of Dieldrin in Water and Channel Catfish from the Des Moines River, Iowa, 1971-73 and 1978,
W82-03590 1508 5B

A Simple, Rapid Bioassay for Detecting Effects of Pollutants on Bacteria,
W82-03604 1508 5C

An In Situ Study of Cadmium and Mercury Stress in the Plankton Community of Lake 382, Experimental Lakes Area, Northwestern Ontario,
W82-03612 1508 5C

Effect of Waters of Various Hardness on the Cardiovascular System. (O Vliyanii vod Raznoi Zhestkosti na Serdechno Sosudistuyu Sistemu),
W82-03699 1508 5C

Cadmium in an Aquatic Ecosystem,
W82-03724 1508 5A

An Epidemiological Study of Well-Water Nitrates in a Group of South West African/Namibian Infants,
W82-03831 1509 5C

Waterborne Disease in The United States and Canada.
W82-03892 1509 5C

The Utility of Diatom Analyses of Lake Sediments for Evaluating Acid Precipitation Effects on Dilute Lakes,
W82-03903 1509 5C

Impact of the 1979 Accident at Three Mile Island Nuclear Station on Recreational Fishing in the Susquehanna River,
W82-03962 1509 5C

Effect of Sediment Copper on the Distribution of Benthic Macroinvertebrates in the Keweenaw Waterway,
W82-04030 1509 5C

Attached Algae of the Lake Erie Shoreline Near Nanticoke Generating Station,
W82-04035 1509 5C

Perivitelline pH of Salmonide Eggs in Relation to Ambient pH,
W82-04064 1509 5C

A Fluoride Overfeed Incident at Harbor Springs, Michigan,
W82-04147 1509 5C

Waterborne Giardiasis--An Overview,
W82-04186 1509 5C

Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 1510 5B

When a Water Supply Went Bad.
W82-04357 1510 5C

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

Effect of Water Pollutants and Other Chemicals Upon the Activity of Lipase in Vitro,
W82-04462 1510 5C

The Restoration of Vegetation in Lakes in the Poda Locality near Burgas After Discharging of Biologically Purified Waste Waters (Vuzstanoviavane na Radtitelnata Pokrivka v Subiratelnite Ezera v Mestnosstta Poda Krai Burgas Sled Puskaneto na Biologichno Prechisteni Otpaduchni Vodi v Tiakh),
W82-04476 1510 5C

Cytogenetic Effects on the Eastern Mudminnow, Umbra Pygmaea, Exposed to Ethyl Methanesulfonate, Benzo(a)Pyrene, and River Water,
W82-04480 1510 5C

Seasonal Variations in Primary Production in Surface Waters of the Saguenay River (Variations Saisonnieres de la Production Primaire dans les eaux de Surface de la Riviere du Saguenay),
W82-04678 1510 5C

Pesticides in the Aquatic Environment,
W82-04727 1510 5C

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

Toxicities of Paraquat and Metribuzin (Sencor) Herbicides to the Freshwater Copepods, Eucyclops Agilis and Diaptomus Mississippiensis,
W82-04814 1511 5C

The Assessment of the Possible Inhibitory Effect of Dyestuffs on Aerobic Waste-Water Bacteria, Experience with a Screenint Test,
W82-04825 1511 5C

A One Year Study of the Seasonal Variations of sDDT and PCB Levels in Fish from Heated and Unheated Areas Near a Nuclear Power Plant.
W82-04836 1511 5C

Effect of Long Term Exposure to Petroleum on Mixed Function Oxygenases in Fish: Further Support for Use of the Enzyme System in Biological Monitoring,
W82-04884 1511 5C

Behavior of Organic Priority Pollutants in the Terrestrial System: Di-n-butyl Phthalate Ester, Toluene, and 2,4 Dinitrophenol,
W82-04965 1511 5B

Initial Microbiological Response in Lakes to the Mt St Helens Eruption,
W82-05125 1511 2H

Placer Mining and Salmon Spawning in American River Basin, California,
W82-05200 1511 8I

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

Changes in the Fatness of Roach (Rutilus Rutilus) Under the Influence of Warm Waste Water from a District Power Station,
W82-05330 1511 5C

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 1511 5C

Cholinesterase Activity in Estuarine Fishes in the Cumulation of DDT,
W82-05507 1511 5C

The Impact of Acidic Precipitation and Heavy Metals on Soils in Relation to Forest Ecosystems,
W82-05534 1511 5C

Evaluation of General and Specific Stress Indices in Mussels Collected from Populations Subjected to Different Levels of Heavy Metal Pollution,
W82-05983 1512 5C

Malignant Melanoma and Drinking Water Contamination,
W82-05989 1512 5C

Peripheral Effects of Cadmium on the Blood and Head Kidney in the Brown Bullhead (Ictalurus Nebulosus),
W82-06003 1512 5C

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

Influence of Salinity and Organic Nutrient Concentration on Survival and Growth of Vibrio Cholerae in Aquatic Microcosms,
W82-06534 1512 5C

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

Effects of Pollution on Freshwater Fish,
W82-06803 1512 5C

Effects of Pollution on Freshwater Invertebrates,
W82-06804 1512 5C

Marine and Estuarine Pollution,
W82-06808 1512 5C

Disease Outbreaks Caused by Drinking Water,
W82-06928 1512 5C

Effects of a Dam and Sewage Outflow on a Small Oligotrophic Stream in the Southern Appalachians,
W82-06966 1512 5C

WATER POLLUTION PREVENTION

Planning Study to Model and Monitor Coal Pile Run-Off,
W82-00091 1501 6A

Protecting Agriculture's Natural Resource Base,
W82-00176 1501 4D

Pulp Companies Face Billion Dollar Cleanup.
W82-00343 1501 5D

Rocky Mountain Pipeline Project: Environmental Impact Statement,
W82-00394 1501 5G

Water-Related Environmental Control Requirements of Waste-to-Energy Conversion,
W82-00443 1501 5D

Preliminary Risk Evaluation for Suspected Hazardous Waste Disposal Sites in Connecticut,
W82-01417 1503 5G

Surface Water Management at Hazardous Waste Sites,
W82-01429 1503 5G

Stabilization/Solidification of Waste from Uncontrolled Disposal Sites,
W82-01432 1503 5E

Remedial Action Controls Groundwater Contamination at a Paper Mill Sludge Disposal Site,
W82-01582 1503 5G

Protecting Virginia's Waterways,
W82-01608 1503 5G

Waste Disposal–Choosing and Licensing Site,
W82-02035 1504 5G

Environmental Control Technology Development for Geothermal Energy,
W82-02197 1505 5C

Managing Hazardous Wastes,
W82-02252 1505 5E

Sewage Outfall Location Reduces Environmental Damage in the Thames Estuary,
W82-02404 1505 5G

The Roman Way,
W82-02744 1506 5F

Liners of Natural Porous Materials to Minimize Pollutant Migration,
W82-03028 1507 5G

Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 1508 5G

Analysis of Waste Load Allocation Procedures,
W82-03550 1508 5G

Construction of Containment Facility for Dredged Materials Begins,
W82-03839 1509 5G

Risk Analysis in the Planning, Design and Operational Control of Water Pollution Prevention Schemes- A Perspective,
W82-03857 1509 5G

Groundwater Contaminants from Land Disposal of Residues: A Survey in The Province of Antwerp, Belgium,
W82-03911 1509 5B

Water Quality Trap Efficiency of Storm Water Management Basins,
W82-04248 1509 5G

Covering Bottom Sediments as a Lake Restoration Technique,
W82-04421 1510 5G

Covering Distribution Storage, Panel Discussion: State of the Art,
W82-04700 1510 6E

Automatic Control of the Discharge of Radioactive Subsubstances from Light Water Nuclear Power Plants of the Pressurized Water Reactor Type into Flowing Streams with Special Reference to the Unterweser Nuclear Power Plant,
W82-04839 1511 5E

Management System for Control of Process Losses and Spills in the Kraft Pulping Industry,
W82-04846 1511 5D

Performance of a Large Advanced Waste Treatment Plant,
W82-05251 1511 5D

Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 1512 5D

WATER POLLUTION SOURCES

Chemical Indicators of Organic River Sources in Rivers and Estuaries,
W82-00035 1501 5B

Water Pollution Potential of Coal-Slurry Pipelines,
W82-00096 1501 6A

Pollution From Land Runoff,
W82-00253 1501 5B

Development of Bioassay Procedures for Defining Pollution of Harbor Sediments,
W82-00387 1501 5C

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

Environmental Control Technology for the Flash Hydropyrolysis of Coal,
W82-00435 1501 5D

Comparative Study on Organic Constituents in Polluted and Unpolluted Inland Aquatic Environments - I. Features of Hydrocarbons for Polluted and Unpolluted Waters,
W82-00453 1501 5B

Aromatic Amines in and Near the Buffalo River,
W82-00622 1502 5B

Assessment of Airborne Organic Contaminants in the Great Lakes Ecosystem,
W82-00709 1502 5B

Assessment of Airborne Inorganic Contaminants in the Great Lakes,
W82-00710 1502 5B

Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 1502 5B

Marine and Estuarine Pollution,
W82-01274 1503 5C

Microbiology of Wastewater Treatment,
W82-01291 1503 5D

Predicting Stream Salinity Changes in South-Western Australia,
W82-01350 1503 6A

Enrichment Ratios for Water Quality Modeling,
W82-01410 1503 2J

Cadmium, Lead, Mercury, Arsenic, and Selenium Concentrations in Freshwater Fish, 1976-77-National Pesticide Monitoring Program,
W82-01584 1503 5B

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 1504 5B

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 1504 5B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 1504 5B

The Hazards of Hazardous Waste Management,
W82-01940 1504 6E

The Modeling of Aquatic Ecological Systems,
W82-01972 1504 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 1504 5C

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 1504 5B

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 1504 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 1504 5B

Poland: Coming to Grips with Pollution,
W82-02092 1504 5G

Major- and Trace-Element Composition of Suspended Matter in the North-East Gulf of Alaska: Relationships with Major Sources,
W82-02259 1505 5B

Increases in Sodium and Chloride in the Mohawk River, New York, from the 1950's to the 1970's Attributed to Road Salt,
W82-02262 1505 5B

Estuarine and Marine Coastal Pollution in the Republic of Ireland,
W82-02418 1505 5B

The Effects of Rapid Infiltration of Municipal Wastewater on Groundwater Quality,
W82-02537 1505 5B

Effects of Recreation on Water Quality in Guadalupe Mountains National Park,
W82-02821 1506 5B

Meteorological Interpretation of the Chemical Composition of Rain-Water at One Measuring Site,
W82-02874 1506 2K

An Analysis of the First Year of MAP3S Rain Chemistry Measurements,
W82-02934 1506 2K

Oxygen-Consuming Organics in Nonpoint Source Runoff,
W82-02966 1506 5B

Chemical Alkylation of Lead(II) Salts to Tetraalkyllead (IV) in Aqueous Solution,
W82-03171 1507 5B

A Finite Element Model for the Migration of Leachate from a Sanitary Landfill in Long Island, New York - Part II: Application,
W82-03220 1507 5B

Practical Techniques of River Monitoring and Pollution Forecasting, Part 1: Continuous Quality Monitoring and Data Acquisition,
W82-03390 1507 5A

Groundwater Monitoring Strategies to Support Community Management of On-Site Home Sewage Disposal Systems,
W82-03527 1508 5G

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Volume I; General.
W82-03624 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol II: Coke Making Subcategory, Sintering Subcategory, Iron Making Subcategory,
W82-03625 1508 5B

Development for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category Vol III: Steel Making Subcategory, Vacuum Degassing Subcategory, Continuous Casting Subcategory Continuous Casting Subcategory,
W82-03626 1508 5D

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol IV: Hot Forming Subcategory.
W82-03627 1508 5B

Development Document for Proposed Effluents Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol V: Scale Removal Subcategory, Acid Pickling Subcategory.
W82-03628 1508 5B

Development Document for Proposed Effluent Limitations Guidelines, New Source Performance Standards, and Pretreatment Standards for the Iron and Steel Manufacturing Point Source Category, Vol VI: Cold Forming Subcategory, Hot Coating Subcategory,
W82-03629 1508 5D

Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 1508 5F

Simulating Coal Pile Runoff as a Design Tool,
W82-03692 1508 5B

Mercury Clean-Up in Canada's Lake St. Clair: Only a Partial Success,
W82-03788 1509 5C

A Simulation of the Enrichment of Atmospheric Pollutants in Snow Cover Runoff,
W82-03838 1509 5B

Nitrogen and Carbon Solution Chemistry of an Old Growth Coniferous Forest Watershed Before and After Cutting,
W82-03843 1509 5B

A Survey of Radioactive Effluent Releases from Byproduct Material Facilities,
W82-03963 1509 5B

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

Transport of Polycyclic Aromatic Hydrocarbons through a Partly Urbanized River Basin,
W82-04191 1509 5B

Numerical Management Models of Groundwater Pollution,
W82-04211 1509 5B

A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 1510 5B

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

Responses of Northern New England Lakes to Atmospheric Inputs of Acids and Heavy Metals,
W82-04420 1510 5B

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 1510 5B

U.S. Geological Survey Research in Radioactive Waste Disposal--Fiscal Year 1979,
W82-04500 1510 5E

Survey of Selected Organic Compounds in Aquifers of New York State Excluding Long Island,
W82-04520 1510 5B

Some Effects of Land Use on Bacteriological Water Quality in a Recreational Lake,
W82-04567 1510 5B

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 1510 5A

Constituents of Highway Runoff; Volume I, State-of-the-Art Report,
W82-04627 1510 4C

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 1510 5A

Constituents of Highway Runoff; Volume III, Predictive Procedure for Determining Pollution Characteristics in Highway Runoff,
W82-04629 1510 5B

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 1510 5B

Constituents of Highway Runoff; Volume IV, Characteristics of Highway Runoff from Operating Highways. Research Report,
W82-04637 1510 5B

Experiences with Floating Reservoir Covers at the Manchester Water Works,
W82-04697 1510 5G

Acid Precipitation in Historical Perspective,
W82-04807 1511 5B

Biotransformation of N-Phenyl-Beta-Naphthylamine to Beta-Naphthylamine in a Laboratory Sludge System,
W82-04824 1511 5B

Water Quality in a Stream Receiving Dairy Feedlot Effluent,
W82-04860 1511 5B

Geothermal Power: Accidental Fluid Releases and Waste Disposal,
W82-04911 1511 5B

Upward Trend in Nitrate Concentrations in River Discharging into Lough Neagh for the Period 1969-1979,
W82-05017 1511 5B

India: Every River Polluted, and Few Effective Controls,
W82-05033 1511 5B

An Evaluation System to Rate Feedlot Pollution Potential,
W82-05207 1511 5B

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

Sulfur Bacterial Problems Revisted,
W82-05264 1511 5B

Metal Concentrations in Guam Urban Runoff,
W82-05302 1511 5B

Settleability of Urban Runoff Pollution,
W82-05320 1511 5G

Septic Leachate Surveys for Lakeside Sewer Needs Evaluation,
W82-05322 1511 5B

Radionuclides in Mono Lake, California,
W82-05461 1511 5B

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 1511 5B

Investigations into the Protective Effect of Estuarine Sediment on Virus Survival,
W82-05485 1511 5C

Copper Pollution Studies in Lakes George and Edward, Uganda: The Distribution of Cu, Cd and Fe in the Water and Sediments,
W82-05578 1511 5B

Ground-Water Contamination Due to Vanishing and Finite-Size Continuous Sources,
W82-05799 1511 5B

Soil Moisture Flow for Point and Line Sources - Computer Programs for Linearized Solutions,
W82-05928 1512 2G

The Oilspill Risk Analysis Model of the U.S. Geological Survey,
W82-06145 1512 5B

Polychlorinated Biphenyls (PCBS): An Australian Viewpoint on a Global Problem,
W82-06232 1512 5B

Geomorphic and Lithologic Controls of Diffuse-Source Salinity, Grand Valley, Western Colorado,
W82-06364 1512 2J

Metal Surveys in South African Estuaries: III. Hartenbos, Little Brak and Great Brak Rivers,
W82-06387 1512 5B

Metal Surveys in South African Estuaries: II. Knysna Estuary,
W82-06388 1512 2L

Hazardous Material Spills--Are You Ready,
W82-06417 1512 5G

Groundwater Pollution from Industrial Waste Disposal, A Case Study,
W82-06434 1512 5B

Nomographs for Rapid Solutions for the Streeter-Phelps Equations,
W82-06460 1512 5B

Impact of Coal Ash from Electric Power Production on Changes in Water Quality,
W82-06623 1512 5B

The Distribution of Heavy Metals in the Bottom Sediments of Three Streams in the Kansas City, Missouri, Metropolitan Area,
W82-06702 1512 5B

WATER POLLUTION TREATMENT

Process for Removal of Mercury and Mercury Compounds From Aqueous Solutions and Industrial Waste Liquors,
W82-00058 1501 5D

WATER POLLUTION TREATMENT

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 1501 5G

Underwater Aerator,
W82-00065 1501 5D

System for Oil and Water Separation,
W82-00611 1502 5D

Management of Ground Water Contaminated by Aromatic Hydrocarbons in the Aquifer Supplying Ames, Iowa,
W82-02611 1506 5B

Aquifer Decontamination for Volatile Organics: A Case History,
W82-02613 1506 5F

Performance Predictions for Removal of Toxic and Carcinogenic Compounds from Water Supplies by Adsorption,
W82-02729 1506 5D

Intraparticle Diffusivity of Methylene Blue into Porous Activated Carbon,
W82-03601 1508 5F

Poisons in the Hudson,
W82-05705 1511 5G

Apparatus for High-Efficient Microbiological Oxidation Treatment,
W82-06166 1512 5D

Apparatus for Cleaning Water Containing Foreign Particles Such as Suspended Matters or Oil,
W82-06699 1512 5D

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 1512 5G

WATER POLLUTON SOURCES
Gully Erosion,
W82-01407 1503 2J

WATER POTENTIAL
Practical Prediction of Actual Evapotranspiration,
W82-02308 1505 2D

WATER POTENTIALS
The Effect of Environmental Uncertainty on Morphological Design and Fluid Balance in Sarracenia Purpurea L.,
W82-00811 1502 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

Diurnal Variation in Water Potential Components and Stomatal Resistance of Irrigated Peach Seedlings,
W82-02202 1505 2I

The Evaluation of a Leaf-Water Potential Function for Corn,
W82-02226 1505 2I

Evapotranspiration and Leaf Water Status of Alfalfa Growing Under Advective Conditions,
W82-02295 1505 2D

Seasonal Patterns of Plant and Soil Water Potential on an Irregularly-Flooded Tidal Marsh,
W82-02340 1505 2I

Winter Water Relations of Red Spruce on Mount Monadnock, New Hampshire,
W82-02634 1506 2I

Stomatal Response to Environmental Variables in Two Tropical Forest Species During the Dry Season in Nigeria,
W82-02884 1506 2D

The Effect of Leaf Water Status on Stomatal Activity, Transpiration and Nitrate Reductase of Sweet Potato,
W82-03793 1509 2D

Comparison of Pressure Chamber and Psychrometer Estimates of Leaf Water Potential in Rice,
W82-04541 1510 2I

WATER PRESSURE
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 1504 7B

Uplift Pressure of Water on the Base of Hydraulic Structures in Limit Design States (Discussion of Construction Specifications),
W82-05582 1511 8A

WATER PROPERTIES
Characterization of Properties of Water,
W82-05540 1511 1A

Prospects of Using Magnetic Wastewater Treatment,
W82-06989 1512 5D

WATER PURIFICATION
Upflow Water Filtration Unit, Test Results,
W82-00407 1501 5F

Ozone Treatment of Potable Water - Part I,
W82-00451 1501 5F

The Removal of Organic Matter from Demineralised Water,
W82-00888 1502 5F

A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 1506 5F

Mixed Bed Technology for Polishing Make-up Water and Condensate Return: Conclusion,
W82-03774 1509 5D

WATER QUALITY
Mount St. Helens Volcanic-Ash Fall in the Bull Run Watershed, Oregon, March-June 1980,
W82-00002 1501 5B

Effects of Mount St. Helens Eruption on Selected Lakes in Washington,
W82-00006 1501 2H

Polychlorinated Biphenyl Transport in the Hudson River, New York,
W82-00008 1501 5B

Relationship of Water Quality of Hudson River, New York, During Peak Discharges to Geologic Characteristics of Contributing Subbasins,
W82-00009 1501 5B

Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 1501 5F

Water Resources Investigations in New York--1980.
W82-00011 1501 7C

Reconnaissance of the Effect of Landfill Leachate on the Water Quality of Marshall Brook, Southwest Harbor, Hancock County, Maine,
W82-00013 1501 5C

Ground-Water Data for Michigan, 1979,
W82-00014 1501 2F

Evaluation of the Malaga Bend Salinity Alleviation Project, Eddy County, New Mexico,
W82-00018 1501 5B

Selected Hydrologic Data, Arkansas River Basin, Pueblo and Southeastern Fremont Counties, Colorado, 1975-80,
W82-00020 1501 7C

Evaluation of Ground-Water Monitoring Network, Santa Cruz County, California,
W82-00023 1501 7A

Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

Water Quality Issues and Energy Assessments,
W82-00036 1501 6B

Conceptual Design of a Regional Water Quality Screening Model,
W82-00038 1501 6A

Assessment of 1978 Water Quality Conditions in the Upper Potomac Estuary,
W82-00052 1501 5C

Premining Hydrologic Conditions of Five Southeastern Ohio Watersheds,
W82-00054 1501 4C

Water Resources Data for New Hampshire and Vermont, Water Year 1980.
W82-00076 1501 7C

Water Resources Data for West Virginia, Water Year 1980.
W82-00077 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 1. Missouri River Basin.
W82-00078 1501 7C

Water Resources Data for Kansas, Water Year 1980--Volume 2. Arkansas River Basin.
W82-00079 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin, and Intervening Coastal Basins.
W82-00080 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-00081 1501 7C

Water Resources Data for Texas, Water Year 1979--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin, and Intervening Coastal Basin.
W82-00082 1501 7C

Quality of Water in Tibbee Creek and Tributaries Near West Point, Mississippi,
W82-00084 1501 5B

Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 1501 7C

Water-Resources Investigations of the U.S. Geological Survey in Colorado--Fiscal Year 1981.
W82-00088 1501 7C

Geologic, Hydrologic and Chemical Data From Test Wells in the Dickson Area, Tennessee,
W82-00090 1501 7C

Comparison of Nine Brands of Membrane Filter and the Most-Probable-Number Methods for Total Coliform Enumeration in Sewage-Contaminated Drinking Water,
W82-00203 1501 5A

Automation of Water Bacteriological Analysis: Running Test of an Experimental Prototype,
W82-00225 1501 5A

Impact of Construction of a Hydroelectric Project on the Water Quality of Five Lakes in Nova Scotia,
W82-00227 1501 5C

Projected Tile Effluent Effects on the Oldman River,
W82-00333 1501 5C

Human Use in a Dispersed Recreation Area and its Effect on Water Quality,
W82-00393 1501 5B

Garrett County Water-Well Records, Chemical-Quality Data Ground-Water Use, Coal Test-Hole Data and Surface-Water Data.
W82-00395 1501 2F

Water in the Elizabethtown Area - A Study of Limestone Terrane in North-Central Kentucky,
W82-00413 1501 5B

Hydrogeologic Data for Rocky Creek Landfill and Adjacent Area, Northwest Hillsborough County, Florida, 1969-73,
W82-00417 1501 5B

Radionuclide Concentrations in Streams in the Upper Blackfoot River Basin, Southeastern Idaho,
W82-00418 1501 5A

Hydrogeologic Data from Test Drilling near Verna Beach, Florida, 1978,
W82-00424 1501 2F

Effects of Surface Mining on Water Quality in a Small Watershed, Sullivan County, Indiana,
W82-00427 1501 5C

Preliminary Evaluation of Ground-Water Contamination by Coal-Tar Derivatives, St. Louis Park Area, Minnesota,
W82-00430 1501 5B

Diel Variations of Selected Physico-Chemical Parameters in Lake Kissimmee, Florida,
W82-00535 1502 2H

Phosphorus Management for the Great Lakes: Final Report of the Phosphorus Management Strategies Task Force,
W82-00702 1502 6E

Health Implications of Non-NTA Detergent Builders,
W82-00703 1502 5G

Ecological Effects of Non-Phosphate Detergent Builders: Final Report on Organic Builders other than NTA,
W82-00704 1502 5G

Report of the Aquatic Ecosystem Objectives Committee,
W82-00705 1502 5G

1980 Annual Report, Committee on the Assessment of Human Health Effects of Great Lakes Water Quality,
W82-00706 1502 5C

1980 Report on Great Lakes Water Quality - Appendix,
W82-00708 1502 5C

Summary Appraisal of Water Resources in the Redmond Quadrangle, Sanpete and Sevier Counties, Utah,
W82-00725 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 1. Illinois Except Illinois River Basin.
W82-00731 1502 7C

Water Resources Data for Illinois, Water Year 1980--Volume 2. Illinois River Basin.
W82-00732 1502 7C

Water Resources Data for Utah, Water Year 1980.
W82-00733 1502 7C

A Portable Pump Sampler for Lotic Periphyton,
W82-00826 1502 7B

Limnological Characteristics of Several Lakes on the Lake Wales Ridge, South-Central Florida,
W82-00914 1502 2H

Influence of Phosphorus Loads and of Some Limnological Processes on the Purity of Lake Water,
W82-00923 1502 2H

Macrobenthos of Pine Island Bayou in the Big Thicket National Preserve, Texas,
W82-00924 1502 5C

Effectiveness of River Models,
W82-00961 1502 6A

Giardia Prevalence in Commercially Trapped Mammals,
W82-01046 1502 5A

Water Chemistry Changes During Artificial Aeration of Spruce Knob Lake, West Virginia,
W82-01049 1502 5G

Changes in Soil Water Quality Resulting from Three Timber Cutting Methods and Three Levels of Fiber Utilization,
W82-01135 1503 2G

Transports in the Duluth-Superior Harbor,
W82-01136 1503 5B

Water Quality from Two Small Forested Watersheds in Southern Illinois,
W82-01140 1503 4C

Some Effects of Agricultural Land Use on Stream Insect Communities,
W82-01159 1503 5C

Biogeochemical Investigation of Big Creek Marsh, Lake Erie, Ontario,
W82-01163 1503 2H

Alterations in the BOD Procedure for the 15th Edition of 'Standard Methods for the Examination of Water and Wastewater',
W82-01186 1503 5A

Water Resources Data for Texas, Water Year 1980--Volume 1. Arkansas River Basin, Red River Basin, Sabine River Basin, Neches River Basin, Trinity River Basin and Intervening Coastal Basins.
W82-01201 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin and Intervening Coastal Basins.
W82-01202 1503 7C

Water Resources Data for Texas, Water Year 1980--Volume 3. Colorado River Basin, Lavaca River Basin, Guadalupe River Basin, Nueces River Basin, Rio Grande Basin and Intervening Coastal Basins.
W82-01203 1503 7C

Water Resources Data for California, Water Year 1980--Volume 1. Colorado River Basin, Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River.
W82-01204 1503 7C

Water Resources Data for California, Water Year 1980--Volume 2. Pacific Slope Basins from Arroyo Grande to Oregon State Line Except Central Valley.
W82-01205 1503 7C

Water Resources Data for California, Water Year 1980--Volume 3. Southern Central Valley Basins and the Great Basin from Walker River to Truckee River.
W82-01206 1503 7C

Water Resources Data for California, Water Year 1980--Volume 4. Northern Central Valley Basins and the Great Basin from Honey Lake Basin to Oregon State Line.
W82-01207 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 1. Hawaii.
W82-01208 1503 7C

Water Resources Data for Hawaii and Other Pacific Areas, Water Year 1980 - Volume 2. Trust Territory of the Pacific Islands, Guam, American Samoa, and Northern Mariana Islands.
W82-01209 1503 7C

Water Resources Data for South Carolina, Water Year 1980.
W82-01211 1503 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 2. Susquehanna and Potomac River Basins.
W82-01212 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 1. Hudson Bay Basin, Missouri River Basin.
W82-01213 1503 7C

Water Resources Data for Montana, Water Year 1980--Volume 2. Upper Columbia River Basin.
W82-01214 1503 7C

Water Resources Data for Florida, Water Year 1980--Volume 3A: Southwest Florida Surface Water.
W82-01215 1503 7C

Water Resources Data for Florida, Water Year 1980--Volume 3B: Southwest Florida Ground Water.
W82-01216 1503 7C

Water Resources Data for Colorado, Water Year 1980--Volume 2. Colorado River Basin Above Dolores River.
W82-01217 1503 7C

Continuous Monitoring, Automated Analysis, and Sampling Procedures,
W82-01240 1503 5A

Solid Wastes and Water Quality,
W82-01269 1503 5B

Microbiology of Water,
W82-01284 1503 5B

Analysis of National Water Pollution Control Policies 1. A National Network Model,
W82-01292 1503 6A

Factors Affecting the Chemistry of Precipitation and River Water in an Upland Catchment,
W82-01322 1503 2K

A Hydrobiological Survey of a Polluted Canal,
W82-01356 1503 5C

Periphyton Analysis for the Evaluation of Water Quality in Running Waters of Greece,
W82-01358 1503 5A

Comparative Limnology of Nine Lakes of Jammu and Kashmir Himalaya,
W82-01361 1503 2H

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

Diurnal, Depth-Wise, and Seasonal Changes of Physico-Chemical Factors in Sathiar Reservoir,
W82-01372 1503 2H

Estimation of Impervious-Area Washoff Parameters,
W82-01465 1503 4C

Hydrochemical Facies in a Tertiary Basin in the Milligan Canyon Area, Southwest Montana,
W82-01481 1503 2F

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 1503 6B

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 1503 5B

Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 1503 5A

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 1503 5G

Random Differential Equations in Water Quality Modeling,
W82-01688 1503 6A

Pollution Permits and Markets for Water Quality,
W82-01699 1503 6A

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 1503 5B

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 1503 6G

Organic Substances in Water,
W82-01783 1503 5A

Infectious Waterborne Diseases,
W82-01784 1503 5A

Microbiology of the Aquatic Environment,
W82-01786 1503 5C

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 1503 7C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 1503 5C

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 1504 2H

Water Quality and the Demand for Recreation,
W82-01942 1504 6D

Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 1504 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 1504 2K

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 1504 5A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 1504 5B

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 1504 5C

Assessment Methodologies for Freshwater Inflows to Chesapeake Bay,
W82-02118 1505 5B

Water Budget and Projected Water Quality in Proposed Man-Made Lakes Near Estuaries in the Marco Island Area, Florida,
W82-02122 1505 5B

Historical Overview of the Freshwater Inflow and Sewage Treatment Plant Discharges to the Potomac River Estuary with Resultant Nutrient and Water Quality Trends,
W82-02161 1505 5C

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

Effects of Lake Michigan Diversion on the Water Chemistry of the Illinois Waterway,
W82-02261 1505 6G

Continuous Simulation of Receiving Water Quality Transients,
W82-02271 1505 5B

The Patterned Mires of the Red Lake Peatland, Northern Minnesota: Vegetation, Water Chemistry, and Landforms,
W82-02300 1505 2H

Trophic Changes Without Changes in the External Nutrient Loading,
W82-02367 1505 2H

Denmark's State of the Environment,
W82-02401 1505 5B

Groundwater Quality in the Severn-Trent Region,
W82-02423 1505 5A

Waterborne Disease Is Prevalent in Egypt,
W82-02435 1505 5C

Impact of Suburban Residential Development on Water Resources in the Area of Winslow Township, Camden County, New Jersey,
W82-02461 1505 4C

Current Water-Resources Investigations of the U.S. Geological Survey in North Dakota--Fiscal Year 1981.
W82-02463 1505 7C

Simulation of an Aquifer Test on the Tesuque Pueblo Grant, New Mexico,
W82-02465 1505 2F

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

Stormwater Quality Processes for Three Land-Use Areas in Broward County, Florida,
W82-02469 1505 5B

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 1505 2K

Water Resources Data for Utah, Water Year 1979.
W82-02474 1505 7C

Water-Resources Investigations of the U.S. Geological Survey in Missouri--Fiscal Year 1981.
W82-02488 1505 7C

Water-Quality Reconnaissance of the Larkin Creek Watershed, Lee and St. Francis Counties, Arkansas,
W82-02489 1505 5A

Selected Hydrogeologic Data from the Judith Basin, Central Montana,
W82-02490 1505 7C

Water Resources Data for Florida, Water Year 1980--Volume 4. Northwest Florida.
W82-02493 1505 7C

Water Resources Data for Pennsylvania, Water Year 1980--Volume 3. Ohio River and St. Lawrence River Basins.
W82-02494 1505 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin.
W82-02495 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 1. Great Lakes and Souris-Red-Rainy River Basins.
W82-02496 1505 7C

Water Resources Data for Minnesota, Water Year 1980--Volume 2. Upper Mississippi and Missouri River Basins.
W82-02497 1505 7C

Water Resources Data for New Mexico, Water Year 1980.
W82-02498 1505 7C

Water Resources Data for Kentucky, Water Year 1979.
W82-02499 1505 7C

Hydrologic Reconnaissance of the Wasatch Plateau-Book Cliffs Coal-Fields Area, Utah,
W82-02500 1505 7C

Water Quality Data, Mackenzie River Basin 1960-1979.
W82-02506 1505 7C

Relationship Between Water Quality and the Community Structure of Epiphytic Diatoms in a Mississippi Bayou,
W82-02531 1505 6G

Water Quality of a Southeast Texas Stream,
W82-02570 1505 2K

Impact of Dredged Material Disposal upon Ground-Water Quality,
W82-02615 1506 5B

The Effects of Urbanization on Small Watersheds and Groundwater,
W82-02738 1506 5C

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 1506 5B

Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

Diel Oxygen Variations in the Rhode River Estuary, Maryland, 1970-1978,
W82-02841 1506 5B

Water Resources Data for Alaska, Water Year 1980.
W82-02845 1506 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 1506 7C

Water Resources Data for Mississippi, Water Year 1980.
W82-02847 1506 7C

Some Ecological Aspects of Lake Qarun, Fayoum, Egypt. Part I. Physico-Chemical Environment,
W82-02859 1506 2H

The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 1506 5A

The Cost of Quality,
W82-02881 1506 5F

Water Quality of the Proposed Norden Reservoir, Nebraska, and Its Implications for Fishery Management,
W82-02983 1506 6G

Recreational Water Quality and Health,
W82-02997 1506 5C

Water Quality and Mangrove Ecosystem Dynamics,
W82-03003 1507 5C

Water Quality Analyses of the Colorado River Corridor of Grand Canyon,
W82-03017 1507 5A

The Influence of Hydrodynamic Transport on Phytoplankton Dynamics in Homogeneous Lakes,
W82-03023 1507 2H

Epidemiological Studies of Otitis Externa: Repot of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers,
W82-03027 1507 5C

Methods of Discharge Compensation as an Aid to the Evaluation of Water Quality Trends,
W82-03056 1507 7B

Detergent Builders and Water Quality - A Changing Scene,
W82-03093 1507 5C

Canada Water Year Book 1979-1980, References.
W82-03097 1507 10C

The Canada Water Act, Annual Report 1980-1981.
W82-03098 1507 7C

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 1507 5G

1981 Report on Great Lakes Water Quality.
W82-03102 1507 5G

1981 Annual Report - Committee on the Assessment of Human Health Effects of Great Lakes Water Quality.
W82-03104 1507 5A

Full-Scale Evaluation of High Rate Screening Devices for Treatment of Sanitary Sewage By-Pass Flow,
W82-03110 1507 5D

Health Aspects of Water Desalination,
W82-03116 1507 3A

A Systems Model of Streamflow and Water Quality in the Bedford Ouse River System -- II. Water Quality Modelling.
W82-03243 1507 5B

New Thrust in the 1980s for U.S. Water-Quality Programs,
W82-03252 1507 5G

Contribution to High Altitude Limnology of the Himalayan System I. Limnology and Primary Productivity of the Plankton Community of Nilnag Lake, Kashmir,
W82-03314 1507 2H

Hydrochemical Balance of an Alpine Watershed in Southeast Alaska,
W82-03402 1508 2K

Will EPA's Nationwide Urban Runoff Study Achieve Useful Results,
W82-03424 1508 6E

Trihalomethanes in Drinking Water,
W82-03447 1508 5F

Water Quality and the EEC,
W82-03472 1508 6E

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 1508 5C

The Effect of Artificial Destratification on Physico-Chemical Parameters and Phytoplankton in Ham's Lake, Oklahoma,
W82-03510 1508 5G

Environmental Effects of Applying Feedlot Runoff to Grassland Plots by Sprinkler Irrigation,
W82-03528 1508 3C

Groundwater Quality in Visakhapatnam Basin, India,
W82-03552 1508 6D

Sulfur and Oxygen Isotopes as Tracers of the Origin of Sulfate in Lake Creteil (Southeast of Paris, France),
W82-03583 1508 2H

Natural Temporal Variations in the Chemistry of Shallow Groundwater, Athabasca Oil Sands Area, Alberta,
W82-03611 1508 2K

Microbiological Quality of Selected Recreational Waters,
W82-03636 1508 5A

Contiuous, Automated, and Low-Cost Monitoring of the Organic Content in Water,
W82-03658 1508 5A

Clean Water Act.
W82-03687 1508 6E

Effect of a Deep-Water Outfall from a Power-Plant Reservoir on Water Quality in the Lower Pool,
W82-03768 1509 5C

Evaluation of Four Concentration/Extraction Procedures on Waters and Effluents Collected for Use with the Salmonella Typhimurium Screening Procedure for Mutagens.
W82-03775 1509 5A

Discussion: Influence of Well Water Quality Variability on Sampling Decisions and Monitoring, By Harry I. Nightingale and William C. Bianchi,
W82-03779 1509 5G

Multi-Constituent Simulation and Optimization Models for Water Quality Management,
W82-03815 1509 5G

Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Information Management: A Role for Primacy Agencies in The 80S,
W82-03891 1509 10B

Inventory of Surface Water Resources of the Stillwater Creek Watershed and an Investigation into the Effect of Land Use on Water Quality,
W82-03948 1509 7B

Hydrologic Almanac of Florida,
W82-03974 1509 7C

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

Time-of-Travel Study in the Sebasticook River Basin, Maine,
W82-03982 1509 5B

Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho Emphasis: 1974-1978,
W82-03984 1509 5B

Preliminary Water-Quality Assessment of the Upper White River Near Indianapolis, Marion County, Indiana,
W82-03986 1509 6B

Water Resources Investigations in Mississippi 1980-81.
W82-03988 1509 7C

Report of the River Master of the Delaware River for the Period December 1, 1979 -- November 30, 1980,
W82-03989 1509 4A

Water Resources Data for West Virginia, Water Year 1979. Appendix - Coal Areas.
W82-03990 1509 7C

Results of Exploratory Drilling at Point Mackenzie, Alaska, 1981,
W82-03993 1509 2F

Water-Quality Reconnaissance of Harding Creek, Lawrence County, Arkansas,
W82-03995 1509 7C

Water Quality of the Tidal Potomac River and Estuary Hydrologic Data Report 1979 Water Year,
W82-03998 1509 2L

ISFETs-New Tools for Water Quality Monitoring,
W82-04059 1509 5A

Energy and Water Resources.
W82-04066 1509 6D

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 7. Effects of Livestock Grazing,
W82-04072 1509 5C

Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

Water Quality and Off-Flavor Problems in Commercial Channel Catfish Culture in West-Central Alabama,
W82-04087 1509 5C

Upgrading Water Treatment Plants: An Alternative to New Construction,
W82-04098 1509 5F

Bacterial Dynamics in a Water Supply Reservoir: A Case Study,
W82-04108 1509 5A

Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

Initial Degradation of Effluent Quality During Filtration,
W82-04134 1509 5F

Taste as an Indicator for Drinking Water Quality,
W82-04141 1509 5A

Aggressive Water: Assessing the Extent of the Problem,
W82-04144 1509 5F

The Geochemical Cycling of Hydrocarbons in Lake Jackson, Florida,
W82-04215 1509 5B

Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

Water Quality Trap Efficiency of Storm Water Management Basins,
W82-04248 1509 5G

Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 1510 6C

The Search for a Corrosion Index,
W82-04279 1510 5F

Evaluating Stream Standard Violations Using a Water Quality Data Base,
W82-04286 1510 5A

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

Acidic Precipitation: Considerations for an Air Quality Standard,
W82-04302 1510 5B

A Preliminary Pollution Survey of the Papenkuils River, Port Elizabeth,
W82-04346 1510 5B

Estimation of Accumulation Parameters for Urban Runoff Quality Modeling,
W82-04432 1510 5B

Ridge Regression Techniques Applied to Landsat Investigation of Water Quality in Lake Okeechobee,
W82-04440 1510 2H

Determination of Trace Inorganic Pollutants (Cu, Pb, Cd, Zn) in Waters by Differential Pulse Anodic Stripping Voltammetry at a Rotating Mercury Film Electrode (Dosage de Micropolluants Mineraux des eaux (Cu, Pb, Cd, Zn) par Voltamperometrie de Redissolution Anodique Impulsionnelle sur Electrode Tournante a Film de Mercure),
W82-04458 1510 5A

Analysis and Prediction of Water Movements and Water Quality in a Shallow River Impoundment. Application to Mississippi River Pool No 2,
W82-04482 1510 7B

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 1510 6D

Maps Showing Ground-Water Conditions in the Bill Williams Area, Mohave, Yavapai, and Yuma Counties, Arizona--1980,
W82-04488 1510 7C

Effects of Land Use on Surface-Water Quality in the East Everglades, Dade County, Florida,
W82-04491 1510 5C

Geohydrologic Reconnaissance of the Crofton Unit, Northeastern Nebraska,
W82-04498 1510 4B

Biota and Biological Principles of the Aquatic Environment.
W82-04499 1510 5C

Dissolved-Solids Concentrations of Ground Water in the Sacramento Valley, California,
W82-04502 1510 7C

Water Resources Data for Arkansas, Water Year 1980.
W82-04503 1510 7C

Hydrologic Reconnaissance of the Beluga, Peters Creek, and Healy Coal Areas, Alaska,
W82-04504 1510 7C

Water Resources Inventory of Connecticut, Part 7, Upper Connecticut River Basin,
W82-04505 1510 2E

Water-Resources Investigations of the U.S. Geological Survey in Kansas--Fiscal Year 1979 and 1980,
W82-04510 1510 7C

Water-Quality Data for Selected Stations in the East Everglades, Florida,
W82-04513 1510 7C

Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980,
W82-04515 1510 7C

Quality of Surface Water in the Coal-Mining Areas of Western Maryland and Adjacent Areas of Pennsylvania and West Virginia from April 1979 to June 1980,
W82-04516 1510 7C

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 1510 7C

Selected Hydrologic Relationships for Soldier Creek, Northeastern Kansas,
W82-04519 1510 2E

Water Resources Data for Pennsylvania, Water Year 1980--Volume 1. Delaware River Basin.
W82-04521 1510 7C

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 1510 7C

Water Resources Data for Louisiana, Water Year 1981--Volume 3. Coastal Louisiana.
W82-04523 1510 7C

An Annotated Key to the Identification of Commonly Occurring and Dominant Genera of Algae Observed in the Phytoplankton of the United States,
W82-04524 1510 5C

Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 1510 5F

Development of Improved Stormwater Quality Models,
W82-04559 1510 5B

Automatic Measuring Station for Continuous Monitoring of Rivers,
W82-04569 1510 5A

Water Quality Monitoring System in Niedersachsen - Application of Automatic Stations for Control and Monitoring of Water Quality,
W82-04575 1510 7B

Manual Groundwater Sampling device (Vorrichtung Zur Manuellen Wasserprobenentnahme Aus Grundwassermessstellen).
W82-04582 1510 7B

Utilization of Data from Automatic Water Quality Monitoring Stations in Finland,
W82-04585 1510 7B

The Unterweser Automatic Water Quality Measurement System,
W82-04588 1510 5A

Continuous Water Quality Monitoring System Using Telemetry in the City of Osaka,
W82-04590 1510 5A

Requirements for Continuous Automatic Water Quality Monitoring in the Thames Estuary,
W82-04591 1510 2L

A Data Acquisition System for Recording and Processing River Quality Monitoring Data,
W82-04592 1510 7A

Recent Developments in and Application of Automation and Monitoring in Water Mangement,
W82-04593 1510 7B

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 1510 5A

Evaluation of Water Quality Data Received by Automatic Control Stations at the Teltow-Canal in Berlin (West),
W82-04607 1510 5A

Constituents of Highway Runoff; Volume V, Highway Runoff Data Storage Program and Computer User's Manual,
W82-04630 1510 5B

An Interactive Data Management System for River Water Quality Data,
W82-04659 1510 10D

Water Quality Monitoring - Identification of Residence/Travelling Times from Hydrological and Water Quality Information,
W82-04663 1510 2E

Note, Water for Oil Shale: Framework for the Legal Issues,
W82-04681 1510 6E

Colloidal Organics,
W82-04689 1510 5F

Prescribed Fire: Effects on Water Quality and Forest Nutrient Cycle,
W82-04690 1510 4C

Massachusetts Water Supply Priorities,
W82-04698 1510 6D

An Integrated Water-Quality Index for Irrigation Use,
W82-04723 1510 5C

Comparison of Various Bacterial Indicators of Fecal Contamination of the Seine in the Paris Region (Comparison de Differents Indicateurs Bacteriens de Contamination Fecale sur la Seine en Region Parisienne),
W82-04763 1511 5A

Groundwater Monitoring,
W82-04809 1511 6E

Comparison of Trihalomethane Levels and Other Water Quality Parameters for Three Treatment Plants on the Ottawa River,
W82-04810 1511 5F

Uptake of Arsenic, Cadmium, Lead and Mercury from Polluted Waters by the Water Hyacinth Eichornia Crassipes,
W82-04936 1511 5B

Data Acquisition and Evaluation in Biological Monitoring Systems,
W82-04944 1511 5A

Hydrogeologic Data Collected from the Kissimmee Planning Area, South Florida Water Management District,
W82-04974 1511 7C

Hydrologic Monitoring in the Coal Fields of Central Utah, August 1978-September 1979,
W82-04976 1511 7A

Index to Water-Resources Data for Louisiana, Surface-Water Records, Water-Quality Records.
W82-04985 1511 7C

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 1511 2F

Viral Pollution Determination of Superficial Waters (River Water and Sea-Water) from the Urban Area of Barcelona (Spain),
W82-05014 1511 5A

Measurement of Effects of Carbaryl in Surface Water on Fecal Pollution Indicator Bacteria by Use of Plate Counts and Respirometry,
W82-05019 1511 5A

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

Problems of the Detection of Organic Trace Substances in Water (Zu Problemen des Nachweises Organischer Spurenstoffe im Wasser),
W82-05093 1511 5A

A Portable System for Measuring Water Temperature, Conductivity, Dissolved Oxygen, Light Attenuation and Depth of Sampling,
W82-05105 1511 7B

New In-Situ Techniques in Biomonitoring,
W82-05157 1511 5A

Direct Analytical Method for Aromatic Compounds in Water by Steam Carrier Gas Chromatography,
W82-05164 1511 5A

Microcomputer Water Quality Simulation Model,
W82-05191 1511 7B

Hydrologic Reconnaissance of the Southern Great Salt Lake Desert and Summary of the Hydrology of West-Central Utah,
W82-05221 1511 7C

Algal Conditions in the Caloosahatchee River (1975-79) Lake Okeechobee to Franklin Lock, Florida,
W82-05222 1511 5C

Quality of Ground Water in Routt County, Northwestern Colorado,
W82-05227 1511 2F

Chemical Character of Water in the Red River Alluvial Aquifer, Louisiana,
W82-05228 1511 7C

A Preliminary Appraisal of the Effects of Agriculture on Stream Quality in Southwest Georgia,
W82-05229 1511 5C

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

A Wind-Powered, Ground Water Monitoring Installation at a Radioactive Waste Management Site in Idaho,
W82-05233 1511 5B

Assessment of Water Quality in Streams Draining Coal-Producing Areas in Ohio,
W82-05234 1511 5B

Methane in Water Wells,
W82-05262 1511 5F

Sampling Frequency Optimization Using a Water Quality Index,
W82-05268 1511 5A

Water Quality Assessment for Agana Springs,
W82-05304 1511 5A

Automated Biomonitoring Applications in Remote Water Quality Surveillance and Time Rated Toxicological Assay,
W82-05305 1511 7B

Water Quality Planning in the Northeast and Midwest: The Section 208 Experience,
W82-05315 1511 6B

Random Differential Equations in River Water Quality Modeling,
W82-05343 1511 6A

Techniques of Trend Analysis for Monthly Water Quality Data,
W82-05344 1511 7C

State-of-the-Art of Modeling Surface Water Impoundments,
W82-05351 1511 2H

The Continuing Struggle of Waterborne Illness,
W82-05366 1511 5C

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 1511 5F

The Status of Groundwater Law in New York State,
W82-05400 1511 6E

Institutional Change - Water Quality Management,
W82-05401 1511 6E

The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 1511 2H

Planktonic Infusoria as Indicators of the Extent of Organic Pollution in Azerbaidzhanian Reservoirs,
W82-05454 1511 2H

Procedure for Calculating the Complex Rank Index of Water Quality,
W82-05457 1511 5A

Chemical Changes of Lakes Within the Mount St. Helens Blast Zone,
W82-05459 1511 5B

Geochemical Environments and the Geographical Distribution of Some Diseases in Sri Lanka,
W82-05463 1511 5C

The Impact of Fish Farming on Water Quality,
W82-05471 1511 5B

Filtering of Dissolved Oxygen Data in Stream Water Quality Analysis,
W82-05488 1511 5B

Factors to be Considered in Disposing Domestic Waste on Problem Sites and Appraisal of Water Quality in a Piedmont Setting,
W82-05536 1511 5D

Multiple Objective Planning of Land/Water Interface in Medium Size Cities: Application to West Lafayette, Indiana,
W82-05550 1511 4A

A Pragmatic Approach to Water Quality Microbiology in a Clean River Area,
W82-05575 1511 5A

Slash Burning Effects on Soil and Water Chemistry in Southeastern Alaska,
W82-05715 1511 4C

Ionic Composition of Ground Waters and Their Distribution in Karnal District (Haryana).
W82-05721 1511 5A

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 1511 5F

Physicochemistry of Water in the St. Lawrence Gulf and Estuary (Physico-Chimie des eaux du Golfe et de l' Estuaire Saint-Laurent),
W82-05763 1511 5B

Protecting the Source,
W82-05785 1511 5F

The Origin of High Iron Concentrations in Groundwater From the Triassic Aquifer in East Devon,
W82-05801 1511 2K

Effects of Waterhyacinth on the Physicochemistry of a South Georgia Pond,
W82-05809 1511 5C

Hydrology of Area 32, Eastern Region, Interior Coal Province, Indiana,
W82-05825 1511 7C

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

Chloride and Total Hardness Concentrations of Water From the Upper Part of the Floridan Aquifer in St. Johns County, Florida,
W82-05829 1511 7C

Hydrology of Area 3, Eastern Coal Province, Pennsylvania,
W82-05831 1511 7C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Hydrology of Area 18, Eastern Coal Province, Tennessee,
W82-05835 1511 7C

Summary of Available Data on Surface Water, State of Hawaii. Volume I: Island of Kauai,
W82-05836 1511 7C

Discharge Data at Water-Quality Monitoring Stations in Arkansas, 1980 Water Year,
W82-05841 1511 7C

Quality of Water in James Creek, Monroe County, Mississippi,
W82-05842 1511 5B

An Evaluation of the Effects of Acid Rain on Low Conductivity Headwater Streams in Pennsylvania,
W82-05843 1511 5B

Quality of Water and Time of Travel in Goodwater and Okatoma Creeks Near Magee, Mississippi,
W82-05845 1511 5B

Quality of Water and Time of Travel in Little Copiah Creek near Crystal Springs, Mississippi,
W82-05847 1511 5B

Statistical Analysis to Derive Improved Stormwater Quality Models,
W82-05857 1511 5B

Variability of Stream Water Quality in Some Land Management Systems in the Southern Kakioka Basin, Japan,
W82-06020 1512 5B

Water Quality and Hydrology in a Coastal Region of the Netherlands,
W82-06103 1512 5B

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 1512 7C

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

Water Resources of the Ochlockonee River Area, Northwest Florida,
W82-06132 1512 2A

Statistical Summaries of Streamflow and Water-Quality Data for Streams of Western North Dakota, 1977-80,
W82-06133 1512 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

Availability and Quality of Water from Underground Coal Mines in Johnson and Martin Counties, Kentucky,
W82-06136 1512 3B

Effects of Effluents from a Coal-Fired, Electric-Generating Powerplant on Local Ground Water Near Hayden, Colorado,
W82-06137 1512 5C

Selected Biological Characteristics of Streams in the Southeastern Uinta Basin, Utah and Colorado,
W82-06140 1512 7C

Water Resources Data for Oregon, Water Year 1980--Volume 2. Western Oregon.
W82-06143 1512 7C

San Juan River Basin,
W82-06144 1512 7C

Effects of Urbanization on Stream Ecosystems,
W82-06165 1512 5C

The Use of Water Quality Objectives in Seine-Normandie,
W82-06254 1512 5G

Some Effects of Shoreline Cottage Development on Lake Bacteriological Water Quality,
W82-06310 1512 5B

Some Effects of Pulp and Paper Wastewater on Microbiological Water Quality of a River,
W82-06315 1512 5C

Optimizing the Evaluation of Lake Water Quality Through Analysis of Existing Remotely Sensed Data,
W82-06370 1512 7C

Destratification of Lakes and Reservoirs to Improve Water Quality,
W82-06385 1512 5G

Models of Annual Cycles in Lentic Water Bodies,
W82-06483 1512 5G

Relationship of Wrter Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 1512 5B

The Practical Handling of Water Quality Monitoring Data,
W82-06591 1512 7C

New Problems with Upland Waters,
W82-06602 1512 5G

The Role of Elemental Oxygen Demand in Total Oxygen Demand for Water Pollutants,
W82-06611 1512 5D

Mathematical Models for Calculating the Dynamics and Quality of Complex Water Systems,
W82-06613 1512 2A

Using Differences Among Carlson's Trophic State Index Values in Regional Water Quality Assessment,
W82-06625 1512 2H

The Mathematical Modelling of Water Quality with Particular Reference to the Industrial Rivers of Yorkshire,
W82-06644 1512 5G

Water Resources Data for Tennessee, Water Year 1980.
W82-06670 1512 7C

Water-Resources Investigations of the U. S. Geological Survey in Arkansas--Fiscal year 1981.
W82-06673 1512 7C

Water Resources Data, Louisiana, Water Year 1981--Volume 1. Central and Northern Louisiana.
W82-06674 1512 7C

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 1512 2E

Areal Extent of a Plume of Mineralized Water from a Flowing Artesian Well in Dade County, Florida,
W82-06680 1512 5B

Flow Characteristics and Water-Quality Conditions in the Spokane River, Coeur d'Alene Lake to Post Falls Dam, Northern Idaho,
W82-06681 1512 5B

Assessment of Water Quality in Canals of Eastern Broward County, Florida, 1969-74,
W82-06682 1512 5A

Organic Solutes in Ground Water at the Idaho National Engineering Laboratory,
W82-06688 1512 7C

Evaluation of a Predictive Ground-Water Solute-Transport Model at the Idaho National Engineering Laboratory, Idaho,
W82-06689 1512 5B

Water Quality of Alimagnet, Farquar, and Long Lakes in Apple Valley, Minnesota,
W82-06690 1512 2H

Hydrologic and Chemical Evaluation of the Ground-Water Resources of Northwest Elkhart County, Indiana,
W82-06691 1512 5B

Field Study of Organic Water Quality Changes during Groundwater Recharge in the Palo Alto Baylands,
W82-06831 1512 5B

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

Microbiological Examination of Sebeel Water,
W82-06882 1512 5C

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

Water Resources Data for Alabama, Water Year 1980--Volume 1. Apalachicola, Choctawatchee, Blackwater, Escambia, Perdido, and Alabama River Basins,
W82-06953 1512 7C

Water Resources Data for Alabama, Water Year 1980--Volume 2. Tombigbee, Mobile, Dog, Pascaguoula, and Tennessee River Basins,
W82-06954 1512 7C

Water Resources Data for Florida, Water Year 1980--Volume 2A. South Florida Surface Water,
W82-06955 1512 7C

Water Resources Data for Florida, Water Year 1980--Volume 2B. South Florida Ground Water,
W82-06956 1512 7C

Water Resources Data for Oregon, Water Year 1980--Volume 1. Eastern Oregon.
W82-06957 1512 7C

WATER QUALITY ASSOCIATION

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 1502 10D

WATER QUALITY CONTROL

Quarterly Progress Report, Nationwide Urban Runoff Program.
W82-00044 1501 5G

Means and Method for Sweeping Material Floating on Water Using Vibrational Energy,
W82-00062 1501 5G

Process for Removing Alkalinity and Hardness From Waters,
W82-00063 1501 5F

European Communities Directive Relating to the Quality of Water Intended for Human Consumption,
W82-00506 1502 6D

Does Improved Waste Treatment Have Demonstrable Biological Benefits,
W82-00779 1502 5C

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 1502 10D

Water Quality Management in River Basins: US National Experience,
W82-00800 1502 6E

Water Movement for Water Quality in Catfish Production,
W82-00866 1502 5G

Water Quality Evaluation of Regional Wastewater Management,
W82-00977 1502 5D

State of Washington Water Quality Assessment Report 1980.
W82-01067 1502 6E

An Intangible Benefit of Water Pollution Control Programs,
W82-01092 1502 6B

Remedial Options for Ground Water Protection at Abandoned Solid Waste Disposal Facilities,
W82-01426 1503 5G

Protecting Virginia's Waterways,
W82-01608 1503 5G

Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 1503 6F

A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 1503 5G

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 1503 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 1503 5F

Upland Marsh for Water Quality Control,
W82-01962 1504 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Pollues' Avenir en Danger Dans le Cas du Rhin),
W82-02067 1504 5G

An Estimation of the Reaeration Coefficient in Natural Streams by Spectral Analysis of Time Series Data,
W82-02458 1505 5G

Water Law, Water Conservation and the Development of Energy Resources in the Coastal, Offshore and Flood Plain Areas of Alabama,
W82-02535 1505 5G

The Physico-Chemical and Planktonic Response of an Algicide-Treated Shallow Mountain Lake in Arizona,
W82-02571 1505 5G

Salinity Forum: What. How. Why,
W82-02587 1505 6E

Guidelines for Control of Septic Tank Systems,
W82-02599 1505 5B

Cropland, Buffer, and Stream: A Case Study in Agricultural Nonpoint Source Water Pollution,
W82-02728 1506 5G

The Agricultural Impact of Water Quality Standards: A Mathematical Programming Approach,
W82-03014 1507 5G

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 1507 5G

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 1507 5G

Parametric Model and Optimal Prediction of the Average Salinity of the Azov Sea,
W82-03154 1507 5G

A Large International River: The Danube,
W82-03369 1507 5G

The River Rhine–Trans-National River Basin Management Developing Programme to Meet New Challenges,
W82-03372 1507 5G

A Control Model for Phosphorus Loading Reduction Under Uncertainty,
W82-03421 1508 5G

An Organics Detection System for the Ohio River,
W82-03436 1508 5A

U. N. Launches International Water Decade; U. S. Role Uncertain,
W82-03449 1508 5G

Costel V. Pacific Legal Foundation, 100 S. Ct. 1095 (1980),
W82-03495 1508 6E

Optimizing Salinity Control Strategies for the Upper Colorado River Basin,
W82-03518 1508 6B

Professional Development for Water Quality Control Personnel,
W82-03531 1508 9A

Effects of a Barrage on Flushing and Water Quality in the Fitzroy River Estuary, Queensland,
W82-03705 1508 4A

An Economic Approach to Ground Water Quality Management,
W82-03732 1508 5G

Comments on a National Ground-Water Protection Strategy,
W82-03740 1508 6F

Flow-Augmentation and Water Quality in Paraiba Do Sul River Basin-Brazil,
W82-03744 1508 5G

Water Quality Management Using the Hazard Assessment Approach,
W82-03823 1509 5G

Procedure for Evaluating the Geologic Integrity of Existing Hazardous Waste Sites in Louisiana: Case Histories,
W82-03932 1509 5A

Ground Water Protection by Recharge Zone Management: Institutional Arrangements,
W82-03951 1509 5G

Laboratory Technique for Measurement of pH for Corrosion Control Studies and Water Not in Equilibrium with the Atmosphere,
W82-04101 1509 5G

Reservoir Improvements as a Key to Source Quality Control,
W82-04145 1509 5G

Optimal Control of Reservoir Discharge Quality Through Selective Withdrawal,
W82-04204 1509 5G

Lake Level Drawdown as a Macrophyte Control Technique,
W82-04235 1509 4A

Effectiveness of Dupont Typar Sheeting in Controlling Macrophyte Regrowth After Overwinter Drawdown,
W82-04246 1509 5G

Analytical Quality Control,
W82-04345 1510 5G

Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

Aeration Characteristics of Flow Release Controls on Illinois Waterway Dams,
W82-04388 1510 5G

Modeled Impacts of Surface Coal Mining on Dissolved Solids in the Tongue River, Southeastern Montana,
W82-04494 1510 5G

Application of the Area of Review Concept,
W82-04674 1510 6E

Hypolimnion Oxygenation Studies in Clark Hill Lake,
W82-05001 1511 5G

Possibilities of Optimizing Processes Forming the Quality of Natural Water,
W82-05115 1511 5G

The River Tame–A Short History of Water Pollution and Control Within an Industrial River Basin,
W82-05242 1511 5C

Water Research in Action.
W82-05292 1511 6B

Groundwater Pollution Investigations in the Great Ouse Basin,
W82-05475 1511 5B

The Colorado River Salinity Problem,
W82-05889 1511 5G

International Problems on the Colorado River,
W82-05892 1511 5G

Developing an ATP Index for Degradation of Drinking Water Quality by Attached Microbes,
W82-05932 1512 5F

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

Biocleaning with Aquatic Weeds: A Means of Removing Asbestiform Fibers from Water,
W82-06363 1512 5F

Evaluation of the 'Lectro Clear Z' Electro-Coagulation Process for Meat Packing Wastewater Treatment.
W82-06378 1512 5D

Eutrophication of Waters: Monitoring, Assessment and Control.
W82-06383 1512 5C

Thermodynamic Controls on Quality of Water from Underground Coal Mines in Colorado,
W82-06624 1512 5G

The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 1512 5G

WATER QUALITY CONTROL. *WATER POLLUTION PREVENTION
Recent Developments in the Field of Eutrophication Prevention,
W82-06299 1512 5C

WATER QUALITY CRITERIA
Water Quality Management Using the Hazard Assessment Approach,
W82-03823 1509 5G

WATER QUALITY DATA
Zooplankton and Their Relationships with Water Quality and Fisheries,
W82-06472 1512 2H

WATER QUALITY INDICES
Water Quality Indices: An Additional Management Tool,
W82-01994 1504 5G

WATER QUALITY MANAGEMENT
WQM Five Year Strategy (FY 81-Baseline).
W82-00045 1501 5G

Water Quality Management Studies, Lake Seminole, April-November 1978.
W82-00051 1501 6G

Potential Management of Florida Red Tide Through Selective Photodynamic Action,
W82-00515 1502 5G

A Procedure Using Modeling and Error Analysis for the Prediction of Lake Phosphorus Concentration from Land Use Information,
W82-00546 1502 5G

Modeling the Transformation of Nitrogen Compounds for Water-Quality Management in Streams,
W82-00598 1502 6A

Great Lakes International Surveillance Plan,
W82-00701 1502 6E

Dryland Management for Salinity Control,
W82-01018 1502 2G

State of Washington Water Quality Assessment Report 1980.
W82-01067 1502 6E

Water Quality Conditions in the Bellingham Bay Area 1979-1980,
W82-01068 1502 5B

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 1504 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 1504 5G

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol I - Technical Report, Part I - Institutional Barriers,
W82-02101 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast - Vol II - Technical Report, Part II - Issues, Problems, and Data,
W82-02102 1505 6E

Institutional Barriers to Water Quality Planning and Management in the Southeast, Vol III - Annotated Bibliography,
W82-02103 1505 10C

Hypolimnetic Aeration of a Small Eutrophic Kettle Lake: Physical and Chemical Changes,
W82-02341 1505 5G

The Use of Mathematical Modelling as a Decision-Making Tool in the Water Authorities of England and Wales for Water-Quality Management,
W82-02424 1505 6A

The Roman Way,
W82-02744 1506 5F

South Australia's Approach to Salinity Management in the River Murray,
W82-02761 1506 5G

Effects of Whole Lake Mixing on Water Quality and Phytoplankton,
W82-02823 1506 5G

Unsteady Water Quality Model for River Network,
W82-02873 1506 5G

Comparison of Statistical Phosphorus-Retention Models,
W82-02930 1506 5G

The Development of Water Quality Management Plans Using Data from Automatic Stormwater Monitoring Networks,
W82-03069 1507 5G

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 1507 5G

1981 Report on Great Lakes Water Quality.
W82-03102 1507 5G

River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

The Evolution of Water Quality Management,
W82-03476 1508 6E

Groundwater Quality Improvement Through Nonlinear Diffusion,
W82-03652 1508 5G

Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 1508 5D

Discussion: A Multiobjective Model for Regional Water Quality Management, by B. N. Lohani and Pakhorn Adulbhan,
W82-03785 1509 5G

Water Quality Management Using the Hazard Assessment Approach,
W82-03823 1509 5G

Risk Analysis in the Planning, Design and Operational Control of Water Pollution Prevention Schemes- A Perspective,
W82-03857 1509 5G

Water Quality Monitoring,
W82-03897 1509 5G

The Wisconsin Soil and Water Conservation District as an Institution to Undertake Subwatershed Planning to Control Non-Point Source Water Pollution,
W82-04212 1509 6A

Eutrophication Measures for Small Lake Water Quality Management,
W82-04243 1509 2H

A Stress Function for Evaluating Strategies for Water Quality Management,
W82-04407 1510 5C

New Developments in Automated Biosensing from Remote Water Quality Stations and Satellite Data Retrieval for Resources Management,
W82-04800 1511 7B

Optimal Dynamic Management of Groundwater Pollutant Sources,
W82-05345 1511 5G

The Shubenacadie-Stewiacke River Basin Study,
W82-05385 1511 6B

New Trends in Water Quality Management,
W82-05429 1511 5G

Institutional Problems of Water Quality Planning in Urbanizing Areas in the Pacific Northwest,
W82-05554 1511 6B

A Land Resource Information System (LRIS) for Water Quality Management in the Lake Erie Basin,
W82-05662 1511 7B

Water Quality Management in British Columbia,
W82-05767 1511 5C

Problems and Processes in Water Quality Management,
W82-06147 1512 5G

Rutland Water Raw Water Quality - Problems and Management,
W82-06475 1512 5G

Fact Finding Hearing - Cottonwood Creek Instream Beneficial Use Program,
W82-06522 1512 6B

The Control of Effluent and Water Quality in an Important Water Supply Catchment,
W82-06652 1512 5G

Systems Analysis,
W82-06997 1512 5G

Economics,
W82-06998 1512 5G

WATER QUALITY SAMPLING
Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

WATER QUALITY STANDARDS
Water Regulations,
W82-00482 1501 6E

Preliminary Pollutant Limit Values for Human Health Effects,
W82-00628 1502 5G

Great Lakes International Surveillance Plan,
W82-00701 1502 6E

Assessment of Water Quality Conditions in Skamokawa Creek, Washington,
W82-01066 1502 5C

State of Washington Water Quality Assessment Report 1980.
W82-01067 1502 6E

Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 1504 6E

Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 1505 6E

Compliance Strategy for Clean Water.
W82-02185 1505 6E

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Industrial Pretreatment Needs to Be Overhauled at the National Level.
W82-02198 1505 5D

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 1505 5A

Evaluation of Water Quality During Herbicide Applications to Kerr Lake, OK,
W82-02327 1505 5B

An Assessment of Current Standards for Selenium in Drinking Water,
W82-02372 1505 6F

1981 Report on Great Lakes Water Quality, Appendix Great Lakes Surveillance.
W82-03101 1507 5G

1981 Report on Great Lakes Water Quality.
W82-03102 1507 5G

Toxic Substances Control Programs in the Great Lakes Basin.
W82-03103 1507 5G

Report of the Aquatic Ecosystem Objectives Committee.
W82-03105 1507 5G

Clean Water Act.
W82-03688 1508 6E

Development of Health Effects Criteria for Freshwater Bathing Beaches by Use of Microbial Indicators,
W82-03730 1508 5A

Intensive Survey of the Sabine-Neches Canal - Segment 0703,
W82-04078 1509 5A

Water Management in Ontario,
W82-04259 1510 6E

Water Treatment at Homestake's Bulldog Mountain Operation,
W82-04311 1510 5D

Reversing Water Pollution Standards in an Uncertain World,
W82-04540 1510 6B

Experiences with EEC Guideline 75/440 on the Quality of Surface Waters for Drinking Water Production in the Member States (Erfahrungen mit der EG Richtlinie 75/440 Uber die Qualitat von Oberflachenwasser fur die Trinkwassergewinnung in den Mitgliedstaaten).
W82-04547 1510 6E

A Preliminary Assessment of Michigan's Phosphorus Detergent Ban,
W82-04786 1511 5G

Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents,
W82-04788 1511 5G

Geochemical Analysis of the State Drinking Water Standard Gost 2874-73 and Ways to Improve It,
W82-05025 1511 5D

Metal Concentrations in Guam Urban Runoff,
W82-05302 1511 5B

Impact of Discharges as a Basis for Control Measures,
W82-05354 1511 5B

Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

The Cost and Effectiveness of Public Notification of MCL Violations,
W82-05669 1511 5G

A Consistent Methodology for Wasteload Allocations,
W82-05702 1511 5G

Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies,
W82-06098 1512 5F

Economic Impact Analysis of Combined Sewer Overflow Regulations on East St. Louis, R81-12
W82-06099 1512 5G

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

United States V. Ward: FWPCA Civil Penalty Prosecution, Not a Criminal Case for the Fifth Amendment,
W82-06181 1512 6E

Pretreatment Removal Credits: Fact or Fiction,
W82-06207 1512 5G

Technical Control of Sewage Sludge Disposal to Sea,
W82-06291 1512 5E

Calculating Consent Conditions to Achieve River Quality Objectives,
W82-06725 1512 5G

Environmental Significance of Pesticide Residues Associated with Aquatic Sediments,
W82-06789 1512 5C

WATER QUANTITY
Water System Design Meets Modern Challenges,
W82-05170 1511 5F

WATER RATES
Price Elasticities for Water: A Case of Increasing Block Rates,
W82-00536 1502 6C

Charging for Water Supply in England and Wales in the 1980s,
W82-01722 1503 6C

Rate Structures and Demand Reduction,
W82-02517 1505 6C

Metering Problems and Meter Management in Tunisia (Les Problemes Du Comptage et la Gestion des Compteurs en Tunisie),
W82-03456 1508 6C

Marginal Cost and Seasonal Pricing of Water Service,
W82-04273 1510 6C

Third-Degree Price Discrimination and Regulation in the Municipal Water Industry,
W82-04747 1510 6C

Estimation of Substitution Possibilities Between Water and Other Production Inputs,
W82-04889 1511 6C

Current Trends in Cost of Service Studies,
W82-05806 1511 6C

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use,
W82-06155 1512 3D

Water Rate Studies and Rate Making Philosophy,
W82-06222 1512 6C

Cost-Based Water Rate Design,
W82-06277 1512 6C

WATER RECLAMATION
Massive Cultivation of Microalgae: Results and Prospects,
W82-00913 1502 5D

The Fate of Organic Micropollutants Through an Integrated Wastewater Treatment Water Reclamation System,
W82-03364 1507 5D

Wastewater Technologies in South Africa: Research and Application,
W82-05350 1511 5D

WATER RECOVERY
Growth of the Bay Scallop, Argopecten Irradians, in a Waste Recycling Aquaculture System,
W82-00842 1502 3C

WATER RENOVATION
Water Reclamation and Reuse,
W82-01252 1503 3C

WATER REQUIREMENT
Municipal and Industrial Water Demands of Western U.S.,
W82-06463 1512 6D

WATER REQUIREMENTS
Temperature and Water Relation Patterns in Subalpine Understory Plants,
W82-00760 1502 2I

Comparative Field Water Relations of Four Co-Occuring Chaparral Shrub Species,
W82-00762 1502 2I

Water Requirement for Sugarcane Production,
W82-00899 1502 3F

A Parametric Crop Water Use Model,
W82-01310 1503 2I

Water Requirements and Man-Induced Climate Change,
W82-01633 1503 2D

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 1504 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 1504 3F

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 1504 5A

Quantification of Rainfall and Its Utilization Efficiency in Rajasthan,
W82-03276 1507 2B

Will Synfuel Development Drain the West Dry,
W82-03292 1507 6D

Water Requirements of Urban Plants,
W82-03972 1509 3D

Water Requirements for Industrial Development,
W82-04117 1509 6D

Water Constraints on Emerging Energy Production,
W82-04151 1509 6D

Use of Modified Blaney and Criddle Formula for Estimating Water Requirements,
W82-04667 1510 2D

A Prediction Equation for Day Night Wind Ratio Correction on Reference Crop Evapotranspiration,
W82-05722 1511 2D

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

WATER RESOURCE DEVELOPMENT
Management of Freshwater Inflow to Estuaries: A Lawyer's Perspective,
W82-02111 1505 6E

Five-Year Plan of the Water Resources Research Center,
W82-05526 1511 6B

WATER RESOURCES
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 1503 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 1503 6A

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

WATER RESOURCES

Access to Water-Related Data in Texas,
W82-04000 1509 10B

WATER RESOURCES DEVELOPMENT

Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

A 10-Year Plan to Study the Aquifer System of Indian Wells Valley, California,
W82-00086 1501 6D

Water Resources Appraisal for Hydroelectric Licensing: Skagit River Basin, Washington.
W82-00368 1501 6D

Water Resources Appraisal for Hydroelectric Licensing: Lewis River Basin, Washington.
W82-00370 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Elwha River Basin, Washington.
W82-00371 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Little Tennessee River Basin, Tennessee, North Carolina, and Georgia.
W82-00372 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Pit River Basin, California.
W82-00373 1501 6B

Water Resources Appraisal for Hydroelectric Licensing: Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington.
W82-00374 1501 6B

Evaluation of the Oldman River Basin Irrigation Proposals: Implications for Interbasin Transfers,
W82-00519 1502 6B

The Caspian Sea Problem,
W82-00657 1502 4A

Richards Bay: An Ecological Dilemma,
W82-00679 1502 6A

Environmental Aspects of Rural Development with Particular Reference to the Keiskamma River Basin Study,
W82-00685 1502 6D

Arkansas Water Policy.
W82-00715 1502 6D

Water Resources Appraisal for Hydroelectric Licensing: Jordan River Basin, Utah.
W82-00736 1502 6D

Game Theory Analyses Applied to Water Resource Problems,
W82-00802 1502 6A

Tampa Bay Water Guarded by Computer,
W82-00934 1502 4B

Great Lakes Environmental Protection Policies from a Fisheries Perspective,
W82-00978 1502 6G

Computer Modeling of Los Angeles Water Resources,
W82-01168 1503 6A

Study of a Complex Water Resources System with Screening and Simulation Models,
W82-01309 1503 6A

Rural Water Supply and Related Services in Developing Countries-Comparative Analysis of Several Approaches,
W82-01330 1503 6A

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

Water Resources Appraisals for Hydroelectric Licensing; Brazos River Basin, Texas-New Mexico.
W82-01439 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Savannah and Edisto River Basins Area; Georgia-South Carolina-North Carolina.
W82-01440 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; American River Basin, California.
W82-01441 1503 6D

Methods for Generating Alternative Solutions to Water Resources Planning Problems,
W82-01449 1503 6A

Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

Discussion-Engineering Geology of Arid Areas,
W82-01568 1503 4B

Hydropower--An Old Technology for a New Era,
W82-01593 1503 4A

A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01580 1503 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 1503 6A

Remote Sensing in Development,
W82-01719 1503 7B

Impressions of Soil and Water Conservation in China,
W82-01730 1503 4D

Sustaining the Growth of Provence.
W82-01738 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 1504 6D

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 1504 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 1504 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 1504 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 1503 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 1503 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 1503 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 1503 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 1503 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 1503 6D

Effects of Alterations of Freshwater Inflows into Matagorda Bay, Texas,
W82-02149 1505 6G

Overview of Freshwater Inflow Depletions,
W82-02152 1505 6D

Characterization of Freshwater Inflow Modification to Estuaries Resulting from River Basin Development,
W82-02162 1505 6G

Hydropower: Untapped Resource and Environmental Hazard,
W82-02277 1505 5C

Do State Water Anti-Exportation Statutes Violate the Commerce Clause. Or Will New Mexico's Embargo Law Hold Water,
W82-02279 1505 6E

Emphasis on Distribution: Strategies for Small Scale Water Resources Development in Thailand,
W82-02408 1505 6A

New Developments in Water Resources Management for Local Governments and Industries,
W82-02522 1505 6E

Optimal Stream-Aquifer Development,
W82-02575 1505 6A

The Combination of Input-Output Analysis and Linear Programming for Water Resource Management: An Application to Northwest Iowa,
W82-02734 1506 6A

An Economic Analysis of Water Resources Development in Deltaic Regions of Asia: The Case of Central Thailand,
W82-02735 1506 6D

Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems,
W82-02737 1506 6A

The Evolution of a Regional Approach to Salinity Management in Western Australia,
W82-02763 1506 4D

Water for Industry,
W82-02767 1506 6D

Argentina's Hydroelectric-Based Energy Plan,
W82-02794 1506 8A

Environmental Implications and Assessments of Hydroelectric Projects,
W82-02896 1506 6G

Digest of Water Resources Policies and Authorities.
W82-02973 1506 6E

West Sacramento Canal Unit Reformulation.
W82-02974 1506 6B

Water Resources Appraisals for Hydroelectric Licensing: Alaska River Basins, Alaska.
W82-02975 1506 6D

Water Resources Appraisal for Hydroelectric Licensing; Pigeon River Basin; North Carolina, Tennessee,
W82-03039 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Cape Fear River Basin; North Carolina - South Carolina,
W82-03040 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Merrimack River Basin; New Hampshire, Massachusetts,
W82-03041 1507 6D

Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

Water Resources Appraisal for Hydroelectric Licensing; Payette River Basin, Idaho.
W82-03043 1507 6D

Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan,
W82-03044 1507 6D

Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin; Colorado, Wyoming.
W82-03045 1507 6D

On Water Availability and Demand in Nigeria,
W82-03062 1507 6D

Canada Water Year Book 1979-1980, Water Research Division.
W82-03096 1507 7C

Canada Water Year Book 1979-1980, References.
W82-03097 1507 10C

Canada Water Year Book 1977-1978.
W82-03099 1507 7C

The Nile - One River and Nine Countries,
W82-03545 1508 4A

Behavioural and Political Aspects of Water Development and Irrigation Projects,
W82-03579 1508 6F

Assessment of Current and Prospective Foundations of Water Resources Planning,
W82-03713 1508 6B

Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 1508 5F

Development of Water Supply to Metro-Manila.
W82-03742 1508 5F

A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 1508 3B

Watering Australia's Driest State,
W82-03767 1509 6D

Urgent Problems in the Transfer of Water Resources Knowledge,
W82-03802 1509 7C

Environmental Aspects of Water-Resources Planning in England and Wales,
W82-03806 1509 6E

A Model for Solving Multiperiod Multireservoir Water Resources Problems with Stochastic Inflows,
W82-03830 1509 6A

Primary and Secondary Impacts of a Water Resource Development Project,
W82-03907 1509 6B

Water Resources Investigations in West Central Iran Using Landsat Data,
W82-03927 1509 7B

Assessment of High Heat-Transfer Evaporators as Power Plant Condensers to Produce Abundant Freshwater,
W82-03949 1509 3A

San Francisco River Wild and Scenic River Study Report; Greenlee County, Arizona.
W82-04076 1509 6G

Making Your Way Through Murky Waters-A Manual for Public Participation Coordinators in Natural Resources Planning,
W82-04085 1509 6A

Small Hydro Stations in Sweden,
W82-04174 1509 8C

Small and Low-Head Hydro in the USA,
W82-04176 1509 8A

Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

Future Directions in Federal Water Resources,
W82-04196 1509 6D

Nile Water for Sinai: Framework for Analysis,
W82-04203 1509 6A

Theory and Reality in Allocating Federal Resources to Water Resources Development,
W82-04224 1509 6E

Energy, Environmental, and Economic Implications of Some Recent Alberta Water Resources Projects,
W82-04226 1509 6B

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

A Multiobjective Branch and Bound Method for Network-Structured Water Resources Planning Problems,
W82-04563 1510 6A

Energy Technology Scenarios for Use in Water Resources Assessments Under Section 13A of the Federal Nonnuclear Energy Research and Development Act.
W82-04635 1510 6B

Water Resources Appraisal for Hydroelectric Licensing: Sevier Lake Basin, Utah.
W82-04636 1510 6D

Massachusetts Water Supply Priorities,
W82-04698 1510 6D

Input-Output and Benefit-Cost Analysis for Water Resource Development Projects,
W82-04733 1510 6A

Hydrogeology for Land-Use Planning: The Potter Creek Area, Anchorage, Alaska,
W82-04981 1511 5G

A Screening Model to Quantify Resilience,
W82-05044 1511 6A

Alternative Indices of Resilience,
W82-05045 1511 6A

Estimates of Resilience Indices by Simulation,
W82-05046 1511 6A

Estimating Resilience by Canonical Analysis,
W82-05047 1511 6A

Use of Mathematical Models to Generate Alternative Solutions to Water Resources Planning Problems,
W82-05072 1511 6A

Robustness of Water Resources Systems,
W82-05077 1511 6A

Reliability, Resiliency, and Vulnerability Criteria for Water Resource System Performance Evaluation,
W82-05078 1511 6A

Water Resources of the Walker River Indian Reservation, West-Central Nevada,
W82-05235 1511 6B

Five-Year Plan for Water Research of the Oklahoma Water Resources Research Institute.
W82-05301 1511 6B

Water Quality Assessment for Agana Springs,
W82-05304 1511 5A

The Ecological Case for the Creation of the Danube-Dnieper Water Resources Utilization System,
W82-05329 1511 6G

Can the Goals of the UN Decade on Water Supply and Sanitation Be Achieved,
W82-05365 1511 6B

New Strategies for Water Resource Planning in British Columbia,
W82-05395 1511 6E

Groundwater Strategy: Protecting a Vital Resource,
W82-05403 1511 5B

California's Peripheral Canal: Skirting the Delta - and the Issues,
W82-05411 1511 4A

Environmental Aspects of Multi-Purpose Reservoir Projects in Developing Countries,
W82-05426 1511 6G

Water Resources in the Legislative Balance, 1982,
W82-05433 1511 6E

Costa Rica Stays Top of Water League,
W82-05500 1511 6D

Frogmen's Subterranean Swim Sites Source,
W82-05501 1511 8A

Can Hard-Rock Wells Solve Africa's Irrigation Problem,
W82-05503 1511 3B

A Five-Year Plan of Water Resources Research.
W82-05527 1511 6B

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 1511 6B

Virginia Water Resources Research Center Five-Year Plan.
W82-05529 1511 6B

Michigan Five-Year Water Resources Research and Development Plan: Fiscal Years 1982-1986.
W82-05530 1511 6B

A Five-Year Plan for Water Research in Colorado.
W82-05531 1511 6B

Five Year Water Resources Research Plan for the State of California,
W82-05532 1511 6B

Nevada Water Resources Research 1982-1987,
W82-05533 1511 6B

Groundwater Resources of Kwajalein Island, Marshall Islands,
W82-05546 1511 4B

The Nile Waters: Sudan's Critical Resource, Part II,
W82-05601 1511 6D

Large Water and Hydroelectric Developments in Fiji,
W82-05614 1511 6D

An Application of Mathematical Programming to Water Resources Planning: An Economic View,
W82-05737 1511 6A

Local Attitudes Toward Alternative Uses of a Reservoir Project,
W82-05743 1511 6B

Water Resources Research Prioritization and Management--Problems and Perspectives,
W82-05753 1511 6B

Turks Press Forward With Ambitious Dam Programme,
W82-05758 1511 6B

Hydro Powers Mindanao Development Plans,
W82-05881 1511 8A

Future Water Development Policies,
W82-05884 1511 5G

Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin,
W82-05886 1511 3C

Colorado River Development,
W82-05887 1511 4A

Development Issues in the Colorado River Basin,
W82-05890 1511 6D

The Physical Environment of the Colorado River Basin,
W82-05891 1511 6D

Review of Treaties on Consumptive Utilization of Waters of Lake Victoria and Nile Drainage System,
W82-05987 1512 6E

Improved Principles, Standards, and Procedures for Evaluating Federal Water Projects,
W82-06063 1512 6B

Rice Fields of South Carolina: A Resource Inventory and Management Policy Evaluation,
W82-06072 1512 6B

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

Tragedy of the San Francisco Bay Commons,
W82-06182 1512 6E

Evaluation of Groundwater Resources in Tokar Delta, Sudan,
W82-06197 1512 2E

Reservoir Planning for Brazilian Dams,
W82-06206 1512 6A

Managing Potomac Water Quality: Evolving Approaches,
W82-06361 1512 6B

Artificial Recharge of Colorado River Water in Las Vegas Valley: Management Options and Potential Aquifer System Responses,
W82-06694 1512 6B

A Fuzzy Sets Model for Measuring the Effectiveness of Public Participation in Water Resources Planning,
W82-06778 1512 6B

Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

Cost Allocation in Water Resources Development,
W82-06854 1512 6C

WATER RESOURCES INSTITUTES
Water Research in Action.
W82-05292 1511 6B

WATER RESOURCES MANAGEMENT
Interpreting Dynamics of Aquatic Resources: A Perspective for Resource Managers,
W82-00539 1502 6A

Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 1504 2H

The Canada Water Act, Annual Report 1980-1981.
W82-03098 1507 7C

WATER REUSE
Gerber Saves 465,000 Gallons of Water/Day,
W82-00187 1501 3E

Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

Assessment of Oil Shale Retort Wastewater Treatment and Control Technology - Phases I and II,
W82-00390 1501 5B

Chemical Recovery from Coal Conversion Wastes by Concentration,
W82-00436 1501 5D

Recycling Urban Stormwater for Profit,
W82-00524 1502 3C

The Cape Flats Sewage Treatment Works,
W82-00957 1502 5D

Environmental Effects of Water Reuse Scheme,
W82-00973 1502 3C

Health Aspects of Urban Water Conservation,
W82-01047 1502 3C

Water Reclamation and Reuse,
W82-01252 1503 3C

Petroleum Processing Wastes,
W82-01262 1503 5D

A Look at Some Water Reclamation Plants in Southern Africa,
W82-01352 1503 5D

Optimum Recycle and Reuse Cooling System Designs Using the BCT Process,
W82-01503 1503 3E

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01579 1503 5D

Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 1503 5D

Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 1503 5D

Food and Energy Production: Conjunctive Water Planning,
W82-01856 1504 3C

Legal, Economic and Institutional Barriers to Water Reuse in Northern New England, Boston, Massachusetts,
W82-02107 1505 3C

Viral Transport to Ground Water at a Wastewater Land Application Site,
W82-02317 1505 3C

An Evaluation of the Potential for Water Conservation and Reuse in the Georgia Pulp and Paper Industry,
W82-02456 1505 3E

Evaluation of Membrane Processes and Their Role in Wastewater Reclamation: Volume II,
W82-02457 1505 5D

Recycling,
W82-02514 1505 6E

Community Evaluation of Adopted Uses of Reclaimed Water,
W82-02551 1505 3C

Combined Flue Gas Desulfurization and Water Treatment in Coal-Fired Power Plants,
W82-02606 1506 3E

Optimal Water Reuse Planning,
W82-02736 1506 6A

Freeze Crystallization Applications for Wastewater Recycle and Reuse,
W82-03128 1507 5D

Water Policy at Inco Metals Company, Ontario Division Mills,
W82-03251 1507 3E

Osmotic Potentials of Roots of Onions and Their Rhizospheric Soil Solutions when Irrigated with Saline Drainage Waters,
W82-03263 1507 3C

Water: Too Much, Too Little, Too Bad,
W82-03291 1507 6D

Water Cost Encourages Reuse and Conservation,
W82-03295 1507 5D

Elimination of Toxic Metals from Wastewater by an Integrated Wastewater Treatment/Water Reclamation,
W82-03439 1508 5D

Wastewater Treatment for Japan's Research Institute.
W82-03905 1509 5D

Dual Distribution Systems Analysis,
W82-04123 1509 5F

Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

The Effect of Reuse of Water for Agriculture on The Arab-Asian Society: A New Interdisciplinary Model for Understanding a Development Problem,
W82-04213 1509 3C

Reuse of Biologically Treated Wastewater as Cooling Tower Makeup,
W82-04317 1510 5C

Zero-Discharge in Practice at Ray D. Nixon Power Plant,
W82-04320 1510 5D

Recycling Allows Zero Powerplant Wastewater Discharge,
W82-04323 1510 5D

Aquacultural Approaches to Recycling of Dissolved Nutrients in Secondarily Treated Domestic Wastewaters--I. Nutrient Uptake and Release by Artificial Food Chains,
W82-04371 1510 5D

Refuse of Power Plant Cooling Water for Irrigation,
W82-04445 1510 3C

Water Reuse Planning Models: Extensions and Applications,
W82-04565 1510 6A

Water Recycling/Reuse in the Food Processing Industry,
W82-04566 1510 5D

Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

Water Reuse Planning by Means of an Input-Output Table,
W82-04794 1511 6A

The Occurrence of Flow Channels in Soils,
W82-04875 1511 3C

Distribution of Phosphorus in Soils Irrigated with Municipal Waste-Water Effluent: A 5-Year Study,
W82-04881 1511 3C

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 1511 6B

Sequential Water Reuse Effect on Stream Salinity,
W82-05731 1511 3C

Seawater Ro Heads Japan's Water Reuse Research.
W82-05756 1511 3A

Strategies for Reuse and Conservation,
W82-05790 1511 3C

Wastewater Reuse Using Microgras Dispersion Stripping,
W82-05911 1512 5D

Water Reuse by Metal Removal from Industrial Plating Effluents,
W82-06307 1512 5D

Waste-Heat Vertical Tube Foam Evaporation for Cooling Tower Blowdown Renovation/Recycle,
W82-06369 1512 3E

Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

Expanding Options for Greywater Treatment,
W82-06491 1512 5D

Immune Response to a Formalin-Treated Bacterial Exotoxin (Toxoid) of Channel Catfish Maintained in a Recirculating Water-Reuse System,
W82-06707 1512 5C

Removal of Toxicants during Direct and Indirect Reuse of Wastewater Evaluated by Means of a Mammalian Cell Culture Technique,
W82-06768 1512 5D

Land Application of Wastewater,
W82-06915 1512 5E

WATER RIGHTS
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Kentucky.
W82-00450 1501 6E

Executive Summary; Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in the Seven Mid-Western States.
W82-00718 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Indiana.
W82-00748 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Ohio.
W82-00749 1502 6E

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in Pennsylvania.
W82-00752 1502 6E

A Water Rights Strategy for Mining Operations in the Western US,
W82-01587 1503 6E

The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 1503 6E

Water Rights on Indian Allotments,
W82-02363 1505 6E

Analysis of Firm Water Supply Under Complex Institutional Constraints,
W82-02501 1505 6A

Reasonable Groundwater Pumping Levels Under the Appropriation Doctrine: The Law and Underlying Economic Goals,
W82-02503 1505 6E

The Evolution of Texas Water Law and the Impact of Adjudication,
W82-03085 1507 6E

The Economic Effects of Changes in Water Use in the Tucson Basin, Arizona,
W82-04156 1509 6E

Pueblo Indian Agriculture, Irrigation and Water Rights,
W82-04208 1509 6E

Conjunctive Management of Water Resources in the Context of Texas Water Law,
W82-04223 1509 6E

The Winters Decision and Indian Water Rights--A Mystery Reexamined,
W82-04410 1510 6E

Water Rights, Allocation, and Conflicts in the Tongue River Basin, Southeastern Montana,
W82-04441 1510 6E

Development of Federal Reserve Rights,
W82-04446 1510 6E

Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

Bubb v. Christensen: The Rights of the Private Landowner Yield to the Rights of the Water Appropriator Under the Colorado Doctrine,
W82-04680 1510 6E

Auctions and Alternative Procedures for Allocating Pollution Rights,
W82-04746 1510 6E

Town of De Beque V. Enewold: Conditional Water Rights and Satutory Water Law,
W82-04801 1511 6E

Bryant V. Yellen: Perfected Rights Acquire New Status under A Belated Clarification of Arizona V. California,
W82-04802 1511 6E

Non-Indian Federal Reserved Water Rights,
W82-04804 1511 6E

Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs,
W82-04932 1511 4B

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 1511 6E

Colorado River Water Allocation,
W82-05888 1511 6C

Development Issues in the Colorado River Basin,
W82-05890 1511 6D

Allocation of Water for Resource Development,
W82-06839 1512 6D

WATER SAMPLING
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

Sampling Ground Water for Organic Contaminants,
W82-00820 1502 5A

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Determination of Polyhalogenated Phenolic Compounds in Drinking Water, Human Blood Serum and Adipose Tissue,
W82-00879 1502 5A

Grab Versus Composite Sampling: A Primer for the Manager and Engineer,
W82-00891 1502 5A

An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 1503 7B

Some Factors Affecting the Determination of Particulate Carbon and Nitrogen in River Water,
W82-01532 1503 5A

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 1503 3A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 1504 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 1504 7B

Evaluation of Automatic Suspended Solids Sampling Procedures,
W82-02316 1505 5A

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 1505 5F

Aquatic Biology of the Redwood Creek and Mill Creek Drainage Basins, Redwood National Park, Humboldt and Del Norte Counties, California,
W82-02484 1505 4C

A Rate of Rise Controller for Automatic Water Samplers,
W82-02938 1506 7B

Toxic Substances Monitoring Program - 1980,
W82-04077 1509 5A

Relationships Between Odor and Commonly Measured Water Quality Characteristics in Surface Water Supplies,
W82-04081 1509 5B

Constituents of Highway Runoff; Volume II, Procedural Manual for Monitoring of Highway Runoff,
W82-04628 1510 5A

Procedures for the Collection of Representative Water Quality Data from Monitoring Wells,
W82-05051 1511 7B

Right Place, Time and Technique: Right Sample,
W82-06642 1512 5A

Reservoir Water Quality Sampling Design,
W82-06868 1512 2H

WATER SCARCITY
Water Conservation Under Conditions of Extreme Scarcity: The U.S. Virgin Islands.
W82-04170 1509 3A

The Interaction Between Water Scarcity and Water Quality Degradation: Israel as a Case Study,
W82-05421 1511 6D

WATER SHORTAGE
Ames' Mutagenic Activity in Recycled Water from an Israeli Water Reclamation Project,
W82-00234 1501 5D

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought,
W82-01553 1503 3D

Updating Antiquated City Water Systems,
W82-03293 1507 5F

Jersey Drought Hastens Water Supply Project,
W82-03385 1507 6D

Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 1508 6D

Analyzing the Risk of Drought: The Occoquan Experience,
W82-04097 1509 2A

Conserving Water Through Pricing,
W82-04272 1510 3D

Five-Year Plan of the Water Resources Research Center,
W82-05526 1511 6B

Drought-Related Water Conservation Efforts in Missouri,
W82-05672 1511 3D

The 1980-1981 Drought in Illinois: Causes, Dimensions, and Impacts,
W82-06523 1512 2E

WATER SOFTENING
High pH Treatment of Combined Water Softening and Wastewater Sludges,
W82-00403 1501 5D

Home Water Softeners, Water Softness and Possible Health Implications,
W82-01045 1502 5F

Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 1503 5F

Precipitation Kinetics of Calcium Carbonate and Magnesium Hydroxide in a Scaling System,
W82-03136 1507 2K

Water Softening by Crystallization,
W82-03750 1508 5F

Lime Softening Sludge Treatment and Disposal.
W82-04276 1510 5E

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 1511 5F

Piloting Mag-Carbonate Treatment,
W82-05794 1511 5F

Florida Style Water Supply and Treatment,
W82-06027 1512 5F

Complex Sequence Treats Fluctuating Flows,
W82-06814 1512 5F

WATER SOURCES
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 1503 2C

WATER SPORTS
Management Concerns for Swimming, Tubing, and Wading in the Great Smoky Mountains National Park,
W82-01475 1503 6A

WATER STORAGE
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 1502 5A

Electronic Measurement and Recording of Evaporation Loss,
W82-01602 1503 7B

Application of a Single Reservoir Operation Policy to a Rain Water Cistern System,
W82-03088 1507 3B

'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 1508 3B

A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 1508 3B

Methodology for Optimization of an Irrigation System with Storage Reservoirs,
W82-03530 1508 3F

Ground-Level Versus Elevated Storage,
W82-03865 1509 5F

Determination and Representation of the Storage Effect (Zur Ermittlung und Darstellung der Speicherwirkung),
W82-04576 1510 4A

Man-Made Storage of Water Resources-A Liability to the Ocean Environment. Part I,
W82-04749 1510 6G

A Floodplain Storage Model Used to Determine Evaporation Losses in the Upper Yobe River, Northern Nigeria,
W82-04863 1511 2D

Optimal Water Pricing and Storage: The Effect of Discounting,
W82-05049 1511 6C

Man-Made Storage of Water Resources--A Liability to the Ocean Environment. Part II,
W82-05126 1511 4A

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

Sensible Energy Storage in Aquifers. 2. Field Experiments and Comparison with Theoretical Results,
W82 06058 1512 4B

Sensible Energy Storage in Aquifers. 1. Theoretical Study,
W82-06059 1512 4B

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

WATER STRESS
Effects of Soil Water Regime and Nitrogen Form on Blossom-End Rot, Yield, Water Relations, and Elemental Composition of Tomato,
W82-00162 1501 2I

Water Relations of Three Cowpea Cultivars (Vigna Unguiculata L.),
W82-00607 1502 2I

Growth and Nitrogen Fixation of Aeschynomene Under Water Stressed Conditions,
W82-00758 1502 2I

Plant-Water Relations and Adaptation to Stress,
W82-00812 1502 2I

Investigations of Control Mechanisms of Germination Under Water Stress,
W82-00912 1502 2I

The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 1502 2I

Water Relations, Soil Fertility, and Plant Nutrient Composition of a Pygmy Oak Ecosystem,
W82-01034 1502 2I

Canopy Temperature as a Crop Water Stress Indicator,
W82-01106 1503 2I

The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 1503 2I

Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 1504 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 1504 3F

Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 1506 3F

The Influence of Plant Water Stress on Stomatal Control of Gas Exchange at Different Levels of Atmospheric Humidity,
W82-03272 1507 2D

Sugar Beet Production as Influenced by Water Stress,
W82-04086 1509 3F

Protein and Free Amino Acids in Field-Grown Cowpea Seeds as Affected by Water Stress at Various Growth Stages,
W82-04184 1509 3F

Sunflower Yield Vs. Water Deficits in Major Growth Periods,
W82-04361 1510 2I

Optimizing the Use of Water and Nitrogen Through Breeding of Crops,
W82-05608 1511 3F

Salt- and Drought-Tolerant Crop Plants for Water Conservation,
W82-05920 1512 3C

Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 1512 2I

WATER SUPPLY

Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 1501 5F

Water Resources of the Santa Ysabel and Mesa Grande Indian Reservations, San Diego County, California,
W82-00021 1501 7C

Water Resources of Prince William Forest Park, Virginia,
W82-00026 1501 7C

Ground Water Availability,
W82-00027 1501 6D

Ground Water Alternatives and Solutions,
W82-00029 1501 6D

Water Supply and Demand in an Energy Supply Model,
W82-00050 1501 6D

Before the Well Runs Dry: A Handbook for Designing a Local Water Conservation Plan.
W82-00396 1501 3D

An Analysis of Reservoir Storage Contents for the Proposed Enlargement of Bumping Lake in Washington,
W82-00421 1501 4A

Environmental Virology and its Problems,
W82-00505 1502 5A

Water-Treatment Chemicals,
W82-00618 1502 5F

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 1502 5F

Supply-Demand Coordination in Water Resources Management,
W82-01299 1503 6C

Multifrequency Radiometer Detection of Submarine Freshwater Sources Along the Puerto Rican Coastline,
W82-01349 1503 3B

Hydrobiological Studies on the Ajwa Reservoir, the Source of Raw Water Supply to the Baroda Water Works,
W82-01364 1503 2H

Organic Contamination of Ground Water: Tell it All,
W82-01474 1503 5C

Small Water Systems: Role of Technology,
W82-01542 1503 5F

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 1503 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 1503 2F

Water Quality Study – Southwest Minnesota Public Water Supplies,
W82-01795 1503 2K

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 1504 6E

Water Management on the Columbia River,
W82-02112 1505 6D

Overview of Freshwater Inflow Depletions,
W82-02152 1505 6D

Freshwater Inflow to the Columbia River Estuary; A Northwest Regional Management Issue,
W82-02155 1505 6D

Scientific Progress and Deteriorating Ecosystems; San Francisco Bay and the 1970's,
W82-02156 1505 6E

The Effect of EEC Directives on Water Supplies,
W82-02432 1505 6E

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 1505 5F

The Integrity of Existing Distribution Systems,
W82-02450 1505 5F

Water Conservation Program of the City of Greensboro,
W82-02518 1505 3D

Water Savings in the Orange Water and Sewer Authority,
W82-02519 1505 3D

Efficient Groundwater Utilization,
W82-02520 1505 6D

Analytical Cost Model for Urban Water Supply,
W82-02584 1505 6C

Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 1506 3A

Reliability of Water Resources,
W82-02749 1506 6A

The Cost of Quality,
W82-02881 1506 5F

Optimal Operating Policies for Water Supply and Distribution Systems,
W82-03010 1507 6A

The Input-Output Water Transactions Model of Supply and Demand,
W82-03055 1507 6D

Airy Holm Dam - Kirkler Water Scheme,
W82-03070 1507 8A

Regional Multiobjective Planning of Water Supply and the Disposal of Residuals with Due Regard to Intraregional Population Distribution,
W82-03210 1507 6A

Water Supply in Denmark,
W82-03274 1507 6D

Water: Too Much, Too Little, Too Bad,
W82-03291 1507 6D

Updating Antiquated City Water Systems,
W82-03293 1507 5F

A Century of Water for Antwerp,
W82-03355 1507 5F

Water Supply Reliability Theory,
W82-03432 1508 6A

Pumped-Storage for Swiss Railways, Part One,
W82-03468 1508 8A

Investment Alternatives in Case of Extended Water Supply Shortages in Cities of Developing Countries,
W82-03507 1508 6D

Generalized Storage-Yield Relationships for Surface Water Reservoirs on Northeastern United States' Watersheds,
W82-03523 1508 6A

The Diffusion of Technology in the Nineteenth Century American City: Municipal Water Supply Investments,
W82-03537 1508 6B

Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 1508 5F

Retrospective Analysis of Water Supply and Wastewater Policies in Pittsburgh, 1800-1959,
W82-03721 1508 5D

Bayanihan, the Spirit Behind the Philippine Water Supply Department Scene.
W82-03741 1508 5F

Development of Water Supply to Metro-Manila.
W82-03742 1508 5F

A Century of Effort Quenches Hong Kong's Thirst,
W82-03743 1508 3B

Global Future: Time to Act. Report to the President on Global Resources, Environment and Population.
W82-03747 1508 6E

Agriculture in the Wider Caribbean,
W82-03778 1509 6D

The Significance of Tropical Cyclone Rainfall in the Water Supply of South Florida,
W82-03821 1509 2B

Institutional Analysis Criteria for Water Supply Planning,
W82-03930 1509 6D

Geologic Structure, Hydrology, and Water Quality of the Laramiefox Hills Aquifer in the Denver Basin, Colorado,
W82-03978 1509 7C

Energy and Water Resources.
W82-04066 1509 6D

How Much Water Supply Capacity Is Enough,
W82-04103 1509 6D

Reevaluating Hunter's Model for Residential Water Demand,
W82-04131 1509 6D

The Costs of Compliance: An EPA Estimate for Organics Control,
W82-04132 1509 6C

Hydropower: Inflation-Proof Energy from Water Supply Dams,
W82-04137 1509 6B

Dual Distribution System Solves Pelican Bay's Water Supply Problems,
W82-04193 1509 5F

Maps--A Planning Tool for Corps of Engineers Regional Water Supply Studies,
W82-04228 1509 6A

Experiments in Improving Rural Water Supplies,
W82-04350 1510 5F

Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

Possible Waterborne Transmission and Maintenance of Influenza Viruses in Domestic Ducks,
W82-04468 1510 5B

Water Type and Suitability of Oklahoma Surface Waters for Public Supply and Irrigation. Part 1: Arkansas River Mainstem and Verdigris, Neosho, and Illinois River Basins Through 1978,
W82-04518 1510 7C

The Neckar as a Source of Process and Reserve Water (Der Neckar als Lieferant von Betriebs- und Reservewasser),
W82-04546 1510 5F

Massachusetts Water Supply Priorities,
W82-04698 1510 6D

Icebergs: Technology for the Future,
W82-04778 1511 2C

The Real Price of Urban Water,
W82-04797 1511 6C

Potable Water Production in Holland.
W82-04851 1511 5F

New Telemetry System for the Cambridge Water Company.
W82-04852 1511 5F

The Use of XAD-Resins for the Detection of Mutagenic Activity in Water. II. Studies with Drinking Water,
W82-04912 1511 5A

Stripmining Arid Navajo Lands in the US: Threats to Health and Heritage,
W82-05036 1511 6D

Water System Design Meets Modern Challenges,
W82-05170 1511 5F

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

Water Use in Ohio, 1975,
W82-05226 1511 6D

Sampling and Analyzing Water,
W82-05263 1511 5A

The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications,
W82-05543 1511 3A

Drought Management: Expecting the Unexpected,
W82-05649 1511 3D

Water Supply for New York City in the 1980s,
W82-05671 1511 6D

Industry Helps Conserve Municipal Water,
W82-05674 1511 3E

Modeling of Water Supply/Demand in the South Platte River Basin, 1970-2020,
W82-05738 1511 6D

Egypt Tackles Rural Supply Task,
W82-05754 1511 5F

Wedge-Block Tunnels in Water Supply,
W82-05803 1511 8F

Cape Cod Aquifer, Cape Cod, Massachusetts,
W82-05807 1511 2F

Conflict Over Water Sources Predicted by Global Study.
W82-05879 1511 6B

Water-Quality Assessment of Cache Creek, Yolo, Lake, and Colusa Counties, California,
W82-06130 1512 7A

Supplying Water to the Rural Community,
W82-06223 1512 5F

Work Management Standards,
W82-06349 1512 6F

Distributing the Risks of Interbasin Water Transfers Under Drought Conditions: The Dilemma Posed by Coal Slurry Pipelines.
W82-06365 1512 6D

Hazardous Material Spills--Are You Ready,
W82-06417 1512 5G

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

The Landscape of Rutland Water,
W82-06478 1512 6G

Bridging the Water Supply Gap,
W82-06508 1512 8A

Swift Action by State Officials Prepares for Water Supply Crisis.
W82-06514 1512 8C

Texas Gulf Coast Project Answers Vital Water Need,
W82-06519 1512 8A

Cave Water--Java's Hidden Resource,
W82-06605 1512 3B

Water Supply Management in the District of Columbia: An Institutional Assessment,
W82-06704 1512 6B

Effects on Global Supplies of Freshwater,
W82-06733 1512 5C

County Provides a Rural Water Supply System,
W82-06843 1512 3D

Reconnaissance of the Ground-Water Resources of Kings and Queens Counties, New York,
W82-06952 1512 4B

WATER SUPPLY DEVELOPMENT

Alternatives Working Group Report.
W82-00032 1501 6B

Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 1501 6D

A Successful Transfer,
W82-00309 1501 4A

Long Distance Mass Transfer of Water,
W82-00858 1502 6D

Dryland Cropping Strategies for Efficient Water-Use to Control Saline Seeps in the Northern Great Plains, U.S.A.,
W82-01023 1502 3F

Effect of Investments in Water Supply and Sanitation on Health Status: A Threshold-Saturation Theory,
W82-01331 1503 6B

Malawi: A Community Approach.
W82-01365 1503 5F

The Water Decade (1981-1990).
W82-01534 1503 6E

Morocco's Largest Multipurpose Scheme,
W82-01724 1503 8A

Impressions of Soil and Water Conservation in China,
W82-01730 1503 4D

Sustaining the Growth of Provence.
W82-01738 1503 6D

Wanted: Water for Development,
W82-02088 1504 6D

Desalting Demonstration Plant Feasibility Study at Laguna Pueblo, New Mexico.
W82-02104 1505 3A

Draft Environmental Assessment Desalting Demonstration Plant, Laguna, New Mexico.
W82-02171 1505 3A

Efficient Groundwater Utilization,
W82-02520 1505 6D

Water Supply and Sanitation Decade Programme,
W82-02757 1506 5F

The Development of a Village Water Supply System on Truk,
W82-02816 1506 5F

Planning Level Estimates of the Value of Reservoirs for Water Supply and Flow Augmentation in New Hampshire,
W82-02825 1506 6B

On Water Availability and Demand in Nigeria,
W82-03062 1507 6D

Who Will Pay the World's Water Bill,
W82-03280 1507 6B

Jersey Drought Hastens Water Supply Project,
W82-03385 1507 6D

'Nadis', The Vital Water Resources of the Indian Arid Zone,
W82-03413 1508 3B

The Nile - One River and Nine Countries,
W82-03545 1508 4A

The Development of Water Supply in Indonesia and All Its Challenges.
W82-03868 1509 6D

An Economic Evaluation of Interbasin Water Transfers: A Case Study of Southwestern Connecticut,
W82-03944 1509 5B

Final Environmental Impact Statement: Cheyenne Stage II Water Diversion, Medicine Bow National Forest.
W82-04073 1509 6D

How Much Water Supply Capacity Is Enough,
W82-04103 1509 6D

Water Supply in the Paris Suburbs: Changing Treatment for Changing Demands,
W82-04125 1509 5F

Will New Orleans Miss The Mississippi, W82-04274 1510 4A
Blaney-Criddle Coefficients for Western Turf Grasses, W82-04310 1510 2D
The Traditional Approach to Water Loss, W82-04656 1510 3D
Tanzania's Master Water Plan Will Miss Decade Goal, W82-04657 1510 5F
Financing Federal Water Development Projects and Sharing the Costs, W82-04739 1510 6C
Water Supply in the USSR. W82-04849 1511 6D
The Riviersonderend-Berg River-Jonkershoek Project Most Outstanding Civil Engineering Achievement of 1980. W82-04886 1511 8A
Water to the South-Western Cape Keeping Up with the Demand. W82-04887 1511 3C
The Potential for Ground-Water Management in the West: A Symposium, W82-04918 1511 4B
Ground-Water Development in Western River Basins: Large Economic Gains with Unseen Costs, W82-04932 1511 4B
A Report on: Research Needs....Water Conservation in Agriculture, W82-05308 1511 3F
Integrated Water Management: Some International Dimensions, W82-05493 1511 6D
Applications of Simulation to Specific Water Projects, W82-05522 1511 6A
The Role of Desalting Tchnology in Water Supply, Wastewater Reuse and Industrial Applications, W82-05543 1511 3A
Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs, W82-05628 1511 4B
Impact of Energy Development upon Water and Salinity in the Upper Colorado River Basin, W82-05886 1511 3C
Colorado River Water Allocation, W82-05888 1511 6C
Development Issues in the Colorado River Basin, W82-05890 1511 6D
The Physical Environment of the Colorado River Basin, W82-05891 1511 6D
Processes for Removal of Inorganic Contaminants from Water, W82-06342 1512 5F
Water Supply Development in Thailand. W82-06367 1512 6B
Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar, W82-06437 1512 5F

WATER SUPPLY SYSTEMS
The Problems of Non-Return and the Use of Valves in Drinking Water Protection Against Waste Water Return, Applying the Regulations in Force, W82-01142 1503 5F
Cost of Small Water Supply Treatment Systems, W82-02318 1505 5F
Emergency Water Supply General Report No. 2, Concept for an Emergency Water Supply in Switzerland, W82-03221 1507 5F
Updating Antiquated City Water Systems, W82-03293 1507 5F
An Integrated Mesh-Nodal Method for Steady-State Water Distribution Network Analysis, W82-03305 1507 5F
Investment Alternatives in Cases of Extended Water Supply Shortages in Cities of Developing Countries, W82-03507 1508 6D
Down to Earth Leak Detection, W82-03561 1508 5F
Urban Water Systems: Problems and Alternative Approaches to Solutions, W82-03580 1508 5F
Uncertainties in Water Distribution Systems, W82-03668 1508 8A
The Costs of Internal Corosion in Water Systems, W82-03809 1509 5F
Readying Boston's Water and Sewer System for the Next Century, W82-03870 1509 6B
Interagency Connections: Insurance Against Interruptions in Supply, W82-04090 1509 5F
Practical Power-Saving Techniques in Pinellas County, W82-04092 1509 5F
Pump Systems: What Price Inefficiency, W82-04093 1509 8C
An Experimental Approach to Corrosion Control, W82-04099 1509 5F
Monitoring and Controlling Corrosion by Potable Water, W82-04100 1509 5F
Dual Distribution Systems Analysis, W82-04123 1509 5F
Computer Modeling Programs: Tools for Model Operations, W82-04130 1509 6A
Controlling the Cost of System Maintenance, W82-04139 1509 8G
The Search for a Corrosion Index, W82-04279 1510 5F
Riding Mill Pumping Station, W82-04292 1510 8A
Obtaining Layout of Water Distribution Systems, W82-04319 1510 8A
Leak Detection--Histories, W82-04363 1510 3D
Covering Distribution Storage, Panel Discussion, Design Aspects and Alternatives, W82-04701 1510 5G
A Pipeline for all Environments, W82-04764 1511 8G
Influence of Chlorination and the Distribution System on Mutagens in a Potable Water Supply, W82-04961 1511 5A
Economic Impact Study of R81-11 Trihalomethane Standards for Public Water Supplies, W82-06098 1512 5F
Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems, W82-06740 1512 5F

WATER SURFACE PROFILES
Characterization of Properties of Water, W82-05540 1511 1A

WATER TABLE
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, May 1980, W82-00409 1501 7C
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, October 1979, W82-00410 1501 7C
Altitude of Water Table, Biscayne Aquifer, Dade County, Florida, March 1979, W82-00411 1501 7C
The Effect of Height of Water Table on the Growth of Holcus Lanatus With Reference to Lolium Perenne, W82-00654 1502 2I
Watertable Management Saves Water and Energy, W82-00943 1502 3F
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers, W82-01890 1504 2F
Rockwood Embankment Slide Between Stations 2001+00 and 2018+00: A Horizontal Drain Case History, W82-02214 1505 8A
Effects of Water-Table Configuration on Seepage Through Lakebeds, W82-02281 1505 2H
A Two-Dimensional Finite-Element Solution Scheme for the Saturated-Unsaturated Flow with Applications to Flow Through Ditch-Drained Soils, W82-02283 1505 2F
The Availability of Ground Water in Western Montgomery County, Maryland, W82-02481 1505 2F
Altitude of the Water Table in the Alluvial and Other Shallow Aquifers Along the Colorado River Near La Grange, Texas, December 1980, W82-02491 1505 7C
Probable High Ground-Water Levels in Massachusetts, W82-02829 1506 2F
Aeration Status of a Stratified Soil with a Falling Water Table, W82-03717 1508 2G
Probable High Ground-Water Levels on Cape Cod, Massachusetts, W82-04511 1510 7C
Groundwater Control, W82-04714 1510 4B
Simulated Interactions Between the Proposed Narrows Reservoir and the Water-Table Aquifer Along the South Platte River, Morgan County, Colorado, W82-04725 1510 6A

Lineboro Quadrangle: Hydrogeology,
W82-04969 1511 7C

Hydrogeologic Sections Through Lee County and Adjacent Areas of Hendry and Collier Counties, Florida,
W82-05830 1511 7C

Effect of Water Management and Bed Height on Sugarcane Yield,
W82-06231 1512 2I

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

WATER TABLE DECLINE
Impacts of Surface Drainage on Ground Water Hydraulics,
W82-03753 1509 4C

The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 1511 4B

Ground-Water Network Design for Northwest Kansas, Using the Theory of Regionalized Variables,
W82-04921 1511 4B

WATER TABLE FLUCTUATIONS
A Mathematical Model of Water Table Fluctuation in a Semi-Infinite Aquifer Induced by Localized Transient Recharge,
W82-01319 1503 2F

Assessment of a Regional Aquifer in Central Illinois,
W82-05052 1511 2F

Occurrence of Fluoride Bearing Groundwaters and Their Relationship with Water Table Fluctuations,
W82-06443 1512 2K

WATER TABLE GRADIENT
Spatial and Temporal Variation of Fecal Coliform Movement Surrounding Septic Tank-Soil Absorption Systems in Two Atlantic Coastal Plain Soils,
W82-02325 1505 5B

WATER TABLE PROFILES
Induced Sinkholes: An Engineering Problem,
W82-02559 1505 4B

Ground-Water Recharge from Rectangular Areas,
W82-02791 1506 2F

WATER TABLE RISE
Irrigation, Crop Yield and Drainage at the Vaalharts Irrigation Scheme: 3. The Influence of Salinization Above a Shallow Ground Water Table on the Yield of Wheat and Other Crops (In Afrikaans),
W82-04359 1510 2G

WATER TANKS
Good Looks, Low Maintenance Guide Water Tank Choice,
W82-00868 1502 5A

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 1504 5A

Recent Water Towers in Norfolk,
W82-03246 1507 8A

Advanced Coatings for the Water Industry.
W82-06503 1512 8G

Water Tanks in Reinforced Concrete,
W82-06604 1512 8F

WATER TEMPERATURE
On the Occurrence of Bimodal Diel Dissolved Oxygen Curves in Aquatic Systems,
W82-02565 1505 2H

LARM Two-Dimensional Model: An Evaluation,
W82-02597 1505 4A

The Production Ecology of Benthic Plants in Some Antarctic Lakes. II. Laboratory Physiology Studies,
W82-02861 1506 2H

An Aerial Technique for Assessing the Impact of Cooling Water Discharges on Receiving Water,
W82-03016 1507 7B

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

Effects of Clearcutting and Slashburning on Stream Temperature in Southwestern British Columbia,
W82-03087 1507 5C

A Note on Minimizing Temperature Rise by Restricting Evaporation from Small Open Water Surfaces,
W82-03440 1508 3B

Space-Time Scales of Temperature Variability in the Seasonal Thermocline of Lake Tahoe,
W82-03519 1508 2H

Optimal Control of Reservoir Discharge Quality Through Selective Withdrawal,
W82-04204 1509 5G

Temperatures and Currents in a Stratified Lake: A Two-Dimensional Analysis,
W82-04378 1510 2H

Winter Temperature Structure in Lake Huron,
W82-04381 1510 2H

Modelling Evaporation from Reservoirs,
W82-04722 1510 2D

Seasonal Stream Temperature Changes Following Forest Harvesting,
W82-04870 1511 4C

Effects of Increased Atmospheric C02 on Great Lakes,
W82-05209 1511 2H

Water Temperatures in Nanticoke-Long Point Bay Region of Lake Erie,
W82-05637 1511 5C

Evaluation of Possible Temperature Fluctuations from Proposed Power Modifications of Hoover Dam,
W82-06092 1512 6G

One-Dimensional Reservoir-Lake Temperature and Dissolved Oxygen Model,
W82-06687 1512 2H

WATER TRANSFER
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 1501 6D

A Successful Transfer,
W82-00309 1501 4A

Long Distance Mass Transfer of Water,
W82-00858 1502 6D

Fishery Importance of the Ural-Caspian Fishing District and Problems of its Water Supply,
W82-05342 1511 8I

The Long Lake Diversion: An Environmental Evaluation,
W82-05568 1511 6G

The Kielder Transfer Works,
W82-06502 1512 8A

The Kielder Water Scheme,
W82-06503 1512 8A

Bridging the Water Supply Gap,
W82-06508 1512 8A

Swift Action by State Officials Prepares for Water Supply Crisis.
W82-06514 1512 8C

Some Characteristics of Calculating the Water Requirement When Designing Irrigation Measures,
W82-06984 1512 3F

WATER TRANSPORT
Environmental Impact Assessment of China's Water Transfer Project,
W82-00129 1501 6D

The Waterway That Cannot be Stopped,
W82-00510 1502 6E

Moisture Transport in a Soil-Plant System: A Mathematical Model and Finite Element Analysis,
W82-00648 1502 2I

Long Distance Mass Transfer of Water,
W82-00858 1502 6D

42-Mile Water Pipeline for Coal Boom Town.
W82-02359 1505 6D

Structure and Function of Mycorrhizal Rhizomorphs with Special Reference to Their Role in Water Transport,
W82-03190 1507 2I

Analysis of the Components of Area Growth of Bean Root Systems,
W82-04715 1510 2I

Icebergs: Technology for the Future,
W82-04778 1511 2C

Fresh-Water Transport by Sea,
W82-04861 1511 6D

WATER TREATMENT
Chemical, Physical, and Radiological Quality of Selected Public Water Supplies in Florida, February-April 1980,
W82-00010 1501 5F

Process for the Removal of Inorganic Salts From a Water Stream,
W82-00055 1501 5F

Fluoridation System,
W82-00061 1501 5F

Process for Removing Alkalinity and Hardness From Waters,
W82-00063 1501 5F

History of a Water Chemical,
W82-00074 1501 5F

Hygiene of Drinking Water in Developing Countries,
W82-00269 1501 5F

A 13-Month Survey of Nematodes at Three Water Treatment Plants in Southern Ontario, Canada,
W82-00294 1501 5F

Silicates as Nonspecific Adsorbents of Bacteriophage: A Model for Purification of Water From Viruses,
W82-00350 1501 5F

Field Evaluation of a Swirl Degritter at Tamworth, New South Wales, Australia,
W82-00376 1501 5F

Effectiveness of Activated Carbon for Removal of Toxic and/or Carcinogenic Compounds From Water Supplies,
W82-00383 1501 5F

Ozone Treatment of Potable Water - Part 1,
W82-00451 1501 5F

Ozone Treatment of Potable Water--Part 2,
W82-00452 1501 5F

Water Treatment Model for Pollutant Exposure Assessment,
W82-00500 1501 5F

Detoxification of Residual Quaternaries,
W82-00562 1502 5G

Chrysotile Asbestos Fiber Removal During Potable Water Treatment. Pilot Plant Studies,
W82-00613 1502 5F

Water-Treatment Chemicals,
W82-00618 1502 5F

Adsorption on Carbon: Solvent Effects on Adsorption,
W82-00619 1502 5F

Acute and Chronic Effects of Alum to Midge Larva (Diptera: Chironomidae),
W82-00650 1502 5F

Flocculation of Clay Particles with a Synthetic Anionic Polymer,
W82-00773 1502 5F

Removal of Nitrate from Public Water Supply Abstractions,
W82-00774 1502 5F

Point-of-Use Water Treatment...An Enlarging Reality,
W82-00784 1502 10D

Assessment of Some Aqueous Residual Chlorine Measurements,
W82-00867 1502 5F

Facts Fix Fund Finding,
W82-00885 1502 9A

Low Turbidity Water from Fast Processes,
W82-00946 1502 5F

Removing Trihalomethanes from Drinking Water,
W82-00953 1502 5F

Ferric Chloride Takes Over,
W82-00954 1502 5F

Economic Analysis of Granular-Bed Filtration,
W82-00975 1502 5F

Chemical Equilibria in Split-Treatment Softening of Water,
W82-01165 1503 5F

Interpreting Laboratory Results for the Design of Rapid Mixing and Flocculation Systems,
W82-01166 1503 5F

Microbiology: Detection, Occurrence, and Removal of Viruses,
W82-01290 1503 5A

Developments in Sedimentation and Flotation,
W82-01391 1503 5F

Bench Scale Assessment of Technologies for Contaminated Ground Water Treatment,
W82-01433 1503 5G

Regeneration of Anion Exchange Resins by Calcium Carbonate and Carbon Dioxide,
W82-01484 1503 5F

Chemical Control of Mussel Settlement in a Cooling Water System Using Acrolein,
W82-01501 1503 5F

Organics in Water - An Engineering Challenge,
W82-01540 1503 5F

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 1503 5A

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 1503 5D

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 1503 5F

Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 1503 8A

A Survey of Trihalomethanes in the Drinking Water System of Murfreesboro, Tennessee,
W82-01817 1504 5B

Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 1504 5F

Tying Up TCE,
W82-01866 1504 5G

Tackling the Nitrate Problem.
W82-01874 1504 5F

Processes--Not Products--Biggest Energy-Saving Factors.
W82-02218 1505 5D

Chemical Pretreatment for Activated-Carbon Adsorption,
W82-02234 1505 5F

Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants,
W82-02307 1505 5A

Phosphorus Removal by Activated Alumina,
W82-02313 1505 5D

Cost of Small Water Supply Treatment Systems,
W82-02318 1505 5F

Shallow-Depth Sedimentation of Biological Materials,
W82-02336 1505 5D

Water Clarification and Decolorization with Regenerable Magnetic Particles,
W82-02351 1505 5F

Optimizing Coagulants and Flocculant Aids for Settling,
W82-02409 1505 5F

New European Experiences in Removal of Organics in Surface Water Treatment,
W82-02420 1505 5F

Continuous Monitoring at Minworth Water Reclamation Works,
W82-02431 1505 7B

Reducing Plumbosolvency - The Effect of Added Lime on the Loch Katrine Supply to Glasgow,
W82-02446 1505 5F

pH Correction: Technical Aspects of a 500 TCMD Treatment Works,
W82-02447 1505 5F

Methods for Treatment of Color in Groundwater,
W82-02532 1505 5F

Trihalomethane Precursor Control by Adsorption,
W82-02598 1505 5F

Energy Management in the Water Works Industry,
W82-02608 1506 5F

Chemical Coagulation of Surface Water,
W82-02623 1506 5F

Method and Apparatus for Supplying Dissolved Chemicals into Water,
W82-02625 1506 5F

Ozone Water Treatment,
W82-02682 1506 5F

A Dynamic Program for Coagulation and Filtration at Chicago's Jardine Water Treatment Plant,
W82-02731 1506 5F

The Roman Way,
W82-02744 1506 5F

Sea Water Distillation in Jersey and Its Use to Augment Conventional Water Resources,
W82-02748 1506 3A

Practical Experiences in Plants Using Activated Carbon,
W82-02788 1506 5F

Bacteria from a Suspended Growth System as Organic Precursors to the Formation of Trihalomethanes,
W82-02806 1506 5F

New Antimicrobial Agents for Treatment of Water,
W82-02808 1506 5F

The Development of a Village Water Supply System on Truk,
W82-02816 1506 5F

The Cost of Quality,
W82-02881 1506 5F

Adsorption of Dissolved Organics in Lake Water by Aluminum Oxide. Effect of Molecular Weight,
W82-02940 1506 5F

The Equilibrium Fluoride Capacity of Activated Alumina,
W82-02968 1506 5F

Inorganic Contaminant Removal from Drinking Water by Reverse Osmosis,
W82-02969 1506 5F

An Introduction to Industrial Water Treatment,
W82-03071 1507 5F

New Techniques to Remove Radon from Ground Water.
W82-03157 1507 5F

Ozone Water Treatment Systems,
W82-03448 1508 5F

Mixed Bed Technology for Polishing Make-Up Water and Condensate Return, Part One,
W82-03471 1508 5F

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 1508 5F

Chlorination of Drinking Water and Pregnancy Outcomes in New York Villages, 1968-1977,
W82-03506 1508 5C

A Novel Chloramine Compound for Water Disinfection,
W82-03551 1508 5F

Kinetics of Trihalomethane Formation in Lyophilized Potomac Water,
W82-03596 1508 5F

Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 1508 5F

Declining-Rate Filtration,
W82-03656 1508 5F

Removing Color and Chloroform Precursors from Low Turbidity Waters by Direct Filtration,
W82-03657 1508 5F

Comparative Performance of Dual- and Mixed-Media Filters,
W82-03659 1508 5F

Methods for Evaluating Performance of Filter Media,
W82-03661 1508 5F

Vinyl Lined Asbestos Cement Pipe Problems-Health Aspects,
W82-03663 1508 5F

Hygienic Evaluation of the Polyamide Membrane Pheylone-2S and Phenol Formaldehyde Resin VIAM-B for Use in Reverse Osmosis Treatment of Water. (Gigienicheskaya Otsenka Poliamidnykh Membran Fenilon-2S I Fenolformal'Degidnoi Smoly VIAM B, Primenenyaemykh pri Obratnoosmoticheskom Oprechnenii Vody),
W82-03698 1508 3A

Water Softening by Crystallization,
W82-03750 1508 5F

Evaluation of Thermodynamical Efficiency of Reverse Osmosis Process Using Entropy,
W82-03760 1509 5D

Effect of Water Treatment on Mutagenic Potential,
W82-03776 1509 5A

Municipal Ion Exchange: Waiting to Take Off,
W82-03837 1509 5F

The Impact of Eutrophication on Water Treatment and Supplies in the Anglian Water Authority,
W82-03866 1509 5C

Clarification with Microsand Seeding. A State of the Art,
W82-03880 1509 5F

Closed-Loop Stripping Analysis as a Tool for Solving Taste and Odor Problems,
W82-03886 1509 5F

Evaluating Adsorbent Filter Performance for Enteric Virus Concentrations in Tap Water,
W82-03887 1509 5F

Gas Chromatographic Techniques for Controlling Organics Removal Processes,
W82-03888 1509 5A

Adsorption of PCBs by Cellulose Fiber Filter-aids and Carbonaceous Adsorbents Used for Water Treatment,
W82-03937 1509 5F

Development of an Ultra-Thin-Skinned Reverse Osmosis Membrane Using Homogeneous Poroplastic Film As the Ultramicroporous Substrate,
W82-03947 1509 3A

Color Removal from Groundwater by Ion Exchange and Sludge Recycle Techniques,
W82-03956 1509 5F

Automated Treatment Plant Keeps Rotterdam Drinking Water Flowing.
W82-04004 1509 5F

Chemical Treatment of Small Remote Water Sources,
W82-04005 1509 5F

Controlling Bed Losses of Granular Activated Carbon Through Proper Filter Operation,
W82-04089 1509 5F

Orthokinetic Flocculation in Deep Bed Granular Water Filters,
W82-04094 1509 5F

Modifications of the Tentative Standard Method for Improved Virus Recovery Efficiency,
W82-04095 1509 5A

Upgrading Water Treatment Plants: An Alternative to New Construction,
W82-04098 1509 5F

An Experimental Approach to Corrosion Control,
W82-04099 1509 5F

Measuring the Velocity of Water in a Paddled Flocculator,
W82-04102 1509 5F

The Status of Direct Filtration.
W82-04105 1509 5F

Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics: Part 5,
W82-04106 1509 5F

Feasibility Studies on Liquid Ion Exchange for Alum Recovery from Water Treatment Plant Sludges,
W82-04107 1509 5E

Activated Carbon Versus Resin Adsorption of Humic Substances,
W82-04109 1509 5F

Algal Concentration as a Quality Parameter of Finished Drinking Waters in and Around Pittsburg, PA,
W82-04114 1509 5F

The Use of Chloramines to Prevent Trihalomethane Formation,
W82-04115 1509 5F

Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant,
W82-04116 1509 5F

Recent Developments in Direct Filtration,
W82-04122 1509 5F

Dual Distribution Systems Analysis,
W82-04123 1509 5F

Disposal and Handling of Water Treatment Plant Sludge,
W82-04126 1509 5E

Studies of Asbestos Removal by Direct Filtration of a Lake Superior Water,
W82-04127 1509 5F

Plant-Scale Comparison of Direct Filtration Versus Conventional Treatment of a Lake Erie Water,
W82-04129 1509 5F

The Costs of Compliance: An EPA Estimate for Organics Control,
W82-04132 1509 6C

Denver's Potable Reuse Project: Pathway to Public Acceptance,
W82-04140 1509 3C

The Bed Depth Service Time Design Method for Deep Bed Filtration,
W82-04143 1509 5F

An Evaluation of Activated Carbon for Drinking Water Treatment: A National Academy of Science Report,
W82-04146 1509 5F

Waterborne Giardiasis--An Overview,
W82-04186 1509 5C

Specific and Chelate Exchangers: New Functional Polymers for Water and Wastewater Treatment,
W82-04275 1510 5F

The Scientific Basis for Control of Lead in Drinking Water by Water Treatment,
W82-04301 1510 5F

Regulating Corrosive Water,
W82-04335 1510 6B

When a Water Supply Went Bad.
W82-04357 1510 5C

Considerations on Organic Matter in Drinking Water Treatment,
W82-04374 1510 5F

Granular Activated Carbon Installations,
W82-04391 1510 5F

Effect of Halogens on Giardia Cyst Viability,
W82-04401 1510 5F

Health Effects of Alternate Disinfectants and Their Reaction Products,
W82-04422 1510 5C

Coagulation Mechanisms: An Electron Microscopic Study Using Aluminum Sulfate,
W82-04423 1510 5F

Coagulation: Experiences in Organics Removal,
W82-04424 1510 5F

Control of Trihalomethanes in Drinking Water,
W82-04425 1510 5F

Evaluation and Treatment of Synthetic Organics in Drinking Water Supplies,
W82-04427 1510 5F

Removal of Total Organic Halogen by Granular Activated Carbon Adsorbers,
W82-04429 1510 5F

Effects of Chlorine Concentration on the Structure of Poliovirus,
W82-04525 1510 5F

Water in Pharmaceuticals and Cosmetics Industries,
W82-04533 1510 5F

The Neckar as a Source of Process and Reserve Water (Der Neckar als Lieferant von Betriebe- und Reservewasser),
W82-04546 1510 5F

Purification of Surface Waters (Reinigung von Oberflachenwasser),
W82-04577 1510 5F

Selective Removal of Fluoride, Arsenate and Phosphate Ions from Water (Selektive Entfer-

nung von fluorid-, Arsenat- und Phosphat-ionen aus Wasser),
W82-04578 1510 5F

Slow-Sand Test-Beds Help Refine Design,
W82-04614 1510 5F

Flocculation in Pipes for Water Pollution Control and Phosphorus Removal Purposes (Uber die Anwendung der Flockenbildung in Rohren zur Wasserreinhaltung und Phosphatelimination),
W82-04615 1510 5F

Colloidal Organics,
W82-04689 1510 5F

Reaction of Ozone with Trans,Trans-Muconic Acid in Aqueous Solution,
W82-04731 1510 5F

Suppression of Break Point Prechlorination by Fast Biological Filtration, Comparative Study of Clarification Efficiencies Obtained by Single or Multilayered Blankets (Suppression de la Prechloration au Break Point par Filtration Biologique Rapide: Etude Comparee de L'efficacite de Decanteurs Biologiques a Lits Fluidises Simples ou Superposes),
W82-04765 1511 5F

Electrophoretic Mobility Measurements in Coagulation with Aluminum Salts,
W82-04790 1511 5F

Factors Affecting Coliform Bacteria Growth in Distribution systems,
W82-04792 1511 5F

Costs for Small Systems to Meet the National Interim Drinking Water Regulations,
W82-04793 1511 5C

Laboratory Testing of Ozonation Systems Prior to Pilot-Plant Operations,
W82-04795 1511 5F

A Spatial Costing System for Drinking Water,
W82-04796 1511 6C

Factors Influencing Formation of Trihalomethanes in Drinking Water with Special Reference to Swedish Conditions,
W82-04826 1511 5F

Potable Water Production in Holland.
W82-04851 1511 5F

The Hygienic Control of Swimming Baths.
W82-04853 1511 5F

Design, Construction and Operation of a New Filter Approach for Treatment of Surface Waters in Southeast Asia,
W82-04869 1511 5F

Preliminary Screening of Bacterial Components as Organic Precursors to the Formation of Trihalomethanes,
W82-04957 1511 5F

Prospects of Using Radiation Water Treatment Methods,
W82-05026 1511 5D

Study of Chlorine Dioxide and Its Metabolites in Man,
W82-05057 1511 5F

Water System Design Meets Modern Challenges,
W82-05170 1511 5F

Removal of Refractory Organics from Water by Aeration. I. Methyl Chloroform,
W82-05174 1511 5D

The use of Activated Carbon in Water Treatment,
W82-05182 1511 5F

Biological Denitrification for Potable Water Treatment,
W82-05247 1511 5F

Methane in Water Wells,
W82-05262 1511 5F

Development of Evaluation of Ion-Exchange Resins for Removal of Specific Metals in Water Treatment,
W82-05282 1511 5F

Fabrication and Characterization of Metal Membranes Having Pore Charge Control for Desalination,
W82-05314 1511 3A

Automation of the Seine Water Treatment Station at Morsang and of the Water Softening Station at Villeneuve-La-Garenne (Automatisation de la Station de Traitement d'Eau de Seine a Morsang et de la Station d'Adoucissement de Villeneuve-La-Garenne),
W82-05364 1511 5F

Development of Water Treatment in France (Evolution dans le Traitement des Eaux en France: Quelques Exemples d'Actualite),
W82-05367 1511 5F

Treatment of Water from Eutrophied Impoundments,
W82-05368 1511 5F

Chemicals in Water Treatment--Effects on Water Quality,
W82-05369 1511 5F

Ozone and Activated Carbon,
W82-05370 1511 5F

Conversion of Aerator to Chlorine Contact Tank at the Owls Head Water Pollution Control Plant,
W82-05402 1511 5D

Water and Wastewater Treatment in Latin America--Applied Technology,
W82-05425 1511 5F

Removing Trihalomethane Precursors by Permanganate Oxidation and Manganese Dioxide Adsorption,
W82-05668 1511 5F

Microbial Activity in Activated Carbon Filters,
W82-05683 1511 5F

Trihalomethanes in Chlorinated Cooling Waters of Nuclear Reactors,
W82-05713 1511 5F

Relationships Between Raw Water Quality, Treatment, and Occurrence of Organics in Canadian Potable Water,
W82-05761 1511 5F

Improvement of Swirl Concentrator,
W82-05821 1511 5D

Influence of Ozonation on Sulfur, Nitrogen, Chloride and Phosphorus Systems in Public Drinking Water Supplies,
W82-05907 1512 5F

Desalination Directory 1981.
W82-05908 1512 3A

Identification of Atypical Coliforms from Public Water Supplies in Missouri,
W82-05935 1512 5A

Plant Expansion Via High-Rate Pretreatment,
W82-05953 1512 5F

Construction Criteria of the Mery-Sur-Oise Storage Basin - Improvements in Water Quality Obtained,
W82-06013 1512 5G

Packaged Plant Treats Turbidity,
W82-06026 1512 5F

Florida Style Water Supply and Treatment,
W82-06027 1512 5F

They Don't Activate Their Sludge in Lagos or Lahore,
W82-06075 1512 5F

Water Treatment by Aquatic Ecosystem: Nutrient Removal Reservoirs and Flooded Fields,
W82-06078 1512 5D

Appropriate Selection of Water/Wastewater Treatment Processes for Small Cities and Rural Areas,
W82-06162 1512 5D

Investigation of the Chemical Nature and Possible Toxicity of Products Formed During the Ozone Disinfection of Drinking Water Containing Organic Substances,
W82-06173 1512 5F

Overhauling a Water System,
W82-06224 1512 5F

Removal of Inorganic Mercury from Water by Bitmuminous Coal,
W82-06265 1512 5D

Advanced Water Treatment for Color and Organics Removal,
W82-06279 1512 5F

Processes for Removal of Inorganic Contaminants from Water,
W82-06342 1512 5F

Potable Water Treatment by Dissolved Air Flotation and Filtration,
W82-06353 1512 5F

Physical-Chemical Treatment and Disinfection of Stormwater,
W82-06389 1512 5G

A Microprocessor-Based Controller for the Plugging Factor Monitor,
W82-06398 1512 3A

Getting Your Money's Worth from Filtration,
W82-06412 1512 5F

The Effect of Backwashing Rate on Filter Performance,
W82-06415 1512 5F

Low-Dosage High-Rate Direct Filtration,
W82-06416 1512 5F

Low Cost Filtration Plants for Water Supply of Ardha-Kumbha Mela, 1980 at Hardwar,
W82-06437 1512 5F

Evolving High Rate Filter and Use of Crushed Stone as Filter Media,
W82-06440 1512 5F

Settling Characteristics of Flocculent Suspension in Defluoridation of Water by Nalgonda Technique,
W82-06441 1512 5F

Presedimentation Tanks for High Turbid Raw Water,
W82-06444 1512 5F

M B Settler: A More Economical Alternative to Conventional Settler,
W82-06446 1512 5F

The Production of Public Supply Drinking Water from Rutland Water at the Wing Treatment Works,
W82-06474 1512 5F

Rutland Water Raw Water Quality - Problems and Management,
W82-06475 1512 5G

Optimum Use of Chlorine in Circulating Water,
W82-06498 1512 5F

Time-Shared Computer Technology for the Water and Wastewater Industries,
W82-06511 1512 5D

Influence of Stabilizer Concentration on Effectiveness of Chlorine as an Algicide,
W82-06539 1512 5F

Factors That Affect Use of Direct Filtration in Treating Surface Waters,
W82-06579 1512 5F

Metal Removal 'A La Carte',
W82-06608 1512 5F

Making Chlorination Trustworthy,
W82-06639 1512 5F

Crisis: Financing Water and Wastewater,
W82-06641 1512 6C

Apparatus for Desalinating Water,
W82-06711 1512 3A

Ultraviolet Systems in Water Treatment,
W82-06726 1512 5F

Geosmin and 2-Methylisoborneol from Cyanobacteria in Three Water Supply Systems,
W82-06740 1512 5F

Complex Sequence Treats Fluctuating Flows,
W82-06814 1512 5F

A Guide to Treatment for Bacterial Problems,
W82-06847 1512 5F

WATER TREATMENT FACILITIES
Development of a Rural Water District,
W82-00288 1501 6A

Treatment Works–The Designer's Problems,
W82-00312 1501 5F

Foam Control in Aeration Tanks,
W82-00525 1502 5D

Empire Controlled by Computer,
W82-00529 1502 5D

Mixing Technology Reduces Energy Use,
W82-00634 1502 5D

Design and Construction of the Danvers, Massachusetts Water Processing Plant,
W82-01088 1502 5F

Expansion of Effluent Constrained Treatment Plants,
W82-01355 1503 5D

The River Ouse Water Supply Scheme,
W82-01371 1503 5F

Scaynes Hill STW Extensions Include Plastic Media Filtration.
W82-01386 1503 5D

Small Water Systems: Role of Technology,
W82-01542 1503 5F

Economic Impact of Existing Ammonia Nitrogen Water Quality Standard, IPCB Chapter 3, Rule 203 (F),
W82-02189 1505 5D

Seasonal Evaluation of Organics Removal at a Conventional Water Treatment Plant,
W82-02248 1505 5F

Specific Organic Removals by Granular Activated Carbon Pilot Contactors,
W82-02260 1505 5F

Jonkoping's Water Supply,
W82-02419 1505 5F

Energy Management in the Water Works Industry,
W82-02608 1506 5F

New Concepts in Filtration Plant Design and Rehabilitation,
W82-02681 1506 5F

Cost Estimates for Water Treatment Plant Operation and Maintenance.
W82-02697 1506 6C

Evaluating a Plant's Potential for Upgrading,
W82-02895 1506 5F

Design and Fabrication of a Low Cost Package Water Treatment Plant for Rural Areas in India,
W82-03115 1507 5F

Modern Management Techniques. Part I: Need for, and Importance of, Productivity Improvement,
W82-03311 1507 6A

Innovations in Wastewater Treatment Processes: Design Background Documents Due In 1981,
W82-03453 1508 5D

Outlook for Water and Wastewater Systems, Processes, and Equipment: Comments from Metcalf and Eddy, Inc., Boston, MA,
W82-03473 1508 5F

Designing an Energy-Efficient Wastewater Treatment Plant.
W82-03477 1508 5D

Upgrading to Increase Treatment Capacity,
W82-03654 1508 5F

Upgrading Water Treatment Plants in San Diego,
W82-03655 1508 5F

Notes and Comments: Leaching of Organics from a PVC-Polyethylene-Plexiglass Pilot Plant,
W82-03890 1509 5F

Tailoring Design of Treatment Plants to Local Conditions,
W82-03893 1509 5F

Automated Treatment Plant Keeps Rotterdam Drinking Water Flowing.
W82-04004 1509 5F

Intensive Survey of Armand Bayou,
W82-04079 1509 5A

Intensive Survey of Hunting Bayou,
W82-04080 1509 5A

Conducting a Regular Main Flushing Program,
W82-04118 1509 5F

Water Supply in the Paris Suburbs: Changing Treatment for Changing Demands,
W82-04125 1509 5F

Direct Filtration Treatment Plants: Costs and Capabilities,
W82-04128 1509 5F

Reliability and Redundancy: Dual Protection for Water Treatment Plants,
W82-04148 1509 5F

Impact of Phosphorus Removal at the Danbury, Connecticut Sewage Treatment Plant on Water Quality in Lake Lillinonah,
W82-04298 1510 5D

Design Models for Adsorption Systems in Wastewater Treatment,
W82-04300 1510 5D

Shaking Down a Solids Handling System,
W82-04338 1510 5D

Benefits from Water Conservation Depend on Comprehensive Planning,
W82-04557 1510 3D

Use of Microscreens to Polish Lagoon Effluents,
W82-04709 1510 5D

Right Velocity Keeps the Solids Up,
W82-05788 1511 5D

Water Pollution Control Plant Upgraded to Meet EPA Regs.
W82-06187 1512 5D

Design Considerations in Waterworks Pumps Selection,
W82-06343 1512 8C

Variable Frequency Drives - Some Application Principles,
W82-06345 1512 8C

Water Supply and Distribution in Larger Communities,
W82-06413 1512 5F

WATER TRETMENT
Characterization of Laverkin Springs Water and Methods for Its Reuse in Energy Development,
W82-06400 1512 5G

WATER USE
Water-Related Environmental Control Requirements at Municipal Solid Waste-to-Energy Conversion Facilities,
W82-00037 1501 5D

Water - Its Use and the Implications for Arkansas Agriculture.
W82-00714 1502 6D

Proposed Water Quality Control Plan for Indio Subarea of the Whitewater Hydrologic Unit, West Colorado River Basin.
W82-00716 1502 6F

State Water Use and Socioeconomic Data Related to the Second National Water Assessment,
W82-00739 1502 6D

Water Resources Appraisals for Hydroelectric Licensing: Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 1504 6D

Water Resources Appraisal for Hydroelectric Licensing: Kennebec River Basin, Maine.
W82-01755 1504 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 1504 6E

An Overview of Texas Law, Policy, and Agency Actions Concerning Estuarine Inflow,
W82-02154 1505 6E

Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

Estimated Water Use in the Southwest Florida Water Management District and Adjacent Areas, 1980,
W82-02482 1505 7C

Water Conservation Program of the City of Greensboro,
W82-02518 1505 3D

Water for Industry, W82-02767 1506 6D

Water Resources Apparisals for Hydroelectric Licensing; St. Joseph - Kalamazoo River Basin; Indiana - Michigan, W82-03044 1507 6D

Groundwater Quality in Visakhapatnam Basin, India, W82-03552 1508 6D

Household Water Use: Technological Shifts and Conservation Implications, W82-03910 1509 3D

Projected Effects of Energy Policies on Agricultural Water Use and Irrigation, W82-03915 1509 6C

Estimating Irrigation Water Use Through Selective Monitoring: A North Florida Case Study, W82-03919 1509 7A

Water Use in Manufacturing, W82-04070 1509 6D

Forecasting Water Demand in the Pacific Northwest, W82-04135 1509 6D

Water Use Data--Who Needs It, W82-04198 1509 7C

Water Savings from Lawn Watering Restrictions During a Drought Year, Fort Collins, Colorado, W82-04232 1509 3D

Deterministic Models for Predicting Residential Water Consumption, W82-04352 1510 6D

An Economist's View of Demand Projections Considering Conservation, W82-04448 1510 6D

Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington, W82-04514 1510 2A

Benefits from Water Conservation Depend on Comprehensive Planning, W82-04557 1510 3D

The Welsh Approach to Water Recreation, W82-04658 1510 6D

The Seven-Trent Studies of Industrial Water Use, W82-04686 1510 6D

A Multivariate Analysis of Municipal Water Use in Utah, W82-04728 1510 3D

Ground-Water Hydrology of Jefferson County, West Virginia, W82-04986 1511 2F

Abandoned Coal Mines in West Virginia as Sources of Water Supplies, W82-05219 1511 3C

Water Use in Ohio, 1975, W82 05226 1511 6D

Water Resources of the Walker River Indian Reservation, West-Central Nevada, W82-05235 1511 6B

Applications of Simulation to Specific Water Projects, W82-05522 1511 6A

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams, W82-05749 1511 6E

Hydrology and the Effects of Industrial Pumping in the Nikiski Area, Alaska, W82-05846 1511 2F

Measurement and Modelling of Primary Production and Water Use in a South Tunisian Steppe, W82-05876 1511 2D

Cost-Based Water Rate Design, W82-06277 1512 6C

Truckee Meadows Water Use - Present and Future, W82-06705 1512 3D

WATER USE EFFICIENCY

Yield and Water Use of Vegetable Crops with Seepage and Drip Irrigation Systems, W82-00544 1502 3F

Mandatory or Voluntary Water Conservation: A Case Study of Iowa Communities During Drought, W82-01553 1503 3D

Water Use Efficiency in Douglas Fir: The Nature of Plant Response to Selected Environmental Variables, W82-03019 1507 2I

Water Use and Water-Use Efficiency of Wheat and Barley in Relation to Seeding Dates, Levels of Irrigation and Nitrogen Fertilization, W82-03266 1507 3F

Quantification of Rainfall and Its Utilization Efficiency in Rajasthan, W82-03276 1507 2B

Consumptive Water Use by Opium Poppy, W82-03356 1507 2I

Performance of Different Crops with Residual Moisture in Vertisols, W82-03357 1507 2I

Soil and Water Regimes for Optimum and for Maximum Yields, W82-04415 1510 3F

Sorghum and Barley in Southern Alberta: Grain Yield Response to Irrigation and Fertilizer, W82-04471 1510 2I

Water Use Efficiency and Rotational Water Supply at the Farm Level: Certain Results from an Experimental Pilot Project in Gujarat State, India, W82-04608 1510 3F

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh, W82-05119 1511 2I

Effect of Moisture Levels in Vegetative and Reproductive Phases of Winter-Sown Maize on Grain Yield, Irrigation Requirement and Water-Use Efficiency, W82-05120 1511 2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat, W82-05121 1511 2D

Effect of Plant Population and Nitrogen on Water-Use Efficiency of Pearlmillet in the Arid Zone of Western Rajastan, W82-05122 1511 2I

Flexcrop: A Dryland Cropping Systems Model, W82-05208 1511 3F

Optimizing the Use of Water and Nitrogen Through Breeding of Crops, W82-05608 1511 3F

Optimizing the Use of Water and Nitrogen Through Soil and Crop Management, W82-05609 1511 3F

Efficient Water Use in California: Conjunctive Management of Ground and Surface Reservoirs, W82-05628 1511 4B

Salt- and Drought-Tolerant Crop Plants for Water Conservation, W82-05920 1512 3C

Adaptive Real-Time Streamflow Forecasting Model for Hydrosystem Operational Planning, W82-05926 1512 2E

Irrigation Requirement of High-Yielding Rice Varieties Grown on Soils Having Shallow Water-Table, W82-05971 1512 3F

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use, W82-06155 1512 3D

WATER USERS

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin, W82-01698 1503 6B

The Impact of Mass Distribution of Water Conservation Devices and a Water Conservation Rate Structure on Residential Water Use, W82-06155 1512 3D

Water Utility Costs and Rate Design for Fire Protection Services, W82-06275 1512 6C

WATER VAPOR

Gravitational Stability of Water Over Steam in Vapor-Dominated Geothermal Systems, W82-00963 1502 1A

A Model of the Antarctic Sink for Stratospheric Water Vapor, W82-01686 1503 2A

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area, W82-01966 1504 2B

Characterization of Properties of Water, W82-05540 1511 1A

WATER WELLS

Methane in Water Wells, W82-05262 1511 5F

Ground Water Quality and Quantity in Fracture Zones in the Piedmont of Northwestern South Carolina, W82-06309 1512 4B

WATER YIELD

Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine, W82-00017 1501 2F

Results of Acidizing Water Wells in Arizona, W82-01199 1503 4B

Water Resources of the Kisatchie Well-Field Area Near Alexandria, Louisiana, W82-02480 1505 7C

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield, W82-02533 1505 2A

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds: In-

terim Report No. 1, A Study of Some Empirical Methods of Determining the Unit Hydrograph,
W82-02803 1506 2A

Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

A Review of Catchment Experiments to Determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration,
W82-05647 1511 4C

Water Yield Estimation in Western United States,
W82-05689 1511 4D

First-Year Effects of Clearcutting an Oak-Hickory Watershed on Water Yield,
W82-06589 1512 4C

WATER YIELD IMPROVEMENT
Forest Management for Increased Water Yield--How Useful in Southern Alberta,
W82-05760 1511 3B

Colorado River Enhanced Snowpack Test Environmental Assessment and Design Phase Finding of No Significant Impact,
W82-06967 1512 6G

WATERBORNE DISEASE
Waterborne Disease in The United States and Canada.
W82-03892 1509 5C

WATERBORNE DISEASES
Waterborne Giardiasis--An Overview,
W82-04186 1509 5C

The Continuing Struggle of Waterborne Illness,
W82-05366 1511 5C

WATERCOURSES
French Experience in Water Pollution Control,
W82-02765 1506 5G

WATERCRESS
Mineral Nutrient Availability in Watercress Bed Substrates,
W82-02769 1506 2I

WATERFOWL
Water-Quality Problems and Management of an Urban Waterfowl Sanctuary,
W82-04384 1510 5G

WATERHAMMERS
Resonant Waterhammer: A Case Study,
W82-05981 1512 8C

WATERLOGGING
Waterlogging Control for Improved Water and Land Use Efficiencies: A Systematic Analysis,
W82-02455 1505 6A

Irrigation, Crop Yield and Drainage on the Vaalharts Irrigation Scheme: 2. The Occurence of and the Influence of Drainage on Salinized Soil (In Afrikaans),
W82-03466 1508 4B

Development of Natural Subirrigation of Lands and Its Prediction Near Large Reservoirs,
W82-05238 1511 4A

The Effect of Short-Term Waterlogging During Furrow Irrigation of Cotton in a Cracking Grey Clay,
W82-06010 1512 3F

WATERPOLLUTION PREVENTION
Assessment of the National Water Quality Management Program, Vol. I, 106 Program Overview, Planning and Standards.
W82-02181 1505 6E

WATERPROOFING
Redesign Controls Manhole Leakage,
W82-01237 1503 8G

Stopping Water with Chemical Grout,
W82-03396 1507 8G

Watertight Manholes Cut Inflow.
W82-06844 1512 5G

WATERSHED MANAGEMENT
Basin Management in the San Bernardino Valley,
W82-00075 1501 4B

Basin Management in the San Bernardino Basin Area,
W82-00280 1501 6A

Multivariate Hydrologic Time Series Analysis,
W82-00647 1502 2A

Answers: A Model for Watershed Planning,
W82-00898 1502 6A

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 1503 2A

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 1503 2J

The Effect of Forest Clearcutting in New England on Stream-Water Chemistry and Biology,
W82-02178 1505 4C

Lake Tahoe Preservation Bill Enacted.
W82-02244 1505 6E

Water Resources Protection Measures in Land Development - A Handbook - Revised Edition,
W82-02453 1505 4D

Forecasting Subsurface Water Flow and Storage on Forested Slopes Using a Finite-Element Model,
W82-03018 1507 2G

Stormwater Detention in Developing Watersheds,
W82-03363 1507 4A

Interstate Highways Versus Watershed Protection in New England,
W82-03431 1508 5B

The Economics of Urban Stormwater Management,
W82-03508 1508 4A

Reservoir Improvements as a Key to Source Quality Control,
W82-04145 1509 5G

The Wisconsin Soil and Water Conservation District as an Institution to Undertake Subwatershed Planning to Control Non-Point Source Water Pollution,
W82-04212 1509 6A

A Hydrologic Simulation for Predicting Nonpoint Source Pollution,
W82-04485 1510 5B

A Kinetic Model for Surface Mine Sediment Yield,
W82-04552 1510 2J

New Strategies for Water Resource Planning in British Columbia,
W82-05395 1511 6E

Water Yield Estimation in Western United States,
W82-05689 1511 4D

Stream Improvement: The Chicod Creek Episode,
W82-05717 1511 4D

Modeling Sediment Yields from Agricultural Watersheds,
W82-05718 1511 4D

Economic Evaluation of Watershed Projects--An Overview Methodology and Application,
W82-05735 1511 6B

Using the Answers Model to Estimate Sediment Yields on Construction Sites,
W82-05865 1511 4D

Streamflow Changes after Logging 130-Year-Old Douglas Fir in Two Small Watersheds,
W82-06849 1512 4C

A Dynamic System Model for Simulating Sediment Discharge,
W82-06876 1512 4D

Management of Watershed Rehabilitation-- Reflections from Mt. St. Helens and Redwood Creek,
W82-06968 1512 4D

WATERSHED MODELS
Managing Land to Meet Water Quality Goals,
W82-01557 1503 4D

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 1504 5B

WATERSHED PROTECTION
Use of Active Alumina Filtration for Removing Phosphates from Small Influents into an Impounding Reservoir (Anwendung der Aktivtonerdefiltration zur Eliminerung von Phosphaten aus Kleinen Talsperrenzulaufen),
W82-04281 1510 5G

Roads in Water-Procuring Regions - Water Pollution Control and Safeguarding of Water Supply, Exemplified by the Stuttgart-Singen Autobahn (Strassen in Wassergewinnungsgebieten-gewasserschutz und Sicherstellung der Wasserversorgung am Beispiel der Autobahn A 81 Stuttgart-Singen),
W82-04551 1510 4B

WATERSHEDS
Element Mass Balances for South Carolina Coastal Plain Watersheds,
W82-00175 1501 5B

Simulation of Lake-Watershed Systems, I. Description and Sensitivity Analysis of the Model,
W82-00926 1502 2A

Simulation of Lake-Watershed Systems, II. Application to Baptiste Lake, Alberta, Canada,
W82-00927 1502 2A

Nutrient Budget Studies for Forests Along an Elevational Gradient in New Mexico,
W82-01036 1502 2K

Suspended Sediment Production from Forested Watersheds on Oahu, Hawaii,
W82-01531 1503 2J

Using Computed Stream Flow in Watershed Analysis,
W82-01538 1503 2A

Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 1503 5B

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 1503 2E

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 1503 6A

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 1503 5B

Transport of Salts in Catchments and Soils,
W82-01880 1504 2G

Use of Cumulants to Estimate Coefficients in Chow-Kulandaiswamy's GHS Model,
W82-02208 1505 2A

Stream Phosphorus Exports from Watersheds with Contrasting Land Uses in Southern Ontario,
W82-02251 1505 5B

Mathematical Models of Water Yield with Particular Reference to Mississippi Watersheds, Interim Report No. 2: Mathematical Modeling of Watershed Yield,
W82-02533 1505 2A

Comparison of Areal Snow Storage Sampling Procedures for Rangeland Watersheds,
W82-02555 1505 2C

Major Physical Features of Long Point Bay and Its Watershed,
W82-02579 1505 2H

Approximate Error Bounds for Simulated Hydrographs,
W82-02678 1506 2A

Ecological Magnification of Persistent Organochlorine Pesticides in an Illinois Watershed,
W82-02741 1506 5A

Watershed Impact on Stream Water Quality: A Technique for Regional Assessment,
W82-02818 1506 5B

Diverging Overland Flow,
W82-03676 1508 2A

Watershed Model Study Using LANDSAT Image Data,
W82-03814 1509 2A

Nitrogen Dynamics in the Surface Waters of the New Jersey Pine Barrens,
W82-03816 1509 2A

Nutrient Cycling in an Agricultural Watershed: Waterborne Nutrient Input/Output Budgets for the Riparian Zone,
W82-03825 1509 5B

Process-Response Systems: A Practical Approach to Watershed Classification Considering Water and Sediment Yields,
W82-04217 1509 2A

Watersheds As The Basic Ecosystems: This Conceptual Framework Provides A Basis For A Natural Classification System,
W82-04253 1510 7C

Relation Between Curve Number and Runoff Coefficient,
W82-04266 1510 2A

Relative Runoff by Curve Number Nomograph,
W82-04307 1510 2A

Search: A Gaged Watershed Inventory,
W82-04433 1510 10B

Soil Conservation Service Runoff Curve Number Estimates from Landsat Data,
W82-04438 1510 7B

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04463 1510 2A

Peak Runoff Model Comparison on Central Illinois Watersheds,
W82-05489 1511 2A

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

Lag Time for Diverging Overland Flow,
W82-05944 1512 2A

A Benefit Cost Analysis of a Soil Erosion Control Program for the Northern Watershed of Lake Chicot, Arkansas,
W82-06170 1512 4D

Calibrating A Mountain Watershed in Wyoming,
W82-06583 1512 2E

Relationship of Water Quality and Pollutant Loads to Land Uses in Adjoining Watersheds,
W82-06587 1512 5B

Evaluation of Effects of Stormwater Detention in Urban Areas,
W82-06698 1512 5G

WATERWAYS

Predicted Effects on Ground Water of Construction of Divide Cut Section, Tennessee-Tombigbee Waterway, Northeastern Mississippi Using a Digital Model,
W82-00428 1501 2F

Water Chemistry of the Illinois Waterway,
W82-04390 1510 2K

The Automatic Measuring of Sewage in the Artois-Picardie Area,
W82-04602 1510 5A

Gowanus Creek Channel; Brooklyn, New York; Review of Reports (Survey); Main Report and Environmental Impact Statement.
W82-06407 1512 6G

WAVE ACTION

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 1503 2L

Effect of Wave Slope on a Rock Mass in a Revetment,
W82-02694 1506 8B

Hindered Bedload Settling as a Model of Sand Bed Planation by Water Waves,
W82-05607 1511 2J

Investigation of the Overflow Spillway of the Velishchai Reservoir,
W82-06220 1512 8A

Sewer Network Routing by Dynamic Wave Characteristics,
W82-06418 1512 8B

Suspended Sediment in a Wave Field,
W82-06527 1512 2J

WAVE HEIGHT

Hydraulic Model Studies of Landslide-Generated Water Waves-Morrow Point Reservoir,
W82-05211 1511 8B

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

Canadian Wave Climate Study: Organization and Operation,
W82-06393 1512 8B

WAVE PROPAGATION

Wave Formation and Heat Transfer at an Ice-Water Interface in the Presence of a Turbulent Flow,
W82-01128 1503 2C

Parametric Study of Flood Wave Propagation,
W82-03425 1508 2E

Canadian Wave Climate Study: Organization and Operation,
W82-06393 1512 8B

Investigation of the Transformation of Breakthrough Waves in the Lower Pool of a Hydrostation with the Use of Computers,
W82-06622 1512 8B

Investigation of the Parameters of Waves on a Reservoir Surface in the Epicentral Zone of an Earthquake,
W82-06783 1512 8E

WAVE VELOCITY

Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1507 1A

WAVES

Resonator Studies for Kincardine Harbour, Lake Huron,
W82-00228 1501 8B

Wave Climate and Potential Longshore Sediment Transport Patterns, Nottawasaga Bay, Ontario,
W82-01156 1503 2J

Wake Collapse in The Thermocline and Internal Solitary Waves,
W82-03365 1507 1A

Numerical Model of Landslide-Generated Waves,
W82-03971 1509 8B

Nature of Wave Attenuation in Open Channel Flow,
W82-05003 1511 2E

Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

WAYNE COUNTY

The Wayne County, Michigan, Wastewater Collection and Treatment System,
W82-01505 1503 5D

Wastewater Collection and Treatment in Wayne County,
W82-02554 1505 5D

WEATHER

The World Climate Programme,
W82-00317 1501 6A

Soil Filtration of Sewage Effluent of a Rural Area,
W82-03004 1507 5D

Water Temperature Dynamics in Experimental Field Channels: Analysis and Modeling,
W82-03025 1507 1A

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

WEATHER DATA COLLECTIONS

Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

Automation of a Sprinkler Irrigation System by the Utilization of Real Time Weather Information,
W82-06695 1512 3F

WEATHER DATA SIMULATION
Simulation of Daily Weather Data Using Theoretical Probability Distributions,
W82-01526 1503 2B

WEATHER FORECASTING
Relation of Satellite-Based Thunderstorm Intensity to Radar-Estimated Rainfall,
W82-00806 1502 2B

Real-Time Rainfall Monitoring-Prediction System and Urban Hydrologic Operations,
W82-02588 1505 7A

Rainfall Prediction-Measurement Systems and Rainfall Design Information for Urban Areas,
W82-03008 1507 7B

Hydroclimatological Characteristics of Isolated Severe Rainstorms,
W82-04336 1510 2B

Determination of the Total Precipitable Water by Varying the Intercept in Reitan's Relationship,
W82-04901 1511 2B

On Predicting the Onset of the Australian Wet Season at Darwin,
W82-06208 1512 2B

On a Statistical Relationship Between Autumn Rainfall in the Central Equatorial Pacific and Subsequent Winter Precipitation in Florida,
W82-06209 1512 2B

Autocorrelations of Moisture Parameters on Isentropic Surfaces,
W82-06210 1512 2B

WEATHER MODIFICATION
Seeding-Opportunity Recognition in Winter Orographic Clouds,
W82-01005 1502 3B

Weather Modification from Cooling Towers. A Test Based on the Distributional Properties of Rainfall,
W82-01527 1503 2B

Evaluations of Illinois Weather Modification Projects of 1976-1980: A Summary,
W82-03006 1507 3B

Atmospheric Issues Identified in State Water Resource Planning,
W82-06176 1512 6B

WEATHER PATTERNS
Recent Variations in Winter Extratropical Cyclone Activity for the Australian Region,
W82-00315 1501 2B

Solar Cycles and Erosional Events on the New South Wales Central and South Coasts,
W82-00318 1501 2J

Historical Nile Floods and Their Implications for Climatic Change,
W82-00326 1501 2E

Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 1504 2B

Cyclic Fluctuations in the Flood Area and Relationship with the Double (Hale) Sunspot Cycle,
W82-04896 1511 2A

The 1980 Summer Heat Wave and Drought in Historical Perspective,
W82-06213 1512 2B

Spatial Coherence of Monthly Precipitation in the United States,
W82-06894 1512 2B

WEATHERING
'Acid Rain', Dissolved Aluminum and Chemical Weathering at the Hubbard Brook Experimental Forest, New Hampshire,
W82-03641 1508 5B

Exchange of Marine Sodium for Calcium During Chemical Weathering in the Isle Aux Morts River Basin, Newfoundland,
W82-05414 1511 2K

WEED CONTROL
Control of Water Weeds by Grass Carp in Two Small Lakes,
W82-00609 1502 3B

A Comparison of Chemical and Cultural Control of Weeds in Irrigation Ditchbanks,
W82-01120 1503 4A

The Toxicity of 2,4-D to Cyprinus Carpio Var. Communis in Relation to the Seasonal Variation in the Temperature,
W82-02294 1505 5C

Aquatic Weed Research in Britain,
W82-03187 1507 4A

The Ecology of a Land Drainage Channel--I. Oxygen Balance,
W82-03306 1507 4A

Water Fluctuation and the Aquatic Flora of Lake Miccosukee,
W82-05808 1511 4A

WEIRS
Discharge Characteristics of Triangular-Notch Thin-Plate Weirs,
W82-02842 1506 8B

Flow Under Weir on Scoured Bed,
W82-05800 1511 8B

The V-Shaped Broad-Crested Weir,
W82-06450 1512 8B

The Annabrucke River Power Station on the Drau, Constructions Taken to Prevent Erosion in the Vicinity of the Barrage on an Exceptional Subsoil (Das Draukraftwerk Annabrucke, Massnahmen zur Verhinderung der Erosion in Bereich Des Bauwerkes auf Aussergewohnlichem Untergrund),
W82-06636 1512 8E

WELL CASING
Cavity Well,
W82-04920 1511 8A

WELL DATA
An All-Teflon Bailer and an Air-Driven Pump for Evacuating Small-Diameter Ground-Water Wells,
W82-01333 1503 7B

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 1503 7C

Geology and Water Availability of Dallas County, Alabama,
W82-02833 1506 6D

Hydrogeologic Data from Two Wells at Myakka Head, Manatee County, Florida,
W82-06129 1512 7C

WELL DESIGN
Fundamental Concepts of Well Design,
W82-02614 1506 8A

WELL DESIGN CRITERIA
Ground Water Monitoring: Part II,
W82-03484 1508 8A

WELL DISCHARGE
Portable Water Elevation Measuring Gage,
W82-06396 1512 7B

WELL DRILLING
Warming Up to Geothermal,
W82-03156 1507 8A

WELL FUNCTION
Evaluation of the Effectiveness and Reliability of Drains of the Tailrace of the Plyavinyas Hydroelectric Station,
W82-03161 1507 8A

WELL HYDRALICS
On Identification and Validation of Some Geothermal Models,
W82-01467 1503 6A

WELL HYDRAULICS
Fundamental Concepts of Well Design,
W82-02614 1506 8A

Estimating Aquifer Parameters for Large-Diameter Wells,
W82-03647 1508 2F

Calculation of Complete Interception of Groundwater Flow to 'Fully Penetrating' Excavations,
W82-04902 1511 8C

Bottom-Entry Large-Diameter Wells,
W82-04919 1511 8A

Cavity Well,
W82-04920 1511 8A

Water-Level Fluctuations Due to Earth Tides at Fort Mackay, Alberta,
W82-05780 1511 4B

On Conducting the Modified 'Slug' Test in Tight Formations,
W82-06060 1512 8B

Locating Monitoring Wells,
W82-06848 1512 8B

WELL WATER
A Study of Samples of Well Water Collected from Selected Areas in California to Determine the Presence of DBCP and Certain Other Pesticide Residues,
W82-00532 1502 5A

New Jersey Community Decontaminates Well Water.
W82-02243 1505 5F

New Techniques to Remove Radon from Ground Water.
W82-03157 1507 [illegible]

Discussion: Influence of Well Water Quality Variability on Sampling Decisions and Monitoring, By Harry I. Nightingale and William C. Bianchi,
W82-03779 1509 5G

Well Water Quality Deterioration in Central Pierce County, Washington,
W82-04133 1509 5B

Empirical Test of the Association Between Gross Contamination of Wells with Toxic Substances and Surrounding Land Use,
W82-05143 1511 5B

Viruses in a Community Water Supply Associated with an Outbreak of Gastroenteritis and Infectious Hepatitis,
W82-06348 1512 5C

A Guide to Treatment for Bacterial Problems,
W82-06847 1512 5F

WELL YIELD
Results of Acidizing Water Wells in Arizona,
W82-01199 1503 4B

Yield Verification of a Dolomite Aquifer in Northeast Illinois,
W82-01334 1503 2F

Managing Wells for Energy Efficiency,
W82-03734 1508 4B

Ground-Water Conditions in the Upper Virgin River and Kanab Creek Basins Area, Utah, with Emphasis on the Navajo Sandstone,
W82-04486 1510 6D

Calculations of the Capacity of Water Intakes with Consideration of Groundwater Leakage Through Steeply Dipping, Poorly Permeable Deposits,
W82-06617 1512 2F

WELLS
Groundwater Availability in Acadia National Park and Vicinity, Hancock and Knox Counties, Maine,
W82-00017 1501 2F

Potentiometric Surface of the Floridan Aquifer in the Suwannee River Water Management District, Florida, May 1980,
W82-00024 1501 7C

Potentiometric Surface of the Floridan Aquifer in the Northwest Florida Water Management District, May 1980,
W82-00025 1501 7C

Water-Level Records for the Northern High Plains of Colorado, 1977-81,
W82-00422 1501 7C

Well-Field Drawdowns Using Coupled Aquifer Model,
W82-00990 1502 2F

Geologic and Hydrologic Factors Controlling Radon-222 in Ground Water in Maine,
W82-01222 1503 2F

Identification of the Wairakei Geothermal System,
W82-01312 1503 2F

Practical Aspects of Ground Water Monitoring at Existing Disposal Sites,
W82-01421 1503 5G

Groundwater Levels in Nebraska 1980,
W82-01785 1503 2F

Water for New Zealand's Plains,
W82-02402 1505 3F

Approximate Altitude of Water Levels in Wells in the Chicot and Evangeline Aquifers in the Houston Area, Texas, Spring 1981,
W82-02459 1505 2F

Water Levels in Bedrock Aquifers in South Dakota,
W82-02466 1505 2F

Ground-Water Data for Michigan 1980,
W82-02467 1505 2F

Chemical Quality of Ground Water in San Joaquin and Part of Contra Costa Counties, California,
W82-02470 1505 2K

Ground-Water-Level Monitoring Network, Hollister and San Juan Valleys, San Benito County, California,
W82-02487 1505 7A

Boise Looks Underground for Heat.
W82-02636 1506 2F

Comparison of the Chemical Composition of the Waters of Lake Piaseczno (Leczynsko-Wlodawskie Lake District) and of the Shallow Ground Waters in Its Catchment Area,
W82-02732 1506 2H

Water-Level Records for the Big Sioux Aquifer, Minnehaha County, South Dakota,
W82-02844 1506 2F

Injection, Recharge and Return Wells,
W82-02920 1506 4B

Programmable Hand Calculator Programs for Pumping and Injection Wells: III. Constant Pumping (Injection) Rate, Fully Confined Aquifer, Partially Penetrating Well,
W82-03225 1507 2F

Managing Wells for Energy Efficiency,
W82-03734 1508 4B

Discussion: Influence of Well Water Quality Variability on Sampling Decisions and Monitoring, By Harry I. Nightingale and William C. Bianchi,
W82-03779 1509 5G

Map Showing General Chemical Quality of Ground Water in the Richfield Quadrangle, Utah,
W82-03977 1509 7C

Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

Chemical Species Dissolved in Shallow Groundwaters of the Plains Around Rokko Mountains, (In Japanese),
W82-04177 1509 2K

Correlation of Selected Well Water Quality Parameters with Soil and Aquifer Hydrologic Properties,
W82-04242 1509 5B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-04387 1510 8B

Recent Developments in Colorado Groundwater Law,
W82-04679 1510 6E

Determination of Effective Well Block Radii for Numerical Reservoir Simulations,
W82-04732 1510 6A

Groundwater Resources of the Williamsport Region, Lycoming County, Pennsylvania,
W82-04971 1511 2F

Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern Pennsylvania,
W82-04973 1511 2F

Sinkhole Development Resulting from Ground-Water Withdrawal in the Tampa Area, Florida,
W82-04982 1511 2F

Water System Design Meets Modern Challenges,
W82-05170 1511 5F

Maps Showing Ground-Water Conditions in the San Simon Wash Area, Papago Indian Reservation, Arizona--1979,
W82-05231 1511 7C

Maps Showing Ground-Water Conditions in the Agua Fria Area, Yavapai and Maricopa Counties, Arizona-1979,
W82-05232 1511 7C

Can Hard-Rock Wells Solve Africa's Irrigation Problem,
W82-05503 1511 3B

Use of Twin Wells and Water-Source Heat Pumps for Energy Conservation in Louisiana,
W82-05535 1511 8B

An Enriched Finite Element for Simulation of Groundwater Flow to a Well or Drain,
W82-05652 1511 2F

Map Showing Ground-Water Conditions in the Sacramento Valley Area, Mohave County, Arizona--1979,
W82-05827 1511 7C

Map of the Antelope Valley-East Kern Water Agency Area, California, Showing Ground-Water Subunits and Areas, and Dissolved-Solids Concentrations, 1970-80,
W82-05851 1511 7C

Hydrogeologic Data from Selected Wells and Test Holes in Suffolk County, Long Island, New York, 1972-80,
W82-06131 1512 7C

Ground-Water Data for the Beryl-Enterprise Area, Escalante Desert, Utah,
W82-06134 1512 7C

Design of Heat Pump Return Wells,
W82-06294 1512 8C

Examination of Probable Causes of Individual Water Supply Contamination,
W82-06435 1512 5B

Purge Aquifer to Remove Volatile Organic Contamination,
W82-06842 1512 5G

WERRA RIVER
Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 1507 5B

WESER RIVER
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 1504 5A

Cadmium in Gammaridae (Amphipoda: Crustacea) of the Rivers Werra and Weser: Geographical Variation and Correlation to Cadmium in Sediments,
W82-03094 1507 5B

The Unterweser Automatic Water Quality Measurement System,
W82-04588 1510 5A

WEST AFRICA
The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

Factors of the Chemical Composition of Seepage and Groundwaters in the Intertropical Zone (West Africa),
W82-03543 1508 2K

Rainfall and Atmospheric Circulation During Drought Periods and Wetter Years in West Africa,
W82-06211 1512 2B

WEST ANTARCTIC ICE SHEET
West Antarctic Ice Sheet Fluctuations in the Antarctic Peninsula Area,
W82-03362 1507 2C

WEST-CENTRAL FLORIDA
Ground-Water Levels in Selected Well Fields and in West-Central Florida, May 1981,
W82-03992 1509 7C

WEST GERMANY
A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

Seepage Flow in Extremely Thin Aquifers,
W82-03594 1508 2F

New Federal Wastewater Discharge Standards in Germany,
W82-04527 1510 6E

Influence of Remedial Measures on the Mohne Gravity Dam (Einfluss Der Sanierungsmassnahmen Auf Die Mohnemauer),
W82-06239 1512 8A

The Grosse Dhunn Dam and the Facilities for the Control of Stability and Functioning (Die Grosse Dhunn-Talsperre Und Die Messeinrichtungen Zur Uberwachung Der Standsicherheit Und Der Funktionstuchtigkeit Des Dammes),
W82-06240 1512 8D

Development of Wastewater Purification in the Ruhr Catchment Area and its Effects on Water Quality in the 1970's (Entwicklung Der Abwasserreinigung Im Ruhr Einzugsgebiet Und Ihre Auswirkungen Auf Die Gewassergute In Den Siebzieger Jahren),
W82-06469 1512 5D

Test and Control Programme for Twiste Dam Situated in Sandstone and with Restricted Extent of Sub-Surface Sealing (Mess- und Uberwachungsprogramm Einer Stauanlage im Buntsandstein bei Begrenzter Untergrundabdichtung am Beispiel der Twistetalsperre),
W82-06632 1512 8D

Investigations on Loading and Quality of Discharge of Municipal Sewage Treatment Plants in the Case of Stormwater Inflow (Utersuchungen Uber Belastung Und Ablaufbeschaffenheit Kommunaler Klaranlagen Bei Mischwasserzufluss),
W82-06634 1512 5D

Quality of Stormwater Runoff from Motorways (Diebeschaffenheit der Niederschlagsabflusse von Autobahnen),
W82-06635 1512 5B

Consequences of Contamination by Heavy Metals in Tidal Estuaries by the Example of the River Elbe (Auswirkungen der Schwermetallbelastung von Tidegewassern am Beispiel der Elbe),
W82-06637 1512 5E

Land Use Policy and Water Procurement (Agrarstrukturpolitik und Wassergewinnung),
W82-06714 1512 6F

50 Years of Lake Baldeney - Some Aspects of Its Characteristics in Terms of Water Management (50 Jahre Baldeneysee - Einige Aspekte Seiner Wasserwirtschaftlichen Besonderheiten),
W82-06716 1512 5G

Turbidity Maximum and Mud Shoaling in the Weser Estuary,
W82-06766 1512 5B

Estimation of Runoff-Producing Precipitation with the Aid of Satellite Imagery (Ermittlung Abflusswirksamer Niederschlage Aus Satellitendaten),
W82-06823 1512 2B

Planned Measures for Water Regulation Constructing the New Munich Airport (Geplante Wasserwirtschaftliche Massnahmen Beim Bau des Neuen Flughafens fur Munchen),
W82-06825 1512 8A

Generation of Weekly Streamflow Data for a Large Hydrological System-An Autoregressive Multivariate Multi-Lag-Model(Simulation Wochentlicher Abflusse fur Ein Grossraumiges Hydrologisches System-Ein Autoregressives, Multivariates Multi-Lag-Modell-),
W82-06826 1512 4A

Fluctuations of the Ichthyo-Fauna in the Elbe Estuary: An Indicator for a Disturbed Ecosystem (Fluktuationen Der Fischfauna Im Elbe-Astuar Als Indikator Fur Ein Gestortes Okosystem).
W82-06913 1512 5C

WEST POINT RESERVOIR
Gonad Development, Fecundity, and Spawning Season of Largemouth Bass in Newly Impounded West Point Reservoir, Alabama-Georgia,
W82-01080 1502 2H

WEST VIRGINIA
Water Resources Data for West Virginia, Water Year 1980.
W82-00077 1501 7C

Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Power in West Virginia.
W82-00753 1502 6E

The Use of Algal Assays and Chlorophyll Concentrations to Determine Fertility of Water in Small Impoundments in West Virginia,
W82-00919 1502 2H

Vegetational Analysis of Big Run Bog, A Nonglaciated Sphagnum Bog in West Virginia,
W82-00992 1502 2I

Ground Water Problems in West Virginia,
W82-01060 1502 4B

Decision-Making Constraints in the Policy Development and Administration of Water Resources in West Virginia,
W82-02173 1505 6E

Water Resources Data for West Virginia, Water Year 1979. Appendiz - Coal Areas.
W82-03990 1509 7C

Primary Production In a Eutrophic Acid Lake,
W82-04192 1509 5C

Proportions of Several Elements Found in Sewage Effluent and Sludge from Several Municipalities in West Virginia,
W82-04465 1510 5B

Water Resources Data for West Virginia, Water Year 1980. Appendix - Coal Areas.
W82-04522 1510 7C

Ground-Water Hydrology of Jefferson County, West Virginia,
W82-04986 1511 2F

Abandoned Coal Mines in West Virginia as Sources of Water Supplies,
W82-05219 1511 3C

Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia,
W82-05833 1511 7C

Hydrology of Area 5, Eastern Coal Province, Pennsylvania, Maryland, and West Virginia,
W82-05834 1511 7C

Fish Responses to Temperature to Assess Effects of Thermal Discharge on Biological Integrity,
W82-06777 1512 5C

WESTCHESTER COUNTY
Review of Reports for Flood Control; Westchester County Streams, New York.
W82-00103 1501 4A

Westchester County's Peekskill Wastewater Treatment Plant Replaces Five Plants,
W82-05399 1511 5D

WESTERN UNITED STATES
The Potential for Ground-Water Management in the West: A Symposium,
W82-04918 1511 4B

Institutional Obstacles to Water Reuse in the Western United States,
W82-04958 1511 6B

Conflict Between Establishment of Instream Flows and Other Water Uses on Western Streams,
W82-05749 1511 6E

WESTERN US
Water Yield Estimation in Western United States,
W82-05689 1511 4D

WETLAND
A System for Measuring Methane Fluxes from Inland and Coastal Wetland Environments,
W82-04989 1511 2L

WETLANDS
Deposition of Riverborne Organic Carbon in Floodplain Wetlands and Deltas,
W82-00034 1501 2J

Worthless, Valuable, or What. An Appraisal of Wetlands,
W82-00177 1501 6B

Effects of Water Regime on Growth, Yield, and Nitrogen Uptake of Rice,
W82-00330 1501 2I

A Model of Natural and Man-Induced Changes in Open Freshwater Wetlands on the Massachusetts Coastal Plain,
W82-00397 1501 2I

Effects of Sewage Effluent Application on Litter Fall and Litter Decomposition in Cypress Swamps,
W82-00499 1501 5E

The Changing Status of Reedswamp in the Norfolk Broads,
W82-00691 1502 5C

Quantitative Assessment of Tidal Wetlands Using Remote Sensing,
W82-00781 1502 7B

Federal Participation in Land Use Decision-Making at the Water's Edge--Floodplains and Wetlands,
W82-00799 1502 6E

Effects of Temperature, pH, Salinity, and Inorganic Nitrogen on the Rate of Ammonium Oxidation by Nitrifiers Isolated from Wetland Environments,
W82-00910 1502 2L

Avoyelles Sportsmen's League V. Alexander,
W82-01456 1503 6E

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 1504 2L

Historical Background and Overview of Plan for Restoring Freshwater Inflow to an Estuary in Conjunction with Urban Development,
W82-02119 1505 4A

Surface Water Flow from a South Florida Wetland Area,
W82-02121 1505 2E

Atchafalaya Delta: Subaerial Development; Environmental Implications and Resource Potential,
W82-02126 1505 2J

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

Establishment of Controlled Freshwater Diversions of the Mississippi River into the Louisiana Coastal Zone,
W82-02145 1505 4A

The Economic Significance of the Long Point Marsh, Lake Erie, as a Recreational Resource,
W82-02229 1505 6B

Wetlands Use for Water Management in Florida,
W82-02590 1505 4A

Concepts in Aquatic Treatment System Design,
W82-02593 1505 5D

Analysis of Flood Hydrographs from Wetland Areas,
W82-02733 1506 2A

Estimation of the Economic Value of Wetlands: Methodology and Application to Southeastern Michigan,
W82-02804 1506 6B

Cooling Water Discharge into Floodplain Meadows and Marshes: Effects, Mechanisms, and Implications for Environmental Analysis,
W82-03022 1507 5C

Home Rule Wetlands Protection in Massachusetts: Lovequist V. Conservation Commission of the Town of Dennis,
W82-03450 1508 6E

State and Local Acquisition of Floodplains and Wetlands; A Handbook on the Use of Acquisition in Floodplain Management.
W82-03966 1509 6F

Hydrogeologic Evaluation of Wetland Basins for Land Use Planning,
W82-04439 1510 2A

Stream Transport of Nutrients Through a Wetland,
W82-04857 1511 5B

A Comparison of Vascular Vegetation and Protozoan Communities in Some Freshwater Wetland of Northern Lower Michigan,
W82-04927 1511 2H

Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

A Low-Cost Multichannel Recording Piezometer System for Wetland Research,
W82-05076 1511 7B

The Ecology of Southern California Coastal Salt Marshes: A Community Profile,
W82-05215 1511 2H

Classification and Management of Wetlands in the Western Kentucky Coal Field,
W82-05549 1511 5C

History, Practice and Emerging Problems of Wetlands Regulation: Reconsidering Section 404 of the Clean Water Act,
W82-05604 1511 6E

Wetlands and Deepwater Habitats: A New Classification,
W82-05716 1511 2L

WEY RIVER
Distribution of Chromobacteria in a Lowland River,
W82-02795 1506 5C

WHEAT
The Manifestation of Dehydration Avoidance in Wheat Breeding Germplasm,
W82-00958 1502 2I

Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 1504 2I

The Influence of Tillage on Soil Water Behavior,
W82-02022 1504 2G

Wheat Response to Drought,
W82-02242 1505 2I

Leaf Photosynthesis, Leaf Permeability, Crop Growth, and Yield of Short Spring Wheat Genotypes under Irrigation,
W82-02373 1505 2I

Planting Date and Water Deficit Effects on Development and Yield of Irrigated Winter Wheat,
W82-02607 1506 3F

Possible Role of Abscisic Acid in Reducing Seed Set in Water-Stressed Wheat Plant,
W82-03197 1507 2I

Wheat Yield Estimation in Northwest Iran,
W82-03267 1507 2I

Seminal Root Morphology and Water Use of Wheat. I. Environmental Effects,
W82-03307 1507 2I

A Field Study with Nitrogen-15 of Soil and Fertilizer Nitrate Uptake and of Water Withdrawal by Spring Wheat,
W82-03410 1508 2I

Movement of Cadmium and Water in Split-Root Wheat Plants,
W82-03662 1508 5B

Water Management of Wheat in Heavy Clay Soils of Madhya Pradesh,
W82-05119 1511 2I

Influence of Seasonal Evaporative Demand on Evapotranspiration and Yield of Irrigated Wheat,
W82-05121 1511 2D

Effect of Irrigation on the Stability of Leaf Size of Wheat, Triticale and Barley,
W82-05972 1512 2I

WHISKEY DISTILLERY WASTEWATER
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 1503 5C

WHITE CLAY CREEK
Fluorescence Spectra of Water-Soluble Humic Materials and Some Potential Precursors,
W82-02648 1506 2K

WHITE RIVER BASIN
Ground-Water Resources of the White River Basin, Madison County, Indiana,
W82-00412 1501 2A

WHITE SANDS MISSILE RANGE
Annual Water-Resources Review, White Sands Missile Range, New Mexico, 1980,
W82-03980 1509 2F

WHITE WATER
Preferences for Allocating River Recreation Use,
W82-01181 1503 6D

Closeup of Whitewater System Helps Menasha Meet Effluent Standards,
W82-01379 1503 5D

WICK DRAINS
The Booming Business in Wick Drains,
W82-05192 1511 8G

WILCOX-CARRIZO AQUIFER
Potentiometric Surface of the Wilcox-Carrizo Aquifer; Bienville, Red River, Northern Natchitoches, and Southern Webster Parishes, Louisiana,
W82-00728 1502 7C

WILD RIVERS
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 1503 6D

User Reaction to Wild and Scenic River Designation,
W82-02278 1505 6G

Don't Damn the Stanislaus,
W82-03275 1507 6E

San Francisco River Wild and Scenic River Study Report; Greenlee County, Arizona.
W82-04076 1509 6G

Carrying Capacity for the Illinois River,
W82-05927 1512 6G

WILDERNESS AREAS
Mercury in the Muscle Tissue of Fish from Three Northern Maine lakes,
W82-01459 1503 5B

Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 1512 6D

WILDLIFE
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 1503 6G

Biological Considerations Related to Freshwater Introduction in Coastal Louisiana,
W82-02128 1505 4C

Effects of Wetland Changes on the Fish and Wildlife Resources of Coastal Louisiana,
W82-02129 1505 4C

Chronic Effects of Ammonia-Stripped Oil Shale Retort Water on Fishes, Birds, and Mammals,
W82-05375 1511 5C

Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 1512 6D

WILDLIFE CONSERVATION
Freshwater Introduction into Louisiana Coastal Areas,
W82-02127 1505 4A

Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

WILDLIFE HABITATS
Santee-Cooper Rediversion: Projected Impacts on Fishery Resources and Wildlife Habitats,
W82-02168 1505 4A

Ground-Water Hydrology of the Mormon Island Crane Meadows Wild-Life Area, Near Grand Island, Hall County, Nebraska,
W82-03991 1509 2F

WILDLIFE HABITATS

Simulated Hydrologic Effects of Possible Ground-Water and Surface-Water Management Alternatives in and near the Platte River, South-Central Nebraska,
W82-04509 1510 6G

Illinois Wetlands: Their Value and Management,
W82-05053 1511 6G

Rutland Water Nature Reserve: Concept, Design and Management,
W82-06471 1512 6D

WILDLIFE REFUGES
Managing Oil and Gas Activities in Coastal Environments: Refuge Manual,
W82-01081 1502 5G

WILLAMETTE RIVER
Water Quality Allocated Cost for Multipurpose Reservoirs,
W82-04255 1510 6C

WILLIAMS LAKE
Limnological and Geochemical Survey of Williams Lake, Hubbard County, Minnesota,
W82-02471 1505 2H

WILLIAMSPORT
Sludge Settling Hampered by Industrial Discharge,
W82-00290 1501 5D

WILSON CREEK
Wilson Creek Drainage - Surface and Ground Water Quality, July 1978 to July 1979.
W82-01069 1502 5B

WILTON CREEK
Physical and Geochemical Characteristics of Suspended Solids, Wilton Creek, Ontario,
W82-02236 1505 5B

WIND
Wind-Induced Mixing in Stratified Fluid,
W82-02371 1505 2H

Wind Aeration in Model Waste Treatment System,
W82-02944 1506 5D

Wind Mixing and Restratification in a Lake Near the Temperature of Maximum Density,
W82-04573 1510 2H

An Analysis of the Appropriateness of Wind and Other Energy Systems for Irrigation Water Pumping in India,
W82-05357 1511 6B

Circulation Patterns; Their Investigation and Prediction,
W82-06477 1512 5F

WIND-DRIVEN CURRENTS
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 1503 2H

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 1303 2L

Prediction of the Circulation in Reservoirs,
W82-04682 1510 2H

Calculation of Currents in Lake Onega with Consideration of Anthropogenic Influences,
W82-06612 1512 2H

WIND TIDES
Numerical Modeling Study of Lake Pontchartrain,
W82-05006 1511 2A

WIND VELOCITY
The Effect of Wind on Ice Pressure on River Structures,
W82-02668 1506 2C

WIND WAVES
Waves Generated by River and Wind on the Illinois and Mississippi Rivers,
W82-06163 1512 2J

WINDBREAKS
Water Stress of Four Windbreak Tree Species During Soil Drying,
W82-06793 1512 2I

WINDHAM
Top-Sealing to Minimize Leachate Generation, Case Study of the Windham, Connecticut, Landfill,
W82-01427 1503 5G

WINTER HAVEN CHAIN OF LAKES
Hydrology of the Winter Haven Chain of Lakes, Polk County, Florida,
W82-04977 1511 7C

WINTERGREEN LAKE
Sulfhydrolase Activity in Sediments of Wintergreen Lake, Kalamazoo County, Michigan,
W82-00241 1501 2H

WIRE INDUSTRY
Pollution Solutions–The Wire Drawing Industry.
W82-02041 1504 5D

WISCONSIN
Legal Obstacles and Incentives to the Development of Small Scale Hydroelectric Potential in Wisconsin.
W82-00746 1502 6E

Interstate Conflict Over Ground Water: Wisconsin-Illinois,
W82-00818 1502 6E

Predictive Depositional Model for Glacial Aquifers,
W82-00828 1502 2F

Seasonal Reversals of Groundwater Flow Around Lakes and the Relevance to Stagnation Points and Lake Budgets,
W82-01103 1503 2F

A Successful Low Technology Wastewater Process,
W82-01178 1503 5D

Changes in Sediment Storage in the Coon Creek Basin, Driftless Area, Wisconsin, 1853 to 1975,
W82-01563 1503 2J

The Impact of Urbanization on Seasonal Hydrologic and Nutrient Budgets of a Small North American Watershed,
W82-02400 1505 5B

River Clean-Up Plan Developed with Citizens and Industry,
W82-03283 1507 5G

Factors and Mechanics of Bluff Erosion on Wisconsin's Great Lakes Shorelines,
W82-03720 1508 2J

The Wisconsin Soil and Water Conservation District as an Institution to Undertake Subwatershed Planning to Control Non-Point Source Water Pollution,
W82-04212 1509 6A

Regional Hydrologic Models for Climatology: An Application to Three Wisconsin Watersheds,
W82-04483 1510 2A

Horizontal Distribution and Flux of Phosphorus in Fish Lake, Wisconsin,
W82-04484 1510 2H

Flood of July 1-5, 1978 on the Kickapoo River, Southwestern Wisconsin,
W82-05236 1511 2E

Microbial Ecology of Pectin Decomposition in Anoxic Lake Sediments,
W82-05275 1511 2H

Climate Variation and the Mobility and Storage of Sediment in Watersheds,
W82-05931 1512 4D

How Appleton Reduced Phosphorus,
W82-06249 1512 5D

Groundwater Seepage as a Nutrient Source to a Drainage Lake; Lake Mendota, Wisconsin,
W82-06285 1512 5B

Cross-Country Force Main.
W82-06640 1512 8G

An Assessment of Streamflow, Water Quality, and the Effects of Constructing an Impoundment on Bridge Creek at Augusta, Wisconsin,
W82-06677 1512 2E

Prevalence of Yersinia Enterocolitica in Waters of the Lower Chippewa River Basin, Wisconsin,
W82-06751 1512 5A

Sampling Characteristics of Macrophyte Biomass,
W82-06779 1512 5A

Effect of the Paper Industry on Water Quality of the Lower Fox River,
W82-06870 1512 5D

WITHLACOOCHEE RIVER
Water-Resources Information for the Withlacoochee River Region, West-Central Florida,
W82-02473 1505 6B

WOOD
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 1504 5D

WOOD PRESERVING INDUSTRY
Wood Preserving Industry Multimedia Emission Inventory,
W82-02993 1506 5D

WOOD WASTES
Conversion of Abienol into Tetrahydroepimanool by Anaerobic Processes in Woodroom Debarking Effluent,
W82-00860 1502 5C

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 1504 5D

WOODBRIDGE
Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

WOODS LAKE
Biogenic and Abiogenic Polynuclear Aromatic Hydrocarbons in Sediments from Two Remote Adirondack Lakes,
W82-04293 1510 5B

WOONSOCKET
Central City Demands in the 80's Woonsocket, Rhode Island,
W82-03665 1508 5F

WORLD METEOROLOGICAL ORGANIZATION
The World Climate Programme,
W82-00317 1501 6A

WRIGHTSVILLE BEACH
Design, Fabrication and Start-Up of a 25,000 Gallons per Day Absorption Freezing Vapor Compression Desalination Pilot Plant.
W82-04724 1510 3A

WYE RIVER
The Application of a Water-Quality Model to the River Wye, Wales,
W82-02876 1506 5A

WYOMING
Water-Resources Investigations of the U.S. Geological Survey in Wyoming, Fiscal Year 1980,
W82-00087 1501 7C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 1504 4A

42-Mile Water Pipeline for Coal Boom Town.
W82-02359 1505 6D

Water Resources Data for Wyoming, Water Year 1980--Volume 2. Green River Basin, Bear River Basin, and Snake River Basin
W82-02495 1505 7C

Water Resources Data for Wyoming, Water Year 1980--Volume 1. Missouri River Basin.
W82-02846 1506 7C

Areal Distribution of Snow Water Equivalent Evaluated by Snow Cover Monitoring,
W82-03842 1509 2C

Limnology of the Upper North Platte Reservoir System, Wyoming,
W82-04067 1509 2H

Thickness, Percent Sand, and Configuration of Shallow Hydrogeologic Units in the Powder River Basin, Montana and Wyoming,
W82-04501 1510 7C

Five-Year Water Resources Research and Development Goals and Objectives for Wyoming.
W82-05528 1511 6B

Evaluation of the Stream Reach Inventory and Channel Stability Index for Instream Habitat Analysis,
W82-06308 1512 4D

Calibrating A Mountain Watershed in Wyoming,
W82-06583 1512 2E

Hydrology of Salt Wells Creek--A Plains Stream in Southwestern Wyoming,
W82-06679 1512 2A

An Empirical Method for Determining Average Soil Infiltration Rates and Runoff, Powder River Structural Basin, Wyoming,
W82-06692 1512 2G

WYRE ESTUARY
Plutonium Occurrence and Phase Distribution in Sediments of the Wyre Estuary, Northwest England,
W82-02760 1506 5B

X-RAY EMISSION
Determination of Sulphur in Snow by Proton Induced X-Ray Emissions (Pixe) Method,
W82-06082 1512 5A

X-RAY FLUORESCENCE
Analysis of Trace Elements in Seawater. Part II. Determination of Heavy Metal Traces in Sea Water by X-Ray Fluorescence Analysis with Totally Reflecting Sample Holders,
W82-03333 1507 5A

XENOBIOTIC CHEMICALS
Relationship Between Biotransformation and the Toxicity and Fate of Xenobiotic Chemicals in Fish,
W82-00186 1501 5C

XENOBIOTICS
Model Ecosystem for Environmental Transport of Xenobiotics,
W82-06760 1512 5B

YADKIN RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Yadkin-Pee Dee River Basin; North Carolina, South Carolina, and Virginia,
W82-03042 1507 6D

YAKIMA INDIAN RESERVATION
Digital-Model Simulation of the Toppenish Alluvial Aquifer, Yakima Indian Reservation, Washington,
W82-04514 1510 2A

YAKIMA VALLEY
Consequences and Responsibilities in Drought Forecasting: The Case of Yakima, 1977,
W82-05082 1511 2E

YAMPA RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Yampa River Basin, Colorado, Wyoming.
W82-03045 1507 6D

YANGTZE RIVER
Yangtze Gorges Scheme Could Yield 110 TWh/Year.
W82-01394 1503 8A

YAQUINA BAY
Petroleum Refinery Wastewater Induction of the Hepatic Mixed-Function Oxidase System in Pacific Staghorn Sculpin,
W82-04895 1511 5C

YARRA RIVER
Trace Metal Speciation in the Freshwater and Estuarine Regions of the Yarra River, Victoria,
W82-03387 1507 5B

YEASTS
Assimilation of Lemonade-Processing Wastewater by Yeasts,
W82-00204 1501 5D

YELLOW RIVER
Sediment Regulation Problems in Sanmenxia Reservoir,
W82-03072 1507 2J

YELLOW RIVER BASIN
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 1503 4D

YELLOWKNIFE BAY
Influence of Water Movements and Other Factors on Distribution and Transport of Heavy Metals in a Shallow Bay (Canada).
W82-05205 1511 5B

YELLOWSTONE NATIONAL PARK
Fluorapatite and Fluorite Solubility Controls on Geothermal Waters in Yellowstone National Park,
W82-05449 1511 2K

YELLOWSTONE RIVER BASIN
Competition for Water Resources: Coal and Agriculture in the Yellowstone Basin,
W82-04805 1511 6D

YEMEN ARAB REPUBLIC
A Qualitative Appraisal of the Hydrology of the Yemen Arab Republic from Landsat Images,
W82-00022 1501 7B

YIELD
Accuracy of Firm Yield Estimates of Direct Supply Reservoirs with Limited Data,
W82-06300 1512 4A

YODO RIVER
Nitrogen Control for the Partly Sewered Basin of Yodo River-Lake Biwa System,
W82-05244 1511 5D

YORK RIVER
York River Destratification: An Estuary-Subestuary Interaction,
W82-06787 1512 2L

YORKSHIRE WATER AUTHORITY
The River Ouse Water Supply Scheme,
W82-01371 1503 5F

Dynamic Parameter Tuning for Water Distribution Network Models in an Extended Period Simulation,
W82-04756 1511 5F

YUCATAN PENINSULA
Chemical Mass-Wasting of the Northern Yucatan Peninsula by Groundwater Dissolution,
W82-01015 1502 2K

YUGOSLAVIA
Evaluation of the Polluted River Savinja with the Help of Macrophytes,
W82-01377 1503 5C

The Thermal Response of Lake Ohrid, Yugoslavia to Meteorological Conditions,
W82-02342 1505 2H

On the Chemistry of Some Salt Lakes and Ponds in Yugoslavia,
W82-04929 1511 2H

YUKON RIVER
Sediment Transport in Norton Sound, Alaska,
W82-00151 1501 2J

YUMA
Development of High Salt Rejection Reverse Osmosis Membranes--Final Report, July 1, 1978 Through December 31, 1980,
W82-02109 1505 3A

YUMA DESALTING TEST FACILITY
Reconnaissance Samplings and Characterization of Aquatic Humic Substances at the Yuma Desalting Test Facility, Arizona,
W82-04983 1511 3A

YUZHNOYE RESERVOIR
The Formation of Water Quality in the Shallows of a Southern Reservoir (Dnieper-Krivoi Rog Canal) Under the Influence of Beds of Higher Aquatic Vegetation,
W82-05453 1511 2H

ZAMBIA
The Hydrogeological Basis for a Water Supply to Kabwe, Zambia,
W82-05804 1511 4B

ZEOLITE
Treatability of Type A Zeolite in Wastewater--Part I,
W82-05687 1511 5D

Treatability of Type A Zeolite in Wastewater--Part II,
W82-05688 1511 5D

ZEOLITES
Sedimentation of Zeolite Type A in Water and Waste Water,
W82-00848 1502 5D

Detergent Builders and Water Quality - A Changing Scene,
W82-03093 1507 5C

Type A Zeolite in the Activated Sludge Process--II: Heavy Metal Removal,
W82-03222 1507 5D

Investigations of Natural Hungarian Zeolite for Ammonia Removal,
W82-05482 1511 5D

Removal of Zeolite Type A During Primary Sedimentation and Its Effect on Metal Removal,
W82-06338 1512 5D

Type a Zeolite in the Activated Sludge Processes - I: Treatment Parameters,
W82-06459 1512 5D

ZERO DISCHARGE
Developments in Wastewater Handling at Power Plants,
W82-05517 1511 5D

ZETA POTENTIAL
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 1503 5D

Optimizing Coagulation with Pilot Filters and Zeta Potential,
W82-03653 1508 5F

ZIMBABWE
The Decline of Salvinia Molesta on Lake Kariba,
W82-04945 1511 2H

Zimbabwean Hand Pump Passes Village-Level Endurance Tests.
W82-06606 1512 8C

ZINC
Acute Toxicity of Zinc to Some Fishes in High Alkalinity Water,
W82-00713 1502 5C

Aquatic Mosses as Monitors of Heavy Metal Contamination in the River Etherow, Great Britain,
W82-00787 1502 5A

The Impact of an Industrially Contaminated Lake on Heavy Metal Levels in it's Effluent Stream,
W82-00886 1502 5B

Mercury and Zinc in the Sediments of Seneca Lake, Seneca River, and Keuka Outlet, New York,
W82-01151 1503 5B

Atomic Absorption Spectrophotometric Studies of Cadmium and Zinc in Commercial Fertilisers, Soils and River Waters,
W82-01388 1503 5B

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 1504 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 1504 5C

A Study on the Accumulation of Copper and Zinc in the Mid-Gut Gland of Cultured Scallop for Environmental Monitoring, (In Japanese),
W82-02379 1505 5B

Changes in Flora Down a Stream Showing a Zinc Gradient,
W82-02946 1506 5C

Zinc in Seawater and Sediments,
W82-03166 1507 5B

Zinc Deficiency in Wetland Rice Along a Toposequence of Hydromorphic Soils in the Philippines. I. Soil Conditions and Hydrology,
W82-03328 1507 2G

Detoxication of Zinc and Cadmium by the Freshwater Protozoan Tetrahymena Pyroformis. I. The Effect of Water Hardness,
W82-03678 1508 5C

Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

The Use of the Three-Ridge Clam (Amblema Perplicata) to Monitor Trace Metal Contamination,
W82-04948 1511 5A

Transport Processes of Copper and Zinc in a Highly Eutrophic and Meromictic Lake,
W82-05518 1511 5B

Transport of Iron, Manganese, Cadmium, Copper, and Zinc by Magela Creek, Northern Territory, Australia,
W82-06054 1512 5B

Comparison of the Extractabilities of Zn, Cu, Ni and Cr from Sewage Sludges Prepared by Treating Raw Sewage with the Metal Salts Before or After Anaerobic Digestion,
W82-06079 1512 5D

Sediment-Water Interactions of Cu, Zn, and Pb Discharged from a Domestic Waste Water Source into a Bay of Lough Neagh, Northern Ireland,
W82-06080 1512 5B

Recovery of Zinc from Wastewater Treatment Sludge,
W82-06485 1512 5E

Heavy Metals in Sludge--Are Their Toxic Effects Additive,
W82-06646 1512 5E

The Adsorption of Cu, Mn, and Zn by Iron Oxyhydroxide in Model Estuarine Solutions,
W82-06668 1512 2L

Pilot Plant Studies of Copper, Zinc, and Trivalent Chromium Removal by Adsorbing Colloid Foam Flotation,
W82-06708 1512 5D

Removal of Zinc by Adsorbing Colloid Foam Flotation: Pilot Plant Study,
W82-06822 1512 5D

ZINC COMPOUNDS
An Experimental Approach to Corrosion Control,
W82-04099 1509 5F

Monitoring and Controlling Corrosion by Potable Water,
W82-04100 1509 5F

ZINC CYANIDE RECOVERY
Demonstration of Zinc Cyanide Recovery Using Reverse Osmosis and Evaporation,
W82-04622 1510 5D

ZIRCONIUM
Phosphorus Inactivation by Zirconium in a Eutrophic Pond,
W82-05856 1511 5G

ZOOPANKTON
Combined Effects of Cadmium and Zinc on a Lake Michigan Zooplankton Community,
W82-04379 1510 5C

ZOOPLANKTON
BIONESS, A New Design in Multiple Net Zooplankton Samplers,
W82-00210 1501 7B

Assessment of Thermal Discharges on Zooplankton in Conowingo Pond, Pennsylvania,
W82-00592 1502 5C

Potential Impact of Size-Selective Planktivory on Phosphorus Release by Zooplankton,
W82-00825 1502 2H

A Bioassay Study of Effects of Zooplankton, Iron and NTA on the Phytoplankton Productivity of a Marl Lake,
W82-01157 1503 2H

Seasonal Features of Zooplankton Assemblages in the Nearshore Area of Southeastern Lake Michigan,
W82-01192 1503 2H

The Crustacean Zooplankton of Mali (West Africa),
W82-01379 1503 2H

Zooplankton Abundance and Diversity in Central Florida Grass Carp Ponds,
W82-01520 1503 2H

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 1504 2H

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 1504 5C

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 1504 5C

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 1504 5C

The Effects of Freshwater Inflow on Salinity and Zooplankton Populations at Four Stations in the Nueces-Corpus Christi and Copano-Aransas Bay Systems, Texas from October 1972-May 1975,
W82-02133 1505 6G

The Effects of Floods on the Zooplankton Assemblage of San Antonio Bay, Texas During 1972 and 1973,
W82-02136 1505 2L

Frequencies of Developmental Morphs of Chaoborus Americanus in Four Fishless Bog Lakes,
W82-02238 1505 2H

The Recolonization of Lake Tahoe by Bosmina Longirostris: Evaluating the Importance of Reduced Mysis Relicta Populations,
W82-02305 1505 2H

Zooplankton Sample Variability in a Tidal Estuary: An Interpretative Model,
W82-02306 1505 2L

Diel Changes in Plankton and Water Chemistry in Wicken Brickpit,
W82-02411 1505 2H

The Influence of Flatworm Predation on Zooplankton Inhabiting Small Ponds,
W82-02655 1506 2H

A Reexamination of the Zooplankton Community of a Delaware Tidal Stream,
W82-02805 1506 5B

Zooplankton of Lake Taupo,
W82-02888 1506 2H

Contribution to the Limnology of Lake Pavin (France) II. Relationships Between Nonbiological Parameters--Phyto and Zooplankton in the 0-

20 Meter Zone (Contribution A L'Etude Limnologique du Lac Pavin (France). II. Relations Entre Parametres Abiotiques-Phyto et Zooplancton Dans la Zone 0-20 Metres),
W82-03178 1507 2H

The Effect of Suspended Materials on the Zooplankton, I. Natural Environments,
W82-03313 1507 2H

The Phytoplankton and Protozooplankton of the Euphotic Zone of Lake Tanganyika: Species Composition, Biomass, Chlorophyll Content, and Spatio-Temporal Distribution,
W82-03419 1508 2H

Investigations on the Sedimentation in the Darst-Zingst Bodden Chain - A Contribution to Establishment of an Energy and Matter Balance in the Ecosystem. Part 2: Research on the Sedimentation of Plankton. (Untersuchungen Zur Sedimentation in der Darss-Zingster Boddenkette Ein Beitrag zur Aufstellung Einer Energie-und-Stoffbilanz im Okosystem. Tiel 2: Untersuchungen zur Sedimentation des Planktons),
W82-04761 1511 2L

Benthos and Zooplankton of Coal Strip Mine Ponds in the Mountains of Northwestern Colorado, U.S.A.,
W82-04946 1511 5C

Metabolic Activity of Herbivorous Zooplankton in Lake Kinneret (Israel) During 1972-1977,
W82-05074 1511 2H

The Use of Container-Reared Cultures of Cladocera in Polishing Fish Farm Effluents,
W82-05327 1511 5D

The Structure of Crustacean Zooplankton Communities in Glaciated Eastern North America,
W82-05379 1511 2H

Interrelationships in the Development of the Three Structural Components of the Plankton in the Off-Bottom Zone of Lakes,
W82-05451 1511 2H

The Importance of Lacustrine Zooplankton to the Feeding Capacity

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